

Interactive comment on “Optical, microphysical and compositional properties of the Eyjafjallajökull volcanic ash” by A. Rocha-Lima et al.

Anonymous Referee #1

Received and published: 11 June 2014

In this paper the authors discuss the analysis of physical, optical and chemical properties of volcanic ash samples collected from the ground at 35 km from the Eyjafjallajökull volcano. The analysis and the results are definitely interesting and in my opinion deserve publication. However, there are a few aspects of the analysis and discussion that are not fully developed, explained or clear to me and in my opinion they require some significant revision/addition. Following are some general and some more specific comments.

General comments:

C3417

It is not clear if the sample so collected is representative of what was long-range-transported over Europe. As this is one of the main motivations of the paper (flight safety), it seems advisable that the authors discuss a bit more on how the sampling location was chosen and why, and especially how representative should be the ash collected at such location with respect to ash transported over Europe. The discussion about why the assumption that light extinction is solely (or mostly) due to absorption is interesting, but I am not 100% convinced by the explanation and I think the paper would benefit from some additional discussion and information supporting this assumption or attempting to estimate the bias that the assumption might introduce. It could be useful to the community to report the values of the index of refraction and uncertainties (as a minimum) also in tabular format so that future investigators could use the data directly; if the authors have good confidence in these results. This might increase the impact and usefulness of the paper. Also it could be useful to discuss how general these values might be with respect to other volcanic ashes. The paper motivates the study with the need to improve the retrieval and quantification of volcanic ash emitted by eruptions; however, there is not much discussion in the end of the paper or in the abstract on how the findings of this study really contribute to improve the retrievals. This also links directly to my previous comments on the general applicability of the results found here. A discussion of the implications of this work might increase the impact of the paper. The added figure 13 is interesting. The use of the measured aspect ratio to evaluate the sensitivity of the obtained refractive index is a good addition. However, as mentioned later in the specific comments, the use of 2D imaging can substantially underestimate (at least for some type of particles) the aspect ratio due to orientation of the particles on the substrate and the unknown third dimension, so the assertion that the aspect ratio of 3 is an extreme and conservative value, might actually not be accurate (see the recent paper by Veghte and Freedman, *Aerosol Science and Technology*, 48:715–724, 2014 as an example of several studies on this issue). This does not mean that the analysis reported here is not interesting, on the contrary; however, the caveats of 2D top-view only analysis should be explicitly discussed. Manufacturer and model of

C3418

each instrument should be explicitly reported, and the methods used for the analysis should in some cases be more explicitly explained. The meaning of the uncertainties should also be explicitly discussed (do the error bars represent 1 standard error, or 1 standard deviations, or something else?).

Specific comments:

Abstract:

The abstract is a bit succinct, it briefly reports what was done and how, but there is no summary of what the significance of the results are. Some more elaboration (e.g. a sentence or two on the significance of the work and the implications) might be beneficial.

Page 13272, Line 17: Please report explicitly the year of the last eruption.

Page 13272, Line 26: As currently put, the motivation in terms of global effects due to large volcanoes seems a bit irrelevant here, as the authors mentioned just a few lines earlier that the Eyjafjallajökull was a small to moderate eruption (line 19).

Page 13274, Line 2: What do the authors refer to by “correction models”?

Page 13274, Lines 21-24: As mentioned in the “general comments” section, this part of the paper needs to have a little bit more detail with some justification of the chosen site and some consideration on how well (or not) the sample collected at a location so close to the volcano (35 km) might be representative for particles transported downwind over long distances (for example larger or denser particles might fall off, mixing, oxidation and agglomeration might happen/change etc.). Also the samples were collected 4 weeks after the eruption, this is of course reasonable considering the proximity to the volcano, but would this result in significant aging (for example morphological changes), weathering of the ash? I am not suggesting these samples are not useful, on the contrary, but I also think that the authors should address these issues.

Page 13274, Lines 26: could the “sieving” affect the particle morphology (e.g.; through
C3419

fragmentation or abrasion)? It might be good to briefly comment.

Page 13275, Line 9: The authors refer to the particles being “disaggregated”, what does that imply with respect to the original shape and size of the particle? Does this imply possible fragmentation of the original particles? If so, how do these fragmented particles represent airborne particles?

