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A semi-analytical method for calculating rates of new sulfate aerosol formation from the gas phase

J. Kazil^{1,2} and E. R. Lovejoy¹

¹NOAA Earth System Research Laboratory, Boulder, CO, USA

²NRC Research Associateship Programs, Washington, D.C., USA

Abstract. The formation of new aerosol from the gas phase is commonly represented in atmospheric modeling with parameterizations of the steady state nucleation rate. Present parameterizations are based on classical nucleation theory or on nucleation rates calculated with a numerical aerosol model. These parameterizations reproduce aerosol nucleation rates calculated with a numerical aerosol model only imprecisely. Additional errors can arise when the nucleation rate is used as a surrogate for the production rate of particles of a given size. We discuss these errors and present a method which allows a more precise calculation of steady state sulfate aerosol formation rates. The method is based on the semi-analytical solution of an aerosol system in steady state and on parameterized rate coefficients for H₂SO₄ uptake and loss by sulfate aerosol particles, calculated from laboratory and theoretical thermodynamic data.

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