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Atmospheric Chemistry and Physics
Discussions

Interactive comment on "Aerosol radiative effects and feedbacks on boundary layer meteorology and $PM_{2.5}$ chemical components during winter haze events overthe Beijing–Tianjin–Hebei region" *by* Jiawei Li et al.

Anonymous Referee #1

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Aerosol radiative effect (or so called aerosol-radiation interaction, ARI) has been demonstrated to play an important role in pollution deterioration near surface, especially during hazy days. This work developed an online coupled regional chemistry climate model to investigate the mechanisms of ARI on haze pollution. It was demonstrated that there existed a significant impact of aerosol radiative feedback on meteorology, chemistry, aerosol distribution and evolution during winter haze events. One strength of this paper is that the numerical simulation was evaluated against comprehensive observational datasets, like meteorological fields, mass concentration of

multiple pollutants as well as aerosol optical properties. Overall, this work is well structured and written but still needs more in-depth analysis to further improve this article. It worths being published in ACP after addressing the following issues.

Since the work mainly focuses on the impact of aerosol radiative effects on meteorology and the subsequent haze pollution, the model descriptions in Section2 ought to provide more detailed information on how aerosols' optical properties are treated in the model and the method of the online coupling with physical parts.

In terms of the model configurations, the spatial resolution of the model seems a little coarse to characterize aerosol radiative effect on the atmospheric stratification, especially in BTH region with complex terrain. There were 16 vertical layers in the vertical dimension, as described in Section 2. How were these vertical grids distributed in the simulations? As demonstrated in previous related works (Wilcox et al., 2016;Wang et al., 2018;Huang et al., 2018), both temperature stratification and aerosol vertical profile, which are vital for aerosol's impact on near-surface pollution, are very sensitive to the vertical grid settings in models. Given that aerosol radiative effect features surface cooling and atmospheric warming and thus more stable stratification, insufficiently fine resolution may partly offset these two opposite tendency and underestimate the pollution deterioration.

Minor concerns:

Line 310-312: It is a little confusing about the definition of the NoAer simulation. Did it include aerosol-cloud interaction? Or it excluded any impact of aerosol on meteorology? Line 856-864: the thermodynamic process of nitrate aerosol is also highly dependent on the air temperature. As shown in Fig. 7, in addition to RH increase, 2-meter temperature decrease significantly and may contribute to the gas-aerosol partitioning and subsequent nitrate formation.

Another minor issue is that most of the labels in all the figures, including the coordinate axis, are too small to be clearly identified. It needs to be improved in the revision.

References: Wang, Z., et al.,: Dome effect of black carbon and its key influencing factors: a one-dimensional modelling study, Atmos. Chem. Phys., 18, 2821–2834, https://doi.org/10.5194/acp-18-2821-2018, 2018.

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