The SPEIbase: A new gridded product for the analysis of drought variability and drought impacts

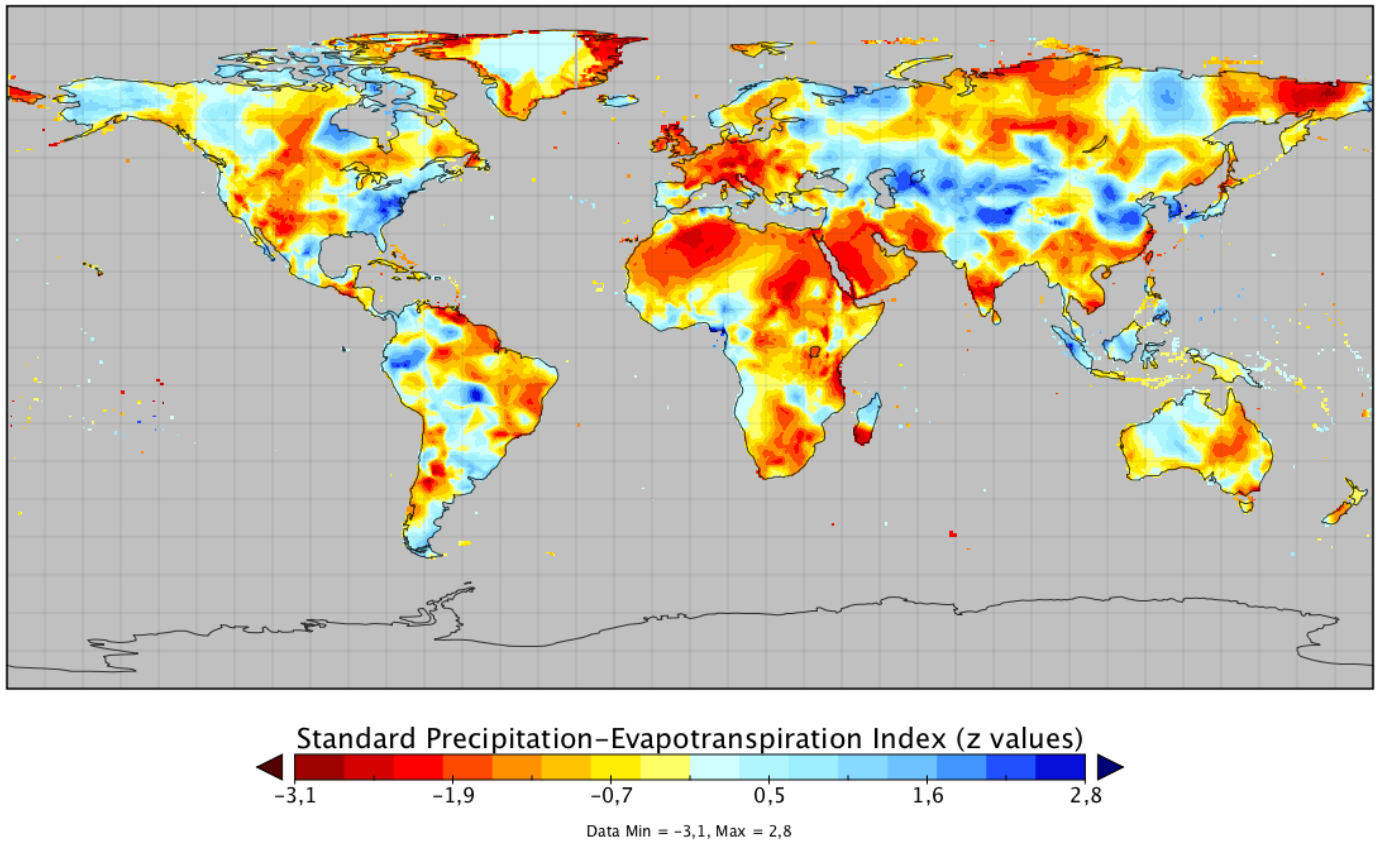
Santiago Beguería, Sergio Vicente-Serrano, Juan Ignacio López-Moreno,
Marta Angulo-Martínez, Ahmed El-Kenawy

Consejo Superior de Investigaciones Científicas (CSIC)
Estación Experimental de Aula Dei / Insituto Pirenaico de Ecología
Zaragoza, Spain

CSIC
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

Overview of the talk

The SPEIbase: A global 0.5° gridded dataset of the Standardised Precipitation Evapotranspiration Index (SPEI) for the period 1901-2006



12-month SPEI (SPEI-12), December 2003

Overview of the talk

The SPEIbase: A global 0.5° gridded dataset of the Standardised Precipitation Evapotranspiration Index (SPEI) for the period 1901-2006

1. The SPEI: motivation, advantages
2. The SPEIbase: methodology, data sources, distribution
3. Examples of use
4. Data distribution

The Standardised Precipitation Evapotranspiration Index (SPEI)

Drought is a real climatological phenomenon representing a threat to ecosystems, crops and many other natural or human systems, but its study is very evasive: how to determine its onset, duration, intensity, magnitude, spatial extent, etc.

Main objectives of a drought index:

- Assessing the vulnerability of various systems to drought
- Monitoring (nowcasting) and early warning (forecasting)

Two main drought indices:

- Palmer Drought Severity Index (PDSI), Palmer (1965)
- Standardised Precipitation Index (SPI), McKee et al. (1993)

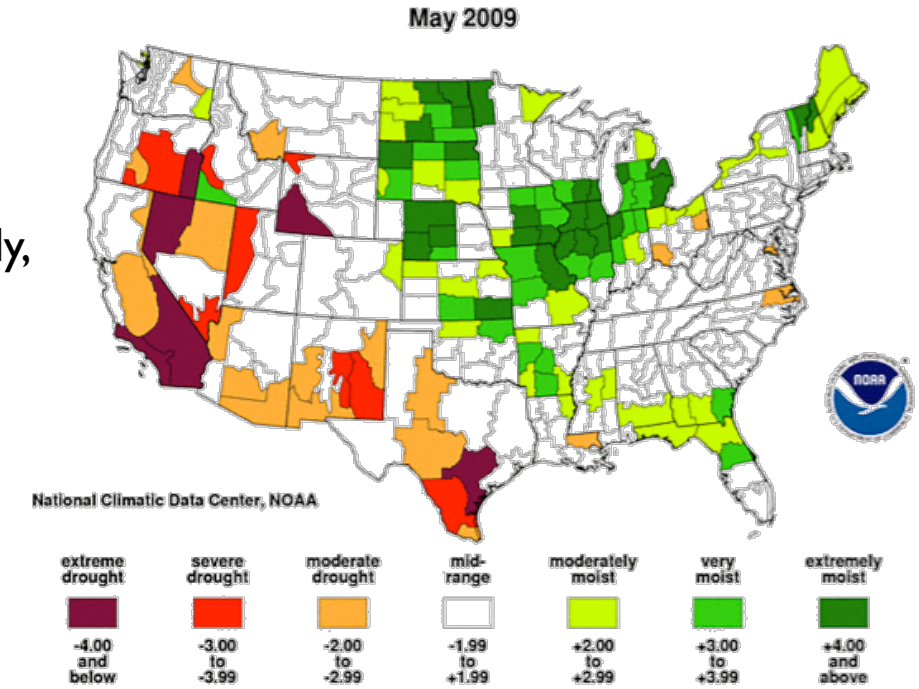
The Standardised Precipitation Evapotranspiration Index (SPEI)

