1945-4

Conference on African Drought: Observations, Modeling, Predictability, Impacts

2 - 6 June 2008

**Predictability of African Drought
Part III: Evaluation of
user forecasts products**

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Predictability of the African drought. Part IV: Evaluation of user forecasts products.

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ACMAD

ICTP African Drougth conference

June 2008

Climate Outlook Fora: An overview

- WMO/CLIPS initiative since 1995 to facilitate applications of seasonal forecasts around the world.

- ACMAD and partners organize COFs since 1998 in Africa

AMMA-SOP Forecasts

- Products made during AMMA-SOP to support Field Campaign .

- ACMAD and partners operated a forecasting center

COFS ACTIVITIES

- training on climate diagnostics, analysis, forecasting and verification

- review of the status of global and regional climate

- production and dissemination of consensus outlooks for the coming season.

The most important West African COFs products has been the rainfall outlooks provided in May or early June and valid for July August September (JAS) season.
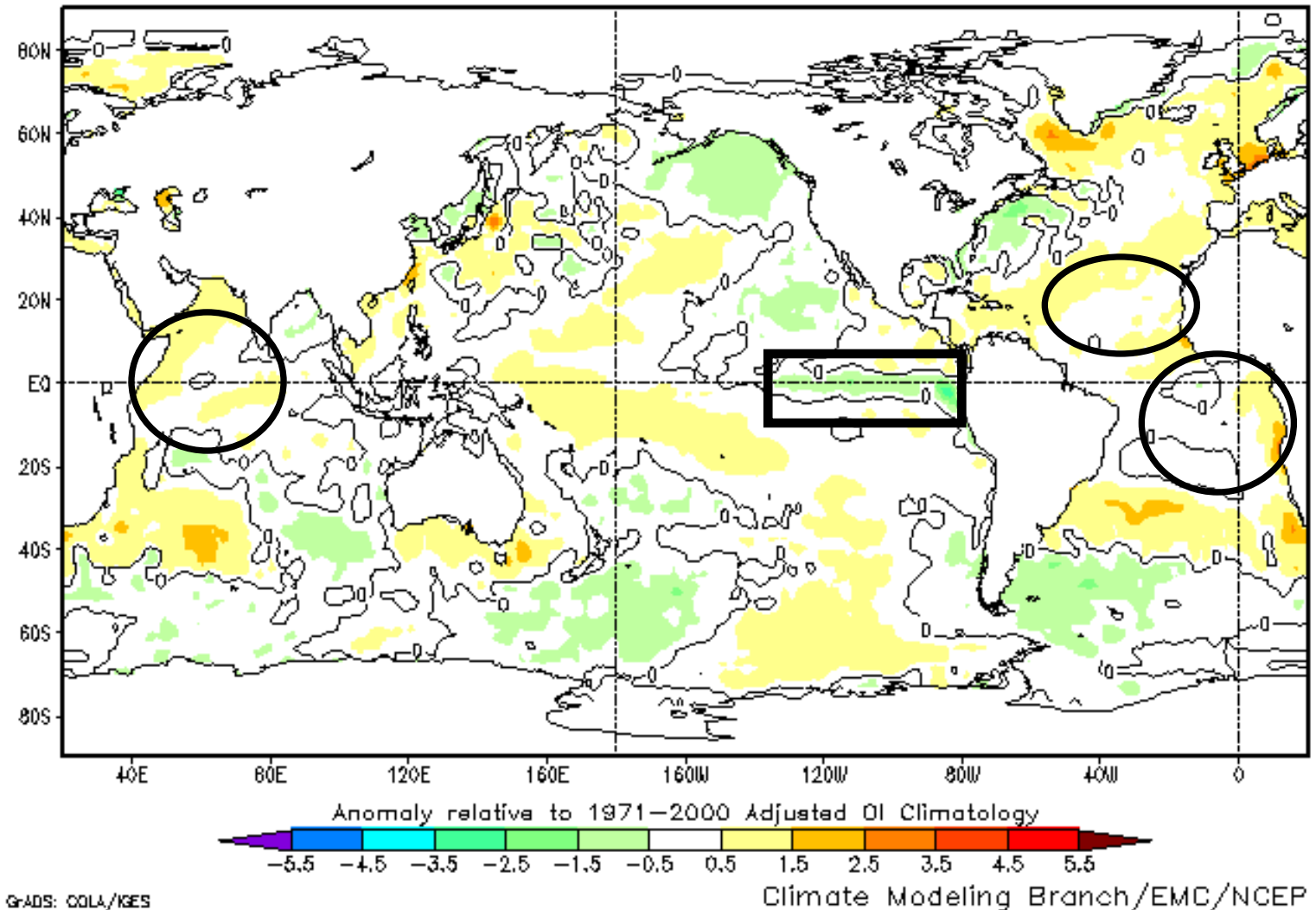
The preparation of COFs outlooks

- Statistical forecasting systems products
- Dynamical forced and coupled ocean-Atmosphere forecasting systems outputs
- Diagnostic analysis of circulation, temperature, moisture fields
- A consensus from statistical, dynamical products, diagnostic analysis and human expertise is discussed and published as the expected outlook for different regions
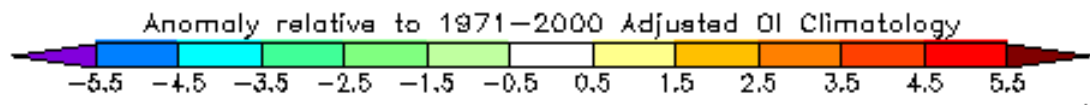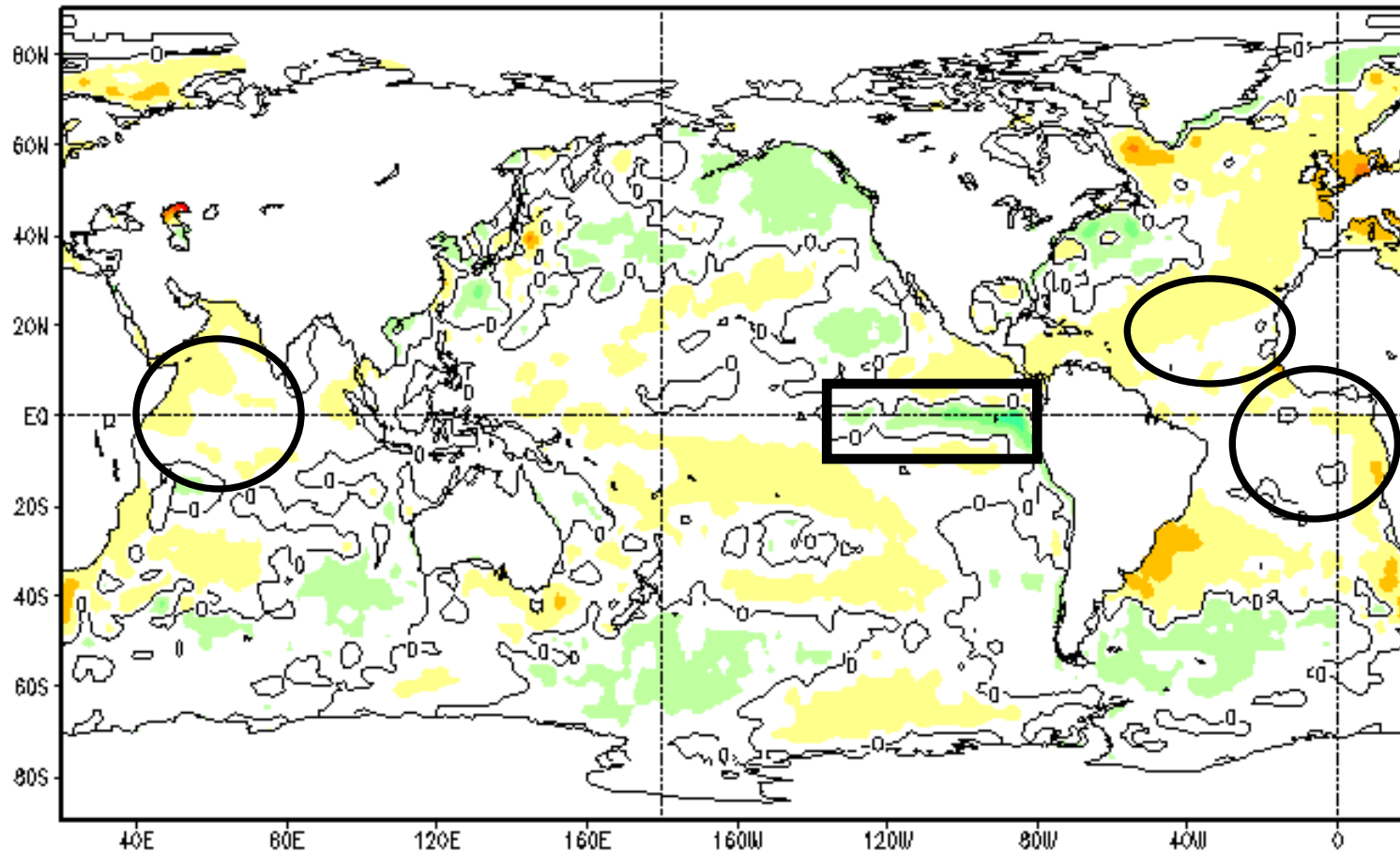
Technical guidance and funding

- ACMAD, IRI, ECMWF, UKMO, Meteo-France and NOAA/NCEP and WMO/WCP/CLIPS.

- ***

- The World Bank, USAID, NOAA/OGP, START and MEDIAS-France, French Cooperation Agency, WMO/WCP/CLIPS, UNECA, SIDA, IRI, UKMO, ECMWF and EUMETSAT funded in 1998.

Sea surface temperature anomalies of the global oceans

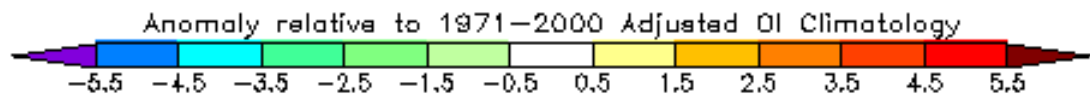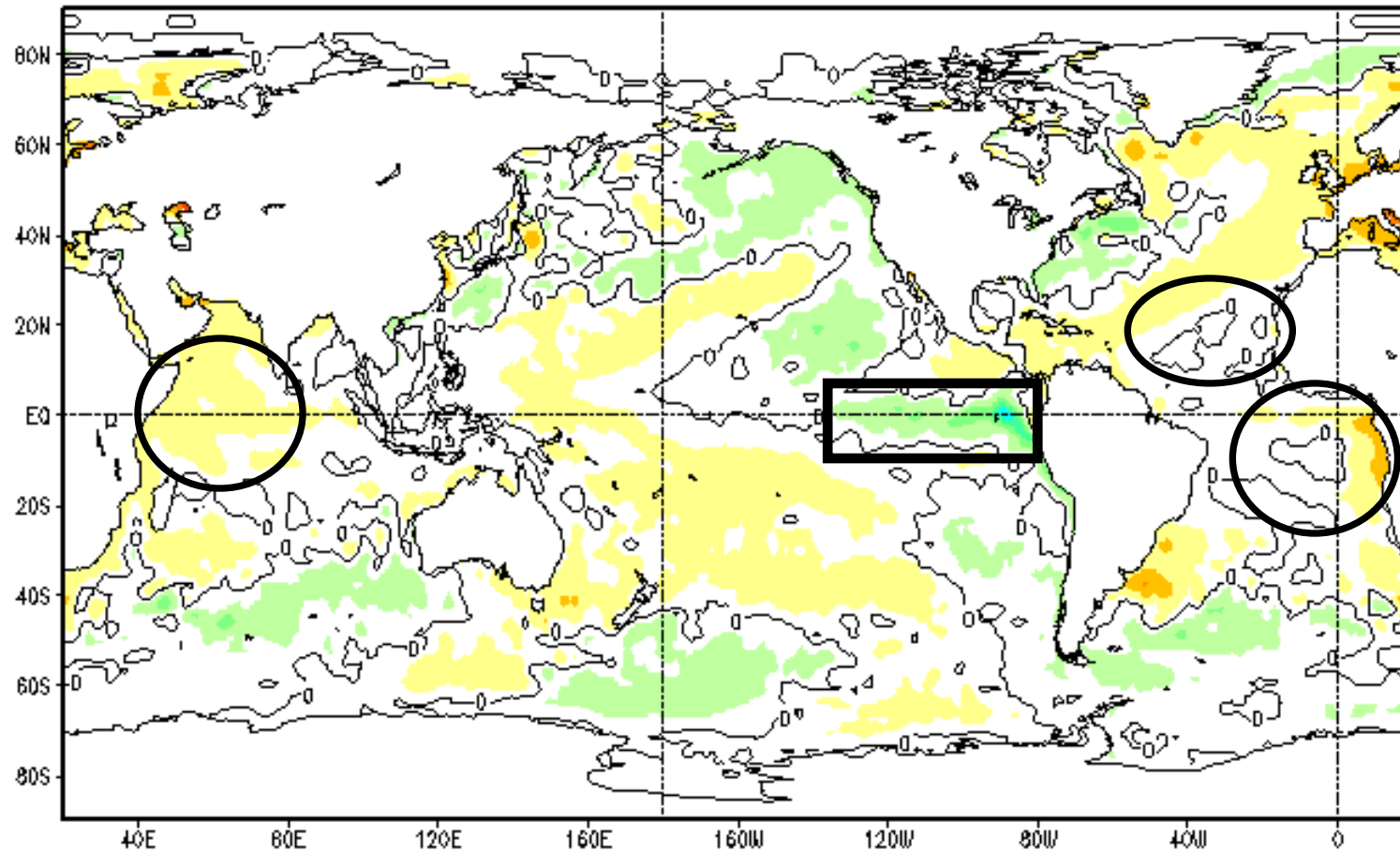Olv2 Sea Surface Temperature Anomaly (°C)
April 2007

