



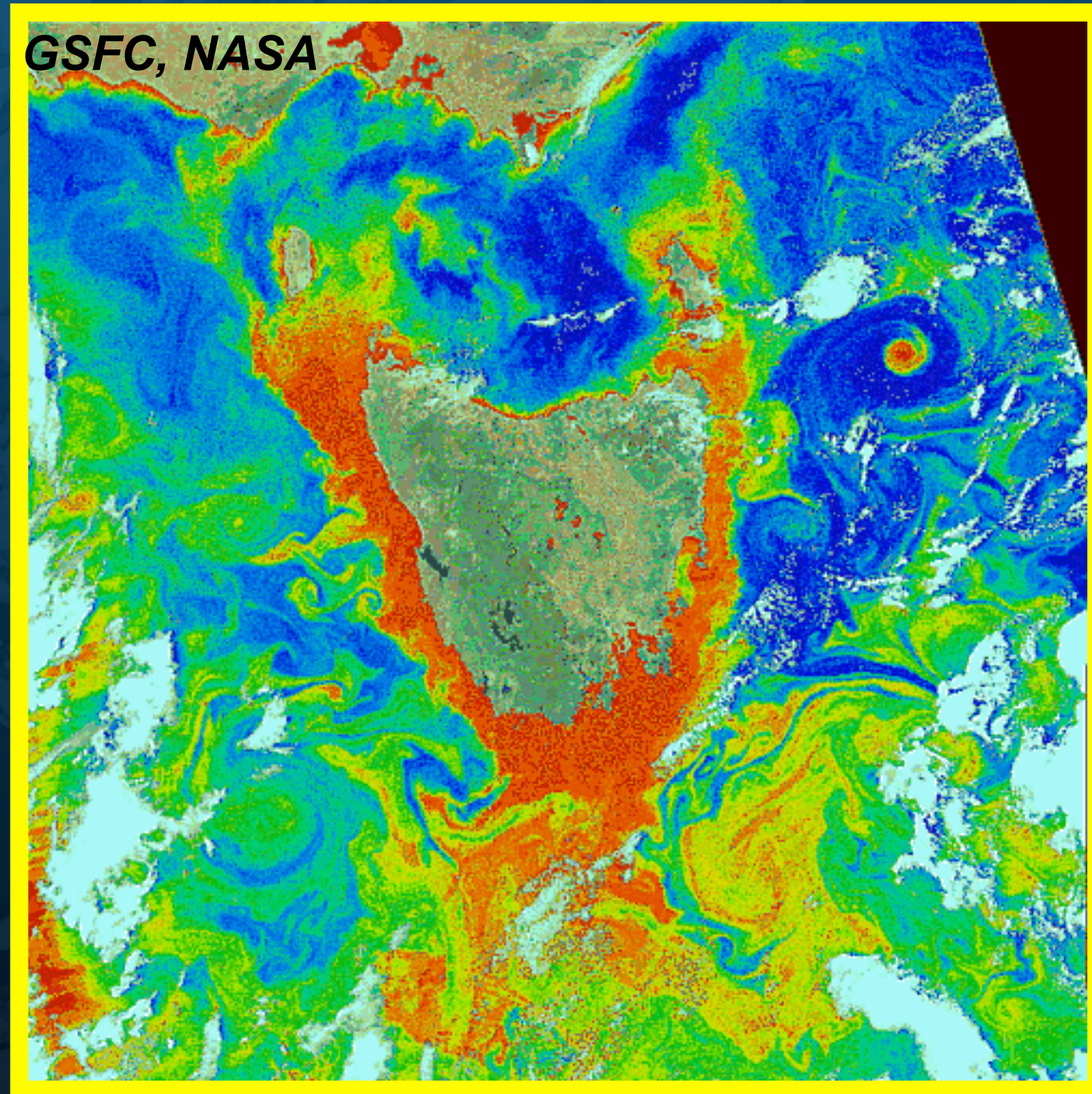
Rise of the Machines

Themes

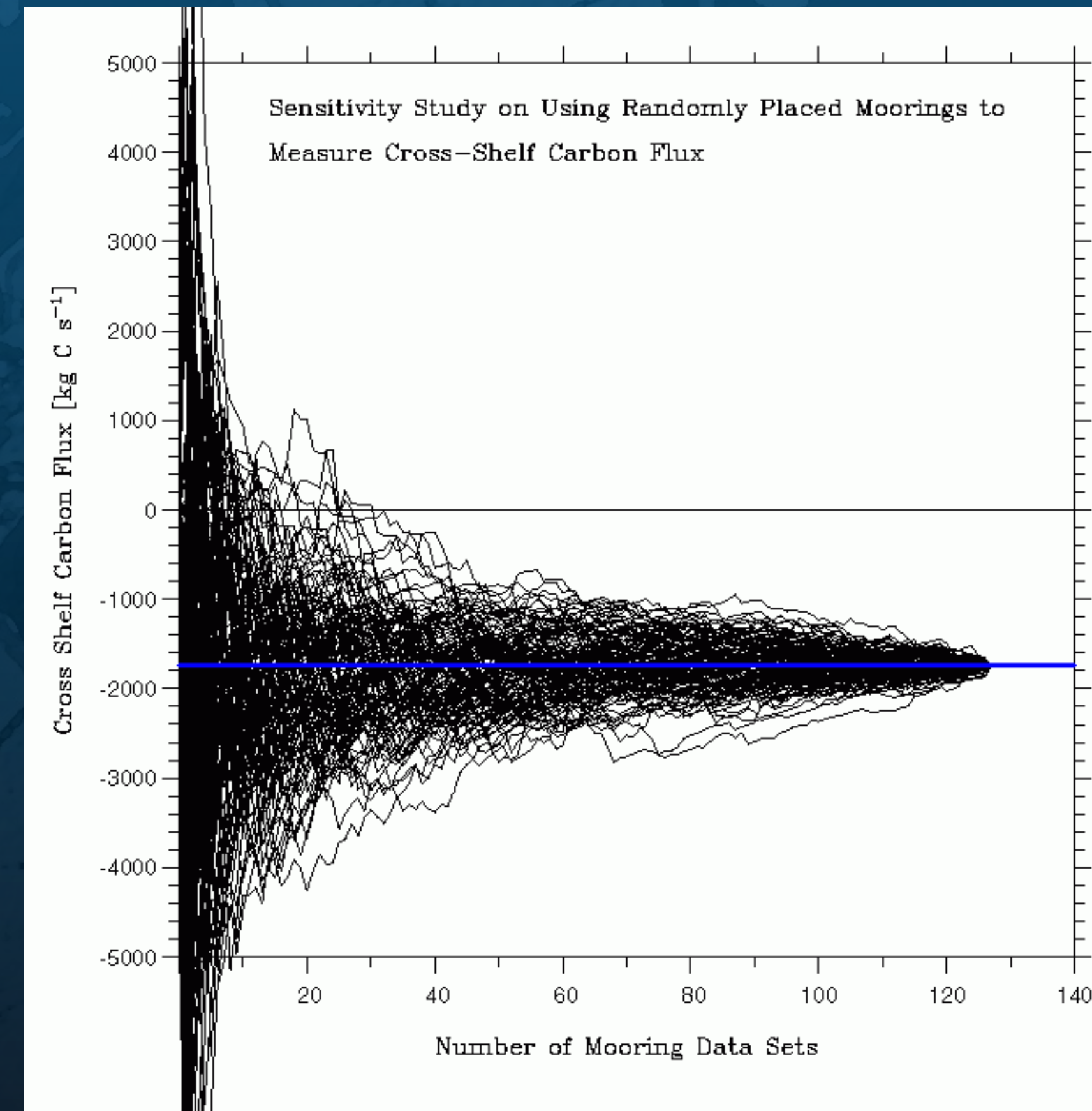
- Some of the new technologies your generation will have
- There are MANY UNKNOWN UNKNOWNs
- Automation is coming



Natural Variability: Where do you put a mooring? Where do you drive the ship? When should you be out there?



Color variability at multiple scales
around Tasmania from CZCS
(winds? currents? bottom topography?)



Simulations of required number of
moorings to predict THE SIGN of
cross shelf carbon transport

Rumsfeld "Unknown unknowns"

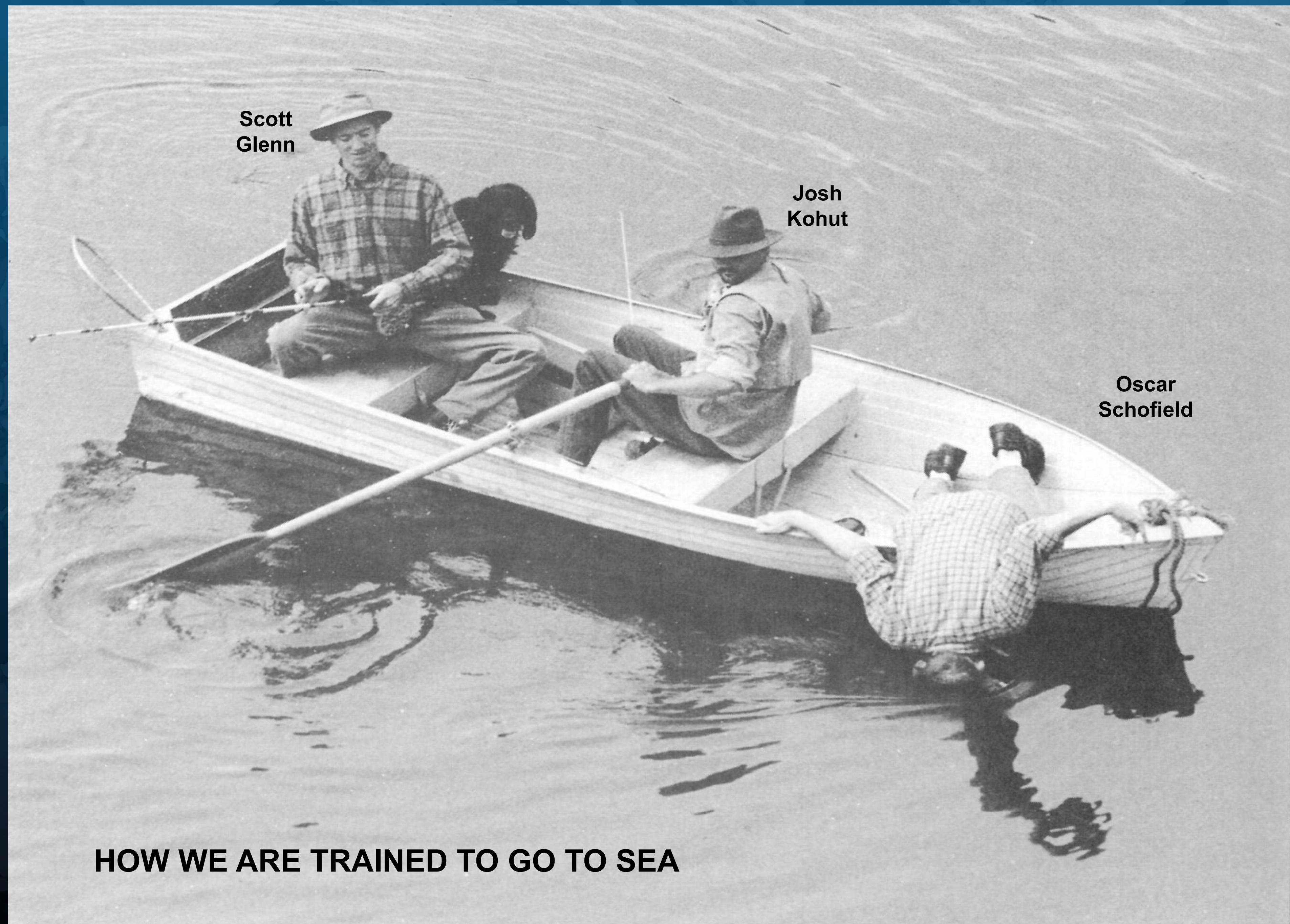
Prior to Deployment

After to Deployment





Rumsfeld “Unknown unknowns”



Scott
Glenn

Josh
Kohut

Oscar
Schofield

HOW WE ARE TRAINED TO GO TO SEA

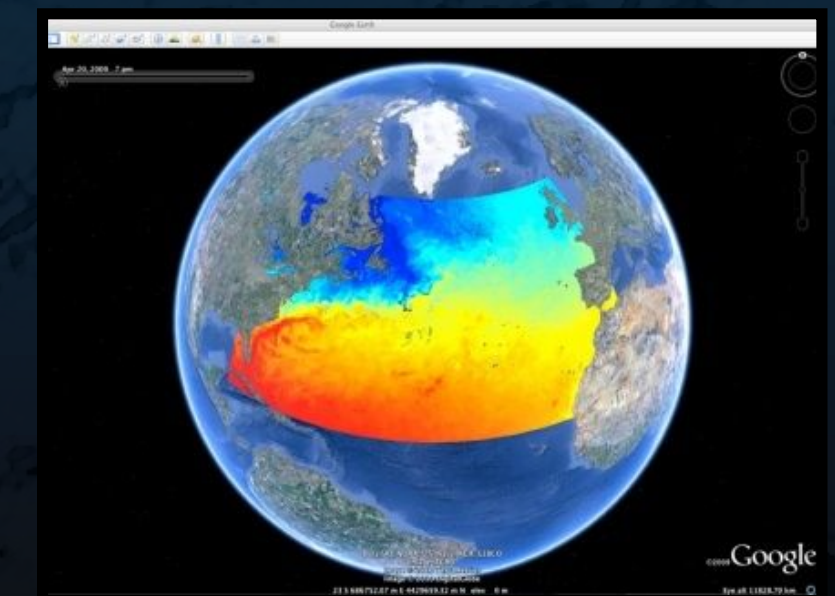
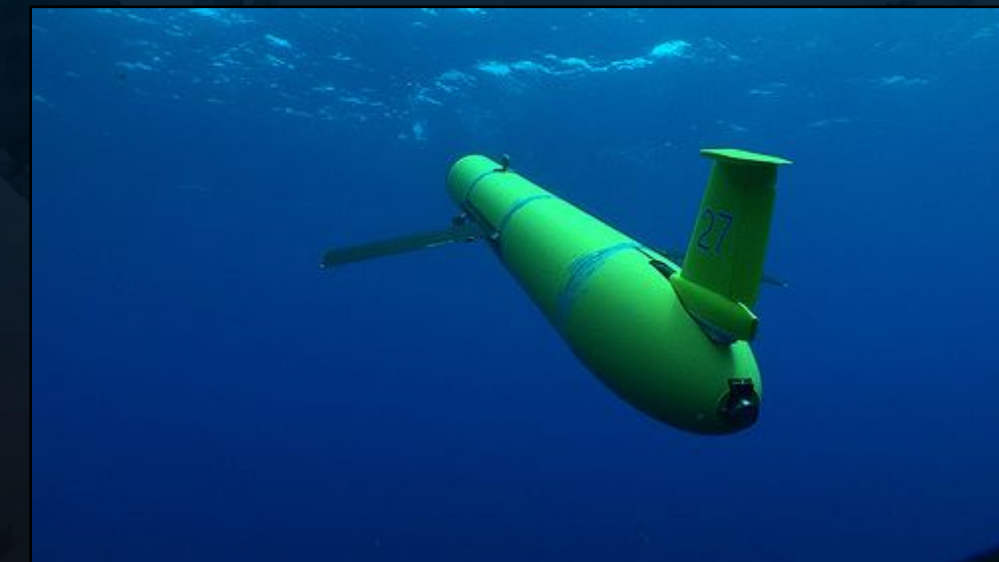
Ocean is hard to sample

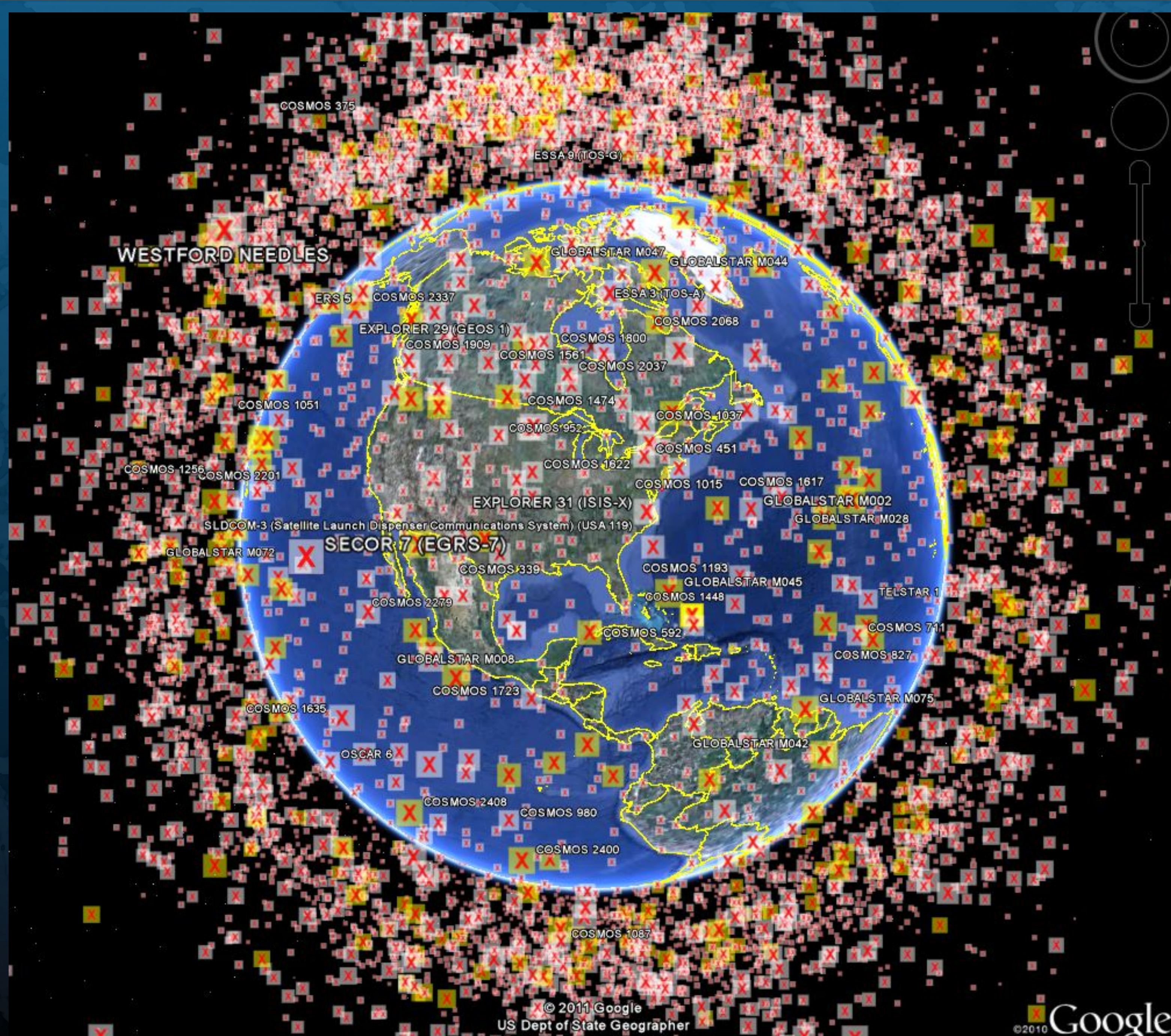


Technology will rescue us!!!!



My Lab (Coastal Ocean Observation Lab: COOL)

