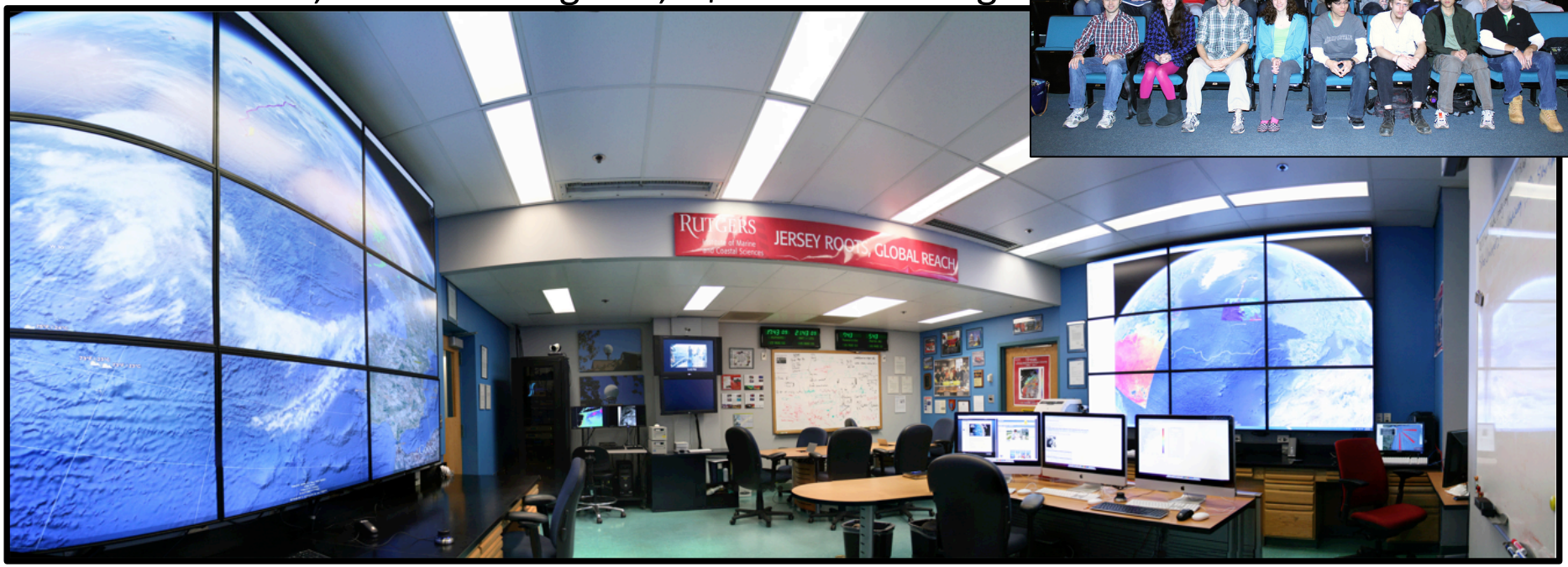
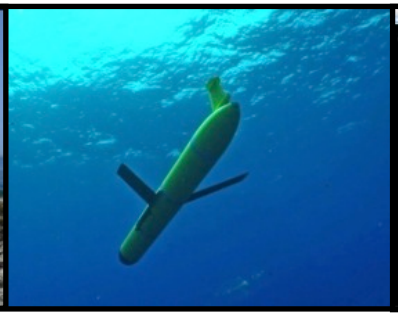
Rutgers University
Coastal Ocean Observation Lab

>20 Researchers, > 100 Undergrads, >$100 M Funding

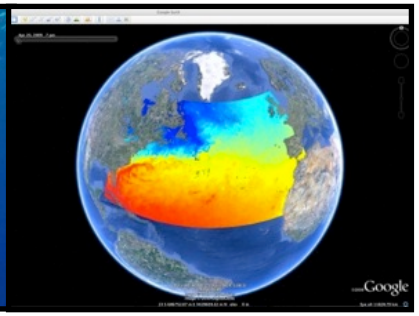


Satellite Data Acquisition Stations

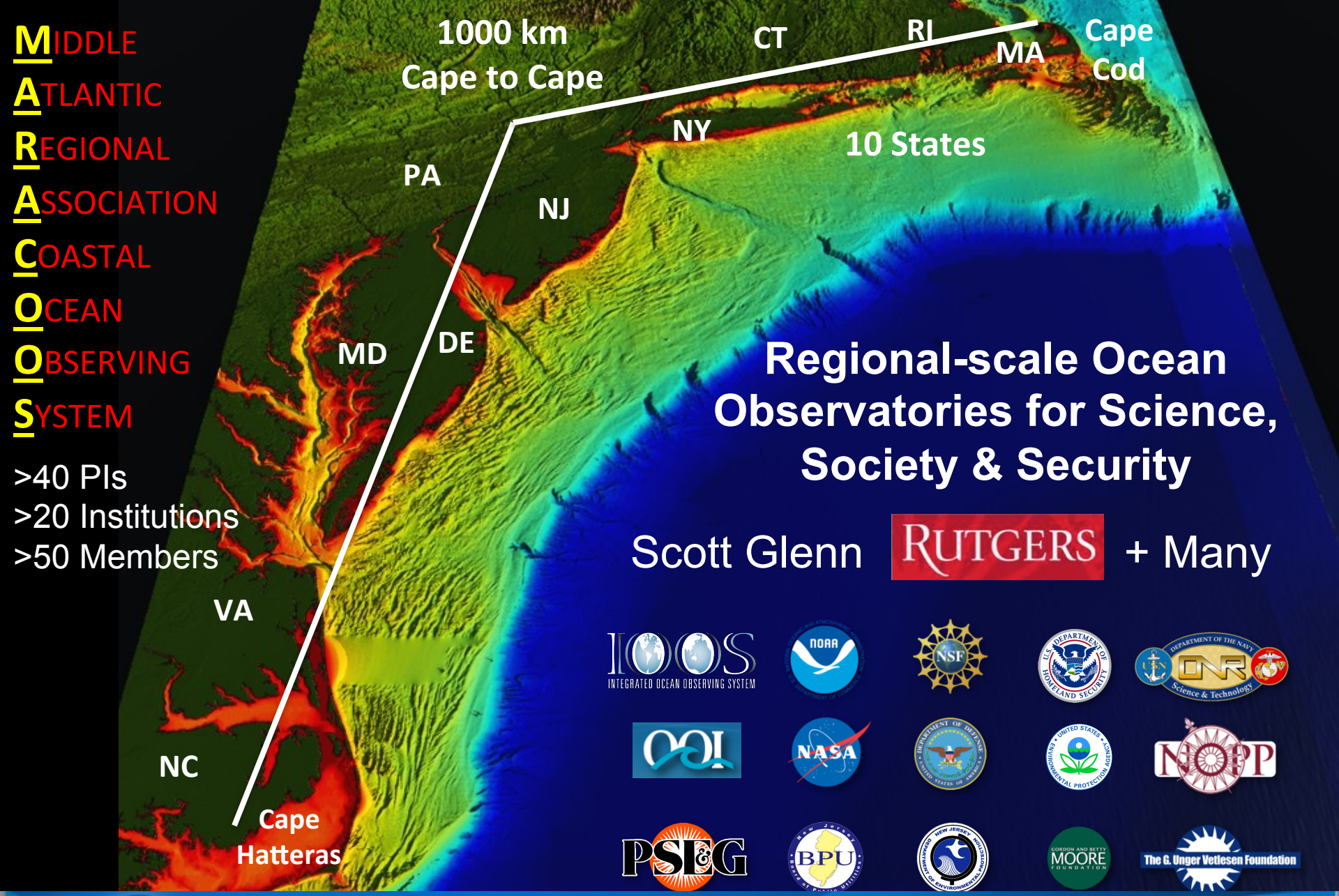
CODAR Network



Glider Fleet



3-D Forecasts


MIDDLE ATLANTIC REGIONAL ASSOCIATION COASTAL OCEAN OBSERVING SYSTEM
>40 PIs
>20 Institutions
>50 Members
1000 km
Cape to Cape
CT
RI
MA
Cape Cod
NY
10 States
PA
NJ
MD
DE
VA
NC
Cape Hatteras
Regional-scale Ocean Observatories for Science, Society & Security
Scott Glenn
RUTGERS
+ Many
IOOS
INTEGRATED OCEAN OBSERVING SYSTEM
NOAA
NSF
U.S. DEPARTMENT OF HOMELAND SECURITY
DEPARTMENT OF THE NAVY
ONR
Science & Technology
OOI
NASA
DEPARTMENT OF DEFENSE
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NOPP
PSE&G
NEW JERSEY BPU
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GORDON AND BETTY MOORE FOUNDATION
The G. Unger Vetlesen Foundation
MARACOOS
Ocean Information for a Changing World
IOOS
INTEGRATED OCEAN OBSERVING SYSTEM

U.S. Integrated Ocean Observing System

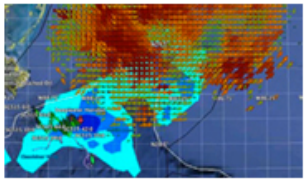
IOOS
INTEGRATED OCEAN OBSERVING SYSTEM

International Component

Glider Asset Map

Glider Fleet

Technologies and Applications

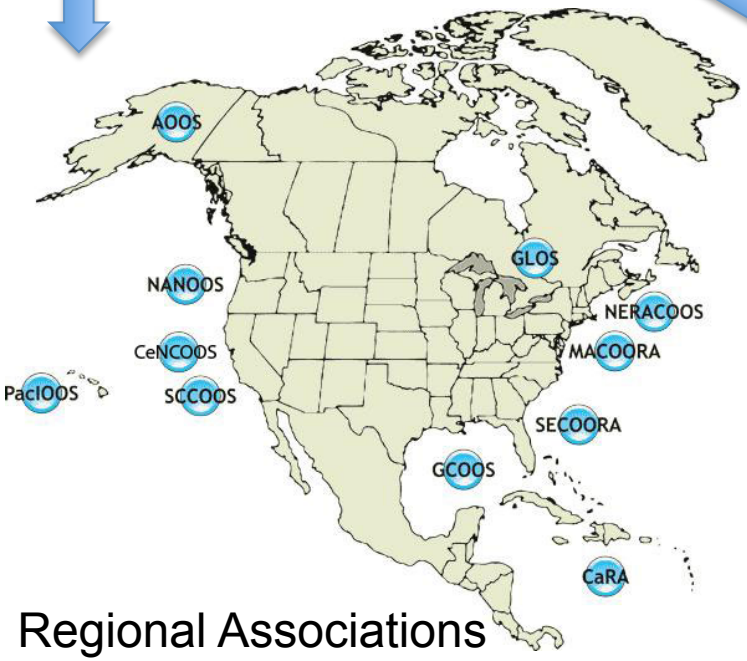


Global High Frequency (HF) Radar Network Component

High Frequency Radars

Regional Component

National Component

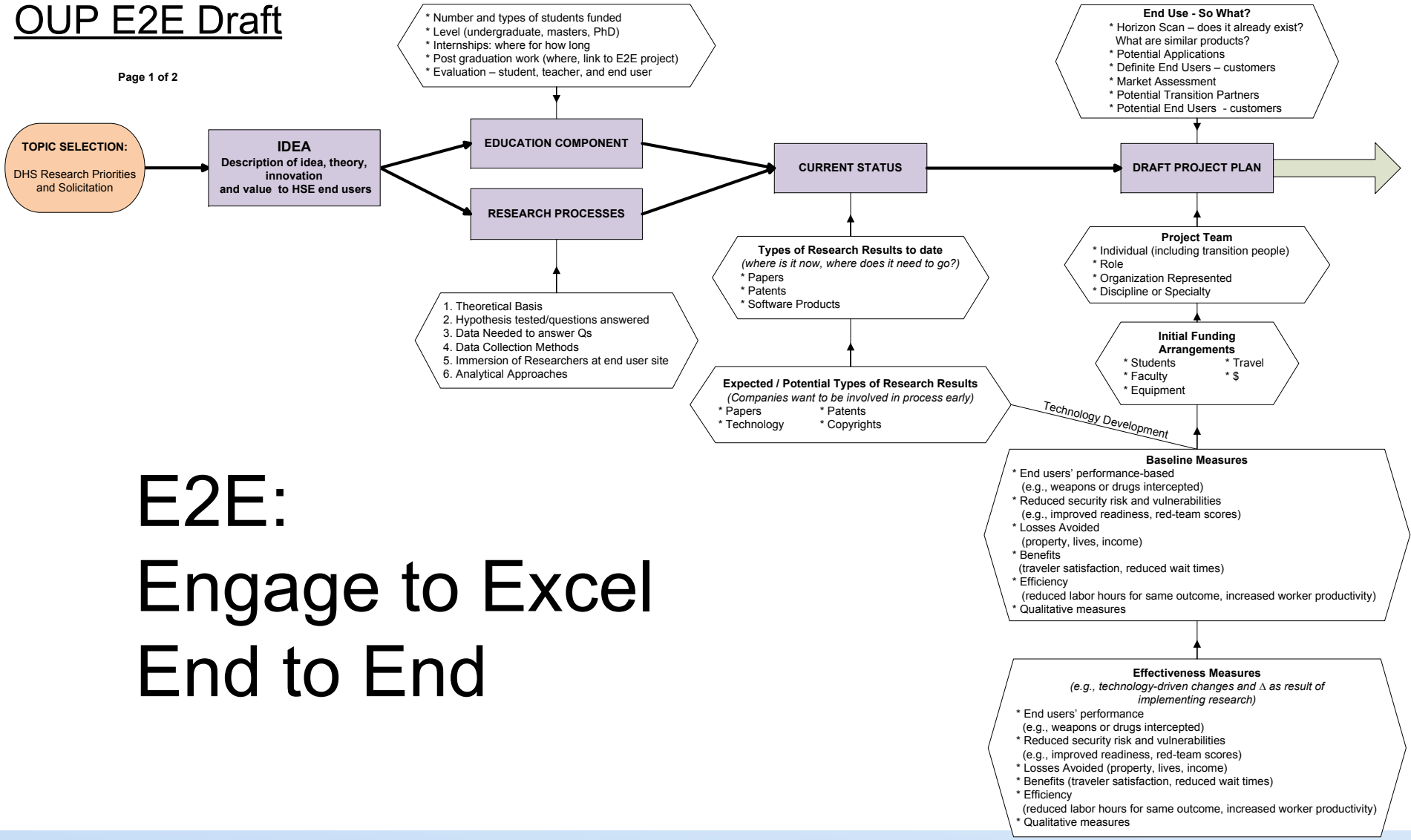


11 Regional Associations

Globally Coordinated Initiatives

17 U.S. Federal Agencies

User Engagement and Transitions

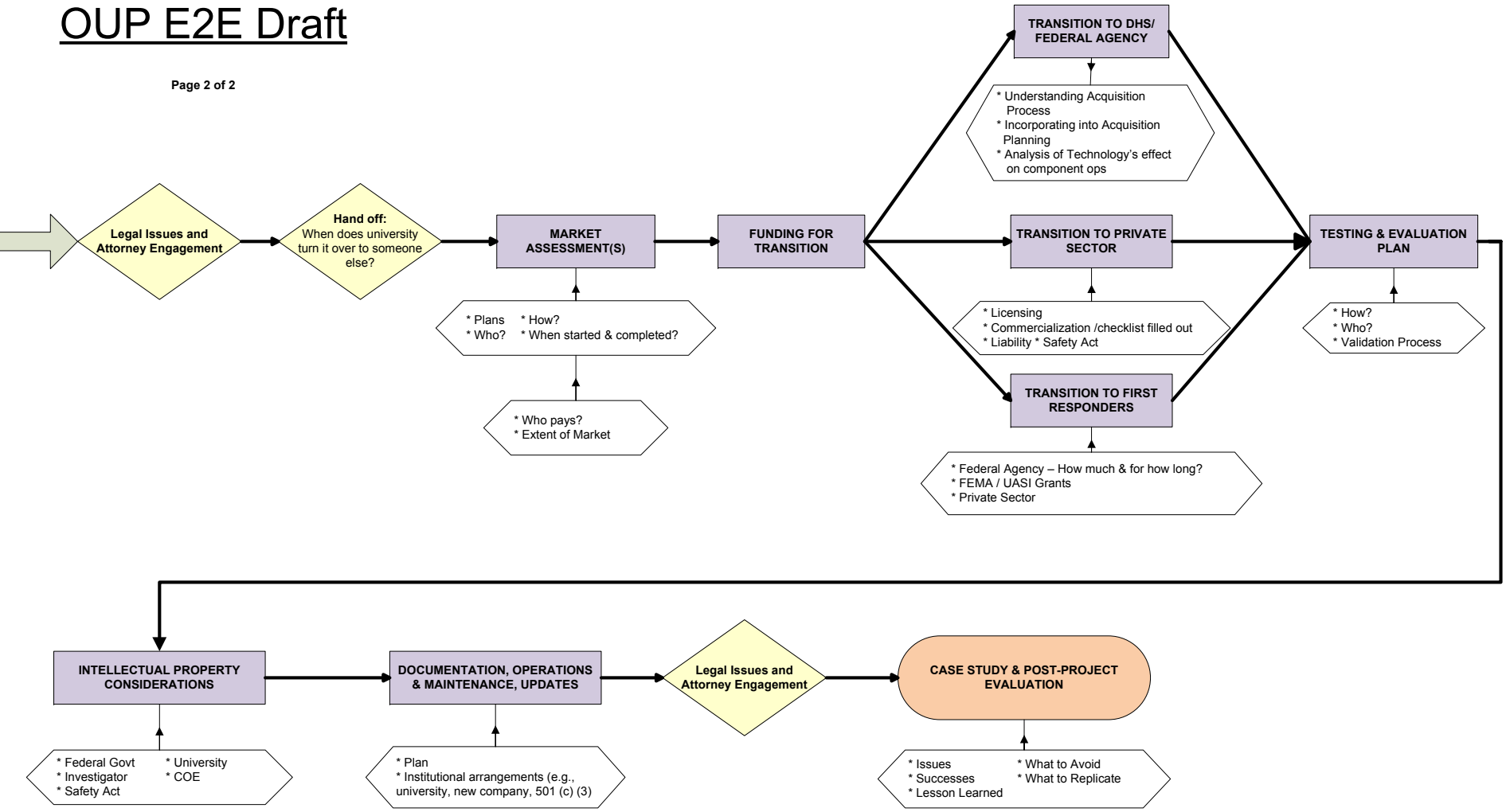


E2E:
Engage to Excel
End to End

User Engagement and Transitions

OUP E2E Draft

Page 2 of 2



The Center for Secure and Resilient Maritime Commerce (CSR)

DHS Center of Excellence for Port Security

11 Institutions – Maritime Domain Awareness & Resiliency

Maritime Domain Awareness

Approach –
- Multi Use Technologies
- Demonstrate Nested Vessel Detection
- Global > Approaches > Port

University of Miami –
- Global Satellite Coverage,
- Visible & Microwave

Rutgers, UPRM, UAF –
- Over-the-Horizon Compact
- High Frequency Radar Networks

Stevens Institute of Technology –
- Local High-Resolution Optics &
- Shallow Underwater Acoustics

The Center for Secure and Resilient Maritime Commerce (CSR)

Rutgers University – CODAR Ocean Sensors
Academic – Industry Partnership since 1998

CSR's HF Radar Mission:

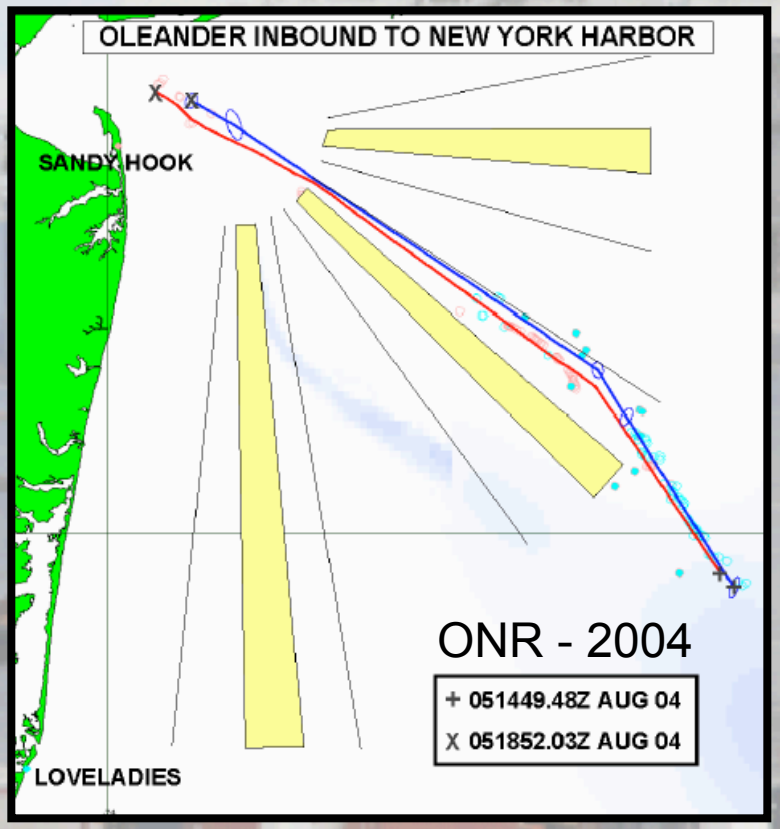
1. **Develop & Verify the HF Radar Multi-Use Capability for Current Mapping & Vessel Tracking.**

2. **Transition these Capabilities to Operational Use for Search And Rescue (SAR) and Maritime Domain Awareness (MDA).**

3. **Educate the Workforce Required to Operate these National Systems.**

The Center for Secure and Resilient Maritime Commerce (CSR)

Rutgers University – CODAR Ocean Sensors
Academic – Industry Partnership since 1998



HF Radar Team

Rutgers University -
Scott Glenn, Josh Kohut, Hugh Roarty, Mike Crowley, John Kerfoot, Ethan Handel, Mike Smith, Colin Evans

CODAR Ocean Sensors -
Don Barrick, Pete Lilleboe, Chad Whelan Belinda Lipa, Bill Rector, Jimmy Isaacson

University or Puerto Rico – Mayaguez
Jorge Corredor, Julio Morell, Miguel Canals

Applied Mathematics, Inc -
Bill Browning

University of Alaska – Fairbanks
Tom Weingarter, Hank Statscewich

Ocean Power Technologies –
Debbie Montagna, Bruce Downie

Naval Research Laboratory
Michael Lovellette, Dan Newton

Norwegian Defence Research Establishment (FFI)
Terje Johnsen, Walther Asen

CODARNor
Anton Kjelaas

27 Researchers @ 9 Institutions

CODAR Compact HF Radar Antennas

25 MHz

13 MHz

Combined Transmitter & Receiver

5 MHz

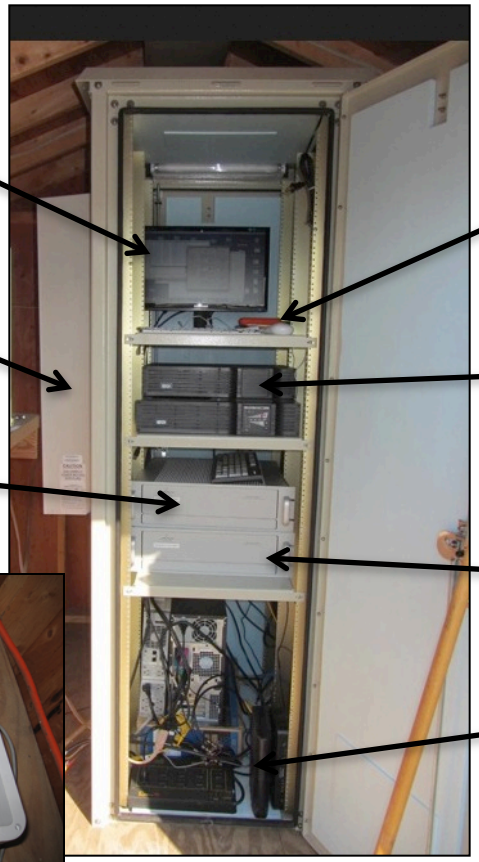
Separate Transmitter & Receiver

Standard CODAR Shore Site:

Shed, Enclosure, Tx/Rx, Comms, Power, GPS, AIS

Shed

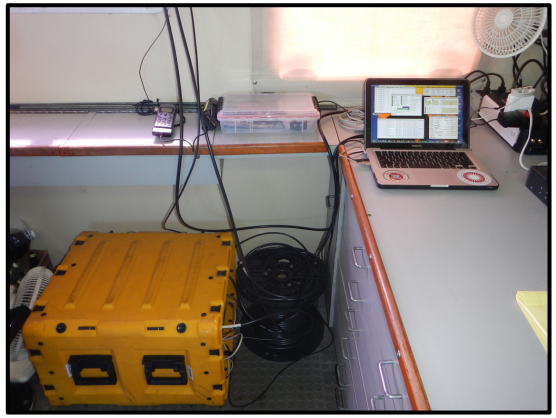
Lightning Protection



Enclosure

HF Radar Bistatic Transmitters –
Extending Range & Number of Look Angles

On Buoys



On Ships

On Shore

OUP E2E Engage to Excel Transition Pathway

1. Topic Selection

DHS Solicitation – COE for Maritime Security – MDA Component

2. Idea

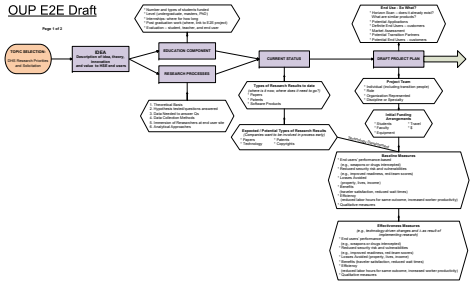
3 Scales – Global, Approaches, Port
3 Technologies – Satellites, HF Radar, Acoustics

3. Research Component – HF Radar

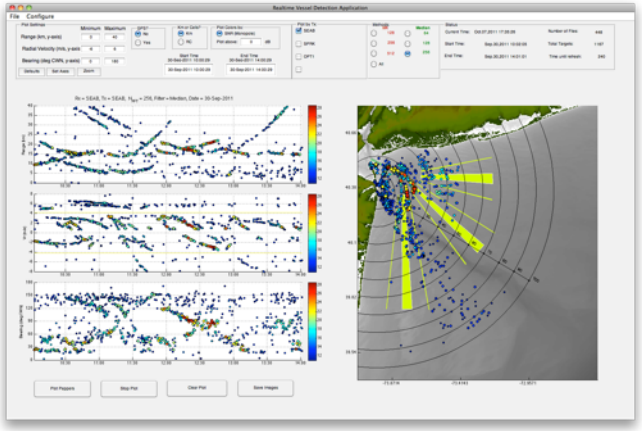
Multi-Use (currents and vessels)
Multi-static Network (monostatic + bistatic)
3 Steps for Currents (radial data > total vector maps > current products)
3 Steps for Vessels (detections > association > track fitting)

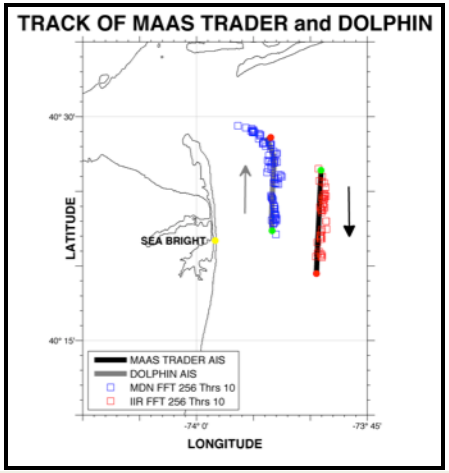
4. Education Component

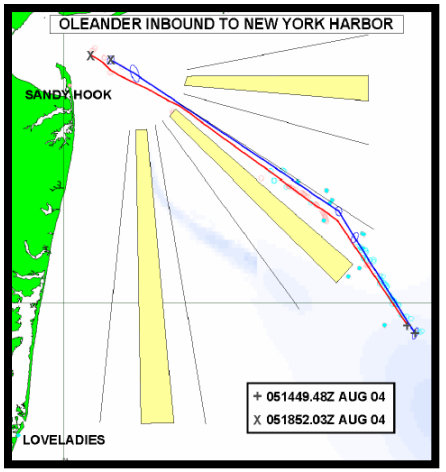
Summer Research Institute
Team Projects with Grand Challenges



