Supplement: How aerosol size matters in AOD assimilation and the correction using Ångström exponent

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Fig. S1 presents the radius-dependent variation of the extinction efficiency $\mathcal{Q}_{ext}$, total cross section per unite mass $\mathcal{S}$, extinction coefficients ϵ_{ext} as well as the interpolated Ångström exponent $\mathcal{A}$ for sulfate aerosol (so4) at various incident bands and relative humidity. Other inorganic aerosols, e.g., NO_3 and NH_4 have the very close density, hygroscopicity and refraction index. Therefore, they share the same curves to so4.

Fig. S2 presents the profiles of the extinction efficiency $\mathcal{Q}_{ext}$, total cross section per unite mass $\mathcal{S}$, extinction coefficients ϵ_{ext} as well as the Ångström exponent $\mathcal{A}$ for black carbon (bc) at various incident bands. Since the bc fails to absorb any water from the surround atmosphere (hygroscopicity index = 0), bc aerosols have the same optical properties in dry and wet atmosphere.

Fig. S3 presents the curves of $\mathcal{Q}_{ext}$, $\mathcal{S}$, ϵ_{ext} as well as $\mathcal{A}$ for organic carbon (oc). Though oc is capable of attracting moisture from the air, the hygroscopicity is very weak. Therefore, bc aerosols have very close optical properties in dry and wet atmosphere.

Fig. S4 and S5 presents the curves of $\mathcal{Q}_{ext}$, $\mathcal{S}$, ϵ_{ext} as well as $\mathcal{A}$ for sea salt (ss) and dust aerosols. In real situations, most of the ss and dust are in coarse-mode, therefore, they usually result in very small Ångström values.

