**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.

Anonymous Referee #1

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This paper contains two parts. The first part is a seven-year analysis of precipitation, lightning flashes, and visibility data in the PRD to infer the potential impact of aerosols on convective activity. The second part is an idealized modeling study that examines the differences in deep convection associated with aerosol concentrations that are either high or low. As described in my specific comments below, there are a number of problems in this manuscript that need to be addressed before it is suitable for publication.

Page 23281, lines 1 - 7: The authors discuss that visibility is used as a proxy for aerosols. They exclude conditions when RH > 90%; however, there is a relationship between aerosol mass and RH on visibility. Even when RH < 90% aerosols can uptake water and can lead to significant scattering of light. So it is possible that a relatively

low amount aerosols with high RH and a high amount of aerosols with low RH could produce a similar visibility value. Have the authors correlated RH with visibility used in this study? This would be useful to include in this study. The authors need to include some text in the manuscript that acknowledge that using visibility as proxy for aerosols has uncertainties.

Page 23281, line 15: Version 2 of WRF is a very old version of the code. Would the authors have reason to think that updates included in newer versions of the code would have any impact on the simulation results?

Page 23181, line 18: Change "Feathers" to "details".

Page 23282, lines 9-14: MODIS data is known to have larger uncertainties over land. The authors need to include which NASA product they are using to obtain the values in Figure 1a. Also include the uncertainty in the MODIS product.

Page 23282, lines 21-22: The authors average all the daily values and then just plot the seven data points, one for each year, and then draw a regression line. I suggest that all the daily data points be included in Figure 2. There is likely a great deal of scatter that is being hidden. Another concern I have is that daily values might also affect the relationship between rain and visibility, since these quantities can vary significantly during the day.

Page 23283, lines 1-10: The authors mention that ". . . heavy rainfall amount in the PRD area are closely linked with atmospheric aerosol loading . . .". But they use visibility, and it is affected by RH. It is natural that higher RH is associated with heavier rainfall. Heavy rain would also scavenge aerosols from the atmosphere, reducing the concentrations. The logic in this paragraph is flawed.

Page 23283, line 15: As stated previous, I am not comfortable using visibility data only to infer aerosol concentrations. In the introduction, the authors mention the PRIDE-PRD campaigns in 2004 and 2008 to "characterize the chemical and meteorological

conditions responsible for accumulations of gaseous and PM pollutants of primary and secondary origins". Why not simulate an event during one of those periods in which aerosols from a known high pollution event are used, rather than the arbitrary aerosol concentration used in this study?

Page 23284, line 20: Two cases are simulated: a "polluted" and "clean" case. These are highly idealized and simplified situations, especially when only two types of aerosols are considered. In reality aerosol concentrations are likely to be highly variable in the region, creating complicated effects on cloud evolution. Both sea-salt and ammonium sulfate are hydrophilic. What about including hydrophobic aerosols that would inhibit CCN activation? Also absorbing aerosols, such as black carbon and dust, will affect the semi-direct effect that can affect cloud evolution as well by changing the thermodynamic profile. Are the direct and semi-direct effects included in the model?

Page 23285, line 10. In this section the authors need to include whether aerosols are scavenged or not in the simulation. If they are not, this could exaggerate the aerosol effect in the "polluted" case.

Page 23287, line 12: I am not sure how "On the contrary" follows from the previous sentence. It is not clear to me what the inconsistency is.

Page 23292: A discussion section is needed to put the present modeling result into the proper context. For example, describing how the "polluted" and "clean "cases are idealized and highly simplified. That the study examines only one case, and that aerosol indirect effects can be different for different synoptic conditions (i.e. vertical wind shears, etc).

Page 23292, lines 12-14: This sentence overstates the findings. As in my previous comments, the use of visibility to infer aerosol loading is problematic because of visibility is affected by RH and there is also a relationship between RH and rain. In addition, only one case study is presented here which cannot be used to develop a sweeping conclusion regarding all situations.

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