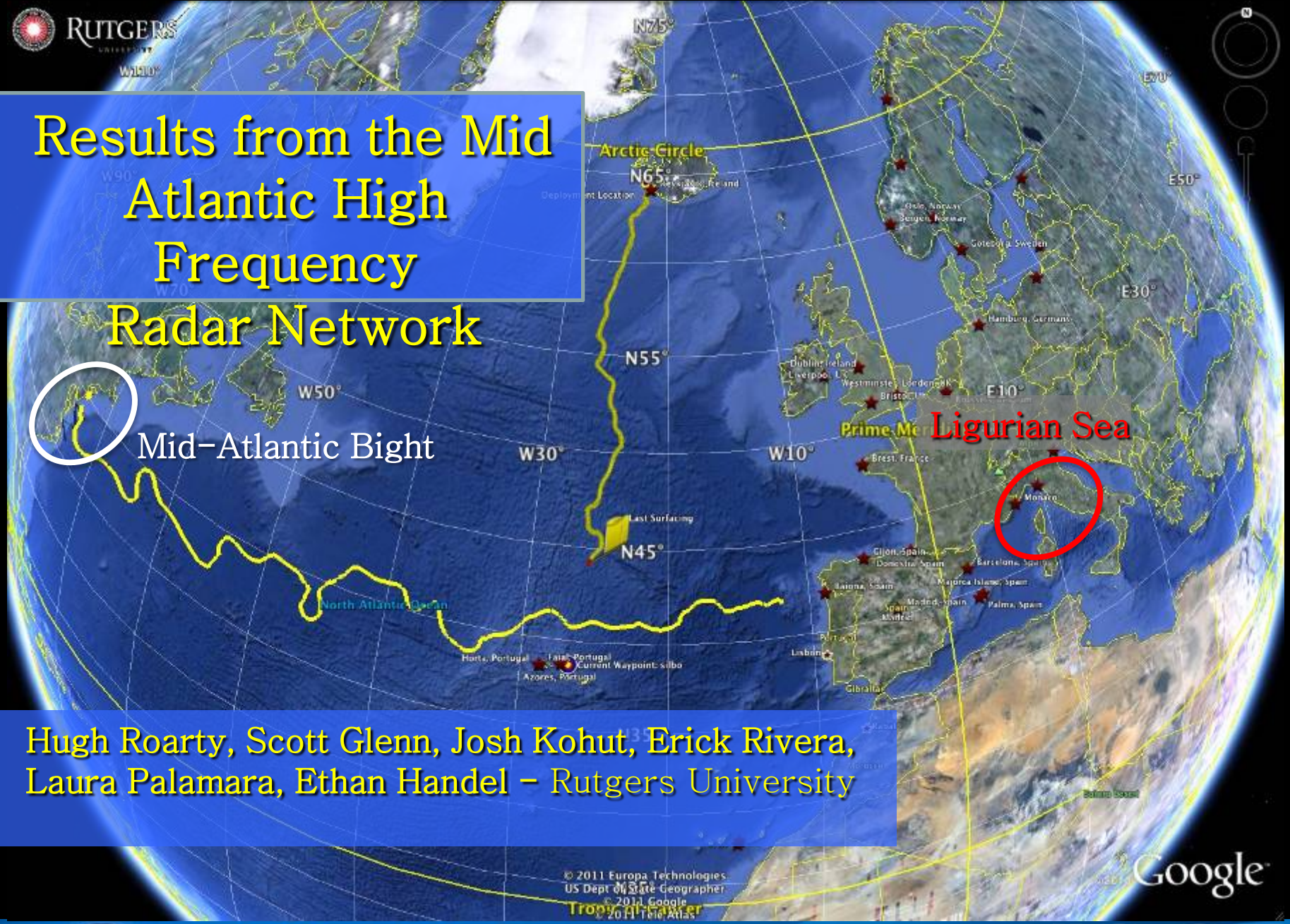
Results from the Mid Atlantic High Frequency Radar Network

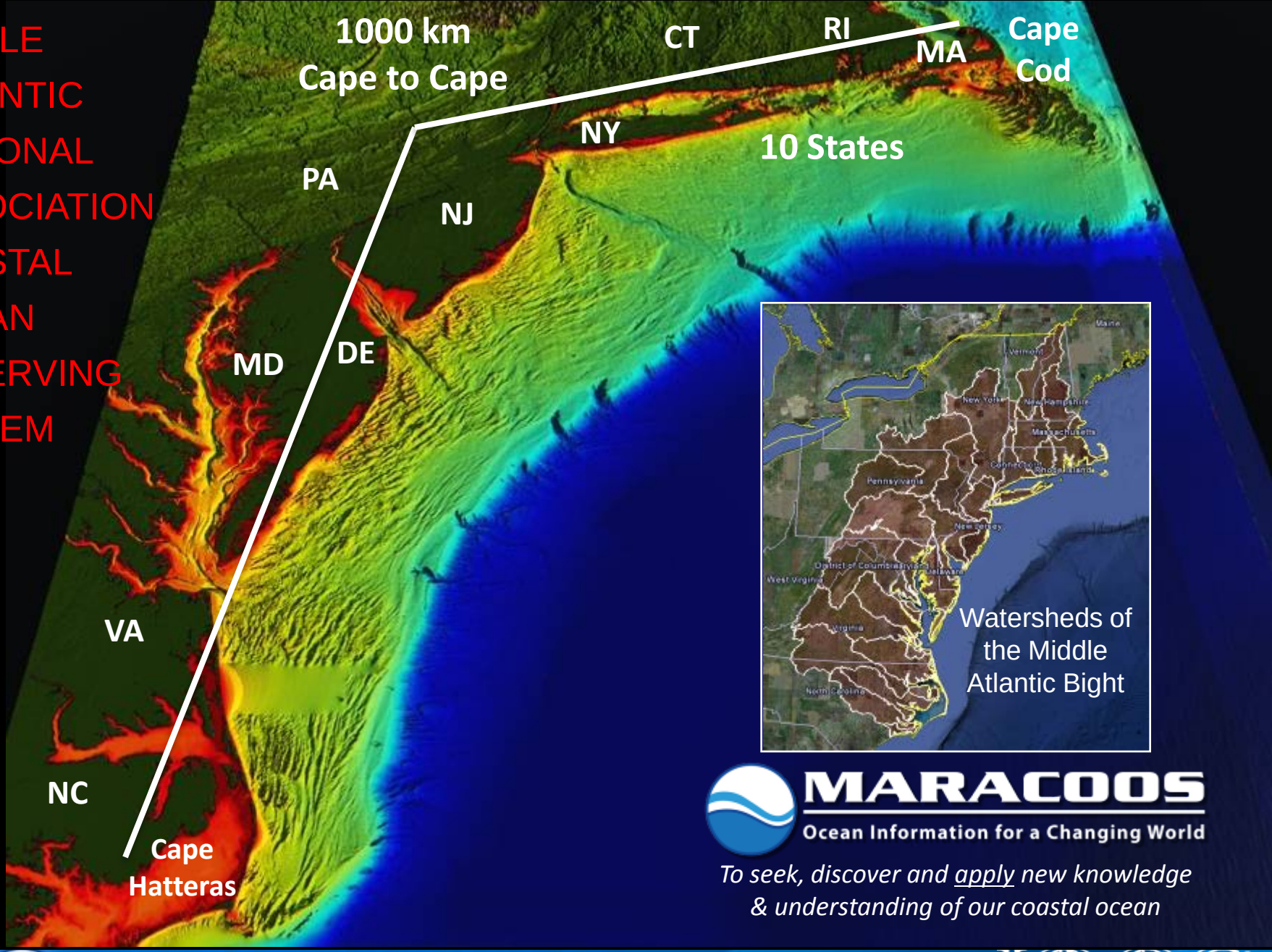


Hugh Roarty, Scott Glenn, Josh Kohut, Erick Rivera, Laura Palamara, Ethan Handel – Rutgers University

MARACOOS
Ocean Information for a Changing World

IOOS
INTEGRATED OCEAN OBSERVING SYSTEM

MIDDLE
ATLANTIC
REGIONAL
ASSOCIATION
COASTAL
OCEAN
OBSERVING
SYSTEM

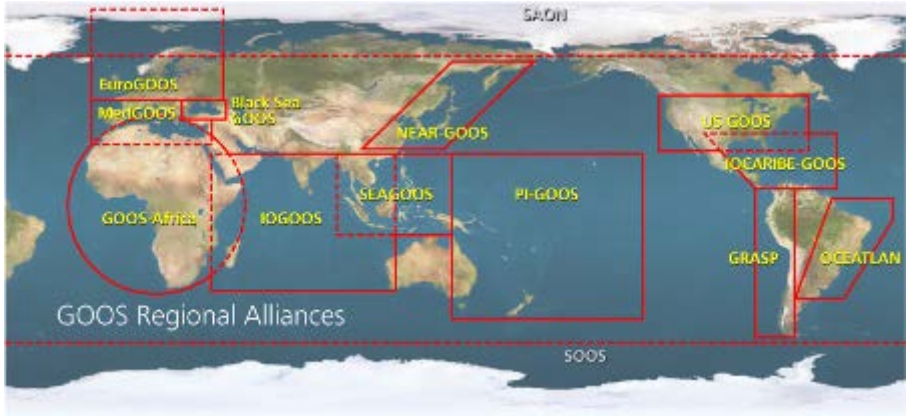


MARACOOS
Ocean Information for a Changing World

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

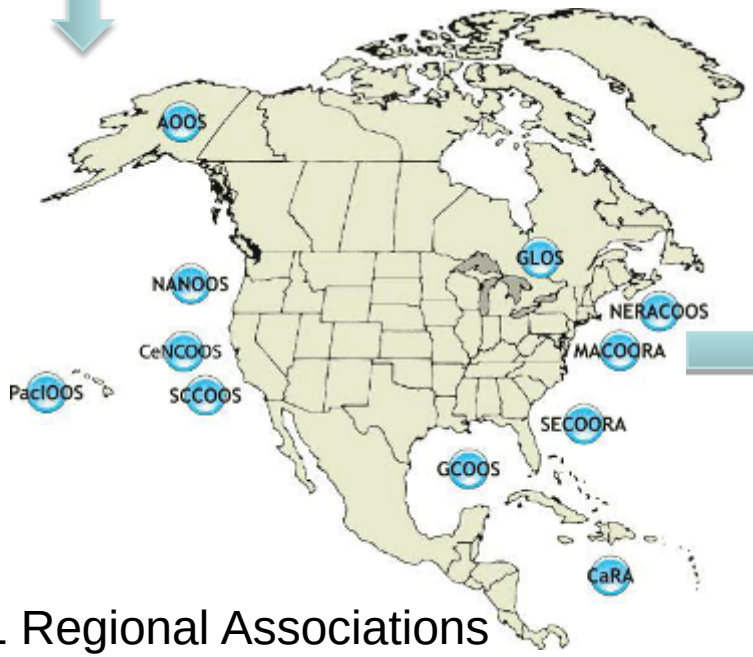
U.S. Integrated Ocean Observing System

International Component



Global Ocean Observing System

Regional Component



11 Regional Associations

8 Universities in MARACOOS contribute to HF Radar Network

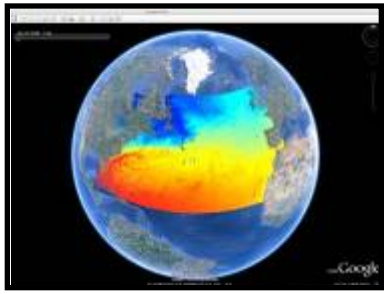
Rutgers University - Coastal Ocean Observation Lab

MARACOOS Operations Center

CODAR Network

L-Band & X-Band Satellite Receivers

Glider Fleet



3-D Nowcasts & Forecasts

MARACOOS
Ocean Information for a Changing World

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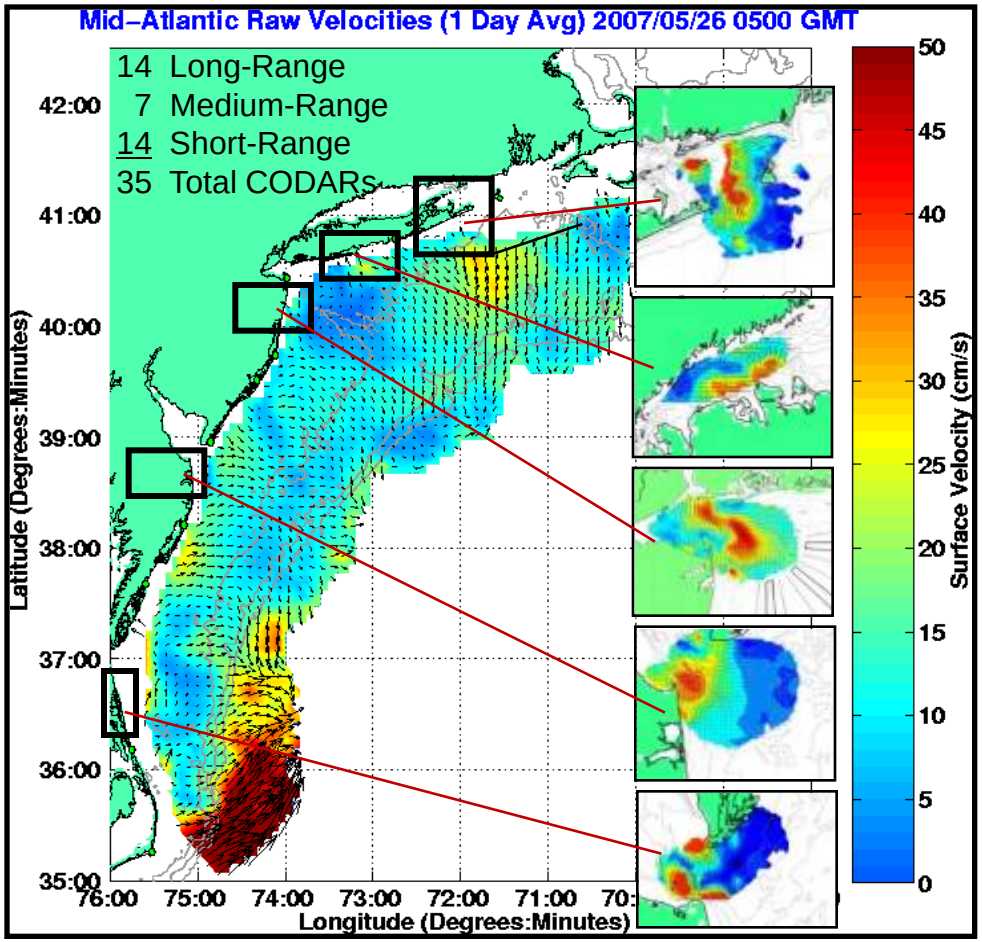
INTEGRATED OCEAN OBSERVING SYSTEM

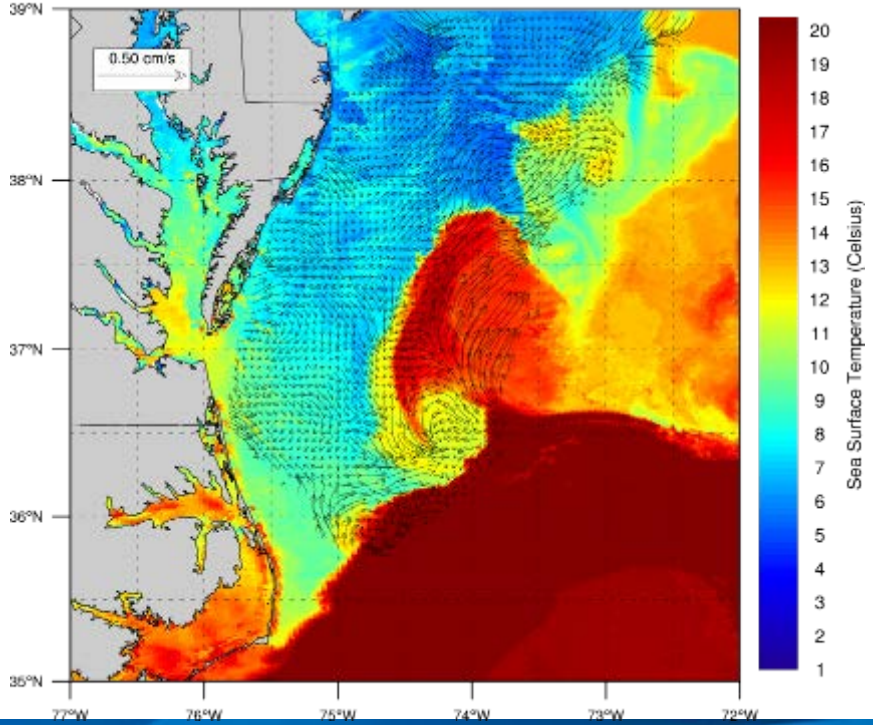
High Frequency Radar – Since 1996



Nested Grids of Hourly Surface Current Maps ^

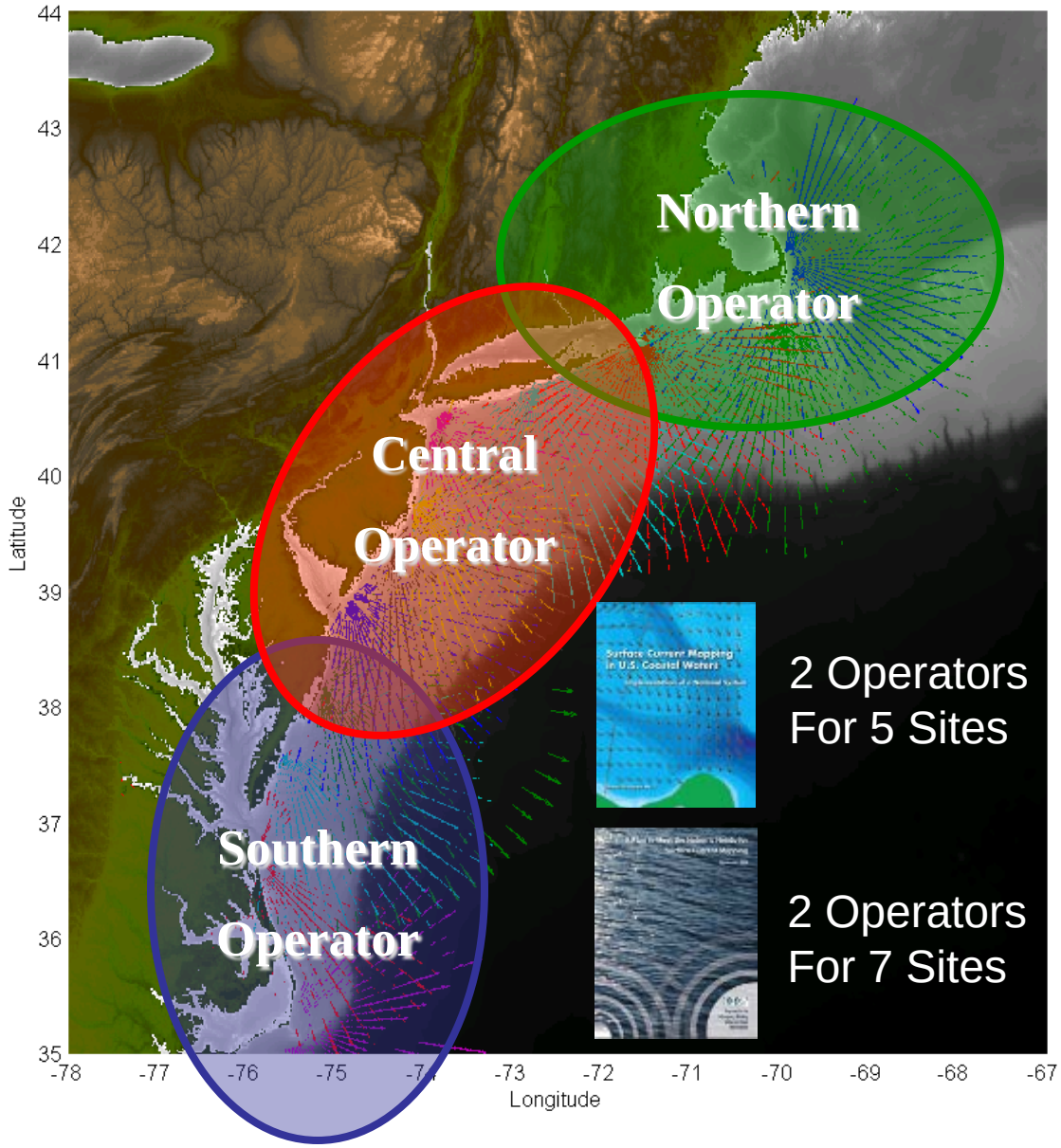
Corporate Partner:

