We thank referee #1 for taking the time to read our manuscript and provide useful suggestions and feedback. We have modified the manuscript to address your points. Referee comments are in black, our responses are in green, and changes to the manuscript are colored blue. Our line references refer to the revised manuscript.

Referee #1

The paper presents a thorough evaluation of mobile car-mounted turbulence measurements near the surface. The mobile measurements are compared with corresponding stationary tower data, which shows that the mobile system can provide satisfactory mean and turbulence data following a proper procedure for flow distortion correction. Furthermore, it is shown that using wavelet analysis for calculating higher order statistics of the mobile measurements can be more appropriate than the traditional eddy-covariance technique. The paper is well written and I recommend publication after minor review.

Specific comments:

1. It is not clear how many measurement passes are made for each track.

Response: We have added new details to the revised manuscript to address this point.

Added lines 151 - 161: Track #1 and Track #2 overlap spatially for 380 m, and so a portion of the data contained within both measurement tracks are identical, for each trip past the tripod. Table 1 gives the number of measurement passes performed on each measurement track. The amount of measurement passes that are excluded (from both Track #1 and Track #2) due to traffic ahead of the instrumented car is also given. Two extra measurement passes corresponding only to Track #2 were also analyzed on 22 Aug, where the car was parked at the tripod and then drove away (a constant vehicle speed was achieved before 120 m). Since the car did not travel down the entire length of Track #1 prior to parking at the roadside, there are no corresponding Track #1 for these two measurement passes on Track #2.

Table 1: The number of measurement passes performed on each measurement track on 20 and 22 Aug.

Date	Track 1	Track 2	Excluded (traffic ahead)	No. of trips past the tripod
20 Aug	6	6	1	7
22 Aug	5*	7*	2	9

* Two extra measurement passes are included corresponding only to Track #2, where the car was stationary prior to the pass. There is no corresponding Track #1 since the car did not complete the entire length of Track #1 before parking near the tripod.

2. In 243: The authors should clarify how exactly the mobile data can have "a time series with a temporal length 11 times that of" the 1–km variance. Since the track length is 1 km, where does the additional data (the temporal equivalent of 10 km) come from?

Response: The wavelet coefficients are calculated following the software developed by Torrence and Compo (1988), which applies the convolution theorem, and hence makes use of the Fourier transform. The Fourier transform assumes the data is periodic, and this periodicity causes errors at the start and end of the wavelet transform calculated from a finite measurement record of temporal length T, known as edge effects (Torrence and Compo, 1988). These edge effects occur because stretched wavelets (i.e., representing long time scales) can extend beyond the boundaries of the measurement period, and into regions where no data exists. Therefore, if we apply wavelet analysis to a time series of only length T (i.e., the same T that eddy-covariance is applied to), there will be some information at large wavelet scales (particularly near the start and end of the time series) that is not reliable. This results in an unreliable wavelet variance or covariance for the time scales of interest (i.e., for wavelet scales $a^* \leq T$) when calculated over T. In an attempt to rectify this problem, Torrence and Compo (1988) recommend padding the time series of length T with zeros (but this too has drawbacks). However, in this study there is no need to pad the time series before or after T with artificial data (or zeros), since the instrumented car continued driving down the same road after measuring on Track #1 and Track #2, providing continuous measured data before and after each measurement pass. This continuous data limits edge effects in our wavelet variances and covariances calculated over T (for the time scales of interest), providing a more reliable estimate for each measurement pass. Hence, when performing wavelet analysis, we include additional data before and after the 1000 m track (equivalent to a spatial distance of about 10 km) that comes from continuous driving in the vicinity of the tripod at a relatively constant speed, and in most cases on the same road. The instrumented car did not come to rest, except briefly at a stop sign or to reverse direction. There are two exceptions for measurement passes on Track #2, where the car initially started from rest and reached a constant speed before travelling 120 m from the tripod.

