Geophysical Research Abstracts,
Vol. 11, EGU2009-2503, 2009
EGU General Assembly 2009

Extreme Events: low and high total ozone over Arosa, Switzerland

H.E. Rieder (1,*), J. Staehelin (1), J.A. Maeder (1), M. Ribatet (2), R. Stübi (3), P. Weihs (4), F. Holawe (5), T. Peter (1), and A.C. Davison (2)

(1) Institute for Atmospheric and Climate Science, ETH Zurich, Zurich, Switzerland , (2) Institute of Mathematics, EPF Lausanne, Lausanne, Switzerland, (3) Federal Office of Meteorology and Climatology (MeteoSwiss), Payerne, Switzerland , (4) Institute for Meteorology, University of Natural Resources and Applied Life Sciences, Vienna, Austria, (5) Institute for Geography and Regional Research, University of Vienna, Vienna, Austria, (*) contact: harald.rieder@env.ethz.ch

The frequency distribution of days with extreme low (termed ELOs) and high (termed EHOs) total ozone is analyzed for the world's longest total ozone record (Arosa, Switzerland - for details see Staehelin et al.,1998a,b), with new tools from extreme value theory (e.g. Coles, 2001; Ribatet, 2007). A heavy-tail focused approach is used through the fitting of the Generalized Pareto Distribution (GPD) to the Arosa time series. Asymptotic arguments (Pickands, 1975) justify the use of the GPD for modeling exceedances over a high (or below a low) enough threshold (Coles, 2001). The analysis shows that the GPD is appropriate for modeling the frequency distribution in total ozone above or below a mathematically well-defined threshold. While previous studies focused on so termed ozone mini-holes and mini-highs (e.g. Bojkov and Balis, 2001, Koch et al., 2005), this study is the first to present a mathematical description of extreme events in low and high total ozone for a northern mid-latitudes site (Rieder et al., 2009). The results show (a) an increase in days with extreme low (ELOs) and (b) a decrease in days with extreme high total ozone (EHOs) during the last decades, (c) that the general trend in total ozone is strongly determined by these extreme events and (d) that fitting the GPD is an appropriate method for the estimation of the frequency distribution of so-called ozone mini-holes. Furthermore, this concept allows one to separate the effect of Arctic ozone depletion from that of in situ mid-latitude ozone loss. As shown by this study, ELOs and EHOs have a strong influence on mean values in total ozone and the "extremes concept" could be further used also for validation of Chemistry-Climate-Models (CCMs) within the scientific community.

References:

Bojkov, R. D., and Balis, D.S.: Characteristics of episodes with extremely low ozone values in the northern middle latitudes 1975-2000, Ann. Geophys., 19, 797-807, 2001.

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

Koch, G., H. Wernli, C. Schwierz, J. Staehelin, and T. Peter (2005), A composite study on the structure and formation of ozone miniholes and minihighs over central Europe, Geophys. Res. Lett., 32, L12810, doi:10.1029/2004GL022062.

Pickands, J.: Statistical-Inference using extreme order Statistics, Ann. Stat., 3, 1, 119-131, 1975.

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 Davison, A.C.: From ozone mini holes and mini highs towards extreme value theory: New insights from extreme events and non stationarity, submitted to J. Geophys. Res., 2009.

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.