African **M**onsoon **M**ultidisciplinary **A**nalyses
Afrikanske **M**onsun**:** **M**ultidisiplinære **A**nalyser
Análisis **M**ultidisciplinario del **M**onzòn **A**fricano
Afrikaanse **M**oesson **M**ultidisciplinaire **A**nalyse
Analisi **M**ultidisciplinare per il **M**onsone **A**fricano
التحليل المتعدد التخصصات للموسميات الأفريقية
Afrikanischer **M**onsun: **M**ultidisziplinäre **A**nalysen
. **A**nalyses **M**ultidisciplinaires de la **M**ousson **A**fricaine

The International Science Plan for AMMA 2010-2020

Initial version v0.0: 6 July 2009

First revised version v1.0: 11th March 2010

Final version v2: 10th December 2010

Coordinated and Edited by: Jean-Luc Redelsperger, Arona Diedhiou, Serge Janicot, Aude Sonneville, Chris Thorncroft

With contributions from: Ernest Afiesimama, Abel Afouda, Abou Amani, Sophie Bastin, Olivier Bock, Aaron Boone, Bernard Bourles, Peter Brandt, Eric Brun, Guy Caniaux, Bernard Cappelaere, Luc Descroix, Hamath Dia, Arona Diedhiou, Hervé Douville, Laurence Eymard, Andreas Fink, Laurence Fleury, Bernard Fontaine, Amadou Gaye, Pierre Hiernaux, Serge Janicot, André Kamga, Cheikh Kane, Harouna Karambiri, Laurent Kergoat, Peter Knippertz, Jean-Philippe Lafore, Kathy Law, Thierry Lebel, Fanny Lefevre, Cathy Liousse, Céline Mari, Béatrice Marticorena, Nadège Martiny, Cheikh Mbow, Ole Mertz, Andy Morse, Eric Mougin, Aminata Ndiaye, Abé Delfin Ochou, Lekan Oyebande, Doug Parker, Christophe Peugeot, Jean-Luc Redelsperger, Claire Reeves, Odile Roussot, Paolo Ruti, Luc Sigha, Leopold Somé, Aude Sonneville, Benjamin Sultan, Chris Taylor, Laurent Terray, Chris Thorncroft;
and **participants to the AMMA-Afrique Meeting** on prospective on the future of AMMA (25-27 February 2009) in Ouagadougou (Burkina-Faso)

Special thanks to Dave Parsons, Head of WWCRP/WMO for his very helpful feedback on earlier version

Executive Summary

AMMA, African Monsoon Multidisciplinary Analyses, launched in 2002, is an international interdisciplinary research program concerned with the variability of the West African Monsoon (WAM) and its impacts on communities in that region.

Purpose

While large uncertainties remain about future prospects for regional climate variability and change in West Africa (IPCC 2007), the impacts of climate variability on the continent, especially in the Sahelo-Saharan zone, are already making themselves felt. Observations have shown that this region experienced one of the largest rainfall deficits on the planet last century. The region is particularly vulnerable to weather and climate variability. This is due to the societal dependence of various activities on weather and climate, such as rain-fed agriculture (on which 80% of Sahel's population depend). Economic and institutional capacities are often too limited to confront situations and adapt to their consequences.

Researchers from Africa, Europe and the USA are working together to study crucial questions posed by these issues. The need to improve weather and climate forecasting for implementation of early warning systems motivated the scientific community to define three major objectives for AMMA:

- 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 variability of the WAM to issues of health, water resources, food security and demography for West African nations and defining and implementing relevant monitoring and prediction strategies.
- To ensure that the multidisciplinary research carried out in AMMA is effectively integrated with prediction and decision making activity.

Phase 1 of AMMA 2002-2010

Strong international multi-agency coordination generated a research community of 600 committed participants. Within this community, 250 African researchers, grouped into a network called AMMA-Africa, have been working on AMMA science.

Thanks to this international coordination, AMMA has achieved a lot during its first phase: 500 papers in quality peer-reviewed publications, including 10 special issues; the organization of international conferences (Dakar 2005, Karlsruhe 2007 and Ouagadougou 2009) bringing together an average of 400 researchers; an unprecedented multi-scale multidisciplinary database used across the world and mirrored in Africa; the deployment of long-term observation systems since 2001, and more far-reaching field campaigns between 2005 and 2007, with several periods of intense observation.

After 8 years of activity, AMMA has become a flagship research program on climate and meteorology in West Africa and is now planning for the next 10 years. The research has lead to significant advances in our knowledge and understanding of the multi-scale multidisciplinary aspects of the coupled ocean-atmosphere-land WAM system – going a long way to addressing the first objective of AMMA. The AMMA program has also succeeded in laying the groundwork in terms of science and establishing research collaborations to address its second and third objectives.

Among the many highlights of AMMA, the program has achieved:

- major progress in understanding the continental water cycle, with measurements and models synthesized from scales of meters to the whole continent;
- comprehensive measurements and analysis of the ocean dynamics in the Gulf of Guinea, and their interaction with the monsoon system;
- new understanding of land-atmosphere interaction, and its role in weather and climate prediction for the region;
- for the first time, a comprehensive understanding of the emissions of climatically important gases and aerosol particles from West Africa into the global atmosphere;
- programs of measurements of health, agricultural and water systems, coordinated with environmental measurements and analyses;

Training and education has been a priority for AMMA. AMMA has helped with the training of about 160 PhD students, of which half were African. About 80 doctoral theses have already been completed, of which 28 were by Africans. Three summer schools, and four training workshops were successfully implemented bringing together students, researchers and forecasters from Africa and all over the world. Through AMMA, new Masters programs have also been established. All of these activities demonstrate AMMA's emphasis on education and training.
The strong intention of AMMA communication is to diffuse knowledge and to increase awareness of issues related to weather and climate and their impacts on societies, especially in Africa.

Phase 2 of AMMA: Scientific priorities

AMMA's 2nd Interantional Scientific Plan hinges on 3 key interacting research themes: (1) interactions between society, environment and climate, which necessitate the second theme: (2) study of predictability and improvement of meteorological, seasonal and climate forecasting, which itself requires the third theme: (3) continued effort to enrich our knowledge of the monsoon system.

(1) Society, Environment and Climate Interactions

Study of these interactions is an essential aspect of the 2nd phase of AMMA. The research will be organized around seven broad themes of scientific study: (i) water resources, (ii) land use, land cover and productivity, (iii) agriculture and food security, (iv) health, (v) energy, (vi) ecosystems, (vii) urban zones and African megacities.

(2) Weather, seasonal and climate predictability and forecasting

The AMMA program will work towards improving our ability to make weather and climate forecasts, and increasing our confidence in climate change projections. In order to do this, the

knowledge acquired from phase 1 must be "pulled-through" to improve dynamical models used for weather and climate prediction.
The research activity will be organized around 4 four major themes: (i) Evaluation and improvement of models; (ii) Utilization of current models (by way of new tools, ensemble prediction systems for example); (iii) Improvement of use of available observations (satellite observations, for example); and (iv) Recommendation and implementation of permanent observing systems to improve monitoring capabilities and forecasts. These themes will be promoted equally for weather (e.g. mesoscale convective storms, easterly waves and Kelvin waves, tropical cyclogenesis) and climate (intra-seasonal, seasonal and inter-annual to decadal) forecasting, as well as for climate change scenarios.
One of the essential aspects of integrating the knowledge acquired into improvement of forecasting models is the reinforcement of links between the AMMA scientists and operational centers, represented by people working on model improvement and data assimilation.

(3) Monsoon system
Improving dynamical models for weather and climate prediction requires continued improvements and refinements in our knowledge and understanding of WAM variability and predictability. The second phase of AMMA is focused on the essential feedback loops at three key scales: weather, intra-seasonal and multi-annual.
At the **weather scale** (less than 10 days), emphasis is placed on interactions; between convection and its environment, between ocean, atmosphere and continental surface, and between chemistry, aerosols and atmosphere.
The studies at the **intra-seasonal time scale** (10-90 days) will receive increased emphasis in this second phase to meet the demands of society (forecasting of dry intervals in the monsoon, useful for agriculture for example) but also to move ahead in our understanding of the annual cycle. The promising avenues opened during phase 1 must be followed up in greater depth, particularly the role of the ocean and its interactions with the atmosphere and interactions with the other tropical regions and mid-latitudes.
The **multi-annual time scales** (inter-annual, decadal and climate change) are still a major concern for AMMA. At the inter-annual to decadal time scale, AMMA is continuing to assess the relative contributions of WAM variability to the key feedback loops between the WAM and the different ocean basins, the continental surfaces and aerosols.
In parallel, AMMA must work towards better understanding of the nature and causes of human-induced climate change, particularly in regard to the disagreement between projections for the 21^{st} Century presented in the last IPCC report.
Crossing these scale-based studies, AMMA also aims to extend the understanding of energy and water cycles of the WAM system (with hydrological studies of watersheds for example).

Observations

In order to support the whole range of these studies, AMMA must continue to develop and implement its strategy for observations with, as the backbone, the maintenance of environmental monitoring systems over the long term. Four major objectives will be pursued:

(i) Long term maintenance and improvement of observing systems installed before or thanks to AMMA (for example AMMA-CATCH, PHOTONS-AERONET, PIRATA, SSS, GPS, IDAF). They are essential for accurate documentation, over a wide range of scales, of climate, the water cycle, the coastal environment, vegetation, soil, agricultural and socio-economic transitions

(ii) Maintenance of the operational observations (atmosphere, continental surface and ocean) at a level as close as possible to that reached during the first phase of AMMA, and improvements in the areas where AMMA was not able to do this.

(iii) Ensure the best links between these research observations, data from operational networks and satellite observations, making best use of the fact that some satellite missions relevant for AMMA have recently been launched or will be launched in the near future.

(iv) Ensure that all the data is available for a wide community, including operational agencies and research scientists in Africa and overseas.

Moreover, AMMA supports the implementation of new experimental campaigns for studying the key processes which were not sufficiently dealt with in the first phase, including especially those that relate to evolution of the Atlantic cold tongue and the Saharan heat low.

Governance and Coordination

It is essential now more than ever before for AMMA to build up its international collaboration. In its second phase, AMMA must be coordinated, as a program enriched with contributions and collaborative ventures generated by the many initiatives under way, and the associated sources of funding, which otherwise runs the risk of dispersion of efforts. In this framework, the African community of AMMA (AMMA-Africa), financed more strongly than during the first phase by sources managed in Africa, must be supported by a stronger system of governance.
For these reasons and to meet the scientific and human challenges, the coordination of AMMA becomes even more vital for the program's success and necessitates the constitution of a permanent International Executive Office (IEO).

Capacity development and training

Education and training activities are strong priorities for AMMA phase 2. In addition, the program intends to reinforce the capacity in Africa in term of information systems (gathering, processing, storing, distributing and use of information), data processing facilities and data bases for resources, environment, climate and meteorology. A larger human and funding mobilization is necessary to support research and applications.

Communication of Science

Whether it is oriented towards the community of researchers, the media, decision-makers or end-users, the diffusion of new scientific knowledge remains a major issue for AMMA. AMMA continues to contribute to awareness-building among the general public, particularly in Africa, on the societal objectives of research conducted in the program. The 2nd phase will give the opportunity to set up a network of people active in scientific communication, generated from the network of journalists formed during phase 1. Awareness-building of end-users and decision-makers in Africa can be achieved by reinforcing the partnership with local institutions and associations.

Résumé exécutif

Démarré en 2002, AMMA, Analyse Multidisciplinaire de la Mousson Africaine, est un programme de recherche international et interdisciplinaire qui étudie la variabilité de la Mousson de l'Afrique de l'Ouest (MAO) et ses impacts sur les populations.

Motivation

Malgré les incertitudes sur les perspectives du climat régional africain (GIEC 2007) en raison de l'imprécision des modèles actuels sur cette région et de la complexité du climat africain, les impacts de la variabilité climatique sur le continent, en particulier dans la région sahélo-saharienne se font déjà sentir. C'est en effet dans cette région que le plus grand déficit régional de pluie a été observé au siècle dernier. Elle est particulièrement vulnérable en raison des fortes amplitudes de ses variabilités météorologique et climatique, d'une dépendance prépondérante des activités sociétales à ces variabilités, comme l'agriculture pluviale (80% de la population au Sahel en dépend) et de capacités économique et institutionnelle souvent limitées pour faire face et s'adapter aux conséquences.

Des chercheurs d'Afrique, d'Europe et des États-Unis se sont regroupés pour étudier les questions primordiales posées par ces enjeux. La nécessité d'améliorer les prévisions météorologiques et climatiques nécessaires à la mise en place des systèmes d'alerte précoce a motivé la communauté scientifique à définir trois objectifs majeurs pour AMMA :

- Améliorer notre compréhension de la Mousson et ses influences sur l'environnement régionalement et globalement.
- Produire les connaissances nécessaires pour relier la variabilité de la MAO aux problèmes de santé, de ressources en eau, de sécurité alimentaire et de démographie pour les pays d'Afrique de l'Ouest, et pour définir les stratégies de prévision et de surveillance appropriées.
- S'assurer que la recherche d'AMMA est intégrée aux activités de prévisions & de prises de décision

Phase 1 d'AMMA 2002-2010

La forte coordination internationale multi-organismes a permis la création d'une communauté de recherche de 600 personnes très impliquées dans laquelle plus de 250 chercheurs africains, regroupés en un réseau AMMA-Afrique, travaillent sur la science d'AMMA.

Grâce à cette coordination internationale, ces équipes dynamiques sont à l'origine des grandes réussites de la première phase d'AMMA : la parution de 500 publications à comités de lecture dont 10 éditions spéciales, l'organisation de conférences internationales (Dakar 2005, Karlsruhe 2007 et Ouagadougou 2009) réunissant une moyenne de 400 chercheurs, une base de données multi-échelles multidisciplinaires sans précédent utilisée à travers le monde et répliquée en Afrique, la mise en œuvre coordonnée de systèmes d'observation sur le long terme depuis 2001, des campagnes de terrain plus vastes entre 2005 et 2007 avec plusieurs périodes d'observation intense.

Après 8 ans d'activité et en ouverture des 10 ans à suivre, AMMA est aujourd'hui le programme de référence sur le climat et la météorologie en Afrique de l'Ouest. L'ensemble des compétences rassemblées a permis des progrès significatifs sur nos connaissances et notre compréhension des aspects multi-échelles et multi-disciplinaires du système couplé océan-atmosphère-continent de la mousson ouest-africaine.

Parmi les nombreux faits marquants d'AMMA, le programme a abouti à :

- De grands progrès dans la compréhension du cycle de l'eau continental, avec des mesures et des modèles synthétisés des échelles du mètre à l'ensemble du continent
- Des mesures et des analyses détaillées de la dynamique de l'océan dans le golfe de Guinée et son interaction avec le système de la mousson
- Une nouvelle compréhension de l'interaction surface-atmosphère et son rôle dans la prévision météorologique et climatique de la région
- Pour la première fois, une compréhension globale des émissions de gaz importants pour le climat et des particules d'aérosol d'Afrique de l'Ouest dans l'atmosphère de la planète
- Des programs de mesures des systèmes de santé, d'agriculture et d'eau en coordination avec des mesures et des analyses environnementales

AMMA a permis aussi de construire les bases scientifiques et une communauté nécessaires pour répondre pleinement aux deuxième et troisième objectifs du program.

La communauté AMMA, continuellement enrichie par la formation, a engagé près de 160 étudiants en doctorat dont la moitié Africains, 80 thèses sont déjà soutenues dont 28 par des étudiants africains. Trois écoles d'été et quatre ateliers de formation réunissant des étudiants, des chercheurs et des prévisionnistes de l'Afrique et du monde entier ont été un succès. A travers AMMA, de nouveaux Masters sont aussi établis. Toutes ces activités sont les réponses actives du soutien d'AMMA à l'enseignement et la formation.

L'essor considérable de la communication scientifique d'AMMA vers tous ses publics a répondu à une volonté forte du programme pour la diffusion des connaissances et plus particulièrement dans sa participation à la sensibilisation en Afrique.

Priorités scientifiques de la Phase 2 d'AMMA

Le 2ème plan scientifique international d'AMMA s'articule autour de 3 grands domaines qui s'imbriquent entre eux : (1) les interactions entre société, environnement et climat nécessitent (2) d'étudier la prévisibilité et d'améliorer la prévision météorologique, saisonnière et climatique, lesquelles requièrent (3) de poursuivre d'enrichir nos connaissances du système mousson.

(1) Interactions Société Environnement et Climat

L'étude des interactions entre la société, l'environnement et le climat est un aspect essentiel de la phase 2 d'AMMA. La recherche sera organisé autour de sept grandes thématiques d'études scientifiques de ses interactions avec la variabilité climatique et les aléas météorologiques: (i) ressources en eau, (ii) utilisation des terres, occupation des sols et productivité, (iii) agriculture et sécurité alimentaire, (iv) santé, (v) énergie, (vi) écosystèmes, (vii) zones urbaines et mégapoles africaines.

(2) Prévisibilité et Prévision météorologique, saisonnière et climatique

Le programme doit œuvrer à l'amélioration des prévisions météorologiques et climatiques, et de notre confiance dans les projections du changement climatique. Pour ce faire, les connaissances acquises de la Phase 1 doivent être intégrées dans les modèles pour améliorer nos capacités à prévoir le temps et les variabilités climatiques. Le programme AMMA s'organise sur 4 axes : (i)

Évaluer et améliorer les modèles (ii) Exploiter les modèles actuels (via de nouveaux outils, des systèmes de prévision d'ensemble par exemple) (iii) Améliorer l'exploitation des observations disponibles (les observations par satellite, par exemple) et (iv) Recommander et mettre en œuvre des systèmes d'observation pérennes pour améliorer les capacités de surveillance et les prévisions. Ces axes seront développés tant pour la prévision météorologique (les systèmes convectifs de méso-échelle, les ondes d'est et de Kelvin, la cyclogénèse tropicale par exemple) que climatique (intrasaisonnière, saisonnière et interannuelle à décennale) et aux scénarii de changement climatique.

Un des aspects essentiels de l'intégration des connaissances dans l'amélioration des modèles de prévision est le renforcement des liens entre les scientifiques d'AMMA et les centres opérationnels, riches des personnes ressources travaillant sur l'évaluation, l'élaboration du modèle ou encore l'assimilation de données.

(3) Système de Mousson

Avoir de meilleurs modèles pour des prévisions plus fiables impliquent de continuer à approfondir nos connaissances et notre compréhension de la variabilité et la prévisibilité de la MAO. La deuxième phase se focalise sur les boucles de rétroaction essentielles à trois échelles pertinentes: météorologique, intra-saisonnière et pluriannuelle.

À **l'échelle météorologique** (moins de 10 jours), l'accent est mis sur les interactions : entre systèmes convectifs et leur environnement, entre océan, atmosphère et surface continentale, et entre chimie, aérosols et atmosphère.

Les études aux **échelles de temps intra-saisonnière** (10-90 jours) sont d'une importance particulière dans cette deuxième phase pour répondre à la demande sociétale (prévision des pauses sèches de la mousson pour l'agriculture par exemple) mais aussi pour avancer sur notre compréhension du cycle annuel. Les voies prometteuses ouvertes durant la phase 1, doivent être approfondies, en particulier le rôle de l'océan et de ses interactions avec l'atmosphère et les interactions avec les autres régions tropicales et les latitudes tempérées.

Les **échelles de temps multi-annuelle**, (interannuelle, décennale et changement climatique) restent une préoccupation majeure pour AMMA. Aux échelles de temps interannuelles à décennales, AMMA continue d'évaluer les contributions relatives à la variabilité de la MAO des principales boucles de rétroaction entre la MAO et les différents bassins océaniques, les surfaces continentales et les aérosols.

Parallèlement, AMMA doit œuvrer à une meilleure compréhension de la nature et des causes des changements climatiques d'origine anthropique, particulièrement compte tenu du désaccord entre les projections pour le 21ème siècle présentées dans le dernier rapport du GIEC

De manière transversale à ces études d'échelles, AMMA vise également à étendre la compréhension des cycles d'énergie et de l'eau du système de la MAO (avec des études hydrologiques des bassins versants par exemple).

Observations

Pour soutenir l'ensemble de ces travaux, AMMA doit continuer à développer et mettre en œuvre sa stratégie d'observations avec, pour colonne vertébrale, le maintien de la surveillance environnementale sur le long terme. Quatre grands objectifs doivent être poursuivis:

(i) Maintenir et compléter les systèmes d'observation sur le long terme qui ont été installés avant ou grâce à AMMA (par exemple AMMA-CATCH, PHOTONS-AERONET, PIRATA, SSS, GPS, IDAF). Ils sont indispensables pour documenter de façon précise et sur une large gamme d'échelles, le climat, le cycle de l'eau, l'environnement côtier, la végétation, le sol, les transitions agronomiques et socio-économiques ainsi que la variabilité inhérente de ces différentes composantes du système environnemental.

(ii) Maintenir les observations opérationnelles (Atmosphère, surface continentale, océan) à un niveau aussi proche que possible de celui atteint au cours de la première phase d'AMMA et améliorer les domaines où AMMA n'a pas été en mesure de le faire.

(iii) Assurer de meilleurs liens entre ces observations de recherche et des réseaux opérationnels avec les observations par satellite, d'autant plus que certaines missions satellitaires pertinentes pour AMMA viennent d'être lancées ou seront lancées prochainement.

(iv) S'assurer que l'ensemble des données soient disponibles pour une large communauté, incluant les agences opérationnelles et les chercheurs en Afrique et à l'extérieur.

D'autre part, AMMA soutient la mise en œuvre de campagnes expérimentales pour des études de processus clefs insuffisamment échantillonnés dans la première phase, dont tout particulièrement la langue d'eau froide Atlantique et la dépression thermique Saharienne.

Gouvernance et Coordination

Aujourd'hui, encore plus qu'hier, la collaboration internationale d'AMMA est indispensable. Dans sa deuxième phase, AMMA doit être coordonné comme un programme enrichi des contributions et collaborations qui émanent des nombreuses initiatives en cours et sources de financement, qui peut tendre à une dispersion des efforts. Dans ce cadre, la communauté africaine d'AMMA (AMMA-Afrique) financée de manière plus importante que durant la première phase par des sources gérées en Afrique, doit mettre en place une gouvernance.

Pour ces raisons et pour répondre aux défis scientifiques et humains, la coordination d'AMMA devient plus critique pour la réussite du programme et nécessite un bureau exécutif international permanent.

Développement des capacités et la formation

En plus de poursuivre les activités d'enseignement et de formation, forte priorité de la 2ème phase d'AMMA, le programme veut renforcer les capacités des systèmes d'information (regroupement, classification, traitement et diffusion de l'information) de traitement de données et de leur gestion en base pour les ressources, l'environnement, le climat et la météorologie. Une mobilisation plus forte humaine et financière est nécessaire pour appuyer les recherches et les applications.

Communication de la Science

Que ce soit en direction de la communauté des chercheurs, des médias, des décideurs ou bien des utilisateurs, la diffusion des connaissances scientifiques acquises reste un enjeu majeur. AMMA continue à participer à la sensibilisation du public, en particulier africain, sur les objectifs sociétaux de la recherche effectuée dans le program. La 2ème phase sera l'occasion de mettre en place des réseaux d'acteurs de la communication scientifique à partir du réseau de journalistes créé durant la phase 1. La sensibilisation des utilisateurs et des décideurs en Afrique passe par le renforcement du partenariat avec les institutions et associations locales.

Introduction

Launched in Niamey in February 2002, AMMA is an international program to improve our knowledge and understanding of the West African monsoon (WAM) and its variability and has emphasized daily-to-decadal timescales including climate change. AMMA is motivated by an interest in fundamental scientific issues and by the societal need for improved prediction of the WAM and its impacts on West African nations (Redelsperger et al 2006).

The international AMMA program has been motivated by three overarching aims:

1) To improve our understanding of the WAM and its influence on the physical, chemical and biological environment regionally and globally.
2) To provide the underpinning science that relates variability of the WAM to issues of health, water resources, food security and demography for West African nations and defining and implementing relevant monitoring and prediction strategies.
3) To ensure that the multidisciplinary research carried out in AMMA is effectively integrated with prediction and decision making activity.

AMMA has made considerable progresses since the questions rose in the first Science Plan (ISP-1) (May 2005). The AMMA community (600 committed participants including 250 African researchers) generated by the international coordination has achieved a lot: 500 papers in quality peer-reviewed publications, 3 AMMA international conferences bringing together an average of 400 researchers, an unprecedented multi-scale multidisciplinary database used across the world and mirrored in Africa, the deployment of long-term observation systems since 2001, more far-reaching field campaigns between 2005 and 2007 with several periods of intense observations.

It is now timely to discuss the future direction and priorities for the AMMA program. The purpose of this document (ISP-2) is to present research plans for the next 10 years, starting from what AMMA has achieved and the key gaps that remain.
AMMA's 2nd Scientific Plan hinges on 3 key interacting research themes (Sections 2a, 2b and 2c):

- Interactions **between society, environment and climate,** which necessitates the second theme:
- Study of **predictability and improvement of weather, seasonal and climate forecasting**, which itself requires the third theme:
- Continued effort to enrich our knowledge of the **monsoon system**.

In section 2d, recommendations and actions are given for the observations necessary to address these science questions, including sustained environmental and socio-economic monitoring, process studies field experiment and use of satellite products and new satellite missions.

The education and training activities are strong priorities for AMMA phase 2 (Section 3). In addition, the program intends to reinforce the capacity in Africa in term of information system (gathering, processing, storing, distributing, use), data processing facilities and databases for resources, environment, climate and meteorology.

Whether it is oriented towards community of researchers, the media, decision-makers or end-users, the diffusion of scientific knowledge acquired remains a major issue for AMMA. As outlined in Section 4, efforts will be also pursued to contribute to awareness building among the general public, particularly in Africa, on the societal objectives of AMMA research.

Today AMMA is a large program enriched with numerous contributions and collaborative projects. It is essential more than ever before for AMMA to have a strong and a powerful international coordination with a permanent International Executive Office. IEO will also help to support the AMMA governance for African network. AMMA is funded in Africa more extensively than before by sources managed in Africa, must be supported now by a dedicated governance (Section 5).

1. General motivations

A regional climatic change

The dramatic change from wet conditions in the 50s and 60s to much drier conditions since the 70s over the whole region of West Africa represents one of the strongest interdecadal signals on the planet in the 20th century. Superimposed on this, marked interannual variations in recent decades have resulted in extremely dry years and droughts with devastating environmental and socio-economic impacts. Such variability has raised important issues related to sustainability, land degradation, food and water security in the region.

The global context of climate change

The Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC) has warned the international community on an expected increase in many regions of the world of the average temperatures and sea levels as well as a possible increase of the frequency and intensity of major natural hazards such as droughts, heat waves, floods, fires... Although they are many uncertainties in regional projections of these changes, especially in the tropics, it is obvious that these changes will impact on water supply, vegetation, animals and people. According to the IPCC (2007), in the semi-arid regions where water availability per capita is low, there will be a decrease of water availability in future climate scenarios, and for the fact of climate change, 75 to 250 million people will be exposed to water scarcity and water stress and a significant food shortage is expected. Arid and semi-arid ecosystems generally located in marginal areas, are subject to disturbances of all kinds (irreversible loss of biodiversity, wildfires, change in natural habitats, etc.). If the temperature increase exceeds 2°C (IPCC, 2007), about 20 to 30% of plant and animal species are threatened with extinction. In these conditions, significant changes in the structure and function of ecosystems are expected, which will have negative consequences on biodiversity, and goods and services rendered by them, including water and food supply. Moreover, there is an increase in the vulnerability of human health to climate change (rising temperatures and changing rainfall regimes) because droughts and floods increase disease vectors.

The impacts in Africa of climate change

These impacts will be particularly severe in developing countries in Africa where communities and economies of these countries depend highly on the direct use of local natural resources and where widespread poverty limits capacity to cope with climate variability and natural disasters (EU 2007). Africa is known to be particularly vulnerable to climate change due to a combination of naturally high levels of climate variability, high reliance on climate sensitive activities such as rain-fed agriculture and limited economic and institutional capacity to cope with and adapt to climate variability and change. 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. Vulnerability may be further increased in association with the effects of climate change and other factors linked to the fast growing population such as land degradation and water pollution. High exposure and low adaptive capacity is experienced from an individual through to national level so that the ability to anticipate, respond and recover effectively from climate related shocks is limited.

Global role of West Africa Monsoon

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 West African rainfall and Atlantic hurricane frequency. Studies during phase 1 of AMMA showed that strong two-way interactions between mid-latitude and WA region existed even at scale of few days. In addition to these large-scale interactions, we know that a majority of hurricanes that form in the Atlantic originate from weather systems over West Africa. 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, 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 both regionally and global climate. Sahara and Sahel regions are the world's largest sources of atmospheric dust. Both the fire aerosols and dust play a major role in radiative forcing and in cloud microphysics, and thus are an important part of WAM system.

AMMA scientific motivation

Urgent actions are required to tackle the issues caused by WAM variability and these actions need to be supported by the best knowledge available. It is therefore urgent to revitalize research in Africa in this field through an integrated interdisciplinary framework that will increase our understanding of the problem and support decision-making. Motivated by this and recognizing the important need to develop strategies to reduce the socioeconomic impacts of WAM variability, AMMA needs to continue to develop around these issues researches in all West African countries and in the World. Though major advances have been achieved during the Phase 1 of AMMA, there are still a lot of challenges. We are currently hindered in providing skilful predictions of WAM variability and its impacts. There are still fundamental gaps in our knowledge of the coupled atmosphere-land-ocean system. 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. Finally, there is a need to maintain the efforts from Phase 1 of AMMA to develop an integrative science linking the studies on WAM variability with those on food, water and health impacts. More effort needs to be made to integrate scientists working in these different areas.

Integrated regional program

International programs exist on topics outlined above (e.g. WCRP, WWRP, IGBP). AMMA is a regional approach with research objectives over West Africa crosscutting most of the programs, which have endorsed AMMA. AMMA is also working with bodies as WMO and ICSU. While the emphasis of AMMA-2 remains focused on the West African region, the methodologies and tools developed in AMMA could be transferred to groups working in other regions of Africa and especially East and Central Africa, as exemplified by THORPEX-Africa, which has benefited from AMMA's experience in West Africa. The integrated generic approach developed within AMMA can be a seed for other initiatives led by other people or funding agencies or countries, or encapsulated by bodies such as WMO and ICSU.

2. Research Themes

2a Interactions Society, Environment and Climate

Background

As outlined above, despite uncertainties regarding the African Regional Climate Outlook (IPCC 2007) because of the vagueness of current models and the complexity of the African climate, it is recognized that the impacts of climate variability on the continent, particularly in the Sahel-Saharan region are already being felt, reflected in the increase in climate extremes, the spread of impacts on land surface conditions and loss of biodiversity in this region.

Usually, perspectives of society-environment-climate interactions studies are considered from either the destructive impact of humans on their local environment or the impact of 'natural' forces (climate) on societies. Human activities and environmental change should be viewed sometimes together as a co-evolutionary and adaptive. An example concerns the African farmers. Although having a low capacity to adapt to such changes, they have, however, survived and coped in various ways over time. Adaptation helps farmers achieve their food, income and livelihood security objectives in the face of changing climatic and socioeconomic conditions, including climate variability, extreme weather conditions such as droughts and floods. Farmers can reduce the potential damage by making tactical responses to these changes. Analyzing adaptation is therefore important for finding ways to help farmers adapt in the rural economies of Africa. Better understanding of how they have done this is essential for designing incentives to enhance private adaptation. Supporting the coping strategies of local farmers through appropriate public policy and investment and collective actions can help increase the adoption of adaptation measures that will reduce the negative consequences of weather and climate variabilities and changes in future climate, with great benefits to vulnerable rural communities in Africa.

More generally, African societies continue to experience the impacts of environmental change directly at a local/regional scale, through for example meteorological extremes, flooding, sea-level rise, drought, soil erosion, fire and pollution. As such, there is a need for a full understanding of societies-environment-climate interactions over cities, landscapes, catchments, coastal zones and ecosystems, and the production of tools and protocols that can offer sustainable management policies in the face of changing climate and social change. At this scale, two sets of questions about vulnerability and adaptation can be applied:

- How sensitive or resilient are modern ecosystems and socio-ecological systems to climate variability and changes and to increased stresses from human activities and climate?
- What are the appropriate sustainable management strategies for the future?

Objectives

Interactions between climate changes, environment and the preservation of biological diversity have to be understood at two levels: the evaluation of the vulnerability of ecosystems and populations to the impacts of climate in one hand, and ways of adapting to these phenomena on another hand. AMMA will therefore contribute to impact studies and will help to identify the more vulnerable sectors to climate change and variability.

The challenge is to understand the dynamics interactions between climate, ecosystem, including biodiversity, and society. In this context, it is no longer possible to isolate one part of the cause (the climate), the other effects (the impacts on the ecosystem) and the response of the disturbed system (adaptation of African societies). Indeed, the perturbed system reacts in turn on the disturbance (ecosystems on climate, policies adaptation to meet changes on climate and ecosystem).

In this framework, AMMA has to contribute to the provision of diagnostics of what is happening and what is expected to happen in relation to climate change and variability at regional and local scales. It is important to make clearly the potential implications of climate change on agriculture, ecosystems, energy or health. We need also to understand how the effects of climate change interact with other global changes in Africa (population growth, urbanization, land use changes, globalization of markets, poverty...) and how some of these changes contribute to modify climate.

AMMA research encompasses the interlinked issues of social, economic, political, and technological change; their consequences for the land surface and its water systems, the oceans, and the atmosphere; the resultant changes in the climate; and the impact of all the above on plant and animal biodiversity and human well-being. To this end, it is very useful for the ecological and socio-economic vulnerability facing the variability and climate change, to be treated in an integrated approach, with appropriate adaptation strategies that take into account development needs.

Understanding the role of and interaction between climate and the many other stresses present in African societies requires careful empirical analysis of case study situations. Synthesizing the results and insights from such studies may provide the basis for developing effective policies to address the challenge of current climate variability and future climate change within a framework that recognizes its interactions with other development challenges.

One of the challenges in managing the impacts of climate change on ecosystems is to have application studies. These studies, at both regional and local scales become an important issue in terms of scientific knowledge for the development of this region. However, analysis and predictive scenarios of the evolution of the local climate are lacking and hence the need for a strategy to monitor climate change and environment, as well as a strategy for using existing historical data and knowledge. Based on these observations, it is important to observe and predict the form of scenarios, the climate variability at a regional scale on medium-term (e.g. changes in rainfall), then bring them in terms of impacts and finally, scenarios of adaptation. The expected progress should be to be able to contribute to decision support in the areas of health, water resources, economic activities, and agriculture...

An objective is to deepen the knowledge (i) on the state of the environment in general, and climate in particular, and (ii) on the relationship between vulnerability (ecological, social and economic) and adaptation (preventative and reactive) in a context of climate change and variability.

Another objective is to propose adaptation strategies to climate variability and change that strengthens supports, stimulates, and promotes the principles of environmental governance adopted by countries. Knowing that the problem is global but the responses are local, national and regional strategies will involve producers, representatives of civil society, researchers and policymakers from West and Central Africa.

The ISP-1 (May 2005) acknowledged the importance of the work on the "science that relates variability of the WAM to issues of health, water resources, food security and demography" (as stated in the second aim of AMMA). Impacts of the WAM variability on four societal issues have been particularly addressed during the first phase of AMMA : i) Health, ii) Water resources, iii) Land productivity, and iv) Interactions Society-Environment-Climate.

Through exchanges between African scientists and end-users, it has become increasingly clear that AMMA has to contribute more to research programs on interactions between society-environment-climate (ISEC), building on the knowledge gained during the first phase of AMMA. Many research projects have already been developed and are still running at national and pan-national levels, new projects are developing and it is essential to ensure appropriate linkages between them and coordination where appropriate. Together with the geophysics research, AMMA has to develop appropriate climate products and information for ISEC and impact studies in the aim to contribute to adaptation and mitigation efforts, including the improvement of Early Warning Systems.

The material of present section 2a is largely based on the outcomes of a meeting of African community of AMMA (Ouagadougou, Feb 2009). Considering the state–of-the-art and ongoing activities, the meeting aimed at determining the burning scientific issues that the African AMMA community would wish to handle in the future. The meeting provided making the following recommendations on the research on interactions on Society-Environment-Climate, which should serve as the basis of international effort of AMMA. Clearly, this represents the first important step before the establishment of an implementation plan including the prioritization of issues, the scientific strategy and the development of links with other existing programs.

The African AMMA community has identified seven broad scientific themes in relation to weather and climate variabilities and climate change, which AMMA can contribute. Future research directions and priorities will be defined considering opportunities for funding and in strong collaborations with stakeholders, managers, and national institutions.

2a1 Water resources

Results from Phase 1 of AMMA

Observed changes at various scales

Historical climate and hydrological data analysis on catchments of various scales showed a deep modification of runoff regimes over this whole range of scales. At small scales, runoff coefficients increased in the Sahel region. Over the Sudanian region, a sharp decrease of the streamflows was observed from the small to the mesoscale. The large rivers fed by both Sahelian and Sudanian tributaries (Niger, Volta, Senegal) consequently underwent complex changes of their regime. A clear evidence was established regarding the role of land uses in hydrological processes in the Sahel. The underlying mechanisms have been understood for the Sahelian area, but the effects of land use change on the hydrologic cycle remain unclear further south, in the Sudanian and Guinean zones. It is now recognized that the conflicting impact of both rainfall regime and land use changes, require deeper studies on the proper hydrological modeling to be used for assessing the water resource impacts. Such studies have started in AMMA and need to be pursued.

Building of an African community

The West African community of hydrological scientists has been strengthened thanks to the AMMA program. It is better organized and has established links with the meteorological and climate community. It is enriched thanks to several young African scientists that have completed PhD in the AMMA framework.

Adaptation strategies

Several AMMA studies have started to study the various strategies of adaptation to climatic and environmental changes, which have been used during the past 30 years. Sociologists and environment jurists working together with climate experts led these pilot studies.

An example is the study of water resources management in Mali. This study was undertaken from the national level down to the village scale taking advantage from long-term observations over one of AMMA-CATCH meso-sites (Hombori, Gourma). At village scale, to analyze the social vulnerabilities on water resources, population was examined to assess action capacities facing climatic fluctuations. The social vulnerability facing the climatic risks was shown to be only a part of a larger system of vulnerabilities (access to health care services, resources and assets, cash, etc.). In such a context, the water shortage risk is perceived as an everyday life hazard that is managed through seasonal and locally specific responses. However, some norms of the social system may restrain the emergence of more sustainable initiatives for a better adaptation. After the great droughts of the 70’s and the 80’s the political and institutional decision-makers became strongly concern by environmental issues, leading to the Sahelian governments to build the CILSS. This political response on West Africa scale was followed in the 80’s by major changes at the institutional level: environment protection increased its status by shifting from the Department level within ministries to a more “autonomous” ministry level in charge of both the management of natural resources and livestock and the protection of the environment. In Mali, new public policy was established though slow implementation occurred. National and local representatives of the territorial governments and rural-oriented organizations have a limited capacity of influence on these policies and practices. This bolt can be considered as a politico-institutional vulnerability that may compromise the mitigation and adaptation efforts of the local communities to ecosystem transformations.

The strongest impacts of climate change in Africa are associated with rainfall and water availability. The probable increase in extreme events coupled with high vulnerability at all levels will greatly increase the risks of wide-ranging effects of disasters, with damaging consequences for economic growth. The need to invest in flood protection systems, water storage arrangements for accumulating reserves, irrigation and other productive uses is essential, as well as the need to prepare for disaster-response measures and integrated water resources management.

The variability of water resources results from a combination of anthropogenic and climatic factors. It is also strongly driven by the local to mesoscale properties of the watershed, The variability of the hydrologic cycle must be studied considering these properties and the related mechanisms. The AMMA-CATCH observing system highlights three contrasted contexts (sub-desertic, sahelian, sudanian), but the results must be extended to a larger scale (sub-continental). Multidisciplinary information is required for improved understanding to be developed. In spite of the crucial importance of these resources, few direct studies have been made of the effects of global warming on water resources in general and groundwater table replenishment in particular. Broader-scope research activity needs to be developed, as it is becoming urgent both to characterize the variability and availability of water and improve our understanding of the contribution of these resources to the overall hydrological cycle and its influence on ecosystems. Understanding of the local means of access to water, the use and management methods practiced by communities, coupled with the application of data produced by regional models to develop water-availability scenarios, could allow the development of tools to help decision-making for integrated management of water resources management and conservation of these resources.

Two different kinds of impacts related to water resources have been identified: i) water shortage/drought, and ii) flooding due to extremely intense or frequent MCS. The first type of impact is linked to the intra-seasonal to inter-annual time-scales of the monsoon system. Previous studies and AMMA results provide the basic knowledge and tools to build impact assessment tools for the near future. One has to bear in mind however that the effect of land use change on the water cycle in Sudanian and Guinean region has been given little attention so far compared to the Sahelian region. More studies are needed to identify the respective impacts of climate and environmental changes on the water resources. The second type of impact occurs at much shorter time scales (synoptic/MCS scale), and requires probably the development of new tools to be correctly investigated (accurate medium range rainfall forecast, flood propagation model, flood warning system). Studies with Numerical Weather Prediction Centers have started in the framework of collaborative work between Africa-THORPEX and AMMA.

Thus, it is important to pursue the characterisation of watersheds and aquifers to better understand local variability and use of water resources. Modelling the response of watersheds and aquifers to various stresses (rainfall, temperature, sampling ...) needs to be encouraged as well as using the outputs of regional models to develop scenarios of water availability. Finally, develop support tools for decision support programs for Integrated Management of water resources, protection of water resources will be an important challenge in the future.

2a2 Land use, cover and productivity

Results from Phase 1 of AMMA

AMMA looked at household strategies over different Sahelian countries. Households have generally increased their wealth, especially when they diversify out from agriculture. Rainfed crop cultivation is more sensitive to climate factors than livestock rearing and generally climate factors play a small role in household decision-making. Local strategies and national adaptation plans are not congruent, and the agricultural sector needs strong support in order to play a role in the future. While agriculture is still the most important source of income in rural areas, the perceived decline in agricultural production expressed in household surveys is corroborated by national statistics in several countries where the total grain production has not increased despite rapid population growth. It is not likely that climate variability and change has been a major driver of these events as none of the multiple approaches employed in AMMA were able to identify climate factors as having a strong weight in driving change. Apparent resilience of the land use system, however, might hamper transformation into alternatives modes of production that are able to meet the growing food demands for a rapidly increasing local population, complicating development efforts. Conclusions are that other political, economic and demographic factors are more important for development pathways in the Sudan-Sahel region. If the agricultural sector is to play a role in the future of Sudan-Sahel zone, strong support for agricultural development and rural adaptive capacity will be needed. Otherwise, off-farm work and migration will continue to increase and dominate Sahelian livelihoods in the future.

Changes in land use and cover can modify the local climate and its prevailing tendencies. Moreover, altered vegetation and soil cover of terrain affects the species diversity, including that of disease vectors. The scientific objective of this theme is to assess the degradation of the soils and vegetation in a context of variability and climate change in order to define better management methods that would be beneficial for ecosystems. The first research questions will concern the availability of environmental indicators (to ensure effective surveillance of ecosystem dynamics) and of decision-making tools intended for the different parties involved (decision-makers, end-users, etc.). Lists of concrete techniques allowing good management and improvement in productivity would help improve approaches to land use. Understanding of the effect of the different kinds of land cover on evapotranspiration and groundwater replenishment could also feed into improved assessment methods for the state of water resources.

2a3 Agriculture and food security

Rainfall decline plus water shortage have yet a significant detrimental effect on agricultural production and food security. Many Africans are already faced with such conditions, particularly in semi-arid areas predisposed to drought conditions. Farmers adapt to the situations themselves by adopting a variety of practices. AMMA works both on improving the knowledge and increasing the knowledge transfer towards applications such as EWS.

Results from Phase 1 of AMMA

A database of multidisciplinary observations

Thanks to AMMA efforts, a unique database has been built combining observations on agriculture, vegetation, livestock and climate. These multidisciplinary observatories have been chosen to cover the agro-eco-climatic diversity of the region:

-Agriculture surveys: 9 sites (Rainfall regimes from 450 to 900 mm per year), 2 to 10 villages per site, 3 crop types, many varieties:

-Rangeland surveys: 3 transects (Rainfall regimes from 100 to 1000 mm per year), more than 50 sites on various soils, vegetation types and pastoral pressure status.

Calibration, evaluation and improvement of production modeling tools

The SARRAH crop research model has been improved and tested thanks to the AMMA dataset. Better performances and more flexibility are obtained, when compared to the existing yield forecasting system operated by AGRHYMET (DHC crop model operationally ran for EWS). The SARRAH model shows some discrepancies for very wet seasons with erroneous assessments of soil and crop water, though comparisons with the DHC model indicate the same discrepancies and even less accurate in the DHC model. On other hand, sensitivity analysis showed that the discrepancies come more from the choice of values for the model parameters than from the models.

Improvement of our understanding on the main drivers of land productivity and the traditional production system

The intraseasonal and seasonal variability of rainfall and crop yields have been specially studied. On Niamey region, the rainfall amount during the critical phases explains 24% of the villages' yields variability. The SARRAH model globally explains 34% of the whole villages' yields variability on the 5 years. Performances of the model may be compared to the rainy season's patterns: driest rainy season and highest spatial variability of rain over the site induced highest yields variability (69%), wettest rainy season and lowest spatial variability of rain over the site induced lowest yields variability (31%). Among the main climate factors that might influence Sahelian agriculture, farmers have identified the start of the rainy season as the most crucial information for agricultural strategy since it determines the sowing period, and thus the potential cycle length. Based on AMMA surveys, most farmers wait for the first rainy event greater than 10 mm to trigger sowing with 23% of the sowings failed because of the occurrence of a dry spell longer than 9 days. Due to the size of the meso-scale convective systems triggering sowings, farmer's sowing strategies, in Niamey area, tend to be synchronous (180-240 plots sowed at the same time) defining sowing waves occurring up to two times per year. Monitoring and prediction of the occurrence and trajectories of mesoscale convective systems and intraseasonal variability of convection are thus of importance for agriculture in this sahelian area. Moreover the prediction of the onset of the rains would be of importance for yields forecasting not only to try to orient sowings but to warn political institutions of a potential crisis in case of an expected late onset (See Section 2b). Based on AMMA surveys, the traditional agricultural options are better in most of the cases than improved ones recommended by breeders until recently. Farmers prefer not to take risks in using less risked seeds rather than the more productive ones. Using a bio-economic model (Sultan et al 2009, Berg et al 2009), it was concluded that to improve yields and to benefit for example from seasonal forecasts, farmers would need to be less risk averse (insurance systems do not exist at present time).

Applications for EWS

AMMA also worked to show how research can be translated in information products for farmers and national EWSs integrating the information produced by national services, to provide inputs for the improvement of the food crises prevention calendar. The research (Genesio et al 2010) highlighted both gaps in the production of appropriate information and also difficulties by the users. The appropriate management of EWS information still remains difficult for decision makers as: (i) decisions have direct impact on people life; (ii) politically it is easier to deal with the effect of a disaster than to take action on the basis of an uncertain information and (iii) the interpretation of the uncertainty level of forecasts is difficult to be understood. In this context a better tailoring of information in terms of timing and format is needed. A major advancement required to improve the effectiveness of EWS is the improvement of the risk profiling, building a comprehensive picture of current and future exposure to hazards, strengthening the knowledge of type, extent and geographical coverage of vulnerability. AMMA showed that an important limitation to the use of seasonal forecasts is that its main product is seasonal rainfall amount (on WA July to September). It is inappropriate for agronomic application in term of time scale and type of information. The onset/end of the rainy season, as well as the distribution of rainfall within the season, are critical determinants of crop productivity (seeding date, drought in flowering period, length of season) enabling the improvement of risk zones forecasting by feeding crop models with predictive information.

The research questions hinge on the impacts of weather and climate variabilities on agricultural development. Multidisciplinary observations, research studies and knowledge transfers to EWS, as started during the phase 1 of AMMA, being pursued. Studies are also necessary to help finding alternatives for improving food supply and nutrition of human communities and their livestock. The general objective would be to analyze the agrarian dynamics associated with climate variability and climate change in order to increase the quantity and quality of crops and livestock yet at the same time conserve natural resources. In order to do this, specific objectives could be to understand technical and socio-cultural practices for animal reproduction, or the development of pest and drought-resistant crops and high-yield varieties with shortened life cycles. This can be done only if the balance of ecosystems is maintained to guarantee the conditions for development in the long term. Improving the predictability of the impacts of climate change and variability on arable, animal and fisheries production will certainly help develop these crucial objectives for societies.

4. Health

The impacts of weather and climate variability and climate change on human and animal diseases (such as bilharzias, malaria, Rift Valley fever, or meningitis) are insufficiently known as well the potential impacts of chemical products on health in West African megacities (see below). Hot climates tend to increase pathogen rate and vector reproduction and also the intensity of transmission of these diseases. The principal climatic factors of these epidemics are anomalous rainfall and temperatures.