CODAR Ocean Sensors



Combined CODAR & Satellite Products >

Long Range HF Radar Workforce



Regional Coordinator
Hugh Roarty

Northern Operator
Chris Jakubiak

Central Operator
Ethan Handel

Southern Operator
Teresa Garner

Future Medium Range Network 13 MHz

RUTGERS
Coastal Ocean Observation Lab

CODAR OCEAN SENSORS

NAVSEA
NAVAL SEA SYSTEMS COMMAND

U.S. DEPARTMENT OF HOMELAND SECURITY

OPT OCEAN POWER TECHNOLOGIES

New Jersey BPU Board of Public Utilities

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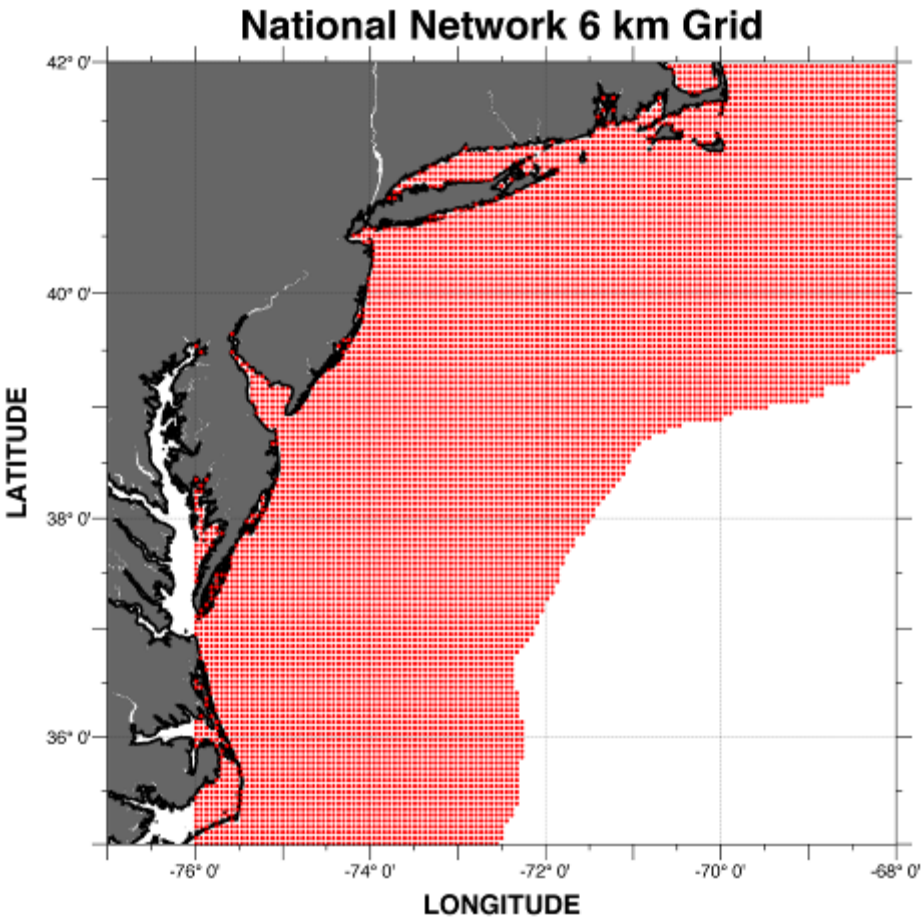
IOOS®
INTEGRATED OCEAN OBSERVING SYSTEM

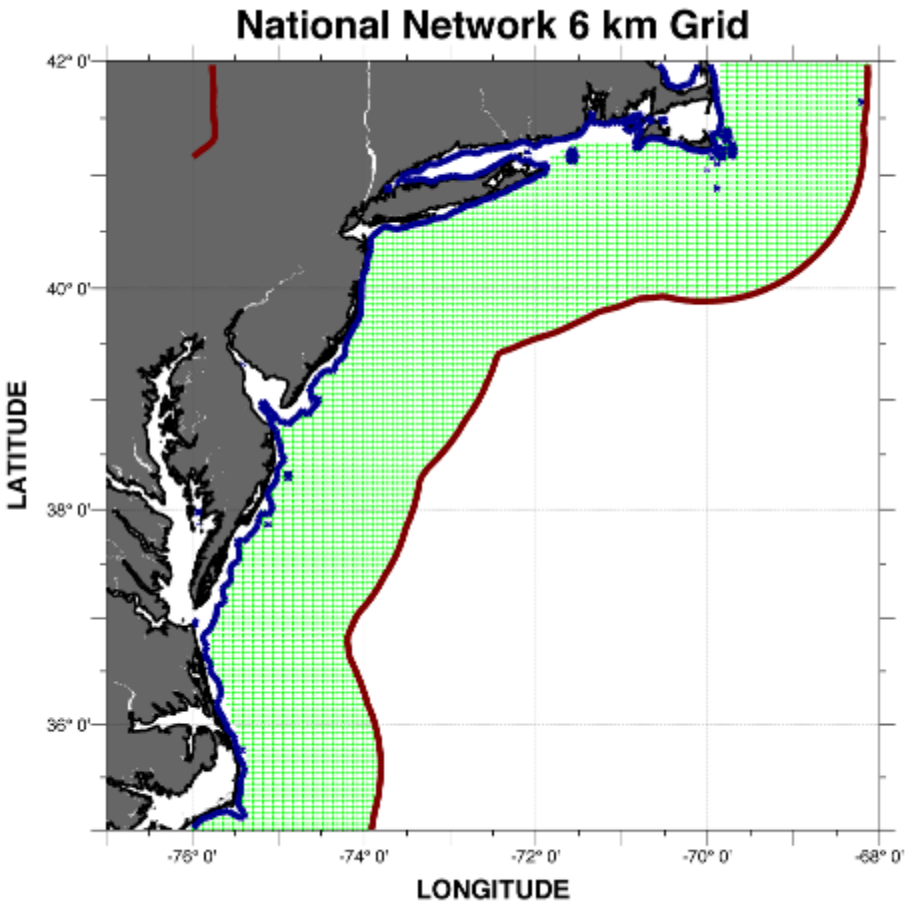
13 MHz Tx/Rx Antenna

- Single antenna at 13 MHz
- Transmit and Receive
- Radial whips no longer needed
- Possible to install with no guy wires and small base

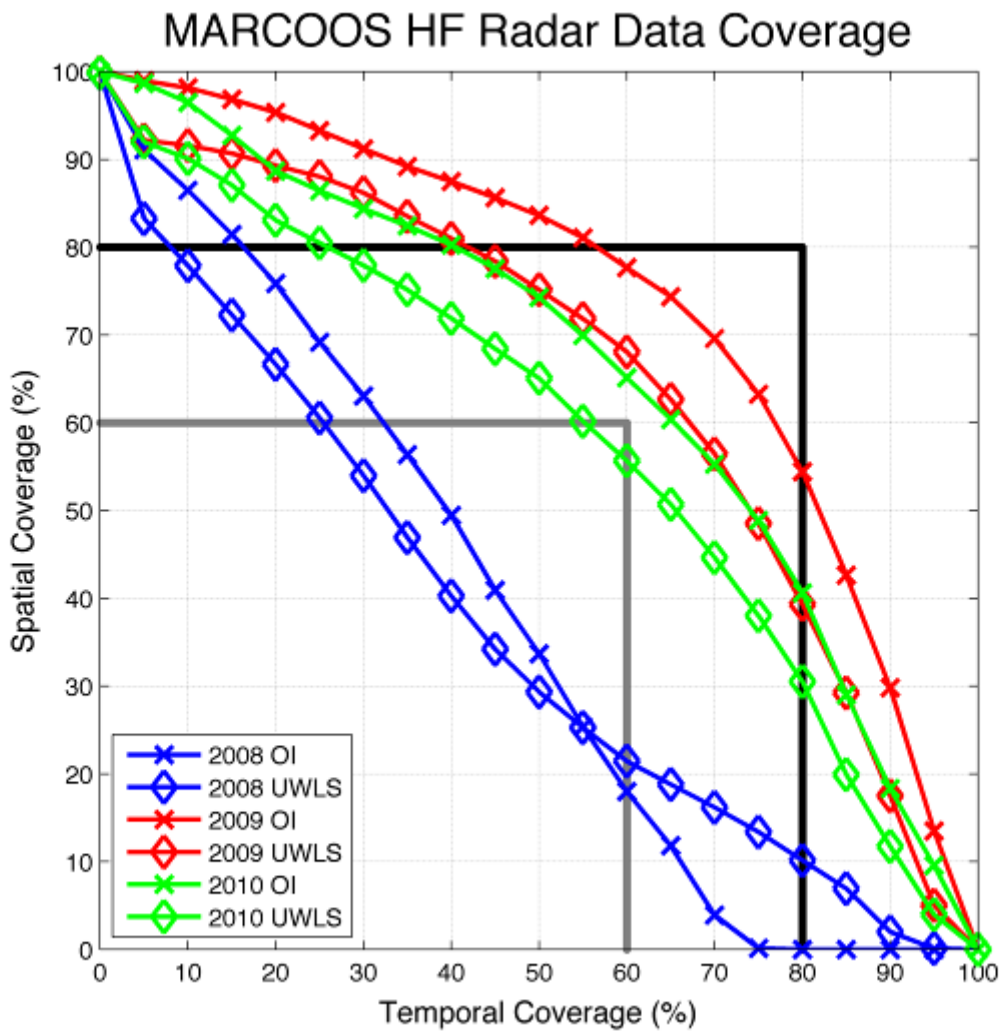
Network Performance

Spatial and Temporal Coverage Metric





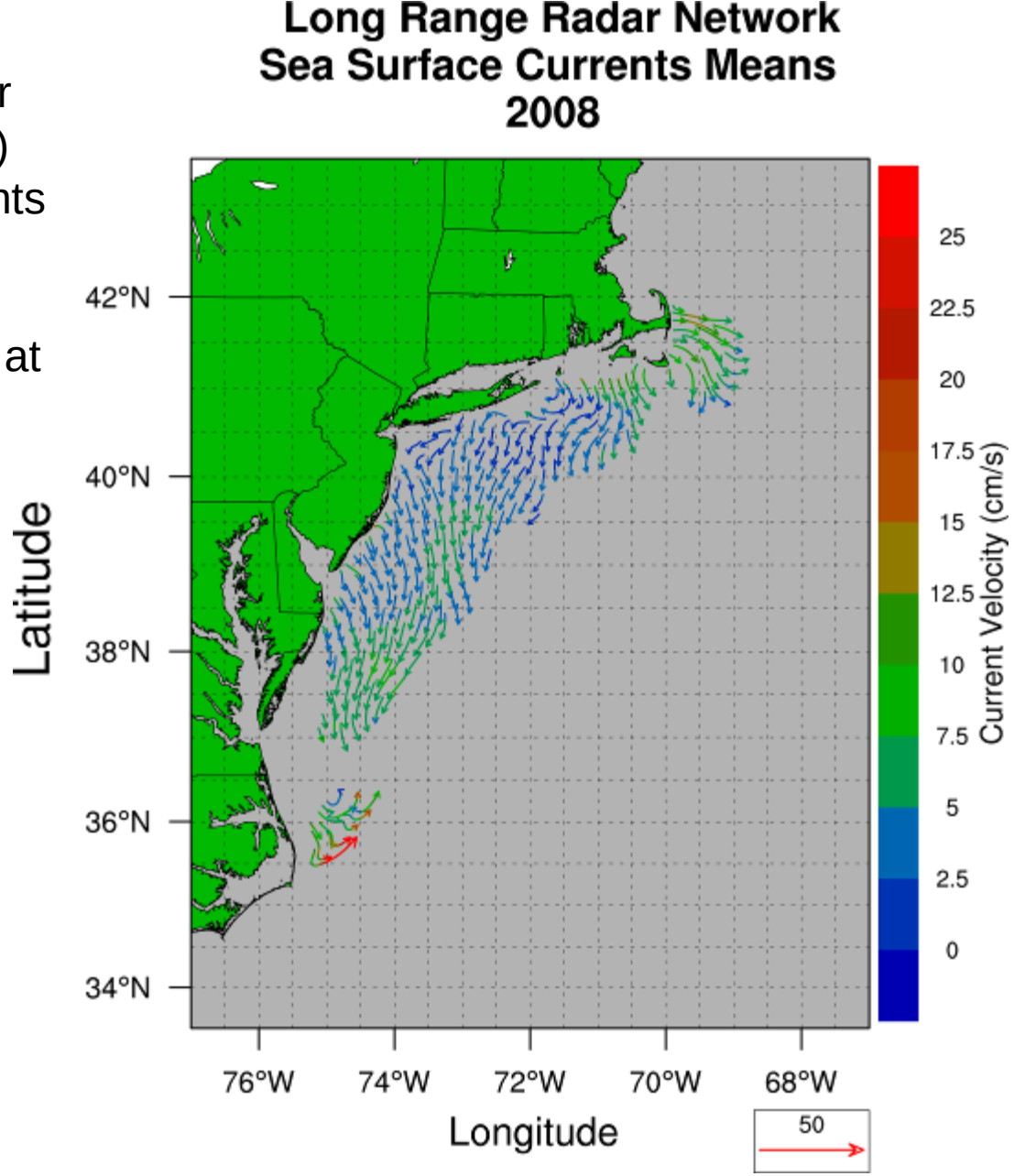
Spatial and Temporal Coverage Metric



Science Results

NCAR Computer Language (NCL) used to plot currents

25% temporal coverage needed at each grid point



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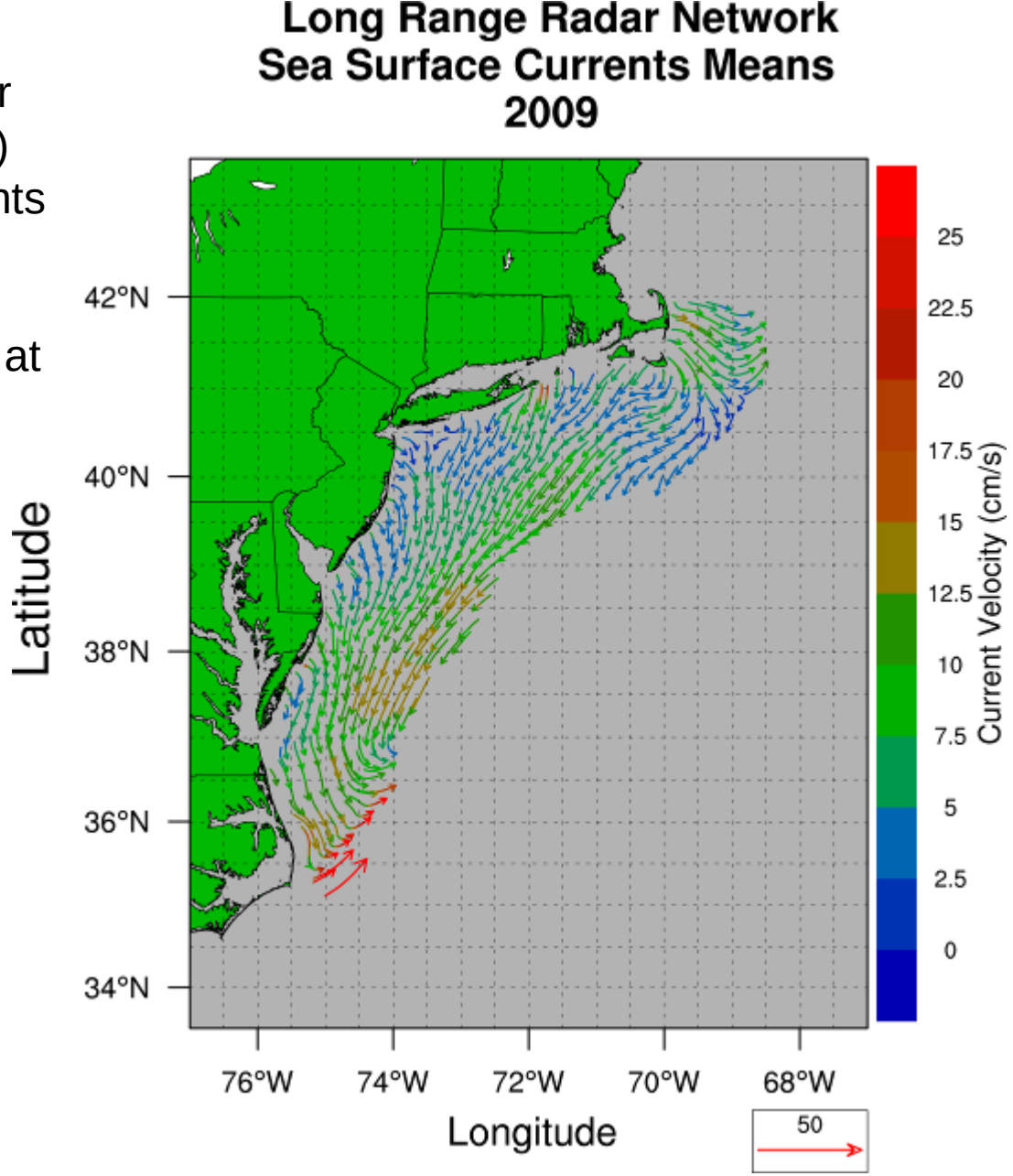

