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Hydrological regionalization of ungauged catchments in the Ethiopian Blue Nile River Basin based on different calibration strategies

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The Upper Blue Nile River Basin has high potential for irrigation, hydropower and other water resource developments for Ethiopia. However, because of the extensive use and high demand of domestic water due to population increase, lack of proper water resource planning, highly variable discharge and groundwater levels as well as user conflicts between upstream and downstream, detailed investigation is inevitable. Recently, the government of Ethiopia is stretching its economic development in all 14 subcatchments of the Upper Blue Nile. A number of computer models were developed in the past to simulate runoff for the basin despite the fact that the results of simulation from the models are inconsistent due to spare input data.

A validated hydrological model is supposed to give a reliable prediction of water availability in future and at ungauged subcatchments. The HBV light model, developed by the University of Zurich for educational purposes with slight changes after Bergström (1992 and 1995), is a semi-distributed lumped hydrological model which simulates catchment runoff.

The main purpose of this research was to simulate small ungauged subcatchments and to investigate a reliable regionalization in order to represent the whole basin. The feasibility and performance of HBV light model was tested in the Upper Blue Nile Basin where the data are scarce and data quality is questionable.

Despite proper input data, the model results depend on the calibration within reasonable parameter intervals. However, the well-known phenomenon of equifinality of hydrological models makes it difficult to determine a "right" parameter set. Different optimization methods (GLUE, MCMC, PSO, SCE-UA, AMALGAM) have been used for different subcatchments of the Blue Nile yielding to different parameter sets. The validation results show remarkable differences but they do not give obvious advice for a preferable model set.

In order to get out of this dilemma and to analyze the uncertainty, a weighting system for different results are introduced which gives a reliable and robust estimation how regionalization can be applied best. This method may help to optimize the water management of the Blue Nile Basin.