CISESS
Cooperative Institute for
Satellite Earth System Studies

Operational Framework for Near-real Time Drought Monitoring Using Global Remotely Sensed Precipitation Products and In-situ Datasets

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NC STATE UNIVERSITY
NCICS North Carolina Institute for Climate Studies
NOAA
National Integrated Drought Information System
NIDIS
Drought.gov U.S. Drought Portal

Outline

- ❑ Objectives
- ❑ Precipitation Datasets (NClimGrid, CMORPH-CDR)
- ❑ Methodology
- ❑ Results
- ❑ Global Drought Information System (GDIS) Dashboard

- ❑ ***Objectives:***

➢ **Compute a daily global Standardized Precipitation Index (SPI) in near-real time based on high-resolution in-situ and satellite precipitation products (NClimGrid, CMORPH, IMERG, …).**

➢ **Provide near-real time drought monitoring resources via a publicly accessible Global Drought Information System (GDIS) dashboard.**

Precipitation Datasets

CMORPH-CDR

- Gridded satellite precipitation dataset (NOAA/CPC)
- Inputs are Passive Microwave (PMW) and IR measurements (and in-situ)
- Daily from 1998 to present
- Global at 0.25-deg spatial resolution
- 1-day lag-time for interim version
- Final CDR version available 4-month to the date

NClimGrid

- Gridded in-situ precipitation dataset (NOAA/NCEI)
- Input is the Global Historical Climatology Network (GHCN-Daily)
- Daily from 1950 to present
- CONUS at 5-km spatial resolution
- 3-day lag-time for preliminary version
- Final version available one-month to the date

Methodology

- Compute daily SPI indices at the 30-, 90-, 180-, 270-, 365-, and 730-day scale.

- The SPI algorithm uses an L-moment approach with Pearson III and Gamma fits (Guttman 1998, McKee et al. 1993).

- Daily SPI indices are computed over CONUS (NClimGrid) and globally (CMORPH)

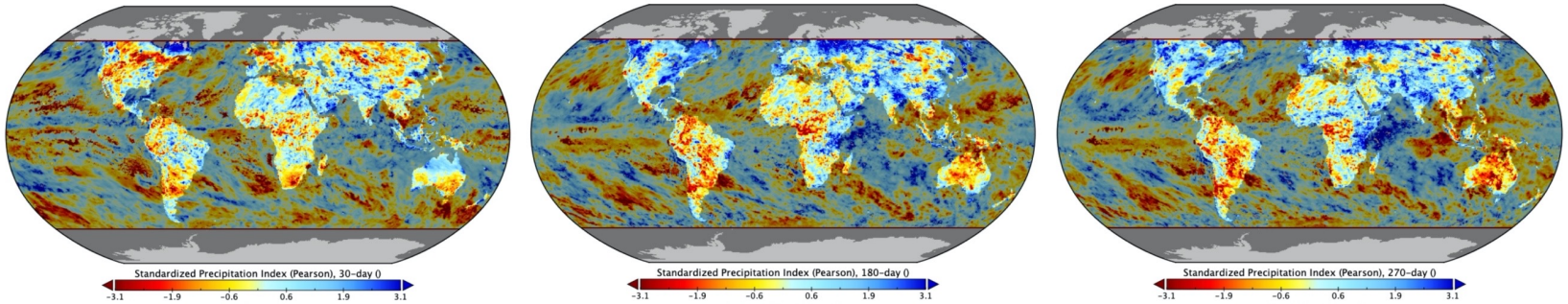
- Droughts are characterized from Mild ($0 \geq SPI \geq -0.99$) to Extreme ($SPI \leq -2$).

SPI index values	Drought category
$SPI \geq 2$	Extreme Wet
$1.5 \leq SPI \leq 1.99$	Severe Wet
$1 \leq SPI \leq 1.49$	Moderate Wet
$0 \leq SPI \leq 0.99$	Mild Wet
$0 \geq SPI \geq -0.99$	Mild Drought
$-1 \geq SPI \geq -1.49$	Moderate Drought
$-1.5 \geq SPI \geq -1.99$	Severe Drought
$SPI \leq -2$	Extreme Drought

Daily CMORPH-SPI

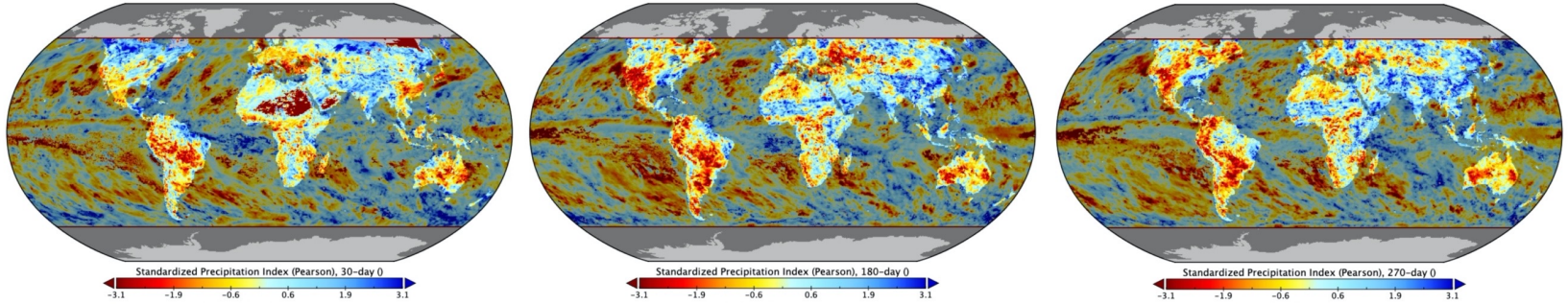
Global SPI on June 1st 2020

(30-, 180-, 270-day SPI)