NCAR Computer Language (NCL) used to plot currents

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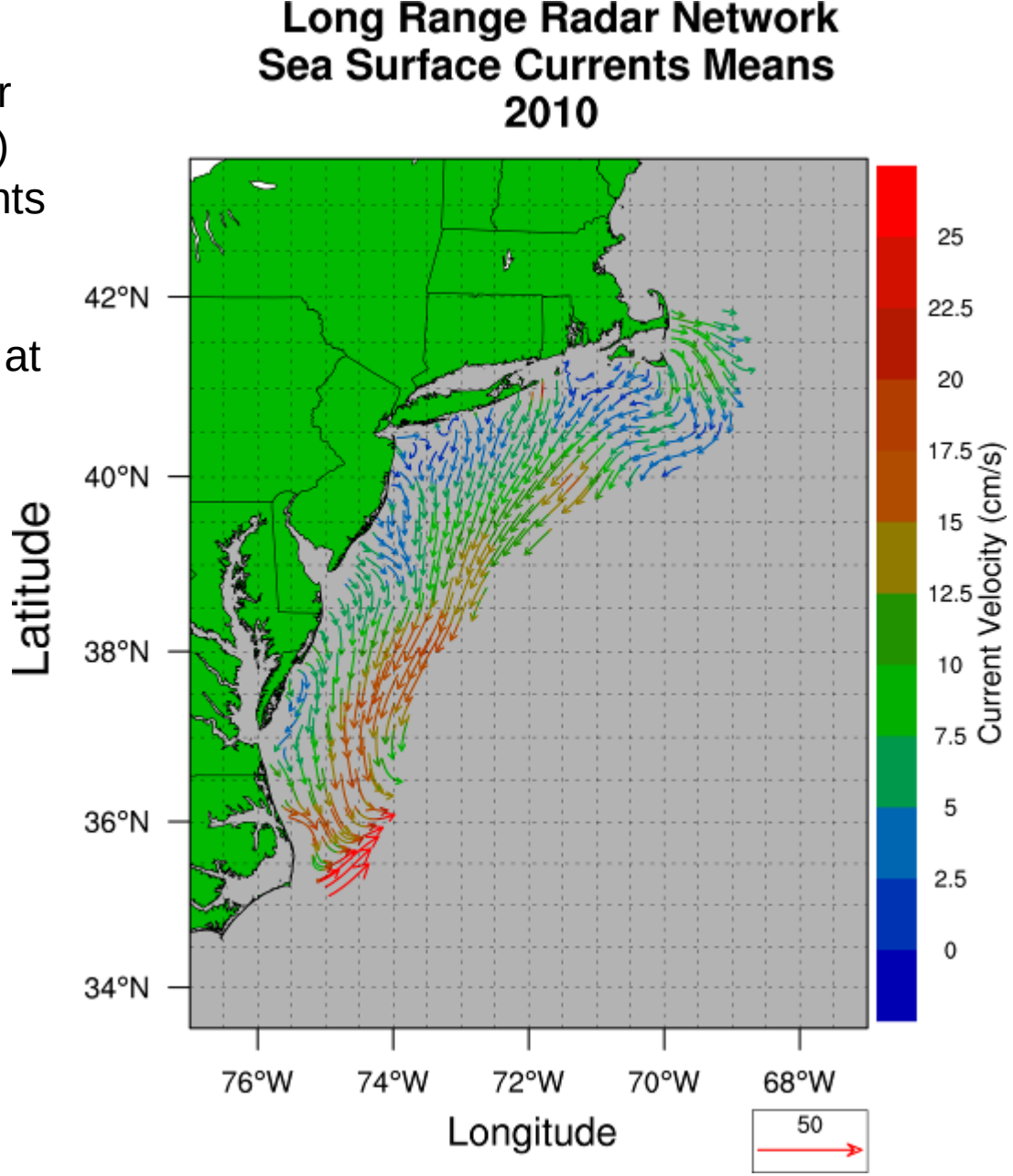
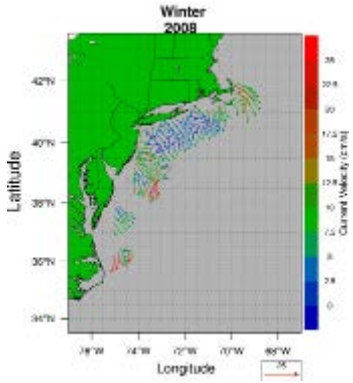
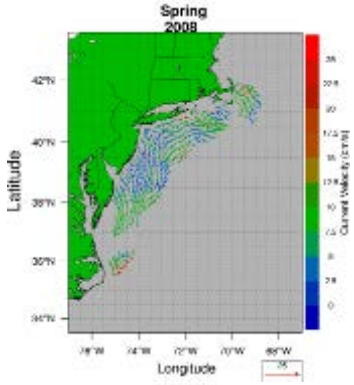
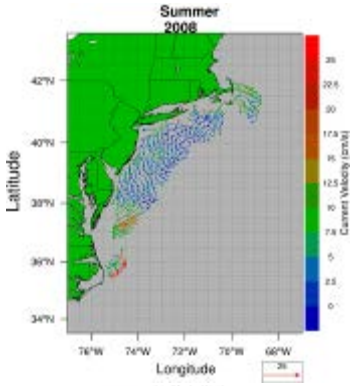
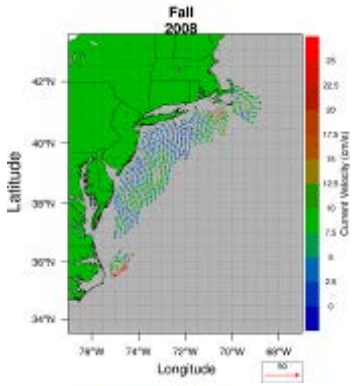
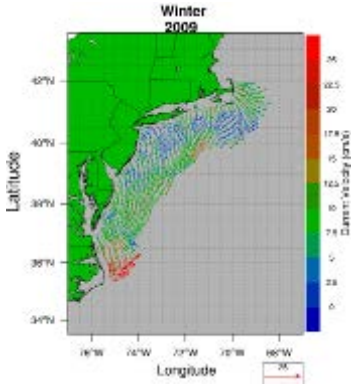
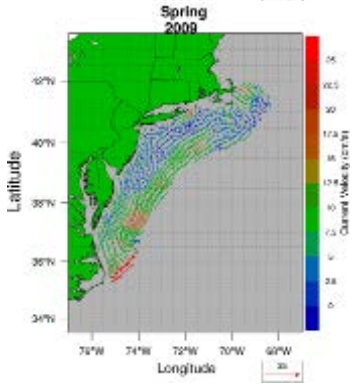
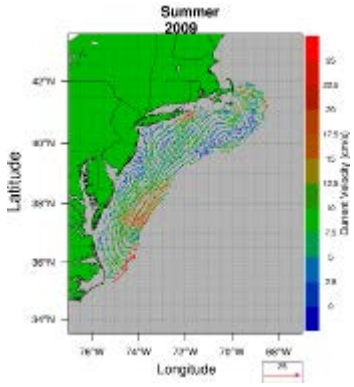
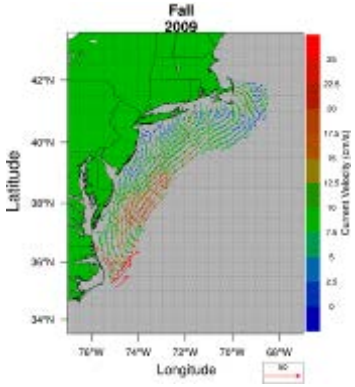
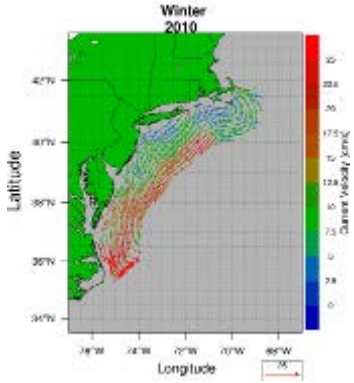
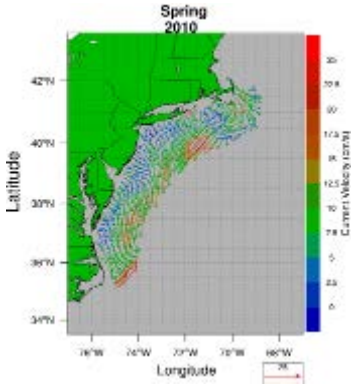
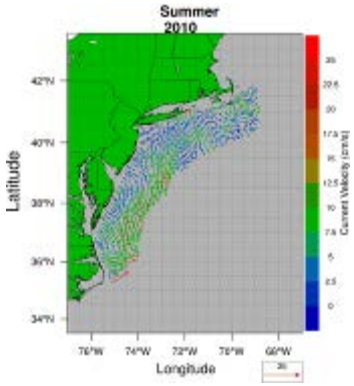
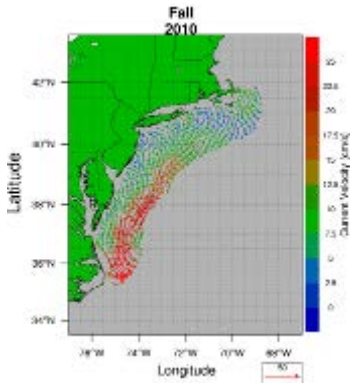
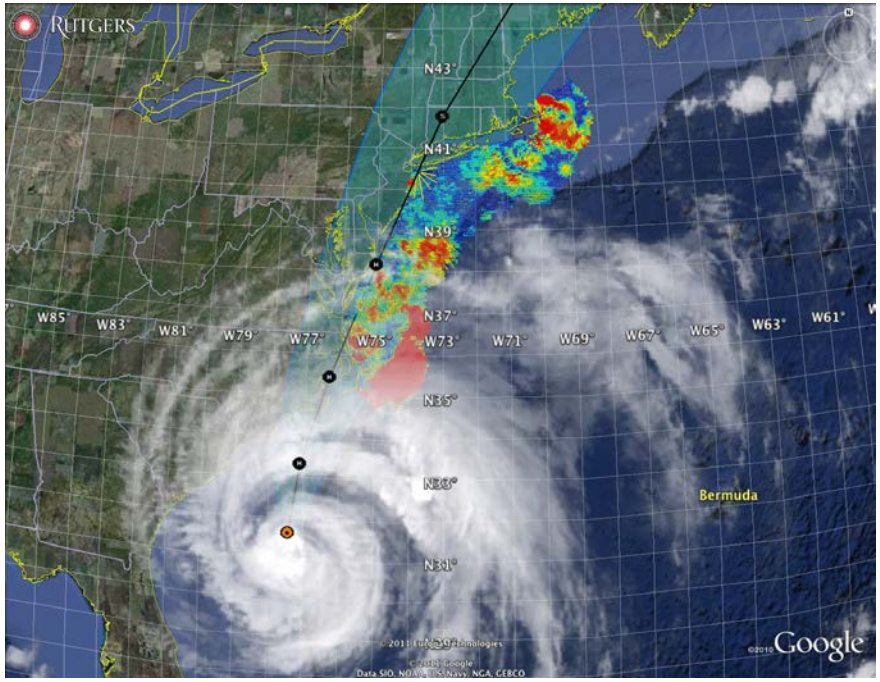
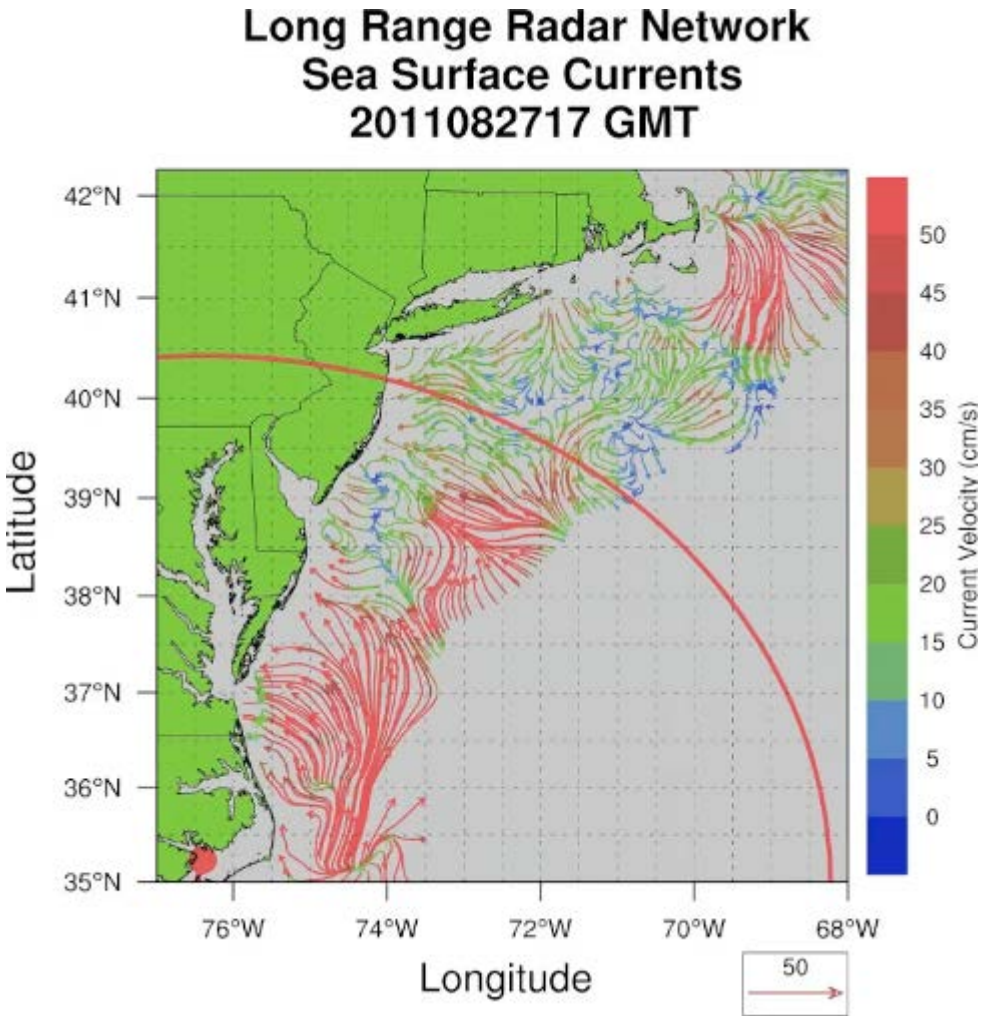


	Winter	Spring	Summer	Fall
2008				
2009				
2010				

Science Results – Tracking Hurricane Irene



Hurricane Irene Approaches the MARACOOS HF Radar Network

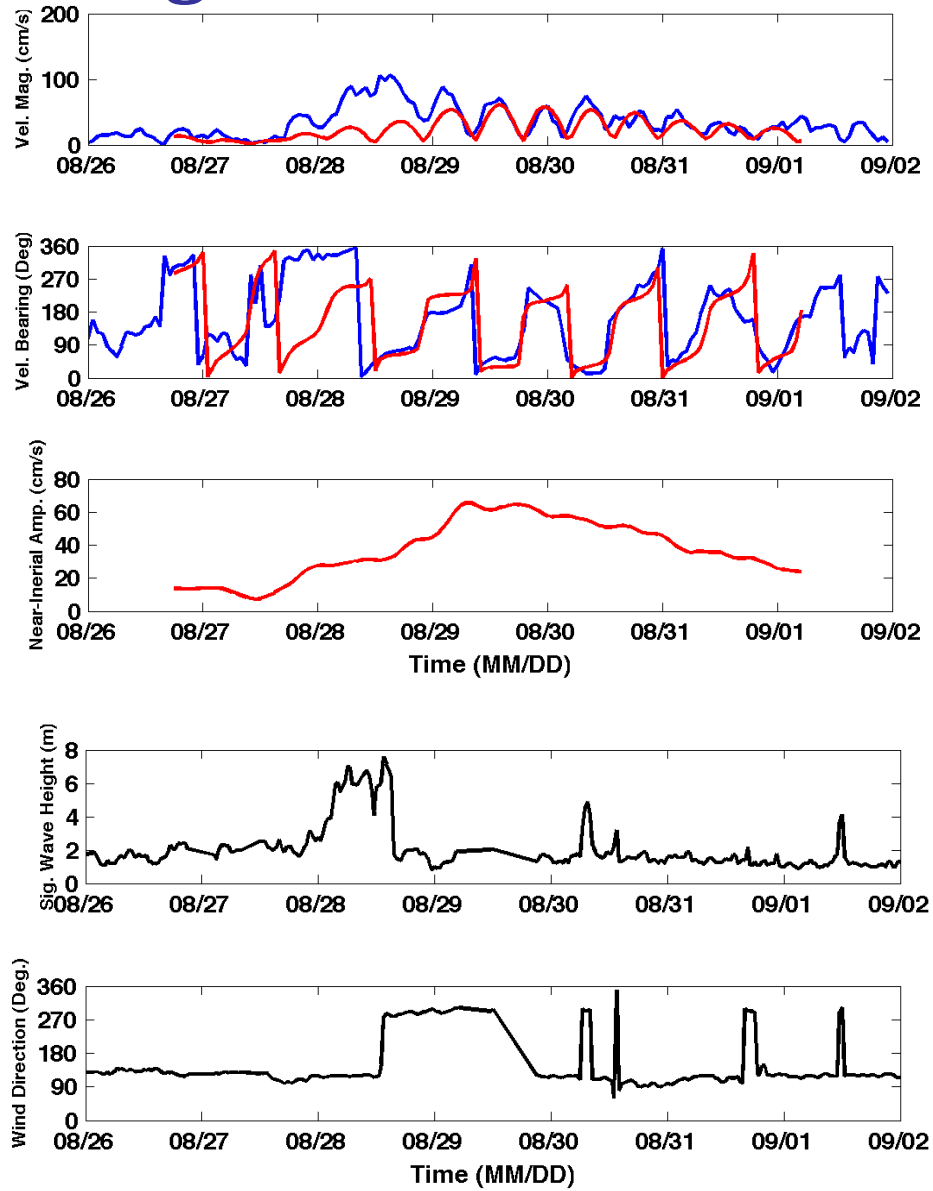


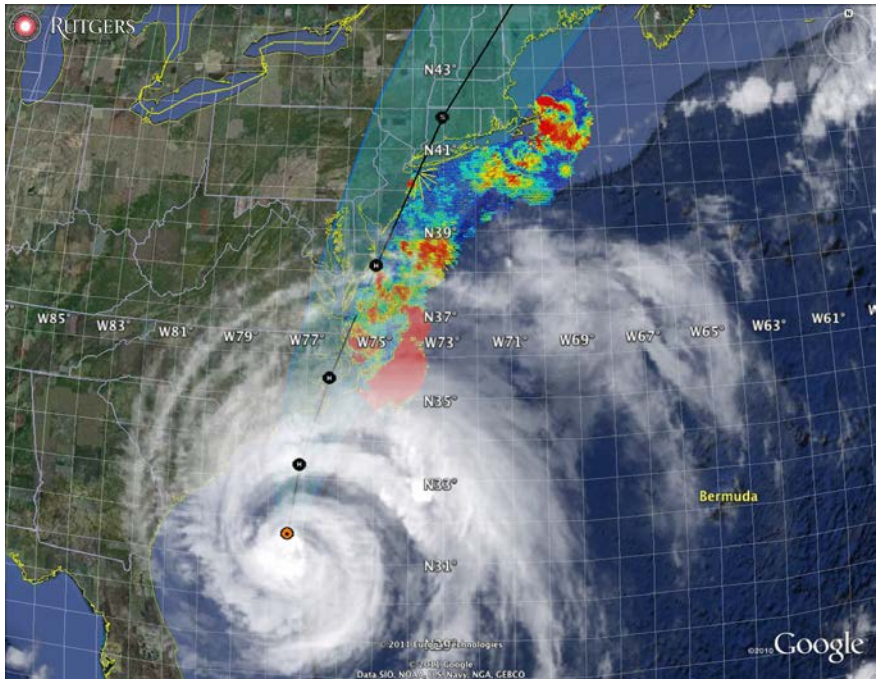
Science Results – Tracking Hurricane Irene

