Analysis of the spatial variation in the parameters of the SWAT model with application in Flanders, Northern Belgium

G. Heuvelmans, B. Muys, and J. Feyen
Department of Land Management, Katholieke Universiteit Leuven, Vital Decosterstraat 102, B-3000 Leuven, Belgium
Email for corresponding author: griet.heuvelmans@agr.kuleuven.ac.be

Abstract. Operational applications of a hydrological model often require the prediction of stream flow in (future) time periods without stream flow observations or in ungauged catchments. Data for a case-specific optimisation of model parameters are not available for such applications, so parameters have to be derived from other catchments or time periods. It has been demonstrated that for applications of the SWAT in Northern Belgium, temporal transfers of the parameters have less influence than spatial transfers on the performance of the model. This study examines the spatial variation in parameter optima in more detail. The aim was to delineate zones wherein model parameters can be transferred without a significant loss of model performance. SWAT was calibrated for 25 catchments that are part of eight larger sub-basins of the Scheldt river basin. Two approaches are discussed for grouping these units in zones with a uniform set of parameters: a single parameter approach considering each parameter separately and a parameter set approach evaluating the parameterisation as a whole. For every catchment, the SWAT model was run with the local parameter optima, with the average parameter values for the entire study region (Flanders), with the zones delineated with the single parameter approach and with the zones obtained by the parameter set approach. Comparison of the model performances of these four parameterisation strategies indicates that both the single parameter and the parameter set zones lead to stream flow predictions that are more accurate than if the entire study region were treated as one single zone. On the other hand, the use of zonal average parameter values results in a considerably worse model fit compared to local parameter optima. Clustering of parameter sets gives a more accurate result than the single parameter approach and is, therefore, the preferred technique for use in the parameterisation of ungauged sub-catchments as part of the simulation of a large river basin.

Keywords: hydrological model, regionalisation, parameterisation, spatial variability

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