EVALUATING NMME AND NASA'S GEOS-5 S2S VERSIONS FOR DROUGHT FORECASTING IN AFRICA

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BACKGROUND

There is increasing interest in prediction of extreme weather and climate events, especially in developing early warning systems to improve food and water security preparedness, as well as to gain a better understanding of the impacts of the changing climate. Extreme weather and climate events pose a serious threat to the health and welfare of people, more so in developing parts of the world where there is a lack of in situ measurements, which can contribute to poorer skill in some forecast systems. Our study focuses on the continental Africa region as it faces some of the most devastating and wide-spread droughts.

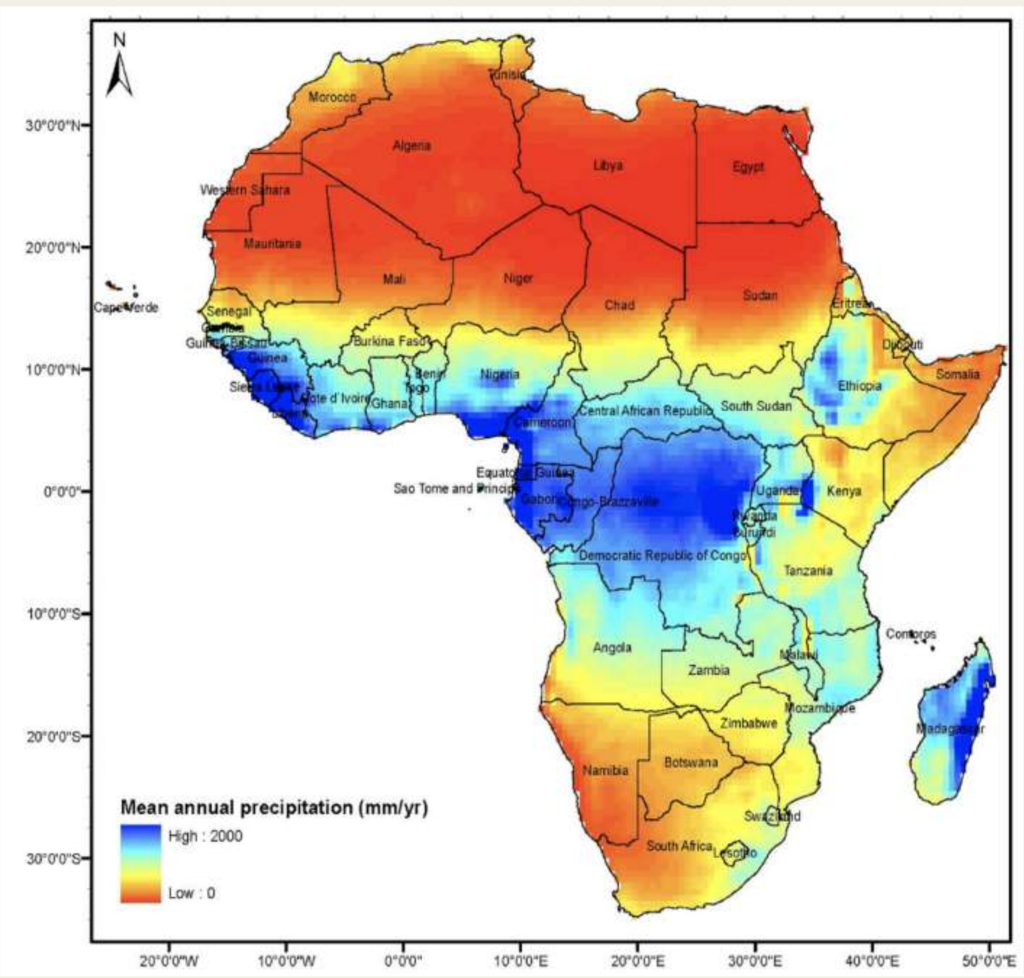


Figure 1. Mean annual precipitation over Africa from 1982-2010 (figure from Masih et al., 2014).

OBJECTIVE

To better understand the skill in seasonal drought prediction, we evaluate seasonal to sub-seasonal (S2S) forecast datasets, which are used by our end-user partner, the U.S. Agency for International Development's (USAID) Famine Early Warning Systems Network (FEWS NET). This study focuses on assessing and identifying areas where there may be more skill in the sub-seasonal and seasonal forecasts for drought over continental Africa. We compare the skill of the North American Multi-Model Ensemble (NMME) and two versions of NASA's Goddard Earth Observing System Model, version 5 (GEOS-5) S2S-1 and S2S-2, in terms of meteorological drought.

DATA

- **NMME** (average of CFSv2, GEOS5 S2S-1, GFDL CM2.2, CCSM3, CanCM3 and CanCM4), GEOS5 S2S-1 **(GEOS5v1)** and S2S-2 **(GEOS5v2)** are used as the monthly precipitation forecast data up to 6 months lead [2, 3].
- The Global Precipitation Climatology Centre (**GPCC**) and the USGS/UCSB Climate Hazards Group InfraRed Precipitation with Station (**CHIRPS**) are used as the monthly precipitation reference datasets [1].
- The data-sets are analyzed for the period of 1982-2010 over Africa.

