

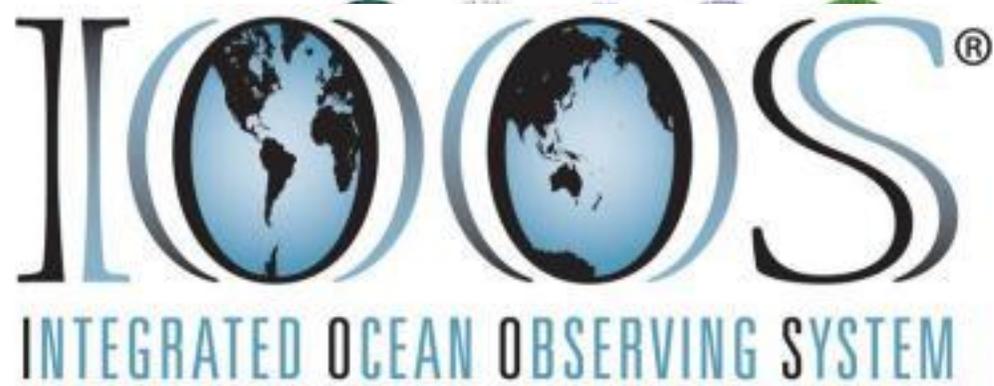
*U.S. Integrated Ocean Observing System*  
*(U.S. IOOS)*  
Contributions To Marine Spatial Planning



Josie Quintrell, Director  
IOOS Association  
February 5, 2014



# U.S. IOOS: The US Contribution to GOOS

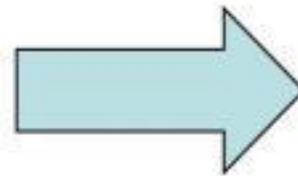


**A National Endeavor**

**But Part of a Global Framework**



**Global Ocean Observing System**



**Global Earth Observation System of Systems**



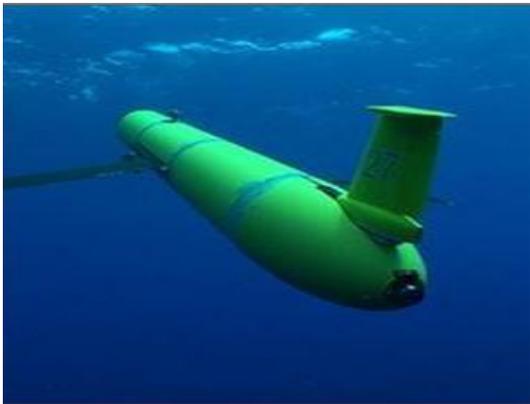
**Enables decision making and science**

# IOOS: Federal Regional Partnership

## 11 Regional Associations Dedicated to Meet Stakeholder Needs

Consortium of academia, tribes, states, fishermen, mariners, NGOs, private sector and the general public working together to provide information

