Geophysical Research Abstracts
Vol. 20, EGU2018-2213, 2018
EGU General Assembly 2018

Can Brewer Umkehr measurements capture ozone variability near the edge of the Southern polar vortex?

Klara Cizkova (1,2), Harald Rieder (3,4), Martin Stanek (1), Irina Petropavlovskikh (5,6), Ladislav Metelka (1), and Kamil Laska (2)

(1) Czech Hydrometeorological Institute, Solar and Ozone Department, Hradec Kralove, Czech Republic (393876@mail.muni.cz), (2) Department of Geography, Faculty of Science, Masaryk University, Brno, Czech Republic, (3) Wegener Center for Climate and Global Change and IGAM/Institute of Physics, University of Graz, Graz, Austria, (4) Austrian Polar Research Institute, Vienna, Austria, (5) Cooperative Institute for Research in Atmospheric Sciences, University of Colorado in Boulder, CO, USA , (6) National Oceanographic and Atmospheric Administration, Global Monitoring Division, Boulder, CO, USA

Every austral spring an ozone hole develops over Antarctica. Severe ozone depletion occurs in altitudes between 10 and 20 km, but not throughout the entire profile (Solomon et al., 1986). Therefore, accurate observations of the vertical ozone distribution in the Antarctic region are of ultimate importance. Various techniques exist for vertical ozone profile retrievals, one of which are Umkehr observations, first described by Götz et al. (1934). These are performed by ground-based spectrophotometers using the measurements of a UV wavelength pair at high solar zenith angles. The data from the Marambio Base (64° 14′ 27.65″ S, 56° 37′ 36.31″ W), Antarctic Peninsula Region, provide a unique opportunity to assess the Umkehr ozone profiles against collocated ozone soundings near the edge of the Southern polar vortex. At the Marambio Base, Umkehr retrievals are performed using the B199 MK-III Brewer spectrophotometer, which was installed in February 2010 and is operated by the Czech Hydrometeorological Institute. The Finnish Meteorological Institute performs ozone soundings, via ECC sondes, at the same site already since the 1980s. As soundings are not performed on a daily basis, a limited record of joint Umkehr and sonde observations is available to assess the degree of agreement/disagreement between ozone profiles derived with those techniques. In total, we assess 158 pairs of vertical ozone profiles over the period 2010–2016. 55 % of these profiles were recorded during the ozone-hole period (September–November). Our results show that when the operational retrieval is based on the generic cosine fit to the McPeters et al. (2007) climatology to represent the seasonal cycle in the a-priori profile, the Umkehr vertical profiles generally overestimate ozone amounts relative to the sondes. The overestimation is particularly pronounced in Umkehr layers 4 and 5, i.e. in approximate altitude of about 15–25 km (33 %, resp. 12 %). Our analysis shows further that overestimation by Umkehr is more pronounced during the ozone-hole period (40 %, resp. 15 %) than other seasons of the year. Due to the non-representative a priori co-variance matrix and profile, the Umkehr ozone retrieval was not capable to derive the shape of the Antarctic depleted profile with less ozone in Umkehr layer 4 than in Umkehr layer 3. Therefore, we developed and assessed results of the updated Brewer Umkehr retrieval based on the new representative seasonal a priori profile and co-variance matrix derived from the ECC ozone soundings for the conditions of the depleted ozone layer.

References:

Götz, F., Meetham, A. R., and Dobson, G. B.: The vertical distribution of ozone in the atmosphere, Proc. R. Soc. Lon. Ser.-A, 145, 416–446, 1934.

McPeters, R. D., Labow, G. J., and Logan, J. A.: Ozone climatological profiles for satellite retrieval algorithms, J. Geophys. Res., 112, D05308, 2007.

Solomon, S., Garcia, R. R., Rowland, F. S., and Wuebbles, D. J.: On the depletion of Antarctic ozone, Nature, 321, 755–758, 1986.