Atmos. Chem. Phys. Discuss., 3, S1314–S1316, 2003
www.atmos-chem-phys.org/acpd/3/S1314/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Intercontinental transport of tropospheric ozone: A study of its seasonal variability across the North Atlantic utilizing tropospheric ozone residuals and its relationship to the North Atlantic Oscillation" *by* J. K. Creilson et al.

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Received and published: 14 August 2003

General comment:

The paper by Creilson et al. investigates a very important topic: The influence of climate variability on ozone transport and the resulting ozone distribution. To my knowledge, this is the first paper that shows ozone maps in dependence of indices of climate variability, the NAO in this case. In fact, very large differences for opposite phases of the NAO are reported in this paper. I therefore wish to congratulate the authors on a

very well written and valuable paper. The magnitude of the signal they have uncovered took me by surprise, even though I'd have expected the signal's direction and basic pattern.

My main concern with the results is that uncertainties and possible artifacts (e.g., from the separation of tropospheric and stratospheric ozone) are not sufficiently well addressed. I believe that the time invested in doing a more thorough uncertainty analysis would be well spent.

Major specific points:

I am not an expert on the retrieval of TOR from satellite data. However, the retrieval algorithm used in this paper was discussed quite controversially by the reviewers of the Fishman et al. (2003) paper (e.g., de Laat, Atmos. Chem. Phys. Discuss. S335-S337). While I find the new validation with the ozonesonde data quite useful, it would be even more so if not only monthly means, averaged over long time periods, would be compared, but data for shorter time periods, perhaps using pixels directly at the ozonesondes' locations instead of the rather large boxes.

The authors should also discuss whether the patterns they find (e.g., in Figure 8) could be due an artefact of the separation between stratospheric and tropospheric ozone. Note that stratospheric ozone also greatly varies as a result of the NAO.

Furthermore, clouds may hamper the retrieval algorithm, and as cloud cover also changes with the NAO, this may also result in artefacts (note that much of the fast intercontinental transport occurs with cloudy WCBs).

It would be interesting if the authors could compare their ozone patterns with a recent 15-year transport climatology by Eckhardt et al. (2003), which investigated the influence of the NAO on pollution outflow patterns from North America. Are the patterns seen in the transport climatology consistent with the ozone patterns?

The differences in ozone over the eastern North Atlantic between the springs of 1980

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and 1990 (Fig. 8) are very large. I wouldn't have expected so large differences for different phases of the NAO. However, while it may be good to show two years as an example, this raises the question of representativity. To resolve this, I'd like to see composites of low and high NAO springs, respectively (either in addition to the 2 years shown, or instead). Alternatively, correlation maps between the NAO and ozone patterns could be presented. Such maps would also better allow to distinguish differences in ozone transport patterns, and thus would help clarify the mechanism through which the strong differences are brought about.

Minor comments:

In Figure 4a, the axis range (25-50 DU) is appropriate. However, why do you use a different one (0-60 DU) for the comparison with the ozonesonde data? It looks as if differences shall be de-emphasized.

In Table 2, there are only 18 rows, although the period covered is 21 years. Why? Are there some years mis sing?

On the influence of the NAO on stratosphere-troposphere exchange you may compare, for instance, with Sprenger and Wernli (2003).

References:

Eckhardt, S., A. Stohl, S. Beirle, N. Spichtinger. P. James, C. Forster, C. Junker, T. Wagner, U. Platt, and S. G. Jennings, The North Atlantic Oscillation controls air pollution transport to the Arctic, Atmos. Chem. Phys. Discuss., 3, 3223-3240, 2003

Sprenger, M., and H. Wernli, A northern hemispheric climatology of cross-tropopause exchange for the ERA15 time period (1979-1993). J. Geophys. Res. Vol. 108, doi: 10.1029/2002JD002636

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 4431, 2003.