PDSI

- Based on the soil water balance equation (mass balance model)
- Incorporates prior precipitation, moisture supply, runoff and evaporation demand

- It includes supply and demand of moisture
- Sensitive to changes in temperature

- High data demands, complexity of calculation
- Depends on calibration
- Problems for spatial comparability
- Fixed time scale



Palmer Drought Index over the US, May 2009 (NOAA)

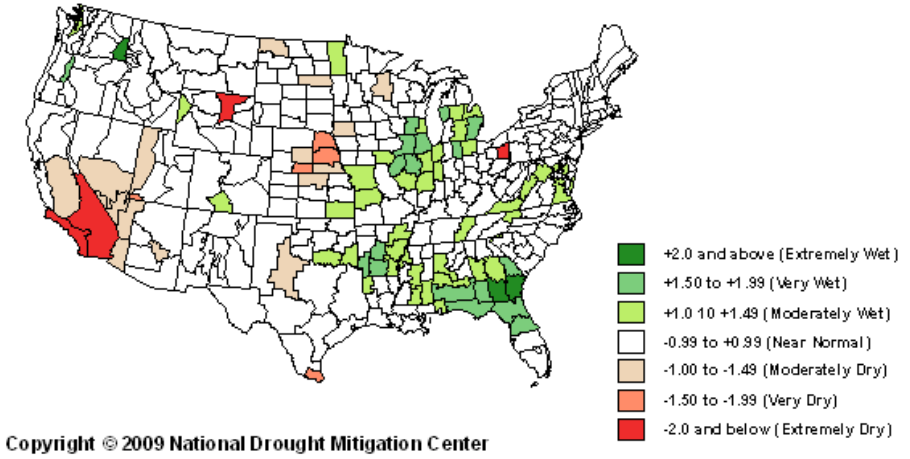
The Standardised Precipitation Evapotranspiration Index (SPEI)

SPI

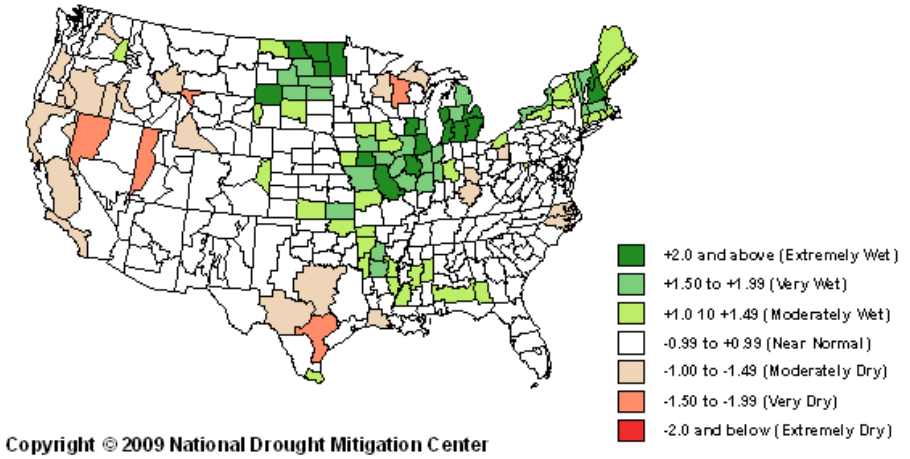
- Based on precipitation anomalies

- Only requires precipitation data
- Easy calculation
- Can be calculated at various time scales

- It does not consider the role of the evapotranspirative demand
- Not sensitive to climate warming

