Public justification (visible to the public if the article is accepted and published):

Dear authors,

The reviewers agree that you have not addressed the primary potential misinterpretation of your results: the paper doesn't have a proper uncertainty assessment, despite the title suggesting otherwise. Instead, it primarily compares different driving data sources (ERA5 and ERA-Interim) and turbine capacities (3.6 MW vs. 15 MW), including a sensitivity analysis of the turbulence correction factor. Critical variables influencing offshore wind power uncertainty, such as model choice, parameterisations, and other factors (e.g., domain location, grid spacing), are overlooked. Therefore, I recommend a further round of major revisions before the manuscript can be accepted for publication in WES.

Dear editor and referees,

We would like to clarify what we believe may be a misunderstanding regarding the interpretation of the terms “uncertainty” and “sensitivity”, and to explain why our approach remains scientifically valid in addressing our study as uncertainties.

In a modelling context, uncertainty refers to the lack of knowledge of the true state of the system (like the turbine model, configuration, etc.) or its boundary conditions (like the driving conditions), which leads to variability in model results. Sensitivity, by contrast, identifies which parameters or inputs exert the strongest influence on model outputs and quantifies their relative importance (like in the modification of the TKE coefficient).

We fully agree that factors such as array design, grid spacing, and turbine design—as highlighted by one of the reviewers—are important contributors to uncertainty in wind farm simulations. These factors are, however, commonly investigated at the local scale (tens of kilometres with tens of metres resolution) using Large Eddy Simulation (LES) or similar high-resolution models.

In contrast, our study comprehends a mesoscale area, covering the entire North Sea region (~1000 × 600 km^2), and our aim is to evaluate how much wind power could realistically be harvested under the 150 GW installed capacity target for 2050. At this spatial scale, other sources of uncertainty become also important, like the interaction of large scale wind farm clusters, the choice of turbine capacities, and the variability of large-scale wind conditions.

The development of offshore wind farms is a very dynamic activity, strongly influenced by the economic strategies and policy decisions of governments and energy companies. As one reviewer correctly noted, turbine models for individual wind farms can often be specified in the near term; nonetheless, at the regional and long-term scales considered in our study, it is currently impossible to predict which specific wind technologies will be deployed in the coming decades. The range of 3.6 MW to 15 MW turbine capacities used in our scenarios reflects the currently available information on turbine models and therefore represents a plausible envelope of uncertainty in future power output projections for the 150 GW installed capacity target.

Regarding the driving conditions, many studies focusing on individual wind farms or small clusters typically employ idealised forcing (e.g., constant wind speed or direction) or short-term realistic simulations lasting from a few hours to several days. Such experiments can be indeed classified as sensitivity studies, as they explore the model response to controlled variations in input parameters. In contrast, our analysis is based on multi-year to decadal simulations driven by ERA5 and ERA-Interim reanalysis datasets, both of which aim to represent realistic atmospheric conditions. However, as is well known—and confirmed by our results—these datasets differ in their mean wind speed by approximately 1 m s^{-1}. This discrepancy reflects the uncertainty in the true state of the wind field, a concept well recognised in the climate modelling community. In our study, this wind-field uncertainty is explicitly propagated into the simulated power output, meaning that our work constitutes an uncertainty analysis, not merely a sensitivity test. The driving wind fields are not hypothetical parameters but representations of the real atmosphere, and therefore embody inherent observational and modelling uncertainties.

The only sensitivity experiment included in our work is presented in Subsection 4.6, where the Turbulent Kinetic Energy (TKE) coefficient is modified to analyse its influence on the simulated power output.

In summary, our study is not a sensitivity analysis but an explicit uncertainty assessment. By considering realistic wind forcing and a plausible range of future turbine capacities, we quantify how uncertainties propagate into large-scale power output, addressing the dominant sources of regional offshore wind uncertainty beyond the more often single-farm sensitivity approach studies.

We acknowledge that the sources of uncertainty highlighted by the reviewer are indeed important. Nevertheless, addressing them comprehensively lies beyond the scope of the present study due to limited available resources. The development of this work required more than two years, including modifications to the model code, integration of the new parameterisation, domain testing, model tuning, and the execution of the scenarios here presented. For instance, exploring the reviewer's suggestion to test different grid resolutions would necessitate rerunning all simulations on the new grids, followed by an additional round of testing before any production runs could be conducted. Such an effort would demand personnel, time and computational resources that are currently not available to us.

Instead, we intend for this study to be understood as part of an ongoing effort to identify and quantify less-explored sources of uncertainty. Our hope is that future research will build upon these results, progressively addressing the remaining knowledge gaps—an iterative trajectory that is fundamental to scientific progress.

We hope this clarification helps to resolve the misunderstanding and reinforces the validity and contribution of our approach.

We have uploaded a revised version of the manuscript that includes modifications to some sections, which we believe enhance the clarity and interpretation of the results.

Sincerely,
Dr. Alberto Elizalde