4. Research report (Follow the guideline on the next page)

Development and application of intertidal carbon cycle model

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Invited and funded by LAMER (Leading Academia in Marine and Environment Pollution Research), Ehime University, Japan, I went to the Marine Environment Research Center of Ehime University in Japan for a 28-day study exchange from July 21 to August 17, 2023. During this time, I have learned a lot, not only academic knowledge, but also a lot of humanistic and social experience and understanding.

The tidal flat is considered to be an important place for coastal biological production (Yara et al., 2007). The ability of natural tidal flat to purify organic pollutants and its ecological regulation function has attracted wide attention in recent years.The tidal flat has a very high function of removing nitrogen, phosphorus and other biological elements in the water, so the purification capacity of the tidal flat has been paid more and more attention recently(Huanget al., 2021). However, there aren't much researches on the quantitative assessment of tidal flat productivity around the world. The ecosystem of inter-tidal wetland and seagrass bed has significant carbon absorption and sequestration capacity, which has an important impact on the global carbon cycle(Shao et al., 2019). I'm preparing for modeling the material cycle and carbon flux in is the basic platform for biogeochemical research in coastal waters especially tidal flat.The tidal flat is considered to be an important place for coastal biological production. The ability of natural tidal flat to purify organic pollutants and its ecological regulation function has attracted wide attention in recent years. In recent years, more and more domestic studies have focused on carbon fluxes in tidal flat, especially in inter-tidal wetlands and seagrass beds(Lima et al., 2022; Gräfnings et al., 2023). The ecosystem of inter-tidal wetland and seagrass bed has significant carbon absorption and sequestration capacity, which has an important impact on the global carbon cycle. Seaweed is an important primary productivity in

marine ecosystems, and the study of its carbon sequestration and carbon storage mechanism is conducive to improving the understanding of the potential of marine carbon sequestration and carbon storage in waters. Furthermore, we can apply the new model to all coastal waters of China(Gao et al., 2022). The more interdisciplinary and comprehensive research is a trend in the future, and the coupled modeling work is also necessary.Furthermore, we can apply the new model to all coastal waters of China. The more interdisciplinary and comprehensive research is a trend in the future, and the coupled modeling work is also necessary.The objective of this study is to quantitatively elucidate the material cycle and carbon flux changes in the intertidal zone, and to propose accurate and effective measures for the assessment and protection of the intertidal ecosystem. The main research content is to establish a hydrodynamic and ecological coupling model applicable to the intertidal carbon cycle, simulate the intertidal algae (seaweed bed) through the calculation of carbon elements in the model, so as to quantitatively simulate and estimate the production and life of the water body in the study area and self-purification capacity, and propose accurate and effective measures to protect the intertidal ecosystem.

This study employs the Princeton Ocean Model (POM), an easy-to-use yet powerful ocean modeling code that can simulate a wide range of issues from small-scale coastal processes to global ocean climate change. POM08 is a model with dry and wet grid developed by Oey in 2008 based on POM and applicable to coastal waters (FIG. 1). The feature of this model is that it can judge whether the grid is in a dry or wet state through changes in water depth (Oey, 2005).

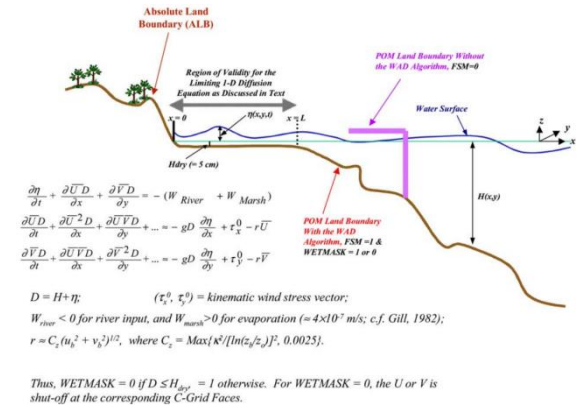

Figure 1 calculation of water depth in POM08

The establishment of benthic algae model refers to the benthic algae model of Yara et al. (2007), and the specific model construction is shown in Figure 2. The upper layer of Box1 represents the material circulation process of phytoplankton in the water, and we mainly consider the benthic algae model of Box2. At present, the main way of suspended nutrient nitrogen cycle in tidal plain is: upper nutrients → phytoplankton → suspended nutrients (bivalves)→ upper nutrients.

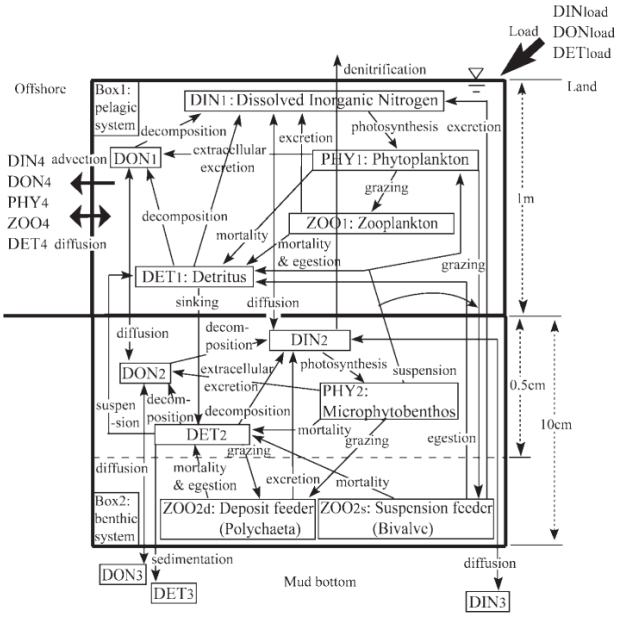

Figure 2 benthic algae model construction

Research schedule：

(1) In the first quarter, Using the POM(Princeton Ocean Model) model to establish an ecological model in the study area.

(2) Collecting the data to train and verify the accuracy of the model.

(3) In the second quarter, engaging to quantitatively predict the effects of regenerated

nutrient and carbon storage fluxes on the productivity of adjacent coastal waters in the lost tidal flat and seagrass bed regenerated areas.

Month1-6: A preliminary inter-tidal three-dimensional dynamic-ecological coupling model was developed, and the simulation results were corrected using observational facts.

Months 7-12: Model results are analyzed and studies are carried out in specific tidal flat to simulate material cycling and carbon fluxes in that area.

Months 13-18: The simulation results were analyzed, and on this basis, the purification capacity of the intertidal seaweed bed was analyzed.

Months 19-24: Summarize scientific problems and write articles.

In terms of study, the experience of going abroad is very meaningful to me. I had the opportunity to be exposed to different disciplines and courses and to learn from the ideas and experiences of different professors and students.After the discussion and study, I believe that using numerical simulation to simulate the carbon flux of the intertidal algae bed and studying the self-purification ability of the intertidal algae bed through simulation is a better way to understand the purification ability of the intertidal algae bed. In addition, the coastal condition flux of the general shelf sea model is usually zero, which is inconsistent with the reality. In order to simulate the Marine ecological environment more accurately, it is necessary to consider the mass exchange flux between the intertidal zone and the shelf sea. The establishment of the intertidal ecological model is also an indispensable part of the establishment of a more perfect and accurate offshore ocean model. At the same time, the Marine biogeochemical model developed by Professor Guo Xinyu on the basis of the Regional ocean model (POM) has been well applied in the study of dynamic processes and nutrient budget in China's offshore areas.

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