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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Detection and characterization of volcanic ash plumes over Lille during the Eyjafjallajökull eruption" *by* A. Mortier et al.

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Thank you very much for your comments. We provide you answers to all 7 points you listed. Paper has been modified in accordance.

1. We agree with that comment and modify the sentence as follow in the text: This value is in relatively good agreement with climatologic values derived from AERONET data for natural non-spherical coarse particles such as desertic dust, 40-50 sr, (Catrall et al., 2005), 55 sr (Schuster et al., 2012) and volcanic particles, 42 sr, (Derimian et al., 2012).

2. We provided a more detailed description of figure. 5, particularly for the first ash

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eruption (April).

“Pictures presented in Fig. 5 show several complex aerosol features distributed over one or several layers from 15 April to 22 April. Range corrected signals are given for 0 to 6km range to focus on the more relevant part of the troposphere for these two periods. On 15th April, LIDAR was operating during night and day time and revealed an almost free-clouds atmosphere and typical of Lille background pollution situation. The weather conditions changed during the night and low level clouds were detected on 16th, at least up to 18:00 UTC. Then clouds disappeared and a layer was detected at about 2 km. Both range corrected signal and geometrical thickness of this layer decreased with time until no more layer were detected between 08:00 and 14:00 UTC. LIDAR operation stopped very temporarily up to 18:00 and when restarted, a very dense aerosol layer was detected at about 1.5 km and remained detectable up to 18th around midnight. Maximum of geometrical thickness, about 1 km, was measured near 22:00 UTC, then decreased to reach its minimum at 07:00 UTC. The day after, 19th, due to bad weather conditions, no data were available. Finally, weak layers of aerosols located between 2 and 3 km were still visible the three next days (20 to 22nd), when both low and high clouds were temporarily present in the atmosphere. “

3. - We provide more details in the figure captions - Fast Fourier Transform (FFT) is used to reduce noise contamination, by filtering the high frequency in the range corrected signal, before the inversion of the data. - The range corrected signal between ground and 250 m is constant and equals to the range corrected signal measured at z=250m. - Referee refers to the following sentences.

“Accounting for the uncertainty of the LRPBL results in an estimated LRAL value of 48 $\pm$ 10 sr. Due to a larger contribution of ash to the total optical thickness, the accuracy on LR is better than the one expected from the theoretical study. All extinction profiles considered in the following analysis were obtained using a fixed value of the LRAL of 48sr.”

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The first point is that we accounted for the error on the PBL lidar ratio to estimate the error on the ash lidar ratio. This yields to an error of 10 sr on ash lidar ratio. For mot clarity, since the details of the mentioned sensitivty study is not shown, the second sentence has been deleted. And last sentence, we had to consider for inverting the whole period that the ash properties were similar to that of the beginning of April because the determination of lidar ratio cannot be performed for other days. We are aware of possible limitation in our retrievals.

4. We fully agree with that comment and have summarized uncertainty sources in a new table (Table 2).

These are the sources of error for the derivation of AMC therefore including LIDAR signal uncertainties which contains, as presented in section 3.1, both instrumental (overlap, noise, . . .) and inversion method (lidar ratio, reference altitude, . . .) errors. The total error on AMC is calculated in case of independent error sources (quadratic square).

Table 2. (see as attachment) Source Uncertainty Impact on AMC rmc 15% 20% σc 10% 8% RI 0.05 <2% density 20% 20% shape - <10% extinction 20% 20% Total - 40%

We hope that this additional description will report more clearly the uncertainty assessment.

5. The authors think that the considered sentence is: “Using the ground-based RH and a standard atmospheric model, it was estimated, within the range of altitudes where extinction peaks reached their maximum (2–3 km), that the positive bias due to humidity could reach up to 50 %. Âż

Unfortunately, radiosondes are not available in the observation area. Moreover, water vapor provided by Sunphotometer measurements relates to the column value, which not provides useful information on the humidity condition at the ash level. Knowing this, our goal was to estimate the effect of humidity on AMC using a standard model and a parameterization of extinction coefficient with humidity. We are aware that this is a

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rough estimation.

6. We updated the density considered in our work to 1.7 g cm-3 to be more consistent with literature. In their works, Sloane (1984), and more recently (Royer et al, 2011) used this slightly higher value for urban background. Figure 8 has been changed in accordance.

7. In the part concerning the estimation of Ash Mass Concentration, we assume as constant VSD, RI and LR. The Lidar Ratio is the one retrieved by the Lidar/Sunphotometer inversion for the 17th April during the first detection of ash. It is relevant to the layer considered as ash (confirmed by back trajectories) because the LR for the boundary layer was assumed as "background" Lidar Ratio estimated the 15th. The VSD and RI are supposed to be equal to the ones derived by AERONET on the same first detection day (17th April) : Cf section 2.1. These parameters are relevant for ash properties.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 31031, 2012.

Source	*Uncertainty*	*Impact on AMC*
r_{mc}	15%	20%
σ_c	10%	8%
RI	0.05	<2%
density	20%	20%
shape	-	<10%
$\sigma_{a,ext}$	20%	20%
Total	-	40%

Table 2. Uncertainty sources and relative impact on AMC estimation. The extinction uncertainty contains both instrumental (Overlap, noise, ...) and inversion method (Lidar ratio, reference altitude, ...) errors. The total error on AMC is calculated in case of independent error sources.

Fig. 1.

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