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Methodology for construction, calibration and validation of a national hydrological model for Denmark

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Abstract

An integrated groundwater/surface water hydrological model with a 1 km^2 grid has been constructed for Denmark covering 43,000 km^2. The model is composed of a relatively simple root zone component for estimating the net precipitation, a comprehensive three-dimensional groundwater component for estimating recharge to and hydraulic heads in different geological layers, and a river component for streamflow routing and calculating stream–aquifer interaction. The model was constructed on the basis of the MIKE SHE code and by utilising comprehensive national databases on geology, soil, topography, river systems, climate and hydrology. The present paper describes the modelling process for the 7330 km^2 island of Sjælland with emphasis on the problems experienced in combining the classical paradigms of groundwater modelling, such as inverse modelling of steady-state conditions, and catchment modelling, focussing on dynamic conditions and discharge simulation. Three model versions with different assumptions on input data and parameter values were required until the performance of the final, according to pre-defined accuracy criteria, model was evaluated as being satisfactory. The paper highlights the methodological issues related to establishment of performance criteria, parameterisation and assessment of parameter values from field data, calibration and validation test schemes. Most of the parameter values were assessed directly from field data, while about 10 'free' parameters were subject to calibration using a combination of inverse steady-state groundwater modelling and manual trial-and-error dynamic groundwater/surface water modelling. Emphasising the importance of tests against independent data, the validation schemes included combinations of split-sample tests (another period) and proxy-basin tests (another area).

Keywords: Groundwater models; Surface water; Large scale; Performance criteria; Calibration; Validation tests