

Tracking the Refugio oil spill using the Surface Current Mapping Network of the Southern California Coastal Ocean Observing System

Libe Washburn, Brian Emery, Eduardo Romero, and Cyril Johnson

Marine Science Institute, UC Santa Barbara

2016 Prevention First Symposium
September 27-28, Long Beach, CA



19 May 2015

Glen Watabayashi (NOAA)



19 May 2015

Glen Watabayashi (NOAA)



20 May 2015

Outline

1. Overview of the Southern California Coastal Ocean Observing System (SCCOOS)
2. Surface ocean circulation mapping with HF radar
3. SCCOOS response to the Refugio oil spill
4. Tracking movement of the spill offshore
5. Lessons learned & future directions



1. Overview of SCCOOS (www.sccoos.org)

- One of 11 coastal ocean observing systems in US
- Funded by NOAA's Integrated Ocean Observing System (IOOS)
- Primary goal: To provide scientific data and information to inform decision-making and understand changing ocean conditions off Southern California

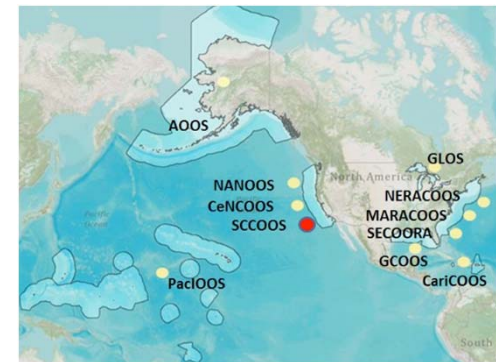
- Focus areas:

Marine operations,

Coastal hazards,

Climate variability & change,

Ecosystems, Fisheries, and water quality



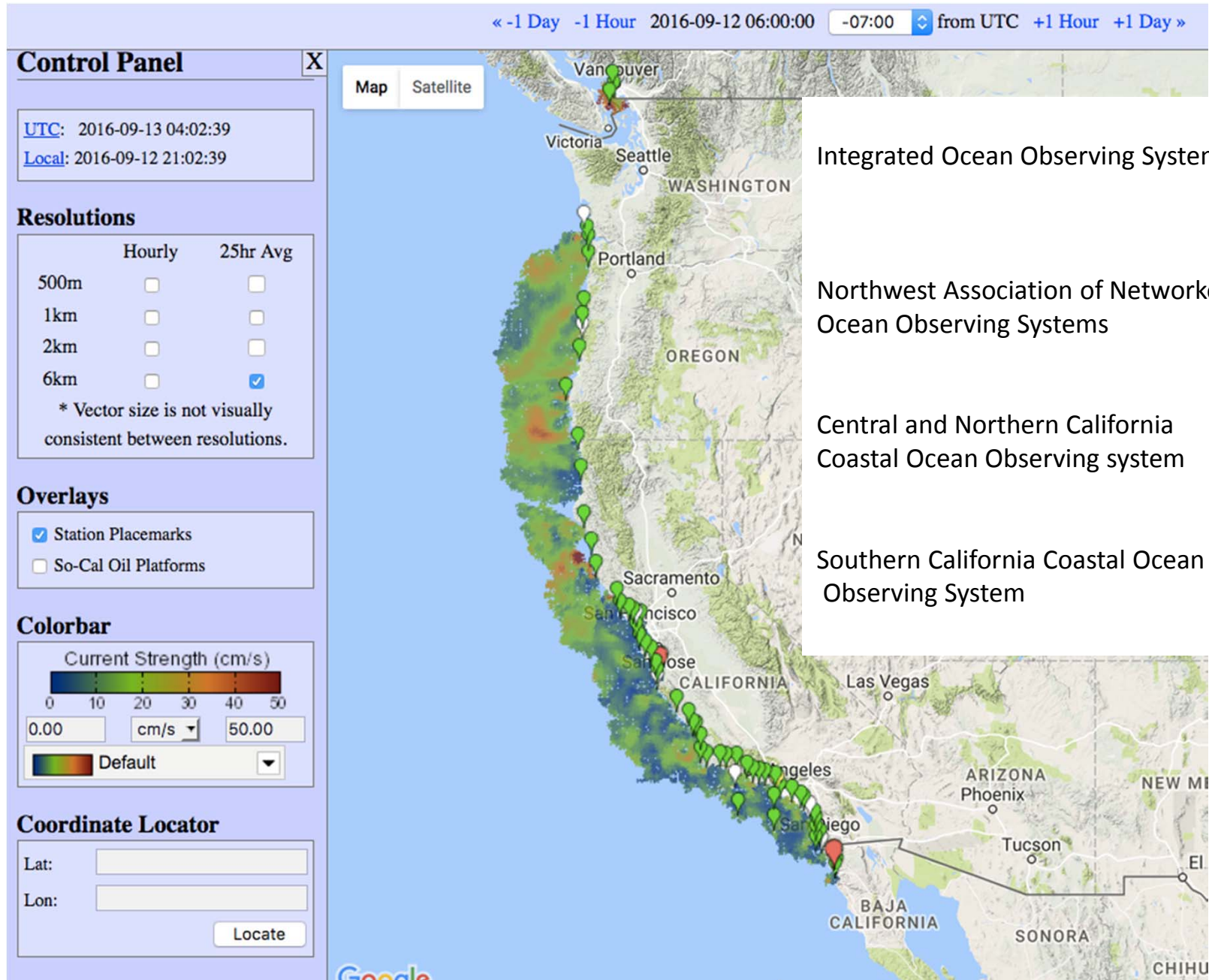
(Credit: P. Alejandro Díaz and Ginny Velasquez/Wikimedia commons)



