

SEA SALT AEROSOL PRODUCTION: PARAMETERIZATION AND UNCERTAINTY

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ABSTRACT

Based on a critical review¹ of sea salt aerosol (SSA) properties and processes, field measurements of concentrations, and production fluxes estimated by a variety of methods, a parameterization is presented for the effective (10 m) size-dependent production flux of SSA particles for r_{80} (radius at 80% relative humidity) 0.1-25 μm and U_{10} (10 m wind speed) 5-20 m s^{-1} . This flux is given by a single lognormal of the form $dF/d\log r_{80}/(\text{m}^2\text{s}^{-1}) = 50[U_{10}/(\text{m s}^{-1})]^{2.5} \exp\{-0.5[\log(r_{80}/r_{80}')/\log(\sigma)]^2\}$, with $r_{80}' = 0.3 \mu\text{m}$ and $\sigma = 4$, and with associated multiplicative uncertainty of a factor of 4-5. At typical wind speed 10 m s^{-1} , this formulation is less than that given by some commonly used parameterizations by up to a factor of 80.

This production flux formulation is based on a size distribution of SSA concentration that encompasses the great majority of reported field measurements and can be represented over the same range of r_{80} and U_{10} by a single lognormal of the form $dN/d\log r_{80}/(\text{cm}^{-3}) = 0.07[U_{10}/(\text{m s}^{-1})]^2 \exp\{-0.5[\log(r_{80}/r_{80}')/\log(\sigma)]^2\}$, with $r_{80}' = 0.3 \mu\text{m}$ and $\sigma = 2.8$, and with associated multiplicative uncertainty of a factor of 3 reflecting variability resulting from factors other than wind speed. Based on this expression, the number concentration of SSA particles that function as CCN is a weak function of supersaturation, with more than 80% of SSA particles activating at supersaturations greater than 0.1%. The time characterizing uptake of reactive gases such as H_2SO_4 at wind speed 10 m s^{-1} is 0.15-1.5 h, implying a possible strong influence of SSA on nucleation suppression and aerosol evolution. The dominant contribution to light scattering by SSA particles is from particles having r_{80} 1-10 μm , implying that measurements that do not include SSA particles throughout this entire size range substantially underestimate the influence of SSA on light scattering and Earth's radiative balance.

¹ Lewis, E. R. and Schwartz, S. E. *Sea Salt Aerosol Production: Mechanisms, Methods, Measurements, and Models - A Critical Review*. In press, American Geophysical Union Monograph Series, 2004.