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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Refinements in the use of equivalent latitude for assimilating sporadic inhomogeneous stratospheric tracer observations, 2: Precise altitude-resolved information about transport of Pinatubo aerosol to very high latitude" *by* P. Good and J. Pyle

P. Good and J. Pyle

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Again we would like to thank the referee for his/her time and most useful comments.

———referee comment

1. The errors in the equivalent latitude in the polar vortex may well be due to peculiar structure in potential vorticity on which the equivalent latitude is based. Allen and Nakamura (2003) show that potential vorticity tends to form local extrema within the vortex due to diabatic effects, which can confuse the definition of equivalent latitude

(i.e., they create scatter in tracer plotted against equivalent latitude). They show that the numerically synthesized tracer using advection-diffusion calculation (without using PV) is much better behaving in the vortex and correlates better with satellite ozone measurements. I suspect that the equivalent latitude used by the authors here has the same problem because it is initialized with PV, and 5 days of transport calculation is probably not long enough to get rid of this undesirable feature of PV. Although I don t think it is necessary to redo the analysis to test this, it may be worth pointing out.

———author response

This point will be raised and the suggested reference included.

———referee comment

2. The mention of the "reversal of the gradient" in the fourth paragraph of section 2.3.1 is a bit confusing. It is confusing because there is a very clear reversal of the gradient at about the same altitude WITHIN the midlatitude segment, which I don t think is what the authors are referring to. The reversal of gradient within the midlatitude is due to the reversal in the vertical gradient (Fig.7) coupled with differential diabatic transport, just as in ozone, and has little to do with poleward transport. So I suggest something like: "In the 380-390 K bin, the contrast in nu_R at the vortex edge, apparent during 0-40 days, has been lost for 41-80 days." This can indeed be attributed to poleward transport, because higher values of aerosols cannot be supplied by pulling down the aerosol-poor air from aloft.

———author response

We are indeed referring to the gradient that appears within the modelled equivalent latitude segment. It should be emphasised that the modelled equivalent latitude segment includes true high latitude air, due to the large error in equivalent latitude at this potential temperature level. The intended argument is that we can say from Figure 1 that _true_ midlatitude air has lower vR than _true_ high latitude air. Clearly, for EQ5$>$70

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(and throughout the potential temperature surface) the error in EQ5 compared to true equivalent latitude air is very high, and some _true_ midlatitude air is included in this region. However, since we have found that true midlatitude air has lower vR than high latitude air, then the maximum vR values at high EQ5 must be representative of high latitude air. It is quite possible that near 355K the very highest true equivalent latitudes have slightly lower vR than, say at true equivalent latitude 70 degrees. However, due to the strong horizontal mixing that occurs in this region (and which also contributes to the large equivalent latitude error), and the relatively small area of this region, the difference is expected to be small; and in any case the error bars of the quoted result are large in this region. This will be clarified in a revised manuscript.

The technical corrections will also be addressed.

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 667, 2004.