File Revision Date:
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Data Set Description:
PI: Paolo Di Girolamo
Instrument: Rayleigh-Mie Raman Lidar
Site: Potenza, Italy
Measurement Quantities:
Vertical profiles of water vapour mixing ratio, temperature, particle backscattering coefficient at 355 nm.

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Reference Articles:

Benedetto De Rosa, Paolo Di Girolamo, Donato Summa, Temperature and water vapour measurements in the frame of the International Network for the Detection of Atmospheric Composition Change, Atmospheric Measurement Techniques, Atmos. Meas. Tech., 13, 405–427, 2020 https://doi.org/10.5194/amt-13-405-2020.

Paolo Di Girolamo, Donato Summa, Rossella Ferretti (2009). Multiparameter Raman Lidar Measurements for the Characterization of a Dry Stratospheric Intrusion Event. JOURNAL OF ATMOSPHERIC AND OCEANIC TECHNOLOGY, vol. 26, p. 1742-1762, ISSN: 0739-0572, doi: 10.1175/2009JTECHA1253.1, Codice ISI: 000270096400003 Codice SCOPUS: 2-s2.0-71149110563.

Benedetto De Rosa, Paolo Di Girolamo, Donato Summa, Dario Stelitano and Ignazio Mancini (2016), Water Vapour Mixing Ratio Measurements in Potenza in the Frame of the International Network for the Detection of Atmospheric Composition Change - NDACC, EPJ Web of Conferences, 119, 05017, doi: http://dx.doi.org/10.1051/epjconf/201611905017.

Benedetto De Rosa, Paolo Di Girolamo, Donato Summa (2018), Characterization of atmospheric thermodynamic variables by Raman lidar in the frame of the International Network for the Detection of Atmospheric Composition Change – NDACC, EPJ Web of Conferences, Volume 176, Article number 04010, doi: https://doi.org/10.1051/epjconf/201817604010.

Instrument Description:
The University of BASILicata Raman lidar system (BASIL) in situated in Potenza, Italy (40°38'45" N, 15°48'29" E, elevation: 730 m). The system is located in a shipping container on the roof of Scuola di Ingegneria (main building) at Università degli Studi della Basilicata. The system includes a Nd:YAG laser,

with both second and third harmonic generation crystals (repetition rate: 20 Hz, beam divergence: 0.5 mrad (FWHM), average power at 354.7 nm of 10 W).

BASIL uses a telescope in Newtonian configuration, with a 40 cm diameter primary mirror and a combined focal length of 1.8 m. BASIL performs accurate and high-resolution measurements of atmospheric water vapour and temperature, at both daytime and night-time, based on the exploitation of the vibrational and rotational Raman lidar techniques respectively, in the UV. Water vapour profile measurements by BASIL cover the altitudinal interval from the surface up to ~ 15 km, whereas temperature profile measurements cover the altitudinal interval from the surface up to the stratopause (~ 50 km).Temperature measurements over such a wide altitudinal interval are possible due to the combined use of the pure rotational Raman technique, which in this system allows the lowest 20 km to be covered, and the integration technique, which covers the altitudinal region from 20 km to typically 50 km. BASIL also carries out measurements of the particle backscattering as well as the extinction coefficient and depolarization at 354.7 nm. Relative humidity profiles are obtained from simultaneous water vapour mixing ratio and temperature profile measurements.

Algorithm Description:

Particle backscatter profile measurements by the combined Raman elastic-backscatter lidar technique and the corresponding algorithms are described in Ansmann et. (1992).

Water vapour profile measurements by the roto-vibrational Raman technique and the corresponding algorithms are described in Whiteman (2003).

Temperature profile measurements by the rotational Raman technique and the corresponding algorithms are described in Behrendt and Reichardt (2000).

Temperature profile measurements by the integration technique and the corresponding algorithms are described in Hauchercorne et al. (1992).

Expected Precision/Accuracy of Instrument:

Considering an integration time of 5 min and a vertical resolution of 150 m, measurement precision at 10 km is typically 5% for water vapour mixing ratio and 1 K for temperature for night-time measurements.

Instrument History:

The Raman Lidar system BASIL began operations in 2004, entered the International Network for the Detection of Atmospheric Composition Change (NDACC) in 2012 and began operations in the frame of NDACC in 2013. For a laser failure, the system is down since 2018, but the laser is in the process to be fixed and the lidar is expected to be up again by the end of July 2021.

References:

A. Ansmann, U. Wandinger, M. Riebesell, C. Weitkamp and W. Michaelis: “Independent measurement of extinction and backscatter profiles in cirrus clouds by using a combined Raman elastic-backscatter lidar,” Appl. Opt. **31**, 7113-7131 (1992).

Behrendt, A. and Reichardt, J.: Atmospheric temperature profiling in the presence of clouds with a pure rotational Raman lidar by use of an interference-filter-based polychromator, Appl. Opt., 39, 1372–1378, 2000.

Hauchercorne, A., Chanin, M. L., Keckhout, P., and Nedeljkovic, D.: Lidar monitoring of the temperature in the middle e lower atmosphere, Appl. Phys. B, 55, 29–34, 1992.

Whiteman, D. N., 2003a: Examination of the traditional Raman lidar technique. I. Evaluating the temperature-dependent lidar equations. *Appl. Opt.,* **42,** 2571–2592.