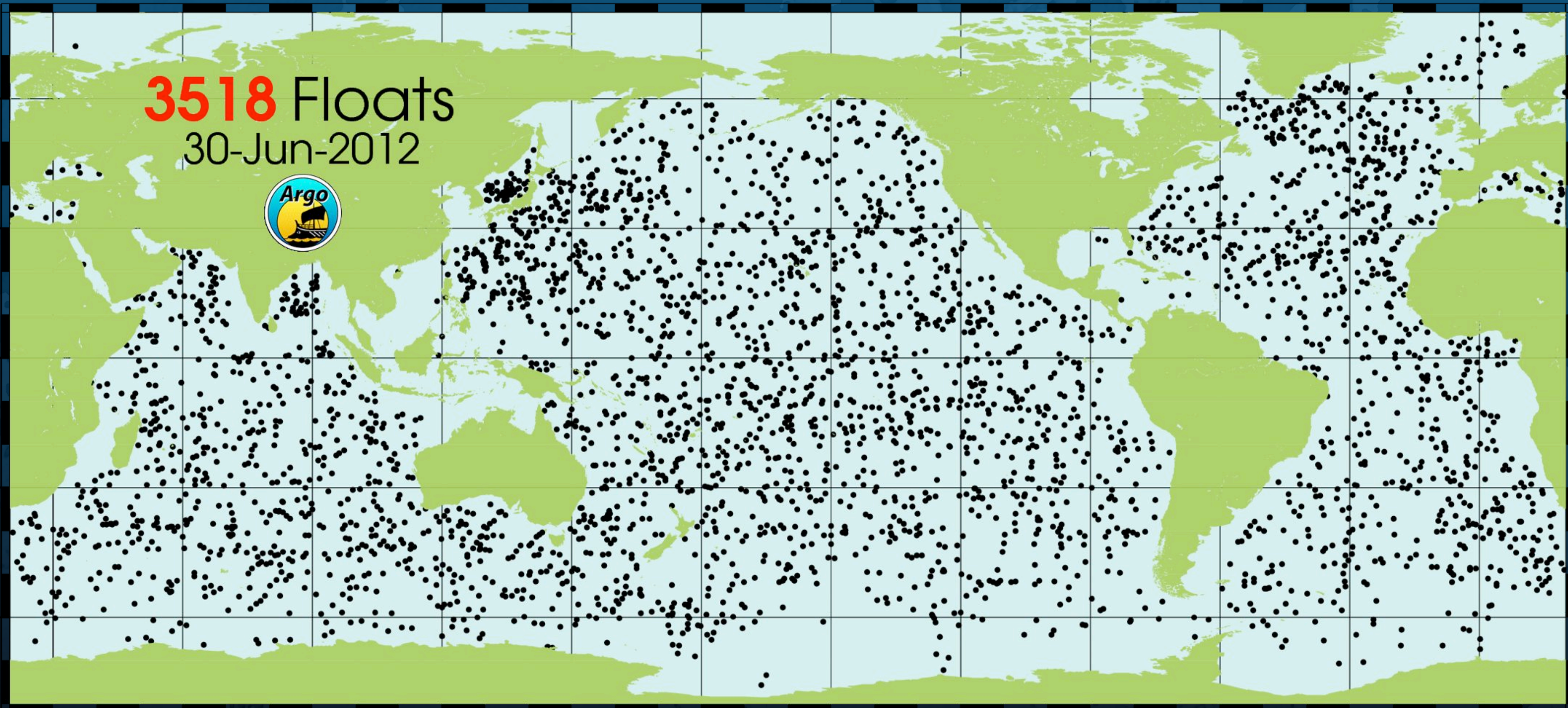




Satellites
-Thousands of
satellites

-After the ships
one of the great
technical
revolutions for
oceanography

3518 Floats
30-Jun-2012



60°E

120°E

180°

120°W

60°W

0°

AUVs: They can be big



Autosub
Southampton Oceanography Center UK



Hugin
Kongsberg Simrad, Norway



Martin-600
Maridan, Denmark



Explorer family,
ISE research, Canada



Odyssey,
Bluefin Robotics, USA

Thanks to Gwynn Griffiths

AUVs: They can be small



Slocum gliders



Mauve



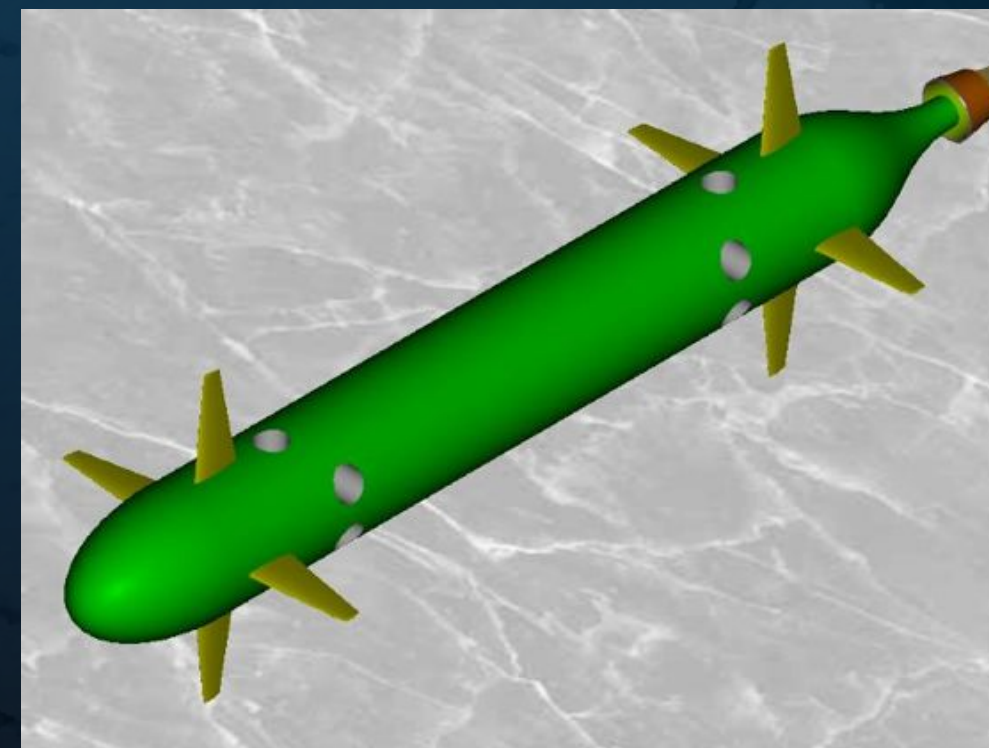
REMUS



Seaglider



Spray

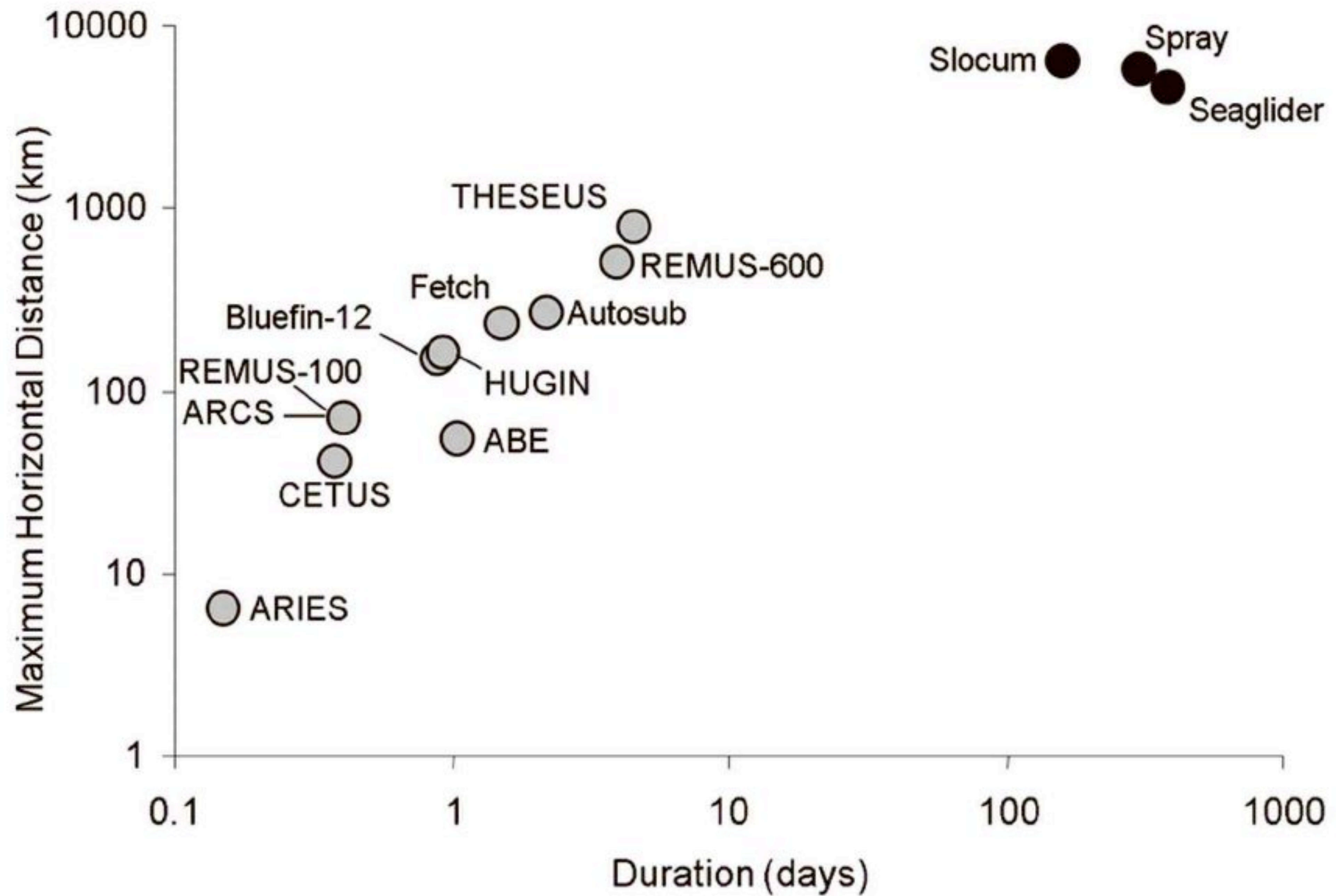


C-Scout

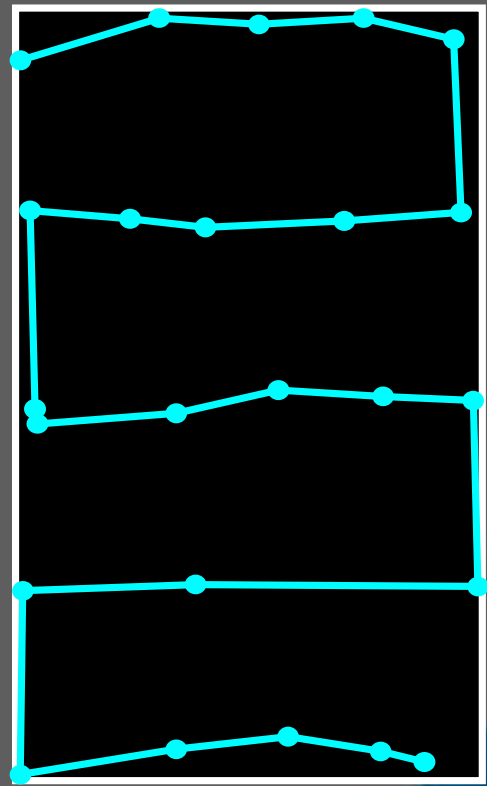


Gavia

Thanks to Gwynn Griffiths

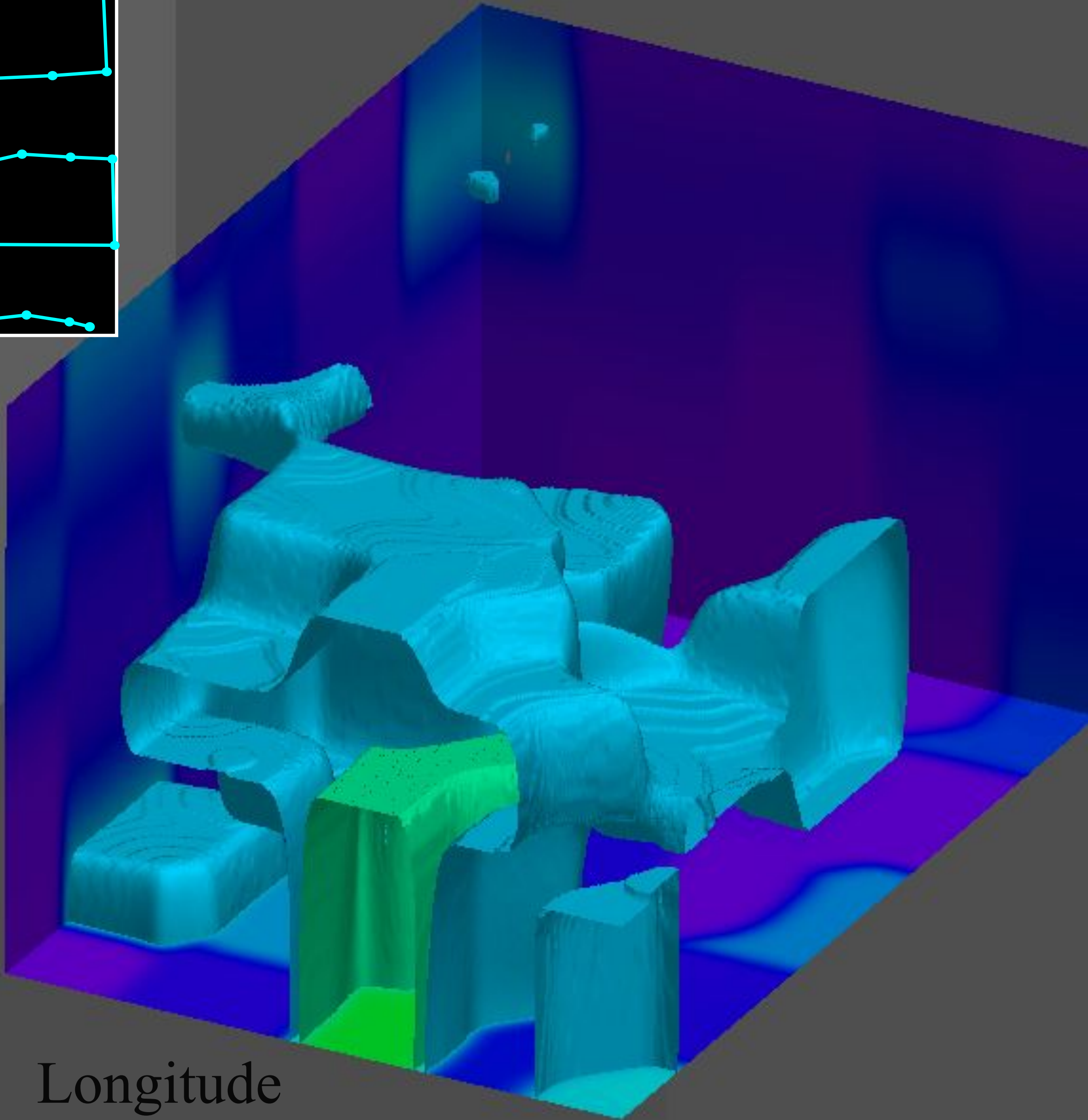






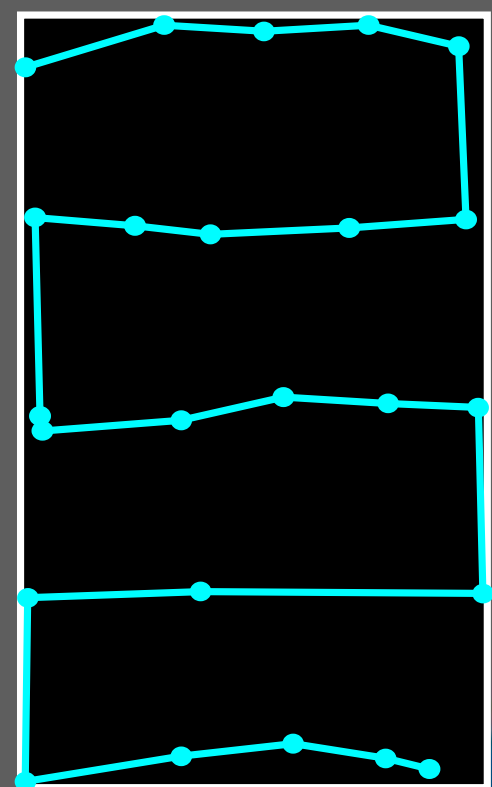
0
Depth (m)
15

Longitude
(~2km)



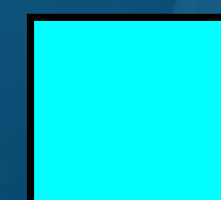
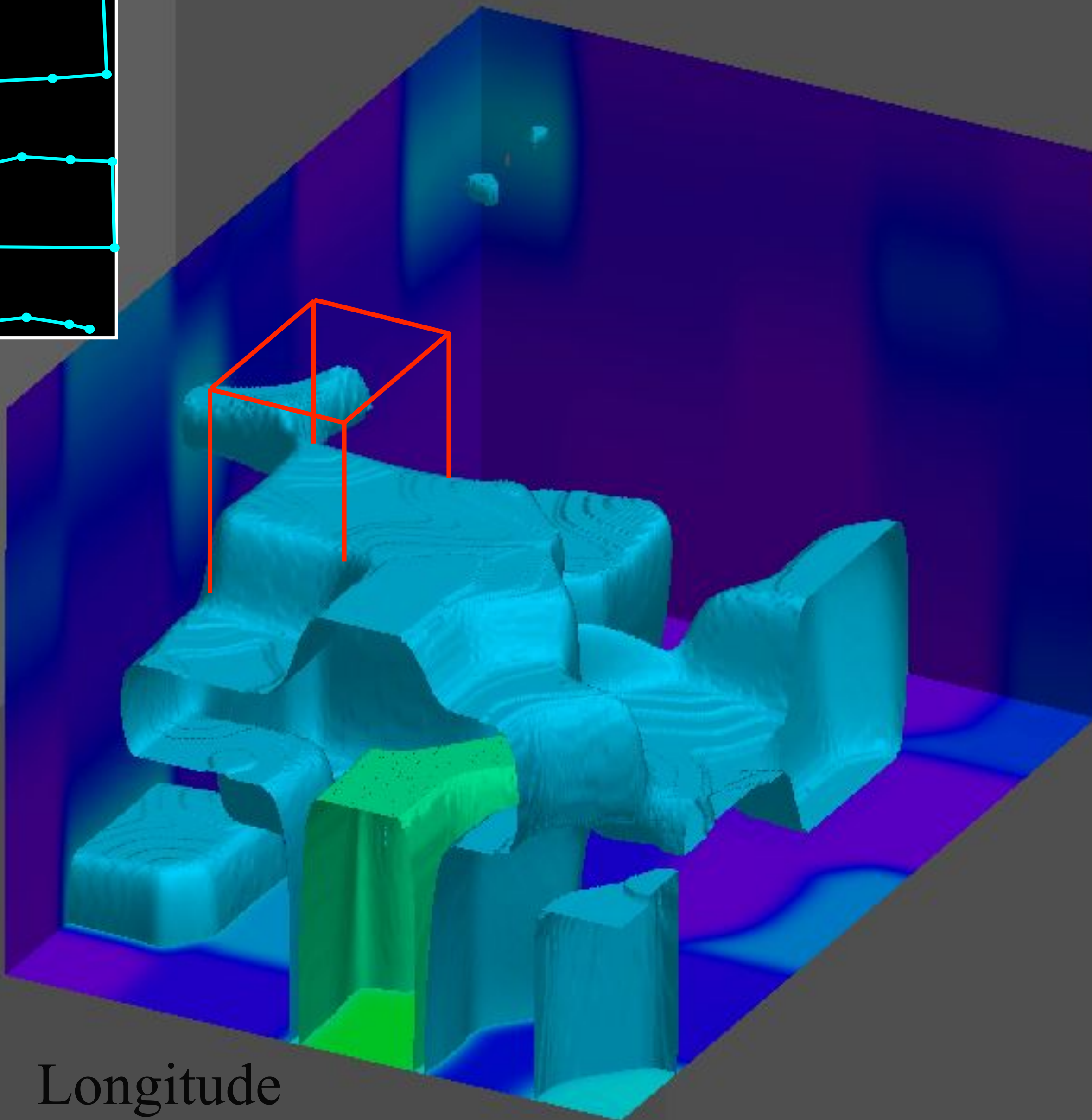
1E10 bioluminescent photons/s

3E10 bioluminescent photons/s

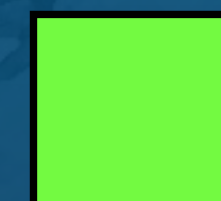


0
Depth (m)
15

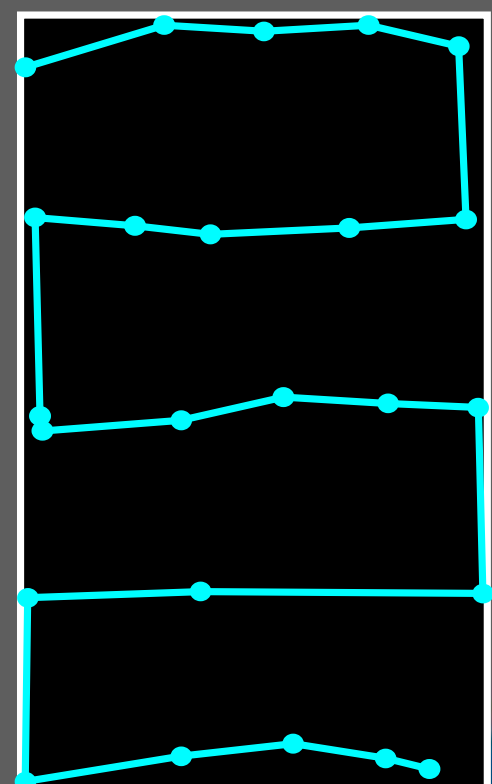
Longitude
(~2km)



1E10 bioluminescent photons/s



3E10 bioluminescent photons/s

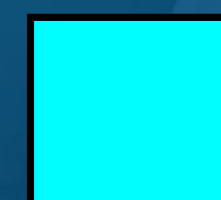


0

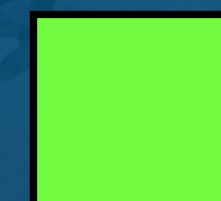
Depth (m)

15

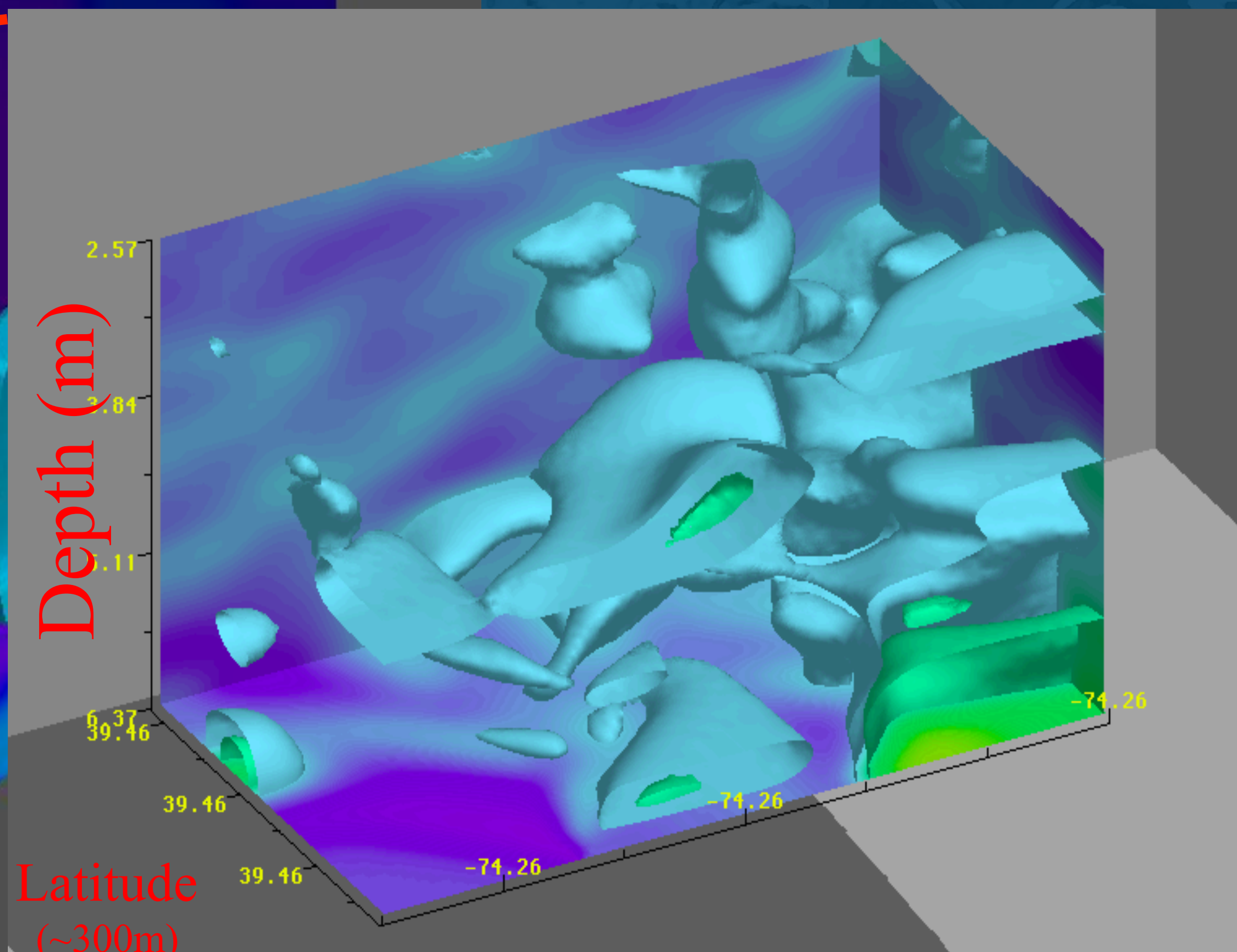
Longitude
(~2km)

