Egusphere-2024-2163- Response Letter 2

Dear Editor and reviewers,

We would like to thank the reviewers and editor for their comments that have allowed us to further clarify some aspects of the manuscript in this revised version. Hereafter, we report reviewers' comments and our replies (*in italics*). For yours and reviewers' convenience we have put the corresponding major changes introduced in red color in the revised version of the manuscript.

Reviewer 2:

A scientifically sound turbulent energy budget analysis is required for better understanding of the generation and dissipation processes of turbulence. However, current research on the generation and dissipation mechanisms of atmospheric turbulence energy is mainly based on ground or tower base observations, leading to unknown vertical TKE budget term. The authors propose a new method based on coherent wind lidar to detect TKE budget terms and compare them with data from a three-dimensional ultrasonic anemometer for verification. The results indicate that their proposed method can comprehensively reflect the impact of each budget term on the vertical structure of TKE, providing a new perspective and method for atmospheric turbulence research. The expression of this paper is clear, the argument is reasonable. It is suitable for publication. I think there are some small issues that can be improved, which is shown as follows:

Response: *Thanks for the reviewer's professional comments.*

Minor comments:

1．Lines 176 and 188：“tenacy” should be “tendency”.

Response: *As the reviewer suggests, we have modified the texts in revised version. (See lines 181 to 185)*

2．In section 3.7 Determination of the Buoyancy Generation Term: I suggest the authors elaborate on the sources of errors.

Response: *As the reviewer suggests, we have modified the texts in revised version. Due to the ability of wind lidar to obtain accurate three-dimensional wind speeds, the terms Et, S, D, and Tt are accurately obtained in turn. Therefore, the error mainly comes from the assumption that the pressure transport term, Tp, is negligible. (See lines 293 to 295)*

3．Figure 8 shows that at the height of 160 m, 48% of the results have an error of less than 0.0001 m2/s3; At the height of 320 m, 47% of the results have an error of less than 0.0001 m2/s3. The error statistical method is not rigorous enough and should be given as mean error or standard deviation.

Response: *Thanks for the reviewer's professional comments. By comparing these data with those obtained with a three-dimensional ultrasonic anemometer, the results indicate that the error of the buoyancy generation term detected by the proposed method is relatively small, with an average absolute value of less than 0.00014 m^2/s^3, which verify the accuracy and reliability of our method. As the reviewer suggests. we have added the texts in the abstract and conclusions. (See lines 444 to 447)*

4. The caption of Figure 8 does not effectively convey the meaning of this figure.

Response: *As the reviewer suggests, we have modified the caption in revised version.*

5. Lines 293 and 294: How do you calculate the error? The calculation method for the error should be provided in the text.

Response: *As the reviewer suggests, we have modified the texts in revised version. The buoyancy generation term (B′) gleaned from the three-dimensional ultrasonic anemometer data was used as the standard value. The error (ΔB = B − B′) of the buoyancy generation term (B) detected by the wind lidar was calculated, and its distribution was statistically analyzed, as shown in Figures 8(a) and (b). (See lines 304 to 307)*

6. Can this method proposed here be applicable in other circumstances? e.g., How about the implications for elucidating the turbulence-convection interaction, and convection initiation.

Response: *As the reviewer suggests, we have added the texts in the conclusions. Based on the detection principle of wind lidar, the method proposed in this study is applicable during sunny and cloudy conditions; however, it is not suitable for deployment during periods of heavy rainfall. Furthermore, this method holds potential for elucidating turbulence convection interactions and convective initiation before precipitation occurs. It is imperative to acknowledge that due to the inability to measure pressure transport terms and monitor high-frequency turbulent energy, the error of the proposed method may increase in weather processes dominated by these two factors. (See lines 447 to 451)*

7. Lines 53-56: "...including changes in surface heat flux, atmospheric stability, and topography". More recent references are needed to support this statement. The authors can refer to https://doi.org/10.5194/acp-21-17079-2021.

Response: *As the reviewer suggests, we have added some relevant references in revised version.*

8. Lines 58-59: Radar wind profiler can provide such high-resolution turbulence measurements (doi:10.1016/j.uclim.2022.101151), and can be mentioned here..

Response: *As the reviewer suggests, we have added some relevant references in revised version.*

On behalf of all authors,
Sincerely,
Honglong Yang

Shenzhen National Climate Observatory
Meteorological Bureau of Shenzhen Municipality
518000 Shenzhen, China
E-mail: yanghl01@163.com