Results from Phase 1 of AMMA

Malaria

Our knowledge of vector born diseases in West Africa has significantly improved during the AMMA project. Several observational sites have been set up together with modeling efforts. That includes observations and bio-statistical modeling of malaria in 4 representative sites in Mali taking into account environment, climate, entomology, land cover and urbanization (Survey of environmental factors including remote sensing), as well a field program over 2 seasons in Senegal and Ghana and 3 seasons in Niger. The spatio-temporal variability of the malaria risk, associated risk zones and malaria transmission have been studied at the village scale using a dynamic model with an extrinsic climatic factor modeled by stochastic models. Results showed clear climate-vector and vector- human infection relationships. The distribution of vectors has also been modeled using reaction-diffusion equations, for which the parameters were adapted to three climatic conditions (dry, early rainy and mid-rainy seasons). Simulations of malaria incidence in human population with a dynamical model highlighted that the malaria epidemic fringe spreads between the latitudes 12°N and 15°N over West Africa. Future climate projections highlight that the malaria incidence decreases at the northern edge of the Sahel and the epidemic belt is shifted southward in autumn. Nevertheless, these results must be interpreted with caution as there are still large biases related to both the disease model and the future climate projections.

Rift valley fever

A methodology to track the climatic events that can favor RVF risk over West Africa has been developed. Animal densities from the FAO archive (2005) are used to overlay the host availability upon the climatic RVF risk to highlight hot spot regions. Environmental risk maps combining high resolution satellite imagery and in-situ data have been produced. Northern Senegal and southern Mauritania appear to be critical areas for RVF risk. The zones potentially occupied by mosquitoes were identified on a daily basis and combined with in-situ entomological measurements and animal parks. This achievement is meant to contribute to the development of a new operational early warning system for RVF over Senegal.

Meningitis

Advances have been achieved in the understanding of relationships between meningitis epidemics and aerosols and meteorological factors in Burkina Faso, Mali and Niger. The projects used a combination of geophysical datasets (satellites, in-situ optical measurements made during the LOP, in-situ aerosols collection) and epidemiological datasets. The studies were performed at two scales, local (understanding of the processes) and regional (representativeness of the results). Three results paves the way to meningitis prediction. The existence of a climate/environmental-meningitis statistical regional signal is considered encouraging, given the other risk factors at other spatial scales as socioeconomics. The evidence that the frequency of aerosol events is more important than quantity of aerosols opens the possible development of EWS based upon satellite products which better capture the occurrence of aerosol rather than their quantity. Finally, the wind has been shown to be a determinant factor and is predicted rather well by numerical weather models. The hypotheses dealing with the physiological link between aerosols and meningitis have also been clarified by epidemiologists and immunobiologists. Multidisciplinary work is going on involving scientists in epidemiology, medicine, immunobiology, physics, chemistry, climatology, and remote sensing, based upon a French/African partnership, with the objective of using remote sensing and numerical modeling to measure and simulate aerosol occurrence and meteorological variables related to meningitis epidemics risks.

It is urgent to revitalize research in Africa in this field and to organize multidisciplinary research and operational centers. Understanding of the scientific basis of diseases in West Africa will make it easier to evaluate the effects of climate variability and change on vectors, dust loads and transport and also on the emergence of new forms of epidemic and epizootic diseases triggered by environmental modifications. Research projects must be nurtured to study the means of utilizing seasonal forecasts in health-risk management. Early warning systems should be developed. Besides this, ways must be found of guaging how the vulnerability of populations is exacerbated when chronic diseases get a hold on societies in transition, and by other factors like poverty or ineffective prevention and care systems.
AMMA research needs also to be more linked to international programs working on issues related to weather and climate impacts on health. For example, the MERIT program on meningitis has be recently developed by the WHO in collaboration with WMO. Advances in the knowledge obtained in AMMA on this issue have to be transferred.

2a5 Energy

Energy is one of the keys to building the foundations of sustainable development. In each country, it is a fundamental prerequisite for ensuring the basic needs like health, infrastructure required for education, processing, storage, transport, food and so on. Knowledge of the variability and availability of water for hydroelectric dams will make it possible to define direct and indirect impacts on the potential quantity of energy available for African cities in a context of population growth and climate change. Other, innovatory avenues can be explored in order to increase sustainable access to high-quality, reliable and affordable energy: it has become essential to consider the alternative sources of 'clean' energy available in Africa.

2a6 Ecosystems

Results from Phase 1 of AMMA

Implemented in the framework of AMMA, the PROPAO program deployed (from 2005 to 2008) a coastal network of five autonomous thermometers between Lagos/Nigera and Sassandra (Côte d'Ivoire) in order to monitor the coastal SST on the long term. Such a network allows a survey of the coastal upwelling system, intraseasonal to interannual SST variability and eventual trend linked to climatic changes. A regional database has been built with all historica coastal data at hand from Nigeria to Côte d'Ivoire, to initiate regional proposals for monitoring the beaches in areas particularly submitted to erosion (that may reach 30m/y). The 5 years time serie of coastal SST aquired at Cotonou (Benin) already allowed to confirm the existence of two coastal upwelling periods, the minor one in boreal winter and the major one in summer. These upwellings appear a few weeks after the equatorial upwellings (linked to the cold tongue in summer). Also, their amplitude exhibit similar interannual variability than the equatorial upwellings, so indicating a close linkage between the equatorial and coastal dynamics and climatic events

<u>Coastal and marine environments</u> The coastal landscapes along the eastern side of the Atlantic between Mauritania and the Democratic Republic of Congo are highly varied: sandy shorelines, lagoons, estuaries, deltas and cliffs. The past two or three decades have seen a considerable

strengthening of sedimentation dynamics, erosion and coastal pressure, generated by population growth in excess of 50% in the coastal countries. Climate change causes adverse effects for the survival, habitat availability, mortality and movement patterns of both marine and freshwater ecosystems. Across Africa, sea-level rise can be responsible for large-scale flooding which exacerbates coastal erosion and intrusion into aquifers in coastal areas. Changes in the ocean dynamics could also have detrimental effects on fishing resources, migrations and nutrient distribution patterns. Links between upwelling dynamics, biochemistry and biodiversity in littoral and coastal waters need to be better established. Improved observation systems on the coast and in the Atlantic Ocean could give research ways of contributing to assessment of changes in coastal and marine ecosystems and of preventing future risks for the coasts presented by temperature increases and sea-level rises. Research could also lead to the establishment of a legal framework for management applicable to the marine and coastal environment (present and future).

<u>Wetlands and internal climatic changes</u> Large rivers, lakes and swamplands are subjected to intense pressure associated with multiple usage, pollution and habitat degradation. The resources coming from aquatic ecosystems have dwindled and the biotope is seriously affected. Increased populations around swamps, plus excessive fishing, large-scale land clearance and farming enclosure have led to a dramatic increase in soil erosion rate which aggravates the problem. For example, large-scale flooding over highly urbanized areas can have substantial socio-economic consequences. The impacts associated with the desertification of the swamplands change, tending towards a dry-terrain environment such as grassland and savannah. The first research to be developed would investigate the impacts of all these stress factors on the wetlands. Understanding of seasonal changes in the water flow or in the components of the hydrological cycle would yield better knowledge of the ways the swamplands are developing. It could also provide information about the movements of humans and animals in the face of climate change, useful for anticipating trends in urban and rural development, and therefore the vulnerability of the swamplands.

<u>Forestry and climate change</u> Forests have a major role in climate change, if over-exploited or degraded. They currently contribute to about one-sixth of global carbon emissions. When managed sustainably, they produce wood, fuel that can be an alternative to fossil fuels. They also have the potential to absorb in their biomass a tenth of the global emissions of carbon released during the first half of this century and store them – perpetually in principle. The first scientific questions that result from these observations concern the immediate causes of destruction of the forest in Africa. Research of the effects and extent of forest clearance will lead to questioning on the nature of the link between climate change and deforestation. Impact of reforestration (e.g. in Sahel region) needs also to be studied.

<u>Forest fires and biodiversity</u>

The increasing frequency and ferocity of forest fires is a major issue today that must be attended to. Africa is one of the world's sensitive areas for fires and millions of hectares burn on the continent every year. Forest fires account for about half the total area for the whole world. There is strong interaction between climate change and fire and this will probably have substantial implications for ecosystem structures and biodiversity. To determine the consequences of climate change on fire regimes, it is necessary to study the impact of particle and trace gas emissions from this source and also the feedback on to the climate. The dynamic interaction between fire, landscape characteristics, weather and land use need to be understood. Finally, the input from research on information systems for operational fire control systems and on the contribution to development of management policies can be vital.

2a7 Urban zones and African megacities

The huge increase of urban population results in most dramatic consequences in developing countries. This is particularly true for West Africa with the rapid development of megacities (Lagos, Accra, Abidjan, Bamako, Dakar ..). Concerning effects on atmospheric chemistry, this signifies an inordinate surge in particle and gas emissions into the atmosphere, which is harmful to health. The impacts of such emissions on the local and regional climate are still unknown.

Results from Phase 1 of AMMA

First studies on the impacts of developing WA megacities have started at the end of phase 1 of AMMA with a focus on health and weather/climate. The focus was first centered on Cotonou, Ouagadougou, Bamako and Dakar to obtain a unique database including in situ measurements, emission inventory developments and modeling.

According to UN, the present urban population of 3.2 billion individuals will rise to almost 5 billion between now and 2030. Three out of five persons will therefore live in urban areas. This increase will have the most dramatic consequences for the continents that are currently the poorest, least urbanized: Asia and Africa. The studies and projections indicate that all the urban growth over the coming 25 years will occur in the developing countries. Concerning effects on atmospheric chemistry, this signifies an inordinate surge in particle and trace gas emissions into the atmosphere. Impacts are already apparent but future changes could be extremely harmful to health. The impacts of such emissions on the local and regional climate are still unknown. Realization of an inventory of the types of harmful chemical substance (heavy metals, polycyclic aromatic hydrocarbons, ozone) produced by the West African megacities, measurements and modeling of both atmospheric composition and health would make it easier to identify the vulnerable sectors and get to know the potential impacts of these chemical products on health. Research would help find out their contribution to climate change at local and regional scales and make it possible to develop scenarios to represent the vulnerability of towns and cities in a context of rising populations and/or extreme events.

2b Weather, Seasonal and Climate predictability and prediction

Included in the second overarching goal of AMMA is the goal to improve our ability to make weather and climate predictions in the West African region. Related to this is the need to improve our confidence in climate change predictions. This is a big challenge for AMMA and something that has arguably not been the priority during its first phase. During this first phase our knowledge and understanding of the West African monsoon (WAM), its nature and variability, has improved drastically (Section 2c). The challenge in this second phase is to "pull-through" this increased knowledge to improve weather and climate predictions as well as our confidence in climate change scenarios.

Improved forecasts are needed at a range of interacting space and timescales. To simplify the discussion, two themes are considered: (i) weather prediction (diurnal-to-daily) and (ii) climate prediction (intraseasonal-to-decadal). Research linked to climate scenarios as developped for the 4th and 5th assesment reports of the Intergovernmental Panel on Climate Change (IPCC), is discussed in section 2c. While these three will be dealt with separately in subsequent sections it should be recognized that they are related. Weather-climate interactions are important both for weather and climate predictions, a fact that has lead to operational "seamless prediction" activities (see 2b.3). Also, one of the major hindrances to improving our ability to predict the WAM is the flawed models used to make those predictions. Indeed, it is well known now that model systematic errors seen at weather timescales are often manifested at climate timescales. This leads us to the inevitable hypothesis that to improve climate forecasts we need to reduce systematic errors at short timescales. Related to this, only by improving our ability to make weather and climate predictions can improve our confidence in climate change scenarios.

AMMA needs to have a strategy for "pulling through" the better knowledge of the WAM to improve our ability to predict it. There are four key areas that AMMA scientists and collaborators need to consider:

- Model evaluation and improvement
- Exploitation of current models (e.g. via new tools, ensemble prediction systems (EPSs))
- Improved exploitation of available observations (e.g. satellite observations).
- Recommending and implementing sustained observing systems to support prediction.

Each of these areas is important and will be challenging. Each will require continued focused research alongside stronger interactions with operational prediction centers and with WMO (especially for implementing new observing systems). Before discussing in more detail the issues relevant to the two themes of (i) weather and (ii) climate, it is first worth considering briefly the strategy for addressing the above four areas for "pulling through" since they are relevant at all timescales.

Model evaluation and improvement

While AMMA faces many challenges, improving models represents one of the most difficult. While it is relatively easy for scientists to highlight problems with models, it is not so easy to find solutions. The role of AMMA scientists is to highlight key processes or phenomena, known to be important for the WAM, that are not being well represented in models. Examples include moist convection, the Atlantic cold tongue development and the heat low but others may turn out to be higher priorities. Communication and collaborations (ideally) need to be established (or strengthened) with operational prediction centers as well as appropriate international working groups (e.g. WGSIP, WGCM). From this perspective, the model inter-comparison initiatives organized under the AMMA umbrella should remain a priority and should be used to motivate discussion on model improvement and development, especially those entailing assessment of different climate components (e.g. ocean, vegetation, atmosphere, chemistry) and timescales.

Exploitation of current models

This is arguably a more achievable goal and work is ongoing in this regard at the weather timescale through the Forecasting Handbook. New user-tailored products should be developed together with interpretative guidance including the uncertainties of forecasts. As successfully organized in 2006, workshops gathering forecasters and researchers need to be scheduled and supported, in order to transfer new knowledge obtained during the phase 1 of AMMA. A major question to ask is whether the ensemble prediction systems available are useful and, if so, whether they are being exploited to their potential. At intraseasonal timescales more effort is likely needed to assess if statistical methods are being adequately exploited. We also need to assess the extent to which available seasonal forecasts (e.g. ENSEMBLES data-base, NCEP, ECMWF etc) are able to reproduce intra-seasonal characteristics of the WAM (onset, jump, dry spells, ending phase) and whether statistical methods can provide added value. These are just a few examples of where effort should be made but there are many more examples of where more effort is required.

Improved exploitation of available observations

In addition to flawed models, our ability to predict the WAM is hindered by the sparsity of in situ observations and lack of key measurements (e.g. sub-surface ocean). Under the auspices of the AMMA-THORPEX working group there are ongoing efforts to achieve this with respect to weather analysis and prediction but more is needed for both weather and climate (e.g. MyOcean). The availability of new satellite measurements in the present and on-going missions will improve our capacity to derive surface parameters and vertical soundings of the troposphere. This initiative should rely on the interaction between satellite research groups and climate modeling groups for the development of process oriented metrics, and improving data sets in space and time.

Recommending and implementing sustained observing systems

Related to the above, work must continue on what the sustained observing system should be in order to support weather and climate prediction in the region. AMMA must continue to work with THORPEX to recommend what the sustained radiosonde network should ideally be to support weather prediction in the region. In addition further work is required for the observing system needed to support climate prediction, that most likely includes improvements to the sustained observing system in the Eastern equatorial Atlantic. This will require close collaboration with CLIVAR programs (e.g. TACE and PIRATA). An additional class of observation that should be considered are those that are useful for monitoring climate and that are also useful for evaluating models. Such observations include the land-surface supersites in Mali, Niger and Benin. Strong synergy is required between researchers on weather and climate in this regard.

While the above bullets are presented from a general strategic perspective it is also worthwhile considering the key predictability issues for (i) weather, (ii) climate and (iii) climate change scenarios perspectives. These are briefly dealt with in the next three sections.

2b.1 Weather

Results from Phase 1 of AMMA

AMMA has made significant progress in improving our understanding of the key weather systems in the WAM including mesoscale convective systems (MCSs), African easterly waves (AEWs), and Kelvin waves (See section 2c). It has also made progress in improving our knowledge and understanding of tropical-extratropical interactions and the relationship between African weather systems and downstream tropical cyclogenesis. A special AMMA issue in the AMS "Weather and Forecasting" journal was devoted to the nature and predictability of these weather systems.

It should also be noted that progress was made during the first phase of AMMA to establish the impacts of key datastreams on NWP analyses and forecasts. To support the work on radiosoundings a significant effort was made to establish the needed moisture bias corrections (Agusti-Panareda et al , 2009; Nuret et al 2008). Using these corrected data, Facani et al (2009) and Agusti-Panareda et al (2010) have highlighted the significant positive impact of the extra AMMA soundings on the representation of WAM, including the African easterly jet. Karbou et al (2009) have also shown how assimilation of satellite microwave measurements on continental surface can dramatically correct humidity errors in analysis and improve weather forecasts in the West African region. Nevertheless, the impact of these new data (soundings and satellite data) on the forecasts was found to disappear after 24 hours due to the significant model biases.

Mesoscale Convective Systems

It is recognized that the prediction of individual MCSs is largely a nowcasting activity and most of the predictability of individual systems is linked to the coherent diurnal cycle and persistence. Any predictability at daily timescales most likely comes from the predictability associated with synoptic waves (see below).

African easterly waves

African easterly waves (AEWs) are the most important synoptic disturbance in the West African region. We have learned that AEWs are usually triggered by upstream topographic convection (e.g. Mekonnen et al, 2006, Thorncroft et al, 2008; see also Hsieh and Cook, 2005) and intensify in association with embedded MCSs (e.g. Berry and Thorncroft, 2005) although there is also some dependence on the basic state (e.g. Leroux and Hall, 2009). Therefore skillful forecasts of AEWs rely on a realistic representation of the basic state along with diabatic processes. It has been shown that there is significant model-to-model variability in the representation of AEWs in operational analyses and forecasts and that models have very little skill beyond about 2 days (Berry et al, 2010). The sensitivity of AEW forecasts to errors in the initial conditions has been explored. At short lead times (~2 days), the forecasts are most sensitive to the mid-level meridional winds (ie the location of the AEW trough) while at long lead times (~5 days) they are most sensitive to mid-tropospheric thetae errors (and subsequent errors in convection) (Torn, 2010). More effort is needed to evaluate the predictability of AEWs at daily-to-medium range timescales – especially as this relates to high impact weather events (e.g. floods, dry spells, tropical cyclones).

Atmospheric Kelvin waves

Considerable progress has been made in AMMA in highlighting the role played by Kelvin waves on convection in the tropical North African region (e.g. Mounier et al, 2007, Mekonnen et al, 2008). While climatologically speaking Kelvin waves are not as important as AEWs, they can sometimes be the dominant synoptic disturbance and may even be instrumental in initiating AEWs (e.g. Mekonnen at al, 2008). Given that they are usually triggered upstream of the West African region, including as far west as the central Pacific, one should be able to exploit this in terms of providing the risk of a significant Kelvin wave event over West Africa and this should be explored.

Tropical-extratropical interactions

Extratropical weather patterns can influence the West African monsoon region all year round. During the winter and transition seasons unseasonal precipitation can be triggered by extratropical upper-level disturbances (e.g. Knippertz and Fink, 2009). More research is needed to document and understand their climatology, the physical mechanisms that lead to the unseasonal rainfall (including moisture transports and soil moisture impacts) and implications of these events for NWP. There is evidence that during the Harmattan dry season convective rainfall periods in West Africa are more predictable due to the strong influence of extratropical weather patterns during this season. During the summer synoptic-to-intraseasonal fluctuations of the Saharan heat low can be linked with extratropical weather patterns (e.g. Atlantic troughs, cold surges from the Mediterranean, Vizy and Cook, 2009). Again, more effort is needed to increase our understanding of the underlying physical mechanisms and whether any inherent predictability can be exploited for short-to-medium range prediction in the Wet African region.

Tropical Cyclogenesis

Through AMMA and NASA-AMMA (NAMMA) we are learning more about the relationship between AEWs and downstream tropical cyclogenesis. We know that the nature of the AEW, including its embedded MCSs, can impact the probability of downstream cyclogenesis (e.g. Hopsch et al, 2010). We also know that dry air can be a hindrance to tropical cyclogenesis just downstream of West Africa. The extent to which this air is Saharan or midlatitude in origin is still a subject of debate.

RECOMMENDATIONS

- Continue to evaluate models used for weather prediction and to highlight systematic errors.
- Continue work on data sensitivity experiments to exploit available observations and make recommendations for future sustained networks.
- Work with operational centers to routinely monitor forecast skill with appropriate metrics.
- Pursue efforts with forecasters to design better tailored products and to organize workshops gathering forecasters and researchers, in order to transfer new knowledge obtained during the phase 1 of AMMA
- Increase communication of results with operational centers to explore how best to improve models (e.g. by organizing focused workshops)
- Efforts shall be undertaken to determine quantitatively and to understand physically the influence of the extratropics on WAM rainfall throughout the year to exploit inherent predictability.
- Maintain and develop interactions with THORPEX/WWRP and WMO (CBS, GCOS, …) to recommend and implement sustained observing systems for weather and climate analysis and prediction.

- Work more closely with the TIGGE project (THORPEX) which includes the deterministic and ensemble products from 10 global NWP centers, and continue collaborations with the WCRP-WWRP/THORPEX YOTC project and Africa-THORPEX.

2b.2 Climate

Under the label of climate prediction we consider three timescales: (i) Intraseasonal (10-60 days), (ii) Seasonal and (iii) Interannual-to-Decadal.

(i) Intraseasonal

As highlighted in the AMMA-Africa report (Ouagadougou, 2009), users are extremely interested in obtaining skillful forecasts of monsoon onset/cessation and the occurrence of wet and dry spells within the rainy season. The intraseasonal timescale is critical for societal impacts (e.g. for crops, water resources etc; Sultan et al. 2005). Hence this scale is crucial for farmers and other stakeholders. Requests are routinely made (See section 2a) for forecasts of the monsoon onset date and of the occurrences of particularly dry or wet spells during the monsoon season (the forecast of the mean seasonal amount is also requested but at a lower priority; this issue is linked to the multi-annual scale studies discussed below).

Results from Phase 1 of AMMA

Monsoon onset: As highlighted in section 2c there has been a substantial effort in AMMA to improve our understanding of the nature and causes of the monsoon onset. Dynamical and statistical forecasts are currently made nowadays (Sultan et al. 2009) but their uncertainties are important and more systematic evaluation and improvement are necessary.

Wet and Dry Spells: AMMA scientists have made some progress towards identifying the nature of the key “modes” of intraseasonal variability which include a quasi-biweekly zonal mode (e.g. Mounier et al, 2008) and the MJO (e.g. Janicot et al, 2009). However, little effort has been made to evaluate how dynamical predictive models represent these waves and the extent to which they are better predicted by dynamical or statistical models. Continued effort is needed to unravel the physical processes responsible for the intraseasonal variability and how this impacts the weather systems themselves.

RECOMMENDATIONS

- Starting the systematic evaluation of monthly forecasts concerning the intra-seasonal features of the monsoon (onset, dry-spell, etc).
- As a priority, in parallel to improve our understanding of the causes of monsoon onset, we need to investigate the skill of dynamical models to predict it.
- Assessment of whether the sustained observing system is sufficient to support this prediction activity. Notable gaps exist in the southern part of the central and eastern tropical Atlantic basin. The CLIVAR AIP strongly recommended in 2006 a PIRATA extension toward the southern ocean, around 23°W-10°S mostly motivated by improvement of the climate and weather prediction. A PIRATA proposal has been endorsed for a South-Eastern Extension - PIRATA SEE- that has been tested during a one-year experiment at one location off Congo in 2006-2007.
- More effort is needed to evaluate the ability of dynamical models to predict intraseasonal variations and to compare these with statistical methods. Specifically this should include evaluation of the model simulations made for the next IPCC report (AR5), the planned decadal predictions (see below) and available seasonal forecasts.

(ii) Seasonal

Results from Phase 1 of AMMA

The forums PRESAO for seasonal forecast of West African rainfall have been gathering each year since 1998 the operational meteorological and climate forecast centers from West Africa, Europe and US to produce a seasonal forecast of the summer rainfall amount. Thanks to the availability of the DEMETER database and to a fruitful collaboration with the European project ENSEMBLES, AMMA has contributed to this effort by evaluating the skill of these forecasts ensembles over West Africa and improving highly their performance by applying calibration with model-output-statistics (Bouali et al. 2008, Philippon et al. 2010). This has been possible because the models better reproduce some atmospheric and surface fields than precipitation, and the availability of some robust regional predictors.

Seasonal prediction has a relatively long tradition compared to either intraseasonal or interannual-to-decadal prediction efforts. Again, as highlighted in the AMMA-Africa planning document, coupled atmosphere-ocean dynamical models are still unable to match the skill exhibited by statistical models. This is a major problem and likely arises due to an inadequate representation of the coupled atmosphere-land-ocean interactions regionally as well as globally (Philippon et al., 2010). Given this, it remains a priority for AMMA to evaluate the ability of coupled dynamical models to predict the WAM a season ahead and to diagnose the key processes that are not being well represented. At the same time it is essential that we evaluate the extent to which the current sustained observing system is adequate (or not) for supporting this prediction activity. Of particular importance for the movement of the peak rainfall from the equatorial region to the coast and then inland is the evolution of the Atlantic cold tongue which needs to be better predicted. Representation of Saharan heat low and its associated shallow meridional circulation needs to be improved.

Exploitation of products from monthly forecasting systems in Africa is quite weak even though some NWP centers as ECMWF have been supporting monthly products development. Use of current monthly forecasting systems need to be developed to provide intraseasonal climate services. Such a work could be linked to the Global Framework decided at the 3rd World Climate Conference.

RECOMMENDATIONS

- In parallel to improve our understanding the annual cycle of the WAM, we need to evaluate its representationd in the dynamical models used for seasonal prediction.
- The seasonal forecasts show a strong tendency to develop a warm bias over the Cold Tongue very early in the forecast. The same warm bias is observed in the AR4 simulations. The link between the two very similar systematic errors should be also analyzed from the perspective of a seamless approach (collaboration with CLIVAR).
- This should be combined with an assessment of the extent to which the sustained observing system is adequate for supporting seasonal prediction (in collaboration with TACE).
- To provide intraseasonal climate services, current monthly forecasting systems need to be more used. Such a work could be linked to the Global Framework decided at the 3rd World Climate Conference.

(iii) Interannual-to-Decadal

Initializing climate models with observations offers the potential to predict internal variability in addition to externally forced climate change on decadal timescales and is thought to be at the heart of the decadal predictability/prediction problem. Most of the decadal predictability probably lies in the ocean heat content slowly evolving patterns, which may have the potential to influence climate variability on interannual to decadal time scales. Perfect model experiments show considerable promise for predicting internal variability, particularly in the north Atlantic. There are however technical obstacles that must be overcome if such potential predictability is to be achieved in reality. A fundamental problem is that climate models are unable to simulate the observed climate perfectly. When initialized with observations, models therefore drift towards their preferred imperfect climatology (e.g. Meehl et al, 2009). This is particularly true for the Atlantic as has been shown by several recent papers (e.g. Ref) and on going work in the Ensembles project with some participation from the CLIVAR Atlantic implementation panel. It is thus crucial to develop and test extensively different strategies for ocean initialization.

Results from Phase 1 of AMMA

The Atlantic Ocean long term variability seems to play a relevant role in determining long drought periods over the Sahelian belt (e.g. Ward, 1998), although some caveats have been raised (e.g. Ref). Recent EU projects and international initiatives will make available decadal predictions and hindcasts whose main objective is to demonstrate our capability to forecast the climate system 20 years ahead relying on innovative initializations of the 3d ocean state (3-D ocean anomaly nudging, SST and SIE nudging only, forcing an ocean model with pseudo-observed atmospheric fluxes, spectral or grid-point nudging of atmospheric variables in addition to the ocean ones, coupled data assimilation, etc ...).

RECOMMENDATIONS

- Evaluate the decadal forecasts performed in EU projects (ENSEMBLES, COMBE) and in US and Japan parallel initiatives. Participate to the AR5 exercise of decadal forecast and evaluate their skill over West Africa. Multi-models ensembles of hindcasts/forecasts will be produced over ten years starting every five years from 1960 to 2005, and over 30 years starting in 1960, 1980 and 2005.
  Questions to ask include: Do the hindcast simulations capture the last 10-15 years behavior in West Africa? What is the influence of the simulated AMO upon West African interannual to decadal variability? Do the natural and anthropogenic aerosols play an important role to shape decadal variability? What are the main physical processes underlying decadal variability and how well are they represented by the current generation of coupled models?
- Issues on model biases and damping processes have to be addressed. Even if we have a perfect observing system and the best possible assimilation scheme, model biases can suppress all the signal in a few months due for examples to inaccurate SST-heat flux feedbacks (it has been shown in the PREDICATE project that many coupled models have too strong a negative feedback, in particular in the Atlantic, leading to a lack of persistence of SST anomalies compared to the observed ones). The same type of diagnostic should be carried out on the current state of the art models.

- There is also a strong need for a detailed intercomparison of ocean synthesis products in the Atlantic (given the variety of ingredients involved in ocean data assimilation, we have to clearly define what we are expecting from this exercise or even if it is at all meaningful).

- Finally it is also very important to assess various ensemble generation methodologies (optimal perturbation approach or others) in order to span the different sources of uncertainties in the probabilistic forecasts.

2b.3 Linkages with Operational Centers and Improving Models

Results from Phase 1 of AMMA

Aided by the AMMA-THORPEX working group, AMMA initiated collaborations with several numerical weather prediction centres including ECMWF, Meteo-France, NOAA-NCEP, and The Met Office. Notable activities included: evaluation of operational models, bias correction of AMMA radiosondes, data denial experiments, as well as provision of web pages to support monitoring of the West African monsoon and forecasts in support of the field campaign. The knowledge and experience gained during the first phase of AMMA was instrumental in the creation of the Africa-THORPEX Plan.

An essential component of the "pull-through" to improve models for weather and climate prediction is to ensure good linkages with operational centers. More than this however is the need to engage with the key people at these centers who work on model evaluation, model development, data assimilation etc.

RECOMMENDATIONS

- Establish a series of high profile workshops to "pull-through" the knowledge gained in AMMA towards improving models used for weather and climate prediction. Where possible this should involve scientists working at a range of timescales (recognizing that model systematic errors are often similar at all timescales). These workshops should be focused on the key phenomena or processes that we think are important but are not well represented. Consideration should be given to having these workshops at operational prediction centers. Effort is needed now to agree the priorities for the coming years and to establish the workshop series.
- More effort is needed to provide routine evaluation of weather and climate forecasts. AMMA should consider providing a website and routine reports to highlight these evaluations and to ensure that operational centers are informed of the problems (and successes!)
- Ensure that the AMMA activities benefit to African national and regional services (i.e. NWHS, ACMAD, AGRHYMET, ..). That includes current or new EWS using products from weather and climate forecasts (e.g. see section 2a on meningitis).

2c Monsoon system

The first phase of the AMMA project was motivated, in part, by the idea that better documentation and understanding of the physical processes involved in the WAM system were necessary to improve our understanding of the whole WAM system and its prediction at different scales. After the huge effort dedicated to process studies, supported in particular by the enhanced observations made between 2005 and 2007, we now summarize the progress made, and the gaps that remain, including greater emphasis on how the future work will help to improve prediction capabilities (see section 2b) and "Interactions Society-Environment-Climate" (ISEC) priorities (see section 2a).

In the second phase of AMMA we propose to promote and coordinate the study of the WAM within three key time scales: weather system, intra-seasonal, and multi-annual, and including how they interact with each other.
To complement and reinforce the "scale" approach, a second integrative theme focusing on the water-energy cycle and its links with the continental and oceanic surfaces is put forward as a cross-cutting field of investigation. Indeed, the WAM system is strongly controlled by the interactions between both the oceanic and continental surfaces and sub-surfaces, including the continental hydrology. Moreover the continental surface is an essential aspect of climate impact studies. This theme addresses all the time scales.

2c.1 Weather system scale (less than 10 days)

Results from Phase 1 of AMMA

Mesoscale Convective Systems: MCS are the main "weather maker" of the WAM providing most of the significant rainfall events as well as the strongest winds and dust outbreaks (Mathon et al. 2002, Flamant et al. 2007). The 2-way interactions between the MCSs and the large-scale environment are key for determining the nature of the MCSs as well as how the MCSs feedback onto larger scales (Barthe et al. 2010). During the 1st stage of AMMA the documentation of this dynamical system has led to an important effort devoted to the 2006 SOP field experiment and to its scientific exploitation.

Dynamics of WAM: While the key features of WAM system were well known before AMMA (e.g. surface condition, monsoon layer, Saharan heat low (SHL), jets and waves etc), the AMMA observations and related diagnostic and modeling studies have resulted in improved knowledge and understanding of these features as well as how they interact. Also some features appear to be more important than previously believed, including, for example, the SHL (Lavaysse et al. 2009). Also while AMMA was initially focused on the meridional structure of the WAM, it has became increasingly obvious that the zonal variations need to be considered. For example it is important to recognize the importance of orographic triggering of MCSs and how east-west variations in orography influence this. Also, recent progress on the theory of African Easterly Waves (AEWs) has highlighted the need to consider localized triggering of AEWs which often takes place upstream of the West African region (Hall et al. 2006, Thorncroft et al. 2008). Similarly the role of the Low-Level Westerly Jet (LLWJ) off the western coast of West Africa has to be better considered and can be obscured by zonal averaging (Pu and Cook 2010).

Convection and soil moisture: It has been shown that local soil moisture conditions are an important factor alongside the synoptic state and diurnal cycle in the triggering of convection. There is a strong preference for convection over drier soils (Taylor and Ellis 2006). An important mechanism here is the generation of daytime circulations forced by mesoscale soil moisture patterns (10 km upwards). The associated convergence zones provide a favorable environment for storm initiation, with convective clouds developing on the dry side of the gradients (Taylor et al. 2010, Gaertner et al. 2010, Gantner and Kalthoff 2010). Strong gradients in surface heating are widespread in the Sahel early in the season, but are suppressed once the seasonal vegetation cover is well developed. There is however less knowledge of how soil moisture affects the propagation of well-established systems, and crucially for seasonal rainfall totals, their decay.

Dust generation: It has also been shown that dust generation in front of MCSs is responsible for the extremely high daily dust concentrations recorded at the beginning of the wet season. The intra-seasonal and inter-annual variability of the dust concentrations is controlled by the number of MCSs at the beginning of the rainy season and by the intensity of the surface winds in the front of these systems (Marticorena et al. 2010). MCSs also play an important role in transporting ozone precursors from surface emissions into the upper troposphere where they contribute towards downwind ozone production (Saunois et al. 2008, Cairo et al. 2009, Ancellet et al. 2009). Overshooting convection, occurring locally over West Africa may also transport trace gases directly into the lower stratosphere (Bechara et al. 2009).

Weather systems and large scale environment: A major challenge that remains for AMMA is to provide a coherent picture of the 2-way interactions that occur between the weather systems and the large-scale including, in particular, the role of zonal variations and the role of midlatitudes. Indeed, recent studies (Vizy and Cook 2009, Chauvin et al. 2010, Coëtlogon et al. 2010) have suggested that there is a close dynamical relationship between some of the important features of WAM system (e.g. Saharan Heat Low) and the weather type at mid-latitudes, and over surrounding oceans (Mediterranean sea and Tropical Atlantic). The merging of all these studies (processes and intra-seasonal variability) will support the creation of a new dynamical conceptual model that will be a major challenge of the 2nd stage of AMMA.

Wind bursts over ocean: It has been shown that strong wind bursts in the west and central parts of the Equatorial Atlantic Ocean play an important role for the preconditioning and onset of the cold tongue in the eastern tropical Atlantic. As observed during the AMMA oceanographic cruises (2005-2007), such short scale events in the West contribute to the surfacing of the thermocline in the east through the generation of equatorial Kelvin waves (Athie and Marin 2008, Polo et al. 2008, Hormann and Brandt 2009). In the East, these wind bursts trigger the cooling of the surface waters and the establishment of the cold tongue (Marin et al. 2009, Giordani and Caniaux 2010).

RECOMMENDATIONS

- Interactions between convection and its environment: Improved understanding of the 2-way interactions between convection and the environment remains a major challenge for AMMA. Continued effort is required in this area and a number of different approaches should be considered including analyses of observations (e.g. satellite, radar, soundings, raingauges) and reanalyzes (e.g. ECMWF interim, NASA, NCEP), as well as a hierarchy of modeling approaches (e.g. GCM, LES, CRM, LAM,1D models, idealized models). More effort is also required to explore the extent to which the interactions are well represented in operational prediction models used for weather and climate and if not recommendations for improvements need to be done.

- Continental surface-atmosphere interactions: The role of surface-atmosphere interactions on the nature of convection requires continued effort. This must include investigation of how soil moisture affects the triggering, and propagation of MCSs and also their decay. This question can be addressed with available statistics and diagnostics tools, using AMMA observations, SMOS and other satellite products, ALMIP and ALMIP2 products, and CRM simulations.

- Ocean-atmosphere interactions: The wind bursts occurring over the tropical Atlantic dynamics deserve additional investigation, e.g. their origin and occurrence, their impact on the ocean and air-sea exchanges and their potential use as predictive events for the conditions encountered in the Gulf of Guinea. For example, most process studies initiated in the frame of AMMA/EGEE indicate that other observations are needed concerning the atmospheric circulation related to the Santa-Helena anticyclone and the influence of south hemispheric southeasterlies strengthening on the response of the ocean. It is a key question for preconditioning and influencing the cold tongue emplacement and for its potential influence on the WAM. The Santa-Helena anticyclone remains one of the less well studied features of the coupled system at the beginning of the WAM.

- Chemistry-aerosols-atmosphere interactions: In order to estimate how much of the dust mobilized by MCSs is effectively available for long-range transport, it is necessary to make the budget between emissions (due to surface wind) and deposition (due to precipitation) in such systems, using SOP1-2 data, CRM and LAM, applied to case studies. Attention must be paid to the cycling of mineral dust in the convective clouds and to the vertical extend of the dust exportation that may control its long-range transport. Another issue is the dust radiative impact on MCS initiation and development. Also dust model inter-comparison exercises must be carried out taking advantage of the AMMA observations, focusing on dust emission and transport processes and on direct radiative forcing. The role of other aerosols, such as imported biomass burning aerosols or anthropogenic aerosols, on cloud formation and the radiation budget are also not well known. Further case studies are also required on the impact of different ozone precursor emissions on the free tropospheric ozone budget. In particular, improved representation of lightning emissions of nitrogen oxides in large-scale global models are needed based on SOP observations and higher resolution mesoscale model studies. Levels of anthropogenic emissions (aerosols and trace gases) from developing megacities in West Africa also require improved assessment since they are likely to increase rapidly in the coming decades.

2c.2 Intra-seasonal scale (between 10 and 90 days)

Here we are concerned with the modulation of the monsoon system at timescales longer than the “weather” scale and up to the typical timescale of the Madden-Julian Oscillation (MJO). Included here it is also necessary to consider the annual cycle of the monsoon in which intra-seasonal fluctuations are embedded since this will affect the impact of the variability. As outlined in section 2b2, this scale is critica for societal impacts (e.g. for crops, water resources etc; Sultan et al. 2005) with requests routinely made (See sections 2a and 2b) for forecasts of the monsoon onset date and of the occurrences of particularly dry or wet spells. This intraseasonal scale is also a critical one as being between the "weather" scale and inter-annual variability scale and their interactions must be studied. It will contribute to build the WAM conceptual dynamical model.

Results from Phase 1 of AMMA

Monsoon onset: Advances have been achieved in the understanding of the WAM onset (Le Barbe et al. 2002, Sultan and Janicot 2003), its links with land and oceanic conditions (Ramel et al. 2005, Caniaux et al. 2010), and the role of internal atmospheric processes like inertial instability (Hagos and Cook 2007). Consensus in this matter has however not been reached and more basic research is required that investigates the cold tongue development (e.g. Caniaux et al, 2010, de Coetlogon et al 2010, Atlantic-Clivar/AMMA/TACE 2009 meeting report) as well as the role of the heat low and equatorial waves in the atmosphere and ocean.

Intraseasonal variability in the atmosphere: New results have been obtained on the detection and characterization of intra-seasonal variability of rainfall and convection at two main periods, 10-25-days and 25-90 days (Sultan et al. 2003, Matthews 2004, Janicot et al. 2009, Lavender et al. 2009). It has been shown that these modes can be controlled both by atmospheric dynamics in the inter-tropical band and by interactions with the oceanic and continental surfaces (Mounier et al. 2008, Taylor 2008). Such activity can also be initiated by atmospheric synoptic activity in mid-latitudes in both northern and southern hemispheres (Vizy and Cook 2009, Chauvin et al. 2010, Coëtlogon et al. 2010). It has also been shown that nudging an AGCM towards observations over the WAM area modifies synoptic weather regimes over Europe (Bielli et al. 2009).

Intraseasonal variability in the ocean: Progress have been obtained in the quantification of the mean and the variability of the equatorial current system (Brandt et al. 2006, Hormann and Brandt 2007, Kolodziejczyk et al. 2009), in the physical understanding of intraseasonal waves (Tropical Instability Waves) either wind-generated or generated by the instability of the zonal current system (Athie and Marin 2008, Marin et al. 2009) and in the diapycnal mixing processes at the base of the mixed layer (Giordani and Caniaux 2010) that strongly influence the SST and mixed layer condition variability.

Intraseasonal variability of aerosols The variability of atmospheric mineral dust and biomass burning aerosols must also be considered since their radiative impact can modulate the African monsoon dynamics at intra-seasonal timescales (Mallet et al. 2009, Raut et al. 2008).

RECOMMENDATIONS

- Studies on others seasons than summer: The work produced up to now has focused on the summer season. It is necessary to extend this investigation for the spring period (March-June) over the Guinean Coast and Central Africa where the rain belt is located at this time of the year, and to the other seasons. This is particularly crucial to better understand the pre-conditioning of the WAM summer onset. It corresponds also to a strong request from the non-Sahelian African community to have and collaborate on more detailed investigation on this issue. Also intra-seasonal variability of mineral dust content must be connected to the statistical distribution and characteristics of the MCS during the monsoon season and of the meteorological weather regimes during the dry season (this issue is very important for the impact studies linked to meningitis epidemics; see Section 2a). Biomass burning aerosol and anthropogenic aerosols in cities may also be important. Quantification of processes influencing ozone in other seasons are needed to build up an improved picture about the annual ozone budget over Wes Africa.

- Interactions within the Tropics and Extratropics: This issue was not central to the 1st stage of AMMA and must be strengthened in the next phase. Preliminary investigations have highlighted a significant impact of the WAM on atmospheric circulations over Europe. Also, variability in the Santa Helena high has been shown to impact the intra-seasonal variability of the WAM. Variability of the WAM is also known to impact other regions in the Tropics; most importantly for instance is the impact it has on Atlantic tropical cyclogenesis. The details of these tropical interactions need further attention. The use of atmospheric simulations nudged either over West Africa or over mid-latitudes, have been shown to be very powerful to address these issues.
- Internal interactions: Different mechanisms have been suggested for the maintenance and for the quasi-periodic evolution of the intra-seasonal modes in the WAM and must be examined in more detail, i.e. the atmospheric recharge-discharge mechanism, the potential role of inertial instability, the occurrence of convectively-coupled equatorial waves, the interactions between atmospheric dynamics and the continental and oceanic surface conditions. This can be addressed by new diagnostic studies of new atmospheric reanalyzes (e.g. ECMWF interim, NASA), high-sampled and new satellite data and AMMA SOP/EOP data sets. Similar studies should be performed in GCM simulations to explore the fidelity of these models. The use of CRM simulations over a large-scale domain is a very good "laboratory" to study convection-environment interactions at this time scale.

  Sensitivity GCM simulations to the albedo, soil moisture in a coupled or a prescribed mode with or without intra-seasonal evolution, and with nudged simulations will be helpful to address this issue. This must be particularly examined in more densely vegetated zones for which our knowledge is weak.
- Ocean-Atmosphere interactions: There is also a need to better understand the interactions between the oceanic cold tongue in the Guinean gulf and the WAM intra-seasonal variability and onset, through the role of the different oceanic processes, the SST gradients associated with the cool tongue and the coastal upwelling, the atmospheric marine boundary layer and precipitation. The development of regional high-resolution coupled models would support this investigation. These simulations would also be useful to address the air-sea interaction mechanisms off the coast of the Senegal where the enhancement of the LLWJ and its links with the SHL is critical during the WAM onset.
- Oceanic waves:

  Although much progress was obtained in the understanding of the Intraseasonal variability in the ocean, including Tropical Instability Waves (TIWs), wind-generated Yanai waves and Kelvin waves, and the fact that it is assumed that TIWs warm and wind-generated Yanai waves in the Gulf of Guinea effectively cool the SST, there are many open questions that deserve to be addressed, as: i) the direct influence of intraseasonal waves on the meridional SST gradient in the eastern tropical Atlantic and thus on the atmospheric convection, ii) the wind changes associated with the meridional SST gradient that might be effective in encouraging atmospheric convection to move northward, iii) the role of the intraseasonal oceanic Kelvin waves in preconditioning diapycnal mixing processes during the onset phase of the cold tongue, iv) the deep thermocline in the far east due to springtime propagation of downwelling Kelvin waves that might prevent diapycnal mixing processes, v) the role of TIWs in the mixed layer heat budget, and vi) the reasons for the strong disagreement among modeling studies, and vii) the processes at work in the region at the junction between the equatorial upwelling and the Angola-Congo upwelling.

2c.3 Multi-annual scale (inter-annual, decadal, and climate change)

The multi-annual scale is extremely important for West African societies. Here we are concerned with variability and predictability of the WAM at inter-annual timescales, multi-decadal timescales (i.e. the next 10 to 30 years) and in association with climate change scenarios (up to 2100 for example).

Results from Phase 1 of AMMA

Teleconnections: During the 1st stage of AMMA, the impact of the Atlantic and the Pacific-Indian basin on interannual variability of the WAM was confirmed (Losada et al. 2009a, Mohino et al. 2010a, 2010b, Rodriguez-Fonseca et al. 2010), and the role of the Mediterranean basins has also been highlighted (Fontaine et al. 2009). It has also been shown that the equatorial Atlantic basin has a significant impact on both the ENSO dynamics and the Indian monsoon variability through modulating rainfall and diabatic heating in the WAM ITCZ and the resultant atmospheric Matsuno-Gill type response within the Tropics (Losada et al. 2009b, Rodriguez-Fonseca et al. 2009). Some debate has been raised about the relative roles of the Indian and Atlantic basins at decadal timescales on WAM variability during the last 60 years and especially for the recent partial rainfall recovery (Knight et al. 2006, Baines and Folland 2007, Hagos and Cook 2008, Mohino et al. 2010c). The AR4 coupled models have been examined in detail and their inability to simulate accurately the ENSO-WAM teleconnection has been highlighted (Joly et al. 2007, Joly and Voldoire 2009).
The mechanisms, which underlay the teleconnections between the WAM region and the Atlantic, Pacific and Mediterranean areas, have been analyzed in a set of coordinated experiments. The Atlantic Ocean long-term variability seems to play a role in determining long drought periods over the Sahelian belt, although some caveats have been raised. Moreover, the cold tongue warm bias and its relevance for the WAM and Indian Monsoon have been analyzed using idealized simulations and seasonal forecast outputs.
Last but not least, we should highlight the fact that the WAM region is a preferential area for studying interactions between chemistry and atmospheric dynamics. A first inter-comparison project has been organized and several models have been compared. Large differences were found between models related not only to differences in dynamical treatments (convection specifically) but also chemical and aerosol schemes, and parameterizations of, for example, lightning NOx emissions. Differences in large-scale circulations, importing trace gases into the region from Asia in the tropical tropopause layer (TTL) are also apparent.

Vegetation coupling: We have obtained evidence that interannual variability of vegetation (influenced by the previous rainy season) can influence the early stages of the following rainy season, although current climate models are not capable of capturing this process (Philippon et al. 2005). It remains an open question as to how much this vegetation memory feeds back on the monsoon. The understanding and modeling of the WAM partly depends on the evolution of land use change (Paeth et al. 2009). However the lack of accurate observations in this regard has hindered progress in this area. Resilience of eco- and agro- systems has also to be accounted for. We cannot evaluate presently the relative role of SST and land memory effects in the potential inter-seasons persistence of the WAM (Douville et al. 2007).

<u>Oceanic coupling:</u> Experiments in the open ocean allowed some fundamental progress to be made for addressing key questions concerning the ocean/atmosphere coupling in the Gulf of Guinea. Most of this research allowed improvement for modeling studies: cold tongue location and related mechanisms, upper layer thermodynamical and dynamical processes and surface flux budgets. The main modes of SST variability in the Tropical Atlantic are the meridional mode most pronounced during boreal spring and the zonal mode most pronounced during boreal summer (Kushnir et al. 2006). The understanding of climate feedback mechanisms for the development of these modes, i.e. the Bjerkness feedback and the wind evaporation SST feedback has been much improved (Peter et al. 2006). Of particular importance are also remote forcing associated with ENSO and the NAO (effect on the northern hemisphere trade winds) and with the AMO probably due to changes of the THC (SST gradient between northern and southern hemisphere), that finally influence the ITCZ complex. It could be shown that variability within the Atlantic subtropical cell (STC) is related to heat content variability in the eastern tropical Atlantic.

<u>Climate change:</u> The AR4 models fail to reach a robust agreement regarding the 21st century outlook for the WAM in a future with increasing greenhouse gases (GHGs; Biasutti and Giannini 2006, Joly et al. 2007). The criteria defined to evaluate the quality of 20th century simulations, mainly based on WAM-SST relationships, are useless for evaluating the confidence in 21st scenarios, meaning that additional influences, like direct radiative GHG effect or land surface processes, may become more important in the future (Biasutti et al. 2008).
Several model integrations were performed for the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), were made available through the Program for Climate Model Diagnosis and Intercomparison (PCMDI), thus providing a unique baseline for intercomparison studies. These simulations were analyzed and evaluated according to wheter they were able to realistically represent the West African region in summer (Cook and Vizy 2006, Joly et al 2007, Joly and Voldoire 2009). Unfortunately, many models were unable to realistically simulate the WAM and so we continue to have little confidence in the predictions of how the West African Monsoon will respond to anthropogenic climate change (Biasutti et al, 2008).

