Title: Underestimation of strong wind speeds offshore in ERA5: evidence, discussion, and correction
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Response to Review Comment 2: Anonymous Referee #2

The original comments from Referee #2 can be found at https://wes.copernicus.org/preprints/wes-2024-27#RC2. They have been reproduced below. Answers from the authors are marked in blue.

General comments

The writing style is extremely terse, and while each writer has their own style, I would encourage to add a bit more context to the storyline throughout the paper, since it becomes sometimes hard to follow since very little details are given, especially about a detailed interpretations of the plots shown and their implication.

Thank you this is an important comment. We have added text to the abstract, which describes the situation and give some context:

- "In turn, these time series are used for assessing wind, water levels and wave conditions, and are thereby key inputs to design activities such as calculation of fatigue- and extreme loads, as well as platform elevations"
- "If left uncorrected, poses a design risk (large- and extreme wind, waves and water level conditions are underestimated)"

Is it correct the results only consider neutral and unstable conditions? If so, this should be highlighted way more in the paper, and a "neutral and unstable conditions" specification should be added every time the main results from the study are discussed, potentially including the title.

Dear reviewer, no, the method applies for all stability conditions, but as discussed further in response to your minor comment no. 4:

a) Deriving a 10m from lidar data is slightly more uncertain in stable conditions.
b) Strong 10 m wind conditions (>15 m/s) occur very rarely in stable conditions.

Therefore, for the validation we have chosen to focus on unstable- and neutral conditions. But, as explained in Section 3.1 and Figure 7, one needs to derive the Obukhov length *L* (from ERA5 time series) for the method to work satisfactorily for all wind speed ranges.

We have added the following clarifications to the text in the article:

- In footnote 6: "An alternative method is described on the ECMWF user support website at https://confluence.ecmwf.int/display/CKB/ERA5%3A+How+to+calculate+Obukhov+Length".
- Section 3.3 first paragraph: "Please note that the MOST should be used to obtain satisfactory results for small to medium wind speeds where atmospheric stability is important, i.e. using the Obukhov length as explained in Sect. 3.1".

ERA-5 has data at heights that can be directly compared with lidar observations. Why not including such a direct comparison to confirm the validity of your results, without the need of wind speed vertical extrapolation?

We have used the single levels data available from the CDS, and these are the data DHI have used as well on their Metocean on Demand database. You are right, there are raw(er) model data available but the download time is much longer and we have not been able to access these data.

Minor comments

1) L. 29: please explain "for design, slightly conservative values are typically desirable" in more detail.

Thank you this a good suggestion. We have added "that is: model results that underestimate large wind speeds, and thereby also large waves, pose a design risk (of too small loads, and too low platform elevations)."

2) Fig. 2: what do the values of 'landmask' for ERA5 mean? Please clarify why values are not either 0 or 1 as one might expect.

Thank you for this suggestion, we have added "For ERA5, and for IFS in general, land/sea mask values range from 0 to 1 and indicate the fraction of land in the model cell" in the caption with a footnote to https://confluence.ecmwf.int/display/FUG/Section+2.1.3.1+Land-Sea+Mask#Section2.1.3.1LandSeaMask-Land-Seamask.

3) In section 1.3, please specify which variables, at which height(s) are downloaded/considered from the models.

Thank you for this suggestion. We have added the required information in this section (which is now called Section 1.4 – there was a typo in the numbering).

4) L. 125: have you checked your statement that "wind speeds larger than 15 and 20 m/s (where stable conditions are very rare)" at all sites

Yes, we did, both in the reanalysis datasets (see Figure 1 below, we have also checked ERA5) and in the literature (Figure 2 below for the North Sea,). We have added:

- "this was checked from both reanalysis data time series but also the literature, see (Sathe et al., 2011) for the North Sea"
- Reference (Sathe et al., 2011)

