Geophysical Research Abstracts, Vol. 5, 09255, 2003

CALIBRATION OF A CONJUNCTIVE SURFACE-GROUNDWATER SIMULATION MODEL USING MULTIPLE RESPONSES

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A multi-cell semi-distributed model was developed to simulate the hydrological processes of the Boeoticos Kephisos river basin and its underlying karst. The whole system (surface and underground) provides water for local irrigation use as well as for the supply of Athens. Moreover, the basin outflow, a significant part of which comes from karstic springs, feeds Lake Yliki, one of the three main supply reservoirs of Athens. The model consists of a set of interconnected cells. Each cell is further divided into a surface and a ground water sub-cell. The former is modelled as a soil moisture reservoir, with precipitation and potential evapotranspiration as inputs, and surface runoff, actual evapotranspiration and deep percolation as outputs. The groundwater sub-cell operates according to DarcyŠs law; it accepts percolation and lateral flow as inputs, and yields lateral outflow to adjacent cells or the sea, spring runoff and water abstractions as outputs. A heuristic evolutionary optimisation algorithm, where a generalised downhill simplex scheme is coupled with a simulated annealing strategy, is applied to calibrate the model. The model calibration is based on a multi-objective approach, aiming at fitting the historical hydrographs, which are available at the basin outlet and the main spring sites, to the simulated ones. Extended analysis illustrated that the uncertainty of parameters is much larger for the groundwater subsystem, mainly due to the existence of non-measurable outflows to the sea. Hence, the selection of the best-compromise parameter set is based on empirical estimations of the location and magnitude of losses to the sea.