Anomaly relative to 1971–2000 Adjusted OI Climatology

−5.5 −4.5 −3.5 −2.5 −1.5 −0.5 0.5 1.5 2.5 3.5 4.5 5.5

GrADS: COLA/IGES

Climate Modeling Branch/EMC/NCEP

Olv2 Sea Surface Temperature Anomaly (°C)
May 1–23, 2007

Anomaly relative to 1971–2000 Adjusted OI Climatology

-5.5 -4.5 -3.5 -2.5 -1.5 -0.5 0.5 1.5 2.5 3.5 4.5 5.5

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Olv2 Sea Surface Temperature Anomaly (°C)
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−5.5 −4.5 −3.5 −2.5 −1.5 −0.5 0.5 1.5 2.5 3.5 4.5 5.5

GrADS: COLA/IGES
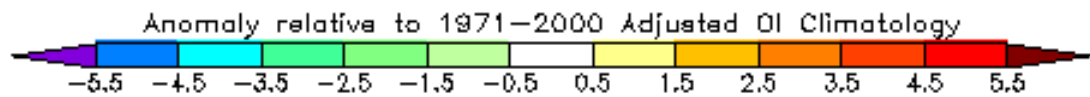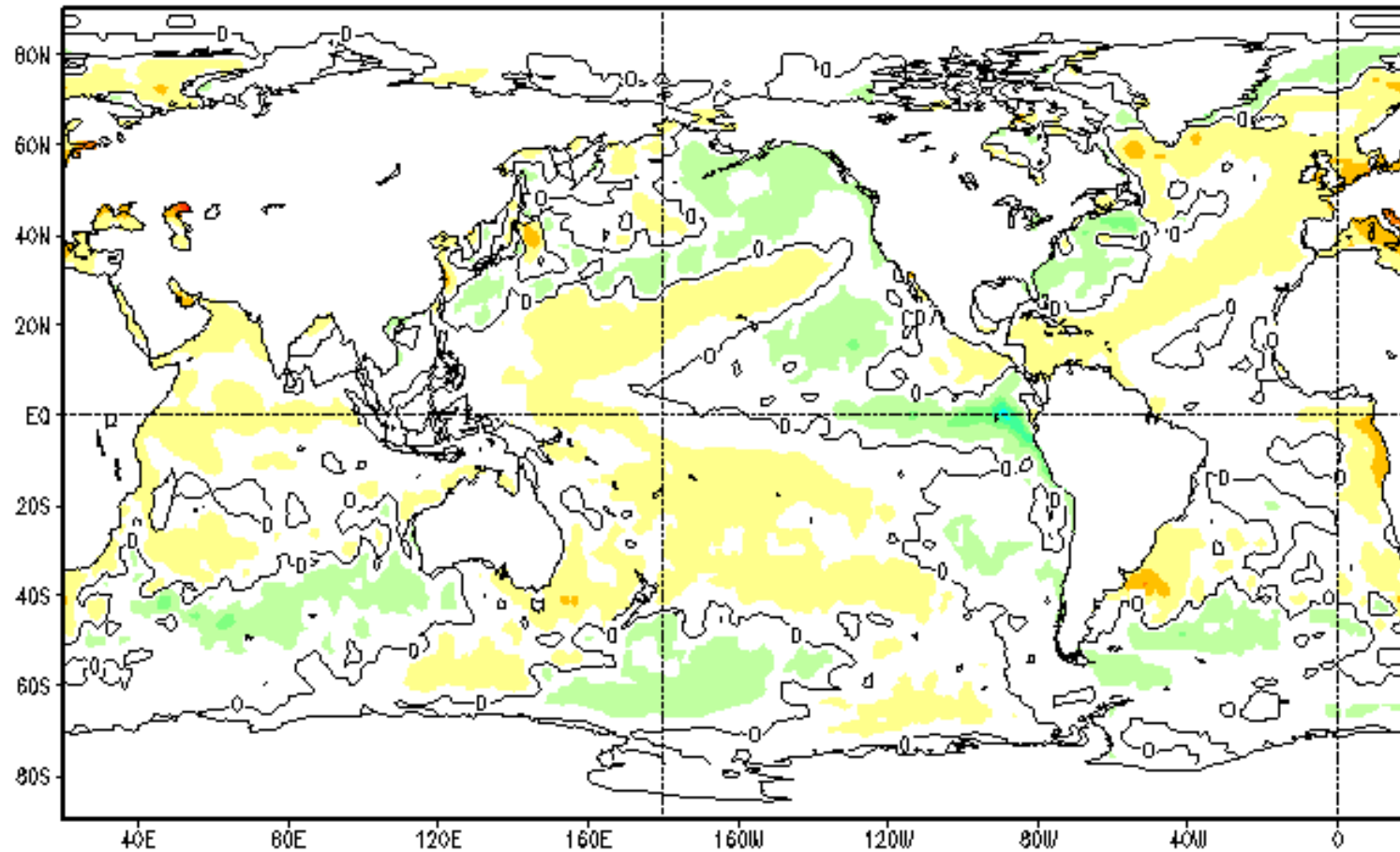
Climate Modeling Branch/EMC/NCEP

ECMWF Seasonal Forecast   System 3

Prob(most likely category of precipitation)   JAS 2007

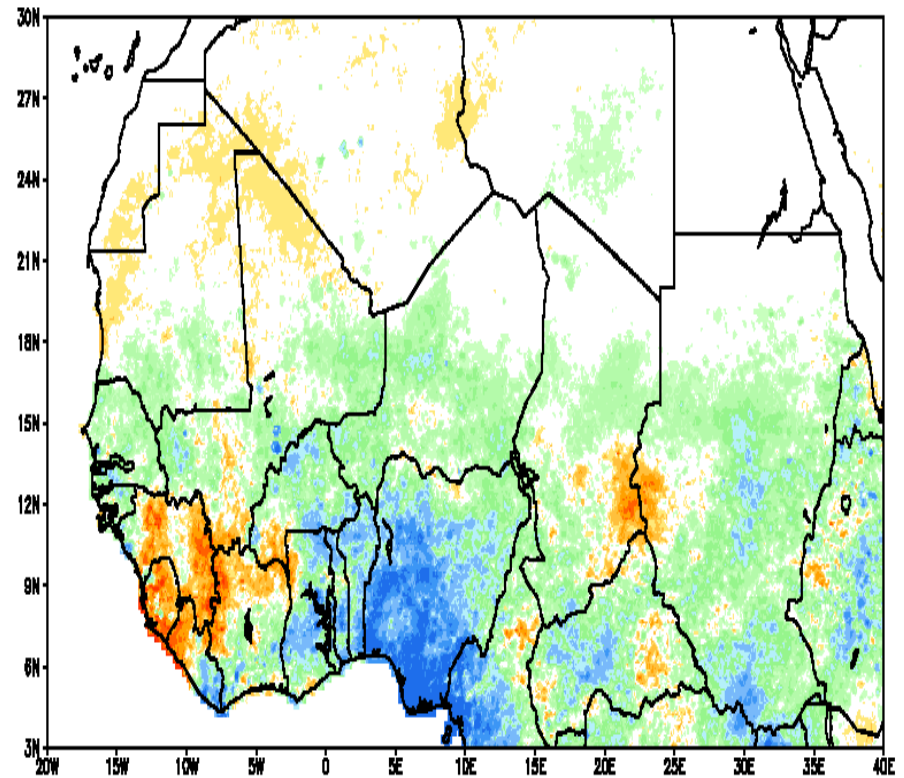Forecast start reference is 01/05/07   No significance test applied
Ensemble size = 41 , climate size = 275

<---- below lower tercile   above upper tercile ---->

70..100%   80..70%   50..80%   40..50%   other   40..50%   50..80%   80..70%   70..100%

Forecast issue date: 15/05/2007

ECMWF

Precipitation Anomaly (mm)

Based on NOAA/CPC RFE Climatology Method

May 1 2007 − September 30, 2007

−400 −300 −200 −150 −100 −50 −25 25 50 100 150 200 300 400
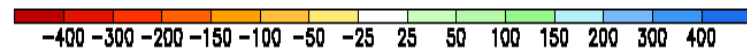
July-August-September 2007
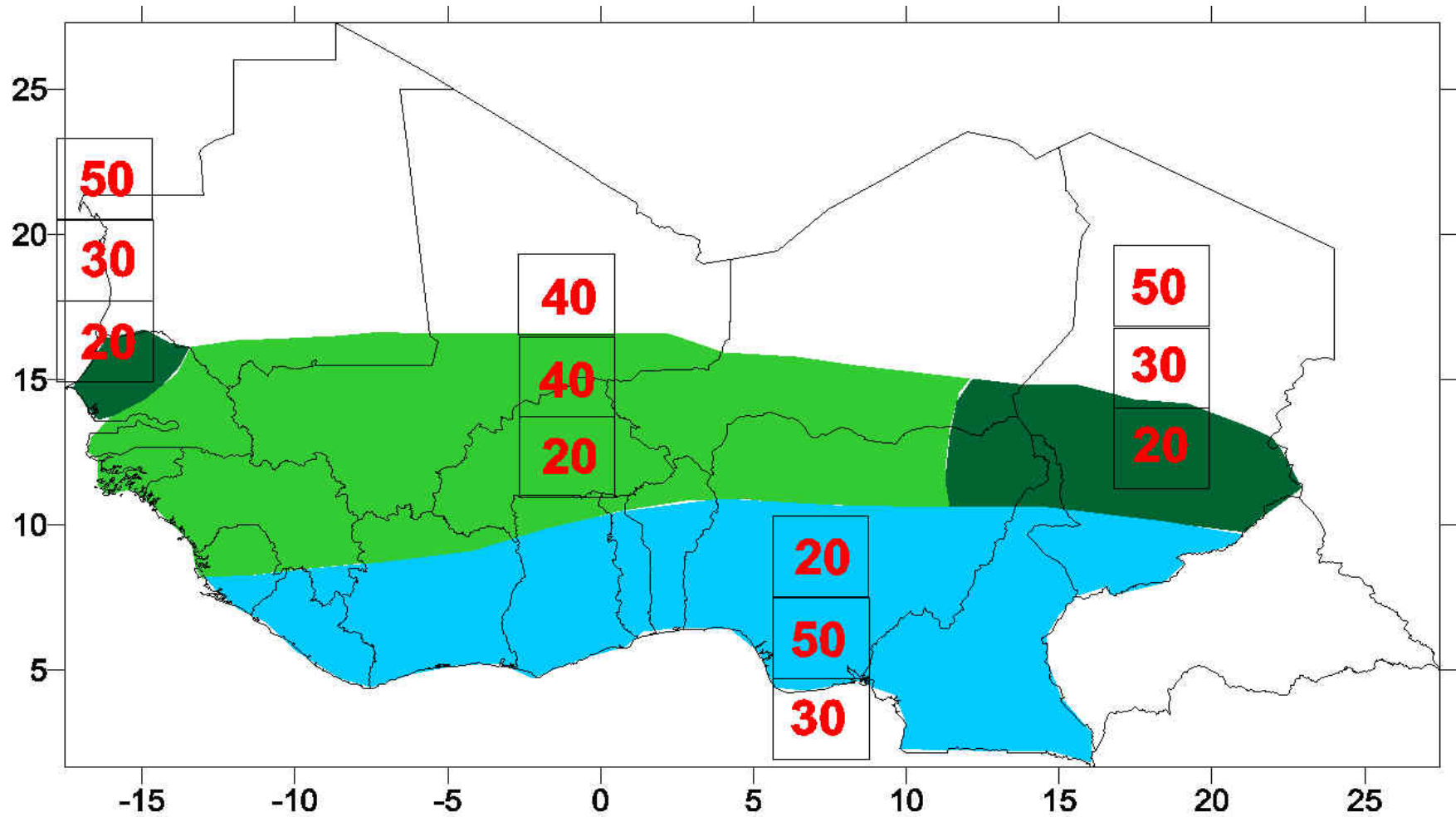
GREATEST CHALLENGES