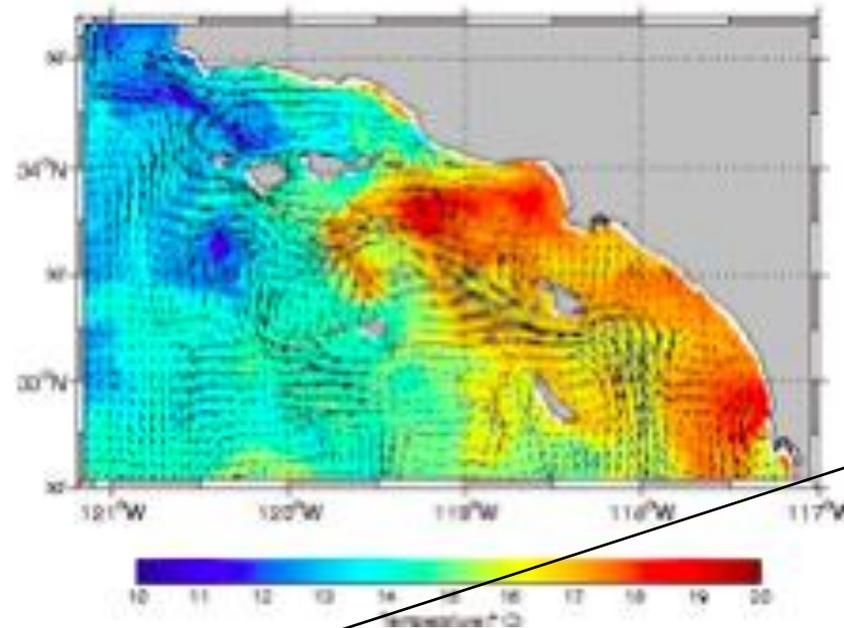
### Observations



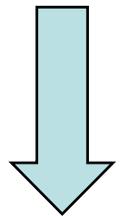
5 x 297 - oceanservice.noaa.gov



DMAC



Modeling & Analysis

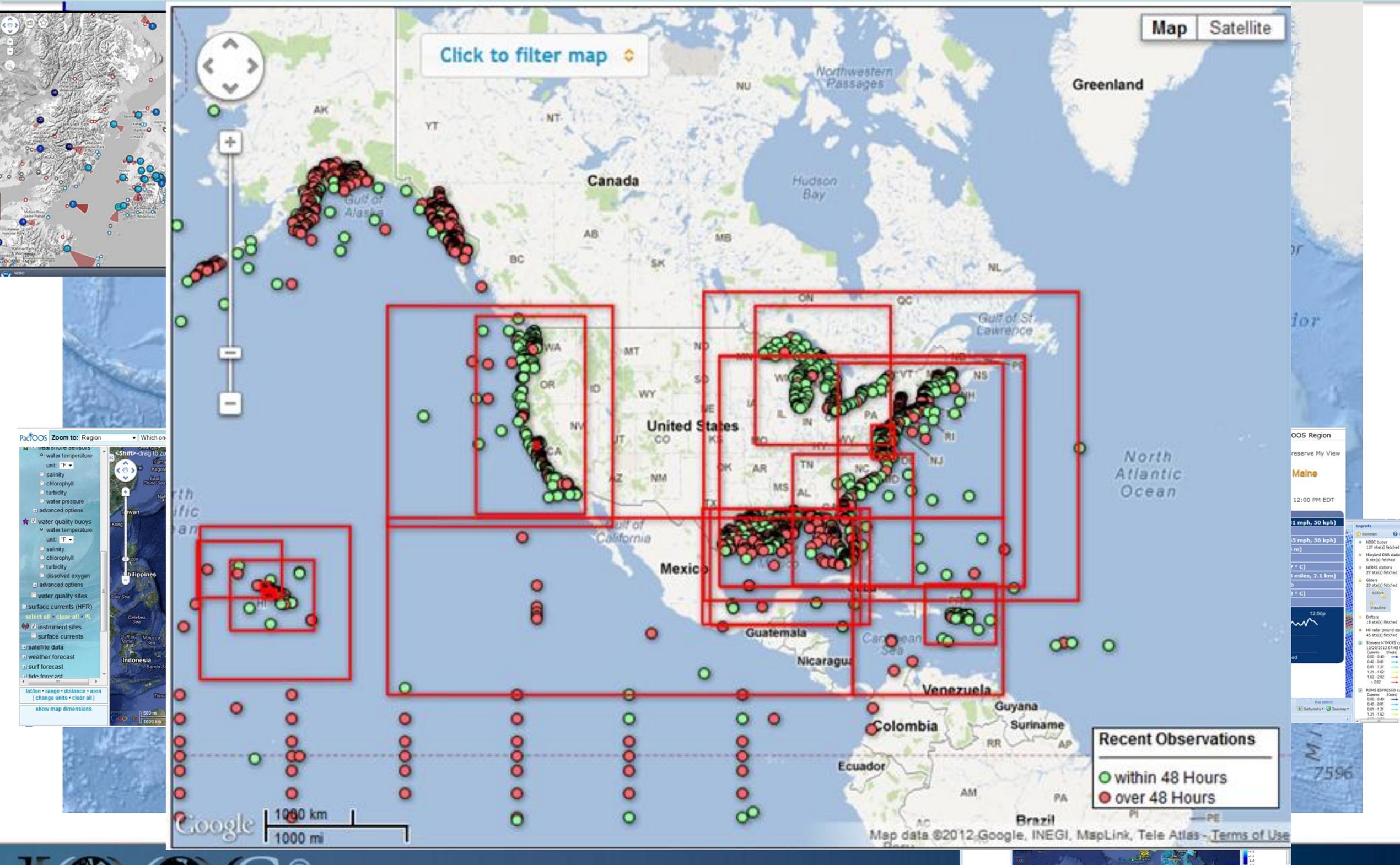


Products



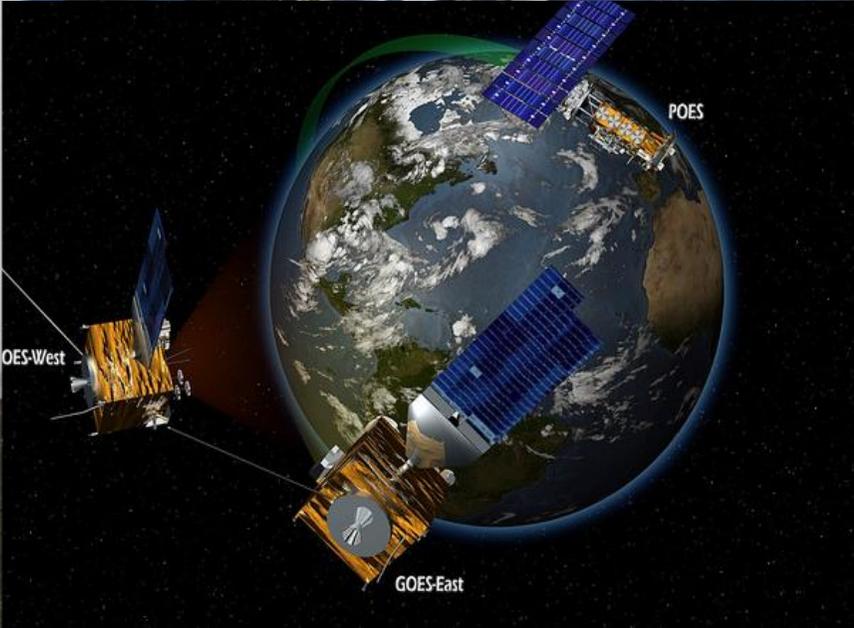
**Bathymetry is the foundation**

# Exposing Ocean Information





# Observing Systems

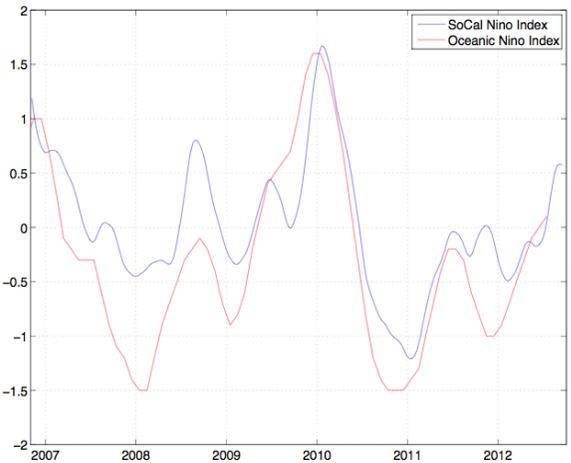


# Glider Missions

Climate/Ecosystem/Fisheries Management/Water Quality



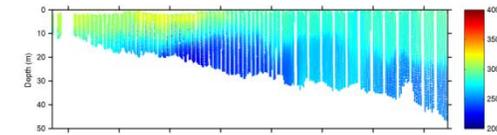
CalCOFI



The SoCal Niño Index



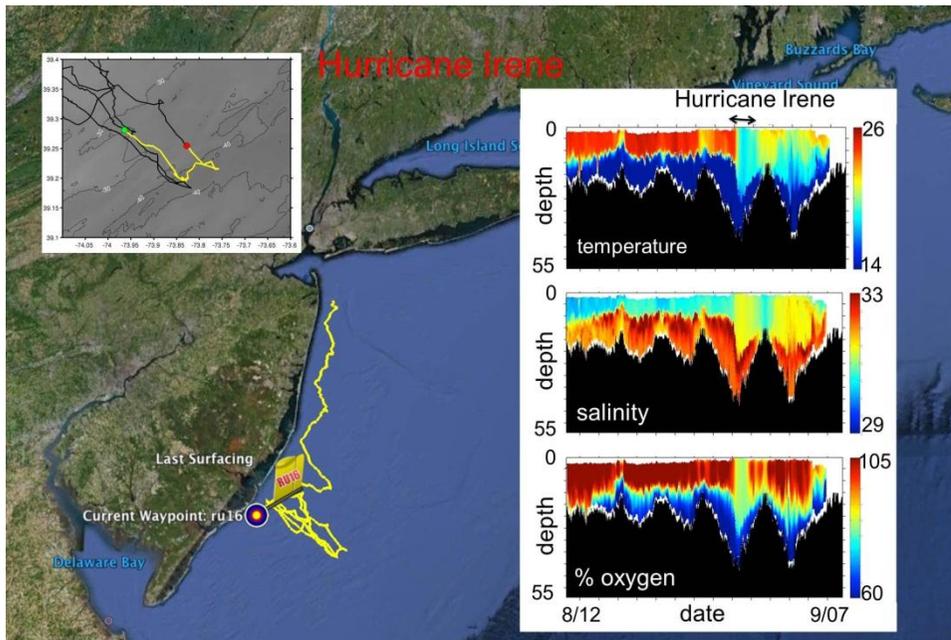
Fish Tracking



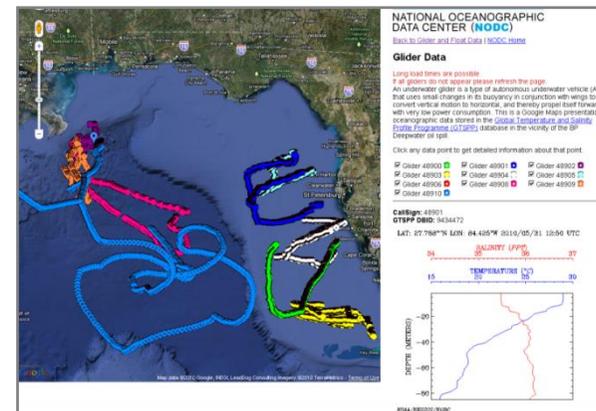
HAB



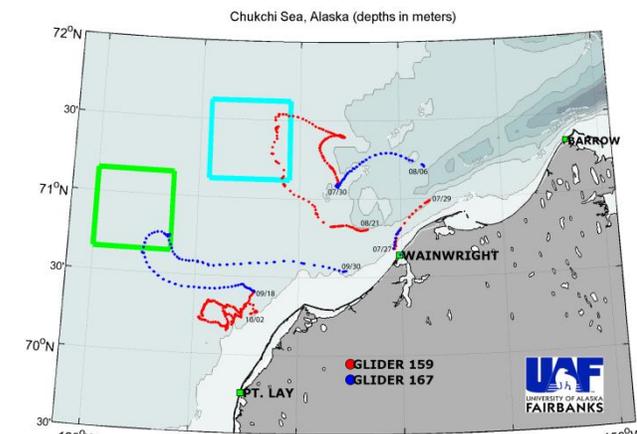
## Hurricane Forecasting



## Response to Oil Spill



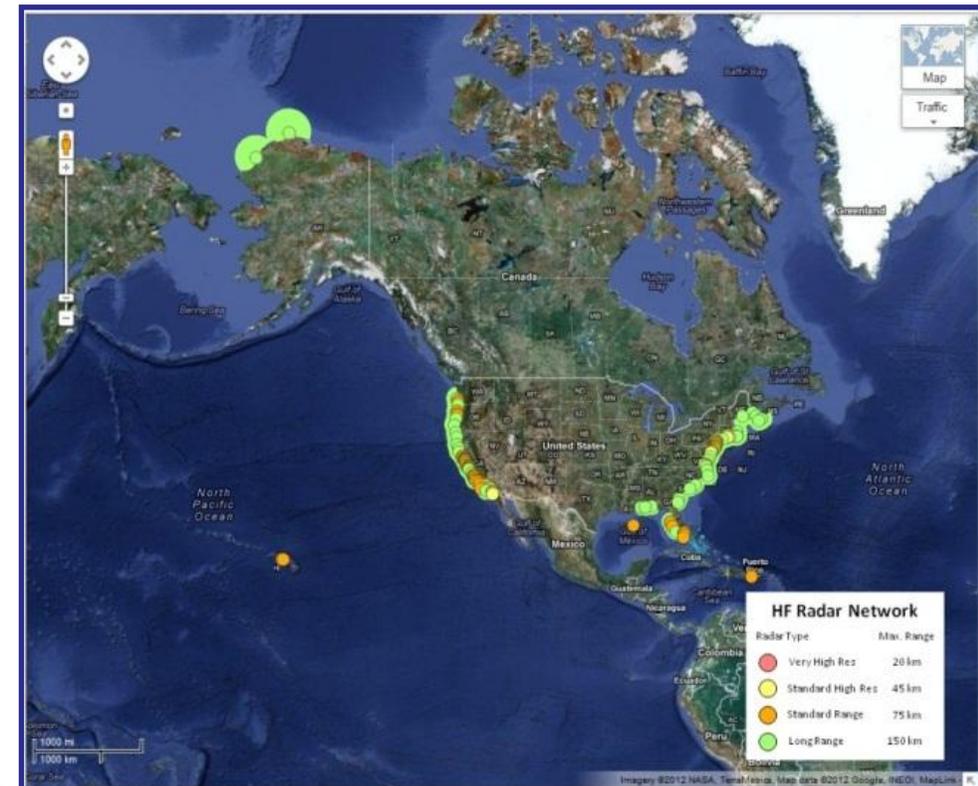
Deep Water Horizon



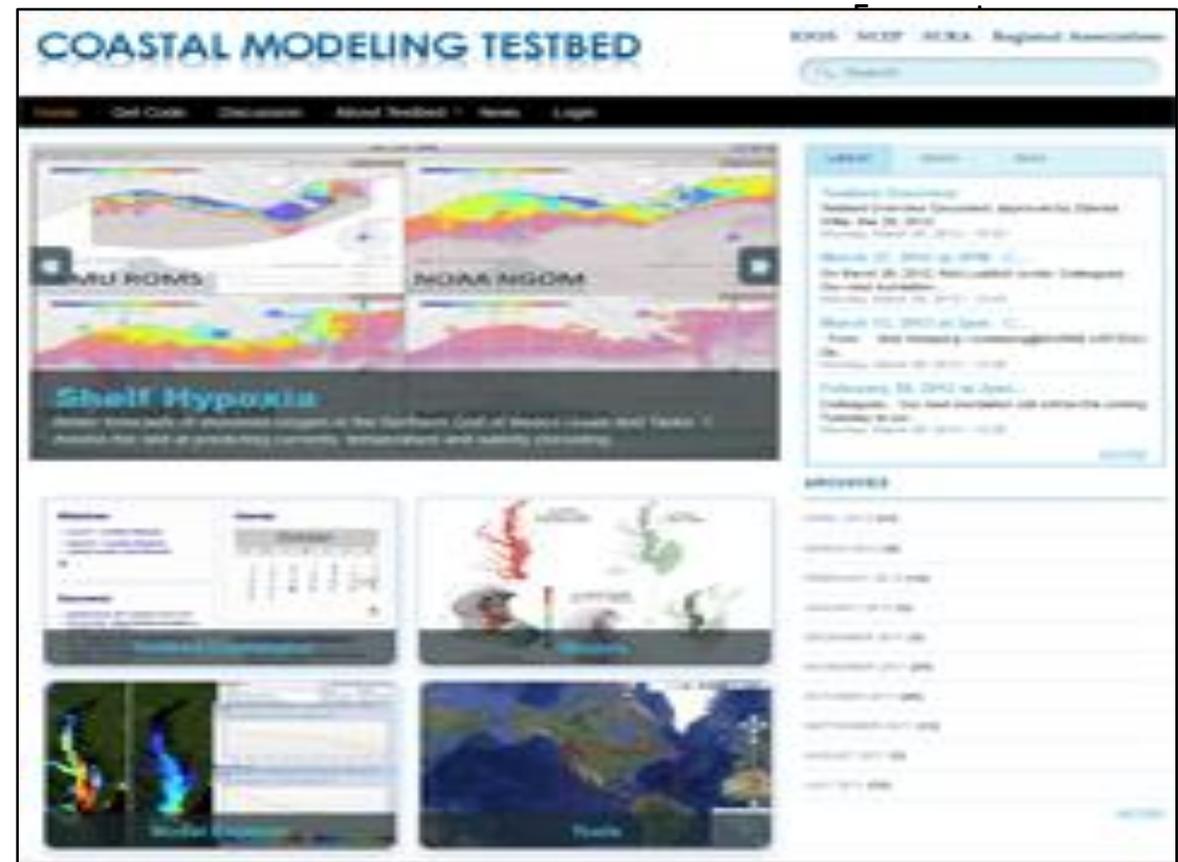
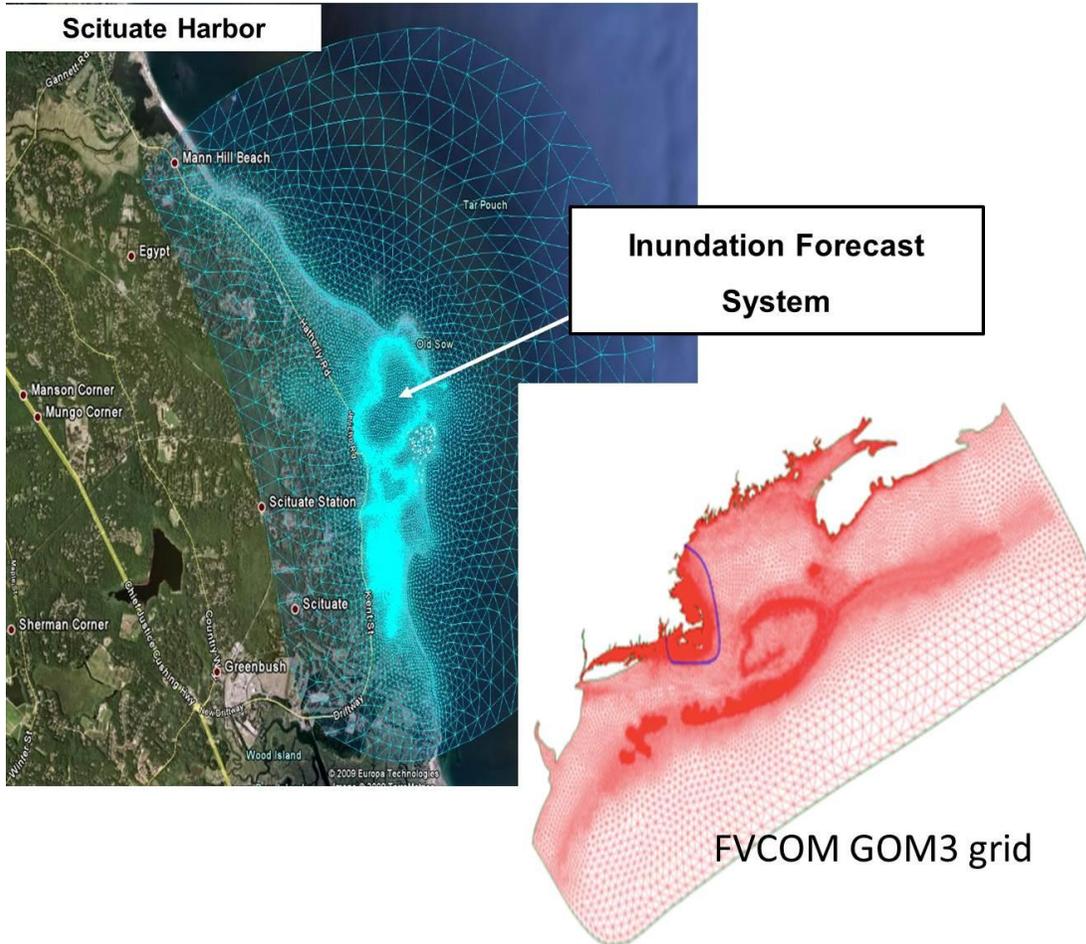
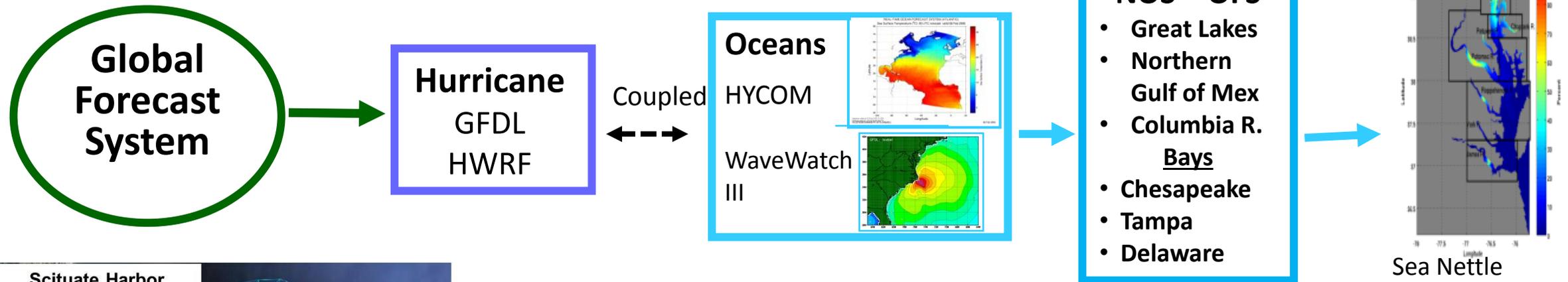
Alaska

# IOOS<sup>®</sup> High Frequency Radar

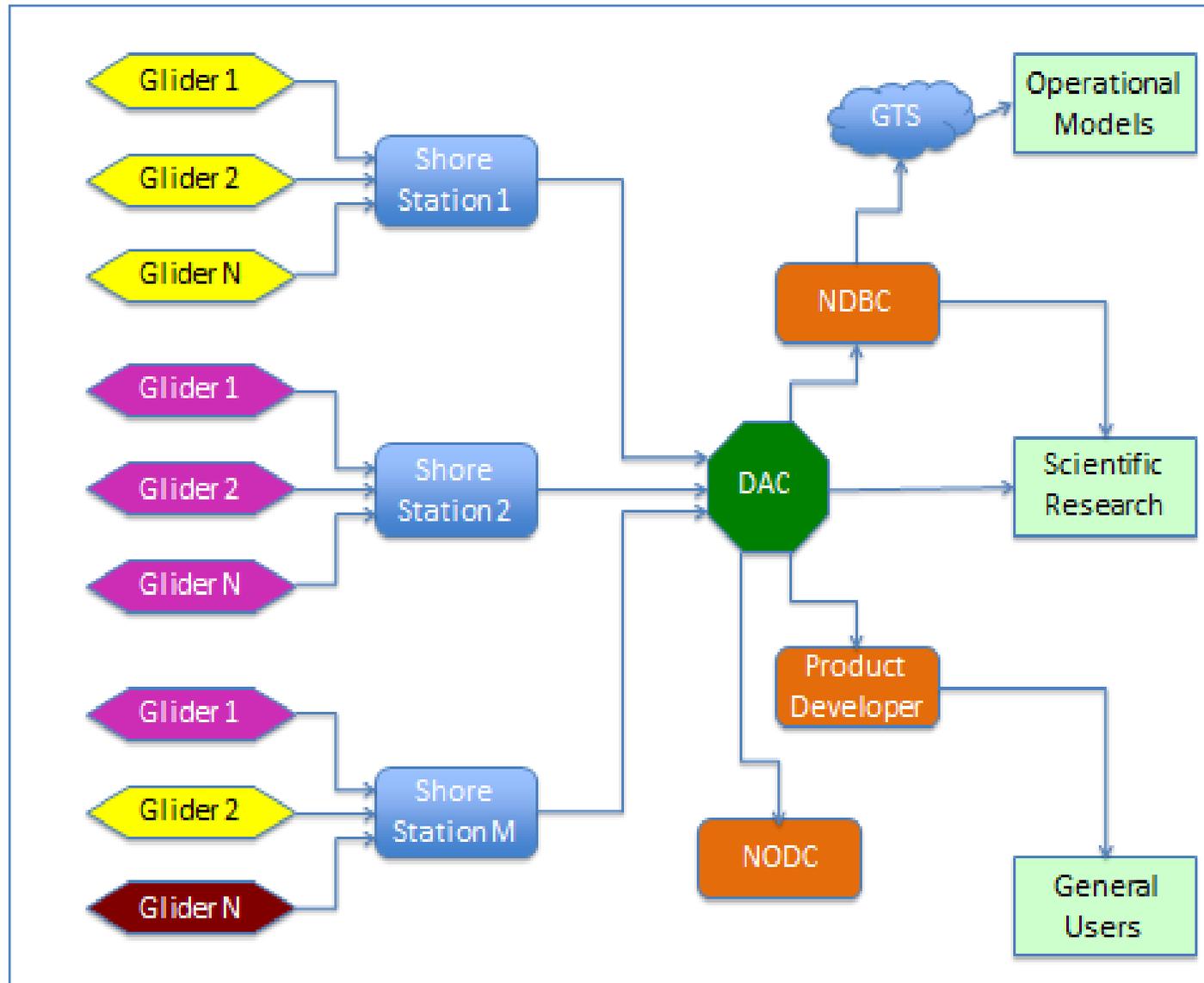
- HF radars measure speed and direction of ocean surface currents
- All-weather effectiveness
- Horizontal resolutions / ranges vary
  - Very high resolution – 15 miles
  - Medium resolution – 55 miles
  - Low resolution – 125 miles
- Paired HF radars cover 6,000 square miles of ocean surface
- Regional network increased to 132 radars in 2013 from 20 HF radars in 2002
- IOOS data management resulted in a national network
- Used operationally by Coast Guard for Search and Rescue