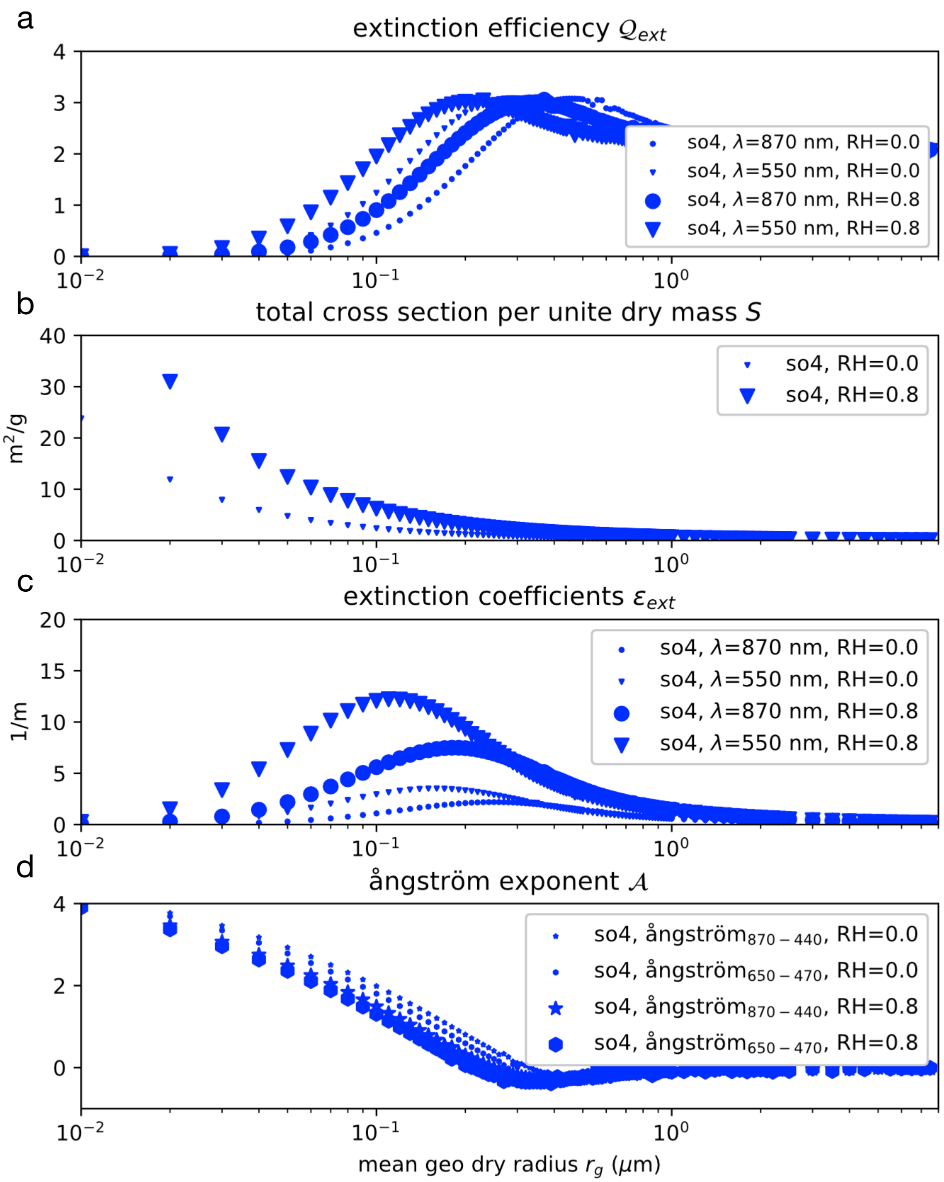

Figure S1. Inorganic aerosol extinction vs. mean geometric dry radius r_g. (a): extinction efficiency $\mathcal{Q}_{ext}$; (b): total cross section per unite dry mass $\mathcal{S}$; (c): extinction coefficients ϵ_{ext}; (d): Ångström exponent $\mathcal{A}$.