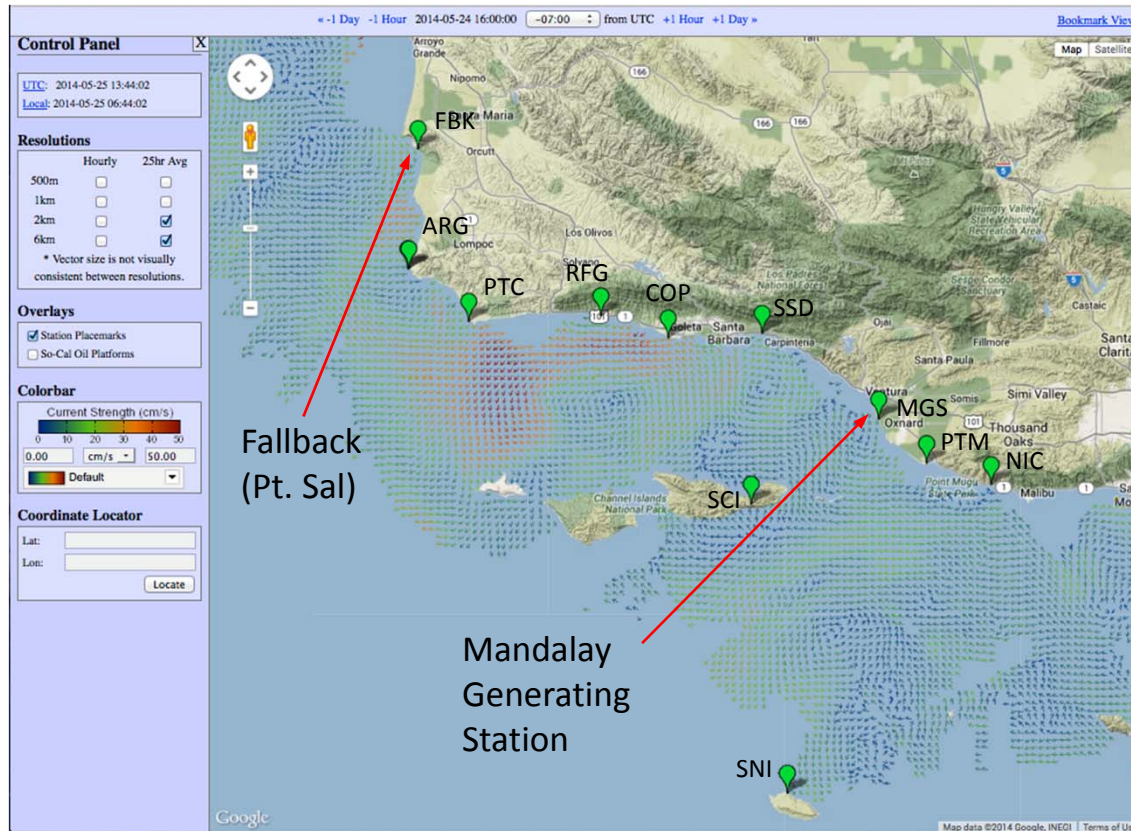
US Coast Guard



West coast coverage of surface current mapping



2. Surface ocean circulation mapping with HF radar



High frequency radio network for measuring surface ocean currents

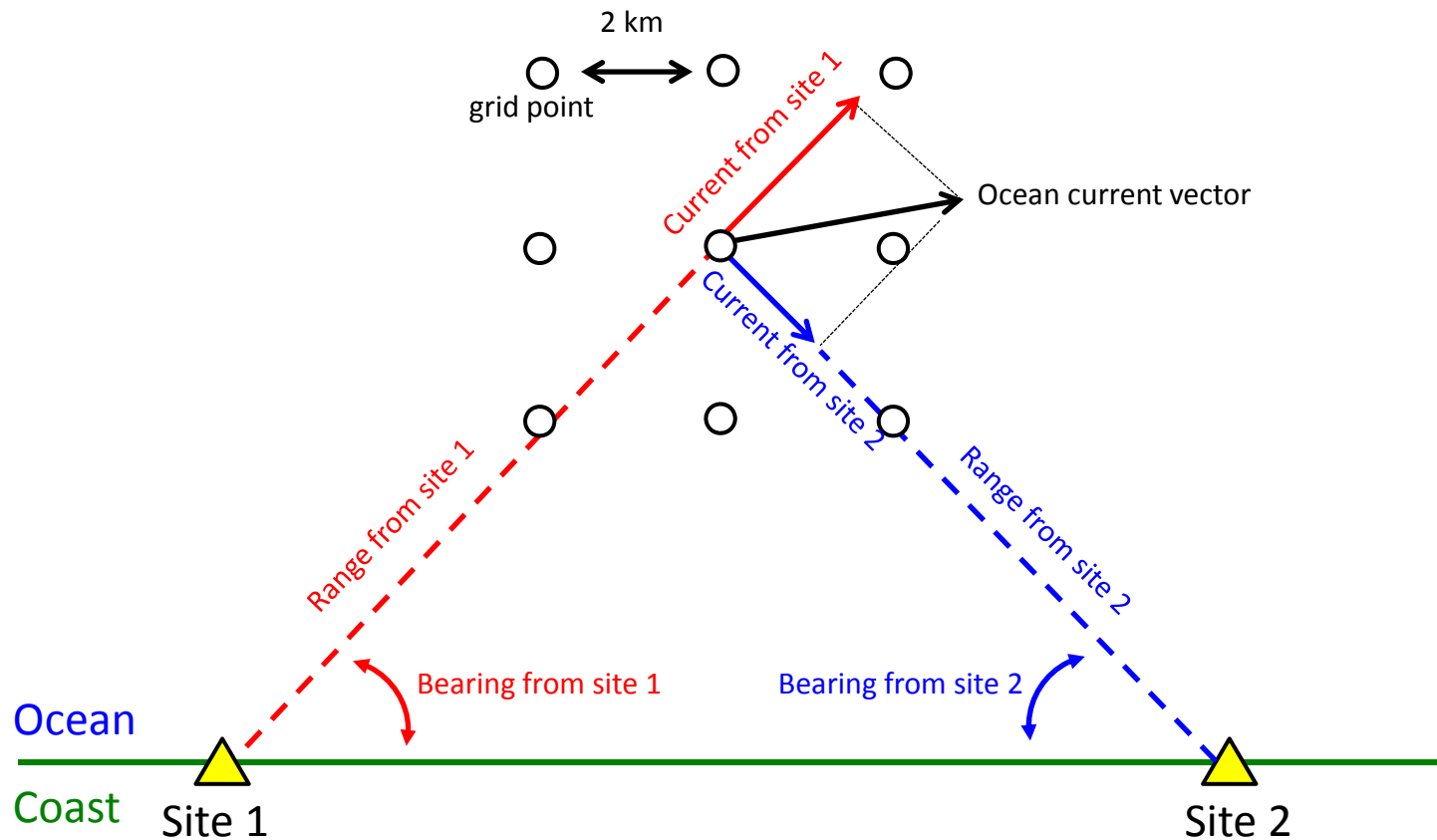
- transmit: freq. = 12 - 14 MHz
- transmit power = < 50 Watts
- resolution ~ 6 km on 2 km grid
- 1-hr average current vectors
- range ~ 50-100 km offshore
- MGS site courtesy of Reliant Energy
- FBK site courtesy of VAFB/US Air Force

