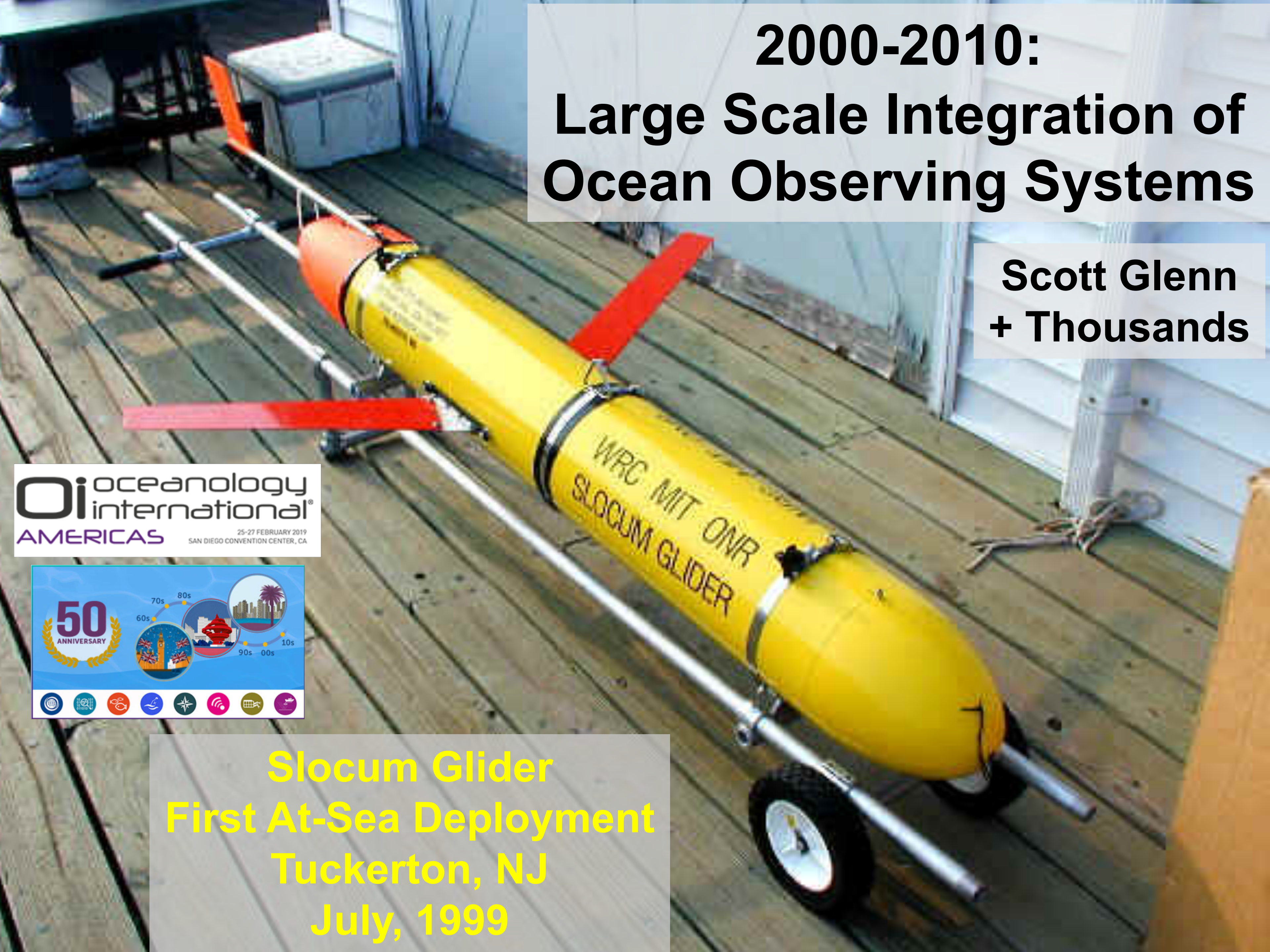
2000-2010: Large Scale Integration of Ocean Observing Systems

Scott Glenn
+ Thousands



**Slocum Glider
First At-Sea Deployment
Tuckerton, NJ
July, 1999**

An early slide from Dave Martin:

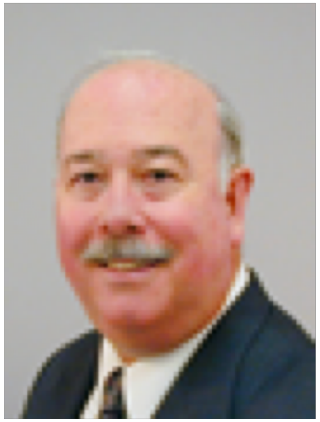
"Ocean.US" is established under the auspices of NOPP

NORLC-commissioned reports in 1998 & 1999 recommended establishment of a national capability for **integrated** and **sustained** ocean observations & prediction

In May 2000: (1) The NORLC directed the establishment of Ocean.US
(2) Formation of Ocean.US announced to Congress.

To manage the development of an Integrated and Sustained Ocean Observing System (IOOS) for research & operations in the following areas:

- **Detecting and Forecasting Oceanic Components of Climate Variability**
- **Facilitating Safe and Efficient Marine Operations**
- **Ensuring National Security**
- **Managing Marine Resources**
- **Preserving and Restoring Healthy Marine Ecosystems**
- **Mitigating Natural Hazards**
- **Ensuring Public Health**



Estimated costs from the 1999 Frosch Report:

"~30M per year to start, ramping up to ~$100M per year when it is fully operational."

An historical timeline:

https://ioos.noaa.gov/about/ioos-history/

U.S. Integrated Ocean Observing System (IOOS)

Partnership effort that leverages dispersed national investments to deliver ocean, coastal and Great Lakes data relevant to decision-makers.

Global Component

- US contribution to Global Ocean Observing System (GOOS)
- 1 of 15 Regional Alliances of GOOS

The Global Ocean Observing System

Now

National Component

- 17 Federal agencies

Regional Component

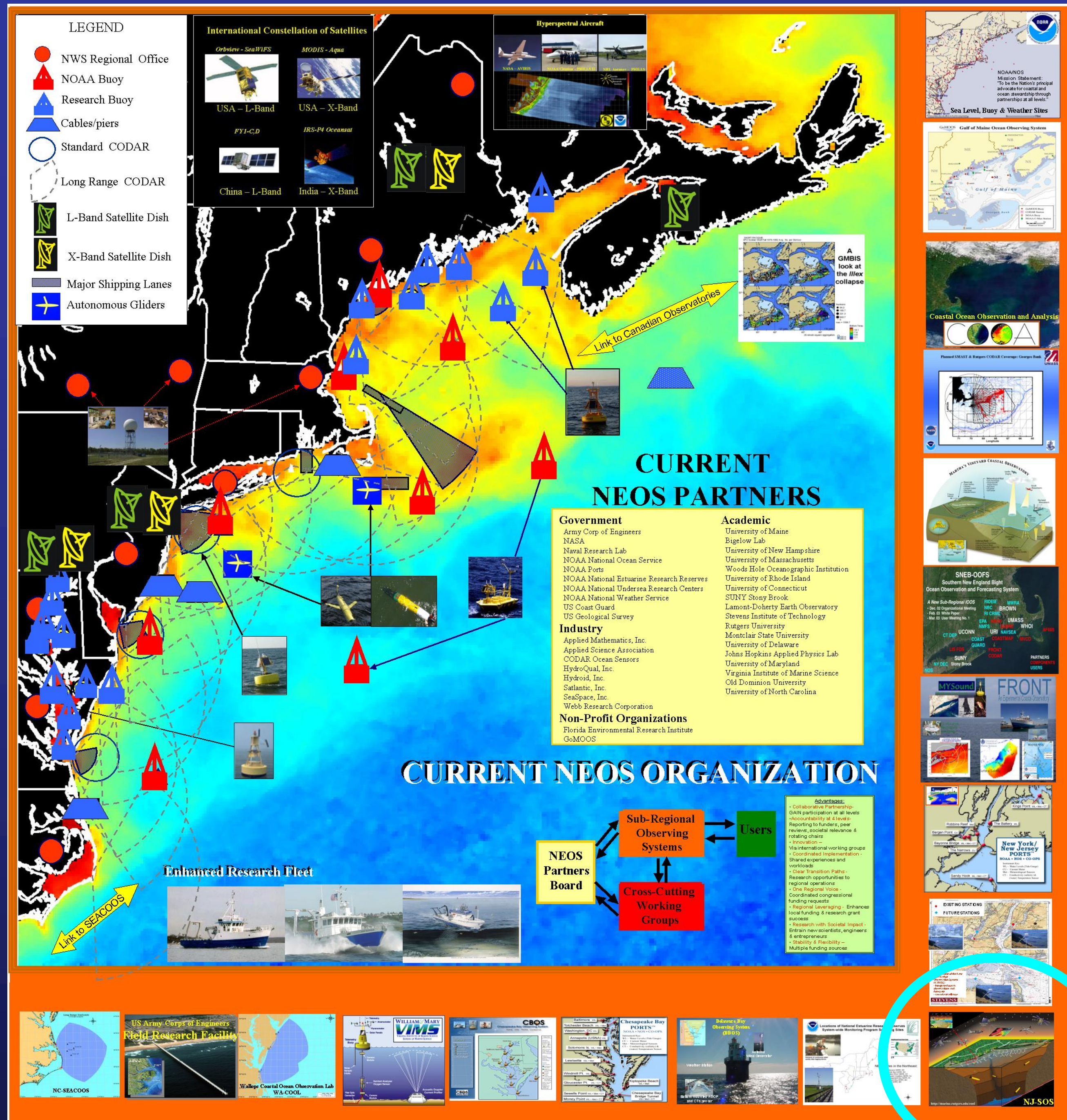
- 11 Regional Associations
  - Stakeholder driven
  - Academia, state/local/tribal government, private industry
  - Government Certified

