Atmos. Chem. Phys. Discuss., 5, S5527–S5530, 2005
www.atmos-chem-phys.org/acpd/5/S5527/
European Geosciences Union

Atmospheric Chemistry and Physics Discussions

Interactive comment on "An unusual stratospheric ozone decrease linked to isentropic air-mass transport as observed over Irene (25.5° S, 28.1° E) in mid-May 2002" *by* N. Semane et al.

Anonymous Referee #3

Received and published: 20 February 2006

This paper discusses very low values of total ozone observed at Southern Hemisphere subtropical ozonesonde site Irene in May 2002. The value on 12 May – 219 DU – is certainly seen from Figure 1 to be low compared to the range of values measured in May during the period 1999-2005, though it might be noted that Figure 1 also shows values of less than 225 DU in early May for some other year (which exactly can't be determined from the Figure).

This paper does not really give any radically new scientific insights, but it is a nice demonstration of how different meteorological and chemical datasets, combined with

suitable models, can now give a reassuringly self-consistent picture. Thus here the low values of column ozone are shown to be associated with anomalously low concentrations in two height ranges 400-450K and above 625K (the authors refer to these respectively as 'lower stratosphere' and 'upper stratosphere', but I prefer 'middle stratosphere' for the latter) and these anomalous concentrations are shown be associated with poleward transport of low-latitude air (in the 400-450K layer) and with equatorward transport of high-latitude air (in the layer above 625K).

The authors argue that the Southern Hemisphere stratosphere at this time (early winter 2002) was unusually disturbed and note that the disturbed early-winter stratosphere was a precursor to the disturbed late-winter stratosphere and eventual highly unusual sudden warming. I have no reason to quarrel with this – I have also had the sense from presentations and papers on this topic that the vortex was anomlously disturbed in early winter. However it is difficult to assess from the data presented how anomalous this disturbance is, and whether the resulting low values of column ozone are quite as unusual (see comment above re Figure 1) as the later September warming. The authors use EP fluxes and 'effective diffusivity' calculations to support their picture of anomalously disturbed dynamics and anomalous transport. If I was seeking to shorten the paper then I would identify this material as possible for deletion. Firstly it is not very surprising that dynamical disturbance in the lower or middle stratosphere is associated with upward and equatorward wave propagation and wave breaking, consistent with the EP fluxes. Secondly I feel that the 'effective diffusivity' needs interpreting with care. 'Effective diffusivity' is all about irreversible transport of tracer across tracer area or equivalent latitude contours and also captures such transport in an averaged sense (with the average being along equivalent latitude contours). The interpretation presented here, on the other hand, is that filaments or air of anomalously low or high equivalent latitude values are present above Irene, in a localised region.

Overall I think that the paper deserves publication in ACP on the basis that it brings together together complimentary data and model output (particularly that shown in

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Figures 1-3) to give a nicely self-consistent picture of a low column-ozone event that is particularly interesting because of its occurence in a very unusual winter. I have raised some general issues above and I raise some specific issues below that should be considered by the authors before publication.

Detailed comments:

p12619 l7: 'best locations for detecting a possible recovery of the ozone layer' – but has there actually been identifiable depletion in tropics? Apparently not – see 4.2.2.1 of WMO Ozone Assessment 2002.

Figure 1: As noted above this shows low values during the period 1-6 May in a different winter to 2002 – though certainly for the period 12 May onwards 2002 is a clear outlier.

Figure 2: good to show all profiles with average superimposed, though note that corresponding plot for early May would presumably, on the basis of Figure 1, not have appeared so anomalous in 2002.

p12626 l6: 'simultaneously in the lower and upper stratosphere' – more middle stratosphere than upper stratosphere? Presumably the biggest contribution to the column comes from below 35 km or so.

p12626 l14: 'less ozone in the polar region at this time of year'? – presumably later in the year, above the region of chemical depletion, ozone concentrations are relatively large at the pole?

p12627 l22: 'changed from easterlies to westerlies early ... etc'. Firstly, we can't tell if this transition is 'early' because we have no information on other years. In fact, if this year is unusually disturbed then one might, in the absence of detailed information, expect that low-latitude winds would be more easterly that normal. Secondly, the relevance of the high values of effective diffusivity in the 20-30S latitude band for the transport shown in Figure 3 is not so clear. In Figure 3 it looks as though high-latitude PV values are advected to the region of the observations – therefore the values of

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equivalent latitude in the region of the observations would be more like 50-60 than 20-30. Again, as noted in general comments above, the relation of effective diffusivity to individual filamentary features is rather subtle.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 12617, 2005.