African Monsoon Multidisciplinary Analysis

Acronym : AMMA

Proposal No. : 004089-2

Sub-Priority 1.1.6.3 : Global change and Ecosystems.

Area 6.3.I : Impact and mechanisms of greenhouse gas emissions and atmospheric pollutants on climate, ozone depletion and carbon sinks.

Topic 6.3.I.3.a) : Hot spots in the Earth system.

Type of Instrument : Integrated Projects

Description of Work

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Co-ordinator : Jan Polcher

Co-ordinator organisation :

CNRS

Institut Pierre Simon Laplace

UVSQ, Bâtiment d'Alembert
5 Boulevard d'Alembert
F-78280 Guyancourt

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1. Project summary

The dramatic change in the region of the West African monsoon (WAM) from wet conditions in the 50s and 60s to much drier conditions from the 70s to the 90s, represents one of the strongest inter-decadal signals on the planet in the 20th century. Marked inter-annual variations in recent decades have resulted in extremely dry years with devastating environmental and socio-economic impacts. The abrupt decrease of water resources in the Sahel divided by two the cattle population and some exportation cultures disappeared. Vulnerability of West African societies to climate variability is likely to increase in the next decades as demands on resources increase due to the rapidly growing population. The situation may be exacerbated by the effects of climate change, land degradation caused by the growing population and water pollution. Motivated by the need to develop strategies to reduce the socio-economic impacts of climate variability and change in WAM we aim :

- to improve our ability to predict the WAM and its impacts on intra-seasonal to decadal timescales,
- to improve our ability to predict the consequences of climate change on WAM variability and its impacts.

These objectives will be achieved in the African Monsoon Multidisciplinary Analysis (AMMA) project by re-enforcing the regional environmental monitoring systems and conducting intensive field campaigns. This will lead to a better understanding of the mechanisms involved and in-fine improve our models and their predictive skills. The observational system will cover the regional water cycle, the atmospheric dynamics and chemistry, the land-surface and oceanic conditions. It will cover 3 time scales :

- a long term monitoring,
- an enhanced observing period of two years and
- a special observing periods over one rainy season.

In order to monitor the human dimension of the West African monsoon variability crop yields, water resources and health will be monitored with the same strategy.

2. Objectives of the project and state of the art

2.1 Scientific and technical objectives

The inter-annual and inter-decadal variability of the West African Monsoon (WAM) is well documented and has motivated many research efforts in recent decades. The dramatic change from wet conditions in the 50s and 60s to much drier conditions in the 70s, 80s and 90s over the whole region represents one of the strongest inter-decadal signals on the planet in the 20th century. Marked inter-annual variations in recent decades have resulted in extremely dry years with devastating environmental and socio-economic impacts. With a large rural population depending on rain fed agriculture, the abrupt decrease of water resources were devastating to both populations and economies. In the Sahel, the cattle population were divided by two, and some exportation cultures disappeared. In the more humid regions to the South, a severe shortage of electricity was caused by hydro power plants being shut down during the summers of 1984 and 1998, following the weakness of the preceding rainy seasons. It was estimated that the solid economic growth (at a rate of over 5% a year) of a country like Ghana was stopped in 1999, due to this water resources related problem. Vulnerability of West African societies to climate variability is likely to increase in the next decades as demands on resources increase in association with one of the World's most rapidly growing populations. The situation may be exacerbated by the effects of climate change, land degradation caused by a growing population, water and air pollution. The relevance of the project should be seen in the light of the extent to which the economic development and human welfare in the West African region has been affected by climatic fluctuations and trends over the last 30 years. The extended drought period of the seventies and early eighties, covering the entire Sahel-Sudan belt, has had both immediate and long-term effects on these countries, which are among the poorest in the world. With a large rural population depending on rainfed agriculture, no other region in the world is more vulnerable to climate change.

Motivated by the need to develop strategies to reduce the socioeconomic impacts of climate variability and climate change in West Africa the targets for the AMMA project are:

- To improve our understanding of the WAM and its influence on the physical, chemical and biological environment regionally and globally;
- To provide the underpinning science that relates climate variability to issues of health, water resources and food security for West African nations and defining relevant monitoring strategies;
- To ensure that the multidisciplinary research is effectively integrated with prediction and decision making activity.

We are currently hindered in providing skillful predictions of WAM variability and its impacts. There are still fundamental gaps in our knowledge of the coupled atmosphere-land-ocean system at least partly arising from lack of appropriate observational datasets but also because of the complex scale interactions between the atmosphere, biosphere and hydrosphere that ultimately determine the nature of the WAM. The monitoring system for the WAM and its variability is inadequate with many gaps in the standard routine network and lack of routine monitoring of some key variables. While the next generation of satellites will partially help, the research that will enable this still needs to be done. Dynamical models used for prediction suffer from large systematic errors in the West African and tropical Atlantic regions; current models have problems simulating fundamental characteristics of rainfall such as the diurnal, seasonal and annual cycles. It must also be outlined that the WAM can be seen as an "archetype" monsoon system, a better knowledge of which will be beneficial to the comprehension of monsoon regimes in Asia and America. Finally, there is a lack of integrative science linking the work on WAM variability and applications such as the areas of food, water and health. More effort needs to be made to integrate scientists working in these different areas.

Further motivation for a research concerned with WAM variability and predictability comes from recognizing the role of Africa on the rest of the world. Latent heat release in deep cumulonimbus clouds in the ITCZ over Africa represents one of the major heat sources on the planet. Its meridional migration and associated regional circulations impact other tropical and midlatitude regions, as is exemplified in the known correlation between Sahelian rainfall and Atlantic hurricane. In general, our understanding of how the African heat source interacts with the global climate is weak and requires attention (CLIVAR report, 2000).

West Africa is also an important source region for natural and anthropogenic emissions of precursors to key greenhouse forcing agents (e.g. ozone, aerosols). For example, biomass burning in savanna and forest ecosystems over Africa contributes around 20% of the global biomass burning fires. These emissions are modulated by the activity of the WAM but in contrast to other surface impacts they feedback directly on the climate. Long-range transport of trace gases out of West Africa has important implications for the global oxidizing capacity of the atmosphere (which controls the level of many greenhouse gases), global climate change and the transport of key constituents (e.g. water vapour, ozone depleting substances) into the stratosphere. The fires also produce huge quantities of particles, complex mixtures of organic materials and black carbon. Tropical Africa is the world's largest source of atmospheric dust. Both the fire aerosols and dust play a major role in radiative forcing and in cloud microphysics. A key priority is to determine the transport of trace gases and aerosols from the surface to the upper atmospheric layers and the subsequent transport by the WAM. It is thus necessary to study the dynamics and the chemistry of the atmosphere in the same framework.

A project that deals with all these issues require a major coordinated international effort involving a multidisciplinary approach to the West African monsoon linking observations, data analysis and modelling on a wide range of space and time scales. In order to make a significant contribution to the way environmental and climate issues are addressed in West Africa, a strong link has to be built with scientists and decisions makers working in the area of applications such as land and water resources management, agricultural and health research.

Based on these targets and the state of environmental monitoring and forecasting today, the AMMA consortium has chosen 5 goals to focus the effort of all partners and to allow each one to evaluate our progress and achievements during the course of the project. Only these goals are presented below with the current state of the art and the progress which we propose to achieve within 5 years.

To reach these goals, fundamental science underpinning the AMMA project is necessary as well as integrative science which brings together different communities is needed. For each of the 5 goals of the project the contributing operational targets of the work-packages will be presented. The achievement of the work-packages on these tasks will the measured by the fulfillment of the milestones.

2.2 State-of-the-art and enhancement by the proposed project

2.2.1 Short to medium range weather forecasting

State of the art

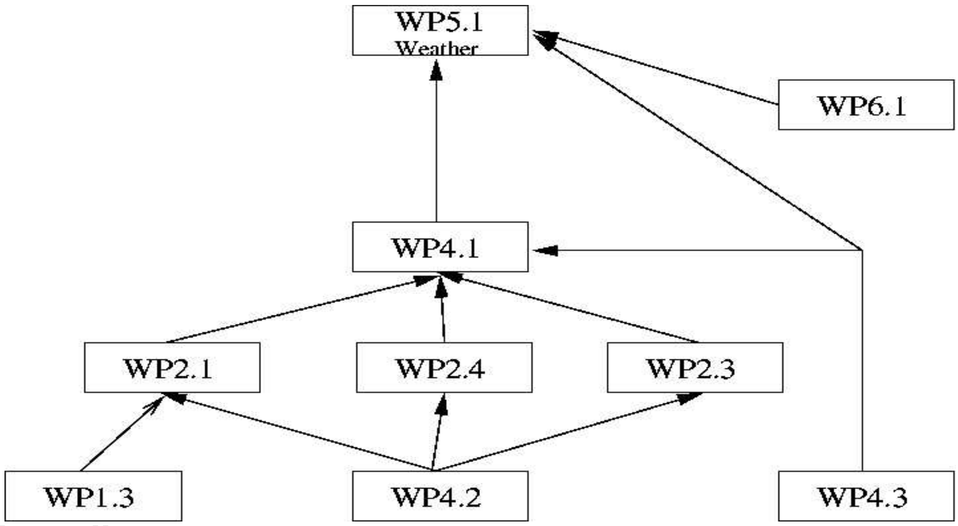
Skills of short to medium range weather forecasts of precipitation in the tropics are well below those obtained today over Europe for instance. This is due in particular to the difficulty to simulate accurately key elements of the WAM like the precipitating convective systems. These forecasts are essential for early warning systems on food security, risk management and civil protection in Africa.

Objective

The intensive field campaign AMMA will provide the data needed to ascertain hypotheses on tropical convection, its interaction with the large scale dynamics and its role in the regional water cycle. Within this project the process studies on convection will be integrated with our improved knowledge of land-surface processes, interactions with aerosols and chemistry in order to be translated into improved parameterizations for the large scale models used in forecasting. Kilometric resolution models able to explicitly represent the convection will be used. Fine scale analyses integrating a maximum of data collected during the SOP will be performed through variational assimilation.

Operational targets

The operational targets needed to achieve the goal of improving short to medium range weather forecasting is to ensure a smooth and efficient transfer of knowledge between the centers of expertise which are the work-package. The graphic below shows how this process will occur so that the work-package dedicated to weather forecasting (WP5.1) can demonstrate success at the end of AMMA.



Contributing milestones

For the various tasks needed to achieve this goal the key milestones are :

- Providing data to the process studies : M4.2.1f, M4.2.2f, M4.2.3c and M4.3b
- Progress in modelling will come from recommendations made by the process sutdies. They will occur in milestones M2.1.1f, M2.1.2hd, M2.1.3d, M2.3.1b, M2.3.1d, M2.4.1e, M2.4.2a and M2.4.2f.
- The resulting improvement in modelling will be evaluated in M4.1.2d and M4.1.3d.
- The impact of an improved forecasting system will also be achieved by assimilation system which make better use of the data as resulting from milestones M4.1.1f and M4.1.1j.
- The impact on the forecasting capabilities will be demonstrated in M5.1i.

2.2.2 Seasonal to climate forecasting

State of the art

The statistical forecasts of the seasonal rainfall over Africa have not yet been surpassed by their deterministic counterparts as is the case in many regions of the world and would be expected from theoretical considerations. Present deterministic forecasts are only forced by the sea surface temperature variability.

Models disagree on the sign and amplitude of rainfall changes for a climate with increased greenhouse gases. This state of affairs can be ascribed to a complex and not well understood 3-way interaction within the monsoon of the oceanic, land-surface and atmospheric processes. Progress in this area is critical for the food security at the shorter range and the development of agronomic adaptation strategies at the longer time scale. On the other hand, the extent to which the biogenic emissions from the WAM region impact the global atmospheric composition depends on the degree to which the monsoon dynamics export the chemical components to other regions and removes via aqueous and heterogeneous processing within clouds. Currently very little is known about these interactions.

Objective

The long term monitoring of the water cycle put into place within AMMA will improve our understanding of the characteristics of the inter-annual rainfall variability. This will provide leads as to which of the slow components in the system have the strongest predictive skill and for which the processes need to be better understood. Key to any significant progress will be an integrative approach which views the monsoon as an object built out of internal interactions but with strong external influences. An improved conceptual view of the monsoon will help the statistical as well as the dynamics seasonal forecasts and allow us to estimate error bars for the climate change studies. The land surface data assimilation system (e.g. EU-funded ELDAS) will be improved on AMMA region thanks to observational effort. This will allow to evaluate for the first time the potential predictability of rainfall associated with soil moisture, which is believed to be high.

Systematic observations of chemical composition over West Africa during AMMA will provide constraints on models, which will be used to assess the processing, export and impact of emissions from West Africa. The strong meridional gradients of the vegetation types and soil moisture of West Africa lead to strong gradients in emissions, and small changes in synoptic, seasonal or interannual climate will have large effects on the emissions from West Africa. Thus the interactions of the land surface and monsoon dynamics with the chemistry will be a critical part of this analysis.

Operational targets

The operational targets needed to achieve improvements in seasonal to climatic forecasting are similar as the ones for the previous goal. The exchange of knowledge will occur between more work-packages as on these longer time scales the integrative approach is a more powerful concept to achieve progress.

Contributing milestones

The new transfer of knowledge needed for the climatic forecasting goal are :

- The contribution of the oceanic processes to the surface/atmosphere interactions (M2.2b and M2.2c)
- An improved understanding of the water cycle and its variability contributes to statistical forecasts and diagnostics (M1.2.1d)
- Climate variability analysis contributes to the statistical forecasting through Milestone M1.1.1g and M1.1.3g.

2.2.3 Food security management

State of the art

West Africa is characterized by low income household economy mainly based on rain fed agriculture. The significant increase in demographic pressure, the progressive impoverishment of natural resources and the vulnerability of rainfall-dependent agricultural systems mark West Africa as the most food insecure area in the world. Understanding the effects of WAM on regional and local food security involves studying both the direct effect of WAM on agricultural productivity and the adaptive mechanisms. Adaptation to climate variability is inherent in traditional agricultural – and broader livelihood - strategies and is embedded in social structures. In this context the effort of international community concentrate on the study of adaptation strategy (improved crops and productive systems) and on the management of the food crisis based on the identification of vulnerable zones and groups. This is done on different scales based on the multidisciplinary analysis and on the prediction of agricultural production through crop modelling. Nevertheless the current understanding of how WAM changes will impact on productive systems and population strategies is still insufficient for guiding policy.

Objective

AMMA will produce estimates of a range of direct and indirect effects of changes in WAM on food security to define the vulnerability context over the region and to improve the prediction of seasonal production to serve as input for Early Warning Systems. The direct effects will include changes in yields of rain-fed crops and changes in water resources available for irrigated cultivation. Indirect effects will evaluate changes in agricultural and livelihood strategies as well as land use. Effects of, and adaptations to, climate change interact with a range of other development trends, economic, demographical. AMMA will develop scenarios for such complex situations, as a basis for analysing the specific sensitivity to WAM changes for each of them, and will test their application in operational Early Warning Systems for food security supporting the decision making process.

Operational targets

The operational goals are to improve our understanding of the environmental dependence of agriculture, water resource, health and the resulting food security. The knowledge gained in each impact studies workpackage needs to be transformed into an application which can then be demonstrated in workpackage 5.2.

Contributing milestones

The key milestones to improve the early warning systems for food security are :

- Improved crop forecasting models (M3.1i)
- New vulnerability assessments for agricultural practices (M3.2f)
- Vulnerability assessments for water resources (M3.3d)
- Health impact forecasting systems (M3.4f)
- All the above depend strongly on a good understanding of the downscaling issues of environmental parameters and the corresponding tools (M1.4b and M1.4j).

2.2.4 Environmental monitoring

State of the art

The African continent is one of the least well covered by the operational atmospheric observations. This hinders considerably the determination of initial conditions for forecasting systems and provides little long term monitoring for climate change detection and attribution studies. The rain gauge network is in steady decline and does not provide a satisfactory basis for water management. The scarcity in chemical observations limits air pollution detection and forecast. Satellite products for climate monitoring have been generally developed for North developed countries and are used over West Africa without any validation.

Trends in vegetation productivity are also of central importance in the context of desertification and land degradation, widely considered to be a central concern in the West African region. Recent studies of time series of satellite images document a major increase since the mid-80-ies, following the abrupt decline in the 70-ies and early 80-ies. It is vital to understanding the environmental changes of the region and their relation to WAM to establish a system of continuous satellite-based monitoring of the productivity of the vegetation, and to expand this to include a range of other environmental variables.

Objective

AMMA will implement a multi-scale and integrated monitoring network providing key parameters for multidisciplinary scientific investigation. One of issue is to determine future monitoring strategies to be implemented in an operational mode. Within the AMMA project we will upgrade the radiosonde and provide the personnel with the appropriate training to maintain them over the long term. The project will demonstrate the benefit for weather and climatic forecasting of these enhancements in the upper air soundings to motivate their funding at international level. Some key catchments will be instrumented to demonstrate to the local authorities the value of environmental monitoring for water resource management. AMMA will also demonstrate the impact of emissions at regional scales on local air quality. AMMA aims to improve and to evaluate satellite products which are critical for West Africa (precipitation is one of key parameters). AMMA will also provide the basis for a system of satellite-based environmental monitoring procedures, focusing on crop and vegetation productivity, and hydrology.

Operational targets

The operational target is to set up together with the African partners a surface flux network and upgrade the current radio-sounding network. The key steps are a joint planing of these deployment using the best available knowledge about the environmental sampling strategies. It also requires that the partners are trained for the operation of the instruments but also learn to appreciate the value of these observations.

Contributing milestones

The long term observing strategies will be developed during the EOP and LOP preparations. The key reports elaborated together with the African partners will be :

- The LOP/EOP planing : M4.2a
- The strategy for the radio-sounding network upgrade : part of M4.2a

2.2.5 Training and education

State of the art

Many African students and scientists view that to contribute to the better understanding and forecasting of environmental conditions in their countries they need to study or work abroad, in Europe preferentially. This leads to an exodus of capable people which is detrimental to the development of bodies of experts which could advise the decision makers in Africa on matters such as mitigation strategies for climate change or develop negotiation positions for international negotiations.

Objective

AMMA will show that the African monsoon is a topic of fundamental research which can mobilize the best scientists in Europe. This will entice African students and scientists to enter this field of research. This movement will be fostered by the organization of summer schools and university PhD programs locally to provide the interested students with access to the expertise they sought abroad and allow the build up of a critical mass which will then enable a continuous scientific activity on African environmental issues. In gathering together students and scientists Africans and Europeans in a motivating project, AMMA will contribute to consolidate both the scientific expertise and the long term collaboration at the Europe and Africa scale.

Operational targets

To entrain the African scientific community and the operational centers into.research and development on predicting the environmental conditions in the region for the benefit of their societies. This will be achieved by the training and eduction WPs but also by the presence of the European scientific community in the region.

Contributing milestones

The key milestones to achieve these targets are :

- Organize summer schools for scientists of the region (M6.2a and M6.2d)
- Organize workshop for stakeholders to show the impact our researcu can have (M6.2b, M6.2c)
- Working with the operational centers to upgrade their monitoring systems (M4.2a)
- Elaborate an agreement with African partners from Universities and organisation outside of AMMA-IP for a free exchange of know-how and knowledge (WP7.4a)

3. Participant List

List of Participants

Partic ip. Role*	Partic. Number	Participant name	Participant short name	Countr y	Date enter project**	Date exit project**
CO	1	Centre National de la Recherche Scientifique	CNRS	France	1	60

CR	2	Institut de Recherche pour le Développement	IRD	France	1	60
CR	3	University of Cologne	U. Koeln	Germany	1	60
CR	4	Deutsches Zentrum für Luft-und Raumfharte. V.	DLR	Germany	1	60
CR	5	University of Leeds	UNIVLEEDS	United Kingdom	1	60
CR	6	Centre for Ecology and Hydrology	CEH	United Kingdom	1	60
CR	7	University of Copenhagen	UKBH.IGUC	Denmark	1	60
CR	8	METEO France	CNRM/ GAME	France	1	60
CR	9	MEDIAS-France	MEDIAS-France	France	1	60
CR	10	University of Burgundy	U.Bourgogne	France	1	60
CR	11	Université Paris 12 – Val de Marne	UP12	France	1	60
CR	12	Université Paul Sabatier	UPS	France	1	60
CR	13	Centre de coopération Internationale en Recherche Agronomique pour le Développement	CIRAD	France	1	60
CR	14	University of Bremen	UB	Germany	1	60
CR	15	Forschungszentrum Kalsruhe	FZK	Germany	1	60
CR	16	Univesität Kiel	CAU	Germany	1	60
CR	17	Ludwig-Maximilians-Universitaet Muenchen	LMU-MUENCHEN	Germany	1	60
CR	18	Rheinische Friedrich-Wilhelms-Universität Bonn	Uni Bonn	Germany	1	60
CR	19	University of East Anglia	UEA	United Kingdom	1	60
CR	20	University of Liverpool	UNILIV	United Kingdom	1	60
CR	21	University of York	UYO	United Kingdom	1	60
CR	22	University of Leicester	ULEIC	United Kingdom	1	60
CR	23	University of Manchester Institute of Science & Technology	UMIST	United Kingdom	1	60

CR	24	Chancellor, Masters and Scholars of University of Cambridge	UCAM-DCHEM	United Kingdom	1	60
CR	25	Institute of Atmospheric Sciences and Climate	ISAC-CNR	Italy	1	60
CR	26	Enea per Nuove Technologie, l'Energia e l'Ambiente	ENEA	Italy	1	60
CR	27	Institute of Biometeorology – National Research Council	IBIMET	Italy	1	60
CR	28	Universita' di Perugia	UNIPG	Italy	1	60
CR	29	Universidad de Castilla- La Mancha	UCLM	Spain	1	60
CR	30	Universitad Complutense de Madrid	UCM	Spain	1	60
CR	31	Universidad Politécnica de Cartagena	UPCT	Spain	1	60
CR	32	Université catholique de Louvain	UCL	Belgium	1	60
CR	33	European Centre for Medium-range Weather Forecasts	ECMWF	United Kingdom	1	60
CR	34	Centre Régional AGRHYMET	AGRHYMET	Niger	1	60
CR	35	Centre de Recherche Médicale et Sanitaire	CERMES	Niger	1	60
CR	36	Ecole Inter-Etats d'Ingénieurs de l'Equipement Rural	EIER	Burkina Faso	1	60
CR	37	African Centre of Meteorological Application for development	ACMAD	Niger	1	60
CR	38	Vaisala OYJ	VAISALA	Helsinki	1	60
CR	39	Ocean Scientific International Ltd	OSIL	United Kingdom	1	60
CR	40	Royal Netherlands Meteorological Institute	KNMI	The Netherlands	1	60
CR	41	Agence pour la Sécurité de la Navigation Aérienne en Afrique et à Madagascar	ASCENA	Senegal	1	60
CR	42	Kalsrhue University	UniKarl	Germany	1	60

4. Relevance to the objectives of the specific programme and/or thematic priority

The large scientific community involved in AMMA (see section 3 and Appendix A) is key to an integrative science project and to the fulfilment of the 5 fundamental goals set by the consortium. They are described in section 2 were the state of the art on which they build is also provided. By its innovative purpose AMMA fits well with the objectives of the specific programme and the thematic priority 6.3 “Sustainable Development – Global change and Ecosystem.”

4.1 Contribution to the Global Change and Ecosystems sub-priority objectives

The West African region has experienced one of the strongest fluctuations of rainfall in the world over the second half of the 20th century. This region has been identified by the IPCC as the most sensitive in the world to climate variability and trends. This strong sensitivity is combined with a high vulnerability of the population to climatic fluctuations. In 1975, Charney proposed a hydro-biological feedback to explain these extreme droughts which occurred at the end of the 60s and early 70s. Since then the relative role of the oceanic forcing and the land-surface processes has been intensely debated but the lack of data has rendered a satisfactory conclusion elusive. Since other tropical regions show also this dual land/ocean forcing of the atmospheric variability, albeit with a weaker amplitude, a better understanding of the African case will be of global value. West Africa therefore provides a natural geographical focus for advancing our understanding of the coupled ocean-land-atmosphere system, and its role in global climate.

West Africa is the world's largest source of biomass burning aerosols and mineral dust. Satellite sensors consistently indicate that these aerosol plumes are the most widespread, persistent and dense found on Earth. The emissions directly impact the microphysics of clouds, and their proximity to tropical deep convection gives them the potential to be exported over great distances. The seasonal cycle of dust and smoke are directly linked to meteorological processes in the monsoon, and in areas remote from the monsoon such as the Mediterranean, making it essential to study the coupling of such aerosols with the energy and water cycles. It is also significant that the aerosol problem has the potential to be a critical issue for aerial security. The region is also critical for global atmospheric chemistry. Important sources of trace gases, biogenic as well as anthropogenic, play a crucial role in the cycle of oxidants in the troposphere. A key priority will be to determine the transport of trace gases from the surface to the upper troposphere and lower stratosphere by deep convection making it a necessity to study the dynamics and the chemistry of the atmosphere in the same framework.

The functioning of the tropical watersheds amplifies the rainfall anomalies to produce larger anomalies of the river discharge. The effect is further enhanced by the anthropogenic water usage and the biological feedbacks. The continental branch of the hydrological cycle requires thus an integrated approach combining the physical, biological as well as the human dimensions of the problem. The enhanced variability of the discharge of major rivers in the region, together with the fluctuation in the monsoon, directly impact the ocean's mixed layer and dynamics. This in turn will modify the sea surface temperature and feedback on the monsoon.

The multitude of interactions existing between the energy, water, aerosols and chemical cycles in the region, imposes a multidisciplinary approach to the problem of climate variability in this region. Europe, through its former colonial presence in the regions, possesses a rich collection of observations which cover the climatic processes as well as the anthropogenic pressure on the environment. This unique dataset will allow this project to place the current variability and trends into their historical context.

It is proposed to study the variability of the climatic and environmental conditions over Western Africa in the framework of an Integrated Project in order to facilitate multidisciplinary research. Furthermore we aim to integrate demonstration and training activities. One of the expected results will be the demonstration of the benefits for the African societies of an enhanced monitoring system through the improvements of environmental forecasts. An integrated understanding of the West African monsoon mechanisms is necessary for the following:

- In the short term, improvement of the prediction capacities of the monsoon intensity, which will allow:
- the setting up of agricultural strategies allowing optimisation of productivity (e.g. seeding dates…),
- definition of sustainable freshwater fishing resource management strategies (in Central Niger Delta for instance),
- definition of coastal fishing resource management strategies, because the survival of many coastal and estuary species depends on river bringing,
- helping public health systems to anticipate peaks of vector-borne disease cases (this requires a parallel improvement our knowledge of rainy season effects for vector-borne diseases transmission (Malaria, arboviral diseases : especially Yellow Fever and Rift Valley Fever, Onchocercasis and Trypanosomiasis).

In the long term, in connection with global change, refinement of evolution scenarios for the monsoon and thus implementation of relevant initiatives for the adaptation or the attenuation of this phenomenon.

As a cause of major environmental change with profound socio-economic consequences, the African monsoon has a strong impact on immigration from Africa to European countries. It is thus clear that the definition and implementation of immigration policies should take into account this climatic phenomenon and its consequences on livelihoods in the region.

4.2. Relevance of the proposal within the European Research Area

African monsoons, thereby AMMA is the key project for the whole European scientific community dealing with climate change in West Africa and its socio-economic impacts. Therefore, it will not only reinforce and integrate the climate variability expertise within Europe, but also establish better links between this scientific community and those engaged in environmental change impact assessment, including the social sciences community. AMMA will play a crucial role in the integration of the efforts of European laboratories regarding the analysis of climate change in West Africa and its consequences. Moreover, it will contribute to develop the links between the European and the African scientific communities. Finally, the research that will be carried out will improve the understanding of the Asian and contributing to enhance international visibility of European Research.

4.3 Relevance of the proposal to FP6

AMMA will promote top international research on climate change and its consequences, which is a key issue for Europe within the next decade. Indeed, the African monsoon will have not only direct climatic consequences on the European climate but also strong socio-economic impact in Africa with repercussions in Europe due to globalisation (e.g. migrations or epidemics). AMMA will bring together first rate researchers from Europe and Africa in order to solve intricate scientific questions which have a strong bearing for both Europe and Africa.

4.4 Relevance of the proposal to the Theme

AMMA deals with the environmental and socio-economic consequences of global climatic change and therefore its thematic content fits completely with the aim of sub-priority 1.1.6.3 “Global Change and Ecosystems”. Due to the strong impact of the West African monsoon on the mechanisms of greenhouse gas emissions and atmospheric pollutants on climate, ozone depletion and carbon sinks, AMMA is relevant to area 6.3.1. Because of the important influence of the West African monsoonwithin the global earth system, it corresponds well to topic 6.3.I.3 “Hot spots in the earth system”.

4.5 Relevance of the proposal to the Hotspot in West Africa

The West African monsoon is the key climatic factor conditioning the evolution of water and agricultural resources in Sub-Saharan North Africa. It also has a strong impact on health issues linked to environmental parameters (such as vector-borne diseases and water linked affections). From a global perspective West Africa is a ‘Hotspot’ in regard to several pressing environmental concerns: it is a region of severe humanitarian problems, including high mortality from malaria and meningitis epidemics and a growing population; it is a zone of globally-significant chemical and aerosol emissions; it is a region of intense convective storms and extremely strong lightning activity; it is the birthplace of the majority of Atlantic hurricanes; and it is a region of extreme climate sensitivity. Beyond this we know that our predictive models for the region are systematically deficient, yet we are unable to test them effectively due to a lack of observations.

4.6 Appropriateness of the IP Instrument

AMMA will anticipate scientific and technological needs linked to climatic change in West Africa. Resulting environment changes will have a major societal impact for West African countries and therefore will affect Europe through globalisation (migration, food exportation, halieutic resources, mining resources, biodiversity…). AMMA results will be directly applicable in order to help in defining sustainable resource management strategies and politics at a planetary level. The globalisation, importance and mutidisciplinary aspects of AMMA, as well as the spread of knowledge in many different European institutions, make it fit well with the IP instrument.

4.7 Critical Mass

The IP will involve 39 partners from Europe and Africa. Many more national African institutions (a dozen Meteorological Services, water resources services, and a dozen Universities) are already working in close cooperation with European laboratories on Climate and environmental issues in West Africa, and will thus be involved in AMMA through bilateral collaborations. The African partners of the IP are regional institutions with the mandate of developing an integrated vision of climatic and environmental related problems in West Africa. As a consequence, they have naturally developed a global vision of both the scientific and application components of the project .

5. Potential Impact

5.0. Introduction

An integrative project of this scope, combining such diverse scientific and applied disciplines to address environmental problems on the continental scale, has never before been attempted.

The European scientific community has a considerable body of knowledge and expertise in the study of the tropical climate and environment of Africa, but requires multi-disciplinary integration to address comprehensively the complex issues of the West African Monsoon. While some dynamical features of the regional climate system over West Africa are reasonably well known and described individually, their interactions are not well understood. At the same time there is a strong but scattered community of European scientists with considerable expertise working on the different components of the West Africa Monsoon (biosphere, hydrology, ocean, atmospheric physics and chemistry), on the various socio-economic impacts (water resources, agriculture and health), and at many different scales (local, regional and global). An integrated study of the West African Monsoon is thus the only way to make significant progress on the questions raised above. In addition, the European research community is in an excellent position to take a lead in this activity. CLIVAR (through its VACS panel), GEWEX (through its GHP panel) and IGBP have all endorsed AMMA as a pilot initiative for an integrated study of climate variability and its socio-economic impact in Africa.

5.0.1 Background to impact

It has been pointed out that this region is one of highly interactive processes. The individual science areas which are important to prediction and monitoring in the West African region are highly dependent on inputs from other systems (for instance the hydrosphere is critical to the evolution of the atmosphere). Furthermore, global predictive methods and satellite remote sensing have far advanced in situ monitoring in the region. Each of these science areas is currently data limited for West Africa, and is also limited by the need for integration of observations from other systems. Within AMMA we aim to make a step-change in our understanding, monitoring and predictive methods for the region, by removing the data and system-integration limits which currently hinder our progress. This can only be achieved through a highly coordinated programme of activity, in which the needs of each research and user community are communicated freely, and in which the fulfilment of these practical needs are systematically coordinated.

5.1 Contributions to standards

NOT APPLICABLE

5.2 Contribution to policy developments

5.2.1. Impact on EU policy/legislation and relevance to European policy for development in Africa

One key element of the European policy for the development of Africa is to promote research on adaptation strategies to a changing climate and environment. AMMA Scientific, innovation and disseminiation activites will be carried out in conformity withe the EU Sustainable Strategy including EU Environnement, Health and Life Quality Policies described in section 11.

This is a complex issue because there are large gaps in concepts, scales and models that separate the various scientific communities involved in the science of climatic impacts. The truly integrated approach developed in AMMA is the basis for designing adaptation strategies. While education and training, both towards African and European scientists, are an important part of AMMA, another important challenge of this programme is to help in building a healthy community of African scientists that can develop research programs of its own conception. Networking is a key issue in this respect. A network of more than 200 hundred African scientists – AMMANet – has been set up (http://www.ird.ne/ammanet/) with the aim of making accessible to these scientists key information on the activity of the scientific community world-wide and on the call for proposals that could help them in funding their research activity.

5.2.2 Overview of Routes for exploitation

Through our IP composition, we have clear strategies for exploitation of scientific knowledge, and we include in the consortium partners whose expertise and motivation lies in such exploitation. For instance, we include world-leading weather and climate prediction agencies, who are experienced in developing state-of-the-art prediction models for economic application. In particular, our subproject and work-package structure allows us to see clearly the pathways from basic scientific advances into demonstrable applied benefits (‘Demonstration Activity’ work-packages). The fact that this structure is clear to each Partner in the consortium at the outset will further enhance the effectiveness of these pathways.

5.2.3 Direct & Indirect Economic Benefits

The primary economic benefits of this IP will be through improved predictive tools for Africa and for the globe. In terms of global prediction, our fundamental integrative studies will feed back, thorough the demonstration activities into improved environmental models. The economic importance of such models, worldwide, to agricultural planning, aviation, shipping and risk assessment is well established. In particular, sub-Saharan North Africa is a data-sparse zone, and improvement in monitoring is needed for better prediction in the downstream Atlantic and the Mediterranean region. In terms of local prediction for Africa, improvements in forecasting for agriculture, health and water resource applications will have direct economic as well as humanitarian benefits. Better predictions mean more efficient deployment of resources (for example, routine agricultural activity, medical resources or international aid in times of crisis). Apart from its humanitarian urgency, reduction in the severity of the effects of disease will lead to more stability in the workforce, with practical economic benefits.

Our SME partners will also develop their scientific products. By installing and using them in this data-sparse and climatically-extreme region, they will be able to develop their methods and improve their products. This will be enhanced by proper validation and intercomparison of instrumentation and methodologies, and will lead to improvement in the competitiveness of these partners in the international market.

5.2.4 Contribution to Community Societal Objectives

Europe and Africa have strong human, cultural and socio-economic linkages that will play an important role in shaping our future. Climate change may deeply affect the fragile equilibrium of the African societies and increase the gap between the global well-being of Europe and the poverty of Africa. A better knowledge of the African monsoon and of the socio-economic impact of its variability will help in implementing adaptation strategies that will be needed to give a chance to a growing African population to prosper in its own continent. Europe is aware that it cannot look the other way while Africa is facing a major potential threat to its development, as demonstrated by the recent 30-year drought. This IP aims to address pressing scientific objectives, but also to engage African scientists in their attainment.

5.2.5. Environment, quality of life and health

The quality of life in West African countries will benefit from a better knowledge of the climate and its interaction with the water cycle, land productivity and health. As already explained in section 4, the objective of AMMA is to improve prediction capabilities for the rainy season and to develop tools that will use these predictions for (1) better management of agricultural campaigns, (2) anticipation of crises in water supply, and (3) prediction of epidemics. Improvement in prediction for each of these applications will have direct consequences in improving quality of life in Africa. Demonstration and training activities will have an important part in AMMA, thus helping in capacity building in local institutions.

5.2.6. Employment

The needs for building a strong sector of activity in climate, environment and natural resource management in West Africa are important. An improved knowledge in these areas will help convince African decision makers that investment is needed to improve the future of their countries, thus creating employment opportunities. The increased skills resulting from the AMMA training component will help to transform these opportunities in real jobs for educated people. Furthermore, by engaging African scientists in environmental monitoring networks which are of international importance, we aim to create pressure for sustainability in these activities. The prestige and sense of usefulness derived from such jobs should create an incentive for a further increase on education.

5.2.7.Training and education

Improving our knowledge of the West African monsoon is not sufficient to face the consequences of its variability. It is a major commitment of this programme to make a significant contribution to the appropriation of this knowledge by the emerging African scientific community and the decision makers.

A first step in that direction was taken in September 2003 with the organisation of a 2-week summer school held in Southern France. The aim of this summer school was to review our present state of knowledge on the WAM and the major questions that need to be addressed in order to improve our prediction capability at climate scales. In order to foster the links between the African and the European scientific communities, a blended audience of young African (two dozen) and European scientists (a dozen) attended this summer school. Future summer schools will focus on applications and impact studies. Through the implementation and upgrade of observing networks in the region, we will also train scientists in data collection and manipulation. We aim that the global importance of these data will be a driver for a sustainable, critical mass of internationally-engaged African scientists.

5.2.8. European dimension of the IP

AMMA is a European-African initiative and its progress is being led by European groups. Europe already has numerous world-leading experts in the science of the WAM region and its applications; we also have several outstanding global environmental prediction agencies. We aim through this IP to activate and integrate this community of European experts, and thereby to address some of the most important global environmental problems of our time. Since our individual activities are limited currently by difficulties of data collection and interdisciplinary integration, we aim to expand our activities. Through this coordination we have the capacity to become world-leaders in this kind of integrative science and its application.

5.2.9. Durable structure

The AMMA programme has come to maturity over several years, and has been carefully conceived to make sustainable changes in our understanding, monitoring and prediction of the West African environment. Our activities are embedded within a 'Long-term observing period' (LOP) structure, which will ensure that our intensive activities are directed towards systematic improvements in monitoring and prediction over the coming decades. An important facet in this strategy is the activation and training of a critical mass of African scientists, to be engaged in the data collection, decision-making and analysis work of AMMA. We will develop and upgrade two important networks of monitoring systems (for the upper air and surface fluxes), and over the LOP we will transfer responsibility for these networks to the local African agencies. These networks of observations are of enormous value both to global prediction systems (operated in Europe) and to local forecasting systems, based in Africa. These networks of scientists and instrumentation will therefore be a driver for long-term maintenance of the scientific integration which is developed in AMMA, since the European as well as the African partners will benefit from their continuation.

5.3 Risk assessment and related communication strategy

No risks for society and citizens are known for research environment activities.

Nevertheless, Work-packages contain Risks and Contingencies plans. The AMMA consortium will be anticipating problems by applying the precautionary principle. Decision making (Governing Board) will be based on precaution in order to prevent damage to the environment related to the use of our equipment in Africa.

5.3.1. African Political Issues

Due to the unstable and fragile political situation in that part of Africa, close collaboration with the local authority will always be sought and measures to provide security for materials and scientists will always be taken accordingly. Decisions on the deployment of instruments and scientists in the area will be taken based on the recommendations obtained from the EU foreign Ministeries and local agencies. The local embassies will always be informed of the AMMA activities in the region. AMMA has underlined the importance of partnership by considering as crucial "the involvement of local scientists from the host African country at the very early stage of the planning and implementation of the research activities ». AMMA intends to develop a culture of collaboration which is different from charity help that one might think regarding Africa.

This project is dependent on stable socio-economic conditions in Africa to allow for a safe deployment of instruments and scientists. This is not a given fact in part due to the high vulnerability of these countries to environmental conditions which can rapidly deteriorate the economical situation. It is thus inherent in the study of this hot-spot in the earth system that one is exposed these risks. Because of the unstable and fragile political situation in this part of the world, close collaboration with the local authority will always be sought and measures to provide security for materials and scientists will always be taken accordingly.

Decisions on the deployment of instruments and scientists in the area will be taken based on the recommendations obtained from the EU foreign Ministries and local agencies. The local embassies will always be informed of the AMMA activities in the region. To minimise the risk the main scientific activities in this project will be carried out in Benin and Niger. Both countries have been very politically stable over the last 2 decades. IRD, which is a partner of the consortium has has a significant scientific presence in these countries for the last 10 years.

In order to spread the risk, some field campaigns have furthermore been positioned in countries such as Burkina Faso, Ghana and Senegal, with some research aircrafts and ships operating out of Abidjan. Should a change of political situation make the deployment of instruments and scientists in Niger and Benin unfeasible two alternate locations are standing buy. The work proposed in then area around Niamey can be shifted to Ouagadougou. The local conditions would allow it and the climatic situations are comparable. As Field campaigns of AMMA are already underway in Burkina Faso the basic infrastructure is available. The studies in Benin can be transfered to the upper-Volta basin in Ghana should the local conditions require it. Partners of the consortium are already present on this catchment and would provide the basic infrastructure.

The exogenous risk in this project is directly linked to the aims which we set ourselves. It is thus essential to face this risk in order to bring better environmental monitoring and forecasting capabilities to these African countries and help them take the socio-economical decisions which will allow them to achieve the stability needed for the well being of their populations.

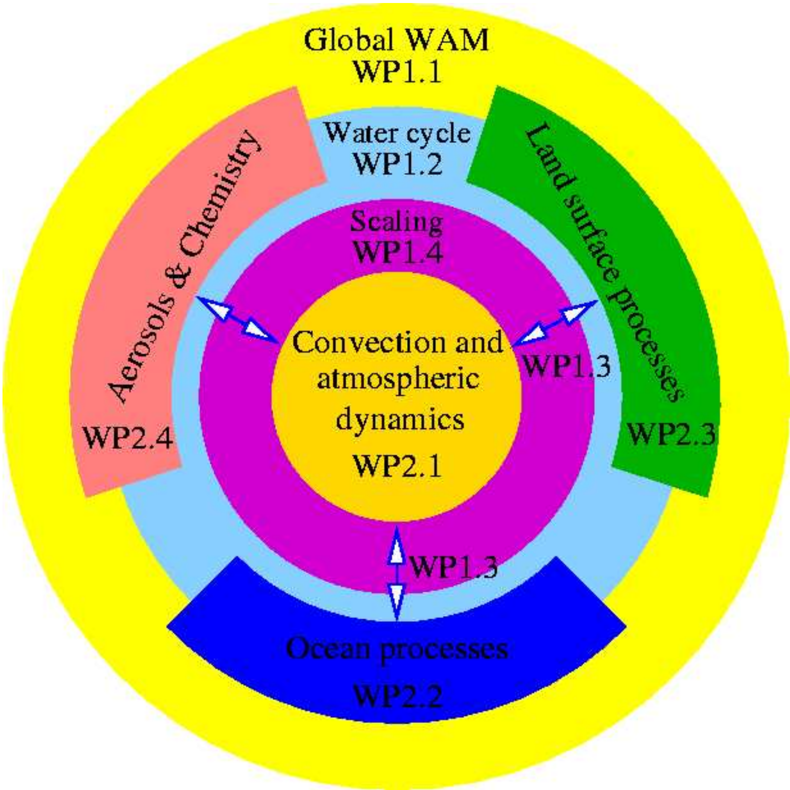
6. OUTLINE IMPLEMENTATION PLAN

6.A - Activities

6.0 Introduction

The implementation of the AMMA science plan will be geared towards helping the African populations to set up an environmental risk decision processes and thus reduce their vulnerability to weather and climatic events. In order to achieve these goals the project needs to integrate the scales at which the geophysical and human processes interact and furthermore the various disciplines involved in the study of the West African Monsoon need to be integrated. This approach has guided the structuring of the scientific objectives along well defined work-packages.

Figure 6.1 : The integrative science work-packages and their links to the process studies for the 4 geophysical components of the West African Monsoon.



6.0.1 The Geophysical Perspective

The fundamental science underpinning the AMMA project can be viewed as the various disciplines coming together within some broader integrative science topics (Fig 4.2).

Integrative Science

The work-packages dealing with integrative science will look at the West African monsoon as a coherent system and study it with a multidisciplinary approach. The 4 topics which were selected are :

1. The interaction of the WAM with the global climate from a physical as well as a chemical perspective.

2. The water cycle of the WAM from the regional to the local scale will be analyzed.

3. The role of surface processes in the evolution of the WAM.

4. Scaling properties of characteristic variables of the WAM.

Process Studies and Scale Integration

To feed these integrative work-packages a sound disciplinary knowledge of the processes and their scale dependence is needed. Four work-packages have thus been selected to advance our understanding of the four components which make up the WAM :

1. Atmospheric processes with a focus on the convective processes which are key to the rainfall production.

2. Oceanic processes as they contribute and depend on the WAM

3. Biophysical processes over the continent from the regional to the local scales

4. Aerosol and chemical processes in the atmosphere.

6.0.2 The Human Dimension

To study the human dimension of the variability and possible trends in the West African Monsoon we have chosen to address the direct impact of the environmental conditions on three limiting conditions for the African societies :

1. Land productivity

2.Water resources

3.Health impacts.

For the case of agriculture we wish to go a step further and examine the adaptation strategies available to the local farmers and the policies which would help reduce the vulnerability of these activities to climatic anomalies. This work-package will also integrate the impact of water resources and public health on the food security and thus provide an integrative view (Figure 6.2).

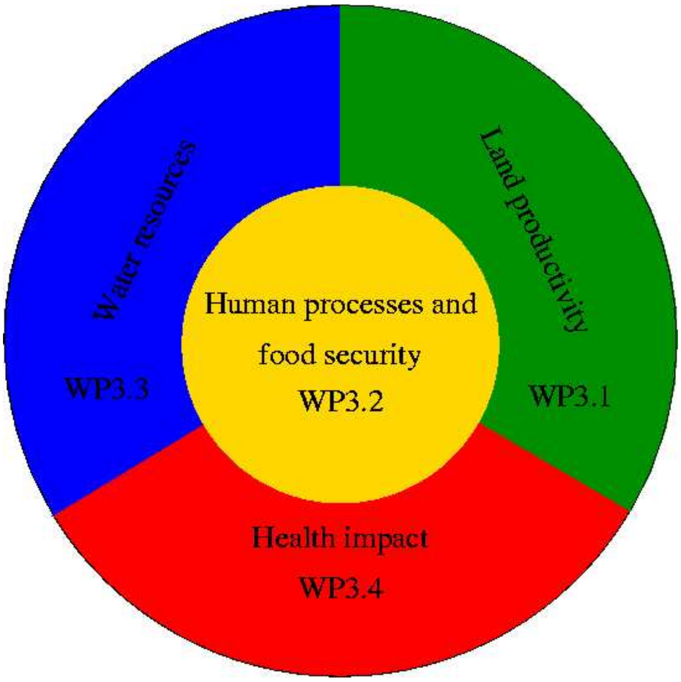


Figure 6.2 : The three components of the human dimension of the West African Monsoon and its integration through the case of food security.

6.0.3 Tools and Methods

To achieve these scientific objectives the partners must work on a consistent set of tools and methods which are well adapted to the problem of the West African Monsoon. In order to ensure a maximum efficiency in the validation, development and use of these tools four work-packages are dedicated to these activities :

1.Model evaluation and data assimilation

2.Field campaigns

3.Satellite remote sensing

4.Data base and historical data

These activities, together with scaling issues covered in the integrative science, are key to transferring knowledge from the geophysical community in AMMA to the human dimension activities. These tools will collect and consolidate knowledge, integrate the knowledge and materialize the predictive skill gained with this knowledge (Figure 6.3).

6.0.4 Demonstration, Training and Education

For the AMMA project to have a lasting impact on the well being of the African populations it needs to be demonstrated that : i) it has an impact on the decision making, ii) technicians can be trained to maintain the environmental monitoring system, iii) African scientists can be motivated to pursue the development of a better understanding of the West African Monsoon and iv) that there is a will to continue improving forecasting systems. This capacity building and motivation of African scientists will be carried out in four Work-Packages :

1.Weather and climate forecasting systems

2.Early warning systems for food security

3.Environmental monitoring systems.

4.University programs.

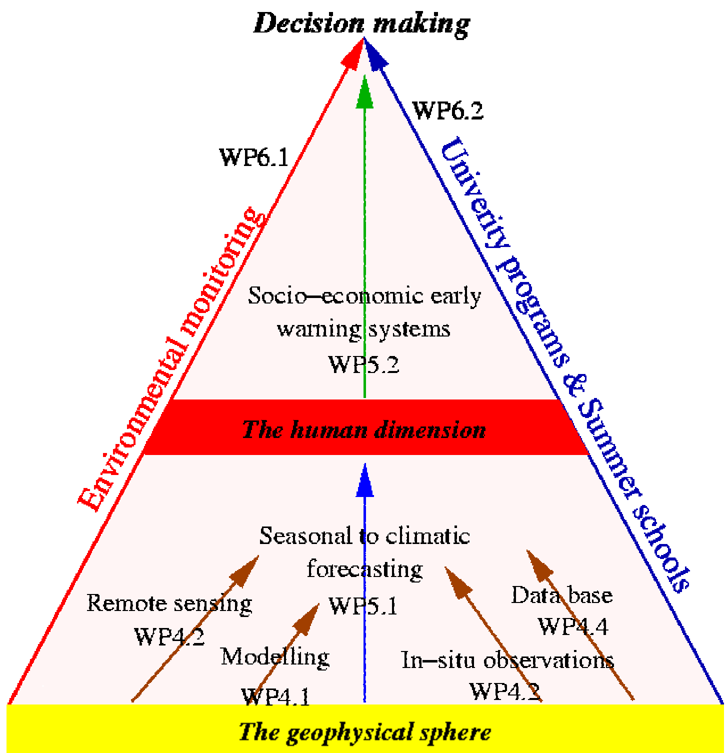


Figure 6.3 : Integration from knowledge in the geophysical sciences through various tools and for the exploitation by impact studies. They provide then advice for the decision making.

We will show that based on our improved understanding of the geophysical and human dimensions of the WAM the forecasting and early warning systems can be improved. In order to maintain this benefit over the longer term the cornerstones of an environmental monitoring system and educational program need to be laid. These applications are also the cement of the scientific activities of AMMA as they are the objectives of all scientists involved in the project.

6.0.5 Management Activities

The ambitious objectives, the number of participants, and the implementation of the integrated project itself require a strong and coherent ”excellence-oriented” management system to carry out projects such as AMMA. The management activities are split into 3 levels of management activities: Strategic management, executive management and operational management (including Work-Package, Financial and Administrative Management) as detailed in B6 (Description of the Project Management).

Three work-packages will implement the management activities, each one focused on specific aspects of the AMMA project :

•Instrument Deployment Management WP is specific to the experimental component of AMMA.

•Scientific Management WP will ensure the consortium remains focused on the scientific objectives.

•The Financial & Administrative Management WP will be the logistics backbone of the project.

•Intellectual property, knowledge and data management WP will oversee the legal issues linked to the creation of knowledge.

The mission and vision of the integrated project will be defined, developed, and facilitated by the leaders, via the governance structures (Governing Board, Executive Committee, work-packager leaders). For the appropriate actions and behavior necessary for implementation, personal involvement of the leaders in particular, will be defined. Actions of the operational management for the AMMA project consist in the consolidation management of the different IP processes (costs, resources, communication and risks). This will include establishing the project management plan, managing the interfaces and interactions between processes, of each process progress, and finally managing their possible modifications. It includes the management of work-packages based upon the principles of the ISO 10006 European project Management standard, which will be the basis and the tool for the successful management and integration of the different work-packages. This will be carried out by work-package leaders.

6.1 Research, technological development and innovation activities

6.1.1 Integrative science

WP1.1 West African Monsoon and the global climate

Partners: U. Koeln, CNRM, CNRS, CAU, UCM, ENEA, ISAC-CNR, IBIMET-CNR, IUP-UB, LMU-MUENCHEN, UniKarl, KNMI, DLR, U. Bourgogne, UCAM.

Objectives:
The aim of this Work-Package (WP) is to better understand and predict the multi-scale variability of the aspects of the global climate linked to the West African Monsoon (WAM). The WAM is a dynamical coupled system in which climate evolution is linked to ocean/land surface forcings and to changes in the atmospheric composition. 'Teleconnection' mechanisms communicate global sea surface temperature (SST) anomaly patterns to the West African region: the different timings of these forcings and the different inertia of the WAM components develop multi-scale interactions, and generate a large spectrum of variability. The variability is dominated by interannual changes, WAM onset variations, intraseasonal monsoon variability, including breaks and surges, and synoptic modulations. All of these modes of variability are critical to prediction methods and decision-making for the region. In this context, we also address the global impacts and regional interactions associated with the WAM emission of chemical oxidants and aerosols on the radiative forcing of the WAM, as well as interactions between photochemical processes and convection.

Inversely the WAM climate and atmospheric dynamics impact on the climate of several remote regions. Firstly, it has impacts inside its own coupled system by modifying the oceanic surface and sub-surface conditions in the eastern tropical Atlantic, which in turn modify the WAM dynamics, as well as to a lesser extent on the Mediterranean summer climate variability. Secondly, it has a significant impact on atmospheric dynamics which will not feedback directly on the WAM, such as the process of cyclogenesis in the northern tropical Atlantic, both through dynamical processes (*e.g.* out-going African easterly waves and mesoscale convective systems) and chemical processes (*e.g.* dust aerosol transport, which is thought to impact on tropical cyclone development). Thirdly, the WAM, through chemical and aerosol emissions, has a big impact on the long-range transport of trace constituents downwind from West Africa, and then on quasi-global oxidant and aerosol budgets, as well as radiative forcing.

This WP is split into a management structure and three sub-WPs which have been defined to better organize the research activities:

WP_1.1.1: Inter-annual variability and trends of the African Monsoon : the main objective is to examine the causes and trends of the WAM variability, and to determine how this will evolve in the years to come with higher greenhouse gas concentrations.

WP_1.1.2 : WAM impacts on atmospheric composition and global climate : the main objective is to determine the impact of the WAM emissions on global oxidant and aerosol budgets, the oxiding capacity and global radiative forcing.

WP_1.1.3 : Interaction between the large-scale flow and WAM weather systems : the main objective is to study the interactions between the large and regional scale atmospheric circulations and the distribution of the main WAM weather systems, so as to better predict key-points of the monsoon; notably its onset and the occurrences of breaks and surges.

These sub-WPs are inter-related. Firstly, WP_1.1.1 and WP_1.1.3 have close links as together they address the WAM dynamics on complementary scales, from global and long-term scales down to synoptic and short-term scales. WP_1.1.2 is related to the two other sub-WPs by addressing the interactions between atmospheric dynamics and trace gas and aerosol budgets; it will provide information on the impact of WAM emissions on global climate including direct impacts on radiative forcing and possible modification of dynamical systems (e.g. tropical cyclone development, linking with WP2.1). WP_1.1.2 will use results on the causes of observed and modelled atmospheric variability at different space-time scales which will aid the analysis of the impact of WAM emissions on global scales. Interactivity will be favoured also by the use of common tools (in-situ and satellite data, climate models).

Work content

To reach the objectives of this WP, diverse datasets and models must be brought together, and there must be good cooperation with a number of other WPs. It is necessary to monitor the exchange of deliverables with other WPs and sub-WPs, so that bottlenecks and constraints can be eliminated. Communication between data providers and modellers will be organised, and common data standards defined. In particular, the management of communications within this WP will be carried out through:

- meetings of the sub-WPs and meetings of the whole WP ;
- coordination of key publications and progress reports ;
- coordination of exchanges with the rest of the AMMA project, in particular through presentation on the AMMA web site.

Foreseen deliverables

- Definition of responsibilities for/within sub-WPs ;
- Organization of coordinated modeling experiments
- Organization of WP and sub-WP meetings.
- Publication of key WP publications and progress reports;

Milestones

- Yearly meeting of sub-WPs partners
- Delivery of reports as required in sub-WPs ;

Data needed from the field campaigns and models

- Global atmospheric analyses including assimilated EOP and SOP data with data assimilation records (WP4.1.1)
- Radiosonde data and surface fluxes (WP4.2)
- Satellite-derived aerosol/trace gases (WP4.3)
- Satellite-derived rainfall estimates (WP4.3)
- Satellite-derived vegetation indices (WP4.3)
- Satellite-derived SSTs (WP4.3)
- Archived atmospheric analyses (WP4.4)

Risks and contingency plans

There is a risk that specific coupled ocean-atmosphere models are unable to simulate specific aspects of the coupled system. This will be assessed by all the modelling partners into their specific tasks. In any case where a model is unable to simulate the key processes, alternative models within the consortium will be considered.

Some uncertainties also exist about the possibility to evaluate the progresses done in the seasonal forecast since this forecast production depends on the identification of a forecast skill potential linked to the continental surface conditions, a topic which will be investigated in other work packages.

A part of this WP is based on data derived from coordinated atmospheric and surface observations to be conducted during the EOP and the SOP as well as from satellite dataset.

Links to other WPs

WP	Input to WP1.1	Output from WP1.1
1.2	Impact and variability of the West African monsoon in terms of regional water budget interaction	Water vapour flux (convergence) over WA in reanalyses and model data. Computations of role of the global climate on regional water budget.
1.3	Provide sound assumptions on soil moisture sensitivity experiments with GCMs Understanding of role of land and ocean feedbacks	Impact of large and regional scale environment and teleconnections processes. Understanding of the impact of ocean feedbacks on WAM.
1.4	Expertise in tools to address interactions between large scale flow and synoptic weather patterns	Analysis of regional scale atmospheric environment.
2.1	Impact of small-scale processes including surface heterogeneity on convective events. Model calculations of tropical cyclone-mineral dust interaction	Large-scale environment of convective events
2.2	Analysis of the different oceanic processes involved in the variability of sea surface temperatures.	Impact of large and regional scale atmospheric environment on the variability of sea surface temperatures.
2.3	Provide sound assumptions on vegetation sensitivity experiments with GCMs	
2.4	Improved models following detailed studies of chemical/ aerosol processes and interactions with WAM dynamics	Impact of WAM emissions on global climate
3.1		Skills of seasonal monsoon prediction
3.2	Land use scenarios	Predictive skills of monsoon onset and breaks
3.3		Variability of continental-scale atmospheric water balance
4.1	Coordination of model experiments/intercomparison s	Intercomparison report of existing model skill on the WAM region
4.2	Provide data	Operational planning

4.3	Observations of coupled system	
4.4	Observations of coupled system	
5.1	Coordination of model and statistical experiments Evaluation of progress made on forecasting.	Provision of suitable forecast models and statistical forecast schemes, including their skills
5.2		Guidance to early warning systems

Work-Package 1.1.1: Inter-annual variability and trends in the African Monsoon

Objectives

The general objective of this sub-WP is to examine the causes of variability and trends of the West African monsoon (WAM) and to determine how these will evolve in the years to come with higher greenhouse gas concentrations. A part of this work will be devoted to identify the key sea-surface temperature (SST) anomaly patterns and trends in the three major tropical ocean basins (Atlantic, Pacific and Indian Oceans) that influence the variability of the WAM on intra-seasonal to decadal time scales. This involves determining the role of the slowly varying boundary conditions over the West African subcontinent in modifying the SST-WAM rainfall teleconnection, as well as quantifying the impact of the West African monsoon dynamics on the SST variability in the tropical Atlantic Ocean. Impact of land surface processes, as well as internal variability of the atmosphere and connections with other monsoon areas will be also considered. The ultimate goal of this sub-WP is the development of multivariate statistical and dynamic WAM forecast models (further evaluated in WP 5.1).

At the heart of this work we will use a hierarchy of general circulation models (GCMs), including hindcasts with prescribed surface conditions and forecasts with coupled atmosphere-land-ocean models (ie DEMETER integrations) along with multivariate statistical analyses to assess to which extent the key modes of WAM variability are predictable. Within this sub-WP, major efforts will be devoted to evaluate the available analyses and simulations (GCM validation, links with WP 4.1) through comparisons with in situ (WP4.2) and satellite data (WP4.3) from the LOP and EOP. Interactions with the WP1.3 will also explore the fundamental processes controlling the land-ocean-atmosphere interactions. Concerning the global change scenarios, the existing scenarios within the ENSEMBLES project will be used to study intraseasonal to decadal changes in Africa, as well as evolution of African easterly waves and cyclogenesis in the tropical Atlantic. In addition, ensembles of seasonal atmospheric simulations (driven by observed SSTs and relaxed toward or initialized with realistic soil moisture fields) as well as ensembles of seasonal coupled atmosphere-ocean forecasts will be made available to the AMMA community.

Workcontent

- Analysis of the coupled ocean-atmosphere monsoon system using simulations with coupled atmosphere general circulation models to understand the nature of the large-scale interactions between the WAM and the global climate system.
- Sensitivity studies with prescribed SST anomalies using ensemble integrations of (simplified) AGCMs as well as with partially coupled runs to determine key SST anomaly patterns and key ocean basins (Guinea Gulf and tropical Atlantic mainly) in the WAM rainfall variability.
- Multivariate statistical analyses of the relation between SST anomalies and WAM using observations (including reanalyses) and AGCM data forced by SST anomalies over different ocean basins (Tropical Atlantic, Indian, Pacific Oceans, Mediterranean sea) to assess the different roles of the ocean basins.
- Analysis of global change scenarios to compare dynamical and rainfall variability of the WAM in past, current and future climate. Sensitivity studies to CO_2 concentrations from scenarios and idealized CO_2 doubling experiments.

- Conversely, analyses of the role of WAM forcing on tropical Atlantic SST. A focus will also be given to the link between African easterly waves and cyclogenesis in the north tropical Atlantic basin.
- Evaluation of the skill of the DEMETER seasonal forecasts over West Africa and rerun of a subset of the DEMETER forecasts with an improved atmospheric physics and/or an improved land surface initialization.
- Validation of the AGCMs and coupled GCM from intra-seasonal to decadal timescales before the field campaigns and after, owing to the use of EOP, SOP and satellite datasets, paying special attention to parameterisation schemes, such as shallow and deep convection.
- Development and validation of statistical and dynamic (DEMETER integrations) forecast models for WAM rainfall onset, performance and breaks.

Deliverables

- Quantification of the relative impact of SST anomalies and continental conditions on the variability of the monsoon dynamics.
- Evaluation of the role played by different ocean basins on the WAM variability based on observed data and GCM output.
- Evaluation of the changes in WAM variability in the future climate scenarios.
- Quantification of the impact of the monsoon dynamics on SST variability in the tropical Atlantic.
- Quantification of the predictability of interannual to interdecadal atmospheric variability over the sub-Saharan region arising from variations in the surface/boundary layer conditions of the atmospheric system.
- Improved real-time forecast of intra-seasonal variability with application to the monsoon onset, and dry sequence occurrences.
- Most of the simulations produced in this sub-WP will be archived and made available to the AMMA community.

Milestones

- Analysis of GCM and coupled GCM outputs from existing simulations to define the first set of planned simulations.
- Synthesis of the results of the first set of planned simulations. Definition of further simulation sets.
- Beginning of the evaluation of AGCM and coupled GCM based on the data from EOP/SOP and satellite available data.
- Rerun of a subset of the DEMETER forecasts with improved physics/parameterisations.
- Synthesis on the predictability of the WAM intra-annual components and the performance of models in forecast mode.

Work-Package 1.1.2 - WAM impacts on atmospheric composition and global climate

Objectives

The main objective of this work is to determine the impact of West African emissions on global oxidant and aerosol budgets, the oxidising capacity and global radiative forcing using a combination of global chemistry-aerosol modelling and data analysis (e.g. satellite). A particular focus is on the role of the WAM in the long-range transport of trace constituents downwind from West Africa. Preliminary calculations of the impact of West Africa on global trace gas and aerosol budgets will be used to pinpoint key model deficiencies over this region. These results, together with detailed model evaluation using existing data (4.1.3), will form the basis of detailed studies into chemical processes, aerosol properties, emissions and regional scale impacts of convection (WP2.4). Following further model evaluation and improved coupling of model processes to physical variations in climate (e.g. lightning emissions to convection) and aerosol interactions with dynamics/radiation (WP2.1, 2.4, 4.1) models with improved predictive capability will be used to quantify WAM impacts on a global scale. Specific objectives are:

- To quantify the key transport pathways, photochemical reactivity and aerosol properties in air masses downwind from West Africa, particularly in relation to WAM dynamics with the aim of determining the net export of trace gases and aerosols from West Africa relative to other sources.
- To quantify the impact of WAM emissions on global trace gas budgets, oxidising capacity, and radiative forcing on seasonal and inter-annual time scales.
- To quantify the impact of West Africa on global aerosol radiative forcing on seasonal and inter-annual time scales with a focus on primary and secondary organic aerosols, biomass burning and dust.

Workcontent

- Analysis of satellite data (SCIAMACHY, GOME, OMI) of global chemical composition (NO_2, O_3, SO_2, and HCHO) in conjunction with global modelling to elucidate key transport pathways of trace gases out of West Africa during WAM during SOPs and on inter-annual timescale***s***.
- Combination of global modelling, trajectories satellite (METEOSAT, TRMM) and airborne data analysis to quantify the contribution of lightning NO_x emissions to ozone production downwind from WAM convective outflow.
- Analysis of satellite aerosol products (e.g. CALIPSO), ground-based and airborne aerosol measurements collected downwind of West Africa and North/South America to examine transport pathways of aerosol layers across the Atlantic. Calculation of the impact of tropical cyclones on the transport of mineral dust using a coupled aerosol/dynamical/radiative model (working interactively with WP2.1).
- Analysis of aircraft SOP data on chemical composition to examine the photochemical processing of layers during long-range transport downwind from West Africa and sensitivity of results to mixing/dilution with air masses of other origin (e.g. stratospheric) using combination of data-initialised trajectory models and a global model.
- Determination of the net impact of WAM emissions (e.g. biogenics, industrial, lightning) on the global ozone budget, including export fluxes and oxidising capacity (OH) over selected annual cycles (inc. 2006) using global chemistry-aerosol-climate/transport models (2 with zoom over West Africa, 1 with assimilated data). Uncertainties will be assessed based on differences in results. Integrations over several annual cycles to investigate the impact of inter-annual variations in WAM dynamics on distributions of key constituents.
- Determination of net impact of aerosols transported downwind from West Africa on global radiative forcing using global aerosol models (one with assimilated data) on seasonal and inter-annual and in particular, the contributions of dust, biomass burning and primary and secondary organic aerosols.

Foreseen Deliverable

- To quantify key pathways transporting oxidants and aerosols out of West Africa associated with the outflow from WAM convective systems and tropical cyclone development
- To evaluate the contribution of lightning to oxidant formation downwind from West Africa
- To determine the photochemical reactivity of air masses transported downwind from West Africa relative to air masses of other origin and the role of dynamical interactions.
- To determine the characteristics of aerosol layers transported downwind from West Africa (e.g. dust, secondary organics)
- To quantify the impact of West African emissions on global oxidant and aerosol budgets, the oxidising capacity and radiative forcing including an assessment of the impact of inter-annual

variations in WAM dynamics and assessment of uncertainties

Milestones

- Report on preliminary estimates of impact of West African emissions on global trace gas and aerosol budgets and identification of key uncertainties in model calculations
- Report on satellite data analysis to identify transport pathways for trace gases and aerosols out of West Africa
- Report on the role of lightning NO_x emissions in the formation of ozone downwind from West Africa
- Determination of photochemical reactivity of air masses transported downwind from West Africa
- Assessment of the modifications to aerosol properties in layers transported downwind from West Africa and role of tropical cyclones
- Quantification of the impact of West African emissions on global oxidant and aerosol budgets, oxidising capacity and global climate change

Sub-Work-Package 1.1.3 : Interaction between the large-scale flow and WAM weather systems

Objectives

The objectives of this sub-WP are to bring together the improved analyses and understanding gained in the Process Studies subproject (In particular, WPs 2.1 – 2.3) in order to better explain the relationships between large scale forcing and the occurrence of weather systems within the monsoon system. This activity is thus central to many of the aims of AMMA, and it feeds directly through into the applications WPs, providing inputs for a clear validation of the statistical predictive schemes (WP 5.1) from intra-seasonal to seasonal timescales (e.g. regional indices, 5-day to 3-month cumulative rainfall fields, dates of onset and pauses), and for an early characterization of the agricultural season (WP 5.2).

In particular, the specific objectives of this sub-WP are:

- To explain the mechanisms which communicate SST anomaly patterns into the West African region
- To determine atmospheric predictors at the intraseasonal time scale of WAM onset and WAM intraseasonal variability, including breaks and surges of the monsoon;
- To evaluate the impact of other tropical (monsoonal) circulations on the SST-WAM rainfall teleconnections;
- To establish the impact of seasonal-to-decadal variability of the WAM on Mediterranean climate variability.

Work content

- Use wave-spectra analyses of re-analyses and GCM output to infer the role of large-scale intraseasonal variability on WAM onset and break periods.
- Multivariate analyses, factorial decomposition and neural networks using reanalyses, satellite and in-situ data will be employed to define and predict the weather types associated with monsoon breaks/surges.
- Statistical diagnostics of reanalysis (ERA40, NCEP) and numerical experiments will be used to determine the role of WAM on the Mediterranean summer climate variability
- Evaluate the impact of global monsoons on the WAM by statistical analysis of re-analysis data.
- Assess the climatological impact of large-scale moisture flux (convergence) on the ability of African Easterly Waves (AEWs) to organize and maintain mesoscale convective systems using ERA-40 and 2002 field campaign data (linking to WP 2.1).

- Perform continental-scale atmospheric water budget calculations using model analysis as well as SOP data, including oceanic source regions and fluxes across the Guinea and West African Coasts (linking to WP 1.2). The models will be tested against the observational analyses, and related to rainfall patterns over the continent.

Foreseen deliverables

- Report on the relationship between tropical waves and WAM dynamics on the intraseasonal time scale
- Identification of key WAM diagnostics/variables and predictands
- Report on variations in the continental-scale atmospheric water budget (link to WP 1.2)

Milestones

- Identification and role of robust weather types describing the monsoon circulation and breaks/surges.
- Development of statistical models at intraseasonal scale.

Knowledge of the atmospheric water budget at different scale WP1.2 The water cycle

Partners: CNRS, DLR, EIER, ENEA, IRD, ISAC-CNR,CNRM, U Bonn, U Bourgogne, UPCT

(Month 0 to 60)

Objectives

The efficiency of the processes controlling the advection of atmospheric humidity, its transformation into precipitation, and the destiny of rain water over land, is a crucial aspect of the West African monsoon. The availability of water is indeed one of the most limiting parameters of life, agriculture and economic development in the Sahel. The role played by energy transport and exchanges in relation with humidity advection and latent heat release is also central for monsoon dynamics and its variability. Therefore, a better understanding – and consequently a probable increase in the forecasting possibilities – of the water cycle in the coupled oceanic, atmospheric and continental system is certainly a major issue of AMMA.

This is however a difficult task since a complete view of the water cycle would require the availability of data concerning a very large number of processes (many of which are physical, but with also a significant influence of some biological and chemical phenomena), at a great variety of spatial and temporal scales. Most importantly, coupling between many of these processes induce complex retroactions which can amplify or mitigate the impact of oceanic, atmospheric or continental perturbations on water availability.

During the EOP and the SOP, AMMA will provide detailed measurements of key parameters concerning the water cycle. An exhaustive documentation of all phenomena occurring at different scales during the West African monsoon is obviously out of reach. However, special observations during AMMA will concentrate on the sampling of statistically representative events at specific locations. From these data, it will be possible to evaluate the different terms of the water budget for different aspects of the monsoon over the ocean, the continent and in the atmosphere. Combined analyses with routine observations, satellite remote sensing measurements and numerical modelling should help to generalize the local results to the regional scale.

This Work Program on Water Cycle will rely on observational and numerical results concerning the different related processes and variables, obtained in other Work Programs. Therefore, among the most important objectives is the requirement to assess the compatibility between independent estimates of water budget relative to different but connected sub-domains (e.g. rain events and watershed, oceanic surface and monsoon flow, …), and to verify that the associated water budgets can be closed. It is also important to assess the importance of spatial and temporal variability of the water budget, in connexion with identified perturbations. The results should provide useful information concerning the natural and anthropically modified processes for water resource management and for weather to climatic forecasting studies.

The objectives of the management structure will be:

- To coordinate the activities of the three sub-packages in determining to what extent ideas and tools can be shared for different problems.
- To ensure communication between different disciplines and tools concerned with scaling issues: observations, data management, modelling, parameterization work, impact studies.
- To coordinate meetings, to control deliverables and to produce reports for the whole WP 1.2.
- To ensure communication of results to related WPs (see below).

Work content

- Coordination of the activities of the three sub-WPs.
- Organization of meetings (sub-WPs and whole WP).
- Coordination of the key publications and progress reports.
- Coordination of the activities of WP_1.2 with the rest of the AMMA project.

Foreseen Deliverables

- Definition of responsibilities for/within sub-WPs.
- Organisation of WP and sub-WP meetings.
- Dissimination of key WP publications and progress report.

Milestones

- Yearly meeting of sub-WPs partners.
- Reports as required in sub-WPs.

Risks and contingency plans

This WP is based on results that will be derived from coordinated atmospheric and surface observations to be conducted during the LOP, EOP and the SOP. He will rely on the combined use of satellite, model and ground data. The access to satellite and model data is guaranteed. Problems in the observing campaigns would be a major impediment but the variety of sites instrumented and already collecting data minimizes the risk of ground data collection failure to the extent of making impossible investigations into the water cycle.

Links to other WPs

This Workpackage is central to AMMA. He thus has both-way links with other WPs.

Requirements from other WPs

1.3	Surface-atmosphere feedbacks	1.2 requires heat and moisture fluxes at the ocean-atmosphere and land-atmosphere interface.

1.4	Scaling issues in the WAM	• Downscaling of precipitation from large-scale fields (e.g. operational analyses and reanalyses) ; • Algorithms to produce fine-scale (e.g. watershed) rainfall structure from mesoscale observations and numerical modelling ; • Small scale characteristics of atmospheric humidity and surface properties (e.g. soil moisture, evapotranspiration, vegetation, geology, …) • Identification of key scales of rainfall variability over the region
2.1	Convection and atmospheric dynamics	• Characteristics and (spatial and temporal) variability of large-scale humidity advection from the Atlantic and Indian oceans and from the Mediterranean sea, of the low-level monsoon flow, of drier air in the African Easterly Jet and in Saharan Air Layer ; • Seasonal climatology of rain events and rainfall statistics ; • 3D fields of wind and precipitation and environemental characteristics (wind and humidity) associated with rain events ; • Insight on microphysical (liquid- , ice- and mixed phase) processes occuring in the observed precipitating systems, relation with lightning as an indicator of rainfall ; • Fine-scale characteristics of humidity in the continental boundary layer, before and after the occurrence of rain events ; • Upper troposphere – low stratosphere interactions associated with the occurrence of precipitating systems
2.2	Oceanic Processes	• Structure and evolution of SST and associated air-sea fluxes in the Gulf of Guinea before the onset and during the rainy season of West Africa
2.3	Physical and biological processes over land surfaces	• Characteristics and (spatial and temporal) variability of runoff, drainage, soil moisture, evapotranspiration and underground water storage • Transient hydrological features (e.g. ponds, …)
4.1	Model evaluation	• Operational analyses and reanalyses to evaluate water budgets • Mesocale modelling results to develop analysis techniques and to compare with results from EOP and SOP data • Modelling of soil – vegetation – atmosphere transfer
4.2	Field campaigns	• LOP, EOP and SOP data on all the components of the water cycle

4.3	Satellite remote sensing	• Seasonal climatology and high-resolution (spatial and temporal) characteristics of cloud clusters and precipitating events • Meso to regional scale estimates of precipitation, integrated water content and humidity profile, SST and air-sea fluxes over the Gulf of Guinea, surface characteristics (vegetation, soil moisture) and land-atmosphere fluxes over the continent

Feeding of other WPs

1.1	West African monsoon and the global climate	• Impact and variability of the West African monsoon in terms of regional water budget
1.3	Surface-atmosphere feedbacks	Estimates (through budget closure) of poorly observed terms of the water budget : evapotranspiration, surface and underground storage.
1.4	Scaling issues in the WAM	• Comparisons between water budgets derived from upscaling (from individual rain events to continental budget) and from downscaling (disaggregation of large-scale modelled and observed fields)
3.3	Water Resources	• Multiscale atmospheric and surface processes controlling the transformation of atmospheric humidity into water available for populations
5.1	Weather to climatic forecasting	• Quantitative estimates of water budget components at different spatial and temporal scales

Sub-WP 1.2.1 The water cycle at large scale

Partners: CNRS, ENEA, IRD, ISAC-CNR,CNRM, U Bonn, U Bourgogne (Month 0 to 48)

Objectives

- Evaluating of the performances of operational analyses and special reanalyses in the estimation of the various terms of the water budget at regional scale over West Africa.
- Comparisons between the results obtained for wet and dry years, or wet and dry intra-seasonal periods.
- Identification of the sources and sinks of water vapour in the region and evaluate how much is transported into the region and how much is recycled.

Work content

Comparison of moisture convergence, precipitation and evaporation from operational analyses and reanalyses, with special observations during AMMA, at various spatial and temporal scales.

Monitoring of precipitable water through the implementation of a GPS network along a north-south oriented transect, which (in addition to other available data) will allow to analyze the meridional progression of the moist monsoon air during the rainy season in relation with the drier easterly air above (Harmattan, AEJ).

Development of the " MANDOPAS " observation assimilation system (retrieval of 4D fields of wind, temperature, humidity and water from operational data and multi-sensor satellite data and products), estimate of water budgets at the scale of West Africa using the 4D fields of atmospheric variables retrieved by MANDOPAS.

Use of existing satellite estimates of energy fluxes (heat and radiation) at the ocean surface, atmospheric humidity, precipitation and evaporation over ocean and land, soil moisture over the continent, to assess the impact of assimilation of EOP and SOP data, and satellite-derived data, on the analysis of the water budget at the continental scale.

Estimate of the heat exchanges between ocean and atmosphere using model bulk formulas (i.e. using meteorological parameters derived from operational analyses) and evaluation of the impact of the diurnal SST cycle on heat flux estimate at the air-sea interface ; Multivariate analysis of SST over the gulf of Guinea and rain field over the oceanic and continental areas.

Use of water vapour transport domain-filling model to characterise the dry intrusion events during the Monsoon season from the Mid-Latitudes upper troposphere.

Foreseen deliverables

- *Evaluation of operational analyses and reanalyses* :
  - ☐ determination of water budget in domains of interest for the West African monsoon ;
  - ☐ comparisons with existing surface data and satellite estimates of atmospheric humidity, precipitation over land and ocean, evaporation over the ocean, evaporation over the ocean, evapotranspiration, soil humidity ;
- Monsoon variability:
  - ☐ differences in water budget (global, spatial and temporal patterns) during dry and wet years, and during dry and wet phases of the monsoon : variability of humidity advection, precipitation and evaporation ;
  - ☐ diurnal cycle of humidity, in relation with surface sensible and latent heat fluxes over the continent and over the ocean ;

Milestones

- Identification of case studies during the SOP; Production of regional fields of wind, temperature, humidity, and water at large-scale using the operational and special AMMA EOP and SOP observations
- Report on the water vapour transport and water budget during the SOP case studies, review on product accuracy versus user requirements
- Report of results

Observations needed from the field campaign

- EOP and SOP supplementary data
- Satellite-derived humidity profiles, precipitation, air-sea fluxes, soil moisture, evaporation

Sub-WP 1.2.2 : The water cycle at the mesoscale

Partners : CNRS, IRD, ISAC-CNR, CNRM, U Bourgogne(Month 0 to 60)

Objectives

- Study of the budget closure at the mesoscale, including the surface and atmospheric parts of the water budget.
- Cross-validation of precipitation estimates using instruments of different spatial coverage model-generated products.
- Insight into upscaling properties for flux parameterizations.
- Provide the understanding needed for coupling an atmospheric model with an hydrological model, with adequate parametrisation to improve the representation of the water cycle.

Work content

This "sub-WP" will mainly concern the AMMA/EOP and SOP periods, at the mesoscale (i.e. upper Ouémé catchment in Benin, Niamey area in Niger, inner Niger Delta in Mali, Volta basin in Ghana, i.e. areas of 10^4 to 10^5 km^2) for typical periods of a few hours to few days, and it will be based on the analysis of operational and enhanced observing network, and data assimilation in numerical models. To this end, a new concept of distributed hydrological model (POWER- Planner Oriented Watershed model for Environmental and socio-economic Responses), will be developed. It will explicitly represent the surface heterogeneity and the branching structure of the river network and will include the surface energy budget. This model will be tested on densely instrumented pilot catchments (see “Sub WP 1.2.3”, below).

This includes the following steps :

Data analysis: *data collected on different scales by different observing systems in different situations will be analysed and compared*

- Pre-processing of the special reanalyses assimilating the supplementary atmospheric data collected during SOP.
- Determination of the high-resolution distribution of water vapor mixing ratio and wind in the low troposphere (monsoon flow) from measurements with the airborne differential absorption lidar (DIAL) LEANDRE 2 and the Doppler WIND lidar during the SOP.
- Determination of atmospheric water budgets for different rainy events (intensity, lifecycle, dynamics, microphysics, …) and different environmental situations (monsoon flow, AEJ, TEJ, AEW, tropospheric humidity, …), at cloud scale and mesoscale.
- Comparisons between high-resolution rainfall derived from radar reflectivity and observed with raingauges network ; comparison of event-scale rainfall statistics between the experimental sites in Niamey (Niger, Sahelian domain) and Ouémé (Benin, Soudanese domain).

Model simulations: *the modelling effort covers both the atmosphere and the hydrology. A combination of atmospheric and hydrological models will be used to asses the water budget and the uncertainties associated with its computation.*

- Atmospheric model simulations and postprocessing of various fields including precipitation and water balance. Model validation against SOP observations and model intercomparison.
- Development and testing of the *POWER* hydrological model on the various catchments of the Ouémé mesoscale site and further testing of existing hydrological models in the Niamey region, using EOP/SOP flux data and vegetation observations.
- The components of the intra-seasonal and inter-annual surface water budget will be estimated with a combination of data (rainfall and runoff), hydrological models (Soil and ground-water storage, and subsequent release in rivers), and analysis of residual (evapo-transpiration). Model simulations will be associated with quantification of uncertainties, and data assimilation will be included to improve water balance assessment.

Water budget evaluation: *Validation of the water budget will be derived from ground observation as well as from satellite derived data, mainly for soil moisture, variable for which satellite products available comply with the scale and resolution of interest. The potential problem of soil moisture maps derived from radar images in forest-covered areas (Benin, Ghana) must be preliminary solved.*

Foreseen deliverables

- Validation of estimates from the network of enhanced radiosounding, profilers, GPS, lidars, radiometers
- Quantification of the efficiency of the various types of " rain producing events " in transforming atmospheric humidity into precipitation
- Assessment of the role of internal dynamics and microphysics, and of external influence of wind and humidity profiles, of aerosol content
- Quantification of the uncertainties in the evaluation of the various components of the water budget at the mesoscale
- Validation of the water budget components

Milestones

- 2D/3D fields of wind and humidity in the vicinity of one selected rain event; series of 3D fields of wind, temperature and water contents for one selected rain event ; input data base and model setup for SOP data processing ; determination of rainfall, runoff, drainage, evapotranspiration, surface and underground storage, with quantification of uncertainties ; model setup for surface water budget estimations
- same as above for a limited list (£ 5) of selected events, first estimates of atmospheric water budget ; numerical simulations of selected events ; watershed response to the occurrence rainfall patterns (space and time intermittency)
- estimates of MCS-related water budgets and relations with environmental characteristics ; Model derived water budget dataset for the SOP ; comparisons between observed results and numerical simulations for some case studies ; Surface water budget estimates (observation- and model-derived) ; integration of vegetation dynamics in surface water budget models
- verification of the results against observations and model intercomparison based on the whole data , report of results

Observations needed from the field campaign

- Coordinated measurements with airborne differential absorption lidar (DIAL) LEANDRE 2 and Doppler WIND lidar ;
- Coordinated measurements with ground-based Doppler polarimetric and airborne Doppler radars ;
- High-resolution environmental fields from enhanced radiosounding network and dropsonde data ;
- Mesoscale rainfall from raingauge networks ;
- River flows and ground-water dynamics ;
- Vegetation maps ;

Sub-WP 1.2.3 : The water cycle at the local scale

Partners : EIER, IRD, UPCT(Month 0 to 60)

Objectives

- understanding of the combining effects of local processes on the hydrological budget at the small catchment scale
- studying how the geology contributes to the various components of the water budget and to the partition between fast and delayed responses of the rivers
- assessing to which extent it is possible to evaluate the deep infiltration and evaporation terms at the local scale so as to be able to close the water balance of small watersheds
- development of simple indicators synthesizing all the environmental changes observed in the Sahel so that to be integrated in hydrological models

Work content

This "sub-WP" will consider the detailed processes identified in dedicated sites and specific watersheds with dense observational networks, to assess the water budget components at local to γ-meso scales. These tasks will involve the development of new hydrological models, or the implementation of available codes. These efforts will include a quantification of model output uncertainties as well as the assimilation of remote sensing data.

For humid areas (Benin), the new concept of distributed hydrological model (POWER) developed for the mesoscale (see “Sub WP” 1.2.2 above) will be evaluated on the Donga catchment (Ouémé sub-catchment of 580 km^2, Bénin).

For more arid areas (in Niger, Mali, Burkina-Faso), existing hydrological models already tested and validated on pilot Sahelian catchments will be further evaluated for water budget assessment.

Data analysis.

- Characterization of evapotranspiration from satellite remote sensing will be analyzed ;

Model simulations: *the focus is on testing POWER for a better representation of the complex processes in the Soudanian region and on refining existing Hortonian-type models for Sahelian catchments. This involves the following steps:*

- The testing hydrological models on pilot catchments (Donga -580 km2- and sub-catchments, Benin; Sahelian catchements : Niamey area, Nakembé) will focus on validation of the simulated components of the water balance using data acquired during the EOP and SOP (soil moisture, surface fluxes, major elements and isotopic geochemistry).
- Sensitivity studies to the degree of complexity in the representation of land surface processes (vegetation, surface energy balance) and to the spatial resolution of rainfall will be undertaken, using rainfall radar data set.
- Integration of surface dynamics (anthropogenic or natural) into hydrological models to better evaluate impacts on water budget.
- Uncertainty analysis and assimilation of remote sensing data and multi-criteria methods and/or Bayesian methods to assess the robustness of parameter estimation and the associated uncertainties will be used. The inclusion of input data uncertainty in model error propagation will improve uncertainty assessment. As well, assimilation of remote sensing data will be performed to improve model simulations of the water balance.

Foreseen deliverables

- Characterisation of the small-scale variability of boundary layer humidity, in relation with soil humidity and vegetation.
- Characterisation of the high-resolution spatial and temporal patterns of rain fields.
- Evaluation of the influence of surface energy balance on rainfall variability.
- Maps of vegetation and related evapotranspiration (in relation with WP 2.3).
- Assessment of environmental degradation (soil erosion, dam silting, water quality degradation, etc…) and related impacts on the water budget.
- New hydrological model at small scale able to account for environmental changes.
- Evaluation of the degree of accuracy in the water budget closure at catchment scale.

Milestones

- Detailed hydrological study of the watersheds.
- High-resolution spatial and temporal characteristics of rainfall.
- Temporal characteristics of the rivers response to rainfall.
- Small-scale variability of boundary layer humidity, influence of soil humidity and vegetation
- Estimate of evaportanspiration at local scale.
- Influence of geology, evaluation of deep infiltration, soil moistening and evaporation terms at local scale.
- Implementation of the components of the POWER model necessary for a coupling with the atmosphere.
- Influence of surface energy balance on rainfall variability.
- Propagation of input data errors and quantification of simulation errors in hydrological models.
- Quantification of the water budget components, including uncertainties.
- Effects of environmental changes on water budget, using models.

- report of results

Observations needed from the field campaign

- Rainfall, river discharge, water table levels, soil moisture content.
- Catchment physical properties (area, channel network, geology, morphology, etc..).
- Soil-related physical parameters (hydrodynamics, erosion).
- Maps of land cover and vegetation types.
- Data linking vegetation type ("functionnal groups") and water use.
- Flux/energy budget measurements.

WP1.3 Surface-atmosphere feedbacks

Partners: CEH, CLM, CNRS, IRD, FZK, IBIMET, CNRM, U Bourgogne, U Leeds, UCLM, U Perugia

(Month 0 to 60)

Objectives

The West African Monsoon is a coupled system in which the evolution of the atmosphere is closely linked to ocean and land surface properties. To understand the characteristics of the monsoon therefore requires a detailed knowledge of feedbacks between the surface and atmosphere. It is the overall aim of this work-package to better understand these interactions between the ocean and land surfaces and the overlying atmosphere. The lack of appropriate observations and models up till now has limited our ability to isolate cause and effect in evolving surface and atmospheric fields. Furthermore, the surface and atmosphere exhibit pronounced spatial variability at a range of scales, and the feedbacks between them are likely to be strongly scale-dependent. This work-package therefore aims to bring together expertise from different process studies (land, ocean and atmosphere) in order to better understand the nature of the coupling between the components.

The surface-atmosphere work-package is structured into 3 sub-work-packages which deal with feedbacks at different time and space scales:

- 1.3.1 deals with ocean-land-atmosphere feedbacks at the scale of the monsoon system, on weekly to multi-annual time scales
- 1.3.2 focuses on synoptic scale land-atmosphere interactions
- 1.3.3 addresses coupling between the land surface and rainfall at the scale of individual storms

The management and coordination of sub-work-packages, the use of common tools and databases, and communication with the rest of the project will take place in this work-package.

Work content

- This WP will coordinate and monitor the activities of the sub-work-packages within WP1.3 through work-package meetings and progress reports. It will also undertake coordination of key publications.
- It will ensure the coordination of the activities of this WP with the rest of the project.
- It will coordinate the communication of observational and modelling needs with WP4.

Foreseen Deliverables

- Definition of responsibilities for/within sub-WPs.
- Compilation of progress reports.
- Coordination of key WP publications

Milestones

- Annual meetings of WP
- Six-monthly progress reports
- Reports from modelling partners after 3 months regarding suitability of model for a specific task.
- Preparation of observational strategy documents

Risks and contingency plans

There is a risk that specific coupled surface-atmosphere models are unable to simulate specific aspects of the coupled system. This will be assessed by all the modeling partners 3 months into their specific tasks. In any case where a model is unable to simulate the key processes, alternative models within the consortium will be considered.

Links to other WPs

The links to other WPs are shown in the table below

WP	Input to WP1.3	Output from WP1.3
1.1	Large-scale environment during 2006	Understanding of role of land and ocean feedbacks
1.2	Analyses of P-E	
1.4	Analysis of rain field patterns over a range of time scales	Understanding of scale dependencies in surface-atmosphere feedbacks
2.1	PBL observations and analyses; synoptic analyses; validated case studies	Impact on atmosphere of surface feedbacks
2.2	Analyses of ocean-atmosphere fluxes	Understanding of ocean-atmosphere forced variability
2.3	Calibrated land surface schemes; Analyses of land-atmosphere fluxes; Understanding of land surface memory	Understanding of land-atmosphere forced variability
2.4	Observational analyses of aerosols	
4.1	Provision of surface analyses and initial conditions for case studies	
4.2	Observations of coupled system	
4.3	Observations of coupled system	
4.4	Historical observations	
5.1	Key predictors to investigate, based on multivariate analyses	Understanding of role of land and ocean feedbacks, and highlight key predictors

Sub-WP 1.3.1 Large-scale surface – atmosphere interactions

Partners: CEH, CLM, CNRS, CNRM, U Bourgogne (Month 0 to 60)

Objectives

- Identification of the fundamental relationships between evolving properties of the ocean and land surfaces, the planetary boundary layer, and the monsoon system, over the course of the annual cycle.
- Quantification of key surface-atmosphere feedbacks at the large scale
- Key questions in this area of work are:
- Does the land surface memory of rainfall in one year affect the monsoon in the subsequent year?
- Vegetation exhibits strong natural variability at the seasonal and interannual time scales – does this behaviour increase variability in rainfall over these time scales?
- Do land or ocean surface processes control the timing of monsoon onset?
- What role do land and ocean surface feedbacks play in determining the characteristics of active and break periods in the West African Monsoon?

Work content

A combination of observational analysis and coupled model simulations will provide an assessment of the role of SST forcing and internal land-atmosphere feedbacks on variability of the monsoon system. In situ and earth observation data combined with surface model output and atmospheric analyses will be used to document large-scale variability of sea surface temperature, soil moisture, leaf area, PBL temperature and humidity and rainfall patterns over the course of the EOP. The availability of surface data of unprecedented quality and resolution will permit the identification and quantification of changes in surface properties and fluxes linked to the evolving monsoon system. Atmospheric modelling experiments will be performed to explore the nature of the feedbacks between atmosphere, ocean and land using observed and idealized surface conditions (soil moisture, leaf area, sea surface temperature), and assess the relative importance of ocean and land surface conditions for atmospheric prediction. These experiments will be performed with both regional and global models, depending on the scales of interest.

Foreseen deliverables

- Documentation of spatio-temporal variability of continental surface from historical earth observation data
- Documentation of spatio-temporal variability of the coupled surface-atmosphere system during the EOP
- Assessment of the sensitivity of the WAM to land and ocean surface conditions on intraseasonal to interannual timescales

Milestones

- Preliminary assessment of sensitivity of WAM to intraseasonal and interannual variability
- Completion of database of surface properties and fluxes for the EOP

Observations needed from the field campaign

In situ/Satellite-derived humidity profiles, precipitation, air-sea fluxes, soil moisture, evaporation

Sub-WP 1.3.2 : The coupling of atmospheric circulations with land surface fluxes

Partners : CNRS, IBIMET, U Leeds(Month 0 to 48)

Objectives

- Investigate the impact of variations in land surface heating on the dynamics of the atmosphere, and the impact of atmospheric processes (including cloud cover and synoptic patterns of rainfall) on the land surface state.
- Assessment of the variations in sensible heat flux forced by both atmospheric composition (aerosol content) and soil moisture
- Assessment of the relative importance of soil moisture and aerosol on heat lows and easterly waves, in collaboration with purely dynamical processes in WP2.1

Work content

The role of surface heating on the dynamics of heat lows and the evolution of easterly waves will be examined through atmospheric modelling studies and evaluation of surface and atmospheric observations. The analysis of observations from the EOP will focus on the variability in surface heat flux (in situ) and brightness temperature (remotely sensed), complemented by surface heat flux data estimated by regional land surface models. In addition, during the SOP, aircraft and sonde data will provide direct measurements of circulation patterns. The relative importance of aerosols and soil moisture in modulating sensible heat fluxes at the daily timescale will be examined using observations of aerosol (from satellite and ground observations including LIDAR) and soil moisture analyses. Realistic aerosol and soil moisture analyses will be incorporated within atmospheric models to assess their impact on heat low dynamics in specific case studies from the SOP. Additional theoretical modelling work will be undertaken, based on idealized surface flux variability. This will explore the impact of surface heating on atmospheric circulations, transport of heat, moisture and momentum, and the interaction with larger-scale dynamics.

Foreseen deliverables

- A report evaluating the atmospheric response to surface variability at diurnal timescale
- A regional climatology of surface heating covering the EOP, focusing on relationships with aerosol loading and soil moisture, and the impact of surface flux variability on heat lows.
- A report evaluating the atmospheric response to surface variability on timescale of days
- Quantitative assessment of the sensitivity of modeled atmospheric systems to surface variability.

Milestones

- Surface analysis complete

Observations needed from the field campaign

- LOP: Mesoscale rainfall from raingauge networks ;
- EOP: Fluxes from networks of flux stations and additional rain data
- SOP data: LIDAR, Airborne LEANDRE

Sub-WP 1.3.3 : Mesoscale surface – atmosphere feedbacks

Partners : CEH, CNRS, FZK, IRD, UCLM, U Perugia (Month 0 to 60)

Objectives

- assess the impact of land surface properties on the characteristics of storms at scales of up to several hundred kilometers
- assess the relative importance of rainfall variability due to both surface and atmospheric processes under the range of conditions experienced in the monsoon region

Work content

Relationships will be explored between the spatial and temporal variability of surface features (notably soil moisture and vegetation) and the initiation, organization, propagation and decay of convective storms. To determine the importance of surface conditions on the life cycle of convective storms, analyses of observations of water vapour and other boundary layer variables (from aircraft and satellite) will be related to land surface information (notably soil moisture and surface flux estimates) and subsequent moist convection (observed by satellite, rain gauge networks and radar). In addition, geostatistical techniques will be applied to long-term rainfall datasets to determine the impact of surface conditions on rainfall at a range of time scales. Case studies for atmospheric modeling from the SOP will be identified, and the sensitivity of convection to realistic surface conditions assessed. Additional idealized modelling studies will assess the impact of length scale on soil moisture – convection feedbacks. A single column version of a large-scale model will be used to assess the time scales of soil moisture – rainfall feedbacks.

Foreseen deliverables

- Assessment of role of surface conditions on modeled precipitation from case studies during SOP
- Report evaluating impact of surface conditions on rainfall based on analysis of rain gauge data
- Report demonstrating land surface-precipitation feedback loops over a series of convective events, and their representation at the larger scale
- Report providing observational analysis of land surface - precipitation feedback loops during SOP

Milestones

- Experimental planning and operational tools developed for SOP from model output and satellite methodologies

Observations needed from the field campaign

- LOP: Mesoscale rainfall from raingauge networks ;
- EOP: Fluxes from networks of flux stations and additional rain data, radar data
- SOP data: LIDAR, Airborne LEANDRE
- Satellite products : water vapour, vegetation indices

WP1.4 Scaling issues in the West African Monsoon

Partners : IRD, AGRYMET, U Bourgogne, U Bonn

(Month 0 to 60)

Objectives

This WP will analyze the scaling properties of key variables which characterise the African monsoon and associated processes. Phenomena such as rainfall and surface fluxes of heat and moisture display a large degree of spatial heterogeneity, and most importantly scale interaction. The WP is split into a management structure and two sub-WPs.

The first sub-WP is dedicated to the ***downscaling of precipitation,*** a quantity central to AMMA. This sub-WP will feed into impact studies. Precipitation is heterogeneous on all scales down to the scale of the individual rain event. Hydrological systems are very sensitive to changes not only to the amount of precipitation, but also to its distribution both in space and time. Impact studies (WP3) rely on knowledge of the statistical properties of precipitation. When direct measurements or reliable simulations of such information are lacking, the information at larger scales needs to be disaggregated following rules derived from field observations or models: this is the object of the first sub-package. These rules can consist of linkages between different variables, such as dynamical signatures of the flow at the large scale and statistical signatures of rainfall at the small scale. The identification of such linkages, and of statistical rules for the reproduction of small scale features is referred to as downscaling*. Downscaling is a prerequisite for local impact studies (WP3).*

Aggregation, or ***upscaling*** of precipitation and fluxes will be addressed in the second sub-WP, which will feed into the water cycle budget and work on parameterization of the land surface and associated feedbacks. There is indeed the need to transfer the precipitation and fluxes deduced from detailed process modelling and local measurements to larger scales. For example, the correct representation of surface fluxes, which is central to a good representation of the monsoon system can be complicated by the nonlinearity of surface processes at small scales. Another application is validation between observing platforms with different spatial coverage. Upscale transfer of information is also required to close the water budget at large scales. *Upscaling is essential to the calibration of observations and parameterization in models.*

The results of this work package will be thus of use to other work-packages dealing with both small scale impact studies and large scale process and budget studies.

The objectives of the management structure will be:

- To coordinate the activities of the two sub-packages in determining to what extent ideas and tools can be shared for different problems.
- To ensure communication between different disciplines and tools concerned with scaling issues: observations, data management, modelling, parameterization work, impact studies.
- To coordinate meetings, to control deliverables and to produce reports for sub-WPs 1.4
- To ensure communication of results to related WPs (see below)

Work content

To reach the objectives of the two sub-WPs, it is important to maintain a coherency between the data sets available and the algorithms/models used. For precipitation studies the responsibility of the management structure will be to make sure that high quality data sets are available – especially from WP4.2 – at various scales and that the errors associated with these data sets are properly assessed. It is also important to ensure that coherent modelling tools are used for downscaling and for upscaling, even though the constraints and objectives of this two actions are different (for instance it will be necessary to verify that the essential features of the spatial structure of rain fields at a given time scale are well taken into account in both downscaling and upscaling). Another important task of the management will be to maintain close links with WPs 1.2 on the water cycle and 1.3 on feedbacks, since downscaling and upscaling are two important aspects of these two WPs.

Foreseen Deliverables

- Reports and peer reviewed papers on progress and meetings.
- Information on upscaling and downscaling properties for impacts studies and multi-scale measurements, budget studies and the development of parameterizations.

Milestones

- Yearly meeting of sub-WPs partners organised to compare methods, to see how different aspects of the project are progressing, to change direction if necessary and to update on the needs and contributions of other work packages.
- Reports as required in sub-WPs.

Risks and contingency plans

To be able to compare the scaling properties of precipitation and other fluxes along the climatic transect, the data from the three major mesoscale sites of AMMA will be used in this WP 1.4. In case of problems on one of these sites, data from national services in the same country – or in neighbouring countries in the same climatic area – will be used. The participation of AGRHYMET, in charge of collecting data for the Sahelian countries and whose mandate will be enlarged to Soudanian and Guinean countries, is a guarantee of accessing to the daily rainfall data. There is also an existing long standing collaboration with national institutions. These institutions are deeply interested in rainfall studies in their country and the risk of not getting access to data in several countries to the extent of compromising the objectives of the WP, is very weak.

