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Decadal predictability of wind energy potentials over Germany in the Earth System Model of the Max-Planck-Institute

Julia Moemken (1), Mark Reyers (1), Joaquim G. Pinto (1,2)

(1) Institute for Geophysics and Meteorology, University of Cologne, Cologne, Germany (jmoemken@meteo.uni-koeln.de), (2) Department of Meteorology, University of Reading, Reading, United Kingdom

Regional climate predictions on timescales from one year to one decade are gaining importance since this time frame falls within the planning horizon of politics, economy, and society. In this context, decadal predictions are of particular interest for the development of renewable energies such as wind energy. The present study examines the decadal predictability of wind energy potentials in the framework of the ongoing MiKlip consortium (www.fona-miklip.de). This consortium aims to develop a model system based on the Max-Planck-Institute Earth System Model (MPI-ESM), that can provide skillful decadal predictions on regional and global scales. Three generations of the decadal prediction system of the MPI-ESM are analysed here with respect to wind energy potentials on the regional and local scale. Ensembles of uninitialized historical and yearly initialized hindcast experiments are used to assess the forecast skill for wind energy output (Eout) over Central Europe, with special focus given to Germany. With this aim, a statistical-dynamical downscaling (SDD) approach is used for the regionalisation of the global datasets. All three MPI-ESM ensemble generations, which are based on different hindcast initialisations, show some forecast skill for wind energy potentials on yearly and multi-yearly time scales over Germany, Poland, Czech Republic and Benelux. In general, the predictive skill for the two latest MPI-ESM generations (baseline1 and prototype) is higher than for the first generation (baseline0). The predictability varies with different leading-time periods and declines with increasing time since initialisation. Regarding seasonal means, skill scores are lowest during winter, and persist longest for autumn in all three generations. In the summer months, differences between the three generations are more pronounced than for the other seasons. In general, forecast skill for wind energy potential is found for all three MPI-ESM ensemble generations. This skill is mostly limited to the first years after initialisation, and depends on the season and on the underlying initialisation of the hindcasts (ensemble generation). Still, these results are promising regarding the establishment of a decadal prediction system for wind energy for Central Europe.