

Response to reviewer:
Stratospheric and mesospheric HO₂
observations from the Aura Microwave Limb
Sounder

February 4, 2015

We sincerely thank the reviewer for his/her thoughtful comments on the previous draft, we hope this new version is more suitable for publication. We believe the comparisons

Below are our responses to the reviewers comments in red.

General comments:

In general the authors did a good job addressing the issues raised in the reviews of the previous manuscript version. The paper has improved and is really very well written. The only remaining concern I have is related to the comparison to the FIRS measurements, which I still think is not a valid comparison (see specific comment below). For most other comparisons you use the daytime – nighttime differences in HO₂ in the 10 – 1 hPa pressure range, because of possible biases in the data. But for the FIRS comparison you average daytime and nighttime data and this obviously leads to a nice comparison.

Sorry the wording was odd, we average the **HO₂ daytime – nighttime differences**. The text in section 4.1 was changed to: The MLS *HO₂* profile corresponds to daytime–nighttime differences averaged over a 20° latitude bin centered at 30° N averaged over 10 days centered on the day of the balloon flight. I hope this clarify the issue, nevertheless see more details below.

This strongly suggests that the day-night average is used for the FIRS comparison in order to improve the agreement between MLS and FIRS, which is not a legitimate approach at all. As long as this issue is not addressed I cannot recommend accepting this paper. Otherwise the paper is very nice.

Specific comments:

Page 3, line 3: The presence of HOx family -> The presence of THE HOx family ?

Done

Page 7, line 14/15: onto a vertical grid of 6 surface per decade change in pressure

Somethings wrong here, please rephrase.

Changed to: These sorted radiances are then averaged onto a vertical grid with six pressure levels per decade (spacing of ~ 3 km) using the tangent pressure retrieved by the standard algorithm.

Page 7, line 25: jointly -> joint

Done

Same line: as oppose to -> as opposed to

Done

Page 8, line 5: have shown -> has shown

Done

Page 10, line 25: delete comma after as well as

Done

Page 11, line 2: its high -> their high

Done

Page 11, section 4.1: In my last review I raised the point that this comparison is in my opinion not a valid comparison, and I still hold this opinion. The FIRS profile you compare to is a single profile and a daytime profile, right?

yes

The MLS profiles shown in Fig. 6 are day-night-mean profiles.

yes

Given the very large diurnal changes in HO_2 within the pressure range used for the comparison, this is NOT a valid comparison. You need to compare averaged MLS daytime HO_2 profiles with the FIRS daytime profile. If only daytime MLS profiles are used, the MLS HO_2 mixing ratios and concentrations will be significantly larger than the FIRS values, but this is comparing apples to apples. Currently, this is not the case.

In addition, for some of the other comparisons you use the daytime-nighttime differences in the 10 to 1 hPa pressure range, because of possible biases of the nighttime profiles. This makes the use of day-night averages for the FIRS comparison even less justified. Perhaps Im missing a point here?

As can be seen, in Figure 1 in the red line bottom panels, at 1:45am MLS should retrieve minimal HO_2 (i.e close to zero values). However, in some instances we retrieved non-zero values indicating that there are some systematic biases affecting the retrievals, presumably not only those made at night but also those made during day. Hence, we recommend using the HO_2 day/night difference as a better estimate of the daytime HO_2 rather than taking the daytime measurements at face value. This is discussed in section 2 (last paragraph) of the paper.

So, even though the MLS is a day-night mean profile, this is used as a better estimate of the daytime HO_2 values and hence we are comparing apples to apples.

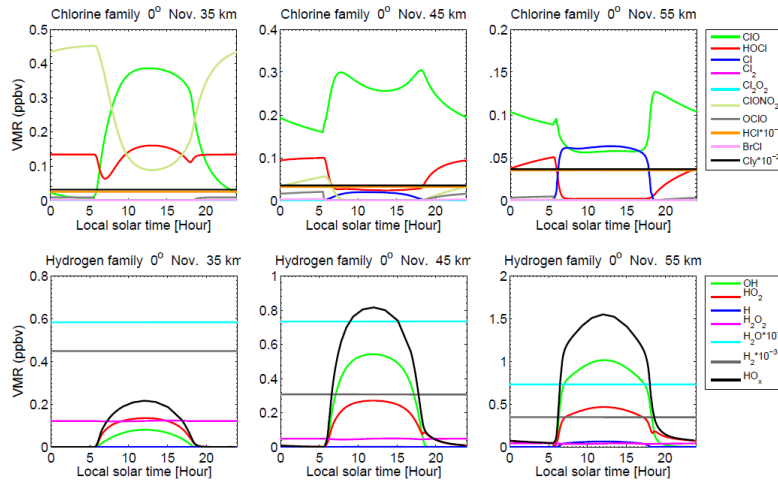


Fig. 2. Modelled diurnal variation of chlorine species (top row) and hydrogen species (bottom row) in the tropics (latitude 0°) calculated for 1 November and altitudes of 35, 45 and 55 km (left, middle and right). The diurnal variation of species are presented as volume mixing ratio versus local solar time. HCl and Cl_y (in the first row) and H_2O and H_2 (in the second row) have been scaled down for better visualisation of minor species (see legend). HO_x is the sum of OH, HO_2 and H.

Figure 1: Figure copied from (sorry for the poor resolution) Khosravi (2013) - Diurnal variation of stratospheric and lower mesospheric HOCl, ClO and HO₂ at the equator: comparison of 1-D model calculations with measurements by satellite instruments, ACP, doi:10.5194/acp-13-7587-2013

Page 12, line 4: in the ISS -> on the ISS ?

Done

Page 12, last paragraph: I suggest mentioning in the text that daytime-nighttime differences in HO₂ are shown in the 10 to 1 hPa pressure range in Fig. 7 and 8. This is mentioned in the Fig. caption, but it would be good to mention it in the text as well.

Page 13, last paragraph: I suggest mentioning in the text that daytime-nighttime differences in HO₂ are shown in the 10 to 1 hPa pressure range in Fig. 9.

In the result section we added “To alleviate biases in the MLS offline HO₂ data, the daytime–nighttime differences are used as a measure of daytime HO₂ for pressures between 10 and 1 hPa.” To make sure that the reader knows that the daytime–nighttime differences were used in all the comparisons / results.

Page 14, line 7: The zonal latitudinal gradient

Im not sure what is meant here. Suggest deleting zonal

Done

Page 16, line 17: smaller that -> smaller than

Done

Page 18, line 23: result that agrees -> a result that agrees ? or remove ; and continue with in agreement with .. but contradicting ..

Done

Brasseur and Solomon reference: add comma after Aeronomy of the Middle Atmosphere

Done

Add commas after last names of first authors in case of: Haigh et al., Rottmann et al., Smith 2012

Done

Summers et al.: Preuse -> Preusse

Done

Summers et al.: for m(see Sect. 4.3 for the model description)iddle ??

Done

Twomey reference: Asss. -> Assoc.

Done

Caption Fig. 4: for A daily .. offline data averaged over a is odd, suggest to rephrase the sentence

Changed to: Precision expected in MLS HO_2 offline data averaged over a 10° latitude bin for a day (D), a week (W), a month (M) and a year (Y).

Caption Fig. 5, line: corresponds to correspond to

Done