

File Revision Date:

June 3, 2021

Data Set Description:

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Rome, Italy
Instrument: Lidar
Site(s): Dome C, Antarctica
Measurement Quantities: Aerosol profiles (NDACC)
Temperature profiles (no NDACC)

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Instrument Description:

The lidar, installed in 2014 at Dome C (75.1 S, 123.35E), Antarctica, is actually the same that was operated from 2004 to 2010 at McMurdo station.

It is based on a compact sealed off Nd:YAG laser with a second harmonic generator. The energy is typically 150 mJ per pulse @ 532 nm and about 70 mJ/pulse @ 1064 nm, with a repetition rate of 10 Hz. The laser beam is expanded 5 times, and has a resulting divergence of about 0.3 mrad. The receiving telescope is a commercial 14" diameter Schmidt-Cassegrain type with a FOV of < 0.7 mrad. Signals are detected at 532 nm (low, high and depolarized) and 607.3 nm (Raman signal) with miniaturized photomultipliers (Hamamatsu) and at 1064 nm with an APD. All signals are fed in photon counting data acquisition cards. The vertical resolution is typically 30 m and vertical profiles are typically 55 km for the 532 high channel, 40 km for the depolarized 532 nm channel and 20-30 km for the 1064 nm channel. The Raman channel is operational but not used for the moment.

Aerosol Algorithm Description:

The inversion algorithm for aerosol needs molecular density profiles routinely obtained by merging radiosonde data (which typically reach 15-20 km) with the NCEP analysis (obtained by Automailer). The data analysis proceeds by successive approximations. A molecular intensity profile is calculated on the basis of the molecular density, taking into account molecular extinction and range attenuation. The lidar signal is fitted to the molecular profile at about 26-30 km where an aerosol-free regions is expected a normalization factor is then obtained and used to calculate the first guess of aerosol optical depth. The backscattering coefficient, beta, is calculated after correcting for the aerosol extinction, which is obtained by assuming different lidar ratios (=extinction-to-backscatter ratio) for different kinds of aerosol (ice, NAT and STS)

The ratio between perpendicular and total polarized signals gives the Volume depolarization

Errors have been calculated as the sum of systematic errors (in the order of 5 % for the backscatter ratio) and standard deviations of the acquired signals in photon counting. In case of dense cirrus clouds the signal to noise ratio might be severely reduced at higher altitudes. The perpendicular backscatter coefficient is calculated for composition classification according to the v2 algorithm used by Pitts (Pitts 2018), but not included in the NDACC data.

Expected Precision/Accuracy of Instrument:

An error estimate (one sigma) is listed in the files.

Instrument History:

January 2014: The lidar previously used at McMurdo Station from 2004-2010 has been installed at Dome C.

In 2019 the lidar was out of use due to a failure of both (operating and spare !) lasers.

January 2020: A new laser source was mounted in a horizontal position (previously it was mounted parallel to the telescope) and was aligned with respect to the telescope by using a laser mirror at 45 degrees mounted on a piezo controlled mirror mount.

From 2020 on the lidar is fully remotely controlled; alignment, laser control, data acquisition can all be controlled remotely.