Response to Anonymous Referee #2 (RC2):

We would like to thank the second referee for her/his time, positive feedbacks and valuable comments. Please find below the original comments and the authors' response (in blue). Except where mentioned, figures and line numbers refer to the original submitted manuscript.

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This paper uses the harmonized timeseries from two ground-based microwave radiometers along with output from several models to investigate the diurnal cycle of ozone in the stratosphere and mesosphere over Switzerland. An interesting finding of this paper is that the amplitude of the ozone diurnal cycle has short-term variability. The paper is well-organized and provides useful data on the diurnal cycle of ozone. I list some general and specific comments below.

General comments:

Section 3.3: Tides are mentioned in the abstract and conclusion but could be discussed here as well to more strongly tie this section to the abstract and conclusions. It might also be helpful to show the timeseries for one of the observations (similar to Fig. 8a) but with the daily mean overplotted, to help distinguish changes in the diurnal cycle from changes in daily mean ozone, since both seem to be happening in the time series.

The authors agree that a discussion on tides effect on the ozone diurnal cycle could be added in this section and we propose to add a dedicated paragraph at the end of section 3.3 in a revised version of our manuscript. Regarding the suggestion of the referee to show the daily mean time series of ozone during one of the observation, we would argue that this is shown already in Fig. 10(b). If added to Fig. 8(a), we believe that it slightly degrades the readability of the figure (see Figure 1 below). If the referee agrees, our suggestion would be to keep Fig. 8(a) without the daily mean over-plotted lines and add some daily grid lines to highlight the time scale of the ozone changes.

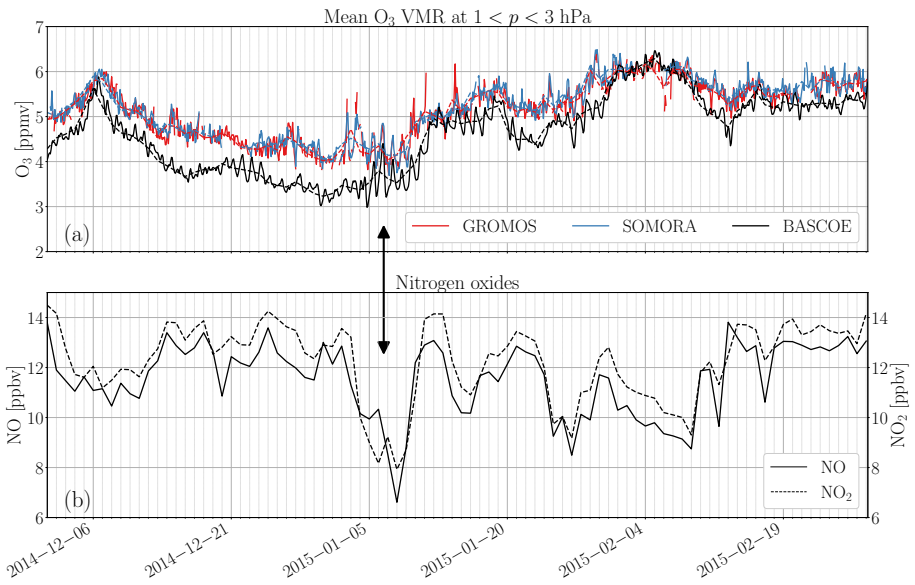

Figure 1: Reproduction of Fig. 8 with daily mean overplots (dash lines)

Specific comments:

Line 125: Are the day and night averaging kernels very different, and if so, how does this affect the results?

