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Are drought vulnerability indices useful tools in order to evaluate the state of a water supply system?

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Water resources availability is affected both by anthropic drivers (increasing demand, modification in the uses) and natural ones such as precipitation decrease related to global climate changes. Water managers and water policy makers are more and more aware that they are facing a changing climate in which the availability of water is claimed to be decreasing in many parts of the world. The possibility that droughts will be more frequent and severe in the next decades is getting a real possibility and a wise manager should know in advance how to face this new reality. Hence new tools and, more important, a methodology to assess the weakest points of a complex water supply system to water scarcity scenarios, are necessary.

The importance of simulation models to assess in advance the impacts of possible conditions of severe water shortage and the effects of feasible mitigation options on water supply systems is well known. Vulnerability is commonly used to characterize the performance of water supply systems, and it can be a helpful indicator in the evaluation of the most likely failures in a complex system in ordinary as well as in more severe climatic conditions. However a common procedure about the exploitation of modeling results is not established yet.

In this research the water supply network of a case study area in Central Italy was modeled under different climatic and management hypothesis. In this area both ground water resources (well fields in alluvial aquifers and Apennine springs) and surface water resources stored in two large reservoirs, are exploited mainly for drinking water supply and irrigation. Climate scenarios were drawn based on three simplistic hypothesis: firstly a progressive reduction of precipitation in 55 years, secondly an increase in its variance during time, lastly a combination of the two.

The model results were elaborated to calculate different indices, in order to analyze the variation of vulnerability of the water supply system to drought, in time and space.

For our case study the model results show that the safety of the water supply system mainly relies on the reservoirs capacity and that the foreseen exploitation of the Apennine springs for drinking water supply could be seriously limited by the discharge natural decrease in fall. A decrease of the water system vulnerability to drought determined by a hypothetical but feasible mitigation option (augmentation of the total reservoir capacity with small reservoirs) was positively tested by the model. As a conclusion, vulnerability indices as well as synoptic risk maps, appear to be useful tools in order to analyze model results. Additionally they could provide scientific based scenarios to be used in a decision making framework considering negotiating among the main users.