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Impact of the choice of a reanalysis dataset on statistical downscaling of precipitation

Pascal Horton, Stefan Brönnimann, and Rolf Weingartner
Oeschger Centre for Climate Change Research, Institute of Geography, University of Bern, Bern, Switzerland

Statistical downscaling techniques based on a perfect prognosis approach often rely on reanalyses to infer the statistical relationship between synoptic predictors and the local variable of interest, here daily precipitation. Nowadays, multiple global reanalysis datasets are available. These are generated by different atmospheric models with different assimilation techniques and present various spatial resolutions. The context of the application of statistical downscaling might drive the choice of an appropriate dataset, for example when the archive length is a leading criterion. However, in many studies a reanalysis dataset is subjectively chosen, according to the user's preferences or the ease of access. The impact of this choice on the results of the downscaling procedure is rarely considered and no comprehensive comparison has been undertaken so far.

The present work focused on the analogue method, which is a statistical downscaling technique. It relies on analogy in terms of synoptic-scale predictors with situations in the past to provide a probabilistic prediction for the day of interest. In order to quantify the impact of the datasets, ten different global reanalyses (NCEP Reanalysis I and II, ERA-Interim, NCEP CFSR, JMA JRA-55 and JRA-55C, NASA MERRA-2, NOAA-CIRES 20CR-2c, ERA-20C, and CERA-20C) were compared in seven variants of the analogue method, over 301 precipitation stations in Switzerland.

Although all reanalysis datasets are usually assumed very good over Europe, significant differences in terms of performance of precipitation prediction were identified. The choice of the dataset can have a larger impact than the choice of the predictor variables. The impact of the reanalyses was found to increase with the complexity of the analogue method, when local variables are added, such as moisture, as compared to synoptic predictors, such as the geopotential height.

As expected, the output spatial resolution of the reanalyses was found to have larger impact on local variables as well. Output resolutions below one degree were found to have generally limited to no benefit. Reanalyses with longer archives allow increasing the pool of potential analogues resulting in higher performances. However, when adding variables affected by errors in a more distant past, the skill decreased again.