Atmos. Chem. Phys. Discuss., 14, C5470–C5473, 2014
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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Ergodicity test of the eddy correlation method" *by* J. Chen et al.

Anonymous Referee #1

Received and published: 30 July 2014

The paper attempts to verify and analyze the ergodicity hypothesis of atmospheric turbulence with some eddy covariance data. While I believe that such work is needed given that ergodicity is assumed in MOST, I have some serious concerns about the analysis and the writing style. Also, given that MOST and EC have been around for decades, I am just surprised that this is the first ergodicity test of the eddy correlation method.

MAJOR COMMENTS

1. The abstract and introduction should simply be rewritten. The authors should seek the help of a native English speaker in doing so. A few specific comments here: - Include a clear description of the eddy covariance method - Avoid going from a super general to a super specific statement (e.g. p. 18210, l. 6-11) - Each paragraph should convey one main idea. - Provide a clear description of the ergodic hypothesis. In its

current form, it could hardly be more confusing.

2. Sections 4.1 and 4.2 are based on 3 h of turbulence data at a single site. How representative is that?

3. The authors rely on three time frames for their analysis, 3:00-4:00, 7:00-8:00 and 13:00-14:00. They claim that the 7:00-8:00 is neutrally stratified, but this is contradictory to the values of z/L they report. Also, this is clearly a transition period (the authors need to report the sunrise time), so I wonder if it is appropriate to test the ergodicity hypothesis when the requirement for stationarity is violated.

4. I am not familiar/comfortable with the concept of "local stability of a vortex". To me, the fact that z/L varies with your "vortex time scales" is simply either because the flow is not stationary or because you are not fully capturing the flux. Can you show some Ogive plots for the buoyancy and momentum fluxes for each of your three time frames?

5. p. 18223, l. 13: Here you need to define how you normalized your ergodic functions. For the ergodic hypothesis to be validated, these functions needs to be strictly speaking equal to zero, which is not going to happen with experimental data - we agree on this. However, I believe you need to define a threshold to decide whether the flow is ergodic or not.

6. p. 18225, l. 1-3: To go for temporal to spatial scales you need to invoke Taylor's hypothesis here. It is valid at all?

MINOR COMMENTS

1. I would use the word "eddy" instead of "vortex".

2. Several references are not properly cited, e.g. - p. 18209 Dennis et al. 2001 should be Baldocchi et al. 2001 - p. 18212 Gabriel et al. 2004 should be Katul et al. 2004.

3. You should definitely read and cite this work: Higgins et al. 2013. Are atmospheric surface layer flows ergodic? GRL, 40, 3342–3346.

4. Eqn (2): can you define the operator E[]?

5. Eqn (4): why over a period 2T? Also, do you have another reference than Wang et al. (2009) which is in Chinese. This equation is key to your analysis.

6. Section 2.2: Is time averaging not sufficient to act as a band-pass filter?

7. Equation (9): Not clear what a and b mean here.

8. p. 18218, l. 11: sigma is actually the standard deviation

9. p. 18219, l. 11: The proper acronym is CASES99.

10. The Nagqu station is located at extremely high altitude ($\sim$4500 m ASL). How do you expect that this will impact your result?

11. p. 18219, l. 15: is 8000 m2 the size of the measurement footprint? If not, why are you reporting this value?

12. p. 18219, l. 19: remove the minus sign or change 'W' to 'E'.

13. p. 18220, l. 3-16: The authors keep referring to 'pulses'. Not clear what they mean here.

14, p. 18221, l. 13-16: Can you better justify why you are using a local similarity framework here? Do you expect strong advection or z-less stratification at your sites?

15. Equation (17) and Table 2: You should compare the coefficients you obtain those from previous studies.

16. I would recommend to split section 5 into "Discussion" and "Conclusions".

17. References: be consistent with title capitalization.

18. Table 1: It does not seem appropriate to use "bucket" here.

19. Figure 1 is useless. Fig. 1a contains little to no useful information. Fig. 1b seems to have been taken directly from another publication (notice the "Figure 4" label on top).

There is just no sufficient information to make sense out of both figures.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 18207, 2014.