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How does particle formation in coal-fired power-plant plumes depend on environmental factors?

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Within the past ten years, global and regional chemical-transport models with online aerosol microphysics have become powerful tools for understanding how humans may be changing aerosols, clouds and climate. However, large uncertainties in processes such as new-particle formation and emissions limit the predictive ability of these models. Related to both of these uncertainties is the question of how to represent sub-grid aerosol processes in large-scale models with grid-box lengths of 10s of km or larger. Sub-grid SO_2 oxidation in coal-fired power-plant plumes with condensation of H_2SO_4 onto newly-formed and existing particles is an important example of these difficult sub-grid aerosol processes. We have developed a modeling framework with aerosol microphysics in the System for Atmospheric Modelling (SAM)(1), a Large-Eddy Simulation/Cloud-Resolving Model (LES/CRM), to explore these plumes in detail and develop parameterizations of plume microphysics for global and regional models. We evaluate the model with airborne data obtained in the plumes of various coal-fired power plants (2). Finally, we show how the effective downwind plume aerosol emissions can be greatly modified by both meteorological and background aerosol conditions.

(1) Khairoutdinov, M. F., and D.A. Randall,. *J. Atmos. Sci*., 60, 607-625, 2003.

(2) Parrish, D. D., et al., *J. Geophys. Res.*, 11, D00F13, 2009