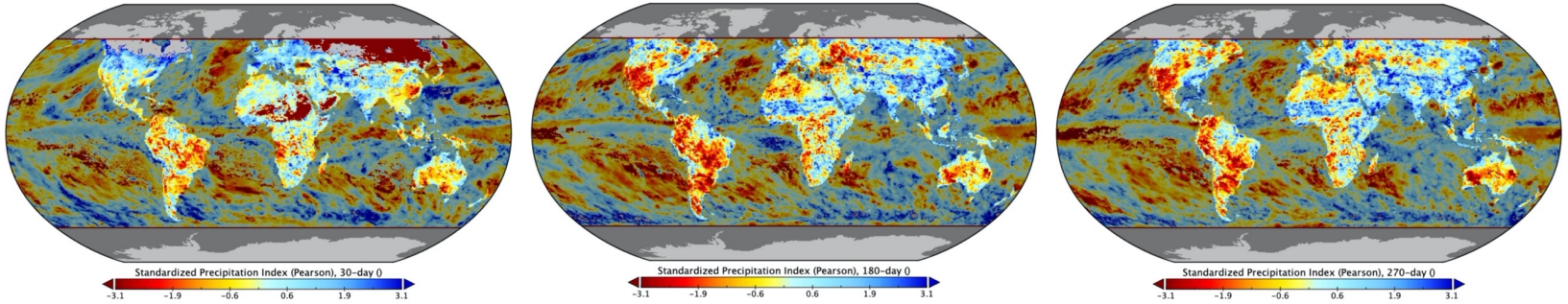
Global SPI on December 1st 2020

(30-, 180-, 270-day SPI)



Global SPI on January 1st 2021

(30-, 180-, 270-day SPI)



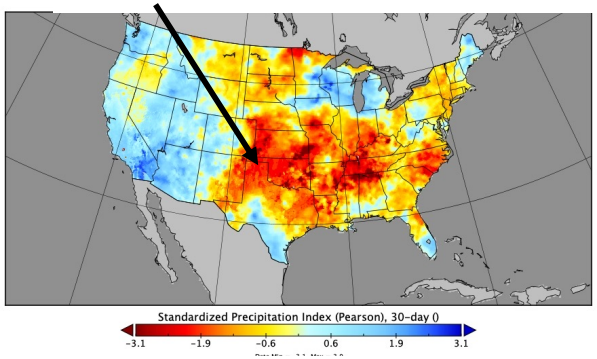
Daily NClimGrid-SPI

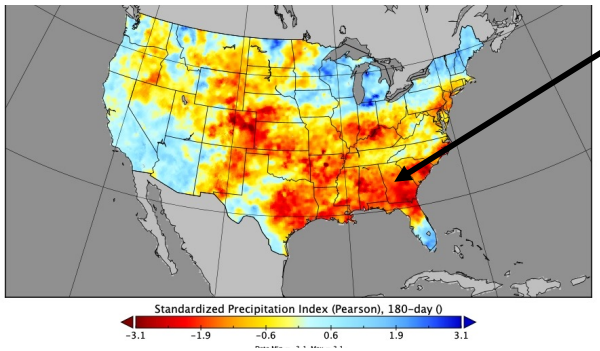
CONUS SPI on July 15th 1954

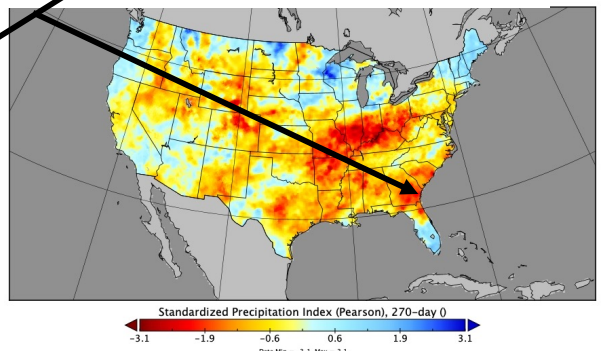
(30-, 180-, 270-day SPI)

1. 1950s Texas drought (1949-1957)