- Deficiencies in forecasting tools

- Difficulties to estimate and communicate forecasts uncertainties

- Limited capacity to tailor forecast products to user needs and build trust in communities

- Lack of comprehensive understanding of users decision system by forecasters

- Limited understanding by users of climate forecast products

- Poor governance and less flexible organizational structure reducing COFs abilities to be effectively interactive, adaptive and responsive. Therefore, verification of COFs products and new products development to meet changing user needs are not yet a regular and integral COF exercise.

AMMA has been an opportunity to meet some of the above challenges

- Improved forecast and early warning is the major operational objective of AMMA

- AMMA Support better weather&climate forecasting with the following activities

- Propose set of metrics and data for models and forecasts verification for the region
- Verify forecasting systems used during AMMA SOP period (summer 2006)
- Verify past seasonal forecasts
- Verify seasonal forecasts and regional climate change modeling systems (AMMA-ENSEMBLE)
- Document forecasting systems deficiencies
- Investigate causes of errors and suggest remedies
- build and use new training materials

General OBJECTIVES OF Climate forecasts verification experiments

- Help for a better understanding, interpretation and use of climate products

- Document seasonal forecasting systems deficiencies, investigate their causes

- Guide future research to improve modeling systems by suggesting remedies to model errors

Specific objectives

- Highlight the performance of COFs in case of extremes (floods, droughts)

- Compare different forecasting systems
- (COF and climatology).

Verification of COFs over Chad
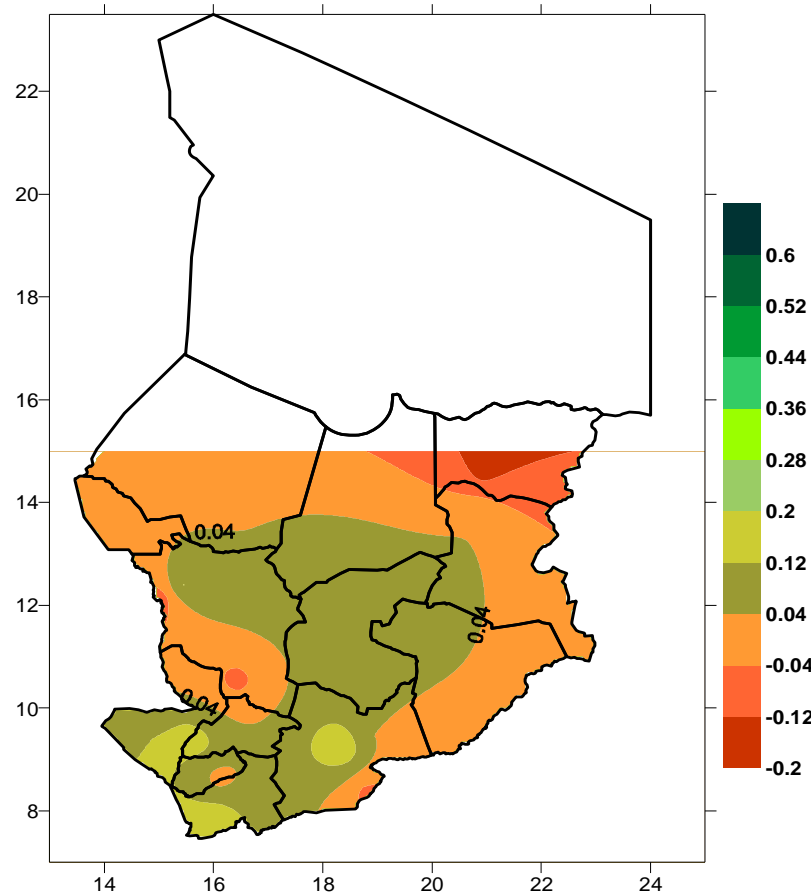
RPSS 1998-2005
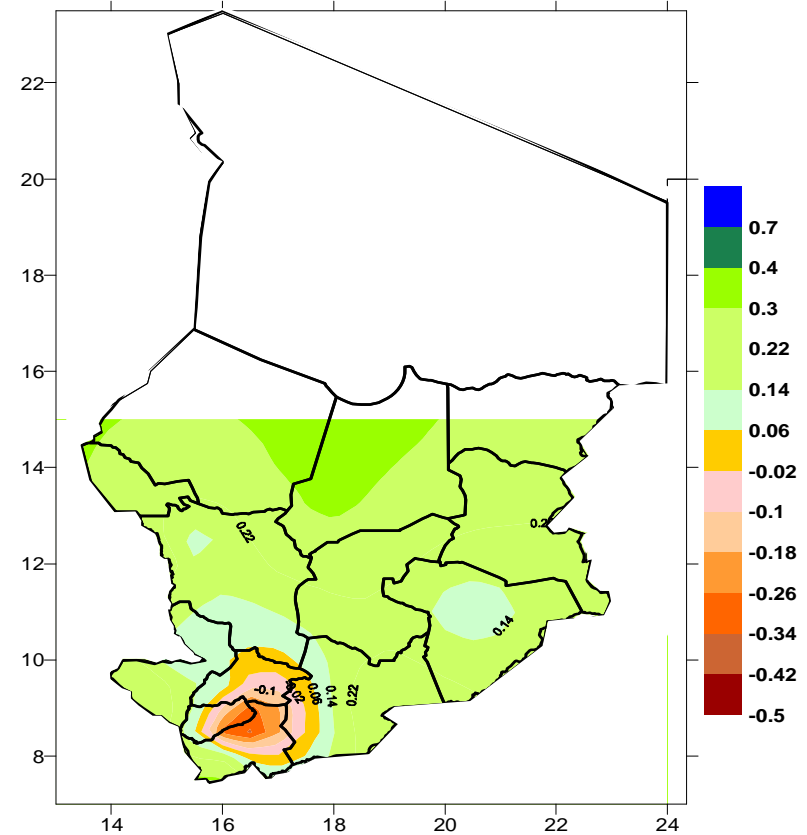
RPSS 1999

