1. Title

Estimate of environmental capacity of dissolved inorganic nitrogen in the Xiangshan Bay.

2. Members' names and affiliations

Junyong Zheng Ocean University of China

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3. Aim

1. With the full consideration of tide, river discharge, wind, sea surface heat flux and etc., a three-dimensional nonlinear baroclinic ocean model based on the Regional Ocean Model System (ROMS) and the North Pacific Ecosystem Model for Understanding Regional Oceanography (NEMURO) will be established to carry out numerical studies of the biogeochemical process in the Xiangshan Bay.

2. On the basis of the model results, the environmental capacity (EC) of dissolved inorganic nitrogen (DIN) will be calculated and allocated by the nonlinear method of the discharge optimization.

3. Enhance bilateral cooperation between our team (Coastal Dynamics Group, Ocean University of China) and the Center for Marine Environmental Studies of Ehime University on academics.

4. Procedure

The pollution of DIN in the Xiangshan Bay is becoming so serious that a series of accompanying problems, such as eutrophication, are needed to be solved urgently. In our study, a three-dimensional ocean model was established based on ROMS and NEMURO to simulate the distribution of DIN in the Xiangshan Bay. In the condition of class Ⅳ water quality standard, the discharge optimization method was applied to calculate the EC of DIN.

5. Results

A three-dimensional water quality model was established based on ROMS and NEMURO to simulate the distribution of DIN in the Xiangshan Bay (Fig.1). Ten land-based discharge sources were involved in this coupled model. The eight principal tidal constituents M_2, S_2, N_2, K_2, K_1, O_1, P_1, and Q_1 are used as tidal forcing in the model, and the tidal data are derived from the Global Inverse Tide Model data set. Besides, the comprehensive influence of wind, heat flux, evaporation, precipitation and so on were also considered. Outputs from this coupled model, including tide level, temperature and DIN concentrations match measured data well, so it is proved to be accurate and reliable.

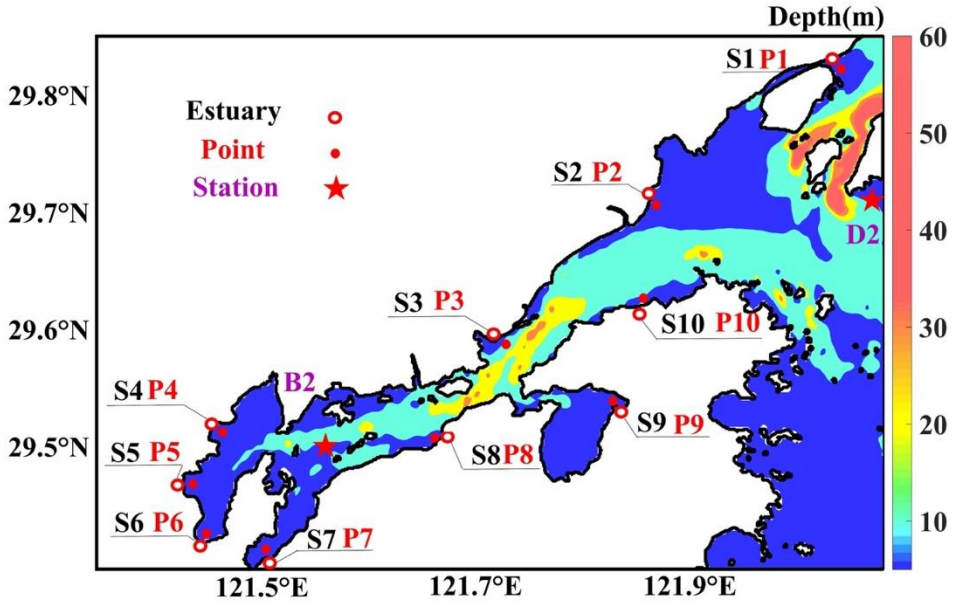

Fig.1 The distribution of water depth, discharge sources (S1-S10), water quality control points (P1-P10) and tidal stations (B2, D2) in the Xiangshan Bay

Tab.1 DIN environmental capacity and discharge flux under four cases

Estuary	Present	Case **a**		Case **b**		Case **c**		Case **d**	
		Allow	Reduce	Allow	Reduce	Allow	Reduce	Allow	Reduce
S6	112.62	**44.02**	**68.60**	**48.46**	**64.17**	**49.32**	**63.30**	**38.92**	**73.71**
S7	160.73	**11.25**	**149.48**	**13.70**	**147.03**	**15.99**	**144.74**	**18.61**	**142.11**
S8	39.70	39.70	-	**7.66**	**32.04**	**3.43**	**36.28**	**3.99**	**35.71**
S4	14.67	14.67	-	14.67	-	**1.50**	**13.17**	**1.74**	**12.92**
S5	16.09	16.09	-	16.09	-	**10.73**	**5.36**	**1.69**	**14.39**
S2	57.96	57.96	-	57.96	-	57.96	-	**44.93**	**13.02**
S3	59.03	59.03	-	59.03	-	59.03	-	**6.70**	**52.33**
S9	2.15	2.15	-	2.15	-	2.15	-	**1.69**	**0.46**
S10	24.40	24.40	-	24.40	-	24.40	-	**3.99**	**20.42**
S1	4.90	4.90	-	4.90	-	4.90	-	4.90	-
Total	492.25	274.17	218.08	249.02	243.24	229.41	262.85	127.16	325.07

