**Atmospheric
Chemistry
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Discussions**

Interactive comment on "The 2009 stratospheric major warming described from synergistic use of BASCOE water vapour analyses and MLS observations" *by* W. A. Lahoz et al.

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This paper investigates the quality of stratospheric water vapour analyses of the 2009 major warming, by looking at their consistency with the meteorology and by comparing computed descent rates to independent estimates. Papers featuring water vapour analyses are still quite rare (perhaps surprisingly), so this will be a useful addition to the literature. The content and methods are appropriate, but there are some major structural changes required to improve the presentation of the work on descent rates.

Major change

Descent rates are computed in both sections 3 and 5.3. However, the same features

are being tracked in the vortex average (Fig. 2, Sec. 3) and in the equivalent latitude-theta plots (Fig. 8, Sec. 5.3) so these estimates are far from independent. In fact, looking at the inconsistencies between estimates would provide a useful indication of their accuracy. These sections are also hard going for the reader due to the proliferation of numbers in the text. Therefore I would suggest:

(a) there should be just one section on descent rates, including also the last two paragraphs from Sec. 6

(b) many of the numbers currently in the text should be moved to a table, along with the Manney et al. (2009) and Lee et al. (2010) estimates, at least for those referring to the dry mesospheric or moist lower stratospheric features, e.g. (i) and (ii) in the terminology of Sec. 3. This will make it much easier for the reader.

Consideration could also be given to putting symbols on Figs. 2 and 3 at the points which are referred to in the text.

Minor

1) p24702 l25 - A reference to one of the long-established textbooks (e.g. Daley, Kalnay) on this subject might be appropriate. More generally, though the references in the introduction are all appropriate, and work on stratospheric water vapour analyses is rarely published, it would be nice to see a more exhaustive description of work on water vapour assimilation in the wider research community. For example, "An annual cycle of long lived stratospheric gases from MIPAS", Juckes, M. N., Atmospheric Chemistry and Physics, Volume 7, Issue 7, 2007, pp.1879-1897. More information explaining why published research has been so scarce to date (e.g. the lack of operational observations of stratospheric water vapour for NWP centres to assimilate) would also be useful.

2) p24705 l25 "averaged for the period..." Presumably a typo? The standard deviations differences (Fig. 1 RH) could not be computed from two averages.

3) Sec. 3 / Fig. 2 (top) Why does a relative minimum appear at 1400K after 26th Jan? This needs to be considered briefly in the text.

4) p24707 l21 / Fig. 2 - "localized features .. are consistent with the meteorological data" - please be clear what is meant here, as many of the localized features appear to be noise coming from the observations, e.g. the jumpiness of the descent of the dry mesospheric air mentioned on p24708 l6.

5) p24707 l28 "positive bias of order 0.25 - 0.5ppmv" this would be better justified if the difference between Fig. 2 (top) and Fig. 2 (bottom) were also shown as a figure.

6) Section 4 - It would be nice to see 16 January and 15 February in figure 3, seeing as they are referred to in the text.

7) Section 5.2, first para. This paragraph could be made more concise by eliminating repetition.

8) p24714 l12 "MLS water vapour observations, linearly interpolated to the orbit indicated" - surely a typo, as this would be pointless?

9) p24718 l1-7 and l19-25 - this information could be better presented graphically, e.g. by lines on the relevant plots

10) Fig. 5,6,7 line plots show a feature on 24 Jan in profiles 1000 to 1010 (a vertical grey bar) where the MLS errors appear to be infinite. This feature stands out and should be explained in the text (unless I have missed that somewhere?)

11) p24717 l28 "MLS observations are noisy within the 1 sigma ... error" This is true but surely that "noise" could also be partly due to real geophysical variability? E.g. fine-scale filament structure.

12) p24719 l3-4 "in the mid-stratosphere ... at 1700K on 8 January" a typo?

Technical

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1) p24704 l25 "are used" -> "were used" - use past tense to avoid confusion with the present tense list of constituents used in the current paper.

2) Caption to Fig. 3 is highly repetitive and should be more concise.

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