Links to other WPs

The strong ties to other WPs are highlighted in the following table:

1.1	West African and the global climate	Large scale dynamical signatures associated with specific rainfall regimes are to be identified in tandem with the insight gained in this WP.
1.2	Water Cycle	Provision of scaling tools central to the problem of closing the water budget, including precipitation and evapotranspiration and cutting across the 3 sub-WPs
1.3	Surface-atmosphere feedbacks	Role of scaling nonlinearities in determining surface fluxes at regional scale and thence climate feedbacks.
2.1	Convection and atmospheric dynamics	Provision of links between mesoscale convective systems and rainfall to disaggregate to the local scale.
2.3	Physical and biological processes over land surfaces	Impact of scaling issues on land surface modelling.

3.1	Land productivity	Disaggregated rainfall as a primary input for crop models.
3.3	Water resources	Disaggregated rainfall techniques for the study of hydrological systems to changing rainfall patterns
3.4	Public health	Disaggregated hydrological and temperature to fields study the spread of vector borne diseases as a function of microclimate.
4.1	Model evaluation	Hydrological & biological modelling activities; value of improved land-data assimilation system.
4.2	Field campaigns	Need SOP/EOP/LOP observations at the mesoscale sites
4.3	Satellite remote sensing	Need satellite products as a vital middle step in the downscaling problem.
4.4	Data base and historical data	User-friendly databases to compare rainfall data at different scales using in-situ, radar and satellite sources

Sub-WP1.4.1 Downscaling of Precipitation

Partners : IRD, AGRYMET, U Bourgogne, U Bonn (Month 0 to 48)

Objectives

- Analysis of the scaling properties of rainfall
- Characterisation of the links between large scale meteorological fields and small scale rainfall properties
- Development and validation of rainfall disaggregation algorithms

Work content

Precipitation is heterogeneous at all scales down to the scale of the individual event. Spatiotemporal information is needed about its statistical properties for many applications of measurements and forecasts of precipitation, including impact studies. Where direct measurements or reliable simulation of such information is lacking, the information at larger scales needs to be disaggregated following rules derived from field observations or models. At the impact scale, many physical systems, particularly hydrological systems are very sensitive to changes not only in totals but also in distributions both in space and time. Downscaling is thus of critical importance for impacts on water resources, vegetation production and health. A complementary approach to disaggregation is proposed here, working with both physical and statistical models and using a variety of data and observing platforms. Since the disparity of scales is so great, we envisage a two-stage strategy working from the monsoon scale to the regional scale using physical/statistical models and then down to the smallest event scales, using pure statistical disaggregation.

Data analysis: data collected on different scales by different observing systems is to be collated and analysed for its spatiotemporal properties. Basic information about the structure of rainfall will then be used in statistical disaggregators to produce simulated fields from larger scale indicators. These statistical properties may vary from place to place and from one instrument to another as different climate regimes and characteristic measuring scales are examined.

- standardisation of grids between scales and between different measurements (in situ/radar/satellite) and different model products (reanalyses/regional atmospheric models/hydrological models).
- characterisation of fine-scale spatio-temporal properties of field data.
- definition of study regions and comparison of properties for widely separated study areas (Sahel/Sudan/Guinea/Gourma).

Large scale physical/statistical downscaling: a two step strategy is envisaged to produce local precipitation indices from large scale indicators. Analysed dynamical and thermodynamic features of the monsoon will be first linked to satellite-derived statistics of mesoscale rain-generating systems, and then further downscaled to provide statistical moments of local rainfall variability.

- investigate statistical links between large scale atmospheric fields (divergent and rotational flow, equivalent potential temperature) and mesoscale convective system event statistics.
- development of algorithms to find statistical links between mesoscale convective system event statistics and drainage basin-scale rainfall indices.

Large scale physical model-based downscaling: regional models will also be analysed and validated against the observations used above to provide a complementary deductive approach, producing time series rather than statistical moments at the resolution of the model.

Use of numerical models to generate basin scale rainfall products including temporal variability.

Small scale pure statistical disaggregation: once the relevant statistical moments of spatiotemporal variability have been produced, a purely statistical approach will be used to generate rainfall products that can be used for impact studies.

- simulation of fine scale rainfall structure with prescribed spatio-temporal statistical properties and validation of disaggregated products against observations.
- application in hydrological models.
- application to agronomic and epidemiological models including determination of pertinent input data.

Foreseen deliverables

- Downscaling rules from statistical and/or dynamical models to link monsoon dynamics with regional rainfall statistics.
- Disaggregated local rainfall products to be used by impact models (Water resources, Vegetation and crop models, Vector born diseases).
- Progress in disaggregation algorithms at all scales for use in further studies including interactive climate system studies

Milestones

- Decisions about which of the many possible statistical downscaling methods is the best
- Assessment will be made on the parallel and complementary statistical and model based approaches to downscaling. Investigations will continue in on both fronts but efforts will be concentrated on the most effective approaches
- Possible adjustment of assessment in regard to the feedback from WP3
- Consolidation and work towards final publications
- Final report on sub-WP results

Observations needed from the field campaign

- Flux station network (WP4.2)
- Rain gauge and meteorological station network (WP4.2)

Sub-WP 1.4.2 : Upscaling of Precipitation and Fluxes

Partners : IRD, AGRYMET, U Bourgogne, U Bonn (Month 0 to 60)

Objectives

- Analysis of the scaling properties of variables playing a key role in linking the climate variability and the water cycle.
- Cross-validation of precipitation estimates using instruments of different spatial coverage and model-generated products.

- Insight into upscaling properties for flux parameterizations

Work content

The state of the land surface, as characterised by measures of temperature and moisture and by land use and vegetation, is heterogeneous on all scales from the broad meridional contrast to the scale of human activity. Budget studies of water and energy differ greatly according to the scale considered. A basin scale hydrological budget will be governed by different processes from those controlling the continental water cycle. Continental budgets are therefore sensitive to the types of measurements used, and a consistent strategy for integrating, or *upscaling* local measurements of precipitation and evapotranspiration must be found. In this work package, consistency will be sought between local scale in situ and radar measurements and the integrated estimates provided by satellites and model-generated and reanalysis products.

The state of the land surface at small scales is also the key element of flux parameterization schemes in land surface models. The nonlinearity of the processes implies that the flux at a large scale can not always be reliably deduced from state variables at a large scale, and their scaling properties must be taken into account when modelling aggregated or *upscaled* land surface / atmosphere exchanges.

Rainfall measurements and hydrological budgets: key points for the integration of precipitation and evapotranspiration from local measurements to continental budgets.

- assessment of controlling factors in local hydrological budgets: variation between sites.
- integration to the continental hydrological budget.
- validation across scales for rainfall estimates from different sources.

Surface fluxes and physical processes at the land surface: key points for the representation of surface fluxes at the resolution scale of a regional or global model.

- physical relations between state variables and surface fluxes at small scales (potential and actual evapotranspiration) – use of field measurements.
- scale disparities and aggregation nonlinearities: parametrisation in surface exchange models with relevance for coupling SVAT and hydrological models with GCMs.

Foreseen deliverables

- Cross calibration of rainfall estimates on a variety of scales.
- Coordination of hydrological budget studies between local and continental scales.
- Scaling characteristics to be used for model parametrisation and for model validation (most notably models used to close the water budgets and surface fluxes).

Milestones

- Data from SOP necessary for cross validation of observing platforms becomes available.
- Validated mesoscale and regional data sets with evaluation of associated uncertainties for EOP.
- Final report on sub-WP results

Observations needed from the field campaign

- Flux station network
- Rain gauge and meteorological station network

6.1.2 Process studies

WP2.1 Convection and atmospheric dynamics

Partners : UNIVLEEDS, CNRS, CNRM, LMU-Muenchen, UniKarl, DLR, IRD,FZK,ISAC,UNIPG

(Month 0 to 60)

Objectives

This WP is devoted to the study of the processes in the atmosphere which control the West African Monsoon and its downstream environment. We know that due to the strong solar forcing in this region, the dynamics of the atmosphere are dominated by the patterns of dry and moist convection. However, we also need to understand and quantify other effects in order to describe the monsoon, including the stable nocturnal boundary layer and the radiative forcing due to aerosol and humidity patterns in the clear air. Ultimately we aim to understand how these convective and radiative processes interact with the dynamics of weather systems developing along the strong thermodynamic gradients of the Sahel.

In this highly-coupled system we take as inputs the forcings from the inhomogeneous lower boundary and its variable patterns of fluxes; we also consider control by global-scale forcing, such as incoming upper level features. In turn, we aim to understand the way in which the atmospheric processes (winds, fluxes, rainfall and so on) create patterns of forcing which will act as inputs for work packages concerned with the land surface and ocean.

This WP is divided into a management structure and 4 sub-WPs, which are separated according to the physical scales of interest. The nature of the convective interactions with the regional dynamics means that this is a region of strong scale-interactions, from the regional-scale control of the convective environment, to the upscale forcing of atmospheric circulations by convective events. In subdividing this WP into sub-workpackages according to scales, we adopt the following principles:

sWP2.1.1 deals with regional and synoptic-scale systems and the ways in which they control the distributions of convection;

sWP2.1.2 addresses the dynamics of synoptic weather systems. In this sWP we concern ourselves with the detailed effects of individual convective storms on the synoptic state. We also consider highly organised convective-synoptic systems, notably tropical cyclones;

sWP2.1.3 is concerned with the details of cloud systems, for which the synoptic environment is an imposed forcing.

In order to achieve our scientific goals, we aim to integrate science across the collaborating European nations within this IP. We aim to recruit talented scientists into research positions which will involve the scientist working for significant periods in different research groups within the WP. We also aim to achieve the integration of data from diverse instruments and models currently being developed across Europe.

Work content

We will coordinate the attainment of targets and deliverables in WP2.1and the activities of the sub-work-packages working in WP2.1. In particular, we will coordinate the input of scientific objectives of this WP into operational planning during the SOPs, and ensure compatibility between the selection of SOP case studies for post-analysis.

We will organize meetings of the sub-WPs and meetings of the whole WP. We will also undertake coordination of key publications.

We will ensure the coordination of the activities of this WP with the rest of the project, in particular through the presentation of progress on the AMMA website.

We will coordinate the communication of operational plans and observational needs from WP2.1 to WP4.2

Foreseen deliverables

- Coordnation of key WP publications: case studies, climatologies and model intercomparisons
- Compilation of progress reports on the WP.

Milestones

- 6-monthly meetings of the WP.
- Preparation of Observational Strategy documents (1 October 2005; updated 1 February 2006 and 1 May 2006);
- 2006 monsoon onset observations and analyses obtained
- SOP case studies identified (October 2006) and analysed (May 2007)
- Standard case study model simulations performed and disseminated (timelines according to sWP).

Observations needed from the field campaigns

- Radiosounding network data, including high temporal resolution (3 hourly or better) radiosonde data;
- Constant level balloons from Cotonou (Benin);
- Continuous planetary boundary layer (PBL) observations of humidity, temperature and winds during SOPs from sodar and microwave radiometric profiles, GPS humidity;
- Surface raingauge data and cloud observations;
- Surface flux measurements;
- METEOSAT surface temperature estimates;
- C-band polarimetric Doppler radar;
- S-band polarimetric Doppler radar;
- (Priority 2): UFH + VHF wind profilers at Parakou (Benin) and Niamey (Niger), Doppler radar in Djougou (Benin)
- Lightning detection network;
- Aircraft (flight level measurements and dropsondes): Boundary layer flights in the ITF zone at different times during the diurnal cycle, plus targetted dropsondes;
- Oceanographic observations with air-sea flux measurements and radiosounding capability;

Risks and contingency plans

Failure of aircraft due to operational problems is always possible. This would greatly diminish the potential benefits from this WP, notably in the fine-scale studies of sWP2.1.3, related to MCS processes, but also in the study of synoptic processes in the northern Sahel where ground-based observations are sparse. However, lack of aircraft data will not preclude the attainment of most of our objectives, as suitable ground-based instruments are available for coarse-resolution analysis. Without aircraft measurements, the dust aerosol / Saharan Air Layer work would need to operate as a sensitivity study, based on ground-level observations and model estimates of transport.

Due to spatial inhomogeneities and the strong diurnal cycle, errors in observational advective flux estimates may be too large. In such cases we still can validate models with local observations, and test the sensitivity of the results to the model processes.

MCS forcings for the larger-scale dynamics are to be derived through nested modelling studies in sWP2.1.3. If these are delayed, or prove inconclusive, we will need to address the role of such forcings in terms of sensitivities to assumed patterns.

Benchmark model simulations are not easy to generate and there is a possibility of delay, which could hold back sensitivity tests and process studies. We aim to minimise this risk by working to set up model configurations for the region in advance of the SOPs.

Links to other WPs

WP	Input to WP2.1	Output from WP2.1
1.1	Large-scale environment of convective events in 2006	Impact of small-scale processes including surface heterogeneity on convective events in 2006. Model calculations of tropical cyclone-mineral dust interaction
1.2		Observations and model analyses of atmospheric humidity fluxes; space-time convective rainfall structures
1.3	Surface flux distributions	Space-time convective rainfall structures; PBL observations and analyses; synoptic analyses
1.4		Space-time convective rainfall analyses
1.5		Space-time convective rainfall analyses
2.2	Surface forcings	
2.3	Surface patterns and forcings	
2.4	Observed aerosol structures for radiative forcing. Mineral dust module with radiation parameterizations.	Analyses of thermodynamics, winds and turbulence for transport and process studies
3.1		Space-time convective rainfall and PBL analyses
3.2		Space-time convective rainfall and PBL analyses
3.3		Space-time convective rainfall and PBL analyses
4.1	Coupled model results	Process studies; model validation through case studies
4.2	Observational data	Operational planning

Sub-WP 2.1.1 : Regional to synoptic scale

Objectives

The objectives of this sWP are to determine the regional and synoptic-scale changes in patterns of convection and atmospheric dynamics associated with the regional-scale monsoon and its variability. This involves determining the relationship between the distributions of dry and moist convection and both the forcing by surface fluxes (WP1.3 and WP2.3) and the forcing by large scale advective processes at different altitudes. In particular, we aim to explain the role of tropospheric and upper level dynamical features (such as potential vorticity (PV) anomalies on the Tropical Easterly Jet (TEJ), extratropical troughs, dry intrusions and Saharan Air Layer (SAL) intrusions) on rainfall over the continent. At the heart of this work, we aim to make the first comprehensive observations of these processes over the continent and the adjacent sea surface, and to do this we need to integrate data from a variety of instruments and platforms, operated by diverse partners. Within this sWP, we aim to use these data to describe the basic state balances of the monsoon, as well as their variability down to synoptic scales. Using these observations made at key times in the seasonal cycle, notably the monsoon onset period, we aim to test the model representations of the dynamics responsible for monsoon variability, and to identify key atmospheric processes which are critical to the correct model behaviour.

Work content

Radiosonde data from the meridional transect (sWP4.2.2) will be used with ECMWF model analyses and remote sensing data for analysis of rainfall events in advance of the SOPs, and during the SOPs including consideration of extratropical forcing events (with WP1.1) and dry intrusions/SAL intrusions. Model analyses including trajectory data will study a climatology of dry intrusions and their origins, in relation to WAM rainfall. Model analyses, satellite land surface and cloud data will be used to study historical monsoon onset processes. These studies will be fed into WP4.2 and used as guidance for the SOP planning.

Boundary layer data (from surface-based data and aircraft), lidar measurements (water vapour and wind), radiosondes, dropsondes and the cloud climatology, land surface data (WP1.3 and WP2.3) and model analyses (WP4.1), will be used to describe the convective and dynamical equilibria of the monsoon layer and Saharan air. In particular the results will be used in the northern Sahel to characterise the thermodynamic structure of the Inter-tropical Front (ITF) and its associated circulations, and to characterise the convective and dynamical changes associated with monsoon onset (linking with WP1.2 and WP 2.3);

Representation of these processes in model analyses and forecasts will be assessed; results will be documented and feed back into sWP4.1.1;

Radiosonde data (at high temporal frequency) and radar data will be used in association with the aircraft flights as well as airborne lidar data (water vapour and wind) to quantify advective fluxes for use in WP1.2;

The interaction of heat low patterns in the northern Sahel with African Easterly Waves (AEW) dynamics will be explored through model analyses and idealised models (combining WP1.3, WP2.1, WP2.2, WP2.4) on regional down to synoptic scales;

The multi-nested aerosol model will be used to assess the sensitivity of the heat lows (regional and synoptic) over land to aerosol processes.

Foreseen deliverables

- A description of changes in boundary layer characteristics, moist convection and regional-scale circulations associated with the monsoon onset;
- An evaluation of the representation of monsoon onset processes in model analyses and forecasts;
- To relate pre-monsoon and monsoonal rainfall events to their synoptic environment and upper level / extratropical forcing;
- A climatology of dry intrusions and their relation to rainfall;
- An observational and dynamical description of the SAL and ITF variability in association with regional and synoptic scale variability in convection;
-
- To describe the links between regional (Saharan) and synoptic (AEW) variability in the northern Sahel and diabatic processes at the surface and in the clear air.

Milestones

- Three WP meetings;
- Analysis of historical rainfall events;
- Dry intrusion climatology generated;
- Analysis of historical monsoon onset diagnostics;
- Contribution to WP2.1 SOP planning document and updates;

- Selection of AEW cases;
- Benchmark global model simulations completed;

Sub-WP 2.1.2 : Synoptic to mesoscale

Objectives

This sWP is aimed at understanding the dynamics of weather systems within the monsoon system (including African Easterly Waves (AEWs) and patterns of intraseasonal variability), and as they propagate downstream over the Atlantic, to form, on occasion, tropical cyclones. The sWP is intimitely connected with sWP2.1.3 which explores the behaviour of Mesoscale Convective Systems (MCSs) and other convective storms: here the focus will be on the synoptic dynamics of weather systems as opposed to the focus of sWP2.1.3 on the dynamics of the convective storms themselves.

Linking with the observational analysis work of sWP2.1.1, we aim for the first time to analyse the full thermodynamic structure of AEWs as they propagate westward over the West African continent and the Atlantic ocean. In this, we aim to explain the synoptic modulation of dry and moist convection and embedded MCSs (with sWP2.1.3). Using the observations and the model analyses, we aim to construct case studies of AEWs in the northern and southern parts of the region, and to test model analyses and forecasts for these cases. At longer timescales, we also aim to observe the atmospheric structure of intraseasonal rainfall anomalies, and their propagation characteristics across the continent.

Linking closely with sWP2.1.3, we aim to determine the effects of MCSs and their degree of organization on the synoptic circulation through forcing of heat, moisture and momentum, the monsoon and harmattan flows, and the structure and evolution of the African and Tropical easterly jets aloft (AEJ and TEJ).

Finally, we aim to assess the role of the Saharan Air Layer (SAL) in AEW dynamics over land and in the development and intensity change of tropical cyclones.

Work content

The kernel of this work is the analysis of an integrated suite of observations of the synoptic structure of weather systems (including AEWs and intraseasonal waves) in the boundary layer and free troposphere as they propagate across the continent. Data from ground-based systems will quantify north-south and east-west transects through propagating waves and will, for the first time, involve comprehensive observations of the boundary layer and convective structure which is critical for the coupling with cumulonimbus systems. Aircraft transects will supplement the ground-based data, using dropsondes and turbulence measurements, to establish the high resolution structure of the systems. Such flights will be conducted on successive days and at different times of day, in order to measure the temporal development of systems.

Nested modeling of key events and case studies will explore the important process- and scale-interactions in the system - for instance, the interaction of AEWs with the regional environment, with smaller MCS events (in association with sWP2.1.3), with SAL aerosol (WP2.4) and with the diurnal cycle of the planetary boundary layer (PBL) (WP1.3);

The environmental characteristics of MCSs (wind, temperature, humidity) and influence of MCSs on their environment through heat, moisture and momentum budgets will be analysed (linking with WP1.2). In particular, synoptic-scale characteristics of the atmospheric boundary layer before and after the occurrence of MCSs will be investigated (linking with WP1.3, WP2.3 and sWP2.1.3);

The synoptic-scale characteristics before and after tropical cyclogenesis will be investigated;

A multi-nested regional scale model will be coupled with a mineral dust module (WP2.4) in order to model the transport of mineral dust and its impact on the radiation budget;

Coupled aerosol/dynamics calculations of TC/SAL interaction will be carried out using historical cases and with idealized configurations. The data (including WP2.4 aerosol spectra) gathered during SOP3 will initialise and validate the model calculations. Idealised calculations using both the multi-nested model and a dry three-dimensional hydrostatic model will isolate the possible contributions of the SAL to tropical cyclone intensity change.

Foreseen Deliverables

- To perform observational analyses of key AEW systems in historical and SOP data;
- To characterize the structural changes of AEWs/MCSs as they propagate westwards and move over the ocean;
- To characterize the impact of MCSs on the synoptic-scale atmospheric boundary layer;
- To evaluate synoptic-scale characteristics before and after tropical cyclogenesis;
- To use nested sets of models to quantify the impact of MCS forcings on the AEW evolution;
- To couple a mineral dust module including parameterizations of the radiative impact of mineral dust (WP2.4) with a multi-nested regional-scale model;
- To quantify the role of the SAL in tropical cyclogenesis and intensity change.

Milestones

- Key historical events identification;
- TC/SAL interaction simulations generated for historical cases ;
- Benchmark AEW simulations generated for historical cases;
- Input of historical cases to SOP planning document;
- Mineral dust transport module coupled with nested model;
- Key SOP events identifion;
- Benchmark AEW simulations generated and validated for SOP;
- Comprehensive AEW case study analyses;
- Radiative parameterizations implemented in nested model;
- Nested model simulations of AEW-MCS interaction.

Sub-WP 2.1.3 : Mesoscale to cloud scale

Objectives

This sWP is intimately connected with sWP2.1.3 which explores the behaviour of synoptic African Easterly Waves (AEWs): here the focus will be on the dynamics of the convective storms which are a key component of such AEWs.

Key aims of this sWP are to determine the processes which control the various aspects of the life-cycle of Mesoscale Convective Systems (MCSs) (triggering, growth, decay, propagation and diurnal cycle). In particular we aim to determine the relative roles of the synoptic environment and surface conditions in controlling the behaviour of organised convection. In regard to surface conditions we aim to assess the influence of land surface heterogeneity on the characteristics of convective clouds (including congestus and MCSs). This involves studying the initiation, evolution and sub-structure (with WP1.3, WP2.3) of cumulonimbus, as an input to WPs on the distribution of rainfall and interaction with the land surface. In regard to large scale forcing we aim to explain the role of the synoptic environment (Saharan Air Layer (SAL) intrusions, dry intrusions, monsoon layer depth, African Easterly Jet (AEJ) shear, Tropical Easterly Jet (TEJ) anomalies) on convective initiation and organisation.

We also aim to explain the role of Saharan dust aerosol in the occurrence of lightning, and furthermore to explain why tropical Africa is so lightning active. To do this, we aim to assess the spatial and temporal distribution of lightning in African storms.

Work content

The three-dimensional structure and evolution of wind and precipitation will be analysed in association with surface rainfall, within precipitating systems passing or developing over the region near Djougou (Benin), using two Doppler radars, and the dense raingauge network and hydrological measurements;

Surface-based, remote-sensed (sWP2.1.1) and aircraft observations will characterise the structure, evolution and sub-structure of shallow cumulus, congestus and MCSs (for output to WP2.3, 1.2, 1.3, 3.1).

The three dimensional structure and evolution of wind and precipitation of MCSs will be analysed as they propagate over West Africa, leave the West African continent and propagate over the eastern tropical Atlantic;

PBL changes resulting from MCSs (with WP1.3, WP2.3 and sWP2.1.2) will be assessed in aircraft and ground-based microwave data. Characteristics of the ocean-atmosphere interaction in association with MCSs will also be investigated, in association with WP2.2;

The SOP case studies for MCS events will be documented and used as the basis for process studies. Careful numerical model intercomparisons and evaluation with observations are necessary, to ensure that the models accurately reflect the observed features, before more sophisticated diagnosics are extracted from them. These studies will be used to evaluate the sensitivities of the genesis and lifecycles of the systems to synoptic environment, and to the pre-storm boundary layer state (and, through sWP1.3.3, land surface state);

The case studies will be employed to evaluate the large scale forcings (heat, moisture and momentum) due to the organised convection. CRM intercomparisons will test the sensitivity to topographic control, synoptic state and the diurnal cycle. From such models, idealised study of AEW forcing by convection will be performed.

CRM and idealised modelling of characteristic convective environments will be used to test theoretical ideas of convective equilibrium (and disequilibrium), from the shallow cumulus through to organised MCSs, for input to WP4.1;

The three-dimensional distribution of liquid and iced hydrometeors will be analysed from polarimetric measurements with the two radars operating at different wavelengths and related to lightning activity. Lightning activity will also be related to convective vertical velocity measurements. A mesoscale model incorporating lightning processes will be applied to the SOP case studies in order to explain the lightning occurrence. This work will link closely with sWP2.4.4 where NOx production by lightning will be analysed from airborne measurements.

Foreseen deliverables

- Comprehensive observational case studies of MCS events, including pre- and post-storm boundary layer state;
- To explain the relationships between convective system behaviour and synoptic environment, inlcuding boundary layer variability;
- Model intercomparisons based on the observational case studies;
- Use of models for evaluation of sensitivities to synoptic environment and land boundary layer

heterogeneity;

- Observations of lightning structure within MCSs in relation to microphysical properties;
- Cloud-lightning model evaluation.

Milestones

- Pre-SOP model setup for the study region, and intercomparisons based on a historical case;
- Selection of MCS case studies;
- Generation of a comprehensive dataset of selected MCS events;
- Generation of benchmark CRM simulations.

WP2.2 Oceanic processes

Partners : CAU, IRD, CNRS, CNRM (Month 0 to 60)

Objectives

The objective of this WP is to determine the ocean role in the variability of the sea surface temperature (SST) of the tropical Atlantic Ocean. In the equatorial Atlantic Ocean, the oceanic circulation and in particular the circulation within the subtropical cell (STC) contributes besides the sea surface fluxes to the annual and interannual variability of the SST. The STC is a shallow overturning circulations confined to the upper 500m of the water column. They connect subduction zones of the subtropics with equatorial and off-equatorial upwelling regions in the tropics via equatorial and off-equatorial undercurrents. One aim of this WP is the combination of hydrographic and current observations with surface flux data acquired within EGEE, PIRATA and other nationally funded projects to determine mean STC pathways and transports, to identify its intraseasonal to interannual variability and to link the observed variability to the variability in the SST. A comparison of observational results with those obtained from an oceanic circulation model will lead to identify key dynamics responsible for SST anomaly pattern that influence the variability of the West African Monsoon (WAM) on intraseasonal to decadal time scales.

Work content

The work within this WP consist of the synthesis of observational results obtained in different programs to obtain a consistent picture of oceanic processes that are relevant for the SST anomaly pattern on intraseasonal to decadal time scales and their representation in ocean general circulation models. A combination of observational results from different ship cruises as well as moorings within EGEE, PIRATA and other nationally funded projects will allow to give a detailed description of the mean circulation and its variability during the period of the AMMA-IP project. This includes the identification of the mean pathways and transports of the main current branches that supply the eastern upwelling regions. The role of oceanic circulation for the intraseasonal, seasonal and interannual variation of the sea surface temperature will be addressed by combining the obtained results regarding the oceanic circulation with results from the surface flux measurements within the PIRATA project. The observational results are compared to results of the OPA ocean general circulation model that has already demonstrated its ability in simulating surface and subsurface temperature, salinity and currents, in particular within the tropics. The model is also used to study the impact of the abrupt onset as well as of the interannual variability of the African monsoon on the ocean circulation and heat budget.

Foreseen Deliverables

- Quantification of the relative importance of oceanic circulation on sea surface temperature patterns that are important for the African monsoon dynamics.
- Estimation of the seasonal mixed layer heat budget of the tropical Atlantic from moored and shipboard surface flux, hydrographic and current measurements.
- Identification of climatological spatio-temporal oceanic patterns and their interannual variability.
- Assessment of the representation of observed circulation and hydrographic pattern in simulations with the OPA ocean general circulation model.
- Numerical process studies to quantify the impact of the African Monsoon on the ocean at different time scales.

Milestones

- Report on observed mean ocean circulation and pathways within the shallow subtropical cell
- Report on the validation of the OGCM in simulating sea surface temperature pattern
- Report on the observed mixed layer heat budget of the tropical Atlantic
- Report on the interaction between ocean dynamics and African Monsoon

Observations needed from field campaigns

There are no oceanographic field measurements funded by the proposed AMMA-IP project. The WP Oceanic Processes is based on results obtained from different nationally funded projects. Within the PIRATA (*Pilot Research Moored Array in the Tropical Atlantic*) network ocean-atmosphere interactions in the tropical Atlantic are studied by moored ATLAS buoys that are relevant to regional climate variability on seasonal, interannual and longer time scales. The surface flux measurements are key observations needed in different WP of the AMMA-IP program. The French Program EGEE-AMMA (*Etude de la circulation oceanique et de sa variabilite dans le Golfe de Guinee*) is closely tied to the observational periods of AMMA-IP. The EGEE-AMMA cruises complement the data set obtained from the SVP drifters and PROVOR profiler network. Actually, the PROVOR deployment in the Eastern tropical Atlantic and Gulf of Guinea, especially via the EGEE cruises, constitutes a French commitment to the ARGO program in the framework of CORIOLIS. Additionally, German cruises will be carried out in the western and central tropical Atlantic on a year to two-year basis that will be also used for APEX- and isopycnic RAFOS float deployments. The Ron-Brown ship funded by NOAA is also scheduled to participate during the SOP1 and possibly during SOP3.

Risks and contingency plans

No risks expected in the WP2.2 (except risks that are already accounted for in other funded projects) since this WP represents a synthesis of research obtained during different nationally funded projects

Links to other WPs

The strong ties to other WPs are highlighted in the following table:

1.1	West African monsoon and the global climate	Provision sea surface temperature forcing fields Use of atmospheric forcing fields from AGCM runs for ocean simulation
1.2	The water cycle	Provision of oceanic surface fluxes
2.1	Convection and atmospheric dynamics	Provision of oceanic surface fluxes and sea surface temperature forcing of the African monsoon on intraseasonal scale
4.1	Model evaluation	Value of oceanic model to represent the key processes
4.2	Field campaigns	Data from cruises not funded by AMMA-IP
4.3	Satellite remote sensing	Provision and access to satellite data relative to ocean

WP2.3 Physical and biological processes over land surfaces

Partners : CNRS, IRD, CEH, IGUC, UPS, FZK, UPCT, KNMI

(Month 0 to 60)

Objectives

This Work-Packages (WP) will study the physical and biological processes over Africa and is split into a management structure and two sub-WPs which will specialize on the two dominant scales of surface processes. The first one will focus on the water and energy balance at the mesoscale while the second one will focus on the hydrological and biophysical processes occurring at the plot scale.

The objectives of the management structure will be:

- To coordinate the activities of WP 2.3.
- To ensure communication to related WPs (see below)
- To ensure communication between sub-WPs
- To present the WP on the AMMA website
- To control the deliverables and reports

Work content

To reach the objectives of the two sub-WPs, process studies and field measurements must be performed, satellite images interpreted and hydrological and biological/vegetation dynamic models applied.

Since the processes are studied at various catchments/field sites in all over West Africa, it is necessary to ensure that data and information flow between all groups. Meetings and discussion groups will be organised, and responsibilities clearly defined and assigned. Information exchange to related WPs will be organised. Proposed deliverables will be controlled. Communication between data providers and modellers will be organised and common data standards defined. Results and activities will be presented to the community via the AMMA web-page.

WP 2.3 will focus on understanding the behaviour of meso-scale catchments (in the order of 10,000 km^2) and how it relates to our understanding of key processes at the local scale (in the order of 1-10 km^2). It will rely on the monitoring of selected catchments that are already under investigation by national funded projects, i.e. the upper Ouémé catchment (Benin, 14600 km^2) with an additional focus on the Donga sub-catchment supersite (600 km^2), the Niamey's square degree (Niger, 12000 km^2), Gourma (Mali, 30000 km^2). Investigation of key processes of vegetation dynamics and partly also for stream flow (or runoff) generation will focus on the Dano testsite (Volta Basin, Burkina Faso, 20 km^2), the Dahra test site (Senegal), a supersite in the Gourma region, the Wankama catchment (Niger, 2 km^2) and the Ara catchment (Benin, 15 km^2). Upscaling to the regional scale is also an objective, with two catchments in focus: the entire Ouémé basin (40,000 km^2) and the Senegal River (Guinea, Mali, Senegal and Mauritania, 350,000 km^2).

Foreseen Deliverables

- Definition of responsibilities within sub-WPs
- Definition of common data standards and measurement protocols
- Organisation of progress reports and meetings

Milestones

- Yearly meeting of sub-WPs partners organised

- Reports as required in sub-WPs delivered

Risks and contingency plans

In case of failure of major measurement devices, alternative periods/episodes are defined. Close communication to national base funded institutions is anticipated. Due to already existing contacts to local research institutions and corresponding positive experience, risk of failure is assumed to be manageable. This is proven by ongoing national research projects in the region for the last 3 years. Satellite data are available from several satellite types handled by different organisations; failure of one platform therefore can be compensated by other satellite types.

Links to other WPs

The strong ties to other WPs are highlighted in the following table:

1.2	Water Cycle	A better understanding of continental processes at the local and the meso scales is essential for modeling the water cycle. Hydrological models developed in 1.2 needed for testing hypothesis on the processes and their scaling properties.
1.3	Surface-atmosphere feedbacks	Feedbacks to be taken into account in order to understand persistency in rain fields, ETP fields; also for modeling. Key role of soil moisture in these feedbacks.
1.4	Scaling issues	Scaling algorithms essential for going from local scale models to mesoscale and regional scales models and for understanding emerging properties.
2.4	Aerosols and chemical processes in the atmosphere	Links between vegetation dynamics and emission/deposits of chemical species.
3.3	Water resources	Influence of continental processes (especially the link between vegetation and runoff) on water resources.
4.1	Model evaluation	Hydrological & biological modeling activities; value of improved land-data assimilation system
4.2	Field campaigns	Need SOP/EOP/LOP observations at the mesoscale sites
4.3	Satellite remote sensing	Need satellite products as a vital middle step in the upscaling to the regional scale
4.4	Data base and historical data	User-friendly databases to provide input and validation data for modeling.

Sub-WP2.3.1 Land-Surface Processes at the Mesoscale, with a View to Regional Upscaling

Objectives

- Understand the key processes of the water balance (runoff generation, groundwater recharge) for selected catchments
- Understand surface energy balance trough analysis of flux station networks
- Understand the memory effects between vegetation, soil wetness and precipitation over different time scales
- Identify vegetation indices and soil wetness through satellite remote sensing and understand regional scale vegetation dynamics
- Characterize surface spatial heterogeneity for selected meso-scale sites
- Understand the role of large river system for lateral transport of water in West Africa

Work content

The meso-scale is the corner scale in understanding how local processes combine in order to produce the hydrological regimes of a given region. Because vegetation, runoff and rainfall forcing have different characteristic scales, measurements of relevant meteorological and hydrological variables are performed within all catchments and test sites, in order to provide an overview of water and vegetation processes with various degrees of resolution and spatial coverage.

Regional upscaling is important since the large rivers in the AMMA region (Niger, Benue for instance) include internal deltas which significantly modify the discharge into the oceans and the local evaporation. It is essential to understand the impact of the processes involved in these deltas to be able to model these rivers, predict the water transported downstream and into the ocean and the impact on the regional surface energy balance.

In Benin, water budget elaborated for each vegetation functional group at local scale will be used to upscale the water budget at the Donga catchment's scale. A regular updating of Satellite maps of vegetation is essential. To make a space-time integration of all the elementary water budgets, a new physically-based and distributed hydrological model will be used. Specific natural tracers of each compartment (direct runoff, subsurface flow and ground water drainage) supposed to contribute to river flow will be researched by regular geochemicals campaigns in traditional wells and at five stream-gauge stations along the Donga river. Hydrograph separations will be performed according to this tracers. Results will be used to calibrate and validate the hydrological models.

In the tropical regime of Niger e.g., rainfall-runoff relationships based on topographic and surface features characteristics of catchments are undertaken on the supersite Kori de Dantiandou. These simplified relationships are deducted from distributed modelling performed at the local scale. By using spatial rainfall distribution, runoff to ponds and ultimately recharge of groundwater will be estimated. The model will be calibrated and validated with historical data of the last half-century for which piezometric and land surfaces evolution are known. Sensivity analysis for different cover and annual rainfall distribution will be performed.

We shall investigate how the memory of past rainfall affects soil moisture, biomass and surface fluxes across the region. The work will be done through analysis of measurements from the micrometeorological flux station network (as implemented in WP 4.2). Observations will be available from stations which cover the full range of climatological conditions in the region, sampling typical vegetation cover from the very sparse canopies of the northern Sahel down to the well-vegetated areas in the south of the monsoon region. The work will include correlation analysis of observed variables, and the use of a calibrated surface model to quantify characteristics of land surface memory.

Since the flux stations are a major source of verification data, they will be used for model verification and quality control by comparing observations to ECMWF grid point time series (so-called DDH diagnostics). In cooperation with activities in WPs 1.2, 4.1, 5.1 validation and improved initialization of global and mesoscale meteorological models will be performed.

Remote sensed vegetation products provided by WP 4.3 will be used to improve and validate ecological models and produce improved land-cover maps. MODIS, MERIS, SPOT/VGT, AATSR, MSG and NOAA-AVHRR satellite images will be interpreted with respect to vegetation indices and vegetation dynamics. The techniques of soil moisture derivation and vegetation dynamics identification from satellite products will be assessed and validated. Soil wetness maps will be derived and correlation to vegetation dynamics investigated. Additionally, a land cover characterization maps of major parts of West Africa will be derived to be used in regional meteorological and climate models.

Foreseen deliverables

- Validated hydrological models for Donga, Niamey's square degree and Senegal River catchments
- Validated vegetation and coupled vegetation / SVAT models at different spatial scales
- Time series of spectral vegetation indexes and soil wetness & specific maps on surface characteristics
- Data base of input parameters for vegetation models
- Data base of validation parameters (biomass, soil moisture) for satellite products

- Vegetation, soil and land cover maps for the Gourma region
- Soil moisture and vegetation biomass maps for the Gourma and the Sahel.
- Report: Analysis of observations and model results

Milestones

- Terrestrial water balance large river systems investigated (month 36)
- Vegetation/land cover maps available (month 24)
- Forcing and validation data bases (month 24, 48)
- Memory effects investigated (month 48)
- Final report on sub-WP results (month 60)

Observations needed from the field campaign

- Flux station network (WP4.2)
- Raingauge and meteorological station network (WP4.2)
- Satellite data (WP4.4)

Sub-WP 2.3.2 : Local Scale Land-Surface Processes

Objectives

- Develop, apply and validate models describing the coupled C/N/H2O cycles
- Understand the interactions between the water cycle and the vegetation dynamics with focus on the C and N cycles
- Understand the response of vegetation to environmental constraints at seasonal and interannual temporal scales.
- Understand the interactions between environmental variables and vegetation phenology
- Identify vegetation functional groups in terms of phenology, water extraction, and ecophysiology
- Identify the key processes for runoff and stream flow
- Joint hydrological and vegetation/biomass modeling
- Build up and operate measurement devices for both non-reactive (e.g. CO2, N2O, CH4) and reactive (BVOC, NOx) carbon and nitrogen cycling in Sudan-Savannah environment
- Develop techniques for scaling up local scale processes to regional scale

Work content

Due to their vast dimensions Savannah ecosystems contribute a significant fraction to global biogeochemical C and N cycling. Interaction between water cycle and C/N turnover will be assessed by measurements of C, N and water vapour exchange as well as the radiation balance (Dano test site and Gourma site). The C-exchange will be split into the “reactive” C-cycle (biogenic volatile organic compounds BVOC) and in the “un-reactive” C-cycle (CO2) as part of fixed CO2 by leaves is directly re-emitted to the air in form of BVOC, significantly lowering the carbon sink in the vegetation. This is particularly important for Savannah ecosystems. BVOC fuel photo oxidative processes as well as processes leading to particle formation.

It is well known that particles in the atmosphere change the solar radiation balance but the feedback to climate including precipitation is still a matter of debate. Therefore, understanding the reactive C-exchange contributes significantly to WP.2.4 and will lead to a conclusive modelling of the C-cycle in Savannah ecosystems. To determine the daily and seasonal dynamics of key BVOC (e.g. isoprene, monoterpenes) and as well as particles, the surface/atmosphere exchange will be measured by micro-meteorological methods. Primary BVOC emission source strength as well as ecophysiological control parameters (CO2-/H2O exchange, PAR, leaf temperature) will be determined using a mobile leaf enclosure system. C and N turnover in soils, i.e. mineralisation, nitrification, denitrification and immobilisation, will be determined in laboratory incubation studies with 13C and 15N labeling techniques. These detailed biological investigations will be performed for the Dano test site and partly also in the Gourma test site.

Process oriented models are applied for the hydrosphere-biosphere-atmosphere exchange. Biological models are jointly run with SVAT models and distributed hydrological models. It is aimed to dynamically couple major parts of the biological models and the hydrological models.

The key processes implied in water surface redistribution strongly depend on the rainfall regime. Direct runoff conditioned by soil surface features and rainfall intensities is preponderant in Sahelians countries (Niger, Burkina, Mali) whereas subsurface water and groundwater drainage supply the rivers in wetter countries (Benin). Therefore, in this sub-WP hydrological process studies will be combined with studies on vegetation dynamics for different scales and rainfall regimes.

In Guinean regime (Benin, Ara catchment), focus will be made first on seasonal dynamic of the unsaturated zone through a joint monitoring of the soil water (humidity, succion) and of the vegetation pattern, composition, phenology and physiology. Humidity stations will be set up along toposequences for the main vegetation functional groups. Water budgets of the functional groups will be established. Subsurface and groundwater flow will be monitored at automatic piezometers along the same transect. The geophysical tool will be used to determine the substrate topology particularly the alterite layer thick. Superficial geophysical surveys will be made to generalize plot humidities along toposequences.

In south-western Niger (which shows a tropical regime), the lowest parts of valleys are occupied by a myriad of seasonal ponds that collect the runoff from the hillsides. Runoff is confined to small scale endoreic catchments. Pool water evaporates but most water percolates to the regional aquifer. Due to its depth (20-60 m above ground level), the groundwater evaporate slightly. Studies will be performed that enable the identification of new probable deep infiltrations zones (gullies along hillside, band of dense vegetation (tiger bush on plateau)) on which water is subtracted from the general surface water cycle.

In Gourma, Agoufou represents the landscape elementary unit for surface water cycle (a dune slope with a depression at bottom) in arid zone. Associated with vegetation measurements, soil water dynamic will be monitored and deep infiltration will be investigated to close the water budget.

Since soil moisture drives the different processes, additional emphasis will also be put on the characterization of the temporal and spatial variation of soil moisture content at different scales. Vegetation dynamics is monitored with focus on dependency of water stress, soil moisture availability and surface temperature using LAI measurements and plant species distribution assessments (Dahra test site, Senegal; Gourma test site, Mali; Wankama catchment in Niger). In addition to water vapour flux measurements, in situ transpiration measurements on the main tree species will be performed. Models will be evaluated with these new data sets. Interaction between runoff and the vegetation dynamic will be analyzed. Sensivities of runoff to vegetation growing (and vice versa) will be tested for different land covers.

Foreseen deliverables

- C/N/H2O stations in Dano and Gourma
- Field measurements (vegetation, soil moisture, runoff, piezometric heads) at the Gourma and Dano, Wankama and Ara and Dahra sites
- Validated hydrological and biological/vegetation dynamic models for Gourma and Dano testsite/catchment
- Identification of interaction between water cycle and C/N turnover
- Report on the impact of surface heterogeneities including soil moisture on simulated fluxes
- Report on the impact of rainfall regime and land cover on water resource (groundwater and runoff)

Milestones

- C/N/H2O station installed at Dano and Gourma and in operation
- Joint hydrological/biological simulations performed for the Dano and Gourma test sites and the Wankama site
- Understanding of annual soil recharge and groundwater drainage (Benin site)
- Location and quantification of deep infiltration for Niger and Mali sites
- Water balance at plot scale for Benin and Mali sites
- Joint hydrological and vegetation growing modelling
- Analysis of climatic and anthropogenic impacts on water resources (Benin, Niger)
- SOP performed and analyzed
- EOP performed and analyzed
- Final report on sub-WP results

Observations needed from the field campaign

- Flux station network
- Raingauge and meteorological station network
- Satellite data

WP2.4 Aerosol and chemical processes in the atmosphere

Partners: CEH, CNRS, ISAC-CNR, FZK, CNRM-GAME, UP12, DLR, ENEA, CNRM-GAME, KNMI, UMIST, LMU-MUENCHEN, UB, ULEIC, UNIVLEEDS, UCAM-DCHEM, UPS, IRD(Month 0 to 60)

Objectives

The main objective of this Process Studies WP is to advance the scientific understanding of the aerosol and chemical processes within the WAM region and to feed this knowledge into the Integrative Science WPs. This WP is divided into 4 sub-WPs:

– **WP2.4.1** Aerosol radiative properties

– **WP2.4.2** Gas and particle phase chemistry

– **WP2.4.3** Surface processes

– **WP2.4.4** Effect of convection on chemical and aerosol budgets

WP2.4.1 and WP2.4.2 use the observations from the SOPs and EOP to build the basic scientific understanding of the trace gas and aerosol distributions, composition and processing in the WAM region required by the other 2 sub-WPs that are designed to address more specific targets. WP2.4.3 quantifies the surface emissions and deposition fluxes of the chemical compounds, whilst 2.4.4 examines the effect of convection on the trace gas and aerosol budgets in the WAM region. The specific aims of this WP is to:

– Coordinate the activities of the sub-work-packages working on the aerosol and chemistry processes in the atmosphere

– Integrate the specialized process studies within this WP

– Ensure the coordination of the activities of this WP with the rest of the project

Work content

- Organize meetings of the sub-WPs
- Organize meetings of the whole WP
- Undertake coordination of key publications.
- Coordinate the communication of observational needs to WP4.2

Foreseen deliverables

- Key WP publications: case studies and climatologies
- Compilation of progress reports on the WP.

Milestones

- 2006 observations and analyses obtained
- SOP case studies conducted
- Annual meetings of the WP

Observations needed from the field campaigns

- Aerosol physical-chemical and optical data, and vertical distribution (lidar) from the F/ATR-42, UK/BAe-146, G/Falcon and F/Falcon aircrafts during SOPs 0-3
- Chemical data from UK/BAe-146, F/Falcon, G/Falcon and F/ATR-42 aircraft during SOPs 0-3,

focussing on SOPs 2-3, including VOC, oxygenates, O_3, CO, NOx, NOy, HOx, aldehydes, peroxides, photolysis rates and dropsondes.

- Aerosol physical-chemical and optical data, and vertical distribution (aerosol lidar network) from the ground-based stations during the EOP and enhanced in SOPs 0-3
- Atmospheric soundings, solar/terrestrial radiative fluxes, and directional radiation, aircrafts and ground-based, whenever available during SOPs 0-3
- Ozone soundings (SOP2, + whenever there are O_3 sondes)
- Ground based chemical data, chemistry flux measurements (instrumented tower), rain gauges, rainwater composition, (EOP + enhanced during SOPs)
- Ground-based real-time radar survey, whenever available during SOPs 1-2
- Size-resolved mineral dust fluxes from SOPs
- Wet and dry deposition fluxes from SOPs
- Meteorological data (e.g winds, T and RH) from ground sites, aircraft and radiosondes
- Data on lightning frequency, intensity (satellite - TRMM, in-situ (radar))
- AERONET and photometer data

Risks and contingency plans

The biggest risk to this sub-WP is a lack of new data from WP4.2, should, for example, any of the measurement sites/platforms or instruments be non-operational. This could be due to malfunction, difficulties with logistics or health and security risks associated with working in West Africa. These risks and the contingency plans are dealt with in WP4.2.

A specific issue of data coverage for this WP is the reliance on SCOUT for in-situ measurements in the TTL. In the case of lack of SCOUT-AMMA synergy the TTL analysis will be restricted to satellite and aerosol lidar data.

The risk is limited for the actual data analysis approaches proposed in this WP due to the experience gained in previous projects where similar types of data have been analysed with models and techniques proven by the publication record of the teams involved.

Links to other WPs

WP	Input to WP 2.4	Output from WP 2.4
4.2	requires new data from field campaigns on aerosol and trace gases (see above)	will provide information on observational needs
4.3		requires satellite observations of integrated column and vertical profiles of chemical species (e.g. O_3, CO, NO_2, CH_2O, CH_4, H_2O from GOME, SCIAMACHY, OMI) observations of aerosols (CALIPSO-AQUA-TRAIN), Cloud top height (TRMM, METEOSAT)
4.1	will provide improved parameterisations of chemical and aerosol processing	requires initial evaluation of models
2.1	requires meteorological parameters from dynamical model output	Will provide chemical diagnostics for the evaluation of transport pathways will provide a parameterisation of optical properties in terms of aerosol composition and microphysical characteristics for input into dynamical models
2.3	requires land use, vegetation type and indices, and soil property maps	

3.2	will use scenarios for future fire distributions provided by 3.2	
1.1		will provide export fluxes and constraints required to assess the impact of the WAM on atmospheric composition and global climate
1.2		will provide knowledge cloud properties for up-scaling for water cycle closure studies

Established links outside AMMA are to the SCOUT and MOZAIC programmes

Sub-Work-Package 2.4.1 Aerosol radiative properties

Partners: UP12, CNRS, ISAC-CNR, FZK, LMU-MUENCHEN, ENEA, CNRM-GAME, DLR, UMIST

(Month 0 to 60)

Objectives

The main objective of this sub-WP is to provide the basic scientific understanding of the physical-chemical characteristics, optical/radiative properties, and regional and vertical distributions of the main aerosol types in the West Africa (WA) region. These are mineral dust, biogenic aerosols, and particles issued by biomass/domestic burning and urban pollution. This knowledge is necessary to determine the aerosol radiative effects, required to predict the dynamics and convection in the West African Monsoon (WAM) correctly, and the export of material over the Atlantic Ocean. Much of the improved understanding obtained by this sub-WP will be built on the interpretation of new data collected in WP4.2 during the Enhanced Observation Period (EOP) and Special Observation Periods (SOPs).

In combination with sub-WP 2.4.2 and 2.4.3, the research developed within this sub-WP will serve as input to other sub-WPs designed to address more specific targets.

Within this sub-WP, the following questions will be addressed:

- What is the regional and vertical distribution of the aerosols over WA, and what is its dependence on the seasonal cycle of the monsoon?
- How do the physical-chemical properties of mineral dust depend on source region (Sahara/Sahel)?
- How does the single scattering albedo of dust and biomass burning aerosols depend on their iron oxide and black carbon/organic carbon (BC/OC) content, respectively?
- How does mixing change the surface, hygroscopic, and optical properties of dust and biomass aerosols?
- How does the aerosol vertical layering control its radiative impact?

Work content

- The characterisation of the physico-chemical and optical-radiative properties, of dust, biogenic, and biomass/pollution aerosols, as a function of their mixing state, will be inferred from (1) in situ measurements at the ground-based stations and onboard aircrafts; (2) column-integrated ground-based (e.g., Aerosol Robotic Network (AERONET)) and satellite data (e.g., ENVISAT (ENVIronmental SATellite), AQUA-Train, CALIPSO (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations)); and (3) range-resolving ground-based data (i.e., lidars).
- The long-term variability of the aerosol vertical distribution and mid-high level thin clouds at the regional scale will be investigated by a set of lidar systems deployed during the EOP and SOPs 0-3. Connections with local scientists will be established in order to assure quality-controlled data during the EOP. Some coordination is envisaged with balloon-borne lidar measurements (SCOUT-AMMA, Stratosphere-Climate Links With Emphasis On The UTLS-AMMA).
- Intercomparison studies amongst different lidar systems or different stations will be performed.

Inversion algorithms for data processing (e.g., backscatter ratio, depolarisation, colour index) will be tested and implemented. Short-term variability of aerosol vertical distributions will be investigated from instrumented airborne platforms and compared to data from simultaneously operating remote-sensing platforms.

- The physico-chemical properties and vertical distribution of the aerosols will be linked to the air mass history (emission region, transport pathways).
- In situ and column optical closure studies will be done to express the aerosol optical properties in terms of their composition, size distribution, particle shape, state of mixing (external/internal), and vertical layering. These studies will be conducted based on the data collected during SOPs 0-3 by the different platforms (see 1 and 2), in some cases in conjunction with laboratory-based studies.
- Radiative transfer modelling will allow an assessment of the radiative impacts of West African aerosols at the local and regional scales. Intercomparison of assimilated aerosol parameters and radiation budget with satellite remote sensing will be carried out.
- Parameterisation of the optical properties of the aerosol will be developed based on detailed radiation schemes. These will serve as tools in numerical models of different scales to quantify the feedback mechanisms of aerosol, radiative transfer, atmospheric chemistry, and atmospheric dynamics.

Foreseen deliverables

- To characterise the physical, chemical, and optical (radiative) properties of the aerosols from WA, as a function of source region and mixing state
- To provide experimental evidence on the temporal evolution and vertical variability of the aerosol properties needed to characterise their transport processes
- To implement optical modelling algorithms in order to interpret aerosol optical parameters in terms of aerosol composition and microphysics
- To evaluate their radiative forcing and climatic impact over West Africa at the local and regional scale, in order to provide insights on their impact on the dynamics of the WAM.
- To validate retrievals from new satellites (e.g., the AQUA-Train, CALIPSO)
- To develop validated parameterisation schemes for atmospheric models

Milestones

- Characterisation of the aerosol properties of the different air flows within the WAM
- Interannual variability of aerosol distribution and properties over West Africa
- Parameterisation of optical properties in terms of aerosol composition and microphysical characteristics
- Estimation of the aerosol radiative local and regional impacts over West Africa

Sub-Work-Package 2.4.2 Gas and particle phase chemistry

Partners: UMIST ,UP12, UEA, UB, CNRS, ULEIC, UNIVLEEDS, FZK, UCAM-DCHEM, CNRM-GAME, DLR

(Month 0 to 60)

Objectives

The main objective of this sub-WP is to provide the basic scientific understanding of the gas phase and particle chemistry required by the other sub-WPs in this WP that are designed to address more specific targets. Specifically it is to characterise (locally and regionally) the trace gas chemical composition and the rates of gas phase and heterogeneous processing in different air masses within the WAM region. This knowledge is necessary to determine the impact of emissions from the West Africa on the chemical processing of air as it is transported through the

WAM system and exported globally. Much of the improved understanding will be built on the interpretation of new data collected in WP4.2 during the EOP and SOPs and by satellites (WP4.3). The aim will be to answer questions such as the following:

- How does the distribution of water vapour produced by the WAM circulation affect oxidant budgets (O_3 and OH)?
- What is the net impact of biogenic VOCs on the oxidative capacity?
- What are the major sources and sinks of the oxidants?
- What are the lifetimes of chemical species within the WAM?
- Is there sufficient NOx emitted from soil and lightning for net O_3 production to occur?
- How much secondary organic aerosol is produced from anthropogenic and biogenic species in the WAM region?
- What is the potential for new particle production in the free troposhere from biogenic and anthropogenic gas-phase precursors?

Work content

- The climatology of O_3, CO, NO_2, SO_2, and HCHO columns over West Africa will be inferred from the ozone soundings, aircraft (e.g. MOZAIC), ground-based and satellite data (e.g. SCIAMACHY), and data assimilation through global modelling.
- The chemical composition (e.g. NOy partitioning, organic composition, water vapour) and processing (e.g. O_3 and HOx budgets, chemical lifetime) will be related to the air mass history (emissions, transport pathways). Observationally constrained zero-dimensional models will be used in the determination of the rates of processing and the model diagnostics from WP2.1 will be used to describe the transport pathways.
- The volatile organic compounds (VOC) degradation mechanisms in chemical models will be tested against observed concentrations of emitted VOCs and gas phase oxidised products. The use of chemical diagnostics to act as indicators of source types, concentrations of unmeasured species and the rate of processing will be tested. This will feed into the evaluation of the chemical mechanisms of chemical transport models (WP4.1).
- Relative hydrocarbon concentrations, which can act as ‘clocks’, will be used to determine the time since emission. This will be useful in the evaluation of transport timescales and extents (WP2.1).
- The chemical characterisation of aerosol produced biogenically and from biomass burning, domestic burning and industrial emissions (sub-WP-2.4.1) will be linked to emitted VOCs and photochemistry (e.g. oxidation rates, and intermediate products).
- The interaction of atmospheric chemistry with mixed aerosols (biomas burning, pollution and mineral dust) and their effect on ageing will be examined using laboratory measurements on key aerosol systems, and a range of aerosol schemes within dynamical models.

Foreseen deliverables

- To characterise the trace gas chemical composition of the different air flows within the WAM
- To determine the impact of emissions of in particular biogenic NO_X and VOCs and transport pathways on the rates of chemical processing (e.g. O_3 and HO_X budgets, lifetimes)
- To link the secondary organic aerosol to emitted VOCs and photochemistry
- To assess the contribution of biogenic and anthropogenic emissions to new particle formation in the free troposphere
- To determine the spatial and temporal variations of O_3, CO, NO_2, SO_2 and HCHO over West Africa
- To determine chemical diagnostics useful in the evaluation of transport timescales and chemical processing

- To create a sub-module to treat the aerosol dynamics of mineral dust including heterogeneous chemistry

Milestones

- Parameterization of the relevant heterogeneous reactions of mineral dust
- Characterization of the chemical composition of the different air flows within the WAM
- Chemical diagnostics for the evaluation of transport and chemical processing
- Climatologies of O_3, CO, NO_2, SO_2, and HCHO columns over West Africa
- Characterization of the chemical processing of trace gases and the link with SOA in the WAM region

Sub-Work-Package 2.4.3 Surface processes

Partners: UEA, UP12, CNRS, ISAC-CNR, ENEA, LMU-MUENCHEN, UB, FZK, UPS, IRD

(Months 0 to 60)

Objectives

The main objective of this sub-WP is to assess and quantify the emissions and deposition fluxes of the chemical compounds present in the West African atmosphere. The natural emissions of gas and aerosols over West Africa are strongly influenced by the climatic conditions at various time scales, either directly meteorological parameters or indirectly via the vegetation and soil properties. One of the key issue of this sub-WP is thus the assessment of the variability of the emissions of aerosol over West Africa due, in particular, to wind erosion and biomass burning activity, and of trace gases from, on particular soils and vegetated surfaces. The final objective is to establish the degree to which their variability is related to human activities or to climatic parameters. Much of the improved understanding obtained by this sub-WP will be based on the interpretation of new data collected in WP4.2 during the EOP and SOPs and on the analysis of data obtained from satellite in the WP 4.3. Estimations of the emission and deposition of trace gas and aerosol are required as input for subWP 2.4.4 and 2.4.5 to estimate their impacts. In addition to natural and biomass burning emissions, estimations of the anthropogenic emissions over West Africa are necessary, in particular for the modelling of atmospheric chemistry (subWP 4.1.4).

Within this sub-WP, questions such as the following will be addressed:

- What is the magnitude of surface emissions of aerosols and trace gases from WA and how do these emissions vary at the seasonal and interannual timescales in relation with the variability of the monsoon system?
- What are the respective contributions of the climatic and anthropogenic factors in the variability of the aerosol (mineral dust and biomass burning aerosols) and trace gas emissions (Volatile Organic Compounds, VOCs and Nitrogen Oxides, NOx)?
- What are the regulating factors of the wet and dry deposition of aerosols?
- Are the African cities a significant source of aerosols and trace gases compared to the natural and biomass burning emissions?
- Is the Sahelian belt a net source of mineral dust or a deposition area for Saharan dust ?

Work content

- Size-resolved mineral dust fluxes measurements (emission and deposition) will be used (i) to improve and validate the parameterisation implemented in regional and global models of the mineral dust cycle and (ii) to estimate the balance between emission and deposition due to squall lines. Modelling will be the integrative tool allowing the assessment of this balance at the regional scale. The simulations will be further constrained by the long-term measurements of the aerosol concentration, optical thickness, and deposition (see WP 4.2EOP) and of the vertical stratification of the atmosphere (see sub WP 2.4.1 and WP 4.2.3).

- Long-term satellite data on vegetation cover will be used to estimate the variations of natural and anthropogenic unvegetated areas. These surfaces will included as source areas in regional models of the mineral dust cycle to assess the influence of the rainfall deficit in the Sahel on the dust emissions, transport and deposition.
- Soil and vegetation characteristics will be analysed to derive emission factors for naturally emitted NOx and VOCs and related to local and regional Planetary Boundary layer (PBL) concentrations.
- Satellite data on vegetation characteristics and fire areas and future fire distributions (from WP 3.2)will be used to derive biomass burning emissions of gases and particles. Analysis of satellite data on chemical species will further constrain the identification of sources of NO_2 and HCHO and the inter-annual variability of these emissions
- Geopolitical and satellite data, regional distribution of fuel consumption and anthropogenic activities will be analysed to provide regional distribution of emission factors for gases and aerosols, constrained by local measurements of anthropogenic pollutants (Sulfur Dioxide SO_2, VOC, NOx, Carbon Monoxide, CO, Polycyclic Aromatic Hydrocarbon PAH, ...) (see WP 4.2.SOPground)
- Inventories of anthropogenic gases (CO, NOx and VOCs) and aerosols will be established to be used by global and/or regional models (see WP 4.1.4) for a reference time period (2000) and for typical scenarii (pre-industrial or future situations)
- Inventories for biogenic VOCs (isoprenes/terpenes and oxygenated : methanol, ethanol, acetone) accounting for their dependence with soil and vegetation properties will be established, to be used by global and/or regional models (see WP 4.1.4)
- Wet and dry aerosol deposition parameterisations will be constrained by local wet and dry deposition measurements performed in the SOP period and during the EOP period (see WP4.2 EOP).

Foreseen deliverables

- To assess the variability of aerosol and trace gas emissions over West Africa due, in particular, to wind erosion and biomass burning activity and how this relates to human activity and to climatic parameters, as an example, the monsoon intensity
- To establish the meteorological processes in WA that result in such close linking of dust transport to rainfall deficits in the region
- To evaluate the contributions of the different types of vegetation to natural emissions of nitrogen and organic species and to relate this to the annual cycle and seasonal variability of vegetation and soil wetness.

Milestones

- Preliminary assessment of mineral dust emissions from natural surfaces on a seasonal and interannual timescale
- Preliminary regional simulations of the mineral dust cycle
- Estimation of the emissions factor for NOx and VOCs from natural soil surface and of for particles from biomass burning
- Analysis of tropospheric columns concentrations of trace gases from satellite observations
- Regional simulations of the mineral dust cycle including a complete size-resolved emission model and a parameterisation of the contribution of squall lines
- Emissions inventories for biogenic emission NOx and COVs, gas and aerosols from biomass burning and fuel consumption at regional scale with a monthly variability for use in regional and global atmospheric models, projection and impact for the future (2050-2100)
- Assessment of mineral dust emissions from anthropogenic activities
- Regional distribution of wet and dry deposition fluxes of aerosols (mineral dust and biomass

burning)

- Estimate of the mineral dust "net" emission budget from the Sahel (EOP/LOP) and of the relative contribution of natural and anthropogenic factors on the variability of this budget

Sub-Work-Package 2.4.4 Effect of convection on regional chemical and aerosol budgets

Partners: ISAC-CNR, CNRS, DLR, ENEA, CNRM-GAME, FZK, KNMI

(Months 0 to 60)

Objectives

The main objective of this sub-WP is to quantify the impact of WAM convective processes on distributions and budgets of aerosol and chemical in the free troposphere. This sub-WP focuses on the impact of processes related to convection (vertical exchange, convective precipitation, lightning production) on the variability of aerosol and chemical species due to transport, mixing, and chemical reactions. Improved understanding will be gained following the interpretation of new data collected in WP4.2 during the EOP and SOPs, modelling effort supported in WP4.1, and satellite data analysis of the TTL (Tropical Tropopause Layer). The subWP will provide input into up-scaling of water cycle closure studies (WP1.2) and quantification of export of oxidants and aerosols from West Africa and their impact on global climate (WP1.1.2).

- The main questions addressed by this sub WP are:
- What is the role of convective physical processes vertical transport, mixing, deposition on the budget of major oxidants and aerosols in the free troposphere over West Africa ?
- How do deep convective processes influence the distributions of chemical constituents in the TTL compared to other transport processes ?
- What is the role of lightning activity in NOx production ?
- What is the role of photochemical reactivity and heterogeneous chemistry on air masses transported over West Africa from large-scale convective outflow ?

Work content

- Simultaneous observations of heat, moisture and chemical profiles from SOP2 will be used to estimate the mean convective flux of trace constituents into the free troposphere and to constrain modelled entrainment and detrainment flux components using a cloud resolving model and a single column model coupled with chemistry.
- Tracer measurements (airborne, ozone soundings) and satellite data (e.g. ENVISAT, CALIPSO, METEOSAT) will be exploited to assess the perturbation to chemical composition in the upper troposphere. A combination of cloud-scale, mesoscale and trajectory modelling and analysis of trace gas and aerosol data collected by micro-lidar will be used to characterise the TTL. Additional information will be obtained by promoting the synergy with the SCOUT-AMMA balloon campaign planned during the AMMA campaign phase.
- Emission rates of lightning produced NOx will be inferred at mesoscale and at regional scale. The total NOx flux out of a single thundercloud is determined using data on NOx and wind speed sampled in the anvil of electrically active thunderclouds and thundercloud lifetimes. A new parametrisation of NO sources will be derived from observed NOx by satellite (e.g. SCIAMACHY, OMI) and in-situ. The total lightning NOx emission for West Africa will be estimated using the information for the single thunderclouds and lightning/thundercloud statistics for the region of interest and compared to global models.
- Global models, run with zoom over West Africa and with improved convection parametrisations, will be used to determine the role of dynamical and physical processes (e.g. washout, mixing) associated with convective systems on regional trace gas budgets (e.g. ozone). The impact of mixing air masses of different origin (e.g. surface, stratospheric), which could significantly alter radical concentrations in the free troposphere, will be investigated using combined

photochemical trajectory and global models and data on the photochemical reactivity of air masses in convective outflow regions obtained in 2.4.2.

- The transformation, mixing, and impact on microphysical and optical properties of particle layers during their transport will be determined using trajectories, Lagrangian and regional-scale models and input from 2.4.1 on the chemical, physical and radiative characteristics of these layers in convective outflow regions . The impact of heterogeneous chemistry (e.g. reactions on dust) on chemical composition from convective outflow will be investigated.

Foreseen deliverables

- To determine the role of deep convective processes (transport, deposition, heterogeneous chemistry) in the budgets of major oxidants in the free troposphere over West Africa
- To establish the chemical characteristics of the TTL region over West Africa and to evaluate the mass exchanges, and associated humidity and trace gas fluxes, between the tropical troposphere and stratosphere in relation to deep convection
- To determine the photochemical reactivity and aerosol properties in air masses transported in large-scale convective outflow over West Africa relative to air masses of other origin on regional scales
- To evaluate the role of the monsoon circulation and other flow patterns, including Monsoon Convective Systems, in the transport of gases and aerosols within the WAM region

Milestones

- Identification of relevant datasets for analyses
- Report on the convective fluxes estimate and evaluation of model performance using field data
- Report on the convective perturbation to oxidant budgets relative to other sources over West Africa
- Report on the chemical composition of the free troposphere during the SOP
- Evaluation of the aerosol properties of layers transported from West Africa
- Evaluation of the TTL aerosols and chemical composition
- Evaluation of total convective flux
- Evaluation of lightning NOx emissions for West Africa and model improvement

6.1.3 Impact studies

WP3.1 Land productivity

Partners: CIRAD, IGUC, IBIMET, LODYC,CESBIO, AGRHYMET (Month 0 to 60)

Objectives

This work package aims at quantifying the likely impacts of climate variability and change on land productivity in agricultural and pastoral production systems in the region, in terms of crop yields and natural vegetation growth. This will be done while taking into account probable adjustments of the system, e.g., in terms of crop variety and management choices that farmers are likely consider to adapt their system to the change of conditions.

The irregularity of the monsoon in West Africa has sharply affected West African populations in the seventies and eighties through massive crop failure and livestock mortality. Sahelian countries, relying heavily on agriculture, are particularly vulnerable to late or irregular monsoon. There is growing evidence from Global Climate model simulations that climate change will lead to an even more irregular climate in the Sahel. On the other hand, recent results obtained by the PROMISE project using crop simulation indicate that intra-seasonal and spatial rainfall distribution, and not just rainfall totals, are a defining element for land productivity and yield stability in the

Sahel and Sudan savannah. Consequently, this work package will not just measure the potential impact of overall trends in climatic conditions as predicted by climate models, but evaluate as well how such regional trends might affect local risks to food production and security. In the AMMA project we will have an unique opportunity to analyse these impacts, from a scaling up of processes from the plot level to more aggregated level such as farm, district or country (in collaboration with WP3.2), and scaling down of climatic information from aggregated level to the plot level, (in collaboration with WP 1.4).

To help farmers cope with changing rainfall patterns, there is a need for both tools that predict those patterns, and tools that translate them into attainable yield and risk of crop failure. Intra-annual predictions of onset dates of rains, of length of growing season and of intra-seasonal drought spells are probably soon within reach and can be used by yield forecasting systems such as the DHC of Agrhymet and the early warning systems of FAO, but will require appropriate models to evaluate impact and formulate recommendations. This work package seeks to lay the methodological basis for this, and to apply it to specific scenarios generated with climate models, feeding into the demonstration workpackage on food security (WP5.2) together with the studies on human processes in WP3.2. This is highly relevant for policy makers in order to mitigate food insecurity. Accurate predictions can improve the management of grain stocks and help them cope with regional or national grain deficit. Lastly, we will try to translate impact of change on crops and cropping systems into food security at the macro level, and derive tentative recommendations with respect to research that aim at mitigating the negative impact of change. This will be used by WP3.2 where agricultural systems and human strategies will be studied.

Specific objectives of this WP are thus as follows:

- Characterization of the effects of regional climate change and variability on crop productivity at the scale of the agricultural field and cropping system
- Identification and evaluation of probable adjustments to climate, including choice of crop and its management strategy
- Identification of anomalies in vegetation trends over the region
- Characterization of the key trends and anomalies in natural vegetation productivity and its relation to regional and local climate

Work content

A large proportion of the work will be methodological in terms of model improvement and adaptation to the specific objectives, as well as field based validation of model relevance (does it simulate the most important factors?) and model accuracy (fit of simulations). This is crucial because even in a highly climate driven, and particular rainfall driven agricultural situation, the impact of climatic factors are sometimes very indirect (e.g., early-season soil nutrient and weed dynamics depend on sowing date relative to onset of rains) or non-linear. A broad participation of disciplines and experts in/from the region will then be sought to study climate impacts on system productivity and behavior (via feedback) by sensitivity analysis. Direct collaboration with regional partners will also be sought with regards to consequences for agricultural research priorities and possibilities to improve existing forecasting systems.

Such studies will with a set of tools (models) and methods to simulate vegetation biomass and crop production at plot and aggregated regional scale. They fall into two groups, i) yield variability and food security based on plot level crop models, aggregation/disaggregation tools, and linkage with tools to assess food security, and ii) vegetation trends based on remote sensing analysis, linked to climate driven biomass modeling. Both approaches will feed into a reflection on how agricultural forecasting and early warning systems can be improved.

Specific activities will address the following:

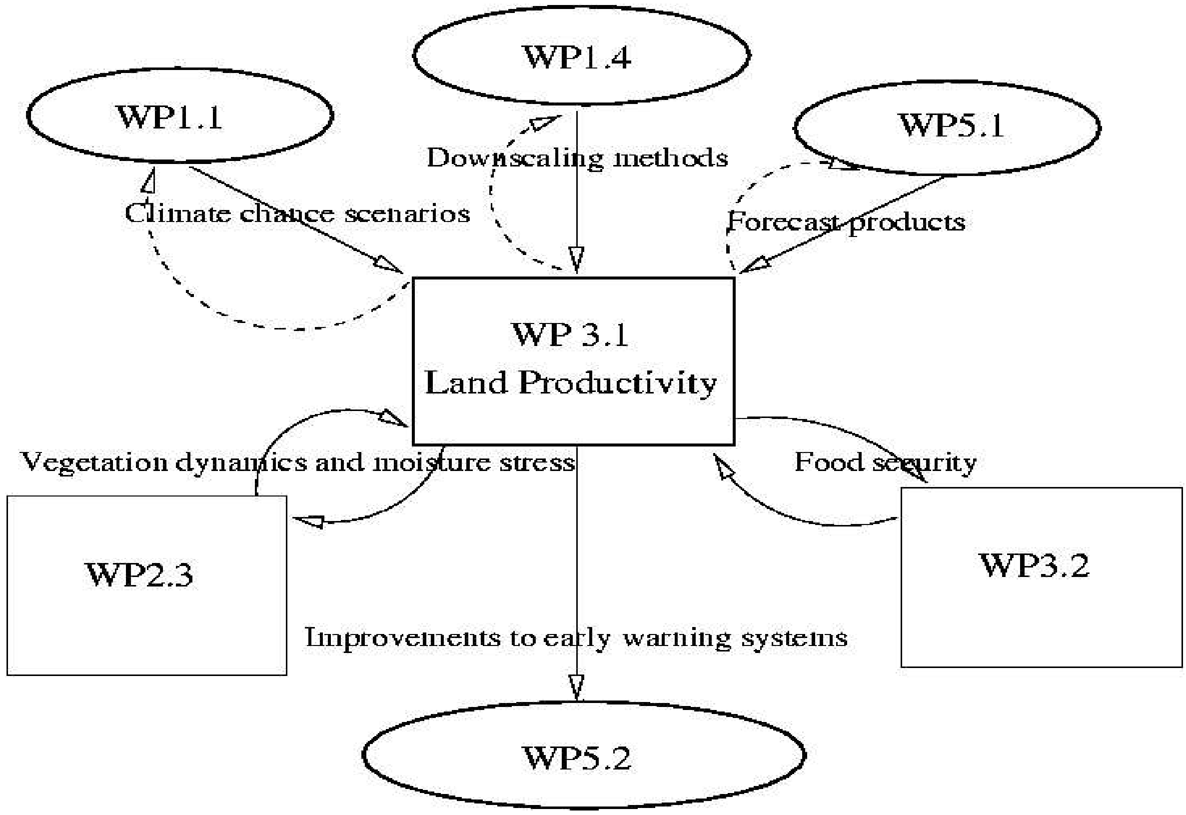
Yield variability

- Analyse trends and accuracy of an aggregating/disaggregating tool coupling with a crop modeling platform for simulations of crop climate interactions at different spatial scales.
- On-farm analyses of climatic and agronomic constraints responsible for yield variability of millet in the Sahel, and critical definition of attainable yield in terms of its dependency on climate.
- Extrapolation of the up-down-scaling tool from Niamey to other regions in West Africa

- Evaluation of agricultural decision making practices (different levels of intensification and risk-aversion: choice of crop/cultivar, sowing date and density, inputs, etc.) with respect to their performance and vulnerability under different climatic scenarios
- Quantitative assessment of WAM variability on national food security (with 3.2 and 5.2)
- Vegetation trends
- Identification of trends in vegetation productivity with satellite remote sensing analysis. The analysis will be done on regional data from 1982 till present (NOAA AVHRR pathfinder)
- Analysis of the relation between vegetation productivity and climate
- Development of new methods to estimate Net Primary Production from satellite data with inclusion of water stress (from 2.3)
- Towards improving agricultural forecasting and early warning systems
- Defining tools and methods for early warning
- Participation in the improvement of the early warning and yield forecasting system of Agrhymet for the Sahel

Links with others WPs

The links are illustrated in the schematic diagram below.



Foreseen Deliverables

- Validated crop model suited for impact studies of principal grain crop coupled with an aggregating/disaggregating tool (spatial issues)
- Crop model linked with climate model output database and GIS
- Biomass and grain production scenarios for different crop management and climatic scenarios
- Scenarios from plant growth models extrapolated to national food balance
- Time series of regional NPP maps 1982-> present
- Vegetation productivity trend map
- Establishment of the relation between climate (rainfall) and vegetation productivity, and identification of anomalies
- A vegetation productivity model using medium resolution satellite data
- Improved algorithms for Early Warning tools at the regional scale for CILSS countries
- Zoning of risks and yields for input to early warning systems

Milestones

- Spatial scaling problems regarding GCM and crop model linkage resolved by aggregating/disaggregating tool
- Yield variability within a 100km x 100km Sahel field observatory broken down to climatic and non-climatic factors
- Times series of regional vegetation productivity ready

- Trend map identifying areas showing positive or negative trends in vegetation productivity ready
- Remote sensing-based model developed and calibrated
- Relation yield variability to climate established
- Relation of vegetation productivity to climate established
- Crop model suited for impact studies for principal West African grain crops
- Impact of climatic scenarios of crop yields for different latitudes and agricultural strategies quantified by simulation
- User-friendly software to simulate food security scenario
- Empirically based vegetation productivity predictions under climate change scenarios available
- Time series of Net Primary Production maps for Sahel
- Tools and crop modeling software for integration into forecasting system available at AGRHYMET
- Impact of climate scenarios on rangeland productivity

Risks and contingency plans
There is an existing longstanding collaboration with national and regional institutions which will assure that access to the required data is possible and that field experiments can be done. Model test and evaluation could be based on data from another area, if planned access to data should fail. The satellite data necessary in this WP is mostly existing data already available.

WP3.2 Human processes and food security

Partners: IGUC, CIRAD, IBIMET, UCL, EIER

Objectives
The overall objectives of this WP are to assess the human component of the West African Monsoon, the impact of climate on the livelihood of people in the region, identification of human adaptation strategies to climate change, and also the feedbacks from human activities to the climate system. Human-environment systems in the Sahel result from a range of interactions between climate change and variability with changes in policies, in macro-economic variables and local management strategies. The multi disciplinary approach in AMMA will make an analysis of such complex systems possible, exploiting the results from modelling of the variability of the WAM and climate change scenarios and the specific efforts to make these results applicable though downscaling (WP1.4). The topics in focus are the structure and functioning of agricultural production systems, including human adaptation strategies to climate change and possible feedback mechanisms from changes in production strategies to climate (WP1.1). The WP is thus closely linked to WP 3.1 which focuses on land productivity with special focus on choice of crops and on productivity of natural vegetation. An analysis of changes in fire occurrence under climate change in the region will be performed together with a regionalization and conversion of land productivity to farming system level and to socio-economic impacts, vulnerability and food security (from WP3.1). Sahelian soil surface characteristics are key reflects of the interactions between climate change and human activities. Another objective of this WP is to elaborate a global index integrating demographic pressure, land uses, grazing pressures, climate variability, policy and economic strategies. This index will be used as an indicator for environmental monitoring to be used in the demonstration on food security (WP 5.2).

Work content
The work will be done on a range of scales, and appropriate tools will be employed at each scale. To analyse these interactions, the work package will utilize empirically based approaches in form of analysis of past human strategies to climate change in the region in combination with

simulation model based methods. The backbone of the work in this WP is to identify past changes in land use /land cover based on satellite data in different parts of West Africa, studied at village, national to regional scale. In particular the changes in rangeland/cropland will be in focus. On regional scale, a simulation model of land use change under climate change in the Sahel will be developed, and validated with the local scale in order to produce a series of nested local, national, and regional scale analysis of land use/cover change. The land use scenarios will build upon empirical studies of past and current adaptive strategies in crop and livestock production systems. In addition, the likely effects of establishment of ‘green CDM projects’ (e.g. afforestation projects) will be studied. Analysis of farmers responses, their adaptation strategies and vulnerability to climate systems, based on field surveys along a North/South transect in representative agricultural systems and areas prone to changes in vegetation productivity will be performed and combined with regional maps of crop and pasture performance and obtained insight in the impact of climate change on crop. The performance of the general land use simulation model will be evaluated against the field surveys on local scale. A set of “what if” scenarios, analyzing the impacts of changes in population pressure, migration, economic development, government policies and climate on representative production systems, will be developed. Statistical methods will be used to define the range of suitable indexes.

Foreseen deliverables

- Meta-analysis of case studies on land use strategies in the context of multiple instabilities
- A series of ‘nested’ local, regional, national and Sahel-Sudan scale analysis of land use/cover change, produced on the basis of high to medium resolution satellite images
- Generalized knowledge on pathways of human-environment interactions in the African Sahel and responses to climate change
- Scenarios of land-use change under a range of hypothesis concerning climate and socio-economic changes
- Analysis of the impacts of changes in population pressure, migration, economic development, government policies and climate on representative production systems.
- A revised mapping for vulnerability context analysis at regional scale over the CILSS countries to support EWS for food security
- An improved mapping context of livestock productivity to support EWS analysis at regional level
- Based on an analysis of existing continental scale information on fire distribution in time and space, scenarios for future fire distribution will be produced.
- Based on scenarios for changes in land use/cover associated with future climate change, in combination with other driving forces, estimates of changes, at the scale of the spatial resolution of climate models, of biophysical variables of climatic significance

Milestones:

- Fire practices monitored and analysed
- Meta study on existing knowledge (case studies) compiled
- Local scale studies 1st phase completed
- Vulnerability assessment framework completed
- Transects for fieldwork identified based on remote sensing data
- Socio-economic models build
- Preliminary “what if” scenarios set up
- Land use simulation model improved
- Performance of land use simulation model analysed
- Field survey in transects completed
- Land use modelling using climatic change scenarios

- Translation of land use scenario maps into physical parameters for assessment of feedbacks to the climate system

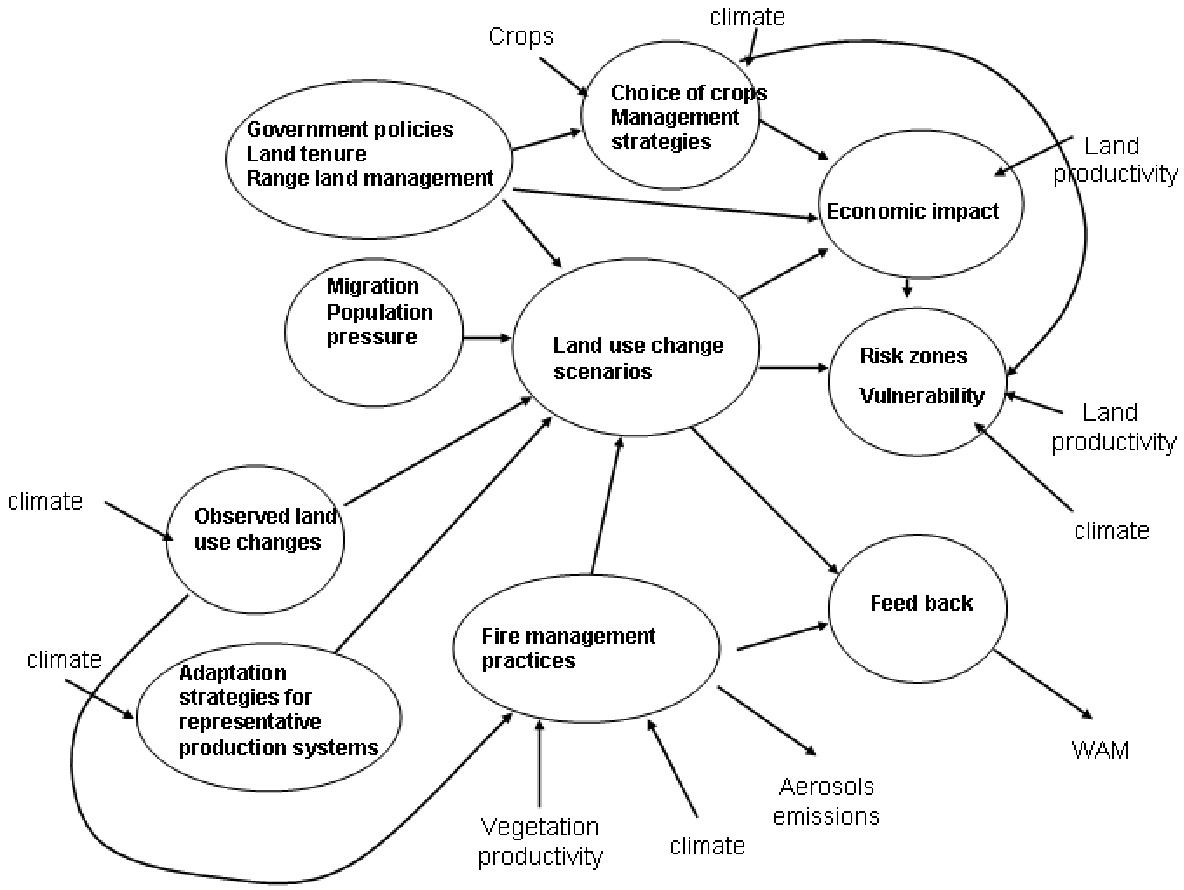
Observations needed from the field campaigns

This WP has its own field campaigns

Risks and contingency plans

- The overall risk in this WP is that the necessary input from other WPs are not ready in due time. That is in particular true for input on climate scenarios. Constructed climate scenarios could be set up, and act as input to the models that will be applied.
- The field surveys could be prevented from fail of infrastructure or for security reasons. Major part of the local scale field work will take place in Senegal, which is considered to be one of the most stable nations in the region. It would be possible to find other suitable areas to perform the field surveys, in a worst case scenario the models could be build on the results from the META study.

Links to other WPs



WP3.3 Water resources

Partners: AGRHYMET, EIER, IRD, IGUC, UPCT (Month 0 to 60)

Objectives

This Work-Package will study the impacts of climate and land use change on water resources in West Africa for a number of river basins on different scales. Important elements of the hydrological cycle will be reviewed in a resource context, and water availability for agricultural production, irrigation, hydropower and domestic use will be addressed as well as the direct impact on river discharge and flood occurrences in selected areas. Management aspects will be taken into account as well. In this WP, the results from several other WPs will be combined allowing the impact on water resources to be evaluated. The specific objectives of the WP are thus to:

- Assess the impacts of climate and land use change on water resources in west Africa and its management at river basin scale
- Compute the vulnerability of hydro-systems related to climate variability and change in combination with human interventions and water use
- Inter-comparison of downscaling models for hydrological impact assessment
- Analyze the effect of climate on flood occurrence in the valley of Senegal River and its relation to dam operation and the hydrological regime of the basin

Work content

In order to reach the objectives in the WP, four river basins in West Africa, some of which is also studied in WP 2.3, with different scales and locations will be considered together with the Epsat-Niger experimental basins. The basins are located in the humid to the semi-arid parts of West Africa. These basins differ in their distribution of rainfall over the year and the human impact on their functioning. Each basin will thus have their specific characteristics and this diversity will, in combination with the results from the other WPs in the project, give a unique opportunity to analyze the impacts of climate and land use changes on water resources in the region.

The large scale, trans-national river basin of Senegal (350000 km^2) which stretches from the sub-humid to the semi-arid West Africa, is a good case study for water management and the expected impacts of climate change and land use on the management of the water resources of the basin for hydro-power production, irrigation and other uses as well as flood occurrences in the river valley. In the Nakambé basin (40 836 km^2) in Burkina Faso the close interaction between the recent drought since 1970 and human activities leads to an accelerated degradation of the environment. This degradation increases the pressure on the water resources of this basin and modifies to a great extend the hydrological cycle. The third basin is the Sirba basin (37 000 km2) which is an affluent of the Niger basin located in Burkina Faso and Niger. During the rainy season, the discharge of Niger River at Niamey is greatly influenced by the runoff recorded at that basin. A great modification of the discharge at this basin related principally to land degradation, contribute in recent years to a complete modification of the hydrological regime of Niger at Niamey leading flooding for some years in the Niger valley around Niamey. Thus, the assessment of the impact on the hydrological regime on that basin due to land use and climate change is of great importance for Niamey and surroundings. The fourth basin is Ouémé (14600 km^2) in Bénin. The particularity of this basin is the fact that it is located in humid area and is a research basin considered during the AMMA operations. The hydrology and hydrogeology of the Epsat-Niger (degree of Niamey) area will be also considered (small experimental basins, aquifer recharge).

The analysis will be based on the use of hydrological modelling of the different basins based on available data, and here the work will benefit from the hydrological models applied in WP2.3. For each of the river basins different models have been adapted and calibrated. The analysis will be based on spatially distributed modelling for the Senegal River basin, Sirba basin and Nakambé basin. Sensitivity analysis of the model simulations to land use modification will be carried out based on observed land use change data from WP 3.2. Land use change scenarios from WP3.2 will be used as input to the models. Scenarios of rainfall and climate obtained from different downscaling methods (results from WP 1.4) are used to assess the climate change impact for the considered basins. Because of the different climatic characteristics of these watersheds, the various downscaling methods proposed by WP 1.4 will need to be explored. The diversity of tools available here allows for a systematic study of the uncertainties in the production chain going from the large scale climate model to the impact on water resources.

For the Senegal River water resources management and regulation tools in the hydrological model of the basin will be incorporated in order to take water resource management into account, and to be able to evaluate the future allocation of water resources for hydropower (upstream) and irrigation (downstream). The regulation tools will allow inclusion of dam operations in the hydrological simulations. The operation of dams is closely linked to the flood regime of the river. Frequency and areal extent of floods will be analysed in a GIS environment, using remote sensing data and a digital elevation model for part of the Senegal River valley, and this in combination with simulations of river discharge from the hydrological model will allow analysis of the impact of climate and land use change on flood occurrences.

In the Nakambé basin, hydrological studies will be combined with environmental, pedological, bio-climatic, vegetation dynamics and meteorological investigations, in order to better understand the functioning of this basin and assess the impacts of climate and land changes. Hydrological modelling by the conceptual distributed model GR2M will be coupled with the QdF (Discharge-Duration-Frequency) approach. Event-based distributed modelling will be also carried at small scale. Different sizes of sub-catchments will be considered so that to study the scaling effects on hydrological response of the Nakambé basin.

Foreseen Deliverables

- Variation of the West African water resources in terms of river discharge for the horizon 2020, 2050 compared to a baseline year for all the studied river basins
- Status of water resource availability for the river basins. Present availability compared to availability scenarios for the horizon 2020, 2050, based on present demands.
- A report describing the vulnerability level of the hydrological systems
- Classification of different downscaling methods based on the basin size and downscale scales.
- Improved hydrological model for the Senegal River basin which includes management and regulation tools
- GIS based tool for dynamic flood monitoring integrating remote sensing and DEM.
- Management and planning tools for policy makers and water managers for the Nakambé basin. These tools integrate new hydrological norms for water infrastructures design, GIS based models for water resources assessment, water quality management, dams silting control and health issues.

Milestones

- Data collection and analysis on rainfall, PET, discharge and physiographical characteristics for each basin
- Current and past water resources and the relation to climate evaluated on river discharge assessed by hydrological modeling based on historical data for each basin
- Evaluation of hydrological response for each downscaled scenarios of rainfall and PET for various downscaled methods for horizon 2020, 2050 (from WP 1.4)
- Assessment of the vulnerability and the impacts on water management for each basin

Observations needed from the field campaign

- Rainfall distribution
- Discharge of rivers
- Meteorological parameters (wind speed and direction, insolation, air humidity and temperature)

- Geomorphologic properties and digital elevation model
- Pedological profiles and Soil surface characteristics
- Soil moisture distribution
- Vegetation distribution and Land uses
- Human activities
- Water uses and demands
- Population dynamics and growth
- Policy and economic planning for temporal horizon projections (2020, 2050)

Risks and contingency plans
The WP is dependant on input from other WPs, and for some of the basins, on observations from the field campaigns. In case the deliverables from these WPs are delayed for some reason, alternative periods/episodes will be defined. The comprehensive network of contacts to regional institutions in the region makes the risk of not having access to the necessary ancillary data low.

Links to other WPs
This package needs input from

- WP 1.4: Downscaled rainfall and climate scenarios ,
- WP2.3: Hydrological modelling and vegetation dynamics
- WP 3.2: Land use change scenarios
- WP4.1 and WP4.2 : Meteorological input
- WP 4.3 Land use change maps

It will give input to WP 3.1, WP5.1, WP 5.2, WP6.2

WP3.4 Health impacts

Partners : UNILIV, CERMES, IRD, MEDIAS-France (Month 0 to 60)

Objectives
West Africa is an important region for studying climate impacts on public health and animal health, for at least two reasons:

i) While inhabitants are poor in general, rural conditions render them extremely sensitive to environmental changes and associated risks including exposure to diseases and epidemics. For example, in Niger one child out of four will die before the age of four. In Niger malaria is the major of cause of mortality and morbidity.

ii) In West Africa there is a delicate balance between climate and environmental variability, water resources, mosquito density, agricultural and pastoral outputs and the quality of life.

As far as meningococcal meningitis is concerned, variability in the seasonality of the monsoon can lead in certain years to a human population becoming very susceptible to epidemics. The AMMA project is to bring together scientists from different disciplines, including those involved with public health and animal health. This unique Health Impacts WP will contribute to a better understanding of linkages and mechanisms between disease diffusion, epidemics, and climate/environment variability and changes. It will start to lay down the foundation for the development of early warning systems to assist with epidemic reduction/prevention through optimising the limited resources in areas of greatest need.

The objectives of this WP are:

- To identify the roles of meteorological and environmental variables in patterns and diffusion of selected diseases: Rift Valley Fever (RVF) in Senegal, malaria in Benin and Niger and meningitis in Niger

- To characterise the impacts of the seasonal and inter-annual variability in the West African monsoon on selected diseases:
- To identify the role of natural river flooding, soil type and agricultural irrigation in the patterns and density of vectors and vector borne diseases
- To examine the impact of rainfall, hydrology and pond dynamics, at selected locations
- To identify the role of rainfall in the circulation of pesticide from agricultural crop fields to mosquito larval breeding sites and the impacts on the selection of insecticide resistance in *An. gambiae* populations
- Evaluate the impact of monsoon rainfall and other climatic factors on the dynamics of malaria and RVF vector populations on the presence, and then absence, of climatic conditions to allow onset, and then cessation, of the spread of meningitis epidemics in Niger

Work content

Health and Vector Data Collection

- Collection of mosquito density data for locations along a north-south transect across Benin. Data will be collected at the beginning of monsoon, at the monsoon maximum and during the cessation of the rains, thus for four years in Benin. At each of the four locations and whenever possible we will collect mosquitoes in cotton and/or rice field areas. The mosquitoes collected in Benin will be screened for insecticide resistance and this will be examined in relation to the use of land use and use agricultural insecticides at each location.
- Collection of mosquito density data at locations in Senegal through the duration of the project. Monitoring ponds in Senegal (in-situ and remote), pastoralism and their impacts on mosquito habitats and density.
- Collection of malaria vectors and parasitological data will be examined across a range of bioclimatic zones in Niger and at one of the field sites (within the EPSAT area in proximity of the Banizoumbou climatological station). Use will be made of the meteorological, hydrological and atmospheric observations and measurements together with measurements of pond dynamics. Impacts of vegetation types, land use, soils and river flooding across a number of bioclimatic zones in Niger will be assessed. The role of local climatic variables and their impact on local mosquito breeding habitats is to be evaluated.
- Clinical surveillance data will be collected that relates to meningococcal meningitis from all districts at risk in Niger and at one location within the EPSAT area. The characteristics of the transmission of the diseases will be related to the seasonal and interannual variability in meteorological conditions (particularly humidity) along with environmental factors such as dust conditions.

Integration of data sets for detailed analysis and the production of pilot modelling studies

- One partner's computer system will be used to integrate meteorological and environmental datasets from AMMA field measurements, remote sensing and relevant AMMA provided historical data with the health and vector data collected through AMMA and historical epidemiological data when and where available.
- Analysis software to be developed this computer system will investigate the patterns and development in disease and vector populations and relate them to the meteorological and environmental data.
- Where analysis indicates relationships between climatic variability, at scales relevant to health, and disease - pilot models will start to be developed and where appropriate existing models will be modified and utilised. Validation of epidemiological models for RVF in Senegal, using entomological and hydrological parameters will be undertaken.
- Where climatological/disease linkages are known, generally presumed or further established, past seasonal ensemble forecasts (EU DEMETER and EU ENSEMBLES) of climatological of key

climate parameters will be analysed. This is to assess the current skill of ensemble prediction systems with 2-to-4 months lead-time.

- Linkages to Early Warning Systems from health-meteorology-environment modelling studies we be assessed through the identification of key weather forecasting and monitoring activities within current operational food early warning and health early warning systems.

Foreseen deliverables

- Identification of key known meteorological and environmental variables for inclusion into analyses, to be derived from project database, from instrumentation networks, remotely sensed data and from historical database (3 months list will be revised after field studies)
- Identification of downscaling requirements and issues
- Output from joint modelling (epidemio-environment) in Senegal.
- Field studies of disease vectors (mosquitoes) and/or detailed disease surveillance programmes in three countries – Benin, Senegal and Niger interim dataset.
- Implementation of a computer system for use in analysis and integration of meteorological and environmental dataset for investigating patterns of disease.
- Metadata and Databank for RVF in Senegal.
- Contribution to development of pilot HEWS (for selected disease) within the AMMA window.
- Field studies of disease vectors (mosquitoes) and/or detailed disease surveillance programmes in three countries – Benin, Senegal and Niger final dataset.
- Assessment of potential of current R&D ensemble seasonal forecasting systems for health impact applications in West Africa.

Milestones

- Information and key findings on RVF, Malaria, Meningitis diffusion, and linkages with climate and environment variability, to be included in the website being developed.
- First modelling output on RVF diffusion made available to the AMMA Health community
- Integration and analysis of climate, environment with vector and disease datasets.

Observations needed from the field campaign

This WP needs to integrate meteorological and environmental data from AMMA field measurements, remote sensing and relevant AMMA provided historical data with the health and vector data collected through AMMA and historical epidemiological data when and where available.

Risks and Contingency Plans

Niger – presidential election in 2005 may lead to problems accessing all of the field sites but indications are that there should be few or no problems. Issues regarding availability of adequate vehicles to access all of the field sites.

Links to other WPs

The ties to other WPs are highlighted in the following table:

WP	Input to WP3.4	Output from WP3.4
1.1	Large-scale context of regional climate anomalies	
1.2	Provide products related to the water cycle at different scales	

1.3	Impact of continental related feedbacks to water resources and vegetation cover	
1.4	Provide downscaled data from model outputs	
2.3	Provide hydrological and biological/vegetation products at different scales	
3.2	Provide information on land use / land cover at different scales	
3.3	Provide information on water resources and hydro-systems	
4.1	Provide expertise on the models involved in WP3.4	
4.2	Provide in-situ data useful for WP3.4	
4.3	Provide satellite data useful for WP3.4	
4.4	Provide historical data useful for WP3.4	
5.1		Provide assessment of seasonal forecasting systems for health aplications
5.2		Provide contribution to pilot Health Early Warning Systems

6.1.4 Tools and methods

WP4.1 Model evaluation and data assimilation

Partners : CNRM, KNMI, ECMWF, ENEA, IRD, ISAC-CNR, CNRS, UPCT, UPS, CEH, UCLM, UCM, UniKarl (Month 0 to 60)

Objectives

Assimilation and modelling techniques are at the base of the AMMA strategy for integrating the wide range of observations, of scales and of components involved in the WAM dynamical system. As a consequence a wide range (component, size, resolution, degree of complexity…) of numerical tools will be used in many WPs. This WP4.1 considers the category of models which we term "integrated numerical tools"; models which are involved in forecast systems or in regional and global climate simulation. Modelling tools dedicated to process studies are employed in subprogram 2 (WP2s), and are dealt with within each particular work-package.

The skills of the "integrated numerical tools" in simulating the whole WAM system will be crucial to address the AMMA-IP main issues. In particular these models will make a link between the fundamental science of the Process Studies, and the applied methodologies of the Impact Studies and Forecasting Demonstration activities. The objectives of WP4.1 are:

- To evaluate the "integrated numerical tools" involved in AMMA-IP and to identify their weaknesses.
- To integrate more observations, and the knowledge gained by the process study work packages (WP2s), into the models, and thereby to improve them.
- To make the model results available throughout the AMMA IP, for use in operational planning and in wider scientific activity
- To evaluate the improvements in the skill of model simulations of the WAM system after implementation of all these improvements

An essential role of this WP is to manage the diversity of models available to the consortium and provide the modelling expertise to ensure that best suited model is always used for the task at hand. It will also ensure that if multi-model approaches are used the full modeling uncertainty is truly explored.

Work content

- Coordinate the actions of the 3 following subWPs and their strong relationships with other WPs (Fig. 4.1) in order to address the above objectives
- sWP4.1.1 Data assimilation and forecasting systems
- sWP4.1.2 WAM in regional and global climate models
- sWP4.1.3 Aerosols/Chemistry - Atmosphere interactions
- Organize regular meetings
- Progress reports of WP4.1

Milestones

- Year 2: to prepare the tools to be run during the field campaign before the SOP beginning.
- Year 4: to provide improved tools to be tested in demonstration WP5.

Observation needed from the field campaigns

- All sources of data delivered by WP4.2 WP4.3 and WP4.4 for assimilation, model initialization and evaluation.
- Some data must be available in real time on the GTS to perform operational or quasi-operational assimilations and forecasts.

