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Case study for the identification and evaluation of rainfall-runoff models

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We investigate the modeling assumptions used in two rainfall-runoff models, namely the model ENNS (Nachtnebel et al., 1993) and the model MIKE SHE (http://www.dhigroup.com/), and study how those assumptions affect the effectiveness and quality of model fitting and runoff simulation. To avoid artificial effects caused by simplifications in the original ENNS runoff equations, a new version of the ENNS code is developed that is fully compatible with the corresponding equations used in MIKE SHE.

The two models are applied in a real-word case study, using 19-year long historical time-series of daily precipitation, temperature and runoff from Glafkos river basin. The latter is located near the city of Patras, in Peloponnese, Greece. Both models are manually calibrated using eleven years of the available data, whereas the remaining part of the data is used for model validation. The effectiveness of the models to simulate the runoff process is evaluated using statistical and water-balance based criteria.

While both models describe the base- and inter-flow hydrological processes using the same conceptual model of linear reservoirs, they use different modeling assumptions to describe surface runoff and groundwater flow in the unsaturated zone. To that extent, the presented comparison sheds light to (a) the effectiveness of each modeling assumption to describe surface runoff and groundwater flow in the unsaturated zone, (b) the quality of model calibration, and (c) the optimality and robustness of the estimated parameters, common to the two models (thickness of the unsaturated zone, water content, field capacity, wilting point etc.).

Ways to combine results from the two models to study the epistemic variability of the simulated runoff, due to uncertainties in model parameter estimation, are also discussed.