
Response to Referee #1

RE: Comprehensive evaluation of typical planetary boundary layer (PBL) parameterization schemes in China. Part I: Understanding expressiveness of schemes for different regions from the mechanism perspective

Author(s): Wenxing Jia et al.

In the manuscript “Comprehensive evaluation of typical planetary boundary layer (PBL) parameterization schemes in China. Part I: Understanding expressiveness of schemes for different regions from the mechanism perspective” by Jia et al., the authors select four typical boundary layer parameterization schemes to systematically analyze and evaluate near-surface meteorological parameters, PBL vertical structure, PBLH, and turbulent diffusion in five key regions of China in different seasons. The work can be useful for other researchers to use as a reference when doing simulation studies. I have the following concerns that need to be addressed.

Thank you for your positive comments and valuable suggestions to improve the quality of our manuscript. Based on these comments and suggestions, we have made careful modifications to our pervious draft, and the detailed point-by-point responses are listed below.

Specific comments:

(1) Abstract section: The abstract is too long and needs some reduction.

Re1: Revised as suggested.

(2) Line 204-207: L-band radiosonde observations by the China Meteorological Administration are generally conducted twice a day (08:00 and 20:00 BJT), except for three times a day at individual stations in summer. More details information about the radiosonde observation data are required.

Re2: Revised as suggested.

(3) The convective/unstable boundary layer is an important part of the study of planetary boundary layer. If there is no observation comparison of the daytime PBLH (14:00 BJT), does the author think that the evaluation of PBLH in different seasons in section 3.3 is insufficient.

Re3: Thank you very much for your valuable comments! Indeed, we lack the daily trend analysis of PBLH in this section compared to the conventional meteorological parameters, but we have made a basic comparison analysis of the characteristics of different PBL parameterization schemes to capture the PBLH using the data of these two moments. In the future, we will cooperate with other groups to analyze and discuss the daily variation results of PBLH using Lidar data or encrypted sounding data.

(4) Lines 449-451: Please add the equation for calculating sensible heat flux (HFX) here, so that readers can directly understand the relationship between HFX and $T_s - T_2$, and HFX and Ch.

Re4: Revised as suggested.

(5) Lines 580-581: Add references to previous studies about wind speed, and explain how these results have been accepted by the public.

Re5: Revised as suggested.

(6) Line 591 and 626: The YSU, ACM2 and BL schemes correspond to the revised MM5 near surface scheme and MYJ scheme correspond to another near surface scheme, right? If so, add the near surface scheme corresponding to MYJ scheme in Table 1.

Re6: Revised as suggested.

(7) Lines 817-818: Regarding the criterion of the PBLH about the virtual potential temperature method, it seems the PBLH at dawn and dusk of the studied stations is at the transitional stage of the PBL (08:00 and 20:00 BJT). How can the authors prove that the determined PBLH is accurate and can be used to verify the simulation results of the BL scheme?

Re7: It may be that we did not express it clearly here, we are comparing the PBLH at 08:00 and 20:00, not the daily average of the PBLH. We have made changes in the text and figures.

(8) Line 819 and 822: Please check that the equation number is correct.

Re8: Revised as suggested. Equations 29 and 30 have been modified to equations 15 and 16.

(9) Lines 859-860: For the evaluation of MYJ scheme PBLH, the author uses virtual potential temperature method instead of TKE method. There may be some uncertainties due to different calculation criteria between observation and simulation.

Re9: You are right that there is indeed uncertainty in this comparison, and this sentence (L859-860) has been rewritten so that we should point this out in the manuscript.

(10) As the authors mentioned in the manuscript, there is currently insufficient observational data to calculate PBLH using TKE. What observations should be used to calculate PBLH using TKE? What is the calculation?

Re10: To calculate the PBLH using the TKE method, the perturbation quantities u' , v' and w' of the three components of wind speed are needed, and also the data of different heights in the vertical direction are needed so that the TKE of different heights can be calculated, and then the PBLH can be judged according to the threshold value.

(11) Lines 870-871: This is a new attempt to analyze the turbulent diffusion coefficient. The current simulation results have not yet been verified by observations. While it would be strengthen the paper a lot if observational data can be included and analyzed.

Re11: Thank you very much for your acknowledgement that the analysis about turbulent diffusion is currently very scarce, especially from the PBL scheme of the turbulent diffusion mechanism. For now, there are very few observations of turbulent diffusion coefficients, and there is not enough data to be able to analyze them in comparison with the model. We have done some work on the turbulent diffusion of particles with data from one site (Jia et al., 2021a, b; 2022), but the amount of data is

still not enough. In the future, if we can cooperate with other groups to get some observation data and do a special issue on turbulent diffusion coefficient, we hope we can get your attention and correction.

Jia, W., and Zhang, X. Impact of modified turbulent diffusion of PM_{2.5} aerosol in WRF-Chem simulations in eastern China. *Atmos. Chem. Phys.*, 21(22), 16827-16841. doi:10.5194/acp-21-16827-2021, 2021.

Jia, W., Zhang, X.,* Zhang, H.,* and Ren, Y., 2021. Application of turbulent diffusion term of aerosols in mesoscale model, *Geophys. Res. Lett.*, 48, e2021GL093199.

Jia, W., Zhang, X.,* Zhang, H.,* and Ren, Y., 2022. Turbulent transport dissimilarities of particles, momentum and heat. *Environ. Res.*, 211, 113111.

(12) Line 871: “section 3.3.2” should be “section 3.2.2”.

Re12: Revised as suggested.

(13) Figure 14 and 15: “Zhanjiakou” should be changed to “Zhangjiakou”.

Re13: Revised as suggested.

(14) Figure 15: The caption is wrong, not 10-m wind speed and direction.

Re14: We are very sorry, and we have corrected the title of Figure 15.

(15) Figure 16: What do "Ri", “PTv”, "PBLHOBS" and “two methods” stand for? It would be better to state this clearly in the caption.

Re15: Based on your comments, we have added detailed descriptions in the corresponding text and figure 16 captions.

(16) Figure 19: The resolution of the image is too low to distinguish the information shown in the image. And “SCB” should be “SB”.

Re16: In accordance with your comments, we have revised Figure 19 and have checked the entire figure.