

An Introduction to California's Ocean Observing Systems

1

How to use ocean observing system data
related to water quality assessment

Leslie Rosenfeld
CeNCOOS
Program Director

Jennifer Patterson
CeNCOOS
Information Manager



Jan. 8, 2013



Introduction Outline

- What is U.S. IOOS®?
- What are CeNCOOS and SCCOOS?
- How are we funded?
- What do we do?
- How does it apply to water quality in California?
- What's in store for the future?



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What is U.S. IOOS?

- US contribution to Global Ocean Observing System
- Program Office in D.C. within NOS / NOAA
- Includes global (satellites, drifters, etc.) and coastal components
- Coastal component includes 17 Federal agencies, 11 regional associations and 2 other consortia
- Federal backbone of coastal component includes tide gauges, NDBC buoys, etc.



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Purpose of U.S. IOOS

A tool that enables the Nation to track, predict, manage and adapt to changes in our ocean, coastal and Great Lakes environment for the purposes of:

Improving safety Enhancing our economy Protecting our environment

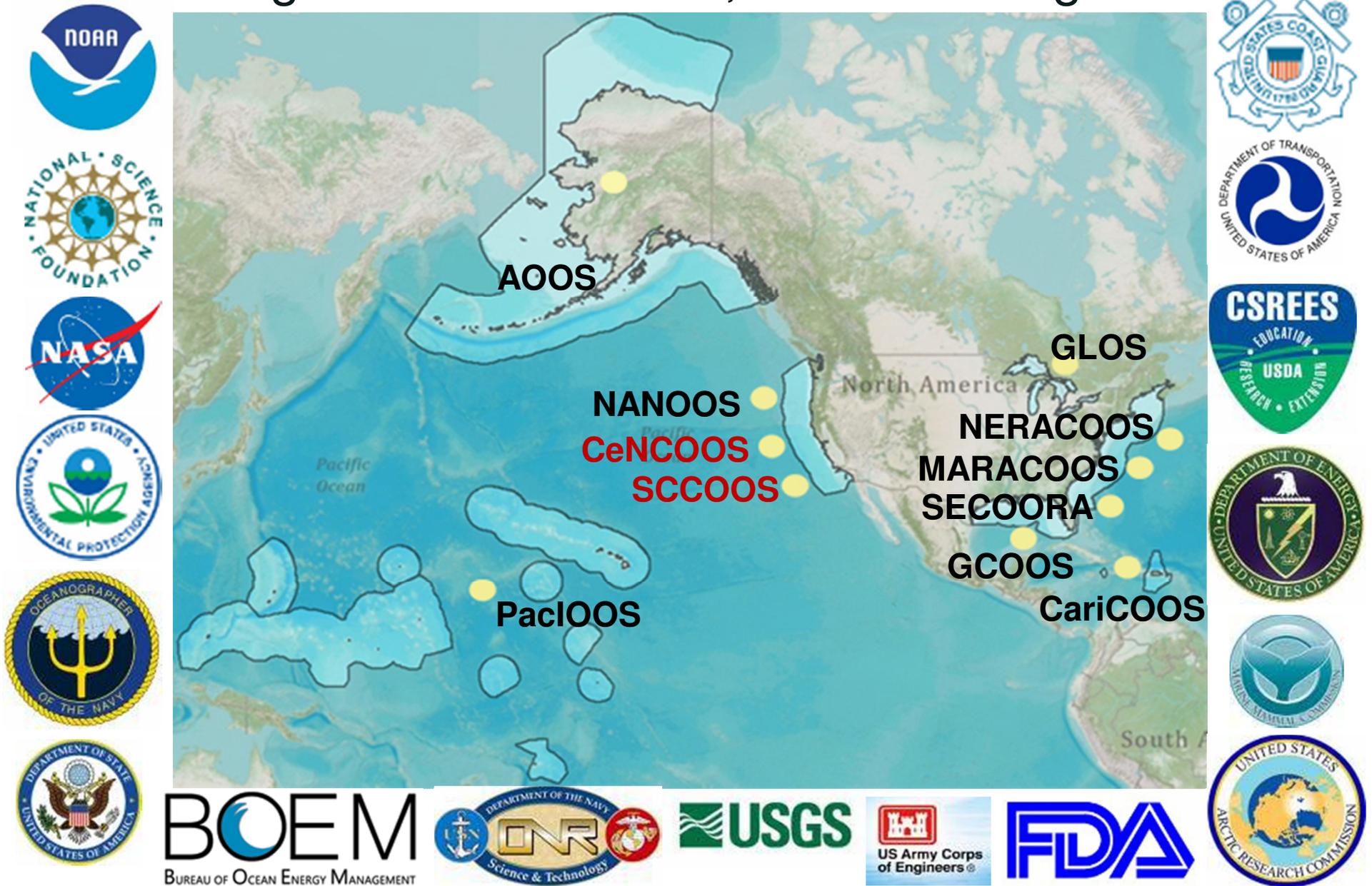


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IOOS Coastal Component

11 Regional Associations; 17 Federal Agencies



What is CeNCOOS?

- Established in 2004, “CeNCOOS is a collaborative that enables sustained and coordinated measurements, model nowcasts and forecasts, and integrated products to inform decisions about our regional ocean.”



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What are CeNCOOS and SCCOOS?

- CeNCOOS www.CeNCOOS.org
 - Central and Northern California Ocean Observing System
 - Extends from Pt Conception to OR border, from the coast out to 200 nm offshore
 - Program Office at MBARI, Moss Landing
 - 48 member organizations
- SCCOOS www.SCCOOS.org
 - Southern California Coastal Ocean Observing System
 - Extends from Pt Conception to Mexican border, from the coast out to 200 nm offshore
 - Program Office at Scripps Inst. of Oceanography, San Diego
 - 11 member organizations



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What are CeNCOOS and SCCOOS?

- They support Principal Investigators at institutions throughout the state who operate the observing system
- They each have a governing body
 - CeNCOOS: 15 member elected Governing Council
 - SCCOOS: 10 member Board of Governors
- They share a 33-member Joint Strategic Advisory Committee linking them with broad stakeholder interests and knowledge within California



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CeNCOOS and SCCOOS Program Office Staffs

- **CeNCOOS**

- Director: Leslie Rosenfeld (70% time, started 9/11)
- Program Manager: Janine Scianna (90%, 1/12)
- Information Manager: Jennifer Patterson (90%, 4/12)
- Product Developer: Fred Bahr (80%, 10/08)

- **SCCOOS**

- Director: Julie Thomas (15%, 1/08)
- Program Coordinator: Danielle Williams (100%, 5/12)
- Data & Information Manager: Darren Wright (50%, 10/12)
- Public & Government Relations Coordinator: Chris Cohen (40%, 2/10)
- Technical Director: Eric Terrill (10%, 2/05)



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CeNCOOS Funding

- Primary funding is via 5-yr grant from NOAA/IOOS
 - FY11 (beginning of 5-yr grant) \$1.74 M
 - FY12 (6/12 - 5/13) \$2.09 M
 - ~ 2/3 goes to observing & modeling; 1/3 for data mgmt, product development, program mgmt & governance
 - \$648K mandated by IOOS for HF radar operations
 - FY13 ???????
- \$14.5K over 5 yr life of NOAA ECOHAB project
- \$62.5K over 3 yr life of OPC/Sea Grant HABs project
- No other state funding at present
- \$34K OCSD



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What isn't CeNCOOS Funding?

- The following slides will discuss activities partially funded by CeNCOOS (unless otherwise noted)
- All CeNCOOS activities are highly leveraged
 - i.e. only a small portion of their support comes through the CeNCOOS Program Office
 - We estimate that CeNCOOS funds are leveraged at ~ 5:1
- Most CeNCOOS PIs get little or no salary from CeNCOOS. They are supported by their institutions and other grants.
- There are many ocean observing system elements in the CeNCOOS area that are supported by federal, state, and private funds that do not go through the CeNCOOS Program Office – some of those will be touched on today
- Think of CeNCOOS funding as glue – it holds the system together and attracts other funds and assets

What do CeNCOOS and SCCOOS do?

Manage an “end-to-end” coastal ocean observing system ...

- data collection
- data management
- data dissemination
- numerical model simulations and forecasts
- product development
- user outreach and facilitation

... to benefit USERS in four broad focus areas:

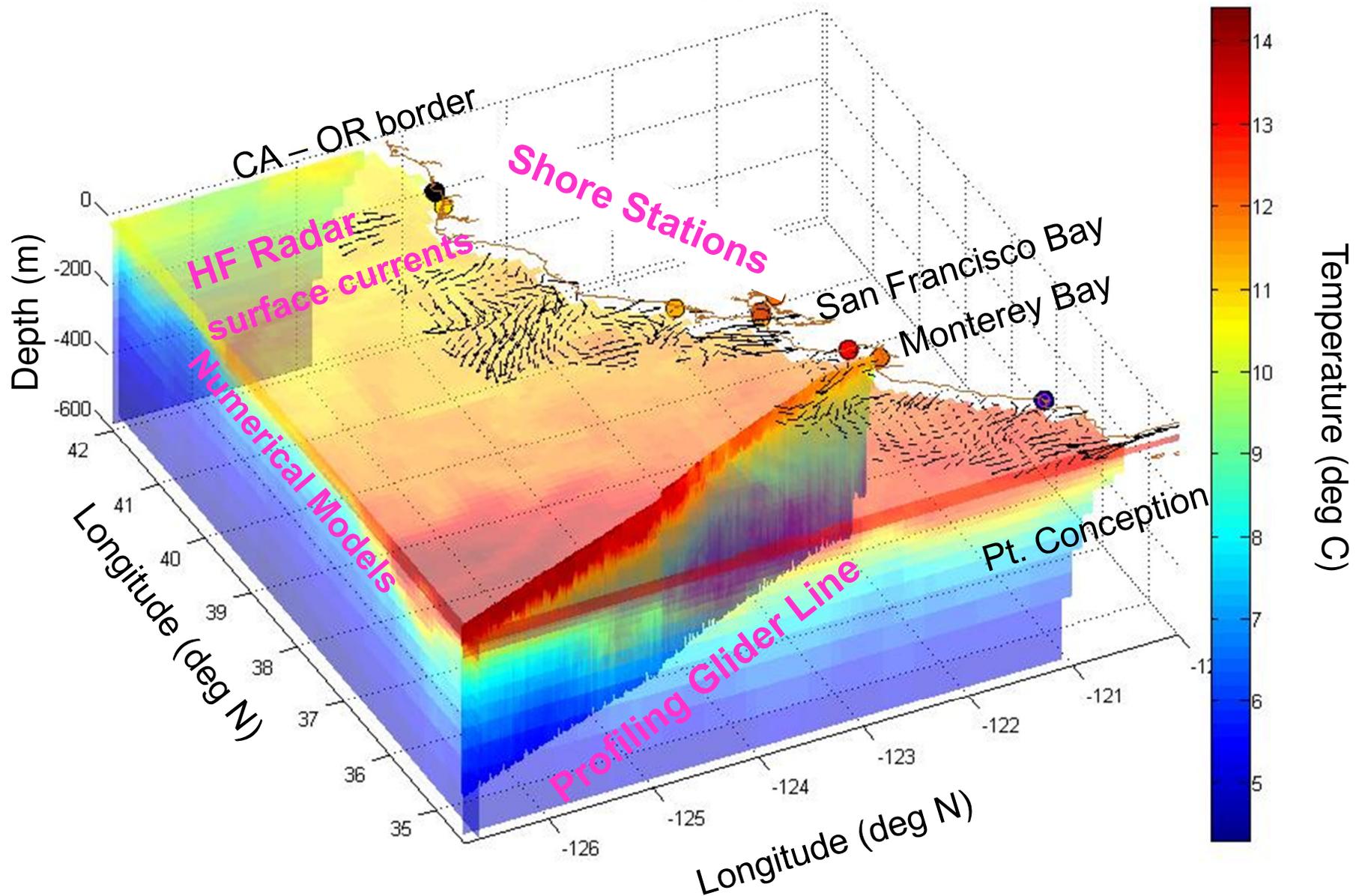
- Water quality
- Ecosystems and climate
- Marine operations
- Coastal hazards



