The Information Available on Short-Term and Long-Term Tropospheric Ozone Variability from Zenith Sky UV Measurements

I. Petropavlovskikh[1], S. Oltmans[2], V. Fioletov[3], P. Disterhoft[1], K. Lantz[1], and P. Kiedron[1]

[1]Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO 80309; 303-497-6279, Fax: 303-497-6546, E-mail: Irina.Petro@noaa.gov
[2]NOAA Earth System Research Laboratory, 325 Broadway, Boulder, CO 80305
[3]Meteorological Services of Canada, Toronto, Ontario, Canada

This work focuses on a study of changes in surface UV levels caused by tropospheric ozone. UV radiation drives photochemical reaction rates that are essential in pollution formation, and exposure to UV radiation can be a human health hazard. The re-established NOAA/EPA UV Network at six locations across the United States (including Bondville, IL, Fort Peck, MT, Raleigh, NC, Boulder, CO, Mountain Research Station at Niwot Ridge, CO, and Houston, TX) will make UV radiation and automated direct sun and zenith sky ozone measurements from which daily ozone profiles can be derived. This work evaluates the quality of tropospheric ozone information derived from the ground-based Dobson and Brewer measurements. A newly developed algorithm allows separation of the tropospheric ozone measurement into two or three layers. We validate tropospheric ozone data through comparisons with co-incident ozonesonde measurements of high vertical resolution. Our analysis concentrates on the short-term and long-term tropospheric ozone variability detected by co-incident and co-located Dobson and Brewer data along with ozone profiles from ozonesondes available from Boulder, CO and Mauna Loa Observatory in Hawaii. Analyses suggest that the Dobson Umkehr technique is capable of monitoring short-term variability in tropospheric ozone. It can explain about 50 % of the variability measured by ozonesondes. It was found that the 1-day co-incident data have higher correlation coefficients than the 2-day window for Boulder, but not for Mauna Loa. In addition, correlation coefficients calculated for co-incident Umkehr and ozonesonde data were found to be relatively large and statistically significant in the troposphere, although the highest correlation was in the lower stratosphere. Moreover, ozonesonde data smoothed with the corresponding Umkehr Averaging Kernel function showed larger correlation coefficients as compared to comparisons using layer-integrated ozonesonde data. Based on correlation analysis Dobson data can capture tropospheric ozone variability. Thus the Umkehr method should be considered capable of measuring long-term changes in tropospheric ozone.

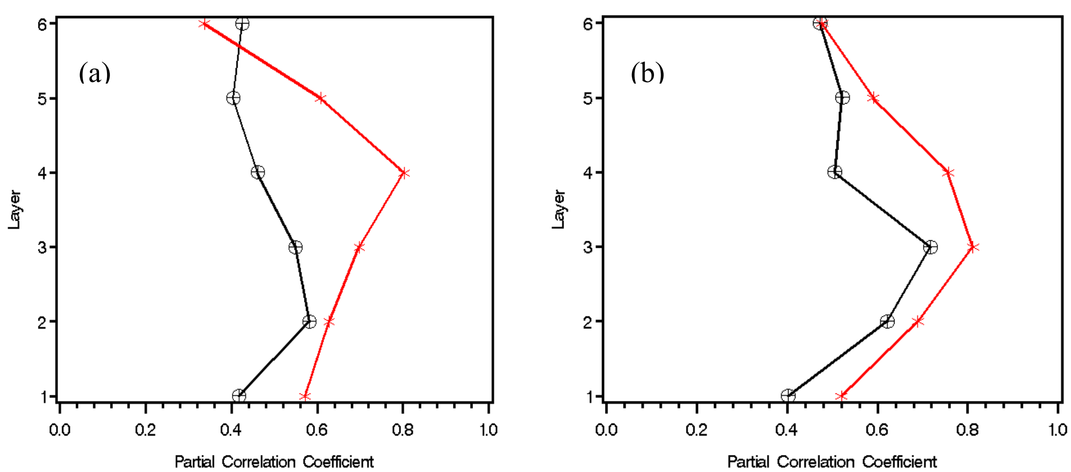

Figure 1. Correlation between co-incidental ozonesonde and Dobson ozone measurements (in excess of a priori) as function of Umkehr layer (~ 5 km wide) for (a) MLO station record during 1985-2005, and (b) Boulder station records during 1985-2005 time period. Black lines represent results for layer -integrated ozonesonde data, red lines show results for Umkehr smoothed ozonesonde data.