Dual Wavelength Lidar Aerosol Retrievals via CRAM

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ABSTRACT

The Constrained Ratio Aerosol Model-fit (CRAM) approach is a method by which aerosol optical properties may be retrieved from dual-wavelength elastic scatter lidar data by applying constraints from aerosol models derived, for example, from analysis of AERONET data. CRAM employs aerosol models which associate spectral ratios of aerosol extinction, backscatter and the extinction-to-backscatter ratio (lidar ratio) of various aerosol types (e.g., Dust, Biomass Burning, Urban/Industrial, etc.). While CRAM is not an inversion as can be applied when more wavelength data is available, employing Raman or HSRL lidars at some wavelengths (e.g., the 3-wavelength backscatter and 2-wavelengh extinction inversion), it is a way of maximizing the aerosol optical parameter information that can be extracted from dual-wavelength lidar data via modeling constraints. Retrievals of backscatter and extinction retrieved from 2-wavelength lidar data, using the Fernald lidar retrieval relation for an assumed model pair of lidar ratios, that yield backscatter and extinction spectral ratios consistent/agreeing with the correspponding ratios of the assumed aerosol model are taken as acceptable solutions, whereas retrievals yielding ratios quite different than those of the assumed models are taken as unacceptable. If more aerosol optical parameter information can be obtained at one of the wavelengths (e.g., one wavelength includes an HSRL lidar), than an enhanced CRAM technique can be employed to further confirm the assumed aerosol model or, when no CRAM fit is obtained, to establish new aerosol model CRAM parameters. Results of CRAM applications to CALIPSO satellite lidar data (532 nm and 1064 nm wavelength elastic scatter) and to NASA Langley airborne HSRL data (HSRL at 532 nm and 1064 nm elastic scatter) are presented to demonstrate the efficacy and utility of the CRAM and enhanced CRAM techniques.