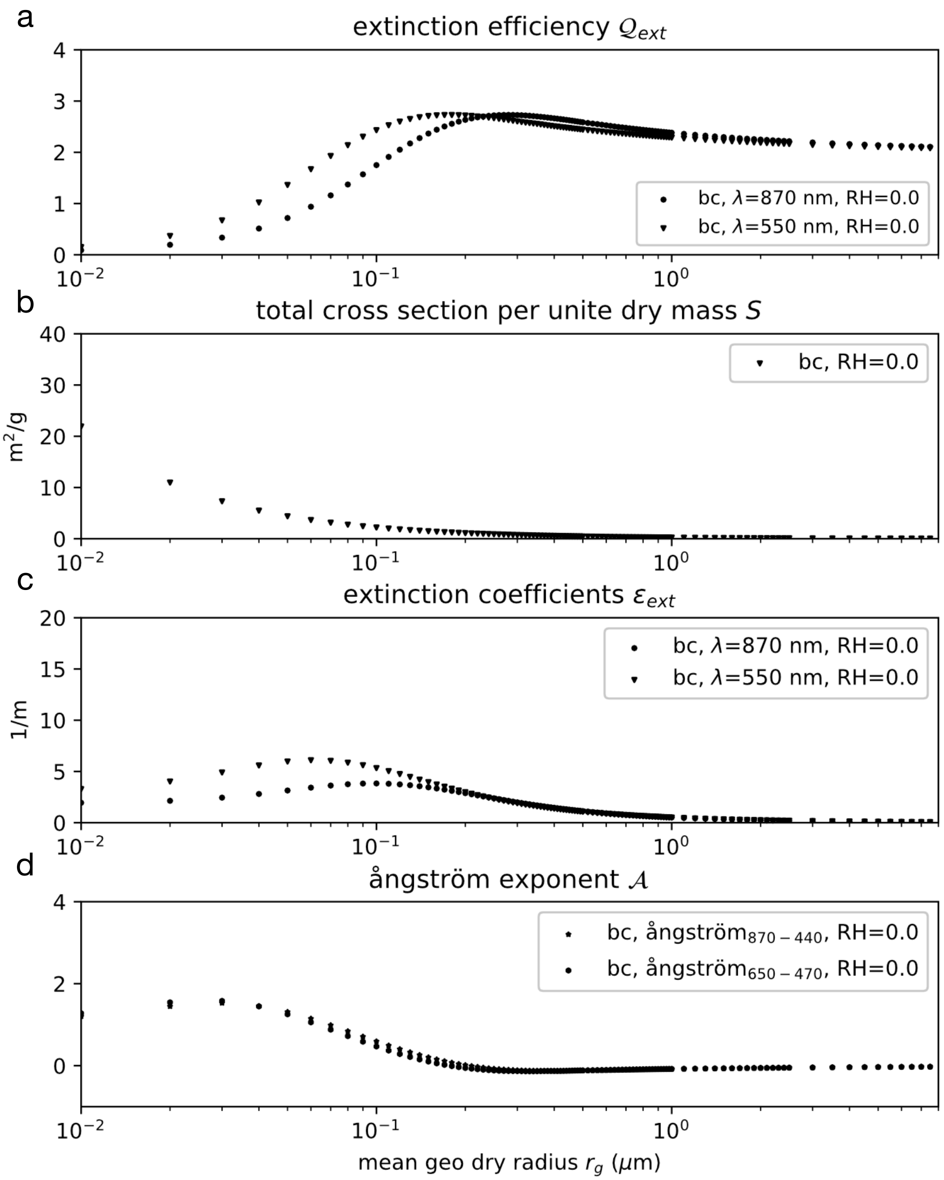

Figure S2. Black carbon extinction vs. mean geometric dry radius r_g. (a): extinction efficiency $\mathcal{Q}_{ext}$; (b): total cross section per unite dry mass $\mathcal{S}$; (c): extinction coefficients ϵ_{ext}; (d): Ångström exponent $\mathcal{A}$.