2. By 1954, the drought extended to other states in the South





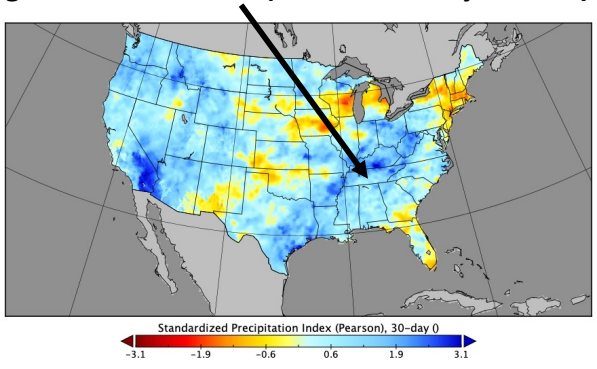


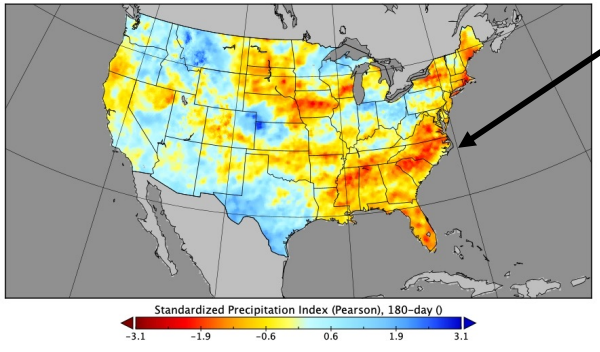
CONUS SPI on June 15th 1981

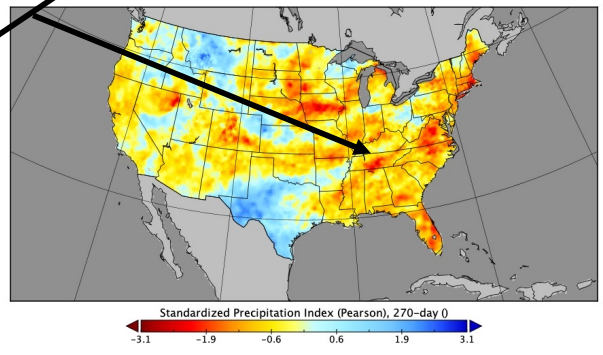
(30-, 180-, 270-day SPI)

4. Heavy rain in early June 1981 over most of drought stricken areas (Karl and Quayle 1981)

3. Long term drought conditions due to 1980 heatwave and rainfall deficit





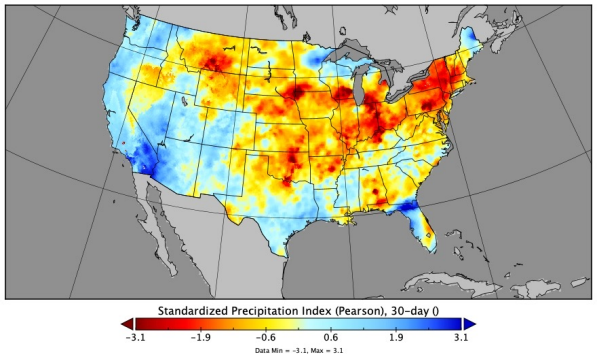


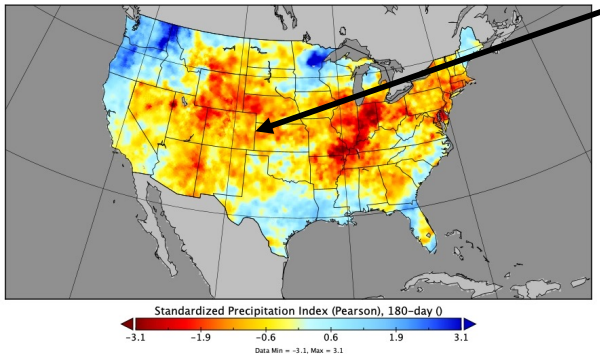
CONUS SPI on July 15th 2012

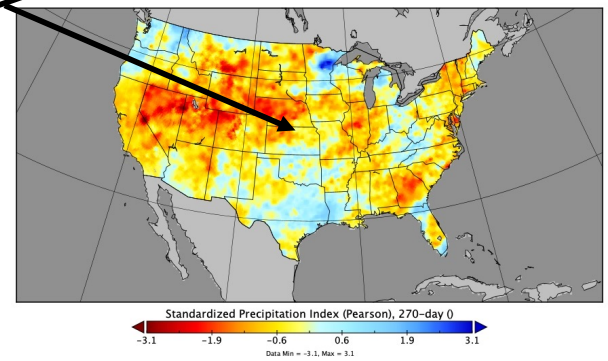
(30-, 180-, 270-day SPI)

5. 2012-2013 North American drought

6. At its peak In July 2012, the drought covered about 81% of CONUS

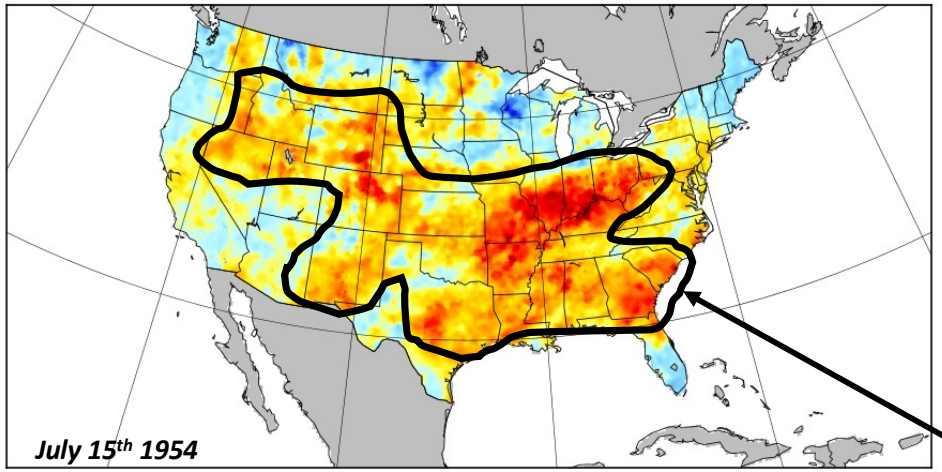




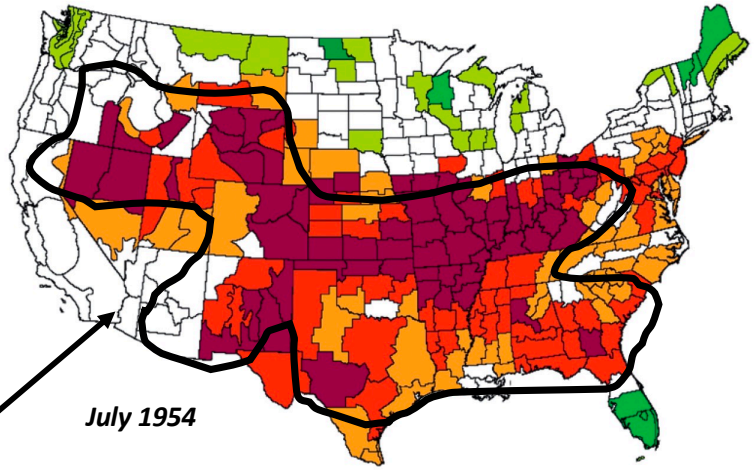


Daily SPI: CMORPH & NClimGrid

270-day SPI (NClimGrid)

