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Optical Properties of Suspended Mineral Dusts from Desert Source Regions

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On a global scale, mineral dust aerosol has the largest mass emission rate, average column mass burden, and average optical depth of all aerosol types, with its single scattering albedo (SSA) determining the sign (heating or cooling) and influencing the magnitude of its radiative forcing. Previously, we had suspended surface soil samples from ten desert sites and characterized their optical properties, especially SSA at two visible wavelengths, concluding that mineral dust SSA was controlled by iron content (Moosmüller et al.; 2009). Here we have extended this work to 65 samples, including sample locations in Africa, Arabian Peninsula, Asia, North and South America, and Australia.

A sieved fraction of each sample was suspended in an entrainment facility, from which the airborne particulate matter (PM) was sampled and analyzed. Instruments integrated into the entrainment facility included PM filter samplers, a beta attenuation gauge for the continuous measurement of PM mass fractions, an aerodynamic particle size (APS) analyzer, and a three-wavelength (405, 532, 781 nm) photoacoustic instrument with integrating reciprocal nephelometer for monitoring aerosol absorption and scattering coefficients of suspended PM2.5. Filter sample media included PTFE membrane and quartz fiber filters for chemical analysis (71 species), and nucleopore filters for individual particle analysis by scanning electron microscopy (SEM). Sieved fractions were also analyzed by X-ray diffraction for their mineral content and further mineralogically characterized by optical microscopy.

We will be presenting results on the optical measurements, showing the relationship between PM optical properties including SSA at different wavelengths and chemical as well as mineralogical properties of the entrained dust samples.

References

Moosmüller, H., J. P. Engelbrecht, M. Skiba, G. Frey, R. K. Chakrabarty, and W. P. Arnott (2012). Single Scattering Albedo of Fine Mineral Dust Aerosols Controlled by Iron Concentration. J. Geophys. Res., 117, doi:10.1029/2011JD016909.