The use of ECMWF products at ACMAD; Their Performance in forecasting severe weather in Africa

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1 Introduction

ECMWF products are received at the African Centre for Meteorological Applicationsor Development, ACMAD, through the GTS via Eumetcast (MSG PUMA systems) and RETIM-Afrique. Some medium range and seasonal forecast products are available on the web. These data, together with a number of the other observational, satellite and model data (ARPEGE, UKMO, NCEP, IRI etc) are used as guidance to prepare our forecast products from short to seasonal range

2 Data reception / Use and performance of ECMWF products

The data received through the GTS are visualized and analysed with Messir Vision and SYNERGIE. SYNERGIE is more used as it is more flexible, offers more possibilities and also the data received via Retim are more regular. There are often big temporal gaps in ECMWF model data received on MSG PUMA systems. Tables 1 and 2 below show the data received on the two systems.

Model and resolution	parameters	levels	Forecast range
ECMWF / 2.5 degres	Sea surface pressure	surface	T+00 - T+168, every 24 hours from 00Z and 12Z run
	geopotential	500 hPa	
	wind	850, 700,50,200 hPa	
	wind speed	850, 700,50,200 hPa	
	humidity	850, 700 hPa	
	temperature	850 hPa	
	dew point temperature	850 hPa	
	relative vorticity	700 hPa	T+00 - T+144 every 24 hours
	relative divergence	700 hPa	

Table 1: Data received through RETIM-SYNERGIE systems

Model and resolution	parameters	levels	Forecast lead time
ECMWF / 2.5 degres	temperature	850 hPa	T+00 – T+10days; every 24 hours from 00Z and 12Z run
	wind	850, 700, 500, 200 hPa	
	wind speed	850, 700, 500, 200 hPa	
	relative humidity	850,700 hPa	
	convergence	850, 700, 500, 200 hPa	
	absolute vorticity	850, 700, 500, 200 hPa	
	geopotential	500 hPa	
	sea level pressure	surface	
ECMWF / 1 degre	temperature	850 hPa	T+00 – T+10days; every 24 hours from 00Z and 12Z run
	wind	925, 850, 700, 500, 200 hPa	
	wind speed	925, 850, 700, 500, 200 hPa	
	relative humidity	850, 700 hPa	
	convergence	925, 850, 700, 500, 200 hPa	
	absolute vorticity	925, 850, 700, 500, 200 hPa	
	relative vorticity	700 hPa	
	relative divergence	925, 700, 200 hPa	
	geopentential	500 hPa	
	Sea level pressure	surface	
ECMWF / 0.5 degre	temperature	surface	T+00 – T+10days; every 6 hours from 00Z and 12Z run
	wind	surface	
	wind speed	surface	
	convergence	surface	
	absolute vorticity	surface	
	total precipitation	surface	

Table 2 : Data received through MSG PUMA systems

3 Example of performance of ECMWF model

3.1 Tropical cyclone Favio

ECMWF model captured well the trajectory of tropical cyclone Favio up to at least five days ahead. Figure 1 shows how well the satellite image matches the ECMWF forecast.

T+00; valid 17/02/07 at 12Z | T+120 forecast, valid 22/02/07 at 12Z | IR image 22/02/07at 12Z

