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Three dimensional simulations of internal solitary waves[1] GUOTU LI, Duke University, FRANCESCO RIZZI, Sandia National Laboratories, OMAR KNIO, Duke University — This study focuses on mass transport and mixing induced by mode-2 internal solitary waves (ISWs) propagating along a pycnocline between two continuously stratified fluid layers. A direct numerical simulation (DNS) model is developed for the incompressible three-dimensional Navier-Stokes equations in the Boussinesq limit. By using high order schemes in both space and time, the model is able to accurately capture the convection-dominated flow at high Reynolds and Schmidt numbers. Simulations both with and without background shear are conducted. The spatial frequency analysis of both density and vorticity fields reveals that no long range spanwise structures are present during the propagation of ISWs, which makes a relatively short spanwise depth sufficient to characterize the evolution of the flow. The growth of 3D structures during the propagation of ISWs is quantified using a spanwise roughness measure. The flow energy budget, dye transport, density mixing and vortex circulations are also analyzed.

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Omar Knio
Duke University

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