**Title**：Influences of Land Reclamation on Sediment Erosion and Deposition in the Bohai Bay

Laboratory of Marine Environment and Numerical Simulation, College of Marine and Environmental Sciences, Tianjin University of Science and Technology, Tianjin,300000

**1. Aim:** This study aimed 1) to analyze the influences of the land reclamation on sediment erosion and deposition in the Bohai Bay; 2) to investigate the effects of wave on sediment by comparing the results where wave action was considered or not.

**2. Methods:** In this paper, the model setting before and after the enclosure filling in the previous work is followed. The distribution of shoreline and water depth in the calculation area is shown in Figure 1, and the location of the measuring station used for model verification below is also shown in the figure. Both the FVCOM-SWAN coupling model and the sediment model adopt the same triangular mesh, which is locally encrypted in the Bohai Bay area. The minimum mesh size is 300 m and the maximum mesh size is about 10,000 m at the open boundary. The water depth data on the grid points of the model before and after filling were obtained by 1 '×1' East China Sea water depth data interpolation provided by Choi et al. The open-boundary tidal level data was calculated by OTPS, and the surface wind field adopted the 10 m wind speed data of CFSR provided by the National Center for Environmental Prediction (NCEP).

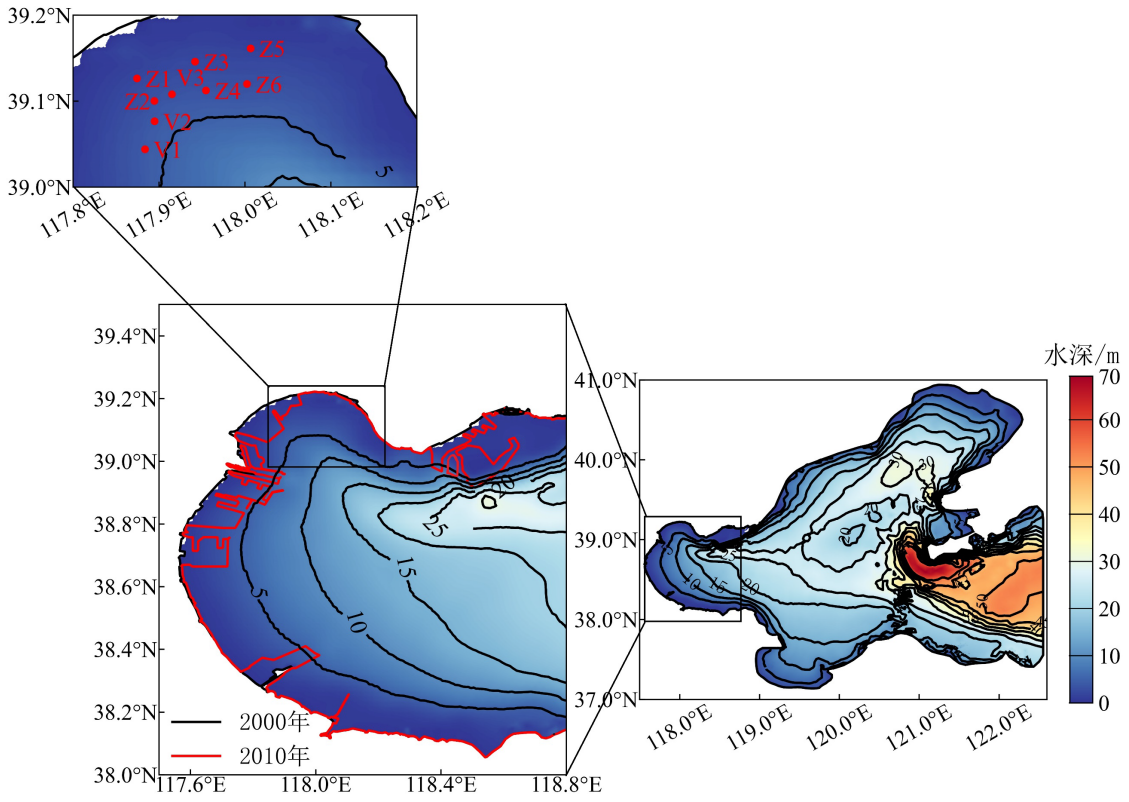

Fig .1 Bathymetric map before and after land reclamation

The vertical FVCOM model adopts σ coordinate system, which is divided into 11 layers. The calculation time step of the external mode is 5s, the calculation time step ratio of the internal and external modes is 3:1, and the calculation time step of the SWAN model is 15min. The two models run separately and exchange data every 30 minutes. In the FVCOM-SWAN coupling model, the shear stress at the bottom was calculated using the formula given by Soulsby. The sediment model is run in the FVCOM model, and the calculation is carried out with single component sediment, with the time step of 15s. Sediment of median diameter of 0.03 mm, according to the measured data rate for other major parameters, including sediment sinking speed is 0.4 mm/s, erosion rate off for 6 × $10^{-6}$ kg/$m^2$/s, the critical shear stress for 0.02 Pa.

