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Effects of climate change adaptation scenarios on perceived spatio-temporal characteristics of drought events

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Drought events develop in both space and time and they are therefore best described through summary joint spatio-temporal characteristics, like mean duration, mean affected area and total magnitude. This study addresses the issue of future projections of such characteristics of drought events over France through three main research questions: (1) Are downscaled climate projections able to reproduce spatio-temporal characteristics of meteorological and agricultural droughts in France over a present-day period? (2) How such characteristics will evolve over the 21st century under different emissions scenarios? (3) How would perceived drought characteristics evolve under theoretical adaptation scenarios?

These questions are addressed using the Isba land surface model, downscaled climate projections from the ARPEGE General Circulation Model under three emissions scenarios, as well as results from a previously performed 50-year multilevel and multiscale drought reanalysis over France (Vidal *et al.*, 2010). Spatio-temporal characteristics of meteorological and agricultural drought events are computed using the Standardized Precipitation Index (SPI) and the Standardized Soil Wetness Index (SSWI), respectively, and for time scales of 3 and 12 months. Results first show that the distributions of joint spatio-temporal characteristics of observed events are well reproduced by the downscaled hydroclimate projections over a present-day period. All spatio-temporal characteristics of drought events are then found to dramatically increase over the 21st century under all considered emissions scenarios, with stronger changes for agricultural droughts.

Two theoretical adaptation scenarios are eventually built based on hypotheses of adaptation to evolving climate and hydrological normals. The two scenarios differ by the way the transient adaptation is performed for a given date in the future, with reference to the normals over either the previous 30-year window ("retrospective" adaptation) or over a 30-year period centred around the date considered ("prospective" adaptation). These adaptation scenarios are translated into local-scale transient drought thresholds, as opposed to a non-adaptation scenario where the drought threshold remains constant. The perceived spatio-temporal characteristics derived from the theoretical adaptation scenarios show much reduced changes, but they call for more realistic scenarios at both the catchment and national scale in order to accurately assess the combined effect of local-scale adaptation and global-scale mitigation.

This study thus proposes a proof of concept for using standardized drought indices for (1) assessing projections of spatio-temporal drought characteristics and (2) building theoretical adaptation scenarios and associated perceived changes in hydrological impact studies (Vidal *et al.*, submitted).

Vidal J.-P., Martin E., Franchistéguy L., Habets F., Soubeyroux J.-M., Blanchard M. & Baillon M. (2010) Multilevel and multiscale drought reanalysis over France with the Safran-Isba-Modcou hydrometeorological suite. *Hydrology and Earth System Sciences*, 14, 459-478.doi: 10.5194/hess-14-459-2010

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