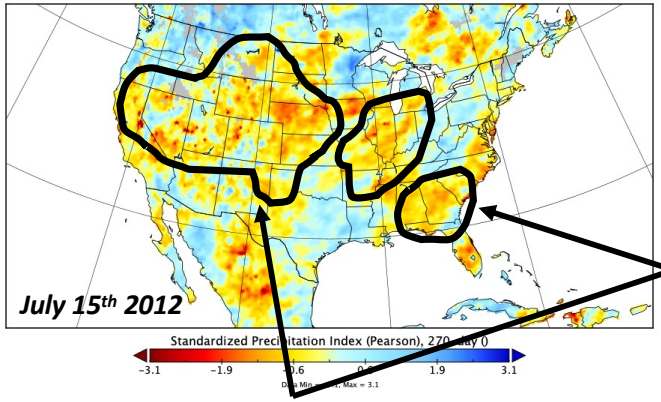


PDSI*

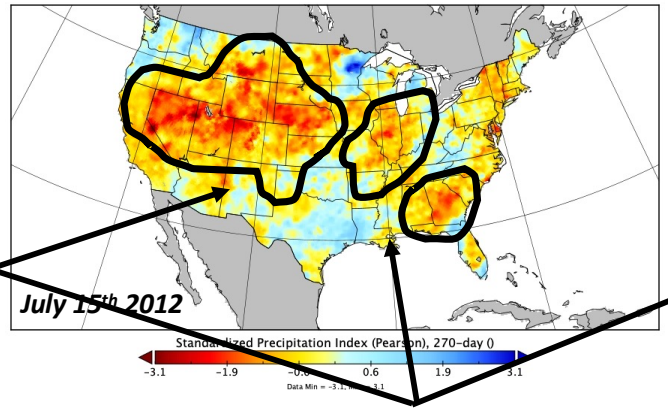


Similar patterns between NClimGrid daily SPI and Monthly PDSI

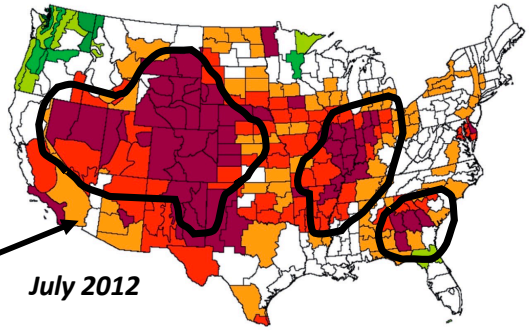
270-day SPI (CMORPH)



270-day SPI (NClimGrid)



