Atmos. Chem. Phys. Discuss., 15, C2699–C2703, 2015
www.atmos-chem-phys-discuss.net/15/C2699/2015/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Interactions among drainage flows, gravity waves and turbulence: a BLLAST case study" *by* C. Román-Cascón et al.

Anonymous Referee #2

Received and published: 18 May 2015

This manuscript presents a rather nice case study from the BLLAST field campaign demonstrating the interaction between shallow drainage flows. gravity waves and turbulence in the hours around and just after sunset. Understanding, and being able to model, the complex small-scale processes which are important in stable boundaries layers over non-homogeneous terrain remains a challenging problem, and detailed observational studies such as this are an important part of talking these challenges. The MRFD technique offers an interesting way of studying the contributions to the flux from different scales in the flow. The material is certainly worthy of publication, however I do have some queries and suggestions which I hope will clarify and improve the presentation of this work.

Major comments

1) p12832 and table 3. The parameters here seem to demonstrate quite a bit of variability from one time period to the next. While this is not surprising given the complications of "real world" flows, it would be useful for the reader to 1) have a clearer idea how they were obtained and 2) give some estimate of the uncertainty in these parameters.

2) p12833. The authors seem to have a conceptual picture of the gravity wave here and how it propagates, but this is not very clearly communicated to the reader. I assume you are picturing some form of trapped gravity wave? Do the profiles of temperature and wind given in figure 8 give rise to trapped waves of the right kind of wavelength? You mention the role of shear at around 100m. Would plotting the Scorer parameter profile in figure 8 demonstrate possible wave trapping?

3) Figure 8. The profiles of N look quite noisy, while the temperature profile appears relatively smooth. Why? Is this a result of how N is being calculated?

4) p12834. You may not have measurements of N from the field, but you do have the WRF simulation here. How do the profiles through the deep drainage flow look in the model, and are they consistent with the observed waves during event 2? This may be difficult, depending on how good the model is, but it would be worth checking.

5) p12835. Throughout you discuss analysis of the surface fluxes, and plot up friction velocity. A pedantic point perhaps, but friction velocity is not a flux, but (depending on definition - not given in this case) the square root of the absolute value of the momentum flux. There are advantages and disadvantages to using friction velocity rather than the momentum flux. If you decide to stick with friction velocity, then please make sure the text does not imply this is a flux.

6) p12836. The heat flux values given in the captions of figures 10 and 12 are K m s-1. If this is correct, then these are not heat fluxes, but temperature fluxes. Can you confirm which they are, and ensure the correct term / units are used throughout.

7) Section 3.4. There are some intriguing differences here. You mention differences

in moisture, but I wonder if the canopy nature of the wheat plays a role here? See for example the literature on nocturnal drainage flows in canopies. I was also interested in the strong differences over the edge site. I do not have a clear enough picture of what the edge site was like to draw real conclusions, but assuming it is hedge like then this perhaps points to the strong impact of features like this on drainage flows, cooling and turbulence in stable boundary layers. In such shallow flows hedges can have an important radiative and thermodynamic impact, as well as a significant dynamical impact on the wind and turbulence. I've seen examples of this myself.

8) The MRFD technique is certainly a nice way of looking at the contributions of different scales to the flow. Do you see some of this scale separation in other techniques, such as more traditional ogive plots?

9) I found the conclusions about what eddy covariance averaging time you should use in this case a bit unsatisfactory. It read a bit as if "you should definitely not use an averaging time of more than 60s, so you don't include the wave contributions, unless the wave contributions are wave-generated turbulence, in which case you probably do want to include them." This is not terribly useful for the user who wants to processes their flux data. Can you provide more discussion on this? There is a body of previous work on wave - turbulence interactions, included papers by some of the co-authors. While it is still certainly an open question, placing these findings in the context of other work might be useful. You might want to look at including Durden et al. (2013), Biogeosciences.

Minor / editorial comments

10) p12825, lines 1-10. In this discussion of recent work on drainage flows, in might be worth mentioning several significant recent field campaigns (PCAPS - Lareau et al 2013 BAMS, METCRAX - Whiteman et al 2008 BAMS and COLPEX - Price et al, 2011 BAMS) focussing on cold air pooling at different scales and their interaction with other proceses.

11) p12830, lines 25-28. "Nevertheless, surface heteorgeneities and differences in local slope between BLLAST sites led to differences in thickness and persistence of the SDFs from one location to another (Fig 4), ..."

12) p12836, line 6. "these contributions ... are clearly separated..." I didn't find this very clear. I don't know if it is the color scheme used in the contour plots, but a number of the features of these MDFD plots were not as obvious to me as the text implied.

13) p12836, line 23. ".. as a consequence of the increase..."

14) p12838, line 3. "Again, the selection of a larger averaging window..."

15) p12838, line 14. The phrases "a different kind of vegetation" is not very helpful. Please include a better description of this edge site since this is rather important in interpreting the results. Is it a hedge? Trees? What height? How dense?

16) p12840, lines 22-24. I didn't understand this sentence. How does an increase in mechanical turbulence related to a reduction of large eddies above? Is it not perhaps that the increased mechanical turbulence leads to a reduce temperature gradient and hence a reduced heat flux?

17) p12842, line 16. "MRFD" not "MRDF"?

18) Figure 3. The caption does not say where these profiles were taken. Also, I would mark on the data points with a symbol so it is clear at which heights the observations are taken rather than just plotting a solid line.

19) Figure 5. Again, the caption does not say where this profile is taken.

20) Figure 6. I found it almost impossible to distinguish the red and purple lines on top of the color contour plot. Perhaps choose a different color, or just stick with solid / dashed lines?

21) Figure 8. It is not at all clear from the figure or the text how the measurements at 8 and 60m are integrated in with the tethered balloon profile. Can you plot these as point

symbols on these figures? Presumably the line is from the tethered balloon?

22) As a general comment all the figures had rather small labels on the axes / legend which made them hard to read. I would suggest using a larger font size for all these labels.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 12821, 2015.