RECOMMENDATIONS

- <u>Inter-annual and decadal scales:</u> The general objective is to evaluate the relative contributions of the feedback loops between the monsoon system and the different oceanic basins, land surface, and aerosols, versus the range of the internal variability of the WAM system. This must be addressed by using a multi-model combination of atmospheric idealized, forced, partly and fully coupled simulations, as well as regional coupled modeling. While a lot has been learned about the WAM-SST variability mechanisms at inter-annual and decadal scales, this investigation must be pursued further. In particular the different possible atmospheric teleconnection mechanisms with the El Niño/La Niña events and the causes for their inaccurate simulation in climate models must be more deeply analyzed. The relative impact of the Atlantic and the Indian basins on the multi-decadal WAM variability must be explored too. Also, the interactions at all time scales between WAM and the European latitudes including the Mediterranean basin must be investigated.

In collaboration with scientists working on prediction and predictability of the WAM (at all timescales), there is a need to identify the key processes that are not well represented in models used for climate prediction; and to work with modeling groups and centers to address these problems.

The role of the long-term evolution of the continental surface characteristics (albedo, vegetation, soil moisture, sub-surface water reservoirs) on the WAM, from natural interactions with climate plus anthropogenic forcing (land-use), is also a key-issue even if there is a consensus to say that it should be a second order in front of the SST component. Given the lack of useful land-surface data the effort to rectify this that was started in the 1st stage of AMMA must be completed. This includes diagnosing the land-surface changes from combining aerial photos, satellite data and long-term fields measurements from 1950 to nowadays (with a focus on the satellite period 1972-present). Such data will hopefully be useful to address questions like the hydrological paradox (the fact that the water-table level and surface ponds increased as precipitation decreased) and the role of the vegetation cover behavior in this context.

Other activities must be developed around the coupling between aerosols, trace gases and African climate. Improved understanding about the climate factors impacting emissions of trace gas (GHG) and aerosol emissions are required in combination with improved land-surface emission models for emissions from, for example vegetation, soils and fires. Lightning may also change as a result of changing convective patterns. It will be important to assess both past inter-annual variability (last 10-15 years) as well as future change. For this purpose, improved seasonally and inter-annually varying anthropogenic and natural emissions will be required. Interactions between chemistry-aerosols and African climate can be investigated using ensembles of global or regional models, and by performing sensitivity studies to examine both radiative impacts of anthropogenic aerosols (biomass burning and megacities) or ozone and/or climate variability. Radiative forcing (RF), including regional variability from dust can be improved (see above) and examined on an inter-annual basis based on studies of the mineral dust cycle and its size distribution signature from SOP1-2 and Sahelian dust transect measurements as well as PARASOL and MSG products. Such RF estimates can be assimilated into climate models. Based on AMMA data, some aspects of the GHG balance can be assessed in terms of ecosystem CO_2 flux, long-term evolution of ecosystems' carbon content. Earth system models can be evaluated over meso-sites.

There are still open questions like e.g. what are the key SST anomaly patterns that influence the WAM on seasonal to decadal time scales and particularly what is the role of ocean dynamics potentially leading to predictability. The starting point of TACE/CLIVAR was the strong SST bias in the tropical Atlantic in coupled climate models. This problem, which does not allow to establish correctly climate feedbacks like the Bjerkness feedback, is still not solved. The mean zonal SST gradient during boreal summer in recent model studies (CMIP3, DEMETER, ENSEMBLES) has still the wrong sign compared with observations. Additionally there is a westerly wind bias in the western equatorial Atlantic during boreal spring, which is responsible for the thermocline deepening in the cold tongue region. The SST-heat flux feedback seems to be overestimated in climate models resulting in a potential damping of seasonal to interannual variability. In general, the SST bias in climate models should have highest priority to be solved through improved parameterizations. The first priority is to identify the key processes contributing to the development of the warm bias in the Atlantic cold tongue region and to recommend strategies for improving these in collaboration with climate modeling groups or centers (Collaboration going on in CLIVAR-Atlantic framework).

Key observations are needed to identify most clearly problems in climate models. Also, the effect of salinity changes on buoyancy surface fluxes remains open. In general the surface freshening is a problem in models and in assimilation system. It is believed that precipitation/evaporation from NCEP/ECMWF must be corrected to obtain realistic hydrological cycle. With the upcoming SMOS satellite there is a chance of improving surface salinity information in the tropical Atlantic.

Moreover, a larger question is the respective position and coupling between the three following large scale features: the Santa-Helena Anticyclone, the Atlantic cold tongue, and the Azores Anticyclone/Saharian heat low that lead to the natural interannual - multidecadal variability of the WAM.

- Climate change scenarios: The general objective is to better understand how the WAM will vary in association with anthropogenic climate change and to improve confidence in model predictions of climate change in the WAM region. This in fact needs a deeper understanding of the WAM system and the processes that cause it to vary on a range of time scales. The first step will be the evaluation of the new climate models used for AR5 in representing both the mean annual cycle of the African monsoon and the WAM-SST teleconnections. This is a critical point if we want to be able to discriminate the direct radiative impact of the greenhouse gas increase from its indirect impact via the modification of the SST patterns. Then more effort will have to be put into the land-atmosphere coupling modeling taking advantage of the AMMA data sets. The extent to which the inability of coarse GCMs to fully resolve the tight meridional gradients of temperature and moisture, negatively impacts climate forecasts, must be evaluated.

  Recently, the international framework CORDEX has been set up to produce a new generation of high-resolution regional projections for use in impact and adaptation studies to be part of the next AR5. The main area selected for this initiative is the African continent (Sylla et al., 2009). Although some scientific caveats should be retained due to the GCM systematic errors, the availability of a large set of regional simulations over Africa could be useful for analyzing the relevance of regional feedbacks and for increasing the members in an ensemble approach to risk assessment.

  Also, simulations of the impact of anthropogenic aerosols on future climate and of global chemistry change (especially ozone budget in the upper troposphere and lower stratosphere) have to be planned on the basis of IPCC scenarios and projected emission inventories, in order to better characterize the combined action and impact of climate change and given the intense development of urban areas in West Africa. It is likely that the future development of megacities in the region, especially along the southern coast, will dramatically increase emissions of ozone and aerosol precursors which will have increased effects on regional air quality (human health) as well as possibly on regional climate through changes in the hydrological cycle. The interaction between coastal megacities and the ocean environment will also require quantification.

- Paleo-climate scales: These time scales have not been considered during the 1st stage of AMMA while investigations carried out within international paleo-climate programs have shown that there are a lot of common scientific questions within the present and the past climates. As simulations at these time scales will also be provided in the AR5 exercise, it represents an opportunity for AMMA to address this issue and to build new collaborations with this community. In particular one must focus on the tropical WAM-SST teleconnections, inter-monsoons atmospheric links, and with the higher latitudes looking on the thermohaline circulation and the relative Atlantic multi-decadal variability impact on the WAM.

2c.4 The water and energy cycles in the coupled surface-atmosphere WAM system

The water and energy cycles are central components of the WAM system. They control both the physics and dynamics of the system and play a crucial role in terms of societal impacts. The availability of water is indeed the most limiting parameter for life, agriculture and development.

Results from Phase 1 of AMMA

Land sur-face Model Intercomparison

The coordination of the land surface modeling activities is supported by the AMMA Land sur-face Model Intercomparison Project (ALMIP) (Boone et al 2009). The recently completed ALMIP Phase I dealt with the regional scale. With a dozen different groups who performed multi-year offline simulations (2002-2007). The resulting LSM simulations are currently being used extensively for hydrological modeling, regional scale water budget estimates, mesoscale atmospheric case studies (initialization and evaluation), regional atmospheric chemistry modeling and evaluation of regional and global scale atmospheric models within the AMMA atmospheric Model Intercomparison Project (AMMA-MIP) and the West African Monsoon Modeling Evaluation project (WAMME). In the next ALMIP Phase II, LSMs will be evaluated using observational data from the three heavily instrumented super-site "squares" from AMMA-CATCH observing system (Mali, Niger and Benin).

The large scale atmospheric water budget over West Africa

The atmospheric water budget of West Africa has been investigated with a hybrid dataset based on observational and modeling products over 2002-2007 period (Meynadier et al, 2010a and b). Seasonal, intra-seasonal and inter-annual fluctuations have been quantified. Links between budget terms were analyzed regionally, from the Guinean coast to the Sahel. Water budgets from several NWP systems were inter-compared and evaluated against the hybrid dataset. The ECMWF AMMA reanalysis provides the best results, but large deficiencies are evidenced in all the NWP systems. Hypotheses have been proposed about their origins and further improvements are foreseen.

Underground-surface water exchanges:

Aquifers may act as reservoirs temporarily storing and subsequently releasing it to the water cycle (drainage to rivers, atmospheric feed-back by the biosphere), on time scales ranging from day to inter-annual. Studies from AMMA observations suggest that deep rooted trees in Guinean or Sudanian areas may extract significant quantities of water, especially in the dry season (Guyot et al. 2009). This may have links with the controls of the monsoon by the continental surface at intra-seasonal to inter-annual time scales (so called "continental memory effect", where the moisture state of the continent in fall may control the monsoon strength the following summer; Philippon et al. 2005). The exchanges between the surface water and groundwater over the West African region are highly dependent on the quantity of precipitation, the surface hydrologic processes, and associated controlling factors, and the nature and geometry of the geological substratum. The paradoxical continuous rise on multi-decadal time scales of the large, sedimentary water table in south-western Niger (Sahelian paradox) is primarily a response to the changes in surface conditions rather than a rainfall-driven process (Leduc et al. 2001, Leblanc et al. 2008). As a side effect, large parts of the water table have been outcropping in the low lying areas of the landscape, creating permanent pond water bodies submitted to evaporation, well recognized by remote sensing data (Gardelle et al. 2010).

Surface radiative budget

Thanks to unprecedented AMMA dataset, seasonal and diurnal cycles of radiative budget over the Sahel have been analyzed over Mali and Niger AMMA sites (Guichard et al 2010). The observational results provide valuable ground truth for assessing models over an area displaying a rich variety of surface–atmosphere regimes. Models experience difficulties during the pre-monsoon period.

During the 1st stage of AMMA, water and energy cycles were mostly studied separately in the different geophysical compartments (atmosphere, land surface, ocean) with an organization that favored splitting into different space and time scales. While this organization was useful to progress in terms of process studies at different compartments/scales, the 2nd stage of AMMA should give greater emphasis to interactions between scales and between compartments. The work will be structured around these interactions organized in different specific research actions, using either observational data analysis and/or modeling activities, including climate models.

In the atmosphere, one must focus on water and energy cycles at multiple scales and interactions with the surface. Beyond the fundamental mechanisms that are now broadly understood, the main objectives are to study intra-seasonal and inter-annual variability of each component of the water budget, the strength of surface water recycling in the atmospheric water budget, and the surface-atmosphere feedback mechanisms and impacts on climate. On the land surface, the integrated studies on the water and energy cycles are structured along with the key “interfaces” (hydrosphere-biosphere, surface hydrology and groundwater dynamics,..), with an emphasis on the dynamics of these systems based on the 1st stage of AMMA data collection and process studies. Special attention is given to the dynamics of the fluxes at the surface/atmosphere interface, as well as to the physical and biological mechanisms driving the interactions with human activities (mainly water and agronomy resources) and ‘impact’ models. For the ocean surface, note that some of the issues are already addressed in the previous sections.

RECOMMENDATIONS

- Atmospheric water and energy budgets: Significant progress has been made in the first stage of AMMA in understanding individual processes at different scales. However a fully quantitative analysis of the strength of many processes and their interactions is still lacking. The atmospheric scale interactions and surface-atmosphere couplings must be addressed from a quantitative point of view with the help of water and energy budgets and moisture recycling indices. It relies on the use of the accurate column-integrated and vertically resolved water and energy budgets produced during the first stage of AMMA (ALMIP-1 multi-model simulations; Boone et al. 2009a). Similar products computed from ALMIP-2 at the mesoscale will have to be used too. These budgets will help the investigation of scale interactions in the atmospheric water budget, the role of and feedbacks on MCSs (intra-seasonal to inter-annual variability), and serve as a reference for validating NWP and climate models. The question of the geographical origin of moisture for WAM rainfall must also be addressed through simulation studies using climate models with various approaches (NWP models, nudged climate model simulations, water isotope tagging…).

- Surface-atmosphere couplings: The vertical moisture and heat exchanges between the surface and the lower troposphere at different latitude bands must be analyzed using observations and high-resolution coupled surface-atmosphere modeling in order to explore the role of the couplings occurring at the diurnal cycle between surface processes, turbulence and shallow convection, in association with atmospheric circulation in mid and low levels (mostly the meridional circulation) both in the pre- and post-monsoon onset. Dedicated case studies can help in identifying deficiencies in models and improve parameterizations. Secondly, surface-convection coupling mechanisms must be analyzed with climate models and idealized simulations (single-column model with parameterized physics and surface hydrological schemes) at various time scales. Observations and budgets computations must be used to guide and validate these studies.
- Water and energy cycle in the troposphere and feedback from clouds and aerosols: The role of feedbacks from aerosols and clouds in the water and energy cycle in the troposphere must be addressed. This includes the building of an enhanced cloud climatology over West Africa based on AMMA data and satellite products, which can be used for the assessment of climate models (AMMA-MIP framework; Hourdin et al. 2009). This also involves modeling, namely ensemble simulations, as well as more fundamental work on processes presently not well constrained where needed (e.g. cloud microphysics and radiation).
- Air-sea fluxes and oceanic processes: In order to better understand the ocean-WAM water cycle in the eastern inter-tropical Atlantic (southern and northern part), one must first better understand the main oceanic processes controlling the meridional SST gradient, the preconditioning of the cold tongue development, the thermocline evolution in the east, and the mixed layer heat budget. Then the impact of the African rivers on the fresh water budget in the gulf of Guinea is still unknown; the use of SMOS data could provide a better estimate of salinity in this area. One has also to develop a better estimate of air-sea fluxes by correcting the impact of atmospheric aerosols on the surface radiative budget in satellite estimate. Then one can better quantify the different scales of variability of the component linked to this oceanic basin of the atmospheric water budget and the sources and sinks of water vapor.
- Surface rainfall and elaborated precipitation products: Among the needs for improved data products, uncertainties about surface rainfall information are still too large to enable providing of a good estimate of the water and energy budgets. More effort is needed to provide a regional-scale evaluation of products from satellite, aircraft and ground observations, and an evaluation of local site to mesoscale products for ALMIP-2 and hydrologic studies. This action is strongly linked to the development and outcomes of the Megha-Tropiques mission and access to rainfall ground measurements in the Guinean region
- ALMIP-2 and associated modeling studies: After the successful first phase of ALMIP (AMMA Land Surface Inter-comparison Project), the second phase, which is the AMMA Model/data comparison project, consists of LSM, hydrology, vegetation models as well as satellite driven models in (ALMIP-2). The idea is to benefit from the rich AMMA data

collected over the 3 meso-sites (Mali, Niger, Benin) to provide a strict evaluation of the models, to highlight model successes and failures, and to benefit from the comparison of 'specialized' models (e.g. basin scale detailed hydrology or vegetation growth models) versus 'general' models (LSM or Earth System Models). In addition, important modeling efforts are planned in parallel with detailed models using different approaches and forced runs on the same meso-sites. Models with 'interactive' or ''dynamical' vegetation and a CO_2 cycle are encouraged. A data base of the best mesoscale,forcings over the 3 meso-sites (land characteristics and 2006-2008 atmospheric forcings) using in situ data and interpolation techniques will be proposed to the international community to run all models. A validation data base will be used to evaluate the simulations. Such studies are also important for improved representation of emissions of biogenic emissions from vegetation which are important for ozone and secondary organic aerosols.

- <u>Underground-surface water exchanges:</u> In West Africa, groundwater is the major source of water for public use (urban or rural areas), and development strategies imply an increasing recourse to these underground stocks. As shown during the phase 1 of AMMA, aquifers may act as reservoirs temporarily storing and subsequently releasing it to the water cycle (drainage to rivers, atmospheric feed-back by the biosphere), on time scales ranging from day to inter-annual. The main issues to be addressed are the links between groundwater dynamics and surface hydrology, the role of groundwater reservoirs in atmospheric feedbacks, and the sensitivity of groundwater to changing climate and environmental conditions.
- <u>Eco-hydrology and water-vegetation relations:</u> Three key-questions must be addressed in the eco-hydrology theoretical and phenomenological aspects.

(1) Desertification or re-greening? There is a hot debate on the nature of desertification or land degradation in the Sahel, because of strikingly opposite views of Sahel re-greening diagnosed by satellite data (Hiernaux et al. 2009). Based on both long term and pluri-annual data, there is the potential to reconcile these two opposite views of the Sahel drought and to infer the changes in eco-hydrology, which are both causes and consequences of the Sahel drought.

(2) The so-called 'Sahelian paradox', summarized as 'less rain, higher water tables' was generally attributed to crop extension and land clearing. New results show that cropped and non-cropped areas display a spectacular increase in pond area over the same period (Gardelle et al. 2010). This issue must be solved and a much-wanted understanding of this paradox is needed involving vegetation and soil dynamics coupled to hydrological regime.

(3) Trees in the monsoon: By their ability to partly decouple climate and leaf presence and to access deep water, trees introduce complexity in the plant/water/monsoon system. Process studies over the AMMA-CATCH gradient offer the opportunity to look at this important question. As often, there is a need to understand both the response of trees (structure and function, demography, succession, management) to the environment and climate, and the impact of trees on the water and energy budget. Another aspect of this question is the societal and political aspect of 'trees' and 'forest' (e.g. 'the green great wall against the desert'), which raise high expectations but lack scientific basis.

To address these 3 issues, modeling activities must be developed in terms of land surface modeling, crop modeling and pastoral resources modeling and assessment, assimilation of remote sensing data into land surface models, and integrated carbon-water-dust-chemistry modeling.

- <u>Long-term evolution of water cycle and surface conditions at the regional scale:</u> The multi-decadal evolution of land surface cover in West Africa (since 1950), now acknowledged, is mainly driven by human activities (agriculture intensification linked to demographic growth; FAO 2004). However, the observed evolution is sometimes driven by the dynamic response (resilience) of the vegetation cover to the climate forcing (droughts). The hydrological cycle intimately interacting with the surface conditions contains the signatures of those evolutions. The best illustrative example is the Sahelian paradox. The understanding of the spatial patterns, nature and rate of land cover evolution and the identification of the controlling factors are essential to correctly estimate the multi-decadal response to climate change (e.g. water resources). Associated with large time scales, the regional scale is relevant to analyze the possible controls of the surface on the monsoon system. Some important issues are the Niger basin which is the largest hydrological integrator in West Africa, the rates and locations of the Sahel re-greening and of a somewhat puzzling reported opposite trend in the Sudanian zone (Hiernaux et al. 2009), and the links between vegetation and dust emissions and between regional plant phenology and the water cycle. Changes in fire emissions are also important in this regard.

- Dynamics of surface water and energy fluxes: In the coupled surface/climate system it is crucial to identify the feedback loops, which can cause or reinforce, among other phenomena, the prolonged droughts in West Africa. The AMMA instrument deployment offers an unprecedented opportunity to obtain a general view of the following two feedbacks:

(1) The 'energy gradient' feedback loop and its variability in time and space, based on the network of in situ flux and meteorological stations. How do surface processes control net radiation, moist static energy flux? What are the time/space modes of variability? Progressing towards a comprehensive understanding of surface, PBL, clouds and aerosol in shaping the latitudinal distribution of energy.

(2) The precipitation - latent heat - convection loop. Identify the mode of variability of the recovery of surface heat fluxes partitioning after a rain event by systematically analyzing the surface flux data. Diagnose these feedback loops in models (ALMIP-2 simulations), in surface-climate simulations starting with the AMMA-MIP database and in coupled simulations.

2.d Observations

When AMMA was launched in 2002, the community faced to difficult challenges in regard to the major lack of operational and research observations over the region. After 8 years, the AMMA observation programme is considered as a great success (Lebel et al. (2009). The field programme was unique in many respects. It is probably the first programme ever conceived with intensive campaigns embedded in a 8-year long-term monitoring, covering a 3 million km² area, research and operational observations being narrowly coordinated. The EOP and SOP campaigns were – to our knowledge – the first with coordinated Air-Land-Ocean surveys at a regional scale, including all the Tropical Atlantic, most of the West-African sub-continent and the atmosphere from the local boundary layer to the stratosphere. The progamme has involved a comprehensive field experiment bringing together ocean, land and atmospheric measurements, on timescales ranging from hourly and daily variability up to the changes in seasonal activity over a number of years. The Long term Observation Period (LOP) strategy has been based on (i) several pre-existing instrumented sites, thanks to several national and international programmes (e.g. PIRATA, GLOWA-IMPETUS, GLOWA-VOLTA, CATCH, Gourma, Senegal basin, …), (ii) the re-inforcement of the meteorological network, and (iii) the development of satellite products. In the next years, the challenges will be to maintain the observation capability at its best level and to extend it spatially as possible, and to develop new integrated products, aimed at better contributing to environment management strategies at the local to national scales (e.g. drought / flood, health / food alerts, evolutions of importance,…).
It is important to appreciate that the AMMA field campaigns followed a scale-nested design, both in time and in space. The AMMA field programme has had to take account of the fact that the operational networks over West Africa are not documenting adequately all the variables of interest for the three scales targeted by AMMA to study the WAM, namely i) the regional scale, controlling monsoon processes and interactions between the atmosphere, land and tropical Atlantic ocean; ii) the mesoscale, which is the scale of the typical rain-producing weather systems in the WAM, the characterisation of which is pivotal for hydrological, water resources and agricultural studies; iii) the sub-meso scale which corresponds to heavilyinstrumented super-sites on which some key aerosol emission and hydrological processes, as well as their interaction with vegetation growth, are studied.

Results from Phase 1 of AMMA

A major achievement of the first phase of AMMA is the implementation and coordination of observing systems in the West African region including the Long Observation Period 2001-2009 as well as the more extensive research field campaigns between 2005 and 2007 (Redelsperger et al 2006, Lebel et al 2009). Central to this were huge improvements to the radiosounding network (Parker et al 2008). A North-South transect for climate and surface monitoring has been enhanced, based on 3 super-sites in Mali, Niger and Benin. A East –West transect has also been implemented to monitor the aerosol transport. AMMA has moreover created a multiscale multidisciplinary database that is used all over the world, physicallly implemented both in Europe and Africa. Hundreds of AMMA scientists continue to work on these observations.

From the research community perspective:
-A unique data set documenting simultaneously the atmosphere-land-ocean interactions over a full seasonal cycle and over the climatic transect, with a strategy designed in regard to scientific objectives (e.g. water cycle, intraseasonal variability, atmosphere-land-ocean coupling)
-3 years of unprecedented monitoring of the key water cycle variables over land, the ocean and in the atmosphere at the regional and the mesoscales, together with a successful aerosol program with extension up to 2010
-A long term (2002–2009) monitoring program over oceanic region and along a North-South continental transect
-A rapid analysis of the collected data set, with numerous publications downstream

That includes in particular:
-first use of an innovative atmospheric sounding system at the regional scale, based on dropsondes carried by a stratospheric ballon drifting in the tropical easterly jet overr Africa and Atlantic (Parsons et al 2007)
-a deep analysis of radiosounding biases caused by solar heating variations on sensors, which lead to a correction method then implemented (Nuret el al 2008, Agusti-Panareda, et al 2009)
-a first implementation of a coastal observation network along the Guinean coast
-the development of improved satellite retrieval and analysis methods to complement operational products (from space Agencies): Atmosphere (gas and aerosols, clouds and rain, water vapor, OLR), Surface (vegetation monitoring, SST and oceanic surface wind, surface fluxes, land surface humidity and roughness), Ocean (currents, chlorophylle).

-An unique multiscale and multidisciplinary AMMA database including AMMA LOP, EOP and SOP data, historical *in situ* data, information about society-environment-climate interactions, satellite products and model outputs produced or used by the AMMA research community
-A unique dataset of key parameters for agriculture, vegetation, livestock and climate in common observatories covering the agro-eco-climatic diversity of the region
-A dataset documenting weather and climate impact on health
-An important use of the AMMA database to evaluate weather, climate and crop models, including international coordinated efforts as ALMIP (Boone et al 2009a), AMIP (Hourdin et al 2010) and WAMME (Boone et al 2009b).

From an operational point of view:
-Demonstration of the capacity of the research community to organize such demanding campaigns in a harsh environment
-A good partnership between the local authorities and the AMMA research community
-An enhancement of relationships between national operational services and universities
-A legacy in terms of retooled networks, training, partnership
Note that not all operational services benefited from the AMMA effort on observations for various reasons (not operating in all West African countries, limited funding, lack of interest of a few services who perceived AMMA to be a short term research project rather than a long term program able to benefit operational services, …).

At the time of the writing of ISP-2, it is difficult to give complete priorities on observation need in future, to address new science questions rose in sections 2a, 2b and 2c. More research is required in order to make recommendations for the future sustained observing system to support monitoring and prediction of climate as well as high impact weather analysis and prediction. Following are nevertheless given important recommendations, which will be completed in the near future. Many studies have still to be done with present data from in situ and satellites, as well as with re-analyses, particularly to initiate products for environment studies (see section 2a).

To further address the scientific questions, the present observation network should be maintained and improved. Integrative studies, using all informations (in situ, satellite, models) should be encouraged to permit the elaboration of novel informations for use in research and applications.
The present network is far from optimal for oceanography, meteorology, atmospheric chemistry / pollution and surface – atmosphere /ecosystems and resources studies. However, the huge domain to cover, associated to the obvious impossibility to reach at any time the quality and density of the observation network in Europe and the United States will require to define a strategy with hierarchized objectives and locations: previous studies have shown the feasibility of targeting to significantly reduce the observation coverage without missing the key phenomena. There is also a need to improve the institutional endorsement of the observing systems by an involvement of end users, regional economical community (ECOWAS, UEMOA, etc…) and regional agencies (ACMAD, AGRHYMET, etc.) in the governance of the network.

2d.1 Long term environmental monitoring

West Africa remains a hot spot of the Earth environmental system, both from a physical (climate, land surface cover) and a socio-economic (demography, economic development) point of view. From this perspective it is especially important to document long term changes, be they either in the continuity of the present observed changes or abrupt changes that would testify to a rupture in the evolution of the regional climate, with possible severe impacts on the population.

Four major objectives should accordingly be pursued:

- **Maintaining and improving the long term research observing systems** that were setup prior to AMMA or thanks to AMMA, in order to document precisely and over a range of scales the climate, water cycle, coastal environment, vegetation, soil, agronomic, atmospheric chemistry and socio-economic transitions as well as the inherent variability of these various components of the environmental system. Improvements concern the extension of the NS transect to the Guinean region and Guinean coast, in order to better document the monsoon pre-onset and onset periods; the extension of the E-W transect, up to now mainly dedicated to dust, to analyse the E-W atmosphere heterogeneity, from Lake Chad to Senegal Coast. The ocean-atmosphere and atmosphere monitoring over the GG, as South as the St Helena anticyclone need also to be completed.
- **Maintaining the operational observations** (upper air, continental surface, ocean) at a level as close as possible to the one reached during the first phase of AMMA and improving in areas where AMMA was not able to do so.
- **Ensuring better linkages between these two field observations and the satellite observations (**key new satellite missions have just been launched or will be launched soon) **and modeling studies (**especially those performed or in preparation for the IPCC reports)
- **Pursuing efforts to make the resulting data sets available to a large community**, specially to the modeling community (e.g. for the second phase of ALMIP)

In parallel, there is a need to develop multiscale analyses based on all data sources (in situ, satellites, re-analyses) to better characterize the space and time variability over the sub-regions of the continent, in order to identify key regions where in situ observations should be implemented. This development will complete the necessary studies in NWP centers to provide guidelines on minimum network of operational radiosoundings.

2d.2 Process studies

Important processes controlling the West African monsoon system and its interactions with the ocean and continental surfaces are still not well understood. Improving our understanding of these processes will require additional specific measurement campaigns.

Ideally we should aim at:

- Coordinating these campaigns in space and time with the long term observing systems. This means either supplementing for a shorter period of time (typically a rainy or a dry season) the gaps of these long term observing systems; or, on the other hand, focusing on regions where long term observing systems provide a good background documentation.
- Seeking synergies between different objectives in order to optimize the return on the deployment investment.

(i) Atmospheric-land field experiments

Few atmospheric-land field experiments are yet scheduled as FENNEC (2011) on the study of Saharian heat low and other coupled with the calibration and validation of algorithms of new satellites important for AMMA (e.g. SMOS and Megha-Tropiques).

(ii)Ocean-Atmosphere field experiments

Processes responsible, and their relative importance, for the cold tongue in Gulf of Guinea and upwelling along the southern African coast in the north of the Gulf of Guinea are still not precisely known (local wind, remote wind forcing and equatorial/coastal Kelvin waves, Guinea current variability,…). Role of the cold tongue and upwelling on regional climate and WAM onset seems important, including for the understanding of WAM variability, from seasonal to interannual scales. During AMMA field experiments, theses phenomena were observed only after their setting up. Following the AMMA recommandations, the French PIRATA 2011 cruise has been shifted during the cold tongue formation period (Boreal spring) and should be maintained during this period for the following years. PIRATA 2011 cruises will operate simultaneously with the IFM-GEOMAR cruises, contributing to the ship and gliders sections across the equator at different longitudes between 0E and 23W. Atmospheric sampling is also scheduled aboard ships. The role of oceanic intraseasonal waves, particularly TIWs, in the heat budget, remains a source of model disagreement and a dedicated observational study has been planned for 2011 by IFM-GEOMAR, possibly including upwelling moorings to determine vertical motions..

2d.3 Integration of environmental and socio-economic observations

It is now widely recognized that the study of environmental systems should take into account the populations and societies that both depend on them and impact them. This is especially challenging to observation programs since the space and time scales involved are not always matching each other properly and also because the methods of observation are different between different scientific communities. Pilot multidisciplinary observatories have been set up during the first phase of AMMA. To pursue this effort, priorities have to be discussed based on present science plan to develop a more long term monitoring program. Exploratory studies based on multidisciplinary data sources could be performed to elaborate relevant indices, trends, or other products mainly from satellite data and model analyses, validated over various sites. The development of this long term monitoring program would also take place within a GMES-like strategy. The climate / environment network discussed above could thus be completed with observations related to society issues, in order to elaborate relevant information for use by stakeholders, as well as entries for scientific activities as described in present science plan (Section 2a).

2d.4 Proposed actions

Reaching the goals listed above requires involving a large array of institutions and people, as was done during the first phase of AMMA. It is not likely that such a large mobilization of funding and people will be possible again in the very near future. It is thus important, as an initial step, to identify a first set of realistic actions that will have to be monitored closely in order to seize any opportunity to improve them or enlarge them. In the same time, it is necessary to continue to fill up the database (see section 3) including satellite part with new gridded products, and prepare exploitation of new satellite missions to support previous research actions

(i) Sustained observing system for weather prediction

As mentioned in section 2b, more effort is needed to recommend what the sustained observing system should be for monitoring and predicting weather and climate in the West African region. We should recognize that we may be currently hindered in this effort by the large model biases that exist but more discussion is needed between scientists, data assimilation groups, and WMO.

- AMMA must make more effort in this area. A series of workshops is likely the best route to push these issues along. For weather issues the AMMA-THORPEX group needs provide routine reports on progress in the area of weather prediction and in the very short time should organize a workshop, ideally at an operational centre. The goal of this workshop would be to collectively assess the state of play today and to coordinate future experiments. Something similar should be done by a Climate Prediction working group.
- Establish or/and maintain formal links with appropriate bodies at WMO (e.g. CBS, GCOS, GOOS). Representatives from these bodies should be invited or at least kept informed of the discussions taking place in AMMA in this regard.

(ii) Long term environmental monitoring from research initiatives

The international GEO / GMES initiative provides a framework for a long term environment observation strategy in West Africa.

Main existing observation sites

First of all, the existing observation sites, and stations should be maintained and developed. They concern:

- AMMA-CATCH (http://ltheln21.hmg.inpg.fr/catch/) for the water cycle and vegetation studies on three meso-sites
- PHOTONS-AERONET (http://loaphotons.univ-lille1.fr/) and IDAF (http://www.aero.obs-mip.fr/spip.php?article96) for aerosol and gaseous species loading and wet and dry deposition and their impacts (radiative and health)
- PIRATA (http://www.brest.ird.fr/pirata/ (co-funded by Brazil, France and USA) and SSS (Sea Surface Salinity) for sea surface temperature, salinity and mixed layer monitoring.

Most of these observing systems were built from pre-existing systems so that in fact the time depth of the monitoring may reach 20 years, and even more in some places. The French institutions have engaged themselves for a support within at least the next four years. They also encouraged possible extensions of these systems both in space and measured parameters (e.g. currents in PIRATA).

Additional monitoring

These observing systems are certainly not sufficient to embrace all the questions raised in the present Science Plan and additional long term monitoring programs would be needed to do so, together with closer collaboration with new or existing initiatives (e.g. possible joined African-German-French effort). Present observation systems constitute a primary basis for a new GMES-like project, named SECAO (Suivi Environnemental et du Climat en Afrique de l'Ouest – Environment and Climate Survey of West Africa), which is encouraged by the French institutions. To organize this network in a consistent and efficient manner, a common set of measurements should be performed in eatch site, and some of them should allow for the development of products of interest for climate – society issues (see section 2d.3). To develop this network, the current priorities are the following:

- Maintaining common measurement sites for AMMA-CATCH, IDAF and PHOTONS, especially at Hombori (Mali, 15°20'), Banizoumbou (Niger, 13°30') and Djougou (Bénin, 9°40')
- Southern extension for PHOTONS-AERONET and AMMA-CATCH observation types (such as Lamto in the Ivory Coast, 6°10')
- Creation of a perennial Sahelian *Dust Aerosol Transect observatory*, from the corresponding "*Dust Sahelian Transect*" instrument of AMMA. This transect is made of 3 stations located in M'Bour (Senegal, also a *PHOTONS* station), Cinzana (in Mali) and Banizoumbou.
- Inclusion in the long term monitoring program of the GPS network maintained during the AMMA EOP on two parallel meridional gradients made of 3 stations each.
- As recommanded by the PIRATA SSG in 2010, new PIRATA site in the central South Atlantic (for example at 15-20°S, 10°W).
- Based on the coastal monitoring of the SSTs between Benin and Ivory Coast (AMMA/ RIPIESCA/Propao), extending the network eastward (up to Cameroon, Gabon) and westward (up to Senegal), also taking into consideration an enhancement of the M'Bour station (or the Petite Côte monitoring) in Senegal and a better sounding coverage.
- To ensure the maintenance, and even its extension, of the coastal tide gauges operated in the framework of GLOSS in West Africa. (possible collaboration between SOERE SONEL and PIRATA).

- Pursuing recent efforts of urban long term measurements in African cities (Pollution and health). Other efforts related to megapole environmental issues should be envisaged as flood risks.

Links between modeling, ground and satellite observations

In parallel to the ground monitoring actions, actions have been taken, or are envisioned, to ensure closer linkage between field observations, satellite monitoring and modeling. The ultimate objective of merging ground observations, satellite observations and modelling is to derive products that will enable a large community of scientists and decision makers alike to monitor the evolution of the climate and the environment over the region for a range of time scales. Ultimately this could lead to setup a SECAO West-African Cyber-Observatory (see http://www.ncar.ucar.edu/cyber/ for more details on the Cyber-Observatory concept) as suggested above.

Building on the SMOS and Megha-Tropique CalVal programs, it is further recommended that all observation sites be used as Tropical Africa CalVal sites for any relevant satellite mission. This is especially the case for the GPM (Global Precipitation Measurement) program, of which Megha-Tropiques is a precursor satellite and PIRATA and SSS SOERE that provide open sea in situ surface measurements during dedicated cruises.

Related to these satellite missions, AMMA-CATCH sites were selected as Calval sites for SMOS (launched November, 2, 2009) and Megha-Tropiques (MT) (due to be launched in 2011). Specific measurement campaigns are currenly added to the routine long term monitoring:

- Sampling the moisture of the top centimeters of soil will be carried out at various locations of the three AMMA-CATCH meso-sites for validation of the SMOS mission;
- The Niger AMMA-CATCH meso-site is the CalVal super-site for deep tropical convection studies. Additional recording raingauges will be added to cover a larger area to the South of the present site, focusing on the Goroubi catchment for the purpose of the hydrological validation program. In summers 2010 and 2011, the C-band MIT radar will operate in conjunction with the XPORT LTHE radar. A campaign of microphysics flights by the French research aircraft FF20 has been also organized during August 2010.

Partnership with African teams and institutions

- Since 1995, IDAF sites are operated and scientifically managed by an African principal investigator from the main universities. In the AMMA first phase, such collaboration has been extended to modeling actions and needs to be reinforced.
- First, there is an urgent need to associate more closely the African scientists and institutions in the operation of the various observing systems installed for environmental research purposes in the region. The aim of the coming 10-year period should be that African teams become the leaders in the operation of these systems. This will require specific means and funding and a great political will on both sides (the present European teams in charge of these observing systems and the African institutions willing and able to operate them in the future).
- In order to better meet the needs of the African partners, the long term environmental monitoring systems should increasingly be concerned with socio-economic observations. AMMA-CATCH plans to foster a “Resources” program, the focus being on water resources in Benin, agriculture in Niger and pastoralism in Mali. IDAF is looking forward to studying the effect of pollution on health in mega-cities. The dust aerosol program is connected with

epidemiologic studies, especially on Meningitis. All these initiatives should take more importance in the next phase of AMMA.

- AMMA & PROPAO/RIPIECSA contributed for the regional coastal countries in the northern Gulf of Guinea (Nigeria, Benin, Togo, Ghana and Côte d'Ivoire) to be now able to maintain an autonomous network of SST sensors (1h time resolution) and will soon also proceed to the calibration of the sensors and validation of the data sets. Partnership and supports are necessary to maintain and extend this network. Some of these countries also maintain tide gauges in the framework of GLOSS and there is a urgent need that other countries maintain other sensors.

(iii) Operational networks documenting the water cycle and the atmospheric dynamics

It has always been difficult to maintain the meteorological and hydrological operational networks at a proper level of operation in this region, for a number of reasons going from funding to governance and priorities. However the AMMA field campaigns have shown that there are competent and motivated people in the meteorological services that are absolutely able to successfully operate Radio-Sounding and surface stations. It was also demonstrated that, with an appropriate level of funding, regional organization of the logistics associated with these operations is effective. Given the existence of several well supported regional organizations in Meteorology and Hydrology that could coordinate a regional program of operational observations in close cooperation with national services, the building blocks exist to build such a program. Of course there are a few places – some of them key places from the perspective of documenting the dynamics of the WAM – where it is presently more difficult to secure regular observations but all in all, maintaining a proper regional monitoring of the key meteorological and hydrological variables controlling the water cycle is feasible, providing a few actions are taken:

- Securing the funding for the radio-sounding network and signing an MOU with ASECNA and/or national met services for operation. The network of 22 stations refurbished during the first phase of AMMA constitutes a good starting point for this action. Special attention should be paid to the coastal stations of Cotonou and Conakry in this regard.
- Mounting a specific action for refurbishing the synoptic surface network
- Establishing a partnership with ABN, OMVS and other regional hydrological bodies in charge of supervising the large international river systems of the region with the aim of ensuring proper streamflow measurements and their dissemination.

Beyond the financial and technical requirements of operating such regional networks, a more strategic action would be to extend the mandate of AGRHYMET so that it becomes a true regional climate-monitoring centre, similar to DMC-Nairobi for East-Africa. Rainfall, surface met observations and hydrological data for the main rivers of the region would be made available to the scientific community at this climate centre. Steps should also be taken to establish closer links with GCOS, HYCOS and GOOS programs.

3. Capacity building & training

Results from Phase 1 of AMMA

A coordinated African Community

A major achievement of AMMA has been the establishment of a large and active African community working on AMMA science, gathered in a network called AMMANET. AMMA has been successful at motivating a very large international community to work on the West African climate and its interactions with the environment, the water cycle and the socio-economic factors controlling the life of the local population. AMMA has thus proved not to be uniquely a punctual scientific action, but also to encompass both important aspects of Training and Capacity Building and Application to bring research at the service of development.

AMMANET has been created to bring together scientists supported by the National Meteorological and Hydrological Services (NMHSs), the African universities and the regional centres (ACMAD, AGRHYMET, ASECNA). It was steered by a regional coordination committee (CSAM) and national focal points and allowed to write the AMMA African Science Plan (PIAF).
Launched in 2002, AMMANET has actively contributed to the deployment of instruments in the field and to the successful implementation of the AMMA field campaigns. In Niger, the AMMA Operation Centre (AOC) was hosted by national and regional institutions. Complementary contributions to support the operations were provided by several national institutions in terms of human resources, premises and logistical help as in Benin, Burkina Faso, Senegal, Mali, Togo and Guinea. Moreover, 18 forecasters chosen by their National Meteorological Offices or by ASECNA and coming from 12 West and Central African countries actively participated in the operations during 4 months, performing and delivering 24h/day, forecast products that helped scientific decision making. These forecasters were based in ACMAD, which operated the AMMA Forecasting Centre, with the support of Météo-France and the World Meteorological Organisation (WMO).

Coordinated support to AMMA African Science Plan

Initiatives to support the implementation of the African Science Plan came to light and allowed the extension of AMMANET to other disciplines and to new African institutions. Among these initiatives, two can be outlined:

-AMMA-TTC supported by the European Community: 1.2 million Euros (2007-2009) for research on impact of climate changes on agriculture, water resources and health. This initiative supported an important part of the « Impact and Applications » studies of the African Science Plan and helped to consolidate the AMMA-EU project. 20 African national research institutions and operational services have been thus funded.

-RIPIECSA (Recherche Interdisciplinaire et Participative sur les Interactions entre les Ecosystèmes, le Climat et les Sociétés en Afrique de l'Ouest) supported by the French Ministry of Foreign and European Affairs through the FSP (Fonds de Solidarité Prioritaire): 3.5 million Euros (2007-2010) for interdisciplinary research on interactions between climate, ecosystems and societies over West Africa. 56 African institutions are funded through 26 interdisciplinary research projects on interactions between climate, ecosystems and societies.

Considerable efforts have been also made for the training and involvement of students, technicians and engineers of national and regional services. Thanks to the motivations of AMMA along with the French FSP-RIPIECSA through a regional program of physical oceanography (2007-2010), a regional Master 2 of «physical oceanography and applications » has been launched in September 2008 by IRD, University of Abomey Calavi at the International Chair in Mathematical Physics and Applications/Unesco (Cotonou), and Université Paul Sabatier (Toulouse). Other initiatives have been launched as major contributions to Master 2 at UCAD. Such efforts at Master level are needed to reinforce the community expertise on AMMA science in West Africa, together with applications related to climate-resources-environment-society and to promote regional collaborations.

During the first phase of AMMA, many scientists and students from Africa have been invited in other countries. For example, chemistry scientists from Ivory Coast, Benin, Cameroon and Niger in the frame of IDAF have been invited in France for a few months for formation, transfer technoly and publication finalization. Thanks to ICTP (Trieste) in conjunction with AMMA for their support for RegCM3 model development in West Africa, which is now running in Ivory Coast and Niger. Thanks also to CORUS-IRD program for a pilot study for pollution and health. International cooperations have been formalized between Cocody University (Abidjan) and University Paul Sabatier (Toulouse) and Yaoundé 1 University and University Paul Sabatier (Toulouse).

Doctoral studies

Around 80 African students are performing doctoral studies and 39 students have already defended their PhD thesis within the framework of AMMA. RIPIECSA project allows to support 35 African students at the Master level, 26 students on AMMA doctoral studies, and 54 technicians and engineers from national services.

Workshops and summer schools

AMMA workshops and summer schools have been organized bringing together students, researchers and forecasters from Africa and around the world to participate in lectures in Tropical Meteorology and Climate with a special focus on the West African Region:

-AMMA Summer School on African Monsoon, September 1-12 2003, Lannemezan, France,

-AMMA Professional training workshop for forecasters, June 2005, Niamey, Niger

-AMMA Training workshop for agricultural modeling, December 2005, Thiès, Senegal

-AMMA Radio-sounding training in various places, 2006

-AMMA Summer School - 1st Ewiem Nimdie International Summer School in Tropical Meteorology and Climate, co-funded by the British Council, July 21-August 1 2008, Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana

-AMMA Summer School, Climate Change and Water Resources, November 9-20 2009, Université Cheikh Anta Diop, Dakar, Senegal.

This series of workshops and schools should continue in the long-term, funded by different national sources. A funding already exists from ICTP for another Ewiem Nimdie International Summer School at KNUST in 2010.

Database

The AMMA database and the associated online tools have been fully developed and are managed by two teams in France (IPSL Database Centre, Paris and OMP, Toulouse). The complete system has been mirrored in Africa at AGHRYMET Regional Centre in Niamey and is operational there since January 2009. Users can now access metadata and request data through one or the other of two equivalent gateways: http://database.amma-international.org or http://amma.agrhymet.ne.

The database contains around 125 past and recent local geophysical observation datasets, 60 satellite products, 10 model output datasets, as well as results from human sciences field survey and value-added products. For example, more than 12000 radiosonde high resolution profiles over the West African area, precipitation estimations combining several data sources and ECMWF AMMA SOP 2006 re-analysis outputs are available. In order to be usable by researchers from any discipline, the data are converted into standard formats and documented. The database total volume is now 12 terabytes and the user community is as large as 400 persons.

AMMA aims to gather and consolidate the African community working on AMMA issues, from scientists to decision makers and users. The need to engage more with users and decision makers is a priority for AMMA in the next phase. This should be reflected in the governing of the program and how it communicates. The enhancement of capacities in Africa need to be pursued with vigor and based on the objectives of the AMMA program. It is important that AMMA coordinates these activities with all relevant bodies. In this regard, a new governance of AMMA-Africa has been proposed in implicating these bodies (See Section 5).

The dramatic events and consequences of climate change and climate variability in Tropical Africa and the awareness about them have considerably grown over the last three decades in Africa and in the rest of the world. The need for developing AMMA has been recognized by African regional institutions (ACMAD, AGRHYMET), national meteorological and hydrological services and African universities. However, all these institutions and universities require strengthening of their capacities to permit them to actively participate in the various components of AMMA. The present proposal meets WMO and ICSU recommendations and covers different aspects of training and institutional capacity building required in the region.

AMMA-Africa has the ambition to promote research in climate and environment sciences for applications to the development. To this purpose, investment in capacity building and training must be actively sought, providing the basis to achieve AMMA objectives but also contributing to the implementation of the ICSU-RoA and THORPEX-AFRICA plans. Strong governance and steering of AMMA-Africa are necessary to achieve these objectives (See section 5).

3a Observing, monitoring and information systems capacities

There is a need for observational data on all components of the climate system. These data are needed to assist governments and industries to assess their vulnerability to climate variability, climatic extremes and climate change and to take mitigating or adaptive measures, such as improved agricultural planning, better design of buildings and structures, optimization of water supply systems and conduct of immunization campaigns. Strengthening observational capacity in the region will, in consequence, assist countries in meeting their respective social, economic, and environmental needs while also contributing to addressing global issues.

The implementation of the project will require close cooperation between the nations of West and Central Africa in the common pursuit of initiatives and funding opportunities and to pool capacities to achieve operational goals. A more coherent regional approach could yield benefits in areas such as the purchase of equipment and consumables, maintenance of observing systems, data management and data access. It would also assist in optimizing the design of observing networks, data management and archive systems, delivering training courses, graduate and post-graduate studies and other capacity building efforts, and in the planning and implementation of research programs.
Equally, the broad spectrum of agencies, institutions and client groups involved in climate system monitoring, data management, and applications within individual countries also generates requirements for enhanced coordination at the domestic level. These domestic and external requirements for cooperation and coordination must be addressed. Appropriate coordination structures must be established to facilitate the delivery of capacity building programs and initiatives, minimize duplication, improve data access and exchange, and gain optimum regional benefits from investments in infrastructure and human resources development.

3b Capacities for hydrology, environment, oceanography and meteorology database management and data processing in Western and Central Africa

The National Meteorological and Hydrological Services (NMHSs) in Western and Central Africa are under constant pressure to respond to the increasing requirements of various economic sectors, planners and other decision makers for climatological and hydrological data. While the NMHSs try hard, often with very limited resources, to establish and maintain national and regional databases to meet these various demands, there are deficiencies in the organization and management of these databases, including problems related to data quality control and reliability and in the provision of up-to-date descriptions and analyses. Moreover, the risk of total loss of vital national databases is often present due to external factors (e.g. socio-politic troubles, riots, civil wars, and fires) and this risk is worsened in situations for which unique databases exist in the country.
An unique multiscale and multidisciplinary AMMA database has been developed during the program's first phase. It includes AMMA LOP, EOP and SOP data, historical *in situ* data, information about society-environment-climate interactions, satellite products and model outputs produced or used by the AMMA research community. The database is accessible in two locations: in Niger (AGRHYMET, Niamey) and in France (IPSL, Paris and OMP, Toulouse). The database may become the core of a broader database for climate and environment in West Africa. AMMA will work in any promotion, formation or technical action that may favor this evolution.