**1999 was the wettest year of the period over Chad.
Better performance for extremes !!!**
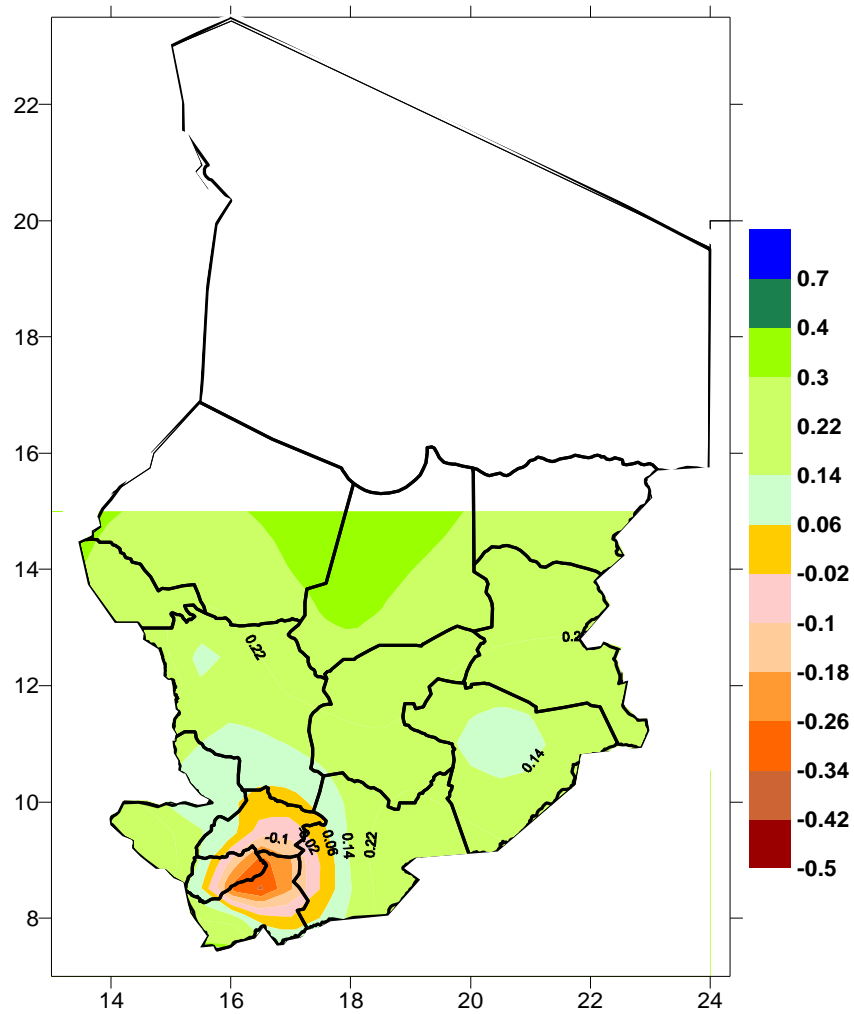
RPSS for 1999
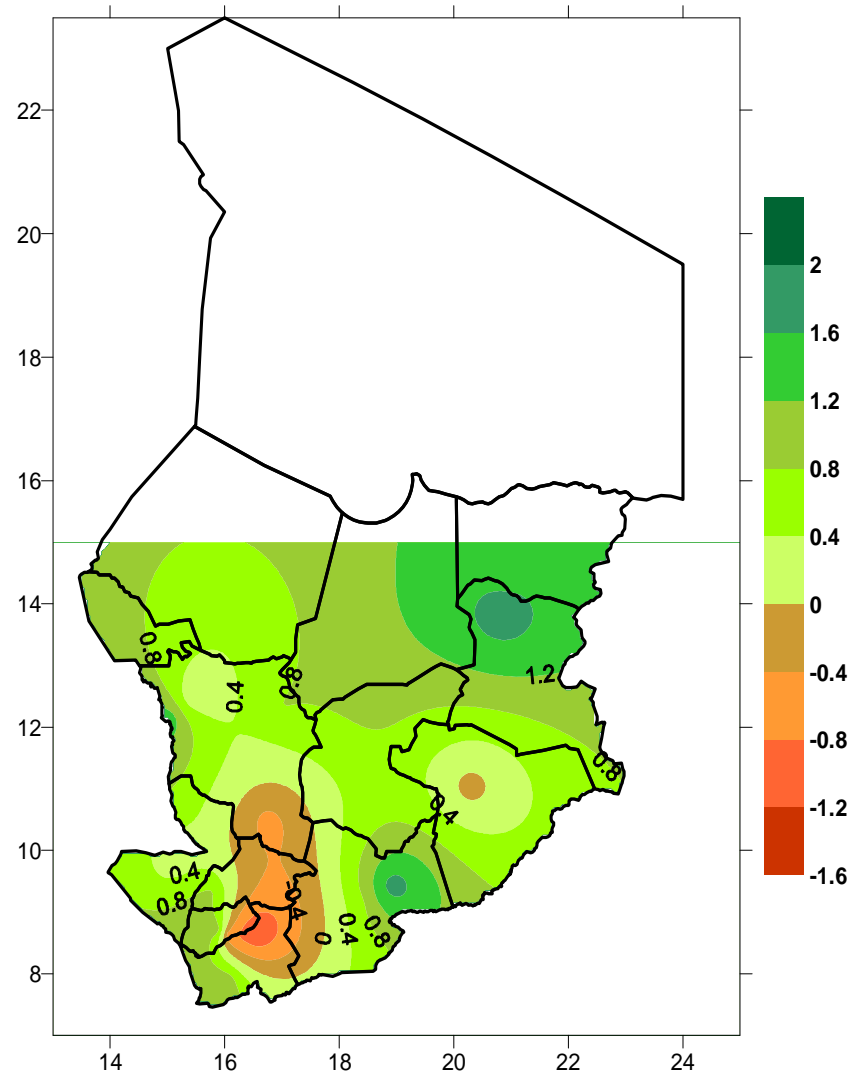
Rainfall anomalies for 1999.   below normal rainfall of local to mesoscale structure. COF forecast exhibits a bad performance this feature.
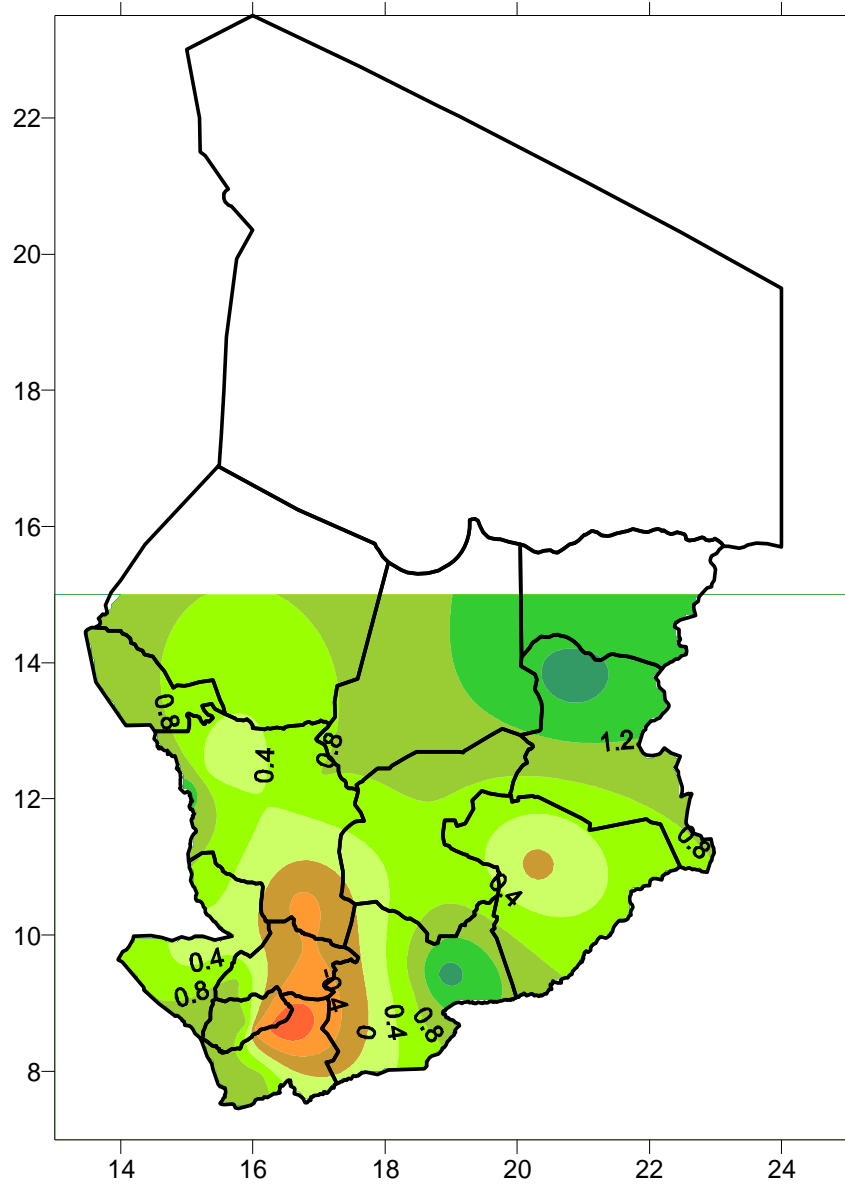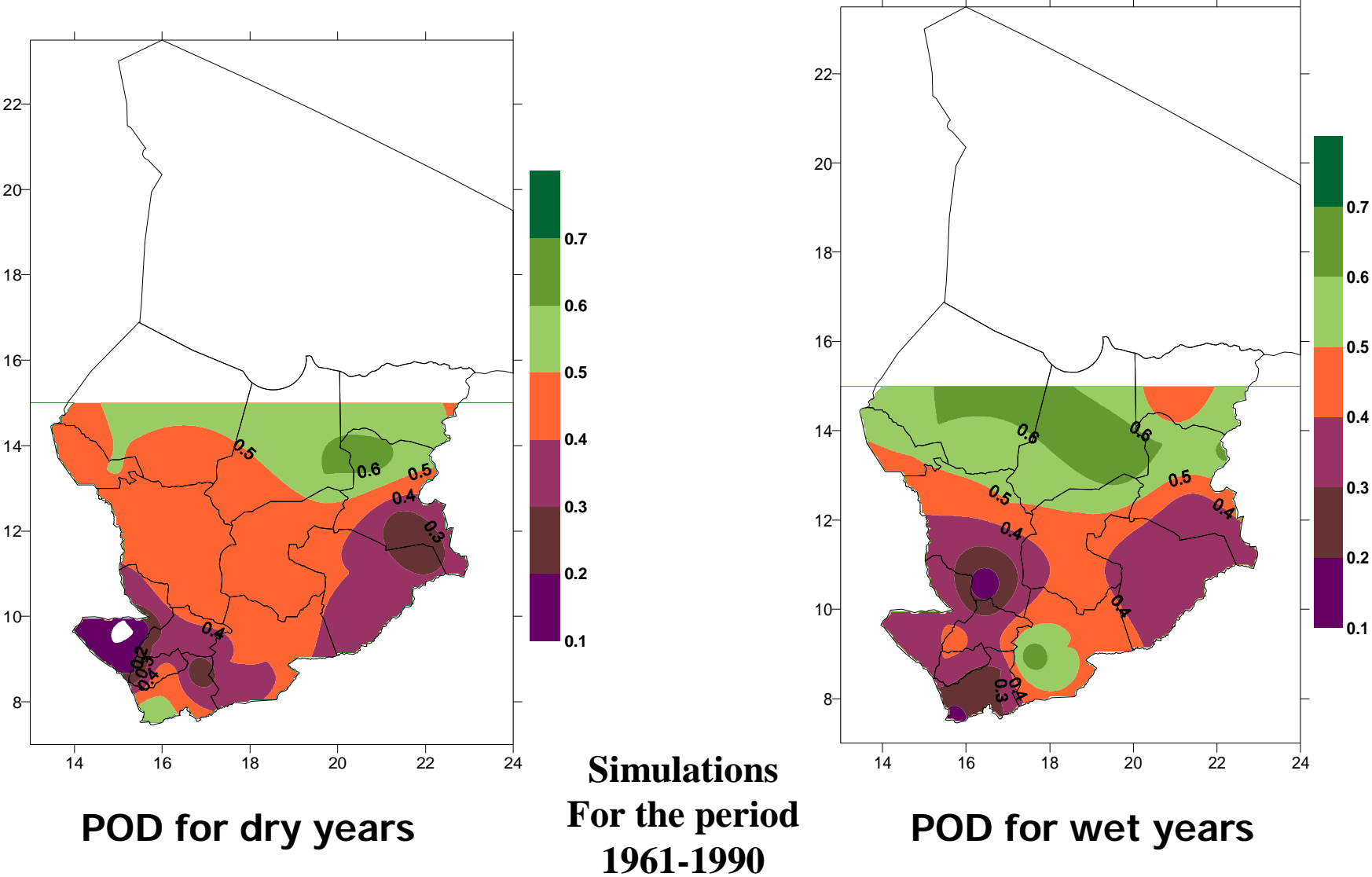
Rainfall anomalies for 1999
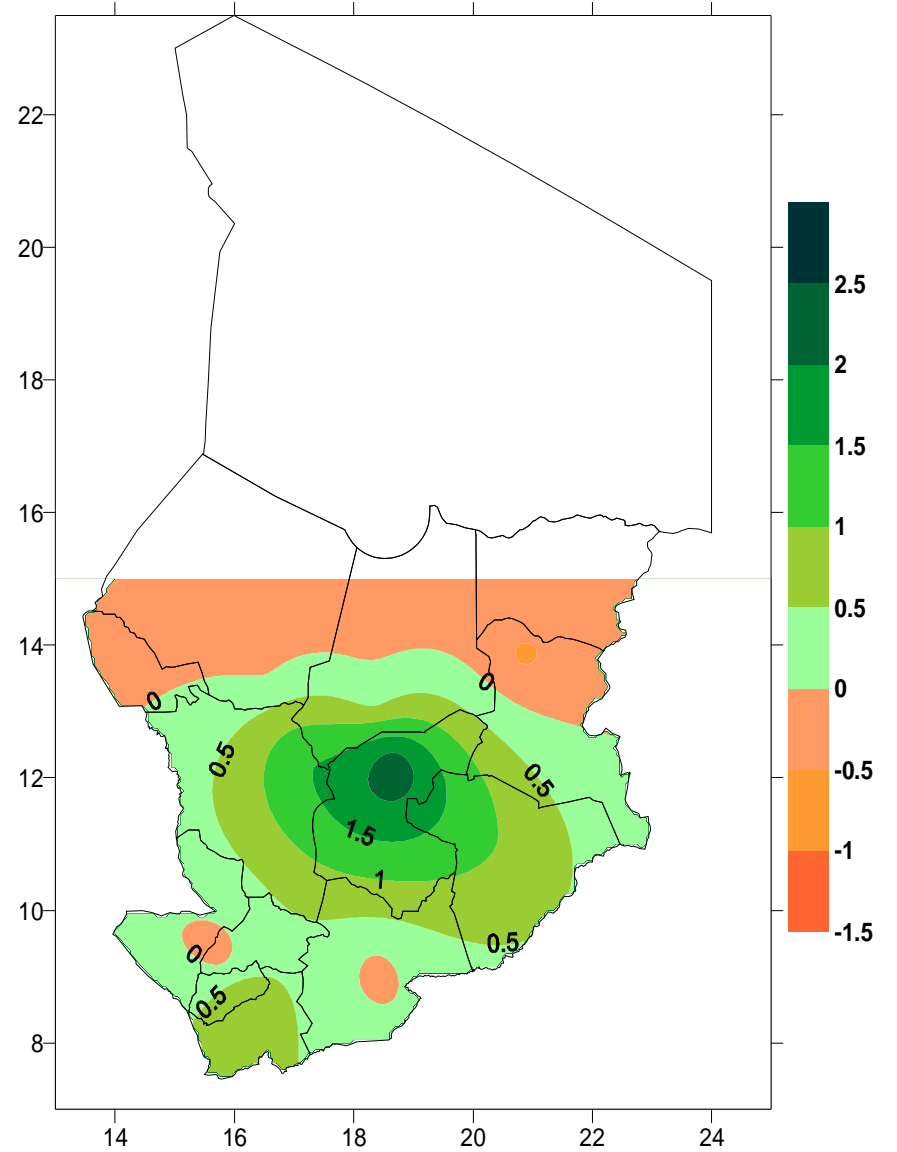
Millet yield anomalies for 1999

# Evaluation of the Hadley Center Regional Climate Modeling System (HADRM3).

A model used to provide climate change scenarios for national communications in many tropical regions