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CeNCOOS – Supported Assets



Data are from the Jan-Feb 2012 timeframe

Intro to CeNCOOS Website

www.cencoos.org

CeNCOOS
Central & Northern California Ocean Observing System

Integrating marine observations to inform decision makers and the general public

Home About Us News & Events **Current Conditions** **Data Products** Download Data Classroom **Models**

OBSERVING SYSTEMS

FOR OCEAN HEALTH

- About Us
- Website Map
- Our Members
- Get Involved
- Map of Our Region
- Report Coastal Issues
- Regional Associations
- Join CeNCOOS Email List
- Ocean Observing Links
- Contact Us

Find us on Facebook

CeNCOOS News & Events recent news >

CeNCOOS Governing Council to Hold Public Meeting

On December 10, 2012, the CeNCOOS Governing Council will convene a meeting at the Bodega Marina Laboratory in Bodega Bay, CA. All interested parties are invited to attend. The meeting will include program updates in the morning and a special session on high frequency radar planning in the afternoon. A draft agenda can be accessed here. RSVPs to the meeting are due November 26 to cencoos_communications@mbari.org.

● ● ● ● ●

See all current news and events

Environmental Data Products all products >

- CDP iPhone App**
CeNCOOS DATA PORTAL IPHONE APP
- REAL-TIME OCEAN SATELLITE IMAGES**
- AIS REAL-TIME SHIP TRACKING MAP**

AT A GLANCE

Monterey Bay
Date: 12/29/2012
Time: 22:50 (GMT)
Water Temp: 55 °F, 13 °C
Air Temp: 51 °F, 11 °C
Wind Spd: 8 kts, 4 m/s
Wind Dir: 20°
Swell: 10 ft, 14 s, WNW
Wind Waves: 5 ft, 10 s, WNW

Get more info on data

HUB MDC SFO MRY MOB
Click a tab to view a location

PARTNER SPOTLIGHT

Liquid Robotics Inc.

Automated Shore Stations

- CeNCOOS supports 13 stations
- Operated by HSU, SSU, BML, SFSU, UCSC, MLML, Cal Poly
- Most report in near real-time
- All measure T, S
- Most measure fluorescence and turbidity or transmissivity
- ~ half also measure DO, pH, and water level
- A few include meteorological variables
- Two are HABs stations; one has an automated nitrate sensor
- T, S, and met variables available thru CeNCOOS data portal; all variables available through PI websites
- New CeNCOOS shore station page is under development



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CeNCOOS Data Portal

<http://204.115.180.244/CeNCOOS/DataPortal.html>

Also available through iTunes

Observation

Operated by SAIC

Standardization

Includes more than 6000 supported assets

Assets include temperature

Wave buoy

Water level and

variety of formats

Barometric pressure

Webcams

Region: San Francisco Bay
Organization: -All-
Variables: -All-
Asset Type: -All-
Asset ID Search: Go Reset

Hide Asset List
Click Row To View Data

| Organization | ID |
|---------------|----------|
| PISCO | WRK001 |
| PISCO | WRK002 |
| SCPD | SCHw |
| SFSU | ANGL |
| SFSU | CMA |
| SFSU | COMM |
| SFSU | CRIS |
| SFSU | LEND |
| SFSU | MONT |
| SFSU | PBON |
| SFSU | PILR |
| SFSU | RTC1 |
| SFSU | RTCw |
| SFSU | SAUS |
| SFSU | SLID |
| SFSU | tibc1 |
| SFSU | TRES |
| SFSU | RTC |
| SFSU | TIB |
| Shoreline Inn | CyBw |
| UCSC | LML |
| UCSC | SCWharf1 |

CeNCOOS Data Portal (CDP)

New! The CeNCOOS Data Portal (CDP) is now available as an app for your iPhone, iPad and iPod Touch! Search 'CeNCOOS' at your app store to download or find out more at iTunes.

Map Satellite Hybrid Terrain

Asset: CMA - Salinity
Asset ID: SFSU-CMA
Lat: 38.07 N Lon: 122.23 W
Date Range: 2012-01-01 to 2012-01-06
Start Date: 2012-01-01 Update
End Date: 2012-01-06
Salinity CSV Get

Legend:
● Buoy
■ Land Station
◆ Pier Station
▲ HF Radar
● Webcam
● Real-time Active (updated within 24 hours)
● Real-time Inactive (not updated recently)
● Non-real-time (updated infrequently)

Google Imagery ©2011 TerraMetrics, Map data ©2011 Google Terms of Use

CeNCOOS Shore Station Page

http://www.cencoos.org/sections/conditions/shore_stations.shtml

Home About Us News & Events Current Conditions Data Products Download Data Classroom Models

CURRENT CONDITIONS

Weather

Surface Currents

Waves

Ocean Buoys

Ocean Shore Stations

Tides

Water Quality

Satellites

Algal Blooms

Web Cams

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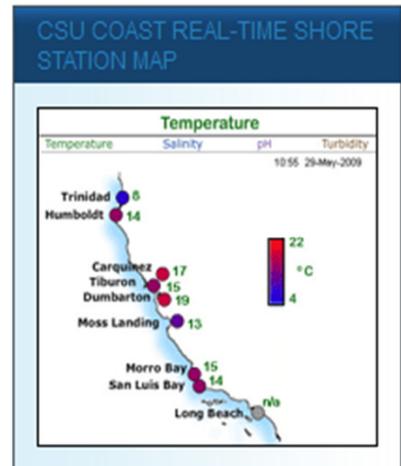
Real-time Ocean Shore Stations

View and download real-time data collected at shore stations with the [CeNCOOS Data Portal](#) or through the individual pages listed below

- [Trinidad \(Back Online!\)](#)
- [Humboldt Bay](#)
- [Tiburon](#)
- [Carquinez](#)
- [Moss Landing \(Seawater Intake Station\)](#)
- [Moss Landing Harbor \(Removed Oct 2010\)](#)
- [Monterey Wharf](#)
- [Morro Bay](#)
- [San Luis Bay](#)
- [Bodega \(Horseshoe Cove\)](#)
- [Fort Point \(near Golden Gate Br.\)](#)
- [Santa Cruz Wharf](#)

Links out to individual
data provider pages
Includes all variables

Click desired station



CeNCOOS contributes funding to the operations of the stations listed above, run in coordination with our partner institutions. The stations are usually attached to piers or docks that extend no more than 100 meters from shorelines. These stations typically monitor water temperature, salinity, dissolved oxygen, pH, chlorophyll and turbidity.

Other Stations

- [NOAA CO-OPS Program - San Francisco PORTS program](#) (weather, water temperature, water currents)
- [NOAA National Estuarine Research Reserve Program](#) (weather, water temperature, salinity, dissolved O2)
- [Scripps Shore Station Program](#) (datasets ranging from years to decades)
 - [Active Stations](#) (including Big Sur, Pacific Grove, Farallon Islands, Trinidad)
 - [Historic Stations](#)



WELCOME

ABOUT BOON

- About BOON
- Researchers
- Projects
- Partners
- News and Documents

SENSOR PLATFORMS

- Shoreline Observations
- Offshore Mooring and Buoy Observations
- High Frequency Radar
- Vessel Based Observations
- Resident Platforms
- Sensor Map

FORT POINT SEAWATER SENSORS

Temperature, Salinity, Conductivity, Transmittance, Fluorescence

[Real Time Data](#) [48 Hour Charts](#) [Sensor Specs](#) [Data Access](#)

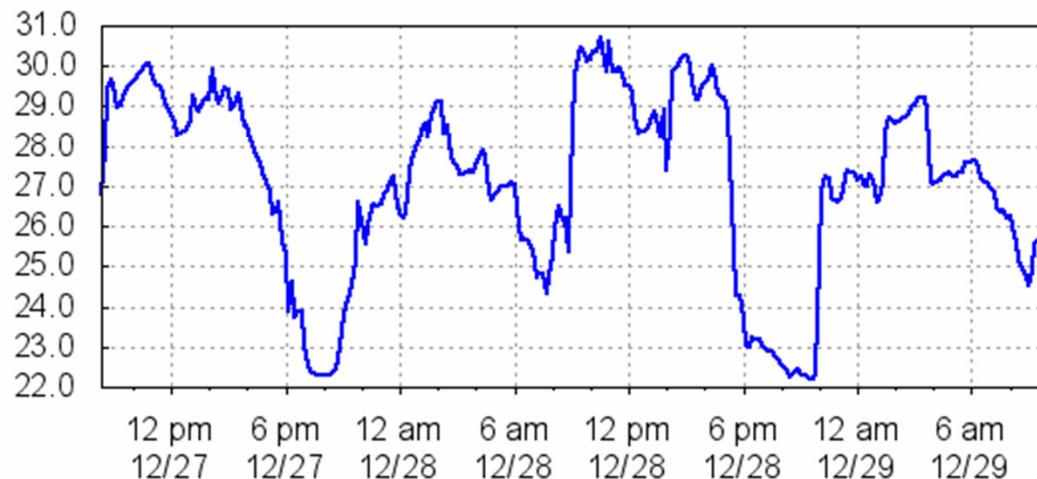
Current Conditions

| | |
|---------------------------------------|--------|
| Seawater Salinity (PSU) | 29.777 |
| Seawater Conductivity (S/m) | 3.4770 |
| Seawater Temperature (deg F) | 54.0 |
| Seawater Temperature (deg C) | 12.2 |
| Seawater Pressure (dbar) | 3.77 |
| Seawater Density (sigma-t kg/m3-1000) | 22.498 |
| Seawater Transmittance (raw) | 0.000 |
| Seawater Fluorescence (raw) | 1.337 |

Last update: Sat Dec 29 10:20:01 2012 PST

[All real time data >](#)

Fort Point Seawater Salinity (PSU)



New Shore Station Page under development



Some uses of shore station data

- HAB detection; contribute to Cal HABMAP
 - Santa Cruz; Monterey
- Support for shellfish mariculture
 - Oysters in Humboldt Bay; abalone on Monterey wharf
 - pH monitoring for ocean acidification
 - working with SWRCB
- Water density used to calculate vessel loads
- Short-term event detection; e.g. tsunamis
- Long-term climate records