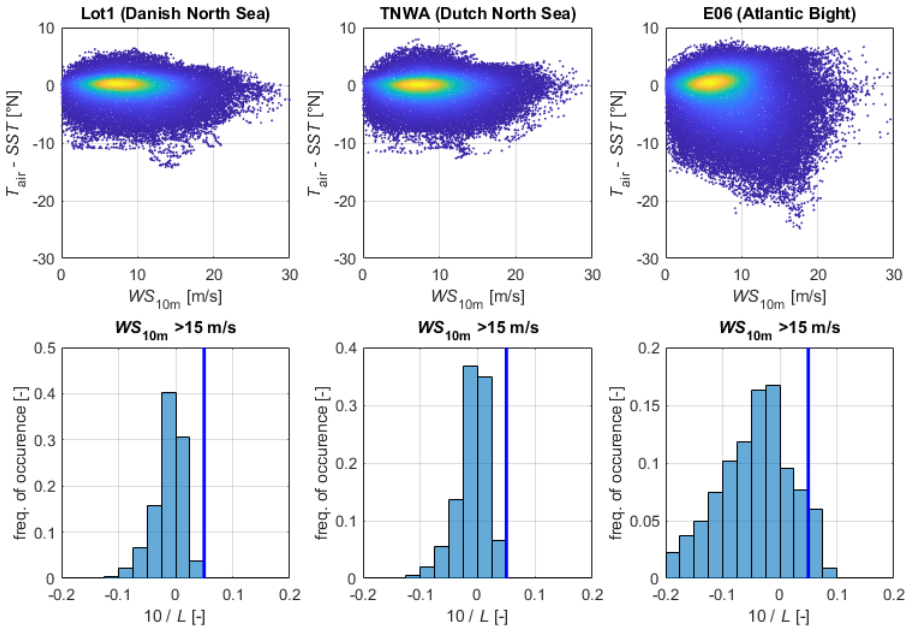

Figure 1: Using CFSR/CFSv2 data. Top: scatter plot of air-sea temperature differences against 10 m wind speeds for three representative measurement locations. Bottom: histograms of 10 m / L where L is the Obukhov length derived from the Bulk Richardson number formulation from (Peña et al., 2008a), where stable conditions are identified for 10/L>0.05, following (Sathe et al., 2011).

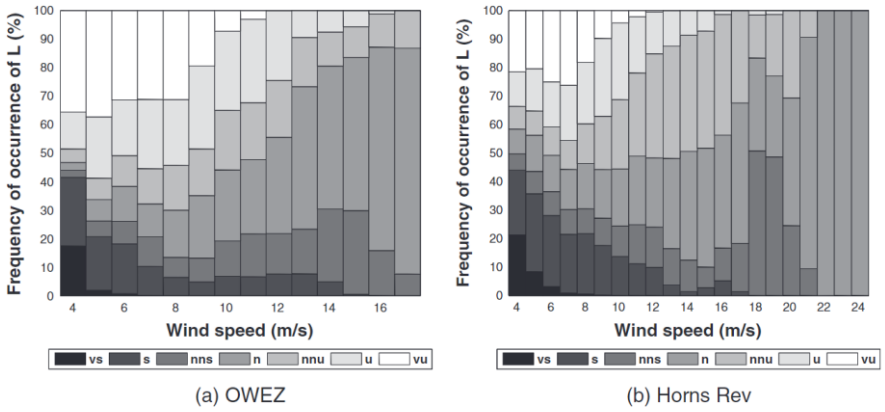

Figure 6. Variation of atmospheric stability with respect to wind speed between 225 and 315°. vs, very stable; s, stable; nns, near-neutral stable; n, neutral; nnu, near-neutral unstable; u, unstable; vu, very unstable.

Figure 2: Reproduced from (Sathe et al. 2011), this figure shows that for large wind speeds in the North Sea and Western wind directions, strong winds occur very rarely for stable conditions.

5) Figures: you need to define all symbols, colors, abbreviations shown in the figure, legend, and title. If not needed, remove them.

Thank you, we have received the same comment from Reviewer#1, and have updated the caption where it was needed, see our response to their comment.

6) L. 155: please provide more context when you start making comparisons about fetch. What are you eferring to, how did you segregate the data, etc.

Thank you, this was missing indeed. We have added “In this example, short fetches are defined as wind directions where wind comes from land across the Bay of Biscay while wind direction oriented towards the Atlantic Ocean are considered long fetches, see Fig. 2”

7) There are several grammar errors throughout the manuscript. One example: in the Fig. 8 caption: “length values” not “lengths values”. Please double check your grammar.

8) Figg. A1 and A2 are impossible to read – make all fonts larger.

We have enlarged the Figures, thanks for this comment.

Technical corrections

1) L.16: do not capitalize “power”

This has been corrected.

2) L. 26-27, 29 and many more: parentheses not needed for these references

This has been corrected.

3) L. 66: “NWP” was already defined

This has been corrected.

4) L. 79: “FLS” was already defined

This has been corrected.

5) L. 119: the sentence is not grammatically correct

Thanks, we have now corrected the sentence to “However, for practical reasons this often needs to be done”.

6) L. 133: comma missing after “i.e.

This has been corrected.

7) L. 143: typo in “MOoD

This has been corrected.

8) L. 157: a verb is missing in this sentence.

Thank you, we have now corrected to “This effect is of the same magnitude (…)”

9) Fig. 6: do we need all the info in the title? If so, please explain what they are referring to, as no information is included in the caption or text

Thank you, see our answer to your minor comment 5) earlier.

10) L. 195: “at” instead of “are”?

This has been corrected.

11) L. 212: “latter” not “later

This has been corrected.

12) L. 213: “leads” not “lead”, and “to a 60%” not “to 60%”

This has been corrected.

13) Copernicus requires you to list a DOI for all references that have one

Thank you, we have checked the list and found, indeed, a handful of missing doi.

14) L. 297: “The analysis was carried out in MATLAB” is probably not needed since the code is not made availably anyways

This statement has been removed.