

Anonymous Reviewer #3:

Guo et al. present a well written manuscript that reports on a comprehensive investigation of the planetary boundary layer height (BLH) in China using fine-resolution sounding observations and reanalysis data from January 2011 to July 2015. The bulk Richardson number based BLH estimation method is a popular approach and the results are finely analyzed and discussed. The findings are important in understanding air pollution in China. This manuscript should be published after my suggestions below have been satisfactorily addressed.

Response: We are quite grateful to referee #3 for his/her positive comments on our work, which are quite constructive and helpful. All these comments and concerns raised by the referee have been explicitly considered and incorporated into this revision. For clarity purpose, here we have listed the reviewers' comments in plain font, followed by our response in italics.

Specific Comments:

1. The physical meaning of the Richardson number method, turbulent flow becomes laminar flow when $Ri > Rc$ (Stull, 1988), should be included in the manuscript in a proper way. $Rc = 0.25$ is the critical value of the bulk Richardson number.

Response: The following paragraph was added in the method section of this revised manuscript to better describe the physical meaning of the bulk Ri method:

“Note that the Ri is dimensionless, and itself says nothing about the intensity of turbulence, but it can tell whether the turbulence exists or not; theoretical and laboratory research suggest that when Ri is smaller than the critical value (~ 0.25), the laminar flow becomes unstable (Stull, 1988). Thus, the lowest level z at which interpolated Ri crosses the critical value of 0.25 is referred to as BLH in this study, similar to the study of Seidel et al. (2012).”

2. Which map projection is used in the manuscript (Figs. 1, 7-10, 13)?

Response: The map project we used is the Lambert-conformal conic projection.

3. Page 5, Line 10: “121operational” → “121 operational”.

Response: Amended as suggested.

4. Page 6, Line 10: “0.7 degree” → “0.75 degree”?

Response: Amended as suggested.

5. Page 7, Line 7: Add latitude, longitude and altitude for Beijing site.

Response: “(116.47°E, 39.80°N, 32m a.s.l.)” has been added for Beijing site.

6. Page 8, Line 4: “Figures 2” → “Figure 2”.

Response: Amended as suggested.

7. Page 10, Lines 16-17: “due to the solar radiation in eastern China is stronger than that of western regions” → “due to stronger solar radiation in eastern China than that of western regions”.

Response: Corrected.

8. Page 14, Line 17: It is not appropriate to write “As the first attempt to obtain climatology of BLHs in China” because Liu et al. (2015) have already done research on BLH over China using CALIPSO and ERA-Interim reanalysis data.

Response: Per your suggestion, it has been revised to “As the first effort to compile the climatological sounding-based BLHs in China...”. Meanwhile, Liu et al., 2015 has been cited in the section of Introduction.

9. Page 16, Line 17: “Reference” → “References”.

Response: Amended as suggested.

10. Page 31, Fig. 10: ERA-BLH and CMA-BLH don't agree well at 0200 BJT, why?

Response: To our knowledge, the soundings at 0200 BJT were launched occasionally in summer in attempt to capture the major severe storms taking place in China, and

consequently a total of 1,578 profiles were collected and used for this study. As shown in Fig. R8, most stations have less than 30 of sounding profiles. Due to this sampling limitation, the seasonally averaged CMA-BLH at 0200 BJT don't agree well with ERA-BLH. Therefore, to reflect this issue, the original Fig. 10 was replaced by Fig. R8 in the revised manuscript, in which only the stations have more than 30 soundings are plotted.

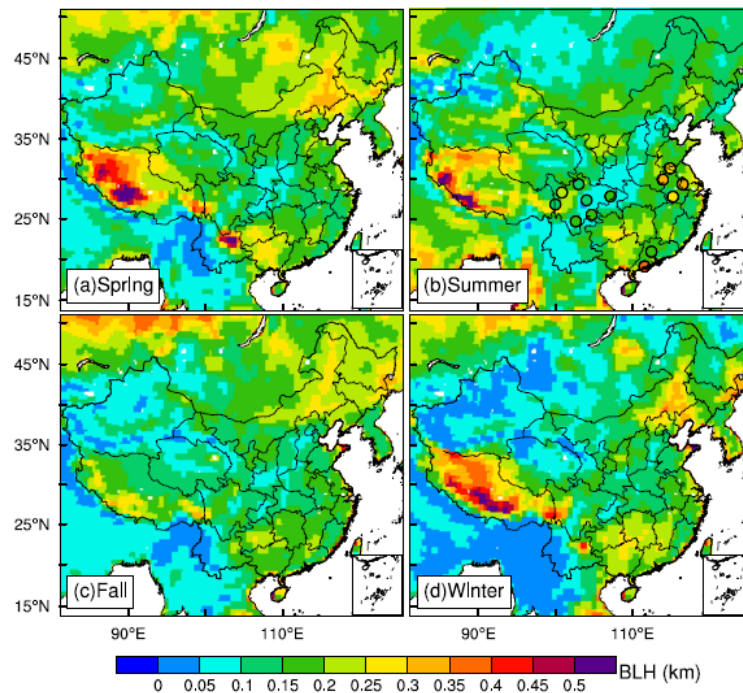


Figure R8. Spatial distributions of the seasonal mean of ERA-BLH (color shaded) and CMA-BLH (color dots) at 0200 BJT in (a) spring, (b) summer, (c) fall, and (d) winter. Note that only the stations have more than 30 soundings are plotted in (b).

References

- Liu, J., Huang, J., Chen, B., Zhou, T., Yan, H., Jin, H., Huang, Z., and Zhang, B.: Comparisons of PBL heights derived from CALIPSO and ECMWF reanalysis data over China, *Journal of Quantitative Spectroscopy and Radiative Transfer*, 153, 102-112, doi:<http://dx.doi.org/10.1016/j.jqsrt.2014.10.011>, 2015.
- Stull, R. B.: *An Introduction to Boundary Layer Meteorology*, edited by R. B. Stull, Springer 5 Netherlands, Dordrecht, 1988.