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Atmospheric Measurement Techniques Discussions

Interactive comment on "SO_2 Layer Height retrieval from Sentinel-5 Precursor/TROPOMI using FP_ILM" *by* Pascal Hedelt et al.

Anonymous Referee #1

Received and published: 14 March 2019

This paper introduces a SO2 plume height retrieval algorithm for the high-resolution TROPOMI instrument. The authors outlined the general procedure in developing the algorithm, and also showed example retrievals for some volcanic eruptions observed by TROPOMI. Comparisons were made with IASI retrieved SO2 height, and also CALIPSO measured backscatter. This is an important paper that should be of interest to the broad atmospheric science community. The injection height from volcanic eruptions is a key factor that determines their climate impact. The SO2 plume height can also be useful for aviation safety applications. The paper is generally well written and I would recommend that it be published after the comments below are addressed:

One main concern, for the specific algorithm, is that it uses wavelengths as short as 310 nm from TROPOMI. While these wavelengths provide higher sensitivity to SO2

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and SO2 plume height, stray light at these wavelengths also can impact the retrievals. I wonder how the authors address this in their training?

I'm not sure how the 2 km accuracy stated in the abstract is determined. I assume this is based on results in Figures 2-4? On the other hand, the temporal mismatch between TROPOMI and the primary validation dataset (IASI) makes it difficult to support this accuracy estimate.

Also given the difference in TROPOMI and IASI overpass time, some sort of trajectory analysis may help to better link the two retrievals in the comparison.

For NRT applications, the algorithm would require input of O3 VCD? How much time is required to retrieve O3? Also can the authors discuss if the plume height algorithm will run all the time or just be triggered by eruptions?

Page 1, Line 15: oxidation of SO2 also takes place in the troposphere.

Page 3: Line 30: can the authors give some examples of the parameter grids determined by the smart sampling technique?

Page 4, Line 12: Maybe figure 6 should be Figure 1, since it is discussed before all other figures.

Page 6, Line 10: is there a way to determine which rows should be used for training that would provide optimized retrievals? One would assume that pixels with large SO2 VCDs should be used?

Figure 1: it is a bit surprising that the error ca be larger for really high SO2 VCD (close to 1000 DU), do we know why?

Figure 1: it is not very obvious from the figure that high albedo values have a negative impact on the height retrievals – why limit training to albedo < 0.5?

Figures 3 and 4: add shade to mark +/- 2 km from the "real" plume height.

Figure 7: plume height retrievals were also done for pixels with small amount of SO2?

Figure 8: would suggest to only plot TROPOMI retrievals with SO2 > 20 DU.

Figure 9: how much can the ∼30 km retrieved plume height be trusted, if the training data only go up to 20 km (Table 1)?

Figure 11: suggest to plot CALIPSO ground track on one of the maps.

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