Atmos. Chem. Phys. Discuss., 14, C2918–C2920, 2014
www.atmos-chem-phys-discuss.net/14/C2918/2014/

Atmospheric Chemistry and Physics
Discussions

Interactive comment on "Observations of the scale-dependent turbulence and evaluation of the flux-gradient relationship for sensible heat for a closed Douglas-Fir canopy in very weak wind conditions" *by* D. Vickers and C. Thomas

Anonymous Referee #2

Received and published: 29 May 2014

This is a very good study on the important topic of characterizing the turbulence field and the consequent exchange of properties within and above a forest canopy. There are certainly many open questions on this subject and studies such as the present one are always important. In particular, there are some very interesting and peculiar observations presented, which by themselves warrant publication of the study. Some of them need, in my opinion, to be more deeply discussed, given their relevance. I point to these and other suggestions in the list below.

- In terms of the turbulence and fluxes, there are two findings that specially called my attention. The first is the peak at very small time scales observed in the subcanopy. This has been discussed in the paper, and the authors seek explanations to the observation, but I feel it would be important as well to provide a further discussion on how it differs from previous studies. To my knowledge, it has not been observed previously (and if I am wrong, I would be very curious to see the referencse for that), and this fact makes it important to assess what is different about this subcanopy that favors such a small time scale peak there, but not in others. For instance, in the previous study by the same authors published in 2013 in AgForMet, such a maximum is absent. The second aspect that called my attention in the "turbulence structure" section was the somewhat similar time scale of the turbulence maximum between the different levels. Other studies (including again Vickers and Thomas 2013) have found a shift towards longer time scales within the canopy that is muvh more subtle here. What explains the difference? Is it associated with this being a closed canopy?

- I also found very interesting the high turbulence intensities (largely exceeding unity) observed at canopy level, which, in my opinion explain the large exchange coefficients found at 38 m in the later part of the paper. Again, I believe this is something new, and that a more detailed comparison to other studies is necessary to further stress the novelty. I would also be curious to see some statistics on turbulence skewness, specially of the vertical component. This is because I have found turbulence in dense canopies (such as Amazon forest) to be more intermittent than above more sparse canopies and when I saw your results I immediately thought you might find the same. Please note, however, that this point on the skewness is merely a suggestion that you may or may not accept to do;

- I think it is important to include a quantification of turbulence such as u* or sigma_w in tables 1 and 2;

- In the first line of p.11937, sentence beginnning with "It is also possible..." is very speculative. A better explanation has been provided before.

- In p. 11938, line 7, when you say "...the idea that the canopy inhibits horizontal fluctuations more than vertical ones". Are there any references for this idea? Anyhow, why would that be? Is there something particular about canopy architecture that would favor that? Could an alternative (and also speculative) explanation be that there is intense vertical turbulence production caused by the enhanced vertical wind shear at that level?

- In p. 11941, lines 13-15: For that purpose, it could be interesting comparing C_H to sigma_w, which decreases monotonically with stability. There would be no self-correlation problems in that case.

- I think it would be nice to see the scatter plot for all heat flux data at 38 m as well, just as made in figure 7 for the subcanopy. In fact, this could be an additional panel in figure 7.

- It is, indeed surprising that you find C_H within the range reported by Stull at the subcanopy, where similarity theory is known to fail, but not at 38 m. On the other hand, this result points to the difficulty of determining exchange coefficients in the roughness layer, and I believe this point must be stressed. In more general terms, the large exchange coefficients may be more easily understandable when one thinks that these observations are just above a canopy with very intense turbulence, such that VAR exceeds unity at canopy level.

- The test of a single source flux-gradient relationship (section 3.6) makes no sense to me, as the results of the comparison confirm. I did not know that some model parameterizations used it, and I agree that, in that case, it is a relevant result to show. However, it is also necessary to explicitly refer to those parameterizations, which is not done.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 11929, 2014.