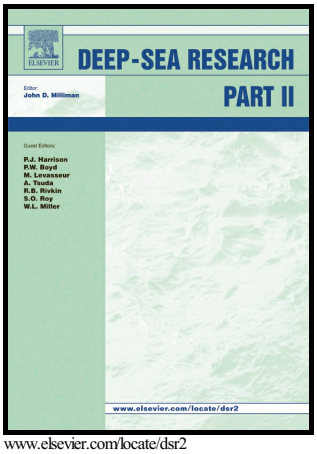

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PII: S0967-0645(16)30233-8
DOI: http://dx.doi.org/10.1016/j.dsr2.2017.01.001
Reference: DSRII4184

To appear in: *Deep-Sea Research Part II*

Received date: 17 August 2016
Revised date: 19 November 2016
Accepted date: 2 January 2017

Cite this article as: Francisco P. Chavez, Jeff Sevadjian, Chris Wahl, Jules Friederich and Gernot E. Friederich, Measurements of pCO_2 and pH from a autonomous surface vehicle in a coastal upwelling system, *Deep-Sea Researc Part II,* http://dx.doi.org/10.1016/j.dsr2.2017.01.001

Measurements of pCO_2 and pH from an autonomous surface vehicle in a coastal upwelling system

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Abstract

Anthropogenic input of carbon dioxide (CO_2) into the atmosphere and its uptake by the ocean with associated changes in ocean chemistry have created an urgent need to expand coverage of sea surface and atmospheric carbon dioxide observations. Conventional sampling platforms (e.g. ships and moorings) do not provide the spatial and temporal resolution needed to assess the effects of rapidly changing carbon dioxide conditions and are expensive to operate. Through a series of deployments beginning in March 2012, two versions of the Wave Glider autonomous surface vehicles from Liquid Robotics, Inc. have been instrumented with sensors to measure pH, partial pressure of CO_2 (pCO_2) of the atmosphere and sea surface, and wind speed and direction, from which instantaneous sea-air fluxes of CO_2 can be calculated. These deployments, most near Monterey Bay, California, were highly correlated with ΔpCO_2 measurements obtained from the Monterey Bay Aquarium Research Institute's (MBARI) long-term mooring station M1, as well as from shipboard observations. In the central California upwelling system with highly variable pCO_2 levels, the gliders captured large spatial gradients associated with upwelling fronts. Differences in sea surface pCO_2 as large as 470 μatm over < 0.5 km were observed. Unlike traditional ship sampling methods, however, this new generation of sampling platforms is capable of continuous long-term (months) deployments at a fraction of the cost. The vehicles