Atmos. Chem. Phys. Discuss., 4, S135–S137, 2004
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Atmospheric Chemistry and Physics Discussions

ACPD

4, S135–S137, 2004

Interactive Comment

Interactive comment on "Investigation of Arctic ozone depletion sampled over midlatitudes during the Egrett Campaign of spring/summer 2000" *by* D. E. M. Ross et al.

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Received and published: 24 February 2004

General comments

This is a very interesting paper that combines a unique set of measurements with the results of a numerical model to deduce conclusions about ozone loss in the lower stratosphere; a field that is often neglected in spite of its importance. My main criticism of the paper is that it does not state its message as clearly as it could be – at least according to my judgment.

The main point of the paper is that on 5 June the Egrett measured a remnant of the Arctic polar vortex and that this airmass is characterized by ozone values that are depleted by 20% relative to a mid-January reference (that is taken as a reference for chemically unperturbed 'early vortex' conditions). Part of this signal will be due to ozone loss in the polar vortex in February and March that is preserved in the airmass and thus can be detected in the CFC-11/O_3 relation. Such a development of ozone/tracer relations has indeed been observed in vortex remnants sampled by HALOE in late April 2000 (Müller et al., 2003). However, the model results show that only $\approx$50% of the total chemical ozone destruction encountered in June is consistent with a polar (90-70°) ozone loss mechanism. Thus one would conclude that further chemical ozone loss has occurred in the vortex remnants between the end of the 'polar ozone loss' period and the measurement in June (consistent with e.g., the discussion in Konopka et al., 2003) and that this ozone loss is responsible for the remaining 50% of the ozone loss signal detected in June.

Another issue is the question in how far mixing will have affected the CFC-11/O_3 relation measured in June. Indeed, model calculations (Konopka et al., 2003) indicate that vortex remnants in the lower stratosphere in early June – in contrast to the vortex remnants in late April (Müller et al., 2003) – will not have remained intact and will be influenced to some extent by mixing with non-vortex air. However, mixing within a linear tracer-tracer relation can not alter the relation. And the CFC-11/O_3 relation at least in this winter is indeed very closely approximated by a linear relation as shown by Fig. 4 of the manuscript and, over a greater altitude range, by Müller et al. (2003). Finally it should be noted that Plumb et al. (2000), as cited in the manuscript, have made the point that the possible impact of mixing must not be neglected when considering changes in tracer-tracer relations. However, they also state that they are using a 'conceptual model' and do not claim that the diffusivities employed in their model constitute a realistic approximation of the diffusivities encountered in the real atmosphere.

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Further specific comments

- p. 144, l. 5: The DESCARTES measurements are shown in Fig. 5 of Müller et al. (2003).
- p. 150, l. 20: Intact vortex remnants have been observed in late April 2000.
- p. 150, l. 23: I believe the Richard et al. study (2001, not 2002) should also provide information on the ozone loss encountered at the Egrett altitude. This piece of information would be useful here.
- It might be helpful to state that a mid-January reference can be taken as a chemically unperturbed reference). Indeed Müller et al. (2003) have shown (their Fig. 5) that the CFC-11/O_3 relation remained unchanged between Nov./Dec. 1999 and Jan. 2000.

References

- P. Konopka, J.-U. Grooß, S. Bausch, R. Müller, G., D. S. McKenna, O. Morgenstern, and Y. Orsolini (2003) Dynamics and chemistry of vortex remnants in late Arctic spring 1997 and 2000: Simulations with the Chemical Lagrangian Model of the Stratosphere (CLaMS) *Atmos. Chem. Phys.*, **3**, pp. 839-849.
- R. Müller, S. Tilmes, J.-U. Grooß, D. S. McKenna, M. Müller, U. Schmidt, G. C. Toon, R. A. Stachnik, J. J. Margitan, J. W. Elkins, J. Arvelius, and J. M. Russell III (2002) Chlorine Activation and Chemical Ozone Loss Deduced from HALOE and Balloon Measurements in the Arctic during the Winter of 1999-2000, *J. Geophys. Res.*, **107**, 8302, doi:10.1029/2001JD001423.

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 141, 2004.