Evaluation of an S2S Model in Predicting Rainfall Onset Date over West Africa

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1. Introduction

➢Reliable seasonal prediction of Rainfall Onset Date (ROD) is crucial for decision-making in various socio-economic sectors.

➢Most of past studies on ROD prediction over West Africa have used empirical models. However, the low predictive skills of the empirical models and their inability to account for other important factors influencing the start of the monsoon season, have led some recent studies to use dynamic climate models in studying the characteristics of ROD over the sub-continent with the aim of improving the ROD predictions .

➢As the demand for reliable forecasts are increasing around the globe, various seasonal climate prediction datasets are now made available publicly for evaluation. An example of such dataset is the European Centre for Medium Range Weather Forecasting (ECMWF) Sub-seasonal to Seasonal (S2S) model output data. The S2S model dataset is a new frontier for atmospheric research.

2. Data and Methodology

➢ The observed data (daily rainfall) are from the African Rainfall Climatology version 2 (ARC2; 1983-2012) and the Climate Hazard Group Infrared Precipitation with Stations (CHIRPS; 1981-2015).

➢The reanalysis datasets are the European Centre for Medium-Range Weather Forecasts (ECMWF) Interim Re-Analysis (ERAIN; 1979-2015).

➢ The global model output dataset is from the ECMWF Sub-seasonal to Seasonal (S2S) data portal, from the China Meteorological Administration (CMA; 1994-2014).

➢For easy comparison, the observation, reanalysis and model datasets were analyzed over 19 years period (1994-2012) and re-gridded to 0.44 x 0.44° horizontal resolution.

Table 1: Definitions of ROD over West Africa

Parameter	Definition of ROD	Reference
DEFINITION 1	The total of at least 25 mm of rainfall within 5 days. The starting day and at least two other days in this 5-day period must be wet (at least 0.1-mm rainfall recorded), followed by a no dry period of seven (7) or more consecutive days occurring in the following 30 days.	Stern et.al (1981
DEFINITION 2	The first two rains totaling 20 mm or more within 7 days, followed by 2 to 3 weeks each with at least 50 % of the weekly crop-water requirement and without a dry spell within 2 to 3 weeks.	Omotosho et.al (2000)

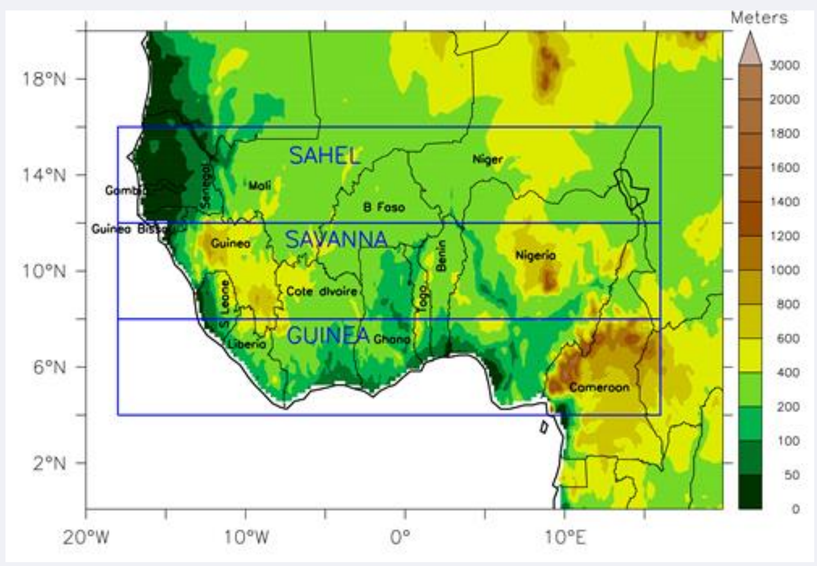

Figure. 1 West African domain showing the topography (meters) and regions designated as Guinea, Savanna and Sahel zones.

3. Results

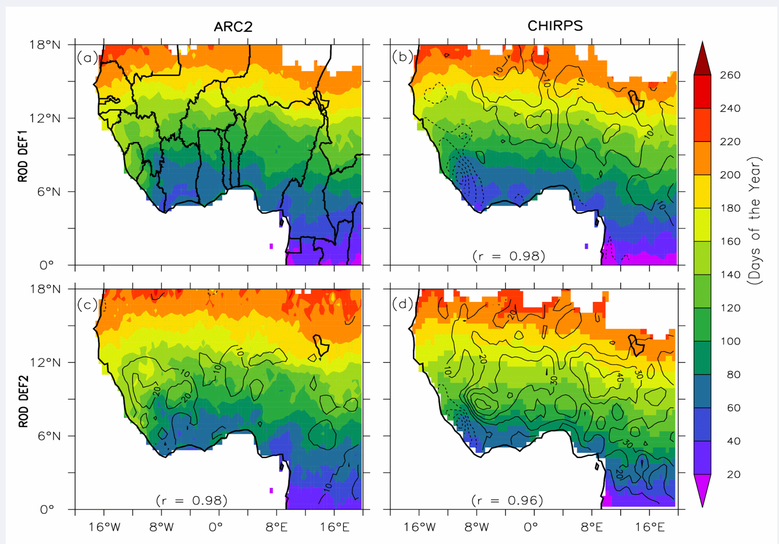

Figure. 2 The spatial variation of RODs over West Africa as depicted by two observation datasets (ARC2 and CHIRPS) using ROD definition (DEF1 and DEF2). The correlation between panel (a) and the other panels are in brackets. The results of panel (a) subtracted from the other panels are shown as contours.