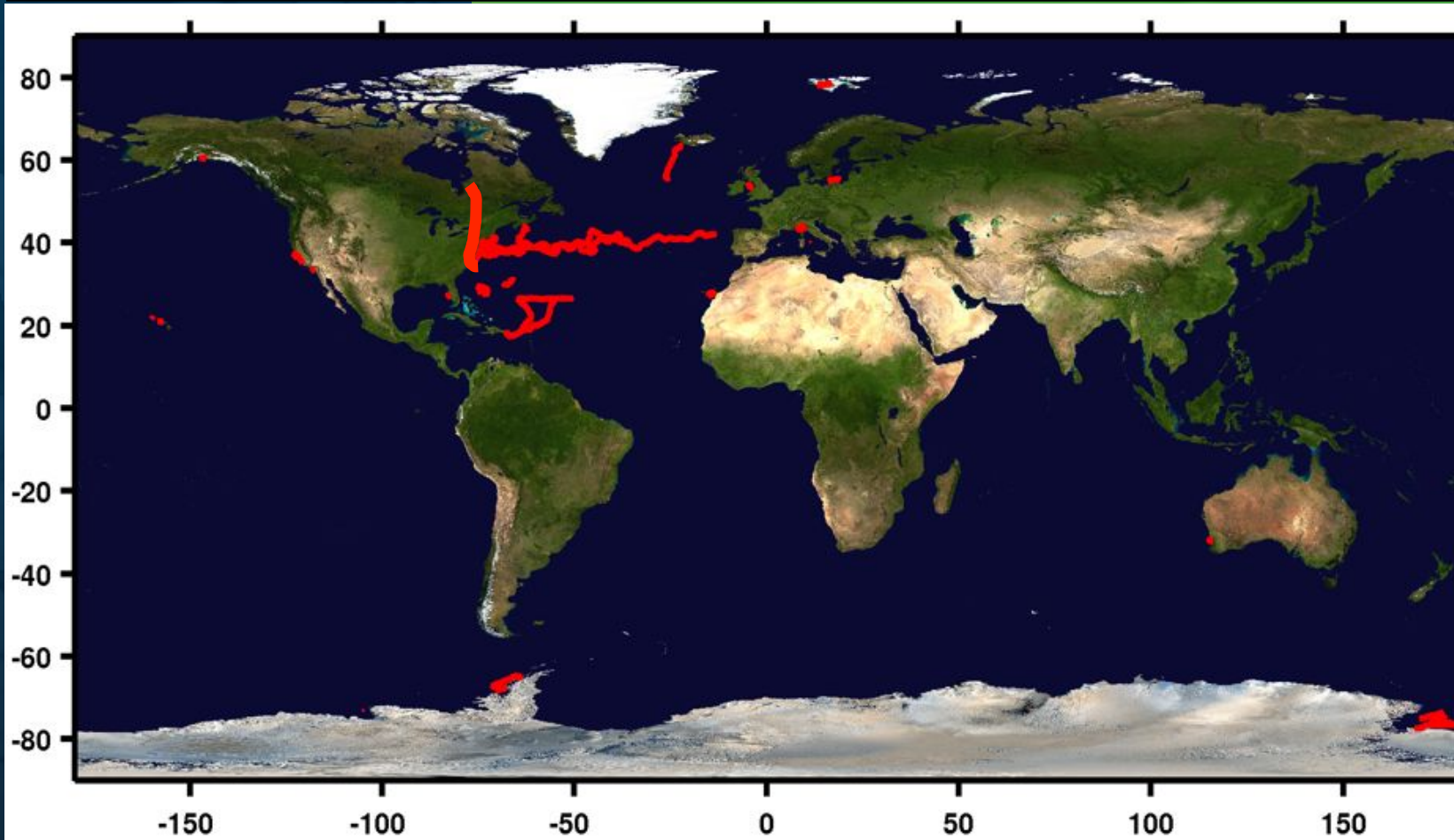
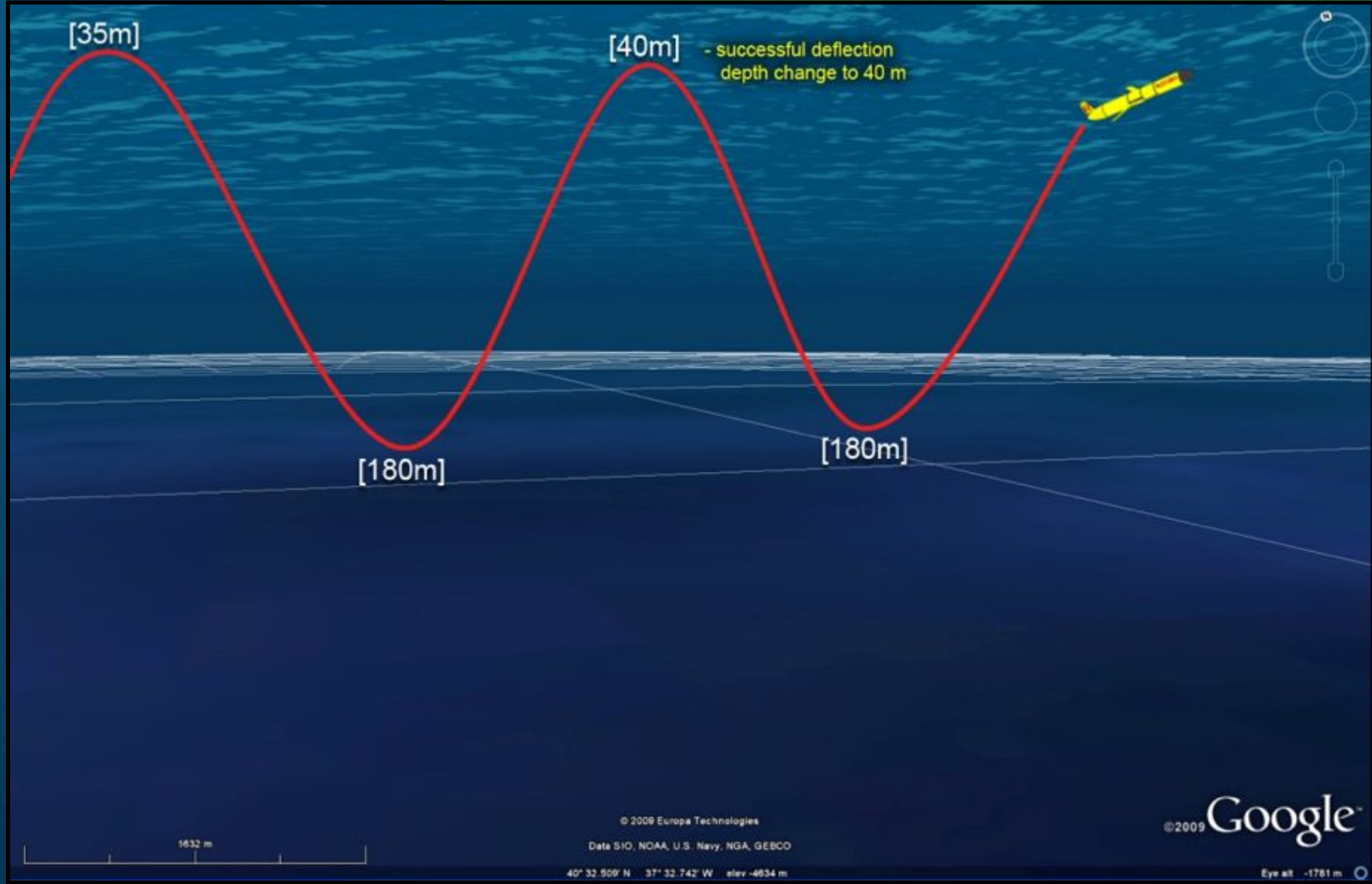


1E10 bioluminescent photons/s

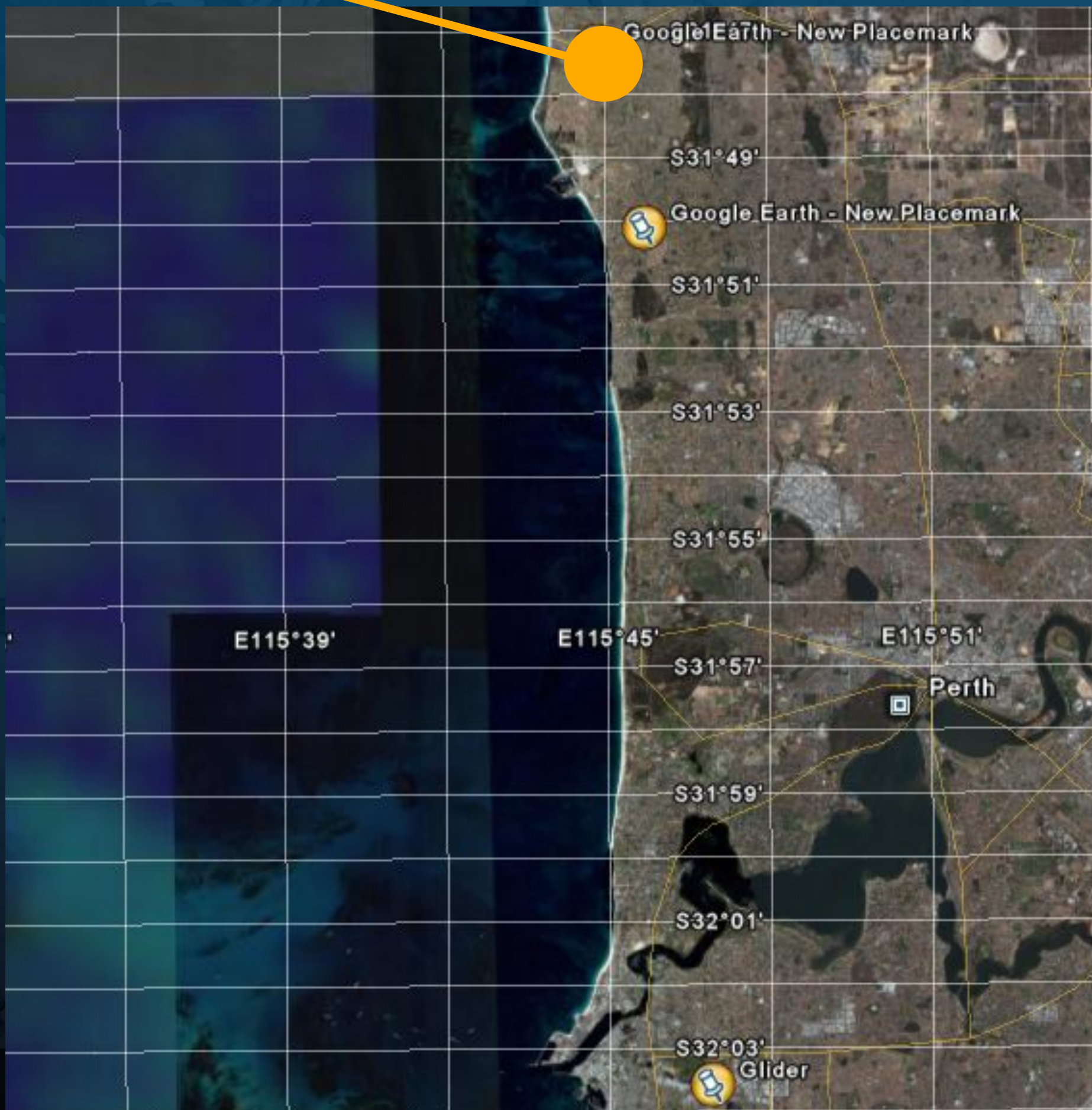
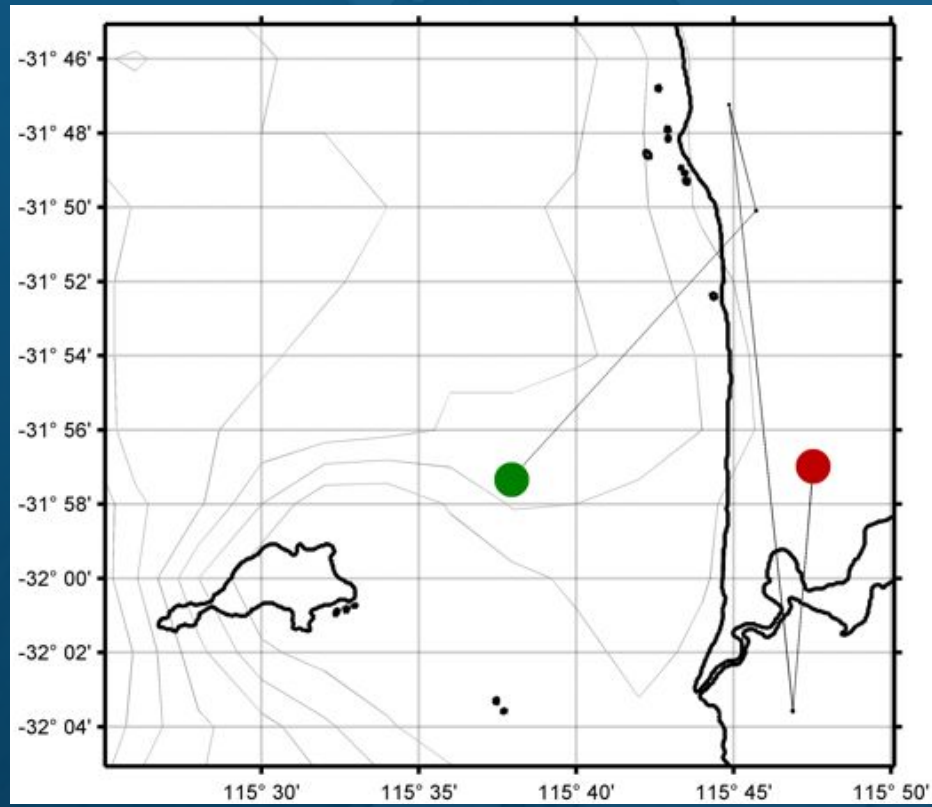


3E10 bioluminescent photons/s

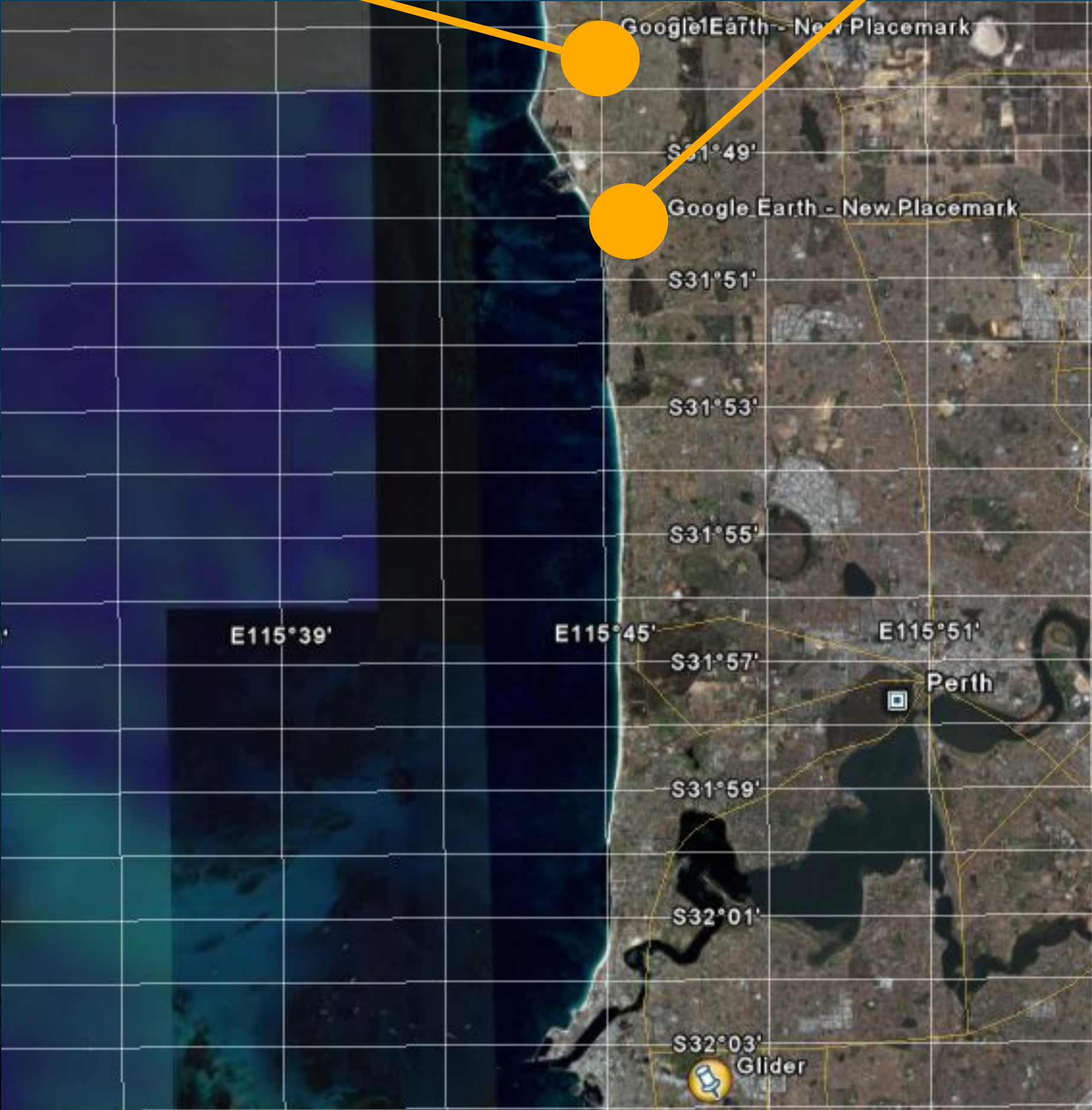




The Communication Revolution Darwin's Odyssey

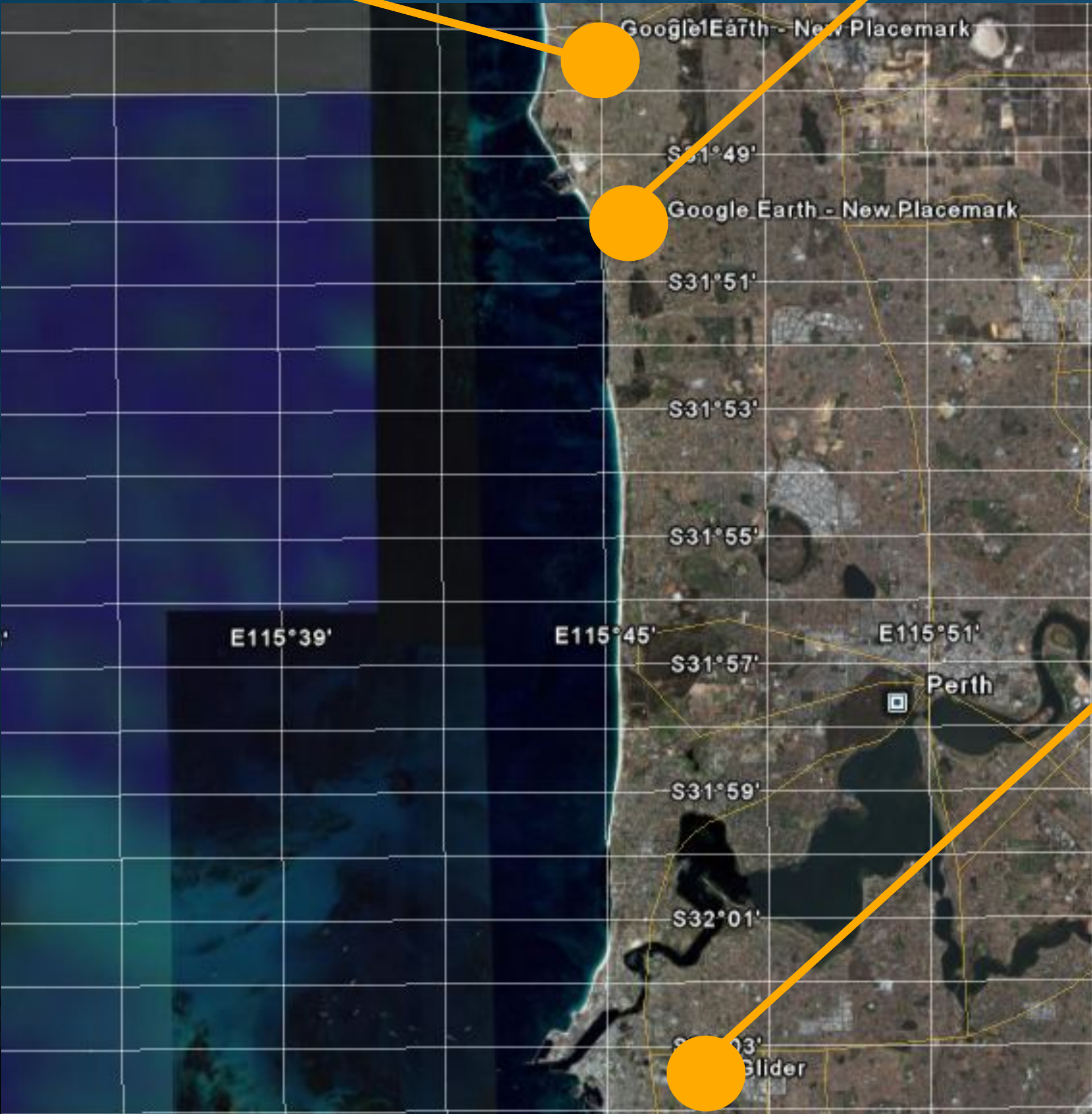
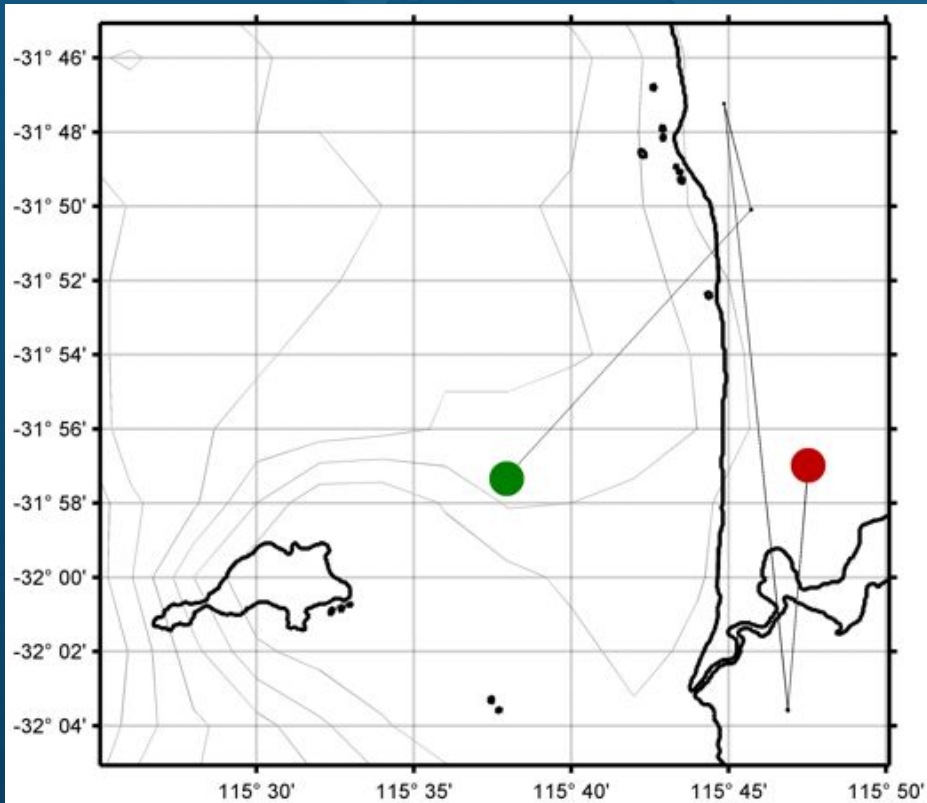


