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International AMMA Newsletter

AMMA
La Mousson africaine
African Monsoon Multidisciplinary Analyses

Editorial

At each conference from Dakar to Ouagadougou, the AMMA programme has given a brilliant demonstration of the pertinence of its mission and is now held in high respect.

Today, AMMA has built up a collection of data and observations of unprecedented quality and brings into play a very high level of very committed expertise.
The need now is not only to make sure that this dynamic current is perpetuated but also to capitalize on all its aspects, both scientific and social (socio-economic aspects).

The engagement of the parties involved (developed countries) is certainly the expression of a need but, above all, crystallizes the possibility of a real North-South research partnership.

Among other achievements, AMMA has succeeded in mobilizing African researchers to work in a network addressing complex scientific questions and also questions concerning durable economic and social development.

What should be emphasized today?

Without the considerable support of the African political decision-makers, any scientific development initiative will be hard-pressed to survive. These decision-makers must be largely made aware of what AMMA represents, both as science but also as a response to an important regional question.

Scientific institutions and operational structures like the meteorological services will have to make a greater and better investment in AMMA if the results are really to bear fruit.

West Africa must take over AMMA: a huge, constant amount of work will have to be invested, doubtless under African leadership, for the benefit of future populations.
This is the great challenge of the new aims to be identified for the second phase of the AMMA programme that is waiting to be built.

Alioune Ndiaye and Pierre Soler
New IGB co-Chairs

Langue de Barbarie, Sénégal©Sonneville

FIRST OUTCOME OF AMMA PHASE I (2002-2009): SYNTHESIS OF BENEFITS AND PERSPECTIVES

Launched in Niamey in February 2002, AMMA is an international programme to improve our knowledge and understanding of the West African monsoon (WAM) and its variability in emphasing daily-to-interannual 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.
The international AMMA programme 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 significant progress towards increasing our knowledge and understanding of the multi-scale and multi-disciplinary aspects of the West African monsoon. Scientists continue to collaborate in various key areas including the coupled atmosphere-ocean-land system, interactions between aerosols and the monsoon, multi-scale analysis of the water cycle and ultimately how the society, environment and climate interact. AMMA has thus been particularly successful in addressing the first aim. AMMA has also built the scientific basis and a community necessary to successfully address the second aim in the coming years. The third aim of AMMA has been taking care but major advances in our knowledge about the West African monsoon system and its variability have now to be transferred into improvement of prediction and early warning systems.

With some of the funded AMMA projects reaching the end of their lifetime in the coming year the future directions and priorities for the AMMA programme are the object of discussions and meetings, including those during the 3rd AMMA Conference in Ouagadougou. AMMA still faces major challenges and, with the tendency of more scattered funding, it is more necessary than ever for

A part of the people present at the 3rd International Conférence in Ouagadougou©AMMA

international coordination to address these challenges. A major achievement of AMMA was the implementation of the long term observation period 2001-2009 and research field campaigns in 2005-2007, that included several intense observing periods. Central to this were huge improvements to the radiosounding network. Hundreds of AMMA scientists continue to work on these observations. AMMA has created a unique multiscale multidisciplinary database that is used from all over the world and has been duplicated in Africa. More research is required in order to provide recommendations for the future sustained observing system to support monitoring and prediction of climate as well as high impact weather analysis and prediction.

Another major achievement of AMMA has been the establishment of a large and active African community working on AMMA science. The enhancement of capacity building and training efforts in Africa need to be pursued with vigour and based on the objectives of the AMMA programme. AMMA needs to coordinates these activities with all relevant bodies and institutions.

Through the exchanges with African scientists and end-users it has become increasingly clear that AMMA needs to work more on the science relevant to the impacts. Some progress has been made in this direction. A research programme on society-environment-climate interactions will be developed based on the first successes of AMMA on this area. Many research projects are currently developed at national and pan-national levels and it is essential to coordinate them at international level. Together with the geophysics research, the research on the society-environment-climate interactions is key to drive adaptation and mitigation efforts, including the improvement of Early Warning Systems. This ultimately means an increased focus on how weather and climate interact since it is the weather statistics that most applications require, rather than a seasonal mean value for example. One area where particularly important gains are likely to be made is at the intraseasonal timescale. This is a key timescale for the end-users and it is a key timescale to explore the weather-climate interaction and to evaluate models ability to represent these interactions.
In addition to this focus there is a clear need to improve models used for climate prediction (from intraseasonal-to-decadal as well as for climate change prediction). The lack of agreement between IPCC AR4 models on the prediction of the sign of the rainfall change in the coming century is further motivation for AMMA to address this problem. There are significant model biases in models used to make predictions of the present climate that must be addressed. Amongst of obvious biases the warm bias in the Tropical Atlantic Ocean is one of the most important to focus. Other biases exist (e.g. heat low strength, rainfall amounts and location) and these must be prioritized for future coordinated research efforts. A third area which AMMA needs to bolster is in how the West African region interacts with the rest of the World, including other regions of Africa and especially East and Central Africa; this will also be an opportunity to strengthen linkages with African scientists working in those regions.

In all of these aspects, AMMA endorsement by WCRP and WWRP and its programmes, needs to be extended with a larger implication of these programmes in the steering of AMMA. The steering of the second phase of AMMA has to be managed differently from the first phase with new forms of governance and coordination and a strong executive committee benefiting from an international support. AMMA has grown from a small group of scientists into a vibrant and truly International Program with presently contributions from more than 500 scientists, 140 institutes and 30 countries.

AMMA has been a grassroots effort driven mainly by the scientists motivated to work on West African monsoon. AMMA has to continue and builds on what has been achieved so far, in keeping a strong international coordination.

The large Dimaako room of the 3rd International AMMA Conference, Ouagadougou©AMMA

Press conference with Aïda Diongue, Cheikh Mbow, Ernest Afiesimama, Harouna Karambiri et Jean-Luc Redelsperger Ouagadougou©AMMA

Le café des sciences, Ouagadougou©AMMA

Tribune d'honneur durant la 3éme Conférence International AMMA à Ouagadougou ©AMMA

RESULTS OF THE 3RD AMMA INTERNATIONAL CONFERENCE

The 3rd AMMA international conference held in Ougadougou in July 2009 has presented the main achievements in front of 500 researchers from all disciplines and allowed to consolidate the plan of the AMMA phase II during debates and meetings from organising committees.
The abstract book is online:

www.amma-international.org/rubrique.php3?id_rubrique=122.

Talks and posters are available on the AMMA bibliographic website.
Talks presented below come from the reports redacted by chairs and/or secretaries of sessions.

3ème Conference International AMMA, Programme

20-24 Juillet 2009

	Monday 20	Tuesday 21	Wednesday 22	Thursday 23	Friday 24	
	Registration	Plenary session 3	Plenary session 5	Plenary session 7	Parallel sessions 9	
08:30	Opening session Introduction and Institutional talks	West African Monsoon Processes J. Polcher, C. Flamant	Weather and Climate Variability and Predictability J.P. Lafore, A. Tompkins	Society-Environment-Climate Interactions S. Traore, L. Genesio	9A Mesoscale convective systems and Atmospheric boundary layer E. Williams, F. Guichard 9B Aerosols-Dust-Chemistry-3 (Dust) A. Konare, B. Marticorena 9C Climate and human impacts on water resources and management strategies H. Karambiri, A. Ali	08:30
10:00	BREAK					
10:30		Break 3 cont.	Break 5 cont.	Break 7 cont.	Break 9A cont. E. Williams, F. Guichard 9C cont. S. Becerra, A. Niang-Fall 9D Regional climate models A. Diongue-Niang, K. Cook	10:30 11:00
12:30	Lunch	Lunch	Lunch	Lunch	Lunch	12:30
	Parallel sessions 2	Parallel sessions 4	Parallel sessions 6	Parallel sessions 8		
14:00	2A Monsoon system and Atmospheric boundary layer S. Janicot, J.P. Lafore 2B Hydrological processes T. Lebel, C. Peugeot 2C Agricultural, livestock and natural vegetation vulnerability to climate variability and change: perceptions and adaptations C. Mbow, O. Mertz	4A Climate Variability and Predictability P. Lamb, P. Ruti 4B African easterly waves and tropical cyclones C. D. Thorncroft, N. Hall 4C Agricultural, livestock and natural vegetation vulnerability to climate variability and change: perceptions and adaptations B. Barbier, L. Genesio 4D Climate impacts on health S. Danuor, N. Martiny	6A Intraseasonal variability C. Zhang, S. Janicot 6B Aerosols-Dust-Chemistry-1 (Chemistry) C. E. Reeves, C. Mari 6C Water cycle A. Agusti-Panareda, M. Gosset 6D Climate impacts on agriculture, livestock and natural vegetation C. Baron, L. Somé	8A Ocean processes G. Caniaux, P. Brandt 8B Land processes C. M. Taylor, E. Mougin 8C Socio-economic vulnerability and adaptations J. Nielsen, P.D. Fall	Recommendations and Round table	14:00
15:15	Poster introduction 2A, 2B, 2C-4C	Poster introduction 4A, 4B-9A, 4C-6D, 4D	Poster introduction 6A-9D, 6B-9B, 6C, 9C	Poster introduction 8A, 8B, 8C		
15:30	Poster session	Poster session	Poster session	Poster session		
16:30	Break	Break	Break	Break		16:30
17:00	Poster session	Poster session	Poster session	Poster session		
17:30	2A cont. 2B cont. 2C cont. P. Hiernaux, M. Bacci	4A cont. 4B cont. 4C Climate impacts on agriculture, livestock and natural vegetation I. Diedhiou, A. Ka 4D cont. J.A. Ndione, A. Morse	6A cont. 6B Aerosols-Dust-Chemistry-2 (Aerosols) A. Konare, P. Formenti 6C cont. 6D cont. S. Traore, B. Muller	8A cont. 8B cont. 8C cont. P. Quirion, A.H. Dia		
18:30			AEWACS			18:30
	Get together cocktail	Café des Sciences				
			AMMA on the screen	Gala dinner		

Plenary Session : Climatic change, African monsoon system, predictability and society-environment-climate interactions

The review of current knowledge and advances made towards understanding the African monsoon since the AMMA programme began has enabled scientists to identify the new questions that must be resolved to arrive at a conceptual model of the monsoon system.
One of the research teams' main objectives in line with this search is to hierarchize the dominant processes involved and unravel their interactions, so that the overall monsoon system balance and the principal ways in which it varies can be deciphered. Other than that, they are seeking to evaluate if the characteristics of this system can be predicted.
Current models cannot properly represent the processes involved in the monsoon. To improve them it is essential to define the most important variable parameters which must be observed.