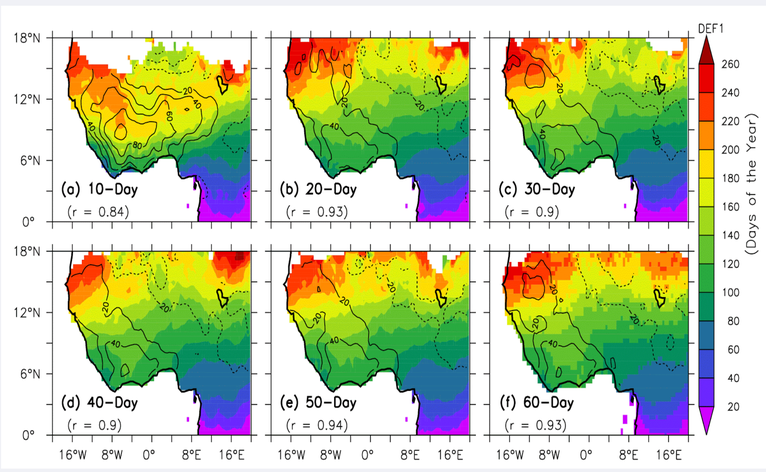

Figure. 3 The spatial distribution of ROD over West as predicted by CMA in different lead forecast days (10 - 60 days) using DEF1. The contour shows the forecast bias (with reference to mean of ARC2 and CHIRPS); the correlation between each forecast and the observed mean is indicated in the bracket.

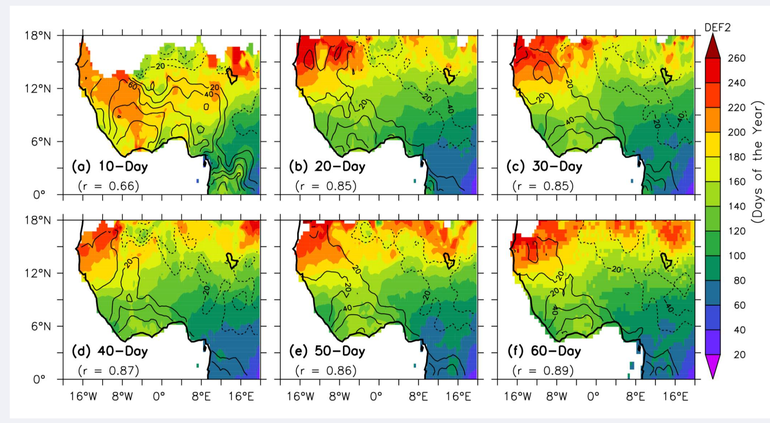

Figure. 4 Same as Figure 3, except for DEF2.

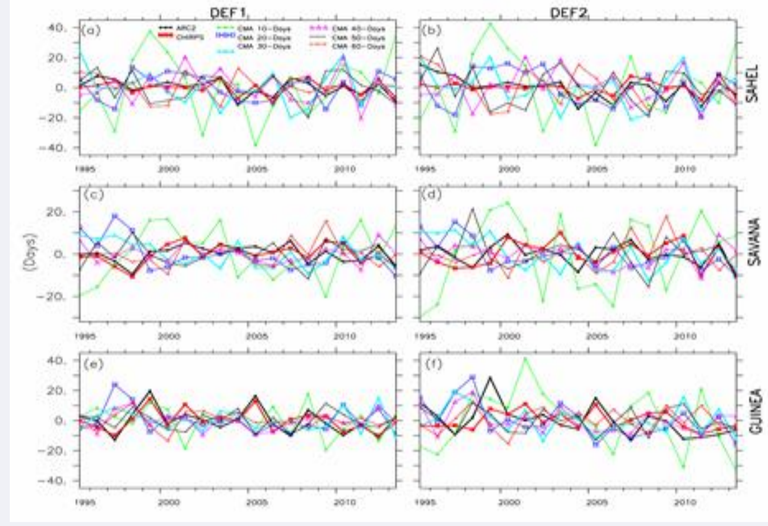

Figure. 5 The inter-annual variability of ROD over the climatic zones (Guinea, Savanna, and Sahel) as simulated (CMA 10 - 60 days forecasts) and observed (CHIRPS and ARC2) using the two definitions (DEF1 and DEF2).

