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Geoscientific Model Development Discussions

Interactive comment on "ASHEE: a compressible, Equilibrium–Eulerian model for volcanic ash plumes" *by* M. Cerminara et al.

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This is an excellent manuscript of high scientific quality presenting a new volcanic plume model able to describe the non-equilibrium dynamics of eruptive plume mixture. The formulation is rigorous and the assumptions and limitations of the model clearly stated. Moreover a few tests are simulated and described in order to validate and show the performance and the code.

However the presentation style is a bit too technical and mathematical for GMD and volcanological audience and I would suggest improving the presentation quality where possible.

I have also a few specific comments that I have listed below:

1- In the Abstract citations should be avoided unless strictly necessary; in this case I reckon they may be removed; line 18: "able to reproduce their observed averaged and.. " -> "able to reproduce the averaged and.. "

2- Pag. 5, lines 18-20: sentence a bit confused, I would rephrase the sentence as "Above that level, the plume rises up to its maximum height and then starts to spread out as a gravity current (e.g. Costa et al., 2013) forming an umbrella ash cloud dispersing in the atmosphere..."

3- Pag. 7: Add reference after "Sod's shock tube problem";

4- Pag. 8: in order to avoid confusion using similar symbols (\hat{\rho}_s and \rho_s) I would use \rho_b to denote bulk density;

5- Pags. 9-10: Eq. (4) is valid for spherical particles only (Ganser, 1993). Tephra particles can differ significantly from spheres and terminal settling velocities of volcanic particles be up to a factor 2-3 with respect spherical assumption (e.g. Dellino et al., 2005; Pfeiffer et al. 2005). Although for the aim of the manuscript is not necessary to change the assumption of spherical particles, the limitations of this assumption should be commented and also the effects of particle sphericity and variation of air density and viscosity with altitude on the estimations Re_s etc should be discussed;

6- Section 5: This part can be a bit shortened referring to other works of the authors where simulations are discussed in more detail (e.g. Suzuki et al, submitted; Cerminara et al., submitted)

REFS: Cerminara, M., Esposti Ongaro, T., Neri, A., (submitted). Large-eddy simulation of kinematic decoupling and turbulent entrainment in volcanic gas-particle plumes. Submitted to J. Volcanol. Geoth. Res.

Costa A., Folch A., Macedonio G. (2013) Density-driven transport in the umbrella region of volcanic clouds: Implications for tephra dispersion models, Geophys. Res. Lett., Vol. 40, 4823-4827, doi: 10.1002/grl.50942

Dellino, P., Mele, D., Bonasia, R., Braia, L., La Volpe, L., Sulpizio, R., 2005. The analysis of the influence of pumice shape on its terminal velocity. Geophysical Research Letters 32 (L21306) doi:10.1029/ 2005GL023954.

Ganser, G., 1993. A rational approach to drag prediction of spherical and nonspherical particles. Powder Technology 77, 143–152.

Pfeiffer T., Costa A., Macedonio G. (2005) A model for the numerical simulation of tephra fall deposits. J. Volcanol. Geotherm. Res., Vol. 140: 273-294, doi: 10.1016/j.jvolgeores.2004.09.001

Suzuki, Y.J., Costa, A., Cerminara, M., Esposti Ongaro, T., Herzog, M., Van Eaton, A., Denby, L.C., (submitted). Inter-comparison of three-dimensional models of volcanic plumes. Submitted to J. Volcanol. Geoth. Res.

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