# Definition of risk indicators for reservoirs management optimization

Giuseppe Rossi (1), Enrica Caporali (1), and Luis Garrote (2)

(1) Department of Civil and Environmental Engineering, University of Firenze, Firenze, Italy (giuseppe.rossi@dicea.unifi.it; enrica.caporali@unifi.it), (2) Department of Hydraulic and Energy Engineering, Technical University of Madrid, Madrid, Spain (garrote@caminos.upm.es)

Identifying the beginning, the extent and the magnitude of a drought is a delicate task. Droughts may lead to a disaster, due to their impacts on people, economy, environment and specifically on the water supply systems. Water shortages on water supply systems depend not only on resources status, but also on water storage, demand fluctuation and on the actions carried out in order to reduce drought effects. For that reason a dynamic indicator relating supply with demand is required in order to identify situations when there is risk of water shortages.

A novel procedure for drought risk assessment and for the mitigation of drought risk is proposed. An analysis of the relationship between failure of water supply systems and reservoir volumes for the urban area of Firenze in central Tuscany, in central Italy, is performed. A simplified model of the water resources system is built to assess the threshold values and the management rules. Long term simulations using Monte Carlo method are carried out using the software package WEAP. The probability to have definite degree of shortage in the water supply system is evaluated as function of the volume stored in the reservoir at the beginning of each month.The reservoir levels and volumes are simulated using time series of the period 1970-2005. Four scenarios (i.e. normal, pre-alert, alert and emergency) associated with different levels of severity of drought are defined. Threshold values are identified considering the probability to assure a given fraction of the demand in a certain time horizon. A demand reduction is related to each threshold level. Definition of the operation rules implies to select the threshold values and to define the required demand reduction at every stage. The operation rules are calibrated with an optimization method, which tries to minimize the water shortages, especially the most intense. The critical situations are assessed month by month in order to evaluate optimal management rules during the year and to avoid conditions of total water shortage.