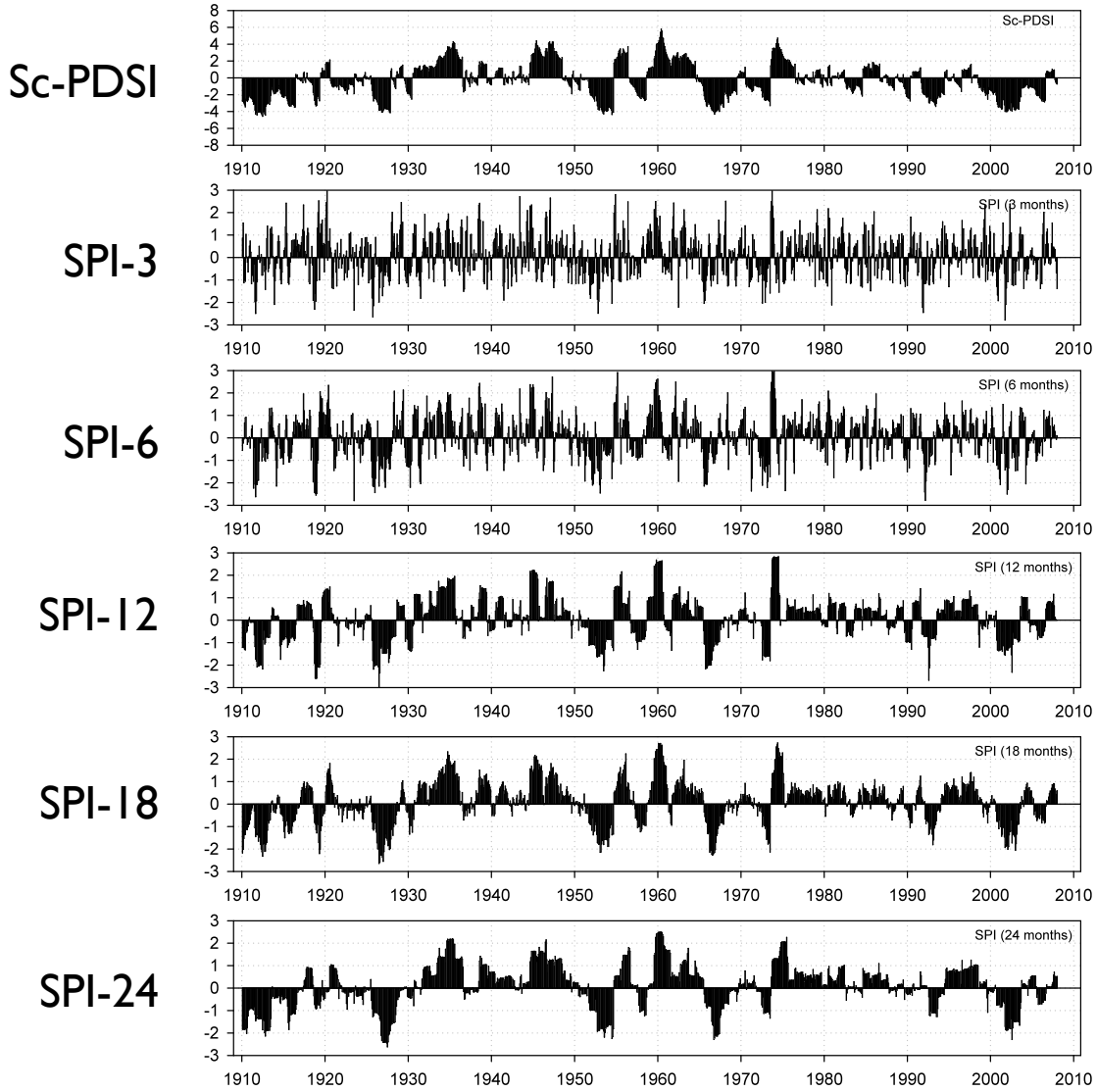


3-month SPI over the US, May 2009 (NDMC)



12-month SPI over the US, May 2009 (NDMC)

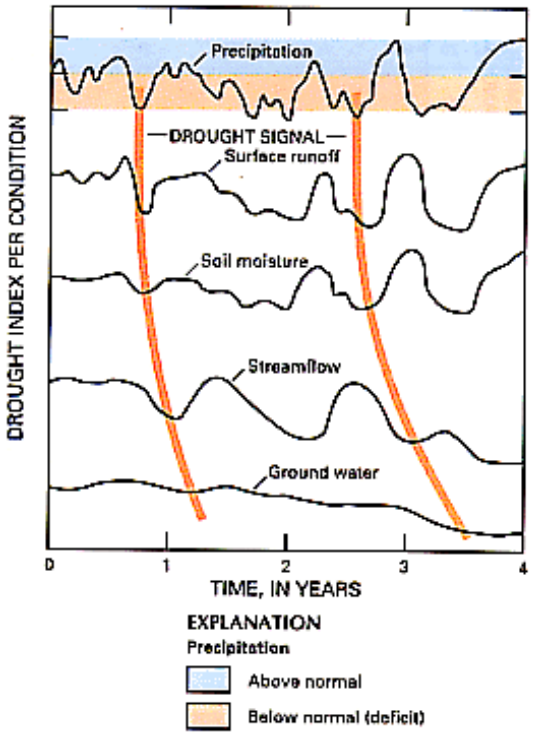
The Standardised Precipitation Evapotranspiration Index (SPEI)



ScPDSI and SPI at various time scales in Indore (India), 1910-2007 (Vicente-Serrano et al., 2010)

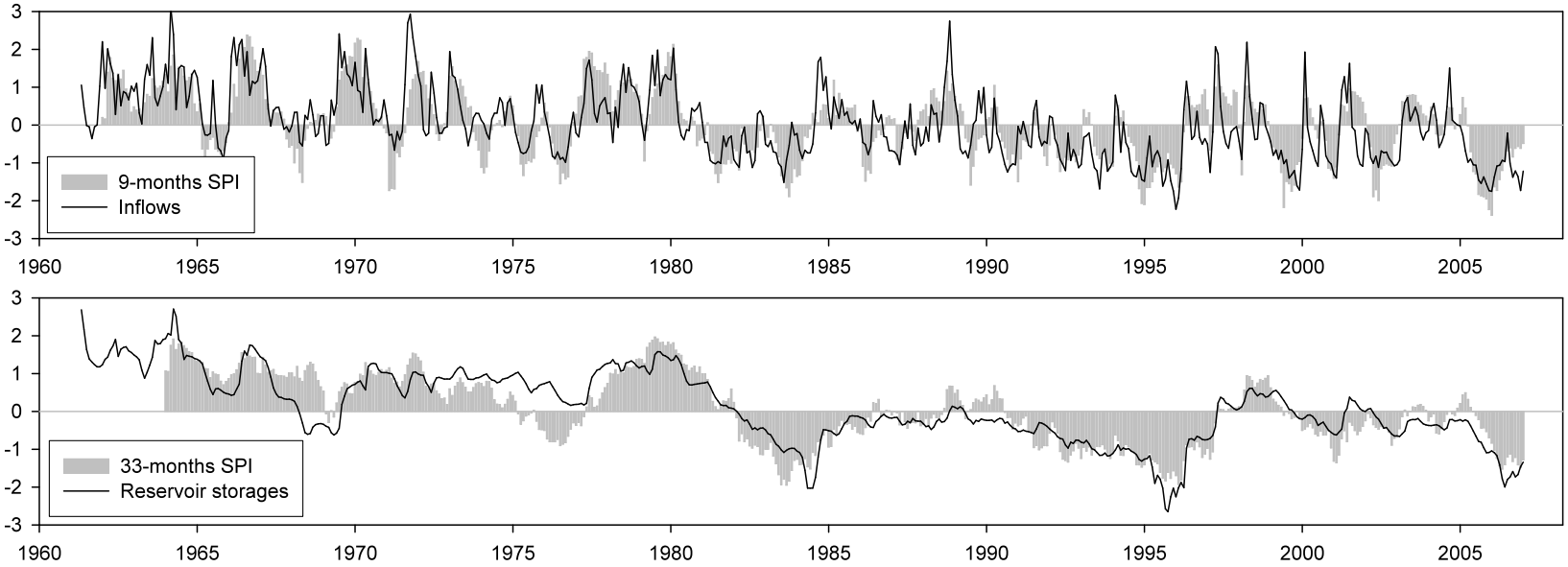
The Standardised Precipitation Evapotranspiration Index (SPEI)

Different systems have different response times to drought:



The Standardised Precipitation Evapotranspiration Index (SPEI)

Different systems have different response times to drought:



