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Biogeosciences Discussions

Interactive comment on "Interactions between nocturnal turbulent flux, storage and advection at an 'ideal' eucalypt woodland site" *by* Ian D. McHugh et al.

Anonymous Referee #1

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General

This paper presents a thorough interpretation of discrepancies between eddy covariance and expected fluxes for an experimental site which would generally be considered as meeting the criteria for flux sites (flat and horizontally homogeneous). The authors make a strong case for the necessity of collecting flux 'storage' measurements to allow the proper interpretation of flux data. The analysis in the paper is well thought out but complicated because of the use of standard u* correction approaches.

Specific

Throughout the paper:

You often using multiple character variables in your equations, eg NEE, Av_c, rb, ER etc. This is considered bad practise because of the potential for mis-interpretation. For example Avc may be interpreted as A * vc. I would recommend usage of subscripts and superscripts for differentiation of variable names eg F_{NEE}, Av , R_b, R_E.

Page 3 lines 10-21:

I think the logic in these two paragraphs characterize the faults in the u* analysis used in this paper. The total flux (NEE) is a combination of turbulent flux, storage and advection. If you only measure turbulent flux then you need to model the other two – either separately or combined – to estimate NEE. In the case of this paper you have measured storage so you only need to model advection. However, you have used the standard u* correction approach which assumes that advection only occurs at night and only under a limited range of u* values. This artificial restriction in the modelling of advection is what results in the double counting and some of the more elaborate explanations required later in the paper. A better approach would be to model the advection term for the entire diel period (see appendix "A" in Clement, Jarvis, Moncrieff, Agricultural and Forest Meteorology, Volume 153, 2012, Page 106). Taking such an approach would provide a simpler interpretation your already excellent data set.

Page 5 line 13:

Are you using the newer low heat emission LI7500 – or are you accounting for sensor associated heat flux enhancement in the WPL correction?

Page 7 line 22:

Was soil moisture not included in the respiration model because it was not measured for because there was no relationship? It seems that a 15 day window smoothing is a poor way of incorporating any soil moisture effects resulting from episodic precipitation

Page 7 line 23:

Using temperature measurements from 36 m as the driver for respiration would require

better explanation, particularly at night when there may be decoupling between the surface/canopy microclimate and the air well above the canopy. It may be that temperature profiles were homogeneous throughout the night (show average nocturnal T profile) or it may be that heterogenic respiration is negligible - which would likely further complicate the interpretations in this paper.

Page 8 line 22:

The error character used in the equation differs from that used in the text.

Page 9 line 1-6:

It is likely that the environmental data corresponding to the missing flux data are not representative of the environmental data corresponding to the available flux data, and it is likely that these environmental data may be under more extreme conditions. Your approach of removing random observational data – likely from periods when the model fits the data well – seems as though it will underestimate the model error.

Page 9 line 14-17:

Why do you assume there is a threshold u*? It is possible, or likely, that advection is occurring under all u* conditions- albeit more severely at small u*. Determining a u*th confidence interval is simply giving you a false sense of security. The only way to truly test for the presence of advection at night is to measure the soil and canopy respiration components and scale them up to verify that EC flux at high u* matches scaled up chamber measurements – an approach that has its own limitations.

Page 10 line 29-31:

This statement is inconsistent with your use of the 36 m temperature as the primary determinant of nocturnal respiration.

Page 11 line 1-6:

Is it not equally plausible that cooling initiated at the surface and progressed upwards,

resulting in suppressed respiration as the depth of surface cooling increased. This could be verified by seeing the strength of the temperature profile changes. If surface cooling is strong they it is likely that your simple one-temperature respiration model will be incorrect and you will need a multiâĂŤlayer model. If you indeed do have advection of low CO2 air into the bottom of the canopy then you likely have a situation of non-homogenous land cover- which may be (possibly) observed as directionally dependent effects on the nocturnal CO2 profiles.

Page 11 line 11:

It appears as if the 8 to 36 m layer has an exponential increase with decreasing u* down to the level of u*$\sim$ 0.1 at which it also appears to decrease. Implementing such an exponential increase is unlikely to result in as good a fit with your results. Perhaps I don't understand why you simply do not use the temperature response model of respiration using data from u* greater than 0.5 to parameterize what was missing. Does it really matter if the advection is reducing turbulent flux or storage, it is still 'missing' flux.

Page 12 line 10: ("…. and applying the uR*R correction,")

Which u* correction - the one you developed using the complete profile or a new u* correction based on only the point calculated storage?

Page 12 line 12-14: ("We expect …..… a decline of corresponding magnitude in storage")

It seems as though this effect should not have an effect on storage. If within canopy, stored, CO2 is ventilated in the morning then surely the above canopy CO2 must see an increase - which would be represented as increased storage in the morning.

Page 15 line 14- 19:

This is a very useful point to make. This point alone justifies the need for storage measurements.

Page 16 line 14- 15: (“. . .the uncertainty resulted in an increase in the potential uptake of carbon”)

How can uncertainty result in an increase in uptake? Or do you mean the lower estimate of u*th resulted in increased uptake?

Page 16 line 15-19:

From this section I assume that you are implying that true NEE will fall within the uncertainty of Fc + Sc while true NEE will not fall within the uncertainty of Fc alone (because Fc does not fall within the uncertainty of Fc + Sc). What is your justification for believing that the true NEE value will fall within the uncertainty estimate for Fc + Sc?

Page 16 line 31:

Can you explain why using u* to remove observational data will reduce random error?

Page 16 line 31 and page 17 line 3:

On the first line you indicate that model error should be larger at night and on the second line you indicate that is larger during the day – which is it?

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