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Extended method of moments for aerosol dynamics simulation

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The method of moments (MOM) provides a unique approach to modeling aerosol dynamics under conditions of new particle formation (through either heterogeneous or homogeneous nucleation) and complex mixing flows. Here the central problem is to the describe the evolution of aerosol over many orders-of-magnitude of particle size range, from subcritical clusters on the molecular scale to particles of larger-than-micron size containing billions of molecules. The MOM solves this problem by tracking the lower order moments of the aerosol size distribution in time, rather than the distribution itself. Fortunately, the lower-order moments of the aerosol size distribution are most important and often sufficient for determining the physical properties of the aerosol. For example, Rayleigh scattering is proportional to sixth moment of the size distribution while light scattering from larger particles is proportional to their surface area (second moment). The third moment is proportional to the total volume of particles and the zeroth moment to particle number density. The key to previous applications of the method is the property that the equations which govern the time evolution of the lower-order moments are in closed form. Applications of the MOM include simulations of aerosol reactors McGraw and Saunders (1984), Pratsinis (1988) and vapor condensation in a supersonic nozzle expansion flow LaViolette et al. (1994).

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