In the condition of class Ⅳ water quality standard, the discharge optimization method was applied to calculate the EC of DIN in the Xiangshan Bay. The minimum DIN discharge concentration of the ten land-based discharge sources (*Rmin*), as a constraint, is also used to optimize the calculation of EC. The *Rmin* can be divided into four cases (Case a: 0≤*Rmin*≤0.10 mg/L, Case b： 0.10＜*Rmin*≤0.12 mg/L, Case c： 0.12＜*Rmim* ≤0.14 mg/L, Case d: 0.14＜*Rmin*≤0.17 mg/L) after 18 numerical experiments. The results show that the EC of DIN in the Xiangshan Bay is 127.16~274.17 t/a (Tab.1). The capacity will decrease

when *Rmin* gets larger, which means more discharge flux of DIN needed to be cut down. According to the reduction priority, ten discharge sources can be divided into four levels (I、II、III、IV), which mainly depends on the water half-exchange time and annual DIN discharge flux (Fig.2).

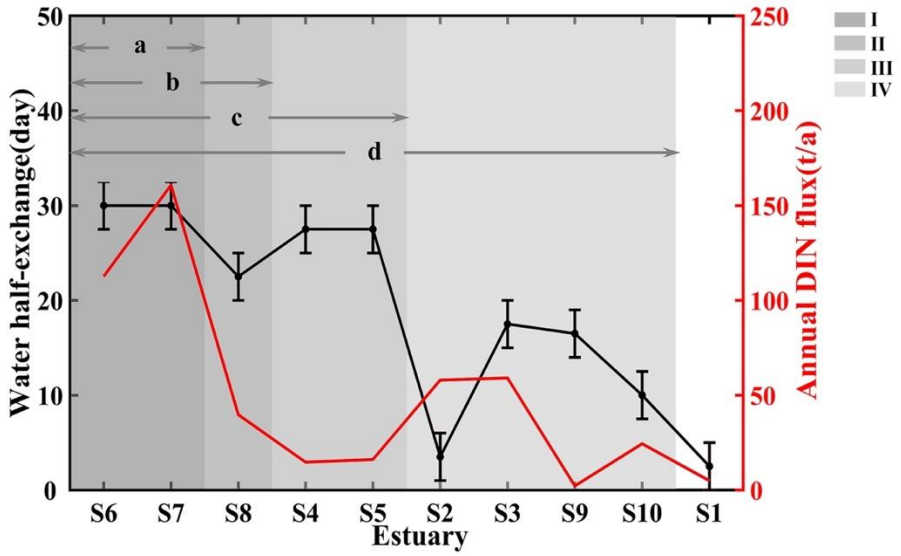

Fig.2 The reduction priority, water half-exchange time and annual DIN discharge flux of the discharge sources

6. Publication/Conference presentation

1) Publication

Zheng, J., X. Mao, X. Sheng, J. Sun, and W. Jiang, Estimate of environmental capacity of dissolved inorganic nitrogen in the Xiangshan Bay. Marine Sciences (In Chinese, accepted).

2) Conference presentation

Conference: The International Symposium on Coastal Ecosystem Change in Asia: Hypoxia, Eutrophication, and Nutrient Conditions

Presentation: Poster presentation

Title: Estimate of environmental capacity of dissolved inorganic nitrogen in the Xiangshan Bay. Marine Sciences

Date: Nov. 14-15th, 2019

Location: Ehime Univesity

7. Perspectives in Future

The JCOPE (Japan Coastal Ocean Predictability Experiment) model and MIROC (Model for Interdisciplinary Research on Climate) data were coupled by Professor Xinyu Guo and his research group, which provides a key to reveal the variation of volume transport and its mechanism on the Tsushima Warm Current from the palaeoceanographic view. Therefore, Junyong Zheng will go on general collaboration with Professor Xinyu Guo

to discuss the millennial-scale fluctuations of volume transport and its mechanism based on the coupled model and data. All of the collaborations will be helpful to Enhance bilateral cooperation between the Coastal Dynamics Group, Ocean University of China and the Center for Marine Environmental Studies, Ehime University.