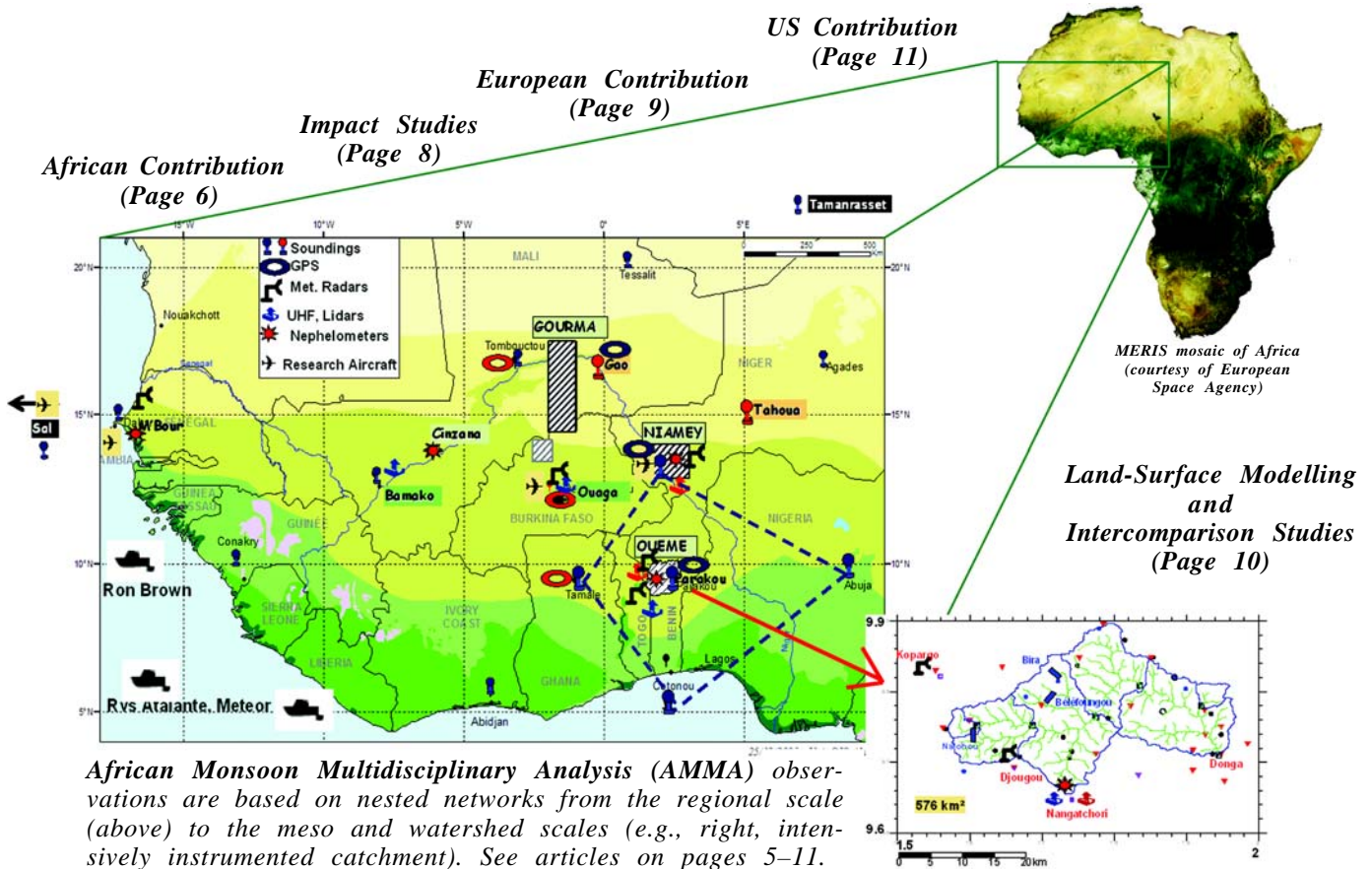


AMMA WEST AFRICAN MONSOON STUDIES ARE ADDRESSING WATER CYCLE ISSUES



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COMMENTARY

GEWEX, AMMA AND CAPACITY BUILDING IN AFRICA

**Richard Lawford, Director
International GEWEX Project Office**

This Newsletter issue deals with Africa and highlights the African Monsoon Multidisciplinary Analysis (AMMA) Project that has recently been launched by African, European and American scientists. Not only does AMMA address critical science issues but it will also help in developing the expertise and infrastructure that is needed to build Africa's prediction capabilities and environmental development. These capabilities are needed on an urgent basis because the West African Monsoon has a major impact on the lives, health and prosperity of millions of people living in west and central Africa. As a project, AMMA not only bridges continents in terms of the scientists involved, but also the interests of GEWEX and the Climate Variability and Predictability (CLIVAR) Project, as well as other global environmental projects.

Sanitation and access to clean water are issues for many African countries. As desertification spreads and droughts become more variable, more countries, particularly in North Central Africa, will experience conditions of severe water stress. Some countries are using groundwater as an interim solution but this resource can only be "mined" (extracted at rates greater than it is being replenished by precipitation) for so long before it becomes depleted.

AMMA presents an unusually broad range of interdisciplinary research activities and promises to marshal both new scientific findings and many of the data sets needed to address water issues in West Africa. AMMA has plans to bring together *in situ* and satellite observations, assimilation and modelling capabilities, and application studies to provide African nations with the knowledge and the tools that they need to address water problems more effectively.

US prediction services can derive major benefits from AMMA research in West Africa because this area and the nearby ocean serve as a spawning ground for many of the hurricanes that affect the southern United States. This is a rich area for collaborative research with The Observing System Research and Predictability Experiment (THORPEX).

Some countries in Africa have experienced difficulty in developing their natural resources because

they lack the roads and infrastructure and also do not have the educational programs in place to provide adequate training in selected disciplines. The lack of expertise and infrastructure makes environmental monitoring very difficult and expensive. The African Development Bank and other organizations are addressing the lack of roads and infrastructure and also the issues related to education and training. AMMA supports these broader development goals by building the levels of expertise in Africa in meteorology, hydrology and interdisciplinary studies.

Some African countries have developed independent meteorological and hydrological services. In other cases, nations draw on centralized services by participating in organizations such as the African Centre of Meteorological Application for Development (ACMAD). The potential for the development of targeted applications by involving these organizations in climate research projects and activities is very large. Opportunities also exist within programs with which GEWEX is affiliated. For example, the Group on Earth Observations (GEO) work plan, which is supported by GEWEX, calls for a capacity building workshop to be held in Africa. The European Space Agency and United Nations Educational Scientific and Cultural Organization (UNESCO) have launched a development program, the Terrestrial Initiative in Global Environment Research (TIGER), where data from European and Canadian satellites are being used to improve the management of regional and local water resources in Africa. GEWEX plans to contribute to these efforts and looks forward to advancing our understanding of how environmental conditions on this continent affect the global climate system and in turn how changes and variability in Africa's climate affect the vulnerability of societies and economies in this large continent.

As part of their outreach activities, GEWEX and AMMA plan to contribute to capacity building. In this context, capacity building is seen as a process for enhancing the ability of regional, national and local stakeholders to evaluate and address crucial questions related to the use of environmental information for better decisions related to the implementation of the best options for resource development and management. Over the next few years AMMA and GEWEX have the unique opportunity to join forces with GEO, the Integrated Global Observing Strategy-Partners Integrated Global Water Cycle Observations Theme and TIGER to develop a coordinated approach for capacity building in many West African countries.

GEWEX WELCOMES NEW SSG MEMBERS



Rucong Yu

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Areas of Interest: Numerical modelling in atmospheric and oceanic sciences, and climate and weather dynamics.



Jun Matsumoto

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Areas of Interest: Monsoon climatology, climatic impacts on ecosystems and agriculture.

CHINESE GEWEX COORDINATOR



GEWEX welcomes Yuping Yan as the Chinese GEWEX Coordinator. Dr. Yan will work on the development and coordination of GEWEX activities within China. Her activities will be evenly divided between GEWEX and the National Climate Center of the China Meteorological Administration.

Dr. Yan received her Ph.D. in atmospheric physics in 1999 and during the period of 2001–03 was a Post Doc Fellow at the Climate Change Institute and School of Marine Science at the University of Maine. Her research interests are climate impact assessment and numerical simulation on interaction between land surface/ocean and atmosphere.

RECENT NEWS OF RELEVANCE TO GEWEX

GEO MEETING RESULTS IN MODIFICATIONS TO THE 2006 GEOSS WORK PLAN

On 13–14 December 2005, the Group on Earth Observations (GEO) met in Geneva to discuss progress in developing the 2006 Work Plan and other central GEO documents. Based on this meeting, the GEO members were asked to identify leaders for individual tasks and country representatives were asked to identify areas in which they would like to make contributions. The GEO Users Interface Committee met the following day and endorsed a number of Community of Practice proposals including those for water and health and coastal zones.