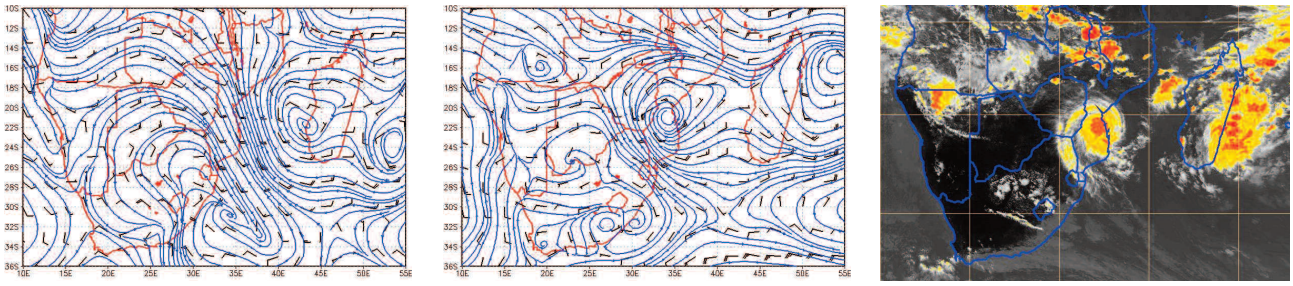

Fig. 1 ECMWF 850 hPa wind and streamlines and IR satellite image

At ACMAD, it was forecast 3 days in advance to reach Mozambique. This forecast wouldn't have been made if only ARPEGE or UKMO were used. Neither of them captured well the tropical cyclone even 24 hours ahead. ARPEGE could not capture the cyclone even on the analysis. There were tremendous differences between the three models starting from the analyses till the 48 hours forecast (UKMO 48 hours forecast not available); ARPEGE gave more weight to the secondary cyclonic circulation in the Mozambique channel than the tropical cyclone while UKMO did not even have the cyclonic circulation but still represented Favio as very weak. On the 48 hour 850 hPa wind forecast shown in figure 2, it can be seen that ARPEGE carried on deepening the cyclonic circulation to the detriment of the tropical cyclone Favio, while ECMWF weakened it and deepened the tropical cyclone in agreement with the IR satellite image.

ECMWF T+48; valid 19/02/07 12Z | ARPEGE T+48; valid 19/02/07 12Z | IR image 19/02/07 12Z

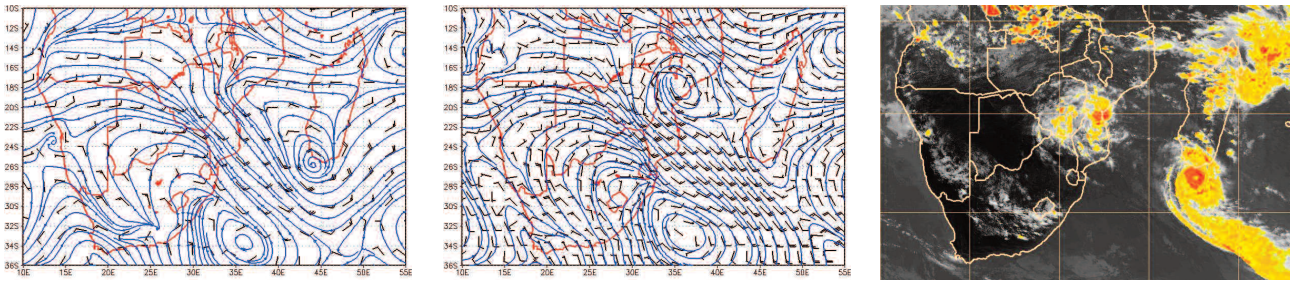

Fig. 2 850 hPa wind and streamlines and IR satellite image

This model intercomparison shows the necessity to use as many models as possible in order to issue the best possible forecast product. Figure 3 shows the 24-hour Southern Africa Synthetic Forecast (SASF) map issued at ACMAD; it is a forecast product derived from a blend of numerical model outputs, observations and satellite images. This map summarizes the significant weather features that affect the area. It can be seen that the delimited forecast rainfall areas agree with the IR satellite image.

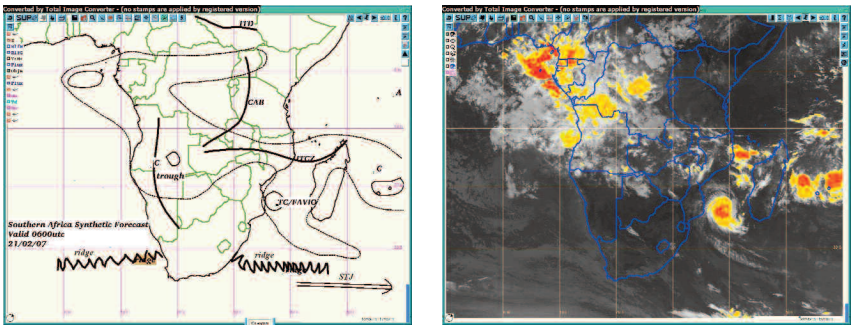

Fig. 3 SASF for 21/02/07 at 06Z and IR satellite image; Dotted lines in the SASF delimit areas of probable cloudiness and light rains; plain circle shows areas of heavy rains; ITD=Inter-Tropical Discontinuity; CAB=Congo Air Boundary; ITCZ=Inter-Tropical Convergence Zone; C=vortex; A=Anticyclone; TC=Tropical Cyclone; STJ=South Tropical Jet

3.2 *Tropical cyclone Gamede*

For tropical cyclone Gamede, shown in figure 4, ECMWF and Arpege mean seal level pressure analysis were quite close until 28th where they start departing especially on the forecast. The 72 hour ARPEGE forecast makes the tropical cyclone go around south of Madagascar on 3rd March while ECMWF keeps the track south westward in agreement with the actual trajectory. The position of the cyclone was corrected in ARPEGE analysis of 3rd March; which is quite similar to that of ECMWF but the intensity remains weaker. It is apparent that ECMWF forecast does better than ARPEGE when the forecast lead time increases; the two model outputs are quite similar for analysis and 24 hour forecast but beyond that differences will start growing.