**3. Result:** It can be seen from fig. 2 that after the enclosure filling, the sediment content of Caofeidian No.1 Port Basin, 2nd Port Basin and Naqiao River channel decreased in different degrees during the surge and fall, with the decrease amplitude mostly within 0.1 ~ 0.2kg/$m^3$. At the same time, the sediment content in the right side of the gate of Sangangchikou and its adjacent internal waters in the northeast of Caofeidian increased with an increase of 0.05 ~ 0.2kg/$m^3$, while the sediment content in other locations decreased with a decrease of 0.15 ~ 0.2kg/$m^3$.

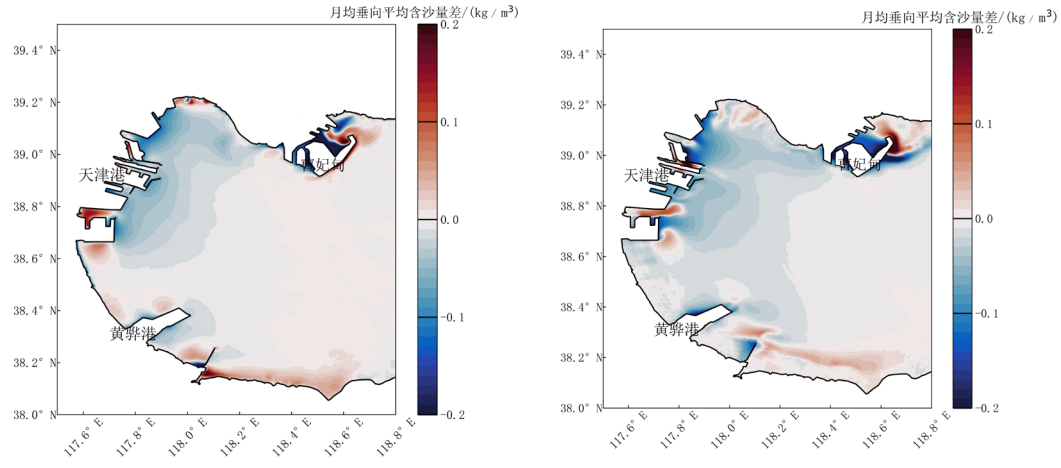


Fig .2 Variation of monthly-averaged and depth-averaged sediment concentration before and after land reclamation in the Bohai Bay

In the emergency period, the sediment content increase area of the Sangang Pond returns to the outside of the mouth, especially near the right side of the mouth, with an

increase of 0.05-0.2kg /m$^3$. The sediment content decrease area has almost covered the entire internal waters of the Sangang Pond, with a decrease of 0.1-0.2kg /m$^3$.

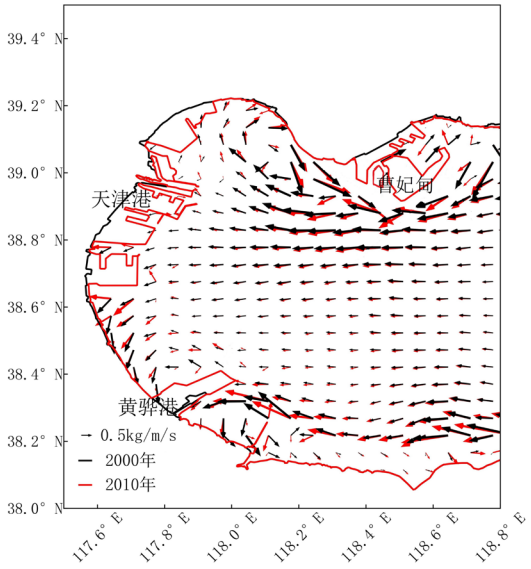


Fig .3 Suspended sediment flux per unit width before and after land reclamation in the Bohai Bay

It can be seen from Figure 3 that the sediment transport direction of Bohai Bay is mainly from east to west to shore before the reclamation, and it is divided into two parts after reaching Tianjin Port. One part is transported to the northwest bay top, and the other part is transported from the coastal line of the bay top back to the bay through Caofeidian, with a single wide suspended sediment flux ranging from 0.5 to 2.25kg/m/s. The other turned to the southwest direction to Huanghua Port near the sea area, singlewide suspended sand flux of 0.5 ~ 1.0 kg/m/s.

