

# Ocean Observations Supporting Maritime Operations

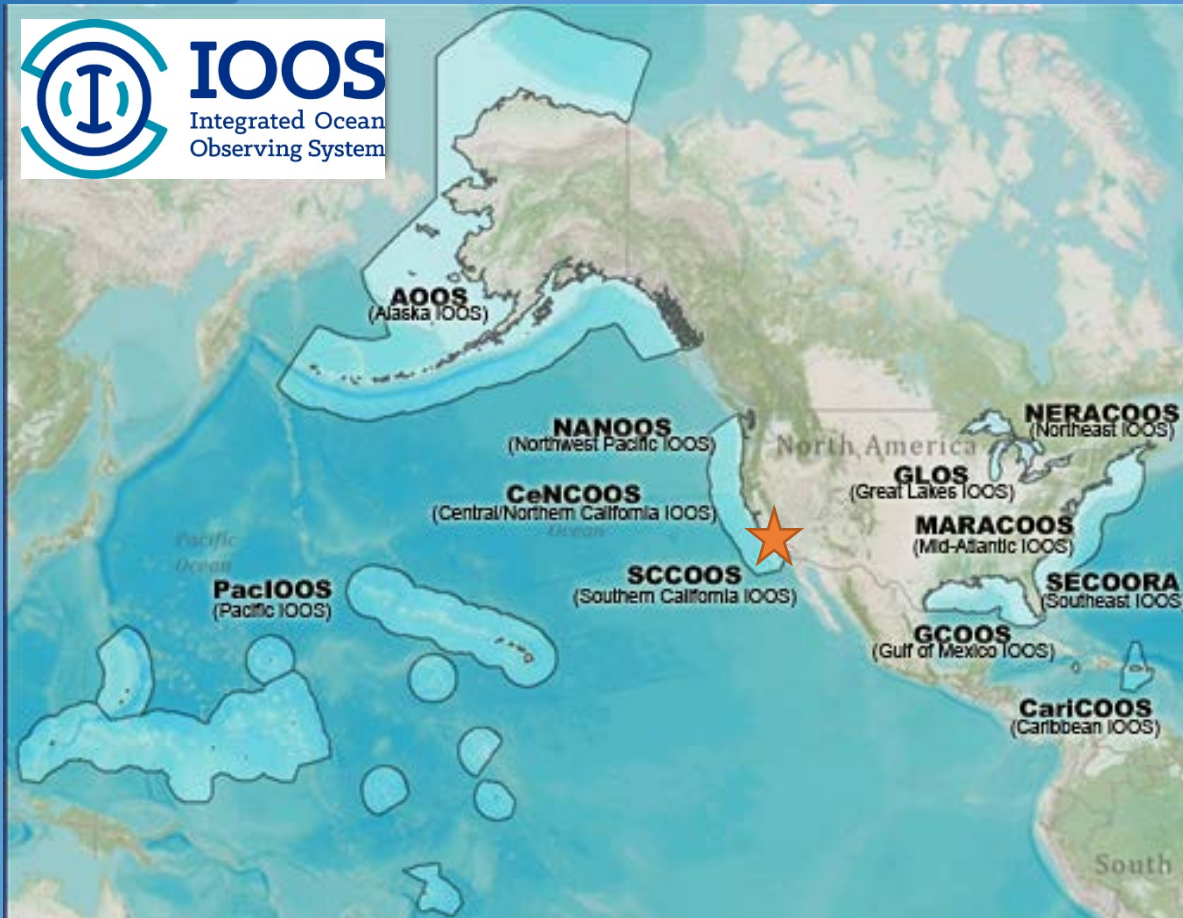


Julie Thomas  
Senior Advisor, SCCOOS  
Program Manager, CDIP  
March 2, 2017



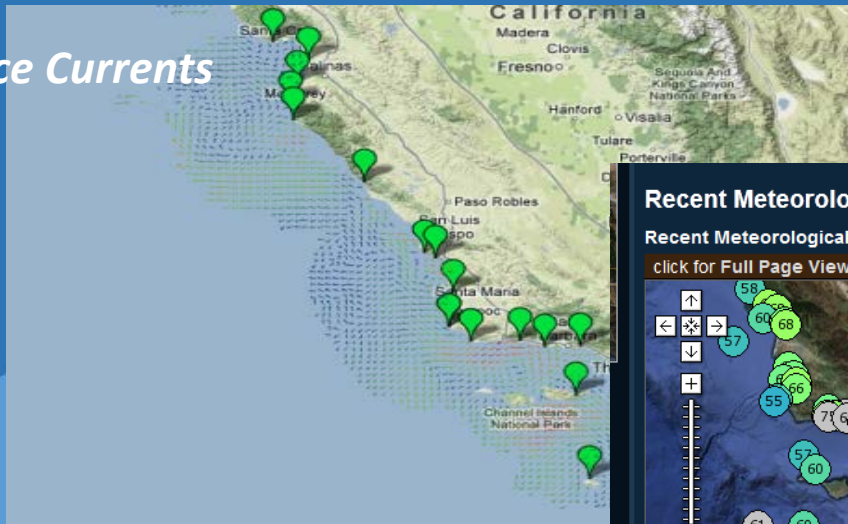
# U.S. Integrated Ocean Observing System

The **Integrated Ocean Observing System** or IOOS was born from the Integrated Coastal and Ocean Observation Act of 2009.



This law designated **11 regional associations** that act as a science based support system.

## Surface Currents



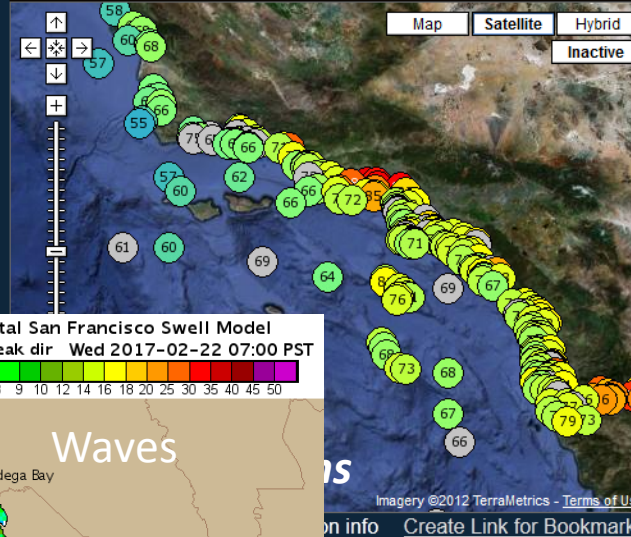
# Regional Focus

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

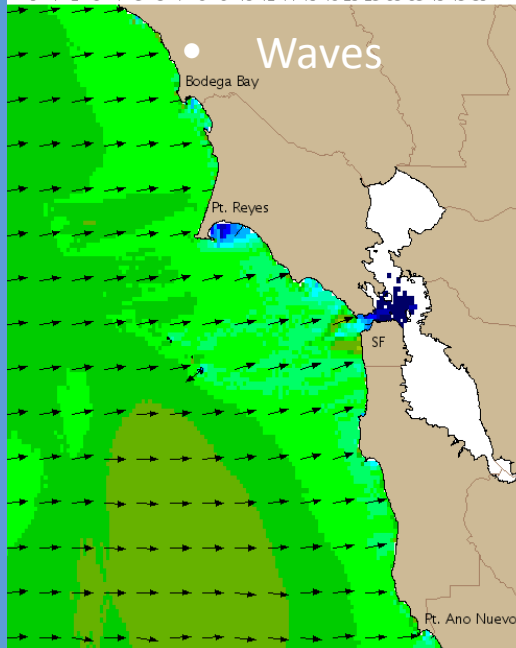
### Recent Meteorological Stations and Observations

#### Recent Meteorological Stations Reporting

[click for Full Page View](#)



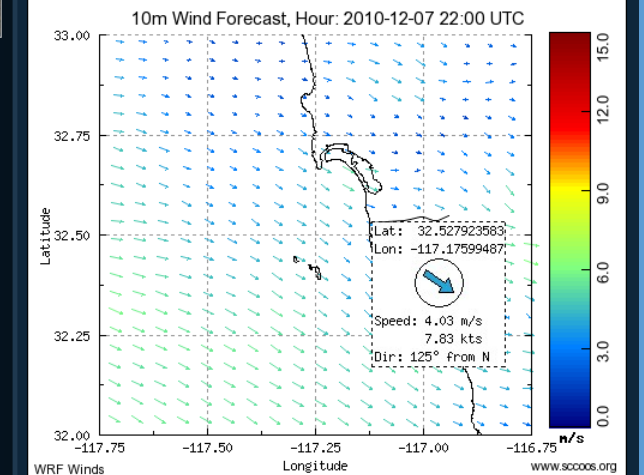
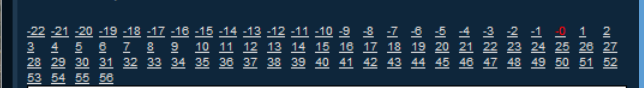
CDIP/SIO Experimental San Francisco Swell Model  
Wave Height (ft) and peak dir Wed 2017-02-22 07:00 PST



