

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 #2

Received and published: 16 October 2015

General comments

In the manuscript the authors present a work based on simulations of brightness temperature spectra for a nadir spectrometer (like IASI) to show which parameters affect the BT spectra and the associate spectral shape and magnitude, for background and volcanic conditions. The simulations are carefully done with the state of the art knowledge for H₂SO₄.

Results are no unexpected, but they can be useful to understand the influence of H₂SO₄ on nadir measurements and to identify the spectral range that can be used

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for retrieving H₂SO₄ in thermal infrared spectrometer (and eventually an ad hoc radiometer).

They show that the dependence, of the H₂SO₄ signal, on temperature is smaller compare to dependence on other parameters as: mixing ratio, concentration and radius of the particles. And these last 3 parameters all affect significantly the radiance in the considered spectral range. Seen the big amount of simulations they have already done, it will be nice, if possible, to end the paper checking in which condition these 3 parameters can all be retrieved and in which condition they have to be constrained with other data; e.g. compute the information content/degree of freedom in the measurements.

Specific Comments

page 8444 - line 5 'were compared to IR high spectral resolution observations': which instrument?

p 8845 l 14-5-5 'phase function), which can be represented by the integral asymmetry parameter (van de Hulst, 1957).' Seen that this paper is on 'simulation only' this is fine, but it could be mention that for a proper retrieval in condition where they said the scattering is not negligible (as for volcanic conditions), a better approximation for the phase function will be to consider the Legendre moments.

p 8446 l 2-3 'we fixed τ to 1.86 (a typical value, see, e.g. SPARC, 2006)'. Any idea on how much the simulated spectra change if this parameter is different?

p 8449 l 'This result suggests that the scattering component of the extinction, even if relatively small with respect to the absorption, cannot be neglected'. This is true for volcanic condition (SSA $\sim$ 0.2) but for SSA of 0.01 (as fig 1 show for background conditions) maybe scattering can be neglected.

p 8450 line 16-17 'This suggests a strong sensitivity of the sulphate aerosols extinction to the size distribution'. This suggest that bigger particle ($r_m=0.3$ micron) affect the TIR radiance more than the smaller particle ($r_m=0.06$ micron), as expected from Mie

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theory.

p 8452 l 4 'in general, the extinction does not vary much with temperature' please give some numbers as 'don't vary more than XXX'

p 854 l 16 missing the '(1)' I think.

p 8456 l 13-17. 'All these considerations suggest that the three aerosol parameters are retrievable as independent quantities only for limited conditions, when using broad-band sulphates extinction spectral features and constraints should be given to at least one parameter (e.g., the number concentration).' In which limited condition we can retrieve the 3 parameters independently? Under volcanic condition with high concentration and bigger radius?

It will be nice to check if the information content in the measurements can be used to retrieve the 3 parameters in both a spectrometer 'IASI like' and a radiometer as 'MODIS like'. For example showing the averaging kernel or computing the degree of freedom for IASI and MODIS. Otherwise we don't know if you need to constrain one parameter, maybe you need to constrain 2 or maybe with few channels you can have 3 degree of freedom. The sentence is reasonable but it can be computed and presented.

l 17-21 A nice addition will be to overplot the spectral range covered by MODIS and SEVIRI channels to an H₂SO₄ spectral signature. (for example on top of figure 8?).

p 8457 l 26 'Impossible' is a big word, Maybe it is possible to use some information from this bands if the retrieval is done together with the O₃ retrieval.

p 8459 l 13 'specral' -> spectral

p 8464 l 11-13 Also CO₂, SO₂ and H₂O have different spectral BT signature/shape from H₂SO₄ and can have similar magnitude. Parameters that affect BT spectra of comparable magnitude should be retrieved simultaneously with H₂SO₄ parameters or constrained from independent data.

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l 25-27. see my comment above on 3 parameters.

Fig 2 Maybe a legend with color line used in the plot and concentration will be better than a colorbar? where are the red and dark blue lines in the second rows plots?

Fig 3 Legend with line color and numbers instead of colorbar.

fig 6. Seen that the 'y' steps are not linear, you should plot the y values for every plotted row. Otherwise, for example in the first plot, the reader don't know which is the value of the concentration in the lower row and if the concentration in the top row is 10 or 9.

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 8439, 2015.

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