

Identifying Aerosol Type/Mixture from Aerosol Absorption Properties using AERONET

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Aerosols are generated in the atmosphere through anthropogenic and natural mechanisms. These sources have signatures in the aerosol optical and microphysical properties that can be used to identify the aerosol type/mixture. Spectral aerosol absorption information (absorption Angstrom exponent; AAE) used in conjunction with the particle size parameterization (extinction Angstrom exponent; EAE) can only identify the dominant absorbing aerosol type in the sample volume (e.g., black carbon vs. iron oxides in dust). This AAE/EAE relationship can be expanded to also identify non-absorbing aerosol types/mixtures by applying an absorption weighting. This new relationship provides improved aerosol type distinction when the magnitude of absorption is not equal (e.g. black carbon vs. sulfates). The Aerosol Robotic Network (AERONET) data provide spectral aerosol optical depth and single scattering albedo – key parameters used to determine EAE and AAE. The proposed aerosol type/mixture relationship is demonstrated using the long-term data archive acquired at AERONET sites within various source regions. The preliminary analysis has found that dust, sulfate, organic carbon, and black carbon aerosol types/mixtures can be determined from this AAE/EAE relationship when applying the absorption weighting for each available wavelength (i.e., 440, 675, 870nm). Large, non-spherical dust particles absorb in the shorter wavelengths and the application of 440nm wavelength absorption weighting produced the best particle type definition. Sulfate particles scatter light efficiently and organic carbon particles are small near the source and aggregate over time to form larger less absorbing particles. Both sulfates and organic carbon showed generally better definition using the 870nm wavelength absorption weighting. Black carbon generation results from varying combustion rates from a number of sources including industrial processes and biomass burning. Cases with primarily black carbon showed improved definition in the 870nm wavelength absorption weighting due to the increased absorption in the near-infrared wavelengths, while the 440nm wavelength provided better definition when black carbon mixed with dust. Utilization of this particle type scheme provides necessary information for remote sensing applications, which needs a priori knowledge of aerosol type to model the retrieved properties especially over semi-bright surfaces. In fact, this analysis reveals that the aerosol types occurred in mixtures with varying magnitudes of absorption and requires the use of more than one assumed aerosol mixture model. Furthermore, this technique will provide the aerosol transport model community a data set for validating aerosol type.