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Multivariate spatial post-processing for renewable energy forecasts

Eadaoin Doddy (1,2), Conor Sweeney (1,2), Frank McDermott (1,3)

(1) UCD Energy Institute, University College Dublin, Dublin, Ireland, (2) UCD School of Mathematics and Statistics, University College Dublin, Dublin, Ireland , (3) UCD School of Earth Sciences, University College Dublin, Dublin, Ireland

As the importance of renewable energy is continuing to grow, accurate forecasts of wind and solar energy are necessary. All numerical weather prediction (NWP) models have errors and if some part of these errors are systematic then they can be removed using post-processing techniques. Our objective is to improve the day-ahead forecast skill of renewable energy variables: 10 metre wind speed, shortwave radiation and 2 metre temperature, by relating systematic forecast errors to anomalous states of the atmosphere.

We consider historical forecast data for upper-level variables such as temperature, geopotential height and wind speed on different pressure levels, from 250hPa to 850hPa, to inform our forecast correction model. Statistical classification methods such as principal component analysis (PCA) will be used to identify spatial patterns over the North Atlantic region for the preceding 60 days. These can be used to highlight periods similar to the upcoming forecast. These periods form a training dataset which will be used in correcting each forecast of the renewable energy variables. We correlate historical forecast errors of renewable energy variables with the training dataset of each upper-level variable. The timestamps from the highest correlated training dataset are used to train the forecast correction model for each day's forecast of renewable energy variables.

This novel method is compared to commonly used prediction methods, such as artificial neural networks (ANN), auto-regressive moving average (ARIMA) modelling and simple regression methods. Three years of hourly ECMWF IFS forecast data for 24-48 hours ahead are used to drive the forecast models, and results are compared with more than 20 weather observation stations around Ireland.