The objectives during AMMA-2 are:

- to manage new data produced during AMMA-2. This will concern geophysical data as well as quantitative or qualitative data about society-environment-climate interactions, that other data from related AMMA program (e.g. odinafrica, propao),
- to help establish a powerful data management system for climatic and hydrological data in the NMHSs in Western and Central Africa including an improvement of data exchange and dissemination between the NMHSs and the World Data Centres, and of data processing capacities of regional institutions,
- to improve the update procedures between the twin databases in Niger and France,

- to maintain and improve the database online tools, in order to provide an efficient data distribution service to the AMMA and scientific community at large,
- to develop the corresponding training activities.

3c Use and assessment of global and regional models for impact studies and for research on risk assessment through training, education, fellowship and exchange activities

This requires an effort to improve computing facilities for modeling studies in the region. As recommended by ICSU-RoA, one objective is to assess societal vulnerability and adaptation to global change by using community-based techniques allowing to measure and record information, and training researchers to assess better the risks due to these changes. Another objective is to build capacity for assessing climate change scenarios from global and regional climate model simulations for use in impact studies in West Africa. This assessment and validation of global and regional models will be performed at regional scale and over the AMMA-CATCH supersites. This concerns mainly the atmospheric models, but hydrological and agricultural models are also concerned over some AMMA-CATCH supersites. The following activities will be performed:

- Strengthening model assessment and validation in implementing summer schools on:
    - data retrieval and analysis methods and tools,
    - modeling and downscaling methods and tools,
    - access, interpretation and use of remote sensing data,
    - GIS and advanced spatial analysis methods and tools.

- Strengthening risk assessment and research capacities in the following areas:
    - participatory and action research methods and tools,
    - risk assessment methods and tools,
    - vulnerability and adaptation assessment methods and tools,
    - multi-criteria assessment methods and tools for evaluation of adaptation.

In West Africa, coastal areas are also of major importance for societal aspects with 70% of the population and about 70% of the PIB due to the ports and trades, fisheries, agriculture…. That deserve specific studies and monitoring in regard of the sea level rise and coastal erosion. Simultaneously to the implementation of coastal networks and capacity building for these networks to be locally maintained (e.g. tide gauges, SST, beaches width monitoring…), efforts have to be dedicated to the development of coastal numerical models for addressing processes responsible for coastal erosion and scenario for the coastal environment management.

3d Fellowships and strengthening resource mobilization in support of research and application on climate change and adaptation in Africa

The Executive Bureau of AMMA Africa (see section 5) will be in charge of advising, submitting or coordinating programs and projects for:

- MSc and PhD fellowships,
- awareness and educational programs for end-users and policy-makers,
- mobility schemes for teachers and students (exchange programs).

The Executive Bureau of AMMA-Africa will contribute through a regional strategy to mobilise resources for strengthening capacities of universities and national institutions as well as capacities of national focal points.

3e Communication, information dissemination and institutional endorsement

The diffusion of AMMA scientific knowledge is required for all sectors of society, especially among political leaders, parliamentary committees on environment and the corporate sector. These should be targeted for sensitization on adaptation with a view to influencing key government ministries such as finance, planning and agriculture. Sensitization of the corporate sector could also promote local generation of additional funds.

Currently, there are no organized mechanisms of collecting, collating, appropriately packaging, and distributing information on adaptation to decision makers, especially from the grassroots. Results from climate change adaptation action research need to be packaged and communicated to policy and other decision makers appropriately and regularly (see Section 4).

4. Scientific Diffusion and Communication

Results from Phase 1 of AMMA

At the beginning of the AMMA program, the communication was dedicated essentially towards the press. The communication teams of partner institutions took in charge actions to realize it. In particular, a press travel was organized on the observational African sites in July 2006. Press releases and packs followed each press conference organized for the three International conferences of the program. Since the beginning of AMMA, events around AMMA have beneficiated from widespread media coverage.

From 2007, institutions decided to reinforce communication component in order to develop aspects of diffusion inside AMMA community and toward the general public as well as to renew their external communication tools to enlarge the target press. Thanks to regular external publications, large public activities as an attentive press to the AMMA progresses, the program is turning to the diffusion of its results, more specifically toward the African continent to increase public awareness about local as global climate questions.

The diffusion of scientific knowledge acquired in AMMA has to be a major involvement of the second phase of program. AMMA communication activities are carried out at the national and international levels. The promotion of the scientific work done in the program, inside and outside AMMA community, will follow four principal routes depending on the targeted public.

- AMMA is working to reinforce and extend its communication network, especially in Africa. The goal is to supply more information to the African actors of scientific diffusion, and to increase the diversity of specialized media able to reach the local public. Dissemination of scientific information in Africa is directed mainly towards:

  a. **African scientific community**
  Through internal and external communication tools, goals are to raise awareness to future African researchers on the themes of AMMA. To reinforce scientific capacities is necessary to enlarge the AMMA community with African scientists and the communication objectives will be to better inform them about AMMA opportunities of PhD, Masters, summer school… (See section 3)

  b. **An African intermediaries network (Communicators and Journalists)**
  Through this network, the goal is to enlarge the diffusion in Africa of the scientific results of AMMA to be used in applications. Increase the diversity of specialized actors will broad the public targeted and insure the use of the scientific information in adequate communication supports. Finally, exchanges of skills between communication networks will insure a better way on how to diffuse the information, with the best tools and adapted to the targeted public.

- **Internal communication** is directed mainly towards **AMMA community and Partner Institutions**. It consists in living up and informing the AMMA community at large, that is today 2,000 persons worldwide, about recent results, events, funding opportunities, ISSC and IGB decisions, … Dissemination is achieved firstly through a bi-annual and bilingual international newsletter of about forty pages which includes the major results of the program, and the latest publications by researchers of AMMA. Short fortnightly informative mails are also sent dealing with research activities, training courses, or conferences of interest for the AMMA community. Institutional articles published in partner journals contribute to increase the visibility towards their mother agencies and research institutions as well as towards the main international programs (WCRP, GEWEX, CLIVAR, IGBP, ILEAPS, THORPEX,…).

- **External communication** is directed mainly towards **mass media, decision-makers and End users.**
  Work with the mass media (press packs, releases and conferences, press relation) allows to inform this "aware" public, including institutions. The scientific as well as societal objectives of the research carried out in AMMA have thus regularly been presented to the press. It is an effective way to diffuse key scientific results from AMMA publications and also to inform the decision makers about state of art on weather and climate prediction and on early warning systems. Ultimately, the external communication contribute to maintain the investment of the partner institutions and to ensure the future of the program.

- **Scientific culture** is directed mainly towards **Large Public**.
  Through entertaining, accessible and diversified tools as touring exhibitions, flyers, meetings between researchers and the general public or between PhD and undergraduate students, the objective is to inform the large public about the societal goals of the research carried out in an international scientific program focused on the West African monsoon It allows to directly increase public awareness of scientific and environmental issues. Sensitizing the public to the issue of research and informing them about scientific questions as well as achievements not only ensures the dissemination of knowledge, but also contributes to the promotion of scientific careers.

These communication actions need a strong implication of AMMA scientific teams. These kind of activities are not always noted in the researcher profession practices. It will be fundamental to inform and sensitize scientific teams to this objective, their work expected and about the different program communication actions to insure their effective participation.

5. Coordination and Governing of program

Results from Phase 1 of AMMA

Following a White Book issued in 2001 by the French scientific community, AMMA was launched at a workshop held in Niamey, 2002. It was initiated and steered by scientists from Africa, Europe and US. In 2005 the International Science Plan (ISP) was completed. A year later an African Science Plan was created, a significant milestone towards the establishment of a coordinated and interacting scientific community working on the West African monsoon.

An International Scientific Steering Committee (ISSC) was born out of these efforts and worked together to agree the key science issues and mobilize funding for research and observing systems. The ISSC has been led by lead scientists and coordinators of major contributing projects.

To prepare and implement the AMMA multi-year field campaigns, an International Coordination and Implementation Group (ICIG) was formed under the supervision of the ISSC to ensure a real coherency and good coordination of all the field work scheduled by each of the various AMMA components. To that end, AMMA was structured in Task Teams (TTs) and Support Teams (STs), defined around a coherent ensemble of instruments in terms of observing strategy. The Task Teams were thus cutting across the scientific working groups, as well as across the individual projects composing AMMA. The specific strategy of each TT was described in detail in the AMMA International Implementation Plan. Back to a long term observation scheme after the EOP, the ICIG, TTs and STs were replaced by lighter cross-cutting groups.

In addition to this an International Governing Board (IGB) was established that consisted of representatives from contributing funding agencies and stakeholders. The IGB was built in a second step in 2005 after funding of major projects was achieved. The coordination by ISSC and IGB, indefectibly supported by the International Project Office (IPO), was vital to success in the first phase AMMA. Without the IPO, it would not have been possible to organize field experiments, workshops and conferences and to diffuse information inside and outside the AMMA community.

It is necessary that AMMA continues and builds on what has been achieved so far. There is still much work to do and international coordination is a requirement. The steering of the second phase of AMMA has to evolve towards a different management from the first phase.

In regard to the program scope, scientific challenges and human issues, and challenges for research in Africa, the legitimacy of AMMA is essential to establish through a reinforced institutional endorsement by i) international scientific bodies (like WMO, ICSU) through associated programs (WCRP, WWRP, IGBP, ESSP, …); ii) local and regional African organizations and stakeholders (such as ECOWAS, UEMOA, AU, UNDP-GEF, PIREM) facing adaptability and mitigation of climate variability impacts; in particular a reference to AMMA should be sought in the discussions or agreements between the African and European Unions in the view of long term support.

The three-level international coordination set up in the first phase of AMMA should be consolidated to involve the bodies and programs mentioned above from the beginning of the second phase. The three levels include an International Governing Board (IGB) with representatives of the institutions and programs supporting AMMA activities, an International Scientific Steering Committee (ISSC), assisted by an International Executive Office (IEO). Compared with the International Project Office of the first phase, extended responsibilities are proposed for the IEO. The so-defined committees will have to define the strategy and means to implement the ISP-Phase 2, encompassing the continuous promotion of the database and publication repository built under the first phase of AMMA, the enhancement of capacity building and training in Africa, and communication activities.

In order to foster a prominent role of Africa community involved in AMMA, AMMA International and AMMA Africa should have a parallel and connected governing structure.

5a Structure of African coordination

During a prospective meeting (Ouagadougou workshop, 25-27 February 2009), AMMA-Africa in considering the high level of success achieved in the first phase, resolved that:

- AMMA continues beyond 2010 and build on what has been achieved in first phase
- Society-based issues should continue to be addressed, particularly on adaptation and mitigation of climate variability and change impacts
- Transfer of knowledge, methodology, tools to researchers working in the region and other regions in Africa be intensified
- Capacity building for African scientists should continue, to meet the challenges of climate variability and change in Africa
- Strong institutional endorsement is necessary

In addition, as a result of the successes from the first phase, more scientists within the West African regions and other regions of Africa have shown significant interest in AMMA. Therefore, AMMA-Africa was challenged to restructure itself to meet the needs of the AMMA-Africa network. This led to the creation of an Association, called AMMANET which was unanimously endorsed by scientists, head of regional institutions in West Africa (Workshop in Abidjan, Ivory Coast, 19–21 May 2010). The association AMMANET is sheltered at ACMAD (Niger) with an AMMANET Projet Office (APO) and under Niger Republic policies. AMMANET has three components :

1. An **AMMA Africa Governing Board** made up of delegates of leading institutions or centers like ACMAD, ECOWAS, CILSS, UEMOA,... shall provide institutional endorsement and support to AMMA-Africa.
2. An **AMMA Africa Scientific Committee (CSAM)** made up of leading scientists from the countries covered by AMMA in West Africa and representing a network of national focal points shall:
    i. participate in drawing up the international science and implementation plans,
    ii. develop them at the regional and national levels,
    iii. draw up and implement a plan for capacity building and training,
    iv. coordinate the replies to calls for proposals or funding,
    v. coordinate the African scientific community in AMMA.

The Co-Chairs of the CSAM are members of the International Scientific Steering Committee (see below).

3. An **AMMA Africa Executive Board** made up of scientific leaders designated by the CSAM and including a Program Manager of AMMA-Africa. This latter

position is of crucial importance at this stage of the life of the program. This position will also be attached to the International Executive Office (see below). The AMMA Africa Executive Bureau shall:

i. help the CSAM elaborate yearly plans of activity,
ii. operate the daily management of AMMA-Africa,
iii. help in mobilizing adequate resources for research and capacity building activities,
iv. bring support to field deployments, as well as the organization of conferences, meetings, and training courses,
v. link scientists and policy-makers at the regional level,
vi. contribute to maintain collaboration between African scientists, other AMMA researchers and international programs

In every country, it is decided to consolidate existing National Committees and to encourage AMMA coordinators to enhance collaboration with UNFCCC focal points.

5b Structure of international coordination

An **International Governing Board** including representatives from the main international programs, regional centers and bodies in Africa, and funding agencies. Its primary functions are:

i. to coordinate the management of the AMMA program, especially by deciding *in fine* on the orientations of AMMA research and application,
ii. to interact with the ISSC and IEO on matters like resources, support and monitoring of the program and contributing projects,
iii. to promote the capacity of the ISSC and AMMA community to build up research and capacity building projects to address the societal needs related to water resources, health, food security, climatology and weather,
iv. to be the institutional link of AMMA with African institutional and political bodies and international scientific bodies,

with the help of the ISSC and IEO, to encourage national governments, regional and international funding agencies to support the implementation of AMMA and the achievement of its goals by providing adequate support to the necessary national, regional and international research.

An **International Scientific Steering Committee** made up of lead scientists and coordinators of major contributing projects with the following primary functions:

i. to ensure that the science in AMMA is integrated in order to address the scientific objectives given in the present ISP2; the ISSC ensures the scientific integrity and coherency of the scientific objectives of AMMA,
ii. to provide scientific guidance to and oversee the development, planning and implementation of AMMA,
iii. to identify and mobilize national and international resources (financial, technical and human) to support current and future AMMA activities; this task will be carried out together with the IGB,

iv. to actively promote and report on AMMA achievements and plans to international programs or organizations; representatives will be appointed by the ISSC to represent AMMA on its behalf,

v. to follow up progress and achievements by defining and monitoring milestones and expected results according to a plan defined with the IEO,

vi. to advise the AMMA Africa coordination bodies especially in terms of capacity building and training; this includes providing guidance to the African operational centers (e.g. NMHSs, Regional Centers) on the timely transition of AMMA research and development into operations.

5c International Executive Office

A permanent **International Executive Office** (IEO) who facilitates the planning and implementation of activities, provides input for the scientific monitoring of the project, and communicates research results to the broader scientific community, as well as to decision-makers and the general public. The funding of the IEO needs to be supported internationally with financial and human resources provided by the partners of the program. The IEO should be comprised at least of a Scientific Director, a Program Manager, a Communication Officer and a Secretary. The Program Manager of AMMA-Africa is also a member of the IEO.

The IEO will be attached to the ISSC and IGB, the IEO Scientific Director working closely with the Co-Chairs of the IGB, the ISSC, and the AMMA Africa Executive Committee. The IEO assists the ISSC and IGB:

i. <u>to ensure the implementation and coordination of AMMA activities by</u>:

   a. assisting in planning, budgeting and implementation of research, database management, training activities, research field campaigns, etc,
   b. assisting the ISSC in assembling and synthesizing information related to AMMA research and application results from various projects contributing to AMMA,
   c. organizing adequate connections with relevant national and regional contributing projects,
   d. ensuring effective coordination with relevant international research programs and bodies,
   e. organizing of workshops and conferences as decided by the IGB and ISSC,
   f. organizing the IGB and ISSC meetings,
   g. ensuring that the actions decided by the IGB and ISSC are executed,
   h. provide adequate support and tools to the work of the IGB and ISSC.

ii. <u>to ensure the efficient realization of the scientific communication objectives by</u>:

   a. elaborating a long term communication strategy to achieve the objectives set out in chapter 5 of ISP2,
   b. elaborating an annual communication plan and budget,
   c. coordinating the execution of the communication plan,
   d. insuring the respect of the communication procedures,
   e. participating in the communication think tank with other international organization particularly in Africa.

5d Links with international programs and bodies

AMMA is endorsed by and/or contributes to numerous international programs (see table below). AMMA is also working bodies as WMO (The new co-Chair of IGB is the Regional Director for Africa in WMO) and ICSU (RoA). To better communicate and report with these programs and bodies, a policy has been established, including the nomination of an unique AMMA contact.

Program	AMMA contacts	Other AMMA supporting people	Main contact in the program or body
WMO	IGB Co-chairs	ISSC Chair	A. Ndaye (Director Africa Region)
ICSU RoA	A. Diedhiou	CSAM	D. Nyanganyura (ISCU-ROA)
WWRP	ISSC Chair	ISSC	Dr Nakazawa (WWRP/Head)
WWRP/THORPEX	C.Thorncroft	A.Diongue E. Afiesima, M. Kadi A. Diedhiou	A. Diongue (Co-Chair THORPEX-Africa, AMMA)
WCRP	ISSC Chair	ISSC	V. Detemmerman(WCRP/Scientific Off) G. Asrar (WCRP/Head)
WCRP/CLIVAR	C.Thorncroft	ISSC	J. Hurrel (Co-Chair) H. Cattle (IPO)
CLIVAR/Atlantic	L. Terray	P. Brandt, B. Bourles	L. Terray (Co-Chair, AMMA)
CLIVAR-Africa (VACS)	C.Thorncroft	ISSC	C. Reason (Co-Chair)
WCRP/GEWEX	ISSC-Chair	ISSC	P. van Oevelen (IPO) K. E. Trenberth (Chair) H. S. Wheater (Co-Chair) A. Gaye (AMMA)
GEWEX/CEOP	T. Lebel		T. Koike (Co-Chair) D. P. Lettenmaier (Co-Chair)
GEWEX/GCSS	A. Beljaars	P. Ruti F. Hourdin JLRedelsperger	P. Siebesma (Co- Chair) C. Bretherton (Co-chair) A. Beljaars (AMMA)
GEWEX/GLASS	A. Boone	J Polcher	A.Boone (AMMA) GLASS/Co-Chair
IGBP	ISSC Chair	ISSC	C.Nobre (Chair) Sybil-Seitzinger (IGBP/Sec)
IGBP/IGAC	A. Konaré	C. Liousse	K. Law (Co-Chair) A. Konaré (AMMA)
IGBP/ILEAPS	D. Serça		N. De Noblet (ILEAPS)

IGBP/GLP	C. Mbow		A. Reenberg (Chair) C. Mbow (AMMA)
CGIAR/ ESSP	T. Lebel		T. Lebel (AMMA)
WMO Observing Systems Division /CBS	M. Kadi	ISSC	M. Ondras (WMO/OSD Dir)
WMO Global Climate Observing System	M. Kadi	ISSC	B. Westermeyer (WMO/GCOS) J. Eyre (ET-EGOS chair) M. Kadi (AMMA)
OOPC (Ocean Observations Panel for Climate) (WCRP-GOOS-GCOS)	B. Bourlès		E Lindstrom (Chair) A. Fisher (OOPC secretary)

6. Cited references

Agusti-Panareda A., V. Drasko, A. Beljaars, O. Bock, F. Guichard, M. Nuret, A-G Mendez, E. Andersson, P. Bechtold, A. Fink, H. Hersbach, J-P Lafore, JB Ngamini, D. J. Parker, J-L Redelsperger, A. Tompkins, 2009 : Radiosonde humidity bias correction over the West African region for the special AMMA reanalysis at ECMWF, Q. J. R. Meteorol. Soc, 135, 595–617.

Agusti-Panareda, A., Beljaars, A., Cardinali, C. and Genkova, I. 2010: Impact of assimilating AMMA soundings on ECMWF analyses and forecasts, Weather and Forecasting (in press).

AMMA-ISSC, 2005: The International Science Plan for AMMA, http://amma.mediasfrance.org/library/docs/AMMA_ISP_May2005.pdf, 103 pp.

Ancellet, G., J. Leclair de Bellevue, C. mari, P. nedelec, A. Kukui, A. Borbon, P. Perros (2009) : Effects of regional-scale and convective transports on tropospheric ozone chemistry releavec by aircraft observations during the wet season of the AMMA campaign, *Atmos. Chem. Phys*., **9**, 383-411.

Athie G, F. Marin (2008) : Cross-equatorial structure and temporal modulation of intraseasonal variability at the surface of the Tropical Atl ocean. *J. Geophys. Res*., **113**: C08020, Doi:10.1029/2007JC004332.

Baines, P.G. and C.K. Folland (2007) : Evidence for a rapid global climate shift across the late 1960s. *J. Climate*, **20**, 2721-2744.

Barthe C., N. Asencio, J.-P. Lafore, M. Chong, B. Campistro, F. Cazenave (2010) : Multi-scale analysis of the 25-27 July 2006 convective period over Niamey: comparison between Doppler radar observations and simulations. *Quart. J. Roy. Meteorol. Soc.*,

Bechara, J and coauthors (2009) : Evidence of deep convective transport of VOC trace gases in the upper tropical troposphere during the AMMA experiment. ACP

Berry, G., and Thorncroft, C. 2005: Case study of an intense African easterly wave. Mon. Wea. Rev., 133, 752-766.

Berry,G., Thorncroft, C.D., Agusti-Panareda, A., Heming, J., Lafore, J.-P. and Thiaw, W. 2010: Intercomparison of African easterly wave representation in operational numerical weather prediction models, Weather and Forecasting (In Prep).

Biasutti, M. and A. Giannini (2006) : Robust Sahel drying in response to late 20th century forcings. *Geophys. Res. Lett.*, **33**, doi:1029/2006GL026067.

Biasutti, M., I.M. Held, A.H. Sobel, and A. Giannini (2008) : SST Forcings and Sahel Rainfall Variability in Simulations of the Twentieth and Twenty-First Centuries. *J. Climate*, **21**, 3471–3486

Bielli, S., H. Douville, B. Pohl (2009) : Understanding the West African monsoon variability and its remote effects: an illustration of the grid point nudging methodology. Climate Dyn., DOI 10.1007/s00382-009-0667-8.

Boone, A., P. de Rosnay, G. Basalmo, A. Beljaars, F. Chopin, B. Decharme, C. Delire, A. Ducharne, S. Gascoin, M. Grippa, F. Guichard, Y. Gusev, P. Harris, L. Jarlan, L. Kergoat, E. Mougin, O. Nasonova, A. Norgaard, T. Orgeval, C. Ottlé, I. Poccard-Leclercq, J. Polcher, I. Sandholt, S. Saux-Picart, C. Taylor, Y. Xue (2009) The AMMA Land Surface Model Intercomparison Project. *Bull. Amer. Met. Soc*., Early online release, DOI: 10.1175/2009BAMS2786.1

Brandt P, Schott FA, Provost C, Kartavtseff A, Hormann V, Bourlès B, Fischer J. (2006) : Circulation in the central equatorial Atlantic: Mean and intraseasonal to seasonal variability, *Geophysical Research Letters* **33**: L07609, Doi:10.1029/2005GL025498.

Caniaux G, Giordani H, Redelsperger J-L, Guichard F, Key E, Wade M. (2010) : Coupling between the Atlantic Cold Tongue and the African monsoon in boreal spring and summer. *J. Climate*, in revision.

Cairo, F. and coauthors (2009) : An overview of the SCOUT-AMMA stratospheric aircraft, balloons and sondes campaign in West Africa, August 2006, *Atm. Chem. Phys., Discuss*, **9**, 19713-19781

Chauvin, F., R. Roehrig and J.-P. Lafore, (2010) : Intraseasonal variability of the Saharan heat low and its link with mid-latitudes. *J. Climate* in revision.

Chazette P., J. Sanak et F. Dulac, A new approach for aerosol profiling with a lidar onboard an ultra light aircraft: application to the African Monsoon Multidisciplinary Analysis, Environ. Sci. Technol., 41, 8335-8341, 2007.

Coëtlogon, G. S. Janicot and A. Lazar (2010) : Intraseasonal variability of the ocean-atmosphere coupling in the gulf of Guinea during northern spring and summer. *Quart. J. Roy. Met. Soc*. Doi:10.1002/qj.554

Cook, K. H., and E. K. Vizy, 2006: Coupled model simulations of the West African monsoon system: 20th century simulations and 21st century predictions. J. Climate, 19, 3681-3703.

Douville, H., S. Conil, S. Tyteca and A. Voldoire (2007) : Soil moisture memory and West African predictability: artefact or reality ? *Climate Dyn*., **28**, 723-742.

Faccani B., F. Rabier, N. Fourrié, A. Agusti-Panareda, F. Karbou, P. Moll, J.-P. Lafore, M. Nuret, F. Hdidou, and O. Bock, 2009: The Impacts of AMMA Radiosonde Data on the French Global Assimilation and Forecast System. Weather and Forecasting, Vol. 24, Iss. 5, pp. 1268–1286.

FAO (2004) : FAOSTAT, Food and Agriculture Organization of the United Nations. Available online at http://apps.fao.org.

Flamant C., J.P. Chaboureau, D.J. Parker, C.M. Taylor, J.P. Cammas, O. Bock, F. Timouk, J.Pelon (2007) : Airborne observations of the impact of a convective system on the planetary boundary layer thermodynamics and aerosol distribution in the inter-tropical discontinuity region of the West African monsoon. *Quart. J. Roy. Met. Soc.,* **133**, 1175-1189.

Fontaine B., J. Garcia-Serrano, P. Roucou, B. Rodriguez-Fonseca, T. Losada, F.Chauvin, S. Gervois, S. Sivarajan, P. Ruti, and S. Janicot (2009) : Impacts of Warm and Cold situations in the Mediterranean Basins on the West African monsoon: observed connection patterns (1979-2006) and climate simulations. *Clim. Dyn*., doi:10.1007/s00382-009-0599-3.

Gaertner M.A, M. Dominguez, M. Garvert (2010) : A modeling case study of soil moisture-atmosphere coupling. *Quart J Roy Meteorol Soc* in press.

Gantner L, N. Kalthoff (2010) : Sensitivity of a modelled life cycle of a mesoscale convective system to soil conditions over West Africa. *Quart J Roy Meteorol Soc* in press.

Gardelle, J., P. Hiernaux, L. Kergoat, M. Grippa (2010) : Less rain, more water in ponds: a remote sensing study of the dynamics of surface water from 1950 to present in pastoral Sahel (Gourma region, Mali), Hydrol. Earth Syst. Sci., 14, 309-324, 2010

Giordani, H., G. Caniaux (2010) : Diagnosing vertical motion in the equatorial Atlantic. *J. Phys. Oceanography*, in revision.

Guichard, F., Kergoat, L., Mougin, E., Timouk, F., Baup, F., Hiernaux, P. & Lavenu, F. (2009): Surface thermodynamics and radiative budget in the Sahelian Gourma: Seasonal and diurnal cycles. *Journal of Hydrology*, 375. 161–177.

Guyot A., Cohard J-M., Anquetin S., Galle S., Lloyd C. (2009) : Combined analysis of energy and water budgets to consolidate latent heat flux estimation using an infrared scintillometer. *J. Hydrology*, **375**: 227-240, doi:10.1016/j.jhydrol.2008.12.027.

Hagos, S.M. and K.H. Cook (2007) : Dynamics of the West African monsoon jump. *J. Climate*, **20**, 5264-5284.

Hagos, S.M. and K.H. Cook (2008) : Ocean warming and late-twentieth-century Sahel drought and recovery. *J. Climate*, **21**, 3797-3814.

Hall, N. M. J., G. N. Kiladis, and C. D. Thorncroft (2006) : Three-dimensional structure and Dynamics of African easterly waves. Part II: Dynamics. *J. Atmos. Sci.*, **63**, 2231-2245.

Hiernaux, P., Lassine, D., Trichon, V., Mougin, E., Soumaguel, N., Baup, F. (2009) Woody plant population dynamics in response to climate changes from 1984 to 2006 in Sahel (Gourma, Mali). *J. Hydrology*, **375**: 103–113, doi:10.1016/j.jhydrol.2009.01.043.

Hopsch, S.B., Thorncroft, C.D. and Tyle, K.R. 2010: Analysis of African Easterly Wave Structures and their Role in Influencing Tropical Cyclogenesis, Mon. Wea. Rev., (in press).

Hormann V. Brandt P. (2009) : Upper equatorial Atlantic variability during 2002 and 2005 associated with equatorial Kelvin waves. *Journal of Geophysical Research* **114**: C03007, Doi:10.1029/2008JC005101.

Hourdin, F., I. Musat, F. Guichard, P.M. Ruti, F. Favot, M.A. Filiberti, M. Pham, J.Y. Grandpeix, J. Polcher, P. Marquet, A. Boone, J.P. Lafore, J.L. Redelsperger, A. Dell'Aquila, T. Losada-Doval, A.K. Traore, H. Gallee (2009) AMMA-Model Intercomparison Project. Bull Am. Met. Soc., 2009 Early online release, doi::10.1175/2009BAMS2791.1.

Hsieh, J.-S. and K.H.Cook, 2005: Generation of African easterly wave disturbances: Relationship to the African easterly jet. Mon. Wea. Rev., **133**, 1311-1327.

Janicot, S., F. Mounier, N.M. Hall, S. Leroux, B. Sultan and G. Kiladis (2009) : The dynamics of the West African monsoon. Part IV: Analysis of 25-90-day variability of convection and the role of the Indian monsoon *J. Climate*, **22**, 1541-1565.

Joly M., A. Voldoire, H. Douville, P. Terray, and J.-F. Royer (2007) : African monsoon teleconnections with tropical SSTs: validation and evolution in a set of IPCC4 simulations. *Clim. Dyn*., **29**, 1-20.

Joly M., and A. Voldoire (2009) : Influence of ENSO on the West African monsoon: temporal aspects and atmospheric processes. *J. Clim*., **22**, 3193–3210.

Joly M., and A. Voldoire (2010): Role of the Gulf of Guinea in the interannual variability of the West African monsoon: what do we learn from CMIP3 coupled simulations?. *International Journal of Climatology*, DOI: 10.1002/joc.2026

Karbou, F., F. Rabier, J-P Lafore, J-L Redelsperger, and O. Bock, 2010: Global 4DVAR Assimilation and Forecast Experiments Using AMSU Observations over Land. Part II: Impacts of Assimilating Surface-Sensitive Channels on the African Monsoon during AMMA. Weather and Forecasting, Vol. 25, Iss. 1, pp. 20–36.

Knight, J.R., C.K. Folland and A.A. Scaife (2006) : Climate impacts of the Atlantic multidecadal oscillation. *Geophys. Res. Lett*., **33**, doi:10.1029/2006GL026242.

Knippertz, P; Fink, AH (2009) Prediction of Dry-Season Precipitation in Tropical West Africa and Its Relation to Forcing from the Extratropics, *WEATHER FORECAST*, **24(4)**, pp1064-1084

Kolodziejczyk N, Bourlès B, Marin F, Grelet J, Chuchla R. (2009) : Seasonal variability of the Equatorial Undercurrent at 10°W as inferred from recent in situ observations. *J.Geophysical Research* **114**: C06014, Doi:10.1029/2008JC004976.

Kushnir, Y., W.A. Robinson, P. Chang, A.W. Robertson (2006) : The physical basis for predicting Atlantic sector seasonal-to-interanual climate variability. *J. Climate*, **19**, 5949-5970.

Lavaysse C., C. Flamant, S. Janicot, J.-P. Lafore, D. Parker, J. Pelon (2009): Seasonal cycle of the West African heat low: a climatological perspective. *Clim. Dyn.,* DOI: 10.1007/s00382-009-0553-4.

Lavender, S.L. and A.J. Matthews (2009) : Response of the West African monsoon to the Madden-Julian oscillation. *J. Climate*., doi:10.1175/2009JCLI2773.1

Le Barbe, T. Lebel, and D. Tapsoba (2002) : Rainfall variability in West Africa during the years 1950–90. *J. Climate*, **15**, 187–202.

Lebel, T, D. J. Parker, C. Flamant, B. Bourles, B. Marticorena, E. Mougin, C. Peugeot, A. Diedhiou, J. Haywood, J.B. Ngamini, J. Polcher, J.-L. Redelsperger, C. D. Thorncroft, (2009): The AMMA field campaigns: Multiscale and multidisciplinary observations in the West African region. Q. J. R. Meteorol. Soc. DOI: 10.1002/qj.486

Leblanc, M., Favreau, G., Massuel, S., Tweed, S., Loireau, M., Cappelaere, B. (2008) : Land clearance and hydrological change in the Sahel: SW Niger. *Global and Planetary Change*, **61**, 135–150.

Leduc, C., Favreau, G., Schroeter, P. (2001) : Long term rise in a Sahelian watertable: the continental terminal in South-West Niger. *J. Hydrology*, **243**: 43–54, doi:10.1016/S0022-1694(00)00403-0.

Leroux, S., and Hall, N.M.J. Relationship between African Easterly Waves and the African Easterly Jet. J. Atmos., Sci., 66, 2303-2316.

Losada, T., B. Rodriguez-Fonseca, S. Janicot, S. Gervois, F. Chauvin, and P. Ruti (2009a) : A multimodel approach to the Atlantic equatorial mode. Impact on the West African monsoon. *Clim. Dyn*., doi: 10.1007/s00382-009-0625-5

Losada, T., B. Rodriguez-Fonseca, I. Polo, S. Janicot, S. Gervois, F. Chauvin, and P. Ruti (2009b) : Tropical response to the Equatorial Mode. AGCM multimodel approach. *Clim. Dyn*., doi: 10.1007/s00382-009-0624-6.

Mallet, M., P. Tulet, D. Serça, F. Solmon, O. Dubovik, J. Pelon, V. Pont, and O. Thouron (2009) : Impact of dust aerosols on the radiative budget, surface heat fluxes, heating rate profiles and convective activity over West Africa during March 2006. *ACP*, **9**, 7143-7160

Marin F, Caniaux G, Bourlès B, Giordani H, Gouriou Y, Key E. (2009) : Why were sea surface temperatures so different in the Eastern Equatorial Atlantic in June 2005 and 2006? *J. Phys. Oceanography* **39(6)**: 1416–1431.

Marticorena, B., B. Chatenet, J. L. Rajot, S. Traore, M. M. Coulibaly, A. Diallo, I. I. Kone, A. Maman, T. NDiaye, A. A. Zakou (2010) : Temporal variability of mineral dust content over West Africa :Analyses of a pluriannual monitoring from the AMMA Sahelian Dust Transect. *ACPD*, MS No.: acp-2009-881, submitted.

Mathon V., H. Laurent, T. Lebel (2002) : Mesoscale convective system rainfall in the Sahel. *J. Applied Meteor.*, **41**, 1081-1092.

Matthews A.J. (2004) : Intraseasonal variability over tropical Africa during northern summer. *J. Climate*, **17**, 2427-2440.

Meehl, Lisa Goddard, James Murphy, Ronald J. Stouffer, George Boer, Gokhan Danabasoglu, Keith Di xon, Marco A. Giorgetta, Arthur M. Greene, Ed Hawki ns, Gabriele Hegerl, Davi d Karoly, Noel Keenlyside, Masahide Ki moto, Ben Kirtman, Antonio Navarra, Roger Pulwarty, Doug Smith, Detlef Stamm er, and Ti mothy Stockdale, 2009: Decadal Prediction, can it be skillful?. BAMS, DOI:10.1175/2009BAMS2778.1

Mekonnen, A., Thorncroft, C. and Aiyyer, A. 2006: On the significance of African easterly waves on convection, J. Climate, 19, 5405-5421

Mekonnen, A., Thorncroft, C.D., Aiyyer, A. and Kiladis, G., 2008: Convectively coupled Kelvin waves over tropical Africa during boreal summer: Structure and Variability, J. Climate, 21,.6649-6667.

Meynadier R., O. Bock, F. Guichard, A. Boone, P. Roucou, J.-L. Redelsperger (2010) The West African Monsoon water cycle. Part I: a new hybrid water budget dataset. J. Geophys. Res., in press

Meynadier R., O. Bock, S. Gervois, F. Guichard, J.-L. Redelsperger, A. Agustì-Panareda, A.Beljaars (2010) The West African Monsoon water cycle. Part II: assessment of NWP water budgets. J. Geophys. Res., in press

Mohino, E. B. Rodríguez-Fonseca, T. Losada, S. Gervois, S. Janicot, J. Bader, P. Ruti,and F. Chauvin (2010a) : Inter-annual SST-forced signals on West African rainfall from AGCM simulations-Part I: changes in the inter-annual modes and modelintercomparison. *Clim. Dyn*. Submitted.

Mohino, E. B. Rodríguez-Fonseca, C.R. Mechoso, S. Gervois, P. Ruti, and F. Chauvin (2010b) : West Africa Monsoon response to Tropical Pacific Sea Surface anomalies. *Clim. Dyn*. Submitted.

Mohino, E., S. Janicot, and J. Bader (2010c) : Sahelian rainfall and decadal to multidecadal SST variability. *Climate Dyn.*, in revision.

Mounier, F. S. Janicot and G. Kiladis (2008) : The West African monsoon dynamics. Part III: The quasi-biweekly zonal dipole. *J. Climate*, **21**, 1911-1928.

Nuret, M., Lafore JP, Bock O., Guichard F. A. Agusti-Panareda, J.B Ngamini, JL Redelsperger; Correction of humidity bias for Vaïsala RS80 sondes during AMMA 2006 Observing Period, 2008: DOI 10.1175/2008JTECHA1103.1. *J. of Atmospheric and Oceanic Technology* , Vol 25, 2152-2158

Paeth, H., K. Born, R. Girmes, R. Podzun, D. Jacob (2009) : Regional climate change in tropical Africa under greenhouse forcing and land-use changes. *J. Climate*, **22**, 114-132.

Parker D.J., A. Fink, S. Janicot, J.-B. Ngamini, M. Douglas, E. Afiesimama, A. Agusti-Panareda, A. Beljaars, F. Dide, A. Diedhiou, T. Lebe, J. Polcherl, J.-L. Redelsperger, C. Thorncroft, G.A. Wilson (2007) : The AMMA radiosonde program and its implications for the future of atmospheric monitoring over Africa *Bul. American Met. Soc.*, July 2008, 1015-1027.

Parsons D., Drobinski Ph, Cocquerez P., Cardonne A., Cole H., Fox J., Hock T., Lefevre J.P., Redelsperger J.L, Romberg K., VanAndel J., Vénel S., 2007 : Des ballons stratosphériques traquent la mousson africaine. La Météorologie, 55, 2-3.

Peter A-C, Le Hénaff M, du Penhoat Y, Menkes CE, Marin F, Vialard J, Caniaux G, Lazar A. (2006) : A model study of the seasonal mixed layer heat budget in the equatorial Atlantic. *Journal of Geophysical Research* **111**: C06014, DOI:10.1029/2005JC003157.

Philippon, N., E. Mougin, L. Jarlan, P.L. Frison (2005) : Analysis of the linkages between rainfall and land surface conditions in the West African monsoon through CMAP, ERS-WSC and NOAA-AVHRR data. J. Geophys. Res., 110, doi:10.1029/2005JD006394.

Philippon, N., F Doblas-Reyes, PM Ruti: Seasonal reproducibility and predictability of the West African Monsoon in coupled GCMs. Accepted with revisions to Climate Dynamics.

Polo I, Lazar A, Rodriguez-Fonseca B, Arnault S. (2008) : Oceanic Kelvin waves and tropical Atlantic intraseasonal variability: 1. Kelvin wave characterization. *J. Geophys. Res*. **113**: C07009, Doi:10.1029/2007JC004495.

Pu, B., K.H. Cook (2010) : Dynamics of the West African westerly jet and its association with Sahel precipitation. 29th Conf. on Hurricanes and Tropical Meteorology, 10-14 May 2010, Tucson, USA.

Ramel, R., H. Galle, and C. Messager, (2006) : On the northward shift of the West African monsoon. *Climate Dynamics*, **26**(4):429–440.

Raut, J.-C. and P. Chazette (2008) : Radiative budget in the presence of multi-layered aerosol structures in the framework of AMMA SOP-0. *ACP*, **8**, 6839-6864

Redelsperger J.L., C. Thorncroft, A. Diedhiou, T. Lebel, D. Parker, J. Polcher (2006), African Monsoon Multidisciplinary Analysis: An international project and field campaign, *Bul.American Met. Soc*., **87(12)**:1739-1746.

Richter, I., S.P. Xie (2008) : On the origin of equatorial Atlantic biases in coupled general circulation models. *Climate Dyn*., **31**, 587-598.

Rodríguez-Fonseca, B., I. Polo, J. García-Serrano, T. Losada, E. Mohino, C. R.Mechoso, and F. Kucharski (2009) : Are Atlantic Niños enhancing Pacific ENSO events in recent decades? *Geophys. Res. Lett*., **36**, L20705, doi:10.1029/2009GL040048.

Rodríguez-Fonseca,B., T. Losada, E. Mohino, S. Janicot (2010) : Inter-annual SSTforced signals on West African rainfall from AGCM simulations-Part II: Understanding global features for the 1979-98 period. *Clim. Dyn*. Submitted

Saunois, M., C. Mari, V. Thouret, J.P. Cammas, P. Peyrille, J.P. Lafore, B. Sauvage, A. Volz-Thomas, P. Nedelec, J.P. Pinty (2008) : An idealized two-dimensional approach to study the impact of the West African monsoon on the meridional gradient of tropospheric ozone. *J. Geophys. Res.,* 113, D07306.

Sultan, B., S. Janicot et A. Diedhiou (2003) : The West African monsoon dynamics. Part I: Documentation of intra-seasonal variability. *J. Climate*, **16**, 3389-3406.

Sultan B. and Janicot S. (2003) : The West African monsoon dynamics. Part II: the “preonset” and “onset” of the summer monsoon. *J. Climate,* **16**, 3389-3406

Sultan, B., C. Baron, M. Dingkuhn, et S. Janicot, (2005) : Agricultural impacts of large-scale variability of the West African monsoon. *Agricultural and Forest Meteorology*, **128**, 93-110.

Sultan, B., S. Janicot and S. Correia (2009) : Medium-lead prediction of intraseasonal oscillations in West Africa. *Weather and Forecasting*, Special Issue « West African weather prediction and predictability », **24**, 767-784, doi :10.1175/2008WAF2222155.1.

Sylla B., E Coppola, A Mariotti, F Giorgi, PM Ruti, A Dell'Aquila and X.Bi, 2009: Multiyear simulation of the African climate using a regional climate model (RegCM3) with the high resolution ERA-interim reanalysis. Climate Dynamics DOI, 10.1007/s00382-009-0613-9

Taylor C.M., R.J. Ellis (2006) : Satellite detection of soil moisture impacts on convection at the mesoscale. *Geophys. Res. Lett.* **33**: L03404.

Taylor, C.M. (2008) : Intraseasonal land-atmosphere coupling in the West African monsoon. *J. Climate*, **21**, 6636-6648.

Taylor C.M., P.P. Harris, D.J. Parker (2010) : Impact of Soil Moisture on the development of a Sahelian Mesoscale Convective System: A Case Study from the AMMA Special Observing Period. *Quart J Roy Meteorol Soc* in press.

Thorncroft, C.D., Hall, N.M.J., and Kiladis, G.N. (2008) : Three Dimensional Structure and Dynamics of African Easterly Waves Part III: Genesis. *J. Atmos. Sci.,* **65**, 3596–3607 DOI: 10.1175/2008JAS2575.1

Torn, D. R. 2010:Ensemble-based sensitivity analyses applied to African easterly waves, Weather and Forecasting (in press).

Vizy, E.K. and K.H. Cook (2009) : A mechanism for African monsoon breaks: Mediterranean cold air surges. *J. Geophys. Res.*, **114**, D01104, doi:10.1029/2008JD010654.

Ward, N. M. 1998: Diagnosis and Short-Lead Time Prediction of Summer Rainfall in Tropical North Africa at Interannual and Multidecadal Timescales, J. Clim., 11, 3167-3191.

AMMA Publications

Abdou, K., Parker, D. J., Brooks, B., Kalthoff, N. & Lebel, T. (2009) The diurnal cycle of lower boundary layer wind in the West African monsoon. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 66–76 DOI: 10.1002/qj.536.

Abiodun, B. J., Pal, J. S., Afiesimama, E. A., Gutowski, W. J. & Adedoyin, A. (2008) Simulation of West African Monsoon using RegCM3 Part II: impacts of deforestation and desertification. IN *Theoretical and Applied Climatology*, 93. 245–261.

Adon, M., Galy-Lacaux, C., Yoboué, V., Delon, C., Lacaux, J.-P., Castéra, P., Gardrat, E., Pienaar, J., Al Ourabi, H., Laouali, D., Diop, B., Sigha-Nkamdjou, L., Akpo, A., Tathy, J. P., Lavenu, F. & Mougin, E. (2010) Long term measurements of sulfur dioxide, nitrogen dioxide, ammonia, nitric acid and ozone in Africa using passive samplers. IN *Atmospheric Chemistry and Physics Discussions*, 10. 4407–4461.

Afiesimama, E. A., Pal, J. S., Abiodun, B. J., Gutowski, W. J. & Adedoyin, A. (2006) Simulation of West African monsoon using the RegCM3. Part I: Model validation and interannual variability. IN *Theoretical and Applied Climatology*, 86. 23–37.

Agusti-Panareda, A., Vasiljevic, D., Beljaars, A., Bock, O., Guichard, F., Nuret, M., Garcia Mendez, A., Anderson, B. E., Bechtold, P., Fink, A. H., Hersbach, H., Lafore, J.-P., Ngamini, J.-B., Parker, D. J., Redelsperger, J.-L. & Tompkins, A. M. (2009) Radiosonde humidity bias correction over the West African region for the special AMMA reanalysis at ECMWF. IN *Quarterly Journal of the Royal Meteorological Society*, 135. 595–617.

Agusti-Panareda, A., Balsamo, G. & Beljaars, A. (2010) Impact of improved soil moisture on the ECMWF precipitation forecast in West Africa. IN *Geophysical Research Letters*, . Also available as ECMWF Technical Memorandum 611.

Agusti-Panareda, A., Beljaars, A., Ahlgrimm, M., Balsamo, G., Bock, O., Forbes, R., Ghelli, A., Guichard, F., Köhler, M., Meynadier, R. & Morcrette, J.-J. (2010) The ECMWF re-analysis for the AMMA observational campaign. IN *Quarterly Journal of the Royal Meteorological Society*, Also available as ECMWF Technical Memorandum nr 612.

Agusti-Panareda, A., Beljaars, A., Cardinali, C., Genkova, L. & Thorncroft, C. D. (2010) Impact of assimilating AMMA SOP soundings on ECMWF analyses and forecasts. IN *Weather and Forecasting*, 25. 1142–1160 Also available as ECMWF Technical Memorandum 601.

Alhassane, A., Traoré, S. B., Zouzou, M., Sarr, B. & Amadou, M. (2008) Effet de la fertilisation azotée et de la densité de semis sur la croissance et le développement d'une variété de mil au Sahel. IN *Agronomie africaine*, 20. 151–163.

Ali, A., Lebel, T. & Amani, A. (2005) Rainfall Estimation in the Sahel. Part I: Error Function. IN *Journal of Applied Meteorology*, 44. 1691–1706.

Ali, A., Amani, A., Diedhiou, A. & Lebel, T. (2005) Rainfall Estimation in the Sahel. Part II: Evaluation of Rain Gauge Networks in the CILSS Countries and Objective Intercomparison of Rainfall Products. IN *Journal of Applied Meteorology*, 44. 1707–1722.

Ali, A. & Lebel, T. (2009) The Sahelian standardized rainfall index revisited. IN *International Journal of Climatology*, 29. 1705–1714.

Ali Eugene, K., Kouadio, A. E., Zahiri, E.-P., Aman, A., Assamoi, P. & Bourlès, B. (2010) Influence of the Gulf of Guinea Coastal and Equatorial Upwellings on the Precipitations along its Northern Coasts during the Boreal Summer Period. IN *Asian journal of applied sciences*,

AMMA ICIG, (2006) The International Implementation Plan of AMMA, http://amma-international.org/

AMMA ISSC, (2005) The International Science Plan of AMMA, http://amma-international.org/

Ancellet, G., Leclair de Bellevue, J., Mari, C., Nédélec, P., Kukui, A., Borbon, A. & Perros, P. (2009) Effects of regional-scale and convective transports on tropospheric ozone chemistry revealed by aircraft observations during the wet season of the AMMA campaign. IN *Atmospheric Chemistry and Physics*, 9. 383–411.

Andrés-Hernández, M. D., Kartal, D., Reichert, L., Burrows, J. P., Meyer Arnek, J., Lichtenstern, M., Stock, P. & Schlager, H. (2009) Peroxy radical observations over West Africa during AMMA 2006: photochemical activity in the outflow of convective systems. IN *Atmospheric Chemistry and Physics*, 9. 3681–3695.

Andrés-Hernández, M. D., Kartal, D., Reichert, L., Burrows, J. P., Meyer Arnek, J., Lichtenstern, M., Stock, P. & Schlager, H. (2009) Corrigendum to "Peroxy radical observations over West Africa during AMMA 2006: photochemical activity in the outflow of convective systems" published in Atmos. Chem. Phys., 9, 3681-3695. IN *Atmospheric Chemistry and Physics*, 9. 8103–8104.

Ansmann, A., Tesche, M., Althausen, D., Müller, D., Seifert, P., Freudenthaler, V., Heese, B., Wiegner, M., Pisani, G., Knippertz, P. & Dubovik, O. (2008) Influence of Saharan dust on cloud glaciation in southern Morocco during the Saharan Mineral Dust Experiment. IN *Journal of Geophysical Research-Atmospheres*, 113 DOI : 10.1029/2007JD008785.

