

Supplementary Material

Exploring the Optimal Scale of Coastal Reclamation Activities Based on an Environmental Capacity Assessment System: A Case Study in Haizhou Bay, China

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Table S1. Pollutant loads from main sewage outfalls in Haizhou Bay (2020).

Enterprise Name		Waste Water quantity (10 ⁴ m ³ /a)	COD(t/a)	Ammonia nitrogen (t/a)	Total nitrogen (t/a)	Total phosphorus (t/a)
Industrial Pollution Sources	Lianyungang Jiejing Marine Biochemistry Co., LTD	70.08	85.80	1.11	1.72	0.39
	Lianyungang Fuyu Chlor-alkali Chemical Co., LTD	61.97	72.45	0.08	0.70	0.25
	Lianyungang Alkali Factory	158.37	104.71	1.66	5.88	0.30
	Jiangsu Xinhai Petrochemical Co., LTD	19.38	15.38	1.17	1.75	0.20
Municipal Waste Water	Ganyu Xincheng Sewage Treatment Plant	720.07	518.45	6.73	59.28	5.01
	Xugou Sewage Treatment Plant	752.13	425.18	23.65	89.34	2.56
Total		1782	1221.97	34.40	158.67	8.71

Table S2. Pollutant loads from main marine estuaries in Haizhou Bay (2020).

Name of the rivers	Discharge (10⁴m³/a)	COD(t/a)	Ammonia nitrogen (t/a)	Total nitrogen (t/a)	Total phosphorus (t/a)
Linhong River	68,135	3838.27	265.73	1726.09	52.24
Longwang River	23,059	4135.22	425.05	1382.76	142.20
Qingkou River	16,170	1891.94	29.65	571.89	25.33
Xingzhuang River	3046	183.75	10.46	40.51	4.26
Zhuji River	3626	294.88	29.97	65.02	6.41
Total	114,036	10,344.06	760.86	3786.27	230.44

Model validation

In the calculation of this study, the influence of wind speed on the tidal current is not considered. After the model is repeatedly calibrated, the roughness is taken as 0.033, the eddy viscosity coefficient is determined as 0.38, and the dispersion coefficient is calculated as 18.7m²/s. In order to ensure the accuracy of the calculation results, the model was validated by comparing the measured data with the simulated data.

Two tide level monitoring points (Figure S1) were selected for tide level verification. The verification takes June 22, 2019 00:00 as the zero point of verification, and the verification time range is from June 22, 2019 0:00 to July 22, 2019 0:00, a total of 31 days.

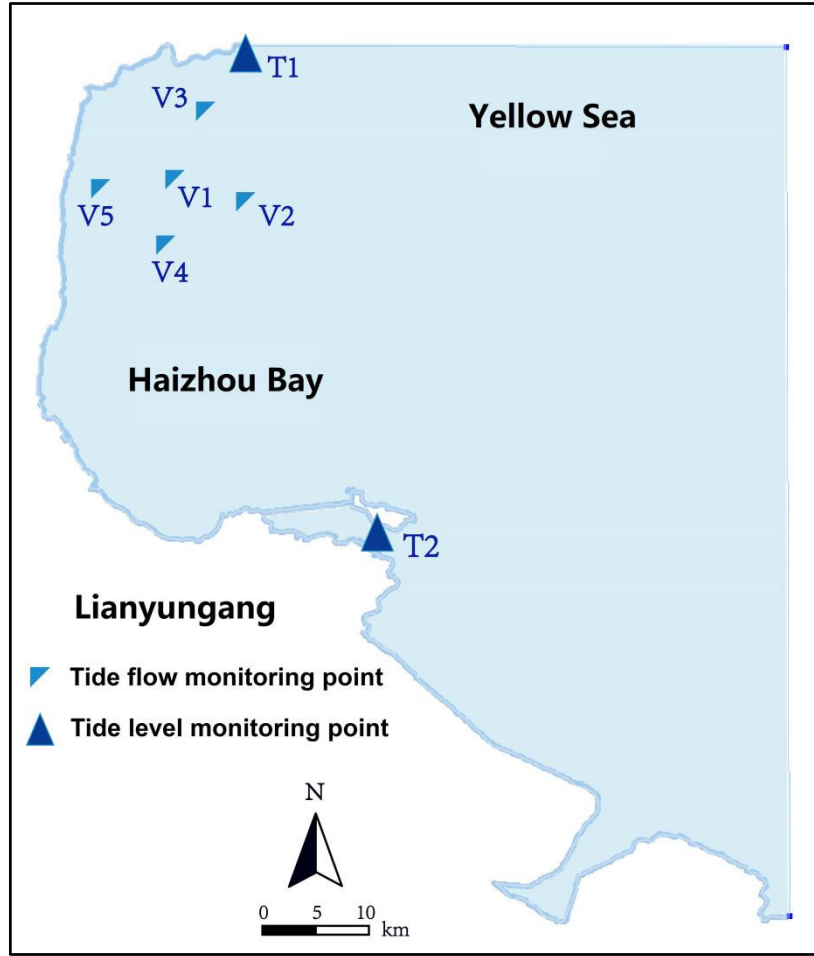
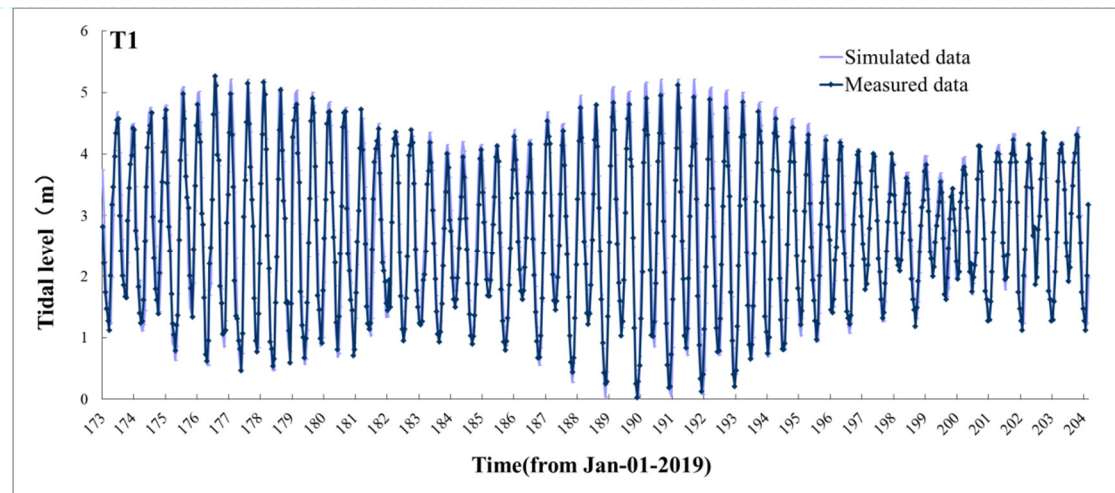


