The second field campaign of AMMA : The scientific community is mobilized in West Africa to study the monsoon.

AMMA International Governing Board

a joint press release of

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The *Special Observing Period* of the international AMMA program, taking place in the summer of 2006 in Niamey was officially launched on the 9th of July. Its focus is to study processes specific to the main phases of the monsoon cycle, that is from the monsoon onset, which occurs typically near the end of June (phase 1) to the well developed monsoon (phase 2) marked by a peak of the rainy season over the Sahel, and a small dry season on the southern coast from the end of June to mid-September. The overarching goal of these summer Special Observing Periods (SOPs) is to enhance our knowledge of the ocean-surface-atmosphere interactions in order to gain insight into the processes responsible for the inter-annual variability of rainy season over West Africa.

For the first time, an important instrumental deployment composed of six research aircraft, balloon-borne soundings, three research vessels, and ground-based instrument platforms will be deployed simultaneously by French, British, German and American scientists with the support of a number of African agencies and a major financial contribution of the European Commission through its 6th framework programme.

The focus of the summer SOP is on key features of the African Monsoon system as well as their interactions, namely:

- the Saharan heat low,
- the Saharan aerosol layer,
- the inter-tropical discontinuity (ITD) which is the interface between the monsoon flow and Harmattan, the African easterly jet and waves (AEJ and AEW, respectively),
- the convective systems isolated or organized at the mesoscale (scales of about 100 km),
- the inter-tropical convergence zone (ITCZ), as well as the thermocline in the coastal waters of the northern Gulf of Guinea and the equatorial Atlantic Ocean.

Although phases 1 and 2 of the field campaign correspond to well defined regional climatic patterns, their exact timing obviously varies from year to year. Thus it is essential to understand the role and interactions of aerosols, chemical processes, surface processes (continental as well as oceanic) in the inter-annual variability of the large scale and mesoscale structures of the monsoon.

The instrumental strategy

The instrumental strategy and set-up across West Africa was tailored according to the monsoon phase under scrutiny and the relevant scientific objectives. Overall, the strategy calls for a balanced contribution of airborne platforms (six research aircraft, balloon-borne sounds) enabling us to gain high temporal and spatial resolution, and ground-based platforms (including three research vessels) providing continuity in time and fixed locations. A synergy of observations from six research aircraft and various ground-based stations (either clustered around mesoscale sites or isolated) has been designed to be operational in June–September 2006. Ships, balloons and aircraft, whose deployments are by necessity relatively short, will be coordinated with the ground-based deployments for specific parts of the SOPs.

Two important modes of instrument operation have been chosen:

1. Intensive observing periods (IOPs) are used to focus attention on specific events in the monsoon: notably the effects of convective rainfall events on the various environmental systems. Central to these IOPs is the deployment of research aircraft.
2. Intensive monitoring is conducted throughout the SOP period using ground-based instruments. The activity of some of the EOP (Enhanced Observation Period 2005-2007) monitoring systems (such as the radiosonde network) will be enhanced in this period.

The surface-based deployment will be implemented in five ways essentially:

- Enhancement of EOP measurements, such as balloon soundings networks around the Niger and Benin mesoscale sites, and ozone soundings in Cotonou, Benin;
- Addition of new instruments on existing supersites, such as precipitation radars in the Donga basin (Benin) and in Niamey. For radiative budget measurements the ARM Mobile Facility (AMF) has been installed at Niamey and will operate for the entire year of 2006. Other ground-based systems will be installed for sub-periods, according to the scientific priorities;
- Networking of instruments along transects according to the coherence of the related measurements, such as the enhancement of the EOP east-west “aerosol sahelian” transect with lidars and in situ aerosol sampling devices or the installation of a north-south GPS transect west of the EOP GPS transect;
- Activation of isolated stations/supersites in remote locations or locations not included in the transects, for example, the supersites of Tamanrasset (Algeria) and Dano (Burkina-Faso), or the balloon releasing sites of Cotonou (constant volume balloon) and Zinder (Driftsounds);

- Seaborne operations in the Gulf of Guinea in the framework of the EGEE-3 cruises involving the R/V Atalante (balloon soundings, air-sea exchanges characterization), as well as R/V Ron Brown and R/V Meteor in the Equatorial and Tropical Atlantic Ocean.

