File Revision Date:
August 24, 2022

Data Set Description:

PI: Marcel Snels
Istituto Di Scienze dell'Atmosfera e del Clima / CNR
Rome, Italy
Instrument: Lidar
Site(s): Dome C, Antarctica
Measurement Quantities: Aerosol profiles (NDACC)
Temperature profiles (no NDACC)

Contact Information:

Name: Marcel Snels
Address: Istituto Di Scienze dell'Atmosfera e del Clima / CNR
Via Fosso del Cavaliere 100
00133 Rome, Italy
Phone: +39-06-49934316
FAX: +39-06-49934323
Email: m.snels@isac.cnr.it, marcelsnels1959@gmail.com

Reference Articles:

Gobbi G.P., T. Deshler, A. Adriani, and D.J. Hofmann, Evidence for denitrification in the 1990 Antarctic spring Stratosphere: I, Lidar and temperature measurements, Geophys. Res. Lett., 18, 1995-1998, 1991.

Adriani A., T. Deshler, G.P. Gobbi, B.J. Johnson, G. Di Donfrancesco, Polar stratospheric clouds over McMurdo, Antarctica, during the 1991 spring: Lidar and particle counter measurements, Geophysical Research Letters, 19, 1755-1758, 1992.

Adriani A., T. Deshler, G. Di Donfrancesco, G.P. Gobbi, Polar stratospheric clouds and volcanic aerosol during the 1992 spring over McMurdo, Antarctica: Lidar and particle counter comparative measurements, J. Geophys. Res. 100, No. 12D, 25,877-25,897, 1995.

Di Donfrancesco G., A. Adriani, G.P. Gobbi, F. Congeduti, Lidar observations of stratospheric temperatures above McMurdo Station (78S, 167E), Antarctica - J. Atmos. Terr. Phys., 58, 1391-1399, 1996.

Cairo F., G. Di Donfrancesco, A, Adriani, L. Pulvirenti and F. Fierli, A comparison of various linear depolarization parameters measured by lidar, Applied Optics, vol. 38, No. 21, 4425-4432 , 1999.

Di Donfrancesco G., A. Adriani, G.P. Gobbi and F. Cairo, Lidar observations of stratospheric aerosol during 1993 above McMurdo Station, Antarctica, J. Atmos. Sol. Terr. Phys., 62, 713-723, 2000.

A. Adriani; P. Massoli; G. Di Donfrancesco; F. Cairo; M.Moriconi; M. Snels, “Climatology of polar stratospheric clouds based on lidar observations from 1993 to 2001 over McMurdo Station, Antarctica”, J. Geophys. Res., 109, (2004), 2421.

C. David, S. Bekki, N. Berdunov, M. Marchand, M. Snels and G. Mégie, “Classification and scales of Antartic polar stratospheric clouds using wavelet decomposition”, Journal of Atmospheric and Solar-Terrestrial Physics, volume 67, issue 3, (2005) 293-300.

Claudio Scarchilli, Alberto Adriani, Francesco Cairo, Guido Di Donfrancesco, Carlo Buontempo, Marcel Snels, Maria Luisa Moriconi, Terry Deshler, Niels Larsen, Beiping Luo, Konrad Mauersberger, Joelle Ovarlez, Jim Rosen and Jochen Schreiner ,“Determination of PSC Particle Refractive Indexes using In Situ Optical Measurements and T-Matrix Calculations”, Applied Optics, 44, (2005) 3302.

M. Hopfner, B. P. Luo, P. Massoli, F. Cairo, R. Spang, M. Snels, G. Di Donfrancesco, G. Stiller, T. von Clarmann, H. Fischer,U. Biermann, "Spectroscopic evidence for NAT, STS, and ice in MIPAS infrared limb emission measurements of polar stratospheric clouds", Atmos. Chem. Phys. Discuss., 5, 10685-10721, 2005.

