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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Daytime ozone and temperature variations in the mesosphere: a comparison between SABER observations and HAMMONIA model" *by* S. Dikty et al.

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Please find my replies to each comment below. The supplement file contains the updated script.

Kind Regards, Sebastian Dikty

Specific comments

2006 1ff: The abstract should be more concise and should report the results of the paper and not just what the authors intend to do. –> I have added more of the results to the abstract and brought the focus away from our intentions.

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Interactive Discussion

Discussion Paper

2006 22: What do you mean with “not well established” (time-scale, observations, and model)? The following paragraphs give a list of references of papers with quite different foci. It is not clear what the scientific problem is you are dealing with. Why do you not compare also diurnal variations with the model calculations? –> Unlike the stratosphere, the mesosphere is not as well understood. I concentrated on daytime, because for one during night ozone does not vary much and on the other hand diurnal variations have been investigated by Huang et al..

2006 23: Whereas it would be instructive to have numbers for comparison the mentioned variations connected with solar variability are of quite different nature. –> The amplitude of the 27-day signal is half of the 11-year solar cycle. Mentioning numbers would distract too much from the actual topic of this paper, which is the daytime variations.

2007 3: Exact sunrise and sunset is altitude dependent, insert approx. 6h and 18h. –> Changed accordingly.

2007 5: Is this a result of this paper or do you quote some other authors? –> This is a result of this paper.

2007 23: Write: ... nightfall when the photo-destruction... –> Changed accordingly.

2008 20: This reference should go to the introductory sentences of the section. –> Why? I do not see the point?

2009 24: The description of SABER should go to line 16. Please give a reference. –> I have moved this paragraph as requested. This certainly provides smoother reading. I also added the according reference to this paragraph.

2010 13: This sentence should go to line 4. In view of the results of your analysis you should explain why you put the 1.27 ïĄ■m emission at your first option. –> I have moved the sentence as requested. 1.27 ïĄ■m was chosen to silhouette ourselves from Huang et al., who chose only 9.6 ïĄ■m ozone for their analysis.

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2011 1: Perhaps “Description of the model” would be more appropriate. –> Changed to: “Description of HAMMONIA model”.

2011 13: non-LTE: I suppose it is meant for IR-cooling scheme. –> Yes, it is. I added this information accordingly.

2011 19: Please specify what you are interpolating (vmr, I guess). Does your interpolation accounts for errors of the vmr values? –> My interpolation does account for errors of the vmr values? Changes were made accordingly. The description of the data processing is getting clearer with the description of the yaw cycle in the following paragraph, perhaps exchange parts. –> Agreed, I exchanged both parts. As it makes a difference if you construct your daytime variations from geometric altitude grid or pressure height grid please specify what you have used for the following comparisons. –> I have mainly used the pressure grid as shown in Figs. 4-7 and mainly because SABER data was calculated on pressure grid. Figs. 3 and 8 have indications to the geometric height which serve as guidance for users who are more used to this kind of height grid. The pressure grid information has been added to the figure captions.

2012 1: What do you mean with time series? For all profiles sampled every day? Or over the whole period? Data gaps in time or in altitude? How do you justify the 3ïĄş criteria? Have outliers something special (twilight, solar activity, etc.)? –> I mean the time series over the whole period. Data gaps occur in time. For some days there’s simply no data available. I chose 3ïĄş as a good value that included nearly all of the data point (daily mean value). Outliers are not appointed to a special event such as twilight or solar activity.

2012 4ff: Do you use mean or true local solar time (accounting for the equation of time)? –> I use the true local time as provided in the SABER profile information. As I bin the data from 20° S to 20 ° N for a single day the true local times spread around a mean by approx. 30 min. This has been shown in Fig. 2.

2012 4ff: What systematic error do you estimate when constructing mean daytime

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variations with one data point per day and HA, shifting slightly over two months? You show in Fig. 3 that there are seasonal variations, so there should be some systematic effect on the construction of the daytime variation. –> On the time axis the systematic error is approx. 30 min as explained above. As for the systematic error in height one has to refer to the field of view and sampling steps of SABER. Last there is also a systematic effect on the construction of the daytime variation. This systematic effect – as for all mean values when not splitting into seasons – increases simply the standard deviation when computing the mean value if compared to just the means of just all Januarys, Februarys, etc..