# Coastal Modeling

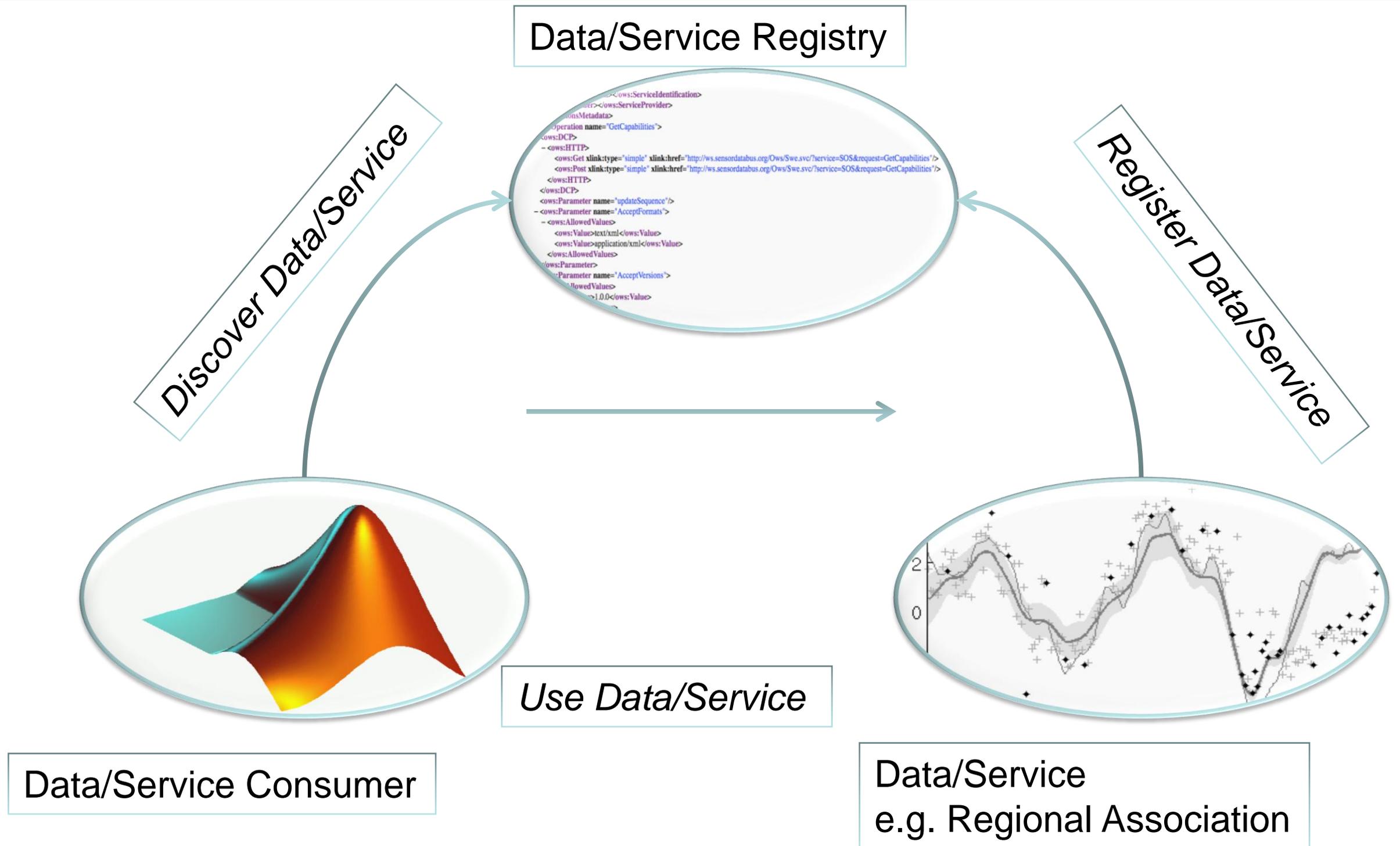


# Data Management

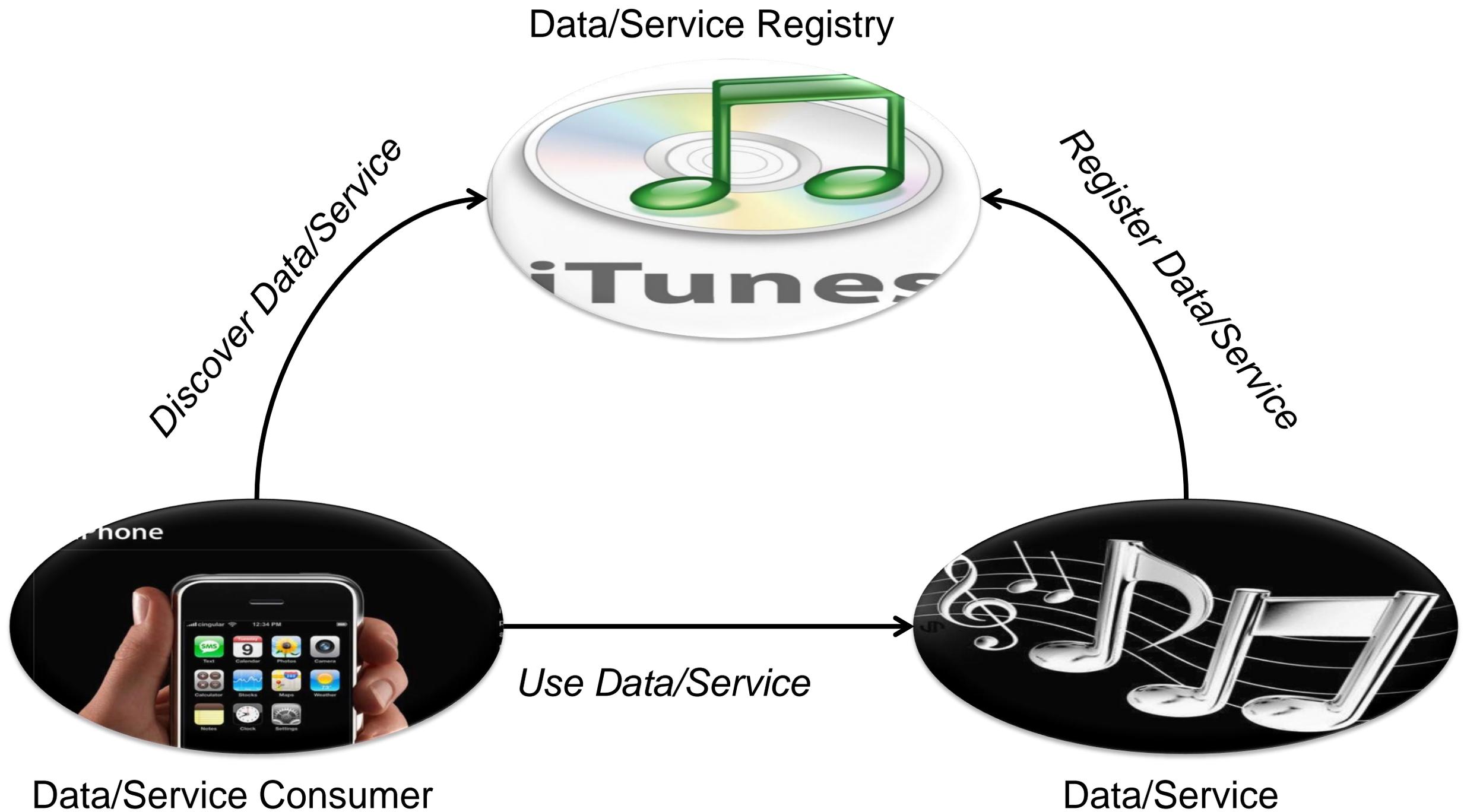


- National standards to ease exchange of data
- Real-time distribution
- Quality control
- Archiving
- > 50% of NWS ocean data from non-federal sources through IOOS

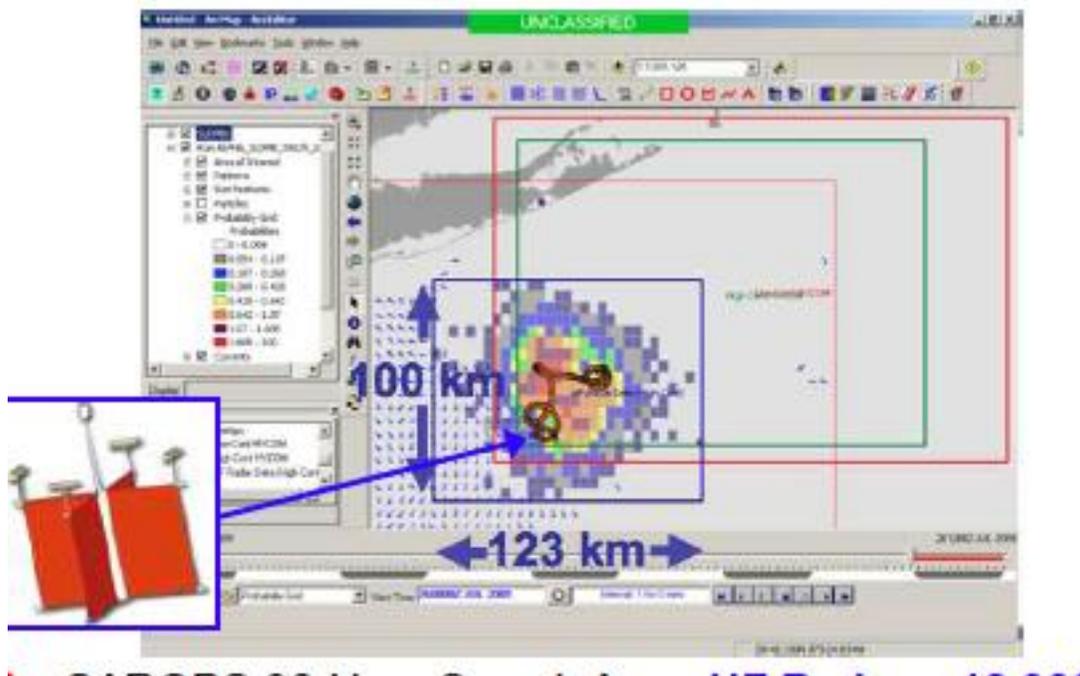
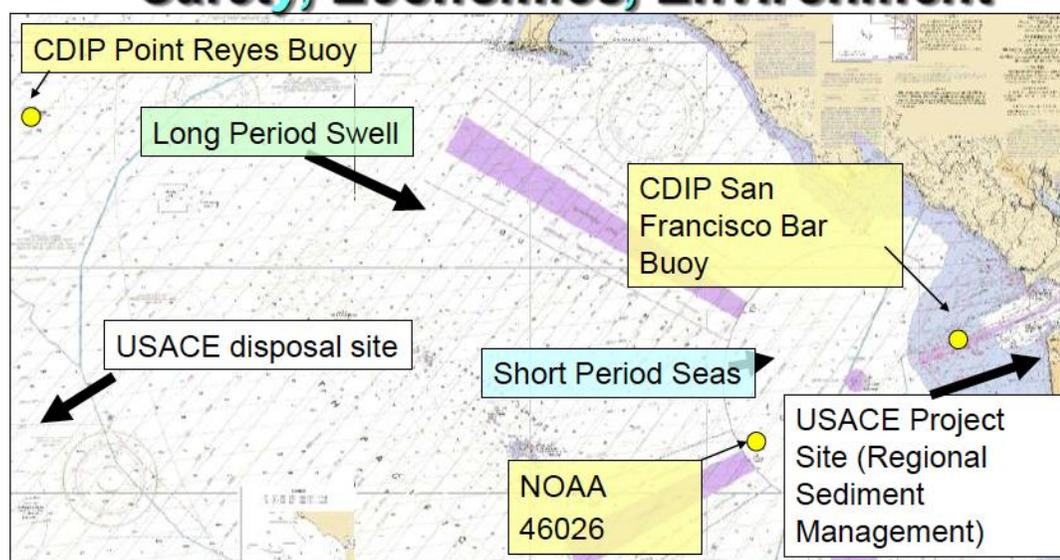
# Helping people find and use data



# Helping people find and use data

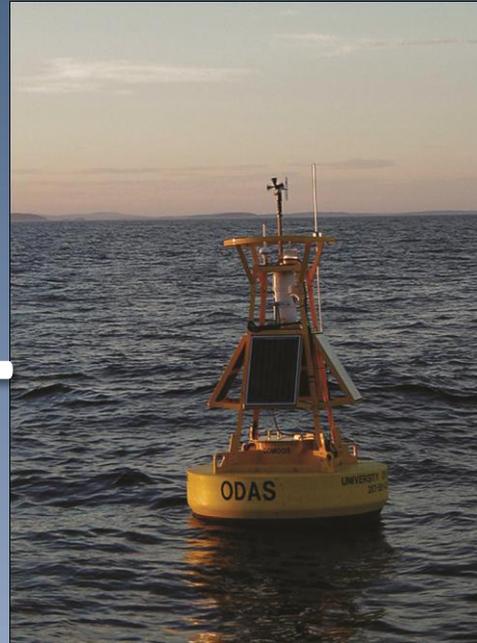


# Meeting User Needs: Safe and Efficient Marine Commerce





+



+

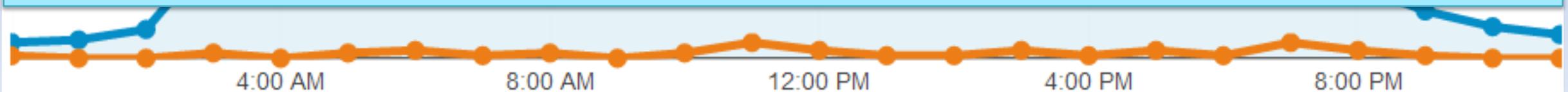


Dec 3, 2012 - Dec 3, 2012: ● Visits

Dec 3, 2011 - Dec 3, 2011: ● Visits

120

*"I trust the weather buoys with my life. Thank you." - Maine Fisherman; "Love your service...I believe your service is a lifesaver. Thanks!" -Dave, Pilot; and "I would like you to know that information you are providing us not only aids us in our work, it almost certainly has saved lives." -Roy Atkinson, Fisherman.*



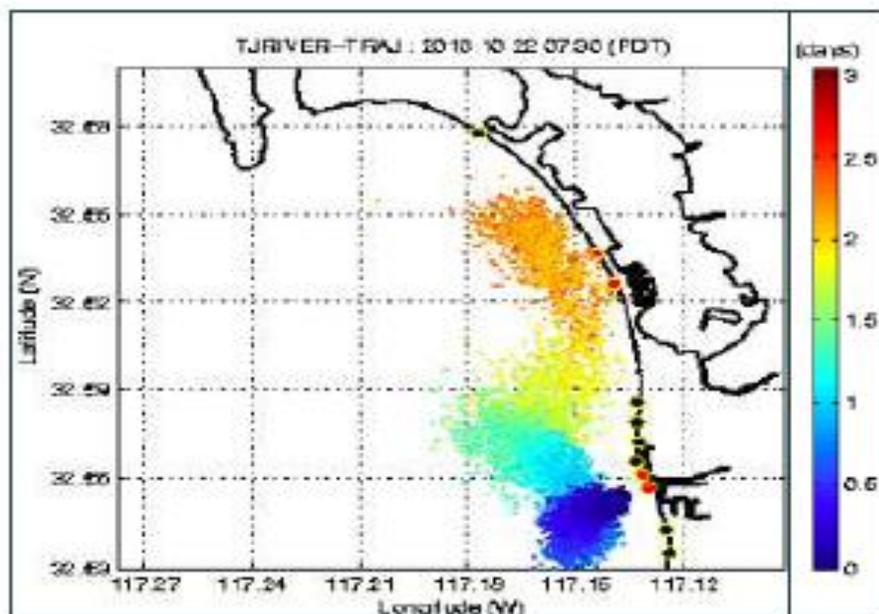


*Observations, including support for partners*

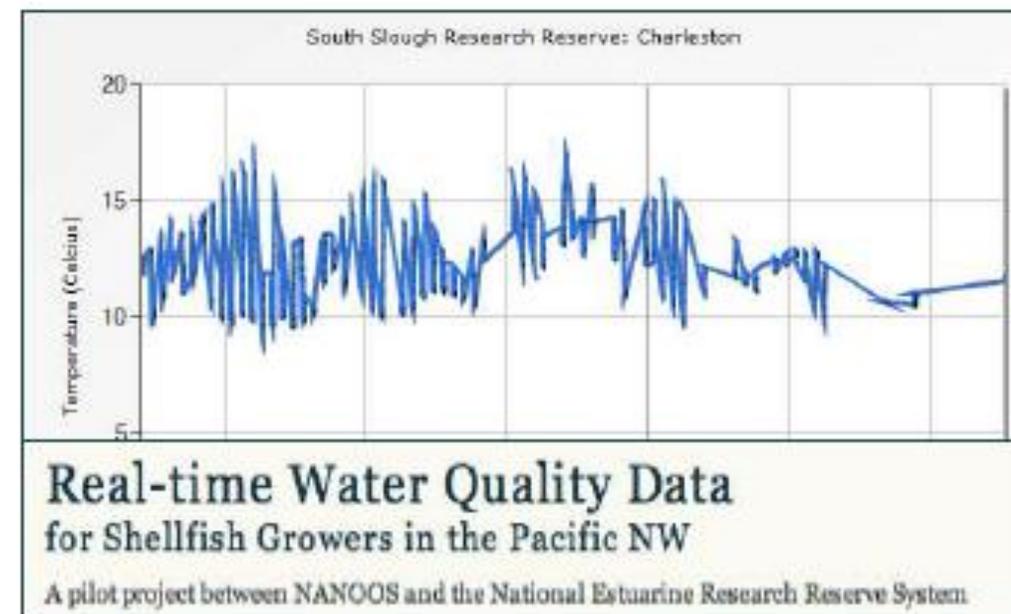
# IOOS RA's Involvement in Water Quality



