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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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1 General comments

The authors present a new design of a mobile car platform aimed for mean wind and turbulence measurements and further calibrated and validated the system with controlled field experiments. They adopted standard aircraft calibration methods for car platforms and evaluated necessary corrections which have to be made for cars. There has not been many studies using a car as a platform in ABL research in the past, and the presented study is the first which presents measurements of both mean wind and the turbulence structure of the ABL. In general, the there is great potential for the use

of car platforms for near-surface observations, especially in conditions where aircraft measurements are not possible. In addition, the simple mounting of the frame and fast setup of the entire system is an asset for many applications. Hence, the presented study is a valuable contribution for ABL research.

In general, the manuscript is well structured and the results are clearly presented. Furthermore, the conducted tests were evaluated in detail and the conclusions on the necessary corrections are plausible. As stated in the comments below, at a few points the interpretation of the results is not as precise. One important issue is the comparison of tower and car measurements, since it proves the applicability of the mobile car platform in this study. Here, a general measure of the agreement between tower and car measurement would be advisable. Alternatively, one should state more clearly the expected agreement for such a comparison (i.e. by putting it in context to studies using aircraft measurements). At some parts the readability of the manuscript can be improved by minor changes. However, the overall quality of the manuscript is good and both the design and procedure are documented in very sound way. For these reasons and the importance of the study for ABL research, I can implicitly recommend the study to be published in AMT.

Besides, there is one important comment for future experiments: The authors state that the design of the mobile car mobile platform was motivated to study the stable boundary layer at night. However, the presented tests were carried out during midday, where most likely no stable conditions occurred. Also, the presented results are based on only small data sets. Hence, for further studies it is recommended to perform also tests at night and over a longer period. This would be important in order to judge whether the presented design is also suited for measurements in the stable boundary layer since night time fluxes are usually smaller and therefore prone to larger uncertainties. This might not apply for the turbulence structure of the ABL.

2 Specific comments

P. 950, L. 21-24: As the use of a moving platform is the key point of this publication, I suggest elaborating on the purpose of aircraft observations or moving platforms here (and not only refer to the references). E.g., like: ”One alternative is research aircraft observations since they/which allow... They have received considerable attention. . ., while/and aircraft sizes...”

P. 951, L. 8: Add “using aircraft” or similar after “techniques” to stress that the following advantages of cars are in relation to aircraft.

P. 953, L. 14-15: “smaller amplitude of car motions” - do you mean compared to aircraft motions? Please specify.

P. 956, L. 16: Add height of wind speed measurement.

P. 957, L. 2-6: How was the area/street characterized (high rise buildings or rather suburban) and were these surroundings expected to influence the speed bump test?

P. 957, L. 7-17: This experiment can be seen as a separate test, which is not only important for the correction of the speed bump test as it was used here, but is of general use for evaluation of wind speed and turbulence data from moving cars. If so, I suggest putting it in an extra section or changing the title of this section accordingly. The results described here would then be presented in Sect. 4.4 or 4.5.

P. 957, L. 19: Were the corrections in 4.1 applied to the data both in test 1 and 2? Please specify. If different, also specify which data the found corrections (p. 958) are based on (only data from test 1 or also from test 2)?

P. 958, L. 12: “This” may be misleading in this context. I suggest using “The method applied here”, or similar.

P. 958, L. 15-16: What do you conclude here? I.e., were non-stationarities and hori-

zontal heterogeneities large, so that it had an effect on the described corrections? How large are the corrections and could uncertainties in the correction explain some of the discrepancies between the car and tower measurements?

P. 959, L. 16: There seems to be a systematic deviation between car and tower measurements, e.g. for the horizontal wind speed in u-direction (Fig. 3). u measured by the car seems to have a negative deviation from the tower measurements. This may hint to an influence of the car speed, which is not corrected for, since u is orientated closely to the direction of the track. If so, are there suggestions how the corrections or the alignment of wind vector could be improved? Or is the result satisfactory, i.e. within the expected range of uncertainty?

P. 959, L. 24-25: Is there a reason why the tower measurements were most likely subject to non-stationarities in the temperature measurements and the car measurements were not? Could the non-stationarities be verified using a stationarity criteria?

P. 959, L. 25: There is factor of up to 2 between the different heat fluxes, which might be also due to varying fetch conditions of car and tower measurements. Also, there are significant differences due to the measurements with sonic and TC as it is described below. The expression “agree well” is hence misleading. I would suggest writing: “are in the same range between XX and YY K m s^{-1}, or similar.

P. 959, L. 25: A general question on the flux calculations: Did you apply other correction methods which are not mentioned (e.g. coordinate rotation (for tower fluxes), cross-correlation between w and TC). If so, please state it in the methods section. If not, could this account for some of the systematic differences?

P. 959, L. 27: I suggest writing “This heat flux difference. . .” or specify it more clearly to distinguish between the differences between sonic + TC and car + tower.

P. 960, L. 6: Is it possible to give a measure of the goodness of the agreement? From first visual inspection the difference in the $\overline{u'v'}$ flux does not seem to be significantly better than, e.g., for $\overline{u'w'}$. As the comparison of the two approaches is challenging, it might be therefore better to give a statistical measure of the flux agreement or the fluxes itself.

P. 960, L. 15-16: Did you also try the opposite test, i.e. extending the sampling period of the car measurements by merging the measurements from the each track at one car speed? If this is possible, the comparison with the tower fluxes would be interesting.

P. 961, L. 6-14: To me the effect on $\overline{w'T'}$ is even more significant than as for the other scalars (when comparing the tower fluxes with the TC-fluxes from the car), hence, it might be worth mentioning here.

P. 962, L. 8: Please specify which $\overline{w'T'}$ measurement you refer to. From the car measurements, the heat flux calculated from the sonic increases with time, however, this was attributed to the overestimation at higher speeds. The TC heat fluxes from the car measurements do not increase with time. For the tower heat fluxes, only the last three tracks exhibit an increase of the heat flux with time. Instead, there is a steady increase of $\overline{w'^2}$ from the car measurements with time in Fig. 4. Could this hint to an increase of turbulence at the sensors at higher car speeds, which would lead an increase in the variance spectra with increasing car speeds?

P. 963, L. 1-4: The difference between the two contributions (black and purple lines) seems to be between 1 (for u), 2 (for w) and 3 (for v) orders of magnitude rather than just one.

P. 963, L. 22: Are there any improvement that can be made to the presented setup, which you may suggest in this section for future turbulence measurements using cars? Also referring to its application in the stable ABL (i.e., whether the presented setup could be also used for the stable ABL or which further tests/development would have to be done in the future) would be important since this was given as a main motivation of the presented study.

P. 969: I would prefer writing “average horizontal car speed” if the average car speed is shown.

P. 971: If possible, mark both the 700 and 900 m track.

3 Technical comments

P. 950, L. 2: Typically no comma before “because” is used (only use comma to avoid misreading). This also applies for the rest of the manuscript.

P. 953, L. 8: Add country of manufacturer.

P. 963, L. 12-15: Use past tense since this is section describes the method that was used.

P. 975, top-right panel: y-axis unit should be also “m^3 s^{-2}”.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 949, 2014.