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Exploring the calibration of a wind forecast ensemble for energy applications

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In the German research project EWeLiNE, Deutscher Wetterdienst (DWD) and Fraunhofer Institute for Wind Energy and Energy System Technology (IWES) are collaborating with three German Transmission System Operators (TSO) in order to provide the TSOs with improved probabilistic power forecasts. Probabilistic power forecasts are derived from probabilistic weather forecasts, themselves derived from ensemble prediction systems (EPS). Since the considered raw ensemble wind forecasts suffer from underdispersiveness and bias, calibration methods are developed for the correction of the model bias and the ensemble spread bias. The overall aim is to improve the ensemble forecasts such that the uncertainty of the possible weather deployment is depicted by the ensemble spread from the first forecast hours. Additionally, the ensemble members after calibration should remain physically consistent scenarios.

We focus on probabilistic hourly wind forecasts with horizon of 21 h delivered by the convection permitting high-resolution ensemble system COSMO-DE-EPS which has become operational in 2012 at DWD. The ensemble consists of 20 ensemble members driven by four different global models. The model area includes whole Germany and parts of Central Europe with a horizontal resolution of 2.8 km and a vertical resolution of 50 model levels. For verification we use wind mast measurements around 100 m height that corresponds to the hub height of wind energy plants that belong to wind farms within the model area.

Calibration of the ensemble forecasts can be performed by different statistical methods applied to the raw ensemble output. Here, we explore local bivariate Ensemble Model Output Statistics at individual sites and quantile regression with different predictors. Applying different methods, we already show an improvement of ensemble wind forecasts from COSMO-DE-EPS for energy applications. In addition, an ensemble copula coupling approach transfers the time-dependencies of the raw ensemble to the calibrated ensemble. The calibrated wind forecasts are evaluated first with univariate probabilistic scores and additionally with diagnostics of wind ramps in order to assess the time-consistency of the calibrated ensemble members.