Can Ozone Cross-Sections Be Verified from the Ground-Based Measurements?

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The recent World Meteorological Organization (WMO)/International Ozone Commission (IO_3C) initiative recommends using Daumont, Brion and Malicet (1995: DBM) ozone cross-sections instead of the previously used Bass and Paur (1984: BP) cross-sections. The DBM cross-section measurements were performed at higher resolution and higher signal-to-noise ratio than BP measurements. Also they generate significantly lower residuals when quadratic parametrization with respect to temperature is performed. The change from BP to DBM cross-sections has surprisingly large impact on ozone column retrieval when Huggins region of 300nm-340nm is used. In particular, the measurements with Brewer spectroradiometers produce 2-3% lower ozone column with DBM. Also the ozone column obtained with UltraViolet-Rotating Shadowband Spectroradiometer (UV-RSS) at Table Mt., Boulder, Colorado shows 1% ozone column reduction. On the other hand, it was reported that Dobson instruments were unaffected. The ozone profile retrieval from GOME data are also affected by the choice of the cross-section. The WMO/IO_3C recommendation disturbed the picture that emerged over last few decades of harmony among different measurements. We emphasize that no ground-based measurements verified which of the two sets of cross-sections is closer to the actual values in the atmosphere. We have attempted to perform verification of the cross-sections using two data sets: (1) 1998 Brewer MKIII at Mauna Loa, Hawaii and (2) 2003-2008 UV-RSS at Table Mt., Colorado. Both studies were aided by NOAA ozone sonde data at nearby locations as the comparisons are dependent on ozone and temperature profiles. So far root-mean-squared of residuals of measured spectra to synthetic spectra based on BP and DBM did not show statistically significant difference to render a judgment which of the cross-section is closer to the truth. Subsequently we performed extensive simulation studies to estimate measurement requirements in terms of noise, resolution and wavelength stability to find conditions when the detection of the difference is possible. Also we evaluate differential absorption technique that improves the detectability at the expense of lost low frequency components.

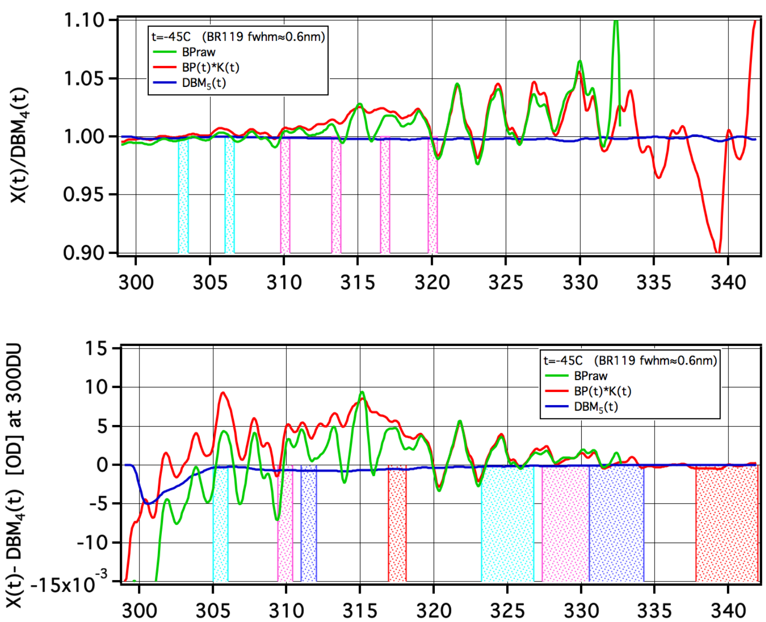

Figure 1. Ozone cross-section comparison at T = - 45ºC with 0.6 nm resolution. Differences (Bottom) in optical depth for 300 DUs and Ratios (Top) shown for four data sets: Raw BP, temperature parametrized BP with Khomyr correction, DBM parametrized using 5-temperature data. These three compared to DBM parametrized using 4-temperature data. (Bands of Brewer (Top) and bands of Dobson (Bottom) are shown.)