Dust aerosol optical depth and particle size retrieval using spaceborne lidar

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Spaceborne lidar such as the Cloud–Aerosol Lidar with Orthogonal Polarization (CALIOP) on the Cloud–Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) satellite provides global observation of aerosol backscatter properties [1]. Light scattering and radiative transfer computations show that in the size range of dust aerosol, both the lidar integrated depolarization ratio (IDR) and integrated color ratio (ICR) are sensitive to the effective particle size and optical depth. The IDR is the ratio of attenuated backscatter in two orthogonal polarization directions, and the ICR is the ratio of attenuated backscatter in 1064 and 532 nm wavelengths.

We develop a retrieval algorithm to simultaneously infer the dust aerosol optical depth and particle size from CALIOP IDR and ICR data. A look-up table (LUT) is built to map the IDR and ICR onto the effective particle size and optical depth. The LUT is computed by a Monte Carlo lidar simulator [2] with the input of dust aerosol single-scattering properties, optical thickness, and atmospheric profile. A hexahedron ensemble model is assumed for dust shape. The two-dimensional cubic spline interpolation and an iteration method are utilized to find an optimal solution in the LUT by matching CALIOP IDR and ICR data with the simulated counterparts.

References

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