Coating material-dependent differences in modelled lidar-measurable quantities for heavily coated soot particles

Franz Kanngießer[a,*] and Michael Kahnert[a,b]

[a]*Department of Space, Earth and Environment, Chalmers University of Technology, SE-412 96 Gothenburg, Sweden*
[b]*Research Department, Swedish Meteorological and Hydrological Institute, Folkborgvägen 12, SE-601 76 Norrköping, Sweden*

[*]*Presenting author (franz.kanngiesser@chalmers.se)*

Atmospheric soot aerosol particles have a strong impact on the Earth's climate and a negative impact on air quality and human health [1]. With the help of remote sensing techniques, the sources, transport pathways and sinks can be monitored. The interpretation of remote sensing data requires a thorough understanding of the particles' optical properties. For individual heavily coated soot particles differences in the refractive index of the coating, i.e., different chemical compositions, are among the main sources of uncertainty regarding the linear backscattering depolarisation ratio [2].

The possibility to distinguish between different coating materials based on the depolarisation ratio and the extinction-to-backscatter ratio for a set of heavily coated soot particles following a particle size distribution was investigated. As coating material sulphate and a toluene-based organic material were assumed, whereas the particle size distribution was assumed to follow a log-normal distribution based on *in situ* field measurements [3]. The depolarisation ratio and the extinction-to-backscatter ratio were calculated using the discrete dipole approximation code ADDA (version 1.2) [4] in conjunction with the morphologically complex particle model described in [2]. The calculations were performed for wavelengths of λ = 355, 532, and 1064 nm, and the results were compared to existing lidar field measurements.

Although there are clear differences in the depolarisation ratio for the different coating materials, the differences in the extinction-to-backscatter ratio are larger; thus the extinction-to-backscatter ratio may provide a more reliable method for distinguishing coating materials than the depolarisation ratio.

References

[1] Bond, T., and R.W. Bergstrom, 2006, Carbonaceous particles: an investigative review. *Aerosol Sci. Technol.* **40**, 27–67.

[2] Kanngießer, F., and M. Kahnert, 2018: Calculation of optical properties of light-absorbing carbon with weakly absorbing coating: a model with tunable transition from film-coating to spherical-shell coating. *J. Quant. Spetrosc. Radiat. Transfer* **216**, 17–36.

[3] China, S., C. Mazzoleni, A. Aiken, A., *et al.*, 2013: Morphology and mixing state of individual freshly emitted wildfire carbonaceous particles. *Nat. Commun.* **4**, 2212

[4] Yurkin, M. A., and A. G. Hoekstra, 2011: The discrete-dipole-approximation code ADDA: capabilities and known limitations. *J. Quant. Spectrosc. Radiat. Transfer* **112**, 2234–2247.

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