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NDACC METAFILE
Dumont d'Urville Aerosols/PSC lidar

Data Set Description:

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| PI: | Christine DAVID (LATMOS-IPSL, Paris, France) |
| CoI: | Marcel SNELS (ISAC-CNR, Roma, Italy) |
| Instrument: | Backscatter Rayleigh-Mie lidar |
| Site: | Antarctic Station |
| | Dumont d'Urville (66S, 140E) |
| Measurement Quantities: | |
| | Stratospheric Aerosols and/or PSC profiles (8-32 km in average) |

Contact Information:


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Reference Articles:


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Stefanutti, L., M. Morandi, M. Del Guasta, S. Godin and C. David, Unusual PSCs observed by lidar in Antarctica, Geophys. Res. Lett., 22, 2377-2380, 1995

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<u>Instrument Description:</u>

The aerosol/PSC lidar in Dumont d'Urville is a backscatter Rayleigh-Mie lidar designed to observe particles in the lower stratosphere, roughly between 8 and 32 km. The system is also able to measure upper stratospheric temperatures at altitudes higher the 30 km (see Dumont d'Urville temperature lidar metafile) and has common part with the ozone lidar (see Dumont d'Urville ozone lidar metafile). The aerosol/PSC lidar is very similar to the McMurdo instrument, as it was build within collaboration with the Italian group in charge of the McMurdo system.

Here are the main characteristics of the instrument:

- Emitted wavelengths of 532 and 1064 nm (Nd:YAG 10 Hz pulsed laser)
- Aer/PSC/T and O3 switch box (manual change optical path)
- Biaxial emission (~ 60 cm out of alignment)
- Beam expander to get 0.5 mrad beam divergence
- 80 cm Newton telescope
- Mechanical chopper (cut signal between 0-5 km)
- First beam splitter:
    - UV wavelengths (for ozone)
    - Wavelength other than UV (for aerosol/PSC and temperature)
- Aerosols beam splitter box:
    - High 532 nm channel (for temperature)
    - Low 532 nm channel, 10% of the high channel (for aerosol/PSC)
    - 608 Raman channel
    - 1064 Infrared channel
- Hamamatsu photomultipliers for 532 nm and 608 nm

- Embedded Devices photodiode for 1064 nm
- Photo-counting mode at 532 nm and 608 nm (60 m vertical resolution, 2048 points)
- Analog mode at 1064 nm (15 m vertical resolution, 2048 points)
- Aer/PSC/T and ozone electronical switch
- Embedded Devices electronic acquisition cards
- Labview acquisition software (developed in 2008)

Algorithm Description:

A new semi-automatic processing code was developed in 2008. Stratospheric particles data processing is divided into three steps. First, atmospheric molecular optical properties are calculated, from daily PTU profiles, provided by the French Met Office (Météo-France) radiosondes. Then, total background (sky and detection) is estimated from upper levels, where signal-to-noise ratio is very low (typically above 80 km). This second step is the most sensitive part of data processing and the largest source of uncertainties on the retrieved optical properties. Finally, the inversion is made using the well-known "Fernald-Klett" method. The altitudes of the different scattering layers are first determined, in order to define a rough profile of lidar ratio (extinction to backscatter coefficients ratio) with literature values.

The optical parameters profiles (8-32 km) obtained at the end of this process are:

- Backscatter coefficient (km-1.sr-1) and backscatter ratio (ratio of the aerosol backscattering coefficient to the total backscattering coefficient) at 532 nm on the parallel polarisation plane (to the emission polarisation);
- Backscatter coefficient (km-1.sr-1) and backscatter ratio at 532 nm on the perpendicular polarisation plane (to the emission polarisation);
- volume total depolarisation ratio at 532 nm (defined as the ratio of the perpendicular backscattering coefficient to the total backscattering coefficient).

Expected precision / Accuracy of the instrument:

A study of error sources for aerosols lidar on Observatory of Haute-Provence and Dumont d'Urville is provided in Chazette et al. (1995). No specific evaluation was performed since the new system implementation. Meanwhile, we expect an uncertainty on backscattering coefficient not exceeding 15% (for low aerosols content).

Instrument History:

Since 1989, France leads a monitoring program on human impacts on the Antarctic polar stratosphere. A set of instruments designed to measure ozone and parameters linked to its chemical equilibrium, were implemented on the French Antarctic base, Dumont d'Urville. The French Polar Institute (IPEV – Institut Polaire Français Paul-Emile Victor) supplies recurrent funding and logistics. In this frame, ground-based lidar aerosol and PSC observations were first conducted within the POLE (Polar Ozone Experiment), a French-Italian collaboration between the Service d'Aéronomie-IPSL and the IROE-CNR. In 1989, a backscatter lidar to measure stratospheric particles was implemented. In 1991, this lidar became a multi-wavelength system allowing sequential observations of the vertical distribution of ozone and stratospheric particles. Failures of this out of date instrument forced to completely stop ozone measurement in 2000. Stratospheric particles observations continued, but were almost unexploitable.

A new instrument was then studied, since 2002, within a new French-Italian collaboration between Service d'Aéronomie-IPSL (becoming LATMOS-IPSL in 2009) and ISAC-CNR. Named LOANA (Lidar Ozone and Aerosols of NDACC in Antarctica), this new lidar system in Dumont d'Urville includes the upgrade of the aerosol/PSC lidar, of the ozone lidar and addition of a temperature lidar. Field implementation started in 2005 for a one year test. Stratospheric particles and temperature measurement are operational since 2006. Ozone measurements only started in 2008, due to THG (Third Harmonic Generator) and PM (Photo-Multipliers) failures. Today, this lidar system is the most complete and is unique on the Antarctic continent. In particular, the ozone lidar in Dumont d'Urville was and is now again the sole instrument of that type running in an operational mode in Antarctica.

Chronology of instrument running:
1988
Field implementation of Rayleigh/Mie aerosol/PSC lidar
Start of NDACC validated data
1989
Rayleigh/Mie aerosol/PSC lidar operational
1998
Instrument becomes old and degraded
Last year of NDACC validated data
2002
Study of a new instrument
2005
Field implementation of the new lidar system LOANA
2006
LOANA Rayleigh/Mie aerosol/PSC lidar operational
Start of NDACC validated data