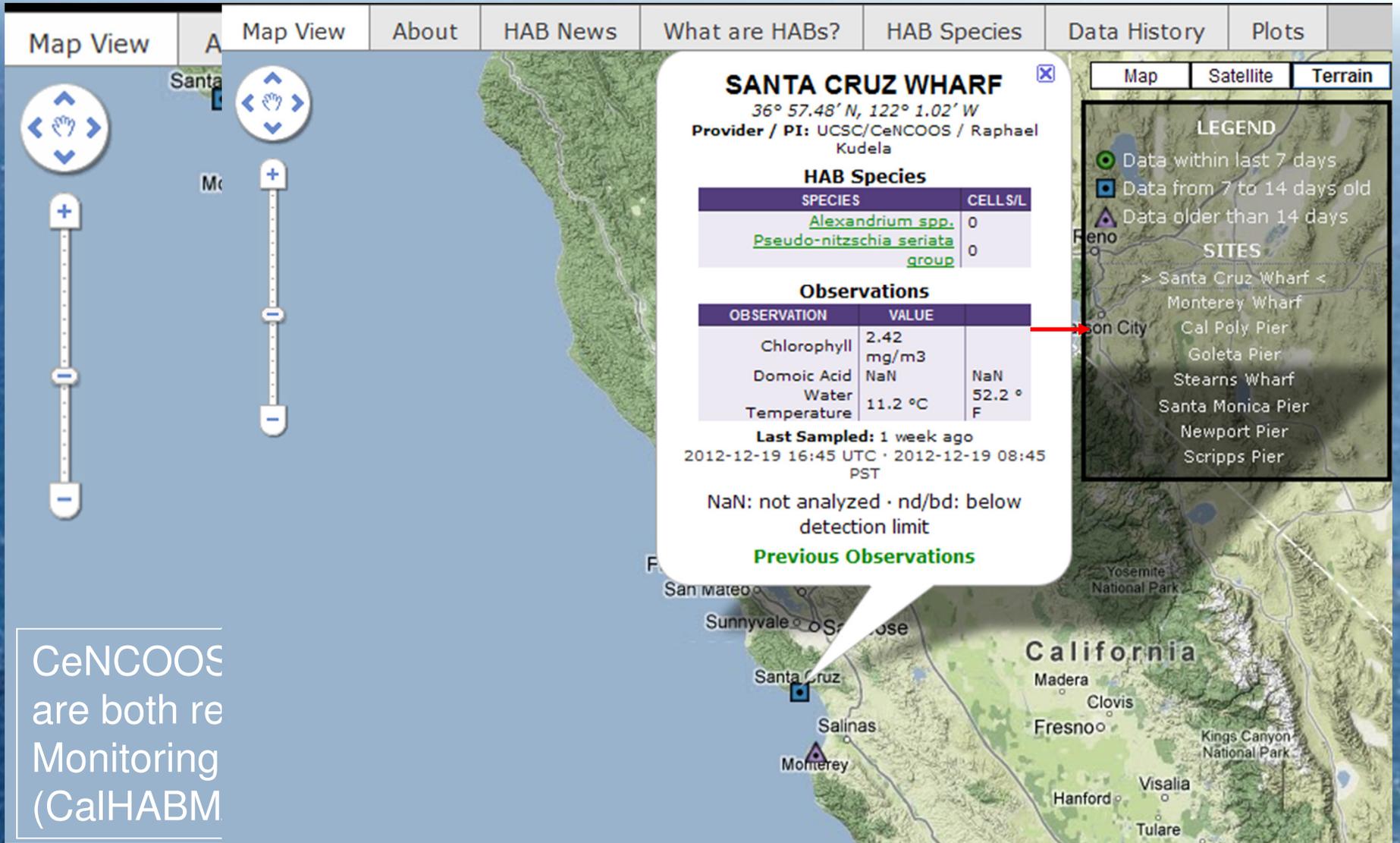
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Harmful Algal Blooms

<http://habmap.info/data.html>

<http://www.sccoos.org/data/habs/index.php>



CeNCOOS
are both re
Monitoring
(CaHABM)

Water Quality & Mariculture

Water quality parameters of concern include:

- Presence of harmful algal blooms
- Chlorophyll concentration
- Dissolved oxygen concentration
- pH

Growers can respond to different conditions by

- Changing the timing of spawning
- Changing timing of harvesting
- Moving crop vertically in the water column



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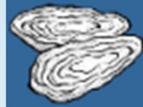
Oysters and Chlorophyll in Humboldt Bay

- Mariculture companies (oysters, mussels, clams) in Humboldt Bay started using real-time CeNCOOS chlorophyll fluorescence data in 2003 to understand factors affecting growth rates of their shellfish.
- Using CeNCOOS data on water temperature, salinity and chlorophyll concentration, scientists are building a simple biophysical model of oceanic productivity off Humboldt Bay into a tool for predicting how this productivity (primarily phytoplankton) is delivered to shellfish growing sites.



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Oyster Conditions

(Humboldt Bay)



DockB

Buoy 46022-Eel River

Buoy 46212-South Spit

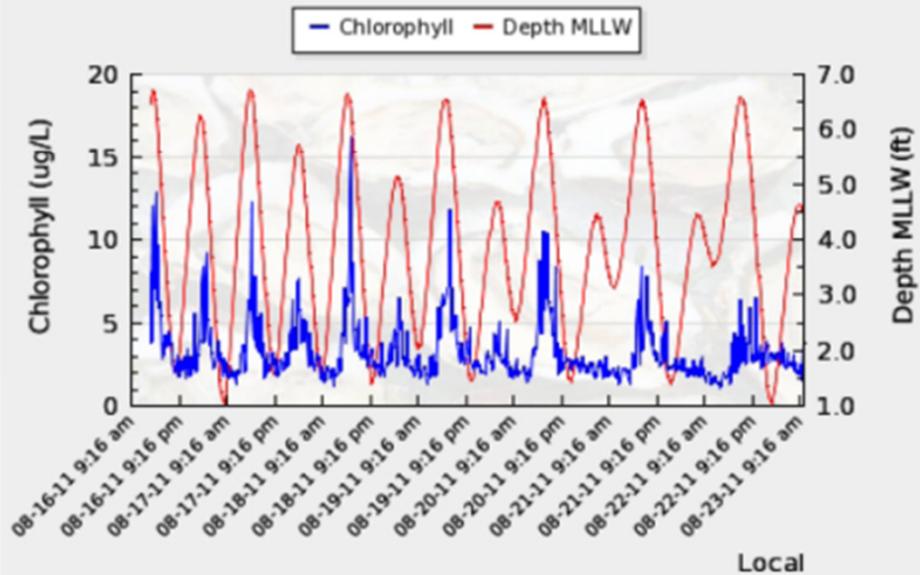
Upwelling Index

Latest Observation: 2011-08-23 10:01:49 Local (PST/LDT)

| | Temp (C) | Chlorophyll (ug/L) | Salinity (ppt) | pH | Precip (in) | Depth (ft) |
|-----------------|----------|--------------------|----------------|-------|-------------|------------|
| Current Value | 14.521 | 3.810 | 33.840 | 8.101 | 0.00 | 4.482 |
| 12 Hour Average | 16.52 | 2.86 | 33.95 | 8.06 | 0.00 | 2.90 |
| Graph: | | | | | | |

Humboldt Bay Dock B (real-time)

CeNCOOS at Humboldt State University



Local

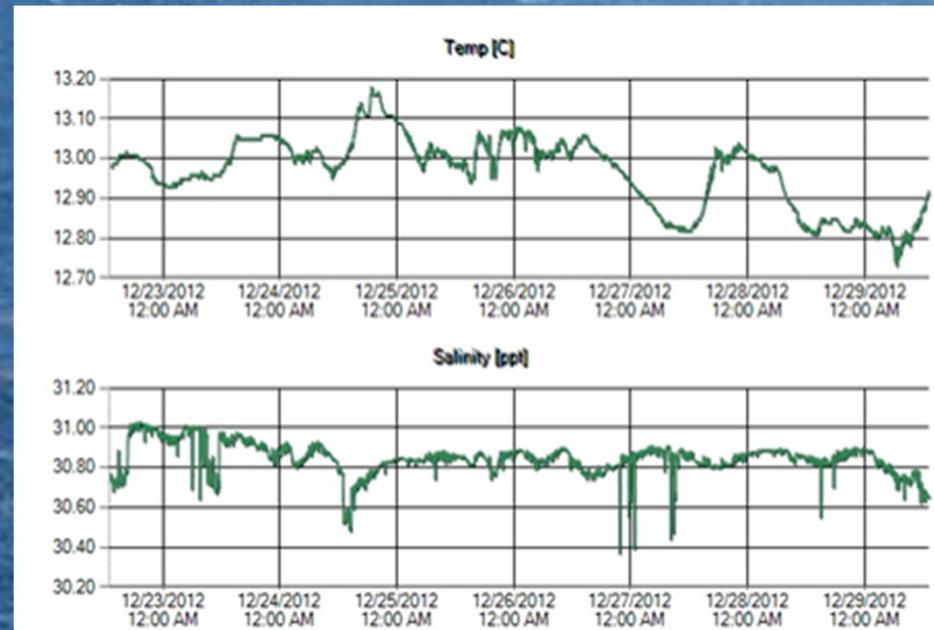
Abalone and HABs in Monterey Bay

- Scientists are using observing system data to develop statistical models to learn under what conditions HAB events are most likely, so they can be predicted in the future.
- To supplement weekly HABs sampling already being done there, CeNCOOS recently installed an automated WQ station on Monterey Wharf. The Monterey Abalone Company helps maintain the instrumentation.

Click on green station marker to view live data.



Disclaimer: The data is presented "as is", with no warranty, expressed or implied, of the data quality or consistency, and should not be used for navigation. It is provided without liability or obligation on the part of MMB. No vessel or other commercial, recreational or professional. For use in publications, and fees should obtain written permission from the director of MMB, and acknowledge MMB as the data source in their publications. The Alliance for Coastal Technology (ACT) does not seek technologies endorsed or used in the selection of technology used for this application.



Ocean Acidification

- SWRCB pilot program on OA
 - Durafet pH sensors have been installed at 3 CeNCOOS and 2 SCCOOS shore stations and 1 LOBO estuarine mooring
 - Water samples are being collected weekly for analyses at Scripps
 - Help establish pH variability in coastal ocean and determine best methods to measure it
- Coordinating with SCCOOS, C-CAN, WCGA, NOAA OA program