Ansmann, A., Tesche, M., Knippertz, P., Bierwirth, E., Althausen, D., Müller, D. & Schulz, O. (2009) Vertical profiling of convective dust plumes in southern Morocco during SAMUM. IN *Tellus B*, 61. 340–353 DOI : 10.1111/j.1600-0889.2008.00384.x.

Ardoin-Bardin, S., Dezetter, A., Servat, E., Paturel, J.-E., Mahé, G., Niel, H. & Dieulin, C. (2009) Using general circulation model outputs to assess impacts of climate change on runoff for large hydrological catchments in West Africa. IN *Hydrological Sciences Journal*, 54. 77–89.

Arhan, M., Treguier, A., Bourlès, B. & Michel, S. (2006) Diagnosing the Annual Cycle of the Equatorial Undercurrent in the Atlantic Ocean from a General Circulation Model. IN *Journal of Physical Oceanography*, 36. 1502–1522.

Arnault, J. & Roux, F. (2009) Case-study of a developing African easterly wave during NAMMA: an energetic point of view. IN *Journal of the Atmospheric Sciences*, 66. 2991–3020.

Arnault, J. & Roux, F. (2010) Failed cyclogenetic evolution of a West African monsoon perturbation observed during AMMA SOP-3. IN *Journal of the Atmospheric Sciences*, 67. 1863–1883.

Assamoi, E. & Liousse, C. (2010) Focus on the impact of two wheel vehicles on African combustion aerosols emissions. IN *Atmospheric Environment*, .

Athie, G. & Marin, F. (2008) Cross-equatorial structure and temporal modulation of intraseasonal variability at the surface of the Tropical Atlantic Ocean. IN *Journal of Geophysical Research*, 113 DOI: 10.1029/2007JC004332.

Athie, G., Marin, F., Treguier, A., Bourlès, B. & Guiavarc'h, C. (2009) Sensitivity of near-surface Tropical Instability Waves to submonthly wind forcing in the tropical Atlantic. IN *Ocean Modelling*, 30. 241–255.

Ayantunde, A., Kango, M., Hiernaux, P., Udo, H. M. J. & Tabo, R. (2006) Herders' Perceptions on Ruminant Livestock Breeds and Breeding Management in Southwestern Niger. IN *Human Ecology*, 35. 139–149.

Ayantunde, A., Briejer, M., Hiernaux, P., Udo, H. M. J. & Tabo, R. (2008) Botanical Knowledge and its Differentiation by Age, Gender and Ethnicity in Southwestern Niger. IN *Human Ecology*, 36. 881–889.

Ayantunde, A., Fernandez-Rivera, Hiernaux, P. & Tabo, R. (2008) Implications of restricted access to grazing by cattle in wet season in the Sahel. IN *Journal of Arid Environments*, 72. 523–533.

Bader, J. & Latif, M. (2003) The impact of decadal-scale Indian Ocean sea surface temperature anomalies on Sahelian rainfall and the north Atlantic oscillation. IN *Geophysical Research Letters*, 30. (22), 2169, doi:10.1029/ 2003GL018426.

Bagayoko, F., Yonkeu, S., Elbers, J. & Van De Giesen, N. (2007) Energy partitioning over the West African savanna: multi-year evaporation and surface conductance measurements in Eastern Burkina Faso. IN *Journal of Hydrology*, 334. 545–559.

Bain, C., Parker, D. J., Taylor, C. M., Kergoat, L. & Guichard, F. (2010) Observations of the Nocturnal Boundary Layer Associated with the West African Monsoon. IN *Monthly Weather Review*, 138. 3142–3156.

Baines, P. G. & Folland, C. K. (2007) Evidence for a rapid global climate shift across the late 1960s. IN *Journal of Climate*, 20. 2721–2744.

Baldi, M., Dalu, G. A. & Pielke, R. A. (2008) Vertical velocities and available potential energy generated by landscape variability. II : Theory. IN *Journal of Applied Meteorology and Climatology*, 47. 397–410.

Balme, M., Galle, S. & Lebel, T. (2005) Démarrage de la saison des pluies au Sahel : variabilité à des échelles hydrologique et agronomique. IN *Sécheresse*, 16. 15–22.

Balme, M., Vischel, T., Lebel, T., Peugeot, C. & Galle, S. (2005) Assessing the water balance in the Sahel : Impact of small scale rainfall variability on runoff. Part 1 : Rainfall variability analysis. IN *Journal of Hydrology*, 331. 336–348.

Balme, M., Lebel, T. & Amani, A. (2006) Années sèches et années humides au Sahel : Quo Vadimus? IN *Journal des Sciences Hydrologiques*, 51. 254–271.

Barbier, B., Yacouba, H., Karambiri, H., Zorom, M. & Some, B. (2009) Human vulnerability to climate variability in the Sahel: farmers' adaptation strategies in northern Burkina Faso. IN *Environmental Management*, 43. 790–803.

Barbier, B., Tourou, B., Yacouba, H. & Zorom, M. (2010) Irrigation et variabilité climatique. IN *Cahiers Agricultures*, .

Baret, F., Weiss, M., Allard, D., Guarrigue, S., Leroy, M., Jeanjean, H., Fernandes, R., Myneni, R., Privette, J., Morisette, J., Bohbot, H., Bosseno, R., Dedieu, G., Di Bella, C., Duchemin, B., Espana, M., Gond, V., Gu, X. F., Guyon, D., Lelong, C., Maisongrande, P., Mougin, E., Nilson, T., Veroustraete, F. & Vintilla, R. (2009) VALERI: a network of sites and a methodology for the validation of medium spatial resolution land satellite products. IN *Remote Sensing of Environment*, .

Baron, C., Sultan, B., Balme, M., Sarr, B., Lebel, T., Janicot, S. & Dingkuhn, M. (2005) From GCM grid cell to agricultural plot : scale issues affecting modelling of climate impact. IN *Philosophical Transactions of The Royal Society B*, 360. 2095–2108.

Barret, B., Ricaud, P., Mari, C., Attié, J.-L., Bousserez, N., Josse, B., Le Flochmoën, E., Livesey, N., Massart, S., Peuch, V.-H., Piacentini, A., Sauvage, B., Thouret, V. & Cammas, J.-P. (2008) Transport pathways of CO in the African upper troposphere during the monsoon season: a study based upon the assimilation of spaceborne observations. IN *Atmospheric Chemistry and Physics*, 8. 3231–3246.

Barret, B., Williams, J. E., Bouarar, I., Yang, X., Josse, B., Law, K. S., Le Flochmoën, E., Liousse, C., Peuch, V.-H., Carver, G., Pyle, J., Sauvage, B., Van Velthoven, P. F. J., Mari, C. & Cammas, J.-P. (2010) Impact of West

African Monsoon convective transport and lightning NOx production upon the tropical upper tropospheric composition: a multi-model study. IN *Atmospheric Chemistry and Physics Discussions*, 10. 2245–2302.

Barthe, C., Asencio, N., Lafore, J.-P., Chong, M. & Campistron, B. (2010) Multi-scale analysis of the 25-27 July 2006 convective period over Niamey: comparison between Doppler radar observations and cloud-resolving simulations. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 190–208.

Bauer, P. (2009) 4D-Var assimilation of MERIS total column water vapour retrievals overland. IN *Quarterly Journal of the Royal Meteorological Society*, 135. 1852–1862.

Baup, F., Mougin, E., de Rosnay, P., Timouk, F. & Chênerie, I. (2007) Surface soil moisture estimation over the AMMA Sahelian site in Mali using ENVISAT/ASAR data. IN *Remote Sensing of Environment*, 109. 473–481.

Baup, F., Mougin, E., Hiernaux, P., Lopes, A., de Rosnay, P. & Chênerie, I. (2007) Radar Signatures of Sahelian Surfaces in Mali Using ENVISAT-ASAR Data. IN *Geoscience and Remote Sensing*, 45. 2354–2363.

Baup, F., Mougin, E., de Rosnay, P., Hiernaux, P., Frappart, F., Frison, P.-L. & Zribi, M. (2010) Mapping surface soil moisture over the Gourma mesoscale site (Mali) by using ENVISAT ASAR data. IN *Hydrology and Earth System Sciences*, 7. 7417–7450.

Bechara, J., Borbon, A., Jambert, C. & Perros, P. (2008) New off-line aircraft instrumentation for non-methane hydrocarbon measurements. IN *Analytical and bioanalytical chemistry*, 392. 865–876.

Bechara, J., Borbon, A., Jambert, C., Colomb, A. & Perros, P. E. (2009) Evidence of the impact of deep convection on reactive volatile organic compounds in the upper tropical troposphere during the AMMA experiment in West Africa. IN *Atmospheric Chemistry and Physics Discussions*, 9. 20309–20346.

Bedou, M., Konaré, A., Seidou-Sanda, I., Assamoi, E. & Diedhiou, A. (2007) Hygroscopic properties of aerosols in the Sahel: preliminary results. IN *Scientific Research and Essays*, 2. 177–183.

Berg, A., Quirion, P. & Sultan, B. (2009) Weather-Index Drought Insurance in Burkina-Faso: Assessment of Its Potential Interest to Farmers. IN *Weather, Climate and society*, 1. 71–84.

Berg, A., Sultan, B. & Noblet-Ducoudre, N. D. (2010) What are the dominant features of rainfall leading to realistic large-scale crop yield simulations in West Africa. IN *Geophysical Research Letters*, 37. doi:10.1029/2009GL041923

Berg, A., Sultan, B. & Noblet-Ducoudre, N. D. (2010) Including tropical croplands in a terrestrial biosphere model: application to West Africa. IN *Climatic Change*, DOI: 10.1007/s10584-010-9874-x.

Bharmal, N. A., Slingo, A., Robinson, G. & Settle, J. (2009) Simulation of surface and top of atmosphere thermal fluxes and radiances from the RADAGAST experiment. IN *International Journal of Remote Sensing*, 114. doi:10.1029/2008JD010504

Biasutti, M. & Giannini, A. (2006) Robust Sahel drying in response to late 20th century forcings. IN *Geophysical Research Letters*, 33. L11706, doi:10.1029/2006GL026067

Biasutti, M., Held, I. M., Sobel, A. H. & Giannini, A. (2008) SST forcings and Sahel rainfall variability in simulations of the twentieth and twenty-first centuries. IN *Journal of Climate*, 21. 3471–3486.

Bielli, S. & Roca, R. (2009) Scale decomposition of atmospheric water budget over West Africa during the monsoon 2006 from NCEP/GFS analyses. IN *Climate Dynamics*, 35. 143–157.

Bielli, S., Douville, H. & Pohl, B. (2009) Understanding the West African monsoon variability and its remote effects: an illustration of the grid point nudging methodology. IN *Climate Dynamics*, 35. 159–174.

Bigot, S., Brou, Y. T., Oszwald, J. & Diedhiou, A. (2005) Facteurs de la variabilité pluviométrique en Côte d'Ivoire et relations avec certaines modifications environnementales. IN *Sécheresse*, 16. 5–13.

Black, E. & Sutton, R. (2007) The influence of oceanic conditions on the hot European summer of 2003. IN *Climate Dynamics*, 28. 53–66.

Blanc, E., Quirion, P. & Strobl, E. (2006) The climatic determinants of cotton yields: Evidence from a plot in West Africa. IN *Agricultural and Forest Meteorology*, 148. 1093–1100.

Bock, O., Guichard, F., Janicot, S., Lafore, J.-P., Bouin, M.-N. & Sultan, B. (2007) Multiscale analysis of precipitable water vapor over Africa from GPS data and ECMWF analyses. IN *Geophysical Research Letters*, 34 DOI : 10.1029/2006GL028039.

Bock, O., Bouin, M.-N., Walpersdorf, A., Lafore, J.-P., Janicot, S., Guichard, F. & Agusti-Panareda, A. (2007) Comparison of ground-based GPS precipitable water vapour to independent observations and Numerical Weather Prediction model reanalyses over Africa. IN *Quarterly Journal of the Royal Meteorological Society*, 133. 2011–2027.

Bock, O., Bouin, M.-N., Doerflinger, E., Collard, P., Masson, F., Meynadier, R., Nahmani, S., Koité, M., Gaptia Lawan Balawan, K., Dide, F., Ouedraogo, D., Pokperlaar, S., Ngamini, J.-B., Lafore, J.-P., Janicot, S., Guichard, F. & Nuret, M. (2008) West African Monsoon observed with ground-based GPS receivers during African Monsoon Multidisciplinary Analysis (AMMA). IN *Journal of Geophysical Research*, 113.D21105, doi:10.1029/2008JD010327

Bock, O. & Nuret, M. (2009) Verification of NWP model analyses and radiosonde humidity data with GPS precipitable water vapor estimates during AMMA. IN *American Meteorological Society*, 24. 1085–1101.

Bock, O., Guichard, F., Meynadier, R., Gervois, S., Agusti-Panareda, A., Beljaars, A., Boone, A., Nuret, M., Redelsperger, J.-L. & Roucou, P. (2010) The large scale water cycle of the West African Monsoon. IN *Atmospheric Science Letters*, DOI : 10.1002/asl.288.

Boone, A. & de Rosnay, P. (2007) AMMA forcing data for a better understanding of the West African monsoon surface-atmosphere-hydrology interactions. IN *IAHS-AISH publication*, 313. 231–241.

Boone, A., Poccard-Leclercq, I., Xue, Y., Feng, J. & de Rosnay, P. (2009) Evaluation of the WAMME model surface fluxes using results from the AMMA land- surface model intercomparison project. IN *Climate Dynamics*, 35. 127–142.

Boone, A., de Rosnay, P., Beljaars, A., Balsamo, G., Chopin, F., Decharme, B., Delire, C., Ducharme, A., Gascoin, S., Grippa, M., Guichard, F., Gusev, Y., Harris, P. P., Jarlan, L., Kergoat, L., Mougin, E., Nasonova, O., Norgaard, A., d' Orgeval, T., Ottlé, C., Poccard-Leclercq, I., Polcher, J., Sandholt, I., Saux-Picart, S., Taylor, C. M. & Xue, Y. (2009) The AMMA Land Surface Model intercomparison Project (ALMIP). IN *Bulletin of the American Meteorological Society*, 90. 1865–1880.

Borrman, S., Kunkel, D., Weigel, R., Minikin, A., Deshler, T., Wilson, J., Curtius, J., Shur, G. N., Belyaev, G. V., Law, K. S. & Cairo, F. (2010) Aerosols in the tropical and sub-tropical UT/LS: in-situ measurements of sub-micron particle abundance and volatility. IN *Atmospheric Chemistry and Physics*, 10. 5573–5592.

Bou Karam, D., Flamant, C., Knippertz, P., Reitebuch, O., Pelon, J., Chong, M. & Dabas, A. (2008) Dust emissions over the Sahel associated with the West African monsoon intertropical discontinuity region: A representative case-study. IN *Quarterly Journal of the Royal Meteorological Society*, 134. 621–634.

Bou Karam, D., Flamant, C., Tulet, P., Todd, M. C., Pelon, J. & Earle, W. (2009) Dry cyclogenesis and dust mobilization in the Inter Tropical Discontinuity of the West African Monsoon: a case study. IN *Journal of Geophysical Research*, 114 DOI : 10.1029/2008JD010952.

Bou Karam, D., Flamant, C., Tulet, P., Chaboureau, J.-P., Dabas, A. & Todd, M. C. (2009) Estimate of Sahelian dust emissions in the intertropical discontinuity region of the West African Monsoon. IN *Journal of Geophysical Research*, 114(d13) DOI : 10.1029/2008JD011444.

Bouali, L., Philippon, N., Fontaine, B. & Lemond, J. (2008) Performance of DEMETER calibration for rainfall forecasting purposes: Application to the July-August Sahelian rainfall. IN *Journal of Geophysical Research*, 113 DOI : 10.1029/2007JD009403.

Boucher, M., Favreau, G., Vouillamoz, J.-M., Nazoumou, Y. & Legchenko, A. (2009) Estimating specific yield and transmissivity with magnetic resonance sounding in an unconfined sandstone aquifer (Niger). IN *Hydrogeology Journal*, 17. 1805–1815.

Boucher, M., Favreau, G. & Descloitres, M. (2009) Contribution of geophysical surveys to ground water modelling of a porous aquifer in semi-arid Niger: an overview. IN *Comptes Rendus Géoscience*, 341. 800–809.

Boulain, N., Cappelaere, B., Séguis, L., Gignoux, J. & Peugeot, C. (2006) Hydrologic and land use impacts on vegetation growth and NPP at the watershed scale in a semi-arid environment. IN *Regional Environmental Change*, 6. 147–156.

Boulain, N., Gignoux, J. & Simioni, G. (2006) Changing scale in ecological modelling: a bottom-up approach with an individual based vegetation model. IN *Ecological Modelling*, 203. 257–269.

Boulain, N., Cappelaere, B., Favreau, G., Gignoux, J. & Séguis, L. (2009) Water balance and vegetation change in the Sahel: a case study at the watershed scale with an ecohydrological model. IN *Journal of Arid Environments*, 73. 1125–1135.

Boulain N., B. Cappelaere, D. Ramier, H.B.A. Issoufou, O. Halilou, J. Seghieri, F. Guillemin, M. Oï, J. Gignoux, F. Timouk (2009) Towards an understanding of coupled physical and biological processes in the cultivated Sahel – 2. Vegetation and carbon dynamics. Journal of Hydrology, 375, 1-2, 190-203, DOI: 10.1016/ j.jhydrol.2008.11.045..

Bouniol, D., Protat, A., Plana-Fattori, A., Giraud, M., Vinson, J.-P. & Grand, N. (2008) Comparison of Airborne and Spaceborne 95-GHz Radar Reflectivities and Evaluation of Multiple Scattering Effects in Spaceborne Measurements. IN *Journal of Atmospheric and Oceanic Technology*, 25. 1983–1995.

Bouniol, D., Delanoe, J., Duroure, C., Protat, A., Giraud, V. & Penide, G. (2010) Microphysical characterisation of West African MCS anvils. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 323–344.

Bourlès, B., Lumpkin, R., McPhaden, M. J., Hernandez, F., Nobre, P., Campos, E., Yu, L., Planton, S., Busalacchi, A., Moura, A. D., Servain, J. & Trotte, J. (2008) The Pirata Program: History, Accomplishments, and Future Directions. IN *Bulletin of the American Meteorological Society*, 89. 1111–1125.

Bourras, D., Weill, A., Caniaux, G., Eymard, L., Bourlès, B., Letourneur, B., Legain, D., Key, E., Baudin, F., Piguet, B., Traullé, O., Bouhours, G., Sinardet, B., Barrié, J., Vinson, J.-P., Boutet, F., Berthod, C. & Clémençon, A. (2009) Turbulent air-sea fluxes in the Gulf of Guinea during the AMMA experiment. IN *Journal of Geophysical Research*, 114 DOI : 10.1029/2008JC004951.

Brandt, P., Schott, F. A., Provost, C., Kartavtseff, A., Hormann, V., Bourlès, B. & Fisher, J. (2006) Circulation in the central equatorial Atlantic: Mean and intraseasonal to seasonal variability. IN *Geophysical Research Letters*, 33 DOI : 10.1029/2005GL025498.

Brandt, P., Hormann, V., Bourlès, B., Fisher, J., Schott, F. A., Stramma, L. & Dengler, M. (2008) Oxygen tongues and zonal currents in the equatorial Atlantic. IN *Journal of Geophysical Research*, 113 DOI : 10.1029/2007JC004435.

Brandt, P., Caniaux, G., Bourlès, B., Lazar, A., Dengler, M., Funk, A., Hormann, V., Giordani, H. & Marin, F. (2010) Equatorial upper-ocean dynamics and their interaction with the West African monsoon. IN *Atmospheric Science Letters*, DOI: 10.1002/asl.287.

Braud, I., de Condappa, D., Soria, J., Haverkamp, R., Angulo-Jaramillo, R., Galle, S. & Vauclin, M. (2005) Use of scaled forms of the infiltration equation for the estimation of unsaturated soil hydraulic properties (the Beerkan method). IN *European Journal of Soil Science*, 56. 361–374.

Broutin, H., Philippon, N., Constantin de Magny, G., Courel, M.-F., Sultan, B. & Guégan, J.-F. (2007) Comparative study of meningitis dynamics across nine African countries: a global perspective. IN *International Journal of Health Georgraphics*, 6 DOI : 10.1186/1476-072X-6-29.

Brut, A., Butet, A., Durand, P., Caniaux, G. & Planton, S. (2005) Air-sea exchanges in the equatorial area from the EQUALANT99 dataset: Bulk parametrizations of turbulent fluxes corrected for airflow distortion. IN *Quarterly Journal of the Royal Meteorological Society*, 131. 2497–2538.

Cairo, F., Pommereau, J.-P., Law, K. S., Schlager, H., Garnier, A., Fierli, F., Ern, M., Streibel, M., Arabas, S., Borrman, S., Berthelier, J.-J., Blom, C., Christensen, T., D' Amato, F., Di Donfrancesco, G., Deshler, T., Diedhiou, A., Durry, G., Engelsen, O., Goutail, F., Harris, N. R. P., Kerstel, E. R. T., Khaykin, S., Konopka, P., Kylling, A., Larsen, N., Lebel, T., Liu, X., Mackenzie, A. R., Nielsen, J. O., Oulanowski, A., Parker, D. J., Pelon, J., Polcher, J., Pyle, J. A., Ravegnani, F., Rivière, E. D., Robinson, A. D., Röckmann, T., Schiller, C., Simões, F., Stefanutti, L., Stroh, F., Some, L., Siegmund, P. & Sitnikov, N. (2010) An introduction to the SCOUT-AMMA stratospheric aircraft, balloons and sondes campaign in West Africa, August 2006: rationale and roadmap. IN *Atmospheric Chemistry and Physics*, 10. 2237–2256.

Caminade, C. & Terray, L. (2006) Influence of increased greenhouse gases and sulphate aerosols concentration upon diurnal temperature range over Africa at the end of the 20th century. IN *Geophysical Research Letters*, 33 DOI : 10.1029/2006GL026381.

Caminade, C., Terray, L. & Maisonnave, E. (2006) West African monsoon response to greenhouse gas and sulphate aerosol forcing under two emission scenarios. IN *Climate Dynamics*, 26. 531–547.

Caminade, C. & Terray, L. (2009) Twentieth century Sahel rainfall variability as simulated by the ARPEGE AGCM, and future changes. IN *Climate Dynamics*, 35. 75–94.

Caminade, C., Ndione, J.-A., Kebe, C., Jones, A. E., Danuor, S. K., Tay, S. C. K., Tourre, Y. M., Lacaux, J.-P., Duchemin, J.-B., Jeanne, I. & Morse, A. P. (2010) Mapping Rift Valley Fever and Malaria Risk over West Africa using Climatic Indicators. IN *Atmospheric Science Letters*, DOI: 10.1002/asl.296.

Caniaux, G., Giordani, H., Redelsperger, J.-L., Guichard, F., Key, E. & Wade, M. (2010) Couplings between the Atlantic cold tongue and the African monsoon in boreal spring and summer. IN *Journal of Climate*,

Canut, G., Lothon, M., Saïd, F. & Lohou, F. (2010) Observation of entrainment at the interface between monsoon flow and Saharan Air Layer. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 34–46.

Capes, G., Johnson, B. T., McFiggans, G., Williams, P. I., Haywood, J. M. & Coe, H. (2008) Aging of biomass burning aerosols over West Africa: Aircraft measurements of chemical composition, microphysical properties and emission ratios. IN *Journal of Geophysical Research*, 113. D00C15, doi:10.1029/2008JD009845

Capes, G., Murphy, J. G., Reeves, C. E., McQuaid, J. B., Hamilton, J. F., Hopkins, J. R., Crosier, J., Williams, P. I. & Coe, H. (2009) Secondary organic aerosol from biogenic VOCs over West Africa during AMMA. IN *Atmospheric Chemistry and Physics*, 9. 3841–3850.

Cappelaere, B., Vieux, B. E., Peugeot, C., Maia, A. & Séguis, L. (2003) Hydrologic process simulation of a semiarid, endoreic catchment in Sahelian West Niger. 2. Model calibration and uncertainty characterization. IN *Journal of Hydrology*, 279. 244–261.

Cappelaere, B., Descroix, L., Lebel, T., Boulain, N., Ramier, D., Laurent, J.-P., Favreau, G., Boubkraoui, S., Boucher, M., Moussa, B. I., Chaffard, V., Hiernaux, P., Issoufou, H. B. A., Breton, L. E., Mamadou, I., Nazoumou, Y., Oï, M., Ottlé, C. & Quantin, G. (2009) The AMMA-CATCH experiment in the cultivated Sahelian area of south-west Niger - Investigating water cycle response to a fluctuating climate and changing environment. IN *Journal of Hydrology*, 375. 34–51.

Cavalieri, O., Di Donfrancesco, G., Cairo, F., Fierli, F., Snels, M., Viterbini, M., Cardillo, F., Chatenet, B., Formenti, P., Marticorena, B. & Rajot, J.-L. (2010) The AMMA mulid network for aerosol characterization in West Africa. IN *International Journal of Remote Sensing*, .

Cavazos, C., Todd, M. C. & Schepanski, K. (2009) Numerical model simulation of the Saharan dust event of 6-11 March 2006 using the Regional Climate Model version 3 (RegCM3). IN *Journal of Geophysical Research*, 114 DOI : 10.1029/2008JD011078.

Cetrone, J. & Houze, R. A. Jr. (2009) Anvil clouds of tropical mesoscale convective systems in monsoon regions. IN *Quarterly Journal of the Royal Meteorological Society*, 135. 305–317.

Chaboureau, J.-P., Tulet, P. & Mari, C. (2007) Diurnal cycle of dust and cirrus over West Africa as seen from Meteosat Second Generation satellite and a regional forecast model. IN *Geophysical Research Letters*, 34 DOI : 10.1029/2006GL027771.

Chauvin, F., Royer, J.-F. & Douville, H. (2005) Interannual variability and predictability of African easterly waves in a GCM. IN *Climate Dynamics*, 24. 523–544.

Chauvin, F., Roehrig, R. & Lafore, J.-P. (2010) Intraseaonal variability of the Saharan Heat Low and its link with the midlatitudes. IN *Journal of Climate*, 23. 2544–2561.

Chazette, P., Sanak, J. & Dulac, F. (2007) New Approach for Aerosol Profiling with a Lidar Onboard an Ultralight Aircraft: Application to the African Monsoon Multidisciplinary Analysis. IN *Environmental Science & Technology*, 41. 8335–8341.

Chong, M. (2010) The 11 August 2006 squall line system as observed from MIT Doppler radar during the AMMA SOP. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 209–226 DOI: 10.1002/qj.466.

Chou, C., Formenti, P., Maille, M., Ausset, P., Helas, G., Harrison, M. A. J. & Osborne, S. (2008) Size distribution, shape and composition of mineral dust aerosols collected during the AMMA SOP0/DABEX field campaign in Niger, January 2006. IN *Journal of Geophysical Research*, 113 DOI : 10.1029/2008JD009897.

Christoph, M., Fink, A. H., Diekkrueger, B., Giertz, S., Reichert, B. & Speth, P. (2008) IMPETUS: Implementing HELP in the Upper Ouémé Basin. IN *Water S. A.* 34. 481–489.

Christopher, S. A., Gupta, P., Haywood, J. M. & Greed, G. (2008) Aerosol optical thicknesses over North Africa: 1. Development of a product for model validation using Ozone Monitoring Instrument, Multiangle Imaging Spectroradiometer, and Aerosol Robotic Network. IN *Journal of Geophysical Research*, 113 DOI : 10.1029/2007JD009446.

Cifelli, R., Lang, T., Rutledge, S. A., Guy, N., Zipser, E. J., Zawislak, J. & Holzworth, R. H. (2010) Characteristics of an African Easterly Wave Observed during NAMMA. IN *Journal of the Atmospheric Sciences*, 67. 3–25.

Cissé, P., Nielsen, J. O., Diouf, A., Maiga, A. & Zorom, M. (2009) Migrations et variabilité climatique. IN *Cahiers Agricultures*, .

Commane, R., Floquet, C., Ingham, T., Stone, D., Evans, M. J. & Heard, D. E. (2010) Observation of OH and HO2 radicals over West Africa. IN *Atmospheric Chemistry and Physics Discussions*, 10. 7265–7322.

Condappa, D. de, Galle, S., Dewandel, B. & Haverkamp, R. (2008) Bimodal Zone of the Soil Textural Triangle: Common in Tropical and Subtropical Regions. IN *Soil Science Society of America*, 72. 33–40.

Conil, S., Douville, H. & Tyteca, S. (2007) The relative roles of soil moisture and SST in climate variability explored within ensembles of AMIP-type simulations. IN *Climate Dynamics*, 28. 125–145.

Cook, K. H. & Vizy, E. K. (2006) Coupled model simulations of the West African monsoon system: twentieth-and twenty-first-century simulations. IN *Journal of Climate*, 19. 3681–3703.

Cornforth, R. J., Hoskins, B. J. & Thorncroft, C. D. (2009) The impact of moist processes on the African easterly jet-African easterly wave system. IN *Quarterly Journal of the Royal Meteorological Society*, 135. 894–913.

Cornforth, R. J. & Hoskins, B. J. (2009) Understanding African easterly waves: a moist singular vector approach. IN *Atmospheric Science Letters*, 10. 185–191.

Coudert, B., Ottlé, C., Boudevillain, B., Demarty, J. & Guillevic, P. (2006) Contribution of Thermal Infrared Remote Sensing Data in Multiobjective Calibration of a Dual-Source SVAT Model. IN *Journal of Hydrometeorology*, 7. 404–420.

Coudert, B. & Ottlé, C. (2007) An improved SVAT model calibration strategy based on the optimisation of surface temperature temporal dynamics. IN *Geophysical Research Letters*, 34 DOI : 10.1029/2006GL028778.

Coudert, B., Ottlé, C. & Briottet, X. (2008) Monitoring land surface processes with thermal infrared data: Calibration of SVAT parameters based on the optimisation of diurnal surface temperature cycling features. IN *Remote Sensing of Environment*, 112. 872–887.

Cournil, C. & Mazzega, P. (2006) Catastrophes écologiques et flux migratoires : Comment protéger les Â« réfugiés écologiques Â» ? IN *Revue Européenne de Droit de l'Environnment*, . 417–427.

Cournil, C. & Mazzega, P. (2007) Réflexions prospectives sur une protection juridique des réfugiés écologiques. IN *Revue Européenne des Migrations Internationales*, 23. 7–34.

Couvreux, F., Guichard, F., Bock, O., Campistron, B., Lafore, J.-P. & Redelsperger, J.-L. (2009) Synoptic variability of the monsoon flux over West Africa prior to the onset. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 159–173.

Coëtlogon, G. d., Janicot, S. & Lazar, A. (2010) Intraseasonal variability of the ocean - atmosphere coupling in the Gulf of Guinea during boreal spring and summer. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 426–441 DOI: 10.1002/qj.554.

Crumeyrolle, S., Gomes, L., Tulet, P., Matsuki, A., Schwarzenboeck, A. & Crahan, K. (2008) Increase of the aerosol hygroscopicity by cloud processing in a mesoscale convective system: a case study from the AMMA campaign. IN *Atmospheric Chemistry and Physics*, 8. 6907–6924.

Crumeyrolle, S., Tulet, P., Garcia-Carreras, L., Flamant, C., Parker, D. J., Matsuki, A., Schwarzenboeck, A., Formenti, P. & Gomes, L. (2010) Transport of dust particles from the Bodélé region to the monsoon layer: AMMA case study of the 9-14 June 2006 period. IN *Atmospheric Chemistry and Physics Discussions*, 10. 5051–5090.

Cuesta, J., Edouart, D., Mimouni, M., Flamant, P.-H., Loth, C., Gibert, F., Marnas, F., Bouklila, A., Kharef, M., Ouchène, B., Kadi, M. & Flamant, C. (2008) Multiplatform observations of the seasonal evolution of the Saharan atmospheric boundary layer in Tamanrasset, Algeria, in the framework of the African Monsoon Multidisciplinary Analysis field campaign conducted in 2006. IN *Journal of Geophysical Research*, 113.D00C07, doi:10.1029/2007JD009417.

Cuesta, J., Lavaysse, C., Flamant, C., Mimouni, M. & Knippertz, P. (2009) Northward bursts of the West African monsoon leading to rainfall over the Hoggar Massif, Algeria. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 174–189 DOI:10.1002/qj.439.

Cuesta, J., Marsham, J. H., Parker, D. J. & Flamant, C. (2009) Dynamical mechanisms controlling the vertical redistribution of dust and the thermodynamic structure of the West Saharan atmospheric boundary layer during summer. IN *Atmospheric Science Letters*, 10. 34–42 DOI : 10.1002/asl.207.

Cui, X., Parker, D. J. & Morse, A. (2009) The drying out of soil moisture following rainfall in a numerical weather prediction model, and implications for malaria prediction in West Africa. IN *Weather and Forecasting*, 24. 1549–1557.

Danuor, S. K., Gaye, A., Yacouba, H., Mariko, A., Bouzou Moussa, I., Maiga, M., Da Dapola, E., Ginoux, K., Parker, D. J., Polcher, J., Laval, K., Diallo, D. & Bourlès, B. (2010) Education in meteorology and climate sciences in West Africa. IN *Atmospheric Science Letters*

Delon, C., Serça, D., Broissard, C., Dupont, R., Dutot, A., Laville, P., de Rosnay, P. & Delmas, R. (2007) Soil NO emissions modelling using artificial neural network. IN *Tellus B*, 59. 502–513.

Delon, C., Reeves, C. E., Stewart, D. J., Serça, D., Dupont, R., Mari, C., Chaboureau, J.-P. & Tulet, P. (2008) Biogenic nitrogen oxide emissions from soils - impact on NO_x and ozone over West Africa during AMMA (African Monsoon Multidisciplinary Experiment): modelling study. IN *Atmospheric Chemistry and Physics*, 8. 2351–2363.

Delon, C., Galy-Lacaux, C., Boone, A., Liousse, C., Serça, D., Adon, M., Diop, B., Akpo, A., Lavenu, F., Mougin, E. & Timouk, F. (2010) Atmospheric nitrogen budget in Sahelian dry savannas. IN *Atmospheric Chemistry and Physics*, 10. 2691–2708.

Dengler, M., Bourlès, B., Chuchla, R. & Toole, J. M. (2010) Enhanced upper ocean mixing and turbulent heat flux in the equatorial Atlantic at 10°W. IN *Geophysical Research Letters*, .

Depraetere, C., Gosset, M., Ploix, S. & Laurent, H. (2009) The organization and kinematics of tropical rainfall systems ground tracked at mesoscale with gages: First results from the campaigns 1999-2006 on the Upper Ouémé Valley (Benin). IN *Journal of Hydrology*, 375. 143–160.

Derimian, Y., Leon, J.-F., Dubovik, O., Chiapello, I., Tanré, D., Sinyuk, A., Auriol, F., Podvin, T., Brogniez, G. & Holben, B. N. (2008) Radiative properties of aerosol mixture observed during the dry season 2006 over M'Bour, Senegal (African Monsoon Multidisciplinary Analysis campaign). IN *Journal of Geophysical Research*, 113. D00C09, doi:10.1029/2008JD009904.

Descroix, L., Mahé, G., Lebel, T., Favreau, G., Galle, S., Gautier, E., Olivry, J.-C., Albergel, J., Amogu, O., Cappelaere, B., Dessouassi, R., Diedhiou, A., Le Breton, E., Mamadou, I. & Sighomnou, D. (2009) Spatio-temporal variability of hydrological regimes around the boundaries between Sahelian and Sudanian areas of West Africa: A synthesis. IN *Journal of Hydrology*, 375. 90–102.

Dia, A. H., Becerra, S. & Gangneron, F. (2008) Crises climatiques et ruptures politiques dans les transformations de l’action publique environnementale au Mali. IN *Vertigo*, 8.

Diallo, D., Ka, A., Da Dapola, E., Zorom, M., Diouf, A., Maiga, A. & Dabi, D. (2010) Evolution de l'agriculture pluviale dans un contexte de variabilité climatique en zone soudano-sahélienne d'Afrique de l'Ouest. IN *Cahiers Agricultures*, .

Diedhiou, A., Janicot, S., Viltard & De Félice, P. (2002) Energetics of easterly disturbances over West Africa and the tropical Atlantic : A climatology from the 1979-95 NCEP/NCAR reanalyses. IN *Climate Dynamics*, 18. 487–500.

Dieng, O., Roucou, P. & Louvet, S. (2008) Variabilité intra-saisonnière des précipitations au Sénégal (1951-1996). IN *Sécheresse*, 19. 87–93.

Dingkuhn, M., Singh, B., Clerget, B., Chantereau, J. & Sultan, B. (2006) Past, present and future criteria to breed crops for water-limited environments in West Africa. IN *Agricultural Water Management*, 80. 241–261.

Dingkuhn, M., Kouressy, M., Vaksmann, M., Clerget, B. & Chantereau, J. (2008) A model of sorghum photoperiodism using the concept of threshold-lowering during prolonged appetence. IN *European Journal of Agronomy*, 28. 74–89.

Diouf, A., Nielsen, J. O., Cissé, P. & Maiga, A. (2010) Vulnérabilité et adaptation à la variabilité climatique : Genre et vie sociale. IN *Cahiers Agricultures*, .

Dominguez, M., Gaertner, M. Á., de Rosnay, P. & Losada Doval, T. (2010) A regional climate model simulation over West Africa: parameterization tests and analysis of land surface fields. IN *Climate Dynamics*, 35. 249–265.

Douville, H., Conil, S., Tyteca, S. & Voldoire, A. (2007) Soil moisture memory and West African monsoon predictability: artefact or reality? IN *Climate Dynamics*, 28. 723–742.

Drobinski, P., Sultan, B. & Janicot, S. (2005) Role of the Hoggar massif in the West African monsoon onset. IN *Geophysical Research Letters*, 32 DOI : 10.1029/2004GL020710.

Drobinski, P., Bastin, S., Janicot, S., Bock, O., Dabas, A., Delville, P., Reitebuch, O. & Sultan, B. (2009) On the late northward propagation of the West African monsoon in summer 2006 in the region of Niger/Mali. IN *Journal of Geophysical Research*, 114. DOI:10.1029/2008JD011159

Druyan, L. M., Fulakeza, M. & Lonergan, P. (2007) The spatial variability of regional model simulated June-September mean precipitation over West Africa. IN *Geophysical Research Letters*, 34 DOI : 10.1029/2007GL031270.

Druyan, L. M., Fulakeza, M. & Lonergan, P. (2008) The impact of vertical resolution on regional model simulation of the West African summer monsoon. IN *International Journal of Climatology*, 28. 1293–1314.

Druyan, L. M., Feng, J., Cook, K. H., Xue, Y., Fulakeza, M., Hagos, S. M., Konaré, A., Moufouma-Okia, W., Rowell, D. P., Vizy, E. K. & Ibrah, S. S. (2009) The WAMME regional model intercomparison study. IN *Climate Dynamics*, DOI:10.1007/s00382-009-0676-7..

Druyan, L. M., Fulakeza, M., Lonergan, P. & Noble, E. (2009) Regional climate model simulation of the AMMA Special Observing Period #3 and the pre-Helene easterly wave. IN *Meteorology and Atmospheric Physics*, 105. 191–210.

Druyan, L. M., Fulakeza, M., Lonergan, P. & Worrell, R. (2010) Regional Model Nesting within GFS Daily Forecasts Over West Africa. IN *The Open Atmospheric Science Journal*, 4. 1–11.

Edwards, D., Emmons, L., Gille, J., Chu, A., Attié, J.-L. & et, A. (2006) Satellite-observed pollution from Southern Hemisphere biomass burning. IN *Journal of the Atmospheric Sciences*, 111 DOI : 10.1029/2005JD006655.

Emmel, C., Knippertz, P. & Schulz, O. (2010) Climatology of convective density currents in the southern foothills of the Atlas Mountains. IN *Journal of Geophysical Research-Atmospheres*, 115 DOI : 10.1029/2009JD012863.

Esteves, M., Descroix, L., Mathys, N. & Lapetite, J.-M. (2005) Soil hydraulic properties in a marly gully catchment (Draix, France). IN *Catena*, 63. 282–298.

Evan, A. T., Heidinger, A. K. & Knippertz, P. (2006) Analysis of winter dust activity off the coast of West Africa using a new 24-year over-water advanced very high resolution radiometer satellite dust climatology. IN *Journal of Geophysical Research-Atmospheres*, 111 DOI : 10.1029/2005JD006336.

Evaristo, R., Scialom, G., Viltard, N. & Lemaitre, Y. (2010) Polarimetric signatures and hydrometeor classification of West African squall lines. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 272–288 DOI: 10.1002/qj.561.

Ezzahar, J., Chehbouni, A., Hoedjes, J., Ramier, D., Boulain, N., Boubkraoui, S., Cappelaere, B., Descroix, L., Mougenot, B. & Timouk, F. (2009) Combining scintillometer measurements and an aggregation scheme to estimate area-averaged latent heat flux during the AMMA experiment. IN *Journal of Hydrology*, 375. 217–226.

Faccani, C., Rabier, F., Fourrié, N., Agusti-Panareda, A., Karbou, F., Moll, P., Lafore, J.-P., Nuret, M., Hdidou, F. & Bock, O. (2009) The Impacts of AMMA Radiosonde Data on the French Global Assimilation and Forecast System. IN *Weather and Forecasting*, 24. 1268–1286.

Favreau, G., Cappelaere, B., Massuel, S., Leblanc, M. J., Boucher, M., Boulain, N. & Leduc, C. (2009) Land clearing, climate variability, and water resources increase in semiarid southwest Niger: A review. IN *Water Resources Research*, 45 . W00A16, doi:10.1029/2007WR006785

Fensholt, R., Anyamba, A., Stisen, S., Sandholt, I., Pak, E. & Small, J. (2007) Comparisons of compositing period length for vegetation index data from polar-orbiting and geostationary satellites for the cloud-prone region of West Africa. IN *Photogrammetry engineering & remote sensing*, 73. 299–309.

Fierli, F., Orlandi, E., Law, K. S., Cagnazzo, C., Cairo, F., Schiller, C., Borrmann, S., Didonfrancesco, G., Ravegnani, F. & Volk, C. M. (2010) Impact of deep convection in the tropical tropopause layer in West Africa: in-situ observations and mesoscale modelling. IN *Atmospheric Chemistry and Physics Discussions*, 10. 4927–4961.

Fink, A. H. & Reiner, A. (2003) Spatio-temporal Variability of the Relation between African Easterly Waves and West African Squall Lines in 1998 and 1999. IN *Journal of Geophysical Research-Atmospheres*, 108 DOI : 10.1029/2002JD002816.

Fink, A. H., Vincent, D. G., Reiner, A. & Speth, P. (2004) Mean state and wave disturbances during phases I, II, and III of GATE based on ERA-40. IN *Monthly Weather Review*, 132. 1661–1683.

Fink, A. H. Das westafrikanische Monsunsystem. In: *Promet*, Nr. 3, 2006, 114–122.

Fink, A. H., Vincent, D. G. & Ermert, V. (2006) Rainfall Types in the West African Soudanian Zone during the Summer Monsoon 2002. IN *Monthly Weather Review*, 134. 2143–2164.

Fink, A. H., Agusti-Panareda, A., Parker, D. J., Lafore, J.-P., Ngamini, J.-B., Afiesimama, E. A., Beljaars, A., Bock, O., Christoph, M., Dide, F., Faccani, C., Fourrié, N., Karbou, F., Polcher, J., Mumba, Z., Nuret, M., Pohle, S., Rabier, F., Tompkins, A. M. & Wilson, G. (2010) Operational meteorology: observational networks, weather analysis and forecasting. IN *Atmospheric Science Letters*,

Fink, A. H., Schrage, J. M. & Kotthaus, S. (2010) On the potential causes of the non-stationary correlations between West African precipitation and Atlantic hurricane activity. IN *Journal of Climate*, 23. 5437–5456.

Flamant, C., Chaboureau, J.-P., Parker, D. J., Taylor, C. M., Cammas, J.-P., Bock, O., Timouk, F. & Pelon, J. (2007) Airborne observations of the impact of a convective system on the planetary boundary layer thermodynamics and aerosol distribution in the inter-tropical discontinuity region of the West African Monsoon. IN *Quarterly Journal of the Royal Meteorological Society*, 133. 1175–1189.

Flamant, C., Knippertz, P., Parker, D. J., Chaboureau, J.-P., Lavaysse, C., Agusti-Panareda, A. & Kergoat, L. (2009) The impact of a mesoscale convective system cold-pool on the northward propagation of the inter-tropical discontinuity over West Africa. IN *Quarterly Journal of the Royal Meteorological Society*, 135. 139–159.

Flamant, C., Lavaysse, C., Todd, M. C., Chaboureau, J.-P. & Pelon, J. (2009) Multi-platform observations of a springtime case of Bodélé and Sudan dust emission, transport and scavenging over West Africa. IN *Quarterly Journal of the Royal Meteorological Society*, 135. 413–430.

Flaounas, E., Bastin, S. & Janicot, S. (2010) Evaluation of the impact of albedo, orography, SST and large scale conditions on the 2006 West African Monsoon onset. IN *Climate Dynamics*, .

Flaounas, E., Bastin, S. & Janicot, S. (2010) Regional climate modelling of the 2006 West African monsoon: sensitivity to convection and planetary boundary layer parameterisation using WRF. IN *Climate Dynamics*, DOI : 10.1007/s00382-010-0785-3.

Fleury, L., Boichard, J.-L., Brissebrat, G., Cloché, S., Eymard, L., Mastrorillo, L., Moulaye, O. & Ramage, K. (2010) A user friendly distributed database for the African Monsoon Multidisciplinary Analyses programme: In: Curdt, C. & Bareth, G. (eds.): Proceedings of the Data Management Workshop, University of Cologne, Germany, 29.-30.10.2009. IN *Koelner Geographische Arbeiten*, 90. 45–51.

Fleury, L., Boichard, J.-L., Brissebrat, G., Cloché, S., Eymard, L., Mastrorillo, L., Oumarou, M., Ramage, K., Asencio, N., Coppeaux, J., Devic, M.-P., Favot, F., Ginoux, K., Lafore, J.-P., Polcher, J., Redelsperger, J.-L., Roussot, O. & Tytéca, M. (2010) AMMA information system: an efficient cross-disciplinary tool and a legacy for forthcoming projects. IN *Atmospheric Science Letters*, DOI : 10.1002/asl.303.

Fontaine, B., Philippon, N., Trzaska, S. & Roucou, P. (2002) Spring to summer changes in the West African monsoon through NCEP/NCAR reanalyses (1968-1998). IN *Journal of Geophysical Research*, 107 DOI : 10.1029/2001JD000834.

Fontaine, B., Roucou, P. & Trzaska, S. (2003) Atmospheric water cycle and moisture fluxes in the West African monsoon: mean annual cycles and relationship using NCEP/NCAR reanalysis. IN *Geophysical Research Letters*, 30. 101029–101032.

Fontaine, B., Roucou, P., Gaetani, M. & Marteau, R. (2003) Recent changes in precipitation, ITCZ convection and northern tropical circulation over North Africa (1979-2007). IN *International Journal of Climatology* DOI : 10.1002/joc.2108.

Fontaine, B. & Louvet, S. (2006) Sudan-Sahel rainfall onset: Definition of an objective index, types of years, and experimental hindcasts. IN *Journal of Geophysical Research*, 111. , D20103, doi:10.1029/2005JD007019

Fontaine, B., Louvet, S. & Roucou, P. (2007) Fluctuations in annual cycles and inter-seasonal memory in West Africa: rainfall, soil moisture and heat fluxes. IN *Theoretical and Applied Climatology*, 88. 57–70.

Fontaine, B., Louvet, S. & Roucou, P. (2008) Definition and predictability of an OLR-based West African monsoon onset. IN *International Journal of Climatology*, . doi :10 .1002/joc.1674

Fontaine, B., Garcia-Serrano, J., Roucou, P., Rodriguez Fonseca, B., Losada Doval, T., Chauvin, F., Gervois, S., Sivarajan, S., Ruti, P. M. & Janicot, S. (2009) Impacts of Warm and Cold situations in the Mediterranean Basins on the West African monsoon: observed connection patterns (1979-2006) and climate simulations. IN *Climate Dynamics*, . 95–114 DOI : 10.1007/s00382-009-0599-3.

Formenti, P., Rajot, J.-L., Desboeufs, K., Caquineau, S., Chevaillier, S., Nava, S., Gaudichet, A., Journet, E., Triquet, S., Alfaro, S. C., Chiari, M., Haywood, J. M., Coe, H. & Highwood, E. J. (2008) Regional variability of the composition of mineral dust from Western Africa: results from the AMMA SOP0/DABEX and DODO. IN *Journal of Geophysical Research*, 113, D00C13, doi:10.1029/2008JD009903

Formenti, P., Nava, S., Prati, P., Chevaillier, S., Klaver, A., Lafont, S., Mazzei, F., Calzolai, G. & Chiari, M. (2010) Self-attenuation artifacts and correction factors of light element measurements by X-ray analysis: Implication for mineral dust composition studies. IN *Journal of Geophysical Research-Atmospheres*, 115 DOI : 10.1029/2009JD012701.

Frappart, F., Hiernaux, P., Guichard, F., Mougin, E., Kergoat, L., Arjounin, M., Lavenu, F., Koité, M., Paturel, J.-E. & Lebel, T. (2009) Rainfall regime across the Sahel band in the Gourma region, Mali. IN *Journal of Hydrology*, 375. 128–142.

