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Calibration of a reinforcement learning method with the ClimEx large ensemble and a weather generator for water management

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Hydropower is a renewable source of energy that relies on efficient water planning and management. As the behavior of this natural resource is difficult to predict, water managers therefore use methods to help the decision-making process. Reinforcement Learning (RL) has been shown to be a potentially effective approach to overcome the limitations of the Stochastic Dynamic Programming (SDP) method that is commonly used for water management. However, convergence to a robust and efficient operating policy from RL methods requires large amounts of data, while long-term historical data is not always available. The objective of this study consists in using tools to generate long-term hydrological series to obtain an efficient parameterization of the management policy. This presentation introduces a comparison of calibration datasets used in a RL method for the optimal control of a hydropower system. This method aims to find a feedback policy that maximizes the production of a hydropower system over a mid-term horizon. Three streamflow datasets are compared on a real hydropower system for RL calibration: 1) the historical streamflow (35 years), 2) streamflow simulated by a hydrological model driven by a high-resolution large-ensemble climate model data (3500 years) from the ClimEx project, and 3) streamflow simulated by a hydrological model driven by climate data generated with a stochastic weather generator (5000 years). The GR4J hydrological model is employed for the hydrologic modelling aspect of the work. The reinforcement learning method is applied on the Lac-Saint-Jean water resources system in Quebec (Canada), where the hydrological regime is snowmelt-dominated. A bootstrapping method where multiple calibration and validation sets were resampled is used to conduct a robust statistical analysis for comparing the methods' performance. The performance of the calibrated management policy is evaluated with respect to the operational constraints of the system as well as the overall energy production. Preliminary results show that is possible to achieve effective management policies by using tools to generate long-term hydrological series to feed a RL method.