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Long-term changes in phytoplankton communities in China's YangtzeEstuary driven by altered riverine fluxes and rising seasurface temperature

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Abstract

Phytoplankton communities have been changed recently in the giant and dynamical China's Yangtze Estuary primarily due to intensifying human activities and climate warming. A large amount of riverine material fluxes into the estuary has been significantly altered in their balances, leading to a change of phytoplankton from siliceous to non-siliceous-dominated communities. We established inter-linkages of changing phytoplankton communities to various controlling factors and revealed that this bio-transformation occurred around 2000. Before it, there were fewer dominant diatom taxa, but since then more have emerged as the variation, along with many dinoflagellates driven by the altered riverine N:P:Si delivered to the estuary, averagely from 75:1:946 (1960s–1970s) to 86:1:272 (1980s–1990s) and to 102:1:75 (2000s–2010s). Excessive nitrogen and lowering DSi has exerted the key environmental stress on such a bio-transformation. *Skeletonema* spp. the most popular in diatoms has lost its dominance by ca 50% since the early 2000s. We further convinced the long-increasing DIN (presently, 150 µmol L^{-1}, maxi., ca 3.5 folds more than that of 1960s–1980s) to meet the long-decreasing DSi (ca 60% off since 1960s) at 110 µmol L^{-1}, around 2004 (Redfield ratio balance 1:1) as a hreshold. Then, this balance has broken, serving as an engine for driving the bio-transformation. Phytoplankton development didn't fully follow the Redfield ratio, especially during the algal blooming season, as revealed by the scattered istribution of dinoflagelate:diatom vs. DIN:DSi when DIN:DSi >1. This implies a much more eutrophic setting attributable to over-loaded nitrogen concentration in the Yangtze Estuary. Besides, the lowering sediment flux in the estuary (lowest after 2003 when the Three Gorges Dam closed) and the rising SST in recent decades has enhanced the biotransformation. Consequently, the estuarine water tends to be more acidic, manifested by continuously lowering pH and DO in the study area.

Keywords

Riverine material fluxes, Nutrients balance, Bio-transformation, Eco-regime shift