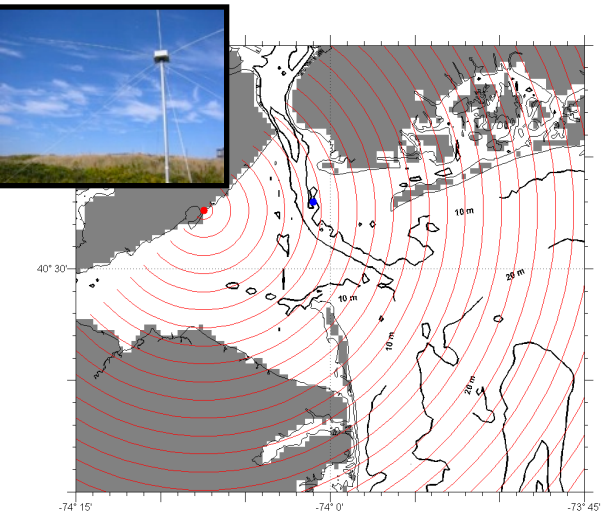
CSR Research Objective – *Develop the Multi-Use Capability in 3 Testbeds*

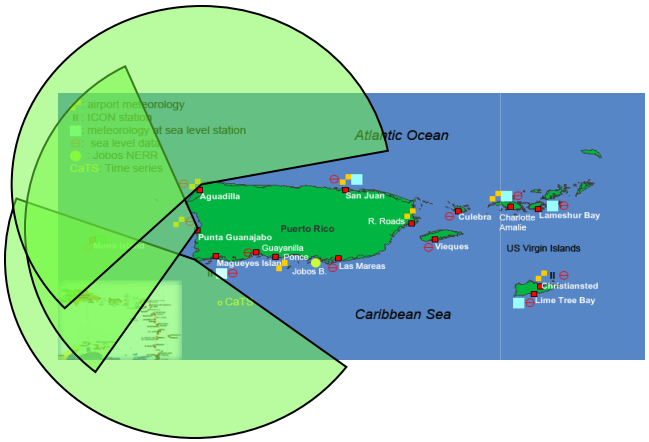


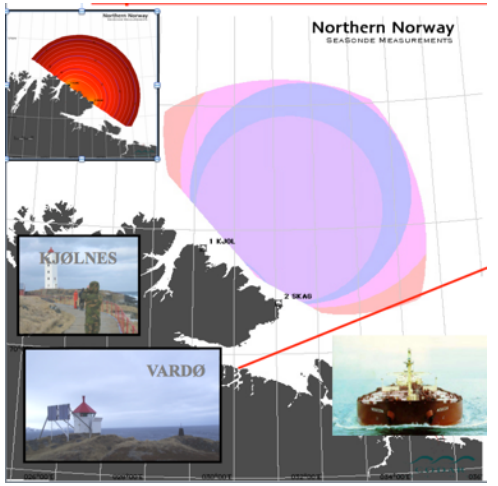




Detection **Association** **Track Fitting**



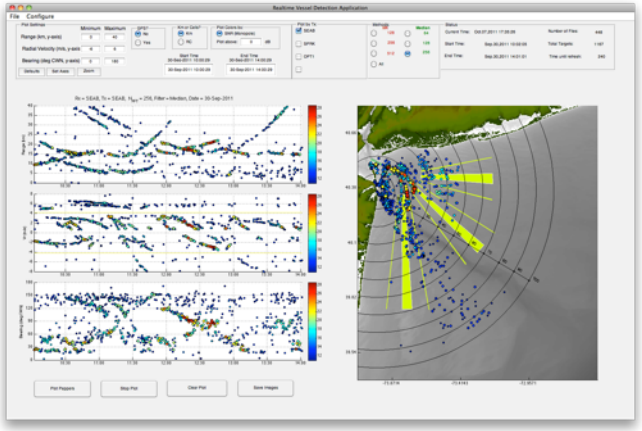


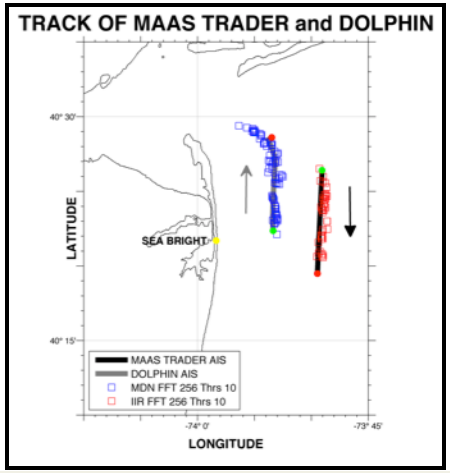


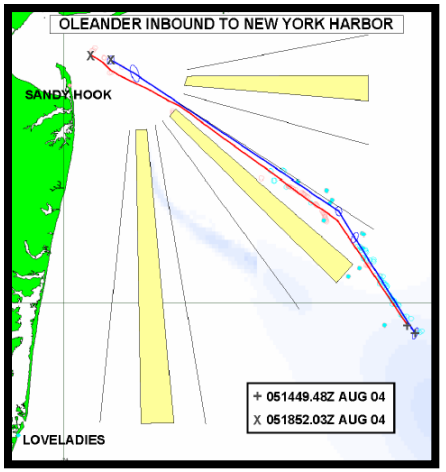
Urbanized Harbor Testbed **Tropical Testbed** **Arctic Testbed**

CSR – Year 0

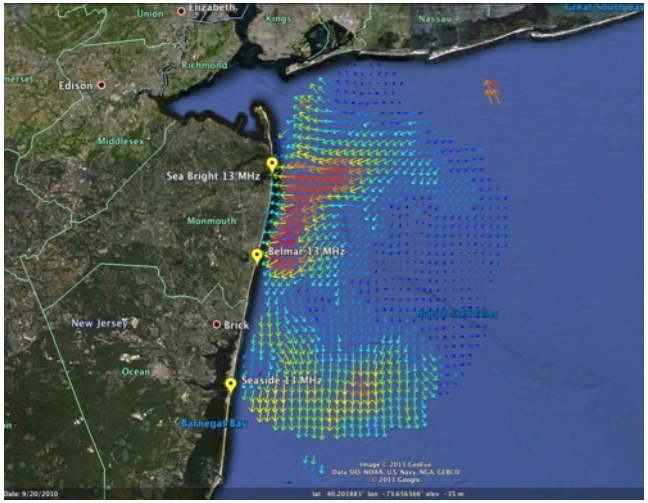
CSR Research Objective – *Develop the Dual Use Capability in 3 Testbeds*

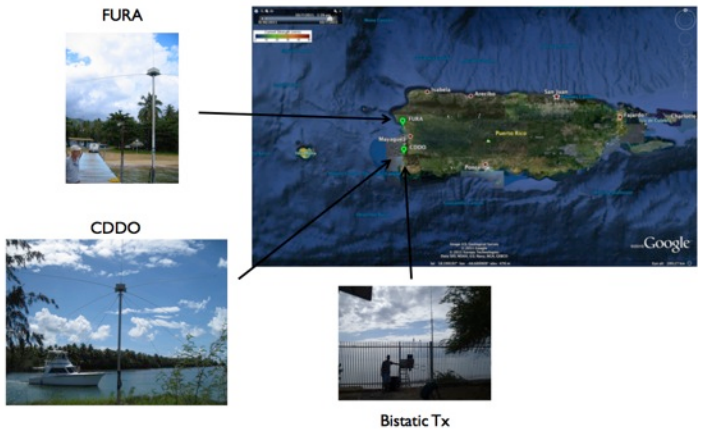


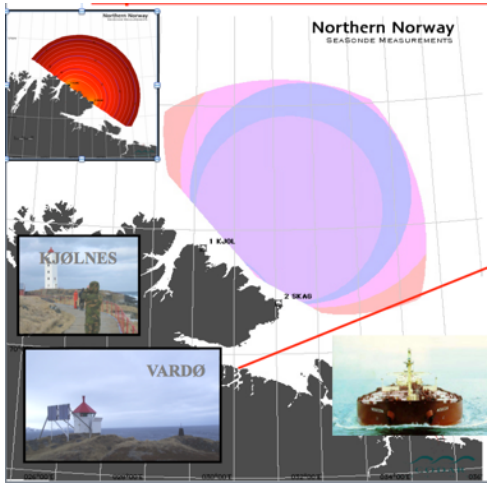




Detection **Association** **Track Fitting**





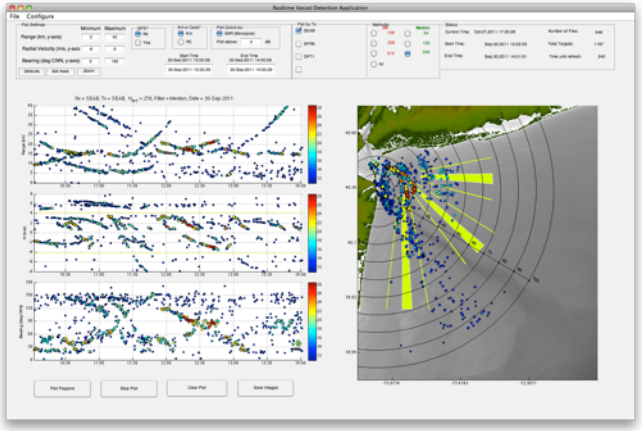


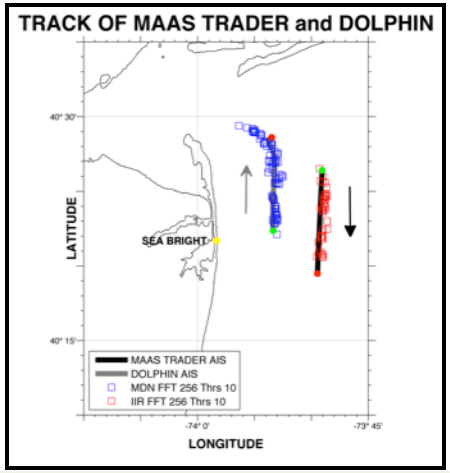
Urbanized Harbor Testbed **Tropical Testbed** **Arctic Testbed**

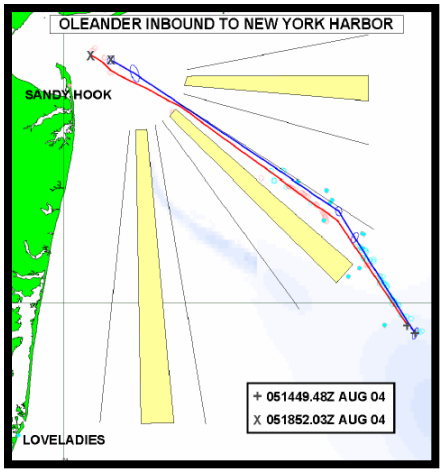
CSR – Year 5 Goal

The Center for Secure and Resilient Maritime Commerce (CSR)

CSR Research Objective – *Develop the Dual Use Capability in 3 Testbeds*



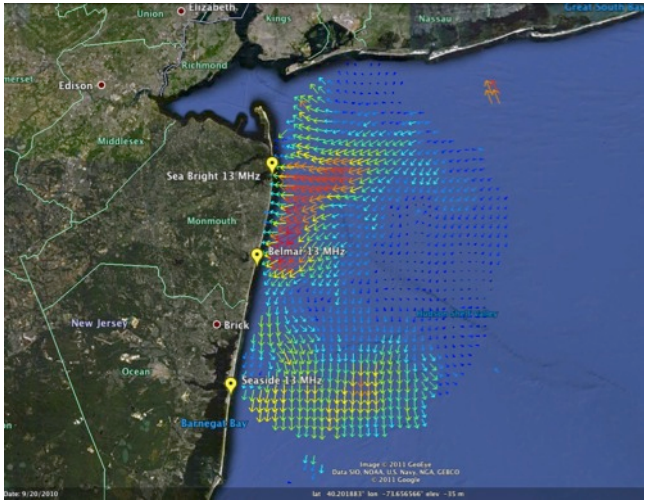


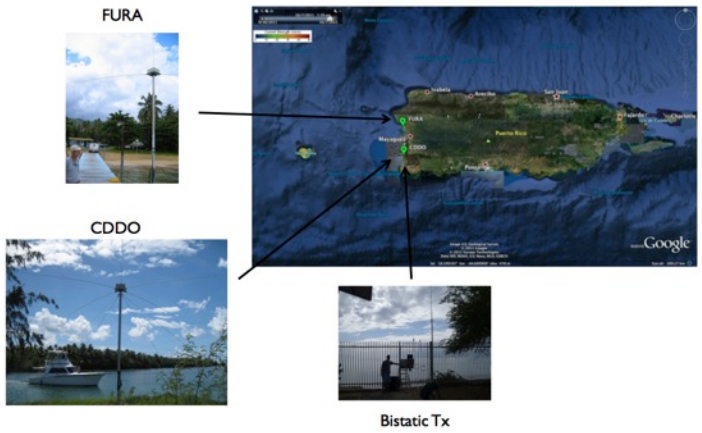


Detection

Association

Track Fitting





Urbanized Harbor Testbed

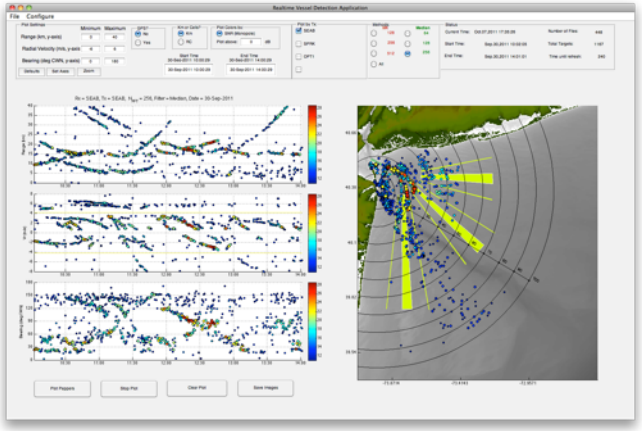
Tropical Testbed

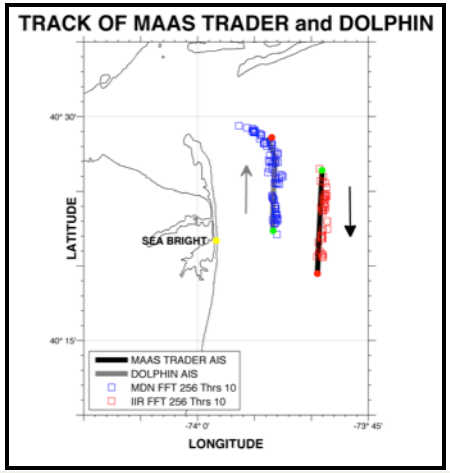
Arctic Testbed

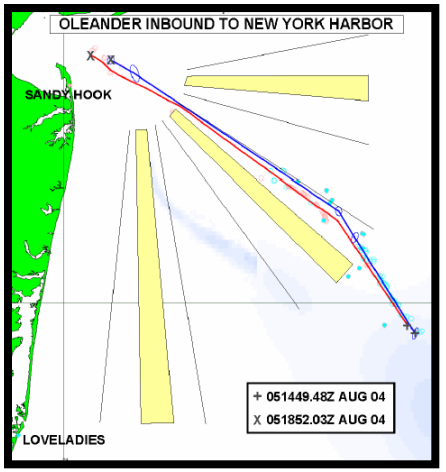
CSR – Year 4 Status

The Center for Secure and Resilient Maritime Commerce (CSR)

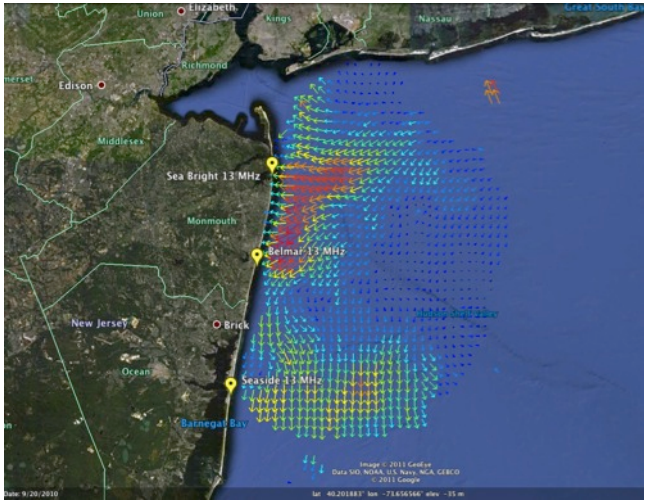
CSR Research Objective – *Develop the Dual Use Capability in 3 Testbeds*

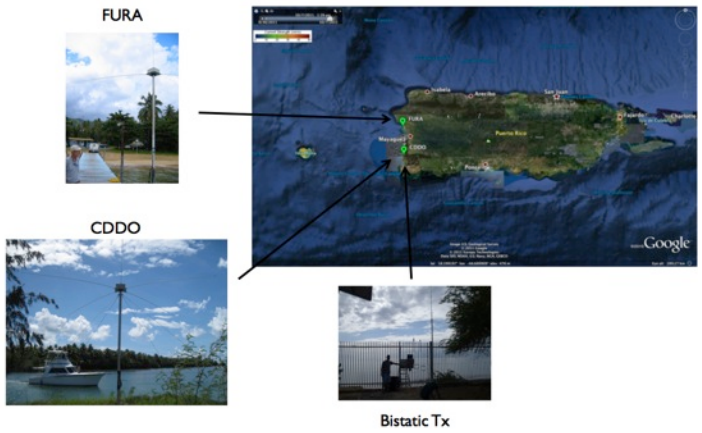






Detection **Association** **Track Fitting**





Urbanized Harbor Testbed **Tropical Testbed** **Arctic Testbed**

OUP E2E Engage to Excel Transition Pathway

5. Current Status (Pre-CSR)

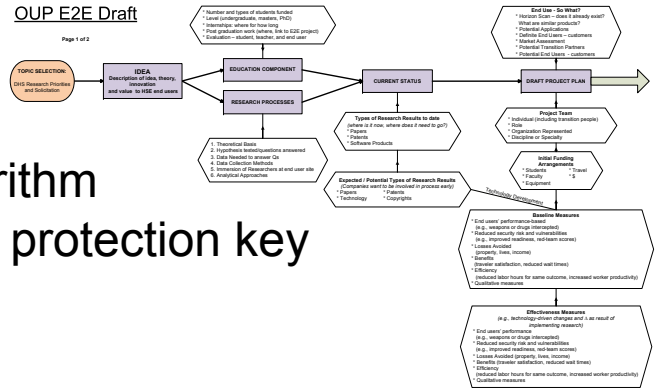
Multi-use, multi-static capability demonstrated in offline post-processing
Currents – Research results produced in real time
Vessels – Research results produced in offline post-processing

6. Draft Project Plan

Establish 3 Testbeds
- Urbanized mainland port – New York Harbor
- Remote Tropical – Puerto Rico
- Remote Arctic – Alaska, Norway

7. Legal Issues

No restrictions on currents
ITAR restrictions on vessel detection algorithm
- Mitigated with compiled software protection key



Maritime Wide Area Surveillance

- 2005 Report
- Network of compact sensors more effective than few large phased arrays
- POC Mr. Gary Hover

1. Report No.	2. Government Accession Number	3. Recipient's Catalog No.

4. Title and Subtitle	5. Report Date
Maritime Wide Area Surveillance Study	June 2005
7. Author(s) H. Abusalem, S. Borchardt, D. Grant, G. Hover, I. Stiglitz, J. Teti, G. Thomas, S. Thomas, J. Thomason	6. Performing Organization Code 7732 8. Performing Organization Report Number RDC 690
9. Performing Organization Name and Address U.S. Coast Guard Research and Development Center 1082 Shennecossett Road Groton, CT 06340-6048	10. Work Unit No. (TRAIS) 11. Contract or Grant No. DTCG32-02-D-R00010 DTCG39-00-D-R00009
12. Sponsoring Organization Name and Address U.S. Department of Homeland Security Homeland Security Advanced Research Projects Agency **Science and Technology Directorate** Washington, **DC 20528**	13. Type of Report & Period Covered Final 14. Sponsoring Agency Code **Mission Support Office** **Homeland Security Advanced Research Projects Agency**

15. Supplementary Notes

The Coast Guard program sponsor for this work is: Commandant (CG-7M)
U.S. Coast Guard Headquarters
Washington, DC 20593-0001

The RDC's technical point of contact is Mr. Gary Hover, (860) 441-2818, email: ghover@rdc.uscg.mil.

16. Abstract (MAXIMUM 200 WORDS)

This report presents the results of an expert panel study sponsored by the Homeland Security Advanced Research Projects Agency. The panel examined research and development options for sensor technologies that can be used to conduct persistent and effective wide area surveillance (WAS) of the U.S. maritime borders in the region from approximately 12 nautical miles (nmi) to 90 nmi offshore. The study focused primarily on land-based, high frequency surface wave radar (HFSWR) and multi-sensor airborne system options. High frequency, over-the-horizon sky wave radar was also considered for applications further offshore.

17. Key Words	18. Distribution Statement
Maritime Domain Awareness (MDA), wide area surveillance (WAS), over-the-horizon (OTH) sensors, high frequency (HF) radar	*WARNING:* This record contains Sensitive Security Information that is controlled under 49 CFR parts 15 and 1520. No part of this record may be disclosed to persons without a "need to know," as defined in 49 CFR parts 15 and 1520, except with the written permission of the Administrator of the Transportation Security Administration or the Secretary of Transportation. Unauthorized release may result in civil penalty or other action. For U.S. government agencies, public disclosure is governed by 5 U.S.C. 552 and 49 CFR parts 15 and 1520.

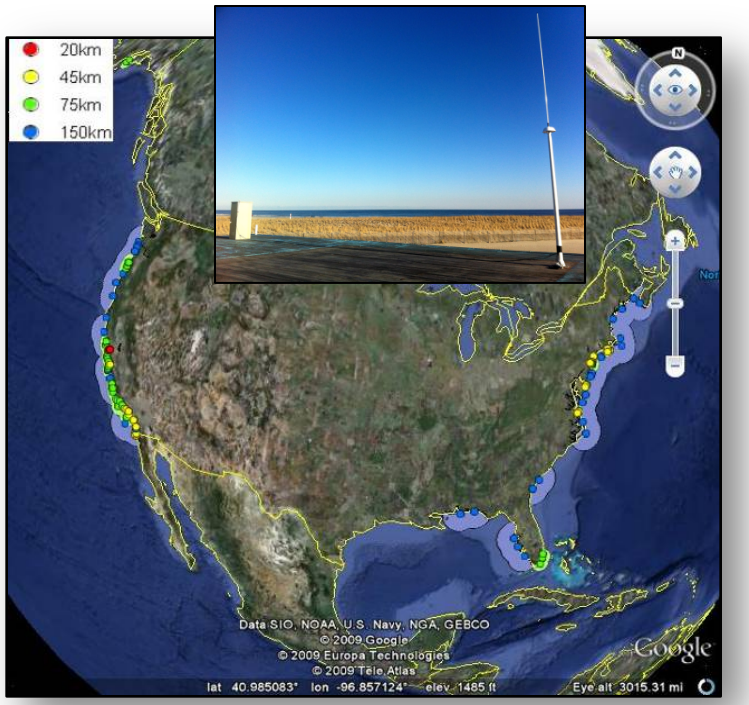
19. Security Class (This Report)	20. Security Class (This Page)	21. No of Pages	22. Price
UNCLASSIFIED - SSI	UNCLASSIFIED - SSI		

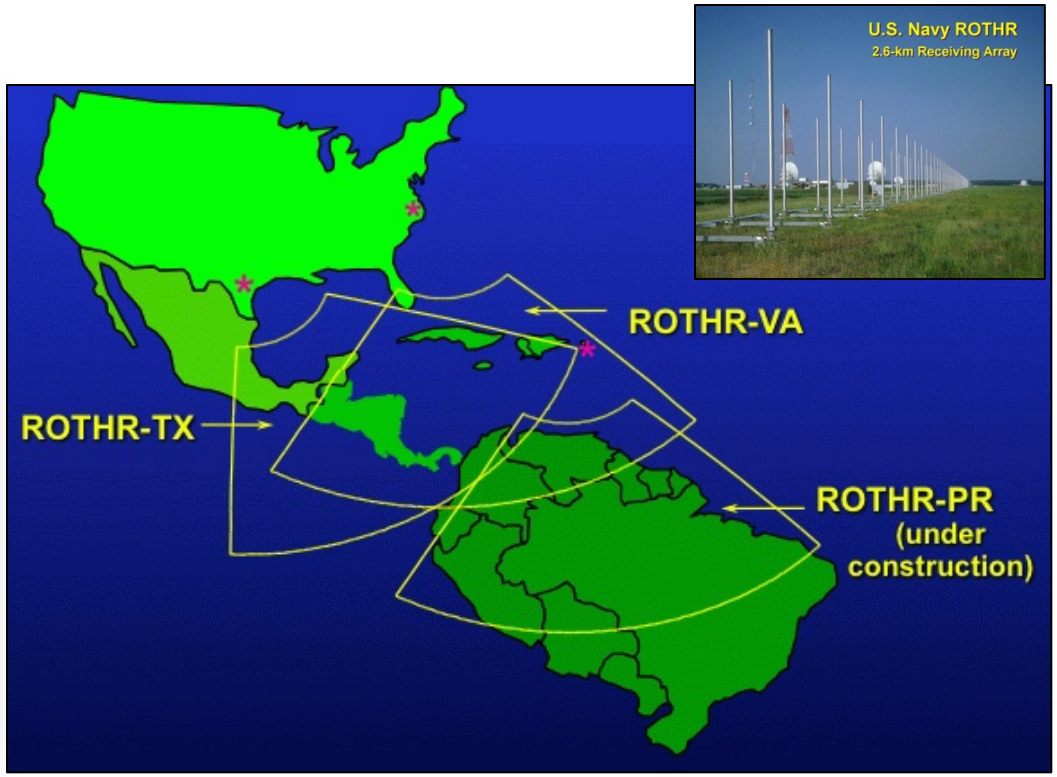
CODAR vs Raytheon

Cost: $150,000
Range: 0-100 km

Cost: $15,000,000
Range: 0-370 km

CODAR vs ROTHR



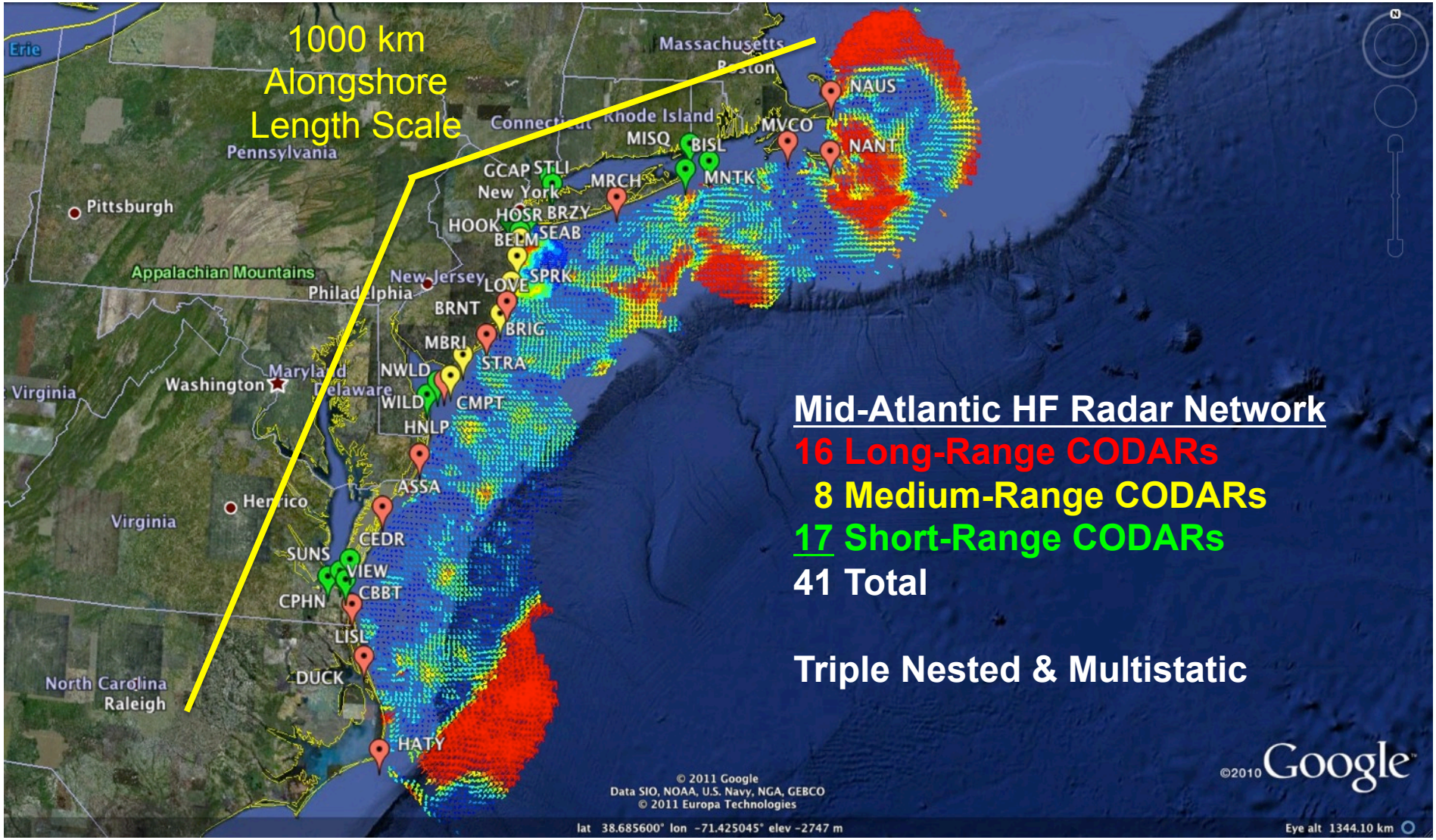


Annual Cost:	$24 million
Coverage:	270×10^3 mi^2
Range:	0-100 km

Annual Cost:	$20 million
Coverage:	2.5×10^6 mi^2
Range:	500-3700 km

CODAR can fill in gap that ROTHR currently has close to shore

Mid-Atlantic Bight HF Radar Network



Transition Success Stories – Making a Difference

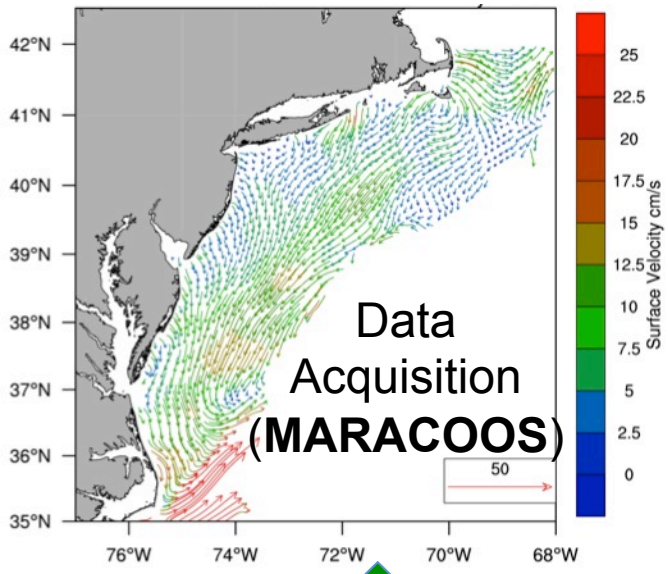
Optimizing HF Radar for SAR using USCG Surface Drifters

