

Response of hydrodynamics and water quality to large-scale reclamation in Sanmen Bay, China

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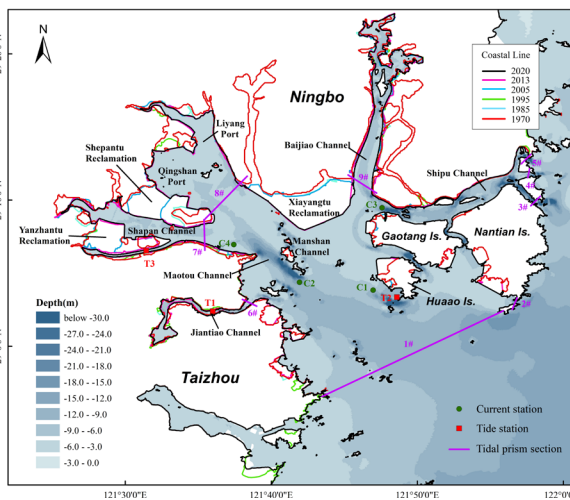
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INTRODUCTION

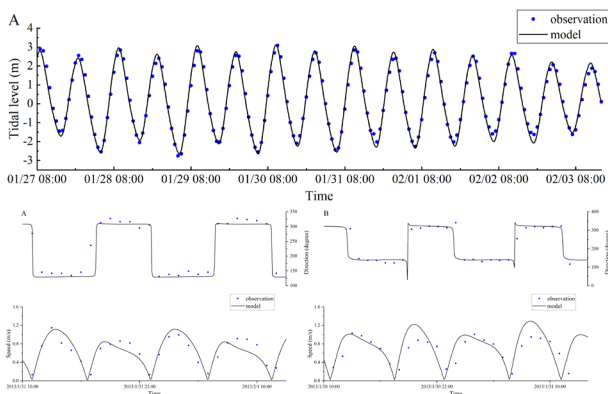
Sanmen Bay, located in the middle of China's coastline, is a typical semi-enclosed macro tidal bay, featuring extensive tongue-like tidal flats interlaced with port branches (Figure 1). Over the last five decades, reclamation projects have encompassed 4.7% of SMB's sea area every ten years and 12.3% of the total mudflat area in SMB.

Thus, extensive and systematic research on the long-term evolution of the water environment in SMB remains necessary. This research addresses the long-term impact of reclamation on the coastline, tidal prism, water exchange and pollutant transport in SMB over the last 50 years.



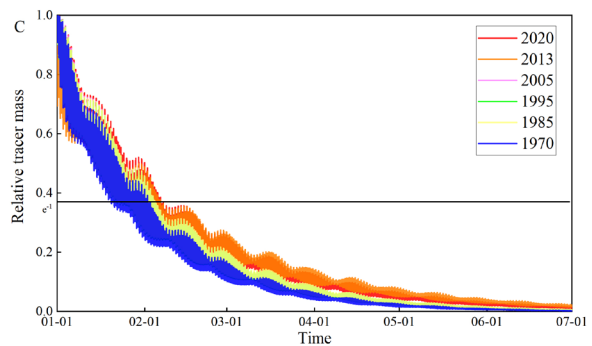
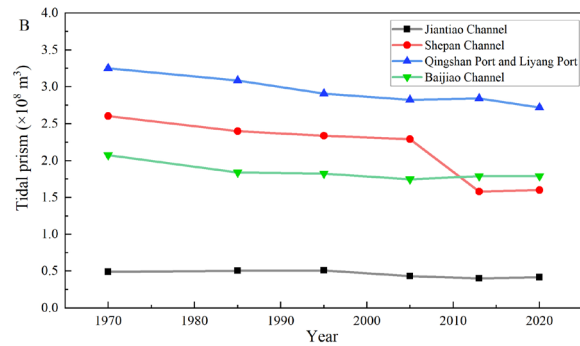
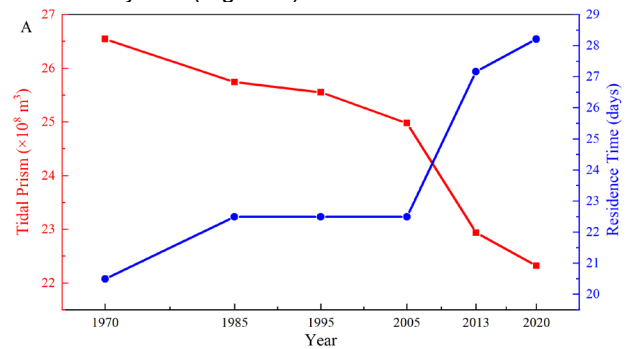
METHODS