39.5N 73W Surface Current Time Series >

Total Current Near-Inertial Current

Period 18 hours

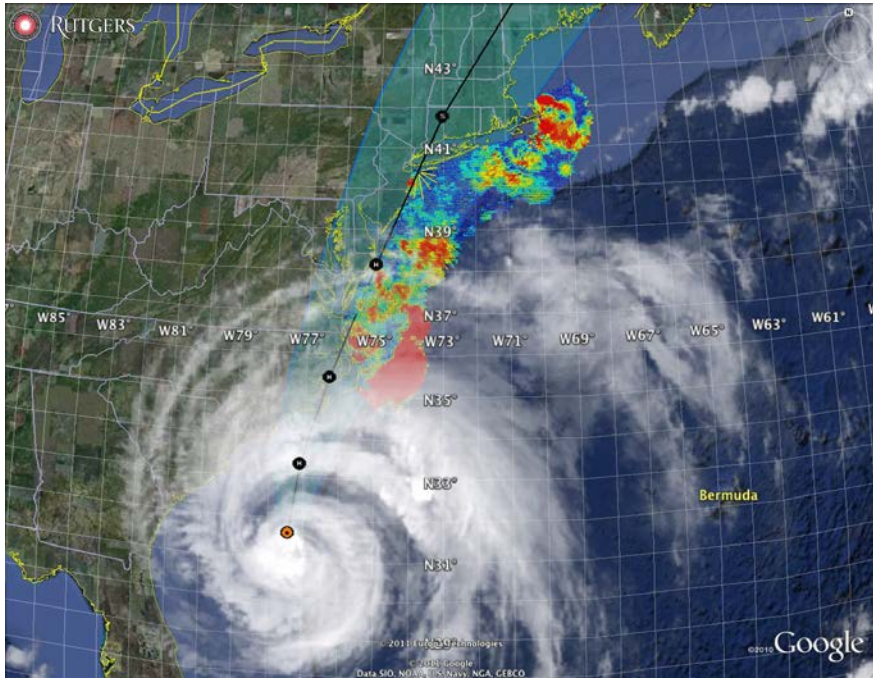




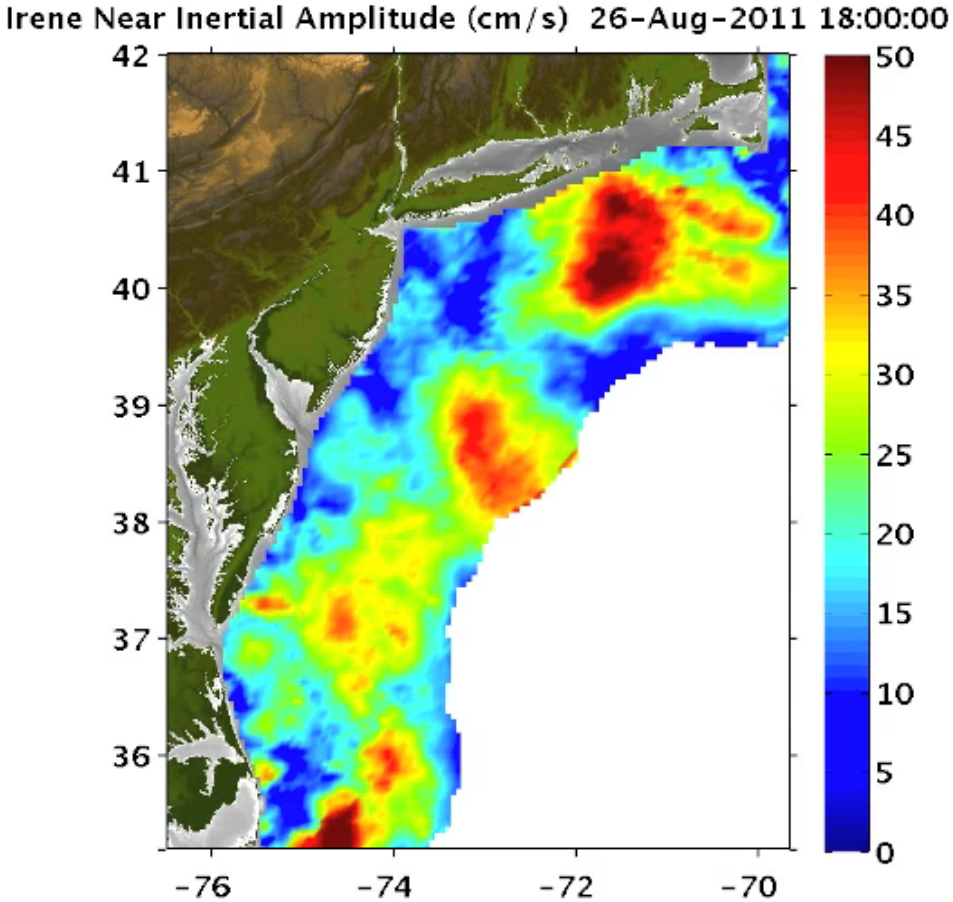
Hurricane Irene Approaches the MARACOOS HF Radar Network

HF Radar Wave & Wind Direction Time Series >

Science Results – Tracking Hurricane Irene

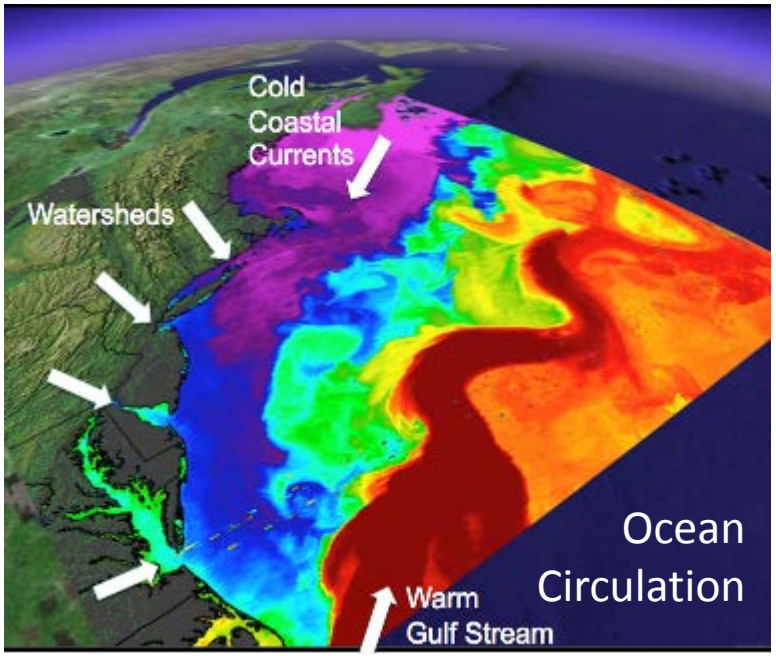


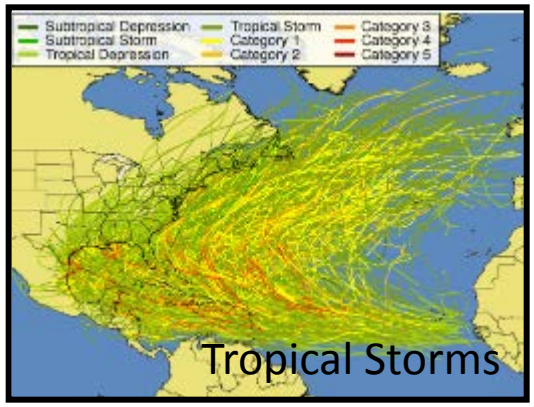
Hurricane Irene Approaches the MARACOOS HF Radar Network

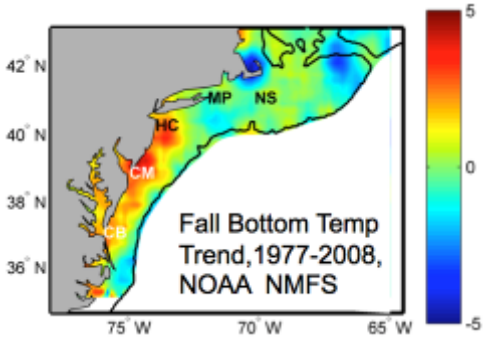


Application Results

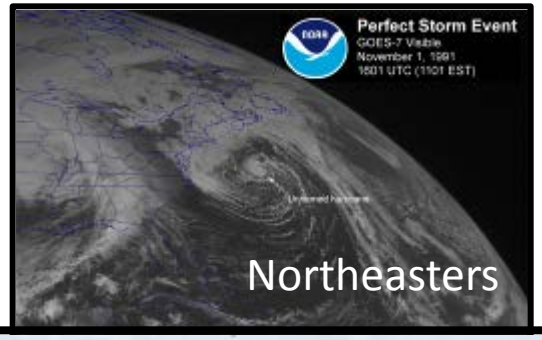
MIDDLE ATLANTIC REGIONAL DRIVERS

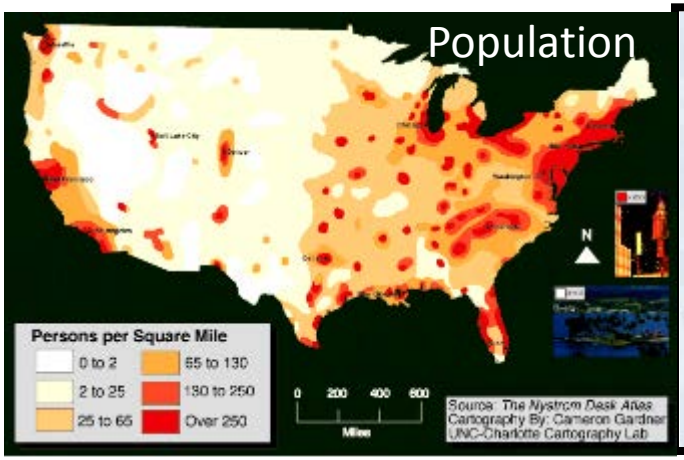






Climate Change





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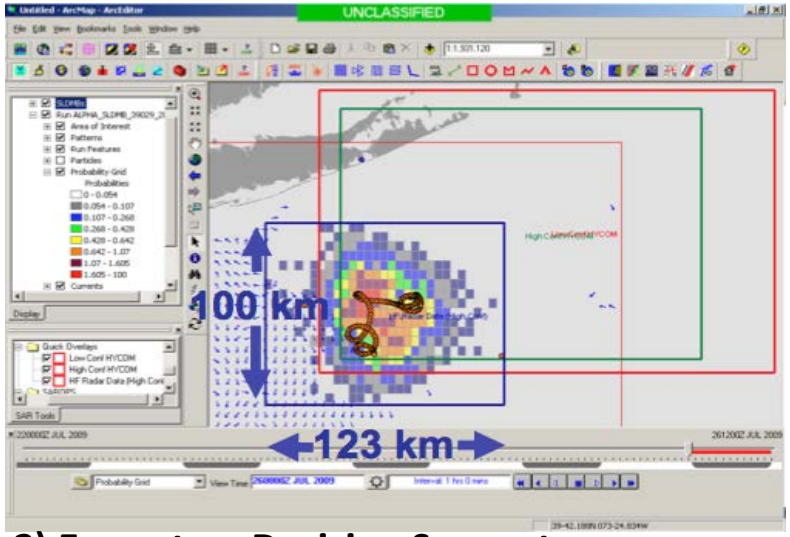
INTEGRATED OCEAN OBSERVING SYSTEM

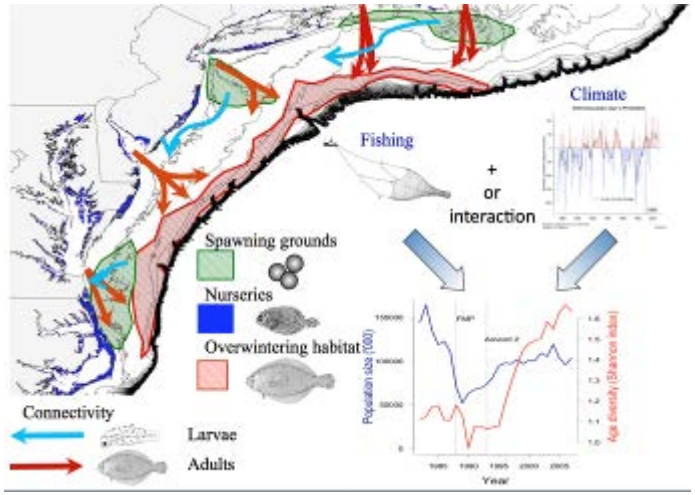
MARACOOS REGIONAL THEMES & SUCCESS STORIES

1) Maritime Operations – Safety at Sea

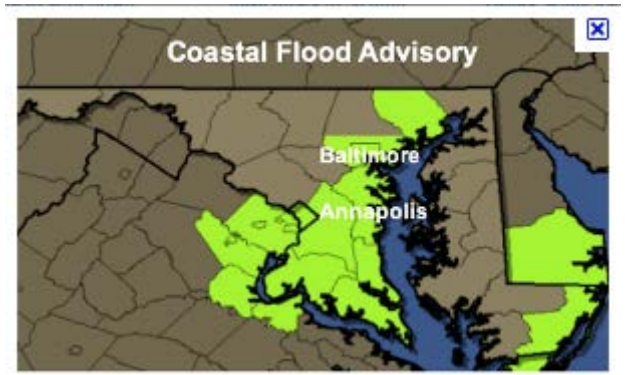


3) Water Quality – a) Floatables, b) Hypoxia, c) Nutrients

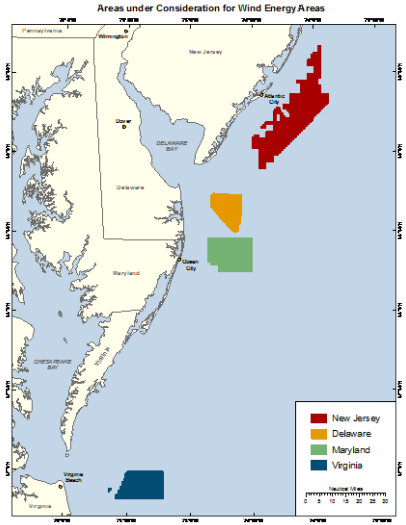
2) Ecosystem Decision Support - Fisheries



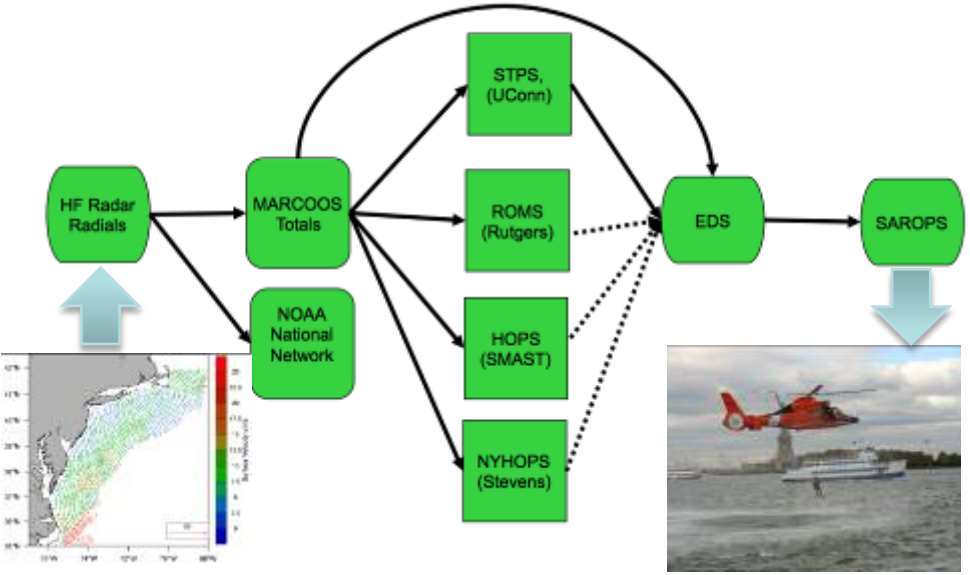
4) Coastal Inundation - Flooding



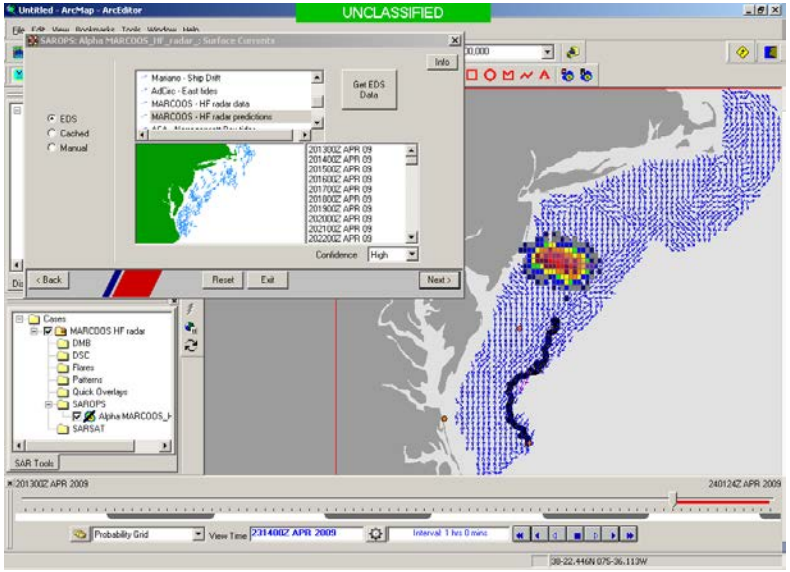
5) Energy – Offshore Wind



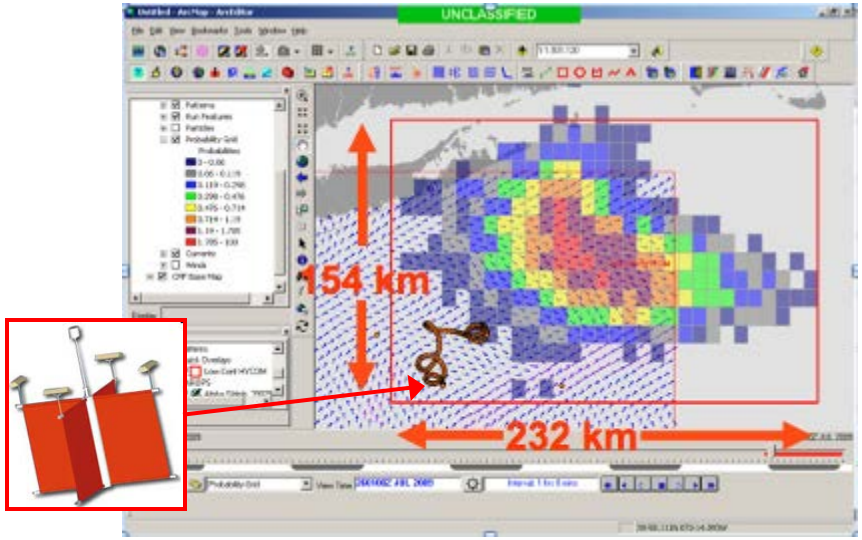
U.S. Coast Guard: Search And Rescue Optimal Planning System *SAROPS*



