**Atmospheric
Chemistry
and Physics
Discussions**

Interactive
Comment

Interactive comment on "Nucleation and growth of sulfate aerosol in coal-fired power plant plumes: sensitivity to background aerosol and meteorology" *by* R. G. Stevens et al.

Anonymous Referee #1

Received and published: 21 September 2011

General:

This manuscript presents on analysis on nucleation and resulting secondary aerosol formation in early stages of a diluting power plant plume. This research topic has been investigated very little in the past, despite its importance in linking the emissions from this major source type to regional or large-scale modeling frameworks. The paper is original and definitely deserves publication. I cannot find any scientific flaws in the analysis. Besides a few minor issues, my only substantial recommendation is related to making some preliminary recommendations for modelers based on this investigation.

Major issue:

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The analysis demonstrates the complexity of new particle formation in a power plant plume: the fraction of SO2 converted to sulfuric acid, the number of new particles formed from sulfuric acid, and the size of these newly-formed particles vary greatly with distance from the source, with ambient conditions and with many other variables. The paper also identifies priorities for future research on this topic. All this is fine and certainly useful information.

What I am missing here is some concrete recommendation(s) for large-scale modelers how to deal with the emissions leading to near-source new-particle formation. I am sure that there is something that can be recommended based solely on the performed analyses. For example, most modelers fix the total mass and size of emitted particles, after which these two quantities then dictate the number of emitted particles. This is probably fine for larger primary particles emitted by the source. However, is it the best way to go for particles formed in the plume, especially when considering how much the size of newly-formed particles may vary depending on both the distance and extend of SO2 to sulfuric acid conversion? The authors certainly have some ideas on this issue and therefore I would encourage them to discuss it shortly in the paper.

Minor/technical issues:

Using roughly 50 lines in describing the OH parametrization in the model sound a bit long and technical issue as part of the main text. I think this part would better fit to an appendix.

Page 24778, lines 5-8. This statement is not entirely correct. A Gaussian representation of a plume can be implemented in a way that allows mixing and chemical reactions within the plume and with ambient air mixed into the plume. This requires using grid boxes that grow in size as the plume is transported downwind from the source.

Table 2. The table is not understandable by itself. Please add information on where to locate the explanation for the different cases given in the first column of the table.

Figures 4, 7, 8 and 9: The term "additional particles" should be clearly defined, and in such a way that the reader finds this information easily when looking at the figures.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 24765, 2011.

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