Future changes in hydrological extremes of a Mediterranean catchment: what can we say in an uncertainty context?

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The Mediterranean region is a hot spot for climate change impact on the water cycle where water resources are anticipated to decrease and hydrological extremes to intensify while population and water use conflicts growth would keep rising. However, the analysis of the uncertainty related to hydrological projections is generally poorly quantified and difficult to translate to decision-makers. In this study, an in-depth analysis of projections and uncertainties for extreme high- and low-flows was performed. Climatic projections derived from a recent downscaling method over France (Adamont, Verfaillie et al., 2017) were used, and hydrological projections were produced on the Hérault River catchment based on two different Radiative Concentration Pathways (RCPs), five global and regional climate model (GCM/RCM) couples, three hydrological models (HMs), and twenty-nine calibration schemes (Lemaitre-Basset et al., sub). This ensemble was analysed with the QUALYPSO approach (Evin et al., 2019) that allows transient uncertainty analysis of ensembles derived from incomplete GCM/RCM matrix. The quasi-ergodic analysis of variance (QE-ANOVA) used in QUALYPSO evaluates the contribution of each impact modelling step to the total uncertainty. For high-flows, GCMs and RCPs contribute the most to the total uncertainty at the short and long lead-time, respectively. For low-flows, HMs structure and calibration period are the most important sources of uncertainty across 2006-2100. While high-flow projections show a significant mean increase of 30% by 2085 compared to the historical period (confidence intervals: [-1%; +64%]), low-flows would slightly decrease (-7%) by 2085, but with a higher uncertainty (confidence interval: [-24%; +13%]). The time horizons for which a change (e.g. -50, -20, -10, ..., +10, +20, +50%) in high- and low-flows intensity becomes robust (i.e. when more than 66% of the ensemble is above/below a given threshold) were also assessed. This provides strong messages to water managers of the Hérault River catchment who can then anticipate the time needed to prepare and adapt to climate change impacts for extreme hydrological hazards.

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