FORECASTING ACTIVITIES DURING THE SUMMER 2006 SOP of AMMA
PROPOSITION OF A SYNTHETIC ANALYSIS SPECIFIC TO THE WEST AFRICA

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ABSTRACT

The AMMA[1] (African Monsoon Multidisciplinary Analysis) is an international project to improve our understanding of the West African Monsoon (WAM) and its variability. A team of African Forecasters have been set up to operationally provide forecasts all during the AMMA 2006 campaign held in Western Africa this summer (1st June to end September 2006). We present here the original forecasting method that has been developed to fulfil the needs of the AMMA Operational Centre in Niamey (Niger).

[1] http://www.amma-international.org/

INTRODUCTION

The task of a forecaster involves the analysis of numerous observations and NWP products (both analysis and forecasts) before deciding on the weather forecast for a given location and range. This is a very complex process involving both objective and subjective criteria and where the experience of the forecaster can play an important role on the skill of the final forecast. The difficulty is even stronger for tropical regions where in contrast to midlatitudes the atmospheric flow is weakly balanced resulting in a weaker predictability, especially for convective events. Also this process needs to be performed as quickly as possible.

Our objective is to present a framework aimed at guiding the forecasters task during the Specific Observation Period (SOP) of the AMMA international project focused on the study of the West African monsoon period (JJAS).

THE WEST AFRICAN SYNTHETC ANALYSIS/FORECAST APPROACH

This proposed forecasting approach is based on the preparation of single synthetic maps that summarize all key features of the WAM analyzed or forecasted at a given time. These synthetic maps are named WASA and WASF for West African Synthetic Analysis and Forecast, respectively. The following 10 features are considered as important and figure on the WASA/F (Fig. 1) maps in order to capture the main characteristic of the situation and to forecast the weather.

WA Synthetic Analysis/Forecast

List of the 10 key features to put

1. ITD
2. Heat-Low
3. SubTrop Jet
4. Trough from midlatitude
5. TEJ
6. AEJ
7. Troughs and cyclonic centres associated to African Easterly Waves (AEW)
8. Midlevel dry intrusions
9. Monsoon layer

9 Provided by models

10. Convective activity:
    a. Suppressed convection
    b. Convection: isolated, MCS and Squall Lines

Other features + Physical understanding Forecaster expertise

The first 9 key features are provided by NWP outputs available at ACMAD (Niger) through the Météo-France forecasting Synergie System (4 PC) fed by the RETIM-Afrique transmission link. They are drawn according to some rules listed below.

WASA/F Drawing rules

1. ITD Intertropical Discontinuity

1. Convergence line at **surface** between southerly and northerly trade winds
2. Strong **gradient** (if available) θ'w , Td or relative humidity
3. Td =15°C
4. Pressure minima for some regions (West coast also Chad, Soudan…)
5. Weather, clouds… (in practice)

2. Heat Low

Caution: Strong diurnal cycle → Outlined by the 2 pressure isolines

- At 0600Z: 1008 and 1006 hPa isolines
- At 1800Z: 1006 and 1004 hPa isolines

Indicate Low locations by the lowest values

3. Subtropical or Polar Jet

Drawn the STJ core above 35 kt at 200 hPa

If intense add (look at divergence field)
- Entrance
- Exit zones

4. Trough axis North the ITD

Vorticity, wind rotation and streamlines at midlevel (500 or 600 hPa)

Caution: Fields not always available

5. Tropical Easterly Jet

Draw the TEJ core above 35 kt (more when the monsoon is well established) at 200 hPa or even higher (150-100 hPa).

