



## **Investigation on the ability of a numerical model to simulate the changes in wind speed and direction ahead of time in a marine environment**

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Because wind resources are highly changeable in time, knowledge on the skills of the commonly used numerical models used in wind energy to simulate the variability is required. It is common knowledge that the atmosphere is inherently chaotic at both small and the larger time scales with some intermediate regime where some predictability has been demonstrated. The chaotic nature at the smaller time scales is predominantly caused by turbulence and the larger scales by the limit in predictability as the accuracy degrades in time.

Here we investigate, based on one year of observations carried out with a wind lidar from 126 to 626-m height at the FINO<sub>3</sub> research platform in the North Sea, the ability of the Advanced Research version of the Weather Research and Forecasting model (WRF) to simulate the changes in the observations ahead of time (lead time). The lead time,  $\Delta t$ , is the look ahead time from time  $t$ . The variability of the change of the wind-speed and direction for lead times of 10 min to 1 day will be reported, thus dealing mainly with the lack of predictability caused by turbulence. Taking a correlation coefficient of 0.6 as lower limit for skills in the simulations corresponds to a lead time of about 4 hours for both wind speed and direction. This value is larger than typically found over land - being about 2 hours. The difference is likely related to the marine conditions of the measurement site, with minor daily variation of the atmospheric conditions but the variability is to a larger degree controlled by the prevailing synoptic conditions.

The persistence approach, which is a commonly used benchmark, will be presented for comparison and completeness. The persistence model states that the expected (measured) value  $\Delta t$  ahead is the same as the most recent value. The persistence model provides the better performance than the numerical simulations for lead times less than about 2 hours for both wind-speed and direction corresponding to a correlation coefficient of about 0.4 between the changes in the observed and simulated wind speed and directions.