### WRF 12.5km Modelled 10m Wind Fields - San Diego & Ensenada Winds

Hourly Forecasts

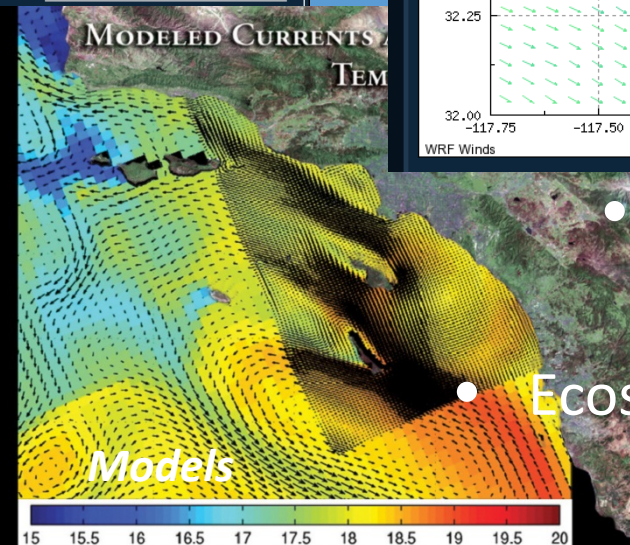
Time Sample: 2010-12-07 22:00:00 UTC



- Coastal Hazards



- Marine Operations



- Water Quality
- Ecosystems and Climate

« -1 Day -1 Hour 2016-09-12 06:00:00 -07:00 from UTC +1 Hour +1 Day »

## Control Panel

X

[UTC](#): 2016-09-13 04:02:39

[Local](#): 2016-09-12 21:02:39

## Resolutions

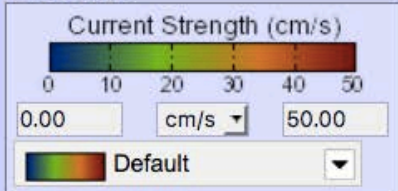
	Hourly	25hr Avg
500m	<input type="checkbox"/>	<input type="checkbox"/>
1km	<input type="checkbox"/>	<input type="checkbox"/>
2km	<input type="checkbox"/>	<input type="checkbox"/>
6km	<input type="checkbox"/>	<input checked="" type="checkbox"/>

\* Vector size is not visually consistent between resolutions.

## Overlays

- ☒ Station Placemarks
- ☐ So-Cal Oil Platforms

## Colorbar



## Coordinate Locator

Lat:

Lon:

Map Satellite



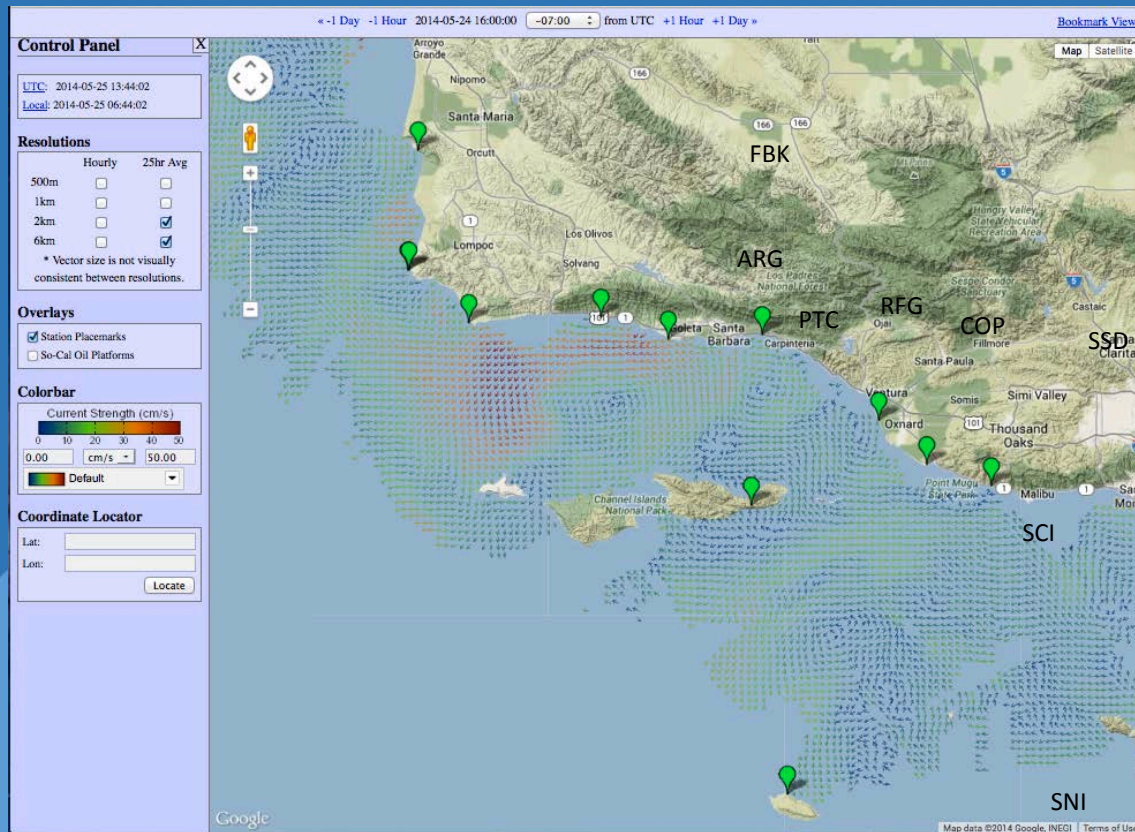
Google

West Coast Coverage of Surface Current Mapping (now disseminated to USCG and NWS)

# Surface ocean circulation mapping with HF radar

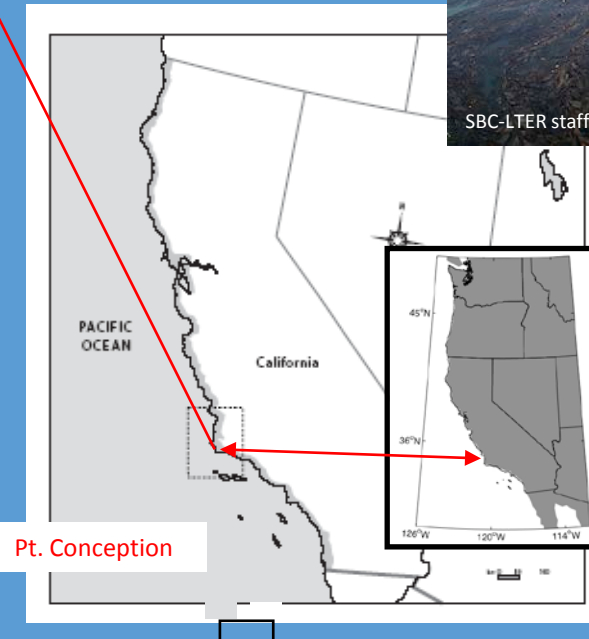
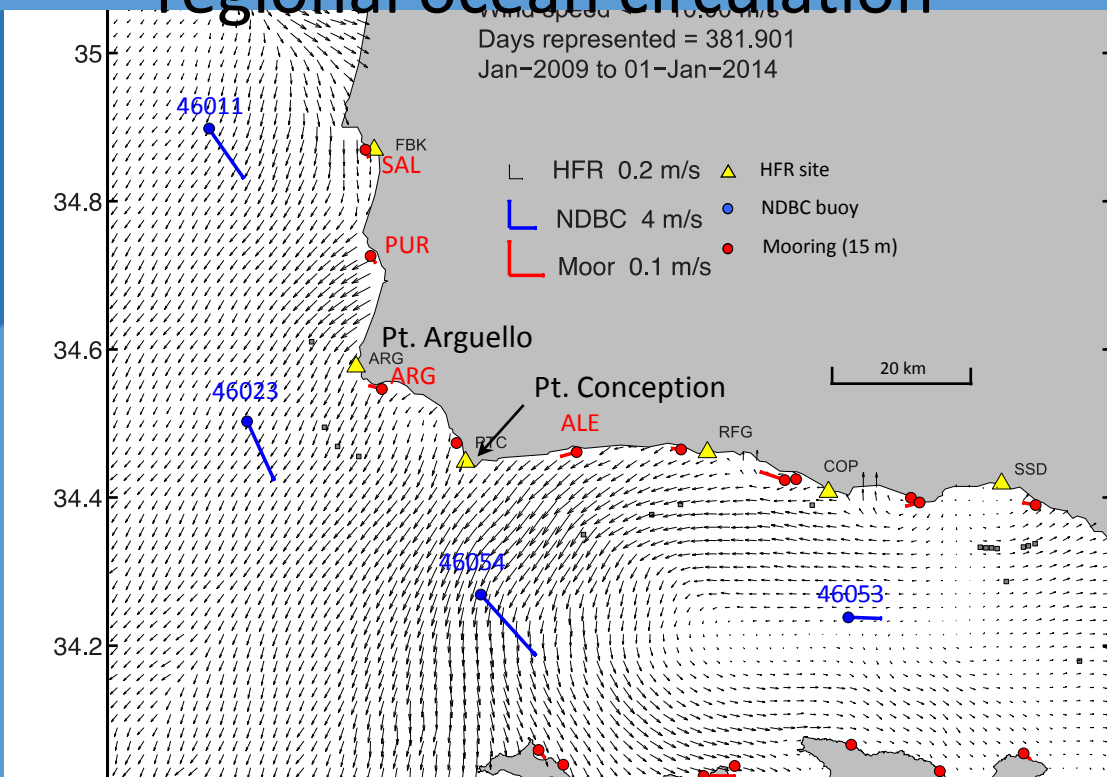
High frequency radio network for measuring surface ocean currents