An aerial photograph of a marina area, likely in the Gulf of Mexico, showing a large body of water with numerous boats docked at piers. The surrounding land features a mix of developed areas, including parking lots, roads, and some industrial or commercial structures. A grid of latitude and longitude coordinates is overlaid on the image, with labels such as 95° 31' 49" 15" W, 95° 31' 49" 10" W, 95° 31' 49" 05" W, 95° 31' 49" 00" W, 95° 31' 48" 55" W, 95° 31' 48" 50" W, 95° 31' 48" 45" W, 95° 31' 48" 40" W, 95° 31' 48" 35" W, 95° 31' 48" 30" W, 95° 31' 48" 25" W, 95° 31' 48" 20" W, 95° 31' 48" 15" W, 95° 31' 48" 10" W, 95° 31' 48" 05" W, 95° 31' 48" 00" W, 95° 31' 47" 55" W, 95° 31' 47" 50" W, 95° 31' 47" 45" W, 95° 31' 47" 40" W, 95° 31' 47" 35" W, 95° 31' 47" 30" W, 95° 31' 47" 25" W, 95° 31' 47" 20" W, 95° 31' 47" 15" W, 95° 31' 47" 10" W, 95° 31' 47" 05" W, 95° 31' 47" 00" W, 95° 31' 46" 55" W, 95° 31' 46" 50" W, 95° 31' 46" 45" W, 95° 31' 46" 40" W, 95° 31' 46" 35" W, 95° 31' 46" 30" W, 95° 31' 46" 25" W, 95° 31' 46" 20" W, 95° 31' 46" 15" W, 95° 31' 46" 10" W, 95° 31' 46" 05" W, 95° 31' 46" 00" W, 95° 31' 45" 55" W, 95° 31' 45" 50" W, 95° 31' 45" 45" W, 95° 31' 45" 40" W, 95° 31' 45" 35" W, 95° 31' 45" 30" W, 95° 31' 45" 25" W, 95° 31' 45" 20" W, 95° 31' 45" 15" W, 95° 31' 45" 10" W, 95° 31' 45" 05" W, 95° 31' 45" 00" W, 95° 31' 44" 55" W, 95° 31' 44" 50" W, 95° 31' 44" 45" W, 95° 31' 44" 40" W, 95° 31' 44" 35" W, 95° 31' 44" 30" W, 95° 31' 44" 25" W, 95° 31' 44" 20" W, 95° 31' 44" 15" W, 95° 31' 44" 10" W, 95° 31' 44" 05" W, 95° 31' 44" 00" W, 95° 31' 43" 55" W, 95° 31' 43" 50" W, 95° 31' 43" 45" W, 95° 31' 43" 40" W, 95° 31' 43" 35" W, 95° 31' 43" 30" W, 95° 31' 43" 25" W, 95° 31' 43" 20" W, 95° 31' 43" 15" W, 95° 31' 43" 10" W, 95° 31' 43" 05" W, 95° 31' 43" 00" W, 95° 31' 42" 55" W, 95° 31' 42" 50" W, 95° 31' 42" 45" W, 95° 31' 42" 40" W, 95° 31' 42" 35" W, 95° 31' 42" 30" W, 95° 31' 42" 25" W, 95° 31' 42" 20" W, 95° 31' 42" 15" W, 95° 31' 42" 10" W, 95° 31' 42" 05" W, 95° 31' 42" 00" W, 95° 31' 41" 55" W, 95° 31' 41" 50" W, 95° 31' 41" 45" W, 95° 31' 41" 40" W, 95° 31' 41" 35" W, 95° 31' 41" 30" W, 95° 31' 41" 25" W, 95° 31' 41" 20" W, 95° 31' 41" 15" W, 95° 31' 41" 10" W, 95° 31' 41" 05" W, 95° 31' 41" 00" W, 95° 31' 40" 55" W, 95° 31' 40" 50" W, 95° 31' 40" 45" W, 95° 31' 40" 40" W, 95° 31' 40" 35" W, 95° 31' 40" 30" W, 95° 31' 40" 25" W, 95° 31' 40" 20" W, 95° 31' 40" 15" W, 95° 31' 40" 10" W, 95° 31' 40" 05" W, 95° 31' 40" 00" W, 95° 31' 39" 55" W, 95° 31' 39" 50" W, 95° 31' 39" 45" W, 95° 31' 39" 40" W, 95° 31' 39" 35" W, 95° 31' 39" 30" W, 95° 31' 39" 25" W, 95° 31' 39" 20" W, 95° 31' 39" 15" W, 95° 31' 39" 10" W, 95° 31' 39" 05" W, 95° 31' 39" 00" W, 95° 31' 38" 55" W, 95° 31' 38" 50" W, 95° 31' 38" 45" W, 95° 31' 38" 40" W, 95° 31' 38" 35" W, 95° 31' 38" 30" W, 95° 31' 38" 25" W, 95° 31' 38" 20" W, 95° 31' 38" 15" W, 95° 31' 38" 10" W, 95° 31' 38" 05" W, 95° 31' 38" 00" W, 95° 31' 37" 55" W, 95° 31' 37" 50" W, 95° 31' 37" 45" W, 95° 31' 37" 40" W, 95° 31' 37" 35" W, 95° 31' 37" 30" W, 95° 31' 37" 25" W, 95° 31' 37" 20" W, 95° 31' 37" 15" W, 95° 31' 37" 10" W, 95° 31' 37" 05" W, 95° 31' 37" 00" W, 95° 31' 36" 55" W, 95° 31' 36" 50" W, 95° 31' 36" 45" W, 95° 31' 36" 40" W, 95° 31' 36" 35" W, 95° 31' 36" 30" W, 95° 31' 36" 25" W, 95° 31' 36" 20" W, 95° 31' 36" 15" W, 95° 31' 36" 10" W, 95° 31' 36" 05" W, 95° 31' 36" 00" W, 95° 31' 35" 55" W, 95° 31' 35" 50" W, 95° 31' 35" 45" W, 95° 31' 35" 40" W, 95° 31' 35" 35" W, 95° 31' 35" 30" W, 95° 31' 35" 25" W, 95° 31' 35" 20" W, 95° 31' 35" 15" W, 95° 31' 35" 10" W, 95° 31' 35" 05" W, 95° 31' 35" 00" W, 95° 31' 34" 55" W, 95° 31' 34" 50" W, 95° 31' 34" 45" W, 95° 31' 34" 40" W, 95° 31' 34" 35" W, 95° 31' 34" 30" W, 95° 31' 34" 25" W, 95° 31' 34" 20" W, 95° 31' 34" 15" W, 95° 31' 34" 10" W, 95° 31' 34" 05" W, 95° 31' 34" 00" W, 95° 31' 33" 55" W, 95° 31' 33" 50" W, 95° 31' 33" 45" W, 95° 31' 33" 40" W, 95° 31' 33" 35" W, 95° 31' 33" 30" W, 95° 31' 33" 25" W, 95° 31' 33" 20" W, 95° 31' 33" 15" W, 95° 31' 33" 10" W, 95° 31' 33" 05" W, 95° 31' 33" 00" W, 95° 31' 32" 55" W, 95° 31' 32" 50" W, 95° 31' 32" 45" W, 95° 31' 32" 40" W, 95° 31' 32" 35" W, 95° 31' 32" 30" W, 95° 31' 32" 25" W, 95° 31' 32" 20" W, 95° 31' 32" 15" W, 95° 31' 32" 10" W, 95° 31' 32" 05" W, 95° 31' 32" 00" W, 95° 31' 31" 55" W, 95° 31' 31" 50" W, 95° 31' 31" 45" W, 95° 31' 31" 40" W, 95° 31' 31" 35" W, 95° 31' 31" 30" W, 95° 31' 31" 25" W, 95° 31' 31" 20" W, 95° 31' 31" 15" W, 95° 31' 31" 10" W, 95° 31' 31" 05" W, 95° 31' 31" 00" W, 95° 31' 30" 55" W, 95° 31' 30" 50" W, 95° 31' 30



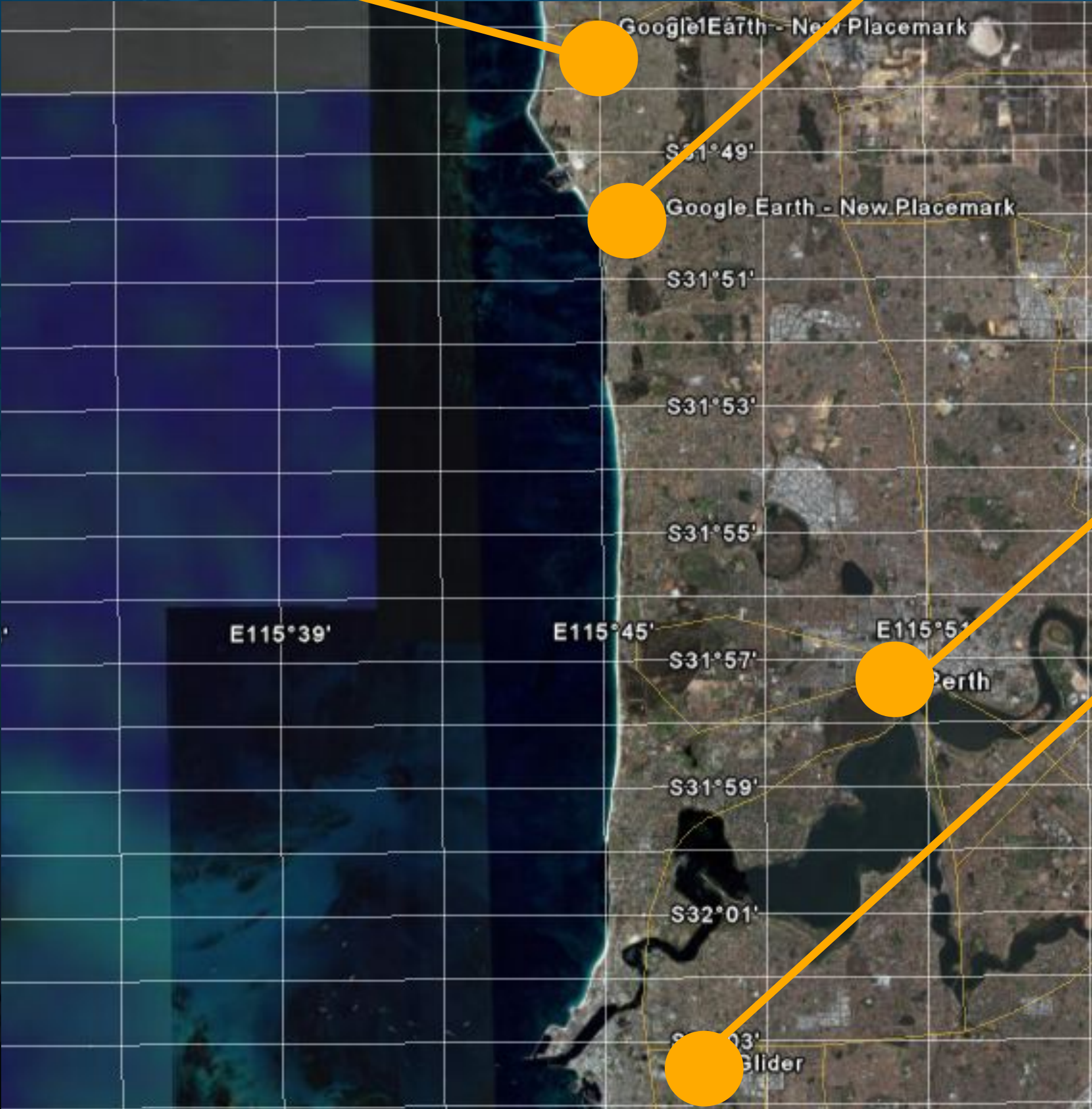
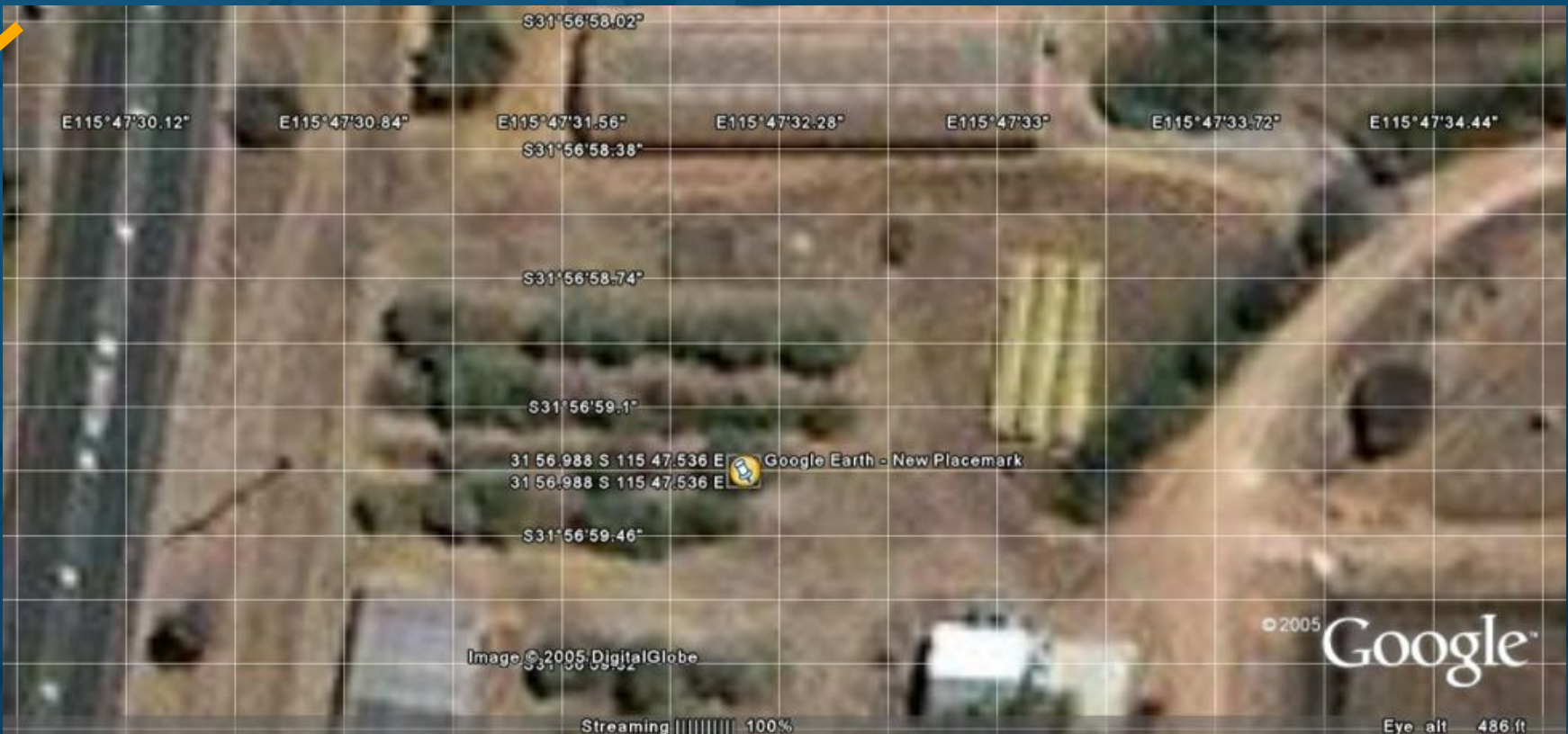
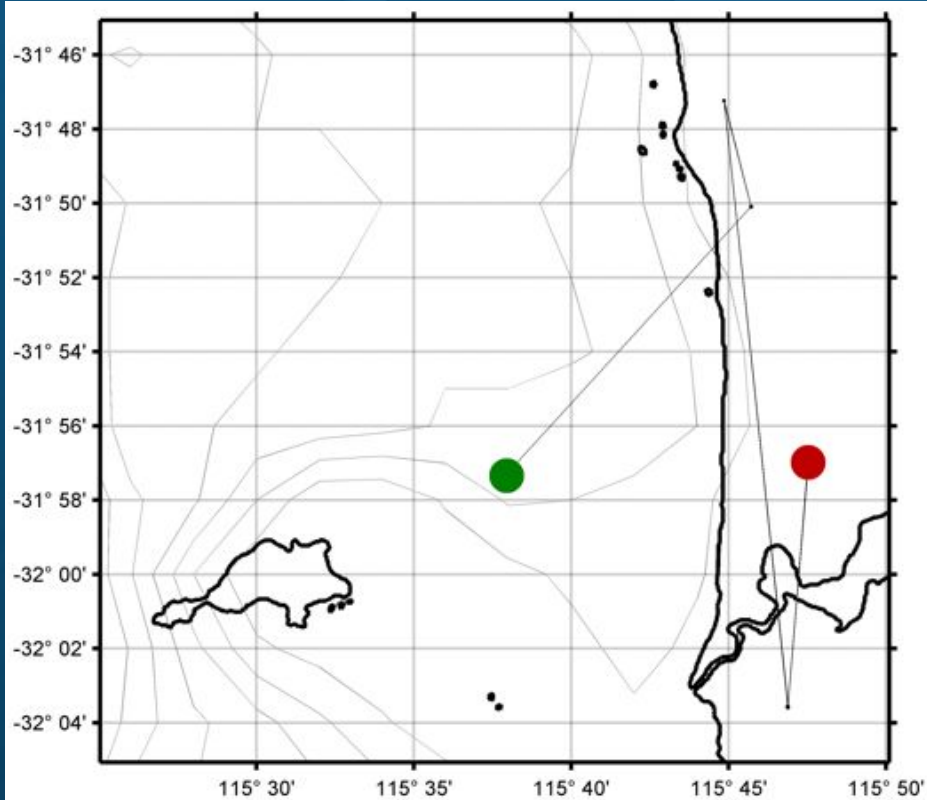
The Communication Revolution

Darwin's Odyssey



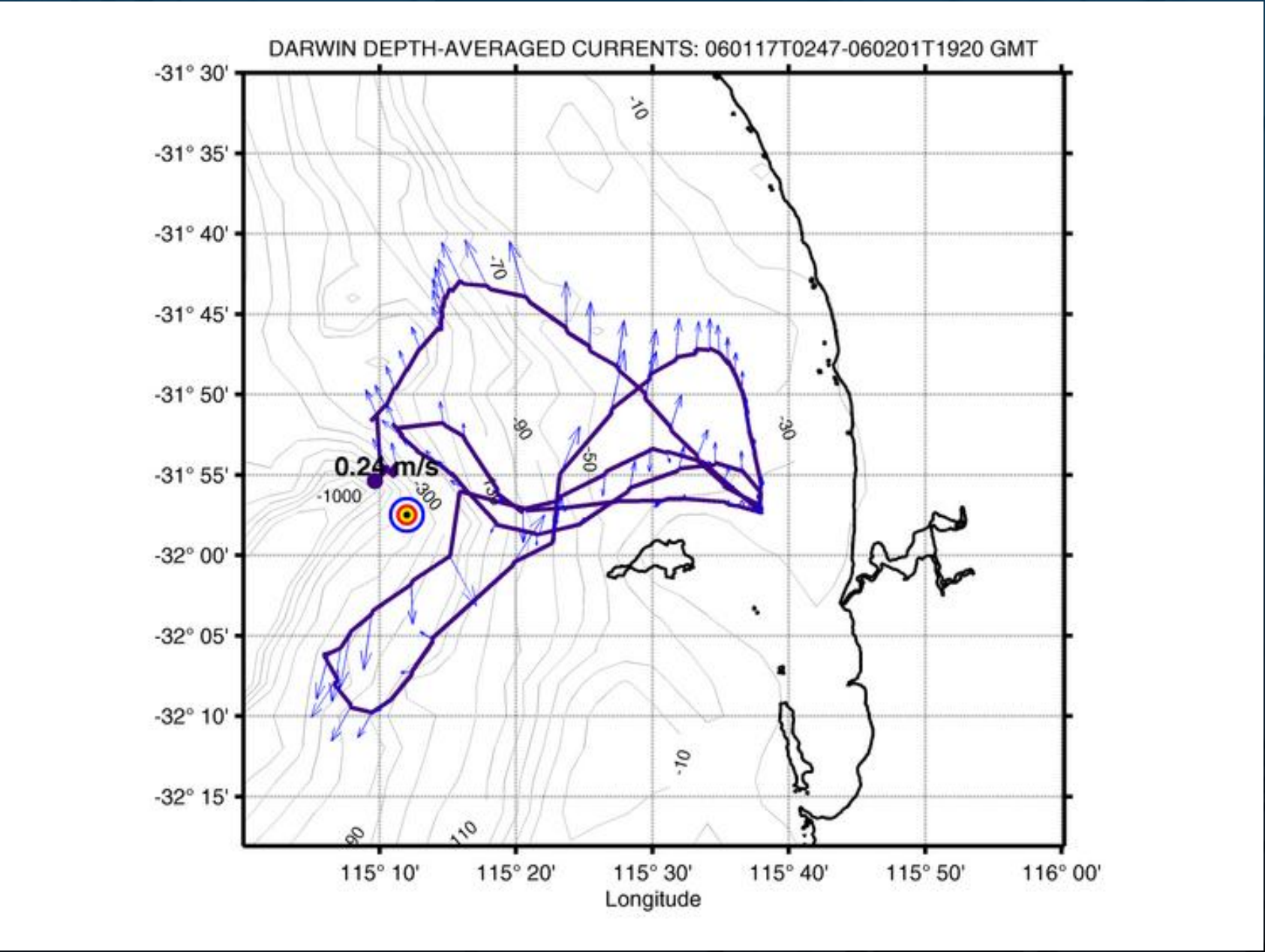
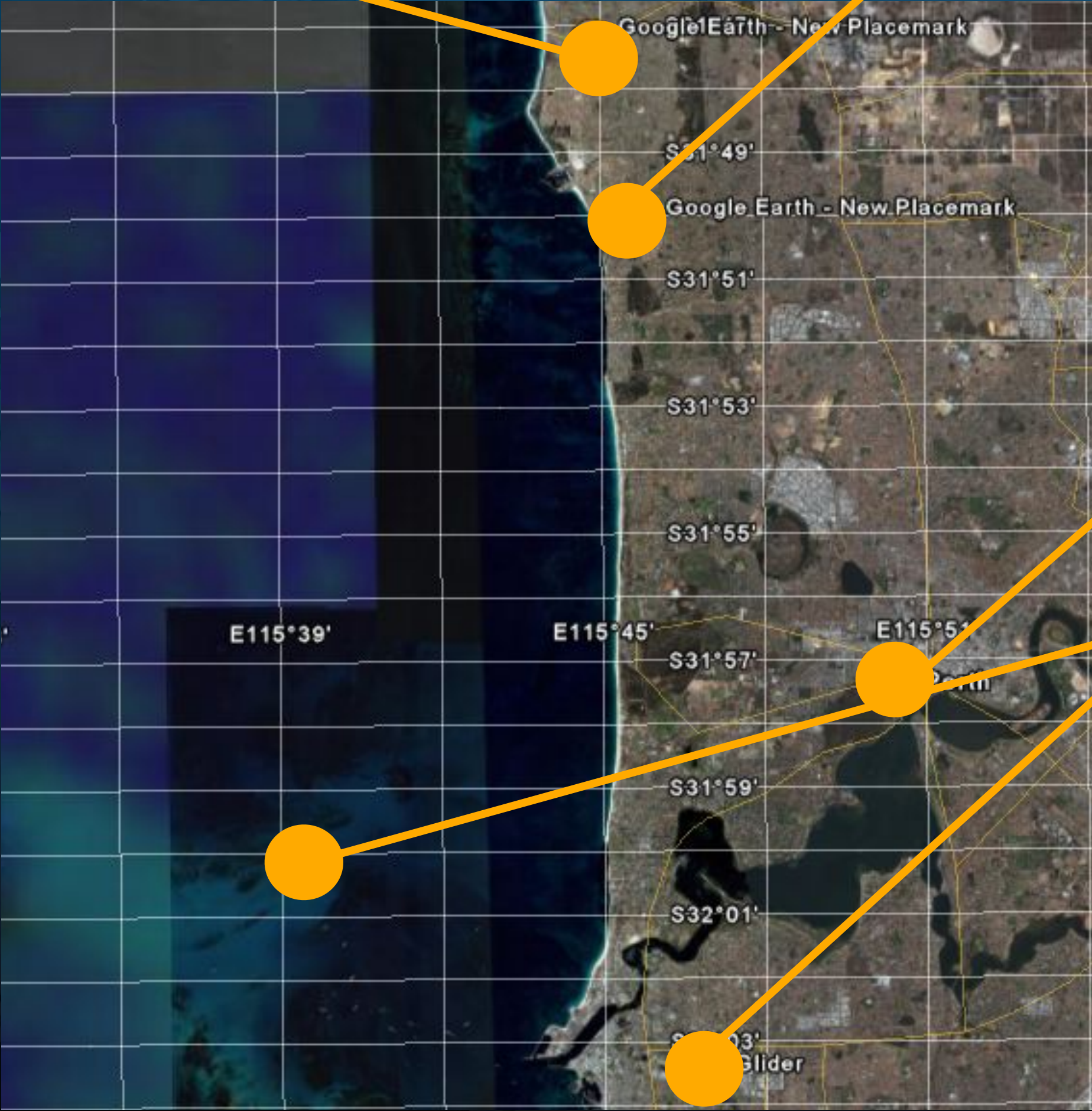
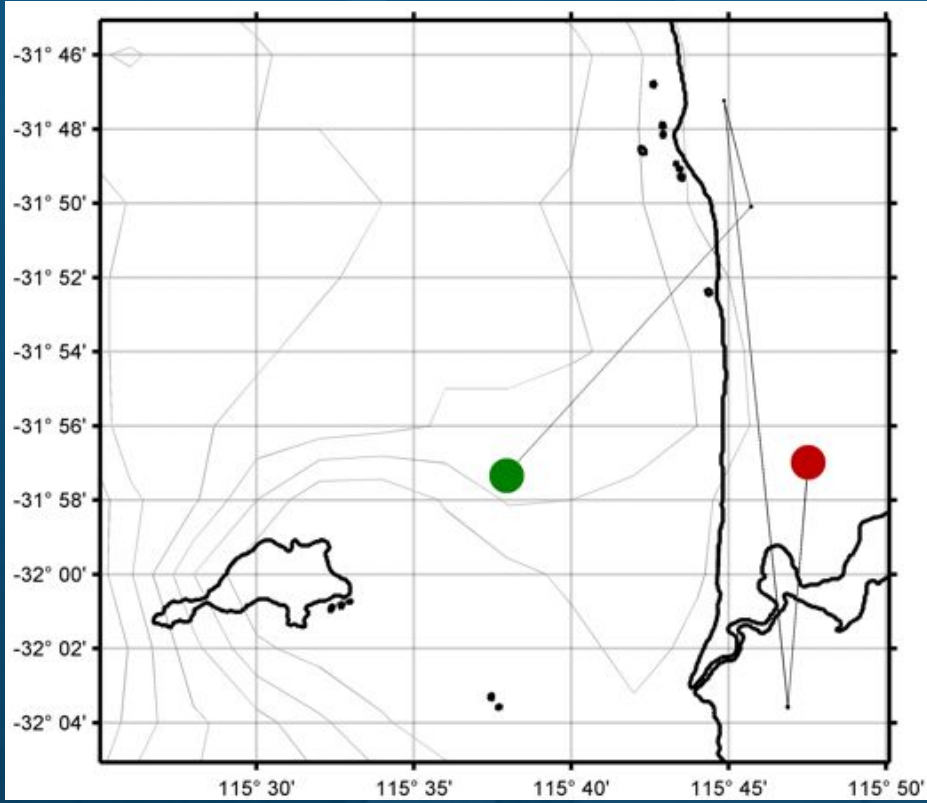
The Communication Revolution

