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Atmospheric
Measurement
Techniques
Discussions

Interactive comment on "Remote sensing of volcanic ash plumes from thermal infrared: a case study analysis from SEVIRI, MODIS and IASI instruments" *by* P. Dubuisson et al.

Anonymous Referee #1

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General Comments and recommendation

1/ The paper does not contribute much to the current literature. The authors have implemented a well known algorithm for the retrieval of airborne volcanic ash from infrared sounders and discussed the results of a single scene of a volcanic plume. The fact that 3 different instruments are used does not mean there is something innovative in the presented paper. The comparison is in any case of little relevance for reasons outlined below.

2/ I have little confidence in the presented retrievals as several implementation choices are dubious at best (see below in the specific comments).

3/ The paper addresses several topics but does not treat any of them in depth. (like section 5 and 6 are far too brief to be useful). Again, nothing new is presented.

So in my personal opinion the paper falls short both scientifically and technically and I can therefore not recommend it to be published in AMT in anywhere near its current form.

Specific Comments

1/ P2796, line 16: "narrow band sensors". Do you refer here to MODIS and SEVIRI? If so, to my knowledge they are more commonly referred to as broadband sensors. Please give a reference or fix in the paper (the term narrow band appears several times).

2/ description of IASI (P2797): please explain or correct how a 50x50 km2 atmospheric cell corresponds with a ground resolution of 12km.

3/ Use of IASI channels. The authors only use 3 IASI channels avoiding interference with gaseous absorption. This in my opinion needlessly complicates the comparison with SEVIRI and MODIS, and results in an apple-orange comparison. A far more logical approach is to integrate the IASI spectrum over the SEVIRI/MODIS bands and proceed in this way. In any case, what is the point of using a high resolution instrument if one only uses 3 channels?

4/ Description of the retrieval algorithm. The split-window technique is mature and very well documented. The authors do not adequately acknowledge and refer to previous work. See "Prata, A. J. & Prata, A. T. Eyjafjallajökull volcanic ash concentrations determined using Spin Enhanced Visible and Infrared Imager measurements J. Geophys. Res., 2012, 117, D00U23. " and all references therein. As far as I can tell nothing is new in the proposed retrieval algorithm of the authors, other than some minor implementation details.

5/ The very important issue of underlying surface temperature/meteorological cloud is

not addressed at all. Normally surface temperature as well as cloud top temperature would be part of the LUT. If this is not the case than any good match of the reported results with the literature can only be attributed to coincidence.

6/ The third point of the retrieval method, namely how exactly the spectra are matched to the LUT is not well described. It appears this matching is done for each particle type; but then how is the particle type selected?

7/ The end of section 3, beginning of section 4 is confusing. They both talk about 6 May, as if it were two different events. The two should obviously be discussed in a coherent way.

8/ On the retrieval of particle type. P2803. It is not serious to retrieve 3 independent parameters (type, radius, optical depth) using only two parameters. How can you report the particle type distribution? It is neither interesting nor surprising that no good results come from this. It is not explained in the paper how this is done. If you do the split-window algorithm properly with 5 different refractive indices, you will obtain 5 different answers. It is not possible to tell which one is the right or the best one.

9/ The retrieval using three channels is not logical. The authors seem to have chosen an approach consisting of performing the retrieval twice, using two times two different pairs. Then these two retrievals are combined when a match is found between the retrieved of the effective radius. This of course yields very poor results. To fully utilize three channels, the logical thing to do would be to match the 3 channels with a 3D lookuptable.

10/ As for the intercomparison, it seems MODIS Aqua was used. This is an odd choice given that MODIS Terra has an overpass time very similar to IASI's one. A collocation in time of MODIS-SEVIRI-IASI is thus possible and I would recommend the authors to redo their analysis using MODIS Terra.

11/ The abstract underlines that the overall motivation of this study is "to evaluate the

consistency of retrievals from different thermal infrared instruments". A comparison like this is usually done when dealing with different retrieval algorithms. This is not the case here. Assuming instruments are well calibrated, the only reason why retrievals from different thermal infrared instruments would be different, is major differences in instrumental characteristics. However this is not the case:

- Spectral resolution/coverage. Here the difference between SEVIRI and MODIS is minimal. For IASI, a logical approach would have been to integrate the spectrum over the SEVIRI/MODIS band, so that also there the influence of the instrument would be minimal. (but see comment 3)

- Footprint: Retrieval of ash has a large dependency on underlying surface/clouds and the presence of semi-transparent overlying clouds. The footprint will have an influence here. The smaller the footprint, the more chance of having 100% clear pixels. Also, a small footprint will allow to catch local concentration peaks.

- Overpass time. Different instruments have a different overpass time. But since SEVIRI has a high revisit time, it is easy to collocate these measurements with the other two, which are around 9.30-10.30 local time (for IASI and MODIS Terra).

So the only real reason why retrievals could be inconsistent is the due to a difference in footprint size. But these differences would naturally average out when looking at a large plume. So the overall conclusion that "the results are in good agreement" is hardly surprising. Given its limited relevance, this should not be the main point of the paper, and it should not be advertised as such in the abstract.

12/ Why is there such a large difference between the retrievals of MODIS and SEVIRI?

13/ Section 6 on retrieval uncertainties is incomplete, both in the number error terms and in the depth of the discussion. See eg. Pavolonis, M. J.; Feltz, W. F.; Heidinger, A. K. & Gallina, G. M. A Daytime Complement to the Reverse Absorption Technique for Improved Automated Detection of Volcanic Ash J. Atmos. Oceanic Technol., 2006,

23 (11), 1422-1444. and Wen, S. & Rose, W. Retrieval of sizes and total masses of particles in volcanic clouds using AVHRR bands 4 and 5 J. Geophys. Res., 1994, 99, 5421-5431. and references therein.

The main sources of errors are (of which only 2 are discussed in the paper):

1. plume height,

2. surface temperature/underlying cloud temperature

3. aerosol refractive index

4. instrumental noise

5. Size distribution

6. interfering trace gases (H2O, SO2) under, in and above the plume

7. overlaying meteo clouds.

14/ Overall, apart from in the introduction, the paper does not discuss the methods and the presented results enough in the context of other relevant studies.

Technical Comments

Although the English is of a sufficient standard to understand what is being said, I highly recommend an overall grammar check by a native speaker or the Copernicus production office. Here just a *subset* of corrections:

P2795, l11 in termS of flight

P2796, l8 in this section, THE contribution

P2796, l10 ". . .then performed similarly to the considered. . .", what is meant is something like ". . .then performed in a similar way for each of the considered. . ."

P2796, l13 replace limit by limitations, also limitations of what?

P2796, l14 remove "the" to yield "of plume composition"

P2797, l5 "to retrieve aerosol properties" (not aerosols)

P2800, l9 replace "are of opposite as those for clouds" with "have an opposite sign as those obtained for clouds"

P2800, l13 replace "varies depending on" with "depends on"

P2801, l13: replace "especially" with "in particular" which I think is what is meant.

P2802, l15 P. Arason et al . This is the first time I see that a first time is cited in a reference. P2802: l17 "get comma pattern"; replace with something like "the plume resembles the shape of a comma"

P2082 l2 and 2804 l1: replace "in complement" which is not correct English, with something else "furthermore", "in addition", "additionally", "moreover"

P2082, l20 as THE one observed by THE satellite

P2804: l22 replace "at last" with "finally"

P2804: l25 replace "but for a very small number" with "for only a very small"

P2808: l2 On the one hand . . . on the other hand (so not TO and not IN)

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