FALL AGU SESSIONS DEAL WITH GEWEX ISSUES

Several sessions held at the Fall American Geophysical Union (AGU) in December 2005 dealt with areas that GEWEX is currently developing. In particular, IGPO co-sponsored a session on orographic precipitation that reviewed the range of issues related to the climatological, meteorological, modelling and observational challenges associated with the formation of precipitation in complex terrain.

MAHASRI AND ASIAN WATER CYCLE PLANNING MEETINGS HELD IN TOKYO

The University of Tokyo was the site of two major workshops in November 2005. The first workshop brought together the international science community that is preparing the science and implementation plan for the Monsoon Asian Hydro-Atmospheric Science Research and prediction Initiative (MAHASRI). Over 50 people commented on MAHASRI plans and discussed how to move forward with its implementation. The subsequent meeting dealt with the expansion of instrument networks across eastern Asia to benefit the Coordinated Enhanced Observing Period (CEOP) and MAHASRI.

GOES REPOSITIONING TO IMPROVE SOUTH AMERICAN COVERAGE

NOAA has agreed to move the Geostationary Operational Environmental Satellite (GOES-10) from its current position above the equator to a new location that will greatly improve coverage of the Western Hemisphere, especially South America. This move is planned for October 2006, pending the successful launch of GOES-N and the continued operation of GOES-12.

HIGHLIGHTS FROM THE 18TH MEETING OF THE GEWEX SCIENTIFIC STEERING GROUP

Dawn Erlich
International GEWEX Project Office

The GEWEX SSG-18 meeting was held in Dakar, Senegal, 9–13 January 2006. The meeting was hosted by the Université Cheikh Anta Diop with exemplary support from Dr. Amadou Gaye and his colleagues from the Ecole Supérieure Polytechnique. The meeting was opened by the Directeur de la Météorologie Nationale du Sénégal and the President de l'Assemblée de l'Université Cheik Anta Diop.

A special session was held on hydroclimatology research in Africa and on the African Monsoon Multidisciplinary Analysis (AMMA) Project. Dr. Daniel Rosenfeld from the Hebrew University of Jerusalem gave a scientific presentation on his recent research related to the thermodynamic responses to precipitation changes induced by surface and aerosol impacts on cloud processes.

In addition to the annual review of GEWEX activities, this SSG provided an opportunity to review linkages with other WCRP projects, including: the Climate Variability and Predictability (CLIVAR) Project, the Climate and Cryosphere (CliC) Project, and the Working Group on Numerical Experimentation (WGNE); as well as with other international communities including: the International Geosphere-Biosphere Project (IGBP)/international Land Ecosystem-Atmospheric Processes Study (iLEAPS); the Global Earth Observation System of Systems (GEOSS); the Integrated Global Observing Strategy-Partnership (IGOS-P); The Observing System Research and Predictability Experiment (THORPEX); the Global Water System Project (GWSP); the UNESCO International Hydrological Programme and the Water And Development Information for Arid Lands—A Global Network (G-WADI);

and the Hydrology and Water Resources (HWR) Programme of the World Meteorological Organization.

Some of the SSG meeting highlights include:

- Two special journal issues are planned with results from the 5th International Scientific Conference on the Global Energy and Water Cycle and the Coordinated Enhanced Observing Period (CEOP). A special issue on the GEWEX Atmospheric Boundary Layer Study benchmark case will appear in the February 2006 issue of the *Journal of Boundary Layer Meteorology*.
- The GEWEX Asian Monsoon Experiment ended in March 2005. A science plan for a proposed follow-on project called the Monsoon Asian Hydro-Atmospheric Science Research and prediction Initiative (MAHASRI) was presented and received approval in principal, subject to approval by the GEWEX Hydrometeorology Panel (GHP) at its next meeting.
- A draft version of the CEOP Phase II Implementation Plan was presented and received preliminary approval. CEOP Phase II will have two stages that run from 1 January to 31 December 2010. The diurnal cycle was adopted as one of the scientific themes.
- A GEWEX Radiation Panel led LandFlux activity is being developed to derive land-surface fluxes from satellite data. When combined with SeaFlux products, these fluxes could be used to address the entire global water and energy budget.
- The GEWEX European Coordinator has prepared a Category-1 proposal for the European Space Agency to release data for CEOP.
- The role of the Water Resources Application Project has been redefined as the Hydrologic Applications Project (HAP). Examples of initiatives with promising links to HAP include the Hydrological Ensemble Prediction Experiment, the Project for Ungauged Basins, and THORPEX.



Participants at the 18th Meeting of the GEWEX Scientific Steering Group.

AMMA AND ITS FIRST INTERNATIONAL CONFERENCE ADDRESS THE WEST AFRICAN MONSOON

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The West African monsoon (WAM) is a coupled land-ocean-atmosphere system characterized by summer rainfall over the continent and winter drought. Over the land the effects of the monsoon are most evident over an area stretching eastward from a line between Cameroon in the south and Niger in the north to the west coast of Africa. The annual cycle of rainfall in the West African region is characterized by a poleward migration of peak rainfall up to August followed by a more rapid retreat. It also includes an apparent “jump” in the location of peak rainfall at the end of June from the coastal region around 5°N to about 10°N. The precipitation is provided by the ubiquitous mesoscale convective systems and synoptic African easterly waves. Ultimately the nature of the surface conditions over the land (e.g., soil moisture, vegetation) and over the ocean (sea surface temperatures) determine the nature and variability of the WAM on interannual and longer timescales. In addition, the Sahara, just north of the rainy zone, provides the WAM an abundant supply of dust which may interact with and impact the intensity of the WAM.

Over the past 50 years the change in West Africa from wet to much drier conditions is among the strongest interdecadal signals of the past century.

This drying trend coupled with marked interannual variations has had devastating environmental and socio-economic consequences.

Fundamental gaps in our observation, understanding, and modelling of this complex system have limited our prediction skills. To bridge these gaps, the African Monsoon Multidisciplinary Analysis (AMMA) Project, has adopted a multidisciplinary approach, involving substantial international collaboration that links observation, data analysis and modelling on a wide range of space and time scales.

The processes that couple the land, ocean and atmosphere take place in association with multiple interacting space and timescales. To address the multiple scales that characterize the WAM, AMMA is structured around four interacting spatial timescales (see figure on page 20). AMMA is a multi-year project with three nested observation periods, LOP (2002–2010), EOP (2005–2007), and SOP (2006), which stand for the long-term, enhanced, and special observing periods, respectively.

The AMMA Project has three overarching aims: (1) improve our understanding of the WAM and its influence on the physical, chemical and biological environment, regionally and globally; (2) 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; and (3) ensure that the multidisciplinary research carried out in AMMA is effectively integrated with prediction and decision-making activity.

Scientists from more than 30 countries, representing more than 130 institutes are involved in AMMA. AMMA receives funding from the European Union,



Participants at the First International AMMA Conference.

France Action Programme Inter-organisme and the United Kingdom, as well as the United States and pan-African projects.

The GEWEX Scientific Steering Group approved AMMA as a Continental-Scale Experiment (CSE) in February 2005, thereby ensuring strong links between the scientific advances in AMMA and other CSEs, as well as interactions with coordinated international modelling activities, such as the GEWEX Global Land-Atmosphere System Study (*GEWEX News*, August 2004, February 2005). AMMA also has strong links to international projects, such as the Climate Variability and Predictability (CLIVAR) Project, the International Geosphere-Biosphere Programme International Global Atmospheric Chemistry Project and international Land Ecosystem-Atmospheric Processes Study, and the Global Climate Observing System and Global Ocean Observing System. In collaboration with The Observing System Research and Predictability Experiment (THORPEX), AMMA is addressing high impact weather prediction and predictability.

The **First International AMMA Conference** which was held in Dakar, Senegal, 28 November–2 December 2005, was very successful with 255 participants from 23 countries and more than 300 abstracts submitted. The Conference brought together researchers from around the world working on the WAM and its impacts, to review ongoing research activities and to discuss future contributions and directions within the AMMA research program. It also provided the first real opportunity for establishing and coordinating collaborations at the international level, and in particular with African scientists.

The Conference program included a mixture of plenary sessions, poster sessions and parallel working sessions. The plenary sessions included invited and contributed oral presentations. The working sessions were designed to provide an opportunity to discuss future research directions in AMMA as well as to coordinate and promote international collaboration. A workshop dedicated to climate impacts took place immediately after the conference and a training workshop on monitoring and forecasting the African monsoon impacts on agriculture and vegetation was held the following week in Thiès.

The AMMA Project articles appearing in this issue involve numerous members of the AMMA team who cannot all be acknowledged here. For contact information for all key Project contributors, please see www.amma-international.org.

AFRICAN CONTRIBUTION TO AMMA

**Amadou Thierno Gaye¹ and
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²LTHE/IRD, Niger

The entire West African region, especially the Sahel, has experienced one of the strongest interdecadal signals in the world, passing from wet conditions in the 1950s and 60s to much drier conditions in the 1970s, 80s and 90s. This has impacted all components of the water cycle and raised important issues related to sustainability, land degradation, and food and water security in the region. The development of strategies to reduce the socio-economic impacts of climate variability in West Africa is a priority. Research from the African Monsoon Multidisciplinary Analysis (AMMA), an international project designed to improve our understanding of the West African Monsoon (WAM) and its variability at different time and spatial scales, will improve prediction of the WAM and its impacts.

