Diagnosing CO2 fluxes in Ocean-Dominated (OceMar) and River-Dominated Margins (RioMar) by coupling the physical dynamics and biogeochemistry

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The contemporary coastal ocean is generally seen as a significant CO_2 sink of ~0.2-0.4 pg C/yr at the global scale. However, mechanistic understanding of the coastal ocean carbon cycle remains limited, leading to the unanswered question of why some coastal systems are sources while others are sinks of atmospheric CO_2. In shaping the concept of the coastal ocean carbon study, we recently proposed a new framework, the Ocean-dominated Margin (OceMar), for mechanistically understanding the CO_2 source/sink nature of an ocean margin (Dai et al., 2013, GRL). This framework highlights the importance of the boundary process between the open ocean and the ocean margin, and proposes a semi-analytical diagnostic approach by coupling the physical dynamics and biogeochemical processes to resolve the sea-air CO_2 fluxes. OceMar is characterized by concurrent off-site inputs, typically from depth, of nutrients and dissolved inorganic carbon (DIC). The interplay between the externally sourced DIC and nutrients through internal metabolism controls to a large extent the CO_2 fluxes. This presentation will use OceMar cases of South China Sea, Caribbean Sea and Arabian Sea as well as the coastal upwelling system off the Oregon-California to diagnose the CO_2 fluxes.

This presentation will also examine the CO_2 dynamics at the land-ocean margin interface by focusing on river dominated margins (RiOMar), which as recognized previously, are featured by concurrent inputs of autotrophic (nutrients) and heterotrophic (organic matter) loadings. At peak river discharges, CO_2 fluxes in RioMars are often dominated by the nutrient discharges and characterized by significant CO_2 drawdown in seawater. Using the same coupled physical-biogeochemical diagnostic approach, we resolved the CO_2 fluxes in two RioMar systems, the northern South China Sea off the Pearl River estuary and the Amazon Plume.

In summary, RioMar and OceMar well characterize the coastal ocean carbon processes and the coupled biogeochemistry-physics/carbon-nutrient diagnostic approach is applicable to both systems.