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Drought severity characterization based on hydro-meteorological indices

Lila Collet (1), Guillaume Thirel (1), Jean-Pierre Wagner (2), Joël Gailhard (3), Fabienne Rousset Regimbeau (4), and Jean-Philippe Vidal (5)

(1) IRSTEA, HYCAR Research Unit, Antony, France (lila.collet@irstea.fr), (2) DREAL Grand-Est, Metz, France (Jean-Pierre.WAGNER@developpement-durable.gouv.fr), (3) EDF/DTG, Grenoble, France (joel.gailhard@edf.fr), (4) Météo-France, DCSC/AVH, Toulouse, France (fabienne.regimbeau@meteo.fr), (5) Irstea, RiverLy Research Unit, Villeurbanne, France (jean-philippe.vidal@irstea.fr)

The French part of the Meuse River catchment was identified as vulnerable to drought hazard by water managers, and this should be critically exacerbated in a changing climate where increasing drought magnitude is expected. Water managers need new statistical tools to better anticipate drought hazard, making best use of the available meteorological data and sometimes spatially scarce hydrological data. This issue is currently explored within the CHIMERE21 project supported by the Rhine-Meuse Water Agency, in which the impacts of climate change on water management are analysed. More specifically, simple and informative indicators are investigated to help decision in managing water scarcity on this international basin. In France, the meteorological services (Météo-France, MF) provide maps of diverse gridded hydro-meteorological indices at a 10-day or 1-month time-step directly to the Water Agencies, including maps of the Standardized Precipitation Index (SPI) and the Standardized Soil Wetness Index (SSWI). The SPI can be used to quantify meteorological drought while the SSWI can help characterising soil moisture drought. Hydrologists of DREAL Grand-Est (Direction Régionale de l'Environnement, de l'Aménagement et du Logement), the public body in charge of water management strategy in the Rhine-Meuse basins, are willing to use these maps for hydrological drought characterization in order to better understand drought hazard and adapt water management accordingly. To define drought hazard, DREAL Grand-Est generally uses a threshold approach, the threshold being calculated with a 3-day moving average minimum flow (VCN3) for different return periods (2, 5, 10, and 20 years). When river flow drops below one of these thresholds, a more or less severe drought state is declared and drought management measures are adopted consequently. The work presented here involves water managers and researchers to develop an innovative approach for drought characterization at the sub-catchment scale. It aims to use a logistic regression approach and build a relationship between the probability of reaching a given drought severity stage (VCN3 for different return periods) and observed hydro-meteorological indices (SPI and SSWI). The French Meuse River catchment is used as a case study to develop this approach. MF maps of SSWI and SPI are available on an 8-km grid. VCN3 indicators are spatially computed at the sub-catchment scale based on observed discharge for 16 stations. Since the ultimate aim is to apply this method on ungauged catchments, regressions are built on a subset of these stations and assessed on the rest of them to estimate their transferability in space.