PDSI*

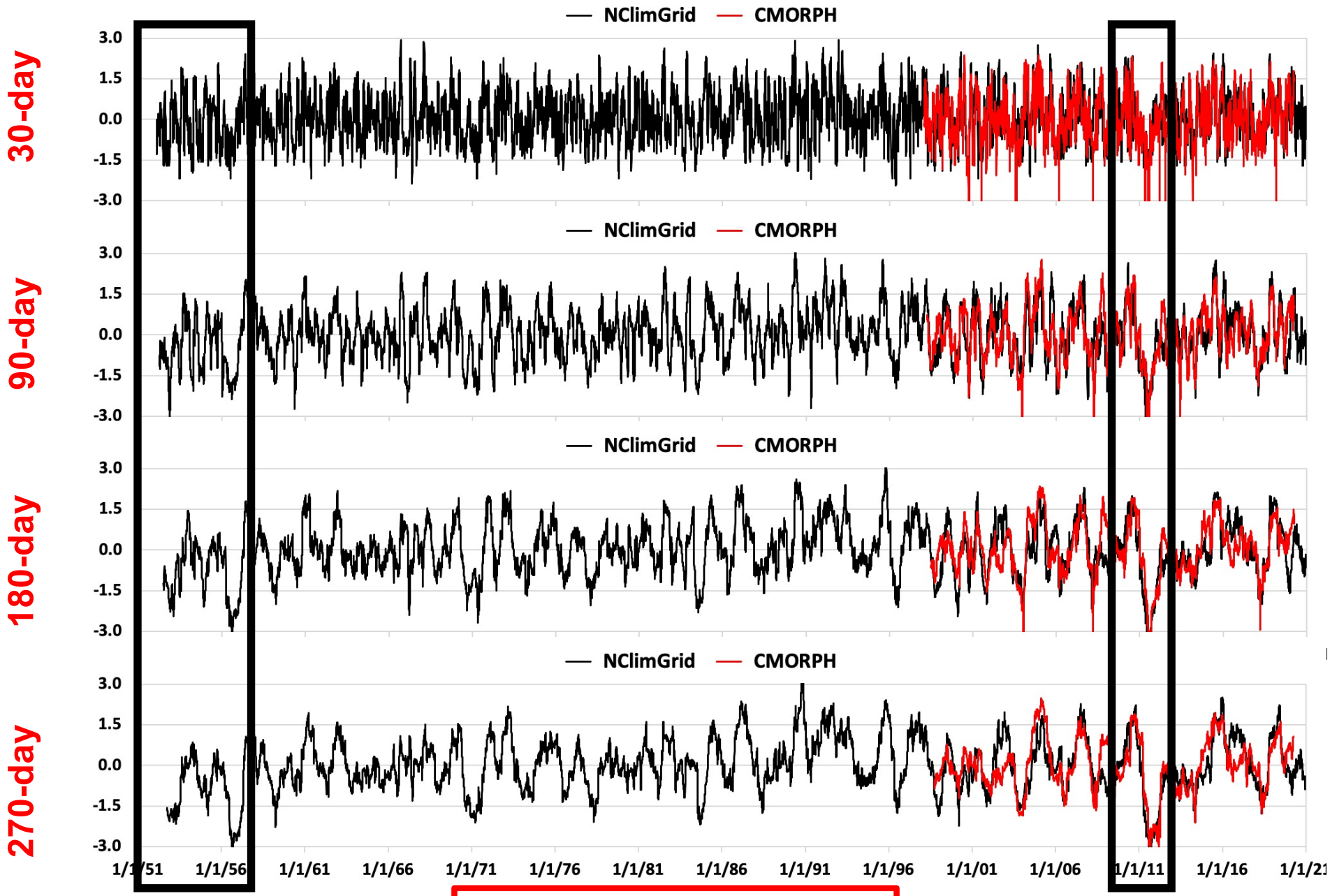


Differences in magnitude between NClimGrid and CMORPH daily SPIs

Similar patterns between NClimGrid and CMORPH daily SPIs and Monthly PDSI

Palmer Drought Severity Index (PDSI) maps (Heim 2017)

CMORPH & NClimGrid SPI: Time Scale



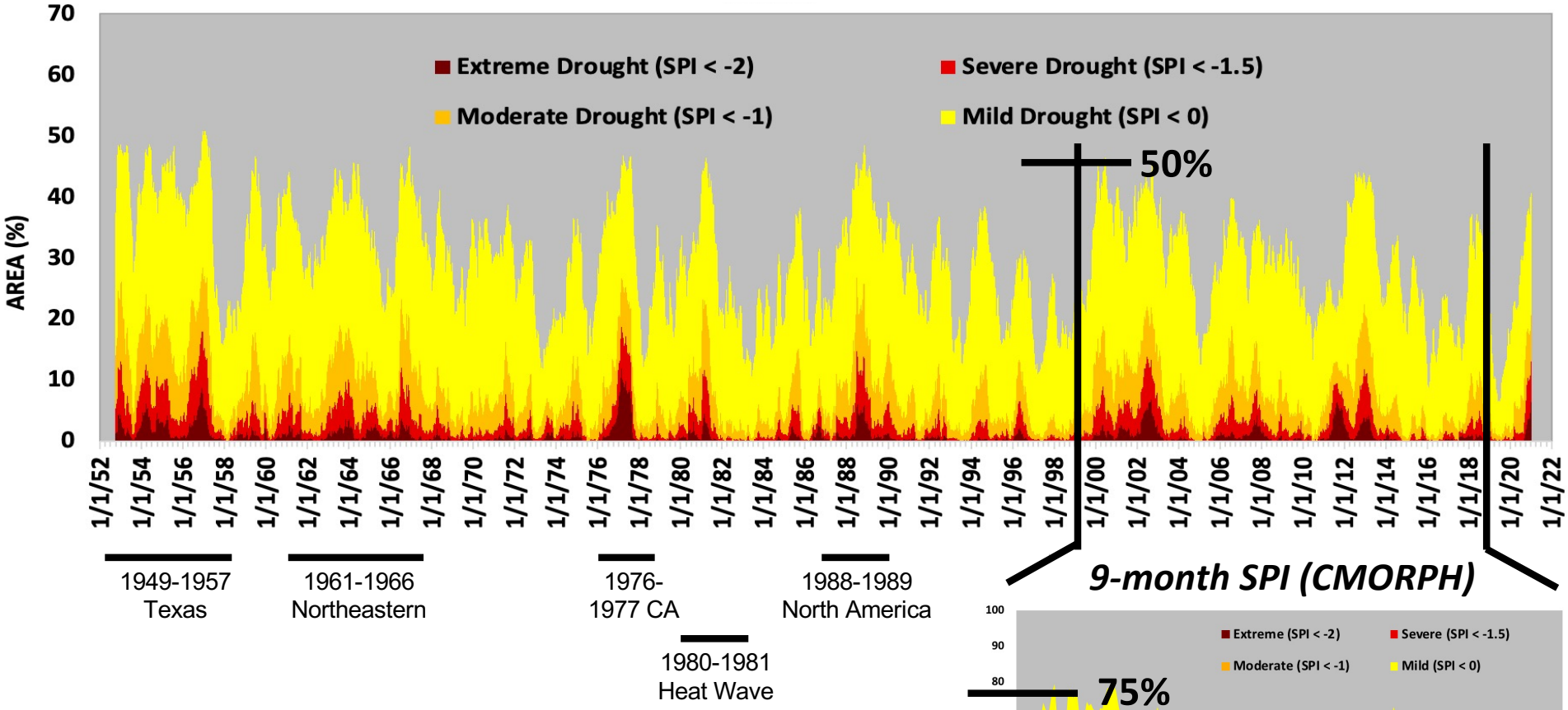
1950s Texas Drought

Lubbock (TX)