Links to other WPs (see Fig. 6.4)

- This WP plays a central and key role in AMMA as it establishes links between all "Integrative sciences" WP1s and "Processes studies" WP2s .

- It will provide better numerical tools suitable to study the WAM system in other WPs
- It will provide improved forecasting systems to the demonstration WP5.1.

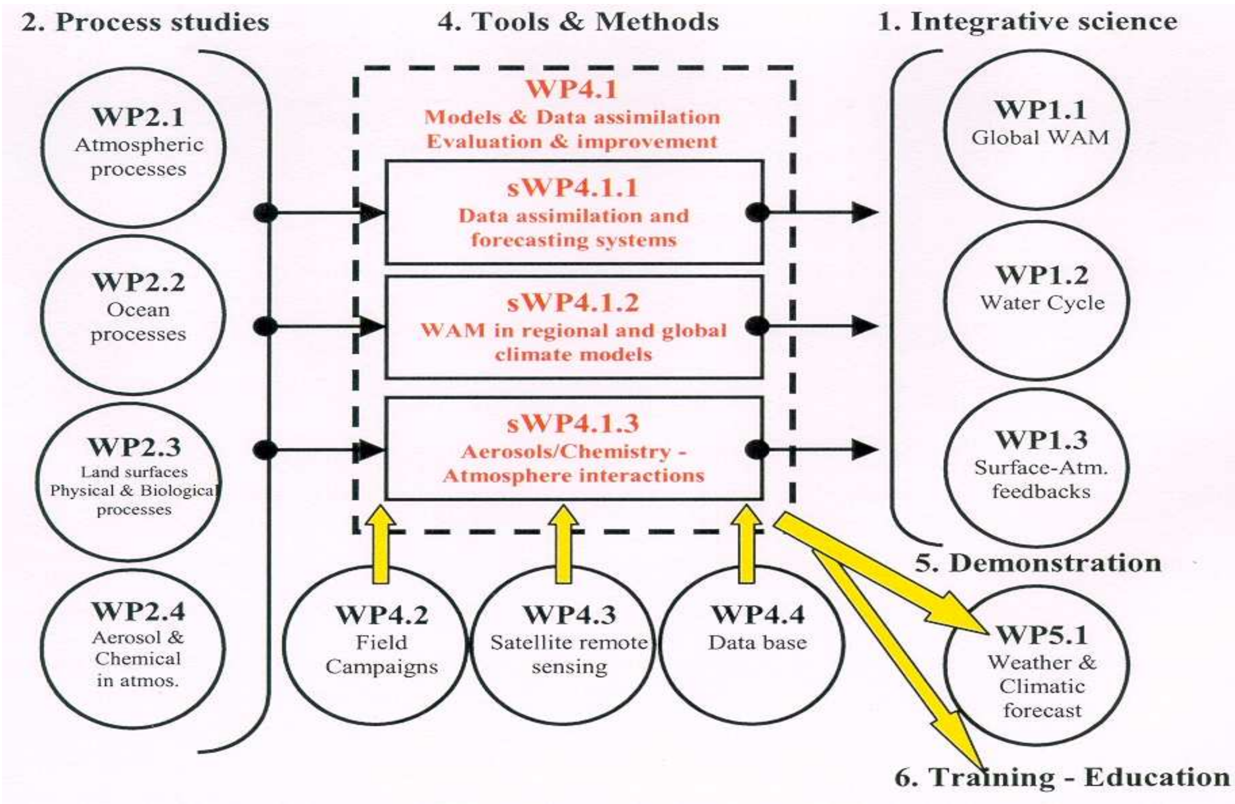


Figure 6.4 : Organization of the WP4.1 and its interactions (thin arrows) with others WPs, and the flows of inner deliverables (thick arrows).

Sub-WP4.1.1 Data assimilation and forecasting systems

Objectives

This sWP is aimed at producing state-of-the-art analyses of the atmosphere and of the land and ocean surfaces for the whole AMMA programme. Furthermore, the sWP aims at providing users throughout the IP with support, documentation and guidance regarding the methodologies and data involved in the generation of these analyses, so that they can be used for research purposes by scientists in this and other WPs. The impact of these analyses on the forecasts will be evaluated in particular for the soil moisture. For the atmosphere, two scales will be considered: the global scale at ECMWF and the mesoscale at CNRM using 4D-Var and 3D-Var variational techniques of assimilation respectively. We identify 3 specific objectives.

O4.1.1.1 Data assimilation in the atmosphere at global scale using 4D-Var

O4.1.1.2 Data assimilation in the atmosphere at fine scale using 3D-Var

O4.1.1.3 Surface data assimilation

Work content

O4.1.1.1 Data assimilation in the atmosphere at global scale

- Software will be prepared and adapted at ECMWF to compute observation statistics (radiosonde and SYNOP's, cloud track winds etc.) for the area of interest. The system will be sufficiently flexible to meet the needs during the field campaigns. Feedback will be given to the relevant institutes in case of obvious deficiencies in the data. The additional real time data will be included in the operational system if demonstrated to be of good quality. The resulting operational analyses will be provided to the partners in the project for diagnostics and for use as boundaries in fine scale simulations.

- Through case studies (sWP2.1.2, sWP2.1.3), the global and regional analyses will be evaluated against independent observations, and will be provided as a product for use throughout the IP.

O4.1.1.2 Data assimilation in the atmosphere at fine scale

- The goal is to provide fine scale analyses integrating a maximum of data collected at small scales during the SOP. Such fields will be extensively used in other WPs for processes studies and to improve the water budget (WP1.2). They also will be use to initialise Cloud Resolving Models (CRMs) and the next generation of high resolution models (~3 km) that are currently being developed and tested.
- This task needs the development of methods to estimate the “covariance matrix of background errors” corresponding to the WAM area and to CRMs and used in the 3D-Var technique.
- Emphasis will be put on all data (satellites, GPS, lidar…) that are expected to improve the quality of humidity fields, a key parameter for the water budget and for convective events forecasting.
- The impact of these improvements on CRMs will be tested in close collaboration with WP2.1, and will allow us to explore the predictability of convection in the WAM. The improvements resulting from the land surface data assimilation work (O4.1.1.3), will also be considered in this last objective.

O4.1.1.3 Land data data assimilation (LDAS)

- The land surface data assimilation system as prepared by the EU-funded ELDAS project will become operational in 2005. Evaluation of the new system will be performed for the AMMA area, using SYNOP observations, radiosonde observations, vegetation parameters and precipitation observations as prepared in WP4.4. Another major source of verification data will be from the flux stations which will be deployed. To facilitate model verification and quality control of the flux stations, ECMWF grid point time series (so-called DDH diagnostics) will be sent to CEH every day for the flux station locations.
- For the 2 year EOP, the land surface scheme will also be run in stand-alone mode without data assimilation using the best possible forcing of precipitation and radiation as can be provided by WP4.4. This will serve as an additional reference for the operational assimilation system. A set of forecasts (e.g. one per week) will be run in which the initial soil moisture has been replaced by the one obtained from the stand-alone simulations and the impact on atmospheric forecasts will be studied (e.g. position of the ITCZ, easterly waves).
- After evaluation, an attempt will be made to improve the system for the AMMA region by optimising parameters. This work will be ongoing during the project as model changes from other projects (e.g. GEOLAND, better aerodynamic coupling as studied in the satellite land SAF) become operational.
- Similar objectives are defined for finer scales to provide surface conditions to forecasting systems and climate models, and for water cycle budget estimations (WP1.2). We identify the following tasks:
- Define and develop a database to force Land Surface Models (LSMs) (at different scales) in collaboration with WP4.2, WP4.3 and WP4.4. It will include precipitation, radiation forcing, near surface atmospheric parameters and surface characteristics. The approach is similar to the Global Soil Water Project but with the AMMA data and at regional, meso and local scales
- Use of this database to force different LSMs involved in AMMA-IP as these products are only indirect estimations depending on the scheme used.
- Inter comparison of the resulting products and comparison with other available products. This last step will be performed in close collaboration with WP1.2

Other evaluations

The extensive use of these analyses by other WPs, in particular to estimate the water cycle budget (WP2.1) will constitute a stringent test of their quality. It will allow us to evaluate the improvements gained by the assimilation of new types of data and of the AMMA supplementary data.

Foreseen deliverables

- After 18 months: System to generate observation statistics. Monthly results for the 1st year electronically published
- Atmospheric and soil analyses during the whole AMMA programme at global scale and during the SOP at mesoscale.

Observations needed from the field campaign

- Radiosounding network data
- Surface flux network data
- Routine surface station data (SYNOPs)
- Surface raingauge data and cloud observations
- Mesoscale network data: GPS humidity, lidar etc,

Sub-WP 4.1.2 : WAM in regional and global climate models

Objectives

Except for the treatment of lateral boundary conditions, Regional and Global Climate Models (RCM and GCM respectively) and also forecast models have similar characteristics and share similar parameterisations. The evaluation of their skill and their improvement will thus be treated in this same subWP with the following objectives.

- O4.1.2.1 : Define pertinent diagnostics to characterize the behaviour of the simulation of the whole WAM chain of interactive processes within RCMs and GCMs
- O4.1.2.2 : Apply these diagnostics to different model experiments in order i) to evaluate their skill and weaknesses by comparing with observations and by model inter-comparisons; ii) to provide information on key components and couplings within the simulated WAM system.
- O4.1.2.3 : Promote actions to improve the representation of these key processes or couplings
- O4.1.2.4 : Test the impact of those improvements on the whole WAM system simulation.

Work content

All the work to be accomplished in this sWP requires strong collaborations with some other WP: i.e. “Processes WP2” to improve the models, “Integrated WP1” and “Demonstration WP5” to design pertinent diagnostics and intercomparisons exercises.

O4.1.2.1 : Definition of pertinent diagnostics of the WAM

- Review all previous work that tried to assess the skill of global models to represent the WAM variability, in particular the WAMP European project, IMPETUS and AMIP projects.
- Define pertinent diagnostics to characterize the WAM (cloud and precipitation distribution, the jet structure, ITCZ position, soil variability…) from its intraseasonal to interannual variability (in collaboration with WP1.1).
- Specific attention must be paid to diagnostics allowing us to quantify the behaviour of the whole simulated WAM system, such as water and energy budgets.
- Linking with WP1.1, design a diagnostic of the mean meridional vertical slab in the WAM region as simulated by GCMs and RCMs to be compared with its observed counterpart built from observations (data base WP4.4). This diagnostic can be defined for all pertinent variables to characterize all WAM components (Atmosphere, Ocean, Chemistry and Continental Surface) and their coupling (fluxes). A similar diagnostic has been developed during EUROCS European project to analyse the North-East Pacific Hadley atmospheric circulation during the EUROCS.

O4.1.1.2 : Assessment of models skills and identification of key elements

- Implementation of the above diagnostics in models involved in AMMA.
- Analysis of the existing GCM and RCM simulations (from international and European projects: AMIP, ENSEMBLE, MERSEA..., WP1.1) on the basis of those diagnostics.
- Organization of ad hoc sensitivity experiments to complete the intercomparison exercise (numerics and physics) in order to identify the weakest elements of the system.

O4.1.2.3 : Improvement of the representation of key processes or couplings

- The Cloud Resolving Simulations (CRM) of typical convective events over West Africa (performed within WP2.1), will be used to force, in 1D mode, parameterisations of dry and moist convection, with the aim to evaluate and improve them. Such multi-model multi-scale methodology has been already used in the EUROCS FP5 project.
- In order to include the coupling with the surface and the 2-way interactions with larger scales, we will develop a novel approach to test all parameterisations working together in a same framework. An idealized 2D WAM model is proposed to develop this approach well suited to study scales and processes interactions.
- Apply the above methodology to different combinations of parameterisations in order to characterize the behaviour of the system.
- For moist convection, emphasis will be put to improve the representation of its triggering, propagation, its interaction with dry mid level layers, the evaporation of precipitations and transports of horizontal momentum. The ideas to modify the parameterisation will root from the knowledge gained in “processes WP2s”.
- The improvement of planetary boundary layer (PBL) schemes should enable better representation of the Sahara PBL, of the heat low and of transport of aerosols and gases. Indeed all these processes have strong feedbacks on the whole WAM system behaviour.

O4.1.2.4 : Impact of those improvements on simulation of the whole WAM system

The same methodology as for the O4.1.2.3 step will be applied.

Foreseen deliverables

Improved GCMs and RCMs systems to be tested in demonstration WP5.1 and used in integrative WP1.1 and WP1.2.

Sub-WP 4.1.3 : Aerosol/Chemistry – Atmosphere Interactions

Objectives

The main objective of this work package is to assess the capabilities of the models that are used in the AMMA integrative science studies (WP1) and impact studies (WP3), with a focus on trace gas and aerosol distributions and their interaction with the dynamics of the WAM. Among the integrated models that are used in AMMA are off-line models (TM3, TM5, CHIMERE-DUST, MOCAGE), climate models (LMDz, RegCM3), and regional NWP models (MesoNH, MM5) and all include either aerosol and/or trace gases. This range of models will enable an estimation of uncertainties in our current predictive capability as they are all run with different chemistry/aerosol/transport schemes.

WP2 delivers the (improved) descriptions of the key processes (chemistry schemes, sources/sinks, subgrid-scale transport processes) and coupling mechanisms (through radiation and/or cloud schemes). This work package will objectively assess the improvements gained by the AMMA observations and process studies by targeted model intercomparisons and by comparison with satellite observations, and independent observations made during the EOP/SOPs of AMMA.

More specifically this work package will evaluate:

- The capabilities of models (global and regional, coupled and off-line) to represent the global distributions of aerosols (dust, carbonaceous aerosols, ..) and trace species (O3, OH, NOx, hydrocarbons, …) over WA.

- The sensitivity of the aerosol and trace gas distributions to different representations of key processes (dust mobilisation, lightning NOx emissions, biomass-burning emissions, interaction between African dust and European emissions, convective transport) related to the WAM (input from WP2).
- The effect on the model performance of improved model descriptions of the key processes as a result of analyses of the AMMA observations (input from WP2).
- The sensitivity of WAM simulations (i.e. dynamics and chemical composition) to different ways of coupling the aerosol/trace gas distributions and the model physics/dynamics (direct radiative impact of aerosols; effect of CCN on cloud processes).

Work content

- Selecting existing observational data on atmospheric composition to evaluate regional and global (chemistry-transport and chemistry-climate) models used in AMMA
- Defining numerical experiments to generate model output for comparison with existing observations, and existing chemical analyses such as from ASSAT FM5 and from the GEMS proposal, in order to test different (1) aerosol representations, (2) atmospheric transport and chemistry representations, (3) descriptions of sources / sinks of aerosols and trace gases, and (4) coupling schemes of atmospheric composition with dynamics.
- Evaluate the model performance of several global chemistry transport or chemistry-climate models (LMDz, TM5, MOCAGE) and regional chemistry models (Meso-NH, CHIMERE-DUST, MM5) using existing data to identify deficiencies in model parameterization schemes (e.g. convection). Assess the ability of models to capture particular events (e.g. long-range transport out of West Africa seen in MOPITT CO data and GOME NOx data).
- Implement improved parameterisation for convective transport (MesoNH, LMDz), boundary layer transport (LMDz), and parameterisation of density current (LMDz)
- Implementation of improved lightning NOx production (TM5)
- Implementation of new emission of biogenic NOx, VOC, biomass burning and fossil fuel aerosols (TM3, TM5,RegCM3)
- Coupling of aerosol with the cloud scheme (LMDz, MesoNH) and with the radiation scheme (LMDz, MesoNH, MM5)
- Assess the skill of models through inter-comparison for a specific time period (same as other subWPs). The sensitivity of model results to variations in key inputs (e.g. emissions) and process representations will be quantified to obtain information on model uncertainties.
- Assess the effects of two-way coupling the atmospheric composition, in particular aerosols, with the model dynamics (LMDz, MM5, MesoNH). Assess the effect on atmospheric composition as well as on e.g. cloud formation and precipitation.
- Re-evaluate the performance of several global chemistry transport or chemistry-climate models over West Africa after implementation of improved parameterisations and input data resulting from WP2.

Foreseen deliverables

- To assess the predictive skill of current chemistry-transport and chemistry-climate models in simulating the seasonal behaviour of trace gas and aerosol distributions over West Africa (4.1.2).
- To assess the predictive skill of chemistry-transport and chemistry-climate models in simulating the seasonal behaviour of trace gas and aerosol distributions over West Africa, after the implementation of improved representations of key processes based on the analyses of AMMA observations. (input from WP2.4)
- To assess the effect on the model skill of the two-way coupling of aerosol distribution and

dynamics.

Milestones

- Report on the evaluation of current CTMs and CCMs using existing data and their relative skill at simulating trace gas and aerosol distributions over West Africa, particularly during the WAM season (to feed into 2.4 and then 1.1)
- Report on the evaluation of CTMs and CCMs using improved representations of key processes based on the analyses of AMMA observations
- Report on the evaluation of CCMs incorporating the two-way coupling of aerosol distribution and dynamics

Observations needed from the field campaign

The observations needed to evaluate current models (1st target) will be extracted from existing datasets. For the evaluation of the 'updated' and two-way coupled models the same datasets may be used to assess the progress made of the model skills. In addition independent (satellite) data over the EOS and SOP periods can be used for the evaluation of models.

WP4.2 Field campaigns

Partners: DLR, CNRS, FZK, LMU-Munich, UKoln, UBonn, MeteoFrance, UP12, ULeeds, IRD, ISAC-CNR, CEH, EIER, IGUC, UPS, UEA, U. Bremen, ULeic, UMIST, UYO, ASECNA

(Month 0 to 60)

Objectives

This activity will manage the field experiment and ensure the availability of the measurements which are necessary to fulfill the scientific objectives of AMMA. An impressive improvement of the information on the Sahel region is expected from the analysis of the new measurements planned in the following years. For this, it is required to optimize the campaign strategy and to efficiently deliver the data to the scientific activities. The field instrumentation necessary for the performance of the different observing periods will be provided to the field sites, the instruments will be operated during the required time windows and the delivery of the experimental data to the project data base will be included in this WP. Since this activity is broad, the tasks are divided into three Work-Packages focusing on Aircraft measurements, Field Campaign and Long-term measurements. This will allow to optimize the WP management and to allow the qualified partnership to focus on the specific aims of the experimental phases.

The special objectives of this integrating WP are (i) to integrate the different aspects of characteristic instrumentation of each sub-WP which are determined by the different observing periods (internal coordination), as well as (ii) to harmonize the experimental requirements from other WPs with the experimental tools and their availabilities (external coordination). In cooperation with the demanding WPs a set of experimental scenarios will be worked out and summarized in the experimental plan for the field studies.

Description of Work

According to the objectives described above the following work will have to be performed in the context of the present WP during the LOP, EOP and the SOPs. During the LOP and EOP a set of basic ground-based instruments will be made available for long term observations. During the SOPs the LOP/EOP equipment will be largely enhanced in order to study different processes in great detail within the framework of focused field campaigns. The coordination WP will care for an optimum integration of the SOP equipment into the concepts of the longer term strategies. The work necessary to ensure a successful campaign performance is composed by:

- The overall coordination and integration of the three experimental sub-WP
- The integration of instrumental activities needs in the AMMA decision-making process
- The consideration of the experimental needs expressed by other WPs and the harmonization

of possible different interests with the experimental tools to be made available

- The coordination of the preparation and performance of the field campaigns including the overall definition of the experimental plan, describing the basic science plan, the operations plan and the flight planning
- The coordination of the measurements with the respective resources made available from other AMMA or AMMA-related projects (e.g. European nationally funded programmes)
- The integration of the relevant SOP equipment into the long term observing systems operating on a larger scale

Foreseen deliverables
The deliverables of the coordinating WP will mainly address the campaign design and the integration of experimental activities within the AMMA community

- Overall Experiment plan, Operations plan, contribution to the White Book
- Overall Report on delivery of quality controlled data to the project data bank
- Integration plan for the SOP equipment into the LOP-EOP frameworks
- Contribution to AMMA project reports

Dependence with other WPs
The measurement activities are the key element of the AMMA and the work carried out in these WPs is tightly linked to the project WPs. Measurement strategy depend on scientific requirements for campaign detailed design, requires model forecasts and satellite data for the campaign planning and rely on the local infra-structure. The measurements will be also the key factor for the scientific, training and demonstration activities. The main flow of information between WPs is given in the tables below

Input from other WPs

1,2,3	Integrative Science, Process, Impacts	• Elaboration of ground measurement strategy • Planning of the airborne experiments
4.1	Modelling	• Elaboration of ground measurement strategy • Planning of the airborne experiments
4.2	Satellite	• Support on campaign planning
7	Management	• Management of the local infrastructure

Input to other WPs

1,2,3	Integrative Science, Process, Impacts	• Provision of EOP, SOP validated data
4.1	Modelling	• Model validation
4.2	Satellite	• Satellite data validation
6.1	Training	• Field campaigns as support for training young scientists and technicians of African institutions in field measurements

Milestones

- Report on sites survey
- Experiment Planning documents
- Campaign Meeting
- Readiness of instrumentation

- Supervise report on the data collected during SOP
- Supervise final report on SOP activities
- Final report

Risks and Contingency Plan
There are several factors of risk in performing a large measurement campaign in distant regions. For this the AMMA structure is optimized to best overcome the most common problems that could be encountered during this activity

- The technical and logistic issues will be supported by a dedicated management WP
- The support of the modelling and activity will allow to optimize the ground-based and aircraft deployment and to carefully forecast possible severe weather conditions
- The experience in performing field campaign and efficient analysis of valuable data is proven by the long record of achievements of the partnership. The integrative and coordination workpackages will support an efficient dissemination of the results within the large AMMA community.
- A wide field campaign in Sahelian countries could be blocked by sudden political change because of logistic and safety issues. In order to overcome this problem, several sites for the measurements are foreseen, and the AMMA overall management will be in contact with Foreign Departments and Local Institutions to rapidly react and re-schedule the campaign activities. The consolidated experience of the key partners in field operations in the region will be an additional asset

Work-Package 4.2.1 Field campaigns : SOP aircraft

Partners: DLR, CNRS, MeteoFrance, UP12, ULeeds, UEA, U. Bremen, ULeic, UMIST, UYO

(Month 0 to 48)

Objectives
This Workpackage will insure that the airborne instrumentation necessary for achieving AMMA's scientific objectives will be installed and tested before the field phase, that the airborne experiments will be correctly conducted during the SOP, and that the airborne data will be quality checked and delivered to the project data base as far as available during the planning period.

In cooperation with the demanding WPs a set of experimental scenarios and coordinated flight plans will be worked out and summarized in the experimental plan for the field studies. The airborne instruments will be operated during the Special Observation Periods. The measurement phases and their tasks are summarized as follow:

- SOP-0 "Dry Season and aerosols" January-February 2006 to measure aerosol properties (physical-chemical and optical properties) to characterize dust and biomass burning aerosols and their variability over dust production areas and in the vicinity of fires
- SOP-1 "Monsoon Onset" May-July 2006 to investigate the structure and evolution of the atmospheric boundary layer and tropospheric jets before the arrival of the monsoon flow and to quantify the water, energy, aerosol and trace gases budgets.
- SOP-2 "Monsoon Maximum" July-August 2006 to – in addition to the SOP-1 goals – to investigate the propagation and evolution of precipitating systems including their interactions with synoptic scales, to measure the chemical components in the tropical tropopause layer (TTL) zone and to study aerosol, clouds and radiative effects
- SOP-3 "Late Monsoon" August-September 2006 to study the transformation of the meso- to synoptic scale perturbations passing from the West African continent to the warm waters of the tropical eastern Atlantic, and the influence of environmental conditions, particularly the presence of dry saharan air in the mid-troposphere.

Description of work

Coordinated flights will be conducted with the British BAe-146, French ATR and Falcon, and German Falcon aircraft (in addition to US aircraft), in agreement with the flight capabilities, the onboard instrumentation, the scientific objectives and the weather situation, in order to sample key variables concerning the most important physical and chemical processes in the atmosphere of West-Africa as outlined in the targets of the process WPs. The list of observations is given in the *Aircraft AMMA instrumentation* table provided as an appendix. Three phases will occur :

- Preparation of the field phase concerning the scientific instruments and their installation in the aircraft, preparation of the "operation plan" including tight coordination between airborne and ground-based observations under WP 4.2 coordination

- The field phase during SOP_0, 1 2 and 3, during which resources must be rationally shared depending on the globally approved scientific priorities and on the weather conditions

- Data analysis and validation period, after which the data will be made available to all participants

Deliverables

- Contribution to experiment plan, operations plan, White Book
- Report on readiness of measurement systems
- Delivery of quality controlled data to the project data bank
- Documentation of progress on AMMA web site

Milestones

- SOP experiment Planning documents
- Dedicated meeting for SOP activities
- Readiness of Airborne instrumentation
- Report on the data collected during the SOP
- Final report on SOP activities
- Report on the analysis and validation of collected data, data transmitted to the AMMA data base

WP 4.2.2 Field Campaigns: SOP-Ground-based

Partners: DLR, CNRS, FZK, UMunich, UKoln, UBonn, UP12, ISAC-CNR

(Month 0 to 60)

Objectives

This WP will ensure that the field instrumentation necessary for achieving AMMA's scientific objectives will be provided to the field sites. The overall objectives are outlined in the previous sub-WP as the ground-based instruments activities included in this sub-WP will be also done during the Special Observation Periods. The list of observations is given in the *Ground-based SOP AMMA instrumentation* table provided as an appendix. The measurement phases and their tasks are summarised as follow:

- SOP-0 "Dry Season and aerosols" January-February 2006 to measure aerosol properties (physical-chemical and optical properties) to characterise dust and biomass burning aerosols and their variability over dust production areas and in the vicinity of fires
- SOP-1 "Monsoon Onset" May-July 2006 to investigate the structure and evolution of the atmospheric boundary layer and tropospheric jets before the arrival of the monsoon flow and to quantify the water, energy, aerosol and trace gas budgets.

- SOP-2 "Monsoon Maximum" July-August 2006 to – in addition to the SOP-1 goals – to investigate the propagation and evolution of precipitating systems including their interactions with synoptic scales, to measure the chemical components in the tropical tropopause layer (TTL) zone and to study aerosol, clouds and radiative effects
- SOP-3 “Late Monsoon” August-September 2006 to study the transformation of the meso- to synoptic scale perturbations passing from the West African continent to the warm waters of the tropical eastern Atlantic, and the influence of environmental conditions, particularly the presence of dry saharan air in the mid-troposphere.

Description of work

During SOPs the EOP equipment will be largely enhanced in order to study different processes in great detail within the framework of focussed field campaigns. The work necessary to insure a successful field campaign performance includes:

- Preparation of the field phase concerning the scientific instruments and their installation, preparation of the "operation plan" under WP 4.2 coordination
- The field phase during SOP_0, 1 2 and 3, during which resources must be rationally shared depending on the globally approved scientific priorities
- Data analysis and validation period, after which the data will be made available to all participants

Foreseen Deliverables

- Contribution to experiment plan, operations plan, White Book
- Report on readiness of measurement systems
- Delivery of quality controlled data to the project data bank
- Documentation of progress on AMMA web site

Milestones

- SOP experiment Planning documents
- Dedicated meeting for SOP activities
- Readiness of Ground-based instrumentation
- Report on the data collected during the SOP
- Final report on SOP activities
- Report on the analysis and validation of collected data, data transmitted to the AMMA data base

WP 4.2.3 Field Campaigns: EOP-LOP

Partners: CNRS, FZK, UKoln, UBonn, UP12, IRD, ISAC-CNR, CEH, EIER, IGUC, UPS

(Month 0 to 60)

Objectives

This WP will ensure the data provision throughout the AMMA project for the study of the inter-annual variability of the WAM, the associated processes and impacts. To do so it is necessary to provide a detailed documentation of ground sites (e.g. catchments, local sites) and to ensure a coherent deployment of instruments during the long term and enhanced observing periods. Moreover this WP will ensure the coherency between the EOP activities and the SOP deployment (in terms of observing strategy, site coordination, logistics). The observations concerned by this sub-workpackage are specific to AMMA. The strategy is to complement the operational measurements carried out by national services, narrowly associated with the AMMA team. The EOP sites are grouped as follow:

- Three mesoscale sites (Gourma in Mali, Niamey degree square in Niger, Ouémé catchment in Bénin), to focus on the water budget and the vegetation dynamics : a long term monitoring started in 2001 and will last until 2009
- Sahelian transect to focus on mineral dust emission, transport and deposition

Work content

- In 2005, the Enhanced Observing Period (EOP) will start with the aim of increasing the time and space resolutions of the various measurements. The list of observations is given in the *LOP_EOP AMMA instrumentation* table provided as an appendix. The core of these measurements is made of high time resolution automated recording of rainfall (a hundred stations), runoff (in the order of 20 stations), ground water levels (several dozens of stations), radiative and energy budgets (one station on each of the super-sites and intensive local sites, as shown on the map), other meteorological parameters on the same sites, soil water profiles, sap flows, leaf area index, wet and dry deposits for the analysis of rainwater and aerosol organic and mineral chemistry, gases concentration
- On the Ouémé catchment, additional integrative measurements are also carried out using an acoustic doppler current profiler, and a scintillometer. The EOP enhancement mainly focus on the atmosphere and the ocean: radio-soundings, water vapour (GPS network) and fluxes (see Table of Instrumentation).While LOP measurements are for the most part funded by national contributions to existing projects (CATCH, EGEE, GLOWA-Volta, IDAF, IMPETUS, PHOTONS-Aeronet), several EOP instruments need additional funding from this UE Integrated Project: radar, LIDAR and GPS deployments, additional flux stations and radio-soundings
- The coordination of the institutions – European and African – managing this large array of measurements is a major task of the sub-workpackage. The climatic and vegetation gradients must be appropriately sampled in a coherent way (same kind of sensors and sampling protocols). This coordination will take place through meetings in Europe and field trips to Africa. Training of African scientists and technicians is a very important component of the activity of European teams involved in LOP_EOP. A large meeting will be organized in early 2005 to ensure a good planning of operations for the coming 18 months.

Foreseen deliverables

- Contribution to experiment plan, operations plan, White Book
- Report on readiness of measurement systems
- Transnational coordination plan
- Delivery of quality controlled data to the project data bank
- Documentation of progress on AMMA web site

Milestones

- EOP start
- Dedicated meeting for EOP activities
- Regular report on the field activities – Delivery of Data from the previous year
- Regular report on the field activities – Delivery of Data from the previous year
- Synthesis for EOP and planning for LOP
- Regular report on the field activities – Delivery of Data from the previous year
- Regular report on the field activities – Delivery of Data from the previous year
- Final report

WP4.3 Satellite remote sensing

Partners : CNRS, UPS, MEDIAS, IRD, Uni. Bonn, KNMI, Uni. Bremen, CNRM-GAME, ISAC-CNR, UPCT, *ENEA (Months 0 to 60)*

Objectives

The final objective of this task is to provide to the different thematic working groups of AMMA data sets of the relevant parameters at the different scales derived from satellite measurements. These data sets must include the corresponding errors estimates, in order to be able to quantify the quality of the further thematic analyses (for example water & energy budgets), and to allow proper assimilation in models.

Satellite measurements are fundamental to cover the different space-time domains considered in AMMA, and establishing relationships with conventional data, field campaigns and modelling issues. Furthermore, these measurements will allow to address the question of scale interactions providing the global description of the relevant fields.

The partners will perform careful validation of these products since the AMMA experiment will be an unique occasion to collect the best data sets, from conventional measurements, model analyses, and specific field measurements and campaigns. The calibration/validation of the satellite algorithms over the relevant areas and time periods will allow to define an unique database optimized for the West African region.

Special care will be given to the formatting in order to facilitate the use in process studies, model validation, model assimilation. This task has to be performed in close relationship with the data base construction and management which is the object of WP 4.4. For this the partners of the WP will work in tight relationship with the scientific WPs, identifying the scientific priorities and providing the needed data through a web page data base

Description of work

Numerous parameters can be derived from satellite observations, and considerable work has been done in the last decades to improve the retrieval methods and most of the products are already available. However, all products have not the same quality, and few have been calibrated/validated over tropical continental areas. The first task would be to identify the priority on the measured parameters. Considering the AMMA scientific aims, this will be given to:

- Precipitation at different scales
- Surface properties (soil moisture, vegetation, land use)
- Convective systems and cloud climatology
- Water vapour, aerosols and atmospheric compounds
- Sea surface fluxes and winds (operational and experimental satellites)
- This ensemble of priorities will be refined together with the AMMA community

The first task of this WP will be to provide an overview of estimate methods for the parameters. The WP will also identify and harmonize the existing data bases. The comparison and the validation of these data will be done on selected months, based on surface measurements. For this the WP will rely on the data bases of conventional and historical data from WP 4.4 and on specific AMMA measurements during the EOP and SOP phases.

The comparison of satellite data will allow to better estimate the uncertainties in function of the time space scales and of the method used and to choice which datasets satisfy the AMMA purposes and to identify the datasets that should be improved. The existing and developmental satellite climatology of key parameters (e.g. cloud classification) will be compared and tested. A methodology will be agreed and used to generate synthetic data.

The production of data sets will be done for the datasets identified in the previous activity and will be done using the optimized algorithms as defined in the previous tasks. This activity will support the production of near real time data for selected periods upon requirement from the project partners. The data sets will be made available to the whole AMMA community through the relevant databases

Deliverables

The deliverables are based on the results obtained at the end of each phase of the work described above :

- Critical report on the existing methods for each parameter
- Report on validation phase, estimation of errors
- Description and codes of the inversion methods retained
- Optimized Data sets
- Data bases provision

Dependence to other WP's

The following tables summarizes the interactions of task 4.3 with other tasks at different levels. The choice of parameters, resolution, accuracy are defined by the tasks 1, 2, 3. Remote sensing has close interactions with other tasks of tools and methods, specially, it needs data from surface measurements for calibration/ validation. It feeds the data bases (specially the AMMA-SAT satellite data base). Return of data sets to tasks 1, 2, 3 is done essentially through data bases. Demonstration tasks may need data directly from satellite analyses (near real time). The contribution of the satellite group to training and education is essential for transferring the methods and products to African countries.

Requirements from other WPs

1, 2, 3	Integrative Science, Process Studies, Impact Studies	Scientific needs to support the choice of the parameters, their resolution and accuracy
4.2	Field Measurements	Provision of specific measurements from the EOP-SOP phases for satellite data validation
4.4	Data Bases	Provision of pre-existing and historical measurements for satellite data validation

Feeding of other WPs

1,2,3	Integrative Science, Process Studies, Impact Studies	Provision and support of optimized satellite databases (through the WP 4.4). Critical review on inversion methods and uncertainty
4.4	Data Bases	Provision and support of optimized satellite databases and additional information on inversion methods and errors
5	Demonstration	Provision of near real-time data for forecasting system assessment. Critical review on inversion methods and uncertainty
6	Training	Provision of satellite products Knowledge transfer on methodologies for data inversion

Milestones

- Critical examination of methods, final discrimination between the parameters to develop or improve specially for AMMA and those which can be taken from existing data bases. Beginning of inter-comparisons and validation exercises on important data sets (pre-SOP)
- Going from validation phase to production phase
- Beginning further detailed validation from SOP measurements
- Applying final processing on a complete data set

Risks relative to task 4.3

This activity mainly rely on computer equipment and personal; so the key factor for success is the coordination within this WP and with the other AMMA WPs. The partnership is composed by well known institution that have wide experience in satellite data analysis, linkage to the relevant agencies and previous collaborations in the frame of several research projects. Concerning the satellite data, the risks are relatively limited as several satellite data sets are yet available and relevant instruments will work on satellite missions for which the continuity for the following years is ensured by a joint effort of the international community. Moreover, several algorithms are available for most products. However, some key data (e.g. precipitation) are critically depending on ground validation and the quality of the products has a risk to be lower in case appropriate surface validation data cannot be provided. The estimate of the error margin will enable the users to best exploit the information contained in the data sets and to minimize the impact of the uncertainty of lower quality measurements on the scientific results and demonstration activities.

WP4.4 Data base and historical data

Partners: CNRS, MEDIAS-France, AGRHYMET (Months 0 to 60)

Objectives

The objective of WP4.4 are (i) to rescue the historical data (network and previous scientific experiments) needed for the project, (ii) to store all the data produced within the project, iii) to provide the documentation associated to the data, and (iv) to make public our results. A web site will be designed, developed and managed, in order to inform about the project, data availability and results obtained. At last we propose that all data, as well as model results, used and acquired in this project will be stored in a project database that will be specifically developed

Work content

Workpackage 4.4 is composed of four tasks: historical data, definition and design of a meta-database, database and web site, development of the Meta-database, database and web site the user's interface and the Database filling

- The historical data (collected by the National Meteorological and Hydrological Services on their network since the beginning of the stations) will be collated with the Agrhymet Regional Centre, and an agreement will be established between these NMHS's, Agrhymet, the Friend-AOC programme, IRD and Medias-France for the scientific use of the data by the partners.

- A user interface will be designed and developed allowing selecting data subsets according to various criteria (location, time period, name of parameter, threshold on these parameters, etc.). Through this interface, specific request will be sent to the database, and data subsets corresponding to these requested criteria could be visualized and/or extracted and imported on the user's computer.
  Each partner will provide his data in the AMMA secured ftp site, in formats defined both by the data provider and the database manager, particularly true for the metadata which will be produced using international standard. Then, the data will be compiled in the database. It is proposed to install, maintain and set up the appropriate structure (e.g. in a PostgreSQL Relational Database Management System) for data archival for the AMMA community at large.
- A particular AMMA Satellite Database (AMMAsat) is being developed by CNRS/IPSL (see WP 4.3).
- Medias-France will design and develop the AMMA meta-database and database including the historical data (before 2000), the Long Observation Period data (2001-2010), the Enhanced Observation Period data (2005 to 2007), the Special Observation Period data (2006).
- The Model data (output of the atmospheric, hydrological and ecological models to be used for the AMMA project) will be managed in co-ordination between IPSL and Medias-France. This will be done in strong relationship with the Regional Database and Software Engineering Unit (RDBSI Unit) of the Agrhymet Centre in Niamey (Niger), who will manage the mirror site of the Amma data- and meta-database.
- The development of such structure will be supervised by the Executive Board of the project for both the type of information that will be archived and the quality control of the data before any

compilation into the database. A data policy will be developed. This database will be developed to facilitate interfacing with the visualization software (i.e., GIS) used by the partners of the project.

The web site will also give detailed information on the AMMA project on-going activities. Additional information will be:

Objectives and methodologies
Milestones and results obtained/expected
Partners, associated partners and sub-contractants
Information needed for the visualization and/or the extraction of the data

The design of this web site will be discussed, developed and implemented on the Internet as soon as possible during the 6 first months of the project

Foreseen deliverables
We expect to produce an efficient web-based tool for managing the project (at the scientific level), for storing and analysing the data, and for the dissemination of the results obtained during the project.

Milestones

- List of the data to be supplied by the partners for the data
- Metadata forms filled by the partners
- Metadatabase development
- Web site and database design
- Definition of the format for the data
- Web site and database development, including the user interface
- Database filling
- Models output inclusion in the database
- Achievement of the database and the web site with all the data collected and collated during the AMMA project.

Risks and contingency plans
No uncertainties exist about the possibility to develop the Amma Web site and database, in so far as the partners will provide information, historical data needed for the project and the data collected during the project.

Links to other WPs
This WP will receive as input the data and the relevant information on the AMMA project. The WP will be used by all WPs

6.2 Demonstration activities

WP5.1 Weather to Climatic forecasting

Partners : CNRS, ECMWF, ACMAD, ISAC, U. Bourgogne (Month 12 to 60)

Objectives
Improving weather to climate forecasts of the West African monsoon is one of the main objectives of the AMMA project. It answers to priority needs expressed by the end-users. The general objective of this work package is to show how improved understanding of the West African

monsoon which will be gained over the course of the project will impact the global and limited area models used for weather to seasonal scale forecasting, as well as statistical predictive schemes. A multi-models ensemble demonstration forecasting experiment will be set-up and will provide an estimate of the forecast skill spread. Moreover, the enhanced observing system which will be put in place will improve the initial conditions on which the forecasts are based and allow for a finer validation of the models in the region.

The evolution of improved observations and improved numerical weather prediction (NWP) systems will be evaluated over the duration of the project. In that sense there is a lot going on at the involved meteorological forecasting centres that should have impact on the forecast. AMMA will benefit from these developments. The African countries linked to the African regional centre ACMAD will also benefit, because the involved forecasting centres have an agreement with ACMAD to provide real time forecasts. The council of one of these centres recently renewed the agreement and sees ACMAD as the main channel of collaboration with African countries. Right now there is a reasonable set of parameters transmitted to ACMAD. ACMAD will collaborate with these centres to develop and improve operational monitoring and forecasts products in the framework of the application component of AMMA. ACMAD will provide training tools tailored to African needs to improve on the way forecast are being operationally made (participation to Summer schools and university programs). Interactions with projects such DEMETER dedicated to seasonal forecasts will be developed. New DEMETER seasonal forecasts with an improved physics and/or an improved land surface initialization will be used in AMMA.

Work content

As demonstrating forecast improvements need that both the understanding has progressed and the enhanced observation networks have been implemented, most of the planned actions will be realized in the period after the first 18-month period.

Using the large-scale analysis from the meteorological forecasting centres participating in AMMA for assigning the initial and boundary conditions, regional models will be set-up in operational NWP mode, based on the previous experience acquired in WP1.2, WP1.3 and WP4.1. Operational pre-processing based on real time large scale analysis and model integration and post-processing of meteorological fields will be performed, including quantitative precipitation forecasts. Model inter-comparison experiments during and after the forecast demonstration programme will be realized.

Specific data assimilation experiments will be performed (e.g. over a period of 2 months) on NWP systems in which the additional AMMA data is taken out. The purpose is to see the impact of the AMMA observations on the quality of the forecasts and to make recommendations and priorities for future observational network.

General analyses of data from the AMMA experiments data assimilation systems will be done to shed some lights on the potentials of the additional data to improve short to medium range weather forecasts produced either by LAM or global models, and climate monitoring and prediction. A specific effort will be put on the running and evaluation of mid to high (about 10 km) resolution real-time short-range forecasting over the AMMA area using an ensemble of limited area models (LAM). Kilometric resolution models will be used also for applications to local scale sub-areas.

Validation of global and limited area models over sub-regions of Africa will be performed by using observations and network expertise of the AMMA program. Sensitivity studies of operational models performances to additional observations will be made during the AMMA experiment. The forecast skill evaluation systems will focus on the prediction of the Inter-Tropical Convergence Zone (ITCZ) characteristics, the atmospheric weather systems, and the surface continental and oceanic conditions, at regional, sub-regional and local scales.

Validation of statistical predictive schemes at various ranges from intra-seasonal to seasonal timescales will be performed at regional scale (regional indices, 5-day to 3-month cumulative rainfall fields, dates of onset and pauses during the meridional progression of the monsoon). The skill of new subsets of the DEMETER seasonal forecasts with an improved physics and/or an improved land surface initialization will be evaluated. Validation with the AMMA datasets will be made after performing downscaling procedures.

Foreseen Deliverables

- System to compute performance of numerical weather forecasting model for the AMMA area. Contribution of the design of operational forecast model performance evaluation system for the AMMA area, based on the African weather forecasters knowledge.
- Daily forecasts from the multi-model ensembles for various meteorological fields including 10-15 km resolution 6 hourly precipitation field over the AMMA area and using the SOP data; evaluation of these products.
- Assessment on parameters and sites of the additional AMMA dataset that have a significant impact of the forecasts at various ranges.
- Production and evaluation of an ensemble of improved seasonal forecasts.
- Production and evaluation of new statistical predictive schemes at various ranges from intra-seasonal to seasonal timescales.

Milestones

- Forecast skill evaluation systems ready to be used during the SOP
- First evaluation of statistical predictive schemes
- Beginning data assimilation experiments with and without additional SOP data
- Definition of multi-models and protocols for the forecast demonstration
- Daily forecast during the demonstration period
- Evaluation of improvements of the statistical predictive schemes.
- Analysis of the results of the multi-model applications in the forecast demonstration period.
- Final evaluation of the skill of the ensemble of improved seasonal forecasts
- Final evaluation of the statistical predictive schemes

Risks and contingency plans

Some uncertainties exist about the possibility to evaluate the progresses done in the seasonal forecast since this forecast production depends on the identification of a forecast skill potential linked to the continental surface conditions, a topic which will be investigated in other work packages (WP1.1 and WP1.3).

Links to other WPs

The strong ties to other WPs are highlighted in the following table:

1.1	West African and the global climate	Seasonal forecasts
1.2	Water Cycle	Knowledge on uncertainties and errors on water cycle
1.3	Surface-atmosphere feedbacks	Knowledge on uncertainties and difficulties to represent surface –atmosphere interactions
2.1	Convection and atmospheric dynamics	Weather forecasts Knowledge on uncertainties and difficulties
3.1	Land productivity	Supply of necessary diagnostics and outputs
3.3	Water resources	Supply of necessary diagnostics and outputs
3.4	Public health	_Supply of necessary diagnostics and outputs
4.1	Model evaluation	Strong interactions between the 2 WPs for all involved models including the supply of diagnostics to evaluate and develop models

4.2	Field campaigns	Need SOP/EOP/LOP observations to evaluate multiscale forecasts Providing of forecasts to SOP
4.3	Satellite remote sensing	Need satellite products validated over West Africa to evaluate forecasts
4.4	Data base and historical data	Need data to evaluate forecasts
5.2	Early warning systems for food security	Supply of necessary diagnostics and outputs

Observations needed from the field campaigns

SOP, EOP and LOP datasets are necessary to evaluate multi-scale forecasts. Important variables are: precipitation from a 10-15 km / 6 hourly resolution over the AMMA area during the SOP to lower space-time resolutions during the LOP; wind, temperature and humidity atmospheric variables from radiosondes and various analyses; surface data and cloud cover from SYNOP and various analyses; surface-air sensible and latent heat fluxes, components of the surface radiative budget, sub-surface oceanic and continental variables, as well as related satellite datasets.

WP5.2 Early warning systems for food security

Partners : IBIMET, AGRHYMET

(Month 48 to 60)

Objectives

The General Objective of this Work Package (WP) is to demonstrate how the results and products of AMMA research can be used to improve the efficiency of existing operational early warning systems for food security. The objective of Early Warning Systems (EWS) for food security is to provide user oriented tools for the identification of famine risk zones in order to activate food aid at the international and national level. In the Sahelian area, where productive systems are mainly based on rain fed agriculture and where the movement of large amounts of food stocks encounter strong territorial constraints, the capability of providing tools able to early detect the dimension and the localization of food crisis is crucial to effectively implement the food aid process.

The institutions having developed Operational EWS over the region (CILSS/AGRHYMET, FIVIMS/VAM, FEWS/USAID and national EWS) usually base their assessments on the evaluation of the risk of the on going season (Current Vulnerability) compared to the time series vulnerability (Structural Vulnerability Context). However the need for early warning tools based on the early assessment of meteorological parameters has been recently stressed by the Food Crisis Prevention Network (PRESAO) for the Sahelian region. Furthermore, the basic characteristics of an EWS and the need for enhanced methodology for EW using climate forecasting have been recently outlined by the CLIMAG-West Africa project (EESD-ENV-99 / ENRICH) as follows:

- The EWS has to allow evolution both in terms of tools and methodologies and information;
- The EWS has to be open and be based on changeable or additional modules;
- The EWS has to respond to the need of decision makers to receive an early alert appropriate to the dimension of the potential crisis;
- The structure should be designed to integrate any tool resulting from a new advancement in forecasting or modelling;
- The EWS should operate in connection to a vulnerability assessment to better understand the degree of fluctuations.

In particular, last methodological developments for food crises prevention process identify the information to be produced by Food security EWS as a function of the level of the crisis, the decision maker, the content, the timing in the year, the tool and the methodology. Following this approach, a timetable considering the climate related products supports the decision making progress.

Work content
This Work Package will test and evaluate the efficiency of AMMA products in feeding the food crisis prevention process and the operational EWS following two approaches:

- Evaluate how the information produced by the impact studies developed by AMMA can improve the existing structural vulnerability context at the regional scale (from regional to the third Administrative level). The first step of the work will be an analysis of information layers currently used by existing EWS to identify structurally vulnerable zones. The second step will be the implementation of a suitable methodology to improve and update the structural Vulnerability mapping based on the information layers produced by the Impacts Studies WP.
- Evaluate how the information and tools produced by AMMA can improve the assessment of current vulnerability and the food crisis prevention processes in terms of improved crop models, improved and on time rainfall estimation and seasonal forecasting. In this context, the efficacy expected deliverables of AMMA WP 3.1, 3.2, 3.3, 3.4 and 5.1 in providing improved inputs to operational EWS, will be tested, in particular:
- rainfall estimates to provide input to risk zoning models and agricultural productivity
- seasonal forecasts for an early characterization of the agricultural season.

Deliverables
- Operational early warning systems taking into account the information and knowledge provided by AMMA project and integrating short term and seasonal weather predictions to respond to the timetable of the food crisis prevention process
- Production of operational systems to make International/National organisations for food aid and the regional trade benefit of appropriate and on time information

Milestones
- Analysis of existing EWS for food security
- Inventory and description of Structural Vulnerability mapping
- Inventory and description of Current Vulnerability products
- Analysis of AMMA products for update of Structural Vulnerability mapping context
- Analysis of AMMA products for update and improvement of Current Vulnerability analysis
- Implementation of the update of existing structural vulnerability mapping context integrating AMMA products
- Integration of AMMA products (crop modelling, seasonal forecasting, rainfall estimates) into Current Vulnerability analysis
- Production of operational input to the food crisis prevention process at regional scale

Observations needed from the field campaign
This WP will integrate products coming from other WPs, regional demographic databases that will be available. In particular informations produced by Impact WPs (land use, vegetatiopn cover, crop models, land productivity, agricultural production systems) and from Weather and Climatic forecasting.

Risks and contingency plans
Some uncertainties exist about the possibility of producing an homogeneous updated regional scale vulnerability mapping context. Some uncertainties still exist on the possibility of regionalize crop modelling developed at local scale, those model will be anyway used to calibrate regional scale crop models for their test zones.

Links to other WPs

The strong ties to other WPs are highlighted in the following table:

1.4	Climate Scenarios	Climate scenarions will be the base for the definition of future long term changes of structural vulnerability context
3.1	Land productivity	Improved methodologies for crop modelling will be used for the assessment of the agricultural campaign
3.2	Human processes	For the characterization of productive systems for the definition of structural vulnerability context
3.3	Water resources	Characterization of agricultural potential for irrigated zones (definition of structural vulnerability context)
3.4	Health impacts	Regional information on human health will help defining the vulnerability of the territory.
4.3	Satellite Remote sensing	NDVI observation will be useful for
5.1	Weather to climatic forecasting	Will provide inputs for crop modelling and at different time steps will provide informations for to the food crisis prevention timetable.

6.3 Training and education

WP6.1 Environmental monitoring

Partners: Väisälä, OSIL, UNIVLEEDS, U. Koeln, ASECNA (Month 0 to 60)

Objectives

The principal aims of this WP are to develop a critical mass of trained scientists within Africa, to use, maintain and profit by a sustainable observing system. It is not sufficient simply to install new instrumentation for monitoring; we also must ensure that enough local experts are able to capitalize on the monitoring systems, and thereby are able to capitalise on the output of such systems. We also aim to set up feedback within the system, so that the groups taking the measurements in Africa are able to make use of the products of those measurements, which are often produced within Europe.

Specifically, we aim to develop and expand two networks of environmental monitoring systems, with associated networks of scientific expertise within Africa. These two complementary networks are the existing radiosonde network and a network of surface flux stations. Each of these networks is essential if we are to develop our international predictive capacity for the WAM; by developing responsibility in Africa for the use and upkeep of these networks, we aim to bring a critical mass of African scientists into the arena of global environmental monitoring.

Description of work

Radiosonde network

The **AMMA Radiosonde Group** (see WP7.1) has identified a network of 12 key stations across the WAM region, which are necessary for environmental monitoring. All of the stations in this network have reported successfully at some point in recent decades, but over recent years the receipt of data at international centres has become patchy, with no data received from some stations for several years. The GUAN programme (GCOS Upper Air Network) of the World Meteorological Organisation (WMO) has identified lack of trained staff as one key reason for these recent shortcomings.

Within the 12 stations in the network, we will take responsibility for complete reactivation of 4 stations, including installation of new instrumentation (2 others will be funded outside this IP) and for the upgrade of 2 stations with new equipment (including GPS wind-finding). We will also provide a maintenance contract for these stations, so that continuity of activity can be assured for the period of the IP. A preliminary survey of these stations is needed, in order to address detailed local needs, and thereby to deploy resources effectively.

We will conduct a programme of comprehensive training for operators of the radiosounding systems. This will comprise training schools in Africa where key African staff will be trained in procedures – these key staff will also be given guidance for disseminating their expertise among fellow staff at their home institution. We will encourage peer-review of operations, by temporary exchange of staff between different national weather services.

During certain periods, notably the aircraft operations of the SOPs, we will need high frequency soundings from some stations. The involvement of local scientists in these key phases of the programme will be one way of integrating them into the major aspects of international coordination within AMMA.

Significantly, we will demand of the observing stations detailed records of their data collection, for testing of the data assimilation in numerical weather prediction models. We will routinely monitor the receipt of data; its quality and its impact. We will also work to supply staff at the African weather services with routine feedback on the use of their measurements by global environmental prediction agencies, and at the same time seek their input to data transmission and quality studies. Through this, we expect to engage African scientists in the weather prediction process more deeply than has occurred in the past.

Finally, through the training activities of WP6.2, we will encourage African scientists to make sophisticated use of the upper air data they are collecting; notably to archive the high resolution data and to use it for scientific research.

Surface flux network

There has never been a systematic, routine network of surface flux monitoring across this region, despite the predominant importance of surface processes in the meteorology and hydrology of the WAM area. By implementing a network of flux stations, and training local scientists in their operation and maintenance, we bring a critical mass of African scientists into the heart of the key scientific questions for the region.

A network of identical flux stations will be installed at pre-existing sites across the WAM area. Local operators will be trained in the maintenance of these flux stations, and in the data collection. By installing identical stations, we enable a network of observational scientists to interact across the region, in the exchange and use of complementary datasets. It is expected that the lifetimes of these instruments will enable them to be used beyond the period of the EOP. The importance of these observations will mean that there is pressure for their continuation into the long-term future; their maintenance by African scientists will keep these scientists engaged in the global environmental monitoring process.

These networks will where possible be integrated with other surface monitoring networks (e.g. AERONET network of aerosol monitoring) in order to further develop the critical mass of integrative science in the region.

Networks of expertise

Through the AMMANET network of African scientists, we will encourage the development of 'Networks of Expertise' in the collection and use of the radiosonde and surface flux data. We will also work through the AMMA Consortium Agreement to maximise the rights of the scientists or groups involved in data collection, to gain suitable acknowledgement in publications using the data.

Dependence with other WPs

The importance of these data in the scientific WPs highlights the significance of the African science networks to the IP.

WP1.1: Makes use of the data for climate variability studies.

WP1.2: Flux and radiosonde data needed for budget studies.

WP1.3: Flux and radiosonde data needed for land-atmosphere studies.

WP2.1: Data needed for atmospheric process studies.

WP2.2: Flux and radiosonde data from ships in the Gulf of Guinea will be integrated in the datasets and will be available to the African scientists.

WP2.3: Flux data needed for process studies.

WP2.4: Flux data needed for boundary conditions; radiosonde data needed for transport studies.

WP3.3: Flux data needed for hydrological modelling.

WP3.4: Flux and micrometeorological data will be combined in health studies.

WP4.1: Radiosonde data will be assimilated at global prediction centres. Feedback will be exchanged between local collection networks and assimilation centres. Flux data will be used to develop surface schemes.

WP 4.2: Flux and radiosonde data will be integrated with the other observational datasets. The radiosonde network will need to respond to the scientific priorities as they evolve according to climatic and weather conditions.

WP4.3: Flux and radiosonde data will be used for satellite validations.

WP4.4: High resolution data will be archived and exchanged.

WP 6.2: Provides training in fundamental science. Makes use of data collected from the radiosonde and surface flux networks.

WP7.1: Through the AMMA Radiosonde Group, African partners involved in the deployment of radiosondes will guide the management of their deployment.

Foreseen deliverables

- To install and upgrade to operational status the radiosonde network and a network of surface flux stations.
- To train a critical mass of African scientists in the use and maintenance of the two observational networks.
- To engage the networks of African scientists making these measurements, in the use of the measurement in global prediction systems, and in scientific research.

Milestones

- By end August 2004 : needed action & material is ordered from Vaisala
- By end January 2005 : needed action & material are implemented on each of the 14 sites
- 1 July 2004 – site surveys complete.
- 1 September – decisions on required infrastructure are made; materials ordered.
- 1 February 2005 – operational networks established.
- 1 December 2006 – strategy for phase-out of AMMA funding for the networks to be agreed
- 1 November 2007 – networks to become independent; locally-supported.

Risks and contingency plans

- Delays in installation could mean that data is not collected systematically by 1 March 2005. We have already begun collecting information regarding the required resources and we will make every effort to be prepared for this target start-date.
- There is some risk that more infrastructure costs are needed at some stations, for instance, water and power supplies. However, we are working with other agencies to set up these networks, and we can expect local and international support for key facilities.

WP6.2 University programs and summer schools

Partners : Medias-France, ECMWF, IBIMET, IRD, UPS (Month 0 to 60)

Objectives
The main objective of this WP is to make a significant contribution to the appropriation of the knowledge by the emerging African community and to its spreading through the European scientific community.

Specially in regard to impacts of regional climate change occurring in Africa, AMMA-IP considers as a high-priority to consolidate the African scientific community. The chief reasons are to ensure that this community has i) the up-to-date scientific expertise to communicate with decision makers and ii) the relevant expertise to carefully use immediate applications (e.g. food security and public health).

Complementary to ongoing educational and training activities in Europe, we also aim to take the opportunity of AMMA-IP which brings together people working on different disciplines and at different scales, to spread knowledge and excellence through the European community.

The AMMA project, because of its involvement in the full spectrum of activities from fundamental research of the physical climate system, forecasting and dissemination of climate products and databases, to multidisciplinary applications, is ideally suited to fulfil all these needs.

Work content
The work within this WP is divided along four tasks:

- Organization of two summer schools
- Organization of two application workshops
- Participation in implementation of PhD programmes in West Africa
- Organisation of visitor scientist programme

A successful AMMA Summer School for European and African students at the PhD level took place September 2003 (more than 100 people demanded to attend the course). It is planned to organise two similar schools during the AMMA project and application workshops, linked to the observational program of AMMA. Assessment by trainees on the outcome and socio-economic benefits from the AMMA Workshops and Schools will be requested. The participation of African scientists and technicians in training courses organised for example by IBIMET and ECMWF in the region will be promoted.

The potential barriers as far as the working languages (English and French) are concerned in the African community, have been solved in the past as follows:

– Experts and trainees should as much as possible be bi-lingual or at least have an excellent knowledge of one language and be proficient in the other.

– Most of the teaching material, multidisciplinary material, application material, documentation... are in both languages

– Special summary sessions are organized everyday in a requested language as required by trainees or deemed necessary

An AMMA oriented PhD program will also be created with African Universities (University of Benin, University Moumouni in Niger, UCAD in Senegal, University of Cocody in Côte-d'Ivoire) with contribution of African and European professors, and grants provided by external funds (START/IGBP, CNRS, IRD, French Educational and Foreign Affairs Ministries, etc.), through specific calls for applications.
The project, by relying on international exchange programs (i.e. Visiting scientists), will enhance participation of European visiting scientists students in PhD programs in Africa.

Foreseen Deliverables
- CD-Roms of courses and reports from the two summer schools
- Reports from two application workshops
- Report on African participation on international training courses
- Yearly report on West African PhD programme

- Yearly report on Visiting scientist programme

Milestones

- First application workshop (Focus on Food security including environmental aspects)
- First summer school (General science with focus on Tools)
- Second application workshop (Focus on Health applications including environmental aspects)
- Second summer school (Focus on Outreach)

Risks and contingency plans

No uncertainties exist about the possibility to organize the summer schools and the workshops planned for the project. For the African participation on international training courses, the West African PhD and the visiting scientist programs, we have to participate in the planning of these activities, organized by other programs and institutions.

Links to other WPs

The strong ties to other WPs are highlighted in the following table:

1	Integrative Science	Integrative knowledge (multi disciplinary and multi scale)
2	Process studies	Knowledge on processes relevant for the African Monsoon
3	Impact studies	Knowledge of applications and theirs limits
4	Tools	State-of the –art models and satellite remote sensing technique; Database, historical data and field campaigns
5	Demonstration	Up-to-date forecast tools

6.4 Management of the consortium activities

WP7.1 Instrument deployment management

Partners : IRD, CNRS, U. LEEDS, ASECNA (Month 0 to 60)

Objectives

The objective of this work-package will be to manage the deployment of the instruments and aircraft in Africa for the intensive field campaigns as well as the longer term observing period. This activity will be carried out from Europe but with a strong local support provided by IRD and frequent site visits to prepare the experimental phase. The management will concentrate on the following instruments which have each specific needs :

- Aircraft deployment : Infrastructure required at base airport and permissions for flight plan.
- Radio-sonde deployment : collaboration with local weather services for infrastructure and personnel training.
- Instrumented sites : required authorisations, transport of equipment, local infrastructure, maintenance and training of staff.

Work content

Aircraft deployment :

All the practical details of the deployment of the aircraft during the 4 phases of the Special Observing Period (SOP) will be managed centrally to ensure a maximal efficiency in the deployment. A tight schedule exists for preparing a field campaign for T0 :

- Site visit with verification of the infrastructure at the airport
- Informing all the authorities of the countries to be overfly

- Preliminary flight plans provided to the authorities
- Final flight plan

Radio-sounding deployment :

Strategies for deployment of the radiosondes are being developed through the AMMA Radiosonde Group. This group includes representatives from African Meteorological Services and from the World Meteorological Organisation (WMO), though the GCOS (Global Climate Observing Systems) Upper Air Network (GUAN) programme. Our strategies are based around key arrays of radiosonde stations, which address specific scientific and monitoring goals. For instance, the 'Meridional Array' extends northwards from the Gulf of Guinea into the continent (with an extension into the Gulf of Guinea by the Ron Brown research vessel during SOP1, funded by the USA), and is needed to monitor the seasonal evolution of the monsoon, as well as studies of the physical processes which determine this. The AMMA Radiosonde Group will also coordinate deployment of radiosondes on these arrays, funded through national agencies in Europe, the USA and Africa.

In order to ensure the effectiveness of the radiosonde network, installation and upgrade of 6 stations will be implemented, through WP6.1. Stations will be supplied with consumables through the regular shipping procedures, and will make local records of soundings, including high resolution data. Receipt of coded observations on the Global Telecommunications System (GTS), and the successful assimilation of these observations in global prediction models, will be monitored in Europe, as part of WP4.1.1. We will set up procedures to monitor this chain of activity; from the receipt of consumables and the release of soundings at the African stations, through to their receipt and assimilation at the forecasting centres. We will also set up procedures to collect the high resolution radiosonde data from the observing stations, for archiving as part of WP4.4.

In order to optimise the deployment of resources, the frequency of soundings from a given station will be adjusted according to season, and on occasions where they are needed for scientific integration (for instance to coincide with aircraft operations). For this reason, an important role of this management activity will be to ensure that communications between the scientific planning teams and the radiosonde stations is rapid and efficient, so that additional sondes can be released at short notice.

As outlined in the WP6.1 description, we plan to have the radiosonde network operating for routine, daily soundings, from 1 March 2005. During the main SOP year of 2006 we will increase soundings to 2 per day across the network, for the period March to October. In the final EOP year, 2007, we will begin to transfer partial responsibility for the long-term deployment of soundings to the local Meteorological Services and to GCOS/GUAN. Attainment of these targets is dependent primarily on the activities of WP6.1.

Instrumented sites :

The deployment management will concern the three mesoscale sites – and their associated super and local sites – listed in the table of platforms and sites given below. The other sites are managed on the basis of bilateral cooperation between the host African institution and the partner European institution – or laboratory. The three mesoscale sites have been in operation for several years, involving several African and European institutions. Funding for LOP observations is, for the greatest part, secured on national funding, meaning that the enhancement of observations during the EOP will be able to use the facilities – technical and administrative – and logistics of LOP operations. The work of the deployment management team in this area will thus mostly be to coordinate the operations on the various sites, ensuring a good cooperation with host institutions and making sure that all appropriate authorization are obtained in due time. IRD scientists and technicians permanently posted in Benin, Mali and Niger will provide a valuable contribution in this respect.

Risks and contingencies

- Radiosonde supplies may be significantly delayed or disrupted due to local infrastructure problems. This kind of trouble can mean that a given station may be unable to make soundings for periods of days or weeks. We will set up contingency plans, using the local agencies and networks, to monitor reserves of consumables and to resupply stations which are at risk of shortages, possibly through non-standard supply routes, as soon as possible.

- There is a risk of disruption in the sounding network in the later parts of the project, when we transfer responsibility to local Meteorological Services. Long-term release of resources must be carefully managed, to maintain continuity during this final EOP year, and onward into the future. We will maintain a reserve of consumables with which to assist problem stations in the later period. We will also provide feedback to the local Meteorological Services on the use of their soundings in weather and climate prediction models, using the results of WP4.1.1
- Other ground based observations are less sensitive to supplying problems, even though delay in transport and logistics is always a possibility to consider. However, given the long experience of the research teams already carrying out research on the mesoscale sites, there is sufficient time, for a project starting in the beginning of 2005 to setup the EOP observations for the rainy season.

WP7.2 Scientific management

Partners : CNRS (Month 0 to 60)

Objectives

The CNRS will be in charge of the scientific management. This activity on the one hand oversees the progress towards the scientific goals the consortium has set together with the European Commission, and on the other hand interacts with the Commission on these objectives and their priorities.

Within the project the scientific management will be the link between the Governing Board, Executive Committee and the work-packages which ensures that information flows and that all partners remain focused on the objectives of the project.

The scientific management will submit requests of the Commission to the Governing Board and ensure that decisions are taken on their implementation. It will also report the deliverables to the Commission and ensure that they meet the terms of the contract. The Scientific Manager will also communicate to the Commission success stories as well as unexpected difficulties.

The scientific management will aim at building an AMMA identity within the consortium and strive to achieve the level of informal collaboration as is commonly found in any research organisation. This will be achieved by a coherent dissemination strategy which highlights the value of each partner in the knowledge produced by the consortium.

Work content

Interactions with the European Commission :

- Report scientific deliverables.
- Take requests regarding the objectives or priorities of the AMMA project.
- Report success stories.
- Warn of unexpected difficulties.
- Provide expertise in the area of the AMMA project to the European Commission.

Overseeing the scientific activity of the consortium covers a wide range of activities within the project but all dealing with the flow of information between the parties.

- Ensure that the Governing Board takes into account the recommendations of the Commission and the advisory board and develops an adequate implementation strategy.
- Ensure that the Governing Board responds to information received from work-package leaders, the Executive Committee and/or partners on new opportunities or unexpected difficulties.
- Ensure that the Executive Committee enacts the implementations decided by the governing board and provides the needed feedback.

- Ensure that the Executive Committee focuses on the preparation of the deliverables for the Commission.
- Ensure that the work-package leaders implement the decisions taken by the Executive Committee and follow their objectives.
- Ensure that the contribution of the European Commission and the AMMA project is properly acknowledged in any communication.

We aim that these activities will translate the management structure which the partners have agreed to in the Consortium Agreement into a living organisation. In addition to this, the Scientific Manager will make sure that the involved scientists feel part of the AMMA family and identify with the goals of the project. This will be achieved through the publication of a Newsletter on the AMMA web-page and internal workshops. This Newsletter will be a forum for the AMMA scientists to inform all partners of their preliminary results.

The dissemination strategy will be coordinated by the Scientific Manager in order to ensure the coherence of the AMMA image and its objectives and show the complementarity of the partners in the consortium. The dissemination will be carried out by the partners through training courses, university programmes, conferences, scientific publications and contributions to the AMMA web-site (www.amma-ip.org). The details of the dissemination strategy are presented in B6.

The Scientific Manager will also promote the exchanges of AMMA with the other projects funded under the 6th Framework Programme and the international community by ensuring the presence of partners in the meetings and at conferences. The international activities with which a closer collaboration will be sought are the World Climate Research Program (WCRP) (specially with GEWEX and CLIVAR), International Geosphere-Biosphere Programme (IGBP), International Human Dimensions Program (IHDP) and the US AMMA initiative.

WP7.3 Financial management

Partners : CNRS (Month 0 to 60)

Objectives

- Financial Management: The CNRS, with its long record experience in financial management of European Project, will be in charge of this activities and will assure the financial / contractual management. The CNRS will check that financial flows are in accordance with the Consortium Agreement and the decision of the Governing Board and Executive Committee and will report to the Commission and to the Executive Committee on the use of funds. They will also carry out financial audit. They will ensure that the appropriate payments are made to contractors without unjustified delay and will keep accounts making it possible to determine at any time what portion of the Community funds has been allocated to each contractor for the purposes of the network and inform the Commission of the distribution of the funds and the date of transfers to the contractors on an annual basis.
- Administrative Management: Day to Day Project Management: The objective is to assure all tasks associated with project management including the planning, organizing, monitoring and controlling of all aspects of the project in a continuous process, which will allow the creation of the right project win-win environment for all participants.
- Information and Communication Management: We intend to make the most of new technology to improve communications. The objective is to implement actions for defining internal communication and production of all forms of information to be used within our Integrated Project, to enhance the flow of information among the different participants.

Work Content

Financial Management

The Project Coordinator as well as the Project Manager will rely on the financial department of the CNRS top run the following:

- Receives all payments made by the Commission for the Contractors,
- Dispatches funds for the various WPs to the Contractors in accordance with the Consortium Agreement and the decisions of the Governing Board and Executive Committee,
- Manages the funds and accounts for the actions, Management Justification of costs
- Reports to the Commission and to the Executive Committee on the consumption of funds, provide a summary financial report, which consolidate the incurred costs of the consortium and the requested Community contribution;
- Negotiates the contracts, agreements and annual amendments, including the Consortium agreement. Ensures signatures.
- Checks that internal audits have been finalized pursuant to the Contractors contractual obligations (audit certificates + Audits by European Commission)

Administrative Management

Day to Day Project Management:

The first work is to define, as early as possible, methodology and tools (dashboards, indicators, planning, reporting) that will permit to check project progress against planned schedule by checking that milestones are met and deliverable properly produced pursuant to the reports submitted by the Contractors.

Another work is to ensure that the tasks regarding the signature of the contract by the other contractors are carried out in a timely and correct manner. The Project Manager will ensure that all deliverables and benefits satisfy the SMART test:

- SPECIFIC: clearly defined with completion criteria
- MEASURABLE: understood metrics are available to identify delivery
- ACHIEVABLE within the current environment and skills available
- REALISTIC: not trying to get the impossible with many unknowns
- TIMEBOUND: is limited by a delivery date based on real need.

At last, they will provide a baseline for progress measurement and control and to provide for planning of the remaining work. This WP is also dedicated to the monitoring of Conflicts, if it ever happens and can implement change control procedures if needed.

This work-package will deal also with logistics in term of meeting, event issues (specific support to concertation and organisation of conferences anywhere in Europe for any number of participants) and “Help Desk Issue”, which is a enquiry centre for the participants, as well as clearing house and onward distribution centre for project documents and deliverables and central contractual document archive.

Information and Communication Management

The information and communication management system will be designed taking into consideration the needs of both the project and the consortium. It will include procedures for preparing, collecting, identifying, classifying, distributing, filing, updating, archiving and retrieving information through the AMMA Web Portal (www.amma-ip.org) or electronic mail. Information include conditions prevailing at the time of occurrence. Another objective of the workpackage is also the provision, maintenance and animation of public communications mechanisms including web, ftp, news, and mail re-distribution services.

WP7.4 Intellectual property, knowledge and data management

Partners : CNRS (Month 0 to 60)

Objectives

Intellectual Property Right and legal issues

The first objective is to determine the skills, the methods and the tools needed to properly handle IPR and legal issues related to the knowledge produced by the AMMA consortium. It will give also orientation on how to promote and exploit the results and transfer to all stakeholders.
Since this Integrated Project requires from every participant to consider a vision on scientific, technical, industrial and commercial aspects and since this vision will have to be underpinned by large **partnerships** bringing together the necessary critical mass to, and have a significant impact in terms of scientific, market and societal issues, we find it necessary to delve in-depth into the knowledge of legal issues during the implementation of our Project. Indeed, it is essential for us to properly manage potential financial risks, sub-projects, and on top of all Intellectual Property Rights.
Therefore, our intellectual Property Committee (IPC) will dedicate through this work-package the joint management of Intellectual Property and legal issues of the consortium.

Knowledge and data Management

We are going to make all scientific publications related to the project available on the site www.amma-ip.org . This site will accumulate the knowledge produced by the partners and enable them to be constantly aware of the state of the art in the field. The researchers will be really interested in accessing the Knowledge Database, containing all the fundamental information about the topics of our project, where the new findings and results from the AMMA IP will be presented in multimedia format.
As addressed by the EU, the IT is one the best way to remove the barriers toward the social inclusion for some weak categories of people (E-inclusion). An example can be the handicapped or diseased persons, which won't be forced to physically move, with waste of energies and money, even though maintaining the possibility of direct contact with the other students and/or researchers. This possibility could also be offered to the female students(gender action plan), for a period of their activity, to stimulate them to apply for PhD positions (see the Social and Ethical issues section). Actually, the provider we use for our Web-pages is a non profit organization which aims at developing the access to computers and information technology in Africa.

Work Content

First of all, within our Consortium Agreement, we have defined among ourselves the arrangements that fit every partner the best within the framework provided in the model contract.

This consortium agreement, which will be signed by every participant before the signature of the contract, contains all the rules and regulation regarding the Ownership of knowledge, Protection of knowledge, Use and dissemination of knowledge.

Mainly, this WP will deal with the following during the project duration:

- Evaluation of the Background Patent and Know-How and management of the access rights among the contractors,
- Assuring the necessary legal environment for any background and foreground knowledge or materials transfer between contractors,
- Assuring knowledge management and evaluate innovative projects (technically, patentability and potential markets and industrial partners),
- Selection and proposing the optimal type of protection and finalizing the protection strategy,
- Management of joint ownership: drafting and negotiation joint ownership agreements and accessing on foreground rights between the Contractors,
- Assuring legal assistance for protection in association with Patent attorneys,
- Proposing rules for publications, thesis, dissemination of information,
- Defining rules for confidentiality issues,
- Defining clustering and dissemination strategy : propose partner search and licensing strategy and if requested negotiate and draft technology transfer agreements : options, licenses, assignments, collaborations.

6.B - Plans

6.5 Plan for using and disseminating knowledge

6.5.1 Plan for the Management of knowledge

Only shared knowledge is significant and that such knowledge should be easily available for everybody. And our ultimate aim is the free flow of knowledge within as well as outside of our AMMA organisation. For the AMMA project free flow of knowledge is particularly important as it is the only way to ensure that the information reaches the African scientific community and the institution which apply this knowledge for the well being of the local population. Knowledge Management will be an on-going programme within AMMA and we did define its process in which knowledge is created, stored, shared and applied.

We intend to define those subprocesses of Knowledge Management as follows :

- **Creation:** the IP outcome will generate a creation of new knowledge
- **Storing:** created knowledge will be further processed into such a form that is easily availablevwith fairly little effort for everybody. This means the handling of knowledge, analysing it and editing it so that the databases of AMMA organisation are logically organised, reliable and accurate. Our **WP 4.4 on database and historical data** is dedicated to this process.
- **Sharing:** Good storage is the precondition for effective sharing. We do plan many different data distribution channels, such as e-mail, mailing of paper report, Web-sites (WP7.3) , the use of the databases (WP4.4) and convening meeting.
- **Transfer of knowledge** : The leading position of Europe in environmental knowledge needs to be shared with the African nation for our mutual benefit. The Work-packaged dedicated to training and education will ensure that University students, technicians and colleagues in African benefit from the European knowhow. Showing that environmental questions in Africa are cutting edge science will motivate teachers and professors to teach it and thus create a snowball effect.
- **Integrating knowledge** : Geophysical and social sciences need to be integrated to achieve a better understanding of the environmental challenges our society faces. The following Workpackages are dedicated for such a purpose:WP3.1, WP3.2, WP3.3, WP3.4.
- **Application:** ultimately, we intend to contribute to turning Europe into the world's most competitive knowledge-based economy through the **social-economic impact** with the knowledge generated by our consortium. Work-packages 5.1 and 5.2 are dedicated to the integration of our gained knowledge into operational forecasting or early warning systems to ensure that they remain cutting edge for the mutual benefit of the African and European societies.

6.5.2.Plan for management of IPRs

To manage and monitor the exploitation of the work being carried out during the project and to ensure a sufficient protection of the knowledge, AMMA has defined a specific work-package (WP7.4) for IPR survey and exploitation activities. The already presented Intellectual Property Committee (IPC) will propose policies and rules of good conduct which will be implement the

WP7.4 management structure. This WP will also implement measures to protect knowledge and its dissemination and identify the elements in the project likely to need protection and to take the necessary measures to secure property. The exploitation plan, which is detailed in the consortium agreement and will be refined during the project life, is based on new market researches, contacts with users, results from the research work and partner search.

Intellectual Property Rights are detailed with precision into the article 9 of the Corsortium Agreement , here is above the general framework :

Knowledge property rights

According to this agreement, the knowledge shall be the property of the partner carrying out the work leading to that knowledge. When several partners have jointly carried out work generating the knowledge and where their respective share of work cannot be ascertained, they shall have joint ownership of that knowledge. In this particular case, partners shall jointly apply to obtain and/or maintain the relevant intellectual property rights and shall strive to set up amongst themselves appropriate agreements in order to do so. The share of each contributor to the Knowledge development shall be defined proportionally to the resources implemented by each, whether human, financial or intellectual.

Access rights to pre-existing know-how and to knowledge

The access rights to pre-existing know-how and knowledge, as defined in the general conditions of the EC contract, will be thoroughly detailed in the Consortium Agreement. The general principle will be that free and unrestricted access will be permitted to all consortium members to knowledge obtained in the course of the project.

In the course of the project a special Agreement will be added to the Consortium Agreement in order to give access to the knowledge with preferential conditions to an enlarged African Community Members (e.i. African Universities...), under the control of the African Contractors.

6.5.3. Plan for Disseminating Knowledge

In order to promote academic and industrial cross-fertilisation within AMMA and towards the European Research Area (ERA), we intend to conduct dissemination activities from the beginning of the project in the following:

- **Internal Workshops** will be organised in order to spread effectively the Project results and know-how to project partners. They will normally consist in a lecture programme and a practical demonstration organised at the organisation’s place responsible for this particular subject.
- **Training courses** for researchers open to ERA will contribute to disseminating knowledge
- **Virtual case-studies** and their corresponding simulation tools will be set up on the basis of the work done and freely distributed via the AMMA **website** www.amma-ip.org as dissemination vectors.
- **International collaborations** with developing countries (most of the West African Countries) as well as with USA (part of AMMA international)
- **Conference**: take part of world class scientific conference related to our work.
- **Scientific presentations**: In addition to scientific presentations held at specific conferences by the individual partners throughout the duration of the project, AMMA intends to attend broadly focused conferences.
- **The Website** (www.amma-ip.org) will interface AMMA with the international scientific community, giving the opportunity to researchers to communicate freely and increase their mobility and interaction with project related-topics. A description of overall objectives, partners and latest success stories will be regularly up-dated. This will allow continuous exchange of information with the international scientific community and updating of the project scientific

program. All the research conducted by project members will be completely open. All the legal issues related to knowledge are defined in the Consortium Agreement, which will be sign prior to the signature of the contract.

- **University Program and summer School:** the world recognized experts from the project teams will give lecture courses to young researchers involved in the project in order to deliver them the newest information in our research field in the most pedagogically adapted form. A Work Package has been dedicated to this activity (WP6.2)
- **Participation at fairs** The visibility of AMMA will also be ensured by the participation in different major European and international conferences such a EGU and AGU. AMMA will also be present at the UN Sustainable Development summits.
- **Publications** in non-specific journals such as Eggs (EGU), Bulletin of the American Meteorological society (AMS) or Eos (AGU) will be prepared to attract maximal attention to the project.

6.5.4 Studies on Socio-Economic Aspects and Activities promoting the exploitation of the results

We have dedicated **4 Work-Packages on Impact studies**, which assess the expected wider societal impact of the knowledge and technology generated by our consortium, as well as the analysis of the factors that would influence their exploitation.

The Work-Packages are the following:

- WP3.1: Land Productivity,
- WP3.2 Human processes and food security
- WP3.3 Water Resources
- WP3.4 Public health

We have dedicated **2 Work-Packages on demonstration**, which demonstrate how the results andproducts of AMMA research can be used to:

- WP5.2: improve the efficacy of existing operational early warning systems for food security
- WP5.1: Improve weather to climate forecasts of the West African monsoon

6.6 Gender Action Plan

AMMA by its activites contibutes to the UE Gender Policy in two ways :

– to promote woman in the European Research in accordance with the Treaty of Amsterdam, Helsinky Conference, ETAN Network;

– to promote the Gender Equality in the Cooperation Developement in conformity with EC Regulation(n°806/2004) and the international committments of the EU towards the Beijing Women Conference and « UN Millenium Goals »

6.6.1Gender Equality within the project

6.6.1.1. Women participation in AMMA

First of all, we are compelled to say that without a strong involvement, determination, and efficient work achieved by our female partners, the proposal could simply not have been presented to the EC (Table 1 : AMMA women Leaders) . Second of all, we can say that AMMA is a universally neutral person in term of gender issues. Indeed, we have made sure that every partner within AMMA is an equal opportunities employer and is committed to the promotion of Equal Opportunities for all of its staff. Therefore, AMMA partners share the concern about the need to promote and endeavour efforts to ensure gender equality and to explore progress made and ways ahead.

Women participation table : WP and sWP AMMA Women Leaders

WP/subWP	WP/sWP Title	Name	Partners Name
WP2.4	Aerosol and Chemical processes in the atmosphere	Claire Reeves	UEA (19)
WP3.2	Human processes and food security	Inge Sandholt	UKBH.IGUC (7)
WP4.4	Data base and historical data	Laurence Eymard	CNRS (1)
sWP 1.1.2 & sWP 2.4.5	WAM impacts on atmospheric composition and global climate Longe Range Transport	Kathy Law	CNRS (1)
sWP 2.4.1	Aerosol radiative properties	Paola Formenti	UNIPG (28)
sWP 2.4.3	Surfaces processes	Beatrice Marticorena	UP12 (11)
sWP 4.2.2	SOP groung based	Susanne Crewell	LMU-Munchen (17)
sWP2. 1.3	Synoptic to Mesoscale	Sarah Jones	UniKarl (42)

It was widely recognised that a transition to a both gender-balanced and gender-sensitive organisation was needed to promote gender integration into research especially society in the long-term.

6.6.1.2. Gender Issues within the Governance and Management Structure of AMMA

Although women are already present as key partners of AMMA, AMMA will implement specific measures in order to increase the number of women taking part in the AMMA IP, panels of WP/sWP, Executive Committee, and scientific Management.

The main objective is to support the systematic participation of woman at all level of the project within AMMA:

- At the Governing Board Level: at every meeting, Gender Issues strategy will always be debated on how to improve our measure to promote equality.
- The Executive committee will implement the gender Issues decided by the Governing Board.
- In the Management Team, the statistical team will play an important role as regards data collection and the development of gendered indicators.

AMMA, through its Management team sets up a gender action plan and recognizes the gender issues.

The Management Team, by the person of the project manager, will ensure the implementation of the GAP, including gender awareness actions.

6.6.2.Gender Action Plan (GAP)

The Gender Action Plan of AMMA is based on the current situation and the following objectives :

Current situation and AMMA objectives:

1. Gender Analysis

Before the submission of the AMMA proposal, we have started essentially a quantitative approach, which consisted simply of counting the number of women and men involved in AMMA at various levels.

Summer school : In September 2003 an AMMA summer school was held in Lannemezan (http://medias.obs-mip.fr/amma/). Courses we taught by 25 professors and scientists among

which were 10 women (gender ratio of 40%). 31 Students from Europe and Africa attended

of which 4 were women (gender ratio of 13%).

AMMA workshops: Worshops were held in preparation of this proposal and which were attended by scientists of the various partner institutions. The typical attendance was 50 scientists with 25% being women.

Preparation of proposal : Among the 30 scientists which have contributed to this proposal by coordinating the preparation of a work-package 7 were women (gender ratio of 23%).

Coordination group : The core group which coordinated the preparation of this proposal is constituted of 10 scientists of which 2 are women (gender ratio of 20%).

A representative sample of scientists already involved at this stage in the AMMA project allows us to estimate that about 25% of the personnel dedicated to this project will be women. This corresponds to the European average of female researches in natural sciences (Eurostat, July 2001).

The objective of the AMMA project will be to improve this statistic for two main reasons :

1) Women's participation in research must be encouraged to ensure their stronger presence in the higher education

2) Their presence within AMMA will ensure that their needs are taken into account and especially those of African woman

Once the project started, we intend to back up this approach by a qualitative measures, which we think can tackle structural inequalities, we call this our “**transformative approach**”, which means,improving our attention to gender at all levels of implementation and in the content of our research agenda.

2. Assessment and Monitoring

A set of **gender indicators** will be produced in order to **measure progress** towards gender equality within AMMA. For this, AMMA will make use of the strategy developed by the European Commission in order to approach the lack of sex-disaggregated data on scientists. AMMA is supportive of The Helsinki Group on Women and Science who considers that the **gendering of indicators** on human resources in science is to be tackled from a threefold perspective: the ‘topdown’ approach, the ‘bottom-up approach, and the gendering of the benchmarking exercise.

In fact, the development of **gender-sensitive indicators** on the basis of appropriate sex-disaggregated **statistics** is regarded as indispensable for the integration of the gender dimension in European research. More precisely, there is a need to develop both **quantitative and qualitative** gender indicators in order to build a holistic view of the situation.

In addition to the measures above, AMMA, either in Europe or in West Africa, will challenge key concepts or terminology which might obscure differences between men and women (e.g. Broad references to ‘communities', ‘groups', ‘households', ‘participants', ‘constituencies' etc.). Wherever possible, we will specify the participants in and the beneficiaries of the research.

3. Mentoring

We will develop mentoring actions of junior women scientists by senior women scientists to contribute to the development of the science women in the European and African science.

4. Awareness Raising

We will also develop a strategy for disseminating the research and maximizing its potential impact on policy. We will discuss the research area and share the results with relevant stakeholders and constituencies (e.g. women's organizations, networks, academic communities, NGOs, ministries of women's affairs, and women's divisions within sectoral ministries).

More attention is paid to the following in Africa:

1. differences between men and women in access to basic resources (e.g. differential access to education, health, information, transportation, technology etc.);
2. differences between men and women related to divisions of labour and responsibilities within AMMA (e.g. attention to limitations on time; gender- specific tasks and responsibilities, including childcare etc.)
3. differences between men and women related to participation within the informal and formal labour markets (e.g. different types of occupations, sectoral distributions, wage and benefit levels, full or part-time work; etc.);
4. differences between men and women in terms of access to power and authority in AMMA organization;
5. social traditions, customs, obligations, entitlements which produce different expectations, opportunities and constraints for men and women.

To achieve these objectives, AMMA GAP will be composed of the following practical actions :

AMMA Gender Actions :

1. **Gender Analysis** : made in recruitment, retention and career advancement, but also the progress

- achieved in policies, procedures and programs which have an influence on the relative position of women and men.
- promote the transparency and equality on the jobs available on the website

2. **Mentoring:** to promote scientific carrers and management scientific carreers
   - mentoring junior women scientists by senior women scientists, and
   - women scientists wishing to take more management responsabilities by women and men involved in these tasks

3. **Awarness arising** : promote science and dissemininate knowledge beyond the scientific Community.
   - gender issues will be addressed in the AMMA Summer schools.
   - a gender issue section will be created on the website to allow to share their experience in the scientific career and in AMMA in particular.

4. **Monitoring and Assessment** : evaluate the actions carried out and make recommendations on new actions or corrective actions:
   - definition of key indicators
   - Annual review for the GB. The management team will report on the implementation of the Gender Action Plan and its impacts. It will formulate corrective measures if necessary.
   - Final report : at the end of the project the management team will be able to assess the GAP, its impacts and formulate recommendations.

6.6.3. Gender issues

Because of its specific environment AMMA will take into account place of the Women into the Sciences discipline but also the African dimension of the Gender issues.

6.6.3.1. Gender dimension across Scientific fields

According to the AMMA project, all the aspects of the research can be equally done by women and men. Nevertheless, tools development and information technology/mathematics are topics which seem more likely to get the interest of men. This is not the case for multidisciplinary research case such as AMMA, which involves chemistry, oceanography, agronomy and health sciences where the number of woman is quite important. There are no gender differences that apply in the AMMA research activities.

Results from AMMA will benefit all people, which do not discriminate between men and women in the scientific research carried out

6.6.3.2. African Gender issues

We are aware that the African socio-political history has impact of upon gender and research. Women in Africa are systematically under-represented in institutions at the local and national level, and have very little say in decision-making. Within AMMA, we will tackle this Gender barriers, which limit women's participation and reinforce power gaps. As civil society emerges, women’s organizations constitute an important social capital resource for strengthening the social institutions necessary for a market economy. Women constitute an important source of opinion (and opposition) on the subject of economic adjustment in Africa, and and we intend to hear their voices and listen to their needs within our tasks, because it is essential for endorsement of successful economic impact in Africa.

Ensuring a higher presence of African woman professors, scientists and students in AMMA will be our contribution to increasing the average level of education of African women. It will be achieved by involving the European women scientists of AMMA in the training and education activities at the organisational level as well as for the teaching.

6.7 Raising public participation and awareness

The AMMA consortium demonstrates a clear readiness to spread awareness as well as knowledge and to explore the wider societal implications of the proposed work in a number of different ways as follows:

- **Internal Workshops** will be organised in order to spread effectively the Project results and know-how to project partners. They will normally consist in a lecture programme and a practical demonstration organised at the organisation’s place responsible for this particular subject.
- **Training courses** for researchers open to ERA will contribute to disseminating knowledge
- **Virtual case-studies** and their corresponding simulation tools will be set up on the basis of the work done and freely distributed via the AMMA website www.amma-ip.org as dissemination vectors.
- **International collaborations** with developing countries (most of the West African Countries) as well as with USA (part of AMMA international).
- **Conference**: take part of world class scientific conference related to our work.
- **Scientific presentations**: In addition to scientific presentations held at specific conferences by the individual partners throughout the duration of the project, AMMA intends to attend broadly focused conferences.
- **The Website** (www.amma-ip.org) will interface AMMA with the international scientific community, giving the opportunity to researchers to communicate freely and increase their mobility and interaction with project related-topics. A description of overall objectives, partners and latest (publishable) success stories will be regularly up-dated. This will allow continuous exchange of **information with the international scientific community** and up-dating of the project scientific program. All the research conducted by project members will be completely open. All the legal issues related to knowledge has been discussed in the Consortium Agreement, which will be sign prior to the signature of the contract.
- **University Program and summer School**: the world recognized experts from the project teams will give lecture courses to young researchers involved in the project in order to deliver them the newest information in our research field in the most pedagogically adapted form.
- **Participation at fairs** The visibility of AMMA will also be ensured by the participation in different major European and international conferences such a EGS and AGU. AMMA will also be present at the UN Sustainable Development summits and contribute to the European Science Week
- **Publications in non-specific journals** will be prepared to attract maximal attention to the project (Global Change Newsletter, WCRP Informal Repots, LUCC Newsletter, Earsel, La Recherche, Pour la Science)
- **Medias**: will be inform regulary on the progress of AMMA. A close contact will be kept with the science journalists:

- **Exhibitions** : In the course of the AMMA project an exhibition will be organized in a science museum. First contacts have been taken.
- **Documentary on AMMA**: CNRS Media will start shooting footage for an AMMA documentary, and on 2005 production and distribution will occur on the second half of the project.

Synergies with education

Through the Workpackage dedicated to Training Activities, synergies between AMMA and education exist at all levels. The main points of synergy which can be emphasized in relation to this are the following:

- **High education for university students**. University students (European as well as African) will be benefited from AMMA through special university seminars dealing with the areas of interest covered by the project. In addition, the partners have expressed their willingness to combine the education opportunities of AMMA with the joint student exchange programs implemented in the participant universities.
- **An AMMA oriented PhD program** will also be created with African Universities (University of Benin, University Moumouni in Niger, UCAD in Senegal, University of Cocody in Côted’Ivoire) with contribution of African and European professors, and grants provided by the Start, CNRS, IRD/DSF, French Educational Ministry, etc., through specific calls for applications (BDI, Chorus, short term scientific exchange grants, etc.).
- **The project, by relying on international exchange programs** (i.e., Visiting scientists), will enhance participation of European visiting scientists students in PhD programs in Africa.
- And the participation of African **scientists and technicians in training courses** organized for example by partners such as IBIMET (27) and ECMWF (33) in the region will be promoted.
- **Involvement of SMEs**, which have the characteristics of knowledge. Their role will be to ensure the training of the technical staff in Africa. They will make a survey of all the concerned radiosonde stations in order to understand in detail the needs for upgrade, training and education.

6.C - Milestones

6.8 Major Milestones over the full duration of the project.

In the following tables the type of deliverables associated to each milestone will be coded as follows :

- P : Publication in a scientific journal,
- R : Report internal to the Consortium or to the EU,
- D : Data to be provided to the database (WP4.4),
- I : Instruments will be ready to be deployed.