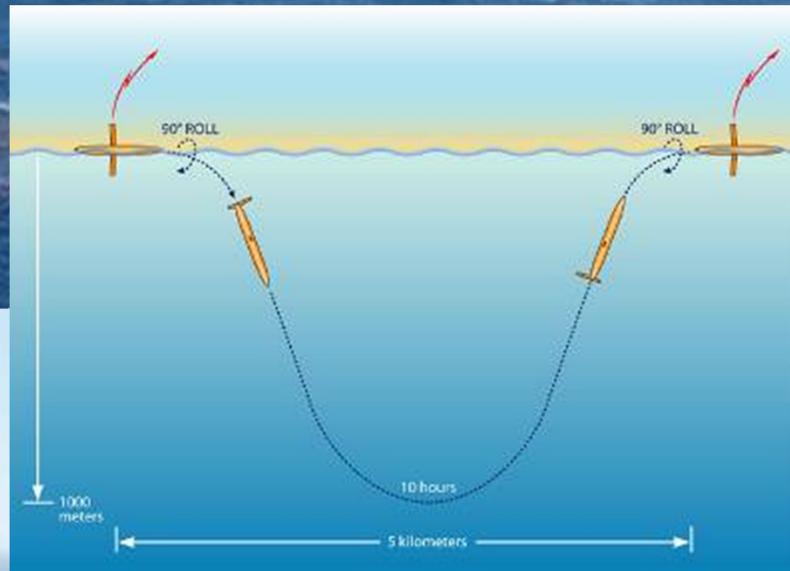
Jan. 8, 2013



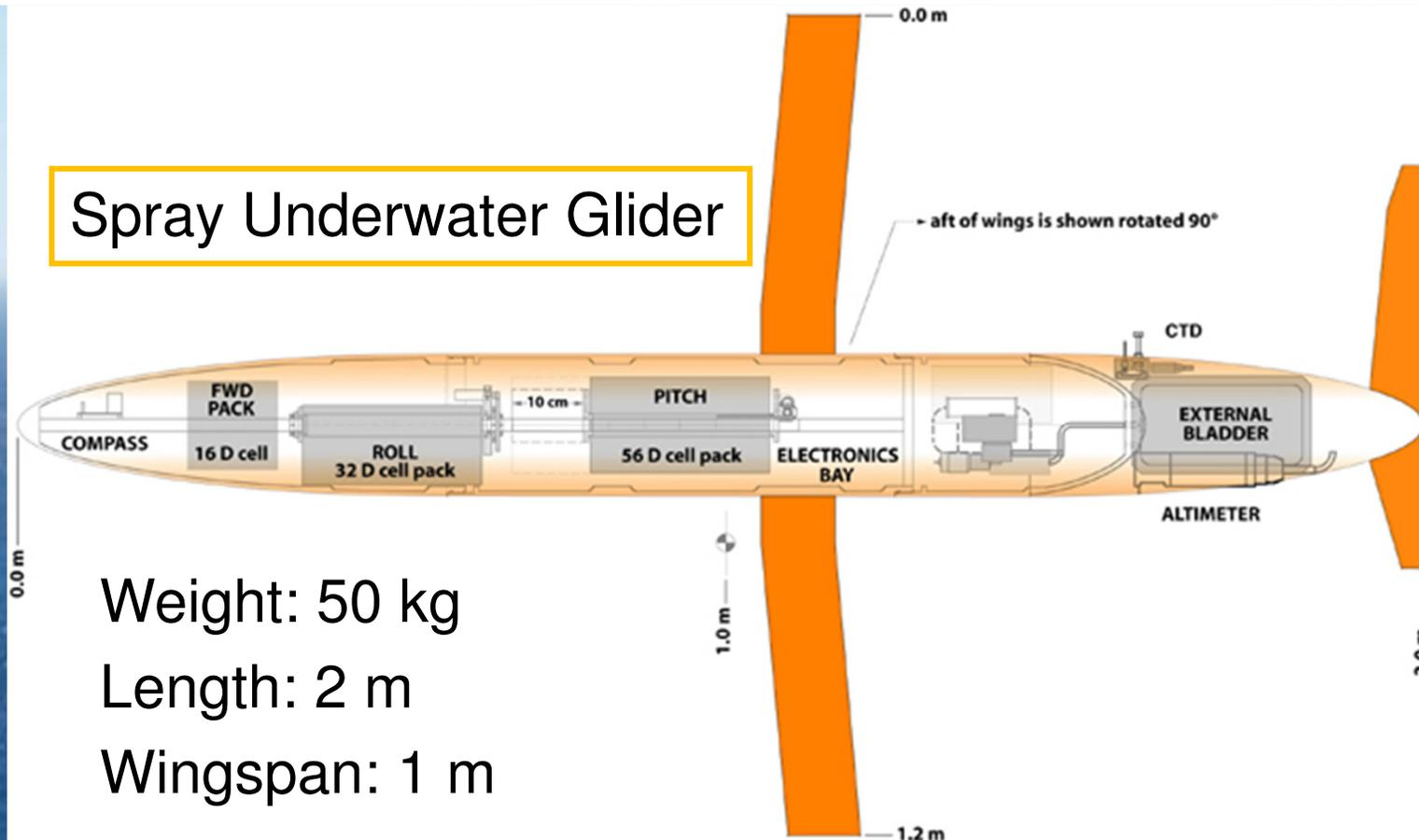
Profiling Gliders



- Gliders are controlled remotely via satellite, and autonomously collect data in the water column
- Measure temperature, salinity, chlorophyll fluorescence, current velocity; some have dissolved oxygen; other sensors to be added
- Data is assimilated into numerical models, and used in studies of climate change and its impacts on California's coast



Spray Underwater Glider



Weight: 50 kg

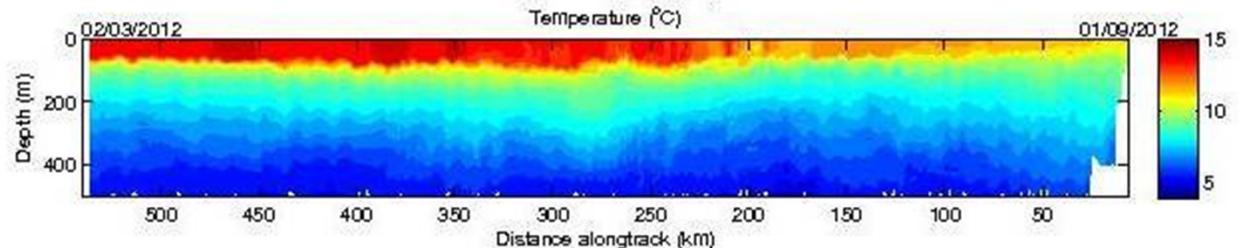
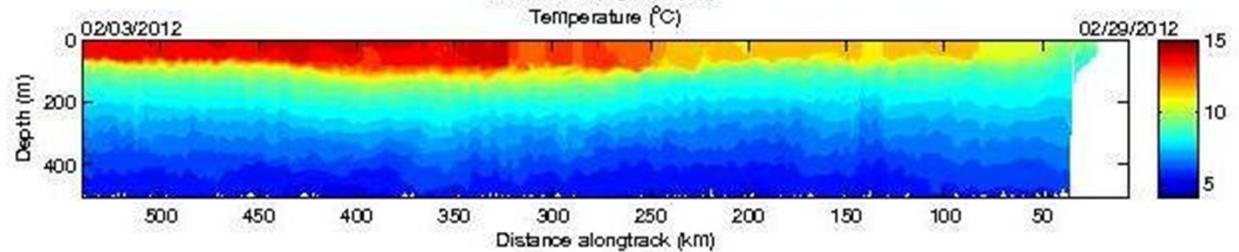
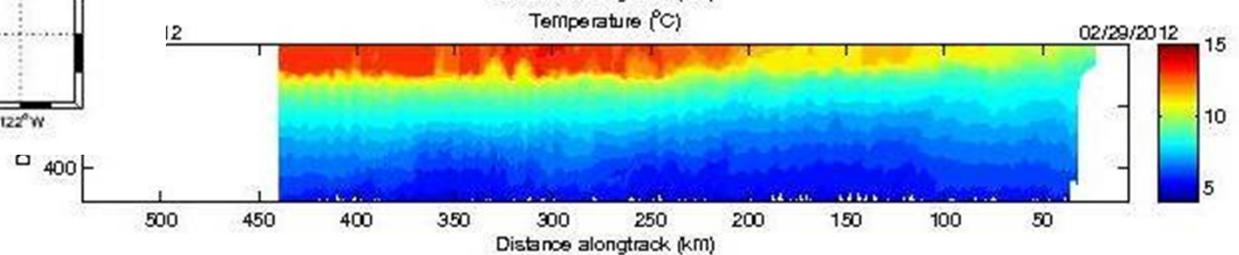
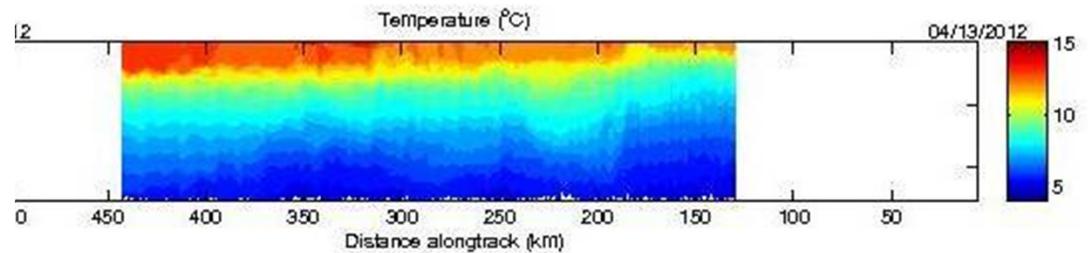
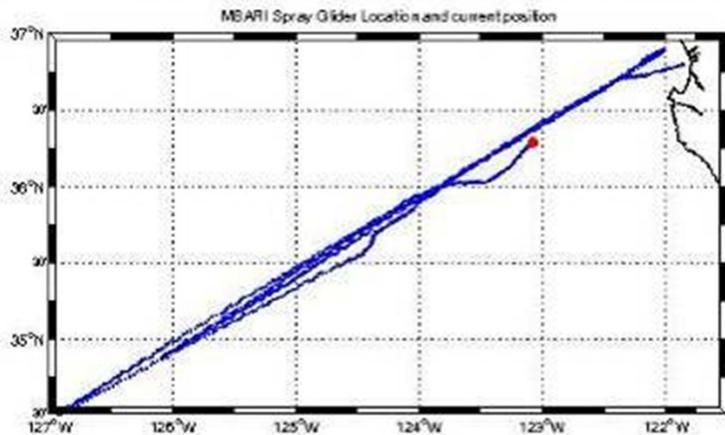
Length: 2 m

Wingspan: 1 m

- Forward propulsion accomplished by varying vehicle's buoyancy; control surfaces transfer vertical motion into forward motion. NO PROPELLER!
- Changes pitch and roll (hence heading) by moving the battery packs back and forth or side to side inside the hull
- GPS navigation
- 2-way Iridium communication

