

Response to Dr. Michaela Hegglin

We apologize for omitting relevant and important references as generously brought to our attention by Dr. Hegglin.

This paper is an interesting contribution to the literature, but as a member of the SPURT science team I have to point out that there seems to be an unjust imbalance between how the SPURT aircraft campaign is referenced in comparison to the STREAM and other earlier campaigns. You cite 5 papers for STREAM in the data description section, but only the overview paper by Engel et al. 2006 for SPURT. While relevant SPURT papers to the discussed topics (Hoor et al. 2004 and Hegglin et al. 2006) appear in the reference list, they are not cited at the most relevant spots.

Section 2 should only give an overview of the applied data sets in this paper. The reason why several STREAM but only one SPURT paper have been cited in this section is simply because there is - in contrast to SPURT - no STREAM overview paper available that describes the complete mission data set.

In particular, the seasonal cycle in the O₃/N₂O relationship from the SPURT aircraft campaign has been published previously in Hegglin et al. 2006 (and for that matter also in Hegglin and Shepherd 2007, using the more extensive ACE-FTS satellite data), along with the explanation of where the seasonal cycle stems from, namely the seasonal changes in the relative strength of downward transport of aged stratospheric air and poleward transport from the tropically controlled transition region due to horizontal mixing from synoptic scale wave breaking; see Fig. 9 of Hegglin and Shepherd 2007. (There is of course also poleward advection associated with this synoptic scale wave drag, but for tracer distributions the meridional transport is dominated by mixing, as is very well known.) I would have expected the authors to acknowledge these earlier studies in their discussion on pages 28409 and 28410 (lines 1-14).

It is true that the papers of Hegglin and Shepherd (2007) and also of Bregman et al. (2000) (not mentioned by the reviewer, but referenced in the Hegglin and Shepherd (2007) paper) are missing and they must be referenced. Hence, we add the following to the revised manuscript:

p.28409, l.18: "In particular, we are interested in the N₂O-O₃ correlation in the LMS that has been also used in former studies for transport diagnostics in this region (e.g. Bregman et al. (2000), Hegglin et al. (2006) and Hegglin and Shepherd (2007)." (The paper of Hegglin et al. (2006) is already on the actual reference list)

p.28410, l.1: "... lower stratosphere above (Hegglin and Shepherd, 2007)."

However, we do not share the sentiment that it "is very well known" that the meridional tracer transport in the lower stratosphere is mainly dominated by two-way mixing and that the impact of the residual circulation on the tracer transport is negligible in this region. The negligibility of advective transport in the tropical transition layer on the tracer distribution in the LMS seems to be very unlikely looking at the net mass transport and at the similarity of the seasonality of mean age, which can be seen as a good proxy for the long-lived N₂O in this region, and the transit times along the residual trajectories (Birner and Bönisch, 2010).

Bregman, A., Lelieveld, J., van den Broek, M. M. P., Siegmund, P. C., Fischer, H., and Bujok, O.: N₂O and O₃ relationship in the lowermost stratosphere: A diagnostic for mixing processes as represented by a three-dimensional chemistry-transport model, J. Geophys. Res., 105, 17279-17290, 2000.

Hegglin, M. I., and T. G. Shepherd, O₃-N₂O correlations from the Atmospheric Chemistry Experiment: Revisiting a diagnostic of transport and chemistry in the stratosphere, J. Geophys. Res., 112, D19301, doi:10.1029/2006JD008281, 2007.