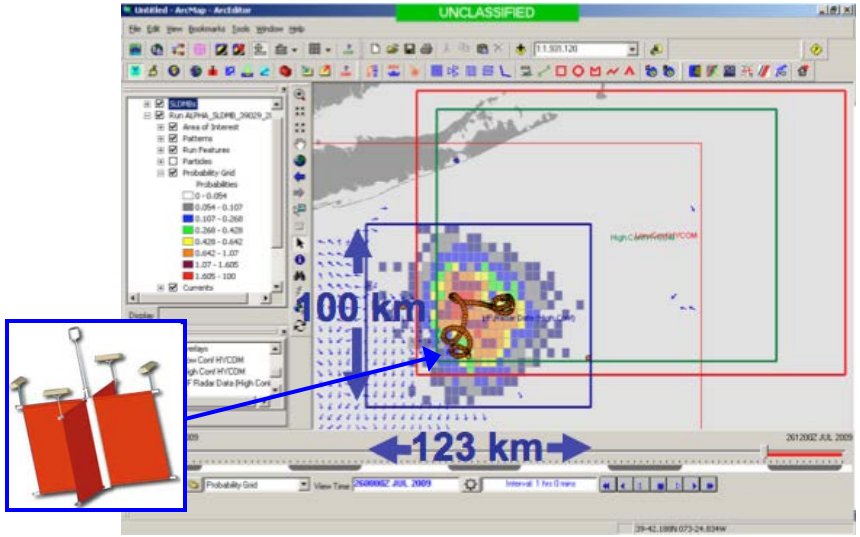
Mid-Atlantic Operational Data Flow to SAROPS



SAROPS User Interface



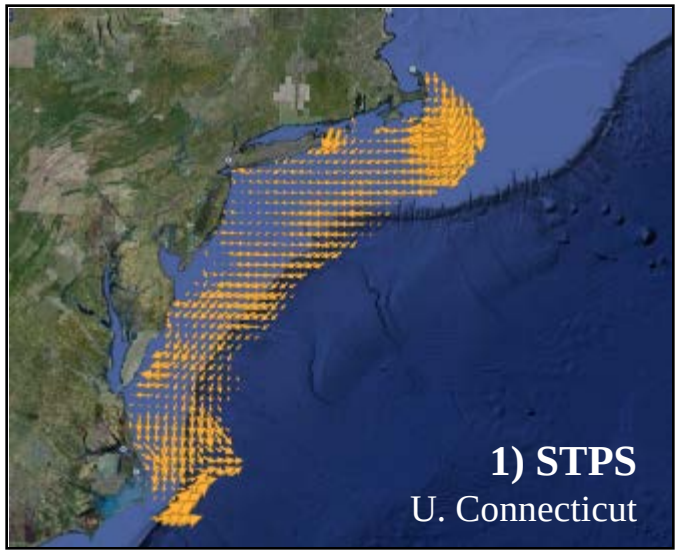
SAROPS 96-Hour Search Area: **HYCOM = 36,000 km²**

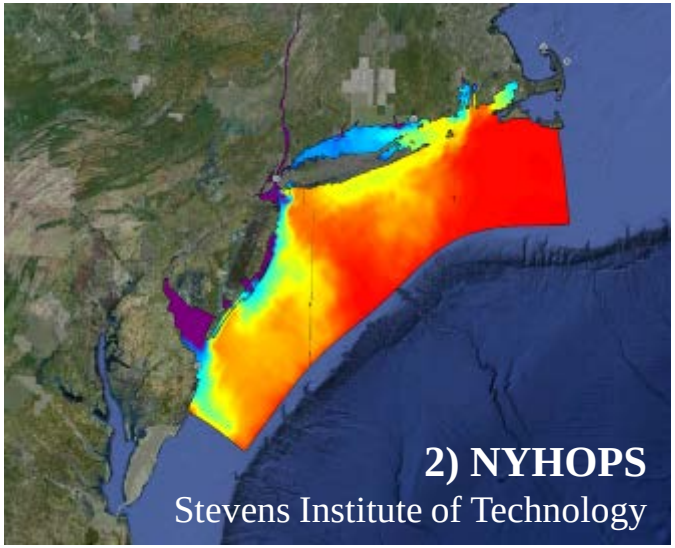


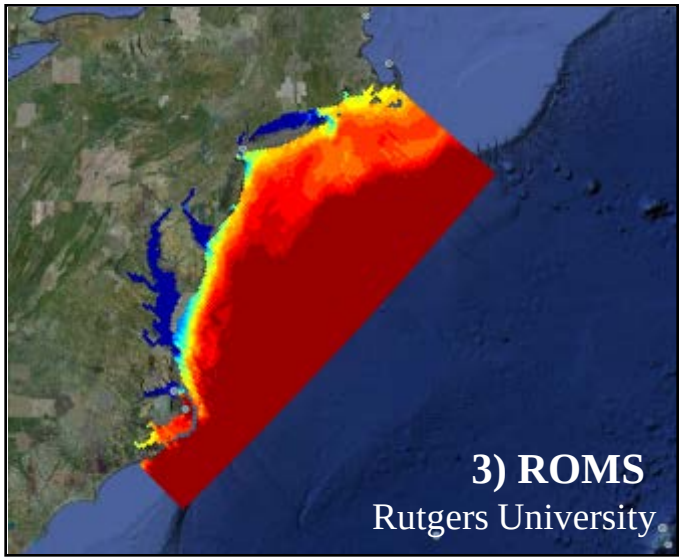
SAROPS 96-Hour Search Area: **HF Radar = 12,000 km²**

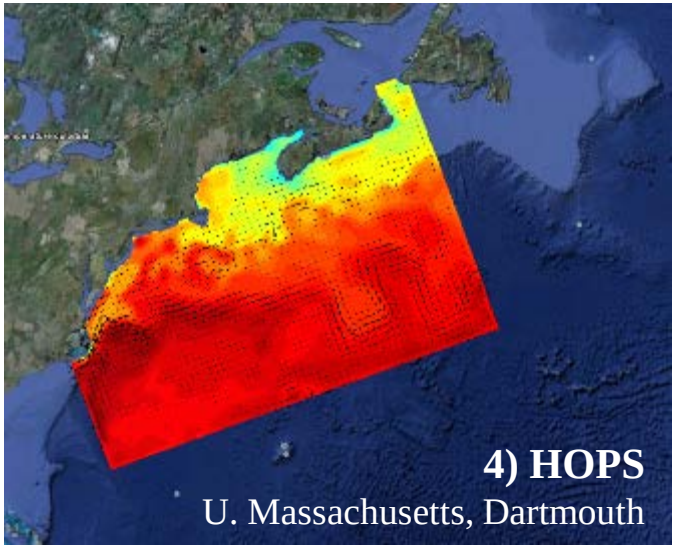
U.S. Coast Guard: Search And Rescue Optimal Planning System *SAROPS*

1 Statistical & 3 Dynamical Data-Assimilative Forecast Models



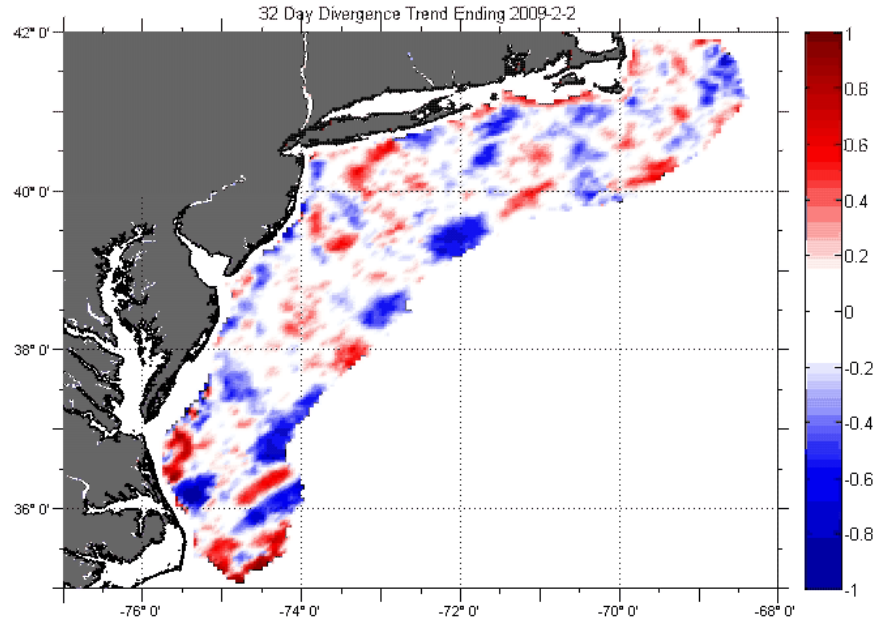






Ecological Decision Support – Fisheries

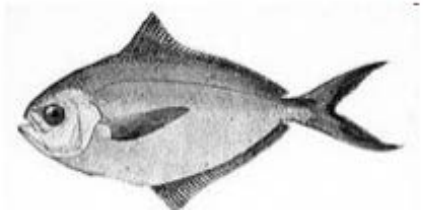
+



Divergence index

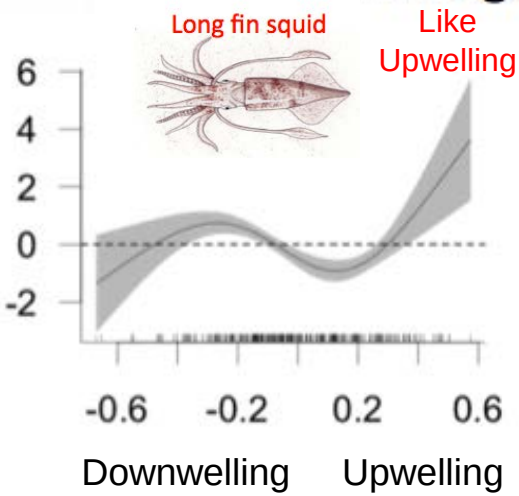
Long fin squid

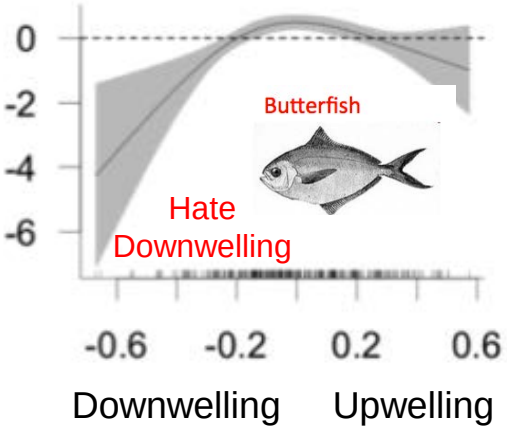
Butterfish



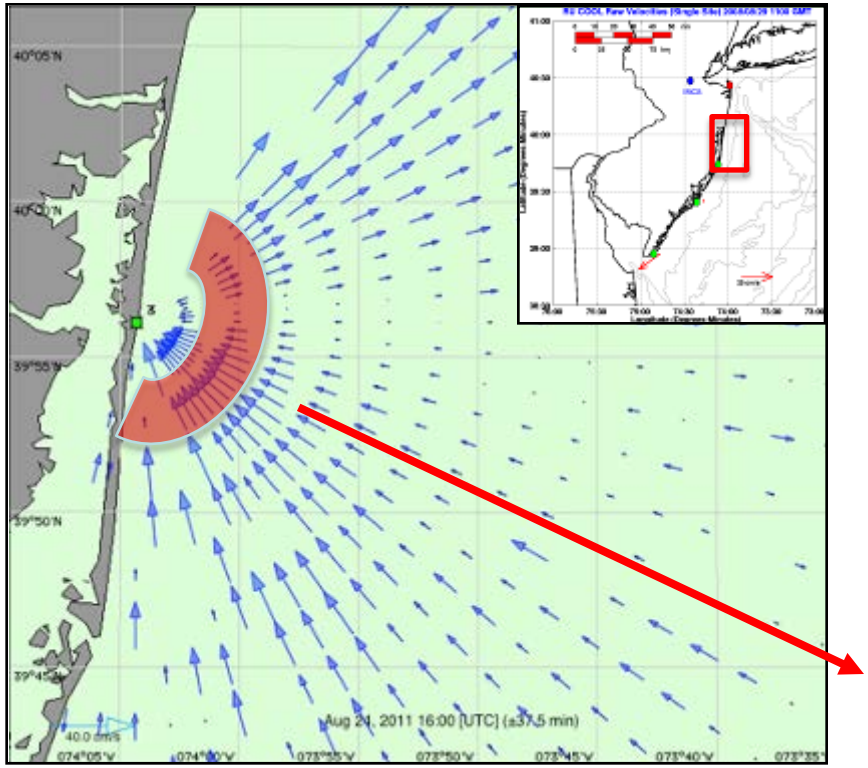
Our Approach:

Develop statistical models using bottom trawl surveys and MARACOOS 3-D data to predict species distribution based on observed or forecasted MARACOOS 3-D fields.

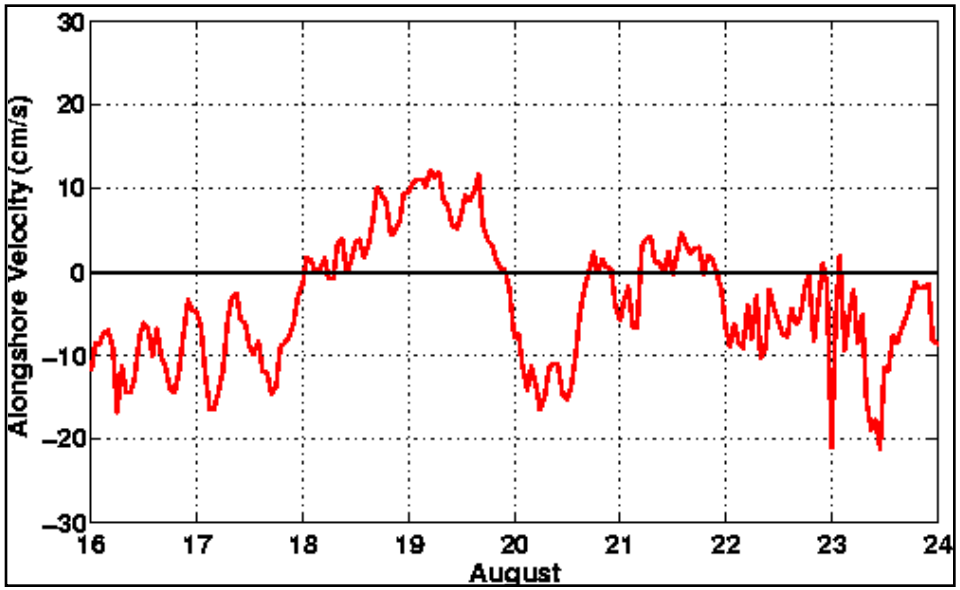




Water Quality – Nearshore Currents



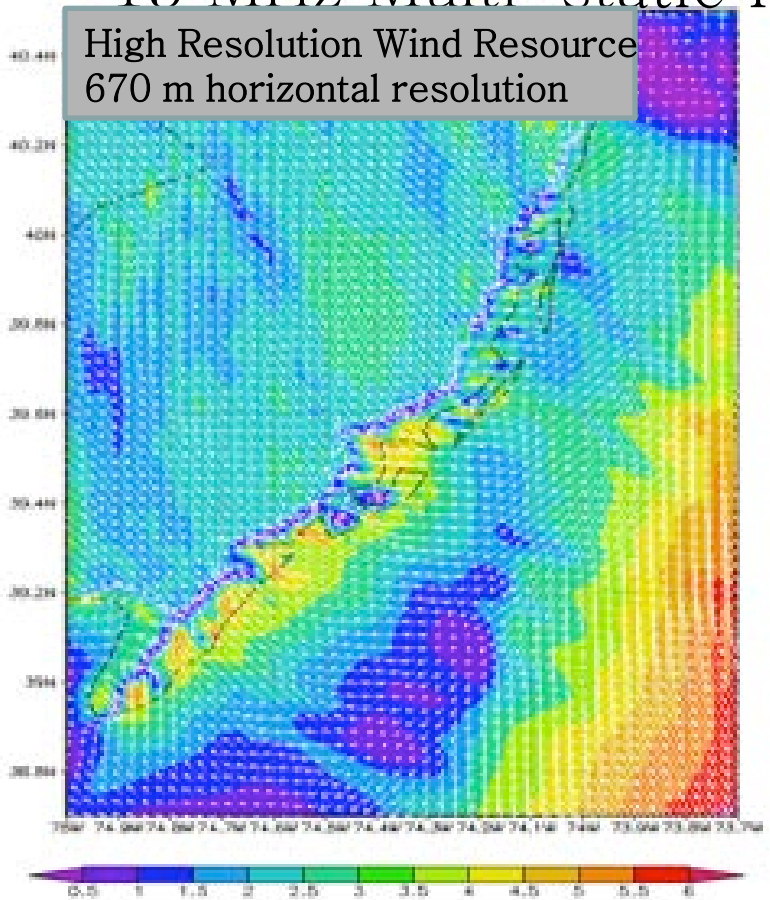
Alongshore Current



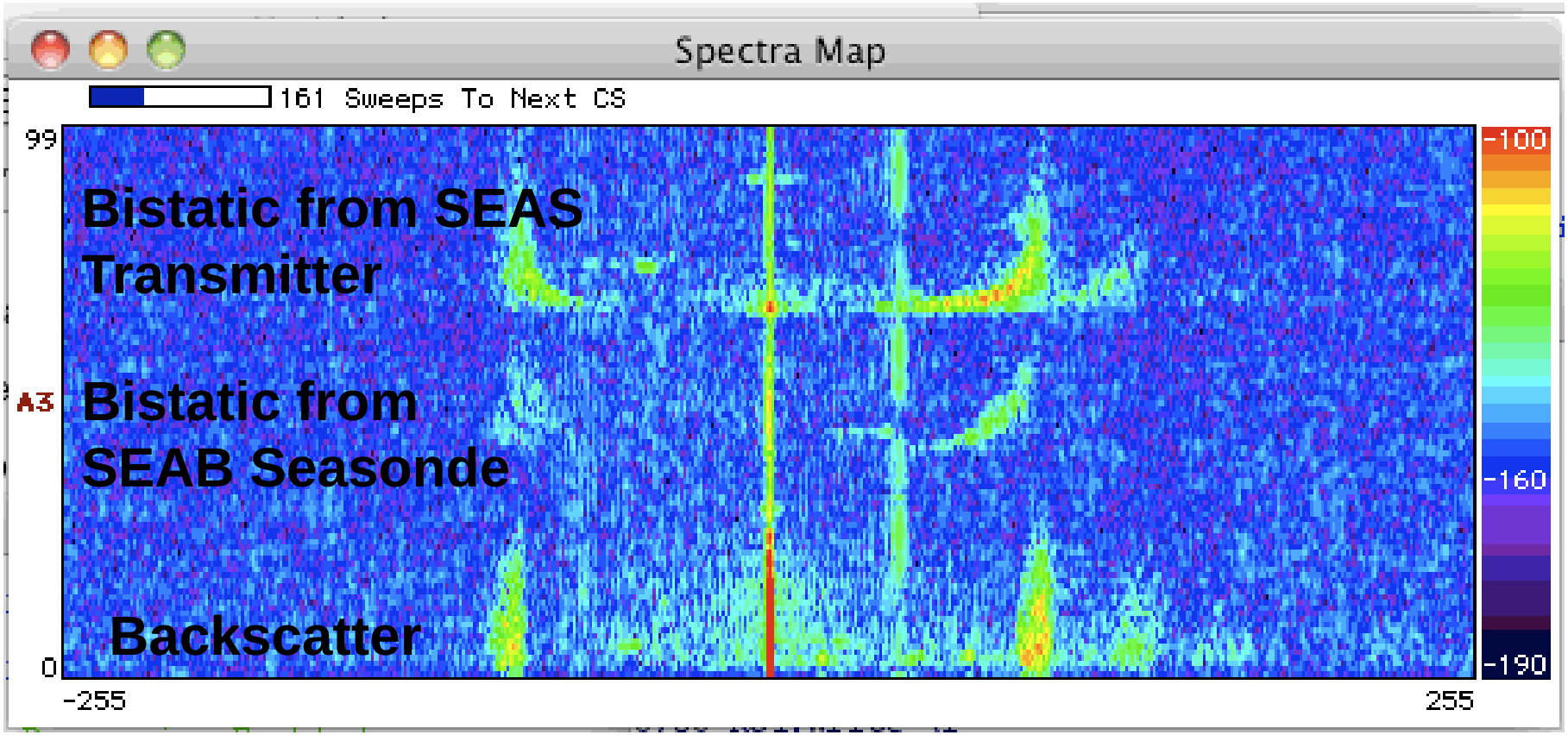
Nearshore currents derived from single site radial currents track the movement of water quality constituents within 3 km of the beach.