The AMMA program provides a unique opportunity for the international scientific community to contribute to the training and capacity building in African countries, regarding geosciences and their impacts (e.g., meteorology, hydrology, atmospheric chemistry, oceanography, agronomy) before, during and after the field program. AMMA will also raise the standard of climate and environmental research in African institutions supported by doctoral and master programs, summer schools and workshops. At the same time, there are areas (e.g., forecasting, human dimensions) in which African institutions have an equal contribution to make in developing environmental and climate science.

AMMA-Africa involves scientists from many African countries and disciplines, including the National Meteorology and Hydrology Services (NMHS), and universities and regional centers, such as the Regional Center on Agriculture, Hydrology and Meteorology (AGRHYMET) and the African Center for Meteorology Applied to Development (ACMAD). The AMMA-Africa Steering Committee includes representatives from 15 West African countries (Benin, Burkina Faso, Cameroon, Cabo Verde, Chad, Côte d'Ivoire, Gambia, Ghana, Guinea Bissau, Guinea Conakry, Mali, Niger, Nigeria, Senegal, Togo) and by an AMMA National Committee composed of members of the NMHS. AMMA-Africa provides a framework for African scientists to: (1) develop and consolidate links between research institutions and NMHS with the aim

of improving products for end-users; (2) provide assistance in responding to different calls for proposals; (3) exchange information, data and tools; (4) federate the initiatives and the individual suggestions for more efficiency; and (5) organize workshops and seminars.

The AMMA-Africa Science Plan or Plan d'Implementation Africain (PIAF), is based on individual and small team research proposals made by scientists in the region from universities, NMHS, and research centers. The goals of the PIAF are: (1) improve weather and climate prediction over West Africa; (2) evaluate the impacts of climate change on sectors (e.g., agriculture, health, water resources, pastoralism, coastal areas); (3) integrate multidisciplinary research for policy making; (4) initiate dialogue between the AMMA national committees and stakeholders; and (5) initiate national and regional capacity building through training and research.

The primary components of the PIAF are integrative geophysical and impact studies related to the impacts of WAM on water resources, agriculture, health and environment. Its implementation will contribute to improved knowledge of meteorological and hydrological sciences and to the operational activities of NMHS. This accounts for the strong involvement of regional centres (e.g., ACMAD, AGRHYMET) in the implementation of the AMMA Project.

The AMMA observational strategy combines measurements from existing and updated operational networks with additional observations concentrated within sub-regional windows where enhanced observations will be carried out during special observing periods. The value of additional, long-term observations in this region of poor data coverage will be assessed with models and data assimilation tools. Strengthened capacities related to systematic climate observations, data processing and archiving are seen as the major expected spin-offs by the NMHS directly involved in the implementation of this international program.

The World Meteorological Organization's endorsement of AMMA-Africa is expected to facilitate the integration of the contributions from the African NMHS with respect to operational aspects of the program and to help them to attract funds from their government and sponsors. The new program should lead to significant and sustainable results for the region, including an accurate observation network, tools and applications for decision making and early warning, and the development of a strong scientific community dedicated to studies of WAM and its impacts.

NEW GLASS CHAIR

Andrew Pitman, Professor at the Department of Physical Geography, Division of Environmental and Life Sciences, Macquarie University, Sydney, Australia, is the new chair of the Global Land-Atmosphere System Study (GLASS). He replaces Paul Dirmeyer, who is now managing the Climate and Large-Scale Dynamics Program at the National Science Foundation (NSF). Bart van den Hurk of the Royal Netherlands Meteorological Institute will serve as the GLASS vice-chair.

GEWEX SCIENTISTS HONORED AT THE ANNUAL AMS MEETING

At the 86th Annual Meeting of the American Meteorological Society, **Paul Dirmeyer**, NSF, received the Clarence Leroy Mesinger Award "for improved understanding of the role of soil moisture in land-atmospheric coupling, climate variability and climate predictability, and for leadership in GEWEX land modelling activities."

Soroosh Sorooshian, University of California, Irvine, was honored as the Robert E. Horton Memorial Lecturer. His talk was on "Significant contributions for estimating precipitation from space-based imagery and the application to semi-arid region hydrology and water resources management."

Other GEWEX affiliates to receive AMS honors include **Robert Houze**, University of Washington (Rossy Award) and **Julia Paegle**, University of Utah (ABBE Award). **Maria A.F. Silva Dias**, CPTEC/University of Sao Paulo, **Konstantine Georgakakos**, Hydrologic Research Center, and **Da-Lin Zhang**, University of Maryland, were honored as new AMS Fellows.

TYLER PRIZE AWARDED TO FORMER GEWEX SSG MEMBER

Former GEWEX Scientific Steering Group member, Igor Shiklomanov of the State Hydrological Institute in Russia, has been named co-recipient of the 2006 Tyler Prize for Environmental Achievement. Established by Los Angeles philanthropists John and Alice Tyler, the Tyler Prize is considered the premiere international award honoring achievements in environmental science, energy, and medical discoveries of worldwide importance that impact upon human existence.

IMPACTS OF AND ADAPTATION TO CHANGES IN THE WEST AFRICAN MONSOON

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There are many reasons to assume that future changes in the West African Monsoon (WAM) will strongly impact living conditions, food security and national economies. In the last rain deficit period, changes in ecosystems functions, vegetation species composition, river discharge (and thus water resources for irrigation) and groundwater availability were observed.

In the African Monsoon Multidisciplinary Analysis (AMMA)-Impact Project, partnerships between institutions from Europe in AMMA-EU and the African research community will be formed around research projects related to climate change and variability of the WAM. These include: (1) changes in water resource availability, its impact on irrigated and rain-fed agriculture, and adaptation measures and strategies; (2) climate change impacts on land use/land cover, and natural vegetation productivity and pastoral production systems; (3) development of improved seasonal forecasts guiding agricultural operations; (4) development and use of policy relevant climate change scenarios as input to impact, mitigation and adaptation studies.

The interannual rainfall variation observed in West Africa during the last 50 years has been characterized by a decreasing annual rainfall of 15–35% between the humid years (before 1970) and drought period (post-1970) which has impacted the discharge of Sahelian rivers. The mean annual discharge varies from 40–60% between the humid and drought periods. Impacts of and the adaptation to climate change in the agricultural sector in the Sahel-Sudan may involve a range of different responses:

- *Changes in agricultural land use at the macroscale.* In periods of deficit rainfall, croplands may be converted into rangelands.
- *Changes in land use and agricultural practices at the microscale.* Individual farmers are expected to adapt to variations in rainfall by selecting suitable field locations, and

taking local soil and terrain conditions into account.

- *Changes in crop choice.* Choosing between subsistence oriented crops (e.g., millet) and market-oriented crops (e.g., cotton and groundnuts), as well as between cultivars.
- *Irrigated agriculture.* May expand in the case of reduced rainfall, yet may be constrained by the availability of surface/groundwater resources.

It should be noted that all of these adaptive strategies are also relevant for other external changes, such as changes in prices of products and inputs (locally or globally), and changes in employment options in other sectors and outside the region. Farmer adaptation to climate change and variability in the Sahel-Sudan must be studied in the context of other important external influences. Also, land use policies must be considered along with water use and water policies, particularly in relation to irrigated agriculture. National natural resource policies and national capacities for planning and monitoring environmental change may have great importance. Climate change will also impact the availability of water resources, and since hydro-power is of considerable importance in several countries, there is also a direct link between changes in rainfall and power production. Thus, adaptation to climate change and variability involves not only individual households and rural communities, but also national governments and administrations. An efficient coupling between local, regional, national and international coping systems is crucial for minimizing climate-related economic losses.

As indicated above, impacts of and adaptation to climate change and variability must be seen in the context of broader development issues. Therefore, climate change adaptation and the pursuit of the UN Millennium Development Goals, including poverty alleviation, strongly overlap with the agriculture sector and rural livelihoods and in environmental themes, such as desertification and biodiversity. This suggests that climate change and variability adaptation strategies should form part of general rural and agricultural development strategies.

The strong international partnerships in AMMA-Impact will not only strengthen our understanding of the impacts of climate change, but also contribute to capacity development. Through the strong involvement of African partners, it will contribute significantly to policy development and in the longer run to sustainable development in West Africa.

EUROPEAN CONTRIBUTION TO AMMA

Jan Polcher

**Laboratoire de Météorologie Dynamique
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A consortium of 41 European and African institutions were awarded a grant from the European Union (EU) within the 6th Framework Program to contribute to the African Monsoon Multidisciplinary Analysis (AMMA) Project. While the aims of this integrated European project are the same as AMMA its main objective is to coordinate the contribution of the European research community and the national agencies in Europe which also fund AMMA. The following briefly describes the main areas of research in AMMA-EU.

