

## ***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 #2**

Received and published: 11 December 2019

#### General

This manuscript presents the correction of shipborne wind observations, which are biased by flow distortion. With the use of reanalysis data these biases can be quantified and the observations can be corrected subsequently. Eventually, the uncertainty of the observations after correction is in the range of the uncertainty of the reanalysis product.

This work is an important contribution, because in-situ wind speed and direction observations on the open ocean are still rare. Therefore, the existing observations from research vessels, buoys, and other platforms need a critical review since they are used for a variety of purposes like scatterometer calibration, model validation and estimates

C1

of air-sea exchange, which are often parameterized with wind speed.

The authors clearly explain their motivation and their method. They use ERA-5 data to fill the gap between observations and to detect and quantify flow distortion, which itself is dependent on the relative wind direction. The ranges of the biases are large for both, relative wind speed and direction. Converting this into true winds, a large error is estimated, which is reduced after applying the bias correction estimated from the flow distortion. As a major result the authors show a final dependence of the corrected bias to the used ERA-5 product. Problems and limits of the approach are discussed and illustrated.

I suggest a minor revision as the manuscript is clearly structured and the scientific workflow is properly described. However, I have some minor specific comments, which are described in detail below.

#### Specific comments

There are some inconsistencies in the labels and/or captions of the figures (cf. technical comments to the figures). Please elaborate generally: Whenever data from one sensor are shown, make sure it is stated consistently in the text/labels/caption.

#### Technical comments/suggestions

Page 2/line 26-29: Just a comment. It's true, that buoys are the backbone for validation of other wind products. The impact of flow distortion is smaller compared to ships, right. However, flow distortion is an issue for buoys, too. Similar to ships this flow distortion is highly dependent from the structure on the buoy. The problem is that usually it is either not recognized or one is not able to estimate this effect due to the lack of redundant observations. Emond et al., 2012 and Bigorre et al., 2013 extensively studied these effects, which can be on the order of 5-10% of the observed wind speeds.

3/21-22: See above comment on buoy flow distortion biases.

3/26: Twice per day is rather good from a global point of view. There is even the

C2

RapidSCAT program, which deals with the diurnal cycle in wind speed. However, for your purposes it's still small.

4/9: Please introduce the abbreviation ACE first (perhaps on page 3/line 31 or whenever it shows up first after the abstract).

4/16: The mentioned study describes altimeter and radiometer observations. They don't deal with scatterometers, do they?

5/3 (first paragraph): Even though it shows up later in figure 8, a map at this part of the paper might help the reader to follow.

5/24: How often does this happen? Can you give an example? Parking of the ship?

6/14: No SSTs from the weather station? What do you mean with 'not yet available'?

6/23: Replace "form" with "from".

9/3: I'd like to read here a number(or a ratio) of how many data are finally used for the estimation of flow distortion parameters. Just to get an impression. I calculated 40.5% (of all 'raw' data). Is that right?

9/9: It is five-minute average? Or five (times) minute-averages? I'd suggest to use five-minute, i.e. with a hyphen, and continue this throughout the paper.

9/22: A function of which relative wind direction? As you've shown before the measurements between the two sensors can differ strikingly. Please clarify. (See also comment to figure 3)

10/31: It looks overcorrected in figure 7, meaning that your peak is now below the ratio 1.0? Any comment on that?

11/4: Unclear formulation "could be caused the uplift". You mean "caused by ...". Please clarify.

11/19: What other sources of uncertainty can play a role for  $u_{10N}$ ?

C3

Fig. 1: Caption: Remove one 'the' in the second sentence.

Fig.3: I'm a bit confused. In the text you describe model against starboard, which is also true for the labels. In the caption you describe model/port ratio and difference. Which one is true? What is on the y-axis, port or starboard? Please clarify.

#### Additional references

Bigorre, S. P., Weller, R. A., Edson, J. B., & Ware, J. D. (2013). A surface mooring for air-sea interaction research in the Gulf Stream. Part II: Analysis of the observations and their accuracies. *Journal of Atmospheric and Oceanic Technology*, 30(3), 450-469.

Emond, M., Vandemark, D., Forsythe, J., Plueddemann, A. J., & Farrar, J. T. (2012). Flow distortion investigation of wind velocity perturbations for two ocean meteorological platforms. Woods Hole Oceanographic Institution.

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