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Stochastic simulation-optimization framework for energy cost assessment across the water supply system of Athens

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The water supply of Athens is implemented through a complex hydrosystem, including four reservoirs, 350 km of main aqueducts, 15 pumping stations, more than 100 boreholes and 5 small hydropower plants. The management of this system is subject to multiple complexities and uncertainties, as well as conflicts between different water uses and environmental constraints. Yet, the key challenge arises from the need to minimize the operational cost of the system, mainly induced to energy consumption across pumping stations and boreholes, at the same time retaining its long-term reliability at the acceptable level of 99%, on annual basis. In general, the energy cost is low, since most of raw water is abstracted and conveyed via gravity, yet occasionally this may be substantially increased, due to the activation of auxiliary resources that require intense use of pumping stations. In order to assess this cost for several water demand scenarios and reliability levels, taking into account all aforementioned issues, we employ a stochastic simulation – optimization framework, implemented within the recently updated version of Hydronomeas software. The outcomes of these analyses are next used in order to estimate the cost of raw water arriving at the metropolitan area of Athens, as function of demand and reliability.