3. Results (cont'd)

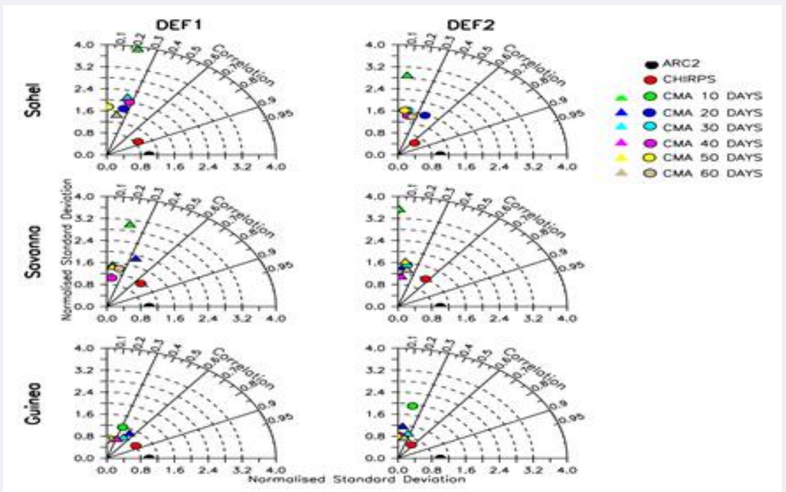

Figure. 6 Taylor diagram of RODs showing the correlation between observation and CMA forecast and the corresponding normalized standardize deviation.

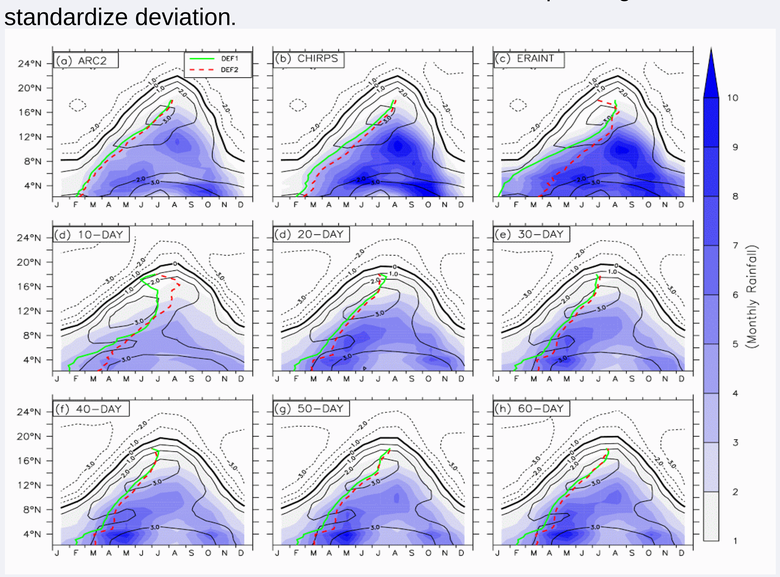

Figure. 7 Time–latitude cross-section of monthly rainfall (millimeters per day; shaded) and RODs (green thick and red dashed lines) averaged over 15° W–15° E for observations, reanalysis (ERA_INT) and CMA model prediction (10-60 days). The contours represent the corresponding surface meridional winds and ITD (thick continuous lines).

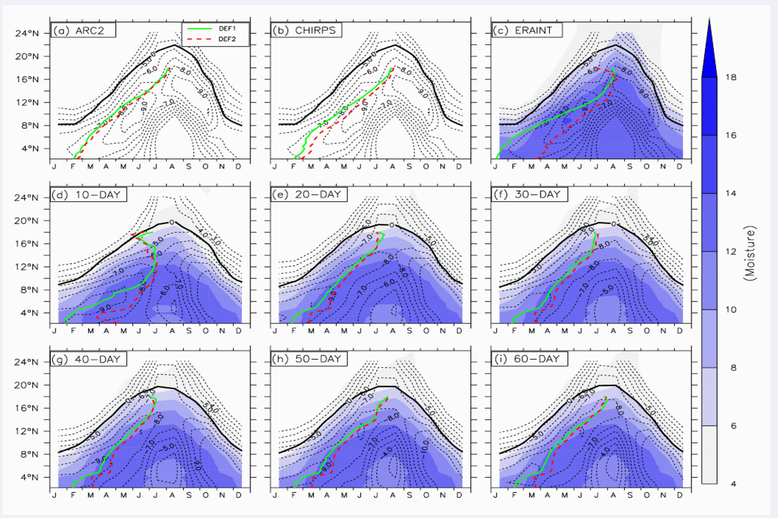

Figure. 8 Same as Figure 7, except for specific humidity at 850hpa (kg/kg; shaded). The contours represent the corresponding 700hpa zonal winds (the African Easterly Jet; AEJ), and ITD (thick continuous lines).

5. Conclusions

➢ The two observation datasets produce similar ROD patterns over West Africa regardless of ROD definition used.

➢The CMA model gives a realistic simulation of the spatial pattern of ROD over West Africa and reproduces all the essential features in the observed pattern.

➢The model performs well in simulating the observed inter-annual variability pattern of RODs over the zones..

➢The model result reproduces the observed rainfall characteristics of the West African Monsoon (WAM) and RODs.

Acknowledgment

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References

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➢Stern R D, DennettMD and Garbutt D J 1981 The start of the rains in West Africa Int. J. Climatol. 1 59–68.

Evaluation of the CMA Subseasonal to Seasonal (S2S) Data