Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union









Atmos. Chem. Phys., 4, 1823-1836, 2004
www.atmos-chem-phys.net/4/1823/2004/


# 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

P. Good[1] and J. Pyle[2]
[1]Institute of Environmental Research and Sustainable Development, National Observatory of Athens, Greece
[2]Centre for Atmospheric Science, Cambridge, UK

Abstract. The use of PV equivalent latitude for assimilating stratospheric tracer observations is discussed - with particular regard to the errors in the equivalent latitude coordinate, and to the assimilation of sparse data. Some example measurements are assimilated: they sample the stratosphere sporadically and inhomogeneously. The aim was to obtain precise information about the isentropic tracer distribution and evolution as a function of equivalent latitude. Precision is important, if transport across barriers like the vortex edge are to be detected directly. The main challenges addressed are the errors in modelled equivalent latitude, and the non-ideal observational sampling. The methods presented allow first some assessment of equivalent latitude errors and a picture of how good or poor the observational coverage is. This information determines choices in the approach for estimating as precisely as possible the true equivalent latitude distribution of the tracer, in periods of good and poor observational coverage. This is in practice an optimisation process, since better understanding of the equivalent latitude distribution of the tracer feeds back into a clearer picture of the errors in the modelled equivalent latitude coordinate. Error estimates constrain the reliability of using equivalent latitude to make statements like "this observation samples air poleward of the vortex edge" or that of more general model-measurement comparisons. The approach is demonstrated for ground-based lidar soundings of the Mount Pinatubo aerosol cloud, focusing on the 1991-92 arctic vortex edge between 475-520K. Equivalent latitude is estimated at the observation times and locations from Eulerian model tracers initialised with PV and forced by UK Meteorological Office analyses. With the model formulation chosen, it is shown that tracer transport of a few days resulted in an error distribution that was much closer to Gaussian form, although the mean error was not significantly affected. The analysis of the observations revealed a small amount of irreversible transport of aerosol across the vortex edge during late January 1992, coincident with a strongly disturbed vortex.

Final Revised Paper (PDF, 853 KB) Discussion Paper (ACPD)

Citation: Good, P. and Pyle, J.: 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, Atmos. Chem. Phys., 4, 1823-1836, 2004. Bibtex EndNote Reference Manager