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Statistical downscaling of GCM outputs for the Czech Republic by nonlinear techniques

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The presented analysis focuses on the problem of statistical downscaling of large-scale data, and suitability of different nonlinear methods of time series analysis for processing GCM predictions of the future climate. Special attention was paid to the issue of the uncertainty of the results and their sensitivity to the choice of the transfer function. The large scale predictors were represented by the NCEP/NCAR reanalysis of various meteorological quantities (employed for calibration of the transfer functions) and the outputs of the HadCM3 global climate model of the Hadley Centre (used for the actual analysis of the climate evolution). Predictands were created from the series of daily mean, minimum and maximum temperature and daily precipitation observations from various Czech weather stations, grouped according to their geographical location and altitude into five separate regions. The applied transfer functions included several nonlinear techniques such as different types of artificial neural networks and local models in the reconstructed phase space, as well as the more traditional multiple linear regression.

Nonlinear techniques were generally able to provide slightly better results than linear regression in terms of RMSE for the calibration interval. On the other hand, values of the quantities describing changes of the local temperature characteristics (e.g. the expected increase of monthly averages of daily mean, minimum or maximum temperatures) were very similar for all tested methods. Tests carried out for daily precipitation sums as predictands showed substantial differences between results from different methods, as well as a distinct contrast between the results for individual Czech regions. This suggests a relatively high degree of uncertainty associated with the application of the tested techniques for precipitation downscaling, in contrast to rather small variations of the results observed in the case of temperature characteristics.