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France-wide future evolution of discharges for the next decades: a multi-RCP/GCM/hydrological model and calibration exercise

Guillaume Thirel (1), Madeleine Nicolas (1), and Jules Beersma (2)

(1) IRSTEA, Hydrology Research Group, Antony, France (guillaume.thirel@irstea.fr), (2) Royal Netherlands Meteorological, Institute (KNMI), the Netherlands (Jules.Beersma@knmi.nl)

Due to complex interactions between atmosphere, vegetation, oceans, land and human beings, climate is continually evolving. The last IPCC report highlighted that by the end of the 21st century, dramatic climate modifications may occur: in Europe, the temperature is expected to increase by several degrees, and the evolution of precipitation is more uncertain. These changes will impact the water cycle, and as a consequence river discharges, which can potentially impact economical, industrial and touristic activities as well as the ecosphere.
In order to provide new insights for hydrology in France, we propose to assess the impact of climate change on discharge module, high and low flows for over 800 river points in France. For this, the last CMIP5 projections are used for the periods 2021-2050 and 2071-2100. This country-wide evaluation, a compromise between basin-based and continental studies usually performed in literature, is of the utmost importance due to the numerous interconnections of water uses inside France.
For this work, the 4 IPCC Representative Concentration Pathways (RCPs) were utilized to drive part or all of 27 Global Circulation Models (GCMs) or versions of GCMs, for which one to ten different runs were available. This represents a total of 183 climatic projections that were then downscaled using the Advanced Delta Change (ADC) method, a statistical method calibrated between a past reference period and the two future periods.
In this study, we applied the ADC to an 8x8 km 52-year meteorological reanalysis available over France. Six global conceptual hydrological models (GR4J, GR5J, GR6J, MORD6, TOPMO, HBV0) were used to produce the hydrological projections, allowing the representation of uncertainty in hydrological modelling. Moreover, one of the hydrological models was calibrated with several objective functions and over contrasted climatic periods. By having several methods or models for every step (except regarding the downscaling method), we aimed at representing the uncertainty in all the components of the modelling chain.
We will present the future evolution of climate and discharge over France. Regarding discharges, we will focus on several indicators dedicated to high and low flows, to discharge module and regimes. If possible, the intensity of the sources of variability from the different components of the modelling chain will be quantified.