IAHS2017-101
IAHS Scientific Assembly 2017

Predictions in ungauged basins and parsimony in calibration parameters

Thomas Skaugen (1), Ivar Olaf Peerebom (1), and Anna Nilsson (2)

(1) Norwegian Water Resources and Energy Directorate, Hydrology, Oslo, Norway (ths@nve.no), (2) Centre for ecological and Evolutionary Synthesis, Dept. of Biology, University of Oslo, Norway

Prediction in ungauged basins (PUB) is necessary for many applications in society and is a demanding, but necessary test for hydrological model structures. Ideally, the relationship between model parameters and catchment characteristics (CC) should be hydrologically justifiable. Many studies, however, report on failure to obtain significant correlations between model parameters and CC's. In this study we investigate if new formulations of hydrological processes in a rainfall-runoff model in which the parameters are determined from observed rainfall variability, mean annual runoff and recession analysis and not calibrated as a set against runoff give better results with respect to correlation between CC's and model parameters and PUB. A model for the spatial distribution of snow water equivalent derived from observed spatial variability of precipitation and an estimate of the capacity of subsurface reservoir derived from mean annual runoff and recession analysis are implemented in the rainfall-runoff model DDD (Distance Distribution Dynamics). The DDD model has a very modest number of calibration parameters. For example, the runoff dynamics is completely parameterized from characteristics derived from digitized maps and runoff recession analysis. Results from the new DDD is compared against those of a previous version where parameters of the spatial distribution of SWE and the subsurface reservoir were calibrated against runoff. Multiple regression equations relating CC's and model parameters were trained from 111 calibrated catchments located from all over Norway and model parameters showed significant correlation with CC's. The significant correlation coefficients (with p- value < 0.01) ranged in absolute values between 0.26-0.6. The coefficient of determination for estimating the model parameters ranged between 0.2-0.6, and were higher compared to those obtained using the previous, more calibrated, version of DDD. The skill of the new DDD for PUB was tested for 25 catchments not used to estimate the multiple regression equations. Mean values for Nash-Sutcliffe (NSE) and Kling-Gupta efficiency criterion were 0.7 and 0.81 respectively and the mean difference in NSE between calibrated and PUB versions of DDD for the 25 catchments was 0.07 which is a reduction by nearly 50% compared to results by the previous version of DDD. Hence, reducing the number of calibration parameters in DDD improved its skill for PUB.