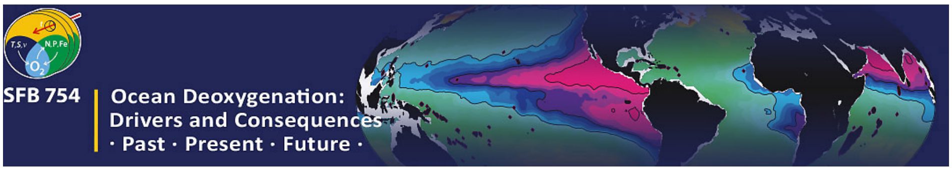

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Quantifying the relative contributions of riverine versus oceanic nutrient sources to coastal hypoxia

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The coastal ocean is increasingly affected by eutrophication, i.e., the supply of excess nutrients with subsequent enhancement of productivity and potentially harmful occurrences of toxic algal blooms and hypoxia or anoxia. Hypoxia occurs when dissolved oxygen concentrations drop below 2 mg/L. Because some systems are naturally prone to hypoxia, a quantification of the relative influence of anthropogenic versus oceanic nutrient sources is important. Here we use coupled physical-biogeochemical models combined with an element tracing technique to assess the impact of different nutrient sources and provide quantitative information on their influence on the individual biogeochemical processes. The technique is applied to two coastal systems that experience severe seasonal hypoxia on large spatial scales (~15,000 km2): the northern Gulf of Mexico (NGoM) and the East China Sea (ECS). The NGoM is an open shelf system with the North American coast in the north and an open connection to the oligotrophic open Gulf in the south. The ECS connects the shallow Yellow Sea in the northwest with the Pacific Ocean in the southeast, and is influenced by the northward Taiwan Warm Current. The NGoM and ECS are both strongly influenced by large amounts of riverine freshwater and nutrients from the Mississippi/Atchafalaya River System and the Changjiang River, respectively. In the NGoM, seasonal stratification due to high freshwater discharge, which limits the exchange between surface and bottom waters, and high sediment oxygen consumption resulting from enhanced productivity generate seasonal hypoxia in the bottom boundary layer. Here, hypoxia is driven primarily by anthropogenic inputs. In the ECS, hypoxia occurs in a thicker layer below the pycnocline, where water-column respiration is an important oxygen sink. In this system, the Changjiang River is among several nutrient sources supporting productivity and oxygen consumption; nutrients of oceanic origin are thought to be a significant driver of oxygen depletion in the ECS. Our analyses of the NGoM and the ECS – two dynamically very different coastal systems – illustrate the value of combining physical-biogeochemical models and element tracing techniques to improve our understanding of hypoxia in coastal systems.

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