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Atmospheric Measurement Techniques
Discussions

Interactive comment on "Performance of a mobile car platform for mean wind and turbulence measurements" *by* D. Belušić et al.

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We thank Prof Foken for his insightful comments and suggestions. The responses are given below, marked with **R**.

1. The turbulent eddies are much smaller near the surface than within the typical height range of low level aircraft measurements of 50 to 100 m. Furthermore, these small eddies make a significant contribution to the flux. Due to the speed of the car, these eddies can be found in the spectral range of up to 100 Hz or more. If you have no low pass filter with a frequency similar to the sampling frequency of 20 Hz, you probably have aliasing effects. The oversampling with 60 Hz probably has a low pass filter frequency that is too low. Please discuss this issue.

R: We discuss this issue in Section 2, first and second paragraph. In the first paragraph, we added the following explanation: "The internal sampling frequency of the sonic is 60 Hz, and this data is internally low pass filtered and block-averaged to 20 Hz to avoid aliasing". The second paragraph is new and discusses the relative contribution of the resolved eddies to the total flux. It is shown that more than 95% of flux is resolved with the current setup (measurement height of 3 m, sampling frequency of 20 Hz, and maximum car speed of about 30 m s^{-1}), which means that this issue will not greatly affect our results.

2. Recently, low-level aircraft measurements have been discussed in relation to the footprint of the fluxes (Hutjes et al., 2010; Metzger et al., 2013). For the interpretation of your car and tower data, such an analysis seems to be necessary. Furthermore, a road can heat up very much and free convection may be possible. Perhaps you can use both effects to explain some of the differences between car and tower data that you found for some tracks. But this is also important for the conclusions, where you give some hints for the application of your system.

R: We agree that such analysis is required for applications of the system in evaluating fluxes over a certain area, which is now listed as one of the possible improvements of the system. This paper focuses on estimation of errors, and we present conservative (maximum) error estimates in that we do not take into account the differences in footprint between the tower and car. Nevertheless, we have calculated the footprint for each car track, and the distances of the footprint peak range from 2 to 8 m (Fig. 5 in Supplement). This indeed indicates that the road can influence the car fluxes, which is now discussed in the paper. On the other hand, we find little-to-no change of the flux footprint and wind direction for those tracks with large differences in $\overline{u'^2}$ and $\overline{v'^2}$, compared to their neighbouring tracks. Therefore, the major differences do not seem to be related to the footprint.

3. I think that offset is not the right wording for the difference between the sonic and the thermocouple temperatures. The difference is clearly a function of the moisture *and pressure (Kaimal and Gaynor, 1991). Furthermore, with the thermocouple you measure the sensible heat flux, and with the sonic temperature, the buoyancy flux. You can explain the difference between both with the SDN-correction (Foken et al., 2012; Schotanus et al., 1983). Therefore, the sentence p. 959, line 25-27 is wrong.*

R: We have rephrased the sentence discussing the differences between the sonic and thermocouple temperatures: "The sonic anemometer measures the sonic virtual temperature (Kaimal and Gaynor, 1991), which explains the difference from the mean TC temperature in Fig. 3." The sentence discussing the heat fluxes has also been rephrased: "According to expectations (e.g., Schotanus et al., 1983; Foken et al., 2012), the car heat fluxes calculated from the sonic temperature (i.e., buoyancy fluxes) are larger than from the TC temperature (i.e., sensible heat fluxes), but the correlation is good."

Minor remarks:

- Perhaps the paper by Li et al. (2012) could give you some hints for explaining problems with the momentum flux measurements.

R: We thank Prof Foken for pointing out this interesting paper. We refer to its results in section 4.2.

- Because your paper is mainly orientated to the measurements of fluxes, the conclusion that the system can be applied for studying stable nocturnal situations could be misinterpreted. It is possible to detect horizontal fields, but fluxes under these situations are too small, are affected by intermittencies and the horizontal wind speed is much lower than the speed of the car, with the consequence that the momentum flux cannot be determined. Please separate between the possibility for measuring fluxes and that for measuring horizontal field structure.

R: We agree. The nocturnal fluxes are notoriously difficult to measure and determine in general, including the tower measurements. Part of the problem (weak winds) has

been addressed here, since we have chosen a weak-wind situation in our first test for comparing the mean and turbulence quantities with the tower. As for the intermittency, we believe that the current system will allow us to study the horizontal structure of both the mean and turbulence quantities (including the intermittency). However, the statistics of the horizontal turbulence fields will not necessarily represent the flux magnitudes, and a statement about this has been included in the conclusions.

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