Gaertner, M. Á., Dominguez, M. & Garvert, M. (2010) A modelling case-study of soil moisture-atmosphere coupling. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 483–495 DOI: 10.1002/qj.541.

Gallée, H., Moufouma-Okia, W., Bechtold, P., Brasseur, O., Dupays, I., Marbaix, P., Messager, C., Ramel, R. & Lebel, T. (2004) A high-resolution simulation of a West African rainy season using a regional climate model. IN *Journal of Geophysical Research*, 109 DOI:10.1029/2003JD004020.

Galy-Lacaux, C., Laouali, D., Descroix, L., Gobron, N. & Liousse, C. (2008) Long term precipitation chemistry and wet deposition in a remote dry savanna site in Africa (Niger). IN *Atmospheric Chemistry and Physics Discussions*, 8. 5761–5812.

Gangneron, F., Becerra, S. & Dia, A. H. (2010) Des pompes et des hommes état des lieux des pompes à motricité humaine d'une commune du Gourma malien. IN *Autrepart*, 3. 39–56.

Gantner, L. & Kalthoff, N. (2010) Sensitivity of a modelled life cycle of a mesoscale convective system to soil conditions over West Africa. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 471–482 DOI: 10.1002/qj.425.

Garcia-Carreras, L., Parker, D. J., Taylor, C. M., Reeves, C. E. & Murphy, J. G. (2010) The impact of mesoscale vegetation heterogeneities on the dynamical and thermodynamical properties of the planetary boundary layer. IN *Journal of Geophysical Research-Atmospheres*, DOI:10.1029/2009JD012811.

Garcia-Serrano, J., Losada Doval, T., Rodriguez Fonseca, B. & Polo, I. (2008) Tropical Atlantic variability modes (1979-2001). Part II: time-evolving atmospheric circulation related to SST-forced tropical convection. IN *Journal of Climate*, 21. 6476–6497.

Garcia-Serrano, J., Losada Doval, T. & Rodriguez Fonseca, B. (2010) Extratropical atmospheric response to the Atlantic Niño damping. IN *Journal of Climate*,

Garcia-Serrano, J., Rodriguez Fonseca, B. & Polo, I. (2010) Large-scale atmospheric response to Mediterranean summer SST anomalies. IN *Journal of Climate*,.

Gardelle, J., Hiernaux, P., Kergoat, L. & Grippa, M. (2010) Less rain, more water in ponds: a remote sensing study of the dynamics of surface waters from 1950 to present in pastoral Sahel (Gourma region, Mali). IN *Hydrology and Earth System Sciences*, 14. 309–324.

Garric, G., Douville, H. & Déqué, M. (2002) Prospects for improved seasonal predictions of monsoon precipitation over Sahel. IN *International Journal of Climatology*, 22. 331–345.

Gaudart, J., Touré, O., Dessay, N., Ranque, S., Forest, L., Demongeot, J., Dicko, A. & Doumbo, O. (2009) Modelling malaria incidence with environmental dependency in a locality of Sudanese savannah area, Mali. IN *Malaria Journal*, 8 DOI : 10.1186/1475-2875-8-61.

Genesio, L., Bacci, M., Baron, C., Diarra, B., Di Vecchia, A., Alhassane, A., Hassane, I., Ndiaye, M., Philippon, N., Tarchiani, V. & Traoré, S. B. (2010) Early warning systems for food security in West Africa: evolution, achievements and challenges. IN *Atmospheric Science Letters*

Gerbaux, M., Hall, N. M. J., Dessay, N. & Zin, I. (2009) The sensitivity of Sahelian runoff to climate change. IN *IAHS-AISH publication*, 54. 5–16.

Giordani, H. & Caniaux, G. (2010) Diagnosing vertical motion in the equatorial Atlantic. IN *Journal of Physical Oceanography*,

Gosset, M., Zahiri, E.-P. & Moumouni, S. (2010) Rain Drop Size distributions variability and impact on X-band polarimetric radar retrieval: results from the AMMA campaign in Benin. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 243–256 DOI : 10.1002/qj.556.

Gosset, M., Moumouni, S. & Zahiri, E.-P. (2010) An analysis of the convective and stratiform regions of the rainy events observed in Benin : rain drop size distributions measured by optical disdrometers and link with polarimetric radar observations. IN *Quarterly Journal of the Royal Meteorological Society*, .

Grams, C. M., Jones, S. C., Marsham, J. H., Parker, D. J., Haywood, J. M. & Heuveline, V. (2010) The Atlantic inflow to the Saharan heat low: observations and modelling. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 125–140.

Grandpeix, J.-Y. & Lafore, J.-P. (2010) A density current parametrization coupled to Emanuel's convection scheme. Part I: The models. IN *Journal of the Atmospheric Sciences*, 67. 881–897.

Grandpeix, J.-Y., Lafore, J.-P. & Cheruy, F. (2010) A density current parametrization coupled to Emanuel's convection scheme. Part II: 1D simulations. IN *Journal of the Atmospheric Sciences*, 67. 898–922.

Greed, G., Haywood, J. M., Milton, S. F., Keil, A., Christopher, S. A., Gupta, P. & Highwood, E. J. (2008) Aerosol optical depths over North Africa: 2. Modeling and model validation. IN *Journal of Geophysical Research*, 113, D00C05, doi:10.1029/2007JD009457.

Grini, A., Tulet, P. & Gomes, L. (2006) Dusty weather forecasts using the MesoNH mesoscale atmospheric model. IN *Journal of Geophysical Research*, 111.

Grippa, M., Kergoat, L., Frappart, F., Araud, Q., Boone, A., de Rosnay, P., Lemoine, J.-M., Gascoin, S., Balsamo, G., Ottlé, C., Decharme, B. & Saux-Picart, S. (2010) Land water storage changes over West Africa estimated by GRACE and land surface models. IN *Water Resources Research*, .

Gruhier, C., de Rosnay, P., Kerr, Y. H., Mougin, E., Ceschia, E., Calvet, J.-C. & Richaume, P. (2008) Evaluation of AMSR-E soil moisture product based on ground measurements over temperate and semi-arid regions. IN *Geophysical Research Letters*, 35, L10405, doi:10.1029/2008GL033330.

Gruhier, C., de Rosnay, P., Hasenauer, S., Holmes, T., De Jeu, R., Kerr, Y. H., Mougin, E., Njoku, E., Timouk, F., Wagner, W. & Zribi, M. (2010) Soil moisture active and passive microwave products: intercomparison and evaluation over a Sahelian site. IN *Hydrology and Earth System Sciences*, 14. 141–156.

Gueye, P., Janicot, S., Niang, A., Sawadogo, S., Sultan, B., Diongue-Niang, A. & Thiria, S. (2010) Weather regimes over Senegal during the summer monsoon season using self-organizing maps and hierarchical ascendant classification. Part I: synoptic time scale. IN *Climate Dynamics*, .

Guichard, F., Kergoat, L., Mougin, E., Timouk, F., Baup, F., Hiernaux, P. & Lavenu, F. (2009) Surface thermodynamics and radiative budget in the Sahelian Gourma: seasonal and diurnal cycles. IN *Journal of Hydrology*, 375. 161–177.

Guichard, F., Asencio, N., Redelsperger, J.-L., Lafore, J.-P., Nuret, M., Boone, A., Decharme, B., Peugeot, C., Bock, O., Cui, X., Morse, A., Garvert, M., Gaertner, M. Á., Lamptey, B., Orlandi, E., Sander, J., Jones, S. C., Fierli, F., Balsamo, G., de Rosnay, P., Harris, P. P. & Bergès, J.-C. (2010) An intercomparison of simulated rainfall and evapotranspiration associated with a Mesoscale Convective System over West Africa. IN *Weather and Forecasting*, 25. 37–60.

Guinot, V., Leménager, M. & Cappelaere, B. (2007) Sensitivity equations for hyperbolic conservation law-based flow models. IN *Advances in Water Resources*, 30. 1943–1961.

Guyot, A., Cohard, J.-M., Anquetin, S., Galle, S. & Lloyd, C. R. (2009) Combined analysis of energy and water balances to estimate latent heat flux of a sudanian small catchment. IN *Journal of Hydrology*, 375, 1-2, 227-240.

Haarsma, R. J., Selten, F. M., Weber, S. L. & Kliphuis, M. (2005) Sahel rainfall variability and response to greenhouse warming. IN *Geophysical Research Letters*, 32, doi:10.1029/2005GL023232.

Hagedorn, R., Doblas-Reyes, F. & Palmer, T. N. (2005) The rationale behind the success of multi-model ensembles in seasonal forecasting. IN *Tellus - Series A: Dynamic Meteorology and Oceanography*, 57. 219–233.

Hagos, S. M. & Cook, K. H. (2007) Dynamics of the West African monsoon jump. IN *Journal of Climate*, 20. 5264–5284.

Hagos, S. M. & Cook, K. H. (2009) Development of aCoupled Regional Model and Its Application to the Study of Interactions between the West African Monsoon and the Eastern Tropical Atlantic Ocean. IN *Journal of Climate*, 22. 2591–2604.

Hagos, S. M. & Zhang, C. (2010) Diabatic heating, divergent circulation and moisture transport in the African monsoon system. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 411–425.

Hall, N. M. J. & Peyrillé, P. (2006) Dynamics of the West African monsoon. IN *Journal de Physique IV*, 139. 81–99.

Hall, N. M. J., Kiladis, G. N. & Thorncroft, C. D. (2006) Three-Dimensional Structure and Dynamics of African Easterly Waves. Part II: Dynamical Modes. IN *Journal of the Atmospheric Sciences*, 63. 2231–2245.

Hand, V. L., Capes, G., Vaughan, D. J., Formenti, P., Haywood, J. M. & Coe, H. (2010) Evidence of internal mixing of African dust and biomass burning particles by individual particle analysis using electron beam techniques. IN *Journal of Geophysical Research*, 115.

Hansell, R. A., Tsay, S. C., Ji, Q., Hsu, N. C., Jeong, M. J., Wang, S. H., Reid, J. S., Liou, K. N. & Ou, S. C. (2009) An Assessment of the Surface Longwave Direct Radiative Effect of Airborne Saharan Dust during the NAMMA Field Campaign. IN *Journal of the Atmospheric Sciences*, 67. 1048–1065.

Haywood, J. M., Pelon, J., Formenti, P., Bharmal, N. A., Brooks, M. E., Capes, G., Chazette, P., Chou, C., Christopher, S. A., Coe, H., Cuesta, J., Derimian, Y., Desboeufs, K., Greed, G., Harrison, M. A. J., Heese, B., Highwood, E. J., Johnson, B. T., Mallet, M., Marticorena, B., Marsham, J., Milton, S. F., Myhre, G., Osborne, S., Parker, D. J., Rajot, J.-L., Schulz, M., Slingo, A., Tanré, D. & Tulet, P. (2008) Overview of the Dust and Biomass burning Experiment and African Monsoon Multidisciplinary Analysis Special Observing Period-0. IN *Journal of Geophysical Research*, 113 D00C17, doi:10.1029/2008JD010077.

Heese, B. & Wiegner, M. (2008) Vertical aerosol profiles from Raman polarization lidar observations during the dry season AMMA field campaign. IN *Journal of Geophysical Research*, 113 D00C11, doi:10.1029/2007JD009487.

.Heese, B., Althausen, D., Dinter, T., Esselborn, M., Müller, T., Tesche, M. & Wiegner, M. (2009) Vertically resolved dust optical properties during SAMUM: Tinfou compared to Ouarzazate. IN *Tellus B*, 61. 195–205.

Heinold, B., Tegen, I., Esselborn, M., Kandler, K., Knippertz, P., Müller, D., Schladitz, A., Tesche, M., Weinzierl, B., Ansmann, A., Althausen, D., Laurent, B., Massling, A., Müller, T., Petzold, A., Schepanski, K. & Wiedensohler, A. (2009) Regional Saharan dust modelling during the SAMUM 2006 campaign. IN *Tellus B*, 61. 307–324.

Hiernaux, P. & Le Houerou, H. N. (2006) Les parcours du Sahel. IN *Sécheresse*, 17. 51–71.

Hiernaux, P., Ayantunde, A., Kalilou, A., Mougin, E., Gérard, B., Baup, F., Grippa, M. & Djaby, B. (2009) Trends in productivity of crops, fallow and rangelands in Southwest Niger: impact of land use, management and variable rainfalls. IN *Journal of Hydrology*, 375. 65–77.

Hiernaux, P., Diarra, L., Trichon, V., Mougin, E., Soumaguel, N. & Baup, F. (2009) Woody plant population dynamics in response to climate changes from 1984 to 2006 in Sahel (Gourma,Mali). IN *Journal of Hydrology*, 375. 103–113.

Hiernaux, P., Mougin, E., Diarra, L., Soumaguel, N., Lavenu, F., Tracol, Y. & Diawara, M. (2009) Sahelian rangeland response to changes in rainfall over two decades in the Gourma region, Mali. IN *Journal of Hydrology*, 375. 114–127.

Höller, H., Betz, H. D., Schmidt, K., Calheiros, R. V., May, P., Houngninou, E. & Scialom, G. (2009) Lightning characteristics observed by a VLF/LF lightning detection network (LINET) in Brazil, Australia, Africa and Germany. IN *Atmospheric Chemistry and Physics*, 9. 7795–7824.

Hopkins, J. R., Evans, M. J., Lee, J. D., Lewis, A., Marsham, J. H., McQuaid, J. B., Parker, D. J., Stewart, D. J., Reeves, C. E. & Purvis, R. M. (2009) Direct estimates of emissions from the megacity of Lagos. IN *Atmospheric Chemistry and Physics*, 9. 8471–8477.

Hormann, V. & Brandt, P. (2007) Atlantic Equatorial Undercurrent and associated cold tongue variability. IN *Journal of Geophysical Research*, 112. C06017, DOI:10.1029/2006JC003931

Hormann, V. & Brandt, P. (2009) Upper equatorial Atlantic variability during 2002 and 2005 associated with equatorial Kelvin waves. IN *Journal of Geophysical Research*, 114. C03007, DOI:10.1029/2008JC005101

Hoshen, M. B. & Morse, A. P. (2004) A weather-driven model of malaria transmission. IN *Malaria Journal*, 3, 32, doi:10.1186/1475-2875-3-32.

Hourdin, F., Musat, I., Guichard, F., Ruti, P. M., Favot, F., Filiberti, M.-A., Pham, M., Grandpeix, J.-Y., Polcher, J., Marquet, P., Boone, A., Lafore, J.-P., Redelsperger, J.-L., Dell' Aquilla, A., Losada Doval, T., Khadre Traore, A. & Gallée, H. (2009) AMMA-Model Intercomparison Project. IN *Bulletin of the American Meteorological Society*, DOI: 10.1175/2009BAMS2791.1.

Hsieh, J. S. & Cook, K. H. (2007) A study of the energetics of African Easterly Waves using a Regional climate model. IN *Journal of the Atmospheric Sciences*, 64. 421–440.

Huang, J., Zhang, C. & Prospero, J. M. (2009) African aerosol and large-scale precipitation variability over West Africa. IN *Environmental Research Letters*, 4. 015006.

Huang, J., Adams, A., Wang, C. & Zhang, C. (2009) Black Carbon and West African Monsoon precipitation: observations and simulations. IN *Annales Geophysicae*, 27. 4171–4181.

Huang, J., Zhang, C. & Prospero, J. M. (2009) Large-scale effect of aerosols on precipitation in the West African Monsoon region. IN *Quarterly Journal of the Royal Meteorological Society*, 135. 581–594.

Jamnadas, R., Mace, E. S., Hiernaux, P., Muchugi, A. & Hanson, J. (2006) Population genetic responses of wild forage species to grazing along a rainfall gradient in the Sahel: A study combining phenotypic and molecular analyses. IN *Euphytica*, 151. 431–445.

Janicot, S., Mounier, F. & Diedhiou, A. (2008) Les ondes atmosphériques d'échelle synoptique dans la mousson d'Afrique de l'Ouest et centrale : ondes d'est et ondes de Kelvin. IN *Sécheresse*, 19. 13–22.

Janicot, S., Thorncroft, C. D., Ali, A., Asencio, N., Berry, G., Bock, O., Bourlès, B., Caniaux, G., Chauvin, F., Deme, A., Kergoat, L., Lafore, J.-P., Lavaysse, C., Lebel, T., Marticorena, B., Mounier, F., Nédélec, P., Redelsperger, J.-L., Ravegnani, F., Reeves, C. E., Roca, R., de Rosnay, P., Schlager, H., Sultan, B., Tomasini, M., Ulanovsky, A. E. & et, A. (2008) Large-scale overview of the summer monsoon over West Africa during the AMMA field experiment in 2006. IN *Annales Geophysicae*, 26. 2569–2595.

Janicot, S., Mounier, F., Hall, N. M. J., Leroux, S., Sultan, B. & Kiladis, G. N. (2009) Dynamics of the West African Monsoon. Part IV: Analysis of 25-90-Day Variability of Convection and the Role of the Indian Monsoon. IN *Journal of Climate*, 22. 1541–1565.

Janicot, S., Mounier, F., Gervois, S., Sultan, B. & Kiladis, G. N. (2009) The dynamics of the West African monsoon. Part V: The role of convectively coupled equatorial Rossby waves. IN *Journal of Climate*, 23. 4005–4024.

Janicot, S. (2009) A comparison of Indian and African monsoon variability at different time scales. IN *Comptes Rendus Géoscience*, 341. 575–590.

Janicot, S., Caniaux, G., Chauvin, F., de Coëtlogon, G., Fontaine, B., Hall, N. M. J., Kiladis, G. N., Lafore, J.-P., Lavaysse, C., Lavender, S. L., Leroux, S., Marteau, R., Mounier, F., Philippon, N., Roehrig, R., Sultan, B. & Taylor, C. M. (2010) Intra-seasonal variability of the West African monsoon. IN *Atmospheric Science Letters*, .

Jarlan, L., Tourre, Y. M., Mougin, E., Philippon, N. & Mazzega, P. (2005) Dominant patterns of AVHRR NDVI interannual variability over the Sahel and linkages with key climate signals. IN *Geophysical Research Letters*, 32.

Jarlan, L., Mougin, E., Mazzega, P., Schoenauer, M., Tracol, Y. & Hiernaux, P. (2005) Using coarse remote sensing radar observations to control the trajectory of a simple Sahelian land surface model. IN *Remote Sensing of Environment*, 94. 269–285.

Jarlan, L., Mangiarotti, S., Mougin, E., Hiernaux, P., Mazzega, P. & Le Dantec, V. (2008) Assimilation of SPOT/VEGETATION NDVI data into a sahelian vegetation dynamics model. IN *Remote Sensing of Environment*, 112. 1381–1394.

Jarlan, L., Balsamo, G., Lafont, S., Beljaars, A., Calvet, J.-C. & Mougin, E. (2008) Analysis of leaf area index in the ECMWF land surface model and impact on latent and carbon fluxes: Application to West Africa. IN *Journal of Geophysical Research*, 113.

Jenkins, G. S. & Pratt, A. S. (2008) Possible linkages between Saharan dust and tropical cyclone rain band invigoration in the eastern Atlantic during NAMMA-06. IN *Geophysical Research Letters*, 35.

Jenkins, G. S. & Pratt, A. S. (2008) Saharan dust, lightning and tropical cyclones in the eastern tropical Atlantic during NAMMA-06. IN *Geophysical Research Letters*, 35. L12804, doi:10.1029/2008GL033979

Jenkins, G. S., Camara, M. & Ndiaye, S. A. (2008) Observational evidence of enhanced middle/upper tropospheric ozone via convective processes over the equatorial tropical Atlantic during the summer of 2006. IN *Geophysical Research Letters*, 35.

Jenkins, G. S. (2010) Numerical Investigations on the Formation of Tropical Storm Debby during NAMMA-06. IN *Weather and Forecasting*, 25. 866–884.

Jenkins, G. S., Kucera, P., Joseph, E., Fuentes, J., Gaye, A., Gerlach, J., Roux, F., Viltard, N., Papazonni, M., Protat, A., Bouniol, D., Renolds, Arnault, J., Badiane, D., Kebe, C. M. F., Camara, M., Sall, S. M., Ndiaye, S. A. & Deme, A. (2010) Coastal observations of weather features in Senegal during the African Monsoon Multidisciplinary Analysis Special Observing Period 3. IN *Journal of Geophysical Research-Atmospheres*, 115.

Jobard, I., Chopin, F., Bergès, J.-C. & Roca, R. (2010) An intercomparison of 10-day precipitation satellite products during West African monsoon. IN *International Journal of Remote Sensing*, .

Johnson, B. T., Osborne, S., Haywood, J. M. & Harrison, M. A. J. (2008) Aircraft measurements of biomass burning aerosol over West Africa during DABEX. IN *Journal of Geophysical Research*, 113. D00C06, doi:10.1029/2007JD009451

Johnson, B. T., Heese, B., McFarlane, S. A., Chazette, P., Jones, A. E. & Bellouin, N. (2008) Vertical distribution and radiative effects of mineral dust biomass burning aerosol over West Africa during DABEX. IN *Journal of Geophysical Research*, 113. D00C12, doi:10.1029/2008JD009848

Joly, M., Voldoire, A., Douville, H., Terray, P. & Royer, J.-F. (2007) African monsoon teleconnections with tropical SSTs: validation and evolution in a set of IPCC4 simulations. IN *Climate Dynamics*, 29. 1–20.

Joly, M. & Voldoire, A. (2009) Influence of ENSO on the West African monsoon: Temporal aspects and atmospheric processes. IN *Journal of Climate*, 22. 3193–3210.

Joly, M. & Voldoire, A. (2010) Role of the Gulf of Guinea in the inter-annual variability of the West African monsoon: What do we learn from CMIP3 coupled simulations? IN *International Journal of Climatology*, .

Jones, A. E. & Morse, A. P. (2010) Skill of ENSEMBLES seasonal re-forecasts for epidemic malaria prediction in West Africa. IN *Geophysical Research Letters*, .

Josset, D., Pelon, J., Protat, A. & Flamant, C. (2008) New approach to determine aerosol optical depth from combined CALIPSO and CloudSat ocean surface echoes. IN *Geophysical Research Letters*, 35. 1–5.

Jung, G. & Kunstmann, H. (2007) High-resolution regional climate modelling for the Volta Basin of West Africa. IN *Journal of Geophysical Research*, 112. DOI:10.1029/2006JD007951

Ka, A., Maman, W., Rasmussen, K., Coulibaly, D. & Zorom, M. (2010) Évolution de l'élevage face à la variabilité climatique. IN *Cahiers Agricultures*, .

Kafando, P. P., Chane Ming, F. F. & Petitdidier, M. M. (2008) Climatology of gravity wave activity during the West African Monsoon. IN *Annales Geophysicae*, 26. 4081–4089.

Kalapureddy, M. C. R., Lothon, M., Campistron, B., Lohou, F. & Saïd, F. (2010) Wind profiler analysis of the African Easterly Jet in relation with the Boundary-layer and the Saharan Heat Low. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 77–91 DOI: 10.1002/qj.494.

Kamagaté, B., Séguis, L., Favreau, G., Seidel, J.-L., Descloitres, M. & Affaton, P. (2007) Processus et bilan des flux hydriques d'un bassin versant de milieu tropical de socle au Bénin (Donga, haut Ouémé). IN *Comptes Rendus Géoscience*, 339. 418–429.

Kamga Foamouhoue, A., Jenkins, G. S., Gaye, A. T., Garba, A., Sarr, A. & Adedoyin, A. (2005) Evaluating the National Center for Atmospheric Research climate system model over West Africa: present-day and the 21st century A1 scenario. IN *Journal of Geophysical Research*, 110 DOI : 10.1029/2004JD004689.

Kaptue Tchuente, A. T., Roujean, J.-L. & Faroux, S. (2010) ECOCLIMAP-II: an ecosystem classification and land surface parameters database of Western Africa at 1 km resolution for the African Monsoon Multidisciplinary Analysis (AMMA) project. IN *Remote Sensing of Environment*, 114. 961–976.

Karambiri, H., Garcia Galiano, S. G., Giraldo Osorio, J. D., Yacouba, H., Ibrahim, B., Barbier, B. & Polcher, J. (2010) Climate variability analysis and impacts assessment on water resources in West Africa. IN *Atmospheric Science Letters*, .

Karbou, F., Gérard, E. & Rabier, F. (2006) Microwave land emissivity and skin temperature for AMSU-A and -B assimilation over land. IN *Quarterly Journal of the Royal Meteorological Society*, 132. 2333–2355.

Karbou, F., Rabier, F., Lafore, J.-P., Redelsperger, J.-L. & Bock, O. (2009) Global 4D-Var assimilation and forecast experiments using AMSU observations over land. Part II: Impact of assimilating surface sensitive channels on the African Monsoon during AMMA. IN *Weather and Forecasting*, 25. 20–36.

Karbou, F., Gérard, E. & Rabier, F. (2010) Global 4D-Var assimilation and forecast experiments using AMSU observations over land. Part-I: Impact of various land surface emissivity parameterizations. IN *Weather and Forecasting*, 25. 5–19.

Kartal, D., Andrés-Hernö¡ndez, M. D., Reichert, L., Schlager, H. & Burrows, J. P. (2010) Technical Note: Characterisation of a DUALER instrument for the airborne measurement of peroxy radicals during AMMA 2006. IN *Atmospheric Chemistry and Physics*, 10. 3047–3062.

Kassimou, A., Parker, D. J., Brooks, B., Kalthoff, N. & Lebel, T. (2009) The diurnal cycle of lower boundary-layer wind in the West African monsoon. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 66–76.

Kaufman, Y. J., Koren, I., Remer, L. A., Tanré, D., Ginoux, P. & Fan, S. (2005) Dust transport and deposition observed from the Terra-Moderate Resolution Imaging Spectroradiometer (MODIS) spacecraft over the Atlantic Ocean. IN *Journal of Geophysical Research*, 110 DOI : 10.1029/2003JD004436.

Köhler, M., Kalthoff, N. & Kottmeier, C. (2009) The impact of soil moisture modifications on CBL characteristics in West Africa: A case-study from the AMMA campaign. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 442–455.

Köhler, M., Kalthoff, N. & Kottmeier, C. (2010) The influence of soil moisture on the energy balance, boundary layer and convective instability during the pre-onset and mature phase of the African monsoon. IN *Quarterly Journal of the Royal Meteorological Society*, 442. 442–455 DOI: 10.1002/qj.430.

Kergoat, L., Grippa, M., Baille, A., Eymard, L., Lacaze, R., Mougin, E., Ottlé, C., Pellarin, T., Polcher, J., de Rosnay, P., Roujean, J.-L., Sandholt, I., Taylor, C. M., Zin, I. & Zribi, M. (2010) Remote sensing of the Land Surface during the African Monsoon Multidisciplinary Analysis (AMMA). IN *Atmospheric Science Letters*, .

Kiladis, G. N., Thorncroft, C. D. & Hall, N. M. J. (2006) Three-Dimensional Structure and Dynamics of African Easterly Waves. Part I: Observations. IN *Journal of the Atmospheric Sciences*, 63. 2212–2230.

Kim, K.-M., Lau, W. K.-M., Sud, Y. C. & Walker, G. K. (2009) Influence of aerosol radiative forcings on the diurnal and seasonal cycles of rainfall over West Africa and Eastern Atlantic Ocean using GCM simulations. IN *Climate Dynamics*, 35. 115–126.

Kim, S.-W., Chazette, P., Dulac, F., Sanak, J., Johnson, B. T. & Yoon, S.-C. (2009) Vertical structure of aerosols and water vapor over West Africa during the African monsoon dry season. IN *Atmospheric Chemistry and Physics*, 9. 8017–8038.

Kleidman, R. G., O'Neill, N., Remer, L. A., Kaufman, Y. J., Eck, T., Tanré, D., Dubovik, O. & Holben, B. N. (2005) Comparison of Moderate Resolution Imaging Spectroradiometer (MODIS) and Aerosol Robotic Network (AERONET) remote-sensing retrievals of aerosol fine mode fraction over ocean. IN *Journal of Geophysical Research*, 110 DOI : 10.1029/2005JD005760.

Klose, M., Shao, Y., Karremann, M. & Fink, A. H. (2010) Sahel Dust Zone and Synoptic Background. IN *Geophysical Research Letters*, 37 DOI : 10.1029/2010GL042816.

Knippertz, P., Fink, A. H., Reiner, A. & Speth, P. (2003) Three late summer/early autumn cases of tropical-extratropical interactions causing precipitation in northwestern Africa. IN *Monthly Weather Review*, 131. 116–135.

Knippertz, P. (2003) Tropical-extratropical interactions causing precipitation in northwest Africa: Statistical analysis and seasonal variations. IN *Monthly Weather Review*, 131. 3069–3076.

Knippertz, P. & Martin, J. E. (2005) Tropical plumes and extreme precipitation in subtropical and tropical West Africa. IN *Quarterly Journal of the Royal Meteorological Society*, 131. 2337–2365.

Knippertz, P. & Fink, A. H. (2006) Synoptic and Dynamic Aspects of an Extreme Springtime Saharan Dust Outbreak. IN *Quarterly Journal of the Royal Meteorological Society*, 132. 1153–1177.

Knippertz, P., Deutscher, C., Kandler, K., Müller, T., Schulz, O. & Schütz, L. (2007) Dust mobilization due to density currents in the Atlas region: Observations from the Saharan Mineral Dust Experiment 2006 field campaign. IN *Journal of Geophysical Research-Atmospheres*, 112 DOI : 10.1029/2007JD008774.

Knippertz, P. (2007) Tropical-extratropical interactions related to upper-level troughs at low latitudes. IN *Dynamics of Atmospheres and Oceans*, 43. 36–62.

Knippertz, P. & Fink, A. H. (2008) Dry-Season Precipitation in Tropical West Africa and its Relation to Forcing from the Extratropics. IN *Monthly Weather Review*, 136. 3579–3596.

Knippertz, P. (2008) Dust emissions in the West African heat trough - the role of the diurnal cycle and of extratropical disturbances. IN *Meteorologische Zeitschrift*, 17. 553–563.

Knippertz, P. & Fink, A. H. (2009) Prediction of Dry-Season Precipitation in Tropical West Africa and Its Relation to Forcing from the Extratropics. IN *Weather and Forecasting*, 24. 1064–1084.

Knippertz, P., Ansmann, A., Althausen, D., Müller, D., Tesche, M., Bierwirth, E., Dinter, T., Müller, T., von Hoyningen-Huene, W., Schepanski, K., Wendisch, M., Heinold, Kandler, K., Petzold, Schütz, L. & Tegen (2009) Dust mobilization and transport in the northern Sahara during SAMUM 2006 - a meteorological overview. IN *Tellus B*, 61. 12–31.

Knippertz, P., Trentmann, J. & Seifert, A. (2009) High-resolution simulations of convective cold pools over the northwestern Sahara. IN *Journal of Geophysical Research-Atmospheres*, 114 DOI : 10.1029/2008JD011271.

Koffi, U., Lefevre, N., Kouadio, G. & Boutin, J. (2010) Surface CO2 parameters and air-sea CO2 flux distribution in the eastern equatorial Atlantic Ocean. IN *Journal of Marine Systems*, 82. 135–144.

Kollias, P., Miller, M. A., Johnson, K. L., Jensen, M. P. & Troyan, D. D. T. (2009) Cloud, thermodynamic, and precipitation observations in West Africa during 2006. IN *Journal of Geophysical Research-Atmospheres*, 114 DOI : 10.1029/2008JD010641.

Kolodziejczyk, N., Bourlès, B., Marin, F., Grelet, J. & Chuchla, R. (2009) Seasonal variability of the Equatorial Undercurrent at 10°W as inferred from recent in situ observations. IN *Journal of Geophysical Research*, 114. DOI : 10.1029/2008JC004976

Konaré, A., Liousse, C., Guillaume, B., Solmon, F., Assamoi, E., Rosset, R., Gregoire, J.-M. & Giorgi, F. (2008) Combustion particulate emissions in Africa: regional climate modeling and validation. IN *Atmospheric Chemistry and Physics Discussions*, 8. 6653–6681.

Kouressy, M., Dingkuhn, M., Vaksmann, M. & Heinemann, A. B. (2008) Adaptation to diverse semi-arid environments of sorghum genotypes having different plant type and sensitivity to photoperiod. IN *Agricultural and Forest Meteorology*, 148. 357–371.

Kucharski, F., Bracco, A., Yoo, J. H., Tompkins, A. M., Feudale, L., Ruti, P. M. & Dell' Aquilla, A. (2009) A Gill-Matsuno-type mechanism explains the Tropical Atlantic influence on African and Indian Monsoon Rainfall. IN *Quarterly Journal of the Royal Meteorological Society*, 135. 569–579.

Lacaux, J.-P., Tourre, Y. M., Vignolles, C., Ndione, J.-A. & Lafaye, M. (2007) Classification of ponds from high-spatial resolution remote sensing: Application to Rift Valley Fever epidemics in Senegal. IN *Remote Sensing of Environment*, 106. 66–74.

Lafore, J.-P., Flamant, C., Guichard, F., Parker, D. J., Bouniol, D., Fink, A. H., Giraud, V., Gosset, M., Hall, N. M. J., Hö¶ller, H., Jones, S. C., Protat, A., Roca, R., Roux, F., Saïd, F. & Thorncroft, C. D. (2010) Progress in understanding of weather systems in West Africa. IN *Atmospheric Science Letters*, .

Lafore, J.-P., Flamant, C., Giraud, V., Guichard, F., Knippertz, P., Mahfouf, J. F., Mascart, P. & Williams, E. (2010) Introduction to the AMMA Special issue on «Advances in understanding atmospheric processes over West Africa through the AMMA field campaign». IN *Quarterly Journal of the Royal Meteorological Society*, 2. 2–7 DOI : DOI: 10.1002/qj.583.

Lambin, E. F., Mertz, O., Rasmussen, K., Reenberg, A., D' Haen, S. & Nielsen, J. O. (2010) Scenarios on the future of the African Sahel. IN *Global Environmental Change*, .

Lavaysse, C., Diedhiou, A., Laurent, H. & Lebel, T. (2006) African Easterly Waves and convective activity in wet and dry sequences of the West African Monsoon. IN *Climate Dynamics*, 27. 319–332.

Lavaysse, C., Flamant, C., Janicot, S., Parker, D. J., Lafore, J.-P., Sultan, B. & Pelon, J. (2009) Seasonal evolution of the West African heat low: a climatological perspective. IN *Climate Dynamics*, 33. 313–330 DOI : 10.1007/s00382-009-0553-4.

Lavaysse, C., Flamant, C., Janicot, S. & Knippertz, P. (2010) Links between African easterly waves, midlatitude circulation and intraseasonal pulsations of the West African heat low. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 141–158 DOI : 10.1002/qj.555.

Lavender, S. L. & Matthews, A. J. (2009) Response of the West African monsoon to the Madden-Julian oscillation. IN *Journal of Climate*, 22. 4097–4116 DOI : :10.1175/2009JCLI2773.1.

Lavender, S. L., Taylor, C. M. & Matthews, A. J. (2009) Coupled land-atmosphere intraseasonal variability of the West African monsoon in a GCM. IN *Journal of Climate*, DOI : 10.1175/2010JCLI3419.1.

Law, K. S., Cairo, F., Fierli, F., Palazzi, E., Borrman, S., Schlager, H., Streibel, M., Viciani, S., Ravegnani, F., Volk, M. & Schiller, C. (2010) Air mass origins influencing TTL chemical composition over West Africa during 2006 summer monsoon. IN *Atmospheric Chemistry and Physics*, 10. 15485–15536.

Lélé, I. & Lamb, P. J. (2010) Variability of InterTropical Front (ITF) and Rainfall over West African Soudano-Sahel. IN *Journal of Climate*, 23. 3984–4004.

Léon, J.-F., Derimian, Y., Chiapello, I., Tanré, D., Podvin, T., Chatenet, B., Diallo, A. & Deroo, C. (2009) Aerosol vertical distribution and optical properties over M'Bour (16°96 W; 14°39 N), Senegal from 2006 to 2008. IN *Atmospheric Chemistry and Physics*, 9. 9249–9261.

Le Barbé, L., Lebel, T. & Tapsoba, D. (2002) Rainfall variability in West Africa during the years 1950-1990. IN *Journal of Climate*, 15. 187–202.

Le Lay, M. & Galle, S. (2005) Variabilités interannuelle et intra-saisonnière des pluies aux échelles hydrologiques. La mousson ouest africaine en climat soudanien. IN *Hydrological Sciences Journal*, 50. 509–524.

Le Lay, M. & Galle, S. (2005) Seasonal cycle and interannual variability of rainfall at hydrological scales. II : The West African monsoon in a Sudanese climate. IN *Hydrological Sciences Journal*, 50. 509–524 DOI : 10.1623/hysj.50.3.509.65029.

Le Lay, M. & Galle, S. (2005) How changing rainfall regimes may affect the water balance: a modelling approach in West Africa. IN *Regional Hydrological Impacts of Climatic Change*, 296. 203–210.

Le Lay, M., Galle, S., Saulnier, G.-M. & Braud, I. (2007) Exploring the relationship between hydroclimatic stationarity and rainfall-runoff model parameter stability: A case study in West Africa. IN *Water Resources Research*, 43 DOI : 10.1029/2006WR005257.

Le Lay, M. & Saulnier, G.-M. (2007) Exploring the signature of climate and landscape spatial variabilities in flash flood events: Case of the 8-9 September 2002 Cévennes-Vivarais catastrophic event. IN *Geophysical Research Letters*, 34 DOI : 10.1029/2006WR005257.

Le Lay, M., Saulnier, G.-M., Galle, S., Séguis, L., Metadier, M. & Peugeot, C. (2008) Model representation of the Sudananian hydrological processes. Application on the Donga catchment (Benin). IN *Journal of Hydrology*, 363. 32–41.

Lebel, T., Diedhiou, A. & Laurent, H. (2003) Seasonal cycle and interannual variability of the Sahelian rainfall at hydrological scales. IN *Geophysical Research Letters*, 108.

Lebel, T. & Vischel, T. (2005) Climate and water cycle in the tropical zone: a problem of scale. IN *Comptes Rendus Géoscience*, 337. 29–38 DOI : :10.1016/j.crte.2004.08.011.

Lebel, T., Peugeot, C., Galle, S., Descroix, L., Rajot, J.-L., Seghieri, J., Timouk, F., Lavenu, F. & Mougin, E. (2006) La mousson ouest-africaine actrice ou victime de la désertification ? IN *Journal Sciences au sud*, 36. 8.

Lebel, T. & Redelsperger, J.-L. (2008) Le projet AMMA, un exemple d'étude intégré et multidisciplinaire sur un système climatique régional. In: *La Houille Blanche*, 38–44.

Lebel, T. & Ali, A. (2009) Recent trends in the Central and Western Sahel rainfall regime (1990 - 2007). IN *Journal of Hydrology*, 375. 52–64.

Lebel, T., Cappelaere, B., Galle, S., Hanan, N. P., Kergoat, L., Levis, S., Vieux, B. E., Descroix, L., Gosset, M., Mougin, E., Peugeot, C. & Séguis, L. (2009) AMMA-CATCH studies in the Sahelian region of West-Africa: An overview. IN *Journal of Hydrology*, 375. 3–13.

Lebel, T., Parker, D. J., Flamant, C., Bourlès, B., Marticorena, B., Mougin, E., Peugeot, C., Diedhiou, A., Haywood, J. M., Ngamini, J.-B., Polcher, J., Redelsperger, J.-L. & Thorncroft, C. D. (2010) The AMMA field campaigns: multiscale and multidisciplinary observations in the West African region. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 8–33 DOI : :10.1002/qj.486.

Lebel, T., Parker, D. J., Flamant, C., Hö¶ller, H., Polcher, J., Redelsperger, J.-L., Thorncroft, C. D., Bock, O., Bourlès, B., Diedhiou, A., Gaye, A., Lafore, J.-P., Marticorena, B., Mougin, E. & Peugeot, C. (2010) The AMMA field campaigns: accomplishments and lessons learned. IN *Atmospheric Science Letters*, .

Leblanc, M. J., Favreau, G., Massuel, S., Tweed, S. O., Loireau, M. & Cappelaere, B. (2008) Land clearance and hydrological change in the Sahel : SW Niger. IN *Global and Planetary Change*, 61. 135–150.

Lefevre, N. Low CO2 concentrations in the Gulf of Guinea during the upwelling season in 2006. IN *Marine Chemistry*, 113. 93–101.

Lefevre, N., Guillot, A., Beuamont, L. & Danguy, T. (2008) Variability of fCO2 in the Eastern Tropical Atlantic from a moored buoy. IN *Journal of Geophysical Research*, 113 DOI : 10.1029/2007JC004146

Leroux, S. & Hall, N. M. J. (2009) On the Relationship between African Easterly Waves and the African Easterly Jet. IN *Journal of the Atmospheric Sciences*, 66. 2303–2316.

Leroux, S., Hall, N. M. J. & Kiladis, G. N. (2010) A climatological study of transient-mean flow interactions over West Africa. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 397–410 DOI : 10.1002/qj.474.

Li, W., Xue, Y. & Poccard-Leclercq, I. (2007) Numerical Investigation of the Impact of Vegetation Indices on the Variability of West African Summer Monsoon. IN *Journal of the Meteorological Society of Japan*, 85. 363–383.

Liousse, C., Guillaume, B., Gregoire, J.-M., Mallet, M., Galy-Lacaux, C., Pont, V., Akpo, A., Bedou, X., Castéra, P., Dungal, L., Gardrat, E., Granier, C., Konaré, A., Malavelle, F., Mariscal, A., Mieville, A., Rosset, R., Serça, D., Solmon, F., Tummon, F., Yoboué, V. & Van Velthoven, P. F. J. (2010) Western African aerosols modeling with updated biomass burning emission inventories in the frame of the AMMA-IDAF program. IN *Atmospheric Chemistry and Physics Discussions*, 10. 7347–7382.

Losada Doval, T., Rodriguez Fonseca, B., Janicot, S., Gervois, S., Chauvin, F. & Ruti, P. M. (2009) A multi-model approach to the Atlantic Equatorial mode: impact on the West African monsoon. IN *Climate Dynamics*, 35. 29–43 DOI 10.1007/s00382-009-0625-5..

Losada Doval, T., Rodriguez Fonseca, B., Polo, I., Janicot, S., Gervois, S., Chauvin, F. & Ruti, P. M. (2009) Tropical response to the Atlantic Equatorial mode: AGCM multimodel approach. IN *Climate Dynamics*, 35. 45–52 DOI 10.1007/s00382-009-0624-6.

Lothon, M., Couvreux, F., Donier, S., Guichard, F., Lacarrère, P., Lenschow, D., Noilhan, J. & Saïd, F. (2007) Impact of coherent eddies on airborne measurements of vertical turbulent fluxes. IN *Boundary-Layer Meteorology*, 124. 425–447.

Lothon, M., Saïd, F., Lohou, F. & Campistron, B. (2008) Observation of the diurnal cycle in the low troposphere of West Africa. IN *Monthly Weather Review*, 136. 3477–3500.

Louvet, S., Fontaine, B. & Roucou, P. (2003) Active phases and pauses during the installation of the West African monsoon through 5-day CMAP rainfall data (1979-2001). IN *Geophysical Research Letters*, 30 DOI : 10.1029/2003GL018058.

Mahé, G., Paturel, J.-E., Servat, E., Conway, D. & Dezetter, A. (2005) Impact of land use change on soil water holding capacity and river modelling of the Nakambe River in Burkina-Faso. IN *Journal of Hydrology*, 300. 33–43.

Mahé, G. & Paturel, J.-E. (2009) 1896-2006 Sahelian annual rainfall variability and runoff increase of Sahelian Rivers. IN *Comptes Rendus Géoscience*, 341. 538–546 DOI : 10.1016/j.crte.2009.05.002.

Mallet, C. & Barthès, L. (2009) Estimation of Gamma Raindrop Size Distribution Parameters: Statistical Fluctuations and Estimation Errors. IN *Journal of Atmospheric and Oceanic Technology*, 26. 1572–1584.

Mallet, M., Pont, V., Liousse, C., Gomes, L., Pelon, J., Osborne, S., Haywood, J. M., Roger, J., Dubuisson, P., Mariscal, A., Thouret, V. & Goloub, P. (2008) Aerosol direct radiative forcing over Djougou (northern Benin) during the African Monsoon Multidisciplinary Analysis dry season experiment (Special Observation Period-0). IN *Journal of Geophysical Research*, 113 DOI : 10.1029/2007JD009419.

Mallet, M., Tulet, P., Serça, D., Solmon, F., Dubovik, O., Pelon, J., Pont, V. & Thouron, O. (2009) Impact of dust aerosols on the radiative budget, surface heat fluxes, heating rate profiles and convective activity over West Africa during March 2006. IN *Atmospheric Chemistry and Physics*, 9. 7143–7160.

Maloney, E. D. & Shaman, J. (2008) Intraseasonal Variability of the West African Monsoon and Atlantic ITCZ. IN *Journal of Climate*, 21. 2898–2918.

Mangiarotti, S., Mazzega, P., Jarlan, L., Mougin, E., Baup, F. & Demarty, J. (2008) Evolutionary bi-objective optimization of a semi-arid vegetation dynamics model with NDVI and σ^0 satellite data. IN *Remote Sensing of Environment*, 112. 1365–1380.

Mangiarotti, S., Mazzega, P., Hiernaux, P. & Mougin, E. (2010) The vegetation cycle in West Africa from AVHRR-NDVI data: Horizons of predictability versus spatial scales. IN *Remote Sensing of Environment*, 114. 2036–2047.

Mari, C. H., Reeves, C. E., Law, K. S., Ancellet, G., Andrés-Hernö¡ndez, M. D., Barret, B., Bechara, J., Borbon, A., Bouarar, I., Cairo, F., Commane, R., Delon, C., Evans, M. J., Fierli, F., Floquet, C., Galy-Lacaux, C., Heard, D. E., Homan, C., Ingham, T., Larsen, N., Lewis, A., Liousse, C., Murphy, J. G., Orlandi, E., Oram, D., Saunois, M., Serça, D., Stewart, D. J., Stone, D., Thouret, V., Van Velthoven, P. F. J. & Williams, J. E. (2010) Atmospheric composition of West Africa: highlights from the AMMA international program. IN *Atmospheric Science Letters*, DOI : 10.1002/asl.289.

Mari, C., Cailley, G., Corre, L., Saunois, M., Attié, J.-L., Thouret, V. & Stohl, A. (2008) Tracing biomass burning plumes from the Southern Hemisphere during the AMMA 2006 wet season experiment. IN *Atmospheric Chemistry and Physics*, 8. 3951–3961.

Marin, F., Caniaux, G., Bourlès, B., Giordani, H., Gouriou, Y. & Key, E. (2009) Why were Sea Surface Temperatures so different in the Eastern Equatorial Atlantic in June 2005 and 2006? IN *Journal of Physical Oceanography*, 39. 1416–1431.

Marsham, J. H., Parker, D. J., Grams, C. M., Taylor, C. M. & Haywood, J. M. (2008) Uplift of Saharan dust south of the intertropical discontinuity. IN *Journal of Geophysical Research*, 113 DOI : 10.1029/2008JD009844.

Marteau, R., Moron, V. & Philippon, N. (2009) Spatial coherence of monsoon onset over Western and Central Sahel (1950-2000). IN *Journal of Climate*, 22. 1313–1342.

Marticorena, B., Chatenet, B., Rajot, J.-L., Traoré, S. B., Coulibaly, M. M., Diallo, A., Koné, I. I., Maman, A., Ndiaye, T. & Zakou, A. (2010) Temporal variability of mineral dust content over West Africa: analyses of a pluriannual monitoring from the AMMA Sahelian Dust Transect. IN *Atmospheric Chemistry and Physics Discussions*, 10. 8051–8101.

Marticorena, B., Haywood, J. M., Coe, H., Formenti, P., Liousse, C., Mallet, M. & Pelon, J. (2010) Tropospheric aerosols over West Africa Highlights from the AMMA international program. IN *Atmospheric Science Letters*, .

Martiny, N., Chiapello, I., Sultan, B. & Fontaine, B. (2007) Les aérosols désertiques, un facteur potentiel des épidémies de méningite en Afrique de l'Ouest. IN *Santé, Décision, Management*, 10. 31–39.

Marullo, S., Santoleri, R., Banzon, V. F., Evans, R. H. & Guarracino, M. (2009) A diurnal-cycle resolving SST product for the tropical Atlantic: toward a bias-free diurnal-cycle resolving SST product combining microwave and infrared satellite data. IN *Journal of Geophysical Research*, 115 DOI : 10.1029/2009JC005466.

Massuel, S., Favreau, G., Descloitres, M., Le Troquet, Y., Albouy, Y. & Cappelaere, B. (2006) Deep infiltration through a sandy alluvial fan in semiarid Niger inferred from electrical conductivity survey, vadose zone chemistry and hydrological modelling. IN *Catena*, 67. 105–118.

Mathon, V., Laurent, H. & Lebel, T. (2002) Mesoscale convective system rainfall in the Sahel. IN *Journal of Applied Meteorology*, 41. 1081–1092.

Matsuki, A., Quennehen, B., Schwarzenboeck, A., Crumeyrolle, S., Venzac, H., Laj, P. & Gomes, . (2010) Temporal and spatial variations of aerosol physical and chemical properties over West Africa: AMMA aircraft campaign in summer 2006. IN *Atmospheric Chemistry and Physics*, 10, 8437-8451.

