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Data Set Description:
PI: Wolfgang Steinbrecht
Instrument: Differential Absorption Lidar
Site(s): Hohenpeissenberg
Measurement Quantities: stratospheric ozone and temperature profiles

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Reference Articles:
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Instrument Description:

The Hohenpeissenberg ozone DIAL is designed to measure stratospheric ozone profiles from 15 to 50 km altitude (by differential absorption) and stratospheric temperature profiles from 28 to 60 km altitude (by Rayleigh backscattering). The system has been measuring 80 to 100 profiles per year in clear nights since September 1987. It uses a XeCl Excimer laser at 308 nm to produce the wavelength absorbed by ozone and an H_2 Raman-Cell to generate the non-absorbed wavelength at 353 nm. A high speed chopper is used to block the intense light returned from lower altitudes, thus avoiding over-exposure of the photomultipliers and signal induced noise. Profiles are acquired in two steps: A high altitude step (where return signals are blocked below about 20 km) and a low altitude step (where a light attenuating grey filter is used and return signals are blocked below about 10 km). The receiver uses a 60cm diameter main mirror Newtonian telescope, dichroic filters for wavelength separation, interference filters for background rejection, and photomultipliers. The photomultipliers convert returned photons into electrical pulses which are then counted as a function of altitude (=time for the laser light to travel up and be scattered back to the receiver). Typically the weak return signals are averaged over an entire night to derive a nightly mean ozone and temperature profile.

In 2016 the old lidar system running since 1987 was supplemented by a new and improved lidar system. The new system also uses a XeCl Excimer laser for pulses at 308 nm. For the reference wavelength, however, a tripled NdYAG laser at 355 nm is used. In addition a larger 100 cm receiver mirror is used, and N2 Raman return signals at 332 and 387 nm are detected as well. Since January 2018 the new system provides the operational NDACC profiles. Return signal for the new system are substantially higher than for the old system - resulting in significantly better precision and higher top altitudes for the ozone and temperature profiles.

Algorithm Description:

Main steps of the data processing are:

- correction of photon-counting deadtime
- selection of good return signals and averaging over the night
- estimation and subtraction of signal background
- merging of low and high altitude acquisitions
- derivation of stratospheric temperature profile
- correction for Rayleigh extinction using nearby radiosonde profile
- merging of lidar and radiosonde temperature profile (would also allow derivation of stratospheric aerosol)
- derivation of stratospheric ozone profile

For more details see Steinbrecht et al. https://doi.org/10.5194/amt-2-125-2009, 2009.

Expected Precision/Accuracy of Instrument:

Old system (1987 to 2017)

Altitude [km]	ozone [%]	temperature [K]
15	10	NA
20	5	NA
25	2	NA
30	2	0.5
35	2	0.5
40	3	1
45	10	2
50	3	3
60	NA	5

New system (since 2018)

Altitude [km]	ozone [%]	temperature [K]
15	5	NA
20	2	NA
25	2	NA
30	1	0.5
35	1	0.5
40	2	0.5
45	5	0.5
50	15	0.5
60	NA	0.5
70	NA	1

Detailed and profile-specific estimates for precision, accuracy and altitude resolution are given in the NDACC *.hdf files (and to a lesser degree in the AMES files).
See also Leblanc et al. 2016 (https://doi.org/10.5194/amt-9-4029-2016, https://doi.org/10.5194/amt-9-4051-2016, https://doi.org/10.5194/amt-9-4079-2016)

Instrument History:
10/2018 and 03/2019 HOPS Intercomparison with NASA GSFC STROZ System
01/2018 (old lidar: new Thyratron)
since 01/2018 NDACC data from new lidar system

until 12/2017 NDACC data from old lidar system

04/2016	begin of regular test measurements with new lidar system
08/2015	1st light / return signals with new lidar system
04/2014	new HV power supply for laser
01/2013	new Thyratron
09/2009	complete reprocessing of entire time series, archived at NDACC
11/2006	new Thyratron trigger-board
10/2005	HOPE Intercomparison with NASA GSFC STROZ System
09/2005	Excimer laser refurbished, new Reservoir, ...
09/2003	new thyratron
03/1999	new achromat on Raman-Cell
11/1998	transmitter and receiver main mirrors recoated (Zeiss Jena)
10/1998	new interference filters (Barr Associates)
05/1995	complete data reprocessing & submission to NDACC
06/1994	new data acquisition 486-Computer & OPTECH counter-board
07/1994	new Excimer Laser LPX210i Novatube
11/1993	new Excimer Laser LPX210i
10/1990	new thyratron
09/1989	major laser damage, water in reservoir

05/1989-08/1989 data lost by harddisk crash	
03/1988	begin of semi-automatic measurements, no operator during the night
09/1987	begin of regular measurements DG10 Computer + LeCroy counters