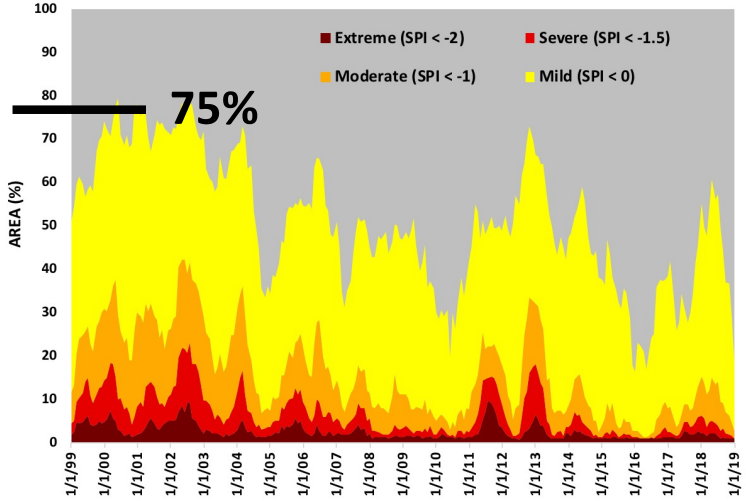
2010-2012 Texas-Mexican Drought

Fraction of CONUS in Drought

270-day SPI (NClimGrid)



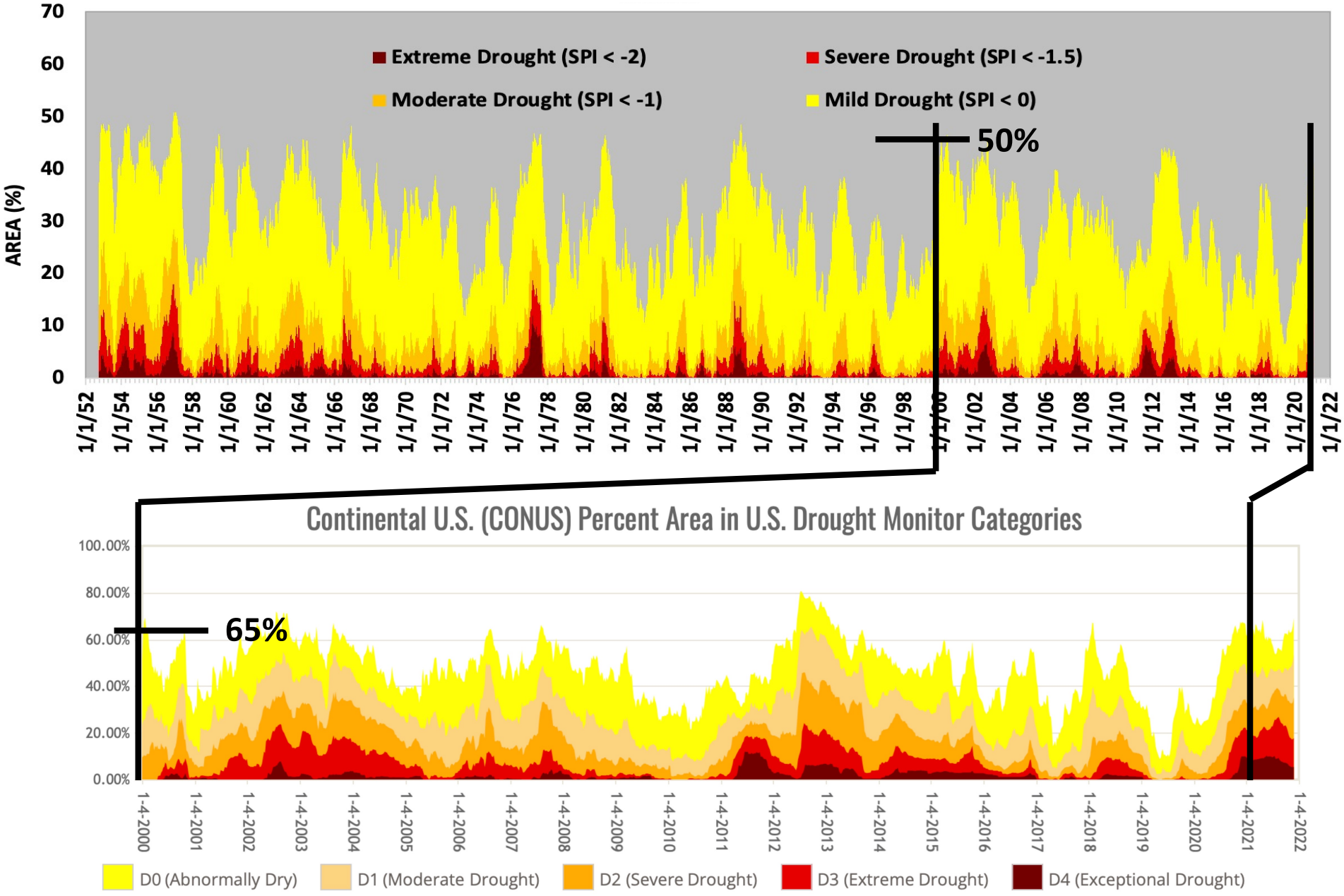
9-month SPI (CMORPH)