NEOS 2003

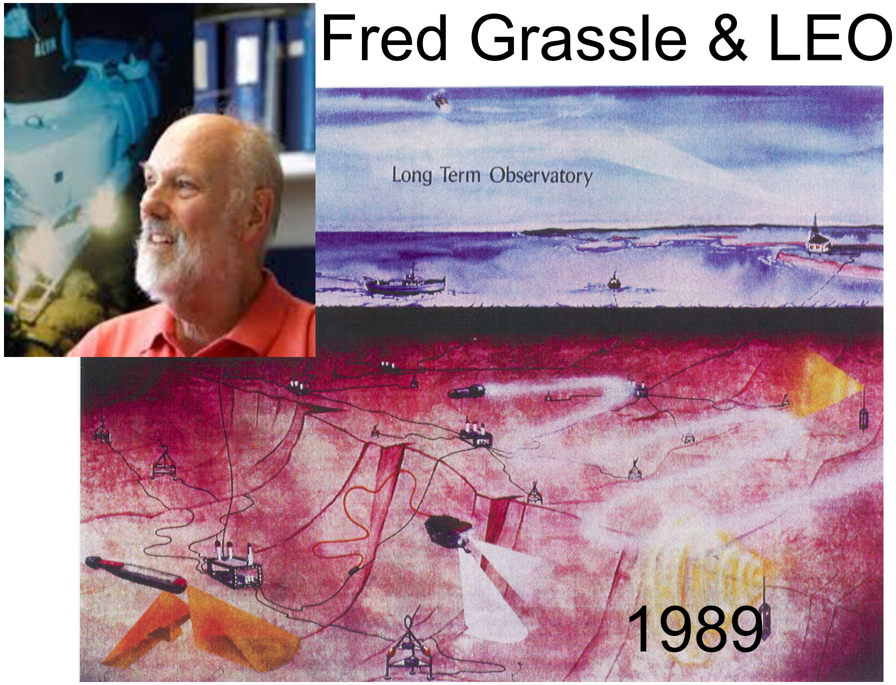
Ocean.US Poster Request

Developed from March 2003 Maryland Workshop

Numerous Existing Sub-Regional Observatories

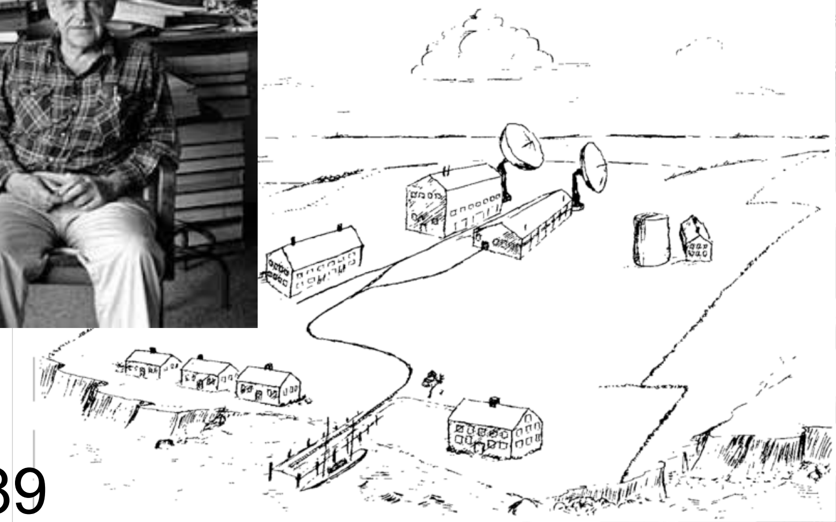


Fred Grassle & LEO



1989

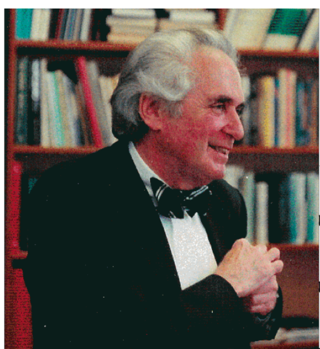
Henry Stommel & The Slocum Mission



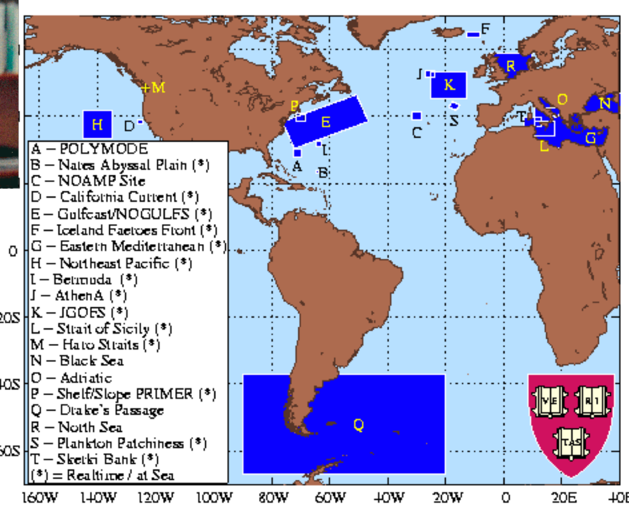
1989

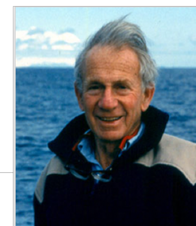
The Slocum Mission Control Center on Nonamesset Island.

Alan Robinson & The Harvard Model



Transitioning Forecasts to Operations 1986-1989





A Look Back

"If I were to choose a single phrase to characterize the first century of modern oceanography, it would be a century of under-sampling."

Walter Munk, 2000

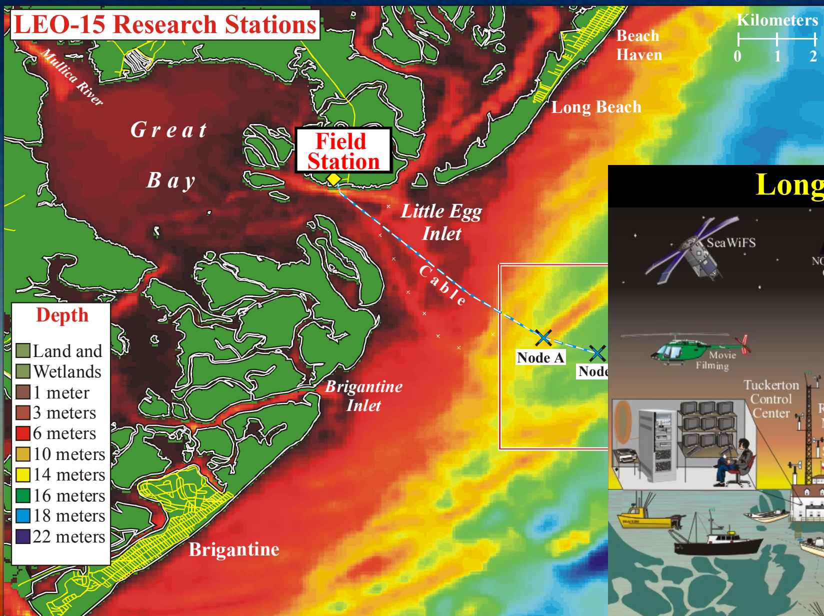
A Look Forward

Technology is Enabling Scientists to Improve Our View

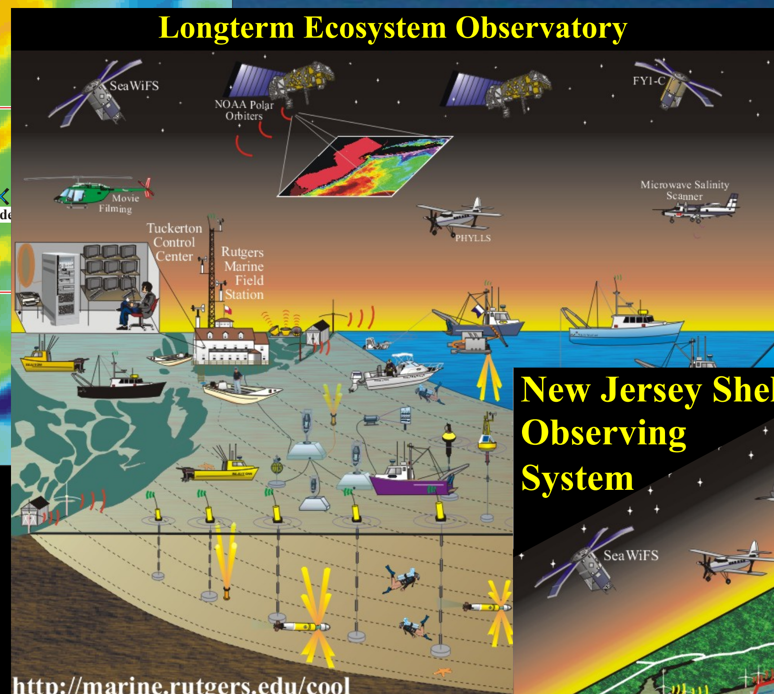
1	**Satellites in Space (Beginning in 1980's)**
+1	**+ Subsurface Ocean Arrays (Now!)**
----	**-----------------------------------**
3	**Well Sampled Ocean**

Walter Munk, 2000, Oceanography Before, and After, the Advent of Satellites.

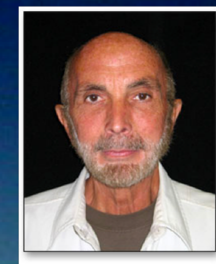
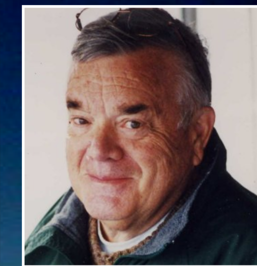
LEO-15 → LEO → NJSOS