*Data Services: Simplifying access to data*



*Plume Tracking*



*Customized Products*

# Drinking Water Quality:

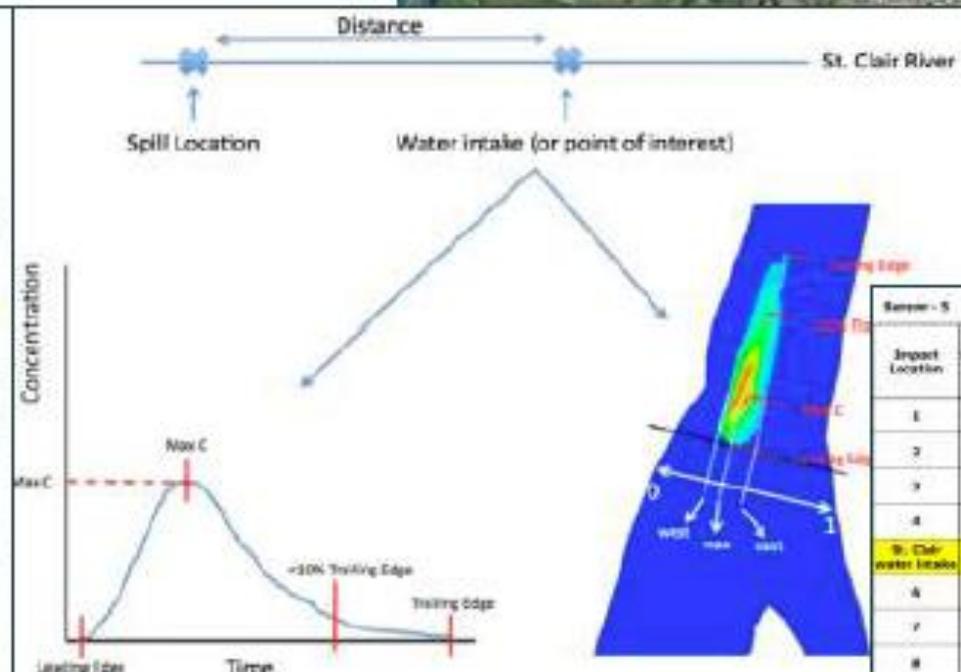
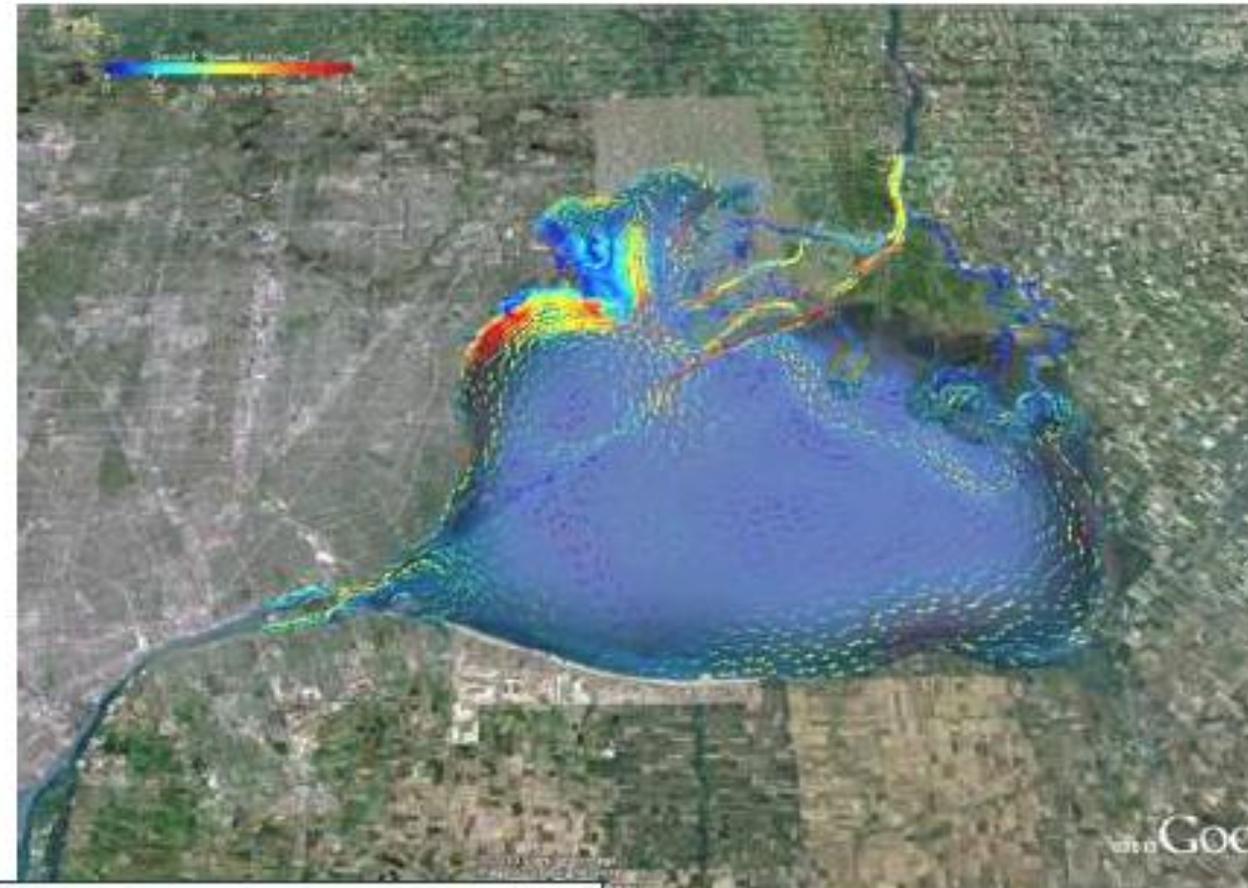
## Huron Erie Corridor Waterways Forecast System (HECWFS)

### Goal:

- Reduce health risks and costs associated with pollutant spills in the Lake Huron to Lake Erie Corridor

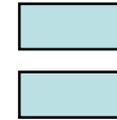
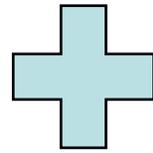
### Major Elements

- Link 2D model for corridor to NOAA Great Lakes Forecasting System
- Generate 3D public domain model
- Use 3D model to support water intake risk assessment work



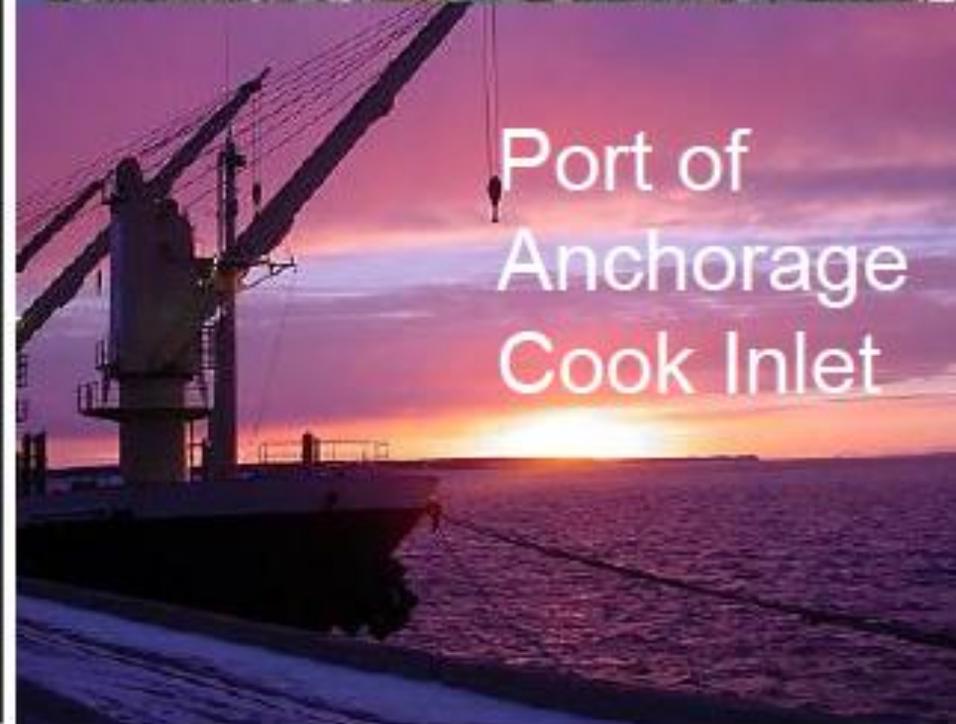
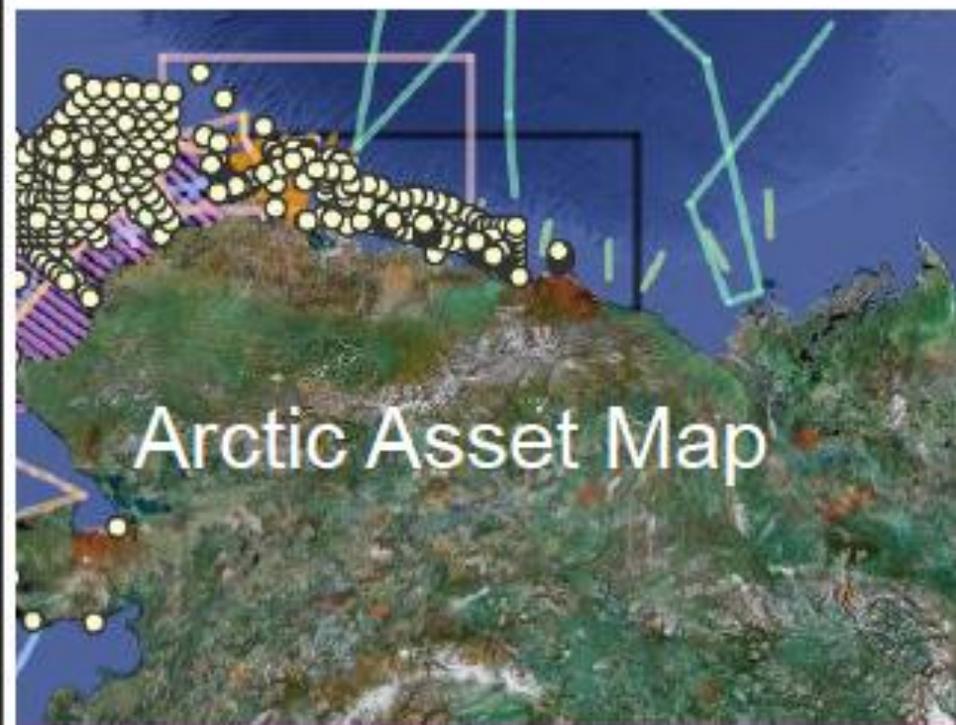
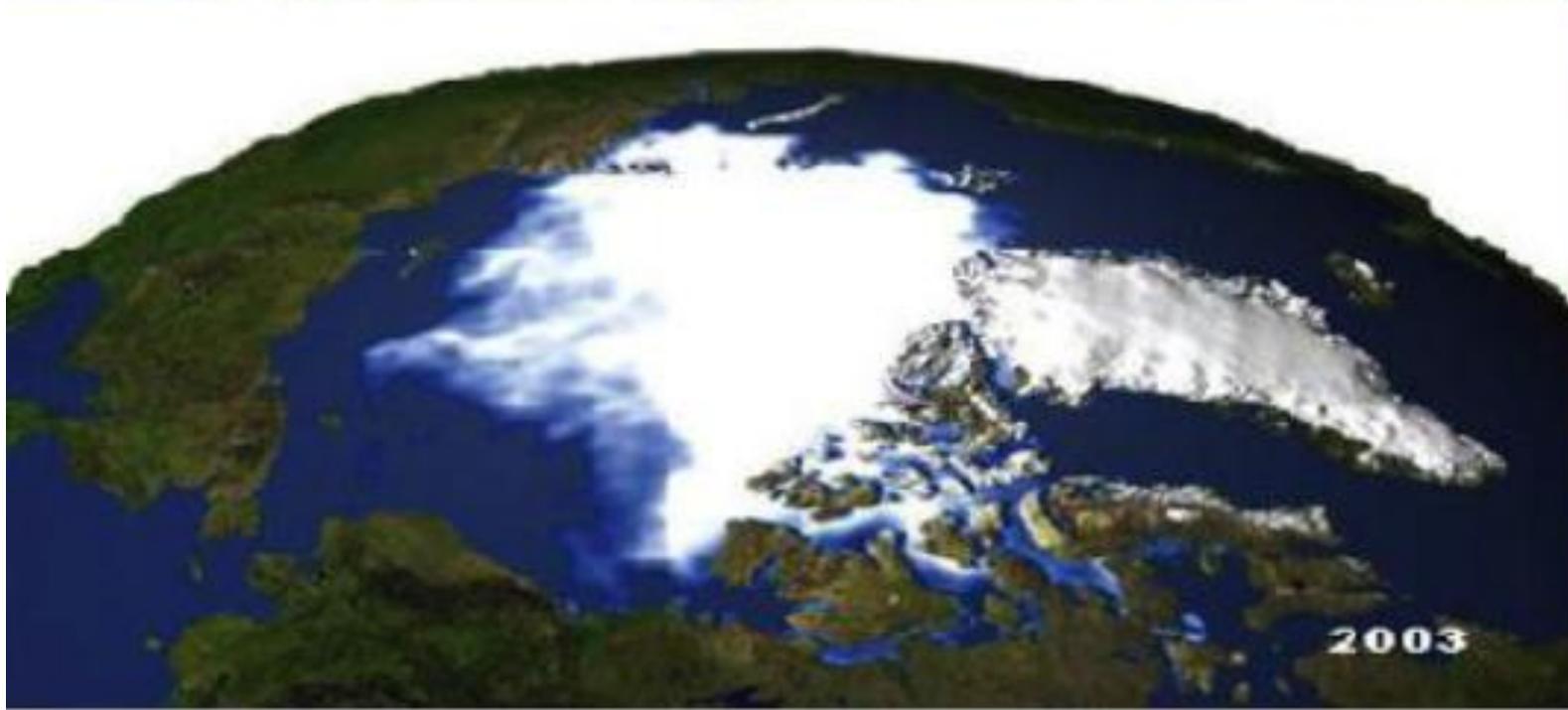
Impact Location	Leading Edge Time	Max Conc.	Time to Max Conc.	Trailing edge Time	Trailing edge at 10% C max	Trailing edge at 1% C max	W. edge	Max Inc.	I. edge
1	0 hr 25 min	2.28	0 hr 20 min	0 hr 20 min	0 hr 21 min	1 hr 28 min	0.21	0.23	0.85
2	1 hr 03 min	4.44	0 hr 22 min	0 hr 25 min	0 hr 30 min	1 hr 28 min	0.31	0.33	0.70
3	1 hr 23 min	4.70	0 hr 25 min	0 hr 40 min	0 hr 45 min	1 hr 48 min	0.25	0.25	0.75
4	2 hr 39 min	5.43	0 hr 28 min	4 hr 00 min	1 hr 21 min	1 hr 18 min	0.15	0.48	0.76
St. Clair water intake	4 hr 03 min	11.32	0 hr 35 min	8 hr 12 min	1 hr 21 min	1 hr 18 min	0.00	0.28	0.76
5	0 hr 05 min	27.2	0 hr 25 min	4 hr 25 min	1 hr 38 min	1 hr 25 min	0.05	0.25	0.80
6	0 hr 48 min	21.07	0 hr 30 min	4 hr 30 min	4 hr 45 min	1 hr 28 min	0.11	0.25	0.80
8	11 hr 13 min	26.42	0 hr 20 min	8 hr 30 min	4 hr 30 min	1 hr 18 min	0.00	0.15	0.85

