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Performance of NCEP–NCAR reanalysis variables in statistical downscaling of daily precipitation[1]

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ABSTRACT: The urgent need for realistic regional climate change scenarios has led to a plethora of empirical downscaling techniques. In many cases, widely differing predictors are used, making comparative evaluation difficult. Additionally, it is not clear that the chosen predictors are always the most important. These limitations and the lack of physics in empirical downscaling highlight the need for a systematic assessment of the performance of physically meaningful predictors and their relevance in surface climate parameters. Accordingly, the objectives of this study are 2-fold: to examine the skill and errors of 29 individual atmospheric predictors of daily precipitation in 15 locations that encompass diverse climate regimes, and to evaluate the best combination of predictors that are able to capture different sources of variation. The predictors utilized are from the National Center for Environmental Prediction–National Center for Atmospheric Research (NCEP–NCAR) reanalysis. Mid-tropospheric geopotential heights and mid-tropospheric humidity were the 2 most relevant controls of daily precipitation in all the locations and seasons analyzed. The role of the tropospheric thickness, and the surface and 850 hPa meridional wind components appear to be regionally and seasonally dependent. The predictors showed low performance in the near-equatorial and tropical locations analyzed where convective processes dominate and, possibly, where the reanalysis data sets are most deficient. Summer precipitation was characterized by the largest errors, likely also due to the enhanced role of convection and sub-grid scale processes. Nevertheless, the model was able to reproduce the seasonal precipitation and the phase of daily events in the mid-latitude locations analyzed. In general, the proposed downscaling models tended to underestimate (overestimate) large (small) rainfall events, which reveal the sensitivity of the downscaling to the spatial resolution of the predictors.

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