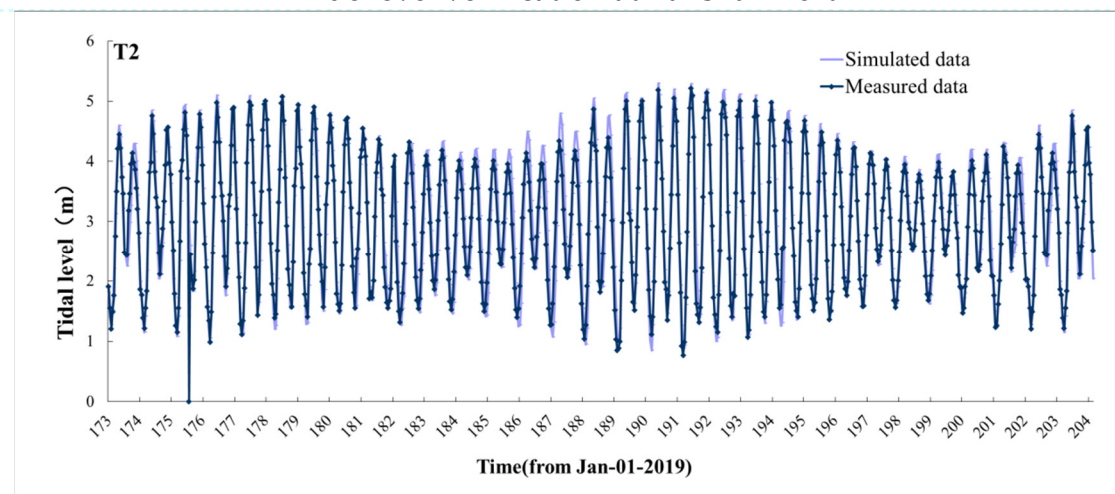
Figure S1. Verification point distribution in tidal flow field.

1. Tide Level Verification

The tide level verification used the water surface datum as the theoretical base. The tide level verification (T1) along the coast of Lanshan Port and the tide level verification (T2) along Dongxilian Island were shown in Figure S2. It can be seen from the verification that the calculated water level process was in good agreement with the measured data, the tide level calculation results were almost consistent with the measured values, and the relative error was distributed between 5% and 20% (Figure S3), indicating that this model can better reflect the actual situation of the current in the sea area.



Tide level verification at Lanshan Port



Tide level verification at Lianyungang Port

Figure S2. Comparison of Simulated and measured tidal level in sea area.

