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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Intense atmospheric pollution modifies weather: a case of mixed biomass burning with fossil fuel combustion pollution in the eastern China" *by* A. J. Ding et al.

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The authors would like to thank the referee for overall positive comments on this paper. Below we provide a point by point reply with these comments.

Major Comments:

(1) The WRF modeling section. This is the weakest part of this study. Authors attribute the failure in the prediction of air temperature and rainfall by the WRF model during a heavy pollution episode" to the weather modification by aerosols. People would argue many other factors could result in the failure of temperature and precipitation prediction

in the model. Many current weather or climate models that have already included the aerosol direct and indirect effects still often fail in predicting precipitation. Without the advanced data assimilation, it is not surprising that the WRF or other weather forecast model is not able to correctly forecast the weather, especially the intensity and location of precipitation, no matter whether or not the model incorporates the aerosol/chemistry component. So further analysis/simulation may be needed to isolate the aerosol effect in the observation so as to convince readers it is the aerosol that has modified the precipitation pattern and temperature during this event. I am wondering why not perform two simulations using WRF-Chem, one with aerosol added and another one without aerosol, then you can easily quantify the aerosol effect on precipitation and temperature. WRF-Chem certainly would be more extensive, but it's just a few days event, so should be affordable.

Reply: We appreciate the referee for raising the concern on the modeling part. We agree that from a modeler's perspective, the modeling section is relatively "weaker" comparing to the other part of this manuscript. However, here this work focused more on reporting the field measured data and discussing the possible mechanisms related to the observation fact. We didn't intent to make a throughout evaluation of the WRF modeling, but just to provide additional support for the comparisons of observation with several other meteorological dataset, including ECMWF forecast and FNL analysis etc and local weather forecast report. For these reasons, we only put a small space to introduce and to discuss the WRF modeling results.

For the suggested WRF-Chem simulation, of course it is affordable from the view of computation consumption. We think that our current comparisons of observation with meteorological simulation results/analysis data maybe are already enough to qualitatively show all these interactions but it is still quite difficult to quantitatively understand those processes because of the lack of the measurement of aerosols profile, which is an important parameter influencing the radiative transfer and can be used to evaluate or assimilate the modeling results. In fact, we conducted some preliminary simulations

ACPD
13, C6780–C6784, 2013

using WRF-Chem before we prepared the current manuscript. We found that with only the satellite fire count data it is very difficult to successfully simulate distribution and time series of aerosol compositions during this episode in Nanjing, where the precipitation modification was found. Considering this point, sensitive studies with subjective assumption of an aerosol profile or without aerosols still cannot give a quantitative support to improve the current understanding. Nevertheless, we agree that this event that we reported is a very unique case for testing the WRF-Chem from both the perspectives of atmospheric environment and air pollution-weather interactions, and these works can be done in the future through collaborative efforts.

However, even if we do not include the WRF-Chem simulation, the referee's comment helps us to think more about how to strengthen the modeling part, especially for the strength the discussion on the rainfall modification. In order to further explore the causes of rainfall modification during the afternoon, we carried out an additional WRF data assimilation simulation by nudging the surface air temperature with observation at Nanjing. Interestingly, the simulation results showed that the daytime rainfall around Nanjing completely disappeared because of a stable PBL and less convection. It indicates that the daytime modification of rainfall likely can be attributed to the dynamics other than microphysical processes related to the intense air pollution. We will include these results and discussions in the revised manuscript.

(2) SORPES data. The paper (e.g. Figures 2, 3 & 4) presents different datasets focusing on chemical compositions, while they are useful, but not really relevant to the focus of this study. What more useful and relevant for this study are the data like aerosol optical depth, single scattering albedo, direct radiation, diffuse radiation, etc., I am wondering why those data are not presented or measured.

Reply: We agree that the aerosol optical depth, single scatting albedo, direct/diffuse radiation is important for understanding the mechanism. Unfortunately, these parameters were not measured during that period at the earlier developing stage of our measurement site, but we will add some of these measurements at our site step by step. How-

ACPD
13, C6780–C6784, 2013

ever, we think the data presented in Figures 2, 3, and 4 are at the same importance with these parameters raised by the referee, especially the chemical compositions, which provided some unique tracers to understand the sources and processes, such as the mixing of biomass burning and fossil combustion pollutions etc.

Technical comments: P14380, L17, More relevant studies over China could be cited here, e.g. Li et al., 2011.

Reply: we will add the reference.

P14382, L5, KAIN-FRITSCH is called in all grid sizes from 45 to 5 km?

Reply: KF scheme is called only in domain 1 and 2. We will clarify this in the revision.

P14385, L9, lowermost?

Reply: Yes. It's lowermost 1 km.

P14385, L17-19, this is the weakest part. Temperature modification is possible, but precipitation modification is less convincing.

Reply: We will add the WRF-FDDA simulation using observation nudging to further support this conclusion (see reply to the comment #1).

P14386, L5-10, the review of other studies should be appeared in the introduction section. More analysis based on the data collected at this site may be needed to support your hypothesis.

Reply: Same as the previous one.

P14386, L16, "positive" feedback?

Reply: We will delete the word "positive".

P14387, L3, on-line models have been developed for many years, e.g. Giorgi et al., 2003.

ACPD
13, C6780–C6784, 2013

Reply: We will add this reference.

P14387, L6, this study should be a good opportunity to evaluate the model.

Reply: Yes. We agree, but this is beyond the focus of this work, but we can do that in the future.

Table1 Do you have separate diffuse and direct radiation flux data?

Reply: Unfortunately, we don't have the separate flux data during this period.

Figure 8 This is a good conceptual figure but not appropriate appeared in a technical paper without the analysis to support the mechnisms illustrated.

Reply: Many mechanisms or processes of this figure have already been understood very well. However, how these processes linked with each other haven't been well established yet. We show this figure to help the readers to understand the story that we discussed. It's a useful figure for both readers in the field of meteorology and atmospheric chemistry, especially for those who attempt to future investigate this event based on modeling and design field measurements.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 14377, 2013.