Art Allen
U.S. Coast Guard

Scott Glenn
Rutgers University

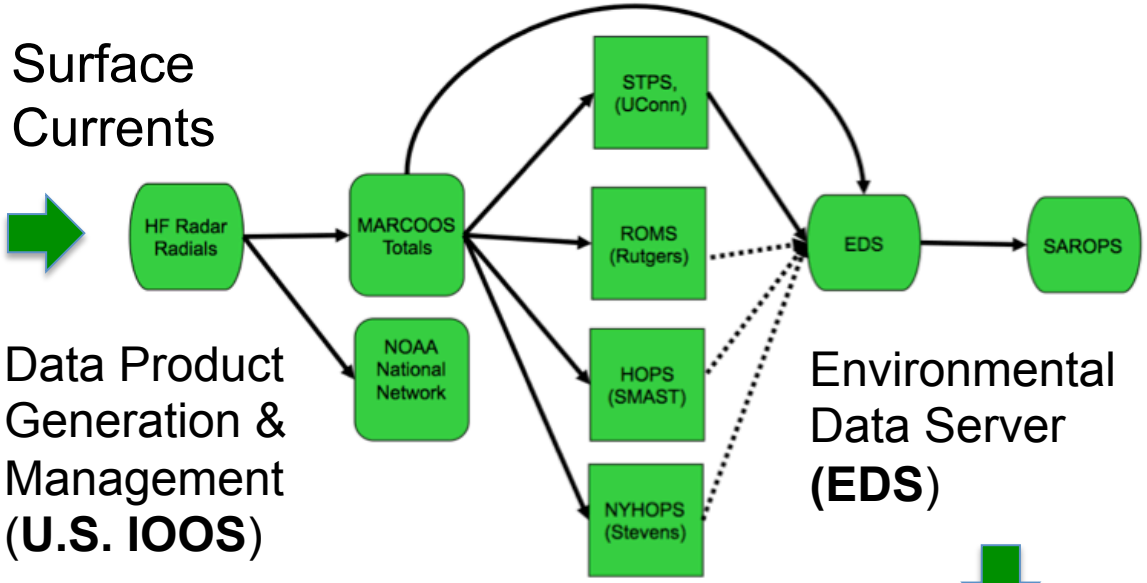
Mid-Atlantic Regional Association Coastal Ocean Observing System

Transition Objective –
Operational Use of HF Radar Surface Currents for Search And Rescue



Data Acquisition (**MARACOOS**)

Surface Currents

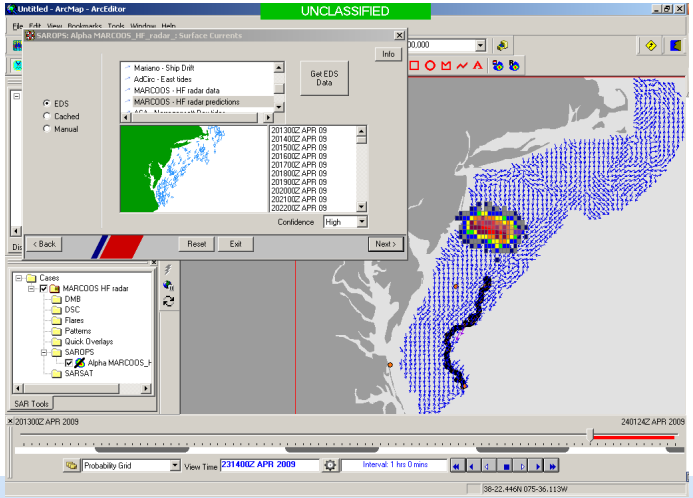


Data Product Generation & Management (**U.S. IOOS**)

Environmental Data Server (**EDS**)

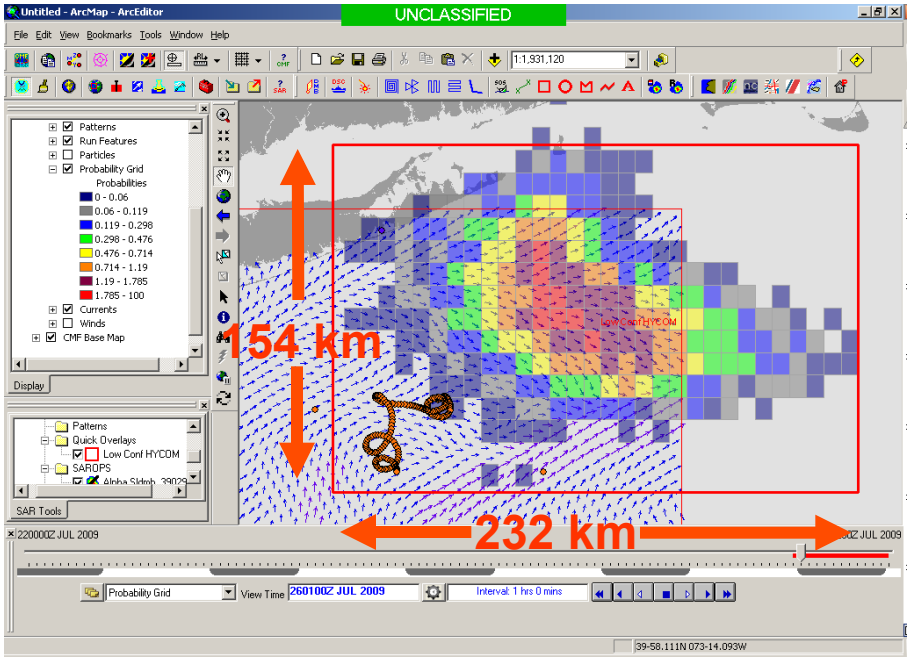
United States Coast Guard
U.S. Department of Homeland Security

Search And Rescue Optimal Planning System (**SAROPS**)



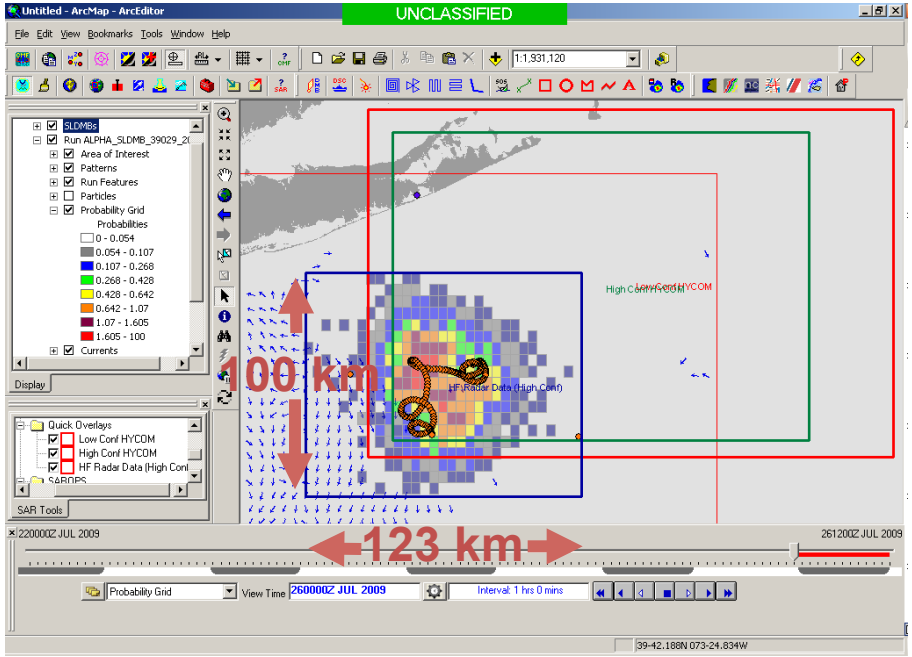
SAROPS Test Case

5000 Virtual Drifters + 1 Real Drifter (Black Line): Search Area After 96 Hours



HYCOM

36,000 km²

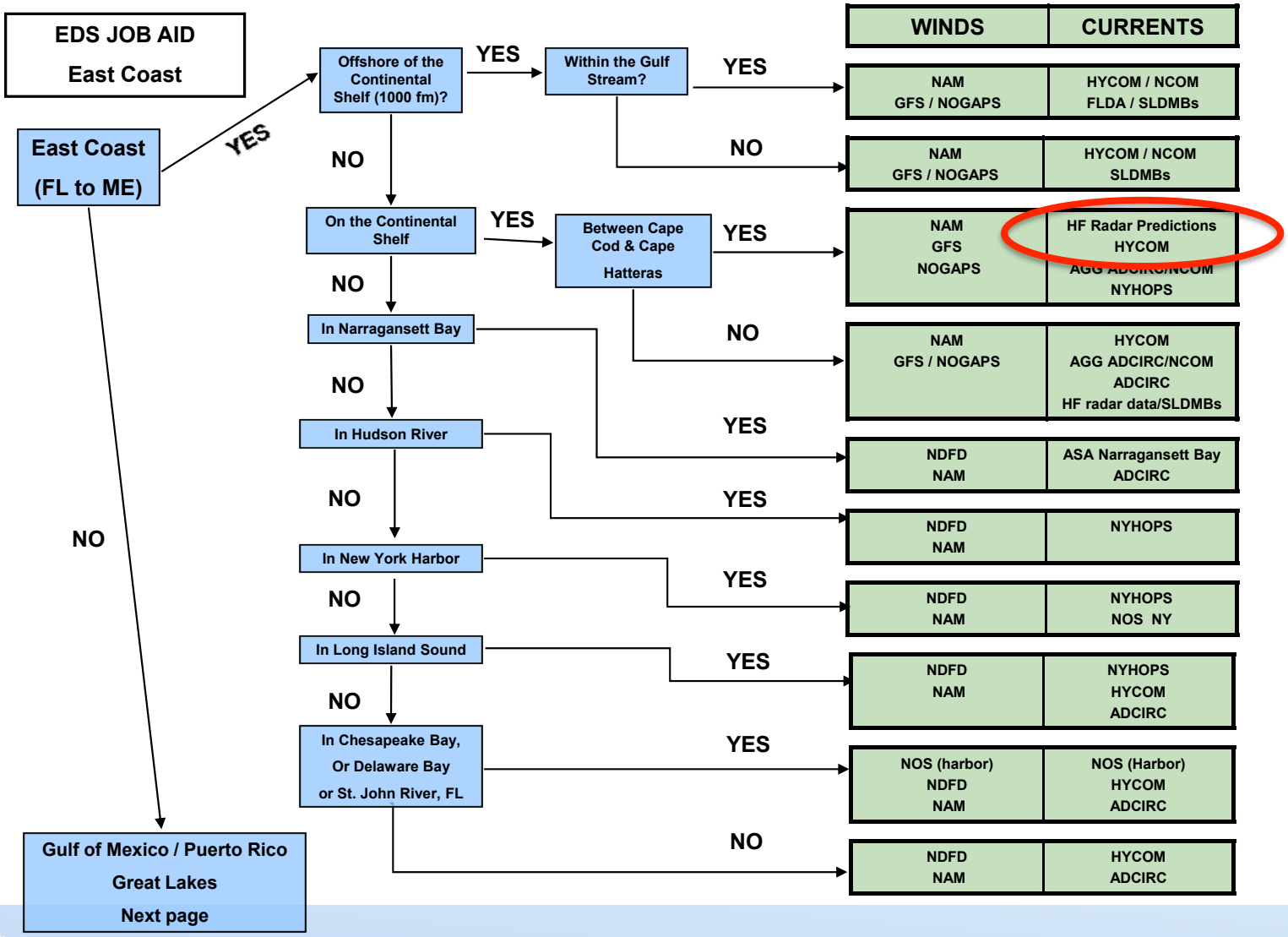


CODAR

12,000 km²

Environmental Data Server (EDS) & SAROPS

Operational May 4, 2009



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

United States of America
DEPARTMENT OF COMMERCE

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Top News

U.S. Coast Guard Photo

NOAA, U.S. Coast Guard: New Ocean Current data to Improve Search and Rescue Activities

Washington (May 4)—A new set of ocean observing data that enhances the ability to track probable paths of victims and drifting survivor craft should improve search and rescue efforts along the U.S. coast. The data comes from the Integrated Ocean Observing System (IOOS®), part of a joint effort among NOAA, the Mid-Atlantic Coastal Ocean Observing Regional Association, the U.S. Coast Guard, and the Department of Homeland Security. The new data sets include surface current maps from high frequency radar systems. (More)

File Photo

Secretary Locke Sworn in at White House Ceremony by Vice President Biden

Washington (May 1)—U.S. Secretary of Commerce Gary Locke and U.S. Health and Human Services Secretary Kathleen Sebelius were sworn in by Vice President Joe Biden in ceremonies at the White House. President Barack Obama also attended the ceremonial swearing-in event in the East Room. "My Cabinet is now full of energetic innovators like Kathleen and Gary. . . I am thrilled to have them by my side as we continue the work of turning our economy around and laying a new foundation for growth that delivers on the change the American people asked for, and the promise of a new and better day ahead," President Obama said. Locke, a key member of the President's economic team, is the department's 36th Secretary, leading its 12 agencies and bureaus and more than 52,000 employees. (President's Remarks)

Secretary Locke Discusses Trade Promotion Agreement with Colombian Minister for Trade

Washington (May 1)—U.S. Commerce Secretary Gary Locke hosted a meeting with Colombia's Minister for Trade, Industry and Tourism, Luis Guillermo Plata, at the Commerce Department today. This was the first meeting between Minister Plata and Secretary Locke. The Secretary and Minister Plata reaffirmed the commitment of both governments to move forward on progress towards the U.S.-Colombia Trade Promotion Agreement. The two leaders also underscored the importance of building stronger business ties through activities like joint cooperation in trade capacity-building for small- and medium-sized enterprises and good governance programs. (More)

Last Updated: May 4, 2009

Questions regarding this section may be directed to the Department of Commerce Webmaster

Recovery.gov

For information about Commerce agencies' efforts, visit Commerce.gov/Recovery.

For information about the entire government's effort, visit Recovery.gov.

Commerce Initiatives
- Department of Commerce Progress Report
- Digital Television Transition

Commerce and You
- Population - U.S. Census Bureau
- Official Time in Your Area - NIST
- Today's Weather - NWS
- Grant Opportunities
- E-Commerce Highlights

International Outreach
- Trade Opportunities for U.S. Businesses
- Trade Statistics Express
- Iraq Reconstruction Task Force
- Afghanistan Reconstruction Task Force

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Present Activity:

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

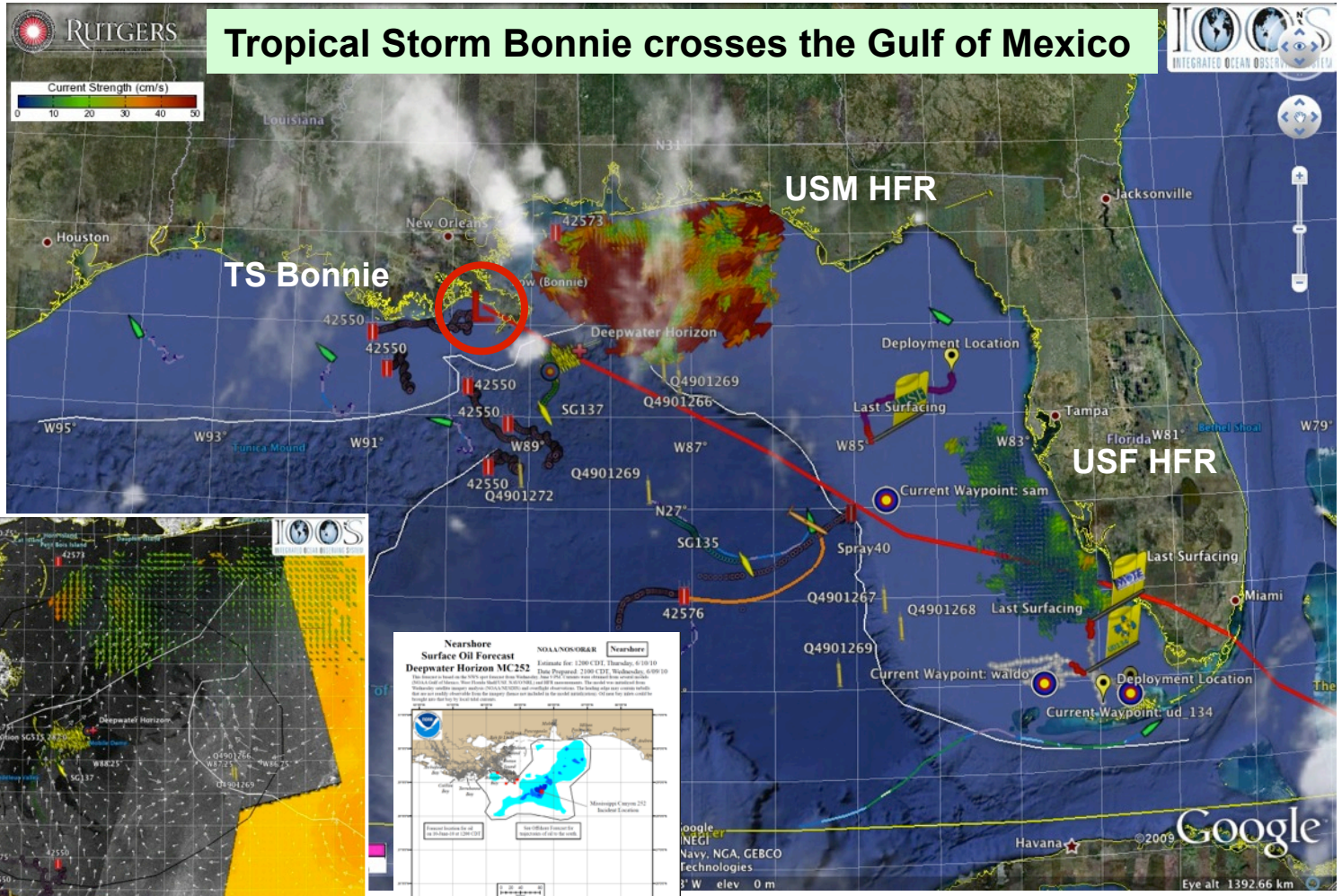
3 West Coast Regions for California & Oregon are ready.

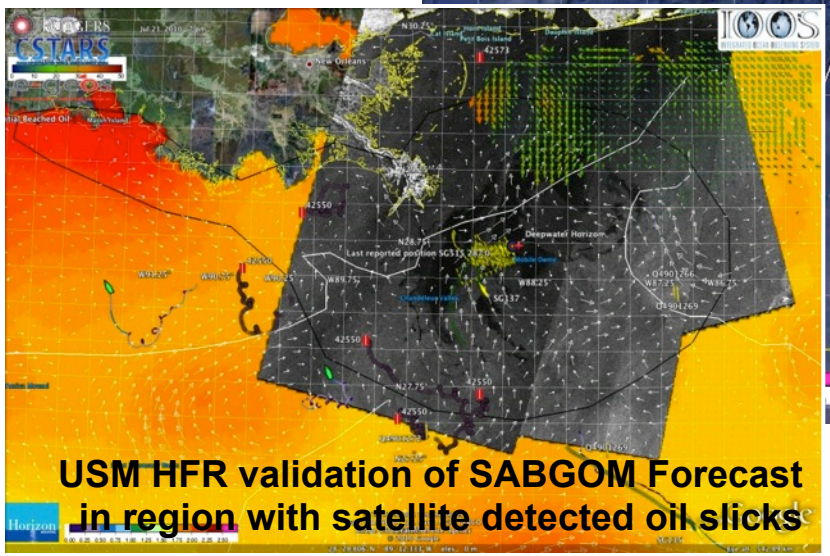
erce (CSR)

IOOS Coordinated Rapid Response: *Deepwater Horizon Oil Spill*

Contributed Assets:

HF Radar Networks
USF, USM
Gliders
iRobot, Mote, Rutgers, SIO/WHOI, UDel, USF
Drifters & Profilers
Horizon Marine, Navy
Satellite Imagery
CSTARS, UDel
Ocean Forecasts
Navy, NCSU
Data/Web Services
ASA, Rutgers, SIO





USM HFR validation of SABGOM Forecast in region with satellite detected oil slicks

HFR used for Oil Slick Forecasts by NOAA/NOS/OR&R

IOOS Coordinated Rapid Response: *Deepwater Horizon Oil Spill*

Contributed Assets:

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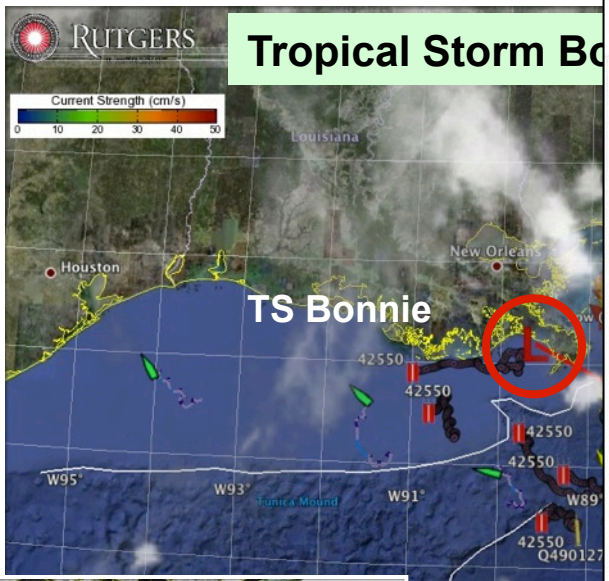
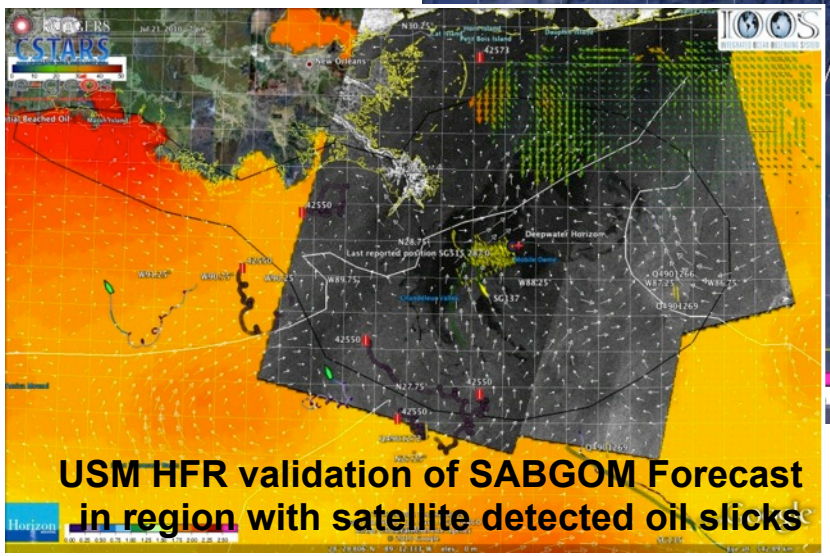
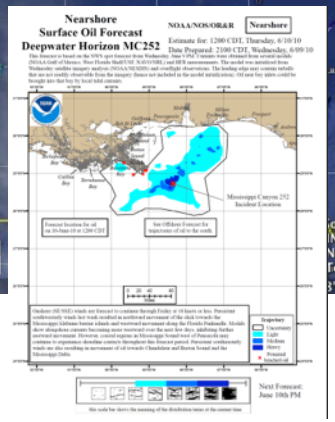
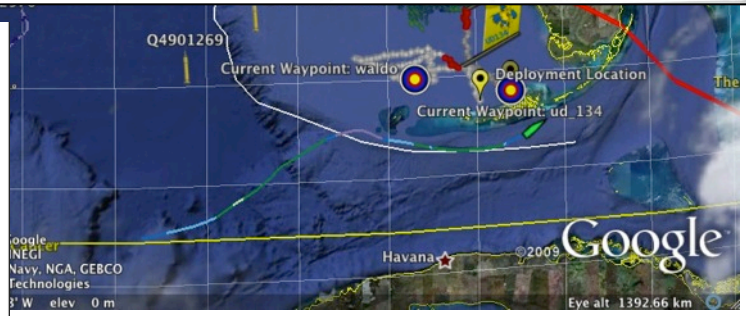
Satellite Imagery
CSTARS, UDel
Ocean Forecasts
Navy, NCSU
Data/Web Services
ASA, Rutgers, SIO





USM HFR validation of SABGOM Forecast in region with satellite detected oil slicks





HFR used for Oil Slick Forecasts by NOAA/NOS/OR&R

WRITTEN STATEMENT OF
JANE LUBCHENCO, Ph.D.
UNDER SECRETARY OF COMMERCE FOR OCEANS AND ATMOSPHERE
AND NOAA ADMINISTRATOR
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

ON THE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION'S
FY 2012 BUDGET REQUEST

BEFORE THE
COMMITTEE ON NATURAL RESOURCES
SUBCOMMITTEE ON FISHERIES, WILDLIFE, OCEANS, AND INSULAR AFFAIRS
U.S. HOUSE OF REPRESENTATIVES

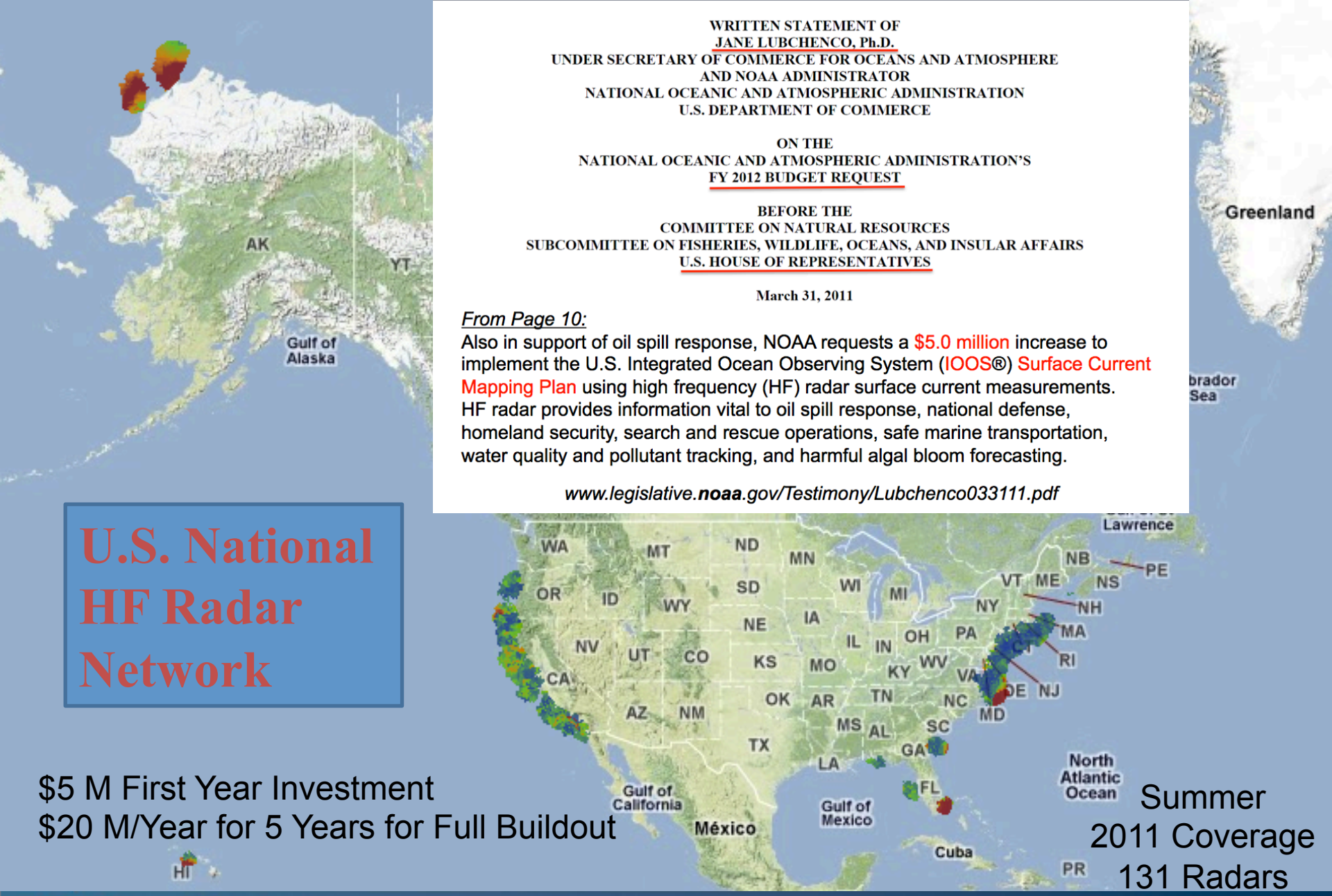
March 31, 2011

From Page 10:

Also in support of oil spill response, NOAA requests a $5.0 million increase to implement the U.S. Integrated Ocean Observing System (IOOS®) Surface Current Mapping Plan using high frequency (HF) radar surface current measurements. HF radar provides information vital to oil spill response, national defense, homeland security, search and rescue operations, safe marine transportation, water quality and pollutant tracking, and harmful algal bloom forecasting.