reliant[®]
an NRG company

U.S. AIR FORCE

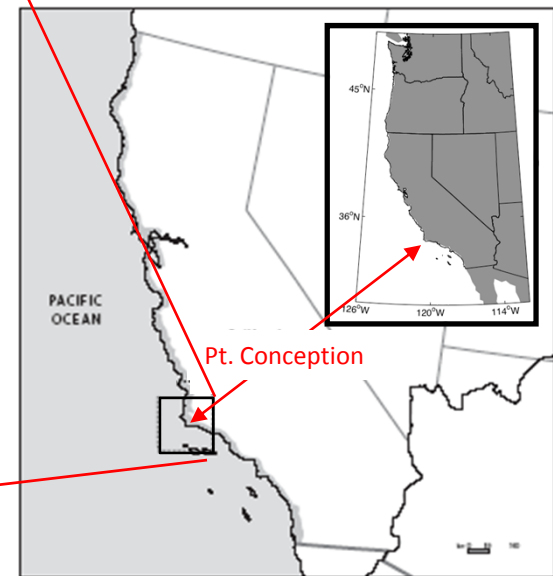
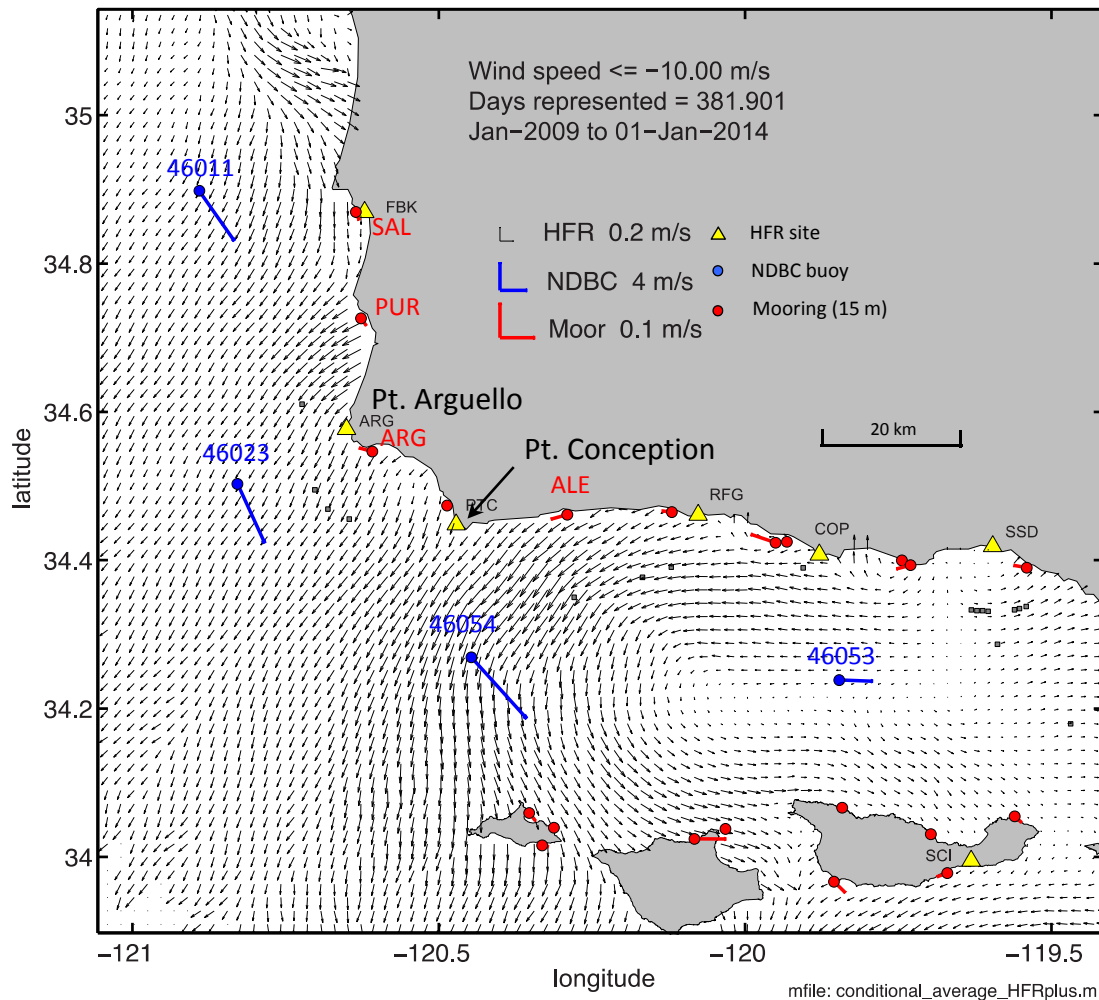


