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Using climate services to evaluate projected changes in the management and planning of hydropower production

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The hydropower sector is sensitive to climate variables as these directly affect energy generation and consumption. Climate services give key information to optimize reservoir operations and to manage water storage. They provide guidelines for climate change adaptation and to build strategies for climate resilience into existing hydropower facilities and the development of new projects. With many climate services flourishing across Europe, the challenge today is to develop energy indicators based on these climate services which can facilitate decision-making at the regional and local levels, most particularly in a context of climate change adaptation and disaster risk reduction.

In this study, firstly, we compared the projected evolutions of river flows (of the Dordogne River) according to GCM/RCM (RCP 4.5) projections for two future periods: near future (2016-2045) and mid-century period (2036-2065), both compared to a reference period (1971-2005). We applied five GCM/RCM projections from SWICCA climate service (http://swicca.eu/) and seven GCM/RCM projections from Clim4Energy climate service (http://clim4energy.climate.copernicus.eu/). For Clim4Energy, we extracted, at the river location, the anomalies directly provided by the portal. For SWICCA, we extracted the flows at the river location and calculated the anomalies, using the same methodology described in the Clim4Energy portal. Secondly, we focused on the EURO-CORDEX temperature and precipitation simulations from Drias portal (http://www.drias-climat.fr/), which we used as input to the GR6J hydrological model. The simulated flows were then used in an operation guide curve module for reservoir management. Based on storage volume trajectories, differences between current and future operating rules of hydroelectric installations in the context of climate change adaptation were evaluated.

Results show that the differences in monthly percentage anomalies between the different pairs of GCM/RCM models are more important during the winter season than in summer. For the two future periods, there is an increase in the dispersion between the different GCM/RCM pairs, even though they have the same greenhouse gas emission scenario. The results highlight the importance of considering several climate services when evaluating future conditions for the management and planning of hydropower production. They also illustrate the importance and the challenge of designing new indicators that do not rely solely on future flow projections.

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