HF Radar Applications for Operational Oceanography Tutorial

Dr. Hugh Roarty

June 10, 2013

OCEANS '13
MTS/IEEE Bergen
June 10-13, 2013

HF Radar Applications for Operational Oceanography Tutorial
at
Oceans '13
MTS/IEEE Bergen
June 10, 2013

By Dr. Hugh Roarty, Dr. Josh Kohut, Dr. Scott Glenn and Mr. Chad Whelan

The tutorial course will provide an introduction to the principles and current state of the art technology for High Frequency radar applications. The course will touch upon the following topics:

- ***What is an HF Radar?*** Principles of operation, data products & state-of-the-art.
- ***Operating an HF Radar Network***: What does a network look like and what does it take to manage? How does one process, analyze and visualize the surface current data? How are the products quality controlled?
- ***Applications & Case Studies***: How are HF data products currently used in operational oceanography? Case Studies will be shown for recent events including search and rescue operations, the Deepwater Horizon oil spill response and Hurricanes Irene and Sandy.

Proposed Curriculum for the HF Radar Course

Principles of operation & data products (0.5 hours)
State-of-the-Art in HF radar technology (0.5 hours)
Data visualization & QA/QC (0.5 hours)
Introduction to US National and Global HF Radar Networks (0.5 hours)
Search and rescue applications (0.5 hours)
Pollution floatables tracking (0.5 hours)
Deepwater Horizon, model validation (0.5 hours)
Storm forecasting (0.5 hours)


Nansen

MIDDLE **A**TLANTIC
REGIONAL
ASSOCIATION
COASTAL
OCEAN **O**BSERVING
SYSTEM

1000 km
Cape to Cape

CT
RI
MA
Cape
Cod

NY
10 States

PA
NJ
DE
MD
VA
NC
Cape
Hatteras

Watersheds
of the Middle
Atlantic Bight

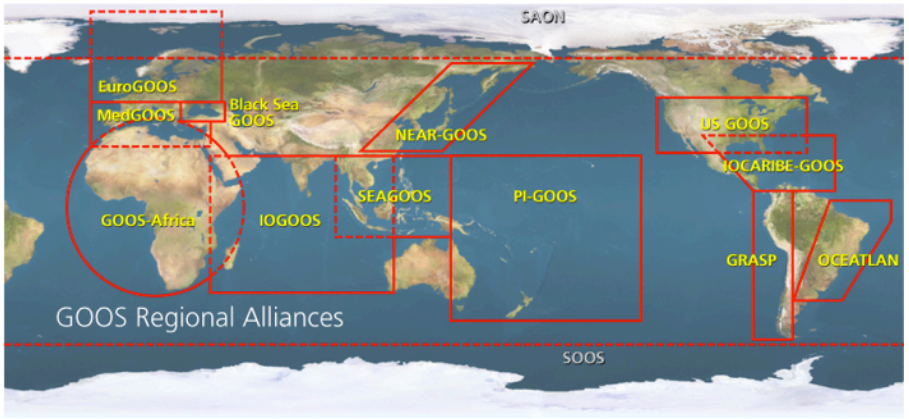
MARACOOS
Ocean Information for a Changing World

To seek, discover and apply new knowledge & understanding of our coastal ocean

U.S. Integrated Ocean Observing System

IOOS
INTEGRATED OCEAN OBSERVING SYSTEM

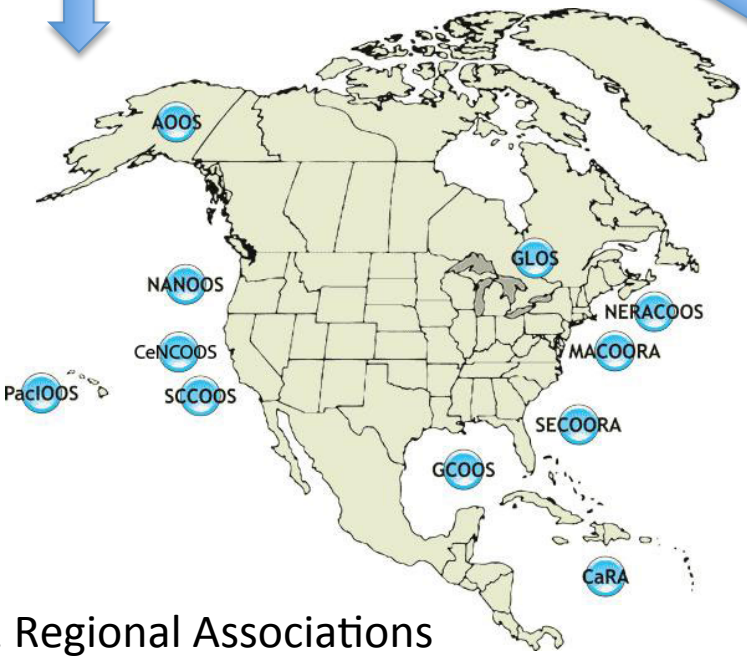
International Component



Global Ocean Observing System

Regional Component

National Component

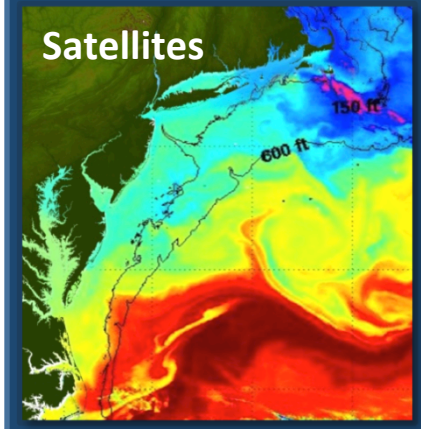


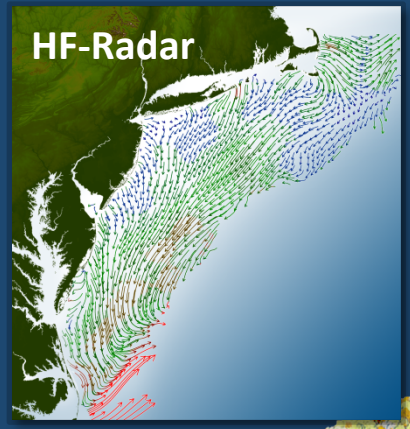
11 Regional Associations

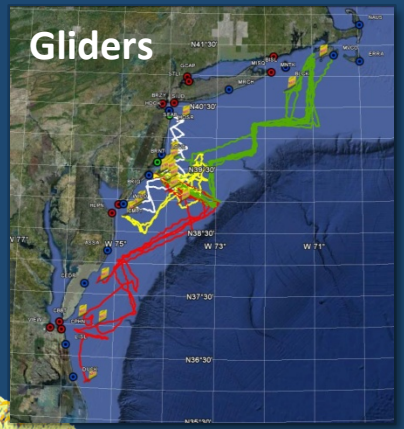
18 U.S. Federal Agencies

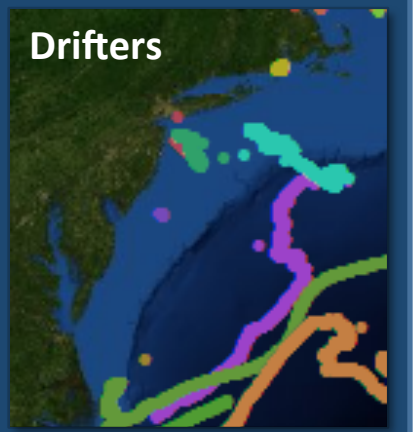
Themes and Capabilities

	MARCOOS Capabilities					
MACOORA Themes	**Weather Mesonet**	**HF Radar Network**	**Statistical STPS Forecast**	**Satellite Imagery**	**Glider Surveys**	**Dynamical Ocean Forecasts**
1. Maritime Safety	Operational input to USCG SAROPS	Operational input to USCG SAROPS	Operational input to USCG SAROPS			
2. Ecological Decision Support		Circulation and divergence maps for habitat		SST & Color for habitat	Subsurface T & S for habitat	3-D Fields of T, S, circulation for habitat
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
4. Coastal Inundation	Weather forecast ensemble validation	Current forecast model validation				Nested forecast ensembles
5. Offshore Energy	Historical analysis & wind model validation	Historical current analysis & wind model validation		Historical analysis surface fronts & plumes for siting	Historical analysis subsurface fronts & plumes	Coupled ocean-atmosphere models for resource estimates

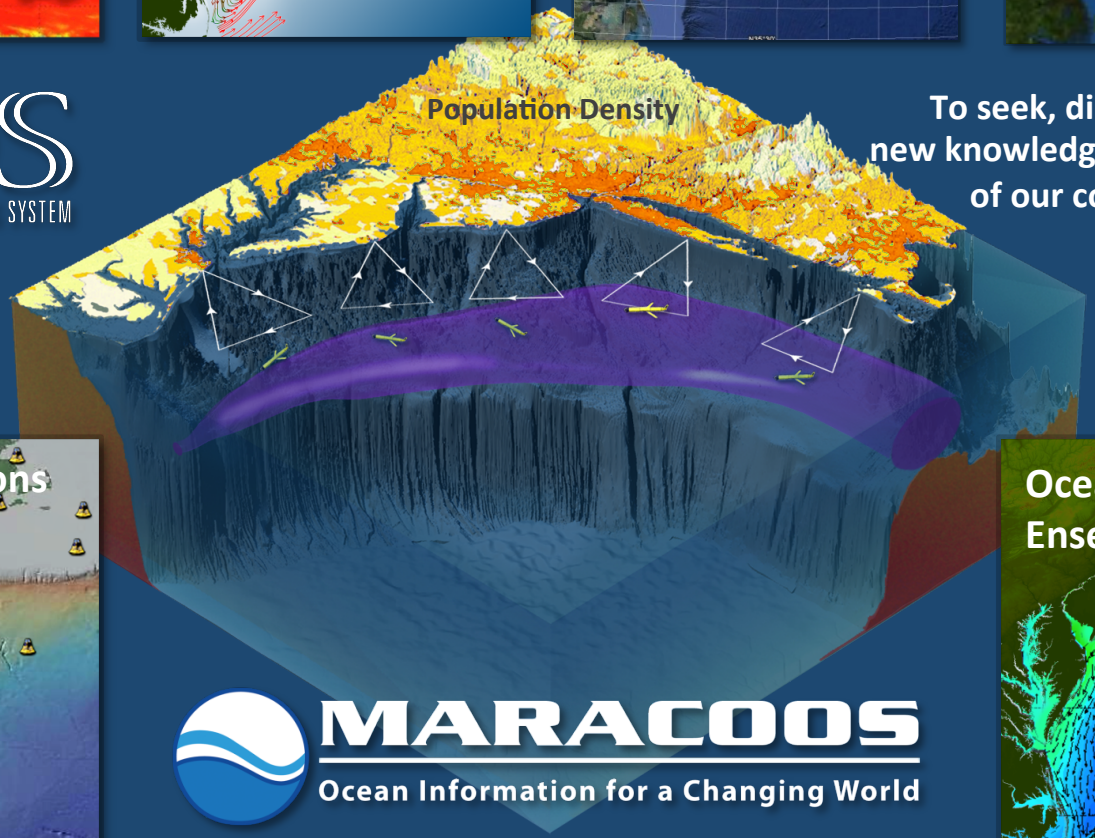




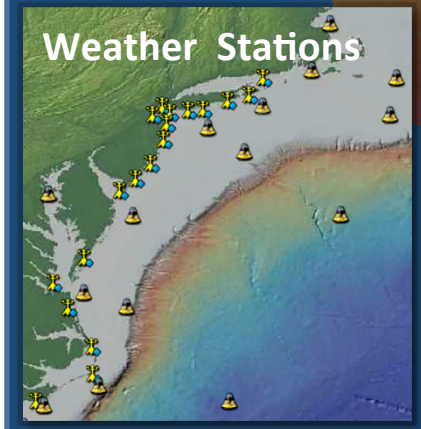


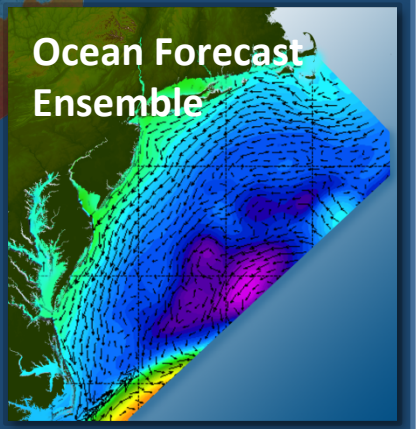


IOOS
INTEGRATED OCEAN OBSERVING SYSTEM



To seek, discover & apply new knowledge & understanding of our coastal ocean





MARACOOS
Ocean Information for a Changing World

MARACOOS HF Radar Network

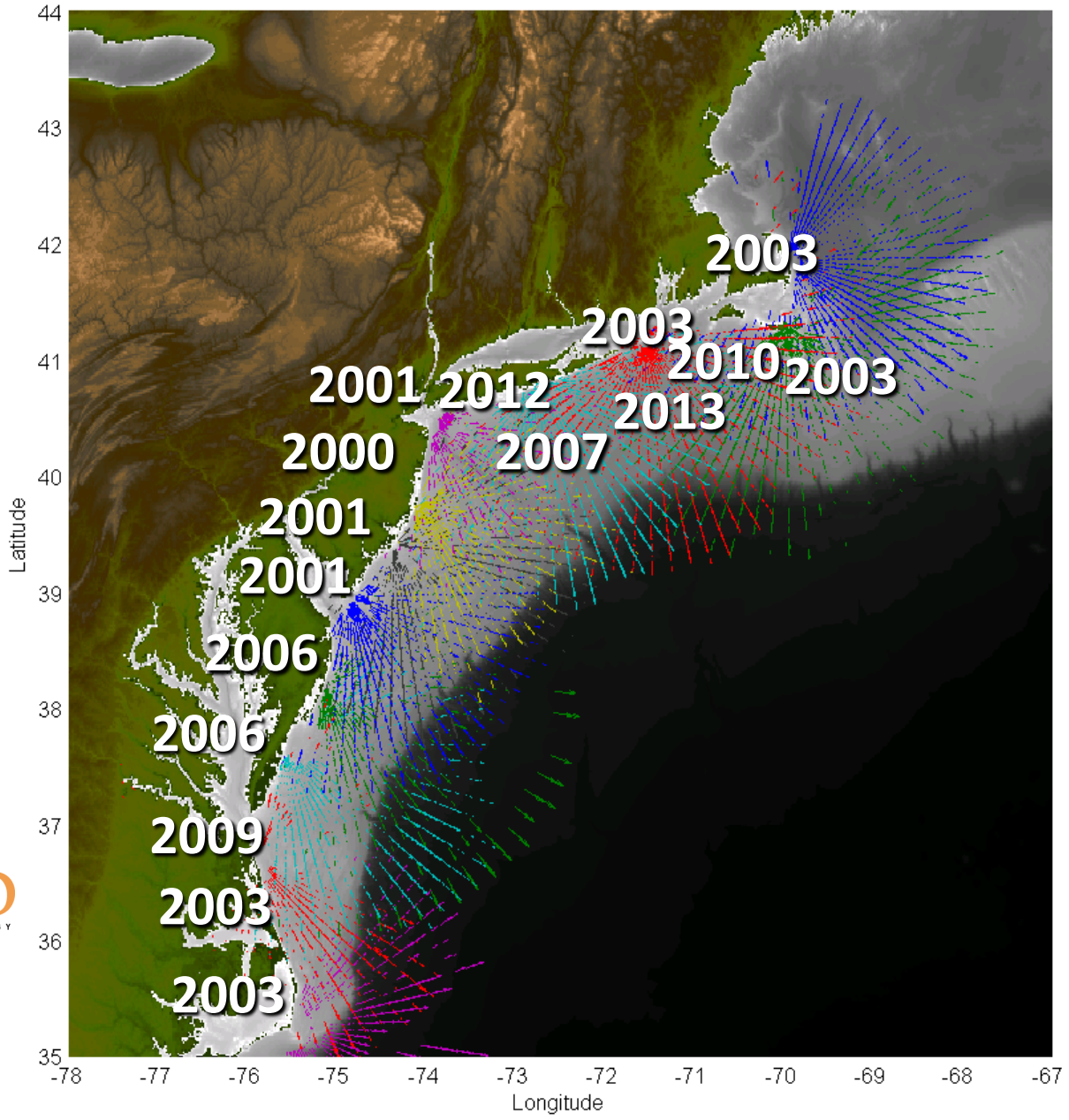
LONG RANGE NETWORK

UMASS DARTMOUTH

RUTGERS
Coastal Ocean Observation Lab

CENTER FOR COASTAL PHYSICAL OCEANOGRAPHY
OLD DOMINION UNIVERSITY

CIT R & D
CENTER FOR INNOVATIVE TECHNOLOGY



Nested High Resolution Network

UCONN

STEVENS INSTITUTE of TECHNOLOGY
THE INNOVATION UNIVERSITY

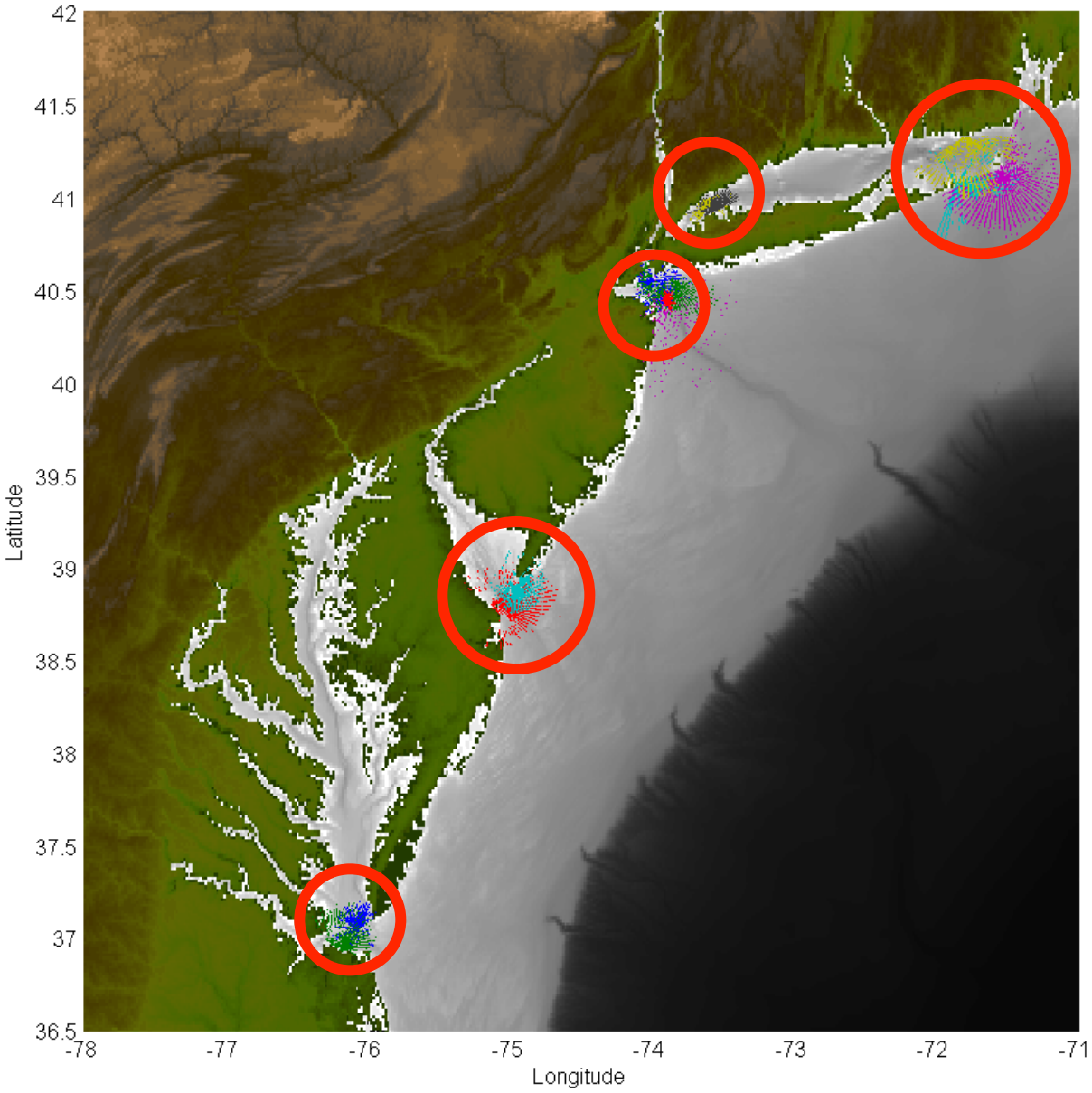
WOODS HOLE OCEANOGRAPHIC INSTITUTION
1930

UNIVERSITY OF DELAWARE

RUTGERS
Coastal Ocean Observation Lab

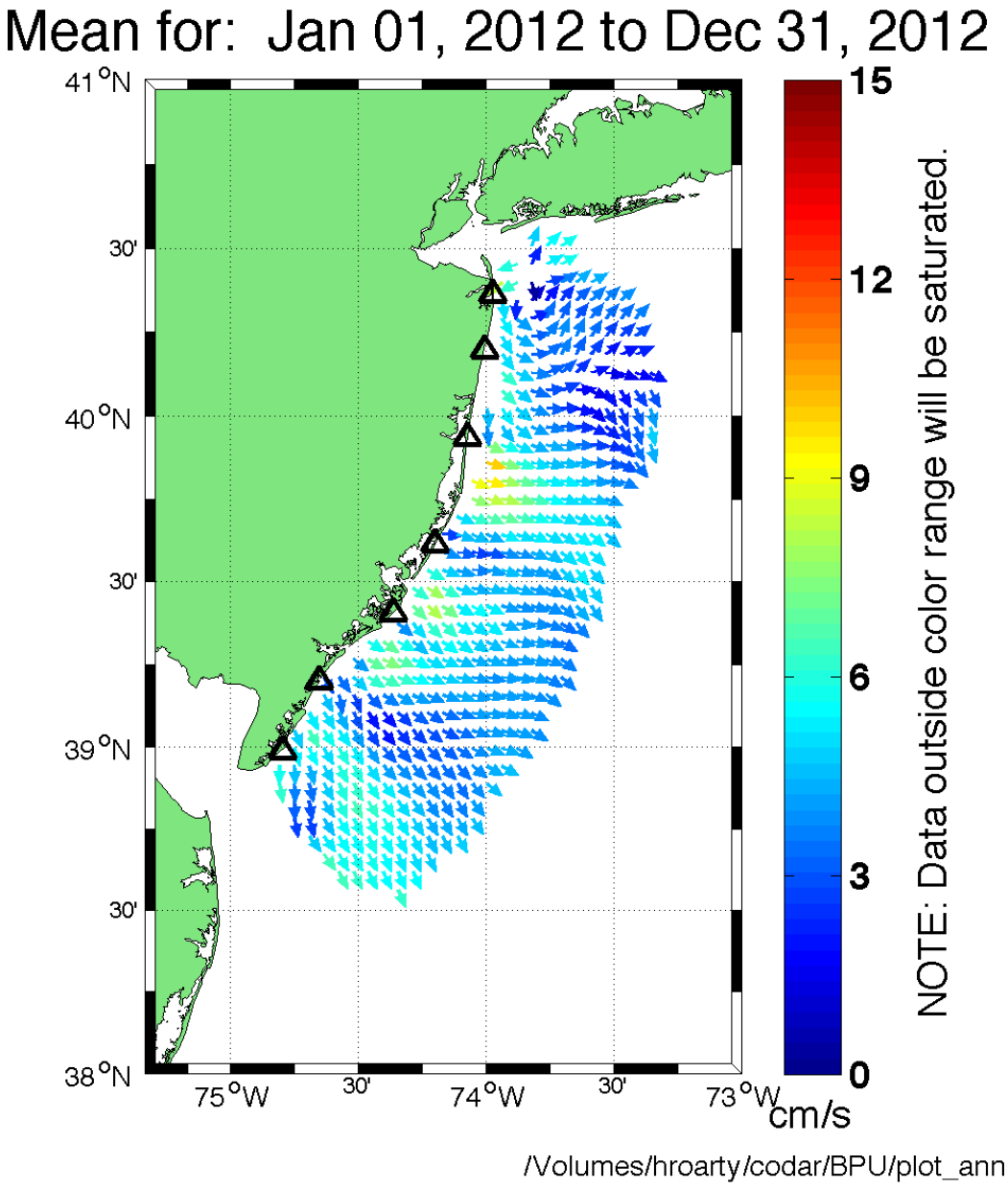
UNIVERSITY OF Rhode Island

CENTER FOR COASTAL PHYSICAL OCEANOGRAPHY
OLD DOMINION UNIVERSITY

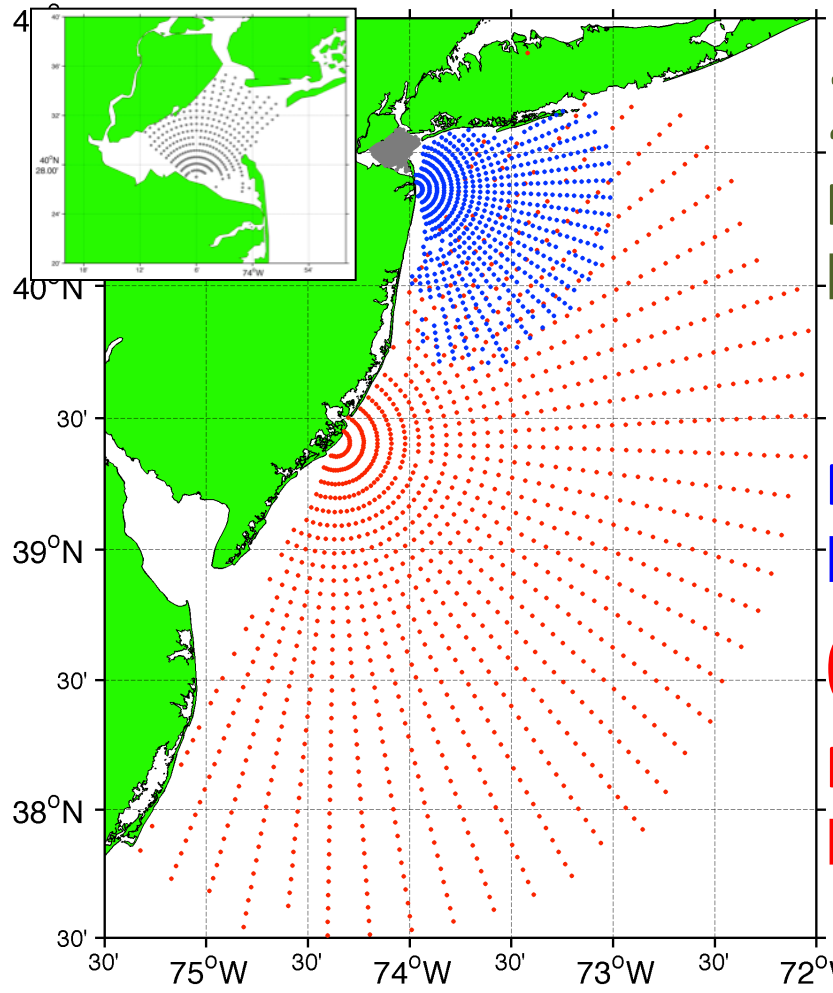


Standard Range Network

RUTGERS
Coastal Ocean
Observation Lab



Surface Current Mapping Capability



25 MHz

Radar λ: 12 m Ocean λ: 6 m

Range: 30 km Resolution: 1 km

13 MHz

Radar λ: 23 m Ocean λ: 12 m

Range: 80 km Resolution: 3 km

05 MHz

Radar λ: 60m Ocean λ: 30 m

Range: 180 km Resolution: 6 km

CODAR Compact HF Radar Antennas

25 MHz

13 MHz

Combined Transmitter & Receiver

5 MHz

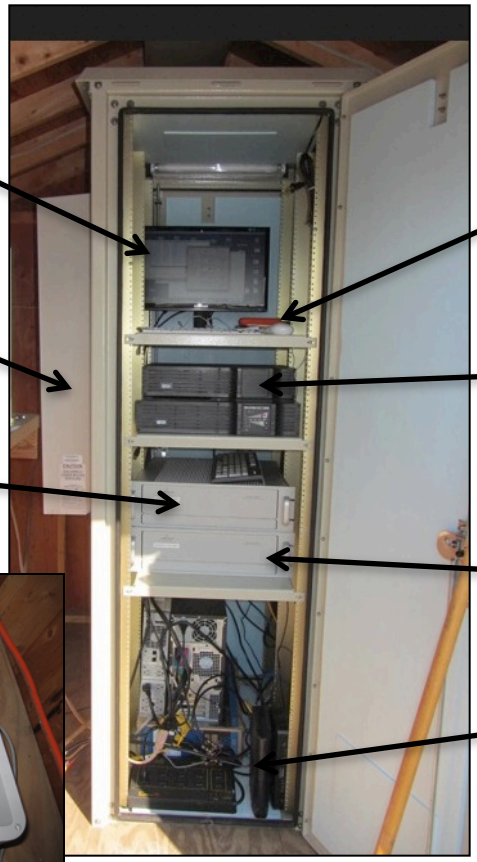
Separate Transmitter & Receiver

Standard CODAR Shore Site:

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

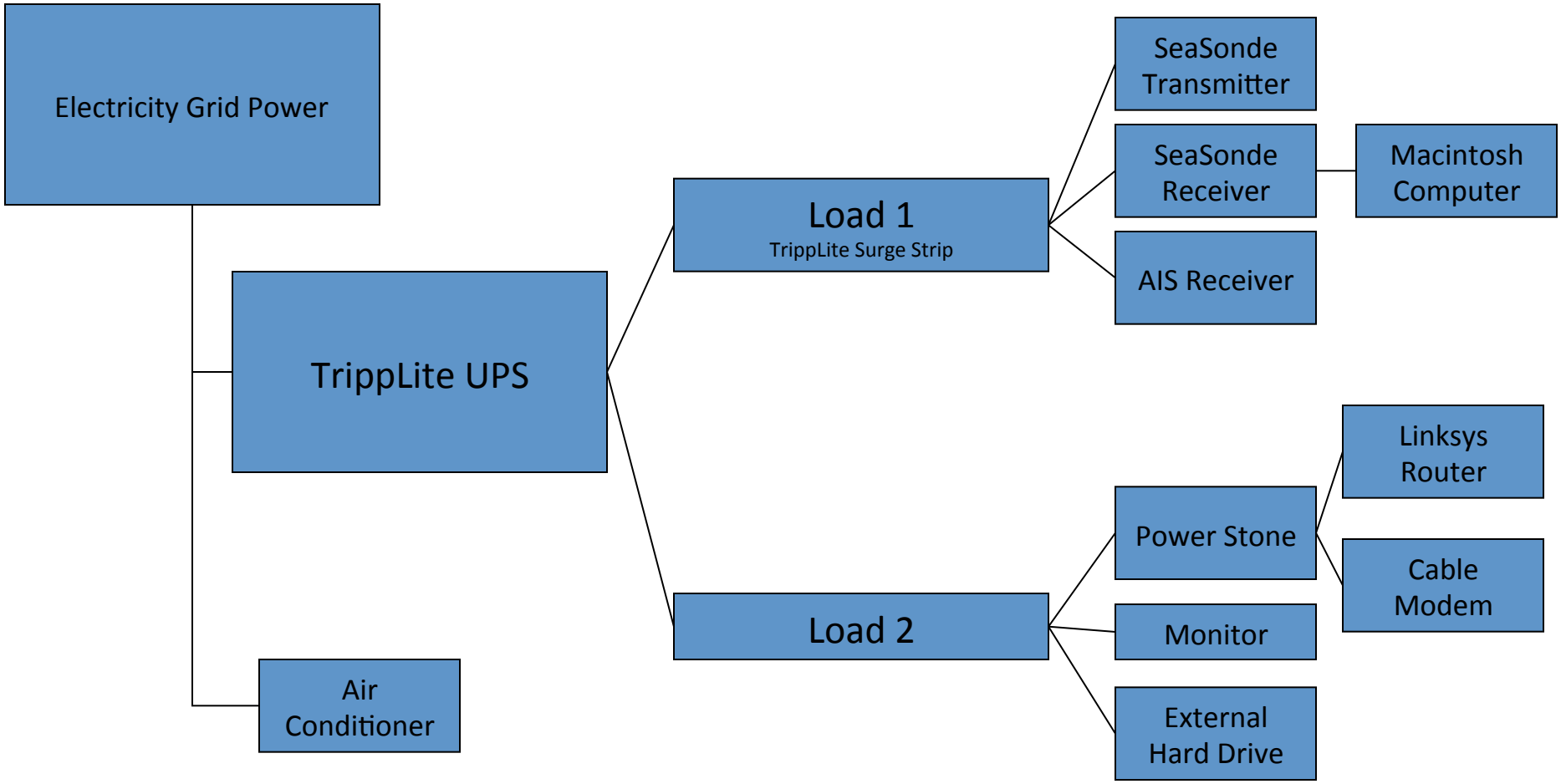
Shed

Lightning Protection



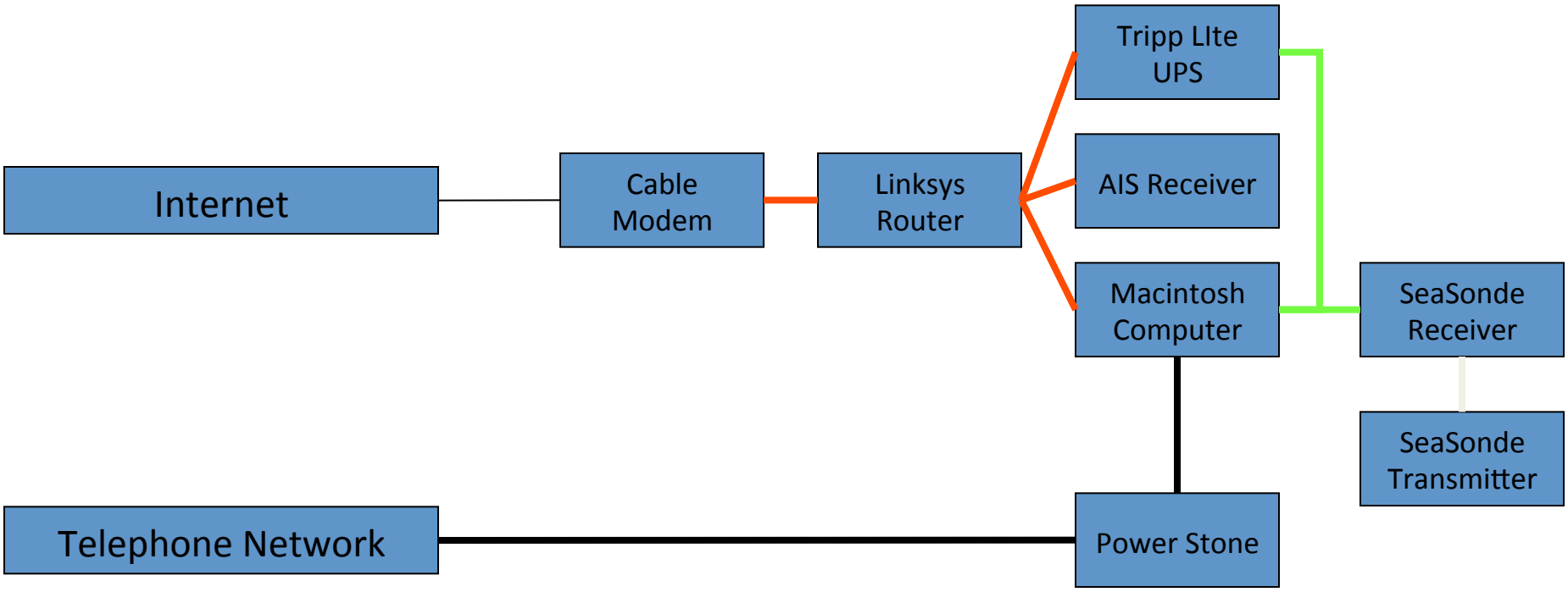
Enclosure

Loveladies Power Configuration



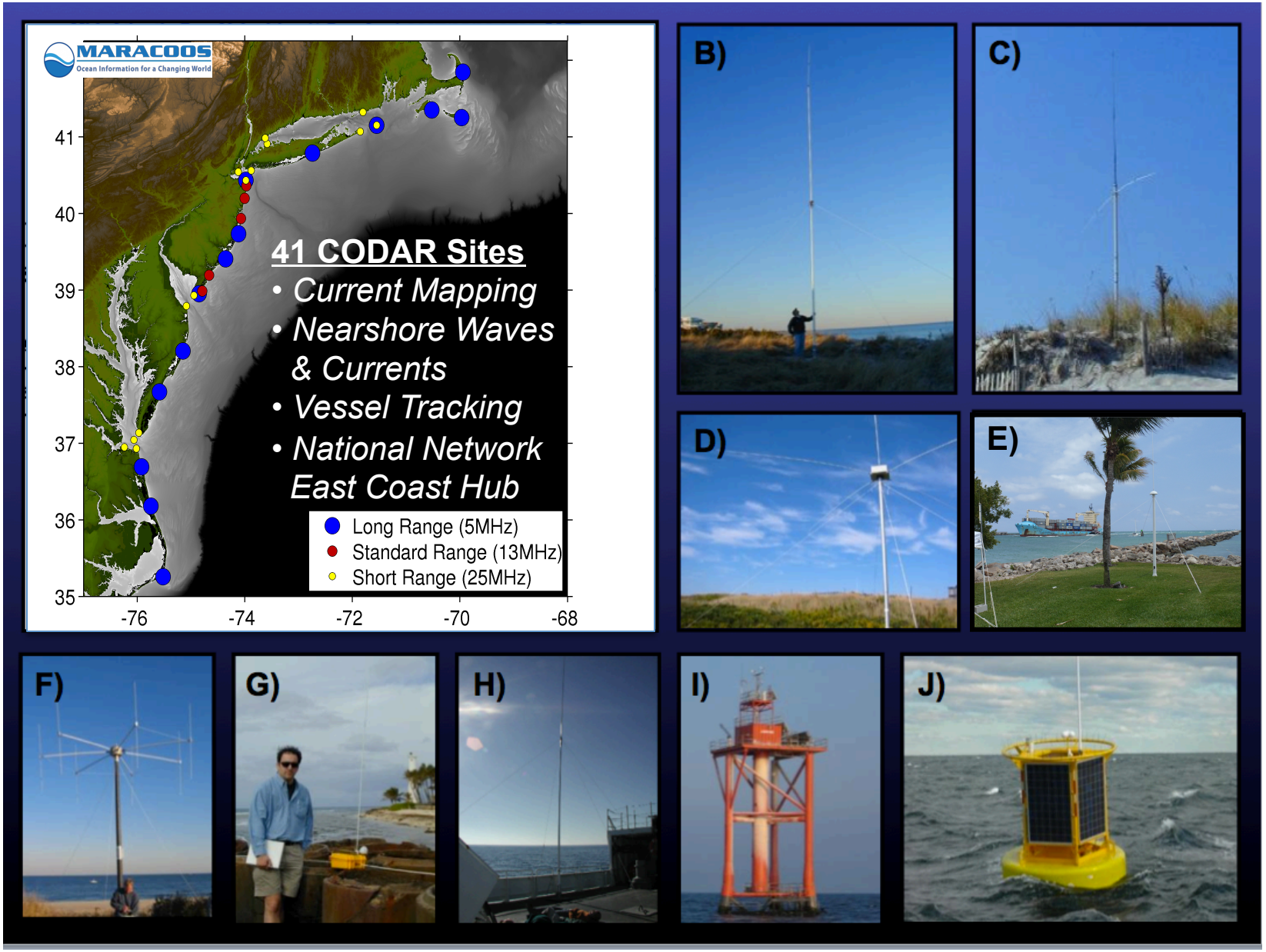
Roarty et al. (2010) MTS Journal

Loveladies Communication Configuration



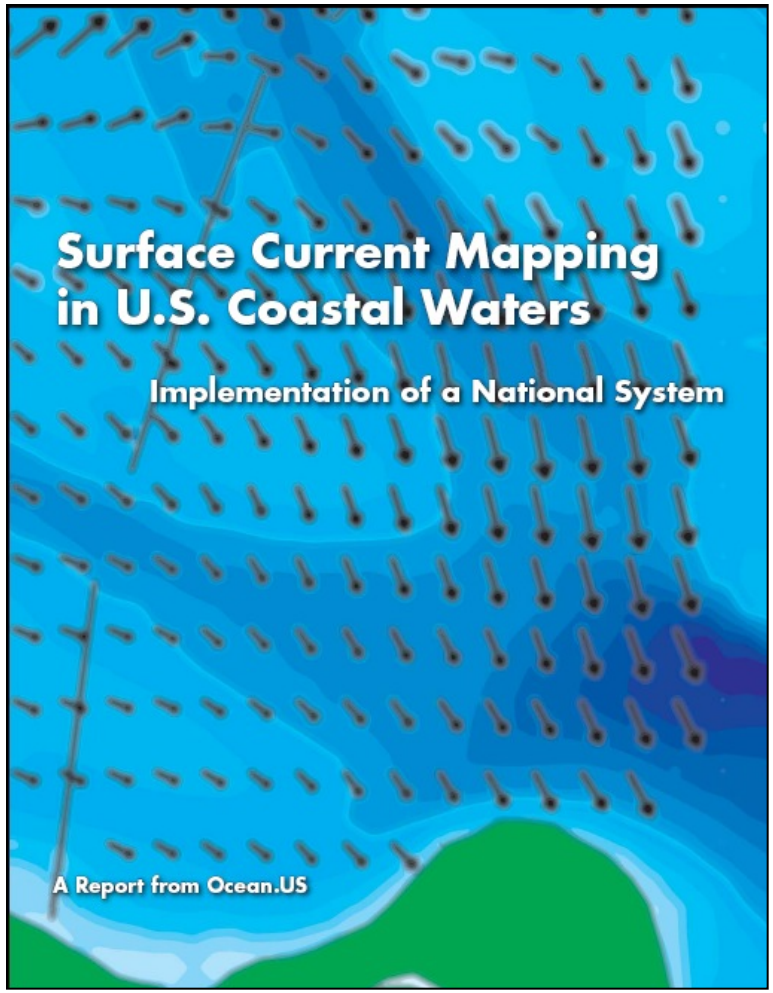
Roarty et al. (2010) MTS Journal

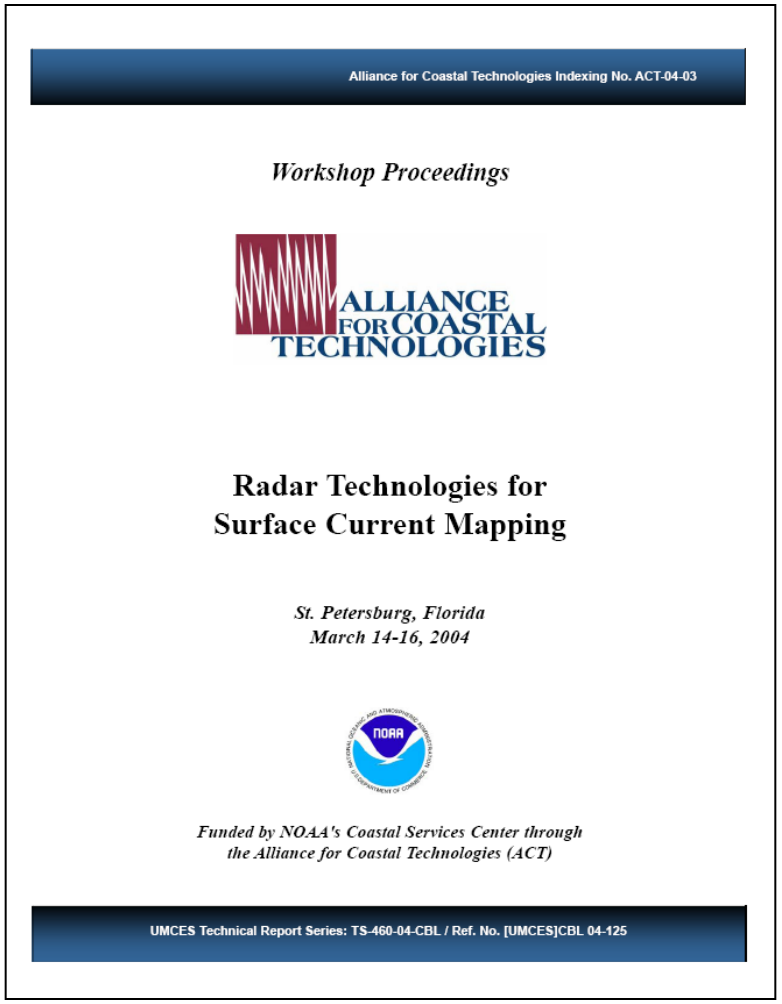
CODAR HF Radar Network Evolution in the Mid-Atlantic



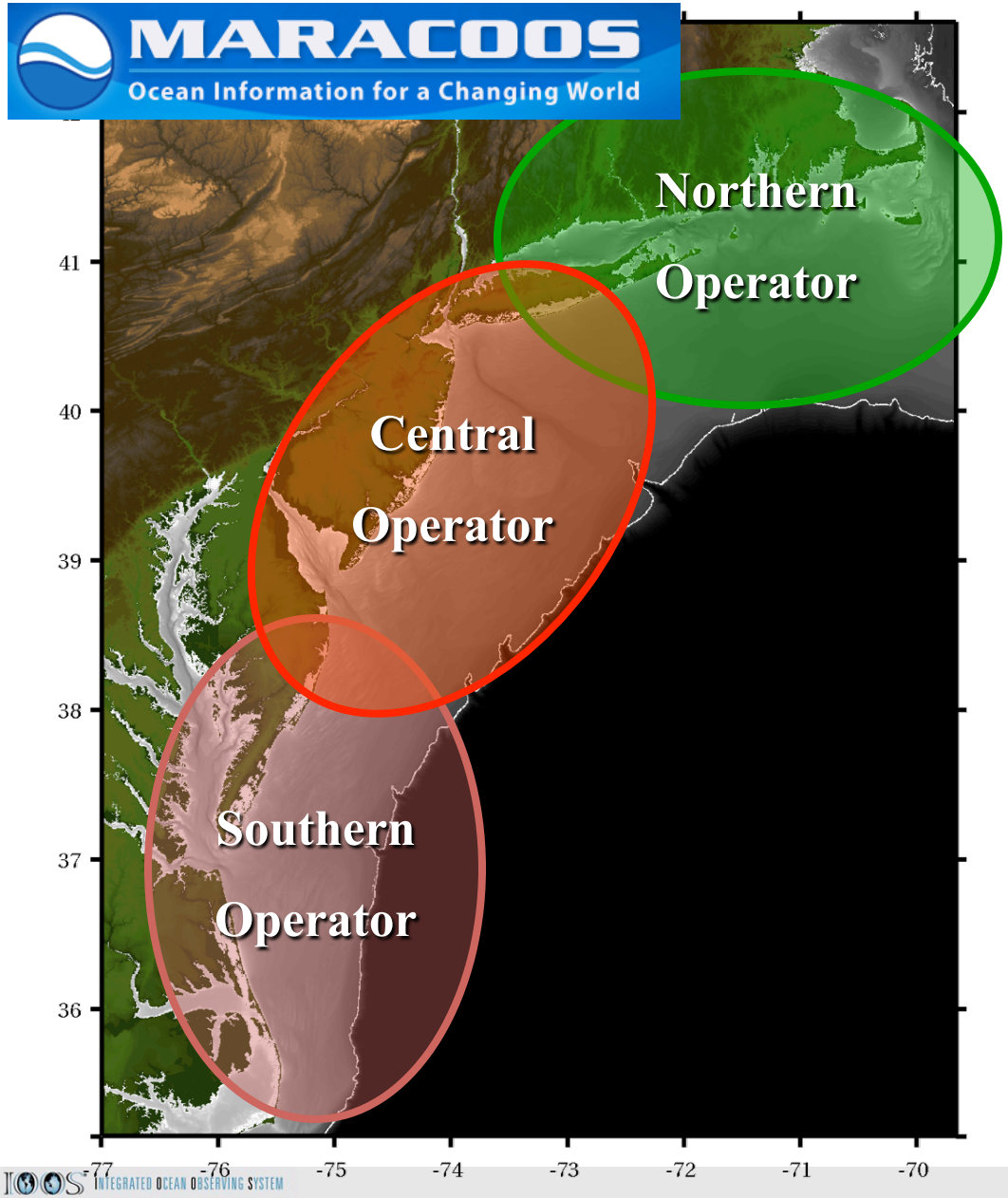
MARACOOS HF RADAR NETWORK 2007-2009 THE BEGINNING

Surface Current Mapping Initiative





September 2003 — March 2004



Management

- Regional Coordinator

RUTGERS Coastal Ocean Observation Lab — Hugh Roarty

- Distributed Technicians

UMASS DARTMOUTH — Chris Jakubiak

UCONN — Todd Fake

RUTGERS Coastal Ocean Observation Lab — Ethan Handel

CENTER FOR COASTAL PHYSICAL OCEANOGRAPHY
OLD DOMINION UNIVERSITY — Teresa Garner

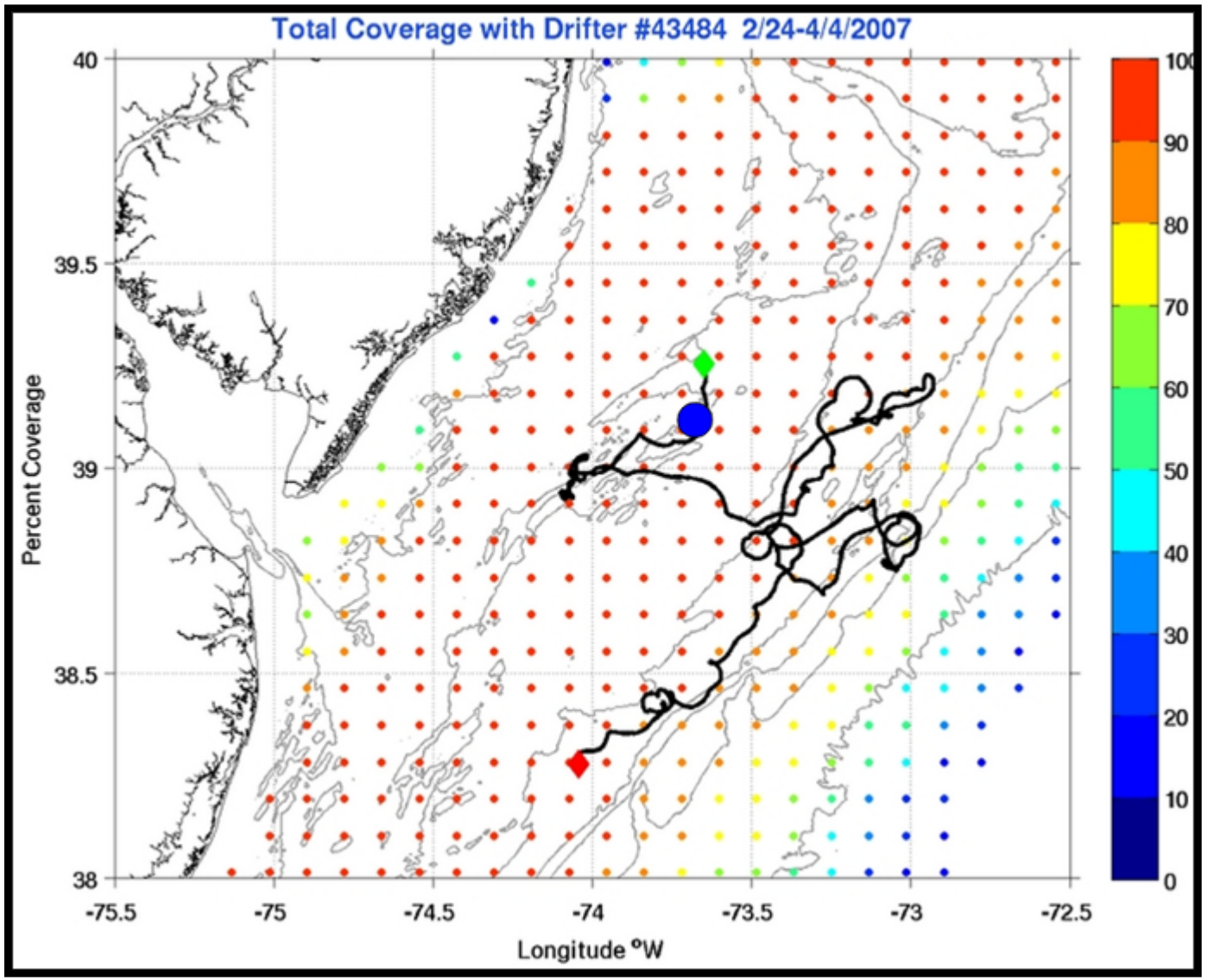
HF Radar Training

VALIDATION OF HF RADAR DATA

Validation of Optimal Interpolation Totals

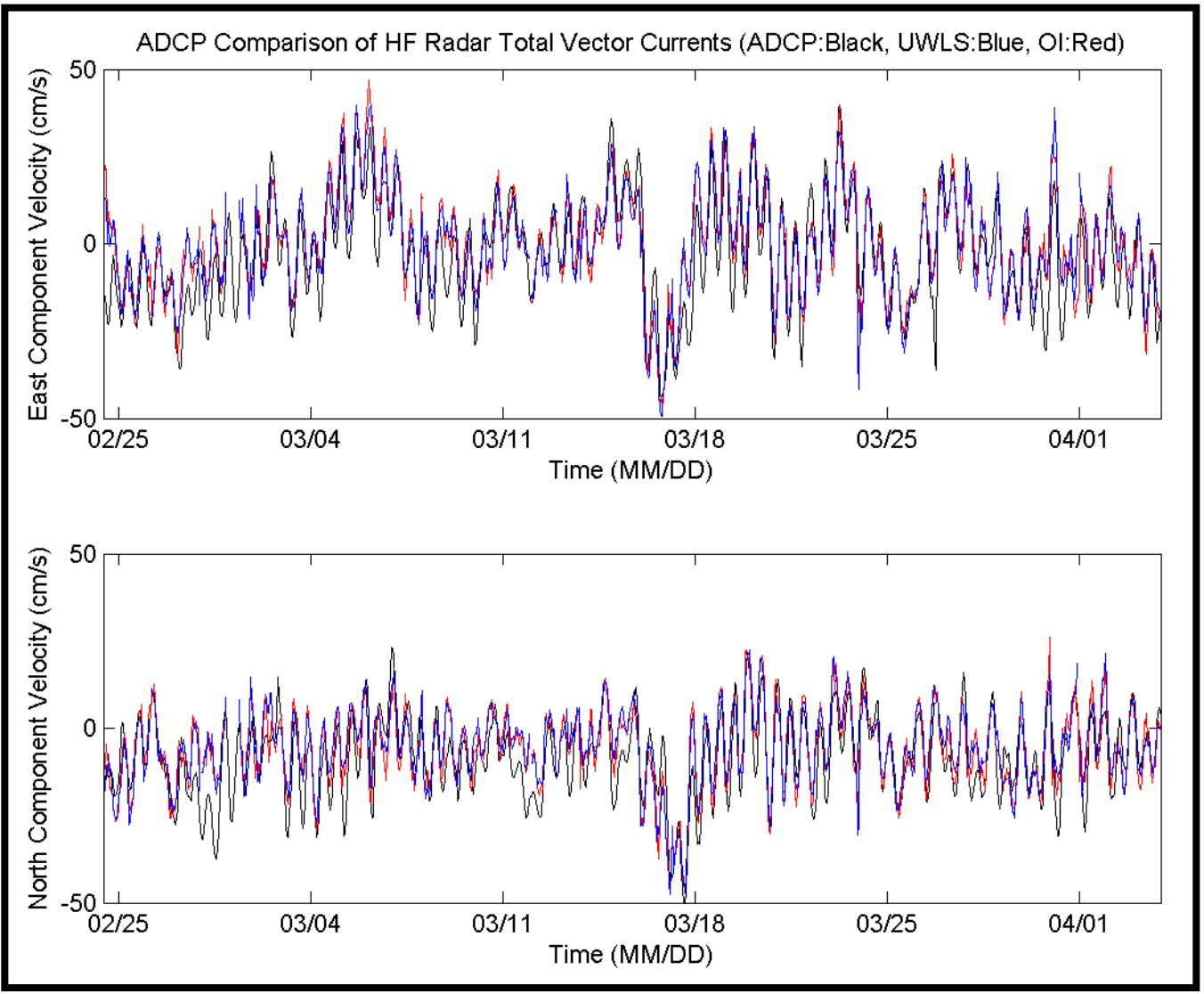
Feb 24-April 4, 2007

39 days



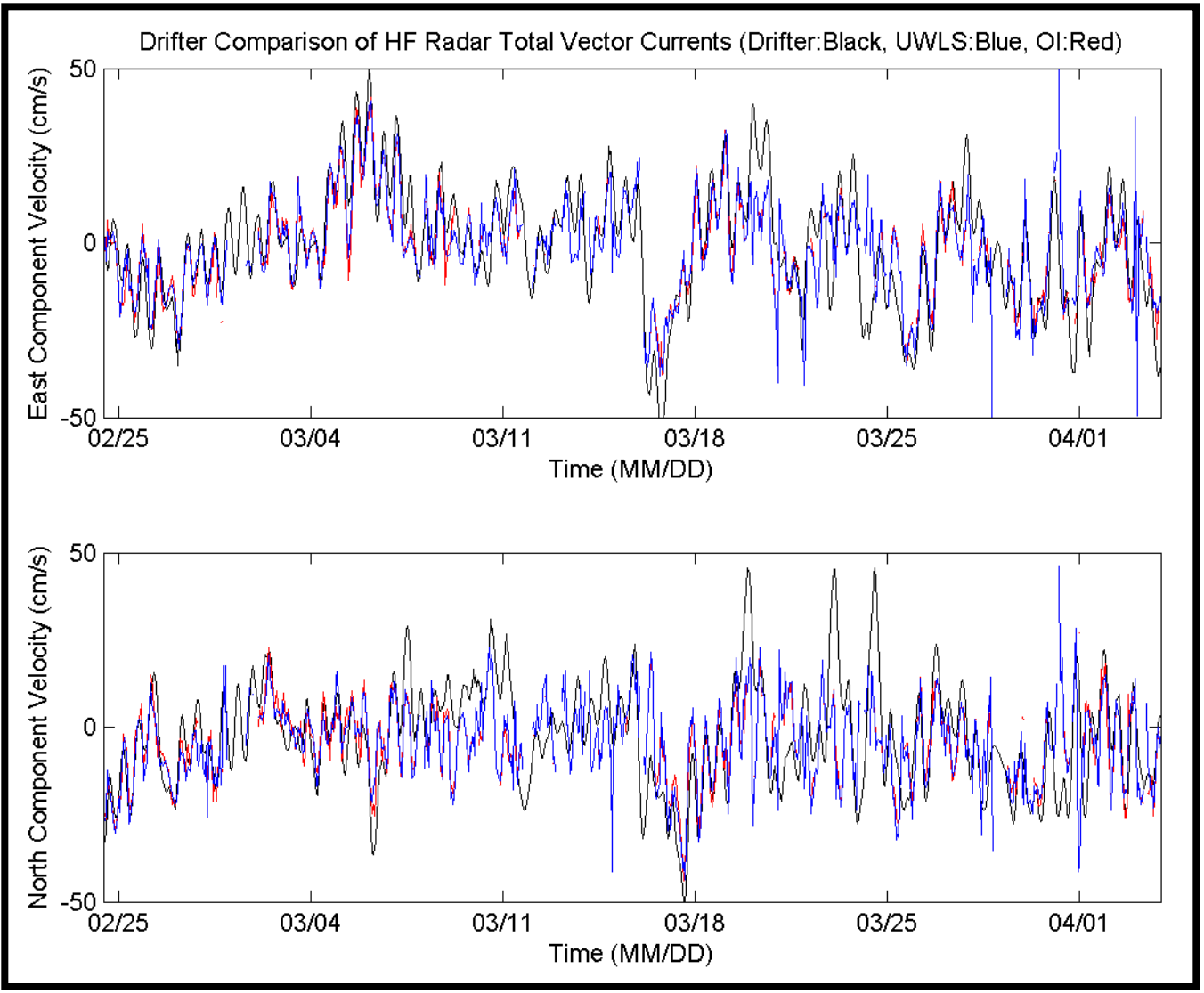
ADCP OI UWLS

Time Series Comparison

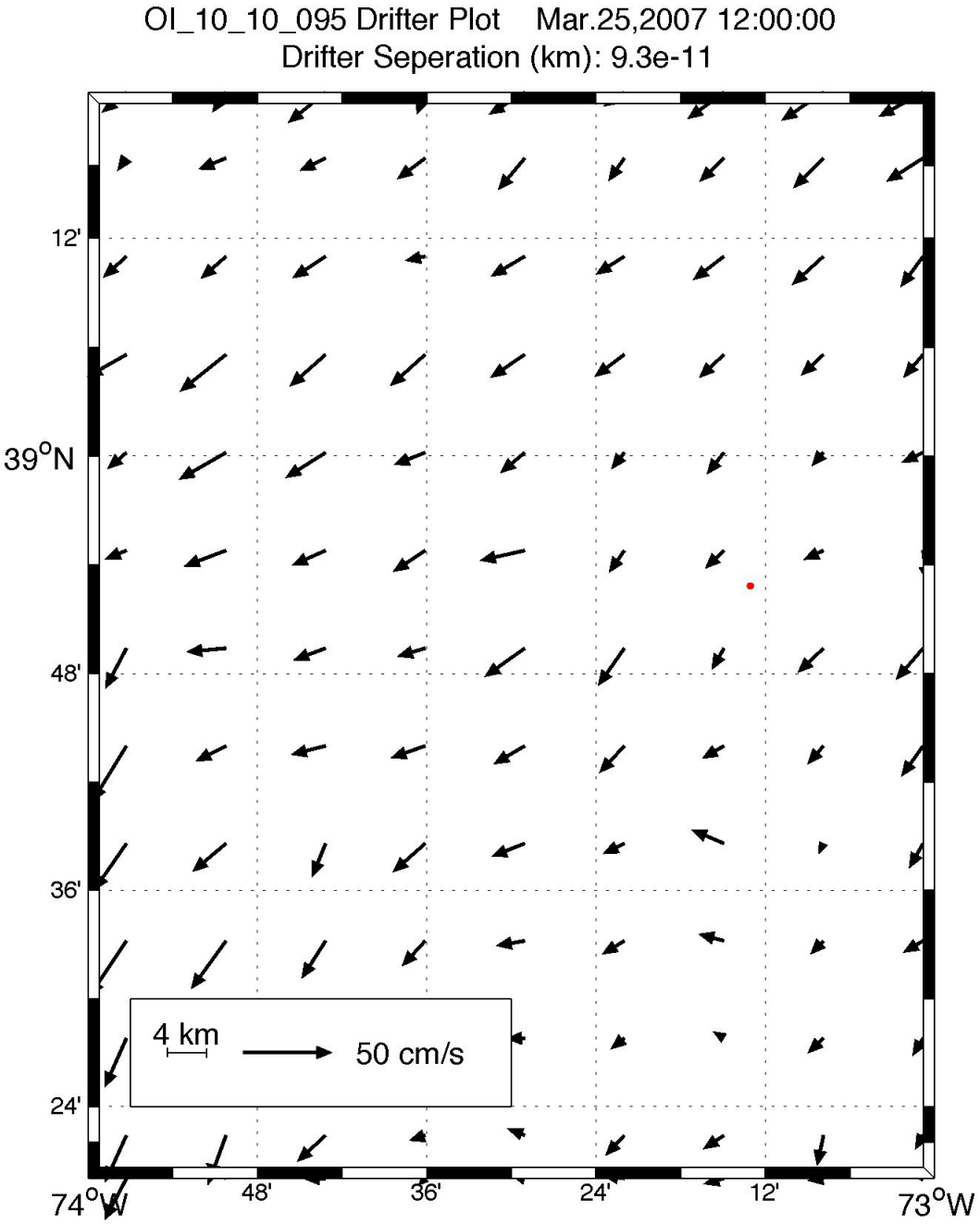


	UWLS	OI
Percent Coverage	93%	95%
RMS U (cm/s)	8.3	8.7
RMS V (cm/s)	7.9	7.5
R^2 U	0.75	0.73
R^2 V	0.63	0.65