Not obvious in some cases! Widespread region, Several maxima…

6. African Easterly Jet

Draw the AEJ core above 20 kt/s at 600 hPa (if available) or 700 hPa

Not obvious in some cases! (Widespread region, When over Gulf of Guinea)

→ Add a map of wind and streamlines at 700 hPa

7. African Easterly Waves

AEW Trough around AEJ level (700 hPa)

+ Vortex centers at 850 hPa with the C symbol
+ Anticyclonic centers at 850 hPa with the A symbol

8. Dry air boundaries

Draw the outline of the Dry air masses Td threshold (<-36°C at 500 hPa)

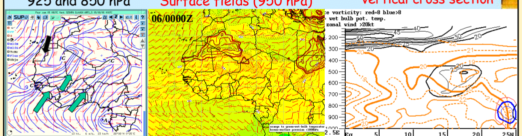
9. Monsoon layer & Low level energy

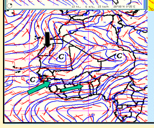
Crucial but not easy to figure on the WASA/F

→ Need to look at:

Need improvement

Stream lines – wind 925 and 850 hPa	Td, θ'w, θe Surface fields (950 hPa)	Monsoon depth vertical cross section





- **CAPE**
- **CIN:** not available diagnostic → look at soundings
- **Precipitable Water**
- **Shear**
- Latent heat fluxes - Soil moiture
  Accumulated rain of previous days,
  Soil temperature (AMSR 5 day delay)

The model skill to forecast convective activity is poor in such tropical regions, so that the final forecast of MCSs is the result of the combination of all above 9 features, following some rules

10. Convective activity

Convection results from the combination of favorable conditions such as:
- Instability, precipitable water, amount of energy
- Vortex at 850 hPa
- Associated with a trough (who is responsible?)
- Shear and midlevel dry air for the fast-moving SL

Depends on the Forecaster expertise and experience

Convection is not well represented in present models → be careful, do not trust them to much
- Humidity field, precipitation, vertical motions
- Vorticies are better treated, but caution wrong convection area can generate erroneous vorticies.

But models are useful if confronted to the forecast and to observations

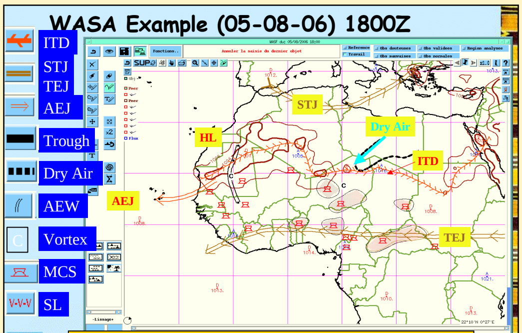


Figure 1. Illustration of the different key features figuring on a WASA/F.

Example 1

For instance active fast moving MCSs need convective instability, high precipitable water, shear (or AEJ), dry air, vicinity of a through and of a vortex at 850 hPa. Figure 2 provides an example of a good forecast of 2 MCSs over West Africa on the 19 of July 2006, up to 2 days in advance.

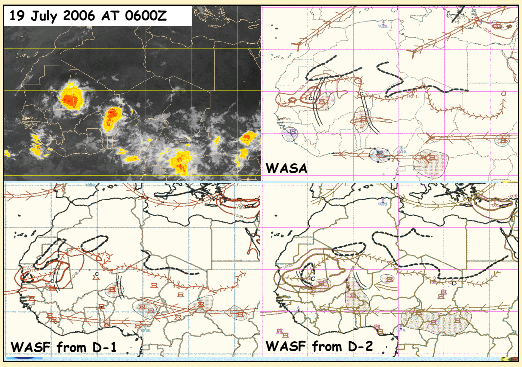


Figure 2. Example of WASA at 0600Z on the 19 of July 2006 as compared with the IR Meteosat image, and corresponding WASFs forecasted 1 and 2 days before.

Example 2

This ventilation event of the HL from 600hPa to the ground (Fig. 3), was associated with
- first intense advection of dry air from north-east penetrating the HL
- then acceleration of the monsoon flux corresponding to a monsoon surge
- both wrapping around the HL
- resulting finally in a HL moistening (with convection quite north) and decreasing.

