Comparison of Two Schemes for the Redistribution of Moments for Modal Aerosol Model Applications

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Abstract

The modal method for modeling atmospheric aerosol size-distributions takes advantage of their observed lognormal characteristics to formulate computationally efficient algorithms for many of the dynamical processes governing their time evolution (Whitby et al., 1991). Thus this approach has been particularly attractive in large-regional-to-global-scale model simulations that must be run over long periods, as in climate change studies. In previous applications of such models, two modes have been typically used to simulate the fine aerosol distribution, and one to represent the coarse particles, with the number of modes remaining fixed throughout the simulation. A drawback in some of these applications has been that the smaller of the fine modes, used to represent Aitken particles, tends to grow to sizes typical of the larger (accumulation) mode and thus cause mode overlap, unless the aerosol moments are redistributed between the modes. Two methods for moment redistribution are compared in the MCNC Multiscale Air Quality Simulation Platform (MAQSIP). In the first scheme the condensation growth rate of the moments is used to determine the initiation of moment transfer from the smaller to the larger of the fine modes to maintain two distinct modes. The second scheme uses a dynamic management of modes that takes account of all the dynamic processes that may lead to either two distinct fine modes, or a single mode, indistinguishable from the other. Size distribution parameters, as well as model performance parameters are compared between the two methods.

Whitby, E. R., McMurry, P. H., Shankar, U., and Binkowski, F. S. (1991). Modal Aerosol Dynamics Modeling, Rep. 600/3-91/020, Natl. Exposure Res. Lab., U. S. Environmental Protection Agency, Research Triangle Park, N. C. (Available as NTIS PB91-161729/AS from Natl. Tech. Inf. Serv., Springfield, VA.)