

Interactive comment on “Retrieval of SO₂ from thermal infrared satellite measurements: correction procedures for the effects of volcanic ash” by S. Corradini et al.

S. Corradini et al.

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In the following the Referee#2 (RC S33) comments and questions have been tagged and the relative authors responses inserted.

***** REFEREE#2 COMMENTS *****

1. General comments: Compares 2 methods for correcting the influence of ash in the volcanic SO₂ retrieval for SEVIRI and MODIS to other retrieval results from MODIS and AIRS. Demonstrates the importance of this correction and conditions where the higher accuracy/slower algorithm is required. My only substantial question is regarding the AIRS SO₂ retrieval. The authors need to describe this in more detail. Does the AIRS retrieval combine the radiances in the 7.3 micron band or does it use spectrally resolved

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information? If the latter case, I would expect AIRS to be closer to the corrected value in table 2 since it can distinguish SO₂ spectral features from ash absorption.

2. The authors should also explain that AIRS has a spectral gap from 8.22 to 8.81 micron and therefore a comparison of SO₂ for 8.7 micron is not possible.

Specific comments & wording suggestions:

3. p. 2 Abstract, 2nd paragraph: change: The results show the importance of the ash correction on SO₂ retrieval at 8.7 micron - the SO₂ columnar abundance corrected by the ash influence is less than one half of the values retrieved without the correction. To: "The results show the importance of the ash correction on SO₂ retrievals at 8.7 micron, where the corrected SO₂ column abundance values are less than 50% of the uncorrected values."

4. p. 5 Section 2, Motivation of the work, 1st paragraph: This has your first mention of AOT - should be defined here since it is used later without definition (aerosol optical thickness)

5. p. 14 sec. 6.2.1 1st paragraph: change: The main reasons for these differences are that the ash influence is stronger on the 8.7 micron channel compared with the 7.3 micron channel (see Sect. 2). The ash absorption that leads to the SO₂ retrieval overestimation is stronger at 8.7 micron than at 7.3 micron. To: "The main reason for these differences is that the ash influence is stronger on the 8.7 micron channel compared to the 7.3 micron channel (see Sect. 2), which leads to a larger SO₂ retrieval overestimation at 8.7 micron than at 7.3 micron."

6. Tables: Combine Table 1 and Table 2 and add AIRS value.

7. Figures: a) Figure 2. As mentioned previously, AOT not defined b) Figure 8. Show a zoomed plot as well to see plume structure.

***** RESPONSES TO REFEREE#2 *****

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1. The referee is quite right to say that the AIRS retrieval is potentially more accurate than retrievals of SO₂ from broadband sensors and this is mostly due to the extra information carried in the spectral variation of SO₂ absorption. The full details of the AIRS retrieval are described in the paper by Prata and Bernardo (2007), but we agree that this needs some elaboration in this paper. The following paragraph has been added to the paper:

"The SO₂ retrieval uses the spectral content of the AIRS measurements across the strong 7.3 micron SO₂ absorption feature. The retrieval method first identifies the spectral shape of the SO₂ 7.3 micron band and then uses an optimal estimation scheme to evaluate the partial column abundance within the pixel. Prata and Bernardo (2007) estimate that the rms error for a single AIRS pixel retrieval is ± 6 DU, which is equivalent to approximately ± 3 metric tons at the nadir AIRS pixel. This assumes that the SO₂ lies above ~ 3 km and that within plume water vapour is not significant. The AIRS instrument has a gap in the spectrum between 1136.7 cm⁻¹ (~ 8.8 micron) and 1217.0 cm⁻¹ (~ 8.2 micron), which covers a large part of the 8.6 micron SO₂ band. Thus it is not possible to perform AIRS 8.6 micron SO₂ retrievals."

2. There is a substantial gap in the AIRS spectral around 8.6 micron which is quite unfortunate for SO₂ retrieval. We have added a comment about this as requested by the referee.

3. Changed.

4. AOT defined.

5. Changed.

6. Tables: Because we suppose that the referee means Tables 2 and 3 (instead of 1 and 2), Tables 2 and 3 have been combined. The AIRS SO₂ retrieval has not been included in the combined table because the table itself summarize only the SO₂ retrievals obtained applying the ash correction procedures (such corrections have not

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been applied for AIRS).

7. Figures: a) AOT defined. b) Figure 8 has been substituted with a zoomed version.

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