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Analysis of the effects of correcting biases in RCM precipitation fields with the local intensity scaling method for a small alpine catchment

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Although regional climate models (RCMs) are a widely used and accepted tool in climate change impact research, the temporal and spatial distribution of precipitation usually has to be adjusted by a certain bias correction technique using site specific parameter sets. For small to medium sized river basins this often also includes some form of downscaling from the coarse RCM grid to the scale of the hydrological model(s) applied. Yet, because these post-processing steps alter the modeled precipitation so the physical relationships with other atmospheric variables may get lost, the uncertainty added to Climate Change impact results by bias correction and more generally any downscaling method that changes the amount of RCM precipitation has to be assessed.
Because of those reasons, within the project Q-BIC3 (Québec-Bavarian Collaboration on Climate Change) two separate methods to correct model biases and to downscale information to the hydrological scale have been chosen, which can be analyzed separately regarding their impact on a) the precipitation characteristics of the reference period 1971-2000 and b) the climate change signal over the investigated catchments. The method to correct biases is the so-called local intensity scaling (LOCI) method modified to be applied on 6-hourly precipitation fields using monthly correction factors of precipitation frequency and intensity. The downscaling of this information from the RCM grid scale (about 50 km resolution) to a catchment area of only 2814 km2 at a resolution of 1 km is accomplished by the scaling tool SCALMET, which adjusts small scale precipitation based on topography while conserving mass within any RCM grid box.
The separate analysis of correction and scaling shows that not only the catchment average monthly precipitation is improved by the LOCI method, although average precipitation is not considered in the LOCI method. Furthermore, also the 1 km scale spatial pattern is positively influenced by the correction and the number of dry days is improved which affects evapotranspiration in hydrological models positively. Finally, we show that the absolute change in precipitation between the reference and the future period is not affected by LOCI, although precipitation intensity is scaled by a multiplicative factor. Hence, because also the scaling method does not alter precipitation amounts, no additional uncertainty regarding the change signal of precipitation is introduced by these methods.