# Oysters on the Half Shell



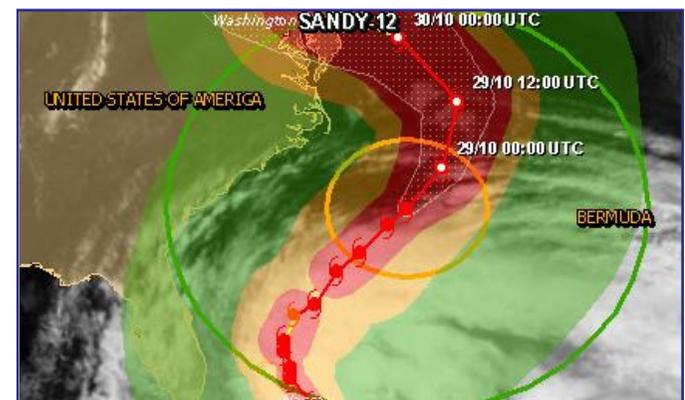
Little wild set of oysters on US northwest  
2008 Whiskey Creek Hatchery lost 100% of oyster larvae  
Ocean Acidification was the cause  
Real-time Observing System established  
By 2010 productivity was back to 70%

# Changing Arctic Conditions



# IOOS<sup>®</sup> Response to Super Storm Sandy

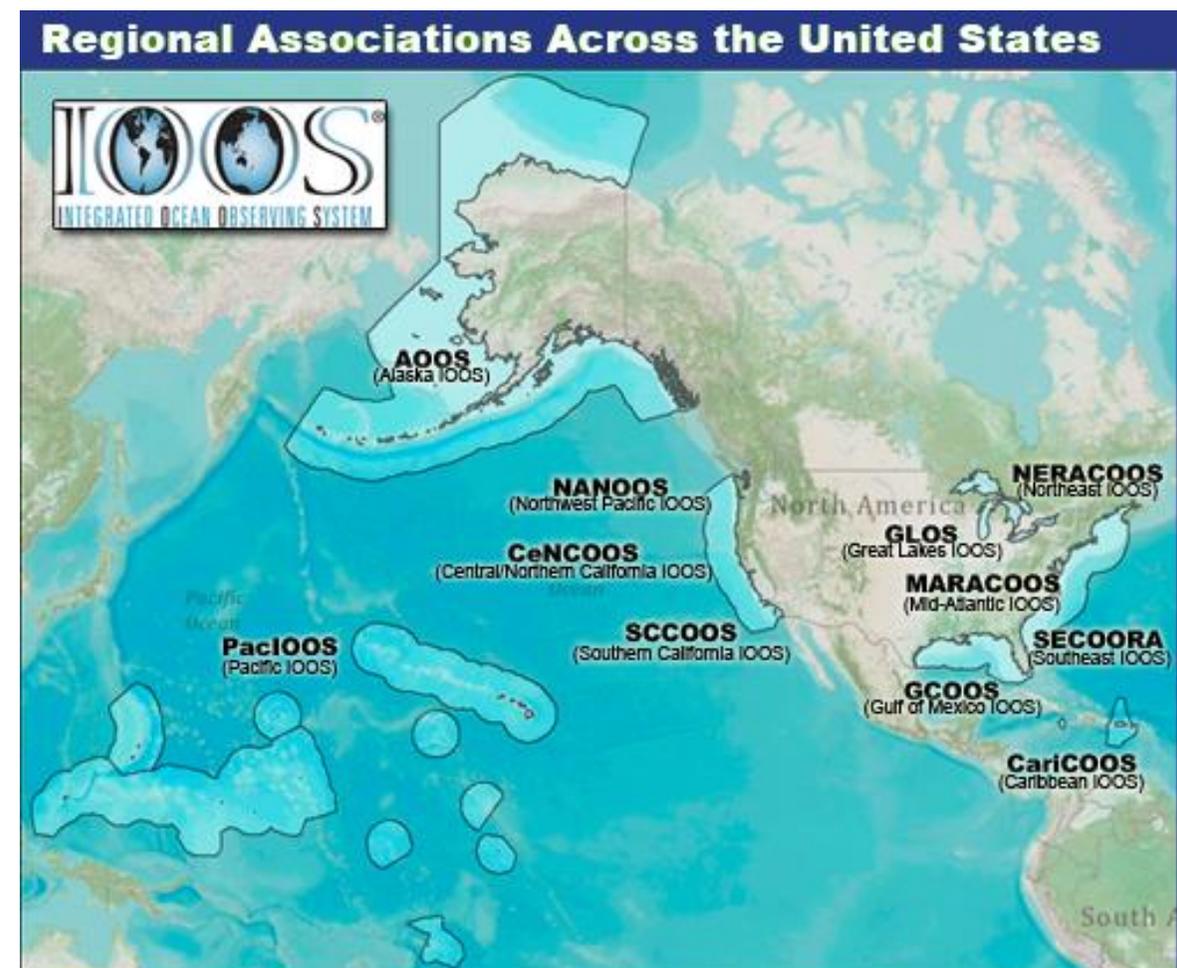
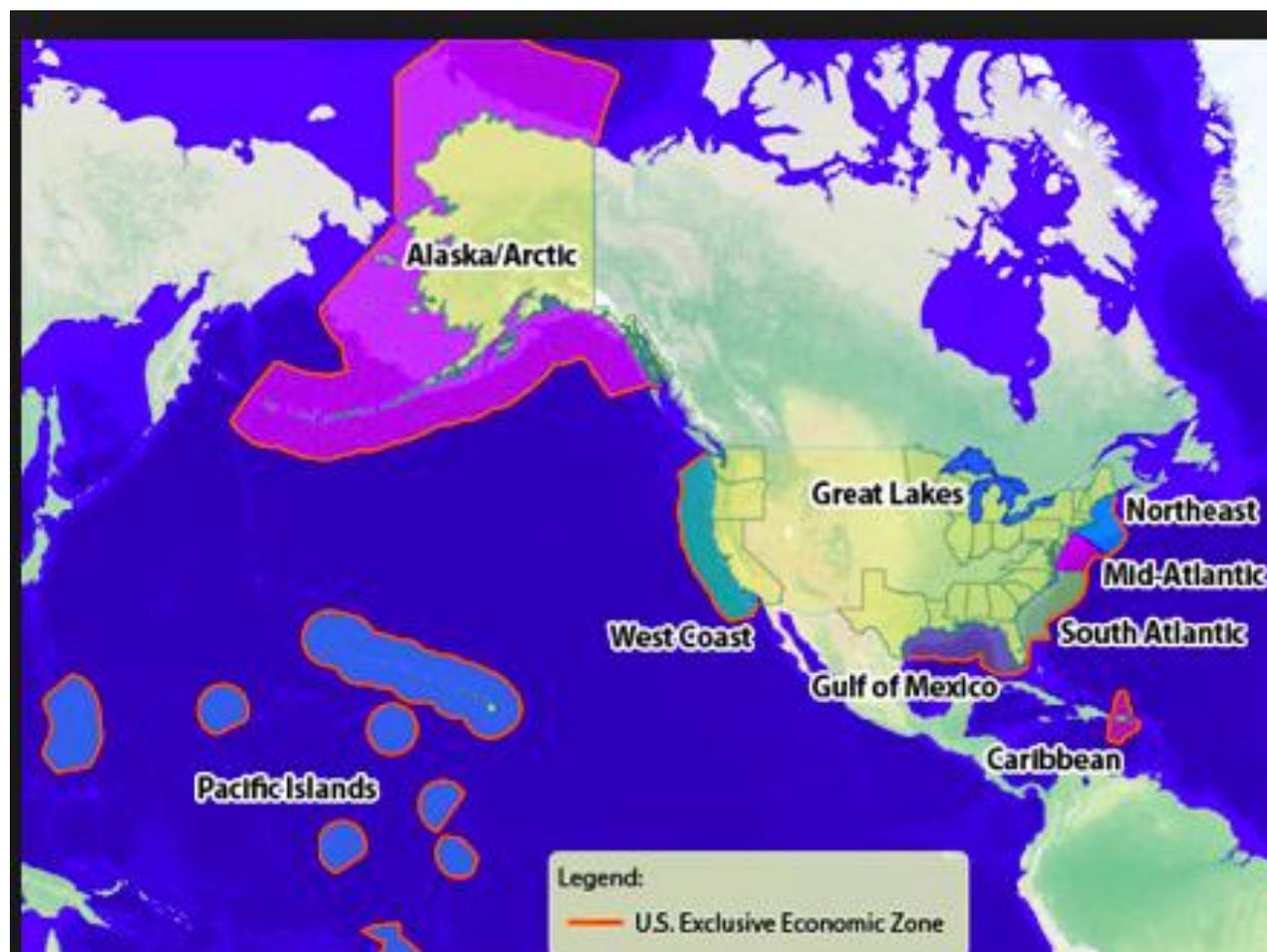
- IOOS partners' buoys, gliders and other sensors generated hourly updates
  - Wind velocities, wave heights and periods, water levels
  - Air and water temperatures
- 40+ High Frequency Radars
  - Ocean current data
- Information shared with National Hurricane Center
- Generated time critical warnings for local public officials
  - Storm path and flooding updates



