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Interannual variabilities of nutrients and phytoplankton off the Changjiang Estuary in response to changing river inputs

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Coastal ecosystems are strongly influenced by terrestrial and oceanic inputs of water, sediment and nutrients. Terrestrial nutrients in freshwater discharge are particularly important for mega-river estuaries. A remarkable increase in nutrient loads transported from the Changjiang River through the estuary to the shelf has been observed from 1999 to 2016. The Finite-Volume Community Ocean Model and the European Regional Seas Ecosystem Model were coupled to assess the interannual variability of nutrients and phytoplankton under these flux dynamics. The system exhibited a rapid ecosystem response to the changing river nutrient contribution. Singular vector decomposition (SVD) analysis demonstrated that abundant nitrate from the river was diluted by low-nitrate water transported from the oceanic domain. In contrast, phosphate exhibited local variation, suggesting the estuarine ecosystem was phosphate-limited. The SVD results showed that there were no significant correlations between the suspended sediment and nutrients, but a significant correlation between sediment and phytoplankton. The nutrient structure of the river discharge resulted in the dominance of non-diatom species in the phytoplankton bloom from spring to autumn. The ratio of diatom and dinoflagellate populations showed a rapid feedback response to the strong oscillations in river nutrient input. High diatom primary production occurred near the sediment front, whereas dinoflagellate bloom extended significantly offshore. Both diatoms and dinoflagellates had major peaks representing spring blooms from empirical orthogonal function Mode 1 and 2, and secondary peaks from Mode 2 in the autumn, which coincided with the autumn bloom.