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**On hydrodynamic instabilities in pseudo-boiling with supercritical fluids.**[1] REBECCA BARNEY, UC Davis, ROBERT NOURGALIEV, Lawrence Livermore National Laboratory, JEAN-PIERRE DELPLANQUE, UC Davis, ROSE MCCALLEN, Lawrence Livermore National Laboratory — We investigate hydrodynamic instabilities arising in mixed forced and natural convection laminar flow at supercritical thermodynamic conditions. Fluid in this regime is compressible, with highly varying properties, even for vanishingly small Mach numbers. Hydrodynamic stability is influenced by the occurrence of pseudo-phase change near the channel wall, as defined by the peak of the specific heat above the critical point. While the fluid properties do not explicitly exhibit a discontinuous change, the steep continuous property changes create flow patterns which qualitatively look like boiling. Of interest is investigating this boiling-like phenomenon to characterize the heat transfer in the supercritical regime. Due to the highly-varying density and specific heat fields, we solve the fully compressible Navier-Stokes equations. An advanced equation of state for supercritical water was implemented in an Arbitrary Lagrangian-Eulerian multi-physics simulation tool developed at Lawrence Livermore National Laboratory. A newly developed, robust, $5^{\text{th}}$ order in both space and time, fully implicit, all-speed, reconstructed discontinuous Galerkin method is used to enable the numerical simulations. As the bottom wall is heated, the density decreases at the wall increasing the flow instabilities. The Richardson number indicates when the flow is dominated by forced or natural convection and provides a map/correlation between buoyancy effects and unstable flow features.

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