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Detecting future performance of the reservoirs under the changing climate

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Climate change is expected to affect the hydrological cycle resulting in changes in rainfall patterns, seasonal variations as well as flooding and drought. Also, changes in the hydrologic regime of the rivers are another anticipated effects of climate change. This climatic variability put pressure on renewable water resources with its increase in some regions, decrease in the others and high uncertainties in every region. As a result of the pressure of climate change on water resources, the operation of reservoir and dams is expected to experience uncertainties in different aspects such as supplying water and controlling the flood. In this study, we model two hypothetical dams on different streamflows, based on the water needs of 20'000 and 100'000 people. UK, as a country that suffered from several flooding events during the past years, and Iran, as a country with severe water scarcity, are chosen as the nations under study. For this study, the hypothetical modeled dam is located on three streamflows in each nation. Then, the mass-balance model of the system is optimised over 25 years of historical data, considering two objectives: 1) Minimisation of the water deficit in different sectors (agricultural, domestic and industrial) and 2) Minimisation of the flooding around the reservoir catchment. The optimised policies are simulated into the model again under different climate change and demographic scenarios to obtain the Resilience, Reliability and Vulnerability (RRV indices) of the system. In order to gain this goal, two different set of scenarios are introduced; the first set is the scenarios introduced in IPCC assessment in its Special Report on Emission Scenarios (SRES). The second set is introduced as a Monte Carlo simulation of demographic and temperature scenarios. Demographic scenarios are defined as the UN's estimation of population based on age, sex, fertility, mortality and migration rates with a 2-year frequency. Temperature scenarios, on the other hand, are defined based on the target of COP21, Paris which proposed to keep "the global temperature increase well below 2 degrees Celsius, while urging efforts to limit the increase to 1.5 degrees", as well as temperatures higher than this limit to better address the effects of climate change. Numerical results of the proposed model are anticipated to represent the performance of the system by the year 2100 through RRV indices. RRV metrices are effective means of quantitative estimation of climate change impacts on reservoir system in order to obtain the potential policies to solve the future water supply issues.