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On the distortion of elevation dependent warming signals by quantile mapping

Martin W. Jury, Thomas Mendlik, and Douglas Maraun
University of Graz, Wegener Center for Climate and Global Change, Graz, Austria (martinwolfgang.jury@edu.uni-graz.at)

Elevation dependent warming (EDW), the amplification of warming under climate change with elevation, is likely to accelerate changes in e.g. cryospheric and hydrological systems. Responsible for EDW is a mixture of processes including snow albedo feedback, cloud formations or the location of aerosols. The degree of incorporation of this processes varies across state of the art climate models.

In a recent study we were preparing bias corrected model output of CMIP5 GCMs and CORDEX RCMs over the Himalayan region for the glacier modelling community. In a first attempt we used quantile mapping (QM) to generate this data. A beforehand model evaluation showed that more than two third of the 49 included climate models were able to reproduce positive trend differences between areas of higher and lower elevations in winter, clearly visible in all of our five observational datasets used. Regrettably, we noticed that height dependent trend signals provided by models were distorted, most of the time in the direction of less EDW, sometimes even reversing EDW signals present in the models before the bias correction. As a consequence, we refrained from using quantile mapping for our task, as EDW poses one important factor influencing the climate in high altitudes for the nearer and more distant future, and used a climate change signal preserving bias correction approach.

Here we present our findings of the distortion of the EDW temperature change by QM and discuss the influence of QM on different statistical properties as well as their modifications.