Geophysical Research Abstracts
Vol. 14, EGU2012-2292-1, 2012
EGU General Assembly 2012

Assessing possibilities of reducing the uncertainty related to climate change impact studies

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As a prerequisite for the development and formulation of water related climate change adaptation strategies, the impact of climate change on the water balance has to be determined at the river catchment scale. For this purpose, stepwise coupled models (global emission scenario -> global climate model -> regional climate model -> hydrological model) are generally used, in which however, every item is afflicted with uncertainties which amplify themselves throughout the model chain. In this study, the resulting uncertainty bounds are analysed and methods proposed to reduce their extent.

In order to achieve this, the impact of climate change on the water balance was simulated using two conceptually different models (HBV-light, WaSiM-ETH) for a headwater subcatchment of the river Spree (Weißer Schöps, 135 km^2). This subcatchment was chosen because it is not affected by water management measures and therefore suitable for the calibration and validation of hydrological models. After calibration and validation, the hydrological models were driven by the meteorological variables of different regional climate models (STAR, WETTREG, REMO) which are all based on the global climate model ECHAM5, emission scenario A1B. The analysis focuses on the difference of the water balance components between the reference period (1961-1990) and the scenario period (2031-2060).

The results indicate that future temperature trends are quite robust for the catchment; however, the uncertainty regarding future precipitation is large, especially between dynamic and statistical regional climate models. While the statistical regional climate models STAR and WETTREG show a reduction in precipitation, REMO, the dynamic regional climate model, predicts an increase. As a consequence, when driving the hydrological models with STAR and WETTREG, a reduction in precipitation and runoff and an increase in potential and actual evapotranspiration is simulated. Unlike that, HBV-light driven by REMO simulates an increase in all water balance components and WaSiM-ETH in all except runoff. This implies that there also exist distinct differences between the results of the two conceptually different hydrological models (when driven by the same regional climate model) which raises the question whether the water balance simulation is stronger affected by the choice of the hydrologic model than through the regional climate model.

The results and the uncertainties revealed must be considered in the formulation of climate change adaptation strategies.