POD for dry years

Simulations For the period 1961-1990

POD for wet years

Is there a significant probability that Sahel experience a dry year Similar to 1972 or 1984 during to coming few decades
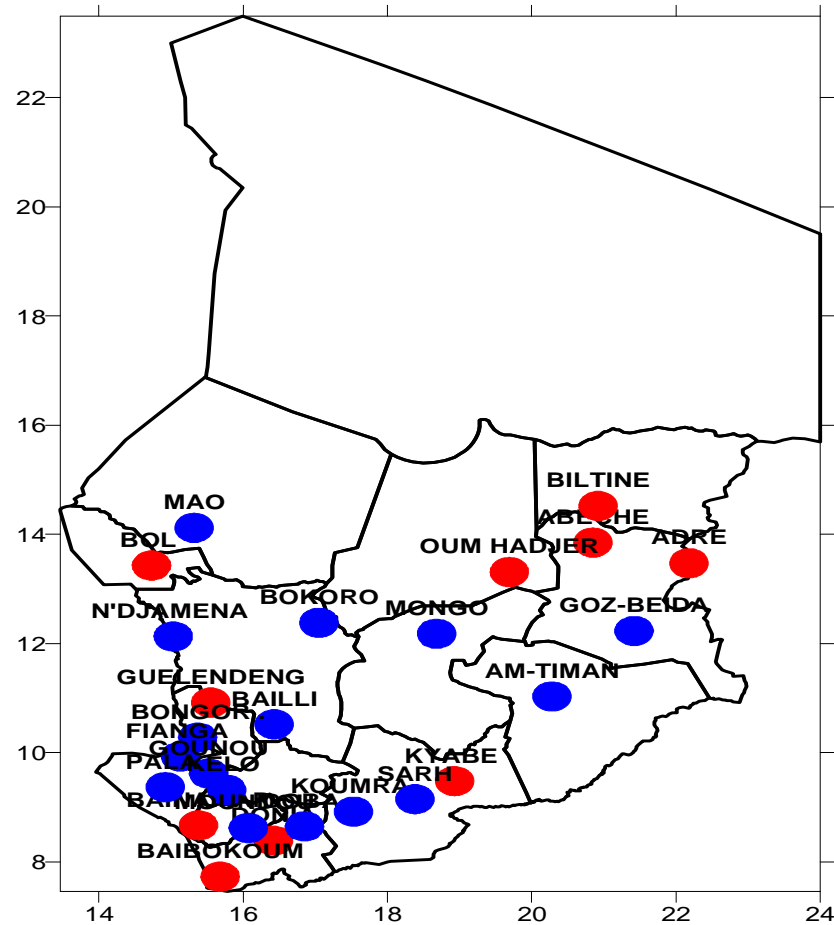
Stations(in red) where dry category was well simulated by HADRM3 in 1972
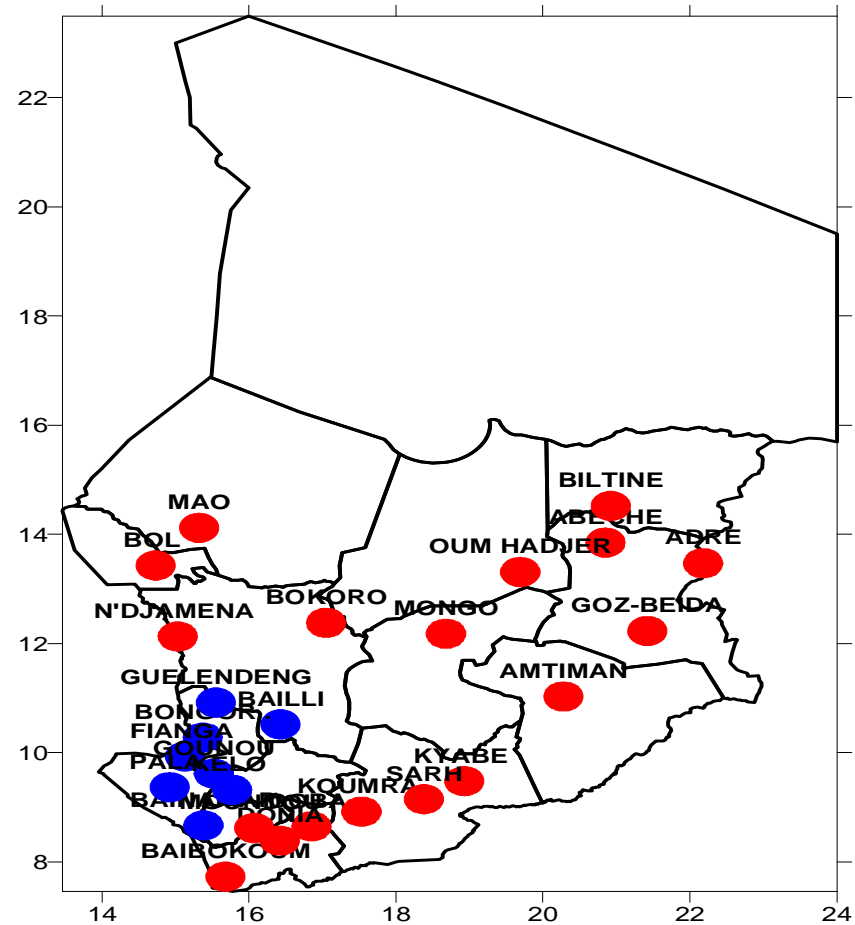
Stations(in red) where dry category was well simulated by HADRM3 in 1984

Evaluation of COFs over Burkina Faso.
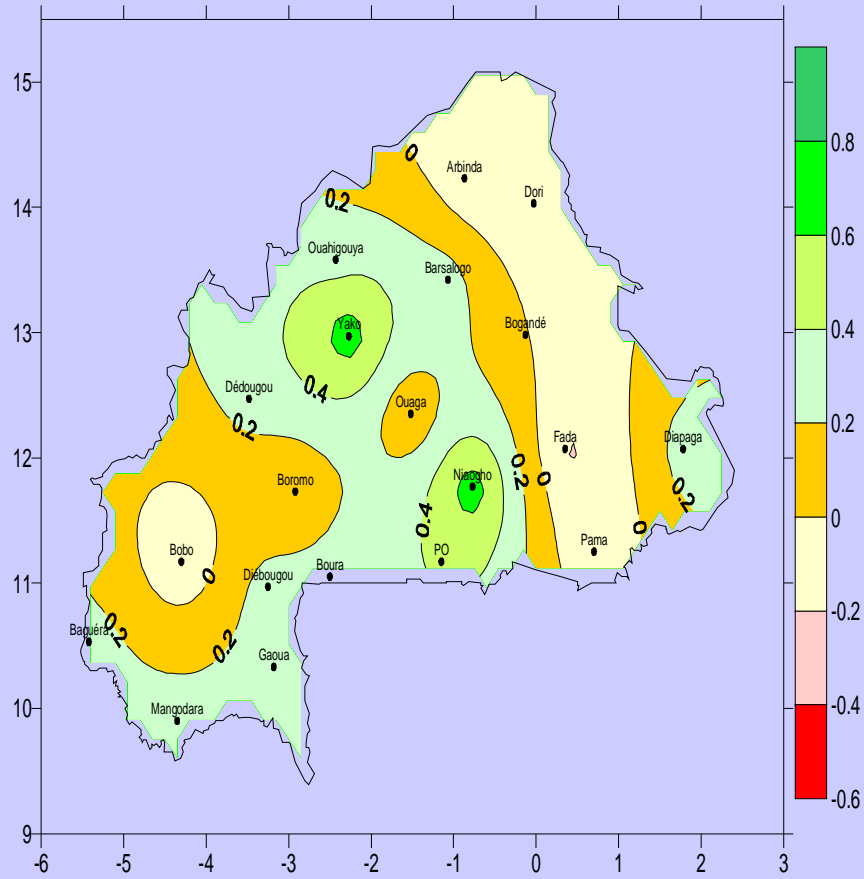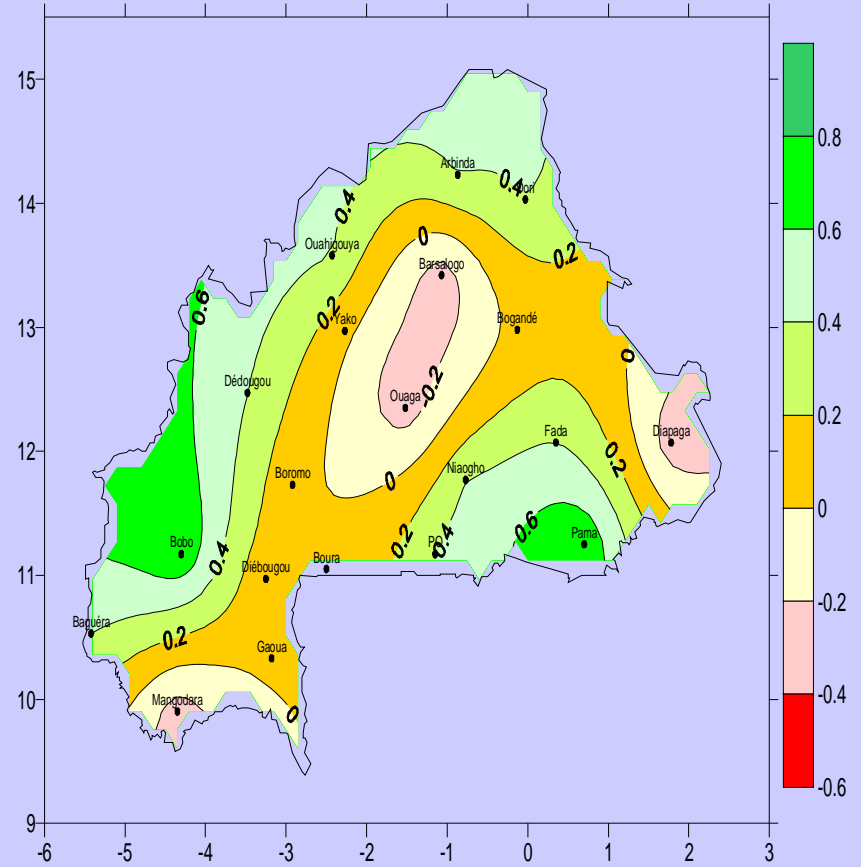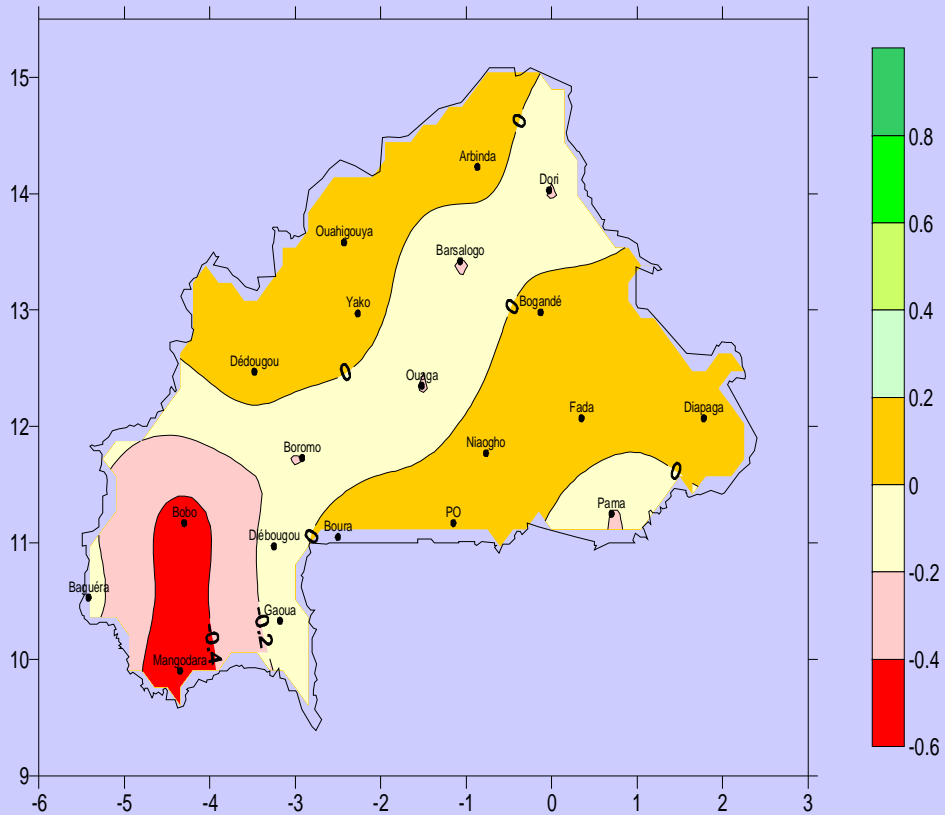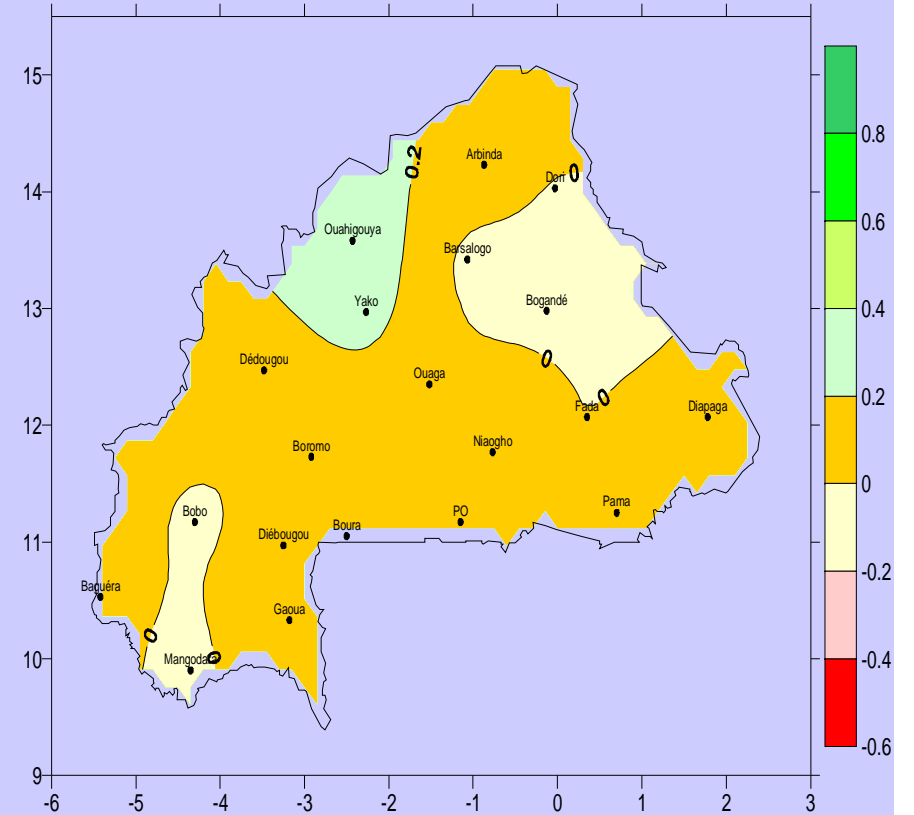# 1999 and 2005 were the wettest years over the period under study
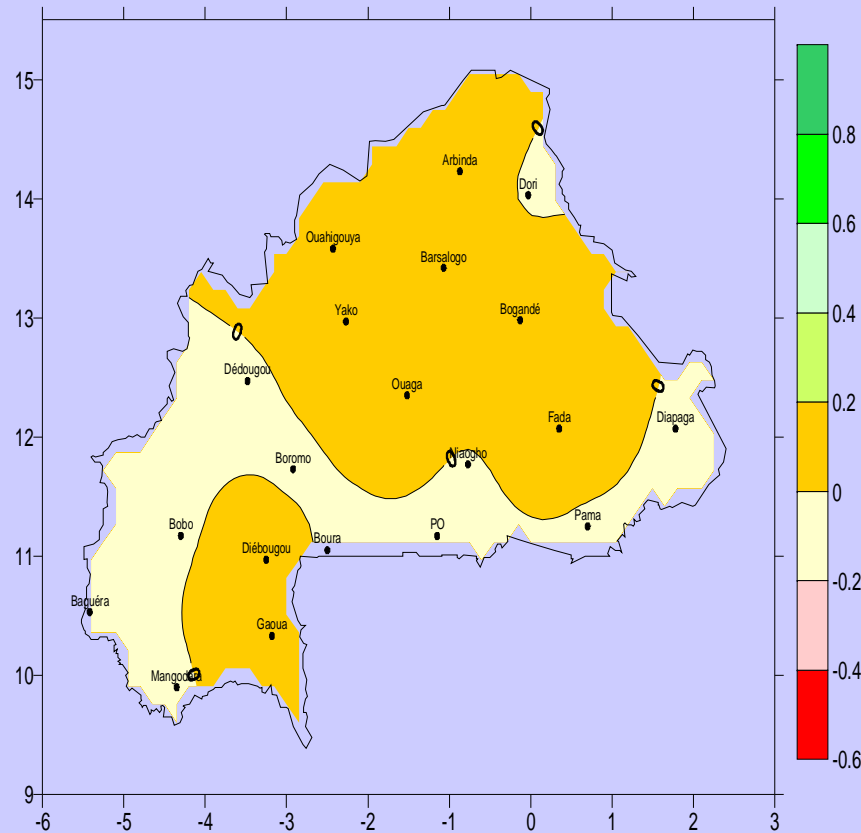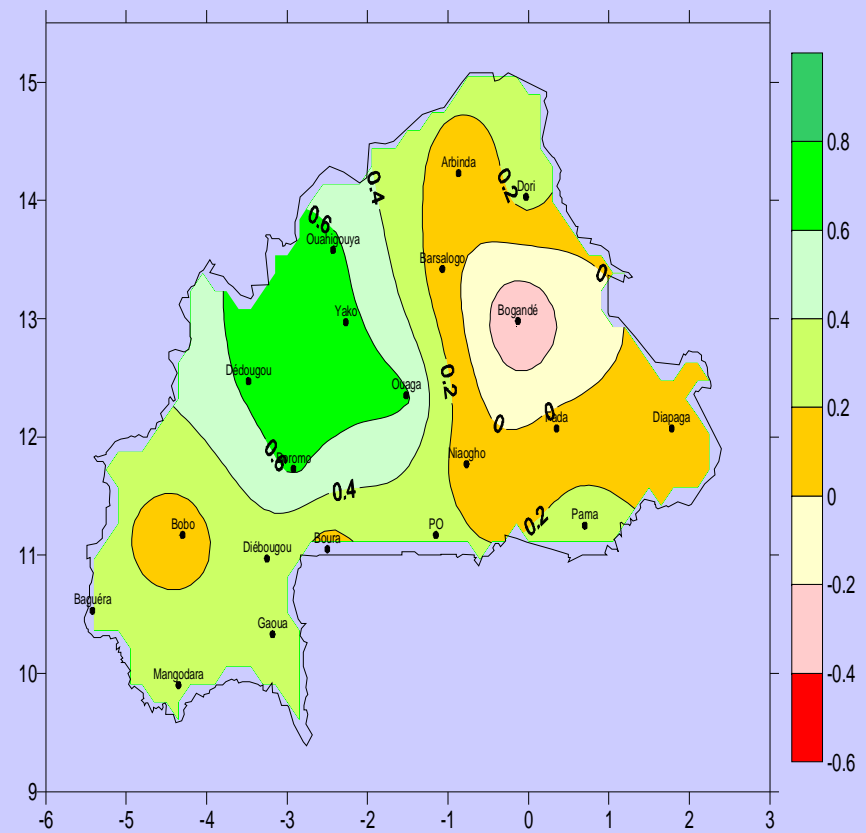
RPSS 2004

