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Interactive Comment

# *Interactive comment on* "Tracer measurements in the tropical tropopause layer during the AMMA/SCOUT-O3 aircraft campaign" *by* C. D. Homan et al.

**Anonymous Referee #2**

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General comment:

This paper presents airborne measurements of atmospheric tracers made during the AMMA/SCOUT-O3 campaigns from the high altitude Geophysicae aircraft. The observations made in the TTL are analyzed in order to identify the transport pathways and mixing processes that have been undertaken by the sampled air parcels. In particular, analyzing the observations, the authors discriminate air masses impacted by e.g. convective mixing, overshooting convection, isentropical mixing across the subtropical barrier. The paper presents the first observations of dynamical tracers in the TTL over West Africa during NH summer and those data are worth being published. Moreover,

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Interactive Discussion

Discussion Paper

the analysis of the aircraft observations complemented by the trajectory analyses of Law et al. (2009) is bringing very interesting results concerning the impact of convection upon the composition of the TTL. Therefore, I support the publication of this paper after my comments are taken into account.

Scientific comments:

Introduction:

In the introduction, the authors cite Ricaud et al. (2007) who "suggest that the maximum penetration of convective systems into the lower stratosphere would occur primarily over Africa at all seasons". Nevertheless, the analysis of Ricaud et al. (2007) is based upon MAM data and is therefore not valid for all seasons. Furthermore, this suggestion from Ricaud et al. (2007) is not in agreement with many studies based on trajectory calculations such as Fueglistaler et al. (2004) or more recently Berthet et al. (2007). The results from Berthet et al. (2007) show that at all season and especially in JJA, Africa is not an important contributor to TST compared in particular to South and South-East Asia. Based on spaceborne observations from trace gases, other studies such as Park et al. (2007) or Barret et al. (2008) also point to a major importance of Asia concerning TST during NH summer. From assimilated spaceborne observations, Barret et al. (2008) especially show that in August, CO is uplifted up to about 100 hPa over Asia and only up to about 180 hPa over West Africa highlighting the more important role played by Asia concerning TST. Some mention to these points should be made in the introduction. Indeed, according to the present study based upon AMMA airborne observations of tracers in the TTL, during NH summer over Africa, vertical convective uplift reaches 350-360 K and unusually 370 K and there is no evidence of convective overshooting. Homan et al. are therefore in good agreement with Berthet et al. (2007) and Barret et al. (2008).

3.1.1 Main convective outflow

Analysing the airborne O3 profiles over Africa during AMMA, the authors state that



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"no boundary layer values are observed at the main level of convective outflow at 355 K" and that "above 370 K, the O3 mixing ratios are up to twice as high as during the SCOUT-O3 campaign". According to literature, they explain this difference (particularly above 370 K) by the seasonal variations of the Brewer-Dobson circulation, the AMMA observations being done in July-August and the SCOUT-O3 observations in November-December. Nevertheless, the important differences observed between the level of main convective outflow around 350 K and 370 K seem more difficult to explain with this dynamical reason. O3 in the tropical UT is strongly impacted by LiNOx emissions in the convective regions. There is a large difference in the LiNOx emissions from Africa and from the Northern Australian, Indonesian region and therefore on the LiNOx induced O3 production. All year round (and also in JJA), the tropospheric O3 columns are much higher over the Atlantic and Africa (zonal Wave-1) than over the Western Pacific (Thompson et al., 2000). Martin et al. (2002) and Sauvage et al. (2007) attribute this O3 pattern to O3 production (mostly from LiNOx) in the UT combined with the subsidence of air masses within the Walker circulation over the tropical Atlantic. In particular, from model simulations Sauvage et al. (2007) infer that LiNOx are responsible for an annual O3 enhancement in the UT of 25-30 ppbv over tropical Africa and only 10-15 over Indonesia/Northern Australia. This makes a 15 ppbv difference. The production of O3 by LiNOx should be mentioned as explanation for the O3 difference at the bottom of the TTL between Africa/AMMA and Australia/SCOUT-O3.

Details:

The authors mention measurements of a number of tracers (CFC's, SF6, CH4) that are not used in the scientific analysis. What is the reason? Are the measurements too noisy? Is the information from those gases redundant?

Fig 1 and 2: a single figure with two vertical axes (Potential temperature as main axes and altitude as left axis) would be better than two figures with two different vertical axes.



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