Darwin's Odyssey

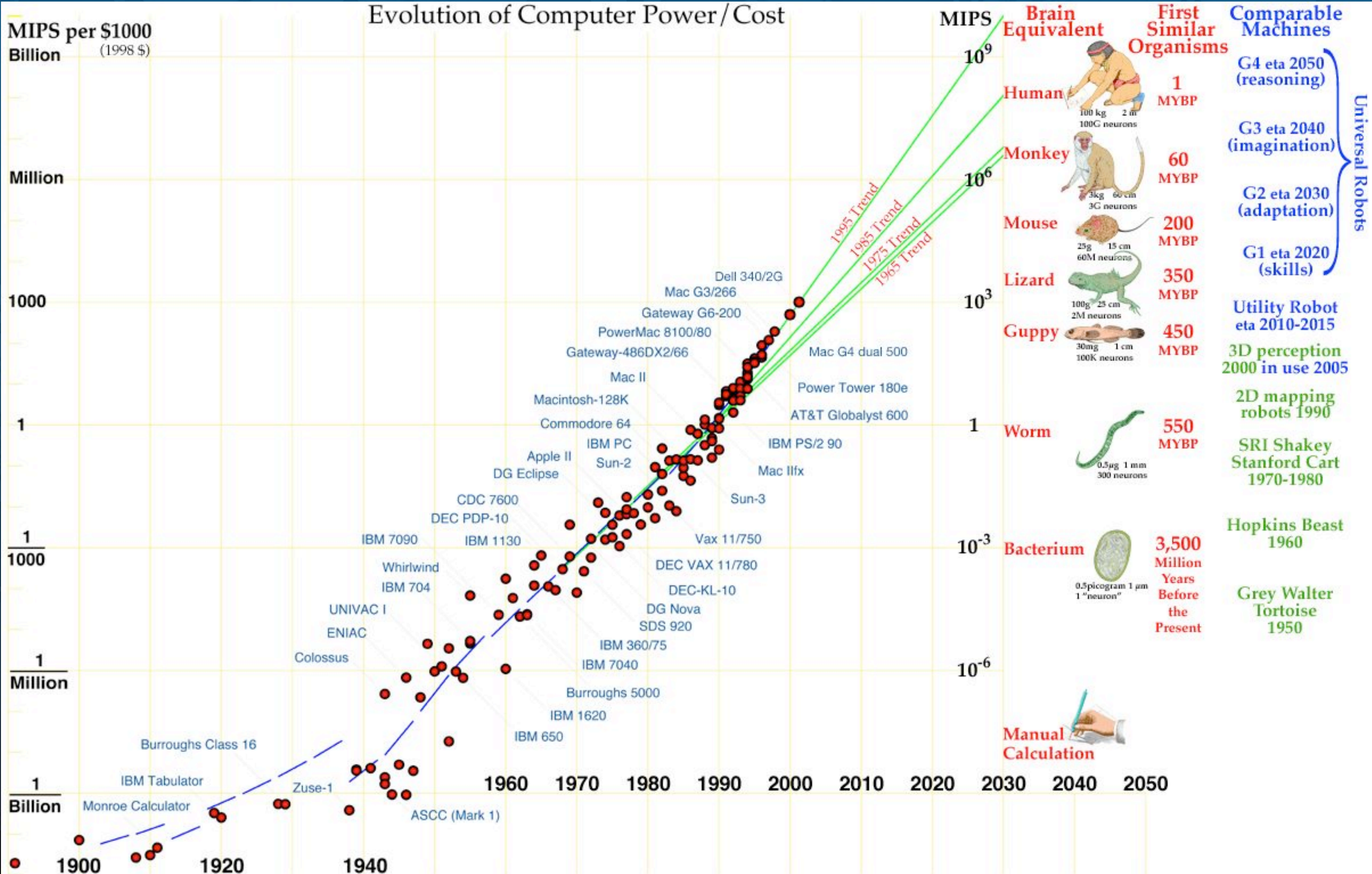


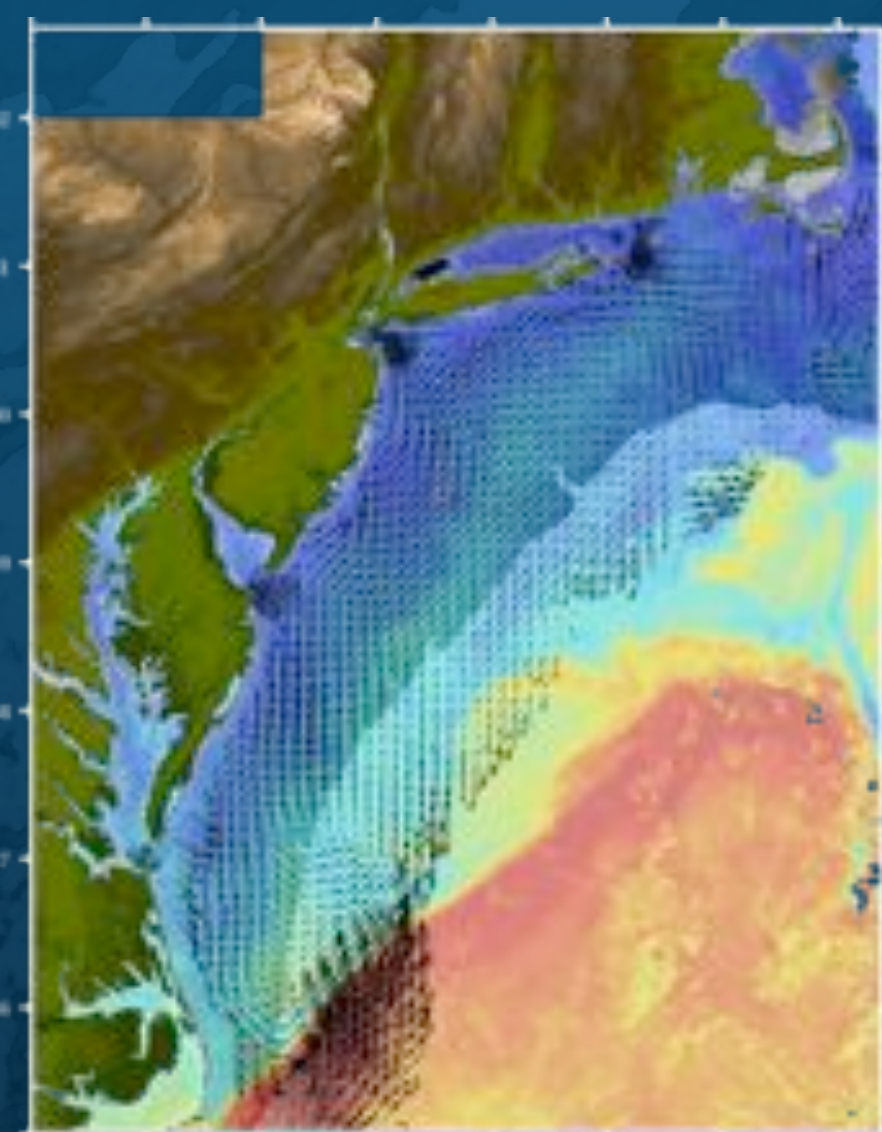
The Communication Revolution

Darwin's Odyssey



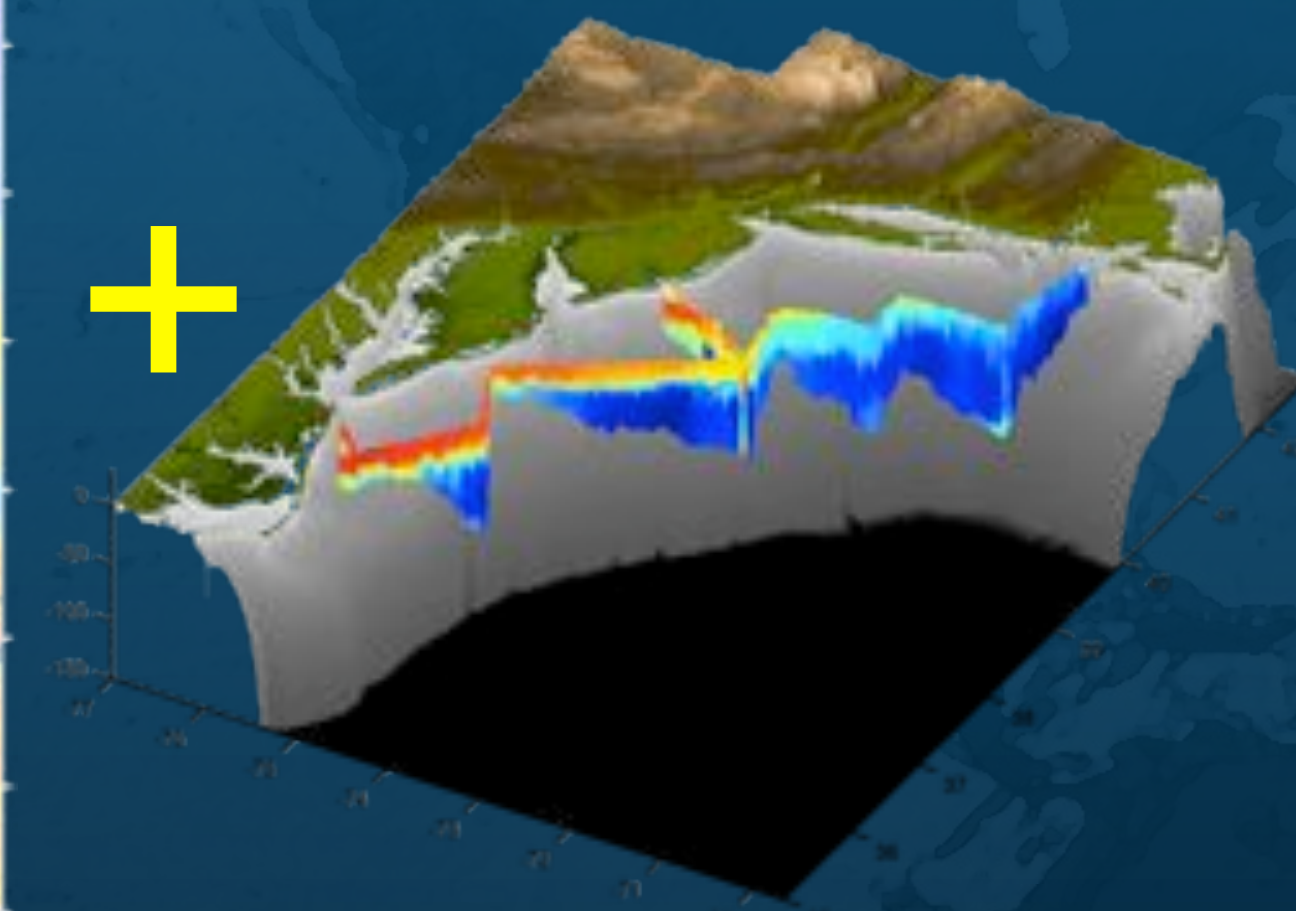
Evolution of Computer Power/Cost





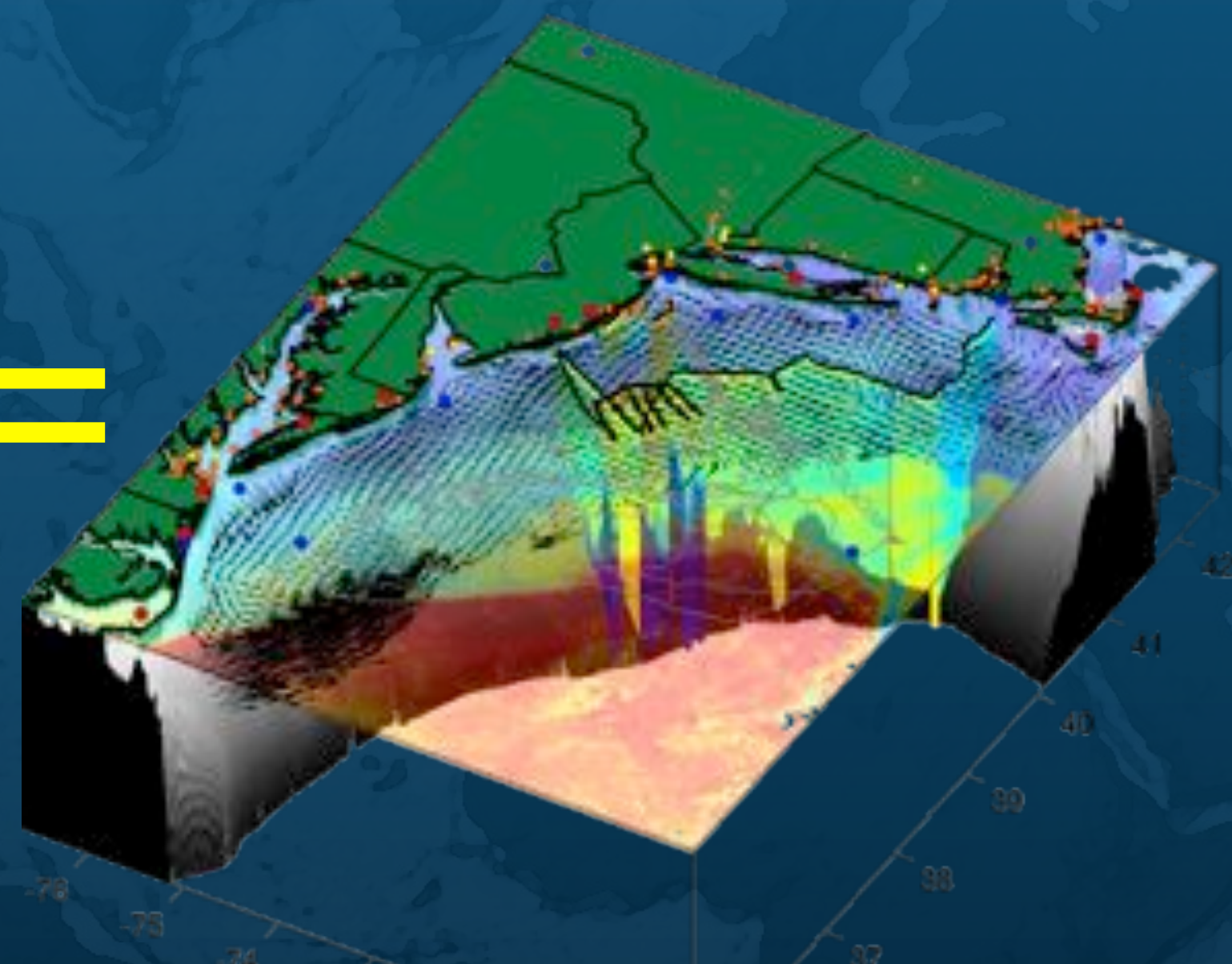
Remote Sensing

+

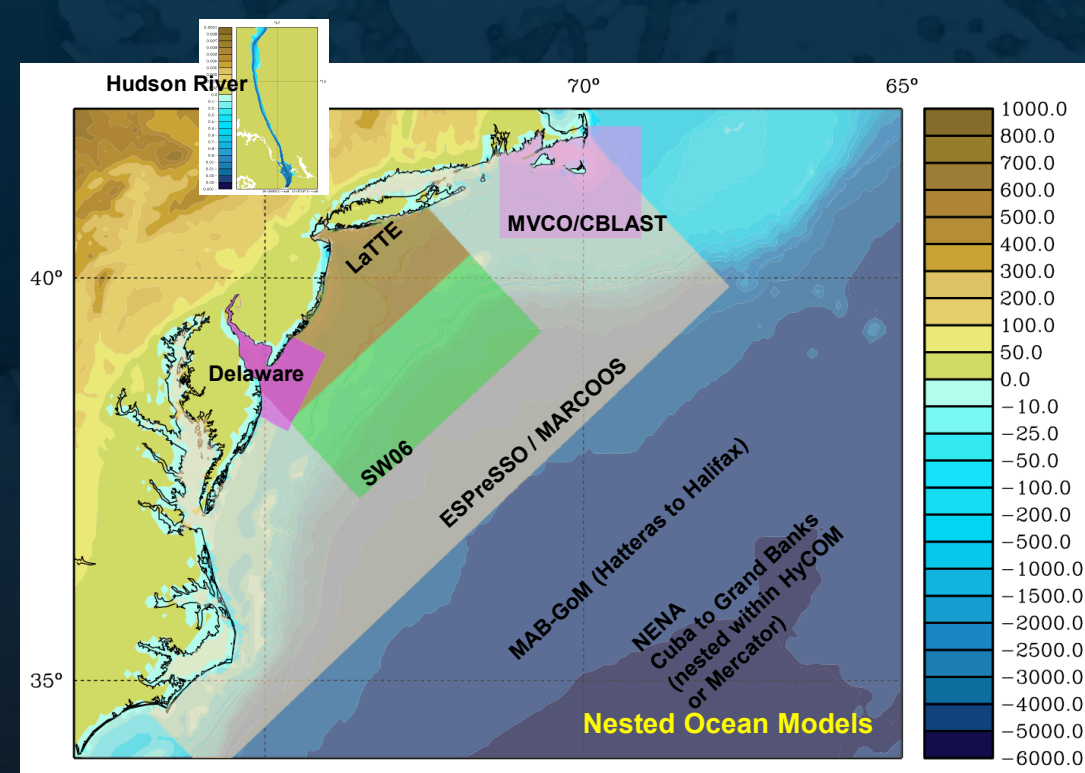


Robots

=



3-D Nowcasts



Nested Models

+

S4DVAR procedure

Lagrange function $L = J(\mathbf{x}) + \sum_{i=1}^N \tilde{\mathbf{e}}_i^T \left(\frac{d\mathbf{x}_i}{dt} - \mathbf{N}(\mathbf{x}_i) - \mathbf{F}_i \right)$ $\mathbf{F}_i = \mathbf{F}(i\Delta t)$ $\mathbf{x}_i = \mathbf{x}(i\Delta t)$
 Lagrange multiplier $\tilde{\mathbf{e}}_i = \tilde{\mathbf{e}}(t_i) = \tilde{\mathbf{e}}(i\Delta t)$

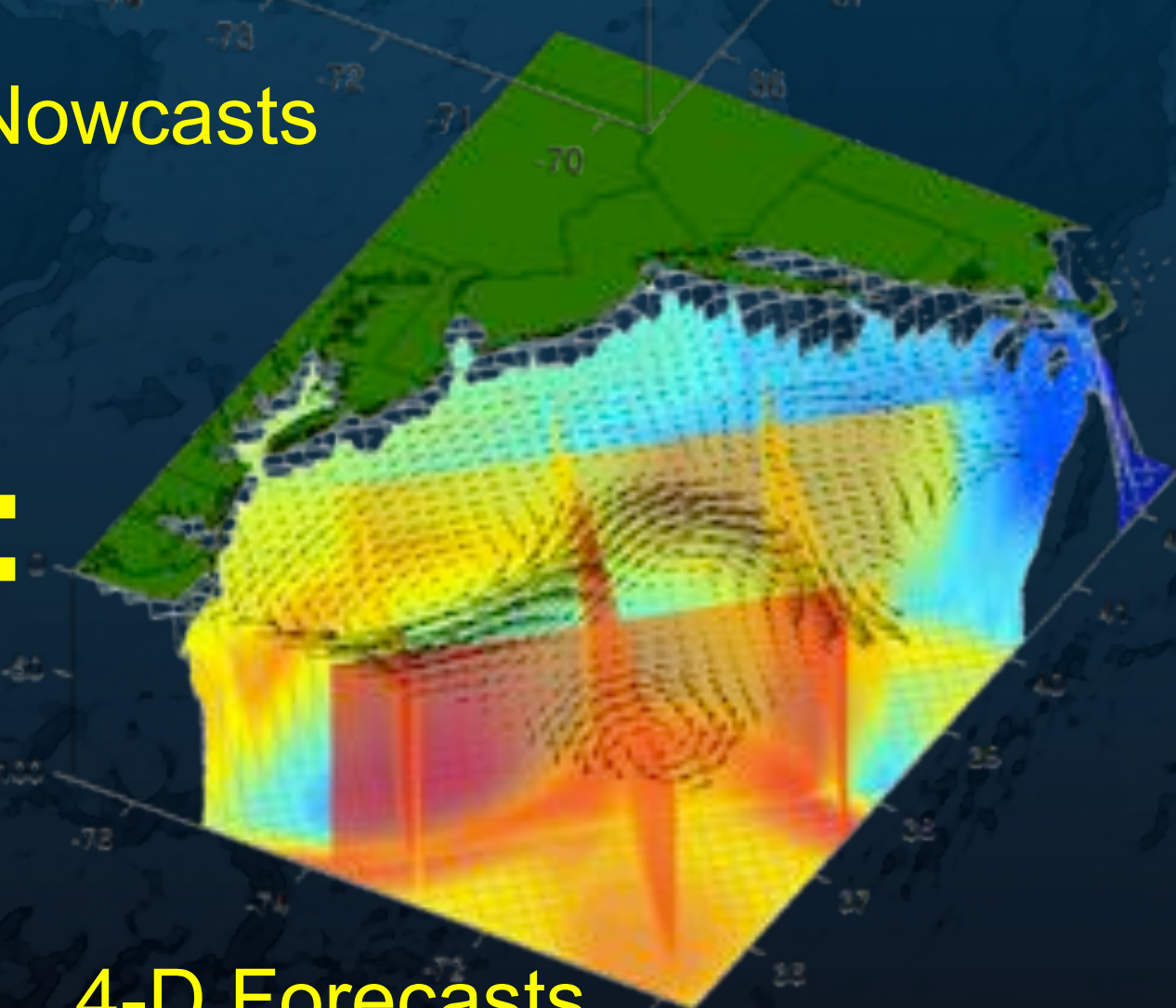
At extrema of L , we require: $\begin{cases} \frac{\partial L}{\partial \tilde{\mathbf{e}}_i} = 0 \Rightarrow \frac{d\mathbf{x}_i}{dt} - \mathbf{N}(\mathbf{x}_i) - \mathbf{F}_i = 0 & \text{NLROMS} \\ \frac{\partial L}{\partial \mathbf{x}_i} = 0 \Rightarrow -\frac{d\tilde{\mathbf{e}}_i}{dt} - \left(\frac{\partial \mathbf{N}}{\partial \mathbf{x}} \right)^T \tilde{\mathbf{e}}_i - \delta_{im} \mathbf{H}^T \mathbf{O}^{-1} (\mathbf{H} \mathbf{x}_m - \mathbf{y}_m) = 0 & \text{ADROMS} \\ \frac{\partial L}{\partial \mathbf{x}(0)} = 0 \Rightarrow \mathbf{B}^{-1} (\mathbf{x}(0) - \mathbf{x}_s) - \tilde{\mathbf{e}}(0) = 0 & \text{coupling of NL \& ADROMS} \\ \frac{\partial L}{\partial \mathbf{x}(\tau)} = 0 \Rightarrow \tilde{\mathbf{e}}(\tau) = 0 & \text{i.c. of ADROMS} \end{cases}$

S4DVAR procedure:

- (1) Choose an $\mathbf{x}(0) = \mathbf{x}_s$
- (2) Integrate NLROMS $t \in [0, \tau]$ and compute J
- (3) Integrate ADROMS $t \in [\tau, 0]$ to get $\tilde{\mathbf{e}}(0)$
- (4) Compute $\frac{\partial J}{\partial \mathbf{x}(0)} = \mathbf{B}^{-1} (\mathbf{x}(0) - \mathbf{x}_s) - \tilde{\mathbf{e}}(0)$
- (5) Use a descent algorithm to determine a "down gradient" correction to $\mathbf{x}(0)$ that will yield a smaller value of J
- (6) Back to (2) until converged

