Wave-Current Interaction and its Influence on Sediment Transport*

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۱. Abstract

The interactions between waves and currents were evaluated and their potential influence on sediment transport assessed. To consider wave-current interactions, wave and current fields were individually examine and then combined. Flow fields were explored using an available hydrodynamic model, the Environmental Fluid Dynamics Code (Hamrick, ۱۹۹۶; Jin et al. ۲۰۰۰). Three flow fields were considered: a strong current (a river), a moderate current (a bay or harbor), and a weak current (small lake with wind-driven circulation). Wave fields were explored using small amplitude (linear) wave theory. The combined effect of wave-current interactions was explored using the approach of Grant and Madsen (۱۹۷۹). These analyses indicate that, in the presence of currents, waves dramatically enhance sediment transport. Even when a current is weak, the combined effect of waves and currents can resuspend and transport sediments. For the conditions explored, bottom shear stresses from wave-current interaction were greater than the shear stresses from currents alone by an order of magnitude or more.

۲. Introduction

The sediments of many river, lakes, and estuaries are contaminated with chemicals that pose risks to human health and the environment. Successful management of environmental risks in coastal zones affected by contaminated sediments is often a complex undertaking since interactions between water and sediment can transport particles and associated chemicals great distances. To select the most beneficial and cost-effective means to address risks posed by contaminated sediments, it is necessary to determine where particles will be transported over time. It is therefore necessary to understand the factors that influence sediment transport in coastal zones.

During the research, the major topics examined were wave generation by astronomical and meteorological forces and wave transformation. As waves approach the shoreline, the bottom velocities originating from the oscillatory motion of progressive waves exert shear forces at the sediment-water interface. These shear forces have the potential to erode sediment. Despite the high

* Some parts of the Article has been omitted to make it more shortened matching as a conference paper (such as motivation and objective sections and some parts from theoretical sections), these parts are available on request.