ONA6) Calculations of Mass Extinction Efficiency for Polydispersed Aerosol Using Harmonic Mean Approximation

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1. 서론

Among many parameters characterizing atmospheric aerosols, aerosol Mass Extinction Efficiency (MEE) is important to understand the optical properties of aerosols. MEE is expressed as functions of the refractive indices (i.e., composition) and size distributions of aerosol particles. Aerosol MEE is often considered as a size-independent constant that depends only on the chemical composition of aerosol particles. Famous Malm's reconstruction equation and subsequent revised methods express the extinction coefficient as functions of aerosol mass concentration and MEE. However, the used constant MEE does not take into account the effect of size distributions of polydispersed chemical compositions. Thus, a simplified expression of size-dependent MEE is required for accurate and conventional calculations of the aerosol extinction coefficient and also other optical properties.

2. 자료 및 방법

Simple and flexible analytical expressions of mass extinction efficiencies taking into account the effects of sizes and chemical compositions of aerosol particles were developed without losing accuracy. The polydispersed size range of aerosol particles was considered with lognormal size distributions for ammonium sulfate, ammonium nitrate, sea salt, and elemental carbon aerosols. The MEE of each aerosol chemical composition was first determined by the separate fitting of the Mie-theory based calculations for small (MEE_S) and large (MEE_L) size ranges in the form of power-law relationships. The coefficients of the power-law relationships were represented as linear express of geometric standard deviation, which allowed flexible parameterizations of various size distributions. The MEE for the intermediate size range was determined using the MEE_S, MEE_L, and harmonic mean-type approximation.

3. 결과 및 고찰

To test the accuracy of the newly developed MEE approximation, the simple forcing efficiency of aerosol was examined. The calculated MEE and simple forcing efficiency using the newly developed method showed high correlations with those determined using the Mie-theory based calculations. The flexible and convenient parameterizations of MEE developed in this study can be readily used to process in-situ observations and adopted in large scale numerical models.

4. 참고문헌

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