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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The water vapour distribution in the Arctic lowermost stratosphere during LAUTLOS campaign and related transport processes including stratosphere-troposphere exchange" *by* A. Karpechko et al.

A. Karpechko et al.

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We thank the Reviewer 3 for the comments. Our answers are given below.

General comments

'Thus the strength of the paper should be the combination of the three aspects, which however is not achieved in the current version of the manuscript.'

The text will be modified in order to demonstrate more clearly the links between different parts of the manuscript. Based on our results we propose that the stratosphere-troposphere exchange near the jet stream and filamentation provide combined mech-

anism acting to transport water vapour into the lowermost stratosphere: first, transport through the tropopause near the jet stream by either turbulence or radiation and, second, transport deeper into the stratosphere by streamer. See also our answer to the Reviewer 2.

Specific comments

'Chapter 2 Data sets and tools: Here, a table with flight dates and some related information e.g. on meteorology would help to demonstrate that 11 flights in a period of 1 month are well suited to observe features as cut-off lows developing ion the vicinity of the jet. Some details given already in the Introduction (time period, location) belong to this Chapter anyway.'

The table will be provided.

'Chapter 2: Start with the description of the FLASH instrument whose data are used in this study, followed by the NOAA hygrometer which is only used as a reference. Describe the calibration procedure for FLASH.'

The calibration procedure for FLASH will be described in the revised version.

'4731, 4-5: Both references Yushkov are not easily accessible (conference proceedings), can they be provided on a website?'

Yushkov et al (2000) is available through request to general@ozone-sec.ch.cam.ac.uk This will be included to reference list, if allowed.

'4731, 7: quantify 'excellent' (in particular since Vomel et al 2006 is not yet published)'

The following sentence will be included to the text:

'The simultaneous measurements showed excellent agreement between FLASH-B and NOAA/CMDL instruments, with a mean deviation of -2.4 +/- 3.1 % (1 sigma) for data between 15 and 25 km.'

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'4731, 24-26: 'This might be taken into account ' This should be done or at least discussed again later in the text and not let to the reader to be done by himself.'

This will be mentioned again in the text when needed.

'Chapter 3 Observations: It is not clearly worked out what the criterion is for an airmass to be free of tropospheric influence, several number between 4 and 7 are used or the variability (determined by eye?).'

We use the variability determined by standard deviation shown in Figure 1. The standard deviation decreases with altitude until the level mentioned in the text. At higher levels the standard deviation does not change with altitude.

'4733, 8: ' out of 11 profiles': Are the2 exceptions 17 and 24 February which are discussed as case studies below? If these are exceptions, I recommend to use the other 9 profiles in the following 'climatology' only and to derive upper limits only for these 9 flights.'

These two flights are 6 February and 24 February flights. The highest penetration with respect to the tropopause was observed on 6 February therefore excluding 17 and 24 February profiles from the climatology will not change the results.

'4734, 14: 'evident in Fig.2': Why are mixing line(s) not plotted in this Figure?'

These lines indeed can be identified in Figure 3 between ozone mixing ratios of about 100 and 400 ppb. In absence of these lines tracer-tracer relationship would take the L-shaped form, with vertical line in the left part of the plot (low water vapour) marking stratospheric reservoir and the horizontal line in the bottom part (low ozone) marking the tropospheric reservoir.

'Figure 3 and discussion in the text: The authors (correctly) derive from the O3 and H2O distribution that the observed airmasses have not yet been mixed and are still filaments. I think it is crucial for the upcoming model studies to demonstrate when and by which processes mixing will occur. Unfortunately, such a mixing probably cannot be

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traced by measurements.'

The question 'when mixing will occur' could be roughly answered using model water vapour fields. Concerning the 17 February case, we can say that the filament largely disappeared from the ECMWF analyses by 18 February, 18UT (Figure 4h). Unfortunately, this can not be confirmed by our measurements. Answering the question 'by which processes mixing will occur' is not as easy and is left for the future work.

'4737, 1-2: I do not understand why this particular event can be useful 'even from a climatological perspective': There are similar observations as well as CAS (and also RDF) studies published previously, what is special of this particular event?'

Here we deal with filaments associated with development of cut-off anticyclones. We did not find in the literature references to similar case studies except cited CAS study by Peters and Waugh, (1996).

'4740, 1: Can a brief explanation of the CAT index be given here, in order to avoid to check Traub and Lelieveld?'

The formula for CAT index will be given in the revised version.

'4740, 18: 'An example', has a similar CTF study been made also for 24 February?'

No, the CTF calculations do not go further than 19 February. 'An example' means that there are several other CTF maps for the period 14-19 February showing similar features as the map presented.

There are also few other grammar and structure corrections suggested by the Reviewer as well as suggestions on improving visualisation of the results, which we greatly acknowledge.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 4727, 2006.