RPSS 2005

RPSS 2006

Mean RPSS 1998-2005

**Best COFs performance in 1999 and 2005 over Burkina Faso.
These are the wettest years of the period.
<u>COFs products perform better in wet years.</u>**

Ouahigouya

Yako

COFs over 2 stations have always been of better quality.
Forecasts of the observed category were usually possible
 over these stations given the level of performance.
Simple and understandable statements for users is possible
over these stations !!!

Selected Stations Across the AMMA Domain Used for the Exercise

- Forecast verification
  - ✓ Bamako
  - ✓ Cotonou
  - ✓ Dakar
  - ✓ Douala
  - ✓ N'Djamena
  - ✓ Niamey
- Validation of FEWS Daily Rainfall Estimate
 - ✓ Douala
  - ✓ N'Djamena
  - ✓ Niamey

Methods

- Bias to detect over forecasting or under forecasting (A+B/A+C)
- Percent correct forecast (PCE= A/A+B)
- Probability of Detection (POD=A/A+C)
- False Alarm Rate (FAR= B/A+B)
- Correlations between Obs&estimates rainfall

Observed

	Yes	No
Forecast Yes	A	B
No	C	D

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  - ✓ Niamey

Selected Weather Features

- **Rainfall**:

  - Synoptic raingauge obs. (NIM, NDJ & Douala)

  - FEWS daily rainfall estimate (BKO, DKR & COO)

  - Forecasts of rainfall occurrences inferred from MCSs on WASF (additional info obtained from AMMA daily bulletins)

- **Mesoscale Convective Systems (WASA/WASF)**

- **African Easterly Waves (WASA/WASF)**

Note :   for MCSs and AEWs, the difference between the observed and predicted positions must not be greater than one (1) degree

Correlation Coefficients Between Observed and Estimated Rainfall

| Stations	Correlation coefficients				
	Jun.	Jul.	Aug.	Sep.	Mean
Niamey	**0.94**	**0.97**	*0.67*	*0.50*	0.75
N'Djamena	**0.96**	**0.99**	*0.47*	*0.73*	0.67
Douala	*0.34*	*0.46*	**0.89**	**0.76**	0.73

Results of the 24-Hours Rainfall Forecasts
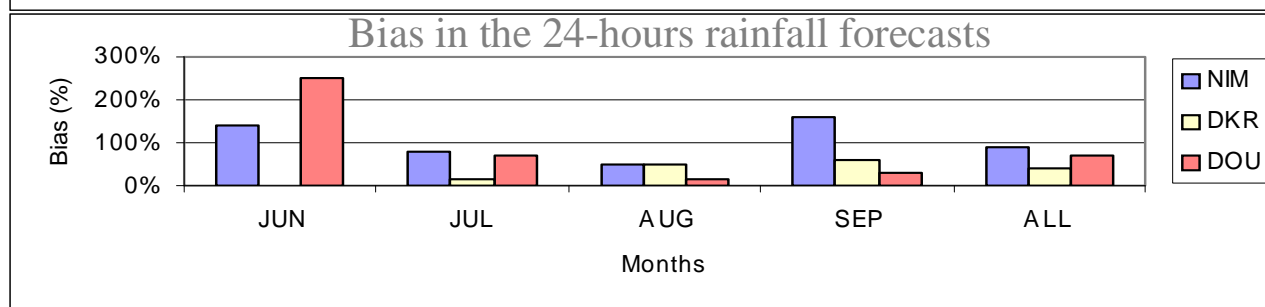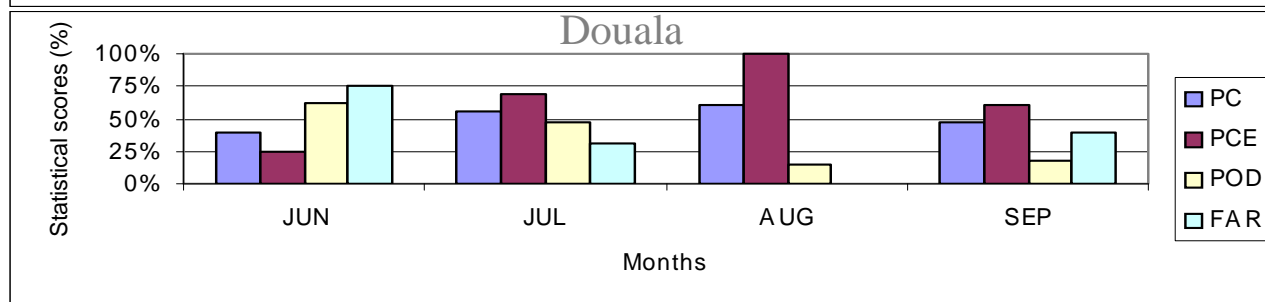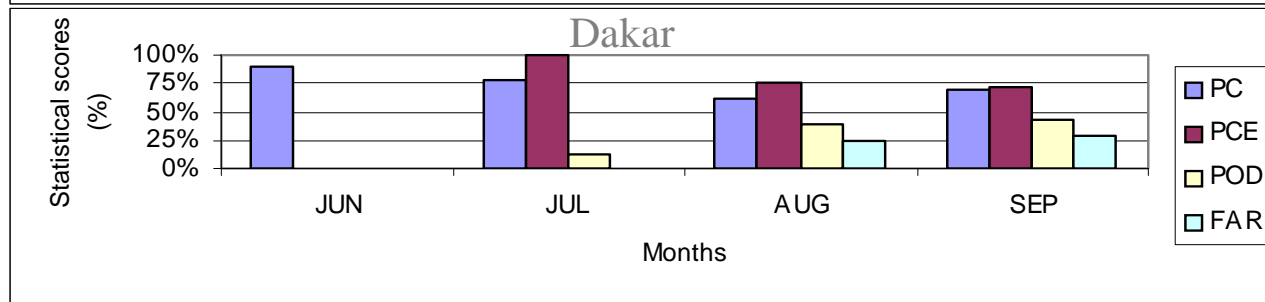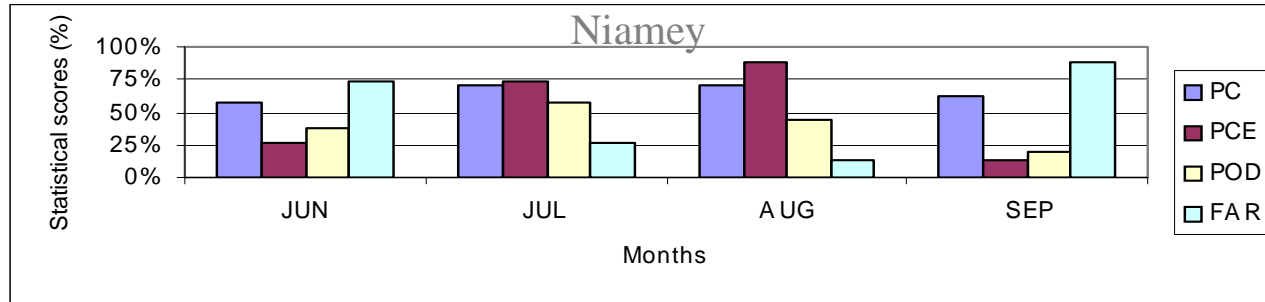