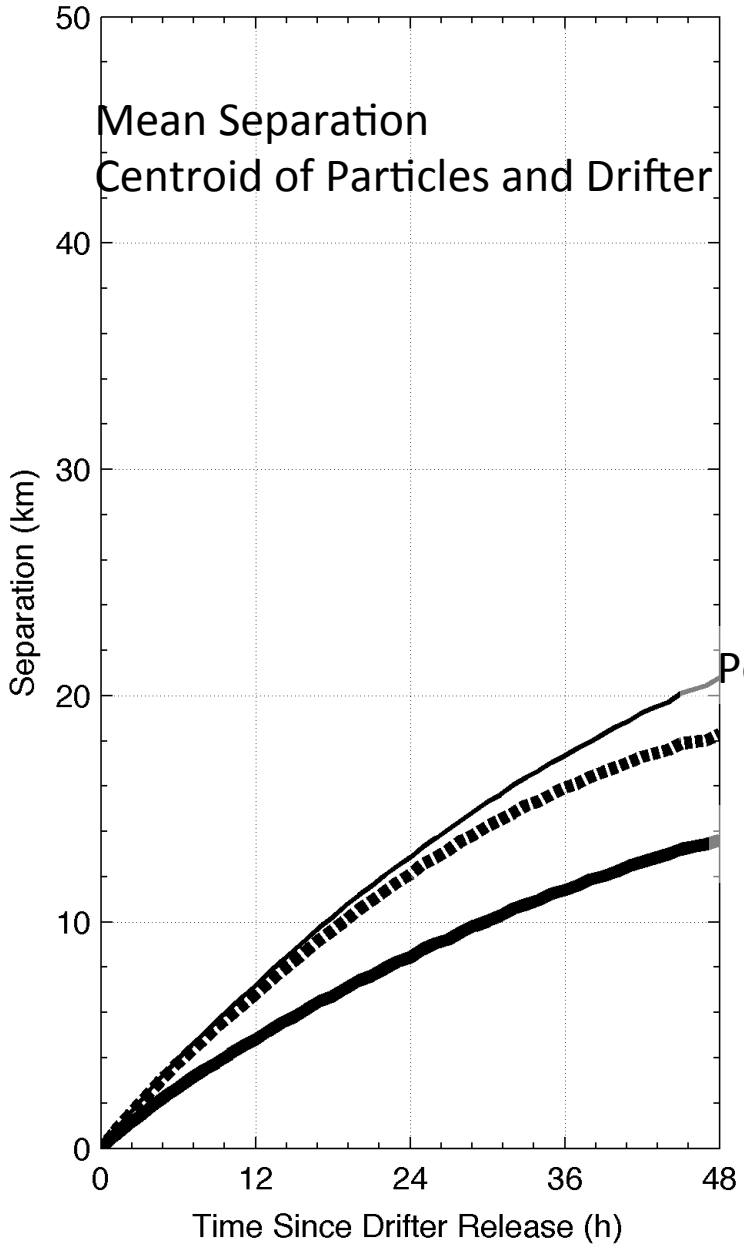
Drifter OI UWLS

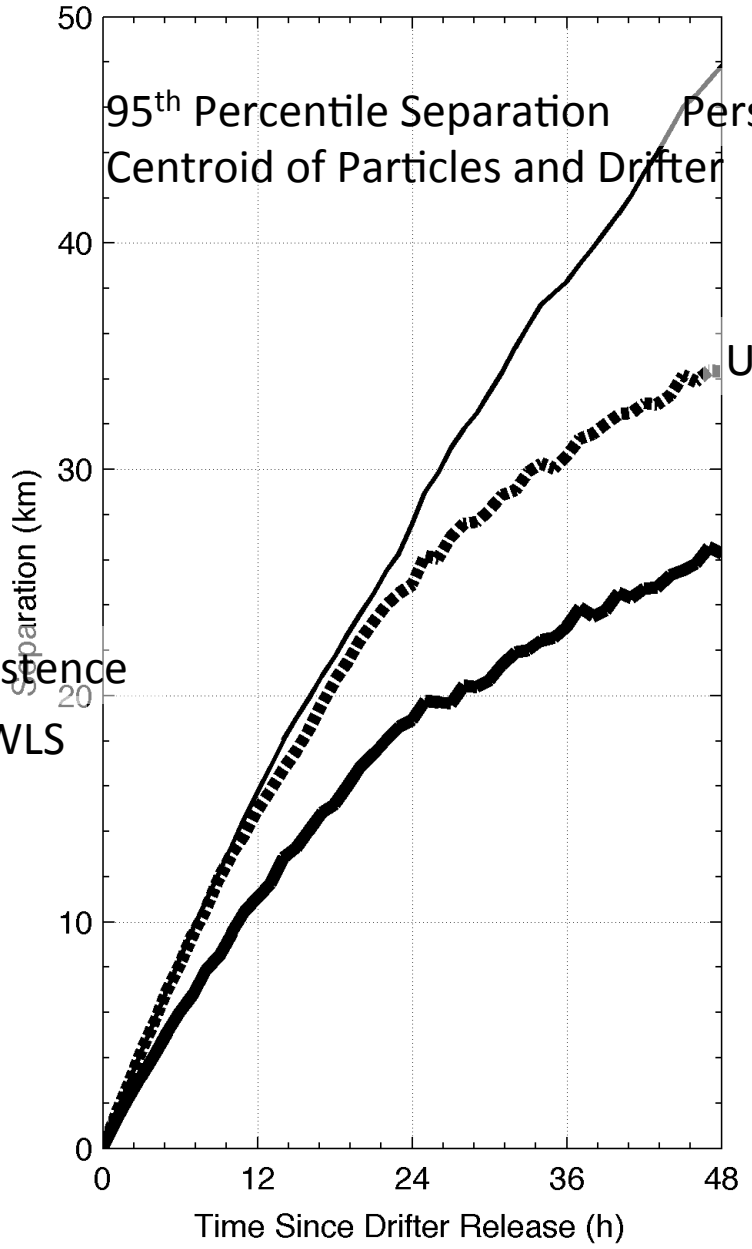


	UWLS	OI
Percent Coverage	53%	65%
RMS U (cm/s)	7.4	8.4
RMS V (cm/s)	9.8	11.8
R^2 U	0.83	0.81
R^2 V	0.58	0.44



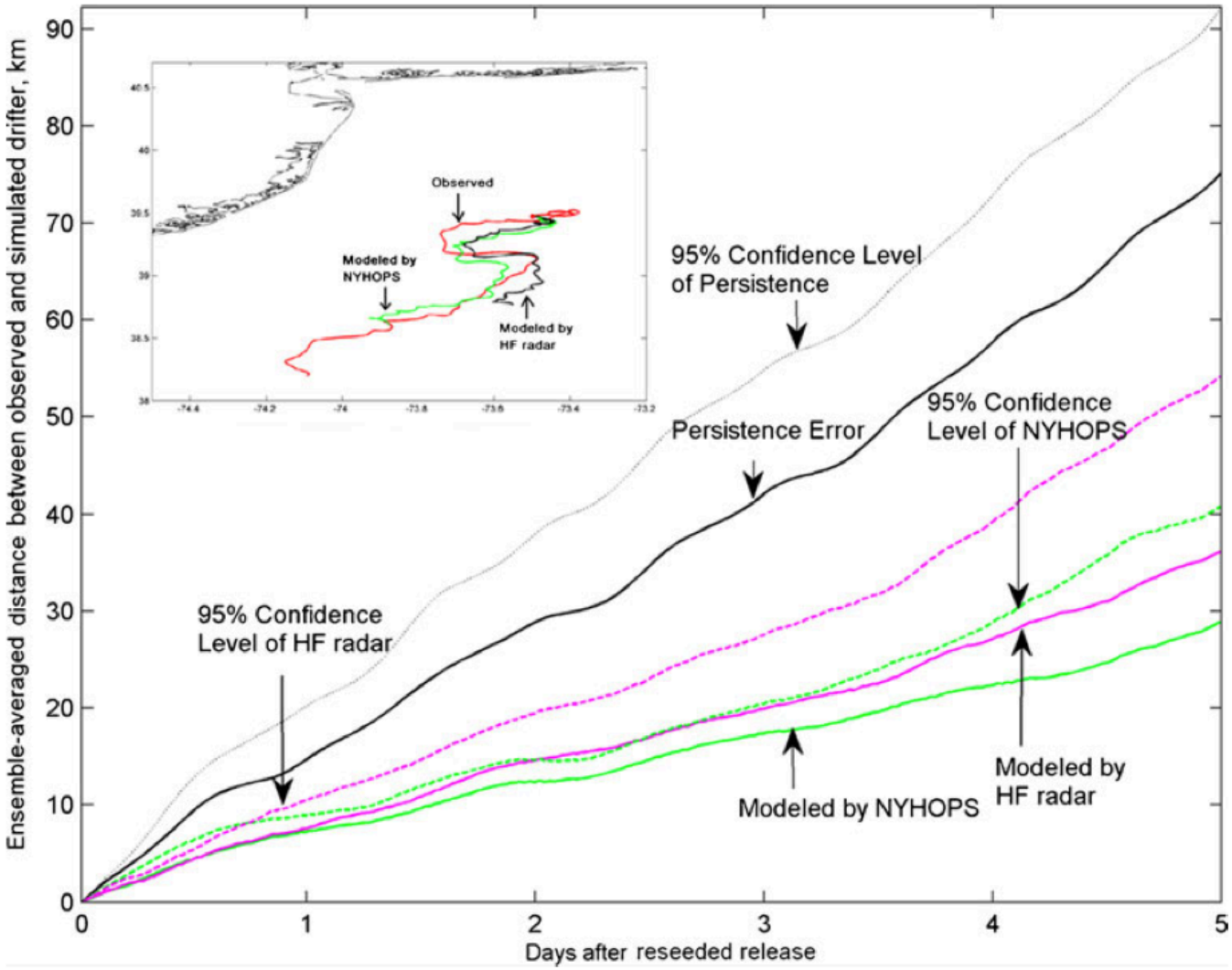
Kohut et al. (2012) Ocean Dynamics





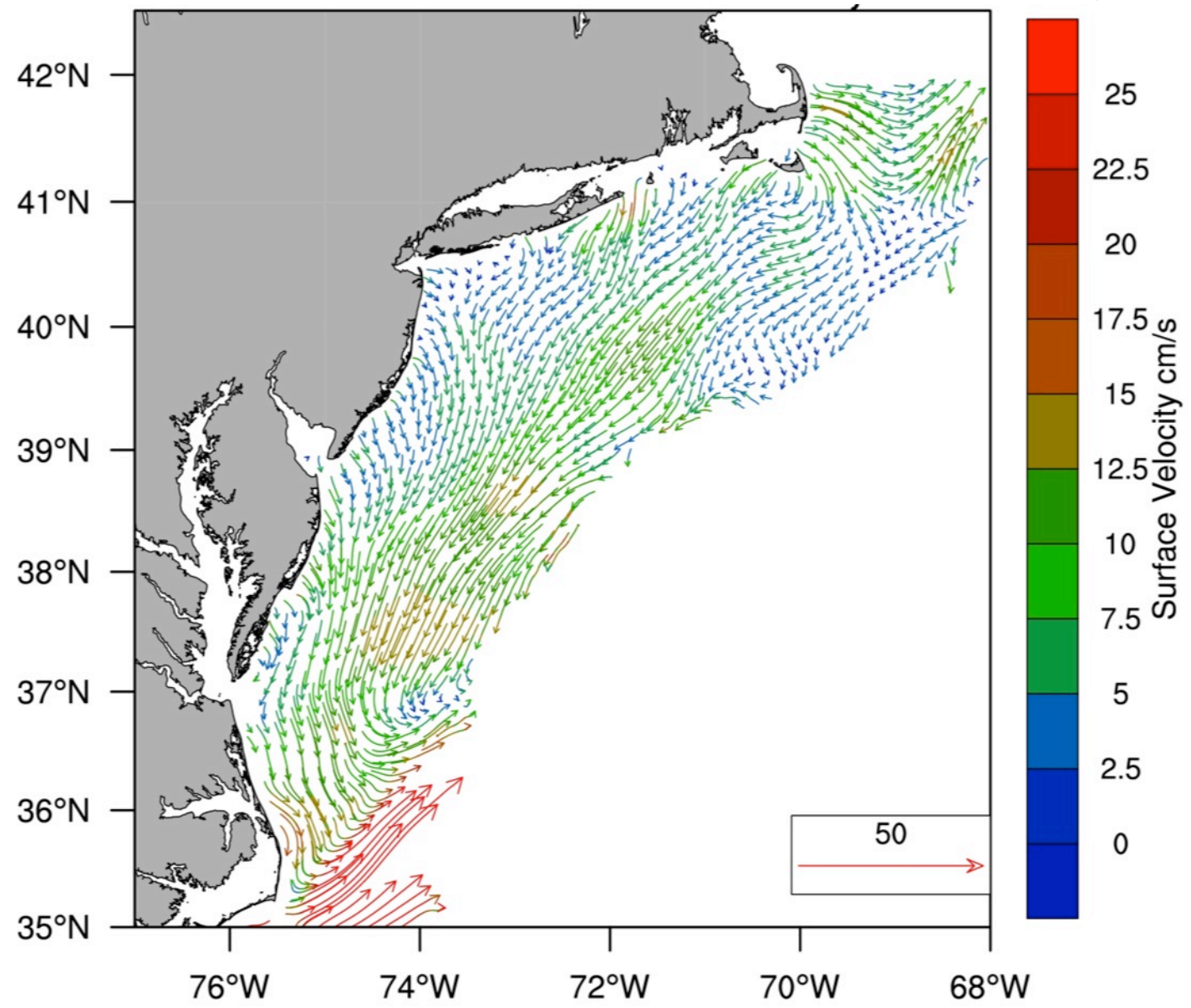
Kohut et al. (2012) Ocean Dynamics

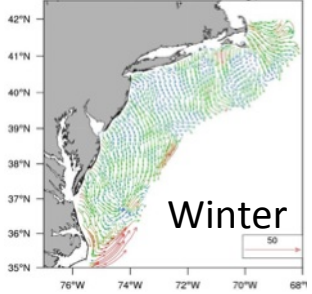
Fig. 7 Ensemble-averaged persistence error (*black solid line*) and separation distance between drifter 3 and numerical drifters based on NYHOPS (*green solid line*) and HF radar (*pink solid line*) surface currents as simulated with GNOME; 95 % upper confidence levels for the persistence error (*dotted black line*) and the separation distance of NYHOPS (*pink dash line*) and HF radar (*green dash line*) are also shown, from the "reseeding" experiments described in the text. *Insert* shows the observed drifter 3 trajectory (*red*) and the respective drifter trajectories simulated using surface currents from NYHOPS (*green*) and HF radar (*black*) over that drifter's complete deployment record

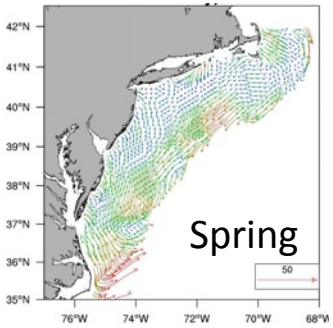


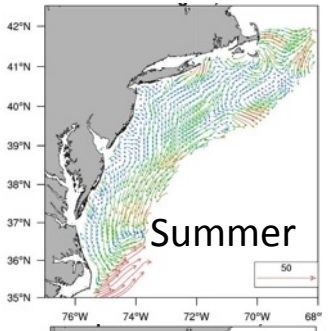
Kuang et al. (2012) Ocean Dynamics

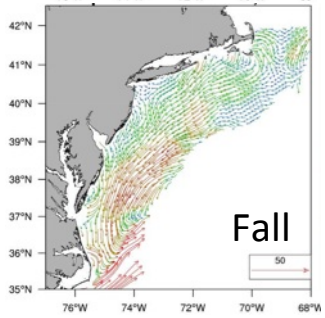
MARACOOS Annual Mean Surface Currents (2009)



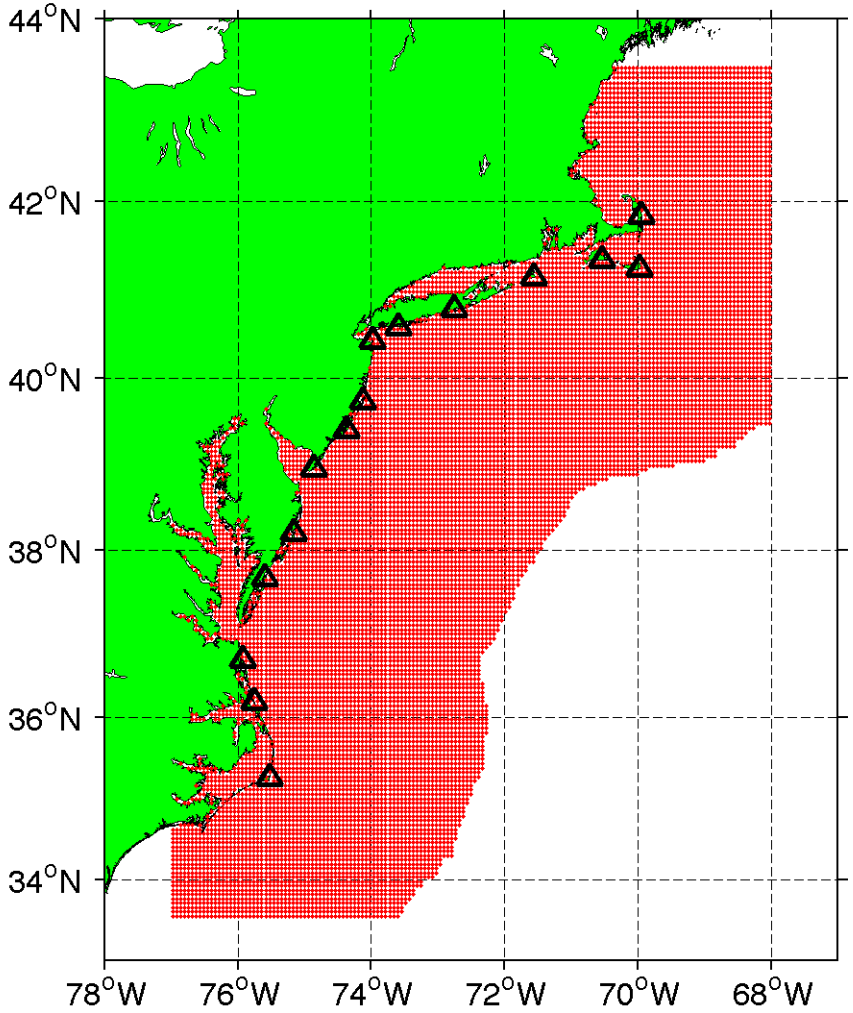








PERFORMANCE METRICS



08/23/12

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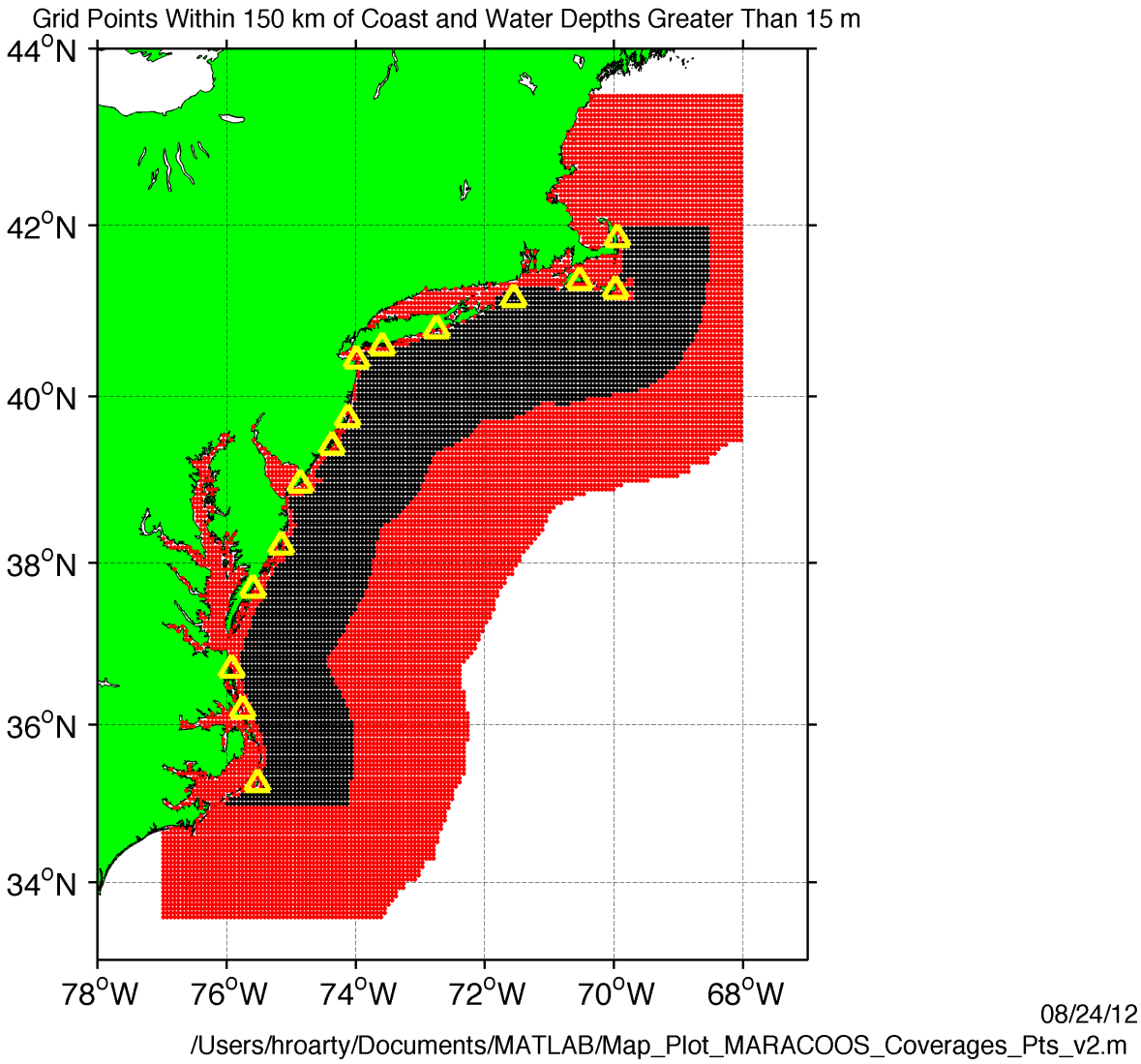
Grid Points Within 150 km of Coast and Water Depths Greater Than 15 m
44°N
42°N
40°N
38°N
36°N
34°N
78°W
76°W
74°W
72°W
70°W
68°W
08/24/12
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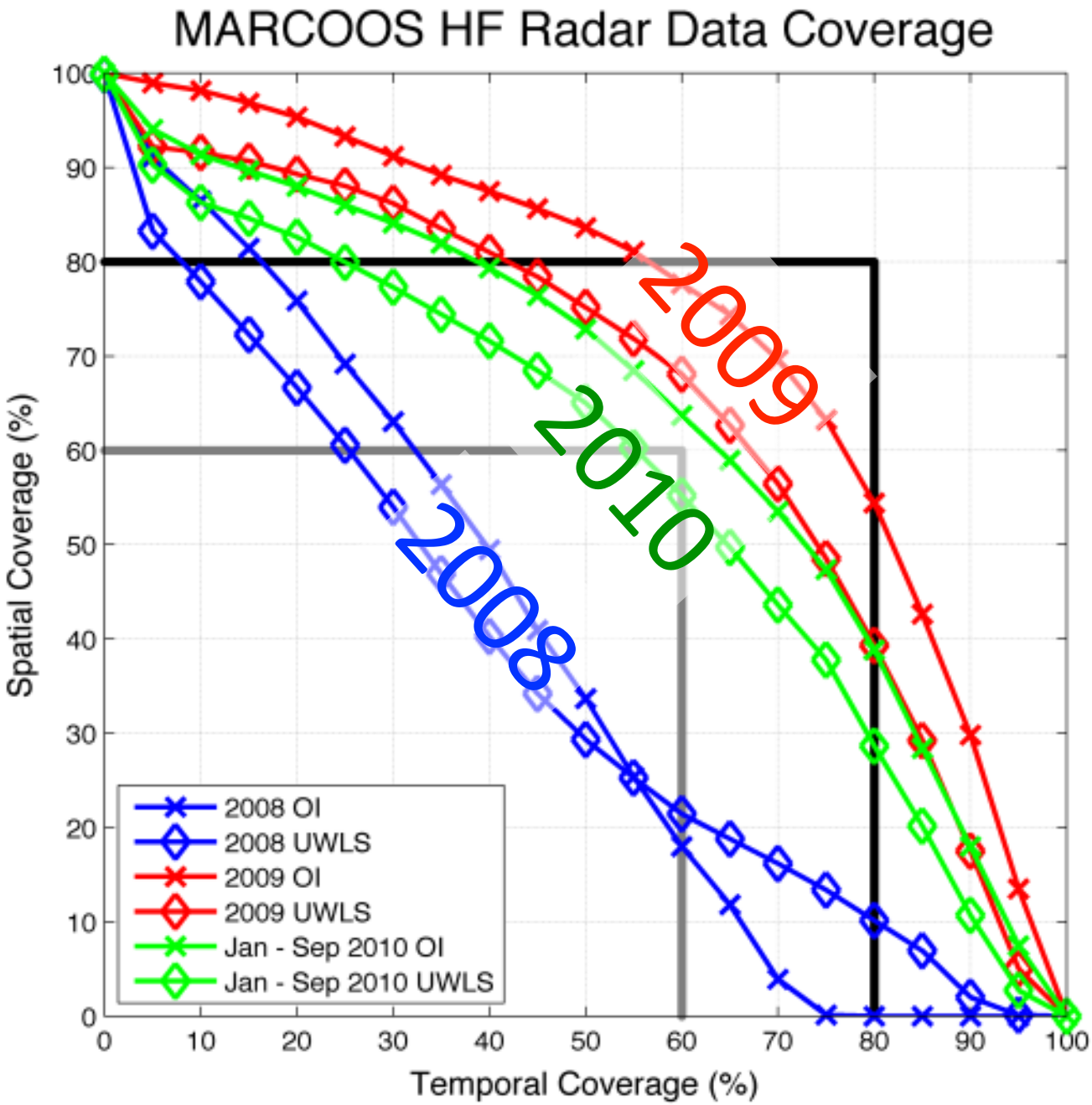
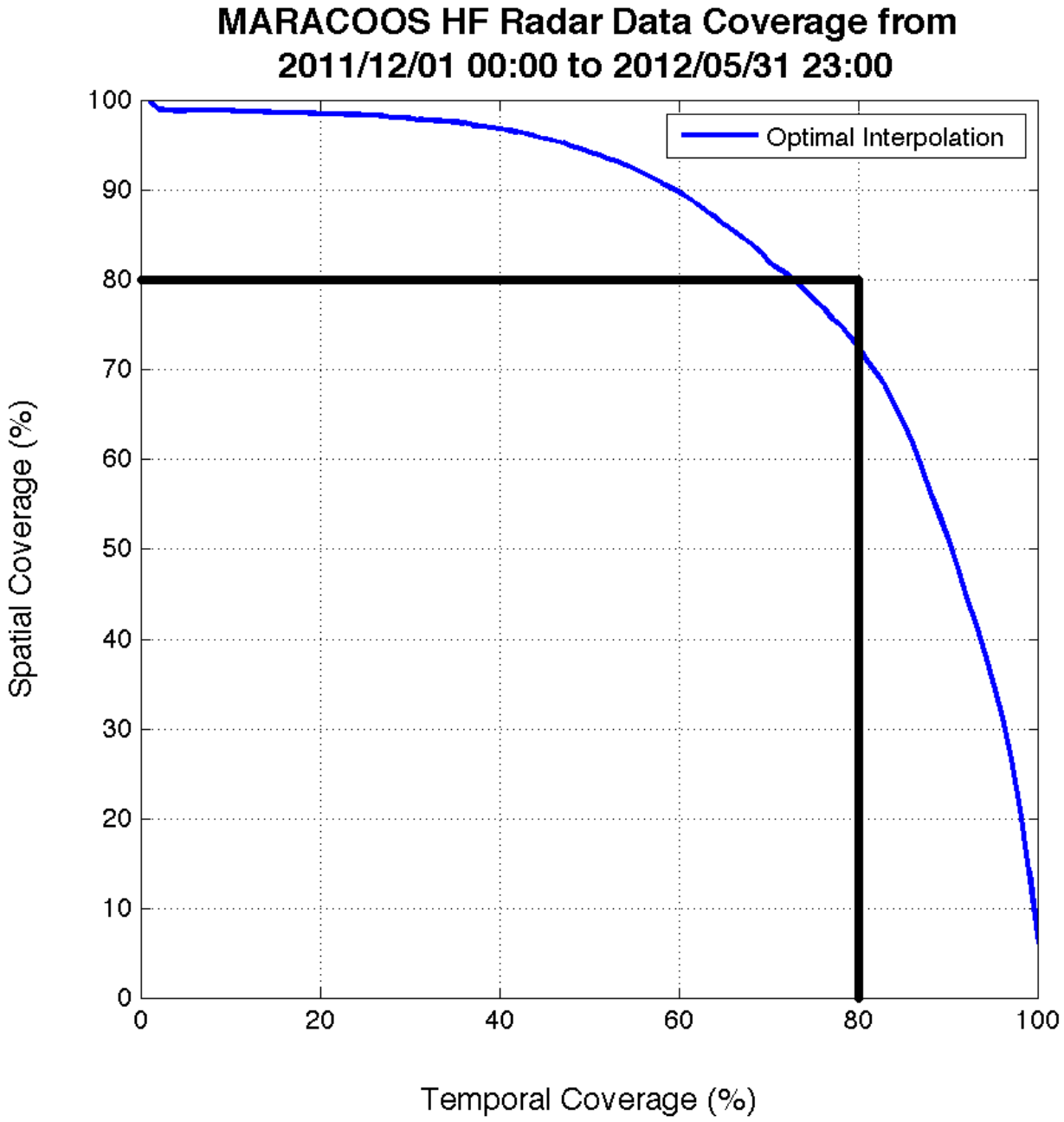
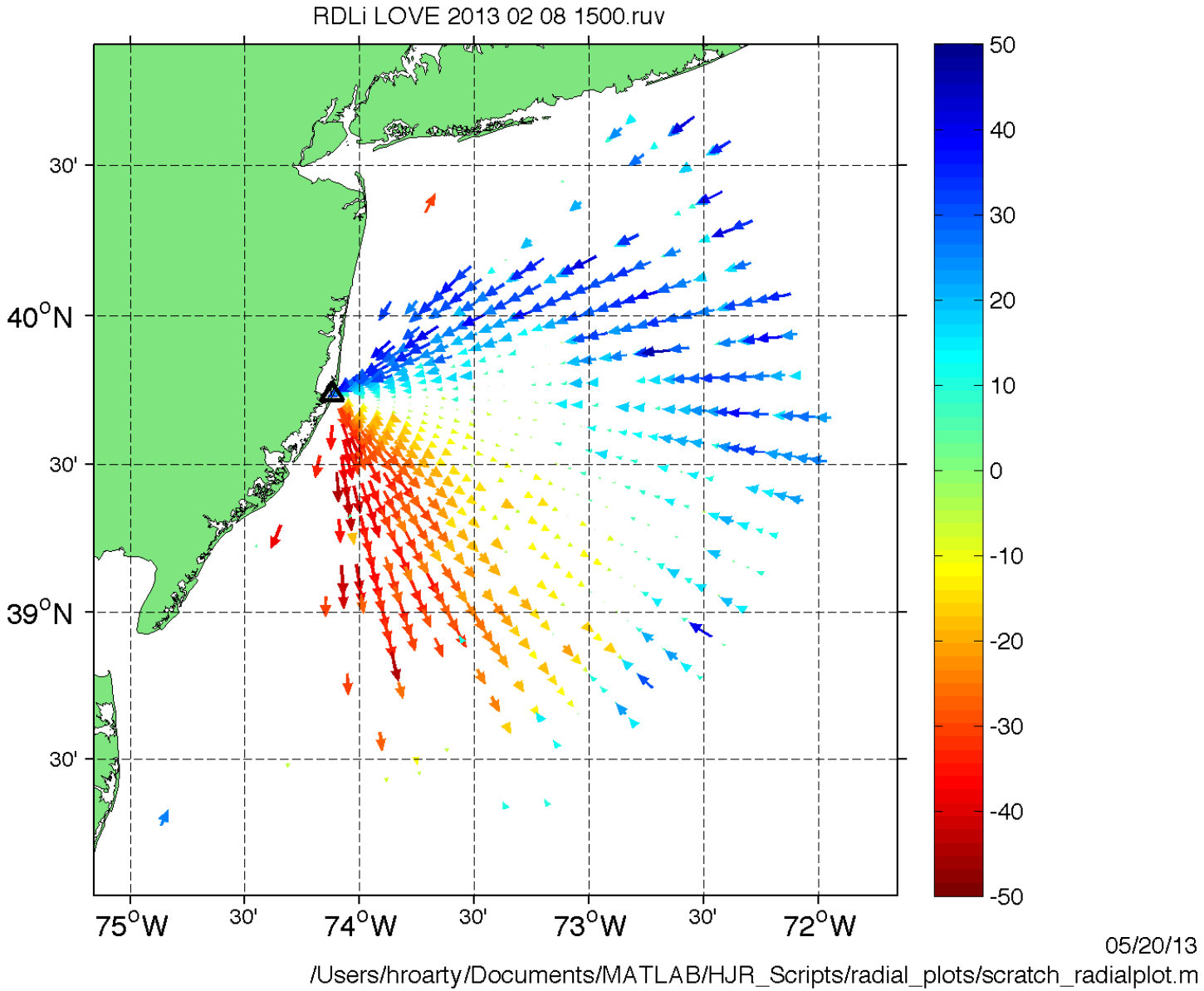
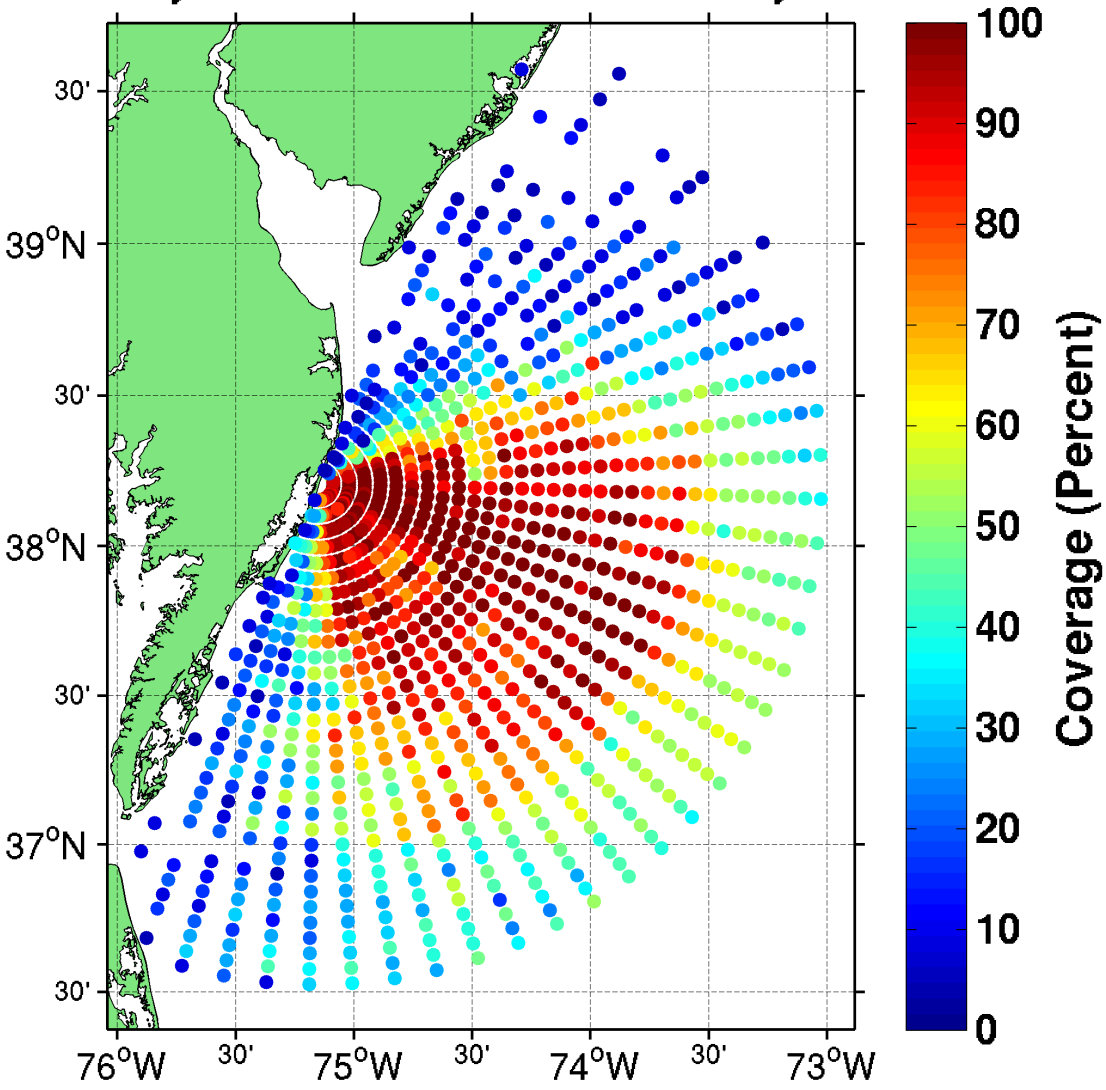