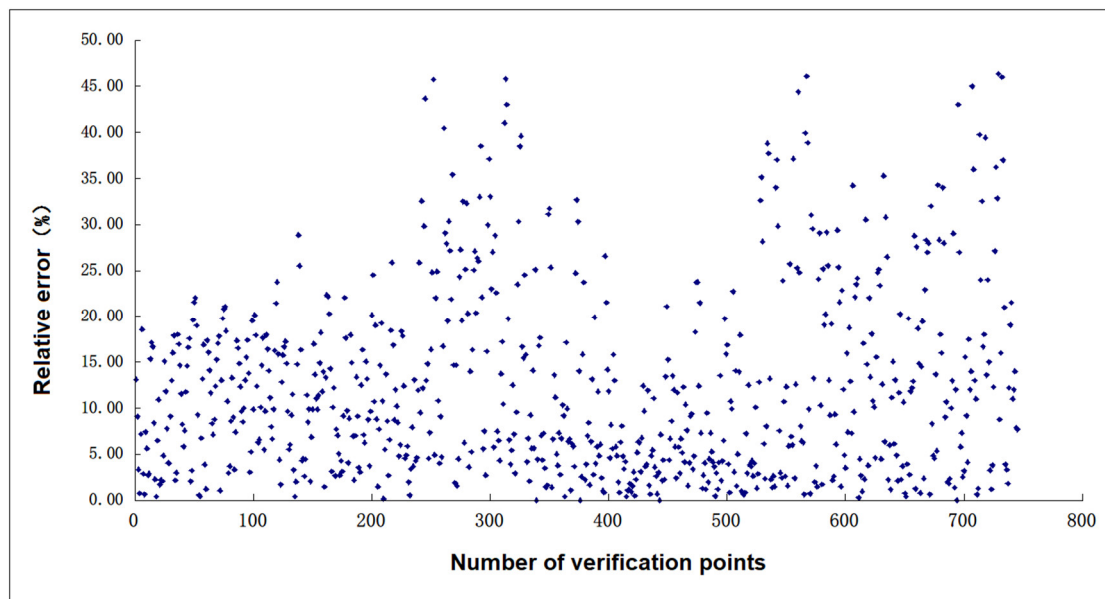
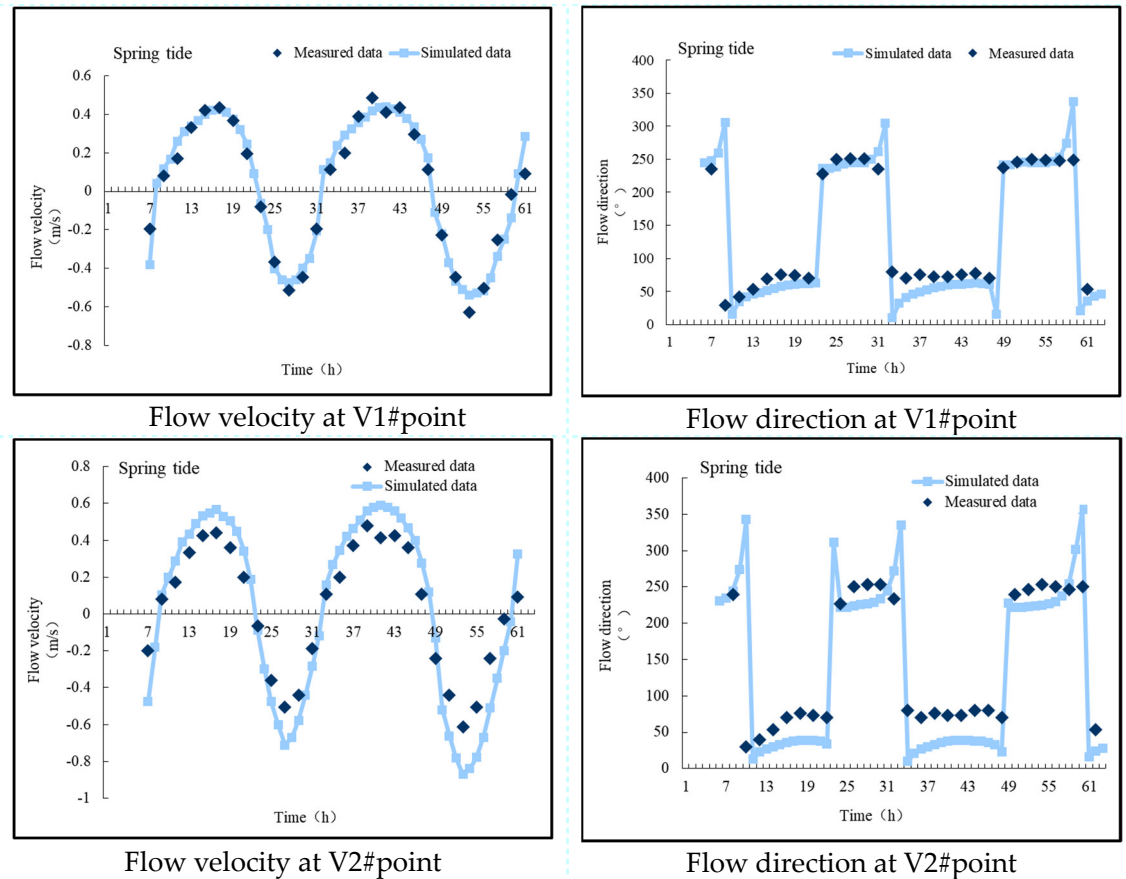
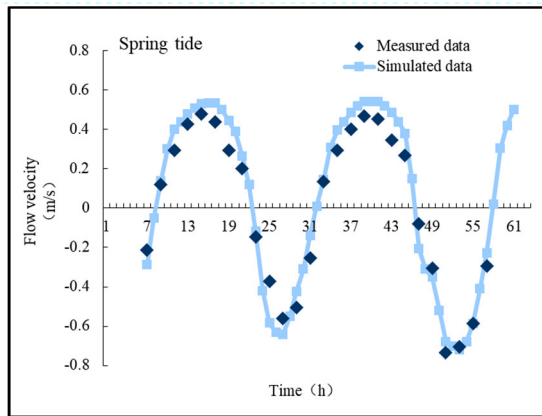


Figure S3. Relative error of simulated and measured tidal level.

