Shoreward advection of phytoplankton and vertical re-distribution of zooplankton by episodic near-bottom water pulses on an insular shelf: Oahu, Hawaii

J.C. Sevadjian [a], , M.A.McManus [a], K.J.Benoit-Bird [b], K.E.Selph [a]

[a] Department of Oceanography, University of Hawaii at Manoa,1000 Pope Road, Honolulu, Hawaii 96822,USA

[b] College of Earth, Ocean, and Atmospheric Sciences, Oregon State University,104CEOAS Administration Building, Corvallis Oregon 97331,USA

Abstract

Shoreward pulses of cold,high salinity,phytoplankton-rich bottom water represent short timescale changes in nearshore hydrography and biological community structure off the leeward coast of Oahu, Hawaii. A three week mooring deployment in Spring 2009 revealed that‘cold pulses ’occurred overall phases of the semidiurnal surfacetide,but that a statistically greater proportion occurred at low slack tide, when the typically along-shore flow rotated and briefly exhibited a more dominant onshore component. Cold pulses were more frequent and propagated farther shoreward when background water-column stratification increased.Targeted shipboard sampling of a cold pulse in Spring 2010 revealed that chlorophyll fluorescence within the cold pulse was 7 standard deviations higher than the 11-h mean outside the cold pulse, phytoplankton concentrations(cellsmL_1) were up to a factor of 3 higher within the cold pulse, and phytoplankton entrained within the cold pulse were adapted to habitats with lower light levels and higher nutrient concentrations compared to ambient waters. Analysis of multi-frequency acoustic data collected during two shipboard surveys in 2009 and 2010 indicated that acoustic scattering during cold pulses was predominantly biological, dominated by1.0– 1.5 mm spheroid fluid-like scatterers, both in the waters above the cold pulse and in a strong-scattering feature at the cold–pulse interface. These aggregations of larger organisms at the cold-pulse interface did not appear to migrate downwards into the phytoplankton-rich water during the active passage of the cold pulse. Observations of similar temperature events throughout the tropical Pacific, combined with our multidisciplinary findings, suggest that pulsed deliveries of phytoplankton-rich water to nearshore habitats may be regular occurrences throughout the North Pacific Subtropical Gyre.

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