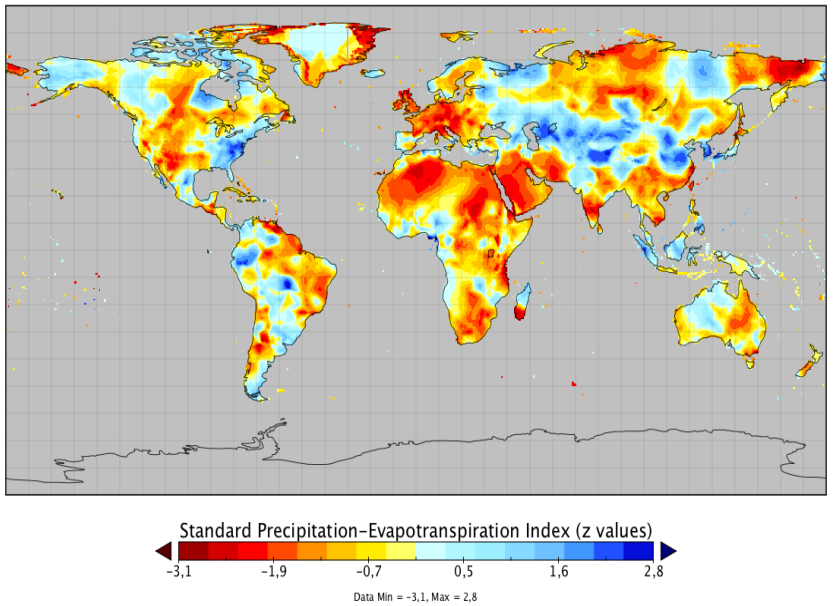
Time series of reservoir inflow and reservoir storage and best correlated SPI series.
Lorenzo-Lacruz et al. (2009), Journal of Hydrology

The Standardised Precipitation Evapotranspiration Index (SPEI)

SPEI

- Based on a climatic water balance (precipitation – potential evapotranspiration) anomalies

- It is sensitive to global warming.
- It can be calculated at different time scales, allowing exploring the vulnerability of various systems to drought.



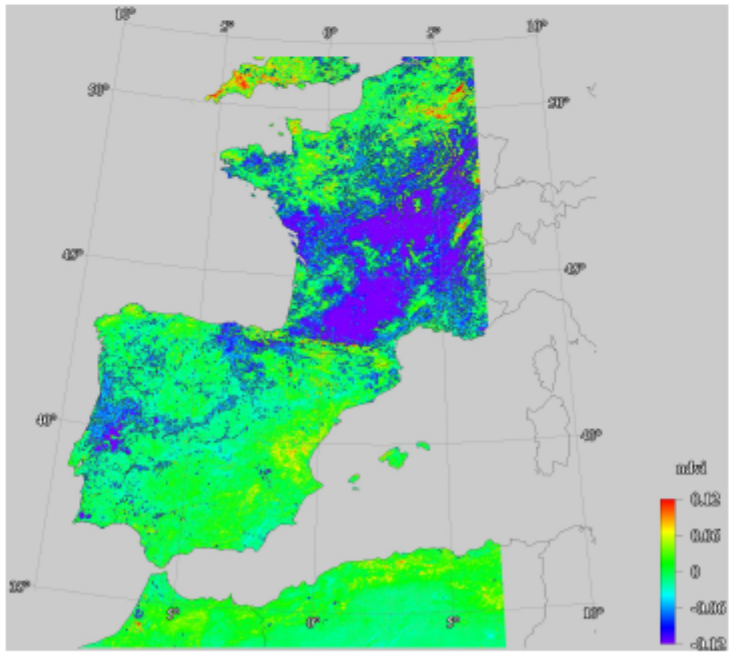
Computation of the SPEI involves the following steps:

1. Computation of the climatic balance ($P-ET_0$)
2. Creation of cumulative series at the desired time scale
3. Fitting the data to an adequate distribution function (LogLogistic)
4. Transforming the data into (standardised) z-values

(more details in a companion poster -562- in Session UC1)

The Standardised Precipitation Evapotranspiration Index (SPEI)

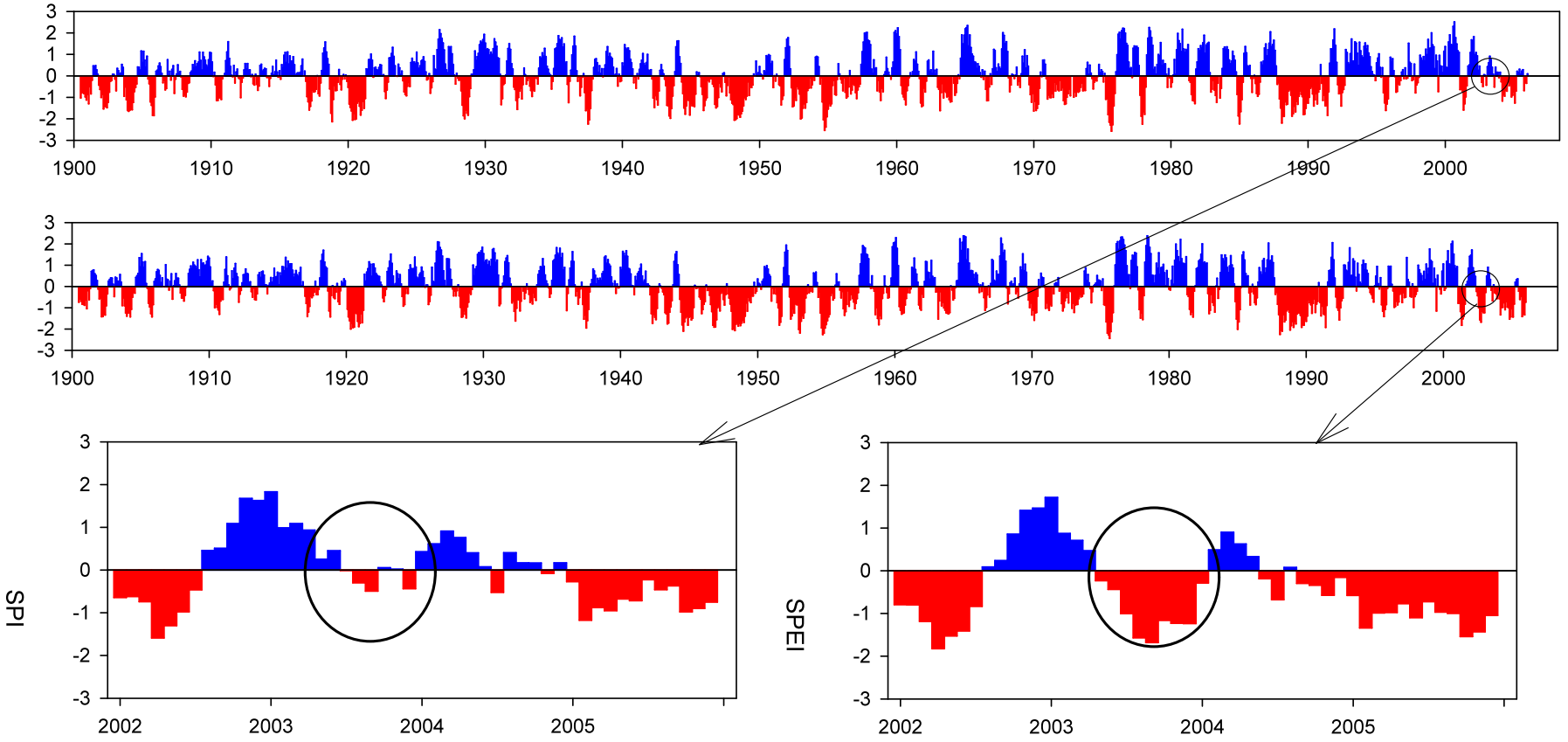
The SPI assumes stationarity in the ET_0, hence it is insensitive to climate warming



The drought of summer 2003 (NDVI anomalies).
Lobo & Maisongrande (2006), Hydrol. and Earth Syst. Sci. 10

The Standardised Precipitation Evapotranspiration Index (SPEI)

The SPI assumes stationarity in the ET_0, hence it is insensitive to climate warming



The drought of summer 2003, as registered by the SPI and the SPEI).

