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# Assessment of the effect of different weight combinations of objective function on the performance and time stability of hydrologic model parameters

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Rainfall-runoff models are common tools for estimation of water balance components. In order to use these models in practical water resources studies, careful calibration is required. Uncertainty linked with the model calibration is a hot topic in various modeling studies. Several studies demonstrated that the use of different variants of objective functions in model calibration can improve the representation of hydrological processes.
The main goal of this study is to assess the effects of different weighting schemes of objective function on the performance and time stability of the hydrologic model parameters related to snow. This study is carried out by a lumped conceptual rainfall-runoff model (the TUW model). This model was calibrated separately for three different climatic periods (1981-1990, 1991-2000, 2001-2010). Seven variants of weights (ws), i.e. from ws = 0 (calibration to runoff only) to ws = 1 (calibration to runoff and snow cover) were employed to evaluate the effect of objective function used for the model calibration. This methodology was tested for 213 catchments in Austria. To draw more general conclusions the catchments were delineated into two large groups, i.e. catchments with a dominant snow regime (71) and the catchments with a dominant soil moisture regime (142). This was done by parameter sensitive study. The model performance was quantified by three metrics (i.e. the Nash-Sutcliffe efficiency – NSE, the volume error – VE, and the error related to snow – SN). The results showed that the model performance in terms of all three metrics decrease when we move from the weight 0 to the weight 1. In other words, the values of SN are lower when high weight is given to snow. The results also indicate that the values of SN are higher in 2001-2010 which represents a warmer period (it is true for both groups of catchments). In catchments with a snow regime the model tended to overestimate runoff (in all three calibration periods). On the contrary, in catchments with a soil moisture regime the model slightly overestimated runoff, mostly in the periods 1991-2000 and 2001-2010.
An analysis of stability of the model parameters indicate that the trend in the values of the model parameters is clearly related to the weights. For example, the values of the degree-day melt parameter (DDF) increase when high weight is given to snow. This trend is more pronounced in catchment with a dominant snow regime (i.e. alpine catchments). Generally, the values of DDF are lower in 2001-2010 (this trend is more pronounced in snow catchments) which can be caused by warmer conditions in this period.

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