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Interactive Comment

Interactive comment on "Impact of meteorological clouds on satellite detection and retrieval of volcanic ash during the Eyjafjallajökull 2010 and Grímsvötn 2011 eruptions: a modelling study" *by* A. Kylling et al.

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Response to interactive comments from Referee #3

We thank the referee for the careful reading of and constructive comments to our manuscript. The referee's comments are repeated below in italic font. Our responses to the comments are shown in roman font.

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Comments

1. *The authors fail to recognize previously published alternatives to the traditional "split-window" approach (see references below) that are not as strongly impacted by underlying meteorological clouds. While I agree that dispersion and transport models should play a role in ash detection, the "split-window" approach has been and continues to be greatly improved upon, mitigating many of the issues highlighted in this paper. The authors are encouraged to recognize these more sophisticated ash detection approaches and indicate that improvements to remote sensing techniques are just as important as merging satellite with models.*

Clarisse, L., P. Coheur, F. Prata, J. Hadji-Lazaro, D. Hurtmans, and C. Clerbaux (2013), A unified approach to infrared aerosol remote sensing and type specification, Atmospheric Chemistry and Physics, 13(4), 2195-2221, doi:10.5194/acp-13-2195-2013.

Clarisse, L., F. Prata, J. Lacour, D. Hurtmans, C. Clerbaux, and P. Coheur (2010), A correlation method for volcanic ash detection using hyperspectral infrared measurements, Geophysical Research Letters, 37, doi:10.1029/2010GL044828.

Gangale, G., A. Prata, and L. Clarisse (2010), The infrared spectral signature of volcanic ash determined from high-spectral resolution satellite measurements, Remote Sensing of Environment, 114(2), 414-425, doi:10.1016/j.rse.2009.09.007.

Mackie, S., and M. Watson (2014), Probabilistic detection of volcanic ash using a Bayesian approach, edited, J. Geophys. Res. Atmos, doi:10.1002/2013JD021077.

Pavolonis, M. (2010), Advances in Extracting Cloud Composition Information from Spaceborne Infrared Radiances-A Robust Alternative to Brightness Temperatures. Part I: Theory, Journal of Applied Meteorology and Climatology, 49(9), 1992-2012, doi:10.1175/2010JAMC2433.1.

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Pavolonis, M., W. Feltz, A. Heidinger, and G. Gallina (2006), A daytime complement to the reverse absorption technique for improved automated detection of volcanic ash, Journal of Atmospheric and Oceanic Technology, 23(11), 1422-1444, doi:10.1175/JTECH1926.1.

Pavolonis, M., A. Heidinger, and J. Sieglaff (2013), Automated retrievals of volcanic ash and dust cloud properties from upwelling infrared measurements, Journal of Geophysical Research-Atmospheres, 118(3), 1436-1458, doi:10.1002/jgrd.50173.

The authors are well-aware of the papers mentioned by the referee and the instruments and techniques described therein. Indeed, IASI data were used for the inversion modelling that generated the 3-D ash fields used as input to the radiative transfer model for both cases investigated in the manuscript. While the effect of underlying clouds to some extent may be mitigated by these improved techniques, they are still vulnerable when the ash clouds are at the same altitude as or underlying water and/or ice clouds. The manuscript address the effect of all cloud situations representative for the the Eyjafjallajökull 2010 and Grímsvötn 2011 eruptions, including ash clouds above, at the same altitude and below water and/or ice clouds.

For completeness the above references and supporting text have been added to the Introduction. We have also added a reference to the recent paper by Stevenson et al. (Stevenson, J. A., Millington, S. C., Beckett, F. M., Swindles, G. T., and Thordarson, T., Big grains go far: reconciling tephrochronology with atmospheric measurements of volcanic ash, Atmospheric Measurement Techniques Discussions, 8, 2015, 65–120, http://www.atmos-meas-tech-discuss.net/8/65/2015/, doi=10.5194/amtd-8-65-2015). In the Conclusions we have have rewritten the second last paragraph to include hyperspectral measurements and judgement of ash extent by experts. The Abstract has also been changed accordingly.

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2. *The authors should document the source of spectrally resolved surface emissivity data used in the radiative transfer simulations.*

   Spectrally resolved surface emissivity maps were taken from Seemann et al. (2008). This reference have been added to the manuscript. We have also added the reference to the refractive index used for the ash particles.

3. *The authors emphasize that the size of the ash cloud detected by the simple "split-window" technique that is rarely used anymore, is greatly underestimated relative to the FLEXPART simulations. This conclusion is severely misleading and should be modified. For instance, in an operational environment, forecasters make heavy use of pattern recognition in addition to the actual value of the "split-window" BTD's. Thus, the area of ash manually derived by a human expert would be much more similar to the FLEXPART results. In other words, the "split-window" BTD is rarely used by itself! The author's really need to add this caveat to the abstract and many body of the paper prior to publication because the amount of ash missed in this study is not consistent with real world results.*

   A paragraph have been added to the Discussions emphasizing that the detected ash is based on an automated implementation of the reverse absorption technique and that in an operational setting information from more sources would be used to improve the knowledge of the extent of the ash. The Abstract and Conclusions have been modified accordingly.

4. *The commentary on the impact of large viewing angles is incomplete. While it is true that large viewing angles can cause more false alarms in the traditional "split-window" method (large viewing angle false alarms are less problematic in more advanced ash detection methods), large viewing angles can also increase the detection efficiency in practice (see reference below). The authors should modify their discussion accordingly.*

   Gu, Yingxin, Rose, William I., Schneider, David J., Bluth, Gregg J. S., and Wat-

son, I. M., 2005, Advantageous GOES IR results for ash mapping at high latitudes: Cleveland eruptions 2001: Geophysical Research Letters, v. 32.

In the Discussion section a paragraph have been added where the Gu et al. (2005) results are discussed together with the present findings. The Conclusions have been modified accordingly.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 11303, 2014.

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