MARCOOS HF Radar Data Coverage
Spatial Coverage (%)
Temporal Coverage (%)
0
10
20
30
40
50
60
70
80
90
100
2009
2010
2008
2008 OI
2008 UWLS
2009 OI
2009 UWLS
Jan - Sep 2010 OI
Jan - Sep 2010 UWLS


MARACOOS HF Radar Data Coverage from
2011/12/01 00:00 to 2012/05/31 23:00
Optimal Interpolation
Spatial Coverage (%)
Temporal Coverage (%)
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100

RADIAL DATA PERFORMANCE


RDLi LOVE 2013 02 08 1500.ruv
30'
40°N
30'
39°N
30'
75°W
30'
74°W
30'
73°W
30'
72°W
50
40
30
20
10
0
-10
-20
-30
-40
-50
05/20/13
/Users/hroarty/Documents/MATLAB/HJR_Scripts/radial_plots/scratch_radialplot.m

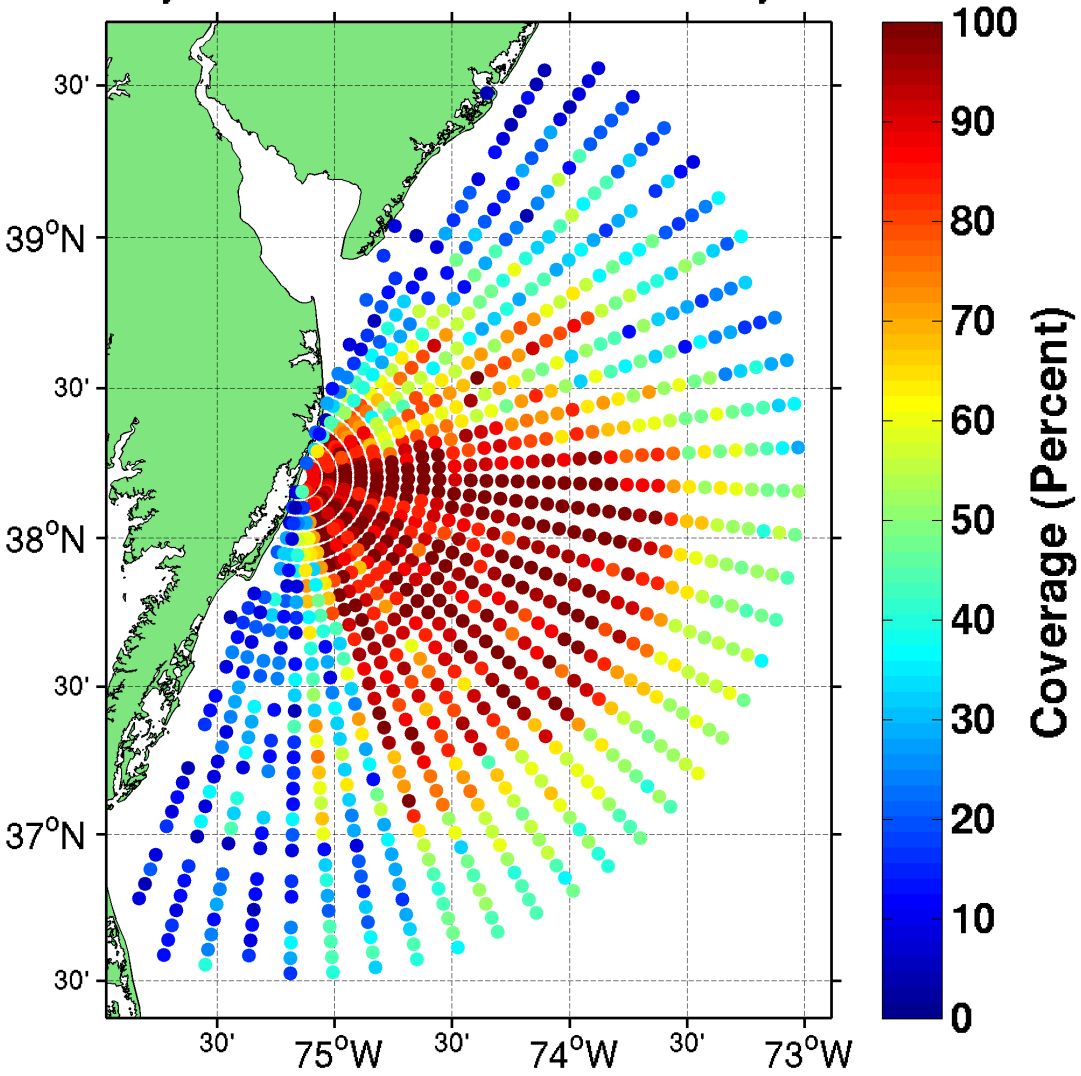
ASSA RDLi Coverage, 25 of 25 possible hourly maps
From 19-May-2013 08:00 to 20-May-2013 08:00



05/20/13

/home/hroarty/codar/MARACOOS/Coverage_Radial/radial_coverage_plot_daily.m

ASSA RDLm Coverage, 25 of 25 possible hourly maps
From 19-May-2013 08:00 to 20-May-2013 08:00



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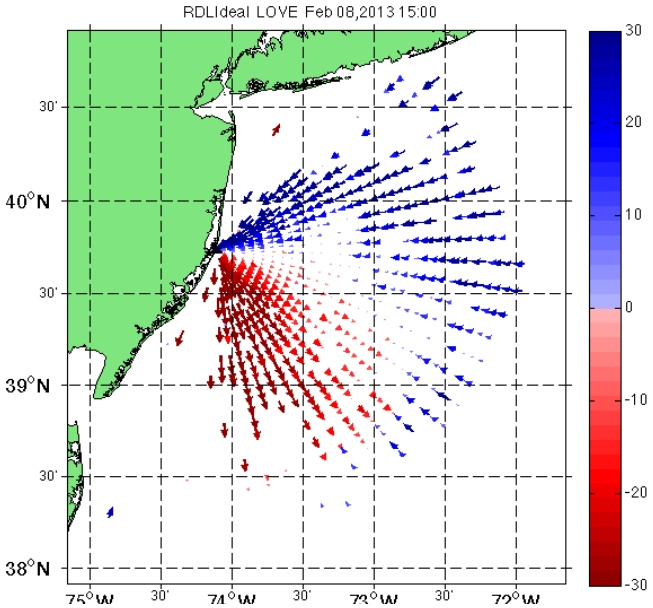

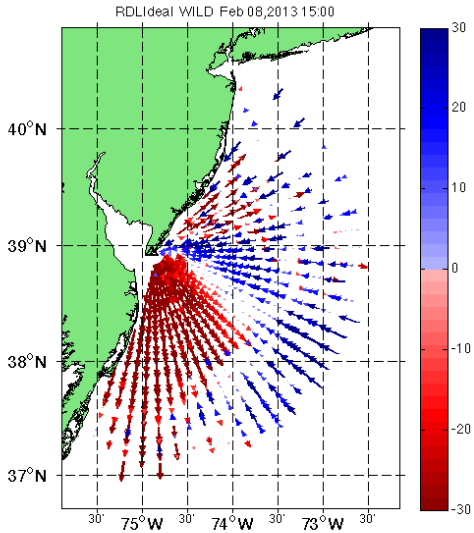

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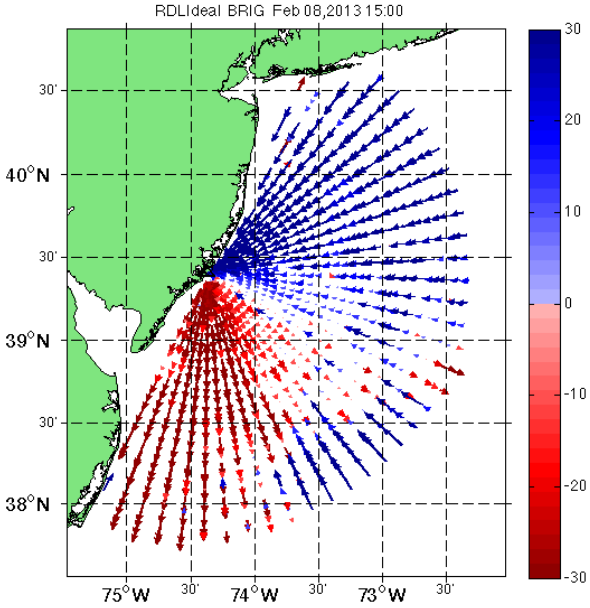
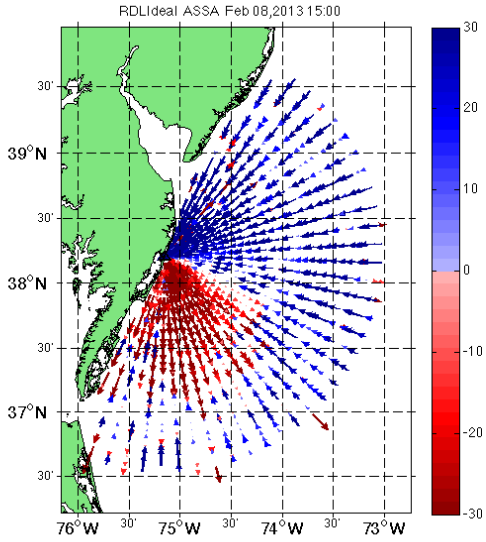
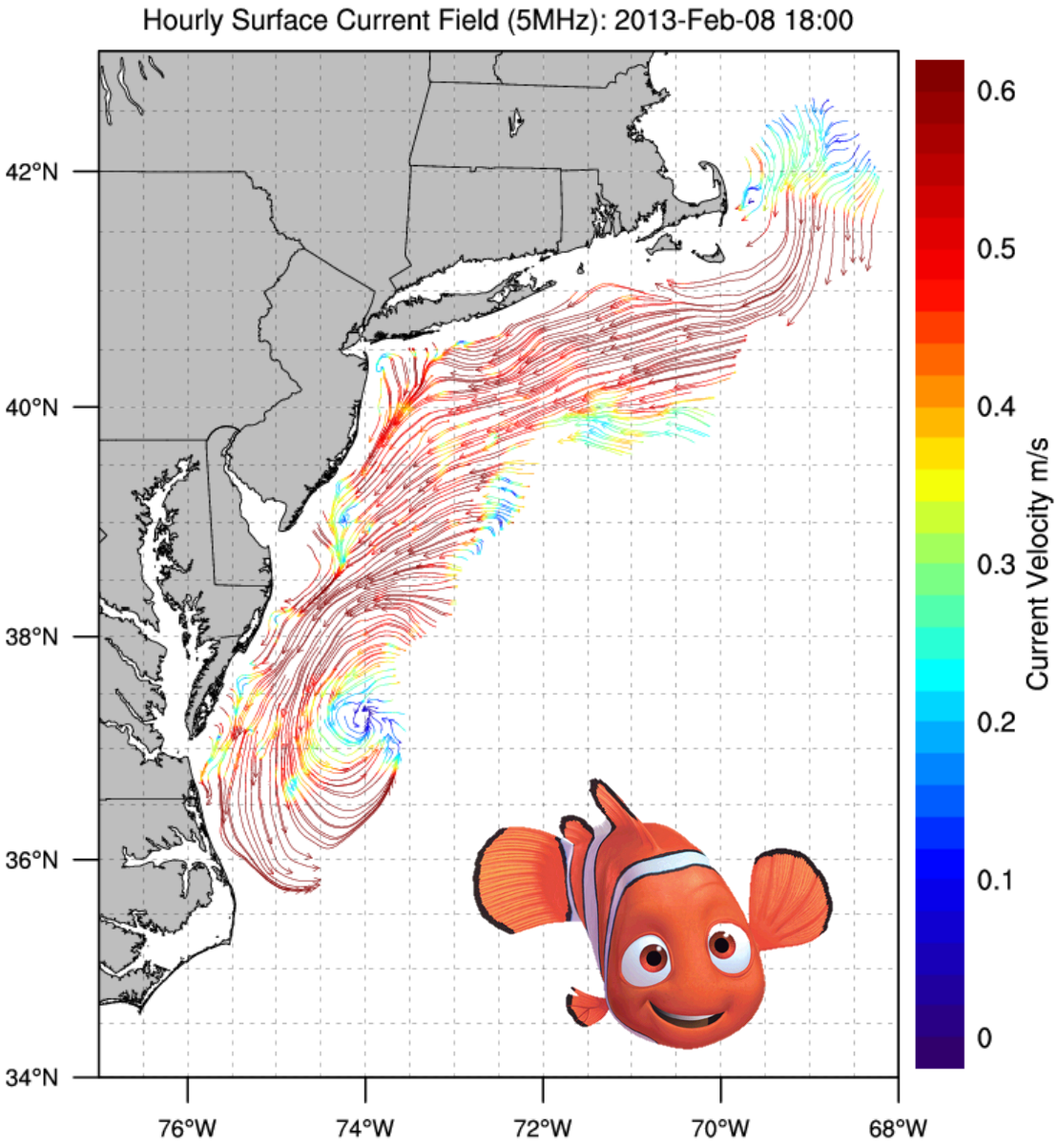


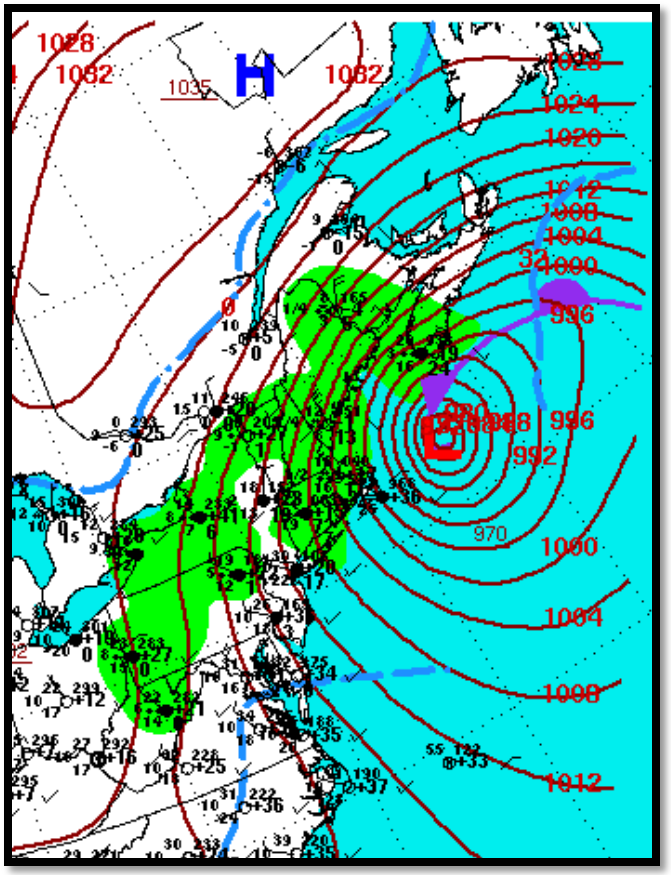
05/20/13
/Users/hroarty/Documents/MATLAB/HJR_Scripts/radial_plots/wrapper_plot_radial.m



05/20/13
/Users/hroarty/Documents/MATLAB/HJR_Scripts/radial_plots/wrapper_plot_radial.m

Winter Storm Nemo





February 9, 2013

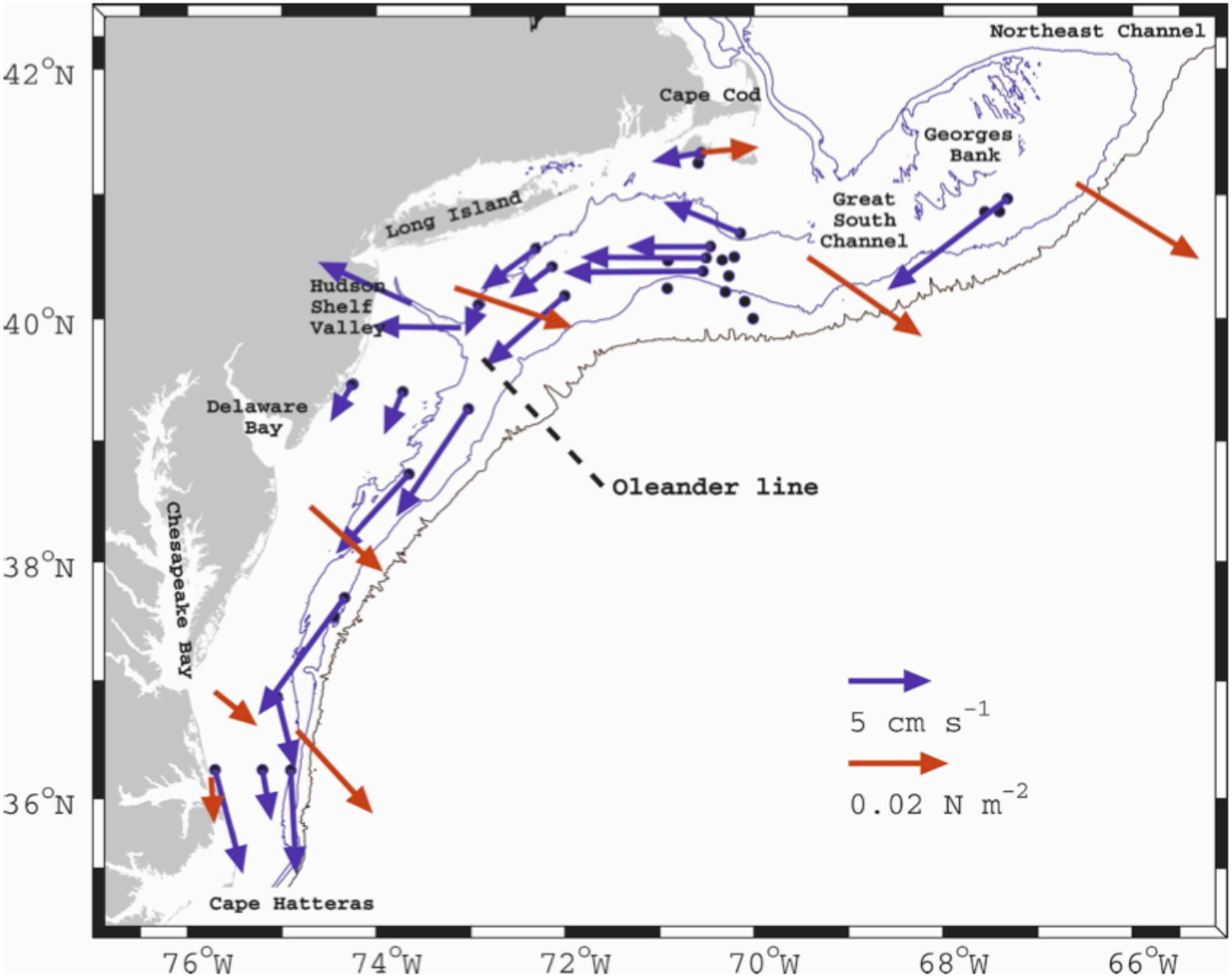
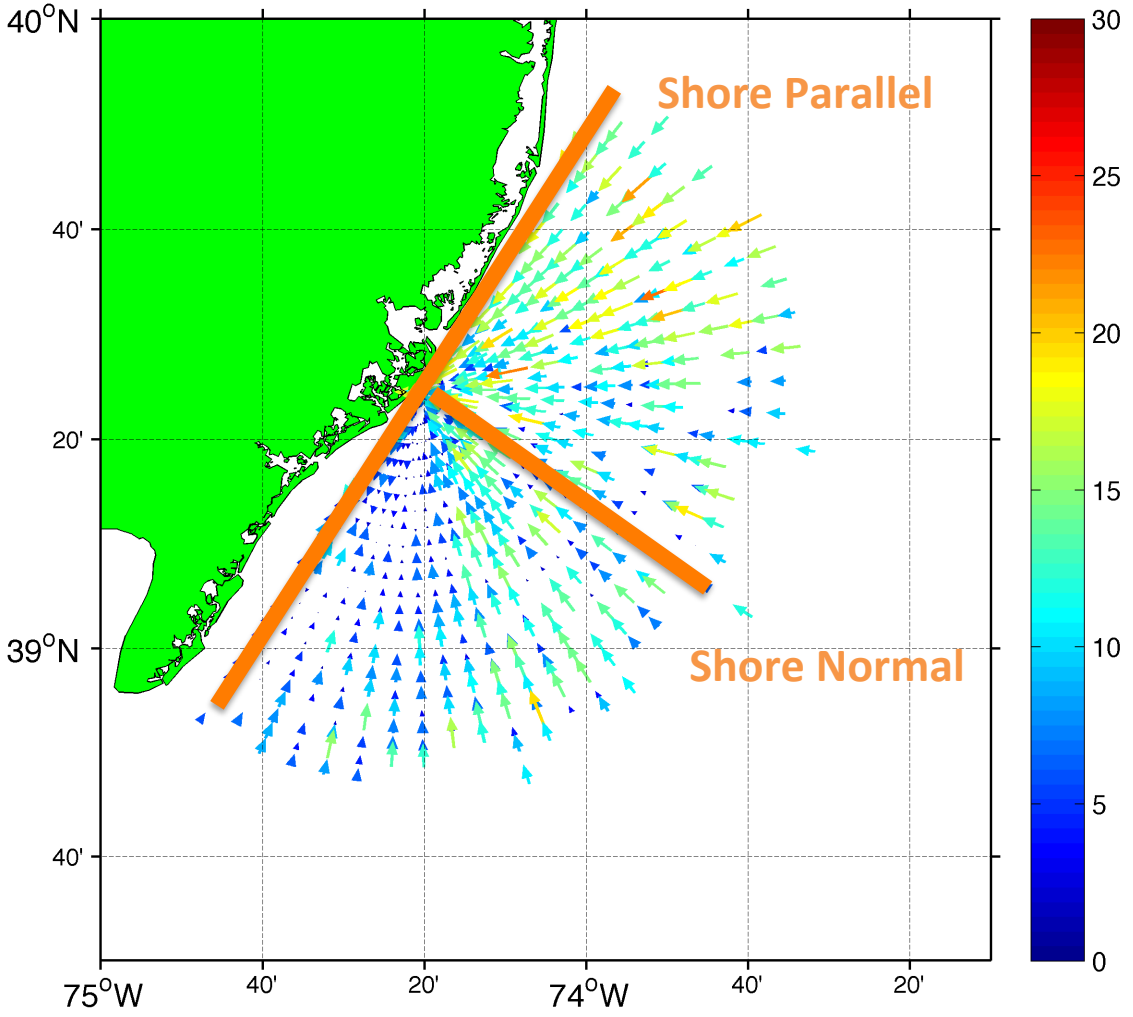


FIG. 1. Map of the Middle Atlantic Bight showing locations of current time series longer than 200 days, mean depth-averaged current vectors (blue), and mean wind stress vectors (red). For clarity, only selected mean current vectors are shown for sites south of Cape Cod and on the southern flank of Georges Bank. The 50-, 100-, and 1000-m isobaths, and the approximate location of the Oleander line (Flagg et al. 2006) are also shown.

