

Interactive comment on “Using global reanalysis data to quantify and correct airflow distortion bias in shipborne wind speed measurements” by Sebastian Landwehr et al.

Anonymous Referee #1

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General comments: Overall, this manuscript presents an intriguing evaluation of the air-flow distortion of wind measurements during the Antarctic Circumnavigation Experiment (ACE). As the authors note, identifying impacts to wind measurements from a ship's superstructure can be challenging, with CFD modeling being the most accurate, but also costly approach. Their use of reanalysis data to estimate the ship-relative winds to determine the flow bias adjustments was an interesting approach.

Overall, I found the manuscript insightful and the results were convincing. They provided a solid justification for why correcting for wind flow distortion is necessary prior to using ship wind observations to develop parameterizations of air-sea exchange pro-

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cesses (in their use case sea spray). The authors did a fairly good job acknowledging the limitations of their methods. I have no major concerns but point out a number of minor additions and changes that will clarify the text and figures. I believe the manuscript is suitable for publication once these minor issues are addressed.

Specific comments/suggestions:

1. Introduction, ~line 30: The authors note that remotely sensed winds are validated using buoy wind, but should also note that ship winds have also been used to validate these systems (e.g., Bourassa, M. A., D. M. Legler, J. J. O'Brien, and S. R. Smith, 2003: SeaWinds Validation with Research Vessels. *J. Geophys. Res.*, 108, DOI 10.1029/2001JC001028.)

2. Introduction, 5th paragraph: The authors introduce reanalyses and note the assimilation of buoys and satellite data, but neglect the fact that ship data are also assimilated to most of these models. Were any data from the ACE cruise assimilated to ERA-5? I would expect if they were, they would have been from the standard hourly bridge reports that would be contributed to the Voluntary Observing Ship scheme.

3. Introduction, 6th paragraph: Please briefly spell out the “observed effects” of pitch and roll noted in O’Sullivan et al. 2013. This will make it easier for the reader to compare your results with those from the O’Sullivan paper.

4. Introduction, 8th paragraph: Again, the authors note that reanalyses assimilate buoy and remotely sensed winds, but what about ships? On any given day there are hundreds of ships making standard weather observations over the ocean and these are archived as part of the International Comprehensive Ocean-Atmosphere Data Set (Freeman, E., S. D. Woodruff, S. J. Worley, S. J. Lubker, E. C. Kent, W. E. Angel, D. I. Berry, P. Brohan, R. Eastman, L. Gates, W. Gloeden, Z. Ji, J. Lawrimore, N. A. Rayner, G. Rosenhagen, and S. R. Smith, 2017: ICOADS Release 3.0: a major update to the historical marine climate record. *Int. J. Climatol.*, 37, 2211–2232. doi:10.1002/joc.4775). These data are assimilated in many reanalysis products.

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Please verify whether or not ship data are assimilated into ERA-5.

5. Same paragraph: Add the ACE acronym to the text where the Antarctic Circumnavigation Experiment is first mentioned.

6. Section 2, line 11 : When you mention Leg 4 in the text, it would be good to refer to the cruise tracks on a map (e.g., refer to figure 8).

7. Section 3, first paragraph: Also, a good place to refer to figure 8 cruise map.

8. Section 3.1, second paragraph. There are several items regarding the instrument set up that should be clarified a. Add more details on the different sonic anemometers used. Are the anemometer models from the same company? The acronyms/model numbers are not very useful. Do they have the same accuracy, precision, sampling rates, etc. b. How tall were the vertical poles for each anemometer? Were they the same height above the nearest deck? If you have them, photos of the installation would be great to add. c. Was the zero-reference mark on each anemometer checked before each cruise? Our experience has shown that any anemometer can come loose over time and the orientation can change. Especially if the sensor were swapped between cruise legs. Was the orientation offset between the zero-reference mark on the anemometer and the zero in the ship's coordinate reference accounted for in your calculations (see Smith et al. 1999)?

9. Section 3.2, 4th paragraph: Change “Due to the complex...” to “Due to the complexity...”

10. Same line you mention the “structures nearby the anemometers”. Are these symmetric for the port and starboard anemometers? Are their differences in the upstream obstacles? Again, photos would be enlightening.

11. Section 3.4. It would be helpful to have a figure or table that quantifies the number of available observations in each relative wind sector. Also, a figure or table showing the results the sensitivity to your choice of averaging period (e.g., how much do the

results change for 5 min vs 60 min averages?).

12. Section 3.5, paragraph 3: How many unique observations were available for bias estimation after all the quality checks. The authors note 44%, but how many observations does that translate to? A table showing the number of original observations for each anemometer and the # of values removed by each test/criteria would be nice.

13. Section 4.3, first paragraph: The second sentence starts “The correction tends. . .” Maybe I missed it, but I was not clear at this point as to how the correction was calculated. Please cross reference back to this equation earlier in the text at this point just to make this clear to the reader.

14. Section 5, 2nd paragraph: I agree completely with the authors that testing agreement between anemometers is not an indicator of their reliability. The approach presented in this paper shows promise for wider application.

15. Section 5, 3rd paragraph: the text is not clear regarding the averaging of the wind speeds. Were averages made separately for the port and starboard anemometers? Or was all data from both anemometers combined and averaged? Just a change in wording is needed to clarify. (the same wording problem exists in the conclusions, 4th paragraph).

16. Figures: All are rather small to see the details, but that may just be how they were presented to reviewers. Several plots show the relative wind direction as negative to positive – it would be helpful to label this axis with “port” and “starboard” as well to make this easy to see.

17. Figure 1: Colors are hard to differentiate (maybe a more distinct color scale would help like the one in figure 2).

18. Figure 3: Use of negative N in the latitude labels is confusing. In the text you call this south (S) latitude. Please do the same in the figures to be consistent with the text.

19. Figure 8: Sort the data by the magnitude of the difference and plot with the largest

ratios (both + and -) on top. At present, some of the smaller ratios are plotted over the larger ratios, thus the plot underestimates the differences.

20. Figure 10: Please clarify the meaning of the lines versus the shading in this figure. I assume the line is the median, and the shading the IQR, but state this in the caption.

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