2012 19: You seem to use the expression "daytime variation" for both: ozone vmr as a function of solar hour angle (HA) and for the anomaly expressed in percentage. Perhaps you should use different expressions. –> Independent of the units (either absolute in [ppm] or relative in [%]) used it is still a "daytime variation".

2012 20: units are ppmv or mumol/mol, the quantity is vmr. –> Changed accordingly.

2012 20: Figure 3: Please specify what is shown: does a dot represent data from one interpolated profile? What altitude is given in the plot (geometric, pressure). What is shown in Fig. 4 or Fig 5, average for a specific HA? Median? –> Each dot in Fig 3 represents a value from the daily area weighted zonal mean profile. The altitude, as indicated with [km] is in geometric height. Fig.4, 5 and 6 do indeed show an average for a specific local time. Changes have been made in the text to clarify things.

2012 25: At least for 2003 solar min conditions haven't been reached. –> True. I do not see the relevance for HAMMONIA which was run under solar minimum conditions.

2013 2: I guess you mean latitude circle. –> Yes, I do. Changed accordingly.

2013 7: This sounds that you have no information what is the HA in the model. –> Indeed, I do not have this information directly. It is explained in Sect. 3.2 how I come about this information.

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2013 18: Something is mixed up what band is shown. From the description Fig. 4 should be from 1.27 ïAęm airglow. –> I mistakenly swapped Fig. 4 and 5. This error has been corrected.

2013 25: What is shown in Fig. 8? Derived from the whole time series? Why Fig. 3 and 8 show 1.27 ïAęm airglow which shows a worse agreement with the model? –> The airglow ozone was chosen to facilitate a plus as compared to Huang et al.. It also shows stronger daytime amplitudes when compared to 9.6 ïAęm ozone that is used in Fig. 4. In addition, someone's attention should be rather put a difference between model and observation. This might draw the attention of the community.

2013 25: Only Fig. 5 gives the impression of a good agreement. Absolute values differ by a factor of two in the afternoon (Fig. 8), in the morning the model cannot reproduce the observations (Fig. 3). –> It is good to have a comparison between both ozone products even if one of them does not show the good agreement as the other does.

2015 1ff: This is very qualitative. You should give numbers. So, what is the progress with your work? –> The progress of our work is that the variations Huang et al. found in the v1.06 data and we in the v1.07 data is the good comparison with model output. In addition, we have included the 1.27 ïAęm ozone product in our analysis. Numbers were given in the chapter "Results" and seem to be out of place if repeated again.

2015 6: Eccentricity of the orbit of the earth should give a greater signal. You may test your hypothesis by analyzing N and S equatorial region separately. –> If that were the case values in Fig. 3 for January and July would differ more from one another than e.g. January and April. This is not the case, so I rule out the eccentricity having a greater effect in ozone than SZA. Another assumption could be that tidal amplitudes are larger during equinox than they are during solstice.

2015 14ff: The whole rest of the section is very qualitative and not conclusive. You should be able to estimate the contributions of chemistry and transport/dynamics to ozone and temperature variations for the model. –> The current model output as used

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in this study does not allow any further quantified statements to the contributions of chemistry and transport/dynamics.

2016 19: I think you mean atomic oxygen from molecular oxygen photolysis. –> Yes, I do. I changed this obvious mistake of mine accordingly.

Technical comments

2006 2: I would prefer to use equatorial instead of tropical. –> My latitude bin goes from 20°S to 20°N, which is not equatorial any more but still tropical. So, I would like to stick to tropical.

2006 20: change “effected” to “affected”. –> Changed accordingly.

2009 15: Change sentence to: The equator crossing time shifts by approx. 12min/day. –> Changed to: “The equator crossing time shifts by approx. 12 min per day.”

2024 Fig 3: Specify in the caption what altitude is given in the plot. –> “69.5 km, 74.5 km, 79.5 km, 84 km, and 88.5km”: That is what it already specified in the caption.

2025 Fig 4: Title and caption contradict in what is shown, see also Fig. 5. –> The title “SABER vs. HAMMONIA” indicates a comparison between observation (SABER) and model (HAMMONIA). So does the caption. I do not see how title and caption contradict in what is shown?

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/10/C5767/2010/acpd-10-C5767-2010-supplement.pdf

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Interactive comment on Atmos. Chem. Phys. Discuss., 10, 2005, 2010.