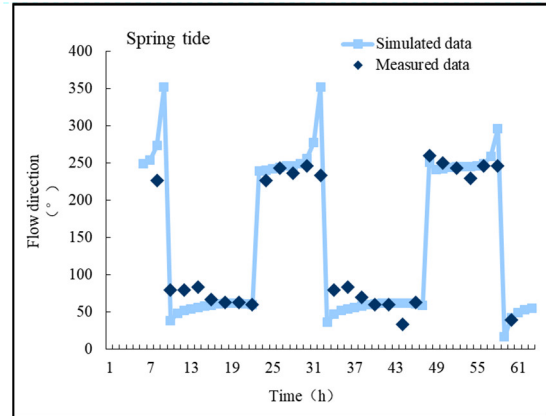
2. Flow Field Verification

For the flow field verification, the flow velocity and flow direction in spring and neap tides of five verification points were selected to compare the simulated and measured values, and the five flow field monitoring points were located in the vicinity of Haizhou Bay (Figure S1). Among them, the spring tide verification used 3:00 June 24, 2019 as the verification zero point, and 10:00 June 25, 2019 as the verification end point. The neap tide verification applied 4:00 July 2, 2019 as the verification zero point, and 11:00 July 3, 2019 as the verification end point. The comparison results were shown in Figure S4, FigureS5. It can be seen from the verification that the simulated data of the spring and neap tides were basically consistent with the measured values, and most of the relative errors were concentrated in 5%-30% (Figure S6), indicating that the model can better reflect the actual situation and more accurately predict the hydrodynamic characteristics of the sea area.