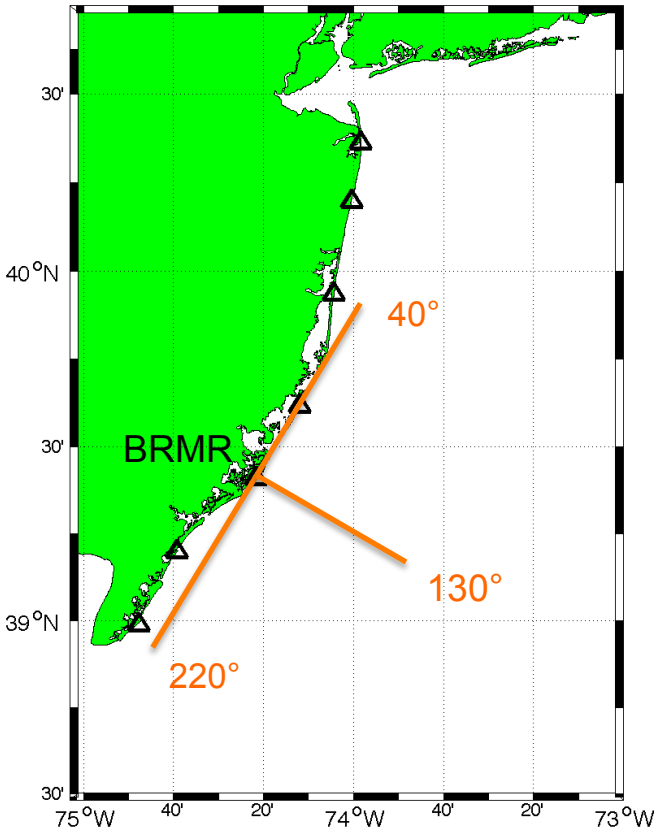
Radial Average Bearing

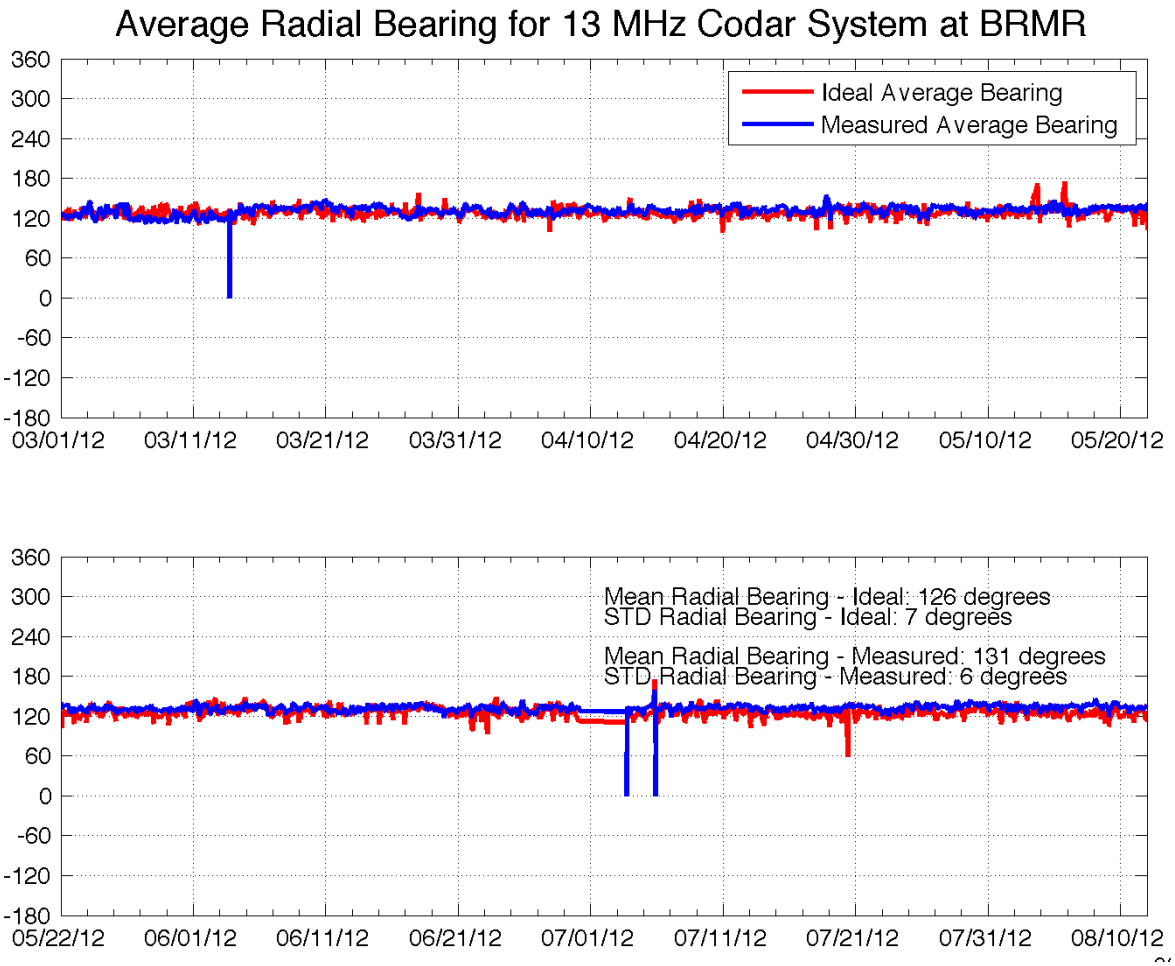
AND

Comparison Between Measured and Ideal Radials

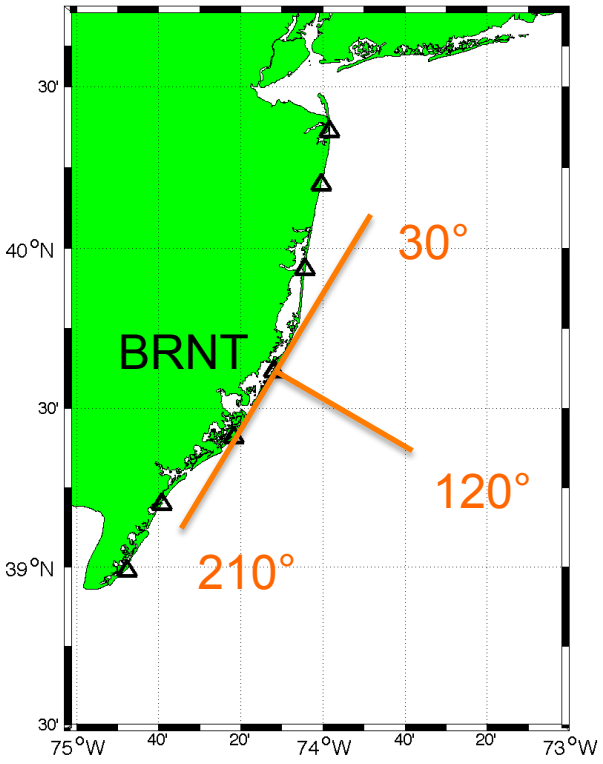


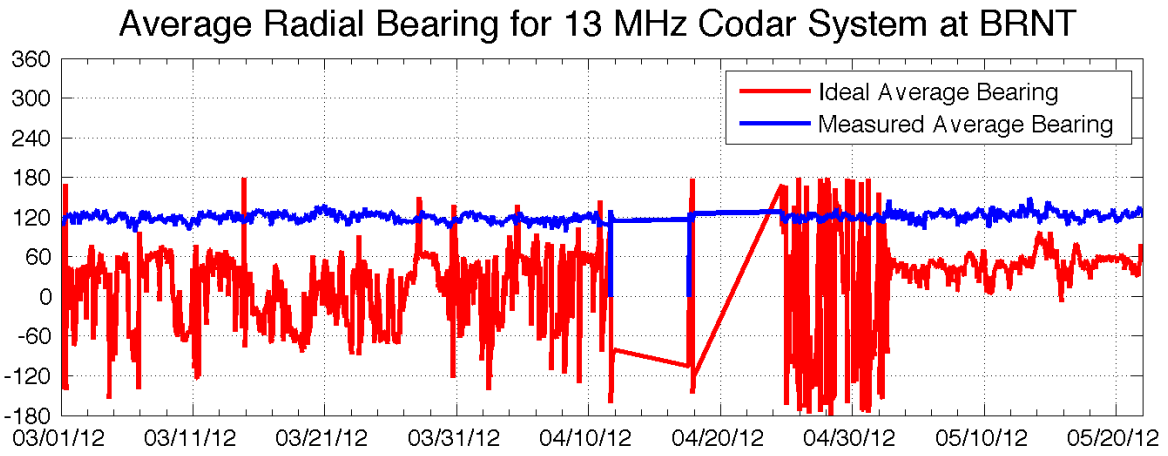
BRMR Site

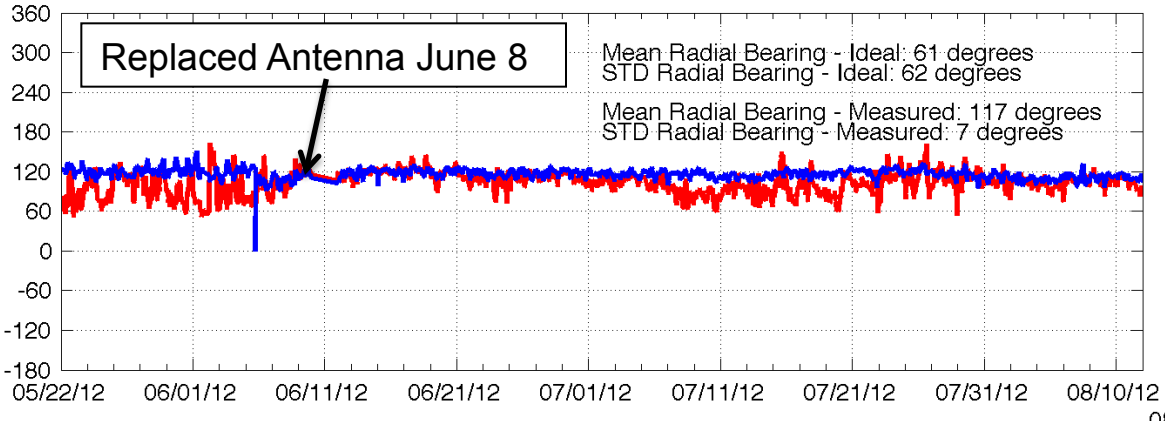

30'
40°N
30'
39°N
30'
75°W
40'
20'
74°W
40'
20'
73°W
BRMR
40°
130°
220°


Average Radial Bearing for 13 MHz Codar System at BRMR
Ideal Average Bearing
Measured Average Bearing
360
300
240
180
120
60
0
-60
-120
-180
03/01/12
03/11/12
03/21/12
03/31/12
04/10/12
04/20/12
04/30/12
05/10/12
05/20/12
Mean Radial Bearing - Ideal: 126 degrees
STD Radial Bearing - Ideal: 7 degrees
Mean Radial Bearing - Measured: 131 degrees
STD Radial Bearing - Measured: 6 degrees
05/22/12
06/01/12
06/11/12
06/21/12
07/01/12
07/11/12
07/21/12
07/31/12
08/10/12

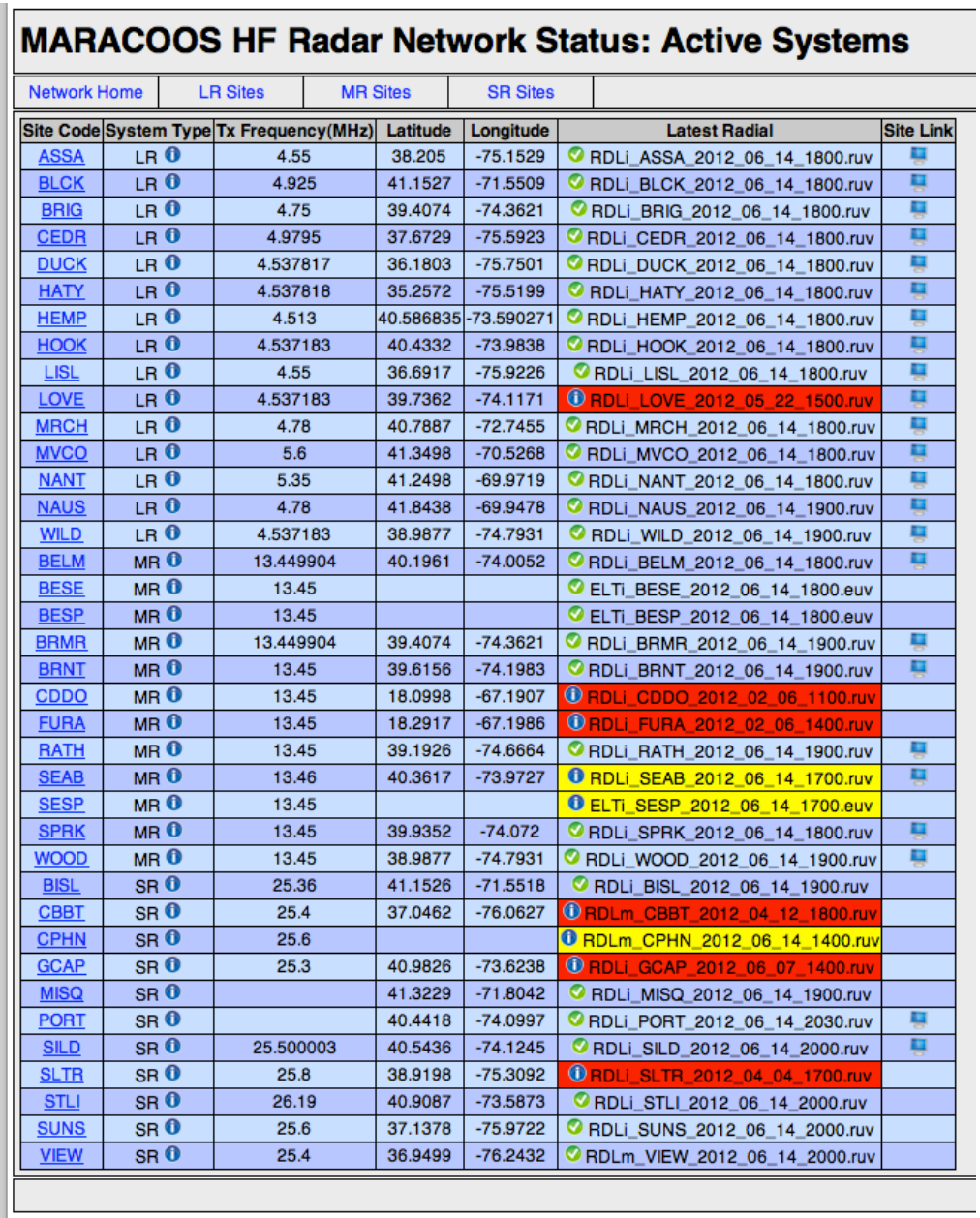
Antenna Problem at BRNT Site







CENTRAL AGGREGATION



MARACOOS HF Radar Network Status: Active Systems

Network Home | LR Sites | MR Sites | SR Sites

Site Code	System Type	Tx Frequency(MHz)	Latitude	Longitude	Latest Radial	Site Link
ASSA	LR	4.55	38.205	-75.1529	RDLi_ASSA_2012_06_14_1800.ruv	
BLCK	LR	4.925	41.1527	-71.5509	RDLi_BLCK_2012_06_14_1800.ruv	
BRIG	LR	4.75	39.4074	-74.3621	RDLi_BRIG_2012_06_14_1800.ruv	
CEDR	LR	4.9795	37.6729	-75.5923	RDLi_CEDR_2012_06_14_1800.ruv	
DUCK	LR	4.537817	36.1803	-75.7501	RDLi_DUCK_2012_06_14_1800.ruv	
HATY	LR	4.537818	35.2572	-75.5199	RDLi_HATY_2012_06_14_1800.ruv	
HEMP	LR	4.513	40.586835	-73.590271	RDLi_HEMP_2012_06_14_1800.ruv	
HOOK	LR	4.537183	40.4332	-73.9838	RDLi_HOOK_2012_06_14_1800.ruv	
LISL	LR	4.55	36.6917	-75.9226	RDLi_LISL_2012_06_14_1800.ruv	
LOVE	LR	4.537183	39.7362	-74.1171	RDLi_LOVE_2012_05_22_1500.ruv	
MRCH	LR	4.78	40.7887	-72.7455	RDLi_MRCH_2012_06_14_1800.ruv	
MVCO	LR	5.6	41.3498	-70.5268	RDLi_MVCO_2012_06_14_1800.ruv	
NANT	LR	5.35	41.2498	-69.9719	RDLi_NANT_2012_06_14_1800.ruv	
NAUS	LR	4.78	41.8438	-69.9478	RDLi_NAUS_2012_06_14_1900.ruv	
WILD	LR	4.537183	38.9877	-74.7931	RDLi_WILD_2012_06_14_1900.ruv	
BELM	MR	13.449904	40.1961	-74.0052	RDLi_BELM_2012_06_14_1800.ruv	
BESE	MR	13.45			ELTi_BESE_2012_06_14_1800.euv	
BESP	MR	13.45			ELTi_BESP_2012_06_14_1800.euv	
BRMR	MR	13.449904	39.4074	-74.3621	RDLi_BRMR_2012_06_14_1900.ruv	
BRNT	MR	13.45	39.6156	-74.1983	RDLi_BRNT_2012_06_14_1900.ruv	
CDDO	MR	13.45	18.0998	-67.1907	RDLi_CDDO_2012_02_06_1100.ruv	
FURA	MR	13.45	18.2917	-67.1986	RDLi_FURA_2012_02_06_1400.ruv	
RATH	MR	13.45	39.1926	-74.6664	RDLi_RATH_2012_06_14_1900.ruv	
SEAB	MR	13.46	40.3617	-73.9727	RDLi_SEAB_2012_06_14_1700.ruv	
SESP	MR	13.45			ELTi_SESP_2012_06_14_1700.euv	
SPRK	MR	13.45	39.9352	-74.072	RDLi_SPRK_2012_06_14_1800.ruv	
WOOD	MR	13.45	38.9877	-74.7931	RDLi_WOOD_2012_06_14_1900.ruv	
BISL	SR	25.36	41.1526	-71.5518	RDLi_BISL_2012_06_14_1900.ruv	
CBBT	SR	25.4	37.0462	-76.0627	RDLm_CBBT_2012_04_12_1800.ruv	
CPHN	SR	25.6			RDLm_CPHN_2012_06_14_1400.ruv	
GCAP	SR	25.3	40.9826	-73.6238	RDLi_GCAP_2012_06_07_1400.ruv	
MISQ	SR		41.3229	-71.8042	RDLi_MISQ_2012_06_14_1900.ruv	
PORT	SR		40.4418	-74.0997	RDLi_PORT_2012_06_14_2030.ruv	
SILD	SR	25.500003	40.5436	-74.1245	RDLi_SILD_2012_06_14_2000.ruv	
SLTR	SR	25.8	38.9198	-75.3092	RDLi_SLTR_2012_04_04_1700.ruv	
STLI	SR	26.19	40.9087	-73.5873	RDLi_STLI_2012_06_14_2000.ruv	
SUNS	SR	25.6	37.1378	-75.9722	RDLi_SUNS_2012_06_14_2000.ruv	
VIEW	SR	25.4	36.9499	-76.2432	RDLm_VIEW_2012_06_14_2000.ruv	

Radial Database

- Central location to monitor region
- Automatic reprocessing of totals with new radials

Administration of the Network by the Operators

MARACOOS HF Radar Network Administration

Sites | Totals | People

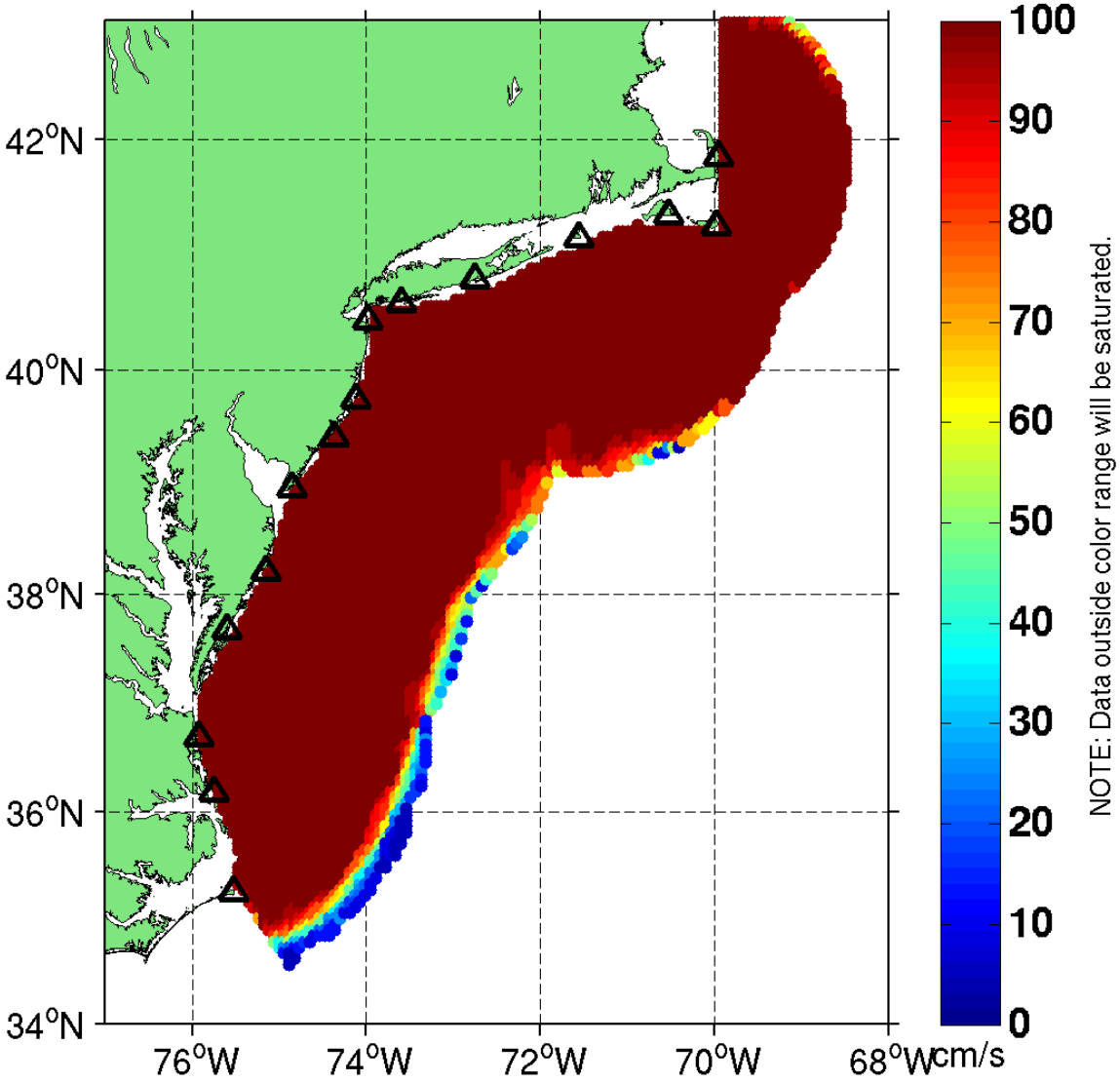
▸ Info

▾ Sites

HF Radar Systems | Long Range | Medium Range | Standard Range | New Site

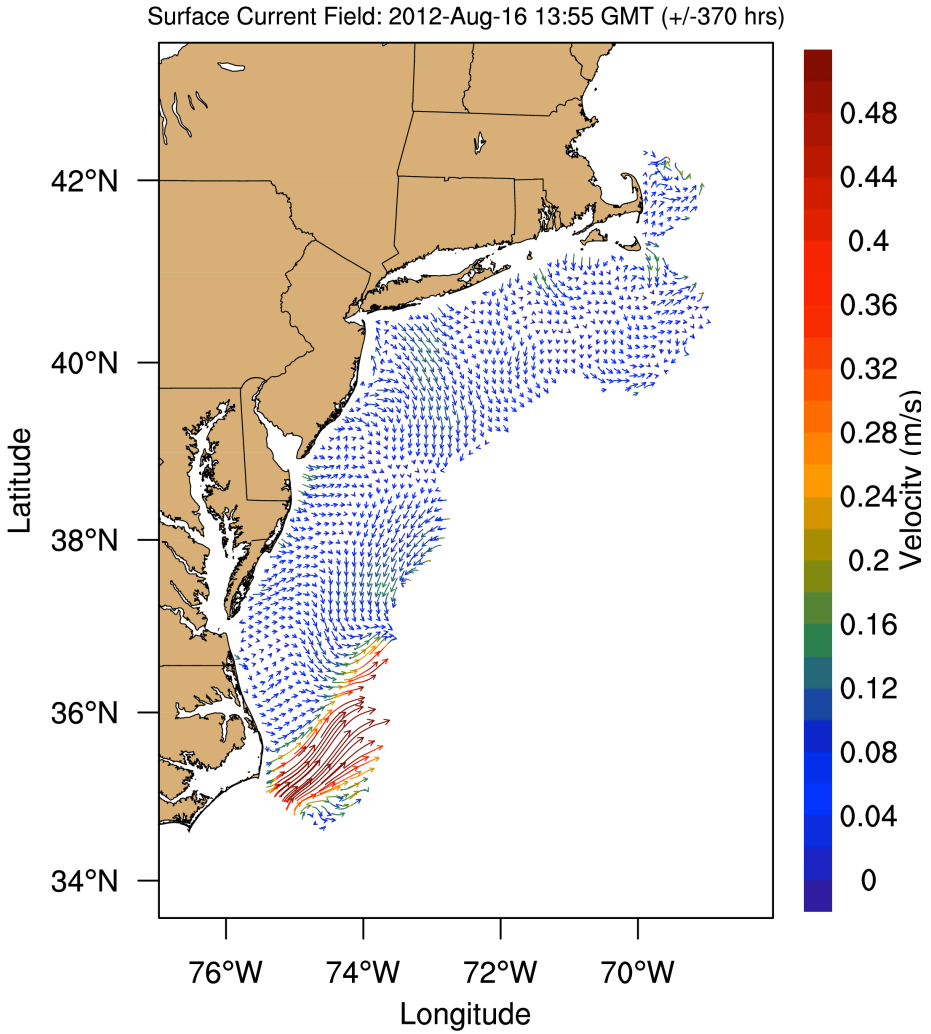
Site	Location	Latitude	Longitude	System Type	Tx Frequency	Status	Mode	Region	Contact	Modify	Delete
ASSA	Assateague, VA	38.2050	-75.1529	LR	4.550 **MHz**	Active	Monostatic	MARACOOS	Kerfoot, J		
BLCK	Block Island, RI	41.1527	-71.5509	LR	4.9250 **MHz**	Active	Monostatic	MARACOOS	Jakubiak, C		
BRIG	Brigantine, NJ	39.4074	-74.3621	LR	4.750 **MHz**	Active	Monostatic	MARACOOS	Handel, E		
CEDR	Cedar Island, VA	37.6729	-75.5923	LR	4.97950 **MHz**	Active	Monostatic	MARACOOS	Garner, T		
DUCK	Duck Island, NC	36.1803	-75.7501	LR	4.5378170 **MHz**	Active	Monostatic	MARACOOS	Muglia, M		
HATY	Cape Hatteras, NC	35.2572	-75.5199	LR	4.5378180 **MHz**	Active	Monostatic	MARACOOS	Muglia, M		
HEMP	Hempstead, NY	40.5868	-73.5903	LR	4.5130 **MHz**	Active	Monostatic	MARACOOS	Handel, E		
HOOK	Sandy Hook, NJ	40.4332	-73.9838	LR	4.5371830 **MHz**	Active	Monostatic	MARACOOS	Handel, E		
LISL	Little Island Park, VA	36.6917	-75.9226	LR	4.550 **MHz**	Active	Monostatic	MARACOOS	Garner, T		
LOVE	Loveladies, NJ	39.7362	-74.1171	LR	4.5371830 **MHz**	Active	Monostatic	MARACOOS	Handel, E		
MRCH	East Moriches, NY	40.7887	-72.7455	LR	4.780 **MHz**	Active	Monostatic	MARACOOS	Handel, E		
MVCO	Martha's Vineyard, MA	41.3498	-70.5268	LR	5.60 **MHz**	Active	Monostatic	MARACOOS	Jakubiak, C		
NANT	Nantucket Island, MA	41.2498	-69.9719	LR	5.350 **MHz**	Active	Monostatic	MARACOOS	Jakubiak, C		
NAUS	Nauset, MA	41.8438	-69.9478	LR	4.780 **MHz**	Active	Monostatic	MARACOOS	Handel, E		
WILD	Wildwood, NJ	38.9877	-74.7931	LR	4.5371830 **MHz**	Active	Monostatic	MARACOOS	Handel, E		

