

Atmos. Chem. Phys. Discuss., referee comment RC1  
<https://doi.org/10.5194/acp-2022-48-RC1>, 2022  
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## Comment on acp-2022-48

Anonymous Referee #1

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Referee comment on "Regional PM<sub>2.5</sub> pollution confined by atmospheric internal boundaries in the North China Plain: boundary layer structures and numerical simulation" by Xipeng Jin et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-48-RC1>, 2022

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### Summary

The manuscript investigated the three-dimensional PBL structures under various pollution types in the North China Plain (NCP) by using the WRF model during autumn and winter of seven years (2014-2020). They proposed three pollution PBL types (frontal category, wind shear category, and topographic obstruction pollution category) and investigated the two main types of wind shear category and topographic obstruction category through case studies in this paper. Such work is a good supplement to the synoptic-scale and boundary-layer scale studies and I believe it will be of interest to the community of atmospheric pollution and boundary-layer meteorology. Overall, the paper is logically structured and well written. However, some details and explanations on methods and data need to provide to justify and support the conclusions. Thereby, I suggest **a major revision** before the paper can be accepted by *Atmospheric Chemistry and Physics*. My detailed comments are listed below.

### Major comments

- My first concern is about the use of the WRF model. Given this study is focused on the different types of aerosol pollution cases, then using the atmospheric chemical transport model WRF-Chem or WRF-CMAQ to simulate these pollution events sounds more plausible than the pure-meteorological model WRF. Otherwise, it is difficult to convince the reader that these pollution cases are reasonably captured without evaluating the performance of simulating PM<sub>2.5</sub> concentration. Moreover, the interaction between aerosols and boundary layer can modify the PBL thermal and dynamic structures, so I wonder if the pure-meteorological model WRF is suitable for

- investigating such pollution cases. The authors at least give some discussions on this.
- Since PBL height is a key parameter in characterizing the PBL structures and the pollution formation mechanism, I am afraid that the authors fail to present this diagnosed variable in the whole manuscript, either for simulation or observation. Moreover, I suggest the author present the vertical cross-sections of potential temperature (like Figure 7) for wind shear category and topographic obstruction category in the supplementary materials to justify that those cases do not belong to the first frontal category.

### Minor comments

- Lines 1-2. I suggest the author give the study period in this sentence, otherwise, this sentence will be inaccurate.
- Line 36. Should be "Petäjä et al., 2016".
- Line 100. Should be "from December 25, 2017, to January 24, 2018".
- Line 103. Please give the full name of LT and UTC when they appeared for the first time.
- Lines 107-108. What does the original data mean here?
- Lines 115-116. Could you show the comparison of the observational and simulated PBL depth?
- Lines 131-133. I wonder if the vertical grid resolution is enough to resolve the PBL structure. It is better to give the detailed height of the model level within 2 km?
- Line 148. The authors do not mention this study period in section 2.1.
- Figure 2. I am wondering why the authors present PM<sub>5</sub> concentrations at different sites for these three cases?
- Figure 3. Please state the figure represents observation data in the caption.
- Figure 4. The figure looks very unclear. I think it should be re-plotted with making the wind vector line thinner.
- Table 1. Give the units of those presented variables.
- Figure 6. Again, it seems that there is an intensive GPS sounding observation during October 7-12, 2014, but the author did not mention such observation in section 2.1.
- Line 314. Should be "5 & 8".
- Line 315 and Figure 7. Why do the authors present the results at 1500 LT and 2200 LT in this front category, but illustrate them at 1400 LT and 2300 LT for other categories? It is better to keep consistent.
- Line 322, "Figs. 5 & 8" is different from the description of the figure caption, please check and keep consistent.
- Line 324. No Fig. 7c-d, please add them in figure 7.
- Line 325-326. It is difficult to see the change of the PBL height; I suggest the authors add the diagnosed PBL height in Figure 7 and other figures (e.g., Fig. 8, 9, 10, 11) to better support their explanations.
- Line 420. Should be **PBL height** in Jinan had increased to 1100 m.