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Atmospheric Measurement Techniques Discussions

Interactive comment on "Sensitivity of thermal infrared sounders to the chemical and micro-physical properties of UTLS secondary sulphate aerosols" *by* P. Sellitto and B. Legras

Anonymous Referee #1

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This paper presents a sensitivity study of TIR sounders to concentration and size distribution of stratospheric sulphate aerosols. It is well written; what has been done is carefully explained and discussed.

However, the paper brings very little to the current literature on sulphate sounding. As a dedicated sensitivity study, it does not go nearly as deep as one would hope for. So while there is nothing wrong with the paper, it is lacking depth and innovation - so that I would recommend either a major expansion, or resubmission to another journal.

Comments (and some suggestions for expansion and improvement):

- while numerous references are cited, the results from this paper should be compared and discussed with what has been found in earlier studies. The introduction of this paper majorly understates the contributions of earlier work. For instance properties such as size distribution and concentration have been retrieved before e.g. Bauman et al (2003), Doeringer et al. 2012, Echle et al (1998), Yu and Rose (2000) (Yu, T. & Rose, W. I. Retrieval of sulfate and silicate ash masses in young (1 to 4 days old) eruption clouds using multiband infrared HIRS/2 data Remote Sensing of Active Volcanism, 2000, 87-100) . The sensitivity study by Steele et al (Steele, H.; Eldering, A. & Lumpe, J. Simulations of the accuracy in retrieving stratospheric aerosol effective radius, composition, and loading from infrared spectral transmission measurements Appl. Opt., 2006, 45, 2014-202) has been completely ignored.

- The analysis focuses on a few wavenumbers. To make it relevant for IASI, a more comprehensive study could for instance exploit information theory (Rodgers et al, Inversion methods for atmospheric sounding, Section 2.4 and 2.5) in which after calculation of appropriate Jacobians it becomes straightforward to discuss what and how much information can be extracted on sulfate aerosol from IASI like spectra (i.e. considering all spectral channels at once). Doing this would yield far more useful and conclusive results.

- The analysis is in my opinion not nearly quantitative enough (this links to the previous point). For instance the reader is left in the dark on lower detection limits, estimated retrieval uncertainties etc.. An example of a more quantitative study is the Steele et al. paper cited above.

- A lot of the analysis is based on the extinction coefficient. In reality, because of the radiative transfer (thermal emission and multiple scattering), it is better to work with actual simulated spectra (as only done in the second part of the paper)

- In several places it is said that the radius is the most important parameter determining the extinction. However this conclusion is based on keeping the number concentration

constant for varying radius. This is deceiving as the mass concentration is proportional to the cube of the radius, so increasing the radius by a factor two will increase the sulfate mass by a factor of 8! Better would be to keep the sulfate mass constant whilst adjusting the radius.

Minor comments:

- The English is not bad, but could be improved in places

- I would remove table 1 and 2, as these are trivial

- Page 8455, the discussion of the "angle of gradients" is unclear and it would be good to write down the exact formula that was used.

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