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

Contact Information:
Name: Wolfgang Steinbrecht
Address: Deutscher Wetterdienst, Albin-Schwaiger-Weg 10, 82383 Hohenpeissenberg, Germany
Phone: +49 69 8062 9772
FAX: +49 69 8062 9707
Email: wolfgang.steinbrecht@dwd.de

Reference Articles:


**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 H2 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 (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


Expected Precision/Accuracy of Instrument:
Old system (1987 to 2017)

<table>
<thead>
<tr>
<th>Altitude [km]</th>
<th>Ozone [%]</th>
<th>Temperature [K]</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>10</td>
<td>NA</td>
</tr>
<tr>
<td>20</td>
<td>5</td>
<td>NA</td>
</tr>
<tr>
<td>25</td>
<td>2</td>
<td>NA</td>
</tr>
<tr>
<td>30</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>35</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>40</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>45</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>50</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>60</td>
<td>NA</td>
<td>5</td>
</tr>
</tbody>
</table>
New system (since 2018)

<table>
<thead>
<tr>
<th>Altitude [km]</th>
<th>Ozone [%]</th>
<th>Temperature [K]</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>5</td>
<td>NA</td>
</tr>
<tr>
<td>20</td>
<td>2</td>
<td>NA</td>
</tr>
<tr>
<td>25</td>
<td>2</td>
<td>NA</td>
</tr>
<tr>
<td>30</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>35</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>40</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>45</td>
<td>5</td>
<td>0.5</td>
</tr>
<tr>
<td>50</td>
<td>15</td>
<td>0.5</td>
</tr>
<tr>
<td>60</td>
<td>NA</td>
<td>0.5</td>
</tr>
<tr>
<td>70</td>
<td>NA</td>
<td>1</td>
</tr>
</tbody>
</table>

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).


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 hard disk crash
03/1988 begin of semi-automatic measurements, no operator during the night
09/1987 begin of regular measurements DG10 Computer + LeCroy counters