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Using COSMO-D2 data for high-resolution WRF offshore wind farm simulations

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To forecast the power output of wind farms with lead times of hours to days, it is best practice to utilize post-processed numerical weather forecasts. Yet in order to improve grid stability and reduce the structural load on wind turbines, detailed and sophisticated forecast tools for even shorter lead times would be desirable. As a first step in this direction, we developed a new setup for the Weather Research and Forecast (WRF) model to simulate meteorological conditions for the alpha ventus offshore wind farm in LES mode with a horizontal resolution of <100m.

Especially for such offshore applications, properly initiating the WRF model and finding the best parameterizations are challenges, since observations are scarce and the marine boundary layer is much less studied than the planetary boundary layer. Hence, we use operational COSMO-D2 data produced by the German Weather Service (DWD) for driving our model, since its 2.2 km grid spacing and 14 vertical layers below 950hPa provide for a much better initialization than using large area or global NWP data with a horizontal resolution around 10 km. By physics parameterizations, we investigate the best setup of the WRF model in order to match the observations of the nearby FINO1 met mast, and found that the simulations are most sensitive to the chosen surface layer physics scheme. We also describe the code and setup adaptations needed to use the model grid COSMO-D2 data with WRF.

In the future, we plan to utilize the optimal high-resolution WRF model centered on alpha ventus as a basis for short-range assimilation experiments and improved wind farm parameterizations for minute-scale wind power forecasts.