Data Products / Glider Data Plots

<http://www.cencoos.org/sections/data/glider/>

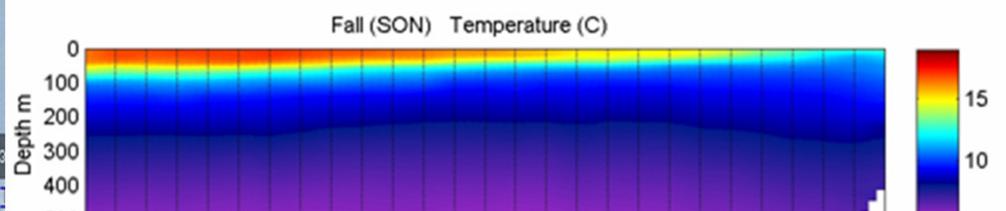
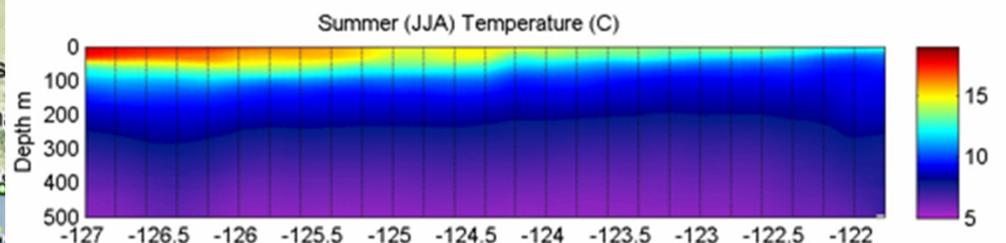
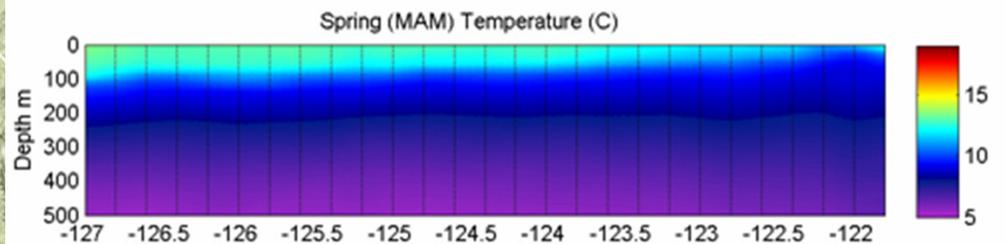
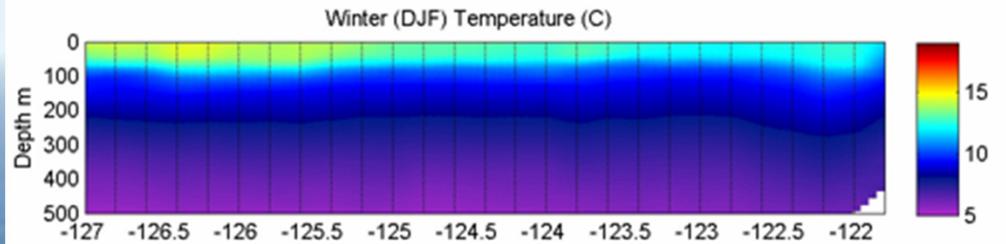
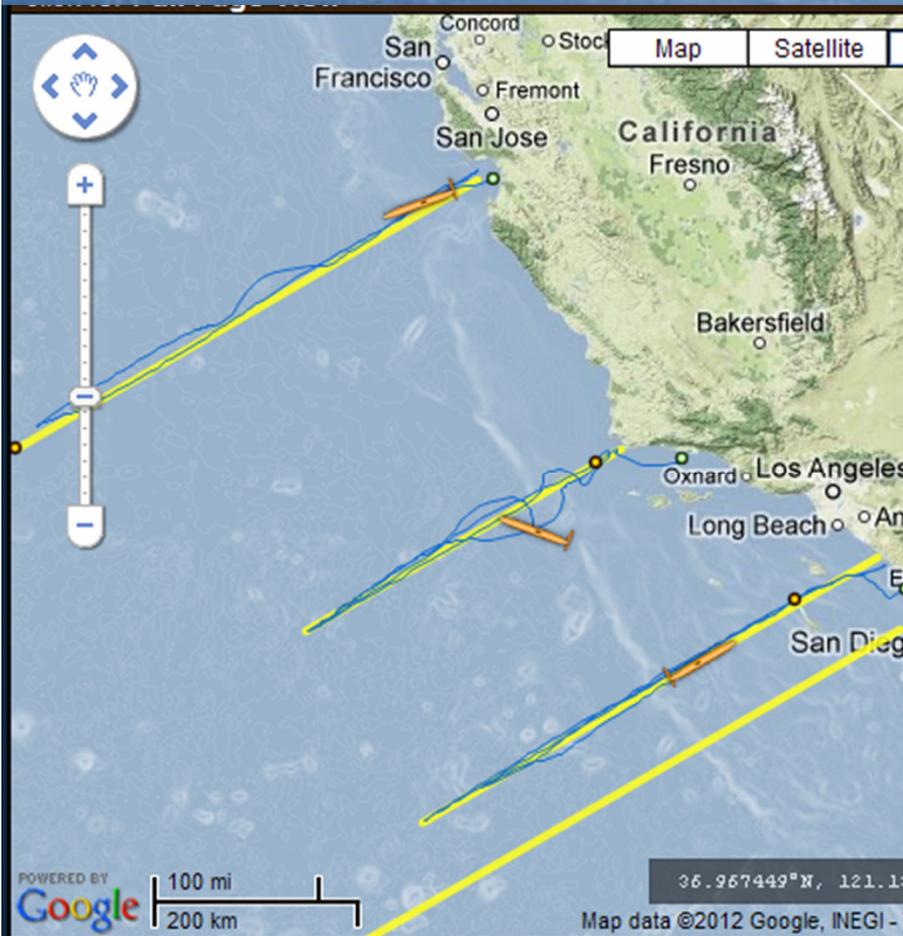


CeNCOOS glider
owned by Scripps

Data on both
CeNCOOS and
SCCOOS web pages

Seasonal climatology on Monterey line (MBARI, linked to CeNCOOS)

CA Glider Ops (SCCOOS)



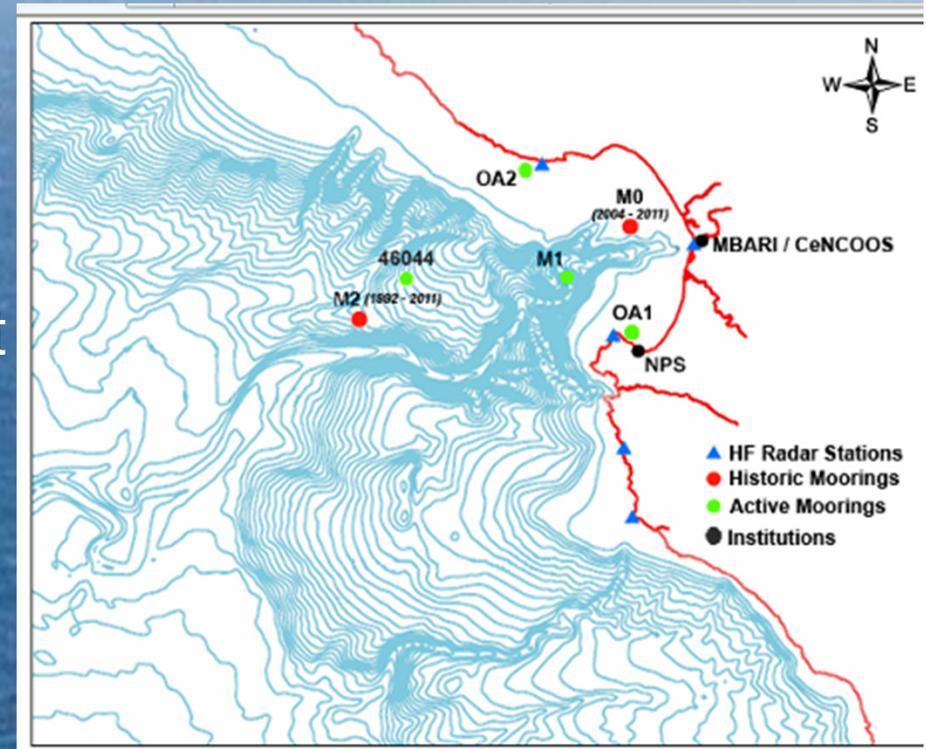
Moorings/Buoys

<http://www.cencoos.org/sections/conditions/buoys.shtml>

Not supported financially by CeNCOOS

Data accessible through CeNCOOS data portal & website

- MBARI (wind, currents, WQ)
- LOBO (WQ)
- BOON (WQ, currents) -
Data not reported in R/T;
receives some CeNCOOS support



- NDBC (primarily wind & waves)
- CDIP (waves)



BREAK!!



**Meet Back in This Room in
15 Minutes, Thank you!**

Waves

<http://www.cencoos.org/sections/conditions/waves.shtml>

- CDIP and NDBC wave buoys linked to CeNCOOS waves page
- CDIP wave models linked to waves and models pages
- CeNCOOS-generated wave climatology product
- Wave ht only available thru CeNCOOS data portal



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Coastal Data Information Program

cdip.ucsd.edu

Mission: Monitor and predict near shore waves and shoreline change.

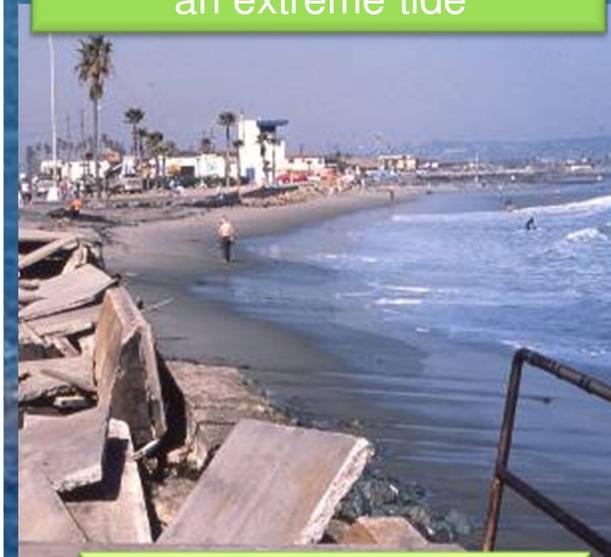


- Based at SIO since 1975
- 35 Wave Stations, LIDAR & In-Situ Beach Surveys
- 17 People
- \$3.5M+ / yr budget
- Funded by:
 - USACE
 - CDBW
- Investigators:
 - Richard Seymour*
 - Robert Guza*
 - Bill O'Reilly*



