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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Atmospheric processes affecting the separation of volcanic ash and $SO_2$ in volcanic eruptions: Inferences from the May 2011 Grímsvötn eruption" *by* Fred Prata et al.

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Atmospheric processes affecting the separation of volcanic ash and SO2 in volcanic eruptions: Inferences from the May 2011 Grímsvötn eruption" by Fred Prata et al.

This study uses multiple Infra-red, Visible and UV satellite data to illustrate the separation of volcanic ash and SO2 occurred in the eruption column of the May 2011 Grímsvötn eruption (Iceland). The observational evidences are complemented with atmospheric dispersal and plume model simulations to elucidate the mechanism leading to separation, here attributed to the formation in the plume of large hydrometeors (ice-coated ash aggregates) eventually leading to partial column collapse. This resulted on ash and SO2 emitted at different atmospheric levels which, combined with strong wind



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Discussion paper

shear conditions, explains the contrasting dispersal patterns. A part from using and comparing an unusually large variety of instruments (AVHRR, MODIS, AIRIS, OMI, SEVIRI and Caliop), the paper supposes also a contribution to: i) warn on the use of SO2 as a proxy for volcanic ash and, ii) claim on the need to implement differentiated source terms for ash and SO2 in atmospheric dispersal models, an option currently not contemplated by any model (to my knowledge). This is a good paper which needs minor revision; I have only few comments detailed below.

Ash aggregation and hail formation provide a plausible mechanism for separation, supported by fallout deposit observations (Fig. 11) and integral plume model insights (existence of a liquid water window). However, the column collapse scenario (Fig. 10) is more speculative (pg. 18, lines 12-14). It is also unclear how is fine ash (not large millimetric size aggregates) was released at low levels. . .

Pg. 3, line 1. "The separation led to a poor forecast of the ash hazard to aviation". It would we worth to clarify why this may happen. In general, if: i) observed column height and ash are assumed collocated or if, ii) SO2 retrievals are used to initialize a dispersal model.

Pg.5, line 9. atmosphere–so-called atmosphere so-called

Pg. 6. Line 4. Reference Degruyter and Bonadonna (2012; 10.1029/2012GL052566) could be added.

Pg. 7, line 1. "The initial amount of erupted fine ash required to generate an ash cloud consistent with the satellite observations cannot be modelled using the fourth power law, as this produces almost 100 times too much fine ash". The H4 scaling applies to the whole granulometric spectrum, not just to the fine ash fraction (typically a few %). The mass scaling may be needed because the model run with a very fine skewed granulometry.

Pg. 7, line 16. ". . .such as low to medium size volcanic eruptions". This limitation of

CALIPSO is more related to the duration of the event than to the eruption size no?

Pg. 11, Fig. 5 caption. “ornage” orange

Pg. 12, line 15. figure Figure

Pg. 16, line 6. “which is an order of magnitude greater from an eruption that was an order of magnitude smaller in total erupted mass than the Grímsvötn eruption”. Section 2 reports 0.7 and 0.27 km3, for Grímsvötn and Eya respectively, which is a factor of about 2 only. . .

Pg. 24, line 11. Reference Folch et al. (2016; doi:10.5194/gmd-9-431-2016) could be added.

Pg. 24, Fig. 14 caption. A third contour (blue) is also visible

Pg. 28, line 5 and line 22. Table number.

Figure 15. Time series unclear. Plume top is a model prediction or imposed from observations? Also, is the plume model wind coupled?

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