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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, 1: Detecting transport of Pinatubo aerosol across a strong vortex edge" *by* P. Good and J. Pyle

P. Good and J. Pyle

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First, we would like to thank the reviewer for taking the time to study our manuscript and for offering some very useful comments.

———referee comment

1. The authors are probably correct in their assessment of the relative contribution to the aerosol-equivalent latitude scatter in the vortex edge regions: the scatter is most likely due to error in the equivalent latitude and not to the measurement errors or chem-

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istry or sedimentation. What is not clear is the extent to which the error estimate in this narrow region of the stratosphere based on single assimilation (UKMO) is representative. Allen and Nakamura (2003) show that equivalent latitude is most sensitive to the driving wind, and that the sensitivity on the wind varies with region and season. In fact, their analysis suggests that the equivalent latitude errors are probably minimal in the edge region where winds are smooth (and hence well modeled) and all tracers are strongly slaved to the wind. If this is true, the 2.6 degree estimate that the authors obtain is perhaps close to the lower bound of errors. I understand that this paper is primarily about the method and not about an exhaustive analysis, but at least some discussion seems necessary on this point.

———author response

Indeed, the quoted error was intended to be representative only of the vortex edge region, and this will be clarified in a revised manuscript. Certainly equivalent latitude errror would be expected to be very much larger outside the edge region. However, these relative errors are due to differences the underlying dynamics, which in turn lead to very different requirements on the equivalent latitude tool in the edge, surf-zone and vortex core. The purpose of this paper was to investigate the use of equivalent latitude in detecting transport across a strong vortex edge. For detecting cross-vortex transport, or in general the position of an air parcel with respect to the vortex edge, only the error in vortex edge equivalent latitude is important.

———referee comment

2. The authors calculate equivalent latitude by integrating SLIMCAT model for 5 days from an observed potential vorticity distribution. It is argued that the effect of transport is to "randomize" errors, making it more Gaussian. First of all, if the model were run longer, does the gaussianity improve further? It seems to me that the method is chosen for practical reasons with two assumptions: a) the equivalent latitude of analyzed potential vorticity is reasonably close to the true equivalent latitude and hence provides

ACPD

4, S518–S520, 2004

a good initial condition; b) 5 days is sufficiently long to achieve gaussianity in errors but sufficiently short so as not to cause computational burden. Is this correct? I think it is clarify potential vorticity and the subsequent transport calcula-tions. An alternative way of obtaining equivalent latitude may be to solve a long-term advection-diffusion problem to numerically generate PV-like tracer (Haynes and Shuckburgh 2000; Allen and Nakamura 2003). This way the equivalent latitude is decoupled from the analyzed PV, and error is likely to be well randomized. (These authors report that the obtained tracer is very similar to PV).

———author response

The reviewer's comments on our reasons for choosing the particular method of generating equivalent latitude are correct. This point will be clarified in a revised manuscript, and the suggested alternative mentioned and referenced.

The other reviewer comments regard clarification and technical correction, and will be addressed in the revised manuscript.

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 635, 2004.