Properties of aerosols and clouds from lidar and radar soundings: experiment and theory

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Aerosols play important roles in environmental quality and sometimes cause serious problems such as endangering human health and reducing visibility. Furthermore, aerosols directly affect the earth's radiation balance through scattering and absorbing solar radiation, and they indirectly influence the properties and lifetimes of clouds by acting as a condensation nucleus or an ice nucleus in cloud formation, eventually influencing the global climate change. At the meanwhile, Clouds strongly regulate radiative transfer and the hydrological cycle, which are important parts of Earth's weather and climate. The optical characteristics of aerosol and cloud are poorly studied yet because of the strong spatial and temporal variability of them. A lidar and a radar are two common useful tools for aerosol and cloud, which can provide the possibility to retrieve the vertical profiles of both the number density of particles and their microphysical characteristics, in comparison with the passive remote sensing methods. In this study, a multi-wavelength Raman–Mie lidar, a CCD lidar, and a 35-Ghz radar are employed to measure the properties of aerosols and clouds. The extinction at 0.355 and 0.532 μm and backscattering at 0.355, 0.532, and 1.064 μm coefficients and the phase function at 0.532 μm from lidar, and the effective reflectivity factor from radar are inversed for use. Furthermore, the quantities responsible for microphysics can be extracted and explained as the dimensionless values, such as the linear depolarization ratio, the color ratio, the lidar ratio and the other ratios. Then these microphysical properties for aerosol and cloud during campaigns are analyzed in detail.

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