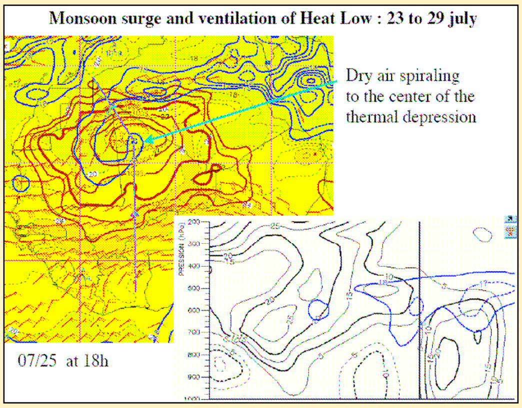
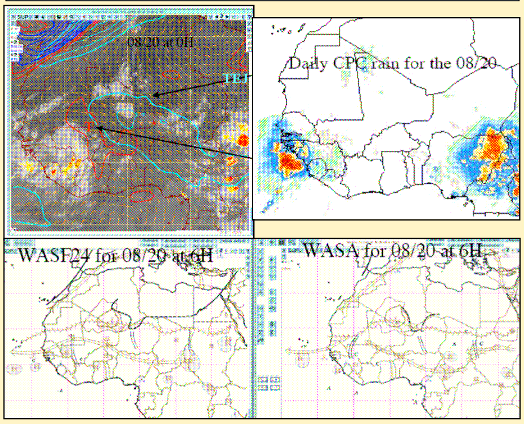
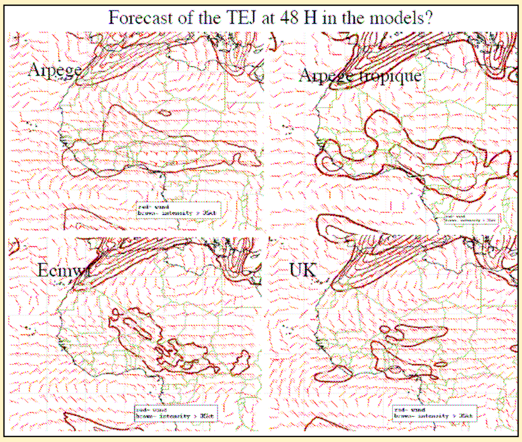


Figure 3. Upper left: Wind (red arrow) and dry air (θ'w in blue) at 600 hPa on the 25 of July 2006, and θ'w at 950 hPa (colour shading). Lower right: vertical cross-section along the blue line of the horizontal map, of normal wind (black) and of θ'w (blue)

Example 3 – Suppressed convection

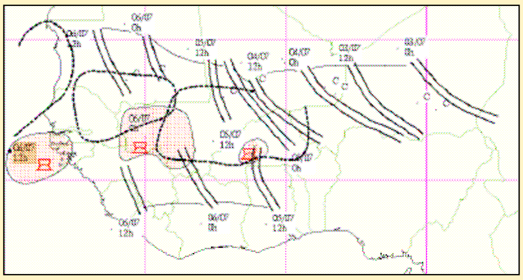
- We had 4 major cases of suppressed convection: 7, 16 July – 23/24 July - 20/21 Aug
- In all cases TEJ over the suppressed area, except for the 7 of July, and a Through





Subjective ANALYSIS of African Easterly Waves

- 3-6 July case
  Trough propagation and its split in 2 parts
  With dry air and a MCS in between
- Over the 4 months of the SOP 2006
  5 cases in June – 4 in July – 9 in August – 6 in September



CONCLUSION

The AMMA-Forecast team adopted this approach during the 2006 monsoon season, allowing testing it. During the THORPEX conference, we will evaluate the relevance of this approach as used during the 2006 summer demonstration experiment. Further steps will be to objectively evaluate the forecast skill using this approach. Also it appears that the method needs to be improved to define clearer drawing rules based on adequate and objective diagnostics.

We hope that this forecasting demonstration experiment will contribute to the development of a new forecasting method for Africa after its extension to the whole Africa by considering the whole year, not only the West African monsoon season.

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