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Hydrological Model Supported by a Step-Wise Calibration against Sub-Flows and Validation of Extreme Flow Events

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Abstract

Most hydrological models have fixed structures and their calibrations are typified by a conventional approach in which the overall water balance closure is considered (without a step-wise focus on sub-flows' variation). Eventually, hydrological modelers are confronted with the difficulty of ensuring both the observed high flows and low flows are accurately reproduced in a single calibration. This study introduced Hydrological Model focusing on Sub-flows' Variation (HMSV). Calibration of HMSV follows a carefully designed framework comprising sub-flow's separation, modeling of sub-flows, and checking validity of hydrological extremes. The introduced model and calibration framework were tested using hydro-meteorological data from the Blue Nile Basin of Ethiopia in Africa. When the conventional calibration approach was adopted through automatic optimization strategy, results from the HMSV were found highly comparable with those of five internationally well recognized hydrological models (AWBM, IHACRES, SACRAMENTO, SIMHYD, and TANK). The new framework enhanced the HMSV performance for reproducing quantiles of both high flows and low flows. The combination of flow separation and step-wise calibration of hydrological model against sub-flows enhances the modeler's physical insight in identifying which areas need focus in modeling to obtain meaningful simulation results, especially of extreme events. The link for downloading the HMSV is provided. View Full-Text

Keywords: rainfall-runoff model; Blue Nile; baseflow separator; discharge splitting; hydrological model; hydrological extremes; high flows; low flows; conceptual model

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