Atmos. Chem. Phys. Discuss., 4, S429–S431, 2004
www.atmos-chem-phys.org/acpd/4/S429/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Passenger aircraft project CARIBIC 1997-2002, Part I: the extratropical chemical tropopause" *by* A. Zahn et al.

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Received and published: 6 April 2004

Atmospheric Chemistry and Physics (ACP)

Title ?Passenger aircraft project CARIBIC 1997-2002 ? Part I the extratropical chemical tropopause?

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 1 contains a study of the characteristics of O3 and CO around the extra-tropical tropopause. As such, the results are interesting and provide some new insights into ways of analysing such datasets. However, the

limitations of the dataset, 75 flights over a period of ˜4.5 years need to be dealt with much 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:

Page 1 ? Introduction ? there needs to be some discussion about why such a study is interesting in order to put the results in a wider context.

Page 1 ? all tropopause definitions are not ?empirical? (statistical) ? they are often based on physical parameters such as T and the derived quantity PV.

Page 2 ? how can it be that only irreversible mixing takes place in the extra-tropica tropopause layer and that the layer is well ventilated as mentioned several times in Part 2. Air that has mixed into the LMS from below can also be mixed out again?

Page 3 (section 3) ? positive O3:CO correlations can also be produced from mixing between ?background? air masses which have lower CO and higher O3 in the UT. Negative correlations are also observed when stratospheric or UTLS air masses penetrate into the troposphere (e.g. see Parrish et al. 1998) as well as often at the surface, during the winter. O3 can also be produced photochemically downwind from source regions, albeit at slower rates but can be higher if in-situ sources (e.g. aircraft NOx) are present. What impact/constraints does this place on the analysis described here?

The fact that negative correlations do often occur in the UT is discussed later on page 7 - amend the text accordingly to take this point more clearly into account as a limitation of the study.

Page 4 ? what does ?meaningful correlations? actually mean? Flights would have to be along isentropic surfaces if data were truly to be collected in coherent air masses. In this respect, theta can be used as a vertical coordinate.

Figure 3 ? what about stratosphere to troposphere transport which is discussed at

ACPD
4, S429–S431, 2004

length in Part 2? This can also enrich the UT with O3 (which has been frequently observed) and also bring air lower in CO into the region. This part of the ?mixing? layer could be attributed to this downward mixing as well as upward mixing from the troposphere. Is this the reason for the jump in O3 concentrations at 1km above the thermal tropopause? What does this figure look like relative to the PV=2 tropopause. Is there any evidence for the layer extending below the definitions used here? How was the CO profile ?inferred??

Page 6 (and elsewhere) ? what is the ?rate of success? for TPchem?

Page 8 ? use of the 100ppbv tropopause has increasingly been replaced by more rigorous definitions of the tropopause ? this point should be acknowledged in the text.

Figure 6 ? What are the regional differences between the different CARIBIC flight routes?

Page 8 ? why are the ECMWF data ?less reliable??

Page 8 ? where does the thermal tropopause lie in relation to the dynamical (PV=2) tropopause? Does this change the definition in Equation 1.

Page 8 ? the CARIBIC dataset cannot really be deemed to be ?extensive? as it only represents between 1 to flights per month over a 4.5 year time period.

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, 1091, 2004.