論文 / 著書情報
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題目(和文)	内湾域における波と流れによる底泥輸送および海底環境の動態に関する研究
Title(English)	Sediment transport and near-bed dynamics by currents and waves in muddy environments of inner bay
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Understanding of dynamics of coastal morphology and sedimentary environment is critical topics for sustainable use and management of coastal and estuarine area. From a view point of economical use of coastal area, for example, prediction of sediment transport rate around ship navigation channel and harbor basin may be crucial for reliable estimate of future maintenance dredging cost. On the other hand, from the environmental view point, since sedimentary environment may strongly influence on the water quality change and the benthic habitat, sedimentary processes have a key role for forecasting temporal variation of coastal water environment. However, since sediment dynamics are often dominated by site specific, unsteady and intermittent phenomena such as sediment discharge through a river with flood events and resuspension of bottom sediments by waves and currents under storm condition, deployment of field monitoring with limitation of space and time causes lack of knowledge on the processes in coastal and estuarine seas.

The target area of the present study, the Ariake Bay and the Tokyo Bay, are typical embayment in Japan, where mud or fraction of silt and clay is dominant in the bottom sediments, and the process of fine sediment transport is an important factor for their water environment in the area. Better understanding of specific characteristics of muddy sediment dynamics, therefore, is required to develop methods of forecast morphological and sedimentary changes, which can be applied for assessing the future environments.

Considering these backgrounds, several field monitoring were carried out in the present study for capturing characteristics of spatial distribution of muddy sediment and near-bottom processes including transport process of mud and water quality changes under the forces of waves and currents. Furthermore, the knowledge obtained through the field monitoring were applied for modelling of fluid mud transport processes, observed in the Tokyo Bay. For the capturing sediment characteristics, besides the acquisition of key parameters of sediment strength such as bulk density and water content from sediment cores, an in-situ device was also newly introduced for direct measure of bulk density of bottom mud. Through the deployments of long-term monitoring in the fields, where several acoustic velocimeters and synchronized measurements of water qualities including turbidity, dissolved oxygen and so on, the present study examines sediment dynamics and water quality change due to waves and currents. In the deployment of monitoring campaign in the Tokyo Bay, dynamical processes during an extreme storm events due to a passage of typhoon were successfully captured and the data obtained through the event were analyzed and applied for numerical simulation of mud transport process under the storm condition.

The thesis consists of 7 chapters as followings,

In Chapter 1 “Introduction”, after descriptions of the background of the study topics and review

of the previous research works, the aim of the study is described.

In Chapter 2 “Characteristics of muddy bed structure”, sediment characteristics in the target fields are described with field observed data, focusing on vertical structures of muddy sediments. At some monitoring points with the deeper condition, the data shows existence of fluid mud layer with the thickness of a few decimeters.

In Chapter 3 “Fine sediment dynamics under tide-dominated condition”, sediment transport characteristics under meso-tidal current condition in the Ariake Bay are examined through data analysis of the long-term monitoring campaign with an acoustic Doppler profiler (ADCP) deployment. Backscatter of the acoustics signal of the instrument were applied to estimate suspended sediment concentrations and resuspension/settling fluxes of sediment under the tidal current were calculated

In Chapter 4 “Data analysis and modeling of mud transport during storm event in Tokyo Bay”, the field data obtained through the monitoring campaign in the summer of 2007 shows muddy bed dynamics during the extreme storm events at a monitoring station with water depth of around 25 m, where the effects of current and wave are none in the normal condition. Based on the monitoring results, fluid mud transport under the shear stress has been modeled and a transport rate formula have been newly derived.

In Chapter 5, “Effect of wind wave disturbance on temporal variation of near-bottom dissolved oxygen in inner Tokyo Bay”, near-bottom dynamics due to waves are examined focusing on the temporal variation of dissolved oxygen.

In Chapter 6 “Application of fluid mud model with stochastic approach of bottom shear stress estimation to storm event simulation”, the newly derived fluid mud transport model in Chapter4 was applied to numerical simulations of muddy sediment dynamics during the observed storm event. In the model, stochastic approach is introduced for estimates of force condition under irregular waves, showing conventional time averaged shear stress model provides under estimation of the sediment transport rate.

In Chapter 7, the thesis is summarized and concluded.