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Inter-variable relationships in the outputs of dynamical and statistical downscaling models

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Validation of global climate models (GCMs) as well as various approaches used for downscaling GCMs' outputs to finer spatial resolutions represents a critical part of climate modeling. Such assessment of the simulations' performance is routinely done for individual climate variables, but less attention is usually paid to the character of their interrelations. However, relying on single-variable validation can turn out to be insufficient when the simulated data is used as an input for a subsequent analysis requiring a dataset realistic in its entire complexity (e.g., application of some types of hydrological or agricultural models).

In this contribution, we investigate the ability of selected downscaling methods to realistically capture mutual relations among the series of daily maximum and minimum temperature, daily precipitation totals and daily mean relative humidity in the region of central Europe. Several ERA-40-driven regional climate models (RCMs) are used as representatives of dynamical downscaling; additionally, we test whether and how the interrelations can be improved by application of statistical postprocessing of the RCM data. The statistical downscaling methods include linear (multiple linear regression) and nonlinear (neural networks) mappings as well as the method of analogues. Interrelations in the datasets of observed and simulated variables are described through cross-correlation functions and contingency table-based scores.