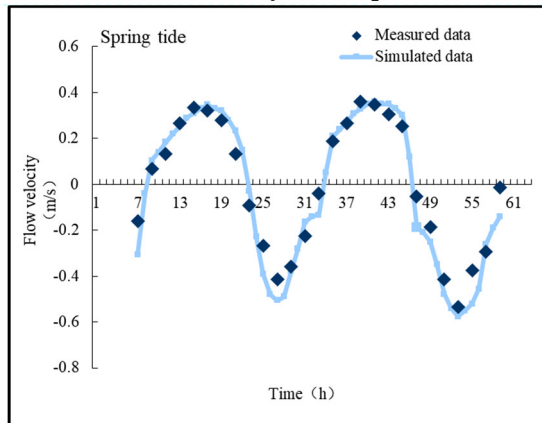




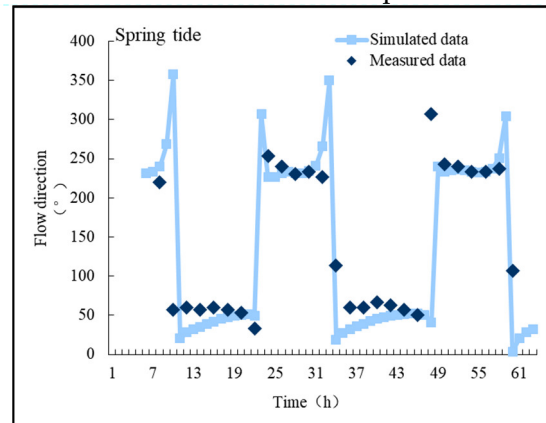
Flow velocity at V3#point



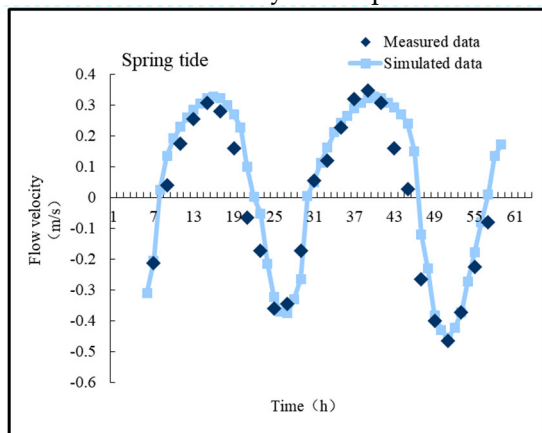
Flow direction at V3#point



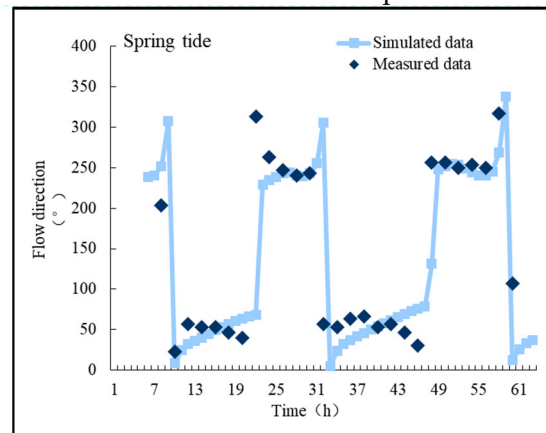
Flow velocity at V4#point



Flow direction at V4#point

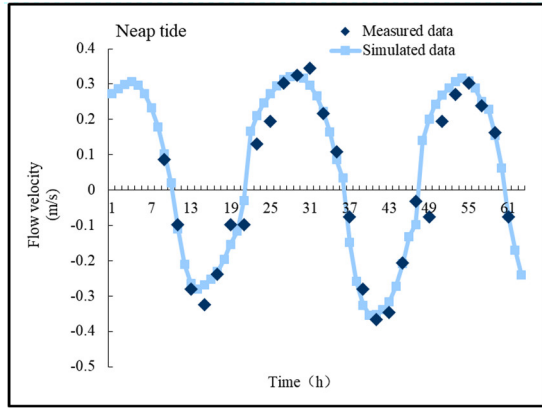


Flow velocity at V5#point

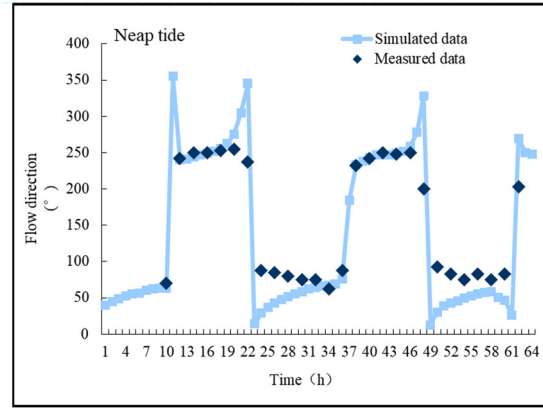


Flow direction at V5#point

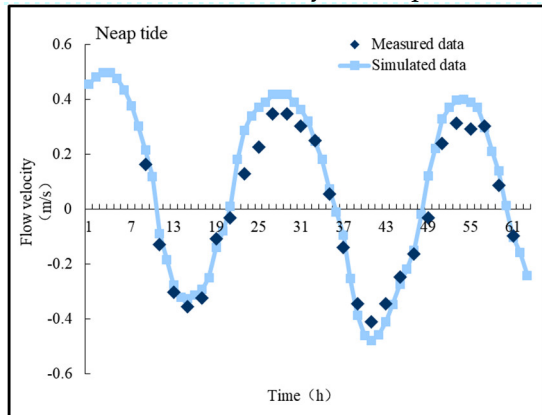
Figure S4. Tide Verification (Spring tide).



