Geophysical Research Abstracts
Vol. 15, EGU2013-8920, 2013
EGU General Assembly 2013

Generalized DSS shell for developing simulation and optimization hydro-economic models of complex water resources systems

Manuel Pulido-Velazquez (1), Antonio Lopez-Nicolas (1), Julien J. Harou (2), and Joaquin Andreu (1)

(1) Research Institute of Water and Environmental Engineering (IIAMA), Universitat Politècnica de València, Valencia,. Spain, (2) Dept. of Civil, Environmental and Geomatic Engineering, University College London, London, UK

Hydrologic-economic models allow integrated analysis of water supply, demand and infrastructure management at the river basin scale. These models simultaneously analyze engineering, hydrology and economic aspects of water resources management. Two new tools have been designed to develop models within this approach: a simulation tool (SIM_GAMS), for models in which water is allocated each month based on supply priorities to competing uses and system operating rules, and an optimization tool (OPT_GAMS), in which water resources are allocated optimally following economic criteria.

The characterization of the water resource network system requires a connectivity matrix representing the topology of the elements, generated using HydroPlatform. HydroPlatform, an open-source software platform for network (node-link) models, allows to store, display and export all information needed to characterize the system. Two generic non-linear models have been programmed in GAMS to use the inputs from HydroPlatform in simulation and optimization models.

The simulation model allocates water resources on a monthly basis, according to different targets (demands, storage, environmental flows, hydropower production, etc.), priorities and other system operating rules (such as reservoir operating rules). The optimization model's objective function is designed so that the system meets operational targets (ranked according to priorities) each month while following system operating rules. This function is analogous to the one used in the simulation module of the DSS AQUATOOL. Each element of the system has its own contribution to the objective function through unit cost coefficients that preserve the relative priority rank and the system operating rules. The model incorporates groundwater and stream-aquifer interaction (allowing conjunctive use simulation) with a wide range of modeling options, from lumped and analytical approaches to parameter-distributed models (eigenvalue approach). Such functionality is not typically included in other water DSS. Based on the resulting water resources allocation, the model calculates operating and water scarcity costs caused by supply deficits based on economic demand functions for each demand node.

The optimization model allocates the available resource over time based on economic criteria (net benefits from demand curves and cost functions), minimizing the total water scarcity and operating cost of water use. This approach provides solutions that optimize the economic efficiency (as total net benefit) in water resources management over the optimization period.

Both models must be used together in water resource planning and management. The optimization model provides an initial insight on economically efficient solutions, from which different operating rules can be further developed and tested using the simulation model. The hydro-economic simulation model allows assessing economic impacts of alternative policies or operating criteria, avoiding the perfect foresight issues associated with the optimization. The tools have been applied to the Jucar river basin (Spain) in order to assess the economic results corresponding to the current modus operandi of the system and compare them with the solution from the optimization that maximizes economic efficiency.

Acknowledgments:
The study has been partially supported by the European Community 7th Framework Project (GENESIS project, n. 226536) and the Plan Nacional I+D+I 2008-2011 of the Spanish Ministry of Science and Innovation (CGL2009-13238-C02-01 and CGL2009-13238-C02-02).