

Review of, ‘Transport of mesospheric H₂O during and after the stratospheric sudden warming of January 2010: observation and simulation’, by C. Straub et al.

General Comments:

This paper describes an analysis of the dynamics in the high latitude Upper Stratosphere/Lower Mesosphere (USLM) region during and after a stratospheric sudden warming (SSW) event. Observations of H₂O at Sodankyla using ground-based microwave radiometer (MIAWARA-C) constitute the main data used in this study. The authors also make use of the H₂O distributions from the Aura/MLS experiment. Backward trajectory analysis using a Lagrangian trajectory model and the results from the WACCM are included to support the analysis. The major findings relate to the meridional advection from low latitudes to the arctic USLM shortly after the onset of SSW and the attendant mesospheric upwelling. The topic and the results are certainly of interest. However, the paper needs to be revised before it is accepted for publication in ACP. Specifically, some of the statements need to be rephrased to remove inconsistencies, and more information on the quality of the observations used in the analysis should be provided.

Specific Comments:

- 1) P. 32815, L 4: The ozone depletion is mainly due to chemistry only in the upper stratosphere. Approximate pressure level should be mentioned in this context. In fact, Flury et al. (2009) also refer to the ozone depletion caused by transport at lower levels.
- 2) P. 32816. Sections 2.1 and 2.2 : Uncertainties in the ground based microwave observations and the Aura/MLS data in USLM region of interest should be mentioned.
- 3) P. 32819. L16. This sentence needs to be rephrased. Also, for obtaining the H₂O along the back trajectories, MLS data are probably averaged over a few scans within the latitude and longitude boundaries of interest. The uncertainties involved may be different from those of zonal averages used elsewhere.
- 4) P. 32822. L17. The zonal mean westerly wind (Figure 4, panel d) shows maxima at 0.1 hPa at 55°N and also at 35°N. Do the authors have any comments?
- 5) P. 32823. L 12. Rephrase the sentence. I am assuming that you mean to say ‘ It is difficult to distinguish between the two effects...’
- 6) P. 32823. L 16. This is not consistent with the figures 6 and 7. Only at 0.3 hPa the H₂O decreases throughout March. At higher levels the zonal mean

- data from MLS in fact shows an increase during March. The statement made here should be consistent with what is shown in Section 6.2.1 (P 32826).
- 7) P. 32823, L 19. The authors should give more evidence before concluding that ground-based measurements are well suited to study dynamical phenomenon like SSW. The agreement between zonal mean data and ground-based observation shown in Figure 6 is valid for the selected year. But there is no proof that zonal average satellite data will compare well with ground-based information every year. In fact, the authors have mentioned the inter-annual variability in the SSW events (Page 32821). Ground-based data are useful, but by themselves they are not enough to analyze dynamical events like SSW.
 - 8) P. 32824, L 4. The use of the term 'time series' is confusing. Except for the blue line, which represents the time series at Sodnakyla based on MIA-C data, the lines represent MLS data interpolated to different locations.
 - 9) P. 32824 L 26. The zonal average H₂O does not increase by 1 ppmv at 0.1 hPa at the time of max warming (Figure 7, region 2). Even at 0.03 hPa, the zonal average from MLS data shows an increase of about 0.7 ppmv and the peak value occurs around January 30. Such differences between ground-based data and zonal averaged satellite data are to be expected especially during a dynamical event like SSW.

Minor Comments:

P. 32812, L 4. 26.6° E

P. 32812, L 7. Define the pressure range of USLM region.

P. 32812, L 8. Delete 'in the end of January'.

P. 32813, L 8. Photolysis in the SR Band also contributes to the destruction of H₂O in the lower mesosphere.

P. 32815, L 1. Flury et al. (2009)

P. 32825, L16. Figure 9 shows the right column to be 0.1 hPa and the left column 1 hPa. Which is correct, the text or the figure? (The Figure caption may also need correction).

P. 32841. Change 26.6°N to 26.6° E in the Figure caption.

