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# The AMMA Observing Network Contribution to GCOS

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**Summary and Purpose of Document**

In July 2009, an exceptional event took place in Ouagadougou, where more than 500 scientists met to evaluate achievements of the first phase of the AMMA experiment (2001-2009) and refined the program for its planned second phase (2010-2020). One of the major achievements is the observation program, including an important component, the radiosonding network that directly contributes to the GCOS Upper Air Network (GUAN).

Huge human efforts and investments have been made to set up and operate for the time period during the experiment an ideal network of upper stations, including GPS stations. Measures have been taken to upgrade the existing operational network of upper air stations, expand it by adding new stations, *and to monitoring to obtain* timely and accurate data using diverse technologies (GTS, internet). These efforts have led to obtaining high quality upper air observations essential to the generation of reliable weather model analyses, quantification of basic atmospheric processes, and thus improvement of forecasting and filling of gaps identified in the African upper air observing network, as stated by GCOS in its 2003 report in terms of availability, quantity, and quality.

With the end of the AMMA project's first phase, the GUAN stations of the area continue to perform, but for the whole developed network which responds to GCOS requirements and which has contributed to forecasting improvement, actions are needed to sustain the developed network and avoid previous known operational problems that some of the stations have started to experience (less soundings produced and/or less data reaching prediction centers (GTS failure)).

**ACTION PROPOSED**

GCOS/SC to:

- ✓ Recommend and assist in achieving transition of investment in GCOS related reference networks from limited duration research to ongoing operational funding.
- ✓ Support the proposed project to sustain the AMMA Built Upper air network to funding from EU.
- ✓ Recommend and support a study of an operational Regional observing Network Coordination.
- ✓ Recommend designation of two additional GUAN stations in the AMMA region as previously suggested.

The third AMMA conference held in Ouagadougou in July 2009 has made an appraisal of the achievements of the AMMA experiment first phase (2001-2009) and refined consequently the program for its planned second phase (2010-2020).

A summary of the achievements and gaps with proposed priorities and strategy for the program have been detailed by its International Scientific Steering committee[1] (ISSC). The programme has had a strong international visibility as 500 scientists from 140 institutions in 30 countries (of which 14 from West Africa), from Europe, Africa and USA have participated and it has been endorsed by major international programmes. These achievements presented at the conference by the ISSC chair, Jean-Luc Redelsbergers covers aspects related to:

a) The West African Monsoon (WAM) System with a better understanding of the atmospheric (key features - Saharan heat low, monsoon onset..), identification of mechanisms linking WAM with surrounding regions (Atlantic, Mid-latitude, Mediterranean, Indian monsoon), its impact on European weather systems, the ocean and land and chemistry components
b) The Meso scale convective system & environment interactions (the important role of the convective activity over central and East Africa on the WAM system and African Easterly Waves (AEW) has been demonstrated),
c) the water cycle with the GPS usefulness to monitor the WAM moisture content
d) the intra seasonal to inter annual and long term WAM variability, weather & climate predictability and prediction, interactions climate with society (health, water resources , land productivity ) and climate change

Underlying these achievements is:

e) The implementation of an observation program and
f) The creation of multidisciplinary data base that is used from all over the world and has been mirrored in Africa.
g) A strong contribution to improving the critical mass of scientist and increased awareness on climate matters among Medias, users and decisions makers.

All these achievements contribute to the objectives of GCOS, as agreed by its sponsors (WMO, IOC of UNESCO, UNEP, and ICSU), which are to meet user's climate related needs[2] but the observation program is the one directly linked to GCOS.

## The observation program: atmospheric soundings

### 1. The radiosonde network

Indeed, the AMMA experiment has implemented a long term observation period (2001-2009) comprising research field campaigns or SOP in 2005-2007, that included several intense observing periods.[3] Central to this were huge improvements to the radiosonde network.

Linking to GCOS objectives and requirements, let's recall that at its regional meeting held in Niamey in March 2003, GCOS produced a comprehensive analysis of the state of the African climate network and highlighted its deficiencies in the different sub regions, including West and Central Africa Regions. Thus, while complying with experiment objectives, AMMA has integrated the GCOS requirements to improve African observing and basic systems.

[1] The International Science Plan for AMMA (2010-2020) - Coordinated and Edited by: Jean-Luc Redelsperger, Arona Diedhiou, Serge Janicot, Chris Thorncroft et al revised version 13 July 2009
[2] GCOS ANNUAL REPORT 20072008, GCOS 126 - (WMO/TD No. 1464)
[3] AMMA International Implementation Plan – Version 2.0