Improve short- to medium-range weather forecasting. Due to the difficulty in accurately simulating key elements of the West African Monsoon (WAM), accuracy in short- to medium-range precipitation forecasts has been poor. Accurate forecasts are essential for early warning systems for food security, risk management and civil protection in Africa. With its intensive field campaign, AMMA-EU will provide the data needed to examine hypotheses on tropical convection, its interaction with the large-scale dynamics, and its role in the regional water cycle. Within this project, process studies on convection will be integrated with an improved knowledge of land-surface processes and interactions with aerosols and chemistry in order to be translated into improved parameterizations for the large-scale models used in forecasting.

Seasonal to climate forecasting. The statistical forecasts of the seasonal rainfall over Africa have not been surpassed by their deterministic counterparts as is the case in many regions of the world and as would be expected from theoretical considerations. Present deterministic forecasts are only forced by the sea-surface temperature variability. Models disagree on the sign and amplitude of rainfall changes for a climate with increased greenhouse gases. This state of affairs can be ascribed to the complex and poorly understood interactions between the monsoonal oceanic, land-surface and atmospheric processes. Progress in this area is critical for the food security at the shorter range and the development of agronomic adaptation strategies at longer time scales. The long-term monitoring of the water cycle by AMMA-EU will improve our understanding of the characteristics of the interannual rainfall variability. This will provide an under-

standing of which of the slow components in the system have the strongest predictive skill and which process needs to be better understood. Key to any significant progress will be an integrative approach that views the monsoon as an object built out of internal interactions but with strong external influences. An improved conceptual view of the monsoon will lead to better statistical forecasts as well as more accurate dynamic seasonal forecasts and allow us to estimate error bars for the climate change studies.

Food security management. West Africa is characterized by a low income household economy mainly based on rain-fed agriculture. The significant increase in demographic pressure, the progressive impoverishment of natural resources and the vulnerability of rainfall-dependent agricultural systems make West Africa the most food insecure area in the world. Understanding the effects of the WAM on regional and local food security involves studying the direct effect of the monsoon on agricultural productivity and adaptive mechanisms. AMMA-EU will estimate the range of direct and indirect effects of changes in the monsoon on the vulnerability of food security over the region and improve the prediction of seasonal production to serve as input for early warning systems. The direct effects will include changes in yields of rain-fed crops and changes in water resources available for irrigated cultivation. Indirect effects include changes in agricultural and livelihood strategies as well as land use.

Environmental monitoring. The African continent has poor coverage by operational atmospheric observations. For example, the rain gauge network is in steady decline and does not provide a satisfactory basis for water management. This considerably hinders the specification of initial conditions for forecasting systems and contributes little to long-term monitoring for climate change detection and attribution studies. AMMA-EU is implementing a multiscale and integrated monitoring network to provide key parameters for multidisciplinary scientific investigations. In particular, it will help to determine future operational monitoring strategies. The African radiosonde network is being upgraded and personnel will be provided with the appropriate training to maintain the network over the long term. The project will demonstrate the benefit of these enhancements in the upper air soundings for weather and climatic forecasting to motivate their funding at an international level.

AMMA LAND-SURFACE MODELLING AND INTERCOMPARISON PROJECTS

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Land-atmosphere feedbacks in the West African Monsoon (WAM) region have been shown to be of critical importance for atmospheric prediction in Africa and over the Northern Hemisphere (Koster et al., 2004). The distinguishing feature of land-atmosphere interactions over West Africa is the large range of the spatial and temporal scales involved in the surface processes and their interactions with atmospheric processes. At the small scale, these interactions have an impact on convective cells within mesoscale storm systems, while at the regional scale they influence the position of the Intertropical Convergence Zone and the African East Jet through a significant meridional surface flux gradient (Taylor et al., 1997). The diversity of processes involved in the WAM, and their interactions at different scales controls the processes themselves, the water budget and the surface-atmosphere feedbacks, all of which are key scientific investigations of the African Monsoon Multidisciplinary Analysis (AMMA) Project.

The land surface modelling strategy of AMMA relies on the following structure: (1) The coordinated development and use of various Land Surface Models (LSMs), each focusing on different processes and working at different temporal and spatial scales, over different domains and sites in West Africa. These include hydrological models, soil-vegetation-atmosphere transfer schemes, crop models and the integrated "second generation" land surface-models. (2) The creation of a multiscale low-level atmospheric forcing database over land. These data are essential in order to have a coherent multi-disciplinary modeling approach at various scales for use by the large and diverse group of land surface models considered in AMMA. (3) The development of an African Land Data Assimilation System. The European Centre for Medium-Range Weather Forecasts are running the recently developed soil moisture data assimilation system for the African area using AMMA data and surface flux and soil moisture data for verification. The off-line simulated land surface state is being used to evaluate and pos-

sibly improve the current assimilation system (for estimating soil moisture) used at Météo-France.

The development and improvement of model parameterizations, coupling, and calibration, as well as assimilation methods, are the basis for the suitability and consistency of the modelling studies conducted in AMMA. These activities are largely supported by the comprehensive field campaign. The instruments will be deployed during the course of AMMA for different periods: LOP (2002–2010), EOP (2005–2007), SOP (2006), which stand for the long-term, enhanced, and special observing periods, respectively. The aforementioned activities will also be supported by the AMMA-Satellite Working Group, thereby allowing developers to access multi-sensor remotely sensed data sets. For more information about AMMA land-surface modelling, see: http://www.amma-eu.org/sections/work_packages/tools-methods/wp4_1.

The goal of attaining a coherent multi-disciplinary modeling approach at various scales with a large group of land surface models is based on the need to build a multiscale forcing database. The coordination of the land surface modelling activities in AMMA is supported by the AMMA LSM Intercomparison Project (ALMIP). ALMIP involves AMMA-EU and AMMA-API partners. It is conducted along the same lines as previous LSM intercomparison studies, such as the Global Soil Wetness Project (GSWP, Dirmeyer et al. 1999), the Project for the Intercomparison of Land-Surface Parameterization Schemes (PILPS, Henderson-Sellers et al., 1995), the Rhône AGGregation Land Surface Scheme Intercomparison Project (Rhône-AGG, Boone et al., 2004), but focuses on Africa and specific land-surface processes involving various spatial and temporal scales. The first phase of ALMIP is being conducted this year with integrated LSMs and SVAT models.

ALMIP has the following objectives: (1) intercompare results from an ensemble of state-of-the-art models; (2) determine which processes are missing or not adequately modeled by the current generation of LSMs over this region; (3) examine how the various LSMs respond to changing the spatial scale (three scales will be analyzed: the local, meso and regional scales); (4) develop a multi-model climatology of "realistic" high resolution (multiscale) soil moisture, surface fluxes, and water and energy budget diagnostics at the surface that can then be used by other projects within AMMA; and (5) evaluate how relatively simple LSMs simulate the vegetation response (in terms of leaf area index or biomass) to the atmospheric forcing on seasonal and interannual timescales.

A series of four 2-year experiments using data from 2003–2004 are being performed and consist of: (1) running the LSM at a regional scale (–20° to 30° E, –5° to 20°N, on a 0.5° grid) using numerical weather prediction forcing data; (2) again using hybridized forcing data; (3) doing a sub-regional or mesoscale (a north-south sub-zone using a 0.05 to 0.10 degree resolution) simulation; and (4) running a LSM at the local scale. A second optional series of experiments repeats the above while using LSMs to simulate the vegetation.

The input data has been distributed to the model participants and the preliminary results are due this summer. A several month period will follow in which the results will be quality controlled and analyzed. A workshop to compare the results is tentatively being planned for autumn, 2006. For more information about ALMIP, see: http://www.cnrm.meteo.fr/amma-moana/amma_surf/almip/

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US CONTRIBUTIONS TO THE 2006 AMMA FIELD CAMPAIGN

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The AMMA field program builds on the Couplage de l'Atmosphère Tropicale et du Cycle Hydrologique (CATCH) experiment and provides enhancements to the current sustained observing system in West Africa. The Sahelian region has one of the strongest soil moisture-precipitation feedbacks in the world (Koster et al., 2004), indicating that improved soil moisture knowledge is likely to yield improved prediction. Central to the AMMA observing strategy are three mesosites that sample contrasting environments across the marked north-south gradient in surface conditions, the so-called “climate transect” (see the figure on page 1). Additional *in situ* observations will be made at the mesosites and along the climate transect to address science issues at local-to-regional scales. In addition, AMMA will provide enhancements to the regional observing system over West Africa and in the Gulf of Guinea and the tropical Atlantic to support this analysis. The following describes the major US facilities contributing to the AMMA field program in 2006.