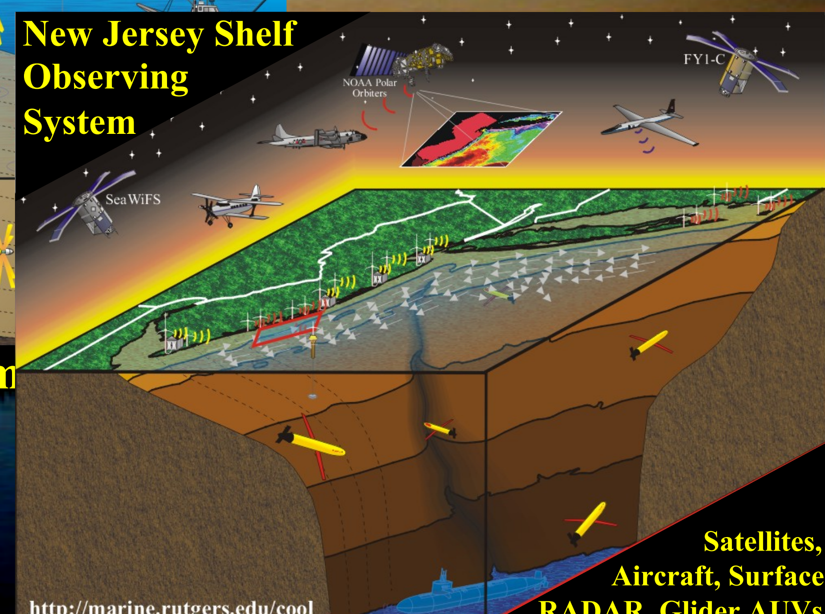
3km x 3km
1996-Present



30km x 30km
1998-2001

HF Radar & Gliders
1 + 1 = 3



Satellites, Aircraft, Surface RADAR, Glider AUVs

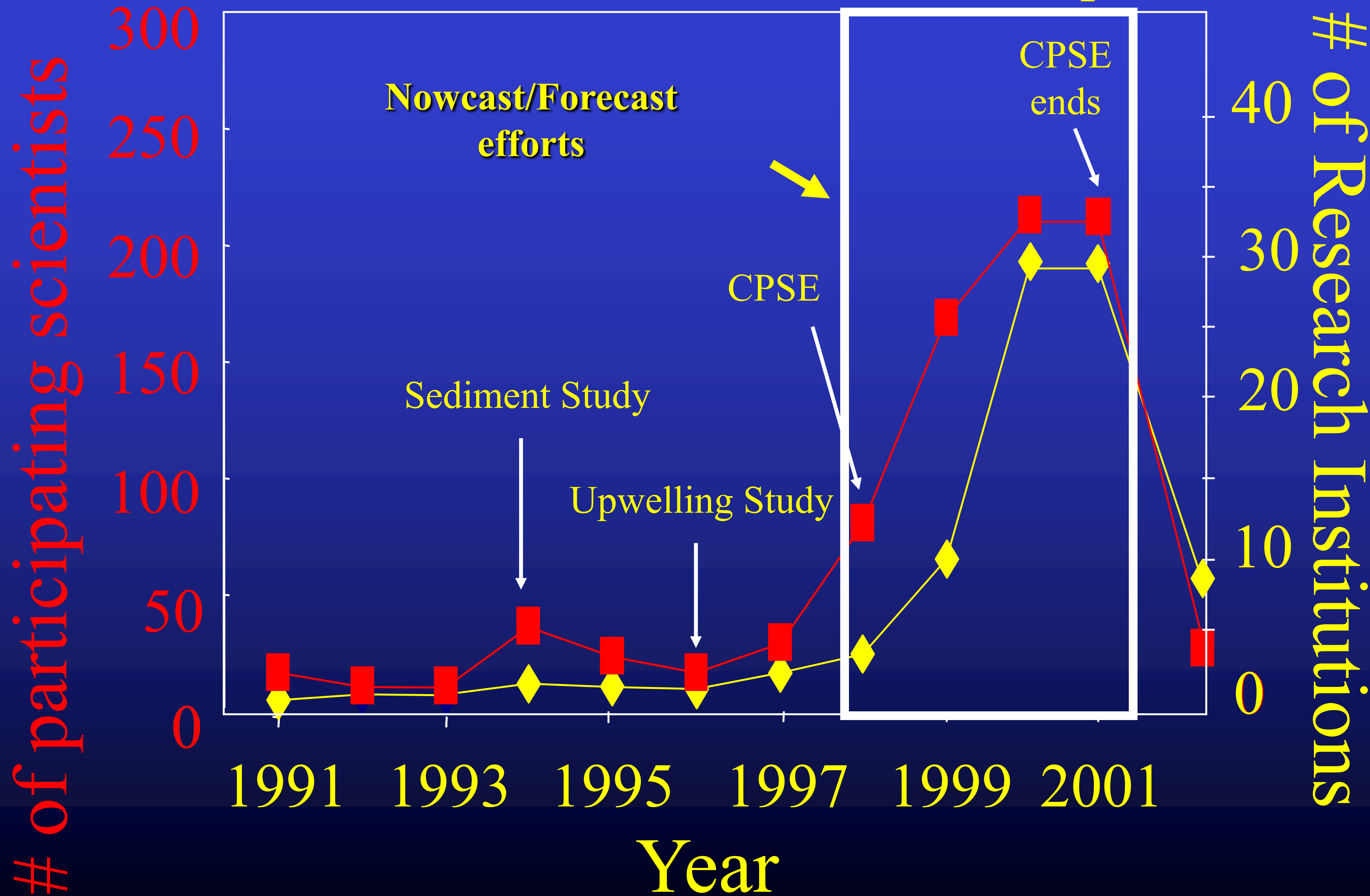
300km x 300km
Beginning 2001

National Undersea Research Program

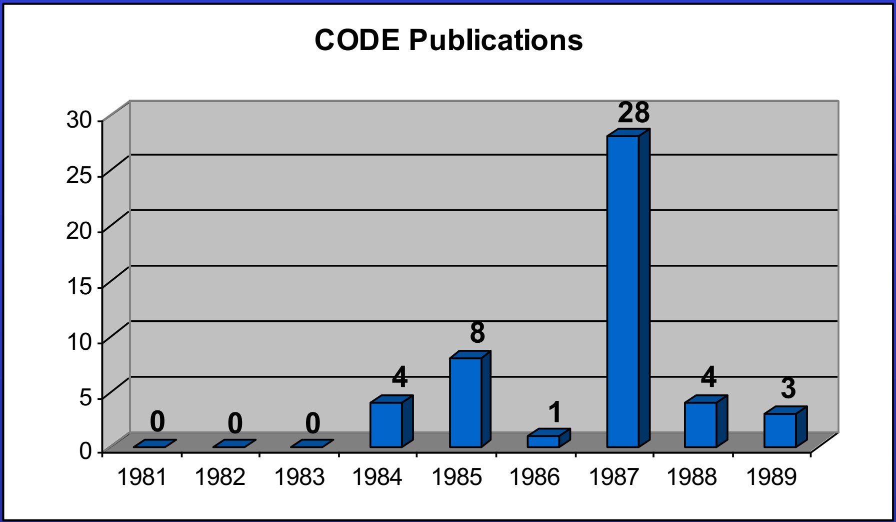
National Oceanographic Partnership Program

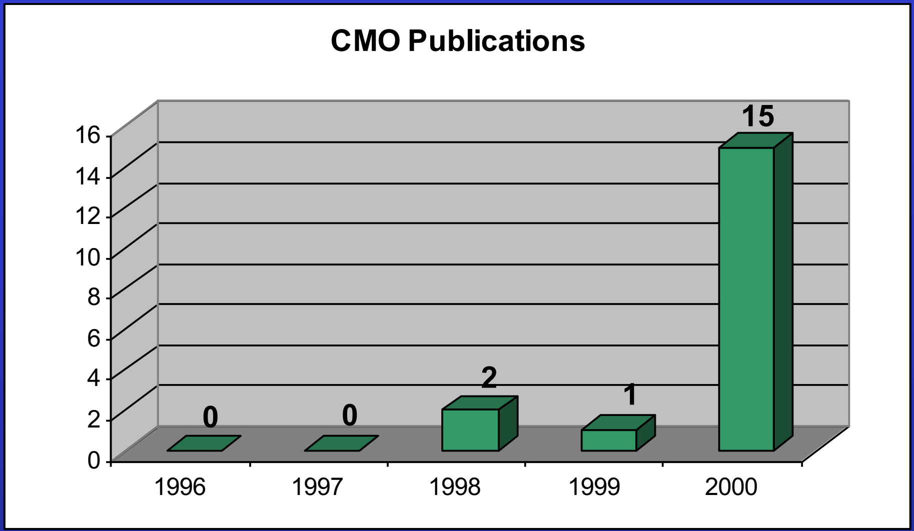
Shore-based Communication Center Enabling Adaptive Sampling
13 Ships/Boats, 4 Aircraft & 2 AUVs

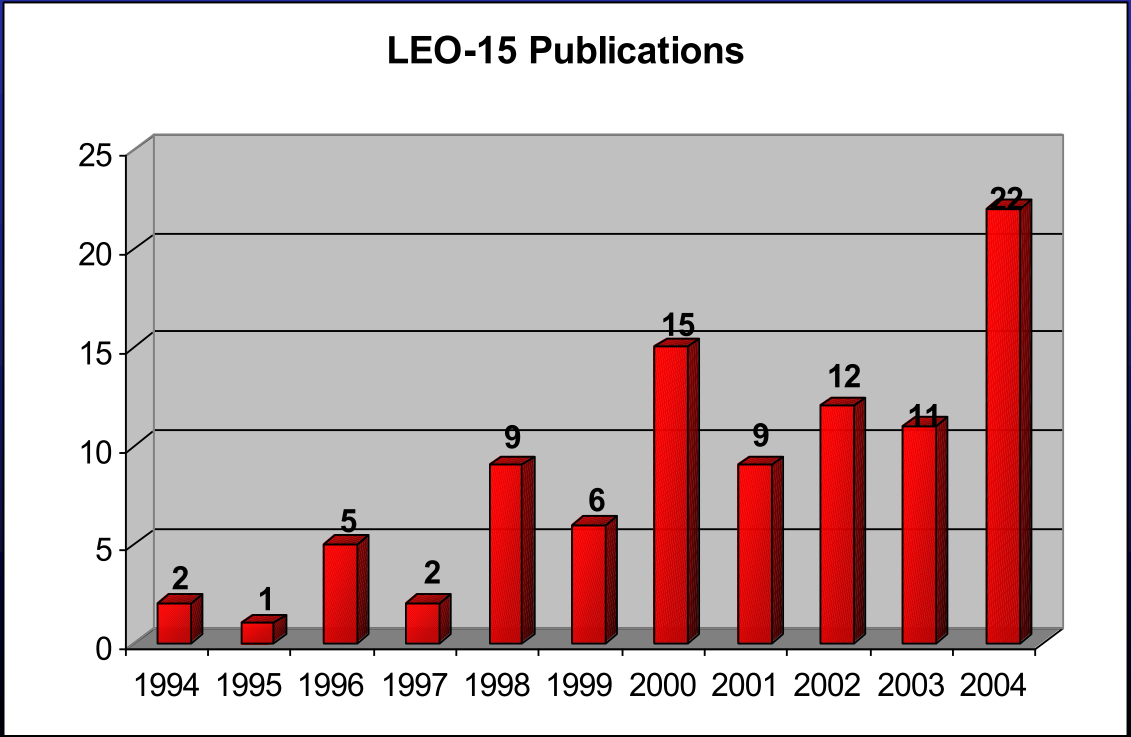
LEO Collaborations & Partnerships



Scientific Publications by Year for Selected Field Experiments







Time between the final mooring recovery and publication of the special issue is still 3 years.

The Observatory transforms the publication step function into a ramp.