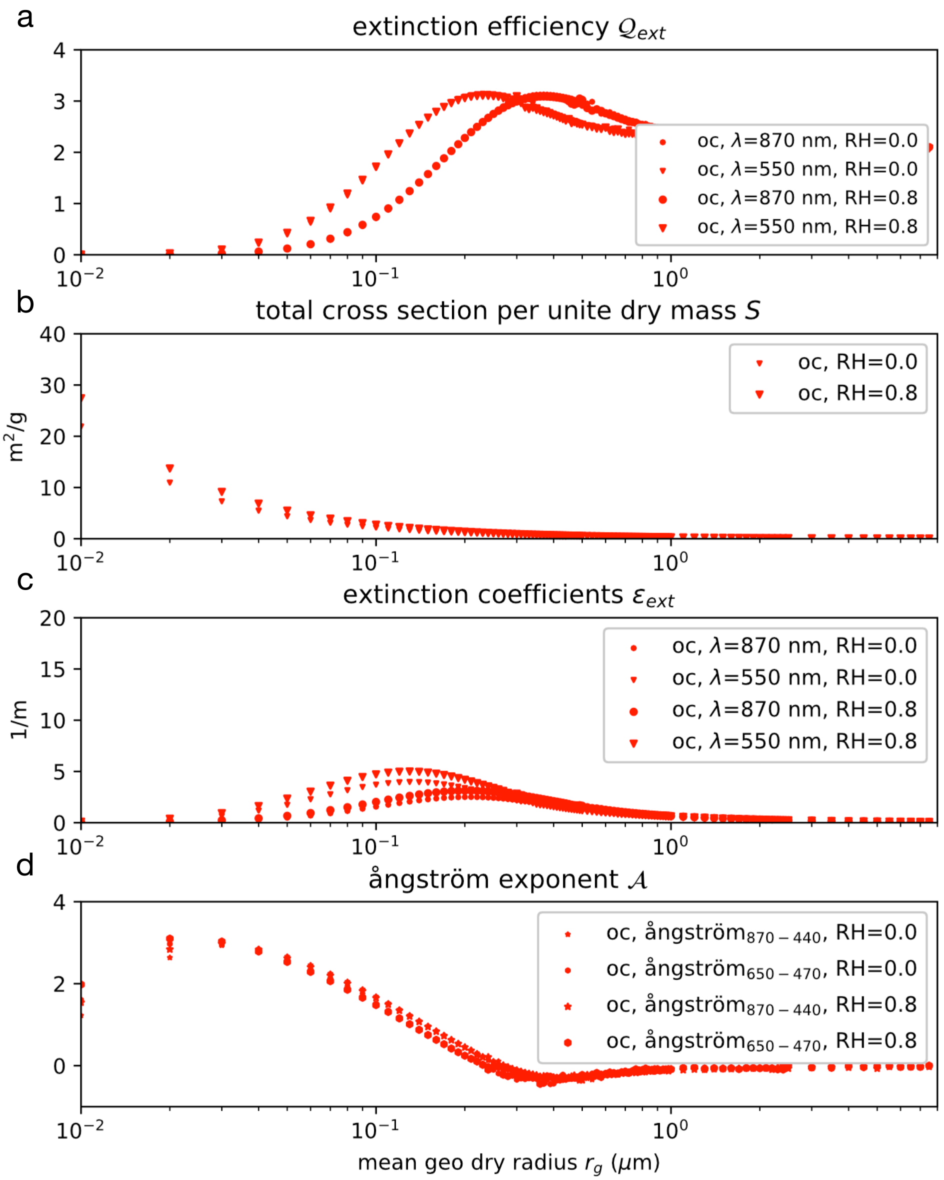

Figure S3. Organic carbon (oc) extinction vs. mean geometric dry radius r_g. (a): extinction efficiency $\mathcal{Q}_{ext}$; (b): total cross section per unite dry mass $\mathcal{S}$; (c): extinction coefficients ϵ_{ext}; (d): Ångström exponent $\mathcal{A}$.

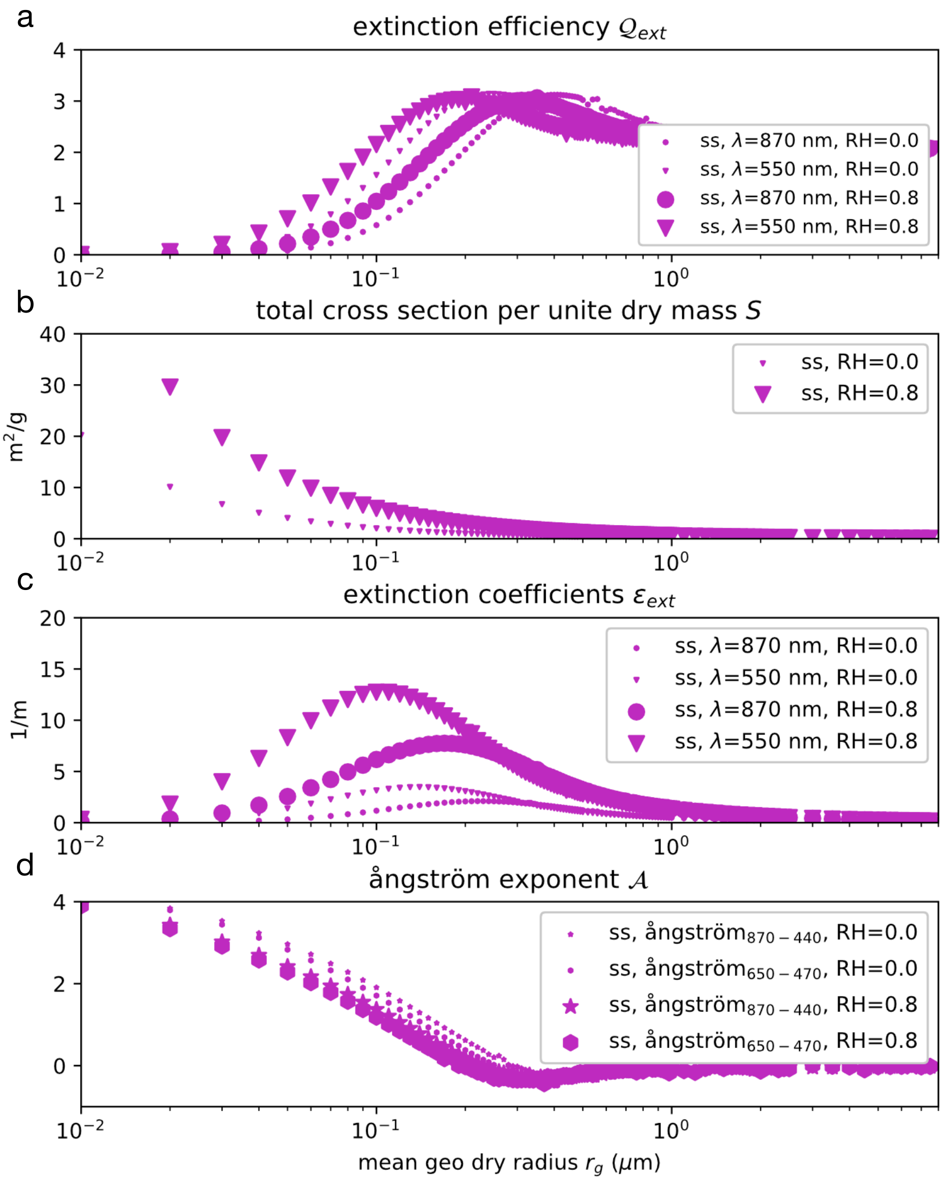

Figure S4. Sea salt extinction vs. mean geometric dry radius r_g. (a): extinction efficiency $\mathcal{Q}_{ext}$; (b): total cross section per unite dry mass $\mathcal{S}$; (c): extinction coefficients ϵ_{ext}; (d): Ångström exponent $\mathcal{A}$.

