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Validation of a dynamical downscaling process in the context of wind resources mapping

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Wind resources mapping requires high frequency wind measurements regularly spatially distributed in the area of interest. In this study the goal is to provide a wind resources atlas in an area where the density of ground measurements stations is low.

To make up for the lack of measurements, numerical meteorological models are used. However, the spatial and temporal resolutions of available global meteorological re-analysis products such as MERRA (Modern Era-Retrospective analysis for Research and Applications) or ERA-Interim (European Center for Medium-Range Weather Forecast Re-Analysis) do not fit these requirements. A meso-scale model, the Weather Research and Forecast (WRF) numerical model, is applied to dynamically downscale an ERA-Interim analysis 3D wind field.

The WRF numerical model is set up, in particular, with a four dimensional data assimilation system (fdda) toward ERA-Interim. Analysis nudging avoids a rapid divergence of the predicted field compared to the ERA analysis. To assess the capability of the WRF model to provide a reliable prediction, we compared the WRF outputs with two analysis datasets.

First, comparison to ERA-Interim analysis - used as boundary and initial conditions – can be used for the determination of the spin-up and stable time period of the WRF model. This information provides some guidance to realize a several year prediction i.e. initial spin-up period and longest possible runtime.

The second comparison to MERRA analysis is used as a “cross-validation” of the prediction. This cross-comparison leads to the scale dependant errors and correlations over a long time period between high resolution prediction from WRF and low resolution analysis from MERRA.

As a final result, the method and the results are validated with large scale analysis and ground based measurements. The resulting wind-energy resources atlas is therefore reliable for feasibility studies of wind-farm projects.