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Atmospheric Measurement Techniques Discussions

Interactive comment on "Low-cost eddy covariance: a case study of evapotranspiration overagroforestry in Germany" *by* Christian Markwitz and Lukas Siebicke

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This manuscript provides an interesting approach to low cost ET measurements that have been tested at large number of sites and is a useful addition to the literature. The instrumental approaches described are shown to be effective in comparisons with the LI-7200 systems. The comparison of cumulative ET (Figure 11) is impressive – it would be informative to show cumulative ET lines (perhaps in appendix) to illustrate if the seasonal responses are comparable. Furthermore it would be worth a look in the literature to put in context the size of the differences (are they close to the disagreement between conventional systems).

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Discussion paper

My first main comment is that I would please like to see are details on: 1) the cost (since this is a low cost system, how low cost is it?); 2) power usage; 3) construction (details needed for people to replicate the build), and 4) maintenance of the low cost system. I see these details as extremely valuable for any readers to replicate this study.

The second main comment I have is that it would be very informative to see details about the actual frequency response of the low cost sensors (RH and T) and if there are environmental dependencies on these response times. It would be good to see a comparison of the sensor specification and actual response times derived from the spectral analyses. A related point is, what was the size of the frequency response correction?

My third main query is what did the energy balance closures look like? ALthough an incomplete assessment of the ET, it would be informative to know the closure for the systems and sites.

Further minor comments are:

Abstract: - A (pedantic) comment on the assumption that Eddy Covariance is appropriate for homogeneous land surfaces: Whilst arguably true (depending on the errors associate with EC) the assumption of homogeneity first needs to be tested using a suitable experimental design. See Hurlbert 1984 (Pseudoreplication and the Design of Ecological Field Experiments). Otherwise our implicit assumption is that the (non-flux) data we have about the full extent of the terrain (which might be limited to little more than a visual/reflectance based observations) is sufficient to predict the fluxes (or at least the variability - or lack of - in fluxes) – and if this is the case why use EC?

-Line 8: Given the general lack of energy balance closure for the EC method, I don't think the 'true' ET flux is known. Therefore, 'underestimation' and 'overestimation' are more accurately termed 'underestimation relative to the conventional system'.

Page 3: Can you describe the site fetch? What are the heights of the trees and the

crops? Reiffenhausen is a small site 18,700 m2 (∼1.9 ha), what is beyond the extent of this site (and likely in your flux footprint)?

Discussion: - I am reluctant to recommend citing my own paper, but as it is one of the only other studies to calculate ET from a low cost RH sensor, I think comparisons with the LE fluxes/approach from Hill GCB 2017 (and any others) should be made somewhere in the discussion.

-Page 6 It would be useful to know the indicative cost and power usage for both systems. What is the volume of the thermohygrometer housing? What is the form of the housing? What response time (and measurement principle) did the temperature sensor of the BME280 use?

- Page 6: it is not entirely clear to me if the systems shared the same sonic, and if not, what was the spatial separation of the comparison system?

-Page 7: I am interested in how much data was filtered through QC and how you filtered data for the LC system?

-Page 8: It would be useful to know the time response of the temperature sensor. Figure B1 does not give a good insight into this response as it convolves: sensor response; sensor noise; housing attenuation and variability of scalar (i.e. RH or T). A look at the spectra/cospectra of the sensors (and a modelled attenuation of the sonic-T would give a much clearer idea (and quantification) of the total combined attenuation of the sensor and housing.

-page 9: provide details here, or later on about the timelag. Are you sure this is due to the vertical separation? (if so it should be dependent on W). Alternatively it could be due to the sensor response/processing time and therefore it reasonable to expect it may include a T/RH dependency.

-page 15: Fig6 It is interesting to see that the LI-7200 is highly attenuated and more sensitive to RH than the LC system. Indeed attenuation of the LI-7200 in panel c (and

even more so in d) is significant and indicates a very poor frequency response for this system. Any thoughts on why? Did you run with filters and did they clog frequently?

Fig 6, can you please clarify (as I assume that the RH is specific for the LI-7200 and the LC sensor (with its higher temperatures and presumably lower RH). Either way the comparison is complicated: if ambient RH is used, then the sensors are effectively seeing different RH, alternatively if sensor RH is used, then the spectra contain different data (i.e. wind speed/stability might differ). Neither point are likely to be particularly significant to the overall interpretation, but should be clarified.

Fig 6/7: please include the criteria for data shown, what correlation strength/LE/stability classes are included?

-Page 17: The linear regressions are very important and it would be very useful to see the scatter plots associated with these to see if they are well behaved. -page 21: figure 12. It is not clear how the 2016 annual ET fluxes were arrived at given the campaign basis of the measurements. Table A3 implies some sites were not measured in 2016.

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