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Statistical Post-Processing of Wind Speed Forecasts to Estimate Relative Economic Value

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The objective of this research is to get the best possible wind speed forecasts for the wind energy industry by using an optimal combination of well-established forecasting and post-processing methods. We start with the ECMWF 51 member ensemble prediction system (EPS) which is underdispersive and hence uncalibrated. We aim to produce wind speed forecasts that are more accurate and calibrated than the EPS. The 51 members of the EPS are clustered to 8 weighted representative members (RMs), chosen to minimize the within-cluster spread, while maximizing the inter-cluster spread. The forecasts are then downscaled using two limited area models, WRF and COSMO, at two resolutions, 14km and 3km. This process creates four distinguishable ensembles which are used as input to statistical post-processes requiring multi-model forecasts. Two such processes are presented here. The first, Bayesian Model Averaging, has been proven to provide more calibrated and accurate wind speed forecasts than the ECMWF EPS using this multi-model input data. The second, heteroscedastic censored regression is indicating positive results also. We compare the two post-processing methods, applied to a year of hindcast wind speed data around Ireland, using an array of deterministic and probabilistic verification techniques, such as MAE, CRPS, probability transform integrals and verification rank histograms, to show which method provides the most accurate and calibrated forecasts. However, the value of a forecast to an end-user cannot be fully quantified by just the accuracy and calibration measurements mentioned, as the relationship between skill and value is complex. Capturing the full potential of the forecast benefits also requires detailed knowledge of the end-users' weather sensitive decision-making processes and most importantly the economic impact it will have on their income. Finally, we present the continuous relative economic value of both post-processing methods to identify which is more beneficial to the wind energy industry of Ireland.