The themes to be addressed hinge essentially on the key components of the monsoon system:

- the monsoon layer and the processes at work in the boundary layer
- the Saharan thermal low and monsoon surges
- dynamics of the Easterly waves, jets and dry intrusions
- clouds and convection
- coupling with aerosols, continental and oceanic surfaces

Significant new results have been obtained and were presented at this conference.
Measurements and investigations on the atmospheric boundary layer have led to identification of intrusions of dry air coming from higher altitudes, especially before monsoon onset. These contribute strongly to exchanges between the monsoon and the Saharan air layer. This is consistent with the existence and size of the northerly return flow of the monsoon. However, these processes have yet to be properly parameterized in today's models

In monsoon pre-onset conditions, the scientists characterized, a process monsoon surge with a 4-day periodicity. This process pushes the moist air masses far towards the north, in a movement controlled by the activity of the Saharan thermal low and it becomes part of the life-cycle of this depression.
Details of the seasonal climate pattern of the Saharan thermal low have now been unravelled and the ventilation processes have been located along the coast of NW Africa and the Mediterranean. These processes are the source of a strong East-West system of variability of this depression related to activity at mid latitudes.
Dry air intrusions originating from the extratropical upper troposphere have been characterized. Their path comes to its end just at the northern edge of the convection zone over Africa.
Highly significant advances have been made on the dynamics of the Easterly waves, their interaction with the East African Jet and the convection movements. The build-up of these waves was shown to require an impulse provided by a diabatic heat source resulting from this convection. Such development also depends strongly on whether or not the base state of the jet is favourable.
Another feature presented was the important role of the formation of the Gulf of Guinea's cold water tongue in the monsoon onset.

It will now be necessary to intensify studies on the interactions between the African monsoon and the extratropical regions, East Africa or the South Atlantic. Research must also be developed on the mechanisms regulating the monsoon's intraseasonal variability and in particular its onset. Development of a conceptual model should also be pursued, by means of appropriate climatological studies and idealized simulations.

Farmers in the Sahel have always had to face problems linked to recurrent variations in climate. The breaking points in households' ability to cope have been influenced by acute reductions in rainfall levels (resulting in drought), food stock failures, livestock management and environmental degradation.
Communities' resilience to such changes is associated with their ability to apply adaptation and confrontation strategies. These strategies include crop diversification, movement of humans and animals, diversification of staple foods and migration. A conceptual analysis of adaptation sheds light on a circle of interlacing causes where the driving force of change extends over a range of factors in which climate, politics and economics play a central role.

With time, how have rural populations in the Sahel developed adaptive responses to what is a wide range of factors? And in what ways have these responses differed significantly in approach, depending on the strategies used, with regard to livestock, poverty level and the scale of the change?

Researchers have attempted to demonstrate the interaction of biophysical and socio-economic causes which create the vulnerability of poor rural communities of the Sahel.
The case of the Sahel shows the importance of concentrating on the "slow acting" variables (for example: agricultural decline) as much as on the abrupt, brutal events (extremes of climate, food crises) to estimate the vulnerability of ecosystems and communities. Such a focused approach will help when actions have to be devised to reduce famine and help societies prepare better to confront these stocks. It is also a support for systems that allow the adaptation to take place.

The hypothesis was advanced that there are several ways of arriving at a sustainable level of resistance to

climate change, dependent on local conditions and the different options people in communities or at national level have for meeting these challenges.
An idea is being followed up to analyse the dynamics of the Sahel environment.
In the early 1970s, during the great Sahel drought, most environmentalists sought explanations for desertification essentially among human and biological factors. During the arid period of 1980-1990, land degradation and natural resources management were predominant in most studies conducted. This period marked the start of participatory research-development projects with a strong investment in communities. In the 1990s, the Rio conventions gave sustenance to the problems revolving around environmental changes. Agreement is now almost unanimous about the great challenges climate change will present. It has therefore become essential for communities in developing countries to improve their resilience, or the ability to adapt to the ensuing changes.

Scientists are comparing the effects of climate change, a vector of vulnerability and change in communities, with those of other stresses (social, political and economic) on key economic sectors like agriculture, forestry or management of pastoral resources, to gain a clearer appreciation of the degree of significance of links between environmental change and responses adopted locally. Climate change appears to be one factor among many others, just as important to consider in the use of the human-environment interactions for developing adaptive strategies.

The political and economic factors are highly complex. They depend not only on several external causes but also on the place where adaptation measures have to be taken. Reactive management of crises must be a step forward, an approach that can help establish sustainable prospects in the long term. Anticipation, prediction, precaution, prevention, conservation and eviction: all are key concepts for any sustainable development policy in a context where a multitude of stresses are at work.

An overview of West African climate variability was presented, since predicting climate change with confidence requires an understanding of climate variability. Decadal variability is especially important since the time scale is the same as the climate change signal. Low rainfall rates in the Sahel in the 1970's and 80's are associated primarily with Indian Ocean warming, exacerbated by a warm tropical North Atlantic. The recent recovery in Sahel rainfall occurred despite continued Indian Ocean warming because the scale of that warming has increased, placing the associated subsidence off the West African coast.

Month-by-month projections of West African climate for the end of this century have been generated using regional and global climate model simulations together. Significant regional and temporal variations in the climate change signal emerge. Severely dry conditions develop over West Africa in June and July, followed by rainfall enhancements in August, September, and October accompanied by large increases in the occurrence of intense rainfall events. The risk of heat stroke increases throughout West Africa.

Because high rates of climate change make adaptation and mitigation more difficult, and because the paleoclimate record tells us that West Africa has experienced rapid climate change in the past, the potential for abrupt climate change under greenhouse gas-forcing was evaluated. This propensity for abrupt climate change may be related to the region's strong land surface atmosphere interactions, which can generate two stable climate states under the same external climate forcing, to the nonlinear internal monsoon dynamics, or to the sensitivity to SSTs.

West Africa's unique and complicated climate, coupled with the vulnerability of the population to climate variability and change, speaks to the continued need for high-quality observations to support increasingly confident and detailed climate prediction.

Oursi, North of Burkina Faso©AMMA

Session 2B Hydrological processes

Several hydrological models, using knowledge about the processes involved, were applied and tested on a variety of hydrological basins across West Africa, as a preliminary step towards water resources assessment. A new formulation for catchment discharge based on the principle of minimum energy consumation was proposed. Several tests will show if this formulation can be an effective alternative for the existing model schemes. A case study using rainfall fields produced from a series of meso-scale atmospheric models show that these fields must be first of all corrected / unbiased before being used in a hydrological model.

Several communications reported results on the environmental and hydrological changes recorded over recent decades. They showed trends that were the converse of the observed reduction in precipitation figures: runoff increase on the Senegal or a rise in deep infiltrations. The processes brought to light are linked to changes in surface conditions, mainly due to human activity (agriculture and so on).
The changes also affect the sediment budget, with a rise sediment transfer which interacts with the hydrological cycle.

Characterization of the geometry, the physical and dynamic properties of underground reservoirs is important for understanding the integrated water cycle. Recent results from field experiments (MRS-Magnetic Resonance Sounding, gravimetry) were described.
The results of the GHYRAF (Gravity, HYdRology in AFrica) are promising: estimations of variations in underground water storage, derived from field gravimetric surveys, are consistent with those obtained from piezometer networks and neutron probes surveys (using MRS data to estimate the reservoir porosity). They are also consistent with the values obtained from the GRACE (gravimetry by satellite) experiment at regional scale.

Two studies deal with investigations on hydrological processes.
The first on the redistribution of rainfall, not well documented until now in ponds or streams in the AMMA meso-scale site of Gourma, using satellite imagery.
The second is on the contribution of underground reservoirs to river discharge, in a tributary of the Niger upstream of the Sudanian zone. These first results represent a preliminary regional extension for investigations conducted at the AMMA Sudanian site in Benin.

Road in the north of Burkina Faso©Devic/AMMA

Session 2C: Vulnerability of farming, cattle and natural vegetation to climate variations and change: perception and adaptations

Climatic changes and fast demographic growth in Sahel print on the environmental system strong modifications that local populations have to support and affront with a rapid adaptation to these new conditions.
Vegetation vulnerability in Sahel are evaluated on the last twenty decades in two test site in Mali (Gourma) and Niger (Fakara). The monitoring period is characterised by a relative increase of the rainfall and a pressure on the resources due to demographic growth.
In a long and short term monitoring, an effective resilience of the vegetation species is observed especially in the moister south part. The scientific questions are concentred on the possibility to manage the natural growing of the vegetation renovation and composition that should explain differences in the resilience.

In the domain of adapting farming activities to climate change, there is a diversity of adaptation options that can be classified according to geographical regions. Production habits also vary among the groups concerned. The results show that much local practice and knowledge exists, which has enabled rural populations to survive in the face of the multiple impacts connected with climate change. These options may be diversified and concern developing irrigation, abandoning certain types of crops, diversifying agriculture, moving production activities, promoting traditional cultivars, producing fruit, exploiting forest resources, etc.

To identify and classify the types of adaptation strategies in the Sahel and determine the key variables that distinguish social groups, active variables, such as cereal production or local rainfall, are tested while illustrative variables essentially concern human resources. In a case study, two principal discriminating factors were brought out by statistical analysis. The first factor is the difference in farming practice according to the soil and the second is temporary migration.

Various forms of adaptation are coming into existence depending on the agro-ecological zone, the relief, access to fertilizers... In Mali for example, strategies concern early sowing, the use of new crops, rearrangement of the farming calendar, religious practices, intensification of cattle rearing, charcoal making, the extraction of palm wine, forest products, the emergence of new jobs like motorbike taxis, etc. But new problems are also coming to light, like the impact these new forms of adaptation have on the climate: motorbike taxis create pollution, charcoal manufacture destroys forest resources, etc.

There are everyday options for ensuring food supplies and attenuating the degradation of the land or fighting the invasion of parasites. But there are limits to people's adaptation options and there is a lack of investment in adaptation practices. Studying the use of traditional plants is a path that should not be overlooked.

