Lidar Multiple Scattering Determinations of Particle Size in Cirrus Clouds

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Basic Approach

HSSL measurements of multiple scattering provide information on the shape of the diffraction peak. The angular width is directly related to the cross-sectional area of individual particles.

Exponential Distribution

Optical radar radius - effective radius

Gamma Distribution

Optical radar radius - effective radius

Log-Normal Distribution

Optical radar radius - effective radius

Changes in lidar multiple scattering caused by changing the shape of the size distribution. Multiples scattering was computed using the scattering cross section profiles measured on 22-Feb-01 with the effective radius fixed at 75 μm. The sum of full and lidar scattered energy from first order scattering is shown for each size distribution and each receiver field-of-view. Size distributions are designated by color.

Doppler radar measurements of particle fall velocity

Provides ice water mass

Provides ice water mass

Optical depth and backscatter cross section

One wide field of view measurements are presented in terms of a normalized return - WFOV signal/A(10 Hz) and EDV molecular signal

Optical depth and backscatter cross section

Comparison between the multiple-look optical depth at the peak of the backscatter cross section and a Monte Carlo simulation of 1014 KF/100 air parcel trajectories (green)

The normalized molecular wide-field of view lidar return computed as function of receiver field of view and with γ = 0. The backscatter cross section profile of the cloud is shown in yellow.