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Investigating the impact of correcting regional climate scenarios on the projected changes in river runoff

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In Climate Change impact research, the projection of future river runoff as well as the catchment scale water balance is impeded by different sources of predictive uncertainty. Some research has already been done in order to quantify the uncertainty of regional climate projections with regard to the applied climate models and downscaling techniques as well as the internal variability apparent in climate model member ensembles. Yet, the use of hydrological models adds another layer of incertitude. Within the QBic3 (Québec-Bavaria International Collaboration on Climate Change) project the uncertainties in the whole model chain (from global climate models to water management models) are investigated in four humid, mid-latitude catchments located in Southern Québec (Canada) and Southern Germany using an ensemble of multiple climate and hydrological models.

Although there are many options to downscale global climate projections to the regional scale, many recent impact studies have used Regional Climate Models. One reason for that is that the physical correlations between atmospheric variables is preserved, especially between temperature and precipitation. Yet, the RCM outputs often are biased compared to the observed climatology of a region, so often the biases in those outputs are corrected to reproduce historic runoff conditions, even if those corrections alter the relationship between temperature and precipitation. For those reasons, the effect of bias correction on the relative changes in runoff indicators, which identify those conditions especially important for water management decisions, is explored. If bias correction affects the conclusion, we should consider BC as a source of uncertainty. If not, there is no need to correct these biases.

The presented results highlight the analysis of daily runoff simulated with four different hydrological models in two natural-flow sub-catchments, driven by different regional climate model outputs for a reference (1971-2000) and a future (2041-2070) period. As expected, bias correction of climate model biases is important for the reproduction of the runoff regime of the past regardless of the hydrological model used. Then again, its impact on the relative change of flow indicators between reference and future period is weak for most indicators but the timing of the spring flood peak for climate scenarios with small biases. At the same time, the runoff simulated with the two most strongly biased climate scenarios was affected the most by bias correction.