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An ensemble of hydrological projections to support climate change adaptation by a hydropower company

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Climate change is already impacting water resources availability in mountainous catchments by altering snowmelt processes, the seasonal distribution of discharge and the magnitude of peak flow. It is therefore necessary to produce projections of streamflow under future climate scenarios that can be used to anticipate future changes and to design adaptation strategies. This project represents an effort towards the integration of elements of the bottom-up approach into hydrological climate change modeling. We are building on the concept that end-users' needs and vulnerabilities should be well-understood in order to provide projections useful for decision-making. Within this project, we collaborate with Group E SA, a hydropower company that manages and has shares in several reservoirs in Switzerland, and we are providing them with projections of runoff entering two of their reservoirs until the end of the century. This information will be used to determine the profitability of their operations under future climate given seasonal changes in energy prices (accounting for instance for the fact that demand is highest in winter because of heating). Our projections will also provide support to negotiate the renewal of their water lease and the design of future infrastructure.

According to the goals of this project, our modeling chain is designed as follows: two emission scenarios (RCP4.5 and RCP8.5), thirteen EURO-CORDEX GCM-RCMs, two Swiss catchments (representing the area upstream of the reservoirs), ten optimized parameter sets for the hydrological model (HBV) and one bias correction method (quantile mapping). This experimental setup enables us to assess uncertainties in the projected discharge and to quantify the proportionate amount of uncertainty stemming from each part of the modeling chain. The hydropower company is familiar with ensembles and uncertainty of hydrological simulations, as they use ensembles of short-term hydrological forecasts for their daily operations. Visualizations are tailored to the needs of the company and include uncertainty decomposition differentiating between modeling and that of a socio-economical nature. The hydrological variables investigated and their modeling are adjusted and refined based on the need and vulnerabilities of the company.