COPING WITH CLIMATE VARIABILITY IN OPTIMIZING SUSTAINABLE WATER SUPPLY MANAGEMENT

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Tampa Bay Water, a wholesale water supplier, provides 180 mgd potable water needs for over 2 million people in the Northern Tampa Bay area of Florida. Since 1999, the agency has been using deterministic optimization model to manage eleven wellfields under the Optimized Regional Operations Plan (OROP). Since that time Tampa Bay Water's supply source have increased to include new groundwater wells, three surface water withdrawals, one regional reservoir, and one desalination plant in addition to the interconnected regional wellfields of about 150 production wells. This paper presents the framework for the next generation of the OROP model, a reliability-based water supply management model that utilizes stochastic optimization techniques to account for uncertainties. These uncertainties include the prediction of water demands, surface water availabilities, baseline groundwater levels, non-anthropogenic reservoir water budget, and hydrogeologic properties. Except for hydrogeologic properties, the uncertainties are largely affected by the climate variability. The primary management goal considered under this framework is to protect wetland ecology and prevent seawater intrusion while satisfying water demands. The developed method maximizes the reliability of achieving this goal. The framework involves (1) a distribution system simulation model to represent the water supply operation under the OROP; (2) a Monte Carlo simulation model to generate climate dependent realizations of water demands, surface water availabilities, and projected groundwater levels; and (3) a unit response matrix (URM) that relates groundwater level response to groundwater extraction. An operations simulator is a rule-based model that imitates how water treatment plant operators adjust the optimized groundwater production, surface water withdrawal, and reservoir inflow/outflow to meet the continuous and variable water demand. The resulting stochastic optimization model is solved in two stages. The inner iteration solves the operations simulator using linear programming and the outer iteration solves the reliability optimization problem using a differential evolutionary algorithm.
Key words: Water Resources Management, Climate, Uncertainty, Water Allocation, Groundwater, Stochastic Optimization, Reliability.