Geophysical Research Abstracts
Vol. 20, EGU2018-12110, 2018
EGU General Assembly 2018

Handling the computation effort of time-demanding water-energy simulation models through surrogate approaches

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We investigate the computational challenges of a model for the integrated simulation – optimization of water and renewable energy fluxes, based on an example (hypothetical) hybrid water – energy system at a small non-connected island (Astypalaia, Greece). The system consists of a hydroelectric reservoir with pumped storage facilities, connected with system of wind and solar power plants. The model runs on hourly time step, using as inputs rainfall and temperature data, data for the water supply, irrigation and electric energy demands, as well as energy production data from wind and solar resources. The reservoir system attempts to fulfill the two water demands and regulate the energy excesses and deficits. Due to the fine time step of calculations and the use of synthetic time series of long horizon, the computational burden of simulation runs in an optimization framework is significant. In an attempt to minimize the computational load, particularly in optimizations, we investigate the use of surrogate approaches, through black-box sub-models (e.g., neural networks) that represent autonomous parts of the whole simulation procedure. The outcomes of surrogate models are compared with the corresponding outputs of the original model.