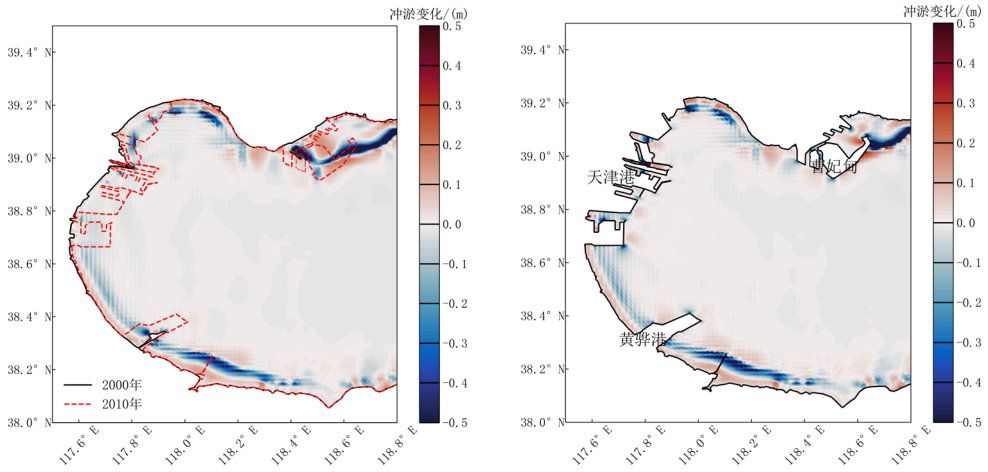


Fig. 4 Monthly bed change before and after land reclamation in the Bohai Bay

Reclamation has a significant effect on the scouring and silting of the nearby sea surface, but has little effect on the far sea area. After the filling, except for the innermost waters

of Caofeidian No.1 and No. 2 Cisterns, the sedimentation in other positions of No.1 Cisterns increased compared with that before the filling, and the increase of monthly sedimentation thickness was mostly 0.05 ~ 0.10m. The sedimentation in other positions of Ergang Basin decreased, and the decrease of monthly sedimentation thickness was mainly 0.03 ~ 0.08m. The inner waters of the first and second port Cisterns and the tidal channel were in a scour state before the filling. After the filling, the scour depth decreased, and the decrease of the monthly scour depth was mainly 0.27 ~ 0.45m. The left and right sides of the mouth of the three port Cisterns changed from the silt before the filling to the scour state after the filling, and the monthly variation range was mainly 0.10 ~ 0.20m. The internal water area on the right side of the adjacent opening changed from scour before filling to siltation after filling, with a monthly variation range of 0.10 ~ 0.30m. The sedimentation of other waters inside the Sangang Basin, especially the northwestern waters, decreased compared with the pre-filling period, and the decrease of monthly sedimentation thickness was mostly 0.10 ~ 0.15m. The reason is that the internal waters of the Sangang Pond are in a semi-closed environment and the hydrodynamic force is weakened, which results in the sediment entering the Sangang Pond through the mouth gate to be silted near the mouth gate. In particular, the sediment in the waters adjacent to the right side of the mouth gate increases, while the sediment in the waters far away from the mouth gate, especially the northwest waters, decreases correspondingly. At the same time, in the sea area with a large change of original tidal current flow direction at the outer boundary of Caofeidian reclamation, the erosion increased compared with that before the reclamation due to the increase of velocity, and the increase of monthly erosion depth was mainly 0.12 ~ 0.19m. The sedimentation in the sea area near the outer boundary of East Xinjiang Port area, harbor Economic zone and Nangang Industrial Zone of Tianjin Port increased compared with that before the reclamation, and the increase of monthly sedimentation thickness was mainly 0.05 ~ 0.15m. At the same time, the sea area around the entrance of Lingang Economic Zone, the entrance of Nangang Industrial Zone and the southeast corner of the outer boundary of the enclosure increased, and the monthly erosion depth increased by 0.15 ~ 0.25m. The change of scour and silt in the sea area adjacent to Huanghua Port was small, and the monthly change range was less than 0.10m.

**4. Discussion:** In the main enclosed reclamation areas, the vertical average monthly sand content increased in the area around Chikou Gate of Sangang in Caofeidian, the area around Tianjin Nangang Industrial Zone and part of Huanghua Port, but decreased in other main enclosed reclamation areas. According to the results of single wide suspended sediment flux, the main sediment transport direction in Bohai Bay has no obvious change, and it is transported from east to west to shore. At the same time, the sediment transport direction and intensity did not change significantly in the sea area with small coastline changes, while the original sediment transport direction was hindered by enclosed buildings in the sea area with large coastline changes. For the bed surface erosion and sedimentation changes, scour decreased in the innermost waters of Caofeidian First Port Cistern and Second Port Cistern and in the tidal channel, silt increased in other positions of the first port Cistern and reduced in other positions of the second port Cistern. The left and right sides of the mouth gate of the three ports Cistern changed from scour to scour, the internal waters near the mouth gate changed from scour to silt, and the other waters inside the three ports Cistern reduced. In Tianjin Port, the sedimentation of sea areas near the outer boundary of East Xinjiang Port Area, Lingang Economic Zone and Nangang Industrial Zone increased, while the sea areas near the entrance of Lingang Economic Zone, the entrance of Nangang Industrial Zone and the southeast corner of the outer boundary of the enclosure increased. The range of erosion and silting change in the sea area near Huanghua Port is relatively small.

**4. Conclusion:** Reclamation has a significant effect on sediment transport in the waters near the reclamation area, but has a small effect on the waters far away from it.

**5 Perspectives in future:** In order to enhance the accuracy of model, we will reevaluate and choose Multicomponent sediment.