*www.legislative.**noaa**.gov/Testimony/Lubchenco033111.pdf*

U.S. National HF Radar Network



$5 M First Year Investment
$20 M/Year for 5 Years for Full Buildout

Summer 2011 Coverage 131 Radars

IOOS®

U.S. National HF Radar Network

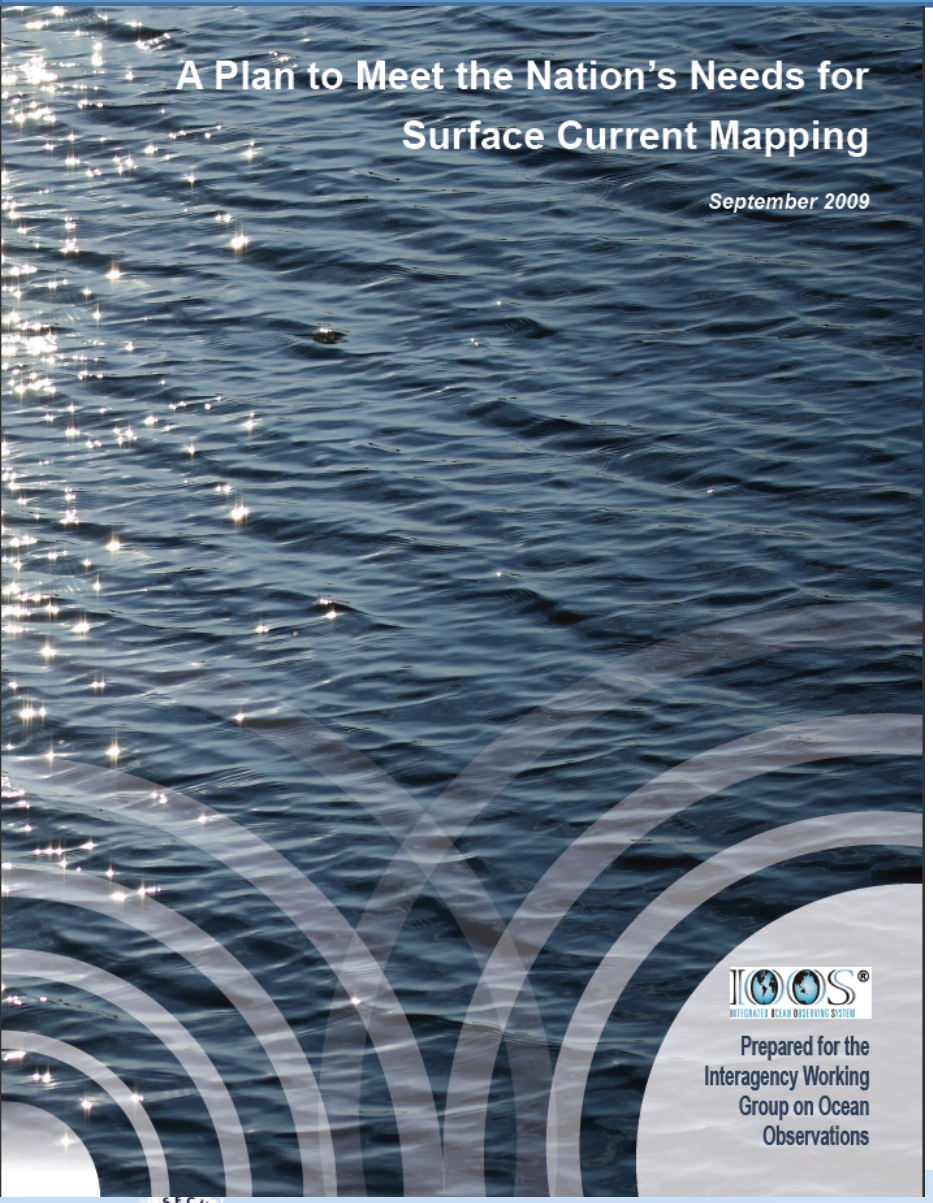
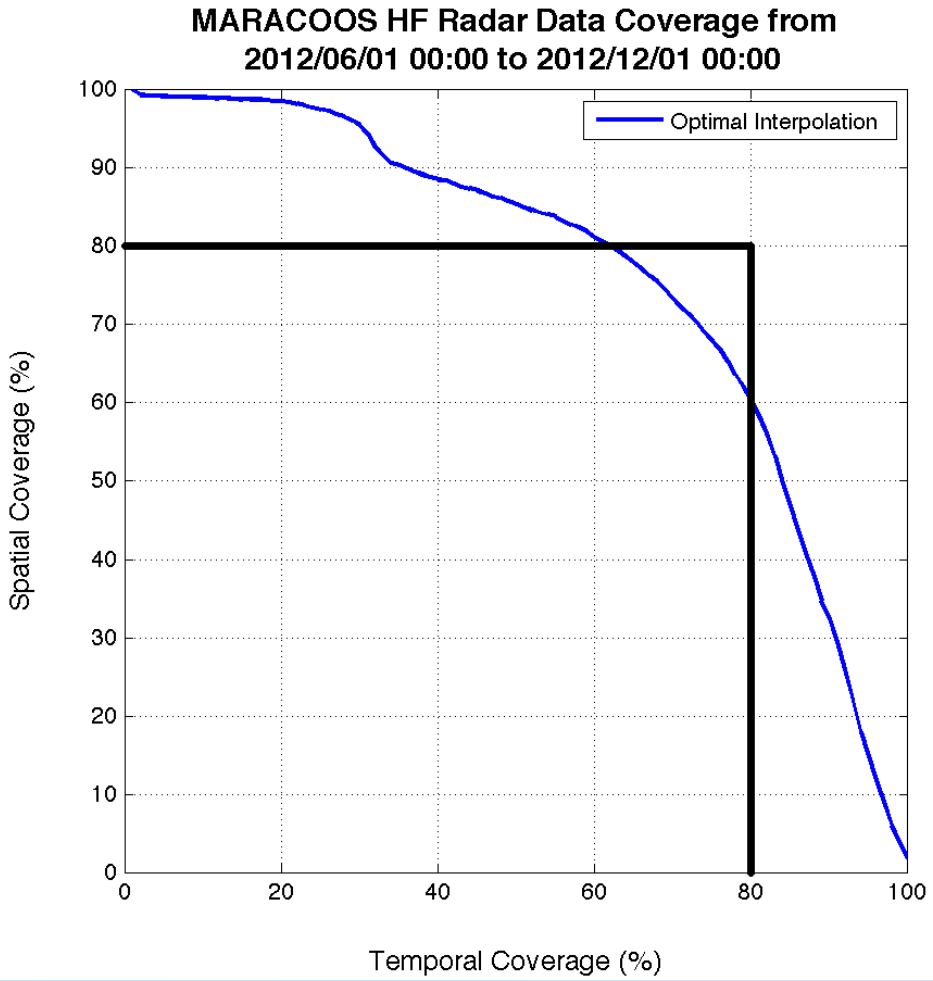


Table 4: Full 5-Year Buildout. Estimated acquisition & maintenance costs.

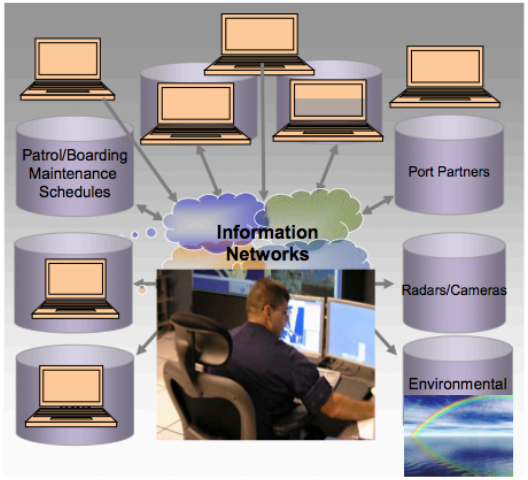
Region	YR1	YR2	YR3	YR4	YR5	Total New	Total Existing	Total at 5-Yr Buildout	Total Acquisition & Deployment ($K)*	Existing Annual Regional O&M ($K)*	Total New Annual O&M* ($K)
Alaska	6	3	4	2	5	20	2	22	$3,200	$98	$371
Caribbean	6	6	6	6	5	29	0	29	$4,640	$0	$539
Pacific Islands	5	6	5	5	5	26	2	28	$7,800	$154	$845
Northeast Atlantic	6	6	3	1	1	17	8	25	$2,720	$393	$316
Mid-Atlantic	10	8	5	0	0	23	29	52	$3,680	$1,425	$427
Southeast Atlantic	6	6	6	6	3	27	12	39	$8,100	$813	$878
Gulf of Mexico	5	4	3	3	2	17	16	33	$5,100	$842	$553
Southern California	3	2	2	2	2	11	31	42	$1,760	$1,523	$204
Central & N. California	4	4	4	4	2	18	32	50	$2,880	$1,573	$334
Pacific Northwest	4	4	4	4	4	20	11	31	$3,200	$541	$371
Totals	55	49	42	33	29	208	143	351	$39,580	$7,362	$4,838

- *Technician fully encumbered salary is estimated at $130,000;*
- *Purchase and deployment for DF HFRs, LPA HFRs are $160,000 and $300,000, respectively.*
- *Two technicians for each 7 DF HFRs, 4 LPA HFRs, respectively.*

80/80 Status


MARACOOS HF Radar Data Coverage from
2012/06/01 00:00 to 2012/12/01 00:00
Optimal Interpolation
Spatial Coverage (%)
Temporal Coverage (%)
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100

End Users: Watchkeeper

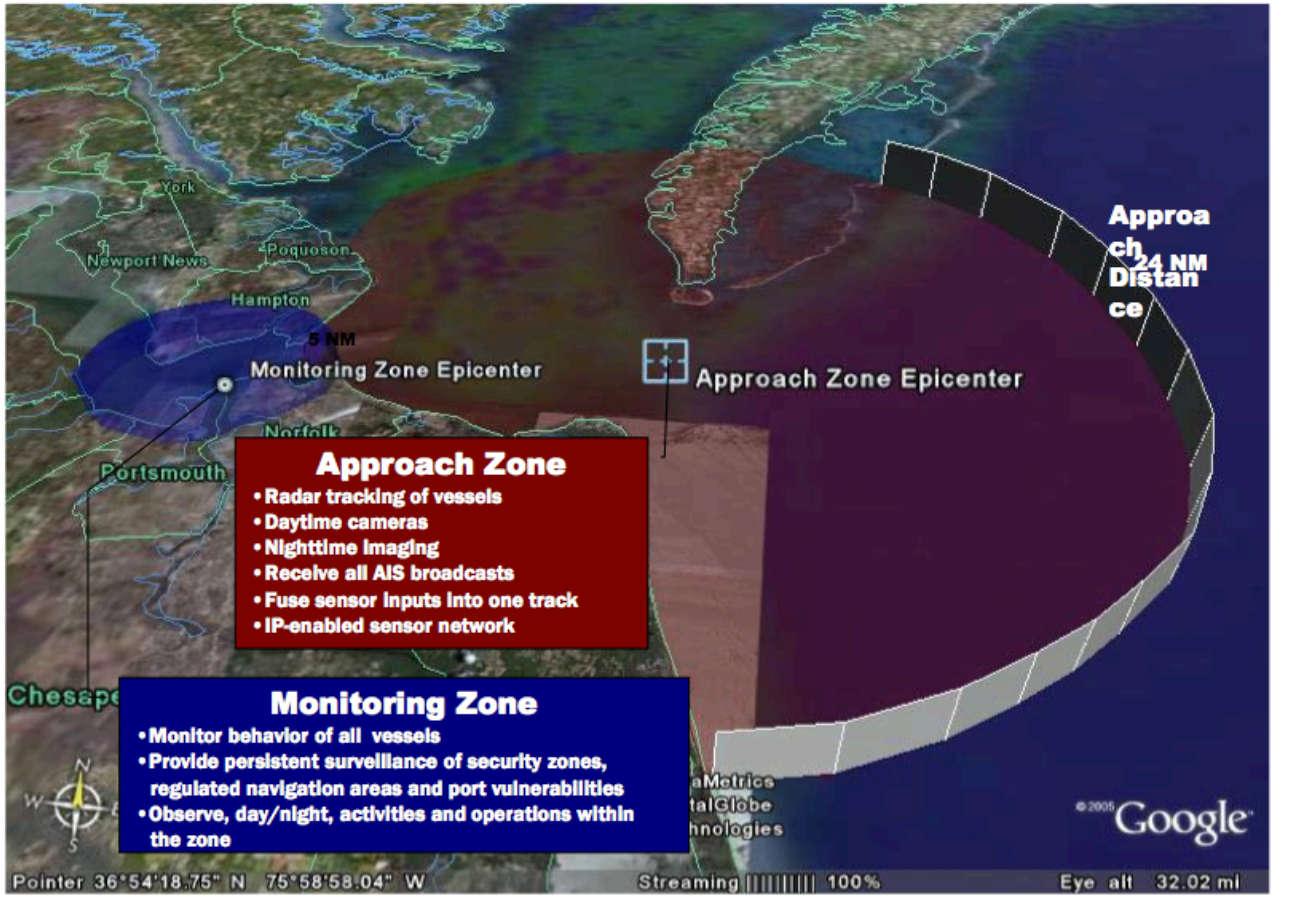


Today

Operator is the Integrator

Tomorrow

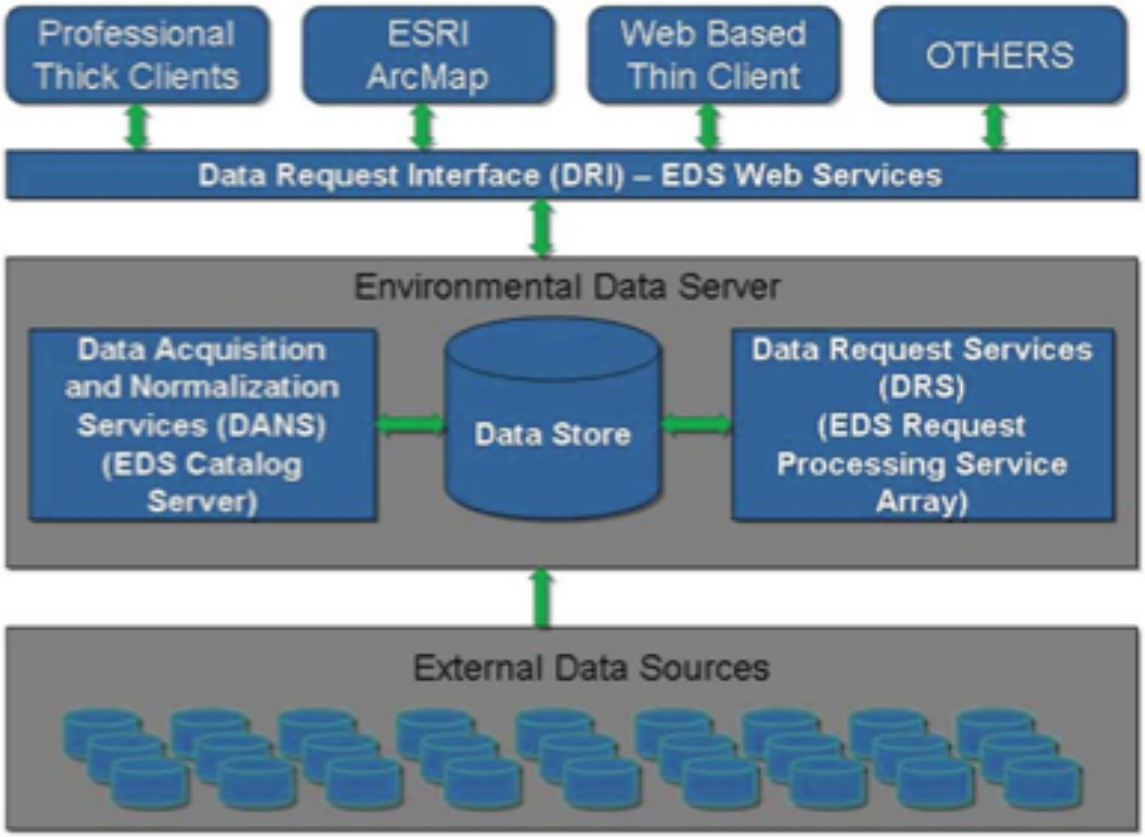
Operator is the Evaluator



Watchkeeper pulls data from EDS

Applied Science Associates

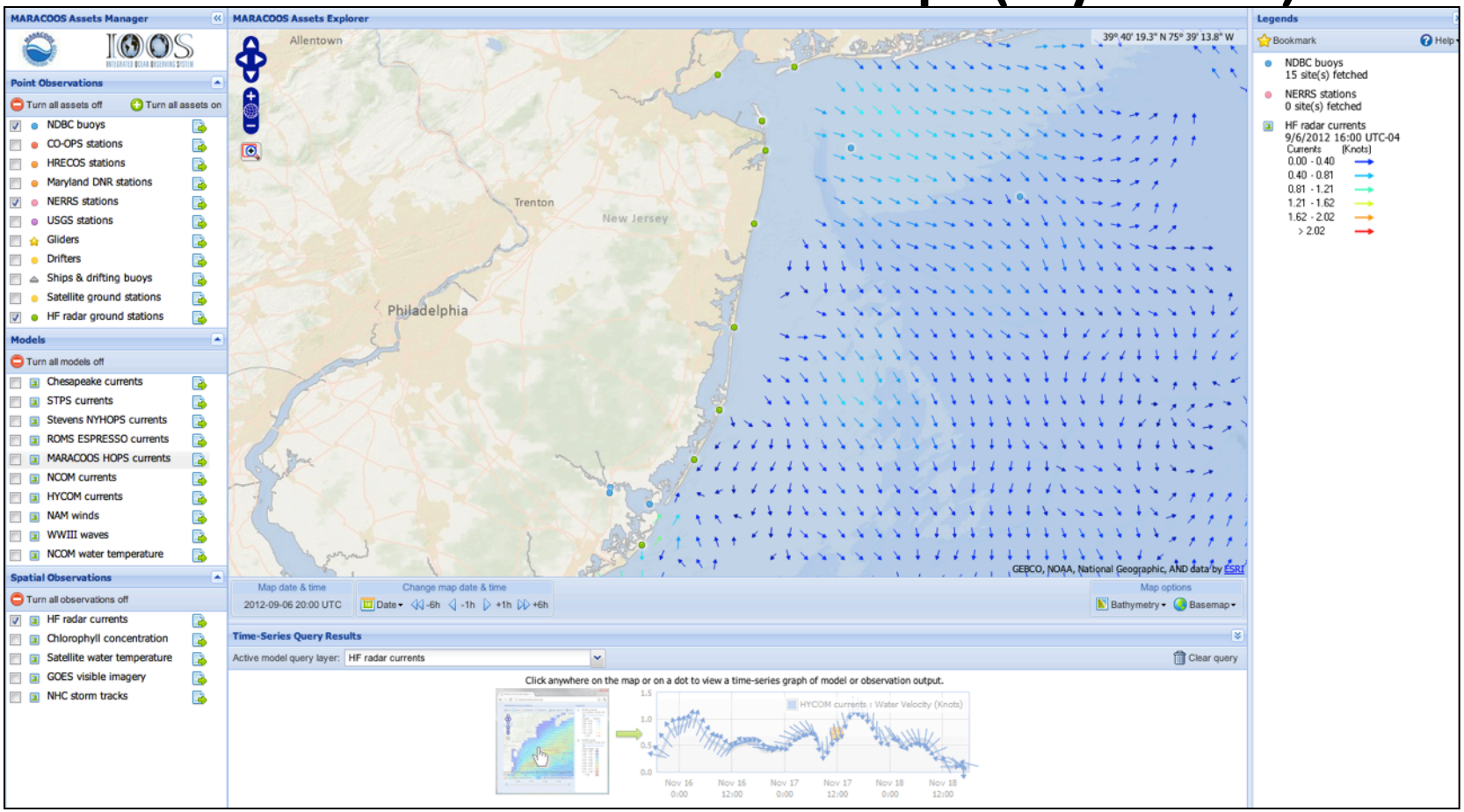
EDS™ Environmental Data Server



EDS Highlights

- World-wide data coverage
- Seamlessly Integrates with ASA modeling software
- Supports spatial and temporal data subsetting
- Data product aggregation
- Built on standard data conventions
- Utilizes open standards data delivery protocols
- Integrated OGC Web Mapping Service (WMS)
- Service oriented architecture
- Extensible framework
- Automated processing and data QA/QC
- Forecast and hindcast data archive

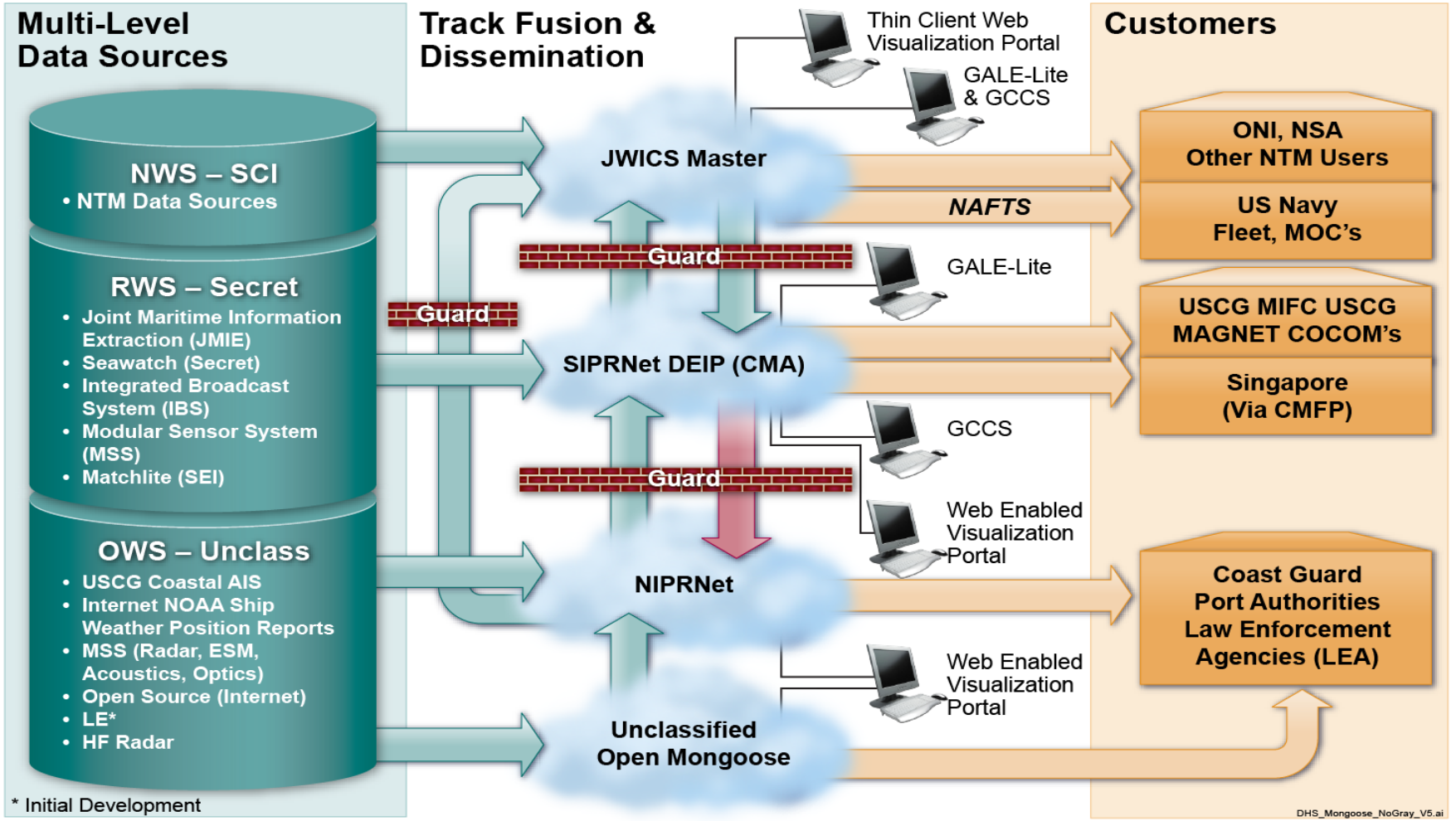
U.S. Integrated Ocean Observing System: Interactive Asset Map (by ASA)