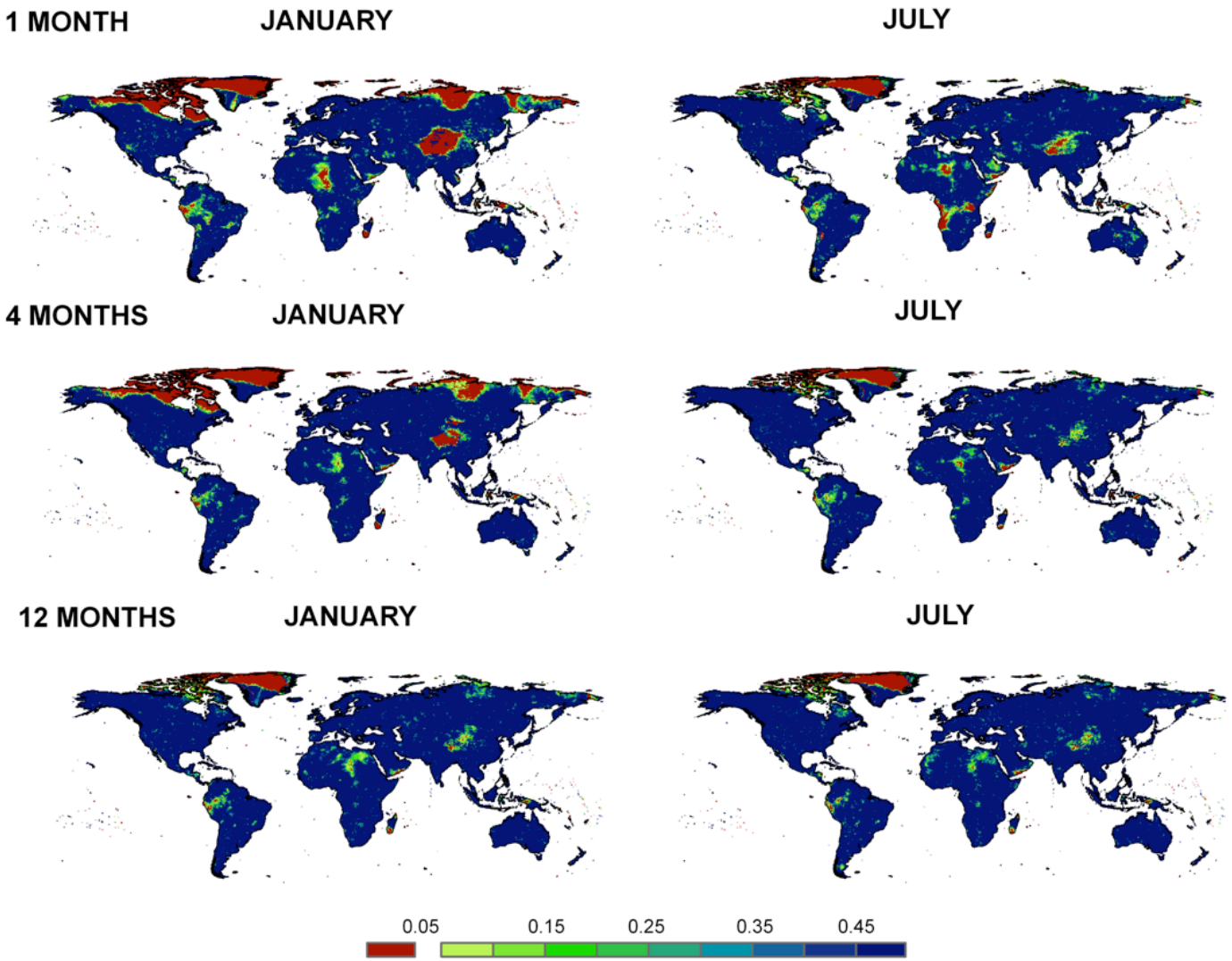
The global gridded 0.5º SPEI dataset (SPEIbase)

The SPEIbase is a global SPEI dataset at time scales from 1 to 48 months with a spatial resolution of 0.5° for the period 1901-2006.

It is based on the CRU TS3 dataset, the most complete and up-to-date source of gridded temperature and precipitation data for the entire World. It is also based on the same grid and time structure.