6.8.1 Integrative Science

WP1.1 - 5 Year Milestones

Milestone N^0	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M1.1.1a	Analysis of GCM and coupled GCM outputs from existing simulations to define the first set of planned simulations.	12	Start + 12M M4.1.2a + 0M	R
M1.1.1b	Definition of experiments.	18	M1.1.1a + 6M Start WP1.3 + 0M	R
M1.1.1c	Synthesis of the results of the first set of planned simulations. Analysis of the role of key parameterizations. Definition of further simulation sets.	30	M1.1.1b + 12M	R + D
M1.1.1d	Evaluation of AGCM and coupled GCM based on the data from EOP/SOP and satellite available data.	36	M1.1.1c + 6M M4.2.2f + 0M M4.2.3d + 0M M4.3b + 0M	P+R
M1.1.1e	Evaluation of the changes in WAM variability in the future climate scenarios.	36	Start + 36M	P+R
M1.1.1f	Quantification of the predictability of sub-seasonal to interdecadal atmospheric variability of the WAM arising from variations in the continental-scale surface/boundary layer conditions and SSTAs in different ocean basins based on observed data and GCM output.	48	M1.1.1d + 12M M1.3.3c + 0M M2.2b + 0M	P+R
M1.1.1g	Synthesis and re-evaluation of the predictability of the WAM on intra-annual time scales and of the performance of models in forecast mode.	60	M1.1.1e + 18M M1.1.1f + 12M	P+R
M1.1.2a	Preliminary report on impact of WA emissions on aerosol/trace gas budgets; identification of model uncertainties & provision of fields for GCM studies	18	Start + 18M M4.1.3a + 0M	R
M1.1.2b	Satellite data analysis of transport pathways for trace gases & aerosols out of WA	36	M4.3b + 18M M4.3c + 6M	R
M1.1.2c	Role of lightning in ozone formation downwind of WA	42	M4.2.1f + 14M M4.1.3a + 0M M2.1.3b + 0M M2.4.2d + 6M	R

Mileston e N^0	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M1.1.2d	Photochemical reactivity of air masses transported out of WA	48	M4.2.1f + 16M M2.4.2e + 4M M2.4.4d + 0M	P/R
M1.1.2e	Characteristics of transported aerosol layers including dust transport by cyclogenesis	54	M4.2.1f + 27M M2.1.2a + 0M M2.4.1c + 0M M2.4.4e + 0M M4.1.3c + 0M	P/R
M1.1.2f	Quantification of impact of WA emissions on regional air quality, global oxidant & aerosol budgets, oxidizing capacity and climate on seasonal & inter-annual timescales (role of dynamical variability); using improved coupled chemistry-climate models	60	M1.1.2b + 24M M1.1.2e + 6M M1.1.1e + 18M M1.1.3c + ?M	P/R
M1.1.3a	Role of the tropical waves on the ITCZ jump and onset of the monsoon	18	Start + 18M	P+R
M1.1.3b	Definition of weather types : dry season, monsoon onset, spring and summer breaks and surges	24	Start + 24M	R+P
M1.1.3c	Pacific warm pool intra-seasonal variability impacts on the occurrence date of the active phases and pauses of WAM (“global” scale)	24	M1.1.3.b + 0M M1.1.3.a + 6M M4.4e + 0M	R
M1.1.3d	Role of the AEW on the intra-seasonal variability (“regional” scale)	36	M1.1.3b + 12M	P+R
M1.1.3e	Evaluation in reanalysis of water budget mean values and variability, including precipitation recycling ratio during wet and dry west African rainy seasons	36	M1.2.1d + 0M M4.2.3d + 6M M4.1.1c + 0M	R
M1.1.3f_pre	Preliminary results from 1.1.3f	36	M1.1.3a + 6M M1.1.3b + 12M	-
M1.1.3f	Development and test of statistical forecasting models for the monsoon onset, breaks and surges	48	M1.1.3a + 18M M1.1.3b + 24M M1.1.1f + 0M	R + P + participation to 3 PRESAO forums
M1.1.3g	Evolution towards statistico-dynamical forecasting models using AGCM outputs	60	M1.1.1f + 12M M1.1.1g + 0M M1.1.3f + 0M M1.3.1d + 0M	R + P + participation to 3 PRESAO forums

WP1.2 - 5 Year Milestones

Milestone N^0	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M1.2.1a	Comparison of MANDOPAS 4D fields with operational analyses	24	Start + 24M M4.1.1b+3M; M4.2.1c+12M, M4.2.3c+12M; M4.3b+6M	P
M1.2.1b	Relationship between lower atmosphere moisture and Tropical Atlantic variability explored.	24	Start + 24M M4.1.1b+3M; M4.2.1c+12M, M4.2.3c+12M; M4.3b+6M	P
M1.2.1c	Large-scale fields of wind, temperature, humidity and precipitation using the operational and SOP observations	24	Start + 24M M4.1.1b+3M; M4.2.1c+12M, M4.2.3c+12M; M4.3b+6M	P
M1.2.1d	Water vapour transport and water budget during selected SOP case studies	36	M1.2.1a+12M , M1.2.1b+12M, M1.2.1c+12M; M4.1.1e+ 6M, M4.2.1f+10M, M4.2.3d+6M; M4.3c+6M	D+P
M1.2.1e	Synthesis of the large-scale water budget analyses	60	M1.2.1d+24M	R+P
M1.2.2a	Evaluation of the atmospheric water cycle in regional models	36	M4.1.1e+6M	R+P
M1.2.2b	Evaluation of mesoscale rainfall and runoff data from observations	36	M4.2.1f+9M, M4.2.2f+9M, M4.2.3c+0M, M4.2.3d+0M	D
M1.2.2c	Evaluation of storage terms (soil and groundwater) and fluxes (Evaporation) from observational data and process-based models	36	M4.1.1e+6M; M4.2.1f+10M, M4.2.2f+10M, M4.2.3c+6M, M4.2.3d+6M	D+P
M.1.2.2d	Evaluation of vegetation impact on water cycle	36	M4.1.1e+6M; M2.3.2b + 6M M4.2.1f+10M, M4.2.2f+10M,	P
M1.2.2e	Environmental fields of wind and humidity, series of 3D fields of wind, temperature and water contents for one selected rain event; model set-up for water budget analyses.	36	M4.1.1e+6M M4.2.1f+10M, M4.2.2f+10M; M4.2.3d+6M	D
M.1.2.2f	Analysis (from observations and numerical models) for a larger list of selected events	48	M1.2.2e + 12M	P

Mileston e N⁰	Brief description	Date of Milestone [Month]	Needs Input from	Type of delivera ble
M.1.2.2g	Watershed response to the occurrence of rainfall patterns for the selected cases (space and time intermittency)	48	M4.2.1f+12M, M4.2.2f+12M; M4.2.3d+12M	P
M.1.2.2h	Estimates of MCS-related water budgets and relations with environmental characteristics; Model-derived water budget for the SOP	60	M1.2.2f + 12M M1.2.2g + 0M	P
M.1.2.2i	Surface water budget estimates (model- and observations-derived); including the role of vegetation dynamics	60	M1.2.2g + 12M M1.2.2f + 0M	P
M1.2.3a	Evaluation of the POWER hydrological model (Donga catchment)	18	Start + 18M	R
M1.2.3b	First simulations of the water balance components	24	M1.2.3a + 6M	R+P
M1.2.3c	High-resolution spatial and temporal characteristics of rainfall for selected events	36	M1.4d + 6M; M4.2.1f+6M, M4.2.2f+6M; M4.2.3d+6M	D
M1.2.3d	Detailed hydrological study of watersheds, temporal characteristics of the rivers response to rainfall	42	M1.2.3b + 6M M1.2.3c + 6M	R+P
M1.2.3e	Coupling of the POWER hydrological model with atmospheric model	48	Start + 48M	R+P
M1.2.3f	Quantification of the influence of boundary layer humidity, soil humidity, vegetation, evapo-transpiration, deep infiltration, …)	54	M1.2.3e + 6M	P
M1.2.3g	Quantification of the water budget components, including uncertainties (input data errors and errors in hydological models)	60	M1.2.3d + 12M M1.2.3f + 6M	P
M1.2.3h	Influence of surface energy balance on rainfall variability, effect of environmental chane on water budget	60	M1.2.3e + 12M	P

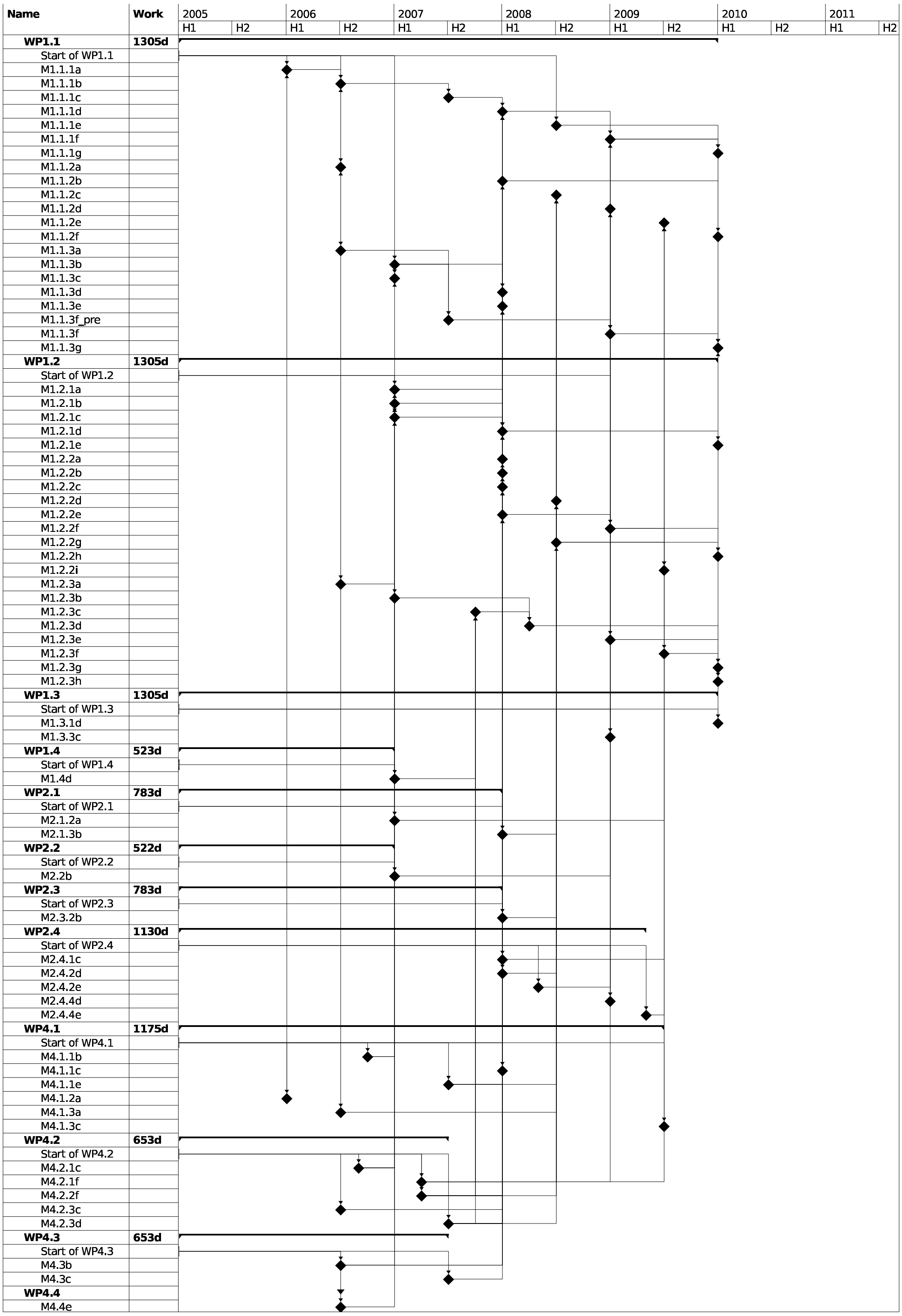
WP1.3 - 5 Year Milestones

Mileston e N^0	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverab le
M1.3.1a	Documentation of spatio-temporal variability of continental surface from historical earth observation data (modes of variability, maps of mean onset and cessation dates of growing season, links with leading rainfall amounts)	12	Start + 12M	P
M1.3.1b	Documentation of spatio-temporal variability of the coupled surface-atmosphere system during the EOP	48	M4.1.1i + 6M M4.2.3f + 6M M4.3d + 6M M2.2c + 6M	P+D
M1.3.1c	Sensitivity to land surface conditions of the WAM on intraseasonal to interannual timescales using numerical models and historical data	60	M1.1.1d + 12M M4.1.1i + 6M M1.3.1a + 0M	P
M1.3.1d	Sensitivity of the WAM to oceanic conditions using coupled ocean-atmosphere model	60	M1.1.1d + 24M M1.3.1a + 0M	P
M1.3.2a	Theoretical and numerical modeling of response to surface variability at diurnal timescale and investigate role of surface-forced circulations on deep convection from case studies	30	Start + 30	P
M1.3.2b	Documentation of spatio-temporal variability in surface heating during the SOP/EOP and its links to forcing (soil moisture, aerosol, cloud)	48	M1.1.3.b + 0M M2.4.1e + 4M	D, R
M1.3.2c	Theoretical modeling of response to surface variability on timescale of days	36	M.1.3.2a + 0M	R + P
M1.3.2d	Quantitative assessment of sensitivity of modeled atmospheric systems during SOP/EOP to surface heating	48	M1.3.2b + 0M	R
M1.3.3a	Experimental planning and operational tools developed for SOP from model output and satellite methodologies	16	Start + 16M	R
M1.3.3b	Assessment of role of surface conditions on modeled precipitation from case studies during SOP	44	M4.2.2f + 12M M1.3.3a + 0M	P + R + D
M1.3.3c	Evaluation of impact of surface conditions on rainfall based on analysis of rain gauge data	48	Start + 48M	P + R
M1.3.3d	Cloud resolving simulations of land surface-precipitation feedback loops over a series of convective events, and their representation at the larger scale using a single column model	42	M2.1.3b + 12M M1.3.3b + 0M	P
M1.3.3e	Observational analysis of land surface - precipitation feedback loops during SOP	60	M2.1.3b + 6M M1.3.1b + 6M	P + R +D

WP1.4 - 5 Year Milestones

Mileston e N^0	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverabl e
M1.4a	Finalise input and output data - (definition of variables and index type) - to be used in statistical model for linking large scale dynamics with mesoscale convective systems.	9	Start + 9M	R
M1.4b	Preliminary synthesis and testing of local scale statistical disagregator for Sahel: interface with impact models.	12	Start + 12M	RP
M1.4c	Identify relevant local scale statistical moments of rainfall for hydrological impact.	18	M1.4b + 6M	RP
M1.4d	Downscaling rules from mesoscale convective event data to statistical properties of local precipitation.	24	M1.4c + 6M M4.2.3c + 6M	R
M1.4e	Application of statistical downscaler to historical data and GCM scenario output – comparison with direct GCM output.	24	M1.4d + 6M M1.1.1a + 0M M5.1a + 0M	RP
M1.4f	Rain event scale disagregator ready for use in application/impact studies.	42	M1.4d + 18M	R
M1.4g	Identify scaling nonlinearities in surface flux estimates from measurements and models for application to parameterisations.	42	M1.4a + 30M M1.3.3d + 0M M2.3.2f + 6M	RP
M1.4h	Report on comparison and consistency of water budget at different scales - from observations and limited area models.	48	M1.4g + 6M M1.2.2f + 0M	R
M1.4i	Synthesis of the scaling properties of rainfall from local to mesoscale. Comparison of different pluviometric regimes.	48	M1.4f + 6M M2.1.1e + 6M	RP
M1.4j	Produce disagregated local scale rainfall input data for impact models – for sensitivity studies and scenarios.	54	M1.4h + 6M M1.4i + 6M	D

Gantt charts for the Integrated science WPs



Name
Work
2005
2006
2007
2008
2009
2010
2011
H1
H2
WP1.1 1305d
Start of WP1.1
M1.1.1a
M1.1.1b
M1.1.1c
M1.1.1d
M1.1.1e
M1.1.1f
M1.1.1g
M1.1.2a
M1.1.2b
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M1.1.3a
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M1.1.3c
M1.1.3d
M1.1.3e
M1.1.3f_pre
M1.1.3f
M1.1.3g
WP1.2 1305d
Start of WP1.2
M1.2.1a
M1.2.1b
M1.2.1c
M1.2.1d
M1.2.1e
M1.2.2a
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M1.2.3e
M1.2.3f
M1.2.3g
M1.2.3h
WP1.3 1305d
Start of WP1.3
M1.3.1d
M1.3.3c
WP1.4 523d
Start of WP1.4
M1.4d
WP2.1 783d
Start of WP2.1
M2.1.2a
M2.1.3b
WP2.2 522d
Start of WP2.2
M2.2b
WP2.3 783d
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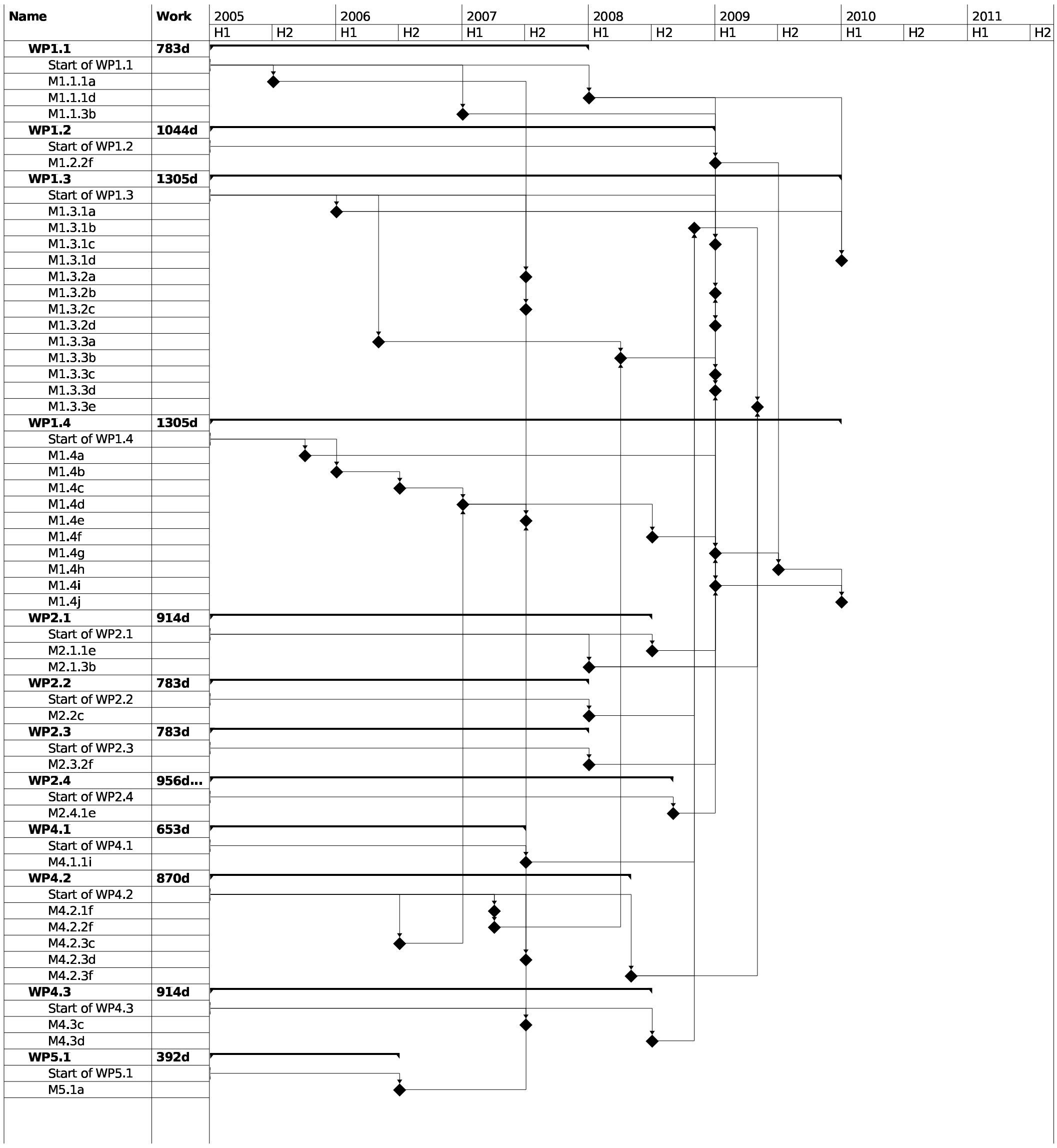
M2.3.2b
WP2.4 1130d
Start of WP2.4
M2.4.1c
M2.4.2d
M2.4.2e
M2.4.4d
M2.4.4e
WP4.1 1175d
Start of WP4.1
M4.1.1b
M4.1.1c
M4.1.1e
M4.1.2a
M4.1.3a
M4.1.3c
WP4.2 653d
Start of WP4.2
M4.2.1c
M4.2.1f
M4.2.2f
M4.2.3c
M4.2.3d
WP4.3 653d
Start of WP4.3
M4.3b
M4.3c
WP4.4
M4.4e



6.8.2 Process Studies

WP2.1 - 5 Year Milestones

Milestone N^0	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M2.1a	EOP and SOP strategy document prepared	11	Start + 11M	R
M2.1b	Coordination of the selection of SOP case studies (convective events, onset processes, synoptic waves, tropical cyclones (TCs)).	18	M2.1a + 7M	R
M2.1.1a	Analysis of historical monsoon onset diagnostics to develop a climatological perspective, and to use as input to operational planning for SOP1.	13	M2.1a + 2M	D,P

Milestone N⁰	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M2.1.1b	Analysis of historical rainfall events in the context of surface observations, dry intrusions. Report feeds into SOP1 planning.	13	M2.1a + 2M	R,P
M2.1.1c	Benchmark SOP global model simulations completed and compared.	30	M4.2.1f + 4M M4.2.2f + 4M	D,R
M2.1.1d	Observational analysis of the atmospheric processes of monsoon onset in EOP and SOP. Report describes basic indicators of monsoon onset for operational prediction and for weather and climate modeling.	36	M2.1.1c + 6M	R,P
M2.1.1e	Analysis of relationship between monsoonal / pre-monsoonal rainfall events and the synoptic, upper level and extratropical forcing. Makes recommendations for key processes to include in numerical models, and key indicators or precursors of rainfall.	42	M2.1.1d + 0M M2.1.3c + 6M	R,P
M2.1.1f	Evaluation of monsoon onset processes in atmospheric models – includes study of the WAM in an idealized 2D framework. Produces recommendations for key processes to include in numerical models, and key indicators for onset analysis and prediction.	44	M1.3.1a + 6M M2.1.1e + 2M	R,P
M2.1.1g	Analysis of links between regional to synoptic variability and diabatic processes. Reports on importance of key diabatic processes for numerical modeling.	54	M2.1.2d + 18M	R,P
M2.1.2a	Mineral dust transport module coupled with nested model.	24	M2.4.2a + 0M	R
M2.1.2b	Benchmark AEW simulations generated and validated for SOP (global and regional).	30	M2.1.1d + 0M M2.1.2a + 0M	D
M2.1.2c	Radiative parametrisations implemented in nested model.	36	M2.4.1d + 0M	R
M2.1.2d	SOP synoptic analyses, using tropospheric and PBL observations with model data. The results will include a catalogue of the daily evolution of the synoptic state during the SOP, as well as key case studies.	36	M2.1.2c + 0M WP4.2.1f + 10M	R,P
M2.1.2e	Nested model simulations of AEW-MCS interactions completed.	42	M2.1.3d + 6M M2.1.2b + 0M	D
M2.1.2f	Analysis of synoptic-scale processes in the troposphere and PBL associated with AEW evolution. Results will include identification of key AEW physical processes, with recommendations for routine monitoring and numerical prediction.	42	M2.1.2d + 6M	R,P

Milestone N⁰	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M2.1.2g	Model case studies of impact of mineral dust on synoptic weather systems. Results will include recommendations for routine monitoring and numerical prediction.	42	M2.1.2c + 6M	D,R,P
M2.1.2h	Observational and model analysis of MCS impact on AEW evolution. Report to include recommendations for modeling strategies for synoptic weather prediction.	45	M2.1.2f + 3M M2.1.3c + 0M	R,P
M2.1.3a	Report on simulations of tests cases of convective activity in idealized conditions with CRM	18	Start + 18	R
M2.1.3b	Analysis of a comprehensive observational and model dataset of selected MCS events. Includes analysis of lightning structure within MCSs in relation to microphysics. This analysis will be available for WPs studying the patterns of rainfall and the structures of rainfall events. Includes recommendations for monitoring techniques.	36	M2.1.3a + 18M	D,P
M2.1.3c	Data based evaluation of effect of PBL and synoptic conditions on evolution of convection (shallow, deep) and MCSs.	42	M2.1.2d + 6M	R,D,P
M2.1.3d	Model-based evaluation of large scale forcings due to organized convection. Results will include a statement on the key forcings due to organised convection which must be addressed in parametrisation schemes.	45	M2.1.3b + 9M	R,P
M2.1.3e	Theoretical analysis of convective equilibrium and disequilibrium. Results will include a statement on the key impacts of WAM moist convection which must be addressed in parametrisation schemes. Results will include discussion of spatial distributions of moist convection, for operational scaling methods.	36	M2.1.3b + 0M	R,P
M2.1.3f	Observational evaluation of the influence of MCSs on tropospheric conditions, boundary layer state and surface fluxes.	44	M4.2.2f + 12M M1.3.2c + 0M	R,D,P
M2.1.3g	Model-based evaluation of sensitivities of genesis and lifecycle of convective systems to synoptic environment and PBL heterogeneity. Results to include recommendations for operational forecasting.	60	M2.1.3d + 15M M2.1.3f + 12M	R,D,P

WP2.2 - 5 Year Milestones

Mileston e N⁰	Brief description	Date of Milestone [Month]	Needs Input from	Type of delivera ble
M2.2a	Identification of ocean processes that influence sea surface temperature forcing of the African Monsoon.	12	Start + 12M	R
M2.2b	Report on the validation of the OGCM in simulating observed sea surface temperature pattern.	24	M4.3b + 6M M2.2a + 0M	R
M2.2c	Report on the observed mixed layer heat budget of the tropical Atlantic.	36	M2.2.b + 12M	R
M2.2d*	Report on mean ocean circulation and pathways within the shallow subtropical cell and its variability.	48	M2.2c + 12M	R,D
M2.2e*	Report on the interaction between ocean dynamics and African Monsoon.	60	M1.1.1f + 12M M1.3 1c + 12M M2.2d + 0M	R,D

***reports** M2.2d and M2.2e rely on historical data (or ship data already obtained during previous EGEE/PIRATA and German cruises), on data that will be obtained during planned EGEE/PIRATA cruises as well as on ARGO, VOS, and satellite data. If there are no further outside fundings for EGEE/PIRATA cruise, the analysis must be stronger concentrate on historical data, already available cruise data, as well as on ARGO, VOS, and satellite data. The WP goals that also rely on the analysis of numerical simulations can still be achieved even if further cruises are not funded.

WP2.3 – 5 Year Milestones

Mileston e N⁰	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverab le
M2.3.1a	Development of improved algorithms for satellite derived vegetation and land cover maps and transfer to AMMA groups requiring these data sets in distributed hydrological and climate/atmosphere models.	24	M4.3b + 6M	D, R
M2.3.1b	Key processes of regional water balance at Donga river, Niamey's square degree, Senegal river and link to atmospheric driving investigated.	36	M4.2.3d + 6M M4.3c + 0M	R
M2.3.1c	Recommendations for regional hydrological model improvement and monitoring strategy	48	M2.3.1b + 12M M2.3.1d + 0M	R
M2.3.1d	Recommendation for improvement of operational land surface schemes by analysis of flux station derived heat fluxes	36	M2.3.1b + 0M	R
M2.3.1e	Biomass dynamics investigated (Gourma region)	48	M4.3d + 6M M4.2.3d + 0M	D, R

Milestone N^0	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M2.3.2a	C/N/H2O measurement campaigns analyzed.	36	M4.2.3d + 6M	D, R
M2.3.2b	Joint hydrological-biological simulations performed and analyzed and the link of biological activity to hydrological and atmospheric driving forces/constraints established	36	Start + 36M	R
M2.3.2c	Recommendation for monitoring surface emissions	42	M2.3.2b + 6M	R
M2.3.2d	Key processes at local scale water balance at Ara (Benin), Wankama (Niger) Dahra (Senegal), Gourma (Mali), Donga & Aguima (Benin) investigated.	54	M1.2.3d + 15M M2.3.1b + 0M	R
M2.3.2e	Recommendations for local scale hydrological model improvement	54	M2.3.2d + 0M	R + P
M2.3.2f	Recommendation for upscaling/downscaling of fluxes between local scale and regional scale	36	M2.3.1.a + 12M M2.3.2.b + 0M	

WP2.4 - 5 Year Milestones

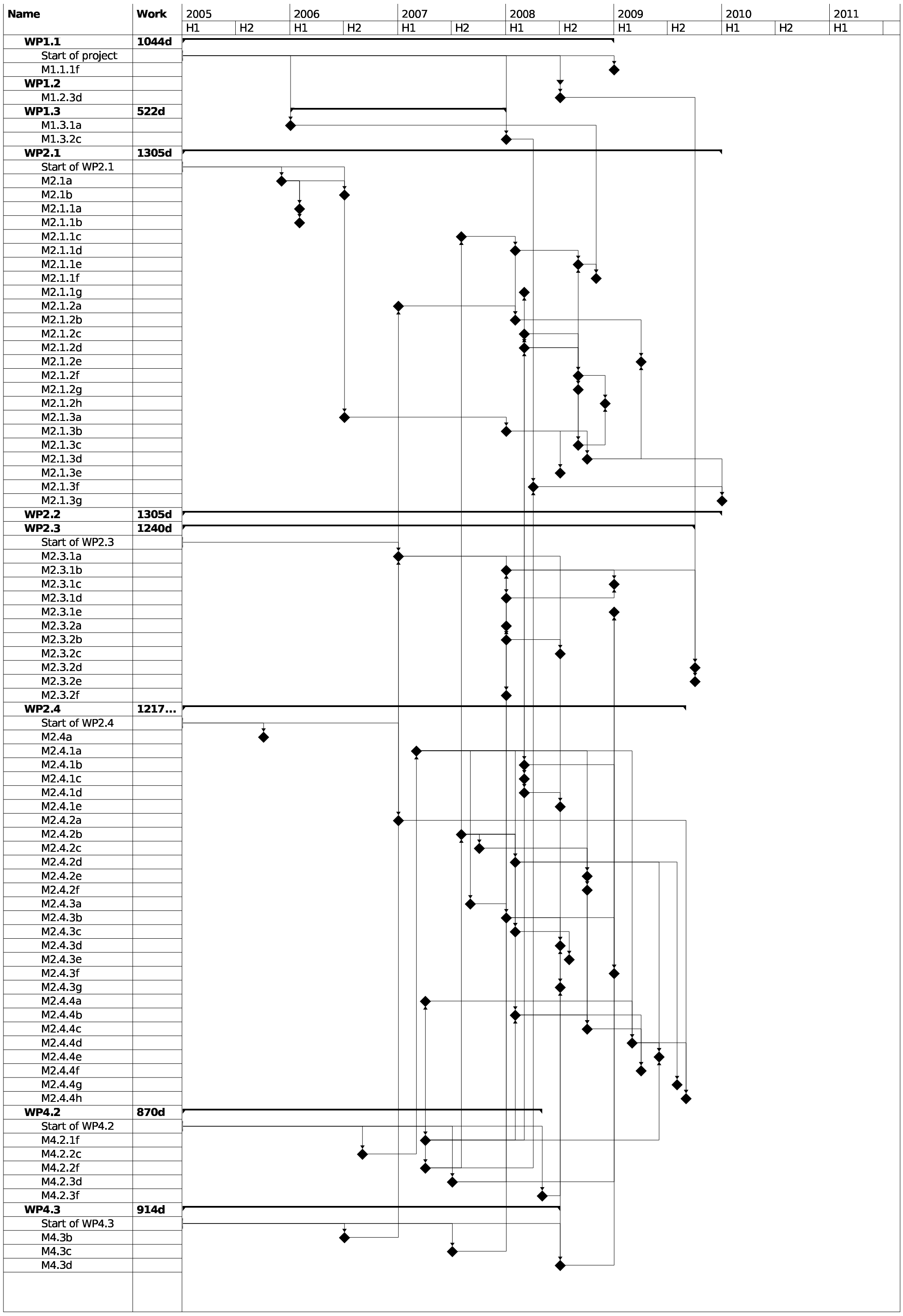
Milestone N^0	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M2.4a	A report on the WP2.4 observational requirements and strategies for the SOPs.	9	Start + 9M	R
M2.4.1a	Characterization of the aerosol properties of the different air flows within the WAM	24	M4.2.2c + 6M	R
M2.4.1b	Inter-annual variability of aerosol distribution and properties over West Africa	36	M2.4.1a + 12M	R
M2.4.1c	Parameterisation of optical properties in terms of aerosol composition and microphysical characteristics	36	M2.4.1a + 12M	R, P
M2.4.1d	Development of validated parameterization schemes of the optical properties of the aerosol for atmospheric models	40	M2.4.1c + 4M	R
M2.4.1e	Estimation of the aerosol radiative local and regional impacts over West Africa	44	M2.4.1d + 4M	R
M2.4.2a	Parameterization of the relevant heterogeneous reactions of mineral dust	24	Start + 24M	R

Mileston e N[0]	Brief description	Date of Milestone [Month]	Needs Input from	Type of delivera ble
M2.4.2b	Characterization of the chemical composition of the different air flows within the WAM	30	M4.2.1f + 4M M4.3b + 0M	R
M2.4.2c	Chemical diagnostics for the evaluation of transport and chemical processing	32	M2.4.2b + 2M	D
M2.4.2d	Climatologies of O3, CO, NO2, SO2, and HCHO columns over West Africa	36	M2.4.2b + 6M	R, D
M2.4.2e	Characterization of the chemical processing of trace gases and the link with SOA in the WAM region	44	M2.4.1a + 0M M2.4.2c + 12M	R
M2.4.2f	Determination of the impact of biogenic emissions and transport pathways on the rates of chemical processing	44	M2.4.2c + 12M	R
M2.4.3a	Preliminary assessment of mineral dust emissions from natural surfaces on seasonal and inter-annual timescales	30	M2.4.1a + 6M	R
M2.4.3b	Preliminary regional simulations of the mineral dust cycle	34	M2.4.3a + 4M	R
M2.4.3c	Estimation of the emissions factor for NOx and VOCs from natural sources (soil surface) and for particles from biomass burning	36	M2.4.2b + 6M M2.4.1a + 0M	R
M2.4.3d	Regional simulations of the mineral dust cycle including a complete size resolved emission model and a parameterization of the contribution of squall lines	42	M2.4.3b + 6M M4.3d + 0M M2.3.1a + 0M	R
M2.4.3e	Emissions inventories of biogenic emission of NOx and COVs, gas and aerosols from biomass burning and fuel consumption for use in regional and global atmospheric model. Projection for 2050-2100.	40	M2.4.3c + 6M	R,D
M2.4.3f	Assessment of mineral dust emissions from anthropogenic activities	46	M2.4.1b + 0M M2.4.3b + 12 M	R
M2.4.3g	Regional distribution of wet and dry deposition fluxes of aerosols (mineral dust and biomass burning)	50	M4.2.3f + 0M M2.4.3d + 0M	R
M2.4.4a	Identification of relevant datasets for analyses	24	M4.2.1f + 0M M4.3b + 0M	R
M2.4.4b	Report on the convective fluxes estimate and evaluation of model performance using field data	36	M4.2.1f + 10M M2.4.2b + 6M	R
M2.4.4c	Report on the convective perturbation to oxidant budgets relative to other sources over West Africa	48	M2.4.2e + 0M M2.4.2f + 0M M2.4.4b + 12M	R

Milestone N^0	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M2.4.4d	Evaluation of the aerosol properties of layers transported from West Africa	48	M2.4.1a + 24M	R
M2.4.4e	Evaluation of the TTL aerosols and chemical composition	52	M4.2.1f + 26M M2.4.2d + 16M	R
M2.4.4f	Evaluation of total convective flux	54	M2.4.4b + 0M M2.4.4c + 6M	R
M2.4.4g	Evaluation of lightning NOx emissions for West Africa and model improvement	54	M2.4.2d + 18M	R
M2.4.4.h	Impact of heterogeneous chemistry on composition during convective transport	54	M2.4.2a + 6M	R

Gantt charts for process studies

Here we do not show the Gantt chart for the Ocean process workpackage (WP2.2) as it is relatively trivial.



6.8.3 Impact Studies

WP3.1 - 5 Year Milestones

Milestone N⁰	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M3.1a	Spatial (dis-)aggregating tool to link crop models with GCM climate output available	12	Start + 12M M1.4b + 0M	P
M3.1b	Time series of regional vegetation productivity and trend analysis completed	18	Start + 18M	R+D
M3.1c	Yield gap analysis (climatic/ non-climatic factors) for Niamey field observatory completed	18	M3.1a + 6M M1.4b + 6M	P+D
M3.1d	Vegetation model for Senegal and Gourma calibrated	18	Start + 18M	P+D
M3.1e	Models for principal grain crops and vegetation validated and ready for impact studies	24	Start + 24M	R
M3.1f	Trends in crop and vegetation productivity predicted for climate change scenarios	36	M3.1e + 12M M1.1.1e + 0M	D
M3.1g	User-friendly model simulating food security scenarios	39	M3.1f + 3M	P
M3.1h	Time series of Net Primary Productivity maps for Sahel	36	M3.1d + 18M M2.3.1a + 12M	P+D
M3.1i	Modeling softwares adapted to requirements of Agrhymet forecasting system (DHC)	48	M3.1g + 12M M5.1g + 0M	R
M3.1j	Impact of climate change on crop yield and rangeland productivity simulated and translated into food security parameters	54	M3.1f + 18M M1.1.1e + 0M	P+D

WP3.2 - 5 Year Milestones

Milestone N⁰	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M3.2a	Fire practices monitored and analysed	18	Start + 18M	
M3.2b	Meta study on existing knowledge (case studies) compiled	18	Start + 18M	R + P?
M3.2c	Vulnerability assessment framework and indices defined completed	18	Start + 18M	R
M3.2f-pre	Preliminary assessment of adaptation strategies based on pilot phase of field survey in Senegal	24	M3.2c+6M	
M3.2d	Estimation of land use intensity and assessment of its relation to climatic variables completed	24	M1.4b + 12M M3.2a + 6M M3.2b + 6M	R
M3.2e	Land Use simulation model improved and “what if” scenarios build	36	M3.2b+18M M3.2f-pre+12M M3.2d + 12M	D+R

Mileston e N⁰	Brief description	Date of Milestone [Month]	Needs Input from	Type of delivera ble
M3.2f	Assessment of adaptation strategies based on field surveys in Senegal and Burkina Faso	48	Start + 48M M3.2a+30M M3.2b+30M M3.2f-pre+24M M3.1b+30M M3.1d+30M M1.4b+36M	D + P?
M3.2g	Land use modeling using climatic change scenarios	54	M1.4j+ 0M M3.1f + 0M M3.2f + 0M M3.2e + 18M M3.2f	R + D + P

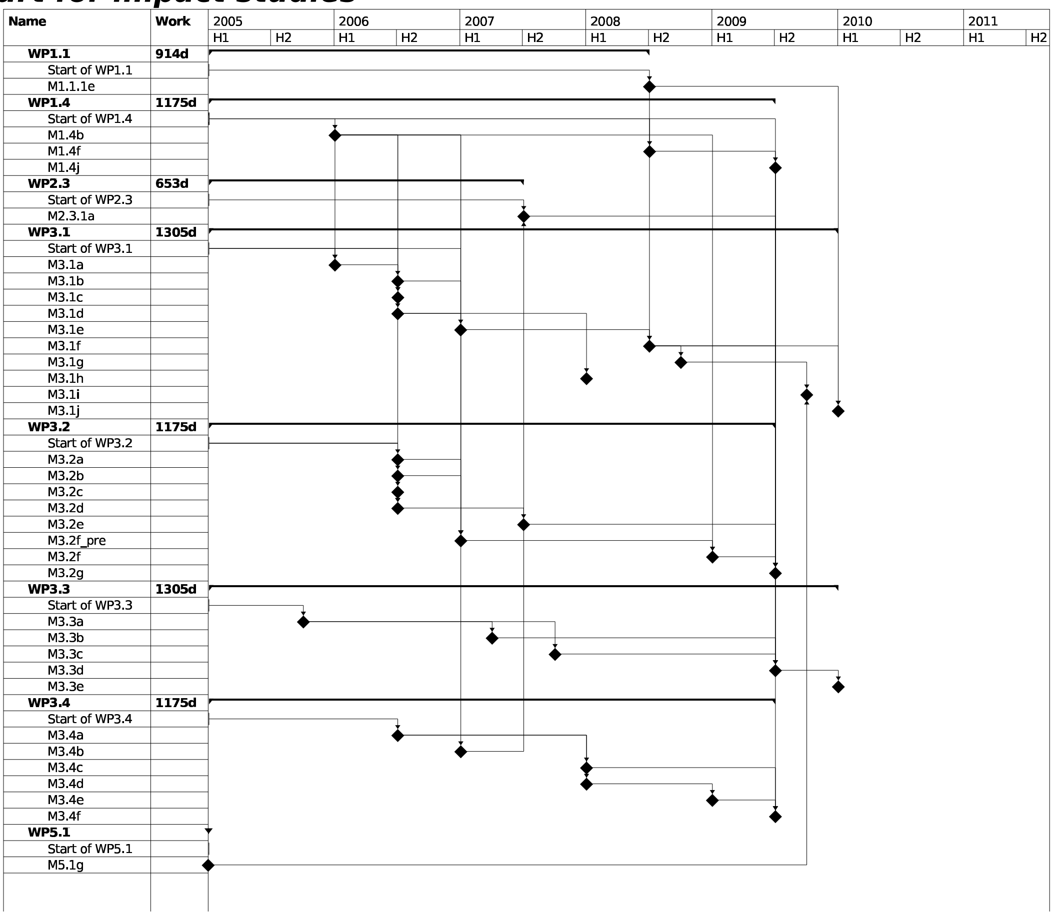
WP3.3 - 5 Year Milestones

Mileston e N⁰	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverab le
M3.3a	Data collection and analysis on rainfall, discharge, satellite images, DEMs from different sources for study basin.	9	Start + 9M	R
M3.3b	Hydrological modeling based on historical data for each basin, and satellite data. Interrelations between basin topographical attributes from different DEMs, with floods characteristics.	18	M3.3a + 18M	R
M3.3c	Analysis of digital and remote sensing data for floods characterization	24	M3.3a + 24M	R
M3.3d	Assess of hydrological response for each scenarios (GIS development. Integration of spatio-temporal information from different sources and monitoring of the flooding in a dynamical form., Application and validation of methodologies).	36	M3.3b + 18M M3.3c + 0M M1.4b + 24M M4.3b + 18M M2.3.1a +12M M3.2d + 12M	R+P
M3.3e	Assess the vulnerability and the impacts on water management for each basin (Proposal of management alternatives of floodplain, Report of final results)	60	M3.3d + 6M M1.4j + 0M M3.2g + 0M M2.3.1d + 0M	R+P

WP3.4 - 5 Year Milestones

Milest one N⁰	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverab le
M3.4a	Commencement of field data collection integrated disease vector and epidemiological data with environmental data	18	Start + 18M	R + D
M3.4b	Identification of meteorological data requirements and downscaling issues	24	M1.4b + 12M	R
M3.4c	Implementation of computer systems for analysis and modeling of data	36	M3.4a + 18M	R
M3.4d	Collation of meta-data and construction of disease database for RVF, Senegal and for activity in Niger	36	M3.4a + 18M	D+R
M3.4e	Final data set from vector and health field studies	48	M3.4d + 12M	D+R
M3.4f	Assessment of potential of current R&D ensemble forecasting systems for health impact application in West Africa	54	M3.4c + 6M M1.4j + 0M M3.4e + 0M	D+R +P

Gantt chart for impact studies



6.8.4 Tools and Methods

WP4.1 - 5 Year Milestones

Mileston e N⁰	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverab le
M4.1.1a	Monitoring system for observations (radisounding) and NWP performance in place	12	Start + 12M	R
M4.1.1b	Global forecasts provided during the SOP	21	M4.1.1a + 3M	D
M4.1.1c	Evaluation of NWP products and of the impact of AMMA radiosoundes.	36	M4.1.1b + 15	R+P
M4.1.1d	Adaptation of regional atmospheric data assimilation (3D-Var). Emphasis on moisture assimilation.	15	Start + 15M	R + P
M4.1.1e	Provide regional analysis for the SOP period	30	M4.1.1d + 15M	D
M4.1.1f	Evaluation of regional assimilation and recommendation for local NWPs	54	M4.1.1e + 24M	R + P
M4.1.1g	Definition and development of a data base to force LSMs and initiate a multi-model LDAS process.	12	Start + 12M	R+D
M4.1.1h	Inter-comparaison of different LDAS products (fluxes, soil moisture..) owing to different methods (assimilation, stand-alone runs..) and different LSMs for a pre-SOP year	18	M4.1.1g + 6M	R+D+P
M4.1.1i	Provide, compare and validate those products against AMMA observations. Different resolutions resolutions will be considered (regional to local)	36	M4.1.1h + 18M M2.3.1b + 0M	R+D
M4.1.1j	Provide final LDAS products which have benefited from EOP and SOP observations.	48	M4.1.1i + 12M	R+D+P
M4.1.2a	Definition and implementation of pertinent diagnostics of the WAM	12	Start + 12M	R
M4.1.2b	First inter-comparison of GCMs and RCMs over the region. Identify systematic deficiencies.	24	M4.1.2a + 12M	R+P
M4.1.2c	Improvement of the representation of key processes or couplings and re-run of the inter-comparison with RCMs and GCMs.	48	M2.1.1f + 0M M4.1.2b + 0M M2.3.1d + 12M M2.4.1e + 0M M2.1.3d + 0M M2.1.2h + 0M	R+P

Mileston e N^{0}	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverab le
M4.1.2d	Re-evaluation of inter-comparions. Impact of the improvements on the simulated WAM system.	60	M4.1.2c+12M	
M4.1.3a	Report on the evaluation of current CTMs and CCMs using existing data and their relative skill at simulating trace gas and aerosol distributions over West Africa, particularly during the WAM season	18	Start + 18M	R+P
M4.1.3b	Inter-comparions of models with improved process representations following the analysis of AMMA observations.	48	M4.1.2c + 0M M2.4.2a + 0M M2.4.2f + 0M M4.1.3a + 0M	R+P
M4.1.3c	Report on the evaluation of CTMs and CCMs used in the second inter-comparision.	54	M4.1.3b + 6M	
M4.1.3d	Report on the evaluation of CCMs incorporating the two-way coupling of aerosol distribution and dynamics	60	M4.1.3c + 4M	R+P

WP4.2 - 5 Year Milestones

Mileston e N0	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverab le
M4.2a	Experimental plan for LOP/EOP ready (including input from other WPs and their LOP/EOP needs)	4	Start WP4.2 + 4M Start WP1.1 + 0M Start WP1.3 + 0M Start WP1.2 + 0M	R
M4.2b	Experimental plan for SOP0 ready (including input from other WPs on their SOP needs)	7	Start WP4.2 + 7M Start WP2.1 + 0M Start WP2.4 + 0M	R
M4.2c	Experimental plan for SOP1,2,3 ready (including input from other WPs regarding their SOP needs)	10	Start WP4.2 + 10M Start WP2.1 + 0M Start WP2.2 + 0M Start WP2.3 + 0M Start WP2.4 + 0M	R
M4.2d	Final report on LOP/EOP/SOP coordination activities	36	M4.2.1g + 0M M4.2.2g + 0M	R

M4.2.1a	SOP0 - Preparation of the airborne instrumentation and the aircraft finished. Readiness for deployment.	12	M4.2b + 5M	I + R
M4.2.1b	SOP0 field phase measurements finished, quick-look data available	14	M4.2.1a + 2M	R + D
M4.2.1c	SOP0 data available from the data base	20	M4.2.1b + 4M	R + D
M4.2.1d	SOP1,2,3 - Preparation of the airborne instrumentation and the aircraft finished. Readiness for deployment.	16 17 18	M4.2c + 7M	I + R
M4.2.1e	SOP1,2,3 field phase measurements finished, quick-look data available	20 21 22	M4.2.1d + 4M	R + D
M4.2.1f	SOP1,2,3 data available from the data base	26 27 28	M4.2.1e + 5M	R + D
M4.2.1g	Report on flight operations during the SOPs.	30	M4.2.1f + 4M	R
M4.2.2a	SOP0 - Preparation and deployment of the ground based instrumentation finished	12	M4.2b + 5M	I + R
M4.2.2b	SOP0 field phase measurements finished, quick-look data available	14	M4.2.2a + 2M	R + D
M4.2.2c	SOP0 data processing finished, data available from the data base	20	M4.2.2b + 4M	R + D
M4.2.2d	SOP1,2,3 - Preparation and deployment of the ground based instrumentation finished	17 18 19	M4.2c + 7M	I + R
M4.2.2e	SOP1,2,3 field phase measurements finished, quicklook data available	20 21 22	M4.2.2d + 4M	R + D
M4.2.2f	SOP1,2,3 data available from the data base	26 27 28	M4.2.2e + 5M	R + D
M4.2.2g	Final report on SOP activities	30	M4.2.2f + 4M	R
M4.2.3a	EOP - Preparation and deployment of the ground based instrumentation finished	9	M4.2a + 2M	I + R
M4.2.3b	First LOP data available for preliminary investigations	9	Start + 9M	
M4.2.3c	Year 1 EOP/LOP data available from data base	18	M4.2.3a + 12M	D + R
M4.2.3d	Year 2 EOP/LOP data available from data base	30	M4.2.3c + 12M	D + R
M4.2.3e	EOP field phase measurements finished, quick-look data available	36	M4.2.3d + 6M	R + D

M4.2.3f	EOP data available from the data base	40	M4.2.3e + 4M	R + D
M4.2.3g	Synthesis of EOP activities and further planning for LOP finished	42	M4.2.3e + 6M	
M4.2.3h	Year 3 LOP data available from data base	42	M4.2.3d + 12M	D + R
M4.2.3i	Year 4 LOP data available from data base	54	M4.2.3h + 12M	D + R
M4.2.3j	Final report on EOP/LOP activities.	60	M4.2.3h + 6M	R

WP4.3 - 5 Year Milestones

Milestone N^0	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M4.3a	Critical review of existing satellite retrieval methods and products (atmospheric, oceanic, land surface). Choice of parameters to retrieve specially or to get from already existing data centers.	6	Start + 6M	**R** Reports (1 per type of product)
M4.3b	Assessment of the products retrieved and their quality (errors) through a first validation phase (analysis of years 2004 and 2005)	18	M4.3a + 12M M4.2.3c + 0M	**R,P,D** Reports+ Publications+ Version 1 sample data sets and maps
M4.3c	Validation using results of the in situ measurements of the SOP's (2006)	30	M4.3b + 0M M4.2.2f + 3M	**R,P** Reports+ publications
M4.3d	Production of version 2 data sets and maps, with quality indicators, for the year 2006	42	M4.3c + 12M	**R,D** Reports + data sets
M4.3e	Production of version 2 data sets and maps, for multi-annual periods (depending on satellite data available)	60	M4.3d + 18M	**R,D** Final data sets

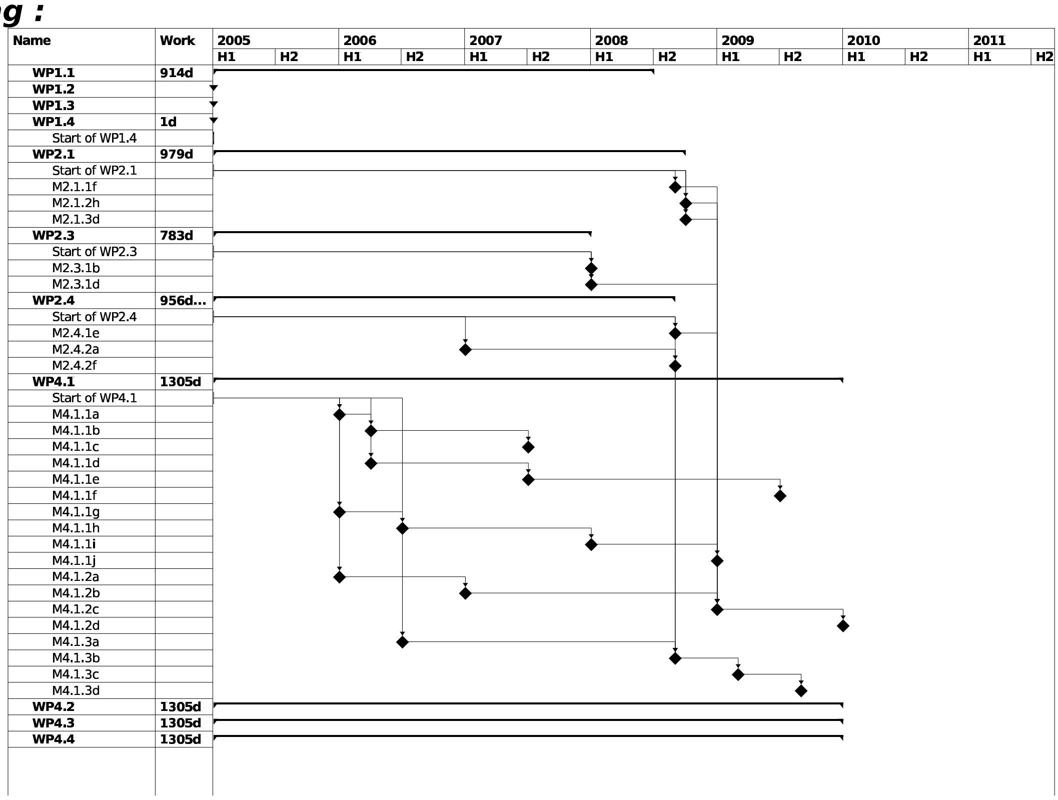
WP4.4 – 5 Year Milestones

Milestone N^0	**Brief description**	**Date of Milestone [Month]**	**Needs Input from**	**Type of deliverable**
M4.4a	List of data to be archived in the data base, and corresponding format	5	All WPs + 2M	R
M4.4b	End of development of the data bases for satellites, historical data and time series (i.e SOP data)	9	M4.4a + 4M	R
M4.4c	End of development of Meta-data base	12	M4.4b + 3M	R
M4.4d	End of design of the web site and user interface	12	M4.4b + 3M	R
M4.4e	First filling of data base with satellite data, historical data and time series. Data from the first year of EOP/LOP will be included.	18	M4.4b + 3M M4.2.3c + 0M M4.3b + 0M	R + D
M4.4f	End of development of the model data base	18	M4.4b + 9M	R
M4.4g	End of development for the website and user interface	21	M4.4d + 9M	R + D
M4.4h	Filling data base with SOP0 data	18	M4.2.1b + 4M M4.2.2b + 4M M4.4e + 0M	D
M4.4i	Filling data base with SOP1,2,3 data	26	M4.2.1e + 5M M4.2.2e + 5M M4.4e + 0M	D
M4.4j	Setting-up the infrastructure for the mirror database in AGRHYMET.	26	M4.4b + 0M M4.4f + 0M M4.4g + 0M	D
M4.4k	Year 2 EOP/LOP data available from data base	30	M4.2.3d + 0M M4.4e + 0M	D
M4.4l	EOP data available from the data base	40	M4.2.3e + 4M M4.4e + 0M	R + D
M4.4m	A first set of model results in data base	26	M4.1.2b + 2M	
M4.4n	Filling (models, new data) / updating data bases (data reprocessing), update meta data base, website, user interface	42	M4.4m + 16M M1.1.1c + 0M M1.1.1d + 0M M1.1.1e + 0M	D
M4.4o	Update of data bases, update user interface; data base mirror installed in AGRHYMET	48	M4.4j+ 22M	R + D

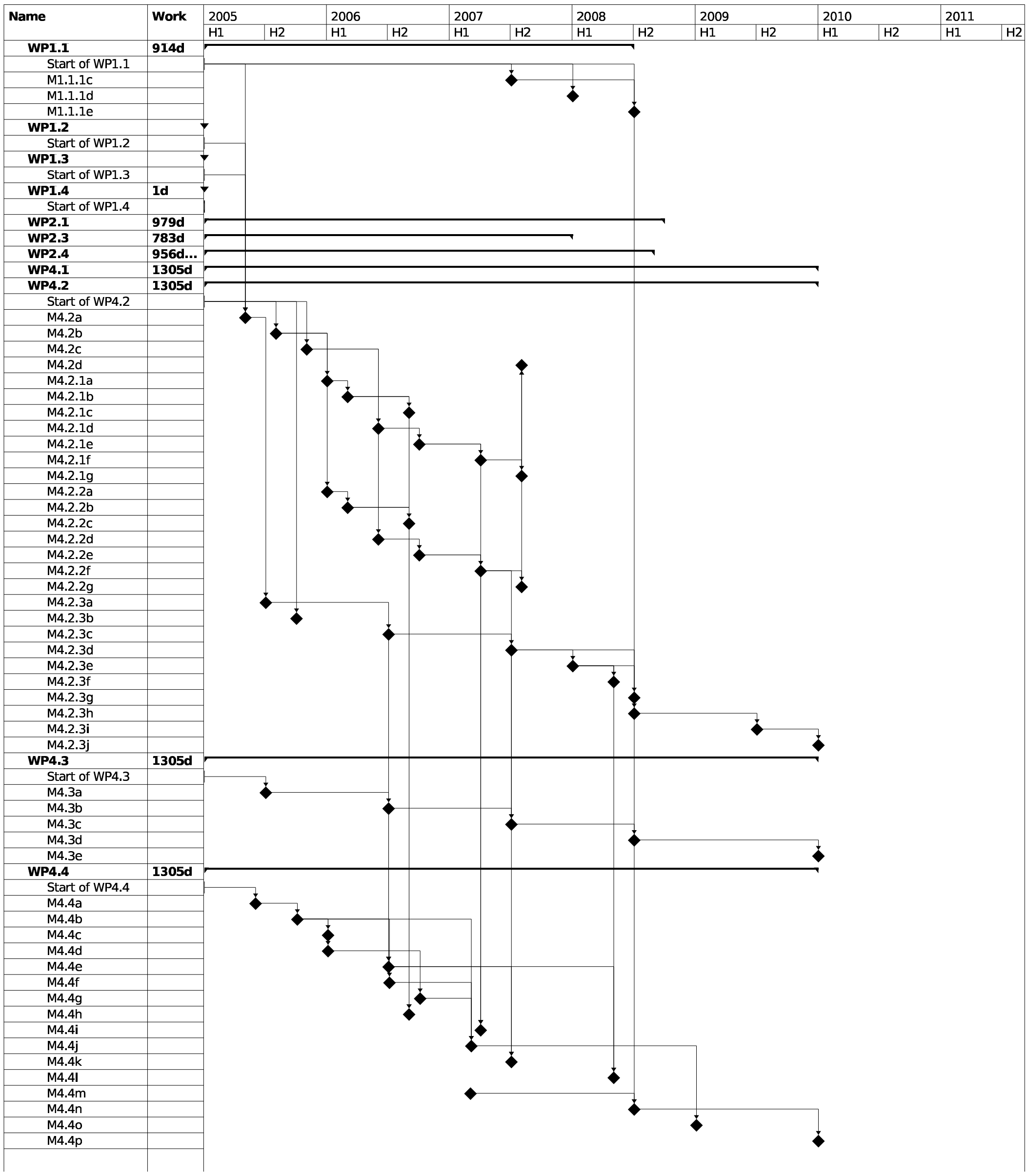
Milestone N⁰	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M4.4p	Final updates, and report	60	M4.4n + 18M	R + D

Gantt chart for Tools and Methods workpackages

Modelling :



Observations, Remote Sensing and Database :



6.8.5 Demonstration activities

WP5.1 – 5 Year Milestones

Milestone N^0	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M5.1a	Forecast skill evaluation systems ready to compute performance of numerical weather forecasting for the AMMA area and to be used during the SOP; including contributions from African weather forecasters knowledge to establish a list of relevant diagnostics.	18	Start + 18M M4.1.2a + 0M	Electronic published results on a monthly basis of ECMWF 1-10-day forecast performance for precipitation, ITCZ evolution, wind profile, surface temperature, humidity and cloud cover R on forecasting models evaluation system tailored to West African weather systems
M5.1b	First evaluation of statistical predictive schemes.	18	Start + 18M	R + participation to PRESAO forum + D (forecasts made available for the “Impact” community) Validation R
M5.1c	First results on data assimilation experiments with and without additional AMMA data	36	M4.1.1.c + 0M M4.2.2f + 0M M4.4i + 0M	R
M5.1d	Set-up of limited area models and protocols for the forecast demonstration, for various meteorolo-gical fields including 10-15 km resolution 6 hourly precipitation field over the AMMA area.	30	M4.1.2b + 6M M4.4i + 0M	
M5.1e	Evaluation of progress in ECMWF numerical forecasts.	48	M5.1a + 24M M4.1.2c +0M M4.4l + 8M	R on the added value related to ECMWF in weather forecasting over West Africa
M5.1f	Evaluation of improvements of the statistical predictive schemes carried out through the use of AGCM outputs (statistico-dynamical models).	48	M1.1.3f_pre + 0M M1.1.1f + 0M	P + participation to PRESAO forum + D (forecasts made available for the “Impact” community)

Milestone N^0	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M5.1g	Production of daily forecasts during the demonstration period.	48	M5.1e + 6M M4.1.2c + 0M M4.4i + 0M M4.4l + 6M	Data and graphical maps R on the added value related to the limited area model approach in weather forecasting over West Africa
M5.1h	Analysis of the results of the limited area model applica-tions in the forecast demonstration period.	54	M5.1g + 6M M4.4l + 0M	R, P
M5.1i	Final evaluation of the skill of the ensemble of improved weather and seasonal forecasts as well as of the statistical predictive schemes. Recommendations for future observational network	60	M1.1.1g + 0M M1.1.3g + 0M M5.1h + 6M M4.4n + 0M	R, P on updated of weather and seasonal forecasting methods for the AMMA area

WP5.2 - 5 Year Milestones

Milestone N^0	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M5.2a	Up to date analysis of existing EWS for food security in the West Africa available	48	Start + 48M	R
M5.2b	Inventory and description of existing “Structural Vulnerability” mapping systems for food security in West Africa completed	48	Start + 48M	R
M5.2c	Inventory and description of existing “Current Vulnerability” products in WA	48	Start + 48M	R
M5.2d	Analysis of AMMA products for update of Structural Vulnerability mapping context available	54	M1.1.1.e + 12M M1.4.j + 0M M3.1.j + 0M M3.2.c + 36M M3.4.f + 0M M4.3.d + 24M M4.4n + 0M	R

Milestone N0	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M5.2e	Analysis of AMMA products for update and improvement of Current Vulnerability analysis available	54	M1.1.3.i + 36M M3.1.i + 0M M3.4.f + 0M M4.3.d + 6M M4.4n + 0M M5.1.1 + 0M	R
M5.2f	Update of existing Structural Vulnerability mapping context integrating AMMA products implemented	60	M4.4n + 0M M5.2.d + 6M	R + D
M5.2g	Test integration of AMMA products (crop modelling, seasonal forecasting, rainfall estimates) into Current Vulnerability analysis available	60	M4.4n + 0M M5.2.g+ 9M	R + D
M5.2h	Operational inputs for the food crisis prevention process at regional scale are available	60	M.5.2.f +0M M5.2.g + 0M	R + D + P

6.8.6 Training and education

WP6.1 – 5 Year Milestones

Milestone N0	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M6.1a	Installation / activation / upgrade of radiosounding equipment and connection to GTS	12	M4.2a + 8M	R
M6.1b	Installation of flux stations	12	M4.2a + 8M	R
M6.1c	Monitoring of the radiosounding network	18	M6.1a + 6M	R + D
M6.1d	Assessment of performed soundings during SOP	30	M4.2b, M4.2c	R
M6.1e	Monitoring of the radiosounding and flux station network	36	M6.1c + 18M	R
M6.1f	Monitoring of the radiosounding and flux station network	48	M6.1e + 12M	R
M6.1g	Monitoring of the radiosounding and flux station network	60	M6.1f + 12M	R

WP6.2 - 5 Year Milestones

Milestone N⁰	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M6.2.a	First summer school (general science with focus on Tools)	12	Start WP2.X+ 12M	R
M6.2.b	First application Workshop (focus on food security including environmental aspects)	18	Start WP3.1 + 18M	R
M6.2.c	Second application workshop (Focus on Health applications including environment aspects)	24	Start WP3.4 + 24M	R
M6.2.d	Second summer school (Focus on Outreach)	36	Start WP3.X + 36M	R

6.8.7 Management

WP7.1 - 5 Year Milestones

Milestone N⁰	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M7.1a	Site visit with verification of infrastructure at the airports	SOP -12M		R
M7.1.b	Informing authorities of all countries to be overflown.	SOP - 12M	M4.2b + 0M M4.2c + 0M	R
M7.1c	Preliminary flight plans provided to the authorities.	SOP - 6M	M7.1.b + 6M	R
M7.1d	Final flight plan communicated to local authorities	SOP -0.5M	M4.2.1a + 0M M4.2.1d + 0M	R
M7.1e	Upgrade plan for radio-sounding network ready and call for tender.	0		R
M7.1f	Choice of subcontractor for network upgrade	3		R
M7.1g	Upgrade of initial radio-sounding stations	6		R
M7.1h	Report on selected mesoscale sites and super-sites with an initial plan for instrument deployment.	4	M4.2a + 0M	
M7.1i	Selection of local contact points for site monitoring.	6	M7.1h	
M7.1j	Regular reports on site status and feedback from local partners.	12/24/36/48	M7.1i	

WP7.2 - 5 Year Milestones

Milestone N⁰	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M7.2a	Progress reporting to the Commission and partners	M6/12/18/24/30/36/42/48/54/60	All WPs	R
M7.2.b	Report scientific deliverables	M6/12/18/24/30/36/42/48/54/60	All WPs	R
M7.2c	Convening the Governing Board	M9/21/33/45/57		R
M7.2d	First AMMA conference	10	All WPs	R
M7.2e	Second AMMA conference	34	All WPs	R
M7.2f	Scientific publications monitoring	12/24/36/48/60	All Partners	R
M7.2g	Briefing of the media	12/24/36/48/60		R
M7.2h	Gathering final report of WPs and starting the editorial work on the final report.	M57	All WPs	R

WP7.3 - 5 Year Milestones

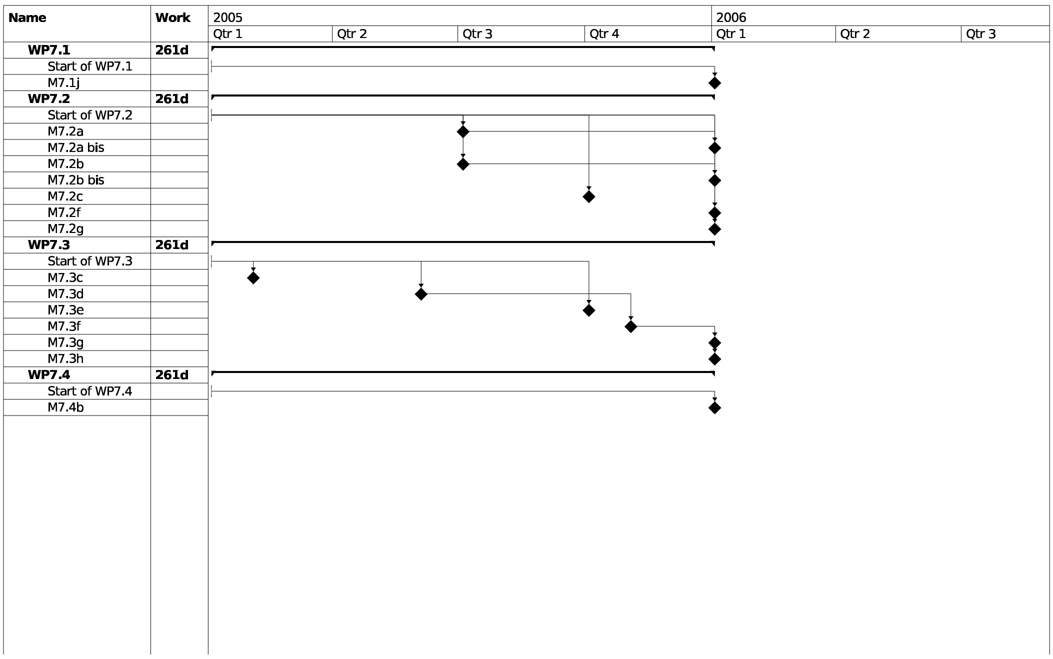
Milestone N⁰	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M7.3.a	Signature of the negotiation forms, notification of the contract, kick off meeting	0		R
M7.3.b	Management plan (draft and final version)	0+3+6		R
M7.3c	Distribution of the EC funds	M1/12/24/36/48		R
M7.3d	Request for intermediate cost statements	M5/17/29/41/53		
M7.3e	Report to the GB on the implementation of the gender plan	M9/21/30/39/54/		
M7.3f	Request for full the cost statements	M10/22/34/46/58	Financial statements & audit certificates of the contractors annual financial rporting and cost breakdown templates	
M7.3g	Transmission of the financial reporting and collection of financial information (cost claims, audit certificates)	M12/26,/36/48/60	Financial statements and audit certificats	
M7.3h	Management of funds	M12/26/36/48/60	Annual financial reporting and cost breakdown table	R
M7.3i	Start of work on the final financial and administrative reports	M57	Financial reports from partners	R

WP7.4 - 5 Year Milestones

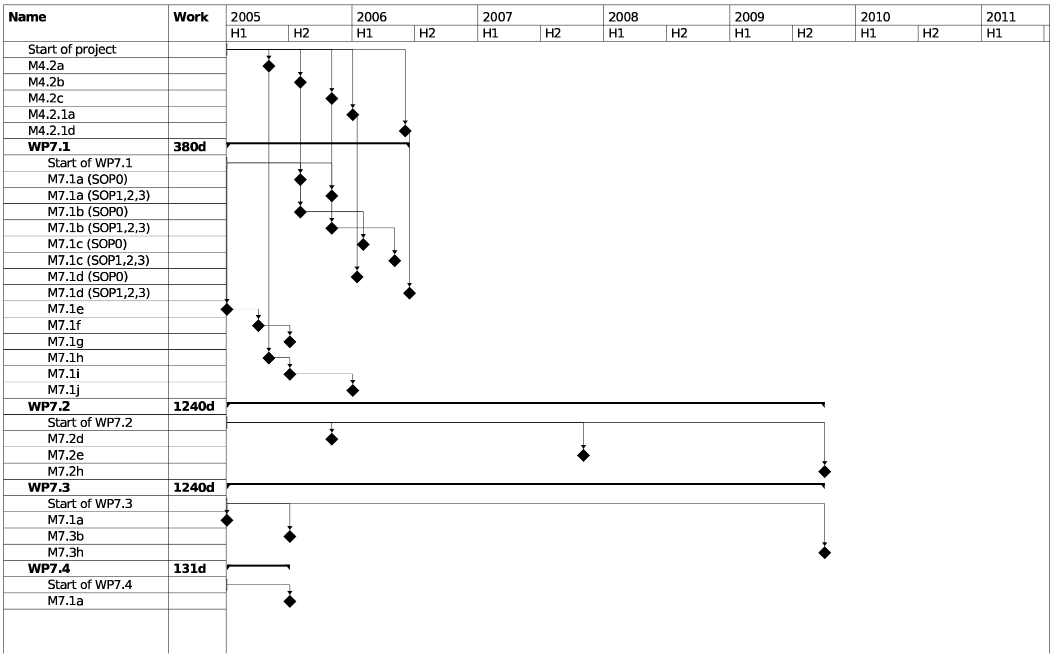
Milestone N^0	Brief description	Date of Milestone [Month]	Needs Input from	Type of deliverable
M7.4a	Definition of procedure for implementing the IPR rules defined in the Consortium Agreement.	6	Exchanges within the consortium and legal representatives of the partners WP 4.4	R
M7.4b	Strategy for use and dissemination	M12/24/36/48 /60	Exchange with the consortium and the IPC WP 4.4	R
M7.4c	Start of the collection of data and information for the final report.	M58	All partners	R

Gantt charts for Management activities.

Activities occurring each year :



Activities occurring once over the 5 years of the project :



7. Project management

7.1 Organisational, management and governance structure

Most importantly, the AMMA IP organization is not an end in itself, but an efficient way of working together to achieve our European objective. The likelihood is that we are going to work long hours and dedicate a huge amount of our time to the AMMA organization, which makes it particularly tragic that our organization is operating inefficiently and doesn't meet its expectations. For such a reason, it was imperative for us to develop an ideal and intelligent organization for such an Integrated Project with a coherent and strong management structure, one that is efficient, able to support our ambitious objectives and the large number of participants, also capable of learning, and sensitive to the well being of every of its participant within the project all at the same time.

First of all, we need to do that in an intelligent way, by taking into account the perspective of the EC, the participants and all the stakeholders that interact with our organization.

Second of all, we believe that by improving the process for performance, competence, and knowledge management, we will be able to find concrete answer to advance on our way towards our intelligent organisation, which means also being capable of continuous renewal, of anticipating changes, of learning fast and the last but not least, capable in a very efficient way to reach our targets.

Last but not least, AMMA will base its Work-Package management upon the principles, processes of the European Management standard **ISO10006**, which we consider as the basis and the tool for the successful management and integration of our different Work-Packages.

One of the general principles of our intelligent organisation is its simplicity, which aspires to reduce, crystallise, focus, and see issues in their entirety.

For all the reasons above, we have come to the following management structure, which is split up into three types of management:

- **The Competence and Strategic Management (Governing Board)**

  This Board is AMMA consortium's decision-making and arbitration body as well as its competence management. Also, this Board will define the core competencies and other necessary skills to achieve the vision, strategy and objectives of the IP, it will give a direction to our action and answers the possible road to proceed from present into our vision.

- **The Performance and Executive Management (Executive Committee)**

  This committee is AMMA's work-packages implementation management. It will emphasize on performance, which steers our daily actions and answers the question on how to implement in very efficient way the targets set and on how to meet them. This committee will link this performance to objectives implementation, reviewing, coaching, evaluation and development in an on-going process in which everyone knows their tasks and individual objectives within the whole project, what kind of competence is expected of them, and make sure that every participant will get enough coaching and feedback.

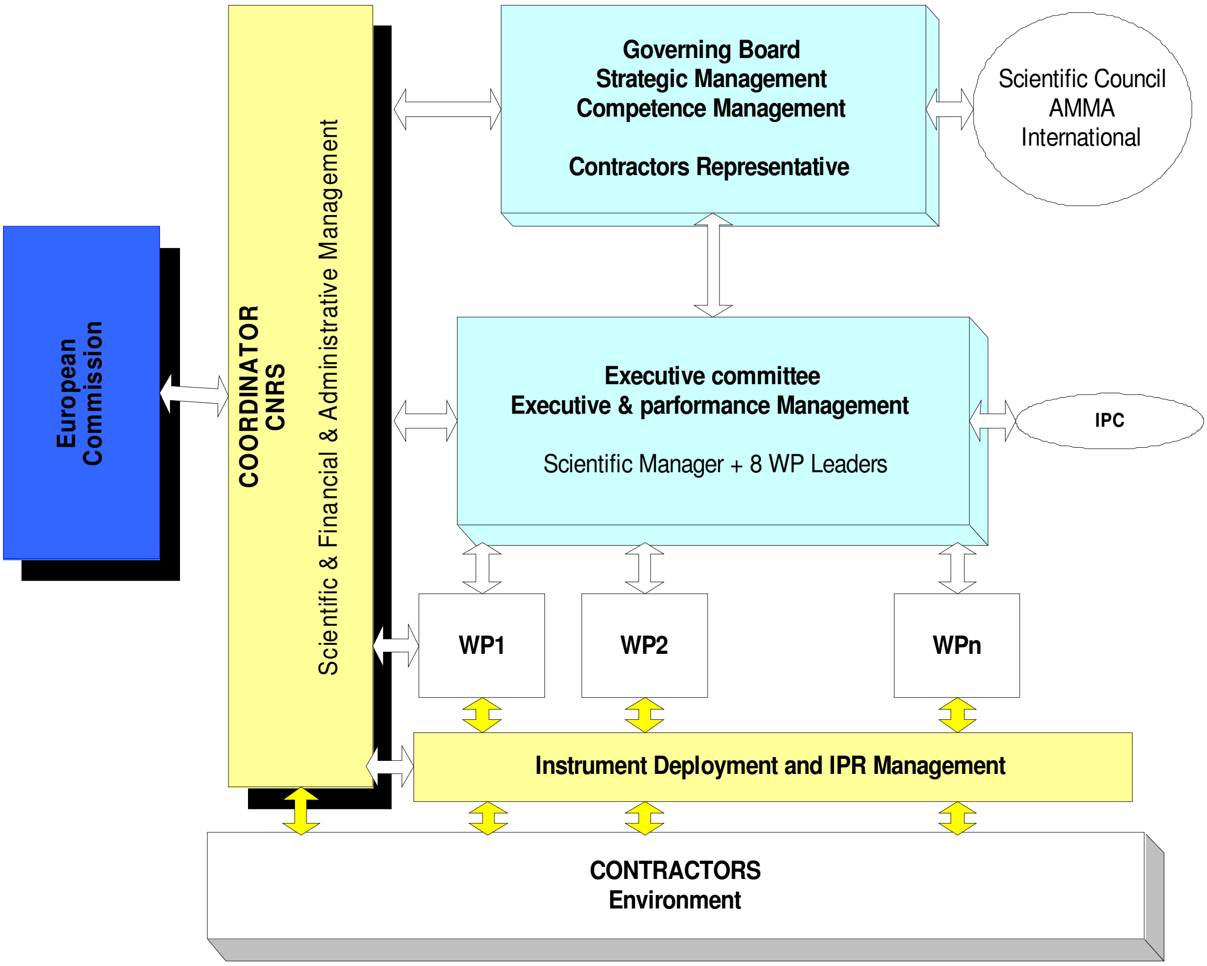
- **The Knowledge Management (IPC)**

  The Intellectual Property Committee will oversee the dissemination of knowledge within the consortium and regulate the distribution of knowledge to the outside and facilitate the access to outside knowledge for the partners. It propose rules of conduct and policies to the governing board.

- **Operational Management**

  This part is AMMA's administrative and financial Management including interface with the EC. It implements also the Knowledge Management, which is a process where we create, store, share and apply AMMA’s knowledge. Its goal is the rapid application of knowledge in decision-making and we will make sure that knowledge is available to everyone and make sure its Socio-economic impact willmeet the EC and our objectives all at the same time.

Figure 7.1 : The Governance Structure



The Competence and Strategic Management : Governing Board (GB)

This management level consists of the Governing board (GB), which is the AMMA Consortium's decision-making as well as the arbitration body. Conceptual thinking and rooting such ability at every level of the organization are done at this level, which means that it looks at our compass all the time, and not just once a year. Such strategic thinking is widespread and strategies are constantly being discussed and evolved within the GB. It insists also on competence management, which helps to determine the most effective techniques, new approach offering a comprehensive as well as effective way of developing the organization's capital in the context of its strategy. In another words, it also decides the critical competence that is needed to meet the IP's objectives.

The GB members will be composed high level representatives of each participant organization with political and strategic orientation character. Their other main role is to oversee the integration of the participants' activities and to make high-level decisions in each organization in order to adapt management structures and accelerate integration. They make sure that the adopted strategy is respected in order to reach excellence.

The chairperson of the governing board is elected by majority of 75% of decision of the representatives among the members of the Governing board.

The Governing Board is assisted in its tasks by the scientific councils (see below).

On a detailed point of view, the Governing Board shall decide, inter alia, on the following matters:

•political and strategic orientation of the Project;

•the Consortium's "Implementation Plan" and "Plan for using and disseminating the Knowledge" as well as the Consortium's budget and the financial allocation of the EU's contribution between the various activities on the one hand, and between the various Contractors on the other;

•approves start-up, suspend and abort decisions of projects

•modifications to the “Implementation Plan”, including, but not limited to, decisions to abandon a research programme or to reduce the budget allocated to it;

•the Governing Board may decide either the inclusion of a new participant or withdraw al of a Contractor after the signature of the EC Contract;

•the Governing Board decides on the commitments proposed by the Executive Committee;

•the Governing Board is the arbitration body for all decisions of the Executive Committee.

•the Governing Board is the decision-making body for any issue concerning the proper operation of the Consortium.

•overseeing the promotion of gender equality in the project.

•resolving escalated issues related to cross-functional working

•Ultimate decision forum for all major problems and issues

The Performance and Executive Management: Executive Committee (EC)

The Executive Committee is a very important decision level within the AMMA management organization and is composed of eight (8) Work-Packages Leaders chosen amongst the WP Leaders and ex-officio of the scientific manager designated by the coordinator.

Unlike traditional organizational situation in which horizontal command and control structures predominate, and a hierarchical (ascending and descending) decision is long and heavy, we have set up a much more adaptive structure, which provides the Executive Committee a close, rapid and intimate contact with the WP Leaders. Such a structure enables the communication overhead to be cut and the communication as well as decision making process to occur much more quickly than it would if the executive committee had to see every item from every Work-Packages Committee before passing it to the WP Leaders, and then to the participants.

Furthermore selecting the executive committee members from the WP-leaders ensures that the performance monitoring is performed by peers. Such an evaluation form is traditional and has proved its efficiency in the scientific community.

Also, at this level, the process of performance management will be used to steer operation. Planning and development discussions and daily leadership are the single most important tool for such a performance management. They would be different types of planning and development discussions on objectives and results.

We also intend to promote feedback culture, which also support open dialogue, open discussion that promotes the ideas.

Their objective is the evaluation, planning and development of the performance of the WP. The following are the concrete objectives:

§ review the status of all active tasks within WP

§ Measuring and monitoring progress

§ Cost control, annual validation of the realised expenditure in accordance to the budget;

§ evaluate the result achieved

§ set objectives for the next working period

§ refine the work plan

§ develop the co-operation between Executive committee and WP leaders , WP leaders – partners participating in WP

§ ensuring environmental influences are taken into account (internal and external)

The executive committee will meet at least once every six months or more often, should special issues be discussed. The chairman of the Executive Committee is elected by the Governing Board

Scientific council (SC)

In order to ensure a good integration of the AMMA Integrated Project into the International Organization, of AMMA the Scientific Council will bethe Scientific Steering Committee from the AMMA international Organization.

The Scientific Council is a scientific evaluation consultative body:

- § it advises the Governing Board on project orientations and strategy;
- § it evaluates the program of Work-Packages for the project as well as the results obtained;
- § it may be consulted by the Governing Board on any scientific issues;
- § it may make any proposal or transmit any information it deems useful to the Governing Board.

Choosing the AMMA International Scientific Steering Committee ensure that the AMMA EU Integrated Project will be well coordinated with the other activities planed over West Africa.

The Intellectual Property Committee (IPC)

The IPC is appointed by the governing board among the specialists of IPR services in the different organizations members of the AMMA. The IPC is in charge of helping WP leaders to identify knowledge that could be the subject matter of protection, use or dissemination based on contemplated publications and activity reports issued by activity leaders. It will assist the Executive committee in the implementation of measures in connection with publications and protection of knowledge and their dissemination. In another words, the IPC will deal with the protection of the knowledge resulting from the project including patent searches, filing of patent (or other IPR) application.

The committee is in strong relationship with the legal and IPR integrative process and submit an annual report to the executive committee and governing board.

The IPC will also carry out any negotiation on access rights for external data that the consortium needs to carry our its work.

The role of the IPC is described in such tems in the Consortium Agreement :

- The IPC shall choose one person from among its members to attend meetings of the Governing Board on an advisory basis.
- The IPC is in charge of proposing to the Executive Committee the updating of the Pre-Existing Know How needed to the Project.
- The IPC is in charge of proposing data policy and distribution, to be submitted to the Governing Board for approval.
- The IPC establishes and reviews the Plan for Use and Dissemination of the Project to be submitted to the Governing Board for approval.
- The IPC identifies Knowledge that could be the subject matter of use or dissemination by decision of the Executive Committee, based on contemplated publications and activity reports issued by Work-Package Committees.
- It shall assist the Executive Committee in the implementation of measures in connection with publications and dissemination Knowledge.
- It shall submit a proposal together with the Executive Committee to the Governing Board on the allocation of co-ownership shares over Knowledge obtained by several Contractors for decision by the Executive Committee.
- It shall assist the Governing Board in the settlement of disputes which may arise amongst Contractors regarding publication procedure set forth in article 9.2 of the Consortium Agreement.
- At the request of the Executive Committee, it shall conduct freedom-to-operate studies and propose solutions to any issue arising from intellectual property matters. When asked by the Governing Board and/or Contractor(s), it may negotiate Access rights to external data needed

by the Consortium for the Project.

- The IPC shall submit an annual report to the Executive Committee and to the Governing Board.
- It shall validate communication actions carried out in the name of the Consortium and, in case of any problem, refer it to the Executive Committee for arbitration.

The Operational Management

AMMA Coordinator (CNRS): The consortium has agreed to entrust the position of Coordinator to Contractor CNRS, which will run the financial and administrative management of the AMMA Integrated Project.

The CNRS is the contractor providing the interface between the consortium and the European Commission. They will assume coordination tasks of the consortium by maintaining contact and communication with the Commission in addition to its charge of the financial and administrative aspects of the contract.

For such a purpose, the CNRS has designed a two heads management working in complementary and close collaboration. Indeed, the CNRS will appoint a **Scientific Manager** for all the science coordination and a **Project Manager** for the administrative and financial part.

Scientific & Work-Package Management (WP7.2)

Scientific Manager

The Scientific Manager (SM) is the head of the Executive Committee.

The SM is in charge of:

– steering the scientific work

– defining and manage the deliverables production process

The SM is particulary responsible for:

- monitoring and implementing by Work-Package Leaders (WPL) the decisions taken by the Executive Committee.
- deploying the decisions and the plan decided by the executive committee
- running the day to day integrative management and the deployment of the necessary procedures and the plan, the monitoring and the control of the necessary actions for a consolidation of the different WPs.
- coordinating of the technical activities of the project, which includes the overseeing science and society issues related to the research activities conducted within the project.
- running also the implementation of competitive calls by the consortium for the participation of new contractors, in accordance with the provisions of the contract.

Work-Package Leaders (WPL)

A Work-Package leader is elected for each Work-Package involved in the detailed co-ordination, planning, monitoring and reporting of the Work-Package and for the detailed communication with other work-packages.

More specifically, Work-Package leaders are responsible for:

§ leading the Work-Package including technical and management activities;

§ continuously monitoring the progress of the participant tasks, controlling its efficiency;

§ reporting WP/task activity to the whole consortium in a bimonthly Newsletters;

§ ensuring that milestones and deliverables of the WPs are fulfilled;

§ providing the planning of the remaining work as well as the progress evaluations

§ organizing, if needed, special meetings to determine suitable measures to be taken.

Each Work-Package leader will manage his/her WP according to the **ISO 10006** project management principles in which processes design the correlated or interactive activities, which turn input data into output data. All levels of decision and action, management of WP, follow the continuous process improvement principle towards Excellence represented by the Deming wheel or the PDCA : Plan Do Check Act.

The Work-Package Leader team has already been structured and a list of names have already been proposed.. The table below provides the names of the scientists who have accepted to be candidate for a Work-Package leadership.

The Team Project Management (WP7.3)

The **Scientific Manager** will be assisted in his every day tasks by a management team headed by a Project Manager. The CNRS considers that Project Management is simply the most effective way to get works well performed.

The management team and its Project Manager are responsible for:

5.managing the administrative, legal, financial and other non-technical aspects of the AMMA integrated Project.

6.checking that flows of funds are in accordance with the Consortium Agreement and the decision of the Governing Board and Executive Committee,

7.reporting any matters to the Scientific Manager.

8.the implementation and the improvement of every day management and consolidates the necessary information necessary for progress monitoring and assessment of results.

9.providing the baseline for progress measurement and control and to establish requirements for quality practices such as documentation, verification, recording,

10.setting up of traceability, reviews and audits throughout the project

11.coordination of knowledge management and other innovation-related activities (including IPR Management);

12.being part of the management of contractual commitments including negotiation of contracts, agreements and amendments,

13.obtaining audit certificates by each of the contractors

14.preparing financial report

15.assisting the Executive Committee in the steering of the project (follow-up of planning schedule, issue reminders for task initiation or completion, etc.);

16.assisting the Scientific Manager (SM) in preparing project deliverables;

17.assisting the Executive Committee in implementing the competitive selection procedure for new contractors;

18.ensure the maintenance of the consortium agreement

19.obtaining any financial security such as bank guarantees when requested by the Commission ;

20.Help desk of the consortium the implementation and the improvement of every day management and consolidates the necessary information necessary for progress monitoring and assessment of results.

7.2 Knowledge Management and Innovation related Activities

The Management team will carry out the Knowledge and IPR Management Plans, described in section 6.5, by the following activities :

7.2.1. Communication Plan and Knowledge Management

The Management Team will design an appropriate communication plan to encourage effective communication and cooperation between all participants in the project. A sufficient communication is a crucial success factor of projects. Therefore, we are going to structure a communication plan that will define the information that will be formally communicated as well as the frequency of communication. The media used to transmit this communication will be the network web-site (www.amma-ip.org),which is primarily an enabling force.

This communication plan will define the following and strongly contribute to the Knowledge management described section 6.5.1:

•the frequency, timing and purposes of meetings

•the format, language and structure of documents to ensure compatibility

•the information management system,

•identification of who will send and receive information and reference the relevant document control and security procedures.

•the format for progress reports, which will help to highlight any deviations from the project plan.

•the exchange of information necessary for the project.

•information management: making necessary information available to project organization members and other relevant stakeholders;

•communication control: controlling communication in accordance with the planned communication system.

7.2.2. Support to IPR Management Plan

The IPR management is handled and carried out by the IPC as described in the Consortium Agreement. The PM follows the work of the IPC and the implementation of the WP7.4. This shall include :

- updated the list of knowledge in the project following IPC meeting and if applicable PEKH updated
- updated list of dissemination material (publications, thesis...) and obtain authorizations from partners for publications
- information to the EC on dissemination and integration efforts and achievements in the consortium
- dissemination and use plan, including updated half-yearly progress report

7.2.3. Monitoring and reporting progress

Every three months, each WP Leader will submit to the AMMA Scientific Manager as well as to the Head of executive Committee short summary of the progress of the different aspects of the project on the basis of a regularly updated detailed planning. The reporting includes information about the technical progress, results obtained (e.g. Deliverables), unexpected difficulties encountered and the compliance with the work-programme.

The progress status of each task will also be reported in terms of percentage of completion, estimated time for completion, actual person-months spent and person-months needed to complete the task and all the information at management level (resources, costs, delays, etc). The Early report of unexpected difficulties by WP Leader to the executive committee will allow it to the precautionary measures and seek advice from the Governing board.

The management team (SM and PM) will summarise the overall project status and planning. At the end, they will also regularly update the bar chart and the person-power matrix using the data he receives from the partners.

This second three-month report will be the basis of the six-month periodic report described below.

Different kinds of reports will be supplied by the WP Leader to AMMA Coordinator Team and through them to the commission. The executive committee will examine these reports. **Periodic Progress reports** (half-yearly) will be prepared by each Work-Package leader (on technical and on a financial point of view). A financial report (half-yearly) will be delivered by each representatives of the partner institutions to the AMMA Coordinator Team in order to draw up a **Financial Report** that will then be submitted to the EC. For each type of report, the management team will prepare a consolidated version. In addition, the integrated project will provide both an **Assessment report** (yearly) and a **Final Report**.

8. Detailed implementation plan – first 18 months

8.1 Introduction

The detailed implementation plan for the first 18 months period is structured in the same way as the general implementation plan (B4), outlining the deep and tight integration levels which will be reached in the very first period of AMMA: i) within each WP, ii) between the WP.

The works presented in paragraph B8 constitute the first steps, defining intermediate objectives and tasks which we intend to reach and which will lead us to reach our global objectives.

The implementation plan for the first 18 months is organised to allow a fast pick up of joint work essentially within WP. For this purpose, our main focus is to kick off smoothly and efficiently the management system, which we think is the basis for a solid advancement of the project. Such a system includes Day to day Management as well as administrative management, financial management and most importantly Scientific Management and WP Management.

At an early stage, just once the project is under way, WP Leaders will assess how every WP is faring against objectives and time targets. Regular progress reports, meetings, identification of milestones that measure the progress will be carried out. The objective is to assure that all tasks including the planning, organizing, monitoring and controlling of all aspects of the project are run in a continuous process, which will allow the creation of the right project win-win environment for all participants.

Strong Review meeting will be held very frequently at the start and they will be on a regular basis throughout the life of AMMA project to discuss about progress and achievement of marked milestones.

We will run those meeting effectively to encourage teamwork and provide all involved with an accurate picture of how the project is faring.

Within the first 18 months, we will make sure that anyone responsible for an activity or a milestone must report on progress (participant to WP Leaders, WP Leaders to Executive Committee) and we will encourage the team to take reports seriously and to submit them on time. Those reports will record the current state of the activity, achievement since the last report, and potential problems, opportunities, or threat to milestones.

Within this first 18 months, we will stress also on communications, indeed, the better the communication, the smoother our AMMA project will flow. We will make sure that everyone who needs it has easy access to project information, and we intend to encourage two-way communication by listening and asking for feedback. We will make sure that everyone has easy access to key project information whenever they need it. Such information will be available on our portal, which is already up and running.

The management will ensure that project data is kept up to date, and recorded efficiently by setting up a knowledge centre.

Significant risks and contingency plan for these :
First of all, change is a risk factor within AMMA for those who are not used to such a program. Flexibility is vital contingency plan for change, some resisting force such as poeple’s resistance to change, the weight of current workload, lack of information are all risks to the project. Indeed, how partners will develop as the project progresses, how can we gain the commitment of all concerned are all factors we take seriously and intend to tackle during the first 18 months. Therefore, we will make sure that the project will start with a well flourish and we will focus everyone on the plan.

A plan to implement an efficient monitoring system, which is vital for a project as ours, without it the project might be thrown off-course. In all cases, as problem can occur once we start to operate in the real world, we encourage the partners to raise any concerns, and we will use the discipline of problem-solving techniques to tackle the difficulties as they arise.

The major priorities that will be treated during the first 18 months can be summarised as follows:

- Integration of the Integrative Sciences as well as process Studies.
- Impact Studies
- Integration of development of tools and methods
- Integration of specific action programme for training, education, and dissemination of selected information.
- Clarification of the patent situation in fields that are relevant to AMMA and creation of the IP rules

8.2 Planning and timetable

WP N°	WORKPACKAGE TITLE	months Leader	3	6	9	12	18
Process Integration							
WP1.1	West African monsoon and the global climate	U.Koln		D		D	D
WP1.2	The water cycle	CNRS		D		D	D
WP1.3	Surface-atmosphere feedbacks	CEH				D	D
WP1.4	Scaling Issues in the West Africaan Monsoon	IRD		D	D	D	
Process Studies							
WP2.1	Convection and atmospheric dynamics	Uni Leeds				D	D
WP2.2	Oceanic Process	CAU				D	
WP2.3	Physical and biological processes over land surfaces	FZK		D		D	
WP2.4	Aerosol and Chemical processes in the atmosphere	UEA			D	D	D
Impact Studies							
WP3.1	Land Productivity	CIRAD					D
WP3.2	Human processes, adaptation and environment interactions	IGUC		D		D	D
WP3.3	Water resources	AGRHYMET				D	
WP3.4	Public health	UniLIV		D			D
Tools and Methods							
WP4.1	Model development and application	CNRM				D	D
WP4.2	Field Campaigns	DLR	D	D		D	D
WP4.3	satellite Remote Sensing and ancillary data	CNRS			D	D	D
WP4.4	Data base and historical data	CNRS		D		D	

Demonstration							
WP5.1	Seasonal to Climatic forecasting	CNRS					D
WP5.2	Socio-economic early warning systems	IBIMET					
Training and educations							
WP6.1	Environmental monitoring	Vaisala	D	D		D	
WP6.2	University programs and summer schools	Medias				D	D
Management of activities							
WP7.1	Instrument deployment management	IRD			D	D	
WP7.2	Scientific management	CNRS		D		D	D
WP7.3	Financial and Administrative Management	CNRS	D	D		D	
WP7.4	Intellectual property, knowledge and data management	CNRS				D	

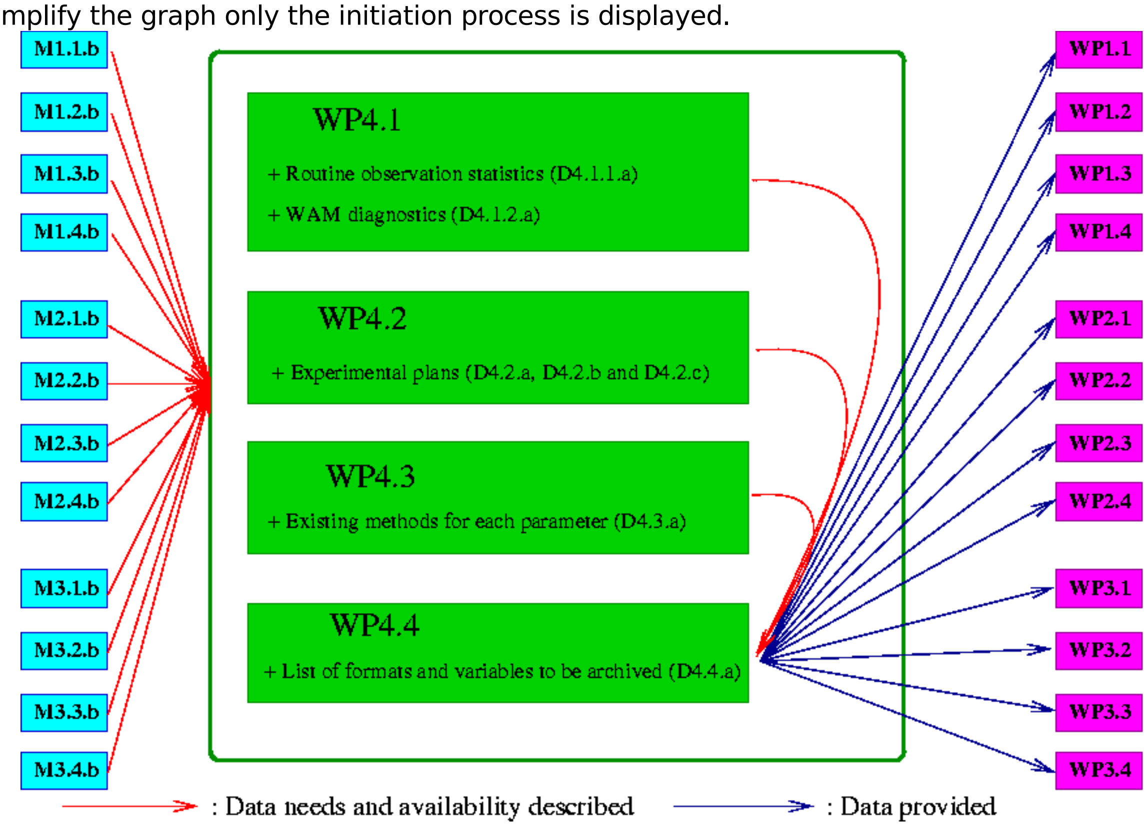
8.3 Graphical presentation of work packages

The focus of all work-packages over the first 18 month will be aimed at defining the needs of the Tools & Methods and making sure that they are off to a good start. The main foci will be :

- Establish the current status of models
- Prepare the field campaigns by launching the EOP and executing the first Special Observing Period (SOP0) which will occur in January-February 2006.
- Establish the current state of the art of remote sensed variables over the region
- Prepare the data based and fill it with existing African data sets and the first AMMA observations.

To ensure this infrastructure is operational for the intensive field campaigns of the rainy season of 2006 and its scientific exploitation, it will require the all WPs contribute to the set up phase of Tools & Methods. Once this is achieved the WPs will start progressing towards their objective with the currently available data. As can be seen in the Gantt chart of the WPs (section 8.6) the collaboration between the partners is not yet very intensive. It will the role of the Scientific Management of the project to make sure that partners find to each other and start collaborations which will then become fully operational in 2006.

The pert chart below shows how the data exchange within the project will be set up during the first 18 month. It is essential for achieving the goals of the project that this data exchange is as efficient as possible as it will allow all partners to access rapidly new observations or new results. To simplify the graph only the initiation process is displayed.



8.4 Work Package list

WORKPACKAGE LIST (18 MONTHS)

WP N°	WORKPACKAGE TITLE	Leader	Person Month	Start Month	End Month	Deliverables
Process Integration						
WP1.1	**West African monsoon and the global climate**	U.Koln	265,50/84	M0	M18	
WP1.1.1	Inter-annual variability and trends in the African Monsoon	IRD		M0	M18	D1.1.1.a/b
WP1.1.2	WAM impacts on atmospheric composition and global climate	CNRS		M0	M18	D1.1.2.a
WP1.1.3	Interaction between the large-scale flow and WAM weather systems	U Bourgogne		M0	M18	D1.1.3.a/b
WP1.2	**The water cycle**	CNRS	126/44	M0	M18	D1.2.a/b
WP1.2.1	Large scale water balance	CNRS		M0	M18	D.1.2.1.a/b
WP1.2.2	Mesoscale water balance	CNRS		M0	M18	D.1.2.2.a/b/c
WP1.2.3	The water cycle at the local scale	CNRS		M0	M18	D.1.2.3.a/b
WP1.3	**Surface-atmosphere feedbacks**	CEH	48/16	M0	M18	
WP1.3.1	Regional scale surface atmosphere interactions	CEH		M0	M18	D.1.3.1.c
WP1.3.2	Surface forcing of atmospheric circulations	CEH		M0	M18	
WP1.3.3	Mesoscale Surface atmosphere feedbacks	CEH		M0	M18	D.1.3.3.a
WP1.4	**Scaling Issues in the West African Monsoon**	IRD	58/17	M0	M18	
WP1.4.1	Downscaling of Precipitation	IRD		M0	M18	D.1.4.1.a/b/c
WP1.4.2	Scaling of State Variables and Fluxes	IRD		START ONLY ON MONTH 24		
Process Studies						
WP2.1	**Convection and atmospheric dynamics**	Uni Leeds	115/17	M0	M18	D.2.1.a/b
WP2.1.1	Global and regional analyses	Uni Leeds		M0	M18	D2.1.1.a
WP2.1.2	Regional to synoptic scale	Uni Leeds		M0	M18	D2.1.2.a/b
WP2.1.3	Synoptic to mesoscale	Uni Leeds		M0	M18	D2.1.3.a
WP2.2	**Oceanic Process**	CAU	56.5/15	M0	M18	D2.2.a

WP2.3	**Physical and biological processes over land surfaces**	FZK	186.5/31 .5	M0	M18	
WP2.3.1	Regional scale surface processes	FZK		M0	M18	D.2.3.1.a
WP2.3.2	Local scale surface processes	FZK		M0	M18	D.2.3.2.a/b
WP2.4	**Aerosol (source of global aerosol) and Chemical processes in the atmosphere**	UEA	163/25	M0	M18	D2.4.a/b
WP2.4.1	Aerosol radiative properties	UNIPG		M0 M0	M18 M18	D2.4.1.a D2.4.2.a/b
WP2.4.2	Chemistry gas phase and aerosol	UMIST		M0	M18	D2.4.3.a/b/c/d/e/f
WP2.4.3	Surfaces processes	UP12				
WP2.4.4	Convection and WAM dynamics	ISAC CNR		M0	M18	D2.4.4.a
Impact Studies						
WP3.1	**Land Productivity**	CIRAD	54/19	M0	M18	D3.1.a.b
WP3.2	**Human process, adaptation and environmental interactions**	IGUC	71/10	M0	M18	D3.2.a.b.c
WP3.3	**Water Resources Impact**	AGRHYMET	106/18	M0	M18	D3.3.a.b
WP3.4	**Public health**	UniLIV	68/18	M0	M18	D3.4.a/b
Tools and Methods						
WP4.1	**Model development and application**	CNRM	124/19	M0	M18	D4.1.a/b
WP4.1.1	Data assimilation and forecasting systems	ECMWF		M0	M18	D4.1.1.a /b
WP4.1.2	The West African Monsoon in regional and global climate models	CNRM		M0	M18	D4.1.2.a /b
WP4.1.3	Modelling the interactions between aerosols/chemistry and the atmosphere.	KNMI		M0	M18	D4.1.3.a /b
WP4.2	**Field Campaigns**	DLR	10/1,5	M0	M18	D4.2.a/b/c
WP4.2.1	SOP aircrafts	CNRS	84/14,4	M0	M18	D.4.2.1.a
WP4.2.2	SOP ground based	Uni Bonn	61/20,3	M0	M18	D.4.2.2.a
WP4.2.3	EOP/LOP	IRD	238/24	M0	M18	D.4.2.3.a
WP4.3	**satelite Remote Sensing and ancillary data**	CNRS	139/62	M0	M18	D4.3.a/b/c
WP4.4	**Data base and historical data**	Medias	24/5	M0	M18	D4.4a/b
Demonstration						
WP5.1	**Seasonal to Climatic forecasting**	CNRS	54/0	M0	M18	D5.1

WP5.2	**Socio-economic early warning systems**	IBIMET	Starts only on month M48			
Training and educations						
WP6.1	**Environmental monitoring**	Vaisala	20/2	M0	M12	D6.1.a/b/c/d
WP6.2	**University programs and summer schools**	Medias	10/5	M0	M18	D6.2.a/b
MANAGEMENT OF ACTIVITIES						
WP7.1	**Instrument deployment management**	IRD	3/0	M0	M18	D7.1.a
WP7.2	**Scientific management**	CNRS	20/20	M0	M18	D7.2.a/b
WP7.3	**Financial and Administrative Management**	CNRS	17/17	M0	M18	D7.3.a/b/c/d
WP7.4	**Intellectual property, knowledge and data management**	CNRS	3/3	M0	M18	D7.4.a/b

8.5 Deliverables list

Deliverable No	Deliverable title	Delivery date	Nature	Dissemination level
WP1.1				
D1.1.1.a	Definition of a coordinated set of experiments	M18	R	PU
D1.1.1.b	First study report on the effect of SST anomalies and more particularly in the Atlantic on WAM rainfall variability	M12	R	PU
D1.1.2.a	A preliminary estimates of the impact of West African emissions on global trace gas and aerosol budgets in order to identify key uncertainties in model simulations of this region which will be addressed in 2.4	M12	R	PU
D1.1.3.a	Identification of key WAM diagnostics/variables and predictands	M6	R	PU
D1.1.3.b	Report on the relationship between tropical waves and WAM dynamics on the intraseasonal time scale	M18	R	PU
WP1.2				
D.1.2.1.a	First estimate of the water budget (moisture flux convergence, precipitation, evaporation, …) for selected situations	M12	R	PU
D.1.2.1.b	Report on the validation of mixed layer models and regression models	M18	R	PU
D.1.2.2.a	Description of identified test cases and target areas	M6	R	PU
D.1.2.2.b	Report on uncertainties associated with model predictions for the target areas	M18	R	PU
D.1.2.2.c	First estimation of annual surface water balance components on meso-scale sites for recent years	M18	R	PU
D.1.2.3.a	Evaluation of the POWER model concept (Donga catchment)	M12	R	PU
D.1.2.3.b	First estimation of the water balance components (evapotranspiration, streamflow, groundwater flow, soil water storage) on the pilot catchments	M18	R	PU
WP1.3				
D.1.3.1.c	Report summarising comparison of earth observation products and identifying the main modes of spatio-temporal variability of the continental surface over WA	M18	R	PU
D.1.3.3.a	Report on geostatistical analysis of rainfall data	M18	R	PU
WP1.4				

D1.4.1.a	Preliminary assessment of LAM out put	M6	R	PU
D1.4.1.b	Report on selection of statistical methods and input/output data for downscaling	M9	R	PU
D1.4.1.c	Initial synthesis of scaling properties for Sahel precipitation and relevant statistical moments for hydrological	M12	R	PU
WP2.1				
D2.1.a	EOP and SOP strategy document prepared	M11	R	PU
D2.1.b	Coordination of the selection of SOP case studies (convective events, onset processes, synoptic waves, tropical cyclones (Tcs) .	M18	R	PU
D2.1.1.a	Report on the analysis of historical rainfall events and monsoon on-sets to guide SOP1 planing	M12	R	PU
D2.1.2.a	Report on case studies of AEW events and TC/SAL interactions .	M12	R	PU
D2.1.3.a	Report on simulations of tests cases of convective activity in idealized conditions with CRM	M18	R	PU
WP2.2				
D2.2.a	First report on observed ocean circulation, heat budget of the surface mixed layer and on a climatological run with the OPA general circulation model	M12	R	PU
WP2.3				
D2.3.1.a	Report on the Algorithms for retrieval of surface parameters from satellite	M12	R	PU
D2.3.2.a	Reports on the operation of the instruments deployed	M6	R	PU
D2.3.2.b	Development plan for a coupled hydrological and dynamical vegetation model	M12	R	PU
WP2.4				
D2.4.1.a	A report on algorithms to be used for optical modelling of aerosols	M12	R	PU
D2.4.2.a	Preliminary climatological ozone and CO vertical distributions for the investigated tropical region with standard deviations	M12	R	PU
D2.4.2.b	Preliminary results of aerosol modelling	M12	R	PU
D2.4.3.a	Mesoscale database of emission factors for Nitrogen oxides and Volatile Organic Compounds for natural and human disturbed ecosystems provided	M18	R	PU
D2.4.3.b	Preliminary version of biomass burning emission inventory over : savanna and forest fires typical of 2000 year including monthly variations	M18	R	PU

D2.4.3.c	Preliminary version of biogenic and industrial emission inventory : mesoscale emission factor measurements for gases and particles	M18	R	PU
D2.4.3.d	Preliminary regional distribution of wet and dry deposition fluxes	M18	R	PU
D2.4.3.e	Preliminary regional simulation of the mineral dust cycle	M18	R	PU
D2.4.3.f	Provision of present-day anthropogenic and biogenic Nox/VOC emissions	M18	R	PU
D2.4.4.a	Report on available historical data and simulations used for observation planning	M9	R	PU
WP3.1				
D3.1.a	Times series of regional vegetation productivity	M18	R	PU
D3.1.b	Trend map identifying areas showing positive or negative trends in vegetation productivity ready	M18	R	PU
WP3.2				
D.3.2.a	A report summarising the meta study on existing knowledge	M6	R	PU
D.3.2.b	Report on observed past fire occurence based on satellite data	M12	R	PU
D.3.2.c	Vulnerability assessment framework	M18	R	PU
WP3.3				
D.3.3.a	Report on the characterization of rainfall and discharge variability on the considered watershed (from all basin)	M12	R	PU
D.3.3.b	Report on the hydrological modelling of the basin including sensitivity analysis on land use modification and rainfall spatial variability (from all basin)	M12	R	PU
WP3.4				
D3.4.a	Identification of downscaling requirements and issues for health impacts	M6	R	RE
D3.4.b	Report on the start up of the field campaigns and initial data analysis	M18	R	RE
WP4.1				
D.4.1.1.a	Synthesis of monthly observation statistics produced by the analysis tools	M12	R	RE
D.4.1.1.b	Case studies on Atmospheric 3D-Var analyses at fine scale before the SOP	M12	R	RE
D.4.1.2.a	Report on existing WAM diagnostics and those developed for AMMA-IP	M9	R	RE
D.4.1.2.b	First intercomparison of models based on the WAM diagnostics	M18	R	RE
D.4.1.3.a	Inventory of existing observational data on atmospheric composition to evaluate integrated models used in AMMA (regional and global scale; chemistry-transport and chemistry-climate models)	M3	R	RE

D.4.1.3.b	Model evaluation report	M15	R	RE
WP4.2				
D.4.2.a	Experimental plan for LOP/EOP ready	M4	R	RE
D.4.2.b	Experimental plan for SOP0 ready	M7	R	RE
D.4.2.c	Experimental plan for SOP 1,2,3 ready	M10	R	RE
D.4.2.1.a	Initial report for SOP_0 and provision of preliminary level1 data	M15	R	RE
D.4.2.2.a	Initial report for SOP_0 and provision of preliminary level1 data	M15	R	RE
D.4.2.3.a	Initial report for LOP/EOP and provision of preliminary level1 data	M18	R	RE
WP4.3				
D4.3.a	Critical report on the existing methods for each parameter	M9	R	RE
D4.3.b	Results of validation phase, estimation of errors	M12	R	RE
D4.3.c	Description (and codes) of the methods retained	M18	R	RE
WP4.4				
D4.4.a	Report on the list of variables and formats to be archived	M5	R	PU
D4.4.b	Report on Metadatabase and database design and development	M12	R	PU
WP5.1				
D5.1	Report on different available forecast skill evaluation systems ready to be applied for the SOP.	M18	R	PU
WP5.2: start only on month M48				
WP6.1				
D6.1.a	D6.1.a Report on the survey related to the needs for training/upgrade/education on radiosonde	M1	R	PU
D6.1.b	Progress report on installation/activation/upgrade of radiosounding stations equipment and connection to GTS	M6	R	PU
D6.1.c	Final report on installation/activation/upgrade of radiosounding stations equipment and connection to GTS	M12	R	PU
D6.1.d	Report on installation of flux stations	M12	R	PU
WP6.2				
D6.2.a	Report on the application workshop on food security	M12	R	PU
D6.2.b	Report on summer school	M18	R	PU
WP7.1				
D7.1.a	Status of sites, Infrastructure/Radio sonde deployed, aircraft deployed and instrumented site	M12	R	RE
WP7.2				

D7.2.a	Progress report to the partners and feedback to the EC of the AMMA Scientific Progress	M6/12 M18	R	RE
D7.2.b	Report scientific deliverables	M12	R	RE
WP7.3				
D7.3.a	Manual of Project Management, Installation of Governing board, Executive Committee	M1	R	RE
D7.3.b	First periodic reports, Project monitoring report, meeting reports	M6	R	RE
D7.3.c	Financial reports upon request by the Commission	M12	R	RE
D7.3.d	Meeting reports	M12	R	RE
WP7.4				
D7.4.a	Consortium agreement : IPR rules for Background and Foreground	M0	R	RE
D7.4.b	Annual report	M12	R	RE

8.6 Work package description

8.6.1 Integrative Science

WP 1.1 : West African monsoon and the global climate

Workpackage number	1.1		**Start date or starting event:**	M0					
Participant ID	UKöln								
Person-months per participant:	2/0								

Objectives

To coordinate activities of the 3 sub-work-package under 1.1 and ensure a close collaboration with other WPs in the project.

