Thesis title

Drought detection at the European Scale

Short description

A drought is a slowly developing natural phenomenon that can occur in all climatic zones and can be defined as a temporary but significant decrease in water availability[1]. Over the past three decades, the cost of droughts in Europe amounted to over 100 billion euros, with the recent summer droughts being unprecedented in the last 2,000 years. An increase in drought severity and frequency is expected from future climate projections[2].

Although drought monitoring and management are extensively studied in the literature[3], traditional drought indices such as Standardized Precipitation Index (SPI), Standardized Precipitation and Evapotranspiration Index (SPEI) and Standardized Runoff Index (SRI) often fail at yielding precise information on detecting critical events and their associated impacts. This is due to the difficulty of capturing the evolution of drought dynamics impacts across different temporal and spatial scales, including short-term meteorological droughts, medium-term agricultural droughts, and long-term hydrological droughts, as well as the non-physical aspects related to droughts (water management, irrigation, etc.).

The aim of this thesis is the analysis of existing drought indexes for assessing their ability in detecting drought events at the pan-European scale. The student is expected to carry out the following activities:

1. Literature review: reviewing the state of the art of existing drought indexes, with a specific focus on their use for drought monitoring and/or forecasting at the European scale (e.g. the European Drought Observatory[4])
2. Data collection: acquisition of observed/reanalysis data (e.g. ERA5[5]) of relevant hydroclimatic variables, such as precipitation, temperature, streamflow
3. Computational experiments:
   - computation of alternative drought indexes with different spatial and temporal aggregations;
   - comparative analysis of the results, potentially correlating drought indexes with drought impact data;
   - spatial analysis, possibly supported by clustering algorithms

Relevant courses and knowledge: Natural Resources Management

Number of Students: 1 or 2

Requisites: The student should be comfortable with data handling and programming skills (Matlab or Python).

References

(1) van Loon A.F. and H.A.J. van Lanen (2012), A process-based typology of hydrological drought, Hydrology and Earth System Sciences
(2) Spinoni et al. (2016), Meteorological Droughts in Europe: Events and Impacts - Past Trends and Future Projections, Publications Office of the European Union, JRC100394
(3) Pedro-Monzonìs et al. (2015), A review of water scarcity and drought indexes in water resources planning and management, Journal of Hydrology
(4) https://edo.jrc.ec.europa.eu/edov2/php/index.php?id=1000
(5) https://climate.copernicus.eu/climate-reanalysis