

## The Short-term and Long-term Stratospheric and Tropospheric Ozone Variability Available from Zenith Sky Measurements.

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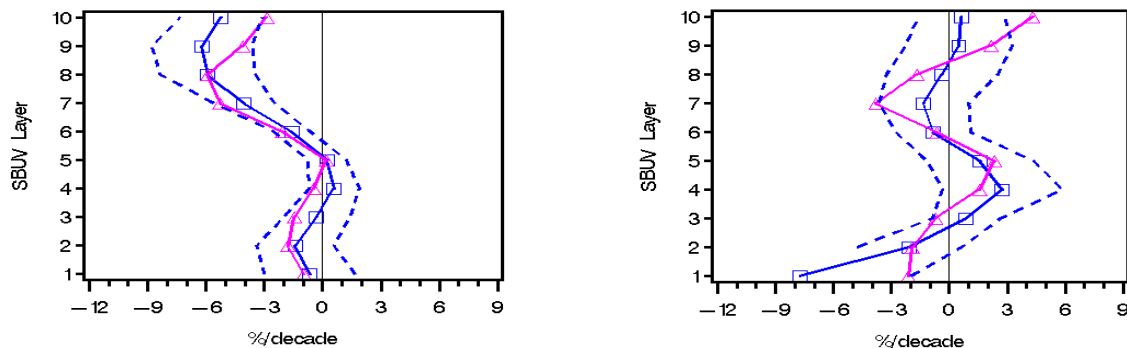
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This work evaluates the quality of stratospheric and tropospheric ozone information derived from ground-based Dobson and Brewer measurements. It assesses the capability and limitations of Umkehr data, use of Umkehr data for studies of tropospheric ozone variability, and natural and instrument variability in Umkehr data sets. 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 (/2) V8 time series collocated with several ground-based stations. The Umkehr ozone data from well-established stations such as Boulder, USA; MLO, USA; OHP, France; Lauder, NZ; and Perth, Australia are selected as reference for the homogenized series of SBUV data for the period 1979-2005. The vertical profile of ozone trends over the northern and southern mid latitudes are estimated from the Umkehr and SBUV (/2) data. The trends are derived using regression to an Effective Equivalent Stratospheric Chlorine (EESC) curve and converted to %/decade using the variation of EESC with time in the 1980s. The long-term ozone trends derived from the two systems are found to be in agreement. A change in the seasonal cycle, ozone trends, and correlations are among several questions addressed in the Umkehr/SBUV data analysis. In addition, the short-term and long-term tropospheric ozone variability derived from two Umkehr data sets available from Boulder, CO, and Mauna Loa Observatory in Hawaii are validated against the reference dataset comprised of co-incident and co-located ozonesonde profiles. Results show that the Umkehr retrieved ozone profile time series are valuable assets in determining ozone inter-annual variability and trends in both stratosphere and troposphere. The Umkehr and SBUV (/2) V8 comparisons indicate drifts between the two systems at some stations (Australia, and possibly at Lauder, NZ). Quality assured Umkehr data show no significant differences in stratospheric ozone trends among stations in the northern mid latitudes. The trend derived from the Lauder Dobson Umkehr data (S.H.) differs from trends derived from the ground-based stations located in the N.H. However, this is most likely related to the difference in the start of the records in the two hemispheres with the Lauder record not beginning until the mid 1980s.



**Figure 1.** Ozone trends (% per decade) are shown as a function of Umkehr layers. The trends are derived from co-incident, homogenized NOAA/2 SBUV satellite (pink) and Dobson Umkehr (blue) ozone profile measurements for (left) Boulder (1979-2006 time period) and (right) MLO (1982-2006 time period) station records. Dashed lines represent uncertainties of the Umkehr ozone trends regressed against the EESC, QBO and Solar cycle time-series.