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Probabilistic scenario-based water resource planning and management:A case study in the Yellow River Basin, China

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Water resource planning and management is subject to large uncertainties with respect to the impact of climate change and socio-economic development on water systems. In order to deal with these uncertainties, probabilistic climate and socio-economic scenarios were developed based on the Principle of Maximum Entropy, as defined within information theory, and as inputs to hydrological models to construct probabilistic water scenarios using Monte Carlo simulation. Probabilistic scenarios provide more explicit information than equally-likely scenarios for decision-making in water resource management. A case was developed for the Yellow River Basin, China, where future water availability and water demand are affected by both climate change and socio-economic development. Climate scenarios of future precipitation and temperature were developed based on the results of multiple Global climate models; and socio-economic scenarios were downscaled from existing large-scale scenarios. Probability distributions were assigned to these scenarios to explicitly represent a full set of future possibilities. Probabilistic climate scenarios were used as input to a rainfall-runoff model to simulate future river discharge and socio-economic scenarios for calculating water demand. A full set of possible future water supply-demand scenarios and their associated probability distributions were generated. This set can feed the further analysis of the future water balance, which can be used as a basis to plan and manage water resources in the Yellow River Basin.

Key words: Probabilistic scenarios, climate change, socio-economic development, water management