Figure from AMMA International Implementation Plan – version 2.0

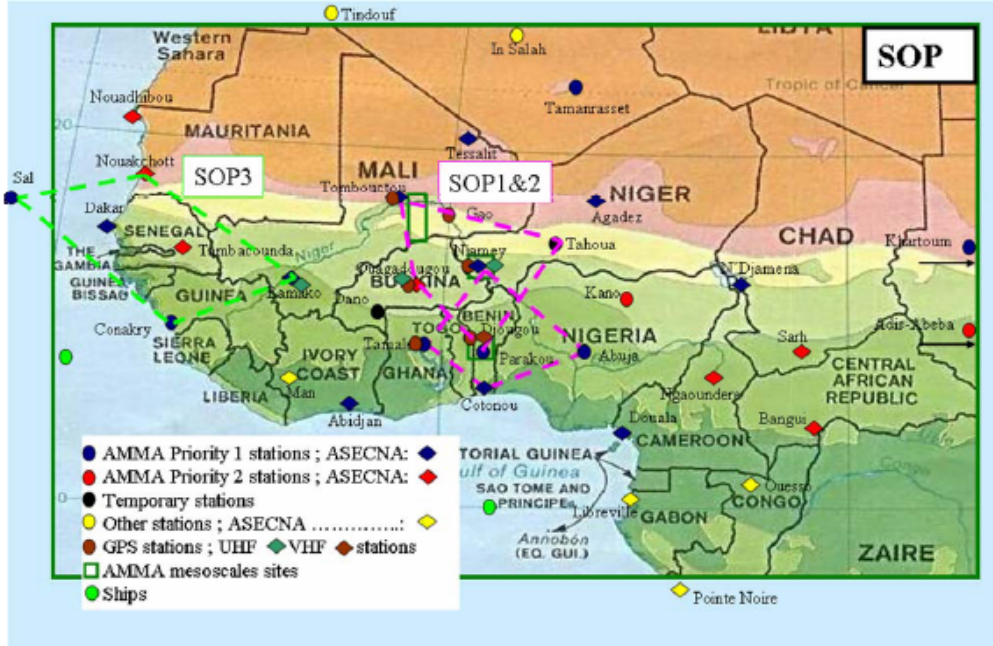


**Fig. 2: Locations, priorities, quadrilaterals (flux arrays), GPS, UHF/VHF profiler and the mesoscale sites of AMMA international during SOP 2006**

AMMA, with strong cooperation with National Meteorological Services, regional and international institutions has developed efforts from 2004 that led to:

- Reactivation of silent radiosonde stations,
- Renovation or upgrading of unreliable stations, and
- Installation of new stations (in regions of particular climatic importance).

This intense activity, under substantial coordination by AMMA, has also included widespread improvements to the transmission of data to the Global Telecommunication System (GTS) and has involved several hundred people (implementation of the field programme has been carried out through 9 coordinated Task teams of which the one on "Soundings of the Atmosphere").

These coordinated AMMA efforts led the upper air network in the AMMA region to jump between 2004 and 2006 from 5 to 21 active stations (including 4 new one), some of which were able to perform up to 8 launchings per day.

Available statistics indicate that during the period June to September 2006 some 7000 soundings were made, representing the greatest density of radiosondes ever launched in the region. Thus, as highlighted in several papers, the radiosonde stations in the AMMA network have achieved unprecedented levels of data acquisition and transmission from the region.[4]

## 2. The GPS Network

It is worthwhile to mention here that the "atmospheric sounding" component of the AMMA observing program comprises a very reliable and well distributed GPS network. The data

[4] Report prepared by Doug Parker (University of Leeds), Anna Agusti-Panareda and Antonio Garcia Mendes (ECMWF). D6.1.i Report on the radiosonde network for 2008 and 2009

analysis from this network provides all weather, high-resolution (5 minutes to 1 hour) precipitable water vapor (PWV) estimates.

Within AMMA, these data have been used[5] to determine sonde biases which, in turn, are used to calibrate and correct the archived radiosondes data. Beyond a better knowledge of the long term monitoring of the climate system, this AMMA upper air network has been proved to have direct impacts on forecasting improvement.[6] In recent communications,[7] analysis of the humidity profile using upper air data from:

- AMMA built up network with humidity bias correction;
- AMMA built up network without humidity bias correction;
- Pre AMMA network (less dense 2005 observation network;

## 3. The current state of the Network and the needed GCOS actions

The demonstrated extreme usefulness of the healthy atmospheric sounding observation built up by AMMA during SOP, for many applications, is being confirmed by many other studies. However, in 2009 with the end of the LOP, the noticed diminishing pressure from researchers and the decline in the close AMMA-related cooperation and management[8] led the built network to experience again customary problems (common in African meteorological operations, notably the lack of financial resources), as for example:

- none of the four new stations made soundings in 2009, except for activity at Abuja in May 2009 (caused by lack of supplies of consumables)
- Of the long-standing (pre-AMMA) stations, some have shown poor performance in the last months.

These problems were anticipated in 2007 while an initiative has been taken to launch a project to sustain the **r**adiosonde network. The draft project,[9] prepared by several institutions to be presented for funding to European Union has been submitted to ASECNA (as coordinator) for endorsement.

Beside this proposal, which still remains of a limited duration, other potential and more lasting solutions and or actions may be raised with involvement GCOS:

1) Important research investment directly concern GCOS reference network or improve its performance in important areas such as the AMMA region, GCOS/SC should assist in achieving transition to ongoing operational funding?

2) Based on the experience outcomes and for such specific climatic region, GCOS/SC is requested to recommend and support a study on setting up operational regional observing network coordination.

3) GCOS/SC is requested to fully support the proposed project related to sustaining the AMMA built observation Upper air network and encourage the inclusion in the GUAN network, of two additional stations (Bamako & Pointe Noire) in the AMMA region as recommended in the recent past.

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[5] Nuret *et al.*, Journal of Atmospheric and Oceanic Technology, 2008, 25. 2152–2158.

[6] Parker, D. J., A. Fink, S. Janicot, J-B. Ngamini, M. Douglas, E. Afiesimama, A. Agusti-Panareda, A. Beljaars, F. Dide, A. Diedhiou, T. Lebel, J. Polcher, J-L. Redelsperger, C. D. Thorncroft, and G. A. Wilson, 2008, 'The AMMA radiosonde program and its implications for the future of atmospheric monitoring over Africa', Bull. Am. Met. Soc., 89, 1015-1027.

[7] AMMA data impact – definition of an optimum observation network for West Africa (Z.Mumba et al)

[8] D6.1.i. Report on the radiosonde network for 2008 and 2009 (Doug Parker et al)

[9] Action title : Impact of real-time observations on weather prediction, seasonal forecast and climate monitoring over West Africa (Coordinator : ASECNA ,Partners : ACMAD, CNRS, ECMWF, IGN, Météo-France,