Toward Earlier Drought Detection Using Remotely Sensed Precipitation Data and Application to the Carolinas

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Introduction

This study evaluates the feasibility of using satellite precipitation data from the Climate Data Record (CDR) program (CMORPH-CDR) to detect and monitor drought on a global scale. Monthly and daily (running mean) Standardized Precipitation Indexes (SPI) were computed over various time scales (from 1- to 24-month, respectively, from 30- to 720-day). Preliminary results indicated that both monthly and daily SPIs presented the same timing and area for the major drought episodes over the continental United States as well as for selected drought events around the globe. The SPI is evaluated primarily over CONUS where long-term drought monitoring based on in situ data exists. Here, we focus on the Carolinas for which we provide an evaluation of the CMORPH-CDR SPI using drought monitoring products from the U.S. Drought Monitor (USDM).

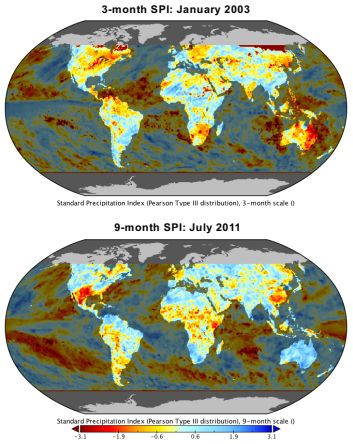

Fig. 1. 3-month SPI for January 2003 and 9-month SPI for July 2011 using CMORPH-CDR.

Reference

Prat, O.P., R.D. Leeper, J.E. Bell, B.R. Nelson, J. Adams, and S. Ansari, 2018. Toward earlier drought detection using remotely sensed precipitation data from the Reference Environmental Data Record (REDR) CMORPH. *2018 EGU General Assembly*, April 8-13, 2018, Vienna, Austria. Contact: opprat@ncsu.edu

CONUS: 9-month SPI and USDM

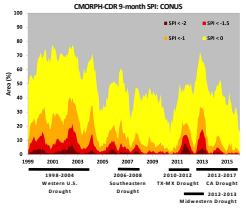

Fig 2. 9-month SPI computed over CONUS for 1999-2016. The figure represents the percentage of land area experiencing mild (SPI < 0), moderate (SPI < -1), severe (SPI < -1.5), and extreme (SPI < -2) drought conditions. The major drought episodes are reported on the figures.

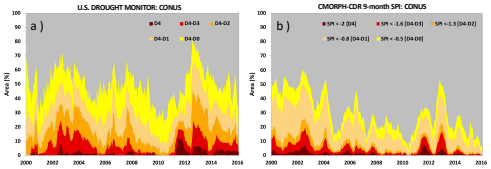

Fig. 3. USDM (Fig. 3a) and CMORPH-CDR SPI (Fig. 3b) binned according to the USDM equivalent drought classification (Table 1).

Category	Description	PDSI index	SPI index
D0	Abnormally Dry	-1.0 ≤ PDSI ≤ -1.9	-0.5 ≤ SPI ≤ -0.7
D1	Moderate Drought	-2.0 ≤ PDSI ≤ -2.9	-0.8 ≤ SPI ≤ -1.2
D2	Severe Drought	-3.0 ≤ PDSI ≤ -3.9	-1.3 ≤ SPI ≤ -1.5
D3	Extreme Drought	-4.0 ≤ PDSI ≤ -4.9	-1.6 ≤ SPI ≤ -1.9
D4	Exceptional Drought	SPI ≤ -5.0	SPI ≤ -2.0

Table 1. Drought severity classification according to the USDM and equivalency with the Standardized Precipitation Index.

Local SPI

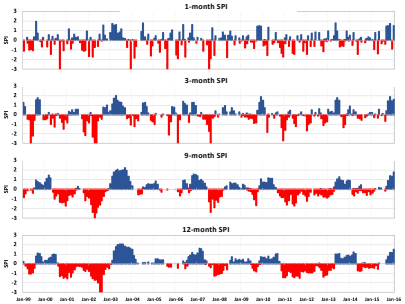

Fig. 4. Monthly CMORPH-CDR SPI for Raleigh-Durham (NC) for 1-, 3-, 9-, and 12-month time scales.

Application to the Carolinas

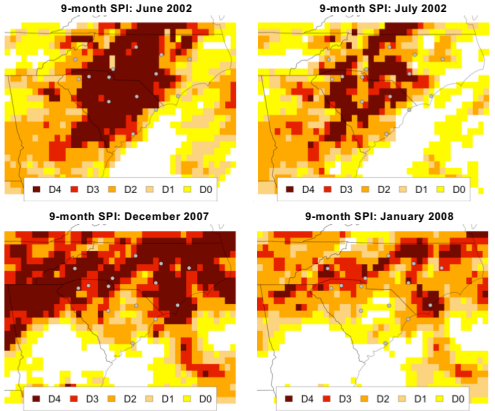

Fig. 5. 9-month SPI for June and July 2002 and December 2007 and January 2008 using CMORPH-CDR.

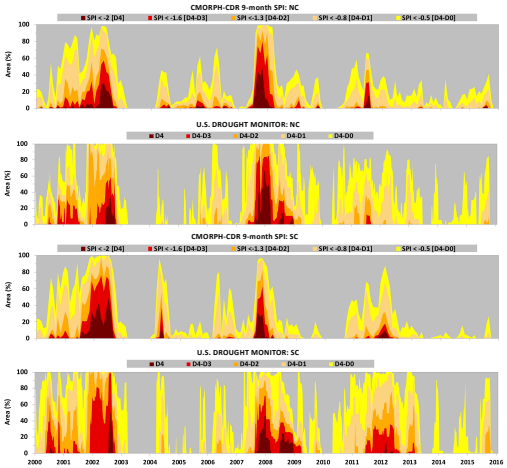

Fig. 6. CMORPH-CDR SPI comparison with USDM for North Carolina (NC) and South Carolina (SC). The CMORPH-CDR SPI is binned according to the USDM equivalent classification (Table 1).

Conclusions and Future Work

The CMORPH-CDR SPI presented similar results when compared to the USDM over CONUS and the Carolinas. Further validation is needed as results may differ in term of magnitude and severity when compared to SPI or other drought indices derived from in situ data. Next, we plan to:

- Evaluate Monthly and Daily SPI against in situ data (USDM, NCEI nClimGrid, WWDT, GPCC-DI).
- Use other satellite precipitation datasets such as IMERG (improved spatial resolution from 0.25° to 0.1°) and PERSIANN-CDR (extended period of record from 20-yr to 35-yr).
- Use routinely updated SPI and NDVI products as a complement to in situ derived drought indices (SPI, SPEI, PDSI). This effort looks forward to developing a hybridized approach for drought detection by incorporating both near-real time precipitation and near-real time vegetation remotely sensed information.

Monitoring of Global Drought Conditions

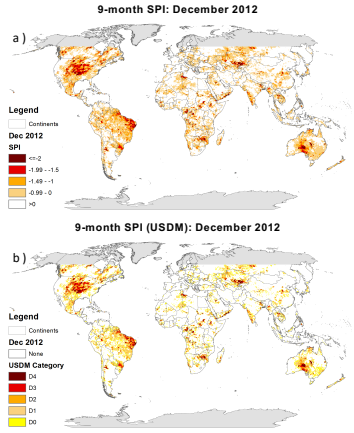

Fig. 7. Global meteorological drought conditions derived from CMORPH-CDR for December 2012. Fig. 7a: 9-month SPI and corresponding drought categories; Fig. 7b: 9-month SPI values binned according to the USDM equivalent classification (Table 1).

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