• Scores are quite variable as a function of stations and months
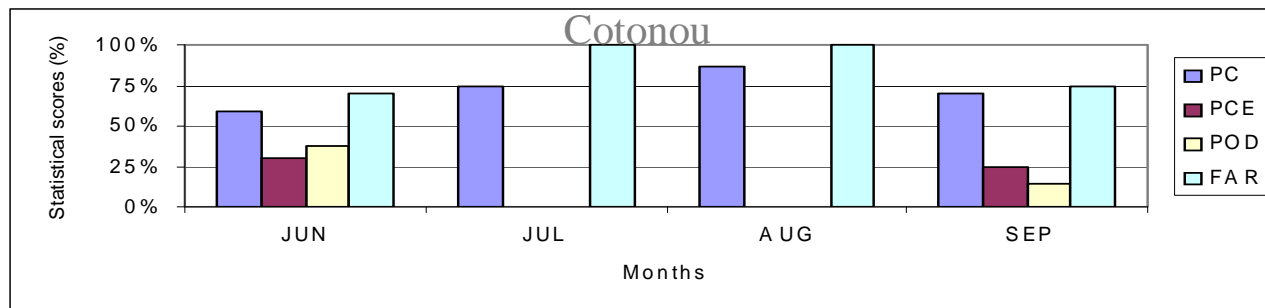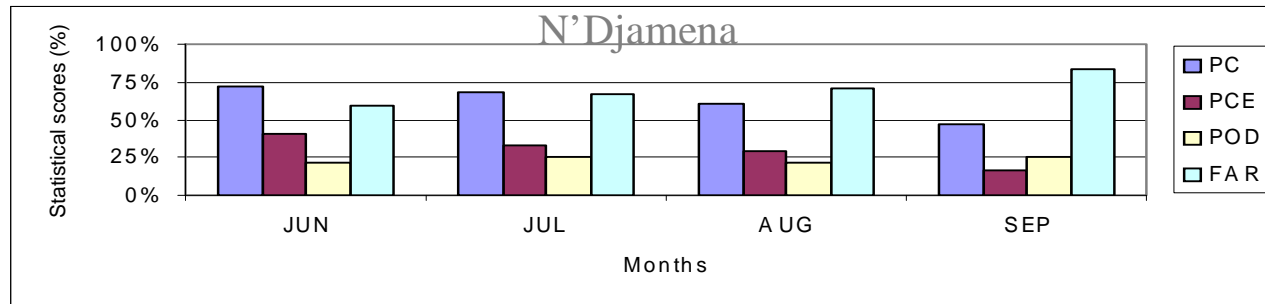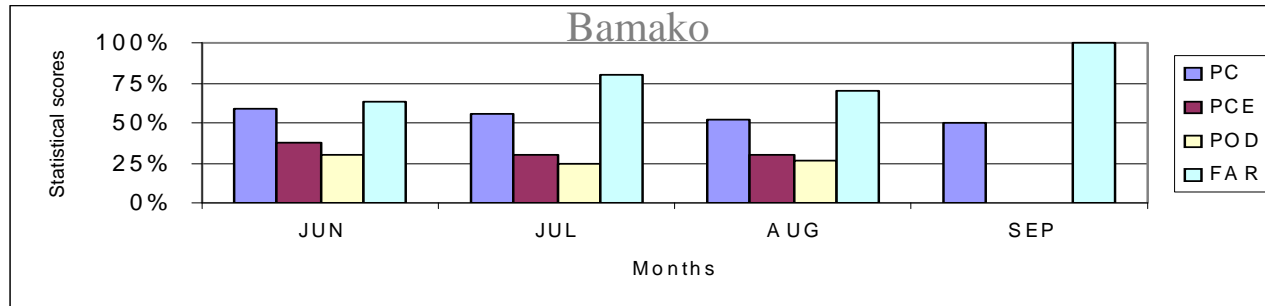
• Under-forecasting noted over the pilot stations on the average, except over N'Djamena.

Results of the 18-Hours MCSs Forecasts
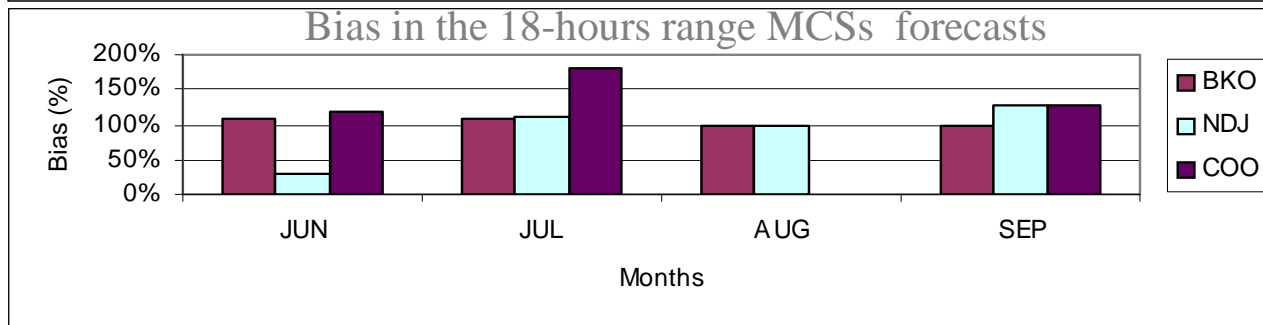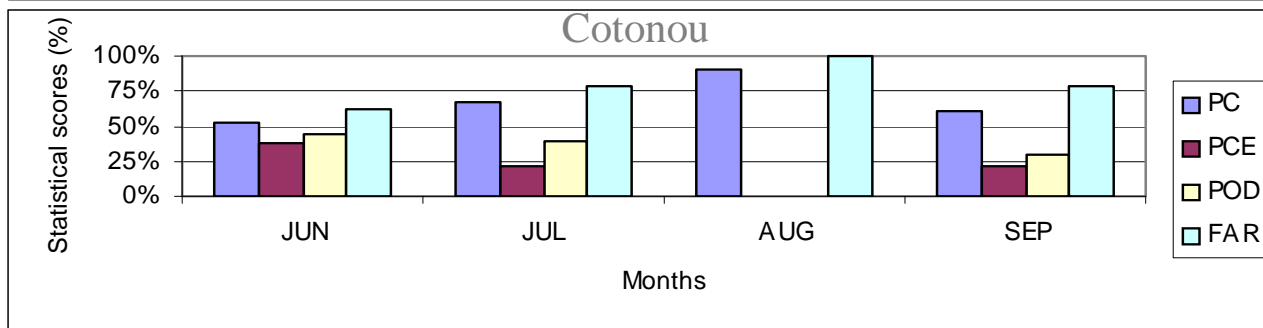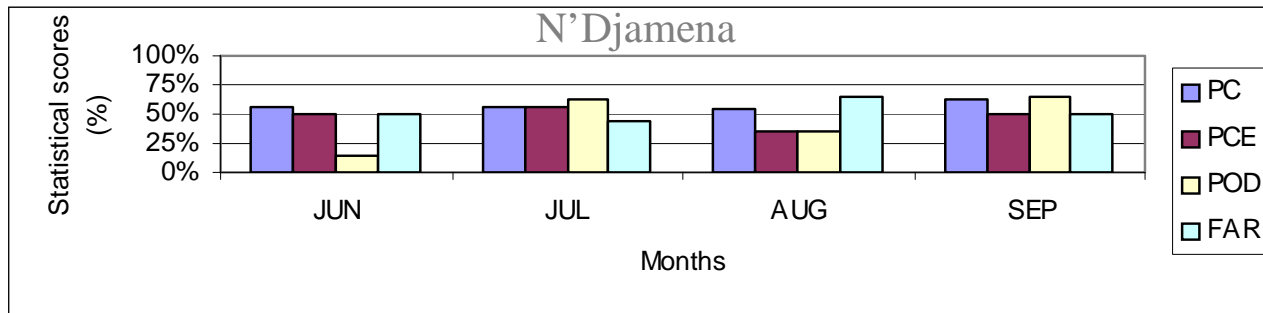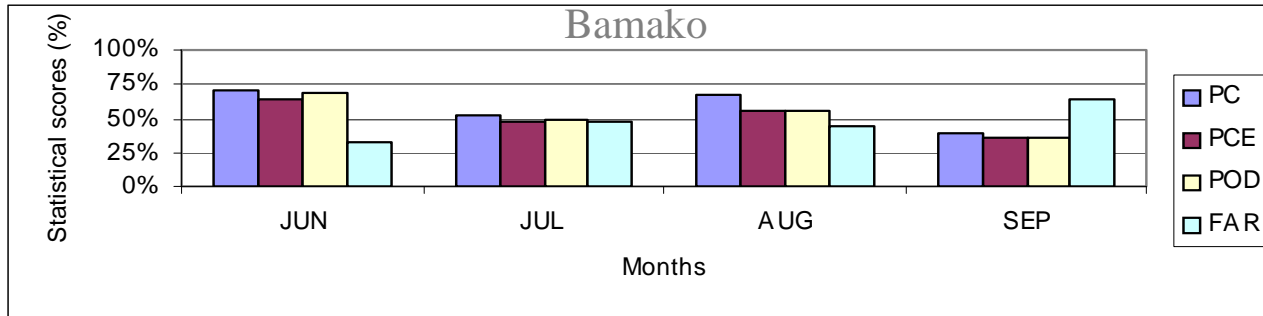
- Scores quite similar to those of the 24 hours rainfall forecasts with the following differences:
✓POD usually around 25% or above.