A comparison of the perception of climate change between farmers who use irrigation and those who rely on rainfall provided evidence of very fluctuating irrigation practices in most of the Sahel countries. For the Nile, 70% of the water is used for irrigation whereas very little water from the Rivers Senegal and Niger is used. Moreover, the cost of irrigation is very high in the Sahel. Farmers practising irrigation are more optimistic in their perception of climate changes: they are less inclined to migrate and tend to diversify more in cases of aridity than those practising rain-dependent agriculture
.
Many questions arise from these observations: How can irrigation practices be improved and water resources be optimized for food production, thus reducing the impact of climate risk? What is the impact of irrigated plots on rain-dependent farming? Are the two production systems in competition or are they complementary?

The effects of climate change on the live of the populations can be describe and guid scientific studies. The population seems to feel the insufficiency of the water supply for crops, and people are conscious of drought or excess water. The perspectives for research are to find an the agreement or contrast between people's perception and scientific results.

Stresses such as degradation of the ecosystem or rainfall variations linked with climate change, added to the insufficiency of infrastructure for cattle and an absence of laws that could reduce conflict over the use of territories, lead to problems for feeding cattle in the Sahel.

The vulnerability of vegetation in the Sahel has been assessed over the last 20 years at two test sites in Mali (Gourma) and Niger (Fakara). The characteristics of the period of observation have been a relative increase in the amount of rainfall and in the pressure on resources due to population growth.
In long- and short-term observation, effective resilience of plant species has been noted, particularly in the more humid southern area. Scientific questions have concentrated on the possibility of controlling the natural renewed growth and the composition of the vegetation that could explain differences in resilience.

Studies have investigated the resilience of pasture with the example of the interaction between agriculture and cattle in the Senegal river valley. Moving cattle should be considered as an adaptation strategy.
A future development of scientific methods for perceiving this climate change phenomenon will give a better understanding of the human and natural forcing that influence environmental changes and could try to provide effective responses for adapting to climate change.

Tuesday 21 of July

Plenary Session: West African Monsoon Processes

The session began with land use impact studies on continental surfaces, including the effect of degradation of the vegetation on river discharges. Deforestation, and surface degradation in general, influence the characteristic run-off time of water coming from low-level tributaries feeding the River Niger in the Sahel region. The competing influences of climate and human activity on the state of the vegetation were the subject of another lecture. Positive trends were observed across the Sahel and the Sudan in the period 1982-2003. The overall positive trend towards a "greener" vegetation and a greater plant biomass is interpreted as a renewed greening of the Sahel. The climate seems to be the primary factor responsible for this overall effect. Locally, however, disparities in vegetation are also observed, this time particularly those caused by human activity (some localities show a negative trend).

One of the objectives of the AMMA Land surface Model Intercomparison Project (ALMIP) is to describe the surface states in West Africa around the years of AMMA's intensive field campaign. The parameters so produced are crucial data and widely used by the AMMA community. Another of ALMIP's aims is to compare current continental surface models. The soil surface humidity is very well simulated at regional scale when the given atmospheric forcing is correct.

The hydrological processes in West Africa associated with shallow water recharge and evapotranspiration were discussed. Impact of humidity bias in the ALMIP products (when the models are forced by TRMM (Tropical Rainfall measuring Mission) rainfall) on the yield of evapotranspiration in a hydrological model was examined. It was nevertheless shown that it could realistically reproduce the runoff at seasonal scale.
A new method of Lagrangian kriging of rain fields which takes account of typical displacements of convection systems in the region has been developed. The aim of this is to elaborate high-resolution rain fields and has certain advantages over standard kriging techniques.

Surface energy flux variations at a range of scales from diurnal to seasonal were characterized and explanations of mechanisms that govern them were proposed. In the Sahel the net radiation responds more to changes in state of the surface whereas in the Sudan region it decreases in response to the cloud radiative forcing. The inter-annual variability of long-wave radiation fluxes is closely bound to that of the rainfall in the Sahel. Case studies were conducted to gauge the impact of passing convective systems on the surface humidity and energy status and the scales of the return time for the various components. The researchers showed that the surface responds in a different way at the beginning and during the mature phase of the rainy season. Clearly, soil moisture is the slowest of the energy reservoirs to return to its initial state after the passage of a convective system, with a characteristic time of about two days.
Several atmospheric processes were discussed. The roles of dry intrusions from the higher latitudes were examined and linked up with the large-scale variability of tropical convective systems. Isotope measurements on water, performed in 2006 as part of the analysis of the water cycle of convective systems, allowed particular study of water recycling. Follow-up of the evolution of water isotopes in a climate model was shown to be highly effective for checking the validity of the simulated water cycle and offers new insights into the processes involved.

The impact of African aerosols was shown on precipitation along the Guinea coast, by using an extended climatology of rainfall and aerosols on the basis of satellite data. The dominant role of aerosols coming from biomass combustion on the annual rainfall cycle along the Guinea coast was shown.
Information was presented on the nitrogen balance in the dry savannah. This allows assessments of nitrogen deposition and emission to be provided for the West African regional scale and also the global scale.
The origin of air masses which influence the composition of air in the transition layer of the troposphere called TTL (Tropical tropopause layer) was presented, with the use of data acquired by the survey aircraft Geophysica which was put into operation during the SOP phase of AMMA. Among the noteworthy results, a distribution related to altitude of contributions was proposed between that resulting from local deep convection and those of distant regions such as the mid-latitudes and Asia.

Burkina Faso©Fleury/AMMA

Session 4A: Climate variability and predictability

Seasonal forecasting

The reproducibility and predictability of West African monsoon rains in a 45-member ensemble forecast dataset (originating from 5 different coupled models contributing to the ENSEMBLES EU project) were evaluated for the periods 1991-2001 and 1961-2005. These exercises demonstrated that the dynamical predictions of ENSEMBLES are affected by an excessively strong link between the Pacific and the Atlantic and did not solve the SST bias. Nevertheless, they are sufficiently coherent in a simple statistical adaptation to be able to provide a fine-grained prediction of the rainy season for a Sahelian index, in particular for the drier months and years across West Africa for the recent period of 1991-2001. At grid point scale, the usefulness of the approach proposed here is less evident. Some worthwhile applications were put forward for locust early warning systems and for South Africa.

Climate variability

Several sensitivity experiments were reported on. They used methods taken to be traditional ones (SST anomalies) but also new techniques (regional model forced by global models). The influence of Pacific, Gulf of Guinea and Mediterranean SSTs on an inter-annual time-scale has been well documented. Such information has provided new openings and ideas (for example, the role of the position of SST anomalies across the Pacific and its seasonality, the role of the Atlantic El Nino).
The role of the Multidecadal Atlantic Oscillation continues to be a strong theme, pursued to arrive at increased long-term predictability of the West African Monsoon (MAO). New ideas were presented on the role of the Atlantic in the variability of the ENSO over the past few years. The impact of the MAO on mid-latitude variability has been demonstrated on the low-frequency variability across Europe.
The possible connection between the seasonal upwelling and the climatic conditions at the coast were analysed. The role of wind could be assessed in order to analyse causal relationships between the SSTs and coastal rainfall.
A study on the variability of the monsoon on the Horn of Africa showed the link with the almost biennial variability and with ENSO.

Climate change and scenarios

A new approach was proposed to downscale global climate model (GCM) projections in order to lower the spread of their responses. A Regional Climate Model is forced by the principal monthly boundary conditions coming from global-scenario simulations. This approach seems promising for producing a more long-term picture of regional climate. The use of a multi-RCM approach could improve this methodology.
Observation studies were proposed for the detection of recent changes in climate: analysis of rainfall trends in Benin; sediments in permanent pools were used to characterize the recent changes in climate; the SSTs of the coasts of Nigeria, a signature of climate change. The rainfall analyses in Benin brought to light the severe southerly change in the behaviour of rainfall events.

Burkina Faso©Devic/AMMA

Session 4B: S4B African Easterly Waves and Tropical cyclones

The key scientific questions are linked with the characterization of relationships between processes at different scales with a view to a better understanding of the relation between convective systems, synoptic conditions and initiation of tropical cyclones
The session showed the progress achieved in the compiling of AMMA observations giving information on the synoptic environment bringing together researchers using a variety of approaches.

New issues arise, including the phase relationships between MCSs and synoptic scale ridges and troughs and their relative propagation, a research field where more detailed understanding is necessary.
Radar observations were used to link rainfall to large-scale environmental factors. Composites could thus be elaborated for 28 cases of squall lines. Two distinct Easterly wave paths were found, corresponding to different rainfall distributions between convective and stratiform components of squall lines.
Observations from the radar systems TOGA (ocean), NPOL (Senegal) and MIT (Niamey) over different AMMA regions were described and the MCS statistics, vertical structure, etc. were compared. The NPOL site has the highest convective fractions. The vertical structure varies between the continental and maritime regions. Follow-up work will entail combining and comparing these statistics with the Easterly wave phase.
Examination of the diurnal convection cycle led to explanation of the morning convection (which propagates) and the type which prevails in the afternoon (local). Three classes were defined from radar data at Niamey: isolated convective towers, convective systems which may or may not be organized into lines. Their distributions in the times of arrival and their directions have been calculated. The squall lines come mainly from the East and most often originate on the Jos plateau on the previous day.

Using data from the Lidar aircraft and from dropsondes, the links between the different phases of the Easterly waves and the characteristics of the planetary boundary layer have been studied. The days of 8 and 11 June corresponded to wave phases in the South with the presence of deep convection and an extremely moist and cloud-charged monsoon layer. On 9 and 12 June, however, there was a phase of waves in the North without cloud. Errors in the reanalysis for humidity were notified.

A synoptic climatology using NCEP2 analyses, OLR data from NOAA and IRD-AGRHYMET rainfall data were established. This allowed definition of different weather regimes characterizing the rainfall systems in Senegal.

A numerical investigation of the generation of hurricanes Hélène was performed using the Cosmo model with an approach involving imbricated slipping nested models to follow up the systems' propagation. Comparison of the simulation results with observed data reveals a small lag in the model but it represents the larger-scale characteristics well. The diagnoses of the simulated convective systems show that vertical currents, diabatic warming and the relative vorticity are sloping when they are over the African continent and vertical over the Atlantic. Drier air at mid-level and stronger descending currents are found as much over the continent as over the ocean

In the case studies on Cape Verde Island cyclones (including Debby), the precursors identified include the convergent input flux of the monsoon and the trade winds, a propagating trough and abundant moisture. A synoptic description of cases that develop or do not develop led to an automatic detection algorithm. The inter-annual link between the atmospheric circulation over Africa and the intra-seasonal cyclogenesis was explored. Cyclone precursors (compared with all the East waves) were found and correspond to a maximum of humidity and a stronger AEJ near the coast.
The Dakar radar data bring out the transitions to tropical cyclones and offer contrasting examples (development and non-development). A precursor index was identified with a similar criterion to those already mentioned.