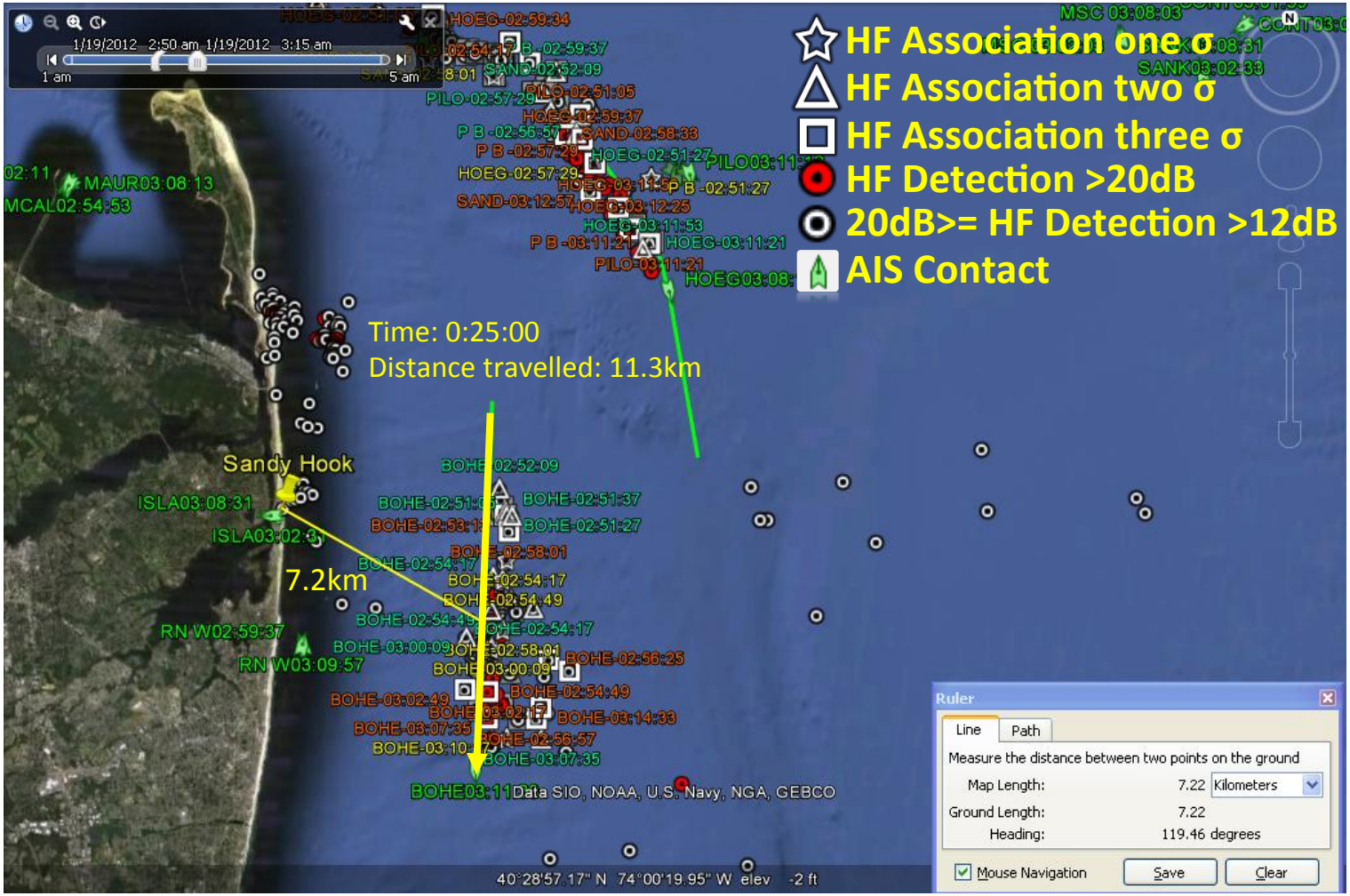
Comprehensive General Purpose and User Specific Versions

Multi-Level Access and Information Sharing with Open Mongoose (MDA CONOP)

(U) Multi-Level Enclaves Provide Appropriate Level Data to Customers

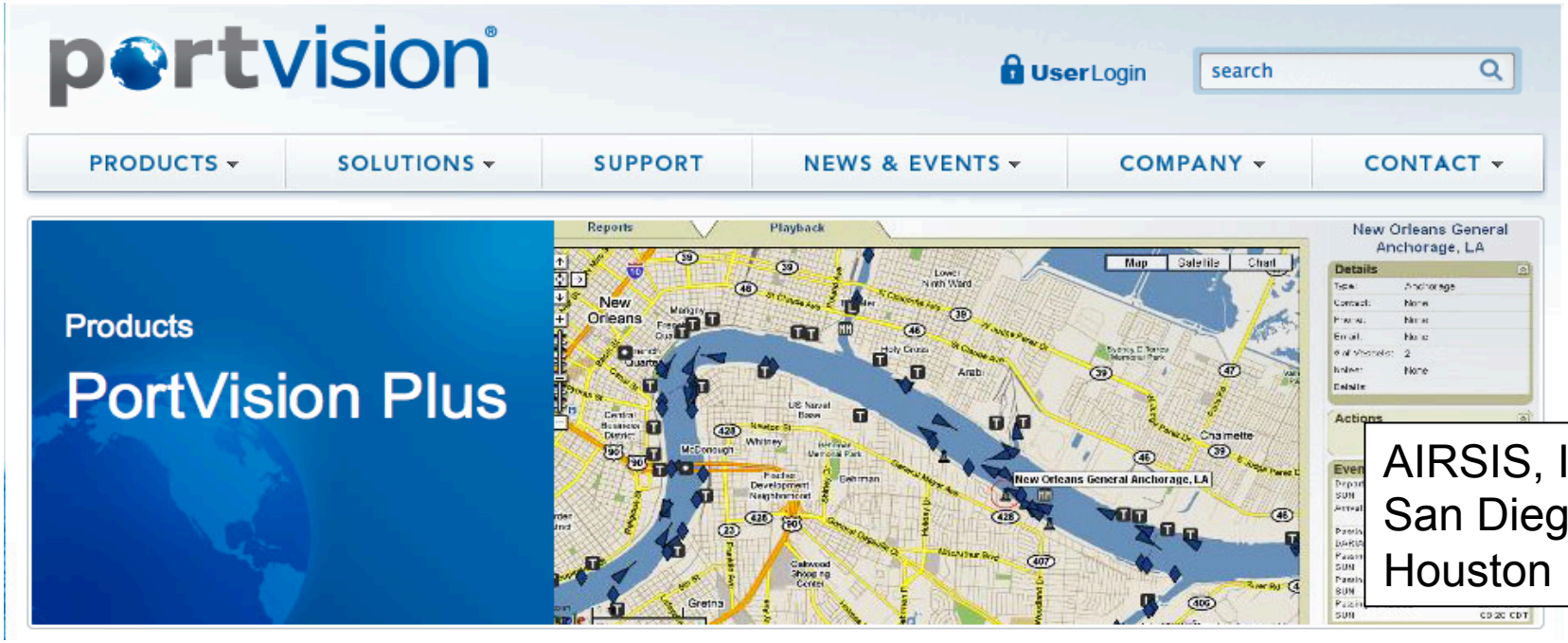


Bohemia AIS Track SNR>9

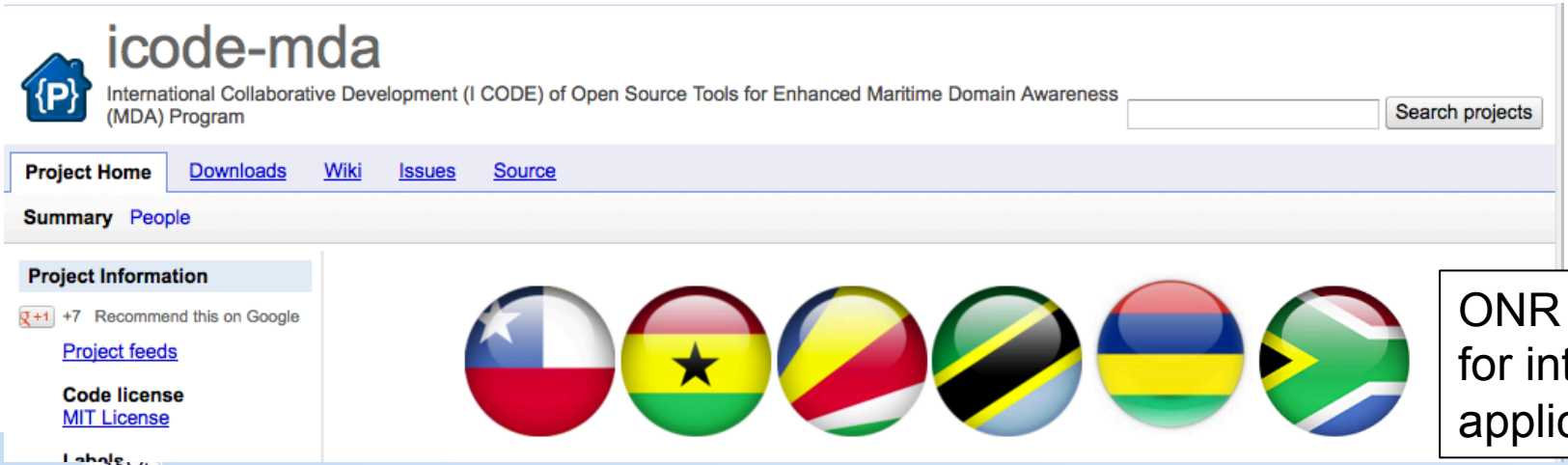


AIS Bohemia Velocity Range: 10.3KTS up to 10.4KTS. Several HF Radar detections associated by one, two and three standard deviations, Radar Characteristics: SNR>9, Distance from radar when tracked: 7.2 km

Other Potential Data Fusion & Visualization Interfaces



AIRSIS, Inc
San Diego &
Houston



ONR Global
for international
applications

OUP E2E Engage to Excel Transition Pathway

8. Hand off

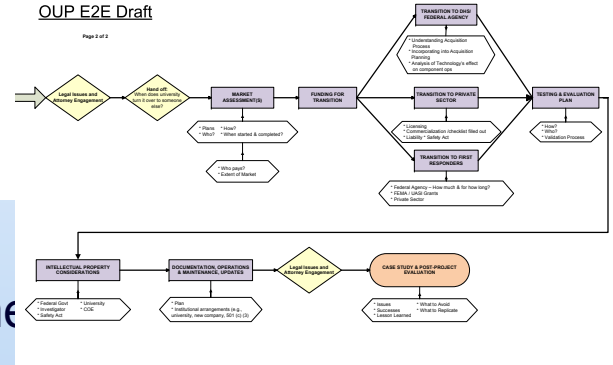
HF Radars owned by academics – need procurement process.
Trained operators are academics – need training program
Government fusion engines and decision aids – need data evaluation and transition plan

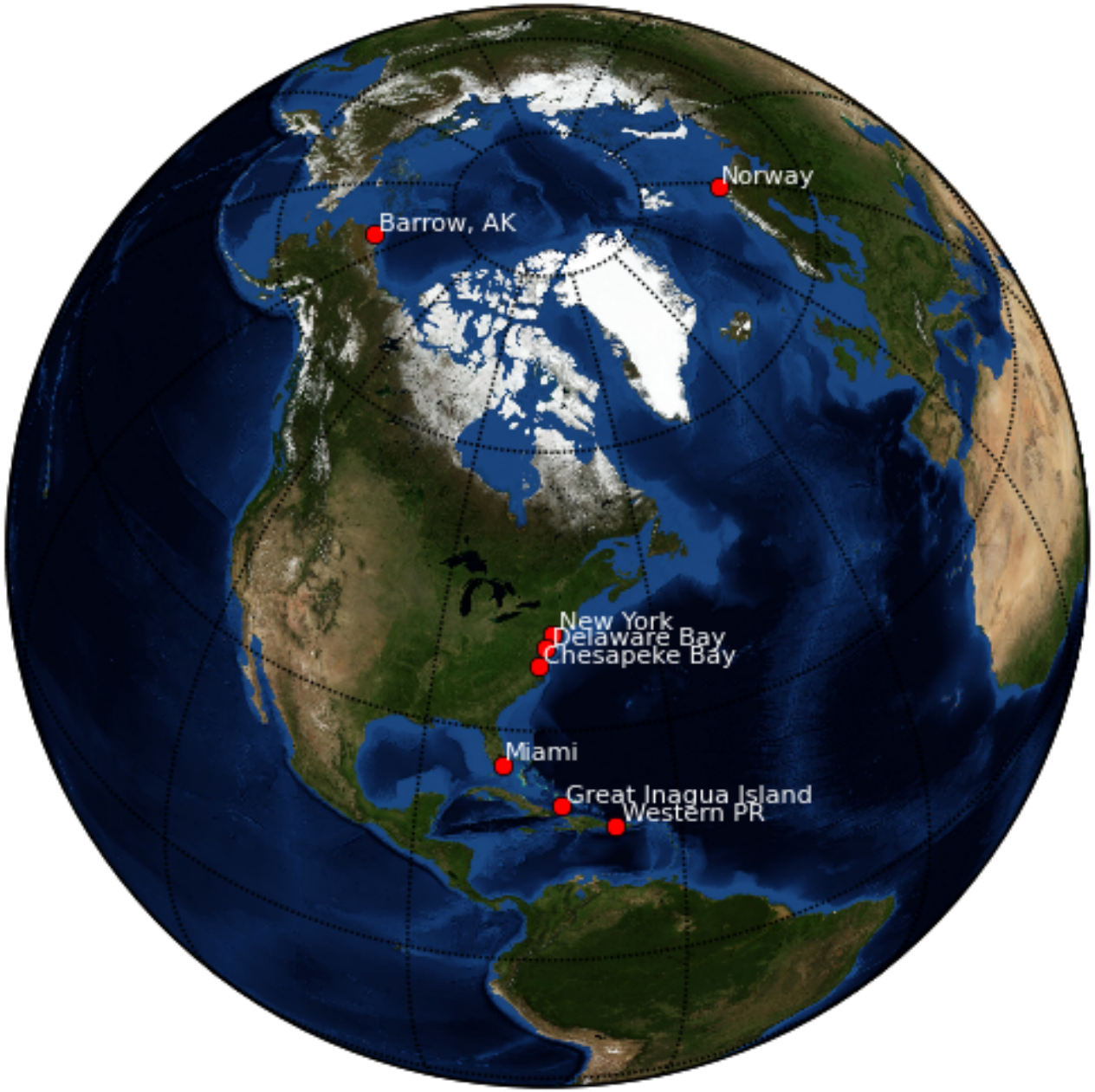
9. Market Assessment

2005 USCG Study – Large Single Radars vs. Compact Radar Network
CSR User Engagement Meetings
2012 DHS Independent Technology Assessment

10. Funding for Transition

Currents – $5 M Year 1 investment on $20 M/year, 5-Year build out plan
Vessels - CSR & small research grants. ~500 K/year.





Vessel Tracking Research Areas

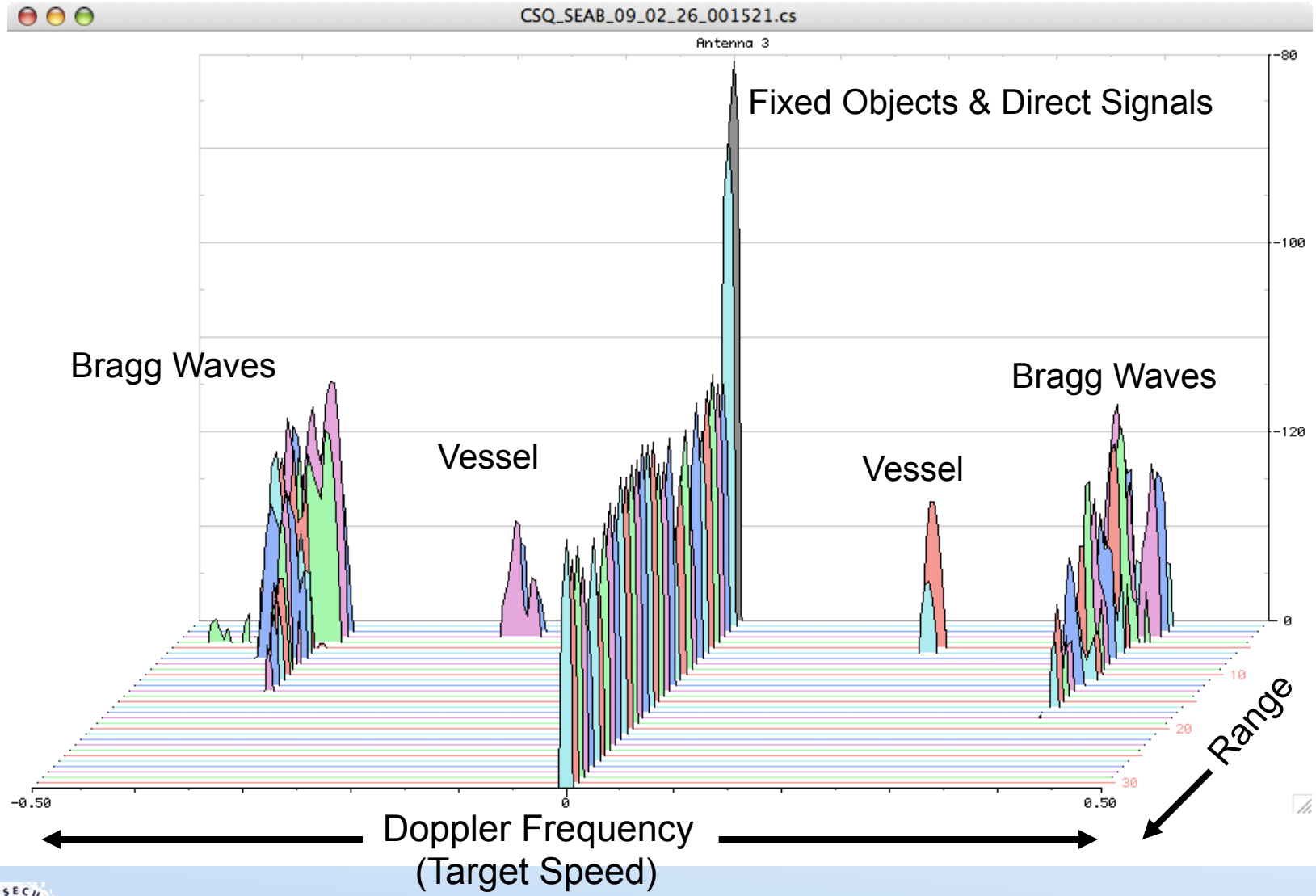
Current Testbeds

New York Harbor
Delaware Bay
Chesapeake Bay
Port of Miami
Western Puerto Rico
Barrow Alaska

Proposed Testbeds

Great Inagua
Norway
San Diego

Doppler Spectra from all Range Cells with Detection Threshold above Background Applied

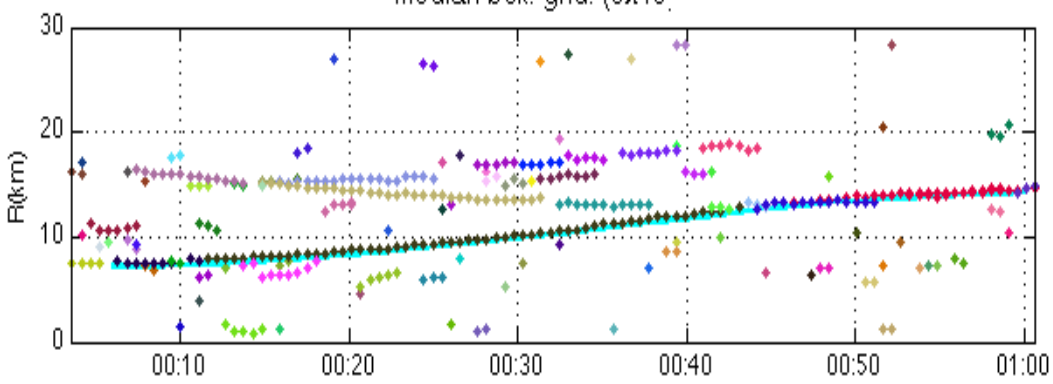


Median Method FFT
256 Threshold 11 dB

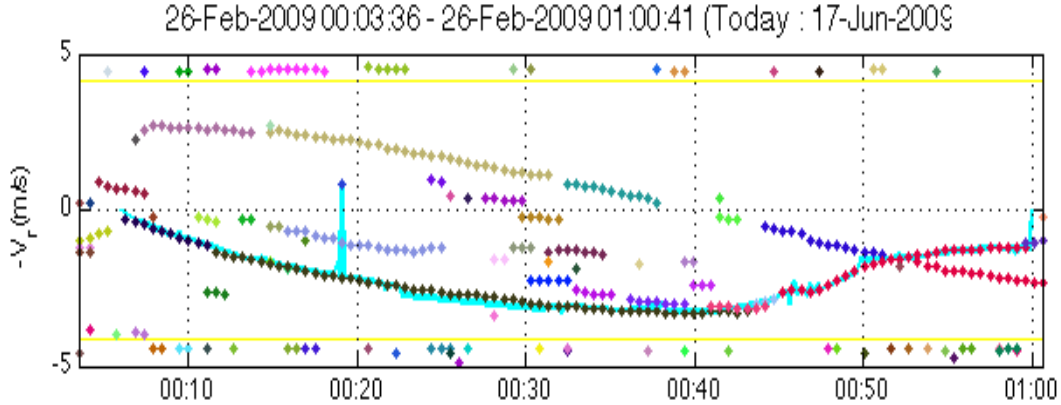
Step 1
Raw Detections
From each HFR:

1. Radial Velocity (most accurate)
2. Range
3. Bearing (least accurate)

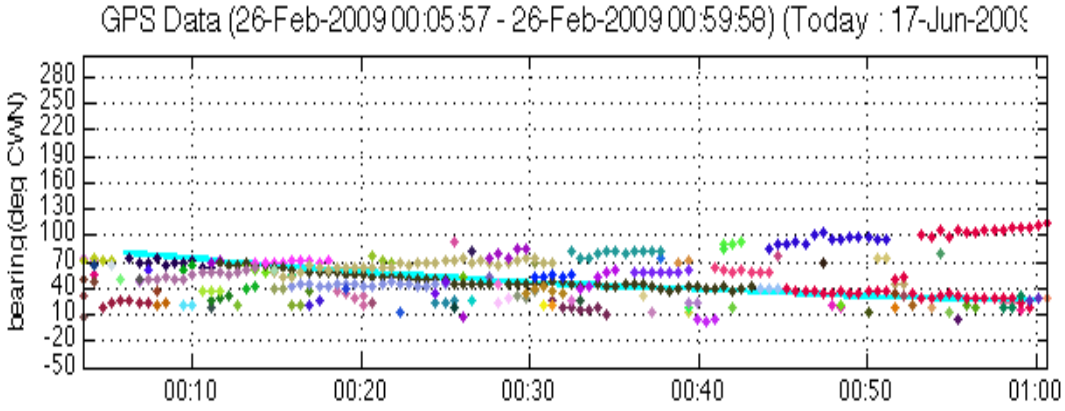
Range (km)



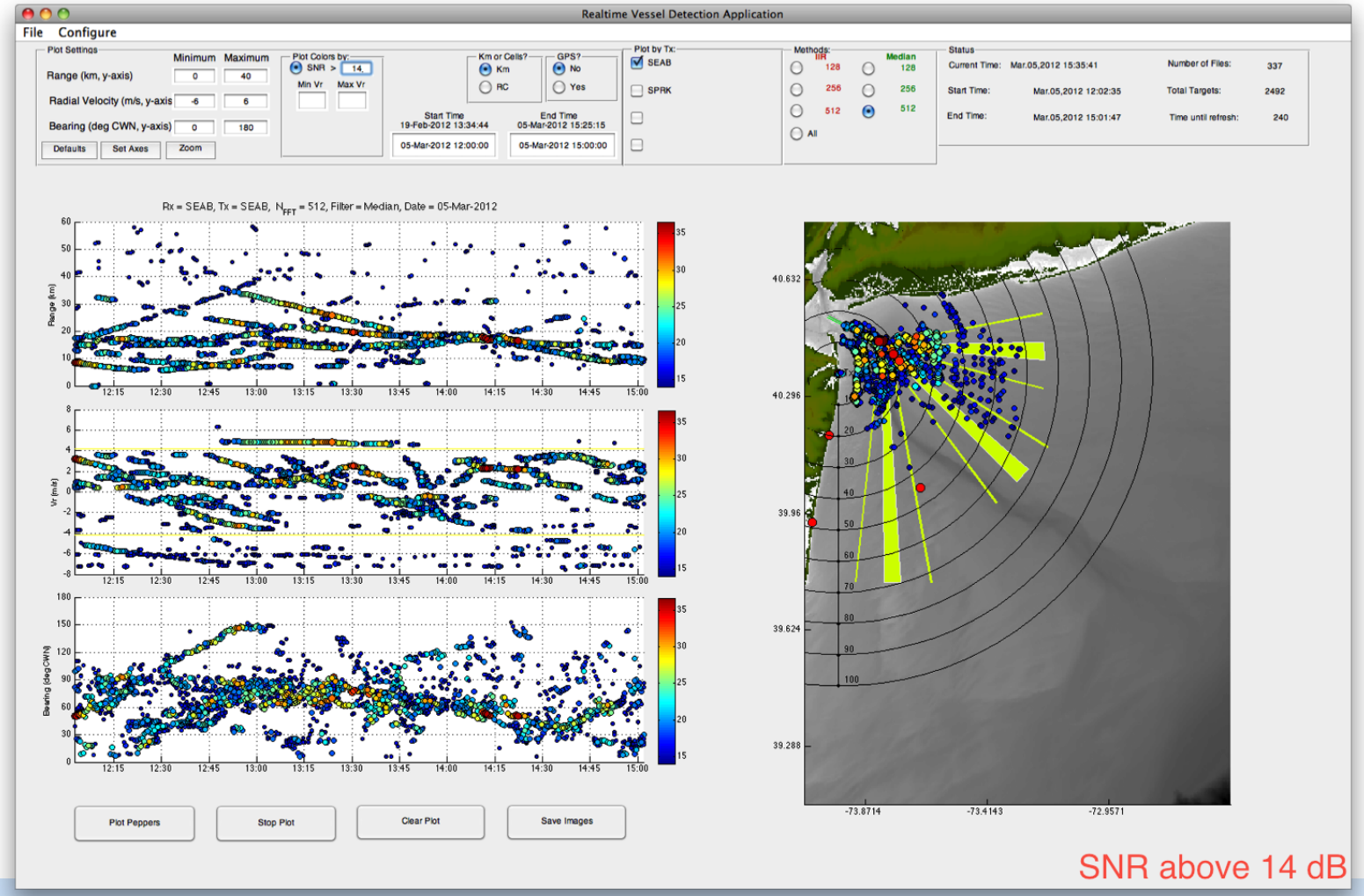
Radial Velocity (m/s)



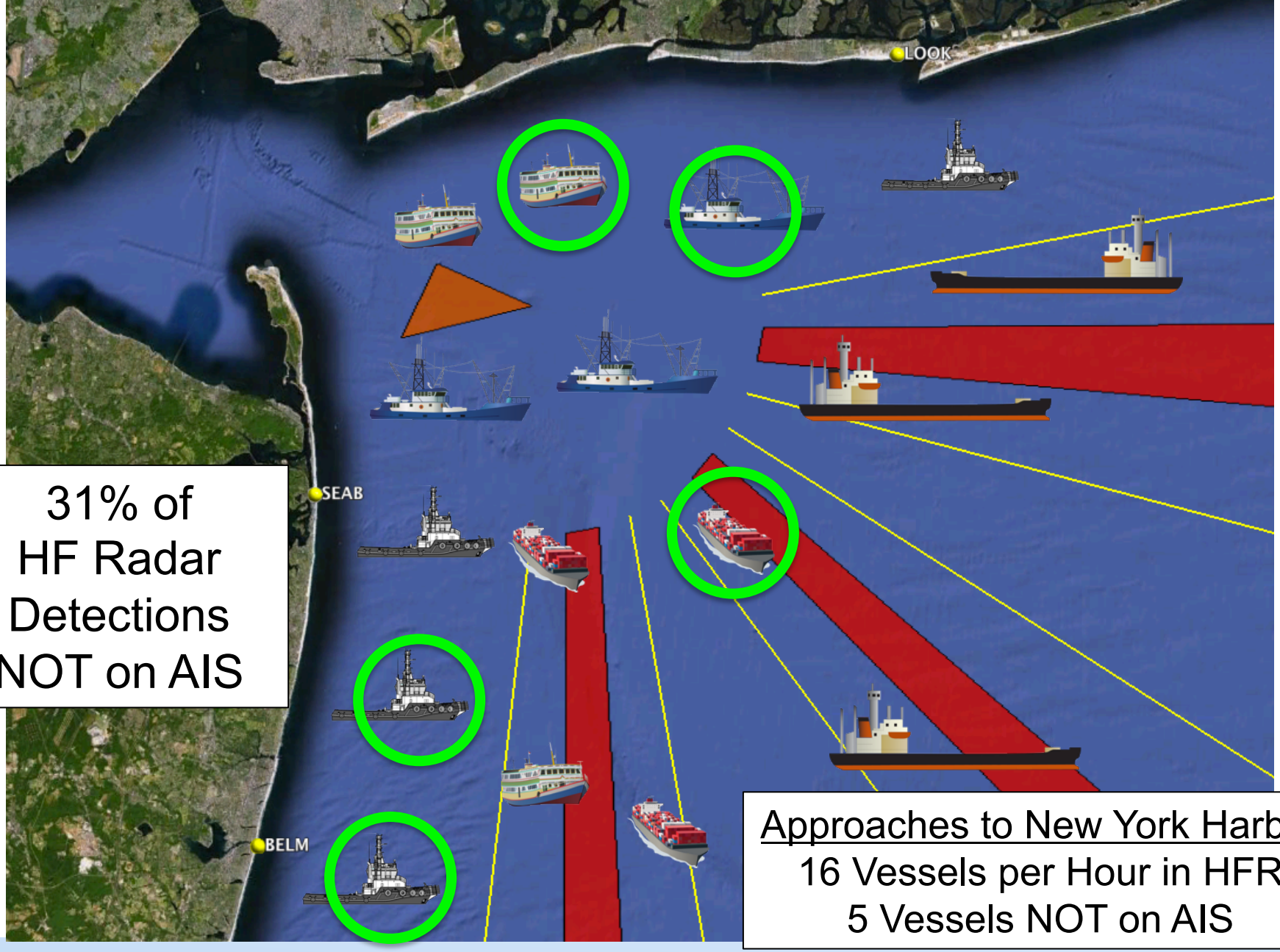
Bearing (°CWN)