Ensure that the tool & method WPs will include the data and models needed by sub-WPs in 1.1 participants in their products.

Ensure participants of WP1.1 will perform the experiments needed by other WP1.2 and WP1.3 and provide them with the requested diagnostics.

Description of work

The objectives will be achieved by organizing every 6 month meetings of the WP and that the coordinator of WP1.1 is present at the key meetings of the tools & methods WPs.

Follow the progress of the sub-WPs of 1.1 and ensure that the deliverables are produced in a timely manner.

Significant Risks

None as all deliverables are based on existing models.

Deliverables

Milestones and expected result

M1.1.a : Progress reports at M6, M12 and M18

M1.1.b : Report on data needs to Tools & Method Wps (M3)

WP1.1.1: Inter-annual variability and trends in the African Monsoon

Workpackage number	1.1.1			**Start date or starting event:**	M0			
Participant id	CNRM	CNRS	CAU	UCM	ENEA	ISAC	IBIMET	
Person-months per participant:	24/9	30/6	24/18	18/6	4/2	2.5/1	6/3	

Objectives

The general objective of this sub-WP is to examine the causes of variability and trends of the West African monsoon (WAM) and to determine how this will evolve in the years to come with higher greenhouse gaz concentrations. During the first 18-month period, an evaluation of the existing GCM runs will be made, and a coordinated set of model experiments will be discussed, based on already realized and on-going runs. Others works will be undertaken concerning diagnostic studies, seasonal forecast skill and climate scenarios.

Description of work

Preliminary large scale evaluation of AGCM over West Africa from intra-seasonal to decadal timescales.

Definition of a coordinated set of model experiments aimed at exploring the role of SST patterns and ocean basins on WAM rainfall by analyzing the existing runs; beginning of the new runs.

Sensitivity assessment of the monsoon system and rainfall to Atlantic Ocean SST.

Preliminary multivariate statistical analyses of the relation between SST anomalies and WAM using re-analyses and GCM output data.

Application of climate scenarios made with coupled Climate models within the ENSEMBLES project.

valuation of the skill of the DEMETER seasonal forecasts over West Africa.

Deliverables

D1.1.1a : Definition of a coordinated set of experiments. (M18)

D1.1.1b : First study report on the effect of SST anomalies and more particularly in the Atlantic on WAM rainfall variability (M12)

Milestones

M1.1.1.a : Definition of a coordinated set of GCM sensitivity experiments based on SST anomaly patterns in the tropical ocean basins.(M6)

M1.1.1.b : Beginning of new simulations (M12)

sWP 1.1.2 : WAM impacts on atmospheric composition and global climate

Workpackage number		1.1.2	**Start date or starting event:**		M0	
Participant ID	CNRS	CNRM	KNMI			
Person-months per participant:	31/0	1/0.5	1/0			

Objectives:

The ultimate objective of this WP is to determine the impact of West African emissions on global oxidant and aerosol budgets, the oxidising capacity and global radiative forcing using a combination of global chemistry-aerosol modelling and data analysis (e.g. satellite). A particular focus is on the role of the WAM in the long-range transport of trace constituents downwind from West Africa. In the first 18 months a range of different global chemistry-climate and chemistry-aerosol transport models will be used to calculate preliminary estimates of the impact of the West African emissions on oxidant and aerosol budgets. This work is closely linked to model evaluation tasks in 4.1.3 which will take place prior to the field campaigns. Results will be used to identify key model uncertainties to be investigated following the collection and analysis of the SOP/EOP field data (2.4). Comparison of model budgets will be used to pinpoint specific processes in models that will require attention and improvement in the detailed studies undertaken in 2.4. Specific objectives are:To determine preliminary estimates of the impact of WAM emissions on global trace gas and aerosol budgets and identify key uncertainties in model calculations.

Description of work

First estimates of the impact of West African emissions on the global trace gas and aerosol budgets using a chemistry-climate model run with assimilation of existing data (4.1) and 2 chemistry-aerosol transport models. Comparison of model results will allow identification of key uncertainties in model calculations

Deliverables
D1.1.2.a : A preliminary estimates of the impact of West African emissions on global trace gas and aerosol budgets in order to identify key uncertainties in model simulations of this region which will be addressed in 2.4 (M12)

Milestones
M1.1.2.a : Report on preliminary estimates of impact of West African emissions on global trace gas and aerosol budgets (M18)

sWP 1.1.3 : Interaction between the large-scale flow and WAM weather systems

Workpackage number		1.1.3	**Start date or starting event:**		M0		
Participant id	CNRS	U. Bourgogne	UCM	U Köln	ENEA	IBIMET	
Person-months per participant:	70/20	17/7	10/7	12/7	2/1	11/6	

Objectives
To explain the mechanisms which communicate SST anomalies patterns to the West African region (Target 4.1.1) Determine atmospheric predictors at the intraseasonal time scale of WAM onset and WAM intraseasonal variability, including breaks and surges of the monsoon. Impact of other tropical (monsoonal) circulations on the SST-WAM rainfall teleconnections (Target 4.1.1) To establish the impact of seasonal-to-decadal variability of the WAM on Mediterranean climate variability.

Description of work
- Wave-spectra analysis of re-analyses (ERA40, NCEP) and GCM output to infer the role of large-scale intraseasonal variability on WAM onset and break periods. - Multivariate analyses, factorial decomposition and neural networks using reanalyses, satellite and in-situ data to define and predict the weather types associated with monsoon breaks/surges - Statistical diagnostics of reanalysis (ERA40, NCEP) and numerical experiments to determine the role of WAM on the Mediterranean summer climate variability - Impact of global monsoons on the WAM by statistical analysis of re-analysis data (IBIMET-CNR) Climatological impact of large-scale moisture flux (convergence) on the ability of African Easterly Waves (AEWs) to organize and maintain meso-scale convective systems using ERA-40 and 2002 field campaign data (link to WP 2.1) - Continental-scale atmospheric water budget calculations using ERA-40, ECMWF and SOP data , including oceanic source regions and fluxes across the Guinea and West African Coasts (link to WP 1.2)

Deliverables
D1.1.3.a : Identification of key WAM diagnostics/variables and predictands (M6) D1.1.3.b : Report on the relationship between tropical waves and WAM dynamics on the intra-seasonal time scale (M12)

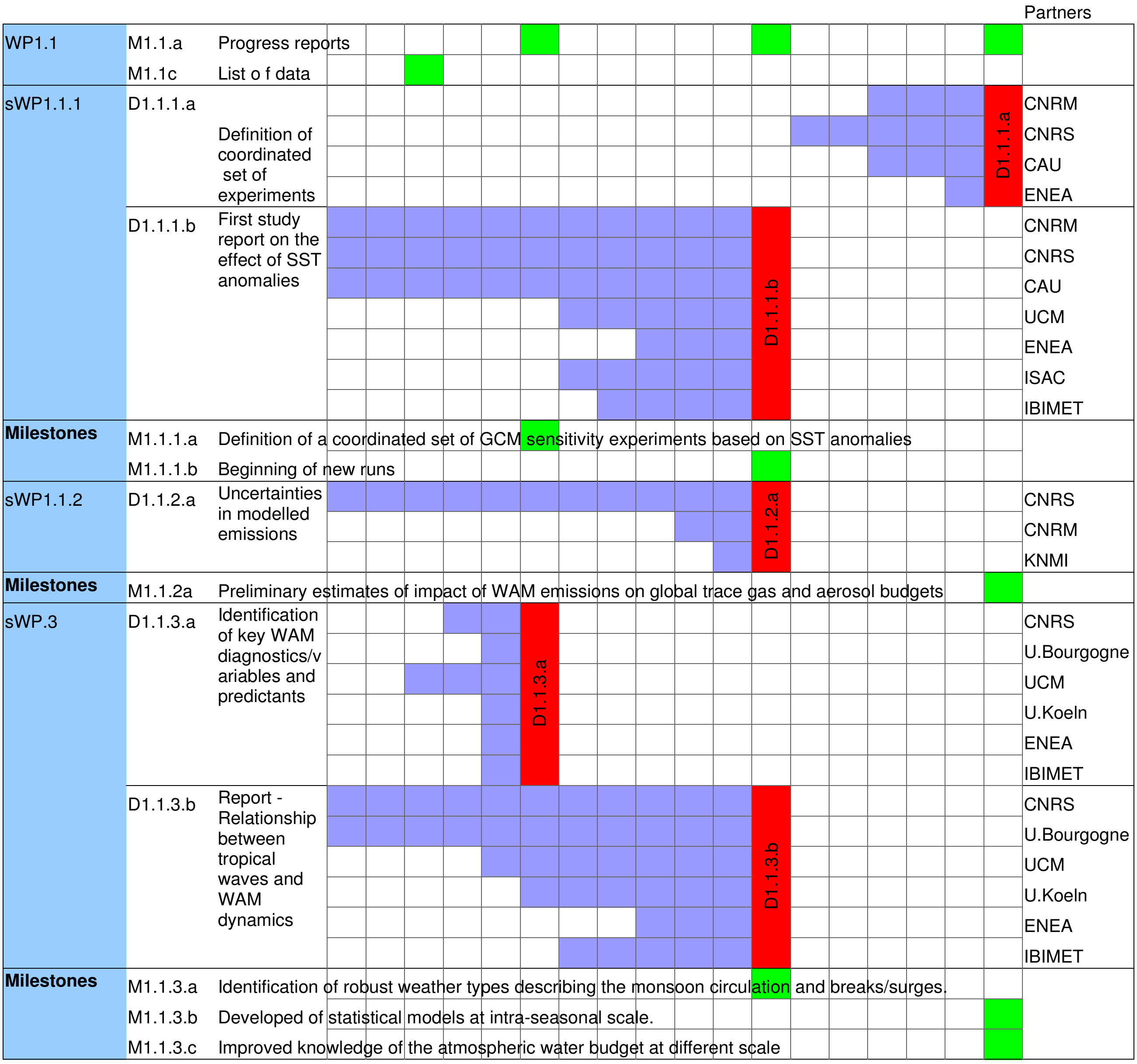
Milestones

M1.1.3.a : Identification of robust weather types describing the monsoon circulation and breaks/surges.(M12)

M1.1.3.b : Development of statistical models at intra-seasonal scale.(M18)

M1.1.3.c : Improved knowledge of the atmospheric water budget at different scale (M18

WP1.1 Gantt Charts



WP1.1 Resources

		Partners	p.m Total	Req.	Tasks by partner
WP1.1	M1.1.a M1,1c	U.Koeln	2	0	Coordination
sWP1.1.1	D1.1.1.a	CNRM	1	1	Test runs with LMDZ and IPSLCM
		CNRS	11	0	Definition of diagnostics
		CAU	4	3	Analyse GCM simulations and contribute to experiment definition
		ENEA	1	1	Synthesys of GCM sensitivity results
	D1.1.1.b	CNRM	23	8	Simulations with LMDZ and IPSLCM
		CNRS	19	6	Looks at the seasonal cycle and the monsoon onset
		CAU	20	15	Perform and analyse GCM experiments
		UCM	18	6	Analysis of UCLA model
		ENEA	3	1	Analysis of ECHAM4 (AMIP run)
		ISAC	2.5	1	Analysis of existing simulations and reanlysis dataset
		IBIMET	6	3	Preliminary analysis of simulations
Milestones	M1.1.1.a M1.1.1.b				
sWP1.1.2	D1.1.2.a	CNRS	31	0	preliminary study on aerosol formation and radiative impact downwind from WA and first assessment of uncertainities
		CNRM	1	0.5	preliminary estimates of ozone budget over WA
		KNMI	1	0	preliminary anlysis of model uncertainities in oxidant predictions
Milestones	M1.1.2a				
sWP.3	D1.1.3.a	CNRS	1	1	detection of the intra-seasonal components of the WAM
		U.Bourgogne	6	1	cross-analyses of intra-seasonal components (active/inactive phases) and leading/synchronous atmospheric fields
		UCM	1	1	Pattern identifications
		U.Koeln	3	1	Identification of a set of key variables describing the WAM
		ENEA	1	0	statistical tools assessment
		IBIMET	1	1	
	D1.1.3.b	CNRS	69	19	role of tropical waves on the WAM jump and onset
		U.Bourgogne	11	6	but for the rainy season core (breaks and surges)
		UCM	9	6	Contributes through the pattern analysis
		U.Koeln	9	6	Impact of moisture transport on MCS generation by tropical waves
		ENEA	1	1	Analysis of ERA40 and ECHAM4 runs
		IBIMET	10	5	Analysis of historical data
Milestones	M1.1.3.a M1.1.3.b M1.1.3.c				

WP1.2 The water cycle

Workpackage number	1.2		**Start date or starting event:**				M0		
Participant id	CNRS								
Person-months per participant:	5/0								

Objectives

The efficiency of the processes controlling the advection of atmospheric humidity, its transformation into precipitation, and the destiny of rain water over land, is a crucial aspect of the West African monsoon.

This Work Program on Water Cycle will rely on observational and numerical results concerning the different related processes and variables, obtained in other Work Programs. Therefore, among the most important objectives is the requirement to assess the compatibility between independent estimates of water budget relative to different but connected subdomains (e.g. rain events and watershed, oceanic surface and monsoon flow, …), and to verify that the associated water budgets can be closed. It is also important to assess the importance of spatial and temporal variability of the water budget, in connexion with identified perturbations. The results should provide useful information concerning the natural and anthropically modified processes for water resource management and for weather to climatic forecasting studies.

Description of work

- Development of new techniques (MANDOPAS observation assimilation system, retrieval of surface parameters from remote sensing satellite data, …) ;
- Analysis of existing data sets (from operational analyses and past reanalyses, from available satellite observations, …) ;
- Preparation of numerical modeling studies (model improvements and verification, specification of surface conditions, selection of case studies, estimate of uncertainties and sensitivities, …)
- Organization of a meeting to start-up and organize the work of the 3 subWPs. It will be prepared in collaboration with other WPs to avoid duplication of tasks. The observation needs will be also detailed to interact with relevant WPs.. A report documenting the proposed strategies will be prepared.

Significant Risks

None as the basic elements of the new development are already available.

Deliverables

Milestones

M1.2.a : Progress reports at M6, M12 and M18

M1.2.b : Report on data needs to Tools and Methods WPs (M3).

sWP 1.2.1 : Large scale water balance

Workpackage number	1.2.1	**Start date or starting event:**	M0				
Participant id	CNRS	ENEA	ISAC	CNRM	IRD	U Bourgogne		
Person-months per participant:	10/3	6/4	4/2	3/0	3/0	10/1		

Objectives

This "sub-WP" is aimed at evaluating the performances of operational analyses and special reanalyses in the estimation of the various terms of the water budget at regional scale over West Africa, through comparisons with independent satellite measurements and special observations during the AMMA EOP and SOP. Comparisons will be made between the results obtained for wet and dry years, or wet and dry intra-seasonal periods.

Description of work
• Comparison of moisture convergence, precipitation and evaporation from operational analyses, at various spatial and temporal scales ; • Evaluation of the seasonal variation of the amplitude of the diurnal SST cycle through the time series of satellite-derived SST in the period 1985 – 2003, validation of the mixed layer model and the regression model. Parameters of the regression model will eventually be adjusted for the project working area. • Use of water vapour transport domain-filling model to characterize the dry intrusion events during the Monsoon season from the mid-Latitudes upper troposphere.This will be done for test cases from decadal climatology under construction. • Development of the MANDOPAS observation assimilation system (retrieval of 4D fields of wind, temperature, humidity, and water). This retrieval method will be applied at the scale of West Africa using the operational data and multi-sensor satellite data and products.

Deliverables
D1.2.1.a : First estimate of the water budget (moisture flux convergence, precipitation, evaporation, …) for selected situations (joint with WP1.1.1) (M12). D1.2.1.b : Report on the validation of mixed layer models and regression models (M18).

Milestones
M1.2.1.a : Report on intra-seasonal variability of TPW and air-sea interface parameters M1.2.1.b : Production of large-scale 4D fields with MANDOPAS. Report on multivariate coupled analysis of TPW, SST and SSH M1.2.1.c : Comparison of the MANDOPAS 4D fields with the operational analyses

sWP 1.2.2 : Mesoscale water balance

Workpackage number		1.2.2		**Start date or starting event:**		M0	
Participant id	CNRS	IRD	CNRM	DLR			
Person-months per participant:	10/0	16/8	1/8	0/0			

Objectives
This " sub-WP " will mainly concern the AMMA / EOP and SOP periods, at the regional scale (i.e. upper Ouémé catchment in Benin, Niamey area in Niger, inner Niger Delta in Mali, Volta basin in Ghana, i.e. areas of 104 to 105 km2) for typical periods of a few hours to few days, and it will be based on the analysis of operational and enhanced observing network, and data assimilation in numerical models. The global objective of the sWP is the budget closure at the mesoscale, including the surface and atmospheric parts of the water budget.

Description of work
Definition and testing of the regional BOLAM atmospheric model configuration to be used in the AMMA target area (specification of land-use and physiographical / geographical conditions, identification of case studies and/or extended periods to be considered, preprocessing of large scale analysis dataset to define model initial and boundary conditions, model simulations and postprocessing of various fields including precipitation and water balance, model verification against analyses and satellite derived operational estimates of precipitation). • Studies of sensitivity to vegetation and soil characteristics • Analysis of vegetation data to infer impact on water-cycle (links with 2.3.1). • Setup of hydrological models at the meso scale for the Ouémé and Niger sites • Estimation of uncertainties associated with model predictions

Deliverables
D1.2.2.a : Description of identified test cases and target areas (M6) D1.2.2.b : Report on uncertainties associated with model predictions for the target areas (M18). D1.2.2c : First estimation of annual surface water balance components on meso-scale sites for recent years (M18)

Milestones
M1.2.2.a : Definition of case studies and/or periods of the atmospheric regional model runs (M3) M1.2.2.b : Input data base set up and atmospheric regional model testing (M6) M1.2.2.c : Atmospheric regional model simulations M1.2.2.d : Atmospheric regional model evaluation and results, evaluation of meso-scale from observations. This includes precipitation, runoff, storage terms (soil and groundwater, also from process-based models), evapotranspiration (Also from process-based models), impact of vegetation on water cycle.

sWP 1.2.3 : The water cycle at the local scale

Workpackage number	1.2.3		**Start date or starting event:**	M0					
Participant id	EIER	IRD	UPCT	CNRS					
Person-months per participant:	12/4	36/12	10/2	0/0					

Objectives
This "sub-WP" will consider detailed processes identified in dedicated sites and specific watersheds (e.g. Donga catchment in the Ouémé river basin in Benin, Niamey area catchments, Nakembé catchment, Burkina-Faso) with dense observational networks, to assess water budget components, and address the closure issue. These tasks will involve the development of new hydrological models, or the implementation of available codes. The aim of this Sub-WP is to understand the combining effects of local processes on the hydrological budget at the small catchment scale

Description of work
Extraction of primary topographical attributes with hydrological interest, from a Digital Elevation Model
Elaboration of the algorithm(s) for retrieval of surface parameters from satellite data and Digital Elevation Model
Analysis and selection of the ET models
Development of the POWER model to include new processes or processes crudely represented into the model.
Setup and of the available hydrologic models for the sahelian catchments ; validation of the deep infiltration term (aquifer recharge) ; validation of the vegetation-hydrology interaction schemes ; validation of erosion schemes
Validation of the simulated components of the water balance using existing data from the LOP (.streamflow, groundwater level, soil moisture)
Sensitivity studies to the resolution, complexity of model and surface conditions.

Deliverables
D1.2.3.a : Evaluation of the POWER model concept (Donga catchment) (M12)
D1.2.3.b : First estimation of the water balance components (evapotranspiration, streamflow, groundwater flow, soil water storage) on the pilot catchments (M18)

Milestones
M1.2.3.a : Selection of case studies
M1.2.3.b : Improvement of the lateral flow component in the POWER model
M1.2.3.c : Evaluation of the POWER hydrological model on the Donga catchment and first simulations of the water balance components
M1.2.3.d : Estimation of uncertainties on the water budget components

WP1.2 Gantt Chart

WP 1.2 Leader : **CNRS** Partners

		Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Partners
WP1.2	M1.2.a	Progress reports																			CNRS
	M1.2.b	Report on data needs																			
sWP1.2.1	D1.2.1.a	First estimate of the water budget (moisture flux convergence, precipitation, evaporation, …) for selected situations												D1.2.1.a							CNRM, CNRS, ENEA, ISAC, IRD, U Bourgogne
	D1.2.1.b	Report on the validation of mixed layer models and regression models																		D1.2.1.b	CNRM, CNRS, ENEA, ISAC, IRD
Milestones	M1.2.1.a	Report on intra-seasonal variability of TPW and air-sea interface parameters																			
	M1.2.1.c	Production of large-scale 4D fields with MANDOPAS.																			
	M1.2.1.d	Comparison of the MANDOPAS 4D fields with the operational analyses																			
sWP1.2.2	D1.2.2.a	Description of identified test cases and target areas						D1.2.2.a													CNRM, CNRS, DLR, IRD
	D1.2.2.b	Report on uncertainties associated with model predictions for the target areas																		D1.2.3.a	CNRM, CNRS, DLR, IRD
	D1.2.2.c	First estimation of annual surface water balance.																		D1.2 2.c	CNRS, IRD
Milestones	M1.2.2.a	definition of case studies and/or periods of the atmospheric regional model runs																			
	M1.2.2.b	input data base set up and atmospheric regional model testing																			
	M1.2.2.c	atmospheric regional model simulations																			
	M1.2.2.d	Atmospheric regional model evaluation																			
sWP1.2.3	D1.2.3.a	Evaluation of the POWER model concept (Donga catchment)												D1.2.3.a							EIER, IRD, UPCT, CNRS
	D1.2.3.b	First estimation of the water balance components																		D1.2.3.b	EIER, IRD, UPCT, CNRS
Milestones	M1.2.3.a	selection of case studies																			
	M1.2.3.b	Improvement of the lateral flow component in the POWER model																			
	M1.2.3.c	Evaluation of the POWER hydrological model on the Donga catchment																			

WP1.2 Resources

			p.m Total	Req.	Task by partner
WP1.2	M1.2.a M1.2.b	CNRS	5	0	coordination
SWP1.2.1	D1.2.1.a	CNRM	3	0	Moisture analysis for selected situations
		CNRS	10	3	Delevopment of MANDOPAS observation assimilation system
		ENEA	3	2	Total precipitable water analysis, WAM pre and mature phase (intra-seasonal time scale)
		ISAC	2	1	Model set-up, case study identification, water budget estimates
		IRD	3	0	Precipitation estimations
		U Bourgogne	10	1	quantification through reanalyses and operational analyses
	D1.2.1b	ENEA	3	2	quantification of relationship between SST, SSH and TPW during WAM pre and mature phase
		ISAC	2	1	Model verification against analyses and precipitation data
Milestones	M1.2.1.a M1.2.1.b M1.2.1.C				
SWP1.2.2	D1.2.2.a	CNRM	0	0	Contribute expertise
		CNRS	0	0	Contribute expertise
		DLR	0	0	Contribute expertise
		IRD	0	0	Contribute expertise
	D1.2.2.b	CNRM			
		CNRS	10	0	Comparisons between MANDOPAS analyses and model results
		DLR	0	0	Cloud scale modelling
	D1.2.2.c	CNRS	0	0	Modelling
		IRD	16	8	estimation of rainfall, evapotranspiration, streamflow, groundwater flow, soil water storage, on Benin, Niger meso-scale sites
Milestones	M1.2.2.a M1.2.2.b M1.2.2.c M1.2.2.d				
SWP1.2.3	D1.2.3.a	EIER	2	0	Local expertise
		IRD	12	0	Applying POWER to the Donga
		UPCT	2	0	Analysis of POWER output
	D1.2.1.b	EIER	10	4	Hydrological modelling
		IRD	24	12	estimation of rainfall, evapotranspiration, streamflow, groundwater flow, soil water storage, on Benin, Niger and Mali super-sites
		UPCT	8	2	Development of algorithms to integrate in hydrological models
		CNRS	0	0	Surface modelling
Milestones	M1.2.3.a M1.2.3.b M1.2.3.c M1.2.3.d				

WP1.3 Surface-atmosphere feedbacks

Workpackage number		1.3		Start date or starting event:			M0	
Participant id	CEH							
P-m per participant:	1/1							

Objectives

The surface-atmosphere WP is structured into 3 sub-WPs dealing with different aspects of the coupling between ocean and land and the atmosphere :

6. feedbacks between the surface (ocean and land) and the atmosphere at the scale of the monsoon on time scales ranging from intra-seasonal (e.g. monsoon active/break periods) to decadal (e.g. the drought dating from the 1970s) are addressed in WP1.3.1
7. land surface forcing of atmospheric circulations, their interaction with synoptic weather systems, and their feedbacks on the surface are addressed in WP1.3.2
8. the influences of soil moisture and vegetation on precipitation at the convective and mesoscale are dealt with in WP1.3.3

The management and coordination of WP1.3 is separate from these 3 subWPs. There are two key management tasks specific to the initial stages of the project:

- Communicating the observational needs for the WP to the rest of the IP, and in particular, WP4.2.
- Ensuring that relevant observational and modelling tools are in place for the SOPs

Description of work

The observational needs of the different studies within the WPs will be collected together in a provisional, and then a final report, which will be communicated to WP4.2. The second report will contain additional information based on preliminary simulations and analysis.

Within WP1.3, specific operational satellite tools will be developed for locating transient surface features. Their development will be coordinated and communicated to WP4.2 to assist flight planning.

There are a number of numerical models which will each be configured to simulate a key aspect of surface-atmosphere coupling in the West African region. For each model, an assessment will be made after 3 months of work of its ability to simulate adequately the basic aspects of the coupling under study.

Significant Risks

None, the work is based on existing models.

Deliverables

Milestones and expected result

M1.3.a : Progress reports at M6, M12 and M18

M1.3.b : Report of data needs to Tools & Method WPs (M3)

sWP 1.3.1 : Regional scale surface – atmosphere interactions

Workpackage number		1.3.1		Start date or starting event:		M0		
Participant id	CEH	UCLM	U Bourgone	CNRS	CNRM			
P-m per participant:	7/3		3/0		12/5			

Objectives

Develop preliminary studies to quantify the role of surface-atmosphere processes related to the intra-seasonal to inter-annual variability of the West African monsoon. At this stage of the project, the work will exploit existing historical data and climate model simulations.

Description of work

To explore land-atmosphere interactions at the intra-seasonal time scale, a global forecast model will be adapted to include more realistic land surface properties (soil and vegetation) in the tropical North African region. An assessment will be made of its depiction of monsoon onset and active/break periods compared to observational data. Subsequent simulations will be set-up in which the sensitivity of these aspects to land surface conditions can be explored.

The influence of surface conditions on inter-annual variability of the monsoon will be assessed using ensembles of 10 year seasonal atmospheric simulations. The work will focus on the influence of SST conditions (mainly in the Gulf of Guinea and tropical Atlantic) and land surface conditions (soil moisture and vegetation). An assessment will be made of the sensitivity to land surface conditions, which will guide subsequent work.

An inter-comparison will be made between earth observation products (AVHRR, SPOT-4 VGT, ERS-SCAT) depicting surface continental state (NVDI, soil moisture content) for the West African region. These products will then be used to explore the spatio-temporal variability of the surface state. In particular, the data will be used to examine the relationship between the land surface during the autumn months and rainfall in the following summer.

Deliverables

D1.3.1.c : Report summarising comparison of earth observation products and identifying the main modes of spatio-temporal variability of the continental surface over WA (M12)

Milestones

M1.3.1a : Report summarising improvements in representation of land surface processes and simulation of monsoon onset in comparison with earth observation data (M18)

M1.3.1b : Report summarisingthe surface influence on interannual variability of the monsoon in a climate model (M18)

sWP 1.3.2 : Surface forcing of atmospheric circulations

Workpackage number		1.3.2	Start date or starting event:				M0	
Participant id	CNRS	U Leeds	IBIMET					
P-m per participant:	2/0	9/3	8/4					

Objectives
In this phase of the project, we shall develop the data analysis and numerical modelling tools necessary for the successful planning and conduct of the SOP operations, and for the efficient analysis of data in the aftermath of the SOPs. We will also aim to provide input to the operational planning in WP4.2, in planning aircraft and other SOP operations to mesh with EOP and satellite monitoring activities. We will also begin a theoretical investigation into the impact of mesoscale and synoptic cells driven by idealized variations in land surface heating.

Description of work
In order that SOP observations are deployed effectively, we will develop operational methodologies for monitoring land surface characteristics during the SOP period. As in WP1.3.3, this will involve the use of cloud-screened Meteosat thermal channel data. In this sub-WP, attention will focus on the production of daily surface diagnostics associated with heat lows, easterly waves, and monsoon onset. The diagnostics will be developed from training periods using archived satellite imagery. The operational diagnostics will guide flight planning. We will set up model configurations for the observational region based on historical case studies. Preliminary results will guide flight planning. Previous theoretical modelling, exploring the impact of idealized surface flux variability on atmospheric circulations in mid-latitudes, will be developed for application to the West African region. The work will focus initially on the response at the diurnal timescale. Subsequent analysis will examine the atmospheric response over timescales of several days variability, associated with easterly waves.

Deliverables

Milestones
M1.3.2.a : Case study model simulations for the study region.(M12). M1.3.2.b : Operational satellite tools developed (M18). M1.3.2.c : Report evaluating fluxes associated with circulations at diurnal time scale.(M18)

sWP 1.3.3 : Mesoscale Surface – atmosphere feedbacks

Workpackage number		1.1.3		**Start date or starting event:**			M0	
Participant id	CEH	UCLM	CNRS	FZK	UNIPG	IRD		
P-m per participant:	1/0	0	0/0	0/0	0/0	5/0		

Objectives
In this phase of the project, modelling tools will be adapted and developed in order to simulate the coupling between the land surface and moist convection. In addition, this sub-WP will contribute to the observational strategy during the SOP, particularly in terms of flight planning.

Description of work

To ensure that best use is made of the aircraft during the SOP, we shall develop an operational methodology for locating areas of heterogeneous soil moisture over which boundary layer flights can be focused. This will be based on an existing system using cloud-screened daytime Meteosat imagery in the thermal channel (as in WP1.3.2) to infer recent storm tracks.

A methodology will be developed for investigating surface – atmosphere feedbacks within a cloud resolving model. Initial runs will be analysed to assess the impact of the land surface on convective activity under controlled conditions of soil moisture and surface fluxes. A single column model will be implemented to study the representation of these surface - atmosphere feedbacks within global circulation models. This will be based on the LMDZ model and include the ORCHIDEE land surface scheme and the Emanuel convection parametrisation. A first determination will be made of the important feedback loops and of the key parameters controlling them.

To determine the impact of surface conditions on rainfall variability, high resolution rain gauge data collected over 15 years from the area will be analysed. These data will be combined with land use maps in a GIS, and geo-statistical analyses performed at the event, yearly and inter-annual time scales.

Deliverables

D1.3.3.a : Report on geo-statistical analysis of rainfall data (M18)

Milestones

M1.3.3.b **:** Implementation of a cloud-resolving modelling system and a single column model and design of subsequent experiments (M18).

M1.3.3.c : Availability of operational satellite tools (M18).

WP1.3 Gantt Chart

WP	1.3	Leader : **CEH**																			Partners
		Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
WP1.3	M1.3.a	Progress reports																			CEH
	M1.3.b	Report on data needs																			
sWP1.3.1	D1.3.1.c	Report summarising comparison of observations and identifying the main modes of spatio-temporal variability of the continental surface over WA												D1.3.1.c							CEH CLM U Bourgogne CNRS CNRM
	M1.3.1.a	Report summarising improvements in land surface modelling and simulation of monsoon onset in comparison with earth observation data (M18)																		M1.3.1.a	CEH CLM U Bourgogne CNRS CNRM
	M1.3.1.b	Report summarising surface influence on inter-annual variability of the monsoon in the climate model.																		M1.3.1.b	CEH CLM U Bourgogne CNRS CNRM
sWP1.3.2	M1.3.2.a	Case study model simulations for the study region												M1.3.2.a							CNRS Univ Leeds IBIMET
	M1.3.2.b	Operational satellite tools developed																		M1.3.2.b	CNRS Univ Leeds IBIMET
	M1.3.2.c	Report evaluating fluxes associated with circulations at diurnal time scale																		M1.3.2.c	CNRS Univ Leeds IBIMET
sWP1.3.3	D1.3.3.a	Report on geo-statistical analysis of rainfall																		D1.3.3.a	CEH CLM CNRS FZK UNIPG IRD
	M1.3.3.b	Implementation of a cloud-resolving modelling system and a single column model and design of subsequent experiments																		M1.3.3.b	CEH CLM CNRS FZK UNIPG IRD
	M1.3.3.c	Availability of operational satellite tools																		M1.3.3.c	CEH CLM CNRS FZK UNIPG IRD

WP1.3 Resources

WP1.3	M1.3.a M1.3.b	CEH	1	1	Coordination
sWP1.3.1	D1.3.1.c	CEH CLM U Bourgogne CNRS CNRM	3	0	Analysis of historical satellite and rainfall data
	M1.3.1.a	CEH CLM U Bourgogne CNRS CNRM	7	3	Comparing surface variables in model with in situ and satellite data
	M1.3.1.b	CEH CLM U Bourgogne CNRS CNRM	12	5	Climate model runs with historical soil moisture estimates and sea surface temperatures
sWP1.3.2	M1.3.2.a	CNRS Univ Leeds IBIMET	9	3	Implementing and running model
	M1.3.2.b	CNRS Univ Leeds IBIMET	2	0	Using historical satellite data to locate surface flux variability
	M1.3.2.c	CNRS Univ Leeds IBIMET	8	4	Theoretical modelling
sWP1.3.3	D1.3.3.a	CEH CLM CNRS FZK UNIPG IRD	5	0	Analysis of historical raingauge data
	M1.3.3.b	CEH CLM CNRS FZK			Implementing single column model
		UNIPG IRD			Implementing cloud-resolving model
	M1.3.3.c	CEH CLM CNRS FZK UNIPG IRD	1	0	Developing operational software

WP1.4 Scaling issues in the West African Monsoon

Workpackage number		1.4		Start date or starting event:			M0		
Participant id	IRD								
P-m per participant:	4/0								

Objectives

To coordinate the activities of WP 1.4 which aims to analyse the scaling properties of a number of key variables which characterise the African monsoon and associated processes.

This WP 1.4 will manage the interactions with the other WPs .

Sub-WP1.4.2 will only start after the SOP, i.e after Month 20.

Description of work

Specific tasks for this coordination work package are as follows:

Coordinate the activities of the two sub-packages. Determine to what extent ideas and tools can be shared for different problems.

Ensure that the right model diagnostics are produced for the disaggregation tools.

Facilitate communication between different disciplines concerned with scaling issues: observations, data management, modelling, parametrization work, impact studies.

Coordinate meetings and produce reports for sub-packages 1.4.

Significant Risks

None

Deliverables

Milestones

M1.4.a : Meeting and progress reports (M6,M12,M18)

M1.4.b : Report on data needs for Tools & Method WPs (M3)

sWP 1.4.1 : Downscaling of Precipitation

Workpackage number		1.4.1		Start date or starting event:			M0		
Participant id	IRD	AGRHYMET	UBonn	U Bourgogne					
P-m per participant:	25/6	16/8	3/0	10/3					

Objectives

Precipitation is heterogeneous at all scales down to the scale of the individual event. Spatio-temporal information is needed about its statistical properties for many applications of measurements and forecasts of precipitation, including impact studies. Where direct measurements or reliable simulation of such information is lacking, the information at larger scales needs to be disaggregated following rules derived from field observations or models. At the impact scale, many physical systems, particularly hydrological systems are very sensitive to changes not only in totals but also in distributions both in space and time. Downscaling is thus of critical importance for impacts on water resources, vegetation production and health.

Description of work

Data analysis: data collected on different scales by different observing systems is to be collated and analysed for its spatiotemporal properties. Basic information about the structure of rainfall will then be used in statistical disagregators to produce simulated fields from larger scale forecasts.

Large scale physical/statistical downscaling: a two step strategy is envisaged to produce local precipitation indices from large scale indicators :

Large scale physical model-based downscaling: regional models will also be analysed and validated against the observations used above to provide a complementary deductive approach.

Small scale pure statistical disagregation: once the relevant statistical moments of spatiotemporal variability have been produced, a purely statistical approach will be used to generate rainfall products that can be used for impact studies.

Deliverables

D1.4.1.a : Preliminary assessment of LAM output (M6)

D1.4.1.b : Report on selection of statistical methods and input/output data for downscaling (M9)

D1.4.1.c : Initial synthesis of scaling properties for Sahel precipitation and relevant statistical moments for hydrological input (M12)

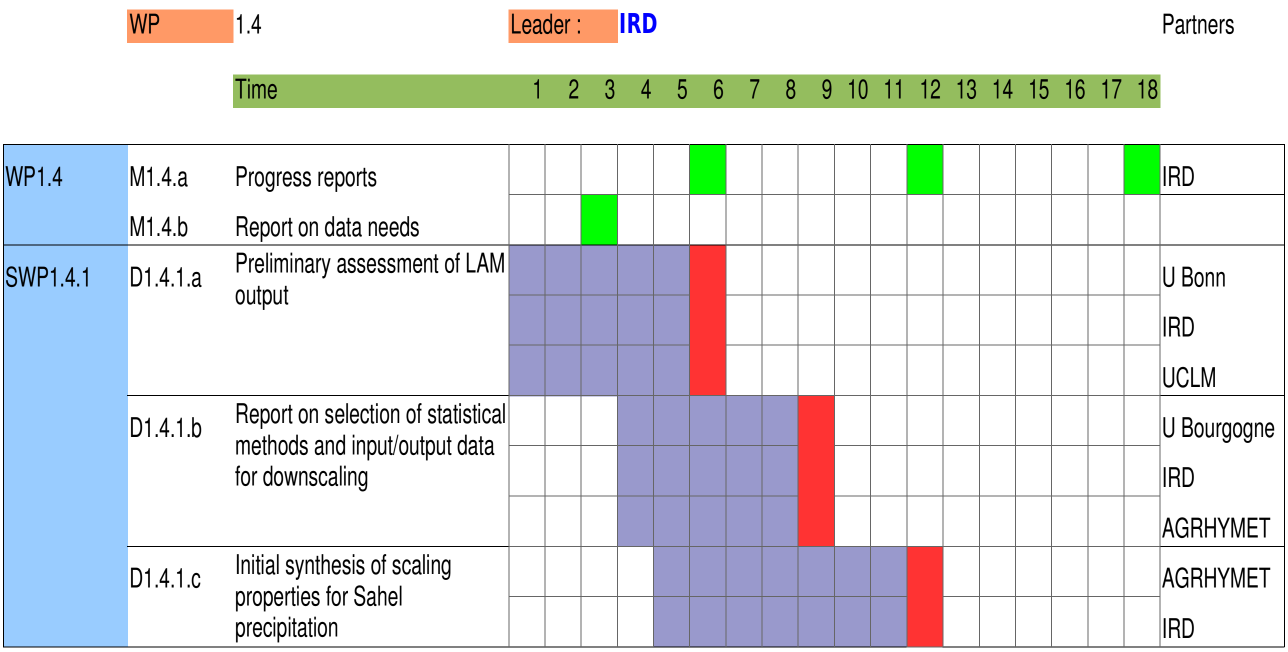
Milestones

sWP 1.4.2 : Upscaling of Precipitation and fluxes

Workpackage number	1.4.2			**Start date or starting event:**	M24			
Participant id								
P-m per participant:								

Stars only after month 24

WP1.4 Gantt Chart



WP1.4 Resources

			p.m Total	Req.	Tasks by partner
WP1.4	D1.4.a	IRD	4	0	Coordination
SWP1.4.1	D1.4.1.b	U Bonn	3	0	LAM output
		IRD	5	0	LAM output and intercomparison
		UCLM			LAM output
	D1.4.1.c	U Bourgogne	10	3	Statistical methods
		IRD	10	3	dynamics / data treatment
		AGRHYMET	10	5	model development
	D1.4.1.d	AGRHYMET	6	3	data analysis and model development,
		IRD	10	3	hydrology and scaling analysis

8.6.2 Process studies

WP2.1 Convection and atmospheric dynamics

Workpackage number		2.1	Start date or starting event:				M0	
Participant id	UNIVLEEDS							
P-m per participant:	5/0							

Objectives

The nature of the convective interactions with the regional dynamics means that this is a region of strong scale interactions, from the regional-scale control of the convective environment, to the upscale forcing of atmospheric circulations by convective events. In subdividing this WP into sub-workpackages according to scales, we adopt the following principles:

- sWP2.1.1 deals with regional and synoptic-scale systems and the ways in which they control the distributions of convection;
- sWP2.1.2 addresses the dynamics of synoptic weather systems. In this sWP we concern ourselves with the detailed effects of
- individual convective storms on the synoptic state. We also consider highly organised convective-synoptic systems, notably tropical cyclones;
- sWP2.1.3 is concerned with the details of cloud systems, for which the synoptic environment is an imposed forcing.

In this 18-month plan, our objectives are to coordinate the start-up of the project, most notably the activities which are necessary for the conduct of the SOPs. Within the sub-WPs we will generate case studies from historical data, and these will be used to generate strategic plans for the SOP which will feed into WP4.2..

Description of work

Observational needs and strategies will be developed through coordination of the sWP plans and historical case studies within WP2.1. A report documenting the proposed strategies will be prepared and revised in the months leading up to the SOPs.

Significant Risks

None

Deliverables

D2.1.a : EOP and SOP strategy document prepared (M11)

D2.1.b : Coordination of the selection of SOP case studies (convective events, onset processes, synoptic waves, tropical cyclones (Tcs) M18.

Milestones

M2.1.a : Progress reports at M6, M12 and M18

M2.1.b : Report on data needs to Tools & Method Wps (M3)

sWP 2.1.1 Regional to synoptic scale

Workpackage number		2.1.1		Start date or starting event:		M0			
Participant id	UNILEEDS	CNRM	UKöln	DLR	IRD				
P-m per participant:	1/1	24/0	6/4	1/0.5	18/0				

Objectives

This sWP will insure that during the first 18 months of the project, the tools necessary for achieving WP2.1 scientific objectives (i.e. determine the regional and synoptic-scale changes in patterns of convection and atmospheric dynamics associated with the regional-scale monsoon and its variability) will be ready and available at the beginning of the Special Observing Period (SOP). This comprises:

- developing the model tools for effective use of the observations collected in the Enhanced Observing period (EOP) and SOP;
- providing the underpinning model results, pre-SOP case studies and theoretical ideas with which to plan atmospheric observations in WP4.2;
- analyzing case studies of extratropically forced rainfall events and monsoon onset;
- performing idealized 2D modelling of the WAM to study involved scales interactions and couplings;
- analyzing the intra seasonal variability of the WAM in connection with dry intrusions, jets, waves and atmosphere-surface-ocean coupling, in historical cases.

Description of work

The work necessary to insure a successful achievement of WP2.1 objectives includes:

- the definition of needs and priorities for the atmospheric components of WP4.2;
- the selection of a few case studies to be used for planning observational strategies during the SOP;
- the use of ECMWF analyses and IMEPTUS 2002 data to diagnose the synoptic evolution and dynamics of the extratropically forcing events;
- generation of a dry intrusion climatology;
- the simulation of a full season (May-September) of the WAM in an idealized 2D framework (60-km resolution), including ocean/atmosphere coupling;
- analysis of monsoon onset in historical data.

Deliverables

D2.1.1.a : Report on the analysis of historical rainfall events and monsoon on-sets to guide SOP1 planing (M12)

Milestones

M2.1.1.a : Contribution to WP2.1 SOP planning document (M9).

M2.1.1.b : Case studies of extra-tropically forced rainfall events in 2002 (M12).

M2.1.1.c : Dry intrusion climatology generated (M12).

M2.1.1.d : Analysis of the simulation of a full season (May-September) of the WAM in an idealized 2D framework (M12)

sWP 2.1.2 : Synoptic to mesoscale

Workpackage number	2.1.2			**Start date or starting event:**			M0		
Participant id	CNRM	UniKarl	FZK						
P-m per participant:	12/0	6/4	1/0.5						

Objectives

This sWP will insure that during the first 18 months of the project, the tools necessary for achieving WP2.1 scientific objectives will be ready and available at the beginning of the Special Observing Period (SOP). This comprises:

- developing the model tools for effective use of the observations collected in the Enhanced Observing period (EOP) and SOP;
- providing the underpinning model results, pre-SOP case studies and theoretical ideas with which to plan atmospheric observations in WP4.2;
- analyzing case studies of African Easterly Waves (AEW) and Tropical Cyclone (TC) - Saharan Air Layer (SAL) interaction from historical data, in order to plan operations.

Description of work

The work necessary to insure a successful achievement of WP2.1 objectives includes:

- the definition of needs and priorities for the atmospheric components of WP4.2;
- the selection of a few case studies to be used for planning observational startegies during the SOP;
- nested model simulations of a historical AEW case;
- the coupling of a mineral dust module (WP4.1) with a multi-nested model;
- the selection and simulation of TC/SAL interaction case studies.

Deliverables

D2.1.2.a : Report on case studies of AEW events and TC/SAL interactions (M12).

Milestones

M2.1.2.a : Identification of key historical events (M3).

M2.1.2.b : Contribution to report on observational strategies for the SOP (M9).

M2.1.2.c : Simulations of historical case studies of TC/SAL interaction (M12).

M2.1.2.d : Benchmark AEW simulations generated: historical cases (M15).

M2.1.2.e : Coupling of mineral dust transport module with nested model (M18)

M2.1.2.f : Implementation of mineral dust transport module (WP2.4) in a multi-nested regional-scale model (M18)

sWP 2.1.3 : Mesoscale to cloud scale

Workpackage number	2.1.3			**Start date or starting event:**			M0		
Participant id	ISAC	UNIPG	CNRS	CNRM	DLR	IRD	FZK		
P-m per participant:	4/2	7/4	6/0	18/0	2/1	2/2	2/1		

Objectives

This sWP will insure that during the first 18 months of the project, the tools necessary for achieving WP2.1 scientific objectives will be ready and available at the beginning of the Special Observing Period (SOP). This comprises:

- developing the model tools for effective use of the observations collected in the Enhanced Observing period (EOP) and SOP
- providing the underpinning model results, pre-SOP case studies and theoretical ideas with which to plan atmospheric observations in WP4.2.

Description of work

The work necessary to insure a successful achievement of WP2.1 objectives includes:

- Adaption of models to the study region by intercomparison based on a historical case;
- Identification of the physical and dynamical elements needed to assess the role of meso-synoptic environment in the control and modification of organized convective activity and to determine feedback of convective-scale dynamics on longer scales of motion;
- Use of a CRM to study convection starting from idealized conditions (statistical equilibrium) with different boundary conditions (topography, heterogeneity of land, shear), appropriate for the study region;
- Development of techniques to assess lightning activity operationally, for the SOP;
- Development of the cloud-lightning model for application to the SOP case studies.

Deliverables

D2.1.3.a : Report on simulations of tests cases of convective activity in idealized conditions with CRM M18)

Milestones

M2.1.3.a : Adapted models and model physics to tropical continental conditions (M6).

M2.1.3.b : Conceptual models of the response of organized convective activity to environmental conditions and its feedback on longer scales of motion (M6).

M2.1.3.c : Contribution to report on observational strategies for the SOP.(M9)

M2.1.3.d : Identification of suitable boundary conditions of land and topography that can be used to assess general conditions of variability for convection (M9)

M2.1.3.e : Report on requirements from the SOP operations (M9)

M2.1.3.f : Pre-SOP models set up for the study region, and inter-comparisons based on a historical case (M15).

WP2.1 Gantt Chart

WP	2.1	Leader : **Univ Leeds**																			Partners
		Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
WP2.1	D2.1.a	EOP and SOP strategy document prepared																			Univ Leeds
	D2.1.b	Report on the case studies to be selected.																			
Milestones	M2.1.a	Progress reports																			
	M2.1.b	Report on data needs to Tools & Method Wps																			
sWP2.1.1	D2.1.1.a	Report on the analysis of historical rainfall events and monsoon on-sets												D2.1.1.a							Univ Leeds CNRM U Koeln DLR IRD
Milestones	M2.1.1.a	Contribution to WP2.1 SOP planning document																			
	M2.1.1.b	Case studies of extra-tropically forced rainfall events in 2002																			
	M2.1.1.c	Dry intrusion climatology generated																			
	M2.1.1.b	Analysis of the simulation of a full season																			
sWP2.1.2	D2.1.2.a	Report on case studies of AEW events and TC/SAL interactions.												D2.1.2.a							CNRM UniKarl FZK
Milestones	M2.1.2.a	Identification of key historical events																			
	M2.1.2.b	Contribution to report on observational strategies for the SOP.																			
	M2.1.2.c	Simulations of historical case studies of TC/SAL interaction																			
	M2.1.2.d	Benchmark AEW simulations generated: historical cases																			
	M2.1.2.e	Coupling of mineral dust transport module with nested model																			
	M2.1.2.f	Implementation of mineral dust transport module (WP2.4) in a multi-nested regional-scale model																			
sWP2.1.3	D2.1.3.a	Report on simulations of tests cases of convective activity in idealized conditions with CRM																		D2.1.3.a	ISAC UNIPG CNRS CNRM DLR IRD FZK
Milestones	M2.1.3.a	Adapted models and model physics to tropical continental conditions																			
	M2.1.3.b	Conceptual models of the response of organized convective activity to environmental conditions																			
	M2.1.3.c	Contribution to report on observational strategies for the SOP																			
	M2.1.3.d	Identification of suitable boundary conditions of land and topography																			
	M2.1.3.e	Report on requirements from the SOP operations																			
	M2.1.3.f	Pre-SOP models set up for the study region, and inter-comparisons based on a historical case																			

WP2.1 Resources

			p.m Total	Req.	Tasks by partner
WP2.1	D2.1.a	Univ Leeds	5	0	Coordination
	D2.1.b				
Milestones	M2.1.a				
	M2.1.b				
sWP2.1.1	D2.1.1.a	Univ Leeds	1	1	2D simulations of the WAM
		CNRM	24	0	Set-up of case studies and simultions
		U Koeln	6	4	Select test cases from ECMWF and IMPETUS 2002
		DLR	1	0,5	Modelling
		IRD	18	0	Contribute in-situ observations
Milestones	M2.1.1.a				
	M2.1.1.b				
	M2.1.1.c				
	M2.1.1.b				
sWP2.1.2	D2.1.2.a	CNRM	12	0	Nested simulations and preparation of cases
		UniKarl	6	4	Modelling
		FZK	1	0.5	CRM simulations with dust module
Milestones	M2.1.2.a				
	M2.1.2.b				
	M2.1.2.c				
	M2.1.2.d				
	M2.1.2.e				
	M2.1.2.f				
	M2.1.2.g				
sWP2.1.3	D2.1.3.a	ISAC	4	2	Modelling activity
		UNIPG	7	4	Application of CRM and SCM
		CNRS	6	0	Contribution of SCM
		CNRM	18	0	Test cases simulated with CRM
		DLR	2	1	Lightning assesment
		IRD	2	2	
		FZK	2	1	Application of CRM
Milestones	M2.1.3.a				
	M2.1.3.b				
	M2.1.3.c				
	M2.1.3.d				
	M2.1.3.e				
	M2.1.3.f				

WP2.2 Oceanic processes

Workpackage number	2.2			Start date or starting event:				M0	
Participant id	CAU	IRD	CNRS	CNRM					
Person-months per participant:	9/8	1.5/7	08/05/00	34/0					

Objectives

Gain a quantitative picture of the circulation in the tropical Atlantic.

Identify pathways within the Shallow subtropical cell.

Quantify the heat budget of the oceanic mixed layer.

Evaluate the quality of general circulation and mixed layer simulations against observations

Description of work

- Synthesis of hydrographic and current measurements obtained in different programs to obtain a consistent picture of oceanic circulation and hydrographic structure.
- Estimation of the ocean heat budget from in-situ and satellite data
- Analysis of oceanic mixed layer simulations and simulations with an OGCM

Deliverables

D2.2.a : First report on observed ocean circulation, heat budget of the surface mixed layer and on a climatological run with the OPA general circulation model

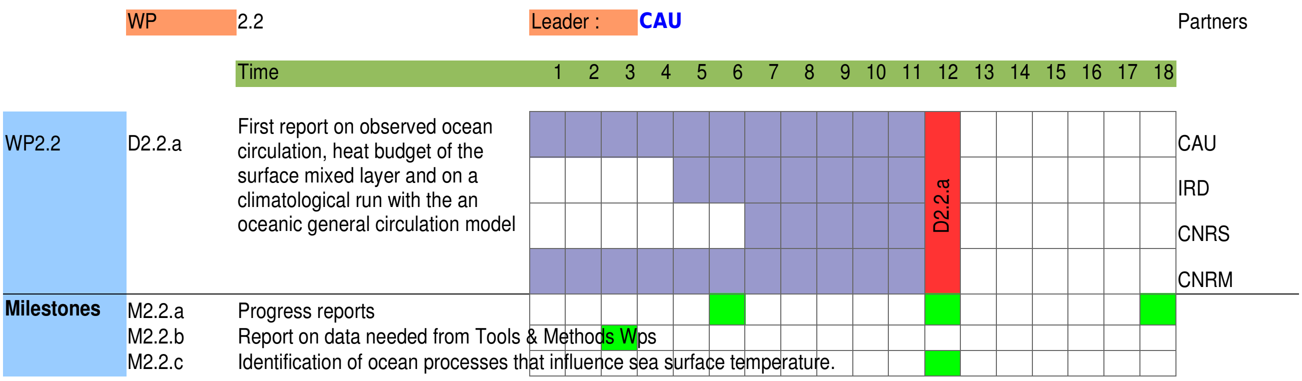
Milestones

M2.2.a : Progress reports (M6,M12, M18)

M2.2.b : Report on data needed from Tools & Method Wps (M3).

M2.2.c: Identification of ocean processes that influence sea surface temperature forcing of the African Monsoon (M12).

<u>WP2.2 Gantt Chart</u>



WP2.2 Resources

			p.m Total	Req.	Tasks by partner
WP2.2	D2.2.a	CAU	9	8	estimation of mean and seasonal current field from WOCE and XBT sections and assimilation models
		IRD	8,5	7	analysis of recent ship data regarding the EUC in the Gulf of Guinea
		CNRS	1,5	0	first analysis of a coarse resolution OGCM regarding ML SST trends and climatological analysis of MLD from data
		CNRM	34	0	preparation of a fine mesh mixed layer model for the Gulf of Guinea
Milestones	M2.2.a M2.2.b				

WP2.3 Physical and biological processes over land surfaces

Workpackage number		2.3		**Start date or starting event:**			M0		
Participant id	FZK	IRD	UPS						
Person-months per participant:	1/0.5	1/0	1/0						

Objectives

Coordinate the activities of WP 2.3. Ensure communication to related WPs (see below),Ensure communication between sub-WPs, Presentation of WP on AMMA webside Control of deliverables and reports

Description of work

Since the processes are studied at various catchments/field sites in all over West Africa, it is necessary to ensure data and information flow between all groups. Meetings and discussion groups will be organised, and responsibilities clearly defined and assigned. Information exchange to related WPs will be organised. Proposed deliverables will be controlled. Communication between data providers and modellers will be organised and common data standards defined. Results and activities will be presented to the community via the AMMA webpage.

Deliverables

Milestones

M2.3.a : Progress reports (M6, M12, M18).

M2.3.b : Definition of responsibilities for/within sub-WPs (M3)

M2.3.c: Definition of data needs and coordination with Tools & Method WPs (M3)

M2.3.d : Preliminary report on state/functioning of devices installed (M18)

sWP 2.3.1 Regional scale surface processes

Workpackage number		2.3.1		**Start date or starting event:**			M0		
Participant id	IRD	IGUC	UPS	CNRS	UPCT				
Person-months per participant:	29/0	6/0	37/5.5	3/0	10/2				

Objectives

Prepare SOP and EOP

Preliminary investigations on hydrological model performance

Analysis of methodologies for hydrological simulation

Description of work

Data availability of satellite products and historical time series will be checked. Techniques for deriving soil moisture from satellite products will be reviewed. Calibration of hydrological models with historical time series (where available) will be started. Calibration of measurement devices will be performed.

Deliverables
D2.3.1.a : Report on the Algorithms for retrieval of surface parameters from satellite (M12)

Milestones and expected result
M2.3.1.a : Elaboration of algorithms for retrieval of surface parameters from DEM and satellite data (M15) M2.3.1.b : Evaluation of the regional runoff in Niger super site (Kori de Dantiandou) (M12) M2.3.1.c : Identification of geochemical signatures and specific natural tracers at the Donga site (M12) M2.3.1.d : Sensivity analysis of the regional runoff in Niger supersite according to anthropogenic and climatic changes (M18) M2.3.1.e : Hydrograph separations of the stream-flow at the Donga site (M18)

sWP 2.3.2 Local scale surface processes

Workpackage number	2.3.2		**Start date or starting event:**	M0					
Participant id	IRD	IGUC	FZK	UPS					
Person-months per participant:	48/9	4/0	18/9	28.5/5.5					

Objectives
Install and start operation of C/N/H_2O station in Dano and Gourma Develop methodological concept for joint hydrological-biological simulations Prepare SOP and EOP

Description of work
The first 18-months works will be affected to instrument set-ups and field surveys according to the objectives defined on the 5-years plan. Hydrological actions will deal with the identification of key processes. According to the first collected data, initial hypotheses could be unfounded or minored (for example : importance of groundwater drainage contribution to stream flow in Benin) which would need an adjustment of the instruments settlement plans. On month 18, key process will be identified and quantification and modelling will really begin. Due to antecedent studies, joint hydrological and vegetation modelling will be performed at Wankama catchment during this phase of the project. In case of the Dano catchment, measurement devices will be installed, calibrated and first test measurements performed. Moreover, the applied biological process oriented models will be adjusted to the Savannah environment.

Deliverables
D2.3.2.a : Reports on the operation of the instruments deployed.(M6) D2.3.2.b : Development plan for a coupled hydrological and dynamical vegetation model (M12)

Milestones

M2.3.2.a : Drilling for piezometer and neutron probe set ups at Wankama and Ara sites (M6)

M2.3.2.b : Joint vegetation and hydrologic data acquisition on Wankama catchment finished (M18)

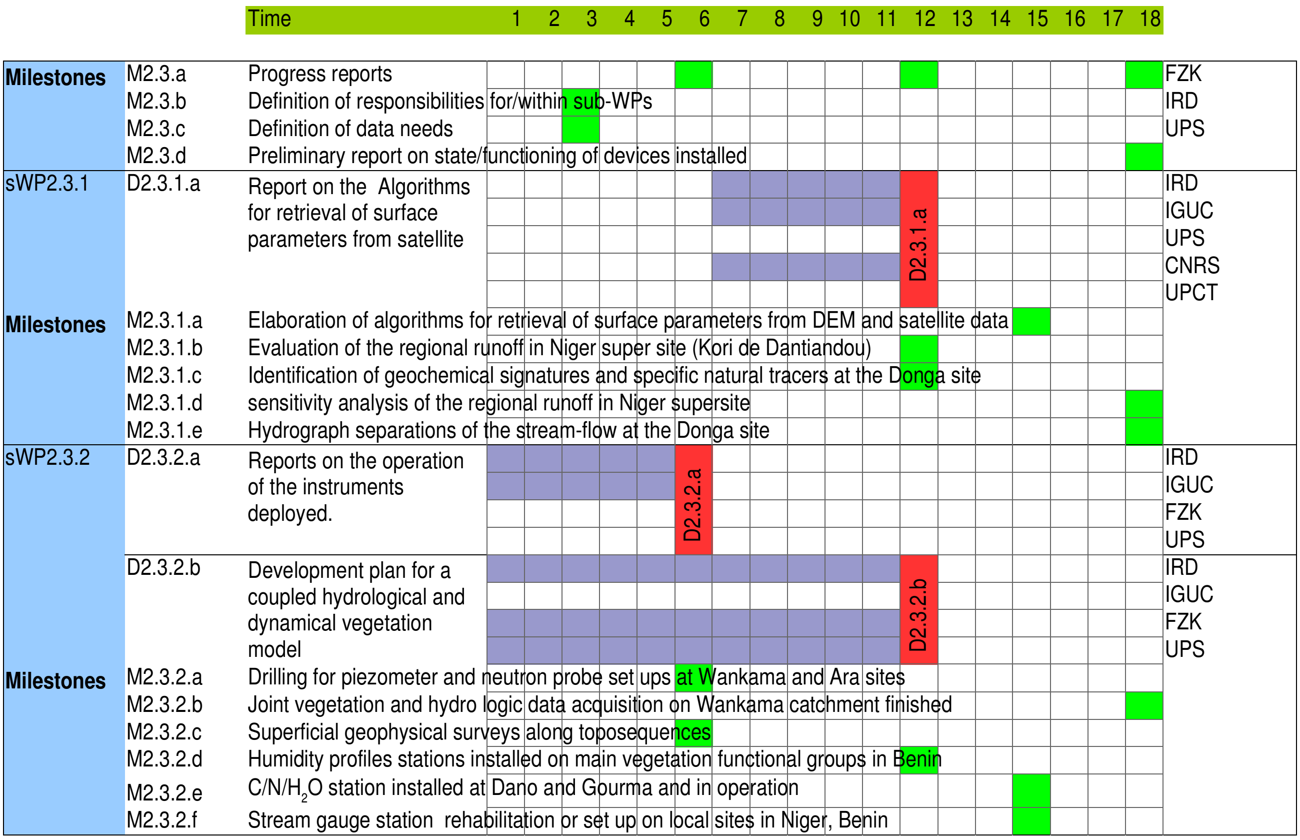
M2.3.2.c : Superficial geophysical surveys along toposequences where humidity profile stations are located (M6)

M2.3.2.d : Humidity profiles stations installed on main vegetation functional groups in Benin (M12)

M2.3.2.e : C/N/H2O station installed at Dano and Gourma and in operation (M15)

M2.3.2.f : Stream gauge station rehabilitation or set up on local sites in Niger (M15)

WP2.3 Gantt Chart



WP2.3 Resources

			p.m Total	Req.	Tasks by partner
Milestones	M2.3.a	FZK	1	0.5	Coordination
	M2.3.b	IRD	1	0	Interface with observational sites
	M2.3.c	UPS	1	0	Interface with observational sites
	M2.3.d				
sWP2.3.1	D2.3.1.a	IRD	29	0	In-situ observations and modelling
		IGUC	6	0	Remote sensing and field observations
		UPS	37	5,5	Remote sensing and field observations
		CNRS	3	0	Modelling
		UPCT	10	2	Modelling
Milestones	M2.3.1.a				
	M2.3.1.b				
	M2.3.1.c				
	M2.3.1.d				
	M2.3.1.e				
sWP2.3.2	D2.3.2.a	IRD	14		Upper-Oueme catchment
		IGUC	4	0	Senegal catchment
		FZK			Volate basin and Dano sites
		UPS			Gourma
	D2.3.2.b	IRD	34	9	Modelling of hydrological processes
		IGUC			Field observations
		FZK	18	9	Field observations
		UPS	28,5	7.5	Ecological modelling
Milestones	M2.3.2.a				
	M2.3.2.b				
	M2.3.2.c				
	M2.3.2.d				
	M2.3.2.e				

WP2.4 Aerosol and Chemical processes in the atmosphere

Workpackage number		2.4		Start date or starting event:		M0			
Participant id	UEA								
Person-months per participant:	1/0								

Objectives

The main objective of this Process Studies WP is to advance the scientific understanding of the aerosol and chemical processes within the WAM region and to feed this knowledge into the Integrative Science WPs. This WP is divided into 4 sub-WPs:

2.4.1 Aerosol radiative properties

2.4.2 Gas and particle phase chemistry

2.4.3 Surface processes

2.4.4 Effect of convection on chemical and aerosol budgets

2.4.1 and 2.4.2 use the observations from the SOPs and EOP to build the basic scientific understanding of the trace gas and aerosol distributions, composition and processing in the WAM region required by the other 2 sub-WPs that are designed to address more specific targets. 2.4.3 quantifies the surface emissions and deposition fluxes of the chemical compounds, whilst 2.4.4 examines the effect of convection on the trace gas and aerosol budgets in the WAM region.

The specific aim of the first 18 months is to coordinate the start-up of the project and, in particular, to feed information into WP4.2 to ensure that the field measurements made during the SOPs meet the needs of this WP.

Description of work

Ensure that the observational needs of this WP are communicated to WP4.2 and WP4.3. Much of this will be done through partners in this WP also participating in the observational planning in WP4.2.

Significant Risks

Problems with field campaigns

Contingency Plan

See section B9 Other Issues.

Deliverables

Milestones and expected result

M2.4.a : Progress reports (M6,M12,M18)

M2.4.b : Report on data needs from Tools & Methods WPs (M3)

M2.4.c : Internal Report on observational needs for SOP 0 only (M6)

M2.4.d : Internal Report on observational needs for the SOPs 1-3. (M12)

sWP 2.4.1 Aerosol radiative properties

Workpackage number		2.4.1		**Start date or starting event:**			M0		
Participant id	UP12	CNRS	LMU	FZK	ISAC	ENEA			
Person-months per participant:	10/0	14/0	1/0	7/3	2/1	2/1			

Objectives

This subWP highly relies on the analysis and interpretation of the Special Observation Periods (SOP), mostly SOP 0 in the dry season, and SOP 1, at the onset of the monsoon season. The first 18 months of the project will be largely devoted to the evaluation of the experimental, observational, modeling, and logistic tools necessary for achieving WP2.4 scientific objectives during SOPs.

(i) developing the observational tools for effective use of the observations collected in the Enhanced Observing period (EOP) and SOP, (ii) providing the relevant model results, pre-SOP case studies and theoretical ideas with which to plan atmospheric observations in WP4.2

Description of work

Define the experimental procedure to measure aerosol physico-chemical and optical properties.

Define preliminary flight planning, and ground-airbone coordination, to be used during SOPs.

Define actual tools and needs in terms of optical modelling algorithms

Deliverables

D2.4.1.a : A report on algorithms to be used for optical modelling of aerosols (M12)

Milestones

M2.4.1.a : Readiness and priority of observational and modeling tools (in connection with WP 4.2 and 4.3) (M6)

M2.4.1.b : Contribute to field campaign report to be submitted WP2.4 (M9).

M2.4.1.c : Observational priorities plan (M12).

M2.4.1.d : Preliminary evaluation of the operations and measurements of SOP 0 (M14)

M2.4.1.e : Preliminary evaluation of the operations and measurements of SOP 1 (M18)

sWP 2.4.2 Chemistry ; gas phase and aerosol

Workpackage number		2.4.2		**Start date or starting event:**			M0		
Participant id	CNRS	FZK							
Person-months per participant:	51/0	5/2							

Objectives

Much of the work in 2.4.2 relates to new data from the SOPs. Therefore the work in the first 18 months includes providing advice to WP4.2 regarding the observational strategy and preliminary analysis of data from the EOP.

To provide a preliminary climatology of ozone and CO vertical profiles over West Africa

To provide a preliminary climatology of mixed aerosols over West Africa with a zoom on secondary aerosol formation from anthropogenic and biogenic origins.

Description of work
The climatology of ozone and CO over West Africa will be inferred from the ozone soundings, the MOZAIC program ozone and CO data, ozone and CO ground-based measurements from AMMA super-sites, satellite and global modelling (Model: MOCAGE, global, CTM) The climatology of mixed aerosols over West Africa with a zoom on the formation of secondary organic aerosols and the hygroscopicity of mixed aerosols will be inferred from IDAF network and from ground-based measurements from AMMA super-sites (Lamto and Djougou). Satellite and regional and global modelling (Model ; RegCM3, TM3 with aerosol modules included). Work on the parameterization of the relevant heterogeneous reactions of mineral dust.

Deliverables
D2.4.2.a : Preliminary climatological ozone and CO vertical distributions for the investigated tropical region with standard deviations (M12) D2.4.2.b : Preliminary results of aerosol modelling (M12)

Milestones
M2.4.2.a : Data becoming available from the EOP (M6) M2.4.2.b : Contribution to the observational strategy report (M9).

sWP 2.4.3 Surfaces processes

Workpackage number	2.4.3			**Start date or starting event:**		M0			
Participant id	UP12	CNRS	FZK	ISAC	ENEA				
Person-months per participant:	10/0	41/13	'3/1.5	2/1	2/1				

Objectives
During the first 18 months of the project, preliminary versions of emissions inventories will be established and sensitivity tests on emissions and depositions parameterisations implemented in regional models will be performed. To reach the objectives of the 5 years plan, the information required for the establishment of emission inventories in addition to the data obtained during the SOP will be collected and analysed. Preliminary runs of available models should help the precise definition of the surface emission and deposition measurements deployed during the SOP

Description of work
Definition of the experimental procedure to measure the size resolved mineral dust emission fluxes and the dry deposition fluxes Development of emission factors data base for trace gases and aerosol from biomass burning and anthropogenic activities Analysis of tropospheric columns of trace gases for the SOP1 Analysis of preliminary data provided by WP4.2.3 on trace gas and aerosols Sensitivity tests of a size-resolved regional model of the mineral dust cycle Development of a high resolution model of the mineral dust cycle during squall lines

Deliverables
D2.4.3.a : Mesoscale database of emission factors for Nitrogen oxides and Volatile Organic Compounds for natural and human disturbed ecosystems provided (M18)
D2.4.3.b : Preliminary version of biomass burning emission inventory over : savanna and forest fires typical of 2000 year including monthly variations(M18)
D2.4.3.c : Preliminary version of biogenic and industrial emission inventory : mesoscale emission factor measurements for gases and particles(M18)
D2.4.3.d : Preliminary regional distribution of wet and dry deposition fluxes(M18)
D2.4.3.e : Preliminary regional simulation of the mineral dust cycle (M18)
D2.4.3.f : Provision of present-day anthropogenic and biogenic NOx/VOC emissions (M18)

Milestone
M2.4.3.a : Readiness of preliminary versions of modeling tool (M6)
M2.4.3.b : Readiness of input data for the preliminary inventories (in connection with WP 4.3) (M6)
M2.4.3.c : Contribution to the report on observational strategies (M9)
M2.4.3.d : Observational priorities plan (M12)

sWP 2.4.4 Convection and WAM dynamics

Workpackage number	2.4.4			**Start date or starting event:**				M0	
Participant id	CNRS	DLR	ISAC						
Person-months per participant:	9/0	1/0.5	2/1						

Objectives

Since this subWP is based on the analysis and interpretation of the Special Observation Period during the wet monsoon season, few tasks will be achieved during the first 18 months. This WP will ensure that during the first 18 months of the project, the tools necessary for achieving WP2.4 scientific objectives will be ready and available at the beginning of the Special Observing Period (SOP) and to provide scientific guidelines for SOP planning

Readiness of the model tools for effective use of the observations collected in the Enhanced Observing period (EOP) and SOP

Providing the relevant model results, pre-SOP case studies and theoretical ideas with which to plan atmospheric observations in WP4.2

Description of work

Analysis of historical data and simulations for observation planning

Definition of needs and priorities for the atmospheric components of WP4.2

Deliverables

D2.4.4.a : Report on available historical data and simulations used for observation planning (M9)

Milestones

M2.4.4.a : Input on priority of modeling tools (in connection with WP 4.1) (M6)

M2.4.4.b : Contribute to report on observational strategies (M9).

M2.4.4. : Observational priorities plan (in connection with WP 4.2 and 4.3) (M12)

WP2.4 Gantt Chart

WP 2.4 | Leader : **UEA** | Partners

Group	ID	Description	Month	Partners
Milestones	M2.4.a	Progress reports	6, 12, 18	UEA
	M2.4.b	Report on data needs from Tools & Methods WPs	3	
	M2.4.c	Internal Report on observational needs for SOP 0 only	6	
	M2.4.d	Internal Report on observational needs for the SOPs 1-3.	12	
sWP2.4.1	D2.4.1.a	A report on algorithms to be used for optical modelling of aerosols	12 (D2.4.1.a)	UP12, CNRS, LMU, FZK, ISAC, ENEA
Milestones	M2.4.1.a	Readiness and priority of observational and modeling tools	6	
	M2.4.1.b	Contribute to field campaign report to be submitted WP2.4	9	
	M2.4.1.c	Observational priorities plan	12	
	M2.4.1.d	Preliminary evaluation of the operations and measurements of SOP 0	14	
	M2.4.1.e	Preliminary evaluation of the operations and measurements of SOP 1	18	
sWP2.4.2	D2.4.2.a	Preliminary climatological ozone and CO vertical distributions	12 (D2.4.2.a)	CNRS, FZK
	D2.4.2.b	Preliminary results of aerosol modelling	12 (D2.4.3.a)	CNRS, FZK
Milestones	M2.4.2.a	Data becoming available from the EOP.	6	
	M2.4.2.b	Contribution to the observational strategy report.	9	
sWP2.4.3	D2.4.3.a	Mesoscale database of emission factors for Nitrogen oxides and Volatile Organic Compounds	18 (D2.4.3.a)	UP12, CNRS, FZK, ISAC, ENEA
	D2.4.3.b	Preliminary version of biomass burning emission inventory	18 (D2.4.3.b)	UP12, CNRS, FZK, ISAC, ENEA
	D2.4.3.c	Preliminary version of biogenic and industrial emission inventory	18 (D2.4.3.c)	UP12, CNRS, FZK, ISAC, ENEA
	D2.4.3.d	Preliminary regional distribution of wet and dry deposition fluxes	18 (D2.4.3.d)	UP12, CNRS, FZK, ISAC, ENEA
	D2.4.3.e	Preliminary regional simulation of the mineral dust cycle	18 (D2.4.3.e)	UP12, CNRS, FZK, ISAC, ENEA
	D2.4.3.f	Provision of present-day anthropogenic and biogenic NOx/VOC emissions	18 (D2.4.3.f)	UP12, CNRS, FZK, ISAC, ENEA
Milestones	M2.4.3.a	Readiness of preliminary versions of modeling tool	6	
	M2.4.3.b	Readiness of input data for the preliminary inventories	6	
	M2.4.3.c	Contribution to the report on observational strategies.	9	
	M2.4.3.d	Observational priorities plan	12	
	D2.4.4.a	Report on available historical data and simulations	9 (D2.4.4.a)	CNRS, DLR, ISAC
Milestones	M2.4.4.a	Input on priority of modeling tools (in connection with WP 4.1)	6	

WP2.4 Resources

2.4	WP	Partners	p.m Total	Req.	Tasks by partner
Milestones	M2.4.a M2.4.b M2.4.c M2.4.d	UEA	1	0	Coordinate WP2.4 and Compile reports
sWP2.4.1	D2.4.1.a	UP12	10	0	Review uncertainties on mineral dust properties
		CNRS	14	0	Analysis of aerosol radiative impact
		LMU	1	0	Relevance of vertical aerosol profiles
		FZK	7	3	Documentation of the available algorithms
		ISAC	2	1	Prep., performance and prelim. data analysis of Micro-lidar
		ENEA	2	1	Prep. And delivery of Micro-lidar network
Milestones	M2.4.1.a M2.4.1.b M2.4.1.c M2.4.1.d M2.4.1.e				
sWP2.4.2	D2.4.2.a	CNRS	51	0	Analysis of MOZAIC O3 and CO, RS O3
	D2.4.2.b	FZK	5	2	First sims. of the aerosol distrib. inc. gasphase chem.
	M2.4.2.a M2.4.2.b				
Milestones	D2.4.3.a	CNRS	13	6	In-situ measurements and database
	D2.4.3.b	CNRS	8	0	Emission inventory from satellite data
sWP2.4.3	D2.4.3.c	CNRS	12	6	Combustion emissions
		ISAC	2	1	Preliminary data analysis of SOP1: estimate of origin of aerosol layers
		ENEA	2	1	Preliminary data analysis of SOP1: estimate of origin of aerosol layers
	D2.4.3.d	CNRS	6	0	Deposition budget
		FZK	3	1.5	Simulation of the dry depsoition flux of gaseous and particulate matter
	D2.4.3.e	UP12	10	0	Dedicated regional model of the mineral dust cycle
	D2.4.3.f	CNRS	2	1	Provision of present-day emissions (global scale)
	M2.4.3.a M2.4.3.b M2.4.3.c M2.4.3.d				
	D2.4.4.a	CNRS	9	0	Mesoscale modelling of case studies
		DLR	1	0.5	Analysis of lightning or convection statistics
		ISAC	2	1	Analysis of TTL water vapor and aerosol. Link to SCOUT.
	M2.4.4.a M2.4.4.b M2.4.4.c				

8.6.3 Impact studies

WP3.1 Land Productivity

Workpackage number	3.1		Start date or starting event:			M0		
Participant id	IGUC	CIRAD	IBIMET	CNRS	UPS	AGRHYMET		
Person-months per participant:	4/0	5/3	14/7	5/2	19/4	7/3		

Objectives

Validated crop model suited for impact studies of principal grain crop coupling with an aggregating/disaggregating tool (spatial issues)

Crop model linked with GCM output database and GIS

Zoning of risks and yields for input to early warning systems

A vegetation productivity model using medium resolution satellite data

Time series of regional NPP maps 1982-> present

Description of work

The first 18 Months, the WP will define a set of tools (models) and methods to simulate vegetation biomass and crop production at plot and aggregated regional scale. Such specific activities will address Yield variability and food security such as analyse of trends and accuracy of an aggregating/disaggregating tool coupling with a crop modeling platform for simulations of crop climate interactions at different spatial scales.

Vegetation trends towards improving agricultural forecasting and early warning systems will be addressed also.

Significant Risks Contingency Plan

One of our approach is field based validation of model relevance and model accuracy, which is crucial because even in a highly climate driven, and particular rainfall driven agricultural situation, the impact of climatic factors are sometimes very indirect (e.g., early-season soil nutrient and weed dynamics depend on sowing date relative to onset of rains) or non-linear. This is the reason of the broad participation of disciplines and experts in/from the region will then be sought to study climate impacts on system productivity and behavior (via feedback) by sensitivity analysis

Deliverables

D3.1.a Times series of regional vegetation productivity (M18)

D3.1.b Trend map identifying areas showing positive or negative trends in vegetation productivity ready (M18)

Milestones

M3.1.a : Progress reports (M6, M12, M18)

M3.1.b : Report on data needs (M3).

M3.1.c : Spatial scaling problems regarding GCM and crop model linkage resolved by aggregating/disaggregating tool (M12)

M3.1.d : Yield variability within a 100km x 100km Sahel field observatory broken down to climatic and non-climatic factors (M18)

M3.1e : LUE-based model developed and calibrated for Senegal and Gourma (M18)

WP3.1 Gantt Chart

WP	3.1	Leader :	CIRAD		Partners

		Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
WP3.1	D3.1.a	Times series of regional vegetation productivity													■	■	■	■	■	D3.1.a	IGUC
																					CIRAD
								■	■	■	■	■	■	■	■	■	■	■	■		IBIMET
																					CNRS
										■	■	■	■	■	■	■	■	■	■		UPS
																					AGHYMET
	D3.1.b	Trend map identifying areas showing trends in vegetation productivity ready																		D3.1.b	IGUC
														■	■	■	■	■	■		CIRAD
															■	■	■	■	■		IBIMET
																■	■	■	■		CNRS
											■	■	■	■	■	■	■	■	■		UPS
											■	■	■	■	■	■	■	■	■		AGRHYMET
Milestones	M3.1.a	Progress reports						■						■						■	
	M3.1.b	Report on data needs from Tools & Methods WPs			■																
	M3.1.c	Spatial scaling problems regarding GCM and crop model linkage												■							
	M3.1.d	Yield variability within a 100km x 100km Sahel																		■	
	M3.1.e	LUE-based model developed and calibrated for Senegal and Gourma																		■	

WP3.1 Resources

3.1

			p.m Total	Req.	Task by partner
WP3.1	D3.1.a	IGUC	4	0	Remote sensing
		CIRAD			
		IBIMET	10	5	Land productivity modelling
		CNRS			
		UPS	9	2	Remote sensing and modelling of vegetation.
		AGHYMET			
	D3.1.b	IGUC			
		CIRAD	5	3	Crop modelling
		IBIMET	4	2	Crop modelling
		CNRS	5	2	Climate variability and change expertise
		UPS	10	2	Remote sensing of crops and natural vegetations.
		AGRHYMET	7	3	Crop modelling and data for validation.
Milestones	M3.1.a				CIRAD
	M3.1.b				All
	M3.1.c				
	M3.1.d				

WP3.2 Human process, adaptation and environmental interactions

Workpackage number		3.2	Start date or starting event:			M0		
Participant id	IGUC	CIRAD	IBIMET	UCL	EIER			
Person-months per participant:	07/0		28/4	12/02	24/04			

Objectives
During the first 18 months the basis for the work in WP3.2 related to human processes and food security will be created. The objectives for the first 18 months are thus to obtain an overview of existing knowledge from the literature and elsewhere, to conduct pilot field surveys and to set up a framework for vulnerability assessment which will guide the work in the WP for the remaining project period when the major tasks of this impact workpackage will be performed.

Description of work

9. A systematic comparative meta-analysis of case studies, over time frames of up to fifty years
10. First iteration in identification of general pathways of land-use change and human-environment interactions in the region, with a focus on adaptation to climate variability
11. Analysis of time series of medium to high resolution satellite data in order to point out areas which have undergone significant changes in land use/land cover, and thus serve as candidates to field surveys and to set up a standard change detection approach
12. Analysis of satellite data with regards to the occurrence of savanna fires
13. Development of questionnaires and perform pilot field surveys in Senegal
14. Identification and selection of the specific models (on bio-economy and land use change that will be applied in the WP
15. Start collection of the socio-economic data on population, land tenure, agricultural subsidies etc

Significant Risks Contingency Plan

(i) Necessary input from other WPs are not ready in due time. That is in particular true for input on climate scenarios. Constructed climate scenarios could be set up, and act as input to the models that will be applied. This would inhibit a true integration with the work in process and integrative science WPs.

(ii) The field surveys could be prevented from fail of infrastructure or for security reasons. Major part of the local scale field work will take place in Senegal, which is considered to be one of the most stable nations in the region. It would be possible to find other sutable areas to perform the field surveys, in a worst case scenario the models could be build on the results from the META study. This would however limit the outcome of the WP significantly

Deliverables

D3.2.a A report summarising the meta study on existing knowledge (M6)

D3.2.b A report on observed past fire occurrence based on satellite data (M12)

D3.2.d Vulnerability assessment framework (M18)

Milestones

M3.2.a : Progress reports (M6, M12, M18)

M3.2.b : Report on data needs from Tools & Methods WPs. (M3)

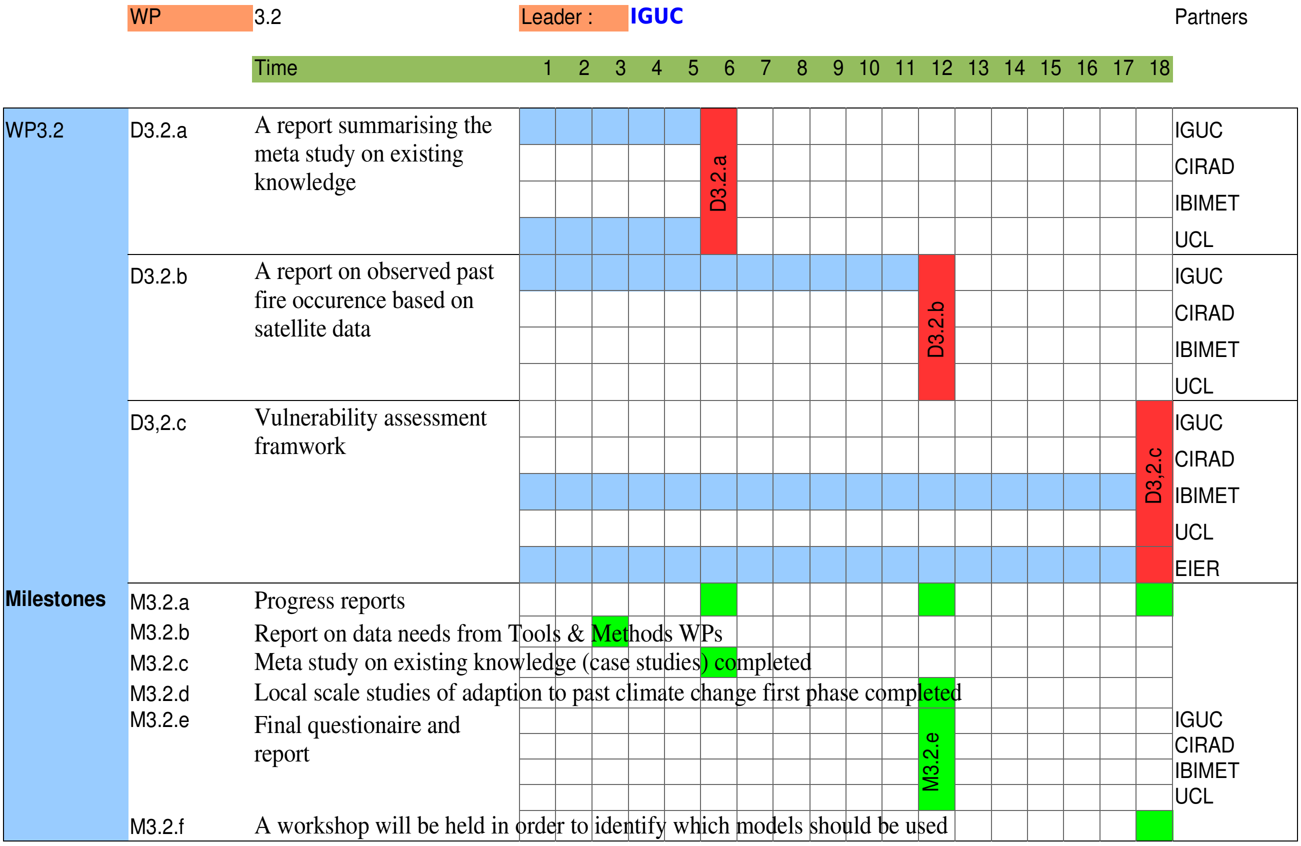
M3.2.c : Meta study on existing knowledge (case studies) completed (M6)

M3.2.d : Local scale studies of adaption to past climate change first phase completed (M12)

M3.2.e : Final questionnaire and report based on pilot field survey produced (M12)

M3.2.f : A workshop will be held by the end of the 18 months period, in order to identify which models should be used, to specify which data should be collected for use with the models and, based on the findings of the work so far, specify the work plan for the remaining project period (M18)

WP3.2 Gantt Chart



WP3.2 Resources

	3.2		p.m Total	Req.	Tasks by partner
WP3.2	D3.2.a	IGUC	2.5	0	Litterature study
		CIRAD			
		IBIMET			
		UCL	12	2	Litterature study
	D3.2.b	IGUC	2.5	0	Analysis of timeseries of satellite data and recompilation of exsting field usrveys and studes
		CIRAD			
		IBIMET			
		UCL			
	D3.2.d	IGUC			
		CIRAD			
		IBIMET	27	4	Analysis of timeseries of satellite data and identification of areas which has undergone change – combined with socioeconomic data
		UCL			
		EIER	24	4	analysis of timeseries of satellite data and identification of areas which has undergone change – estimation of stress indices
Milestones	M3.2.a	IGUC	1	0	Status report writing
		IBIMET	1	0	Contribution on vulnerability assessment
	M3.2.b	IGUC	0.5	0	Overview of requested data, contribution from all partners
	M3.2.c				
	M3.2.d	IGUC	0.5		Assessing local scale adaptation
	M3.2.e	IGUC	1		Development of questionare

WP3.3 Water resources

Workpackage number	3.3		Start date or starting event:			M0		
Participant id	AGHRYMET	IRD	EIER	IGUC	UPCT			
Person-months per participant:	12/7	59/0	9/3	8/0	18/8			

Objectives

Detail descriptions of each selected basin (topography, morphology, soils, vegetation, land use, etc)

Characterization of rainfall, PET and discharge variability for each watershed

Hydrological Modelling of each basin

Assess of land use change on the hydrological response

Analysis of several methodologies oriented to dynamic flood monitoring

Description of work

Analysis of the variability of rainfall, PET and discharge of the Sirba, Senegal, Nakambé, Ouémé and Epsat-Niger experimental basins.

Hydrological modelling of different basins. Distributed models will be considered for the majority of basins. For each basin, a model will be calibrated and validated based on historical data of rainfall, evaporation, discharge and land use available.

Sensitivity analysis of the hydrological modelling for land use modification and the scale of input variable principally for rainfall.

Analysis of the potential of remote sensing and digital elevation model in the monitoring and forecasting of floods in the valley of Senegal River

Deliverables

D3.3.a : Report on the characterization of rainfall and discharge variability on the considered watershed (M12)

D3.3.b : Report on the hydrological modelling of the basin including sensitivity analysis on land use modification and rainfall spatial variability (M12)

Milestones

M3.3.a : Progress reports (M6, M12, M18)

M3.3.b : Report on data needs from Tools & Methods WPs (M3)

M3.3.c : Data collection and analysis (rainfall, discharge, ETP, ..) (M12)

M3.3.d : Rainfall and discharge characterization (inter-annual and spatial variability) (M12)

M3.3.e : Hydrological modelling and sensitivity analysis (M12)

M3.3.f : Report on the suitable methodologies of flooding mapping from remote sensing in the selected area of Senegal River valley (M12)

WP3.3 Gantt Chart

WP	3.3		Leader : AGRHYMET																		Partners
		Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
WP3.3	D3.3.a	Report on the characterization of rainfall and discharge variability on the watersheds												D3.3.a							AGRHYMET IRD EIER IGUC UPCT
	D3.3.b	Report on the hydrological modelling of the basin including sensitivity analysis												D3.3.b							AGRHYMET IRD EIER IGUC UPCT
Milestones	M3.3.a	Progress reports																			AGRHYMET
	M3.3.b	Report on data needs from Tools & Methods WPs																			All
	M3.3.c	Data collection and analysis (rainfall, discharge, ETP, ..)																			
	M3.3.d	Rainfall and discharge characterization (inter-annual and spatial variability)																			
	M3.3.e	Hydrological modelling and sensitivity analysis																			
	M3.3.f	Report on the suitable methodologies of flooding mapping from remote sensing.												M3.3.f							AGRHYMET IRD EIER IGUC UPCT

WP3.3 Resources

3.3			p.m Total	Req.	Tasks by partner
WP3.3	D3.3.a	AGRHYMET	5	2	Charagcterization of rainfall and discharge variability on the Sirba basin
		IRD	25	0	Charagcterization of rainfall and discharge variability of the Ouémé and EPSAT-Niger hydrological systems
		EIER	4	1	Charagcterization of rainfall and discharge variability of the Nakambé basin
		IGUC	2	0	Charagcterization of rainfall and discharge variability of the Senegal basin
		UPCT	**4**	**2**	Characterization of floods of the Senegal Valley.
	D3.3.b	AGRHYMET	6	4	Hydrological modelling of the Sirba basin
		IRD	25	0	Hydrological modelling of the Ouémé and EPSAT-Niger hydrological systems
		EIER	3	1	Hydrological modelling of the Nakambé basin
		IGUC	6	0	Hydrological modelling of the Senegal Basin
		UPCT	**3**	**1**	Interrelations between basin topographical attributes from different DEMs with floods characteristics.
Milestones	M3.3.a	AGRHYMET			
	M3.3.b	All			
	M3.3.c				
	M3.3.d				
	M3.3.e				
	M3.3.f	AGRHYMET	1	1	Remote sensing data analysis
		IRD	9	0	
		EIER	2	1	Aerial photography and LANDSAT images analysis
		IGUC			
		UPCT	**11**	**5**	Analysis of digital and remote sensing data for floods characterization

WP3.4 Health impacts

Workpackage number	3.4		Start date or starting event:			M0		
Participant id	UNILIV		CERMES		IRD	MEDIAS		
Person-months per participant:	8/4		48/10		“4/0”	“8/4”		

Objectives
Establishment of IP links and integration activities to link disease and disease vectors to climate variability and the environmental conditions.
Implementation of disease vector and multidisciplinary disease surveillance data through ongoing projects and new field campaigns in the West African AMMA window

Description of work
The establishment and commencement of field studies investigating disease vectors (mainly mosquitoes) will be undertaken in selected area of Sahel: Benin, Senegal and Niger. Careful selection of the field sites will give a wide range of bio-climatic regimes within each of the three countries in the study. Supporting environmental and human and animal related data sets will also start to be collected for the study areas.
The majority of the integration and analysis activities to investigate the linkages between the patterns of disease and disease vectors and the patterns in the rainfall variability and environmental factors will take place after the first 18 months, however, interaction will commence with the workpackages (WP4.x) collecting the meteorological, climate and environmental data from a variety of sources to establish the needs of the health impacts partners. Pilot multidisciplinary datasets will be examined to start to ascertain analysis requirements and mechanisms for diseases transmission.
Interaction will take place between the downscaling and other integrative workpackages (WP1.x) to define key products and parameters required for health impacts studies. Interactions will take place with the other impacts workpackages (WP3.x) to minimise duplication of supporting data analysis.
Discussion will be undertaken with the demonstration workpackages (WP5.x) particularly the early warning partners to ascertain requirements of a potential health early warning system (HEWS) for selected diseases.

Deliverables
D3.4.a : Identification of downscaling requirements and issues for health impacts (M6)
D3.4.b : Report on the start up of the field campaigns and initial data analysis (M18)

Milestones
M3.4.a : Progress reports (M6,M12,M18)
M3.4.b : Identification of key meteorological, climate,and environmental variables for use by health impacts groups (M3)
M3.4.c : Establishment of disease vector and disease surveillance data collection in selected areas of Benin, Senegal and Niger (M18)
M3.4.d : Establishment and commencement of field data collection integrated disease vector and epidemiological data with supporting meteorological and environmental data (M18)

<u>WP3.4 Gantt Chart</u>

WP	3.4	Leader :	**UNILIV**																		Partners
		Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
WP3.4	D3.4.a	Identification of downscaling requirements and issues for health impacts						D3.4.a													UNILIV CERMES IRD MEDIAS
	D3.4.b	Report on the start up of the field campaigns and initial data analysis																		D3.4.b	UNILIV CERMES IRD MEDIAS
Milestones	M3.4.a	Progress Report																			
	M3.4.b	Identification of key meteorological and environmental variables			M3.4.b																UNILIV CERMES IRD MEDIAS
	M3.4.c	Establishment of disease vector and disease surveillance data collection																			
	M3.4.d	Establishment ommencement of field data collection																			

WP3.4 Resources

			p.m Total	Req.	Tasks by partner
WP3.4	D3.4.a	UNILIV	1	0	Identification of overall requests and establishing contacts with other WPs
		CERMES	1	0	Identification of requests for downscaling for application in Niger
		IRD	0.5	0	Identification of requests for downscaling for application in Benin
		MEDIAS	0.5	0.5	Identification of requests for downscaling for application in Senegal
	D3.4.b	UNILIV	5	4	Overview of field and environmental data collection and initial analysis of DEMETER probabilistic seasonal hindcasts
		CERMES	41	8	Establishement of field data collection and environmental data programmes in Niger and initial data analysis
		IRD	3	0	Collection of field data in Benin
		MEDIAS	7	3	Collection of field and enviornmental data in Senegal and establishment of database and initial analysis
Milestones	M3.4.a	UNILIV	1	0	Overall report writing
		CERMES	1	0	Section report on overall African field activity and progress to date
	M3.4.b	UNILIV	1	0	Report and discussuion of key meteorological variable
	M3.4.c	CERMES	3	1	Collation of data and report on field vector and diease
		MEDIAS	0.5	0	Ditto
		IRD	0.5	0	Ditto
	M3.4.d	CERMES	2	1	Collation of data and report on field envirnmental data
		MEDIAS	0	0.5	Ditto

8.6.4 Tools and Methods

WP4.1 Model evaluation and data assimilation

Workpackage number	4.1		**Start date or starting event:**		M0		
Participant id	CNRM		KNMI				
Person-months per participant:	2/0		0,5/0				

Objectives

To coordinate the start-up of the project within the WP in close collaboration with other WPs

Set up the strategy and the planning to generate analyses and to evaluate models

To ensure that subWPs prepare the tools to be run during the field campaign before the SOP beginning

Description of work

Organize a meeting to start-up and organize the work of the 3 subWPs. It will be prepare in collaboration with other WPs (more specifically with WP5.1, 1.1, 1.2, 1.3, 2.1) to avoid duplication of tasks, such as numerical experiments and intercomparisons exercises.

