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Statistical Downscaling Considering Non-stationarities

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The present study aims to introduce a novel downscaling approach which explicitly takes non-stationarities into account. For the illustration of this approach the Mediterranean area is chosen, because it shows a wide range of different climatic characteristics, from humid conditions in the western, northern and eastern Mediterranean regions in winter to arid conditions in the southern and eastern Mediterranean regions in summer.
Precipitation in the Mediterranean area is assessed by using a combined circulation- and transfer-function-based approach. Daily station data for the Mediterranean area is used as local precipitation predictand. As large-scale predictors geopotential heights of the 700hPa level in the area 20°N-70°N, 70°W-50°E are selected to include large-scale atmospheric regimes showing inter-annual to decadal variability. To account for daily to inter-annual influences on precipitation 700hPa-geopotential heights are used, again, but now within the scope to obtain circulation patterns within station-specific predictor domains. Furthermore, 700hPa-relative humidity, zonal and meridional wind components of the 700hPa level and convective inhibition are included to describe within-type characteristics of the circulation patterns.
At first the statistical models are established using the whole time period available for a particular station. Subsequently, 31-year sub-periods are used to detect non-stationarities in the predictors-predictand-relationships. As a measure of performance the bias and its confidence interval limits are used for error analysis of the distributional mean. The (non-)overlaps of the bootstrap confidence interval of the mean model performance (derived by averaging the performances of all calibration/verification periods) and the bootstrap confidence intervals of the individual model errors are used to identify (non-)stationary model performance. If non-stationarities are detected, the varying predictors-predictand-relationships are analysed for the underlying reasons and statistical model ensembles are built to capture the range of observed relationships. In case of the absence of non-stationarities the statistical downscaling approach follows a conventional split-sampling approach for verification. Finally the statistical models and model ensembles are used to predict mean daily precipitation in the Mediterranean area until the end of the 21st century under increased greenhouse warming conditions.
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