WORLD METEOROLOGICAL ORGANIZATION

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COMMISSION FOR BASIC SYSTEMS
OPEN PROGRAMMME AREA GROUP ON
INTEGRATED OBSERVING SYSTEMS

ITEM: 5.3

EXPERT TEAM ON EVOLUTION OF THE GLOBAL OBSERVING SYSTEM
THIRD SESSION

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GENEVA, SWITZERLAND, 9–13 JULY 2007

AMMA ACTIVITIES

(*Submitted by Jean-Luc Redelsperger)*

SUMMARY AND PURPOSE OF DOCUMENT

The document provides a summary related to the status on African Monsoon Multidisciplinary Analyses (AMMA) project soundings and views on the future.

ACTION PROPOSED

The meeting is invited to note the information contained in this document when considering its recommendations.

AMMA International ISSC
International Scientific Steering Committee

African Monsoon Multidisciplinary Analyses
Afrikanske Monsun : Multidisiplinære Analyser
Afrikaanse Moesson Multidisciplinaire Analysen
Analisi Multidisciplinare per il Monsone Africano
Afrikanischer Monsun : Multidisziplinäre Analysen
Analisis Multidiciplinar de los Monzones Africanos

Analyses Multidisciplinaires de la Mousson Africaine

Dr Alexander KARPOV
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Toulouse, 2 July 2007

Dear Dr Karpov,

Many thanks for your request for information on the status of the AMMA observational programme over West Africa, for the forthcoming CBS / ET-EGOS meeting. We have prepared a short interim summary of the status of the radiosonde network at the present time, including some quantitative assessment of its performance.

We very much welcome your desire to establish a closer collaboration between AMMA and the WWW Programme. It was always the aim of the AMMA scientific management to encourage a transition from research-led activity during our 'Extended Observing Period' (EOP - 2005-2007), to management based on long-term monitoring, towards the end of the AMMA funding. To some extent this process is already going on within AMMA, with the operational agencies in 2007 taking most of the leadership and initiative in managing the upper air network. In the longer-term, close international cooperation, outside the scope of the AMMA programme, will be needed.

We can identify some reasons why AMMA has been successful in rejuvenating the radiosonde network, and suggest how these might be carried forward. The interaction in radiosonde management of operational agencies in Africa, numerical weather prediction (NWP) agencies outside Africa and research scientists worldwide has enabled priorities to be made, and has applied some pressure for a quick solution whenever bottlenecks have been encountered. ASECNA has played a central part in this management structure. We hope that this type of interaction can continue in some form, under the auspices of the WWW. Quite specifically, we would be grateful for a response from the Expert Team, with recommendations for how such a management team might be able to operate under WMO, and how we might help in making a transition.

It should be recognised that AMMA commanded a reasonably large budget, in the order of 2.5 MEu, around half of which was used for infrastructure upgrades. The infrastructure in many places was worn-out, but in other places needed upgrade due to incompatibility with the RS92 Vaisala

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sonde. Although the research budget for AMMA was large, comparable resources were provided by African meteorological agencies in some countries; for instance in the construction of buildings at Abuja, Nigeria, funded by NIMET. The largest part of the consumables budget came from ASECNAs operational funds, which should be sustainable in the future. Additional funds will always be needed - at much lower levels than those spent by AMMA - to deal with technical problems. Non ASECNA stations in particular may need some levels of international support. We are aware that funds do become available internationally, for instance through VCP. A coordinated deployment of such resources would be of great value.

A final point we would like to put forward, in view of the agenda of your meeting, is that AMMA/THORPEX scientists, through a shared working-group (AMMA WG5) are now putting efforts into OSEs regarding the impact of the radiosondes on NWP systems. This should include a major ECMWF reanalysis activity in the coming months, and we aim to use the results to make specific recommendations for future monitoring strategy. We very much welcome your advice and involvement in this work.

To summarise, we regard future funding issues as secondary to the need for active management and coordination of the network. We have suggested that the work of a 50% staff member to coordinate the network is needed, and ideally would work within WMO. We consider that a management group should exist, led by this coordinator, bringing together operational and scientific groups with interest in the network, including: ASECNA (Mr Jean-Blaise Ngamini) and other national Met Services; NWP centres in Europe and the USA; and scientists with active enthusiasm for the successful collection of radiosonde data.

Dr Andreas Fink, co-chair of the AMMA radiosonde management group, will be able to act as a single point of contact with you regarding this matter. We look forward to the outcomes of your meeting next week.

