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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Assessing the formation and evolution mechanisms of severe haze pollution in Beijing–Tianjin–Hebei region by using process analysis" *by* Lei Chen et al.

Anonymous Referee #3

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General Comments

This study investigated a haze event over BTH region in December 2015 with the process analysis method. The study examined the mechanisms underlying the event formation and evolution. They found the event was mainly controlled by the change of vertical mixing. In the end, the study also found that the vertical mixing and transport were two main processes that were responsible for the aerosol radiative feedback. The manuscript is well-written. However, the main point of processing analysis alone is not novel at all. Many previous studies have used this method in multiple air quality models, including WRF-Chem. The study only selected one event as the analysis case.

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Although the study found that the vertical mixing was the main contributor to the formation and evolution of the event, I didn't find anything new brought to the community. Besides these general comments, I also have some specific comments.

Specific Comments

1. The study selected the event of Dec. 20-29. Based on the result, it seems that the PM2.5 concentration reached 200 ug/m3 on average on Dec. 20. To better show the formation of event, the simulation and analysis should start from the earlier date to demonstrate the concentration rising from a lower level such as 50 ug/m3 as shown in the end of this event.

2. Line 19-21 of page 6, if the FDDA is turned on for the control and noARE experiments, I do expect some aerosol meteorological feedbacks can be diminished by the FDDA. Free runs without FDDA is preferred for studying aerosol feedback.

3. Line 11-12 of page 7, the MOSAIC aerosol mechanism in WRF-Chem has not been coupled with the Shao dust emission scheme, at least in the publicly released version. If it was coupled in this study or any previous studies, please briefly introduce it and cite the related references.

4. Line 18-24 of page 9, this part is confusing. In WRF-Chem, the aerosol-cloud interaction is linked with wet deposition and cloud aqueous chemistry. If aerosol-cloud interaction is turned off in this study, then the control and noARE experiments should use different chemistry mechanisms, i.e., noARE likely used the one without wet deposition and cloud chemistry. Please provide more details about this. If this is the case, the difference between the control and noARE should include not only the aerosol feedback but also the difference in chemical processes. Based on the results, it seems that there were little cloud and precipitation during the period. The major aerosol feedback is from aerosol-radiation interaction, therefore, it makes more sense that in noARE experiment only the aerosol radiative feedback is turned off with aerosol-cloud interaction not touched. Furthermore, we generally do not call aerosol-cloud interaction as aerosol

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radiative effects.

5. Line 11 of page 10, please provide the full name of NOAA READY GDAS. In addition, please provide more information about the PBL data from this dataset. Is it retrieval or direct observation? If it is retrieval, what is the method used for the retrieval?

6. In the figures of hourly timeseries such as Fig. 3 or 4, please specify whether it is local time or UTC time? In Fig. 3, is there a low limit from PBL retrieval? It seems the values are limited to 50 m. The same is applied to the simulations. Any specific reason?

7. Fig. 5 shows the aerosol components at the station of Shijiazhuang? Why not show the total PM2.5 surface concentration at this station as a reference? In addition, since the simulation seems capturing the hourly PM2.5 variation well, why not show the hourly component comparison instead of period average only? It would be interesting and provide useful information.

8. What does the black line represent in Fig. 10?

9. In Fig. 11, the process analysis showed the averaged 24-h change of PM2.5 during the period. What does this mean? Why is the averaged 24-h change important? I think that the change through each stage of the event would be more interesting. Please clarify.

10. In Fig. 12b, using height (m) instead of model levels as the y-axis makes more sense.

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