ABSTRACT

題　目　Spatial and temporal variability in salinity and tidal flow in a shallow tidal channel
（浅い感潮水路における塩分と潮流の空間的および時間的変動性）

Nguyen Thi Hiep

Estuaries are often the transport connection between rivers and the ocean as well as the source of several factors that impact on human life such as food, water consumption, economic, and so on. The results of the interaction between freshwater and saltwater will create a unique environment of each estuary, which affects significantly several estuarine species. Salinity that is the salt amount dissolved in water body and water current caused by the tides from the ocean always change within the time and space. Understanding the mechanisms that control the salinity and tidal flow has an important role in estuarine management.

This work focuses on indicating the spatial and temporal variability in salinity and tidal flow in the Ōta diversion channel which is one branch of the Ōta river system in Hiroshima city, Japan. With the longest distance, large tidal flats, and freshwater run-off is limited by the gates, the Ōta diversion channel becomes the most important branch of the Ōta river system in controlling flood, transportation, economic development, etc. Besides, with the tidal range of 0.5 m to 4 m, the bottom of the Ōta diversion channel is completely submerged at high water and partly dries out at low water, which indicates that the Ōta diversion channel is a shallow tidal estuary.

The present study also aims to examine the performance of the proposed scheme using the FAT system, which is a zigzag configuration in a rectangular tomographic domain of 700 m × 170 m, in terms of providing sufficiently accurate and cost-effective method to estimate riverine characteristics.

Three field observations were conducted during both neap and spring tides in a river segment with the length of 850 m at the central part of the Ōta diversion channel (about 4.5 km from the estuary) to collect the data set of salinity, water temperature, water density, and tidal current. Analyzing these data set results in the spatial and temporal variation of salinity and tidal flow, then the estuarine dynamics will be displayed.

By using the quantity and the depth of stratification layers as well as the surface-to-bottom salinity difference deduced from the transverse and vertical distributions of salinity, the stratification/de-stratification degree is evaluated in a shallow, narrow, and tidal estuary. In detail, it was found that, in the lateral and vertical dimensions, density driven is the main mechanism that controls the stratification in the Ōta diversion channel. Stratification occurs during spring-ebb tides

and early of neap-flood tides because of the effect combination of tidal straining, tidal asymmetry and freshwater inflow from upstream, while the lateral distribution of salinity appears during spring-flood tide and the late of neap-flood tides due to the lateral density gradient.

In the longitudinal dimension, it was found that both tidal flow and salinity patterns reveal a completely tide-dominated influence. The tidal flow is asymmetry, mostly due to the interaction of the $O_1 – K_1 – M_2$ tidal constituents; and the topographic effects. The longitudinal dispersion coefficient was found to increase toward the mouth of the river, and the tide-driven mechanism might be the dominant mechanism in the dispersion process in the study site.

The salinity in the Ōta diversion channel does not response to the water level fluctuations immediately. It was found that there are delays in time between the salinity and water level variations, with the salinity response time lags ranged from approximately 12 minutes to 1.5 hours, corresponding to a phase lag range of 13°–47°. The time lags increase seaward along the channel, and decrease corresponding with the increase of the upstream freshwater release.

Finally, the present research shows that with the lower needed instrument number, the new zigzag configuration of FATs can be an accurate and cost-effective measurement method for monitoring estuarine physics.