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Future changes of wind energy potentials over Europe in a large CMIP5 multi-model ensemble

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A statistical-dynamical downscaling method is used to estimate future changes of wind energy output (Eout) of a benchmark wind turbine across Europe at the regional scale. With this aim, 22 global climate models (GCMs) of the Coupled Model Intercomparison Project Phase 5 (CMIP5) ensemble are considered. The downscaling method uses circulation weather types and regional climate modelling with the COSMO-CLM model. Future projections are computed for two time periods (2021-2060 and 2061-2100) following two scenarios (RCP4.5 and RCP8.5).
The CMIP5 ensemble mean response reveals a more likely than not increase of mean annual Eout over Northern and Central Europe and a likely decrease over Southern Europe. There is some uncertainty with respect to the magnitude and the sign of the changes. Higher robustness in future changes is observed for specific seasons. Except from the Mediterranean area, an ensemble mean increase of Eout is simulated for winter and a decreasing for the summer season, resulting in a strong increase of the intra-annual variability for most of Europe. The latter is, in particular, probable during the second half of the 21st century under the RCP8.5 scenario. In general, signals are stronger for 2061-2100 compared to 2021-2060 and for RCP8.5 compared to RCP4.5. Regarding changes of the inter-annual variability of Eout for Central Europe, the future projections strongly vary between individual models and also between future periods and scenarios within single models.
This study showed for an ensemble of 22 CMIP5 models that changes in the wind energy potentials over Europe may take place in future decades. However, due to the uncertainties detected in this research, further investigations with multi-model ensembles are needed to provide a better quantification and understanding of the future changes.