Session 4C: The impacts of climate on agriculture, livestock and natural vegetation

To detect a possible food crisis in the face of a climatic event, strategies using seasonal forecasts are developed to define the risk thresholds. Also it is essential to have a system for informing users so that they can prepare themselves before the event happens. Gaps in rainfall patterns sometimes occur when the millet comes to maturity, so forecasting becomes a major scientific and economic issue.

The seasonal agriculture forecasting model (SARRAH) provides simulation of yields by integrating as variables: the varieties grown, sowing date, fertilization date. It can thus demonstrate whether or not a variety is well adapted. The simulations showing the best strategies are founded on four chosen types of parameter which appear to be highly relevant. Farmers prefer not to take risks and aim to ensure the best yields by judicious choice of sowing, the date of the start of sowing or varying seasonal activities.

Many practices in the Sahel are geared towards the use of natural resources. The densification and growth of population and the ensuing needs pose problems of access and availability of resources. These processes induce communities to devise a wide range of responses to confront climatic and environmental changes and increasing variability. The results from satellite photos show that the low level of agricultural crop production dependent on rainfall leads communities to develop adaptation strategies. Mobility and migration are in this regard indicators of resilience.

In Mali, in a rural village locality of the cotton basin an agro-ecological diversity correlated with the diversity of the agricultural holdings themselves. The results of the local communities' perceptions of climate change are quite clear in relation to the question of decreased rainfall and weakening of the rainy season. Concerning the effects of violent winds on soil quality, opinions are more nuanced. The processes of land use and overexploitation of forests have a direct impact on the satisfaction of rural populations' needs, all the more so in that complementary foodstuffs become rarer.

The links between the climate and socio-economic changes have been studied in the Ivory Coast to assess the environmental changes and the behaviour of communities. The objective is to see how production and environmental changes interrelate. The slipping of the isohyets in the period 1950-1990s was expressed by inequality in access to drinking water (compensated by government action (well installation)) and well depths that had to become deeper and deeper. Adaptation strategies then developed, involving modification of the calendar and crop growing options for example or with the association of different species of plants.

In Mali, research work has assessed wood production and the floral richness as a function of climatic gradient and the dominant soil types. In the River Senegal basin, the parameters of the vegetation such as wood production, stem density per hectare, richness and diversity index are strongly correlated with rainfall levels and soil type. The equitability index is in fact higher in the Guinean and Sahelian bioclimates, where ecosystems are relatively stable, than in the Sudanian zone.

Climatic factors influence fire incidence but fire itself can influence the variability of the climate owing to its gas and particle emissions. Work is under way, using satellite data from SPOT-JRC (LGBA) and also field data.

Surveillance of the degradation in the Sahel is being conducted with the use of NDVI (Normalized Difference Vegetation Index) remote-sensing. Combination of this remote sensing with rainfall data has made it possible to monitor changes and developments in vegetation.

The fluctuations around a water point in a pastoral area (northern Senegal) were studied in terms of the productivity and dynamics of the frequency rates of storage in the FERLO. The objective is to determine of the potential and frequency-related loads (follow-up of the evolution of resources and the rational management of the pastoral space) of the paths used.

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Session 4D: Session 4D
Impacts of Climate on Health

In the health sector, much work has been done on the vectors of diseases.
The description of the bioecology of local anopheles vectors, their numbers and their type contribute to the aim of obtaining predictions of how and where malaria will occur long enough in advance for appropriate action to be taken to reduced the mortality linked with the disease. We also need to optimize the efficiency of vector control so that the transmission and incidence of malaria can be reduced. It is necessary to continue entomological investigations of this type today in order to cover the dry season (Nov-April) and the minor rainy season (Sep-Oct), thus completing the study currently in progress of the June-August 2008 rainy season.

On the basis of climatology and epidemiology, it would be possible to use forecasts in the prevention of catastrophes and their associated diseases. In Chad, for example, further and more serious malaria have been observed in connection with climatic conditions. The frequency of extreme events tends to increase the levels of pathogens, the reproduction of the vectors and the intensity of transmission of the disease. PRESAO is a much appreciated product for rainy season forecasting and its performance is even better in cases of extreme, very wet events. It could be used to develop operational strategy in the prevention of catastrophes and the associated diseases.

Which environmental and climatic factors will encourage the transmission of the cholera bacterium? The results show unusual, intense precipitation levels just before epidemic cholera outbreaks in Dakar for example. The distribution of the rainy season is more important than the amount of rain itself in a context where cholera transmission already exists.
Temperature gradients of the ocean surface could be used to predict the specific characteristics of the rains in Senegal. It is necessary to work with epidemiologists and climatologists to broaden the scope of research concerning the transmission of cholera and its associated climatic conditions in the continent the most affected by the disease at present: Africa.

To advance our understanding of the links between climate and diseases, the thresholds of weather sequences and annual climate that control the transmission of diseases must be identified. It is also necessary to know the transmission starting points and understand the main (non-climatic) confounding factors, particularly socio-economic and climatic factors that must be taken into consideration to understand the role of climatic disease dynamics. This can be done by identifying the associated delays between dust events and the start of meningitis outbreaks for example. The use of satellite remote sensing (products from OMI and TOMS measurements) is really useful to detect dust events. A pond evaporation model enables the depth of ponds to be predicted. Used in conjunction with the development potential of mosquitoes, this allows the transmission of the fever virus in the Rift Valley to be forecast.

The links with climate forecasting need to be developed. But it is first necessary to develop the links between climate and disease.

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Wednesday 22 of July

Plenary Session: Weather and Climate Variability and predictability

In line with the theme of weather and climate monitoring and short-term forecasting, the WASA/F (West African Synthetic Analysis/Forecast) methods developed in AMMA were presented. This analysis and prediction system requires human expertise for interpreting observations and output data from digital prediction operations. Software tools were developed for the SOP (Special Observation Period) phase of AMMA to assist with this task. The success of the system led to its adaptation for application in other regions of Africa. It worked for Southern Africa on the occasion of the Severe Weather Demonstration project (SASA/F, Southern African Synthetic Analysis/Forecast) between 2006 and 2007 with special emphasis on identification of the impact of severe weather events and early warning systems.

The WASA/F method will certainly feed into the planned forecasters' manual to be developed in AMMA. The central question of high-impact meteorological events is also represented in the Thorpex-Africa programme (in its stage of creation of a pan-African database and case-study base), the RIPIECSA project and a new project steered by ACMAD called AEWACS (African Early Warning and Advisory Climate Services). These weather event are important topics especially for favouring interaction with the emergency relief organizations like the NGOs or governmental bodies. The sub-programme CEOP (Coordinated Enhanced Observing Period) of GEWEX/WCRP was presented along with its objectives for increasing access to products from models and observations over a period of several years.

Several communications summarized the assessments of products derived from analyses and predictions resulting from numerical weather models, including details on the AMMA reanalysis conducted at the European Centre for Medium-Range Weather Forecasts (ECMWF) for the whole of 2006. This reanalysis was run with additional radiosounding which had not been transmitted in real time and also those resulting from driftsondes from AMMA. New correction techniques to deal with humidity bias in radiosondes were also set out in detail. The utilisation of ECMWF reanalysis is recommended by preference to that of ERA-Interim for the 2006 studies owing to its higher resolution and improved data assimilation. Nevertheless some bias remains, like the positioning of the rainfall too far south over the Sahel.

Many global and regional modelling systems were compared during the AMMA-MIP and the West African Monsoon Modelling and Evaluation (WAMME) projects with regard to their representation of atmospheric conditions, a study which highlighted a wide diversity of responses between models. The results from WAMME indicate high sensitivity to the surface scheme used. Analysis of inter-model differences brings out their mediocre simulation and prediction of the development of the cold water tongue of the Gulf of Guinea, a crucial element in the dynamics of monsoon onset. A study using a coupled ocean-atmosphere model gave pointers for identifying which component of the error of wind surface stress was responsible for this default. The method consists in performing progressive series of forcing experiments, showing the prevailing importance of the zonal wind on the Equator.
Land-atmosphere interactions were also discussed. The question to resolve was to know if these interactions could act at a distance in time and space by the intermediary of river drainage networks. Excessive rainfall can provoke flooding and wetlands can increase the triggering rate of new convective systems or increase pre-existing precipitation systems.

Examination of the main ways in which rainfall variability in the Sahel manifests itself jointly with the Madden-Julian oscillation (MJO), brought out the operation of a feedback loop involving the surface-atmosphere interactions in the existence of a rainfall mode over the Sahel at a shorter time scale.
The study of African Easterly Waves (AEW) as a means of variability, by using direct observations of convection, shows how convection is triggered in relation with the waves, and therefore how the convection systems propagate through the structure of these waves. The role of the convective triggering is still an open question. It was discussed on the basis of indices of periods of high wave activity so that composites on the 'before' and 'after' periods could be produced. It was thus possible to show that the African Easterly Jet (AEJ) was reinforced before the rise in activity of the AEW and it was located further north afterwards. The Darfour region was stressed for its role in triggering convection.
A combination of direct observations of convection and radiative observations (ARM Mobile Station and Geostationary Earth Radiation Budget (GERB) instrument on Meteosat), it was shown that the radiative divergence varied very little on the long waves and that the condensation level was critical for convection occuring rather than convective available potential energy (CAPE).

Session 6A : Intra-seasonal variability

The most recent results concerning the mechanisms if intra-seasonal variability (between 5 and 90 days) in rainfall and the convection of the African monsoon were presented in the first part. The second part concerned itself with forecasting on these time scales using statistical tools or numerical models. The posters also looked into the same questions. Over this session as a whole, the general approach is either to develop diagnostic analyses or to carry out investigations by means of atmospheric or coupled models of different complexities.
The main aim is to better understand the mechanisms governing intra-seasonal variability in order to be able to develop forecasting approaches on these time scales. The forecasting potential is also examined at regional scale over Sub-Saharan Africa and for cyclone activity in the tropical Atlantic.

