

Interactive comment on “A new simplified procedure for the simultaneous SO₂ and ash retrieval in a tropospheric volcanic cloud” by S. Pugnaghi et al.

Anonymous Referee #1

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The authors present an interesting approach of simultaneously retrieving volcanic ash and SO₂ from MODIS thermal infrared bands. Nevertheless some clarifications are necessary before the manuscript is published in AMT. Especially the authors several times point towards a potential global applicability for quick response to volcanic eruptions. I do not believe that this is in any way possible with the method presented here, as it strongly relies on the radiative transfer calculations done specifically for Mt. Etna (run with upper air observations from a station close to that specific volcano). Moreover the manuscript would benefit from a more detailed discussion of the uncertainties which accompany the presented method. In several cases the authors use phrases

which are not commonly used in the community (e.g. "diffusion" instead of "scattering") which partly makes it hard to understand what exactly is meant.

Specific comments:

p. 8860 l. 22: (and elsewhere): It is not really clear from the paper, what the authors mean with "ash type". I assume that the mineralogical composition is meant, which (besides other influences) is a function of the volcanic setting (e.g. the composition is different between volcanoes at subduction zones and mid-ocean ridges). Or is a class of ash composition (like dacite, rhyolite, andesite) meant here in a broader sense? The same confusion may arise from the use of the phrase "atmospheric profiles". Although it is rather clear to me that temperature and humidity are meant, it is nowhere precisely described what profiles the authors refer to and what the impact is.

p. 8861 l. 12: It is not at all clear to me what the different between a "plume" and a "dispersed volcanic cloud" is. Moreover I would advise to be careful with the use of "volcanic cloud", as many times volcanic eruptions also eject large amounts of highly buoyant wayter vapour, which then forms "real" clouds in the meaning of water droplets / ice crystals around or within the plume of volcanic ash.

p. 8861 l. 23: I doubt that SEVIRI has global coverage.

p. 8862 l. 14: It would be good to see a reference for the statement that volcanic ash absorbs in the whole TIR window, as e.g. quartz aerosol has only very weak absorption around $12\mu\text{m}$.

p. 8863 l. 21: "more times a day" in most regions means exact twice daily for each satellite, resulting in four observations per day.

p. 8863 l. 24: I do not really like the word "dirtied" in this context. "Attenuated" would be a much better and more appropriate choice.

p. 8864 l. 9: NDVI is not a TIR method, consequently I would suggest not to refer to it here.

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p. 8865 I. 9: How far is "not too far"?

p. 8865 II.16ff.: I wonder what happens if the plume would be embedded in ice clouds often forming above volcanic vents... Is there any cloud mask involved in the algorithm?

p. 8866 I. 24 and elsewhere: What the authors describe is the effect of scattering, which is important in TIR radiative transfer through volcanic ash. It thus would be more appropriate to correctly refer to "scattering" instead of "diffusion".

p. 8867 I. 21: Are these numbers also representative for other regions of the world? In the abstract and conclusions the authors comment on the potential global applicability of the method. Therefore it would be necessary to determine Delta-T globally...

p. 8868 eq. (7): How is the single scattering albedo determined? Does it come from the Volz optical properties?

p. 8869 I.1/I.5: How are the values 0.965 respective 0.98 obtained?

p. 8869 II. 11ff.: How representative are the Volz optical properties for Etna volcanic ash? How do they compare to others, e.g. from Pollack et al. (1973)? Is Mie theory applied in the MODTRAN simulations, i.e. are spherical particles assumed? What is the uncertainty brought about by this assumption? eq. (13): How is the extinction efficiency determined?

p. 8875 I. 6: Both, Z and T of the plume have to be known a priori. Especially in fast response cases: how is this achieved? What is used as first guess for plume height and temperature? Moreover, how reliable is the assumption that ash and SO₂ plumes are found at the same height? The grimsvötn eruption 2011 was a very good example that this is not always the case.

p. 8877 I. 26: What is a "heavy radiative transfer code"?

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