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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A new scheme for sulphur dioxide retrieval from IASI measurements: application to the Eyjafjallajökull eruption of April and May 2010" *by* E. Carboni et al.

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Carboni review ACPD – Matt Watson, Bristol.

This paper details the development and testing of a new algorithm to retrieve SO2 burdens from the IASI sensor. The authors use published observations of the 2010 eruption of Eyjafjalljokull as a case study to compare with their results. I've seen this work presented a few times and I am familiar with the algorithm and the early results. The retrieval is physically sound and has the capacity to significantly improve our ability to retrieve SO2 from hyperspectral sensors. The paper has two issues, both of which are serious but easy to address.

The first issue is a lack of understanding of the volcanological literature. It is inappropriate, for example, to suggest that Prata, 2009, was the first paper to demonstrate SO2 is the third most abundant volcanic gas. Throughout the m/s there are problems where the authors use recent papers as a proxy for better citations. They also (understandably) lean on the remote sensing literature a little too much. This is bearable until the description of the eruption and the context of the results. The authors need to read the special issue on Eyja carefully and reassign their results accordingly. This section should be rewritten in the light of this work.

The second serious issue with the work is the presentation – the English is poor in places and the figures, especially the axis labels are unreadable in several figures. A really good proof read would have made the reviewer experience much better. I have tried to capture as many of the editorial issues as possible but confess to losing the will to live at some point...

Reviewer 1 raises interesting and valid points. In addition, please consider the following...

11862 5: wavelength/wavenumber relationship between two absorption bands flipped 20: Not sure this should be counted as 'phase 1' – see later. . . 22: 0.2 is not an order of magnitude lower than 0.14

11863 2: More than one process. . . 3: Change 'could' to 'can' and add 'potentially' before explained 5: Implies Prata (2009) was the first to make this observation. Better would be Symmonds et al., 1994 8-9: This was not really the finding of Thomas and Prata, 2011 – quite the opposite in fact. It is very often not a good idea to use SO2 as a tracer for ash. 12: Carn et al., 2003 is a better description of the TOMS archive. 16-17: Insert 'the' in front of each of the satellite names 22: EstimateS 24 and 26: THESE data

11864 3: (and elsewhere): ground measurements should be 'ground-based measurements' unless you are measuring the ground 6: Add recent paper by Henney et al, 2012

and rewrite. 16: co-located 20: 7.3 is ïĄő3 21: insert an ‘a’ between in and brightness 22: 8.6 is ïĄő1 23: containS 27: I’d give Realmuto (1994, 1997, 2000) credit for this observation.

11865 9: Change ‘is’ to ‘has been’

11866 12: Recast the sentence ending ‘reference forward model’ 14: ‘Several’ is vague, please provide more detail.

11867 19: ‘each other’ is unnecessary – delete. 28: change ‘is’ to ‘are’

11868 1-4: The sentence that starts ‘The spectra of both. . .’ is impenetrable, please recast

11869 2: degreeS 13: define DISTORT

11871 7: constituentS

11872 9: Recast sentence starting ‘The new error. . ..’ 14: insert ‘the’ before ‘Eyja. . .’

11873 2: ‘are’ should be ‘is’ 3: ‘wrong spectroscopy’ should be changed. . .

11875 17: remove carriage return 18 and onwards: The section that starts ‘The Fig 3. . . .’ is very poorly written and should be thoroughly checked and adapted until it makes sense. It’s quite an important paragraph that covers a lot of ground, detailing the sensitivity and issues with the retrieval.

11876 3: ‘trough’ should be ‘through’ 4-5: proof read and formalise these lines 10: insert ‘a’ between ‘for ‘ and ‘plume’ 11: change ‘isn’t not’ 13: amountS 16 and onwards: The paragraph starting ‘Moreover. . .’ is not clear at all, please recast.

11877 What are the justifications for the choices of optical depth and particle size for the aerosols in the synthetic spectra? 1-4: not clear at all, please rewrite 7 and onwards: this section is particularly poor – please rewrite this section through to line 23 27: presented 27 onwards: this sentence is also impenetrable

11878 10: Add reference to Kearney and Watson, 2009 16: flowS 20: and onto the next page: I’m not convinced that Zehner’s categorisation of the eruption is widely accepted. I think you should carefully read the JGR special issue, focusing on the papers by the volcanologists (esp. Thor Thordarson) for a more adroit analysis. 26: ‘steams’ should be ‘steam’

11879 5: ‘one’ should be ‘an’ 15-16: where did these numbers come from? 17-23: rewrite 24: Makes no sense 28: Chronologise references. . ..

11880 1: Chronologise references. . .. 6-onwards: This section is also very weak. Much of this has been approached in the literature, mostly in the JGR special issue. The section should be much better referenced to reflect this. It’s also badly written. . .

Some specifics: Meteorology is affecting the plume at all times, not just after the first 48 hrs. SO2 production during ‘phase 1’ is NOT zero (see Fig 9). I’m not convinced there’s a ‘new injection’ of SO2 – most likely the eruption has run out of ice/water for scrubbing.

11881 1-9: The first paragraph is unreadable 11: remove ‘as’ x2 17: seems

11882 15-onwards: unfinished? Almost in note form?

11883 8: tick should be ‘thick’

Figures:

Figures 1, 6-8 have axis labels that are far too small. . . Fig 1 caption – ‘waiting’ should be ‘weighting’

Additional refs: Carn, S.A., Krueger A.J., Bluth, G.J.S., Schaefer, S.J., Krotkov, N.A., Watson, I.M., Datta, S, 2003, Volcanic eruption detection by the Total Ozone Mapping Spectrometer (TOMS) instrument: a 22 year record of sulfur dioxide and ash emissions, Volcanic Degassing (eds Oppenheimer, Pyle and Barclay), Special Publication of the Royal Society, SP213, pp. 177- 203

Henney, L.A., Rodriguez, L.A., Watson, I.M., A comparison of sulphur dioxide retrieval techniques using mini UV spectrometers and ASTER Imagery at Lascar volcano, Bulletin of Volcanology, 2012, Volume 74, Number 2, Pages 589-594

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Realmuto VJ, Abrams MJ, and Buongiornio MF, and Pieri DC, The use of multispectral thermal infrared image data to estimate the sulfur dioxide flux from volcanoes: a case study from Mount Etna, Sicily, 29 July 1986, J Geophys Res, 99, 481-488, 1994.

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