Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Investigation of mean flow and turbulence for a variable-density jet near transition[1] STEPHEN SOLOVITZ, Washington State University Vancouver, LARRY MASTIN, USGS Cascades Volcano Observatory, BIANCA VIGGIANO, TAMARA DIB, NASIM ALI, RAUL CAL, Portland State University, VOLCANIC PLUME RESEARCH TEAM COLLABORATION — Plumes can vary widely in size and speed in geophysical systems, with Reynolds numbers (Re) extending from thousands to billions. Concurrently, their densities also have significant deviations, resulting in Richardson numbers (Ri) from negligible levels to near one. To investigate a range of these flow conditions more closely, a laboratory-scale experiment considered helium jets exhausting into air. The tests considered Re from 1500 to 10000 and Ri magnitudes near 0.001, which encompasses a series of jet conditions near the exit, including laminar, transitioning, and turbulent flow. Using particle image velocimetry (PIV), instantaneous velocity fields were acquired, and these were used to determine the mean velocity, entrainment, and turbulent statistics. The laminar jet showed very little development or entrainment, with only minor fluctuations. Turbulent jets had rapid flow development, nearing fully-developed conditions earlier than similar non-buoyant jets. For the transitioning jet, the entrainment and turbulent stresses were significantly larger than even the fully turbulent jet, with axial normal stresses more than doubled. Examining the instantaneous flow fields, these increases coincided with large, non-axisymmetric eddies in the shear layer.

[1]Supported by NSF grant: EAR-1346580

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Date submitted: 28 Jul 2016 Electronic form version 1.4