

## Response to Reviewer 2's Comments

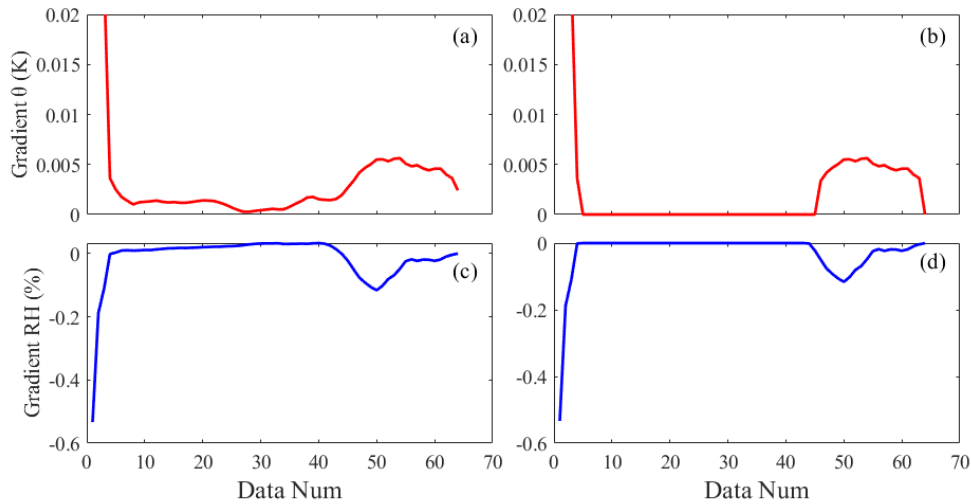
*Response: We thank the anonymous reviewer for his/her comprehensive evaluation and thoughtful comments. We have addressed the reviewers' concern one by one. For clarity purpose, here we have listed the reviewer' comments in plain font, followed by our response in bold italics.*

This study focuses on the performance of four common RS methods under different thermodynamic stability conditions and proposes an optimal processing flow for the RS data retrieval of PBLH. This study provides an optimal RS standard value retrieval method for further inversion of the PBLH through artificial intelligence algorithms. The article has a clear structure and contributes to this area. But in my opinion, there are still some problems should be solved before publishing.

*Response: Thanks for the reviewer's positive comments on our manuscript.*

1. For gradient method, the author mentioned that the threshold values of the potential temperature and RH vertical gradients were set as 0.003 K/m and 0/m, respectively. Why need to set this threshold? Similarly, why was the threshold of Ri set to 0.25, and whether the sensitivity test has been carried out?

*Response: We gratefully appreciate for your valuable comment. Taking the case of May 25, 2019 as an example, as shown in Figure 1 of the response, Figs. 1a and 1c is a vertical gradient image of potential temperature and RH with no threshold set. It can be seen from the Figs. 1a and 1c that there is an oscillation curve before the local peak of the vertical gradient occurs, which affects the search for the local peak of the vertical gradient. Therefore, we have found the most appropriate threshold of 0.003K/m and 0/m through many experiments, which can eliminate the influence of oscillation on the final result, as shown in Figs. 1b and 1d.*



**Figure 1. Vertical gradients of the potential temperature and RH.**

*The reason why the threshold of Ri set to 0.25 is that Guo et al. (2016) have carried out sensitivity analysis on the threshold of Ri and indicated that it is appropriate to set it to 0.25.*

#### **Reference**

**Guo, J., Miao, Y., Zhang, Y., Liu, H., Li, Z., Zhang, W., He, J., Lou, M., Yan, Y., and Bian, L.: The climatology of planetary boundary layer height in China derived from radiosonde and reanalysis data, *Atmospheric Chemistry and Physics*, 16, 13309-13319, <https://doi.org/10.5194/acp-16-13309-2016>, 2016.**

2. About the RS data, why did author choose only nine sites for the experiment? Will there be similar results using data from all sites in the country?

**Response: We gratefully appreciate for your valuable comment. The nine sites in China were selected because they are equipped with radar wind profiler, which facilitates the subsequent comparison of RS observations with radar wind profiler observations for verification. For the second question, Guo et al. (2021) investigated the global boundary layer height using high-resolution RS data and reanalysis data, which included about 120 stations from China, and the results of the spatial distribution and diurnal variation of the boundary layer height were similar to our study.**

## **Reference**

**Guo, J., Zhang, J., Yang, K., Liao, H., Zhang, S., Huang, K., Lv, Y., Shao, J., Yu, T., and Tong, B.: Investigation of near-global daytime boundary layer height using high-resolution radiosondes: First results and comparison with ERA-5, MERRA-2, JRA-55, and NCEP-2 reanalyses, Atmospheric Chemistry and Physics Discussions, 1-39, <https://doi.org/10.5194/acp-2021-257>, 2021.**

3. Section 1: In the third part of the introduction, only a few methods compared in this paper are described in the description of the existing RS data retrieval methods of PBLH, which should be described more comprehensively.

**Response: Per your kind suggestion. We have made a further comparative study on the existing RS data retrieval methods of PBLH, which have been added to the Introduction section in the revised manuscript.**

4. P4-L18-19: This article studies PBLH retrieval method based on RS data. What is the role of radar wind profiler here?

**Response: We gratefully appreciate for your valuable comment. As in the answer to the second question, the purpose of adding the radar wind profile here is to show that the nine sites selected for this study are equipped with a radar wind profiler, so that the RS data can be compared with the radar wind profiler for verification of the boundary layer height observations in the future.**

5. P6-L6: Although there is an explanation for the abbreviation of  $GM_\theta$  in the abstract, what does the  $\theta$  refers to here, should be explained again.

**Response: Per your kind suggestion. We have added an explanation of the meaning of  $\theta$  in the revised manuscript**

6. P6-L19: Does the “rib” here refer to the Richardson number? If so, “b” should be in the form of subscript. And the specific meaning of  $ri_b$  needs to be explained.

***Response: Per your kind suggestion. The “rib” in this context does refer to the Richardson number. We have changed “b” to the standard subscript form according to your suggestion and explained it in detail***

7. Figure 2: Why is the proportion of various categories not 100% at All time? At different times, the proportion of different categories is relative to all the cases of a site, or relative to the effective cases?

***Response: We gratefully appreciate for your valuable comment. The reason why the total percentage of each category at all times is not 100% is that we have excluded some cases with abnormal data and not all cases are valid. The proportion of different categories at different times is calculated relative to all cases at a site.***

8. Section 3.3: This section analyzes the consistency of different algorithms under various classification conditions, and finds out the reasons for the inconsistency. However, we notice that the inconsistency ratio under SBL classification is higher than that under other classification conditions. It is suggested to make a key explanation for the high inconsistency ratio under SBL classification.

***Response: Per your kind suggestion. We have further analyzed and explained the causes of the high inconsistency ratio of various algorithms under SBL classification in Section 3.3 of the revised manuscript.***