Comment on amt-2021-178

Anonymous Referee #2

Referee comment on "Retrieval algorithm for OClO from TROPOMI (TROPOspheric Monitoring Instrument) by differential optical absorption spectroscopy" by Jānis Puķīte et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-178-RC1, 2021

Review of Pukite et al. submitted to AMTD:

Retrieval algorithm for OClO from TROPOMI by Differential Optical Absorption Spectroscopy

The authors present a new algorithm to retrieve OClO from measurements of the TROPOMI satellite instrument. Overall, the paper presents valuable information and recommended DOAS settings for OClO retrievals from space that deserves to be archived. I believe the paper should be published in AMT. The authors present convincing comparison between TROPOMI and ground-based OClO SCDs, which clearly demonstrate the value of the satellite dataset. The authors present a number of tests and new settings. Some of these are new and make a lot of sense. However, the impression is also that many complication is introduced that is not really necessary. What is missing is a summary of the retrieval settings and choices that has the largest impact on the accuracy. The English is not very good and could be improved.

-Retrieval settings: Section 2.1

-Calibration: It is unclear whether it is performed on solar measurements or on mean radiance spectra. In the latter case, atmospheric SCDs should be fitted as part of the calibration step? The description in Appending A1.1-2 is unclear. I don't understand what is tau_i and I_i and what the proposed weighting (section A1.2) is supposed to solve.

-The sentence on l106 "The effect for this application is however negligible" is strange. Why introducing something in the text which has no effect?

-the description of the Ring effect is unclear. It is explained that Ring spectra are calculated at 2 Temperatures from the reference spectrum. Do you mean the reference for SZA 60-65°? If yes, I don't understand how it is calculated. Are the 4 Ring cross-sections fitted?

-Section 2.2

To help the reader, I suggest to add directly in Fig1 the indication of which days are expected to have enhanced OClO or not. In Fig1 left, the marker "x10" should be "divided by 10"?

-Figure 3: it would make sense to show the standard error also or instead of the std (which is already shown in Fig1).

-Section 3:

-the ground-based data are not analyzed using the same settings as used for TROPOMI. It is not fully clear to what extend and how this can explain the observed differences. E.g. in Fig6 left, there is a clear offset of ~1e13 cm-2 between TROPOMI and ground-based data for low SZA. Is this related to different DOAS settings, sampling bias, other? Please discuss this in the text.

-Interestingly at Neumayer, the scatter of the SCD differences is much higher than for Kiruna. Is it because the SCDs range is larger? Or is there an instrumental related

difference? Or something else? Please elaborate.

-Section 4: it would be good to understand what is the dominating factor explaining the offset between the 2 OClO data sets. I imagine it is probably related to the use of irradiance as reference spectrum and it is likely the largest source of error of the retrievals.

-The Appendix B is hard to digest. I suggest to add a summary table (extending Table B1) in the main text with typical errors on the SCDs coming from the main sensitivity tests so that the reader can have a rapid idea of what matters and what not. How the errors from the sensitivity studies are relevant compared to the typical OClO values and the differences from the validation exercise?

-Sensitivity studies 5, 6, 13,14,15 have very little impact on the results. Consequently, one could argue that the related settings introduced are not really necessary. E.g. the mean of normalized earthshine spectra, the offset correction quadratic term could be optional.

Minor comments

-Abstract: the first 10 lines are too generic for an abstract and should belong to the introduction section. "OClO" is defined twice in the abstract.

- "so called" -> "so-called"

-wording such as "Last but not least" should be avoided.

-lines 315-316: a reference to a next section (Sect. ??) is erroneously made. Please remove.