Retrieval of fine-mode and coarse-mode aerosol optical properties from sun and sky radiance measurements based on aerosol type classification method

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Aerosols are an important part of the atmosphere for it changes the radiance balance of the Earth–Ocean–Atmosphere system by absorption and scattering shortwave solar radiation and longwave earth radiation. Detailed knowledge of aerosol optical properties is needed not only to assess the aerosol climate effect but also to improve the accuracy of remote sensing. The widespread ground-based Aerosol Robotic Network (AERONET), as well as the sky radiometer network mainly located in eastern Asia (SKYNET), provides related parameters including the aerosol optical depth, complex refractive index (m), and volume size distribution (VSD) [1–3]. However, both the AERONET and SKYNET algorithms use the internal mixing hypothesis that assumes that fine- and coarse-mode aerosol particles have the same m values. This is not correct as the different particle modes have different compositions, and thus different m values [4,5].

In this study, we propose a new algorithm to retrieve the fine- and coarse-mode m values and VSD simultaneously by using ground-based measurements of direct sun and diffuse sky radiance. Seeing the ill-posed nature of retrieving m and VSD from scattered radiances, using a priori constraints is critical for successfully solving such problems with many parameters. So on the basis of the previous constraints we introduce an aerosol type classification method into the retrieval process to apply specific constraints of modal m values to specific aerosol types. Numerical tests show good performance when the specific a priori constraint for different aerosol types is introduced compared to that a unified a priori constraint is used. Our results also suggests distinct seasonal variations of modal m values in typical AERONET sites.

References

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