The US will support two major platforms at the Niamey, Niger mesosite: (1) the Department of Energy Atmospheric Radiation Measurement (ARM) Program Mobile Facility (AMF); and (2) the National Aeronautics and Space Administration (NASA) sponsored Massachusetts Institute of Technology (MIT) C-band radar. The AMF includes a comprehensive suite of instruments, including surface radiometers for both broadband and spectrally resolved fields, standard surface meteorological measurements, and active instruments for probing the vertical structure of the troposphere, including a 95 GHz cloud radar, a micropulse lidar, and radar wind profiler. The AMF has been making measurements at the Niamey airport and at an ancillary rural site 60 km east since the beginning of January 2006 and will remain deployed there for 1 year. It is a key facility of the Radiative Atmospheric Divergence Project which uses the AMF, Geostationary Earth Radiation Budget (GERB) sensors, and AMMA stations. The measurements made by the suite of instruments available from the AMF along with

US AMMA WORKSHOP

4–5 May 2006
Washington, DC

The Workshop is being held to promote and coordinate the US contributions to the African Monsoon Multidisciplinary Analysis (AMMA) Project. The goal of the workshop is to develop a US strategy for addressing the key science issues related to the water cycle, land-surface-atmosphere interactions, and radiation (including the impact of aerosols). For more information, see: <http://www.ucar.joss.edu/amma>.

measurements from research aircraft, GERB sensors, and the others will be used to examine the radiation budget of the atmospheric column. Particular emphasis will focus on the effects of the high dust loadings during the dry season, and the abundant water vapor during the summer monsoon season.

The MIT C-band Doppler radar will be deployed in Niamey for a minimum of 75 days starting in June 2006. The radar will provide reflectivity and radial Doppler velocity in full volume scans at 10-minute intervals on a continuous basis. Efforts are ongoing to deploy it for an additional year to sample two consecutive summers. The radar in Niamey will support analysis of: (1) convection including the ubiquitous intense Mesoscale Convective Systems (MCSs) in this region; and (2) hydrology and land-surface interactions. The analysis of the intense and electrically active MCSs will also be supported by the Zeus lightning detection network that is now operating in the West African region (Chronis and Anagnostou, 2006).

Understanding the variability of the water cycle and associated rain-bearing systems in the two contrasting mesosites in Niamey and Oueme (Benin) along the climate transect (see figure on page 1) is essential to improving our knowledge of the WAM. Both sites are supported by a unique array of hydrological and atmospheric measurements, and by precipitation measurements from the NASA Tropical Rainfall Measuring Mission (TRMM). These measurements will be supplemented by two radars in the Oueme region (RONSARD and an X-band) provided by Europe and two quadrilaterals of rawin sounding stations (akin to the intensive flux arrays in the Tropical Ocean Global Atmospheres/Coupled Ocean Atmosphere Response Experiment–TOGA-COARE) centred on Niamey and Oueme (figure on page 1) provided by Europe and Africa. This later network will provide high frequency sonde launches to support the analysis of water, heat and momentum budgets.

The National Oceanic and Atmospheric Administration's (NOAA) research vessel, the *Ronald H. Brown* will perform two transects during the 2006 AMMA field campaign. During the first transect, the French Tropical Atmosphere Ocean (TAO) Mooring, currently deployed at the equator, will be serviced and two additional TAO Moorings will be deployed along the transect $\sim 5^{\circ}\text{N}$ and $\sim 12.5^{\circ}\text{N}$. In addition, oceanic

(e.g., surface and subsurface temperature, salinity and current observations) and atmospheric (e.g., rawinsondes and *in situ* thermodynamics) measurements will be made along this initial leg to support the regional analysis of the WAM. The second leg will also be along 23°W from 5°S to 20°N collecting oceanic and atmospheric observations similar to those obtained during the first leg. These observations will support the regional analysis of the coupled WAM system as well as the environment downwind from the West African coast. In particular, these data will support the study of mechanisms that influence the tropical Atlantic upper layer heat content (including sea-surface temperature) and the Saharan Air Layer (SAL), both known to be important for summer monsoon rainfall and tropical cyclone development.

NASA and NOAA aircraft will be coordinated to study the evolution of precipitating convective systems downwind from West Africa, largely as this evolution pertains to tropical cyclogenesis. The NASA-AMMA (NAMMA-06) component will build on one or more airborne science platforms, satellite sensors (e.g., TRMM), and ground-based instrumentation. The NASA DC-8 high altitude research aircraft will serve as the primary research tool for NAMMA-06 investigations. The DC-8 will likely be based at the Cape Verde Islands and may be flown in coordination with one or more NOAA Hurricane Research Division (HRD) aircraft in the central and eastern Atlantic basin. NASA also anticipates conducting a surface-based scientific component with its polarimetric weather research radar (NPOL) and C-band Doppler weather radar (TOGA radar). Together, these radars will provide an understanding of the transition of convective systems and their contributions to tropical cyclogenesis as they move from continental to marine environments. Other possibilities include the placement of the TOGA radar on the Cape Verde Islands and the deployment of one or more Aerosonde unmanned aerospace vehicles (UAVs) for continuous monitoring of the oceanic planetary boundary layer and lower half of the SAL. The suite of ground-based measurements in Cape Verde and Senegal will support the aircraft objectives on a continuous basis.

As part of the SAL Experiment (SALEX) investigations which began during the 2005 hurricane season, the NOAA HRD anticipates deploying the G-IV high altitude research aircraft and a single WP-3D Orion from Barbados in the

Caribbean. These aircraft will be used to provide *in situ* thermodynamic and kinematic profiles in and around developed African easterly waves (AEWs), tropical cyclones, and the SAL using geostationary positioning system dropsondes.

A driftsonde system was developed by the National Center for Atmospheric Research (NCAR), primarily in response to needs of the World Meteorological Organization THORPEX (THE Observing System Research and Predictability Experiment) (e.g., Shapiro and Thorpe, 2004). The effort is a technical collaboration between the French Space Agency, CNES, providing the ballooning expertise and NCAR providing the sounding (including deployment) expertise. The driftsonde operations during the AMMA SOP will be based in N'dajamena, Chad with daily launches during periods of interest. This location is well-suited to cover the West African region as well as regions of hurricane genesis in the tropical Atlantic. Currently the driftsonde is funded for eight missions carrying 40 sondes each. This AMMA-THORPEX collaboration will be the first driftsonde research deployment and will be useful for several AMMA and THORPEX research and forecast topics including: (1) characterization of the SAL and the ability of models to represent its evolution, (2) numerical and observational studies of the impact of dry air on convection and tropical cyclogenesis, (3) investigation into the interactions between convection and African easterly waves, (4) studies of tropical cyclone genesis and efforts aimed to extend the accurate prediction of tropical cyclones in the medium range, and (5) studies of the impact of targeted observations on weather system prediction.

For more details about these platforms (including the Principal Investigators) and other US contributions to AMMA (including the role of NCEP) see the AMMA-US website at: <http://www.joss.ucar.edu/amma>. Information about plans for the AMMA US workshop will also be made available here (see page 11).

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TIGER INITIATIVE

Diego Fernández Prieto
European Space Agency

Following the 2002 Johannesburg World Summit on Sustainable Development, the European Space Agency (ESA) launched the Terrestrial Initiative in Global Environment Research (TIGER), focusing on the use of space technology to supply water-related geo-information in support of integrated water resource management for sustainable development in developing countries (with a particular focus on Africa). TIGER consists of two major elements: (1) a set of individual projects with limited geographical coverage and scope, which are “building blocks” for the (2) political process, which aims at developing long-term, large-scale, sustainable information services for better decision making in the water-resource management domain.

Since its initiation, TIGER has benefited from the association of the space and water resources-related programs of the United Nations Educational Scientific and Cultural Organization (UNESCO) and other United Nations agencies (e.g., the UN Economic Commission for Africa-International Water and Sanitation Centre; the Food and Agriculture Organization); other space agencies, international agencies; and key African organizations [e.g., the African Ministerial Conference on Water, the Council for Scientific and Industrial Research (South Africa), the Department of Water Resources and Forestry (South Africa)].

TIGER projects span the African continent, and address the various stages of the water cycle, including the use of satellite data to map soil moisture across Southern Africa, monitoring flood plains and humid zones in the Sahel region of Senegal, combining radar and optical Earth observation data to monitor the environmental state of the northwest coast of Madagascar, and modelling the water balance of semi-arid rock watersheds using both satellite imagery and *in situ* data.

TIGER is implemented through a number of development and demonstration projects, research, training and capacity building activities. Through these activities the specific needs and demands for geo-information by water managers are expressed by more than 150 African water authorities, universities, environmental agencies and technical centers.

ESA projects operating under the TIGER umbrella reflect the TIGER priority topics of wetland



Girls at the water source. (Photo Credit: ESA)

monitoring, food security, epidemiology and ground-water resources management. Currently, 50 TIGER-related projects are in progress, 70% of which are being headed by African organizations. These projects include:

- **Globwetland** – provides satellite data on 15 African wetland sites—important for protecting biodiversity, moderating flooding and maintaining water purity—with ten different African governments among the project users. Products include land cover and land use change maps on the scale of individual wetland sites and drainage basins in support of reporting obligations for the international Ramsar Convention on Wetlands.
- **Global Monitoring for Food Security (GMFS)** – employs Earth observations to maintain a continental-scale overview of sub-Saharan Africa to produce subnational and selected high-resolution crop production forecasts for African agricultural ministries and nongovernmental organizations.
- **Epidemio** – uses satellites to provide environmental information in the service of epidemiology, including the charting of water bodies to prepare malaria risk maps for users such as the World Health Organization.
- **Rivers and Lakes Project** – developed a system for authorities that monitors levels for rivers and lakes.
- **Aquifer Project** – generates products and services related to the management of ground water-storing subsurface aquifers, a crucial source of fresh water in North Africa. These include land-use cover and land use change charts, digital terrain maps, soil moisture mapping and subsidence monitoring to help identify and encourage the use of new and existing

aquifers in a sustainable manner. Users include the governments of Algeria, Libya, Mali, Niger, Nigeria and Tunisia.

