

Reply to reviewer 1

Aircraft observations and model simulations of concentration and particle size distribution in the Eyjafjallajökull volcanic ash cloud

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I would like to thank the reviewer for his/her very detailed review of the paper. The text added to the paper in response to these comments has greatly enhanced the clarity of the paper.

Specific Comments

1. **P22589, L13-14: The term ash is not defined; perhaps better use particles which is explained few sentences before:** The word 'ash' has been replaced with 'particles' in this sentence.
2. **P22589, L20: What is meant by near-source mass?:** Near-source mass refers to the total mass emitted from the volcano. We have replaced 'near-source mass' with 'total emitted mass'.
3. **P22590, L5: PSD not defined:** We have now defined PSD as 'particle size distribution' in the text.
4. **P22590, L20: For better understanding, the extent of the near-source region should be explained in more detail.:** We have added a definition of 'near-source' in the Introduction. Near-source refers to ash < 500 km or < 6 hours travel time from the volcano.
5. **P22591, L11: NWP not defined:** NWP has been expanded to read 'numerical weather prediction'.
6. **P22592, Chapter 3: Is it possible to abridge the text? Satellite measurements and comparison with NAME simulations is not the subject of this paper. A short summarize of the meteorological conditions these days are sufficient but the comparison studies should be discussed elsewhere:** We have combined the text from sections 3 and 6.1 in the paper which both described the meteorological conditions. We have also combined original figures 1 and 7.
7. **P22594, L1-3: Each of these ... : a reference or figure, e.g. atmospheric sounding, would be nice here to verify the absence of water or ice clouds:** The verification of water or ice clouds was made using in-situ observations of ambient atmospheric humidity. These are not presented in the paper but are discussed in Johnson et al. (2012). This reference has been added to the revised paper.
8. **P22596, L17: What is the particle size range of the distal fine ash? The term DFAF should be explained in more detail:** In this paper fine ash refers to particles < 30 μ m in diameter. We have added this expanded definition of the DFAF at the start of section 4.1 and in section 1.

9. **P22599, L5, 6: What is meant by meteorological errors, errors in the model meteorology in comparison to the real meteorological conditions?:** Meteorological errors refers to errors in the driving numerical weather prediction wind fields used in NAME. These meteorological errors are indeed errors in the modelled meteorology in comparison to the real meteorological conditions. We have included this text in the revised paper.
10. **P22600, Chap. 6.1: The meteorological conditions are already described in chapter 3. To repeat them is not necessary here and only lengthen the paper. Or the description in chapter 3 can be abridged:** See response to comment 6 above.
11. **P22601, L3-5: It seems that a verb or something is needed to complete the sentence. 'The aircraft observations on 14 May were taken close to the central ash cloud axis in a region in which the ash had traveled for an average of 26 h from the volcano and a column integrated mass of 969mg m⁻²':** We have split this sentence in two. It now reads 'The aircraft observations on 14 May were taken close to the central ash cloud axis in a region in which the ash had traveled for an average of 26 hours from the volcano. The observed column integrated mass was 969 mg m⁻².
12. **P22602, L24-28: The insertion in the brackets is unclear to me and should be set after concentrations. A long sentence with insertion in brackets is difficult to read and understand:** We agree that this sentence is difficult to read and understand. Therefore we have split the sentence into two and have reworded it. It now reads, 'For the in-situ measurements on 5, 14 and 17 May, the layer average ash age is estimated from the NAME model simulation. The observed range of normalised concentrations are calculated using the maximum and minimum observed concentrations in the vertical profile measurements shown in Fig. 3'.
13. **P22605, L1: asl not defined:** We have expanded asl to read 'above sea level' in all places.
14. **P22608, L19-20: The insertion in brackets is not necessary because DPSD is explained elsewhere but it could be repeated in Chap. 5.2. The insertion makes it more difficult to comprehend the text:** The insertion has been removed from the text as suggested. We have also added a definition of the DPSD at the start of section 4.2 and in section 1.
15. **P22608, L23: A reference would be fine here, e.g. S. R. Gislason, T. Hassenkam, S. Nedel, N. Bovet, E. S. Eiríksdóttir, H. A. Alfredsson, C. P. Hem, Z. I. Balogh, K. Dideriksen, N. Oskarsson, B. Sigfusson, G. Larsen, and S. L. S. Stipp (2011). Characterization of Eyjafjallajökull volcanic ash particles and a protocol for rapid risk assessment. PNAS 108, 7307-7312:** The suggested reference has been added to the text.
16. **P22611, L8: The title of the reference is incorrect, it shall be: Grain-size analysis of volcanic ash for the rapid assessment of respiratory health hazard doi:10.1039/B710583P:** The reference has been corrected.
17. **P22612, L8: The reference is incorrect. doi:10.1029/2011JD016762 refers to Petersen et al., 2011. The impact of the atmosphere on the Eyjafjallajökull 2010 eruption plume. Possibly the correct reference should be**

here doi:10.5194/essd-3-9-2011 (Arason et al., 2011, Observations of the altitude of the volcanic plume during the eruption of Eyjafjallajökull, April-May 2010): The reference has been corrected.

18. P22612, L11: The reference is incorrect. The journal title shall be J. Geophys. Res. and not J. Volcanol. Geoth. Res: The reference has been corrected.
19. P22617, Fig 3: For a better understanding the text could be shorten to '... Name simulation using distal particle size distribution 1 (dotted) and 2 (solid). Furthermore, to emphasise the observations solid lines should be used, but dashed lines for DPSD2: We have shortened the figure caption and changed the line style for the observations and DPSD2 as suggested.

Technical Corrections

1. P22558, L18: change by small ($< 30\mu\text{m}$ diameter) particles to by small particles ($< 30\mu\text{m}$ diameter): Done.
2. P22589, L10-13: split the sentence into two sentences: Done.
3. P22590, L1: extra the: Corrected.
4. P22592, L4: wants respective at the end of the sentence: Done.
5. P22594, L18: typing error: sun in lower case: Corrected.
6. P22592, L15, L22 and P22596, L5, L7: Numbers could be rounded: Done.
7. P22603, L15: extra space before comma: Corrected.
8. P22604, L6: Somewhere in this section the link to a figure is missing, which is explained here: A reference to figure 9a has been added.
9. P22607, L8, L9: need blanks before the bracket: Corrected.
10. P22621, Fig. 7; P22624, Fig. 10: It is hard to find the crosses in the plots. Perhaps they should be of different colour/shape/size: Done.