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Atmospheric Measurement Techniques Discussions

# *Interactive comment on* "A new discrete wavelength BUV algorithm for consistent volcanic $SO_2$ retrievals from multiple satellite missions" *by* B. L. Fisher et al.

**Anonymous Referee #2**

Received and published: 6 June 2019

General comments: In this paper the authors present a new algorithm for retrieving volcanic sulfur dioxide total columns from UV satellite instruments which is used operationally to process TOMS and EPIC data. It is also able to process data from current hyperspectral UV spectrometers. The algorithm has been applied to several volcanic cases and compared to a modified operational OMI & OMPS PCA algorithm.

The main advantage of such an algorithm is that it helps in assembling a long-term consistent satellite-based volcanic SO2 emissions climatology. Furthermore, this new algorithm is able to correctly retrieve SO2 even in the presence of aerosols using a 2-step procedure.



Overall I think the paper is suitable for publication in AMT after some moderate revisions. The paper can be slightly shortened in my opinion - although sections 2.1 and 2.2 are very interesting to read, they can be shortened and only focus on how they relate to the new MS_SO2 algorithm (i.e. remove the 'history' part of the algorithms).

What I am missing in the paper is a clear statement about the advantage of the new algorithm over e.g. the modified PCA algorithm the authors are using for comparison. Furthermore, a better description of how exactly the algorithm is working is required from my point of view (see below)

Specific comments: -P3 L15 Suggest to add S5P to the list

-P5 L3: BUV appears for the first time, please add the full name here

-P5 L3/4: Please add the wavelength of the three TOMS channels (i.e. move them here from line 7) Equation 2 and P8, L1-4: Usually the AMF corrects for the geometric optical path (as well as surface properties), as described, so why do the coefficients a and b depend on the satellite viewing geometry and cloud-surface properties as well?

-P8 L17: What are 'standard' O3 profiles? Please add a reference which profiles are used (e.g. TOMS V7. . .)?

-P8 L30+: I don't really understand what you are doing exactly. Are I0,I1,I2 the radiances at the three wavelengths? What is T? Temperature? Temperature for what? What is S_b? This appears here for the first time. Please add more details

-Figure 4 c/d Choose a different color bar (or color bar max values) since the SO2 VCD extends up to 550DU)

-Figure 5: After the correction, still a bias of about 1DU is visible in b). Why? Please add a plot showing the total SO2 map after the correction. Please also choose a different colorbar, with a white color in the center, such that is easier to identify positive and negative total columns (or differences)

-Section 4.1 I guess that the random errors change over time (degradation of the instrument), so it would be better to show and analyze the standard deviation as a function of time and not for the entire 10yrs time frame

-P22 L10 & Equation 11: So far you used the SUM symbol for the SO2 total column and OMEGA for O3. Please stick to that and don't use OMEGA_SO2 here. This is confusing

-P22 L21: Please describe your criterion why you are using only 5 PCs and not more (or less)

- Supplement P2 L31-32: What are the parameters I0, T and s_b? Please explain (see also my comment above)

Technical corrections: -P2, L27: SO2 (wrong format)

-Figure 1: European Sentinel-5P -> ESA Sentinel-5P

-P12,L26: (step 1) (missing parenthesis)

- Supplement Figure S3: Please remove the border around the colorbar

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