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Defining operating rules for mitigation of drought effects on water supply systems

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Reservoirs play a pivotal role for water supply systems regulation and management especially during drought periods. Optimization of reservoir releases, related to drought mitigation rules is particularly required. The hydrologic state of the system is evaluated defining some threshold values, expressed in probabilistic terms. Risk deficit curves are used to reduce the ensemble of possible rules for simulation. Threshold values can be linked to specific actions in an operational context in different levels of severity, i.e. normal, pre-alert, alert and emergency scenarios. A simplified model of the water resources system is built to evaluate the threshold values and the management rules. The threshold values are defined considering the probability to satisfy a given fraction of the demand in a certain time horizon, and are validated with a long term simulation that takes into account the characteristics of the evaluated system. The threshold levels determine some curves that define reservoir releases as a function of existing storage volume. A demand reduction is related to each threshold level. The rules to manage the system in drought conditions, the threshold levels and the reductions are optimized using long term simulations with different hypothesized states of the system. Synthetic sequences of flows with the same statistical properties of the historical ones are produced to evaluate the system behaviour. Performances of different values of reduction and different threshold curves are evaluated using different objective function and performances indices. The methodology is applied to the urban area Firenze-Prato-Pistoia in central Tuscany, in Central Italy. The considered demand centres are Firenze and Bagno a Ripoli that have, accordingly to the census ISTAT 2001, a total of 395.000 inhabitants.