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Characteristics of the spread of wind speed distribution in WRF ensemble for wind energy

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The goal of the NEWA project was to create the New European Wind Atlas together with relevant uncertainty information. As the wind energy is proportional to the third order of wind speed, it is necessary to consider the whole distribution of wind speed in addition to mean values.
During the project a multi-physics ensemble of WRF (Weather Research and Forecast model) results with different parametrization schemes was created. It included members with different combinations of Planetary Boundary Schemes, Surface Schemes (where possible) and Land Surface Models, with additional members representing different SST dataset or changes in nudging methodology (grid nudging vs spectral nudging). ERA-5 reanalysis is used for lateral boundary conditions and initialization. In total around 20 members providing significant spread were identified.
The analysis is carried out for two different regions of Europe – one covers central Europe, including Denmark, northern Germany and North Sea (302x296 grid points), second covers Greece representing mountainous terrain (302 x 284 grid points), with 3 km target spatial resolution. The dataset represents one complete year of calculations, with each run being one-week long, using nudging towards reanalysis data.
There exists several metrics that can compare two distributions in a single grid-point, such as Chi-square or EMD (Wasserstein metric). In this work the two main topics of interest are (1) how to compare the spread in neighboring grid-points and if it is possible to formulate any regional level conclusions about the spatial characteristics of the spread and (2) what are the physical processes the representation of which results in the most uncertainty.
In the context of NEWA project such approach was used to guide the development of smaller ensembles that could replicate the same properties of uncertainty as the larger ensemble, however such assessment serves as important insight in the sources and causes of model uncertainties, therefore paving way in reducing them.
Results show that changes in SST input data can provide spread over the North Sea, but the spread over the land is influenced by land use category and surface properties.

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