A51G-0180. Enhanced operational methods in the NOAA Umkehr ground-based network for the future OMPS validation.

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Abstract. This work evaluates the quality of stratospheric and tropospheric ozone information derived from the ground-based Dobson and Brewer measurements. The updated and homogenized SBUV/2 V8 ozone profile time series is evaluated for internal consistency and potential drifts between different satellites. Long-term records from well-maintained Dobson Umkehr stations are used for assessment of the SBUV time series. The Umkehr technique for producing a vertical ozone profile by ground-based observations of the Umkehr effect is well known. However, observations of the Umkehr effect by co-located Dobson and Brewer spectrophotometers yield slightly different results, which are also dependent on total ozone values. These differences make it difficult to compare ozone profiles between stations. Statistical methods can be used to adjust measurements of a specific instrument to those of a reference instrument and produce more coherent data sets, but they fail to explain the cause of the differences. They also require intercomparisons at various total ozone amounts to define the parameters. Our recent investigations suggest that differences are due to the effects of out-of-band (OOB) stray light within the instruments and can be corrected by including a stray light parameter in each instrument's characterization. Here we present some resulting changes to retrieved ozone profiles along with their implications for observational methods, and for completeness of the existing data sets. The NOAA Earth Systems Research Lab has a number of capabilities and extensive experience with the ground-based ozone measurements that will be useful for the Ozone Mapping and Profiler Suite (OMPS) products under the NPOESS validation program. We plan to provide regular ozone profiles derived from the NOAA-operated and calibrated Dobson and Brewer instruments that are also an integral part of the US and international ozone monitoring networks.

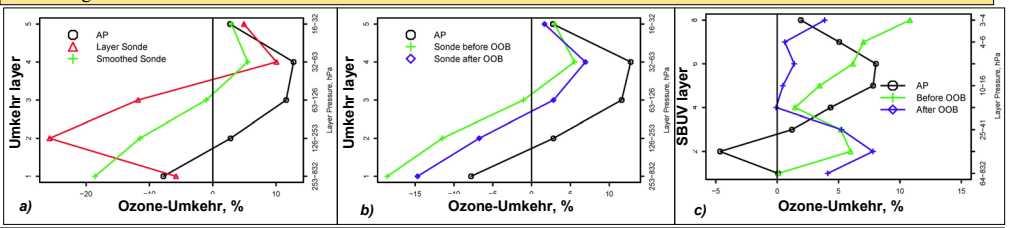


***Figure 1.** Comparisons between Umkehr retrievals and coincident ozone sounding and SBUV NOAA-16 for Boulder (a) Comparisons with sounding are shown before the OOB correction. The ozone sounding profile was either integrated in Umkehr layers (red triangles) or smoothed with Dobson Umkehr Averaging Kernels, AK (green pluses). The difference between Umkehr a priori (black) and layer integrated ozone sounding profiles (red) is shown for comparisons. (b) Comparison between AK-smoothed sounding and Umkehr retrievals, both before (green pluses) and after (blue diamonds) OOB correction. The Umkehr a priori comparison against the sounding is also shown for a reference. (c) Comparisons between SBUV NOAA-16 dataset (2000-2007) and Umkehr ozone profile before (green triangles) and after (blue pluses) OOB correction. Results are shown in SBUV layer system (left side axes) and corresponding atmospheric pressure for layers (right side axes) are shown on the plot. Comparisons for respective a priori profiles (black circles) are also provided for reference.*

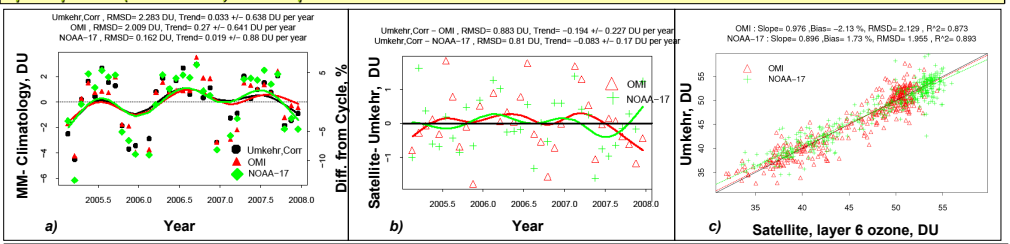
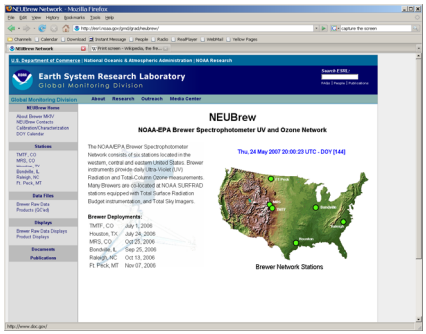
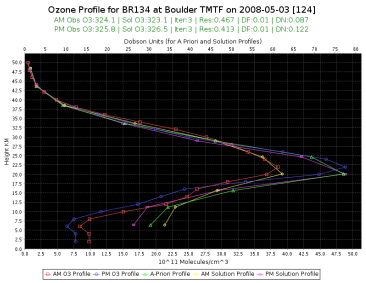