Surface currents from HF radar



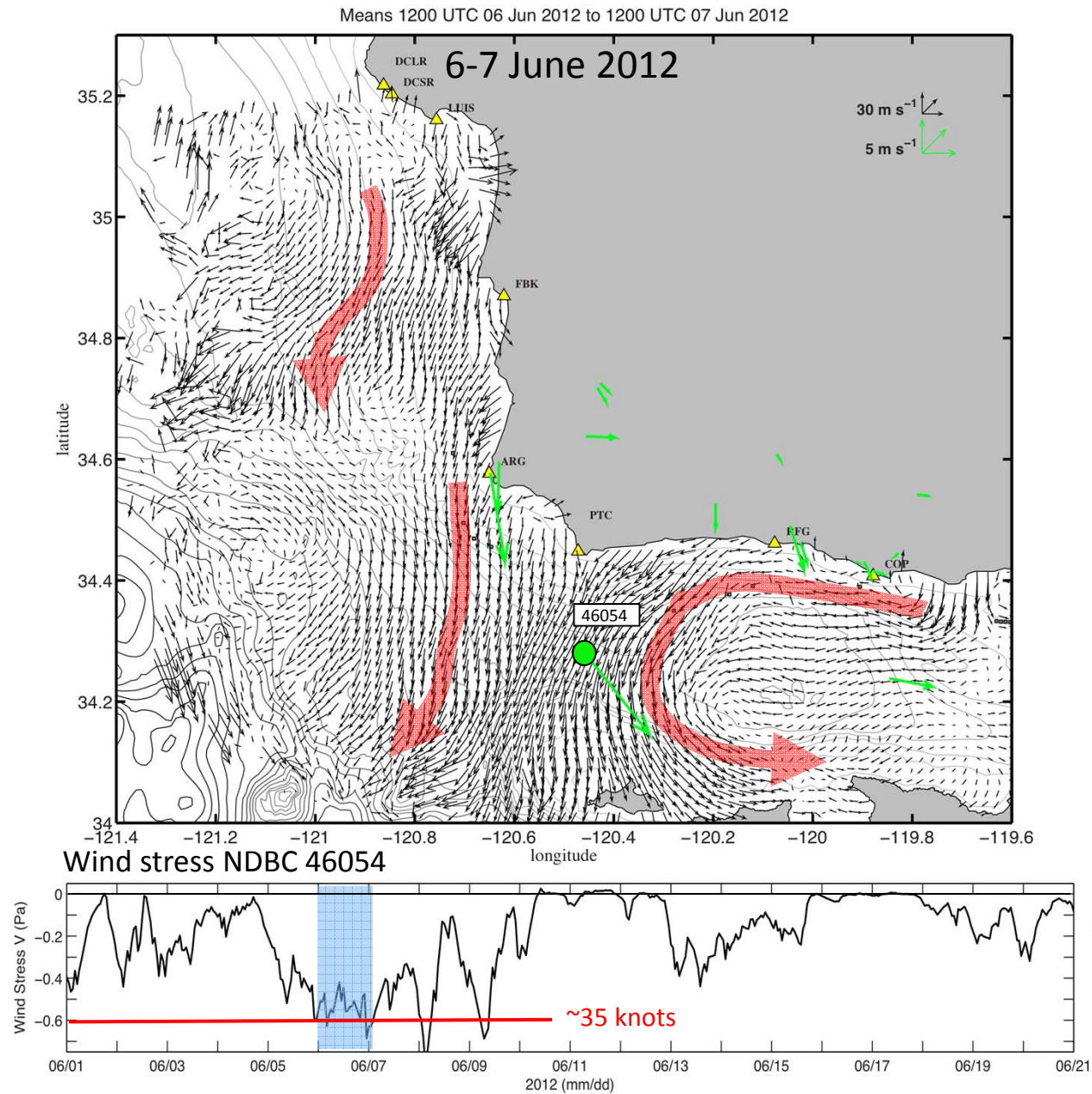
- Doppler shift in received signal gives radial component of surface current (~ 1 m depth)
- Timing of return signal gives range to measured current location
- Directional receive antenna gives bearing to measured current location

