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Bias-correction for precipitation over the Alps using orographic features

Patricio Velasquez (1,2), Martina Messmer (1,2), Christoph C. Raible (1,2)

(1) Climate and Environmental Physics, University of Bern, Bern, Switzerland (velasquez@climate.unibe.ch), (2) Oeschger Centre for Climate Change Research, University of Bern, Bern, Switzerland

This work presents a new bias-correction method that considers the orographic characteristics. The correction method provides a tool to improve the accuracy of the input data, e.g. precipitation and temperature, used by the hydrological and glacier models. To present the new bias correction, we use a simulation for present day conditions performed with the Weather Research and Forecasting (WRF) model at a resolution of 2 km that is driven by the coupled model Climate Community System Model version 4 (CCSM4). The domain simulated encompasses the Alps and its forelands.

The bias correction consists of two steps: (i) separation with respect to different orographic characteristics and (ii) Empirical Quantile Mapping method. Several orographic characteristics are tested: For the first step, different height-intervals (100 or 400 meters), the slope-orientation (north, east, south and west) and the combination of both are tested. Furthermore, two observational datasets are used to assess the uncertainty related to the observational product. The Alpine region is separated in two regions, Switzerland and the rest of the Alps. Fitting the bias correction to one region and applying it to the other delivers an independent test of the quality of the method.

Focussing on precipitation, the results show that all three settings of the orographic characteristics are able to correct the biases in both regions. Hence, the mean values of precipitation over the flatlands and the annual cycle are adequately adjusted. Nonetheless, not all biases in particular those related to mountain peaks and deep valleys are corrected. One reason for these biases is that the observational dataset uncertainties, which may be more than 30% above 1500 m.a.s.l, make it impossible to obtain a fully adequate correction. In most months, the correction related to height-intervals in combination with slope-orientations amends slightly better results than just using one orographic characteristic. Still, the combined bias correction yields only a minimal gain compared to the correction related to the height-intervals only, so that the latter one seems to be the optimal choice. Thus, the new bias correction provides a flexible tool which can be also used in studies where orography strongly changes, e.g. during glacial times.