Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC3
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# Comment on amt-2020-479

Anonymous Referee #3

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Referee comment on "The high-frequency response correction of eddy covariance fluxes – Part 1: An experimental approach and its interdependence with the time-lag estimation" by Olli Peltola et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2020-479-RC3, 2021

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General comments:

This manuscript discusses Eddy Covariance (EC) flux post-processing corrections. They present important clarifications to the theory and demonstrate the presence of a systematic bias in some standard post-processing software packages from time lags induced by low-pass filters in closed path EC systems when using the cross-covariance maximization technique to determine lag times. They also present a correction method to account for this effect and provide a thorough theoretical and empirical discussion of its implementation. This manuscript is well written, and the topic is well suited for AMT. The methods presented here are likely to prompt reprocessing of a number of historical flux data sets and the revision of some of recommended best practices for EC flux processing. I recommend publication after some revisions.

Specific Comments:

P5 L27-L32: The equations presented here are quite important and should be broken out into numbered equations.

P6 L21: What is the calculated transit time through the sampling tube from the volume and flow rate (if that information is available).

P9 L3-10: The limitations at higher attenuation levels needs further comment. Long responses times are common for studies of more reactive trace gases and it is not clear if this method should be considered in those cases. Some explicit guidelines for the reader about where this method breaks down would be useful.

P12 L1-3: This inequality seems important and draws into question the utility of approximating to sqrt(H) when you present a method to calculate H $H_p$

P14 L8: Why does the bias in CF only increase linearly with τ/ITS at Siikaneva and not Hyytiälä?

P15 Fig6: It is interesting that the Hyytiälä data for unstable conditions shows a positive slope for Methods 2-4. Some discussion of this would be useful.

P16 L4: Calculated t(phys) from tube volume and flow rate would be helpful here as well if that information is available.

P17 L17: Further comment on this discrepancy is needed. Is the implication that the response times were fast enough that the LPF induced lag time was minor compared to other potential factors?

P20 Summary and conclusions: It is addressed in the third point but I think it is warranted to be more direct in discouraging the use of Method 1 based on your clear demonstration of systematic biases using that method.

Misc: The use of cross-covariance moving average methods for determining lag times (as in Taipale et al. 2010) is becoming more common as an alternative to the cross-covariance maximisation. The attenuation induced lag time effect and your Method 4 correction should be equally valid when this method is used, but a brief comment would be useful.

Minor Technical Comments:

P8 L6: insert word “to” after “prior”

Figure 3. Recommend making the colors more distinguishable.

Figure 5 panel b. Why is Method 1 not plotted

P16 L10: Wording of this sentence is unclear “can attain values only with the temporal resolution of the underlying data itself”.

References:

Taipale, R., Ruuskanen, T. M., and Rinne, J.: Lag time determination in DEC measurements with PTR-MS, Atmos. Meas. Tech., 3, 853–862, https://doi.org/10.5194/amt-3-853-2010, 2010.