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Analysis of wind for the Carpathian Basin using homogenized and simulated data sets

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Observations suggest that global climate change has reduced the Pole to Equator temperature gradient, which certainly affects regional climatic conditions. As an indirect consequence, global warming may also alter the wind climate of the Carpathian Basin. In order to provide reliable projections for the future climate model simulation is an obvious and widely used tool. However, as a first step simulated results for the past have to be validated against measurements. Therefore, an analysis of wind climatology of the recent past including both mean and extreme wind conditions, as well as trend and wind related indices analysis are completed for Hungary using various tools from mathematical statistics. Then, the detailed analysis continues with assessments of future changes on the basis of regional climate model simulations embedded in global climate models. Specifically, in this paper detailed analysis of observed wind fields, fitted trends to different annual and seasonal percentiles, return values, various wind indices and their spatial distributions over Hungary are discussed using the homogenized Hungarian synoptic data sets and the homogenized and gridded CARPATCLIM database. Wind-related climate indices are defined to analyze the frequencies and the trends of moderate and strong wind days for the last few decades. In addition, simulated wind climate variability is evaluated for the future periods of 2021–2050 and 2071–2100 relative to the 1961–1990 reference period. Since wind speed is highly overestimated by the simulation of the regional climate model RegCM in the reference period (1961–1990), a bias correction is necessary to apply to the raw simulated wind data using CARPATCLIM as a reference database. (For instance, the overestimation of the yearly average wind speed is about 2 m/s). The applied bias correction method is based on monthly-scale and consists of fitting the empirical cumulative distribution functions of simulated daily time series to the observations for each gridcell using multiplicative correction factors. For regional climate change assessment, projected changes of mean and extreme wind conditions are analyzed. Monthly average changes in the 0.50 and 0.90 percentiles are relatively small (about 0.4 m/s and 0.6 m/s, respectively) for both future periods (2021–2050 and 2071–2100), but in case of the 0.99 percentile value it is considerably high, i.e. about 2 m/s.