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Adapting Dam and Reservoir Design and Operations to Climate Change

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In order to identify the potential initiatives that the dam, reservoir and water resources systems owners and operators may undertake to cope with climate change issues, it is essential to determine the current state of knowledge of their impacts on hydrological variables at regional and local scales. Future climate scenarios derived from climate model simulations can be combined with operational hydrological modeling tools and historical observations to evaluate realistic pathways of future hydrological conditions for specific drainage basins. In the case of hydropower production those changes in hydrological conditions may have significant economic impacts.
For over a decade the state owned hydropower producer Hydro Québec has been exploring the physical impacts on their watersheds by relying on climate services in collaboration with Ouranos, a consortium on regional climatology and adaptation to climate change. Previous climate change impact analysis had been including different sources of climate simulation data, explored different post-processing approaches and used hydrological impact models. At a new stage of this collaboration the operational management of Hydro Quebec aspired to carry out a cost-benefit analysis of considering climate change in the refactoring of hydro-power installations. In the process of the project not only a set of scenarios of future runoff regimes had to be defined to support long term planning decisions of a dam and reservoir operator, but also the significance of uncertainties needed to be communicated and made understood.
We provide insight into a case study that took some unexpected turns and leaps by bringing together climate scientists, hydrologists and hydro-power operation managers. The study includes the selection of appropriate climate scenarios, the correction of biases, the application of hydrological models and the assessment of uncertainties. However, it turned out that communicating the science properly and explaining aspects of uncertainty was key to the success of the project. As an outcome the reservoir owner was provided with a number of options within the likely range of expected future climate change. The custom tailored scenarios can be applied to support the design and dimensioning of sustainable hydraulic infrastructures.