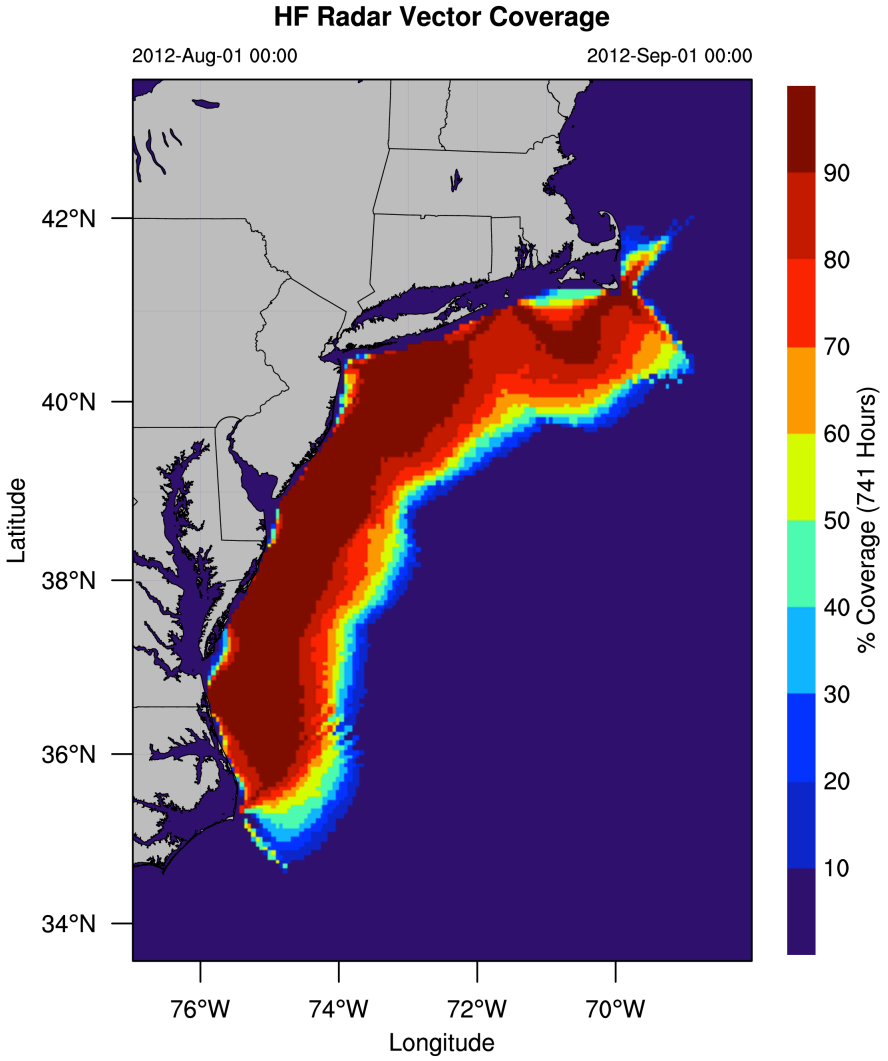
MARA OI Coverage, 24 possible hourly maps
From 2013-06-07 07:00 to 2013-06-08 07:00



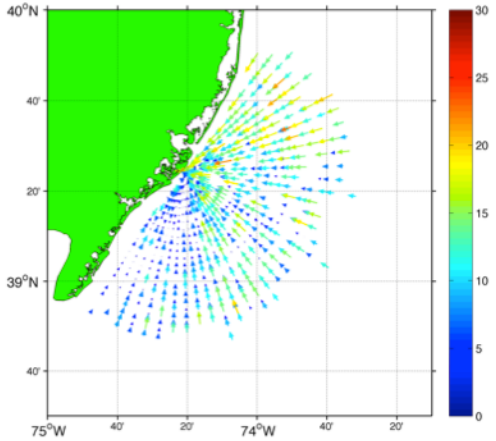
06/08/13

/home/hroarty/codar/MARACOOS/Coverage_Total/mean_coverage_plot.m


Surface Current Field: 2012-Aug-16 13:55 GMT (+/-370 hrs)
42°N
40°N
38°N
36°N
34°N
Latitude
76°W
74°W
72°W
70°W
Longitude
0.48
0.44
0.4
0.36
0.32
0.28
0.24
0.2
0.16
0.12
0.08
0.04
0
Velocity (m/s)

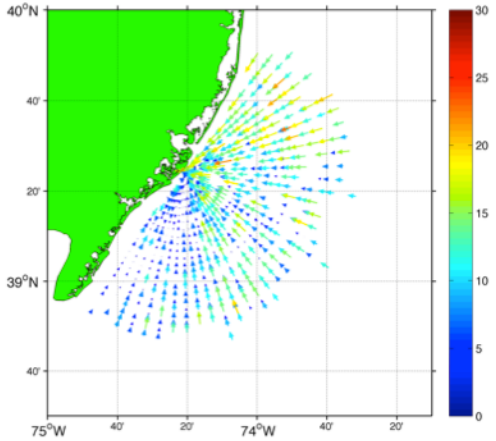

HF Radar Vector Coverage
2012-Aug-01 00:00
2012-Sep-01 00:00
42°N
40°N
38°N
36°N
34°N
Latitude
76°W
74°W
72°W
70°W
Longitude
90
80
70
60
50
40
30
20
10
% Coverage (741 Hours)

Average Radial Velocity



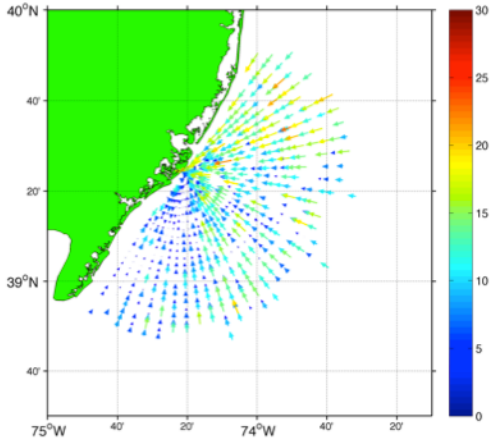
RDLi_BRMR_2012_08_1300

5 cm/s



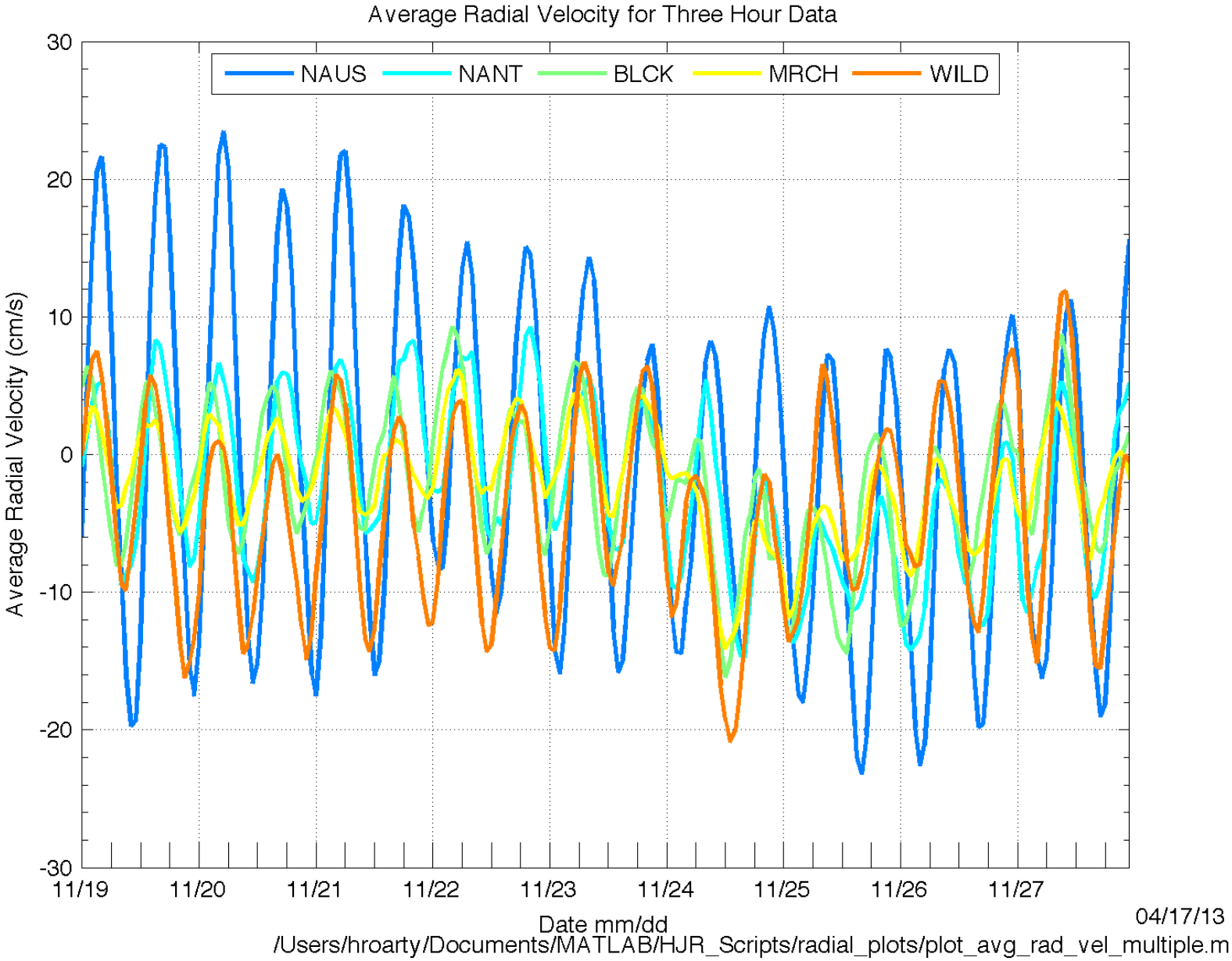
RDLi_BRMR_2012_08_1400

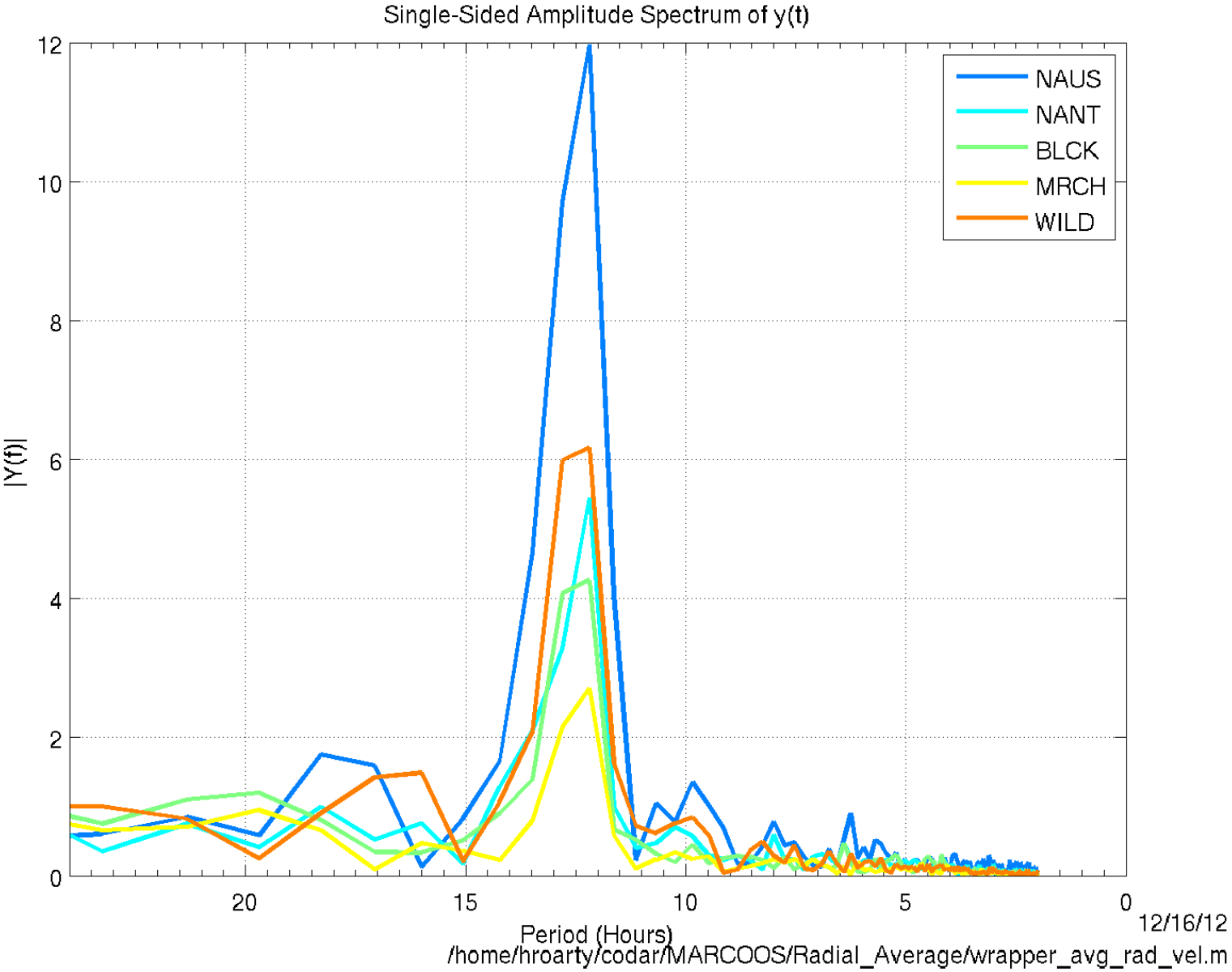
7 cm/s



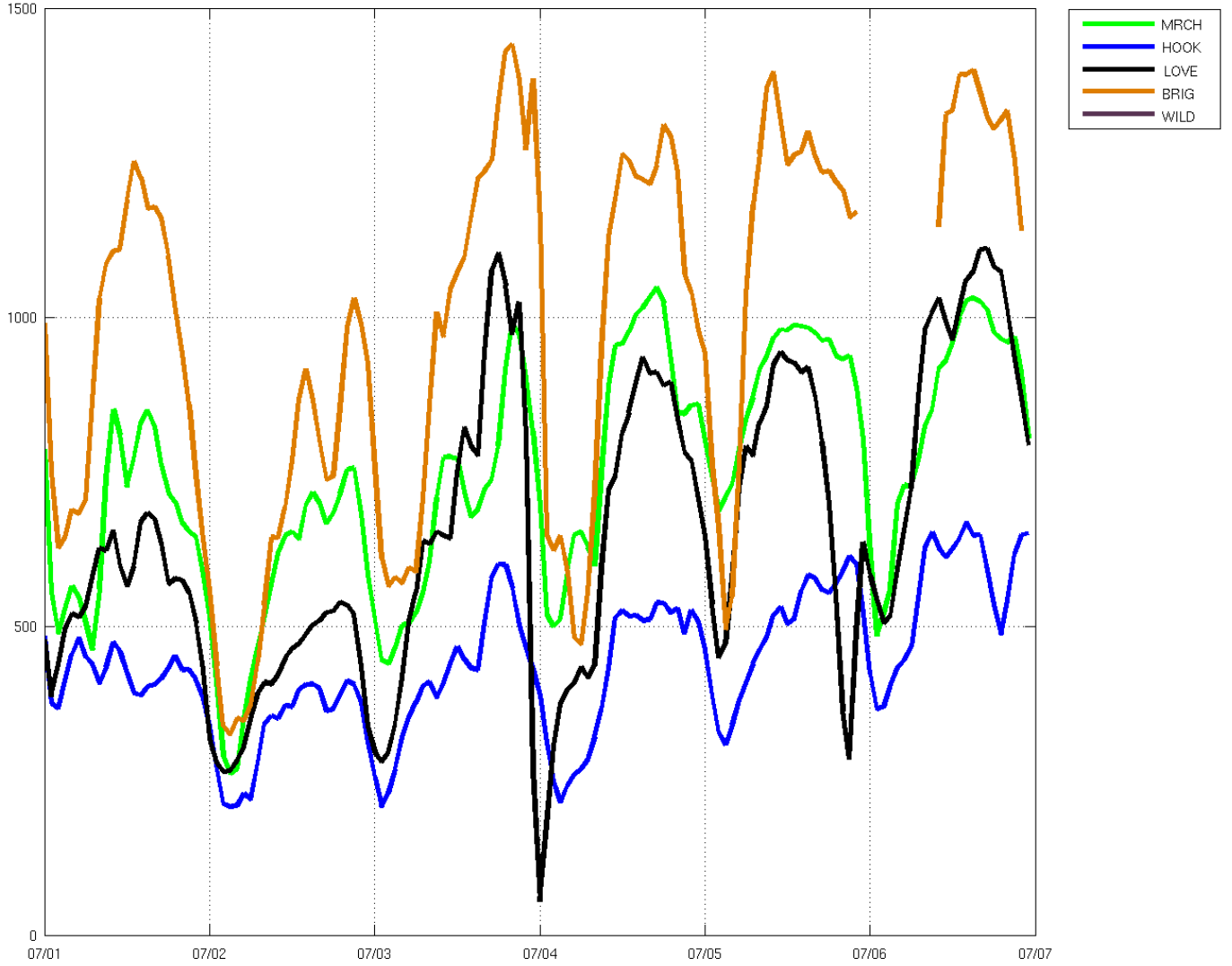
RDLi_BRMR_2012_08_1500

10 cm/s


Average Radial Velocity for Three Hour Data
NAUS
NANT
BLCK
MRCH
WILD
Average Radial Velocity (cm/s)
30
20
10
0
-10
-20
-30
11/19
11/20
11/21
11/22
11/23
11/24
11/25
11/26
11/27
Date mm/dd
04/17/13
/Users/hroarty/Documents/MATLAB/HJR_Scripts/radial_plots/plot_avg_rad_vel_multiple.m

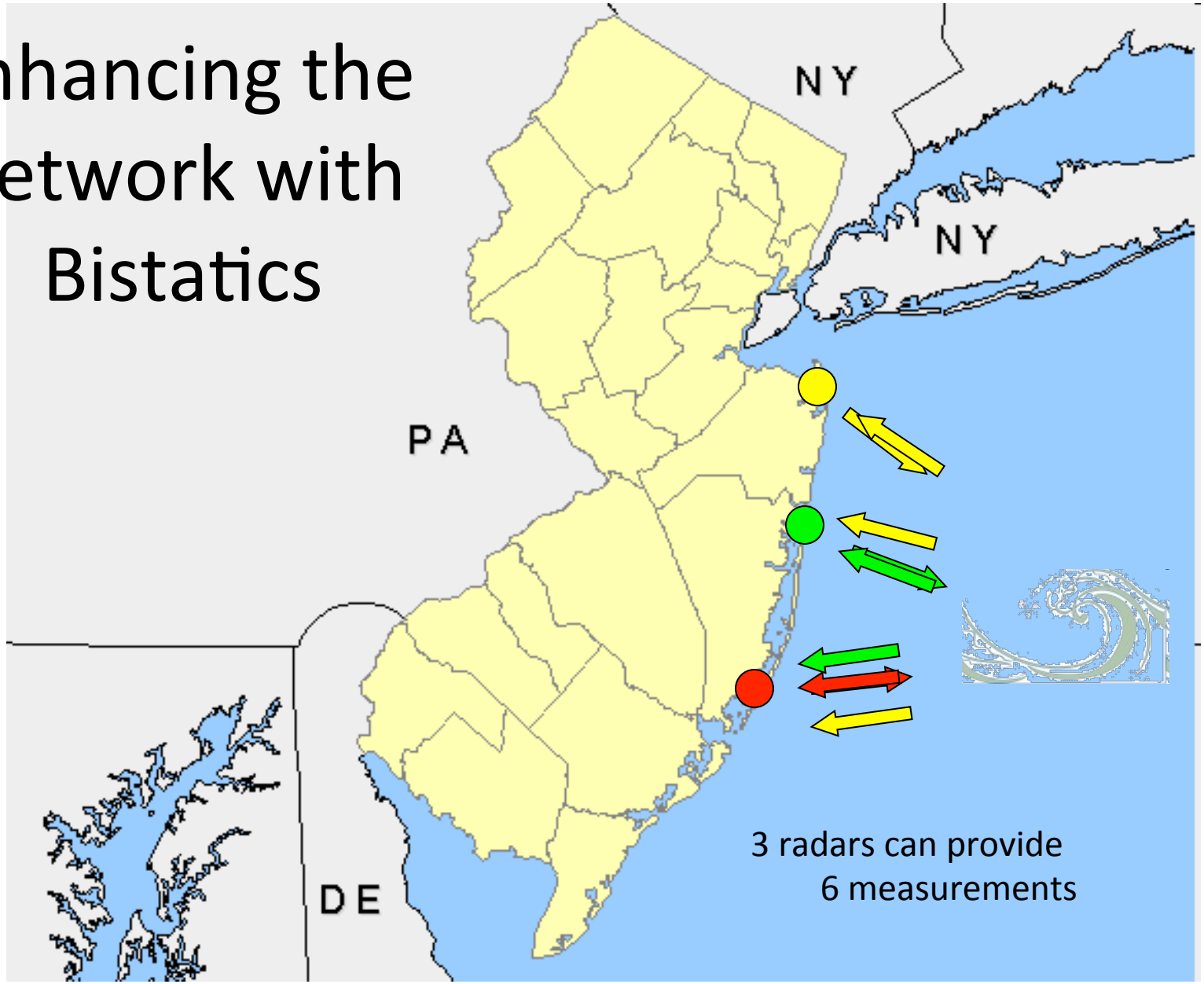

Single-Sided Amplitude Spectrum of y(t)
|Y(f)|
Period (Hours)
12/16/12
/home/hroarty/codar/MARCOOS/Radial_Average/wrapper_avg_rad_vel.m
NAUS
NANT
BLCK
MRCH
WILD
0
2
4
6
8
10
12
20
15
10
5
0

