Productivity and CO_2 Exchange Between the Ocean and Atmosphere in Kaneohe Bay, Hawaii, a Subtropical Coastal Embayment

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Pulsed inputs of freshwater, sediments and nutrients to the oligotrophic coastal waters of Hawaii result from runoff driven by storms typical of high subtropical islands. The pulsed inputs quickly change the quality of receiving waters and exert strong controls on primary productivity and CO_2 concentrations, particularly in semi-enclosed coastal embayments such as Kaneohe Bay.

Our study combines continuous measurements at an instrumented buoy (CRIMP-CO_2) with spatially distributed synoptic sampling to produce data that reflect both the short-term variability and the longer-term evolution of this coastal ecosystem. This allows us to characterize immediate impacts of runoff on coastal waters during storms as well as the longer-term ecosystem response subsequent to these events. Our CRIMP-CO_2 buoy in Kaneohe Bay documented the response of the bay to a series of intense pulses associated with a particularly wet La Nina winter season (2005-2006). Because the CRIMP-CO_2 acquires time-series data at a single location, complementary but lower frequency measurements were made at a network of stations that are spatially distributed throughout the bay. This approach permitted elucidation of the relationships between physical, biological, and chemical processes in the bay during and subsequent to phytoplankton blooms.

Significant drawdown of CO_2 in the water column of Kaneohe Bay following these pulsed inputs is attributable to phytoplankton blooms and temporarily changes the bay from a net source to a net sink of CO_2. Physical forcing strongly influences how the system responds, in particular stratification/mixing, therefore controls the duration of blooms and the attendant changes in CO_2 concentration.