Preliminary Aerosol Observations With the CMDL Boulder Lidar

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A lidar operating at 532 nm wavelength was designed and constructed for stratospheric aerosol measurements at CMDL in Boulder, Colorado, and first observed the aerosol stratospheric layer in August 1999. Components of the lidar were tested at Mauna Loa Observatory (MLO) and compared to the MLO lidar. The Boulder lidar uses many of the same components as the MLO lidar, the main difference being the much lower power laser used at Boulder. The agreement of multiple profiles measured on July 20, 1999, at MLO was within the expected error (~6%).

The first few months of measurements over Boulder indicated that the lower tropopause (compared to MLO) and greater scattering in the upper troposphere, complicated the interpretation of the lower part of the stratospheric aerosol profile. It was determined that the dynamic range of the single-detector channel could not accurately profile the aerosol backscatter over the entire altitude range of interest. A second, low-altitude channel, for which the signal is attenuated, was added in April 2000. This increased the altitude range covered and decreased the error in the Integrated Aerosol Backscatter (IABS) from an average of 8.3% to 5.9%.

The average IABS (integrated above the tropopause) for the winter of 2000-2001 was 38% higher than the winter of 1999-2000 (4.60E-4 per sr versus 3.32E-4 per sr). The IABS was significantly lower over MLO, but the same increase of 38% was observed (1.82E-4 versus 1.32E-4). The peak backscatter ratio (analogous to a mixing ratio) is very similar between the two locations both in magnitude and seasonal dependence. The higher IABS over Boulder reflects the lower altitudes (higher densities) of the bulk of the aerosol compared to MLO. Profiles show the winter increase occurs at all altitudes in the stratospheric layer as well as the in the upper troposphere. The top of the aerosol layer is near 31 km in the winter and near 27 km in the summer over Boulder.