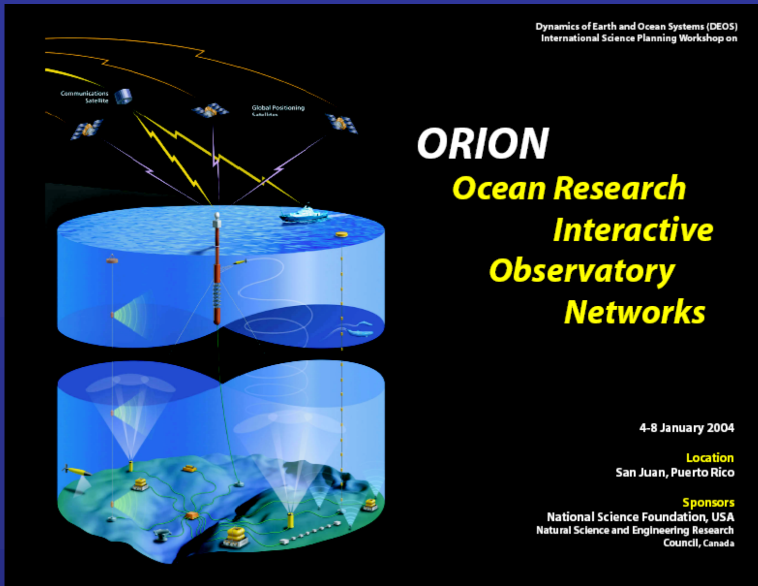
Thanks to
Steve Ramberg

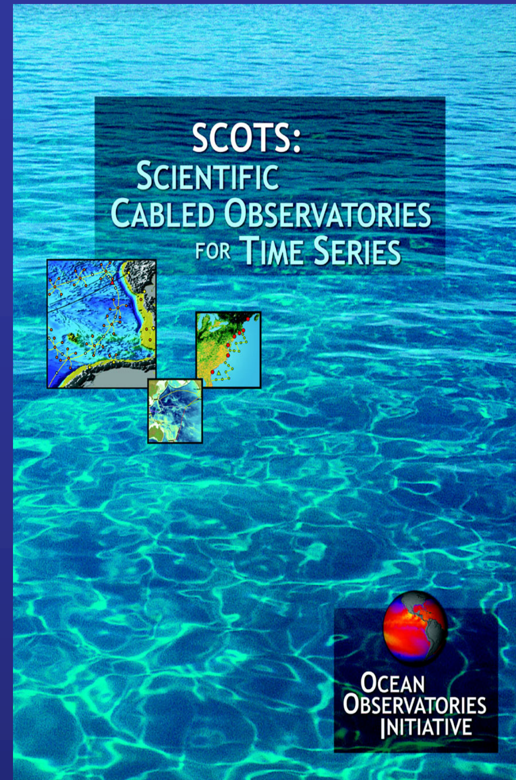
Can a scientist be operational?

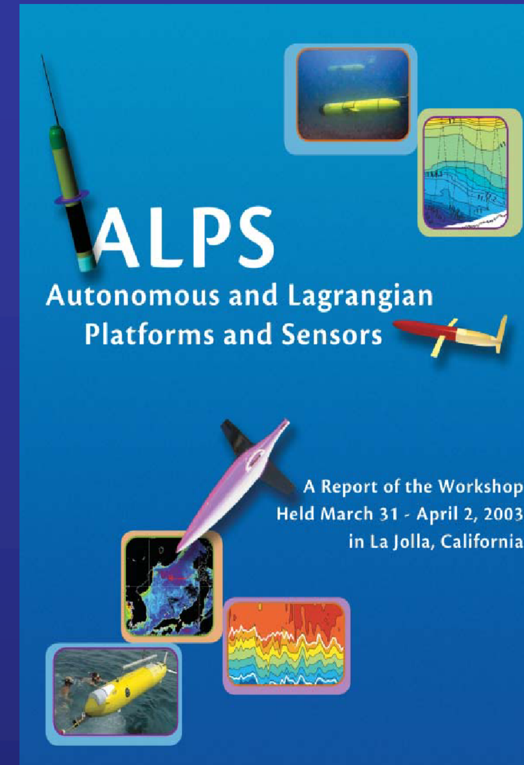
YES
and they should have substantial role in the operational observatories.

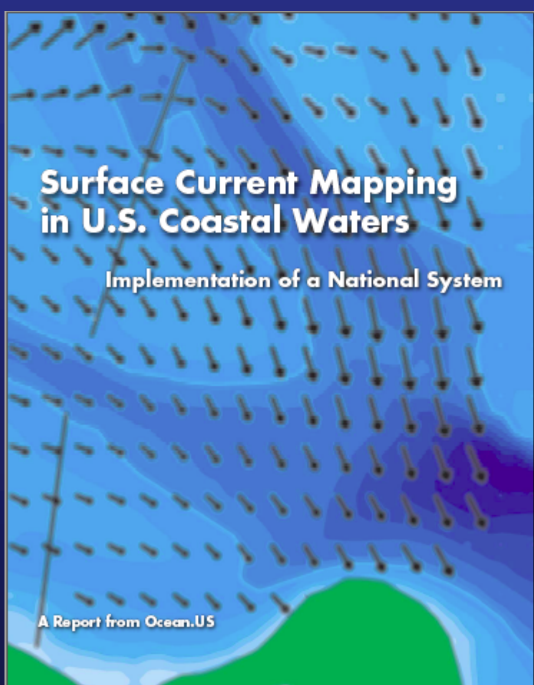
Glenn and Schofield 2003, Oceanography

National Initiatives For Ocean Observing Technologies









"The ocean sciences are now on the threshold of another major technological advance as the scientific community begins to establish a global, long term presence in the ocean…"

Robert Detrich – National Research Council

Enabling Ocean research in the 21st Century

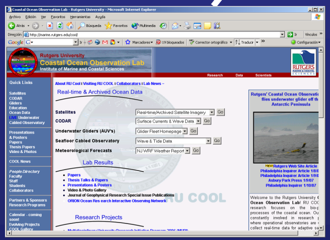
Rutgers University
Coastal Ocean Observation Lab

CODAR Network

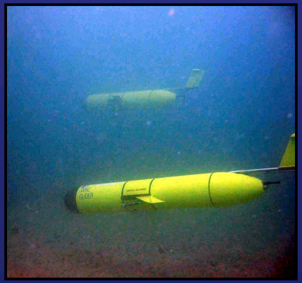
L-Band & X-Band Satellite Systems

Mission Planning

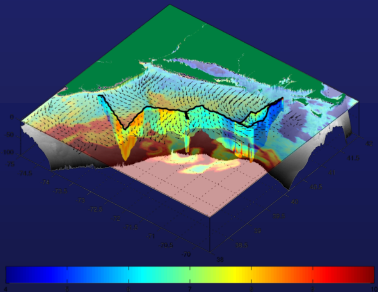
Operations & Communications Station



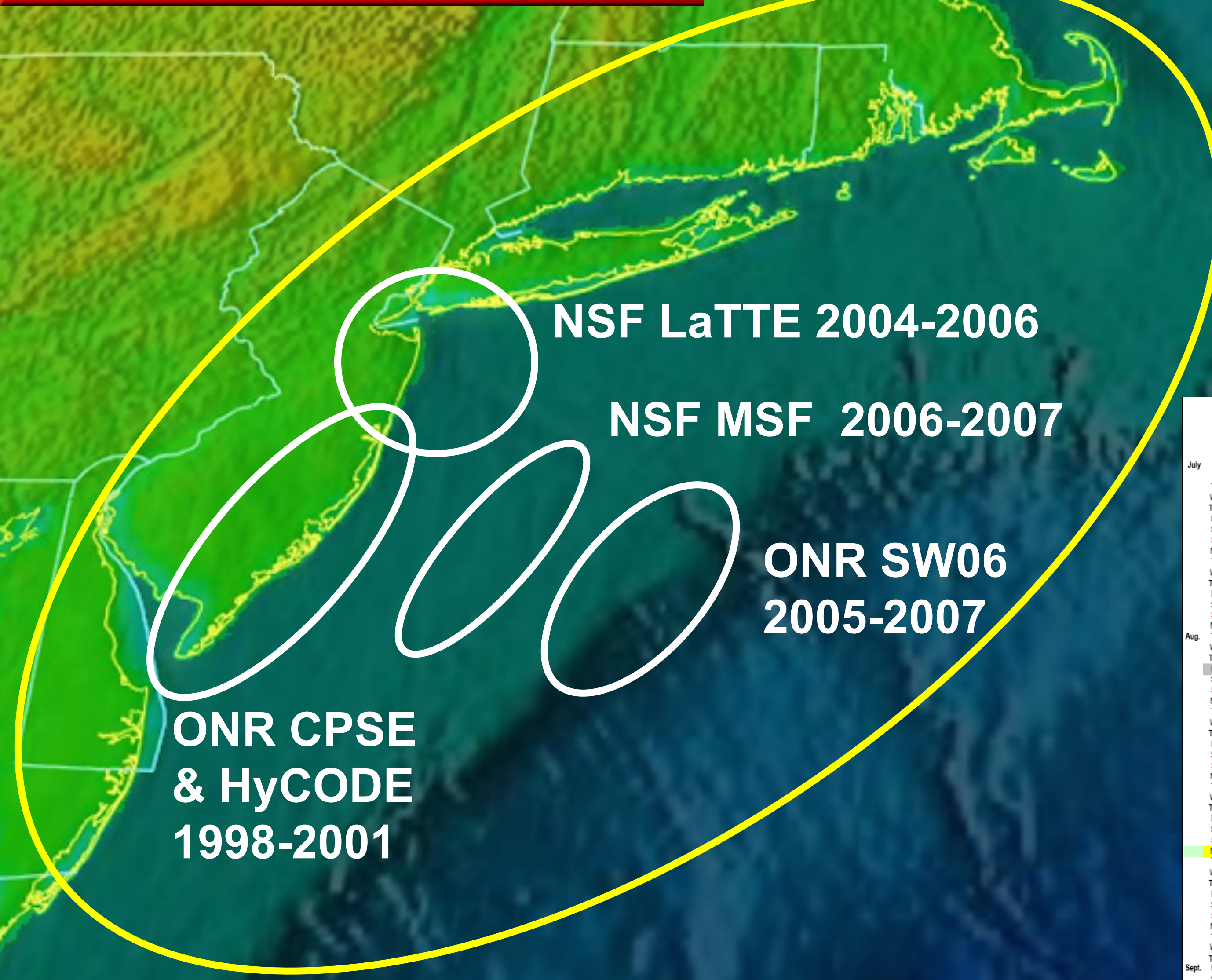
A “Stommel” View of the Ocean: WWW & Interactive 3-D



