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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Seasonal and inter-annual variations in Troposphere-to-Stratosphere Transport from the Tropical Tropopause Layer" *by* J. G. Levine et al.

**J. G. Levine et al.**

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Responses to Referee 1

We would like to thank the referee for his/her comments. We believe the paper has been improved in the process of responding to them.

Responses to main comments

1. As in our earlier study [Levine et al., 2007], we use a global, Eulerian model driven by ECMWF analyses to locate the tropopause and define the locations in which trajectories are released. At the start of each experiment, in each model column, we identify the grid box that contains the tropopause. The TTL is defined as the region four grid

boxes deep immediately below the boxes that contain the tropopause, between +/-20 degrees latitude. The trajectories are released from points spaced 1 degree apart on the pressure surfaces that bound the lowest of the boxes comprising the TTL (i.e. the lowest of the four boxes in each column between +/-20 degrees latitude). The result is, the trajectories are released between about 165 and 195 hPa (roughly 345-355K in potential temperature). We have not changed the text describing the locations of trajectory release in the Method section as we feel the additional detail, regarding the use of a global Eulerian model, may cause confusion instead of clarification; much of this detail is included in our earlier paper to which the reader is pointed.

In our earlier study, we found that the fraction of a TTL tracer found in the stratosphere four weeks after release increased upon increasing the altitude of tracer release within the TTL. However, the variations in the amount of TST taking place from different geographical (longitudinal) regions of the TTL were found to be insensitive to the altitude of tracer release. We have included a note, regarding the insensitivity of regional variations in TST to the altitude of tracer release, in an additional paragraph inserted before the final paragraph of the Method section.

2. In the additional paragraph inserted before the final paragraph of the Method section, we have also explained why we chose to investigate TST over periods of four weeks and discussed how our central finding - most TST from the TTL comprises transport into the ELS (c.f. transport to the overworld) - is influenced by the length of the trajectory calculations. Based on a single-release tracer experiment in our earlier study [Levine et al., 2007], the relative importance of transport to the overworld increases as we explore TST on increasing timescales. However, even after twelve months, two thirds of the TTL tracer found in the stratosphere is found in the ELS.

Levine, J. G., Braesicke, P., Harris, N. R. P., Savage, N. H., and Pyle, J. A.: Pathways and timescales for troposphere-to-stratosphere transport via the tropical tropopause layer and their relevance for very short lived substances, J. Geophys. Res., 112, doi:10.1029/2005JD006940, 2007.



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Interactive Comment