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Atmospheric Measurement Techniques Discussions

Interactive comment on "Flux calculation of short turbulent events – comparison of three methods" *by* Carsten Schaller et al.

Anonymous Referee #2

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The manuscript focuses on the problem of turbulent flux calculation from fast-response measurements (methane flux in this case). As this measurement technique becomes a standard in investigations on surface-atmosphere gas exchange a problem of the most reliable flux estimation is of vital importance. Authors compare results from classical eddy-covariance method (EC) with two alternatives: conditional sampling and wavelet analysis. A general scientific quality of the manuscript is good, it is well organized, results are clearly present and documented. These justify publication in AMT.

As the wavelet analysis allows to overcome the stationarity postulate and calculate turbulent fluxes with high time resolution it seems to be especially attractive for EC community. However, the wavelet analysis could be extended and clarified in some points, especially concerning frequency detection:

1) First of all, I suggest to refer an explicit form of the mother wavelet functions. The most common forms are (real part): for Mexican Hat: yMHat=(1-xˆ2).*exp(-xˆ2/2); for Morlet: yMO=cos(w0.*x).*exp(-xˆ2/2) with w0=6 for which the scale is almost equal to the Fourier period, but different values of w0 results in different shape of wavelet and different basic 'frequency'.

2) Because of different shape of mother wavelet, especially because of different basic 'period' (the 'period' for scale parameter a=1; the 'period' can be defined here as the range of two deepest minima in mother function), the same range of scale parameter 'a' for different mother wavelets results in different frequency bands. It is clearly visible at color contours at Figures 4 and 5. Assuming the mother wavelet functions as given above, the scale parameter for MO must by multiplied by factor 3 to detect similar frequency band as MHat. I am not sure what does 'Period' at Figs 4 and 5 mean, but I recommend Authors to make additional calculation and compare wavelet cross-scalograms of Mexican Hat for 'Period' 5-30min with Morlet 'Period' 1.5-10min (or MHat 15-45min with MO 5-30min) - results should be more similar than presented in manuscript. So, I am not fully convinced to the conclusion: "The Mexican hat flux allowed an exact localisation of the event in time, while the Morlet flux resolves the flux contributions in frequency domain best" (p.11, ll. 4-5) – in some extend yes (because of mother wavelet shape), but not as significantly as suggested by Figs 4-5.

3) The above suggests also that both wavelet functions filer frequencies in different way. This can explain the finding that Morlet wavelet, covering lower frequencies (which contribute in larger extend to total flux) gives higher fluxes than MHat (p. 9, l. 22). However, the above rise a problem with spectral corrections. Because different wavelets act as different bandpass filters, how final data should be corrected for spectral losses? Authors suggest that it should be done in standard way (p.3, l.26) which is not obvious.

I think that Authors should briefly discuss issues 2 and 3 in the revised manuscript.

Specific comments:

p.3, l.17: “the value 0.675 corresponds to the Gaussian distribution” – in which sense?

p.4, l.5: in equation under the bar (average operator) it should be rather ‘w’ than ‘wk’ and rather ‘c’ than ‘ck’.

Paragraph 2.4: It is not clear if Authors apply real mean ‘w’ in Eq. (4) calculated as in lines 20-23 (p.4) or they assume that it is equal zero as it stated in line 15?

p.5, l.5: Equation (8) inconsistency. What is summed (where is ‘n’ in right site)? What dose ‘j’ mean? – similarly in next equations.

p.6, l.5: what is unit of 0.25? (the same p.8, l.19) ;

p.6, l.21: Why corrected data are needed to detect steady state? The stationary test can be done for covariances;

p.7, l.1: it should be rather xi=0 than di=0;

p.7, l.28: it is not clear what referenced “Fourier periods”?

p.8, l.12: ‘w’ at the end of sentence - overbar needed;

p.8, l22: what is unit of ‘t=-0.010’;

p.11, ll.4-5: see general comment;

Figs. 4 and 5: It is difficult to distinguish which line on bottom plot refers to which method.

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