***Figure 2.** Comparison between Umkehr and coincident Aura OMI O3PROF [Liu et al., 2005] and SBUV NOAA-17 ozone detected in 8-16 hPa layer over Boulder, CO station. (a) Monthly averaged residuals from ozone climatology are plotted. All data show consistency in capturing ozone variability. (b) Difference between satellite and Umkehr RT monthly mean ozone is plotted as function of time. Drift of each satellite from Umkehr data is estimated over 3 years (marked as "Trend" at the top of the plot). (c) Scatter plot of satellite and Umkehr ozone comparisons. Slope, bias and correlation are shown.*



Comparisons of Dobson/Brewer ozone profile retrievals taken in Boulder on September 20, 2007 and stray light evaluation

- The same day ozone-sonde, MLS data are +/-5 degrees latitude coincidence.
- Reference profile: Ozone sonde below 16 mb (Layer 1-5), MLS above (6-10)
- Radiative-transfer code (TOMRAD and VLIDORT) to simulate spectrally resolved zenith sky radiance between 300 and 440 nm.
- Nominal band pass for Dobson and Brewer or extended band-pass to account for stray light
- Brewer Umkehr routine data collected by the NEUBrew network in Boulder, CO
- Martin Stanek PC software (O3BUmkehr) is used to retrieved daily Brewer ozone profiles.



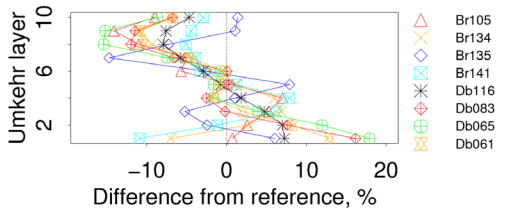
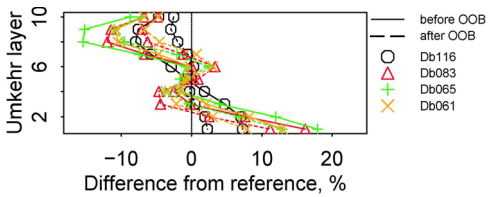


***Figure above:** Errors in the retrieved ozone for NOAA Dobson (Db) and NUEBrew (NOAA/EPA UV Brewer network) Brewer (Br) instruments in Boulder, CO, USA. Retrieval errors are associated with uncorrected OOB (out-of-band) stray light contribution in Dobson and Brewer measurements.*

***Figure below:** Results of the Dobson Umkehr retrievals where the OOB (out-of-band) stray light is accounted for through simple correction (dashed lines).*



Validation of Brewer tropospheric ozone data against sonde, Boulder 2006-2008 time series

Sampling:

- *Brewer* – daily, multiple
- *Sounding* – weekly

Limitations:

- *Brewer* – clouds, time-consuming, vertical resolution
- *Sounding* – sampling, buffer solution

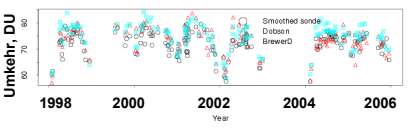
Stratospheric ozone 16-32 hPs Dobson, Brewer and sonde MLO/Hilo, HI, 1998-2006

Trend, %/decade :

Dobson: -1.1+/-0.3

Brewer: -0.5+/-0.2

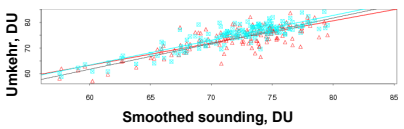
Sonde: -0.3 +/-0.02



Slope (correlation):

Dobson: 0.87 (0.62)

Brewer: 0.97 (0.76)



Summary of Results

- National and international Dobson Umkehr ozone profile data are available under WMO network.
- To date, 65 Brewers worldwide recorded Umkehr data. NOAA/EPA UV Brewer network maintains 6 stations since 09/2006.
- Long-term Umkehr data records provide ground-truth for homogenized SBUV-types satellite data records.
- The stray light (OOB) synthetic correction influences Umkehr retrieved profiles. Comparisons against sounding and SBUV data over Boulder indicate improvement in the OOB-corrected Umkehr retrieved ozone profile. More measurements are needed to verify these results, and to streamline and standardize the process without intensive modification of instruments.

Continuing research

- Work on Brewer ozone profile retrieval: collaboration with Martin Stanek (*new PC software "O3BUmkehr", stanek@chmi.cz*), NASA/Goddard, NOAA/NESDIS, Ozone SAG and USA Environmental Protection Agency.
- Implement the multi-spectral Brewer ozone profile retrieval that will minimize data collection time.
- Look for daily Brewer Umkehr ozone profile data from 6 NEUBrew sites at http://esrl.noaa.gov/gmd/grad/neubrew
- Extended Brewer ozone profile data set will be available for future satellite mission validation (NPOESS) and ozone recovery analysis.