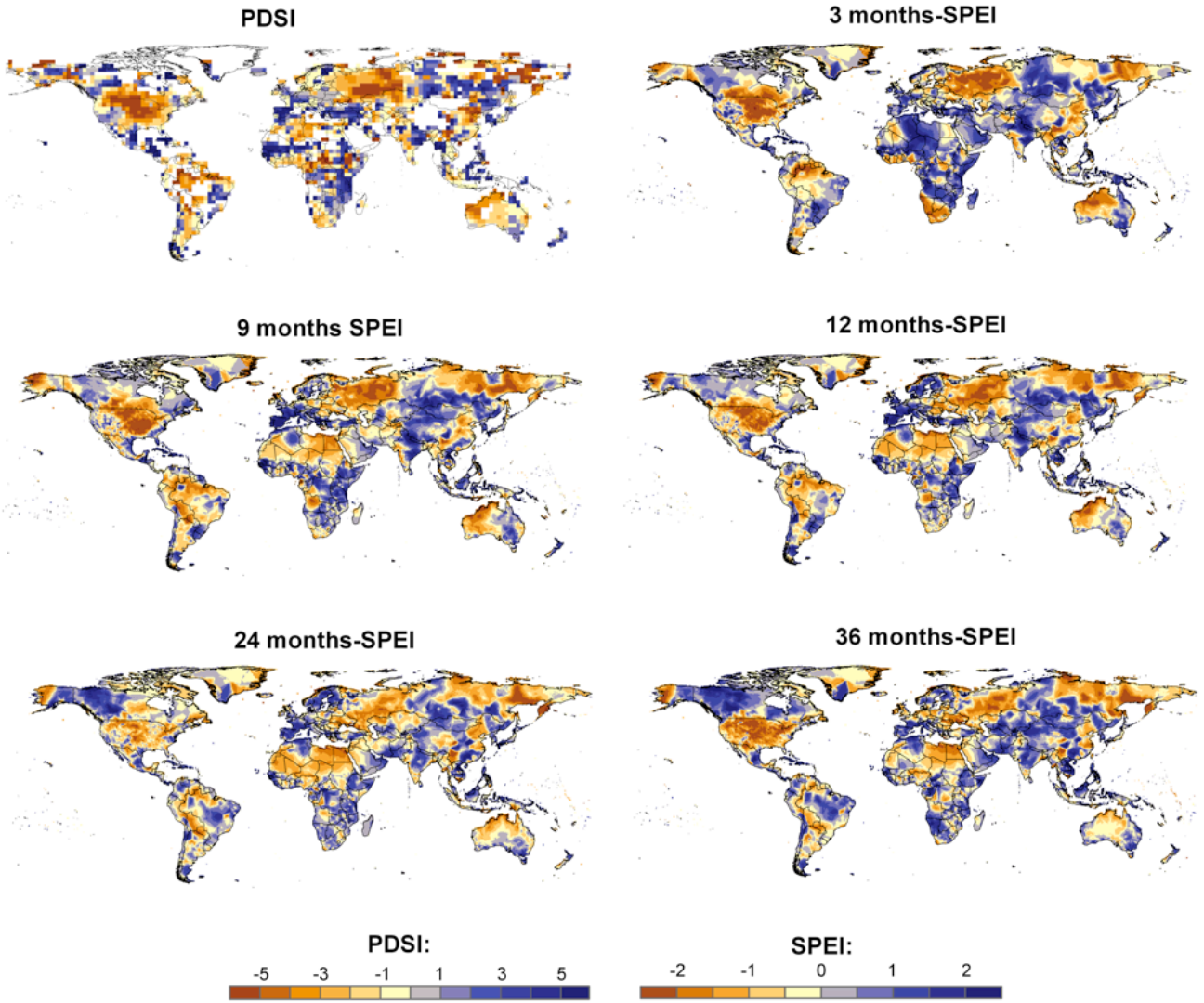
Monthly temperature data was used to compute the ET0 based on the approximation of Thornthwaite (1948).

The global gridded 0.5º SPEI dataset (SPEIbase)



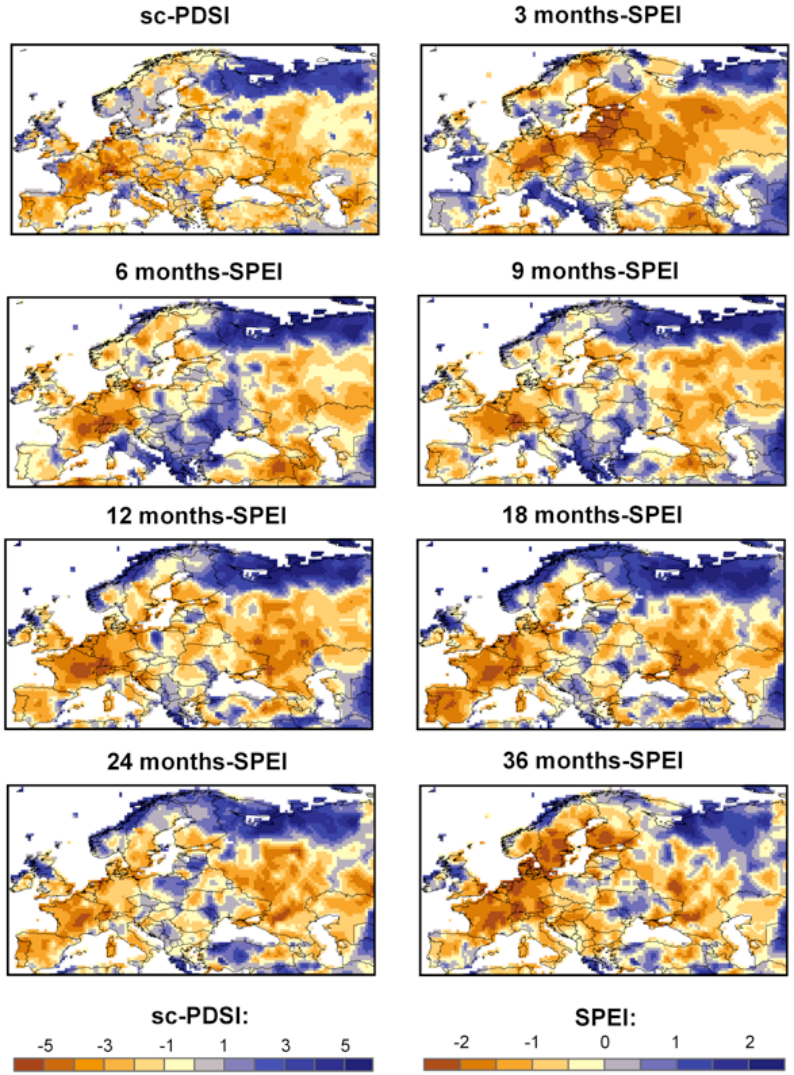
Goodness of fit of the climatic balance series to a log-logistic distribution in January and July, at various time scales (red indicates no significant fit). Vicente-Serrano et al. (2010), J. Hydromet. 11(4).

The global gridded 0.5º SPEI dataset (SPEIbase)



