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Effect of Parametrization in a Grid based mesoscale Hydrologic model on the Streamflow Prediction

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Distributed hydrologic models have the potential to simulate the spatial distribution of hydrological processes and provide the estimate on streamflow at all points along the river network within the catchment. While such models can explain the variability of spatially distributed hydrological process, they have often complex structure and contains significant number of unknown model parameters that need to be defined for every spatial element. To reduce the complexity of these models, in terms of number of free parameters that need to be estimated through the calibration process, several parametrization schemes have been introduced in the recent past.

The purpose of this study is to investigate and compare the performance of two different parameterization schemes, namely: Hydrological Response Units (HRU) and Multiscale Parameter Regionalization (MPR) employed in the grid based mesoscale Hydrologic Model (mHM), for the daily streamflow prediction. The HRU concept works on the basis that groups the modeling cells, in which the dominant hydrological processes are represented, into homogenous units based on the available catchment characteristics (elevation, slope, landcover, soil textural information, geological characteristics, etc). The unique sets of parameters are assigned to each HRU through the calibration process. In the case of the MPR method the model parameters at coarser resolution (modeling cell) are linked to their corresponding ones at a finer scale, in which the datasets are available, through upscaling operators such as harmonic mean, average mean, amongst others. Parameters at the finer scale are linked to catchment characteristics through different nonlinear transfer functions. The global parameters (very few as compared to the total number of free parameters) of these transfer functions are found via calibration process.

The proposed study was carried in the upper catchment of the Neckar River (Germany) covering an area of approximately 4000 km^2. The finer and coarser resolution were fixed at (100 $\times$ 100) m and (4000 $\times$ 4000) m, respectively. The modeling cells at the coarser resolution were grouped into 15 HRUs by k-means clustering algorithm. The free parameters of both parametrization schemes were calibrated with the simulated annealing algorithm using the discharge data of the catchment outlet. Results obtained in this study indicated that the MPR method is more robust and reliable than the HRU method. The Nash Sutcliffe Efficiency (NSE) of the MPR method at the calibration and internal gauging stations were on average 5% and 10% greater than that obtained with the HRU method but has 60% less free parameters to calibrate.