

Interactive comment on “Reconstructing volcanic plume evolution integrating satellite and ground-based data: Application to the 23rd November 2013 Etna eruption” by Matthieu Poret et al.

Anonymous Referee #2

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This manuscript (hereafter referred to as MS) presents a method to estimate the Total Grain size Distribution (TGSD) of volcanic ash by combining field (ash deposits) and remote sensing data (radar, and satellites). The method is applied to the paroxysmal eruption of Etna volcano, Italy on 23rd November 2013. The resulting TGSD is then used as input for a tephra dispersal model to reproduce the tephra loading and the far-field airborne ash mass. The results highlight the necessity of integrating the field and remote-sensing data (from different instrument) to achieve a better estimate of the initial TGSD, which is a key input parameter for modeling the ash dispersion and

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hazards.

The study is novel and within the scopes of ACP. Indeed, the integrated approach introduced in the MS can lay the ground for developing new methods or tools to assess the full spectrum TGSD, which is very important to improve the ash dispersion modeling and volcanic hazard assessment. Although the methods and assumptions seem sound and valid, they are not clearly outlined. For example the methodology is vague in some places (please see the general comments below). So I recommend the MS for publication after addressing the following points.

General Comments:

1-In the methodology section the text is vague and hard to follow (especially P5L20-30, P6L26-42, whole section 3.3). It could be substantially improved. Moreover, there are several tuning parameters introduced in each section and used for specific purposes. Adding one table to show these parameters, ranges and purposes would be helpful.

2-The authors refer to very fine ash as PM20 based on Rose and Durant (2009), which is a mistake. Rose and Durant (2009) define PM30 as the very fine ash and not PM20. Authors should either justify the changes in the size range (reduced range to PM20) or redo the calculations using the correct value of PM30.

3-There are references to unpublished (submitted) papers. I recommend removing these references.

4-In several locations (e.g P4L23, P10L27), it is written that ice is released/emitted/erupted. Volcanoes never emit ice. They emit water vapor that is transformed into liquid water and ice due to microphysical processes. This could be seen also in Fig 4 where ice formation starts later than SO₂ and ash emission. Taking this into account, how would the interpretations change?

5-The 1D plume model FPlume is able to reproduce the ash to ice ratio during the plume evolution. It would be interesting to see how the FPlume modeling results com-

pare with the values shown in Fig. 4 (ice/ash ratio could be calculated from this data). This is very important for model evaluation. Indeed the authors take a primary input (TGSD) and then try to reproduce the very last outputs: deposition and airborne mass. This means they omit all the important factors and uncertainties that affect the plume rise and transport between emission and deposition (like the ash/ice ratio mentioned above or vertical distribution of the plume). These uncertainties and simplifications should be clearly explained and justified.

Specific Comments:

P1L02: do you mean “explosive volcanic eruptions”?

P2L05: replace automatic with automated.

P2L08: By Making . . .

P2L41-P3L2: This belongs either to the abstract or conclusions.

P3L10: 17th episode in the history or in one specific duration?

P3L16: “heavier” or denser?

P3L17: Volcanoes do not emit any water/gas droplets. Water droplets and aerosols are indeed formed in the atmosphere.

P6: What are the input parameters of FPlume (exit velocity, vent diameter etc)? Please explain.

P6L8: 2.5 wt% of what? Water?

P6L13: This is not clear. Do you mean less than 2 wt% of the fine ash is removed by aggregation?

P8L23: what is the difference between RMSE1, 2 and 3? Please explain.

Fig3: The quality is so low that the ash and ice plumes are very hard to recognize. Please use a higher resolution if available.

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Fig5: please clarify the difference between Whole TGSD and the integrated TGSD in the text.

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