Reconstructed expression for aerosol extinction coefficient by considering mass extinction efficiency and hygroscopic growth for polydispersed aerosol

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In this study, simplified analytic type of expression for size dependent MEs (Mass efficiencies) are developed. The entire size was considered assuming lognormal size distribution for sulfate, nitrate and NaCl aerosol species and the MEE of each aerosol chemical composition was estimated by fitting Mie’s calculation. The obtained results are compared with the results from the Mie-theory-based calculations and showed comparable results.

The mass efficiencies of all aerosol components for each size range are compared with Mie’s results and approximated as a function of geometric mean diameter in the form of a power law formula. Finally, harmonic mean type approximation was used to cover entire particle size range.

Also, analytic expression of approximated scattering enhancement factor which stands for the effect of hygroscopic growth factor for polydispersed aerosol on aerosol optical properties are obtained.

Based on aerosol thermodynamic models, mass growth factor can be obtained and their optical properties can be obtained by using Mie theory with different aerosol properties and size distribution. Finally, scattering enhancement factor was approximated fRH for polydispersed aerosol as a function of RH.

Finally, we also compared the simple forcing efficiency (SFE, W/g) of polydisperse aerosols between the developed simple approach and by the method using the Mie theory. The results show that current obtained approximated methods are comparable with existing numerical calculation based results for polydispersed particle size.