Snels, M., Cairo, F., Colao, F. and Di Donfrancesco, G.'Calibration method for depolarization lidar measurements', International Journal of Remote Sensing, 30: 21, 5725 — 5736, 2009

Klekociuk, A., Pitts, M., Alexander, S., David, C., Snels, M. and von der Gathen, P. Studies of the Antarctic stratosphere during IPY, Stratospheric processes and their role in climate (SPARC) Newsletter, 33IV, 2009, Vol. 14

David, C., Keckhut, P., Armetta, A., Jumelet, J., Snels, M., Marchand, M. and Bekki, S. Radiosonde stratospheric temperatures at Dumont d'Urville (Antarctica): trends and link with polar stratospheric clouds, Atmospheric Chemistry & Physics, 2010, Vol. 10, pp. 3813-3825

David, C., Haefele, A., Keckhut, P., Marchand, M., Jumelet, J., Leblanc, T., Cenac, C., Laqui, C., Porteneuve, J., Haeffelin, M., Courcoux, Y., Snels M .and Viterbini, M. and Quatrevalet, M. Evaluation of stratospheric ozone, temperature, and aerosol profiles from the LOANA lidar in Antarctica, Polar Science, 2012, Vol. 6, pp. 209-225

Di Liberto, L., F. Cairo, F. Fierli, G.Di Donfrancesco, M. Viterbini, T.Deshler, and M. Snels (2014), Observation of polar stratospheric clouds over McMurdo (77.85◦S, 166.67◦E) (2006–2010), J. Geophys. Res. Atmos., 119, doi:10.1002/2013JD019892.

L Di Liberto, R Lehmann, I Tritscher, F Fierli, JL Mercer, M Snels, Lagrangian analysis of microphysical and chemical processes in the Antarctic stratosphere: a case study, Atmospheric Chemistry and Physics 15 (12), 6651-666

M. Snels, A. Scoccione, L. Di Liberto, F. Colao, M. Pitts, L. Poole, T. Deshler, F. Cairo, C. Cagnazzo, and F. Fierli, “Comparison of Antarctic polar stratospheric cloud observations by ground-based and space-

borne lidar and relevance for chemistry climate models", Atmospheric Chemistry and Physics, 19(2):955-972, 2019.

Marcel Snels, Francesco Colao, Francesco Cairo, Ilir Shuli, Andrea Scoccione, Mauro De Muro, Michael Pitts, Lamont Poole, Luca Di Liberto, "Quasi-coincident observations of polar stratospheric clouds by ground-based lidar and CALIOP at Concordia (Dome C) from 2014 to 2018", Atmospheric Chemistry and Physics 21, 2165-2178, 2021

Marcel Snels, Francesco Cairo, Luca Di Liberto, Andrea Scoccione, Marco Bracaglia, Terry Deshler, "Comparison of Coincident Optical Particle Counter and Lidar Measurements of Polar Stratospheric Clouds above McMurdo (77.85°S, 166.67°E) from 1994 to 1999.", Journal Of Geophysical Research Atmospheres, 126, 6, 2021

Ines Tritscher, Michael C. Pitts, Lamont R. Poole, Thomas Peter, S. P. Alexander, F. Cairo, M. P. Chipperfield, J.-U. Grooß, M. Höpfner, A. Lambert, B. P. Luo, S. Molleker, A. Orr, R. Salawitch, M. Snels, R. Spang, W. Woiwode "Polar Stratospheric Clouds: Satellite Observations, Processes, and Role in Ozone Depletion", Review of Geophysics, 2021

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 60 m and vertical profiles with sufficient S/N ratio 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). A molecular backscatter profile is calculated from 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 a fixed lidar ratio of 70.

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

Errors have been calculated from estimated 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.
January 2018: The old data acquisition cards for photon counting (3 cards with 2 channels each) have been substituted with 2 new acquisition cards with 5 photon counting channels each.
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 vertically, 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.
In 2022 a second, smaller telescope was added to provide observations of tropospheric aerosols and clouds from 4 to 10 km.

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DOI (optional ?)