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A CRITERION FOR EVALUATION OF THE VALIDITY OF BLACK CARBON REFRACTIVE INDEX FROM MEASUREMENTS OF LIGHT ABSORPTION IN THE VISIBLE AND NEAR-INFRARED

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ABSTRACT. The fractal-like black carbon particles emitted from combustion systems and biomass burning are short-lived pollutants that contribute significantly to climate forcing. To accurately quantify the forcing and interpret optical measurements of uncoated and coated black carbon (BC) particles, it is indispensable to know the refractive index m = n + ki of BC in the visible and near infrared. In this study the effects of various morphological parameters and structure defects of black carbon particles on their mass absorption cross section (MAC) were first investigated using the generalized Mie-solution method (GMM) and discrete dipole approximation (DDA). The accuracy of the Rayleigh-Debye-Gans (RDG) approximation is also evaluated. Based on recent measurements of the soot absorption function E(m) and freshly emitted BC MAC in the visible and near-infrared, the most probable range of E(m) was recommended. A criterion was proposed to determine the valid range of refractive index of freshly emitted BC based on the contour plot of E(m) on the n-k plane.