CDIP wave buoys in California

Storm and El Niño enhanced sea levels during an extreme tide

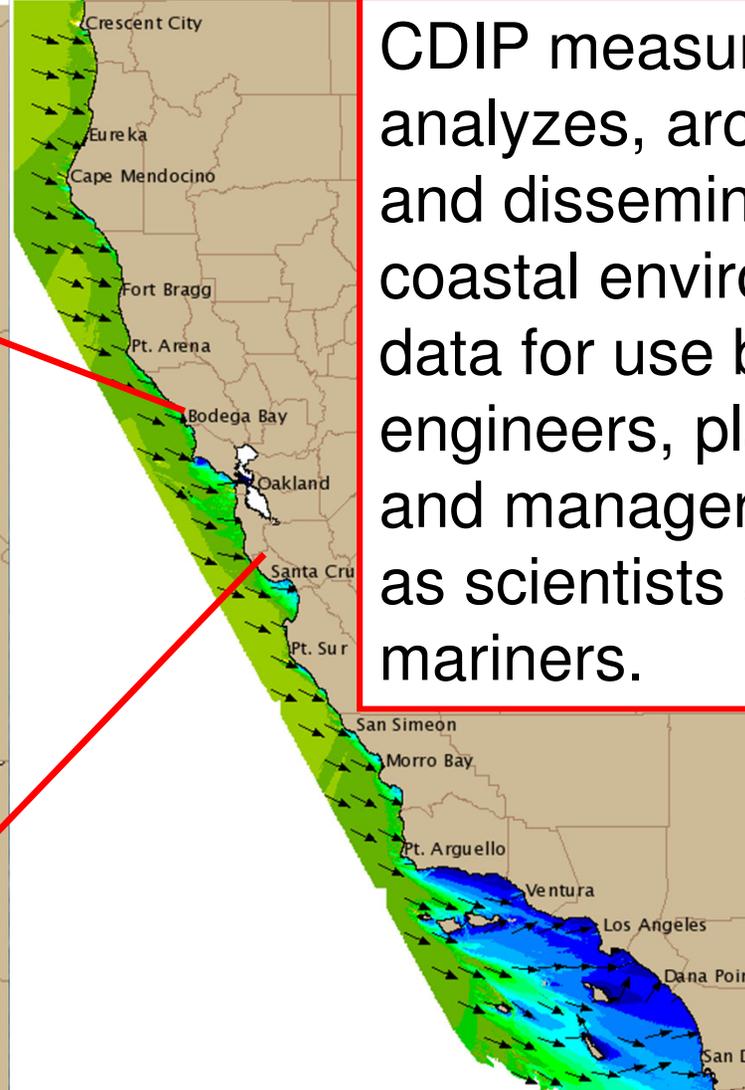
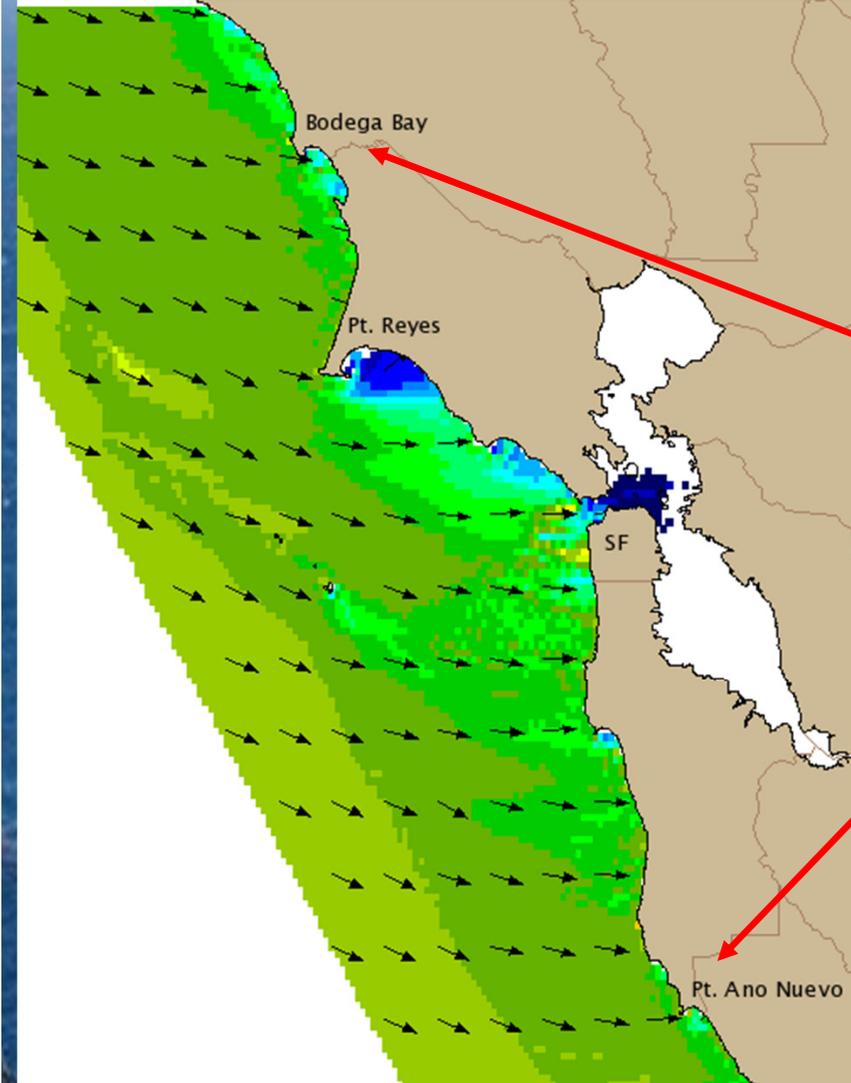


Ocean Beach Feb 1983

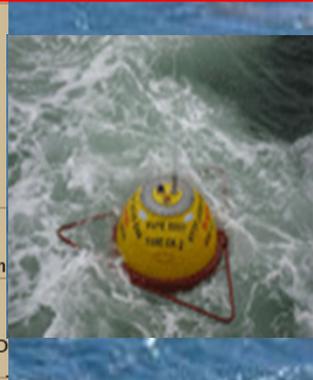
CDIP Swell Model

CDIP/SIO Experimental San Francisco Swell Model
Wave Height (ft) and peak dir Sat 2012-12-29 15:00 PST

CDIP/SIO Experimental California Swell Model
Wave Height (ft) and peak dir Sat 2012-12-29 15:00

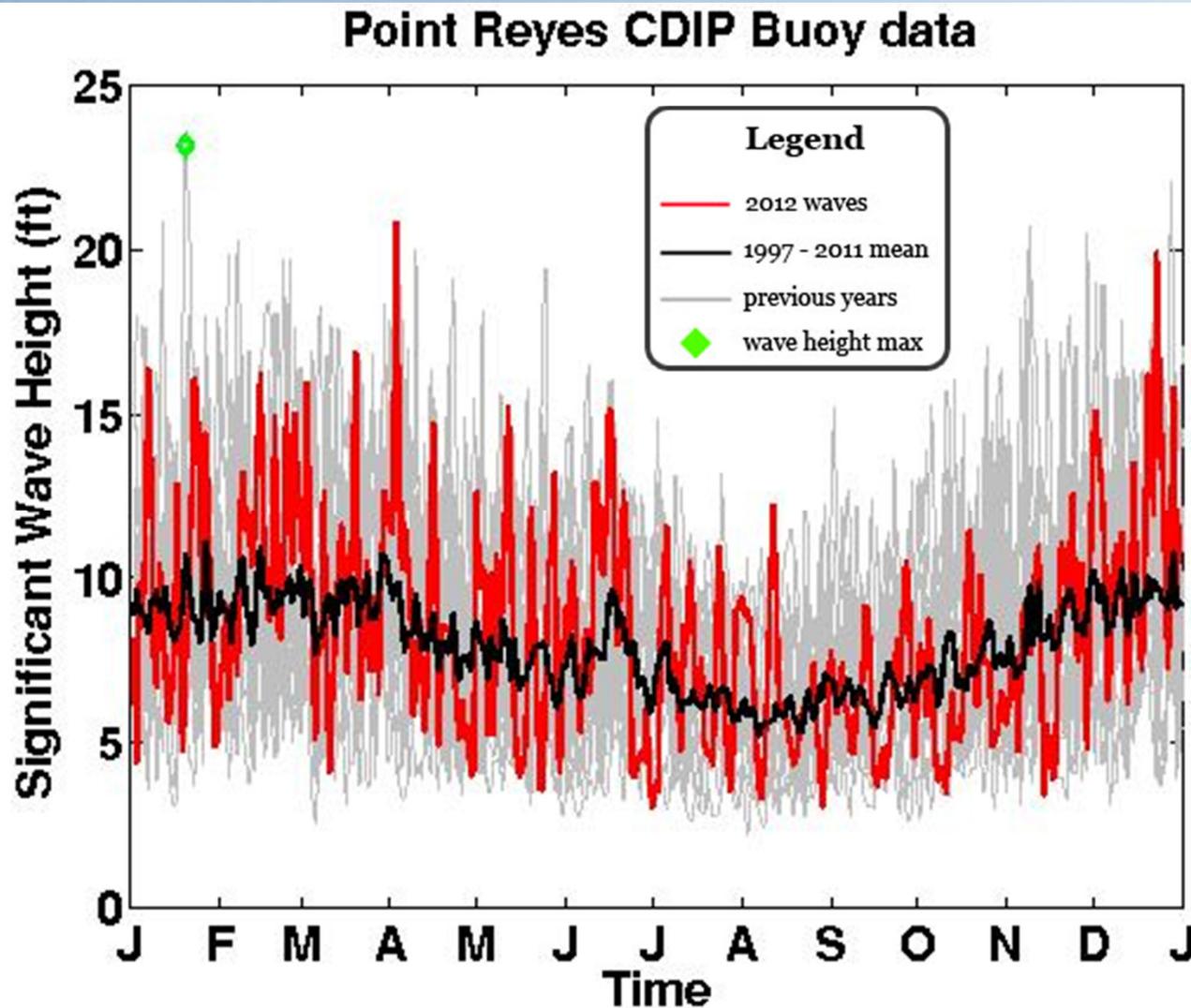


CDIP measures, analyzes, archives, and disseminates coastal environment data for use by coastal engineers, planners, and managers, as well as scientists and mariners.



Wave Climatology: CDIP Buoy Pt. Reyes Past/Present Wave Heights

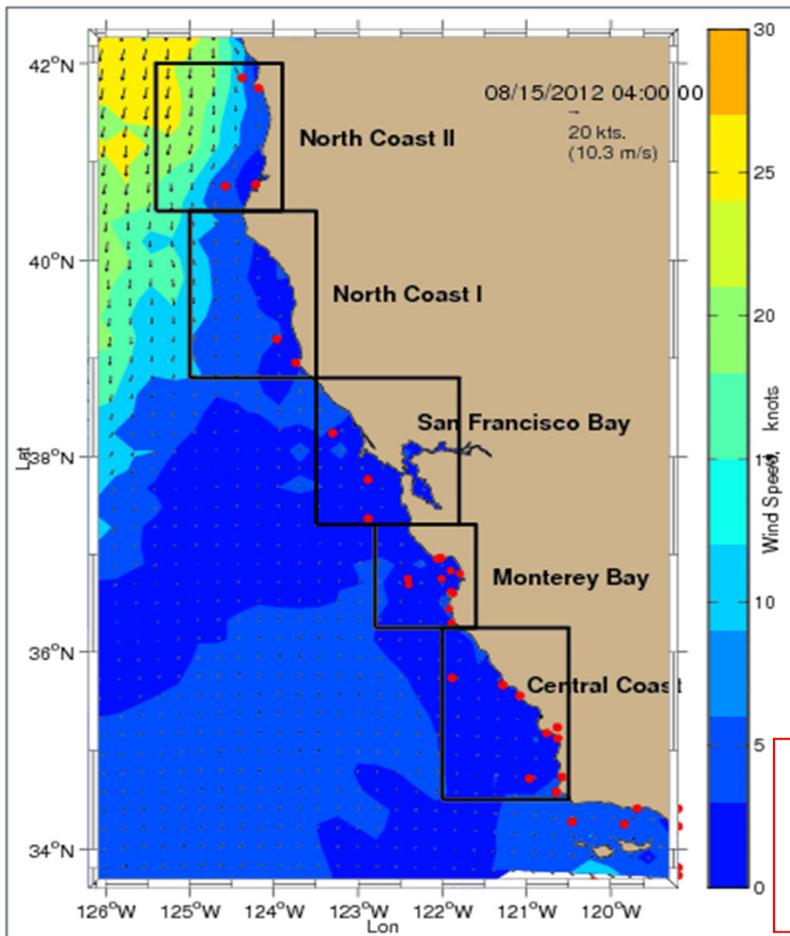
http://www.cencoos.org/sections/products/wave_climatology.shtml