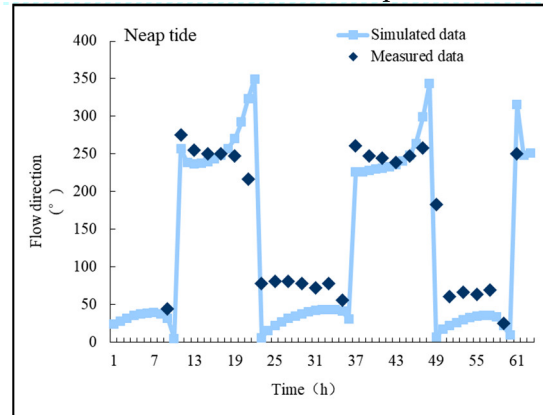
Flow velocity at V1#point



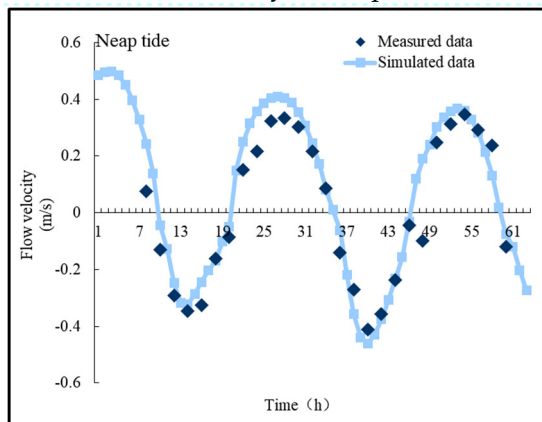
Flow direction at V1#point



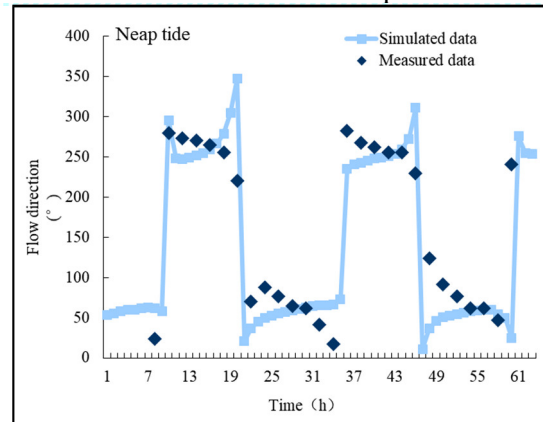
Flow velocity at V2#point



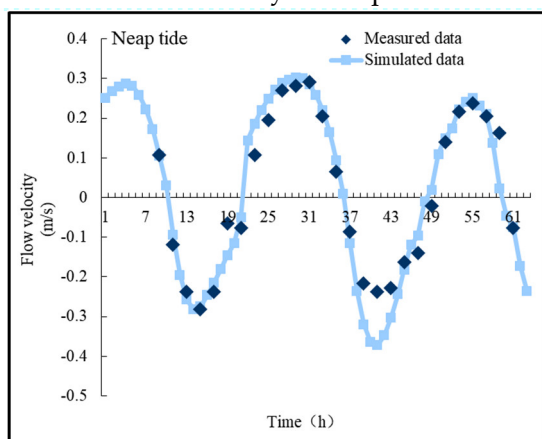
Flow direction at V2#point



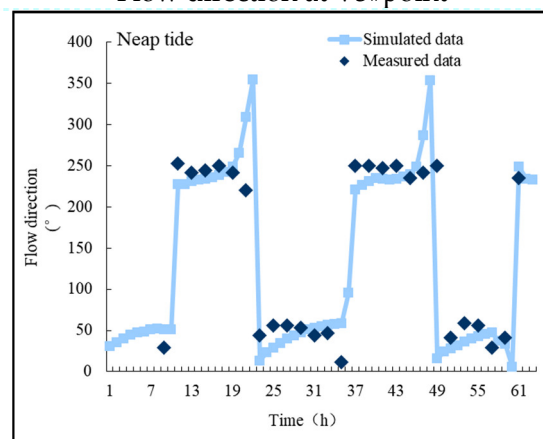
Flow velocity at V3#point



Flow direction at V3#point



Flow velocity at V4#point



Flow direction at V4#point

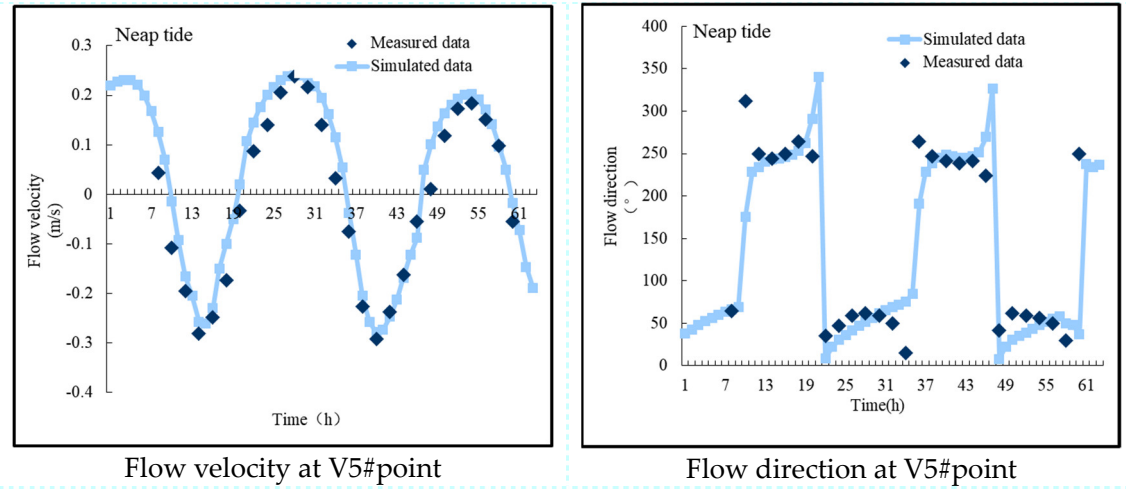


Figure S5. Tide Verification (neap tide).

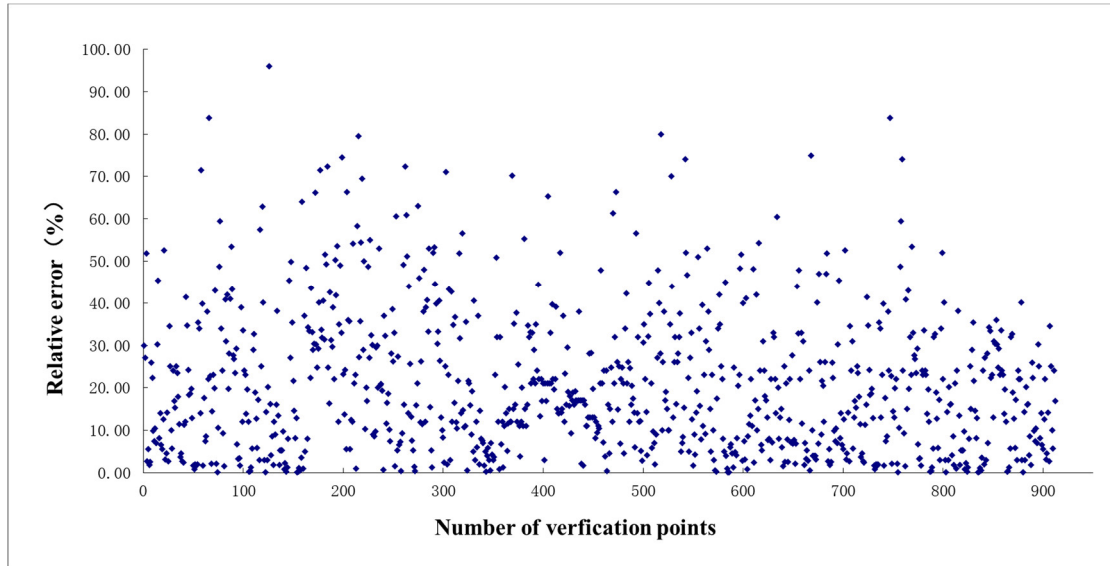


Figure S6. Relative error of simulated and measured tide.

3. Water Quality Validation

In the calculations of this study, the dispersion coefficient was set at $18.7 \text{ m}^2/\text{s}$ after iterative determination of the model; the degradation coefficients of COD、 $\text{NH}_4\text{-N}$ 、 $\text{NO}_x\text{-N}$ 、 $\text{PO}_4\text{-P}$ were 0.08 d^{-1} , 0.04 d^{-1} , 0.01 d^{-1} and 0.03 d^{-1} , respectively. Water quality verification selected 17 water quality monitoring points for data verification (Figure S7). Comparison results of simulated and measured values were shown in Figures S8–S11. After comparison and analysis, the simulation and measured values of pollutant concentrations basically matched, and most of the relative errors were concentrated between 10% and 30% (Figure S12). It indicated that the model simulated the pollutant concentration in this sea area well and can reflect the actual situation at the zone, which provided a basis for further study of the environmental capacity

of Haizhou Bay.

