Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2018-365-RC2, 2019

Atmospheric Measurement Techniques Discussions

Interactive comment on "First high resolution BrO column retrievals from TROPOMI" *by* Sora Seo et al.

Anonymous Referee #1

Received and published: 7 March 2019

This is a well-written and detailed manuscript describing initial spectral fitting results from the TROPOMI sensor on Sentinel 5P. The images in the manuscript show dramatic improvement in identifying small-scale features that are allowed by the higher resolution of this new satellite sensor. The authors nicely describe their methods and selections that were made to avoid biases by other absorbers. I feel that the manuscript is appropriate for AMT, but have a few comments that I think should be addressed in a revised version.

Broader comments:

The authors show that formaldehyde causes a particularly challenging species to retrieve along with BrO, particularly when using narrow spectral windows. In the end the authors make what appears to be a good compromise to avoid the larger absorbers

Printer-friendly version

Discussion paper

and other issues, but one really wants to quantify all absorbers and not simply try to avoid them and then hope that the selection was good enough. Therefore, I think the manuscript should indicate that this window is a good choice, but future work needs to be done to continue to improve quantification of all the absorbers that occur. This window is a good start, but quantitative results will be improved by further research, which should be encouraged in the manuscript and conclusions.

The manuscript shows dramatic images of small scale BrO features that are amazing to see and will increase our scientific understanding. However, it is important that the manuscript points out that albedo effects are really important for quantification of lower-tropospheric BrO. Therefore, some things that are evident in the images using the simple geometric airmass factor should be pointed out as likely due to albedo effects. The reason for this is that I worry that a reader less aware of these issues may not take proper care of the albedo and misinterpret the images. An example that I think is likely an albedo effect is the sharp edge of small BrO evident North of Scandinavia/Russia in Figure 9a. That feature could be caused by the sea ice edge (http://nsidc.org/arcticseaicenews/2018/04/), with the high albedo of snow/sea ice allowing you to observe tropospheric BrO, while the low albedo of open ocean tends to prevent observation of lower tropospheric BrO. These albedo effects may also be important in some of the Rann of Kutch observations shown in Figure 13. The authors should point these effects out and indicate that they need to be taken into account for quantitative work.

The comparison of these retrievals to those of OMI and GOME-2B assist in assuring consistency between these different satellite sensors. However, they do not assure "accuracy" of the measurements; they show consistency. Therefore, on page 15, line 7, it should say "To evaluate the consistency of TROPOMI BrO..." Additionally, on page page 2, lines 26-28, the text should read "TROPOMI BrO columns were compared with those from the two existing satellite instruments, GOME-2B and OMI, with the consistency of these data sets were investigated." These comparisons do not either

"validate" this method, nor do they assure "accuracy". They are more "precise" and "consistent", which can be pointed out and are nice advances in the field.

I believe from the text on page 15, line 8 that the authors have used spectra from OMI and GOME-2B and retrieved BrO using the same processing methods applied here for TROPOMI data to compare with their TROPOMI measurements. Both OMI and GOME-2B have operational products, but my reading of this sentence is that those operational products were not used in this consistency check, but a single retrieval method (described here and using Table 2 settings) was used on spectral data from the three satellites. It needs to be made more clear whether spectra (Level 1) data or slant column (Level 2) operational products are being used. The reason it needs to be made more clear is that one might read that this paper says there is good correlation between this method and OMI, and take that to mean that the OMI operational product (OMBRO) agrees with this product, which is not what I think is plotted in Figure 10 panels. Alternatively, if the operational OMI and GOME-2B products are being used, they don't appear to be cited appropriately. Any references in the abstract and/or conclusions also needs to make clear what this "consistency" check is.

Specific comments:

Page 1, line 18: This should say "...reactions that deplete ozone..." (replace "which" with "that").

Page 2, line 27: Remove "verified" and "accuracy". Clarify if you are using operational products or re-analysis of spectra.

Page 3, line 2: Should say either "... which allows it to monitor..." or "... which allows monitoring of ..."

Page 10, line 15: The word "dependency" should be "dependence"

Page 12, line 2: Although this is a "robust selection", it would be valuable to point out that further work is warranted, particularly to retrieve both HCHO and BrO.

Page 17, Figure 11: As a courtesy to the reader, please point out the geographic region where this coastal edge occurs. I think it is the Kara Sea in the Russian Arctic. Potentially pointing out some island or landmass would help.

Page 18, Figure 12: Again, it would be nice to see where this image is – I think it is the Beaufort Sea, North of Alaska.

Page 20, Line 26: I is possible that using wavelengths longer than 362 nm had poorer results because of poor fitting of O4. O4's spectrum is temperature dependent and a warm temperature was chosen. If you cut the wavelength region at 362nm, then the polynomial can remove some aspects of the O4 absorption, while if you go beyond the peak, it gets harder for the polynomial to fit the features.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2018-365, 2018.

Printer-friendly version

Discussion paper