Now that the existence of intra-seasonal variability has been proved, we need to identify the key mechanisms. In this session, we have examined the role of synoptic activity over Europe and the Mediterranean on the intra-seasonal variability of rain over the Sahel, then some of the mechanisms of interactions in the African Easterly Jet – Easterly wave system. We also examined the impact of climate variability on the inter-annual modulation of intra-seasonal variability. In terms of predictability, we examine the relative influence of the Madden-Jullian oscillation (MJO), the African rainfalls and the sea temperatures in the tropical Atlantic on cyclone activity.

A very novel result of the first two presentations is the demonstration of the impact of the activity of Rossby wave trains on the way the Saharan thermal depression is positioned (East-West dipole over North Africa) and on the occurrence of intrusions of cold air towards the South from the East of the Mediterranean. A consequence of this is the modulation of convection over the Sahel on an intra-seasonal scale in a form close to the Sahelian mode described in session 5, although additional investigations are necessary (in particular, the role of the interactions with the surface and the possible role of equatorial Rossby waves are dealt with in the posters). The third presentation, using an atmospheric model with primitive equations reinforces this idea by showing that the transient activity of mid-latitudes has a large impact on the intermittence of the African Easterly waves. The following presentation shows that the internal dynamics of the African atmosphere, involving the African Easterly jet, the Easterly waves and the humid processes, can also induce intra-seasonal scale variability. We finally show that the large-scale climatic anomalies, like El Niño or in the Mediterranean, have a significant impact on the activity of East African waves and also that the climate models have difficulty in reproducing these remote connections.
In terms of forecasting potential, a preliminary statistical approach showed that it is possible to predict the intra-seasonal convective activity of some of the modes identified elsewhere, with better performance than persistence, even though this performance remains moderate. The predictability of Atlantic tropical cyclones with elaborate numerical forecasting models is high because of the good predictability of the transient activity over the Sahel, the surface temperature of the Atlantic Ocean and some phases of the MJO.

Pursuing these investigations of the mechanisms of intra-seasonal variability implies taking an interest in the interactions between the atmosphere and the continental surface, and the dynamics of the equatorial waves coupled with convection, and means better understanding the mechanisms of the interactions between the atmospheric circulation of mid-latitudes .

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Session 6B et 9B: Aerosols-Dust-Chemistry-1 and 3

The quantification of emissions, and the modelling of ozone, aerosols, their transport, and their impact on air quality and on the climate involve studies of:

- the respective roles played by meteorological conditions, vegetation, soils, lightning, biomass burning and anthropogenic activity in the emissions
- physical and chemical evolution
- transport (long range transport and transport by convection)
- climatic and radiative impacts
- surface deposition.

Improved inventories have been made of anthropogenic and natural emissions to take in account the specific sources of West Africa. For the first time, they take account of polluting emissions by two-wheeled vehicles, ammonia production from cattle faeces (never quantified before), gaseous and particles emissions due to domestic fires, mineral dust induced by wind erosion (measurements in the field allowed to elaborate an emission model), and gas emissions product by local vegetation (evaluated using isoprene concentrations).
Very strong concentrations of atmospheric pollutants were measured in African mega-cities where dedicated campaigns were made.
A good representation of regional distribution and seasonal variability of the gases and particles in the atmosphere now exists, in particular for nitrogen and ozone, and carbon-containing and mineral aerosols. The data analyse from intensive campaigns shows that convective systems modify the physical and chemical properties of aerosols and the production of ozone in the upper troposphere. These convective systems play a very important role at seasonal and inter-annual variability of the concentrations and deposits of the desert aerosols. The large range transport of aerosols is influenced by the initial vertical distribution of the aerosol over the African continent which show a marked seasonality. A first quantification has been made of the influence of convection on the chemical composition of the upper troposphere. The influence of burning biomass in the southern hemisphere is extended on West Africa during the wet season greater than was supposed – particularly by the intermediary of the transport in the high troposphere linked to the convection over central Africa. The chemical composition in the higher troposphere in West Africa is also influenced by the long-range transport of gas from Asia.

AMMA has enabled to propose a regional view of the optical properties and direct radiative impact of aerosols to be constructed together with a seasonal-scale view of dry and wet deposition of nitrogen and mineral dust. The possible retroaction of the radiative impact of mineral dust on precipitation has also been studied at regional scales.

Following that arise from this work are numerous, notably those concerning regional air quality and its impact on health and the climate. It is necessary to do specific measurement campaigns in cities and rural areas, and to interact with epidemiologists, medical doctors, and socio-economists in order to obtain an emissions data base and a cost analysis.

It is essential to pursue the long-term monitoring at regional scale (Sahelian Dust Transect, IDAF, AERONET-PHOTON, ozone sounding) of atmospheric contents and gas and aerosol deposition to document their inter-annual variability and to define the parameters that control it.
Acquired results allowed to compare models and observations. We is necessary to improve the dynamic models that guide the chemistry-transport models and understand the reasons for the differences between the models and observations, in particular for the Guinea coast, where air transport is influenced by the burning of biomass in the southern hemisphere.
Modelling studies based on physical and chemistry properties of aerosols will allow to grasp the impacts of West African emissions on the radiative forcing and to study the reactions between dynamics and radiative effects of the aerosol.

Session 6C: Water cycle

The main aims of these studies are to characterize and understand the various modes of variability (e.g. daily, intra-seasonal, inter-annual) of the different components of the water budget in the atmospheric and surface water budget. Uncertainties and errors are high for some terms on spatial and time scales and efforts are under way to lower them. It is important to make corrections for bias in the observations (e.g. radiosonde moisture) by making comparisons between different types of sensors. Assimilating satellite data sensitive to low-level humidity into weather forecasting models is indispensable because of the lack of in-situ data in West Africa. Characterizing the variability of precipitation over a wide range of space and time scales enables its impact on the computation of the water budget to be studied on the basis of observations and thus improves our knowledge of the large-scale continental water budget.

At regional scale, the atmospheric budget includes precipitation, evaporation, the divergence of the vertically integrated moisture flux and the temporal variation of the water vapour content integrated over the column (IWV). A hybrid method has been developed for estimating these terms using the best information available, which includes ALMIP evaporation, TRMM precipitation, and the GPS column integrated water vapour. This method shows a sub-diurnal modulation in the time variation of the IWV and the divergence of the moisture flux, together with the signature of the passing of meso-scale convective systems. It also provides a reference for evaluating the water cycle of the models and analyses for weather and climate forecasting. Each model has its specific deficiencies in the representation of the various components of the water budget and these components can be better understood if we have a reference. Analysis brings out the differences in the evaporation regime and its response to precipitation along the North-South gradient.

Considerable work has concerned corrections for humidity bias in atmospheric sounding. A campaign was organized in Niamey in 2008 to compare the Vaisala RS80-A, Vaisala RS92 and MODEM probes with the reference SnowWhite humidity probe. The GPS network has proved to be a valid reference tool for diagnosing these biases during AMMA.

Evaluation of the impact of radiosounding observations with and without bias corrections on the analyses of the numerical forecasting models is an important step. The automatic bias correction on atmospheric moisture measurements operationally included in ECMWF gives an improvement in the analysis of moisture and wind over West Africa in comparison with the pre-AMMA scenario without the AMMA soundings and without correction of the moisture bias of the probes. The assimilation of ASMU-B, SSM/I and MERIS satellite data over the continent provides information on the humidity of the lower layers and has broad impact on West Africa, with an improvement in precipitation and cloud cover forecasting over the Sahel as well as a reduction in the error on the geopotential at 500 hPa. Comparisons of IWV with GPS measurements also show an improvement on the water vapour field provided by this assimilation The assimilation of the AMSU-B surface-sensitive channels above the continental surface will be implemented operationally at Météo-France and ECMWF (2009-2010).

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In the future, the longer term impact of correctly assimilated radiosonde data and AMSU-B data on numerical weather forecasting must be evaluated.
Using AMSR-E satellite measurements and rain products, mapping of soil moisture has been product for West Africa at a resolution of 10 km and 30 minutes. It demonstrates the strong effect of dry soil on the development of convection in June (little signal for the rest of the rainy season) and an influence on half the trajectories of convective clouds by the spatial structure of ground moisture. A new method for evaluating the fluctuations of the sub-surface water budget at regional scale using remote sensing from space (GRACE) has been validated on West Africa and is an important step forward for the estimation of underground water reservoir on this scale.
The impact of the errors in the rainfall estimation on water resource variability has been quantified with the n-TOPAMMA hydrological model. For the Ouémé mesosite, the satellite-derived rainfall available on the West Africa exhibits a large bias. Hybrid products (IMPETUS method) using a desegregation method, Meteosat data and monthly rainfall as measured by densified AMMA-CATCH network provide better results. The development of new rain products combining satellite and ground information, stays a priority for the future.

The model amplifies rain bias on an annual scale, in particular when its spatial distribution is used.
Meso-scale coupled models will improve our understanding of the water budget on this scale (the ALMIP II experiment will be an important step).
An examination of the underground water fluctuations in Senegal shows that the levels have fallen, notably for ground water. There is a correlated drying of continental rivers and flood plains, and salt is penetrating fresh water and cultivated land in coastal areas. Actions such as mini-dams and dikes have been proposed to attenuate these changes.

Mapping cultivated areas using satellite images and agro-ecological stratification enables us to propose a reliable method for estimating the fields sown with cereals each year at the scale of a country. The interest of this lies in the fact that it improves agricultural production statistics. The results obtained show that the use of free, medium-resolution (250 m) images (TERRA/MODIS) can allow the cultivated fields to be well distinguished.

The relationships between rains and millet yields in Niger during the AMMA multi-scale agroclimatic measurement campaigns of 2004 to 2007 were modelled using the SarraH simulation model. The results show that the efficiency of this model depends on the accuracy of simulation of the water stress of the crops. The cumulative total of seasonal rain offers a poor explanation of the variability of yields, the intra-seasonal scale being more important. Agronomic experiments conducted at the Saria research station in the centre of Burkina Faso in 2007 and 2008 studied the impact of the monsoon on a maize crop. The aim was to provide the data to calibrate and validate the SarraH simulation model. Preliminary results show a good correlation between the observed and simulated yields (biomass and grain), particularly for crops sown in June.

