Geophysical Research Abstracts
Vol. 12, EGU2010-11640, 2010
EGU General Assembly 2010

Total ozone patterns over the southern mid-latitudes: spatial correlations, extreme events and dynamical contributions

Harald E. Rieder (1), Stefania Di Rocco (1,2), Johannes Staehelin (1), Jörg A. Maeder (1), Mathieu Ribatet (3), Thomas Peter (1), and Anthony C. Davison (3)

(1) Institute for Atmospheric and Climate Science, ETH Zurich, Zurich, Switzerland (harald.rieder@env.ethz.ch), (2) Institute of Geography, University of Zurich, Switzerland, (3) Institute of Mathematics, EPF Lausanne, Lausanne, Switzerland

Tools from geostatistics and extreme value theory are applied to analyze spatial correlations in total ozone for the southern mid-latitudes. The dataset used in this study is the NIWA-assimilated total ozone dataset (Bodeker et al., 2001; Müller et al., 2008). Recently new tools from extreme value theory (Coles, 2001; Ribatet, 2007) have been applied to the world's longest total ozone record from Arosa, Switzerland (e.g. Staehelin 1998a,b) and 5 other long-term ground based stations to describe extreme events in low and high total ozone (Rieder et al., 2010a,b,c). Excursions in the frequency of extreme events reveal "fingerprints" of dynamical factors such as ENSO or NAO, and chemical factors, such as cold Arctic vortex ozone losses, as well as major volcanic eruptions of the 20th century (e.g. Gunung Agung, El Chichón, Mt. Pinatubo). Furthermore, atmospheric loading in ozone depleting substances lead to a continuous modification of column ozone in the northern hemisphere also with respect to extreme values (partly again in connection with polar vortex contributions). It is shown that application of extreme value theory allows the identification of many more of such fingerprints than conventional time series analysis on basis of annual and seasonal mean values. Especially, the analysis shows the strong influence of dynamics, revealing that even moderate ENSO and NAO events have a discernible effect on total ozone (Rieder et al., 2010b,c). Within the current study patterns in spatial correlation and frequency distributions of extreme events (e.g. ELOs and EHOs) are studied for the southern mid-latitudes. It is analyzed if „fingerprints"found for features in the northern hemisphere occur also in the southern mid-latitudes. New insights in spatial patterns of total ozone for the southern mid-latitudes are presented. Within this study the influence of changes in atmospheric dynamics (e.g. tropospheric and lower stratospheric pressure systems, ENSO) as well as influence of major volcanic eruptions (e.g. Mt. Pinatubo) and ozone depleting substances (ODS) on column ozone over the southern mid-latitudes is analyzed for the time period 1979-2007.

References:

Bodeker, G.E., J.C. Scott, K. Kreher, and R.L. McKenzie, Global ozone trends in potential vorticity coordinates using TOMS and GOME intercompared against the Dobson network: 1978-1998, J. Geophys. Res., 106 (D19), 23029-23042, 2001.

Coles, S.: An Introduction to Statistical Modeling of Extreme Values, Springer Series in Statistics, ISBN:1852334592, Springer, Berlin, 2001.

Müller, R., Grooß, J.-U., Lemmen, C., Heinze, D., Dameris, M., and Bodeker, G.: Simple measures of ozone depletion in the polar stratosphere, Atmos. Chem. Phys., 8, 251-264, 2008.

Ribatet, M.: POT: Modelling peaks over a threshold, R News, 7, 34-36, 2007.

Rieder ,H.E., Staehelin, J., Maeder, J.A., Ribatet, M., Stübi, R., Weihs, P., Holawe, F., Peter, T., and A.D., Davison (2010): Extreme events in total ozone over Arosa – Part I: Application of extreme value theory, to be submitted to ACPD.

Rieder, H.E., Staehelin, J., Maeder, J.A., Ribatet, M., Stübi, R., Weihs, P., Holawe, F., Peter, T., and A.D.,

Davison (2010): Extreme events in total ozone over Arosa – Part II: Fingerprints of atmospheric dynamics and chemistry and effects on mean values and long-term changes, to be submitted to ACPD.

Rieder, H.E., Jancso, L.M., Staehelin, J., Maeder, J.A., Ribatet, Peter, T., and A.D., Davison (2010): Extreme events in total ozone over the northern mid-latitudes: A case study based on long-term data sets from 5 ground-based stations, in preparation.

Staehelin, J., Kegel, R., and Harris, N. R.: Trend analysis of the homogenized total ozone series of Arosa (Switzerland), 1929-1996, J. Geophys. Res., 103(D7), 8389-8400, doi:10.1029/97JD03650, 1998a.

Staehelin, J., Renaud, A., Bader, J., McPeters, R., Viatte, P., Hoegger, B., Bugnion, V., Giroud, M., and Schill, H.: Total ozone series at Arosa (Switzerland): Homogenization and data comparison, J. Geophys. Res., 103(D5), 5827-5842, doi:10.1029/97JD02402, 1998b.