Geophysical Research Abstracts
Vol. 20, EGU2018-1408-1, 2018
EGU General Assembly 2018

Comparing the impact of different categories and positions of scenario weights on the derivation of reservoir adaptive operating rules

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Climate change is posing substantial challenges to water resources management. In order to mitigate the adverse impacts of climate change, adaptive operating rules are generally derived using General Circulation Models (GCMs) ensembles. However, up to date, few studies investigate the impact of the categories and positions of scenario weights on the derivation of adaptive operating rules (AOR). To address it, this paper focuses on the effect of different uses of scenario weights on deriving AOR under climate change. Four adaptive operating rules are proposed based on two criterions: (1) whether scenario weights are identical; and (2) where scenario weights are applied. With respect to the former, two weighted methods are introduced, including equal weights (EW) and unequal weights based on the Reliability Ensemble Average method (REA). In terms of the latter, two situations are considered: (I) scenario weights are directly used in the reservoir operation model which maximizes the weighted average annual hydropower generation for all scenarios; and (II) scenario weights are adopted to incorporate GCMs ensemble climate projections into the weighted climate condition, and then the maximization of annual hydropower generation is selected as the optimization objective of the reservoir operation model. The simulation-based optimization method (SBO) serves to extract AOR. As a result, four adaptive operating rules are formed, namely EW-AOR(I), EW-AOR(II), REA-AOR(I), REA-AOR(II). Based on the case study of Jinxi Reservoir in China, the results show that REA-AOR(I) outperforms other three operation schemes and EW-AOR(II) performs better then REA-AOR(II). In other words, equal weights are suitable to incorporate climate conditions, while unequal weights tend to improve the performance of the reservoir operation model. Therefore, two comparative benchmarks, i.e. EW-AOR(II) and REA-AOR(I), are suggested for further adaptive operation research.