Data Assimilation

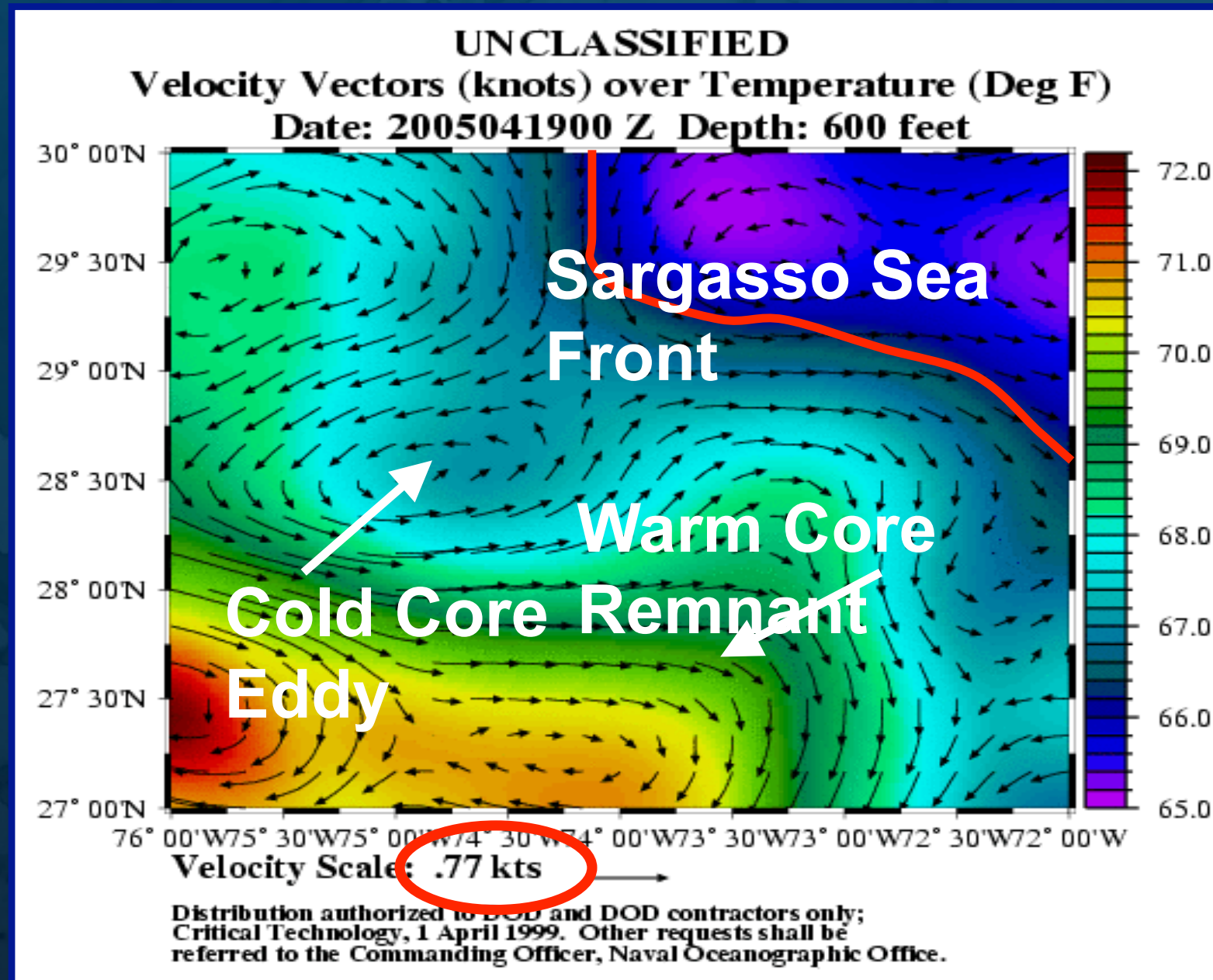
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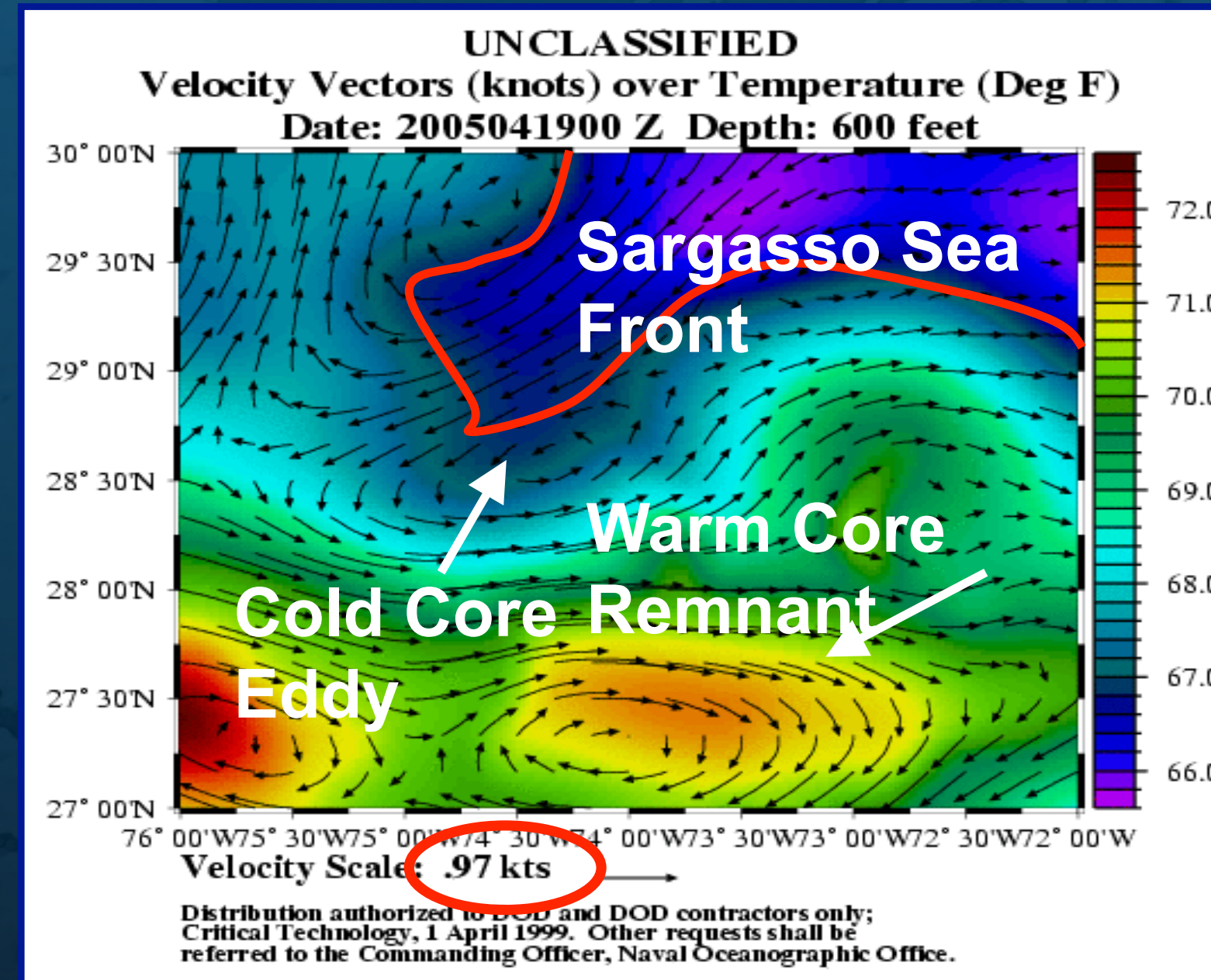
4-D Forecasts

Lets say you are hunting “whales”

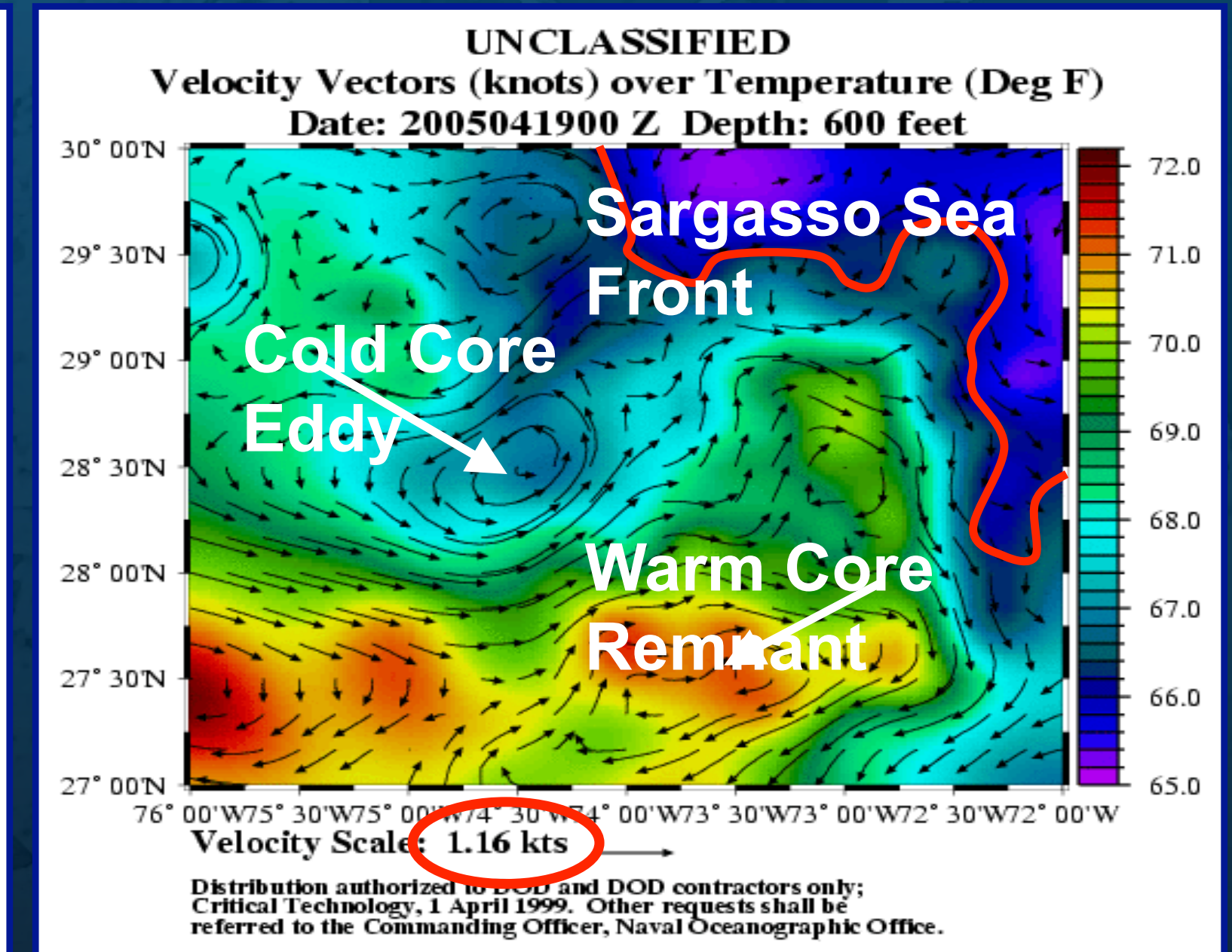
Knowledge of the environment will give you a tactical advantage
Knowledge of future environment will give you a bigger tactical advantage



No in situ data
into the model

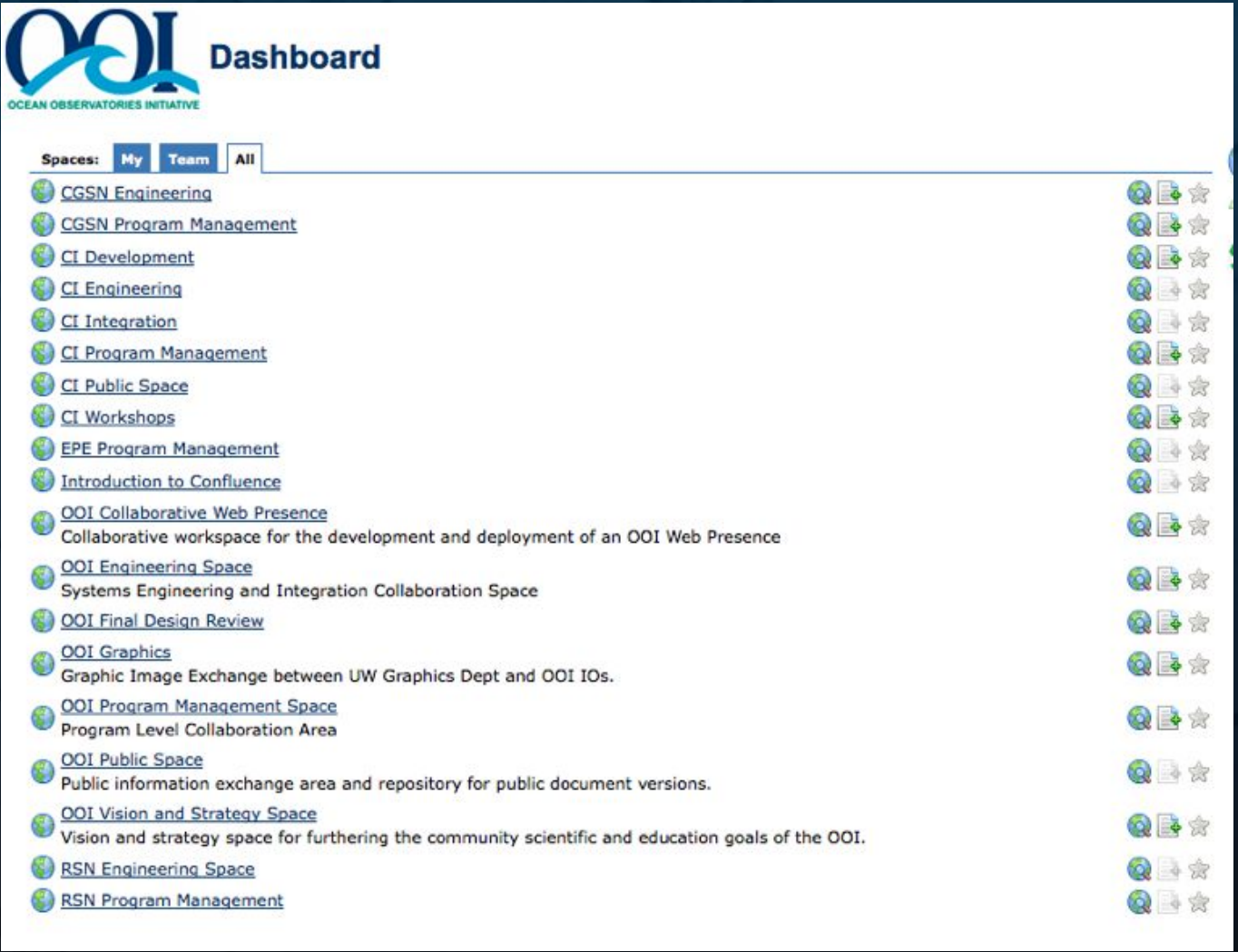
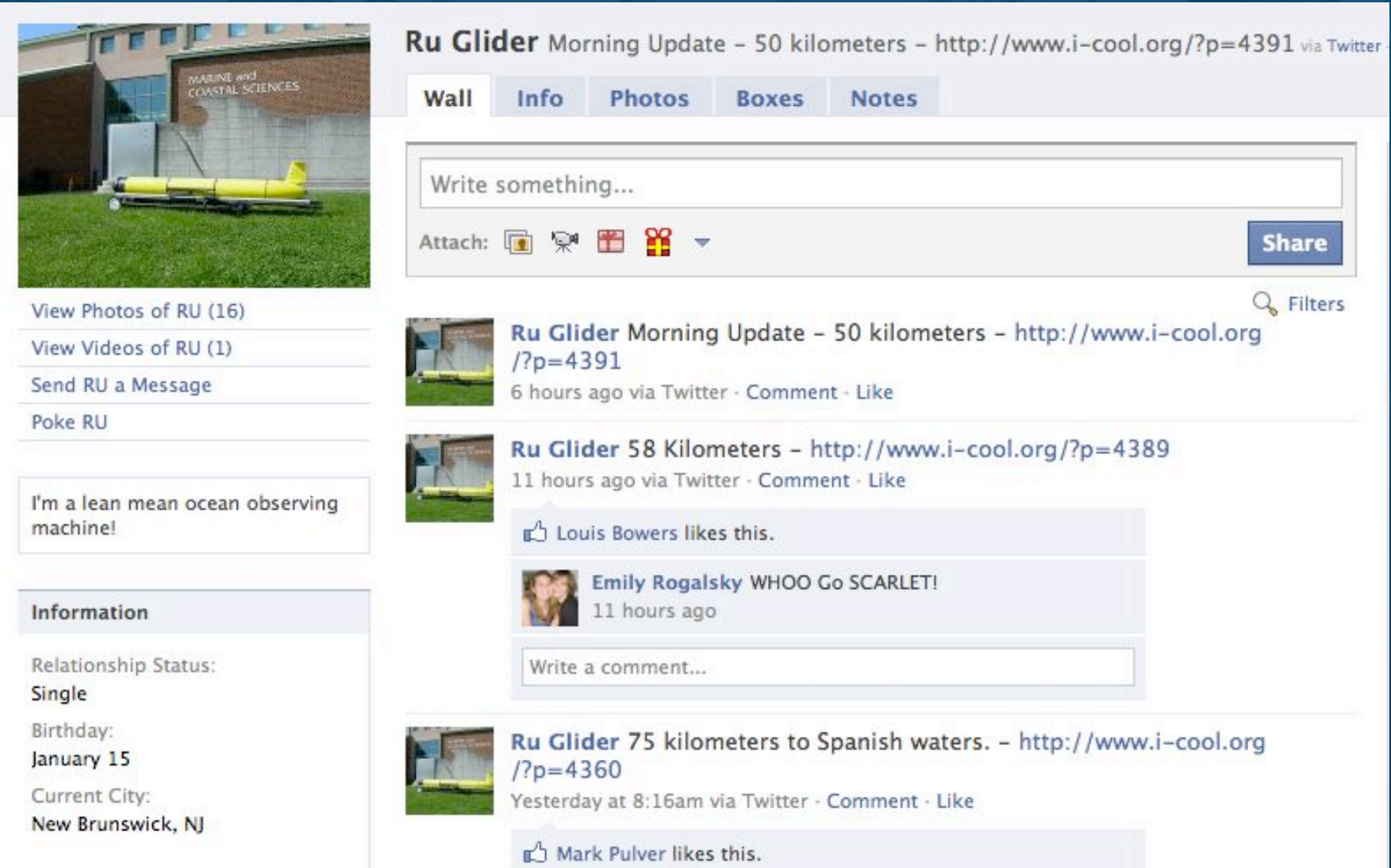
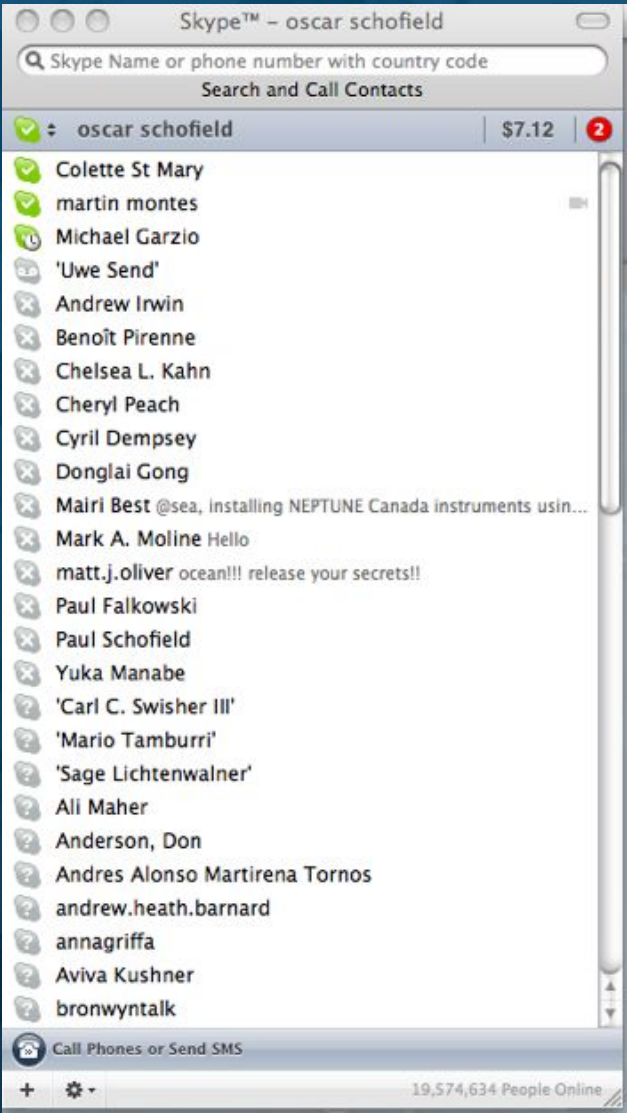


BSP in situ data
into the model



Gliders (4) in situ data
into the model

Science enabled by social networking



Network allows for construction of ad hoc networks when needed

Contributed Assets:

HF Radar Networks

USF, USM

Gliders

iRobot, Mote, Rutgers,
SIO, UDel, USF, Navy

Drifters & Profilers

Horizon Marine, Navy

Satellite Imagery

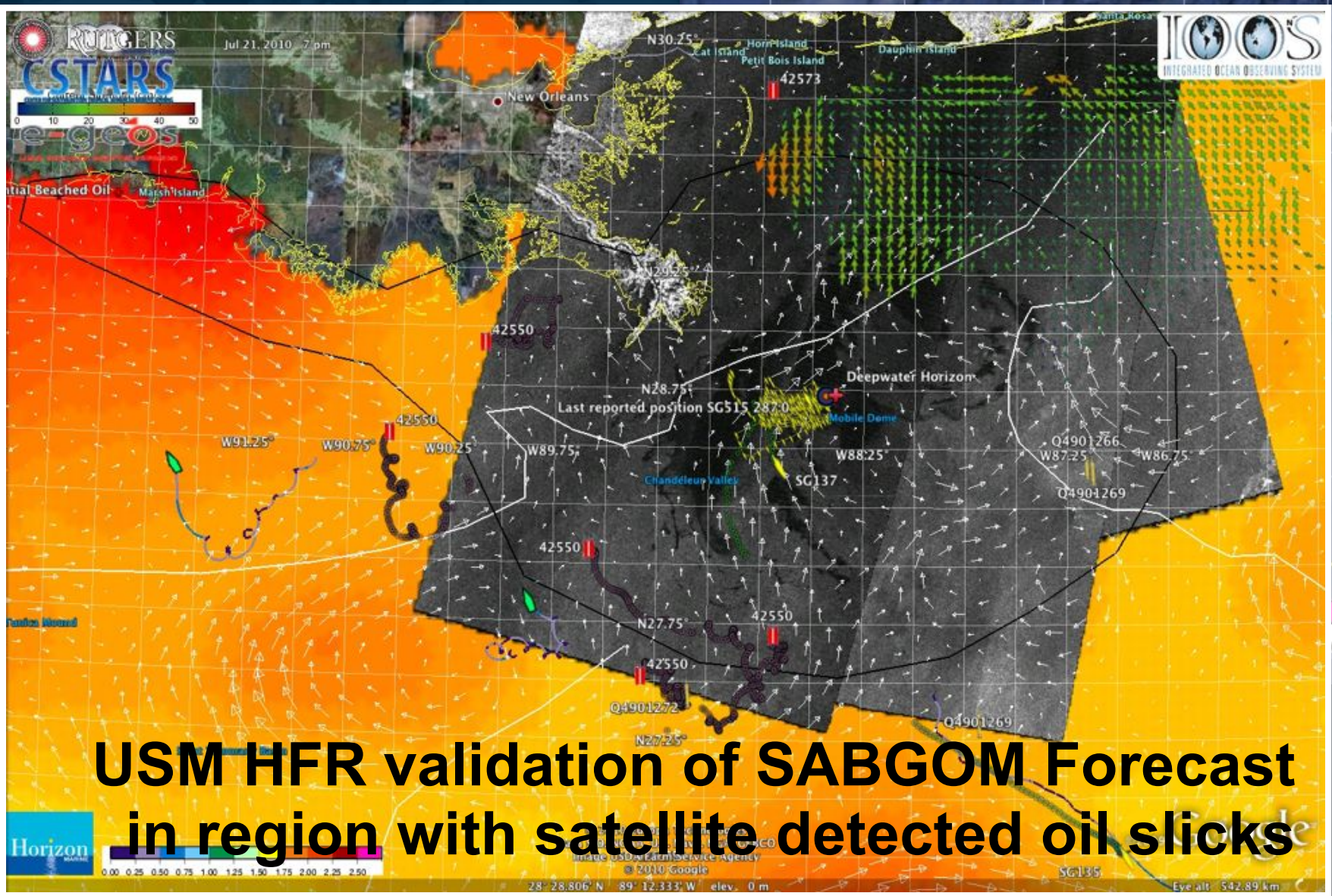
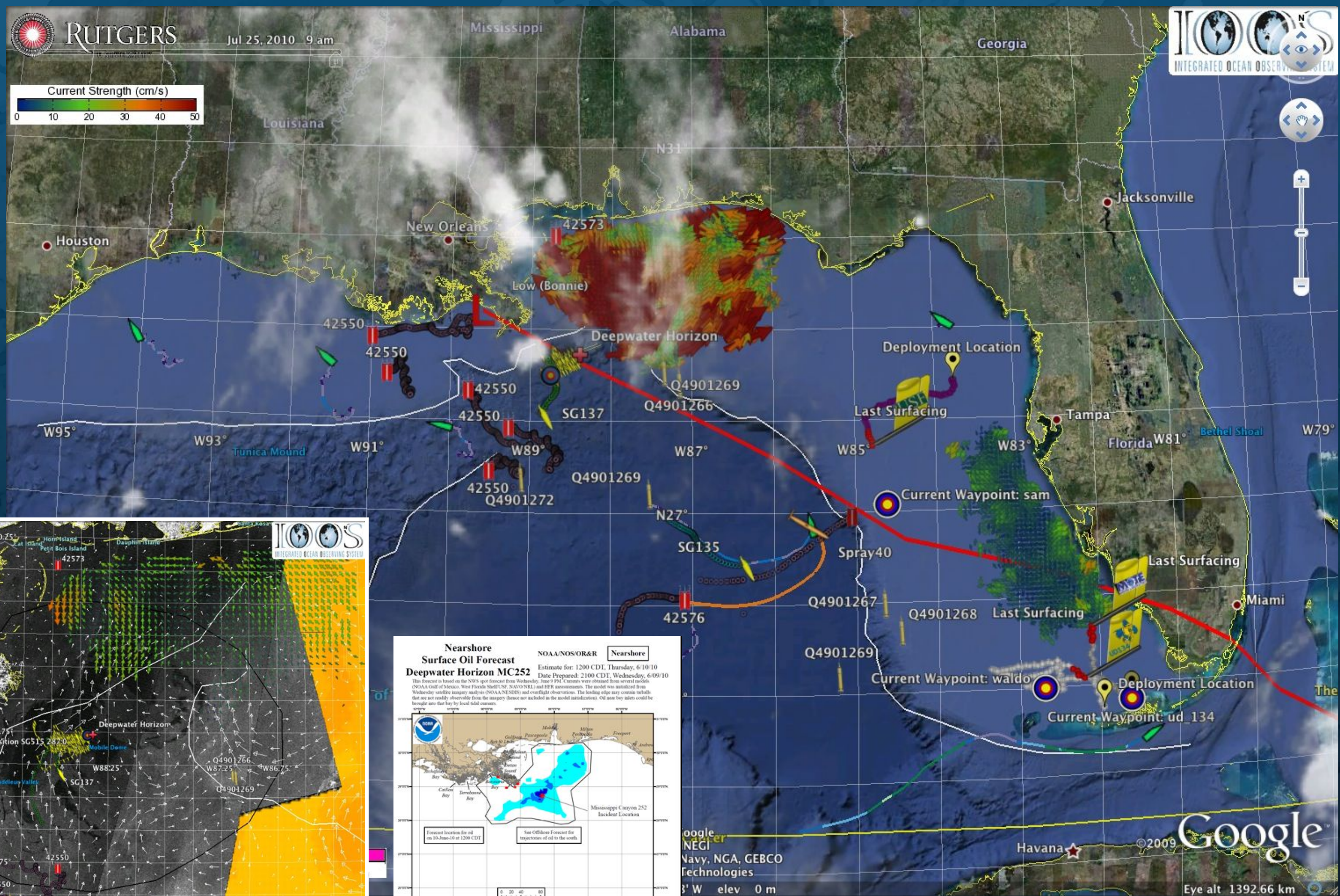
CSTARS, UDel

