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Chemistry and photochemistry of tropospheric aerosols: Their role in controlling the earth albedo

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Aerosol particles affect the earth's energy balance directly by absorbing and scattering radiation and indirectly by altering the reflectance and persistence of clouds. Laboratory experiments show that the absorptivity of representative aerosol organic matter is not a single-valued function of its molecular composition CxHyOz, but markedly depends on temperature and ionic strength, which is inversely dependent on relative humidity, and changes from dark to bright conditions (i.e., between night and day). Suites of representative polyfunctional CxHyOz oligomers in water develop intense visible absorptions upon addition of inert electrolytes such as ammonium bisulfate (ABS). The resulting mixtures reach mass absorption cross sections (532 nm) ~0.1 m^2/gC in a few hours, absorb up to 9 times more solar radiation than the starting material, can be half-bleached by sunlight in ~1 hour at noon and repeatedly recycled without carbon loss. Visible absorptions red-shift and evolve increasingly faster in subsequent thermal aging cycles. These transformations are deemed to underlie the daily cycles of aerosol absorption observed in the field, which introduce critical feedbacks in the Earth's radioactive balance. These phenomena and their timescales are consistent with the diel cycles of aerosol scattering and absorption observed over Mexico City at constant total carbon (15.5) gm^{-3} loadings. Aerosol absorptivity peaks early in the morning and reaches minimum values.

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