Offshore Energy – High Resolution Atmospheric Forecast validated with HF radar

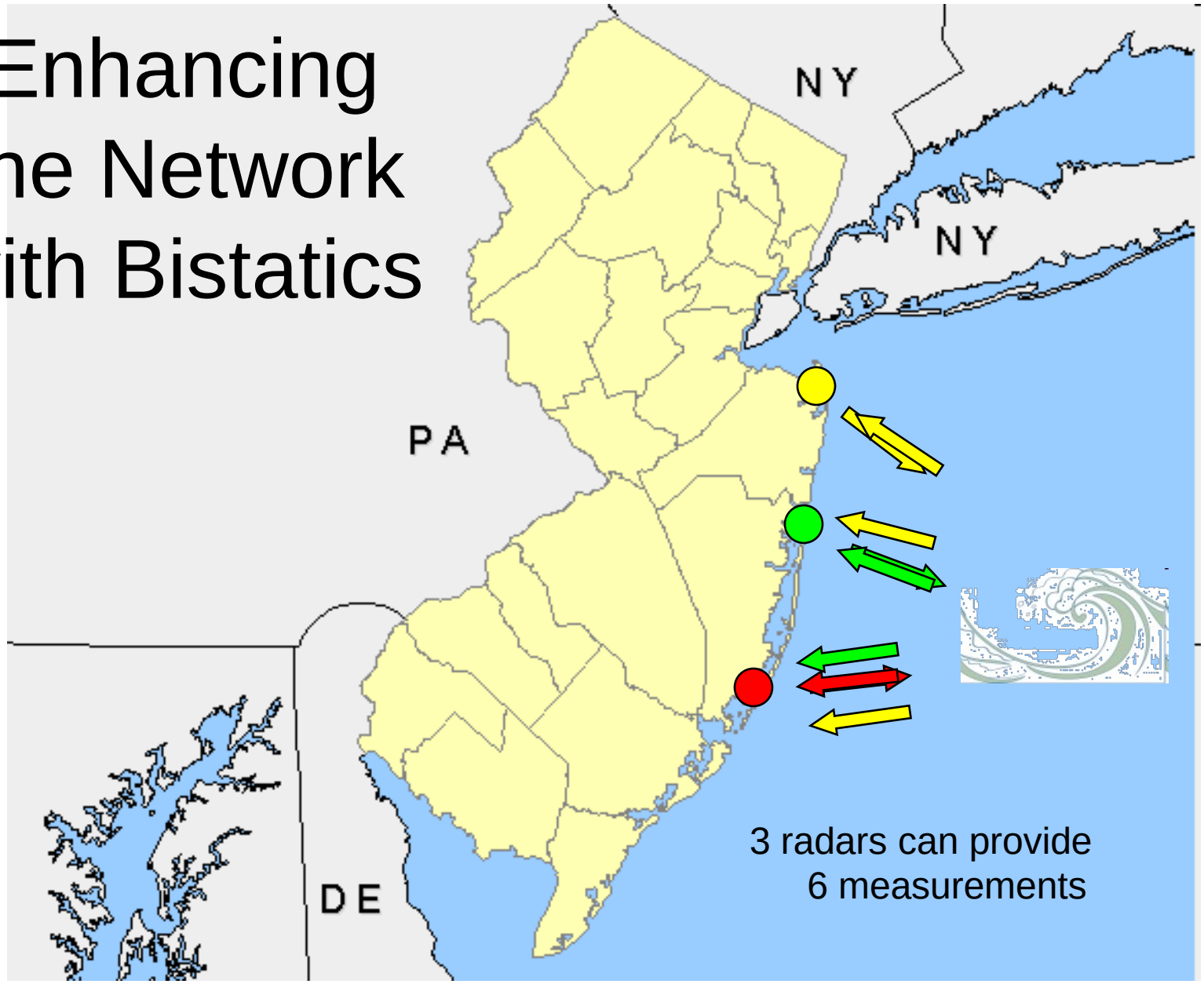
Spatial validation of Atmospheric Model with 13 MHz Multi-static HF Radar Array



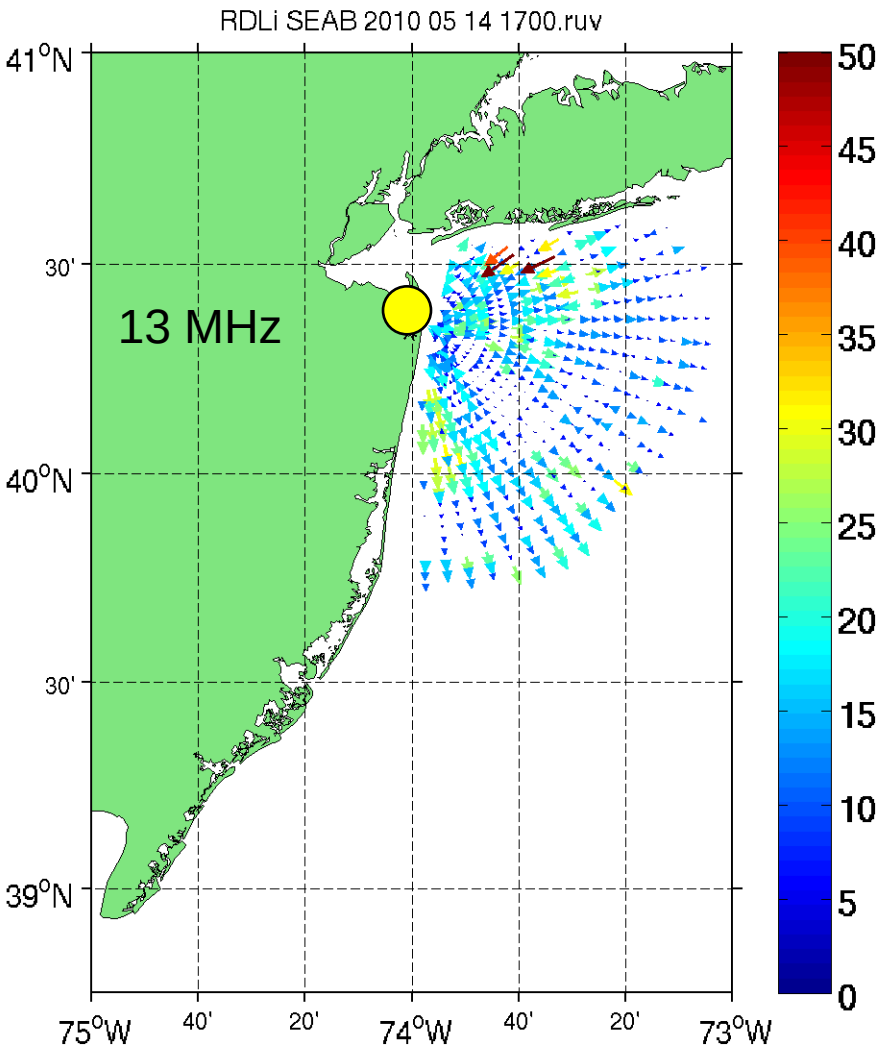
Enhancing the Network with Bistatics



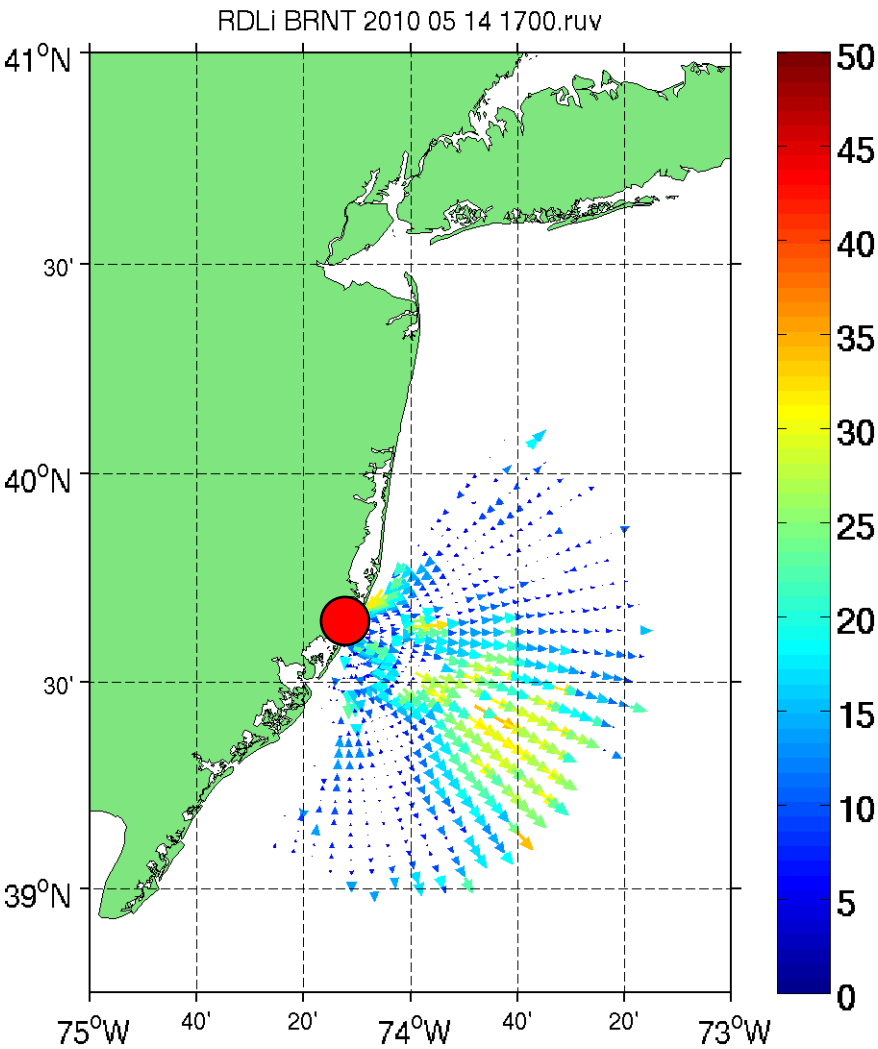
Enhancing the Network with Bistatics



Radial Current Vectors



/home/hroarty/codar/MARCOOS/Radial_Plot/scratch_radi



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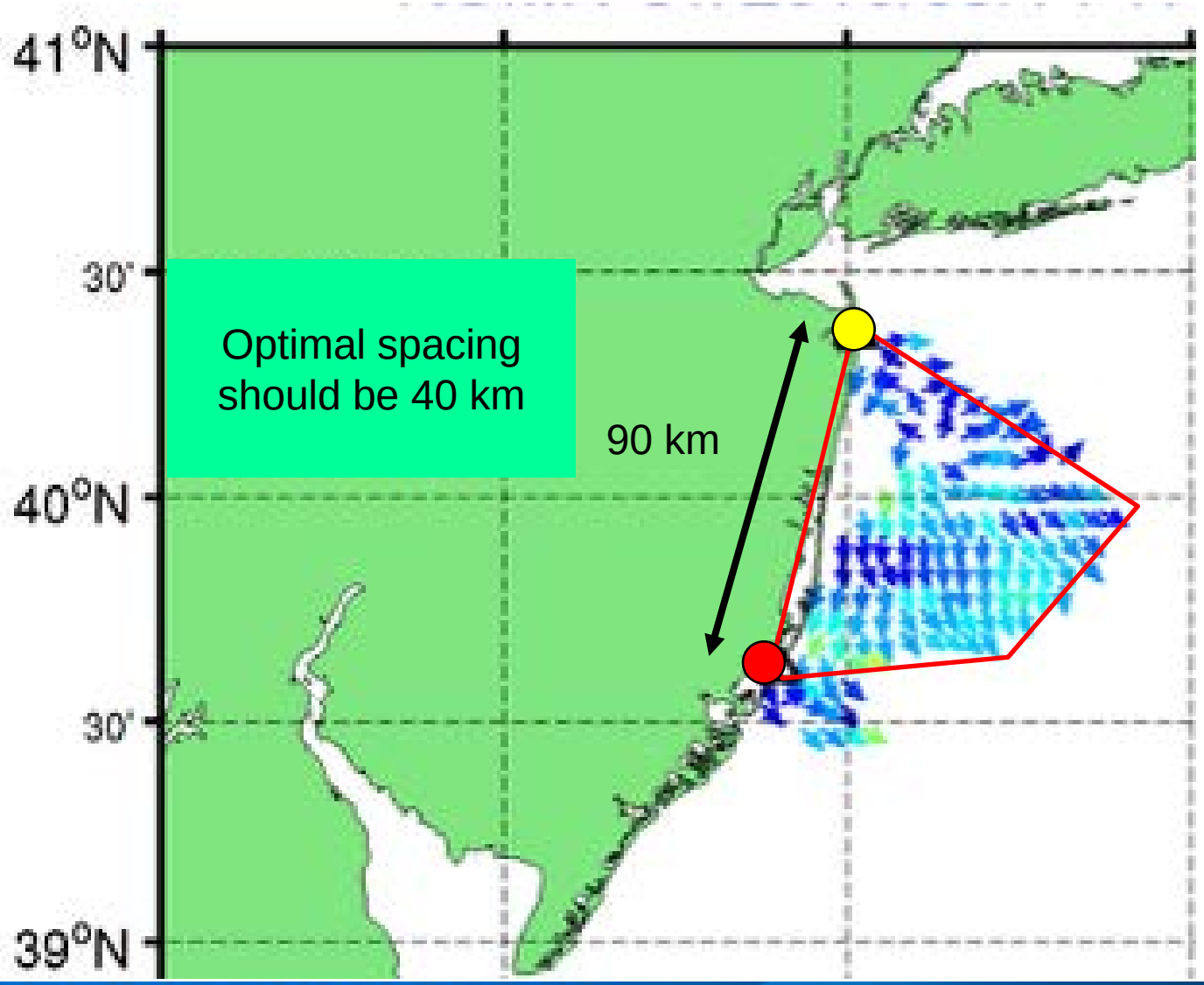
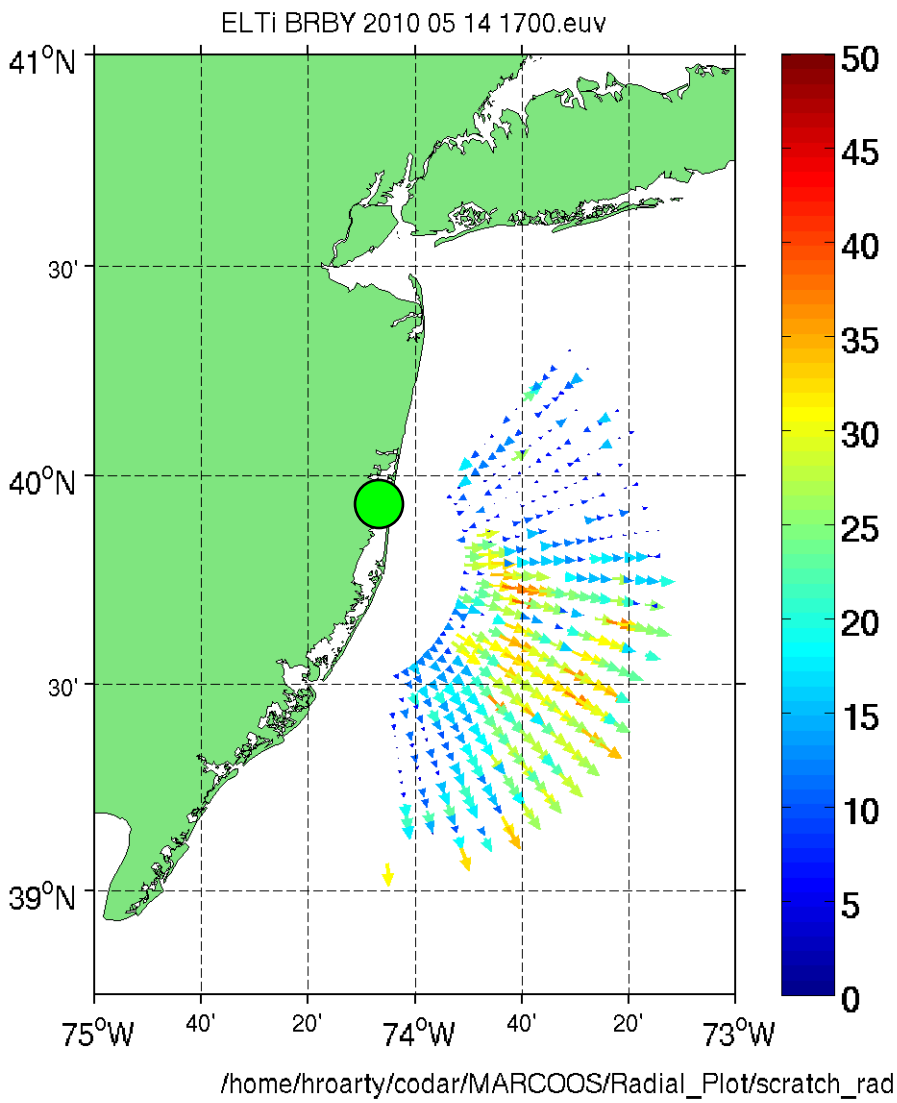
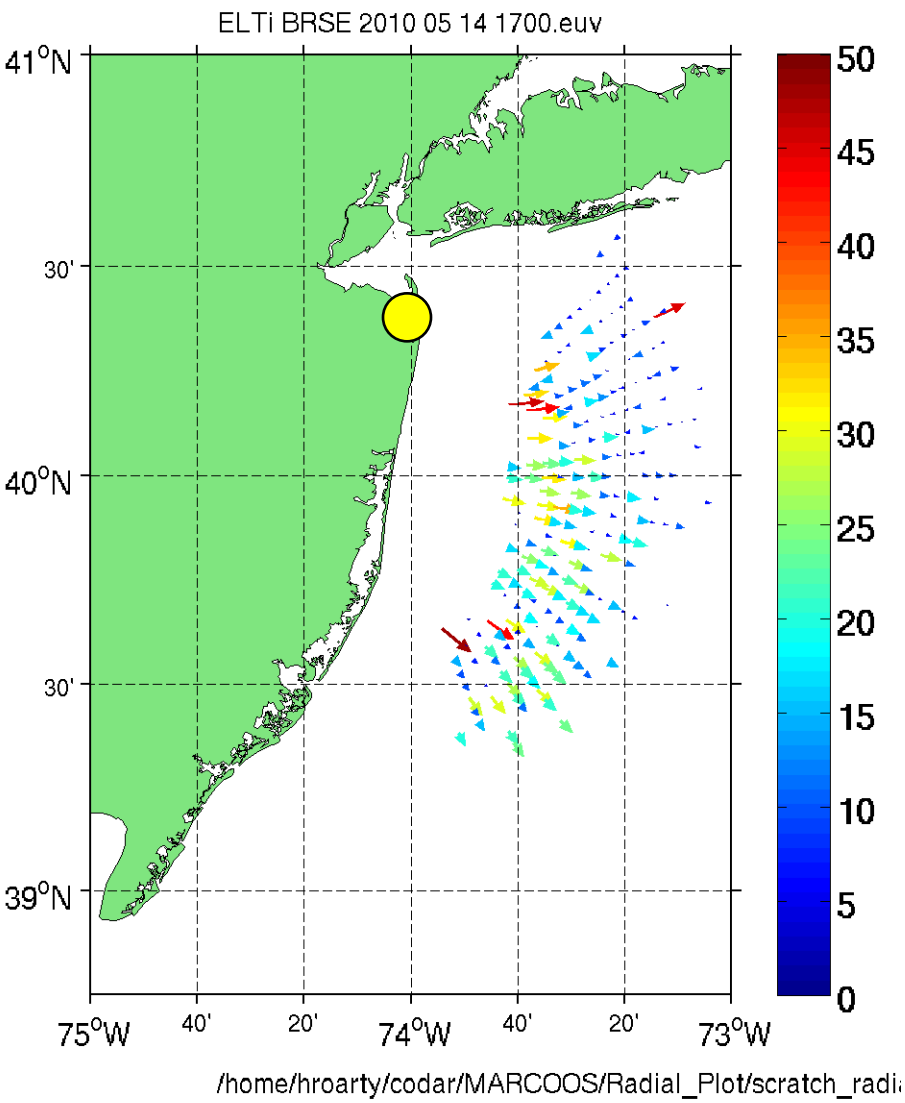
Totals from Radials

