Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Internal hydraulic jumps with large upstream shear KELLY OGDEN, Massachusetts Institute of Technology / Woods Hole Oceanographic Institution, KARL HELFRICH, Woods Hole Oceanographic Institution — Internal hydraulic jumps in approximately two-layered flows with large upstream shear are investigated using numerical simulations.The simulations allow continuous density and velocity profiles, and a jump is forced to develop by downstream topography, similar to the experiments conducted by Wilkinson and Wood (1971).High shear jumps are found to exhibit significantly more entrainment than low shear jumps.Furthermore, the downstream structure of the flow has an important effect on the jump properties.Jumps with a slow upper (inactive) layer exhibit a velocity minimum downstream of the jump, resulting in a sub-critical downstream state, while flows with the same upstream vertical shear and a larger barotropic velocity remain super-critical downstream of the jump.A two-layer theory is modified to account for the vertical structure of the downstream density and velocity profiles and entrainment is allowed through a modification of the approach of Holland et al. (2002).The resulting theory can be matched reasonably well with the numerical simulations. However, the results are very sensitive to how the downstream vertical profiles of velocity and density are incorporated into the layered model, highlighting the difficulty of the two layer approximation when the shear is large.

Kelly Ogden
Massachusetts Institute of Technology / Woods Hole Oceanographic Institution

Date submitted: 30 Jul 2015 Electronic form version 1.4