

Raman lidar measurements of aerosol distribution and cloud properties

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ABSTRACT

Measurements obtained by the PSU Lidar Atmospheric Profile Sensor (LAPS) Raman lidar, during different periods, provide a comprehensive dataset to characterize cloud properties and aerosol distributions. The PSU Raman lidar measures the profiles of molecular nitrogen, molecular oxygen and the rotational Raman scatter (the mixture of all molecular species) at both visible and ultraviolet wavelengths, which are then used to generate vertical aerosol extinction profiles from the incremental extinction. Since the optical extinction at different wavelengths is strongly dependent on the size distribution of aerosols, variations in the profile of the size distribution can be inferred over an interesting range corresponding to accumulation mode particles, 50 nm to 1 μ m. The variation in the extinction profiles at different wavelengths is also used along with the water vapor profiles to observe the formation, growth and dissipation of cloud structures. The water vapor concentrations have been seen to decrease in regions surrounding a growing cloud as the particles increase in size by absorbing the water. Also, the water vapor concentration is found to increase as clouds begin to dissipate. The change in the size of the cloud particles during the different stages can also be observed in the multi-wavelength aerosol extinction. Results obtained from different locations, and for a wide range of atmospheric conditions, are used to compare and contrast the aerosol distributions and also to study the physical properties of clouds.

Keywords: Raman lidar, remote sensing, optical extinction, aerosol distribution, cloud physics.