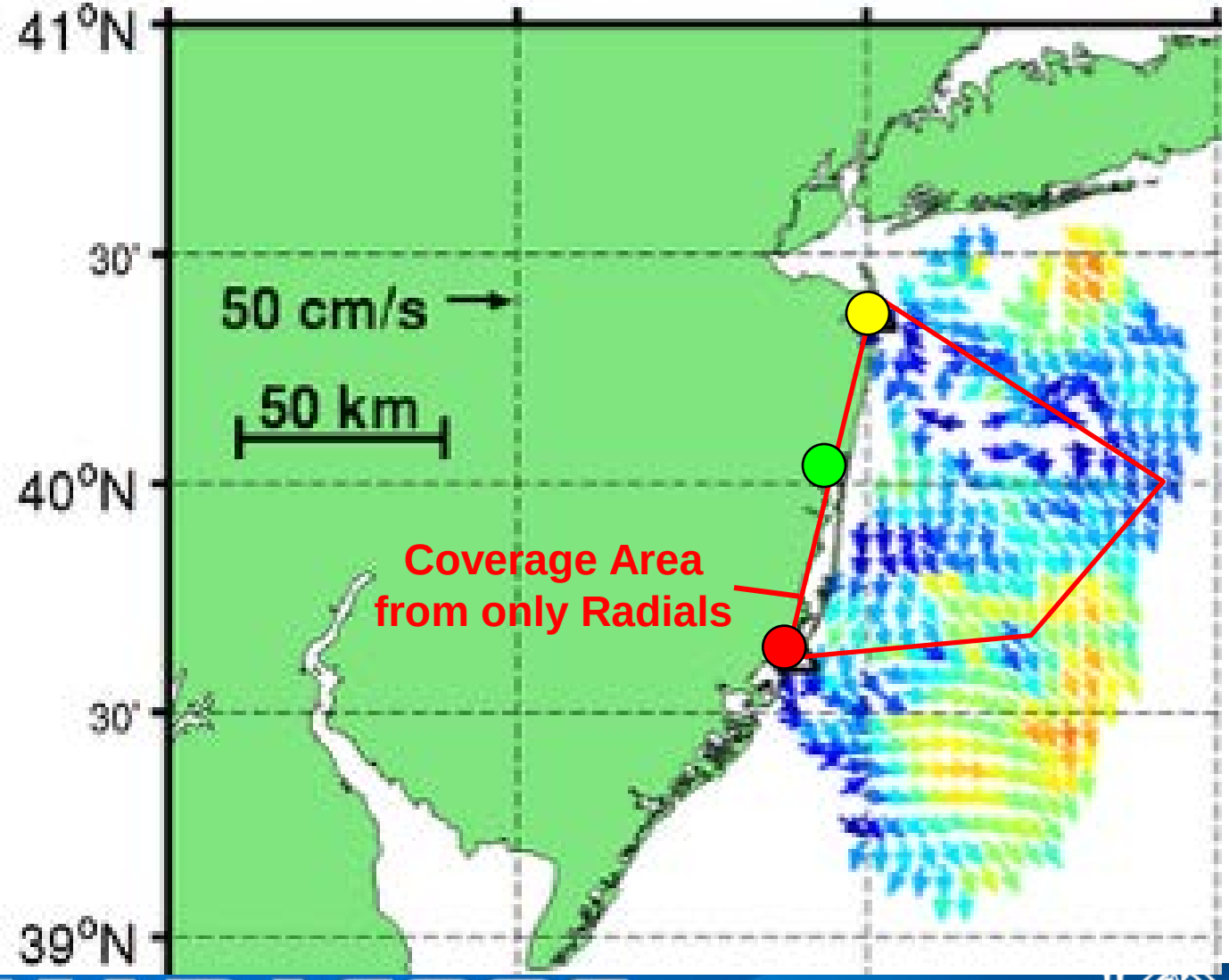


Elliptical Current Vectors





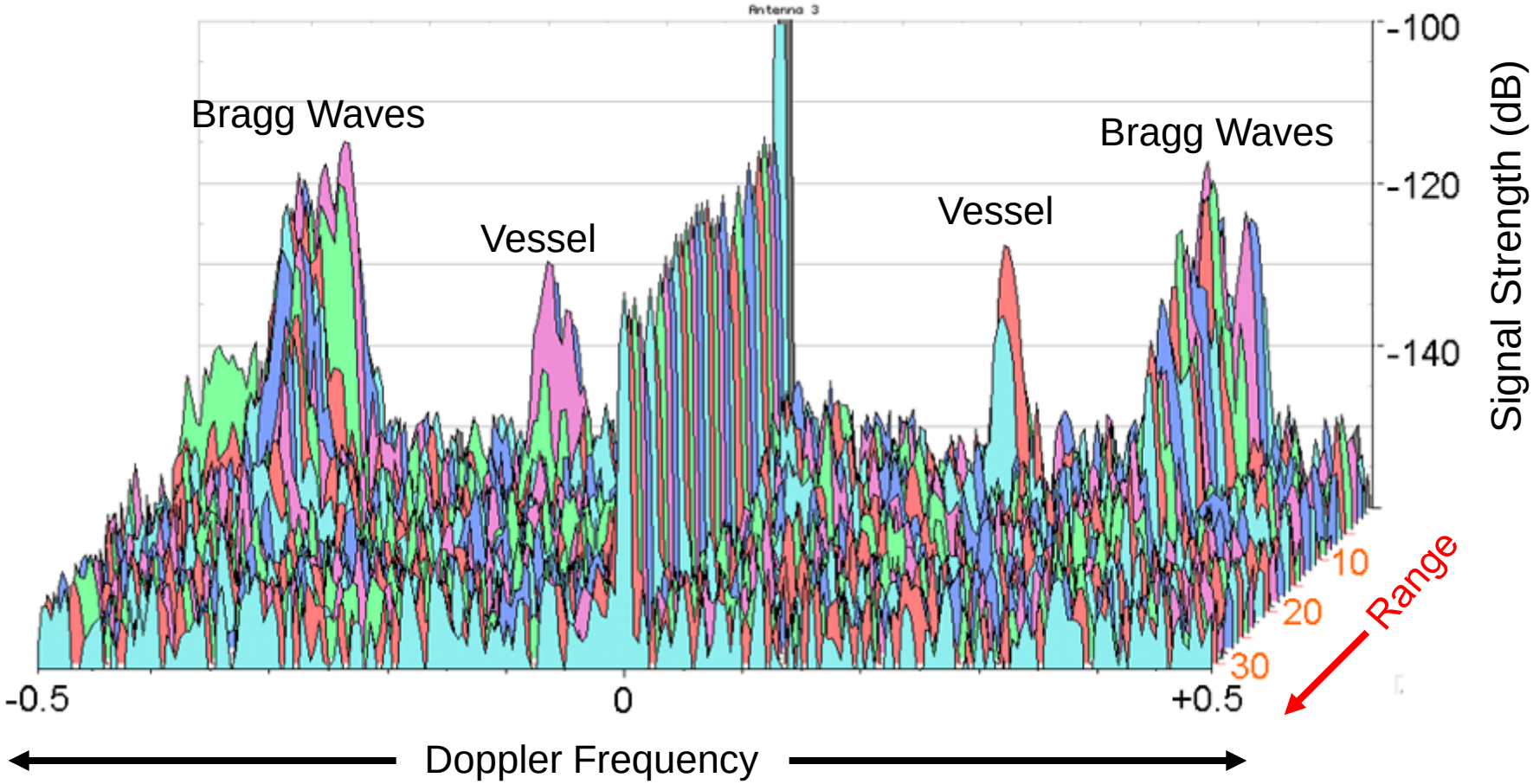
Totals from Radials & Ellipticals



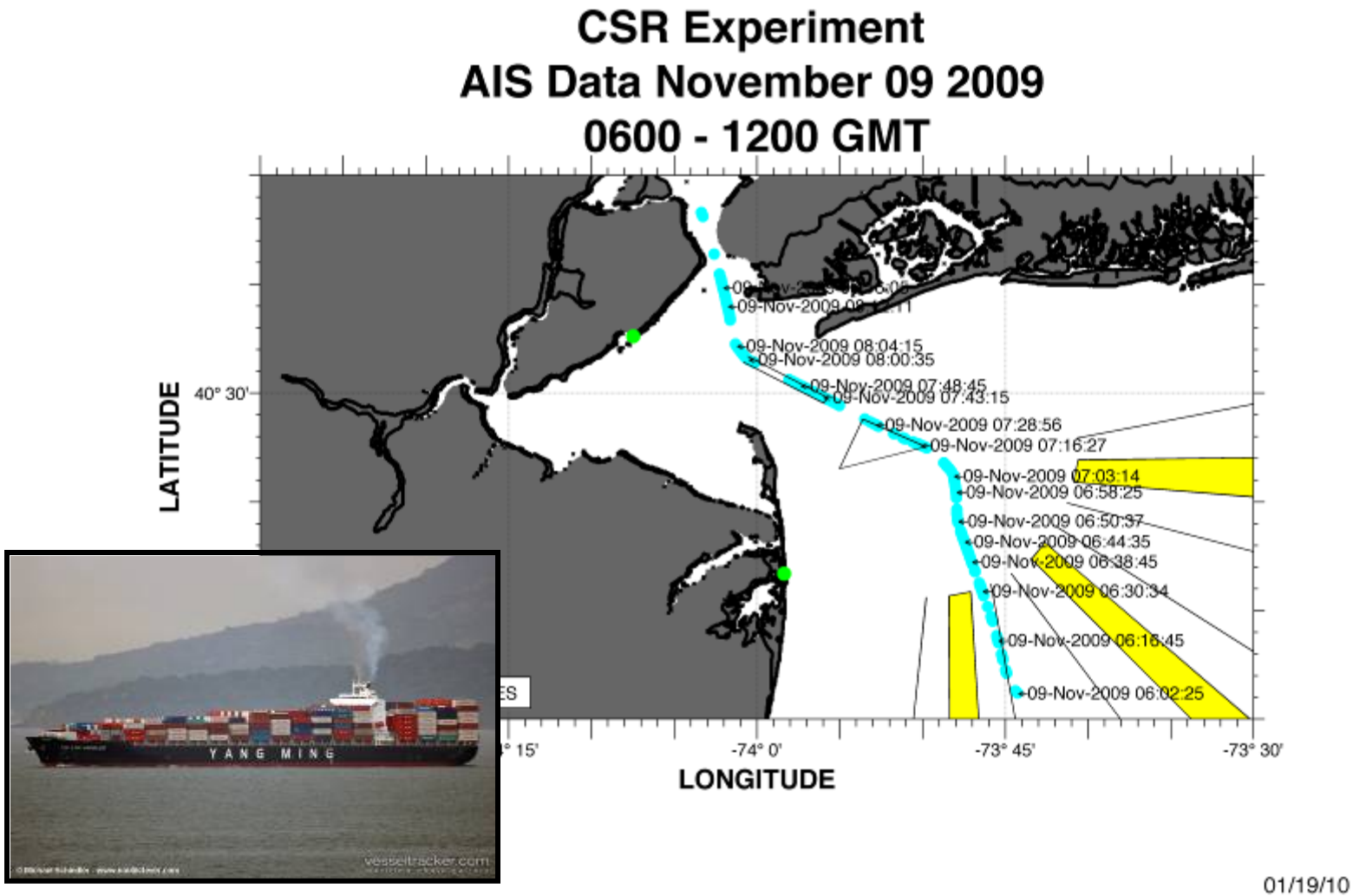
Vessel Detection with HF Radar

HF Radar Spectra

Fixed Objects & Direct Signals



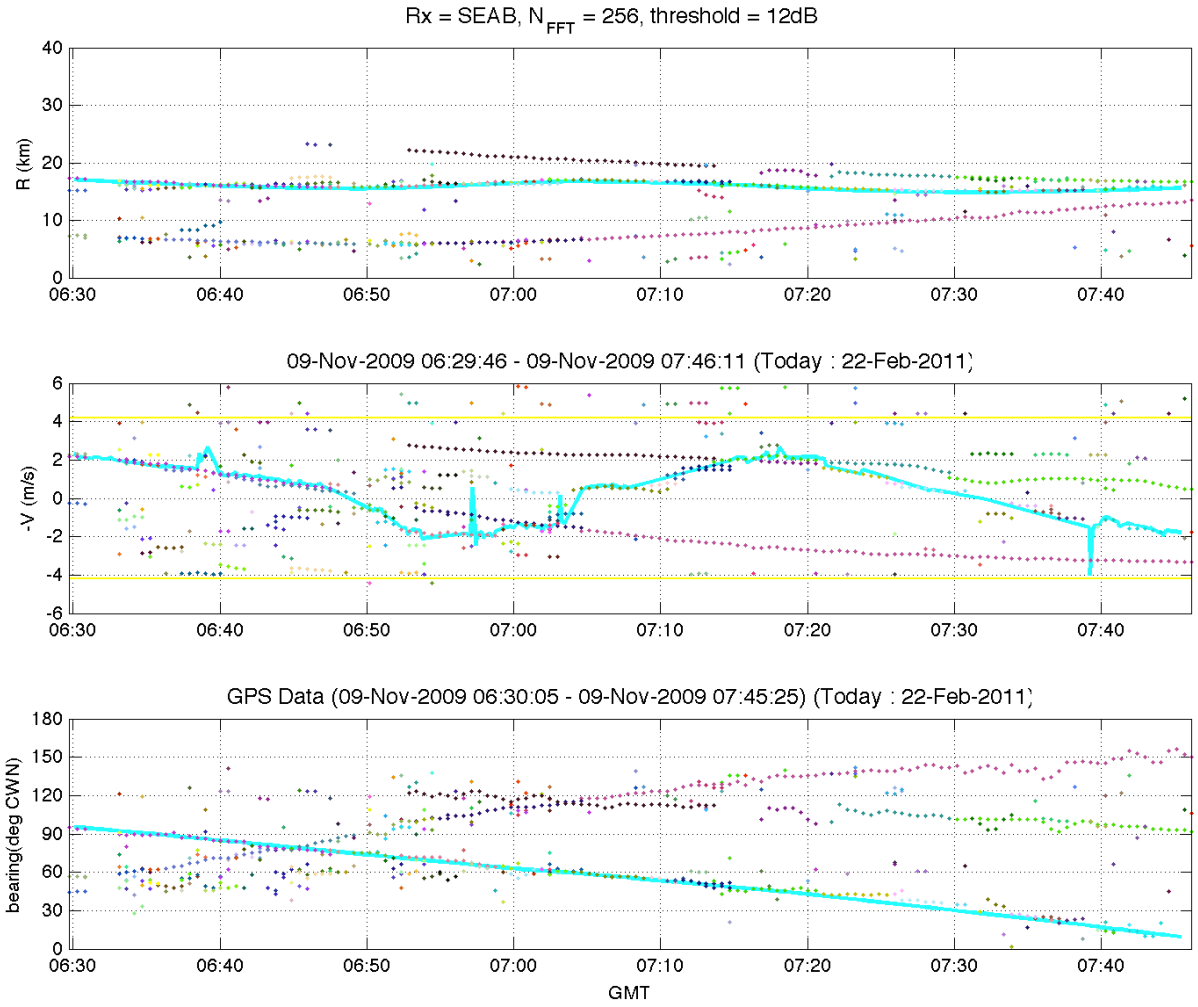
GPS Track of YM Los Angeles



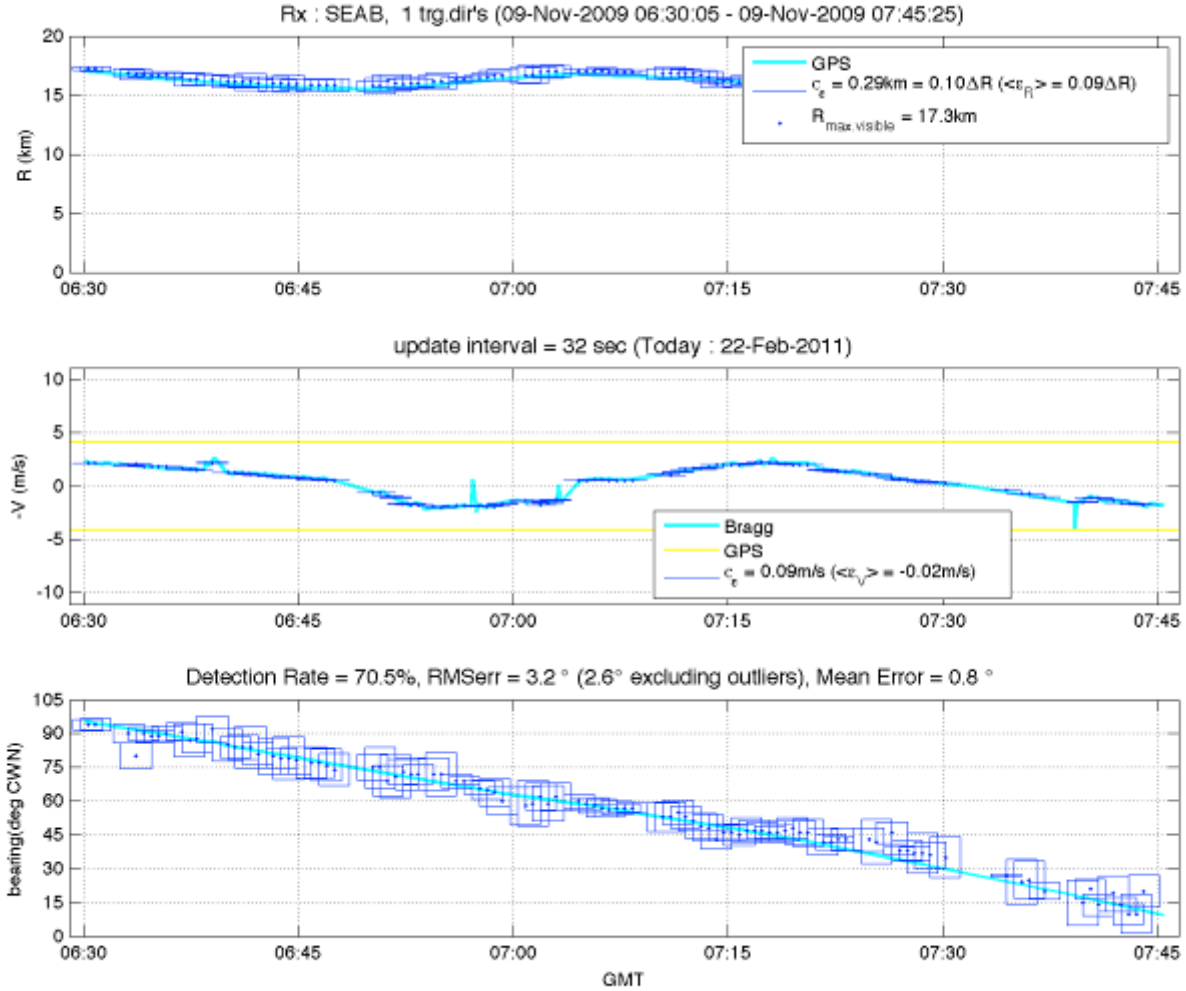
01/19/10

/Users/lemus/Documents/AIS/ship_detection/CSR_experiment/ship_11_09_09/create_trak.m

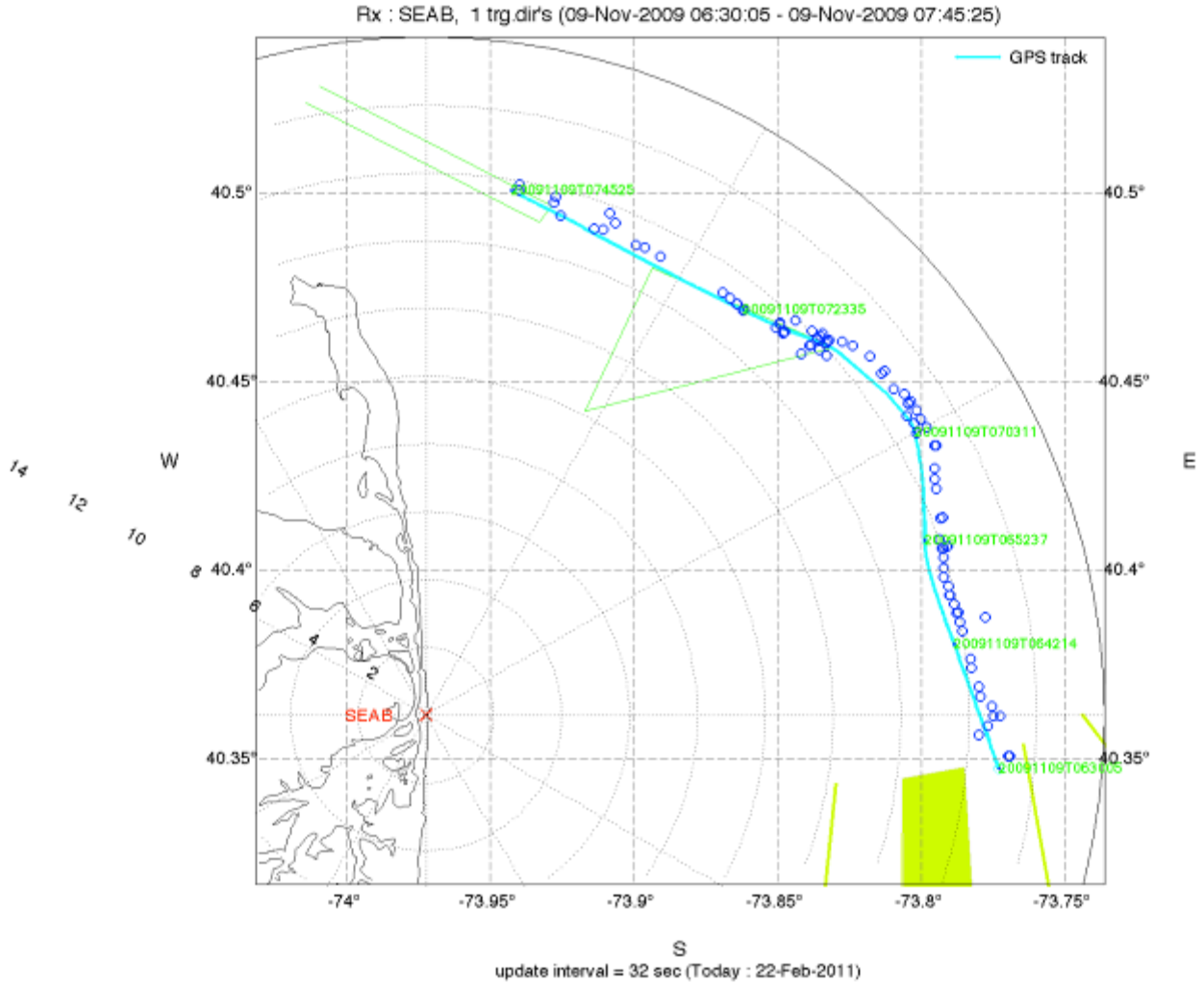
Pepper Plot of All Detections



Association of Detections with GPS



Detections on a Map



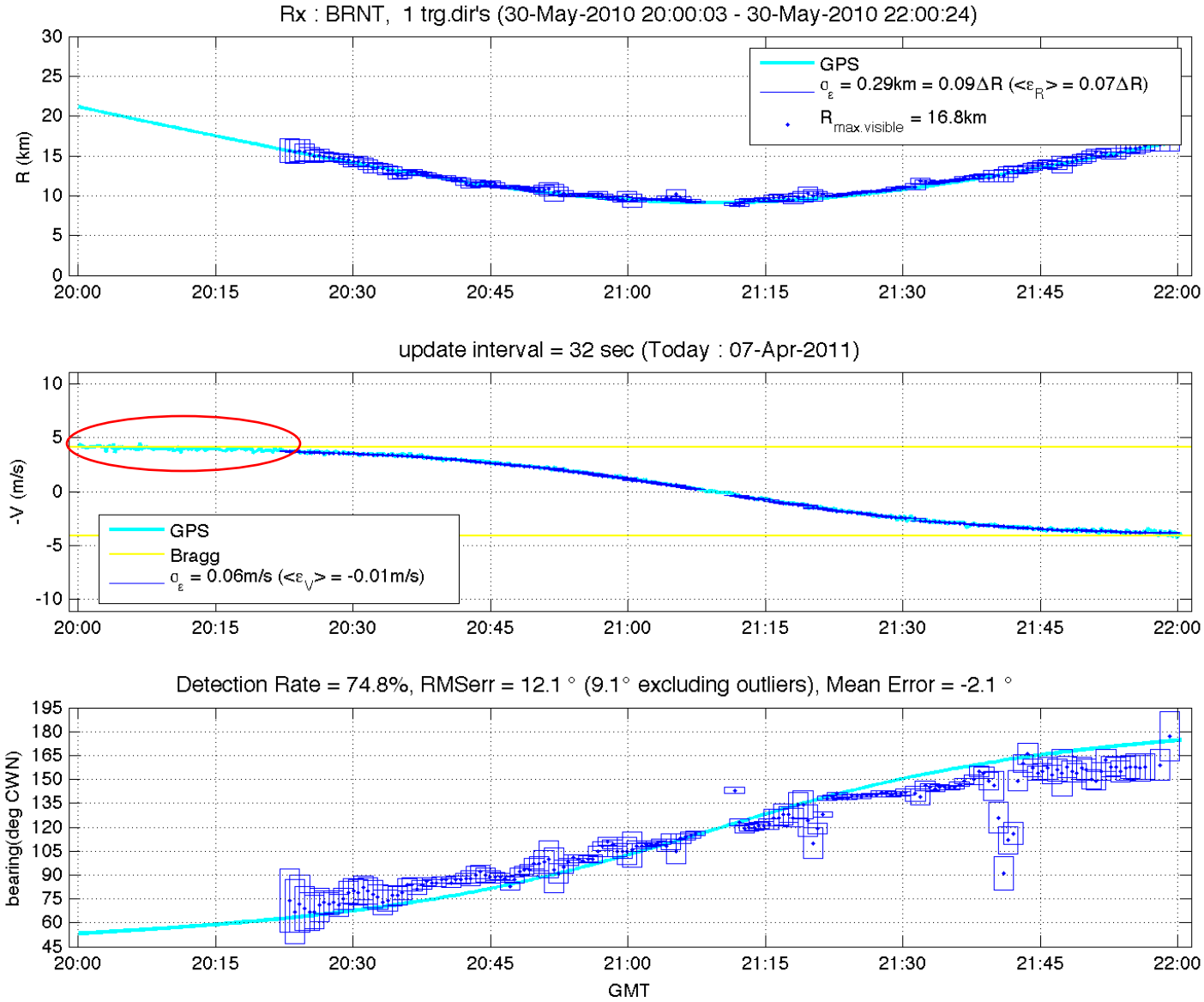
Test Case – Dace Reinauer

