

## ***Interactive comment on “On the impact of atmospheric waves on fluxes and turbulence statistics during nighttime conditions: a case study” by D. J. Durden et al.***

### **Anonymous Referee #2**

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#### General Comments:

The manuscript presents an investigation of the impact of atmospheric waves on fluxes and turbulence statistics during nighttime conditions. The topic is very interesting and results provide valuable information. Nevertheless, there is a lack of scientific analysis and interpretation of results. The abstract shows content of the manuscript. The methods applied for the analysis are well described and the information presented is sufficient to allow replication of the investigations. However, the title and the introduction reflect the article only partly. The experimental design is suitable but not well used. Therefore, major revisions should be addressed before recommending acceptance of this manuscript.

C1740

#### Specific Comments:

The introduction doesn't report the author's hypothesis and I lost the line reading Sec. 1. Different kind of gravity waves were introduced like internal gravity waves, terrain induced gravity waves, ducted waves. The influence of gravity waves on turbulence statistics is discussed. Hence, the analysis of the impact of gravity waves is expected. Nevertheless, in Sec. 2.3 is noted that not all events are attributed to gravity waves, as other phenomena e.g. density currents and solitary waves may also contribute to the observed events. The title is correct (“The impact of atmospheric waves ...”). and clearly demonstrates content of the paper, but introduction not. It is a case study and the full analysis of gravity waves can not be expected. But then it should be reflected in the introduction.

Why the sensible heat and latent heat fluxes are not used for the analysis, whereas sonic temperature and H<sub>2</sub>O concentration were measured? The sensible heat flux is mentioned only once and not shown. The latent heat flux is ignored. Thus, the title “On the impact ... on fluxes...” is too general.

Why a microbarograph at surface level is used to detect wave-like activity? The authors have three sonic anemometers located at different levels in the boundary layer measuring wind components and sonic temperature. These physical parameters can be used to detect wave motions in the atmosphere and moreover they are measured at the same levels where the fluxes are derived.

#### Minor comments:

Page 5150, line 6: do not use abbreviations in the abstract “SC”

Page 5150, line 14: replace “ $u^*$ ” by “friction velocity  $u^*$ ”

Page 5151, line 9, 11, 16, and page 5152, line 1: Do not list different phenomena and then provide list of citations to all of them. It is confusing. Each statement has to be supported its own citation.

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For example, replace "...can be impacted by internal gravity waves, "sub-meso" motions, and advection (Aubinet, 2010; Mahrt, 2009; Nappo et al., 2008) " by "... can be impacted by internal gravity waves (Nappo, 2008), "sub-meso" motions (Mahrt, 2009), and advection (Aubinet, 2010) "

Page 5151, line 21: replace "properties and propagation of gravity waves " by "properties and propagation of gravity waves in the boundary layer". Otherwise the list is incomplete. Gravity waves have different scales and propagate to higher altitudes playing role in different atmospheric phenomena like stratospheric warming or polar mesosphere summer echoes.

Page 5153, line 7: Figure 1 showing the tower and not invented instrument is redundant.

Page 5154, line 5: If the wavelet analysis is already applied, why the backward wavelet analysis is not used to estimate wave-like perturbations? Which kind of filter is used for the band-pass filtering?

Page 5154, line 13: Did you use for detrending and band-pass filtering the entire time series or from the start time to the end of the wave episode?

Page 5154, line 16: Did you apply any kind of window during band pass filtering to minimize side lobe level?

Page 5155, line 11: replace "EST" by "Eastern Standard Time (EST)" in line 11 and replace "Eastern Standard Time (EST)" by "EST" on page 5156 line 17.

Page 5156, line 7: The authors restrict the analysis to waves with a period less than 30 min. However, the impact of larger waves is included by averaging of turbulence statistics over large periods. How it could be done, when these waves are already band-passed filtered?

Page 5157, line 3 and 6: replace "u\*" by "friction velocity (u\*)" in line 3 and "friction velocities (u\*)" by "u\*" in line 6.

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Page 5158, line 25: The inflation for averaging times longer than the period of wave event observed for 23 April is shown in Fig. 5. Did the authors observed the inflation of turbulence statistic for 3 December?

Fig. 2: Add units to colorbar. Are the peaks located outside the cone of influence? The sentence "Increases in wavelet ..." is not a figure title, move it to the text.

Fig. 3: The abbreviation "c" is not defined even in the text.

Fig. 4: replace "34, 68, and 329" by "34 (a,d), 68 (b,e), and 329 (c,f)" or "34 (c,f), 68 (b,e), and 329 (a,d)". The sentence "The phase relationship..." is not a figure title, move it to the text.

Fig.5: replace '("original")' by '("solid")', '("corrected")' by '("dashed")', and '("% Error")' by '("dot-dashed")'. Increase the thickness of the dot-dashed line in Fig. 5, 6, and 7. Replace "(5, 10, 15, and 30 min)" by "(5 (a,e), 10 (b,f), 15 (c,g), and 30 (d,h) min)"

Fig. 6 and Fig. 7: Replace 'turbulent kinetic energy (<TKE>), u\* (<u\*>), and CO2 flux (<Fc>)' for the "original" and "corrected" time series' by 'turbulent kinetic energy <TKE> (a,d), friction velocity <u\*> (b,e), and CO2 flux <Fc> (c,f) for the "original" (solid) and "corrected" (dashed) time series'. Replace "The average percent error" by "The average percent error (dot-dashed)".

Fig. 5(a,b,e), Fig.6(a,e): correct the ranges of the right Y-axis. The dot-dashed line has points outside the bounding box.

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