

Interactive comment on “Passenger aircraft project CARIBIC 1997-2002, Part II: the ventilation of the lowermost stratosphere” by A. Zahn et al.

Anonymous Referee #1

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Atmospheric Chemistry and Physics (ACP)

Title ?Passenger aircraft project CARIBIC 1997-2002 - Part II the ventilation of the lowermost stratosphere?

Zahn et al.

General Remarks:

The paper by Zahn et al. forms part of a 2-part analysis of CARIBIC O₃ and CO over the period 1997 to 2002. Part 2 describes an analysis of CARIBIC O₃ and CO investigating the transport and transfer of trace gases between the troposphere and stratosphere via the extra-tropical UTLS. The limitations of this analysis, particularly in relation to the estimate of the net O₃ cross-tropopause flux need to be considered

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further. Also, the differences between the CARIBIC data and the ozonesonde data need to be made more clear together with the implications for the conclusions.

As with Part 1, the limitations of the dataset, 75 flights over a period of ~4.5 years need to be dealt with more thoroughly in the text and some caveats placed on the analysis. Once the specific points detailed below are taken into account, I recommend that the paper can be published.

Specific comments:

Abstract: what is an isentropic iso-surface?

Figure 3 ? this figure is unclear. Why not plot CARIBIC data relative to thermal tropopause also (this is available according to Part 1). Also, it is very difficult to tell if location is having an impact on the results when they are averaged. It would be expected that data collected further south would have a different behaviour to that collected further north over the North Atlantic.

Page 4 (section 4) ? it is not possible to draw the conclusion that the Hohenpeissenberg has not been affected by vortex air because there is no trend.

Page 5 (section 5) ? why is the analysis based on 4 flights ? what does Figure 4 look like if all the data are plotted as a function of season? Is there still some clear demarcation between different times of year?

Page 6 ? what are the implications of the fact that there is no phase shift in the CARIBIC data between the LMS and TP cycles? It is difficult to compare the Hohenpeissenberg data with the CARIBIC data due to the different coordinates chosen. Add also TPchem to Figure 5.

Figure 6 ? there needs to be a discussion of the 12-day phase shift otherwise it is very misleading to include this in the figure. The CARIBIC data were collected in multiple locations compared to one location over Hohenpeissenberg therefore differences due to latitude need to be taken into account or it needs to be demonstrated using the

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CARIBIC data that they have little impact.

Page 7 ? which ?latter? sections?

Page 7 ? The section(s) discussing the amplitude of the O₃ seasonal cycle are confusing. Here, the authors state that the seasonal amplitude relative to the annual mean should be conserved whereas on Page 4 it is stated that at 380-400K the seasonal cycle is 10% of the mean and this rises to 40% at the tropopause. Which view is correct? There is an acknowledged discrepancy between the ozonesonde data and the CARIBIC data which needs to be addressed further. The ratio figures (O₃ max/O₃ min) would be better in a table.

Page 7 ? the calculation of the net O₃ cross-tropopause flux assumes that the transport of air to be negligible. How can this be the case, if it is needed to explain the O₃:CO relationships in part 1? Why is the calculation a lower limit?

Page 8 ? the discussion about the phase shift in cross-tropopause transport is not very clear and again the need for UT to LMS transport is invoked. It is also needed to explain CO behaviour in the LMS. Thus, there are contradictory points which need to be addressed. Further caveats need to be added to the text to address the impact of the assumptions and simplifications used to produce this estimate.

Page 8 ? the role of sporadic events in determining the composition of the LMS still requires determination and analysis of more comprehensive datasets covering different seasons and locations. The CARIBIC data (~1-2 flights per month) over the 4.5 years do not represent a large enough sample to draw such broad conclusions.

Page 9 ? how is it possible to determine that most mixing events are remote?

Page 9 ? the text gives a succinct summary of current knowledge about transport processes in the extra-tropics but it needs to be made more clear how this analysis of the CARIBIC data has contributed to furthering our knowledge.

Page 10 ? conclusions ? it is concluded that the O₃:CO lines are not the result of

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single events ? How is this conclusion reached (what does weak short-term variability in the O₃:CO relationship mean?)

Page 10 ? what are the bounds of the estimate of the net O₃ flux ? give a range.

Page 10 ? some general concluding remarks are missing.

General: the paper needs to be read by a native english speaker who can correct the wording in several places.

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 1119, 2004.

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