✓On average, over forecasting of MCS over most pilot stations

Results of the 30-Hours MCSs Forecasts
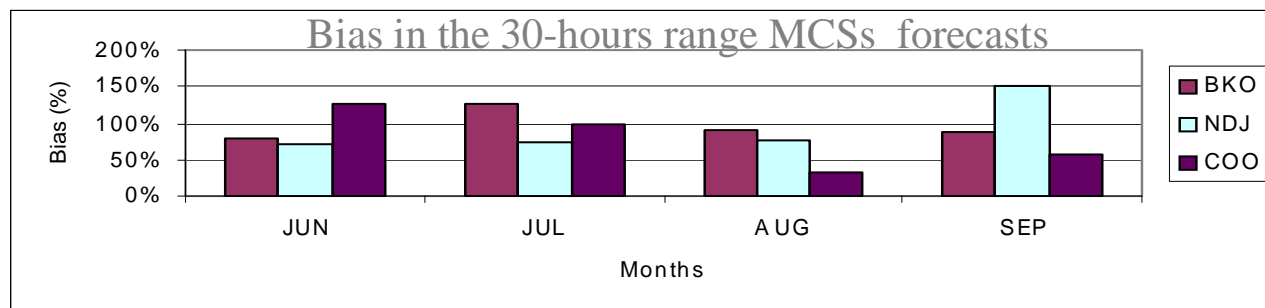
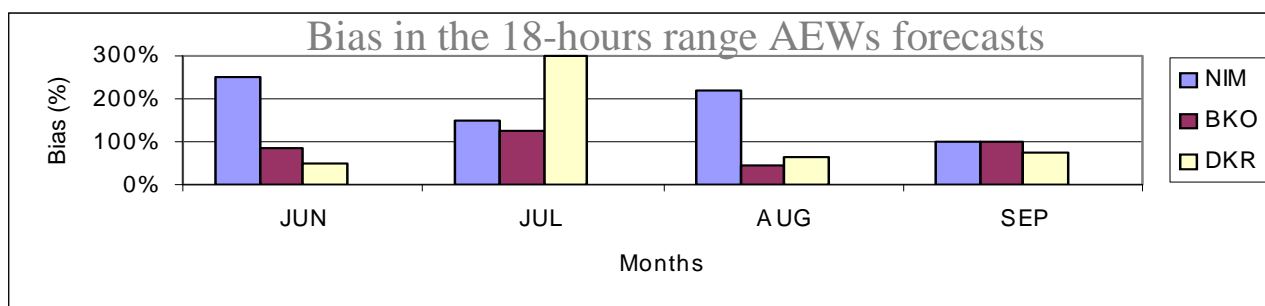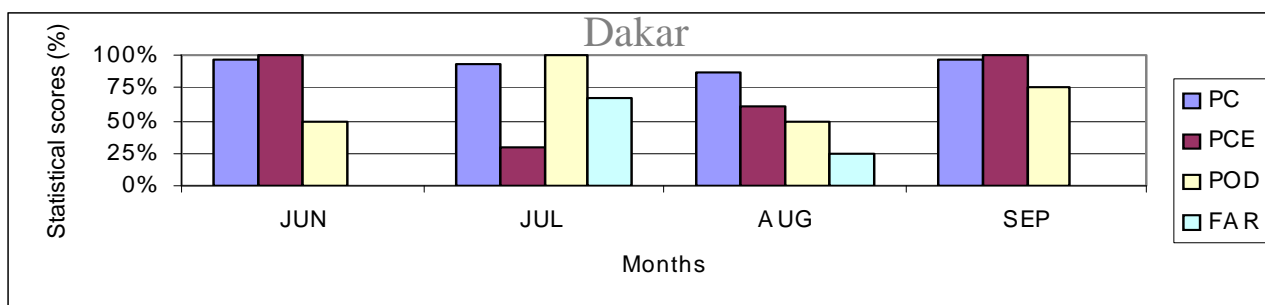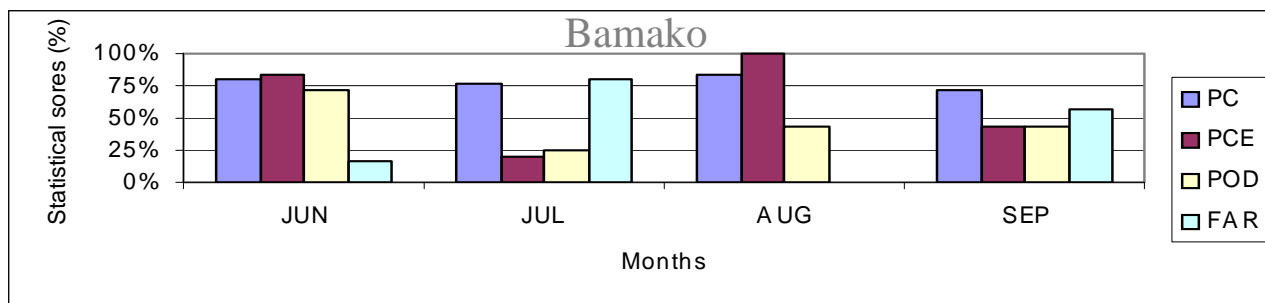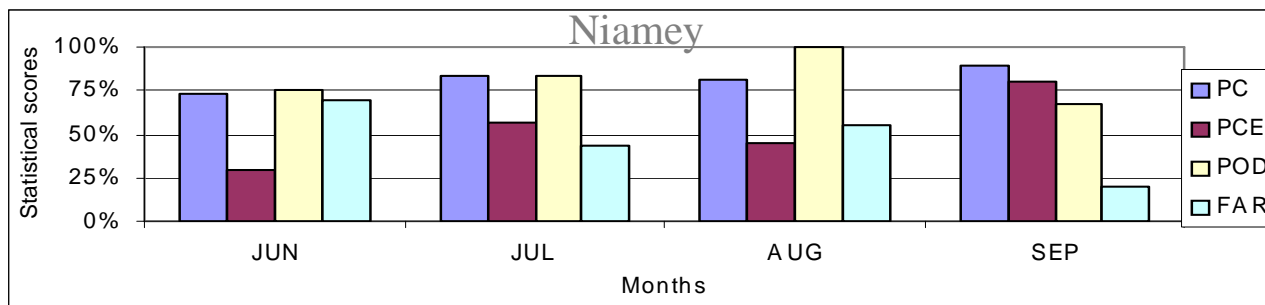- **Important Decrease in the predictability of MCSs (poor forecasts).**

- **Best scores over NIM & DKR with however more misses (low POD)**

- **Very high FAR in the forecasts over all stations**

- **Under-forecasting of MCS at 30h.**

- **Lowest POD obtained in September at both two ranges except over NDJ**
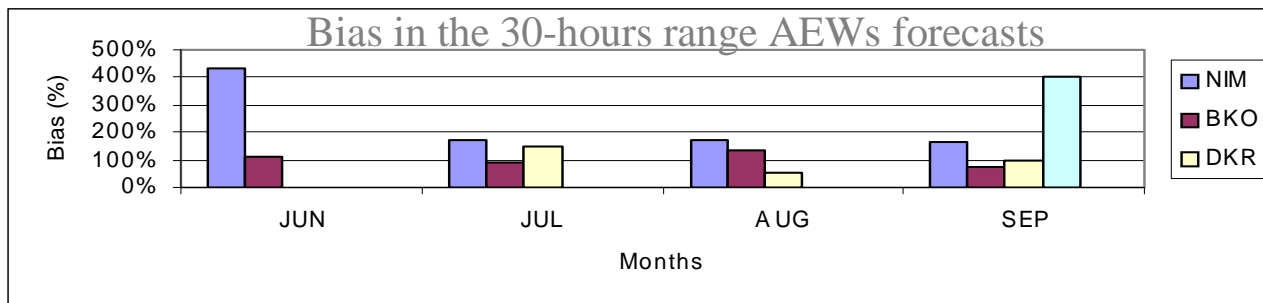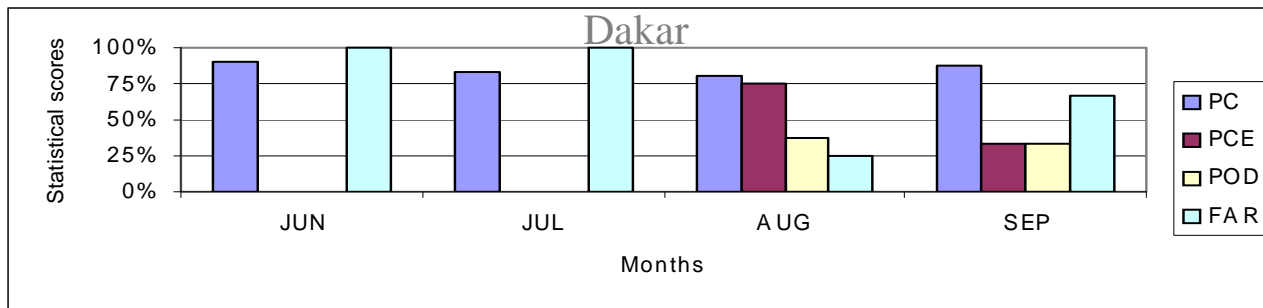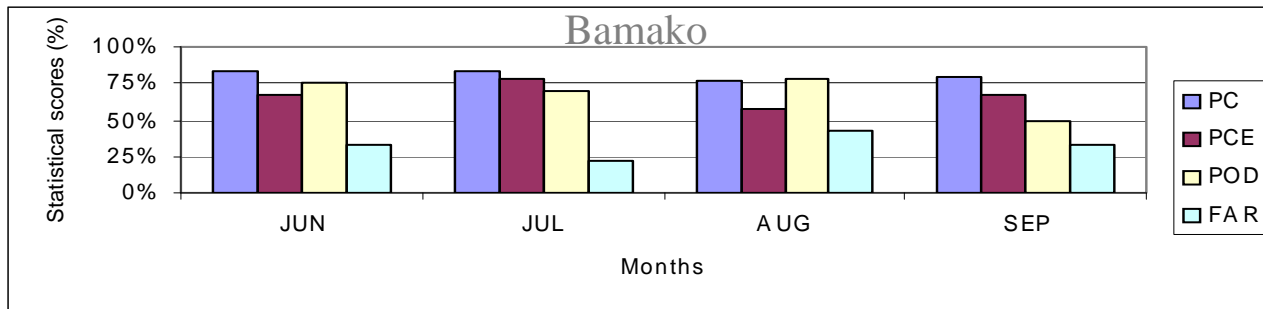
Results of the 18-Hours AEWs Forecasts
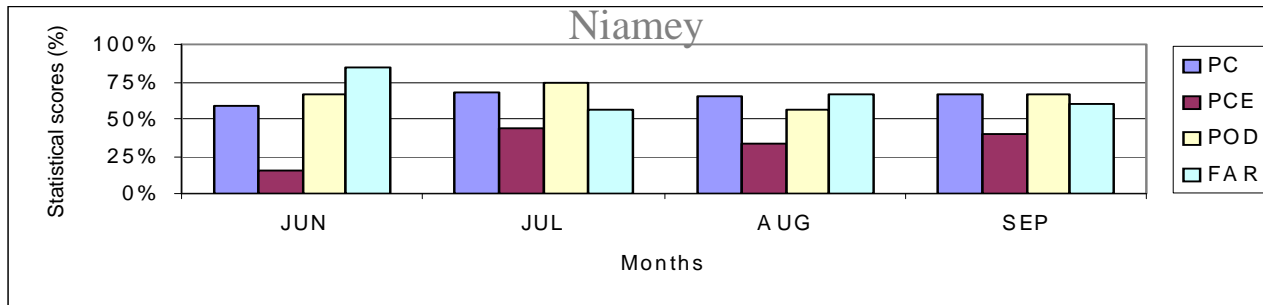

- The predictability of AEWs quite satisfactory

- (POD usually > 50%)

- The non-occurrence of AEWs at NDJ, COO & Douala is well predicted

- Under forecasting at BKO & DKR and over forecasting at NIM

Results of the 30-Hours AEWs Forecasts

-Quite high Predictability particularly over BKO where they are better predicted at this range

-Over prediction over all stations.

Conclusion

- The overall predictability of rainfall and MCSs was relatively poor during the SOP

    - Easterly waves are relatively well-predicted at both two ranges (Because of its synoptic scale structure better represented in current global forecasting systems !!!!

Way Forward

- Capitalise and consolidate the AMMA experience

- take advantage of the relatively well-predicted AEWs

Future Potential actions to improve forecasts

- Consideration by forecasters of systematic errors associated with NWP models over tropical Africa in issuing the forecasts

- More comprehensive verification of NWP models and forecasts information by operational&research centers

- More training of forecasters on NWP products interpretation and African scientists on weather/climate modeling in the framework of ICTP-Affiliated Universities and Meteorological Centers in Africa

- Need for Systematic forecasts verification and dissemination of verification results (to improve forecasts interpretation and communication)