Proceedings of the Eighteenth (2008) International Offshore and Polar Engineering Conference
Vancouver, BC, Canada, July 6-11, 2008

ISBN 978-1-880653-70-8 (Set); ISBN 1-880653-68-0 (Set)

Effects of Tidal Currents and Waves on Bottom Suspended Sediment Fluxes off Two River Mouths

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ABSTRACT

Effects of tides and waves on bottom suspended sediment fluxes were studied by conducting a series of field measurements. The measurements were conducted simultaneously at inlet of Hamanako (a semi enclosed bay) and river mouth of Tenryu river. The effects were investigated by analyzing time series data of tide level, currents, waves and bottom turbidity levels. The comparisons explain that the turbidity at the two observation points give different responses to the tides and waves. Bed shear stresses of waves and currents were calculated separately to see the contribution of the elements to the bottom turbidity levels.

KEYWORDS: bottom turbidity, tidal currents, waves, bed shear stress

INTRODUCTION

Characteristics of the sediment transport due to waves and tides have been one of eminent progressive studies in coastal subject recently. The studies were focused on how to explain the effects of coastal hydrodynamic elements on sediment fluxes in or out from one observed area. Waves and tides are the two elements that have been told as important driving forces in coastal processes. It is generally understood that sediment transport, for instance around a tidal inlet, is complex due to nonlinear interaction between water motion (tide, wind, and wave driven) and the channel and shoal structures. Thus, many aspects of the inlet dynamics are still not well known (Elias *et al.,* 2006). Another study proved that high concentration of suspended particulate material in estuaries would most likely be the result of either locally generated wave suspension, high freshwater sediment loads due to freshets, or intruding sea water carrying suspended sediments deduced from wave activity in coastal zone (Uncles, *et al.*, 2002). Observation conducted by Uncles *et al.* (2002) in Delaware, Scheldt, Rio de la Plata, Gironde, Bay of Fundy, Changjiang, Amazon, Patos Lagoon, and the Hawkesbury Estuary revealed that turbidity level also depends on the length of the estuary. Short estuaries would rapidly flush their erodable fine sediment to coastal zone. On the other hand, long estuaries would slowly flush the sediment and able to accumulate large and increasing amount of fine sediment in the long term.

Tidal forces may enable suspended sediment to intrude deep into upstream direction of river or inlet. The degree of tidal forces effects on suspended sediment distribution may differ depending on the area and the forces magnitude. Variations in tidal conditions and freshwater volume, as well as stochastic events such as large storms, have the ability to control residence time of particles and organic matters, in which they may create further process of flocculation (Goni *et al.,* 2005). Voulgaris and Meyers (2004), who studied sediment concentration in a tidal creek, found that strong ebb currents can re-suspend any fine, flocculated sediment that might have been deposited on the bed or on the lower banks of the creek. Although this investigation was not conducted at a tidal creek, similar effects of the ebb currents are still possible to occur.

Despite the above-mentioned studies, studies on detail characteristics of sediment fluxes on a semi enclosed bay and a river mouth at the same time are rare. Previous studies were mainly focused on upper layer suspended sediment movement (Hiramatsu *et al*., 2005). Therefore, this study was conducted to formulate bottom sediment fluxes characteristic due to tides and waves by observing the fluxes at the inlet of Hamanako (a semi enclosed bay) and at the river mouth of Tenryu river.

This study was conducted through a simultaneous field observation to obtain the response of the locations to the same oceanographic input. Beside oceanographic input, river discharge is included in this study as one of possible factors that may cause a high suspended sediment concentration during ebb tide at a river mouth (Kitheka, et.al, 2005).

MEASUREMENT LOCATIONS

A series of measurement has been conducted at two points located at Enshu Nada Coast. The Enshu Nada Coast is located in Shizuoka Prefecture of Japan. This coast faces to the Pacific Ocean. There are two main coastal features found along this coast, i.e. some river mouths and a semi enclosed bay of Hamana Lake. Measurement of this research was conducted at two places, namely river mouth of Tenryu River and Inlet of Hamana Lake (Fig. 1). The two locations are separated about 15km apart. Tenryu rivermouth observation point, which has an average depth of about 18.2m, was located about 1.1km to the south the outlet of the river. The Tenryu River is the number 9th longest river in Japan which has 213km length. Tenryu River flows from Lake Suwa in Okaya-Nagano Prefecture to the Enshu Nada