Atmos. Chem. Phys. Discuss., 5, S91–S94, 2005
www.atmos-chem-phys.org/acpd/5/S91/
European Geosciences Union

Atmospheric Chemistry and Physics Discussions

ACPD

5, S91–S94, 2005

Interactive Comment

Interactive comment on "Fall vortex ozone as a predictor of springtime total ozone at high northern latitudes" *by* S. R. Kawa et al.

S. Tilmes

Simone.Tilmes@t-online.de

Received and published: 23 February 2005

General Comments

This paper describes an interesting observation, namely that springtime total ozone at high northern latitudes is linked in some way to fall vortex ozone. The main statement of the paper is based on a large correlation coefficient between November ozone mixing ratios in $\approx$ 600–700 K and the total ozone in March for high northern latitudes. However, no specific correlation with any dynamic indicators of March ozone was found.

As discussed in this paper, November ozone in the early polar vortex is clearly dependent on meteorological conditions, such as wave activity and temperature. Considering 550–800 K (where ozone is showing a relatively small vertical gradient) is similar to considering ozone mixing ratios in ozone-tracer correlations in autumn/winter []Tilmes2004b. Diabatic descent will not impact ozone-tracer relation, and therefore mixing ratios of ozone at a certain tracer level remain constant []Mueller1999,Tilmes2004b. (The tracer-tracer correlation method allows to isolate photochemical ozone loss from transport processes.) When a polar vortex is developed and sufficiently isolated, ozone-tracer correlations and, therefore, ozone mixing ratios in 550–800 K are not changing any more.

In the study of []Tilmes2004b the variability of early winter reference functions in autumn/winter, that is similar to the discussion of November ozone in this paper, is shown and discussed. For example, an early isolation generally resulted in smaller ozone mixing ratios in the polar vortex than a late isolation of the vortex. Further, enhanced wave activity in winter 1991/92 owing to the presence of volcanic aerosols from the Pinatubo eruption result in larger ozone mixing ratios at the beginning of the winter.

Comparing column ozone in March inside the polar vortex and autumn ozone, it may be problematic considering just simply November values. For example in winter 1996/97 []Tilmes2003 have shown, that ozone mixing ratios on a tracer surface were still increasing during December within the vortex area, due to a major warming in the first half of December 1996. Indeed, in March 1997 the value seems to be an outlier in the correlation in Figure 5. The situation is similar for the winter 1991–92 []Tilmes2004b. Using ozone-tracer correlations, an early winter reference function has to be considered at a time, when the vortex is isolated. Testing similar approach might be useful for the present study, considering ozone mixing ratios inside the early polar vortex.

The March column ozone loss depends on wave activity (increase of ozone) and chemical ozone loss, as described in the paper. Information on chemical ozone loss over the winter in the Arctic is available from a number of studies []Tilmes2004b,Rex2004,Manney2003,Goutail2003. This information might be worth

ACPD
5, S91–S94, 2005

Full Screen / Esc
Print Version
Interactive Discussion
Discussion Paper

EGU

considering in this study as to allows to separate the chemical signal to analyse the changes of column ozone in March separated in the chemical and the dynamical signal.

Further, it might be interesting to examine the influence of the wave activity in autumn and the time of the vortex isolation on the temperature evolution during the entire Arctic winter and therefore on the amount of ozone loss in spring. In the study of []Tilmes2004b no correlation was found between the shape of the early winter reference function and chemical ozone loss in spring. However, ozone loss was found to be correlated with temperature and wave activity in spring that increases solar illumination on the area of the vortex air masses.

Goutail, F., J.-P. Pommereau, and F. Lefèvre, Total ozone reduction in the Arctic during the winters 2001 and 2002 from the saoz network and comparison to previous winters, in *Proc. 6th Europ. Symp., EU Air Pollution Res. Rep. 79, Göteborg (Sweden) 2002*, edited by N. R. P. Harris, G. T. Amanatidis, and J. G. Levine, pp. 181–184, 2003.

Manney, G. L., L. Froidevaux, M. L. Santee, N. J. Livesey, J. L. Sabutis, and J. W. Waters, Variability of ozone loss during Arctic winter (1991 to 2000) estimated from UARS Microwave Limb Sounder measurements, *J. Geophys. Res.*, *108*, 2003.

Müller, R., J.-U. Grooß, D. S. McKenna, P. J. Crutzen, C. Brühl, J. M. Russell, L. L. Gordley, J. P. Burrows, and A. F. Tuck, Chemical ozone loss in the Arctic vortex in the winter 1995-1996: HALOE measurements in conjunction with other observations, *Ann. Geophys.*, *17*, 101–114, 1999.

Rex, M., R. J. Salawitch, P. von der Gathen, N. R. Harris, M. P. Chipperfield, and B. Naujokat, Arctic ozone loss and climate change, *Geophys. Res. Lett.*, *31*, 2004.

Tilmes, S., R. Müller, J.-U. Grooß, D. S. McKenna, J. M. Russell, and Y. Sasano, Calculation of chemical ozone loss in the Arctic winter 1996-1997 using ozone-tracer correlations: Comparison of Improved Limb Atmospheric Spectrometer (ILAS) and Halogen Occultation Experiment (HALOE) results, *J. Geophys. Res.*, *108*, 4045, 2003.

Tilmes, S., R. Müller, J.-U. Grooß, and J. M. Russell, Ozone loss and chlorine activation in the Arctic winters 1991–2003 derived with the tracer-tracer correlations, *Atmos. Chem. Phys.*, *4*, 2167–2238, 2004.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 155, 2005.