Measurement and impacts of the mass fraction of volatile coatings on soot

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Soot particles entering a high-intensity laser beam (~1 MW/cm^2 at 1064 nm) reach incandescent temperatures prior to vapourization. This laser-induced incandescence is proportional to the mass of refractory black carbon (rBC) in the particle, as exploited for example in the Single Particle Soot Photometer (SP2). This proportionality may be calibrated to rBC mass using thermally denuded, charge-neutralized soot particles classified by a Centrifugal Particle Mass Analyzer (CPMA), as the CPMA transmits only particles of a known mass-to-charge ratio. Subsequently, SP2 measurements of CPMA-classified, possibly coated soot particles directly provides single-particle rBC mass fractions. Inversion of the processed data provides a two-dimensional distribution of the soot coating mass fraction at any given size. In this presentation, we will compare the direct CPMA-SP2 quantification of soot mixing state with previous approaches. We will discuss how this two-dimensional distribution must be considered in order to accurately estimate the direct radiative forcing on climate by atmospheric soot, and address the uncertainties in such estimates.

[1] A. Naseri, J. C. Corbin, J. Olfert, EGUsphere, 2023, 1-30. doi:10.5194/egusphere-2023-2216