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Changes in drought characteristics in France during the 21st century

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Standardized drought indices such as the Standardized Precipitation Index (SPI) have been shown to be highly relevant for drought reconstruction and drought monitoring. Such indices can be built to deal with different types of drought (meteorological, agricultural and hydrological) and to study droughts at different time and spatial scales. In this study, a 50-year multilevel and multiscale drought reanalysis over France recently built with Safran-Isba-Modcou hydrometeorological suite will serve as a basis for assessing the impact of climate change on droughts.

An ensemble of climate projections have been statistically downscaled in order to force the Isba and Modcou hydrological models over France and generate 8-km gridded soil moisture time series as well as streamflow time series at more than 900 locations. Two different statistical downscaling methods have been applied using the Safran high resolution atmospheric reanalysis dataset over France: a method based on weather types and regressions, and a quantile-quantile method. As a first step, transient runs from only one general circulation model have been used under different climate scenarios.

Three different standardized indices previously applied for the drought reanalysis are here used to estimate the evolution of droughts in the future: the commonly used SPI, the Standardized Soil Wetness Index (SSWI) based on soil moisture simulated by Isba and the Standardized Flow Index (SFI) based on streamflow computed by Modcou.

Changes in the characteristics (occurrence, intensity, duration, spatial scale) of meteorological, agricultural and hydrological droughts in France during the 21st century are here presented using the different drought indices. This panel of indices may provide useful information at the level of interest of different human activities (water supply, irrigation, hydropower, etc.).