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Possibilities and limitations of regional hydrological models applied within an environmental change study in Benin (West Africa)

Bormann, H.*; Diekkrüger, B.

Hydrology Research Group, Department of Geography, University of Bonn
*h.bormann@uni-bonn.de

ABSTRACT: The main goal of the hydrological part within the IMPETUS project ('an integrated approach to the efficient management of scarce water resources in West Africa') is the prediction of environmental change effects on the water cycle and the water availability of regional scale West African catchments. As a prognosis of possible environmental change effects on hydrology has to be based on scenario analyses, an appropriate regional hydrological model is required. Therefore a preliminary goal is the adaptation and validation of a regional hydrological model in the target region. Due to the fact that a validation of spatially distributed simulation results is not feasible at the regional scale, two different strategies of modelling regional water fluxes are followed. First a multi scale approach is proposed. Based on highly resolved pedological and hydrological measurements at the local scale (30 km^2) a parameterisation scheme for the spatially distributed TOPLATS approach is developed. After validation at the local scale regional model applications based on parameterisation rules developed at the local scale are performed at the regional scale where only gauge data are available for comparison. Due to data and parameter uncertainty and the fact that the distributed model cannot be calibrated at the regional scale, the model results remain uncertain. For comparison a simplified, lumped model approach is applied directly at the regional scale. The model requires less input data and seems to be more robust with regard to input data and model parameter uncertainties which is mainly due to the fact that uncertainties and errors are smoothed out by the calibration. As it can be calibrated a noticeable better correlation between observed and simulated discharges is obtained because also data uncertainties are calibrated. While a good prediction of the discharge at the regional scale can more easily be obtained by applying the simplified model, environmental change scenario analyses require that land cover change is considered as detailed as possible. Therefore, distributed approaches are still indispensable although model calibration often fails. Model parameter and data uncertainties have to be taken into account and have to be quantified.