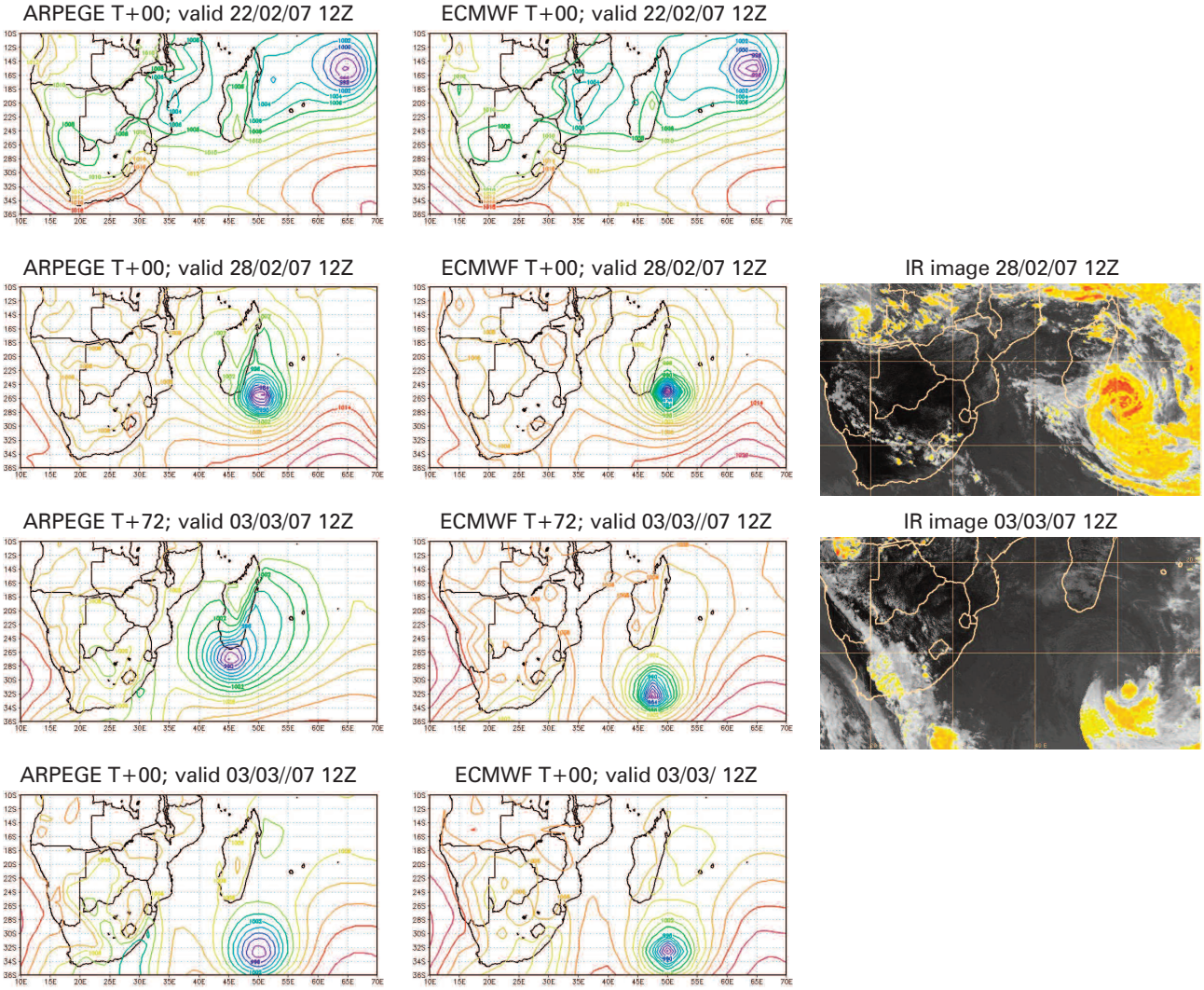

Fig.4 Mean Sea Level Pressure and IR satellite images

3.3 *West Africa*

Figure 5 shows the West African Synthetic Forecast (WASF)°produced at ACMAD and the IR satellite image for 28 August 2007 at 18Z. It can be seen that a good number of convective systems have been missed.

