Atmos. Meas. Tech. Discuss., referee comment RC2
Comment on amt-2021-61
Anonymous Referee #3

We appreciate your revision and comments.

After investigations of the spatial patterns of the limb-nadir matching for retrieving tropospheric ozone, we extended the total ozone retrieval to FOVs from 10 to 22. Therefore, the following figures have changed: Figs. 5-7, 9, and 10. The added FOVs do not change main conclusions in the manuscript.

All your technical comments have been addressed and will be included in the revised manuscript. With respect to the major comments, we detail the following points:

Review comment on

The paper describes a total ozone Ozone retrieval from OMPS-NM data using a modified DOAS approach.

As preparational work a new ozone climatology has been generated. Which might be interesting in itself, is this available for other user? Has it been compared to existing data sets?

The climatology will be available for download in the same way as the previous one developed by us (Lamsal et al. 2007). We include this information in the revised manuscript in the data availability section. This climatology has not been compared with other datasets.

The algorithm is based on the Weighting Function Differential Optical Absorption Spectroscopy algorithm (WFDOAS), that is adapted to the OMPS-NM. However OMPS-nm has a spectral resolution of 1 nm and a spectral sampling of 0.42 nm, hence the slit function is represented by ~2.2 measurements points, for a classical DOAS analysis this might cause an undersampling issue. The authors solve this issue by skipping half of the spectral points (using only the odd spectral channel) - which gives reasonable results compared to other observations, however no real explanation is given why the approach is working. Moreover, when the other half of the data is used the comparison shows stronger deviation.

The reason to select the wavelength sample is rather empirical. Our investigations have shown that the retrieval with the preferred wavelengths (odd-numbered) is less sensitive to the temperature than any other wavelength combination we tried. We discuss this issue in detail in Appendix A2 of the revised manuscript.

The comparison showed good agreement with operational OMPS and TROPOMI data sets, as well as with ground based Brewer and Dobson measurements.

general comment

The analysis is applied to roughly 44 data points (316-336nm) where only half of the data is used. The algorithm is described to become unstable if the complete data range is used. Is its possible that the major deviation are caused by just a few data points? To check this

possibility I suggest to run the analysis for one orbit skipping one even data point after the other. A combination might also be possible but this might easily end up in larger study.

Many sensitivity tests have been carried out to select the optimum fitting window and the wavelength sample. In short, we could not identify any particular spectral point responsible for the observed behaviour. For the final window selected, skipping/adding points at the window's boundaries does not produce significant differences. The use of all the spectral points makes the retrieval much more sensitive to the temperature and typically results in a bias of about -1% to -2%. In the revised version of the paper, we illustrate in detail that the selected wavelength sample results in less dependence on the temperature, which we believe is the main reason for the reduced bias (see Appendix A2)

minor comments:

5.3 S5P/TROPOMI

- L 197 This reference is about a tropospheric ozone retrieval but in this context it seems to be a reference on the RTM LIDORT.

The paragraph reads now as follows:

"The L2 product of S5P/TROPOMI used in this study is the offline (OFFL and RPRO) total ozone column product (Lerot et al., 2020). S5P/TROPOMI OFFL and RPRO total ozone are very similar and are obtained using the GODFIT version 4 retrieval (Lerot et al., 2014). The algorithm performs a direct comparison with simulated radiances through non-linear least- square inversion, using the sun-normalized measured radiance from 325 to 335 nm. The modelled radiances and Jacobians are obtained with the RTM LIDORT (Spurr et al., 2018)." (now lines 203-207).

L 207 why gridding data from two algorithms applied to TROPOPMI spectra for the comparison? Both resulting VCDs have identical coverage. So a direct mapping seems easier.

Due to the large amount of TROPOMI data, it is much more time consuming to make direct comparisons.

6 Validation

L 218 For the comparison of OMPS with TROPOMI the data are again gridded, this probably can not be avoided. But I suggest to use only one gridded TROPOMI data set here.

There is nothing about two TROPOMI datasets in line 218. You probably mean Sect. 6.2. The reason to use only one TROPOMI dataset is, however, unclear from your comment. We prefer to keep both.

Figure 5: The seasonal map shows a strong orbital pattern, which seems surprising when 4 years of data were averaged.

This is because we originally used only four central FOVs considered sufficient for the limb-nadir matching. However, as we mentioned above, the revised version of the manuscript shows FOVs from 10 to 22. This higher sampling strongly reduced the striping.

6.2 Comparison with OMPS-NM operational product and S5P/TROPOMI

For the OMPS-NM data set only the central field of view was used in the comparison 150km, while for TROPOMI the complete swath was taken into account ~2600 km. I suppose the comparison will improve if also for TROPOMI only the central pixels (~210 to 240) are used.

This issue is reduced by using more FOVs in the OMPS retrieval.

technical comments

- Figure 2: [VMR] stands for volume mixing ratio and is hence not a correct unit, please change to [ppm]

Done

- Figure 4: in Figure 3 a positive bias between S5P/TROPOMI WFDOAS relative to the ground based observations is shown, here (in figure4) it seems there is a negative bias of the Operational OFFL data relative to the WFDOAS. I suggest showing WFDOAS - OFFL instead, to have more consistent figures.

We corrected the plot as suggested by the reviewer.

- Figure4: The minus sign at (-10) has disappeared from scale.

Fixed