A TIGER Workshop was held at the European Centre for Earth Observation in Frascati, Italy on 3–4 October 2005, followed by 3 days of Earth observation technology training sessions. Ninety-five participants from 31 countries attended the workshop to review the status of TIGER-related projects in progress. Existing activities have now been bolstered by new project types called “TIGER Innovators” started by ESA in December 2005. These projects are aimed at developing innovative, low-cost solutions to support African water authorities in the conservation and monitoring of scarce water resources. Utilizing the latest Earth observation technologies and geographical information systems, these partnerships involving European/Canadian and African organizations will tackle a range of different water-related issues across the African continent.

Several major developments were reported at the workshop. Dr. Stephen Donkor, UN Economic Commission for Africa (UNEC-A), Chairman of the TIGER Steering Committee, reported that UNEC-A is hosting an Africa Water Information Clearing House intended to be a “one-stop shop” for all available data on African water, which will be made available to everyone who needs it. Results from individual TIGER projects will be added to this Clearing House on the basis that increasing their visibility and data accessibility will increase their overall effectiveness. It should also be a means of attracting funding from national and international funders to support the continuation of TIGER project activities. Dr. Jean-Marc Chounard, Canadian Space Agency (CSA), reported that the seven projects being supported by CSA would all be receiving free Radarsat-1 data, including a high-resolution radar mosaic of the African continent.

In conclusion, there is no doubt that the management of water resources will pose a major challenge in this century, particularly as the growth in the global population is greatest in regions with dry and semi-dry climates. With its TIGER initiative, ESA is addressing this challenge head-on by fostering a greater understanding of the water cycle, and by providing crucial information to decision makers at local, regional and global levels. Improved information about the use of water resources not only provides a better basis for life and health to local people, but is also a critical factor in supporting peace and stability among countries desperately concerned about the use of shared water resources. For more information, see: <http://www.tiger.esa.int>.

GLOBAL SURFACE ALBEDO DERIVED FROM GEOSTATIONARY SATELLITES

Yves Govaerts¹, Alessio Lattanzio², and Johannes Schmetz¹

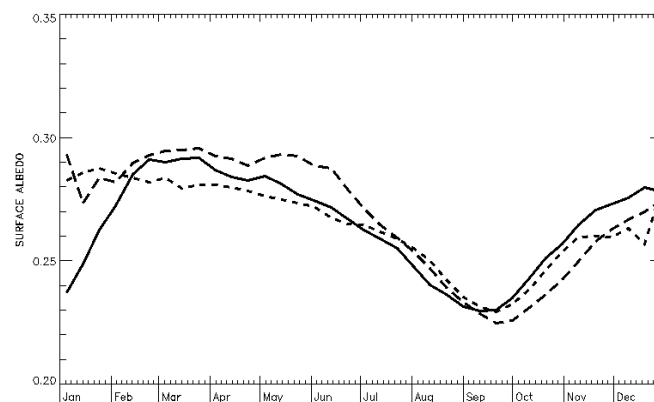
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The albedo of the Earth's surface determines the partition between the solar radiation reflected back to the atmosphere and absorbed at the surface, and thus largely determines the surface energy balance. Vegetation type and amount play a significant role in the temporal and spatial variability of surface albedo. Climate models show a positive feedback between surface albedo and precipitation in large subtropical regions like the Sahel where an increase in surface albedo implies a reduction in rain rates, which in turn leads to vegetation removal, thus reinforcing high surface albedo values.

Although the potential of space-based observations for mapping global surface albedo has long been recognized, these observations have only been routinely retrieved since 2001 from the Moderate Resolution Imaging Spectroradiometer (MODIS) and Multi Angle Imaging Spectroradiometer (MISR) on Terra. This is partly due to the limited number of space instruments dedicated to land-surface observations before the late 1990s when systematic space-borne observations were essentially limited to data acquired by geostationary meteorological satellites and a few polar platforms. Recently EUMETSAT demonstrated that surface albedo can be derived in a consistent manner from geostationary satellites located at regular intervals around the Equator (see figure on page 20) by using archived satellite observations (Govaerts et al., 2004a) in conjunction with state-of-the-art retrieval techniques (Pinty et al., 2000). The consistency of this global product has been thoroughly verified by comparing surface albedo values over common areas observed by two adjacent satellites (Govaerts et al., 2004b). Pinty et al. (2005) demonstrated that surface albedo derived from geostationary satellites compares favorably with MODIS or MISR observations.

The possibility to consistently and accurately generate such a product is very encouraging since data from the corresponding geostationary satellite archives cover more than two decades and thus offer a unique opportunity to derive long-term data sets of surface albedo for climate studies. These will provide new insights into climate and vegetation variability. In particular, the Meteosat archive, whose images encompass the African continent for the last 25 years, permits the monitoring of seasonal

surface albedo changes in sensitive regions such as the Sahel where interannual relative differences as large as 10 percent are observed (see figure below). It will also shed new light on important questions concerning the hydrological cycle and its interaction with surface albedo as already demonstrated by Knorr et al. (2001).



Interannual variations of surface albedo seasonal cycle over a region ranging from 8°W to 8°E and 0° to 12°N. Solid line is for year 2000, dashed line 2001, and long-dashed line 2003.

This pilot study, conducted at EUMETSAT in collaboration with the European Union Joint Research Centre in the framework of a Coordination Group for Meteorological Satellites request and a Global Climate Observing System recommendation, demonstrates that geostationary satellite data archives hold promise for relevant, yet untapped information on our climate system. The new information will be useful for long-term monitoring of the climate system as it potentially covers already more than two decades. The study also demonstrates the utility of archived data from meteorological satellites for climate studies.

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GEWEX RELEVANT PUBLICATIONS OF INTEREST

Monitoring the Response of Vegetation Phenology to Precipitation in Africa by Coupling MODIS and TRMM Instruments

Reference: X. Zhang, M. A. Friedl, C. B. Schaaf, A. H. Strahler, and Z. Liu. *J. Geophys. Res.*, Vol. 110, D12103: 2005.

Summary/Abstract: While temperature controls on vegetation phenology in humid temperate climates have been widely investigated, water availability is the primary limit on vegetation growth in arid and semiarid ecosystems at continental and global scales. This paper explores the response of vegetation phenology to precipitation across Africa from 2000–2003 using vegetation index data from the Moderate-Resolution Imaging Spectroradiometer (MODIS) and daily rainfall data obtained from the Tropical Rainfall Measuring Mission (TRMM). The results indicate that well-defined thresholds exist in cumulative rainfall that stimulate vegetation green-up in arid and semiarid regions of Africa.

Investigation of Hydrological Variability in W. Africa Using Land Surface Models

Reference: K. Y. Li, M. T. Coe, and N. Ramankutty, 2005. *J. Clim.*, Vol. 18, No. 16, pp. 3173–3188.

Summary/Abstract: In this study, a land surface model, the Integrated Biosphere Simulator (IBIS), and a hydrological routing model, the Hydrological Routing Algorithm (HYDRA), are used to investigate the hydrological variability in two large basins, the Lake Chad basin (LCB) and the Niger River basin (NRB), located in W. Africa, over the period from 1950 to 1995. The results show that the hydrology in this area is highly variable over time and space. The coefficient of variance (CV) of annual rainfall ranges from 10%–15% in the southern portions of the basins to 30%–40% in the northern portions. The annual evapotranspiration (ET) varies with a slightly lower CV compared to the rainfall, but the runoff is extremely sensitive to the rainfall fluctuation, particularly in the central portions of the basins (8°–13°N in LCB and 12°–16°N in NRB) where the CVs in runoff are as high as 100%–200%. The annual river discharge varies largely in concert with the rainfall fluctuation, with the CV being 37% in LCB and 23%–63% in NRB. In terms of the whole basin, the relative hydrologic variability (rainfall, ET, runoff, and river discharge) is significantly higher in the dry period.

Influence of Surface Processes over Africa on the Atlantic Marine ITCZ and South American Precipitation

Reference: S. M. Hagos and K. H. Cook, 2005. *J. Clim.*, Vol. 18, No. 23, pp. 4993–5010.