The overall coordination of the various SOPs will be handled from the main AMMA Operation Center (AOC) located in Niamey. This main AOC will be supported by a forecasting desk composed of personnel of African services under the auspices of ACMAD in Niamey, and the guidance of Meteo-France. A web interface has also been developed to gather numerous numerical prediction model products and operational observations to enhance decision making on the field during the SOP. Secondary AOCs are also installed in Benin to coordinate the Oueme ground activities with the aircraft operations and in Burkina Faso to coordinate aircraft operations from Niamey and Ouagadougou. The main Niamey AOC is in daily contact with R/V Atalante collecting the information sent by the two other R/Vs, Ron Brown and Meteor.

The first SOP took place from 1st of June to the 15th and focused on observations to support analysis and understanding of the seasonal evolution of the low-level thermodynamic contrasts along the climate transect (including the Gulf of Guinea), their relationship with regional circulations (e.g. jets and direct circulations) and atmospheric and continental water budgets (at local to regional scale). Surface energy budgets over land and ocean are required to support this analysis, including how these are impacted by the evolution of the land surface (vegetation, soil moisture) and the ocean (mixed layer).

Special observations before and after the onset of the monsoon are required to support this analysis in addition to those provided by the EOP:

(i) observations of the atmospheric boundary layer thermodynamic variables and winds over land and ocean by aircraft and boundary layer drifting balloons (in addition to radiosoundings and surface flux measurements provided by the EOP)

(ii) high resolution observations of the ocean mixed layer and atmospheric boundary layer from ships cruising in the Gulf of Guinea and the Tropical Atlantic deploying additional moored buoys and drifters;

(iii) in parallel with the evaluation of the energy budgets, measurements of the concentrations and fluxes of trace gases and aerosols at the surface (including emission and deposition) and in the atmosphere, for comparison with the results before and after the arrival of the monsoon flow

Some SOP ground instruments have been in place since the beginning of 2006, others operated during SOP0 and were re-activated for SOP1, and the last set of instruments were installed in May. The SOP1 aircraft campaign lasted from 1st June to 15th June, with the two French aircraft (Falcon 20 F-GBTM and ATR42 F-HMTO). The first leg of the EGEE campaign started from Cotonou on the 26th of May and ended on the 15th of June.

The onset of the monsoon in West Africa is late this year. As a consequence, dry climatic conditions were observed throughout May and June over the Sahel and also over the Ouémé catchment. The atmospheric, oceanic and continental components of SOP1 were very successful in term of instrument coverage and operations, and all research objectives have been fulfilled.

The second summer SOP, which started on the first of July and will be conducted until the 15th of July 2006 will focus on:

- surface-ocean-atmosphere interactions just after the monsoon “onset”. More specifically, the objectives are to gain insight into the Harmattan-monsoon-AEJ

interactions in the vicinity of the ITD and into the latitudinal evolution of the monsoon flux structure and properties,
- the dynamics of Mesoscale Convective Systems (MCS) environment in the early monsoon season, and particularly on MCS-surface interactions.

The third SOP will take place between the 17th of July and 21st of August 2006 and focus on improved our understanding of:
- the dynamics-chemistry interactions in MCSs environment in the mature phase of the monsoon (MCS-surface interactions & long-range transport),
- surface-ocean-atmosphere interactions during this period, with an emphasis on the role of soil moisture variability and vegetation heterogeneity,
- aerosol mixing between the desert dust to the north and the biomass burning aerosol to the south, and the evolution of the hygroscopic properties,
- vegetation and urban areas emission surveys.

Finally, an SOP will take place from the first to 15th of September 2006, and will focus on microphysical and dynamical properties of stratiform and cirriform clouds and their interaction with the West-African Monsoon system. The objectives are to improve our understanding of the impact of the anvils and the atmospheric dynamics over a large area. This includes the modulation of the subtropical jet, warming of the upper troposphere, modification of the radiative budget, dynamical feedbacks with the convective part of the squall lines, moistening of the environment of the convective anvils, modification of the precipitation efficiency, and of the re-evaporation after the passage of an MCS.

AMMA is a coordinated international project to improve our understanding of the West African monsoon and its variability with an emphasis on daily-to-interannual time scales.

AMMA overarching aims are:

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

It is AMMA's aim to provide the African decision makers with improved assessments of similar rainfall changes which are likely to occur during the 21st century due to natural fluctuations and as a result of anticipated global climate change. An essential step in that direction is to improve our ability to forecast the weather and climate in the West African region.

Based on a French initiative, AMMA was built by an international scientific group and is currently funded by a large number of Agencies, especially from France, UK, US and Africa. It has been the beneficiary of a major financial contribution from the European Community's 6th Framework Programme.

Detailed Information on the scientific coordination and the funding which made AMMA possible is available on the AMMA International web site:
http:/www.amma-international.org

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