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Distributed conceptual modelling considering sub-grid variability of land use in a mesoscale lowland catchment in Sweden

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A distributed version of a conceptual runoff model, the HBV model, was applied in the Fyrisån catchment in Sweden using 50-by-50 m grid cells and a daily time step. Key elements for the spatial distribution were obtained from the TAC^D model and separate parameterisations were used in the runoff generation routine for dominant land use classes. To account for small-scale landscape features of the catchment the model was equipped with a sub-grid parameterisation scheme and simple conceptual lake and flow distribution routines. Calibration of the model was achieved against measured runoff at two stations by coupling the model to the automated parameter estimator PEST.

Model validation included split-sample test, proxy-basin test, evaluation against synoptic runoff measurements and the comparison with a lumped HBV model. The evaluation revealed an overall good model performance and a conceptual reasonable simulation of spatial distributed hydrologic conditions in the Fyrisån catchment, but also indicated weaknesses of the model. The sub-grid parameterisation scheme allowed a correct representation of small scale land use patterns, such as wetlands, within the catchment while the lake and flow distribution routines captured the runoff dynamics adequately.

The results further demonstrated the importance of a thorough model evaluation procedure and showed that the comparison with a hydrologic benchmark models, such as

the lumped HBV model, was crucial to gain insight in the model performance. The additional use of synoptic data allowed to add a spatial component to the validation process and proofed to be a feasible method in a multi-scale validation strategy.