

Interactive comment on “Using computational fluid dynamics and field experiments to improve vehicle-based wind measurements for environmental monitoring” by Tara Hanlon and David Risk

Anonymous Referee #1

Received and published: 28 December 2018

Review of Hanlon and Risk's 'Using computational fluid dynamics and field experiments to improve vehicle-based wind measurements for environmental monitoring'

Summary: The experiment, as suggested by the abstract, is well motivated and designed. The abstract is exceptionally well written. However, the paper does not meet the expectations from the abstract. I believe that major changes can make this work an extremely useful contribution.

Critical details regarding calculations are missing. The CFD work appears to be well

C1

done, except for one very worrisome statement that I suspect the authors can easily explain. However, the CFD work is not useful as presented because it is not put in the context of a moving car, as could be done if the above mentioned equations were added to the paper. The bias adjustments presented in the field study appear to be an artifact of experimental design, rather than physically meaningful. This is again because the above mentioned equations were not used. The promise of meaningful use of the stationary anemometers was not fulfilled. These could have been used to make a correct assessment of biases as a function of the speed of the car (using the above mentioned equations), but this work was not done. While the authors are to be commended on obtaining useful observations and CFD calculations, they should redo the non-CFD work and present the final results in a context that combines the conclusions from the CFD results and field results. Such a reanalysis would make an extremely useful contribution. Furthermore, the field data are not made publicly available, which is preferred and often a requirement for modern journal publications.

Major Comments: 1) Section 2.1, end of first paragraph. Please say why these two sets of experiments appropriate to address the research objectives. I agree that they are appropriate, but some readers will not understand how they can be combined. This point is not addressed in the conclusions either, making this work needlessly incomplete. The relevant equations are presented in a variety of ways in

Smith, R. S, M. A. Bourassa, and R. J. Sharp, 1999: Establishing more truth in true winds. *J. Atmos. Oceanic Technol.*, 16, 939-952.

2) Page 4: lines 10 and 11: The meaning of 'The drag coefficient was determined when the change in CD was less than 0.001.' is not clear. Is this condition sufficient? Or is convergence slow enough that this condition leads to large errors. How was it determined that this condition is sufficient, as 0.001 is rather a large fraction of the drag coefficient over a smooth surface? The following sentences are insufficient for such a test. Granted, this situation becomes clear later, but it should be clear when presented.
3) Separating the experimental design (for two experiments) from the results (for two

C2

experiments) is irritating and needlessly confusing. After the experimental design for the CFD I would greatly prefer to see the results from the CFD. a. Why are limitations of the CFD method/results discussed in the section on field observations? b. If this lack of results from flow into the wind is true (as literally read), then why should I read further? This seems like it could be critical flaw. 4) Are the observational data made publicly available? If so where? If not, should this work be published? 5) Page 10, Equation 1 and following line: What are the units of wind direction and wind speed? There will be quite a difference for m/s vs mph, and for radians vs. degrees! 6) Figure 6: It appears that there are fluctuations in the ratio of anemometer wind speed to vehicle wind speed that is associated with the speed of the car. This is not surprising because the measured speed is equal to the magnitude of 'the wind velocity minus the car velocity.' Such a dependency is expected as an artifact of the situation, and not as a systematic correction in the manner that the authors suggest. Showing the math requested in comment (1) would help the authors organize their thoughts and experiment in a manner that conveys useful information. I had expected the authors to use differences from the stationary anemometers to illustrate these biases, but that work is not contained in this paper. 7) Page 12, figure 8: What is actually shown in Fig. 8b? The caption and text claim that the figure shows the corrections, which suggests that the corrections are nearly identical to the measured winds. It appears that what is shown is the corrected winds.

Minor Comments: 1) Line 3: 'Used to study Meteorology' is too broad. Be more specific about the scale and the type of vehicle (for example, ships are vehicles, but not included in this study). 2) Table 1: Improve the caption to explain the labels of the table rows and columns. 3) Page 6, line7 and line 10-12: How were these corrections made? Was the car motion subtracted from the wind, or was the adjustment done correctly following Smith et al. 1999? The statement that the calculations were done in R does not tell us how they were done. Smith, R. S, M. A. Bourassa, and R. J. Sharp, 1999: Establishing more truth in true winds. *J. Atmos. Oceanic Technol.*, 16, 939-952. How was the temporal averaging done? See the above paper for the importance of the

C3

correct averaging while wind directions are changing relative to the vehicle. 4) Page 7, line 3: 'similar qualitative trends' is so vague as to be nearly meaningless. 5) Page 7, line 10: This statement makes sense only for a fixed wind speed and direction. If it is being applied in general as suggested by the writing, then this result cannot be correct – or important caveats are missing. 6) Page 7, lines 21-22 & page 8, line 3 The logic '(where measured windspeed = true windspeed)' must be missing key caveats. 7) Page 7, line 34: 'How big is 'significant' in terms of heights? The existing text is too vague. 8) What is meant by wind speed > 3 standard deviations? Standard deviations of what (relatively to what)? 9) Page 9, line 2: What is meant by 'normalized wind speed'? 10) Page 10: At or near the end of the CFD results, please remind the reader that these are CFD results rather than field results. Changing the order of the paper to put method and results together would reduce this problem. a. The last line of this section belongs in the section on field results b. How was this yaw determined? c. How was temporal averaging applied? Was it after individual calculations were corrected, or was the averaged corrected? The first approach is correct when the vehicle relative wind direction is changing.

Interactive comment on *Atmos. Meas. Tech. Discuss.*, doi:10.5194/amt-2018-354, 2018.

C4