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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 #3

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The article 'Sensitivity of thermal infrared sounders to the chemical and micro-physical properties of UTLS secondary sulphate aerosols' by P. Sellito and B. Legras uses simulations to investigate the potential of IR nadir sounders to retrieve microphysical properties of sulphate aerosol. Generally the manuscript is very detailed and well structured. However, I have some major and minor concerns that should be addressed before publication.

Major comments: 1. The introduction motivates why it is important to observe UTLS sulphate aerosol. Please explain here, how well nadir observations can give an altitude information. Do you assume that sulphate aerosol is mainly located in the UTLS

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region? Can nadir measurements only observe UTLS aerosol but not aerosol in the lower and middle troposphere?

2. If you focus on UTLS sulphate aerosol, I would recommend to constrain the temperature and mixing ratio range to UTLS conditions. At first reading it was not clear to me if this should be a general sensitivity study or a study focussing on the UTLS.

3. Section 3.3 and Figure 3 are very critical to this study. When keeping the radius constant and increasing the concentration (or keeping the number concentration constant and increasing the radius) the volume and hence the extinction increases. To investigate the effect of different radii, the volume should be kept constant. Also I suggest to normalize the spectra in Figure 3 to make the differences/similarities in the spectral slope more visible.

4. When discussing the retrievability of sulfate aerosol properties I highly recommend to also discuss previous work on this topic with IR measurements, e.g. Baran et al., 1993, GRL Clarisse et al., 2010, Applied Optics Karagulian et al., 2010, JGR Lambert et al., 1997, JGR

Minor p.8442 l. 27 What do you mean with 'different sulphates'? also ammonium sulphate or different concentrations?

p.8443 l.6 What is the source of the size distributions used?

The mixing ratio of sulphate aerosol depends on temperature and water vapour concentration. Can you please discuss how much variability of sulphate can be expected in the UTLS?

p.8446 l.22-24 in the IR and for particles smaller than about 15 microns you should be careful with the effective radius, because scattering is not necessarily linear with the effective radius (when varying the median radius and the distribution width), but with the scattering radius.

Section 3 titles: 'dependence on' instead of 'dependence from'

AMTD

8, C3455–C3458, 2015

p.8449 l.5-7 Griessbach et al. consider scattering for sulphate aerosol

p.8450 l.9 please quantify the size of 'bigger particles'

p.8451 l.11-15 Isn't the mixing ratio dependent on temperature?

p.8452 l.14-15 If the altitude cannot be retrieved, how do you know that the sulphate aerosol is in the UTLS region? (e.g. longer life time in UTLS that in lower troposphere?)

p.8453 l.7 What do you mean with 'severe volcanic conditions'? After Pinatubo extinctions?

p.8454 l.13 Please give some examples for broad band radiometers you have in mind.

p.8460 l.4 How many levels did you use? What was the vertical step?

p.8461 l.3 Does 'smaller spectral resolution' mean broader or finer resolution?

p.8464 l.1-3 '...seem not observable by IASI-like TIR instruments because of (1) small BT signatures, mainly due to the high sensitivity to the effective radius,...' I'd rather say that background sulfate aerosol is not observable due to its low extinction/number concentration.

p.8464 l.11-13 Isn't the ash effect on the radiances stronger that the effect of sulfate aerosol? Please give a reference for this statement.

Can you show how much better results would be for high resolution instruments in conrast to broad band instruments?

Figure 8: the colors are very pale (close to invisible)

Finally, I would recommenend to carefully read and correct the paper after reworking. There are several typos and mistakes, e.g. p.8442 l.2 '...,due to the their extended...' ... p.8446 l.14 '.. of a few tents particles...' ... p.8463 l.2 '...where the the sulphate...' p.8463 l.8 '...bynary...' p.8464 l.26 '...contraints...' (these are just a few examples)

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8, C3455–C3458, 2015

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