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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Transport of short-lived species into the Tropical Tropopause Layer" *by* M. J. Ashfold et al.

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Anonymous Referee #1

Referee: This paper analyzes back trajectories in the Asia - Pacific region to understand transport into the tropical tropopause layer. The manuscript is generally well written. It does need some clarification and minor revisions before it is publishable in ACP: there are some figures that are not properly explained and documented in their captions, and there are some ambiguities with the analysis and references that need to be cleared up as detailed below.

Response: We thank the reviewer for their comments and address specific issues below.

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Interactive Discussion

Discussion Paper

Referee: P445, L24: There is earlier work on vertical transport of tracers in models. See Lawrence, Mark G., Philip J. Rasch, 2005: Tracer Transport in Deep Convective Up-drafts: Plume Ensemble versus Bulk Formulations. J. Atmos. Sci., 62, 2880–2894.

Response: We now refer to this paper.

Referee: P446, L7: This is misleading: Heyes et al use winds from a model that includes a convective parameterization: the large scale fields have convection implicit in them. Please rephrase.

Response: We agree that this sentence is slightly ambiguous and have therefore re-ordered it. The Heyes et al trajectory calculations did not use a parameterisation of convection, though the model from which the resolved winds were obtained does include such a parameterisation.

Referee: P447, L15: All of these aircraft reach to 19km or so

Response: We have changed the middle of this sentence to 'easily within range' to emphasise this point.

Referee: P449, L3: Is that a problem with the model PBL scheme? What moves air in the free troposphere from 4km –> 12 km? Only convective entrainement would.

Response: We don't believe that we have presented any results that allow an assessment of the representation of the PBL in NAME. Instead, and as we note in section 5, our calculations seems to support the finding of Hosking et al. (2010). Their figure 7 shows that in their version of the Unified Model (run at 0.83 by 0.56 degrees): 1) a large fraction of convective cloud tops are found at 4-5 km, and 2) maxima in convective mass flux are frequently found between 4–5 km and 12–14 km. In other words, transport to the TTL is often a two-stage process: lifting from the boundary layer to the free troposphere, followed by lifting from the free troposphere to the TTL. The resolved winds that NAME uses, also from the Unified Model, will reflect these processes.

Referee: P454, L3: How do you get 10K trajectories from 342 sample locations?

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Response: We have clarified this sentence. 10K trajectories are released for each of the 342 measurements, giving a total of 3.42 million.

Referee: P454, L8: Which panel of figure 8 for clarity...

Response: We include a new figure, and have slightly reworded this section with the aim of clarifying the comparison between model and observations.

Referee: P466, Fig 2: Needs a color scale (frequency?) Is this a linear or log density/frequency scale for the joint PDF? Referee: P472: Fig 6: same issue as figure 2, needs a color scale.

Response: In the ACPD format figures 2 and 6 are split over two pages – the linear scale is on the second page.

Referee: P476, Fig 10: What would a perfect correlation look like here?

Response: Given the uncertainties in VSLS source strengths, in VSLS lifetimes, and in modelled transport we would not expect this calculation to perfectly reproduce the observed variability. A number of these uncertainties are already discussed in the text on page 455, and we now include a short discussion related to an additional figure which shows the correlation between modelled 15 day tracer and $CHBr_3$ observations for both CR-AVE and TC4.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 441, 2012.