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**GMFIX validation studies of supersonic, turbulent multiphase jets for igneous consequences predictions in the Yucca Mountain Project.**

Sébastien Darteville

Earth &amp; Environmental Sciences Division, Los Alamos National Laboratory, NM 87544.

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Supersonic and multiphase flows are very complex transient flows at all scales (from large geophysical to small laboratory-engineering scales). The transient, heterogeneous, anisotropic nature of these flows make them inherently difficult to both numerically and experimentally model. Hence high quality, well-constrained experimental analog data usable for validating numerical models are sparse. However this validation step is critical for modelers to gain confidence in their results, even more so if these results are used for performance assessment of radioactive waste disposal such as at the Yucca Mountain (YM) nuclear waste repository. GMFIX (Geophysical Multiphase Flow with Interphase eXchanged) is a multiphase code that has been recently redeveloped to meet the strict quality assurance and validation requirements of the YM-project. GMFIX relies on the Implicit Multiphase Formalism in which each phase is modeled as continuum. It solves Navier-Stokes and energy partial differential equations for each phase with appropriate turbulence and interfacial coupling between phases. The turbulence model couples production and dissipation of turbulence between the dispersed and the gas phase in merging together classical Reynolds-Averaged Navier-Stokes approach of gas turbulence with a kinetic-collisional model for the dusty phase. GMFIX has been validated against analog experiments of supersonic underexpanded gas jets from Ladenburg *et al.* [1949, *Physical Review*, 76, 662-677] and matched multiphase turbulent jets from Hishida *et al.* [1985, *Trans. Japan Society of Mechanical Engineers*, 51, 2330-2337]. For the supersonic underexpanded jet case, GMFIX displays within 10% (~ within 1 mm) the exact position of the first Mach disc (normal shock). In addition, GMFIX displays all the features found in these jets, such as expansion fans, incident and reflected shocks, and subsequent downstream mach discs, which make this code ideal for further investigations of equivalent volcanological phenomena. One of the most challenging aspects is the multiphase nature of turbulence. We also validated GMFIX in comparing the velocity profiles and turbulence quantities against the analog experiments from Hishida. The velocity profiles agree with the analog ones as well as these of production of turbulent quantities. Overall, these validation experiments –although inherently challenging– suggest GMFIX captures the most essential dynamical properties of multiphase and supersonic flows and jets.