Atmos. Chem. Phys. Discuss., 9, C5547–C5550, 2009
www.atmos-chem-phys-discuss.net/9/C5547/2009/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Diagnostics of the Tropical Tropopause Layer from in-situ observations and CCM data" *by* E. Palazzi et al.

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Received and published: 2 October 2009

General answer to referees/editor comments

Dear editor, dear reviewers,

authors kept in regard your comments, amendments and suggestions and thank all of you for many useful remarks, that have allowed to widen and improve the analysis presented in the paper.

We do hope that the manuscript is now more readable and fluent, and the conclusions less generic and more quantitative, than in its previous version.

Since the requests to sharpen the manuscript and extend the analysis were in common

among reviews, we include this general answer within each reply, to summarize the major changes done on the manuscript.

The paper presents additional analyses, consisting in the discussion of the vertical temperature and static stability (N2) profiles, the relative vertical CO gradients, and an extension of the H2O-O3 joint PDFs to the whole observational database. The vertical profile of N2, and the relative vertical CO gradients, in addition to the ozone gradient, allow to calculate the top and bottom bounds of the tropical transition layer and provide a precise metric to accurately and quantitatively compare the model and the measurements. All new analyses have allowed to improve the evaluation of the model capabilities in the TTL.

The most important differences among the campaigns arisen from the tracer analyses have also been deepened, though they were not among the principal objectives of the paper. This bring to a deeper evaluation of the model capability in reproducing the TTL structure and its thickness, and also allows to better analyse the factors leading to the model-measurements discrepancies. Additional figures on that point have been included in the specific answers to referees.

In order to highlight the objectives and the results in the text, the abstract has been changed to describe the main findings of the paper; the introduction has been substantially modified presenting the results of previous aircraft, satellite and model studies carried out in the UT/LS region, and clearly stating the aims of the work. The section “Methodology” has been re-structured to better describe the diagnostics used (Tropopause coordinates, vertical tracer gradients, and tracer-tracer correlations) and how data have been handled to perform the model-measurement comparison. One table (Table 3) is added to resume the observed and simulated values of the TTL thickness; Figures 4 and 5 (now Figures 6 and 4) have been modified to show, respectively, the vertical temperature profile, and the relative vertical CO gradient and N2 vertical profile. PDFs analysis has been improved taking into account the vertical distribution of the number of observations, and extended to all the measurement campaigns. The

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conclusions have been rewritten to summarize our findings and the new quantitative results.

Response to Editor

Introduction: please discuss the chemistry-climate study of Kremser et al., Atmos. Chem. Phys., 9, 2679-2694, 2009 The study of Kremser et al., focusing on water vapour transport in the tropical tropopause region in coupled Chemistry-Climate Models has been cited in the introduction after the CCM study of Gettelman and Birner, and briefly discussed.

P10-11: I don't think it is correct to state that referring data to a thermal tropopause removes geophysical or dynamical variability – see, e.g., Fujiwara, M., Hasebe, F., Shiotani, M., Nishi, N., Vömel, H., and Oltmans, S. J., 2001: Water vapour control at the tropopause by equatorial Kelvin waves observed at the Galapagos, Geophys. Res. Lett. 28, 3143–3146... for Kelvin wave modification of the thermal tropopause. The sentence has been rewritten: "[..] minimizing the effects of day-to-day variability related to meteorological factors (Pan et al., 2007)".

In section 3 or 4, I would welcome recognition of the discussion of vertical profiles in the TTL in MacKenzie et al., JGR 2006 This paper has been cited in the subsection 4.2, dedicated to discussion of water vapour vertical profiles.

P13/14: Please look to see what has been said of ozone transport in Heyes et al. (SCOUT-O3 special issue) and Vaughan et al. 2008 The studies by Heyes et al. and Vaughan et al. have been cited in section 4.1, and linked to the paper by Brunner et al., to explain the difference between the modelled and observed ozone vertical profiles during the SCOUT-O3 campaign.

Section 4: I think some metric(s) for model-measurement comparisons is required. In its revised form, the paper aims at presenting quantitative results, allowing the comparison between model and measurements to be more precise and objective than it was

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in the first version of the manuscript. For this, we have added an estimate of the TTL thickness, which is summarized in the new Table 3.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 11659, 2009.