Yours sincerely,

Dr Doug Parker and Dr Andreas Fink, Co-chairs TT1 (AMMA sounding Group)

Dr Jean-Luc Redelsperger, Chair ISSC

CC: Dr Eric Brun and Dr Alan Thorpe Co-Chairs AMMA International Governing Board
Dr Chris Thorncroft Chair of AMMA WG5.

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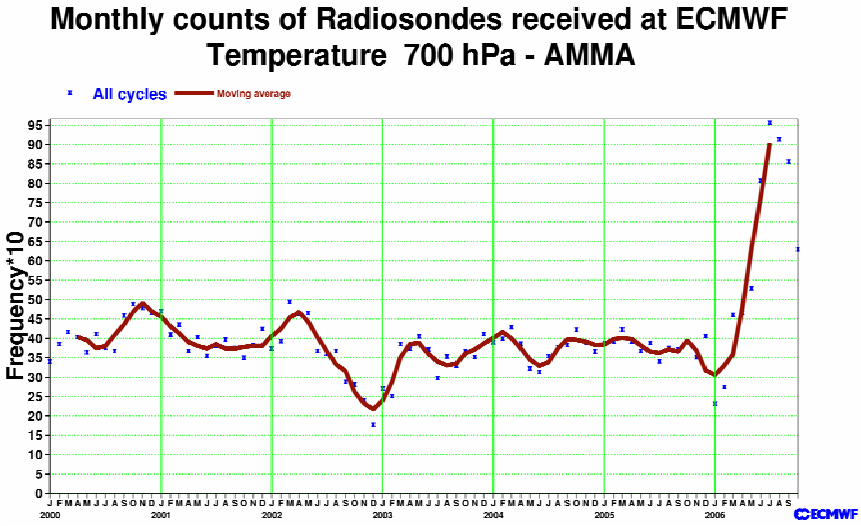
Analyse Multidisciplinaire de la Mousson Africaine
African Monsoon Multidisciplinary Analysis

Report to WMO / CBS on the AMMA radiosounding programme

AMMA Task Team (TT1) in charge of soundings

30 June 2007



Summary
The AMMA radiosonde programme has, since 2004, conducted an observational campaign making use of the upper air network of West Africa. In contrast to many field programmes, one of AMMA's core objectives has been to link the science of its short-term observing programme with investment in the long-term future of that network. This strategy has been broadly successful, and at the time of writing, a network of 21 stations is operating in West Africa with an overall success rate of data transmission to the GTS of around 80%.

A comprehensive summary of the AMMA radiosonde programme is in preparation and should be completed by the end of 2007 (when the AMMA Extended Observing Period, or EOP, is complete). However, an interim report for the European Union was generated in January 2007, describing the success of the radiosonde data collection in 2006 – and by implication, the functionality of the network.

This report makes some strong statements regarding upper-air operations in the region:

I. *Stations which have good infrastructure and are supplied with consumables can all achieve 95% success or better. Therefore we confirm that the primary problems on the network are* ***supply of consumables*** *and* ***communications.***

II. *Ensuring the reliability of the network has been, and will continue to be a major management task (typically requiring 6-12 months of management time per year). The work involves planning of supplies and communications, as well as responsiveness to technical problems.*

III. *The overall success rate for 2006, relative to our plans, was 54% (ECMWF), 52% (NCEP) and 47% (GTS – estimated). Significantly, most of the data lost to the wider GTS were from the 4 new stations. For the stations which existed before AMMA, the success rate improved from 64% (2005) to 73% (March-December 2006; NCEP).* [Note that in recent months in 2007, average success across the network has been better than 80%]. *We estimate that 6% of the data for the whole network in 2006 were missing due to supply failures; the rest of the missing data can be attributed to communication failures.*

IV. *We estimate the combined value of all soundings which were made but not communicated to the GTS, in consumables alone, to be around €1.4M.*

Overall, we regard AMMA as having been successful in implementing its upper air programme because it had a clear strategy and a set of priorities which enabled the project to deal promptly with problems in infrastructure and consumables.

We therefore wish to recommend the establishment of a long-term management group for the upper air network in West Africa, involving, as it has done for AMMA, specialists from data-using as well as data-collecting agencies.

