An algorithm to retrieve aerosol optical properties from ATLID and MSI measurements

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We develop an algorithm to retrieve aerosol optical properties using data of 355nm high spectral resolution lidar (HSRL) with depolarization measurement function "ATLID" onboard EarthCARE satellite. The ATLID has three channel data of Mie copolar, Mie crosspolar and Rayleigh attenuated backscatter coefficients at 355nm. Using the three channel data, the developed algorithm estimates (1) extinction coefficient (α), backscatter coefficient (β) and depolarization ratio (δ) of particles (aerosols and clouds) without assuming a particle lidar ratio (S), (2) identifies molecule-rich, aerosol-rich, or cloud-rich slab layers, (3) classifies aerosol type (e.g., dust and maritime) using the derived β, S, and δ by a threshold method, (4) retrieve planetary boundary layer height using the feature mask products (i.e., (2)), and (5) estimate extinction coefficients for several main aerosol components in the atmosphere (e.g., dust, sea-salt, carbonaceous, and water-soluble aerosols) using difference in depolarization and light absorption properties of the aerosol components from the retrieved α, β, and δ. This method assumes an external mixture of aerosol components and prescribe their size distributions, refractive indexes, and particle shapes and considers hygroscopic growth of water-soluble, carbonaceous, and sea-salt aerosols. In the retrieval of α, β, and δ (i.e., (1)), we introduce an optimization method using Gauss-Newton method with biconjugate gradient method instead of conventional direct method. For the aerosol typing (i.e., (3)), we construct optical and microphysical models for each aerosol type by cluster analysis using sky scanning radiometer data (e.g., AERONET and SKYNET) and ground-based lidar data (e.g., Raman lidar and HSRL). Furthermore, we develop an aerosol retrieval algorithm using both the ATLID and multi-spectral imager "MSI" onboard EarthCARE. This algorithm retrieves vertically mean mode-radii for dust and fine-mode aerosols as well as the extinction coefficients for the four aerosol components using the three channels of the ATLID and radiances at 670nm and 865nm of MSI with the optimization technique used in the above method. These products above are planned to be distributed by JAXA, Japan. We develop the aerosol component retrieval algorithm based on our developed algorithm for the Mie-scattering lidar CALIOP onboard CALIPSO satellite. Global analysis using CALIOP data is also underway in parallel. In the conference, we report the latest status of the development of the algorithm for EarthCARE and the results of CALIOP analysis.