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An Examination of the Effects of Aerosol ChemicalComposition and Size on Radiative Properties of Multi-Component Aerosols

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ABSTRACT

The sensitivity of aerosol radiative properties (i.e., scattering coefficient, extinction coefficient, single scatter albedo, and asymmetry factor) and radiation transmission to aerosol composition, size distributions, and relative humidity (RH) is examined in this paper. Mie calculations and radiation calculations using a tropospheric visible radiation model are performed. The aerosol systems considered include inorganic and organic ions (e.g., Cl—, Br—, , , Na+, , K+, Ca2+, Mg2+, HCOO—, CH3COO—, CH3CH2COO—, CH3COCOO—, OOCCOO2—, MSA1—), and (2) water-insoluble inorganic and organic compounds e.g., (black carbon, n-alkanes, SiO2, Al2O3, Fe2O3 and other organic compounds). The partial molar refraction method and the volume-average method are used to calculate the real and imaginary parts of refractive index of real aerosols, respectively. The sensitivity simulations show that extinction coefficient increases by 70% when RH varies from 0 to 80%. Both extinction coefficient and asymmetry factor increase by ~48% when real part varies from 1.40 to 1.65. Scattering coefficient and single scattering albedo decrease by 18% and 24%, respectively, when the imaginary part varies from –0.005 to –0.1. Scattering and extinction coefficients increase by factors of 118 and 123, respectively, when the geometric mean radius varies from 0.05 to 0.3 ? m. Scattering and extinction coefficients and asymmetry factor increase by factors of 389, 334, and 5.4, respectively, when geometric standard deviation varies from 1.2 to 3.0. The sensitivity simulations using a tropospheric visible radiation model show that the radiation transmission is very sensitive to the change in geometric mean radius and standard deviation; other factors are insignificant.

KEYWORDS

Radiative Properties, Sensitivity Study, Aerosol Composition, Aerosol Size Distribution, Multi-Component Aerosols

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