Management of the 'AMMA' radiosonde programme
In order to balance the different scientific and operational objectives of the AMMA radiosonde programme, a management group was set up – the so-called 'Task Team 1' (TT1), bringing together research scientists, operational agencies in Africa making the soundings, and operational centres in Europe and the USA, whose models assimilate the data. TT1 was able to deal with some long-standing difficulties in the meteorological observing network through the following means:

- Through the involvement of many Anglophone and francophone partners, and a significant number of bilingual (and multilingual) participants, various cooperative actions were carried out between English-speaking and French-speaking countries.
- Through the deep involvement of ASECNA in the programme, with ASECNA's considerable capacity in skills and training, solutions to many problems could be carried out without non-African intervention, thereby building local capacity.
- To overcome the difficulties associated with the communication on management matters, AMMA appointed 'monitors' for each station in the network. These monitors were volunteers from among the scientific community, with an interest in the station for their own scientific purposes, or through fieldwork at neighboring sites. The monitors were able to communicate regularly by telephone with the Chef de Station (typically monthly – also at short notice when needed), to liaise over issues of data transmission, supply of consumables, staffing, changes in the operational plans and so on. The fact that 10 different monitors were engaged in the network, working with Anglophone or francophone stations, points to the magnitude of the management burden required to keep the network running smoothly.

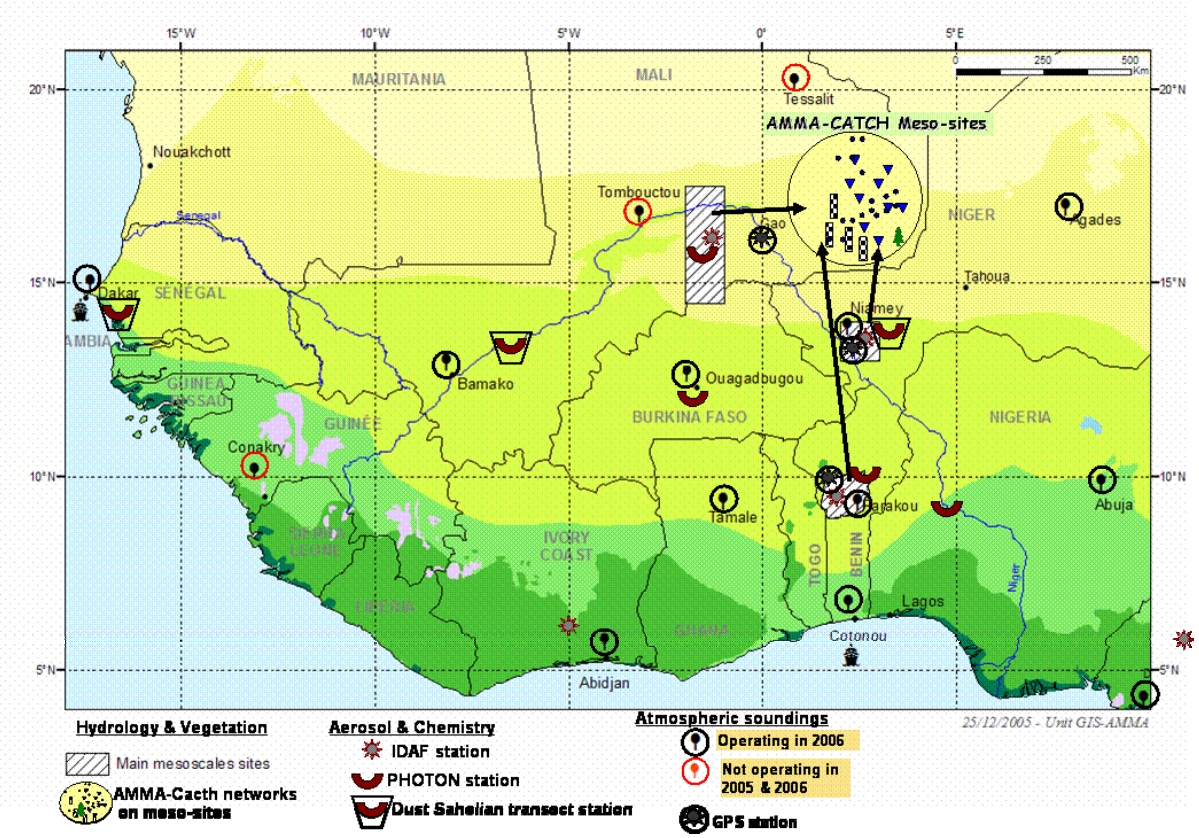
ASECNA has played a leading role in the management of the radiosonde programme for AMMA, and had full control of the main budget. Through its economies of scale, ASECNA is able to support training schools and a long-term capacity in technical and support staff, enabling the organisation to deal with problems rapidly, within Africa, rather than being reliant on costly support from outside the continent. During the AMMA programme there was excellent cooperation between ASECNA and other meteorological operators, in Algeria, Ghana, Guinea and Nigeria.

Infrastructure
Through scientific funding for AMMA, major investment has been made in the infrastructure in the region, including provision of buildings, ground stations, communications, gas-making facilities and staff training.