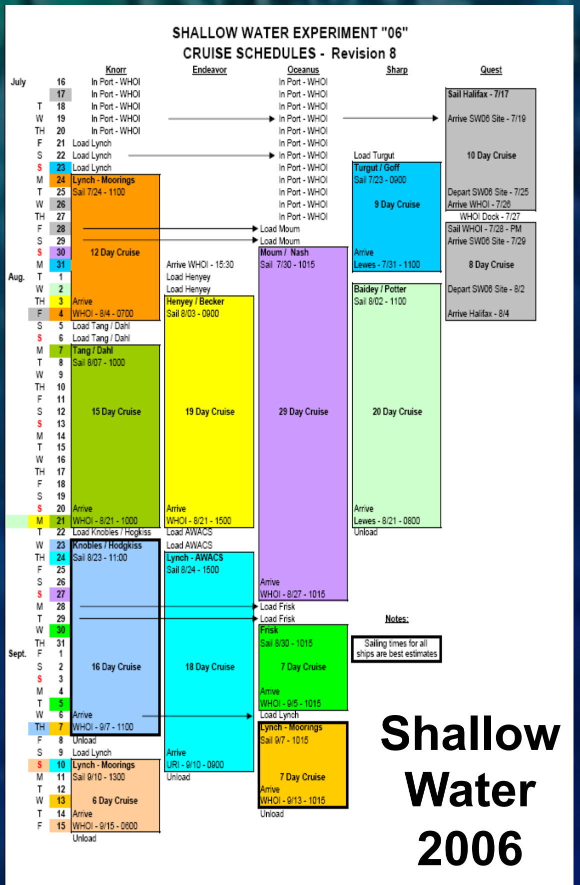
Glider Fleet



Rutgers New Brunswick Campus
School of Environmental & Biological Sciences



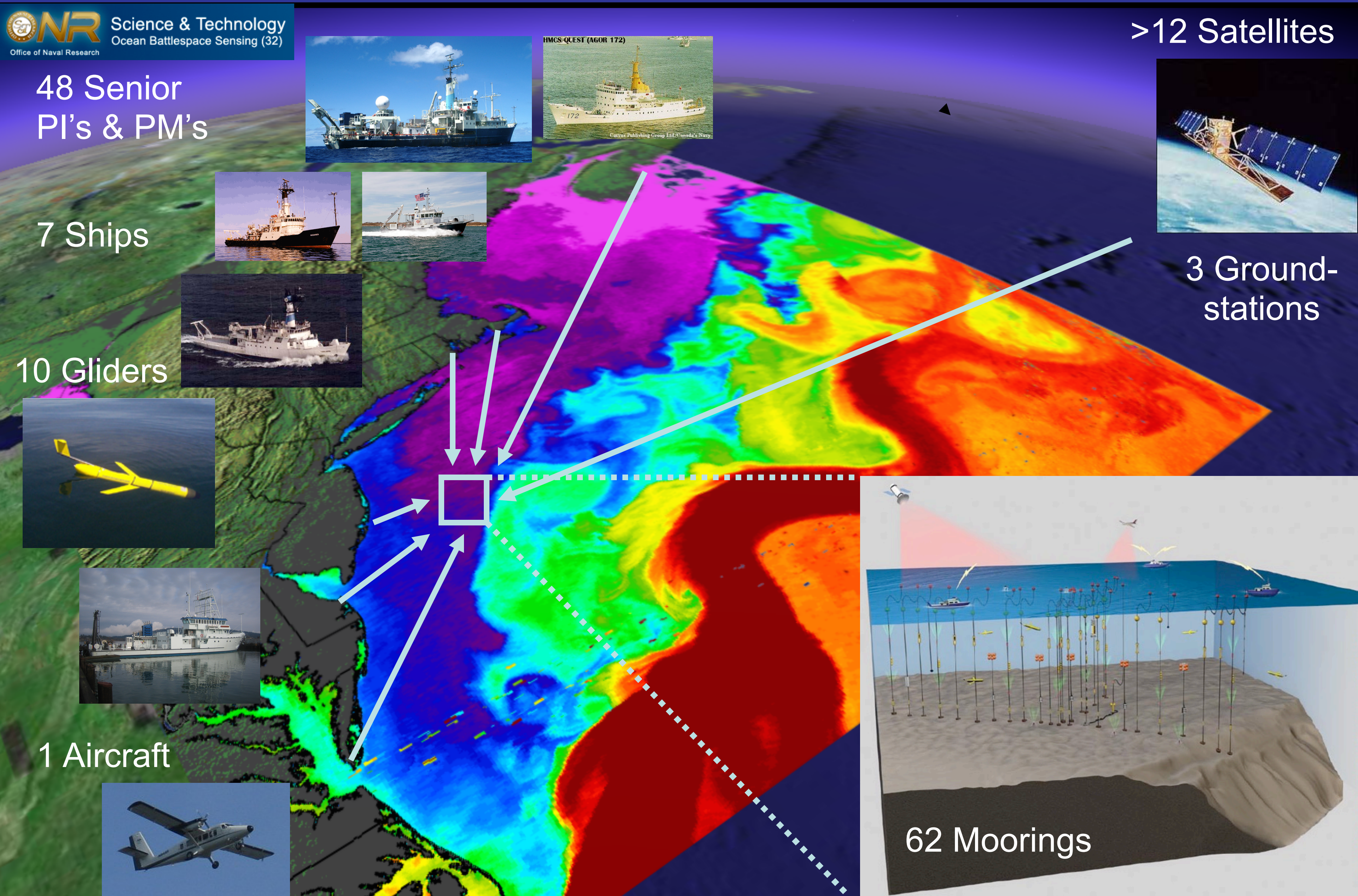
ONR MURI REA
2006-2010



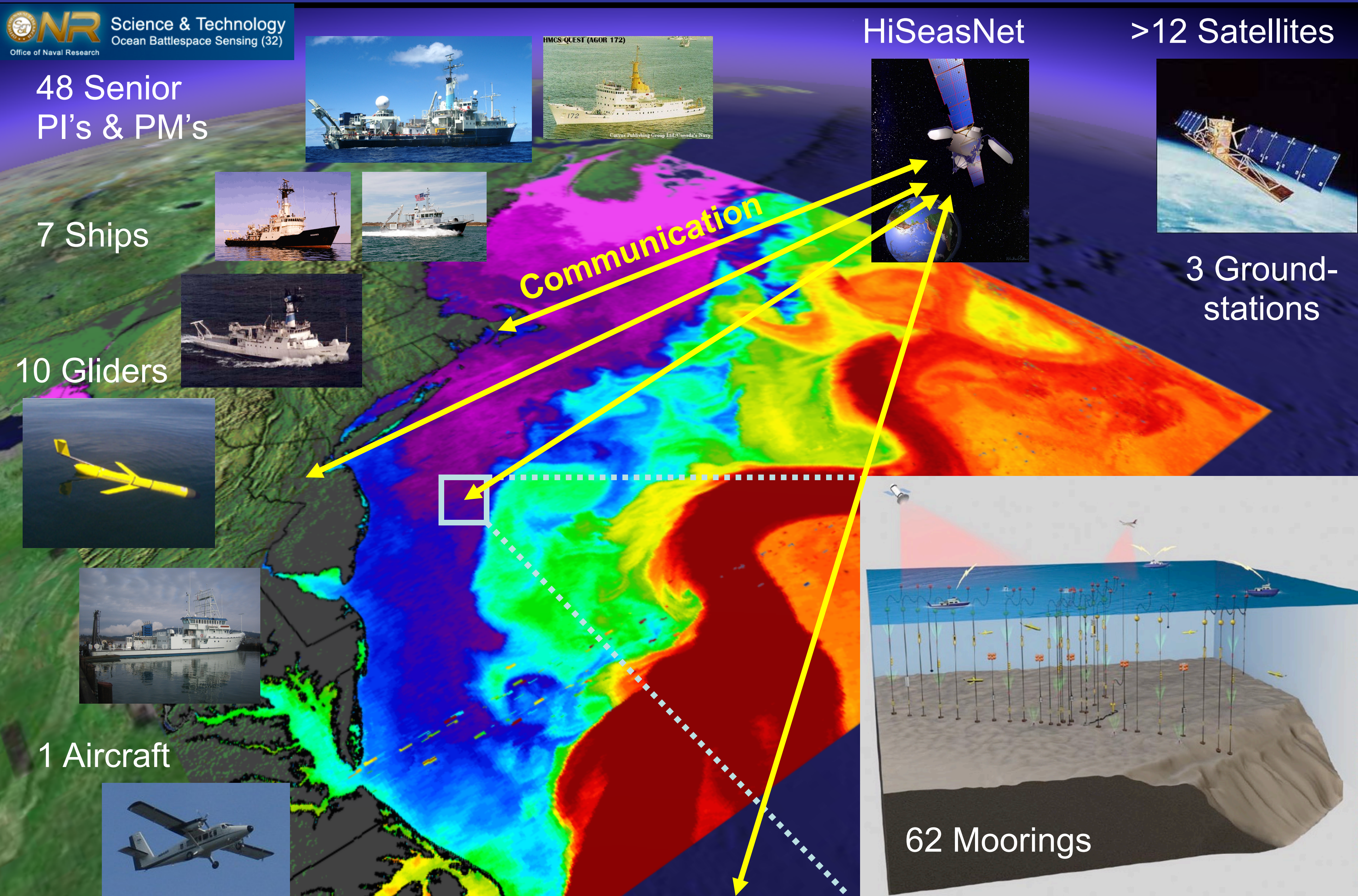
Shallow Water 2006

Observatory-Enabled Collaborative Research Campaigns in the Mid-Atlantic Bight

Collaborative Campaign Science in the Middle Atlantic Bight:
The Shallow Water 2006 Joint Experiment (SW06)



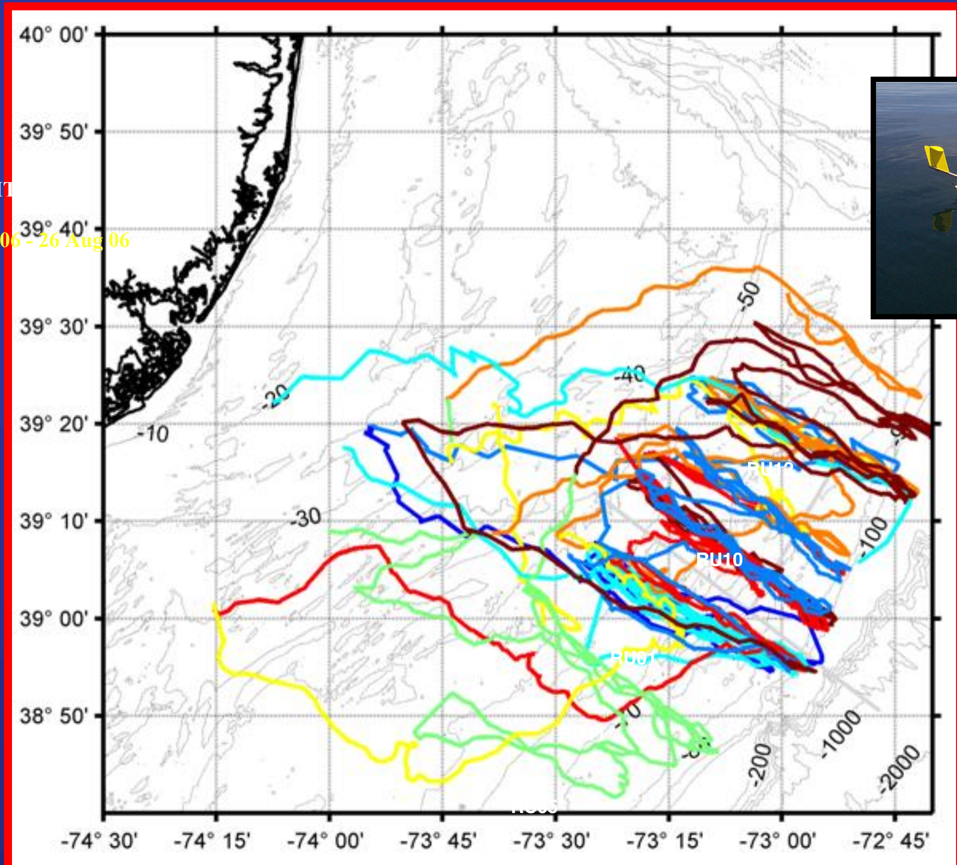
Collaborative Campaign Science in the Middle Atlantic Bight: *The Shallow Water 2006 Joint Experiment (SW06)*

