Answers to the comments of the reviewers for the manuscript

„Airborne measurements for investigating offshore wind farm wakes

and modifications of sea state - benefits and limitations “

Submitted to Wind Energy Science

by

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The authors would like to thank the reviewers and the editor Roland Schmehl for their detailed comments and suggestions to improve the manuscript. In the following, the comments are provided in italic letters. Each point is answered in normal letters. Changes to the text are indicated by quotation marks. Lines refer to the original manuscript. Changes suggested by the editor in the pdf are included directly in the text, and highlighted in the diff-file.

Reviewer 1:

The authors have addressed all comments in an excellent way

We are happy that the reviewer is satisfied with the changes we performed to the manuscript.

Reviewer 2:

The authors have clearly responded to the referees' comments and have made corresponding improvements to the manuscript. I therefore recommend publication. I only have a few minor final points for the authors to consider:

We are happy about the acknowledgement of the improvements. We answer the final points below, and take them into account accordingly.

** In my previous report, I did not complete my comment on "including a different visual appearance (Ladenburg, 2009)." My intended point was that visual appearance is not really an environmental or technical aspect, as implied by the sentence, but rather a social aspect. This part of the sentence should therefore either be removed or clarified.*

We fully agree, and changed the text to: "The installation and operation of large offshore wind farms have environmental and technological consequences (Bailey et al., 2014, Windt et al., 2024) and in addition socially relevant aspects, like a different visual appearance (Ladenburg, 2009), which is not an issue because of the far-offshore placement in the German Bight"

** Line 53: "of LES for resource assessment".*

Thank you – we corrected the typo.

** Line 85: please check whether the value should be 70 m s^{-1} or 65 m s^{-1}; I noticed the latter value in some of the responses.*

Thank you for pointing out the inconsistency! We changed to “is around 65 m/s”.

***Public justification (visible to the public if the article is accepted and published)**:*
Dear authors,

Thank you for your patience with the peer review of this article. We have received the 2nd-round feedback from two of the original three reviewers, and both recommend proceeding with publication.

Before we do this, I would like to point you to the feedback of reviewer #2, who had a few remarks.

We took the feedback into account, see responses above.

I also read through the manuscript and provided an annotated PDF with corrections, comments, and suggestions to improve readability.

We would like to thank the editor for careful reading, and included the changes directly in the text. They are highlighted in the diff file. Only the statement “Powered by Esri.” is a requirement from Copernicus, therefore we leave this in the figure captions.

Finally, I would like to point you to this recent publication from our research group:

Cayon, O., Watson, S., and Schmehl, R.: Kite as a sensor: wind and state estimation in tethered flying systems, Wind Energy Science, 10, 2161–2188, https://doi.org/10.5194/wes-10-2161-2025, 2025.

In this study, we use a very similar measurement technique to determine the wind velocity (magnitude and direction) at a flying kite, using measurement data. At the core of this approach is an extended Kalman filter (EKF) that employs sensor fusion for an accurate reconstruction of the wind velocity from measured properties, such as GPS and IMU mounted on the kite, a Pitot tube with flow vanes mounted in the kite's bridle line system, tether force, etc. The estimated wind velocities compare well with Lidar data, which are also provided in the study.

Your measurement approach is very similar, with the difference that (1) you use a free-flying aircraft instead of a kite, and (2) you analyze the wake of turbines, while we analyze the undisturbed wind field. But in both approaches, predefined flight trajectories are executed to reconstruct the wind field. You are following a Cartesian two-dimensional grid layout for the flight path, while our kite, due to its variable-length tether, sweeps out a volume bounded by spherical surfaces. What I do not see in your approach is the use of sensor fusion to integrate measurements from multiple sensors into higher-quality results. This was one of the key findings of our paper.

Best regards,
Roland Schmehl

I recommend discussing our paper shortly, as an alternative airborne measurement study for reconstructing the wind field, in a suitable place in your introduction.

We would like to thank the editor for this comment. As the focus of the article is on wind farm wakes, and the introduction has the focus on wind farm wakes, we included a sentence about the importance of data fusion and a reference to the article in the Methodology section: “The different sensors are combined by advanced data fusion techniques, like complementary filtering and Kalman filters to gain data of enhanced quality and reduced uncertainties, as described, e.g., in Bärfuss et al., 2018. This is generally of high importance for improving airborne measurements of the wind speed, e.g., Cayon et al., 2025.”