The expenditure on infrastructure was strongly affected by Vaisala's phase-out of the RS80 sonde, and the consequent need to replace many ground stations, and upgrade others. The monopoly situation meant that costs were beyond our research budget, so we reduced prices by putting some stations to tender, and bringing an alternative manufacturer – Modem – into the network. This will lead to calibration problems in data analysis and assimilation – but appears to be necessary in order to control costs.

Geographically, AMMA has rectified several critical failings in the network for the region:

- The GCOS station at Abidjan has been reactivated, by the provision of a new building.
- 4 new stations have been constructed in the critical Guinea Coast zone, without which there are no inflow data for the monsoon system.
- The upstream station of Ngaoundere, Cameroun, has been provided with a GTS connection, through DCP.
- The northern stations of Tombouctou and Tessalit, have been reactivated.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TOGO
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AMMA-CATCH Meso-sites
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Gao
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Tahoua
Niamey
Dakar
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Ouagadbugou
Conakry
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Kano
Abuja
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Cotonou
Abidjan
Senegal
Niger
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Hydrology & Vegetation
Main mesoscales sites
AMMA-Cacth networks on meso-sites
Aerosol & Chemistry
IDAF station
PHOTON station
Dust Sahelian transect station
Atmospheric soundings
Operating in 2006
Not operating in 2005 & 2006
GPS station

STATIONS	RADIOSONDE EQUIPMENT		PC	TELECOM	GIP-3
	In use before AMMA	Upgraded or installed by AMMA			
Abidjan	DIGICORA II	DIGICORA II /RS92	**PC**	Modem (Coffret Fime)	
Abuja		DIGICORA III		DCP	2
Agadez	DIGICORA I	DIGICORA II /RS92	**PC**	connexion to VSAT	1
Bamako	STAR	DIGICORA II /RS92	**PC**	Modem (Coffret Fime)	
Bangui	STAR	MODEM SR2K2		Modem (Coffret Fime)	1
Conakry		No upgrade done		No connection	Note 1
Cotonou		MODEM SR2K2		Modem (Coffret Fime)	
Dakar	DIGICORA I	DIGICORA II /RS92	**PC**		
Douala	DIGICORA I	DIGICORA II /RS92	**PC**	Radio Modem	
Man	DIGICORA II	DIGICORA II /RS93		Station not reachable	
N'djamena	DIGICORA II	DIGICORA II /RS92	**PC**	Modem (Coffret Fime)	
Ngaoundere	DIGICORA II	DIGICORA II /RS92	**PC**	DCP	
Niamey	DIGICORA I	DIGICORA II /RS92	**PC**	Modem (Coffret Fime)	
Nouadhibou	STAR	DIGICORA II /RS92	**PC**	Coffret Fime + VSAT	
Nouakchott	DIGICORA II	DIGICORA II /RS92	**PC**	Modem (Coffret Fime)	
Ouagadougou	STAR	MODEM SR2K2		Modem (Cofret Fime)	1
Parakou		MODEM SR2K2		DCP	1
Sarh	DIGICORA I	DIGICORA II /RS92		Radio Modem + VSAT	
Tamale		DIGICORA III		DCP	2
Tambacounda	STAR	MODEM SR2K2		Radio Modem + VSAT	
Tessalit	DIGICORA I	DIGICORA II /RS92	**PC**	Connexion Card + VSAT	1
Tombouctou	DIGICORA I	DIGICORA II /RS92	**PC**	Connexion Card + VSAT	1
EAMAC	DIGICORA II	DIGICORA II /RS92			
EAMAC	STAR	MODEM SR2K2			
DTT	DIGICORA II	DIGICORA II /RS92		DCP	
DTT secour		MODEM SR2K2			
DTT	STAR	MODEM SR2K2			

Table1: Upgrades and current status. Note that this table includes some stations outside the 'AMMA' network, as well as the ASECNA training centres (EAMAC and DTT). Note that the gas cylinders at Conakry were reactivated through the supply of new heads by ASECNA, but that no long-term solutions were put in place for this station.

Communications
There are two functions of communications which are critical for radiosonde operations in West Africa; data transmission, and management. Apart from local use by airport forecasters, radiosonde data in the region have little value unless they are effectively transmitted to the GTS, promptly enough to be assimilated by NWP models. Equally, unless communications permit the operation of the station to be managed effectively, then experience shows us that it will be unreliable and unlikely to make consistent measurements.

