Response to Anonymous Referee #1 (RC1):

We would like to thanks the first referee for her/his time, positive feedbacks and valuable comments. Please find below the original comments and the authors' response (in blue). Note that figure and line numbers refer to the submitted manuscript.

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General comments:

This study provides new results on the diurnal variability of ozone; the data figures are very good based on the two nearly co-located ground-based microwave radiometer instruments. The authors emphasize monthly and seasonal diurnal ozone scaling factors, but they also report finding significant sub-monthly diurnal ozone variations during northern hemisphere winter. Even so, the original stated goal of the study is to generate a refined diurnal model for the purpose of merging multiple datasets for analyses of long-term ozone time series and for comparisons with model ozone time series. Thus, I would argue that they are showing that it is best to avoid winter hemisphere data for that purpose. Winter anomalies in temperature may be more important than those of NOx, but it is not easy to assess that prospect because of the low vertical resolution of the MW ozone profiles.

The authors agree completely with the general comment, especially with the part about the assessement of temperature effect on the ozone diurnal cycle anomalies. In fact, our study aims at showing that the sub-monthly variability can be observed using microwave radiometers, thus confirming some modeling studies. By focusing on a single case study, we wanted to show that chemisty could have an impact on the winter anomalies but we are not able to rule out the effect of temperature. Also, we believe that the sub-monthly variability can have multiple origins and that in some cases, the temperature changes will clearly prevails over the composition changes (e.g. NOx). We are currently attempting to correlate our ozone diurnal cycle anomalies with collocated temperature measurements but as the referee rightly mentioned, it is quite challenging because of the low vertical resolution and the low signal-to-noise ratio of the radiometers.

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Specific comments:

Line 73—It would be helpful to learn at this point why there was an overestimate of the ozone diurnal cycle previously. Also define GROMOS here.

The exact source of the previous overestimation of the ozone diurnal cycle is difficult to identify but was due either to the calibration or retrieval algorithms. In fact, with the old retrieval algorithm, GROMOS was significantly less sensitive to ozone changes above approx. 45-50km which probably explained most of the discrepancies between the old GROMOS series and the modelled ozone diurnal cycle.

Also, we will define GROMOS in the introduction directly.

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Line 134—Here the authors give two specific overpass times for the MLS measurements, while on line 179 they indicate a more general range of time. Which is correct?

The overpass times for MLS indicated in Line 134 are the correct ones. The times indicated in Line 179 are the time ranges we used for the measurements and model datasets, which were chosen close to the MLS overpass times. The sentence on Line 179 was not very clear in the original manuscript so we will make it clearer in a revised version.

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Line 213—What is the source of the noisy appearance? Gravity waves, perhaps?

In the context of line 213, the noise source of the daily diurnal cycle is due to the rather low signal-to-noise ratio of the radiometers themselves. The computation of the ozone diurnal cycle divides 2 hourly ozone profiles which are noisy by essence, resulting in a high noise level, so that this is not possible to use a single day to get an accurate view of the diurnal cycle. Averaging over multiple days reduces the noise and unravel the diurnal patterns of ozone in the middle atmosphere.

Regarding gravity waves, it is a very interesting point as gravity wave-induced ozone changes are of particular interest to our group. We believe that they can impact as well the ozone diurnal cycle by adding additional noise to the measurements when considering only a single day, however, this additional noise likely remains small compared to the inherent noise of the radiometer itself. As mentioned in the general comment's answer, we are currently looking for potential ozone response to gravity waves in the middle atmosphere but it remains challenging.