Geophysical Research Abstracts
Vol. 17, EGU2015-15185, 2015
EGU General Assembly 2015

High Spectral Resolution Lidar: System Calibration

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One of the unique features of the high spectral resolution lidar (HSRL) is simultaneous measurements of backscatter and extinction of atmosphere. It separates molecular scattering from aerosol and cloud particle backscatter based on their Doppler spectrum width. Scattering from aerosol and cloud particle are referred as Mie scattering. Molecular or Rayleigh scattering is used as a reference for estimating aerosol extinction and backscatter cross-section. Absolute accuracy of the backscattered signals and their separation into Rayleigh and Mie scattering depends on spectral purity of the transmitted signals, accurate measurement of transmit power, and precise performance of filters. Internal calibration is used to characterize optical subsystems Descriptions of high spectral resolution lidar system and its measurement technique can be found in Eloronta (2005) and Hair et al.(2001).

Four photon counting detectors are used to measure the backscatter from the combined Rayleigh and molecular scattering (high and low gain), molecular scattering and cross-polarized signal. All of the detectors are sensitive to crosstalk or leakage through the optical filters used to separate the received signals and special data files are used to remove these effects as much as possible. Received signals are normalized with respect to the combined channel response to Mie and Rayleigh scattering. The laser transmit frequency is continually monitored and tuned to the 1109 Iodine absorption line. Aerosol backscatter cross-section is measured by referencing the aerosol return signal to the molecular return signal. Extinction measurements are calculated based on the differences between the expected (theoretical) and actual change in the molecular return. In this paper an overview of calibration of the HSRL is presented.

References:
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