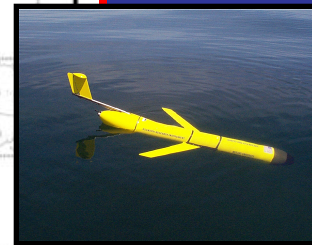


SW06 Glider Statistics (as of 10/02/2006)

SALINIT

24 Aug 06 - 26 Aug 06





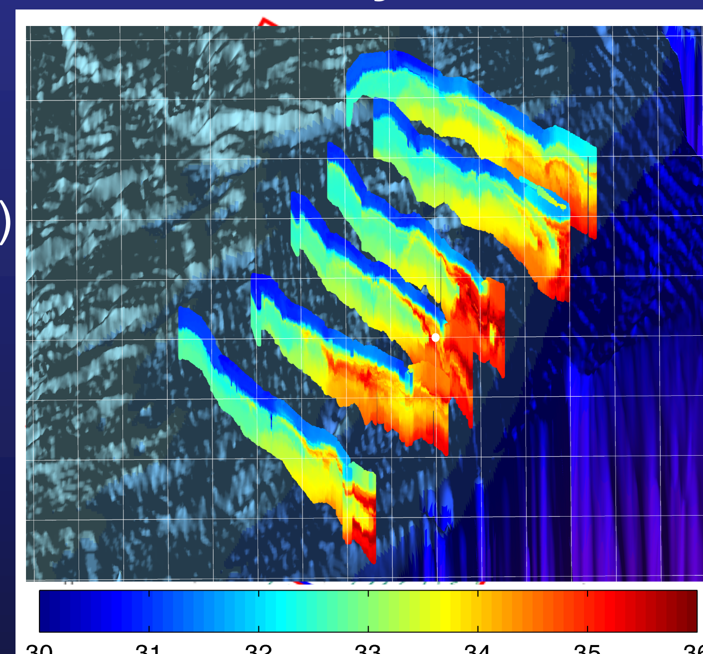
Deployments: 17

Km Flown: 6,683

CTD Profiles: 51,933

Calendar Days: 94

Glider Days: 360



Glider Costs:

RU07

Support Vessels - $41,404.50 (< 4 UNOLS Ship Days)

Batteries - $17,000 (<2 UNOLS Ship Days)

Iridium Communications – $65,000

Total Costs: $123,404.50

5 People for 3 months - none full time ~ 1 person year

Equivalent Ship Cost Estimate:

360 days x $10,000/day = $3,600,000

Trans-Atlantic Glider Challenge – May 24, 2006 –
UNESCO E.U./U.S. Baltic Sea Conference in Lithuania

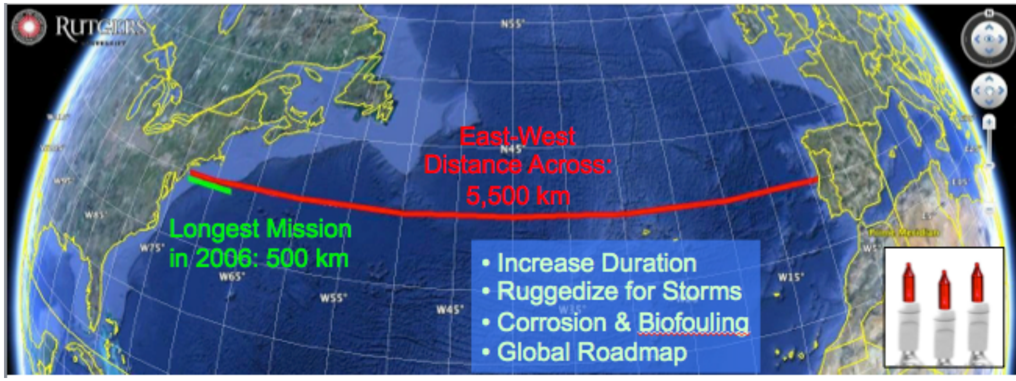
Dr. Rick Spinrad

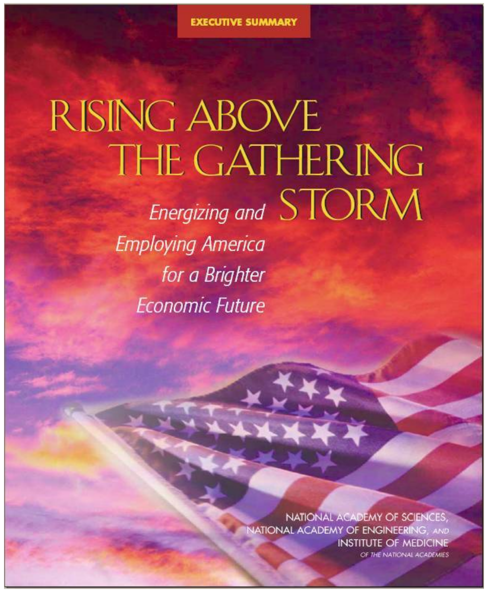
Assistant Administrator

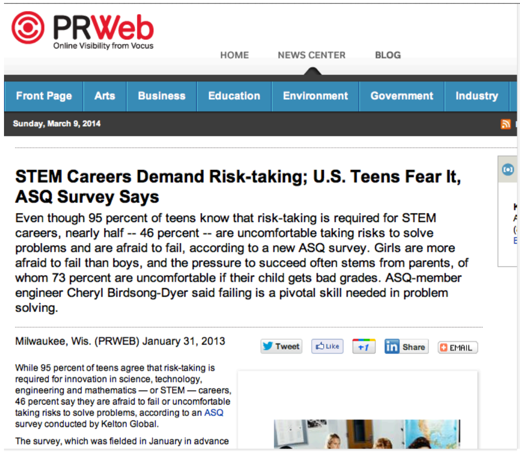
NOAA
Office of Oceanic and Atmospheric Research

"I have something you need to do for the good of your country."

"Take one of your gliders, modify it, and fly it across the Atlantic, inspiring students along the way."






PRWeb
Online Visibility from Vocus
HOME NEWS CENTER BLOG
Front Page | Arts | Business | Education | Environment | Government | Industry
Sunday, March 9, 2014

STEM Careers Demand Risk-taking; U.S. Teens Fear It, ASQ Survey Says

Even though 95 percent of teens know that risk-taking is required for STEM careers, nearly half -- 46 percent -- are uncomfortable taking risks to solve problems and are afraid to fail, according to a new ASQ survey. Girls are more afraid to fail than boys, and the pressure to succeed often stems from parents, of whom 73 percent are uncomfortable if their child gets bad grades. ASQ-member engineer Cheryl Birdsong-Dyer said failing is a pivotal skill needed in problem solving.

Milwaukee, Wis. (PRWEB) January 31, 2013

While 95 percent of teens agree that risk-taking is required for innovation in science, technology, engineering and mathematics — or STEM — careers, 46 percent say they are afraid to fail or uncomfortable taking risks to solve problems, according to an ASQ survey conducted by Kelton Global.

The survey, which was fielded in January in advance

Positive risk-taking is required for innovation in STEM careers!

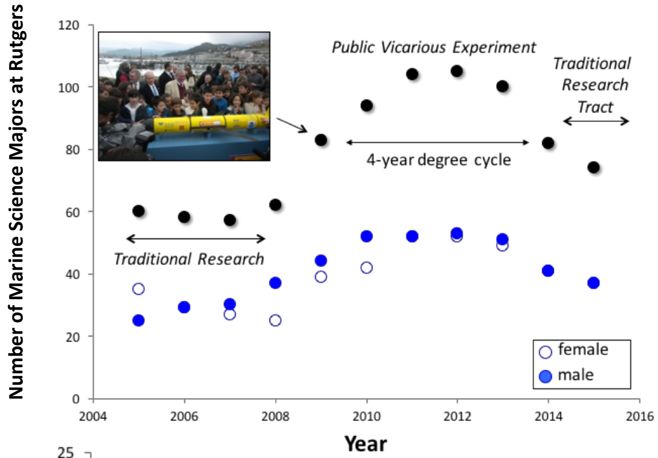
RUTGERS
THE STATE UNIVERSITY OF NEW JERSEY

With real data we can improving undergraduate education through living the science in real-time

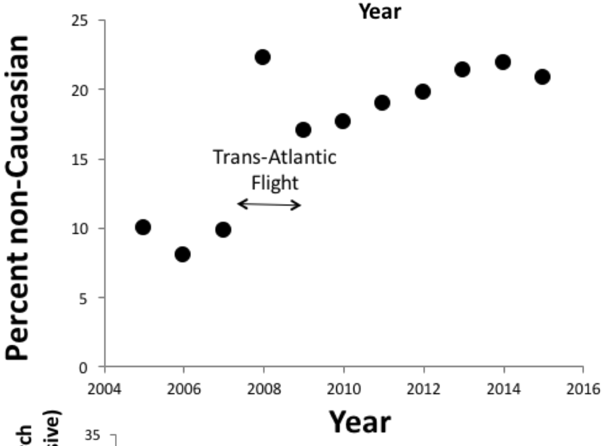
The Trans-Atlantic Glider Challenge
December 9, 2009 – Baiona, Spain

Funded by University Donor & NOAA

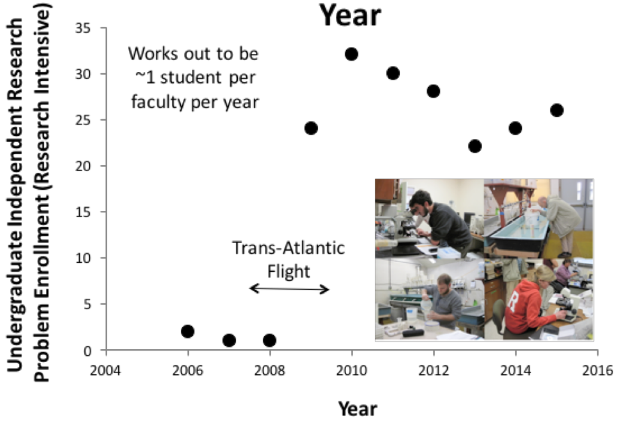
Increased Enrollment



Increased Diversity



Increased Hands-on Research



FY2007 Regional Integrated Ocean Observing System Development

Letters of Intent (LOIs) due January 31, 2007.
Top LOIs were recommend to go forward.

Full Proposals due April 17, 2007.

"NOAA views this announcement as an opportunity to demonstrate the regional observing system concept."

Three Focus Areas

1. Regional Coastal Ocean Observing Systems (RCOOS) development
   $500,000 to $2,000,000 per year for up to 3 years.
   On March 28, 2007, years 2 & 3 were increased to $3,500,000 per year.

