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Using principal component analysis in empirical-statistical downscaling to emphasise synoptic scales

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We test a strategy for downscaling seasonal mean temperature for many locations within a region, based on principal component analysis, and assess potential benefits of this strategy which include an enhancement of the signal-to-noise ratio, more efficient computations, and reduced sensitivity to the choice of predictor domain. The downscaling results are expected to be insensitive to the choice whether the predictands are downscaled individually or as a group through the means of a principal component analysis. These conditions are tested in some case studies for parts of Europe (northern and central) and northern China. We find that the downscaled results were not highly sensitive to whether a principal component analysis-basis or a more traditional strategy was used. However, the results based on a principal component analysis were associated with marginally and systematically higher correlation scores as well as lower root-mean-squared errors. The results were also consistent with the notion that principal component analysis emphasises the large-scale dependency in the station data and an enhancement of the signal-to-noise ratio. Furthermore, the computations were more efficient when the predictands were represented in terms of principal components.We also present downscaled projections for the Arctic and the Nordic countries, making use of PCA and large multi-model ensembles from CMIP5.