- transmit: freq. = 12 - 14 MHz
- transmit power = < 50 Watts
- resolution ~ 6 km on 2 km grid (3.72-1.24 miles)
- 1-hr average current vectors
- range ~ 50-100 km offshore (31-62 miles)



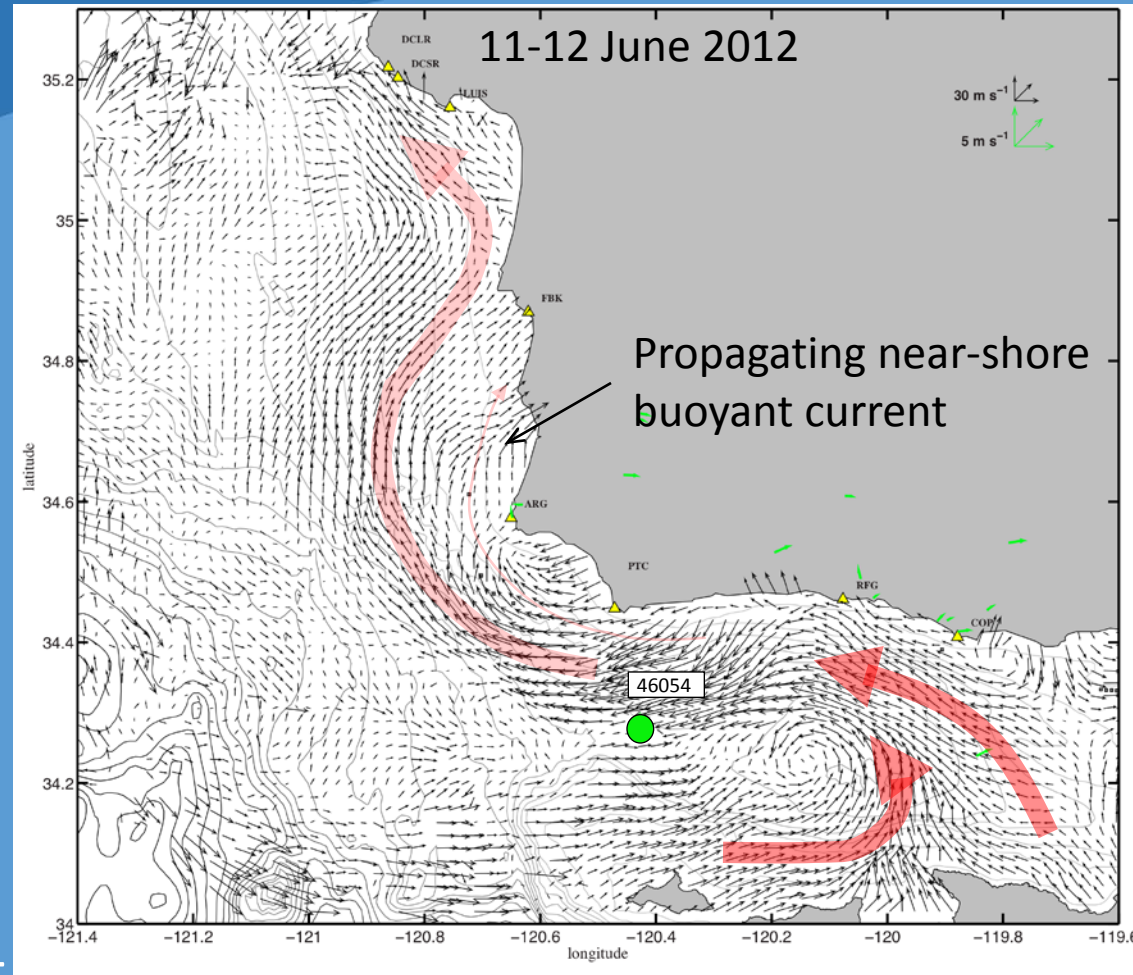
**84% HFR Performance  
Coverage in 2016  
In California**

# 5 Year Prevailing conditions: Upwelling winds and regional ocean circulation

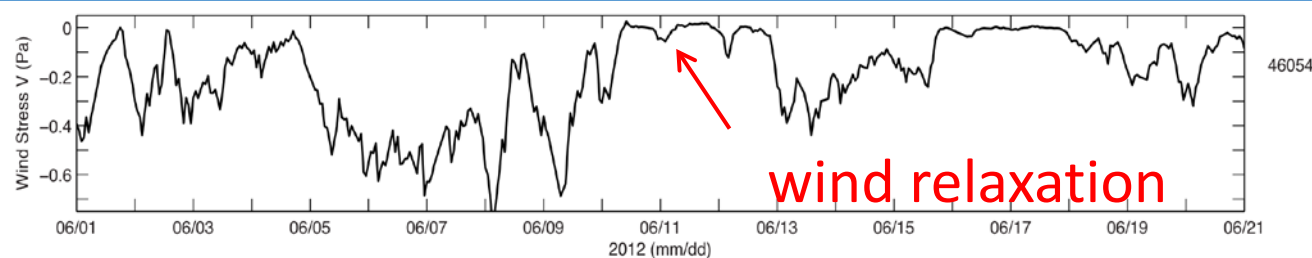


- Winds typically blow from the northwest
- Map shows current pattern when winds exceed ~20 knots from the NW from 5 years of observations
- Circulation in the Santa Barbara Channel is westward current flowing along mainland coast
- Westward current is turned southward and south eastward by wind

