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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Coupling aerosol-cloud-radiative processes in the WRF-Chem model: investigating the radiative impact of elevated point sources" *by* E. G. Chapman et al.

Anonymous Referee #2

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This manuscript reports on an investigation of the local and regional influence of elevated point sources on summertime aerosol forcing and cloud-aerosol interactions in northeastern US using WRF-Chem. A prognostic treatment of the cloud droplet number on the basis of the Lin Scheme was implemented as a two-moment approach for cloud physical processes, and modules to handle the activation of aerosol particles to form cloud droplets were incorporated into WRF-Chem. The predicted meteorological, chemical, aerosol, and radiative quantities were evaluated by comparison with measurements during clear, partly-cloudy, and cloudy conditions. Sensitivity simulation that

removes elevated stack emissions was performed to assess the impact of point sources on surface radiation and cloud properties. This work represents a valuable contribution on aerosol-cloud-radiation interaction using WRF-Chem, and the paper can be suitable for publication in ACP after addressing the following issues. Major Comments (1) Aerosol Nucleation. It appears in the present work that the authors adopted the binary H2SO4-H2O scheme by Wexler et al. (1994) and the ternary H2SO4-NH3-H2O scheme from Napari et al. (2002), but indicated a plan to convert to a scheme by Merikanto et al. (2007) in the future. It is clear that the classic nucleation approach is problematic in the treatment of binary and ternary nucleation (Yu, J. Chem. Phy., 127, 054301, 2007; Yu, J. Geophys. Res., 111, D01204, 2006). In addition, it is also realized that organic compounds contribute to aerosol nucleation (Zhang et al., Science, 304, 1487, 2004; Fan et al., Geophys. Res. Lett., 33, L15802, 2006). Those aspects need to be assessed, particularly in the content of their model performance. (2) Meteorology conditions. It was discussed that pollutant transport is affected not only by surface winds but also by winds aloft and meteorology is particularly important for pollutant emissions from large stacks. Some wind errors were mentioned in this manuscript. FDDA will likely reduce the effect of error of winds on the modeling, especially for small-scale or boundary layer simulations, but yet it was not performed. (3) There was no mention in this paper on how ice nucleation was treated. What ice nucleation schemes were adopted? (4) I suggest simplifying section 2 "Model description", since some parts of this section have been discussed in Fast et al. (J. Geophys. Res., 111, D21305, 2006). This paper should focus primarily on the improvement to the existing WRF-Chem.

Minor Comments P14800, Line 31, in "Wesely, M. L.", "16" should be "Vol. 23, No. 6". P14812, in Figure 6, the x-axis was not labeled. P 14773, line 7, water vapor was classified as one of the six hydrometeors?

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 14765, 2008.

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Interactive Comment