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Editorial: Eutrophication and hypoxia and their impacts on the ecosystem of the Changjiang Estuary and adjacent coastal environment

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ABSTRACT

The Changjiang (Yangtze River) Estuary plays an important role in the land–ocean interactions of East Asia, particularly in regard to the fate of land-derived materials and their impact on marine ecosystems in the Northwest Pacific Ocean. The 12 papers included in this special issue describe results from the MEcoPAM Study, an IMBER-China project, which occurred in 2011–2015. This project used a multi-disciplinary approach to understand ecosystem function of the Changjiang Estuary in response to multiple stressors (i.e. combined external forcings). The results presented here show that human activities in the watersheds have greatly changed the flux and variation of dissolved and particulate materials from the river. Further interactions between the Changjiang Watersheds and the East China Sea can dramatically modify the pathways of biogeochemistry and food web dynamics of the estuary and adjacent coastal environment at seasonal and inter-annual scales.

Content

Estuaries play a critical role in land–ocean interactions. In the estuary and adjacent coastal environment, energies from river flow and tides converge, producing a special dynamic condition with strong gradients of hydrographic and chemical properties of water. Also, material inputs from land and oceanic sources are mixed by the hydrodynamic processes, and the resulting distributions have important effects in regulating food web structure and ecosystem function. Estuaries also support spawning and/or hatching grounds for many fishery species that have a great economic value. Hence, sustainability of the estuarine habitat and ecosystem (e.g. bio-diversity) is of great concern to human society. Historically, the evolution of human society in many parts of the world has been closely tied to the functioning of estuaries and the adjacent coastal waters through fisheries, trade (navigation) and natural resource extraction (e.g. salt).

Large river estuaries, such as the Changjiang (Yangtze River), have important effects on the ecosystem services of a larger marine environment (Fig. 1). For example, in summer the Changjiang effluent plumes can extend into coastal waters covering an area of up to 10×10^3 km^2, and can be tracked as far as Cheju Island and even beyond. In winter, water from the Changjiang flows southward along the east coast of mainland of China and can reach Taiwan Strait and/or further into the South China Sea, when driven by northeasterly monsoon winds (Fig. 2). The critical importance of fresh water flow from Changjiang in affecting the fishing ground of the Zhoushan Archipelagoes has been recognized since the late 1940s (cf. Chu and Yang, 1949). The Changjiang Estuary is an important waterway linking the mainland of China with other economic centers of the world. Similar to other aquatic systems that have been negatively impacted by human influences, the Changjiang Estuary and adjacent coastal environment can be considered to be over-stressed (e.g. reclamation, urbanization, and over-fishing) and experiencing deterioration of ecosystem function, such as evidenced by eutrophication, seasonal hypoxia, and changes in food web structure.

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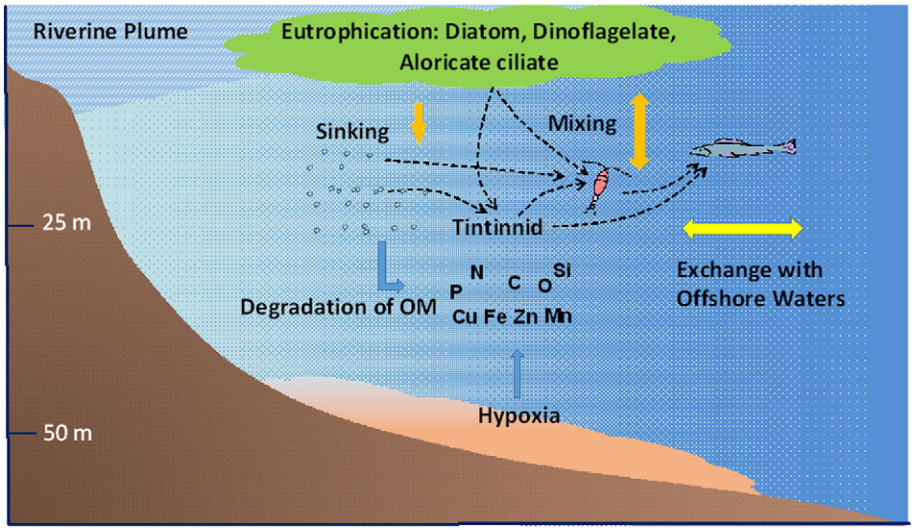

Fig. 1. Conceptual illustration of ecosystem function under the influence of combined external forcings in the Changjiang Estuary and adjacent coastal environment, which shows the coupling of biogeochemical cycles with food-web dynamics regulated by hydrodynamic processes.

