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The mesoscale production and ensemble simulations for the New European Wind Atlas

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The New European Wind Atlas (NEWA) project aims to develop a new reference method for wind resource assessment and wind turbine site suitability based on a mesoscale to microscale model-chain. This new approach will produce a more reliable wind characterisation than current models, leading to a significant reduction of uncertainties on wind energy production and wind conditions that affect the design of wind turbines.

The selection of the Weather Research and Forecasting (WRF) model configuration for the mesoscale production run was based on assessing a large ensemble of WRF model simulations with different model setups. Simulations covered a full year (2015) for a domain covering Germany, Denmark, the Netherlands and the North Sea with 3-km grid spacing. The parameters tested in the nearly 50 ensemble members include, among others: model version, atmospheric and sea surface temperature input, land surface model as well as surface and PBL parameterisations. The wind speed climatology of each member is compared to the reference configuration and to wind observations at tall masts using annual averages, RMSE, and wind speed distributions. This comparison revealed that no single setup was ‘best’ for all the available measurement masts, but one performed slightly better at 2-3 sites. This configuration was chosen as the base setup for 30 years of simulations for 10 overlapping domains over Europe at a spatial grid spacing of 3 km x 3 km. These data will be released to the public in June 2019.

Results of the methods used to select ensemble members, the spread found in different regions and their possible relationship to the uncertainty of the mesoscale wind atlas will also be presented. A further ensemble of simulations was done for other domains and time periods. Interestingly, and perhaps not unexpected, a different set of ensemble members is needed in different regions in Europe. The results showed 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. The spread among all ensemble members and combinations of ensemble members was estimated. Furthermore, data clustering techniques were applied, together with the integral of differences in parameter probability distributions, to find a reduced (5-10) number of ensemble members that provided the largest spread. This final ensemble will be the backbone of the NEWA probabilistic wind atlas which serves to provide information about model uncertainties.