File Revision Date:
2022 September 15

Data Set Description:
PI: Wolfgang Steinbrecht
Instrument: Ozone sonde
Site(s): Hohenpeissenberg
Measurement Quantities: ozone and temperature profiles

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DOI:
None at this point

Reference Articles:

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Instrument Description:
Hohenpeissenberg is an isolated mountain 30 km north of the Alps in a hilly, rural area. It rises 300 m above the surrounding area, which is populated to an extent typical for central Europe and partly covered with meadows (~70%) and forests (~30%). The Meteorological Observatory is situated on top of Hohenpeissenberg at an altitude of 980 m a.s.l., its coordinates are 47 deg. 48 min. N, 11 deg. 01 min. E.

Ozone soundings by balloons using the Brewer/Mast ozonesonde have been carried out since 1967. For the first 11 years sounding frequency was once per week on Wednesdays. From 1978 onward sounding frequency has been increased to 2-3/week; i.e., Nov.-April on Mondays, Wednesdays and Fridays, May-Oct. on Mondays and Wednesdays.

Description of the instrument: The Brewer Mast sonde is a low-cost instrument, consisting of an electrochemical cell filled with potassium-iodide solution and a small gas-sampling pump. During sounding ambient air is continuously pumped into the cell where ozone molecules react with the solution to form free iodine according to the redox reaction

2KI + O3 + H20 ---> 2KOH + I2 + O2

The net effect is a flow of two electrons per ozone molecule between the silver anode and platinum cathode. The output current of a few microamperes is proportional to the ozone partial pressure and follows the same equation as for ECC sondes. At Hohenpeissenberg each ozone profile is normalized to the independently measured total ozone amount using a Dobson or a Brewer. This generally reduces the error of the ozone profile and detects faulty soundings. The main sources of error are:

- uncertainty of pump efficiency during the sounding
- wall losses in the oiled pump (Brewer-Mast sondes do not have a teflon pump)
- incomplete absorption of ozone in the reaction cell
- interference with other trace substances, especially in the troposphere
- uncertainties of the pump temperature which is assumed to be 300K.

Overall these errors lead to an underestimation in the ozone raw profile of the order of 5-10%, some soundings show too low readings up to 20-25%. These errors are reduced to a great extent by the normalization procedure (especially in the stratospheric ozone maximum), whereas the tropospheric part of the profile deteriorates, if the correction is too large. The so-called correction factor is a good measure for the quality of each sounding.

The precision of ozone profiles measured by Brewer-Mast sondes varies with altitude. Typically it is better than 5% around the ozone maximum at 40 hPa and is up to 15% in the troposphere. At 10 hPa (~30km) and above the precision rapidly deteriorates to values of 10% and more (Kerr et al. 1991). For more details see SPARC Report No. 1(1998).

Calibration and Quality Control Procedures: The sondes are prepared in an extensive and well-tried procedure (Claude et al. 1987). There is no calibration before launch, however, only sondes showing a response better than 92 % and a background signal lower than 3 nb (0.3mPa) using a precise ozone generator were launched. Soundings with a correction factor less than 0.9 or higher than 1.25 are rejected and there is a relaunch in the same morning. Whenever a lidar-measured profile is available within a reasonable time, it is compared with the balloon profile. On clear nights the lidar at Hohenpeissenberg produces very accurate ozone profiles between 15 and 40 km. In recent years there were many investigations to improve the quality of the long data set (Koehler and Claude, 1998) and to improve the knowledge about the Brewer-Mast sonde (Steinbrecht et al. 1998). The Observatory participated in the JOSIE I comparison. Results confirmed the findings of previous intercomparisons and demonstrated that the Brewer-Mast ozonesonde is capable of accurate and precise measurements suitable for long-term monitoring of the ozone layer both in the stratosphere and troposphere.

For the Version 3.0 data submitted to the NDSC, the effects of radiosonde-changes (VIZ 1393 to Vaisala RS80-30NES in August 1994 and to Vaisala RS80-30NE in August 1996), and effects of a colder pump-motor (throughout 1994) have been corrected (Claude et al. 1999).

Apart from the change-over from VIZ to Vaisala RS80 radiosondes in 1994, there were two more changes in radiosonde type:

- From Vaisala RS80 to Vaisala RS92 in 2005/2006
- From Vaisala RS92 to Vaisala RS41 in 2019/2020

For ozone (and temperature) below 25 to 30 km effects of these two radiosonde changes were minor and the Hohenpeissenberg ozone sounding data, so far, are not corrected for these radiosonde changes.

Overall, changes in sonde-type and procedures have been kept to a minimum.

Expected Precision/Accuracy of Instrument:

Altitude [km]	ozone [%]	temperature [K]
Below 25	5	0.2
Above 25	10	0.4

Instrument History:

Since 2020:	Vaisala RS41 radiosondes
2006 to 2019:	Vaisala RS92 radiosndes
1995 to 2006:	Vaisala RS80 radiosondes
1967 to 1994:	VIZ 1x92 and 1x93 radiosondes, usually with hypsometer In the early years also AMT and other radiosondes
Since 1967:	Brewer-Mast ozone sondes