2. IOOS application and product development for regional stakeholders.
   $100,000 to $500,000 per year for up to 3 years.

3. Data management and communication by local data network nodes.
   $100,000 to $300,000 per year for up to 3 years.

FY2007 Regional Integrated Ocean Observing System Development

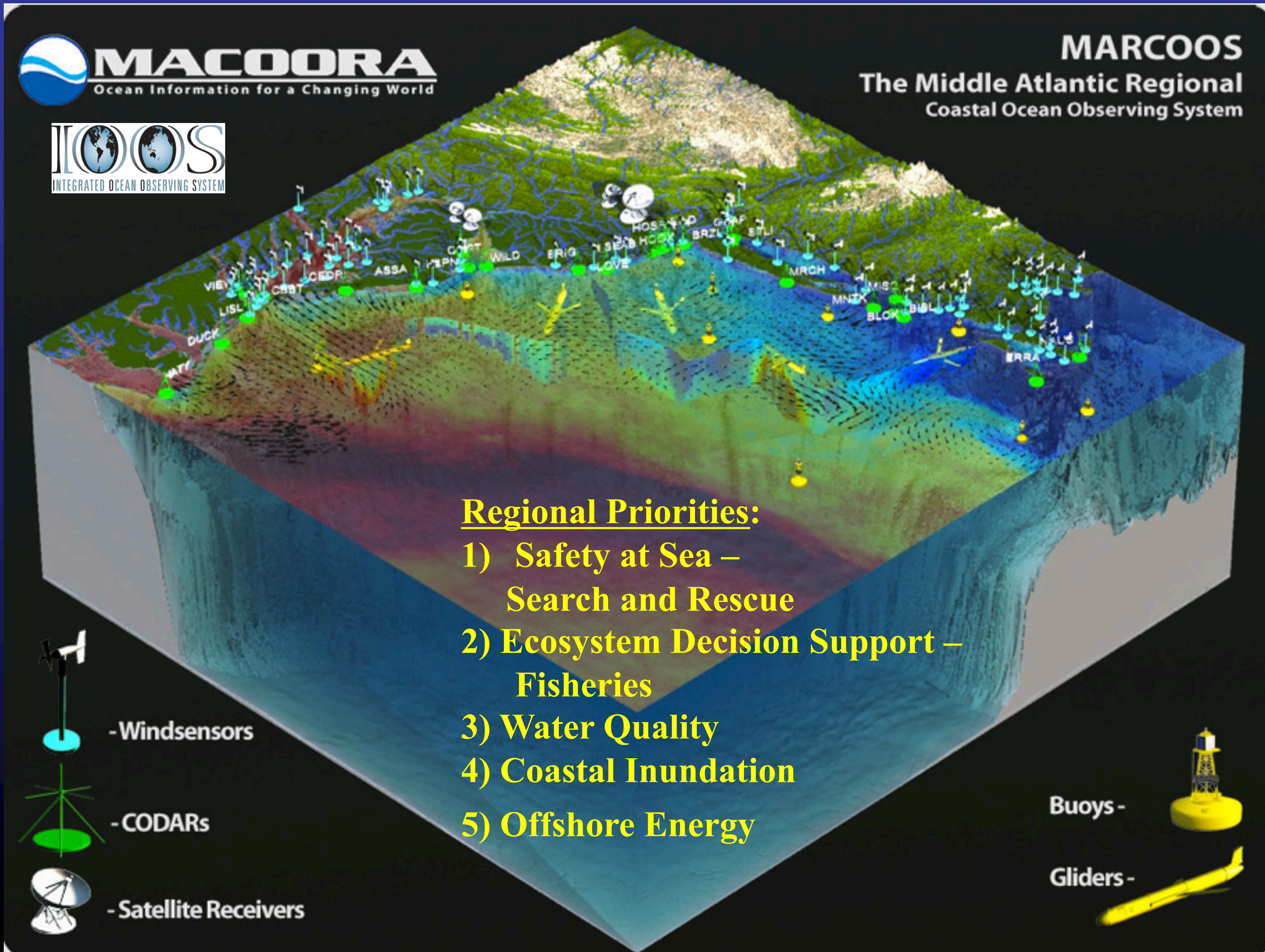
Regional Coastal Ocean Observing Systems (RCOOS) development guidance:

- Demonstrate the approach and benefits of integration at the scale of the Regional Association.
- Implement an end-to-end RCOOS that addresses regional needs.
- Further the development of RCOOSs through integration and operation of regional observing system assets.
- Any existing or proposed assets would be deployed and managed as part of a regional deployment design.
- Proposals should address the following:
  (a) regional deployment, operation and maintenance of sensors and platforms;
  (b) regional integration of data streams, quality assurance procedures, and data delivery; and
  (c) generation of regional products, including data products and model output, that facilitates the development of value added products for identified users.


Stanley 16-Pound Hickory Handle Sledge Hammer 56-816

The Mid-Atlantic Regional Coastal Ocean Observing System

Established 2007: 35 Co-PIs, 25 Institutions, 10 States



Regional Priorities:

1) Safety at Sea – Search and Rescue
2) Ecosystem Decision Support – Fisheries
3) Water Quality
4) Coastal Inundation
5) Offshore Energy

Our Innovative Approach: The Integration Matrix
Capabilities Support Multiple Themes

REGIONAL INFORMATION COORDINATION ENTITY CERTIFIED 2016	Regional Observation & Modeling Capabilities					
	Weather Mesonet	**HF Radar Network**	**Statistical STPS**	**Satellite Imagery**	**Glider Surveys**	**Dynamical Ocean Forecasts**
Theme 1. Maritime Safety	Operational Input to USCG SAROPS	Operational input to USCG SAROPS	Operational input to USCG SAROPS	SST for survivability planning	Assimilation dataset for forecast models	Surface currents for SAROPS
Theme 2. Ecological Decision Support	Weather forecast ensemble validation	Circulation and divergence maps for habitat		SST & Color for habitat	Subsurface T & S for habitat	3-D fields of T, S, circulation for habitat
Theme 3. Water Quality	Winds for transport, river plumes, & upwelling	Surface currents for floatables, bacteria, spill response	Surface currents for floatables, bacteria, spill response	Ocean color for river plumes	Nearshore dissolved oxygen surveys	Surface currents for floatables, bacteria, spill response
Theme 4. Coastal Inundation	Weather forecast ensemble validation	Current forecast model validation		SSTs assimilation into forecast models	Assimilation dataset for forecast models	Nested forecast ensembles
Theme 5. Offshore Energy	Historical analysis & wind model validation	Historical current analysis & wind model validation		Historical analysis surface fronts & plumes for siting	Historical analysis of subsurface fronts & plumes	Coupled ocean-atmosphere models for resource estimates

Our Innovative Approach: The Integration Matrix
Capabilities Support Multiple Themes

REGIONAL INFORMATION COORDINATION ENTITY CERTIFIED 2016	Regional Observation & Modeling Capabilities					
	Weather Mesonet	HF Radar Network	Statistical STPS	Satellite Imagery	Glider Surveys	Dynamical Ocean Forecasts
Theme 1. Maritime Safety	Operational Input to USCG SAROPS	Operational input to USCG SAROPS	Operational input to USCG SAROPS	SST for survivability planning	Assimilation dataset for forecast models	Surface currents for SAROPS
Theme 2. Ecological Decision Support	Weather forecast ensemble validation	Circulation and divergence maps for habitat		SST & Color for habitat	Subsurface T & S for habitat	3-D fields of T, S, circulation for habitat
Theme 3. Water Quality	Winds for transport, river plumes, & upwelling	Surface currents for floatables, bacteria, spill response	Surface currents for floatables, bacteria, spill response	Ocean color for river plumes	Nearshore dissolved oxygen surveys	Surface currents for floatables, bacteria, spill response
Theme 4. Coastal Inundation	Weather forecast ensemble validation	Current forecast model validation		SSTs assimilation into forecast models	Assimilation dataset for forecast models	Nested forecast ensembles
Theme 5. Offshore Energy	Historical analysis & wind model validation	Historical current analysis & wind model validation		Historical analysis surface fronts & plumes for siting	Historical analysis of subsurface fronts & plumes	Coupled ocean-atmosphere models for resource estimates

