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WARGI: a Tool for Water System Drought Mitigation within EU and National Projects

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Even if Mediterranean regions have frequently experienced drought events in last 20 years, the definition of a comprehensive drought management plan with clear objectives and tools is still far to be achieved. Currently, the common response to droughts includes expensive measures to minimize its impacts once the drought occurs instead of a planning strategy to reduce system vulnerability with a set of structural and non structural measures, and to improve the effectiveness of these measures to face drought. Likely, the achievement of a large consensus on a drought plan is the main goal for those responsible for managing the resources in those systems. In our view, the definition and implementation of severe measures in advance is a good way to reduce conflicts among users. Nevertheless, when pre-emptive measures are taken before the drought events the level and the timing of these measures are critical aspects. Computer modeling provides a way of predicting the future behaviour of water systems (Loucks, 1992), and to reach a common understanding and agreement on what should be done when drought occurs.

A methodology to reach the best combination of mitigation measures has been developed by the University of Cagliari (Italy) within the SEDEMED II Project (2003) operating in the INTERREG IIIB MEDOCC framework. SEDEMED II has involved 13 international partners from Southern Europe and Northern Africa with the aim of defining and spreading shared standards and techniques which permit to prevent and mitigate drought events on different spatial scales.

The proposed methodology is a full integration of optimization and simulation model implemented in the WARGI (WAter Resources Graphical Interface) (Sechi and Sulis, 2007) decision support system. The exploratory power of the optimization model allows to dynamically defining a set of pre-emptive measures under a large set of future hydrological and demand scenarios that the water system might experience. The optimization model assures a good balance between the effectiveness and costs of these measures and avoids the implementation of unnecessary early restriction on demands or too late and no effective measures. The simulation model analyses these set of measures and adopts additional measures during the drought event particularly in the case of a drought more severe than in the past. The proposed approach has been under test in the South Sardinia water system within the SEDEMED II Project and in the Agri-Sinni water system (South Italy) within a national research project (PRIN, 2005).

Particularly in complex systems as the South Sardinia with a large set of representative hydrological and demand scenarios, the search of the best combination of mitigation measures worthy to be simulated might be time consuming. In such cases, the proposed approach might require more advanced computing resources.

GRIDs allocate the computational power of a large number of computers to solve large-scale problems and involve sharing and virtualizing computing resources located in
different places and connected by a network. The goal is to scale the problem so that each computing resource can make a useful contribution. When WARGI is interfaced with a GRID, each deterministic optimization problem based on a particular demand and hydrological scenario is analyzed by a different computing element of the GRID. Problem submission, and retrieving information and outputs are performed by GRID services in a user friendly manner. In the search of the best combination of drought mitigation measures, preliminary applications to the South Sardinia water system show:

1. Significant time and resource saving;
2. Higher resilience in the case of failure of a single computing element;
3. Easy access to distributed information stored in different places.

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