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Spatial downscaling of climate projections of temperature and precipitation over complex mountain terrain: A case study in the north-eastern Italian Alps

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Mountain regions are particularly sensitive to climatic change. In these areas the complex topography modulates meteorological and climatic patterns with the elevation playing the strongest influence on temperature and precipitation. However, most regional climate models used in climate change assessments are too coarse to capture the relevant elevation gradients for impact studies, such as in hydrology, which require detailed spatial information on water availability, either in liquid or in solid state.

Focusing as a case study on Trentino-Alto Adige region in the north-eastern Italian Alps, we compare several statistical approaches for downscaling regional climate models to the spatial scale needed for impact studies in mountain areas. In particular, we propose a comparison between a novel method, based solely on climate model output using generalized additive models (GAM), and quantile mapping (QM) methods using an interpolated observational dataset as reference. We then evaluate and discuss the effectiveness of downscaling approaches, relying on both spatial and temporal metrics and taking into account the possible elevation dependency.

Preliminary results show that the approach using GAMs offers spatial fields consistent with the large-scale climate model, while the QM methods have artificial breaks at grid cell boundaries. On the other hand, the GAM approach inherits the biases from the climate model, while QM also simultaneously performs bias adjustment using the observational dataset.