

Enhanced Biogeochemical Cycling Along the U.S. West Coast Shelf

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ABSTRACT

Continental margins play an essential role in global ocean biogeochemistry and the carbon cycle; however, global assessments of this role remain highly uncertain. This uncertainty arises from the large variability over a broad range of temporal and spatial scales of the processes that characterize these environments. High-resolution simulations with ocean biogeochemical models have emerged as essential tools to advance biogeochemical assessments at regional scales. Here, we examine the processes and balances for carbon, oxygen, and nitrogen cycles along the U.S. West Coast in an 11-year hindcast simulation with a submesoscale-permitting oceanic circulation coupled to a biogeochemical model. We describe and quantify the biogeochemical cycles on the continental shelf, and their connection to the broader regional context encompassing the California Current System. On the shelf, coastal and wind stress curl upwelling drive a vigorous overturning circulation that supports biogeochemical rates and fluxes that are approximately twice as large as offshore. Exchanges with the proximate sediments, submesoscale shelf currents, bottom boundary layer transport, and intensified cross-shelf export of shelf-produced materials further impact coastal and open-ocean balances. While regional variability prevents extrapolation of our results to global margins, our approach provides a powerful tool to identify the dominant dynamics in different shelf setting and quantify their large-scale consequences.

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