Interactive comment on "Comparison of ozone profiles and influences from the tertiary ozone maximum in the night-to-day ratio above Switzerland" *by* Lorena Moreira et al.

Anonymous Referee #2

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This paper has two main goals: to present a new version of the retrieval algorithm of the GROMOS dataset and to illustrate novel results concerning the diurnal variation of mesospheric O3 as observed by GROMOS. GROMOS provides an important long-term dataset for monitoring stratospheric ozone and therefore both points are important and make this work worth publishing in ACP or, possibly, AMT. However, I think this manuscript needs important improvements before publication.

For the first goal, my main objection is that the authors should show how the new retrievals compare with the previous ones. A comparison between the two versions of the dataset would provide to potential readers the necessary information on the improvements of the new dataset with respect to the GROMOS dataset presented in

the past (also very recently, for example by Moreira et al., 2016, in this same special issue). Additionally, such a comparison would offer a qualitative overview on how these new retrievals compare with other satellite-based or in situ datasets used in previous validation efforts of the GROMOS dataset.

For the second goal, I find that the main novelty contained in this manuscript is not in the observation of the MMM of O3 at mid-latitudes, but the fact that this specific long-term dataset (GROMOS data) displays it. It would therefore be interesting to show how well GROMOS does the job, i.e., how well GROMOS depicts the true state of the tertiay O3 which could be possibly represented by MLS original (high resolution) profiles.

Specific comments

Pg 1

Ln 13-15: This sentence presents a repetition that should be removed.

Pg 2

Ln 8-10: If GROMOS data have been validated in the past what is the need of an additional comparison with Aura/MLS? Differently, if the comparison with MLS serves as a validation of the new retrieval version, then a comparison of the new version with previous versions should also be present.

Ln 23-24: Awkward sentence

Ln 27: I would remove this sentence, or place it elsewhere.

Pg 3

Ln 9: What apriori information are you referring to? Temperature and pressure profiles? What about the ozone apriori profile?

Ln 18: Why do you have a systematic bias in the spectral measurements?

Ln 19: Even though the authors cite earlier papers describing in more details the tech-

nical aspects of the measurements, I think Figure 1 should still show an example of the spectrum measured and specify whether the 1-hour average spectrum is binned before deconvolving it. Are all channels binned in groups? Also those near the line center? This is critical for the high altitude comparison. Additionally, maybe a table similar to Table 1 of Moreira et al., 2015, would be a useful reminder of the main characteristics of GROMOS.

Ln 22: In figure 1, apriori and retrieved profiles are terribly close. I am aware that in the altitude region where the retrieval algorithm is the most sensitive the apriori has a very small impact on the profile retrieved, yet it would be nice to see it. Most readers don't know and will wonder what's the point of the measurement if the climatology from other datasets already provides you with the true state.

Pg 4

Ln 1: How is this an improvement with respect to the older version? Again, a comparison with the previous retrieval version is necessary.

Ln 19: Are these criteria consistent? The spatial requirement seems particularly generous compared to the temporal one. How far does a parcel of stratospheric air travel in one hour? A mesospheric one? Would a stricter spatial criterion improve your comparison results in the upper stratosphere/mesosphere? In other words, you should motivate your choices of coincident criteria.

Ln 21: I suggest "to" instead of "with the compliance of"

Pg 5

Line numbers indicated in the manuscript don't seem to be correct here and in the next page. I will refer to the actual line number.

Ln 1: I am not sure what this sentence implies. Are you suggesting that either the ground-based or the satellite-based data are inevitably faulty at high altitudes? Additionally, if I am not mistaken, the manuscripts you cite are either on SOMORA retrievals

(which reach 55 km at the most) or GROMOS itself. Are you suggesting that the present relatively large discrepancy in the GROMOS-MLS comparison at high altitude is likely to be due to GROMOS? If this is correct just say so.

Ln 4: I would write: "For an overview on the differences between coincident profiles, ..."

Ln 11: I would quantify the "almost perfect" with the slope of the linear fit. Second to last sentence in Section 3 : Could this be due to the spatial coincidence criterion? Last sentence in Section 3: I would suggest to postpone this last sentence to the conclusions section.

Pg 6

Line numbers indicated in the manuscript don't seem to be correct here or in the previous page. I will refer to the actual line number.

Ln 2: This needs to be better explained. Specifically, what part of your results agree with the work of Sonnemann 2007 and what doesn't. The fact that one dataset can peak at values that are twice as much as those of GROMOS seems an important difference. Do their data have a better vertical resolution? Retrievals that reach higher altitudes? Can you briefly address this difference?

Ln 4-8: I would remove these two sentences as they were already stated in the introduction

Ln 19: I would explicitly state what this anomaly is. Last two sentences in Section 4: It is not clear whether you ascribe the difference from Sonnemann et al. to the fact that Lindau is at higher latitudes. If this is the case, I would object that 5 degrees latitude cannot make this large difference in mesospheric ozone values and that a latitude of $51.7°$ N is not much higher than $47°$N.

Ln 27: Please, rephrase avoiding the repetition.

Ln 29: Together with the relative difference I would quote here also the absolute one, which is less than 0.2 ppmv, on average (if I read correctly from figure 2). Last sentence: I would specify what the anomaly is also here in the conclusions

Figure 1

- I would add a panel with the GROMOS 1-hour spectrum.

- I would enlarge, make it longer, the X-axis of the 3rd panel (maintaining the range 10-70 km).

Figure 2

- Would it be useful to show two separate averages, one for the daytime and one for the nighttime comparison?

- I would reduce the range of the X-axis of the middle plot to be from -60% to 60%

- I would use the same vertical unit (altitude or/and pressure) in all the figures or, even better, use both of them all the times. In figure 1 there's altitude, in figure 2 there's pressure.

Figure 3

- I would make these plots much larger, removing one or two pressure levels if necessary.

- Please specify in the caption the number of points involved in the moving average

Figure 4

- Same comment as for Figure 3: I would make these plots much larger, removing one or two pressure levels if necessary.

- I would add the numbers m and q in the equation y=mx+q for each linear fit, or at least the slope m.

- I am surprised by the relatively low correlation value at 0.617 hPa. By looking at figure 3 I was expecting a better result. Any comment?

Figure 5

- It would be useful to see a comparison of averaged nighttime vertical profiles, not just level 0.05 hPa, in order to establish, for example, whether the MLS O3 peak is at higher altitudes.

- As a matter of fact, it would be useful to see a comparison of GROMOS mesospheric profiles also with the averaged MLS original (not weighted with GROMOS AVK) nighttime profiles, in order to understand the capabilities of GROMOS to spot the MMM with the "correct" intensity at the "correct" altitude.

- It would be best if line colors in the various figures were consistent, e.g., MLS always in red, GROMOS always in blue, and so on. In particular, maybe colors in Figure 5 could be changed (GROMOS in blue and cyan, MLS in red and orange?)

- Again, please in the caption state how many points are included in the average

- In the bottom plot I would add the standard deviation of the mean for both GROMOS and MLS.

Figure 6

- Given that the daytime mesospheric ozone at 0.05 hPa is relatively constant, the night to day ratio provides more or less the same information already present in Figure 5. Maybe I am wrong, but then the authors should make an effort in discussing this figure a little more.