Atmos. Chem. Phys. Discuss., 6, S6354–S6356, 2007
www.atmos-chem-phys-discuss.net/6/S6354/2007/

Atmospheric Chemistry and Physics Discussions

ACPD

6, S6354–S6356, 2007

Interactive Comment

Interactive comment on “A numerical study of tropical cross-tropopause transport by convective overshoots during the TROCCINOX golden day” *by* J.-P. Chaboureau et al.

Anonymous Referee #1

Received and published: 19 January 2007

This paper provides an interesting comparison of in situ measurements in the UT/LS with model simulations of deep convection. On the basis of the comparisons, it is justified that the model reasonably accurately represents cross-tropopause vapor transport. From the model results a vapor mass flux is estimated.

The goals of the paper are highly laudable, and the paper's general approach is a good one. It is unclear, however, that the paper's conclusions are adequately justified, particularly to the point of putting a number on deep convective vapor ejection into the tropopause.

The calculations rest on the extent to which it can be assumed that the model is doing things right. Specifically, that the model is able to reproduce, and reproduce correctly the relevant phenomena at the tropopause. There are a number of concerns here that should be addressed.

1. Obviously, the strength of a quadruply nested model is its ability to represent a wide range of scales. The smallest scale represented is 625 m. Physically, this number seems arbitrary. A case needs to be made for why this scale should be physically sufficient. For example, mixing in the inertial subrange occurs down to inner scales of millimeters. Obviously such mixing would need to be parameterized, but what evidence can be provided that the model parameterizes this correctly for the conditions described (vigorous convection in a highly stratified environment)? At the very least, shouldn't the model be able to resolve the outer scale of the mixing? Does it? This is important, because the accuracy of the mixing representation rests on such parameterizations.

2. Many different phenomena have been observed around deep convective cloud tops. Only interfacial mixing between cloud and its environment appears to be considered here. Wang (2003) have simulated gravity wave breaking and shooting cirrus plumes. Garrett et al., 2004; 2006, have argued that pileus cloud can form. To what extent might these account for the observations in Figure 2? Can the model resolve such phenomena? If it can't, can these phenomena be ruled out?

3. It is concerning that the model employs saturation adjustment rather than being able to directly simulate humidity fields with their very long adjustment times near the tropopause. To what extent does this affect the mass flux calculations?

4. It is not clear what exactly is being seen in Fig 2. It is stated in the text that the pilots attempted to fly above the deep convection. Where then do the particles come from? The paper argues the particles come from deep convection doesn't it?

ACPD

6, S6354–S6356, 2007

5. It would be very helpful to plot specific points in Fig 2 on a mixing diagram, with total water mass on one axis, and potential temperature on the other. Without this sort of plot, it is very difficult to ascertain where the cloud came from.

6. Relative humidity and potential temperature appear to be anticorrelated at times, including within cloudy air. This would appear to point to in situ formation such as might be associated with a pileus cloud. Again, a mixing diagram would help.

7. If indeed the particles measured come from deep convection, there should be evidence for precipitation sized particles in the measurements. If formed in situ the particles should be very small, less than 5 um radius. Which was it? Were there both small and big particles? Again, mixing has specific microphysical and thermodynamic signatures that should be evident in the data. If they are not evident, or only minimally so, it is more difficult to make a case that the model is representing accurately the actual physics of the day.

8. Generally the writing is cumbersome to understand.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 13001, 2006.