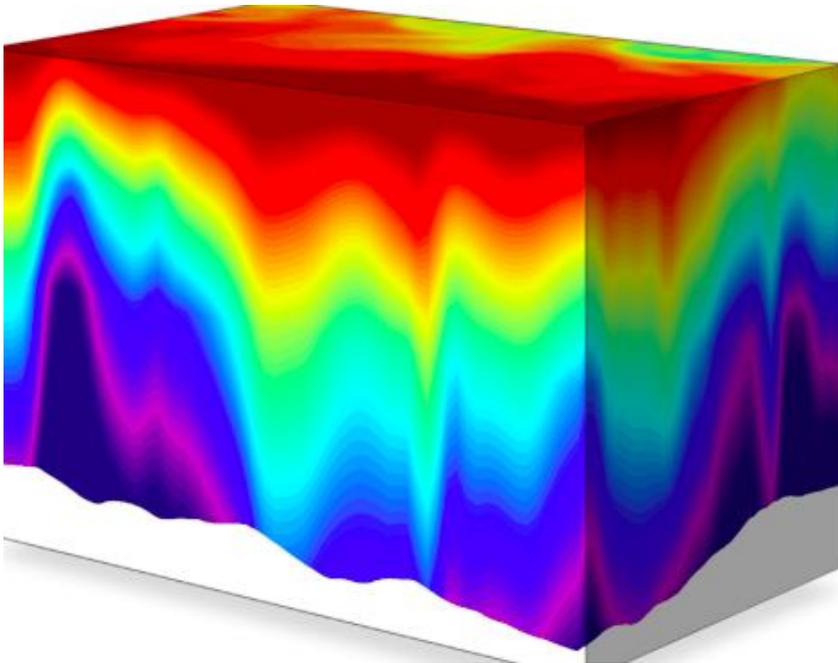
# Regional Approaches for MSP and IOOS

National Ocean Council:  
9 Regional Planning Bodies

U.S. IOOS:  
11 Regional Associations



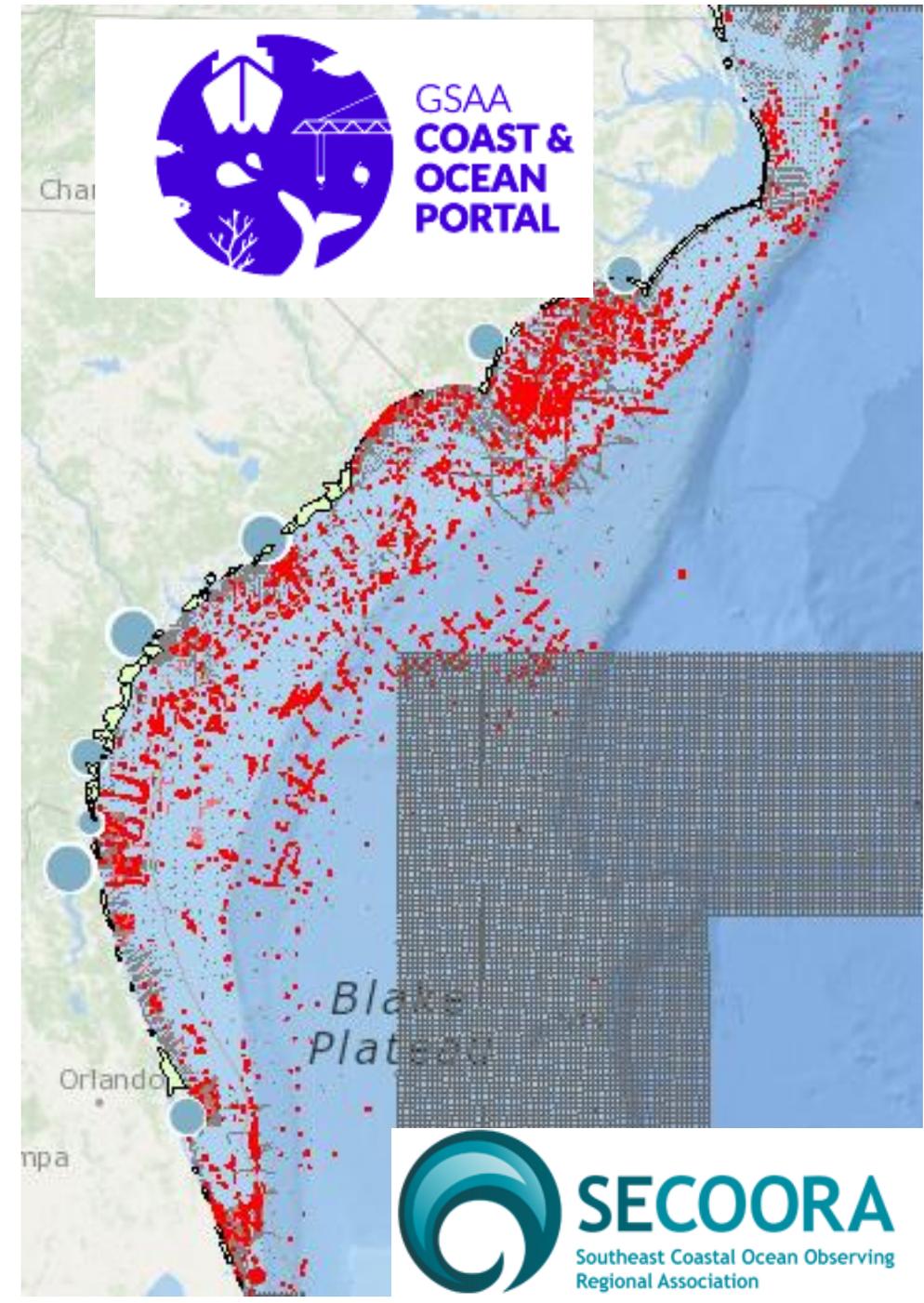
# Regional Data Portals



Oceans are complex

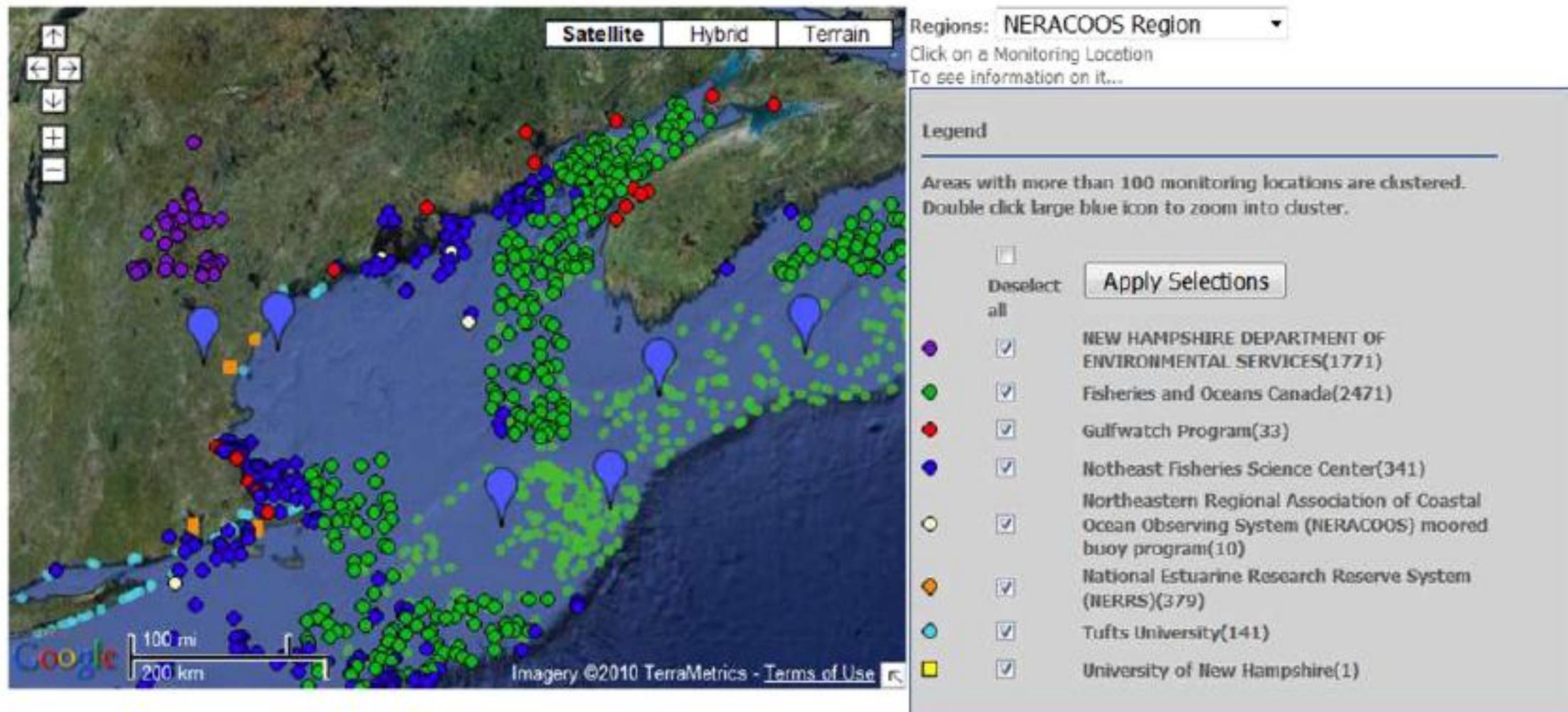
RAs enhancements to MSP:

- Data Integration
- Real-time data access
- Historic trends
- Model outputs
- Provides 4-D look at ocean – over time and throughout the water column



# Northeast Data Management and Portal

(<http://odpdx.neracoos.org>)



NH GRANIT

**NeCODP**  
Northeast Coastal and  
Ocean Data Partnership

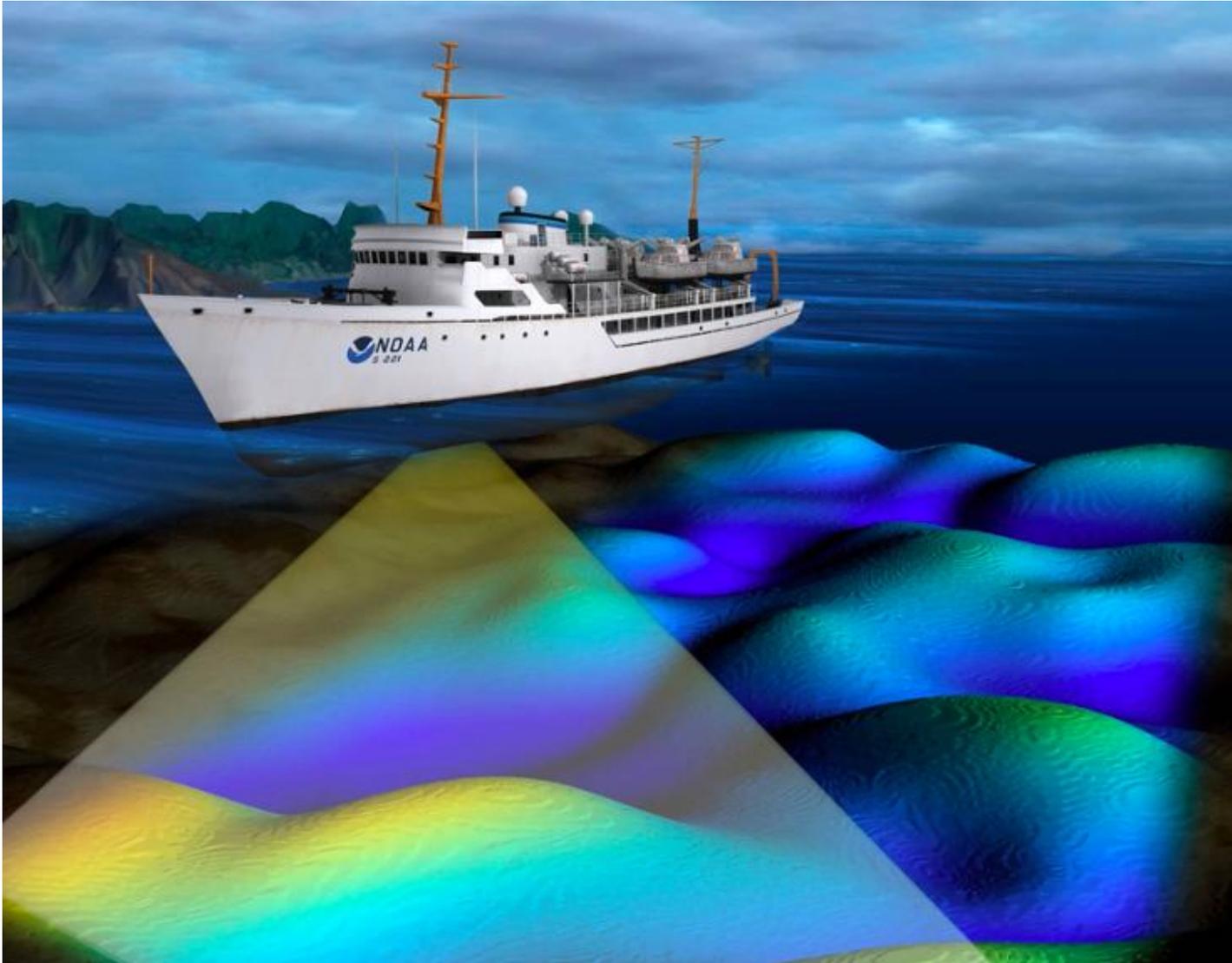


**NERACOOS**



Environmental Information  
**exchange**  
Network

# Bathymetry enables IOOS

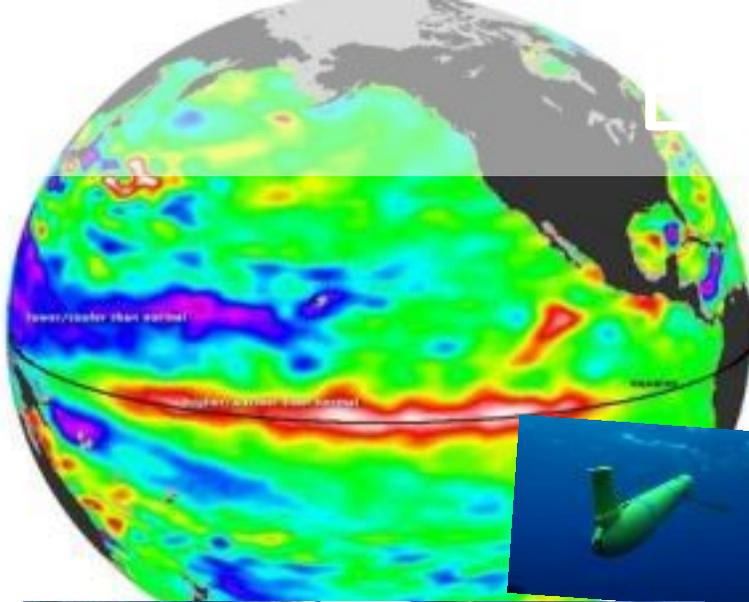


- IOOS depends on bathymetry for all its products
- US IOOS Program Office and Office of Coast Survey are now sister programs in NOAA's National Ocean Service
- Nearshore bathymetry for flooding is a critical need

**Thank you!**



# Education and Outreach



**IOOS** Integrated Ocean Observing System

**Education, Outreach and Training**

This site is designed for formal and informal education, training, and outreach activities. You can view, download information about physical, chemical, biological, and geological changes in our oceans, coasts, and Great Lakes.

**Member Websites**

- Alaska (AKIOOS)**
  - Alaska Center for Ocean Education (ACEO)
  - The ACEO/IOOS seeks to help you design and implement educational programs that are relevant to scientists, teachers, students, and the public.
  - Training for Coastal Management, Alaska Coastal Observing System, coastal education, other products.
- California (CALIOOS)**
  - The CALIOOS Education Center provides easy adaptation of videos, audio, graphics, water quality and coastal flooding in real time for the various needs of coastal users such as recreational and commercial fishermen, parties, scientists, students, researchers, government regulatory agencies, and emergency management agencies, among others.
- Central and Southern California (CASCIOOS)**
  - The CASCIOOS provides educational products for users of all ages to learn about IOOS and topics related to ocean observing in the region.
- East of Mexico (EOMIOOS)**
  - East of Mexico Coastal Ocean Observing System Education and Outreach offers formal and informal education resources, regional grant calls, and training information for the Gulf Coast - from Florida to Texas.
- Great Lakes (GLIOOS)**
  - Working with Great Lakes IOOS - Great Lakes University and activities, data sets and tools.
- Mid Atlantic (MATIOOS)**
  - MATIOOS Education seeks to educate users on real product delivery and understanding. Through workshops, programs, studies, and projects and publications, MATIOOS hopes to educate the many users of ocean observation data.
- Northwest Pacific (NWPACIOOS)**
  - Learning tools, lesson plans, and data to support classroom use for teachers and students.
- Northwestern Atlantic (NORWACIOOS)**
  - Resources ranging from teacher materials, classroom programs and fieldkits to publications and outreach materials.
- Northwest Atlantic (NORWACIOOS)**
  - Classroom activities, field observations, and data sets and more.
- Northwestern California (NWCALIOOS)**
  - Works in an ocean observing system: surface current mapping, understanding of systems, automated data access, remote data viewing, and more. Topics include: education, professional development, and data sets for classroom and field.

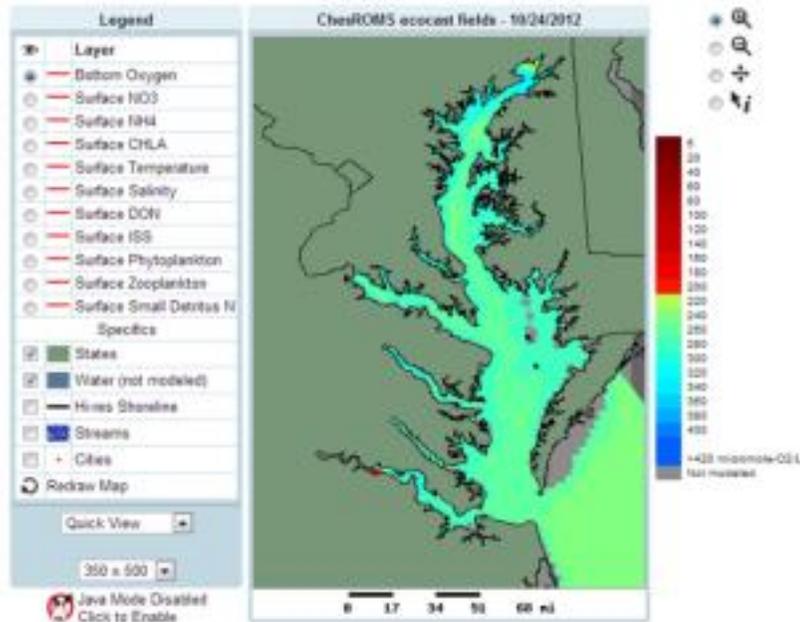


## Basic Observational Buoy (BOB)

Educational project for Universities and High schools to address STEM disciplines



# Estuarine Hypoxia

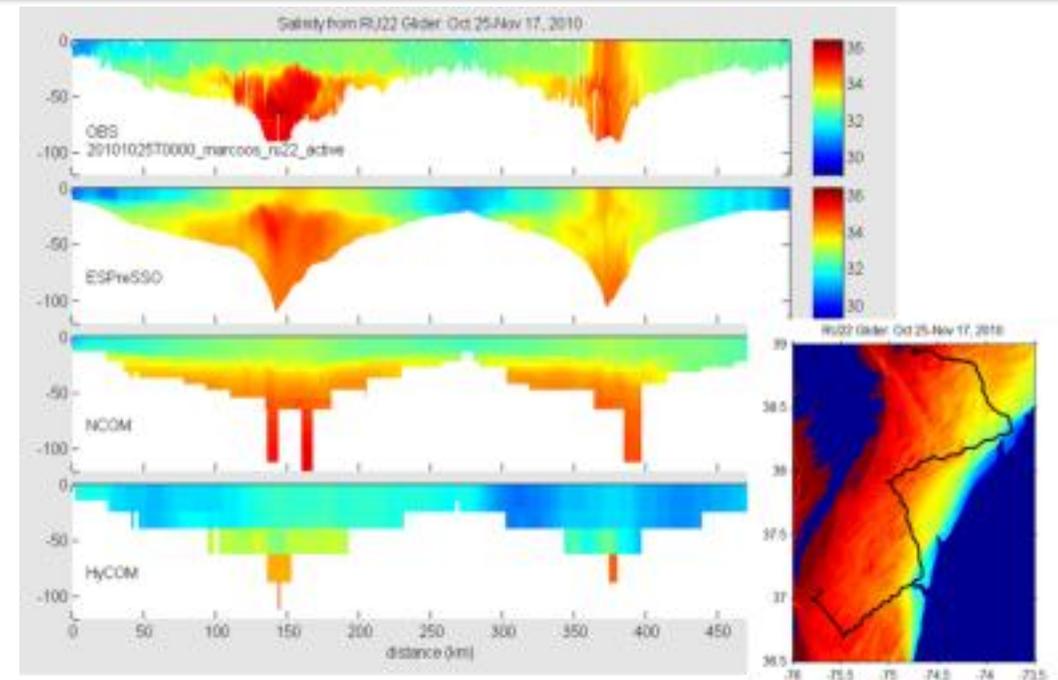


This project represents collaboration between scientists of the National Oceanic and Atmospheric Administration, the University of Maryland and the University of Maryland Center for Environmental Science. Funding from NOAA's Coastal Ocean Program, Monitoring for Ecosystem Services for Maryland's Coastal Bays, and Ocean and Human Health Initiatives are responsible for the project.