No, the day and night AVKs are very similar for the two instruments, which is why we showed only the daily averaged ones in our manuscripts. In Figure 2 below, the reviewer will find a comparison plot of the averaged day and night AVKs for GROMOS and SOMORA:

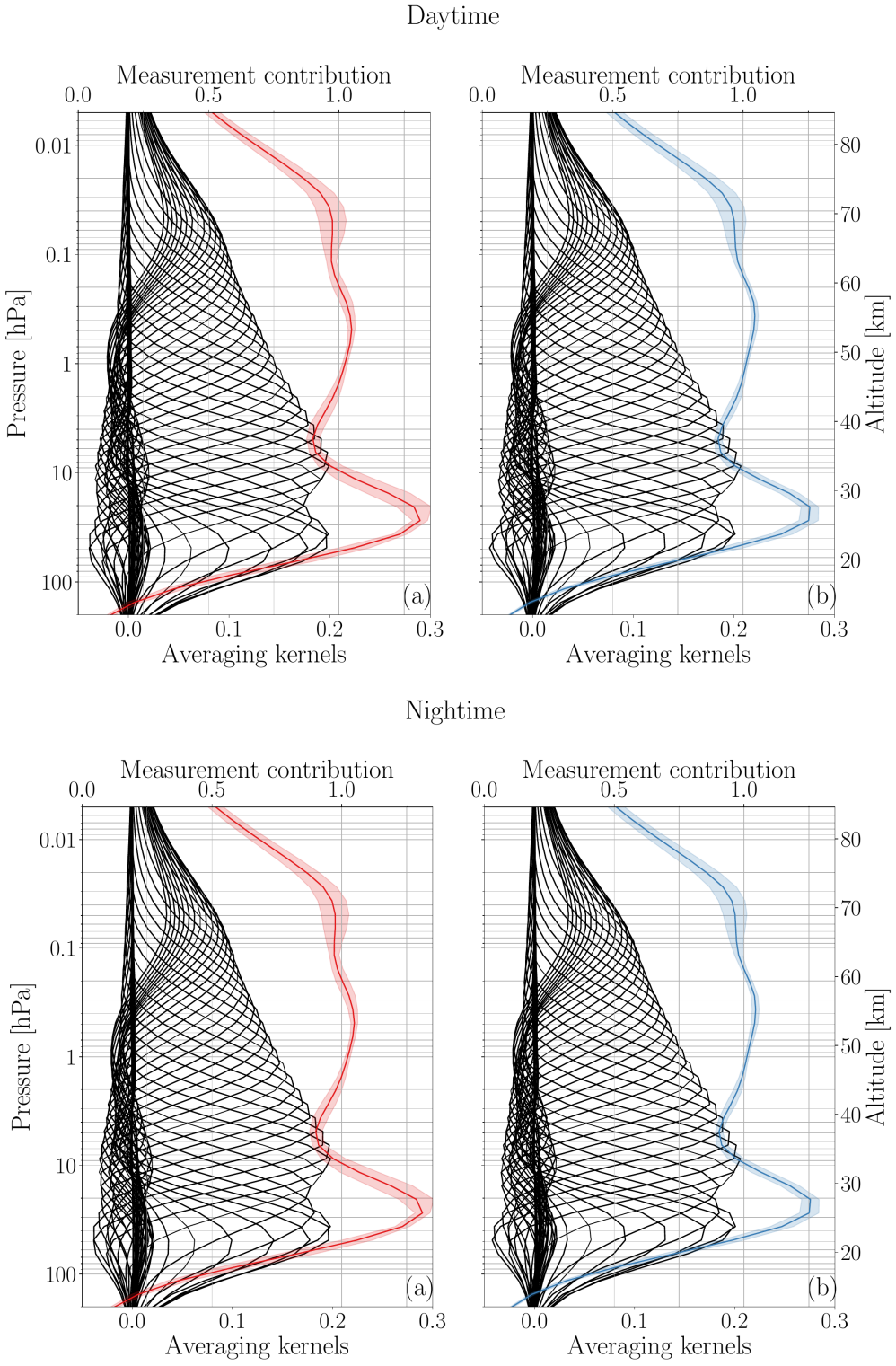

Figure 2: Daytime (top) and Nighttime (bottom) averaging kernels (AVKs) for GROMOS (a) and SOMORA (b)

Therefore, we consider that the difference between day and nighttime AVKs will not affect significantly the results for the diurnal cycle. In fact, because of their sensitivity to the weather conditions (through noise level and signal-to-noise ratio of the measurements), the AVKs show a seasonal variability which could influence the monthly diurnal cycle. As the ozone diurnal cycle itself shows a strong seasonal variability this effect is very difficult to quantify though. In any case, it will not affect the monthly comparisons against the various model dataset, nor the cross comparisons between the two radiometers.

