SFB 754 | Ocean Deoxygenation: Drivers and Consequences · Past · Present · Future ·

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Linking shelf/break processes to coastal hypoxia in the upwelling core of the central California Current System

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Coastal upwelling supports highly productive ecosystems in eastern boundary currents that provide ecologically and economically important habitats, e.g., off the west coast of North America. However, upwelling of nutrient-rich deep waters poses ecosystem risks as well as benefits, as cold upwelled waters are increasingly enriched in CO2 and depleted in oxygen. Because the mechanisms responsible for changing oxygen levels within the California Current System (CCS) are not fully understood, our ability to characterize the duration and extent of exposure to hypoxia is limited, thus preventing proper assessment of habitat vulnerability, and how management tools can be applied to address local impacts of globally driven changes. Oxygen levels in coastal upwelling regions vary owing to influx of oxygen-poor undercurrent waters, local drawdown of oxygen through net respiration, local oxygen replenishment through net production and/or vertical mixing of oxygenated surface waters. Recent observations of oxygen levels in coastal waters of the CCS have revealed a complex pattern of variability in space and time, controlled by the interaction of multiple processes. Observations document (i) a shoaling hypoxic boundary in the southern CCS; (ii) a decline of oxygen in both the northern and southern CCS; and (iii) an increased frequency of hypoxic events off the Pacific Northwest and Southern California. Similar trends are expected for the central CCS (the region between 36°N and 42°N). However, there has been comparatively limited research on dissolved oxygen in the central CCS, despite being the location of maximum upwelling wind stress over the CCS, and despite the well-recognized productivity of the greater Gulf of Farallones (from Monterey Bay to Bodega Bay) – a "hot spot" for its biological resources, as recognized by three National Marine Sanctuaries. Further insight to this variability has emerged from associated studies of ocean acidification, given the close coupling between low oxygen, low pH and low aragonite saturation state in these productive coastal waters. Here we present new information acquired from near-bottom moored sensors, deployed at a few different locations over the shelf from 2013 to 2018. These continuous time-series measurements of temperature, salinity, and dissolved oxygen provide new insight and allow us to describe the seasonal cycle in dissolved oxygen and short-term events. Our aim is to develop an understanding of spatio-temporal patterns and to quantify the multiple mechanisms that can account for hypoxic events in the central CCS by relating temperature, salinity and oxygen variability to forcing mechanisms and source water types.

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