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Atmospheric Chemistry and Physics Discussions

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

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Thank your comments!

While the main hypothesis; testing the assumption of stationarity, homogeneity and ergodicity in canopy turbulence is relevant to the field of micrometeorology and to this journal, the article needs to be thoroughly restructured. Apart from the numerous grammatical errors, the ideas expressed in the article are scattered, i.e all over the place. The authors also limit the analysis to 3 hrs and over two sites; in order to extend the validity of their results, the authors must include data from multiple sites. With all this in to consideration, in its current form, the paper is not suitable for publication.

-Influence of land cover needs to be tested. If possible the analysis should include data from multiple sites (forest, crop, urban, mountain etc). The two sites used in this

analysis look very homogenous in terms of surface cover; many contemporary eddy flux measurements are devised over heterogeneous landscapes. It would immensely add to the article if the analysis is extended to include the influence of surface characteristics.

We had paid much money to a native English speaker in order to present a perfect manuscript. Moreover, an ACPD editor helped us revise the manuscript. On your comments, we have found some errors. We will carefully revise the manuscript to avoid some improper and wrong descriptions. The ergodic assumption was first raised by Boltzmann (1871) in his study of ensemble theory of statistical dynamics. The stationarity and ergodicity turns into two central concepts (required conditions) used to link field measurements and the NS equations or field measurements to "boundary conditions" at the land-atmosphere interface. The ergodic hypothesis is a basic hypothesis in atmospheric turbulent experiment. Stationarity, homogeneity, and ergodicity are routinely used to link the ensemble statistics (mean and higher-order moments) of turbulence field measurements collected in the ASL and CSL to land surface processes. Many literatures habitually referred to the ergodic assumption, as some descriptions such as "when satisfying ergodicity hypothesis, ..." or "something indicates that ergodicity hypothesis is satisfied". Though the evidence of the validity of the ergodic hypothesis in the ASL is just the success of Monin-Obukhov similarity theory (MOST) for unstable and near-neutral conditions in atmospheric surface layer, the success of similarity theory, as a necessary condition for ergodicity in the ASL, does not prove ergodicity (Katul et al., 2004). However, the direct testing of the ergodic hypothesis in the ASL has frustrated all experimental efforts and frames the compass of this work (Higgins et al., 2013). So the theoretical demonstration or quantitative testing of direct observational experiment, which is relating to the ergodicity of the atmospheric turbulence, was hardly found. However, after Boltzmann's ergodic assumption, the theoretical demonstration and testing of direct experiment in the mathematics and physics have notable advances, as shown in our article. Especially, the ergodic theorem of the stationary random processes is proved in the mathematics and the ergodicity of turbulence in the physics is tested. And that the necessary and sufficient condition of the ergodicity for stationary random processes is offered. Obviously, the advances of research on the ergodicity in the mathematics and physics are far more quickly than the atmospheric science. This paper tries firstly to introduce the ergodic theorem of the stationary random processes to atmospheric turbulence in surface layer. And that it is a trying firstly to verify and analyze atmospheric turbulence in surface layer by using the ergodic theorem of the stationary random process. Of course, it does not in the roundly analyze the land surface processes over heterogeneous landscapes. We believe that the results are the success and offer a promising first step for direct evaluation of ergodic hypotheses for ASL flows. Of course, we will extend the validity of their results, which include data from multiple sites as a second step.

Main Comments -The land cover characteristics of the two sites discussed in this paper needs to explained thoroughly.

Our study needs a flat surface to study a stationary turbulence. The lands of the two sites are uniform and covered by grass.

-Information on data used for the analysis, time periods, stability need to be tabulated. Also all the error correction and data processing need to be explained more thoroughly.

This work is a study to apply the ergodic theorem of the stationary random processes to atmospheric turbulence in surface layer. At first, the raw data were filtered with Fourier transform. So the eddies whose scale is less than 1 hour were retained. Secondly, after deleting artificially spike data, we calculate the six segment variances of 5-min vertical velocity and temperature by using every 1 hour data set that has been filtered with 5-min high-pass filter. When the segment variances were within the range of the relative difference 10%, the selected turbulent flows were considered to be steady.

-Why are the temporal states in local time, stability parameter must be used?

This study discusses the ergodicity of different scale eddies. M-O similarity framework

is not appropriate.

-The authors refer to 10 mins, 1000 m as some indices, these numbers have to be presented in a non-dimensional form so it can be compared to other experiments. -The analysis should include fluxes: momentum, heat and humidity to the analysis.

10 mins for 1 hour observational period, 1000 m is a corresponding length under the condition of velocity 1ms-1. As the above mentions, this work is a trying firstly to verify and analyze atmospheric turbulence in surface layer by using the ergodic theorem of the stationary random process as a first step. The second step of this work will be to extent the analysis included fluxes: momentum, heat and humidity to the analysis.

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