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Atmospheric Measurement Techniques Discussions

Interactive comment on "MIPAS temperature from the stratosphere to the lower thermosphere: comparison of version vM21 with ACE-FTS, MLS, OSIRIS, SABER, SOFIE and lidar measurements" *by* M. García-Comas et al.

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Response to Reviewer 2:

We thank Dr. Kristell Pérot for reviewing our manuscript and for her useful and detailed comments. We think we addressed all issues she raised. The answers (AA) to her comments (RC) and the changes made in the revised version are given below.

RC: The main comment is that the description of the inter-comparison seems to be

a bit too optimistic in my opinion (the differences shown in the figures are quite often beyond the ranges given in the text). That should be reconsidered.

AA: We are more precise in the revised version when quantifying the intercomparison differences written in the text. We have followed the referee's specific comments listed below in order to address this main comment.

RC: p.6656, l.14: Is there any reference (an ESA technical note for example), describing the version 5.02/5.06 of MIPAS L1b spectra? If so, it would be useful to add this information.

AA: We include now the following reference: 'Raspollini et al.: Eight years of MIPAS measurements, in: Proc. 'ESA Living Planet Symposium', ESA SP-686, pp. 011-d2, ESA Publication Division, 2010.'

RC: p.6657,l.10-12: "In the summer high latitudes, WACCM-SD atomic oxygen is 2-3 times larger than NRLMSISE-00 at the mesopause (87 km), leading to 5-6 K larger temperatures." Could you please briefly explain why larger atomic oxygen abundances lead to larger temperatures at the summer high latitude mesopause, while it leads to lower temperatures anywhere else (other altitudes and seasons)?

AA: During polar summer, the mesopause is very cold and, opposite to the behavior under other atmospheric conditions, the non-LTE population of the $CO_2(v_2)$ levels is larger than their population in LTE (the vibrational temperature is larger than the local kinetic temperature). Atomic oxygen quenches $CO_2(v_2)$ ($CO_2(v_2)+O(^3P)$ <-> $CO_2(v_2-1)+O(^3P)$). Larger quencher abundance leads to vibrational level populations closer to LTE. Thus, a larger atomic oxygen abundance leads to less populated $CO_2(v_2)$ and, consequently, a smaller forward radiance. The increase in the retrieved temperature, which leads to larger $CO_2(v_2)$ populations, compensates that smaller forward radiance due to the smaller $CO_2(v_2)$ populations. This is described in detail in Garcia-Comas et al., (2008). We include now the following sentence in the text: 'The response of the retrieved temperature compensates the changes in the modeled CO_2 vibrational levels

non-LTE populations induced by the change in the atomic oxygen abundance, which are described in Garcia-Comas et al. (2008).'

RC: p.6663: By looking at Fig.3 to 5, it seems that the temperature increases (up to about 6 K) above 100 km in the winter hemisphere, when upgrading from vM11 to vM21. Could you please comment this difference?

AA: As mentioned in the text, that is mainly due to the change in the CO_2 abundance ('Retrieved temperature variations due to the change from WACCM3 to WACCM-SD CO_2 are –1K at low- and mid-latitudes and 2-3K in the winter high latitudes above 85 km (...)'), and the change in the O abundance also around 105 km but not at 100 km (' WACCM atomic oxygen in the winter and equinox high latitudes (...) slightly changes at 100 km, producing there an unnoticeable effect').

RC: p.6664,l.8-12: SMR aboard Odin also provides temperature in the MLT on a regular basis from 2001 and it is still in operation (although it doesn't cover the whole altitude range considered here). The study by Orsolini et al. (JGR, 2010) has been done using this data set for example. Consequently, I think that it is not correct to affirm that the satellite instruments included in your study are the only ones providing this kind of measurements.

AA: We deleted 'are the only ones that' and '(as of the time of this publication)'.

RC: p.6665,l.14: "from 316 to 0.001 hPa": Please indicate an estimate of the corresponding altitude range, in order to make this vertical range comparable to that given for the other instruments.

AA: We also write now '(10 km to 97 km)'.

RC: p.6668,l.20: "for each hemisphere": Do you mean "for each season and latitude box" instead?

AA: Changed.

RC: p.6670,l.19-20: "and, to a lesser extent, in autumn": I would say to a lesser extent in spring as well (around 70 km).

AA: Spring also included.

RC: p.6672,l.21-23: "MLS and OSIRIS [. . .] differences of up to 10K" I would say 15K rather than 10K (summer, [30°-50°]).

AA: We write now '10K and 15K, respectively'.

RC: p.6672,l.28: "3-5K warmer than MLS": in winter, MIPAS mesopauses are 7K warmer than MLS at [50°-70°] and 9K warmer at latitudes greater than 70°. The 3-5K difference range is clearly underestimated.

AA: We write now '3-5K and 7-9K warmer than MLS in the equinoxes and the winter, respectively'

RC: p.6674,l.10-13: By looking at the figures, I would remove the word "slightly" (l12): these differences are significantly larger in the NLC mode comparisons than in the other modes (especially with ACE-FTS around the stratopause in the winter at high latitudes).