METHODOLOGY

- **Standardized Precipitation Index** at 3 months (**SPI3**) and 6 months (**SPI6**) are applied to each dataset [3].
- The **drought** conditions, **skill** and categorical skills – **Equitable Threat Score**, **Hit Rate**, **False Alarm** and **Critical Success Index -** are evaluated and compared for all the forecast datasets with respect to reference data.

RESULTS

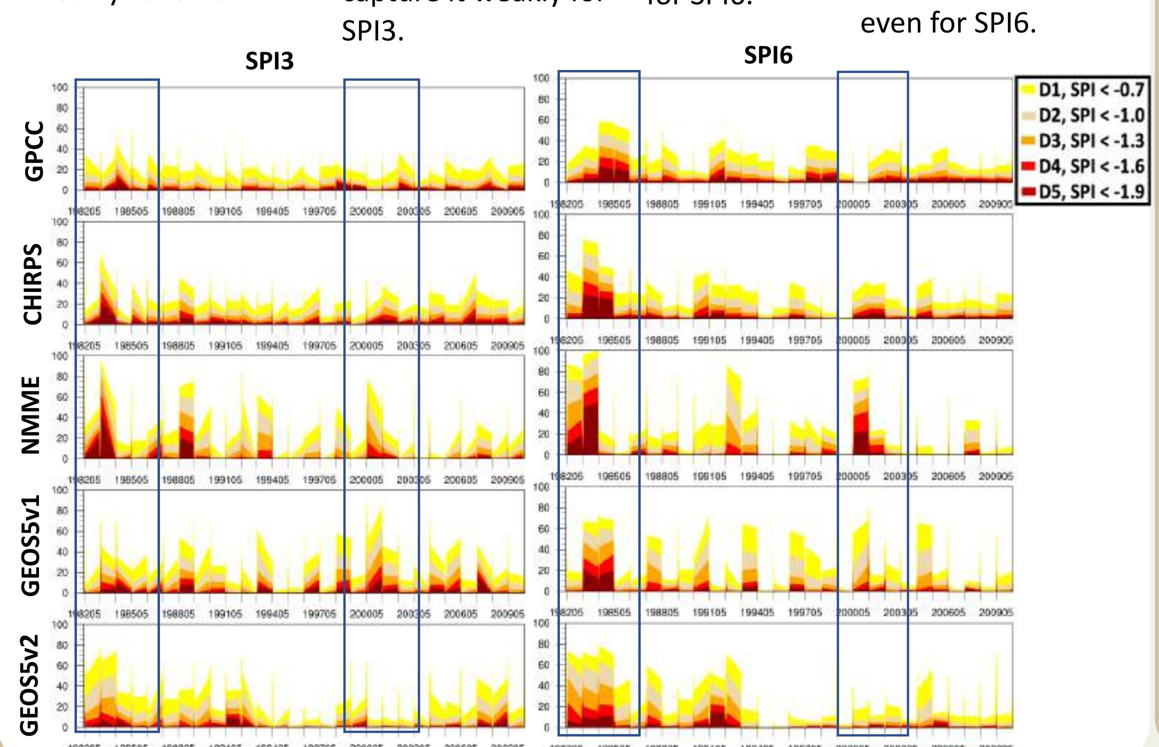
Meteorological Drought over Western Africa

1982-84 drought is captured by CHIRPS, NMME, GEOS5v1 and v2, GPCC captures it weakly for SPI3.

2000-2001 drought captured by CHIRPS, NMME and GEOS5v1; GPCC and GEOS5v2 capture it weakly for SPI3.

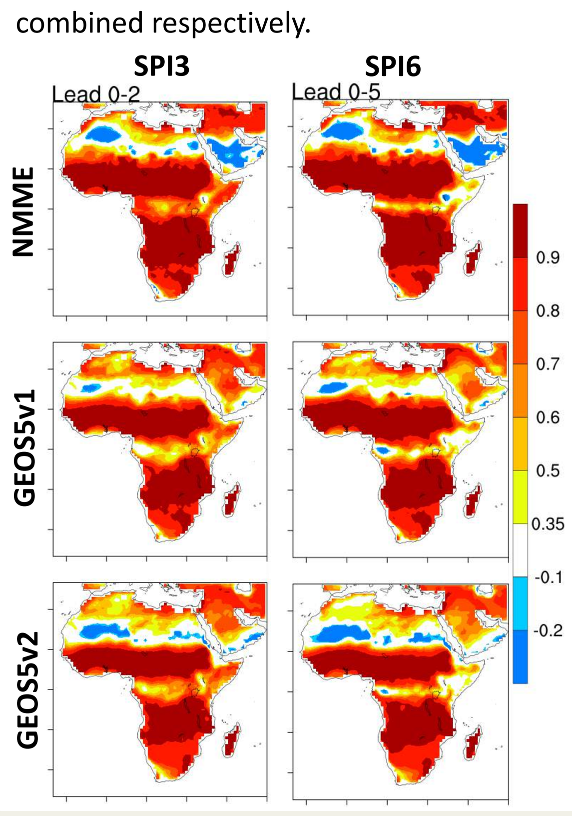
1982-84 drought captured well by all datasets for SPI6.

