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The added value of downscaling

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The availability of in situ atmospheric observations decreases with elevation and topographic complexity. Data sets based on numerical atmospheric modeling, such as reanalysis data sets, represent an alternative source of information, but often suffer from inaccuracies, e.g., due to insufficient spatial resolution. This study analyses the added value of sDoG, a reanalysis data postprocessing and downscaling tool designed to extend short-term and/or interrupted weather station data from high mountain sites to the baseline climate. sDoG is applied to ERA interim predictors to produce a retrospective forecast of daily air temperature at the Vernagtbach climate monitoring site (2640 MSL) in the Central European Alps. sDoG training and cross-validation is based on observations from 2002 to 2012. The availability of observations at the Vernagtbach climate monitoring site further back in time allows us to perform a true evaluation: "true evaluation" in contrast to cross-validation, by assessing the performance of the sDoG retrospective forecast for the period 1979 to 2001.

We demonstrate the ability of sDoG in modeling air temperature in the true evaluation period for different temporal scales. sDoG adds significant value over a selection of reference data sets, including state-of-the-art global and regional reanalysis data sets, output by a regional climate model, and an observation-based gridded product (SPARTACUS). However, we identify limitations of sDoG in modeling summer air temperature variations, most probably related to changes of the microclimate around the Vernagtbach climate monitoring site that violate the stationarity assumption underlying sDoG. Comparing the performance of the considered reference data sets reveals that higher resolution data sets do not necessarily add value over data sets with lower spatial resolution. For example, the global reanalyses ERA5 (31 km resolution) and ERA interim (80 km resolution) both clearly outperform the higher resolution surface analyses ERA5-Land (11 km resolution), HARMONIE (11 km resolution), and UERRA MESCAN-SURFEX (5.5 km resolution). Performance differences amongst ERA5 and ERA interim, by contrast, are comparably small. The results highlight the importance of station-scale uncertainty assessments of atmospheric numerical model output and downscaling products for high mountain areas, both for data users and model developers.

[1] https://www.uibk.ac.at/acinn/graduate-seminar/index.html.en