

UC San Diego

Research Final Reports

Title

Dispersion in the Surfzone: Tracer Studies for Water Quality and Ecology

Permalink

<https://escholarship.org/uc/item/3s52n48s>

Authors

Feddersen, Falk
Guza, Robert T.

Publication Date

2010-10-13

Supplemental Material

<https://escholarship.org/uc/item/3s52n48s#supplemental>

**California Sea Grant Sea Grant
Final Project Progress Report**

10/13/2010

R/CZ-196

03/01/2006–09/01/2010

Dispersion in the Surfzone: Tracer Studies for Water Quality and Ecology

Falk Feddersen
Scripps Inst. of Oceanography
falk@coast.ucsd.edu
858.534.4345

Robert T. Guza
Scripps Institution of Oceanography
rguza@ucsd.edu
858.534.0585

Project Hypotheses

Measurement of the spatial and temporal scales of nearshore chlorophyll-a (chl) is critical to our ability to understand or predict dense, and potentially harmful blooms of phytoplankton along the California Coast. Patchiness in chl may result from patchiness in nutrient availability, swimming or sinking, predation, or transport and mixing by breaking waves, currents, internal waves and tides. We performed a study during the Fall 2006 Huntington Beach (HB06) experiment to investigate the biological and physical factors that affect phytoplankton patchiness. Autotrophic phytoplankton require light and nutrients to survive. However, the nearshore euphotic zone (the critical depth for photosynthesis) is often nutrient-depleted due to uptake and planktonic growth. In order to sustain populations, phytoplankton rely on delivery of new nutrients from below the euphotic zone through upwelling or vertical mixing. or 2) terrestrial sources (from rain, ground water, tidal flushing or river outflow) that feed directly into the nearshore.

A Sea Grant-sponsored experiment conducted in Huntington Beach CA in 2006 (HB06) with P.I.s Falk Feddersen, Jim Leichter and Bob Guza successfully achieved the first continuous in situ measurements of chl in the surfzone. An expansive array of instrumentation extending from the surfzone to 60 m depth addressed mechanism for nutrient delivery into the nearshore and the causes of phytoplankton patchiness.

Under some oceanographic conditions, deep chl and nutrients from below the thermocline were periodically mixed into the euphotic zone within 1 km from shore. This deep-water delivery of nutrients appears to play an important role in inner shelf phytoplankton bloom events. However, the role of terrestrially-derived nutrients in determining nearshore chl patchiness remains unexplored.

Project Goals and Objectives

The overall project goal is improved understanding and modeling capability of the dispersion in the surfzone (within a few 100 m of the shoreline) of tracers including pollutants and phytoplankton. A basic understanding of dispersion statistics including diffusivities, length-scales, time-scales, and anisotropies is required to reach this goal.

Field observations of nearshore tracer phytoplankton concentrations were acquired using a new and unique jetski sampling platform. Additional small boat CTD+F+nutrient sampling occurred within a few km of shore in addition to fixed mooring observations. These observations leveraged the infrastructure and observations of an Southern California Coastal Ocean Observing System (SCCOSS) led HB06 nearshore field experiment a site selected for its chronic water quality problems and the extensive observations previously collected there.

Briefly describe project methodology

Subsequent to the HB06 field experiment, the primary methodology has been to analyze the extensive and disparate data set collected - moored T chains, ADCPS, wirewalker data, CTD transects, bottle water samples, jetski surface Chl and T data, and surfzone instrumented frames.

Describe progress and accomplishments toward meeting goals and objectives

The two primary milestones towards meeting project goals and objectives include 1) near publication of Omand et al. in *Limnology and Oceanography* (in revision). This paper describes the sudden surface appearance of a red-tide patch and describes the factors that led to its development 2) Omand et al. in prep for *Limnology and Oceanography*: In this paper, NO3 fluxes at the base of the eutrophic zone are estimated in order to drive a NP model for the observed Chl for a 120-day period covering the summer and fall of 2006.

Project modifications

There have been no substantial modifications to the research plans. In collaboration with the Orange County Sanitation Districts and Orange County Health Care Agency, we were able to add a bacterial sampling program in to the HB06 experiment where bacteria, phytoplankton, and nutrient sampling were coordinated. SIO graduate student Meg Rippy is leading the analysis of the bacteria data.

Project outcomes

The primary project outcomes are the papers that have been published or are near published and are given in the next section

Impacts of project

No response

Benefits, commercialization and application of project results

No response

Economic benefits generated by discovery

No response

Issue-based forecast capabilities

No response

Tools, technologies and information services developed

No response

Publications**Peer-reviewed journal articles or book chapters**

Title: The Influence of Bubbles and Sand on Chlorophyll Fluorescence Measurements in the Surfzone

Authors: Omand, Feddersen, Leichter, Clark, Guza

Date: 2009

Journal Name: *Limnology and Oceanography Methods*

Issue/Page Numbers: Vol 7 354-362

Title: Measuring Fluorescent Dye in the Bubbly and Sediment Laden Surfzone

Authors: Clark, Feddersen, Omand, Guza

Date: 2009

Journal Name: *Water, Air, Soil, Pollution*

Issue/Page Numbers: DOI: 10.1007/s11270-009-0030-z

Title: Observations of Drifter Dispersion in the Surfzone: The Effect of Sheared Alongshore Currents

Authors: Spydell, Feddersen, Guza

Date: 2009

Journal Name: *JGR Oceans*

Issue/Page Numbers: 114, C07028

Title: Quality Controlling Surfzone Acoustic Doppler Velocimeter Observations to Estimate the Turbulent Dissipation Rate

Authors: Feddersen

Date: 2010

Journal Name: *J. Atmospheric and Oceanic Technology*

Issue/Page Numbers: in press

Title: Cross-shore Surfzone Tracer Dispersion in an Alongshore Current.

Authors: Clark, Feddersen, Guza

Date: 2010

Journal Name: *JGR Oceans*

Issue/Page Numbers: in press

Title: Physical and Biological Processes Underlying the Sudden Appearance of a Red-tide Surface Patch in the Nearshore

Authors: Omand, Leichter, Franks, Guza, Lucas, and Feddersen

Date: 2010

Journal: *Limnology and Oceanography*

Issue/Page Numbers: revised

Student

Melissa Omand

Scripps Inst. of Oceanography

Department: Physical Oceanography

Theses/dissertation title: Nearshore red-tide blooms: physical and biological forcings

Supported by Sea Grant funds? [x] yes [] no

Start date: 03/01/2006

End date: 02/28/2009

Cooperating organizations

Federal

US Geological Survey

Local and state

Orange County Sanitation District
Orange County Health Care Agency

Awards

Omand, M: Outstanding Student Paper Award at the 2006 Fall AGU Meeting

Keywords

red-tide, internal-wave, bloom, nutrient fluxes