

Interactive comment on “Middle atmospheric water vapor and ozone anomalies during the 2010 major sudden stratospheric warming” by D. Scheiben et al.

Anonymous Referee #1

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Review of "Middle atmospheric water vapor and ozone anomalies during the 2010 major sudden stratospheric warming" by Scheiben et al.

This paper presents analysis of a sudden stratospheric warming that occurred early in 2010. It uses reanalysis, satellite and ground based data. The observed variability in ozone and water vapour are attributed predominantly to a shift in the location of the polar vortex. There are several concerns with the manuscript in its present form (listed below) that need to be addressed before I could recommend acceptance in ACPD.

Major Comments:

- 1) The major concern with this paper is that it is not clear what was learned from
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the ground-based measurements that could not be determined from the satellite observations. The way the paper is structured (showing a global view and then point measurements) is unfortunate. It perhaps would have made more sense to show the ground-based first and then explain the variability from a the global observations of the large scale circulation. Still, even in that case, what was learnt from the ground-based observations? Unless this can be answered the scientific value of the paper is limited.

Figures 7 and 8 indicated the H₂O measurements are very sparse at Sodankylä and Onsala. The light and dark color shading in these figures makes it difficult to discern when the ground-based systems were taking data. For Onsala, there is a change in H₂O data source that is concurrent with a large increase - the reader is left to wonder if this is an instrument offset or the SSW. I would prefer to see timeseries plots showing both satellite and ground-based data at two heights (e.g. lower mesosphere and middle stratosphere).

- 2) Several times in the paper there is discussion of ozone loss caused by PSCs:

"The low ozone concentrations are possibly due to polar stratospheric clouds (PSCs), i.e. PSCs activate catalytic ozone destruction cycles by heterogeneous reactions of chlorine reservoir compounds on the surface of the PSC particles. Such PSCs were observed over Northern Europe during the time of the major SSW", "In the lower stratosphere, ozone concentrations remained very low until 20 February due to the same effect as over Onsala, i.e. due to catalytic ozone destruction caused by PSCs.", "low ozone concentrations were measured in the lower polar stratosphere, i.e. between 50 and 10 hPa, which are assumed to be linked to ozone depletion driven by heterogeneous reactions on PSCs."

This is speculation. No references are provided that indicated ozone chemical loss occurred during 2010. Did the temperatures get cold enough for PSC to form? It is also not clear the timing is correct - presumably sunlight is necessary to create active chlorine, and in January this may not be the case, depending on latitude. Since the

authors have access to MLS data they could presumably look to see if HCl decreased and ClO increased during this winter, i.e., there was evidence of chlorine activation.

3) The trajectory analysis in Figure 5 is not particularly illuminating or convincing. The lines often cross making them hard to follow. In addition, they do not show if the variations in temperature or water vapor come predominantly from horizontal or vertical advection.

Minor Comments:

32392/14: Is it necessary to define NDACC in the abstract?

32393/10: Suggest 'The lack of solar radiative heating at the polar leads to a large. . .'

32393/14: Be consistent throughout the document regarding commas following e.g. and i.e. My preference is for a comma after e.g..

32393/24: This should be zonal mean zonal wind

32393/26: I think it should be y^{-1} rather than yr^{-1} . I think 0.6 refers to major warmings, which should be defined here rather than 32395:5-9.

32394/18: You should probably explain how a "warming" can lead to the formation of PSC.

32394/22: Supply reference for NO_x loss temperature dependence

32395/22: Be consistent and comply with journal style regarding Sect. and Section.

32396/8: Is OEM used elsewhere - if not, do not define the acronym

32396/27: MLS defined after it is first used.

32397/2: Not sure what you mean by 'in the frame'

32397/3: Ref. for LAPBIAT?

32397/10: What is the valid MLS range?

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32397/19: Why are two sets of reanalysis data necessary? If they are different, then the discussion and figures should indicate which set is being shown. How good is the data in the mesosphere? I seem to recall a paper by Manney indicating reanalysis near the lid (~80km) is in error during an SSW due to the handling of parameterized gravity waves.

32398/4: 'typical' is vague. Is it a zonal mean? Is it a monthly mean? In a winter without an SSW? How are in and out of the vortex determined?

32398/23: photodissociation or reaction with O(1D)

32399/13-18: Move to Introduction

32400/5-14: The text should make clear this is satellite data

32401/24: "at this altitude" - which altitude?

32402/21 "associated with the"

32403/12: PSCs have already been defined

32408: "Red (blue) colors correspond to relatively high (low) mixing ratios." This shorthand is often used but makes for difficult reading, and its usage should be eliminated. In this situation, however, it is unnecessary since there is a scale.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 32391, 2011.

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