The observation needs will be also detailed to interact with relevant WPs

A report documenting the proposed strategies will be prepared

Organize a second WP4.1 meeting aimed at monitoring progress on work throughout the WP.

Deliverables

Progress reporting occurs through the Scientific Management WP (7.2).

Milestones

M4.1a : Progress reports (M6,M12,M18)

M4.1b : Report on data provided to the database (WP4.4) (M3).

sWP 4.1.1 Data assimilation and forecasting systems

Workpackage number	4.1.1			**Start date or starting event:**			M0		
Participant id	ECMWF	CEH		CNRM	UPCT	UCLM	CNRS		
Person-months per participant:	4/4	3/1,5		30/0	5/1	0/0	10/0		

Objectives

Preparation of the tools to generate state-of the-art analyses of the atmosphere and of the surfaces for the whole AMMA programme, as well as providing users with support, documentation and guidance.

Description of work
Software will be prepared and adapted to compute observation statistics, To develop methods to estimate the “covariance matrix of background errors” corresponding to the WAM area and used in the 3D-Var technique at high resolution, To perform atmospheric 3D-Var analyses at fine scale of at least 2 cases, Define with others involved WPs (4.2, 4.3, 4.4, 1.3, 2.3) the data base to force Land Surface Models (LSMs), Develop the first version of the LSM forcing data base, First use and evaluation of this base to retrieve soil moisture and surface fluxes using LSMs. Significant Risks Contingency Plan Risk is low in this sWP as the technology to achieve the objectives exists. The assimilation of data from new radiosonde stations needs some attention. Nevertheless the LDAS will strongly depend on the quality of surface data and of precipitation estimates.

Deliverables
D4.1.1.a : Synthesis of monthly observation statistics produced by the analysis tools (M12) D4.1.1.b : Case studies on Atmospheric 3D-Var analyses at fine scale before the SOP (M12)

Milestones
M4.1.1.a : Forcing data base definition (First version of the data base to force LSMs over one season) (M6) M4.1.1.b : Adaptation of 3D-Var to the WAM region at high resolution (M12) M4.1.1.c : First Land Data Assimilation System (LDAS) tests and evaluation (M18)

WP4.1.2 The West African Monsoon in regional and global climate models

Workpackage number	4.1.2		**Start date or starting event:**			M0	
Participant id	ECMWF	ENEA	CNRS	CNRM	UCLM	UCM	UPCT
Person-months per participant:	2/2	4/2	17/0	18/0	0/0	7/2	4/2

Objectives
Define pertinent diagnostics to characterize the behaviour of the simulation of the whole WAM chain of interactive processes within RCMs and GCMs Apply these diagnostics to different models experiments, and evaluation to identify the most critical parameterisations and couplings for the WAM system simulation Start of the work to improve some parameterisations

Description of work
Review all previous works that tried to assess the skill of global models to represent the WAM. To be performed in close collaboration with WP1.1 and WP5.1 and processes WPs. Define pertinent diagnostics to characterize the WAM? Implementation of those diagnostics in GCMs and RCMs In collaboration with other WP4s, preparation of the image of the "mean meridional vertical slab in the WAM region" as provided by the observations. This will be done for at least one season using all type of data. Such synthetic picture will be later elaborated for the whole 10-yr period of the LOP, with more details for the SOP and EOP periods to take advantage of all collected data for the all the WAM components (atmosphere, chemistry, aerosols, continental and oceanic surfaces). To start the work to improve parameterisation will be focused on dry and moist convection. Available Cloud Resolving Model (CRM) simulations will be used to propose numerical experiments to force and evaluate convective parameterisations. The 2D idealized model of WAM will be adapted to develop a new methodology to evaluate parameterisations by considering their feedbacks with all others processes and scales involved in the WAM.
Significant Risks Contingency Plan
Improvements of parameterisations and input data depend on the success of the AMMA observational periods.

Deliverables
D4.1.2.a : Report on existing WAM diagnostics and those developed for AMMA-IP (M9)
D4.1.2.b : First inter-comparison of models based on the WAM diagnostics (M18)

Milestones
M4.1.2.a : Definition and implementation of pertinent diagnostics of the WAM (M6).
M4.1.2.b : Observed mean meridional vertical structure of the WAM for one season elaborated with all WP4s (M12)

sWP 4.1.3 Modelling the interactions between aerosols/chemistry and the atmosphere

Workpackage number	4.1.3		**Start date or starting event:**	M0				
Participant id	KNMI		CNRS	LMU	CNRM			
Person-months per participant:	2/2		12/4	0/0	6/0			

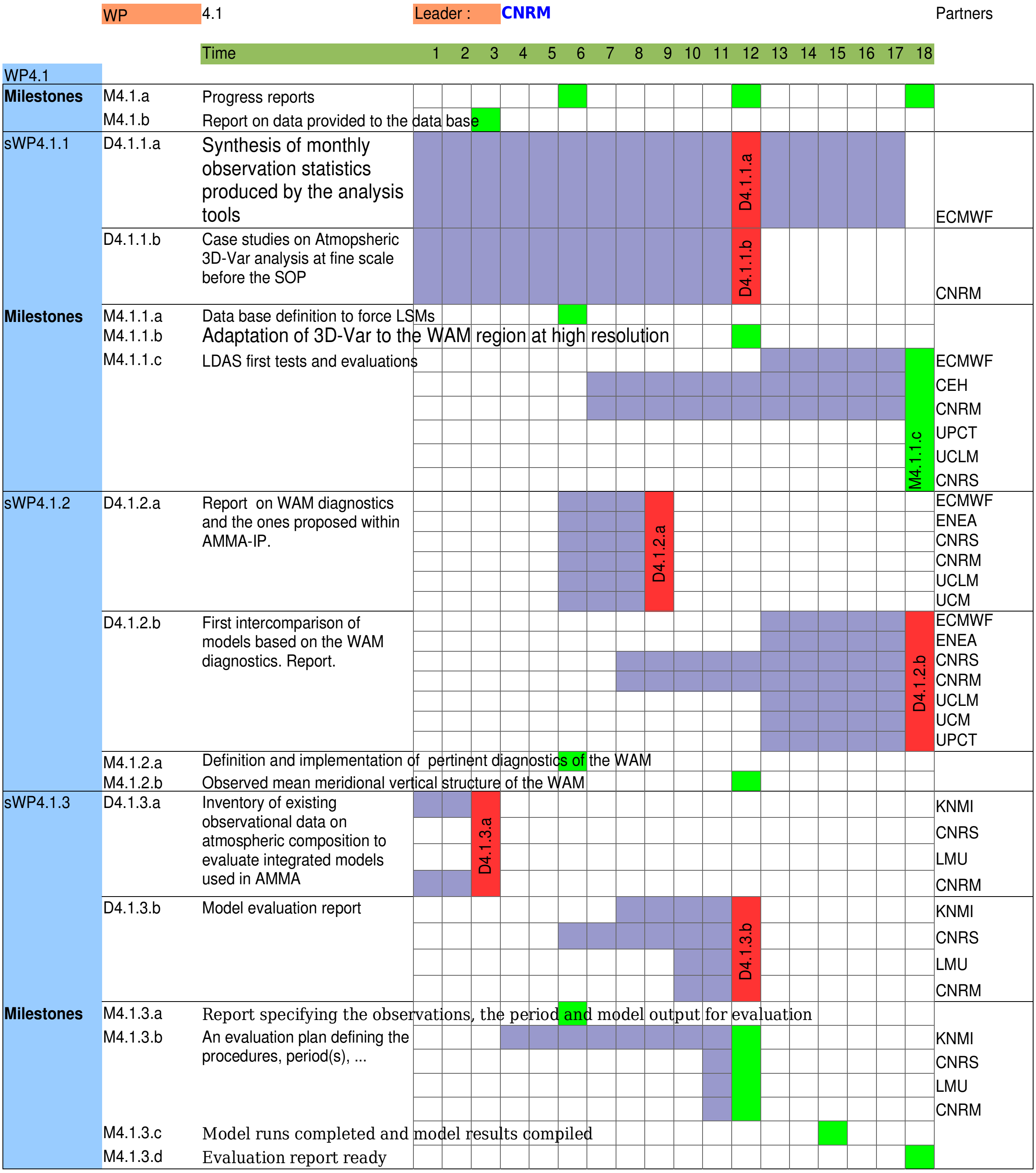
Objectives
To evaluate the capability of existing models (global and regional, coupled and off-line) to represent the 3D distribution of aerosols and trace gases over West Africa.

Description of work
Selecting existing observational data on atmospheric composition to evaluate integrated models used in AMMA (regional and global scale; chemistry-transport and chemistry-climate models) Defining numerical experiments to generate model output for comparison with existing observations, in order to test different (1) aerosol representations, (2) atmospheric transport and chemistry representations, (3) descriptions of sources / sinks of aerosols and trace gases, and (3) coupling schemes of atmospheric composition with dynamics Applying the different models to the AMMA region Comparing of the model output with observed aerosol and trace gas distributions and assessing model skills Significant Risks and Contingency Plan Improvements of parameterisations and input data depend on the success of the AMMA observational periods.

Deliverables
D4.1.3.a : Inventory of existing observational data on atmospheric composition to evaluate integrated models used in AMMA (regional and global scale; chemistry-transport and chemistry-climate models) (M3) D4.1.3.b : Model evaluation report (M15)

Milestones
M4.1.3.a : Report specifying the observations, the period and model output and evaluation method for the model evaluation study (M6) M4.1.3.b: Evaluation plan defining the procedures, period(s), output, and observational data to evaluate existing integrated models incorporating aerosols and/or trace gases used in AMMA (M12 M4.1.3.c :Model runs completed and model results compiled (M15) M4.1.3.d:Evaluation report ready (M18)

WP4.1 Gantt chart



WP4.1 Resources

	4.1		p.m Total	Req.	Tasks by partner
WP4.1	M4.1.a	CNRM	1	0	contrib from sWP4.1.1 and sWP4.1.2
		KNMI	0,25	0	contrib from sWP4.1.3
	M4.1.b	CNRM	1		contrib from sWP4.1.1 and sWP4.1.2
		KNMI	0,25		contrib from sWP4.1.3
sWP4.1.1	D4.1.1.a	ECMWF	2	3	Sonde monitoring system
	D4.1.1.b	CNRM	12	0	Use of the AROME 3D-Var
Milestones	M4.1.1.a		10	0	
	M4.1.1.b				
	M4.1.1.c	ECMWF	2	1	ELDAS land surface assim. Operational end of 2005
		CEH	3	1.5	UK Met Office LSM
		CNRM	18	0	Data base building, ISBA runs in forced mode. 10-yr global soil moiture climatology with ISBA forced by ISLSCP2
		UPCT	5	1	
		UCLM	0	0	
		CNRS	10	0	ORCHEDEE LSM run in forced mode and comparison with other forcing data.
sWP4.1.2	D4.1.2.a	ECMWF	1	1	Specific AMMA diagnostic in ECMWF
		ENEA	1	1	ECHAM4 model: Travelling wave diagnostic
		CNRS	8	0	LMDz GCM
		CNRM	18	0	Mean vertical AMMA structure. ARPEGE-Climat GCM
		UCLM	0.5	0	
		UCM	4	1	UCLA GCM
		UPCT	3	1	please details!
	D4.1.2.b	ECMWF	1	1	1st evaluation of model changes at ECMWF
		ENEA	3	1	Analysis of Echam4, Speedy
		CNRS	9	0	LMDz GCM
		CNRM	9	0	Organization of intercomparaison. ARPEGE GCM
		UCLM	0	0	
		UCM	3	1	UCAL GCM
		UPCT	1	1	
Milestones	M4.1.2.a				
	M4.1.2.b				
sWP4.1.3	D4.1.3.a	KNMI	0,5	0,5	Selection and compilation of observations
		CNRS	4	2	Selection and compilation of observations
		LMU	0	0	
		CNRM	2	0	Selection and compilation of observations
	D4.1.3.c	KNMI	1	1	TM3 runs and evaluation
		CNRS	4	2	
		LMU			
		CNRM	2	0	
	M4.1.3.a				
	M4.1.3.b	KNMI	0.5	0,5	
		CNRS	3	1	
		LMU	0	0	
		CNRM	2	0	
	M4.1.3.c				

WP4.2 Field campaigns

Workpackage number		4.2		Start date or starting event:				M0	
Participant id	DLR	CNRS	IRD	LMU					
Person-months per participant	1.5/1.5	5/0	2/0	2/0					

Objectives
To coordinate activities of the 3 sub-work-package under WP4.2 and ensure a close collaboration with other WPs in the project (WP1.1, WP1.2, WP1.3, WP1.4, WP2.2, WP2.3, WP2.4, WP3.1, WP3.3, WP3.4, WP4.1, WP4.3, WP5.1, WP6.1) to achieve an efficient deployment of the instruments and platforms listed in Annex B. Coordination with other national AMMA programmes. In cooperation with the demanding WPs, a set of experimental scenarios will be worked out, dedicated flight plans will be elaborated and summarized in the experimental plan for the field studies. The main objective is to harmonize the experimental requirements from other WPs with the available aircraft, their capabilities and the associated instruments, and the ground-based operations. The coordination with other related international field progammes will be another focus of the present WP.

Description of work
• Coordination plan for the cooperation with other national AMMA programmes and the international science plan • Coordination with the needs of WPs requesting measurements from WP4.2 • Coordination of the data transfer from the measuring systems to the data base • Organisation of coordination meetings/Contribution to project reports

Deliverables
D4.2.a : Experimental plan for LOP/EOP ready (M4) D4.2.b : Experimental plan for SOP0 ready (M7) D4.2.c : Experimental plan for SOP1,2,3 ready (M10)

Milestones
M4.2.a : List of variables to be provided to the data base (M3) M4.2.b: Experimental plan for LOP/EOP finshed (including input from other WPs and their SOP needs) (M4) M4.2.c : Progress report 1 (M6) M4.2.d : Experimental plan for SOP0 finished (including input from other WPs and their SOP needs) (M7) M4.2.e : Experimental plan for SOP1,2,3 finished (including input from other WPs and their SOP needs) (M10) M4.2.f : Progress report 2 (M12) M4.2.g : Progress report 3 (M18)

sWP4.2.1: SOP aircrafts

Workpackage number		4.2.1		**Start date or starting event:**				M0	
Participant id	DLR	UB	CNRM	CNRS	UEA	UnicLeeds	ULeic	UMIST	UYO
Person-months per participant:	3.5/1.5	1.5/1	33/0	31/5.7	11/5.5	1.5/0.2	0.5/0	1.5/0.5	0.5/0

Objectives

Insure that the airborne instrumentation and the required flight plans necessary for achieving AMMA's scientific objectives will be provided during the first 18 month of the project. The aircraft and the airborne instruments will be operated during Special Observation Periods SOP_0 "Dry Season and aerosols" January-February 2006 and SOP_1 "Monsoon Onset" May-July 2006. The experimental data will be quality checked and delivered to the project data base as far as available during the planning period.

The airborne observations comprise:

SOP_0: The measurements of aerosol properties (physical-chemical and optical properties) will be conducted with the French low tropospheric ATR and upper tropospheric F20 aircraft to characterize dust and biomass burning aerosols and their variability over dust production areas and in the vicinity of fires, through the use of flight level and remote sensing measurements.

SOP_1 : Description of the dynamic, thermodynamic and chemical properties of the boundary layer and the low troposphere, in relation with the northward progression of the monsoon flow. Coordinated flights with the French ATR (flight level measurements, LEANDRE DIAL lidar) and the German Falcon (WIND Doppler lidar), and if available with the US / NRL-P3 (ELDORA Doppler radar and LEANDRE DIAL lidar), will document the atmosheric circulation, the associated heat, moisture and momentum fluxes, the spatial organization at different scales, and the evolution of these characteristics during the pre-monsoon and the monsoon onset.

Description of work

The work necessary to insure a successful coordinated campaign with the different aircraft during SOP_0 and SOP_1 includes:

i. organization of a dedicated “SOP session” during the AMMA project meetings ;

ii. definition of observation strategies in coordination with WP which will be the future data users

iii. coordination of observations conducted with the different instruments installed on the different aircraft ; coordination with ground-based observations ;

iv. preparation of the experimental plan describing the scientific objectives and the coordinated flights to be conducted, depending on the atmospheric conditions ;

v. preparation and readiness of the airborne instrumentation

vi. performance of the field campaigns

vii. elaboration and the delivery of quality controlled data to the project data base

viii.contribution to AMMA web site and documentation of results to the public

As SOP_2 and SOP_3 are scheduled to happen immediatly after SOP_1 is finished, an appreciable amount of work will be devoted to the preparation of these SOPs. Nevertheless, the final milestone is outside the first 18-month period.

Deliverables

D4.2.1.a Initial report for SOP_0 and provision of preliminary data (M15)

Milestones
M4.2.1.a : Airborne SOP contribution to experiment plan for SOP0 (M7) M4.2.1.b : Airborne SOP contribution to experiment plan for SOP1,2,3 (M10) M4.2.1.c : Fully prepared airborne equipment for SOP0. Readiness for deployment (M12). M4.2.1.d : Operation centre for SOP0 operational (M12) M4.2.1.e : SOP0 airborne measurements finished, preliminary data available (M15) M4.2.1.f : Fully prepared airborne equipment for SOP1. Readiness for deployment (M17). M4.2.1.g : Operation centre for SOP1,2,3 operational (M17) Milestones ending in second 18-months period but work performed during first period: M4.2.1.h : SOP2 - Preparation of the airborne instrumentation and the aircraft finished. Preparation report. Readyness for deployment (M19) M4.2.1.i : Quality controlled SOP0 data available from the data base (M20) M4.2.1.j : SOP3 - Preparation of the airborne instrumentation and the aircraft finished. Preparation report. Readyness for deployment (M20)

sWP 4.2.2 SOP ground based

Workpackage number	4.2.2			**Start date or starting event:**			M0	
Participant id	CNRS	FZK	LMU	UKoeln	U Bonn	UP12	DLR	ISAC-CNR	
Person-months per participant:	7.5/2.3	6.5/1	14/6.5	6.5/3	2.5/2	19/3.5	3.5/1.5	1.5/0.5	

Objectives
Main focus is ground-based observations and also harmonizing of the experimental requirements from other WPs with the experimental tools and their availability. The ground-based observations comprise:

Objectives

SOP-0: Measurements of aerosol properties (physical-chemical and optical properties) will be performed at the supersite of Banizoumbou (Niger) and at other stations to characterise dust and biomass burning aerosols and their variability over dust production areas and in the vicinity of fires.

- observations with sun photometer, nephelometer, aetholometer, impactors and filters for in situ characterisation of mineral dust at Banizoumbou (UP12)
- observations by lidar at Banizoumbou to obtain vertical profiles of mineral dust and biomass burning aerosol (UMunich)
- vertical and horizontal dust flux measurements at Banizoumbou to estimate the net emission of mineral dust from the WA (UP12)
- observations of optical aerosol properties by lidar and sun photometer both in Djougou (Benin) and in M'bour (Senegal) (ULille).

SOP-1 :

- Radio soundings at high temporal resolutions (3 h) at Tamale (Ghana) and Dano (Burkina Faso) in advance, during and after an MCS event (FZK)
- additional radio soundings at Parakou (Benin) from mid-March 2006 onward. During the SOP-1 from 15 May - 5 July two additional soundings will be carried out. Extra sondes will be launched before/after major rainfall events. All data will be transmitted to the GTS in real-time (UCologne).
- coordination of additional measurements at the radiosounding network (4 ascents instead of 2 routine ascents) (Link to WP6.1 U Cologne)
- surface energy balance measurements at Tamale and Dano to investigate the influence of the energy exchange at the surface on the modification of MCS (FZK)
- high temporal resolution (<10 min) remote sensing observations at Tamale with profiling instruments (Doppler Sodar, Microwave Profiler) to study the diurnal cycle of the wind field, temperature, humidity and liquid water in the planetary pundary layer (FZK, UBonn)
- operation of wind profilers (sodar + UHF/RASS + VHF at Niamey (Niger) and Parakou/Djougou to observe wind and also virtual temperature profiles (UPS/LA)
- operation of the 5,6 GHz polarimetric Doppler radar RONSARD at Djougou (Benin) to observe the three-dimensional distribution of precipitating particles and their radial velocity (CNRS)
- installation (SOP1) and operation (SOP2) of a bistatic radar network in conjunction with the Ronsard radar to derive the 3-D wind field (DLR)
- installation (SOP1) and operation (SOP2) of a lightning detection network (DLR)
- GPS network observing the integrated water vapour at up tp 7 GPS stations aligned along a north-south transect going through Benin to study the progression of the intertropical front (CNRS)
- operation of an instrumented van at Djougou (Benin) with devices to measure atmospheric chemistry components and atmospheric dynamics (fluxes and turbulence) (UPS/LA)
- observations with sun photometer, nephelometer, aetholometer, impactors and filters for in situ characterisation of mineral dust at Banizoumbou (UP12)
- vertical and horizontal dust flux measurements at Banizoumbou to estimate the net emission of mineral dust from the WA (UP12)
- aerosol observations by lidar and sun photometer in Djougou (Ulille)
- operation of a micro-lidar network (4 lidars) in a meridional transect(ISAC-CNR)

Description of work
During SOP0 and SOP1 the EOP equipment will be largely enhanced in order to study different processes in great detail within the framework of focused field campaigns

Deliverables
D4.2.2.a Initial report for SOP_0 and provision of preliminary level1 data (M15)

Milestones
M4.2.2.a : Ground-Based SOP contribution to experiment plan for SOP0, operations plan, White Book (M7) M4.2.2.b : Ground-Based SOP contribution to experiment plan for SOP1, operations plan, White Book (M10) M4.2.2.c : Fully prepared ground based equipment for SOP-0, delivery and installation of ground based instrumentation, preparation report (M12) M4.2.2.d : Setup of the operation centre for SOP-0 (M12) M4.2.2.e : Completion of SOP-0 measurements, initial report for SOP-0 and provision of preliminary data (M15) M4.2.2.f : Preparation, delivery and installation of ground based equipment for SOP-1 finished, preparation report (M17) M4.2.2. g : Setup of the operation centre for SOP1,2,3 (M17) Milestones ending in second 18-months period but work performed during first period: M4.2.2. h : SOP2 - Preparation and deployment of the ground based instrumentation finished. Preparation report.(M19) M4.2.2. i : Delivery of quality controlled SOP-0 data to the project data bank (M20)

sWP4.2.3 : EOP/LOP

Workpackage number	4.2.3		**Start date or starting event:**			M0			
Participant id	IRD	CNRS	CEH	EIER	FZK	ISAC	UBonn	UKoeln	UP12	UPS
Person-months per participant:	197.5-**54**/14 *	1.5/0	7.5/3	21.5/4	1.5/0	2/1	3.5/2	0/0	1.5/0	1.5/0

*In bold : **the figure is for associated African institutions**

Objectives
• Documentation of ground sites (catchments, local sites) • Launching of EOP • Ensure coherency with SOP deployment (observing strategy, site coordination, logistics)

Description of work

The first 18 months of the sub-work-package are critical for the whole deployment of AMMA. The documentation of the mesoscale sites and supersites (mapping, identification of specific key local processes) will have to be completed during the first 12 months of the project. In parallel the deployment of EOP measurements will start, with an emphasis on flux stations and radio-sounding stations. A strong coordination with the whole community of AMMA scientists will be set-up. Efficient links with the other work packages will be created to get information from and to them.

Partnership with African institutions will be consolidated, so as to associate these institutions, their scientists and their technicians to the field work.

Elaborate sampling strategies and location of sites in close connection with WP 4.1 (Models) and 4.3 (Satellites)

Deliverables

D4.2.3.a Initial report for LOP/EOP and provision of preliminary level1 data (M18)

Milestones

M4.2.3.a : Near real-time information available on the AMMA web site on the evolution of the LOP/EOP AMMA set-up (anytime)

M4.2.3.b : Contribution to experiment plan for LOP/EOP, operations plan, White Book (M4)

M4.2.3.c : Setting-up a proper framework for coordination of field activities, operation center for LOP/EOP activities (M6)

M4.2.3.d : EOP - Preparation and deployment of the ground based instrumentation finished. Preparation report.(M6)

M4.2.3.e : Contribution to experimental plan for SOP0 (M7)

M4.2.3.f : LOP data to be made available for preliminary investigations (M9)

M4.2.3.g : Contribution to experimental plan for SOP1,2,3 (M10)

M4.2.3.h : Mesoscale and super-Sites ready for starting SOP measurements, report on evaluation of the overall set-up in preparation of the SOPs (M12)

M4.2.3.i : Year 1 LOP/EOP data available for preliminary investigations (M18)

WP4.2 Gantt Chart

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
	WP	4,2	Leader :			**DLR**															Partners
		Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
WP4,2	D4,2.a	LOP/EOP White Book																			DLR
	D4,2.b	SOP0 White Book																			CNRS
	D4,2.c	SOP1,2,3 White Book																			IRD
																					LMU
Milestones	M4,2.a	List of variables provided to the data base finished																			
	M4,2.b	Experimental plan for LOP/EOP finshed (including input from other WPs and their SOP needs)																			
	M4,2.c	Progress Report 1 finished																			
	M4,2.d	Experimental plan for SOP0 finished (including input from other WPs and their SOP needs)																			
	M4,2.e	Experimental plan for SOP1,2,3 finished (including input from other WPs and their SOP needs)																			
	M4,2.f	Progress Report 2 finished																			
	M4,2.g	Progress Report 3 finished																			
sWP4,2.1	D4,2.1.a	Initial report for SOP0 and provision of preliminary data															D4,2				CNRS
Milestones	M4,2.1.a	Airborne SOP contribution to experiment plan for SOP0																			CNRS
	M4,2.1.b	Airborne SOP contribution to experiment plan for SOP1,2,3																			CNRS
																					DLR
																					UB
																					ULeeds
																					UEA
																					UYO
																					ULEIC
																					UMIST
	M4,2.1.c	SOP0 - Preparation of the airborne instrumentation and the aircraft finished. Preparation report. Readyness for deployment.																			CNRS
	M4,2.1.d	Operation center for SOP0 operational																			CNRS
	M4,2.1.e	SOP0 field phase measurements finished, prelimiary data available																			CNRS
	M4,2.1.f	SOP1 - Preparation of the airborne instrumentation and the aircraft finished. Preparation report. Readyness for deployment.																			CNRS
																					DLR
	M4,2.1.g	Operation center for SOP1,2,3 operational																			CNRS
	M4,2.1.h	SOP2 - Preparation of the airborne instrumentation and the aircraft finished. Preparation report. Readyness for deployment (m19)																			CNRS
	M4,2.1.i	Quality controlled SOP0 data available from the data base (m20)																			CNRS
	M4,2.1.j	SOP3 - Preparation of the airborne instrumentation and the aircraft finished. Preparation report. Readyness for deployment (m20)																			CNRS
																					DLR
																					UB
																					UEA
																					UnivLeeds
																					ULEIC
																					UMIST
																					UYO

sWP4,2.2	D4,2.2.a	Initial report for SOP0 and provision of preliminary data	CNRS
			UP12
			LMU
Milestones	M4,2.2.a	Ground based contribution to experiment plan for SOP0	LMU
			CNRS
			UP12
	M4,2.2.b	Ground based contribution to experiment plan for SOP1,2,3	LMU
			FZK
			U Koeln
			U Bonn
			DLR
			CNRS
			UP12
			ISAC-CNR
	M4,2.2.c	SOP0 - Preparation and deployment of the ground based instrumentation finished. Preparation report.	LMU
			CNRS
			UP12
	M4,2.2.d	SOP0 operation center set up	CNRS
	M4,2.2.e	SOP0 field phase measurements finished, preliminary data available, initial report	LMU
			CNRS
			UP12
	M4,2.2.f	SOP1 - Preparation and deployment of the ground based instrumentation finished. Preparation report.	CNRS
			UP12
			UKoeln
			FZK
			UBonn
			ISAC-CNR
	M4,2.2.g	Operation center for SOP1,2,3 set up	CNRS
	M4,2.2.h	SOP2 - Preparation and deployment of the ground based instrumentation finished. Preparation report.(M19	DLR
	M4,2.2.i	Quality controlled SOP0 data available from the data base (M20)	LMU
			CNRS
			UP12

sWP4,2.3	D4,2.3.a	Initial report for LOP/EOP and provision of preliminary data	D4,2.3.a	IRD
				CNRS
				CEH
				EIER
				FZK
				IGUC
				U Bonn
				U Koeln
				UP12
				UPS
Milestones	M4,2.3.a	Near real time LOP/EOP status on web site (anytime)		IRD
	M4,2.3.b	Contribution to experimental plan for LOP/EOP		IRD
				CNRS
				CEH
				EIER
				FZK
				IGUC
				U Bonn
				U Koeln
				UP12
				UPS
	M4,2.3.c	LOP/EOP operation center setup		IRD
	M4,2.3.d	EOP - Preparation and deployment of the ground based instrumentation finished. Preparation report.		IRD
				CEH
				UBonn
				EIER
				ISAC
	M4,2.3.e	Contribution to experimental plan for SOP0		IRD
				CNRS
				CEH
				EIER
				FZK
				IGUC
				U Bonn
				U Koeln
				UP12
				UPS
	M4,2.3.f	LOP data to be made available for preliminary investigations		IRD
	M4,2.3.g	Contribution to experimental plan for SOP1,2,3		IRD
				CNRS
				CEH
				EIER
				FZK
				IGUC
				U Bonn
				U Koeln
				UP12
				UPS
	M4,2.3.h	Mesoscale and super-sites ready for starting SOP measurements, evaluation report for SOP preparation		IRD
				CEH
				UBonn
				EIER
				ISAC
	M4,2.3.i	Year 1 LOP/EOP data available for preliminary investigations		IRD
				CEH
				EIER
				UBonn
				ISAC

WP4.2 Resources

		Partners	p.m		
			Total	Req.	Tasks by partner
WP4,2	D4,2.a	DLR	1.5	1.5	Overall coordination activities
	D4,2.b	CNRS	5	0	Overall coordination activities
	D4,2.c	IRD	2	0	Overall coordination activities
		LMU	2	0	Overall coordination activities
Milestones	M4,2.a				
	M4,2.b				
	M4,2.c				
	M4,2.d				
	M4,2.e				
	M4,2.f				
	M4,2.g				
sWP4,2.1	D4,2.1.a	CNRS	2	0	
Milestones	M4,2.1.a	CNRS	0,5	0	Definition of experimental plans
	M4,2.1.b	CNRS	0,5	0	Definition of experimental plans
		DLR	0,5	0	Definition of experimental plans
		UB	0,5	0	Definition of experimental plans
		ULeeds	0,5	0	Definition of experimental plans
		UEA	0,5	0	Definition of experimental plans
		UYO	0,5	0	Definition of experimental plans
		ULEIC	0,5	0	Definition of experimental plans
		UMIST	0,5	0	Definition of experimental plans
	M4,2.1.c	CNRS	4	1	Preparation of airborne instruments
	M4,2.1.d	CNRS	5	0	OC infra-structure ready
	M4,2.1.e	CNRS	4	1	Field operations SOP0
	M4,2.1.f	CNRS	3	0,7	
		DLR	2	1	Preparation/integration of WIND on DLR-Falcon
	M4,2.1.g	CNRS	4	1	
	M4,2.1.h	CNRS	3	0,7	Preparation/integration of instruments and aircraft
	M4,2.1.i	CNRS	4	1	Processing of SOP0 data
	M4,2.1.j	CNRS	1	0,3	Preparation/integration of instruments and aircraft
		DLR	1	0,5	Preparation/integration of instruments and aircraft
		UB	1	1	Preparation/integration of instruments and aircraft
		UEA	10,5	5,5	Preparation/integration of instruments and aircraft
		UnivLeeds	1	0,2	Preparation/integration of instruments and aircraft
		ULEIC	0	0	Preparation/integration of instruments and aircraft
		UMIST	1	0,5	Preparation/integration of instruments and aircraft
		UYO	0	0	Preparation/integration of instruments and aircraft

sWP4,2.2	D4,2.2.a	CNRS			
		UP12			
		LMU			
Milestones	M4,2.2.a	LMU	0,5	0	Definition of experimental plans
		CNRS	0,5	0	Definition of experimental plans
		UP12	0,5	0	Definition of experimental plans
	M4,2.2.b	LMU	0,5	0	Definition of experimental plans
		FZK	0,5	0	Definition of experimental plans
		U Koeln	0,5	0	Definition of experimental plans
		U Bonn	0,5	0	Definition of experimental plans
		DLR	0,5	0	Definition of experimental plans
		CNRS	0,5	0	Definition of experimental plans
		UP12	0,5	0	Definition of experimental plans
		ISAC-CNR	0,5	0	Definition of experimental plans
	M4,2.2.c	LMU	4	2	Instrument preparaton, deployment
		CNRS	1	0,5	Instrument preparaton, deployment
		UP12	5	1	Instrument preparaton, deployment
	M4,2.2.d	CNRS	1	0	OC infra-structure ready
	M4,2.2.e	LMU	6	3	Field operations SOP0
		CNRS	1	0,5	Field operations SOP0
		UP12	5	1	Field operations SOP0
	M4,2.2.f	CNRS	2	1	Instrument preparaton, deployment
		UP12	5	1	Instrument preparaton, deployment
		UKoeln	6	3	Instrument preparaton, deployment
		FZK	6	1	Instrument preparaton, deployment
		UBonn	2	2	Instrument preparaton, deployment
		ISAC-CNR	1	0,5	Instrument preparaton, deployment
	M4,2.2.g	CNRS	1	0	OC infra-structure ready
	M4,2.2.h	DLR	3	1,5	Instrument preparaton, deployment
	M4,2.2.i	LMU	3	1,5	Processing of SOP0 data
		CNRS	0,5	0,3	Processing of SOP0 data
		UP12	3	0,5	Processing of SOP0 data

sWP4,2.3	D4,2.3.a	IRD			
		CNRS			
		CEH			
		EIER			
		FZK			
		IGUC			
		U Bonn			
		U Koeln			
		UP12			
		UPS			
Milestones	M4,2.3.a	IRD	1	0	Information on web site
	M4,2.3.b	IRD	0,5	0	Definition of experimental plans
		CNRS	0,5	0	Definition of experimental plans
		CEH	0,5	0	Definition of experimental plans
		EIER	0,5	0	Definition of experimental plans
		FZK	0,5	0	Definition of experimental plans
		IGUC	0,5	0	Definition of experimental plans
		U Bonn	0,5	0	Definition of experimental plans
		U Koeln	0,5	0	Definition of experimental plans
		UP12	0,5	0	Definition of experimental plans
		UPS	0,5	0	Definition of experimental plans
	M4,2.3.c	IRD	1	0	OC infra-structure ready
	M4,2.3.d	IRD	66	5	Instrument preparaton, deployment
		CEH	3	1,5	Instrument preparaton, deployment
		UBonn	1	1	Instrument preparaton, deployment
		EIER	11	2	Instrument preparaton, deployment
		ISAC	1	0,5	Instrument preparaton, deployment
	M4,2.3.e	IRD	0,5	0	Definition of experimental plans
		CNRS	0,5	0	Definition of experimental plans
		CEH	0,5	0	Definition of experimental plans
		EIER	0,5	0	Definition of experimental plans
		FZK	0,5	0	Definition of experimental plans
		IGUC	0,5	0	Definition of experimental plans
		U Bonn	0,5	0	Definition of experimental plans
		U Koeln	0,5	0	Definition of experimental plans
		UP12	0,5	0	Definition of experimental plans
		UPS	0,5	0	Definition of experimental plans
	M4,2.3.f	IRD	60	4	Data processing and delivery to data base
	M4,2.3.g	IRD	0,5	0	Definition of experimental plans
		CNRS	0,5	0	Definition of experimental plans
		CEH	0,5	0	Definition of experimental plans
		EIER	0,5	0	Definition of experimental plans
		FZK	0,5	0	Definition of experimental plans
		IGUC	0,5	0	Definition of experimental plans
		U Bonn	0,5	0	Definition of experimental plans
		U Koeln	0,5	0	Definition of experimental plans
		UP12	0,5	0	Definition of experimental plans
		UPS	0,5	0	Definition of experimental plans
	M4,2.3.h	IRD	0	0	Site preparation, instrument deployment
		CEH	0	0	Site preparation, instrument deployment
		UBonn	0	0	Site preparation, instrument deployment
		EIER	0	0	Site preparation, instrument deployment
		ISAC	0	0	Site preparation, instrument deployment
	M4,2.3.i	IRD	66	5	Data processing and delivery to data base
		CEH	3	1,5	Data processing and delivery to data base
		EIER	9	2	Data processing and delivery to data base
		UBonn	1	1	Data processing and delivery to data base
		ISAC	1	0,5	Data processing and delivery to data base

WP4.3 Satellite Remote Sensing

Workpackage number		4.3		Start date or starting event:			M0		
Participant id	CNRS	Medias	UPS	IRD	UNI BONN	ISAC	UB	ENEA	KNMI
Person-months per participant:	56/16	07/2	25/16	07/4	10/5	10/5	8/5	10/5	6/4

Objectives

- To provide satellite derived data sets of the parameters needed for the other tasks of AMMA*
- To validate the products from conventional and specific AMMA measurements, in order to evaluate the errors at different scales
- To feed data bases with products in proper shape for easy use

*including precipitation, clouds, water vapour, sea surface parameters, land surface parameters, radiative fluxes, aerosols, atmospheric chemistry parameters

Description of work

- review of already developed methods and/or data bases able to provide required parameters at the required scales
- Comparisons and validation of selected methods from surface measurements (data bases of conventional and historical data, specific AMMA measurements)
- Determination of the errors in function of the time space scales and of the method used
- Choice and eventual improvements of data sets and/or methods from the results of the validation phase

Significant Risks and Contingency Plan

Risks for this task are relatively limited, as satellite data are available, and the task is mainly depending on computer equipment and personal. Moreover, several algorithms are available for most products. However, some products (f.e. precipitation) are critically depending on ground validation. The quality of the products has a risk to be lower in case appropriate surface validation data cannot be provided. But it is foreseen anyway to give each product with its error margin.

Deliverables

D4.3.a Critical report on the existing methods for each parameter (M9)

D4.3.b Results of validation phase, estimation of errors (M12)

D4.3.c Description (and codes) of the methods retained (M18)

Milestones

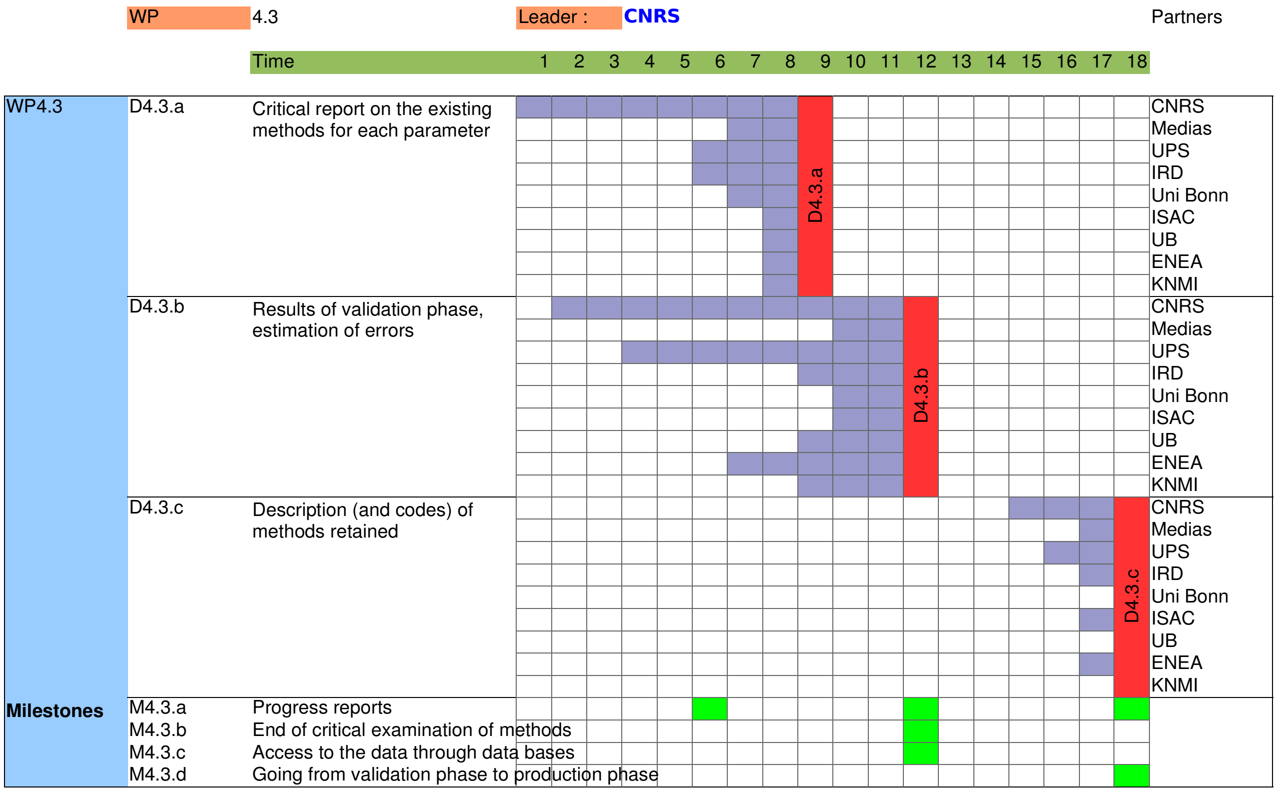
M4.3.a : Progress reports (M6,M12,M18)

M4.3.b : End of critical examination of methods, final discrimination between the parameters to develop or improve specially for AMMA and those which can be taken from existing data bases. (M12)

M4.3.c : Access to the data through data bases (M12)

M4.3.d : Going from validation phase to production phase (M18)

WP4.3 Gantt chart



WP4.3 resources

	4.3		p.m Total	Req.	Tasks by partner
WP4.3	D4.3.a	CNRS	9	0	Will contribute to the choice of existing methods for the water cycle, ocean fluxes, land-surface parameters, aerosols and chemical components.
		Medias	2	0	Land-surface expertise contributed
		UPS	5	0	Contributes to the choice for land-surfaces and chemistry
		IRD	3	0	Choice for water cycle and ocean surface variables.
		Uni Bonn	2	0	Choice for water cycle and ocean surface variables.
		ISAC	1	0	Contributes to the choice of water cycle variables
		UB	1	0	Expertise in atmospheric chemistry methods
		ENEA	1	0	Ocean surface fluxes and properties
		KNMI	1	0	Atmospheric chemistry expertise
	D4.3.b	CNRS	44	16	Validation of the water cycle, ocean fluxes, land-surface parameters, aerosols and chemical components.
		Medias	5	2	Validation of anthropogenic pressures on the continents
		UPS	20	16	Validation of surface parameters and atmopsheric chemistry.
		IRD	3	3	Contributes to the water cycle and oceanic variable validation
		Uni Bonn	8	5	Expertise in oceanic and water cycle variables.
		ISAC	8	5	Contributes to the water cycle.
		UB	7	5	Validation of atmospheric chemistry
		ENEA	8	5	Oceanic parameter validation
		KNMI	5	4	Atmospheric chemistry validation
	D4.3.c	CNRS	3	0	Contributes the same expertise as in D2.3.a
		Medias	0	0	Contributes the same expertise as in D2.3.a
		UPS	2	0	Contributes the same expertise as in D2.3.a
		IRD	1	0	Contributes the same expertise as in D2.3.a
		Uni Bonn	0	0	Contributes the same expertise as in D2.3.a
		ISAC	1	0	Contributes the same expertise as in D2.3.a
		UB	0	0	Contributes the same expertise as in D2.3.a
		ENEA	1	0	Contributes the same expertise as in D2.3.a
		KNMI	0	0	Contributes the same expertise as in D2.3.a

WP4.4 Data base and historical data

Workpackage number	4.4	Start date or starting event:	M0			
Participant id	CNRS	Medias	AGRHYMET			
Person-months per participant:	12/0	8/1	4/4			

Objectives

The objective of WP4.4 during the first 18 months are (i) to rescue the historical data (network and previous scientific experiments) needed for the project, ii) to provide the documentation associated to the data, and (iv) to design and develop the web site and the database of the project

Description of work

Workpackage 4.4 is composed of three tasks during the first 18 months: (i) Historical data, (ii) Metadatabase, database and web site design, (iii) Metadatabase, database and web site development, including the user's interface. The historical data (collected by the National Meteorological and Hydrological Services on their network since the beginning of the stations) will be collated with the AGRHYMET Regional Centre, and an agreement will be established between these NMHS's, AGRHYMET, the Friend-AOC programme, IRD and Medias-France for the scientific use of the data by the partners. A user interface will be designed and developed allowing selecting data subsets according to various criteria (location, time period, name of parameter, threshold on these parameters, etc.). Through this interface, specific request will be sent to the database, and data subsets corresponding to these requested criteria could be visualised and/or extracted and imported on the user's computer. A particular AMMA Satellite Database (AMMAsat) is being developed by CNRS/IPSL (see WP 4.3).
Medias-France will design and develop the AMMA metadatabase and database including the historical data (before 2000), the Long Observation Period data (2001-2010), the Enhanced Observation Period data (2005 to 2007), the Special Observation Period data (2006). The Model data (output of the atmospheric, hydrological and ecological models to be used for the AMMA project) will be managed in co-ordination between IPSL and Medias-France. This will be done in strong relationship with the Regional Database and Software Engineering Unit (RDBSI Unit) of the AGRHYMET Centre in Niamey (Niger), who will manage the mirror site of the AMMA data- and metadatabase. The web site will give detailed information on the AMMA project.

Additional information will be: Objectives and methodologies - Milestones and results obtained/expected
- Partners, associated partners and sub-contractants - Information needed for the visualisation and/or the extraction of the data. The design of this web site will be discussed, developed and implemented on the Internet as soon as possible during the 6 first months of the project

Significant Risks and Contingency Plan

No uncertainties exist about the possibility to develop the AMMA Web site and database, in so far as the partners will provide information, historical data needed for the project and tehe data collected during the project

Deliverables

D4.4.a : Report on the list of variables and formats to be archived (M5)

D4.4.b : Report on Meta-database and database design and development (M12)

Milestones

M4.4.a : Progress reports (M6,M12,M18)

M4.4.b : End of database development (except models)(M9)

M4.4.c : Meta-database developed (M12)

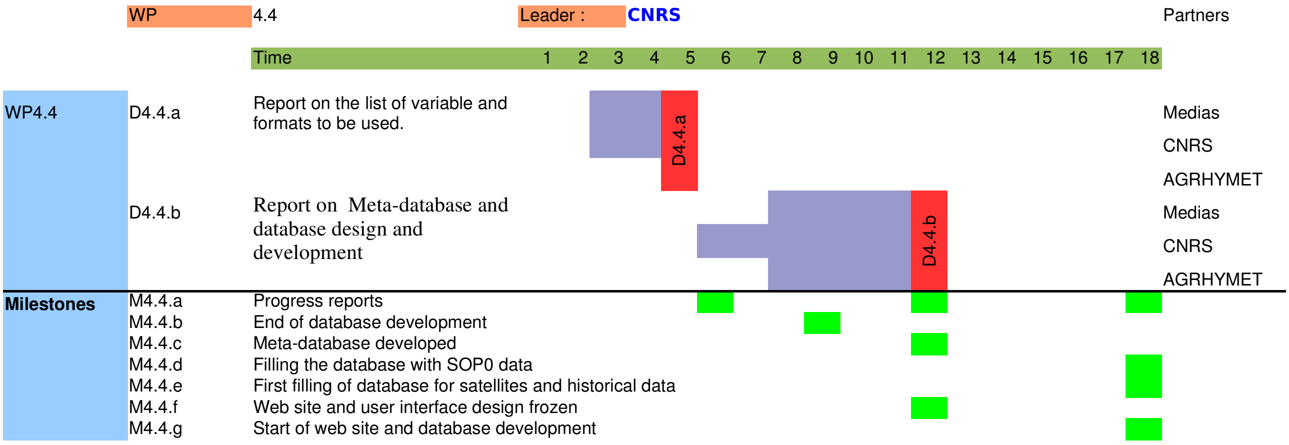
M4.4.d : Filling of the database with SOP0 data (M18)

M4.4.e : First filling of data base with satellite data, historical data and time series. Data from the first year of EOP/LOP will be included.

M4.4.f : Web site and user interface design frozen (M12)

M4.4.g: Web site and user interface development start (M18)

WP4.4 Gantt Chart



WP4.4 Resources

WP4.4	D4.4.a	Medias	3	1	Gathering and processing of the input from Wps
		CNRS	4	0	Expertise in data base design and scientific usage
		AGRHYMET	0	0	Expertise in data base design and scientific usage
	D4.4.b	Medias	5	0	Design of the Meta-data base
		CNRS	6	0	Coding and tests of the database
		AGRHYMET	4	4	Implementation and tests
Milestones	M4.4.a M4.4.b M4.4.c M4.4.d M4.4.e M4.4.f M4.4.g	CNRS	2	0	Reporting and interaction with other Wps

8.6.5 Demonstration activities

WP5.1 Weather to Climatic forecasting

Workpackage number		5.1		**Start date or starting event:**			M0		
Participant id	ECMWF	ACMAD	ISAC	UCLM	U Bourg	CNRS			
Person-months per participant:	6/0	44/0	0/0	0/0	2/0	2/0			

Objectives

The main objective will be to set-up and analyse verification systems outputs of the short to seasonal ranges forecasts. As demonstrating forecast improvements need that both the researches have progressed and the new observation networks have been implemented, few actions will be realized in the first 18-month period.

Description of work

A specific verification system for Africa will be set up and the results will be published electronically on a monthly basis. Focus will be on precipitation forecasts in the day 1 to 10 forecast range, making use of the best possible rainfall product from the AMMA project. Resolution will be operational resolution (currently 40 km) or any degraded resolution as imposed by the verification data source. Special attention will be paid to the movement of the Inter-Tropical Convergence Zone. Other verification parameters will be wind (e.g. 850 hPa level against analyses and radiosondes) and temperature, humidity and cloud cover against SYNOP reports. The skill of available DEMETER seasonal forecasts will be evaluated on the AMMA area. First evaluation of statistical predictive schemes will be performed.

General analyses of the verification system outputs provided in the project will be done and the implications on forecasting of West African weather and climate systems will be highlighted. In particular, numerical Weather Prediction (NWP) products will be used and evaluated by forecasters from African national weather services.
A lot of preparation work devoted to the improvement of regional models will be included in the other work packages WP1.3, WP2.1 and WP4.1 ; so no specific work will be done in the present work package.

Significant Risks and Contingency Plan

Some uncertainties exist about the possibility to evaluate the progresses done in the seasonal forecast since this forecast production depends on the identification of a forecast skill potential linked to the continental surface conditions, a topic which will be investigated in other work packages (WP1.1 and WP1.3).

Deliverables

D5.1 Report on different available forecast skill evaluation systems ready to be applied for the SOP. (M18)

Milestones

M5.1.a : System to compute performance of numerical weather forecasting model for the AMMA area (M12)

M5.1.b : Design of operational forecast model performance evaluation system for the AMMA area (M12)

M5.1.c : Estimate of the skills of the forecast models for various ranges from daily to seasonal scales (M12)

<u>WP5.1 Gantt Chart</u>

WP	5.1	Leader :	ECMWF	Partners

		Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
WP5.1	D5,1	Report on different available forecast skill evaluation systems ready to be applied for the SOP																			D5,1	ECMWF ACMAD ISAC UCLM U Bourg CNRS
Milestones	M5.1.a	System to compute performance of numerical weather forecasting model for the AMMA area																				
	M5.1.b	Design of operational forecast model performance evaluation system for the AMMA area																				
	M5.1.c	Estimate of the skills of the forecast models for various ranges from daily to seasonal scales																				

WP5.1 Resources

5.1			p.m Total	Req.	Tasks by partner
WP5.1	D5.1.a	ECMWF	6	0	Evaluation of ECMWF forecasts over the AMMA region
		ACMAD	44	0	Analysis of all available forecasts at ACMAD with the AMMA diagnostics
		ISAC	0	0	
		UCLM	0	0	
		U Bourg	2	0	Development, real-time application and evaluation of statistic-dynamical predictive schemes
		CNRS	2	0	Development, real-time application and evaluation of statistical predictive schemes
Milestones	M5.1.a M5.1.b M5.1.c				

WP5.2 Early warning systems for food security

Starts only month 48

8.6.6 Training and education

WP6.1 Environmental Monitoring

Workpackage number		6.1		Start date or starting event:			M0	
Participant id	Vaisala	Osil	Asecna					
Person-months per participant:	6/0	2/2	12/0					

Objectives
Set up of radiosounding equipment for the upgrade of the operational network and set up of flux stations network

Description of work

- Make a survey of all the concerned radiosonde stations in order to understand in detail the needs for upgrade, training and education.
- Install / activate new radiosounding equipment on 8 locations
- Upgrade / repair the radiosounding equipment on 6 locations
- Install / repair the equipment for connecting radiosounding stations to GTS (Global Telecommunication System)
- Train operators to use radiosounding equipment, radiosondes, balloons and gaz generator.
- Monitor the functioning of the radiosounding stations
- Install the flux stations and educate operators

NOTE : Infrastructure, like buildings, electricity, water, telecommunication means are not part of radiosounding systems provider's work.

Deliverables

D6.1.a Report on the survey related to the needs for training/upgrade/education on radiosonde (M1)

D6.1.b Progress report on installation/activation/upgrade of radiosounding stations equipment and connection to GTS (M6)

D6.1.c Final report on installation/activation/upgrade of radiosounding stations equipment and connection to GTS (M12)

D6.1.d Report on installation of flux stations (M12)

Milestones

M6.1.a Survey related to the needs for training/upgrade/education on radiosonde (M1)

M6.1.b Installation and activation of new radiounding equipment on 4 location (M9)

M6.1.c Upgrade / repair the radiosounding equipment on 2 locations (M9)

M6.1.d Statistics report on soundings performed (M12)

M6.1.e Installation and activation of flux stations (M9)

M6.1.f List of training and education actions (M12)

M6.1.g Statistics reports on sounding and flux measurements performed (M18)

WP6.1 Gantt chart

WP	6.1	Leader :	VAISALA	Partners

			Time 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Partners
WP6.1	D6.1.a	Report on survey related to needs for radiosonde	D6.1.a																		VAISALA ASECNA OSIL
	D6.1.b	Progress report on radiosonding equipment and connection to GTS						D6.1.b													VAISALA ASECNA OSIL
	D6.1.c	Final report on radiosonding equipment and connection to GTS												D6.1.c							VAISALA ASECNA OSIL
	D6.1.d	Report on installation of flux stations												D6.							VAISALA ASECNA OSIL
Milestones	M6.1.a	Survey to needs on radiosondes																			
	M6.1.b	Activation of 4 new radiosonde equipment																			
	M6.1.c	Upgrade of 2 radiosonde equipment																			
	M6.1.d	Statistics report on soundings performed																			
	M6.1.e	Activation of flux stations																			
	M6.1.f	List of training and education actions																			
	M6.1.g	Statistics report on sounding and flux measurements performed																			

WP6.1 Resources

6.1			p.m Total	Req.	Tasks by partner
WP6.1	D6.1.a	VAISALA	2	0	Write report
		ASECNA	2	0	Write report
	D6.1.b	VAISALA	2	0	Write report
		ASECNA	5	0	Write report
	D6.1.c	VAISALA	2	0	Write report
		ASECNA	5	0	Write report
	D6.1.d	OSIL	2	2	Write report
Milestones	M6.1.a				
	M6.1.b				
	M6.1.c				
	M6.1.d				
	M6.1.e				
	M6.1.f				
	M6.1.g				

WP6.2 University programs and summer schools

Workpackage number		6.2	Start date or starting event:			M0		
Participant id	IRD	Medias	AGRHYMET	UPS	ECMWF			
Person-months per participant:	2/0	4/2	2/2	1/0	1/1			

Objectives
To make a significant contribution to the appropriation of this knowledge by the emerging African scientific community and the decision makers.

Description of work

- Task T6.2.1: Organising one summer schools
- Task T6.2.2: Organising one application workshops
- Task T6.2.3: Facilitating participation of African Scientists to training courses
- Task T6.2.3: Participating in implementation of PhD programme in West Africa
- Task T6.2.4: Organising scientist programme

It is planned to organise one similar school during the first 18 months of the AMMA project. It is also planned to organise during the first 18 months one application workshop on Food Security linked to the observational program of AMMA. Medias-France will organise it with IRD and AGRHYMET. The potential barriers as far as the working languages (English and French) are concerned have been solved in the past (AMMASS/1, Workshops...) as follows:

– Experts and trainees should be bi-linguals or at least have an excellent knowledge of one language and be proficient in the other

– Most of the teaching material, multidisciplinary material, application material , documentation... are in both languages

– Special summary sessions can be organized everyday in a requested language as required by trainees or deemed necessary

An AMMA oriented PhD program will also be created with African Universities (University of Benin, University Moumouni in Niger, UCAD in Senegal, University of Cocody in Côte-d'Ivoire) with contribution of African and European professors.
The project, by relying on international exchange programs (i.e., Visiting scientists), will enhance participation of European visiting scientists in PhD programs in Africa.

Deliverables

D6.2.a : Report on the application workshop on food security (M12)

D6.2.b : Report on summer school (M18)

Milestones

M6.2.a : Progress reports (M6,M12,M18)

M6.2.b : African participation on international training courses (M12)

M.6.2.c : List of West African PhD programme (M12)

WP6.2 Gantt chart

WP	6.2	Leader :	MEDIAS																		Partners
		Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
WP6.2	D6.2.a	One application workshop on food security												D6.2.a							IRD, MEDIAS, Agrhymet, UPS, ECMWF
	D6.2.b	Summer school on modelling																	D6.2.b		IRD, MEDIAS, Agrhymet, UPS, ECMWF
Milestones	M6.2.a	Progress reports																			
	M6.2.b	African participation on international training courses																			
	M6.2.c	List of West African PhD programme																			

WP6.2 Resources

6.2			p.m Total	Req.	Tasks by partner
WP6.2	D6.2.a	IRD	1	0	Establishes link with users in Africa
		MEDIAS	2	1	Coordinate workshop prearation
		Agrhymet	2	2	Organisation
		UPS	0	0	
		ECMWF	0	0	
	D6.2.b	IRD	1	0	Thematical organisation
		MEDIAS	2	1	Coordinate summer school preparation
		Agrhymet	0	0	
		UPS	1	0	Contribute to the preparation and teaching
		ECMWF	1	1	Teaching and organisation
Milestones	M6.2.a				
	M6.2.b				
	M6.2.c				

8.6.7 Management

WP7.1: Instrument Deployment

Workpackage number		7.2		Start date or starting event:		M0		
Participant id	CNRS	IRD		Univ LEEDS				
Person-months per participant:	3/0	18/18		6/6				

Objectives

- Aircraft deployment
- Radio-sonde deployment
- Instrumented sites

Description of work

Management of the Infrastructure required at base airport and permissions for flight plan

collaboration with local weather services for infrastructure and personnel training

work on required authorisations, transport of equipment, local infrastructure, maintenance and training of staff

Deliverables

D7.1.a status on sites, Infrastructure/Radio sonde deployed, aircraft deployed and instrumented site (M12)

Milestones

M7.1.a : Site visit with verification of the infrastructure at the airport for SOP0 (M0)

M7.1.b : Informing all the authorities of the countries to be overflown during SOP0 (M0)

M7.1.c : Preliminary flight plans provided to the authorities for SOP0 (M6)

M7.1.d : Final flight plans for SOP0 (M12)

M7.1.e : Site visit with verification of the infrastructure at the airport for SOP1-3 (M6)

M7.1.f : Informing all the authorities of the countries to be overflown during SOP1-3 (M6)

M7.1.g : Preliminary flight plans provided to the authorities for SOP1-3 (M12)

M7.1.h : Final flight plans for SOP1-3 (M18)

M7.1.i :Upgrade plan for radio-sounding network ready and call for tender.(M0)

M7.1.j :Choice of subcontractor for network upgrade (M3)

M7.1.k :Upgrade of initial radio-sounding stations (M6)

M7.1.l : Report on selected mesoscale sites and super-sites with an initial plan for instrument deployment. (M4)

M7.1.m : Selection of local contact points for site monitoring. (M6)

M7.1.n : First reports on site status and feedback from local partners (M12)

WP7.1 Gantt chart

WP	7.1	Leader :	IRD		Partners

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Partners
WP7.1	D7.1.a	status on sites, Infrastructure/Radio sonde, aircraft and instrumented sites deployed												D7.1.a							CNRS IRD U Leeds
Milestones	M7.1.a	Site visit with verification of the infrastructure at the airport for SOP0	X																		
	M7.1.b	Informing all the authorities of the countries to be overflown during SOP0	X																		
	M7.1.c	Preliminary flight plans provided to the authorities for SOP0						X													
	M7.1.d	Final flight plans for SOP0												X							
	M7.1.e	Site visit with verification of the infrastructure at the airport for SOP1-3						X													
	M7.1.f	Informing all the authorities of the countries to be overflown during SOP1-3						X													
	M7.1.g	Preliminary flight plans provided to the authorities for SOP1-3												X							
	M7.1.h	Final flight plans for SOP1-3																		X	
	M7.1.i	Upgrade plan for radio-sounding network ready and call for tender	X																		
	M7.1.j	Choice of subcontractor for network upgrade			X																
	M7.1.k	Upgrade of initial radio-sounding stations						X													
	M7.1.l	Report on selected mesoscale sites and super-sites				X															
	M7.1.m	Selection of local contact points for site monitoring						X													
	M7.1.n	First reports on site status and feedback from local partners												X							

WP7.1 Resources

7.1			p.m Total	Req.	Tasks by partner
WP7.1	D7.1.a	CNRS	3	0	Management of the aircraft deployment
		IRD	18	18	A deployment manager will be dedicated to the ground observation and aircraft deployment.
		U Leeds	6	6	Management of the radio-sounding upgrade.
Milestones	M7.1.a M7.1.b M7.1.c M7.1.d M7.1.e M7.1.f M7.1.g M7.1.h M7.1.i M7.1.j M7.1.k M7.1.l M7.1.m M7.1.n				

WP7.2: Scientific Management

Workpackage number		7.2		Start date or starting event:			M0		
Participant id	CNRS								
Person-months per participant:	18/0								

Objectives
Scientific + WP Management Dissemination Management Interaction with the EC

Description of work
Interactions with the European Commission : Report scientific deliverables. Take requests regarding the objectives or priorities of the AMMA project. Report success stories. Warn of unexpected difficulties. Provide expertise in the area of the AMMA project to the European Commission. Overseeing the scientific activity of the consortium covers a wide range of activities within the project but all dealing with the flow of information between the parties. Overseeing the scientific activity of the consortium covers a wide range of activities within the project but all dealing with the flow of information between the parties.

Deliverables
D.7.2.a : progress report to the partners and feedback to the EC of the AMMA Scientific Progress (M6/M12/M18) D7.2.b report scientific deliverables (12)

Milestones
M7.2.a : Represent AMMA at University program and conferences(M6) M7.2.b : Monitor scientific publications on AMMA (12) M7.2.c : Editorial activities for the AMMA web-site (M6)

<u>WP7.2 Gnatt Chart</u>

WP 7.2 Leader : **CNRS** Partners

		Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Partners
WP7.2	D7.2.a	progress report to the partners and feedback to the EC						D7.4.a						D7.4.a						D7.4.a	CNRS
	D7.2.b	report scientific deliverables												D7.2.b							CNRS
Milestones	M7.2.a	Presentation of AMMA at University program and conferences																			
	M7.2.b	Monitor scientific publications																			
	M7.2.c	Editorial activity for the AMMA web-site																			

WP7.2 Resources

The scientific manager will be dedicated full time to these activities.

WP7.3: Financial, administrative and dissemination Management

Workpackage number		7.3		**Start date or starting event:**			M0			
Participant id	CNRS									
Person-monts per participant:	15/15									

Objectives
Financial and Administrative Management of the AMMA IP, dissemination activities.

Description of work

M0 to M0 +12

Ensure signature of the contract by contractors, (CA/partners)

Receive and Distribute first periodic payments to contractors (6 months),

Define financial report instruments, Prepare all project deliverables, Send deliverables to the Commission.

Define adapted tools and methods (dashboards/indicators/planning/ reporting,...) to be used by all partners

Define rules of internal communication, Draft the management plan (at M0+3, final version at M0+6)

Organize, participate and report all meetings

Monitor the project, verify progress against schedules and propose remedies if necessary

M0+12 to M0+18

Negotiate the update program, Ensure the signatures of the amendments (CA)

Receive and allocate all payments.

at any time

4.Perform audits

5.Resolve contractual problems (defaulting partners, ...),

6.Implement Consortium Agreement amendments,

7.Interface with the Commission,

Deliverables

D7.3.a Manual of Project Management, Installation of Governing board, Executive Committee (M1),

D7.3.b First periodic reports, Project monitoring report, meeting reports (M6),

D7.3.c Financial reports upon request by the Commission (M12)

D7.3.d Meeting reports(M12)

Milestones

M7.3.a : Signatures of negotiation forms,M0: Notification of the contract to CNRS (M0)

M7.3.b : 1st payment from the Commission and 1st distribute to the partners (M0)

M7.3.c : Kick Off meeting, Executive committee, and WP committee meetings (M0)

M7.3.d : First draft of management plan (+dashboards and indicators) (M3)

M7.3.e : Final version of management plan Executive committee and WP committee meetings, training meeting (M6)

M7.3.f : Request for all the cost statements (M10)

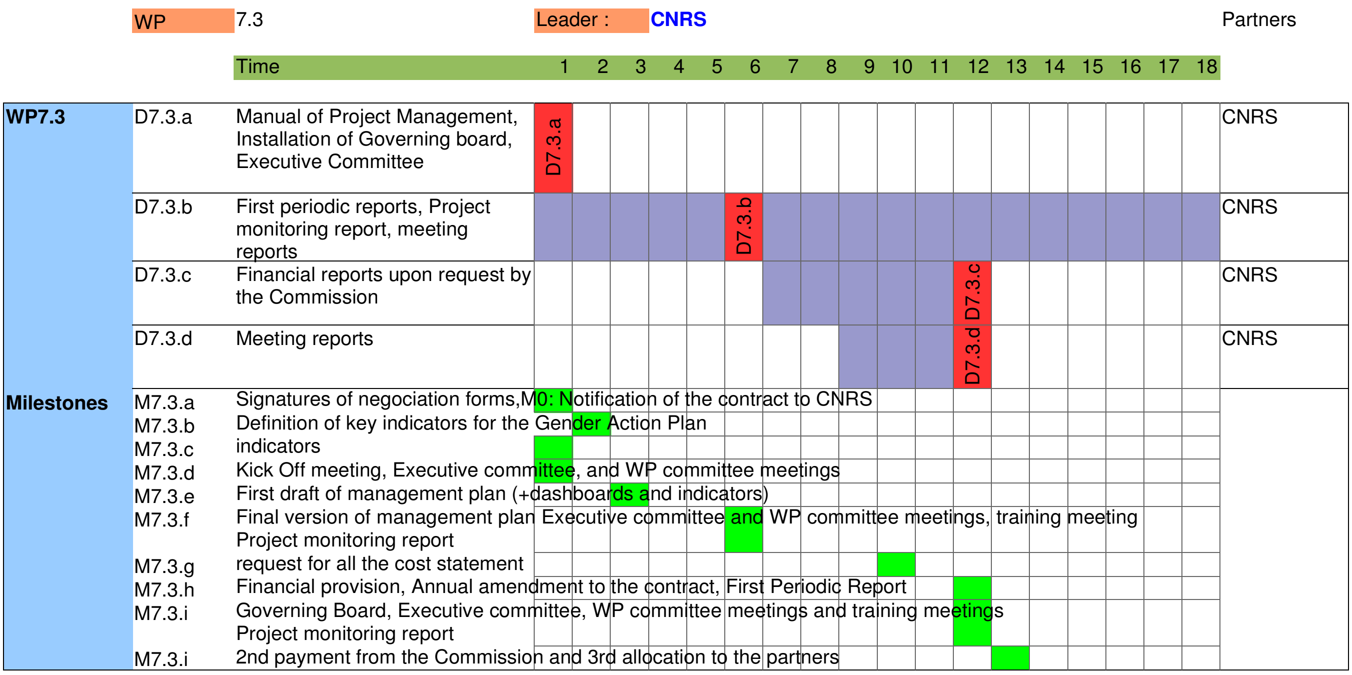
M7.3.g : Financial provision, Annual amendment to the contract, First Periodic Report (financial report, activity report and update of the Implementation Plan) (M12)

M7.3.h : Governing Board, Executive committee, WP committee meetings and training meetings

Project monitoring report (M12)

M7.3.i : 2nd payment from the Commission and 3rd allocation to the partners (M13)

WP7.3 Gnatt Chart



WP7.3 Resources

The project manager will be dedicate 80% of his time to these tasks.

WP7.4: Intellectual Property Management

Workpackage number		7.4		**Start date or starting event:**				M0	
Participant id	CNRS								
Person-months per participant:	3/3								

Objectives

CNRS is in charge of this Work Package and will update the pre-existing know-how and prepare and propose plans for the protection, use and dissemination of results for the Executive Committee and Governing Board. CNRS will be the watchdog and will identify exploitable results for the Executive Committee and suggest patenting or other appropriate protection for said knowledge. If agreed with the results owners, he will propose exploitation strategy of said results, including but not limited to technical studies (innovation, feasibility, existing technology and so on), negotiations and licensing.

Description of work

M0 to M0 +18

Evaluate the Background Patent and Know-How and manage the access rights among the contractors,

Assure necessary legal environment for any background and foreground knowledge or materials transfer between contractors,

Assure knowledge management and evaluate innovative projects (technically, patentability and potential markets and industrial partners),

Select and propose the optimal type of protection and finalize the protection strategy,

Manage joint ownership: drafting and negotiation joint ownership agreements and accessing on foreground rights between the Contractors,

Assure legal assistance for protection in association with Patent attorneys,

Propose rules for publications, thesis, dissemination of information,

Define rules for confidentiality issues,

Define clustering and dissemination strategy : propose partner search and licensing strategy and if requested negotiate and draft technology transfer agreements : options, licenses, assignments, collaborations.

Deliverables

D7.4.a: Consortium agreement : IPR rules for Background and Foreground, (M0)

D7.4.b: Annual report. (M12)

Milestones

M0+6 Main rules and methods defined and accepted in the field of IPR,

M0+12 Strategy for use and dissemination

WP7.4 Gnatt Chart

WP 7.4 Leader : **CNRS**

		Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Partners
WP7.4	D7.4.a	Consortium agreement : IPR rules for Background and Foreground	D7.4.a																		CNRS
	D7.4.b	Annual report												D7.4.b							CNRS
Milestones	M7.4.a	Main rules and methods defined and accepted in the field of IPR,																			
	M7.4.a	Strategy for use and dissemination improved																			

WP7.4 Resources

The project manager will dedicate 20% of his time to this activity.

9. Project resources and budget overview

9.1 Efforts for full duration of the project

PartnerNumber		1 CNRS		2 IRD		3 U. Koeln		4 DLR		5 Univ Leeds		6 CEH	
		Total	Req.	Total	Req.	Total	Req.	Total	Req.	Total	Req.	Total	Req.
RTD/Innovation activities													
WP 1.1	Total	335				18		6					
	Req.		41				10		3				
WP 1.2	Total	158		172				3					
	Req.		16		32				1.5				
WP 1.3	Total	63		5						53		29	
	Req.		20		0						11		12
WP 1.4	Total			114									
	Req.				9								
WP 2.1	Total	234		54		18		8		26			
	Req.		24		0		12		4		2		
WP 2.2	Total	5		12									
	Req.		0		7								
WP 2.3	Total	12		195								2	
	Req.		0		23								1
WP 2.4	Total	473		15				20		12			
	Req.		20		0				7		6		
WP 3.1	Total	15											
	Req.		0										
WP 3.2	Total												
	Req.												
WP 3.3	Total			104									
	Req.				0								
WP 3.4	Total			12									
	Req.												
WP 4.1	Total	114										7.5	
	Req.		9										3
WP 4.2	Total	305		492		23		35		24		17	
	Req.		16.5		33.5		10.5		15.5		6		8.5
WP 4.3	Total	100		12									
	Req.		16		4								
WP 4.4	Total	12											
	Req.		0										
Demonstration activities													
WP 5.1	Total	5											
	Req.		0										
WP 5.2	Total												
	Req.												
Training activities													
WP 6.1	Total												
	Req.												
WP 6.2	Total			6									
	Req.				0								
Management activities													
WP 7.1	Total	6		24						12		3	
	Req.		0		24						12		3
WP 7.2	Total	60											
	Req.		0										
WP 7.3	Total	50											
	Req.		50										
WP 7.4	Total	10											
	Req.		10										
Total		1957	222.5	1217	132.5	59	32.5	72	31	127	37	58.5	27.5
Ratio Req./total(%)			11.37		10.89		55.08		43.06		29.13		47.01

PartnerNumber		7		8		9		10		11		12	
		IGUC		CNRM		Medias		U Bourgogne		UP12		UPS	
		Total	Req.	Total	Req.	Total	Req.	Total	Req.	Total	Req.	Total	Req.
RTD/Innovation activ													
WP 1.1	Total			100				109					
	Req.				16				11				
WP 1.2	Total			12				20					
	Req.				0				3				
WP 1.3	Total			24				3					
	Req.				5				0				
WP 1.4	Total							15					
	Req.								0				
WP 2.1	Total			208									
	Req.				18								
WP 2.2	Total			102									
	Req.				0								
WP 2.3	Total	30										201	
	Req.		0										30
WP 2.4	Total			46						80		6	
	Req.				4						9		0
WP 3.1	Total	13										18	
	Req.		0										6
WP 3.2	Total	70											
	Req.		32										
WP 3.3	Total	26											
	Req.		0										
WP 3.4	Total					13							
	Req.						7						
WP 4.1	Total			165								6	
	Req.				0								0
WP 4.2	Total	4								56		18	
	Req.		0								8		0
WP 4.3	Total			30		7						50	
	Req.				0		2						14
WP 4.4	Total					24							
	Req.						5						
Demonstration activ													
WP 5.1	Total							5					
	Req.								0				
WP 5.2	Total												
	Req.												
Training activities													
WP 6.1	Total												
	Req.												
WP 6.2	Total					12						12	
	Req.						6						0
Management activit													
WP 7.1	Total												
	Req.												
WP 7.2	Total												
	Req.												
WP 7.3	Total												
	Req.												
WP 7.4	Total												
	Req.												
Total		143	32	687	43	56	20	152	14	136	17	311	50
Ratio Req./total(%)			22.38		6.26		35.71		9.21		12.5		16.08

PartnerNumber		13 CIRAD Total	Req.	14 UB Total	Req.	15 FZK Total	Req.	16 CAU Total	Req.	17 LMU-MUENCH Total	Req.	18 Uni Bonn Total	Req.
RTD/Innovation activ													
WP 1.1	Total			11				63		2			
	Req.				5				19		1		
WP 1.2	Total			0								2	
	Req.				0								2
WP 1.3	Total					7							
	Req.						3.5						
WP 1.4	Total											20	
	Req.												0
WP 2.1	Total			0		14				22		0	
	Req.				0		7				10		0
WP 2.2	Total							30					
	Req.								20				
WP 2.3	Total					31							
	Req.						15.5						
WP 2.4	Total			24		51				14			
	Req.				10		12				5		
WP 3.1	Total	15											
	Req.		8										
WP 3.2	Total	16											
	Req.		4										
WP 3.3	Total												
	Req.												
WP 3.4	Total												
	Req.												
WP 4.1	Total									0			
	Req.										0		
WP 4.2	Total			28		15				16		13	
	Req.				10		2.5				8		9
WP 4.3	Total			16								14	
	Req.				5								5
WP 4.4	Total												
	Req.												
Demonstration activ													
WP 5.1	Total												
	Req.												
WP 5.2	Total												
	Req.												
Training activities													
WP 6.1	Total												
	Req.												
WP 6.2	Total												
	Req.												
Management activit													
WP 7.1	Total												
	Req.												
WP 7.2	Total												
	Req.												
WP 7.3	Total												
	Req.												
WP 7.4	Total												
	Req.												
Total		31	12	79	30	118	40.5	93	39	54	24	49	16
Ratio Req./total(%)			38.71		37.97		34.32		41.94		44.44		32.65

PartnerNumber		19		20		21		22		23		24	
		UEA		UNILIV		UYO		ULEIC		UMIST		UCAM	
		Total	Req.	Total	Req.	Total	Req.	Total	Req.	Total	Req.	Total	Req.
RTD/Innovation activ													
WP 1.1	Total											5	
	Req.												0
WP 1.2	Total												
	Req.												
WP 1.3	Total												
	Req.												
WP 1.4	Total												
	Req.												
WP 2.1	Total												
	Req.												
WP 2.2	Total												
	Req.												
WP 2.3	Total												
	Req.												
WP 2.4	Total	45				12		24		24		5	
	Req.		7				6		8		8		0
WP 3.1	Total												
	Req.												
WP 3.2	Total												
	Req.												
WP 3.3	Total												
	Req.												
WP 3.4	Total			22									
	Req.				14								
WP 4.1	Total												
	Req.												
WP 4.2	Total	39				12		12		24			
	Req.		14				6		6		12		
WP 4.3	Total												
	Req.												
WP 4.4	Total												
	Req.												
Demonstration activ													
WP 5.1	Total												
	Req.												
WP 5.2	Total												
	Req.												
Training activities													
WP 6.1	Total												
	Req.												
WP 6.2	Total												
	Req.												
Management activit													
WP 7.1	Total												
	Req.												
WP 7.2	Total												
	Req.												
WP 7.3	Total												
	Req.												
WP 7.4	Total												
	Req.												
Total		84	21	22	14	24	12	36	14	48	20	10	0
Ratio Req./total(%)			25		63.64		50		38.89		41.67		0

PartnerNumber		25		26		27		28		29		30	
		ISAC		ENEA		IBIMET		UNIPG		UCLM		UCM	
		Total	Req.	Total	Req.	Total	Req.	Total	Req.	Total	Req.	Total	Req.
RTD/Innovation activ													
WP 1.1	Total	12		18		34						30	
	Req.		5		7		13						17
WP 1.2	Total	18		14									
	Req.		6		5								
WP 1.3	Total					18		10		21			
	Req.						8		4		11		
WP 1.4	Total									9			
	Req.										5		
WP 2.1	Total	10						20					
	Req.		1						11				
WP 2.2	Total												
	Req.												
WP 2.3	Total												
	Req.												
WP 2.4	Total	21		18									
	Req.		8		6								
WP 3.1	Total					42							
	Req.						21						
WP 3.2	Total					28							
	Req.						14						
WP 3.3	Total												
	Req.												
WP 3.4	Total												
	Req.												
WP 4.1	Total	12		11						0		10	
	Req.		6		6						0		2
WP 4.2	Total	6											
	Req.		3										
WP 4.3	Total	20		20									
	Req.		5		5								
WP 4.4	Total												
	Req.												
Demonstration activ													
WP 5.1	Total	10								10			
	Req.		3								5		
WP 5.2	Total					28							
	Req.						8						
Training activities													
WP 6.1	Total												
	Req.												
WP 6.2	Total												
	Req.												
Management activit													
WP 7.1	Total												
	Req.												
WP 7.2	Total												
	Req.												
WP 7.3	Total												
	Req.												
WP 7.4	Total												
	Req.												
Total		109	37	81	29	150	64	30	15	40	21	40	19
Ratio Req./total(%)			33.94		35.8		42.67		50		52.5		47.5

PartnerNumber		31		32		33		34		35		36	
		UPCT		UCL		ECMWF		AGRYMET		CERMES		EIER	
		Total	Req.	Total	Req.	Total	Req.	Total	Req.	Total	Req.	Total	Req.
RTD/Innovation activ													
WP 1.1	Total												
	Req.												
WP 1.2	Total	36										39	
	Req.		8										12
WP 1.3	Total												
	Req.												
WP 1.4	Total							24					
	Req.								12				
WP 2.1	Total					0							
	Req.						0						
WP 2.2	Total												
	Req.												
WP 2.3	Total	12											
	Req.		0										
WP 2.4	Total					0							
	Req.						0						
WP 3.1	Total							20					
	Req.								10				
WP 3.2	Total			35								24	
	Req.				19								4
WP 3.3	Total	57						30				30	
	Req.		20						12				9
WP 3.4	Total									144			
	Req.										32		
WP 4.1	Total	4				24							
	Req.		2				24						
WP 4.2	Total											57	
	Req.												12
WP 4.3	Total												
	Req.												
WP 4.4	Total							12					
	Req.								12				
Demonstration activ													
WP 5.1	Total					12							
	Req.						12						
WP 5.2	Total							20					
	Req.								5				
Training activities													
WP 6.1	Total												
	Req.												
WP 6.2	Total					2		8				9	
	Req.						0		8				9
Management activit													
WP 7.1	Total												
	Req.												
WP 7.2	Total												
	Req.												
WP 7.3	Total												
	Req.												
WP 7.4	Total												
	Req.												
Total		109	30	35	19	38	36	114	59	144	32	159	46
Ratio Req./total(%)			27.52		54.29		94.74		51.75		22.22		28.93

PartnerNumber		37 ACMAD Total	Req.	38 Vaisala Total	Req.	39 OSIL Total	Req.
RTD/Innovation activ							
WP 1.1	Total						
	Req.						
WP 1.2	Total						
	Req.						
WP 1.3	Total						
	Req.						
WP 1.4	Total						
	Req.						
WP 2.1	Total						
	Req.						
WP 2.2	Total						
	Req.						
WP 2.3	Total						
	Req.						
WP 2.4	Total						
	Req.						
WP 3.1	Total						
	Req.						
WP 3.2	Total						
	Req.						
WP 3.3	Total						
	Req.						
WP 3.4	Total						
	Req.						
WP 4.1	Total						
	Req.						
WP 4.2	Total			6			
	Req.				0		
WP 4.3	Total						
	Req.						
WP 4.4	Total						
	Req.						
Demonstration activ							
WP 5.1	Total	18		0		0	
	Req.		0		0		0
WP 5.2	Total						
	Req.						
Training activities							
WP 6.1	Total			6		18.9	
	Req.				0		18.9
WP 6.2	Total			6		6	
	Req.				0		0
Management activiti							
WP 7.1	Total						
	Req.						
WP 7.2	Total						
	Req.						
WP 7.3	Total						
	Req.						
WP 7.4	Total						
	Req.						
Total		18	0	18	0	24.9	18.9
Ratio Req./total(%)			0		0		75.9

PartnerNumber		40		41		42		
		KNMI		ASECNA		UniKarl		Total
		Total	Req.	Total	Req.	Total	Req.	Total
RTD/Innovation activ								
WP 1.1	Total	8				6		751
	Req.		4				2	
WP 1.2	Total							474
	Req.							
WP 1.3	Total							233
	Req.							
WP 1.4	Total							182
	Req.							
WP 2.1	Total					36		614
	Req.						12	
WP 2.2	Total							149
	Req.							
WP 2.3	Total							483
	Req.							
WP 2.4	Total	8				0		898
	Req.		5				0	
WP 3.1	Total							123
	Req.							
WP 3.2	Total							173
	Req.							
WP 3.3	Total							247
	Req.							
WP 3.4	Total							191
	Req.							
WP 4.1	Total	8				3		361.5
	Req.		5				3	
WP 4.2	Total			15		0		1202
	Req.				0		0	
WP 4.3	Total	8						277
	Req.		4					
WP 4.4	Total							48
	Req.							
Demonstration activ								
WP 5.1	Total							60
	Req.							
WP 5.2	Total							48
	Req.							
Training activities								
WP 6.1	Total			30				24.9
	Req.				0			
WP 6.2	Total			15				61
	Req.				0			
Management activiti								
WP 7.1	Total							
	Req.							6600.4
WP 7.2	Total							
	Req.							
WP 7.3	Total							
	Req.							
WP 7.4	Total							
	Req.							
Total		32	18	60	0			
Ratio Req./total(%)			56.25		0			

9.2 Efforts for the first 18 months

PartnerNumber		1		2		3		4		5		6	
		CNRS		IRD		U. Koeln		DLR		Univ Leeds		CEH	
		Total	Req.	Total	Req.	Total	Req.	Total	Req.	Total	Req.	Total	Req.
RTD/Innovation activities													
WP 1.1	Total	131				14		0					
	Req.		26				7		0				
WP 1.2	Total	25		55				0					
	Req.		3		20				0				
WP 1.3	Total	2		5						9		9	
	Req.		0		0						3		4
WP 1.4	Total			29									
	Req.				6								
WP 2.1	Total	6		20		6		3		6			
	Req.		0		2		4		1,5		1		
WP 2.2	Total	5		8.5									
	Req.		0		7								
WP 2.3	Total	3		78								0	
	Req.		0		9								0
WP 2.4	Total	115						1					
	Req.		13						0.5				
WP 3.1	Total	5											
	Req.		2										
WP 3.2	Total												
	Req.												
WP 3.3	Total			59									
	Req.				0								
WP 3.4	Total			4									
	Req.				0								
WP 4.1	Total	39										3	
	Req.		4										1,5
WP 4.2	Total	58.5		199.5		6.5		8.5		1.5		7.5	
	Req.		9.3		14		3		4.5		0.2		3
WP 4.3	Total	56		7									
	Req.		16		4								
WP 4.4	Total	12											
	Req.		0										
Demonstration activities													
WP 5.1	Total	2											
	Req.		0										
WP 5.2	Total												
	Req.												
Training activities													
WP 6.1	Total												
	Req.												
WP 6.2	Total			2									
	Req.				0								
Management activities													
WP 7.1	Total	3		18						6		0	
	Req.		0		18						6		0
WP 7.2	Total	18											
	Req.		0										
WP 7.3	Total	15											
	Req.		15										
WP 7.4	Total	3											
	Req.		3										
Total		498.5	91.3	485	80	26.5	14	12.5	5	22.5	10.2	19.5	7
Ratio Req./total(%)			18.31		16.49		52.83		40		45.33		35.9

PartnerNumber		7		8		9		10		11		12	
		IGUC		CNRM		Medias		U Bourgogne		UP12		UPS	
		Total	Req.	Total	Req.	Total	Req.	Total	Req.	Total	Req.	Total	Req.
RTD/Innovation activ													
WP 1.1	Total			25				17					
	Req.				9,5				7				
WP 1.2	Total			4				10					
	Req.				8				1				
WP 1.3	Total			12				3					
	Req.				5				0				
WP 1.4	Total							10					
	Req.								3				
WP 2.1	Total			54									
	Req.				0								
WP 2.2	Total			34									
	Req.				0								
WP 2.3	Total	10										66.5	
	Req.		0										11
WP 2.4	Total									20			
	Req.										0		
WP 3.1	Total	4										19	
	Req.		0										4
WP 3.2	Total	7											
	Req.		0										
WP 3.3	Total	8											
	Req.		0										
WP 3.4	Total					8							
	Req.						4						
WP 4.1	Total			56								0	
	Req.				0								0
WP 4.2	Total	0		33						20.5		1.5	
	Req.		0		0						3.5		0
WP 4.3	Total					7						25	
	Req.						2						16
WP 4.4	Total					8							
	Req.						1						
Demonstration activ													
WP 5.1	Total							2					
	Req.								0				
WP 5.2	Total												
	Req.												
Training activities													
WP 6.1	Total												
	Req.												
WP 6.2	Total					4						1	
	Req.						2						0
Management activit													
WP 7.1	Total												
	Req.												
WP 7.2	Total												
	Req.												
WP 7.3	Total												
	Req.												
WP 7.4	Total												
	Req.												
Total		29	0	218	13	27	9	42	11	40.5	3.5	113	31
Ratio Req./total(%)			0		5.96		33.33		26.19		8.64		27.43

PartnerNumber		13		14		15		16		17		18	
		CIRAD		UB		FZK		CAU		LMU-MUENCH		Uni Bonn	
		Total	Req.	Total	Req.	Total	Req.	Total	Req.	Total	Req.	Total	Req.
RTD/Innovation activ													
WP 1.1	Total			0				24		0			
	Req.				0				18		0		
WP 1.2	Total			0								0	
	Req.				0								0
WP 1.3	Total					0							
	Req.						0						
WP 1.4	Total											3	
	Req.												0
WP 2.1	Total			0		3				0		0	
	Req.				0		1,5				0		0
WP 2.2	Total							9					
	Req.								8				
WP 2.3	Total					19							
	Req.						9.5						
WP 2.4	Total					15				1			
	Req.						6.5				0		
WP 3.1	Total	5											
	Req.		3										
WP 3.2	Total	0											
	Req.		0										
WP 3.3	Total												
	Req.												
WP 3.4	Total												
	Req.												
WP 4.1	Total									0			
	Req.										0		
WP 4.2	Total			1.5		8				16		6	
	Req.				1		1				6.5		4
WP 4.3	Total			8								10	
	Req.				5								5
WP 4.4	Total												
	Req.												
Demonstration activ													
WP 5.1	Total												
	Req.												
WP 5.2	Total												
	Req.												
Training activities													
WP 6.1	Total												
	Req.												
WP 6.2	Total												
	Req.												
Management activit													
WP 7.1	Total												
	Req.												
WP 7.2	Total												
	Req.												
WP 7.3	Total												
	Req.												
WP 7.4	Total												
	Req.												
Total		5	3	9.5	6	45	17	33	26	17	6.5	19	9
Ratio Req./total(%)			60		63.16		37.78		78.79		38.24		47.37

PartnerNumber		19		20		21		22		23		24	
		UEA		UNILIV		UYO		ULEIC		UMIST		UCAM	
		Total	Req.	Total	Req.	Total	Req.	Total	Req.	Total	Req.	Total	Req.
RTD/Innovation activ													
WP 1.1	Total											0	
	Req.												0
WP 1.2	Total												
	Req.												
WP 1.3	Total												
	Req.												
WP 1.4	Total												
	Req.												
WP 2.1	Total												
	Req.												
WP 2.2	Total												
	Req.												
WP 2.3	Total												
	Req.												
WP 2.4	Total	1											
	Req.		0										
WP 3.1	Total												
	Req.												
WP 3.2	Total												
	Req.												
WP 3.3	Total												
	Req.												
WP 3.4	Total			8									
	Req.				4								
WP 4.1	Total												
	Req.												
WP 4.2	Total	11				0.5		0.5		1.5			
	Req.		5.5				0		0		0.5		
WP 4.3	Total												
	Req.												
WP 4.4	Total												
	Req.												
Demonstration activ													
WP 5.1	Total												
	Req.												
WP 5.2	Total												
	Req.												
Training activities													
WP 6.1	Total												
	Req.												
WP 6.2	Total												
	Req.												
Management activit													
WP 7.1	Total												
	Req.												
WP 7.2	Total												
	Req.												
WP 7.3	Total												
	Req.												
WP 7.4	Total												
	Req.												
Total		12	5.5	8	4	0.5	0	0.5	0	1.5	0.5	0	0
Ratio Req./total(%)			45.83		50		0		0		33.33		###

PartnerNumber		25		26		27		28		29		30	
		ISAC		ENEA		IBIMET		UNIPG		UCLM		UCM	
		Total	Req.	Total	Req.	Total	Req.	Total	Req.	Total	Req.	Total	Req.
RTD/Innovation activ													
WP 1.1	Total	2.5		6		17						28	
	Req.		1		3		9						13
WP 1.2	Total	4		6									
	Req.		2		4								
WP 1.3	Total					8		0		0			
	Req.						4		0		0		
WP 1.4	Total									0			
	Req.										0		
WP 2.1	Total	4						7					
	Req.		2						4				
WP 2.2	Total												
	Req.												
WP 2.3	Total												
	Req.												
WP 2.4	Total	6		4									
	Req.		3		2								
WP 3.1	Total					14							
	Req.						7						
WP 3.2	Total					28							
	Req.						4						
WP 3.3	Total												
	Req.												
WP 3.4	Total												
	Req.												
WP 4.1	Total	0		4						0		7	
	Req.		0		2						0		2
WP 4.2	Total	3.5											
	Req.		1.5										
WP 4.3	Total	10		10									
	Req.		5		5								
WP 4.4	Total												
	Req.												
Demonstration activ													
WP 5.1	Total	0								0			
	Req.		0								0		
WP 5.2	Total					0							
	Req.						0						
Training activities													
WP 6.1	Total												
	Req.												
WP 6.2	Total												
	Req.												
Management activit													
WP 7.1	Total												
	Req.												
WP 7.2	Total												
	Req.												
WP 7.3	Total												
	Req.												
WP 7.4	Total												
	Req.												
Total		30	14.5	30	16	67	24	7	4	0	0	35	15
Ratio Req./total(%)			48.33		53.33		35.82		57.14		###		42.86

PartnerNumber		31 UPCT Total	Req.	32 UCL Total	Req.	33 ECMWF Total	Req.	34 AGRYMET Total	Req.	35 CERMES Total	Req.	36 EIER Total	Req.
RTD/Innovation activ													
WP 1.1	Total												
	Req.												
WP 1.2	Total	10										12	
	Req.		2										4
WP 1.3	Total												
	Req.												
WP 1.4	Total							16					
	Req.								8				
WP 2.1	Total					0							
	Req.						0						
WP 2.2	Total												
	Req.												
WP 2.3	Total	10											
	Req.		2										
WP 2.4	Total					0							
	Req.						0						
WP 3.1	Total							7					
	Req.								3				
WP 3.2	Total			12								24	
	Req.				2								4
WP 3.3	Total	18						12				9	
	Req.		8						7				3
WP 3.4	Total									48			
	Req.										10		
WP 4.1	Total	9				6							
	Req.		3				6						
WP 4.2	Total											21.5	
	Req.												4
WP 4.3	Total												
	Req.												
WP 4.4	Total							4					
	Req.								4				
Demonstration activ													
WP 5.1	Total					6							
	Req.						0						
WP 5.2	Total							0					
	Req.								0				
Training activities													
WP 6.1	Total												
	Req.												
WP 6.2	Total					1		2					
	Req.						1		2				
Management activit													
WP 7.1	Total												
	Req.												
WP 7.2	Total												
	Req.												
WP 7.3	Total												
	Req.												
WP 7.4	Total												
	Req.												
Total		47	15	12	2	13	7	41	24	48	10	66.5	15
Ratio Req./total(%)			31.91		16.67		53.85		58.54		20.83		22.56

PartnerNumber		37 ACMAD		38 Vaisala		39 OSIL	
		Total	Req.	Total	Req.	Total	Req.
RTD/Innovation activ							
WP 1.1	Total						
	Req.						
WP 1.2	Total						
	Req.						
WP 1.3	Total						
	Req.						
WP 1.4	Total						
	Req.						
WP 2.1	Total						
	Req.						
WP 2.2	Total						
	Req.						
WP 2.3	Total						
	Req.						
WP 2.4	Total						
	Req.						
WP 3.1	Total						
	Req.						
WP 3.2	Total						
	Req.						
WP 3.3	Total						
	Req.						
WP 3.4	Total						
	Req.						
WP 4.1	Total						
	Req.						
WP 4.2	Total						
	Req.						
WP 4.3	Total						
	Req.						
WP 4.4	Total						
	Req.						
Demonstration activ							
WP 5.1	Total	44		0		0	
	Req.		0		0		0
WP 5.2	Total						
	Req.						
Training activities							
WP 6.1	Total			6		2	
	Req.				0		2
WP 6.2	Total						
	Req.						
Management activiti							
WP 7.1	Total						
	Req.						
WP 7.2	Total						
	Req.						
WP 7.3	Total						
	Req.						
WP 7.4	Total						
	Req.						
Total		44	0	6	0	2	2
Ratio Req./total(%)			0		0		100

PartnerNumber		40		41		42			
		KNMI		ASECNA		UniKarl		Total	TOTAL
		Total	Req.	Total	Req.	Total	Req.	Total	Requested
RTD/Innovation activ									
WP 1.1	Total	1						265.5	
	Req.		0						84
WP 1.2	Total							126	
	Req.								44
WP 1.3	Total							48	
	Req.								16
WP 1.4	Total							58	
	Req.								17
WP 2.1	Total					6		115	
	Req.						4		17
WP 2.2	Total							56.5	
	Req.								15
WP 2.3	Total							186.5	
	Req.								31.5
WP 2.4	Total							163	
	Req.								25
WP 3.1	Total							54	
	Req.								19
WP 3.2	Total							71	
	Req.								10
WP 3.3	Total							106	
	Req.								18
WP 3.4	Total							68	
	Req.								18
WP 4.1	Total	2,5						124	
	Req.		2						19
WP 4.2	Total			0				407	
	Req.				0				61.5
WP 4.3	Total	6						139	
	Req.		4						62
WP 4.4	Total							24	
	Req.								5
Demonstration activ									
WP 5.1	Total							54	
	Req.								0
WP 5.2	Total							0	
	Req.								0
Training activities									
WP 6.1	Total			12				20	
	Req.				0				2
WP 6.2	Total							10	
	Req.								5
Management activiti									
WP 7.1	Total			0				27	
	Req.				0				24
WP 7.2	Total							18	
	Req.								0
WP 7.3	Total							15	
	Req.								15
WP 7.4	Total							3	
	Req.								3
Total		7	6	12	0	6	4		
Ratio Req./total(%)			85.71		0		66.67		

9.3 Overall budget for the full duration of the project

PartnerNumber	1	2	3	4	5	6
	CNRS	IRD	U. Koeln	DLR	Univ Leeds	CEH
Cost Model	FCF	FC	AC	FC	AC	FC
Total RTD cost (Euros)	1411660	1161000	321513	1116144	184780	674850
Requested RTD	1411660	580500	321513	558072	184780	337425
Training cost (Euros)						
Requested Training						
Mangement (Euros)	73310	40000	6000	20000	40000	4000
Requested Mangement	73310	40000	6000	20000	40000	4000
Total costs (Euros)	1484970	1201000	327513	1136144	224780	678850
Requested costs	1484970	620500	327513	578072	224780	341425

PartnerNumber	7	8	9	10	11	12
	IGUC	CNRM	Medias	U Bourgogn	UP12	UPS
Cost Model	AC	FCF	AC	AC	FCF	AC
Total RTD cost (Euros)	306800	231200	141600	33200	196248	217125
Requested RTD	306800	231200	141600	33200	196248	217125
Training cost (Euros)			150000			
Requested Training			150000			
Mangement (Euros)	0	0	0	0	0	0
Requested Mangement	0	0	0	0	0	0
Total costs (Euros)	306800	231200	291600	33200	196248	217125
Requested costs	306800	231200	291600	33200	196248	217125

PartnerNumber	13	14	15	16	17	18
	CIRAD	UB	FZK	CAU	LMU-MUENC	Uni Bonn
Cost Model	FCF	AC	FC	AC	AC	AC
Total RTD cost (Euros)	81600	122600	530071	258000	199200	316800
Requested RTD	81600	122600	265035	258000	199200	316800
Training cost (Euros)						
Requested Training						
Mangement (Euros)	0	10000	0	0	0	0
Requested Mangement	0	10000	0	0	0	0
Total costs (Euros)	81600	132600	530071	258000	199200	316800
Requested costs	81600	132600	265035	258000	199200	316800

PartnerNumber Cost Model	19 UEA AC	20 UNILIV AC	21 UYO AC	22 ULEIC AC	23 UMIST AC	24 UCAM AC
Total RTD cost (Euros)	237679	107880	97200	106667	489200	15600
Requested RTD	237679	107880	97200	106667	489200	15600
Training cost (Euros)						
Requested Training						
Mangement (Euros)	0	0	0	0	0	0
Requested Mangement	0	0	0	0	0	0
Total costs (Euros)	237679	107880	97200	106667	489200	15600
Requested costs	237679	107880	97200	106667	489200	15600

PartnerNumber Cost Model	25 ISAC FC	26 ENEA FC	27 IBIMET FC	28 UNIPG AC	29 UCLM AC	30 UCM AC
Total RTD cost (Euros)	826051	317500	444400	40800	112500	92750
Requested RTD	413026	158750	222200	40800	112500	92750
Training cost (Euros)						
Requested Training						
Mangement (Euros)	0	0	0	0	0	0
Requested Mangement	0	0	0	0	0	0
Total costs (Euros)	826051	317500	444400	40800	112500	92750
Requested costs	413026	158750	222200	40800	112500	92750

PartnerNumber Cost Model	31 UPCT AC	32 UCL AC	33 ECMWF AC	34 AGRYMET AC	35 CERMES AC	36 EIER AC
Total RTD cost (Euros)	122229	130560	372777	99600	96000	99600
Requested RTD	122229	130560	372777	99600	96000	99600
Training cost (Euros)						
Requested Training						
Mangement (Euros)	0	0	0	0	0	0
Requested Mangement	0	0	0	0	0	0
Total costs (Euros)	122229	130560	372777	99600	96000	99600
Requested costs	122229	130560	372777	99600	96000	99600

PartnerNumber Cost Model	37 ACMAD AC	38 Vaisala FCF	39 OSIL FCF	40 KNMI FC	41 ASECNA FCF	42 UniKarl AC	Total
Total RTD cost (Euros)	20000	5000	0	237250	2030634	114000	13720269
Requested RTD	20000	5000	0	118625	2030634	114000	11066635
Training cost (Euros)			290050				440050
Requested Training			290050				440050
Mangement (Euros)	0	0	0	0	0	0	193310
Requested Mangement	0	0	0	0	0	0	193310
Total costs (Euros)	20000	5000	290050	237250	2030634	114000	14353629
Requested costs	20000	5000	290050	118625	2030634	114000	11699995

9.4 Budget for the first 18 months

PartnerNumber Cost Model	1 CNRS FCF	2 IRD FC	3 U. Koeln AC	4 DLR FC	5 Univ Leeds AC	6 CEH FC
Total RTD cost (Euros)	788933	678000	188747	555056	70034	190180
Requested RTD	788933	339000	188747	277528	70034	95090
Training cost (Euros)						
Requested Training						
Mangement (Euros)	21000	12000	6000	0	12000	1200
Requested Mangement	21000	12000	6000	0	12000	1200
Total costs (Euros)	809933	690000	194747	555056	82034	191380
Requested costs	809933	351000	194747	277528	82034	96290

PartnerNumber Cost Model	7 IGUC AC	8 CNRM FCF	9 Medias AC	10 U Bourgogn AC	11 UP12 FCF	12 UPS AC
Total RTD cost (Euros)	82604	71600	63240	26000	135248	136538
Requested RTD	82604	71600	63240	26000	135248	136538
Training cost (Euros)			75000			
Requested Training			75000			
Mangement (Euros)	0	0	0	0	0	0
Requested Mangement	0	0	0	0	0	0
Total costs (Euros)	82604	71600	138240	26000	135248	136538
Requested costs	82604	71600	138240	26000	135248	136538

PartnerNumber	13	14	15	16	17	18
	CIRAD	UB	FZK	CAU	LMU-MUENC	Uni Bonn
Cost Model	FCF	AC	FC	AC	AC	AC
Total RTD cost (Euros)	31800	34800	219375	163200	84600	267600
Requested RTD	31800	34800	109688	163200	84600	267600
Training cost (Euros)						
Requested Training						
Mangement (Euros)	0	3000	0	0	0	0
Requested Mangement	0	3000	0	0	0	0
Total costs (Euros)	31800	37800	219375	163200	84600	267600
Requested costs	31800	37800	109688	163200	84600	267600

PartnerNumber	19	20	21	22	23	24
	UEA	UNILIV	UYO	ULEIC	UMIST	UCAM
Cost Model	AC	AC	AC	AC	AC	AC
Total RTD cost (Euros)	97294	53537	39600	38400	394625	4800
Requested RTD	97294	53537	39600	38400	394625	4800
Training cost (Euros)						
Requested Training						
Mangement (Euros)	0	0	0	0	0	0
Requested Mangement	0	0	0	0	0	0
Total costs (Euros)	97294	53537	39600	38400	394625	4800
Requested costs	97294	53537	39600	38400	394625	4800

PartnerNumber	25	26	27	28	29	30
	ISAC	ENEA	IBIMET	UNIPG	UCLM	UCM
Cost Model	FC	FC	FC	AC	AC	AC
Total RTD cost (Euros)	562555	172000	165400	15600	6600	69750
Requested RTD	281278	86000	82700	15600	6600	69750
Training cost (Euros)						
Requested Training						
Mangement (Euros)	0	0	0	0	0	0
Requested Mangement	0	0	0	0	0	0
Total costs (Euros)	562555	172000	165400	15600	6600	69750
Requested costs	281278	86000	82700	15600	6600	69750

PartnerNumber	31	32	33	34	35	36
	UPCT	UCL	ECMWF	AGRYMET	CERMES	EIER
Cost Model	AC	AC	AC	AC	AC	AC
Total RTD cost (Euros)	65714	29880	79613	38969	46200	38478
Requested RTD	65714	29880	79613	38969	46200	38478
Training cost (Euros)						
Requested Training						
Mangement (Euros)	0	0	0	0	0	0
Requested Mangement	0	0	0	0	0	0
Total costs (Euros)	65714	29880	79613	38969	46200	38478
Requested costs	65714	29880	79613	38969	46200	38478

PartnerNumber Cost Model	37 ACMAD AC	38 Vaisala FCF	39 OSIL FCF	40 KNMI FC	41 ASECNA FCF	42 UniKarl AC	Total
Total RTD cost (Euros)	6000	1500	0	82750	1006000	31800	6834620
Requested RTD	6000	1500	0	41375	1006000	31800	5521962
Training cost (Euros)			290050				365050
Requested Training			290050				365050
Mangement (Euros)	0	0	0	0	0	0	55200
Requested Mangement	0	0	0	0	0	0	55200
Total costs (Euros)	6000	1500	290050	82750	1006000	31800	7254870
Requested costs	6000	1500	290050	41375	1006000	31800	5942212

9.5 Management level description of resources and budget.

9.5.1Aircraft deployment budget

The budget requested in this project for the operation of research aircrafts is in addition to national resources already dedicated to AMMA. In the tables below we will detail the total cost of the operation of the national research aircrafts and grant requested from the EU.

