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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "High-ozone layers in the middle and upper troposphere above Central Europe: strong import from the stratosphere over the Pacific Ocean" *by* T. Trickl et al.

**Anonymous Referee #1**

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General comments

An important mechanism for stratosphere-troposphere transport is suggested on the basis of the analysis of observations of very dry-ozone layers by lidars and mountain ground stations in Germany a few days after the onset of high-pressure periods during the warm season. The paper is partly based on a set of already published observations (Trickl et al., 2003) that are re-analysed making use of backward options developed for the particle dispersion model FLEXPART (Stohl et al., 2003). Simulations are pushed fifteen to twenty days backward in time in order to capture potential stratospheric intrusions over the Pacific or Asian anthropogenic contributions. The focus of the paper is

well within the focus of ACP.

My major concern with this paper is that it leaves on one side what could be conceptually new in the scientific literature. A too large part of the paper is devoted to reaffirm the ubiquity of laminar structures of different origins in the troposphere. However, that has been extensively published (e.g., Newell et al., 1999 ; Stohl and Trickl, 1999) and multiplying case studies makes little progresses. What is lacking in the paper is the analysis of the stratosphere - troposphere transport mechanism itself. What is the synoptical setting of the UTLS over the Pacific Ocean that could drive the Stratosphere-to-Troposphere Transport (STT) mechanism ? How a rather shallow transfer from the stratosphere into these rapid upper- and mid-tropospheric air streams over the Pacific Ocean that the authors claim to be the STT mechanism can produce the ozone rich layers with considerable vertical extent over Europe ? Is there a cause and effect relationship between this STT mechanism and the arrival of high-ozone layers a few days after the onset of high-pressure periods during the warm season ? Why the synoptical setting of the UTLS over the Atlantic Ocean and North America would not be able to produce such STT events ? Those are questions that the case studies presented bring to the fore and that the authors should tackle.

My conclusion is therefore that the paper needs major modifications, i.e. answering the above questions, before to be published on ACP. Alternatively, a much shorter paper could be re-written as a scoping study for a next paper devoted to the analysis of the STT mechanism. Since the stratospheric influence is shown to be mostly dominating with FLEXPART diagnoses, I recommend to get rid of the study of the vertical distribution of emission tracers from the different source continents above Germany (e.g., Figs. 5, 9 and 11). Only the most promising case studies should be selected as far as STT is concerned. Such a short and scoping study may end in laying the foundation for the next paper that will identify and document the upper level dynamics associated with the STT mechanism.

Specific comments



**ACPD**

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In the introduction (p3116 lines 21-23), the reference to Cooper et al. (2006) to state that a significant ozone enhancement in the upper troposphere above mid-latitude North America is due to import from the stratosphere is misused. Cooper et al. (2006) concluded on the significant contribution of LiNOx ozone production. Please check.

There seems to exist a contradiction in the hypothetical STT mechanism that is described as shallow at several places of the paper (p3114 line 08, p3116 line 28, p3117 line 01, p3128 line 16, p3129 line 03, p3133 line 11, p3135 line 01) and the fact that the observed high-ozone layers are several kilometres thick. Please explain or comment.

The stratospheric influence with the retroplume analysis is indeed quite important over the Pacific Ocean for case 1 (Figs. 2 and 3), case 2 (Fig. 7) and case 4 (Fig. 17), but it is not that negligible all along the subtropical jet from Africa, Middle-East and central Asia. Is there any reason to rule out the dynamics of the subtropical jet ? Sprenger et al. (2003) showed that during summer STT maxima are located over the continents, particularly over southeastern Europe and central Asia.

Minor comments

Figures for the retroplume analyses do not seem to connect exactly along the date line (180W/180E).

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Interactive comment on Atmos. Chem. Phys. Discuss., 9, 3113, 2009.



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Interactive Comment