The evolution of internal waves in a rotating, stratified, circular basin and the influence of weakly nonlinear and nonhydrostatic accelerations

de la Fuente, Alberto, Kenji Shimizu, Jörg Imberger, Yarko Niño

Limnol. Oceanogr., 53(6), 2008, 2738-2748 | DOI: 10.4319/lo.2008.53.6.2738

ABSTRACT: The evolution of internal waves in a two-layer rotating circular lake was studied under nonlinear and weak nonhydrostatic effects. Inclusion of nonlinear acceleration allowed the waves to steepen at the rear of the crest in deep lakes, forming a front with time. The nonhydrostatic acceleration is shown to counteract this wave steeping, leading to wave dispersion, and when the two effects are in balance, solitary-type waves can form. It is shown that a Kelvin wave evolves by imparting energy primarily to submodes of the parent cyclonic wave by steepening and to solitary-type waves. By contrast, a Poincare´ wave is shown to evolve without shedding much of its energy to other waves, and only a small fraction of the wave energy goes to other submodes, and this is not lost from the parent wave but rather is periodically transferred back into the parent wave. When both Kelvin and Poincare´ waves were present simultaneously in the waterbody, then an interaction was observed when both waves were in phase, which gave rise to additional wave components.