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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Contribution of mixing to the upward transport across the TTL" *by* P. Konopka et al.

**Anonymous Referee #3**

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Review of acpd-2006-0343 "Contribution of mixing to the upward transport across the TTL" by Konopka et al.

This manuscript runs and evaluates a lagrangian chemical transport model in 3 dimensions. Simulations are compared to tropical/subtropical aircraft flights over South America. Results are extended to climatological (seasonal) simulations of the TTL. It is argued that some additional 'mixing' can lift air parcels in the TTL from 350K to 380K (the main convective outflow to the level of zero heating or the cold point). In general, this paper is well presented and discussed.

However, the conclusions need substantial revision. This paper may be publishable in ACP with several important revisions.

The major conclusion, that there is some sort of shear induced vertical motion, needs to be better analyzed and discussed. Mixing in CLaMS is parameterized from the shear and strain, so the conclusion seems to follow directly from 'tuning' the simulations. But what physical process is responsible for the mixing? And what does the model tuning (or the parameters that govern mixing in CLaMS) say about processes in the atmosphere? The conclusions should be tied back to the analysis of individual cases to illustrate that the mixing is not a model artifact.

There are a few issues in the model description that need clarification as well. These are detailed below.

Specific Concerns:

p12220, l6 and l17: If you are discussing radiative heating, the reference to Gettelman et al 2002 here should be a different paper: Gettelman et al 2004 (JGR-Atmospheres).

p12222, l20: How does the simulation work when topography intersects the gray lines in figure 2? I thought this was some sort of terrain following coordinate?

p1226,l7 & l20: The references to figure 7 here I think should be to figure 3.

p1228, l17: I think the reference to figure 7 here should be figure 5.

p1228, l20: Does z refer to geometric height (km)?

p1229, l22: Please be more specific regarding the boundary conditions. What chemical species are initialized for new parcels? Does the bottom boundary condition imply a flux, or do parcels 'bounce' off the boundary? Do you conserve the mass (number) of air parcels in the simulation? How might this affect the results?

p12232, l15: the first arrow in figure 7 is not clearly elevated ozone.

p12232, l22: "indicating TOO weak upward (or TOO strong downward) transport..."

p12234, l4: is there an objective way of determining the limits of the AB and BC flight



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regions? How do you know what these air masses are? Is there an objective way to do it with tracer-tracer correlations?

p12234, l16: Is there a clear mixing line here that would show how tropospheric and stratospheric air in this region mixed? I do not see one.

P12234, l26: are you implying that there was lightning NO production in the stratosphere in these observations? Or is it only in the upper troposphere?

p12240, l2: Here is where the general comment comes in. What physical process at the sub-grid scale from the meteorological analysis, or in the flow field itself, is doing the mixing? Is it some sort of wave breaking? How does shear mix? In CLaMS you prescribe the mixing. What does this represent? Not 'diffusivity' in the molecular sense. What is the 'effective diffusivity' representing?

p12243, l3: There are comments made about the seasonality of transport at the end of the conclusions here. Where is any seasonal information shown? How do you know this? The 100 day simulations are southern hemisphere summer. If you are going to make this statement, it needs to be defended with better seasonal analysis. Perhaps just remove it.

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Interactive comment on Atmos. Chem. Phys. Discuss., 6, 12217, 2006.