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Atmospheric Measurement Techniques Discussions

Interactive comment on "Retrieval of daytime mesospheric ozone using OSIRIS observation of $O_2(a^1\triangle_g)$ emission" *by* Anqi Li et al.

Anonymous Referee #1

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General comments:

This manuscript presents a generally well written study on a new MLT ozone data set retrieved from O2 IR A-band airglow emission measurements with the IR imager on the Odin satellite. The calibration of the IRI measurements is described, as is the retrieval approach and a first comparison with independent satellite measurements. The study presents an interesting and relevant contribution to the field and should eventually be published. I ask the authors to address the following comments, many of which are really minor.

I have two general comments:

1. The section on the calibration of the IRI measurements should be more specific and

detailed. I guess this paper will be THE paper on the calibration of these measurements and will be used as a a reference for future papers. The description is not detailed enough to understand the details and to reproduce the individual steps. I'm not asking for every little detail to be explained, but more information on the vague parts should be provided (see also the specific comments below).

2. The agreement of the IRI O3 retrievals with some of the other data sets is not very good or rather poor at some altitudes, latitudes and/or time of the year. The authors offer different explanations for these differences, but issues with the photochemical model are not discussed. I think this is an obvious candidate to investigate. I'm not asking for new analyses etc. but suggest mentioning that the model may be an issue here and may / will be tested in a future study. In my opinion the data sets (IRI and co-located SMR measurements are a unique opportunity to test and improve the photochemical model.

Specific comments:

Title: "OSIRIS observation" –> "OSIRIS observations"?

Line 12: "19 years-long mission" -> "19-year mission" ?

Line 38: "affect the inferred ozone distribution, especially whose lifetime is comparable to the transport timescales."

Something is missing / wrong here. Please correct

Line 54: "Degenstein et al. (2005b)"

I suggest changing the order of the papers in the reference list such that Degenstein et al. (2005a) is cited first.

Line 64: "sample .. have been processed." -> "sample .. has been processed."

Line 70: "we also include MIPAS and ACE-FTS ozone profiles, measurements retrieved from other satellites"

This is only a really minor thing, but “measurements retrieved” sounds somewhat strange. I tend to associate “measurements” with the initial radiance spectra measurements. Perhaps you could write, e.g. “.. ozone profiles, i.e. data sets retrieved from measurements with instruments on other satellites”. I leave it up to you to decide, whether you want to change this or not.

Line 83: “emissions with“ -> “ emissions with a” ?

Line 91: “dark current and electronic offset” -> “dark current and electronic offset correction”

Line 93: “version of (Bourassa, 2003).“ -> “version of Bourassa (2003).”, i.e. wrong cite command used.

Line 116: “The fitting process is a periodized”

Please explain what “periodized” means in this context. It is unclear to me.

Line 131: “The in-flight curves closely resemble the pre-flight curves with notable differences towards the edges of the arrays.”

It would be interesting to show this comparison, because this paper will probably serve as a description of the calibration process also to be used for future studies.

Line 141: “The shape of the stray light is then extrapolated to lower tangent altitudes”

Please describe, how this is done. There are many different ways to extrapolate data.

Line 148: “or photons per second from a unit area”

from a unit area? I think it’s photons passing through a unit area, right?

Same line: “The usual per nm wavelength dependence of the radiance”

This would then be “spectral radiance”. The quantity with your units is simply “radiance”

Line 162: “The final reported error also incorporates the error in the pixel electronics

offset”

How is the final error determined based on the individual error components? This should be explained in more detail.

Figure 1, left panel, x-axis label: “Radiance”

Units missing.

Line 187: “The value of phi is relatively insensitive to the emission temperature.”

Can this be quantified? If you have tested that it is relatively insensitive to T, you should be able to easily provide a rough quantitative estimate.

Caption, Figure 2: “Every two rows” -> “Every second row”?

Line 181: space missing in “B-band(688nm)“

Line 300: “are only sensitive below 90km or below.” ?

Line 330: “Eq.9” -> “Eq. 9”

Caption, Figure 6: “Every two rows” -> “Every second row”?

Caption, Figure 7: “scaled with their corresponding a priori profiles.” -> “divided by the corresponding a priori profiles.”

Line 347: “the 20 years data“ -> “20 year data set“

Line 386: “the thermal emission line of ozone”

Line? It’s many, many lines, right?

Line 388: “Van Der A” -> “Van der A”

Line 406: “SMR ozone measures from“ -> “SMR provides/measures ozone from”

Figure 8, IRI data: Why is O3 negative over such an extended altitude range? It would be good to discuss potential reasons in more detail. What about problems with

the photochemical model? Please also mention, whether the VERs are also already negative in these regions.

Line 425: “every 20th orbits .. have“ -> “every 20th orbit .. has“

Line 343: “and therefore blanked out in Fig. 9.”

Please check grammar of this sentence. Something is missing here.

Line 437: “MIPAS observes a deeper trough in the winter hemisphere as in IRI and SMR data, but a relatively even distribution in the MLT region.”

I can’t really see that in the figure. What does “deeper” refer to here? The ozone values or altitude? This is not clear.

Lines 441 following: The authors discuss differences in SZA as a cause for the differences between the different datasets. This is certainly a possible reason, at least for part of the differences. But are the differences between the data sets consistent with the diurnal variation of O3 and the different SZAs of the measurement shown in Fig. 10? This could be easily addressed qualitatively.

Figure 11, left panel: x-axis label is wrong -> “cmˆ-3”

Line 454 following: It should also be mentioned that the differences can be significantly larger at other latitudes.

Line 474: “Overall, IRI agrees very well with SMR”

Looking at Figures 9 and 12, I think this statement is not justified. Relative differences between the two data sets reach very large values, right?

Line 477 following: “The differences between IRI, ACE-FTS and MIPAS in Fig.12 may be explained ..”

There may also be issues with the photochemical model used to retrieve O3. I think this should be explicitly mentioned. The dataset should be used in future studies to

attempt to improve the photochemical model used.

Figure 12: I suggest that negative values are more clearly indicated (e.g. in black). The current depiction makes it difficult to identify negative values.

Table A2: “ACE-FTS tmospheric”

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