Prevailing conditions: Upwelling winds and regional ocean circulation

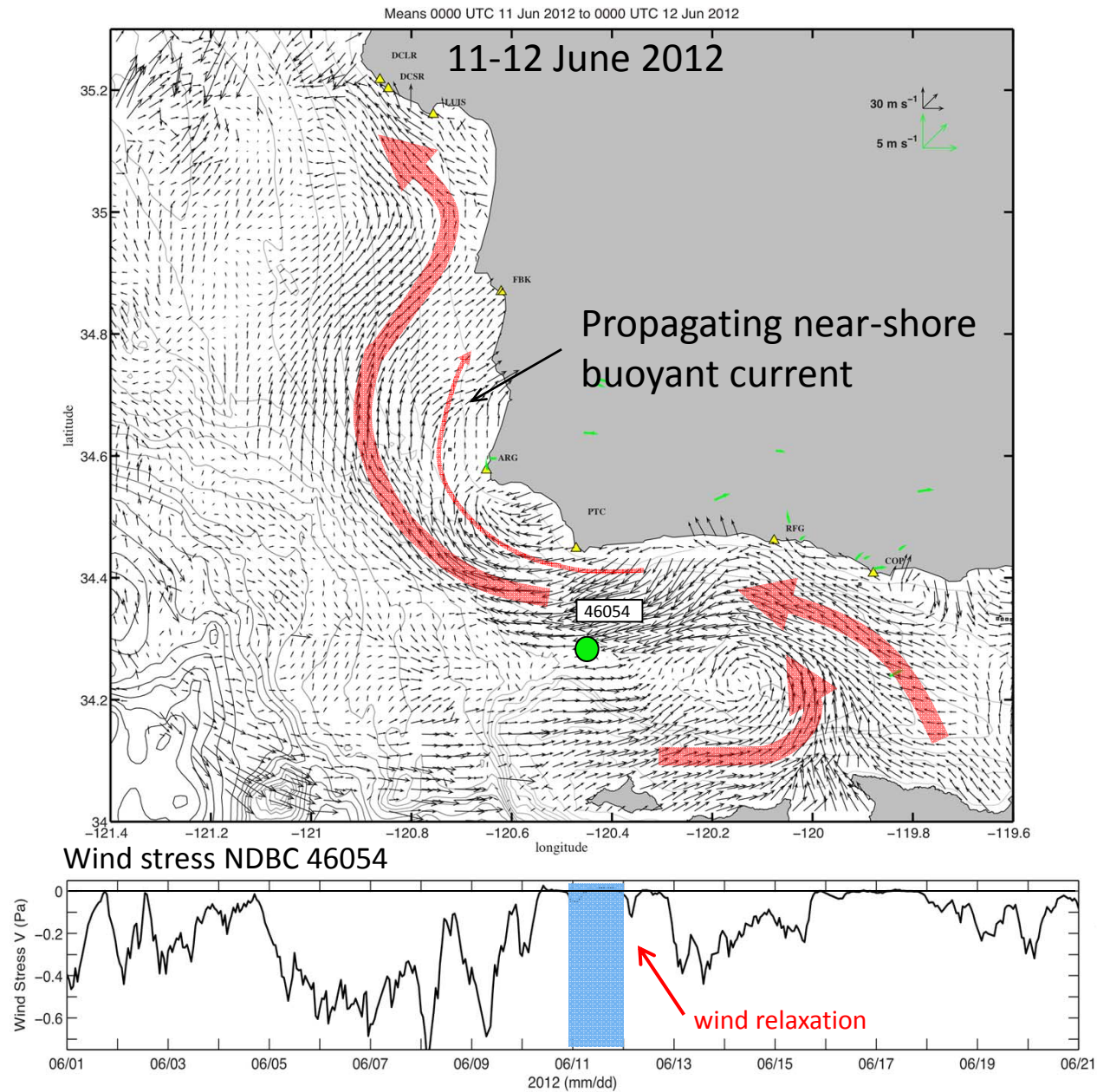


- Winds typically blow from the northwest
- Map shows current pattern when winds exceed ~ 20 knots from the NW from 5 years of observations
- Circulation in the Santa Barbara Channel is westward current flowing along mainland coast
- Westward current is turned southward and south eastward by wind

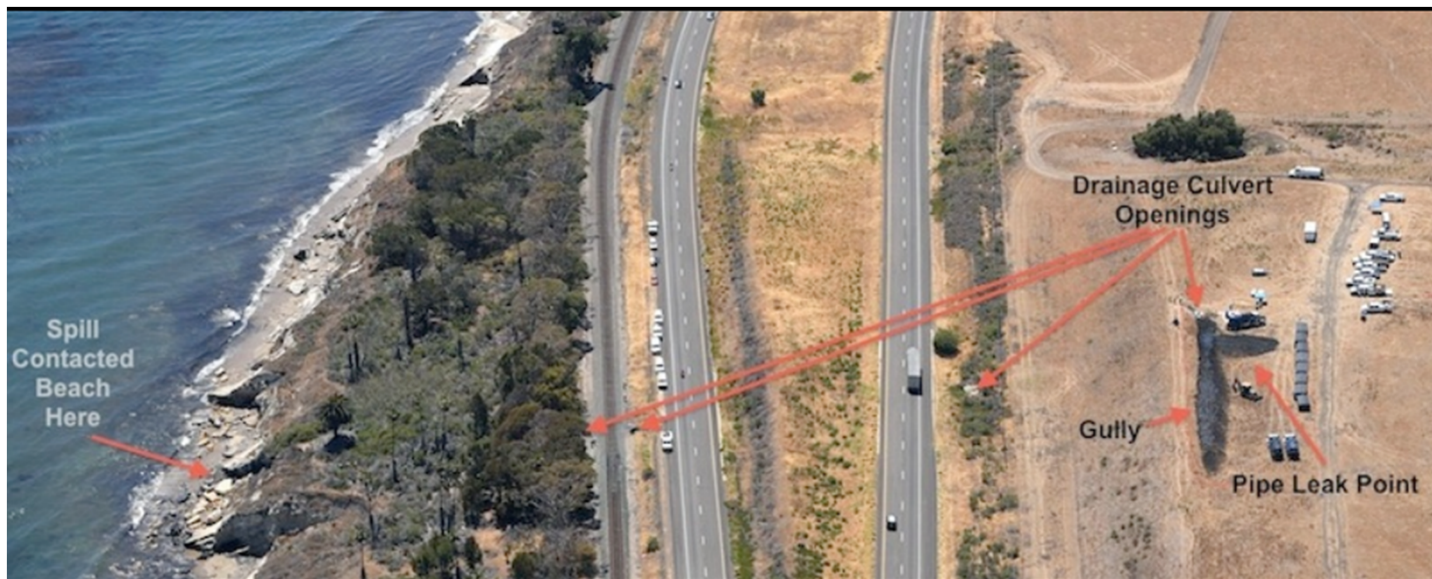
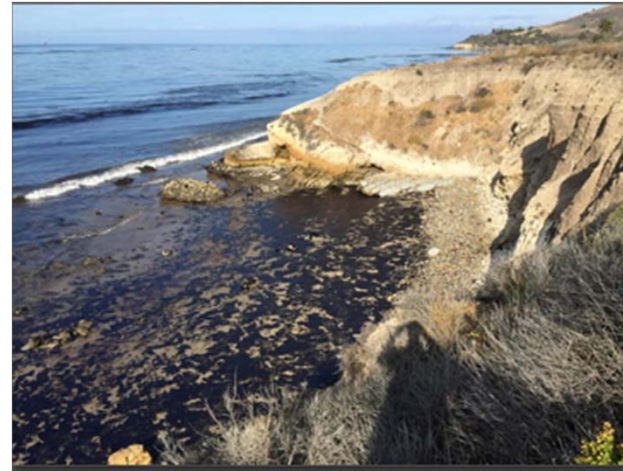
Strong upwelling winds & equatorward currents