Matsuki, A., Schwarzenboeck, A., Venzac, H., Laj, P., Crumeyrolle, S. & Gomes, L. (2010) Cloud processing of mineral dust: direct comparison of cloud residual and clear sky particles during AMMA aircraft campaign in summer 2006. IN *Atmospheric Chemistry and Physics*, 10, 1057–1069.

Maynard, K., Royer, J.-F. & Chauvin, F. (2002) Impact of greenhouse warming on the West African summer monsoon. IN *Climate Dynamics*, 19. 499–514.

Mbaye, M., Mahé, G., Servat, E., Laganier, R., Bigot, S., Diop, O. & Guégan, J.-F. (2009) Water and public health in Sahelian countries: The case of infectious disease in Saint-Louis (Senegal). IN *Sécheresse*, 20. 161–170.

Mbow, C., Mertz, O., Diouf, A., Rasmussen, K. & Reenberg, A. (2008) The history of environmental change and adaptation in eastern Saloum-Senegal. II : Driving forces and perceptions. IN *Global and Planetary Change*, 64. 210–221.

Mbow, C., Diouf, A., Ka, A., Diallo, D., Mertz, O., Moussa, I. & Maiga, A. (2010) Ressources forestières et variabilité climatique. IN *Cahiers Agricultures*, .

McConnell, C. L., Highwood, E. J., Coe, H., Formenti, P., Anderson, B. E., Osborne, S., Nava, S., Desboeufs, K., Chen, G. & Harrison, M. A. J. (2008) Seasonal variations of the physical and optical characteristics of Saharan dust: Results from the Dust Outflow and Deposition to the Ocean (DODO) experiment. IN *Journal of Geophysical Research*, 113 DOI : 10.1029/2007JD009606.

McConnell, C. L., Formenti, P., Highwood, E. J. & Harrison, M. A. J. (2010) Using aircraft measurements to determine the refractive index of Saharan dust during the DODO Experiments. IN *Atmospheric Chemistry and Physics*, 10. 3081–3098.

McFarlane, S. A., Kassianov, E. I., Barnard, J. C., Flynn, C. J. & Guillaume, B. (2009) Surface shortwave aerosol radiative forcing during the Atmospheric Radiation Measurement Mobile Facility deployment in Niamey, Niger. IN *Journal of Geophysical Research*, 114 DOI : 10.1029/2008JD010491.

Meier, F. & Knippertz, P. (2009) Dynamics and Predictability of a Heavy Dry-Season Precipitation Event over West Africa-Sensitivity Experiments with a Global Model. IN *Monthly Weather Review*, 137. 189–206.

Menut, L., Schmechtig, C. & Marticorena, B. (2005) Sensitivity of the Sandblasting Flux Calculations to the Soil Size Distribution Accuracy. IN *Journal of Atmospheric and Oceanic Technology*, 22. 1875–1884.

Menut, L. (2008) Sensitivity of hourly Saharan dust emissions to NCEP and ECMWF modeled wind speed. IN *Journal of Geophysical Research*, 113 DOI : 10.1029/2007JD009522.

Menut, L., Chiapello, I. & Moulin, C. (2009) Predictability of mineral dust concentrations: The African Monsoon Multidisciplinary Analysis first short observation period forecasted with CHIMERE-DUST. IN *Journal of Geophysical Research*, 114 DOI : 10.1029/2008JD010523.

Merbold, L., Ardo, J., Arneth, Scholes, R. J., Nouvellon, Y., De Grandcourt, A., Archibald, S., Bonnefond, J. M., Boulain, N., Brueggemann, N., Bruemmer, C., Cappelaere, B., Ceschia, E., El-Khidir, H. A. M., El-Tahir, B. A., Falk, U., Lloyd, J., Kergoat, L., Dantec, L. V., Mougin, E., Muchinda, M., Mukelabai, M. M., Ramier, D., Rouspard, O., Timouk, F., Veenendaal, E. M. & Kutsch, W. L. (2009) Precipitation as driver of carbon fluxes in 11 African ecosystems. IN *Biogeosciences*, 6. 1027–1041.

Mertz, O., Halsnö¦s, K., Olesen, J. E. & Rasmussen, K. (2009) Adaptation to Climate Change in Developing Countries. IN *Environmental Management*, 43. 743–752 DOI: 10.1007/s00267-008-9259-3.

Mertz, O., Mbow, C., Reenberg, A. & Diouf, A. (2009) Farmers' perceptions of climate change and agricultural adaptation strategies in rural Sahel. IN *Environmental Management*, 43. 804–816.

Mertz, O., Mbow, C., Reenberg, A., Genesio, L., Lambin, E. F., D' Haen, S., Zorom, M., Rasmussen, K., Diallo, D., Barbier, B., Bouzou Moussa, I., Diouf, A., Nielsen, J. O. & Sandholt, I. (2010) Adaptation strategies and climate vulnerability in the Sudano-Sahelian region of West Africa. IN *Atmospheric Science Letters*, .

Mertz, O., D' Haen, S., Maiga, A., Moussa, I., Barbier, B., Diouf, A. & Diallo, D. (2010) Perceptions of environmental stress by rural communities in the Sudan-Sahel zone of West Africa. IN *Cahiers Agricultures*, .

Mertz, O., Mbow, C., Nielsen, J. O., Maiga, A., Diallo, D., Reenberg, A., Diouf, A., Barbier, B., Moussa, I., Zorom, M., Ouattara, I. & Dabi, D. (2010) Climate factors play a limited role for past adaptation strategies in West Africa. IN *Proceedings of the National Academy of Sciences*, .

Messager, C., Gallée, H. & Brasseur, O. (2004) Precipitation sensitivity to regional SST in a regional climate simulation during the West African monsoon for two dry years. IN *Climate Dynamics*, 22. 249–266.

Messager, C., Gallée, H., Brasseur, O., Cappelaere, B., Peugeot, C., Séguis, L., Vauclin, M., Ramel, R., Grasseau, G., Léger, L. & Girou, D. (2006) Influence of observed and RCM-simulated precipitation on the water discharge over the Sirba basin, Burkina Faso/Niger. IN *Climate Dynamics*, 27. 199–214.

Messager, C., Parker, D. J., Reitebuch, O., Agusti-Panareda, A., Taylor, C. M. & Cuesta, J. (2010) Structure and dynamics of the Saharan atmospheric boundary layer during the West African monsoon onset: observations and analyses from the research flights of 14 and 17 July. IN *Quarterly Journal of the Royal Meteorological Society*, 107. 107–124 DOI : 10.1002/qj.469.

Meynadier, R., Bock, O., Guichard, F., Boone, A., Roucou, P. & Redelsperger, J.-L. (2010) The West African Monsoon water cycle. Part I: a new hybrid water budget dataset. IN *Journal of Geophysical Research*, 115 DOI : 10.1029/2010JD013917.

Meynadier, R., Bock, O., Gervois, S., Guichard, F., Redelsperger, J.-L., Agusti-Panareda, A. & Beljaars, A. (2010) The West African Monsoon water cycle. Part II: assessment of NWP water budgets. IN *Journal of Geophysical Research*, 115 DOI : 10.1029/2010JD013919.

Miller, M. & Slingo, A. (2007) The Arm Mobile Facility and Its First International Deployment: Measuring Radiative Flux Divergence in West Africa. IN *Bulletin of the American Meteorological Society*, 88. 1229–1244.

Miller, R. L., Slingo, A., Barnard, J. C. & Kassianov, E. I. (2009) Seasonal Contrast in the Surface Energy Balance of the Sahel. IN *Journal of Geophysical Research*, 114 DOI : 10.1029/2008JD010521.

Milton, S. F., Greed, G., Brooks, M. E., Haywood, J. M., Johnson, B. T., Allan, R. P., Slingo, A. & Grey, W. M. F. (2008) Modeled and observed atmospheric radiation balance during theWest African dry season: Role of mineral dust, biomass burning aerosol, and surface albedo. IN *Journal of Geophysical Research*, 113 DOI : 10.1029/2007JD009741.

Minga, A., Thouret, V., Saunois, M., Delon, C., Serça, D., Mari, C., Sauvage, B., Mariscal, A., Leriche, M. & Cros, B. (2010) What caused extreme ozone concentrations over Cotonou in December 2005. IN *Atmospheric Chemistry and Physics*, 10. 895–907.

Mishra, A., Hansen, J. W., Dingkuhn, M., Baron, C., Traoré, S. B., Ndiaye, O. & Ward, M. N. (2008) Sorghum yield prediction from seasonal rainfall forecasts in Burkina Faso. IN *Agricultural and Forest Meteorology*, DOI : 10.1016/j.agrformet.2008.06.007.

Mohino, E., Janicot, S. & Bader, J. (2010) Sahelian rainfall and decadal to multidecadal SST variability. IN *Climate Dynamics*, DOI : 10.1007/s00382-010-0867-2.

Mohino, E., Rodriguez Fonseca, B., Mechoso, C. R., Gervois, S., Ruti, P. M. & Chauvin, F. (2010) West Africa monsoon response to Tropical Pacific sea surface anomalies. IN *Climate Dynamics*, .

Mohino, E., Rodriguez Fonseca, B., Losada Doval, T., Gervois, S., Janicot, S., Bader, J., Ruti, P. M. & Chauvin, F. (2010) Inter-annual SST-forced signals on West African rainfall from AGCM simulations. Part I: changes in the inter-annual modes and model intercomparison. IN *Climate Dynamics*, .

Monsivais-Huertero, A., Chenerie, I., Sarabandi, Baup, F. & Mougin, E. (2010) Microwave electromagnetic modelling of Sahelian grassland. IN *International Journal of Remote Sensing*, 31. 1915–1942.

Montera, L. de, Barthès, L., Mallet, C. & Golé, P. (2009) The Effect of Rain-No Rain Intermittency on the Estimation of the Universal Multifractals Model. IN *Journal of Hydrometeorology*, 10. 493–506.

Montmerle, T., Lafore, J.-P., Berre, L. & Fischer, C. (2006) Limited-area model error statistics over Western Africa: Comparisons with midlatitude results. IN *Quarterly Journal of the Royal Meteorological Society*, 132. 213–230.

Moron, V., Philippon, N. & Fontaine, B. (2003) Skill of Sahel rainfall variability in four atmospheric GCMs forced by prescribed SST. IN *Geophysical Research Letters*, 30. 2221.

Moron, V., Philippon, N. & Fontaine, B. (2004) Simulation of West African monsoon circulation in four atmospheric general circulation models forced by prescribed sea surface temperature. IN *Journal of Geophysical Research*, 109. D24105.

Moron, V., Robertson, A. W. & Ward, M. N. (2006) Seasonal Predictability and Spatial Coherence of Rainfall Characteristics in the Tropical Setting of Senegal. IN *Monthly Weather Review*, 134. 3248–3262.

Moron, V., Robertson, A. W., Ward, M. N. & Camberlin, P. (2007) Spatial Coherence of Tropical Rainfall at the Regional Scale. IN *Journal of Climate*, 20. 5244–5263.

Moron, V., Robertson, A. W., Ward, M. N. & Ndiaye, O. (2008) Weather Types and Rainfall over Senegal. Part I: Observational Analysis. IN *Journal of Climate*, 21. 266–287.

Moron, V., Robertson, A. W., Ward, M. N. & Ndiaye, O. (2008) Weather Types and Rainfall over Senegal. Part II: Downscaling of GCM Simulations. IN *Journal of Climate*, 21. 288–307.

Moufouma-Okia, W. & Rowell, D. P. (2010) Impact of soil moisture initialisation and lateral boundary conditions on regional climate model simulations of the West African monsoon. IN *Climate Dynamics*, 35. 213–229 DOI : DOI:10.1007/s00382-009-0638-0.

Mougin, E., Hiernaux, P., Kergoat, L., Grippa, M., de Rosnay, P., Timouk, F., Dantec, L. V., Demarez, V., Lavenu, F., Arjounin, M., Lebel, T., Soumaguel, N., Ceschia, E., Mougenot, B., Baup, F., Frappart, F., Frison, P.-L., Gardelle, J., Gruhier, C., Jarlan, L., Mangiarotti, S., Sanou, B., Tracol, Y., Guichard, F., Trichon, V., Diarra, L., Soumaré, A., Koité, M., Dembele, F., Lloyd, C. R., Hanan, N. P., Damesin, C., Delon, C., Serça, D., Galy-Lacaux, C., Seghieri, J., Becerra, S., Dia, H., Gangneron, F. & Mazzega, P. (2009) The AMMA-CATCH Gourma observatory site in Mali: Relating climatic variations to changes in vegetation, surface hydrology, fluxes and natural resources. IN *Journal of Hydrology*, 375. 14–33.

Moumouni, S., Gosset, M. & Houngninou, E. (2008) Main Features of Rain Drop Size distributions observed in Benin, West Africa, with Optical Disdrometers. IN *Geophysical Research Letters*, 35 DOI : 10.1029/2008GL035755.

Mounier, F. & Janicot, S. (2004) Evidence of two independent modes of convection at intraseasonal timescale in the West African monsoon. IN *Geophysical Research Letters*, 31 DOI : 10.1029/2004GL020665.

Mounier, F., Kiladis, G. N. & Janicot, S. (2007) Analysis of the Dominant Mode of Convectively Coupled Kelvin Waves in the West African Monsoon. IN *Journal of Climate*, 20. 1487–1503.

Mounier, F., Janicot, S. & Kiladis, G. N. (2008) The West African Monsoon Dynamics. Part III: The Quasi-Biweekly Zonal Dipole. IN *Journal of Climate*, 21. 1911–1928.

Moussa, I. B., Maiga, O. F., Ambouta, J.-M. K., Sarr, B., Descroix, L. & Moustapha Adamou, M. (2009) Geomorphological consequences of land use and climate change in a sahelian rural catchment basin. IN *Sécheresse*, 20. 145–152.

Murphy, J. M., Oram, D. & Reeves, C. E. (2010) Measurements of volatile organic compounds over West Africa. IN *Atmospheric Chemistry and Physics Discussions*, 10. 5281–5294.

Myhre, G., Hoyle, C. R., Berglen, T. F., Johnson, B. T. & Haywood, J. M. (2008) Modeling of the solar radiative impact of biomass burning aerosols during the dust and biomass burning experiment (DABEX). IN *Journal of Geophysical Research*, 113 DOI : 10.1029/2008JD009857.

Ndiaye, O., Goddard, L. & Ward, M. N. (2009) Using regional wind fields to improve general circulation model forecasts of July-September Sahel rainfall. IN *International Journal of Climatology*, 29. 1262–1275.

Ndione, J.-A., Diop, M., Lacaux, J.-P. & Gaye, A. (2008) Variabilite intra-saisonniere de la pluviometrie et emergence de la fievre de la vallee du rift dans la vallee du fleuve Senegal : Nouvelles considerations. IN *Climatologie*, 5. 83–97.

Ndione, J.-A., Lacaux, J.-P., Tourre, Y. M., Vignolles, C., Fontanaz, D. & Lafaye, M. (2009) Water ponds and sanitary risk in the Ferlo area: Contribution of remote sensing in studying Rift Valley Fever between August 2003 and January 2004. IN *Sécheresse*, 20. 153–160.

Ngo-Duc, T., Polcher, J. & Laval, K. (2005) A 53-year forcing data set for land surface models. IN *Journal of Geophysical Research*, 110 DOI : 10.1029/2004JD005434.

Nguyen, H. & Duvel, J. P. (2008) Synoptic Wave Perturbations and Convective Systems over Equatorial Africa. IN *Journal of Climate*, 21. 6372–6388.

Nielsen, J. O. A Cautionary Tale. Drought, social change, and the continued relevance of single diciplinary research. IN *Ecology and Society*, .

Nielsen, J. O. (2009) Choosing Against Adaptation. Cultural barriers to climate change adaptation a case study from Northern Burkina Faso. IN *Global Environmental Change*, 20. 142–152.

Nielsen, J. O. & Reenberg, A. (2010) Cultural barriers to climate change adaptation: a case study from Northern Burkina Faso. IN *Global Environmental Change*, 20. 142–152.

Nielsen, J. O. & Reenberg, A. (2010) Temporality and the problem with singling out climate as a current driver of change in a small West African village. IN *Journal of Arid Environments*, DOI : 10.1016/j.jaridenv. 2009.09.019.

Nuret, M., Lafore, J.-P., Guichard, F., Redelsperger, J.-L., Bock, O., Agusti-Panareda, A. & Ngamini, J.-B. (2008) Correction of Humidity Bias for Vaisala RS80-A Sondes during the AMMA 2006 Observing Period. IN *Journal of Atmospheric and Oceanic Technology*, 25. 2152–2158.

Onibon, H., Lebel, T. & Afouda, A. (2004) Gibbs sampling for conditional spatial disaggregation of rain fields. IN *Water Resources Research*, 40 DOI : 10.1029/2003WR002009.

d' Orgeval, T., Polcher, J. & Li, L. (2006) Uncertainties in modelling future hydrological change over West Africa. IN *Climate Dynamics*, 26. 93–108.

d' Orgeval, T., Polcher, J. & de Rosnay, P. (2008) Sensitivity of the West African hydrological cycle in ORCHIDEE to infiltration processes. IN *Hydrology and Earth System Sciences*, 5. 2251–2292.

Orlandi, E., Fierli, F., Davolio, S. & et, A. (2010) A nudging scheme to assimilate satellite brightness temperature in a meteorological model: Impact on African mesoscale convective systems representation. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 462–474.

Osborne, S., Johnson, B. T., Haywood, J. M., Baran, A. J., Harrison, M. A. J. & McConnell, C. L. (2008) Physical and optical properties of mineral dust aerosol during the Dust and Biomass-burning Experiment. IN *Journal of Geophysical Research*, 113 DOI : 10.1029/2007JD009551.

Paeth, H. & Hense, A. (2004) SST versus climate change signals in West African rainfall: 20th-century variations and future projections. IN *Climatic Change*, 65. 179–208.

Paeth, H., Born, K., Podzun, R. & Jacob, D. (2005) Regional dynamical downscaling over West Africa: model evaluation and comparison of wet and dry years. IN *Meteorologische Zeitschrift*, 14. 349–367.

Paeth, H., Girmes, R., Menz, G. & Hense, A. (2006) Improving seasonal forecasting in the low latitudes. IN *Monthly Weather Review*, 134. 1859–1879.

Paeth, H., Capo-Chichi, A. & Endlicher, W. (2008) Climate change and food security in tropical West Africa. IN *Erdkunde*, 62. 101–115.

Paeth, H. (2009) Postprocessing of simulated precipitation for impact studies in West Africa - Part I: model output statistics for monthly data. IN *Climate Dynamics*, DOI : 10.1007/s00382-010-0760-z.

Paeth, H., Born, K., Girmes, R., Podzun, R. & Jacob, D. (2009) Regional climate change in tropical Africa under greenhouse forcing and land-use changes. IN *Journal of Climate*, 22. 114–132.

Paeth, H. & Diederich, M. (2009) Postprocessing of simulated precipitation for impact studies in West Africa - Part II: a weather generator for daily data. IN *Climate Dynamics*, DOI : 10.1007/s00382-010-0840-0.

Paeth, H., Hall, N. M. J., Gaertner, M. Á., Dominguez Alonso, M., Moumouni, S., Polcher, J., Ruti, P. M., Fink, A. H., Gosset, M., Lebel, T., Gaye, A. T., Rowell, D. P., Moufouma-Okia, W., Jacob, D., Rockel, B., Giorgi, F. & Rummukainen, M. (2010) Progress in regional downscaling of West African precipitation. IN *Atmospheric Science Letters*, .

Paeth, H., Fink, A. H., Pohle, S., Keis, F., Mö¤chel, H. & Samini, C. (2010) Meteorological characteristics and potential causes of the 2007 flood in sub-Saharan Africa. IN *International Journal of Climatology*, DOI : 10.1002/joc.2199.

Parard, G., Lefevre, N. & Boutin, J. (2010) Sea water fugacity of CO_2 at the PIRATA mooring at 6°S, 10°W. IN *Tellus B*, 62. 636–648.

Paris, R., Desboeufs, K., Formenti, P., Nava, S. & Chou, C. (2009) Chemical characterisation of iron in Dust and Biomass burning aerosols during AMMA-SOP0/DABEX: implication on iron solubility. IN *Atmospheric Chemistry and Physics Discussions*, 9. 25023–25047.

Parker, D. J., Burton, R. R., Diongue-Niang, A., Ellis, R. J., Felton, M., Taylor, C. M., Thorncroft, C. D., Bessemoulin, P. & Tompkins, A. M. (2005) The diurnal cycle of the West African monsoon circulation. IN *Quarterly Journal of the Royal Meteorological Society*, 131. 2839–2860.

Parker, D. J., Thorncroft, C. D., Burton, R. R. & Diongue-Niang, A. (2005) Analysis of the African Easterly Jet using observations from the JET2000 experiment. IN *Quarterly Journal of the Royal Meteorological Society*, 131. 1461–1482.

Parker, D. J., Fink, A. H., Janicot, S., Ngamini, J.-B., Douglas, M., Afiesimama, E. A., Agusti-Panareda, A., Beljaars, A., Dide, F., Diedhiou, A., Lebel, T., Polcher, J., Redelsperger, J.-L., Thorncroft, C. D. & Wilson, G. A. (2008) The AMMA radiosonde program and its implications for the future of atmospheric monitoring over Africa. IN *Bulletin of the American Meteorological Society*, 89. 1015–1027.

Parker, D. J. (2008) A simple model of coupled synoptic waves in the land surface and atmosphere of the northern Sahel. IN *Quarterly Journal of the Royal Meteorological Society*, 134. 2173–2184.

Parsons D., Drobinski Ph, Cocquerez P., Cardonne A., Cole H., Fox J., Hock T., Lefevre J.P., Redelsperger J.L, Romberg K., VanAndel J., Vénel S., 2007 : Des ballons stratosphériques traquent la mousson africaine. La Météorologie, 55, 2-3

Patricola, C. M. & Cook, K. H. (2009) North African precipitation and monsoon dynamics at the end of the 21st century: Regional Climate Model development and simulations. IN *Climate Dynamics*, 35. 193–212 DOI 10.1007/s00382-009-0623-7..

Pellarin, T., Ali, A., Chopin, F., Jobard, I. & Bergès, J.-C. (2008) Using spaceborne surface soil moisture to constrain satellite precipitation estimates over West Africa. IN *Geophysical Research Letters*, 35 L02813, DOI : 10.1029/2007GL032243.

Pellarin, T., Tran, T., Cohard, J.-M., Galle, S., Laurent, J.-P., de Rosnay, P. & Vischel, T. (2009) Hourly soil moisture mapping over West Africa using AMSR-E observations and a satellite-based rainfall product. IN *Hydrology and Earth System Sciences discussion*, 6. 4035–4064.

Pellarin, T., Laurent, J.-P., Cappelaere, B., Decharme, B., Descroix, L. & Ramier, D. (2009) Hydrological modelling and associated microwave emission of a semi-arid region in South-western Niger. IN *Journal of Hydrology*, 375. 262–272.

Pellarin, T., Tran, T., Cohard, J.-M., Galle, S., Laurent, J.-P., de Rosnay, P. & Vischel, T. (2009) Soil moisture mapping over West Africa with a 30-min temporal resolution using AMSR-E observations and a satellite-based rainfall product. IN *Hydrology and Earth System Sciences*, 13. 1887–1896.

Pelon, J., Mallet, M., Mariscal, A., Goloub, P., Tanré, D., Bou Karam, D., Flamant, C., Haywood, J. M., Pospichal, B. & Victori, S. (2008) Microlidar observations of biomass burning aerosol over Djougou (Benin) during African Monsoon Multidisciplinary Analysis Special Observation Period 0: Dust and Biomass-Burning Experiment. IN *Journal of Geophysical Research*, 113 , D00C18, DOI : 10.1029/2008 JD009976.

Penide, G., Giraud, V., Bouniol, D., Dubuisson, P., Duroure, C., Protat, A. & Cautenet, S. (2010) Numerical simulation of the 7 to 9 September 2006 AMMA mesoscale convective system: Evaluation of the dynamics and cloud microphysics using synthetic observations. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 304–322 DOI: 10.1002/qj.558.

Peter, A.-C., Le Hénaff, M., Du Penhoat, Y., Menkes, C. E., Marin, F., Vialard, J., Caniaux, G. & Lazar, A. (2006) A model study of the seasonal mixed layer heat budget in the equatorial Atlantic. IN *Journal of Geophysical Research*, 111 DOI:10.1029/2005JC003157.

Peugeot, C., Cappelaere, B., Vieux, B. E., Séguis, L. & Maia, A. (2003) Hydrologic process simulation of a semiarid, endoreic catchment in Sahelian West Niger. 1. Model-aided data analysis and screening. IN *Journal of Hydrology*, 279. 224–243.

Peugeot, C., Guichard, F., Bock, O., Bouniol, D., Chong, M., Boone, A., Cappelaere, B., Gosset, M., Besson, L., Lemaitre, Y., Séguis, L., Zannou, A., Galle, S. & Redelsperger, J.-L. (2010) Meso-scale water cycle within the West African Monsoon. IN *Atmospheric Science Letters*, .

Peyrillé, P. & Lafore, J.-P. (2007) An Idealized Two-Dimensional Framework to Study the West African Monsoon. Part II: Large-Scale Advection and the Diurnal Cycle. IN *Journal of the Atmospheric Sciences*, 64. 2783–2803.

Peyrillé, P., Lafore, J.-P. & Redelsperger, J.-L. (2007) An Idealized Two-Dimensional Framework to Study the West African Monsoon. Part I: Validation and Key Controlling Factors. IN *Journal of the Atmospheric Sciences*, 64. 2765–2782.

Philippon, N. & Fontaine, B. (2002) The relationship between the Sahelian and previous 2nd Guinean rainy seasons: a monsoon regulation by soil wetness. IN *Annales Geophysicae*, 20. 575–582.

Philippon, N., Mougin, E., Jarlan, L. & Frison, P.-L. (2005) Analysis of the linkages between rainfall and land surface conditions in the West African monsoon through CMAP, ERS-WSC, and NOAA-AVHRR data. IN *Journal of the Atmospheric Sciences*, 110.

Philippon, N., Jarlan, L., Martiny, N., Camberlin, P. & Mougin, E. (2007) Characterization of the Interannual and Intraseasonal Variability of West African Vegetation between 1982 and 2002 by Means of NOAA AVHRR NDVI Data. IN *Journal of Climate*, 20. 1202–1218 DOI:10.1175/jcli4067.1..

Philippon, N., Martiny, N. & Camberlin, P. (2009) Forecasting the vegetation photosynthetic activity over the Sahel: a Model Output Statistics approach. IN *International Journal of Climatology*, 29. 1463–1477.

Philippon, N., Doblas-Reyes, F. & Ruti, P. M. (2009) Skill, reproducibility and potential predictability of the West African monsoon in coupled GCMs. IN *Climate Dynamics*, 35. 53–74.

Philippon, N., Broutin, H., Constantin de Magny, G., Toure, K., Diakite, C. H., Fourquet, N., Courel, M.-F., Sultan, B. & Guégan, J.-F. (2009) Meningococcal meningitis in Mali: a long-term study of persistence and spread. IN *International Journal of Infectious Diseases*, 13. 103–109.

Pohl, B., Janicot, S., Fontaine, B. & Marteau, R. (2009) Implication of the Madden-Julian Oscillation in the 40-Day Variability of the West African Monsoon. IN *Journal of Climate*, 22. 3769–3785.

Polcher, J., Parker, D. J., Gaye, A., Diedhiou, A., Eymard, L., Fierli, F., Genesio, L., Hö¶ller, H., Janicot, S., Lafore, J.-P., Karambiri, H., Lebel, T., Redelsperger, J.-L., Reeves, C. E., Ruti, P. M., Sandholt, I. & Thorncroft, C. D. (2010) AMMA's contribution to the evolution of prediction a0nd decision-making systems for West Africa. IN *Atmospheric Science Letters*, .

Polo, I., Lazar, A., Rodriguez Fonseca, B. & Arnault, S. (2008) Oceanic Kelvin waves and tropical Atlantic intraseasonal variability: 1. Kelvin wave characterization. IN *Journal of Geophysical Research*, 113 DOI:10.1029/2007JC004495.

Polo, I., Rodriguez Fonseca, B., Losada Doval, T. & Garcia-Serrano, J. (2008) Tropical Atlantic Variability Modes (1979-2002). Part I: Time-Evolving SST Modes Related to West African Rainfall. IN *Journal of Climate*, 21. 6457–6475 DOI : 10.1175/2008JCLI2607.1.

Pospichal, B. & Crewell, S. (2007) Boundary layer observations in West Africa using a novel microwave radiometer. IN *Meteorologische Zeitschrift*, 16. 513–523.

Pospichal, B., Bou Karam, D., Crewell, S., Flamant, C., Hünerbein, A., Bock, O. & Saïd, F. (2009) Diurnal cycle of the intertropical discontinuity over West Africa analysed by remote sensing and mesoscale modelling. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 92–106 DOI : 10.1002/qj.435.

Pradier, S., Attié, J.-L., Chong, M., Escobar, J., Peuch, V.-H., Lamarque, J.-F., Khattatov, B. & Edwards, D. (2006) Evaluation of 2001 springtime CO transport over West Africa using MOPITT CO measurements assimilated in a global chemistry transport model. IN *Tellus B*, 58. 163–176.

Protat, A., Bouniol, D., Delanoe, J., O'Connor, E., May, P., Plana-Fattori, A., Hasson, A., Gö¶rsdorf, U. & Heymsfield, A. J. (2009) Assessment of Cloudsat Reflectivity Measurements and Ice Cloud Properties Using Ground-Based and Airborne Cloud Radar Observations. IN *Journal of Atmospheric and Oceanic Technology*, 26. 1717–1741.

Protat, A., Delanoe, A. J., Plana-Fattori, A., Bouniol, D., Stubenrauch, C. J. & O'Connor, E. (2010) The statistical properties of tropical ice clouds generated by the West African and Australian monsoons, from ground-based radar-lidar observations. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 345–363 DOI: 10.1002/qj.490.

Pu B. and Cook K.H.,2010, 2010; Dynamics of the West African Westerly Jet . Journal of Climate, DOI : 10.1175/2010JCLI3648.1

Rabier, F., Gauthier, B., Cardinali, C., Langland, R. H., Tsyrulnikov, M., Lorenc, A., Steinle, P., Gelaro, R. & Koizumi, K. (2008) An update on THORPEX-related research in data assimilation and observing strategies. IN *Nonlinear Processes in Geophysics*, 15. 81–94.

Rajot, J.-L., Formenti, P., Alfaro, S. C., Desboeufs, K., Chevaillier, S., Chatenet, B., Gaudichet, A., Journet, E., Marticorena, B., Triquet, S., Maman, A., Mouget, N. & Zakou, A. (2008) AMMA dust experiment: An overview of measurements performed during the dry season special observation period (SOP0) at the Banizoumbou (Niger) supersite. IN *Journal of Geophysical Research*, 113 D00C14, DOI : 10.1029/2008JD009906.

Rajot, J.-L., Karambiri, H., Ribolzi, O., Planchon, O. & Thiebaux, J.-P. (2009) Wind and water erosions of pastured sandy soils in the Sahel: A case study in Northern Burkina Faso. IN *Sécheresse*, 20. 131–138.

Ramel, R., Gallée, H. & Messager, C. (2006) On the northward shift of the west African monsoon. IN *Climate Dynamics*, 26. 429–440.

Ramier, D., Boulain, N., Cappelaere, B., Timouk, F., Rabanit, M., Lloyd, C. R., Boubkraoui, S., Métayer, F., Descroix, L. & Wawrzyniak, V. (2008) Towards an understanding of coupled physical and biological processes in the cultivated Sahel - 1. Energy and water. IN *Journal of Hydrology*, 375. 204–216.

Ramier D., F. Guichard, B. Cappelaere, L. Kergoat, S. Galle, F. Timouk, N. Boulain, M.Boucher, C. Taylor, A. Boone (2009) Impact of the monsoon on downwelling surface radiative fluxes across West Africa: an evaluation of ECMWF-IFS and satellite estimates with ground measurements. Geophysical Research Abstracts, 11, EGU2009-10586-1

Raut, J.-C. & Chazette, P. (2008) Radiative budget in the presence of multi-layered aerosol structures in the framework of AMMA SOP-0. IN *Atmospheric Chemistry and Physics*, 8. 6839–6864.

Real, E., Orlandi, E., Law, K. S., Fierli, F., Josset, D., Cairo, F., Schlager, H., Borrman, S., Kunkel, D., Volk, C. M., McQuaid, J. B., Stewart, D. J., Lee, J., Lewis, A., Hopkins, J. R., Ravegnani, F., Ulanovsky, A. E. & Liousse, C. (2010) Cross-hemispheric transport of central African biomass burning pollutants: implications for downwind ozone production. IN *Atmospheric Chemistry and Physics*, 10. 3027–3046.

Reale, O., Lau, W. K.-M., Kim, K.-M. & Brin, E. (2009) Atlantic Tropical Cyclogenetic Processes during SOP-3 NAMMA in the GEOS-5 Global Data Assimilation and Forecast System. IN *Journal of the Atmospheric Sciences*, 66. 3563–3578.

Redelsperger, J.-L., Diedhiou, A., Flamant, C., Janicot, S., Lafore, J.-P., Lebel, T., Polcher, J., Bourlès, B., Caniaux, G., de Rosnay, P., Desbois, M., Eymard, L., Fontaine, B., Genau, I., Ginoux, K., Hoepffner, M., Kane, C., Law, K. S., Mari, C., Marticorena, B., Mougin, E., Pelon, J., Peugeot, C., Protat, A., Roux, F., Sultan, B. & van den Akker, E. AMMA, une étude multidisciplinaire de la mousson ouest-africaine. In: *La Météorologie*, 2006, 22–32.

Redelsperger, J.-L., Thorncroft, C. D., Diedhiou, A., Lebel, T., Parker, D. J. & Polcher, J. (2006) African Monsoon Multidisciplinary Analysis: An International Research Project and Field Campaign. IN *Bulletin of the American Meteorological Society*, 87. 1739–1746.

Redelsperger, J.-L. & Lebel, T. (2009) Surface processes and water cycle in West Africa, studied from the AMMA-CATCH observing system. IN *Journal of Hydrology*, 375. 1–2.

Reenberg, A. (2009) Embedded flexibility in coupled human-environmental systems in the Sahel. : talking about resilience. IN *The Question of Resilience Social implications of environmental changes*.

Reeves, C. E., Formenti, P., Afif, C., Ancellet, G., Attié, J.-L., Bechara, J., Borbon, A., Cairo, F., Coe, H., Crumeyrolle, S., Fierli, F., Flamant, C., Gomes, L., Hamburger, T., Jambert, C., Law, K. S., Mari, C., Matsuki, A., Methven, J., Mills, G., Minikin, A., Murphy, J. G., Nielsen, J. K., Oram, D., Parker, D. J., Richter, A., Schlager, H., Schwarzenboeck, A. & Thouret, V. (2010) Chemical and aerosol characterisation of the troposphere over West Africa during the monsoon period as part of AMMA. IN *Atmospheric Chemistry and Physics Discussions*, 10. 7115–7183.

Reinfried, F., Tegen, I., Heinold, B., Hellmuth, O., Schepanski, K., Cubasch, U., Hübener, H. & Knippertz, P. (2009) Simulations of convectively-driven density currents in the Atlas region using a regional model: Impacts on dust emission and sensitivity to horizontal resolution and convection schemes. IN *Journal of Geophysical Research-Atmospheres*, 114 DOI : 10.1029/2008JD010844.

Reverdin, G., Marin, F., Bourlès, B. & L'Herminier, P. (2009) XBT Temperature Errors during French Research Cruises (1999-2007). IN *Journal of Atmospheric and Oceanic Technology*, 26. 2462–2473.

Rhein, M., Dengler, M., Sültenfuss, J., Hummels, R., Hüttl-Kabus, S. & Bourlès, B. (2010) Upwellingand associated heat flux in the equatorial Atlantic inferred from helium isotope disequilibrium. IN *Journal of Geophysical Research*, 115 DOI : 10.1029/2009JC005772.

Rickenbach, T., Nieto Ferreira, R., Guy, N. & Williams, E. (2008) Radar-Observed Squall Line Propagation and the Diurnal Cycle of Convection in Niamey, Niger during the 2006 AMMA IOP. IN *Journal of Geophysical Research*, In press DOI : 10.1029/2008JD010871.

Rio, C. & Hourdin, F. (2008) A Thermal Plume Model for the Convective Boundary Layer: Representation of Cumulus Clouds. IN *Journal of the Atmospheric Sciences*, 65. 407–425.

Risi, C., Bony, S., Vimeux, F., Descroix, L., Ibrahim, B., Le Breton, E., Mamadou, I. & Sultan, B. (2008) What controls the isotopic composition of the African monsoon precipitation? Insights from event-based precipitation collected during the 2006 AMMA field campaign. IN *Geophysical Research Letters*, 35 DOI : 10.1029/2008GL035920.

Risi, C., Bony, S., Vimeux, F., Chong, M. & Descroix, L. (2010) Evolution of the water stable isotopic composition of the rain sampled along Sahelian squall lines. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 227–242 DOI: 10.1002/qj.485.

Roca, R., Lafore, J.-P., Piriou, C. & Redelsperger, J.-L. (2005) Extratropical Dry-Air Intrusions into the West African Monsoon Midtroposphere: An Important Factor for the Convective Activity over the Sahel. IN *Journal of the Atmospheric Sciences*, 62. 390–407.

Roca, R., Chambon, P., Jobard, I. & et, A. (2009) Comparing satellite and surface rainfallproducts over West Africa at meteorologically relevant scales during the AMMA campaign using error estimates. IN *Journal of Applied Meteorology and Climatology*, 49. 715–731.

Rodriguez Fonseca, B., Polo, I., Garcia-Serrano, J., Losada Doval, T., Mohino, E., Mechoso, C. R. & Kucharski, F. (2009) Are Atlantic Niños enhancing Pacific ENSO events in recent decades. IN *Geophysical Research Letters*, 36 L20705, DOI :10.1029/2009GL040048.

Rodriguez Fonseca, B., Janicot, S., Mohino, E., Losada Doval, T., Bader, J., Caminade, C., Chauvin, F., Fontaine, B., Garcia-Serrano, J., Gervois, S., Joly, M., Polo, I., Ruti, P. M., Roucou, P. & Voldoire, A. (2010) Interannual and decadal SST forced responses of the West African monsoon. IN *Atmospheric Science Letters*, .

Rodriguez Fonseca, B., Losada Doval, T., Mohino, E. & Janicot, S. (2010) Inter-annual SST forced signals on West African rainfall from AGCM simulations-Part II: Understanding global features for the 1979-98 period. IN *Climate Dynamics*, .

Rogel, P., Tourre, Y. M., Benoit, V. & Jarlan, L. (2006) Tropical Atlantic moisture availability and precipitation over West Africa: Application to DEMETER hindcasts. IN *Journal of Geophysical Research*, 33 DOI : 10.1029/2006GL027178.

de Rosnay, P., Drusch, M., Boone, A., Balsamo, G., Decharme, B., Harris, P. P., Kerr, Y. H., Pellarin, T., Polcher, J. & Wigneron, J.-P. (2009) AMMA Land Surface Model Intercomparison Experiment coupled to the Community Microwave Emission Model: ALMIP-MEM. IN *Journal of Geophysical Research*, 114 DOI : 10.1029/2008JD010724.

de Rosnay, P., Gruhier, C., Timouk, F., Baup, F., Mougin, E., Hiernaux, P., Kergoat, L. & Le Dantec, V. (2009) Multi-scale soil moisture measurements at the Gourma meso-scale site in Mali. IN *Journal of Hydrology*, 375. 241–252 DOI : 10.1016/j.jhydrol.2009.01.015.

Ross, R. S., Krishnamurti, T. N., Pattnaik, S. & Simon, A. (2009) Energy Transformation and Diabatic Processes in Developing and Nondeveloping African Easterly Waves Observed during the NAMMA Project of 2006. IN *Weather and Forecasting*, 24. 1524–1548.

Russell, B., Williams, E., Gosset, M., Cazenave, F., Descroix, L., Guy, N., Lebel, T., Ali, A., Metayer, F. & Quantin, G. (2010) Radar Raingage Comparisons on Squall Lines in Niamey, Niger for the AMMA. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 289–303 DOI: 10.1002/qj.548.

Rust, H. W., Vrac, M., Lengaigne, M. & Sultan, B. (2010) Quantifying Differences in Circulation Patterns Based on Probabilistic Models IPCC-AR4 multi-model comparison for the North Atlantic. IN *Journal of Climate*, .

Ruti, P. M. & Dell' Aquilla, A. (2010) The 20th century AEWs in Reanalyses and IPCC simulations, from intra-seasonal to inter-annual variability. IN *Climate Dynamics*, .

Ruti, P. M., Williams, J. E., Hourdin, F., Guichard, F., Boone, A., Van Velthoven, P. F. J., Favot, F., Musat, I., Rummukainen, M., Dominguez, M., Gaertner, M. Á., Lafore, J.-P., Losada Doval, T., Rodriguez De Fonseca, M. B., Polcher, J., Giorgi, F., Xue, Y., Bouarar, I., Law, K. S., Josse, B., Barret, B., Yang, X., Mari, C. & Traore, A. K. (2010) Modeling the West African climate system: systematic errors and future steps. IN *Atmospheric Science Letters*, .

Saïd, F., Canut, G., Durand, P., Lohou, F. & Lothon, M. (2009) Seasonal evolution of the boundary-layer turbulence measured by aircraft during AMMA 2006 Special Observation Period. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 47–65 DOI: 10.1002/qj.475.

.Samain, O., Kergoat, L., Hiernaux, P., Guichard, F., Mougin, E., Timouk, F. & Lavenu, F. (2008) Analysis of the in situ and MODIS albedo variability at multiple timescales in the Sahel. IN *Journal of Geophysical Research*, 113 DOI : 10.1029/2007JD009174.

Sambou, S., Diémé, Y., Touré, A. K., Badji, A. M. & Nicaise, E. (2009) Impact of the Manantali dam on the modifications of the Senegal river basin hydrological regime: A statistical approach. IN *Sécheresse*, 20. 104–111.

Sankaran, M., Hanan, N. P., Scholes, R. J., Ratnam, J., Augustine, D. J., Cade, B. S., Gignoux, J., Higgins, S. I., Le Roux, X., Ludwig, F., Ardo, J., Banikwa, F., Bronn, A., Buccini, G., Caylor, K. K., Coughenour, M. B., Diouf, A., Ekaya, W., Feral, C. J., February, E. C., Frost, P. G. H., Hiernaux, P., Hrabar, H., Metzger, K. L., Prins, H. H. T., Ringrose, S., Sea, W., Tews, J., Worden, J. & Zambatis, N. (2005) Determinants of woody cover in African savannas. IN *Nature*, 438. 846–849.

Saunois, M., Mari, C., Thouret, V., Cammas, J.-P., Peyrillé, P., Lafore, J.-P., Sauvage, B., Volz-Thomas, A., Nédélec, P. & Pinty, J.-P. (2008) An idealized two-dimensional approach to study the impact of the West African monsoon on the meridional gradient of tropospheric ozone. IN *Journal of Geophysical Research*, 113, D07306.

Saunois, M., Reeves, C. E., Mari, C. H., Murphy, J. G., Stewart, D. J., Mills, G., Oram, D. & Purvis, R. M. (2009) Factors controlling the distribution of ozone in the West African lower troposphere during the AMMA (African Monsoon Multidisciplinary Analysis) wet season campaign. IN *Atmospheric Chemistry and Physics*, 9. 6135–6155.

Sauvage, B., Thouret, V., Cammas, J.-P., Gheusi, F., Athier, G. & Nédélec, P. (2005) Tropospheric ozone over Equatorial Africa: regional aspects from the MOZAIC data. IN *Atmospheric Chemistry and Physics*, 5. 311–335.

Sauvage, B., Thouret, V., Thompson, A., Witte, J., Cammas, J.-P., Nédélec, P. & Athier, G. (2006) Enhanced view of the «tropical Atlantic ozone paradox» and «zonal wave one» from the in situ MOZAIC and SHADOZ data. IN *Journal of Geophysical Research*, 111.

Sauvage, B., Thouret, V., Cammas, J.-P., Brioude, J., Nédélec, P. & Mari, C. (2007) Meridional ozone gradients in the African upper troposphere. IN *Geophysical Research Letters*, 34 (3), Art. No.L03817.

Sauvage, B., Gheusi, F., Thouret, V., Cammas, J.-P., Duron, J., Escobar, J., Mari, C., Mascart, P. & Pont, V. (2007) Medium-range mid-tropospheric transport of ozone and precursors over Africa: two numerical case studies in dry and wet seasons. IN *Atmospheric Chemistry and Physics*, 7. 5357–5370.

Sauvage, B., Martin, R. V., van Donkelaar, A. & Ziemke, J. R. (2007) Quantification of the factors controlling tropical tropospheric ozone and the South Atlantic maximum. IN *Journal of Geophysical Research*, 112 DOI : 10.1029/2006JD008008.

Saux-Picart, S., Ottlé, C., Decharme, B., André, C., Zribi, M., Perrier, A., Coudert, B., Boulain, N., Cappelaere, B., Descroix, L. & Ramier, D. (2009) Water and energy budgets simulation over the AMMA-Niger super-site spatially constrained with remote sensing data. IN *Journal of Hydrology*, DOI : 10.1016/j.jhydrol.2008.12.023.

Saxton, J., Lewis, A., Kettlewell, J., Ozel, M., Gogus, F., Boni, Y., Korogone, S. & Serça, D. (2007) Isoprene and monoterpene measurements in a secondary forest in northern Benin. IN *Atmospheric Chemistry and Physics*, 7. 4095–4106.

Schiller, C., GrooöŸ, J. U., Konopka, P., Plö¶ger, F., Silva Dos Santos, F. H. & Spelten, N. (2009) Hydration and dehydration at the tropical tropopause. IN *Atmospheric Chemistry and Physics*, 9. 9647–9660.

Schlecht, E., Hiernaux, P., Kadaouré, I., Hülselbusch, C. & Mahler, F. (2006) A spatio-temporal analysis of forage availability and grazing and excretion behaviour of herded and free grazing cattle, sheep and goats in Western Niger. IN *Agriculture, Ecosystems & Environment*, 113. 226–242.

Schrage, J. M., Fink, A. H., Ermert, V. & Ahlonsou, E. D. (2006) Three MCS Cases Occurring in Different Synoptic Environments in the Sub-Sahelian Wet Zone during the 2002 West African Monsoon. IN *Journal of the Atmospheric Sciences*, 63. 2369–2382.

Schrage, J. M. & Fink, A. H. (2006) Nocturnal Stratiform Cloudiness during the West African Monsoon. IN *Meteorology and Atmospheric Physics*, 95. 73–86.

Schrage, J. M. & Fink, A. H. (2007) Use of a Rain Gage Network to Infer the Influence of Environmental Factors on the Propagation of Quasi-Linear Convective Systems in West Africa. IN *Weather and Forecasting*, 22. 1016–1030.

Schwendike, J. & Jones, S. C. (2010) Convection in an African Easterly Wave over West Africa and the Eastern Atlantic: a model case study of Helene (2006). IN *Quarterly Journal of the Royal Meteorological Society*, 136. 364–396 DOI: 10.1002/qj.566..

Scialom, G. & Lemaitre, Y. Apparent moisture sink budget within AMMA convective systems from VAD analysis of radar wind and reflectivity. IN *Quarterly Journal of the Royal Meteorological Society*, .

Seghieri, J., Simier, M., Mahamane, A., Hiernaux, P. & Rambal, S. (2005) Adaptative above-ground biomass, stand density and leaf water potential to droughts and clearing in Guiera senegalensis, a dominant shrub in Sahelian fallows (Niger). IN *Journal of Tropical Ecology*, 21. 203–213.

Seghieri, J., Vescovo, A., Padel, K., Soubie, R., Arjounin, M., Boulain, N., de Rosnay, P., Galle, S., Gosset, M., Mouctar, A. H., Peugeot, C. & Timouk, F. (2009) Relationships between climate, soil moisture and phenology of the woody cover in two sites located along the West African latitudinal gradient. IN *Journal of Hydrology*, 375. 75–89.

Séguis, L., Cappelaere, B., Milesi, G., Peugeot, C., Massuel, S. & Favreau, G. (2004) Simulated impacts of climate change and land-clearing on runoff from a small Sahelian catchment. IN *Hydrological Processes*, 18. 3401–3413.

Séguis, L., Boulain, N., Cappelaere, B., Favreau, G., Galle, S., Hiernaux, P., Mougin, E., Peugeot, C., Ramier, D., Seghieri, J., Cohard, J.-M., Demarez, V., Demarty, J., Descroix, L., Descloitres, M., Grippa, M., Guichard, F., Guyot, A. S., Kamagaté, B., Kergoat, L., Lebel, T., Le Dantec, V., Le Lay, M., Massuel, S., Timouk, F. & Trichon, V. (2010) Contrasted land surface processes along a West African rainfall gradient. IN *Atmospheric Science Letters*, .

Seo, H., Jochum, M., Murtugudde, R., Miller, A. J. & Roads, J. O. (2008) Precipitation from African Easterly Waves in a Coupled Model of the Tropical Atlantic. IN *Journal of Climate*, 21. 1417–1431.

Settle, J., Bharmal, N. A., Robinson, G. & Slingo, A. (2008) Sampling uncertainties in surface radiation budget calculations in RADAGAST. IN *Journal of Geophysical Research*, 113 DOI : 10.1029/2008JD010509.