Page 13275, Line 13: “efficiency close to 100%” shouldn’t that depend on the particle size? So to what size do the authors refer to? $>0.4\mu\text{m}$?

Page 13275, Line 14: Judging from figure 4, it seems like the $5\mu\text{m}$ pore substrates might have a very broad size cut as several submicron particles still seem to be retained by the filter, do the authors still consider all of these as coarse? Does the retention of the top filter affect the measured vs. the actual distribution of the fine particles?

Page 13275, Line 16: Provide the model of the microbalance used and uncertainties.

Page 13275, Line 21: SEM, please provide model and some basic specifications

Page 13275, Line 17: What procedure? Discuss how the procedure works, with at least some minimal detail.

Page 13275, Line 24: The area equivalent diameter is a useful parameter, but did the authors explore the issue of deposition orientation? In other terms, what is the third dimension of the ash? How tall are they? 2D analysis is very useful, but it also has limitations and it would be good to admit the limitation due to the unknown third dimension, to warn the reader about this caveat. Page 13276, Line 12: Is the pycnometer a custom made instrument? Describe briefly. Also what are the uncertainties associated with these volume measurements?

Page 13276, Lines 18-19: Discuss potential reasons for these discrepancies.

Page 13276, Line 25: provide some specification, manufacturer and model of the broad band light source.

Page 13277, Lines 7-14: It would be good to have some reference supporting these conclusions.

Page 13278, Line 10: What is the “range considered”?

Page 13278, Lines 22-23: There is also a dependence on shape.

Page 13279, Lines 1-2: “with the assumption of spheroids”... how? Using a fitted ellipsoid? Explain. Also what was used as third axis of the ellipsoids? Are these prolate or oblate?

Page 13279, Line 8-9: “. . .within a trusted interval”, specify what interval was used and how it was “trusted”

Figure 2: In the caption, or better in the text, provide the manufacturer and the model of all the components, in particular the CPC and its size range.

Figure 3: Consider using higher resolution image format as the length scales are hardly readable.

Figure 5: Here or in the text, it might be wise to put the explicit formula for Vash as a function of all the known parameters. Also was this a custom made instrument? What are the performances in terms of precision and accuracy?

Figure 6: The authors mention in the text that reflectances were measured at different angles. What angle is the reflectances in the figure measured at? Also what is the uncertainties on these curves? How do these uncertainties propagate; in other words, how do the index of refraction retrievals change if one would consider noise and other source of uncertainties?

Figure 7: What do the error bars represent? Please discuss also how the uncertainties were estimated. Also is there any uncertainty associated with the choice of b? In the caption add to “power law fitting. . .” also what is reported on both axes, so that the figure can be interpreted as standalone. Is there any uncertainty on the loaded mass?

C3421

Figure 8: What do the error bars represent? Please discuss also how the uncertainties were estimated.

Figure 9: What do the error bars represent? Please discuss also how the uncertainties were estimated.

Figure 10: What do the error bars represent? Please discuss also how the uncertainties were estimated. Why there are uncertainties associated with the Mie but not with the T-matrix calculations?

Figure 11: What do the error bars represent? Please discuss also how the uncertainties were estimated.

Figure 12: What do the error bars represent? Please discuss also how the uncertainties were estimated.

Technical corrections

Page 13273, Line 3: Consider removing “in the form”

Page 13273, Line 23: Consider to add “to be” in front of “known”

Page 13275, Line 17: Probably a “t” is missing in “weighed”

Page 13276, Line 9: Consider adding “with the distribution from ” after “overlap”

Page 13277, Line 24: Consider removing “fraction” after “reflectance”

Page 13278 (and 12381), Line 11 (and line 26): Change Moosmuller into Moomsüller

Page 13279, Line 14: Consider changing “bellow” to “below”.

Page 13280, Lines 13: “modified gamma function” modified how? Also do the authors mean “modified gamma distribution” . . .

Page 13281, Line 20: Consider changing “submitted” to “subjected”

Figure 4: There seems to be a gap at bin 9 um. Is that real or is something missing?

C3422

In the caption, consider changing “bellow” into “below”. What does the sentence “as presented by Seinfeld and Pandis” really mean (or refers to) here?

Figure 13: The x-axis in plot A is labeled “axial ratio”, for consistency with the text the authors should consider labeling the axis as “aspect ratio”.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 13271, 2014.