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Examining the initial development of convective instability in a three-dimensional shoaling internal solitary wave of depression in over gentle slopes[1] GUSTAVO RIVERA-ROSARIO, PETER DIAMESSIS, Cornell University — A convectively unstable internal solitary wave (ISW) of depression, shoaling over gentle slopes (<3%), is examined through fully nonlinear and non-hydrostatic simulations. These simulations are based on a high resolution/accuracy deformed spectral multidomain penalty method flow solver. The convective instability occurs due to a sudden decrease in the propagation speed, below the maximum horizontal wave induced velocity; the wave retains its nearly symmetric shape as it shoals. Subsequently, an unstable region develops characterized by the entrapment of heavier-over-light fluid, in the form of a recirculating, or trapped, core. The preceding convective instability is attributed to the stretching of the near-surface vorticity layer of the baroclinic background current from the propagating ISW. According to recent field observations in the South China Sea, this region may persist for more than 10 km and drive turbulent-induced mixing, estimated to be up to four times larger than that in the open ocean. Motivated by such observations, emphasis in this presentation is placed on the onset of the 3D convective instability as the ISW shoals. The ISW propagates in the normal-to-isobath direction. The initial 3D instability is visualized via a transitional structure that develops in the lateral direction. The evolution of the lateral instability is compared with the convective overturn of the core. As such, a preliminary understanding of the formation of recirculating cores in ISWs is obtained.

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