Shao, Y., Fink, A. H. & Klose, M. (2010) Numerical Simulation of a Continental-Scale Saharan Dust Event. IN *Journal of Geophysical Research-Atmospheres*, 115 DOI : 10.1029/2009JD012678.

Sijikumar, S., Roucou, P. & Fontaine, B. (2006) Monsoon onset over Sudan-Sahel: Simulation by the regional scale model MM5. IN *Geophysical Research Letters*, 33 DOI:10.1029/2005GL024819.

Simões, F., Berthelier, J.-J., Godefroy, M. & Yahi, S. (2009) Observation and modeling of the Earth-ionosphere cavity electromagnetic transverse resonance and variation of the D-region electron density near sunset. (2009) IN *Geophysical Research Letters*, 36 DOI : 10.1029/2009GL039286.

Slingo, A., Ackerman, T. P., Allan, R. P., Kassianov, E. I., McFarlane, S. A., Robinson, G., Barnard, J. C., Miller, M., Harries, J. E., Russel, J. & Dewitte, S. (2006) Observations of the impact of a major Saharan dust storm on the atmospheric radiation balance. IN *Geophysical Research Letters*, 33 DOI : 10.1029/2006GL027869.

Slingo, A., Bharmal, N. A., Robinson, G., Settle, J., Allan, R. P., White, H., Lamb, P. J., Issa Lélé, M., Turner, D. D., McFarlane, S. A., Kassianov, E. I., Barnard, J. C., Flynn, C. J. & Miller, M. (2008) Overview of observations from the RADAGAST experiment in Niamey, Niger. Part I: Meteorology and thermodynamic variables. IN *Journal of Geophysical Research*, 113 DOI : 10.1029/2008JD009909.

Slingo, A., White, H., Bharmal, N. A. & Robinson, G. (2009) Overview of observations from the RADAGAST experiment in Niamey, Niger. Part II: Radiative fluxes and divergences. IN *Journal of Geophysical Research*, 114 DOI : 10.1029/2008JD010497.

Sohne, N., Chaboureau, J.-P. & Guichard, F. (2008) Verification of cloud cover forecast with satellite observation over West Africa. IN *Monthly Weather Review*, 136. 4421–4434.

Solmon, F., Giorgi, F. & Liousse, C. (2006) Aerosol modelling for regional climate studies: application to anthropogenic particles and evaluation over a European/African domain. IN *Tellus B*, 58. 51–72.

Sow, M., Alfaro, S. C., Rajot, J.-L. & Marticorena, B. (2009) Size resolved dust emission fluxes measured in Niger during 3 dust storms of the AMMA experiment. IN *Atmospheric Chemistry and Physics*, 9. 3881–3891.

Speth, P., Christoph, M. & Diekkrueger, B. (2010): Editors Book " Impacts of Global Change on the Hydrological Cycle in West and Northwest Africa". Springer, 675pp.

Stewart, D. J., Taylor, C. M., Reeves, C. E. & McQuaid, J. B. (2008) Biogenic nitrogen oxide emissions from soils: impact on NOx and ozone over west Africa during AMMA (African Monsoon {Multidisciplinary Analysis): observational study. IN *Atmospheric Chemistry and Physics*, 8. 2285–2297.

Stisen, S., Sandholt, I., Nö¸rgaard, A., Fensholt, R. & Jensen, K. H. (2008) Combining the triangle method with thermal inertia to estimate regional evapotranspiration - Applied to MSG-SEVIRI data in the Senegal River basin. IN *Remote Sensing of Environment*, 112. 1242–1255.

Stisen, S., Jensen, K. H., Sandholt, I. & Grimes, D. I. F. (2008) A remote sensing driven distributed hydrological model of the Senegal River basin. IN *Journal of Hydrology*, 354. 131–148.

Stone, D., Commane, R., Floquet, C., Ingham, T., Bandy, B., Brookes, D., Hopkins, J. R., Lee, J., Lewis, A., McQuaid, J. B., Mills, G., Monks, P., Murphy, J., Oram, D., Parker, A., Purvis, R. M., Reeves, C. E., Stewart, D., Heard, D. E. & Evans, M. J. (2010) Understanding HOx observations over West Africa during AMMA: box modelling with the Master Chemical Mechanism. IN *Atmospheric Chemistry and Physics Discussions*, .

Stubenrauch, C. J., Chédin, A., Rö¤del, G., Scott, N. & Serrar, S. (2006) Cloud Properties and Their Seasonal and Diurnal Variability from TOVS Path-B. IN *Journal of Climate*, 19. 5531–5553.

Stubenrauch, C. J., Eddounia, F., Edwards, J. & Macke, A. (2007) Evaluation of Cirrus Parameterizations for Radiative Flux Computations in Climate Models Using TOVS-ScaRaB Satellite Observations. IN *Journal of Climate*, 20. 4459–4475.

Sultan, B. & Janicot, S. (2003) The West African Monsoon Dynamics. Part II: The «Preonset» and «Onset» of the Summer Monsoon. IN *Journal of Climate*, 16. 3407–3427.

Sultan, B., Janicot, S. & Diedhiou, A. (2003) The West African Monsoon Dynamics. Part I: Documentation of Intraseasonal Variability. IN *Journal of Climate*, 16. 3389–3406.

Sultan, B. & Janicot, S. (2004) La variabilité climatique en Afrique de l'Ouest aux échelles saisonnière et intra-saisonnière. I : mise en place de la mousson et variabilité intra-saisonnière de la convection. IN *Sécheresse*, 15. 321–330.

Sultan, B., Labadi, K., Beltrando, G. & Janicot, S. (2004) La méningite à méningocoque au Mali et la circulation atmosphérique en Afrique de l'Ouest. IN *Environnement, Risques & Santé*, 3. 23–34.

Sultan, B., Baron, C., Dingkuhn, M., Janicot, S. & Sarr, B. (2005) La variabilité climatique en Afrique de l'Ouest aux échelles saisonnière et intra-saisonnière. II : Applications à la sensibilité des rendements agricoles au Sahel. IN *Sécheresse*, 16. 23–33.

Sultan, B., Labadi, K., Guégan, J.-F. & Janicot, S. (2005) Climate Drives the Meningitis Epidemics Onset in West Africa. IN *Plos Medicine*, 2. 43–49.

Sultan, B., Baron, C., Dingkuhn, M., Sarr, B. & Janicot, S. (2005) Agricultural impacts of large-scale variability of the West African monsoon. IN *Agricultural and Forest Meteorology*, 128. 93–110.

Sultan, B., Janicot, S. & Drobinski, P. (2007) Characterization of the Diurnal Cycle of the West African Monsoon around the Monsoon Onset. IN *Journal of Climate*, 20. 4014–4032.

Sultan, B., Janicot, S., Baron, C., Dingkuhn, M., Muller, B., Traoré, S. B. & Sarr, B. (2008) Les impacts agronomiques du climat en Afrique de l'Ouest : une illustration des problèmes majeurs. IN *Sécheresse*, 19. 29–37.

Sultan, B., Barbier, B., Fortilus, J., Modou MBaye, S. & Leclerc, G. (2009) Estimating the Potential Economic Value of Seasonal Forecasts in West Africa: A Long-Term Ex-Ante Assessment in Senegal. IN *Weather, Climate and society*, 2. 69–87.

Sultan, B., Janicot, S. & Correia, C. (2009) Medium Lead-Time Predictability of Intraseasonal Variability of Rainfall in West Africa. IN *Weather and Forecasting*, 24. 767–784 DOI : 10.1175/2008WAF2222155.1.

Sultan, B., Bella-Medjo, M., Berg, A., Quirion, P. & Janicot, S. (2010) Multi-scales and multi-sites analyses of the role of rainfall in cotton yields in West Africa. IN *International Journal of Climatology*, 30. 58–71.

Sylla, M. B., Coppola, E., Mariotti, A., Giorgi, F., Ruti, P. M., Dell' Aquilla, A. & Bi, X. Q. (2009) Multiyear simulation of the African climate using a regional climate model (RegCM3) with the high resolution ERA-interim reanalysis. IN *Climate Dynamics*, 35. 231–247 DOI 10.1007/s00382-009-0613-9.

Sylla, M. B., Gaye, A. T., Pal, J. S., Jenkins, G. S. & Bi, X. Q. (2009) High-resolution simulations of West African climate using regional climate model (RegCM3) with different lateral boundary conditions. IN *Theoretical and Applied Climatology*, 98. 293–314.

Sylla, M. B., Dell' Aquilla, A., Ruti, P. M. & Giorgi, F. (2010) Simulation of the intraseasonal and the interannual variability of rainfall over West Africa with RegCM3 during the monsoon period. IN *Journal of Climate*, 30. 1865–1883.

Tarhule, A., Saley-Bana, Z. & Lamb, P. J. (2009) Rainwatch: A Prototype GIS for Daily and Seasonal Rainfall Monitoring and Visualization in West Africa. IN *Bulletin of the American Meteorological Society*, 90. 1607–1614.

Taylor, C. M., Parker, D. J., Lloyd, C. R. & Thorncroft, C. D. (2005) Observations of synoptic scale land surface variability and its coupling with the atmosphere. IN *Quarterly Journal of the Royal Meteorological Society*, 131. 913–938.

Taylor, C. M. & Ellis, R. J. (2006) Satellite detection of soil moisture impacts on convection at the mesoscale. IN *Geophysical Research Letters*, 33, L03404.

Taylor, C. M., Parker, D. J. & Harris, P. P. (2007) An observational case study of mesoscale atmospheric circulations induced by soil moisture. IN *Geophysical Research Letters*, 34 DOI : 10.1029/2007GL030572.

Taylor, C. M. (2008) Intraseasonal Land-Atmosphere Coupling in the West African Monsoon. IN *Journal of Climate*, 21. 6636–6648.

Taylor, C. M., Harris, P. P. & Parker, D. J. (2009) Impact of Soil Moisture on the Development of a Sahelian Mesoscale Convective System: A Case Study from the AMMA Special Observing Period. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 456–470 DOI: 10.1002/qj.465.

Taylor, C. M. (2010) Feedbacks on convection from an African wetland. IN *Geophysical Research Letters*, 37.

Taylor, C. M., Parker, D. J., Kalthoff, N., Gaertner, M. Á., Philippon, N., Bastin, S., Harris, P. P., Boone, A., Guichard, F., Agusti-Panareda, A., Baldi, M., Cerlini, P., Descroix, L., Douville, H., Flamant, C., Grandpeix, J.-Y. & Polcher, J. (2010) New Perspectives on Land-Atmosphere Feedbacks from the African Monsoon Multidisciplinary Analysis (AMMA). IN *Atmospheric Science Letters*, .

Thorncroft, C. D., Hall, N. M. J. & Kiladis, G. N. (2008) Three-Dimensional Structure and Dynamics of African Easterly Waves. Part III: Genesis. IN *Journal of the Atmospheric Sciences*, 65. 3596–3607.

Thouret, V., Saunois, M., Minga, A., Mariscal, A., Sauvage, B., Solete, A., Agbangla, D., Nédélec, P., Mari, C., Reeves, C. E. & Schlager, H. (2009) An overview of two years of ozone radio soundings over Cotonou as part of AMMA. IN *Atmospheric Chemistry and Physics*, 9. 6157–6174.

Timouk, F., Kergoat, L., Mougin, E., Lloyd, C. R., Ceschia, E., Cohard, J.-M., de Rosnay, P., Hiernaux, P., Demarez, V. & Taylor, C. M. (2009) Response of surface energy balance to water regime and vegetation development in a Sahelian landscape. IN *Journal of Hydrology*, 375. 178–189.

Todd, M. C., Washington, R., Raghavan, S., Lizcano, G. & Knippertz, P. (2008) Regional model simulations of the Bodele low-level jet of northern Chad during the Bodele Dust Experiment (BoDEx 2005). IN *Journal of Climate*, 21. 995–1012.

Tompkins, A. M., Cardinali, C., Morcrette, J.-J. & Rodwell, M. (2005) Influence of aerosol climatology on forecasts of the African Easterly Jet. IN *Geophysical Research Letters*, 32 L10801, DOI : 10.1029/2004GL022189.

Tompkins, A. M. & Feudale, L. (2010) Seasonal Ensemble Predictions of West African Monsoon Precipitation in the ECMWF System 3 with a Focus on the AMMA special observing period in 2006. IN *Weather and Forecasting*, 25. 768–788.

Torn, R. D. (2010) Ensemble-Based Sensitivity Analysis Applied to African Easterly Waves. IN *Weather and Forecasting*, 25. 61–78.

Tourre, Y. M., Lacaux, J.-P., Vignolles, C., Ndione, J.-A. & Lafaye, M. (2008) Mapping of zones potentially occupied by Aedes vexans and Culex poicilipes mosquitoes, the main vectors of Rift Valley fever in Senegal. IN *Geospatial Health*, 3. 69–79.

Tracol, Y., Mougin, E., Jarlan, L. & Hiernaux, P. (2006) Testing a Sahelian grassland functioning model against herbage mass measurements. IN *Ecological Modelling*, 193. 437–446.

Traoré, S. B., Alhassane, A., Muller, B., Kouressy, M., Somé, L., Sultan, B., Oettli, P., Siéné Laopé, A. C., Vintrou, E., Sangaré, S., Vaksmann, M., Diop, M., Bégué, A., Dingkuhn, M. & Baron, C. (2010) Characterizing and modelling the diversity of cropping situations under climatic constraints in West Africa. IN *Atmospheric Science Letters*, DOI : 10.1002/asl.295.

Tulet, P., Mallet, M., Pont, V., Pelon, J. & Boone, A. (2008) The 7-13 March 2006 dust storm over West Africa: Generation, transport, and vertical stratification. IN *Journal of Geophysical Research*, 113 DOI : 10.1029/2008JD009871.

Tummon, F., Solmon, F., Liousse, C. & Tadross, M. (2010) Simulation of the climatic impacts of the natural aerosol loading over southern Africa during the biomass burning season using RegCM3. IN *Journal of Geophysical Research*, 115 DOI : 10.1029/2009JD013738.

Turner, D. D. (2008) Ground-based infrared retrievals of optical depth, effective radius, and composition of airborne mineral dust above the Sahel. IN *Journal of Geophysical Research*, 113 DOI : 10.1029/2008JD010054.

Turner, M. D., Hiernaux, P. & Schlecht, E. (2005) The Distribution of Grazing Pressure in Relation to Vegetation Resources in Semi-arid West Africa: The Role of Herding. IN *Ecosystems*, 8. 668–681.

Twohy, C. H., Kreidenweis, S. M., Eidhammer, T., Browell, E. V., Heymsfield, A. J., Bansemer, A. R., Anderson, B. E., Chen, G., Ismail, S., DeMott, P. J. & Van Den Heever, S. C. (2009) Saharan dust particles nucleate droplets in eastern Atlantic clouds. IN *Geophysical Research Letters*, 36 DOI : 10.1029/2008GL035846.

Valentin, C., Rajot, J.-L. & Mitja, D. (2004) Responses of soil crusting, runoff and erosion to fallowing in the sub-humid and semi-arid regions of West Africa. IN *Agriculture Ecosystems and Environment*, 104. 287–302 DOI : 10.1016/j.agee.2004.01.035.

Vallebona, C., Genesio, L., Crisci, A., Pasqui, M., Di Vecchia, A. & Maracchi, G. (2008) Large scale climatic patterns forcing desert locust upsurges in West Africa. IN *Climate Research*, 37. 35–41.

Vanvyve, E., Hall, N. M. J., Messager, C., Leroux, S. & van Ypersele, J.-P. (2008) Internal variability in a regional climate model over West Africa. IN *Climate Dynamics*, 30. 191–202.

Varado, N., Braud, I., Galle, S., Le Lay, M., Séguis, L., Kamagaté, B. & Depraetere, C. (2006) Multi-criteria assessment of the Representative Elementary Watershed approach on the Donga catchment (Benin) using a downward approach of model complexity. IN *Hydrology and Earth System Sciences*, 10. 427–442.

Varado, N., Ross, N., Braud, I. & Haverkamp, R. (2006) Assessment of an efficient numerical solution of the 1D Richards' equation on bare soil. IN *Journal of Hydrology*, 323. 244–257.

Verrier, S., De Montera, L., Barthès, L. & Mallet, C. (2010) Multifractal analysis of African monsoon rain fields, taking into account the zero rain-rate problem. IN *Journal of Hydrology*, 389. 111–120.

Vigaud, N., Roucou, P., Fontaine, B., Sijikumar, S. & Tyteca, S. WRF/ARPEGE-CLIMAT simulated climate trends over West Africa. IN *Climate Dynamics*, DOI : 10.1007/s00382-009-0707-4.

Vignolles, C., Lacaux, J.-P., Tourre, Y. M., Bigeard, G., Ndione, J.-A. & Lafaye, M. (2009) Rift Valley Fever in a zone potentially ocupied by Aedes vexans in Senegal: dynamics and risk mapping. IN *Geospatial Health*, 3. 211–220.

Vischel, T. & Lebel, T. (2007) Assessing the water balance in the Sahel: Impact of small scale rainfall variability on runoff. Part 2:Idealized modeling of runoff sensitivity. IN *Journal of Hydrology*, 333. 340–355.

Vischel, T., Lebel, T., Massuel, S. & Cappelaere, B. (2009) Conditional simulation schemes of rain fields and their application to rainfall-runoff modeling studies in the Sahel. IN *Journal of Hydrology*, 375. 273–286.

Vizy, E. K. & Cook, K. H. (2009) A mechanism for african monsoon breaks: Mediterranean cold air surges. IN *Journal of Geophysical Research*, 114 DOI : 10.1029/2008JD010654.

Vizy, E. K. & Cook, K. H. (2009) Tropical Storm Development from African Easterly Waves in the Eastern Atlantic: A Comparison of Two Successive Waves Using a Regional Model as Part of NASA AMMA 2006. IN *Journal of the Atmospheric Sciences*, 66. 3313–3334.

Voigt, C., Schlager, H., Roiger, A., Stenke, A., De Reus, M., Borrman, S., Jensen, E., Schiller, C., Konopka, P. & Sitnikov, N. (2008) Detection of reactive nitrogen containing particles in the tropopause region - evidence for a tropical nitric acid trihydrate (NAT) belt. IN *Atmospheric Chemistry and Physics*, 8. 7421–7430.

Von Schuckmann, K., Brandt, P. & Eden, C. (2008) Generation of tropical instability waves in the Atlantic Ocean. IN *Journal of Geophysical Research*, 113 C08034, DOI:10.1029/2007JC004712.

Vouillamoz, J.-M., Descloitres, M., Toe, G. & Legchenko, A. (2005) Characterization of crystalline basement aquifers with MRS: comparison with boreholes and pumping tests data in Burkina Faso. IN *Near Surface Geophysics*, 3. 205–213.

Vouillamoz, J.-M., Favreau, G., Massuel, S., Boucher, M., Nazoumou, Y. & Legchenko, A. (2008) Contribution of magnetic resonance sounding to aquifer characterization and recharge estimate in semiarid Niger. IN *Journal of applied Geophysics*, 64. 99–108.

Wade, M., Caniaux, G., Du Penhoat, Y., Dengler, M., Giordani, H. & Hummels, R. (2010) A one-dimensional modeling study of the diurnal cycle in the equatorial Atlantic at the PIRATA buoys during the EGEE-3 campaign. IN *Ocean Dynamics*, DOI : 10.1007/s10236-010-0337-8.

Wagner, F., Bortoli, D., Pereira, S., Costa, M. J., Silva, A. M., Weinzierl, B., Esselborn, M., Petzold, A., Rasp, K., Heinold, B. & Tegen, I. (2008) Properties of dust aerosol particles transported to Portugal from the Sahara desert. IN *Tellus B*, 61. 297–306.

Williams, E. R., Lyons, W. A., Hobara, Y., Mushtak, V. C., Asencio, N., Boldi, R. A., Bö³r, J., Cummer, S. A., Greenberg, E., Hayakawa, M., Holzworth, R. H., Kotroni, V., Li, J., Morales, C., Nelson, T. E., Price, C., Russell, B., Sato, M., Sö¡tori, G., Shirahata, K., Takahashi, Y. & Yamashita, K. (2010) Ground-based detection of sprites and their parent lightning flashes over Africa during the 2006 AMMA campaign. IN *Quarterly Journal of the Royal Meteorological Society*, 136. 257–271 DOI: 10.1002/qj.489..

Williams, J. E., Scheele, M. P., Van Velthoven, P. F. J., Bouarar, I., Law, K. S., Josse, B., Peuch, V.-H., Yang, X., Pyle, J., Thouret, V., Barret, B., Liousse, C., Hourdin, F., Szopa, S. & Cozic, A. (2009) Global chemistry simulations in the AMMA-Model Intercomparison project. IN *Bulletin of the American Meteorological Society*, 91. 611–624 DOI: 10.1175/2009BAMS2818.1.

Williams, J. E., Scheele, M. P., Van Velthoven, P. F. J., Cammas, J.-P., Thouret, V., Galy-Lacaux, C. & Volz-Thomas, A. (2009) The influence of biogenic emissions from Africa on tropical tropospheric ozone during 2006: a global modeling study. IN *Atmospheric Chemistry and Physics*, 9. 5729–5749.

Williams, J. E., Scheele, M. P., Van Velthoven, P. F. J., Thouret, V., Saunois, M., Reeves, C. E. & Cammas, J.-P. (2010) The influence of biomass burning on tropospheric composition over the tropical Atlantic Ocean and equatorial Africa during the West African Monsoon in 2006. IN *Atmospheric Chemistry and Physics Discussions*, 10. 7507–7552.

Xue, Y., Ji, J., Sun, S., Wu, G., Lau, W. K.-M., Poccard-Leclercq, I., Kang, H.-S., Zhang, C., Schaake, J. C., Zhang, J. Y. & Jiao, Y. (2005) Multiscale Variability of the River Runoff System in China and Its Long-Term Link to Precipitation and Sea Surface Temperature. IN *Journal of Hydrometeorology*, 6. 550–570.

Xue, Y., De Sales, F., Lau, W. K.-M., Boone, A., Feng, J., Dirmeyer, P., Guo, Z., Kim, K.-M., Kitoh, A., Kumar, V., Poccard-Leclercq, I., Mahowald, N., Moufouma-Okia, W., Pegion, P., Rowell, D. P., Schubert, S. D., Sealy, A., Thiaw, W. M., Vintzileos, A., Williams, S. & Wu, M.-L. C. (2009) Intercomparison and analyses of the West African Monsoon and its variability in the West African Monsoon Modeling and Evaluation. IN *Climate Dynamics*, 35. 3–27 DOI : 10.1007/s00382-010-0778-2.

Yaka, P., Sultan, B., Broutin, H., Janicot, S., Philippon, N. & Fourquet, N. (2008) Relationships between climate and year-to-year variability in meningitis outbreaks: A case study in Burkina Faso and Niger. IN *International Journal of Health Georgraphics*, 7 DOI : 10.1186/1476-072X-7-34.

Zahiri, E.-P., Gosset, M., Lafore, J.-P. & Gougé, V. (2008) Use of a Radar Simulator on the Output Fields from a Numerical Mesoscale Model to Analyze X-Band Rain Estimators. IN *Journal of Atmospheric and Oceanic Technology*, 25. 341–367.

Zawislak, J. & Zipser, E. J. (2010) Observations of Seven African Easterly Waves in the East Atlantic during 2006. IN *Journal of the Atmospheric Sciences*, 67. 26–43.

Zhang, C., Woodworth, P. & Gu, G. (2006) The seasonal cycle in the lower troposphere over West Africa from sounding observations. IN *Quarterly Journal of the Royal Meteorological Society*, 132. 2559–2582.

Zine, S., Jarlan, L., Frison, P.-L., Mougin, E., Hiernaux, P. & Rudant, J. (2005) Land surface parameter monitoring with ERS scatterometer data over the Sahel: A comparison between agro-pastoral and pastoral areas. IN *Remote Sensing of Environment*, 96. 438–452.

Zorom, M., Barbier, B., Zoungrana, T. P., Mertz, O., Maiga, A. & Ka, A. (2010) Les stratégies d'adaptation des ruraux sahéliens à la variabilité climatique: analyse de la diversité. IN *Cahiers Agricultures*, .

Zribi, M., Saux-Picart, S., André, C., Descroix, L., Ottlé, C. & Kallel, A. (2007) Soil moisture mapping based on ASAR/ENVISAT radar data over a Sahelian region. IN *International Journal of Remote Sensing*, 28. 3547–3565.

Zribi, M., André, C. & Decharme, B. (2008) A Method for Soil Moisture Estimation in Western Africa Based on the ERS Scatterometer. IN *Geoscience and Remote Sensing*, 46. 438–448.

Zribi, M., Pardé, M., de Rosnay, P., Baup, F., Boulain, N., Descroix, L., Pellarin, T., Mougin, E., Ottlé, C. & Decharme, B. (2009) ERS scatterometer surface soil moisture analysis of two sites in the south and north of the Sahel region of West Africa. IN *Journal of Hydrology*, 375. 253–261.

Ph Dissertation defended in AMMA framework

Adéaga, O. (2005) Modelling Rainfall-Runoff Relationship in Ungauged Basins: A Case Study of Yewa Basin. . University of Lagos.

Ali, A. (2004) Modélisation de l'invariance d'échelle des champs de pluie sahéliens. Application aux algorithmes d'estimation et aux études de variabilité climatique. Institut National Polytechnique de Grenoble.

Ali Eugene, K. (2009) Relation entre les variations de la température de la surface de la mer et des précipitations le long de la bande côtière du nord du Golfe de Guinée. Université Cocody.

Amogu, O. (2009) Dégradation des espaces sahéliens et conséquences sur l'ensablement du fleuve Niger. Université Joseph Fourier.

Arnault, J. (2009) Evolution cyclogénétique des perturbations convectives de l'Afrique de l'Ouest et de l'Atlantique tropical. Université Paul Sabatier Toulouse III.

Athie, G. (2008) Étude de la structure spatio-temporelle de la variabilité intra-saisonnière dans les couches superficielles de l'océan Atlantique tropical. Université de Bretagne Occidentale.

Bain, C. (2008) Interactions between the land surface and the atmosphere over West Africa. School of earth and environment, Leeds, UK.

Balme, M. (2004) Analyse du régime pluviométrique sahélien dans une perspective hydrologique et agronomique. Etude de l'impact de sa variabilité sur la culture du mil. Université Joseph Fourier.

Baup, F. (2007) Apport des données ENVISAT/ASAR pour le suivi des surfaces continentales: application a la zone sahélienne. Université Paul Sabatier Toulouse III.

Bechara, J. (2009) Impact de la convection nuageuse profonde sur la chimie troposphérique : cas de l'Afrique de l'ouest. . Université Paris XII.

Bella-Medjo, M. (2008) Analyse multi-échelles de la variabilité pluviométrique au Cameroun et ses conséquences sur les rendements de coton. Université Paris VI.

Ben Rehouma, A. (2007) Restitutions et analyse des paramètres climatiques mesurés par satellites sur l'Afrique et l'Océan Atlantique pour les deux dernières décennies. Tendances et variabilité des flux radiatifs en liaison avec les autres paramètres climatiques. Université Paris VI.

Besson, L. (2009) Processus Physiques Responsables de l'Etablissement et de la Variabilité de la Mousson Africaine. . Université Paris VI, Pierre et Marie Curie.

Bou Karam, D. (2008) Meteorological mechanisms involved in dust emissions over West Africa. . Paris VI, Université Pierre et Marie Curie.

Bouali, L. (2009) Prévisibilité des précipitations ouest africaines (échelles intrasaisonnières et saisonnières) au travers des simulations type DEMETER et des observations. Université de Bourgogne, DIjon.

Bouarar, I. (2009) Impact de la mousson africaine sur la composition chimique de l'atmosphère en Afrique équatoriale. . Paris VI, Université Pierre et Marie Curie.

Bouet, C. (2007) Modélisation multi-échelle de la dynamique des panaches d'aérosols naturels en Afrique. . Clermond-Ferrand II, Université Blaise Pascal.

Boulain, N. (2004) Effet des facteurs climatiques et anthropiques dans l'évolution récente des écosystèmes tropicaux : modélisation spatialisée du bilan hydrique d'un petit bassin versant sahélien. . Paris VI, Université Pierre et Marie Curie.

Cain, M. (2009) Transport and processing of ozone over the North Atlantic and in the West African monsoon. . University of Reading, UK.

Camara, M. (2006) Cyclogenèse dans l'Atlantique Nord en relation avec le système de mousson en Afrique de l'Ouest. Institut National Polytechnique de Grenoble.

Caminade, C. (2006) Rôle de l'océan et influence des émissions d'origine anthropique sur la variabilité climatique en Afrique. Université Paul Sabatier Toulouse III.

Canut, G. (2010) Intéraction Mousson/Harmattan, échanges de petite échelle. Université Paul Sabatier Toulouse III.

Crumeyrolle, S. (2008) Impact des systèmes convectifs sur les propriétés hygroscopiques des aérosols: Analyse de deux cas d'étude durant la campagne AMMA. Université Paul Sabatier Toulouse III.

Derive, G. (2003) Estimation de l'évapotranspiration en région Sahélienne. Synthèse des connaissances et évaluation de modélisations. Application à la zone d'HAPEX-Sahel. Université Joseph Fourier de Grenoble

Dia, A. H. (2006) Décentralisation et développement local. Le cas de la vallée du fleuve Sénégal. Université du Mirail, Toulouse.

Diatta, S. (2009) Etude Statistique des profils verticaux de Précipitation en Afrique de l'Ouest à partir du radar spatial de TRMM (Tropical Rainfall Measurement Mission). . Sénégal, Université de Dakar.

Diello, P. (2007) Inter-relation Homme-climat-environnement dans le sahel burkinabé. Impact sur les ressources en eau et la modélisation hydrologique. Université Montpellier II.

Dodds, P. (2010) Development of a crop model to examine crop management and climate change in Senegal. . School of earth and environment, Leeds, UK.

Dorgeval, T. (2006) Impact du changement climatique sur le cycle de l'eau en Afrique de l'Ouest: Modélisation et incertitudes. . Paris VI, Université Pierre et Marie Curie.

Dupont, R. (2007) Emissions biogéniques de NO par les sols - Impact sur la chimie atmosphérique. Université Paul Sabatier Toulouse III.

Evaristo, R. (2009) Microphysique des systèmes convectifs observés par radar polarimétrique en Afrique de l'Ouest. . Versailles, Université de Versaille Saint Quentin en Yvelines.

Gastineau, G. (2008) Changement de la circulation atmosphérique tropicale et conséquences lors du changement climatique. . Paris VI, Université Pierre et Marie Curie.

Gruhier, C. (2010) Approche multi-échelle de la dynamique de l'humidité des sols en Afrique de l'Ouest : des observations terrain et satellitale à la modélisation régionale, dans le cadre de la préparation à la mission SMOS. . Paris VI, Université Pierre et Marie Curie.

Guyot, A. (2010) Estimation de l'évapotranspiration sur un couvert complexe par utilisation de la scintillométrie infrarouge. Application à un bassin versant de zone soudano-sahélienne. . Grenoble, Université Joseph Fourier.

Joly, M. (2008) Rôle des océans dans la variabilité climatique de la mousson africaine. Université Paul Sabaltier de Toulouse.

Josset, D. (2009) Etude du couplage radar - lidar. Application à l'étude des aérosols, des nuages et de leurs interactions. . Paris VI, Université Pierre et Marie Curie.

Journet, E. (2008) Etude du facteur minéralogique sur la solubilité et la spéciation redox du fer dissous dans le contexte biogéochimique du depôt atmosphérique des aérosols désertiques sahélo-sahariens. . Paris VII, Université Paris Diderot.

Kamagaté, B. (2006) Fonctionnement hydrologique et origine des écoulements sur un bassin versant de milieu tropical de socle au Bénin : bassin versant de la Donga (haute vallée de l'Ouémé). . Montpellier, Université Montpellier II.

Kebe, C. M. F. (2005) Relation entre les intégrales spatio-temporelles de la couverture nuageuse et la pluie au sol aux latitudes tropicales. Université Paul Sabatier Toulouse III.

Kolodziejczyk, N. (2008) Analyse de la circulation de subsurface et de sa variabilité dans le Golfe de Guinée. . Université de Bretagne Occidentale.

Lamrani, N. (2008) Dynamique et microphysique des systèmes convectifs de l'Afrique de l'Ouest : Une analyse d'une ligne de grains par radar Doppler polarimétrique. Université Paul Sabatier Toulouse III.

Lavaysse, C. (2006) Etude des relations onde-convection-pluie et influence de la variabilité du flux de mousson en Afrique de l'Ouest. . Institut National Polytechnique de Grenoble.

Lawin, A. E. (2007) Analyse climatologique et statistique du régime pluviométrique de la Haute Vallée de l'Ouémé à partir des données pluviographiques AMMA-CATCH Bénin. Université Joseph Fourier de Grenoble.

Le Lay, M. (2006) Modélisation hydrologique dans un contexte de variabilité hydro-climatique. Une approche comparative pour l'étude du cycle hydrologique à méso-échelle au Bénin. Université Joseph Fourier de Grenoble

Leroux, S. (2009) Dynamique des ondes d'est africaines: origine, propagation et interaction avec leur environnement. Université Joseph Fourier de Grenoble.

Louvet, S. (2008) Modulations intrasaisonnières de la mousson d'Afrique de l'Ouest et impacts sur les vecteurs du paludisme à Ndiop (Sénégal) : diagnostics et prévisibilité. . Dijon, Université de Bourgogne.

Ly, M. (2010) : Représentation du cycle de l'eau en Afrique de l'Ouest par le modèle LMDZ pendant la campagne AMMA. Université Paris 6.

Madougou, S. (2009): Étude du potentiel éolien du jet nocturne dans la zone sahélienne à partir des observations de radars profileurs de vent. , Université Paul Sabatier Toulouse III.

Massuel, S. (2005) Evolution récente de la ressource en eau consécutive aux changements climatiques et environnementaux du sud-ouest Niger. Modélisation des eaux de surface et souterraines du bassin du kori de Dantiandou sur la période 1992-2003. Université Montpellier II.

Mbengue, A. A. (2009) Estimation par satellite de l'humidité spécifique au dessus de l'océan par radiométrie hyperfréquence. Université de Versailles Saint Quentin en Yvelines.

Messager, C. (2005) Couplage des composantes continentale et atmosphérique du cycle de l'eau aux échelles régionale et climatique. Application à la Mousson Ouest Africaine. .Grenoble, Université Joseph Fourier.

Meynadier, R. (2010) Analyse multi-échelle du cycle de l'eau dans la mousson africaine à l'aide d'observations GPS. . Paris VI, Université Pierre et Marie Curie.

Moufouma-Okia, W. (2003) Modélisation du climat de l'Afrique de l'Ouest avec le modèle régional MAR. . Institut National Polytechnique de Grenoble.

Moumouni, S. (2009) Analyse des distributions granulométriques des pluies au Bénin : caractéristiques globales, variabilité et application à la mesure radar. . Grenoble, INPG, Université Joseph Fourier.

Mounier, F. (2005) La variabilité intra-saisonnière de la mousson de l'Afrique de l'Ouest et Centrale. . Institut National Polytechnique de Grenoble. Université Joseph Fourier

Nzeukou, A. (2002) Variabilité spatiale à moyenne échelle des conditions de propagation des micro-ondes dans les précipitations. . Toulouse, Université Paul Sabatier Toulouse III.

d' Orgeval, T. (2006) Impact du changement climatique sur le cycle de l'eau en Afrique de l'Ouest : modélisation et incertitudes. Université Paris VI.

Penide, G. (2010) Mise en place de simulateurs d'instruments de télédétection dans un modèle méso-échelle (BRAMS): Application à l'étude d'un système convectif observé pendant la campagne AMMA. . Clermond-Ferrand II, Université Blaise Pascal.

Peter, A.-C. (2007) Variabilité de la température de la couche de mélange océanique en Atlantique équatorial aux échelles saisonnières à interannuelles, à l'aide de simulations numériques. Université Paul Sabatier Toulouse III.

Peyrillé, P. (2006) Etude idéalisée de la mousson ouest-africaine à partir d'un modèle numérique bi-dimensionnel. . Université Paul Sabatier Toulouse III.

Philippon, N. (2002) Une nouvelle approche pour la prévision statistique des précipitations saisonnières en Afrique de l'ouest et de l'est : méthodes diagnostics (1968-1998) et applications (2000-2001). . Dijon, Université de Bourgogne.

Pohl, B. (2007) L'Oscillation de Madden-Julian et la variabilité pluviométrique régionale en Afrique Subsaharienne. Dijon, Université de Bourgogne.

Pospichal, B. (2009) Diurnal to annual variability of the Atmospheric Boundary Layer over West Africa: A comprehensive view by remote sensing observations. . Austria, LOGO des IGAM Institute for Geophysics, Astrophysics, and Meteorology.

Ramel, R. (2005) Impacts des processus de surface sur le climat en Afrique de l'Ouest. . Grenoble, Université Joseph Fourier.

Revillet, C. (2009) Cycle de vie des lignes de grains. Bilan d'eau et d'énergie. Université de Versaille Saint Quentin en Yvelines.

Rio, C. (2007) Paramétrisation de la couche limite atmosphérique convective et représentation du cycle diurne des nuages dans un modèle de climat. . Institut National Polytechnique de Grenoble.

Risi, C. (2009) Les isotopes stables de l'eau: applications à l'étude du cycle de l'eau et des variations du climat. . Paris VI, Université Pierre et Marie Curie.

SALL Saidou Moustapha , 2005 Recherches sur les facteurs influençant la cyclogénèse Atlantique à proximité des côtes Africaines, UCAD, Sénégal

Saunois, M. (2009) Bilan de l'ozone troposphérique en Afrique : Apport du programme AMMA-Chimie. Université Paul Sabatier Toulouse III.

Sauvage, B. (2004) Analyse des distributions d'ozone et de monoxyde de carbone en Afrique équatoriale à partir des données du programme aéroporté MOZAIC. Université Paul Sabatier Toulouse III.

Saux-Picart, S. (2007) Etude couplée modélisation/télédétection pour le suivi des états et bilans hydriques de surface en zone sahélienne. . Paris VI, Université Pierre et Marie Curie.

Sow, B. A. (2007) Impact de la météorologie côtière sur l'upwelling sénégalais. . Université de Bretagne Occidentale.

Sow, M. (2009) Mesure, caractérisation et paramétrisation des flux d'aérosols terrigènes produits par érosion éolienne en zone sahélienne. . Université Paris XII.

Sultan, B. (2002) Etude de la mise en place de la mousson en Afrique de l'Ouest et de la variabilité intra-saisonnière de la convection. . Paris VII, Université Paris Diderot.

Trzaska, S. (2002) "Global SST impacts on the tropical atmosphere in the peri-atlantic region in the ARPEGE-Climat AGCM. Application to the climate variability in the Western and Southern Africa. Dijon, Université de Bourgogne.

Varado, N. (2004) Contribution au développement d'une modélisation hydrologique distribuée. Application au bassin versant de la Donga, au Bénin. Grenoble, INPG, Université Joseph Fourier.

Vischel, T. (2006) Impact de la variabilité pluviométrique de méso-échelle sur la réponse des systèmes hydrologiques sahéliens : Modélisation, simulation et désagégation. Grenoble, INPG, Université Joseph Fourier.

Wade, M. (2010) : Caractérisation de la couche limite océanique pendant les campagnes EGEE/AMMA dans l'Atlantique Equatorial Est. . Toulouse, Université Paul Sabatier Toulouse III.

Yaka, P. (2008) Rôles des facteurs climatiques et environnementaux dans l'apparition et la prédiction des épidémies de méningite cérébro-spinale en zone sahélo-soudanienne de l'Afrique de l'Ouest ; cas du Burkina Faso et du Niger. Université Paris 1 Sorbonne.

Zahiri, E.-P. (2007) Cycle de l'eau des systèmes convectifs Ouest Africains: préparation à l'exploitation des mesures radar Xport dans AMMA par simulation. Université Paul Sabatier Toulouse III.

Acronyms used in this document

A

ABN : Autorité du Bassin du Niger

ACMAD : African Centre of Meteorological Application for Development

AERONET: AErosol RObotic NETwork

AEW : African easterly waves

AGCM : Atmospheric General Circulation Models

AGRHYMET : Regional Centre for Agricultur, Hydrologyi and Meteorology

AIP : Atlantic Implementation Panel

ALMIP : AMMA Land surface Model Intercomparison Project

AMIP : Atmospheric Model Intercomparison Project

AMMA : African Monsoon and Multidisciplinary Analyses

AMMANET : AMMA Network

AMO : Atlantic Multidecadal Oscillation

AMSU : Advanced Microwave Sounding Unit

AOC : AMMA Operation Center

APO : AMMANET Projet Office

AR : Assessment Report (IPCC)

ARPEGE : AGCM in Meteo-France

ASAR : Advanced Synthetic Aperture Radar

ASECNA : Agence pour la Sécurité de la Navigation Aérienne en Afrique et à Madagascar

AU African Union

AVHRR : Advanced Very High Resolution Radiometer

C

CATCH : Service d'observation AMMA : Couplage de l'Atmosphère Tropicale et du Cycle Hydrologique

CBS : Commission for Basic Systems

CGIAR : Consultative Group on International Agricultural Research

CHIMERE : Chemistry-transport model

CILLS : Comité permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel

CLIVAR : Climate Variability and Predictability

CMAP : CPC Merged Analysis of Precipitation

CMIP : Coupled Model Intercomparison Project

COMBE

CORDEX : COordinated Regional climate Downscaling EXperiment

CORUS : Coopération pour la Recherche Universitaire et Scientifique

CPC : NOAA Climate Prediction Center

CRM : Cloud Resolving Model

CSAM : Comité de Suivi AMMA Afrique

D

DABEX : Dust and Biomass burning Experiment

DEMETER : Development of a European Multimodel Ensemble system for seasonal to inTERannual prediction

DHC : Drought Monitoring Centre

DODO : Dust Outflow and Deposition to the Ocean

DUALER : dual-channel airborne peroxy radical chemical amplifier

E

ECMWF : European Centre for Medium-Range Weather Forecasts

ECOCLIMAP: Global database of land surface parameters at 1km resolution

ECOWAS : Economic Community of West African States

EGEE : Etude de la Circulation Océanique et de sa Variabilité dans le Golfe de Guinée

EGOS : European Group on Ocean Stations

ENSEMBLES : Ensemble-based Predictions of Climate Changes and their Impacts

ENSO : El Niño et Southern Oscillation

ENVISAT : ENVIronment SATellite

EOP : Enhanced Observation Period

ERA : ECMWF ReAnalysis

ERS : European Remote Sensing

ESSP : Earth System Science Partnership

ET : Expert Team

EWS: Early Warning Systems

F

FAO : Food and Agriculture Organization

FENNEC : Field experiment on the Saharan Climate System

FSP : Fonds de Solidarité Prioritaire

G

GCM : General Circulation Model

GCOS : Global Climate Observing System

GCSS : GEWEX Cloud System Study

GEF : Global Environment Facility

GEO : Group on Earth Observations

GEOMAR : Research Center for Marine Geosciences

GEWEX : Global Energy and Water Cycle Experiment

GFS : Global Forecast System
GG : Gulf of Guinea
GHG : GreenHouse Gas
GIEC : Groupe d'experts intergouvernemental sur l'évolution du climat
GLASS : Global Land/Atmosphere System Study
GLOSS : Global Sea-Level Observing System
GLOWA : Global Change and the Hydrological Cycle
GLP : Global Land Project
GMES : Global Monitoring for Environment and Security
GOOS : Global Ocean Observing System
GPM : Global Precipitation Measurement

H

HAPEX : Hydrological Atmospheric Pilot Experiment
HYCOS : Hydrological Cycle Observing System

I

ICIG : International Coordination and Implementation Group
ICSU : International Council for Science
ICTP : International Centre for Theoretical Physics
IDAF : IGAC/DEBITS/AFRICA (Monitoring Network of Atmospheric Chemistry in Africa)
IEO : International Executive Office
IFM : Institute for Marine research
IGAC : International Global Atmospheric Chemistry
IGBP : International Geosphere-Biosphere Program
ILEAPS : Integrated Land Ecosystem – Atmosphere Processes Study
IMPETUS: Integrated approach to efficient management of scarce hydrology ressources in West Africa
IPCC : Intergovernmental Panel on Climate Change
IPO : International Project Office
IPSL : Institut Pierre Simon Laplace
IRD : Institut de la Recherche pour le Développement
ISEC : Interactions Society-Environment-Climate
ISP : International Science Plan for AMMA
ISSC : International Scientific Steering Committee of AMMA
ITCZ : Inter-Tropical Convergence Zone
ITF : InterTropical Front

K

KNUST : Kwame Nkrumah University of Science and Technology

L

LAM : Limited Area Model

LES: Large Eddy Simulation

LIDAR : light detection and ranging

LINET: Lidar NETwork for monitoring aerosol and ozone

LLWJ : Low-Level Westerly Jet

LOP : Long Observing Period

LSM : land surface model

M

MAO : Mousson d'Afrique de l'Ouest

MCS : Mesoscale Convective System

MERIT : Meningitis Environmental Risk Information Technologies

MIP : Model Intercomparison Project

MJO : Madden-Julian Oscillation

MODIS : Moderate Resolution Imaging Spectroradiometer

MOPITT : Measurements of Pollution in the Troposphere

MOU : Memorandum of understanding

MOZAIC : Measurement of OZone and water vapour by AIrbus in-service airCraft

MSG : Meteosat Second Generation

MT : Megha-Tropiques

N

NAMMA : NASA AMMA

NASA : National Aeronautics and Space Administration

NCAR : National Center for Atmospheric Research

NCEP : National Center for Environmental Prediction

NDVI : Normalized Difference Vegetation Index

NMHS : National Meteorological and Hydrological Services

NOAA : National Oceanic and Atmospheric Administration

NWHS : National Weather and Hydrological Services

NWP : Numerical Weather Prediction

O

OLR : outgoing longwave radiation

OMP : Observatoire Midi-Pyrérées

OMVS : Organization for the Development of the Senegal River
OOPC : Ocean Observations Panel for Climate
OSD : WMO Observing Systems Division

P

PCMDI : Program for Climate Model Diagnosis and Intercomparison
PhD : Post Doc
PHOTONS : French component of AERONET
PIAF : Plan d'Implementation AMMA Afrique
PIRATA : Prediction and Research Moored Array in the Tropical Atlantic
PIREM : Plate-forme des Institutions Régionales pour l'Environnement et la Météorologie
POMME : Progamme Océan Multidisciplinaire Méso Echelle
PREDICATE : Predictability of Decadal Fluctuations in Atlantic-European Climate
PRESAO : PREvision Saisonnière en Afrique de l'Ouest
PROPAO : Programme Régional d'Océanographie Physique en Afrique de l'Ouest

R

RADAGAST : Radiative Atmospheric Divergence using ARM mobile facility
RCM : Regional Climate Model
RegCM : CTP REGional Climate Model
RF : Radiative forcing
RIPIECSA : Recherche Interdisciplinaire et Participative sur les Interactions entre les Ecosystèmes, le Climat, et les Sociétés d'Afrique de l'ouest
ROA : Regional Office for Africa
RVF : Rift valley fever

S

SAMUM : Saharan Mineral dUst experiMent
SARRAH :Modèle de croissance de plante
SCOUT : Stratospheric-Climate links with emphasis on the Upper Troposphere and lower stratosphere
SECAO : Suivi Environnemental et du Climat en Afrique de l'Ouest
SEVIRI : Spinning Enhanced Visible and Infrared Imager
SHADOZ : South Hemisphere Additional Ozonesonde
SHL : Saharan heat low
SMOS : Soil Moisture and Ocean Salinity (Satellite)
SOERE : Systèmes d'Observation et d'Expérimentation pour la Recherche en Environnement
SONEL : Système d'Observation du Niveau des Eaux Littorales

SOP : Special Observing Period
SPOT : Satellites Pour l'Observation de la Terre
SSG : Scientific Steering Gro
SSS : sea surface salinity
SST : Sea Surface Temperature
ST : Support Teams
STC : subtropical cell
SVAT : Soil Vegetation Atmosphere Transfer

T

TACE: Tropical Atlantic Climate Experiment
THORPEX : The Observing System Research and Predictability Experiment
TIGGE : THORPEX Interactive Grand Global Ensemble
TIW : Tropical Instability Waves
TOVS : TIROS operational vertical sounder
TRMM : Tropical Rainfall Measurement Mission
TT : Task Team
TTL : tropical tropopause layer

U

UCAD : Université Cheikh Anta Diop
UEMOA : Union Économique et Monétaire Ouest Africaine
UN : United Nations
UNDP : United Nations Development Programme
UNFCCC : United Nations Framework Convention on Climate Change

V

VACS : Variability of the African Climate system
VEGETATION: SPOT sensor for vegetation
VOC : volatile organic compound

W

WA : West Africa
WAM : West African Monsoon
WAMME : West African Monsoon. Modeling and Evaluation
WCRP : World Climate Research Programme
WGCM : Working Group on Coupled Modelling
WGSIP : Working Group on Seasonal to Interannual [or Seasonal-to-interannual] Prediction

WHO : World Health Organization
WMO : World Meteorological Organization
WWRP : World Weather Research Programme

Y

YOTC : Year of Tropical Convection

Based on a French initiative, AMMA has been built up by an international scientific group and is currently financed by a large number of agencies, particularly from Africa, European Commission, France, the United Kingdom and the United States. Full details on the scientific coordination and financing are available from the AMMA International site:

www.amma-international.org