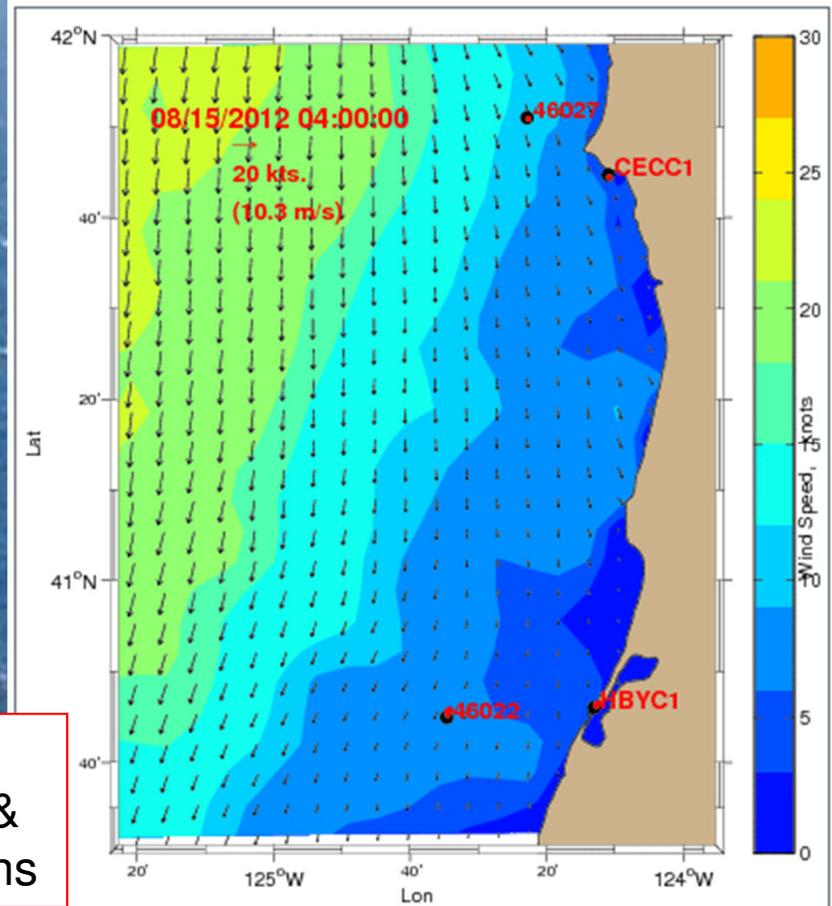
CeNCOOS Coastal Winds Model and Observations

<http://www.cencoos.org/cgi-bin/ccencoos.cgi>

Wind for 08/15/2012 04:00 Pacific Daylight Saving Time



Wind for 08/15/2012 04:00 Pacific Daylight Saving Time



3 km
COAMPS &
observations

ANIMATE STOP PAUSE RESUME

ANIMATE STOP PAUSE RESUME

Ongoing comparison of measured and modeled winds

CeNCOOS
Central & Northern California Ocean Observing System

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| January 2012 | | | | | | |
|--------------|----|----|----|----|----|----|
| Su | M | T | W | Th | F | S |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | 31 | | | | |

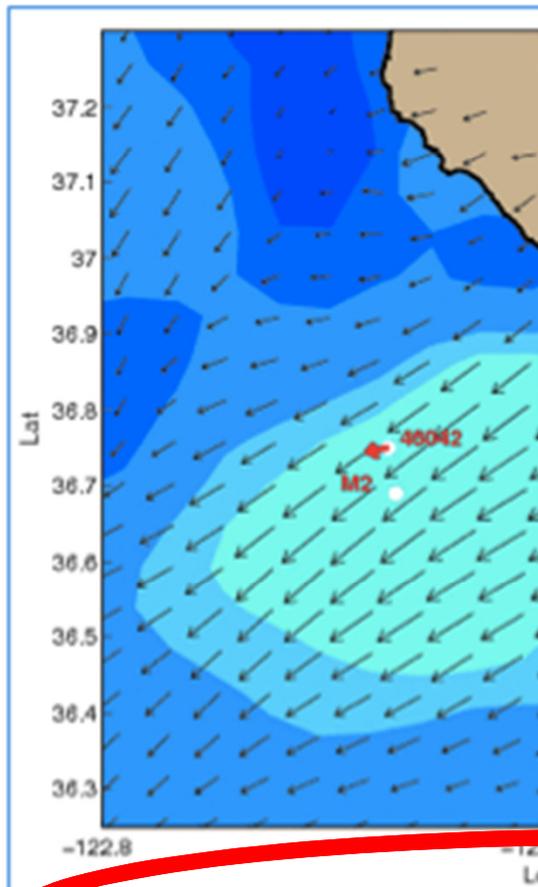
Hour:

04:00:00

Area:

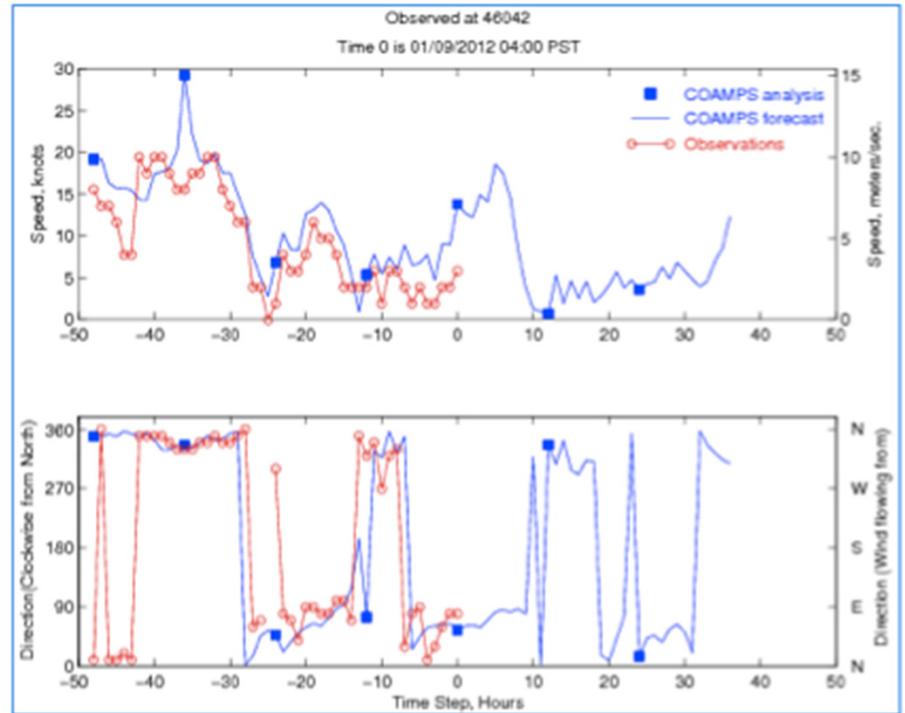
- CeNCOOS Domain
- North Coast II
- North Coast I
- San Francisco Bay
- Monterey Bay
- Central Coast

Wind for 01/09/2012



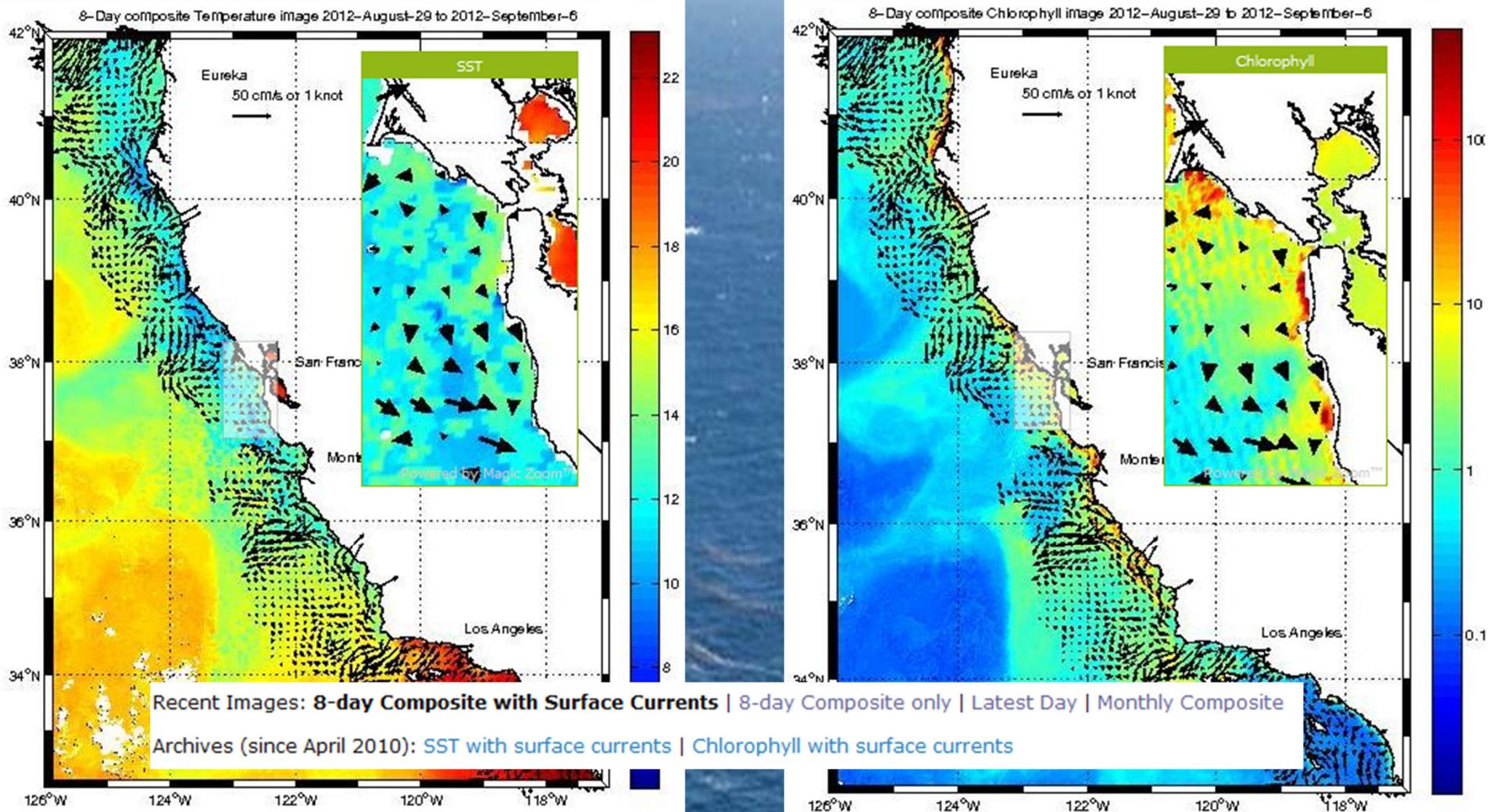
points represents the direction wind is blowing. The length of the arrow represents the wind speed (in knots), which is also shown in color. The important locations are indicated by white dots.