# Wind relaxation & poleward currents



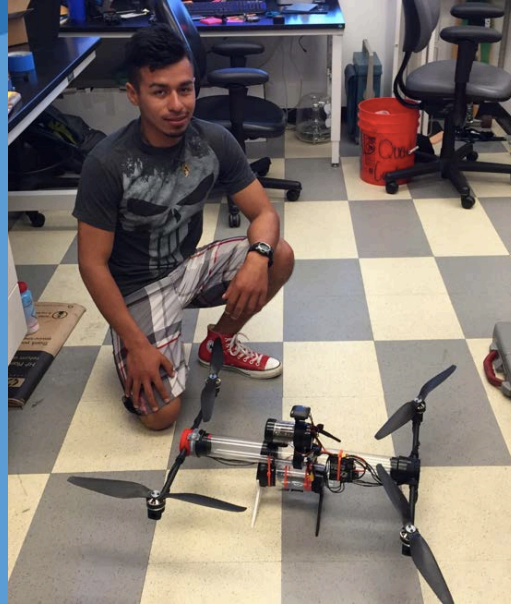
Wind stress NDBC 46054



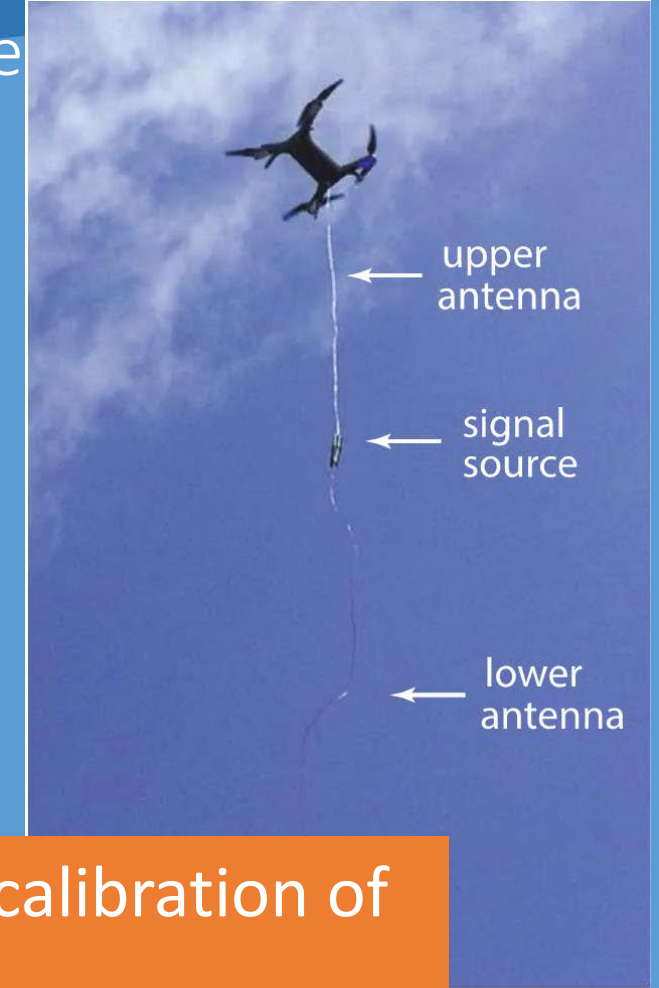
# Calibration of radar antennas using quadrotor drone



Cyril Johnson



Eduardo Romero



- Quadrotor allowed rapid calibration of site at Gaviota, CA
- During calibration quadrotor flew in circular arc around site
- Signal source constructed in SCCOOS lab at UC Santa Barbara

# Aiding in Oil Spill Response

- May 19<sup>th</sup>, 2015 Refugio Pipeline, Carpinteria, CA
- April 20<sup>th</sup>, 2010 Deepwater Horizon, Gulf of Mexico
- November 7, 2007 Cosco Busan, San Francisco, CA

## Future Directions - HFR

1. Surface current mapping is a valuable tool in supporting oil spill response.
2. Important to **form relationships among responders before oils spills**: Allowed rapid transfer of SCCOOS data for use by NOAA in spill-tracking model, General NOAA Operational Modeling Environment (GNOME)
3. **Temporary HFR site installations** can fill gaps to improve coverage. Use of AAVs allows rapid antenna calibration to improve accuracy.
4. Future directions:
  - a) **Fill gaps** in coverage of surface current mapping.
  - b) **Upgrade equipment for temporary site installations.**
  - c) Continue **development of spill tracking models.**
  - d) **Improve quantification** of amounts of oil/tar on beaches from spill.

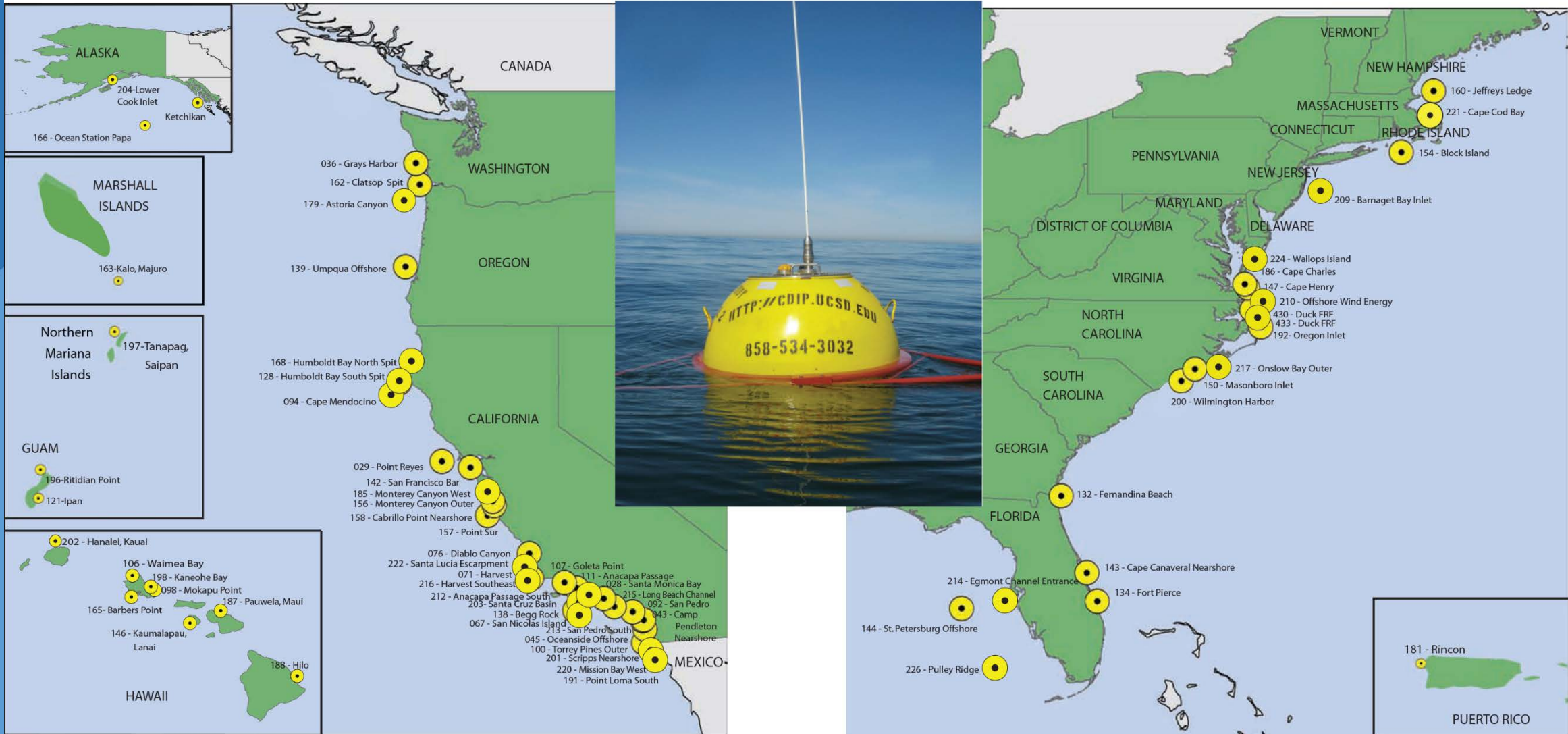
# Coastal Data Information Program (CDIP)

*To monitor and predict nearshore waves,  
temperature, and shoreline change.*

- Based at Scripps since 1975
- 68 Wave and Temperature Stations
- 17 People
- Major Funding by:  
**USACE, CA State Parks, NAVY**
- Partners  
(NOAA, IOOS, USGS, Industry)



