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Editorial: Biogeochemical responses to physical processes in the North Pacific and its adjacent marginal seas

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Editorial on the Research Topic

Biogeochemical responses to physical processes in the North Pacific and its adjacent marginal seas

The Pacific Ocean covers a vast area with a large number of different marginal seas. The coastal areas around the North Pacific (NP) are densely populated and economically active, so climate and ecological changes in the NP have attracted much attention. Fundamentally, ocean physical processes (such as wind-driven mixing, boundary currents, upwelling, downwelling, mesoscale eddies and internal tides) redistribute ocean chemical compounds and affect ocean primary productivity and carbon sequestration. Even in the nutrient-poor open oceans, intense physical processes caused by tropical cyclones (TCs) can rapidly alter nutrient supply and prompt phytoplankton blooms for a short period of time. In addition, multiscale physical processes may produce large spatial variability in biogeochemical and carbonate systems. All these issues are worth exploring, especially in the context of global warming.

This Research Topic in "Frontiers in Marine Science" aims to better understand effects of various physical processes on biogeochemical processes in the NP and its adjacent marginal seas. Eight valuable research articles have been included in this special volume. Based on various observations and numerical simulations, they touch on several aspects of biogeochemical responses to physical processes, including biogeochemical changes due to physical processes induced by TCs, primary production response to internal tides, influence of mesoscale eddies on biological activity, spatiotemporal variations of marine carbon stocks due to coastal processes, effect of water masses on lipid biomarker production, linkage between photosynthetic electron transport and phytoplankton productivity, and driving factors of red tides.

Zheng and Zhang used Biogeochemical-Argo float and satellite data to investigate the complex physical-biogeochemical responses to two sequential TCs in the Kuroshio region south of Japan. They found that the two TCs jointly induced an extraordinary phytoplankton bloom, and both vertical phytoplankton migration and phytoplankton

growth were responsible for the observed surface bloom. Additionally, their results indicate that satellite sensing data alone may overestimate (underestimate) the effect of TCs on primary production in the upper ocean due to TC-induced vertical phytoplankton migration (phytoplankton growth in the subsurface).

Chen et al. analyzed hydrodynamic changes and nutrient supply in Zhanjiang Bay during Typhoon Talim (2023), based on observations from two cruises before and after the typhoon. The typhoon destroyed stratification and changed water mixing in the bay. A strong ocean front was formed between the upper bay and the lower bay with much seawater intrusion from the outer bay, preventing freshwater and terrestrial nutrients in the upper bay from being transported downwards.

Jacobsen et al. used a coupled physical-biological model with a range of idealized underwater terrains to examine primary production response to internal tides. The results show that nutrient effect (nutrient supply) is larger by an order of magnitude than light effect (light enhancement) in the primary production response to tidal beams. In the euphotic zone, nutrient availability is increased by the nutrient flux convergence within tidal beams, enhancing primary production.

Wang et al. analyzed the deep scattering layer (DSL) and marine diel vertical migration (DVM) using *in-situ* observations from a mooring system deployed east of Taiwan Island during the period of January 2016 to May 2017. They found a significant intraseasonal variability with a period of approximately 80 days in both the DSL and DVM, which is related to the westward-moving mesoscale eddies. Anticyclonic (cyclonic) eddies moving westward cause local isotherms to bend downward (upward), warming (cooling) the 400–600 m layer. This warming (cooling) condition is favorable (unfavorable) to vertical migration of organisms, deepening (shoaling) the DSL upper boundary depth.

Ma et al. examined the carbon stocks (marine/terrestrial) and carbon stock accumulation rate in the mud areas of the South Yellow Sea and the East China Sea. They found that marine sediments in these seas totally store 0.75×10^{15} g C. The temporal records suggest that anthropogenic activities have reduced carbon stocks in the two marginal seas since 1950, causing carbon to re-enter the atmosphere to impact climate changes.

Gao et al. investigated the vertical distribution patterns of key lipid biomarkers and their correlations with water masses in the Zhejiang coastal sea area of the East China Sea, based on the observations obtained in spring of 2017 and summer of 2018. They found that the distribution patterns and composition of lipid biomarker are depth dependent and vary with different water masses, suggesting the significant influence of water masses on lipid biomarker production.

Fei et al. examined light responses of phytoplankton electron transport rates (ETR), ^{18}O-labeled gross primary production, and O_2-based net community production in the Changjiang River Estuary during the bloom season. They found that ETR to phytoplankton O_2 production increases from the nutrient-rich Changjiang diluted water to the nutrient-poor seawater. They explained the complex relationship between ETR to phytoplankton O_2 production ratios and various environmental factors from nutrient-rich river plume to nutrient-limited offshore seawater.

Jiang et al. established a coupled physical-biological model to investigate driving factors of a red tide event in 2021. The results show that the variation of wind field enhances the proliferation and aggregation of dinoflagellate cells, triggering the red tide. They pointed out the necessity of comprehensively considering all these factors in accurately forecasting and preventing red tide events.

Marine biogeochemical responses to physical processes are very complex, not only because of the diversity of physical processes, but also because of the cross-effects of multiple physical processes. In addition, the effects of physical processes are often deeply coupled with biogeochemical processes. Obviously, the articles included here do not cover all aspects of this topic. Nevertheless, these studies are of great significance to the in-depth understanding of the regulatory role of physical processes on marine biogeochemical processes and their impacts on marine ecological environment, and will attract more scholars to participate in this research. There are still many unknown questions about marine biogeochemical responses to physical processes, and there is still a lot of room for its future progress, and we hope that this Research Topic will help to facilitate more research in this field.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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