Adjusting the Signal to Noise



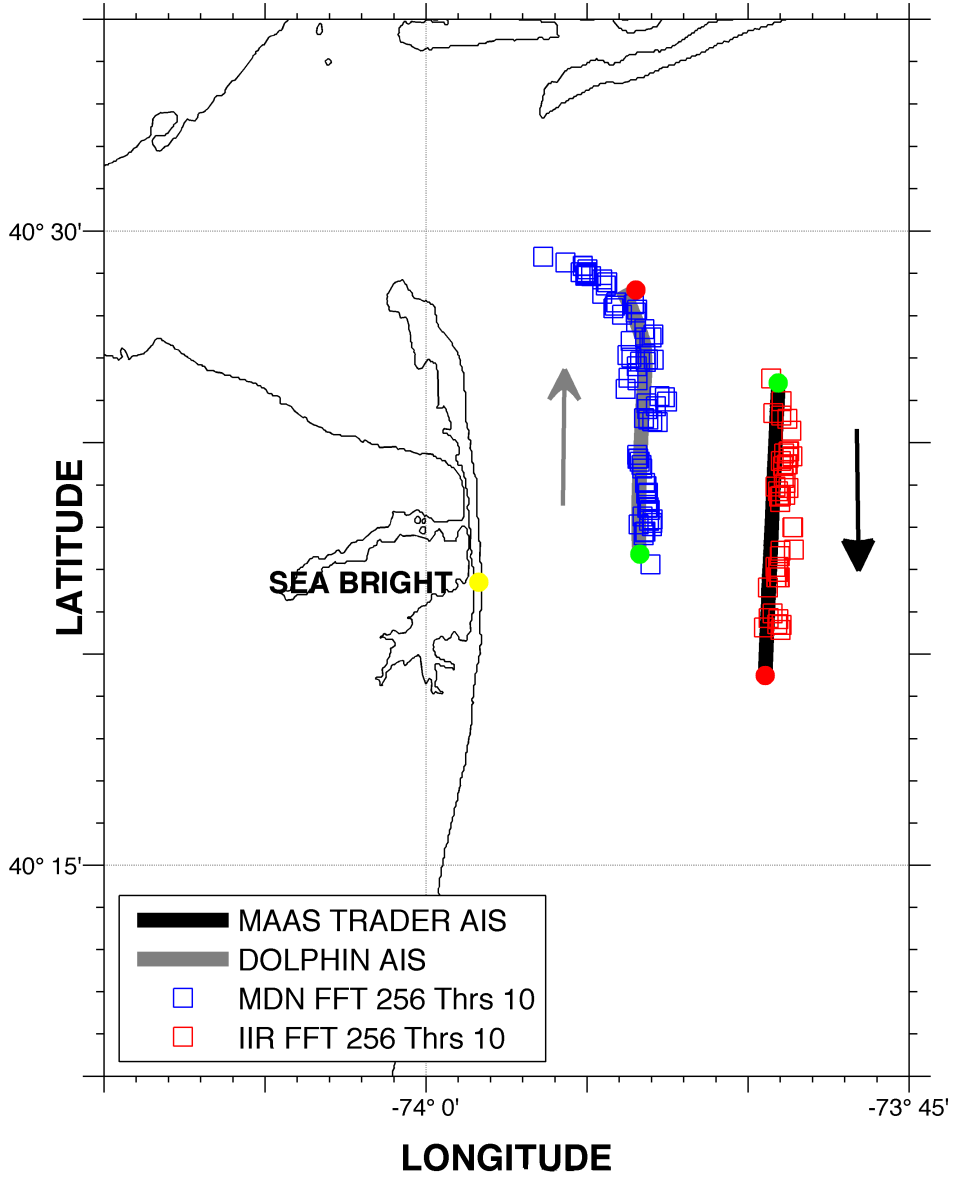
SNR above 14 dB

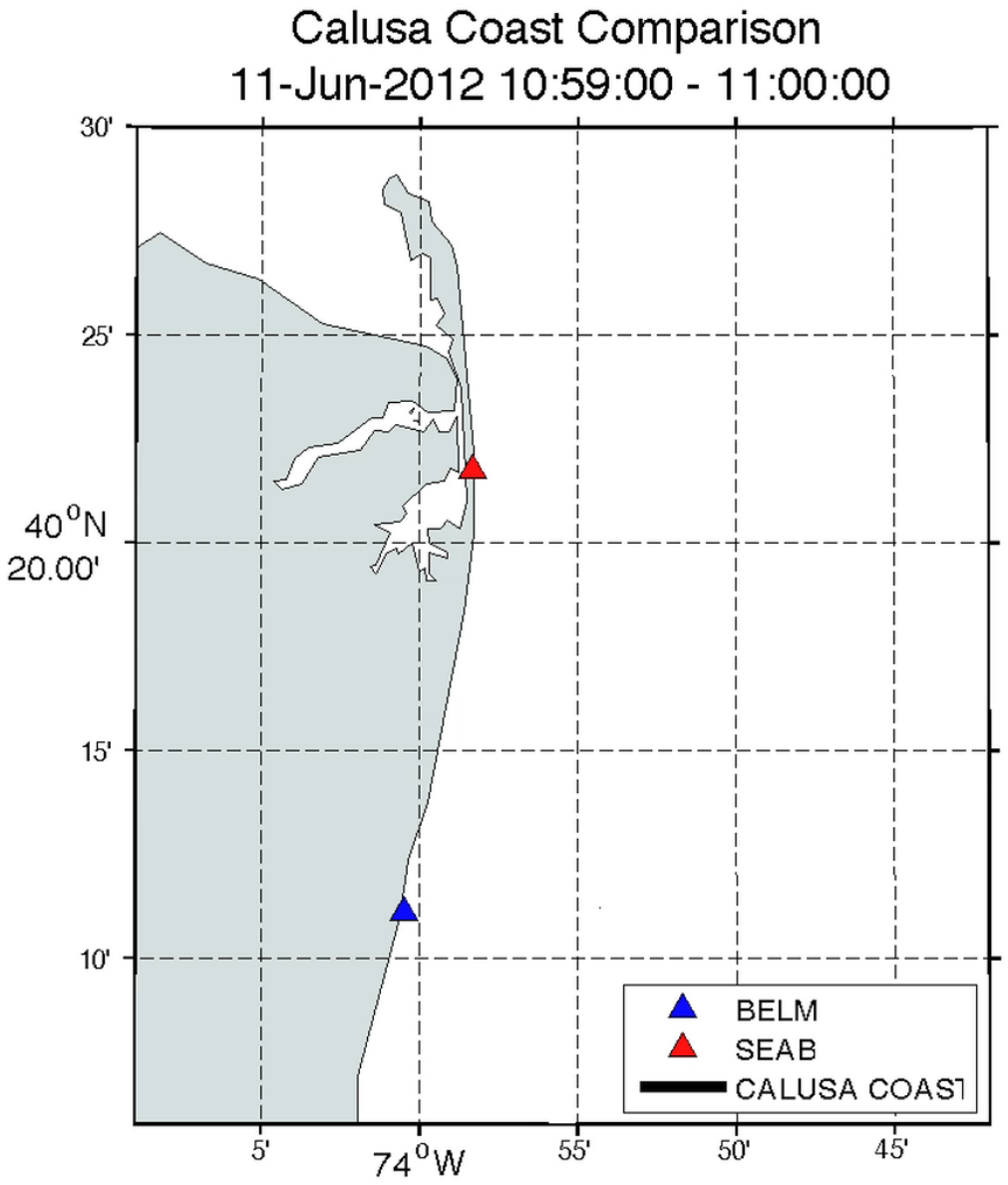


31% of
HF Radar
Detections
NOT on AIS

<u>Approaches to New York Harbor</u>
16 Vessels per Hour in HFR
5 Vessels NOT on AIS

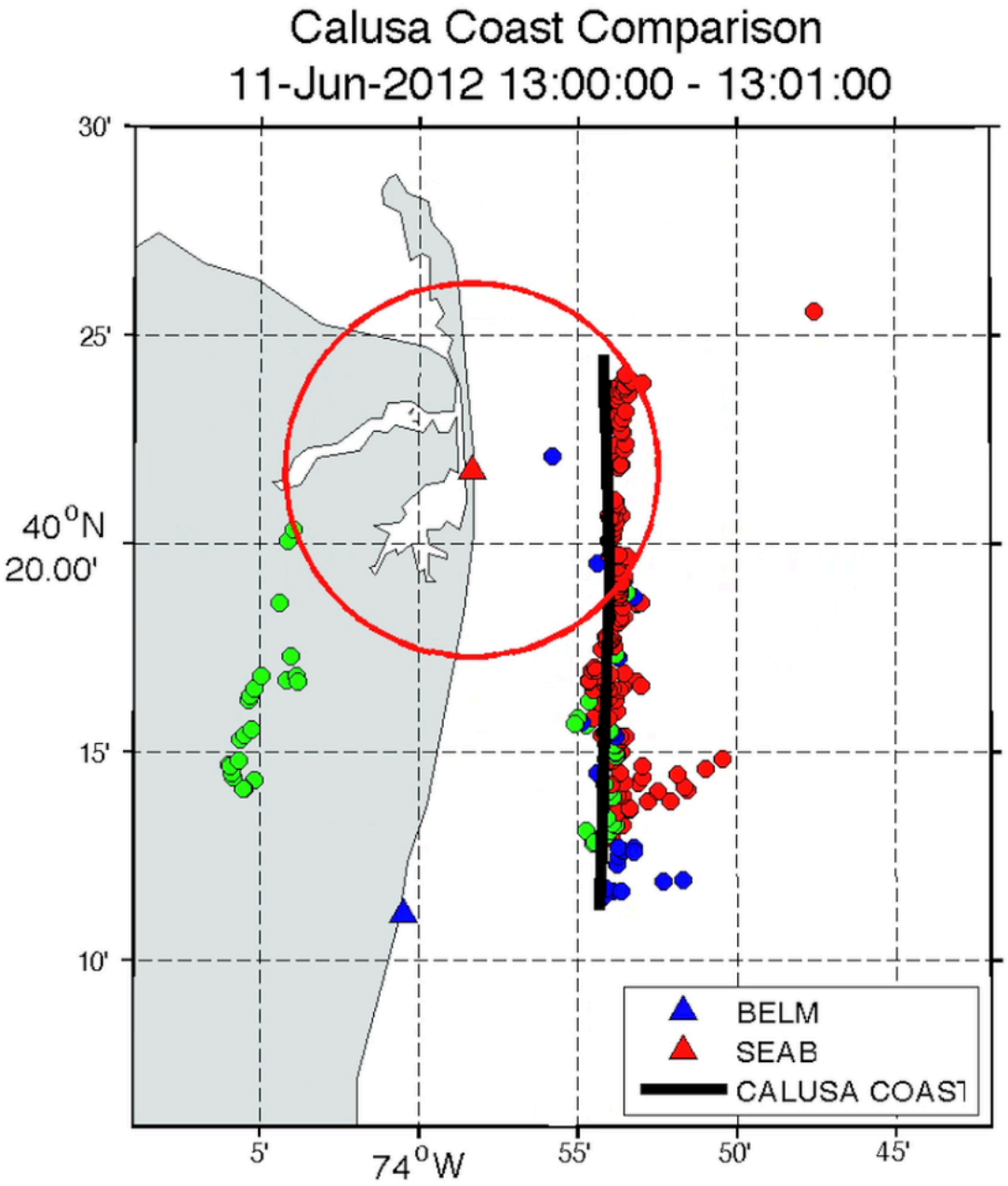
Step 2 Association: TRACK OF MAAS TRADER and DOLPHIN





Calusa Coast Test Case

Calusa Coast Test Case



Association

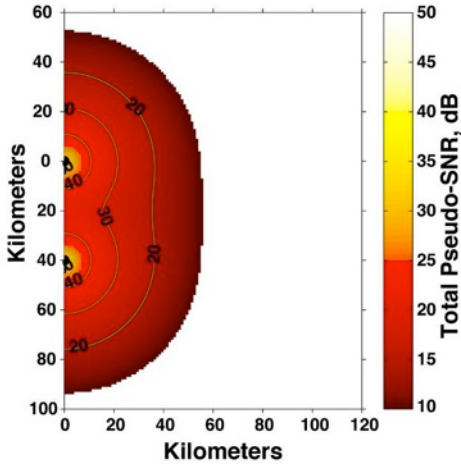
- Level 1 Association occurs out at the shore station and combines the multiple FFT lengths, thresholds and backgrounds for the backscatter and bistatic target files
- Level 2 Association occurs at the central station where the new ASCII files from each shore station that result from Level 1 Association are combined with others (backscatter as well as multi-static), to give Latitude/Longitude and x-y target velocity of the same targets as seen by multiple looks geometrically.

Scenario 2 Association

Site 1 Monostatic

Site 1 Bistatic

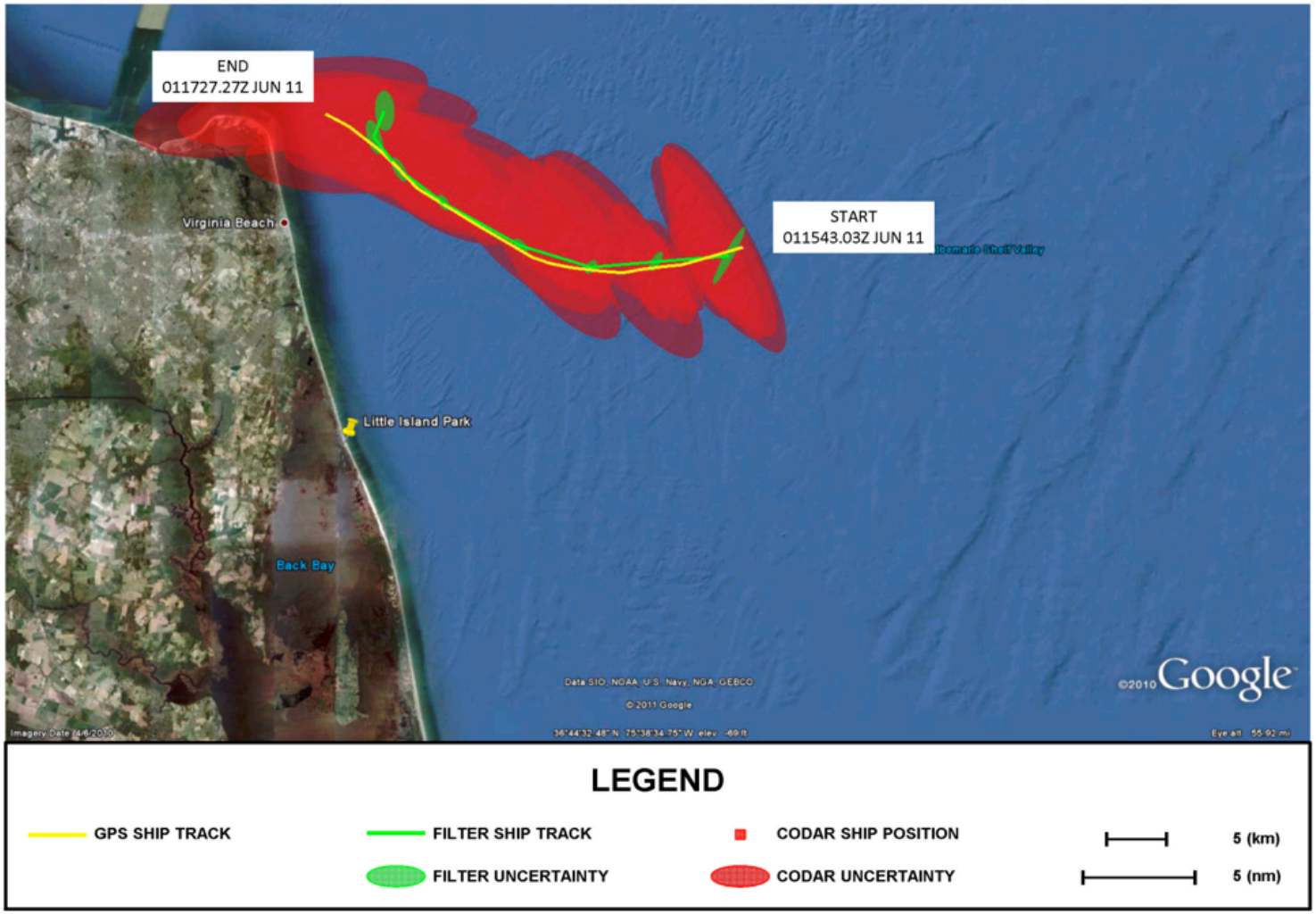
Site 2 Monostatic



Scenario 2: $R_{x1}T_{x1}$
$R_{x2}T_{x2}$
$R_{x1}T_{x2}$

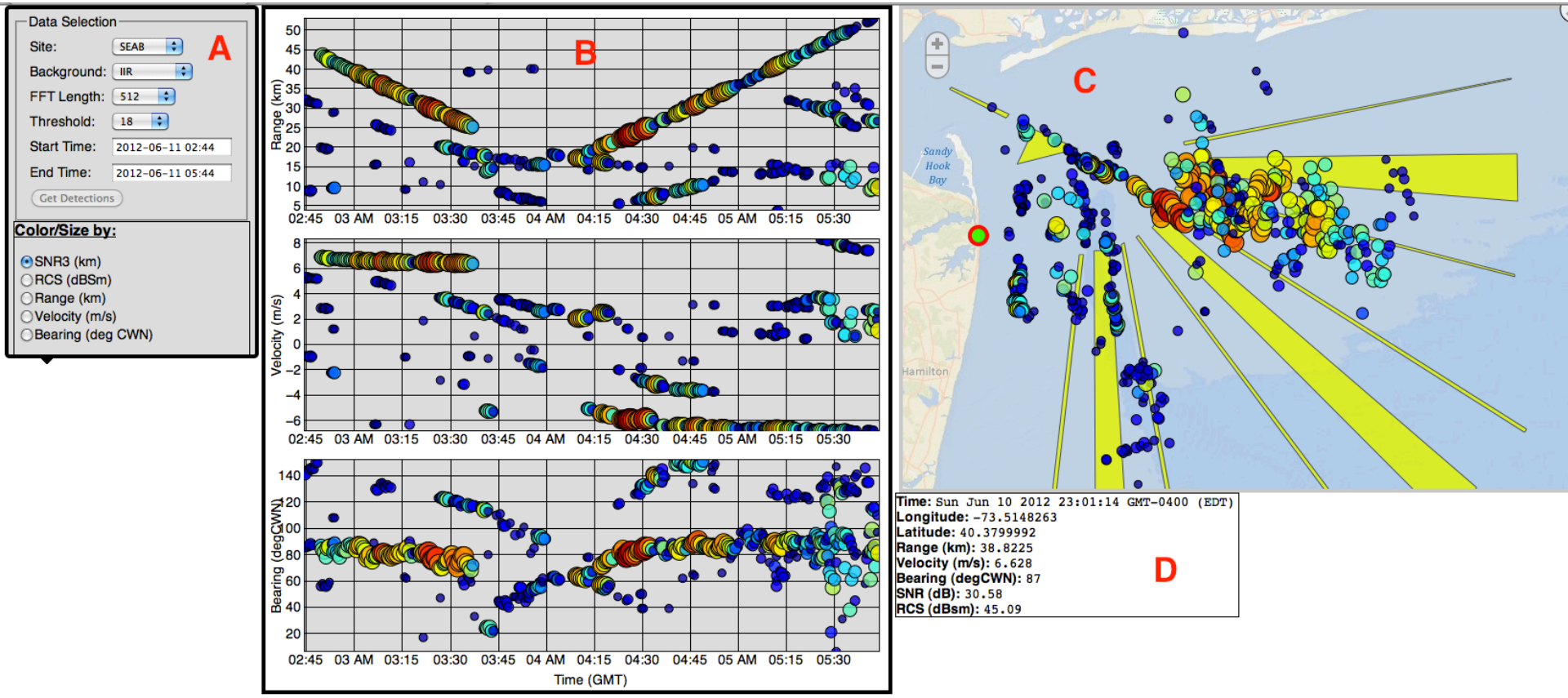
CENTRAL STATION/
ASSOC PROCESSOR

Step 3 Track Fitting: M/V Victorius



M/V VICTORIOUS: GPS Track, CODAR Data, and Ship Tracker Solution with Uncertainty Ellipses

CSR Ship Detection Visualizer



OUP E2E Engage to Excel Transition Pathway

11. Transition to Federal Agency

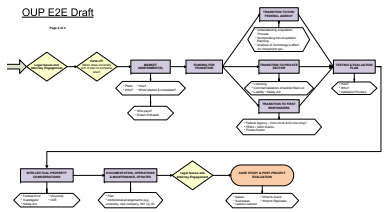
U.S. IOOS providing partial operating funds for currents -
Below nationally recommended standard to meet USCG 80/80 criteria
Ongoing evaluation for input to Open Mongoose Data Fusion Engine

12. Transition to Private Sector

CODAR Ocean Sensors - Radar hardware and real-time shore-site processing for radial currents and vessel detections.
Applied Mathematics Inc – Real-time track fitting algorithms
Applied Science Associates – Environmental Data Server operators

13. Transition to First Responders

Through existing data fusion engines and decision aids – SAROPS, Watchkeeper, Environmental Data Server, Open Mongoose, U.S. IOOS, Port Vision, ICoDE MDA

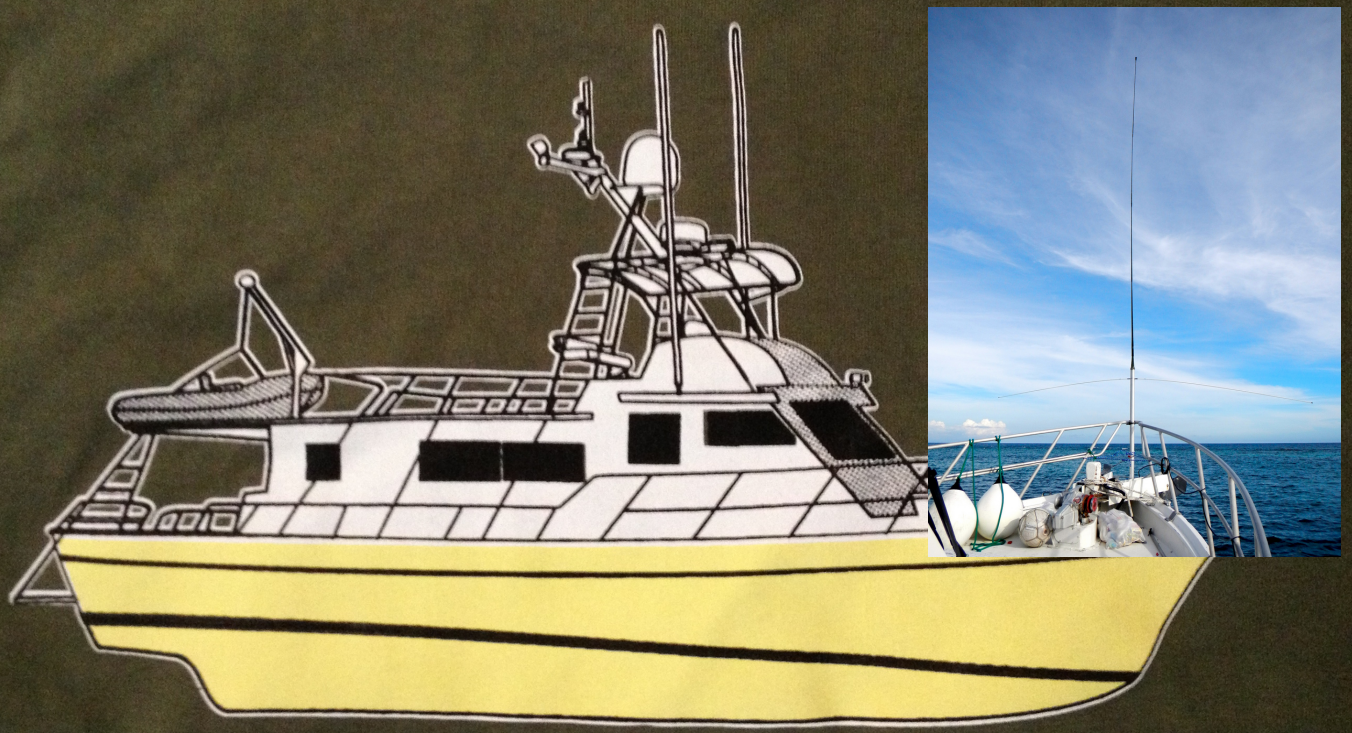


14. Testing & Evaluation Plan

Demonstrate End-to-End in the Mid-Atlantic Bight First
Transition to a National capability – Start at remote testbeds


