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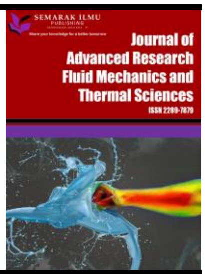

Simulation of Internal Undular Bores in Rapidly Varying Topography

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ABSTRACT

This paper intends to look at the influence of rapidly varying regions on the propagation of internal undular bores in a two-layer fluid flow. Internal undular bores have been observed in the ocean around the world. The appropriate mathematical model to describe the evolution of internal undular bores in a stratified fluid is the variable-coefficient extended Korteweg-de Vries equation. The governing equation is solved numerically using the method of lines to simulate the propagation of internal undular bores. Our numerical results show that the effects of rapidly varying topography lead to adiabatic and non-adiabatic deformation of the internal undular bores, including the generation of solitary wavetrain, generation of nonlinear wavetrain and generation of rarefaction wave. Besides, multi-phase behaviour is also observed during the evolution.

1. Introduction

Internal undular bores have been observed propagating in coastal regions, e.g. Australian North West Shelf [1], Andaman Sea [2], etc. due to fluid stratification [3-4]. Undular bore connects two different basic flow states and has a structure of slowly modulated nonlinear periodic waves with soliton at the leading edge [5]. In a real-world situation, the bottom topography of the oceans is not constant and varies most of the time. Hence, the propagation of the internal waves is often under the influence of variable topography and Earth's rotation [6-7].

The appropriate model for internal waves is the variable-coefficient extended Korteweg-de Vries (veKdV) equation since very often internal waves have large amplitudes. Grimshaw et al. [8] (also see references therein) gave a detailed derivation of the veKdV equation for internal waves. When a single isolated internal solitary wave propagates over a slowly varying topography, it would exhibit several adiabatic and non-adiabatic effects due to the topographic effects. These effects include the formation of a trailing shelf which would then decomposes into a secondary wavetrain, the generation of an internal solitary wave of opposite polarity, etc. [3-4, 9-11]. Furthermore, internal solitary waves will evolve or fission into several solitons when they propagate over a step or rapidly

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