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Atmospheric Measurement Techniques
Discussions

Interactive comment on "Volcanic ash detection with infrared limb sounding: MIPAS observations and radiative transfer simulations" *by* S. Griessbach et al.

Anonymous Referee #2

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In their paper Griessbach et al. present a technique for the fast detection of volcanic ash clouds from mid-infrared limb emission spectra. Based on extensive radiative transfer simulations and examples from MIPAS/Envisat observations it is shown that volcanic ash can be detected and distinguished from ice and sulphate aerosols within certain limits of size and extinction coefficients. The paper provides a valuable baseline for further in-depth investigations of volcanic eruptions from limb-emission observations. Further it clearly demonstrates the complementarity of limb-sounding with its high sensitivity and altitude resolution and nadir measurements with their large horizontal resolution. The manuscript is well written and clearly structured and I strongly

recommend publication within AMT after a few clarifications/corrections as mentioned below.

Specific comments

p. 9940, l. 17 'derived the detectable effective radius range of 0.2 to 3.5 μm':

I strongly doubt that there exists a lower size limit: in the mid-IR the scattering from particles smaller than about 0.2-0.5 um is generally small compared to the absorption. Thus, the resulting IR spectra are no more dependent on the aerosol size, but only on the aerosol volume density (volume absorption; i.e. only on the imaginary part of the refractive index). This means that a spectrum from 0.2 μm large particles looks the same as one with 0.01 μm particles, under the condition that the total aerosol volume is constant. Since the spectral feature of volcanic ash, which is the baseline for the detection method, is mainly due to the imaginary part (as shown in Fig. 1) and as mentioned in the text, it is most pronounced for small particles. Thus, I cannot see the need for a lower size limit.

p. 9940, l. 25 'Because they are efficient scatterers of ultraviolet and infrared radiation (Pueschel et al., 1994), they change the aerosol optical thickness':

In the infrared, they are at least similar strong absorbers of IR radiation. This should be made clear.

p9945, l. 18 'volcanic ash (Volz, 1973)':

Also other sources of volcanic ash refractive indices should be given. Further, I strongly recommend that these are shown, e.g. in Fig. 1, and some simulations be performed, e.g. for the example of Fig. 3. Otherwise the whole study is based on one example of refractive indices which makes the case a bit weak.

p9945, l.28 'The spectral slope of the imaginary part of the refractive indices directly determines the extinction coefficient spectra':

Doesn't it depend also strongly on the particle size via the real part?

p.9946, l.11 'Therefore we expect a weaker radiance increase for sulphate aerosol in the MIPAS spectra than for ice and volcanic ash.':

A weaker increase with respect to what? To aerosol mass?

p.9947 and Fig. 3:

1. The exact position of the tangent points should be stated.

2. In Fig. 3b, for the ice cloud simulation a subvisible cirrus has been used with rather small particles. However, I think profile 18 of MIPAS orbit 48509 is located at northern mid-latitudes which makes the use of SVC not obvious. (Particularly, further below on p. 9954 it is mentioned that: 'These median radii are very small and can only be expected in the tropics for sub-visible cirrus clouds.')

p.9948, l.3:

It is mentioned that in the simulation for Fig. 3a, the water vapour has been assumed too high compared to the measurements in Fig. 3b. Can you indicate how much of the radiance continuum is due to the water vapour continuum.

Technical comments

p.9952, l.27 and p.9995, l.3:

check units (W/(cm2. . .)

Fig.1:

Lines are very difficult to distinguish. Use color?

Figs 8-10, 13:

Use color to distinguish plot symbols.

F. 12, caption:

Units for the extinction coefficients are missing.

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 9939, 2013.