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Atmospheric Measurement Techniques Discussions

Interactive comment on "Observation of volcanic ash from Puyehue-Cordón Caulle with IASI" *by* L. Klüser et al.

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Author reply to the comments of Referee # 2 (F. Prata)

General reply to "I am not aware that volcanic ash retrievals have been made from solar backscatter measurements". We fully agree. No quantitative ash retrieval has been made from solar backscatter measurements, but often the aerosol absorbing index (AAI) derived from GOME-2, OMI, SCIAMACHY is treated quasi-equivalent to ash. This is done for example at the aviation control service SACS, where the AAI is displayed as aerosol/ash (http://sacs.aeronomie.be)

Comment 1: As a result of the comments of one reviewer in the Quick Response to

the Paper submission prior to the publication in AMTD we added the somewhat lengthy paragraph about the method. In our opinion this reduced the readability of the paper. Consequently we do agree with the referee and will substantially shorten section 2 following his suggestion in the revised manuscript. Thus section 2 will then only contain a short but precise summary of the method. The mathematical description of the method, for example, has already been published in another paper (also in AMT). We will also follow the suggestion of (shortly) explaining similarities and differences between SVD and (classical correlation based) PCA, and the different use in our method compared to previous TIR studies.

Comment 2: We agree that size distribution is a strongly needed boundary condition for forward modelling of radiance. As we do not use explicit forward modelling in the IASI retrieval (we will explicitly add this to the revised manuscript) but use an approach based on spectral correlation between singular vectors and different extinction spectra, the retrieval results may well reflect the ash AOD while the reasons can be ash composition as well as particle size distribution. Consequently we do not really trust either the retrieved ash effective radius or on the retrieved composition as the signal may equally contain both and with the current method separation of those two boundary conditions is unfortunately not yet possible. We will add an explanation / clarification to the revised manuscript.

Comment 3: This is closely connected to Comments 1 and 2. We fully agree that both, refractive indices (connected to mineralogical composition) and particle size distribution have strong impact on the radiance field. As in our method we do not use explicit forward modelling of radiance we are not as strongly bound by the inappropriate knowledge of both as is the case for methods relying on simulated radiance fields. As already mentioned above we will reformulate the manuscript, shorten the algorithm description following the helpful (and in this case very similar) comments of both referees and also explain the fact that we do not use explicit radiance modelling more concisely.

Comment 4: We agree to the referee that the minerals used in the retrieval are not

the same as used in previous studies. Furthermore we do not claim that this list is the best suited or most appropriate one for volcanic ash (in fact we have the feeling that a “most appropriate” list will depend on the specific volcano). The component "Obsidian" (silicate glass) is used by many other authors, too. Our main intention for the components used was that the mixed-mineral ash optical properties used in most other studies can be represented by the minerals used here and the selection applied in our retrieval consequently allows for higher spectral variability of the ash than using only one or two mixed-mineral components (which furthermore are quite often not very well resolved spectrally). Especially the possibility of allowing for high feldspar and quartz / silicate glass contents (which build the majority of Andean volcanic ash, e.g. Watt et al., JGR, 2009; Alfano et al., Bull. Volcanol., 2011) by including the respective minerals provides the potential of high correlations between the linear combination of input spectra and the actually observed IASI spectra. As already explained in the reply to Comment 2, we do not claim the retrieved mineral fractions really represent the mineralogy of the volcanic ash, as it is quite hard to separate composition and size effects in our retrieval. Nevertheless the possibility of the spectral extinction variability allowed in the retrieval with the minerals used (and presented in Table 1) also allows the retrieval to account for effects of particle size on spectral extinction (e.g. Salisbury and Wald, JGR, 1992) and thus the correlation improves which gives higher confidence in retrieved TIR AOD. We will add a clarification on the selection of minerals as well as on the impact of size distribution to the revised manuscript.

Comment 5: We fully agree that the optical depth, particle size and ash composition all affect radiance extinction in spectrally high resolved TIR measurements. We can add the reference to Gangale et al. for clarification based on previous studies. Regarding the effect of particle size we will add explanations / discussions to the manuscript on appropriate places as already described in replies to above comments.

Comment 6: We agree that there is little discussion about validation, but, as pointed out by the referee himself, this is challenging. We have indeed thoroughly checked the

literature and web for reliable data at the time the paper was prepared and submitted. Admittedly, it is always the problem that during the review more and more information and data becomes available. At the time the paper was prepared the main information for validation purposes was available from ground-based observations (SERNAGEOMIN). Regarding space-borne observations mainly SO2 plots were available. The visible interpretation of MODIS or GOES does not result in quantitative measures. In case of long-range transport and optically thin ash plumes they often are mixed up with cirrus clouds. Unfortunately, the lack of ground-based measurements is also a problem, even AERONET stations are very sparse in the Southern Hemisphere. However, we will consider CALIOP data and revert to possible other sources and expand the validation section and discussion accordingly.

Comment 7: The reference will be added (it is already referenced further below but admittedly this is not clear enough): van Geffen, J., Van Roozendael, M., Di Nicolantonio, W., Tampellini, L., Valks, P., Erbertseder, T. and Van der A, R.: 2007, "Monitoring of volcanic activity from satellite as part of GSE PROMOTE,"in: Proceedings of the 2007 ENVISAT Symposium, 23-27 April 2007, Montreux, Switzerland, ESA publication SP-636.

Comment 8: We will correct this mistake.

Comment 9: We will change the revised manuscript accordingly.

Comment 10: OK

Comment 11: We fully agree. We did not intend to say that ashfall occurred in Australia or New Zealand and consequently will change the wording accordingly.

Comment 12: Maybe the title of the section is somewhat misleading as the IASI retrieval used in this paper is meant here. We will change this in the revised manuscript. The work of ULB researchers belongs to the general retrieval overview of the introduction and will be included accordingly there.

Comment 13: OK

Comment 14: Will be removed according to Comment 1.

Comment 15: as for Comment 14.

Comment 16: as for Comment 14.

Comment 17: We will add an overview on previously used mineralogical compositions to the revised manuscript (see also reply to comment 4).

Comment 18: The densities are generally quite similar - only densities of mafic minerals are higher due to the high iron contents. Nevertheless in our retrieval (and in the ash of Andean volcanoes, e.g. Watt et al., JGR, 2009 for Chaiten) the weights of mafic minerals are low. Thus the ash densities do not differ much from those used in previous studies. We will add an according statement to the revised manuscript.

Comment 19: We will reformulate this sentence.

Comment 20: OK

Comment 21: OK

Comment 22: We agree and will reformulate.

Comment 23: We will have a look at CALIOP data.

Comment 24: as for Comment 23.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 4249, 2012.