

Comments on ‘FPLUME-1.0: an integrated volcanic plume model accounting for ash aggregation’

This is a generally well written and interesting paper. I have a number of detailed comments, including several grammatical corrections, which I would ask the authors to consider. In particular, I would like them to provide more justification of the form of their entrainment coefficient. This seems to be based on the similarity drift observed by Kaminski *et al.* (2005) (and later by Carazzo *et al.* 2006, 2008). However, the veracity of this similarity drift is inconclusive: it was not observed by Wang and Law (JFM, 2002) in their experiments nor has it been seen in DNS or LES of buoyant plumes (see papers by van Reeuwijk and co-workers especially JFM 2015). It may simply be an artefact of Kaminski *et al.*’s experiments and for this reason I am somewhat sceptical of its adoption in volcanic plume models.

Detailed comments

- p. 8010, l. 26 Buoyancy drives the plume upwards *below* the NBL; above the NBL the buoyancy is negative. I would delete the sentence from ‘above’ onwards; you also need to insert ‘to’ after ‘leads’.
- p. 8011, l. 2 Momentum reaches a maximum at the NBL and carries the plume upwards above the NBL for all plumes regardless of eruption strength.
- p. 8011, l. 5+ I didn’t understand the sentence beginning ‘Depending on the balance ...’
- p. 8011, l. 10 I didn’t understand what is meant by ‘characterization through observations’
- p. 8011, l. 14 ‘build’ → ‘built’
- p. 8011, l. 18 ‘its’ → ‘their’
- p. 8011, l. 28 Woods (1988) does not include moisture.
- p. 8012, l. 14+ Can the authors substantiate their claim that atmospheric dispersion models without aggregation overpredict ash concentrations in the far field? While this seems plausible, aggregation may reduce fall speeds by increasing the drag (more irregular shapes) and reducing the effective density (relative to a single particle of the same size). I think one needs to be careful with what is being compared with what, and what is being kept fixed as the reference point. I would make the statement less strong.
- p. 8012, l. 24 ‘bent’ → ‘bending’
- p. 8013, l. 10 ‘specie’ → ‘species’
- p. 8013, l. 23 I didn’t understand ‘univocally’.
- p. 8016, l. 6 ‘in’ → ‘on’
- p. 8023, l. 4 ‘than’ → ‘as’
- p. 8016, l. 8+ Do the authors have any evidence that there is no entrainment in the umbrella region? The dynamics of the region are clearly complicated but the flow is turbulent which suggests entrainment has at least the potential to take place.

p. 8025, Eq. (28) I'm assuming that the sum over all A_j^- has index k ? Is this correct?

p. 8025, l. 16 'where' $\rightarrow$ 'were'

p. 8027, l. 1 'to' $\rightarrow$ 'in'

p. 8027, l. 11 Insert 'a' after 'as'

p. 8028, l. 6 Insert 'to' after 'respect'

p. 8030, l. 8 'meet' $\rightarrow$ 'met'

pp 8032-8034 Regarding Fig.7, could the authors comment on why the model and observations agree better for small and large values of ϕ but not intermediate values?

p. 8034, l. 3 'allows to' is not grammatically correct. Something like '... is that it allows estimation of the fraction ...'

p. 8034, l.17 Remove 'a'

p. 8034, l. 18 'on' $\rightarrow$ 'in'

p. 8034, l. 19 'along' $\rightarrow$ 'during'