# COASTAL DATA INFORMATION PROGRAM



US Army Corps  
of Engineers

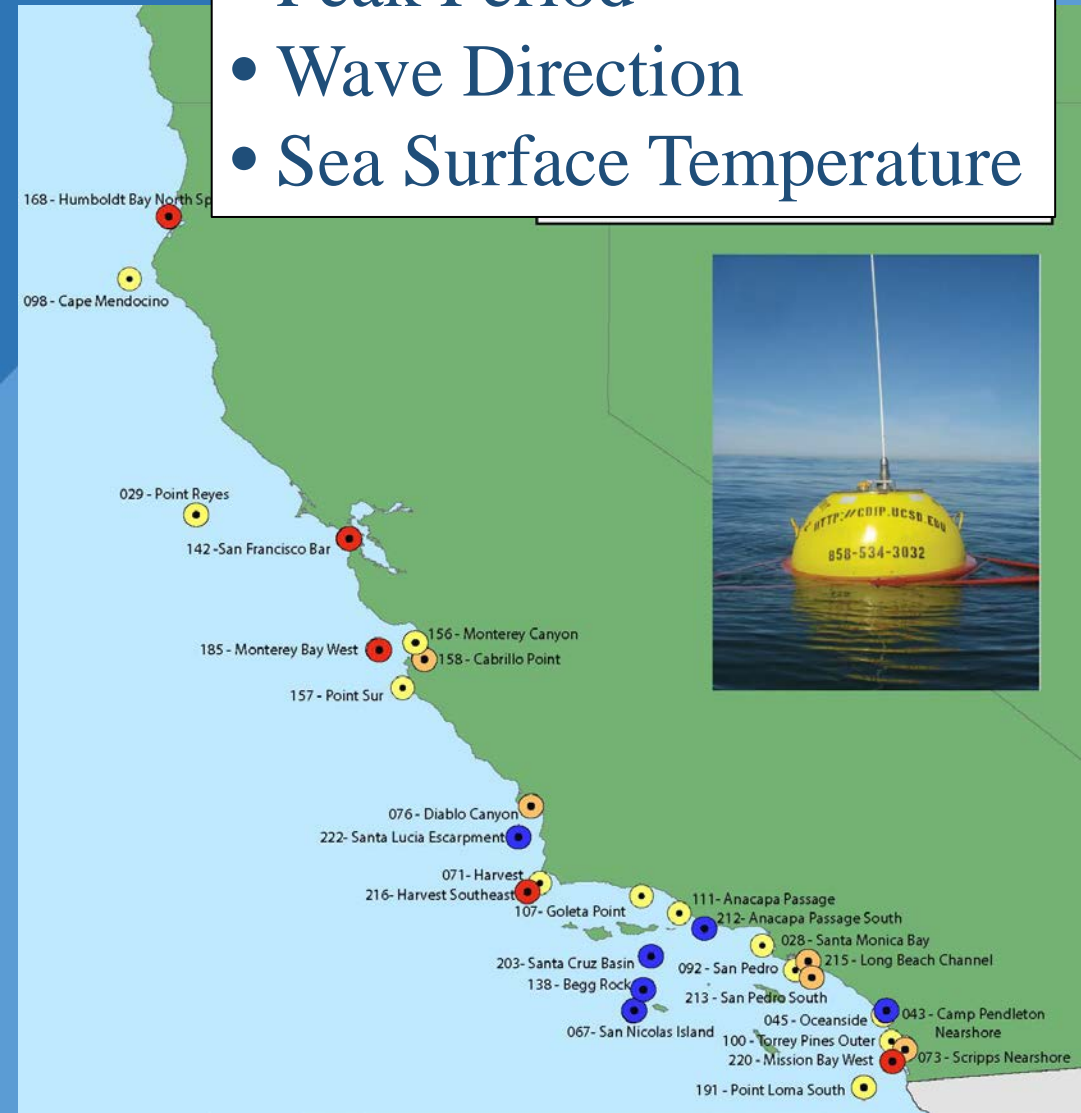
Program Manager: Julie Thomas  
Scripps Institution of Oceanography  
University of California San Diego MC 0214, La Jolla, CA 92093  
858-534-3032 [cdip.ucsd.edu](http://cdip.ucsd.edu)

## Wave buoys monitor:

- Swell Wave Height
- Peak Period
- Wave Direction
- Sea Surface Temperature

## Supports:

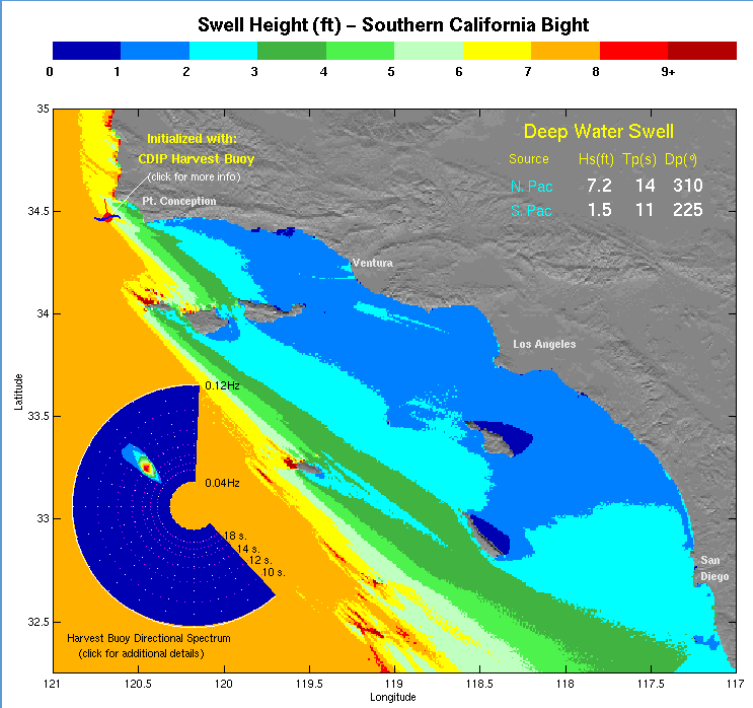
- Recreational Boating Safety
- Commercial Shipping & Fishing
- Oil Spill Prevention and Response
- Shoreline Processes (beach erosion & inundation models/warnings)
- Beach Marine Safety – Lifeguards, Surfing, Fishing, Paddling, Diving, Beachgoers
- Outreach and Education (Aquarium displays)
- Ecologic and Climate Monitoring; Sea Level Rise



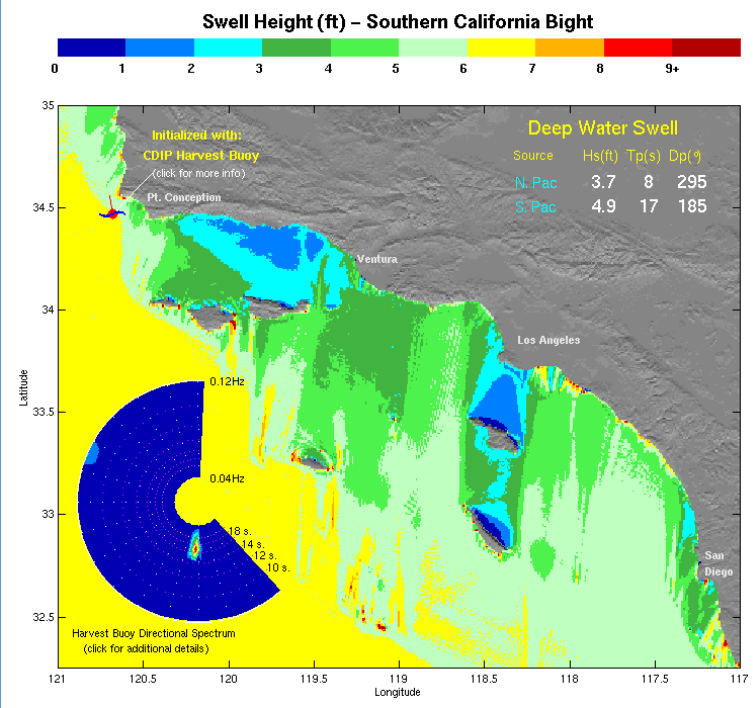
# CDIP Wave Predictions

Island shadowing and deep water canyons influence distant swell when they reach our coastlines.