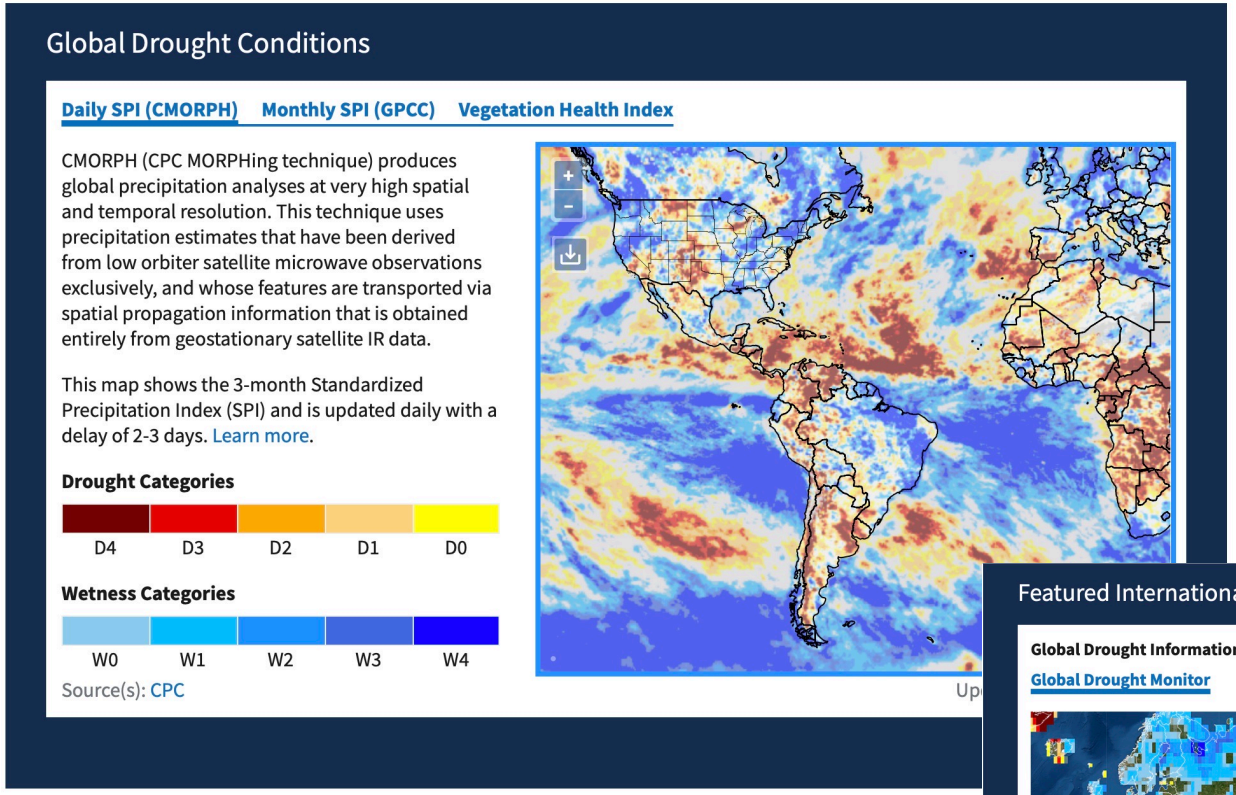
Similar time series between NClimGrid and CMORPH with significant differences in terms of percentage of CONUS under drought conditions

Fraction of CONUS in Drought

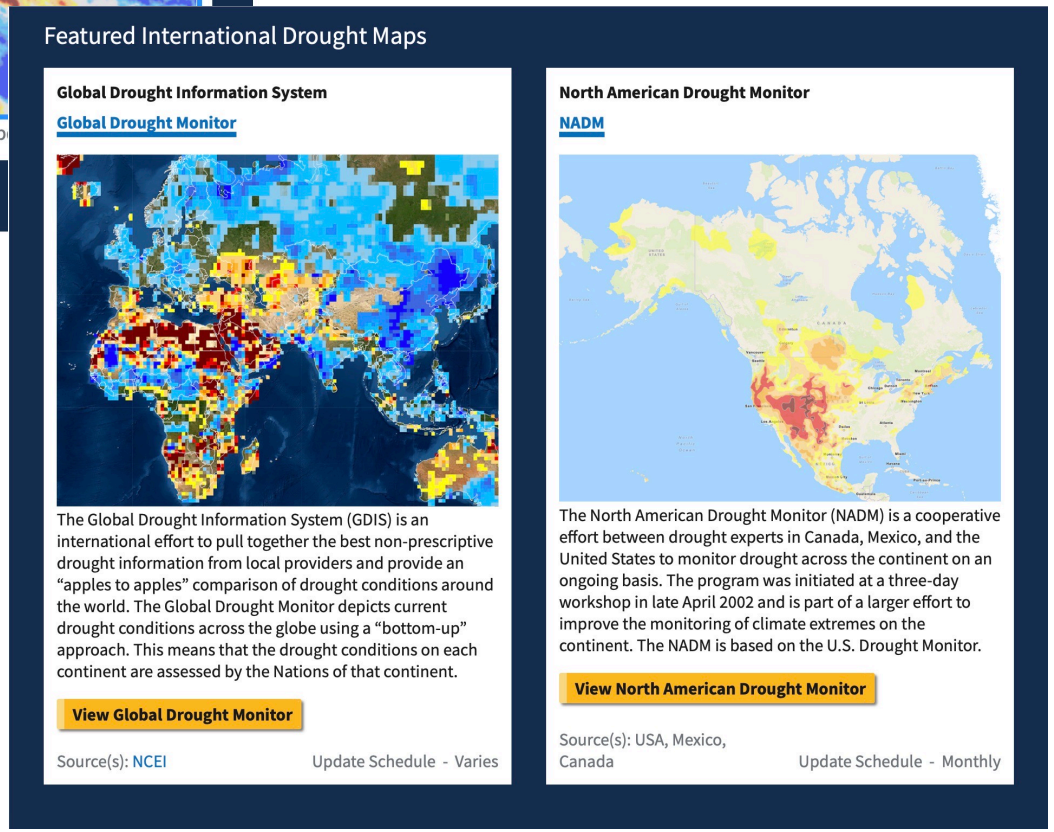
270-day SPI (NClimGrid)



