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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol Optical Properties at SORPES in Nanjing, East China" *by* Yicheng Shen et al.

Anonymous Referee #2

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This manuscript presents a summary and analysis of 2 years of aerosol optical measurements at a monitoring site near Nanjing, China in the Yangtze River Delta region. The measurements are extremely interesting and represent a compilation of some of the most complete, co-measured aerosol optical properties (AOP) data available in eastern China. These AOP measurements are complemented by particle size distribution and meteorological observations. The authors do a nice job of summarizing the data and analyzing it to describe the radiative forcing consequences of the heavy aerosol loading present in this area.

Some improvements need to be made to the manuscript prior to publication. These go beyond minor and typographical corrections and so should be placed in the "major revision" category, but I do not wish to imply that this work is substantially flawed. It

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Discussion paper

could just be a better with a few changes.

My major scientific concerns are:

1) The heater in the nephelometer did not work for much of the 2-year observations period. Given the warm temperatures and high humidity during much of the year and the operation of the instruments in a (presumably cooler) indoor laboratory, there may be considerable aerosol water remaining even if the data are restricted to calculated RH <50%. The authors have not attempted to compare the SMPS size distribution measurements with the nephelometer by using Mie theory to calculate ambient scattering. There should be a short section that compares all measurements to whatever extent possible, including scattering, backscatter fraction, and aerosol mass. In other words, show internal consitency for the measurements analyzed. Then the reader would be more assured that the instruments are operating within their expected uncertainty.

2) Measurement variability is often discussed as a mean and standard deviation (e.g., in the abstract). However, these metrics are not descriptive when the parameter is not normally distributed, as is the case for most of the extensive parameters. In time plots, the data are shown to vary on a logarithmic scale. Thus it would be more logical to calculate, display, and discuss geometric means and geometric standard deviations. I appreciate that the 10th and 90th percentile values are also used as an indicator of variability; this is good and should be retained.

3) The time plots (Figs 1 and 8) are not very useful because there are so many parameters displayed. Figures 1 and 8 in particular are extremely dense, and it is very hard to see systematic changes during the "episodes" that are discussed in the text. I recommend focusing on one exemplary "episode" for Figure 8 and eliminating the other times shown on this graph. Then average values, described in a table, could be shown to describe the remaining episodes, e.g. length of each episode, changes in optical properties from episode start to finish, etc. This would be more quantitative and useful to the reader. Please make a quantitative definition of an "episode" and use it

consistently to identify these events.

4) The authors may wish to consider explicitly if biomass burning (mostly agricultural) could explain the cases of very high scattering but low absorption coming from the west-northwest direction.

5) On p. 14, line 30, an assumption is made that new particle formation and growth to optically significant sizes are necessary to explain increases in aerosol scattering. In fact, light scattering is roughly proportional to particle volume or mass because the scattering efficiency increases very approximately linearly across the broad accumulation mode, leaving scattering proportional to diameter cubed. Most of the increase in mass, hence light scattering, is almost certainly occurring on this accumulation mode. The growth of recently formed particles is very unlikely to compete with condensational growth on existing accumulation mode particles because of this strong diameter dependence of scattering.

6) In Section 3.6.2 it is confusing to describe the radiative effect as "decreasing" or "getting smaller" as light scattering increases. The magnitude of the effect is increasing; the sign of the effect is negative. I recommend explicitly saying that the magnitude of the RFE is increasing and use this consistently throughout the text.

Technical comments:

1) P1, line 34. The parameter "b" is not defined.

2) P2, line 15. Is the acronym "LAC" ever used again? There is no need to define an acronym that is not used later.

3) P3, line 7. Change "month" to "months".

4) P10, line 23. Change "there" to "their"

5) P16, line 23. Correct "to1".

6) Fig. 1. The choices of gray-scale error bands make the whole graph look out-of-

focus. Is there some better way to do this?

7) Fig. 1. I don't see any "blue vertical lines". It's not at all clear how the vertical lines that are shown on the graph are related to any "episodes".

8) Fig. 1. The scales/units for the absorption coefficient are incorrect.

9) Fig. 4. What is the color scale in Fig. 4f? Is this dN/dlog(Dp)? Is this an average (mean) sized distribution over the entire period of the observations? Is it rational to average size distributions in this way? For example, an accumulation-mode-dominated size distribution averaged with one dominated by an Aitken mode peak might result in a size distribution that represents neither case. Would it be better to show temporal evolution of modal parameters (e.g., accumulation mode Dgeom, Aitken/nuclei mode Dgeom) calculated and displayed as in Fig a-e?

10) Fig. 4. Can you show some sparsely plotted error bars that represent the 10th and 90th percentile values on the plots? This might make the graphs too crowded, but there needs to be some way to show if the changes in the parameters are significant relative to the hourly variability of the data.

11) Fig. 5. Please explain these color contour plots. What is a "counter polar plot". What do the colors represent?

12) Fig. 6. Please explain the color scale and the units. What does "retroplume" as a value mean exactly?

13) In Fig. 7 the trajectories are labeled "1", "2", etc. In Fig. 8 they are given names. Please use the names instead of numbers in Fig. 7.

14) The color scale for Fig. 12 is readable by most color-blind people, while the color scales on the other figures are not. Please use this color scale on all figures for the $\sim$7% of readers who are color-blind.

15) Table 1. Show geometric means and standard deviations.

16) Table 2. Add the current results to this table so we can compare directly.

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