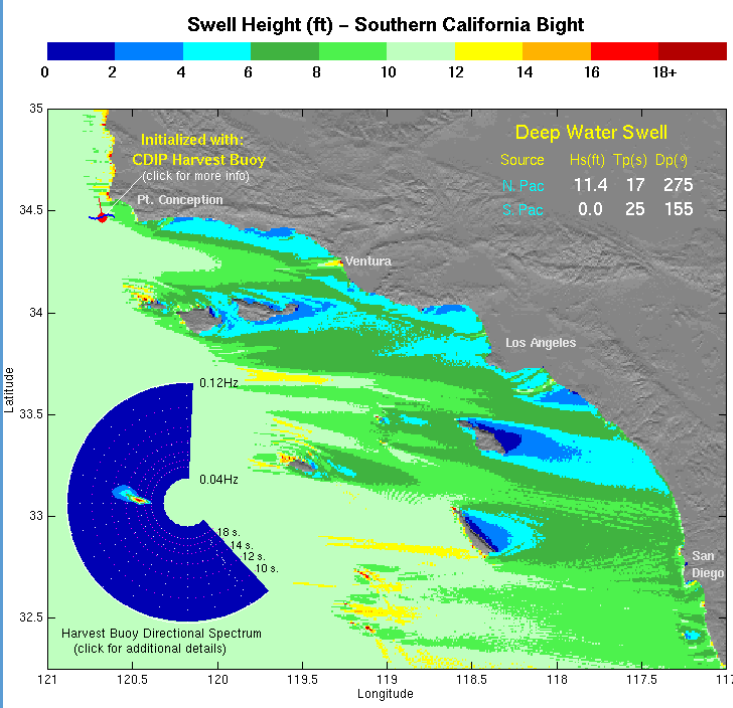
## Northwest Swell



## South Swell



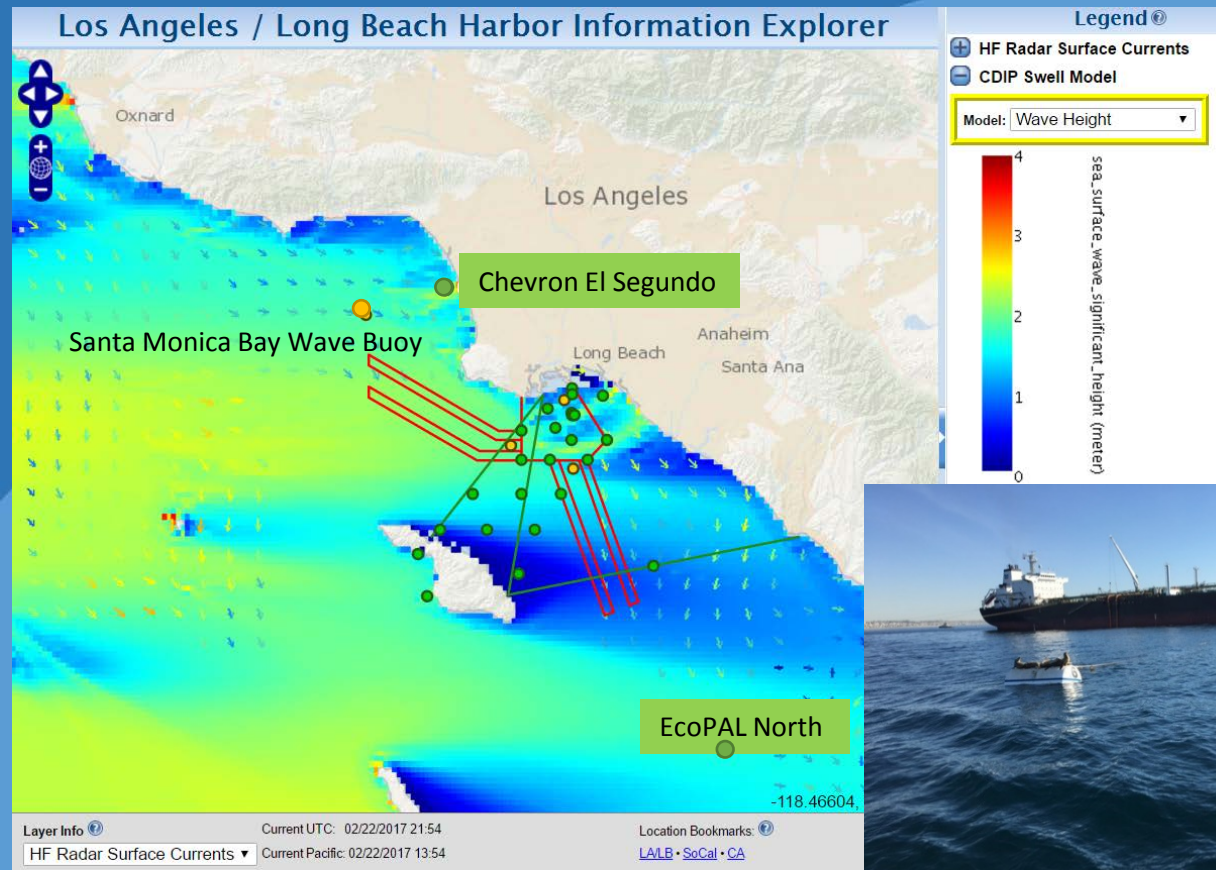
## West Swell



# Overview of 2 projects

- Automated messaging for Chevron operations (El Segundo & Echo-Pal).
- Under Keel Clearance Project, Port of Long Beach

# Wave Messaging based upon requested thresholds from Chevron.



Prediction site: SP400 - **Chevron El Segundo**

Swell (14s+) height threshold (3ft) exceeded

Date (PST) 14+ Hs 14+ Tp 14+ Dp Tot Hs Tot Tp Tot Dp

(ft) (secs) (deg T) (ft) (secs) (deg T)

2017-02-21 11:00 pm

3.15 16.67 249 4.17 16.67 250

2017-02-22 02:00 am

3.38 16.67 248 4.49 16.67 249

2017-02-22 05:00 am

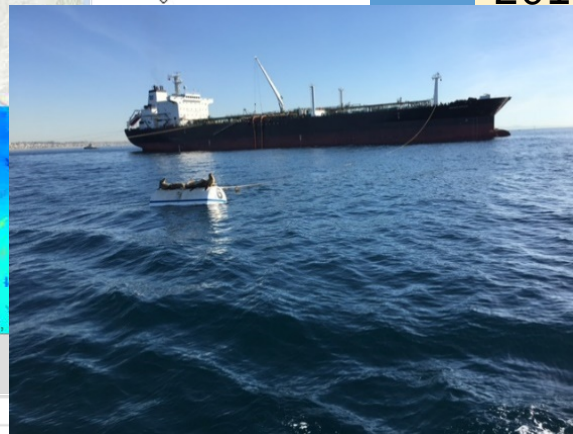
3.38 16.67 247 4.53 16.67 248

7-02-22 08:00 am

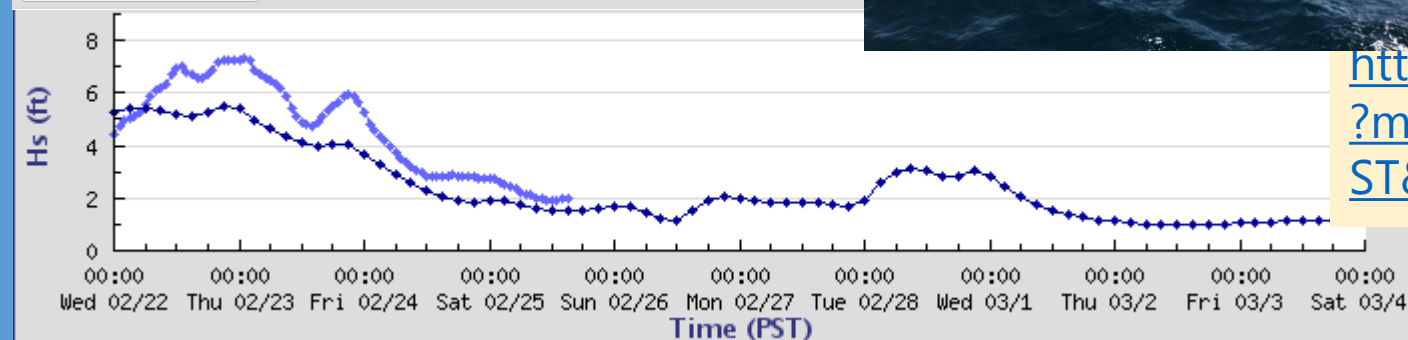
3.25 15.38 245 4.46 15.38 246

7-02-22 11:00 am

3.02 15.38 244 4.27 15.38 245



[http://www.sccoos.org/data/harbors/lalb/mop\\_site.php?mop=SP400&page=forecast\\_plot&xperiod=14&tz=PST&units=english](http://www.sccoos.org/data/harbors/lalb/mop_site.php?mop=SP400&page=forecast_plot&xperiod=14&tz=PST&units=english)