Summary/Abstract: Previous studies show that the climatological precipitation over S. America, particularly the Nordeste region, is influenced by the presence of the African continent. The influence of African topography and surface wetness on the Atlantic marine ITCZ (AMI) and S. American precipitation are investigated. Cross-equatorial flow over the Atlantic Ocean introduced by north–south asymmetry in surface conditions over Africa shifts the AMI in the direction of the flow. African topography, for example, introduces an anomalous high over the southern Atlantic Ocean and a low to the north. This results in a northward migration of the AMI and dry conditions over the Nordeste region. The implications of this process on variability are then studied by analyzing the response of the AMI to soil moisture anomalies over tropical Africa. Northerly flow induced by perturbations in soil moisture over northern tropical Africa shifts the AMI southward, increasing the climatological precipitation over northeastern S. America. Flow associated with an equatorially symmetric perturbation in soil moisture, however, has a very weak cross-equatorial component and very weak influence on the AMI and S. American precipitation.

Evaluating the NCAR Climate System Model Over W. Africa: Present-day and the 21st Century A1 Scenario

Reference: A. F. Kamga, G. S. Jenkins, A. T. Gaye, A. Garba, A. Sarr, and A. Adedoyin, 2005. *J. Geophys. Res.*, Vol. 110, D03106.

Summary/Abstract: An analysis of observed and simulated June–July–August W. African climate during the last 2 decades of the 20th and 21st centuries is presented. The National Center for Atmospheric Research coupled atmosphere–ocean climate system model (CSM) simulation is compared to long-term observations and National Centers for Environmental Prediction reanalysis with an emphasis on the wet season during the late 20th century. While there are significant improvements in the simulation of the African Easterly Jet and African easterly waves relative to the uncoupled Community Climate Model, Version 3, biases still exist. These biases are related to a poor simulation of the Azores high, which extends into E. Europe, allowing for cold air advection into N. Africa. There is also little improvement in the upper troposphere Tropical Easterly Jet in the CSM, which is too weak and does not extend westward over the Atlantic Ocean.

GLASS/GABLS WORKSHOP ON LOCAL LAND-ATMOSPHERE COUPLING

19–21 September 2005
De Bilt, The Netherlands

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The Global Land-Atmosphere System Study (GLASS)/GEWEX Atmospheric Boundary Layer Study (GABLS) Workshop on Local Land-Atmosphere Coupling provided a wide range of new scientific insights in the mutual interaction between the land-surface and the atmospheric boundary layer. Highlights from the workshop are presented here.

Land-atmosphere interactions for stable boundary layer (BL) conditions were described by Gert Jan Steeneveld who presented encouraging results from a coupled land-atmosphere 3-day simulation using the Cooperative Atmosphere-Surface Exchange Study-1999 (CASES-99). His work suggests that a simple set of surface energy balance equations is well suited for describing the role of an interactive surface-planetary BL system. Michael Ek presented the derivation and applicability of a general relative humidity tendency equation (see Ek and Holtslag, 2004). This equation may be used as a diagnostic tool to quantify the relative contributions of surface moisture conditions, atmospheric stratification and boundary layer growth in the formation of BL clouds. Frank Beyrich illustrated the use of the Lindenberg Inhomogeneous Terrain-Fluxes between the Atmosphere and Surface, a long-term Study (LITFASS) measurements for studying the role of land-surface heterogeneity on land-atmosphere interaction as well as BL studies.

Luis Bastidas demonstrated the impact of land-atmosphere coupling in the process of parameter calibration. Optimal values of parameters both in the land and the atmospheric components of a coupled single column land-atmosphere model were quite different, depending on whether the land-only or the coupled system was used to optimize the parameter values. Eleanor Blyth and Richard Essery presented the Joint UK Land Environment Simulator (JULES) infrastructure, which may be integrated into the National Aeronautics and Space Administration (NASA) Land Information System.

Land-atmosphere interaction diagnostics derived from large-scale model experiments were reviewed. Paul Dirmeyer compared the Global Land-Atmosphere Coupling Experiment (GLACE) coupling strength to

the measured response of surface fluxes to soil moisture. He concluded that in contrast to observations, the GLACE models tend to give a stronger relationship between evaporation and soil moisture than between evaporative fraction and soil moisture. Also, the strength of the link between sensible heat flux and soil moisture is generally underestimated in the models. Anton Beljaars reported on analyses by Alan Betts, and made a plea for scientists to compare model output to observable quantities that express various coupling processes in the land-atmosphere system, in particular net longwave radiation and diurnal temperature range for coupling aspects under stable conditions, and cloud albedo, lifting condensation level and BL relative humidity in daytime conditions.

In addressing data assimilation methodologies, Dara Entekhabi reported that: (1) these techniques, when applied to relatively simple coupled land-atmosphere models, are very helpful in extracting relevant information on coupling processes, as they allow the explicit formulation of errors in both the observations and models; and (2) remotely sensed surface temperatures that are readily available in a large range of spatial and temporal resolutions, could be used to define the actual state of the land surface and overlying atmosphere, such as the spatial distribution of the aerodynamic exchange coefficient.

Joseph Santanello, Jr. showed the value of high resolution profiling instruments, the NASA Atmospheric Infrared Sounder (AIRS) and the Moderate Resolution Imaging Spectroradiometer (MODIS), in determining the likelihood of a dry-down feedback cycle. When soil conditions are already dry, a deep nocturnal residual layer allows for a rapid boundary layer growth and thus ventilation after sunrise, promoting a rapid removal of evaporated moisture. Some of the conclusions and recommendations resulted from the Workshop include the following:

CASES-99

- In view of the difficulty in collecting data to show differences between modelled and true states, it was recommended that LES simulations be carried out for a (series of) complete diurnal cycle(s) that would serve as reference for future observational campaigns.
- The set of meaningful diagnostic evaluations should be extended following the lines of the recent work of Alan Betts (e.g., inspection of net longwave radiation, partitioning between soil and sensible heat, diurnal temperature range).

- Current CASES-99 simulations should be repeated with models in which surface temperature is not prescribed but has more freedom to vary, thereby explicitly accounting for interactive land-atmosphere coupling. Rather than including a complex land surface scheme, a simple set of (calibrated) surface energy balance equations is recommended, for its ease of implementation in participating schemes, and its ease for standardizing among the participating models.

Hydrological coupling

- Single column integrations should be conducted in a different number of locations, both within and outside the so-called GLACE identified “hotspots.” These integrations should examine the causes of differences in coupling strengths among large-scale models and between models and observations.
- Ek and Holtslag’s RH-tendency equation should be extended to include the relative contribution of lateral advection and possibly other diagnostics that express the presence of a residual layer or vegetation stress regime.

General recommendations

- The extension of uncoupled with coupled simulations helps to increase the understanding of the role of coupling in the processes seen in nature. It also reveals possible phenomena not emerging in uncoupled simulations. However, prior to carrying out a series of simulations, it is advisable to: (1) define a null-hypothesis to the experiments; (2) define the diagnostics to be examined; and (3) do the simulations with well-defined standardized interfaces.
- Simple data assimilation models and diagnostics should be used to extract relevant information from both observations and model equations because they avoid long integrations and provide better inputs to experimental designs.

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3RD SESSION OF THE WGDMA

**14–17 November 2005
Darmstadt, Germany**

**William B. Rossow
NASA Goddard Institute for Space Science**

The Third Session of the GEWEX Radiation Panel Working Group on Data Management and Analysis (WGDMA) was hosted by EUMETSAT. Topics covered at the meeting included data project and data center status and readiness to continue operations for 2006–2010 and the data product assessment activities. Other topics discussed were the identification of improvements to the data products and plans for a coordinated product reprocessing. Related data product activities and plans for analyses of the global energy and water cycle were also discussed.

The following improvements to the Global Precipitation Climatology Project (GPCP) data products were proposed: (1) substitute the Global Precipitation Climatology Centre 50-year gauge analysis for the original product to improve record homogeneity; (2) adjust the results for topographic altitude; (3) replace the microwave radiance data with a more homogeneous version and modernize the microwave algorithm; (4) anchor the microwave products to the Tropical Rainfall Measuring Mission data; (5) increase time resolution in the earlier products using the denser infrared radiance product from the International Satellite Cloud Climatology Project (ISCCP) (B1U); (6) consider the possibility of obtaining and using daily rain gauge data; and (7) implement new snow retrieval methods as part of the analysis using ancillary surface air temperature data to discriminate between rain and snow.

Proposed improvements to the ISCCP data products included: (1) refine detection of polar clouds; (2) refine treatment of ice clouds and land and ice surfaces; (3) reduce the satellite viewing angle dependence in the results; (4) switch processing from B2 to the B1U radiance data set; (5) process all overlapping data; and (6) release a global DX product and a DS product and consider producing a daily product.

Recommendations for improving the Surface Radiation Budget (SRB) Project data products included: (1) use a uniform atmospheric temperature and humidity data set for the entire record; (2) improve the trace gas climatology and use the Stratospheric Aerosol and Gas Experiment (SAGE) and GACP data for

aerosol records; (3) use recent products to improve surface albedo and emissivity spectral and seasonal dependence; (4) consider processing all available satellite pixels in a grid box rather than using current satellite hierarchy; (5) evaluate clear-sky composite-based values of surface albedo and temperature; (5) refine cloud emissivities and day-night difference treatment; (6) implement new Clouds and Earth's Radiant Energy System angle dependence models and refine optical properties for aerosol and ice clouds; and (7) evaluate cloud layer thickness, overlap and cloud base location treatments.

