Response to Short Comment #1

We thank Sara Barsotti for taking the time and posting this short comment which we think would improve our manuscript.

Answers to the questions are given below, questions are given in black, answers are given in blue, and changes in the manuscript are noted in quotations (“”), also in blue.

1) why not to use the best assessment for mass flow rate when it is available and already published?,

If a new volcanic eruption erupted now, there would be little information on the flow rate available during the first days, and the Mastin et al. (2009) relationship is the first best guess used in a . As this study aims to represent a real case, the Mastin relationship is used, and the improvement of this simple relationship should be done with the inversion technique.

2) how the results and the conclusion of this paper would change if the apriori scenario would be built on these "more constrained" values of mass flow rates?

Figure 1 in reply to review #2 shows inversion results for the four day period using the 0.1 fine ash fraction. The sensitivity of the a posteriori with regards to uncertainties connected to a priori and satellite mass load re shown to be similar only the a priori now have similar values as the a posteriori with the smaller standard deviation 1.5, 1.75. The sensitivity spread between the a posteriori with different uncertainty still do not represent the real uncertainty in the satellite retrieval as seen in the different a posteriori obtained by using different satellite sets.

Comparing to the estimates from Folch et al. (2011) and Gudmundsson at al. (2012) where larger source terms were found indicates that there indeed is ash that is not observed by the satellite and, especially during the April period where the satellite retrieve only narrow clouds with high ash loads. The corresponding model fields show clouds more spread out with lower concentrations.

This aspect should be included in the discussion of the manuscript:

p.15 line 26:

“Even though the 0.1 fine ash fraction match better with satellite retrievals, Gudmundsson et al. (2012) found by studying ash deposition on land almost four times more very fine ash (< 28 µm) for the first days of the Eyjafjallajökull eruption (14-16 April) compared to Stohl et al. (2011) a posteriori over the entire eruption. This large discrepancy indicates that satellite observations indeed do not observe all ash that is either obscured by meteorological clouds or too opaque ash clouds.”

how did you extrapolate the information provided by Mastin et al. 2009 which provide an indication for fraction of material smaller than 63micron to assess the amount of ashes smaller than this size?

The Mastin fine ash fraction is distributed only over 4 to 25 µm as these are the sizes that the satellite is most sensitive to and are not extrapolated. This may miss cause some of the smaller and larger ash articles not to be described correctly in the model transport. Other size distributions, such as the one used by London VAAC (Volcanic Ash Advisory Centre) described in Hobbs et al. (1991) show that 95.6 % of the measured ash distribution is under 30 µm. However, more work should be done on how to translate the sizes that is sensitive to satellite data to the larger (µm > 30) and smaller (µm < 4) sizes.

References:

Folch, A., Costa, A., & Basart, S: Validation of the FALL3D ash dispersion model using observations of the 2010 Eyjafjallajökull volcanic ash clouds. *Atmospheric Environment*, *48*, 165-183, 2012.

Gudmundsson, M. T., Thordarson, T., Höskuldsson, Á., Larsen, G., Björnsson, H., Prata, F. J., ... & Hayward, C. L. (2012). Ash generation and distribution from the April-May 2010 eruption of Eyjafjallajökull, Iceland. *Scientific reports*, *2*, 572, 2012.

Hobbs, P. V., Radke, L. F., Lyons, J. H., Ferek, R. J., Coffman, D. J., & Casadevall, T. J: Airborne measurements of particle and gas emissions from the 1990 volcanic eruptions of Mount Redoubt. *Journal of Geophysical Research: Atmospheres*, *96*(D10), 18735-18752, 1991.

Mastin, L. G., Guffanti, M., Servranckx, R., Webley, P., Barsotti, S., Dean, K., ... & Schneider, D: A multidisciplinary effort to assign realistic source parameters to models of volcanic ash-cloud transport and dispersion during eruptions. *Journal of Volcanology and Geothermal Research*, *186*(1), 10-21, 2009.