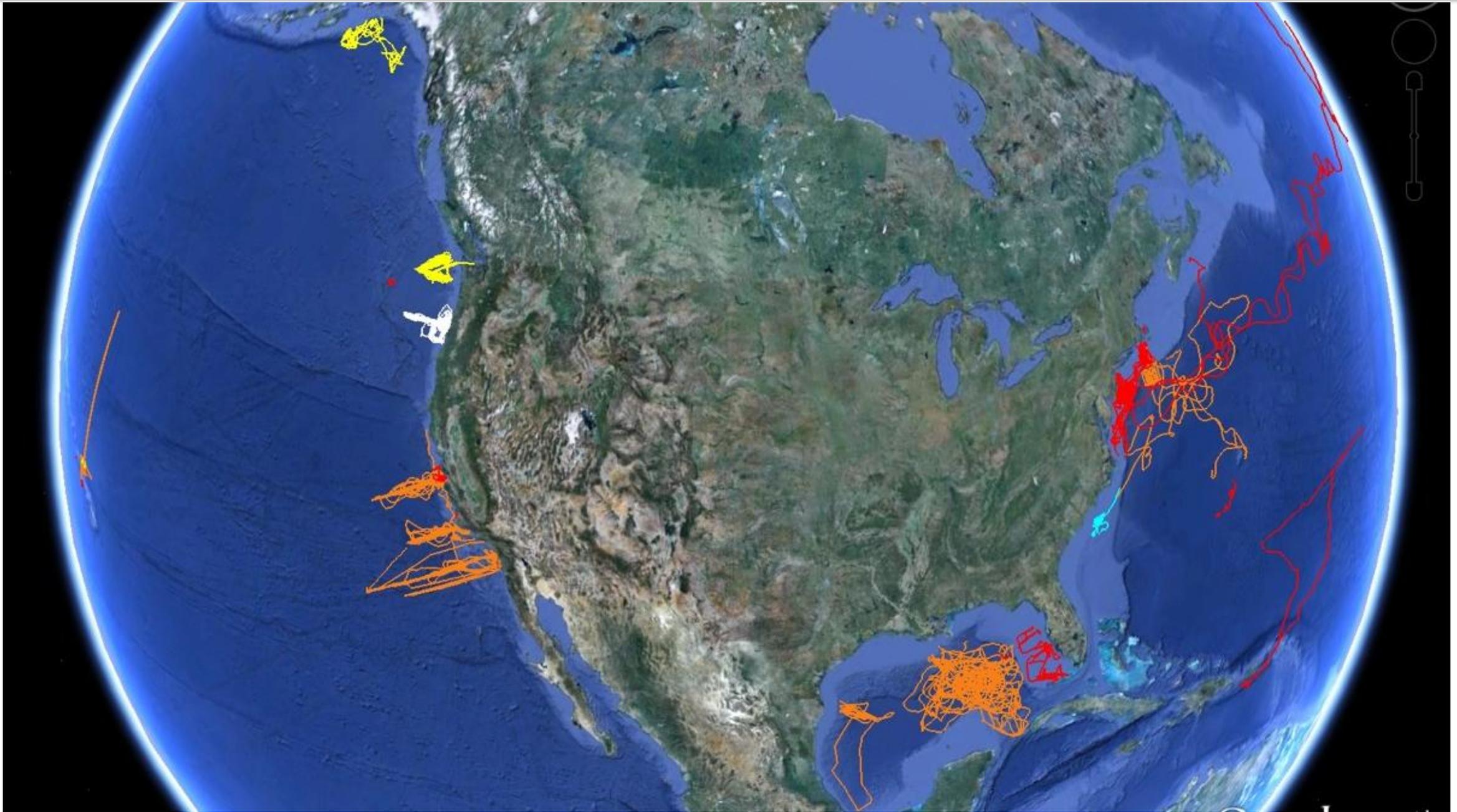
- Transitioning information to federal agencies
- Model Comparison
- Conducting sensitivity experiments
- New, single term hypoxia model

# Cyber Infrastructure



- Interactive Model and Observation Explorer
- Unstructured Grid Support
- NCToolbox
- Matlab as a Web Service
- Skill Assessment Tools
- Collaborative Web Site

# Glider observations on the US coast



- Gliders' role in ocean observing system is to patrol the boundaries, connecting the coastal and open ocean

# Why IOOS: A Growing Enterprise

## Summary of Glider Days for 2008-2012

Year	Glider-days of data collected annually by glider operators. (Glider-day = 1 glider in the water collecting data for 1 day)	Glider-days completed outside of the EEZ	Glider-days supported by IOOS PO
2008	4007	890	349
2009	4739	1132	337
2010	4944	1329	990
2011	5740	1663	772
2012	6292	1793	715
<b>2008 – 2012 Totals</b>	<b>25722</b>	<b>6807</b>	<b>3163</b>

\* Glider Days provided with support from Federal Agencies including NSF, ONR, NOAA, EPA, state and local governments and private foundations.

# *Safety and Environment*



**IOOS uses HF radar to hasten response to oil spills and harmful algal blooms**



Improves the quality of life at home and around the globe

Surface current data, continuous and in near real time, inform models

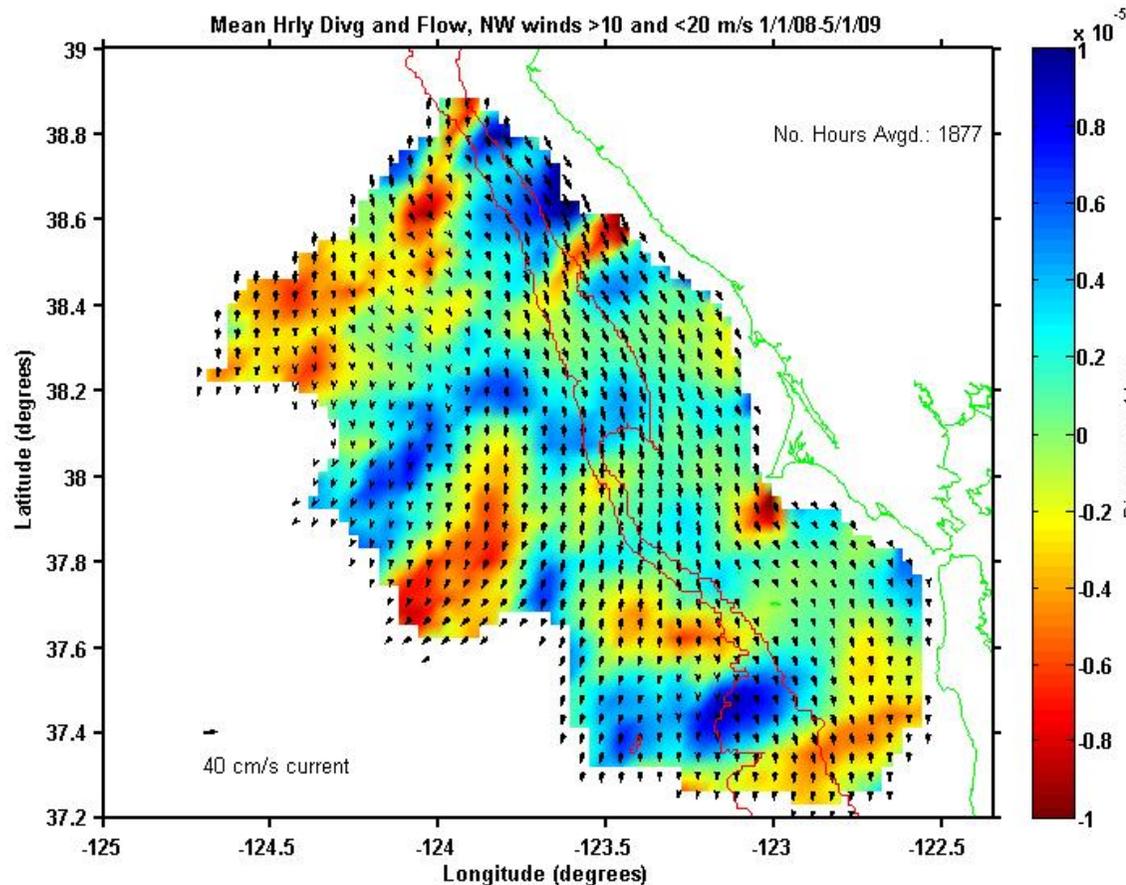
People lost at sea are found faster

Pollution can be tracked and ecosystems better assessed

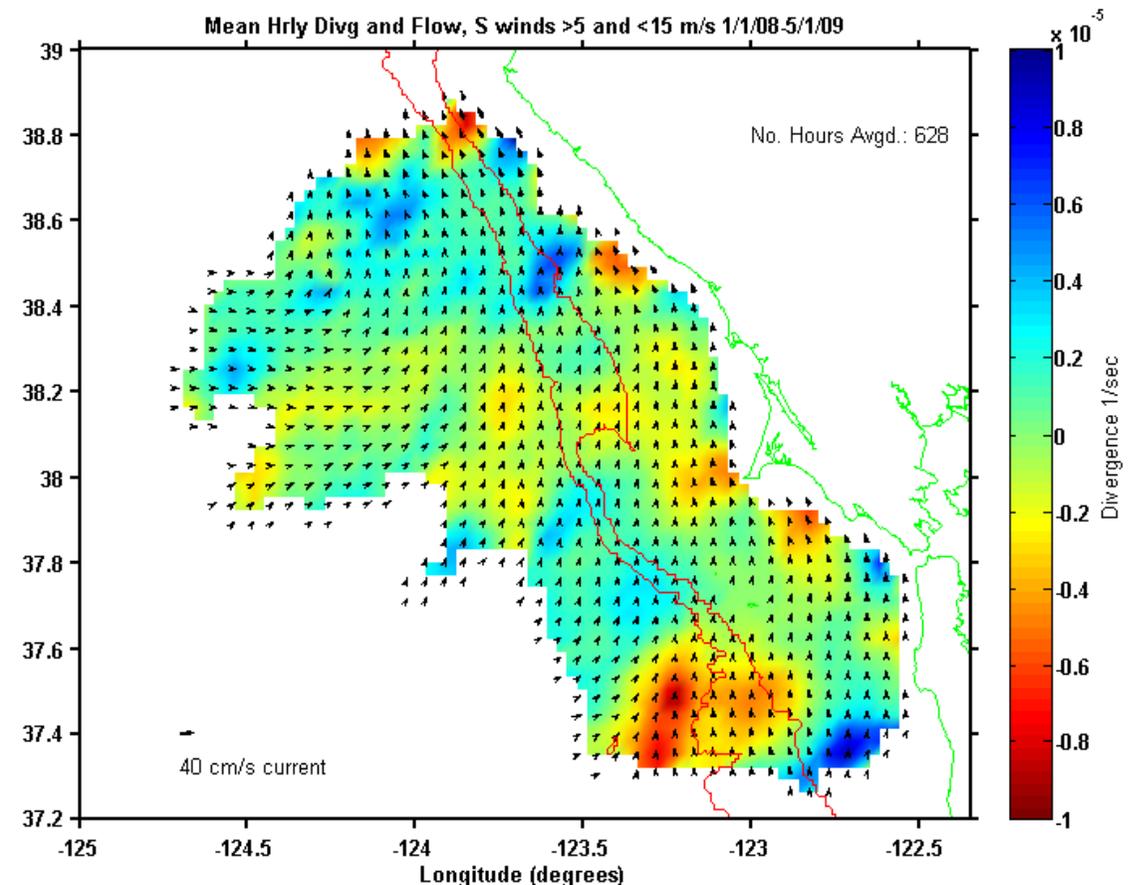
*U.S. Integrated Ocean Observing System (IOOS)*

# DIVERGENCE & CONVERGENCE (FRONTS)

- Divergence – regions of persistent surface divergence & upwelling due to wind-driven Ekman transport & flow past topography.
- Convergence – associated with flow past topography & fronts.
- Fronts represent high-productivity interfaces ... aggregations of plankton, fish, birds, mammals.



Upwelling Winds



Weak Winds

# U.S. Integrated Ocean Observing System (IOOS)



**We need advanced tools to understand and monitor our oceans, coasts & Great Lakes**



# Data Management Efforts

- NetCDF file format:
  - based on Trajectory CF Discrete Sampling Geometry
  - IOOS optimized for web services distribution via THREDDS Data Server
- **Proposal:** GROOM/EGO; IMOS; IOOS agreed to international standardization of NetCDF – GROOM Assembly meeting June 4-5, 2013
- GTS Distribution
  - IOOS funding National Data Buoy center to write encoding software to deliver glider data in both TESAC and BUFR
  - Need to work through JCOMM Task Team on Table Driven Codes to get this approved through WMO
- **Proposal:** GROOM/EGO; IMOS, IOOS agreed to work together on this effort and with corresponding meteorological agencies – GROOM assembly meeting June 4-5, 2013

# Maritime Transportation-San Pedro Channel

Site SP001 - info  
San Pedro Harbor  
Site 001

## Data Tables

- Parameter
- 9-band energy
- 9-band direction

## Daily & Weekly Plots

- Waves - 1 day
- Waves - 1 week
- Wave forecast

## Simulated Time Series

### Series

- Z displacement values
- Z displacement plot

## Latest Model Run

- 9-band plot
- Spectral plot
- Directional spectrum
- Spectral file

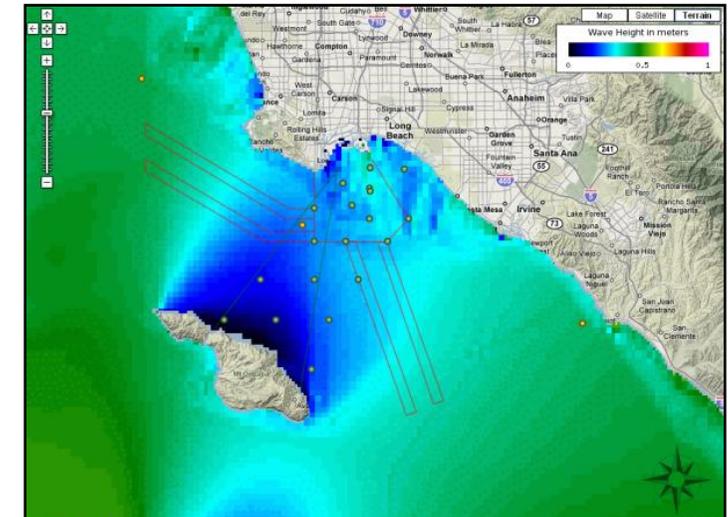
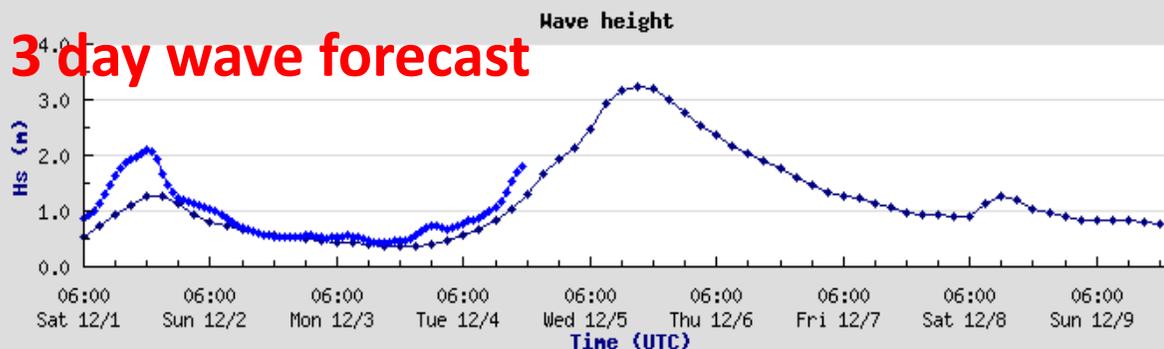
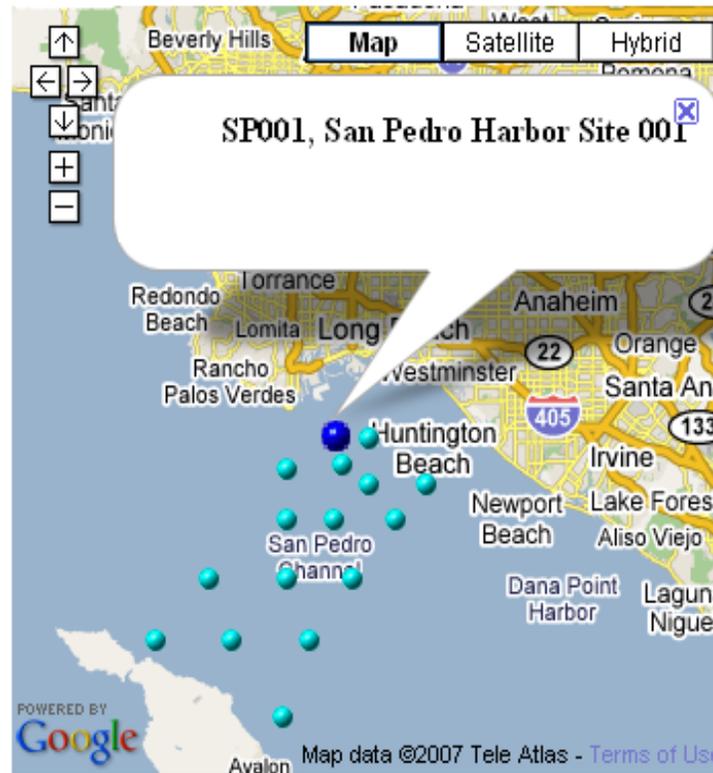
## Descriptions/Help