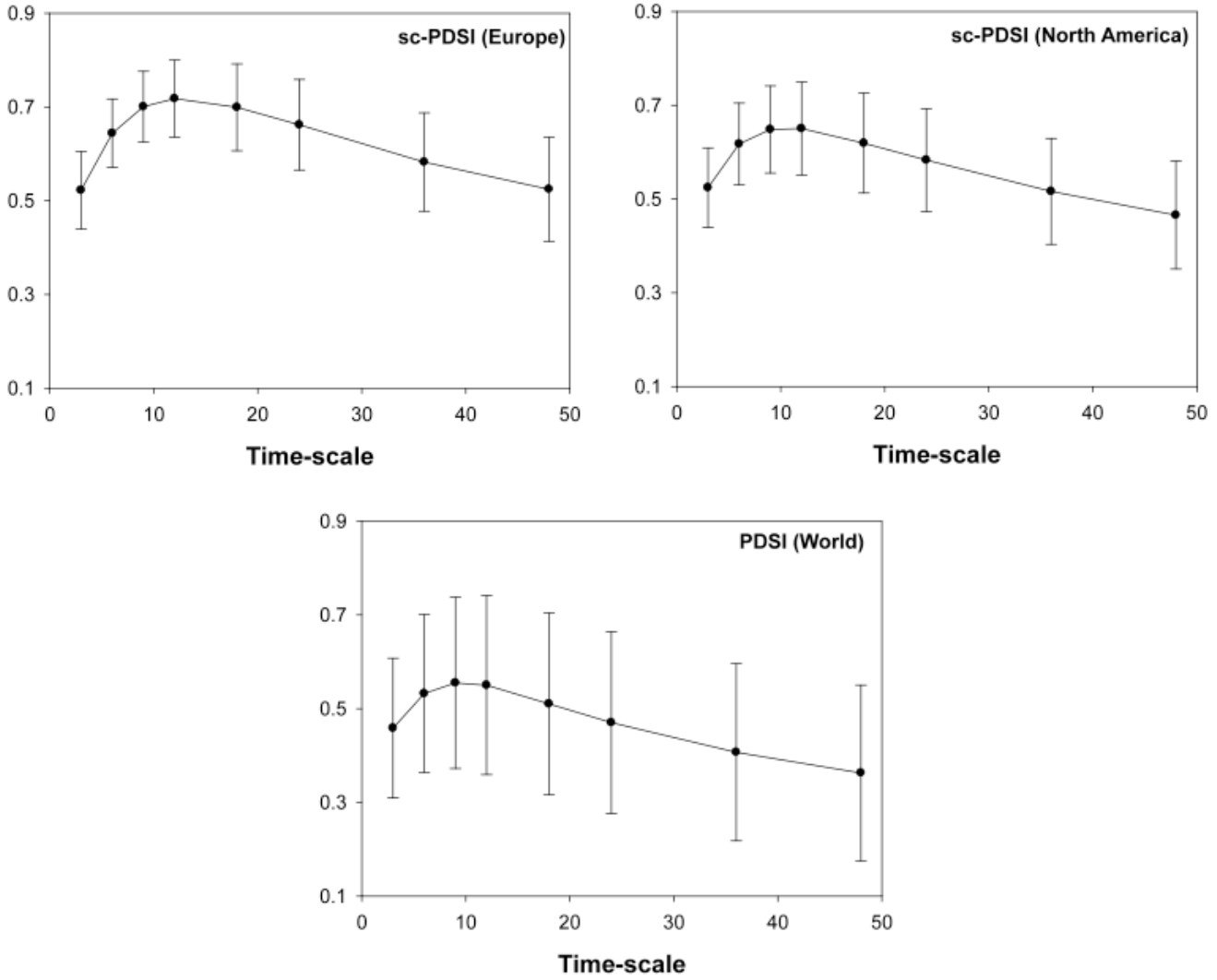
Comparison of the UCAR PDSI and the SPEI at various time scales, August 1936. Vicente-Serrano et al. (2010), J. Hydromet. 11(4).

The global gridded 0.5º SPEI dataset (SPEIbase)



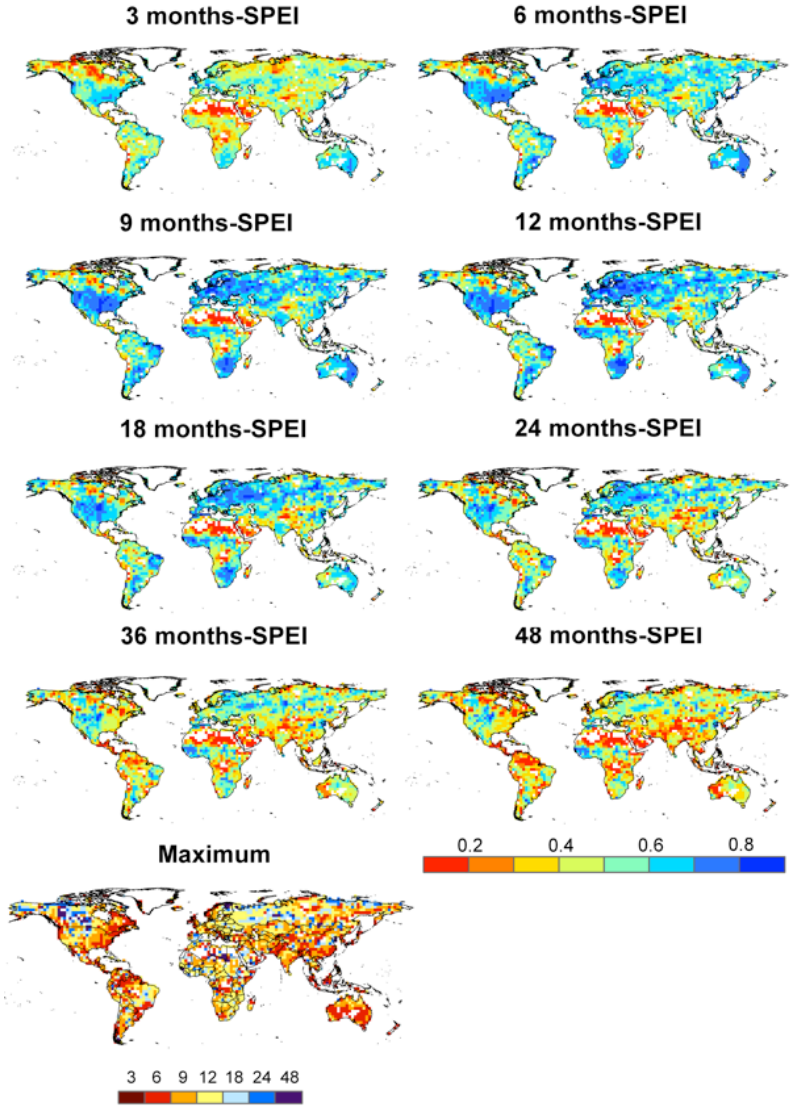
Comparison of the CRU sc-PDSI and the SPEI at various time scales for the European continent, November 1949. Vicente-Serrano et al. (2010), J. Hydromet. 11(4).

The global gridded 0.5º SPEI dataset (SPEIbase)



