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Atmospheric Measurement Techniques Discussions

Interactive comment on "An adaptation of the CO_2 slicing technique for the Infrared Atmospheric Sounding Interferometer to obtain the height of tropospheric volcanic ash clouds" *by* Isabelle A. Taylor et al.

Anonymous Referee #1

Received and published: 25 January 2019

General Comments:

The authors adapt the well-known CO2 slicing technique to obtain the height of tropospheric volcanic ash clouds. They perform simulations to select optimal channels for determining the ash layer height. Subsequently, they employ the technique on IASI spectra obtained during the Eyjafjallajökull and Grimsvötn eruptions, and compare the results against optimal estimation and CALIOP retrievals. These comparisons show that the CO2 slicing technique outperforms optimal estimation. Considering the computational speed of this algorithm, the authors suggest that the technique could be

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used to obtain a first approximation of ash height, which could help with hazard mitigation, especially for aircraft navigation. It could also be used to obtain good a priori data for optimal estimation retrievals. The work is scientifically sound and socially relevant. I would recommend publication of the manuscript after the changes listed below are implemented.

Specific Comments:

The words “meteorological cloud” is used a lot. It is not obvious what that term means. Some explanation should be given to introduce it.

Line 12, page 3: “Assuming an atmosphere which is decreasing in temperature with height”: This is not a realistic assumption since it is true only for the troposphere. There is some discussion on this in the last paragraph of section 2 but it should probably be moved here.

Do the simulated spectra cover the range of atmospheric conditions expected over the globe? The authors use six different atmospheres: high latitude, mid-latitude day and night, tropical daytime and polar summer and winter. What about tropical night, summer and winter in the tropics and mid-latitudes, etc?

Lines 6-7, page 6: Need a reference(s) showing that those are appropriate values for ash cloud properties.

How is the weighting function w = d(tau)/d(lnp) computed?

Fig. and Figure are both used. Choose one and be consistent.

It is surprising that a technique using just a few channels (CO2 slicing) outperforms one that uses many more channels and retrieves several parameters self-consistently using radiative transfer simulations and iterative fits to spectra (OE). The authors suggest that this may be due to the OE retrievals being strongly influenced by the height a priori. This may be so. However, this suggests that the measurements do not have much information on ash height (otherwise, the prior should not strongly affect the retrievals).

If that is the case, how does the CO2 slicing obtain a better retrieval? A qualitative discussion of the difference between the two techniques is in order (not just that the results are different, but why they are different).

Technical Comments:

Line 7, page 2: which can result is -> which can result in

Line 10, page 3: need reference for RTTOV

Line 28, page 4: remove “That”

Line 30, page 4: “The second” -> “The third”

Line 8, page 5: dependant -> dependent

Line 1, page 9: demonstrated -> demonstrates

Line 23, page 9: including the CO2 slicing technique -> including those obtained using the CO2 slicing technique

Figure 3 caption: lines of the plot -> rows of the plot

Figure 6 caption: The plots show the true (simulated) pressure plotted against the CO2 slicing retrieved value for the six different atmospheres. -> Panels (a)-(f) show the true (simulated) pressure plotted against the CO2 slicing retrieved value for the six different atmospheres.

Figure 8 caption: The authors should note that the maroon distribution represents CALIOP retrievals.

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