Six challenges to successfully inform hydropower operation by improved hydrometeorological forecasts

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Hydropower is facing considerable global change-related challenges from the point of view of both hydrological conditions, e.g., water availability and frequency of extremes events, and of energy market conditions, e.g., partial or total liberalization of the market and increasing share of renewable power sources. In this evolving context, hydropower reservoir operations might benefit from the information coming from hydro-meteorological prediction over a broad range of time scales, from short-term to seasonal and decadal time horizons, to combine strategic planning decisions on the medium- to long- term with daily and sub-daily operational decisions. In this talk, we explore potential advantages and concomitant challenges of informing hydropower operation with improved hydro-meteorological forecasts with a focus on Alpine hydropower systems. Specifically, we identified six fundamental, still unreplied questions: How much is the max potential improvement by streamflow forecast? How to find the most skillful lead time? How much is the seasonal forecast value as revenue for a hydropower company? How does forecast quality relate to forecast value? How does forecast informed operations change downstream hydrological patterns? Will climate change expand or shrink this potential?

To address these questions, we developed a machine-learning based procedure to identify the most valuable forecast to an Alpine hydropower company and to quantify the economic benefit (value) of using the seasonal hydrological forecasts generated by the Swedish Meteorological and Hydrological Institute (SMHI) using the E-HYPE model as their contribution to increasing the annual company revenue. Lastly, insights from similar studies conducted across different European case studies will be reported.