Torrence and Compo (1988) define the cone of influence as "the maximum period of useful information at that particular time" which is determined as an e-folding time "chosen so that wavelet power for a discontinuity at the edge drops by a factor e^{-2}". In our study wavelet analysis is performed on a time series of length $11T$, with the measurement pass located between $5 \leq T < 6$. Based on the cone of influence definition by Torrence and Compo (1988), wavelet coefficients for each measurement pass are primarily influenced by data between $3.63 \leq T < 7.37$ for $a^* \leq T$. Therefore, the data between $0 \leq T < 3.63$ and $7.37 \leq T < 11$ have little impact on the calculated wavelet variance or covariance, and thus are not necessary to give a reliable estimate for the measurement pass.

Edited and expanded lines 256 – 274: In Eq. (10) index value a^* represents the maximum (Fourier equivalent) wavelet scale and controls the time scales that are included in the wavelet variance, which in this work is set to match T_m as closely as possible. $G_n^x(a_j)$ is calculated from a measured time series with a temporal length of $11T_m$, where the data corresponding to the measurement pass (over which $\sigma_{x\,1\,\mathrm{km}}^2$ is calculated) are located at the center of this period (i.e., from $5 \leq T_m < 6$). This approach is applied to ensure that the wavelet transform coefficients used to calculate the wavelet variances are not impacted by edge effects for scales up to a^* (i.e., they do not lie outside of the cone of influence), while still retaining good computational efficiency (Torrence and Compo, 1988; Schaller et al., 2017). Torrence and Compo (1988) recommend zero padding a finite series of length T_m to reduce edge effects, but in this study, there is no need to pad the time series before or after the measurement pass with zeros, since the instrumented car continued driving down the same road after measuring on Track #1 and Track #2, providing continuous measured data before and after each measurement pass. This continuous data limits edge effects in the wavelet variances and covariances calculated over $5 \leq T_m < 6$ for $a^* \leq T_m$, providing a more reliable estimate for each measurement pass. Hence, the additional data before and after the measurement pass (equivalent to a spatial distance of about 10 km) comes from continuous driving in the vicinity of the tripod at a relatively constant speed, and in most cases on the same road. The instrumented car did not come to rest, except briefly at a stop sign or to reverse direction. There are two exceptions for measurement passes on Track #2, where the car initially started from rest and reached a constant speed before travelling 120 m from the tripod. Based on the cone of influence definition by Torrence and Compo (1988), wavelet coefficients for each measurement pass are primarily influenced by data between $3.63 \leq T_m < 7.37$ for $a^* \leq T_m$. Therefore, the data between $0 \leq T_m < 3.63$ and $7.37 \leq T_m < 11$ have little impact on the calculated wavelet variance or covariance, and thus are not necessary to give a reliable estimate for the measurement pass.

3. lns 605–607 and 617: The interpretation of the confidence interval should be clarified. Why is one standard deviation related to the 95% confidence interval?

Response: We have expanded lines 647 – 654 to clarify the definition of confidence interval (see below).

Why is the confidence related to "not significantly different than 0" at ln 607 and "consistent with the tripod" at ln 617?

Response: For some measurement passes the 95% confidence interval of $\overline{u'^2}_{EC\,car}$ includes zero, suggesting these variances are not statistically different than zero in the 95 % confidence interval. When the confidence interval of a variance or covariance measured on the car includes the value measured on the tripod, then measurements are deemed consistent between the two systems in that confidence interval for that measurement pass. We have corrected line 617.

Edited and moved to beginning of section (line 647-654): δ_{FS} and δ_{ML} give 1 standard deviation of the random measurement uncertainty of a measured variance or covariance for the averaging period T, which Rannik et al. (2009) demonstrate is nearly equivalent to the standard error of the variance or covariance. Thus, in this work we define the 68 % confidence interval as the range $F \pm \delta$, and likewise the 95 % confidence interval as the range $F \pm 1.96\delta$, where F is the measured variance or covariance. When the confidence interval of a variance or covariance includes the value measured on the tripod, then measurements are deemed consistent between the two systems in that confidence interval (for that measurement pass).