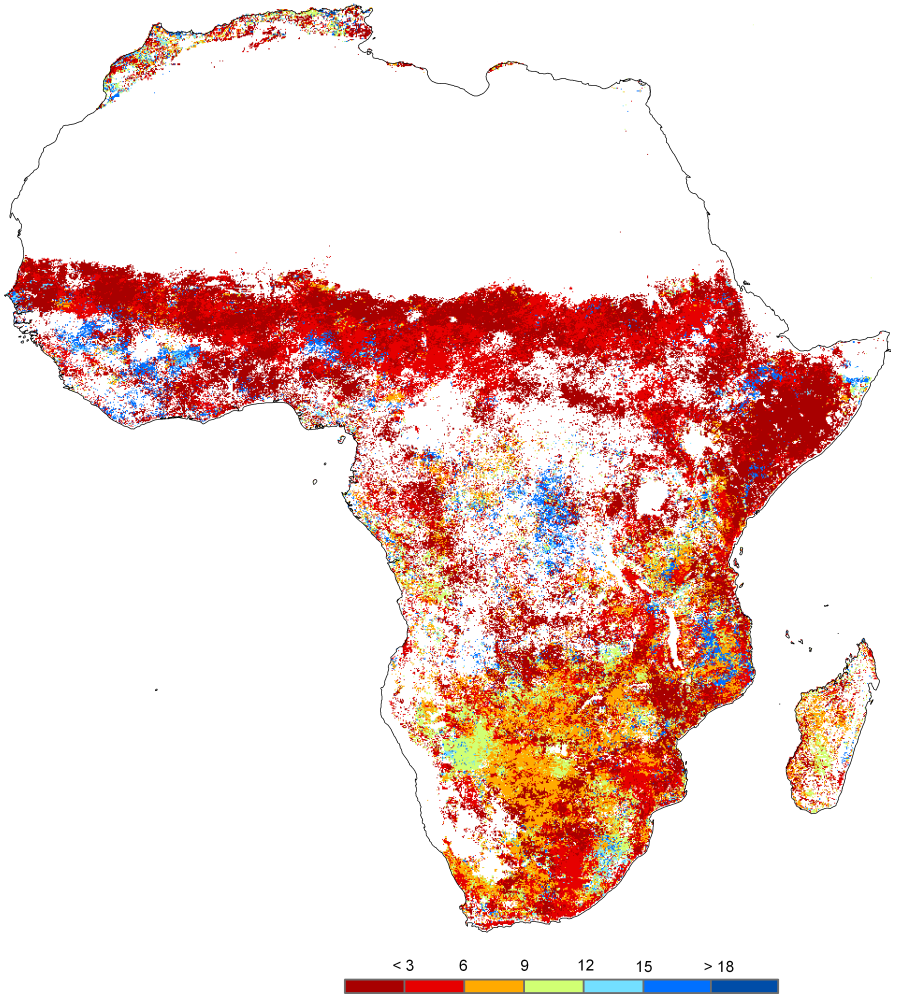
Correlation (Pearson's R) between the sc-PDSI and the SPEI at various timescales for Europe North America and the World. Vicente-Serrano et al. (2010), J. Hydromet. 11(4).

The global gridded 0.5º SPEI dataset (SPEIbase)



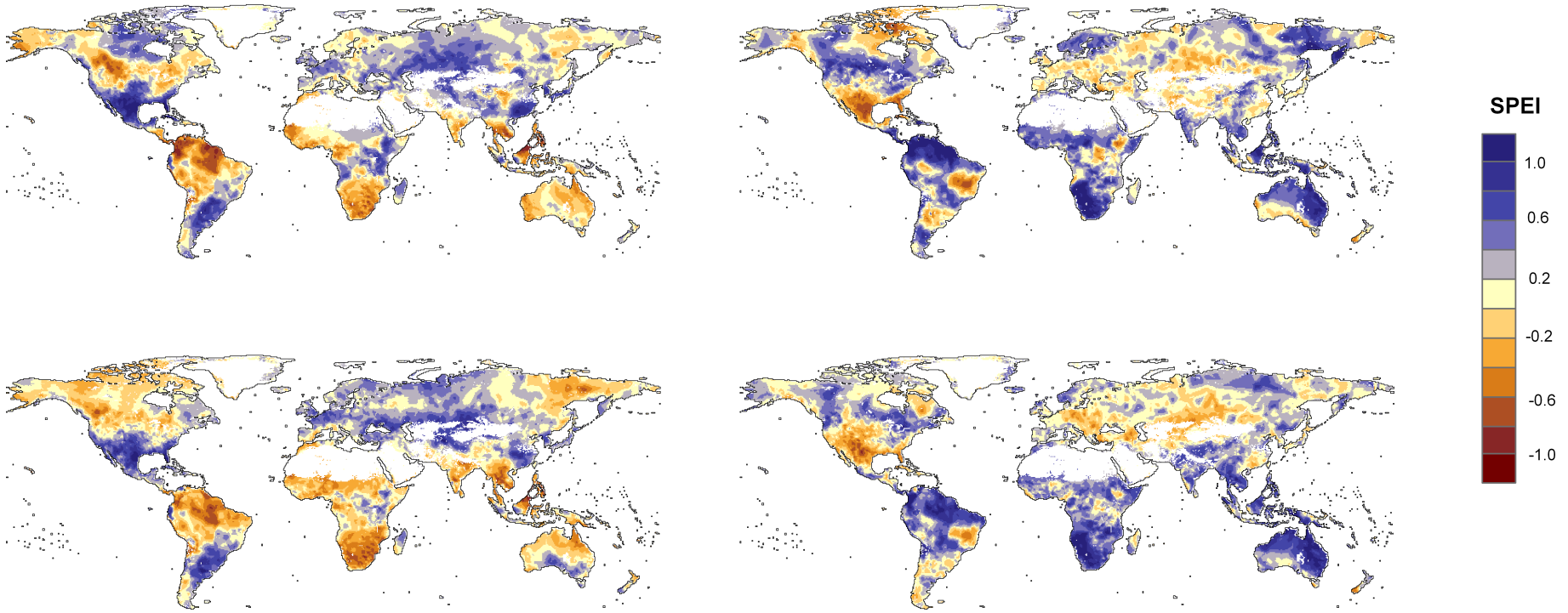
Correlation between the UCAR PDSI and the SPEI at various time scales, and time scale of the SPEI at which the correlation was highest. Vicente-Serrano et al. (2010), J. Hydromet. 11(4).

Examples of use:
African biomes resistance to drought



Time scale (months) at which the SPEI shows the highest correlation with the September-November normalized difference vegetation index (NDVI) negative anomalies in Africa.
Beguería et al. (2010), BAMS – early view.

Examples of use: Impact of El Niño Southern Oscillation (ENSO) on drought



Global impact of El Niño Southern Oscillation (ENSO) on the SPEI: average 3-months February SPEI during ENSO's warm years (El Niño, top left) and cool years (La Niña, top right), and average 9-months August SPEI during the same years (bottom left and bottom right). Beguería et al. (2010), BAMS – early view.

Data distribution

Public access to the data is provided by Digital.CSIC, the institutional repository of the Spanish National Research Council (CSIC), in the following formats:

- netCDF
- raw binary
- plain text

The Global 0.5° gridded SPEI dataset is made available under the **Open Database License** and the **Database Contents License** (ODbL 1.0), which allow the users to:

- Share (copy, distribute and use the database)
- Create (produce derivative works)
- Adapt (modify, transform and build upon the database)

Under the following conditions:

- Attribution (by citing one or more of the papers referenced)
- Share-Alike (offer any derived work under the ODbL)

Data distribution

The SPEI web site: **http://sac.csic.es/spei**