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Subseasonal to interannual variations of sea surface temperature, salinity, oxygen anomaly, and transmissivity in Santa Monica Bay, California from 1987 to 1997

Nikolay P. Nezlin, John J. Oram[1], Paul M. DiGiacomo[2] and Nicolas Gruber[1]

[1]*University of California, Los Angeles, CA*

[2]*California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA*

ABSTRACT

While the basic hydrographic and circulation patterns of Santa Monica Bay (SMB) are relatively well known, the seasonal and interannual variations of these patterns are not well established nor are the mechanisms behind them well understood. We analyzed 10 years of hydrographic observations (1987–1997) in the surface layer of SMB, off southern California, to establish the mean seasonal cycle and to deduce patterns of subseasonal to interannual variability of sea surface temperature, salinity, oxygen anomaly (the difference between oxygen concentration and its solubility), and transmissivity using empirical orthogonal functions and time-lagged cross-correlation methods. All four variables exhibit distinct seasonal variations, whose spatial distributions are a consequence of the interaction of bottom topography, vertical mixing, horizontal advection, freshwater discharge, and biological processes. The seasonal anomalies of all four parameters were estimated by removing the mean seasonal cycle. They exhibit three basic patterns: (1) an inshore/offshore gradient; (2) a balance between horizontal advection of the California Current from the northwest and the Southern California Countercurrent from the south; and (3) freshwater discharge from Ballona Creek. Air/sea heat flux and vertical mixing are the main factors regulating the dynamics of sea surface temperature. Freshwater discharge centered at Ballona Creek is the principal factor creating the salinity pattern. The annual mean oxygen anomaly shows a substantial supersaturation across the entire SMB. The variations of oxygen anomalies are regulated by local biological productivity, vertical mixing, and horizontal transport. Vertical mixing influences water transparency by suspension of sediments and nutrient supply stimulating phytoplankton growth. A remarkably clear pattern of spatio-temporal variations of all parameters is observed in a relatively small basin; these variations are regulated by both local meteorological factors (air temperature, wind, and atmospheric precipitation) and remote forcing, including the El Niño-Southern Oscillation (ENSO) cycle.

Full Text

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