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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Volcanic ash from Iceland over Munich: mass concentration retrieved from ground-based remote sensing measurements" *by* J. Gasteiger et al.

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We thank Dr. Nishizawa for his thoughtful comments. In the following, comments by Dr. Nishizawa are in italic font, answers by the authors in normal font.

You emphasize the mass concentration retrieval in this paper as shown in the title, however, they explain its importance by only one sentence, i.e., "Page26708 Line16: because it is a critical parameter for flight safety". Why important? If "flight safety", are the optical properties such as extinction coefficient more important, aren't they? Related to this question, how do you use this retrieved mass concentration in the future? It is essential in this paper to mention why you must convert extinction to mass

concentration.

We agree that this aspect should be elaborated in more detail. We add more details in the introduction about why mass concentration is important.

In addition, a flowchart on the algorithm helps readers to understand the algorithm well.

We add a flowchart of the lidar inversion algorithm.

You should summarize all the retrieved parameters in Table 2 as well as their range.

A list of the retrieved parameters (given as median and uncertainty range) might lead to misinterpretation because an ensemble with the medians of each parameter is not necessarily compatible with the measurements. Furthermore, statistics about the retrieved parameters for the shape distributions ($\sigma_{o,p}$ and $\mu_{o,p}$) could not be interpreted independently, e.g., because they have to be weighted with ζ (e.g., if ζ is close to zero, σ_p and μ_p are hardly relevant). The parameters of the size distribution (r_{mod} and σ) are correlated, making statisitcs over r_{mod} not useful. r_{eff} is probably better suited than r_{mod}; the ranges for r_{eff} are given in the paper. For σ we find 1.6 (1.3..2.0). For m_i we find 0.0069 (0.0024..0.0151). For ζ we find 0.49 (0.14..0.95), thus oblate and prolate shapes are almost equally often present in the ensembles. For conciseness reasons, we prefer not to include these numbers in the paper.

2-2) I understood that this algorithm estimated all candidates (ensemble) of solutions (each candidate consists of 10 parameters and matched the observed 7 parameters within the measurement uncertainties) and considered the median of the candidates as the best solution (i.e., equal (or closest) to the true value of the estimates). To indicate this clearly, you should show a simple simulation result. For example, you make an aerosol vertical profile, simulate a profile of the observed parameters using the made aerosol vertical profile, and apply the algorithm to the simulated profile.

We understand that Dr. Nishizawa's comment refers to η (mass/extinction-factor). As a matter of fact, the "true" η is unknown due to the ambiguity that comes from the physical setup of the measurement. The median η is just a statistical parameter of the retrieved η-distribution. The "true" η is included in the retrieved η-distribution if all measurement uncertainties are considered and the model is adequate. It is not required that the median η is equal (or close) to the "true" η.

Any simulation as suggested will result (1) in a η-distribution that includes η of the aerosol ensemble used as input ("truth") and (2) in a η-distribution with a median η that not necessarily agrees with the η from input ("truth"). The relationships between microphysical and optical ensemble properties are non-linear; consequently, the position of the "true" η relative to the retrieved η-distribution depends on r_{mod}, σ, m, and shape distribution of the input ensemble ("truth").

2-3) How did you separate the ash (spheroid) and non-ash (spherical) particles? You should mention the method clearly.

For the lidar retrieval (Section 3) we only allow ash particles (Page 26716, line 12). It it unlikely that a relevant amount of spherical particles were present in the ash plume, given the high linear depolarization ratio (35-37%) and the low relative humidity this layer. We improve the text to emphasize that we only use spheroids. Some more details about this topic is given in the answer to the report of an anonymous referee (16 Jan 2011).

2-4) You should mention the relationship between the observed parameters and aspect ratio distribution. For example, you should describe qext(r,) as qext(r, fp) in Eq(4), and qsca(r)F11(r,180) as qsca(r, fp)F11(r,fp,180) in Eq(5).

We agree that this point should be described more clearly. In this respect, the refractive index is also relevant for the observed parameters. We clarify in the revised paper that Eq. 4 is for fixed shape and refractive index and add a paragraph with a more detailed description of the calculation of observed parameters.

In addition, you should mention assuming size-independent aspect ratio distribution.

We add a sentence to emphasize this point.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 26705, 2010.