

Interactive comment on “Parameterization of sea-salt optical properties and physics of the associated radiative forcing” by J. Li et al.

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Comment on "Parameterization of sea-salt optical properties and physics of the associated radiative forcing"; by J. Li et al.

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The published discussion (Anon., 2008) of Li et al. (2008a), in dealing with the

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radius ratio $r(h)/r_{\text{dry}}$ (ratio of radius at fractional relative humidity $h=\text{RH}/100\%$ to that of the dry particle) of sea salt aerosol particles and the authors' response (Li et al., 2008b) incorrectly characterize the error in the parameterization of Lewis and Schwartz (2006) to the measurements of Tang et al. (1997) as exceeding 10%. Tang et al. presented the results of their measurements as expressions for the water activity (which, for the present considerations, can be considered as equal to h) and density of sea salt solutions as functions of solute mass fraction x , implicitly allowing determination of the radius ratio, given by

$$\frac{r}{r_{\text{dry}}} = \left(\frac{\rho_{\text{dry}}}{\rho} \frac{1}{x} \right)^{1/3},$$

as a function of h . Lewis and Schwartz (2004, p. 54; 2006) presented a physically-based parameterization of this dependence as

$$\frac{r}{r_{\text{dry}}} = 1.08 \left(\frac{2.0-h}{1-h} \right)^{1/3},$$

where the quantity $(1-h)^{-1/3}$ accounts for Raoult vapor-pressure lowering, and the values 1.08 and 2.0 are fit parameters. In their response cited above, Li et al. presented an empirical parameterization of this dependence as

$$\frac{r}{r_{\text{dry}}} = \exp \left[0.331 + 0.562h^2 + \frac{0.00261}{(h-1.05)^2} \right],$$

where the four constants are fit parameters. Radius ratios as a function of h calculated using the expression of Lewis and Schwartz (2006) are shown in Figure 1, which can be found at http://www.ecd.bnl.gov/steve/ssa_rh, together with the values obtained from the expressions of Tang et al. Examination of the difference plot (lower panel)

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shows that the parameterization of Lewis and Schwartz departs from the data of Tang et al. by no more than 3% over the entire range of relative humidity. In contrast, results calculated from the expression of Li et al. are approximately 2% higher than those of Tang et al. over a wide range of relative humidity (and up to 3.5% too high at very low relative humidity), and become increasingly low at high RH: by nearly 5% at 99% RH, and by much more at higher RH. (As the radius ratio varies only as the cube root of the density of dry sea salt, the difference in the values used by Lewis and Schwartz, 2.2 g cm^{-3} , and by Li et al., 2.24 g cm^{-3} , would account for a difference of only 0.6%.) These considerations allow the parameterization of Lewis and Schwartz (2004, 2006) to be used with confidence.

References:

Anonymous Referee #3, *Interactive comment* on "Parameterization of sea-salt optical properties and physics of the associated radiative forcing," *Atmos. Chem. Phys. Discuss.*, 8, S1639-S1641, 2008.

Lewis, E. R., Schwartz, S. E., Sea Salt Aerosol Production: Mechanisms, Methods, Measurements, and Models—A critical review, Geophysical Monograph Series, v. 152, American Geophysical Union, Washington, D. C., pp. 413, 2004.

Lewis, E. R., Schwartz, S. E., Comment on "size distribution of sea-salt emissions as a function of relative humidity," *Atmos. Envir.*, 40, 588-590, 2006.

Li, J., Ma, X., von Salzen, K., Dobbie, S., Parameterization of sea-salt optical properties and physics of the associated radiative forcing, *Atmos. Chem. Phys. Discuss.*, 8, 5813-5845, 2008a.

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Li, J., Ma, X., von Salzen, K., Dobbie, S., *Interactive comment* on "Parameterization of sea-salt optical properties and physics of the associated radiative forcing," *Atmos. Chem. Phys. Discuss.*, 8, S2397-S2399, 2008b.

Tang, I. N., Tridico, A. C., Fung, K. H., Thermodynamics and optical properties of sea salt aerosols, *J. Geophys. Res.*, 102D, 23269-23275, 1997.

Interactive comment on *Atmos. Chem. Phys. Discuss.*, 8, 5813, 2008.

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