Ocean Forecasts

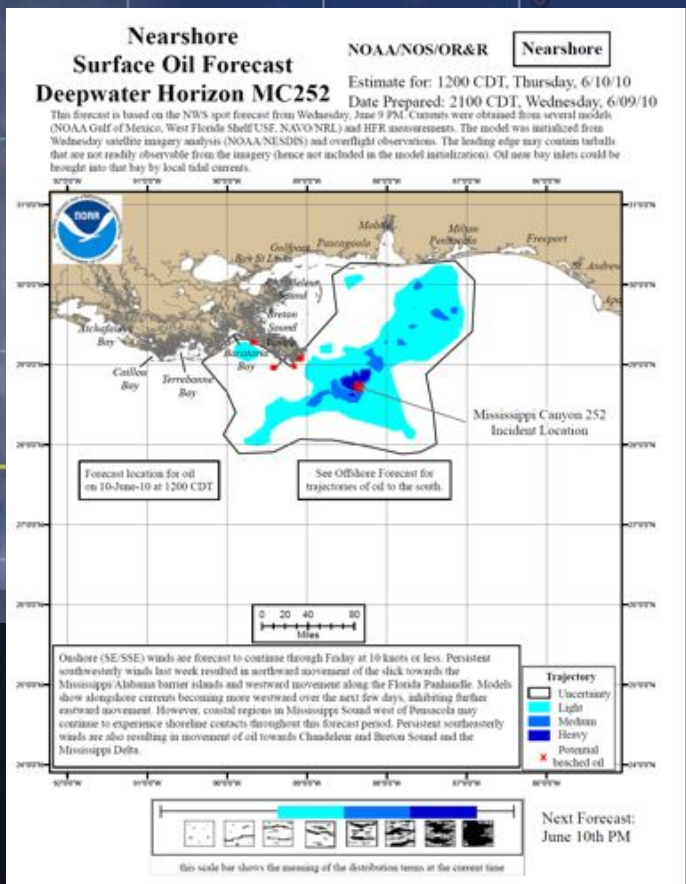
Navy, NCSU

Data/Web Services

ASA, Rutgers, SIO



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



Data and models for situations where the University does not allow
me to send graduate students



Hurricane Irene
August 2011

The Miami Herald > Weather >

Hurricanes

Sunday, 02.19.12 Welcome Guest •

HOME NEWS SPORTS ENTERTEINMENT

Miami-Dade | Broward | Keys |

Posted on Friday, 09.02.11

HURRICANE SEASON

Intensity remain

f Like 1

The National Hurricane Center says it wasn't the first time — but the increasing standards of



The New York Times

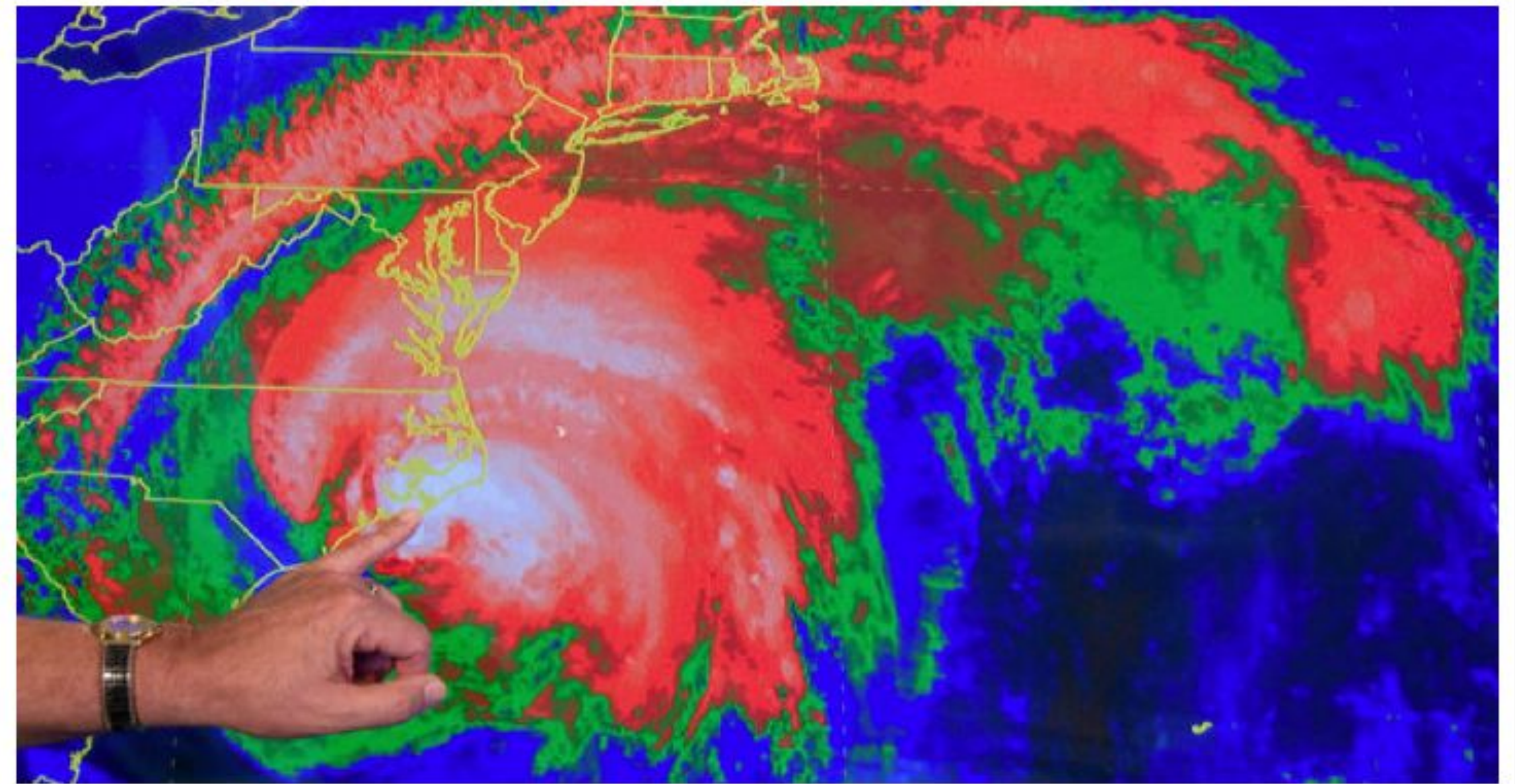
U.S.

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POLITICS EDUCATION BAY AREA CHICAGO TEXAS



Challenges in Predicting the Intensity of Storms



Andy Newman/Associated Press

Scientists say that it is much easier to accurately predict what path a hurricane will take.

By HENRY FOUNTAIN

Published: August 27, 2011

The Miami Herald > Weather >

Hurricanes

Sunday, 02.19.12 Welcome Guest •

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Miami-Dade | Broward | Keys |

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HURRICANE SEASON

Intensity remain

f Like 1

The National Hurricane C
it wasn't the first time —
the increasing standards



The New York Times

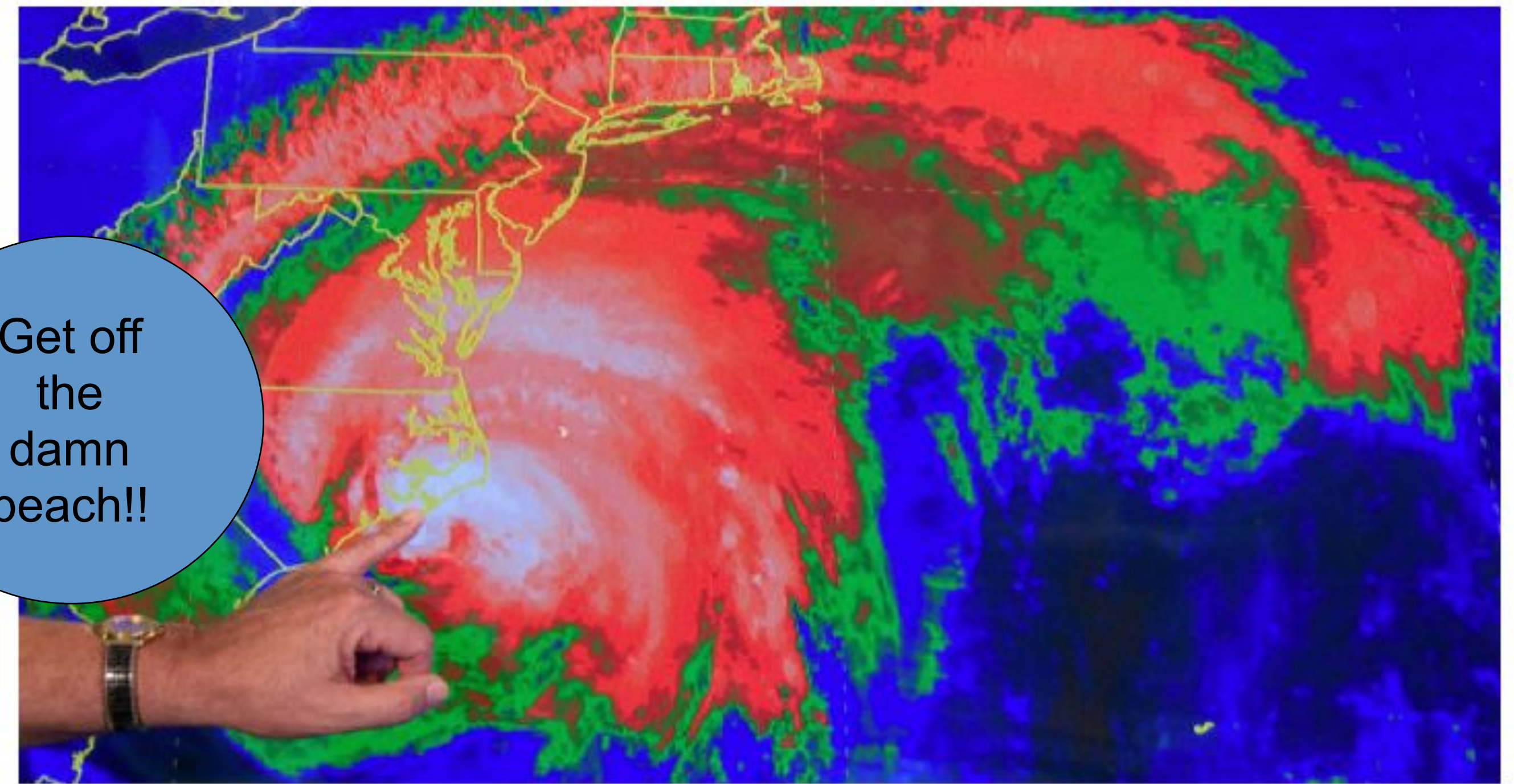
U.S.

WORLD U.S. N.Y. / REGION BUSINESS TECHNOLOGY SCIENCE HEALTH SPORTS OPINION

POLITICS EDUCATION BAY AREA CHICAGO TEXAS



Challenges in Predicting the Intensity of Storms



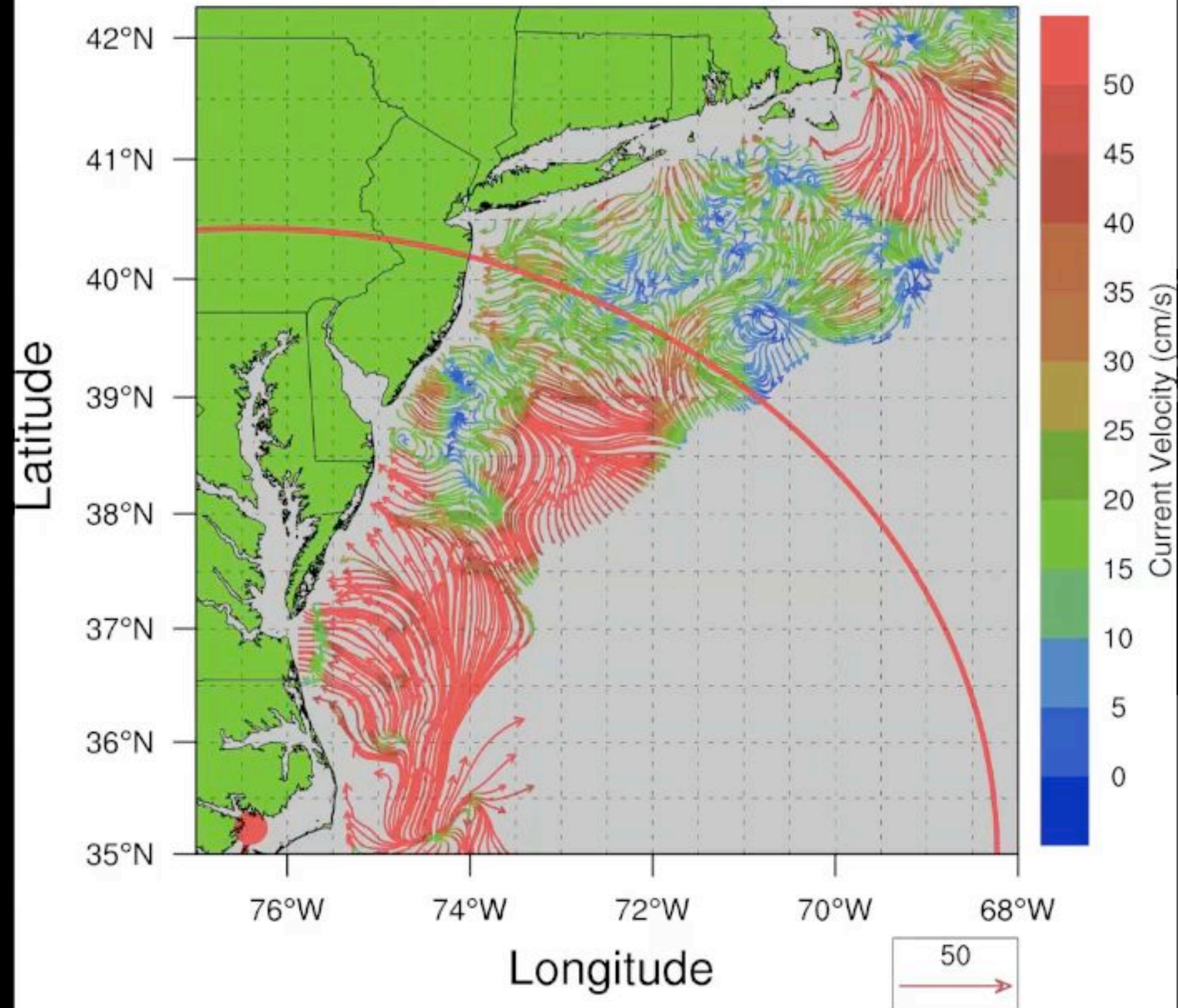
Andy Newman/Associated Press

Scientists say that it is much easier to accurately predict what path a hurricane will take.

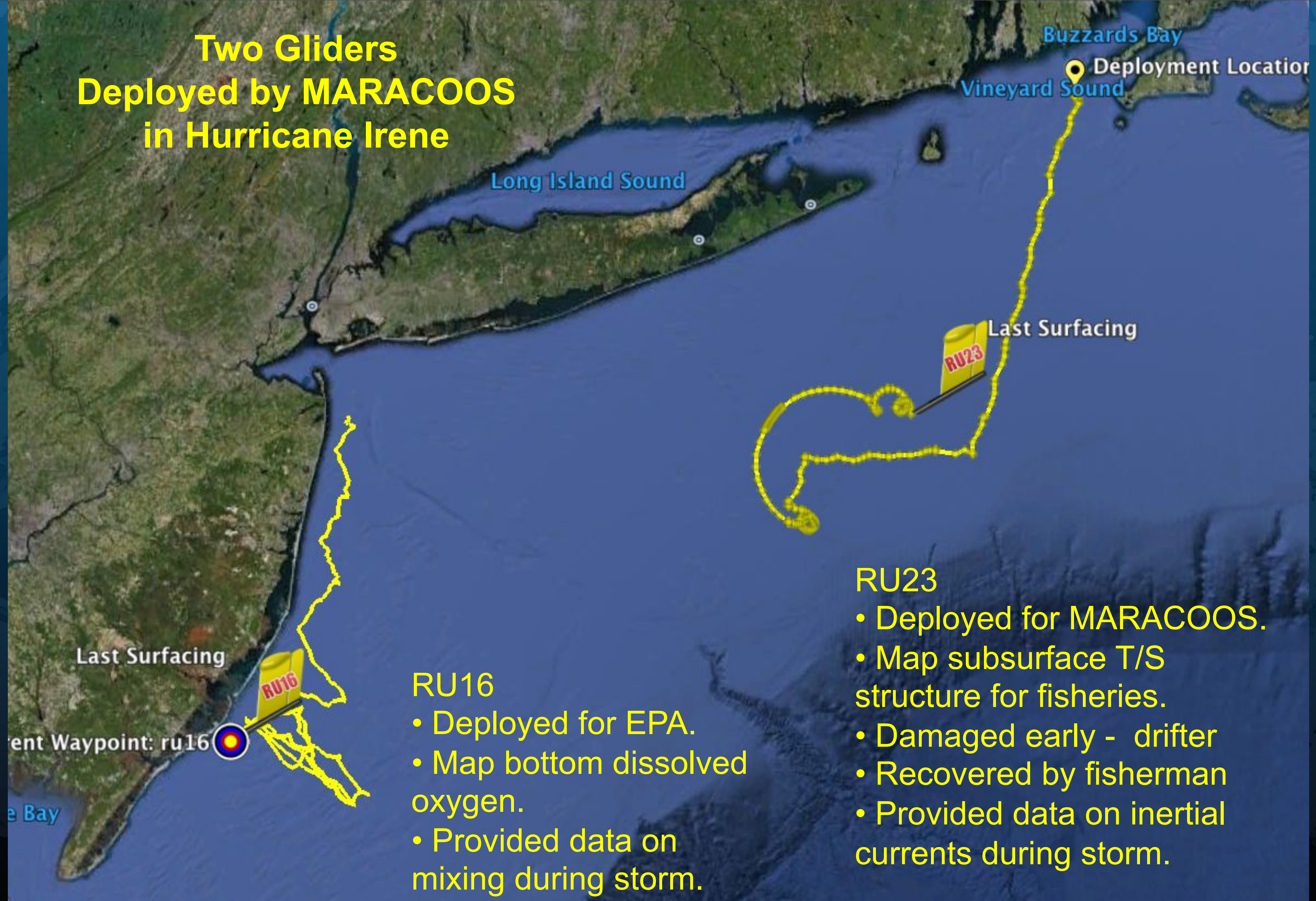
By HENRY FOUNTAIN

Published: August 27, 2011

Long Range Radar Network Sea Surface Currents 2011082717 GMT



Two Gliders Deployed by MARACOOS in Hurricane Irene

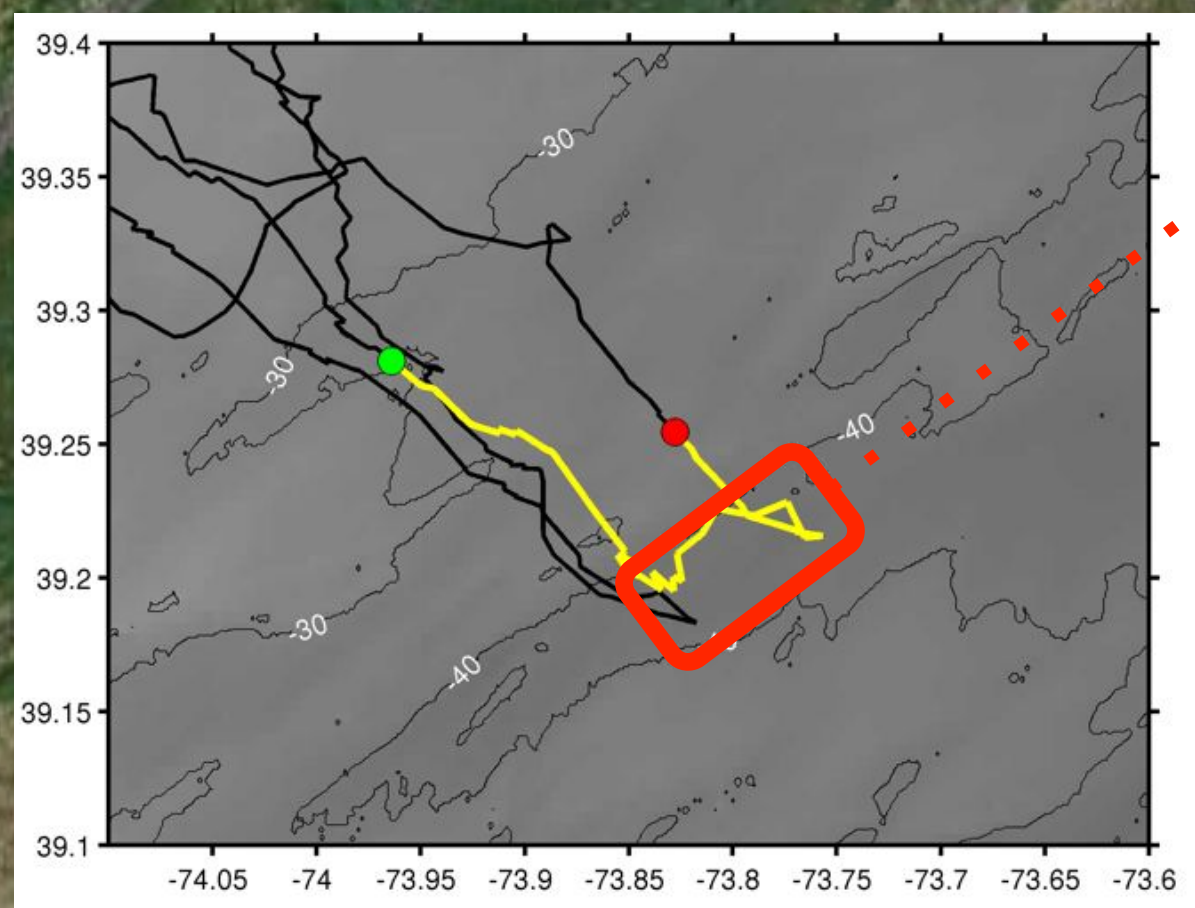


RU16

- Deployed for EPA.
- Map bottom dissolved oxygen.
- Provided data on mixing during storm.

