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Generation of Rip Currents from Single Disturbance in Bottom Topography

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ABSTRACT

A possibility of rip current generation from a single disturbance is examined numerically. A series of numerical simulations are conducted on a bottom that has parallel contours with a single disturbance. It is found that a clear rip current is generated by taking an interaction between change in water depth, wave transformation on the deformed bottom and wave-induced current into account in numerical simulations.

KEY WORDS: rip current, interaction between bottom topography, wave transformation and wave-induced current, numerical simulation, rip spacing, rip channel

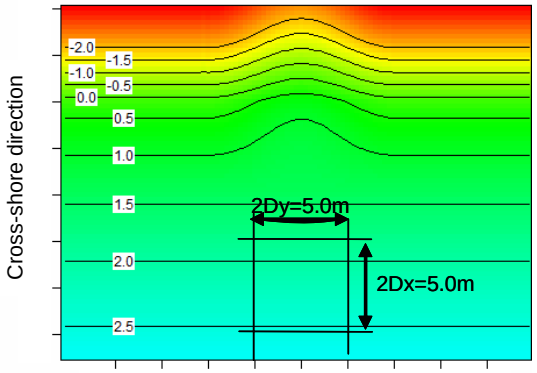
INTRODUCTION

Near shore current plays an important role in transport of various materials, especially sediment transport in the shallow water region. Many researchers have attempted to find out the mechanism of the formations of rhythmic patterns of bottom topography and near shore current by theoretical and experimental studies and field measurements. However, due to their dramatic variations in time and space, there are still many outstanding issues to be settled. Generations of cuspate geometry and rip channels are usually analyzed by an instability analysis by giving sinusoidal perturbation with a small amplitude in a bottom topography and/or incident waves in the longshore direction (Hino, 1980. Damgaard et al., 2002) or by applying a so-called self-organization model (Werner and Fink, 1993, Coco et al., 1999). In these analyses, the whole fluid motion in the region under consideration is restricted by the same wave length in the longshore direction.

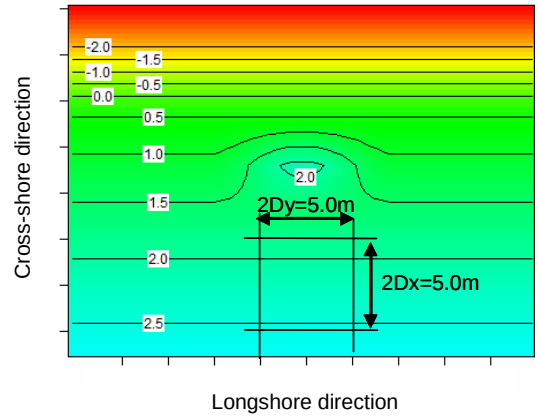
The aim of this study is to examine the possibility for the occurrence of rip current and rip channel generated from a single disturbance in a beach which has parallel contours instead of a sinusoidal perturbation through numerical simulations. Calculated rip current and rip channel spacing are compared with the measured value from the satellite images.

NUMERICAL SIMULATION

A series of numerical simulations were carried out to investigate the generation of rip channel from a single disturbance in bottom topography. In this study, the authors examined two types of disturbance. One was a cusp and the other was a hollow on an uniform model beach in the longshore direction. An initial straight beach was determined according to 2/3-power law with the bottom grain size of 0.5mm. The both bottom profile are shown in Fig.1.



(a) cusp-type disturbance



(b) hollow-type disturbance

Fig.1 Two types of single disturbance

Iterative calculations of wave, wave-induced current and change in water depth were conducted on the initial bottom shown in Fig.1.