

Atmos. Meas. Tech. Discuss., referee comment RC1
<https://doi.org/10.5194/amt-2021-319-RC1>, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on amt-2021-319

Anonymous Referee #2

Referee comment on "True eddy accumulation – Part 1: Solutions to the problem of non-vanishing mean vertical wind velocity" by Anas Emad and Lukas Siebicke, Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-319-RC1>, 2022

Review of the manuscript amt-2021-319 "Advances in the True Eddy Accumulation Method: New theory, implementation, and field results" by Emad and Siebicke (2021)

The authors address one of the aerodynamic micrometeorological methods for surface-atmosphere turbulent flux measurement, the eddy accumulation. They propose interesting improvements to the classical method, namely the division of the half-hour averaging period into shorter periods and an approach to account for non-zero vertical wind speed. These are intended to reduce the uncertainties in the calculated fluxes and adapt the eddy accumulation system to the emerging faster-response gas analyzers. A theoretical framework explaining the basics of the method and the substantiating the proposed developments is well presented. The success of the modified eddy accumulation is apparent from the close similarity of the fluxes with the estimates from a collocated eddy-covariance system. I evaluate this work as a high quality contribution, which will certainly be of interest to the micrometeorological and flux measurement communities.

My criticisms are related to the treatment of the nighttime periods, the importance of different crops planted on either side of the EC tower leading to step-change in aerodynamic roughness, the actual extent of the vertical wind problem at the measurement site since it is very flat, and the insufficient evidence of STEA technique superiority over the classical TEA method.

I recommend acceptance of the manuscript after the below points will be addressed.

Detailed comments:

Vertical wind more of a problem in sites with complex topography – this uncertainty needs to be discussed.

48: I am at a loss as to what kind of error is implied – mean random error of the 30-min averaging periods, mean systematic error, error on the annual cumulative sum, ...? It would be good to clarify how big the problem you are solving really is.

94-95: the local topographical slope should be among the factors

100: “realizations” is unclear, perhaps explain that this means the need to record the fluctuations of scalar concentration at a frequency sufficient to represent the individual flux-transporting eddies, i.e. at frequencies higher than 1 Hz. Please specify how long an averaging period (or range) you mean at line 101.

115-116 change "maps" for "ensures the proportionality"

231-232: alpha has already been defined.

Section 2.4: it is not quite clear how the division into shorter periods improves the flux estimates (if it is expected to improve them?) Maybe an introductory sentence explaining this should be added.

Section 2.6.1. The site description is missing important details on what crops were planted within the EC footprint during the measurement period, how tall the plants were etc. The photograph reveals that there was a significant change in surface roughness just near the tower, effectively dividing the EC flux source area into two contrasting halves. This would have long-reaching consequences for the surface exchange in general, and the functioning of aerodynamic flux measurement techniques, even if the step-change in roughness creates no significant wall effects affecting the vertical wind speed. Please clarify these points. My recommendation is that, in case the crops were as shown in the photo and it shows in the wind direction dependent quality criteria of EC fluxes, the following sections should treat the two sectors separately.

Fig. 3 and its discussion in the text: I think the explanation of the exact method of choosing the representative concentration for each short period is missing. Is it the mean or median? Are there any QC indicators to reject the poor quality short periods, based on e.g. the properties of distribution of recorded concentrations?

Sections 2.9-2.10: how were the nights treated? From my experience, stable periods lead to the generation of thermal decoupling at 0.5-4 m height in such short vegetation sites, cutting the aerodynamic flux measurement system off from the ground sources of scalars. However, as it is well known, moderately stable periods lead to biases in EC/TEA fluxes even at the absence of decoupling. Can you briefly discuss how the performance of modified TEA differs from EC, and how much night time data you had to reject for the above reasons.

Line 493 and whole section 3.1.1: you are saying that there is an upper limit on the absolute value of mean vertical wind speed, up to which the alpha coefficient correction is still effective. At the same time, as your experiments takes place in a very flat ground (ignoring the surface roughness changes which require clarification), that one is led to think that nonzero vertical wind speed is of less concern for this site than it is, say, for a mountain site in, or a flat site with a discontinuous canopy consisting of large trees. Please provide some]

Figure 5: the neutral periods are not visible – covered by the other symbols?

503-505: what range are you referring to?

Figure 6b: the representation of volume as area of the boxes is confusing the way it is currently presented; I think it's better to have the bats of the same width and only vary their length.

Figure 8 and the related text: It would be important to add the flux calculated using the traditional eddy accumulation approaches, to show that STEA offers superior performance in terms of smaller deviation from EC.