Wind relaxation & poleward currents



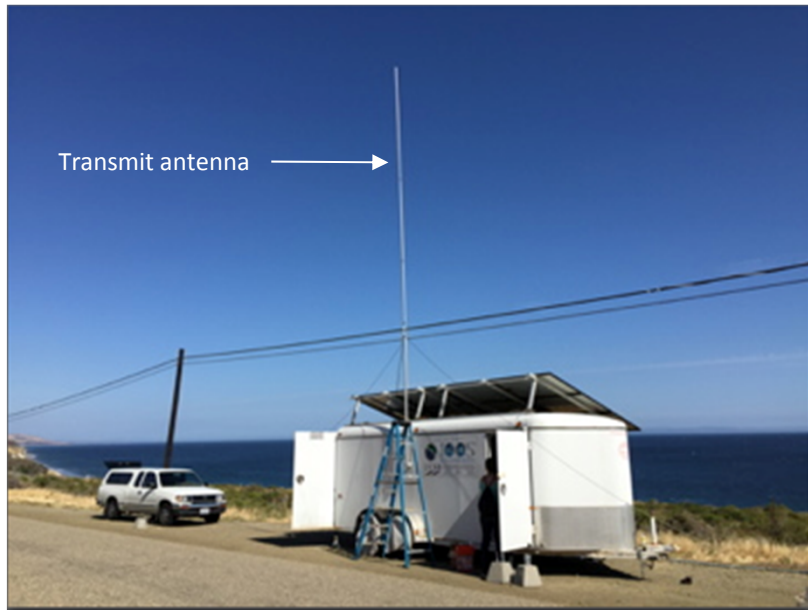
3. SCCOOS response to the Refugio oil spill



https://en.wikipedia.org/wiki/Refugio_Oil_Spill#/media/File:1486_RefugioOilSpill2015.jpg

- Spill occurred on 19 May 2015 near Refugio State Beach
- Initial reports of 480-500 barrels into ocean.

Temporary SCCOOS HF radar site near Gaviota, CA



- Solar-powered HF radar site set up near Gaviota, CA on 20 May 2015 (1 day after spill)
- 12 Mz site with 50-100 km range
- Data were transmitted via satellite to SCCOOS server at Scripps Institution of Oceanography for near real-time display on website

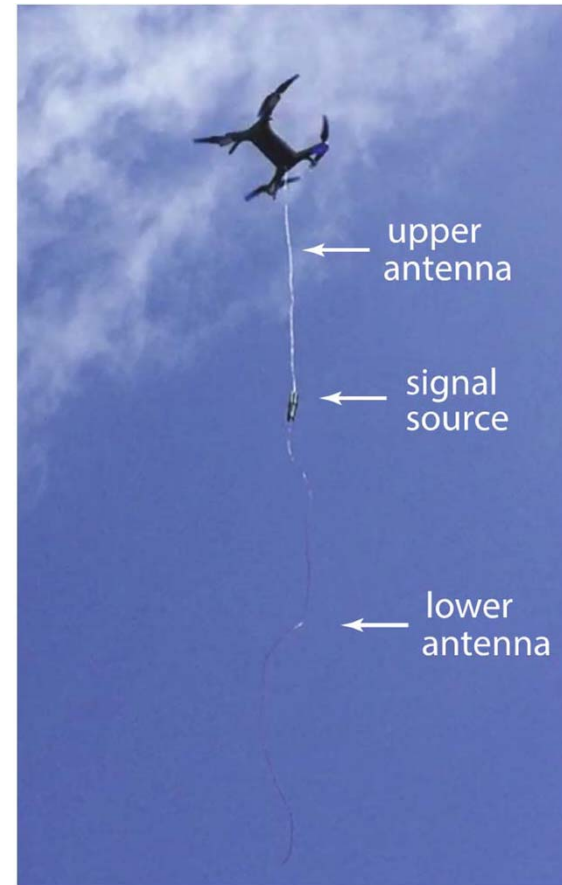
Calibration of radar antennas using quadrotor drone



Eduardo Romero



Cyril Johnson



Quadrotor drone in flight

- 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

Trailer site (TRL) installed to fill coverage gap near site

Control Panel X

UTC: 2015-11-01 00:53:34
Local: 2015-10-31 17:53:34

Resolutions

	Hourly	25hr Avg
500m	☐	☐
1km	☐	☐
2km	☐	☒
6km	☐	☐

* Vector size is not visually consistent between resolutions.

Overlays

☒ Station Placemarks
☐ So-Cal Oil Platforms

Colorbar

Current Strength (cm/s)

