

Interactive comment on “Water vapor transport in the lower mesosphere of the subtropics: a trajectory analysis” by T. Flury et al.

T. Flury et al.

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General Response to Referee's comments

The authors thank the reviewers for their work on this paper.

We intend to adapt the article in the following way. Trajectories are now all calculated for the 2700 K isentropic surface for 3 days backward. The treated water vapor phenomena are compared to Aura MLS version 2.2 maps for the 2700 K surface. The explanation for the occurrence of the depletion and increase in water vapor remains the same and is still supported by the trajectory analysis and the corresponding MLS maps. Further we change the overview figure for all measured profiles and plot them as a function of latitude and the binning grid for the difference plot is taken smaller as suggested by Artem Feofilov. The CIRA86 zonal mean zonal wind figure is substituted

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by a ECMWF wind field at 60 km for the encountered situation on November 15. Finally some more details are given for the trajectory model.

Reply to anonymous referees #1 and #3

We would like to thank you for the remarks about the inconsistency of the MLS map altitude and trajectory altitude.

We agree that the trajectory altitudes do not correspond with the MLS map altitude for the Arabian Sea event. The MLS V 2.2 maps of 60 km (2700 K) do as well confirm our assumption of lower values above the Atlantic Ocean on November 5 and higher values one week later above northern India on November 12. In order to be consistent we now calculated 3 day backward trajectories for the 2700 K isentropic surface for both events. For the Arabian Sea event trajectories start on November 5 above the Atlantic Ocean around 21 N between the Cape Verde Islands and the Canary Islands, MLS shows H₂O values in dark green of about 6.2 ppm. The 3 day backward trajectories for the Arabian sea 1 week later start in northern India and Nepal and the MLS shows there a small yellow zone of 7.4 ppm surrounded by light green of 7 ppm what is a 20 % difference to the values 1 week before above the Atlantic Ocean. Looking at the MLS maps of November 6, 7 and 8 reveals that in fact the dark green zone of 6.2 ppm on the west coast of Africa moves towards the Arabian Sea, where there was more water vapor on November 5 and thus decreased until November 8-the measurement day. On the other hand the yellow zone above Northern India, Nepal and China moves into the Arabian Sea region the days following November 12. This shows the consistency of the calculated trajectories. For the Mediterranean event trajectories were now calculated at 2700 K instead of 2600 K. The trajectories do not change much and the reason for the decrease in water vapor on the return flight remains the same. This section of the results will be carefully rewritten and the new figures will be added.

Minor comments: 1) page 13777 (line 10-15): Delete the lines dealing with the general circulation of zonal winds, also delete Fig. 2 (CIRA wind). This is all too general, every

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reader is familiar with this, and even some of your sentences are not fully correct. Instead of, it would really impressive to show the horizontal plots of zonal and meridional wind fields of ECMWF which are used in the trajectory calculations. These should be discussed in section 4.

Reply:

We agree that the situation leading to the water vapor enhancement is more complicated than just a change of the zonal wind direction. ECMWF horizontal winds show a more complicated situation above India which is only slightly different for November 8 than November 15 but led to completely different 3 day trajectories. ECMWF winds on November 8 above India show almost zero zonal wind but a southward meridional wind at 60 km. On November 15 the zonal wind had small negative values and the meridional wind was also small but northward. In the text we will show the actual wind situation for November 15 at 60 km. Besides India one will see the strong mid latitude jet. This figure will replace the CIRA climatology figure.

2) page 13777 (line 22): Solar lyman alpha photolyses in the upper mesosphere. In the lower mesosphere and partly in the stratosphere it are the deeper Schumann-Runge bands. 3) page 13777 (line 24): The reason of enhanced water vapour at high latitudes during summer in the 60-80-region is an upward vertical wind, thus, the gradient of H₂O from the equator to the pole in the mesosphere is due to vertical transport, and not due to photolysis.

Reply:

This information is added to the text.

4) page 13778 (line 18): Is the vertical resolution of your instrument really 10-15 km? (typing error?)

Reply:

The FWHM of the Averaging Kernels at mesospheric altitudes is about 10-15 km. This

S7891

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Discussion Paper



is also the reason why the first time we did not question ourselves about the MLS map of 50 km, because there is also little contribution from 50 km for the retrieval at 60 km.

5) page 13779 (line 19): I miss the definition of the Mediterranean area in lat/long intervals.

Reply:

Information added to the text.

6) page 13780 (line 12): Delete Figure 7, say something about your numerical trajectory model, please delete the acronym TomTOM. Obviously, T. Flury has written this code, but do you really think that using Matlab and some visualisation software is so important to mention this several times?

Reply:

An efficient handling of large data fields is important for trajectory models. Our experience indicates that MySQL is ideal for the extensive administrative and search tasks connected with trajectory calculations. Thus it is important to describe the new environment and methodology of our trajectory model. All the search routines is taken over by MySQL. Matlab calculates and plots trajectories in a few seconds. We think that this is a new method which is very practical and should be mentioned in the text.

7) page 13780 (line 22): Here I would insert a more detailed discussion of the wind fields (ECMWF) in combination with corresponding plots (see minor point 1).

Reply:

A discussion in combination with the new figure of ECMWF winds at 60 km is added.

8) Caption of fig. 11: In the text you write Nov 11, in the caption it is Nov 8.

Reply:

Changed.

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Further minor comments were taken into account and errors corrected in the text.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 13775, 2008.

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Interactive
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S7893

