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Geoscientific Model Development Discussions

Interactive comment on "A semi-implicit, second order accurate numerical model for multiphase underexpanded volcanic jets" *by* S. Carcano et al.

F. X. Giraldo (Referee)

fxgirald@nps.edu

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General Comments: The paper is quite good because it combines many different areas of research in interesting areas. For example, the application area is the simulation of volcanic eruptions. The model is based on a collection of conservation laws that are coupled in an integrated way. I find the application area quite novel for this reason and the manuscript is very well written. The main focus of the paper is on the extension of second order methods to the already first-order model. Although the methods used are not novel (they are well established within the literature on numerical methods) the authors are able to show that the improved model yields much better solutions than the original first-order model. My main criticism of the paper is the following. For those of us not well-versed on volcanic flow problems it is difficult to discern how this work is

different from existing models. It is imperative for the authors to state what hole in the literature this paper fills. For example, are all volcanic eruption models low-order? If there are some that are high-order, how does this model differ? Please note that I gave this paper a rating of "good" because I am not sufficiently familiar with the literature on volcanic models. I also gave the paper a "good" rating only on Scientific Quality because I am not familiar with which numerical methods other such models are based on. This is also the case for Scientific Reproducibility because I am not so familiar with the test cases. However, the test cases appear to be standard in this field.

Specific Comments:

P. 401, line 18: Is turbulence included in your model? If so, how is it represented in your model?

P. 409, line 4: Later in the manuscript you state that you use theta=0.5 but here you do not state that. You should state so here. If so, do you use a time-filter? If not, why do the solutions remain stable. Crank-Nicholson is notoriously neutrally stable which, through nonlinear interactions, may become unstable.

P. 410, line 1: The system is represented by a 6N system of equations. Can the problem size be reduced to a smaller system? How are the system of equations solved, iteratively? With what method and is preconditioning used?

P. 416, line 1-5: What are the corresponding Courant numbers for the time-steps mentioned? Are the 3D simulations computed serially? If not ,how many processors and how long does it take? Our experiences have found that 3D Simulations for Navier-Stokes in parallel are much faster than 2D serial simulations (even with the modest number of processors, < 500).

Technical Corrections:

P. 401, line 8: should read "...ated with the rapid...."

P. 406, line 18: should read "...in both the gas..."

P. 423, line 12: should read “compute as $/mu...” (remove one of the two “as”).

Interactive comment on Geosci. Model Dev. Discuss., 6, 399, 2013.