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Atmospheric Measurement Techniques Discussions

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 #2

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This study aims to guidance and correction factors for those aiming to use vehicle-based instruments to measure wind speed and direction. As such, it is a useful contribution to the literature. The paper is well organized and well written, but suffers from some problems with methods and the interpretation and presentation of results. It requires major revisions before being considered for publication.

General Comments

The reasons for focusing on installation of an instrument on top of a pickup cap are not

provided and not clear. Much of the initial discussion focuses on the work of Straka et al. (1996) and others that chose to put the anemometer out front of the vehicle to avoid the vehicle's flow field. And the authors show in their results (e.g. Fig. 3) that such a location would indeed be preferable. The authors need to be much more clear about the reasons for choosing to focus only on a location on top of a cap.

Problems with wind direction and speed data from a mobile instrument occur when the vehicle is experiencing acceleration (either changes in speed or direction). Data under such conditions should be removed from the analysis. However, this issue is not mentioned by the authors, even though it has a significant influence on both methods and results. I can only assume the authors have left these data in, and it helps to explain some of the large scatter in Fig. 7. This issue needs to be fully addressed.

Mobile wind data are collected at a 1 Hz interval, and fixed wind data are collected in one minute intervals (it is not clear if these are 1-min averages or not). The authors do not address challenges with comparing one data set to the other. Particularly in Fig. 8, it is hard to see how the mobile measurements and wind rose plots are an 'apples to apples' comparison. The authors need to address this issue.

The authors provide corrected wind data in Figs. 7 and 8 but readers (including myself) will want to see the uncorrected data in these plots as well. This will have the side benefit of making the plots larger and more legible.

Lastly, there is quite a bit of material relating to ships in the paper, and the reason is not entirely clear. Unless the authors can justify the inclusion of all of this material, it would be good to pare this down to essentials.

Detailed Comments

Page 2 Line 3 – There have been a number of other field studies that have made use of mobile measurements, including studies in Canada related to severe weather-related mesoscale meteorology (Taylor et al. 2011, Curry et al. 2017), air quality (Brook et al

2013) and urban meteorology (Joe et al. 2018). The authors should consider including these in the literature review and possibly make use of some of the results.

P4 L10 – re 22.222 m/s – do the authors believe the inlet velocity could be controlled to this accuracy? Please use a reasonable number of significant digits.

P4 L26 - To eliminate confusion here, it should read "The flow around a pickup truck with an open box is more complex than...because of wake interactions".

P4 L31 – Why is this the 'area of interest', and what evidence is there to support that flow atop the cap of the vehicle is located away from large pressure gradients?

P5 L5 - Were the speeds ranging from 40 to 100 also applied to these eight domains? Need to be more clear about this.

P5 L16 – Given known problems with measuring during acceleration, why make fixed measurements in the corners rather than the straight-aways? Why were the corners chosen in the first place?

P5 L19 – The meaning of this sentence is not clear – what is the 'frontal wind' from the vehicle? Please revise.

P6 L1 – Data should only be used when the vehicle speeds were kept constant – the authors do not mention this, and should fully explain their decisions here.

P6 L12 – I would like to see the detailed calculations included in an appendix.

P7 L25 – The meaning of this sentence is not clear to me. Please reword.

P8 L14 – It is not clear what these sentences are referring to – I see nothing in Table 2 that "shows" this.

Figure 7 – A few problems here – the grey bars need to be explained, another panel that shows the uncorrected mobile measurements needs to be included, and the separation of data at 0/360 degrees needs to be addressed so that there are only four 'bars' of

data, as in the control.

Page 11 L5 – 'data was' should be 'data were'

Figure 8 – A few issues here – the wind rose plot details are illegible particularly the frequency values (which appear to be missing entirely), a diagram the uncorrected mobile winds needs to be included, and the reason needs to be given to explain the WNW winds measured only along the top, headwind leg. The authors also need to specify what samples are being plotted here – certainly not 1 Hz data.

P12 L7 – The use of 'levels' as a verb here is confusing. Please reword.

P13 L4 – Over what periods are the data for the wind roses taken? This needs to be specified.

P13 L5 – Why not also average the winds over the leg and compare to the wind rose over that leg?

P13 L10 – The authors drove the route at speeds of 40, 50, 60, 70, and 80 km/h but only present results from 70 km/h in Fig 8. They need to also show results from the other speeds (perhaps best using averages).

P13 L10 – Re "improved", it is difficult to see this and is not quantative. The authors need to better support/interpret the results.

P13 L15 – I understand that CFD cannot simulate this but it could use a clearer explanation.

P13 L26 – Why is there more variability in tailwind conditions? Please explain for readers.

P13 L30 – Perhaps this could be better explain – the tail wind will be 'embedded' in the flow around the vehicle in real-world conditions, so why wouldn't it be 'detected'?

P14 L1 – Should be 'mobile anemometers'

P14 L1 – Not sure where the 'mean' was compared. Please expand on this.

P14 L7 – What about other uses of mobile wind data? How would this improve a meteorological field study, for example?

P15 L20 – On a daily basis? Only during field studies?

P15 L30 – But what is the representative height being aimed for? You could try to install at 20 m mast and it would certainly be out of the vehicle envelope, but do you want to know the winds at that height? The authors have not made it clear at what height stakeholders require wind data.

References

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