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Line 151: Is it because the profile is normalized that you cannot apply the kernel, or because it is a monthly average?

Indeed, the GEOS-GMI Diurnal Ozone Climatology (GDOC) climatology only contains the hourly ozone values normalized to ozone midnight values (ΔO_3). To apply the AVK smoothing procedure we would need the “original” ozone profiles used to produce the GDOC (see eq. (1) from our original manuscript).

We decided not to ask for the GDOC raw ozone profiles because we would then need to recompute the zonally averaged diurnal cycle after the AVK smoothing. Therefore, it could not be considered to be a comparison against the original climatology anymore. Also, we would argue that the effect of the smoothing can be seen with the other model datasets and would affect similarly the GDOC.

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Line 168: Why was a free-running perpetual year simulation used for this study instead of nudging?

Because it is often considered that the ozone diurnal cycle has relatively low (however not negligible) inter-annual variability. Therefore, we thought that it would be interesting to compare this free-running simulation against the BASCOE chemistry transport model (CTM) and the two radiometers. The fact that all of them agree well tends to confirm that the inter-annual variability of the diurnal might indeed be small, not only compared to seasonal variations but also against short-term variability.

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Section 2.2.2: Please provide some information on the chemical mechanism in BASCOE

Agreed, we will modify section 2.2.2 to add a more thorough description of the BASCOE CTM.

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Line 261: This might be easier to see if there was a plot of just the magnitude of the diurnal cycles.

We agree with the referee that an overview plots of the diurnal cycle amplitude was actually missing in our submitted manuscript. It is quite difficult to represent at once the whole middle atmospheric diurnal cycle so we would suggest to add an overview plots focusing on the stratosphere, where larger biases are observed. An example of such a plot is shown in Figure 3 below. The authors would add this figure at the beginning of Section 3.2 where we discuss the monthly ozone diurnal cycle and use it to introduce the monthly diurnal cycle and discuss the upper stratospheric bias from the GDOC with respect to the four seasons.

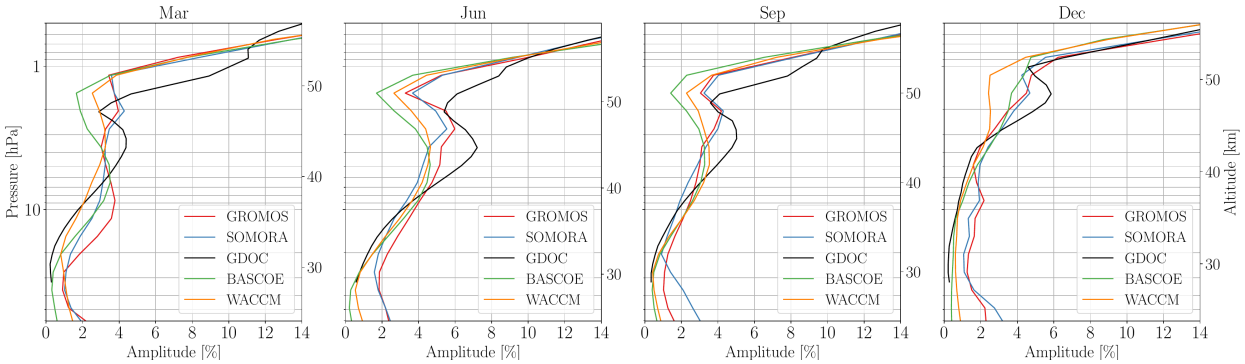

Figure 3: Diurnal cycle amplitude in the stratosphere shown as the percentage point difference between the maximum and the minimum values of ΔO_3 (as defined in the original manuscrit) for four different months as proxis for the four seasons.