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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Where do the air masses between double tropopauses come from?" *by* A. C. Parracho et al.

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Response to specific comments:

1. We have added a new section "Composites of static stability and zonal wind". In this section we analyse the latitude-height cross section for the composites of the static stability of the zonal wind. In these composites we have also plotted the first and second tropopauses. The works of Shapiro (1980) and Keyser and Shapiro (1986) are mentioned in that section.

2. The composites of the static stability and zonal wind fields show that, in most domains, a significant number of events of overlap of the tropopauses must be as-

sociated with meridionally extended intrusions of tropical tropospheric air into the lower extratropical stratosphere, such as those analysed by Pan et al. (2009) and *Homeyer et al.* (2011). On the other hand, in four domains, all located in the east Asia/western Pacific sector, where the subtropical jet is stronger, the composites reveal a structure reminiscent of the 'Shapiro-like' tropopause folds (*Shapiro*, 1980). At these domains, for both DT and ST events, the tropical tropopause breaks close the jet core, and the narrow overlap of the tropopauses is consistent with the effect of the secondary meridional circulation (*Keyser and Shapiro*, 1986).

Figure 1 has been redone to include the 200-hPa wind speed. In this Figure the centers of maximum DT frequency are visibly located near the jet core. This suggests that the semipermanent character of DT structures there may be due to the effect of the secondary meridional circulation.

3. In the new version of the paper we have simplified the criteria for the selection of single an double tropopause events. However, in order to follow the reviewer's suggestion we would have had to compute back trajectories for regularly distributed domains, both horizontally and in altitude. Then, when analysing the back trajectories, we would have had to select the domains inside a DT layer at each initialization time. This would have been much more expensive computationally, and would have made it difficult to compare double tropopause events with single tropopause events.

4. The composite analyses of the static stability helps to clarify this point. It seems that a layer of extratropical tropospheric air just above the first tropopause is very frequent, whenever a tropospheric intrusion occurs.

5. It is not enough to simply look at the trajectories for DT cases because the air, just as it reaches the domain, may be transported southward when the DT event is associated with an anticyclonic Rossby wave breaking (see Figs. 2e and 2f

and Figs. 5d and 5e of *Homeyer et al.* (2011), and their comments in the first paragraph of section 4.1, and at the bottom of the left column in page 6).

Response to technical comments:

All suggestions have been taken into account. With respect to the question about the caption of Fig.1, the meaning of the relative frequency of DTs is explicit in the last paragraph of section 2.1: "The ratio between the number of times a second tropopause is found at a given grid point and the number of times a first tropopause is calculated, in the same grid point, gives the relative frequency of DT occurrences."

A copy of the revised manuscript is attached as a supplement file.

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Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/14/C604/2014/acpd-14-C604-2014-supplement.pdf

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 1349, 2014.