Atmos. Chem. Phys. Discuss., 5, S65–S68, 2005
www.atmos-chem-phys.org/acpd/5/S65/
European Geosciences Union

Atmospheric Chemistry and Physics Discussions

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

Anonymous Referee #3

Received and published: 16 February 2005

General Comments:

The paper by Kawa et al. presents a relation in the inter-annual variability of Arctic ozone occuring between two different seasons (early winter and early spring), based on satellite observations in the last 25 years. It is shown that the vortex ozone (POAM and SBUV) at 500K-800K in November is correlated (r=0.5-0.7) to the TOMS total ozone in the following March.

The paper also investigates some potential causes of this correlation. It was not possible to explain it with some dynamical indicators such as temperature and heat flux looking at their November vs their March values (and January or February for the heat flux). The authors could try (or mention that they tried) other combinations of November vs winter average values, as suggested in the specific comment (8) below. Although not self-explanatory about the driving mechanism, indices of NH teleconnection patterns (known to correlate with the polar vortex strength) could have also being tried (NAO, AO etc.).

The results of this paper are interesting as they add another piece to the puzzle of understanding the chemical and dynamical factors in past and future trends of Arctic ozone depletion. It should also encourage further studies (observational and modelling) on the issue raised.

Specific Comments (for brevity I use "you" instead of "the authors"):

1. page 157, line 27: I can see from figure 1 that the maximum year-to-year variation observed so far is around 50 DU, but can you clarify why "... no one can predict NH high latitude O3 in the next few years or decades better than about 50 DU (Fig. 1)." ?

2. page 160, line 15: For SBUV, how do you sample/define the "November vortex O3 data" ? Using the same method (theta/eq. latitude intervals) that you describe for POAM ? This is only indirectly inferred later, from page 161, line 5.

3. page 162, line 15: In figure 6, the correlation seems to picking up again at 1000K (r=0.55). Do you have information for the correlation at levels higher than 1000K ?

4. page 163, line 11: which is the "... separate model test .." you refer to ?

5. page 163, line 12: can you clarify "... the residual influence of halogens ..." ? Do you mean the second order effect of changing halogens, where polar ozone depletion caused by halogen loading changes circulation ?

6. page 165, line 20: which "November total ozone ..." have you used, TOMS or vertically integrated from POAM/SBUV ? If only the latter, it should be then nice to know how November TOMS correlates with March TOMS (or the same for column POAM/SBUV if TOMS is used).

ACPD

5, S65–S68, 2005

7. page 166, line 3: what is the actual value of the correlation coefficient of TOMS total ozone in November versus March which correlates "... fairly well ... but not as well as November POAM O3 ..." ?

8. page 166, line 17: Have you tried correlating for the heat flux, the Jan-Feb-Mar average with November (and not the Jan., Feb., Mar. individually, as you say) ? For example, the winter heat flux (which is connected to the extra-tropical ozone build-up and the March total ozone) in Randel et al., (2002) is considered as the November-March average (their figure 12). Have you looked at other combinations of averages of winter months to the November flux ? (Although it has been shown that November-December (early winter) stratospheric heat flux is anticorrelated with the January-February one, see Randel et al., 2002; Karpetchko and Nikulin, 2004).

The following comments are of more general (and optional for the authors to take any action) nature:

i) 166, line 24: the Ma et al. (2004) simulations did not include neither a QBO (as you also mention) nor inter-annual variations in external forcing. Braesicke and Pyle (2004) emphasised the sensitivity of chemistry-climate modelled stratospheric ozone to the inter-annual variability of sea surface temperatures (SSTs) through changes in tropospheric circulation and heat flux. In addition, chemical-transport models (CTMs) forced by meteorological analyses constructed from observations can be used to study the ozone control by dynamics (for example, Hadjinicolaou and Pyle, 2004, related the winter heat flux with the spring Arctic and mid-latitude ozone depletion). Modelling studies which account for the observed inter-annual variability or forcings can be a useful tool in diagnosing the November vortex vs March total ozone correlation.

ii) page 167, line 24: Have you looked for a similar correlation between early winter vortex and spring total ozone in the Antarctic ? Are there long enough POAM measurements that could be combined to SBUV data ? An intercomparison of N.H. - S.H. ozone (in the context of dynamical control, like in Weber et al., 2003) could be helpful (in a separate study maybe).

iii) The paper is generally well written but feels rather long in sections 1 and 2. Especially section 2 is mainly consumed describing the different versions of POAM and SBUV data, their latitudinal coverage, precision, etc. Most of this information could be put in an appendix so that the reader can reach section 3 more fresh.

Technical Corerctions:

page 157, line 6: the Andersen and Knudsen, 2002 citation is not in the list of References.

page 157, line 19: replace "... has a major affect on O3 ..." with "... has a major effect on O3 ...".

References mentioned in my comments (optional):

Braesicke and Pyle, Sensitivity of dynamics and ozone to different representations of SSTs in the Unified Model, Q.J.R. Meteorol. Soc., 130, 2033-2045, 2004.

Hadjinicolaou and Pyle, The impact of Arctic ozone depletion on northern middle latitudes: interannual variability and dynamical control, J. Atm. Chem., 47, 25 43, 2004.

Karpetchko and Nikulin, Influence of early winter wave activity flux on midwinter circulation in the stratosphere and troposphere, J. Clim., 17, 4443-4452, 2004.

Weber et al., Dynamical control of NH and SH winter/spring total ozone from GOME observations in 1995-2002, Geophys. Res. Lett., 10.1029/2002GL016799, 2003.

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