The Mona Island
Sentry Experiment 2012
M/V MARIANGIE

The Mona Island
Sentry Experiment 2012



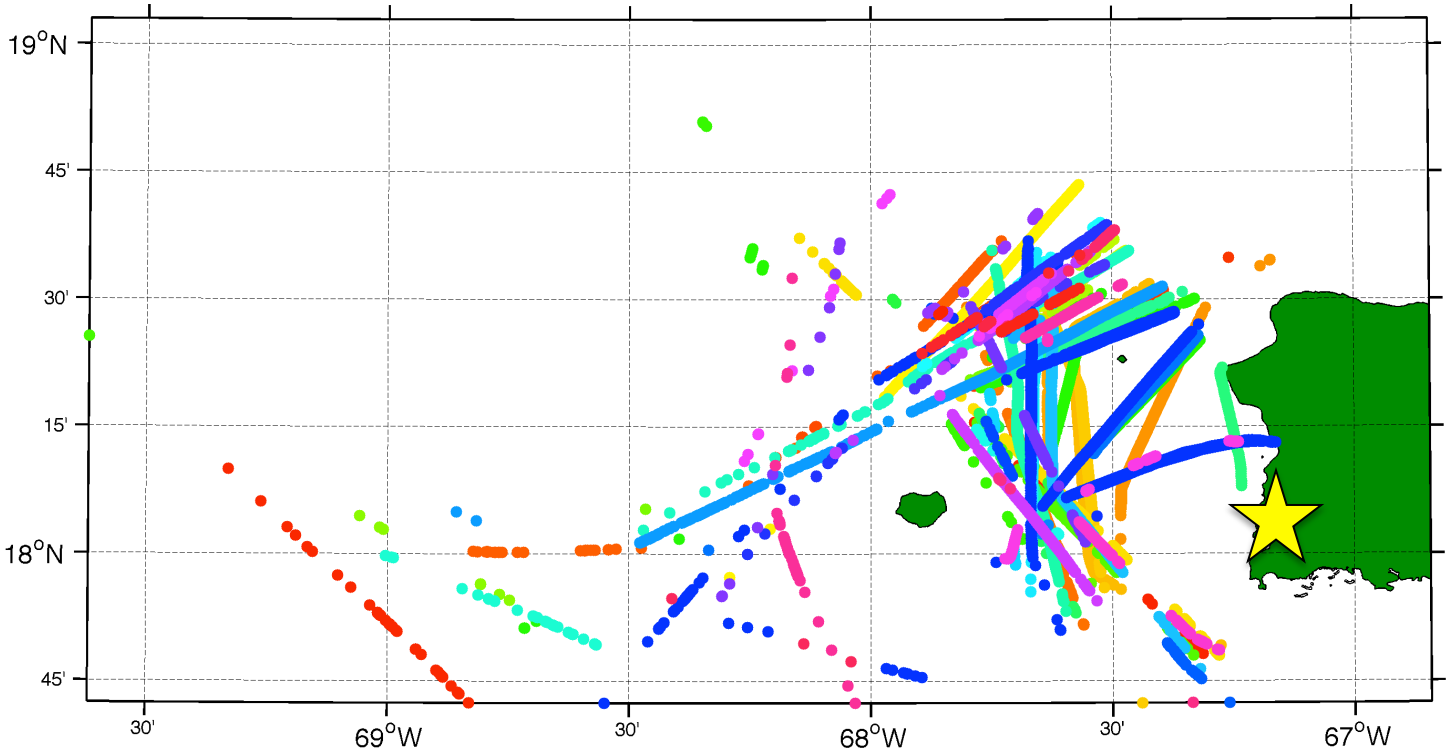
M/V MARIANGIE

Mona Island Experiment

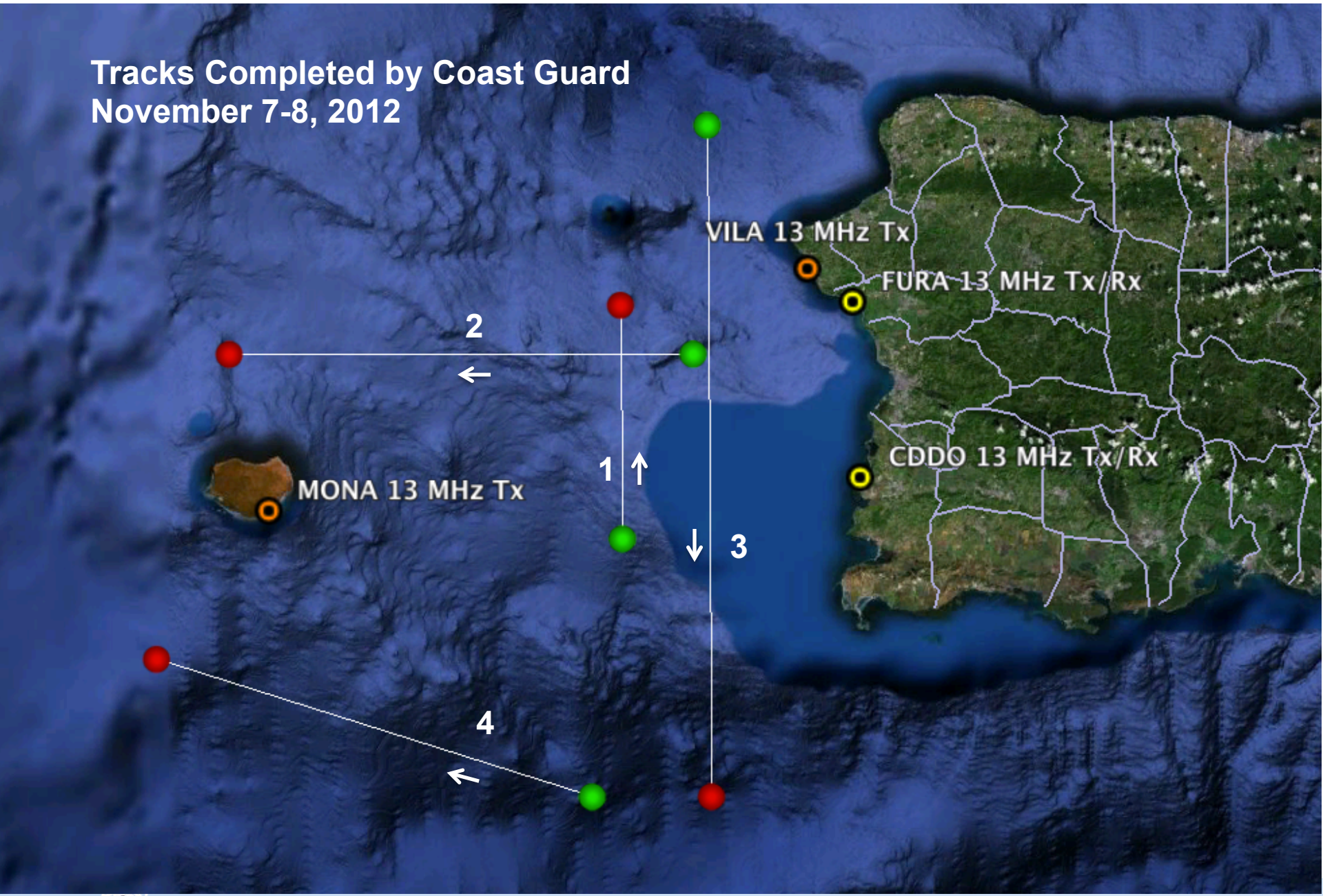
- November 4-9, 2012
- Operated AIS receiver at Rincon
- Bistatic transmitter (Tx) operated at Rincon Nov 5-6
- Bistatic Tx operated on Mona Nov 7-9

CSR Tropical HF Radar Testbed

AIS Data November 4 -9, 2012



84 vessels captured on AIS
36 vessels within 100 km of the radar station
23 vessels detected by the radar that were on AIS
13 vessels detected by the radar NOT on AIS

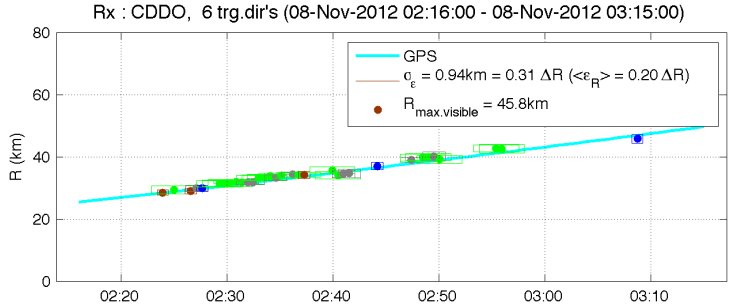

Tracks Completed by Coast Guard
November 7-8, 2012
VILA 13 MHz Tx
FURA 13 MHz Tx/Rx
CDDO 13 MHz Tx/Rx
MONA 13 MHz Tx
1
2
3
4

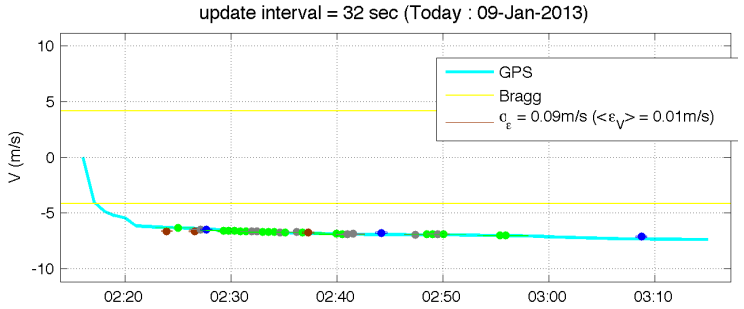
Coast Guard Cutters Used in Experiment

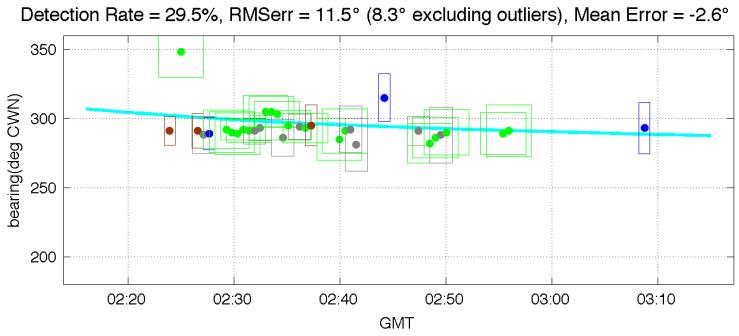
CGC Cushing
Capt. Gordon Goetchius
Tracks 1 & 2

CGC Sapelo
Capt. Colin Langeslay
Tracks 3 & 4

CSR Tropical HF Radar Testbed

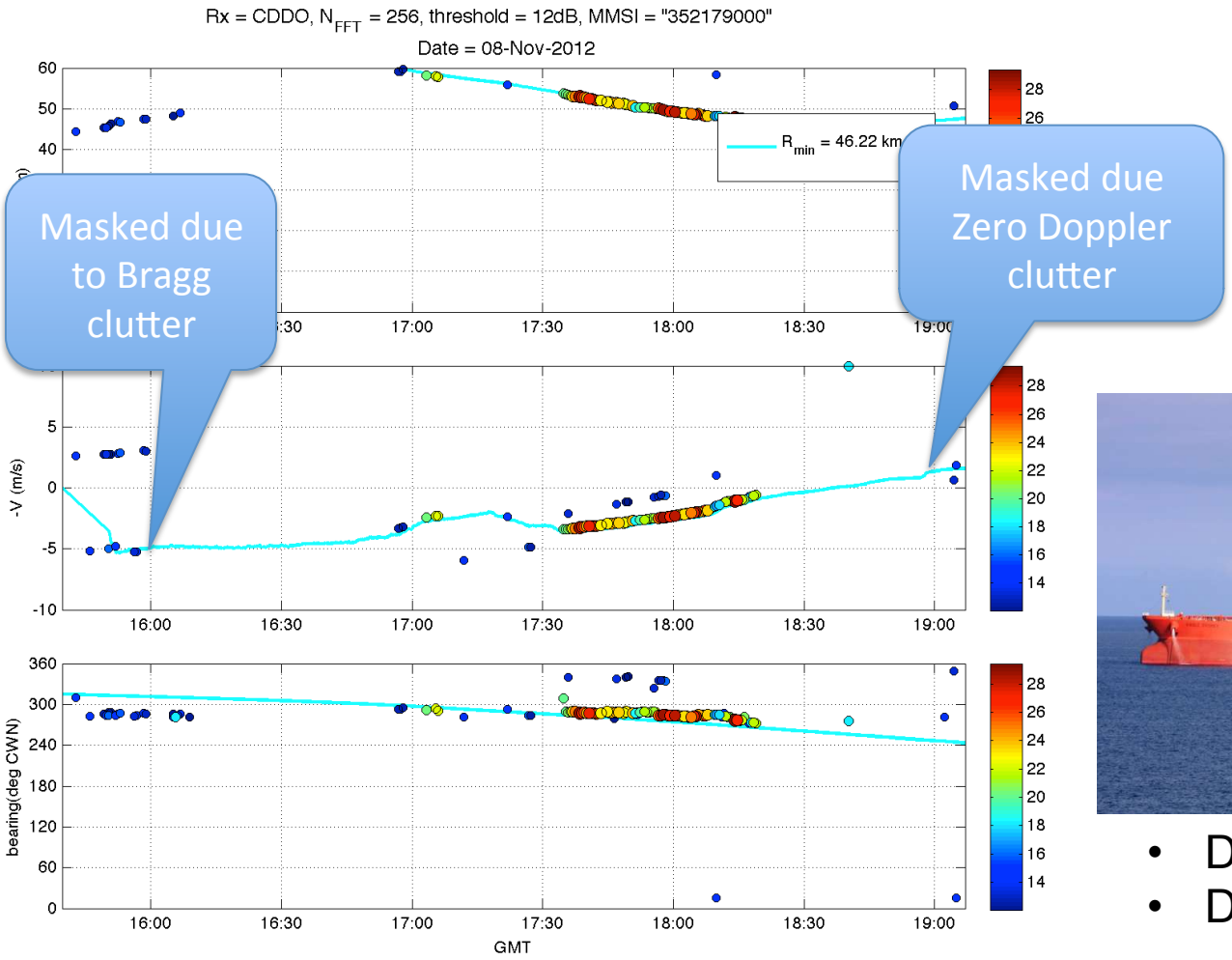






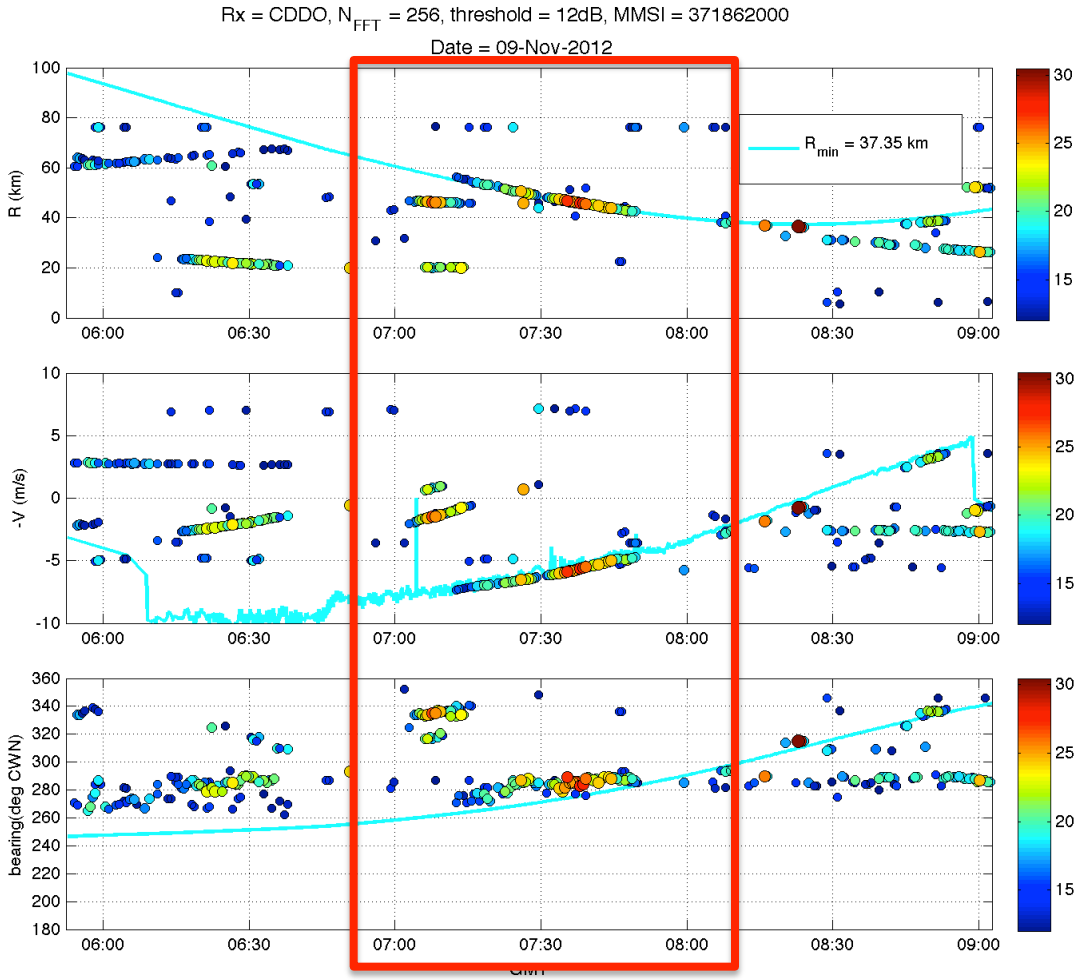
Detections of CGC Cushing Track 2

Eagle Sydney Detections



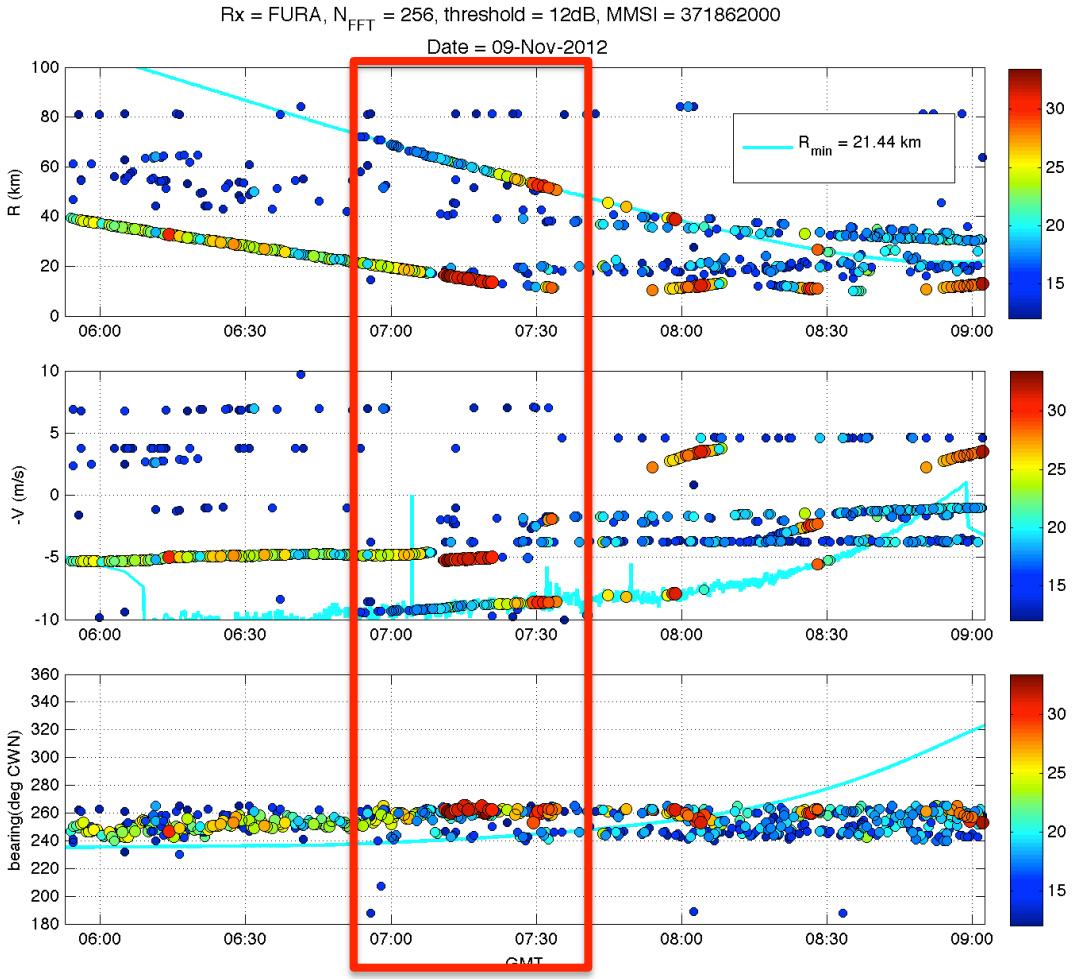
- Detected for ~ 1 hour
- Detected out to 46 km

Triton Ace Detections



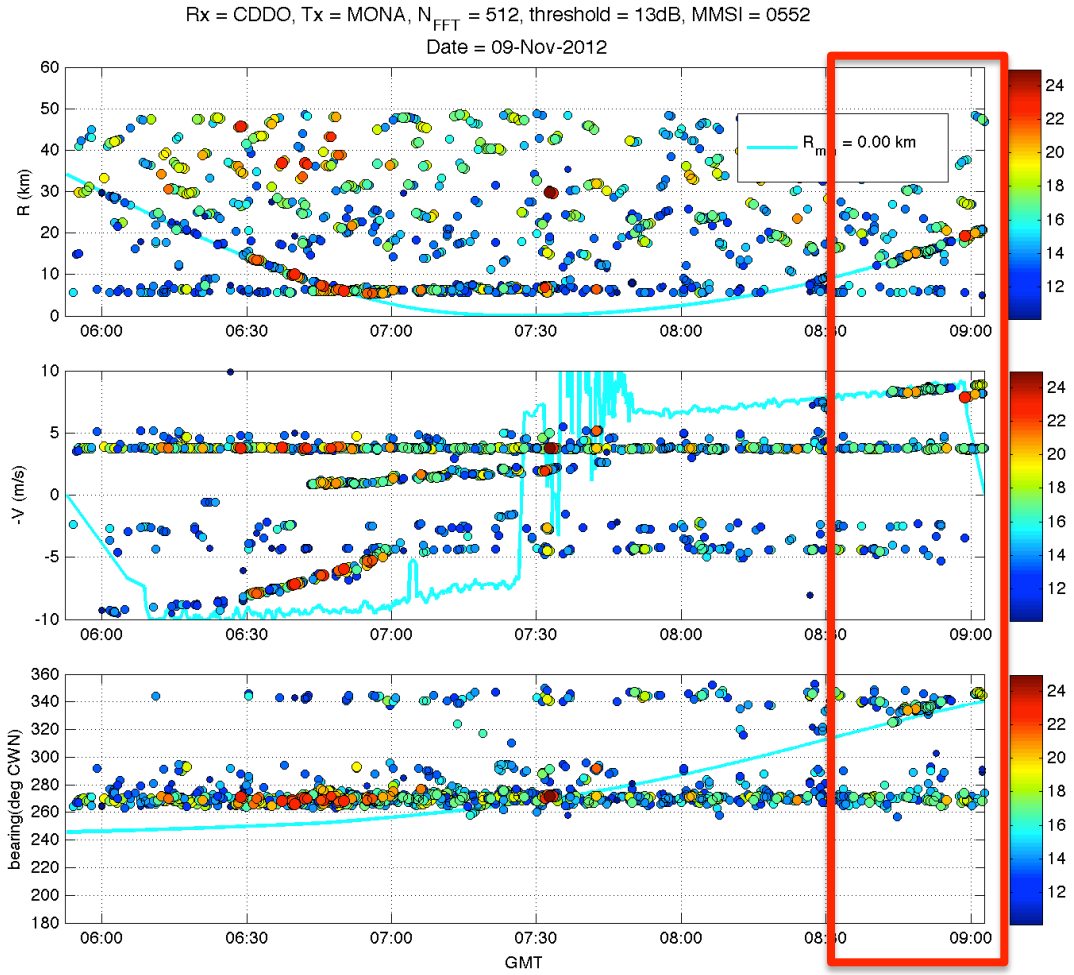
CDDO Detections

Triton Ace Detections



FURA Detections

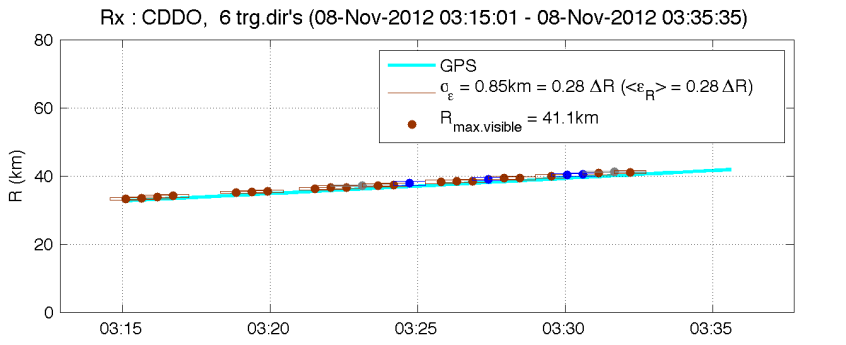
Triton Ace Detections

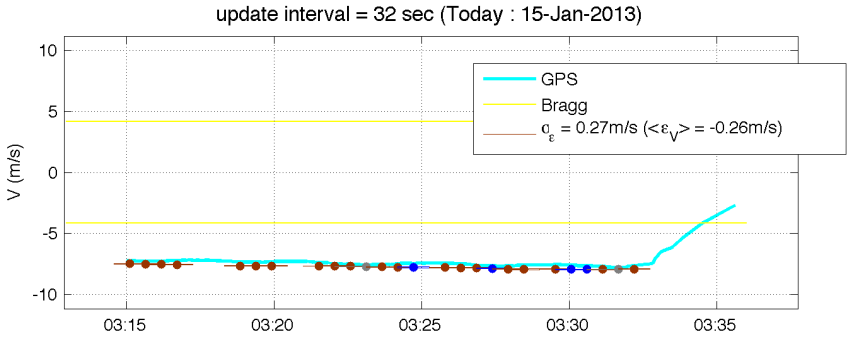


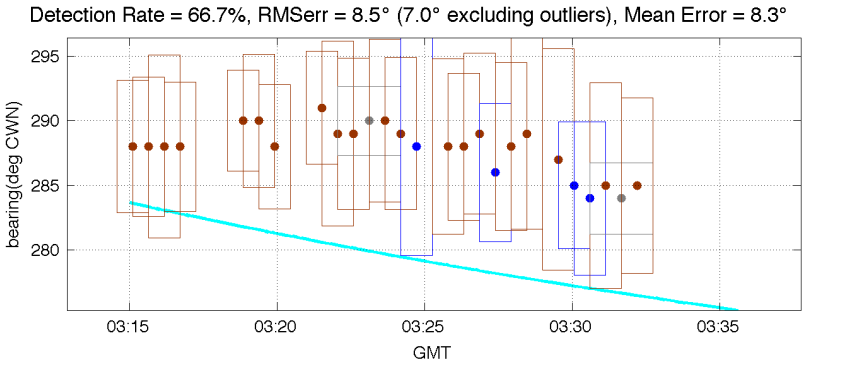
Bistatic Detections

Triton Ace Detections

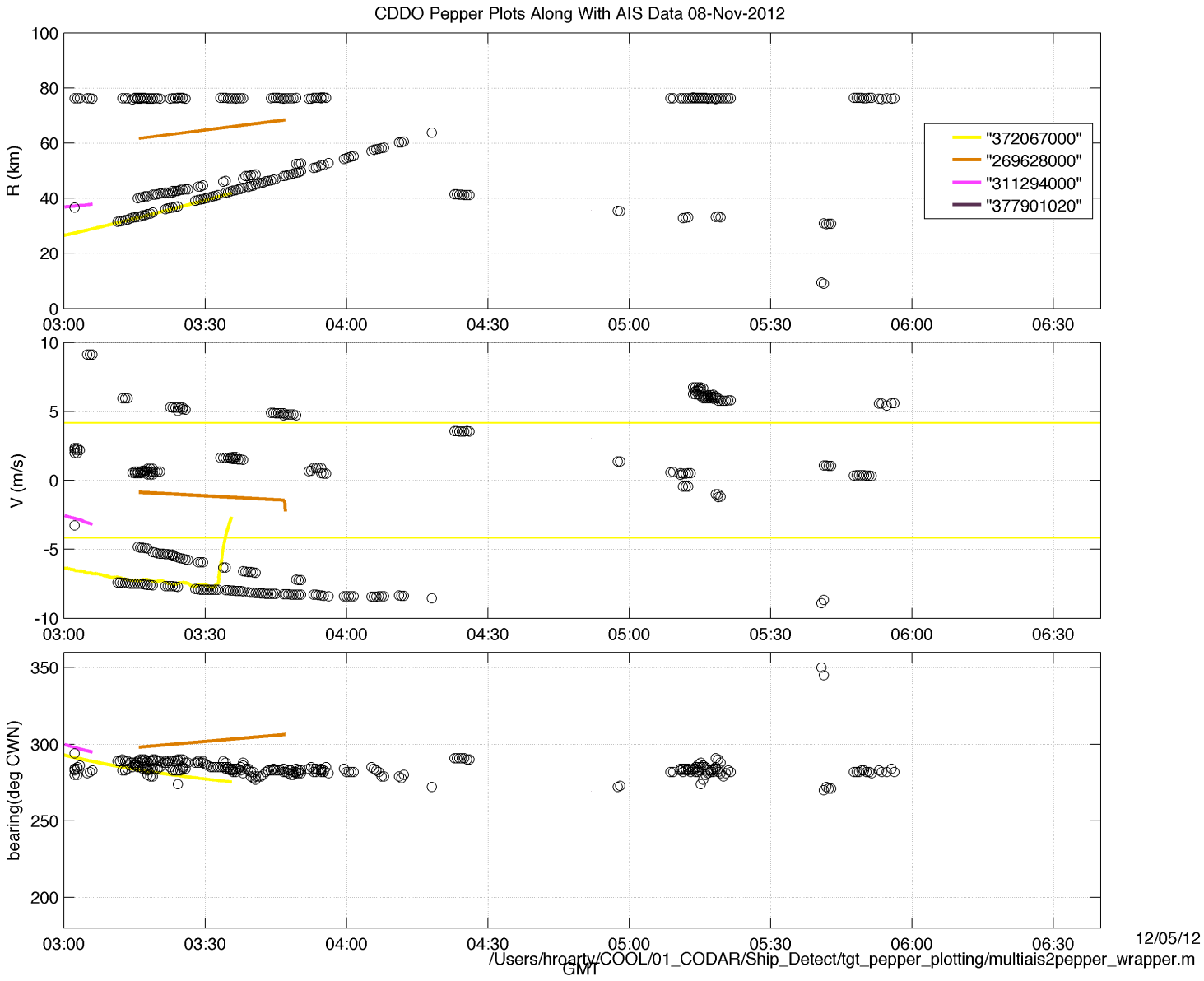
- Detections at CDDO from 07:00 to 09:00
- Detections at FURA from 07:00 to 07:30
- Detections from Mona at CDDO from 08:30 to 09:00







Caribbean Fantasy Detections


CDDO Pepper Plots Along With AIS Data 08-Nov-2012
R (km)
V (m/s)
bearing(deg CWN)
"372067000"
"269628000"
"311294000"
"377901020"
03:00
03:30
04:00
04:30
05:00
05:30
06:00
06:30
GMT
12/05/12
/Users/hroarty/COOL/01_CODAR/Ship_Detect/tgt_pepper_plotting/multiais2pepper_wrapper.m

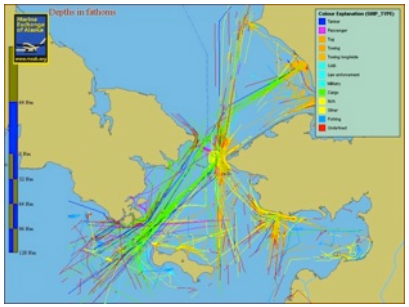
CSR High Latitude HF Radar Testbed

Objective:
Test the capability of the SeaSonde HF Radar as a detection and surveillance sensor at high latitudes in anticipation of the polar ice cap melting and the increased usage of the Northwest Passage.

