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Applying the DTU Global Wind Atlas for bias correction of simulated nationally aggregated wind power generation time series for Austria and Brazil

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In recent years, reanalysis data have gained popularity amongst the energy modelling community as the gridded data can be used for spatially and temporally explicit simulation of wind or solar power generation for specified locations or aggregated or disparate regions. As the data is available globally, in principle simulations can be run for all world regions. However, existing global analysis do not use bias-correction and do not validate their output against real generation data.
The aim of this study is to evaluate the suitability of ERA-5 reanalysis data for simulation of wind power generation and to assess the effects of using the Global Wind Atlas for bias correction. The two climatically and topographically different and distant regions of Brazil and Austria are selected as study area to assess the applicability of ERA-5 data to distinct areas of the world as a first step towards a global analysis. Simulated wind power generation time series (15 years in Austria and twelve years in Brazil) are validated with historical wind power data provided by the transmission system operators. Furthermore, the Global Wind Atlas from the Technical University of Denmark (DTU) is applied for wind speed correction, in order to eliminate the observed bias in reanalysis data. The Global Wind Atlas provides mean wind speeds at a spatial resolution of 1 km x 1 km, which is higher than any global reanalysis dataset available and thus enables a means for spatial downscaling. Simulation results are analysed on a daily basis by evaluation of statistical parameters as well as boxplots.
Results show that for Austria bias correction with the Global Wind Atlas has no positive effect on the simulation, as the RMSE is increased from 1.8 to 4.4, and the MBE is closer to 0 without bias correction, while the mean of daily wind power generation shows a higher deviation after applying mean wind speed correction. Boxplots show that before bias correction simulated wind power generation represents the actual generation well, whereas if Wind Atlas wind speeds are applied, the simulation tends to overestimate historical values. In Brazil comparable results are found, regarding MBEs and means, which indicate that without Wind Atlas correction better simulation quality can be achieved. Regarding the RMSE, however, a lower and thus better value is obtained when mean wind speed approximation is performed. Graphical analysis is not fully conclusive, although indicating that applying Global Wind Atlas wind speeds leads to overestimation. These results show, that spatially more explicit data are not always necessary or useful, and furthermore, that recent reanalysis datasets provide data in sufficient quality for simulation of time series of wind power generation.