Review of “Tall Wind Profile Validation Using Lidar Observations and Hindcast Data”

General comments

This paper addresses an important and timely topic by validating three widely used wind reanalysis and hindcast models—NORA3, NEWA, and ERA5—against lidar measurements at five strategic locations in the North Sea and along the Norwegian coast. The validation focuses on wind speed profiles at heights relevant to modern wind turbines and emerging airborne wind energy systems (100-500 m), making this study directly applicable to the future of wind energy technology.

The study effectively uses appropriate error metrics, including the Earth Mover’s Distance (EMD), to evaluate model performance across offshore, coastal, and complex terrain sites. The findings emphasize the critical need to select appropriate wind atlases based on site-specific geography and altitude, particularly in complex terrain where regional models like NORA3 tend to outperform global datasets like ERA5. The study also underscores the need for more tailored lidar wind profilers to accommodate the growing size of modern wind turbines and the emerging technology of airborne wind energy systems.

While the paper provides valuable insights, it acknowledges limitations in the temporal scope, as the datasets do not cover a full climatology period. The authors suggest expanding measurement sites and improving temporal resolution in future studies to strengthen conclusions. Overall, this study makes a significant contribution to the ongoing effort of properly validating reanalysis models for the evolving wind energy sector.

Specific comments

1. Why is the FINO1 platform used for model validation when it is located near several wind farms? As noted in the manuscript, this proximity likely affects the measurements, making FINO1 unsuitable for validation unless the models explicitly account for the wind farms or the data are filtered to exclude disturbed wind directions. Since the measurements at FINO3 do not have nearby wind farms, wouldn’t they already provide a more representative view of undisturbed offshore conditions?
2. In line 300, it is mentioned that the EMD values are comparable across all models at coastal locations. However, this is not the case for the Sola site, where there are noticeable differences between the models.
3. The paper emphasizes the validation of hindcast data at higher altitudes, beyond what has been extensively studied. Given this, why focus on results at 150 m, a height already typical for current wind turbines, when higher-altitude data are available? The higher-altitude comparisons would seem more aligned with the study’s stated objectives.

Technical corrections

1. In the introduction, it might be appropriate to add the reference, where they use ERA5 to compute AEP of airborne wind energy systems:
   Schelbergen, M., Kalverla, P. C., Schmehl, R., and Watson, S. J.: Clustering wind profile shapes to estimate airborne wind energy production, Wind Energy Science, 5, 1097–1120, https://doi.org/10.5194/wes-5-1097-2020, 2020.
2. In line 54, the acronym "AWE" is repeated unnecessarily. Please use the acronym directly after the first mention.
3. In line 111, it is generally not proper styling to add directly an url to the text. Please include it in the references and refer to that.