Number of Radials vs. Time

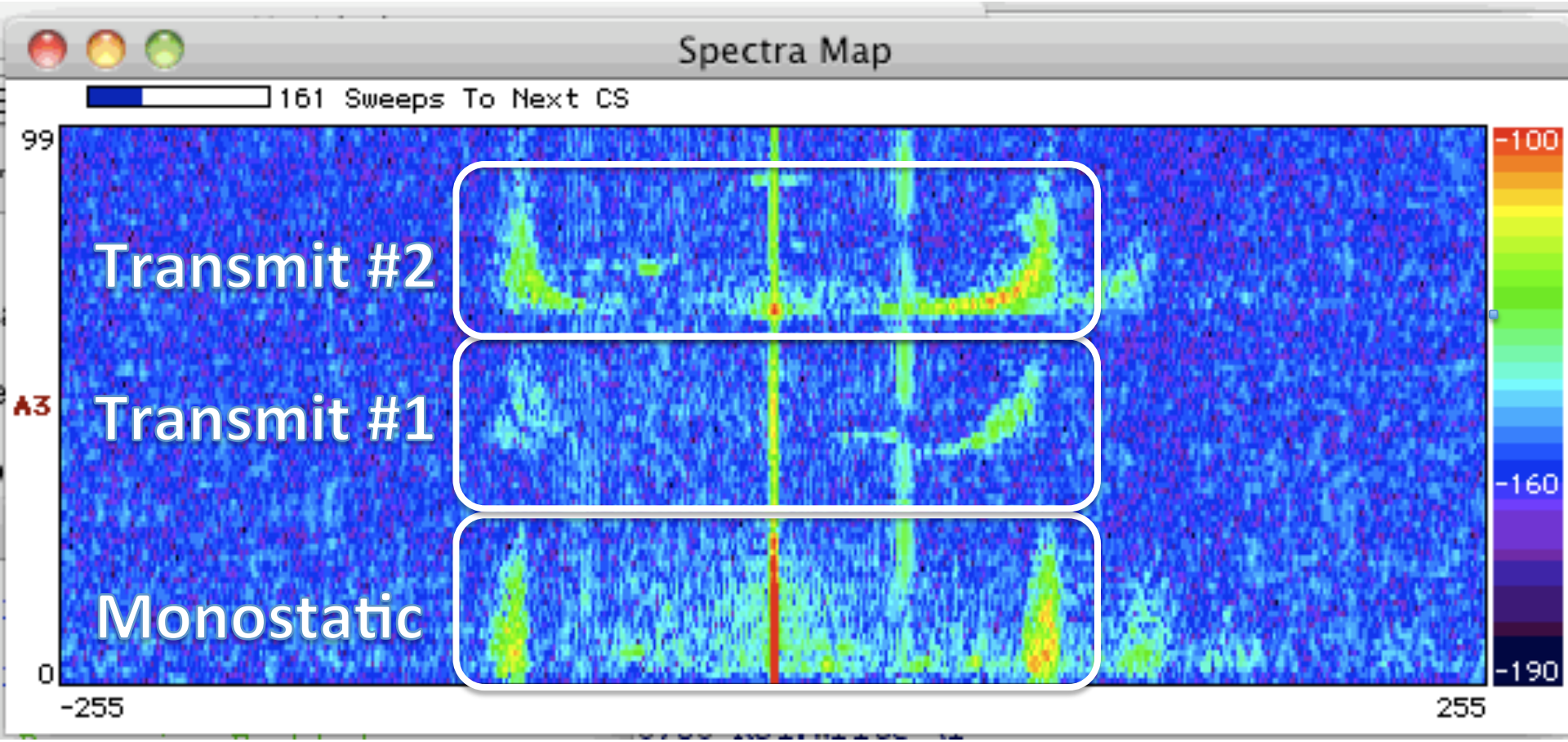


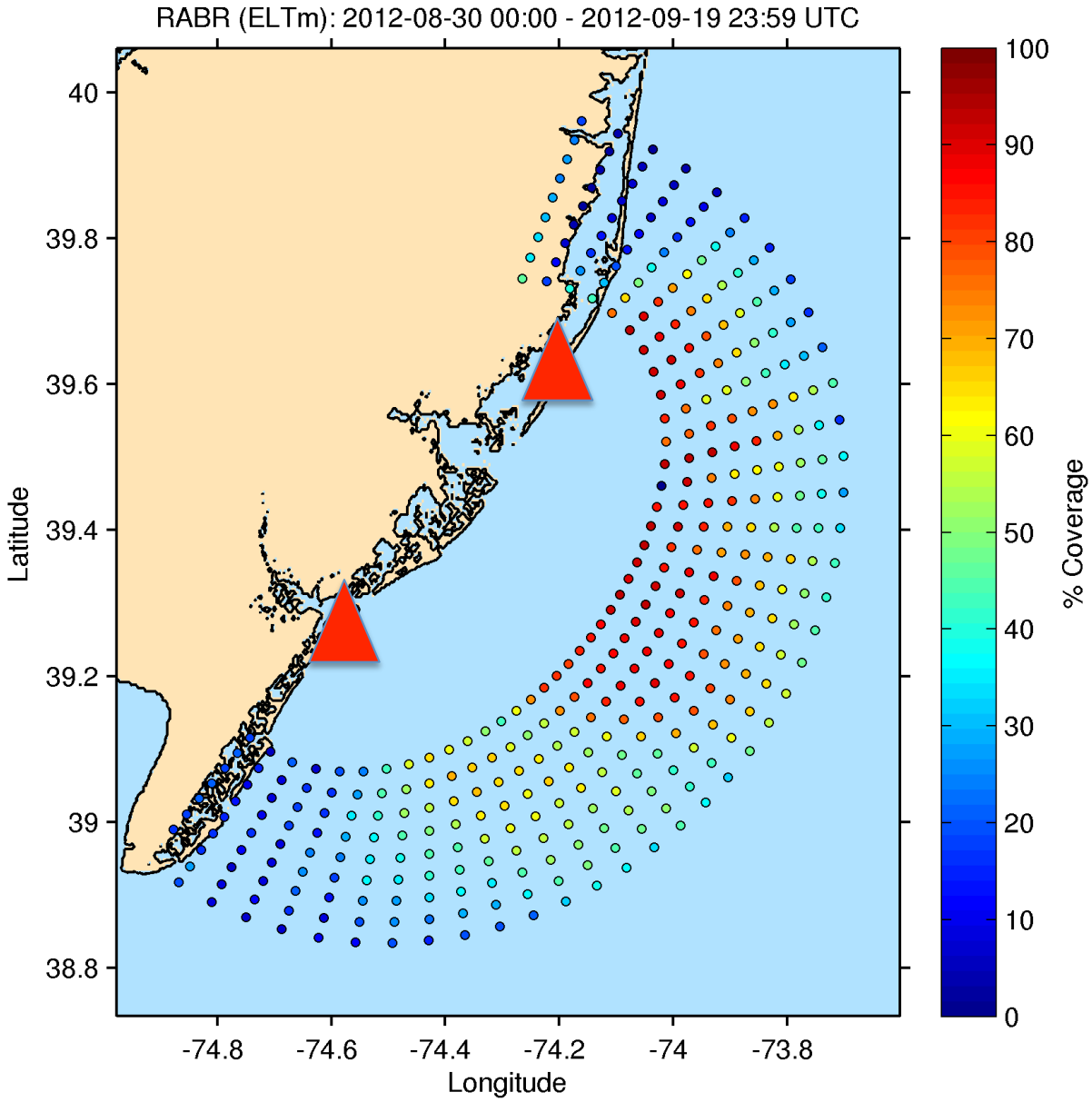
BISTATICS FOR SURFACE CURRENTS

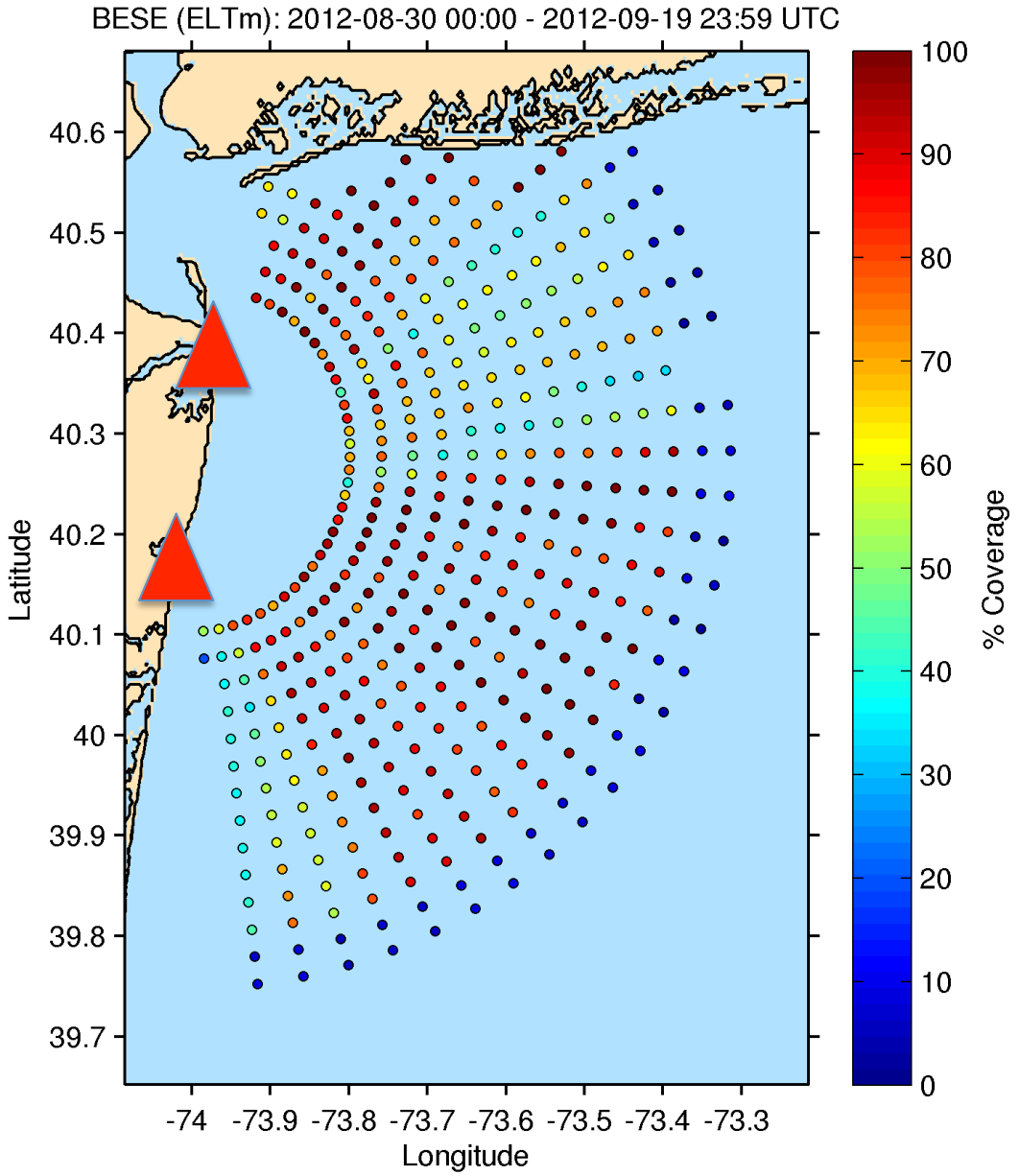
Enhancing the Network with Bistatics

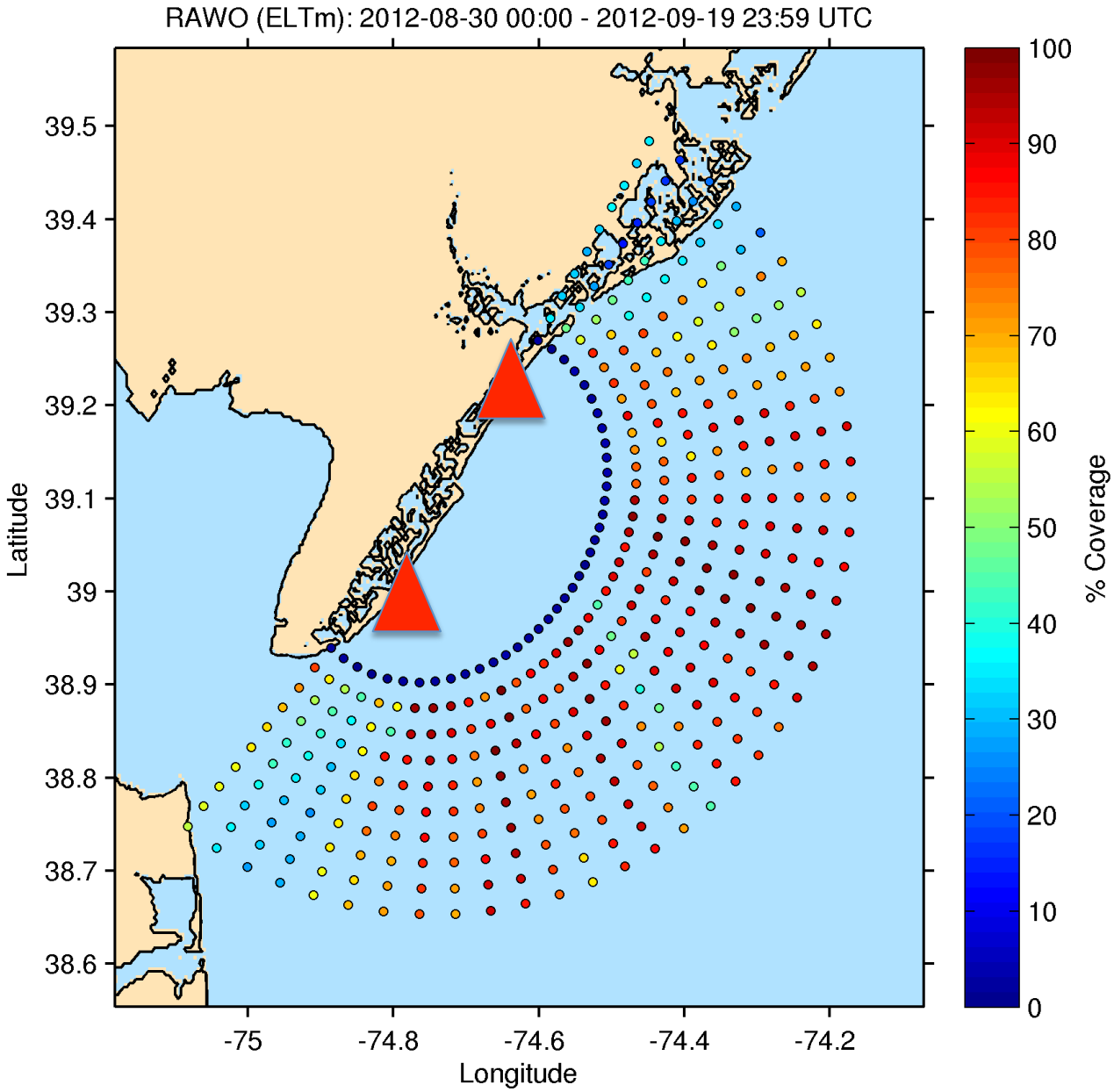


Bistatic Data in the Spectra




RABR (ELTm): 2012-08-30 00:00 - 2012-09-19 23:59 UTC
Latitude
40
39.8
39.6
39.4
39.2
39
38.8
-74.8
-74.6
-74.4
-74.2
-74
-73.8
Longitude
% Coverage
100
90
80
70
60
50
40
30
20
10
0


BESE (ELTm): 2012-08-30 00:00 - 2012-09-19 23:59 UTC
Latitude
40.6
40.5
40.4
40.3
40.2
40.1
40
39.9
39.8
39.7
-74
-73.9
-73.8
-73.7
-73.6
-73.5
-73.4
-73.3
Longitude
100
90
80
70
60
50
40
30
20
10
0
% Coverage

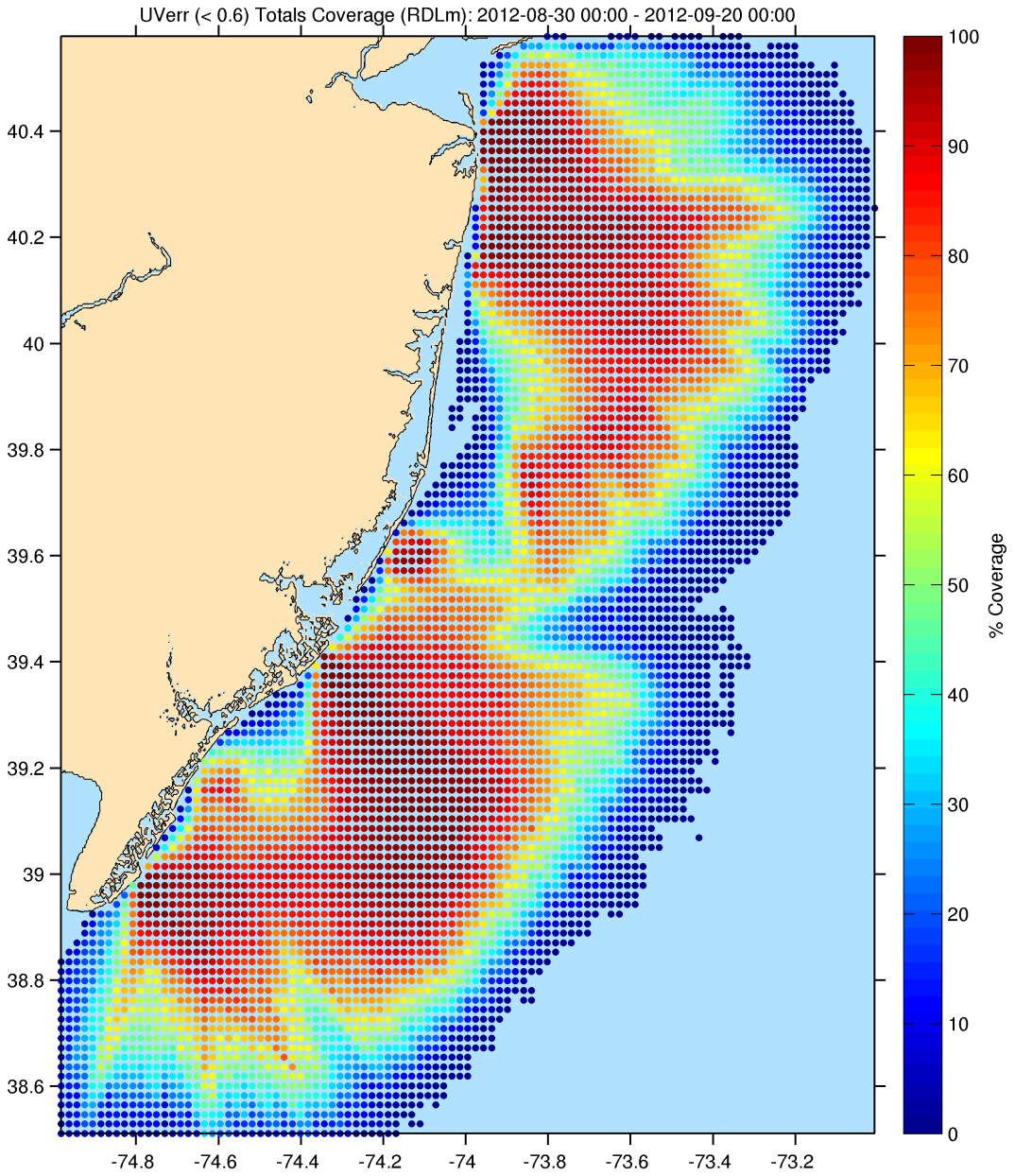

RAWO (ELTm): 2012-08-30 00:00 - 2012-09-19 23:59 UTC
Latitude
39.5
39.4
39.3
39.2
39.1
39
38.9
38.8
38.7
38.6
-75
-74.8
-74.6
-74.4
-74.2
Longitude
% Coverage
100
90
80
70
60
50
40
30
20
10
0

Total Surface Currents

Three Weeks

August 30 – September 20, 2013

Radials Only

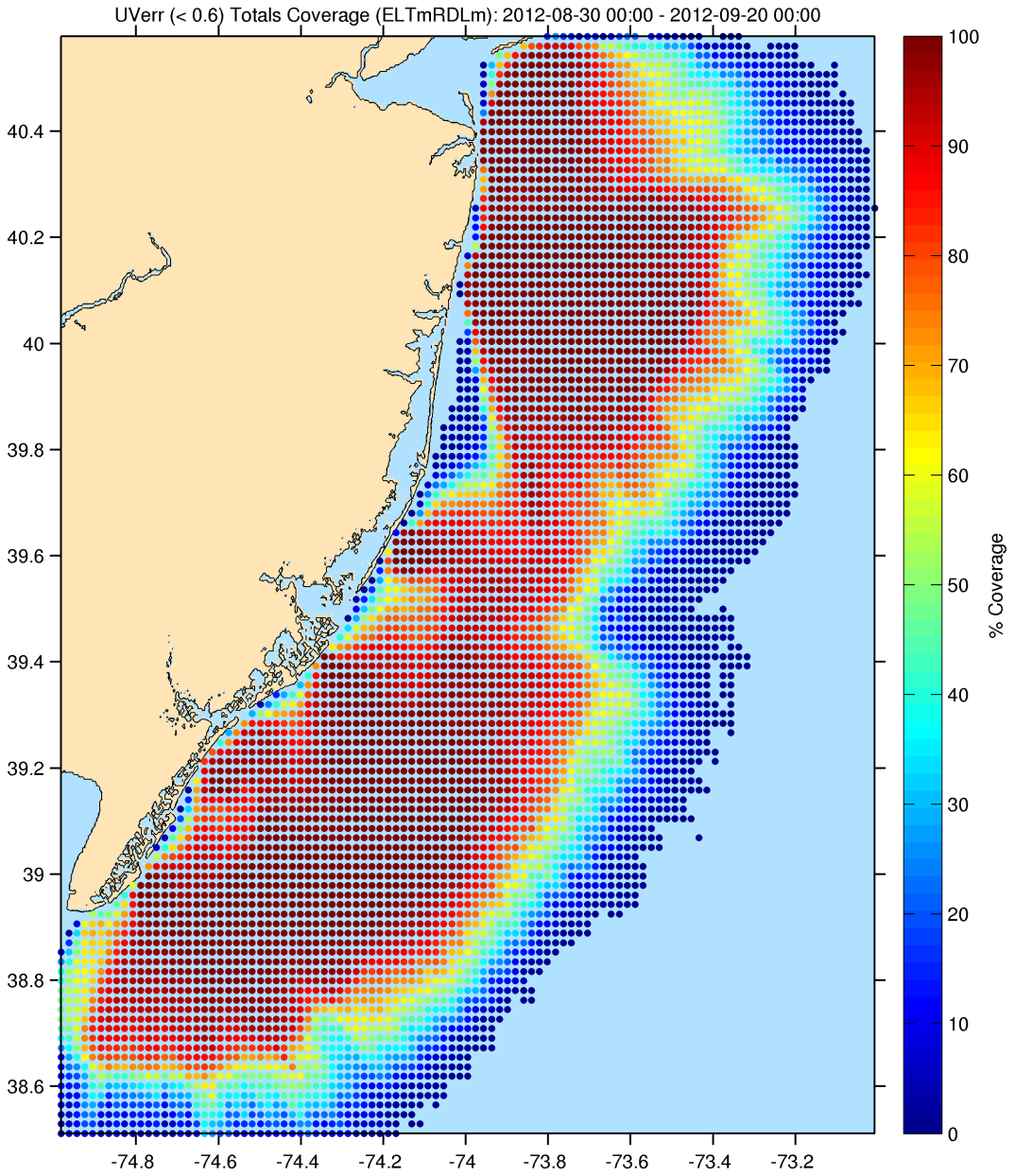


Total Surface Currents

Three Weeks

August 30 – September 20, 201

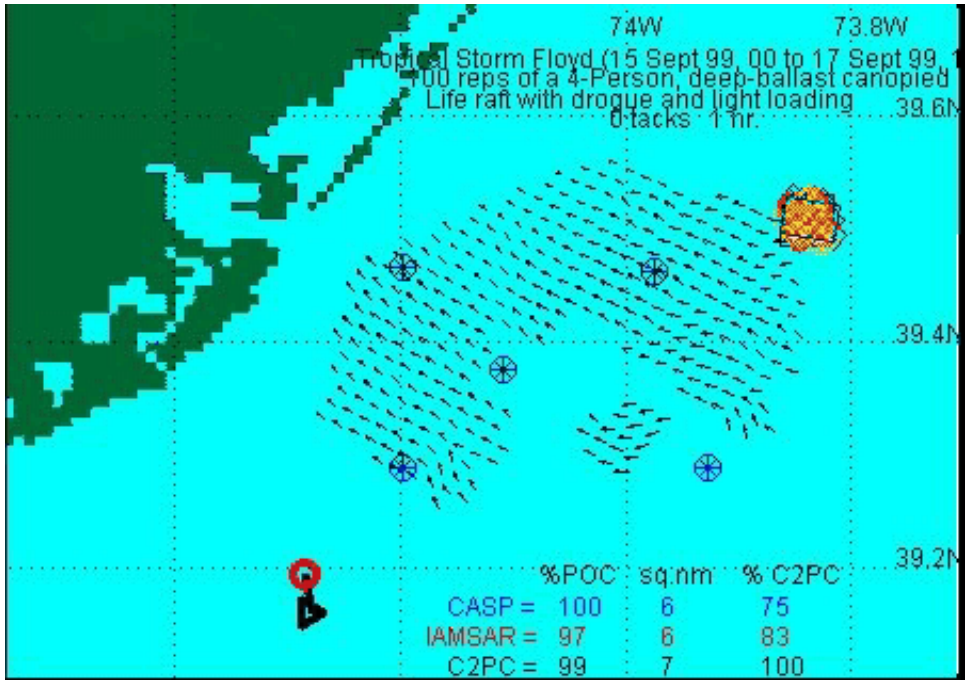
Radials & Ellipticals



APPLICATION:
SEARCH AND RESCUE

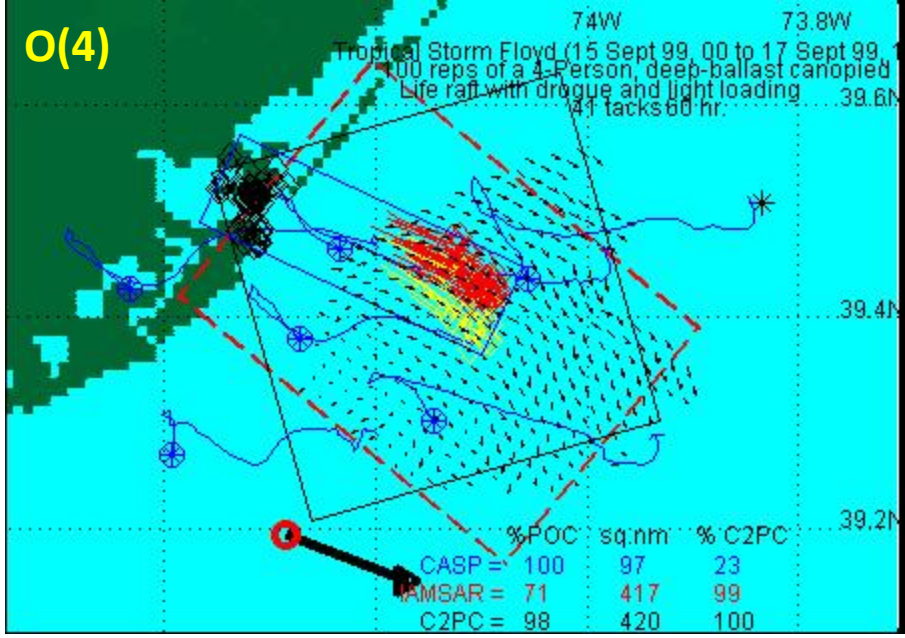
Application to Search and Rescue
United States Coast Guard
Office of Search and Rescue

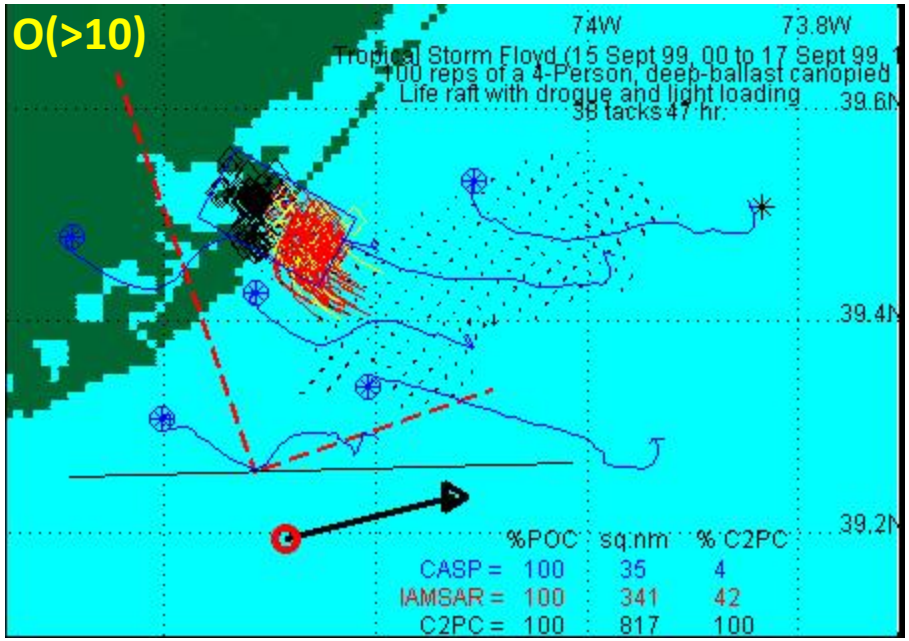
Point measurement vs. Field of measurements:
Hurricane Floyd Simulation



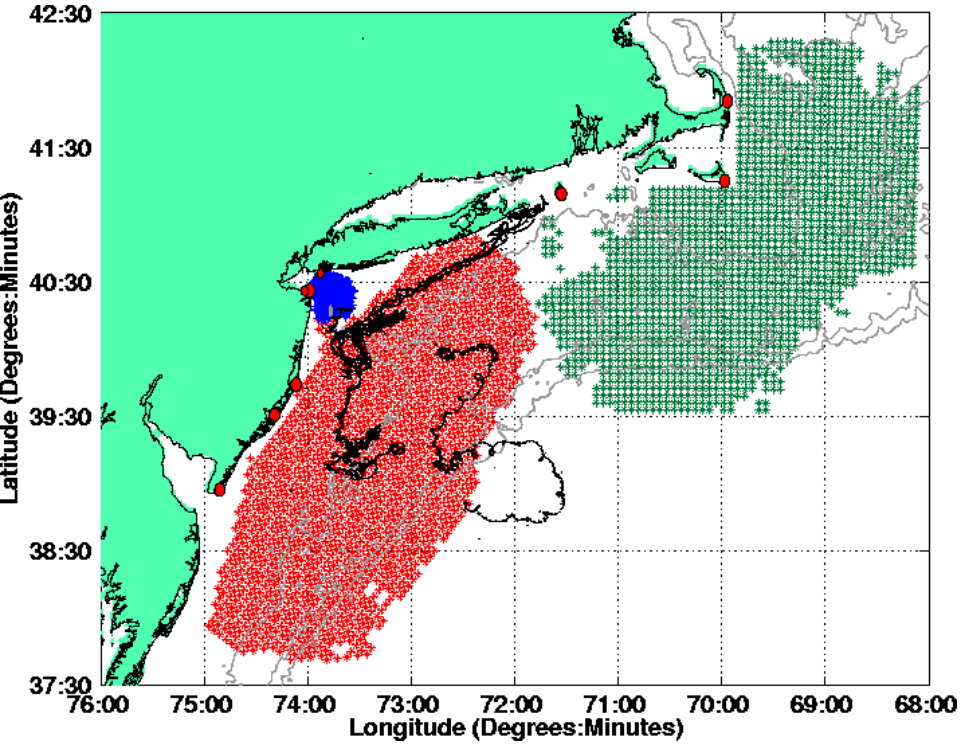
Search area reduced by factor of 4 (>10)

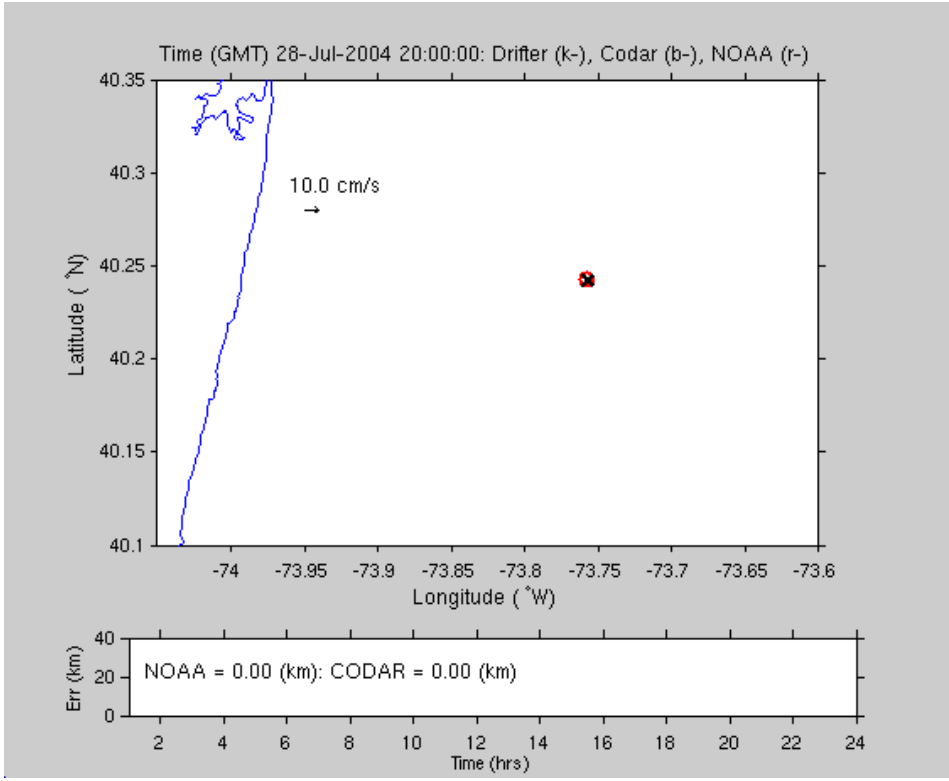
Courtesy Art Allen, USCG Office of SAR



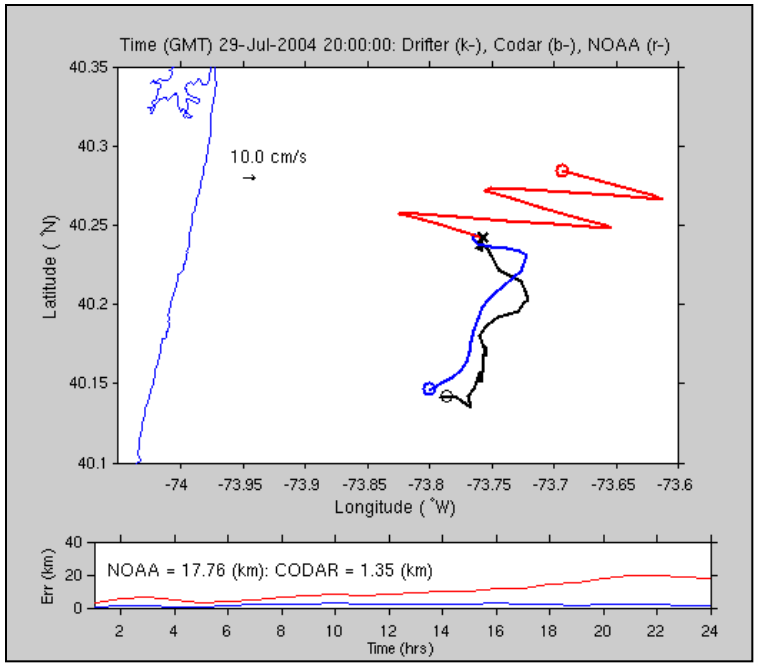


Status 2004


42:30
41:30
40:30
39:30
38:30
37:30
Latitude (Degrees:Minutes)
76:00
75:00
74:00
73:00
72:00
71:00
70:00
69:00
68:00
Longitude (Degrees:Minutes)


Time (GMT) 28-Jul-2004 20:00:00: Drifter (k-), Codar (b-), NOAA (r-)
10.0 cm/s
Latitude (°N)
40.35
40.3
40.25
40.2
40.15
40.1
-74
-73.95
-73.9
-73.85
-73.8
-73.75
-73.7
-73.65
-73.6
Longitude (°W)
Err (km)
NOAA = 0.00 (km): CODAR = 0.00 (km)
40
20
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (hrs)

Status 2004



U.S. Coast Guard Research and Development Center
1082 Shennecossett Road, Groton, CT 06340-6048

Report No.

INTEGRATION OF COASTAL OCEAN DYNAMICS APPLICATION RADAR (CODAR) AND SHORT-TERM PREDICTIVE SYSTEM (STPS) SURFACE CURRENT ESTIMATES INTO THE SEARCH AND RESCUE OPTIMAL PLANNING SYSTEM (SAROPS)

FINAL REPORT
November 2005

MARACOOS
Ocean Information for a Changing World

Success Stories – Making a Difference

Optimizing HF Radar for SAR using USCG Surface Drifters

Art Allen
U.S. Coast Guard

Scott Glenn
Rutgers University

and the Mid-Atlantic Regional Coastal Ocean Observing System

May 4, 2009: After a year of testing, NOAA Announces on U.S. Department of Commerce Website that MARACOOS 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

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U.S. IOOS Goal for 2010-2011: Bring all sustained regional-scale HFR networks up to operational status in USCG SAROPS

3 West Coast Regions for California & Oregon

Status September 2009

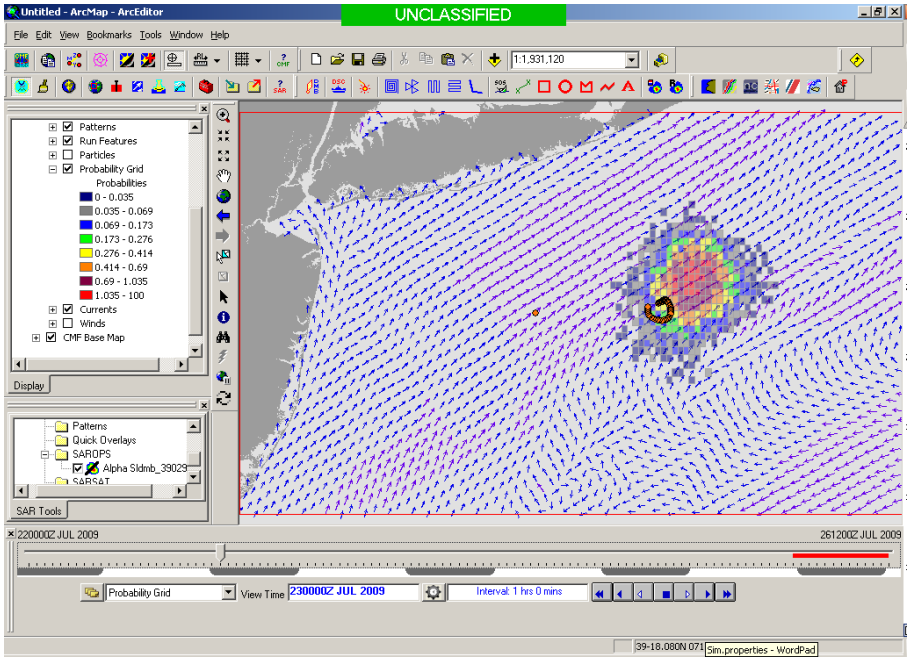
- What is the benefit/value of HF radar data in Coast Guard search tool?

