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Investigation of the Transferability of Hydrological Models

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Uncertainty in the results of hydrological models can be due to different reasons. Besides the uncertainty of input and output measurements, there also exists the incertitude of model structure, process representation and parameter estimation. Often such errors are not noticed. This is especially crucial when a model is to be used for predictions outside the calibration conditions in systems with non-linear behaviour. We tested a method that seems to be able to avoid systematic model errors during the calibration period. In order to find a model parameterization such that the model performs well on different events, appropriate model performance measures have to be determined. A common performance measure is the Nash Sutcliffe efficiency. Usually it is performed between observed and modelled daily values. We modified it in order to calibrate a model on different time scales at the same time (days up to years).

A spatially distributed hydrological model based on HBV concept was used. The modelling was applied on the Upper Neckar catchment, a mesoscale river in south western Germany with a basin size of about 4,000 km2. The catchment was divided into 13 subcatchments. In order to assess the transferability, the hydrological model was calibrated on different climatic periods and then validated on other climatic periods. Thus, different 10-years periods with different climatic conditions were compiled: 10 cold, 10 warm, 10 wet and 10 dry years from the time series 1961 - 1990 were collected. The first step of validation was to adapt the model to the same period it was calibrated to. Then the model was applied to other 10 years, e.g. the model calibrated on the cold years was used on the warm years. Parameter sets were optimized by an automatic calibration procedure based on Simulated Annealing. The results show, that calibrating a hydrological model that is supposed to handle short as well as long term signals becomes an important task. Special attentiveness has to be focussed on the choice of the objective function.