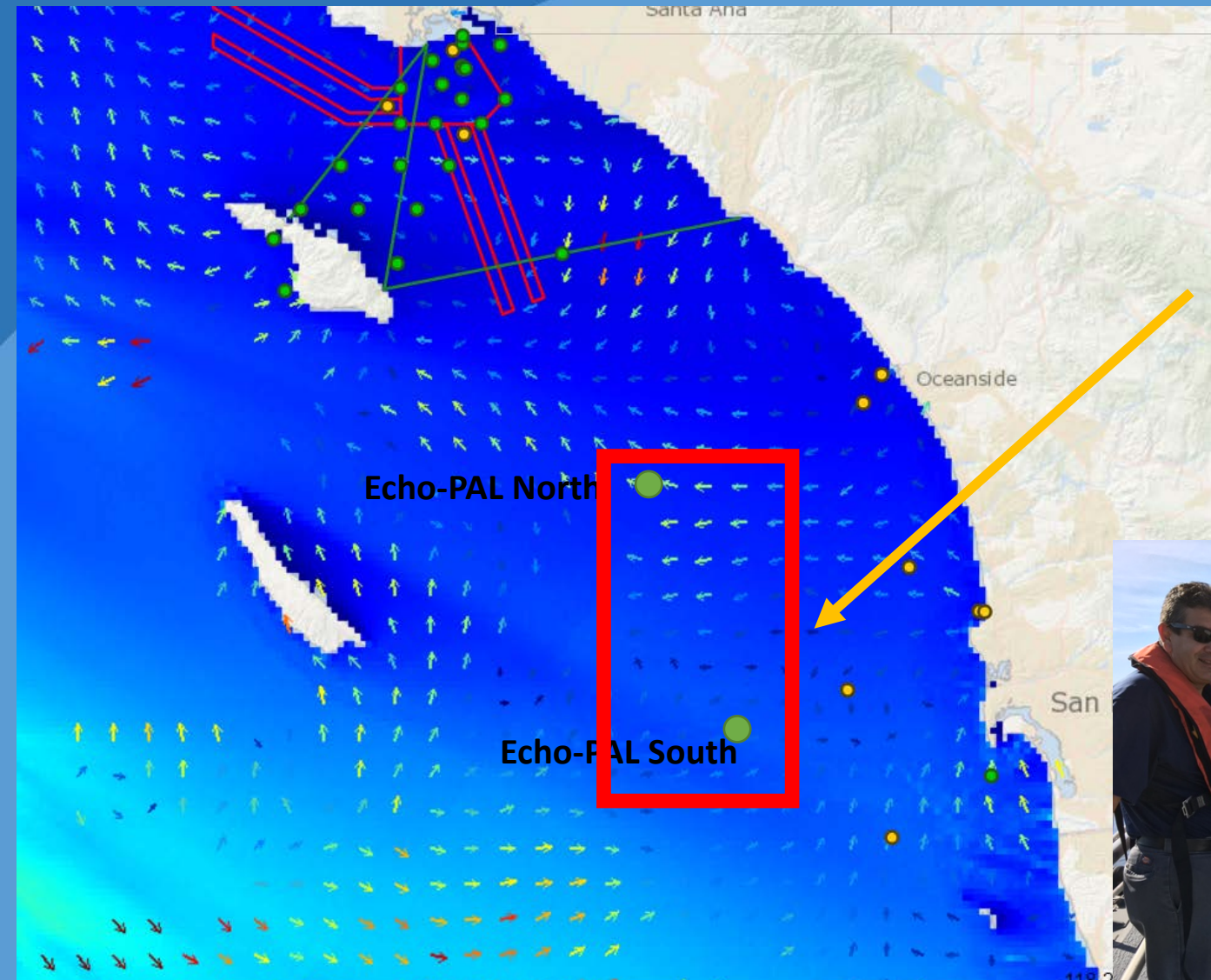


# Wave Messaging based upon requested thresholds from Chevron during the lightering at Echo-Pal

Prediction site: SP402 - Echo-PAL South

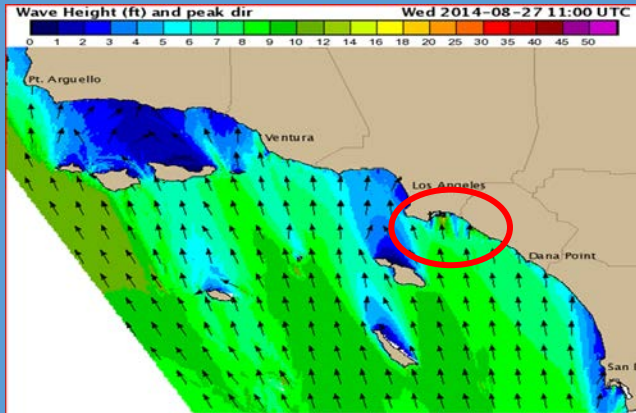
Swell (14s+) and total wave height thresholds (4ft, 8ft) exceeded

Date (PST)	14+ Hs Tp	14+ Hs (ft)	14+ Tp (secs)	14+ Dp (deg T)	Tot Hs (ft)	Tot (secs)	Tot (deg T)
2017-02-18 11:00 pm	5.84	14.29	266	11.29	13.33	267	
2017-02-19 02:00 am	4.72	14.29	267	10.11	12.50	268	
2017-02-19 05:00 am	3.77	14.29	268	8.89	12.50	269	

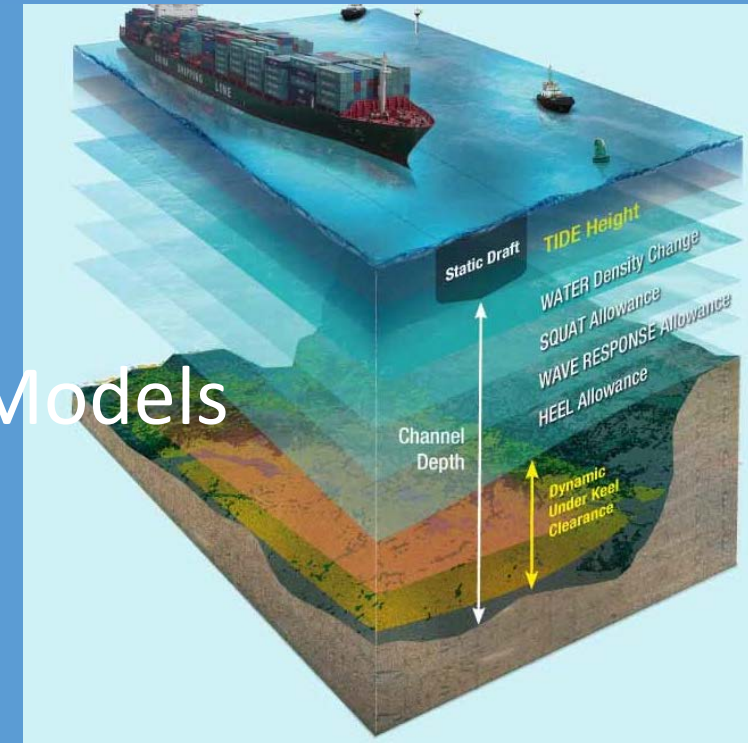


# Dynamic Under Keel Clearance Project

- **The Challenge:** Very Large Tankers enter the Port of Long Beach. How can we reduce the risk they touch bottom?
- During south swell, tankers start to pitch.

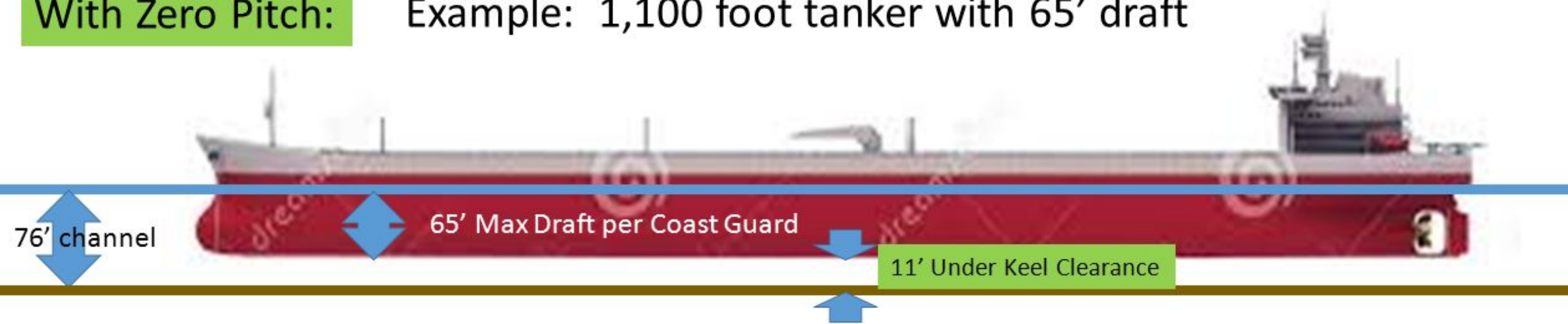


- What is happening right now? Observations/Models
- Future resolution.  
Integration of MANY data sources.



With Zero Pitch:

Example: 1,100 foot tanker with 65' draft

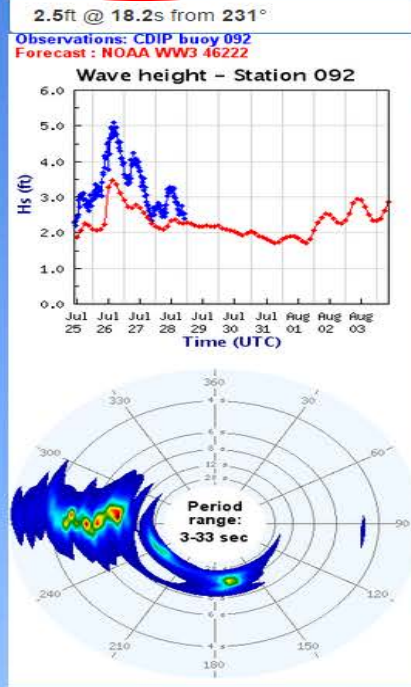


With 1 degree pitch, the draft increases 9.6 feet!

