Geophysical Research Abstracts
Vol. 17, EGU2015-9859, 2015
EGU General Assembly 2015


# Applying SDDP to very large hydro-economic models with a simplified formulation for irrigation: the case of the Tigris-Euphrates river basin.

Charles Rougé and Amaury Tilmant
Université Laval, Québec, Canada (charles.rouge@gmail.com)

Stochastic dual dynamic programming (SDDP) is an optimization algorithm well-suited for the study of large-scale water resources systems comprising reservoirs – and hydropower plants – as well as irrigation nodes. It generates intertemporal allocation policies that balance the present and future marginal value of water while taking into account hydrological uncertainty. It is scalable, in the sense that the time and memory required for computation do not grow exponentially with the number of state variables. Still, this scalability relies on the sampling of a few relevant trajectories for the system, and the approximation of the future value of water through cuts –i.e. hyperplanes – at points along these trajectories. Therefore, the accuracy of this approximation arguably decreases as the number of state variables increases, and it is important not to have more than necessary.

In previous formulations, SDDP had three types of state variables, namely storage in each reservoir, inflow at each node and water accumulated during the irrigation season for each crop at each node. We present a simplified formulation for irrigation that does not require using the latter type of state variable. It also requires only two decision variables for each irrigation site, where the previous formulation had four per crop – and there may be several crops at the same site. This reduction in decision variables effectively reduces computation time, since SDDP decomposes the stochastic, multiperiodic, non-linear maximization problem into a series of linear ones. The proposed formulation, while computationally simpler, is mathematically equivalent to the previous one, and therefore the model gives the same results. A corollary of this formulation is that marginal utility of water at an irrigation site is effectively related to consumption at that site, through a piecewise linear function representing the net benefits from irrigation. Last but not least, the proposed formulation can be extended to any type of consumptive use of water beyond irrigation, e.g., municipal, industrial, etc

This slightly different version of SDDP is applied to a large portion of the Tigris-Euphrates river basin. It comprises 24 state variables representing storage in reservoirs, 28 hydrologic state variables, and 51 demand nodes. It is the largest yet to simultaneously consider hydropower and irrigation within the same river system, and the proposed formulation almost halves the number of state variables to be considered.