HF Radar
vs
HYbrid Coordinate Ocean Model or (HYCOM)

- High Confidence (HF Radar)
  - sigma (1 std dev) = 0.22 knots
  - Tau (half life) = 264 minutes
- Low Confidence (HYCOM)
  - sigma (1 std dev) = 0.37 knots
  - Tau (half life) = 264 minutes
- Number of particles = 5000
- SLDMB 39029

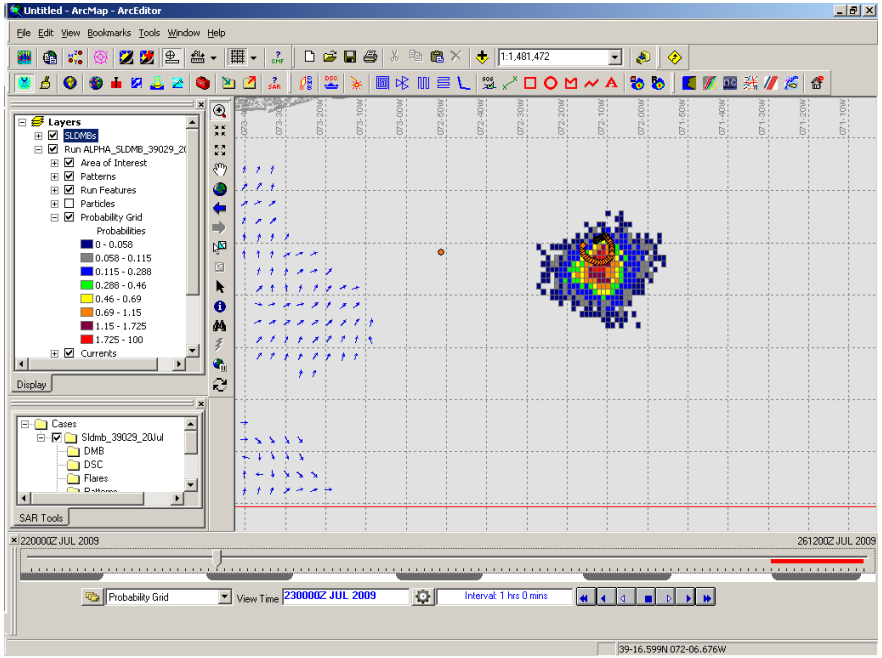
Date	Time
22 July 2009	00 hours
23 July 2009	24 hours
24 July 2009	48 hours
25 July 2009	72 hours
26 July 2009	96 hours

24 Hours Into Search



HYCOM

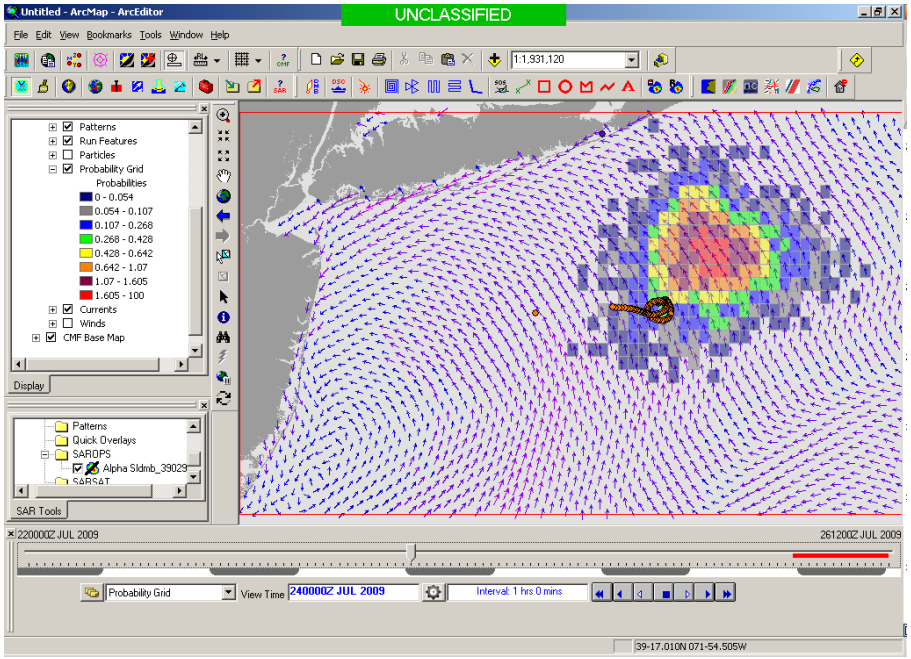
Low Confidence



CODAR

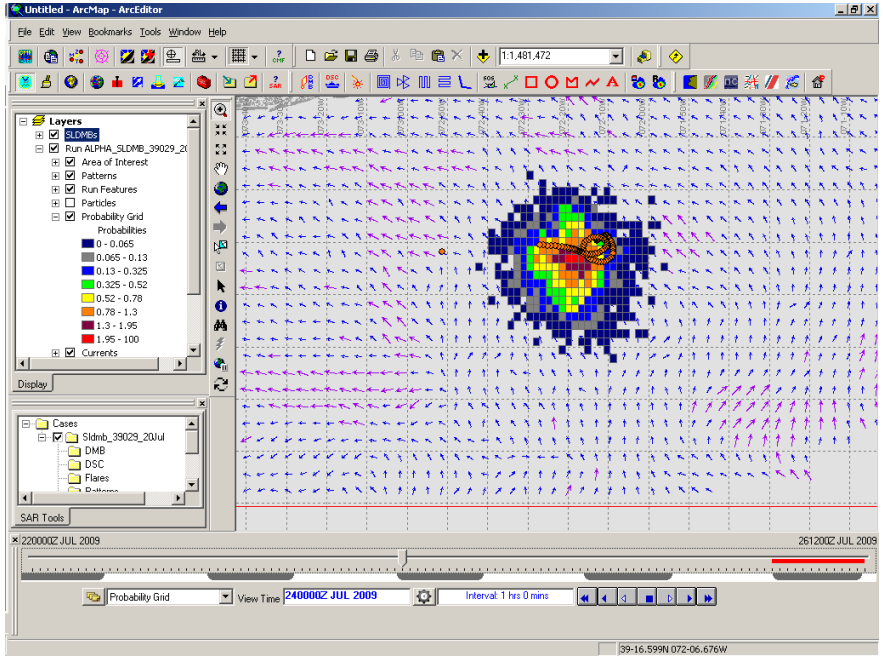
High Confidence

48 Hours Into Search



HYCOM

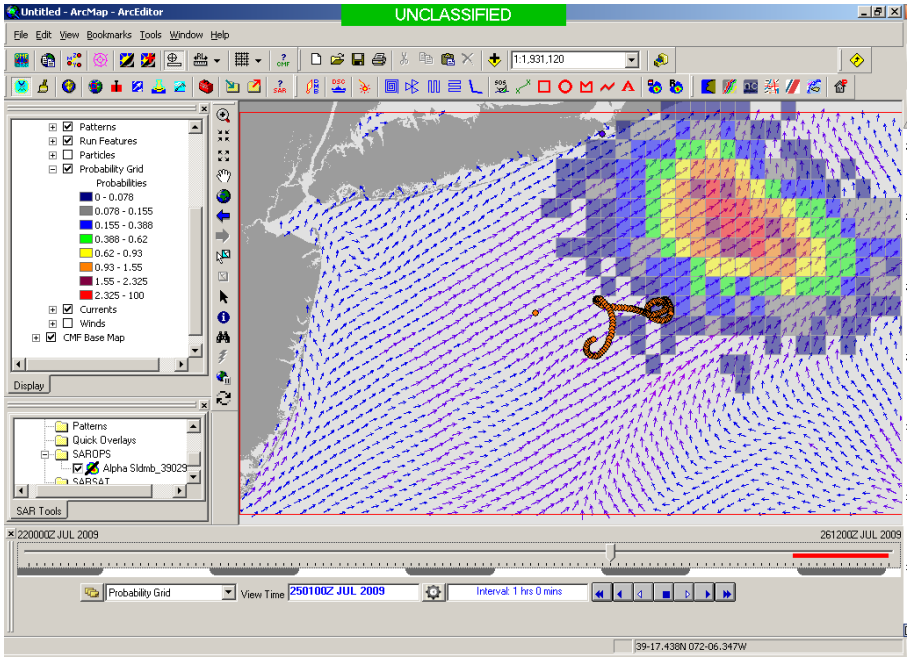
Low Confidence



CODAR

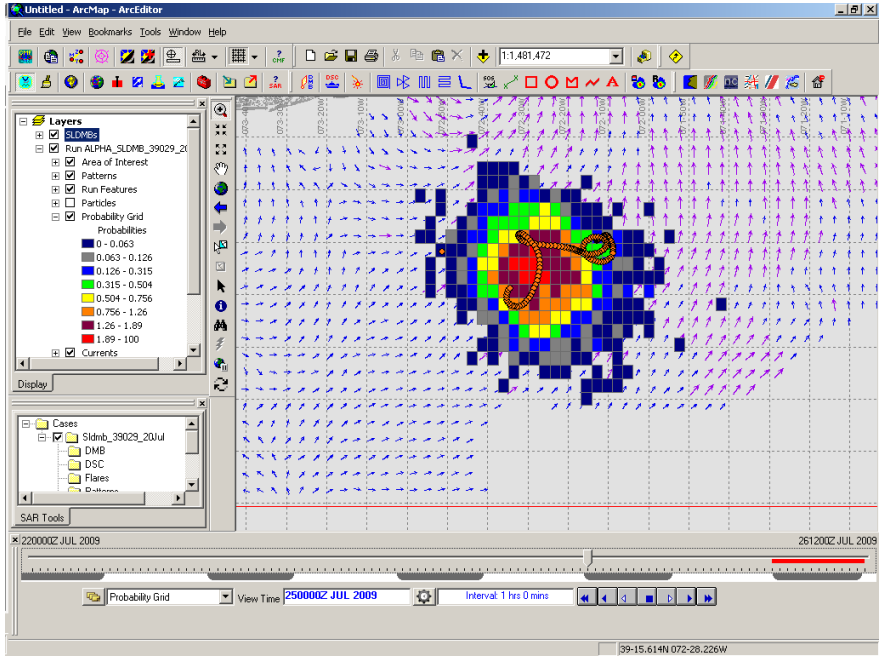
High Confidence

72 Hours Into Search



HYCOM

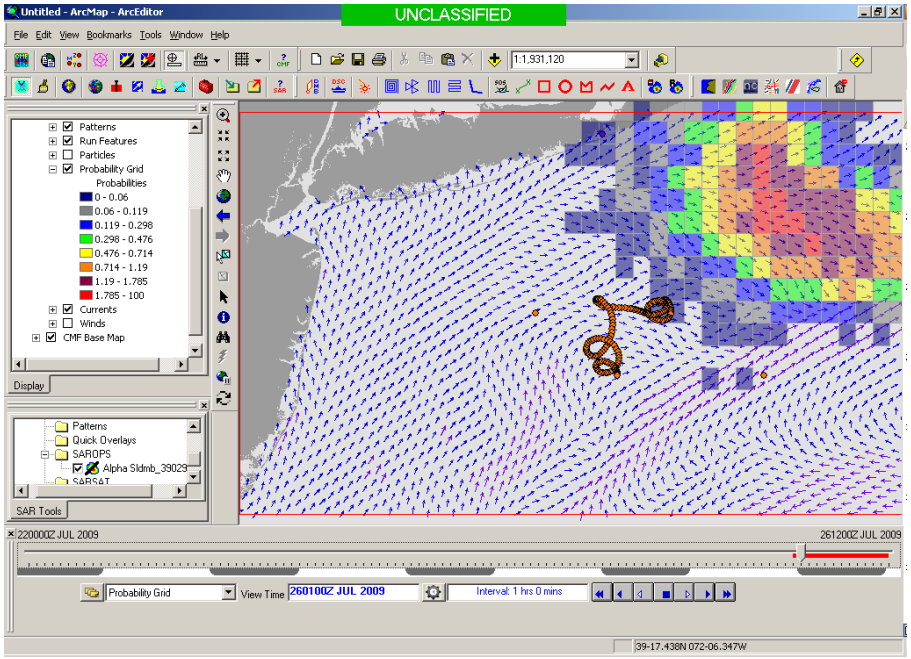
Low Confidence



CODAR

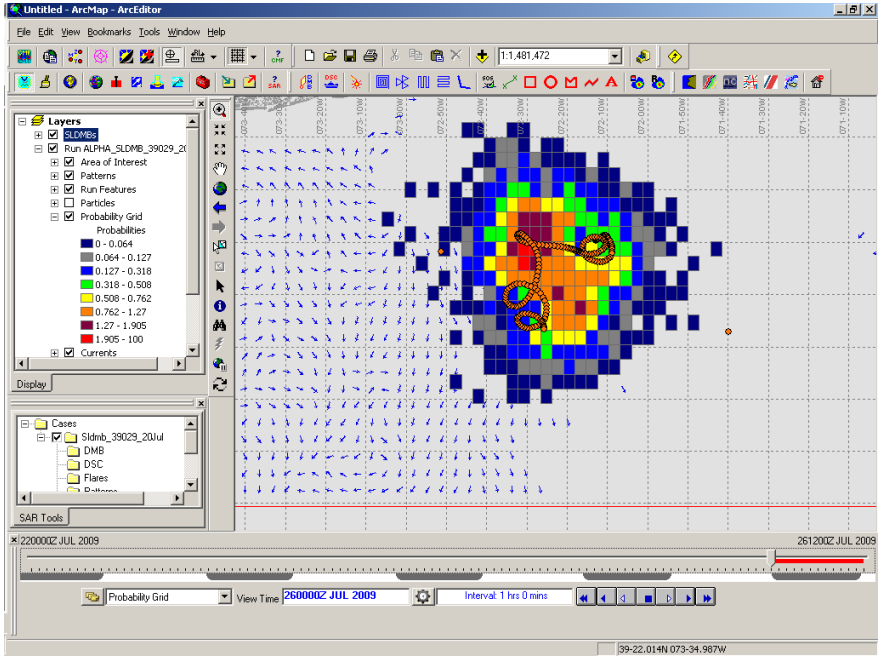
High Confidence

96 Hours Into Search



HYCOM

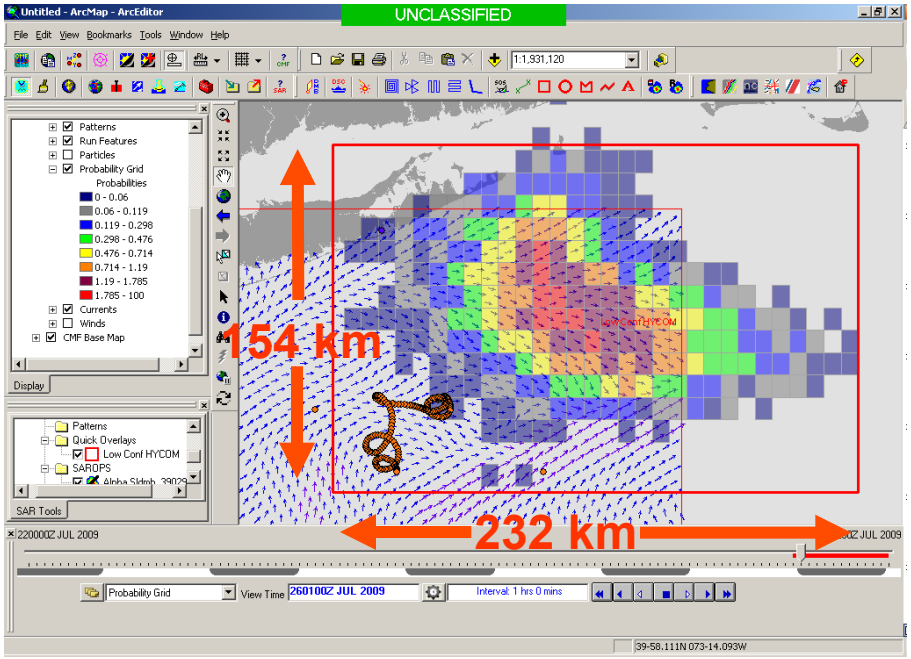
Low Confidence



CODAR

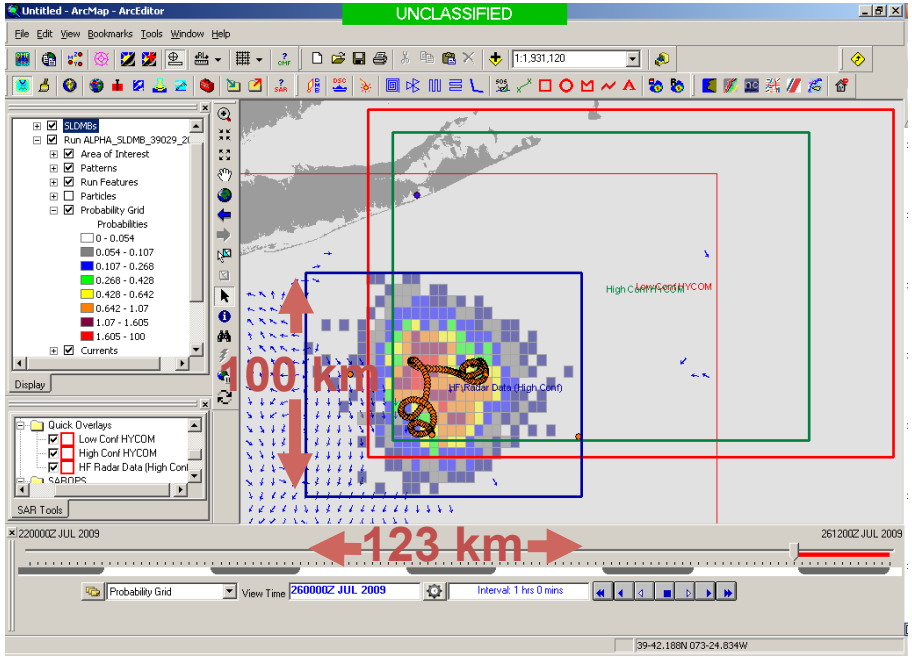
High Confidence

Search Area After 96 Hours



HYCOM

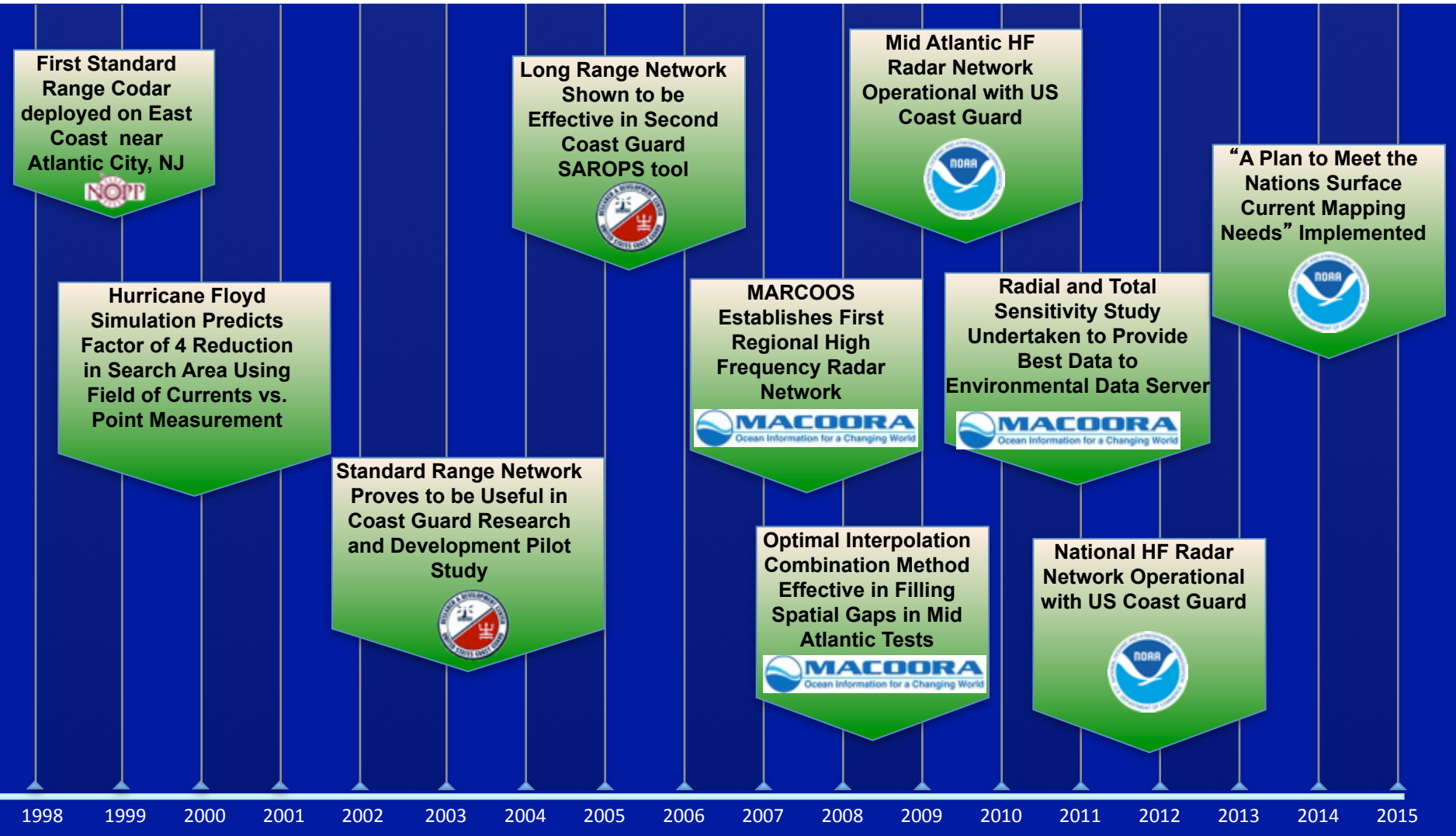
36,000 km^2



CODAR

12,000 km^2

HFR Current Mapping Product Development Road Map for Search and Rescue

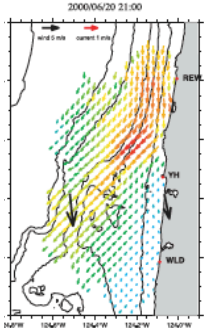


NATIONAL HF RADAR NETWORK

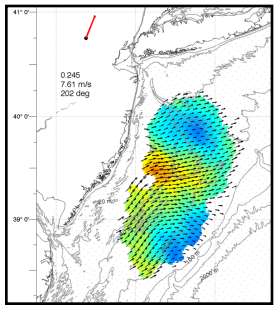
Development of a U.S. National HF Radar Network

1990's

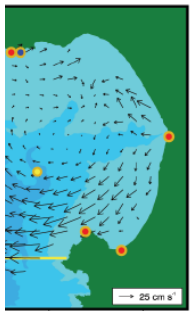
Local Science Applications



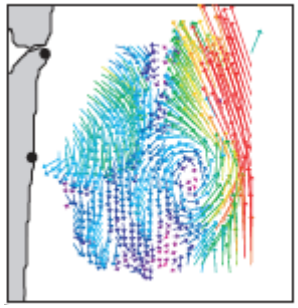
Oregon



New Jersey



California



Florida

Coordination Meeting 1999

Since 2000

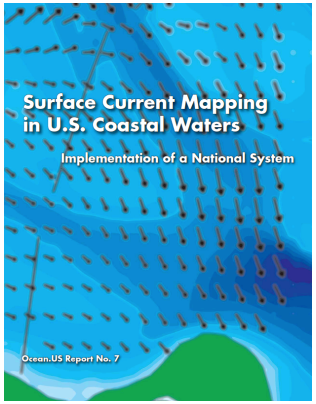
International Coordination

Annual Radiowave Oceanography Workshop (ROW)

-HF Radar Developers
-Ocean Scientists

Since 2004

Societal Products



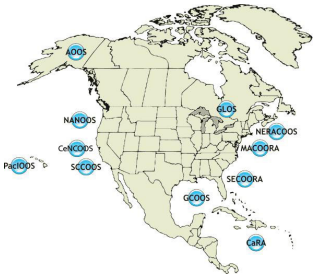
Technical Expertise

ROWG

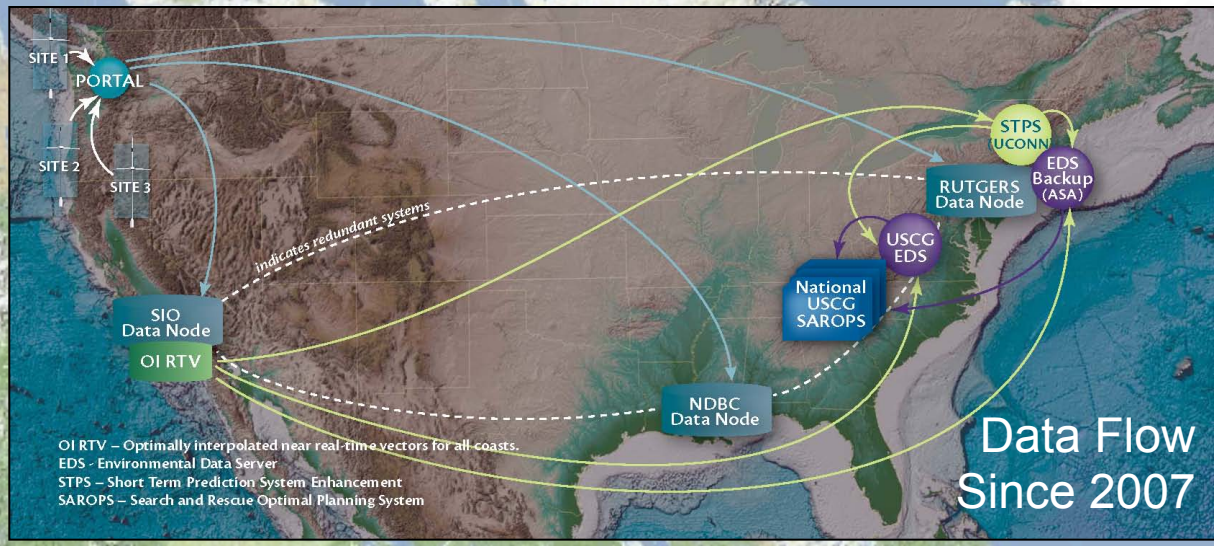
Since 2007

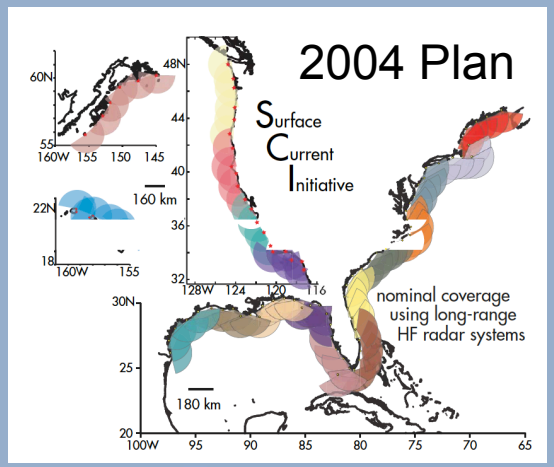
National Coordination

Regional Implementation



U.S. National HF Radar Network





U.S. National HF Radar Network

http://ioos.gov/hfradar/

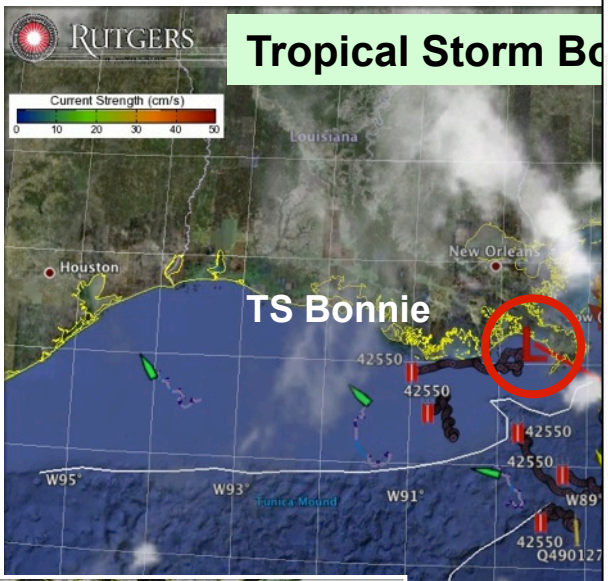
Region	YR1	YR2	YR3	YR4	YR5	Total New	Total Existing	Total at 5-Yr Buildout	Total Acquisition & Deployment ($K)*	Existing Annual Regional O&M ($K)*	Total New Annual O&M* ($K)
Alaska	6	3	4	2	5	20	2	22	$3,200	$98	$371
Caribbean	6	6	6	6	5	29	0	29	$4,640	$0	$539
Pacific Islands	5	6	5	5	5	26	2	28	$7,800	$154	$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

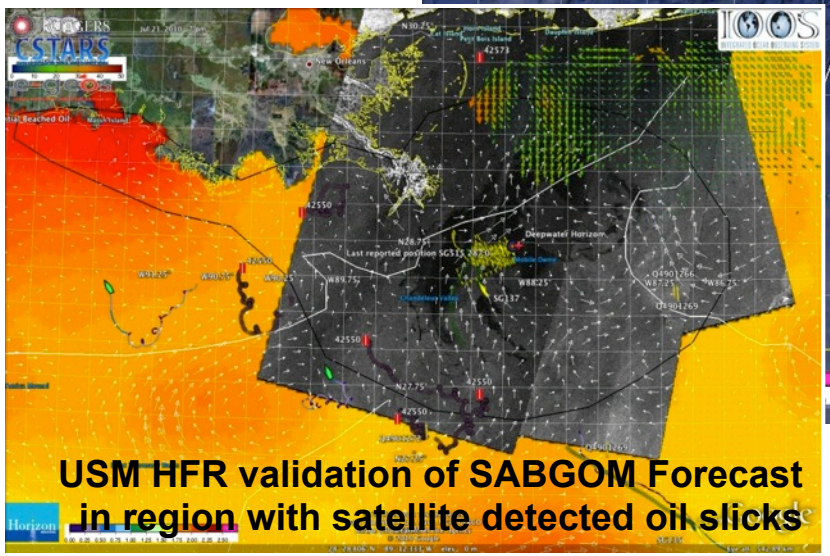
- *Technician fully encumbered salary is estimated at $130,000;*
- *Purchase and deployment for DF HFRs, LPA HFRs are $160,000 and $300,000, respectively.*
- *Two technicians for each 7 DF HFRs, 4 LPA HFRs, respectively.*

IOOS Coordinated Rapid Response: *Deepwater Horizon Oil Spill*

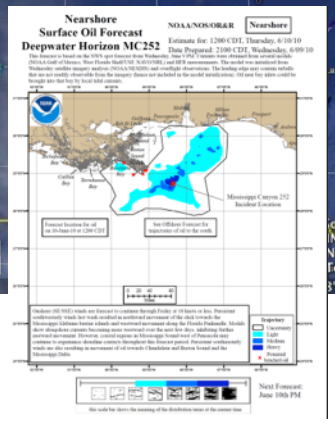
Contributed Assets:

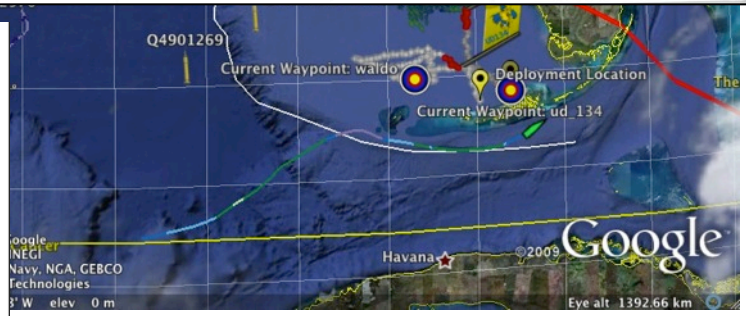
HF Radar Networks
USF, USM
Gliders
iRobot, Mote, Rutgers, SIO/WHOI, UDel, USF
Drifters & Profilers
Horizon Marine, Navy
Satellite Imagery
CSTARS, UDel
Ocean Forecasts
Navy, NCSU
Data/Web Services
ASA, Rutgers, SIO





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





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

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*

Thank You