INSU

FALCON INSU :				In kEuros
SOP-0 : 15 January – 15 February 2006				
Falcon will be equipped with remote sensing instrumentation				
Cost of stay :	Days	KE per day		
	25	3.4	85	
Flight hours:	Hours	kE/h		
	45	0.94	42.3	
Travel for perso	Persons	kE/p		
	3	4	12	
		Total SOP-0 :		139.3
SOP-1 : 15 June – 15 July 2006				
Falcon will be equipped with LEANDRE water vapour lidar				
Cost of stay :	Days	KE per day		
	25	3.4	85	
Flight hours:	Hours	kE/h		
	40	0.94	37.6	
Travel for perso	Persons	kE/p		
	3	4	12	
		Total SOP-1 :		134.6
SOP-2 : 15 July – 15 August 2006				
Falcon will be equipped with dropsonds and chemistry instruments				
Cost of stay :	Days	KE per day		
	25	3.4	85	
Flight hours:	Hours	kE/h		
	80	0.94	75.2	
Dropsonds	Number	kE/sond		
	300	0.75	225	
Travel for perso	Persons	kE/p		
	6	4	24	
		Total SOP-2 :		409.2
SOP-3 : 15 August – 1 Septembre 2006				
Falcon will be equipped with dropsonds and radar-lidar				
Cost of stay :	Days	KE per day		
	25	3.4	85	
Flight hours:	Hours	kE/h		
	40	0.94	37.6	
Dropsonds	Number	kE/sond		
	300	0.75	225	
Travel for perso	Persons	kE/p		
	3	4	12	
		Total SOP-3:		359.6
		TOTAL cost for SOPs :		1042.7
		Requested contribution :		439.2

Instruments for the Falcon		
	Falcon	20
	Instrument shipping to Africa	10
	Instrument running cost during 40 d. (250 E/d)	10
	Total :	40
	Requested :	40

ATR INSU :		
	Total cost :	500
	No funding requested from the EU	

BAE146 – NERC

SOP-2 : 15 July – 15 August 2006				
Bae146 will be equipped with in-situ chemistry and aerosol instrumen dopsondes				
Cost of stay :	Days	KE per day		
	30	5.68	170.4	
Flight hours:	Hours	kE/h		
	94	8.09	760.84	
Aircraft costs			**931.24**	
Recce			3	
Dropsonds	Number	kE/sonde		
	96	0.8	76.8	
		Total SOP-3:		1011.04

SOP-3 : 15 August – 1 September 2006				
Bae146 will be equipped with in-situ chemistry and aerosol instrumen dopsondes				
Cost of stay :	Days	KE per day		
	15	5.68	85.2	
Flight hours:	Hours	kE/h		
	30	8.09	242.82	
Aircraft costs			**328.02**	
Recce			3	
Dropsonds	Number	kE/sond		
	40	0.8	32	
		Total SOP-3:		363.02

TOTAL cost for SOPs :	1374.06
Requested contribution :	365

DLR Falcon

SOP-1 : 1 July – 15 July 2006				
Falcon will be equipped with WIND lidar				
SOP-2 : 15 July – 30 July 2006				
Falcon will be equipped with chemistry and aerosol instruments				
Cost of stay :	Days	KE per day		
	30	3.93	117.9	
Flight hours:	Hours	kE/h		
	60	2.71	162.6	
Travel for persor	Persons	kE/p		
	5	7.5	37.5	
Aircraft operation costs			98.5	
		Total cost for SOPs:		416.5
		Requested contribution :		208.25

9.5.2 Flux station budget

The project proposed to set up a network of 12 flux stations produced by OSIL (An SMI member of the AMMA consortium) and to train the personnel in the region to operate the network over the long term. The network is jointly funded by NERC and this project. Below the full budget for the instrumentation and its deployment is provided. The cost for scientific exploitation are in the effort table and the corresponding budget.

Staff	123
Equipment	216
Travel etc.	26
Shipping	24
Total :	389

4 Station funded by AMMA-IP		
Man power		
Activity	p.m	FEC kEuros
Development	2.8	23.8
Assembly	1	8.5
Integration	2	17
Software	1.1	9.35
Testing	1.5	12.75
Site scoping	0.7	5.95
Installation	1	8.5
Project co-or	2.5	21.25
Documentation	1.1	9.35
Technology demonstration	2.1	17.85
On-site training	3.1	26.35
Total	18.9	160.65
T+S		10
Consumables		7.2
Equipment		112.2
Grand total :		679.05
Requested contribution :		290.05

9.5.3Radio-sounding Budget

The budget requested from the EU for the radio-sounding network will contribute to ASECNAs currently operational network. For the goals of the AMMA-IP project, the improvement of forecasting capabilities in particular, the enhancement of the current radio-sounding network and the training of the local operators to ensure a sustained observing system is crucial. The upper-air measurements need to be available in time for the operational forecasting and the enhanced soundings during the intensive field campaigns will ensure an optimal deployment of instruments.

ASECNA currently operates a network of 22 stations of the previous generation. This infrastructure values at 3m€. The operation of this network requires a budget of 2.7m€ per year. The proposed contribution of the EU for the upgrade of the network and training of the operators is of 2.010m€ over 5 years.

9.5.4Lidar deployment budget

The optimal distribution of lidar stations depends on the scientific task. Below is a description of the distribution of lidar stations to contribute to the main scientific tasks. Deployment strategy should satisfy the measurement coordination requirements, as described in the following paragraph.

- Aerosols characterization in the Monsoon area requires a regular grid of lidar stations with routine measurements. AMMA should offer the chance to pursue such measurements at selected stations equipped with aerosol routine measurements. Measurements can be limited to night-time lower troposphere.
- Evaluation of aerosol inflow and outflow in/from the Monsoon region requires a longitudinal

transect (N/S transport) and a latitudinal one (E/W transport). Lidar play a key role measuring the vertical extent of the aerosol layer. Same requirements as above.

- Evaluation of aerosol-convection interaction requires measurements before the passage of a squall line to characterize the vertical distribution of aerosol that could be advected in convective towers. Moreover, lidar can measure the presence of high tropospheric aerosol as remnants of convective activity. These activity requires a more powerful system, to sample the lower troposphere both at night-time and at day-time, and to sound the upper tropospheric layers.
- Evaluation of the radiative budget requires an ensemble of complementary aerosol measurements; lidar should provide measurements simultaneous to other sounding systems (AERONET, particle counters) in routine configuration. This can be carried out in one selected station.

The stations that will host lidars from AMMA IP partner institutions are:

- Banizombou (Niger) will be the key station (Niamey airport, AERONET, Particle counters...) and will host a Mie-Raman lidar from U-Munich during SOP0 and an ISAC microlidar for all SOP and the whole EOP
- Cinzana (Mali) is an AERONET station managed by LISA (UP12) and will be equipped with an ISAC micro-lidar
- M'Bour (Senegal) will be equipped with a micro-lidar from LOA (CNRS)
- Tamanrasset (Algeria) will host several radiometric and aerosol measurements of CNRS: 1) a multi-wavelength elastic and Raman channel mini-lidar with diverse polarization capability at 532 nm, 2) a sun photometer, 3) an infrared (IR) radiometer, 4) a pyranometer and 5) a full sky visible channel web-type camera
- Djougou (Benin) will be the southern transect station and it is foreseen to perform measurements with a micro-lidar from ISAC. The system could be re-deployed in the EOP after SOP phase

Additional activities are foreseen in Cap-Vert and Barbados in the frame of the US-AMMA project. The deployment strategy is summarized in table 1

Coordination of lidar measurements with the other measurements

Aircraft: Flights dedicated to atmospheric chemistry and dynamics are planned during SOP0 - SOP3 from Niamey Airport. Ground-based lidar will be an ancillary measurement to provide a complementary view of the aerosol content near to the base airport.

Ground-based: Lidars will be deployed together with other aerosol and dynamics measurements. Lidar will provide complementary information since aerosol conventional measurements can provide information over the whole vertical column or near the ground

	2005	**SOP0**	**SOP1**	**SOP3**	**SOP3**	**SOP4**	**2006**	**2007**
Banizombou (Niger)		LMU-Munich	ISAC	ISAC	ISAC	ISAC	ISAC	ISAC
Cinzana (Mali)		ISAC	ISAC	ISAC	ISAC	ISAC	ISAC	
M'Bour (Senegal)	MPL	ISAC	ISAC	ISAC	ISAC	ISAC	ISAC	
Tamanrasset (Algeria)		CNRS	CNRS	CNRS	CNRS	CNRS		
Djougou (Benin)		CNRS	CNRS	CNRS	CNRS	CNRS		
Tenerife (Canaria)							MPL	MPL
Barbados							MPL	MPL

Table 1: The longitudinal transect comprises the stations M'Bour, Banizombou and Cinzana, while the latitudinal transect consist of the the stations at Tamanrasset, Banizombou and Djougou.

Costs

The Network will be partly funded by the EU and partly by the partners. Table 2 provides the actual costs and the contribution requested from the EU within the AMMA-IP.

	IPSL (CNRS)	ISAC	LMU-Munich	ÖOA (CNRS)	Total
Task	Deployment of 1 daytime micro-lidar during SOPs in Tamanrasset	Deployment of 1 daytime micro-lidar and 2 night-time micro-lidar in Banizombou, Cinzana and Djougou during SOPs and EOP	Deployment of a Raman-Mie lidar in Banizombou during SOP0	Deployment of 1 night-time micro-lidar during SOPs in M'Bour	
Observing systems	20	185	209	50	
Personnel	0	180	95	50	
Durables	20	0	0		
Consumables	10	15	8		
Transport	40	5			
Travel	40	15	17		
Total	130	400	329	100	849
Required from the EU	0	195*	74	30	348

Costs are given in kEuro

* These costs will be mainly subcontracted (175 kE) and are not included in the general part of the Institution budget

9.5.5 Other ground observations

Partner UP12 will equip two sites in the AMMA region for continuous aerosol measurement. Within the AMMA-IP project a financial contribution is requested to the toal cost of the equipment.

INSTRUMENT	SITE	WP	total cost (k€)	Requested to EU
3 TEOM	Mali (Cinzana)	4.2.3	75	25
Sun Photometer CIMEL	Mali (Cinzana)	4.2.3	31.5	28
3 Wet Deposition sampler	Niger (Banizoumbou)	4.2.3	15	15
3 Dry Deposition sampler	Niger (Banizoumbou)	4.2.3	15	0
3 Meteorological station	Niger (Banizoumbou)	4.2.3	7.5	0
	Total :		144	68

Uni Bonn will contribute to the project a vertical profiler for humidity and temperature to provide nearly continuous information on the vertical distribution of these quantities and the liquid water path. The instruments requires further developments before it can be deployed within AMMA. A financial contribution is requested from the EU for these additional developments and the deployment in Africa.

Development of instrument	80
Development of tropical retrieval algorithms	30
Preparation and installation of instrument	50
MRR, Ceilometer	50
Solar Photometer	20
Durable equipment	140
Tropical conditioning	10
Consumables and deployment	10
Total :	390
Requested :	160

9.5.6 Contribution of ECMWF to AMMA

The European Centre for Medium-Range Weather Forecast (ECMWF) is an important partner of the AMMA project. It it is using an additional cost reporting model but quantification of ECMWF's own resources contributing to the project is not possible because of the diverse sources of the effort within ECMWF. We are thus providing here a detailed qualitative description of its own contribution with an emphasis on the risk this puts on the AMMA project.

ECMWF is a global modelling center which provides state-of-the-art analysis of the atmosphere and the land surface coupled to daily medium range forecasts and seasonal forecasts. Substantial research is carried out to continuously improve the system and to adapt it to the most recent observing systems. Because the system is global it includes the AMMA region. As most of the ECMWF activities are relevant to AMMA it has to be considered as an ECMWF contribution to AMMA. However, it is impossible to separate the AMMA part from the ECMWF operational activities. The EU funding of AMMA will be used to get the most out of the ECMWF system for the AMMA project, e.g. by making optimal use of extra observation, by providing the project with analyses of the atmosphere and the land surface, by monitoring the forecast performance of the medium range forecasts as they are used by the African Partners through ACMAD and by evaluating changes in the system as they come along contributing to the understanding of the West African Monsoon. The existing ECMWF infrastructure is essential for this task but impossible to quantify.

A few specific comments in relation to the work packages:

- **WP5.1** : ECMWF will develop a verification system for the medium range forecasts in the AMMA region. This work builds on existing software to evaluate the ECMWF global forecasts. The system will be extended with specific diagnostics for AMMA, also making use of the extra data that will be gathered in the other work packages. This is low risk, because ECMWF has stable funding for general diagnostic work over the coming 5 years. The EU funding will be used for the AMMA specific tasks.
- **WP4.1** : ECMWF will monitor and assimilate the additional radiosonde data and provide feedback to the observationalist by publishing the statistics on the web. Risk is low because the main components for the monitoring exists. Specific developments for AMMA will be made using the EU funding. The ELDAS land surface data assimilation system will be operational and available for stand alone simulations by the end of 2005. The ELDAS system has been developed and it has already been demonstrated to perform well (supported by EU funding). The operational implementation will start soon and will be done by ECMWF staff. This is low risk because the staff has already been allocated.
- **WP4.1** : In this work package models will be inter compared and model developments as the come along will be evaluated. Of particular interest are the developments in the convection parametrization, atmospheric moisture analysis and the soil moisture analysis. In all these areas, activities are underway with ECMWF core funding which are highly relevant for the AMMA region. The evaluation will also make use of tools that are under continuous development.

10. Ethical issues

The importance of conforming to National and EC legislation, international conventions and declarations regarding ethical issues has been fully acknowledged and taken into consideration.

10.1 Conformity with EC legislation and and the Ethical Rules of the FP6

As stipulate in the Article 3 of FP6 :“All the research activities carried out under the Framework Programme 2002-2006 must be carried out in compliance with fundamental ethical principles” (Council Decision 1513/2002/EC of 27 June 2002 and 2002/835/EC of 30 September 2002).

- Participants will conform to relevant EU legislation and International Convention such as :
- The Charter of Fundamental Rights of the EU
- Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data
- the UN Convention on the Rights of the Child.

10.2 National legislation conformity

Participants in AMMA projects will conform to current legislation and regulations in the countries where the research and deployment of equipment will be carried out. Where required by national legislation or rules, together with the management team, AMMA participants will always seek the approval of **the relevant ethics committees** prior to the start of the RTD activities that raise ethical or other issues.

Clinical data Issues :

The partners working on health impacts are not involved directly in the collection of clinical data. Any clinical data to be used in the project will be collected by either national health ministries or agencies appointed by these ministries. As far as we are aware these agents have complied with any requirements in force for the countries in which they are working relating to the collection of clinical data. Partners who subsequently obtain this data will ensure, once the project is active, that they have followed correct procedures in their own institutions to allow them to work on these clinical data sets. Further, health partners working in Africa on disease vectors and the environmental controls of these vectors are undertaking their research with the acknowledgment of local agencies and appropriate ministries.'

11. Other issues

During the implementation of the IP AMMA, the research activities carried out will be in compliance with the relevant EU Policies at the European and international level.

11.1 UE-policies related to Environment

AMMA’s objectives meet the following EC Environment DG Mission Statement :

- To promote Sustainable Development, preserving the rights of future generations to a viable environment.
- To work towards a high level of environmental and health protection and improvement of the quality of life.
- To promote environmental efficiency.
- To encourage the equitable use, as well as the sound and effective management, of common environmental resources

11.2 EU-policies related to Sustainable development and knowledge-based society

Göteborg declaration on Sustainable Development :
AMMA is a major support to the EU strategy for Sustainable Development which has been decided in 2001 by the Göteborg European Council. AMMA will contribute to EU sustainable development goals, which are enhancing health, wealth, quality of life and employment in developing and developed countries alike, while preserving limited material resources.

AMMA is Europe's contribution to the UN Sustainable Development Summits

International conventions and declarations
At the international level the UN has set Sustainable Development (SD) as one of its priorities and has been promoting it through the Summit on Sustainable Development in Johannesburg in 2002 and New Dehli 2004. Over the planed 5 years, the AMMA project though its integrative science approach will be a major EU contribution to the cycle of thematic clusters of issues selected by the United Nation Division for Sustainable Development. The following topics of the UN plan will be covered by AMMA :

Cycle Thematic Cluster :

2004/2005	Water
2006/2007	Air pollution/Atmosphere, Climate change
2008/2009	Agriculture, Desertification and Africa

N.B: The only region explicitly named in the work plan of the UN Division for Sustainable Development is Africa.

Lisbon European Council 2000

AMMA will contribute in turning Europe into the world’s most competitive knowledge-based economy.

AMMA greatly contributes to the creation of European Research Area where EU and national R&D efforts are better integrated.

AMMA has a focus on economic and development through its essential knowledge in its different forms, on the production, acquisition and use of knowledge AMMA intends to satisfy social demand as well as social needs especially in connection with the evolution of work and emergence of new ways of life and activities.

AMMA will foster further industrial development as well as generate driving forces of economic growth, competitiveness and employment at the European and West African level.

AMMA activities will strengthen the necessary scientific knowledge for the future orientation of the Sustainable Development strategy in the west of Africa

AMMA intends to promote Platforms for technological organisational and social innovation

AMMA will also provide the socio-economic tools and assessments and the overall management practices.

Furthermore AMMA will ensure its implementation at the world level, AMMA participants are aware and will conform to the UN Convention on the Rights of the Child.

11.3 UE-policies related to Health and Life Quality

AMMA has a strong contribution to solving major societal problems related to Health and Life Quality. AMMA has a specific interest and complies with the health priorities of the host country and not for reasons of pure convenience.

In a short, medium and long term perspective, through its work in order to improve health and life quality, AMMA intend to have a huge impact on the following:

Public Health :
Characterize the impacts of the seasonal and inter-annual variability in the West African monsoon on selected diseases examining the impact of rainfall, hydrology and pond dynamics, at selected locations

To evaluate the impact of monsoon rainfall and other climatic factors on the dynamics of malaria vector populations, identify the role of rainfall in the circulation of pesticide from agricultural crop fields to mosquito larval breeding sites and the impacts on the selection of insecticide resistance in Angambiae populations.

Identify the roles of other meteorological and environmental variables in patterns of diffusion of selected diseases

Identify the role of natural river flooding, soil type and agricultural irrigation in the patterns and density of vectors and vector borne diseases

Land Productivity :
Characterization of the effects of regional climate change and climate variability on biophysical processes at the scale of the agricultural field and cropping system,

Identification and evaluation of probable adjustments of agricultural systems and its components, including choice of crop and its management strategy, to climate change,

Identification of opportunities for mitigation of negative impacts of change on agricultural systems, and identification of research needs to realize them,

Characterization of the trends in natural vegetation productivity and the relation to regional and local climate,

Identification of anomalies in vegetation trends over the region

Human processes and food security :
Study the impact of climate on the socio-economy and livelihood of people in the region,

identification of human adaptation strategies to climate change,

Human-environment systems in the Sahel result from a range of interactions between climate

change and variability with changes in policies, in macro-economic variables and local management strategies

Water Resources :
Asses the impacts of climate and land use change on water resources in west Africa and its management at river basin scale,

Compute the vulnerability of hydro-systems related to climate variability and change,

Evaluation of downscaling methods for hydrological impact assessment,

Dynamic flood monitoring in the valley of Senegal River basin and the analysing of its implications in the floodplain management

11.4 AMMA International and its relation to AMMA-IP

To achieve the aims of AMMA International, substantial international collaboration and coordination are required. AMMA wants to strengthen the international framework needed to facilitate interactions between researchers working on different aspects of the WAM and its impacts. At this time more than 20 countries from more than 25 national and pan-national agencies are involved in AMMA. National scientific steering groups now exist in France, UK and US alongside regional groups for Africa (AMMANET) and the EU (this proposal). An international structure has also been established to oversee and coordinate these efforts. This consists of two levels: the International Scientific Steering Committee (ISSC) and International Governing Board (IGB). The ISSC consists of leading atmospheric, hydrological and oceanographic scientists and is responsible for the formulation of well defined objectives and of a coherent scientific programme for AMMA. The ISSC will ensure the scientific integrity and coherency of the scientific objectives of AMMA and *will coordinate the implementation of AMMA*. The IGB has final responsibility for the implementation of the AMMA Programme. It is responsible for approving the structure and implementation of AMMA, particularly with respect to the necessary financial and technical support and will help to mobilize national and international resources to support AMMA activities. AMMA continues to develop in association with and with the support of international programs such as WCRP (especially GEWEX and CLIVAR) and IGBP. Where appropriate AMMA has also made linkages with other relevant international programmes such as the WMO supported THORPEX project.

Appendix A - Consortium description

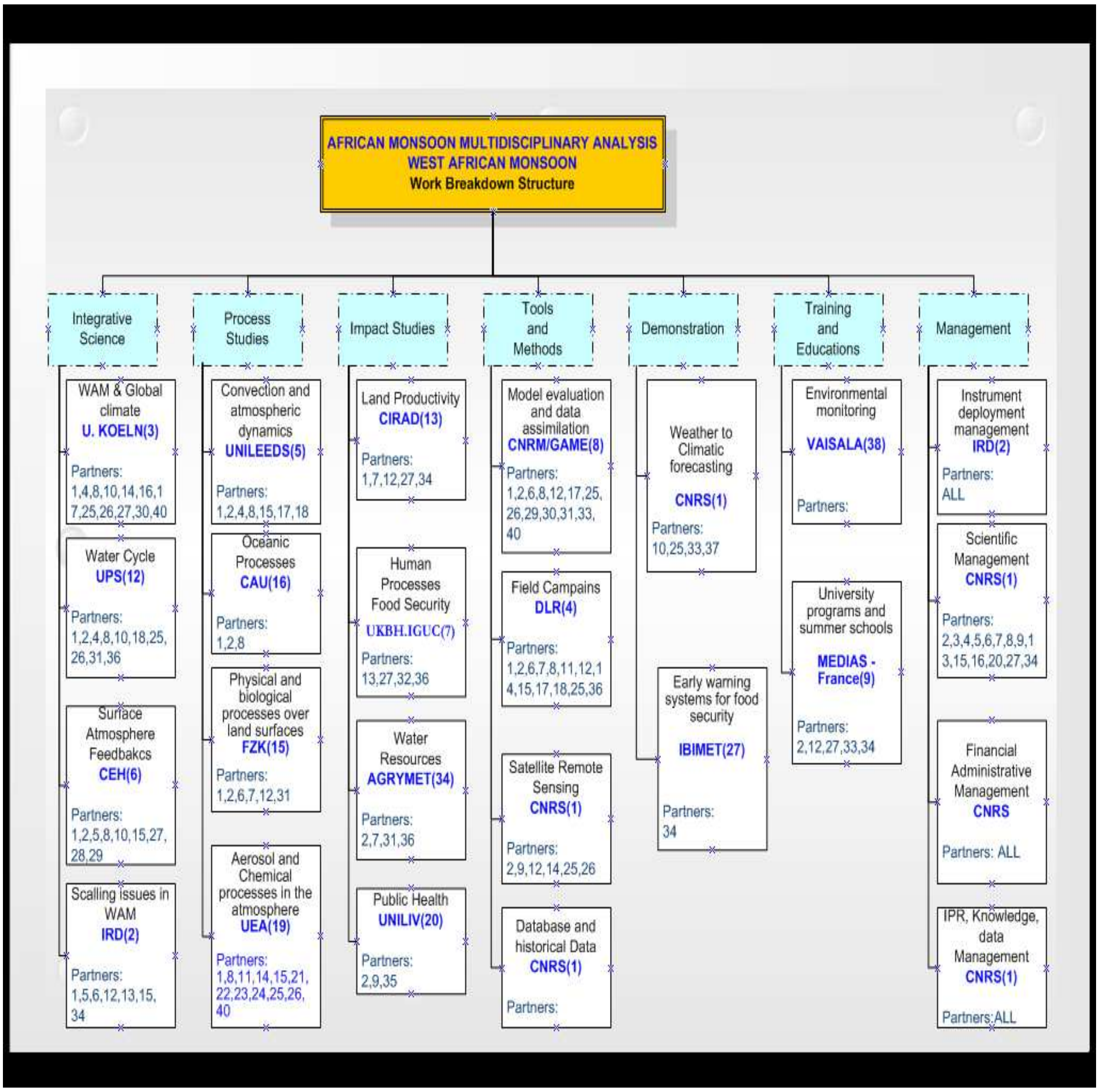
A.1 Participants and consortium

A.1.1. Description of the consortium

Introduction

AMMA is meticulously designed to generate the knowledge required to implement the EC priority thematic area of Global change and Ecosystems, as well as to aim the Topic’s (6.3.I.3.a) regarding Hot spots in the Earth system objectives. AMMA has ambitious, clearly-defined scientific and technological objectives: to achieve these we aim to integrate a critical mass of activities, expertise and resources (material as well as human).

The nature of the activity means that this critical mass embraces a wide spectrum of fields. The AMMA consortium is aware that our performance depends on the competence of every individual partner, and that our existence as a consortium is defined by our diversity. Therefore, the composition of the consortium has been carefully designed, and it embraces a large number of competencies (including the physical sciences, human sciences, operational prediction, training and management). Furthermore all partners have already performed research in one or more of the cross-cutting themes proposed and are hoping to carry this work further within this integrated project. The following WBS (Work Breakdown Structure) table relates best how partners fits within our work group.



Consortium Agreement

Every AMMA partner has decided to bring together their knowledge, their skills, their attitudes, their experience, and their contacts, as well as their operational models (including materials, equipment) and culture into AMMA-IP consortium. We have been working on the conclusion of a consortium Agreement, which deals with AMMA's internal organisation, management of the consortium as well as intellectual property arrangements (IPR), and also settlement of internal disputes.

This Consortium Agreement has been discussed amongst partners and attached in the annexes (Annex B: Letter of appointment) of this proposal is a letter of appointment, which stipulates that this Consortium Agreement is ready for signature and has been agreed in its general terms. Such a status has been reached thanks the strong commitment of all the partners. Each of them - hand in hand with its legal adviser - has been working on all the clauses appropriate to the nature and purpose of the overall collaboration and to everyone's interest. All issues that may arise during the implementation of a research project have been discussed and will are addressed and governed by means of this Consortium Agreement.

Partners Complementarity

The network is composed of 40 participants, including academic institutions, SMEs working in 10 countries (France, UK, Germany, Denmark, Spain, Italy, Belgium, Niger, Finland, Burkina Faso; 36 EU Members, and 4 African INCO members). Each of these participants has a pre-existing, long-term commitment to the activities within AMMA. Partners have been chosen with regard to their profiles and records of achievement, and tasks have been assigned which correspond to the organizational structure of the AMMA-IP in order to assure a complementarity between them.

Integrative science

This subproject is essential to AMMA, and epitomises our research philosophy. By bringing together partners with skills and resources in complementary areas, we will generate new science that would not exist without the integration.

Process studies

This subproject represents core activities in existing subject areas, where we will expand our capacity by integration of facilities from different partner groups. For instance, by combining data from ground-based, aircraft-based and satellite instrumentation, as well as theoretical and numerical modelling, we will be able to achieve scientific goals which would be inaccessible otherwise. Scientists working in these process studies will also integrate their results by contributing to the Integrative Science subproject.

Impact studies

Partners in this subproject have been brought in for their track record of applying basic science to generate practical solutions to human problems. The success of these studies is essential to our aims. Partners in these areas have been working to guide the planning of the Integrative Science and Process Studies subprojects, to ensure that the basic science addresses their needs.

Tools and methods

Partners in this subproject have been chosen for their track record in developing state-of-the-art observations, models and databases. In these areas we have collected world-leading Partners, who have extensive experience of leading complex, interdisciplinary field campaigns and in developing, archiving and processing complex datasets.

Demonstration

In this subproject we have brought in Partners who are actively engaged in environmental prediction and its development. By including Partners who are leading the development of these prediction systems we aim to nsure that our basic science leads to measurable improvements in forecasting skill.

Training and education

In this subproject we include Partners with a proven record of developing scientific and technological skills, in Europe and Africa.

INCO countries involvement

This project focuses on the West African Monsoon and the choice of including African Partners has become as obvious as it is relevant. African involvement includes academic researchers as well as African forecasting centres. The regional atmospheric forecasting for the project will be the responsibility of African Centre of Meteorological Application for Development (ACMAD) a pan-African institution dedicated to this work. The regional centre AGRHYMET in Niamey and the Centre de Recherches Médicales et Sanitaires (CERMES) will use the output of the meteorological services to forecast water resources, agronomical yields and issue warning regarding impacts on health. The responsibility of these forecasting centres will be to demonstrate the direct benefit to the African societies of an improved understanding of the West African Monsoon and an enhanced observing system. AMMA's socio-economic Impact in Africa go through the activities of those INCO Partners.

Involvement of SMEs and Industry

The SMEs involved in AMMA have the characteristics of knowledge creation and medium to high scale. In order to ensure that the enhancement of weather and climate monitoring systems proposed by the AMMA-IP remains in place beyond the life of the project, SMEs specialized in these observations are involved. Their role will be to ensure the training of the technical staff in Africa, and to upgrade the current systems to more robust and cost effective solutions. They will provide product and services including rental of specialist equipment, design and deployment of moorings, data processing, sampling.

Scale of critical mass of activities and resources (human and materials)

This high quality level of the consortium is reinforced by the nature of the key personnel from each organisation committed to the project. The consortium includes participants who have an international reputation for developing and applying the tools which are needed for the AMMA project.

To name a selection of core AMMA contributors, the IP can strongly rely on the contribution of following prominent European scientists :

- **Jan Polcher** is a scientist at CNRS. He has coordinated previous European projects and is currently heading the GEWEX modeling and Prediction Panel of the World Climate Research Program.
- **Thierry Lebel** is a scientist at IRD. He has coordinated the HAPEX-Sahel campaign in Africa and he is leading the environmental observatory over the Ouémé basin in Benin.
- **Hartmut Hoeller** is a scientist at DLR. He has coordinated European projects under the 4th and 5th Framework programs and led a number of field campaign.
- **Michel Desbois** is a scientist at CNRS. He has been PI and initiator of a number of satellite missions dealing with cloud observations or precipitation estimations.
- **Jean-Philippe Lafore** is a scientist at Meteo-France. He has headed the French project Méso-NH Atmospheric Simulation System team.
- **Claire Reeves** is senior researcher at the University of East Anglia. Her field of expertise is atmospheric chemistry and She is a member of the Facility for Airborne Atmospheric Measurements Operations Committee.
- **Andreas Fink** is a scientist at the Institute of Geophysics and Meteorology of the University Cologne. He is leading the IMPETUS project in Benin.
- **Doug Parker** is senior lecturer at University of Leeds. He is currently PI of the JET2000 project which deals with the dynamics of the African monsoon.
- **Chris Taylor** is a Senior Scientist in the Climate and Land Surface Group at CEH. He has been PI in several projects examining land-atmosphere feedbacks.
- **Inge Sandholt** is an associate professor at the University of Copenhagen. She is coordinating the INTEO project over the Senegal basin and other national research projects in Denmark.

The following paragraphs deal in details with how the participants will collectively constitute a consortium capable of achieving the project objectives and how they are suited and are committed to the tasks assigned to them. For further information on the different partners, the Annex B (Detailed Description of the Consortium) of this proposal proposes a complete description of every partner, which includes their area of expertise and their suitability in the project. Next to those characteristics, we deemed necessary to introduce in the critical mass a sample of the key personnel with an overview of all the competencies involved in the project in terms of knowledge in various technological and scientific fields, of origin (industrial or academic world), diversity of functions and skills (product manager, head of department, scientist) and the already existing part of feminine key personnel.

A 1.1.2 Presentation of The Coordinator (CNRS)

The CNRS has a long track record in the administration of large projects and the management of intellectual property and will bring its expertise to the effective management of the project.

The AMMA-IP consortium will be led by the Centre National de la Recherche Scientifique (CNRS). It will be present in the scientific activities of this project through 3 of its leadings institutes :

- Institut Pierre Simon Laplace (IPSL),
- Laboratoire d'Aerologie (LA)
- Laboratoire d'Optique Atmosphrique (LOA)

The scientific coordination of the AMMA-IP will be the responsibility of IPSL. The Institute has been coordinator of a number of European projects in the 4th and 5th Framework Program. The diversity of environmental research done at IPSL has enabled it to build a good expertise in managing interdisciplinary research.

A.1.1.3 Presentation of The Core Partners

Prior to the submission of this proposal, AMMA’s group of core partners met during meetings organised by the Co-ordinator in Paris. This meeting has taken place after ongoing communication and exchange of information between the partners and followed several months’ intense and close collaboration teamwork to build up the proposal. The main objectives of the meeting were to discuss the relevance and coherence of the proposal, debate the main scientific, technological and industrial outcomes, and to set-up exploitation and dissemination policies. Finally, the Consortium Agreement was discussed in order to have it ready on the day of submission.

The group of core partners has been working very efficiently and tribute should be paid to the remarkable human synergy that has been achieved in the work done in order to prepare the implementation phase.

The core partners, as listed below, assisted the co-ordinator to organise the overall work of the consortium and are strongly committed to, and responsible for, the completion of the main tasks as ordered by the co-ordinator. Most of the core partners are also Work-Package Leaders.

N°	Organisation	Type	Country	Key Person	General Expertise/Suitability in the Activity/project
1	CNRS	RES	France	Jan Polcher	Coordinator, public basic-research organization that defines its mission as producing knowledge and making it available to society. The CNRS strives to develop collaboration between specialists from different fields of expertise. These interdisciplinary programs and actions offer a gateway into new domains of scientific investigation and enable the CNRS to address the needs of society and industry. Research activities concern the turbulent structures and transports in the atmospheric boundary layer, the dynamic, microphysical and electrical phenomena associated with clouds and atmospheric perturbations, biogenic and anthropogenic emissions and deposits of minor atmospheric components at the surface and in the overlying atmosphere
2	IRD	RES	France	Thierry Lebel	Long experience of carrying out field research in West Africa in partnership with local institutions, especially in hydrology, oceanography, agronomy and health sciences.
3	U.KOELN	HE	Germany	Andreas Fink	Long research record in the field of tropical and subtropical meteorology and climatology. Expertise on the synoptic-scale forcing of West African rainfall events and on the climatology of the West African climate zones
4	DLR	RES	Germany	Hartmut Höller	the German Aerospace Centre, performs aerospace research and is responsible for management of the national space programme. Its major topics of research addresses: atmospheric processes and trace species in the troposphere and stratosphere at regional and global scales, climate change, meteorology, and impact of weather on air traffic. Performing of large field experiments using research aircraft, Radar, Lidar, airborne in situ chemical and aerosol instruments, and satellite observations. DLR-IPA also has many years experience in co-ordinating international research projects.
5	UNIVLEEDS	HE	UK	Doug Parker	One of the largest atmospheric research groups in the UK amongst the largest and most prestigious centres for chemistry research in Britain with its creation of technology transfer company, which help academics to develop and to commercialise ideas
6	CEH	RES	UK	Chris Taylor	UK government's primary research organization with responsibility for terrestrial and freshwater ecology and hydrological research. It has a long history of fieldwork in hydrology and hydrometeorology in West Africa dating back to the 1980s. Its expertise in land-atmosphere feedbacks are key components of the Joint Centre for Hydro-Meteorological Research (with the Met Office), and the NERC Centre of Excellence "CLASSIC".

N°	Organisation	Type	Country	Key Person	General Expertise/Suitability in the Activity/project
7	UKBH.IGUC	HE	Denmark	Inge Sandholt	The Institute of Geography has long tradition for conducting research in West Africa and large field work experience in human and socio-economic science as well as with physical measurements of surface parameters in the region.
8	CNRM/GAME	RES	France	Jean Philippe Lafore	Responsible for conducting the largest part of the meteorological research activities, primarily oriented towards the needs of public utility in the domain of meteorology, the research actions encompass the atmosphere, extending to, and including, closely related fields and boundaries, such as stratospheric ozone chemistry, upper ocean, physics and dynamics of the snow cover, surface hydrology
19	UEA	HE	UK	Claire Reeves	Graded as double 5* for research (the highest mark possible) founded on the principle of the interdisciplinary study of the environment and carries out research in the following areas: atmospheric and oceanographic science, climate research, earth sciences, ecology, social science. Expertise in the implementation of major airborne studies of gas phase chemistry, involving the planning and direction of flights
25	ISAC/CNR	RES	Italy	Federico Fierli	ISAC-CNR is the National Research Council Institute in charge of the activities of research, promotion and technology transfer in the Meteorology and its applications, Climate change and predictability, Atmospheric structure and composition and Observations of the planet Earth. ISAC-CNR has a long experience in a wide range of atmospheric studies with particular focus on mesoscale modelling, climate analysis, satellite remote sensing, aerosol and atmospheric composition measurement and analysis. ISAC-CNR is deeply involved in field campaigns and long-term monitoring of the atmospheric composition and in management of international projects
15	FZK	RES	Germany	Harald Kunstmann	Responsible for regional climate modelling and hydrological modelling of the Volta Basin in West Africa within the national funded GLOWA-Volta project. Broad expertise in the field of hydrological, meteorological and regional climate modeling, in particular in semi-arid environments; institute has long research record in process oriented biological modeling and measuring C/N turnover

A.1.1.4 Presentation of The other Participants

N°	Organisation	Type	Country	Key Person	Role in the Activity/Project
9	MEDIAS-France	Others	France	Michel Hoepffner	Bring together scientists, service providers and policy makers addressing global change issues, origins and impacts within the so-called international Medias network, within a sustainable development perspective. Developing data and metadata bases is its key service activity.
10	U.Bourgogne	HE	France	Bernard Fontaine	Leading role in climate variability studies and statistical rainfall prediction all over the African continent and especially in the AMMA region
11	UP12	HE	France	Béatrice Marticorena	Expertise on tropospheric aerosols and in particular on mineral dust studies, both from experimental (field campaigns, process studies, long-term monitoring, …) and modelling approaches (physical model of dust emissions). Investigation of the interactions between monsoon system and mineral dust emissions and of the impact of dust on the regional climate
12	UPS	HE	France	Eric Mougin	This laboratory conducts research into observation and numerical modelling of continental surfaces, collaborates to the definition of satellite programs and to the analysis of remote sensing data with the objective to improve the understanding on the working and the dynamics of continental biosphere at various spatial and temporal scales.
13	CIRAD	RES	France	Michael Dingkhun	Specialist in research for tropical agriculture. Contributing crop models and applications for the estimation of climate impact on crop water balance, growth and yield, including studies on scale effects and climate based decision criteria for crop management.
14	IUP-UB	HE	Germany	Maria Dolores Andrés-Hernández	Long experience in the measurement and interpretation of radicals and other trace gases of atmospheric relevance from a number of different platforms including ground based and aircraft.experiments. The institute is amongst the leading European research institutions in the field of space-borne remote sensing of the atmosphere.
16	CAU	HE	Germany	Latif Mobij	Long record in investigating the ocean's role in climate. In particular, the institute has a lot of experience in studying large-scale air-sea interactions both by taking and analysing observations and by conducting numerical modeling
17	LMU-MUENCHEN	HE	Germany	Susanne Crewell	Remote sensing group operating several groundbased remote sensing instruments (two mobile lidar systems, several sky and sun photometers, microwave radiometers), developing corresponding retrieval methods and significant parts of the hardware, mesoscale modelling, dynamics of heat-lows.

N°	Organisation	Type	Country	Key Person	Role in the Activity/Project
18	Uni Bonn	HE	Germany	Lindau Ralf	Covers a wide spectrum of research topics from boundary-layer meteorology, mesoscale modeling, polar and tropical research, analysis of measured and modelled climate data, to remote sensing from the surface (including radar meteorology) and satellites. Responsible for the development of a rainfall monitoring system from space for Northwest Africa and modelling studies using the Lokal-Modell
20	UNILIV	HE	UK	Andy Morse	Considerable experience in experimental atmospheric science and the analysis of meteorological of data sets for health impacts. Working on the applications of model forecasts from ensemble prediction systems particularly for health
21	UYO	HE	UK	Lewis Alastair Charles	Significant experience in the measurement and interpretation of volatile organic compounds in the atmosphere related mostly closely to objectives within WP 2.4.2 and 2.4.5. Access to unique instrumentation for complex mixture analysis and has pioneered the development of new measurement methods for semi volatile organic compounds in the atmosphere.
22	ULEIC	HE	UK	Paul Steven Monks	Atmospheric measurements and modelling from a number of different platforms including ground-based experiments, aircraft and satellites in national and international experiments. Interests are based around the broad issues of the role of photochemistry in the control of atmospheric composition
23	UMIST	HE	UK	Hugh Coe	Long history of research on the physical and chemical properties of clouds and radiative transfer processes in cloud and clear air, UV radiation studies, pollution transport and evolution, physics of precipitation, cloud-aerosol interactions, aerosol physical and chemical processing, aerosol measurement, and atmospheric electrification
24	UCAM-DCHEM	HE	UK	John Adryan Pyle	UGAMP's approach is to use a heirarchy of models as research tools for controlled experimentation, for comparison with observational data, and in other ways for the advancement of basic understanding in atmospheric phenomena.
26	ENEA	RES	Italy	Paolo Michele Ruti	R&D, testing of innovative technologies and equipment. Transfer of innovations to industry and agriculture;- development of technologies, equipment and components designed to exploit renewable energy sources and to save energy, and stimulation of demand for them; design, construction and testing of demonstration plants. Providing of the modeling, satellite and measurements groups

N°	Organisation	Type	Country	Key Person	Role in the Activity/Project
27	IBIMET	RES	Italy	Lorenzo Genesio	Ongoing activities on basic research in atmospheric dynamics and climate, development of a short term to seasonal regional monsoon forecasting system, analysis of teleconnections of the West Africa monsoon to the Mediterranean summer climate, development of Early Warning Systems (EWSs) for the timely prediction of food shortages in the Sahel area (CILSS Countries), the monitoring and assessment of environmental and socio-economic vulnerability in the West African countries.
28	UNIPG	HE	Italy	Paolina Cerlini	Specific link to the African and third world countries. Specifically, there are strong links with the international centre WARREDC (Water Resources Research and Documentation Centre). Organisation of advanced courses and graduate programmes, conferences and seminars; formulation and organisation of research programmes in collaboration with scientific institutions, both national and international collection, analysis and dissemination of information related to water resources in developing countries and also environmental issues like hydrogeological disaster prevention and management
29	UCLM	HE	Spain	Miguel Angel Gaertner	The extensive meteorological and climatological modelling experience of the group, illustrated by the development of PROMES (acronym for PROgnostic at the MESoscale) limited area model, will be the base of the contribution of UCLM group
30	UCM	HE	Spain	Belen Rodriguez	General Circulation Model simulations with the UCLA GCM, and observational analysis. The broad experience on observed Atlantic atmospheric and oceanic connection with the precipitation variability on inter and intra-annual time scales, together with the use of the UCLA General Circulation Model will be the main contribution of the UCM group to AMMA.
28	UPCT	HE	Spain	Sandra Garcia	Development and application of parameterization techniques of hydrological models, so as to enable its use in basins which present insufficient data. Mapping evapotranspiration using data from Earth observation satellites. Integration of remote sensing data and GIS information within SVAT (Soil-Vegetation-Atmosphere Transfer) models. Development and application of GIS-environment oriented to dynamic flood simulation, integrating spatio-temporal information from different sources and making an intensive use of DEM.

N°	Organisation	Type	Country	Key Person	Role in the Activity/Project
32	UCL	HE	Belgium	Eric Lambin	Experience on local scale case studies on patterns and causes of land-use change in the African Sahel, and has conducted systematic comparative analyses of case studies on the causes of desertification. This led to the development of the SALU model, which provides region-wide scenarios of future changes in land use (up to 2040) and a reconstruction of past land uses (back to 1960).
33	ECMWF	Others	UK	David Burridge	Development of numerical methods for medium-range weather forecasting, preparation on a regular basis of medium-range weather forecasts for distribution to the meteorological services of the member states, scientific and technical research directed to improvement of these forecasts, and collection and storage of appropriate meteorological data.
40	KNMI	Others	The Nehterlands	Gé Verver	Main tasks of KNMI , the Netherlands national meteorological service, is Climate Research in natural and anthropogenic changes in atmospheric composition and their consequences for climate and air quality. the coordinator of the fp6 EU project STAR (Support for tropical atmospheric research). It also develops and applies the global atmospheric chemistry transport model TM, which is driven by 3- or 6-hourly meteorological fields from the ECMWF weather forecast model.
42	UniKarl	HE	Germany	Sarah Jones	Dynamics of tropical weather systems, tropical cyclones, convection. Mesoscale to synoptic scale modelling. Disaster management and risk reduction. Link to THORPEX.

A.1.1.5 Presentation of SMEs - Industry

N°	Organisation	Type	Country	Key Person	Role in the Activity/project
38	VAISALA	Ind	Finland	Peter Eriksson	Their role will be to upgrade the current systems to more robust and cost effective solutions and train the technical staff in Africa to use it to its full potential. Vaisala systems, sensors and instruments are used for measuring environments of all proportions, from the earth's atmosphere to the inside of an engine component. Continuous, dynamic product development, close cooperation with customers, and specialization are the basis for path-breaking Vaisala products

39	OSIL	Ind	UK	Paul Ridout	Specialist in the provision of high quality products and services for marine, freshwater and meteorological measurement. Provide on-site training including presentations, demonstrations and practicals. It has generated and developed for **EUROSEISMIC** a central metadatabase for geophysical data derived from marine seismic surveys for the European Seas

A.1.1.6 Presentation of The INCO Participants

The West African countries have set-up multi-national research organizations on environmental issues linked to the West African Monsoon. These institutions have reached a level of expertise in their field of research which is international acclaimed. The AMMA project would not be complete without them. Furthermore as one of the objectives of AMMA is capacity-building in this area of the world, their role in transferring knowledge existing in Europe and obtained during this project to applications and education is essential.

N°	Organisation	Type	Country	Key Person	Role in the Activity/project
34	AGRHYMET	RES	Niger	Brahima Sidibe	Specialized institution of CILSS (Permanent Interstate Committee for Drought Control in the Sahel). Specialized in the sciences and techniques applied to agricultural development and natural resource management, in charge of promoting information and training in the field of agro-ecology ".Monitor the various meteorological, agrometeorological, agricultural, phytosanitary, hydrological and environmental situations at subregional level, and to develop and transfer tools and methodologies to the relevant technical offices called of AGRHYMET National Components in the CILSS member countries.
35	CERMES	RES	Niger	Isabelle Jeanne	Key Nigerian organism of the Ministry of Health for biological expertise. Strong links with the Malaria Control Division of the MOH and intensive fieldworks in multilateral studies on efficacy of malaria treatments. Interface with biomedical and "environmental (climate, hydrology, atmosphere..) " communities in Niger and at the international level
36	EIER	HE	Burkina Faso	Hamma Yacouba	Offers advanced and multi-focused professional trainings in rural engineering to meet the social and economic needs of its 14 western and central African member States. Reference in Africa as regards research, essentially applied research, in the fields of equipment and management of water and waste in urban areas, water and land management, and management of natural resources and the environment. Suits well in research priorities defined in the Strategic Plan of the Scientific Research in Burkina Faso.

37	ACMAD	Other	Niger	Abdallah Nassor	African organization with the expertise in weather and climate. Main research areas encompass, regional climate variability and change simulations, validation of numerical weather/climate models over Africa, development of training tools for African weather/climate forecasters and interpretation and use of existing operational weather /climate prediction systems.
41	ASECNA	Other	Senegal	Jean Blaise Ngamini	African organisation with an expertise in environmental monitoring. The main activity is the monitoring of the upper atmoshpere and airport vincinity for the safety of air navigation.It opperates the radisounding network currently in place in the AMMA region and a number of weather radars. It is a critical user of weather forecasts in the region.

A.1.1.7. Detailed description of AMMA Consortium

<u>1- Centre National de Recherche Scientifique (CNRS – FRANCE)</u>

Institut Pierrer Simon Laplace (CNRS – IPSL, France)

(FR636 CNRS)

Area of expertise: The Institut Pierre-Simon Laplace federates 6 laboratories working on global environmental issues. Its mission is to advance the fundamental understanding of the global environmental issues as climate change and pollution and to provide climate change scenarii and environmental assessments to decision makers.

Each of the laboratories of IPSL is specialized in several aspects of the climate system :

- Service d'Aéronomie: atmospheric physics and chemistry
- Laboratoire de Météorologie dynamics: atmospheric physics and surface atmosphere biosphere interactions
- Laboratoire d'Océanographie DYynamique et de Climatologie: oceanic physics and biochemisty
- Centre d'étude des Environnements Terrestre et Planétaires: atmospheric physics and surface atmosphere-biosphere interactions
- Laboratoire des Sciences du Climat et de l'Environnement: Carbon cycle and paleoclimate
- Laboratoire de Biogéochimie et Chimie Marines: biochemical cycles in the oceans

IPSL has a personel of 750 which are split evenly between scientists, students and PostDoc andtechnical staff.

Suitability: The research within IPSL is organized through cross cutting themes which build on disciplinary expertise available in the 6 laboratories and constitute a unique approach to the global environmental issues. The cross cutting themes of IPSL which are relevant to the AMMA project are the following :

- The water cycle : The group deals with the exchanges of water between the ocean, land-surface and the atmosphere, water and energy exchanges in the atmosphere and remote sensing. The activities focus on the tropical regions and Africa in particular.

- Modeling : This group develops and maintains the hierarchy of models available at IPSL which go from specific process models to the full Earth System Model. Surface atmosphere interactions in the tropical regions is one of the foci.
- Remote sensing : This group federates the satellite instrument developments teams at IPSL as well as the research activities which deal with the exploitation of remotes sensed data and its applications. This group has an internationally acclaimed expertise in remote sensing of the tropical water cycle.
- Data management : This group builds and maintains the data base of IPSL which collects all the products of the groups cited above to provide a simple access to all scientists at IPSL.

Critical mass: Cyrille Flamant, Michel Desbois, Laurence Eymard, Serge Janicot, Alban Lazar, Kathy Law, Jan Polcher, Alain Protat.

Cyrille Flamant: atmospheric physics, boundary layer dynamics, water vapor - aerosol – cloud interactions, laser remote sensing. Interest in AMMA: water vapor transport associated with the monsoon flow; inter-tropical front dynamics; heat low dynamics and the influence of its variability on monsoon onset; Saharan atmospheric boundary layer.

Michel Desbois : satellite meteorology and climatology, cloud cover, water vapour, precipitation, watercycle in the tropical regions,investigator of space missions (passive remote sensing). Interest in AMMA : life cycle of the convective systems; precipitation from satellites; interannual and intraseasonal variations.

Laurence Eymard: air-sea interactions,water vapour, microwave radiometry. Interest in AMMA: satellite data and monsoon development; multi-disciplinary analysis of data; data base coordinator.

Serge Janicot : atmospheric physics, tropical climate variability, multi-variate statistical analysis,

modelling sensitivity experiment, African monsoon and weather systems. Interest in AMMA: monsoon onset; intra-seasonal variability; tropical teleconnections; impact of climate variability on rainfall regimes; agricultural yields and public health.

Alban Lazar: oceanic and atmospheric tropical-subtropical cells, roles of the upwelling in the Climate, air-sea-land coupling: ITCZ and Monsoon. Interest in AMMA: oceanic circulation and its variability in the Gulf of Guinea; linkages between oceanic circulation in the Gulf of Guinea and the climate of the neighbouring regions.

Kathy Law: atmospheric chemistry, global tropospheric chemistry modelling, trace gas budgets and

role of dynamical processes. Interest in AMMA: role of deep convection in regional oxidant budgets; impact of West African emissions on global trace gas budgets, oxidising capacity and climate on seasonal and inter-annual timescales.

Alain Protat: atmospheric physics, thermodynamics and microphysics in mid-latitude frontal systems, thermodynamics and microphysics in non precipitating clouds. Interest in AMMA: microphysical processes in West African squall lines and energy budget of mesoscale convective systems; dynamical, radiative and microphysical properties of tropical cirrus.

Jan Polcher: is a scientist at CNRS. He has coordinated previous European projects and is currently heading the GEWEX modeling and Prediction Panel of the World Climate Research Program.

Laboratoire d'Aérologie (CNRS – LA - France)

(UMR 5560 Université Paul Sabatier UPS – CNRS ; Toulouse, France)

The scientific objectives of LA deal with the observation, the understanding and the numerical modelling of dynamic, physical and chemical processes controlling the evolution of the atmosphere and of coastal ocean. The main research activities concern the turbulent structures and transports in the atmospheric boundary layer, the dynamic, microphysical and electrical phenomena associated with clouds and atmospheric perturbations, biogenic and anthropogenic emissions and deposits of

minor atmospheric components at the surface and in the overlying atmosphere. The development and maintenance of efficient and realistic numerical models for atmospheric and oceanic studies, as well as the development and maintenance of observing networks concerning atmospheric and precipitation chemistry in Africa, tropospheric ozone from measurements aboard commercial aircraft and monitoring of trace gases, radar measurements in the troposphere, are recognized specificities of LA.

Critical Mass: Its scientific teams have also been involved largely in the preparation, the management and the exploitation of international scientific programs such as FASTEX (1997), MAP (1999), ESCOMPTE (2001).

The Laboratoire d'Optique Atmosphérique (CNRS - LOA)

Area of expertise: The Laboratoire d'Optique Atmosphérique (LOA) is a research institute, located in Villeneuve d'Ascq (France), with contractual links to the "Université des Sciences et Technologies de Lille" (USTL) and the Centre National de la Recherche Scientifique (CNRS). Its main expertise is in the remote sensing and study of tropospheric and stratospheric aerosols, clouds, and their link with shortwave and longwave radiation. The LOA developped several instruments for aircraf observations of clouds and aerosols, has good experience in field experiments and was involved in the SaHaran Dust Experiment (SHADE) in September 2000. The LOA is in charge of most of the sunphotometers operating in West Africa through the AERONET program.

Suitability

The LOA is involved in climate modelling, aerosol and cloud measurements, aerosol-cloud interactions, aerosol and cloud remote sensing. The LOA also has a strong expertise in aerosol modelling at the global scale and is using the LMDZ general circulation model with a representation

of the multi-component aerosol.

Critical mass: The LOA was strongly involved in the preparation, validation, and analysis of the Polarization and Directionality of the Earth's Reflectances (POLDER-I and II) and is in charge of the PARASOL mission that will be part of the A-Train. The institute is also involved in the development of aerosol and cloud retrieval schemes from other satellites, like MODIS. It collaborates with IPSL/SA on the CALIPSO mission The LOA participates in several projects funded by the EC (PHOENICS, DAEDALUS, CIRAMOSA). The LOA is responsible for maintaining, calibrating, and assuring the quality of the PHOTONS network of sunphotometers, in liaison with the CIMEL manufacturer of sunphotometers.

2- Institut de Recherche pour le Développement (IRD – FRANCE)

L'Institut de Recherche pour le Développement (IRD) is a public science and technology research institute under the joint authority of the French research and overseas development ministries. It conducts research in developing countries.

IRD staff includes 2089 employers, among them 767 researchers. IRD has a annual research income of 193 Millions euros. IRD has benefited yearly of about 1184 Keuros coming from European Commission fundings.

The three main areas covered by IRD research are Environmental Sciences, Living Resources, Social and Health Sciences. The mission of IRD is to improve our understanding of the processes governing the environment and the life of populations.

IRD has a long experience of carrying out field research in West Africa in partnership with local institutions, especially in hydrology, oceanography, agronomy and health sciences. There are almost a dozen young African scientists preparing their PhD in the six research units of IRD, already or potentially involved in AMMA. IRD scientists are carrying out both theoretical research on processes and research on the impacts of climate variability. IRD is associated with AGRHYMET (Niger) in a project funded by Canada, with the aim of improving the knowledge and the techniques for preparing adaptation strategies to climate and environmental changes.

A total of more than 15 scientists belonging to three units (HSM, LEGOS and LTHE) are currently involved in the long term observing period of AMMA, via their participation to the two “Observatoires de Recherche sur l’Environnement” : AMMA-CATCH (water cycle in West Africa) and PIRATA (lont term monitoring of the Tropical Atlantic), funded by the French Ministry of Research and IRD. An additional dozen scientists would participate to the Enhanced Observing Period, with an emphasis on a multi-scale understanding of the water cycle and its links to the climate variability. Twelve researchers and technicians are already permanently based in Benin, Mali and Niger to run the Ouémé and Niamey mesoscale sites, and an additional two will be posted in Mali to run the Gourma site. They work in association with a dozen scientists and technicians of national institutions from these three countries. This group of scientists is led by Thierry Lebel, former field coordinator of HAPEX-Sahel (1991-1993) an experiment funded by the EU Fourth Framework Program and devoted to the study of atmosphere-land surface interactions in semi-arid regions. He was associated with LMD in the EU Framework IV ‘West African Monsoon Project (WAMP)’, 1998-2000; and PI’s in several projects funded by various French national programs (Programme National de Recherche en Hydrologie, Programme National d’Etude de la Dynamique des Climats). He is a member of the CLIVAR-Africa panel and of the GEWEX Hydrometeorological panel and is currently an Associate Editor of the *Journal of hydrology*

3- University of Cologne (U. Koeln – GERMANY)

Area of Expertise The Institute of Geophysics and Meteorology (U.Koeln) of the University of Cologne has a long research record in the field of tropical and subtropical meteorology and climatology. Its major research foci have been: intraseasonal-to-decadal-scale variability of the tropical large-scale circulation, dynamics of synoptic and meso-scale weather systems – including their interaction with the large scale -, atmospheric branch of the hydrological cycle, and diagnosis of output from climate change GCM simulations. Since 2000 the U.Koeln is the coordinating organisation of the large, nationally-funded multidisciplinary research project IMPETUS (‘An Integrated Approach to the Efficient Management of Scarce Water Resources in West Africa”) that is planned to run until 2009. The joint project between the Universities of Bonn and Cologne aims at investigating all aspects of the hydrological cycle, including socio-economic, human, and medical aspects, in two river catchments in subtropical and tropical North Africa: the Wadi Drâa in Morocco and the river Ouémé in Benin. Within the framework of IMPETUS, the U.Koeln has acquired expertise in the installation, operation and maintenance of hydro-meteorological and upper-air observation networks in Africa.

Suitability: Several major scientific goals of AMMA will benefit from U.Koeln’s expertise on the synoptic-scale forcing of West African rainfall events and on the climatology of the West African climate zones. Data from the IMPETUS hydro meteorological network in the Upper Ouémé Valley

(Benin) will enhance the planned AMMA ground observations. U.Koeln’s experience in installing and operating ground and upper-air instruments under the difficult West African conditions will be utilized within the AMMA project. The co-operation between IMPETUS and IRD-CATCH, established in 1999, will facilitate the successful implementation of instruments in the Ouémé mesoscale site that are planned in the present proposal.

Critical mass: The PI, Prof. Dr. Speth, is chair of the multi-disciplinary IMPETUS project and has a demonstrated record in the diagnostics of large-scale meteorological processes, in various climate sub-systems, including the Tropics. The co-PI, Dr. Fink, is heading the meteorological working group of IMPETUS-Benin consisting of five scientist. In 2002, Dr. Fink was responsible for an upper-air radiosonde campaign at Parakou (Benin). Together with Dr. Christoph, he is in charge of the proper functioning of the hydro-meteorological network and the scientific exploitation of the data. Dr. Fink has worked in the field of tropical meteorology since 1991 and has recently published several papers on synoptic weather systems and their impact on major rainfall events in West Africa, as well as on the climate aspects of the West African monsoon

4- Deutsches Zentrum für Luft- und Raumfahrt (DLR – GERMANY)

Area of Expertise: DLR, the German Aerospace Centre, performs aerospace research and is responsible for management of the national space programme. DLR is funded by the Federal Ministry of Research and Education, the German Federal States, and by specific projects. DLR includes 25 research institutes in the fields of air and space research and operations, energy technology, trafic research, and runs large facilities like research aircraft, satellite data receiving stations, and others.

The DLR - Institut für Physik der Atmosphäre (DLR-IPA), Institute of Atmospheric Physics) in Oberpfaffenhofen near Munich performs research in atmospheric dynamics, atmospheric trace species, remote sensing, and cloud physics. Major topics of research addresses: atmospheric processes and trace species in the troposphere and stratosphere at regional and global scales, climate change, meteorology, and impact of weather on air traffic. DLR-PA develops simulation models for largescale, meso-scale, and micro-scale atmospheric dynamics and air chemistry, air-borne instruments for measurements of chemical species, aerosols and meteorological parameters, software tools for passive remote-sensing and processing of satellite data, and airborne Lidar instruments.

Suitability: DLR-PA has many years expertise in performing large field experiments using research aircraft, Radar, Lidar, airborne in situ chemical and aerosol instruments, and satellite observations. DLR-IPA also has many years experience in co-ordinating international research projects, e.g., the EU-projects AERONOX (Impact of NOx Emissions from Aircraft upon the Atmosphere at Flight Altitudes 8 - 15 km , 1992-94), POLINAT 1 and 2 (Pollution from Aircraft Emissions in the North Atlantic Flight Corridor, 1994-1996 and 1996-1998; EULINOX (European Lightning Nitrogen Oxides Experiment, 1998-2000), and INCA (Interhemispheric Differences in Cirrus Properties from Anthropogenic Emissions, 2000-2003).

Critical mass: Dr. Hartmut Höller has many years experience in the area of thunderstorm research using atmospheric models, cloud microphysical studies, and Doppler radar data. He acted as coordinator of national (LINOX) and international (EULINOX) field experiments on lightning Nox and trace gas redistribution by deep convection. Dr. Hans Schlager is head of the department “Atmospheric Trace Species” at DLR-PA since 1991. He has many years experience in research related to the distribution and chemistry of tropospheric and stratospheric trace gases, development of aircraft instrumentation, and field measurements using balloons, rockets, and aircraft. He coordinated various international aircraft campaigns and is member of the EC VINTERSOL Coordination Core Group. Dr. Andreas Petzold has strong experience in experimental aerosol research since 12 years. He is leading the experimental aerosol-related activities at IPA. He contributed significantly to the in situ characterisation of atmospheric aerosol, and the development of aerosol instrumentation. Dr. Oliver Reitebuch has extensive experience in airborne Lidar technology. He is the coordinatar of a major DLR project on the preparation of space-borne wind measurements using Lidar.

5- The University of Leeds (UNIVLEEDS - UK)

UNILEEDS is an international centre of excellence for research and teaching. It ranks among the top 10 research universities in the UK, with some 3,000 researchers and an annual research income in 2002 of more than £63 million, of which 9.5% is from EU awards. Under the Fifth Framework Programme, the University of Leeds was awarded 157 contracts to the total value of EUR32.5 million; 57 of these were co-ordinated by Leeds. The last national Research Assessment Exercise (RAE) in 2001 confirmed the University as a leading research institution, with 28 departments undertaking research of international quality. Leeds was the first university in the country to create a technology transfer company 30 years ago. In 1999 it set up a unique partnership with the investors "Forward Group" providing £20 million to help academics develop and commercialise ideas. The **Institute for Atmospheric Science** is an active and expanding research unit. From its inception in the early 1990's it is now one of the largest atmospheric research groups in the UK, with 56 members including 12 academic staff, and it was awarded a Grade 5 in the recent RAE. Atmospheric processes are investigated using numerical models and field and laboratory experiments, from the Earth's surface to the stratosphere. The **Department of Chemistry** is amongst the largest and most prestigious centres for chemistry research in Britain, ranked Grade 5 in the RAE. It attracts considerable outside research funding and has over 100 postgraduate students. Approximately 140 research papers are produced annually. The atmospheric chemistry group comprises 4 academic staff and ca. 25 postdoctoral fellows/postgraduate students, and spans laboratory kinetics / photochemistry, field measurements and chemical modelling.

Doug Parker is a Senior Lecturer in the Institute for Atmospheric Science. His research interests have been in the interaction of convection with synoptic weather systems. He is PI of the JET2000 project, which involved instrumented flights over West Africa, and its analysis phase. Other experience includes: Flight planning for FASTEX, January 1997; Partner in the EU Framework IV 'West African Monsoon Project (WAMP)', 1998-2000; PI of NERC-funded project, 'Orographic

triggering of land-based tropical convection'. He was awarded the L.F. Richardson Prize by the Royal Meteorological Society in 1999 and is currently an Associate Editor of the *Journal of the Atmospheric Sciences.*

Dwayne Heard is a Reader in Physical Chemistry. His research interests cover field measurements of short-lived free-radicals in the atmosphere, in particular OH and HO2, using laser-induced fluorescence at low pressure (FAGE), and laboratory studies of the reaction kinetics and photochemistry of important processes in the atmosphere. His group have participated in 9 field campaigns worldwide. He organised NAMBLEX at Mace Head in Ireland in 2002; a campaign involving over 50 scientists. His group have also developed a FAGE instrument to measure OH and

HO2 aboard the BAE-146 aircraft.

Mike Pilling is Director of NCAS/DIAC and Professor of Physical Chemistry. His interests centre around (i) laboratory measurement of rate coefficients and reaction channel yields for elementary reactions of atmospheric significance, (ii) construction, reduction and application of chemical mechanisms, notably of the master chemical mechanism (MCM) which describes tropospheric oxidation of a wide range of compounds, (iii) testing of chemical mechanisms using field experiments and experiments at the European Photochemical Reactor at Valencia and (iv) modelling of radical chemistry, using the MCM, in the analysis of field experiments.

6- Centre for Ecology and Hydrology (CEH – UK)

Area of Expertise: The Centre for Ecology and Hydrology (CEH) is a component institute of the UK Natural Environment Research Council (NERC). NERC is the UK's principal agency conducting research into the structures, processes and functioning of the Earth and the animals and plants that live on it. NERC's mission is to advance understanding of the natural environment and the processes of environmental change. In this spirit NERC supports basic and strategic science within universities and its own institutes, undertakes surveys and long-term observations, funds postgraduate training and provides advice to government and public agencies in the UK and in Europe. CEH is, with a staff of approximately 600 researchers, the UK government's primary research organization with responsibility for terrestrial and freshwater ecology and hydrological research. The science in CEH is organised in 5 science programmes, one of which is Climate Change. This programme combines long standing expertise both in the area of i) climate modelling and biogeochemical cycles; and ii) Earth observation and remote sensing. CEH is one of the founding partners of the NERC Earth Observation Centre of Excellence CLASSIC (Climate and LAnd-Surface Systems Interaction Centre). The Centre investigates land surface-atmosphere interactions using remote sensing and state-of-the-art climate and land surface models in a coordinated research programme.CEH Wallingford has considerable experience with running and improving climate models. Through a close collaboration with the Hadley Centre, through the Joint Centre for HydroMeteorological Research at Wallingford (JCMHR) CEH researchers work have made extensive use of the Met Office Unified Model to investigate climate impacts of land cover change (for example in the Sahel) and land/atmosphere interactions (for example in Amazonia). CEH have considerable experience in taking measurements of the fluxes ofheat, water and carbon in field campaigns throughout the world including the Sahel, Amazonia, boreal and tundra regions. These data have been used to test and improve the land surface model of the Met Office Unified Model for these biomes.CEH researchers have made substantial contributions to European research, notably leading the FP4 programmes: Climate and Land Degradation (CLD) and Land Arctic Physical Processes (LAPP), and contributing to FP5 programmes including Predictability and Variability of Monsoons and the Agricultural and Hydrological Impacts of Climate Change (PROMISE).

7- University of Copenhagen (UKBH.IGUC – DENMARK)

Area of Expertise: The Institute of Geography (IGUC) has more than 35 permanent scientists employed. These are dealing with physical and human geography covering the following aspects: remote sensing, GIS, climatology, hydrology, soil science, the marine environment, geomorphology, ecology, development and economic geography. A cross disciplinary group of approximately 10 scientists plus an equal number of PhD's and post-docs are working with remote sensing, ecology, environment, flows of energy and matter in the IGUC-LUCC Research Forum headed by Professor, Dr. Scient. Anette Reenberg. The group addresses pertinent issues of methodological as well as theoretical nature that all concern land use and land cover dynamics and their relation to human resource management, landscape structures, biogeochemical cycles and water resources management. The research projects address general aspects such as land use histories, hydrology and land use, vegetation dynamics and diversity in human influenced land use systems, socio-economic and biophysical function of agricultural systems, watershed management, and biogeochemical cycling in land use systems.

Suitability: Within AMMA IGUC contributes with expertise on human dimensions of climate change, natural resource management and remote sensing for studies of land use, the hydrological cycle and vegetation. IGUC has a long tradition for conducting research in West Africa and large field work experience in human and socio-economic science as well as with physical measurements of surface parameters in the region. Major research activities in Africa have been centred around the Centre de Suivi Ecologique (CSE), Dakar, Senegal, University in Ouagadougou, Burkina Faso and

University of Ghana, Legon. The collaboration with CSE has permitted the development of biomass and crop yield models and fire monitoring using NOAA AVHRR data. The INTEO research project (1997-2005), that has developed methods to derive parameters from remote sensed data to be used in fully distributed hydrological models, with specific focus on the Senegal River basin. The EOVS project which ended by the end of 2003 focused on modelling of vegetation productivity using new satellite sensors. The State of the Senegalese Environment project, aimed at identifying anomalies in vegetation development in time series of AVHRR data in order to support the implementation of the desertification and climate conventions in Senegal. IGUC was carrying out an EO-based subproject constituting part of the multidisciplinary program Fires in Tropical Ecosystems, using NOAA AVHRR and other satellite data for identification and monitoring of fires in Senegal, Burkina Faso, Ghana and Ethiopia. The 5 year Sahel-Sudan Environmental Research Initiative (SEREIN) anchored at the IGUC focused on the sustainable land use and natural resource management strategies in semiarid West Africa.

Critical mass of expertise: The contribution to AMMA by IGUC will be based on IGUC-LUCC team members. The contribution will be headed by Associate Professor Inge Sandholt, who is specialised in remote sensing and natural resource management with special focus on water and vegetation in Africa. She is Vice president for the International Association of Hydrologists commission of Remote Sensing, and the project coordinator of the multidisciplinary INTEO project. Other team members include Professor Anette Reenberg (agricultural geography, land use systems and human processes), Associate Professor Kjeld Rasmussen (agricultural systems, climate impact, remote sensing, modelling), Post Doc Rasmus Fensholt (remote sensing, vegetation, in situ observations), Associate Professor Thomas Theis Nielsen (remote sensing, vegetation trends, fires) and Msc Simon Stisen (hydrological modelling and remote sensing). The contribution will draw on the experience from other in the IGUC-LUCC research group as well.

8- Centre National de Recherches Météorologiques (CNRM/GAME – FRANCE)

Field of activity: Within Météo-France, the « National Centre for Meteorological Research (CNRM) is the department responsible for conducting the largest part of the meteorological research activities, and for coordinating research/development undertakings conducted within other departments.

Primarily oriented towards the needs of public utility in the domain of meteorology, the research actions encompass the atmosphere, extending to, and including, closely related fields and boundaries, such as stratospheric ozone chemistry, upper ocean, physics and dynamics of the snow cover, surface hydrology

Critical Mass of resources: To carry out its missions, CNRM hosts approximately 225 permanent positions (one-third being research scientists), and 45 students and visitors, working in specialized divisions:

the numerical weather prediction group « GMAP » (dynamics, physical parameterizations and data assimilation techniques) ;

the mesoscale group « GMME » (study and modelling of boundary layer processes, land-surface luxes, convection, clouds,...) ;

the climate group « GMGEC » (physical processes for climate, ozone, long-range forecasting,climate evolution, development and management of the atmospheric part of the French community climate model,...) ;

the experimental and instrumental group « GMEI » (development of new instrumentation systems, field experiments, water channel,...) ;

the snow centre « CEN » (study of snow mantle, techniques and methodologies associated with the forecasting of avalanches) ;

the meteorological airplanes centre « CAM » (two airplanes equipped with instruments for atmospheric research) ; the marine meteorology centre « CMM » (development and implementation of oceanic and meteorological buoys for the study of air-sea interactions) the knowledge transfer unit « RETIC » (aimed at facilitating the spreading of research results within operational departments of Météo-France.

Suitability: The research is conducted in close cooperation, at the national level with atmospheric laboratories from other institutions and agencies (Universities, National Centre for Scientific Research CNRS -of which CNRM is also the « GAME » joint laboratory-, ...) and, at the international level, with many different foreign research laboratories. This collaboration is realized through:

participation to multidisciplinary research programmes such as IGBP, WCRP, french national programmes...

organization of, and participation to, international and national large-scale field experiments (such as HAPEX-Sahel, BOREAS, PYREX, FASTEX, TOGA-COARE,.MAP,..)

participation to the management of heavy systems (atmospheric research aircrafts, massively parallel computer machines, ...).

CNRM also tightly cooperates with the European Center for Medium-Range Weather Forecasts ECMWF (joint undertakings such as the development of new-generation atmospheric numerical simulation models).

9- MEDIAS-France (MEDIAS-France – FRANCE)

The Medias-France structure was created in 1994 and consolidated in 2000 as a non-profit public organisation ("Groupement d'intérêt public" according to the French law). Its main objective is to bring together scientists, service providers and policy makers addressing global change issues, origins and impacts within the so-called international Medias network, whithin a sustainable development perspective, particularly in the African continent.

Medias-France brings formally together seven sponsoring institutes and companies: Cnes, CNRS, IRD, Meteo-France, University Paul-Sabatier, CLS, Spot-Image. The main disciplines addressed are: atmospheric chemistry, palaeoclimatology, meteorology and climate, biosphere and ecosystems, land cover and land use, hydrology, epidemiology, and remote sensing. The area of expertise of Médias-France, particularly for the Amma project, are offered along with four main guidelines:

Developing data and metadata bases is a key service activity (WP 4.4). This service allows helping scientists to archive data and information in standard formats and offers them a friendly access to interdisciplinary information.

Within the framework of the Postel project (development of a Thematic Centre on Land Surfaces to be part of the future European GMES service infrastructure), provision of biogeophysical products derived from space observations and characterising land surfaces at regional and global scales (WP 4.3).

Capacity building and outreach (WP 3.4 and WP 6.2): Medias-France most often acts by bringing a contribution of its own within existing frameworks, either projects, symposia, summer schools, training sessions, thematic workshops, …

Support to projects, most often in terms of administrative and technical co-ordination in the main disciplines listed above, including multidisciplinary aspects.

Medias-France has strong links with many institutions at all levels: national (ministries, scientificorganisations, industries); bilateral (environment and space agencies, laboratories and research centres or structures, service structures, industries); European (European Commission, Esa); regional (Acmad, Agrhymet, APN, OSS), global (IGBP, IHDP, WCRP, Diversitas, Lucc, Start).

Key persons:

Michel Hoepffner, Senior Scientist from IRD, Deputy Director of Medias-France, in Niger (West Africa) from 1974 to 1980 with IRD and Agrhymet, co-ordinator of the APD and Search EU/Inco-Dev projects, PI for the WP 6.2 (University programs and summer schools), strongly involved in the WP 4.4 (Database and historical data),

- Jean-Pierre Lacaux, Senior scientist from UPS, partner in the WP 3.4 (Public Health)
- Yves Tourre, Senior Scientist from Meteo-France, involved in the WPs 6.2 and 3.4, responsible for the Amma/Lannemezan summer school
- Marc Leroy, Senior Scientists from Cnes, deputy co-ordinator of the Geoland Integrated Project in the GMES European framework, involved in the WP 4.3 (Satellite remote sensing).
- Jean-Luc Boichard, Research Engineer from Meteo-France, head of the Database Team at Medias-France (software engineers from Cnes, CNRS, IRD), involved in the WP 4.4.

Some Medias achievements:

Databases for African (Expresso, Idaf, Format, African Pollen, Catch, etc.) and European projects (Fetch, Catch, Escompte, etc.),

- S2E projects in Senegal (Space Surveillance and Epidemiology),
- EU funded Cyclopes and Geoland project within the GMES framework,
- Niamey, Nairobi, Amma/Lannemezan Summer Schools,
- Geoss and AID-CCD projects in the UNCCD context, etc.

10- University of Burgundy (U. Bourgogne –FRANCE)

Area of Expertise: The Climate Research Centre (Centre de Recherche de Climatologie, CRC) is a CNRS unit at the Faculty of Science (~ 6 000 students) within the University of Burgundy (~25 000 students). CRC was founded in 1969 and has currently 10 permanent scientists, plus 12 PhD's and post-docs employed. These people are dealing with physical climatology and geography covering aspects in hydrology, land cover dynamics and impacts studies along with methodological / statistical developments. It is involved in several national and international research programs such as the PNEDC, ECCO-PNRH, PATOM and CORUS programs. It has been also successfully involved in 2 Work-packages of the EU /FP5 project "Predictability and Variability of Monsoons and the Agricultural and Hydrological Impacts of Climate Change" (PROMISE) It is also involved in French Master, DEA, PhD programs and also training in which French and African scientists are taught.

Suitability: CRC plays a leading role in climate variability studies and statistical rainfall prediction all over the African continent and especially in the AMMA region. It has close collaborations with lot of the CNRS research units and African laboratories involved in AMMA (mainly in Benin, Cameroon, Niger and Senegal). For the AMMA project, CRC investigates the water cycle in the monsoon system through atmosphere dynamics and land surface-atmosphere interactions using model simulations, outputs from the ERA40 and NCEP reanalyses, satellite estimates and in situ data. Recent results obtained by the team for the AMMA project, show that the seasonal cycle of

precipitation is characterized by a succession of surges/breaks at specific dates that can be related to recurrent atmospheric conditions. Moreover, the dates could be modified by the soil moisture conditions several months in advance.

Critical Mass: Dr. B. Fontaine has extensive experience in physical climatology and has been working at CRC since 1985 as a CNRS researcher; since 1993 he has been leading the CRC unit. S. Louvet is a PhD student working since 2002 on surges and breaks associated to meteorological situations and ITCZ displacements.

Dr. N. Philippon (CNRS researcher) is an acknowledged expert in seasonal rainfall forecasting and has been working at CRC since 1995. Dr. P. Roucou (Prof. Assoc) has extensive experience in climate data analysis and has been working

at CRC since 1994.

11- Université Paris 12 - Val de Marne (UP12 – FRANCE)

Area of Expertise: The Laboratoire Interuniversitaire des Système Atmosphérique (LISA) within University of Paris 12 Val de Marne (Créteil, France) is administrated both by the Centre National de la Recherche Scientifique and the two Universities Paris 7 and Paris 12. Its field of competence concerns the evolution of the terrestrial and planetary atmospheres. The methods used are based on field experiments (aircraft, land based stations, satellite, orbiters…) , laboratory works (photochemical smog chamber, spectroscopy properties, experimental simulations…) and modeling (chemical models, mineral dust emission model, chemical-transport models at continental scales).

The LISA group involved in air pollution and aerosols has long standing experience in measurements and modeling of short lifetime species. He has been involved in recent large scale experiments like Expresso (Impact on the atmospheric composition of the biomass burning emissions in West Africa) INDOEX (Indian Ocean Experiment) or ESCOMPTE (Study and Sensibility of Regional Air Pollution Model) operating various instruments dedicated to the measurements of aerosols chemical and optical properties and gaseous key species. The LISA group has also developed regional and continental chemical transport models in order to analyse and forecast air pollution events. These models are used both by various laboratories and operational administrations. The LISA group has a specific expertise on mineral dust emissions, both from experimental approaches (intensive field campaigns, long-term monitoring of aerosols, long-term monitoring of wind erosion, wind tunnel experiments, …) and from a modelling point of view. In particular, LISA has developed a physical emission model for desert dust. This model is used with success in most of the climate models dealing with the effects of dust on climate.

Suitability : The LISA brings to the AMMA-IP consortium expertise on tropospheric aerosol and in particular on mineral dust studies. LISA is involved in the investigation of the link between climatic conditions and the mineral dust cycle. In the framework of the AMMA project, LISA's contribution will concern the interactions between monsoon intensity and mineral dust emission and the impact of this dust on the regional climate.

Critical mass of expertise: LISA-UP12 will contribute to the field experiments in West Africa for the SOP and EOP period and to the modeling work. The experimental contribution will be led by Dr. Paola Formenti. She is internationally recognized for her work on aerosol optical properties, from ground-based and airborne platforms. She has participated to many international file campaigns such as ACE-2, LBA, INDOEX, SAFARI-2000, SHADE. Her involvement has conduced to various publications in international journals. The modeling contribution will be led by Dr. Béatrice Marticorena, Research Scientist of the CNRS. She is internationally recognized for her model of mineral dust emissions that has been implemented or adapted for many global and regional model of the mineral dust cycle. She is also recognized for her expertise on surface characterization from remote sensing observations. Her involvement has conduced to various publications in international journals. Stéphane Alfaro is a maître de conférences at University of Paris 12 in Créteil. His publications in international journal has gained him international recognition in his two fields of expertise: 1) experimental studies of wind erosion processes in the LISA wind-tunnel and on the field, followed by modeling of these processes, and 2) elemental, mineralogical, and optical characterization of pure and mixed mineral aerosols. He took part in several international campaigns(INDOEX, ACE-Asia, …). Annie Gaudichet is full professor at the University of Paris 12, Créteil. She is internationally recognized for her work on individual particle characterization by analytical/transmission electron microscopy. She has participated to many international file campaigns such as DECAFE, SAFARI-92, EXPRESSO, INDOEX, ACE-ASIA. Her involvement has conduced to various publications in international journals. Gilles Bergametti is Senior scientist of the CNRS. He has a large experience in aerosol studies both from experimental and modelling approaches. He has worked on volcanic emissions, air-sea exchange of particles and is involved from 15 years mainly in mineral dust studies. He is the leader of the atmospheric modelling group in LISA. He has published more than 50 papers in international journals. He was member of the European Community Science Panel on Atmospheric Composition Change and he is President of the French committee on Ocean/Atmosphere Sciences at INSU/CNRS (Institut National des Sciences de l'Univers).

12- Université Paul Sabatier (UPS – FRANCE)

Area of Expertise : The « Centre d'Etudes Spatiales de la Biosphère » (CESBIO) is within «Université Paul Sabatier Toulouse III » (UPS). This university groups together teaching and research activities concerning science, health, technology and sport, with a staff of about 3500 teachers, researchers, engineers, technical and administrative personnel, and 28000 students. CESBIO is, with six other laboratories within the « Observatoire Midi-Pyrénées », a federative structure in the field of astronomy, astrophysics, solid earth, oceanography, atmosphere, continental surfaces. The main scientific objective of CESBIO is to improve the understanding on the working and the dynamics of continental biosphere at various spatial and temporal scales. This laboratory conducts research into observation and numerical modelling of continental surfaces, collaborates to the definition of satellite programs and to the analysis of remote sensing data. These activities are at the interface between physical and biological sciences, and in close connexion with socio-economic activities. Scientific activities in CESBIO are organized around three major themes concerning the structural and functional description of the surface and their evolution from satellite remote sensing, the modelling of ecosystems working through the combined use of ecological and physical methods to study vegetation, carbon and water budgets, the modelling of the biospheric component of the continental hydrological cycle for watersheds of increasing sizes. Four dedicated projects als concern specific regions : « Midi-Pyrénées » in south-western France to document the structure and the evolution of a heterogeneous ensemble of ecosystems ; « Southern Mediterranean » to describe the working of hydro-ecological processes in a semi-arid environment and their influence on human activities ; « SIBERIA – II » to evaluate the carbon and greenhouse gases budgets in the boreal part of northern Eurasia ; « Circum-Sahara » to observe and understand the working and inter-annual variability of sahelian ecosystems and their impact on regional climate. **19** researchers, **20** engineers, technical and administrative personnel, and **25** graduate students and post-docs work in CESBIO.

Suitability: The CESBIO has built strong links with Malian research institutes such as the national

institute for Agronomic research (Institut d'Economie Rurale) and have links with several institutions and national services in meteorology and hydrology. Since 1999, the CESBIO has been conducting field campaigns in the rangelands of northern Mali in the Gourma region aimed at monitoring primary productivity. The CESBIO has the responsibility of the Malian Gourma meso-scale site and of the Hombori-Agoufou super-site which is instrumented since 2002. Vegetation sites are used for calibration of production models based on remote sensing data (VEGETATION , MODIS) and will be used to test soil moisture estimation from passive and active microwave sensors.

Critical mass : Dr. Eric Mougin, Dr. Laurent Kergoat and Dr. Patricia de Rosnay are Chargé deRecherche CNRS, Bernard Mougenot and Josiane Seghieri are Chargé de Recherche IRD, Valérie Le Dantec and Eric Ceschia are Maître de Conférences in UPS. Their research interests are in the field of terrestrial ecosystem dynamics based on satellite observations, field work and numerical modelling. They have been conducting research work in West Africa, mainly in Mali, for several years.

13- Centre de coopération Internationale en Recherche Agronomique pour le Développement (CIRAD – FRANCE)

Area of Expertise. The ECOTROP team has participated in the PROMISE project, contributing crop models and applications for the estimation of climate impact on crop water balance, growth and yield, including studies on scale effects and climate based decision criteria for crop management. The team, consisting of ecophysiologists, agronomists and agro-meteorologists, maintains close ties with partners in SS-Africa, such as Agrhymet (Rep. Niger), CERAAS / ISRA (Senegal), ICRISAT / IER (Mali) and WARDA (Senegal and Ivory Coast). ECOTROP's modelling platform SARRAH is well suited for agricultural impact studies at various scales. The ECOPOL team has a recognized track record in agricultural policy analysis, particularly with respect to environmental impacts and pollution and carbon budgets. GEOTROP has also participated in PROMISE an dis experienced in evaluating land use and ground cover from satellite images.

Suitability. ECOTROP , ECOPOL and GEOTROP will focus on research on agricultural,

environmental and economic impact of climate variability and change. The teams dispose of suitable research tools such as models that will be adapted in the process. Proposed sub-contracting of CERAAS in Senegal, a CORAF based laboratory for research on drought adaptations, is justified by its excellent access to experimental fields and intimate knowledge of local cropping systems.

Critical mass. Each of the three research teams has 15-20 scientists. Key scientists are Michael Dingkuhn (crop physiologist and modeller), Christian Baron (crop and water balance modeller), Christian Feau (remote sensing and GIS), Bruno Barbier (policy economics). Michael Dingkuhn and the ECOTROP team have an internationally recognized track record in ecophysiology and crop modelling research.

14- University of Bremen (UB – GERMANY)

Area of expertise: The Institute of Environmental Physics and Remote Sensing within the Faculty of Physics of the University of Bremen (IUP/IFE-UB) was founded in 1992 and has three departments: Physics and Chemistry of the Atmosphere (PCA), Earth Remote Sensing (ERS) and Tracer Oceanography. Institute leader Prof. Dr. J. P. Burrows is Lead Scientist of the Global Ozone

Monitoring Experiment GOME and Principal Investigator of the SCIAMACHY satellite project and proposer of the GeoSCIA initiative. Professor Burrows has published over 250 (over 150 peer reviewed) manuscripts in atmospheric physics and chemistry, physical chemistry, photochemistry and radiative transfer.

Suitability: The institute with currently about 100 members has been successfully involved in a number of EU projects (SESAME, SCUVS1-3, PRICE, PRIME, THESEO-BROMINE, COSE, GODIVA, THESEO-2000-EUROSOLVE, FORMAT, RETRO, QUILT). Parallel to the satellite studies, an important number of ground-based and air-borne remote-sensing experiments are carried out by

IUP/IFE-UB scientists, using microwave, infrared and UV-visible spectroscopic techniques. Professor J.P. Burrows developed the first calibrated PERCA (Peroxy Radical Chemical Amplifier) instrument for the measurement of peroxy radicals whilst at the Max Planck Institute for Chemistry in Mainz. Since then the Bremen PERCA has been continually modified and optimised on the basis of experience gained during several field measurement campaigns and laboratory studies.

Critical Mass: Dr. M.D. Andrés Hernández has extensive experience in tropospheric chemistry. She has been working at the IUP-UB since 1995 and participated in PRICE II in 1996, in BROK during1995-1997 and in INDOEX and PRIME in 1999. Since 1997 has been leading the research group responsible for tropospheric chemistry at the IUP-UB.

Dr. Andreas Richter is leader of the Differential Optical Absorption Spectroscopy (DOAS) Research Group at the IUP-UB. He is an acknowledged expert in the analysis and interpretation of Remote Sensing observations.

15- Forschungszentrum Karlsruhe (FZK – GERMANY)

Forschungszentrum Karlsruhe GmbH is an independent science and research institution in Germany with a staff of about 3500 employees. In the area of technology and the environment, the Centre devotes its attention to research and development work in the interest of the public. It is owned by the Federal Republic of Germany and the Land Baden-Württemberg and a member of the Helmholtz

Association of National Research Centres.

The Institute for Meteorology and Climate Research (IMK) with its four divisions has significantly contributed to atmospheric and climate research on the national and European level. Its major fields of research are transport processes and variability of atmospheric trace constituents, atmospheric chemistry, and biosphere-atmosphere interactions, by development and application of atmospheric models as well as field and aerosol chamber measurements. Contributions to AMMA will be provided by the IMK divisions “Tropospheric Research (IMK-TRO)”, headed by Prof. Ch. Kottmeier and “Atmospheric Environmental Research (IMK-IFU)”, headed by Prof. W. Seiler.

The IMK-TRO has dedicated expertise in tropospheric research covering problems of turbulent transport, dynamics and energetics as well as air pollution. It is complemented by long-term experience in remote sensing using operational satellites and surface-based remote sensing. The research strategy comprises the development and application of numerical models, forced and validated by data from extensive field experiments. The institute played a leading role in several large research projects on the national and European level In AMMA the experimental working groups “Land surfaces and Planetary Boundary Layer” and “Convective Systems as well as the modeling working groups “Aerosols and Climate Processes” and “Climate and Water Cycle” are involved. The Institute for Meteorology and Climate Research (IMK-IFU) investigates the impact of man’s activities on the atmosphere, hydrosphere, biosphere and climate, particularly in climate sensitive regions. It is involved in numerous international, European, and national research programmes. It is additionally involved in training programs in which scientist of developing countries are taught mesoscale meteorological and air-quality modelling. Currently, IMK-IFU is responsible for regional climate modelling and hydrological modelling of the Volta Basin in West Africa within the national funded GLOWA-Volta project. Within the framework of the recently established network between the Helmholtz-Association and German universities, additionally a virtual institute is build up in cooperation with the Centre for Development Research (ZEF), Bonn University. Within this framework, IMK-IFU will set up a test site in Dano (Burkina Faso) and perform measurements on C/N/H2O dynamics and BVOC emissions. IMK-IFU leads the workpackage 2.3 “Physical and hydrological processes over land surfaces”.

16- Universität Kiel (CAU – GERMANY)

Area of Expertise: The Leibnitz-Institute of Marine Research (IfM) at the University of Kiel has a long record in investigating the ocean's role in climate. In particular, the institute has a lot of experience in studying large-scale air-sea interactions both by taking and analysing observations and by conducting numerical modelling.

Suitability: Fields of experise relevant to AMMA are ocean measurements and their analysis, and the interpretation of atmospheric variations using these measurements. Furthermore, the institute has a lot of experience in global modelling, which is one key element of AMMA.

Critical Mass: PI Prof. Dr. Mojib Latif is an expert in the fields of climate variability and predictability, climate modelling, and large-scale air-sea interactions. He has published about 90 scientific papers. He received the Sverdrup Gold Medal of the American Meteorological Society (AMS) for his contributions in the field of air-sea interactions and was elected as a "Fellow" of the AMS.

17- LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN (LMU-MUENCHEN GERMANY)

Area of Excellence: Remote sensing, mesoscale modeling, dynamics of tropical cyclones and heat-lows. The remote sensing group operates several ground-based remote sensing instruments (two mobile lidar systems, several sky and sun photometers, microwave radiometers), develops corresponding retrieval methods and significant parts of the hardware. Research ranging from the theory of radiative transfer to experimental work with "state-of-the-art" systems especially designed for the remote sensing of aerosols and clouds. The group was involved in the EU-programme EARLINET for the establishing of a European aerosol climatology where it was responsible for the quality assurance of several lidar systems in Italy, Slovenia and Greece. In the German Priority Program on "Quantitative Precipitation Forecasting" the group combines diverse remote sensing observations from the ground and from satellite to evaluate and improve the representation of clouds and precipitation in atmospheric models. Projects of the group are funded externally by e.g. the German Research Foundation (DFG), EU, EUMETSAT, ESA, and the State of Bavaria. The tropical cyclone research group, headed by Roger Smith and funded largely by the United States Office of Naval Research, is one of the leading groups in this area worldwide. A further area of expertise is the dynamics of heat lows.

Suitability: The lidar and microwave activities are based on a long tradition of international experiments, some in very tough environments. This experience will be brought into new cooperations with British and French groups (e.g., Universities of East Anglia, Manchester, and LISA). Analysis of the boundary layer proceses on the basis of remote sensing methods will benefit from ongoing model evaluation activities. A new collaboration will be developed with the University of Leeds, University of Karlsruhe and the Forschungszentrum Karlsruhe to study heat-low dynamics.

Critical mass of expertise: Prof. Dr. Susanne Crewell has strong expertise in the organization of field experiments, for example she co-ordinated the EU-project CLIWA-NET where the prototype of a European cloud monitoring network was set up. The lidar contribution will be led by Dr. Matthias Wiegner, senior scientist and lecturer. His expertise is in active and passive remote sensing with special focus on lidar remote sensing, where he is internationally recognised. His group was involved in several international lidar experiments (e.g., ACE-2, LACE, EARLINET) and concept studies for spaceborne lidar systems. The key personnel of the group include Dr. Volker Freudenthaler (hardware development), Dr. Birgit Heese (airborne experiments), Dr. Ulrich Löhnert (sensor synergy) and Dr. Nicole van Lipzig (model evaluation). Prof. Roger Smith is internationally recognised for his work on tropical cyclones and heat-low dynamics. Dr. Wolfgang Ulrich will contribute numerical modelling expertise to the project.

18- Rheinische Friedrich-Wilhelms-Universität Bonn (Uni Bonn – GERMANY)

Area of Expertise: The Meteorological Institute of the Rheinische Friedrich-Wilhelms Universität Bonn (MIUB) covers a wide spectrum of research topics from boundary-layer meteorology, mesoscale modeling, polar and tropical research, analysis of measured and modelled climate data, to remote sensing from the surface (including radar meteorology) and satellites. The group headed by Prof. Clemens Simmer concentrates on remote sensing of meteorological parameters (temperature, humidity, cloud liquid water and precipitation) and their use for validation of and assimilation in mesoscale models (e.g. the Lokal-Modell of the German Weather Service). The group operates several ground-based remote sensing instruments (laser ceilometer, infrared radiometer, passive microwave radiometers, X-Band radar, micro rain radar) and develops retrieval methods using a synergetic sensor approach. Recently, in the framework of water resource management projects and hydrology related projects more weight was put onto satellite remote sensing of soil moisture and rainfall. The group is funded externally by the EU, ESA, EUMETSAT, German Research Foundation (DFG) by individual projects and a Graduierten-Kolleg, Deutsche Bundesstiftung Umwelt, the German Weather Service (DWD), and several minor contributions from work done for industrial partners.

Suitability: UniBonn is participating in IMPETUS – a project in the German Global Change in the Hydrological Cycle program. Here the group is responsible for the development of a rainfall monitoring system from space for Northwest Africa and modelling studies using the Lokal-Modell. The group has strong expertise in the organisation of field experiments, e.g. the institute was the prime co-ordinator of the EU-project CLIWA-NET which leaded to the setup of the prototype of a European cloud monitoring network.

Critical mass: Overall coordination of the Uni Bonn contributions will be done by Prof. Dr. Clemens Simmer who has been one of the initiators of the IMPETUS project. Dr. Ralf Lindau has been working on satellite remote sensing since more than 15 years. He was a member of WCRP's working group on air-sea fluxes. In the framework of BALTEX he uses remote sensing data for model evaluation. Malte Diederich is working within IMPETUS on the rainfall monitoring system and has also a strong background in radar remotes sensing and the performance of field campaigns. Additionally, technical personal is available to support field measurements.