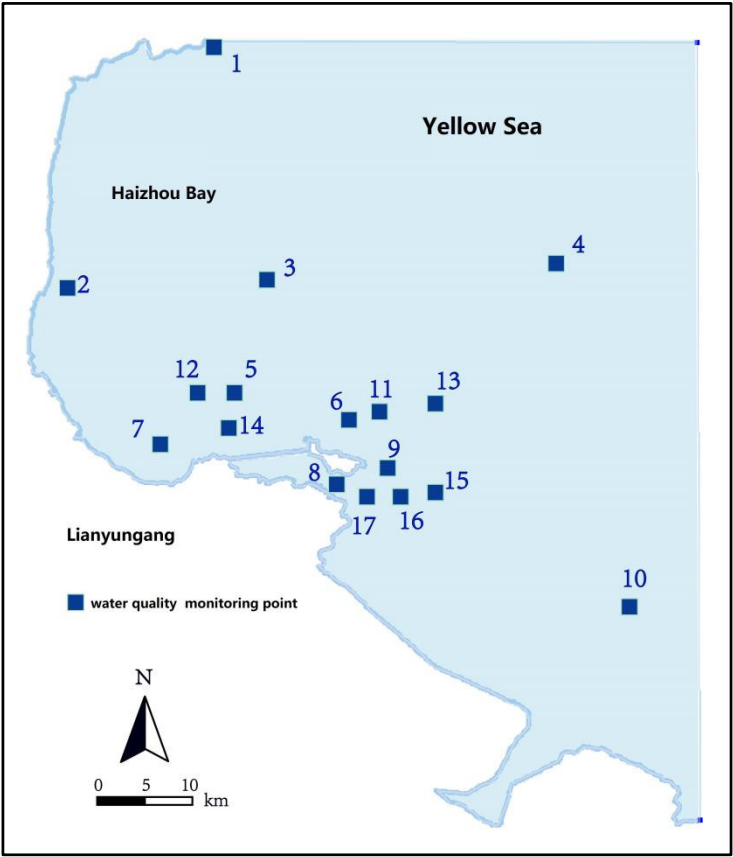


Figure S7. Distribution of verification points on water quality.

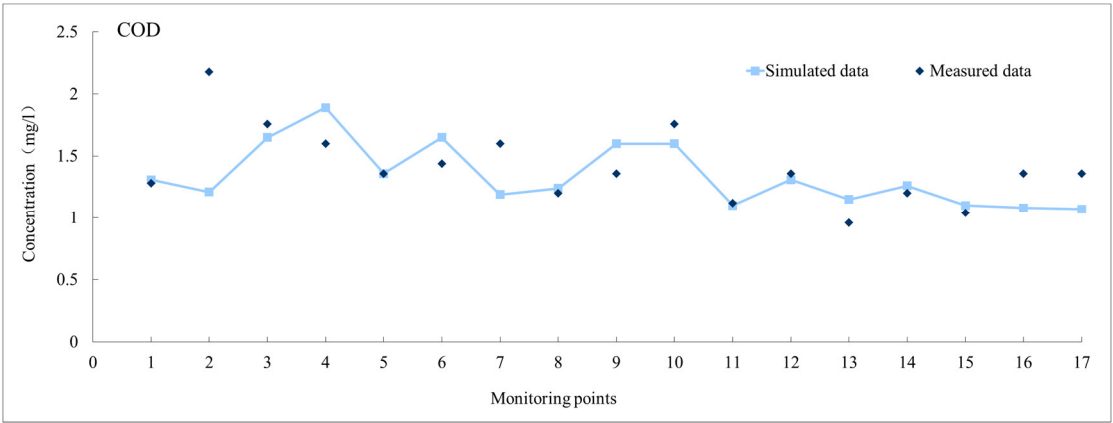


Figure S8. Comparison of simulated and measured data of COD concentration.

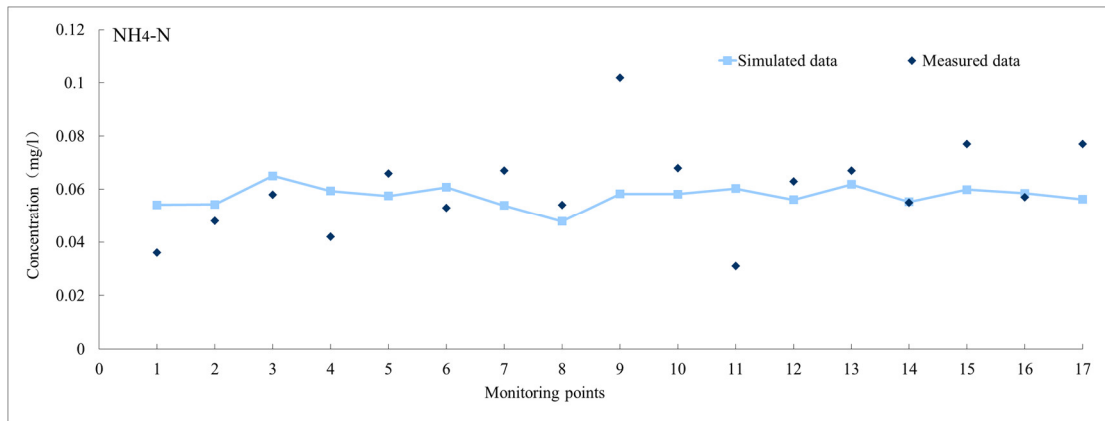


Figure S9. Comparison of simulated and measured data of $\text{NH}_4\text{-N}$ concentration.