Edited line 677-678: However, for times when wavelet analysis predicts a smaller $\overline{u'^2}$, δ_{FS} is also found to be proportionally reduced.~~, and $\overline{u'^2}$ on most passes becomes consistent with the tripod in the 95% confidence interval.~~

Line 20,591,676,749,765: Changed ‘significantly’ to ‘statistically’.

Technical comments:

– ln 365: the sentence looks unfinished?

Response: The sentence has been updated.

Edited line 423 - 424: The mean wind speed shown in Fig. 3.5 (b) shows relatively good agreement between the car and tripod with no significant bias ($\mathrm{MBE_{car}}/\bar{u}_{tripod}$ = 2 % and $\mathrm{RMSE}_{car}/\bar{u}_{tripod}$ = 22 %).

– ln 394: "Figure 6(a), (b) and (c) show..." – Such statements should be clear from figure captions and are not needed in the main text. Similar holds for other figures (e.g. Fig. 8).

Response: We have modified the revised manuscript to remove such statements.

Deleted: Figure 6(a), (b) and (c) show $\overline{u'^2}$, $\overline{v'^2}$ and $\overline{w'^2}$ respectively.

Deleted: Figure 6(c) displays $\overline{w'^2}$ measured on the mobile car compared to $\overline{w'^2}$ measured on the tripod.

Deleted: Figure 8(a) displays the vertical momentum flux ($\overline{u'w'}$) and Fig. 8(b) shows the sonic heat flux ($\overline{w'T'}$). Figure 8 follows the same conventions as Fig. 6.

Deleted: The vertical momentum fluxes, $\overline{u'w'}$ measured by the car and tripod are displayed in Fig. 8(a).

Deleted: Figure 11 displays the random measurement uncertainty of the horizontal velocity variances ($\overline{u'^2}$ and $\overline{v'^2}$) measured on the car plotted as a function of the magnitude of the variance. Likewise, Fig. 12 shows the random measurement uncertainty of the vertical velocity variance ($\overline{w'^2}$) and Fig. 13 displays the random measurement uncertainty of the measured covariances ($\overline{u'w'}$ and $\overline{w'T'}$).

Replaced with: Figures 11 to 13 display the random measurement uncertainty of the measured variances and covariances, calculated using these three methodologies.

Deleted: Figures 11 and 12 show the random measurement uncertainty due to white noise in the measured signal (δ_L) estimated according to Lenschow et al. (2000).

– ln 478: delete one occurrence of "of the".

Response: This has been corrected in the revised manuscript.

– Fig. 12b: x–axis should say "... sonic...".

Response: This has been corrected in the revised manuscript.

Other minor corrections/changes:

1. Changed T to T_m to represent the averaging period in the updated manuscript. In the original manuscript T is also being used for sonic temperature, which may lead to confusion.
2. **Corrected Line 784-785 in conclusion section**: For $\bar{u}$ measured on Track #1 and Track #2, the $\mathrm{NMBE} \approx 2$ % and $\mathrm{NRMSE} \approx 22$ % respectively.
3. Other grammar fixes (i.e., missing “the” and “or”).

References

Rannik, Ü., Mammarella, I., Aalto, P., Keronen, P., Vesala, T., & Kulmala, M. (2009). Long-term aerosol particle flux observations part I: Uncertainties and time-average statistics. Atmospheric Environment, 43(21), 3431–3439. https://doi.org/10.1016/j.atmosenv.2009.02.049

Torrence, C., & Compo, G. P.: A practical guide to wavelet analysis, Bulletin of the American Meteorological Society, 79(1), 61–78, https://doi.org/10.1175/1520-0477(998)079<0061:apgtwa>2.0.co;2, 1998.