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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

Anonymous Referee #1

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General comments

This paper uses equivalent latitude and potential temperature as coordinates to demonstrate transport of aerosols into the polar vortex in the lower stratosphere. The result (e.g., Fig.7) is very convincing and complements earlier studies (e.g., Plumb et al. 1994) with observational data. This is a good paper but I do feel that the elegance of equivalent latitude is somewhat undermined here by the errors in high latitudes. The errors could actually be attributed to the potential vorticity structure inside the vortex

(see below). There is also a confusing statement about the reversal of the gradient, which merits minor revisions.

Specific comments

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.

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.

Technical points

p.2 col.1 2nd para. L.9 The definition of equivalent latitude: see my comments on Part 1. p.3 Sections 2.2 and 2.3.1 There appears to be disagreement between the potential

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temperature levels covered by SLIMCAT (380-520 K) and actual analysis (350-520 K). p.3 col.2 3rd para. L.11 390-390 K –> 380-390 K (?) p.4 Section 3.1 3rd para. L.1 Klessthan (typo) p.4 Section 3.1 4th para. L.1 Klessthan (typo)

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