

Inversion of polar nephelometer measurements based on randomly oriented fractal-like clusters for biomass-burning aerosols

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Accurate characterization of biomass-burning aerosols remains a significant challenge due to their complex, non-spherical and inhomogeneous structure. Retrieval algorithms for determining aerosol optical properties typically rely on models of homogeneous particles, which can introduce uncertainties interpreting the measurement results of the angular dependencies of the scattering matrix elements (F11 and F12). Meanwhile, a large number of measurements clearly indicate the inhomogeneous structure of biomass-burning aerosols, which are complex structures of carbon-containing particles and can be modeled as fractal-like clusters (aggregates) of carbonaceous monomers [1-2]. In this study, measurements of F11 and F12 at 405, 515 and 660 nm with 1° degree resolution by polarized polar imaging nephelometry (Airphotons PIN100) [3] serve to present the inversion using an advanced aerosol model based on fractal-like aggregates.

The prototyped database of the optical characteristics of fractal-like aggregates was developed and implemented into GRASP algorithm [4]. This approach enables a more physically realistic representation of biomass-burning aerosols and their interaction with radiation. The inversion was applied to in-situ measurements of angular scattering matrix elements (F11 and F12) obtained during an intense biomass-burning event, complemented by absorption measurements from an Aethalometer, chemical analyses and images of by X-rays microscopy. The results of retrieving biomass-burning aerosols using a fractal-like cluster model are compared with those obtained under the assumption of homogeneous particles. The impact of the cluster-based model on the retrieved characteristics is analyzed and discussed.

References

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