The impact of rain parameters (date the season started, its duration and the rain volume in June) on the cotton yield was studied in northern Cameroon. The study also analysed the predictability of the June rainfall using the STREAM2 model of the ENSEMBLES project.
Other works have concerned the influence of rainfall perturbations on the production of cotton in Benin. The results bring out the impact of delays in the rains, insufficient rainfall, and floods, all of which combine to cause a non-negligible loss of cotton yields.

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Thursday 23 of July

Plenary Session: Society Environment Climate Interactions

In the study of interactions among society, the environment and the climate, evaluating the impact of climate on non-intensive agriculture in West Africa is one of the objectives of agro-meteorology in AMMA. By documenting the yields of rain-fed cereal crops (millet, maize, sorghum), it will be possible to improve simulation and prediction methods. For example, the SarraH simulation model gives a fairly good estimate of yields with the impact of the climate expressed in the model response. It also gives a good response in controlled conditions and can be used in studies seeking solutions for the choice of varieties, climate forecasting or insurances based on weather.
By using a satellite estimation of the precipitation already received together with predicted future rains in the ZAR model, early detection of sowing failures and areas of crop stress is possible. In Senegal and Niger, 7-day weather forecasts have proved to be very useful in risk-detection zones but the resolution of weather forecasts needs to be improved. The impact of the climate on the cereal markets is high. Lack of information on rainfall leads to biases in pricing and thus inefficiency of the market and an increase in food crises. Rainfall information is thus essential and it must circulate better.

Studies of the extent of climate change in the Sudan area show a reduction in rainfall that is more marked from north to south but less so in the east. Cattle transhumance takes place mainly from north to south; only 22% of cattle-rearers are sedentary.
Added to the political problems, extensive cattle rearing in this Sudan area causes problems between arable farmers and cattle rearers. The isohyets move and the cattle rearers follow their movement, but at a different rate. The migrations appear to be cyclic with a period of 15 years. Studies on the terrain show that, in farming, the first cause of lowered income is insufficient rainfall but that arable farming is seen to be more sensitive to rainfall deficits than cattle rearing. Migration is another adaptation to climate variability in the Sahel. But in cases of drought or good rainfall, the behaviour of households differs from one country to another. It is in Mali that people migrate most, followed by Burkina Faso. In Senegal and Niger more temporary migrations are seen. Burkina Faso has the highest long-term migration, due to poverty and thus a search for cash. By developing a few scenarios, it is possible to understand the vulnerability of the societies that live on arid land.

For some years, the wet zones called Niayes in Senegal, which are of prime economic, social and ecological importance in the region, have been under water stress because climate variability has caused, among other things, a lowering of the potential of aquifers and gradual drying of coastal lakes. The response to this variability and its corollaries have been particularly aggressive ways of using the land. These wet areas are environmentally very vulnerable and the consequences for the environment are disastrous. The ecological and economic viability of the Niayes is at serious risk.

By determining the pollution of the African mega-cities, it is possible to study its epidemiological effects at local and regional scales in the short and medium term. The results show astonishing levels of pollution, with values for carbon-containing particles of around 10 µgC/m3 in urban areas, about the same as in mega-cities like Cairo or Tokyo. Short- and long-term measurement campaigns are planned with the development of an integrating model. It is also important to develop expertise in air quality networks.

Oursi, Burkina Faso©AMMA

Session 8A : Ocean processes

Research projects on oceanic processes were presented in the context of the characterization and understanding of the sea surface temperature (SST), the equatorial current systems, the cold water tongue origin, the extent of the River Congo plume. They also aim to establish the heat budget with oceanic models. These studies aim at a better understanding of ocean processes, their strong seasonal and interannual variability.

Collection of repeated data on trans-equatorial radials during the campaigns EGEE/AMMA, PIRATA, TACE and so on is used to describe the seasonal and interannual variability of zonal currents (principally the equatorial sub-current) in the equatorial East Atlantic.
Advances have been made in the understanding of formation mechanisms of the cold water tongue by means of measurements taken during AMMA oceanographic campaigns.
Other works focus on the impact of a mode of variability in the Atlantic on the monsoon system over West Africa (strong correlation between the SSTs, wind and rainfall on the continent). Forced ocean models and coupled ocean-atmosphere models will be improved thanks to the understanding of the origin of the cold water tongue and its role on the monsoon flux. To ensure development of research in Africa, a regional Masters 2 in physical oceanography and applications (climate, resources, coastal environment) has been founded in Benin (created by IRD and UPS / LEGOS, and UAC).

Research efforts will concentrate on extending the observation series over long time periods (permanence of data sets, notably PIRATA buoys, current-measuring devices, tide gauges etc.). A search will be made for the origin of the intra-seasonal variation of wind burst associated with the Saint Helena anticyclone.
The activation of measuring stations on the islands lying in the South Atlantic (Ascension, Saint Helena), and an additional PIRATA buoy at 10°W-15°S, will allow to record the variability of south-east trade winds and a better monitoring of the indicators of the cold water tongue formation.

Session 8B: Surface processes

The main objectives of research on surface processes are i) to analyse the response of continental surface to climate variability at various space and time scales and ii) to clarify the role played by these surfaces in the modulation of radiation and energy budgets.
It is necessary to determine not only the impact of a rain event on surface flows but also the impact of rainfall variability on the surfaces on seasonal and inter-annual scales. The response of the various component parts of the surface (soils, herbaceous, woody vegetation ...) and the nature of the coupling between hydrology and vegetation has to be precised.
A major question is how changes in vegetation cover resulting from drought years and human actions have modified the dominant hydrological processes on the surface. It is important to know the long-term trends that are appearing in West Africa, particularly as far as vegetation cover are concerned.

Thanks to surface flow measurements made over the past 3-4 years, our understanding of the impact of climate on the response of surfaces has improved. A 'second Sahelian paradox', expressed by a general increase in the area of ponds in the Sahel, has been observed on the Gourma zone in Mali. The contrasting response of woody vegetation in the Sahel has been highlighted (spectacular increase in low lying areas, more moderate increase on sand dunes, and regression, sometimes spectacular, for tiger bush on superficial soil). At modelling level, coupled hydrology-vegetation models have been developed for the Sahel. A new classification of the principal types of soil occupation at 1-km resolution is now available for West Africa (ECOCLIMAP-II)

Better knowledge and understanding of changes in ground occupation are indispensable if we are to analyse the observed trends in the long term, for hydrology, and energy budgets at the surface and for vegetation. To help our understanding of these changes, links with the human and social sciences need to be strengthened.

Sénégal©Sonneville

Session S8C: Socio-economic vulnerability and adaptations

Study of the vulnerability and adaptation requires the involvement of several different disciplines: sociology, anthropology, geography, economics and environmental sciences.

The general objectives include the identification of good practices for adaptation to climate change and the assessment of national policies in this sphere.
Are the responses communities have made to modification of their climate appropriate for ensuring sustainable development in the local areas investigated? What complementary measures need to be taken? And what is the effect of socio-cultural determinants such as age, gender, social class on adaptation strategies?

The various communications presented stressed the specific local character of adaptation which indeed takes the form of a local response. However, researchers also highlighted the great diversity of responses devised. The gender aspect in particular has attracted the attention of several authors. Women are more vulnerable than the men, and are involved in forming the bases of specific strategies which allow them to make the best of the situation. The local political context exerts a large influence on the adaptation model adopted.
It has become important now to move on from contextualization to generalization, or how to integrate the different methodologies in unified research on the subject.

Surveys have indicated that the wealth of rural households in Burkina Faso grew between 1998 and 2007. A wealth index was devised. It is measured by the value of a portion of the property possessed (housing, mobile telephone and so on). Changes in wealth are not correlated with trends in rainfall, but they are positively correlated with trends in household's diversification of their activities.

Some assurances are based on weather indices. The main accomplishments made in the world and the methods used are presented. The researchers identify the barriers to their development in West Africa and the criteria for selecting areas and crops in order to conduct pilot projects.

The management of climate hazards was analysed in the vulnerable peri-urban zones. Early warning systems need to be properly mobilized and activated and study is required on the means of creating assurance against climatic disasters.

The obstacles to decentralization of natural resources management were identified. This decentralization is not working, in spite of the avowed intentions. Scientists bring to light the insufficiencies in competence, the gap between political will and the reality, the lack of coordination and the poorly developed structuring of representatives of elected leaders and civil society.

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Friday 24 of July

Session 9A: Mesoscale convective systems and the atmospheric boundary layer.

This session concentrated on convective and turbulent processes. Analysis of the data collected during AMMA covered a wide variety of boundary layers observed over West Africa during the monsoon. The data also greatly helped to extend our understanding of the MCSs (meso-scale convective systems) observed in the region.

First of all, the overall characteristics of turbulent and convective phenomena has been established. It includes the properties, the diurnal cycle, the entrainment and growth of boundary layers, and also documentation of MCSs, in particular the microphysical processes associated with their precipitation, anvil clouds and cloud cover.
Interesting synergies have emerged between observations and modelling (e.g. the surface measurements and the LES simulations of large eddies) and between in-situ data and satellite data (e.g. from the ground network of rain gauges and the Megha-Tropiques satellite).

Strong but varied coupling has been identified between the dynamic and physical processes at different scales, for example between surface heterogeneities, the circulation of the boundary layers and convective development, the East African Jet and the boundary layer processes, or the African easterly waves and convection.
For the first time, meso-scale models have been widely used over periods of several days to explore the interactions between the turbulent and convective processes and also synoptic-scale processes such as the African easterly waves.
At meso-scale, the data analyses and modelling studies prove the importance of the mechanisms of interaction between surface, turbulent processes and convective processes. In the coming years, reinforcing the synergies between these approaches will be indispensable to a deeper understanding of the West African monsoon.

On the basis of results obtained from the data, now is a good time to make a more precise evaluation of the models' capacity to reproduce the principal turbulent and convective processes. It is also indispensable for a correct simulation of the mechanisms that couple these processes with other phenomena, on pre-identified scales of space and time. This would constitute an adequate basis to guide the improvement of model parametrisations.

Concerning the boundary layer processes, it is now necessary to insist more on the analysis of the boundary layer and of low level clouds (since the concept of a cloud-free boundary layer is not pertinent in all cases) and to take the optical properties of aerosols more fully into consideration in both modelling and observational studies. This is necessary for a general understanding of the interactions among surface, boundary layer and Saharan air layer. The strong coupling identified between the boundary layer and surface processes implies that the links between these disciplines must be strengthened.