0 10 20 30 40 50

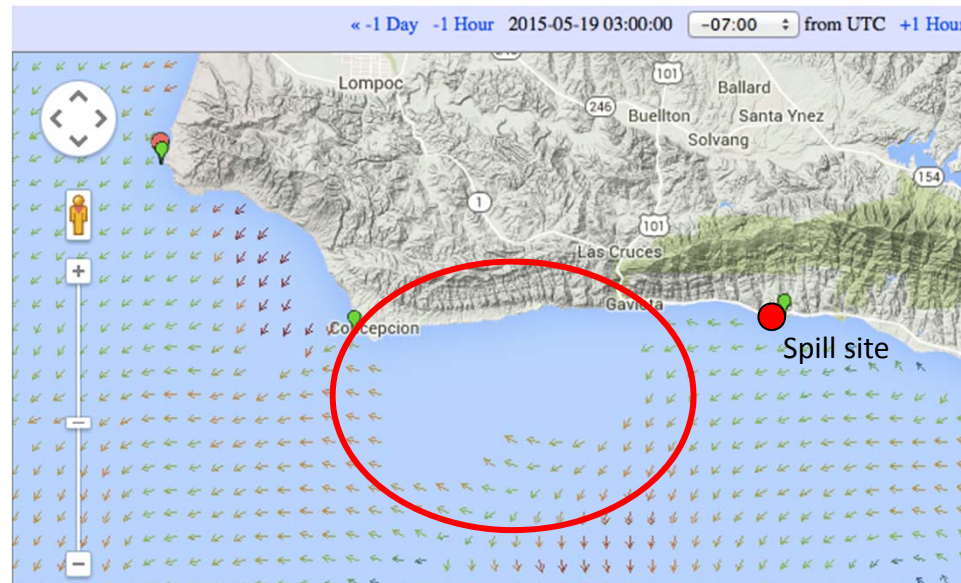
0.00 cm/s 50.00

Default

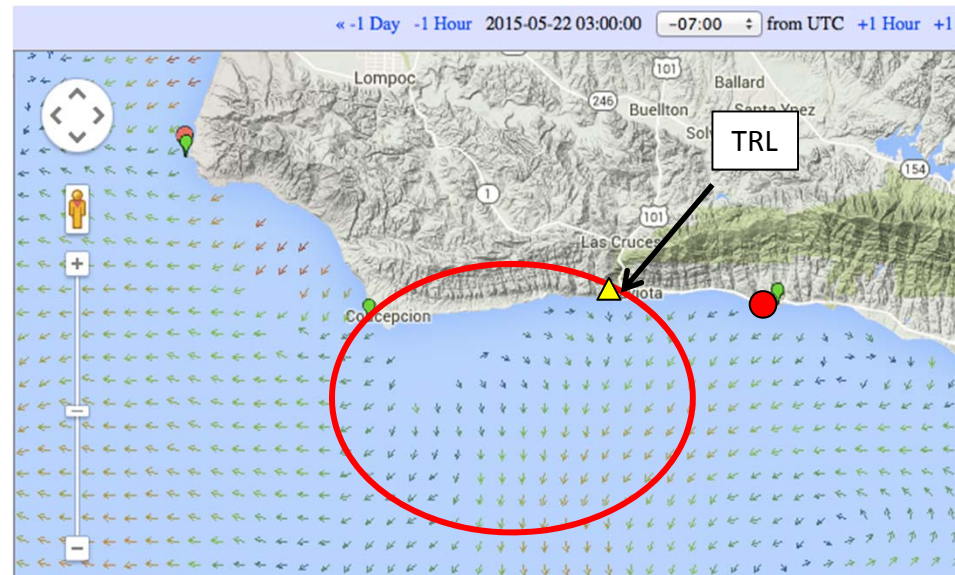
Coordinate Locator

Lat:
Lon:

Locate



Coverage on
19 May 2015
(Date of spill)



Coverage on
22 May 2015

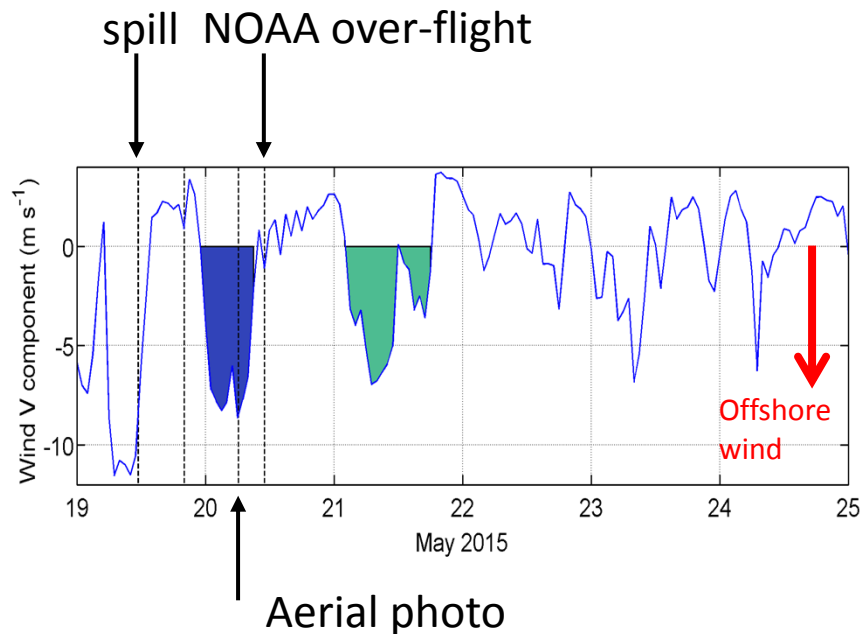
4. Tracking movement of the spill



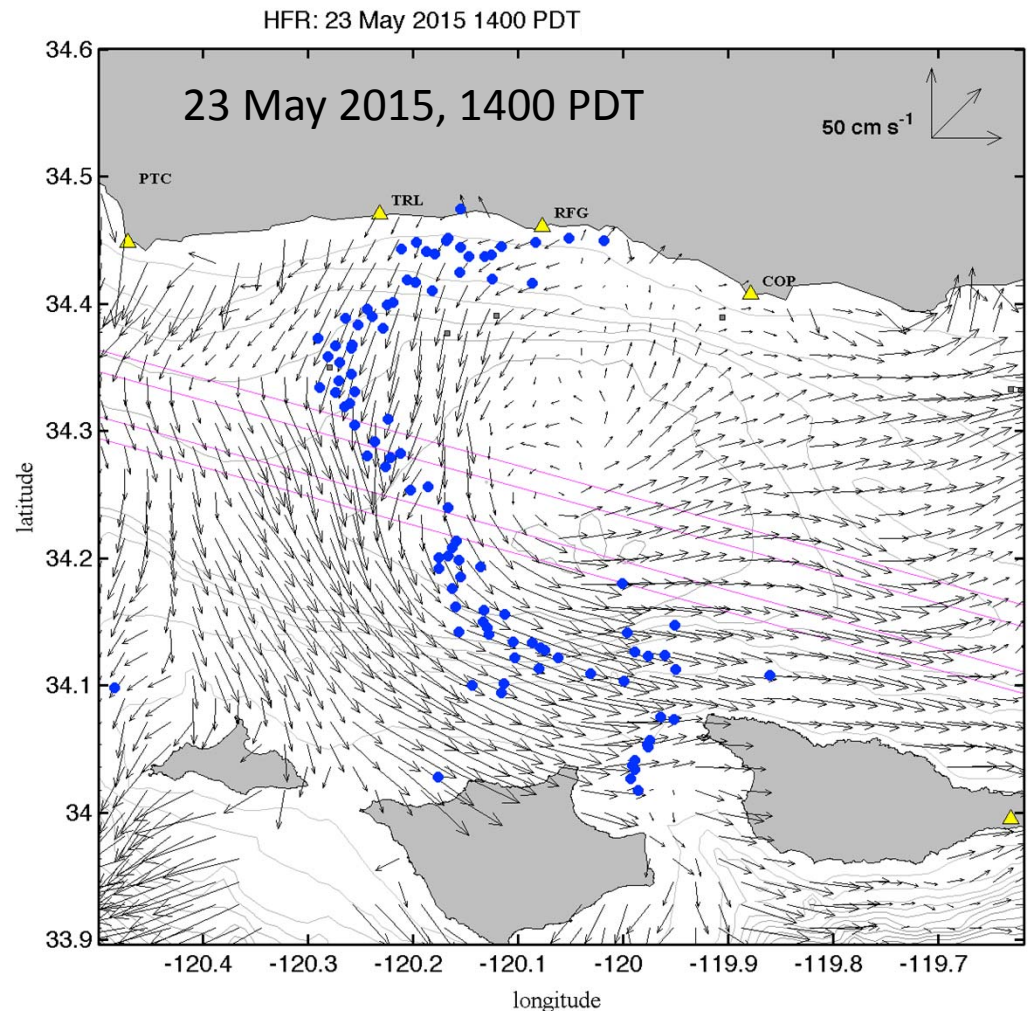
- Offshore movement of spill on 19 May 2015
- Strong offshore winds present