Sponsor:

Participants:

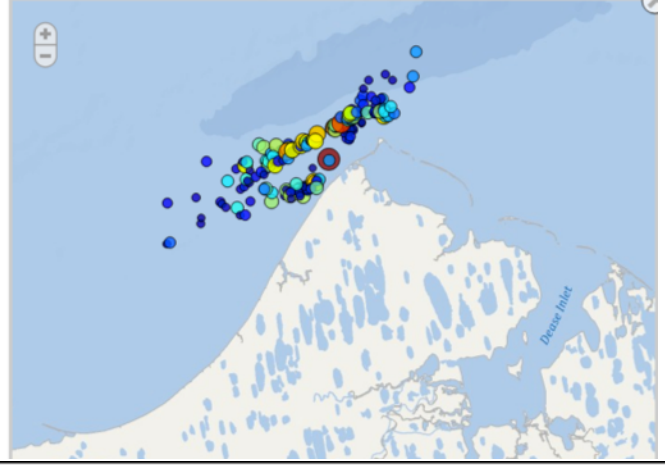
Northwest passage routes

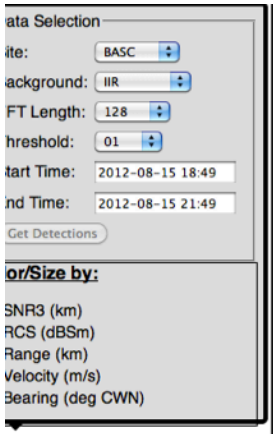


AIS traffic near Barrow, AK

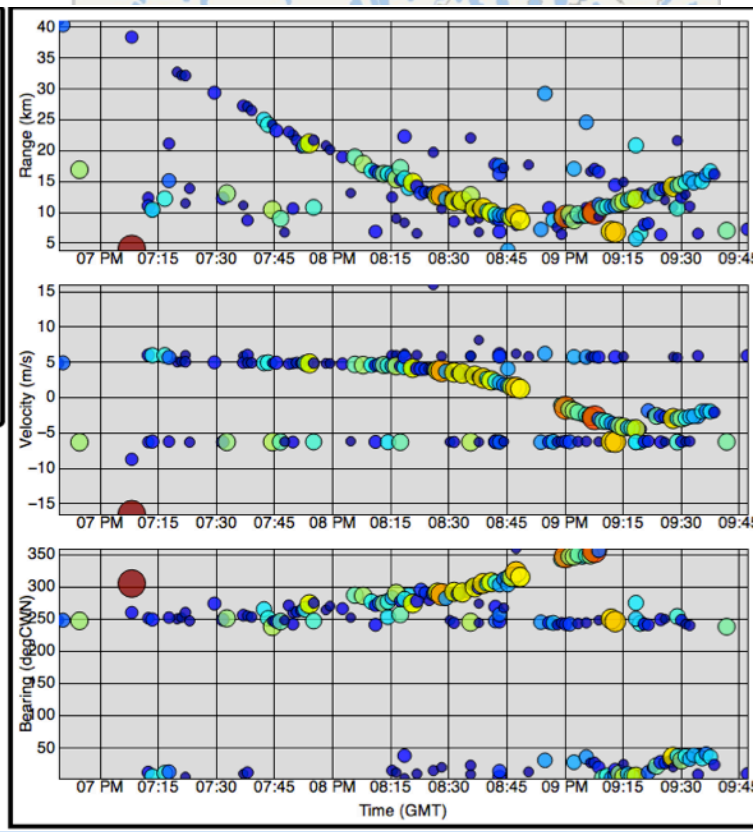
Remote Power Module

Point Barrow Detections



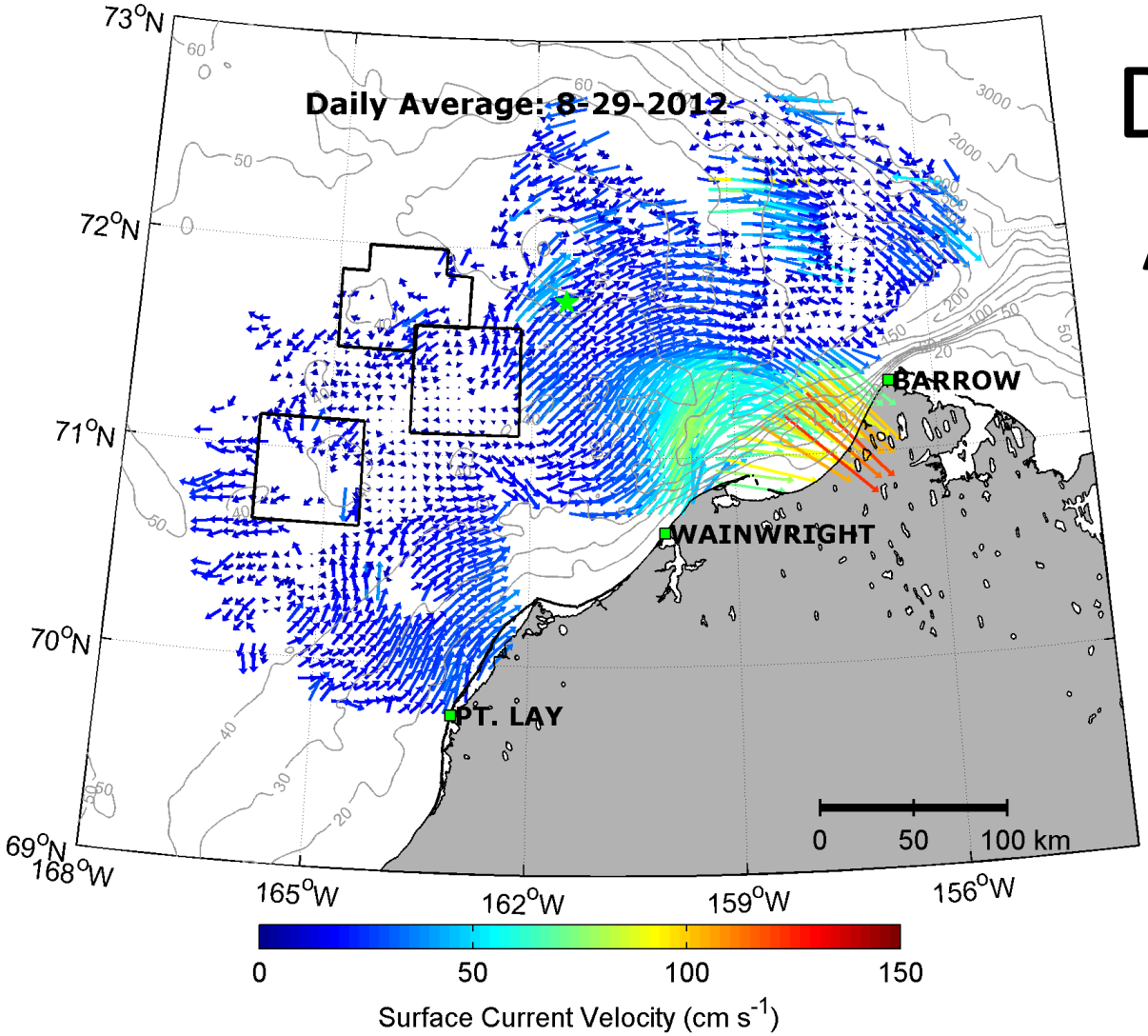


All AIS vessels detected. Range to 70 km.



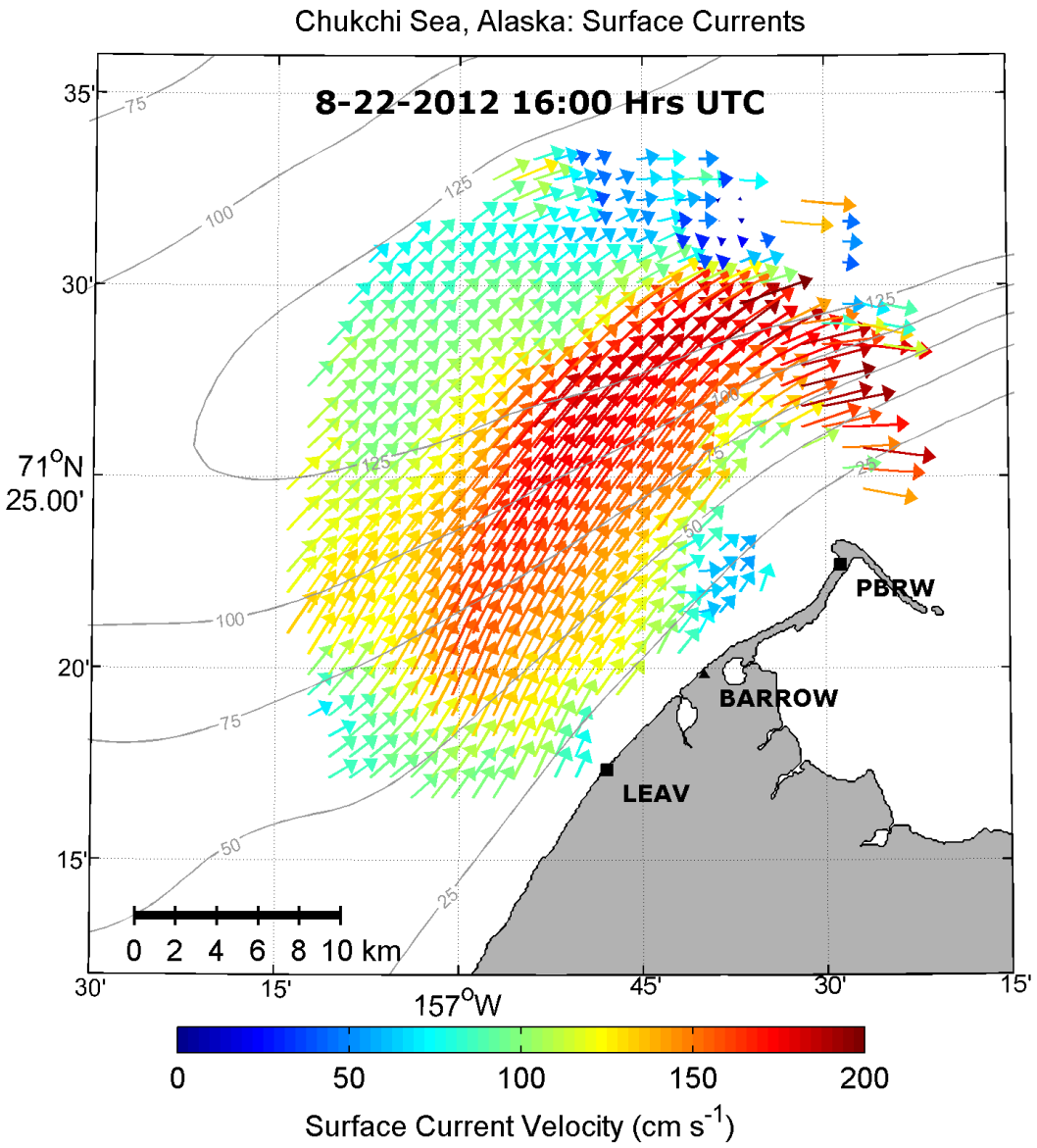
Alaska Experiment

- Installed radars in June 2012
- Collected vessel real time vessel detection data starting on July 9
- Data transferred back to Rutgers in real time
- Focused analysis on September 9 and 10



Daily Average Aug 29, 2012

5 MHz Long Range Network

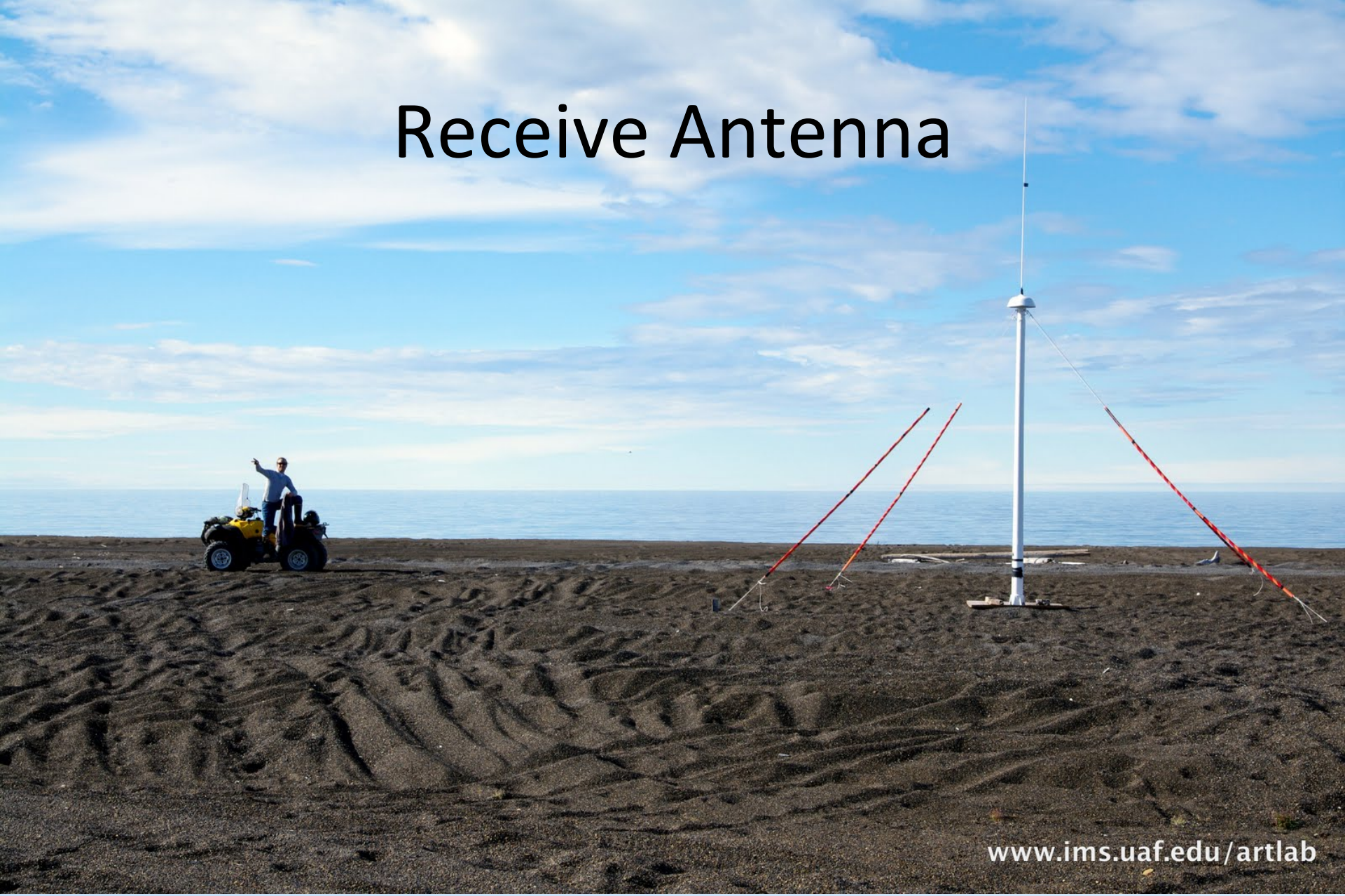


Aug 22, 2012 16:00 UTC

25 MHz High Resolution Network

Remote Power Module

Receive Antenna



Vessels Detected During Sept 9/10


© Dave Brennan
MarineTraffic.com

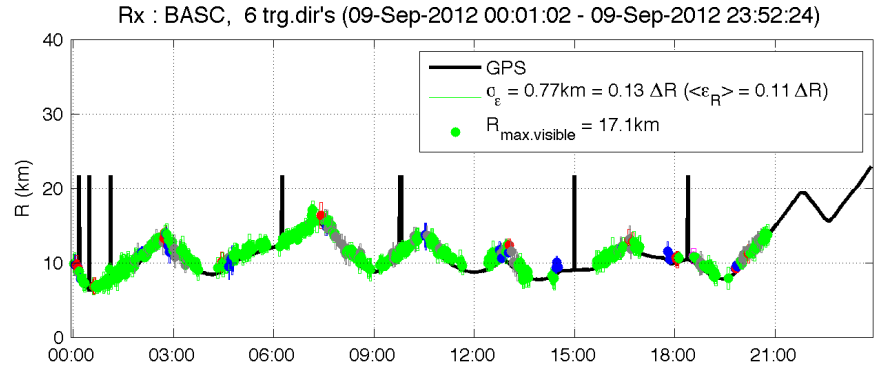

PACIFIC RAVEN

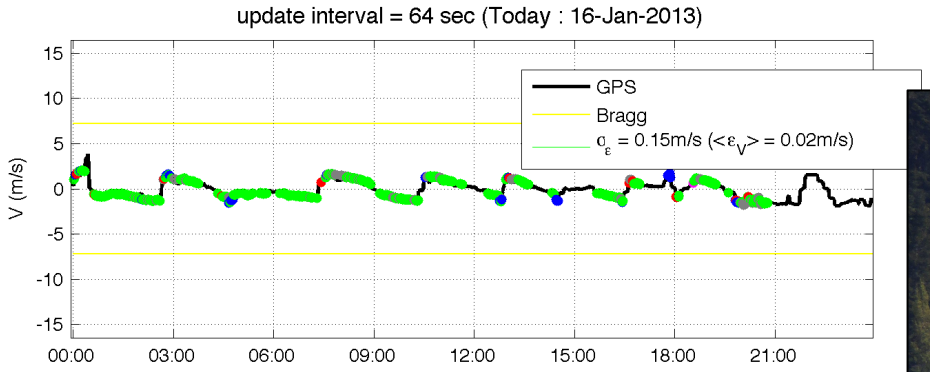

© linda g evans
MarineTraffic.com

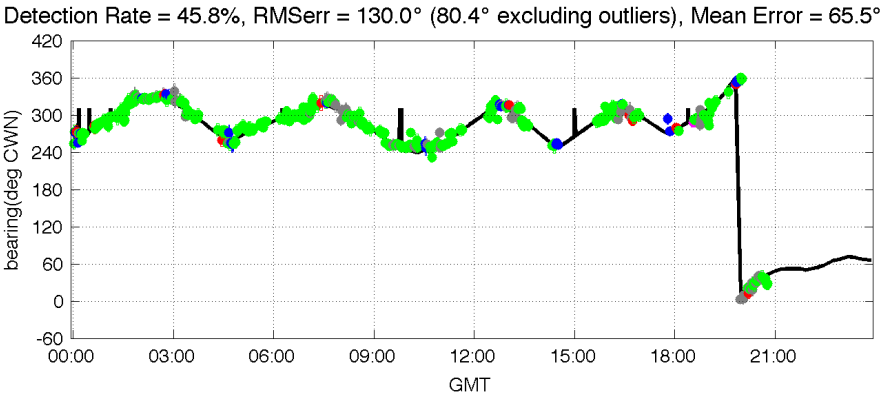

© Henry Bonk
MarineTraffic.com

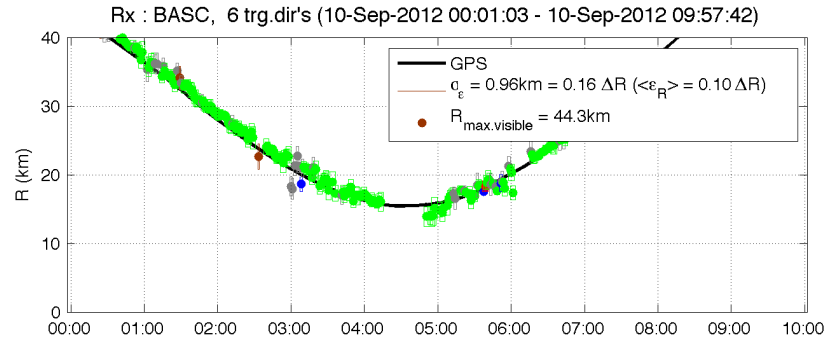

© Richard Gulbransen
MarineTraffic.com

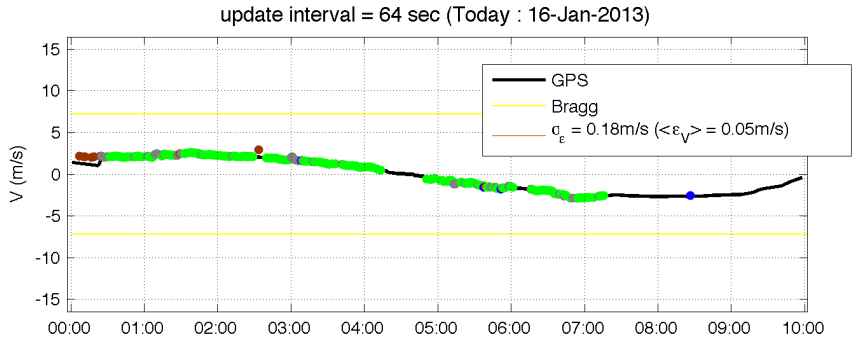
21 hours of Detection for Tug Boat Nokea

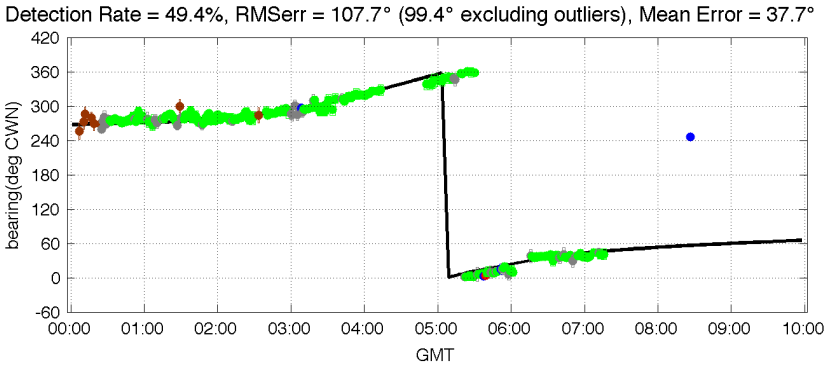


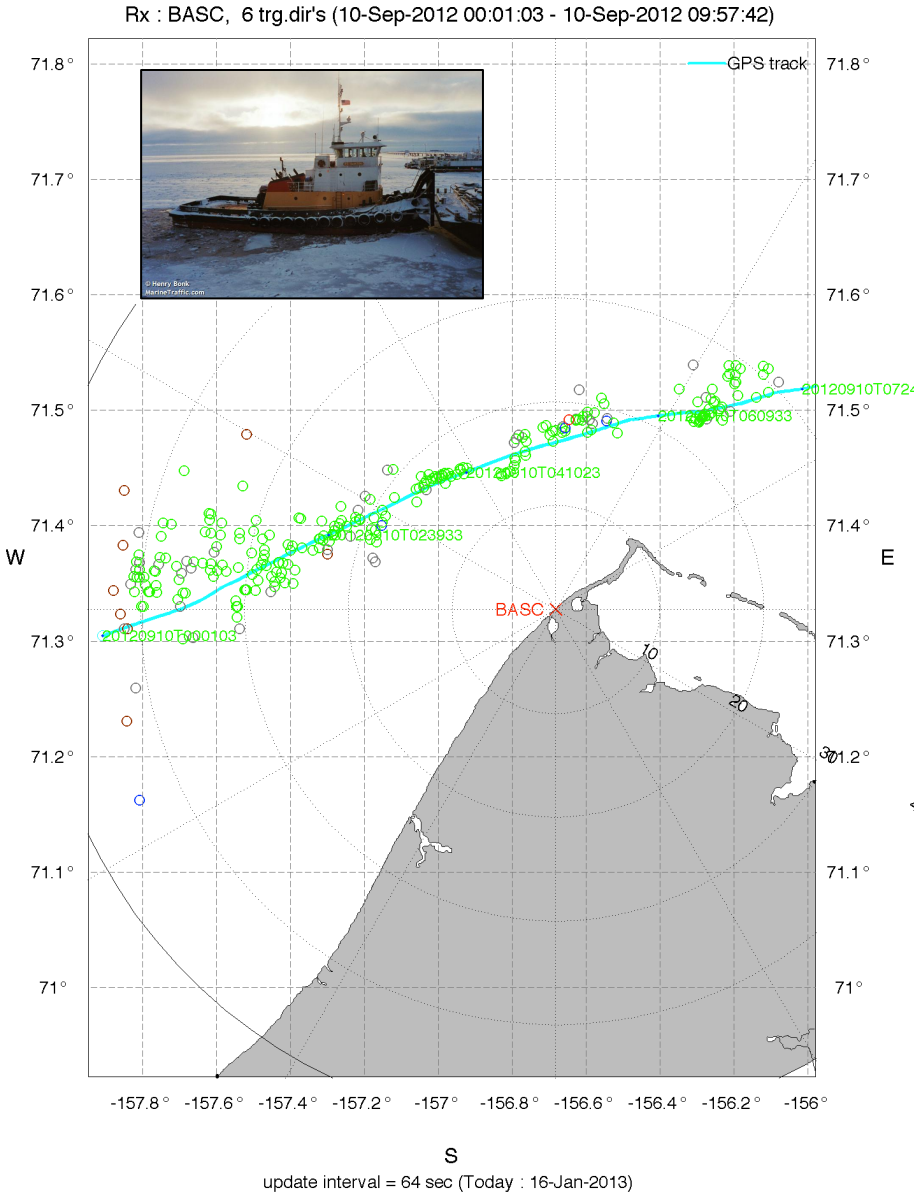




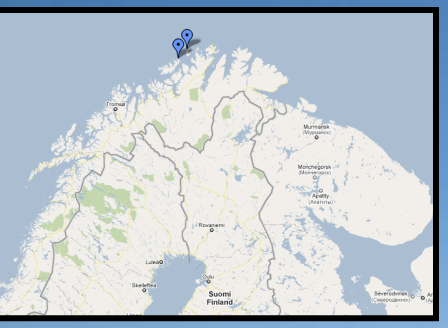

Rx : BASC, 6 trg.dir's (10-Sep-2012 00:01:03 - 10-Sep-2012 09:57:42)
GPS
σε = 0.96km = 0.16 ΔR (<εR> = 0.10 ΔR)
Rmax.visible = 44.3km
R (km)


update interval = 64 sec (Today : 16-Jan-2013)
GPS
Bragg
σε = 0.18m/s (<εV> = 0.05m/s)
V (m/s)


Detection Rate = 49.4%, RMSerr = 107.7° (99.4° excluding outliers), Mean Error = 37.7°
bearing(deg CWN)
GMT


Rx : BASC, 6 trg.dir's (10-Sep-2012 00:01:03 - 10-Sep-2012 09:57:42)
GPS track
BASC
W
E
S
update interval = 64 sec (Today : 16-Jan-2013)

Rapid Response Capability - Norway



- Self Contained
- Transportable
- Propane generator
- Satellite Communications

NOFO

CODAR OCEAN SENSORS

OUP E2E Engage to Excel Transition Pathway

15. Intellectual Property Considerations

CODAR owns patents on hardware and IP on real-time software.
Applied Math owns IP on real-time trackers.
Applied Science owns EDS

16. Documentation, Operations & Maintenance, Updates

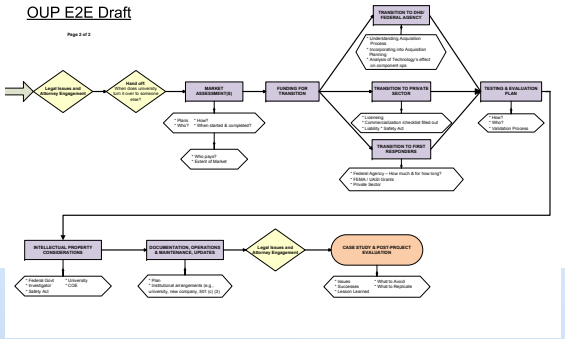
Example - Teledyne Brown led manuals for U.S. Navy glider operations
Currents – Operations Plan published for National HF Radar Network
Currents – Updates generated as U.S. IOOS funding permits.

17. Legal Issues

ITAR Status of Association Process Unknown
Collaborative agreement with Norway needs to be developed

18. Case Study & Post Project Evaluation

Currents – Gulf of Mexico Oil Spill



Next Steps:

1) Continue Research on Association (with Norway) & Engage the Real-Time Tracker (with Applied Math)

2) Demonstrate in NY Harbor, Puerto Rico & Alaska Testbeds

3) Develop a Concept of Operations for the National Network