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Forecasting the weather
- ensemble techniques
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WRF modelling of contrasting sea breeze scenarios with applications to coastal zone wind energy

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The fundamentals of sea breezes have been known about by sailors since the time of Aristotle and, yet, additional complexities such as the effects of terrain, land use and synoptic flow still ensure that sea breeze forecasting remains a challenging task. Presently, the majority of studies focus on the landward advance as it may have a significant impact on air quality, aviation and coastal city flow regimes. Restrictively, data availability often makes studying the seaward extent somewhat difficult and, consequently it is often neglected from studies.

In the UK an opportunity has arisen for the collection of offshore measurement data through the recent construction of offshore wind farms. This, used in conjunction with on-land wind profiler data from a nearby station enables the study of the offshore components of the sea breeze. Several case studies are presented in conjunction with simulations from the Weather Research and Forecasting (WRF) model, exploring the effect of different flow regimes on the sea breeze. A sensitivity study is conducted analysing the impact of different boundary layer schemes for each case.

In order to identify case studies with the potential for sea breeze establishment, it is important not to assume that they occur in a classical way. Historically, selection procedures have tended to focus only on "pure" cases ignoring both "corkscrew" and "back door" types; therefore a more comprehensive method for identifying potential cases of sea breeze flow was developed. Here, the Jenkinson-Lamb weather typing scheme was first used to classify weather types over the UK for the period 2000-2010, using NCEP 6 hourly final analyses of mean sea level pressure. Potential study periods were selected by eliminating those that showed cyclonic curvature or excessively strong pure directional winds. Critical values for elimination were found by using idealized WRF simulations to test the effects of variations in atmospheric stability, land-sea thermal contrast, wind speed and direction.

Initial results with the idealized experiments show that the seaward extent shows a much higher degree of variability than landward advancement. At its peak, the seaward extent makes up 60% of the total length of the sea breeze system. This could have a significant effect on power output of offshore wind farms during lower wind speed conditions.