Optimizing HF Radar for SAR using USCG Surface Drifters

Art Allen
U.S. Coast Guard

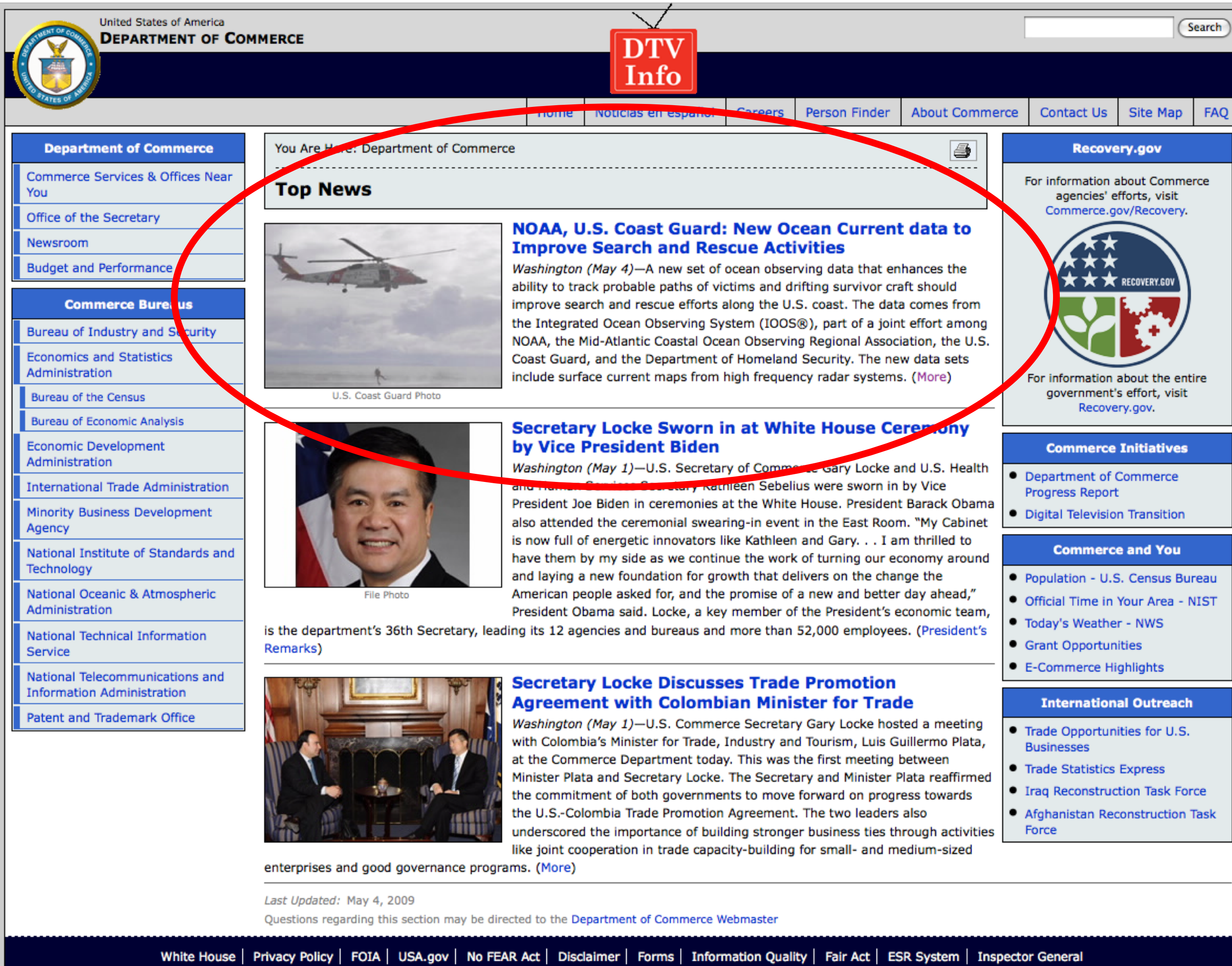
Scott Glenn
Rutgers

and Mid-Atlantic Regional Association
Coastal Ocean Observing System

Based on a Defined Need, a Process for Positive Impact –

1. Observations + Scientific Analysis > Understanding (Models)
2. Models + Observations > Forecasts
3. Forecasts + Decision Aids > Actionable Information
4. Actionable Info + Knowledgeable User > Positive Impact

May 4, 2009: After a year of USCG testing, NOAA announces on U.S. Department of Commerce Website that MARACOOS CODAR is Operational in USCG SAROPS



2009-2010 Activity:

Bring all sustained regional-scale HFR networks up to operational status in USCG SAROPS

3 West Coast Regions for California & Oregon are ready.

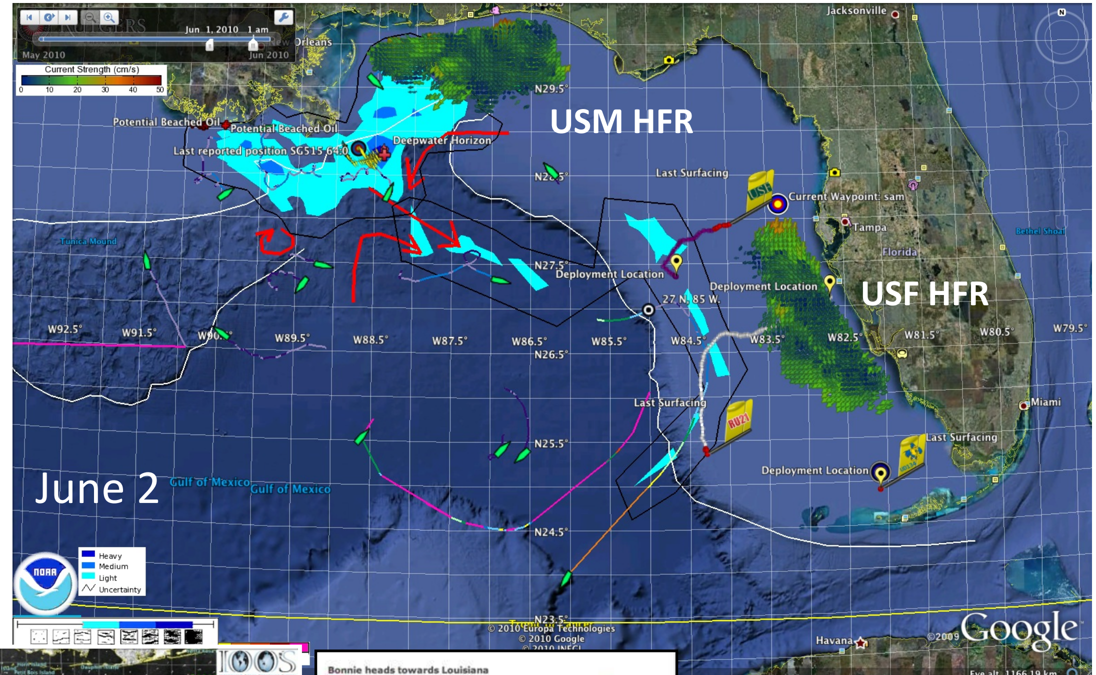
Integrated Ocean Observing System

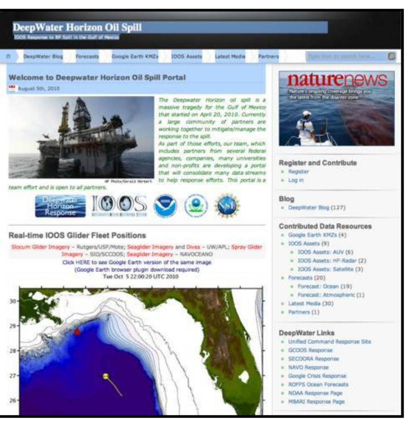
Responding to Crisis: Deepwater Horizon

U.S. IOOS partnership demonstrated ability to:

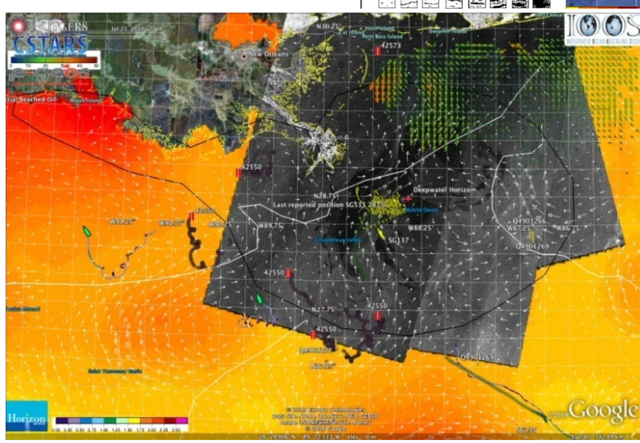
2010

- Quickly deploy technologies: Gliders and HF radar, saving resources/improving safety
- Models/Imagery ingested into NOAA/Navy models
- Data assimilation improved spill response decision-making and public understanding

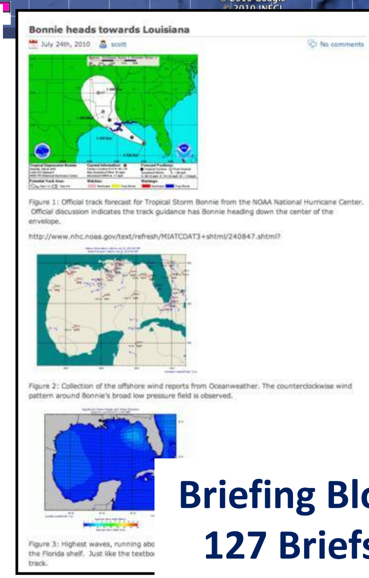




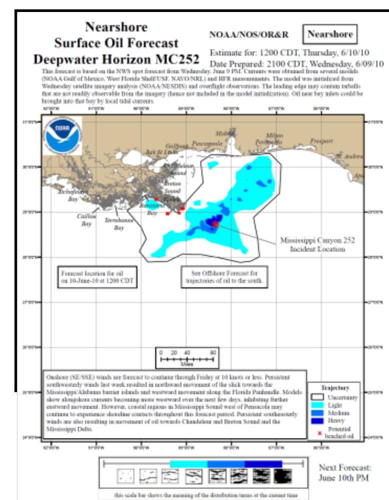
Web Portal



HFR validation of SABGOM Forecast combined with satellite detected oil slicks

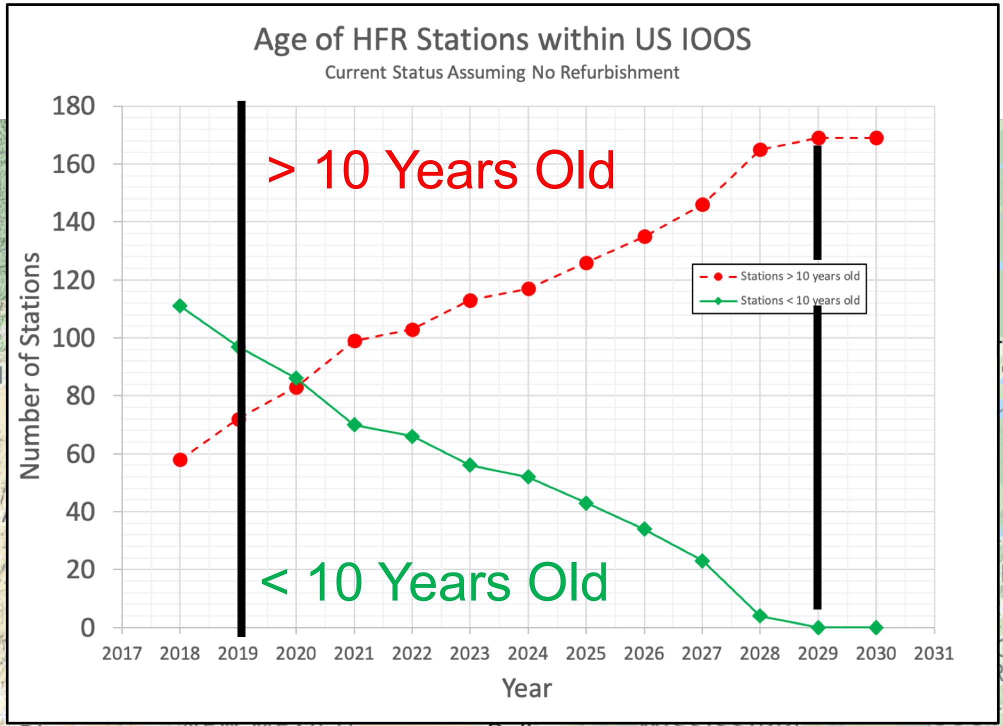


Briefing Blog
127 Briefs



HFR data informed NOAA trajectory forecasts

U.S. National HFR Network Today



Gap Making Campaign

Gap Filling Campaign

The Growing Challenge: Maintaining the Baseline on which we Build

Lessons Learned:

- ***People – Leaders & Followers, Teachers & Students, Scientists & Storytellers***
- ***Passion - Set Noble Goals, Embrace Grand Challenges***
- ***Persistence - Work on the Hard Things, Take a Risk***

Proven Pathways:

- ***Form Partnerships, Bridge Barriers***
- ***Communicate, Mentor, Inspire***

Pathways to Discover:

- ***Sustainability***

Slocum Glider RU27 - The Scarlet Knight
Departs Tuckerton, NJ - April, 2009
Arrives Baiona, Spain – December, 2009
First Glider to cross an ocean basin