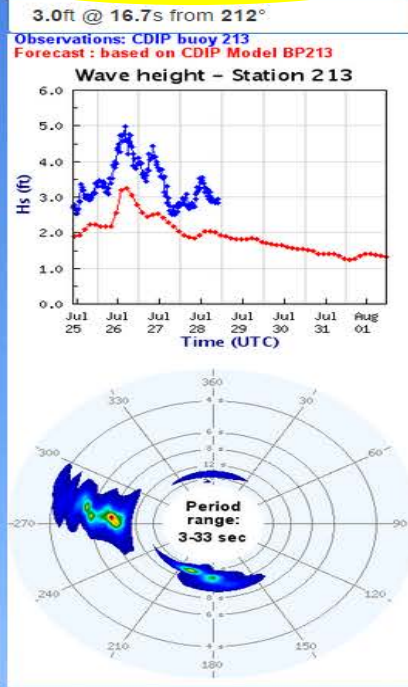


Result: Only 1.4 foot Under Keel Clearance!

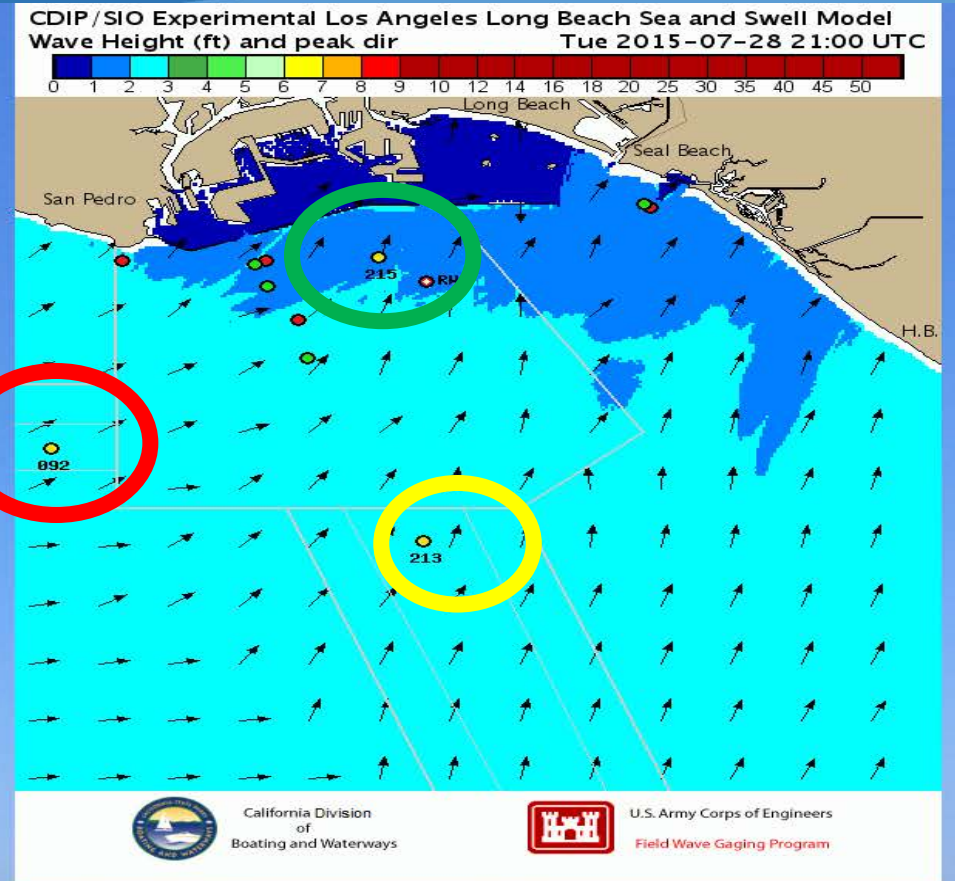
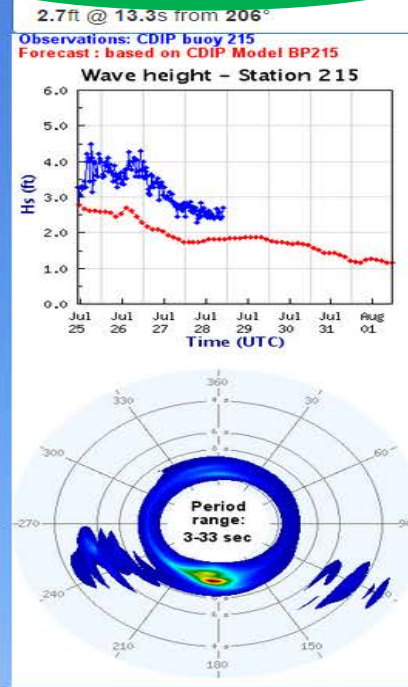
092 San Pedro



213 San Pedro South



215 Long Beach Channel



Real-Time Messaging to Pilots and Display at Marine Exchange. Buoys update every 30 minutes

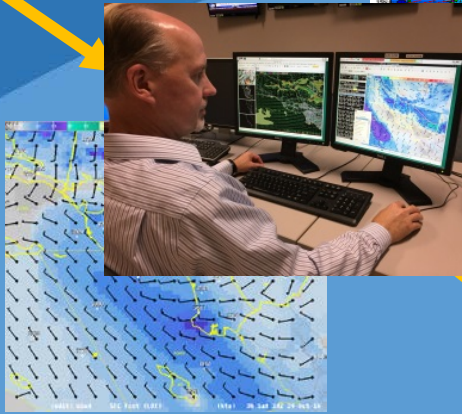
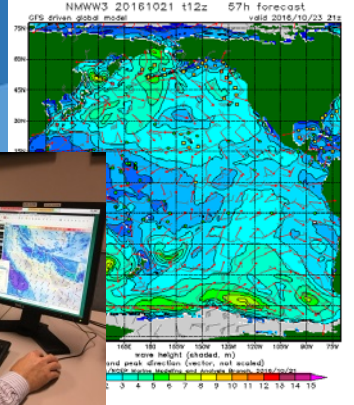


Satellite



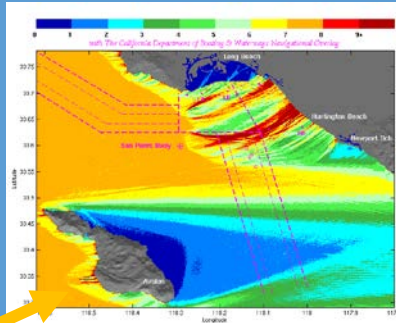
Buoy Obs

# NCEP WaveWatch III & Nearshore Wave Prediction System

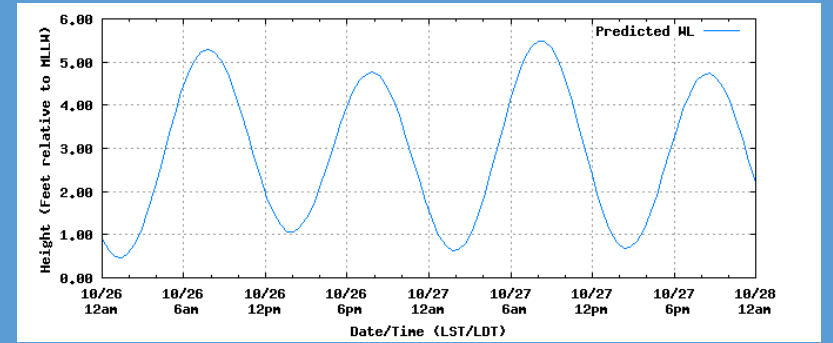


NWS Gridded Forecast Winds

CDIP Hi Res Wave Buoy



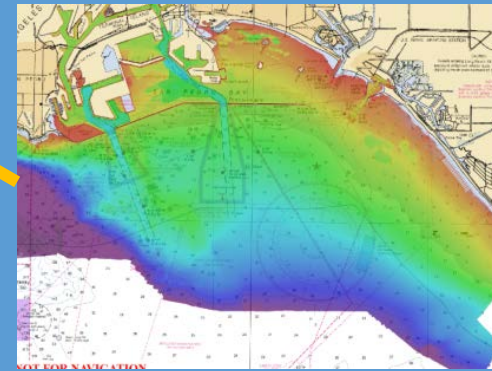
CDIP Wave Model



CO-OPS Tides



Decision Support Model



NOS Hi Res bathymetry

# Moving to the Future... UKC Program:

## Stakeholders:



& PIER 121 USERS



## Partners in providing critical weather and wave information to UKC:



Coastal Data Information Program