## Summary Table

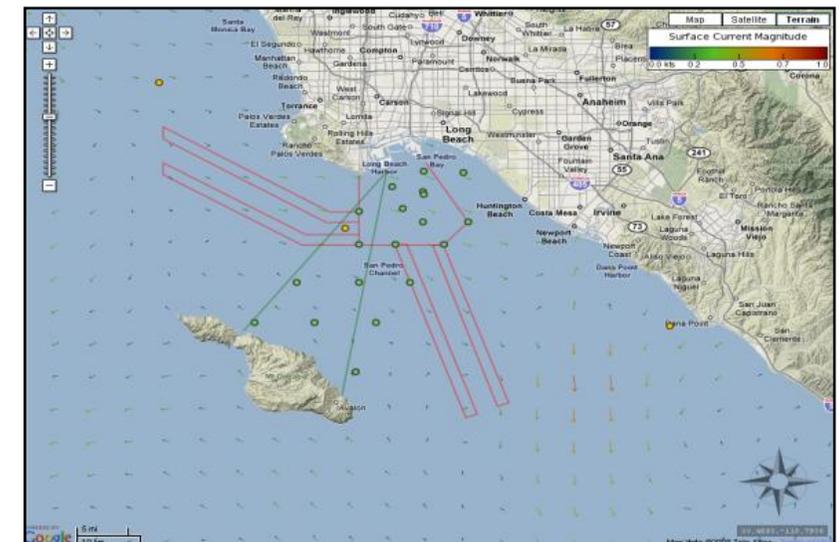
## Location Map

Site ID:

- Location:  
33 41.10 N 118 14.22 W  
(33.6850 - 118.2370)
- Water depth:  
999.9 m (3281 ft, 547 fm)
- Modeled parameters:  
wave energy, wave direction



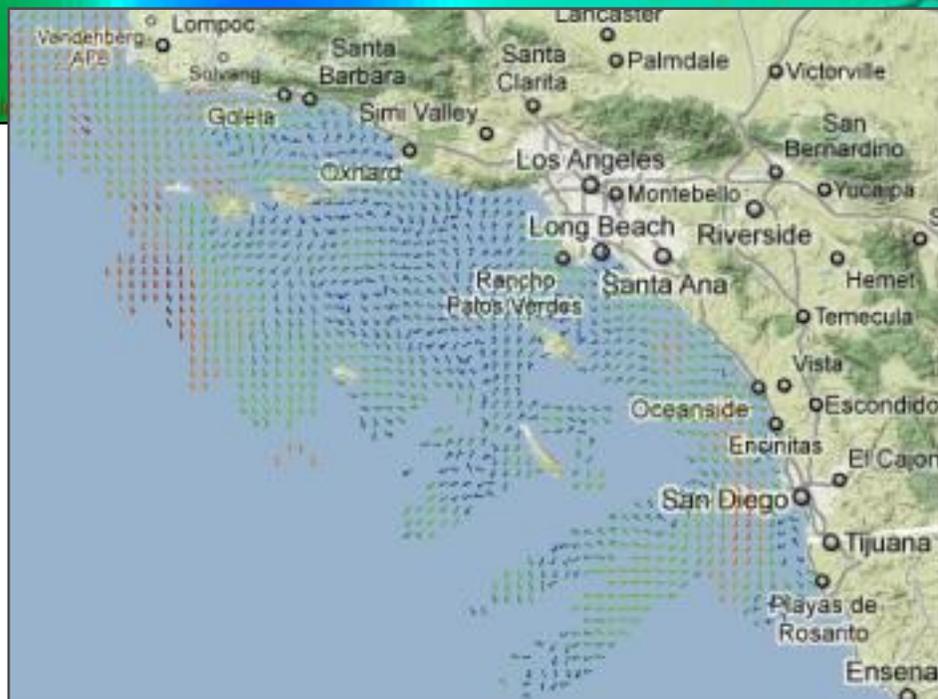
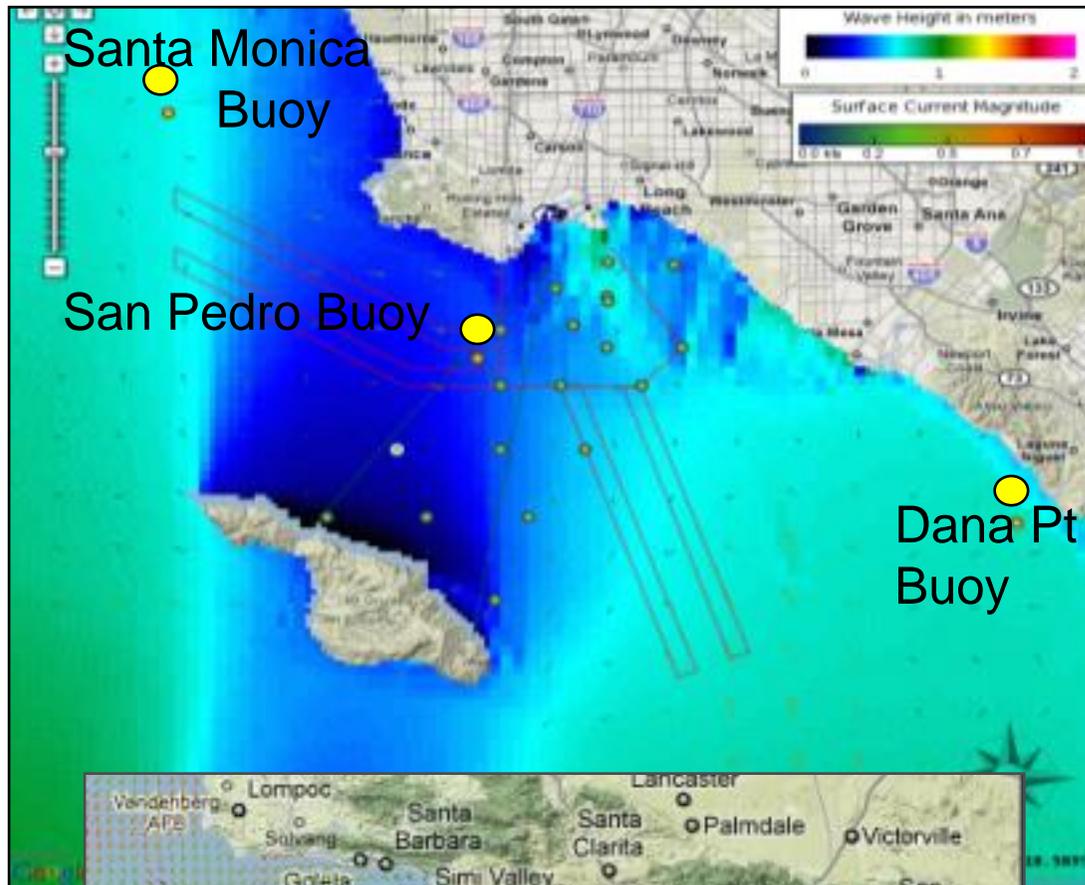
**CDIP provides waves**



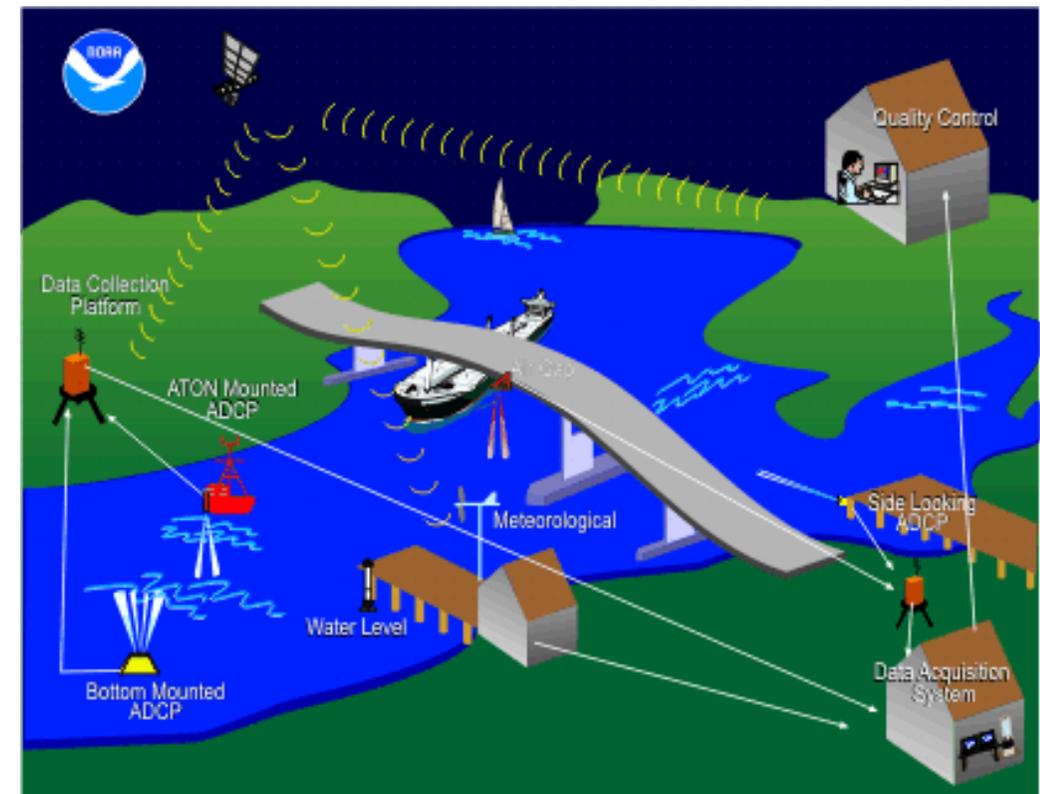
**SCCOOS provides currents**

Automated notification when thresholds exceeded

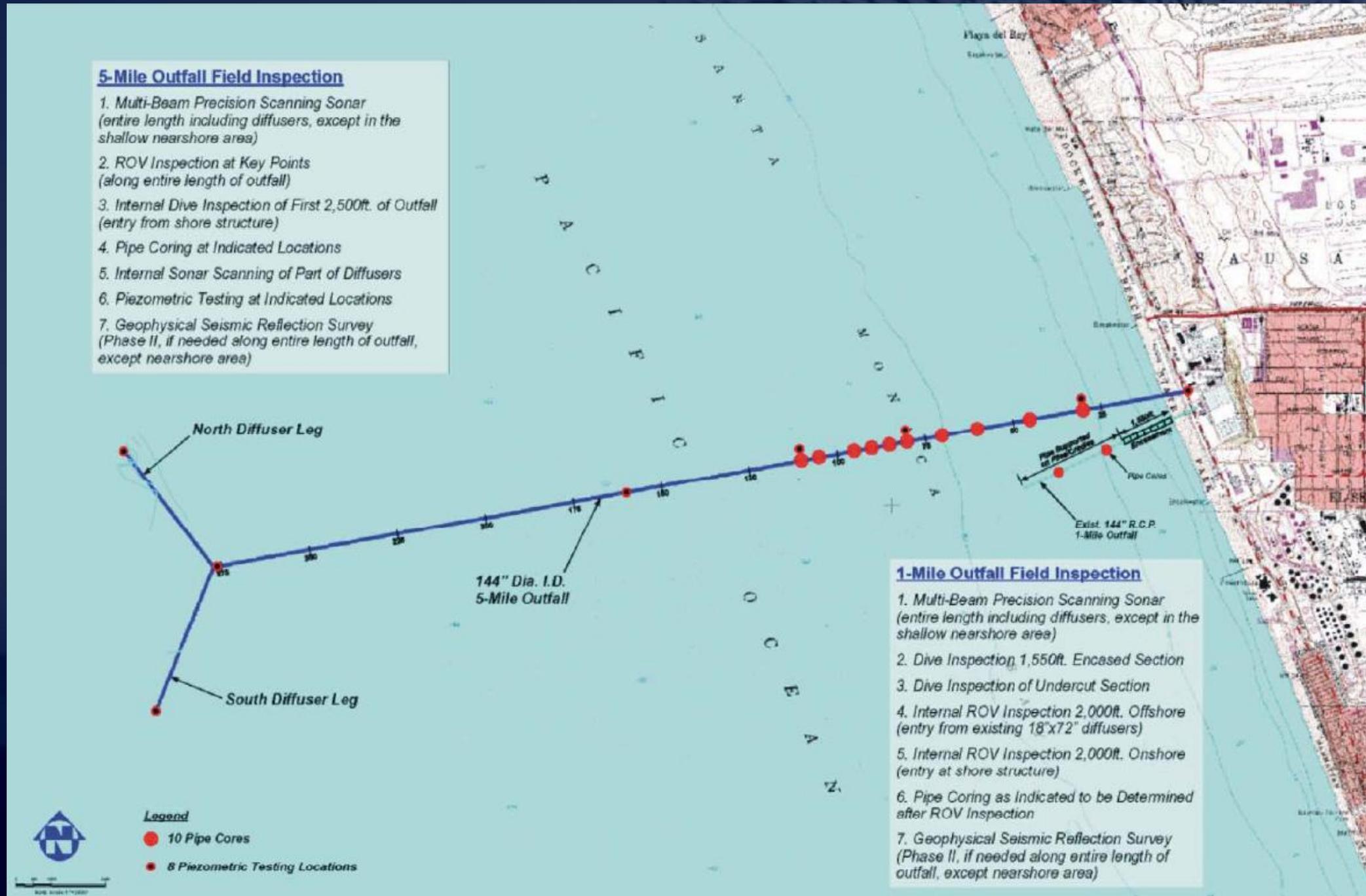
# Safe and Efficient Navigation



- Coastal Data Information Program (CDIP) providing wave observations, nowcasts, and forecasts.
- SCCOOS providing HF Radar surface currents.
- NOAA Physical Oceanographic Real-Time System (PORTS)



# Hyperion Outfall Diversion



- Inspection of Hyperion Outfall Pipe (never internally inspected for 50 years). Serves City of Los Angeles. One of the world's largest coastal populations.
- Close to a billion gallons of sewage to be diverted to an in-shore/shallow outfall.
- Concern of extent of impact and public health risk in the Santa Monica Bay