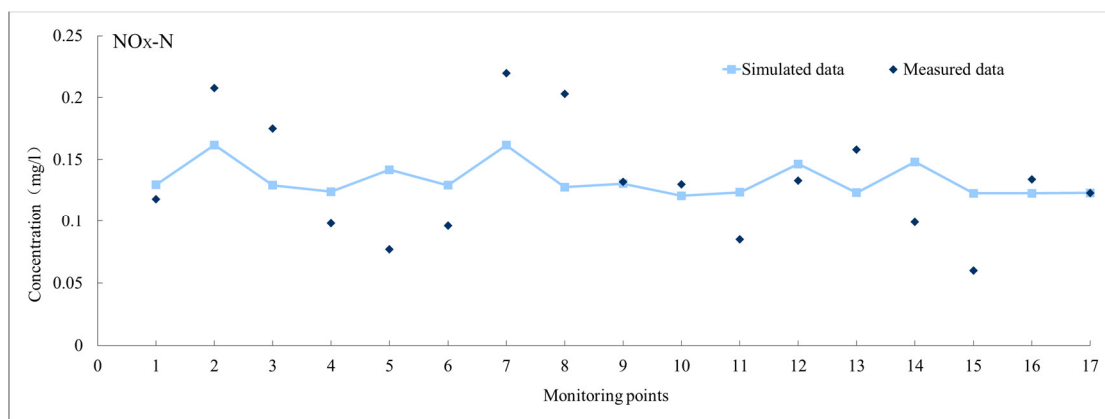


Figure S10. Comparison of simulated and measured data of $\text{NO}_x\text{-N}$ concentration.

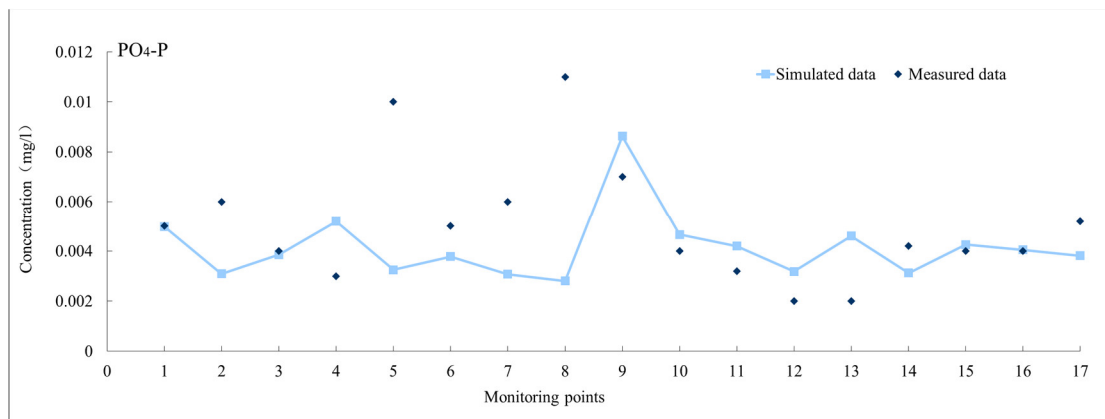


Figure S11. Comparison of simulated and measured data of $\text{PO}_4\text{-P}$ concentration.

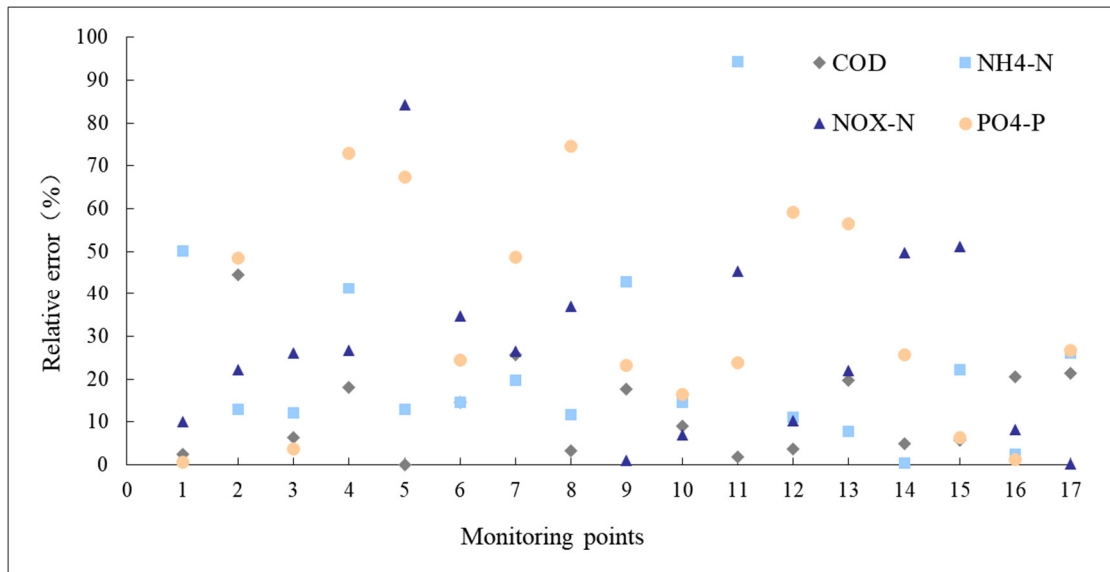


Figure S12. Relative error of pollutant concentration simulated and measured values.