In situ observations of sediment dynamics in Tongzhou Bay, China: in response to wave-current interaction and strong wind forcing

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Introduction

Tongzhou Bay connects with the margin of Southern Yellow Sea, China, and is adjacent to the month of Changjiang River Estuary (Fig. 1). About 50% of the sediments in the bay are slit and clay particles that originated from the Old Changjiang River and Old Yellow River (Milliman *et al.*, 1986). According to the measurement under the normal weather, the average tidal range in Tongzhou Bay is about 3~4m; the max current velocity in the spring and neap tide are about 1.3m/s and 0.7m/s respectively; the maximum suspended sediment concentration is 1.2g/L; the suspended sediment median size D_{50} is about 0.004~0.016mm; and the bed sediment D_{50} is about 0.02~0.07mm. However, few studies are conducted to illustrate the complex local sediment dynamics under the interaction of waves and currents, especially during the strong wind period. The depth of deep-water channel may change after the period of strong wind. The sediment load during this period may increase dramatically in the harbour and cause severely sudden siltation in the navigation channels. Thus, it has a realistic significance to understand the sediment dynamics under the impacts of wave-current interaction and strong winds, and make it applicable to solve scientific and engineering issues such as sudden siltation in Tongzhou Bay.

Methodology

A quadruped bottom observation system with various instruments (e.g., Nortek ADP, OBS-3A, and LISST-100) will be mounted near the bed of the bay to illustrate the patterns of the bottom sediments under the effects of wave, tidal currents, and strong winds. As shown in Fig. 2, a downward, 1MHz Nortek ADP will be used to find the time-averaged current velocity of the measuring point 120cm above bed. The ADP will record Suspended Sediment Concentrations (SSC) as well by using an OBS-3A (Downing, 1983). The OBS-3A will be calibrated both *in situ* and in the laboratory. The grain-size distributions of suspended sediments will be observed by using a LISST-100 instrument (Type C) (Agrawal and Pottsmith, 2000). In addition, the current velocity profile will be obtained using an upward 600kHz RDI broadband ADCP, with wave gauge assembled to measure the wave height and wave period (Van Haren, 2001). The ADCP also records SSC results using another two OBS-3As. Key parameters that influence sediment dynamics such as bed erodibility and settling velocity will also be estimated from the collected data to understand 'how much sediment is suspended' and "how far that sediment is transported" (Friedrichs *et al.*, 2008).

Results and conclusions

The following results can be expected according to the collected data using this bottom observation system:

1) The vertical structure of suspended sediment concentration in response to wave-current interaction and strong wind forcing can be measured with high temporal and spatial resolution.

2) The available data can also be processed to find various sediment parameters such as settling velocity and erosion rate that valuable to develop and verify a mathematical model, and even more important, to understand the sediment processes under complex hydrodynamic conditions in Tongzhou Bay.

Fig. 1. Map of Tongzhou Bay, China. The location is marked in red pentagram.

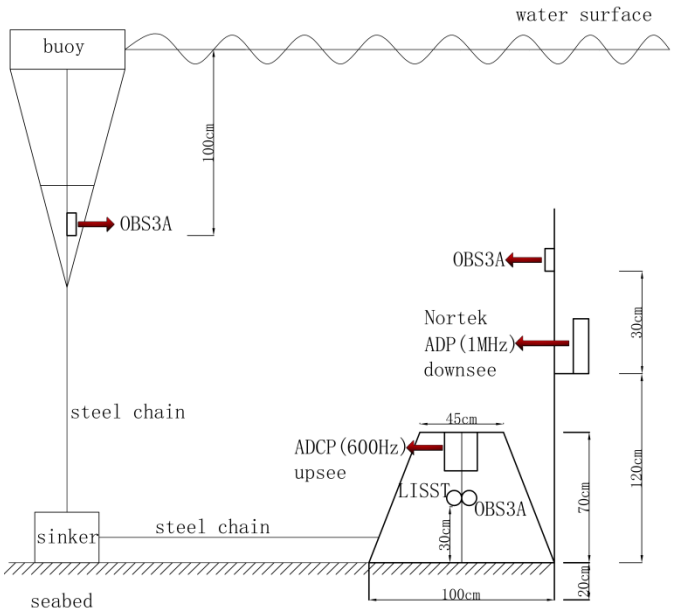

Fig. 2. Bottom observation system with mounted ADCP, ADP, OBS, and LISST.

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