Length: 134 m
Beam: 21 m

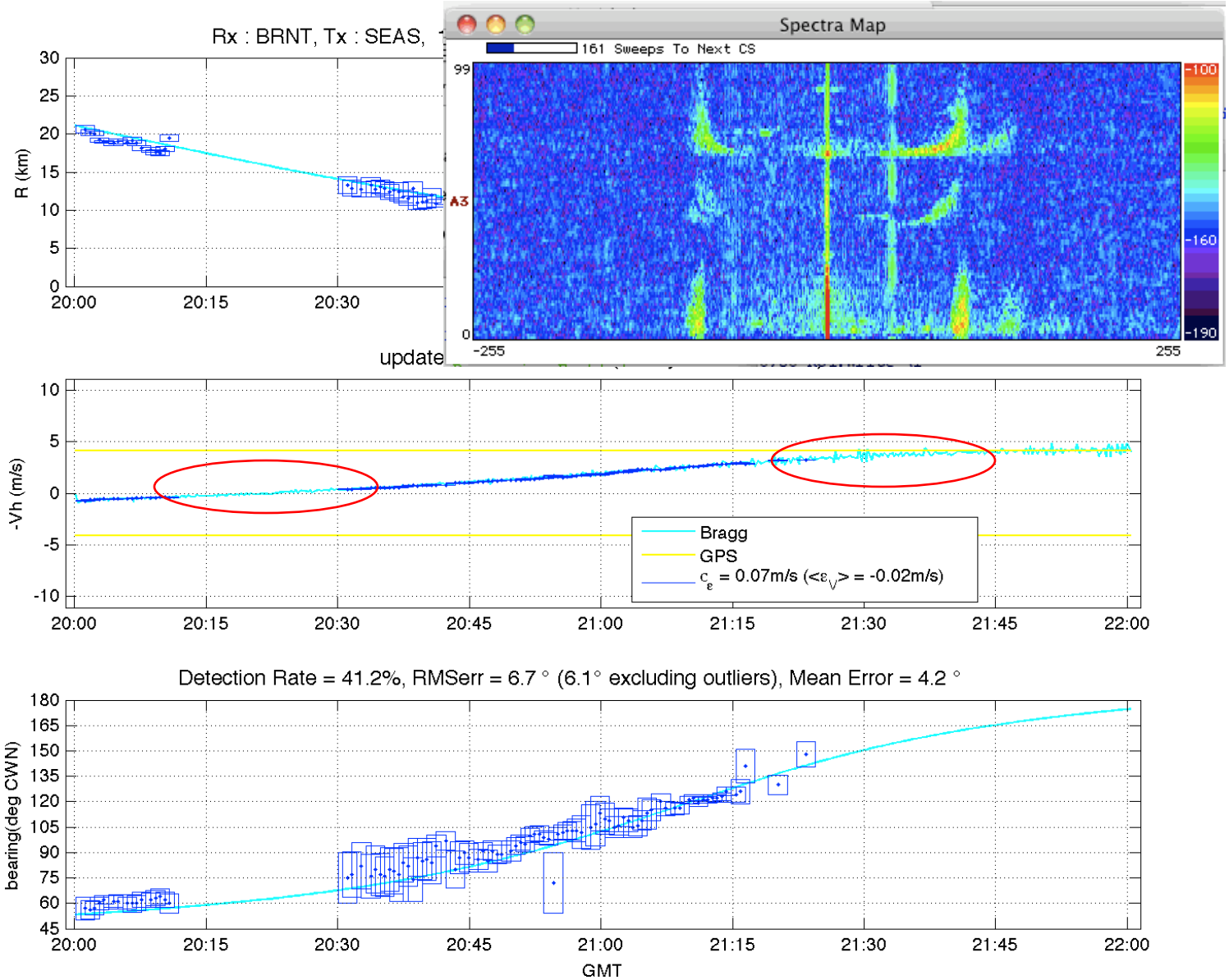
Monostatic and Bistatic Detection of the Dace Reinauer

- Type of Vessel: Tug
- IMO: 8993368
- MMSI: 366238710
- Length: 134 m
- Beam: 21 m

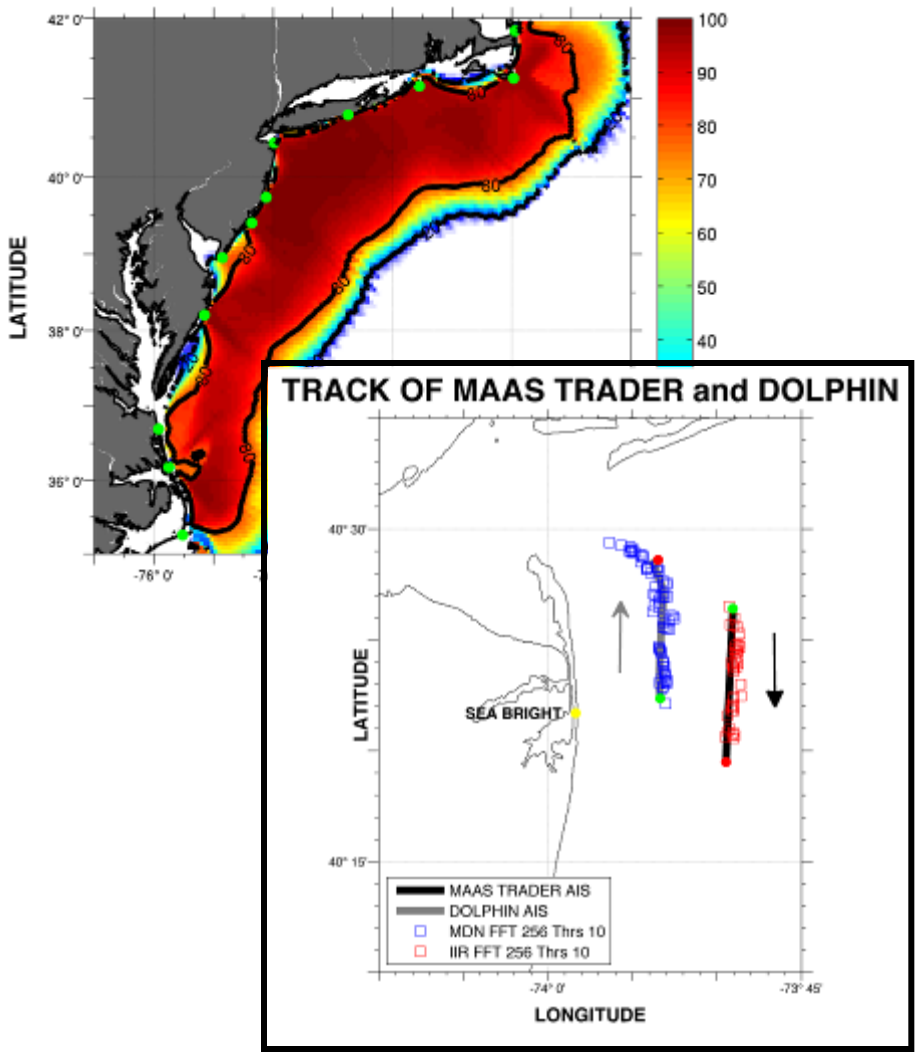
Monostatic Detections



Bistatic Detections



Conclusions



- Mid Atlantic Long Range HF Radar Network is celebrating its 10th anniversary
- MARCOOS is delivering Quality Controlled Surface Current Data and Forecasts to the US Coast Guard for improved SAR
- HF Radar Network is helping to describe the nature of the flow in the Mid Atlantic
- We are also developing the dual-use capability of the radar for vessel detection