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Simulation-optimization of large agro-hydrosystems using a decomposition approach

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In this contribution a stochastic simulation-optimization framework for decision support for optimal planning and operation of water supply of large agro-hydrosystems is presented. It is based on a decomposition solution strategy which allows for (i) the usage of numerical process models together with efficient Monte Carlo simulations for a reliable estimation of higher quantiles of the minimum agricultural water demand for full and deficit irrigation strategies at small scale (farm level), and (ii) the utilization of the optimization results at small scale for solving water resources management problems at regional scale. As a secondary result of several simulation-optimization runs at the smaller scale stochastic crop-water production functions (SCWPF) for different crops are derived which can be used as a basic tool for assessing the impact of climate variability on risk for potential yield. In addition, microeconomic impacts of climate change and the vulnerability of the agro-ecological systems are evaluated. The developed methodology is demonstrated through its application on a real-world case study for the South Al-Batinah region in the Sultanate of Oman where a coastal aquifer is affected by saltwater intrusion due to excessive groundwater withdrawal for irrigated agriculture.