Station 46042: 01/09/2012 04:00 PST



CeNCOOS Remote Sensing Sea Surface Temperature (SST) & Chlorophyll

http://www.cencoos.org/sections/conditions/SST_Ch1.shtml



HF Radar Surface Current Maps

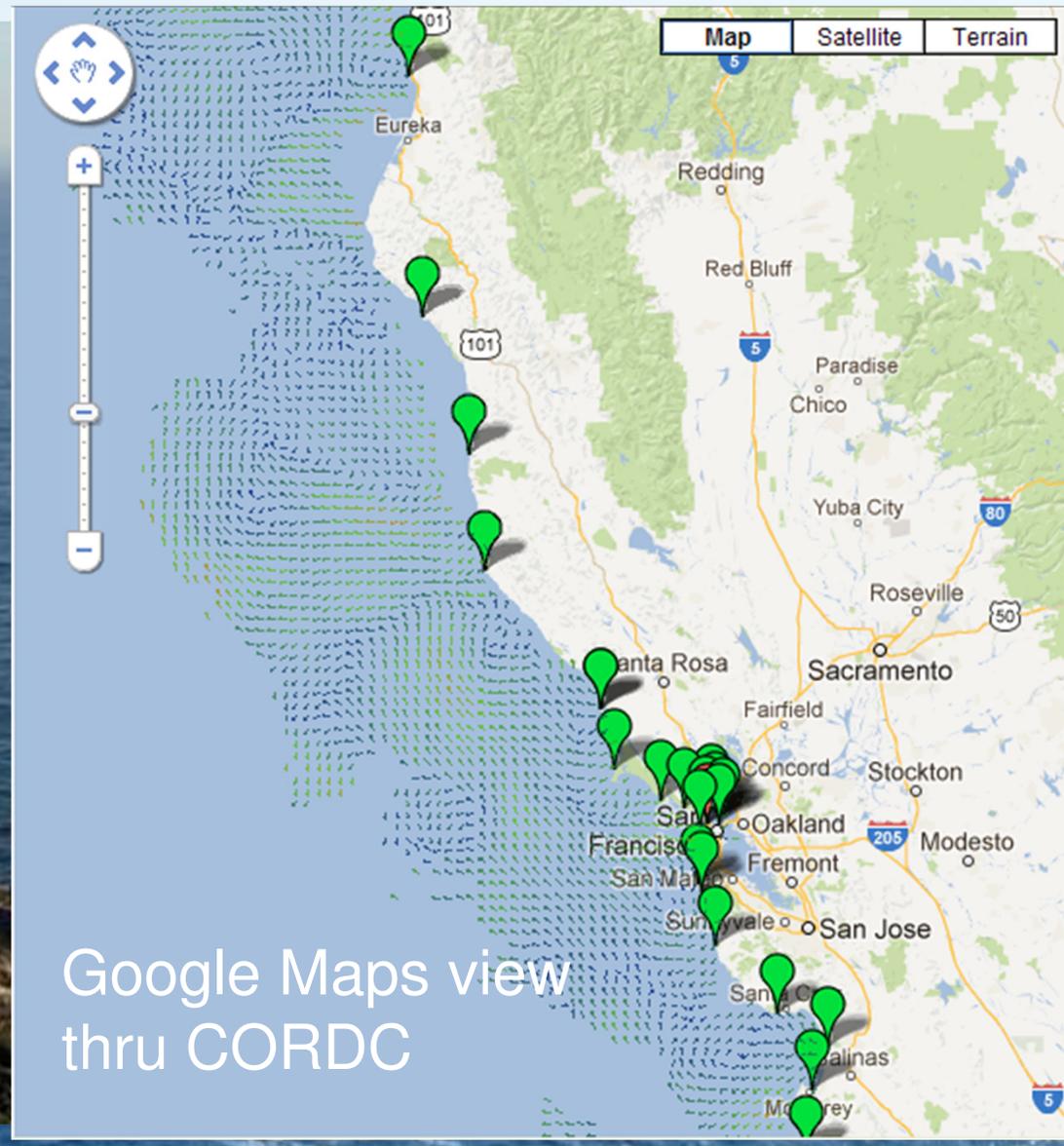
<http://www.cencoos.org/sections/conditions/currents/index.shtml>

Other views and derived products can be found at the CeNCOOS HF data providers websites

Monterey Bay (cencal)

SF Bay (norcal)

Bodega Bay (boon)

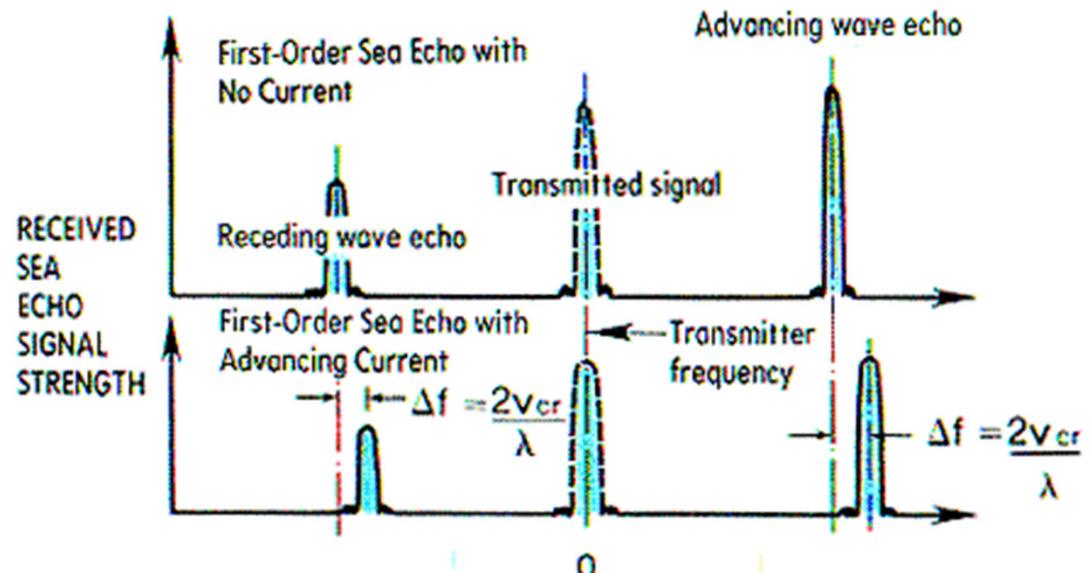
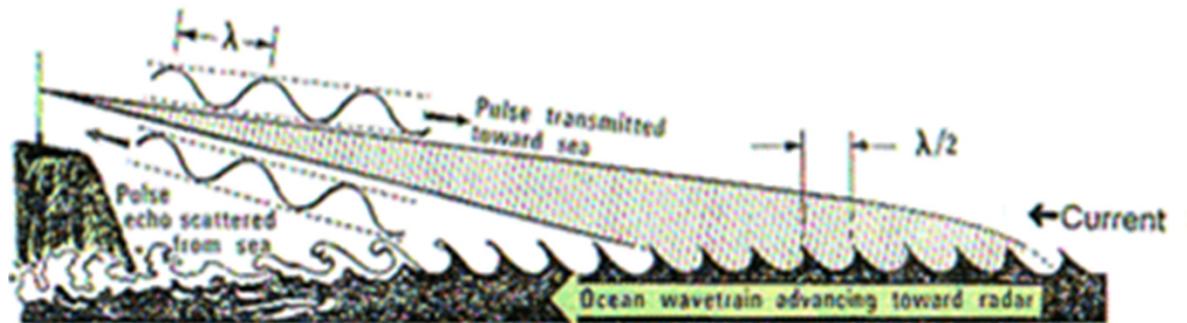


- Radar sends radio waves in the 10 to 50 MHz band and listens to the scattered signal from the surface waves that have wavelengths in the 15 to 3 m range

- System directly measures the speed of the waves that scatter the radar signal

- Differences between the measured speed and the known speed of surface waves in a still ocean are the ocean surface currents. This is derived from the Doppler shift of the Bragg-scattered EM energy from ocean waves with $\frac{1}{2}$ the wavelength of the radio waves.

HF Radar Surface Currents

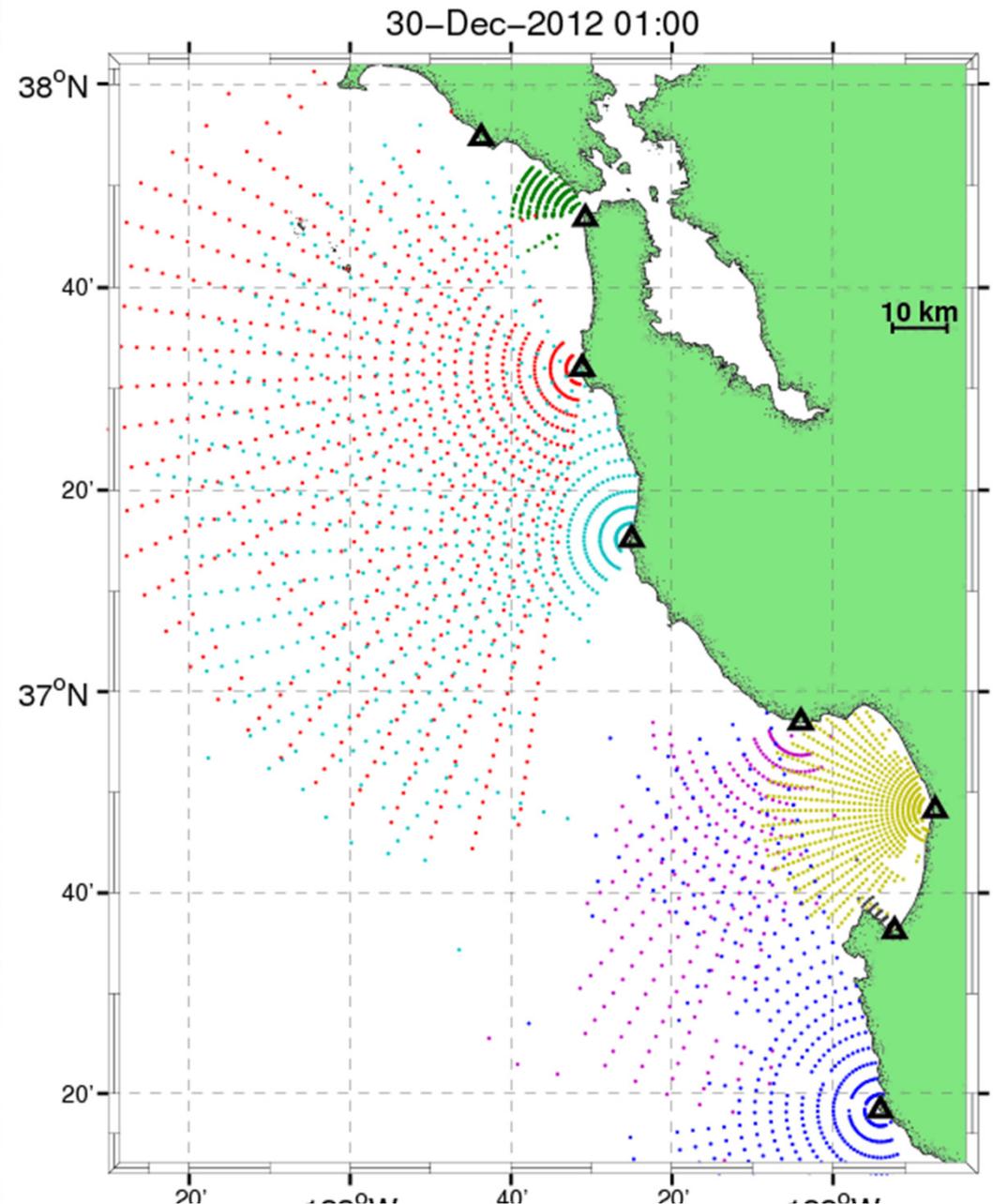


http://www.cencoos.org/sections/conditions/currents/what_is_hfradar.shtml

<http://cordc.ucsd.edu/projects/mapping/>

HF Radar-Derived Surface Current Data Processing

- Currents along radials from multiple antennas are combined to form vector maps each hour
- Spatial gaps must be filled to compute surface particle trajectories
- 24-hr predictions based on past 24 hr average plus tides are produced
- Data are output in various formats, including those used by NOAA for oil spill response and by Coast Guard for Search and Rescue



Why is surface current mapping with HF radar important? 43

Provides continuous, high resolution mapping of currents for:

- Tracking point source pollution or discharges
- Oil spill preparedness and response
- Search and Rescue
- Marine operations
- Connectivity analyses: e.g. MPAs, coastal discharges, larval retention areas
- Assimilation into numerical models
- Analysis of long-term trends



Jan. 8, 2013



SF Bay currents from norcal website; also thru iTunes app

24-hr particle trajectories from cencal website