19- University of East Anglia (UEA – UK)

Area of Expertise: The Trace Gas Laboratory (TGL) is a well-established research group within the newly-formed Laboratory for Global Marine and Atmospheric Chemistry within the School of Environmental Sciences (ENV). ENV is graded as double 5* for research, the highest mark possible. It was founded on the principle of the interdisciplinary study of the environment and carries out research in the following areas: atmospheric and oceanographic science, climate research, earth sciences, ecology, social science. The TGL is involved in gas phase atmospheric chemistry studies in the global troposphere and stratosphere, including the behaviour of oxidants, radicals, reactive nitrogen, hydrocarbons, halocarbons, and alkyl nitrates.

Suitability: The TGL brings to the AMMA-IP consortium expertise in the implementation of major airborne studies of gas phase chemistry, involving the planning and direction of flights, including coordination of multiple aircraft, the development of instruments for use on aircraft, such as the No*xy* and instruments to measure peroxides, formaldehyde and peroxy radical, post-flight GC-MS analysis of whole air samples, and the interpretation of airborne data. Past experience comes from work on the UK Met Office C-130 through participation in EU (OCTA, TACIA, and MAXOX) and NERC (ACSOE, ACTO, EXPORT) projects, taking the lead in 3 of them.

We are currently involved in a major international multi-aircraft experiment ICARTT investigating intercontinental transport of pollution along with other partners in the International AMMA (both European and American), and a UK project examining tropospheric organic chemistry.

Critical Mass: Dr Claire Reeves is a Post Doctoral Researcher Associate (PDRA) in the NERC Centre for Atmospheric Science (NCAS) Distributed Institute for Atmospheric Composition (DIAC). She is currently a member of the Facility for Airborne Atmospheric Measurements (FAAM) Operations Committee, the ESF Scientific Advisory Committee for Environmental and Geo-sciences Airborne Research, the IGAC Intercontinental Transport and Chemical Transformation Steering Group, the NERC Peer Review College and UK Stratospheric Ozone Review Group. Dr. David

Oram has 16 years experience measuring halocarbons by GC/MS and is currently a NERC DIAC PDRA examining VOCs using PTR-MS. Dr Graham Mills has worked at UEA since 1996 measuring formaldehyde, ozone and carbon monoxide and developing an automatic instrument for measurement of PAN and has considerable experience working on the C-130 aircraft making measurements of formaldehyde. Brian Bandy is a senior research associate responsible for the aircraft peroxide instrument and also has considerable experience in running other instruments through his role as the UFAM Weyborne Atmospheric Observatory Manager. Dr. David Stewart joined the TGL in July of 2003 and has been trained in the operation of the NOxy instrument.

20- The University of Liverpool (UNILIV – UK)

Area of Expertise **:**The University founded in 1881 received its Royal Charter in 1903 and is a leading research university associated with eight Nobel Laureates. The University has six faculties with 54 departments and schools with an annual income of almost £180 million; research grant and contract awards £63 million with an additional £14.6 million from the Science Research Investment Fund (SRIF) to support research infrastructure in the new Biosciences Centre, the Magnetic Resonance and Image Analysis Research Centre, and the installation of computer hardware to take advantage of the opportunities around the e-Science GRID initiative.

Suitability: The Department of Geography in collaboration with the Liverpool School of Tropical Medicine were the co-ordinators of the application modelling partners in EU FP5 DEMETER ensemble seasonal forecasting project running an integrated malaria model. Department recent grants include 'impacts of HIV and AIDS on the school population in parts of Africa' (UK Department for International Development, ~136kEu), 'social structural issues relating to rapid climate change' (UK Economic and Social Research Council, ~62kEu).

Critical Mass: Dr. Morse has 18 years research experience in experimental atmospheric physics and in the application of data sets for health impacts, since 1996 an investigator on projects totalling

1MEu. Dr. Morse works on the applications of model forecasts from ensemble prediction systems for health application models. On EU FP6 15MEu ENSEMBLES IP he is part of the project management and leads two work packages on seasonal to decadal impacts of climate variability. He leads funded projects that utilise the University of Liverpool 940 node GRID cluster. A small proportion of the Liverpool budget may be subcontracted to the Liverpool School of Tropical Medicine

21- University of York (UYO – UK)

Area of expertise: The University of York is ranked one of the United Kingdoms top seven universities for teaching and research, and is a major centre for studies in environmental and atmospheric sciences. An active atmospheric chemistry research group is located within the Department of Chemistry (a grade 5 rated research department) specializing in the study of emissions and atmospheric chemistry of volatile organic compounds (VOCs). To enable this research the University has developed an extensive analytical capability to undertake both field and laboratory experiments and receives core funding from the U.K NERC Centres for Atmospheric Science. Other areas of related research include petrochemical and combustion emissions, ocean-atmosphere chemical exchange and biogenic emissions processes.

Suitability: The research group at York brings to the AMMA consortium significant experience in the measurement and interpretation of volatile organic compounds in the atmosphere related mostly closely to objectives within wp 2.4.2 and 2.4.5. The research group has access to unique instrumentation for complex mixture analysis and has pioneered the development of new measurement methods for semi volatile organic compounds in the atmosphere. Lewis is currently the Principle Investigator of two £1M+ UK community experiments studying the tropospheric chemistry of VOCs and the long-range transport of ozone precursors. The PI has also participated in both national and international atmospheric experiments notably through the international framework of IGAC and has significant experience of EU collaboration working as part of projects such as FIELDVOC, AEROBIC, and EXACT.

Critical mass: Alastair Lewis is a Reader in Atmospheric Chemistry, at the University of York, with research expertise in both the atmospheric chemistry of organic compounds and their analytical and measurement science. Atmospheric chemistry research within the Department of Chemistry comprises two faculty staff, 6 postdoctoral researchers and 10 PhD students. The research group receives long-term funding from the UK NERC for two positions directly relevant to this project: Dr Jim Hopkins is an Experimental Officer within the Department of Chemistry with expertise in field

measurements of organic compounds and is responsible for aspects of UK VOC measurement standardization, validation and quality control. Dr James Lee is a NERC Centre for Atmospheric Science (NCAS) Distributed Institute for Atmospheric Composition (DIAC) Research Fellow with expertise in tropospheric radical chemistry, ozone photochemistry and observational atmospheric chemistry data interpretation.

22- University Of Leicester (ULEIC – UK)

Area of expertise: The University of Leicester was formed as a University College in 1919, receiving Royal assent to become a full university in 1957. It is a medium sized university with 8-9,000 full time students spread across six broad-based faculties. The atmospheric chemistry research group (ACRG) at the University of Leicester is based in the Department of Chemistry. It is part of an interdisciplinary Earth Observation Science Initiative. The group has extensive experience in atmospheric measurements and modelling from a number of different platforms including groundbased experiments, aircraft and satellites in national and international experiments. Research interests are based around the broad issues of the role of photochemistry in the control of atmospheric composition. The group has co-ordinated the FPV TROTREP project and has been active in a number of national and international science programmes including the UK-NERC Polluted troposphere, EUROTRAC-2 EXPORT, TOR-2 and TROPOSAT programmes and FPVI ACCENT.

Suitability: Key scientific questions will be addressed using the aircraft and ground-based data such as what is the role of long-range transport into and out of the monsoon system in terms of its impact

on chemical composition (2.4.5), the impact of biogenics on the peroxy radical budget (2.4.2), investigation the concept of chemical lifetime and transport with respect to the persistence of photochemical pollution (2.4.2) and assess the impact of transport vs. *in-situ* lifetime in maintaining the O3 balance (2.4.5). In order to fulfil this, the University of Leicester team will draw upon its technical expertise and knowledge in the measurement of peroxy radicals. These measurements will be coupled to fixed bandwidth airborne radiometric measurements developed at Leicester for the determination of photolysis frequencies.

Critical mass: Paul Monks is a Reader in atmospheric chemistry in the Department of Chemistry, University of Leicester with research experience in the broad areas of tropospheric oxidation chemistry, stratospheric chemistry, atmospheric composition and photochemistry. The ACRGconsists of 10 people working on a range of science from the interpretation of satellite measurements to the measurement of tropospheric composition from the ground and aircraft based platforms. The group will provide full support for the ULEIC ACRG AMMA activities.

23- University of Manchester Institute of Science and Technology (UMIST.-UK)

Area Of Expertise : UMIST is an educational establishment with origins dating back to 1824, and is one of the outstanding universities in the UK for courses in Science, in Engineering and Management. It is a research based university with a large programme of research in environmental science conducted in several departments. The Atmospheric Physics Research Group within the Physics Department has a long history of research, largely concentrated on the physical and chemical properties of clouds and radiative transfer processes. Current research projects include the radiative transfer processes in cloud and clear air, UV radiation studies, pollution transport and evolution, physics of precipitation, cloud-aerosol interactions, aerosol physical and chemical processing, aerosol measurement, and atmospheric electrification. The group includes 8 academic staff and appropriate support and technical staff. The group uses a variety of techniques and facilities: the research includes experimental work in the laboratory, observational studies at the group's two field stations or making use of extensive mobile facilities, observational studies using the C130 aircraft of the Meteorological Research Flight, the new UK BAe 146 FAAM aircraft or the group's own instrumented Cessna aircraft. Several members of the group have actively participated in a number of large scale international and European experiments.

The group have a 10 year track record of developing aerosol instrumentation. This includes measurements using aerosol mass spectrometers and hygroscopicity instruments. The group have recently installed an Aerodyne AMS on the UK BAe 146 and are testing it in combination with a low turbulence inlet.

Critical Mass: Dr. Hugh Coe BSc., PhD. is currently a Senior Lecturer in the Physics Department at UMIST. He has over 8 years experience of aerosol measurement and is currently UMIST PI in the

HIBISCUS and SCOUT projects. He chairs the EUFAR expert working group for aerosol chemistry and is a member of the aircraft operations committee of the UK FAAM aircraft. He has published 26 peer reviewed publications in the last 5 years and leads a group of 5 postgraduate researchers and 4 PhD students. He is the associate editor of the Quarterly Journal of the Royal Meteorological Society

24- Masters and Scholars of the University of Cambridge (UCAM-DCHEM – UK)

One of the premier atmospheric chemistry groups in the UK with extensive expertise in modelling and field campaigns. We are coordinating the EU SCOUT programme which will contribute to AMMA. We are also the UK NCAS funded Atmospheric Modelling Support Unit carrying out research in global modelling of tropospheric and stratospheric chemistry and processes. Our modelling results have been used in international research programmes and assessments, including the 1998 and 2002 WMO/UNEP ozone assessment and recent EU assessments.

25- Institute of Atmospheric Sciences and Climate (ISAC-CNR – Italy)

General Description and areas of Expertise: The Institute of Atmospheric Sciences and Climate of the National Research Council (ISAC-CNR) is established to carry on activities of research, promotion and technology transfer in the Meteorology and its applications, Climate change and predictability, Atmospheric structure and composition, Observations of the planet Earth. The Institute is organized in four divisions and a technical service structure. The institute develops atmospheric numerical modelling, ground based and space borne sensor, field campaigns, and laboratory activity support studies on a wide variety of atmospheric science issues from the climate scale down to cloud microphysics. The institute employs 140 staff members, and a comparable number of postdoctoral researchers, students, and fellows. CNR-ISAC has a high fraction of women involved in research as PhD, post-docs and young scientist (45 %). CNR-ISAC has a close link with Universities (Ferrara, Bologna, Torino, L'Aquila, Roma) in degree teaching and PhD training. The Institute participated to several European and international projects focusing the tropical atmosphere and is actively involved in the new VI FP projects. The CNR-ISAC areas of excellence involved in the AMMA proposal are mesoscale modelling, convection studies, climate variability, satellite and lidar remote sensing, aerosol and chemistry transport studies, precipitation.

Suitability: The ISAC-CNR contribution is in collaboration with key partners based on the previous experience on many EU funded and international projects. Through the AMMA-IP, new collaborations are foreseen on modelling and observation analysis (e.g. LISA, IRD). The collaborations with the US tropical convection community will support the link between EU and US efforts in the AMMA project. The lidar activities are based on a long record of international field campaigns and long-term measurements in polar and tropical regions.

Critical mass: The research groups involved in this proposal have a wide experience in studies of the tropical upper troposphere-lower stratosphere (EU projects APE-THESEO, HIBISCUS, TROCCINOX, SCOUT), convection studies and climate variability (PROMISE, ENSEMBLES),

precipitation estimate (EURAINSAT, MUSIC, CARPE-DIEM), mesoscale modelling (MAP, COMPARE) and the quality of the work carried out in such projects is proved by the quality of the publication record. The involved scientists have also a wide experience in PhD and post-doc supervising. Three research teams from ISAC-CNR will contribute to the AMMA project. The modelling group is led by Dr. Andrea Buzzi. He is internationally recognised for its work in atmospheric dynamics and he has a wide experience in steering and coordinating international projects. The modelling contribution to AMMA involves Dr. Piero Malguzzi (Tropical mesoscale

modelling), Dr. Susanna Corti (Climate variability) and Dr. Maurizio Fantini (Convectiv Processes). The aerosol and chemistry studies are based on in-situ aerosol observations by lidar, led by Dr. Francesco Cairo and aerosol-chemistry transport modelling, led by Dr. Federico Fierli. The group is involved in several key projects for the study of the tropical UTLS region and has a wide experience in lidar design and operation during polar and tropical field campaigns. Other personnel involved are Dr. Marcel Snels (Lidar scientific supervision) and Mr. Maurizio Viterbini (Technical support). The precipitation group is led by Dr. Vincenzo Levizzani; his activities in satellite meteorology with particular regard to deep convection and precipitation formation processes are carried out in several international projects. The key personnel include Dr. Francesca Torricella (Precipitation estimate)

26- Enea per le Nuove Tecnologie, l'Energia e l'Ambiente (ENEA – ITALY)

Area of expertise: ENEA is the Italian government agency responsible for the areas of new technology, energy and the environment. Its two fundamental tasks are to conduct research in these areas and to diffuse the results nationally.

ENEA's activities involve:

- research, development and testing of innovative technologies and equipment, and transfer of innovations to industry and agriculture;- development of technologies, equipment and components designed to exploit renewable energy sources and to save energy, and stimulation of demand for them; design, construction and testing of demonstration plants;
- research and testing of innovative nuclear reactors possessing greater inherent or passive safety; dismantling of fuel cycle systems in earlier generation nuclear power plants;
- environmental surveying and monitoring; research and assessment of the impact of productive activities on the human and natural environments; development of advanced technologies and
- new products with low environmental impact;

The Agency, which has a staff of around 3000, is present throughout Italy, operating nine major Research Centres and a number of smaller facilities. ENEA has a special project devoted to Global Climate research and divided in observing, modeling and impact groups with a staff of about 100 employees. This special project combines long standing expertise both in the area of oceanic and atmospheric modelling (regional and global) and Earth observation and remote sensing .

Its major fields of research are Mediterranean circulation, the Mediterranean hydrological cycle and related teleconnections, atmospheric low frequency variability, regional atmospheric radiative budget, satellite analysis of air-sea interaction, aerosols measurments and paleoclimate measurements.These groups have been successfully involved in a number of EU projects (TEMPO, MERMAIDS, Clivamp, MTP II-MATER, TRACMASS) and ESA project (AO-Earth2 Study of relation between surface signature and 3-D dynamical structure of Mediterranean sea; AO-Envisat Use of ocean color data to study the relation between mesoscale dynamics and ocean productivity of the Mediterraneansea).

Suitability: Contributions to AMMA will be provided by the modeling, satellite and measurements groups. The modelling group will be envolved in to establish the key SST anomaly patterns and the key ocean basins that influence the WAM rainfall on seasonal to decadal time scales. The satellite group will provide ad hoc gridded SST data for modelling and analysis. While the measurements group will assist the lidar network development and deployment and will contribute to the analyis of gathered data.

Critical mass: Dr. Salvatore Marullo has 20 years experience in satellite data management and analysis, air-sea interaction. Dr. Guido Didonfrancesco has a good skill in lidar network and lidar data analysis. Dr. Vincenzo Artale, Dr. Paolo M Ruti, Dr Annarita Mariotti have strong experience in climate modelling at regional and global scale, climate downscaling and teleconnection analysis.

27- Intitute of Biometeorology - National Research Council (IBIMET – ITALY)

Area of Expertise: The Institute of Biometeorology (IBIMET) of the National Research Council (CNR), Italy, is engaged in a wide spectrum of research activities in basic and applied meteorology, climatology, ecosystem analysis, socio-economic development in agriculture and forestry at different scales and over several distinct geographical areas. West Africa is a special study area, in which IBIMET is involved both by means of national and international co-operation projects, technology transfer, training programmes and basic research. In particular, since the eighties, IBIMET has been operating in West Africa on issues regarding agro-meteorology (WMO Pilot projects), food security (CLIMAG WA/EU; PRESAO/CILSS), early warning systems (AP3A/WMO/AGRHYMET; Sahel Resources/Italy) and analysis of vulnerability to combat desertification (DISMED/UNCCD), evaluation and monitoring of natural resources and land reclamation assessment (PDRADM/FAO; PEICRE/Italian Cooperation; PAFAGE/Italian Cooperation). In the field of atmospheric dynamics and climate and its variability the Institute is collaborating with several national Institutions and Universities (Project on Extreme events in the Mediterranean / ASI ; Antarctic Project/Italy ; CLIMAGRI/Italy ; Arno river basin authority) and with Universities in North America (NSF Projects / Colorado State University / Duke University). In the domain of EWS IBIMET is partner of WFP, FEWS, FAO, WMO and CILSS for the creation of a shared system of vulnerability analysis for Sahel.

IBIMET is also a recognized Regional Meteorological Training Centre of WMO for the VI Region and organize each year a training course for developing countries.

Suitability: IBIMET bring to AMMA IP the expertise developed during past and ongoing activities on basic research in atmospheric dynamics and climate, development of a short term to seasonal regional monsoon forecasting system, analysis of teleconnections of the West Africa monsoon to the Mediterranean summer climate, development of Early Warning Systems (EWSs) for the timely prediction of food shortages in the Sahel area (CILSS Countries), the monitoring and assessment of environmental and socio-economic vulnerability in the West African countries

Critical mass: **Andrea di Vecchia** is responsible of cooperation activities at IBIMET CNR with a wide experience of coordinator of research and cooperation projects in west Africa for Italian Cooperation, WMO, FAO, WB, in the field of remote sensing, EWS and natural ressources assessment. Other key scientists are **Gianni Dalu**, **Marina Baldi** and **Francesco Meneguzzo** for the climatological aspects and **Patrizio Vignaroli** and **Lorenzo Genesio** for impact assessments and EWS

28- UNIVERSITA' DI PERUGIA (UNIPG – ITALY)

Area of Expertise: University of Perugia has a specific link to the African and third world countries. Specifically, there are strong links with the international centre WARREDC (Water ressourcesResearch and Documentation Centre), established in 1985 (http://www.unipg.it/h2o/warredoc.htm). WARREDOC carries out didactic, research, organizational and documentation activities in the sphere of water resources, environment and natural disasters management, with particular regard to such problems in the third world. Towards these goals WARREDOC collaborates with the General Directorate for Co-operation and Development of the Italian Ministry of Foreign Affairs, the National Research Council – in particular with the Group for the Prevention of Hydrogeological Disasters (GNDCI) – as well as with foreign universities and research institutions. It also maintains contacts with relevant United Nations institutions like UNESCO, WMO, FAO, and others. The activities of the Centre are directed at achieving an appropriate level of synthesis, both scientifically and professionally, from a multidisciplinary perspective of characterising water resources and environment management as a science. The objectives and tasks of WARREDOC are based on the following guidelines: organisation of advanced courses and graduate programmes, conferences and seminars; formulation and organisation of research programmes in collaboration with scientific institutions, both national and international collection, analysis and dissemination of information related to water resources in developing countries and also environmental issues like hydrogeological disaster prevention and management. Due to the 1997 earthquake in central Italy, activity of the Centre decreased until the dormitory was completely restored in 2002. Dr. B. Cerlini has always beenparticipating to the activity of WARREDOC.

During the 2003 IUGG (International Union of Geodesy and Geophysics) General Assembly the Univ. of Perugia was selected as the site of the 2007 IUGG General Assembly. It is a huge event with more than 5000 participants from all over the world. The University of Perugia has many international contacts and is very active and interested in presenting projects involving foreign Universities and Institutions. University of Perugia has 45 research projects already approved in the Fifth Framework Programme (with 7 where we are coordinators) and for the current session 8 projects (not considering AMMA) are under consideration by competent European Authorities in the Sixth Framework Programme.

Key persons: The University of Perugia has then a core of a research team people involved with this research: two faculty professors (Prof. Paolo Diodati and Prof. Giancarlo Mantovani) and Dr. Paolina Bongioannini Cerlini as key scientist. The level of research carried out both in theoretical and experimental fields of Physics in Perugia can help Dr. B. Cerlini to deepen the understanding of processes such as what are studied inside AMMA taking advantage of collaboration with researches within this University. Her connection with the international centre WARREDC can benefit the AMMA project for possible connection and implications with the African countries, students and scientists involved in the AMMA project.

29- Universidad de Castilla-La Mancha (UCLM – Spain)

Area of expertise: This research group within the Department of Environmental Sciences of the University of Castilla – La Mancha (UCLM) in Toledo (Spain) consists of 4 senior scientists. They have extensive experience in atmospheric modelling, as demonstrated by the research undertaken during the last 15 years which led to the development of their own mesoscale atmospheric model named PROMES (acronym for PROgnostic at the MESoscale). A climatic version of such model has been applied in several studies on regional climate change since 1992, as well as on the role of landsurface characteristics in regional-scale atmospheric circulations in western Mediterranean, in the frame of four EU FP and five national funded projects. A version of this model is currently used for operational daily short-range weather forecasting at high resolution over the Iberian Peninsula.

Suitability: The extensive meteorological and climatological modelling experience of the group, illustrated by the development of PROMES limited area model, will be the base of the contribution of UCLM group. The main aim of the work will be the analysis of the atmosphere/land-surface coupling and feedbacks. In this area, the group has already participated in previous european projects : “Climate and Land Degradation”, led by CEH, and “Land surface processes and climate response”, led by LMD (IPSL). There is a long-lasting collaboration with the LMD group, that will continue with the coupling of ORCHIDEE land-surface model to PROMES. Finally, the short-range weather forecasting experience of UCLM group will be applied in the demonstration phase of AMMA.

Critical mass: Dr. Miguel A. Gaertner is Titular Professor at the Faculty of Environmental Sciences of the University of Castilla-La Mancha (Spain). He is one of the main authors of PROMES model and has published several papers related to the interactions between atmosphere and land-surface in the main meteorological and climatological journals. He is presently leading a spanish project related to these issues. Dr. Manuel de Castro is Full Professor at the Faculty of Environmental Sciences of University Castilla-La Mancha (Spain). As the head of the group developing PROMES model for 15 years, he has a large research experience in the fields of meteorological and climate modelling. He was the responsible scientist in four European projects and in several national projects as main coordinator.

He is currently the Spanish scientist representative for the World Climate Research Program (WCRP). Dr. Clemente Gallardo is currently Associate Professor at the Faculty of Environmental Sciences of University Castilla-La Mancha (Spain) and has more than 10 years of experience in atmospheric modelling. He has remarkably contributed to improving PROMES model. He has published several peer-review articles about regional climate modelling and is presently leading a spanish project related to weather forecasting. Dr. Enrique Sanchez joined the group in 2002. He has been involved in mesoscale modelling for several years and has full experience in the use of PROMES model.

30- Universidad Complutense de Madrid (UCM – SPAIN)

Area of Excellence: Low frequency variability studies over the North Atlantic The *Low Frequency variability group from the Department of Geophysics and Meteorology of the Universidad Complutense de Madrid* (LFVUCM) has been working during the last 15 years in different areas related to the meteorology. Nevertheless, this group started to focus its work more in the physics of climate in 1995. This research line started in the frame of a national project (ref. CLI96-1843 PI1:Manuel de Castro Muñoz de Lucas), characterizing the anomalous atmospheric circulation patterns responsible of the intra and inter-annual anomalous precipitation variability in the Iberian Peninsula (IP). In this project, the reliability of the ERA-15 rainfall 24h forecast data in the analysis of the Low Frequency Variability of the Precipitation was also tested. Results of this study are collected in one PhD Thesis and a pair of papers published in international journals. As a continuation of the above project, and under the frame of another national project (ref. REN2000-0770, PI: Encarna Serrano Mendoza), the LFVUCM group has been studying the role of the Atlantic

SST as a potential predictor of the IP rainfall; and also establishing other oceanic and atmospheric predictors of the anomalous precipitation variability, including stratospheric ones. From this second project, the subtropical North Atlantic SST variability has been found to be a potential predictor of the IP and Northern Africa winter precipitation variability, determining its influence from the previous summer months. From this project there is a publication in the GRL2. This study has been extended to the whole European area, finding that this subtropical signal is also a predictor for the Northern European precipitation (ENA region). Following this result , in the last year the group is working in another national Project (REN2002-03424, PI: Belen Rodriguez de Fonseca), whose aim is to determine the physical mechanisms involved in the subtropical North Atlantic SST-precipitation connection found, that means, to look for dynamical mechanisms that explain the summer SST changes in the subtropical North Atlantic. For this reason, in this current project, we are working not only with observations but also with simulations from UCLA GCM. We have incorporated to our group two physical oceanographers who are going to characterize the subtropical North Atlantic ocean dynamics, from both observations and UCLA GCM simulations.

Suitability: The experience of the LFVUCM in analysing the ocean-atmosphere-precipitation teleconnection in the North Atlantic region provides an adequate contribution to AMMA project. In particular, LFVUCM contribution fits in the analysis of pre-existing observations and simulations (from UCLA GCM) in the Tropical Atlantic, what means a convenient starting point in this project, because it will enhance the knowledge of the WAM area of interest. Also, the link found between the subtropical Atlantic SST and the Mediterranean precipitation will be of high interest in the study of the connection between the WAM and the Mediterranean variability.

Critical mass of expertise: The modelling contribution of LFVUCM will be led by Dr. Belen Rodriguez de Fonseca in collaboration with the Department of Atmospheric Sciences of UCLA. Belen Rodriguez de Fonseca has been working during the last 7 years in the North Atlantic atmospheric and oceanic connection with the precipitation on inter and intra-annual time scales. Nowadays she is the principal investigator of a national project in which Dr. Roberto Mechoso and other members of the UCLA Atmospheric Department collaborate performing simulations for different subtropical Atlantic SST boundary conditions. The observational contribution will be led by Dr. Encarna Serrano Mendoza, who has a broad experience in data analysis. Encarna Serrano was one of the components of the international group that developed the first ECMWF Re-analysis (ERA15). Also, she has been working in the LFVUCM group from its beginning.

31- Universidad Politécnica de Cartagena (UPCT – SPAIN)

Area of expertise: The Universidad Politécnica de Cartagena (UPCT), created in 1998, is a mediumsize University (6500 students), composed by six Schools (4 Higher Technical Schools) and 23 Scientific Departments. The UPCT offers advanced academic programmes in about 20 major fields of study. The two Departments of the UPCT involved in AMMA are the Department of Civil Engineering and the Department of Agricultural Engineering. The first one has experience in hydrologic studies and modeling based on GIS environments, using spatio-temporal information (remote sensing data, DEM, thematic cartography) and automatic acquisition systems of hydrometeorological data (SAIH systems in Spain). The second one has a sound background in studies related to agrometeorology (prediction and modelling of crop water consumption and evapotranspiration, crop modelling) and environmental crop physiology (modelling of canopy gas exchanges, effect of irrigation strategies on water use efficiency). The Departments are involved in several national projects dealing with these topics. Several investigators who have joined the University in 1999 have participated in European Projects (CAMAR, INCO-DC) related to agricultural resources and land management

Suitability: The team has the expertise and tools that will allow to bring a significant contribution in the following topics: (i) - Development and application of parameterization techniques of hydrological models, so as to enable its use in basins which present insufficient data. (ii) – Mapping evapotranspiration using data from Earth observation satellites. (iii) - Integration of remote sensing data and GIS information within SVAT (Soil-Vegetation-Atmosphere Transfer) models. (iv) - Development and application of GIS-environment oriented to dynamic flood simulation, integrating spatio-temporal information from different sources and making an intensive use of DEM.

Critical mass: The team is composed of 4 scientists, all of them full professors at the University. S. García Galiano has extensive experience in distributed hydrological modelling, sensitivity analysis of scale factors related with DEM, and GIS-based tools development. She has been working as hydrologist, for six years, at the water management agency of Segura River basin (Confederación Hidrográfica del Segura) of the Spanish government. Actually, she is teaching Hydrology and Water Resources at the School of Civil Engineering and leading the DYUNUT R+D National Project (2002-2005). DYUNUT refers to development of methodologies oriented to flood simulation and forecasting in real-time.V. Martinez is a researcher also involved in the DYUNUT Project. His topics of research are distributed hydrological modeling and estimation of evaporation, both using GIS. He is teaching Hydrology and Hydraulics at the School of Agricultural Engineering. A. Baille, former senior scientist of INRA-France, and M.M. González-Real have both a sound experience in studies on crop evapotranspiration and on the coupling processes between vegetation and atmosphere, in open field and in greenhouse environments. They have developed models of evapotranspiration and canopy gas exchanges with the atmosphere, that are presently available. These models will serve as the basis for developing the modelling tools necessary for the above-mentioned tasks.

32- Université catholique de Louvain (UCL – BELGIUM)

Area of Expertise: The Laboratory for remote sensing and land-use/-cover change, in the Department of Geography of the University of Louvain, Louvain-la-Neuve, Belgium, is conducting research projects on: (i) integrated studies of human-environment systems (e.g. historical reconstruction of land-use changes in the African Sahel for input into a GCM, role of environmental change in influencing long-range migrations in the Sahel, the influence of macro-economic changes on deforestation in Central Africa, land-use changes around the Serengeti-Mara ecosystem, impact of land-use change on malaria and dengue, …); (ii) the monitoring of land-cover changes and biomass burning by remote sensing; (iii) the modelling of land-use changes.

Suitability: The UCL research team has extensive experience on local scale case studies on patterns and causes of land-use change in the African Sahel, and has conducted systematic comparative analyses of case studies on the causes of desertification. This led to the development of the SALU model, which provides region-wide scenarios of future changes in land use (up to 2040) and a reconstruction of past land uses (back to 1960). UCL has also worked on the design of remote sensing indicators of land-cover change and land degradation for the Sahel, and on detailed studies on the vulnerability of Sahelian populations to environmental change and variabilility. The UCL team has established long-term collaborative relationships with scientists from sahelian countries, and in particular Senegal and Burkina Faso

Critical Mass: Professor Eric F. Lambin was previously Assistant Professor at *Boston University* and Expert for the European Commission at the *Joint Research Center* (Ispra). He is the Chair of the « Land-Use and Land-Cover Change » (LUCC) programme of the *International Geosphere-Biosphere Programme* (IGBP) and *International Human Dimensions Programme on Global Environmental Change* (IHDP). From September 2002 to August 2003, he was resident as Fellow at Stanford University, USA. Eric Lambin has published about one hundred papers and book chapters in leading scientific journals in remote sensing, geography and environmental sciences. Helmut Geist has a Ph.D. in economic geography from the University of Wuerzburg. He is conducting research on human-environmental relations, driving forces and mitigation policies. He is the Executive Director of the of the « Land-Use and Land-Cover Change » (LUCC) programme. Marc Linderman has a Ph.D. from the Department of Fisheries and Wildlife, Michigan State University. He has a crossdisciplinary training in remote sensing, GIS, ecology, and spatial modeling. His research is on regional land-cover change monitoring and integration of ecological and socio-economic data to study land-cover change. Suzanne Serneels obtained her PhD in Geography in 2001 for a study on causes and impacts of land use/cover changes around protected areas in East Africa. Her main area of expertise is the study of LUCC with remote sensing data, impacts of LUCC on protected areas and human livelihoods in Africa. David Benz earned a Master's degree in Geographic Information Science from Clark University in 2002. David is examining imagery of Africa at multiple resolutions to determine thresholds of land-cover change detection.

33- European Centre for Medium-range Weather Forecasts (ECMWF –UK)

Area of expertise: ECMWF (European Centre for Medium Range Weather Forecasts) is an international organization supported by 24 European states. The principal objectives of the Centre are:

(i) the development of numerical methods for medium-range weather forecasting,

(ii) the preparation on a regular basis of medium-range weather forecasts for distribution to the meteorological services of the member states,

(iii) scientific and technical research directed to improvement of these forecasts, and

(iv) collection and storage of appropriate meteorological data. In addition, the Centre is involved in seasonal forecasting and ocean wave modelling using the atmospheric model coupled to an ocean circulation model and to a wave model.

Suitability: ECMWF has a long experience in operational data monitoring (e.g. to provide feedback to WMO on the quality of the meteorological network), use of a variety of observations (e.g. radiosondes ,satellite observations) in data assimilation and the use of research quality observations to improve the modelling system. The latter have been used extensively to optimize various aspects of the parametrized processes e.g. convection, radiation, clouds and land surface processes. ECMWF has also been active in the EU-funded EUROCS project to improve parametrization schemes and has done active research as part of JET2000 to study model performance in West Africa and the impact of additional data. Currently ECMWF is involved in the EU-funded projects ELDAS and GEOLAND. Both projects are relevant to AMMA. ELDAS develops a state of the art land surface data assimilation system to provide the best possible soil moisture analysis given a variety of (indirect) observations. GEOLAND focuses on the assimilation of vegetation parameters (leaf area index, vegetation fraction) and on extending the ECMWF modelling capability to CO2 fluxes. AMMA will be important for validation/verification and optimization of model parameters.

Critical mass: Anton Beljaars is head of the Physical Aspects section of the research department. This is a group of about 10 scientist active in the area of further development of the parametrization of subgrid processes in the ECMWF model. This work is done in close collaboration other sections of the research department (e.g. numerics, satellite and data assimilation sections) and the operations department in order to achieve optimal performance of the forecasting system. Extensive experience exist in the areas that are relevant to AMMA e.g. convective parametrization, use of research data, soil moisture analysis,data monitoring, model diagnostics

34- AGRHYMET REGIONAL CENTRE (AGRHYMET – NIGER)

Area Of Expertise: The AGRHYMET Regional Centre is a specialized institution of CILSS (Permanent Interstate Committee for Drought Control in the Sahel). It was created in December 1974 and defined as a " regional body, specialized in the sciences and techniques applied to agricultural development and natural resource management, in charge of promoting information and training in the field of agro-ecology ".

The Centre major objective is to monitor the various meteorological, agrometeorological, agricultural, phytosanitary, hydrological and environmental situations at subregional level, and to develop and transfer tools and methodologies to the relevant technical offices called of AGRHYMET National Components in the CILSS member countries,.

The AGRHYMET Regional Centre has several functions that help strengthen its actions in the areas of information and training, for a sustainable natural resource management and food security in the

Sahel. These include:

- producing information for decision-makers in the areas of food security and natural resource management;
- training employees of the countries of the subregion towards their specialization in climatology agrometeorology, hydrology, crop protection, natural resource management and equipment maintenance.

Suitability: Based on what precedes, it is obvious that in accordance with its mandate, the Centre is interested in research activities associated with climatic impacts on food security and natural ressource management in West Africa, and particularly in the Sahel. Monitoring the

Sahelian ecosystem as a whole, particularly during the rainy season is directly linked to the understanding of rainfall distribution in space and time during the season. Rainfall is the main input for virtually all the physical and biological models used at the Centre for this monitoring. Therefore, any enhancement of our knowledge of the spatial and temporal variability and predictability of rainfall in West Africa will contribute to improving the quality of our products. The Centre's main needs for applied research on the West African Monsoon and its impacts are described below: Cropping Season monitoring: monitoring climatic conditions, the vegetation cover, water resources, crop pests and diseases, forecasting agricultural production, forecasting seasonal conditions Natural resource monitoring: monitoring changes of state in the various ecosystems Climate change and variability impact studies on the Sahelian ecosystem: on water resources, agricultural production, the biomass, the environment etc...

Key persons and their track record

Dr. Abou AMANI, Civil Engineer: Expert in Hydrology. He got his PhD at the *Ecole Polytechnique de Montréal*, Canada in 1995. He has had a two-year postdoctoral stay at LTHE in Grenoble, France.

Since 1998, he is in charge of the activities of the Information Major Programme of the AGRHYMET Regional Centre related to hydrology and water resources (Regional hydrological monitoring, regional hydrological database management and analysis, regional assessment of water resources, seasonal forecast of discharges, assessment of climate change and variability impacts on Sahelian water resources). He has co-ordinated the FRIEND-AOC Project from 1999 to 2002 and is the Assistant Co-ordinator of the HYCOS-AOC Project (Component of the World Hydrological Cycle Observing System for West and Central Africa). He has published seven pre-reviewed papers in international scientific journals. Dr. Seydou TRAORE: Expert in Agrometeorology, Information Major Programme. Dr. DJABY Bakary: Expert in Pastoralism (Officer in charge of the Methods and Applications Unit). He is an Engineer in Agronomy, specialized in Pastoralism. Since 1995, he is in charge of all the issues related to pastoral production at the AGRHYMET Regional Centre. From 1995 to 2001, he has actively contributed to developing the ISEW (Integrated System for Early Warning) tools within the framework of the "Early Warning and Agricultural Production Forecast" Project (AP3A).

35- CENTRE de RECHERCHE MEDICALE et SANITAIRE (CERMES – NIGER)

Area of expertise Transmission of communicable diseases. The CERMES is the key-organism of the Ministry of Health for biological expertise. Main research areas concern malaria, meningococcal meningitis and Climate & Health. Technical environment, specialized researchers and support of the Réseau International des Instituts Pasteur have brought up the CERMES in the head of applied medical research in the regional area.

Suitability: Meinigococcal meningitis is one of the main disease in Africa to be defined as the "meningitis belt" in the sahelian and soudanian areas. Climatic factors are evident in the onset of outbreaks of meningitis. In this field and since the 1980's, the CERMES is the first regional reference center. For example : the first in the region using routinely molecular techniques for typing microbes strains and one of the four in the world for serological techniques of protective immunity. Malaria is a disease caused a parasite transmitted by mosquitoes and relation with rainfall appear obvious in the west African region. The CERMES has built strong links with the Malaria Control Division of the MOH and intensive fieldworks have recently underlined the comeback of a major malaria vector, *Anopheles funestus*, in Niger ,where it was considered as absent for several decades. The CERMES participates to multilateral studies on efficacy of malaria treatments. Such competencies have allowed collaborations with national, regional and international teams in the field of remote sensing, climate, hydrology and environment to establish links between environmental factors and transmission of pathogens. Interface between biomedical and "environmental (climate, hydrology, atmosphere..)" communities have been already drawn with strong interactions in the field and local level.

Critical Mass : Isabelle Jeanne is an epidemiologist specialized in remote sensing and geomatics. After experiences in French Guiana and Madagascar, she is responsible for the Health and Climate Unit in the CERMES. It relations with WHO and national and regional teams put her at the cross-road between biomedical and environmental fields.

Rabiou Labbo is a field researcher experienced in schistosomiasis studies since two decades , he is now in charge of entomological studies in the malaria transmission area. He has got benefits of intensive formation in Madagascar in malaria research and has obtained funds from the Multilateral Initiative on Malaria (WHO). **Jean-Bernard**

Duchemin is a medical parasitologist with experiences on malaria and plague since almost. His research fields are : ecology and genetics of malaria vector and chemoresistance of the malaria parasite.

36- Ecole Inter-Etats d'Ingénieurs de l'Equipement Rural (EIER – BURKINA FASO)

Area of Expertise The school, created in 1968, offers advanced and multi-focused professional trainings in rural engineering to meet the social and economic needs of its 14 western and central African member States. EIER is today a reference in Africa as regards research, essentially applied research, in the fields of equipment and management of water and waste in urban areas, water and land management, and management of natural resources and the environment. This research is structured into thematic trans-disciplinary groups, which work with international partners and professionals.

Suitability This AMMA-IP suits well research priorities defined in the Strategic Plan of the Scientific Research in Burkina Faso. EIER is one of the important mainstays of this Plan because of its role and reputation in climate, environmental and water researches. These key issues will be addressed by EIER in the AMMA-IP and the expected results will ensure a better understanding of climate change and variability effects on natural resources in Burkina Faso.

Critical mass

Dr. Hamma YACOUBA is the Studies Director of EIER and the coordinator of the Research Team "Land and Water Management". He has a great experience in landscape degradation of the Sahel and also in surface temperature of sahelian fallow lands. **Dr. Amadou Hama MAIGA** is the Research Director of EIER and he is specialised in eutrophication and solid-matters transport in reservoirs in West Africa. **Dr. Harouna KARAMBIRI** is a young researcher at EIER and has great skills in Hydrology, water erosion and modelling in the Sahel. **Dr. Samuel YONKEU** is a lecturer and a senior researcher at EIER.. He is also the coordinator of the research program on Natural ressources and Environment. He is specialised in natural eco-systems and agro-systems dynamics, and in the study of agricultural and livestock farming production systems. **Mr. Amadou Lamine MAR** is a lecturer and a researcher in the field of Hydrological modelling by Discharge-Duration-Frequency approaches, applied to large basins in the Sahel. **Mr. Christophe LAROCHE** is a lecturer and a researcher in Hydrological processes and modelling.

37- African Centre of Meteorological Application for development (ACMAD – NIGER)

Area of expertise: Weather and climate monitoring and prediction. ACMAD is the African organization with the expertise in weather and climate for the 53 member states. Activities of the center include: on the job training, summaries, reports and outlooks in weather/climate monitoring and prediction. Several meetings and workshops on numerical weather prediction and seasonal/intraseasonal climate prediction are organized every year. Training on the use of new technology (Radio and Internet) for climate information dissemination on time is an additional activity to facilitate delivery of forecasts to end users.

Main research areas encompass, regional climate variability and change simulations, validation of numerical weather/climate models over Africa, development of training tools for African weather/climate forecasters and interpretation and use of existing operational weather /climate prediction systems. A close collaboration with CERMES, AGRHYMET is established to develop tailored forecasts for health, agriculture and pastoralism. These forecasts will contribute significantly to mitigate impacts of weather/climate anomalies live and property.

38- VAISALA OYJ (VAISALA - FINLAND)

General: Vaisala develops, manufactures, and markets electronic measurement systems and equipment for meteorology, environmental sciences, traffic safety, and industry. Vaisala operates on a global scale, equipping meteorological organizations, research institutes, defense forces, air and road trafic authorities, and industry.

- Vaisala products provide the measurement data necessary for forecasting the weather, protecting the environment, and improving the safety of air and road traffic. In industrial settings they help improve the work environment, increase the efficiency of manufacturing processes as well as reduce adverse impacts on the environment. Vaisala systems, sensors and instruments are used for measuring environments of all proportions, from the earth's atmosphere to the inside of an engine component.
- Continuous, dynamic product development, close cooperation with customers, and specialization are the basis for path-breaking Vaisala products. High investment in Research & Development guarantees that Vaisala products are in the forefront of environmental measurement technology both now and in the future, offering high performance and reliability. Comprehensive customer support is an essential part of the Vaisala service concept. We provide our customers with maintenance, training, and calibration services as well as spare parts all over the world.

Thunderstorm systems

Lightning data is used in meteorology, aviation, electric power and power-sensitive operations, outdoor recreation, forestry, insurance, and many other industries sensitive to thunderstorms.

Vaisala helps thunderstorm-sensitive organizations operate safely and productively by knowing when and where lightning is active.

Sounding systems

- Vaisala sounding systems use balloon-borne radiosondes to measure upper-air temperature, humidity, pressure, wind speed and wind direction.
- The data that the radiosonde transmits is received by automated sounding systems that process the data in order to produce weather messages.
- Measurement of ozone and radioactivity can also be carried out.
- Ground-breaking research and improved forecasts have already been achieved thanks to the data gathered by Vaisala GPS dropsondes in hurricanes and winter storms.

39- Ocean Scientific International Ltd . (OSIL – UK)

OSIL specialises in the provision of high quality products and services for marine, freshwater and meteorological measurement. We recognise the need for comprehensive technical support and endeavour at all times to meet our customers' requirements in an informed and efficient manner. Specialist 'hands-on' training workshops are held regularly at our facility in Petersfield. These include 'Laboratory Measurement of Salinity', 'CTD Calibration' and 'AML Instrument Users'. The workshops range from 1 to 2 days duration and comprise a mix of lectures, demonstrations and practical sessions to cover all aspects of the latest theories and techniques in the field

40- Koninklijk Nederlands Meteorologisch Instituut (KNMI – THE NETHERLANDS)

Area of Expertise: One of the main tasks of KNMI, the Netherlands national meteorological service, is Climate Research. The division of Atmospheric Composition Research performs research into natural and anthropogenic changes in atmospheric composition and their consequences for climate and air quality.

Suitability: KNMI is strongly involved in many aspects of monitoring and modeling of atmospheric change. It takes part in the retrieval, assimilation and validation of atmospheric constituent observations from GOME, SCIAMACHY, OMI, and related instruments. Both the co-PI of

Sciamachy and the PI of OMI are part of this group. KNMI took the initiative to set up an atmospheric observatory in tropical South America (Paramaribo, Suriname), and is the coordinator of the fp6 EU project STAR (Support for tropical atmospheric research). It also develops and applies the global atmospheric chemistry transport model TM, which is driven by 3- or 6-hourly meteorological fields from the ECMWF weather forecast model. TM is able to simulate tropospheric and stratospheric chemical processes, including most types of aerosols. TM has been applied to simulate past and future changes in atmospheric composition, amongst others as a contribution to EU and IPCC assessment reports.

Critical mass: **Dr. Gé Verver** developed an off-line aerosol assimilation scheme for sun-photometer aerosol optical depths. He implemented the variational assimilation scheme for aerosol optical depths in the TM3 model. He is involved in the EU project DAEDALUS-CREATE, advising on chemical data assimilation, and is coordinator of the tropical observatory in Paramaribo and of the fp6 EU project STAR..

Dr. Peter van Velthoven has been involved in studies of atmospheric chemistry since 1990, and has more than 30 publications in peer-reviewed journals. He co-ordinates the further development and use of the chemistry-transport model TM3/TM5 at KNMI. He has been involved in many past EU projects such as POLINAT, EULINOX, CARIBIC, PRISM, RETRO and TRADE-OFF.

Dr. Roeland van Oss is Head of the workgroup Observations of the Section of Atmospheric Composition Research at the Royal Netherlands Meteorological Institute (KNMI). He has developed satellite retrieval algorithms for GOME, SCIAMACHY, OMI and GOME-2. He is chairman of the validation sub-group of the SAF on Ozone Monitoring and is responsible for the GOME-2 ozone profile algorithm within the SAF. He is project leader of the ESA project TOGOMI on the development of a GOME Total Ozone retrieval algorithm.

41- AGENCE POUR LA SECURITE DE LA NAVIGATION AERIENNE EN AFRIQUE ET A MADAGASCARE (ASECNA)

Area of Excellence: ASECNA is in charge of air trafic safty over the AMMA region. It is reposible for installing and operating the equipment of telecomunication and environmental monitoring needed in airports for the approach area as the equipment to monitor the meteorogical sitation in the region for route planing. ASECNA is implemented in all airports of French speaking Africa and provides there the most up to date forecasts.

Suitability: As the largest operator of meteorological observing equipment in Africa, ASECNA will provide a wealth of expertise to the AMMA project and its instrumental deployment. It will develop in collaboration with the AMMA project the strategy for the upgrade of the radio-sounding network. ASECNA Headquarters will provide the training needed to all its staff operating the radiosounding in order to ensure that the observations are readily available for the global forecast models and thus benefit the society at large. ASECNA will also provide expertise and personel for the deployment and operation of the airborn observing platforms during the Special Observing Periods.

Critical mass of expertise: The expertise contributed by ASECNA will be from its Departement de l'exploitation headed by Mr Amadou Gitteye. Mr SISSAKO as head of the Meteorological department will ensure the coordination between the operational needs of ASECNA and the objectives of AMMA. Mr Ngamini, chef de bureau for the metorological observations will ensure the day to day communication between ASECNA and AMMA and follow the actions needed for the goals of the projects are carried out.

42- UNIVERSITAET KARLSRUHE (TH) (UniKarl - GERMANY)

Area of Excellence: Dynamics of tropical weather systems, convection. UniKarl has a strong record of research into convection and mesoscale weather systems and into natural disasters and disaster management (Center for Disaster Management and Risk Reduction Technology - CEDIM). Through the appointment of Sarah Jones as associate Professor the area of expertise will be extended to include tropical meteorology, tropical cyclones and synoptic-scale weather systems. The tropical research involves collaboration with a number of US Institutes including NOAA/Hurricane Research Division, MIT, the Naval Postgraduate School, and the State University of New York at Albany as well as with the Canadian Meteorological Service.

Suitability: Pre-existing collaborations with the US tropical cyclone community will enhance the link between the European and US AMMA contributions. The active involvement of UniKarl in the WMO research programme THORPEX will enable links to be developed between the two major international research programmes THORPEX and AMMA. Strong links to the tropical meteorology group at the University of Munich will be maintained. Through the AMMA-IP new collaborations will be developed with Forschungszentrum Karlsruhe, University of Leeds, Laboratoire d'Aerologie, and other European partners.

Critical mass of expertise: UniKarl will make a modelling contribution to the AMMA-IP. This will be led by Dr. Sarah Jones who completed her Habilitation at LMU-Muenchen in 2003 (as the first woman ever to do so in the Physics Faculty at Munich) and has recently been appointed Associate Professor at the University of Karlsruhe. She is internationally recognised for her work on the dynamics of tropical weather systems, tropical cyclones in vertical shear and extratropical transition and is a member of the THORPEX International Science Steering and European Regional Committees.

A.2 Sub-contracting:

A.2.1 Description of the Procurement procedure for riadiosonding

According to the Consortium Agreement, the Governing Board, shall decide the budget and the financial allocation of the EU's contribution between the various activities on the one hand, and between the various Contractors on the other. In order to develop the radio-sounding network in Africa during the implementation of AMMA, the Consortium makes the choice of a Procurement procedure.

Thus this procurement procedure will allow interested parties, Contractors and suppliers, to submit tenders. The procurement procedure will involve fair and transparent tendering, evaluation and award procedure.

The procedure of publication and evaluation of the calls for tenders will be carried out by ASECNA, in conformity with the Article II.6 contract and Procurement Guide of the European Investment Bank

The Procurement procedure ASECNA uses is described below:

1) the calls for tenders are open
2) the Procurement notices are published in the Official Journal of the European Union in compliance with the European Investment Bank Procurement Guide
3) the Opening of Tenders is performed at the ASECNA's Headquarter by the Commission.
4) the Technical Commission, located at the Headquarter, analyses the bids on a best technical and price quality ratio.
5) An agreement on the selection procedure and result is required by the sponsor if the funding is provided by a third party
6) the Contract Commission of ASECNA is composed of members of the ASECNA's Board of Directors. The Contract Commission shall convene meetings four times a year. This Commission is in charge of checking the procurement procedure and tender evaluation criterias
7) the competitive bid contract is signed by the General Director of ASECNA

A.2.2 Presentation of The other Subcontractors work

UKBH.IGUC will hire 2 local subcontractors that are 1) a university lab in Dakar (ISE), and 2) a national environmental institution in Senegal, (CSE). Indeed, the CSE are experts in doing field surveys and biomass sampling, and technicians from CSE will assist them in those works. In another hand, the ISE are experts in field studies of vegetation and field surveys as well. Students from ISE will be hired to do part of the work. We will not be able to conduct their field work without local partners, with whom they have been collaborating for more than 15 years.

Isac-CNR the have foreseen to subcontract the construction of the instrumentation composing the micro-lidar network to an external small enterprise. The instrumental design, the inversion codes and the scientific exploitation will be done by the ISAC-CNR team. This choice will allow to concentrate the ISAC-CNR team effort on the campaign preparation and to reinforce the synergy between qualified SMEs and national research institutes in scientific projects. The identified potential subcontractors have proven experience (within collaborations with ISAC-CNR) in supporting experimental activities in optical remote sensing.

Uni Bonn will subcontract the German Weather Service (DWD) for the provision of 3D water vapour fields derived from satellite measurements during the EOP and SOP phases. DWD is running EUMETSAT's Satellite Application Facility on Climate Monitoring aiming at a new 3D water vapour product from data of geostationary and polar orbiting satellites. It will deliver data free of charge to several workpackages of the AMMA IP. However, the subcontracting approach seems necessary because DWD is not an explicit partner within AMMA but will provide its products for direct use within the AMMA IP, e.g. data reformatted to several model grids and interpolated for measurement sites. This is not foreseen in the SAF standard package and Uni Bonn will not be able to produce those data by their own means.

A.3 Third parties

NOT APPLICABLE

A.4 Competitive calls

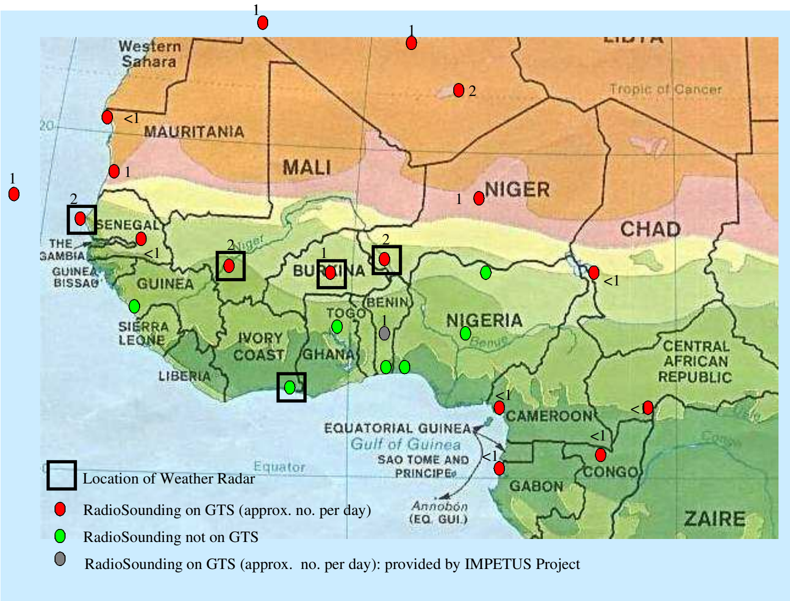
NOT APPLICABLE

A.5 Funding of third country participants

NOT APPLICABLE

Appendix B- Planed Instrument Deployment

B.1 Platforms and Sites



B.1.1 Regional window and transects

Name	Location	Description	African Partners	Scientist in Charge	Period of Activity
Sub-Regional Window*	5°N -18°N; 0-4°E + 11°N -18°N; 2°W-0° 780,000 km²	Contains 3 densely instrumented mesoscale sites (Gourma in Mali, Niamey in Niger and Ouémé in Benin) and samples the climatic and vegetation gradients characterising West Africa. Operational data to be collected: daily rainfall, synoptic met. Data, River flows). Also contains ancillary sites in Burkina Faso (Nakambe and Upper Volta) and includes 3 IDAF* stations (Hombori, Mali; Banizoumbou, Niger; Djougou, Benin) measuring wet and dry atmospheric deposition. Aerosol climatic impact studies.	AGRHYMET, EIER DMNs and DH Bénin, Burkina, Mali, Niger Univ. Abidjan, Bamako, Abomey-Calavi, Niamey.	T. Lebel lebel@hmg.inpg.fr	2001-2008
Sahelian Transect	Sénégal, Mali, Niger	Emphasis on the Aerosol measurements (3 stations)** ; Study of the Mesoscale Convective Systems and African Easterly Waves, including their role in dust transport.	Mali : IER, DMN Niger : University.	Jean-Louis Rajot rajot@lisa.univ-paris12.fr	2004-2008
Meridional Transect	Ivory-Coast, Benin, Burkina, Niger, Mali	Emphasis on meridional gradients of energy, water, vegetation and atmospheric chemistry. Most sites belong to the sub-regional window but extends to the North in order to document the Heat Low.	EIER, DMNs, Univ. Abidjan, Bamako	A. Fink fink@meteo.uni-koeln.de	??-2008

** The IDAF network (long term survey of atmospheric chemistry) covers a larger window extending to Zoetele 3°N,11° E (Cameroun) and 3 sites in South Africa*Regional Window and Transects
** Part of *the PHOTON-AERONET network covering a window extending to Sal (Cap Verde), Ouagadougou (Burkina), Dakla (Morocco), Agoufou (Mali) and Illorin (Nigeria)*

B.1.2 Meso-scale sites

Name	Location	Description	African Partners	Scientist in Charge	Period of Activity
Ouémé Catchment (O)	Benin; 9°-10°N; 1.5°-3°E 14200 km²	Densely instrumented catchment with denser instrumentation on sub-catchments (Donga, Aguima, Ara). Soudanian climate (different types of rain systems) and Savannah vegetation. Global models; impact of climate variability on water resources.	DH, DMN, AC Univ.	C. Peugeot Peugeot@ird.fr	1997-2008
Niamey Area (N)	Niger; 13°-14°N; 1.6°-3°E 14200 km²	The survey of the “Niamey square degree” started in 1990. Heavy observations in 1992, monitoring from 1994 to 2002, densification starting again in 2003. Sahelian climate with semi-arid vegetation (Millet crops, Tiger bush, …). Long series of high resolution rain data and groundwater levels.	DMN, Niamey Univ.	L. Descroix Descroix@ird.ne	1990-2008
Gourma Malien (G)	Mali; 14.5°-17.5° N; 2°-1°W 30000 km²	Sahelian to saharo-sahelian climate (between isohyets 400 and 100 mm). Semi-arid natural vegetation composed of annual grasses and a sparse tree layer. Crops only present in the southern part of the area. 16 vegetation sites monitored since 1984. Also satellite products validation sites (vegetation, soil moisture).	IER, DMN, DH	E. Mougin Mougin@cesbio.cnes.fr	1984-2008

B.1.3 Super Sites

*.Local in situ measurements, only used for satellite validation, satellite data being used in Hydrological modelling.Super sites

Name	Location	Description	African Partners	Scientist in Charge	Period of Activity
Donga Catchment (Od)	Benin; 9.6°-9.9° N; 1.6°-2°E 590 km²	Sub-catchment of the Ouémé catchment with a dense recording raingauge network (14 stations) and 5 streamflow stations. Land surface process studies, hydrological modelling, coupling with the sub-surface and the atmosphere.	DH, DMN, AC Univ.	S. Galle /L. Seguis galle@ hmg.inpg.fr	2002-2008
Aguima Catchment (Oa)	Benin; 9.10°-9.14°N; 1.90°-2° E, 30 km²	Sub-catchment of the Ouémé catchment, with a dense recording raingauge network (9 stations, some are in neighbouring catchments) and 5 water level recorders, 3 weather stations. Evaporation and soil moisture measurements. Land-surface process and agricultural studies; hydrological modelling.	DH, DMN, AC Univ.	A. Fink fink@meteo.uni-koeln.de	2001-2008
Niamey Central Super Site (Nc)	Niger; 2°35'-2° 48'; 13°25'-13° 45', 600 km²	Kori de Dantiandou and adjacent areas. Dry vegetation cover. Land surface process studies, hydrological modelling, coupling with the sub-surface and the atmosphere. Rainfall vs vegetation spatial relationship, at the local scale	DMN, DRE, Niamey Univ., AGRHYMET Roselt, ICRISAT	L. Descroix Descroix@ ird.ne	1991-2008
North Titao catchment	Burkina Faso; 13°40'-14°N, 2°-2°2' W < 50 km²	Sub-catchment located in the north of the Nakambé basin. Hydrological, erosion, bio climatic, environmental, soil physics and vegetation dynamics studies. Water, matters (solid and dissolved) and energy flux. Three different soil surface types (bare soils, cultivated lands and natural vegetation covered surfaces).	EIER, University of Ouagadougou, CNRST, DMN, DGIRH H. Yacouba, Hamma.Yacouba@eieretsher.org H. Karambiri, Harouna.Karambiri@eieretsher.org		2004-2009
Dano	Burkina Faso, 11.15°N, 3.07°W, 20km²	Sudan Savannah, dam at outlet of subcatchment/testsite, micrometeorological system and various devices for C/N/H2O turnover	INERA	H. Kunstmann	2005-2007

B.1.4 Intensive local sites

Name	Location	Description	African Partners	Scientist in Charge	Period of Activity
Ara Catchment (Or)	Benin; 9.9°N; 1.6° E 14 km²	Sub-catchment of the Donga and Ouémé catchments. Geophysical and geochemical studies. Flux measurements. X-Band radar and disdrometer. Emphasis on process studies	DH, DMN, AC Univ.	S. Galle /L. Seguis galle@ hmg.inpg.fr	2003-2008
Banizoumbou (Nb)	Niger (13° 31’30’’N, 2° 38’21’’E)	Ground based measurement of aerosols properties (physico-chemical, optical) and dust fluxes measurements. Weather station. Local water budget.	Niamey Univ.	Jean-Louis Rajot	1991-2008
Wankama or Sama Dey	Niger; ? km²	Flux measurements ; the location of a (possible) second super site is not yet determined	DMN, DRE, Niamey Univ., AGRHYMET Roselt, ICRISAT	L. Descroix Descroix@ ird.ne	1991-2008
Hombori-Agoufou (Gh)	Mali; 15.2°N, 1.3° W 1 km²	Sand dune site with a sparse tree cover. Annual rainfall : 370 mm (1920-2003). Vegetation and soil moisture measurements. Automatic Weather Station. Flux measurements. Sun photometer. Validation of satellite products. Vegetation modelling.	IER, DMN	E. Mougin Mougin@c esbio.cnes .fr	2002-200
Tougou catchment	Burkina Faso; 13°40'39'' N, 2° 13'41'' W 36 km²	Sub-catchment located in the north of the Nakambé basin. Hydrological, erosion, bio climatic, environmental, soil physics and vegetation dynamics studies. Water, matters (solid and dissolved) and energy flux. Three different soil surface types (bare soils, cultivated lands and natural vegetation covered surfaces).	EIER, University of Ouagadougou, CNRST, DMN, DGIRH H. Yacouba, Hamma.Yacouba@eieretsher.org H. Karambiri, Harouna.Karambiri@eieretsher.org	2004-2009	
Dahra (Ferlo region)*, Senegal	15° 49' 09.012" N 15° 03' 39.118" W	Sahelian climate (300-450 mm rain) with semi-arid savannah vegetation. Annual grasses with a maximum height of 60 cm. Tree and shrub canopy cover generally < 5 %. Pastoralism is the dominant activity, but rain-dependent cultivation is an important secondary land use. Livestock are present year-round	CSE (Centre de Suivi Ecologique) and ISE (Institut Sciences de l’Environnement), Senegal	I. Sandholt is@geogr. ku.dk	
Lamto	Côte d’Ivoire	Flux measurements ; wet and dry atmospheric deposition. Vegetation studies	Univ. Abidjan,	C.Galy-Lacaux lacc@aero .obs-mip.fr	

B.1.4 Aicraft

Name	Location	Description		Logisitcs	Scientist in Charge	Period of Activity
British BAe 146	SOP2: Niamey (NERC proposal) SOP 3 : Dakar (UE request)	Wingspan: 26.34 m Length: 31 m Height: 8.61 Weight: 44.2 t Take off distance: 1600 m Typical operating speed 220 kts	Max Altitude: 35 000 f Min Altitude: 50 ft (bottom of profile) 100 ft (up to 2 hours) over sea, 250ft over land Range: about 3,500 km, Endurance: about 5.5 hours,	Flying crew: 21 Ground Crew: 2-3 Fuel load: 12000 kg Consumption : ?? l/h GPU: 60 kva Other:	C. Reeves c.reeves@uea.ac.uk	2006
French ATR42	SOP 1 and 2 : Niamey SOP 3 : Dakar	Wingspan: 24.57 m Length: 22.67 m Height: 7.59 Weight: 16.9 t Take off distance: 1040 m		Flying crew: 11 Ground Crew: 3 Fuel load: 3500 l Consumption : ?? l/h GPU: 28 kva Other:		2006
French Falcon	SOP 1 and 2 : Niamey SOP 3 : Dakar	Wingspan: 16.31 m Length: 18.30 m Height: 5.40 Weight: 14.5 t Take off distance: 1400 m		Flying crew: 6 Ground Crew: 3 Fuel load: ?? 4130 kg Consumption : ?? l/h GPU: 28 kva Other:		2006
German Falcon	SOP 1: Niamey SOP 3 : Dakar	Wingspan: 16.46m Length: 18.75m Height: 5.45 m Weight: 13.8 t Take off distance: 1830 m	Max. cruising speed: 917 km/h Ceiling: 42000 ft Max. range: 3700 km Max. endurance: 5 h	Flying crew: 6 Ground Crew: 3 Fuel load: 4100 kg GPU: 28 V, 1000 A	Hans Schlager Hans.Schlager@dlr.de	2006

Name	Location	Description		Logisitcs	Scientist in Charge	Period of Activit y
NRL P3	SOP 1&2 : Niamey SOP 3 : Dakar	Wingspan: 30.24 m Length: 35.45 m Height: 10.39 Weight: 60.75 t Take off distance: 2430 m	P3B Orion 4-engine turboprop equipped to make basic meteorological measurements, including temperature, pressure, moisture and winds. The P-3 will be also be equipped with the ELDORA radar and the water vapor DIAL LEANDRE 2.	Flying crew: Ground Crew: Fuel load: ?? Consumption : ?? l/h GPU: ?? kva Other:	Among others: F. Roux rouf@aero.obs-mip.fr C. Flamant cyf@aero.jussieu.fr	2006

B.1.5 Ships

Name	Location	Description	African Partners	Scientist in Charge	Period of Activit y
French Ship	SOP1; Gulf of Guinea SOP3: Dakar-CapVert & Guinea dome & 10°W + EOP 2005-2007: Gulf of Guinea	Atmosphere: Turbulent fluxes measurements, radiosoundings, photometer for aerosols + maybe Aeroclippers during SOP3 Ocean: hydrology (water masses), currents, tracers, drifters (Marisonde, SVP) + Lagrangian profilers PIRATA ATLAS buoys monitoring	LAPA, Univ.Cocody CRO, Abidjan, CRHO, Cotonou LC,P Univ.Lomé ? LPA, Dakar (SOP3)	B.Bourlès bourles@ird.fr G.Caniaux guy.caniaux@meteo.fr	2005-2007
Ron Brown	SOP 1: 20°W from equator to 15°N SOP 3 : one Station around 10°N-28°W	Atmosphere: Turbulent fluxes measurements, radiosoundings, photometer for aerosols; 3 additional ATLAS buoys deployments during SOP1 at 0°N, 10°N and 15°N; Ocean: hydrology and currents + SVP drifters			2006

- ## B.2 Deployed instruments

B.2.1 Airborne instrumentation for the SOP

Provisional status of Aug 04. Note that some instruments/aircraft will only be partially funded by the EC.

DLR–Falcon Measurements

Component	Technique	SOP and deployment site	Operation days/flight hours	Scientist In Charge/ Institute
O_3	UV-Absorption	SOP3 (Dakar)	12/15	Hans Schlager DLR
H_2O	Lyman-alpha			
CO_2	IR-absorption			
CO	VUV flourescence			
NO	Chemiluminescence			
NOy	CL + Au-converter			
J(NO_2)	Filterradiometer			
HCOH	Hantzsch reaction			
Acetone	CIMS			
CH_3CN	CIMS			
SO_2	CIMS			
RO_2				Dolores Andrés, Uni Bremen
Size distribution of Nucleation mode particles (4 – 20 nm)	Multi-channel Condensation Particle Counter			Andreas Petzold, DLR
Size distribution of Aitken mode particles (20 – 100 nm)	Airborne Differential Mobility Analyzer			
Size distribution of Accumulation mode particles(100–1000 nm)	PCASP 100X			
Size distribution of dust particles 1 – 100 µm))	FSSP100/300			
Volatility analysis of Nucleation and Aitken mode particles	Thermodenuder (Multi-channel Condensation Particle Counter and optical particle spectro.			
Multi-spectral aerosol absorption coefficient	3 □ Particle Soot Absorption Photometer			
Meteorology	p, T, hum			

Wind field	WIND Lidar Hor. wind vector Aerosol backscatter	SOP1 (Niamey)	12/15	Oliver Reitebuch DLR Philippe Drobinski IPSL-SA
Meteorology	p, T, hum			

UK Bae 146

Funds from AMMA-IP are only requested for the 146 for SOP3. SOP0 is funded by the UK Met Office and SOP2 by NERC AMMA-UK.

It was applied to the Facility for Airborne Atmospheric Measurements (FAAM), who run the 146, that the instruments below be fitted on the 146 during SOP2 and SOP3. It is not yet clear if all instruments can be included on a single fit due to space/weight/power limits.

Component	Technique	SOP and deployment site	Operation days/flight hours	Institute
Ozone in situ	UV	SOP0 SOP2 Niamey SOP3 Niamey	SOP0 21/50, SOP2 28/80, SOP3 14/30	FAAM
Water Vapour H2O	Lyman-α fluorescence and dewpoint			UKMO/FAAM FAAM
Position, winds, u,v,w	INS, GPS, wind vanes			Camb
Turbulence	5-port turbulence probe			FAAM
Temperature T	Rosemount PRT			FAAM
Vertical profiles of dynamical variables	AVAPS dropsondes			FAAM
Broadband radiation	Pygreometers and Pyranometers			
NO2 photolysis j(NO2)	Photometer	SOP2 Niamey SOP3 Niamey	SOP2 28/80, SOP3 14/30	Leicester
O3 photolysis j(O1D)	Fixed bandwidth radiometry,			Leicester
Microwave radiation	Dual-frequency Extension to In-flight Microwave Observing System	SOP0, SOP2 Niamey, SOP3 Niamey	SOP0 21/50, SOP2 28/80, SOP3 14/30	UKMO UKMO
Microwave radiation	Microwave Airborne Radiometer Scanning System (Marss)			FAAM
Carbon monoxide CO	VUV fluorescence			

Component	Technique	SOP and deployment site	Operation days/flight hours	Institute
Real-time VOCs	ORAC in-flight GC	SOP2 Niamey, SOP3 Niamey	SOP2 28/80, SOP3 14/30	Leeds
Real-time Oxygenates	PTR-MS			UEA
>100 VOCs inc NMHCs, alcohols, ketones, aldehydes, ethers	Whole air samples (WAS) and ground analysis with dual channel GC			York York York
Semivolatile VOCs	WAS and ground analysis with 2DGC			UEA UEA
VOCs	Microadsorbent tubes and ground analysis with GC-TOF-MS			UEA UEA
>40 halocarbons	WAS and ground analysis with GC-MS			UEA FAAM/York
Total reactive N NOy	Gold convertor + chemiluminescence			UEA UEA
Nitric oxide NO	Chemiluminescence			Leicester/UEA
Nitrogen dioxide NO2	Photolysis + chemiluminescence			Leeds
Nitric Acid HNO3	Gold convertor + chemiluminescence			
Peroxyacetylnitrate	Gas chromatography (GC)			
Speciated peroxides (inorg/organic)	Fluorometric			
Formaldehyde	Fluorometric			
Peroxy radicals (RO2 + HO2)	Chemical amplifier – PERCA			
OH, HO2	FAGE (laser induced fluorescence at low pressure)			
Aerosol size and composition	Aerosol mass spectrometer AMS	SOP0, SOP2 Niamey, SOP3 Niamey	SOP0 21/50, SOP2 28/80, SOP3 14/30	UMIST FAAM/UMIST
Particle number concentration > 3nm	TSI condensation particle counters			FAAM/UMIST FAAM/UMIST
Size distribution (0.2-30 um)	internally and externally sampling (OPCs) GRIMM and PCASP			FAAM UKMO
Ions	filters for sub and supermicron particle collection and ionic analysis			FAAM FAAM
Drop size spectrum	Fast FSSP			
CCN	CCN spectrometer			
Particle soot, black carbon	PSAP			
Scattering	Nephelometer (TSI),			

France / SAFIRE / FA-20 F-GBTM (partial funding requested from EU)

Component	Technique	SOP and deployment site	Operation days / Flight hours	Contact person
RO2, HO2 and OH in situ S.HOX_FF20	Mass spectrometer with chemical ionisation	SOP-2	SOP-2 : 32 h	A. Kukui alexandre.kukui@aero.jussieu.fr
NO, NO2 and NOy in situ S.Mona_FF20	Nitrogen oxides analyser	SOP-2	SOP-2 : 32 h	P. Perros perros@lisa.univ-paris12.fr
Cloud physical proporties S.RALI_FF20	95 GHz radar / aerosol Lidar	SOP-3, lidar only during SOP-1 (to be confirmed)	SOP-1: 40 h, SOP-3 : 24 h	N. Grand noel.grand@dt.insu.cnrs.fr
O3 and CO in situ S.Mozart_FF20	UV-O3 and IR-CO instrument	SOP-0,1,2,3	SOP-0 : 45, SOP-1 : 30+36 SOP-2 : 32+40 SOP-3: 12+24	M. Pontaud marc.pontaud@meteo.fr
Water Vapour H2O S.LA_FF20	Lyman-□ fluorescence and dew point	SOP-0,1,2,3	id	M. Pontaud marc.pontaud@meteo.fr
Position, winds, u,v,w S.GPS_FF20	INS, GPS	SOP-0,1,2,3	id	M. Pontaud marc.pontaud@meteo.fr
Turbulence S.5PTP_FF20	5-port turbulence probe	SOP-0,1,2,3	id	M. Pontaud marc.pontaud@meteo.fr
Temperature T S.PRT_FF20	Rosemount PRT	SOP-0,1,2,3	id	M. Pontaud marc.pontaud@meteo.fr
Vertical profiles of dynamical variables S.Drop_FF20	AVAPS dropsondes	SOP-0,1,2,3	id	M. Pontaud marc.pontaud@meteo.fr
Relative Humidity S.HUR_FF20	Aerodata humidity sensor	SOP-0,1,2,3	id	M. Pontaud marc.pontaud@meteo.fr
Broadband radiation S.BBR_FF20	Pygreometers and Pyranometers	SOP-0,1,2,3	id	M. Pontaud marc.pontaud@meteo.fr
NO2 photolysis j (NO2) S.JNO2_FF20	Photometer	SOP-0,1,2,3	id	M. Pontaud marc.pontaud@meteo.fr

Component	Technique	SOP and deployment site	Operation days / Flight hours	Contact person
300 to 3 000 nm PCASP PMS: 1DC-OAPX, 1DP-OAPY, 2DC, S.PMS_FF20	Size particle / rain drop distribution	SOP-0,1,2,3	id	M. Pontaud marc.pontaud@meteo.fr

France / SAFIRE / ATR-42 F-WQNI (no funding requested from EU)

Component	Technique	SOP and deployment site	Operation days / Flight hours	Contact person
Static pressure S.SPR_ATR42	Rosemount,Thales Avionic	SOP-0,1,2	SOP-0 : 45 h; SOP-1 : 30+45 h, SOP-2 : 32+40 h	M. Pontaud marc.pontaud@meteo.fr
Temperature T S.PRT_ATR42	Rosemount PRT	SOP-0,1,2	id	M. Pontaud marc.pontaud@meteo.fr
Dew point S.DP_ATR42	Buck Research dew point sensor	SOP-0,1,2	id	M. Pontaud marc.pontaud@meteo.fr
Water Vapour H2O S.LA_ATR42	AIR and ERCLyman-	SOP-0,1,2	id	M. Pontaud marc.pontaud@meteo.fr
Liquid water content S.LWC_ATR42	King Probe, Gerber Probe, JW	SOP-0,1,2	id	M. Pontaud marc.pontaud@meteo.fr
Position, winds, S.GPS_ATR42	INS, GPS	SOP-0,1,2	id	M. Pontaud marc.pontaud@meteo.fr
Turbulence S.5PTP_ATR42	5-port turbulence nose	SOP-0,1,2	id	M. Pontaud marc.pontaud@meteo.fr
Height above ground S.HEIGHT_ATR42	Thales Avionic radioaltimetre	SOP-0,1,2	id	M. Pontaud marc.pontaud@meteo.fr
NO, NO2 in situ S.NOx_ATR42	Chemioluminescence NOx instrument	SOP-0,1,2	id	M. Pontaud marc.pontaud@meteo.fr
CO in situ S.CO_ATR42	IR-CO instrument	SOP-0,1,2	id	M. Pontaud marc.pontaud@meteo.fr
O3 in situ S.O3_ATR42	UV-O3 instrument	SOP-0,1,2	id	M. Pontaud marc.pontaud@meteo.fr
NO2 photolysis j (NO2) S.JNO2_ATR42	Photometer	SOP-0,1,2	id	M. Pontaud marc.pontaud@meteo.fr

Component	Technique	SOP and deployment site	Operation days / Flight hours	Contact person
Particle number concentration > 3nm S.CPC_ATR42	TSI condensation particle counters	SOP-0,1,2	id	M. Pontaud marc.pontaud@meteo.fr
Size distribution (0.2-30 um) S.PCASP_ATR42	Externally sampling PCASP	SOP-0,1,2	id	M. Pontaud marc.pontaud@meteo.fr
Broadband radiation S.BBR_ATR42	Pygreometers and Pyranometers	SOP-0,1,2	id	M. Pontaud marc.pontaud@meteo.fr
PMS: 1DC-OAPX, 1DP-OAPY, 2DC, FSSP S.PMS_ATR42	Size particle / rain drop distribution	SOP-0,1,2	id	M. Pontaud marc.pontaud@meteo.fr
Size distribution (0.2-30 um) S.GRIMM_ATR42	internally sampling (OPCs) GRIMM	SOP-0,1,2	id	formenti@lisa.univ-paris12.fr
Particle soot, black carbon S.AETH_ATR42	Aethalometer	SOP-0,1,2	id	formenti@lisa.univ-paris12.fr
Scattering S.Neph_ATR42	Nephelometer	SOP-0,1,2	id	formenti@lisa.univ-paris12.fr
Particle shape S.Filt_ATR42	filters individual particle analysis	SOP-0,1,2	id	formenti@lisa.univ-paris12.fr
Aerosol composition S.DKT_ATR42	impactor	SOP-0,1,2	id	formenti@lisa.univ-paris12.fr

B.2.2 Ground based instrumentation for the SOP

Component	Technique	SOP and deployment site	Scientist In Charge/ Institute
spectral aerosol optical thickness (AOT)	sun photometer	SOP0,1,2 (Banizoumbou)	Paola Formenti UP12
aerosol mass concentration	Tappered Element Oscillating Microbalance (TEOM)		
spectral particle absorption coefficient	aetholometer		
spectral particle scattering coefficient	nephelometer		
size-segregated mass concentration and composition	two 4-stage cascade impactors		
bulk filters	mineralogy and individual particle shape		
wind velocity, air temperature, and relative humidity	mast		
vertical aerosol flux	isokinetic samplers at 2 heights		

Component	Technique	SOP and deployment site	Scientist In Charge/ Institute
horizontal aerosol flux	25 micro-masts each equipped with three sand catchers		
vertical aerosol distribution aerosol backscatter profile aerosol lidar-ratio aerosol shape characterisation (type) mixing layer height spectral aerosol optical thickness	lidar lidar lidar lidar lidar sun photometer	SOP0 (Banizoumbou)	Matthias Wiegner, Uni Munich
vertical aerosol distribution spectral aerosol optical thickness (AOT)	lidar sun photometer	SOP0,1,2 Djougou (Benin) & M'bour (Senegal)	Didier Tanre, ULille, CNRS
temperature, humidity and pressure profile surface energy balance wind profiles	radio soundings flux station Doppler Sodar	SOP1,2 Tamale (Ghana) & Dano (Burkina Faso)	Norbert Kalthoff FZK Karlsruhe
temperature & humidity profile profile of rain drop size distribution	microwave radiometer micro rain radar	SOP1,2 Dano (Burkina Faso)	Susanne Crewell UBonn
temperature, humidity and pressure profile	radio soundings up to every 3 hours	SOP1,2 Parakou (Benin)	Andreas Fink UCologne
wind profiles virtual temperature profiles	sodar & UHF radar UHF/RASS	SOP1,2 Niamey (Niger) and Parakou/Djougou	Bernard Campistron UPS/LA/CNRS
radar reflectivity & doppler velocity precipitation rate & radial velocity	5,6 GHZ RONSARD weather radar 5,6 GHZ RONSARD weather radar	SOP1,2 Djougou (Benin)	CNRS
3-D wind field occurence and position of lightning (CG, IC) precipitable water	bistatic radar network lightning detection network GPS	SOP2 Djougou (Benin) SOP2 Djougou (Benin) SOP1,2 Parakou and Cotonou (Benin); Niamey (Niger), Gao, Tombouctou and Bamako (Mali); Ouagadougou (Burkina Faso); Tamale (Ghana); and Agadez (Niger)	Martin Hagen DLR Hartmut Höller DLR Oliver Bock CNRS

Component	Technique	SOP and deployment site	Scientist In Charge/ Institute
backscatter profiles	microlidar	SOP1,2 Ségou (Mali), M'bour (Senégal), N'guigmi (Niger), Lamto (Benin)	Francesco Cairo

B.2.3 Atmosphere LOP and EOP

Code	Instrument	Platform or site	Description	Institution/ Project	PI Name	Period of deployment	Funding
AE.RS_Q*	Radio-Sounding network	Water Cycle Quadrilateral	5 VAISALA Digicora stations generation 3	VAISALA+CNRS/IPSL	S. Janicot janicot@lmd.fr	2005-2007	1 extant, 1 secured 3 EU Request.
AE.RS_T1*	Radio-Sounding network	Transect Sahel	5 VAISALA Digicora stations, generation 3	U. Leeds	D. Parker doug@env.leeds.ac.uk	2005-….	3 extant 2 EU request
AE.RS_T2*	Radio-Sounding network	Meridional Transect	4 VAISALA Digicora stations generation 3	U. Köln + CNRS/IPSL	A. Fink af@meteo.uni-koeln.de	2005-….	2 secured, 2 EU request
AE.RS_T3*	Radio-Sounding network	Northern stations	2 VAISALA Digicora stations generation 3	CNRS/IPSL	S. Janicot	2005-….	1 extant 1 EU request
AE.RS_T4	Radio-Sounding network	Northern quadrilateral	5 existing stationsfrom national services	U. Leeds	D. Parker doug@env.leeds.ac.uk	2005-….	Nat. Request (consumabs)

Code	Instrument	Platform or site	Description	Institution/ Project	PI Name	Period of deployment	Funding
AE.Flux_Gh	Flux station network	Gourma Super-Site	3 Eddy Correlation Stations	CEH/ NERC	C. Lloyd crl@ceh.ac.uk	2005-2008	1 Secured 2 Nat Req.
AE.Flux_Nc	Flux station network	Niamey Super-Site	3 Eddy Correlation Stations	CEH/ NERC	C. Taylor cmt@ceh.ac.uk	2005-2008	Nat. Request
AE.Flux_Od	Flux station network	Donga Super-Site	2 CEH Eddy Correlation Stations + 2 CATCH Eddy Correlation Stations	CEH/ IRD-CATCH	C. Taylor, C. Peugeot	2005-2008	Nat. Request
AE.Flux_T2	Flux station network	Additional to the super-sites	8 Eddy Correlation Stations	CEH/ UE	C. Taylor,C. Lloyd	2005-2007	EU Request
AL.Met_Oa	Weather station network	Aguima (Intens. Local site)	3 recording weather stations	U. Bonn/ IMPETUS, S. Giertz sgiertz@uni-bonn.de/ J. Burkhardt: j.burkhardt@uni-bonn.de		2001-2008	Secured
AL.Met_Or	Weather station	Ara (Intens. Local site)	1 recording weather station (Djougou)	IRD/ CATCH	S. Galle	2001-2008	Secured
AL.Met_G	Auto. Weather Station network	Gourma Mesoscale site	2 stations giving 15-min. 18 parameters	CNRS/CESBIO/IRD	E. Mougin	2004-2008	Secured
AE.Met_Na	Auto. Weather Station		2 automatic recording weather stations [illegible] Mesoscale site	INERA/EIER/IRD	L. Somé	2004-2008	Secured
AE.GPS_1	GPS station network	Regional Window	3 GPS stations over meridional transect	CNRS/IGN/SA bouin@ensg.ign.fr	M.-N. Bouin, O. Bock bock@aero.jussieu.fr	2005-..	Nat. Request
AE.RadX_O	X Band Hydromet. Radar	Donga Catchment (Super-Site)	X-Band poloarized weather radar	IRD/CATCH	M. Gosset	2004-2007	Secured
AE.Prof_T	Microwave profiler	Tamale/Ghana	14 channel microwave radiometer	U. Bonn	S.Crewell screwell@uni-bonn.de	2005-2007	EU Request
AE.RadK_T	Micro rain radar	Tamale/Ghana	Vertical pointing Ka-band radar	U. Bonn	S.Crewell	2005-2007	EU Request

*There is considerable overlap in these arrays, but each is the support of some specific investigation, while the whole of them support the global study of the WAM dynamics

B.2.4 Land-surface LOP and EOP

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Code	Instrument	Plate-form or site	Description	Institution/ Project	PI Name	Period of deployment	Funding
L.Rain_O	Recording raingauge network	Ouémé Catchment (Meso. Site)	31 Raingauges providing 5-min. Rainfall	IRD/ CATCH	C. Depraetere Depraetere @ird.fr	2001-2008	Secured
L.Rain_Od	Recording raingauge network	Donga Catchment (Super-Site)	14 Raingauges providing 5-min. Rainfall	IRD/ CATCH	C. Depraetere	2003-2008	Secured
E.Rain_Oa	Recording raingauge network	Aguima Catchment (Local Site)	9 Raingauges providing 1-min. Rainfall	U. Koln/ IMPETUS	A. Fink af@meteo.uni-koeln.de	2002-2008	Secured
E.Dsd_Or	Optical spectro granulometer	Ara Catchment (Intens. Local site)	PMtech Parsivel, laser disdrometer	IRD/ CATCH	M Gosset Gosset@hmg.inpg.fr	2005-2007	Secured
L.Rain_N	Recording raingauge network	Niamey Mesoscale site	30 Raingauges providing 5-min. Rainfall	IRD/ CATCH	T. Lebel lebel@hmg.inpg.fr	1990-2008	Secured
E.Rain_Nc	Recording raingauge network	Niamey Central Super-Site	5 Raingauges providing 5-min. Rainfall	IRD/ CATCH	T. Lebel	2004-2008	Secured

Code	Instrument	Plate-form or site	Description	Institution/ Project	PI Name	Period of deployment	Funding
E.Rain_G	Recording raingauge network	Gourma Mesoscale site	10 Raingauges providing 5-min. Rainfall.	CNRS/CESBIO/CATCH	E. Mougin	2004-2008	Secured
L.Run_O	Recording runoff network	Ouémé Catchment (Meso. Site)	12 Recording streamflow Stations	/	C. Peugeot Peugeot@ird.fr	2005-2008	Secured
L.Run_Od	Recording runoff network	Donga Catchment (Super-Site)	5 Recording streamflow Stations	/	S. Galle galle@ird.fr	2005-2008	Secured
L.Run_Oa	Recording water level network	Aguima Catchment (Local Site)	5 recording water level gauges	U. Bonn/ IMPETUS	S. Giertz sgiertz@uni-bonn.de	2001-2008	Secured
L.ADCP_O	acoustic doppler current profiler	Ouémé Catchment (Meso. Site)	Streamflow measurement	IRD/ CATCH	C. Peugeot	2003-2008	Secured
L.Run_N	Pool and creek level recording network	Niamey Central Super-Site	6 Recording streamflow Stations	IRD/ CATCH	L. Descroix descroix@ird.ne	2005-2008	Secured
L.Gwat_Od	Recoding piezometer network	Donga Catchment (Super-Site)	111 Piezometers recording level fluctuations with 1 mm accuracy	IRD/ CATCH	L. Seguis seguis@ird.fr	2001-2008	Secured
E.Gwat_Or	Recoding piezometer network	Ara (Intens. Local site)	5 Piezometers as above	IRD/ CATCH	L. Seguis	2004-2008	Secured
L.Gwat_Nc	Recoding piezometer network	Niamey Central Super-Site	7 Piezometers recording level fluctuations with 1 mm accuracy	IRD/ CATCH	G. Favreau Favreau@ird.fr	2004-2008	Secured
L.Sap_Gh	Sap flow station network	Hombori (Intens. Local site)	3 Sap flow stations	CNRS/CESBIO/CATCH	E. Mougin Mougin@cesbio.cnes.fr	2005-2007	Secured
L.PAR_Ga	PAR stations network	Gourma supersite	LAI and PAR measurements	CNRS/CESBIO/CATCH	E. Mougin	2003-2008	Secured
E.SW_Od	Soil water stations network	Donga Catchment (Super-Site)	Soil water profile, succion and temp.	IRD/ CATCH	S. Galle	2003-2008	EU Request
L.SW_Oa	Soil water stations network	Aguima Catchment (Local Site)	21 TDR-probes and 2 BWS sites with: TDR, Tensiometer, Suction cups.	U. Bonn/IMPETUS: S. Giertz/T. El-Fahem sgiertz@uni-bonn.de, elfahem@uni-bonn.de		2001-2008	Secured
E.SW_Nc	Soil water stations network	Niamey Central Super-Site	Soil water profile, succion and temp., neutron probe access tubes	IRD/CNES/CIRAD	L. Descroix	2004-2008	Nat. Request
E.SW_G	Soil water stations network	Gourma Mesoscale site	3 soil water profiles.	CNRS/CESBIO/IRD	E. Mougin	2004-2008	Secured

L.Depot_RW	Wet and Dry deposition network (4 stations)	IDAF network (4sites) Regional Window	Wet and dry deposition : Rainwater and Aerosol organic and mineral chemistry, Gases concentration (passive samplers)	LA/IDAF	C.Galy-Lacaux lacc@aero.obs-mip.fr	1996-2008	Secured
E.Rain_T	Recording raingauge network	Tougou (Local Site)	5 Raingauges providing 5-min. Rainfall	EIER/IRD/DMN	H. Yacouba	2004-2009	Secured
E.Rain_Nt	Recording raingauge network	North Titao (Local Site)	5 Raingauges providing 5-min. Rainfall	EIER/IRD/DMN	H. Yacouba	2004-2009	Secured
E.Run_Na	Recording runoff network	Nakambe	11 Recording streamflow Stations	EIER/IRD/DGIRH	H. Yacouba	2004-2009	Nat. Request
E.SW_T	Soil water stations network	Tougou (Local Site)	3 sites with TDR, Tensiometer	EIER	H. Yacouba	2004-2009	Nat. Request
E.SW_Nt	Soil water stations network	North Titao (Local Site)	3 sites with TDR, Tensiometer	EIER	H. Yacouba	2004-2009	Nat. Request

AE.Sound _O3	Radio-Sounding	Cotonou (Intens. local site)	P, T, U, Ozone probes, Vaisala	LA	V. Thouret thov@aero.obs-mip.fr	2005-2007	Part Nat. Req., Part EU Req.
AE.Aerosol _RW	Aerosols properties (physical-chemical and optical)	Lamto, Djougou, Banizoumbou	TEOM, Nephelometer, GRIMM counter, Aethalometer, Chemistry speciation (mineral , organic, metals)	LA /IDAF	C. Liousse lioc@aero.obs-mip.fr	2005-2010	Part secured, part National request
AE.Van _Or	Mobile Van - flux station (Pollution-characterization and emissions)	Cotonou/Djougou Abidjan/Lamto	Anthropogenic and biogenic NOx and COV emissions, energy budget; dynamic chambers and eddy covariance methods	LA	D. Serça serd@aero.obs-mip.fr	2005-2007	Part secured, part National request
AE.Dust _ST	Mineral dust network (3 Stations)	Sahelian transect	Photometer, TEOM, micro-lidars, wet and dry deposition	LISA/IRD/PHOTON-AERONET/CNR-ISAC	Jean-Louis Rajot rajot@lisa.univ-paris12.fr	2005-2009	Part secured, part EU request
AL.Aer_O	Photometer	Ouémé Catchment	Photometer	PHOTON/AERONET	P. Goloub	2005-2009	Secured
AE.Flux _D	Flux measurements	Dano Local site (Burkina Faso)	2 Eddy correlation systems (1 mobile, 1 stationary), 1 relaxed eddy-accumulation-system, scintillometer	FZK (IMK-IFU) / GLOWA-Volta	H. Kunstmann kunstmann@imk.fzk.de	2005-2007	Secured
AE.Chem_D	Chemistry analysis	Dano Local site (Burkina Faso)	C/N analyser, automated closed and dynamic chambers, GC/MS/FID/ECD and chemoluminescence analysis, 13C and 15N labelling techniques, TSI particle counter, Grim spectrometer, canopy analysers	FZK (IMK-IFU) / GLOWA-Volta & Virtual HGF-Institute	H. Kunstmann kunstmann@imk.fzk.de	2005-2007	Part secured, part EU request

B.2.5 Ocean – LOP, EOP

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Code	Instrument	Plate-form or site	Description	Institution/ Project	PI Name	Period of deployment	Period of deployment
OE.Buoy_P	PIRATA ATLAS buoys SVP drifters Lagrangian profilers ARGO + VOS (sst & sss)	Tropical Atlantic	10 Atlas buoys (4 in the Gulf of Guinea, east of 10°W). Number of SVP, ARGO depends upon cruises of opportunity VOS along merchant shiplines.	IRD-LEGOS : EGEE ORE PIRATA&SSS	B. Bourles bourles@ird.fr	2005-2007	Secured
OS.Flux_S		Ship in Gulf of Guinea	photometer for aerosols	IRD/EGEE MétéoFrance / EGEE	B.Bourlès, G.Caniaux guy.caniaux@meteo.fr	2005-2007	Nat. Request
OE.Drift_S		Ship in Gulf of Guinea	hydrology (water masses), currents, tracers, drifters (SVP) + Lagrangian profilers	IRD/EGEE	B. Bourles bourles@ird.fr	2005-..	Nat. Request

E.SW_D	Water cycle	Dano Local site (Burkina Faso)	Soil moisture, TDR system , streamflow	FZK (IMK-IFU) / GLOWA-Volta	H. Kunstmann kunstmann@imk.fzk.de	2005-2007	2005-2007
L.PAR_S	PAR/NIR radiation, surf. temp	Dahra Local site (Senegal)	1-4 sites with Light Sensors and IR brightness temperature (10/30 min values)	IGUC/INTEO	I. Sandholt is@geogr.ku.dk	2001-2005	Secured
L.SW_S	Rainfall, Soil moisture	Dahra Local site	1-4 sites providing 10/30 min values	IGUC/INTEO	I. Sandholt	2001-2005	Secured
E.Ev_S	Flux Profile	Dahra Local site	1 site providing 30 min values	IGUC/INTEO	I. Sandholt	2004-2005	Secured

• B.3 Planed use of the observations by Work-Packages

The table below provides the importance of each observing system to the objectives of the work-package.
The collor coding is as follows :

- Black for essential to the objectives of the WP
- Grey important
- White not relevant.

	Plate-form or site	PI Name	Integrative Science				Process Studies				Impact Studies				Tools and Methods			
			1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
AE.RS_Q*	Water Cycle Quadrilateral	S. Janicot	Black	Black														
AE.RS_T1*	Transect Sahel	D. Parker	Black	Grey		Grey	Black											
AE.RS_T2*	Meridional Transect	A. Fink	Black	Grey		Grey												
AE.RS_T3*	Northern stations	S. Janicot	Black	Grey														
AE.RS_T4	Northern quadrilateral	D. Parker	Black															
AE.Flux_Gh	**Gourma**Super-Site	C. Lloyd	Grey	Black	Black	Black			Black									
AE.Flux_Nc	**Niamey**Super-Site	C. Taylor	Grey	Black	Black	Black			Black									
AE.Flux_Od	**Donga**Super-Site	C. Taylor,	Grey	Black	Black	Black			Black									
AE.Flux_T2	Additional to the super-sites	C. Taylor,C. Lloyd	Grey	Black	Black	Black			Black									
AL.Met_Oa	**Aguima**(Intens. Local site)	S. Giertz	Grey	Grey	Black	Black			Grey									
AL.Met_Or	**Ara**(Intens. Local site)	S. Galle	Grey	Grey	Black	Black			Grey									
AL.Met_G	**Gourma**Mesoscale site	E. Mougin	Grey	Grey	Black	Black			Grey									
AE.Met_Na	**Nakambe Mesoscale site**	L. Somé	Grey	Grey	Black				Grey									
AE.GPS_1	Regional Window	M.-N. Bouin, O. Bock	Grey	Grey	Black	Grey			Grey									
AE.RadX_O	**Donga**Catchment (Super-Site)	M. Gosset		Grey		Black			Grey									
AE.Prof_T	**Tamale**/Ghana	S.Crewell							Grey									
AE.RadK_T	**Tamale**/Ghana	S.Crewell							Grey									
AE.Sound_O3	**Cotonou**(Intens. local site)	V. Thouret								Black					Grey	Grey		
AE.Aerosol_RW	Lamto, Djougou, Banizoumbou	C. Liousse	Black						Grey	Black					Grey	Grey		
AE.Van_Or	Cotonou/Djougou, Abidjan/Lamto	D. Serça	Black							Black					Grey	Grey		
AE.Dust_ST	Sahelian transect	Jean-Louis Rajot	Black						Grey	Black								
AL.Aer_O	**Ouémé**Catchment	P. Goloub							Grey	Black								
AE.Flux_D	**Dano** Local site (Burkina Faso)	H. Kunstmann	Grey	Black	Black	Black			Black	Black		Black						
AE.Chem_D	**Dano** Local site (Burkina Faso)	H. Kunstmann								Black								
L.Rain_O	**Ouémé**Catchment (Meso. Site)	C. Depraetere		Black	Black	Black			Black	Grey								

	Plate-form or site	PI Name	Integrative Science				Process Studies				Impact Studies				Tools and Methods			
			1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
L.Rain_Od	**Donga**Catchment (Super-Site)	C. Depraetere		Black	Black	Black			Black	Grey								
E.Rain_Oa	**Aguima**Catchment (Local Site)	A. Fink		Black	Black	Black			Black	Grey								
E.Dsd_ Or	**Ara**Catchment (Intens. Local site)	M Gosset		Black	Grey	Grey			Black	Black								
L.Rain_N	**Niamey**Mesoscale site	T. Lebel		Black	Black	Black			Black	Grey								
E.Rain_Nc	**Niamey Central**Super-Site	T. Lebel		Black	Black	Black			Black	Grey								
E.Rain_G	**Gourma**Mesoscale site	E. Mougin		Black	Black	Black			Black	Grey								
L.Run_O	**Ouémé**Catchment (Meso. Site)	C. Peugeot		Black					Black									
L.Run_Od	**Donga**Catchment (Super-Site)	S. Galle		Black					Black									
L.Run_Oa	**Aguima**Catchment (Local Site)	S. Giertz		Black					Black									
L.ADCP_O	**Ouémé**Catchment (Meso. Site)	C. Peugeot		Black					Black									
L.Run_N	**Niamey Central Super-Site**	L. Descroix		Black					Black									
L.Gwat_Od	**Donga**Catchment (Super-Site)	L. Seguis		Black					Black									
E.Gwat_Or	**Ara**(Intens. Local site)	L. Seguis		Black					Black									
L.Gwat_Nc	**Niamey Central Super-Site**	G. Favreau		Black					Black									
L.Sap_Gh	**Hombori**(Intens. Local site)	E. Mougin				Grey			Black									
L.PAR_Ga	**Gourma**supersite	E. Mougin							Black									
E.SW_Od	**Donga**Catchment (Super-Site)	S. Galle	Grey	Black	Black	Black			Black									
L.SW_Oa	**Aguima**Catchment (Local Site)	S. Giertz	Grey	Black	Black	Black			Black	Grey								
E.SW_Nc	**Niamey Central Super-Site**	L. Descroix	Grey	Black	Black	Black			Black	Grey								
E.SW_G	**Gourma**Mesoscale site	E. Mougin	Grey	Black	Black	Black			Black	Grey								
L.Depot_RW	IDAF network (4sites)Regional	C.Galy-Lacaux	Black						Grey	Black					Grey	Grey		
E.Rain_T	**Tougou**(Local Site)	H. Yacouba		Black	Black	Black			Black	Grey								
E.Rain_Nt	**North Titao** (Local Site)	H. Yacouba		Black	Black	Black			Black	Grey								
E.Run_Na	**Nakambe**	H. Yacouba		Black					Black									
E.SW_T	**Tougou**(Local Site)	H. Yacouba	Grey	Black	Black				Black	Grey								
E.SW_Nt	**North Titao** (Local Site)	H. Yacouba	Grey	Black	Black				Black	Grey								
E.SW_D	**Dano** Local site (Burkina Faso)	H. Kunstmann	Grey	Black	Black				Black	Grey								
L.PAR_S	**Dahra** Local site (Senegal)	I. Sandholt				Grey			Black	Grey								
L.SW_S	**Dahra** Local site	I. Sandholt	Grey	Black		Grey			Black	Grey								
E.Ev_S	**Dahra** Local site	I. Sandholt		Black		Grey			Black	Grey								
OE.Buoy_P	**Tropical Atlantic**	B. Bourles	Black					Black										
OS.Flux_S	Ship in **Gulf of Guinea**	G.Caniaux	Grey					Black										
OE.Drift_S	Ship in **Gulf of Guinea**	B. Bourles	Grey					Black										