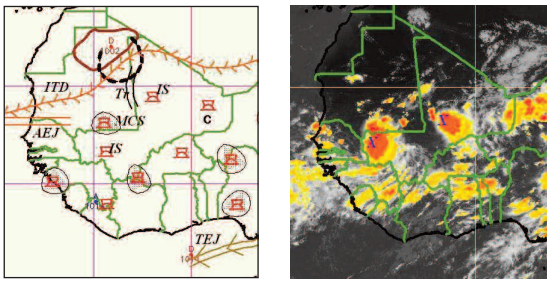

Fig. 5 WASF valid 28/08/07 18Z and IR image

ITD=Inter-Tropical Discontinuity; AEJ=African Easterly Jet;
TEJ=Tropical easterly Jet; C=Cyclonic vortex;
Tr=trough of African easterly wave;
IS= Isolated convection; MCS=Mesoscale convective system

The WASF are produced for 18Z and 06Z. As model outputs on our RETIM-SYNERGIE systems for these times are only available for ARPEGE and few parameters of UKMO, forecasters tend to use mainly data from ARPEGE. For this case, using the single ARPEGE model outputs was misleading. For instance the forecast was missed in west and central Mali. The 18 hour forecast of the wind field at 850 and 700 hPa does not show strong favourable areas in Mali. However, although ECMWF model outputs were not available, an interpolation of the analysis and the 24hour forecast (Fig. 6) would have helped forecast the convective systems shown on the satellite image (marked with crosses) as not only were these systems already developed in the morning but the cyclonic circulation at 850 hPa and the African easterly wave trough at 700 hPa would have triggered new developments. These favourable conditions could have also been seen in the UKMO model outputs both at 18Z (not shown) and 00Z.

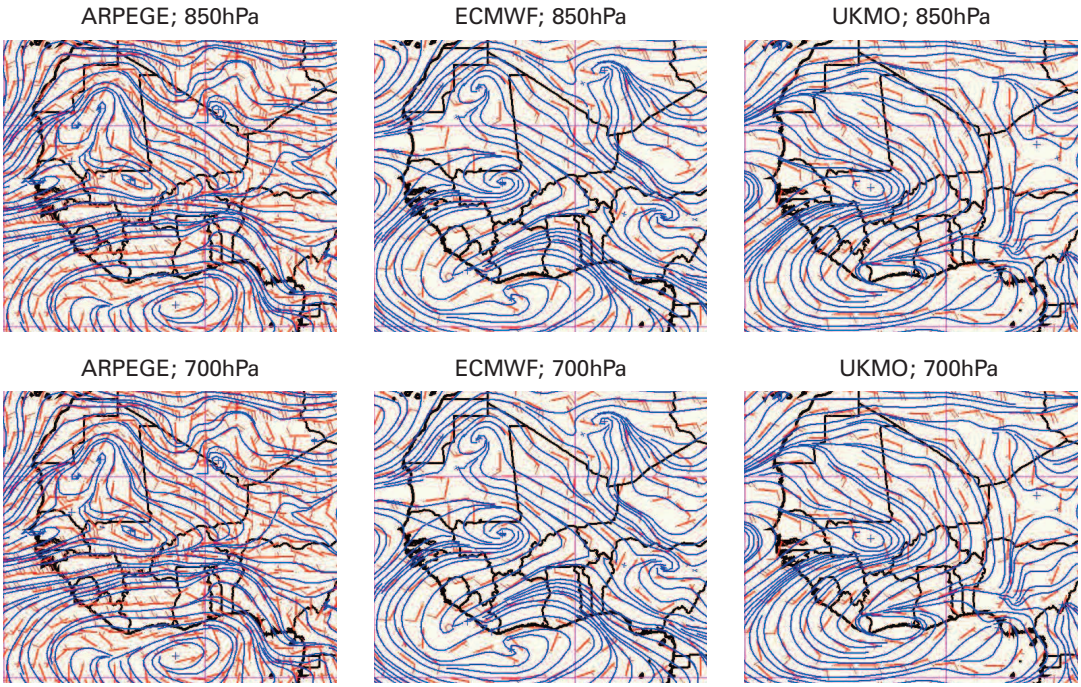

Fig.6 24-hour forecast wind field and streamlines from the three models; valid 29/08/07 00Z

The 30h forecast was obviously missed in Senegal.The cyclonic circulation in ARPEGE that can even be seen on 29th at 00Z (24h forecast) had made the forecasters move the isolated storm forecast in West of mali for 18Z into Senegal; while inspection of both UKMO and ECMWF (although outputs at 06Z not available) wouldn't allow a mature storm in Senegal, situated within a neutral point and a weak ridge.

4 Concluding remarks

ECMWF products seem to help give good forecast guidance but not enough parameters are received through RETIM-Africa. They are also available late. It would be more beneficial to the African community if more data and the 6-hourly forecast data were available early enough to be used.

These examples also show the value in using as many models as possible in order to issue appropriate forecast guidance.

5 References

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