4. Tracking movement of the spill offshore

- Strong offshore winds during spill
- NOAA flight tracks slick next day
- SCCOOS deploys temporary radar site on 19 May 2015

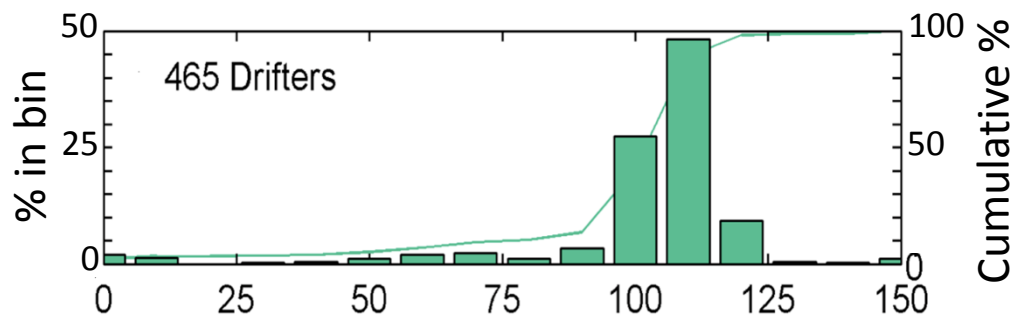
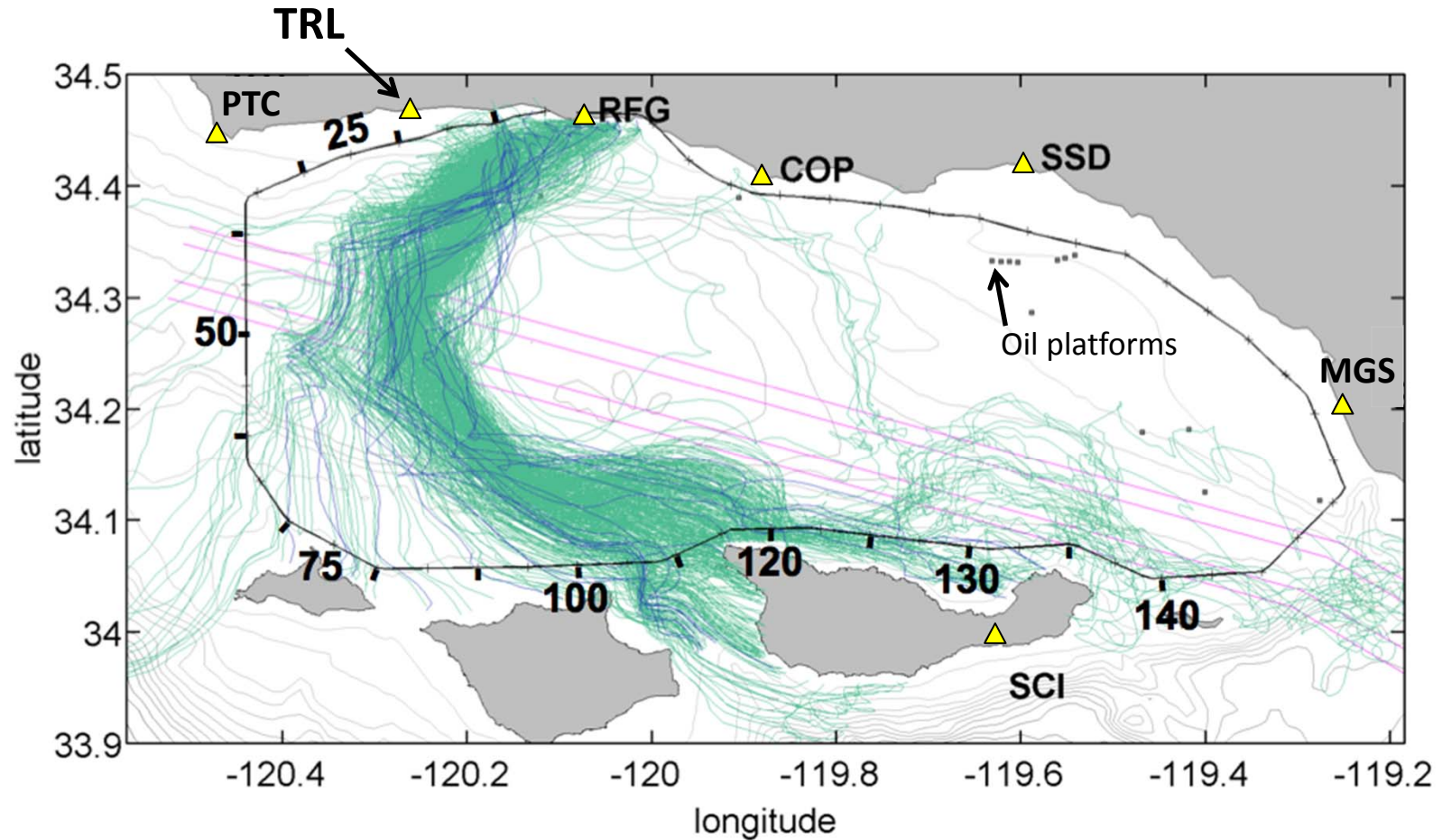


Real-time display on SCCOOS website:



- Blue dots show oil movement by currents

Simulated oil trajectories due to surface currents



- Half of drifters left coverage in 2.5 days
- All left after 4.5 days

5. Lessons learned & future directions

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.



End