Our understanding of the relations between the MCSs and the large-scale environment has been renewed in recent years. However, the mechanisms that currently control the life cycle of MCSs (growth, propagation, decay, division...) need to be looked into more deeply. The use of a limited series of case studies, like those obtained during SOP 2006, could prove very precious for this objective.
The interactions between boundary layers and convective processes are not restricted to the development of cumulus; the impact of the density current driven by MCS for the boundary layer properties needs to be studied in greater detail using observations to determine the dominant feedback actions in play at different scales and for different environments.

Lacher de ballon©Gérald Bourret

Session 9C: Human and climatic impacts on water resources and management strategies.

Some of the objectives of RESSAC ('vulnerability of Surface Water Resources in the Sahel to medium-term Anthropogenic and Climate changes') are to analyse and determine the vulnerability (past and future) of water resources of the River Bani under the influence of climate and the human environment, and also to improve hydrological models by including the environmental dynamic.
Study of cultivated areas with a 48% reduction in uncovered soil between 1986 and 2000 brought out evidence for a close link between the changes and developments in the state of the surface and that of the population, especially concerning rural communities.
The need for more refined socio-economic models is a vital. The hydrological applications have yielded better results for the Sahel than for more humid sectors, probably owing to the effects of evapotranspiration (problems of conceptual models with PET).

Since the early 1970s, the submersion level of the Inner Delta of the Niger has diminished owing to drought and low rainfall. In parallel, human and animal populations have strongly increased. Satisfaction of the needs of the human and animal populations led to competing usage of the available natural resources. That situation provoked an increasing number of conflicts over this resource. Surveys are carried out to assess the impact of the low flood levels on the conflicts in the Inner Niger Delta, establish the general situation as to natural-resources centred conflict and put forward solutions envisaged by the local populations for handling and managing such disputes. The major conflicts are between crop farmers and stockbreeders (41%) and between fishermen (23%). The implementation of integrated environmental management would lead to a decrease in the number of conflicts or at least help tone them down by awareness-building among the interested parties. Moreover, that could help communities to become more autonomous in the conflict resolution.

Many environmental and social repercussions ensued after the opening of the breach in the River Senegal estuary. The River Senegal basin is located in a space characterized by the irregularity of rainfall and especially by its lessening from the South to the North of the basin. The hydrological regime of the River Senegal has been radically changed following alteration schemes realized in the basin aiming to alleviate the effects of the persistent drought.

The environmental consequences are manifold. For example, the high water evacuation rate produces severe erosion and the biodiversity is threatened owing to a substantial loss of the of the island surface. From the socio-economic point of view, a decline in the fishing activity brings with it a massive exodus of people from the villages located on the lower estuary towards Senegal's urban centres and sometimes people even resort to illicit immigration.

Strong concentrations of nitrates and pesticides (Aldrin, Endosulfan) have been measured in cotton growing and market-garden areas. Levels exceed by far the standard amounts permitted in intensive agriculture. From the environmental and public health points of view, this situation is expressed in some stark impacts, such as: eutrophication of water bodies, loss of biodiversity, direct or indirect poisoning.

The causes of these various problems are, among others, the increase in the use of chemical products in intensively farmed areas, by 11% per year from 1991 to 1997, chemical utilization and storage practices or again the use of banned products supplied through the parallel market. These different problems are occurring in a context of high population pressure and a severely variable rainfall pattern.

In the current context, the village communities feel more concerned by the quantity and proximity of water than by its quality. Water quality is seen by a majority of local players as an "open access" resource.
A consensus on the quality status of water, seen as a «common resource» can only be reached under a consistent integrated system of institutions, in other words coordination between public policies, property rights and both modern and traditional rules. Such an integrated system of institutions is itself a result of a collective learning process involving the different categories of parties involved.

Langue de Barbarie, Sénégal©Sonneville

Session 9D: Modelling of regional climate

The session concerned simulation using regional atmospheric models of the West African monsoon system. The aim was to learn how the monsoon system works by using regional models. Improving the simulation of the monsoon system in these models will help with forecasting on all time scales.
In particular, it is important to know which processes are responsible for the onset and the variability of the monsoon system. Similarly, the individual and combined roles of local and remote forcing on the system need to be determined. It is necessary to study whether the regional models can provide a better simulation of the West African monsoon than global models do.

After precise selection of the physical parametrizations and validation of the models, regional models are able to reproduce the characteristics observed for the West African monsoon system with higher accuracy than global models. This is important because the regional models provide information on spatial scales that are more appropriate for evaluating the impacts on society and the interactions with hydrological systems. The improvement through global models comes partly from the increase in horizontal resolution but choosing parametrizations suited to the West African region is just as, or even more, important.

AMMA observations are extremely important for validating and testing the simulations made by the regional models. Several projects concern simulations of the years for which AMMA observations are available. 2006 is of special interest as a modelling target because of the SOP that took place then.

The relationships between the WAM and surface hydrological processes are not well known and AMMA can help to improve our understanding by providing observations for validating and initializing the models. In this framework, it is essential to accumulate many years of observations. It is also probable that we are at the beginning of a time for which it is possible to validate the forecasts for climate change. AMMA could define the observation programmes intended to verify these forecasts and allow the earliest possible observations of climate changes induced by greenhouse gases (agreement between the models and the observations would validate the simulations and allow the changes observed to be attributed to their causes).

Many presentations concerned sensitivity studies of different parametrizations in a regional model, including the convection one, and parametrizations of surface hydrology, examining their skill to produce a precise simulation of precipitation in West Africa. The characteristics of the intra-seasonal variability were examined, as were the vertical moisture structure, the potential temperature and the diabatic heating. Another study compared the results of different regional models over the same domain and the same period of time, showing that the regional models could reproduce the characteristics of inter-annual variability.

Two studies of processes were presented: one that examined the effects of modified orography and surface albedo on the triggering of the monsoon, and a second that examined the role of exceptionally warm Mediterranean SSTs in 2003 on the West African monsoon. In each case, surface characteristics were changed in the model in one or more sensitivity simulations.

International Project Office

International Coordination

ISSC

The International Scientific Steering Committee of AMMA has met on July 19 in Ouagadougou. The discussions have been devoted mainly to the science plan for 2010-2020 (ISP2) and to how to complete its elaboration.
To the attention of the IGB, the ISSC has formulated the following priorities regarding the possible extent of AMMA's region of interest: extend more on the Atlantic region on the West of Africa as interactions exist with monsoon, keep forces on the present regional focus (West Africa), climate variability being different over East Africa, extend some atmospheric studies up to the East, transfer methodology to researchers working on other regions. The ISSC also suggests to organise common workshops on topics of interest to several programmes.

The ISSC continues elaborating ISP2 (societies-environment - resources - climate interactions, ecosystems, observations, notably).
For database issues, the ISSC has invited the scientific committee of AMMA Africa (CSAM) to express any recommendation deemed necessary on the international working group in charge of making proposals for the future of the database, as well as well as on its mandate.
Besides structuring the African community, reinforcing the observation networks, the many Master's and PhD works and summer schools, the ISSC has agreed on the wide dissemination of AMMA knowledge at all levels in Africa as an additional mean of capacity building and training. Finally the ISSC has adopted the proposal for the coordination and governing of the AMMA programme contained in ISP2, though recognising that it will be dependent on the human resources contributing at the international level.

The ISSC has adopted a policy to adequately communicate and report to the various international programmes endorsing or contributing to AMMA. In particular, ISSC representatives will be appointed for each programme.
The ISSC will get in touch with the American Meteorology Society and UK Royal Meteorology Society in order to foster a facilitated access to the papers issued in the journals of both societies through the AMMA Publications database.
A review of the projects contributing to AMMA has been included in the July 2009 issue of the AMMA International Newsletter. Are to be noted the funding of the QweCI project (Quantifying Weather and Climate Impacts on Health in Developing countries), coordinator A. Morse, within FP7, and the funding by NERC of the field experiment on the heat low Fennec (2011, ground and aircraft).

IGB

The International Governing Board of AMMA has held a meeting on July 23, in parallel to the 3rd International Conference in Ouagadougou.

The previous IGB meeting in March 2009 had reviewed the on-going initiatives towards the second phase of AMMA, one month after the AMMA Africa meeting of Ouagadougou. The draft science plan (ISP2) has been elaborated and circulated since.

The IGB has expressed its support to the main orientations described in the document. The IGB and ISSC share the view that the regional focus on West Africa should be kept at this stage in order to favor the best capitalization of AMMA and to be able to maintain instrumentation networks, while cooperating with other programmes focusing on other regions. Some atmospheric processes could be studied in the East (upstream flow, precipitating systems generated on the East), a judicious development being to expand eastward in the Sahel beginning with issues that affect West Africa. Weather and intraseasonal timescales are also reasons to target this data scarce region to improve predictability. On the other hand and as far as possible, the methodology and tools developed in AMMA should be transferred to other programmes. This is exemplified in the strategy chosen for Thorpex Africa which benefits from the assets of AMMA for its activities in West Africa, especially regarding observing systems and data assimilation. The integrated generic approach developed within AMMA should be promoted in international programmes like CLIVAR, or ESSP, and be a seed for other initiatives led by other people or agencies.

During the gala dinner in Ouagadougou©AMMA

The IGB has recommended that the scientific community further elaborate the science plan and its priorities, especially for societies-environment-resources-climate interaction studies, so that the perimeter of AMMA in its second phase could be defined, and the needed collaborations beyond this perimeter could be identified. A new version of the plan should be submitted to the IGB by the end of the year, for a formal endorsement by the umbrellas at the beginning of 2010.

The future of the AMMA database and related issues are being addressed by an international working group. Considering the stakes for African research and the expected outcomes for the benefit of African populations, the AMMA Africa scientific committee has recommended a wide access of African scientists to the AMMA database for research purposes, and that the Governing Board of AMMA Africa be associated with the management of the database. The IGB has also restated its will of a large valorisation of the data collected during AMMA, not only for the meteorological system knowledge and forecasts, but also towards applications for society.

Changes at the IGB

Mr. Alioune N'Diaye (WMO) and Mr. Pierre Soler (IRD) are the new co-chairs of the IGB since September 2009.
Mr Philippe Bougeault, Head of Research at Météo-France, is the new representative of Météo-France CNRM in the IGB.