A hydrodynamic model coupled with water quality module was validated with measured data (Figure 2).



RESULTS and DISCUSSION

The model results showed the tidal prism of SMB decreased by 13% and the average velocity and residual current of the main branches became weakened remarkably over the last 50 years. There was an increase of 7.7 days in the basin residence time during the last 50 years (Figure 3).



The distribution pattern of pollutants in SMB was altered

by the large-scale reclamation, leading to an obvious area expansion of high concentration of COD (Figure 4). The Shepan Channel, Baijiao Channel and Jiantiao Channel were identified as areas with pronounced susceptibility to water pollution resulting from bay reclamation.

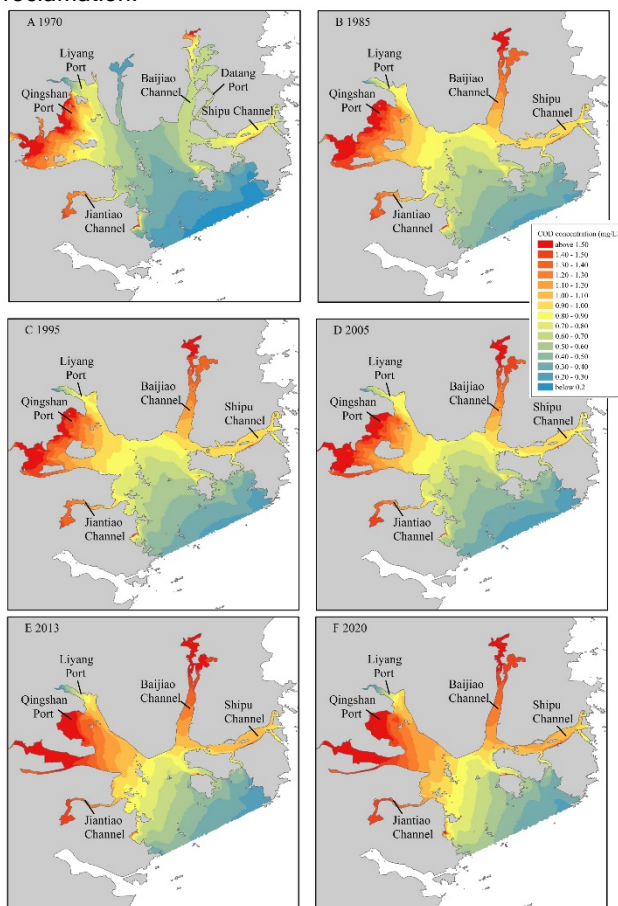


Figure 4. Averaged chemical oxygen demand concentration in (A) 1970 (B) 1985 (C) 1995 (D) 2005 (E) 2013 (F) 2020

CONCLUSION

The long-term evolution of tidal current, tidal prism, water exchange capacity and pollutant transport in SMB from 1970 to 2020 was investigated in this research through a hydrodynamic model coupled with water quality module. The study found that two large-scale bay reclamations in the 1970s and 2005-2013 significantly impacted the hydrodynamics and pollutant transport in SMB. The findings can offer a scientific foundation for marine spatial planning strategies in SMB, enhancing the utilization of marine resources, and improving the natural environment and ecosystem of the bay, while also can provide references to similar studies for other semi-enclosed bays with intense anthropogenic activities.