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Statistical short-term wind forecast at a buoy in the Bay of Biscay

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This study focuses on the Bilbao Bizkaia buoy located in the Bay of Biscay. In particular, wind forecast is calculated for the zonal and meridional u and v components for the next 24 hours. These forecasts have been made by using the following three statistical models: Linear regression, random forest (a machine learning algorithm) and analogs with different norms. The results are compared with the persistence (the most evident forecast to be outperformed) and the forecasts provided by ERAInterim at the nearest gridpoint.

In this study, hourly observations are used at 00h and 12h corresponding to the 2007-2014 period. The first half of the records (2007/01/01 00:00 - 2011/02/06 00:00) is used to train the models and the second one (2011/02/06 12:00 – 2014/12/31 12:00) for testing them (3793 cases in total). The statistical models have been fitted with three types of predictors or inputs, i) the last measured observation, ii) the plain forecast provided by ERA-Interim at the nearest gridpoint and iii) the Extended Empirical Orthogonal Functions (ExtEOFs) corresponding to several meteorological variables. ExtEOFs are calculated taking into account reanalysis information of the mentioned numerical model in a predetermined domain and the observations during last 24 hours. As a result, the leading Extended EOFs hold the most relevant time and space description of the most recent (24h) meteorological information over the area of study.

The results show that the statistical models outperform persistence for predictions beyond four hours ahead. These models also outperform the ERAI (numerical wind) forecast, although, not always significantly (95% confidence level is calculated by means of a bootstrap analysis). This is due to the fact that the most influential predictor in the statistical models is the ERAI forecast. In fact, if they are not included as inputs in the different models, a notorious deterioration of forecasting error takes place. An important result is that the three types of meteorological models tend to perform similarly at predicting u and v wind components.

To summarize, the conclusions of this study is that at short horizons (<4h) persistence outperforms the rest of models and the ERAI forecast is the most influential input. It is important to highlight that for this location - a Bilbao Bizkaia buoy on the sea - there is not a significant difference in performance among the three types of statistical model used. This means that using a sophisticated and difficult to implement technique machine learning - like random forest - does not make any significant difference, thus making linear regression or analogs the most reasonable option. Similar intercomparison procedures are currently being carried out at other locations to confirm these conclusions.