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Probabilistic Calibration of a Reservoir Optimization Model for Flood Control

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Flood events require that dam managers make decisions efficiently in order to avoid risks to the dam and damages on river downstream, and to store water for further uses. It is a highly complex problem. Optimization models are a useful tool that might provide operating policies to support decision-making process during floods. However, they rely on objective functions which must represent the needs of dam managers appropriately. Objective functions are usually parameterized, and this contribution presents a novel procedure to identify the right parameter values to obtain the required routing behavior in the reservoir. The procedure is based on the probabilistic analysis of reservoir behavior for a stochastic ensemble of inflow hydrographs. A Montecarlo environment is used to handle the stochastic nature of inflows, and a large number of hydrographs are utilized to analyze the reservoir operation rules. A mixed integer linear programming optimization model is applied to four dams, all of them located in the Segura River Basin (Spain) to optimize the operation rules. The objective function consists in minimizing the weighted sum of two penalty terms that depend on the water released and stored. In order to evaluate the reservoir operation strategy with a unique numeric value, an indicator named 'risk index' is proposed. This index is based on two elements: the probability distributions of maximum flow released and of maximum water level during every episode, and the relationship between those variables and the expected cost of damages. The combination of objective function parameters which minimize the expected cost of damages (risk index) is selected in every dam.