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Risk indicators for water supply systems for a drought Decision Support System in central Tuscany (Italy)

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Identifying the occurrence, the extent and the magnitude of a drought can be delicate, requiring detection of depletions of supplies and increases in demand. Drought indices, particularly the meteorological ones, can describe the onset and the persistency of droughts, especially in natural systems. However they have to be used cautiously when applied to water supply systems. They show little correlation with water shortage situations, since water storage, as well as demand fluctuation, play an important role in water resources management. For that reason a more dynamic indicator relating supply and demand is required in order to identify situations when there is risk of water shortages. In water supply systems there is great variability on the natural water resources and also on the demands. These quantities can only be defined probabilistically. This great variability is faced defining some threshold values, expressed in probabilistic terms, that measure the hydrologic state of the system. They can identify specific actions in an operational context in different levels of severity, like the normal, pre-alert, alert and emergency scenarios. They can simplify the decision-making required during stressful periods and can help mitigate the impacts of drought by clearly defining the conditions requiring actions. The threshold values are defined considering the probability to satisfy a given fraction of the demand in a certain time horizon, and are calibrated through discussion with water managers.
A simplified model of the water resources system is built to evaluate the threshold values and the management rules. The threshold values are validated with a long term simulation that takes into account the characteristics of the evaluated system. The levels and volumes in the different reservoirs are simulated using 20-30 years time series. The critical situations are assessed month by month in order to evaluate optimal management rules during the year and avoid conditions of total water shortage. The methodology is applied to the urban area Firenze-Prato-Pistoia in central Tuscany, in central Italy. The catchment of the investigated area has a surface of 1231 km2 and, accordingly to the census ISTAT 2001, 945˙972 inhabitants.