The IGB has started the process of revising its Terms of Reference in accordance with the new science plan and the evolution of AMMA's objectives. This revision will notably aim at reinforcing the links between AMMA and international programmes, the stakeholders interested in the outcomes of AMMA research, and initiaves carried out in West Africa on environment and development issues. A new governance will also be defined for AMMA as an international programme. The African institutions represented in the IGB and the governing bodies of AMMA Africa will be involved particularly in the new IGB missions and structure. The revised version of the ToR should be adopted together with the new science plan, at the beginning of 2010.

Communication AMMA

Around the conference

A Science Café was held on the evening of Tuesday 21st July on the terrace of the Jardin de l'Azalaï. Six women were present on the platform: Marie-Christine Dufresne, Aïda Diongue-Niang, Nancy Akinyi Omolo, Awa Niang-Fall and Regina Folorunsho. Each presented her work and special interests to start a discussion on the theme «What actions can scientists develop to contribute to the active engagement of women in Africa to face up to climate variability, both in scientific activities and in their social implications?». Each of the women explained how she was involved in the question of the place of women in the sciences. These introductions were punctuated with numerous interventions from the public, the vast majority of whom told of their experience and their actions to have these issues taken into account, acted upon or reflected on according to the specificities of each country.
As a follow-up to the Science Café, a page of the AMMA website will be devoted to articles and research work having the characteristic of posing the question of the place of women in science. Everyone is invited to contribute to this page and enrich it.

The **film** show and aperitif on Wednesday 22nd July at the Georges Mélies French Cultural Centre was attended by more than 50 people who came to see the films «Niger, un fleuve à la dérive», by Philippe Constantini (52 min), an Auteurs Associés/ARTE co-production, and «La calebasse et le pluviomètre», by Marcel Dalaise (26min), CNRS Images.

The **exhibition** «Sous la mousson, des Hommes...» (Man in the monsoon) was open throughout the conference week in the hall of the Azalaï and at the George Méliès Centre. On this occasion, orders were also placed for it to be shown in Niger, Benin and Grenoble. In Africa, it is continuing to be exhibited in Senegal and Burkina Faso. In France, several events have provided opportunities for spreading scientific knowledge, with the «Researchers' Night» exhibition at MétéoFrance, «La Novela» the Arts and Science Festival of the city of Toulouse, the Science Festival at the Rangeuil campus of Toulouse University, the Meteorology Forum organized by INSU in Paris...

A **communication stand** at the Azalaï on the transmission of science in the AMMA programme was held by two students from the Ouagadougou teachers' association who had been trained to present the exhibition in the high schools of Ouagadougou.

Press

As far as the media are concerned, two press conferences were held in Ouagadougou, one on the Monday for the opening and one on the Wednesday, and another was organized in Paris in September. Some of the programme's researchers have presented AMMA's results and prospects. T**o date, thirty or so articles and television or radio programmes have relayed AMMA's advances** to the general public through:
Le pays, l'observateur, Sidwaya, the Nigeria Guardian, the Agence Sénégalaise, Fraternité, Ivory Coast National Television and the Burkina Faso television and radio services,
Jeune Afrique, Le Monde (2 articles), Libération, ActuEnvironnement, African Press Organisation, Afrique Verte, AllAfrica, Appablog, Blog piles, Catastrophe Naturelle, Courrier du Vietnam, Infos vertes, News Alerts on EUResearch, Newspeg, PreCanada, RFI, RFO tv, SciDev, Science Actualité, Site H2O TemoustWebsite...

The introductions to these articles are to be found on the AMMA site: www.amma-international.org

The communication stand during the conference in Ouagadougou©AMMA


Café des sciences with Marie-Christine Dufresne, Aïda Diongue, Nancy Akinyi Omolo, Awa Niang-Fall et Regina Folorunsho in Ouagadougou©AMMA


Exhibition in Ouagadougou ©AMMA


AMMA at La Novela in Toulouse©AMMA


Press conference in Ouagadougou©AMMA

Beginnings of a network to spread information in Africa

Representatives of communication media, such as journalists, were present during the conference and met to discuss the question of diffusing scientific information in Africa. Conscious of the importance of a transfer of scientific knowledge to the users, they raised the question of what action they should take and what structure should be used or set up to ensure the transmission of sciences in an effective, comprehensive way.

The first point stressed by all the participants involved in communication was the importance of setting up distribution lists of African communicators, the set of people whose work is to ensure the spread of information. They should thus participate in making a broad public aware of the major questions of society, notably those posed by climate change, through scientific data that can contribute to advances on these questions.

The second point was the work in close cooperation with the researchers that must take place upstream, in which scientists need to make even greater efforts to transform the scientific information into knowledge that can be taken in by the population. Researchers and communication professionals must together help to draw up comprehensible documents for the most vulnerable populations. This information would then be relayed by the communicators to the structures the best placed to redistribute it: associations, teachers, NGOs, etc. The role of the AMMA community should tend towards this «popularization» of scientific information by reinforcing its capacity to circulate its scientific data. To do this, it is important to collect and organize the information that is most pertinent for the populations. This would also provide a means to identify gaps in the information. Recovering the work of the researchers and having the form of the message revised by the communicators would allow tools, like technical information sheets, to be made for transmission to a network in charge of ensuring the broadest possible coverage of participants able to directly use the information in the populations. For this to happen, a correspondent is needed, who would be responsible for centralizing the information and acting as a contact point for each request concerning his country.

The final point highlighted the importance of training the communicators who will be in charge of distributing the information; they must understand the ideas the are to use in their work.

For such a network to come into successful operation, all the participants, both scientists and communication and journalism professionals, must be mobilized for concrete actions.

If you would like to obtain more information and/or participate in the setting up of this network,

contact the communication department of the AMMA programme
amma.com@amma-int.org

Scientific publications and diffusion

AMMA's communication department has been seeking to develop actions targeting the general public, the press and the community inside the programme for the past two years. Today, to continue to keep the the programme as much in view as possible, it is necessary for regular scientific information to be transmitted not only to these groups but also to new recipients not reached previously. Every scientist can take part in this by informing the AMMA communication department of work to be published two months in advance of the publication date. Through cooperation between the researcher and the communicator, it will be possible to draw up scientific information sheets for wide circulation.

Do not hesitate to contact us
amma.com@amma-int.org

Some of the comunicators present at the conference ©AMMA

AMMA Publications

The communications presented at the 3rd International Conference are being archived on the AMMA Publications website where a number of other papers resulting from AMMA are also available. This database is a wiki-based system: users can contribute develop and enrich the bibliographic resources shared by the community. When adding new resources, you make your works better known to the community and participate in AMMA's support to capacity building and training.

A quick tour of the database:

Find the most recent addition or edits on the Home page.
Use the Wikindx menu to customise your environment, like subscribing to an automatic e-mail notification of new resources, or get useful information, on publisher policies for instance.
Register to access more information on the publications and get the right to add and edit references.
Retrieve resources either by sorting, selecting, or searching them or by browsing clouds by authors, journals, publishers or keywords.
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Looking forward to your visit on the website.

AMMA Publications:
http://biblio.amma-international.org

Contact:
amma.biblio@amma-int.org

Guidelines for new users to add resources:
http://biblio.amma-international.org/index.php?action=viewNewsItem&id=9

AGENDA

2009

October

Colloque formation/recherche en océanographie et applications en Afrique de l'Ouest
31 October - 6 November, Cotonou, Benin
Contact AMMA: bernard.bourles@ird.fr

November

25th session of the CAS/JSC Working Group on Numerical Experimentation to be held with the 11th session of the GEWEX Modelling and Prediction Panel
2 - 6 November, Offenbach, Germany

2nd GRACE Hydrology Workshop
4 November 2009, Austin, Texas, USA

Earth-System Initialization for Decadal Predictions Workshop
4 - 6 November, Utrecht, the Netherlands

ECMWF/GLASS Workshop on Land Surface Modelling and Data Assimilation and the Implications for Predictability
9 - 12 November, ECMWF, Reading, United Kingdom
Contact AMMA: aaron.boone@meteo.fr

A Changing Climate for Europe-the ENSEMBLES Final Symposium
17 - 19 November, Exeter, United Kingdom
Contact AMMA: paolo.ruti@casaccia.enea.it

December

United Nations Convention on Climate Change (UNFCCC) COP15/MOP5
30 November - 11 December, Copenhagen, Denmark

Fall AGU Meeting
14 - 18 December, San Francisco, California, USA

2010

Spring 2010

AMMA France workshop
Contact: serge.janicot@locean-ipsl.upmc.fr, odile.roussot@meteo.fr

AMMA International ISSC and IGB meetings
Contact: redels@meteo.fr, odile.roussot@meteo.fr

January

US CLIVAR Workshop on Predicting the climate of the coming decades
11 - 14 January, Miami, USA

22nd Conference on Climate Variability and Change, 24th Conference of Hydrology, 90th AMS Annual Meeting, with a session on Surface/Atmosphere Interaction
17 - 21 January, Atlanta, Georgia

February

31st session of the Joint Scientific Committee for WCRP & Technical Conference on Changing Climate and Demand for Climate Services for Sustainable Development
16 - 18 February, Antalya, Turkey

March

TACE/PIRATA Meeting, Tropical Atlantic Climate and Variability
2 - 5 March, Miami, Florida
Contact AMMA: bernard.bourles@ird.fr

6th EGU Alexander von Humboldt International Conference on Climate Change, Natural Hazards, and Societies
14 - 19 March, Merida, Mexico

May

EGU General Assembly 2010
2 - 7 May, Vienna, Austria
Contact AMMA: serge.janicot@locean-ipsl.upmc.fr

«Earth System Science: Climate, Global Change and People" The AIMES Open Science Conference on Earth System Science
10 - 13 May, Edinburgh, Scotland

29th Conference on Hurricanes and Tropical Meteorology
10 - 14 May, Tucson, Arizona
Contact AMMA: Kerry Cook kc@jsg.utexas.edu

Based on a French initiative, AMMA was developed by an international scientific group and is currently funded by a large number of agencies, especially from France, the UK, the USA and Africa. It has been the beneficiary of a major financial contribution from the European Community's Sixth Framework Research Programme.
More information on the scientific coordination and funding is available on the AMMA International web-site: *http//:www.amma-international.org*

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Institutions fondatrices

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Avec la participation

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