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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impacts of aerosols on weather and regional climate over the Pearl River Delta megacity area in China" *by* Y. Wang et al.

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We would like to thank this anonymous referee for his/her detailed comments, which have helped to improve the quality of the manuscript.

(1) We have added a statement that "It should be pointed out that the use of visibility as a proxy for the aerosol content has certain uncertainties. In particular, the aerosol optical properties may also be dependent on the relative humidity (RH), since hygroscopic aerosols will increase their size as RH increases (Zhang et al., 2008)". Nevertheless, several previous studies have suggested that the aerosol amount (PM) is well correlated to visibility with a correlation coefficient of above 0.8 over the PRD area (Wu et al., 2005; Deng et al., 2008). In the present study, we have already excluded the days with precipitation in producing the statistics of the daily mean visibility. We have

also excluded the conditions with RH > 90%, to remove extreme humid circumstances such as fogs, in which liquid water is dominant by droplet concentrations. Also, the RH measurements have been examined from 2000 to 2006 and the daily averaged RH (in exclusion of rainy and foggy days) ranged from 65% to 70%, indicating that the interannual variation of visibility cannot be explained by the variation of RH in the data. Those points have been now reflected in the text. The x,y axis labels in figure 2 have been corrected.

(2) We have stated "To our knowledge, there are rather few updates applied to the dynamic core of the WRF frame in version 2. Other updates in PBL and land surface schemes have rather limited impacts on the sensitivity study of aerosol-cloud interaction discussed in this paper". To verify such an effect, we have implemented our microphysical scheme into WRF V3.1.1 and performed a simulation for the polluted case. The results show that the cloud water path and precipitation exhibit consistency with the results predicted by version 2.2.1. Those points have been now reflected in the text.

(3) Page 23181, line 18: change has been made as suggested.

(4) We have added the following statements "The derivation algorithm to retrieve high resolution AOD has been discussed by Li et al. (2005). The AOD derived from MODIS over PRD has been validated by sunphotometer in the studies by Li (2005) and Tan (2009). Uncertainty in the MODIS AOD product has been reported to be about 20%."

(5) We have now pointed out that the lightning flashes density represents the summation of lightning occurrences during the four months for each year. Furthermore, as discussed above (1), the visibility date is merely intended as a reflection of the yearly aerosol loading condition.

(6) See above replies in (1) and (5). The visibility data from the rainy days and extreme humid circumstances (RH > 90%) have been excluded in our statistics.

(7) We have now stated that “The number concentration and mass mixing ratio of ammonium sulfate aerosol over the surface in the polluted case are constrained by field measurements from Liu (2008) and Liu (2007), respectively, in the field campaign PRIDE-PRD 2004. The exponential decreasing profile of aerosol vertical distribution is supported by aircraft measurement during PRIDE-PRD 2004 (Wang et al., 2008). The most recent analysis from high-resolution AMS measurement (He et al., 2011) provides a similar mass concentration of ammonium sulfate to the value employed in this study.”

(8) We have now stated “The modeling work in this study only focuses the indirect effect of aerosols, which serves as CCN to affect precipitation and lightning activities associated with thunderstorm event.” We agree that conditions of aerosols in real atmosphere are extremely complicated in terms of their chemical species and their ability to form CCN. Extensive lab work and field measurements are needed.

(9) We have stated “The scavenging of aerosols by hydrometeors is not considered in our current microphysical scheme. However, our model simulations indicate that most of aerosols are activated as CCN during the developing stage of the cloud and precipitation process.”

(9) We have changed “On the contrary” to “Our results show that”.

(10) We have now stated in the conclusion session “In the present work, we have simplified the aerosol conditions as clean and polluted cases, both containing ammonium sulfate and sea salt but with different concentrations. The conditions of aerosols in the real atmosphere are extremely complicated in terms of the diverse chemical species and their ability to form CCN, which are not well understood presently. Extensive experimental work and field measurements are needed to develop parameterizations for incorporation of those processes into atmospheric models.”

(11) We have changed the wording from “closely linked” to “may be correlated”.

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