Improvements proposed for the Global Aerosol Climatology Project (GACP) data products included: (1) develop and implement a retrieval procedure over land; (2) evaluate differences among satellite aerosol products to "calibrate" long-term products; and (3) merge aerosol and cloud products to facilitate study of aerosol indirect effects.

Actions recommended for a coordinated reprocessing of all the products included: (1) complete the product assessments to identify problems and suggest improvements with a focus on improved homogeneity of the time record; (2) coordinate the review of all radiance calibrations and adopt common results for all projects; (3) evaluate available ancillary data sets describing the properties of the atmosphere and surface and adopt a common set for all projects; (4) exploit interdependencies using SAGE and GACP as input for ISCCP, and using SAGE, GACP and ISCCP as inputs for SRB and GPCP; (5) implement refinements to increase space-time sampling intervals towards a common goal of at least 100 km, daily (3-hourly if possible); and (6) develop at least one product from all projects that has a common map grid interval and time step.

The WGDMA members proposed the following milestones to meet their GEWEX Phase II Plan objective to produce long-term research quality data sets for the study of the global energy and water cycle.

- 2006: Release current products as a package
- 2006: Complete review of radiance calibrations
- 2007: Complete first analyses of global energy-water cycle with current products
- 2007: Complete data product assessments
- 2008: Complete reprocessing of precipitation, aerosols, cloud, and radiation products
- 2009: Complete improved SeaFlux products and the new LandFlux products
- 2010: Complete second product assessment
- 2011: Complete second global analyses

GEWEX/WCRP MEETINGS CALENDAR

For a complete listing of meetings, see the GEWEX web site (<http://www.gewex.org>)

6–11 March 2006—27TH SESSION OF THE WCRP JOINT SCIENTIFIC COMMITTEE, Pune, India.

13–17 March 2006—WORKSHOP ON THE ORGANIZATION AND MAINTENANCE OF TROPICAL CONVECTION AND THE MADDEN JULIAN OSCILLATION, Trieste, Italy.

13–18 March 2006—ESA SYMPOSIUM—15 YEARS OF PROGRESS IN RADAR ALTIMETRY, Venice, Italy.

16–22 March 2006—FOURTH WORLD WATER FORUM: LOCAL ACTIONS FOR A GLOBAL CHALLENGE, Mexico City, Mexico.

20–22 March 2006—1ST GEWEX RADIATION PANEL AEROSOLS WORKSHOP, College Park, Maryland, USA.

21–24 March 2006—2006 NOAA CLIMATE PREDICTION APPLICATIONS SCIENCE WORKSHOP, Tucson, Arizona, USA.

23–24 March 2006—GLOBAL WATER SYSTEM PROJECT SSC MEETING, Oaxaca, Mexico.

28–29 March 2006—WORKSHOP ON THE DEVELOPMENT OF A GLOBAL IN-SITU SOIL MOISTURE NETWORK, Noordwijk, The Netherlands.

2–7 April 2006—EGU 2006 GENERAL ASSEMBLY, Vienna, Austria.

19–21 April 2006—WORKSHOP ON ASSESSMENT OF GLOBAL CLOUD CLIMATOLOGY PRODUCTS, Ft. Collins, Colorado, USA.

19–22 April 2006—CLIVAR SSG-14, De Bilt, The Netherlands.

4–5 May 2006—US AMMA WORKSHOP, Washington, DC, USA.

22–23 May 2006—ASSESSMENT OF CLIMATE CHANGE FOR THE BALTIC SEA BASIN, Goteborg, Sweden.

23–26 May 2006—AGU, GS, MAS, MSA, SEG, AND UGM 2006 JOINT ASSEMBLY, Baltimore, Maryland, USA.

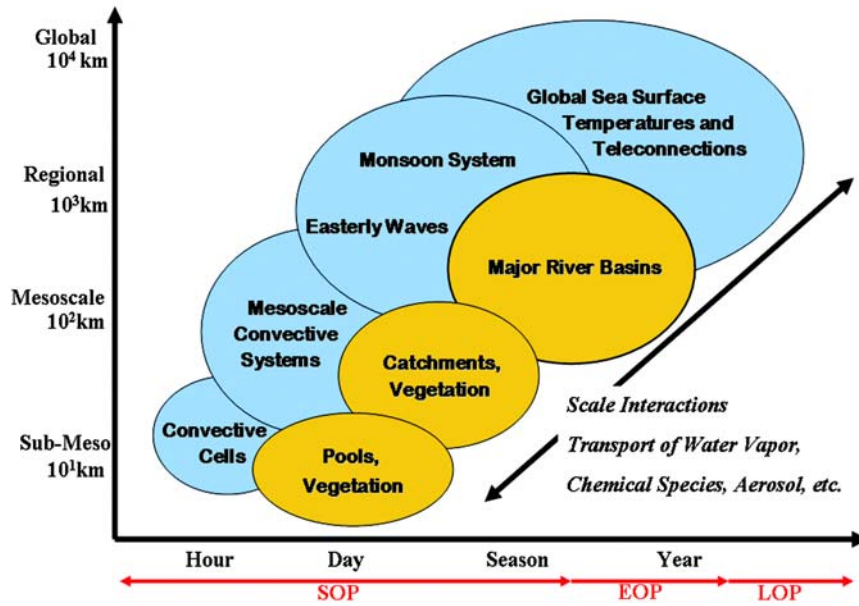
4–8 June 2006—5TH BALTEX STUDY CONFERENCE, Island of Saaremaa, Estonia.

6–9 June 2006—WCRP WORKSHOP ON UNDERSTANDING SEA-LEVEL RISE AND VARIABILITY, Paris, France.

12–15 June 2006—SPARC-GEWEX/GCSS-IGAC WORKSHOP: MODELLING OF DEEP CONVECTION AND ITS ROLE IN THE TROPICAL TROPOPAUSE LAYER, Victoria, BC, Canada.

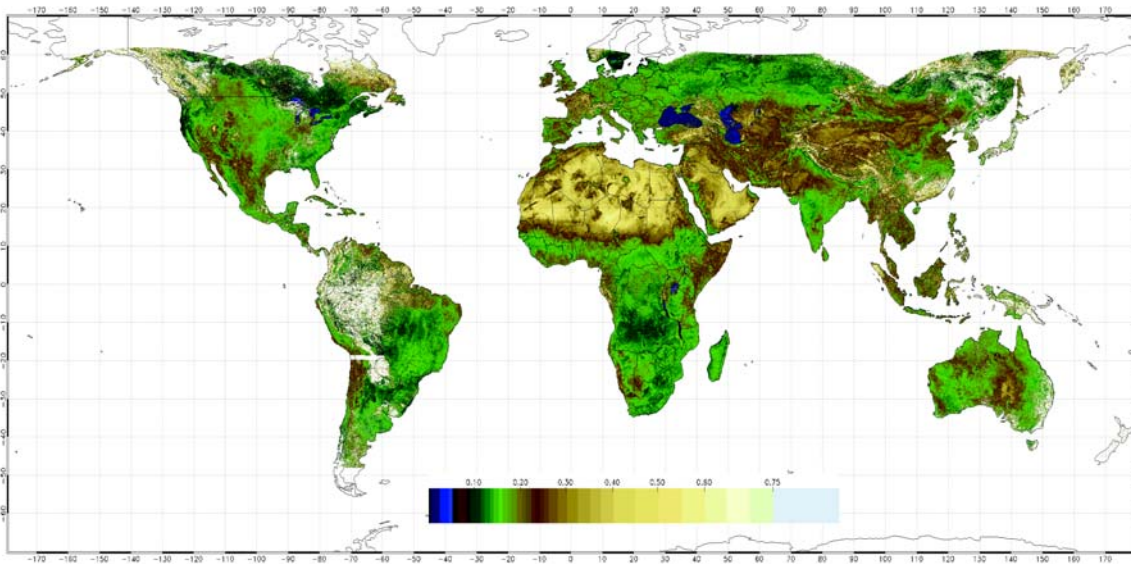
20–22 June 2006—1ST WORKSHOP ON REMOTE SENSING AND MODELLING OF SURFACE PROPERTIES, Paris, France.

AMMA ADDRESSES THE MULTIPLE TIME SCALES THAT CHARACTERIZE THE WEST AFRICAN MONSOON



The key phenomena and associated space and time scales to be addressed by the African Monsoon Multidisciplinary Analysis (AMMA) Project. The arrow highlights the importance of scale interactions and transport processes in the West African Monsoon. See article on page 5.

SURFACE ALBEDO DERIVED FROM GEOSTATIONARY SATELLITES



Broadband surface albedo as derived at EUMETSAT from observations acquired by Meteosat-5 and -7, GOES-8 and -10, and GMS-5 for the period of 1–10 May 2001. See article on page 15.

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