GCOS (2003) have documented the same issues:

> *"The need was emphasized for improved coordination between GCOS Monitoring Centres, station operators, and on-site personnel to ensure that GCOS requirements were clearly understood and that operational problems were resolved as quickly as possible."*

Transmission of data to the GTS is a task which can be simply defined, but is often fraught with problems. In Africa, there are several means of transmitting such data – all have problems of some kind and all have been tried in AMMA. The three systems which were most effective are described here

(a) GTS
The existing GTS connections in West Africa are unreliable and complex; certainly the workings of the GTS are poorly understood by the local meteorological services and the authors of this document. A basic problem with the GTS connection at many stations has been the separation between the radiosonde ground station and the local GTS link (the 'CAT'). This has meant that observers have needed to carry the TEMP message by hand to the CAT, and there type it manually into the system – clearly this can lead to delays and human errors in the data transmission. AMMA has been able to rectify this situation at several stations (Table 1) through the provision either of a direct cable link or a radiolink between the radiosonde station and the CAT.

The reliance of the GTS on single connections leads to considerable vulnerability to technical failures. In January 2006, at the height of AMMA dry season Special Observing Period (SOP0), a failure of the connection between Dakar Europe led to the loss (to the GTS and therefore the NWP models) of most of the upper air data from west Africa, for a period of several days. Such failures are not uncommon.

A common complaint among African data collection agencies is that their transmission of data through their local hub is often blocked through the incorrect formats of messages. At first sight, the resolution of such problems may appear trivial, but here the relatively poor management communications (phone, fax, email) between African agencies is exacerbated by language differences between anglophone and francophone centres. Indeed, GCOS (2003) have noted

> *"Unsatisfactory liaison and coordination between operators of observing stations, ASECNA, and global Monitoring Centres".*

Some problems of this kind were overcome during AMMA through the close cooperation between ASECNA, who operate the primary GTS connections for the region, and the other participating meteorological services. This effort needs clear management and communications.

(b) DCP
In AMMA we chose to purchase DCPs and install them at 4 sites which were known to have problems in connecting to the GTS – Tamale, Parakou, Abuja and Ngaoundere. At the time, several people with experience of data transmission issues in Africa advised us against the DCP option, based on 3 lines of reasoning:

- Drift in the clocks on the DCP mean that the message may miss its time window, meaning that messages are simply not transmitted. This problem has been overcome with the new generation of DCPs which use GPS correction of their clocks.
- Data is transmitted to the GTS from a remote station without going through the local Meteorogical Service – this means that the local forecasters do not have direct use of the data and local operators may not be immediately aware of problems. However, with the installation of the PUMA system at all West African meteorological services, acquisition of the data through a return from the GTS *should* now be possible.

- The DCP is a dedicated system and therefore relies on the operator to keep it running (unlike a commercial option such as VSAT or internet, which will be maintained by the operator).

Despite many problems which affected these instruments in 2006, the DCPs are now functioning well, and it is hard to imagine a superior means of transmission at this time.
Note that some stations use an aviation VSAT system (e.g. Tombouctou) to relay their data to a GTS hub.

(c) Email
During AMMA, 4 stations (Tamale, Parakou, Abuja, Ngaoundere) made provision to send data by email. Our partners at the ECMWF agreed to receive these data and ingest them into their own assimilation system, as well as the AMMA scientific database. However, ECMWF do not have the capacity to submit data to the GTS, so the UK Met Office kindly agreed also to receive the messages and perform this function. Unfortunately, ECMWF and the Met Office demand different message formats for the emails. Given the problems which always arise in ensuring that message formats are precisely followed, this doubled the efforts needed to coordinate the transmission of data.

At this stage we must acknowledge the efforts of many of the operational staff in Africa, notably those at Ngaoundere (Chef de station: Mr Jean Tchassem Kamgang), who travelled each day to the local cyber café to transmit their data.

The AMMA intensive sounding programme

For two parts of the AMMA SOPs in the summer of 2006, 8-per day soundings were made at 6 stations in the network. These stations comprised the 'southern quadrilateral' of Cotonou, Tamale, Parakou, Abuja and Niamey, with the addition of Agadez as a reliable northern station (see Table 1). The intensive sounding periods were denoted IOP5.1 (20-29 June 2006) and IOP5.2 (1-15 August 2006).

The successful accomplishment of these two IOPs is one of the triumphs of the AMMA radiosonde programme, and is a testament to the skilled work which was made on behalf of AMMA by many operators at the radiosonde stations. Although high frequency measurements of this kind have been made in numerous field experiments around the world, we are not aware of such 3-hourly observations being made with locally-generated hydrogen, even for shorter periods of time. Over 90% of soundings were accomplished, although transmission of the data was less successful, with some stations experiencing sustained problems for one or both of the IOPs.