Global Drought Information System (GDIS) dashboard

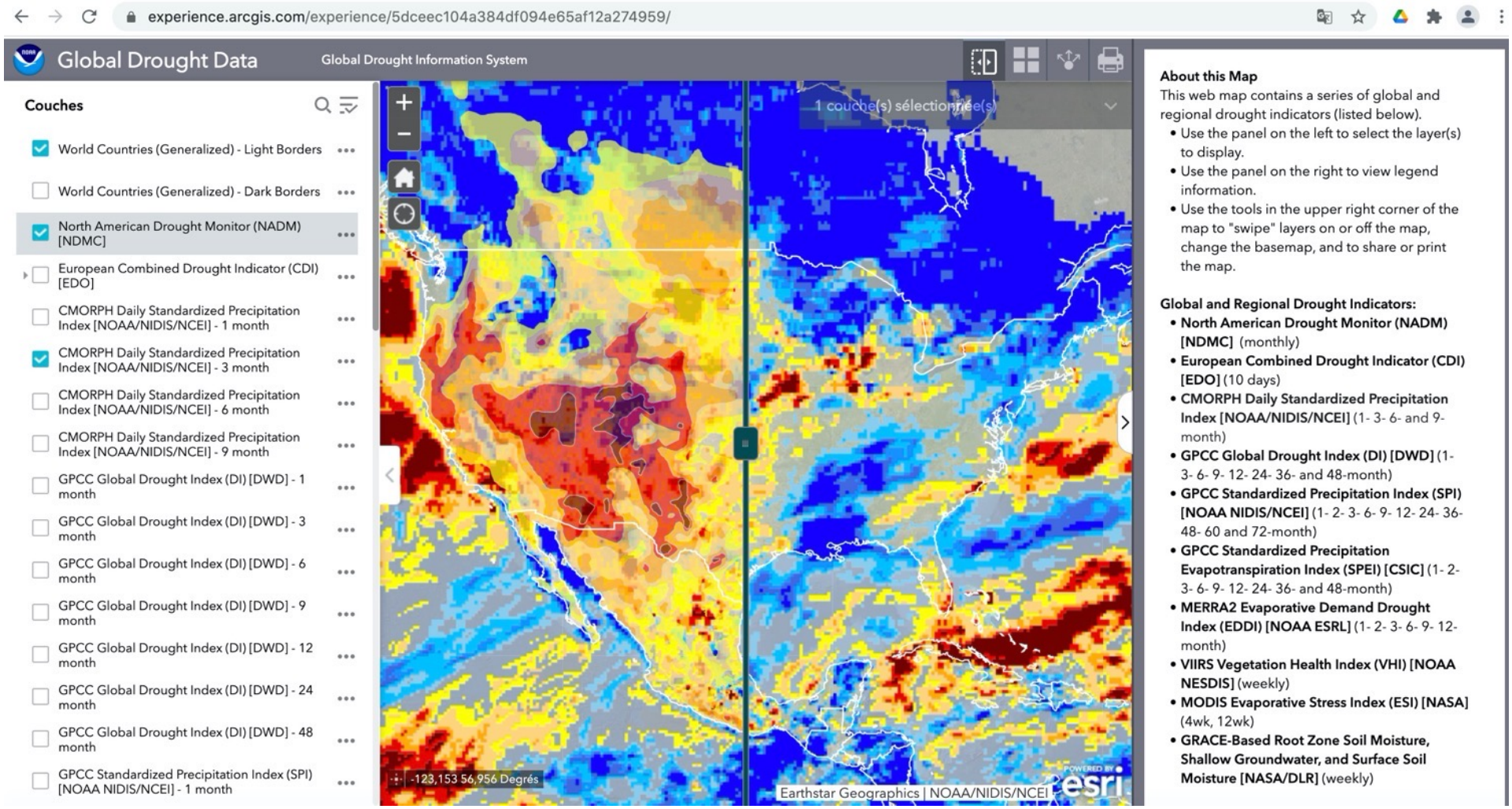


CMORPH-SPI is available in the GDIS dashboard to display global drought conditions. The 3-month Standardized Precipitation Index (SPI) and is updated daily with a delay of 2-3 days: https://www.drought.gov/international



The Global Drought Monitor (GDM) depicts current drought conditions across the globe where drought conditions on each continent are assessed by the Nations of that continent. The North American Drought Monitor (NADM) is a cooperative effort between Canada, Mexico, and the USA. It is based on the U.S. Drought Monitor.

Global Drought Information System (GDIS) dashboard



Global Drought Information System dashboard displaying the North American Drought Monitor (top layer on the left) and the 90-day CMORPH-SPI (right). Data are publicly available at: https://gdis-noaa.hub.arcgis.com/pages/drought-monitoring.

Conclusions

- **Daily global SPI based on CMORPH is generated in near-real time and is available on the GDIS dashboard: *https://www.drought.gov/international.***
- **Daily CONUS SPI based on NClimGrid has been developed and is currently being evaluated against monitoring tools and CMORPH-SPI.**
- **The NClimGrid based SPI provides 70-year of daily drought conditions.**
- **Both CMORPH and NClimGrid SPIs display similar drought patterns and time series (SPI, percent area in drought). Both identify historical droughts events.**
- **A good qualitative agreement is found for satellite (CMORPH) and in-situ (NClimGrid) derived drought conditions with existing monitoring tools (USDM) and other drought indices (PDSI).**
- **We are currently working on extending the current framework to other datasets (IMERG) to provide a higher resolution (0.1deg) global SPI.**