

Interactive comment on “Global nighttime atomic oxygen abundances from resampled GOMOS hydroxyl airglow measurements in the mesopause region” by Qiuyu Chen et al.

Anonymous Referee #2

Received and published: 11 June 2019

This paper describes how GOMOS observations of radiances in the OH(8-4) band are used to derive a new [O] product, a very important species in the mesosphere-lower thermosphere. It is presented in straightforward and easy to follow manner and is fairly well written. I believe it would be a suitable topic for ACP and would recommend it for publication after some mostly minor details (discussed below) are properly addressed.

General point: In my opinion, the introductory material focuses too much on the level 1 data and not nearly enough on the retrieval (level 1 to level 2) process. It might not be necessary to cut text about the level 1 data, but much more detail about the retrieval algorithm itself is needed, e.g. what kind of retrieval algorithm is it (as Rogers outlines

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many different schemes)? What did you use for your a priori? What assumptions are made in the forward model that could lead to potential uncertainties in the I2 data?

Specific points:

P1 Line 3: “based on” should be “derived from”.

Line 22: there should be “e.g.” at the start of the reference list.

P3 Line 2: OH(v=8) should be OH(8-4)

Line 12: please change “entities” to some thing like trace species, or atmospheric states. Also, what is meant by “mostly”?

Line 14: “descending node equator crossing time” is redundant.

Line 23: “lights” should be “emissions”

P4 Line 19: please, briefly, explain “star leakage” in the text.

P5 Line 12: what is meant by “quantified”?

P6 Fig 3: “altitude” should be either “tangent altitude” or “tangent height”.

Fig 4: If I’m understanding this correctly you’re showing slant column radiances, in which case it should really be “tangent height” (this would also need to be corrected in the caption and anywhere else it is discussed).

P7 Line 10: there are many approaches given in Rogers. As your technique hasn’t been published before, you need to have a lot more detail here about the retrieval algorithm.

Line 11: it is unclear what “complemented by variables” means. As it is, it sounds like the intention is to retrieve, e.g., wavelength shift parameters. Are you retrieving those? Or are you just trying to say that there is a wavelength shift taken into account in the spectral fitting?

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Line 15: where is your a priori coming from? If you say that it's coming from the "real atmosphere" that implies that you already know what the true state is. Your a priori needs to be described in much more detail.

P8 Line 3: "longtime" should be "time"

Fig 5 (right): I get somewhat nervous when I see measured and fitted profiles that agree that well. How did you choose to show this specific profile? Is this a typical fit, or is it one of the best fits? Some discussion needs to go in to why this example was chosen. Also, the y-axis is labelled as "altitude". Again, if I'm understanding this correctly you're showing slant column radiances, in which case it should really be "tangent height" (also needs to be corrected in the caption).

Line 15: "accuracy" is probably not the correct term here (implies systematic error). I think you're discussing "total uncertainty".

P9 Fig 6 caption: "lower" should be "lesser"

Lines 1-10: this section just needs a few lines of text describing how the error estimates were calculated (presumably through error propagation).

Multiple instances: "average kernel" should be "averaging kernel"

Lines 17-18: it is not the fact that the vertical resolution is close to the retrieval grid that tells you that the results is coming from the measurements and not the a priori. That information comes from the sum of the averaging kernels (which you have plotted and is near 1). Please discuss this.

P10 Fig 7 caption: "The retrieval altitude grid refers to the vertical resolution of the derived quantities". It's unclear what you were trying to say here.

Eq 1: It may not be strictly necessary, but why are you only fitting to an offset and not an offset + slope? I assume the slope wouldn't be significant, but it would be nice to have for completeness.

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P11 Lines 9-10: Please rephrase this sentence, as it doesn't fully or accurately define what is being shown in Fig 10.

P12 Fig 9 caption: could be good to remind people that the time bins are monthly means

Line 1: I could easily be wrong, but I doubt that the uncertainty on the solar cycle fit is precise to 0.1%. If it is, fine. But if not, I'd recommend rounding 17.1% to 17% (same with 9.6% at line 7).

P13 Fig 10: the AO and SAO panels are missing units (relative amplitude, I assume), same for the given P values (months, I assume).

Fig 10 and Table 2: It is unclear what the values for Solar Max and Solar Min represent. Please explain in the text and captions.

P14 Line 1: This may be a matter of opinion, but "validation" requires in depth analysis of comparisons with multiple other instruments. I would recommend changing the name of this section to "comparisons with SCIAMACHY".

Line 9: Did SCIA "always" measure at 10PM? Surely, that must change somewhat with latitude? Perhaps "always measured near 10pm"?

Line 17: could perhaps also mention fields-of-view.

Line 27: Please clarify what you mean by "consistent". Do you mean agree within the combined uncertainties?

Lines 32-33 (and on next page): When you use "OH($v=8$) emissions", it makes me think that you're measuring multiple OH($v=8$) bands, when I believe you're only looking at 8-4 (same with the $v=9$ instances). Please use the more specific notation. Also, at some point early on you should define that OH(8-4) means OH($v'=8 \rightarrow v''=4$).

P15 Fig 11: One thing that immediately grabs your attention in this plot is that the difference is becoming noticeably more positive over time, which seems to indicate

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that there's a drift in one, or both, of the data sets. Can you please comment in the text what might be the source of this change over time?

P16 Line 2: I don't think I agree with "as proxies for"; I would agree with "to derive". And to keep this sentence consistent with the next, I'd suggest instead of "excited states" you could have "excited state emissions".

Line 5: There are many more references available. At the very least you need an "e.g." before the reference.

Line 6: what is meant by "selective"?

P19 In the conclusions, please also summarize how the new data set compares with those from other instruments.

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2019-417>, 2019.

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