AA: Removed.

RC: p.6676,l.26-27: The difference between MIPAS and SOFIE stratopause altitude NH-SH asymmetries is not within the given range at latitudes greater than 70°.

AA: We changed 'smaller than 1 km' to 'smaller than 1.5 km'.

RC: p.6677,l.15-16: Please specify that you are talking about the [50°-70°] latitude box.

AA: Done.

RC: p.6679,l.8-11: The exception mentioned here is not the only one. Here are some examples: - Spring: MIPAS 4K colder than MLO lidar around 70km. - Autumn: MIPAS 3 to 4K warmer than TMF above 65km and 5K colder than MLO around 70km. -

Summer: the difference between MIPAS and TMF lidar temperature measurements is beyond the 2K difference range already from 75km. - Winter: MIPAS 3K colder than TMF at 45 and 75km, and 3K colder the MLO around 55-60km. - And the comparisons with both lidars are significantly out of the 2K difference range in the NLC mode (except for MLO in the summer). As a result, I think that these exceptions are too numerous for this statement to be true. Please reconsider it.

AA: We rewrote this paragraph. We changed the range to 'within 1K below 60 km and within 2-3K above 60 km' and mentioned the suggested exceptions out of those ranges: 'The MLO and TMF lidar measurements and MIPAS vM21 temperatures are generally within 1K below 60 km and within 2-3K from 60 km to 80 km. Systematic exceptions occur in the winters around 45 km in the comparisons over TMF, where MIPAS temperatures are 3K lower, in both equinoxes around 70 km over MLO, where MIPAS temperatures are 4K lower, and in the summers above 70 km over MLO and around 80 km over TMF, where MIPAS temperatures are up to 4-5K lower and higher, respectively.' We also wrote in section 4.1 the following exception: 'Around 45 km during the winter in comparisons with the TMF lidar, where MIPAS and SABER measure 3K lower temperatures than the lidar. The differences are slightly larger than the MIPAS and lidar combined estimated systematic error at this altitude (2K) and occurs systematically during this season.'

RC: p.6690-6695 (Fig.6-11): Why is the difference in the stratopause temperature not represented for the two lidars?

AA: We thank the referee for this comment because we did not notice before they were missing. All figures now include the MIPAS-lidar stratopause differences.

Technical comments:

RC: p.6654, l.3: Typo "Envirnonmental Satellite"

AA: Done.

RC: p.6655, l.19: Please specify more clearly the period considered in your study: it is January 2005 to March 2012, according to the abstract and summary, while it stops in April 2012, when communication with EnviSat was lost, according to what you say on pages 6654, 6661 and 6664.

AA: We corrected to 'from January 2005 to April 2012' where needed.

RC: p.6656, l.20: Isn't it more correct to say "the temperature increases BY 4K"?

AA: Done.

RC: p.6657, l.1: Please change "VM21" to "vM21".

AA: Done.

RC: p.6659,l.27: Please add a "s" to "field".

AA: Done.

RC: p.6660, l.22: Please change "VM11" to "vM11", and add a "s" to "contribution".

AA: Done.

RC: p. 6661, l.17: I guess you mean "July" instead of "June" for the NLC mode, don't you? I would be more logical as it corresponds to the peak of the NLC season. Moreover, "June" is in contradiction with the captions of the figures 5, 10 and 11. If July is the right month, please correct it on p.6662(l.20) as well.

AA: Corrected.

RC: p.6663,l.11: "arctic" should be written with a capital A.

AA: Done.

RC: p.6666,l.3: Typo "Earths's"

AA: Corrected.

RC: p.6666,l.6: Please add “km” after “45 to 72”.

AA: Added.

RC: p.6666,l23: Please correct the reference Remsberg (2008), there is a mistake. The paper you are citing here has nothing to do with SABER. I guess you wanted to refer to another paper by Remsberg et al., written in 2008 as well: “Assessment of the quality of the version 1.07 temperature-versus-pressure profiles of the middle atmosphere from TIMED/SABER, JGR”.

AA: Done.

RC: p.6673,l.24-25: You should not skip a line here, otherwise it is not clear that you are still talking about the summer high latitudes in this last paragraph.

AA: Done.

RC: p.6678,l24: Repeated word “horizontal”.

AA: Done.

RC: p.6679,l.18: I would suggest to change “smaller” to “lower”.

AA: Done.

RC: p.6685-6689: I think the labels for the figures 1 to 5 should be slightly bigger.

AA: Done.

RC: p.6686 (Fig.2): Typo “tproduced”

AA: Changed.

RC: p.6687-6689 (Fig.3 to 5): Adding the seasons (DJF, MAM, JJA, SON or January/July) at the beginning of each “line” of plots would make the figures clearer.

AA: Done.

RC: p.6697 (Fig.13): You mention only the [70;90] latitude band in the caption. Please add [50;70].

AA: Done.

RC: p.6697 (Fig.13): “northern” should be written with a capital N.

AA: Done.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 6651, 2014.