2000-2001 drought captured by CHIRPS, NMME and GEOS5v1; GPCC and GEOS5v2 capture it weakly even for SPI6.



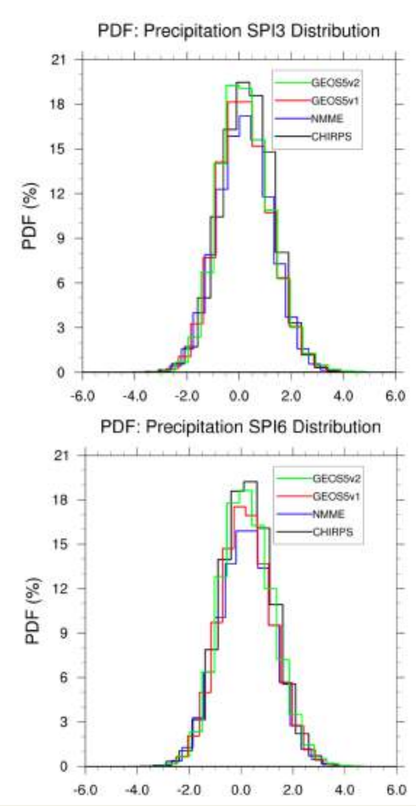
Skill with CHIRPS

As GPCC misses several drought events, CHIRPS is considered as reference, and we kind very high correlation when the SPI3 and SPI6 leads 0-2 and 0-5 are combined respectively.



Probability Distribution

The PDF shows that CHIRPS, NMME, GEOS5 v1 and v2 have very similar distribution amplitude and spread for both SPIs.



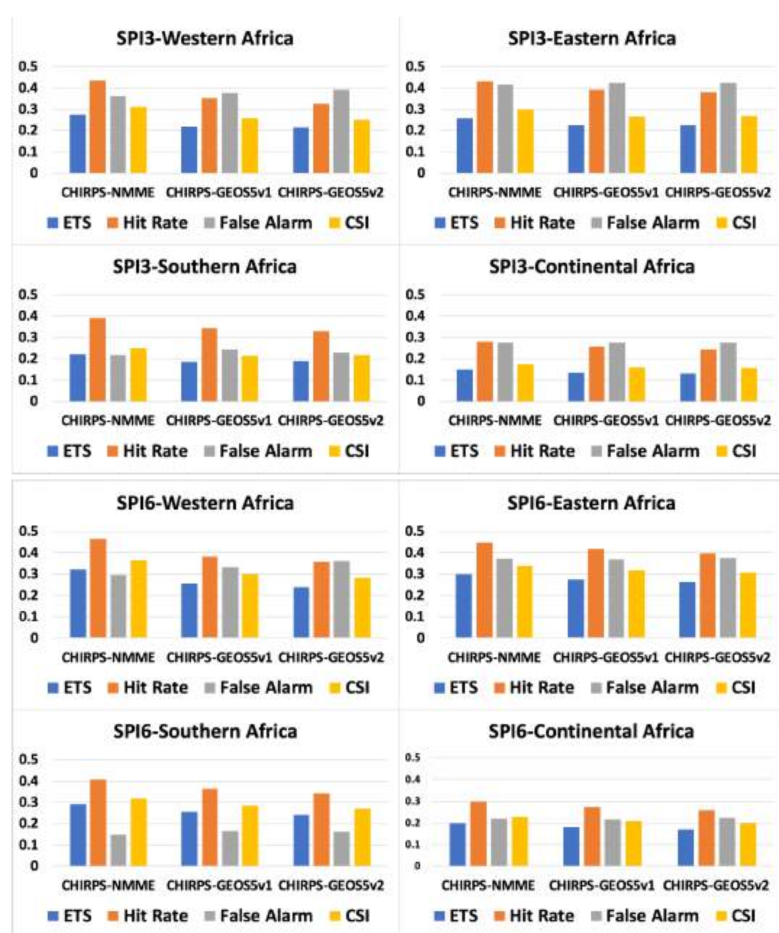
Categorical Skill Scores of the SPIs for African Sub-Domains

From the PDFs, we consider SPI values equal to or less than -1.2 SPI as a threshold for drought condition, as it forms the upper bound of the lowest tercile.

SPI6 shows marginally and sometimes significantly better skill scores than SPI3 over all sub-domains of Africa.

NMME consistently does better with the skill scores and SPI values over all African sub-domains relative to the GEOS5 versions.

GEOS5v1 does better than GEOS5v2 for all African sub-domains and both the SPIs.



CONCLUSION

- Difficult to identify droughts using SPI metric on GPCC data over different regions on several occasions.
- NMME, GOES-5 S2S-1 and S2S-2 are found to have significantly good skill with CHIRPS in decreasing order over all domains of Africa, and SPI6 shows better skill scores than SPI3.
- The categorical skill scores show that we can forecast drought with significant confidence over Southern and Western Africa, with higher Hit Rate and CSI than False Alarm and ETS.

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https://lis.gsfc.nasa.gov/projects/fame

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