Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2016-309-RC1, 2016
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Atmospheric Measurement Techniques Discussions

Interactive comment on "Sulfur dioxide retrievals from TROPOMI onboard Sentinel-5 Precursor: Algorithm Theoretical Basis" *by* N. Theys et al.

Anonymous Referee #1

Received and published: 18 October 2016

This paper introduces the SO2 retrieval algorithm for the upcoming S-5P TROPOMI instrument. In addition to a description of the product requirement and retrieval algorithm (wavelength calibration, fitting window selection, DOAS analysis, bias correction, AMF calculation), the authors also provided a list of potential error sources in the retrievals and gave estimates of these errors where possible. Results from comparison with a verification algorithm (also based on the DOAS technique) were given, showing generally good agreement for a few volcanic cases, although the agreement between the two algorithms seem to be worse for higher SO2 loading. The authors also discussed future effort and potential data sources for product validation. Overall, this is a well-written and well-organized paper on an important product from the TROPOMI mission. The authors' effort in characterizing retrieval errors, while done in the absence of actual data before the launch of the instrument, is appreciated. I would recommend that the

paper be accepted for publication in AMT after some minor changes suggested below.

Page 2, line 21: another recent paper on long-term trend of SO2 is He et al., 2016:

He, H., Vinnikov, K. Y., Li, C., Krotkov, N. A., Jongeward, A. R., Li, Z., Stehr, J. W., Hains, J. C. and Dickerson, R. R. (2016), Response of SO2 and particulate air pollution to local and regional emission controls: A case study in Maryland. Earth's Future, 4: 94–109. doi:10.1002/2015EF000330.

Page 4, Line 6: consider spelling out the acronyms for the first use (e.g., CAPACITY and CAMELOT). A list of acronyms in the appendix may also help the readers.

Page 5, Line 23: special should be spatial?

Page 8, Line 12, maybe refer readers to Table A3 so that it is easier to find out which L2 cloud product will be used?

Page 9, Line 16: change "enables to define" to "enables us to define" or "enables defining".

Page 13, Line 27: "prior to the" DOAS "analysis"?

Page 14, Line 13: the average residual is calculated for the entire row or orbit? Also what is the percentage of pixels rejected in OMI?

Page 15, Line 22: typically how many pixels are available for averaging in each slant O3 column bin?

Page 20, Line 16: "what is the SO2 vertical profile" should be "what the SO2 vertical profile is".

Page 20, Line 24: so both fixed profiles and TM5 profiles will be used in the operational retrievals?

Page 21, Line 9: please specify how rescaling will be done.

Page 21, Line 12: if TM5 SO2 profile will be used, why not also use its temperature

profile (instead of assuming a constant lapse rate everywhere).

Page 23, eq. 12: define m'

Page 24, Line 22: is it implied that a constant 0.2 DU positive bias exists in the slant column SO2?

Page 26, Line 28: how was this uncertainty estimated?

Page 27, Line 6: do you expect uncertainty in LIDORT in terms of comparison with VLIDORT or TOMRAD?

Page 31, Line 22: "error associated" should be "associated error".

Page 40, Line 6: "newly" should be "new"?

Page 42, Line 14: does the comparison between the two algorithms suggest that the measurement requirements will be met?

Table 6, #19: is 15% an upper limit for the effects of anthropogenic aerosols on air mass factor? Could this be an underestimate given the uncertainties in aerosol properties and vertical distribution?

Figure 11: I'm not sure that the figure is completely necessary: this is essentially the same program implemented in different systems and the results are expected to be very close if not identical.

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