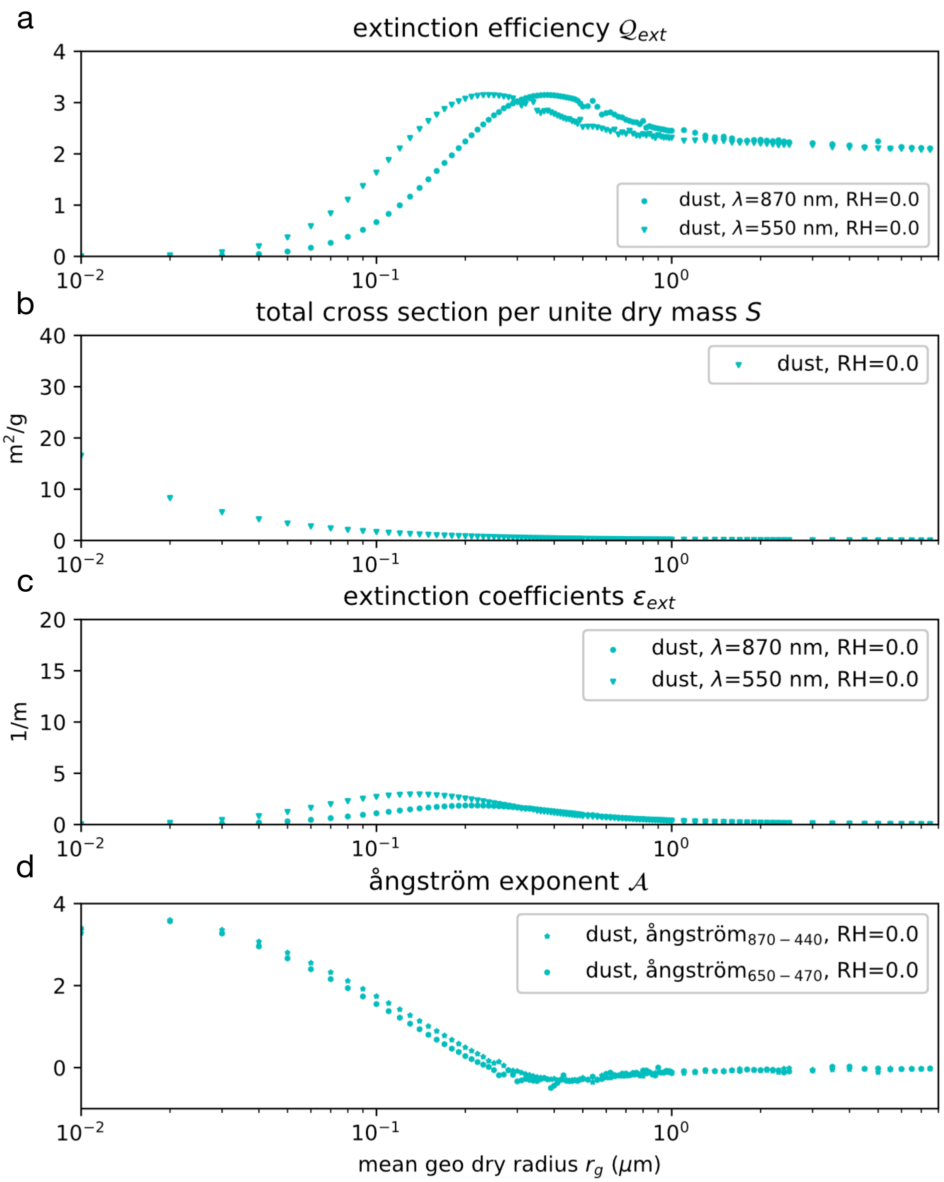

Figure S5. Dust extinction vs. mean geometric dry radius r_g. (a): extinction efficiency $\mathcal{Q}_{ext}$; (b): total cross section per unite dry mass $\mathcal{S}$; (c): extinction coefficients ϵ_{ext}; (d): Ångström exponent $\mathcal{A}$.