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Interactive Comment

Interactive comment on "PLUME-MoM 1.0: a new 1-D model of volcanic plumes based on the method of moments" *by* M. de' Michieli Vitturi et al.

Y. Suzuki (Referee)

yujiro@eri.u-tokyo.ac.jp

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General comments

The paper presents a new 1-D model of volcanic plume based on the method of moments. Two formulations are presented; one is based on a continuous distribution of the number of volcanic ash particles as a function of the size and the other is based on a continuous distribution of the mass fraction. The proposed method is expected to be useful to estimate the variation of the size distributions of particles into the volcanic plume rather than the previous models. The paper shows that the size distribution has a small change along the plume. This is a well-written paper containing interesting

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results for volcanology. For the benefit of the reader, however, a number of points need clarifying.

In Section 5.3 – 5.4, the logic is complicated and messy, and there are many technical jargons that are not defined nor fully explained. “Response surface” is not clearly defined, and therefore, it is difficult to understand Figs. 7 and 8. For these uncertainty and sensitivity analysis, more systematic parameter study is required using a lot of simulation settings such as vent and atmospheric conditions to obtain the general conclusion about a small change of the size distribution along the plume. In my opinion, in order to clarify the focus of this paper, it is better to describe the discussion of Section 5.3 – 5.4 in another paper after thorough analyses and discussion.

Specific comments

p.3755, Eq.(16): It needs a reference that clearly expresses the formulation. For example, Bursik et al. (1992).

p.3759, Eq.(28): In order to evaluate this equation, it will be helpful to briefly describe the derivation from Eq.(26) to Eq.(28) in appendex.

p.3760, Eq.(30): It is also required to describe the derivation from Eq.(29) to Eq.(30) in appendix.

Section 4.1: For researchers in volcanology community, this section is quite difficult to understand. In order to clarify the algorithm, the wording and style of this section need careful editing. What are the meanings of “realizable” and “unrealizable”?

p.3770, paragraph from line 20: Usually, the variation of distribution is also evaluated by kurtosis. The skewness has a peak value at about 2 km and decreases with height. What do these features of the skewness at the lower region of plume mean?

Section 5.2: We would like to see the variations of size distributions for Cases 1 and 3 like Figure 5. It is better to carefully describe the similarity and difference between the cases on the basis of these figures. In addition, it will be helpful to show the variation

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of 2-D distributions in the horizontal spaces.

p. 3786, caption of Figure 5: The caption should clearly indicate that these figures are the results of Case 2.

Technical correction

p.3751, Eq.(5): The second term of the middle equation is alpha_s,j rather than alpha_s?

p.3752, line 10: “Pfeiffer et al. (2005); Textor et al. (2006a,b)” is replaced by “(Pfeiffer et al., 2005; Textor et al., 2006a,b)”.

p. 3775, line 5: “relvance” -> “relevance”

p. 3775, line 6: “aid” -> “air”

p. 3785, caption of Figure 4: “ocntinuous” -> “continuous”

p. 3789, Figure 8: The color bars in the upper figures should be modified.

p. 3890, caption of Figure 9: “indexes” -> “indices”

References

Bursik, M. I., R. S. J. Sparks, J. S. Gilbert, and S. N. Carey (1992) Sedimentation of tephra by volcanic plumes: I. Theory and its comparison with a study of the Fogo A plinian deposit, Sao Miguel (Azores), Bull. Volcanol., 54, 329 – 344.

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