Comments to essd-2023-115

This paper represents an important contribution to the field of experimental offshore wind energy.

The literature review in the introduction is scarce but in the context of a technical study like the present it can be acceptable. Also, several references are added throughout the manuscript. Some statements need additional references, as reported in the specific comments.

The methodology is described exhaustively including calibration and accuracy of the difference sensor.

The description of the physics should be improved as follows:

- The key concept of wave physics (e.g. significant height, spectral behavior) can be briefly explained for the reader that is not familiar with wave dynamics
- The TI from la profiling lidar is well-known to be affected by severe artifacts (probe averaging, cross-contamination) that should be discussed in this context
- The characterization of the lidar statistics as yearly averages in section 4.2 does not provide insight on the 10-minute differences between the different approaches. It is recommended to show the error on the 10-minute statistics as a function (at least) of wind sector and stability.

A main aspect where the paper can be improved is also its clarity and readability. The authors should try to limit the amount of numerical information in the text and summarize results more in tables or plot (see for instance section 4.3 that shows an average of 2 numbers per line). Actually, many details could be omitted to shorten the manuscript. The last point is left at the discretion of the authors. Also, the order in which text and figures present the two sites should be kept the same for the whole manuscript to improve readability.

The above remarks indicate that minor reviews are needed before acceptance.

Specific comments

L 27, “The U.S. … by 2030”: please add reference

L 29, “…particularly wind speed and direction at hub-height, where offshore turbine blades will be spinning.”: this can be rephrased as: “…particularly where offshore turbine blades will be installed” since 1) turbine do not spin only at hub height, 2) the whole rotor vertical span is of interest generally, 3) oceanographic conditions above the sea level sounds odd.

L 33: please specify if the wind turbines slated to be placed in the mentioned areas are of floating or fixed-bottom type.

L 80: “discuss”.

Section 2.3: please add the results of the IMU calibration for both buoys and move it to section 2.1.

L 132-134: the 91% availability of the Humboldt buoy does not match Fig. 3 and Table 2.

Figure 3: please plot all timelines for both buoys on the same time axis.

Section 2.3: the acquisition frequency of the IMUs do not match the data in section 2.3.

L 234: “attitude”.

Equations 4-6: please expand the A matrix on the same line though a matrix product. Also, please provide a graphic of the yaw, pitch and roll angles signs. Matrix R_1 shows a different rotation direction compared to the other two and it would be interesting to understand why.

L 322: “gravity waves” could be mistaken for atmospheric inertial oscillation. Could “sea-surface wave” be clearer to the generic reader?

L 349: please define maximum and significant wave height.

L 353: add reference to the “theory”.

L 355: add reference to “historically”.

Table 7: why the criterion for good significant wave height does not apply for the spectral peak wave period in this table but is present in Table 6?

L 406: Tables’ references look wrong, please check.

Figure 9: “COT” instead of “COD”

Section 4.1: the title could be “Surface wind speed, direction and temperature statistics”

Figure 13: please describe meaning of error bars.

Section 4.2: the title could be “Doppler lidar wind speed, direction and turbulence statistics”

L 409: Please specify that the STA are the Windcube-corrected statistics.

L 530-531: please clarify that w is larger “in magnitude” in the STA data.

L 531-534: the mentioned vertical velocity variances are not shown.

Section 4.2: please provide an explanation of why the TI and vertical velocity variance is higher in the WIndcube data.

Figure 17 is not mentioned in the text.

L 565: Is referred to the direction or is it a spectral consideration?

L 595-594: please add reference.

Figure 21: please describe meaning of error bars and dots.

L 602-603: the wave heights are not always higher than the all-time average, please clarify.

Figure 22: please describe what ”Peak” and “Mean” refer to in calculating the roughness.

L 719-720: the comparison of 10-minute data was not shown, yearly averages were provided instead which could be affected by error cancellation.