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Assessment of the indirect calibration of a rainfall-runoff model for ungauged catchments in Flanders

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Abstract

In this research the potential of discharge-based indirect calibration of the Probability Distributed Model (PDM), a lumped rainfall-runoff (RR) model, is examined for six selected catchments in Flanders. The concept of indirect calibration indicates that one has to estimate the calibration data because the catchment is ungauged. A first case in which indirect calibration is applied is that of spatial gauging divergence: Because no observed discharge records are available at the outlet of the ungauged catchment, the calibration is carried out based on a rescaled discharge time series of a very similar donor catchment. The latter is selected out of a catchment population on the basis of a dissimilarity measure which takes in account the mutual catchment distance and differences in drainage area, land topography, soil composition and land cover. Both a calibration in the time domain and the frequency domain (a.k.a. spectral domain) are carried out. Furthermore, the case of temporal gauging divergence is considered: Limited (e.g. historical or very recent) discharge records are available at the outlet of the ungauged catchment. Additionally, no time overlap exists between the forcing and discharge records. Therefore, only an indirect spectral calibration can be performed in this case. To conclude also the combination case of spatio-temporal gauging divergence is considered. In this last case only limited discharge records are available at the outlet of a donor catchment. Again the forcing and discharge records are not contemporaneous which only makes feasible an indirect spectral calibration. The post calibration model performance is assessed using four indicators: the Pearson correlation coefficient (R), the relative absolute bias (BIASn), the relative Root Mean Square Error (RMSEn) and the Nash-Sutcliffe coefficient (NS). The modelled discharge time series are found to be acceptable in all three considered cases. In the case of spatial gauging divergence, indirect temporal calibration results in a slightly better model performance than indirect spectral calibration. Furthermore, indirect spectral calibration in the case of temporal gauging divergence leads to a better model performance than indirect spectral calibration in the case of spatial gauging divergence. Finally, the combination of spatial and temporal gauging divergence does not necessarily lead to a worse model performance compared to the separate cases of spatial and temporal gauging divergence.