Geophysical Research Abstracts
Vol. 19, EGU2017-1455, 2017
EGU General Assembly 2017


# Hydrological modeling as an evaluation tool of EURO-CORDEX climate projections and bias correction methods

Kirsti Hakala (1), Nans Addor (2), Jan Seibert (1,3)

(1) Department of Geography, University of Zurich, Zurich, Switzerland, (2) National Center for Atmospheric Research, Boulder, Colorado, USA, (3) Department of Earth Sciences, Uppsala University, Uppsala, Sweden

Streamflow stemming from Switzerland's mountainous landscape will be influenced by climate change, which will pose significant challenges to the water management and policy sector. In climate change impact research, the determination of future streamflow is impeded by different sources of uncertainty, which propagate through the model chain. In this research, we explicitly considered the following sources of uncertainty: (1) climate models, (2) downscaling of the climate projections to the catchment scale, (3) bias correction method and (4) parameterization of the hydrological model. We utilize climate projections at the 0.11 degree ∼12.5 km resolution from the EURO-CORDEX project, which are the most recent climate projections for the European domain. EURO-CORDEX is comprised of regional climate model (RCM) simulations, which have been downscaled from global climate models (GCMs) from the CMIP5 archive, using both dynamical and statistical techniques. Uncertainties are explored by applying a modeling chain involving 14 GCM-RCMs to ten Swiss catchments. We utilize the rainfall-runoff model HBV Light, which has been widely used in operational hydrological forecasting. The Lindström measure, a combination of model efficiency and volume error, was used as an objective function to calibrate HBV Light. Ten best sets of parameters are then achieved by calibrating using the genetic algorithm and Powell optimization (GAP) method. The GAP optimization method is based on the evolution of parameter sets, which works by selecting and recombining high performing parameter sets with each other. Once HBV is calibrated, we then perform a quantitative comparison of the influence of biases inherited from climate model simulations to the biases stemming from the hydrological model. The evaluation is conducted over two time periods: i) 1980-2009 to characterize the simulation realism under the current climate and ii) 2070-2099 to identify the magnitude of the projected change of streamflow under the climate scenarios RCP4.5 and RCP8.5.

We utilize two techniques for correcting biases in the climate model output: quantile mapping and a new method, frequency bias correction. The FBC method matches the frequencies between observed and GCM-RCM data. In this way, it can be used to correct for all time scales, which is a known limitation of quantile mapping. A novel approach for the evaluation of the climate simulations and bias correction methods was then applied. Streamflow can be thought of as the "great integrator" of uncertainties. The ability, or the lack thereof, to correctly simulate streamflow is a way to assess the realism of the bias-corrected climate simulations. Long-term monthly mean as well as high and low flow metrics are used to evaluate the realism of the simulations under current climate and to gauge the impacts of climate change on streamflow.

Preliminary results show that under present climate, calibration of the hydrological model comprises of a much smaller band of uncertainty in the modeling chain as compared to the bias correction of the GCM-RCMs. Therefore, for future time periods, we expect the bias correction of climate model data to have a greater influence on projected changes in streamflow than the calibration of the hydrological model.