Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

A Model for Large-Amplitude Internal Solitary Waves with Trapped Cores KARL HELFRICH, Woods Hole Oceanographic Institution, BRIAN WHITE, Univeristy of North Carolina at Chapel Hill — Large-amplitude internal solitary waves in continuously stratified systems can be found by solution of the Dubreil-Jacotin-Long (DJL) equation. For finite ambient density gradients at the surface (bottom) for waves of depression (elevation) these solutions may develop recirculating cores for wave amplitudes above a critical value. These recirculating cores contain densities outside the ambient range, may be statically unstable, and thus are physically questionable. To address these issues the problem for trapped-core solitary waves is reformulated. A finite core of uniform density and velocity, but unknown shape, is assumed. The core density is arbitrary, but generally set equal to the ambient density on the streamline bounding the core. The uniform core velocity set to the wave phase speed. The exterior flow satisfies the DJL equation and pressure continuity is imposed at the core boundary. Simultaneous numerical solution of the DJL equation and the core condition gives the exterior flow and the core shape. Numerical solutions of time-dependent nonhydrostatic equations with the theoretical solutions as initial conditions show that the waves are stable up to a critical amplitude above which shear instability destroys the initial wave. Trapped-core waves formed by lock-release initial conditions also agree well with the theoretical wave properties despite differences in the core circulation.

Karl Helfrich
Woods Hole Oceanographic Institution

Date submitted: 07 Aug 2009 Electronic form version 1.4