

# **Intense Nonlinear Internal Waves in Oceans**

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## **Abstract**

Internal waves on a shelf are important and interesting topics for investigation due to many reasons. Internal waves are main source of vertical mixing in the ocean and thus it provides a useful function of oceanic ventilation. Internal waves have positive influence on biological productivity (as it leads to phytoplankton growth) and negative influence on human activities (such as causing considerable damages to offshore platforms). Internal waves can create resuspension and transport of sediments, etc. The effect of internal waves on a shelf has been observed by acousticians, due to their significant influence on acoustic characteristics of shallow sea. Furthermore, due to specific features of shelf (shallow water of varying depth, nearness of thermocline to the sea surface and to the bottom, phenomena of downwelling and upwelling, presence of strong shear currents, etc.), the propagating nonlinear internal waves may undergo various transformations as they approach the shorelines.

The Korteweg de Vries equation is based on the inviscid hydrodynamical theory, as a result, the investigation of viscous and diffusive effects cannot be accomplished effectively. In order to gain a more comprehensive understanding of the various interaction processes that the solitary wave undergoes, a detailed knowledge incorporating the nonlinearity of fluid quantities and real fluid effects is desirable. Therefore, the full Navier-Stokes and diffusion equations are used for this study. These equations, which incorporate all physics of real fluids, are solved numerically through a numerical scheme that eliminates truncation errors that would mask real fluid effects in the range of parameters of interests.

In this investigation, numerical modeling case studies are carried out. Emphasis is on the shoaling and breaking of an internal solitary wave of depression on a uniform slope and the interactions of an internal solitary wave with various shapes of bottom topography. Comparisons are made with the available laboratory as well as field experiments.