

Dear Dr. Huang,

On behalf of all authors, I'd like to thank you for the encouraging comments and careful revisions which helped to improve the quality of our manuscript [No.6295878]. Following the comments and suggestions, we have substantially made the according revisions on our manuscript. Thank you very much for your kind consideration.

Sincerely yours,

Tian Li

Feb 10, 2016

***Reply to Referee***

***In the followings we quoted each review question in the square brackets and added our response after each paragraph.***

*[1. While the current findings are sound and interesting, they are based on averages of data from 88 stations across the Jing-Jin-Ji Region. The reader is left to guess if the area, over which they are averaged, is complex or diverse enough so that some of the stations might not be representative.]*

**Reply 1:** The comments are greatly appreciated. Five representative stations of Beijing, Taiyuan (on the west of Taihang Mountain), Zhangjiakou (in the northwest of 3JNS), Cangzhou (the coastal station), and Xingtai (the east of Taihang Mountain) were additionally picked up to represent different topographies and surface types in the Jing-Jin-Ji. The modeling outputs by four schemes for specific stations were quite interesting as a result while much similar to the averaged outputs. The detailed analyses are discussed in section 3.2 and 3.4 and more information is displayed in Figure 5 and Figure 9.

*[2. The model is further run at a 9 km resolution – is this enough to capture all the*

*meteorological events and topography in that area?]*

**Reply 2:** Thanks for the kind question. The resolution of pollutant emission is  $0.1^{\circ} \times 0.1^{\circ}$ , which approximately equal 11km. The resolution of 9km in second domain was appropriate. Furthermore, 9km horizontal resolution is acceptable for mesoscale or synoptic scale haze episodes. We also understands that this horizontal resolution maybe enough to capture all the meteorological events and topography in the simulation area. For a better modeling of haze and boundary layer variations, the fine resolution could be in the further modeling study.

*[3. It sounds like you were using the whole WRF output, and not discarding the first hours of simulations due to spin up. Is this correct? The first hours of simulations are usually not used, as the model takes time to adjust from the coarse initial conditions. This adjustment can take somewhere between 6-12 hours or so.]*

**Reply 3:** Thanks for your comments. In the revised manuscript, we have clarified this description as follows:

This is a continuous running of WFR-Chem simulation over Feb. 2014. The model restarted each day at 00:00 UTC and ran for 24 hours. The simulation period was 32 days, and the previous 4 days were not used for the analysis to obtain the chemical component balance from pollutant emissions. Further, the prediction field (the last hour) of the previous day was used as the initial field (the first hour) of the new day for spinning up, making sure that the model has adjusted from the coarse initial conditions. In sum, we are pretty sure about steps in the model run, and the comparing results of simulation with observations showed that this kind of processing maybe acceptable.

*[4. Section 2.1:- Headline: Model Introduction and Configuration; - for the sigma levels, please add a reference to table 3; please explain why 9 km resolution seems to be enough for your research question. Can you elaborate on the uncertainty in the PM<sub>2.5</sub> measurements? How are these measured?*

**Reply 4:** Thanks for the kind suggestion. A reference has been added in section 2.1;

the resolution of origin emission is  $0.1^{\circ} \times 0.1^{\circ}$ , which approximately equal 11km. Therefore, the resolution of 9km in second domain was appropriate. The PM<sub>2.5</sub> measurement data are from the China National Environmental Monitoring Center. These one month data of PM<sub>2.5</sub> measurement are only used to evaluate the PM<sub>2.5</sub> simulation in our present study. We need the long-term measurement data to assess the uncertainty; therefore, we cannot elaborate on the uncertainty in the PM<sub>2.5</sub> measurements, which is also beyond the objective of this study.

*[5. Why did you pick Feb. 21 – 25? Can you define a “haze” period, and oppose that to a “clean” episode?]*

**Reply 5:** We picked Feb. 21-25 due to high PM<sub>2.5</sub> measurements and better WFR-Chem simulation during those days. “Haze” period refers to a high PM<sub>2.5</sub> pollution period, contract to the “clean” period with daily averaged PM<sub>2.5</sub> observations  $> 200\mu\text{g m}^{-3}$  in the “haze” and  $< 50\mu\text{g m}^{-3}$  in the “clean” days, which is metioned additionally in the section 3.4 of the revised manuscript.

*[6. Why did you simulate February and not a whole year?]*

**Reply 6:** Thanks for the kind question. Winter is the typical season with frequent haze phenomenon. According to lots of observation data analysis, we found that the haze periods occurred in Feb, 2015 were very classic. In addition, considering the data of PM<sub>2.5</sub> is quite precious, and our computational sources as well as time are very limited, we simulate the whole Feb. not a year.

*[7. You state in section 3.2 that it does not make sense to compare the PBLHs among the PBL schemes. In fig. 3 and 4 you do that though. Can you explain that discrepancy?]*

**Reply 7:** Thanks for the kind suggestion. We admit that this sentence is not an appropriate description and it has been corrected in Sect. 3.2. For the different diagnoses of PBLH by different PBL schemes, the specific values of PBLH between different PBL schemes are not comparable, so our focus is here to explore relationship

with PM<sub>2.5</sub>, wind speed and vertical diffusivity. Therefore, the figures of PBLH are necessary.

*[8. Table 2: it is confusing to see two numbers xx&xx. I would make 2 columns and add “MB” and “NMB” as a sub header to make it clearer; Fig. 2a: please mention the date range in the caption; Fig. 5. I don’t see profiles of PBLH as indicated in the caption.]*

**Reply 8:** Thanks for the kind suggestion. The format of Table 2 has been changed to a new style which is clearer than before; the number of Fig. 2a has changed to Fig. 2 which was added the date range in the caption; the “PBLH” has been deleted in the caption of Fig.5 for our carelessness before.