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Interactive comment on "Mapping flow distortion on oceanographic platforms using computational fluid dynamics" *by* N. O'Sullivan and B. Ward

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Response to Referee

We would like to extend our thanks and gratitude to the reviewer for his constructive comments. The proposed review questions have been answered in the following document and the following corrections have been applied to the article.

RC: The CFD code OpenFOAM used in the paper is run to a steady-state rather than producing a spatial and temporal description of the distortion of the turbulence by the presence of the ship. The authors need to make it clear how a mean airflow correction from a

steady-state solver can be used to correct Eddy correlation (EC) fluxes. For example they state, ''CFD modelling for the quantification of flow distortion for EC measurements was first conducted by Yelland et al. (1998) for the RSS Discovery and the RSS Charles Darwin.'' Yelland et al. (1998) did not correct EC measurements for the effects of flow distortion. Mean airflow corrections were applied to the inertial dissipation measurements of the friction velocity (u*).

AC: The abstract and the introduction have been modified to clarify the importance of a flow distortion correction for the measurement of average wind speeds and direct flux measurements with the eddy correlation method, and the derivation of gas transfer velocities from this measurements. The correction presented in this article is a correction for mean wind speeds. We also do not aim to correct eddy correlation direct flux measurements with the current flow distortion model. The mean wind speed correction is however important when the results of direct flux measurements are correlated with the insitu wind speed to derive wind speed based transfer velocity parametrisations. The following paragraph has also been added to the conclusions to define the application of the current corrected wind speeds to the eddy correlation calculations:

> The spatial differencing method that has been developed shows a defined method for correction of wind speed data for full cruise periods. This gave RMS values to experimental results of 0.42 ms^{-1} for 20.5 m prediction space and 0.013 ms^{-1} across a 0.5 m prediction space. It has been shown that matching the mean difference from experimental results to corrected wind speeds led to a prediction within 10% for the 20.5 m space from free-stream undistorted flow to the mast mounted sonic anemometer and 50% for the 0.5 m space between the mast mounted Gill sonic and Young's Mean 1. Therefore, over a small space, the prediction of error using a steady state model is not appropriate and sub-scale LES model should be used to im-

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prove accuracy. This defines also that for the Eddy Correlation calculations a more accurate LES model should be used to reduce the errors in correcting the wind speed measurements used in these calculations

RC: A major result hinges around the increase of the wind speed error with increasing wind speed (Figure 5, 7 and 8), which has not been observed before. The z-axis (wind speed error) in the figures should be plotted as a ratio of (Anemometer wind speed/free stream undisturbed flow), not as the difference between anemometer pairs (see Yelland et al. (1998). Does the trend with increasing wind speed error exist in figures 5 and 7 when this is done? If the trend disappears then a simpler correction based on wind speed direction could be employed.

AC: This was also highlighted by the second reviewer, and we have therefore changed Figures 5, 7 and 8 to ratio plots. We have shown these updated figures in second reviewer's response, defining the mean differences between wind speed bins in both experimental and numerical data. It can be established that wind speed dependence is present to a maximum level of 5.6%.

RC: The paper as it stands is confusing and needs to be better presented to fully understand what model runs have been performed and what the results show.

AC: This was highlighted by the second reviewer also, and we have made significant changes to the text. We believe that the updated version of the manuscript is much clearer, and our results are better presented.

References Cited

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Popinet, S., Smith, M., and Stevens, C.: Experimental and numerical study of the turbulence characteristics of airflow around a research vessel, J. Atmospheric and Oceanic Technology., 21, 1575–1589, 2004.

Yelland, M., Moat, B., Taylor, P., Pascal, R., Hutchings, J., and Cornell, V.: Wind stress measurements from the open ocean corrected for airflow distortion by the ship, J. Oceanogr., 28, 1511–1526, 1998.

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