In 2011, a 5-year national research project on "Sustainability of Marine Ecosystem Production under Multi-stressors and Adaptive Management (MEcoPAM)" was initiated by the Ministry of Science and Technology of China (MoST-China No. 2011CB409800). The MEcoPAM project was developed around five cross-linked research modules that include:

SP1—Biogeochemical Dynamics of Marine Ecosystems
SP2—Nutrient Cycles and Response to Multi-stressors
SP3—Response of the Hydrodynamics to Multi-stressors and Its Impact on the Supply of Nutrients
SP4—Microbial Loop and Coupling with Biogeochemical Cycles
SP5—Feedback Mechanisms of Ecosystem Structure and Function to the Climate Change and Human Activities

In 2013, MEcoPAM was endorsed as a China national contribution to the Integrated Marine Biogeochemistry and Ecosystem Research (i.e. IMBER-China) (http://www.imber.info/index.php/Science/Endorsed-Projects/MEcoPAM-June-2013); IMBER is co-sponsored

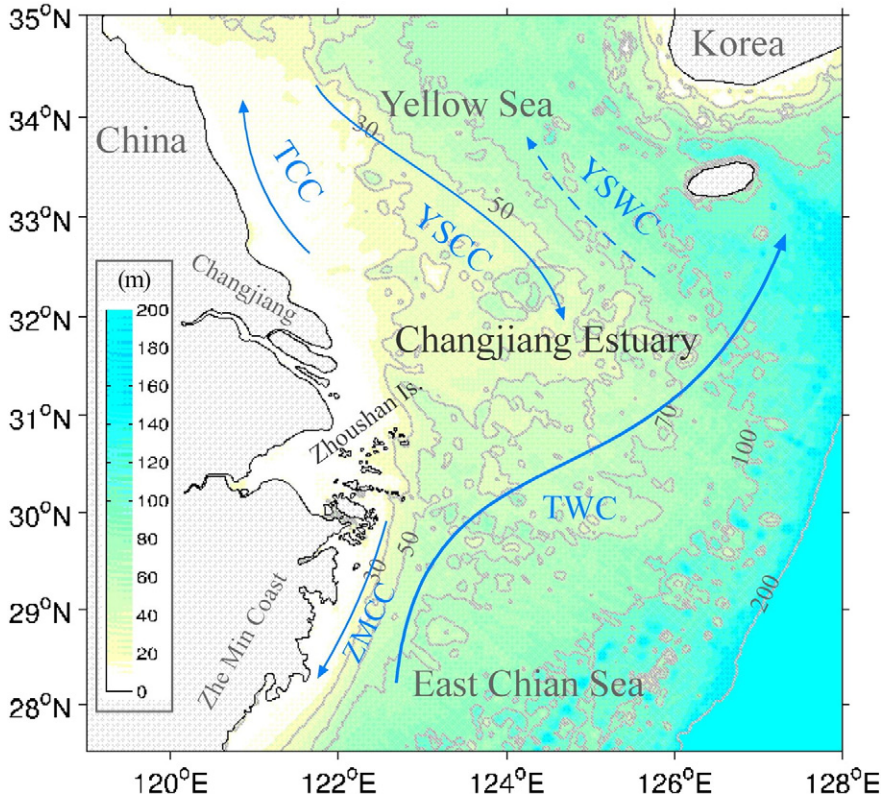

Fig. 2. Map of the study area, which shows the geographic location of the Changjiang Estuary and its adjacent coastal environment with bathymetry and major components of circulation. In the figure TWC, ZMCC, TCC, YSCC and YSWC represent Taiwan Warm Current, Zhe-Min Coastal Current, Tidal-induced Coastal Current, Yellow Sea Coastal Current and Yellow Sea Warm Current, respectively.