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Absorption Angstrom Exponent in AERONET and related data as an indicator of aerosol composition

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Abstract. Recent results from diverse air, ground, and laboratory studies using both radiometric and in situ techniques show that the fractions of black carbon, organic matter, and mineral dust in atmospheric aerosols determine the wavelength dependence of absorption (often expressed as Absorption Angstrom Exponent, or AAE). Taken together, these results hold promise of improving information on aerosol composition from remote measurements. The main purpose of this paper is to show that AAE values for an Aerosol Robotic Network (AERONET) set of retrievals from Sun-sky measurements describing full aerosol vertical columns are also strongly correlated with aerosol composition or type. In particular, we find AAE values near 1 (the theoretical value for black carbon) for AERONET-measured aerosol columns dominated by urban-industrial aerosol, larger AAE values for biomass burning aerosols, and the largest AAE values for Sahara dust aerosols. These AERONET results are consistent with results from other, very different, techniques, including solar flux-aerosol optical depth (AOD) analyses and airborne in situ analyses examined in this paper, as well as many other previous results. Ambiguities in aerosol composition or mixtures thereof, resulting from intermediate AAE values, can be reduced via cluster analyses that supplement AAE with other variables, for example Extinction Angstrom Exponent (EAE), which is an indicator of particle size. Together with previous results, these results strengthen prospects for determining aerosol composition from space, for example using the Glory Aerosol Polarimetry Sensor (APS), which seeks to provide retrievals of multiwavelength single-scattering albedo (SSA) and

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aerosol optical depth (and therefore aerosol absorption optical depth (AAOD) and AAE), as well as shape and other aerosol properties. Multidimensional cluster analyses promise additional information content, for example by using the Ozone Monitoring Instrument (OMI) to add AAOD in the near ultraviolet and CALIPSO aerosol layer heights to reduce height-absorption ambiguity.

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