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Interactive comment on "Simulations and parameterisation of shallow volcanic plumes of Piton de la Fournaise, La Réunion Island using Méso-NH version 4-9-3" *by* S. G. Sivia et al.

Anonymous Referee #2

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In this article, the authors successfully demonstrate the ability of a modified Eddy Diffusivity - Mass Flux (EDMF) scheme (based on Pergaud et al. 2009) to model a SO2 deep updraft induced by a volcanic eruption of le Piton de la Fournaise volcano (La Réunion Island). First the heat flux from the volcano is shown to be necessary to increase the height reach by SO2 above the volcano (both in LES and EDMF simulations). Second the dependence of the model results to entrainment and detrainment is illustrated (and used to choose the best set of parameters). The objectives of the paper stand at the interface between physical volcanology and atmospheric sciences and its results will contribute to bridge the gap between small-scale modeling of (active) volcanic plume and meso or large scale modeling of the dispersion of volcanic

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gas and ashes by atmospheric circulation. This is an important topic and a valuable contribution. I thus support the publication of paper. I have two main comments and a series of minor points the authors may wish to take into account in a revised version of the manuscript.

Main comments: * the results of the modified EDMF simulation are shown to be mainly sensitive to alpha, the amount of air entrained at the basal layer of the plume. Alpha itself is a function of the rates of entrainment and detrainment as illustrated figures 7 & 8. While informative, I found the result of the figures a bit too restricted, and, as alpha is not an explicit parameter of the model, I suggest the authors show two contours plots giving as a function of entrainment and detrainment (i) the altitude of detrainment and (ii) the concentration of SO2 at the level of detrainment. This will allow the reader to better estimate the sensibility of the model to the two input parameters. * if I understand well the modified EMDF model, the parameters of entrainment and detrainment are modified at the base layer (with a thickness Delta z). I did not really get why these parameters had to be modified only at the base of the layer and not over the whole height of the plume. Furthermore I wonder if there is a trend of between, for example, Delta z and the respective values of entrainment and detrainment required to find the same results as in the LES simulation.

Minor comments:

p8362 - l 17: the eruptive mass flux is the main parameter controlling the height reached by the volcanic plume.

p8363 - l10: is it possible to show a map of the area affected by the pollution?

p8362 - l8363: the study of Kaminski et al., Journal of Geophysical Research, 2011, could be cited as an attempt of a study coupling volcanic plume dynamics (1D model) and atmospheric circulation models.

p8364 - l1: if I'm not mistaken, the study of Suzuki cited in the reference list shows how

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a model of entrainment in volcanic turbulent plumes depends on the resolution of the grid (the finer the resolution the more efficient the entrainment) and could be cited as a further argument for sub grid modeling.

p8364 - l13: the term "initialised" may not be understood correctly for readers from different backgrounds and should be explicitly defined.

p8366 - l14: I'm sorry I dot not understand the idea beyond the notion that " vertical motions dominate the vertical sub-grid transport".

p8367 - equ. 2: perhaps use a different label than a in the equation (in order to avoid any confusion with the relative area of the plume).

p8369 - equ5: If I understand well there is no solid fraction in the plume. It could be useful to state that more clearly.

p8369 - l20: It might be more relevant to cite Woods 1988 here.

p8371 - l8: I think this sentence might rather be placed in the introduction.

p8372 - l7: It might be good to explain what "deep convection option" means for readers a different scientific backgrounds.

p8374 - l10: I find this paragraph a bit confusing. Did you use or not a wind profile in the different simulations?

p8376 - l27: the sentence does not seem grammatically correct.

Table 3: I think the third line of the table (H2O by SO2 ratio) is not very useful.

Figure 6: is it possible to show the temperature scale for the thermal image?

Interactive comment on Geosci. Model Dev. Discuss., 7, 8361, 2014.