RU23

- Deployed for MARACOOS.
- Map subsurface T/S structure for fisheries.
- Damaged early - drifter
- Recovered by fisherman
- Provided data on inertial currents during storm.



Hurricane Irene

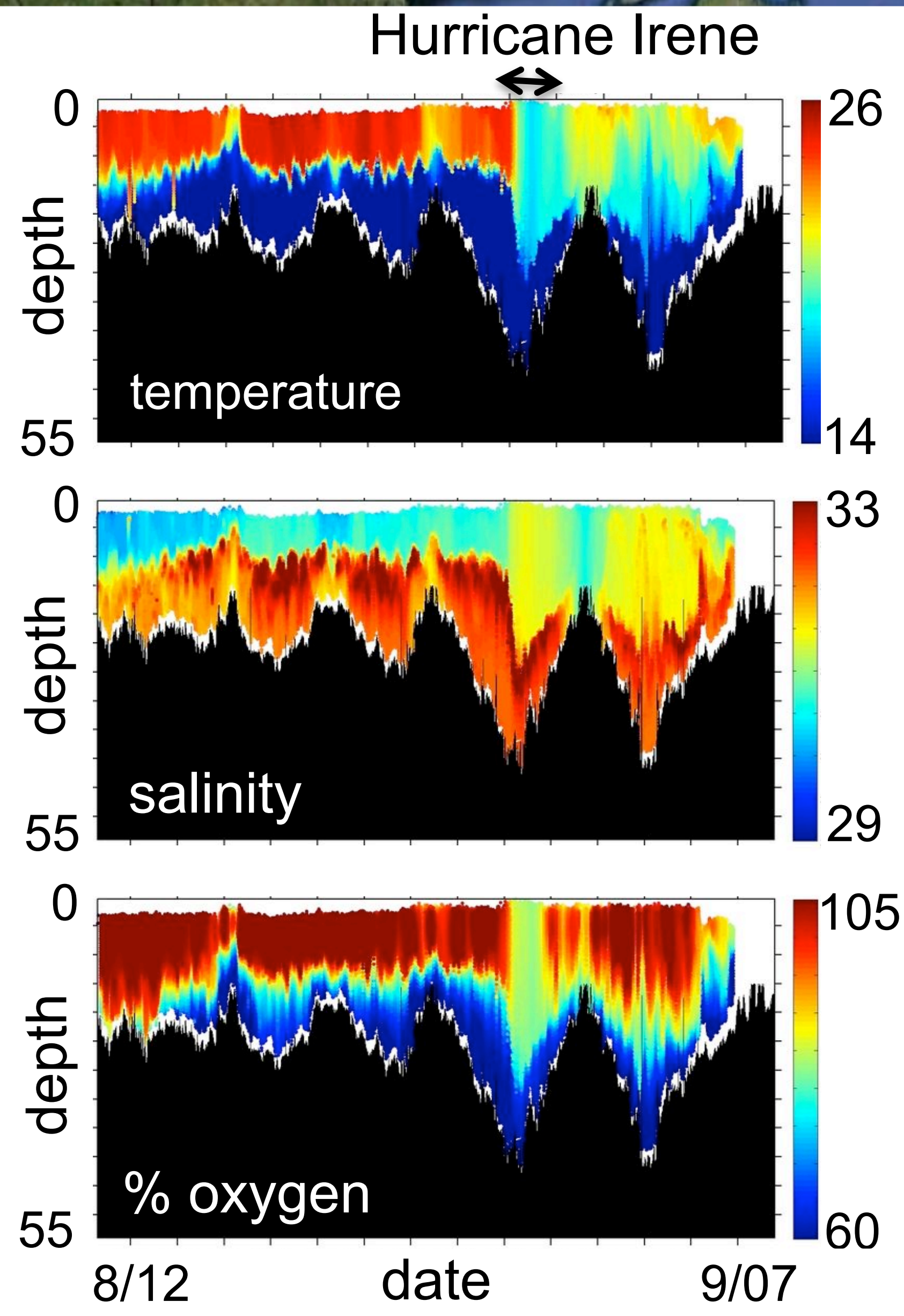
Long Island Sound

Last Surfacing

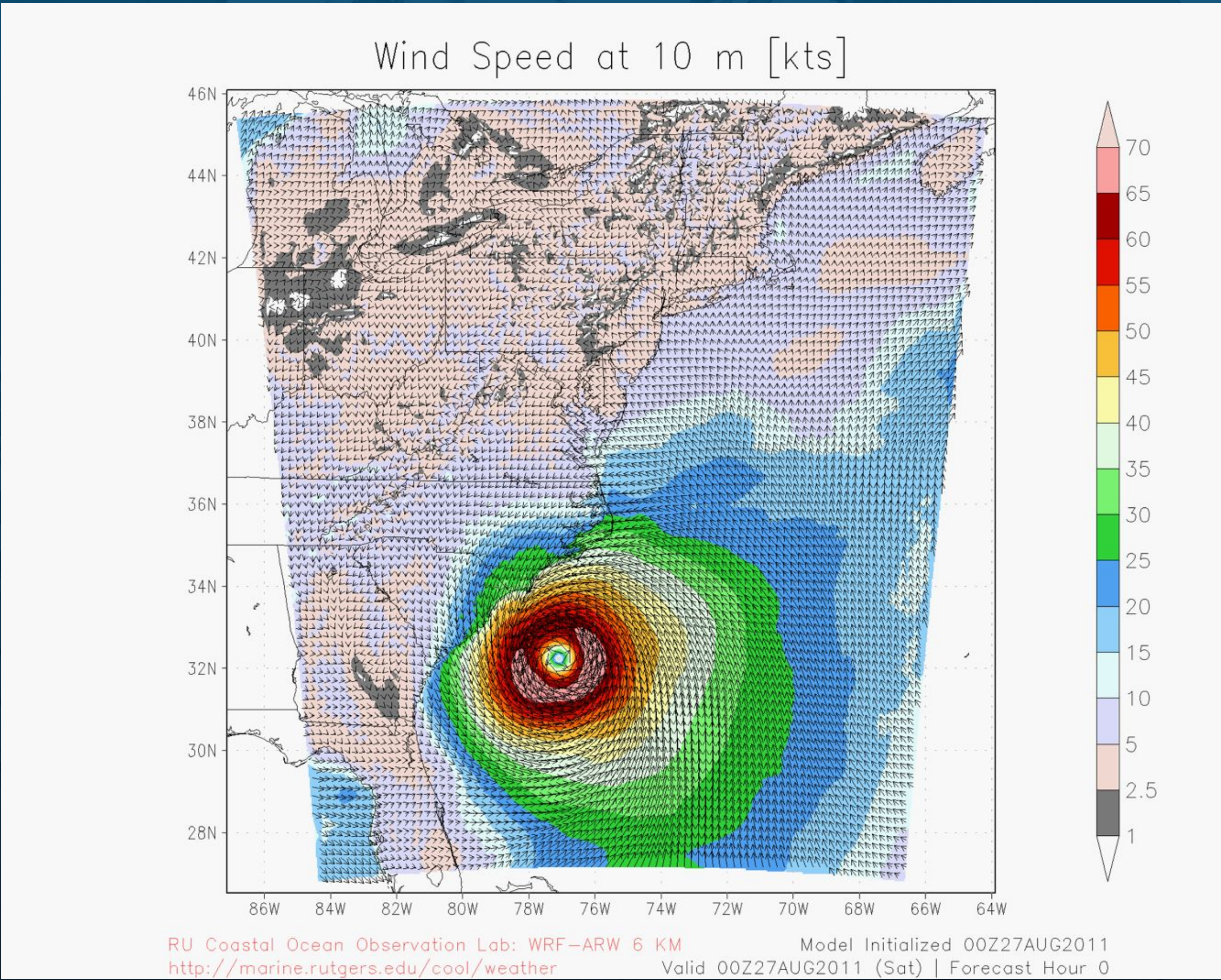
Current Waypoint: ru16



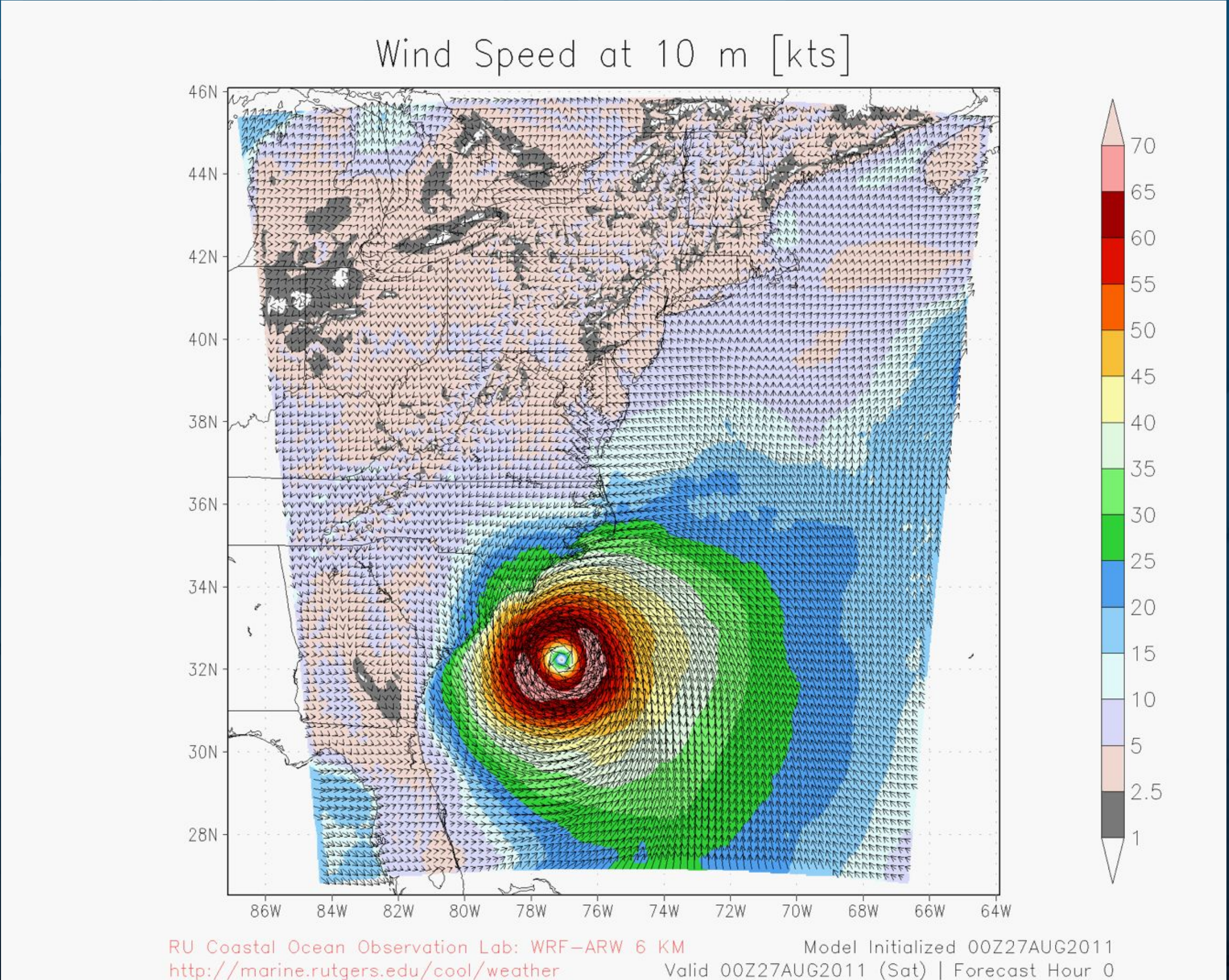
Delaware Bay



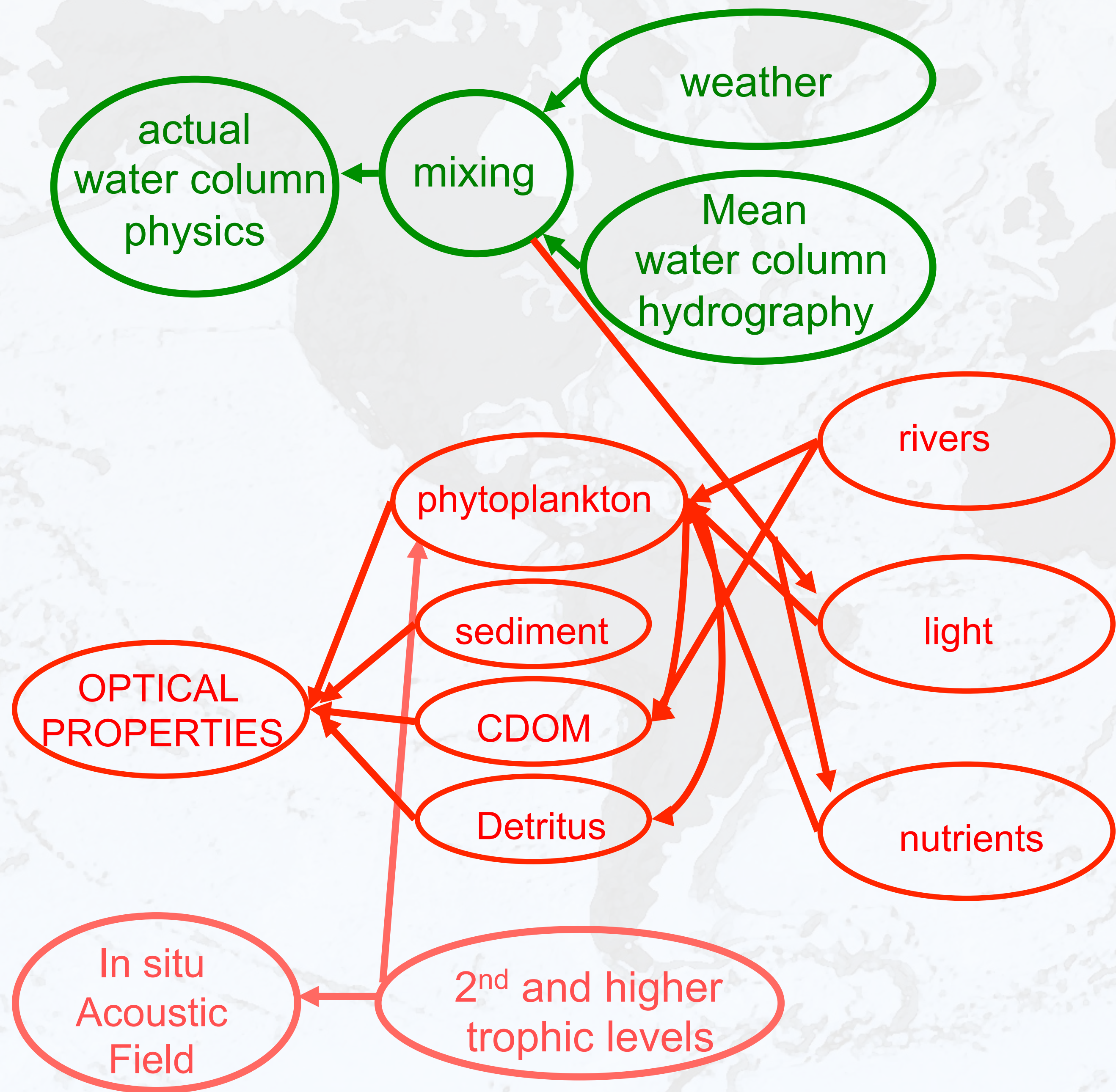
Winds assuming warm temperatures

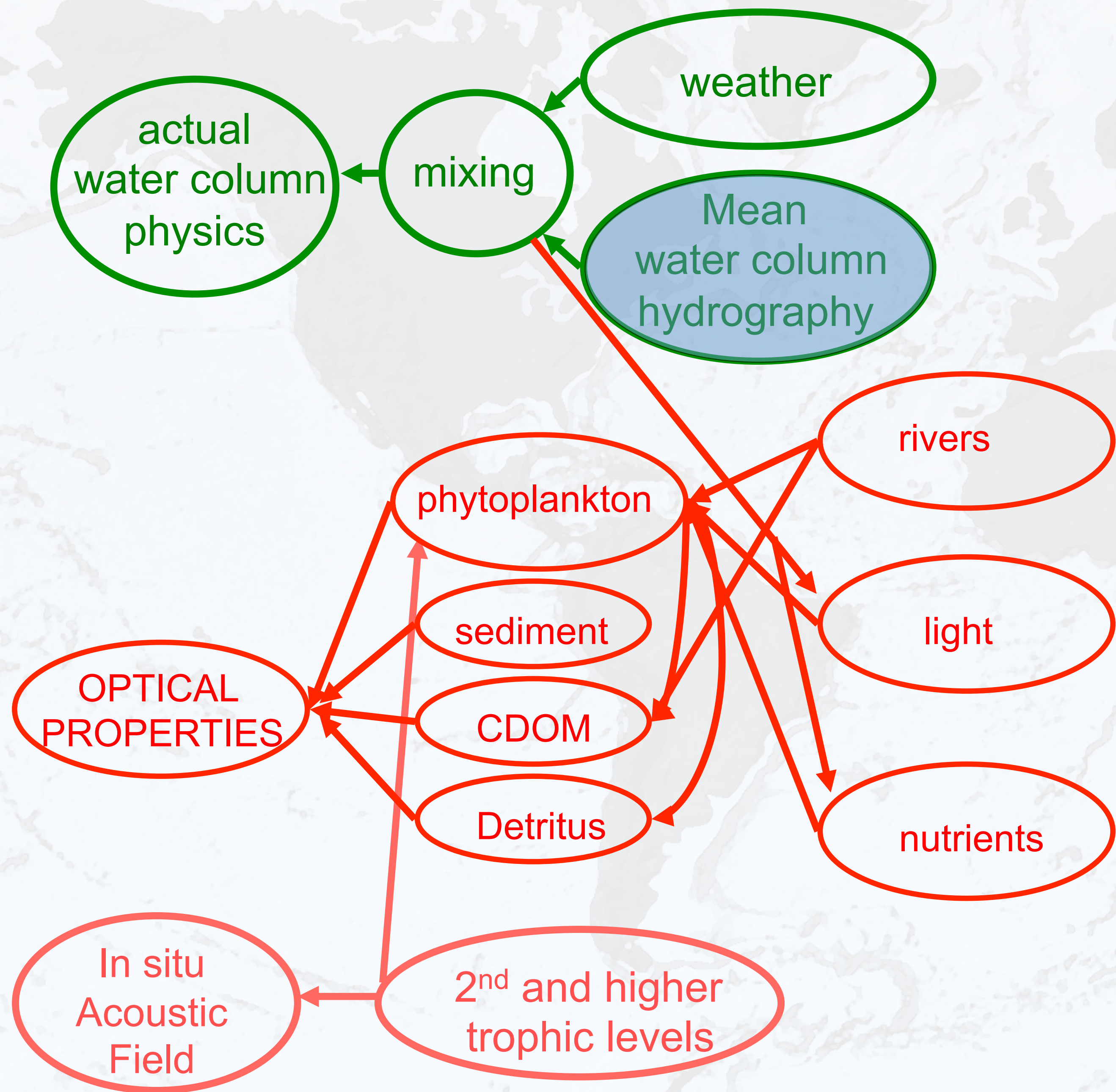


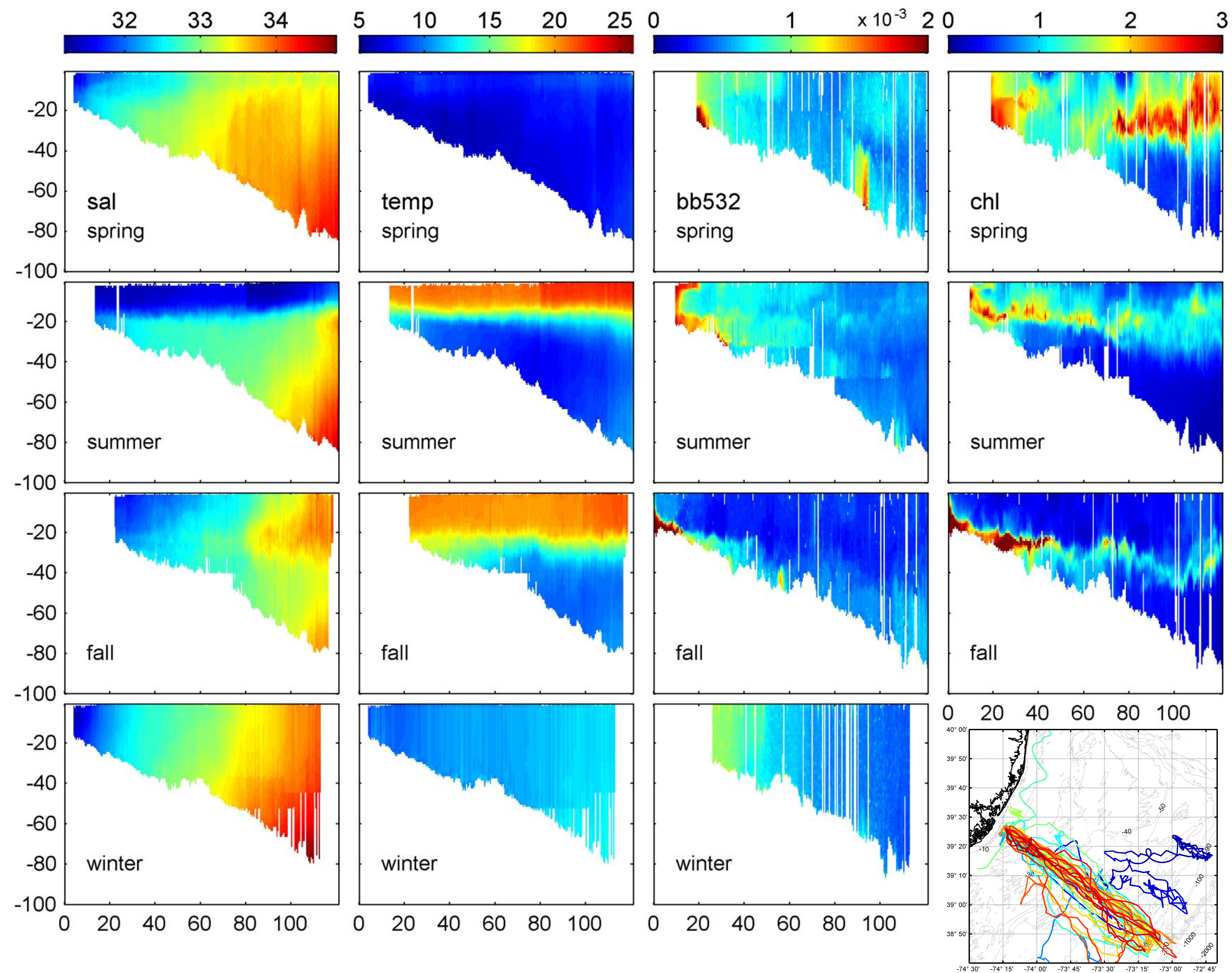
Winds using glider temperatures

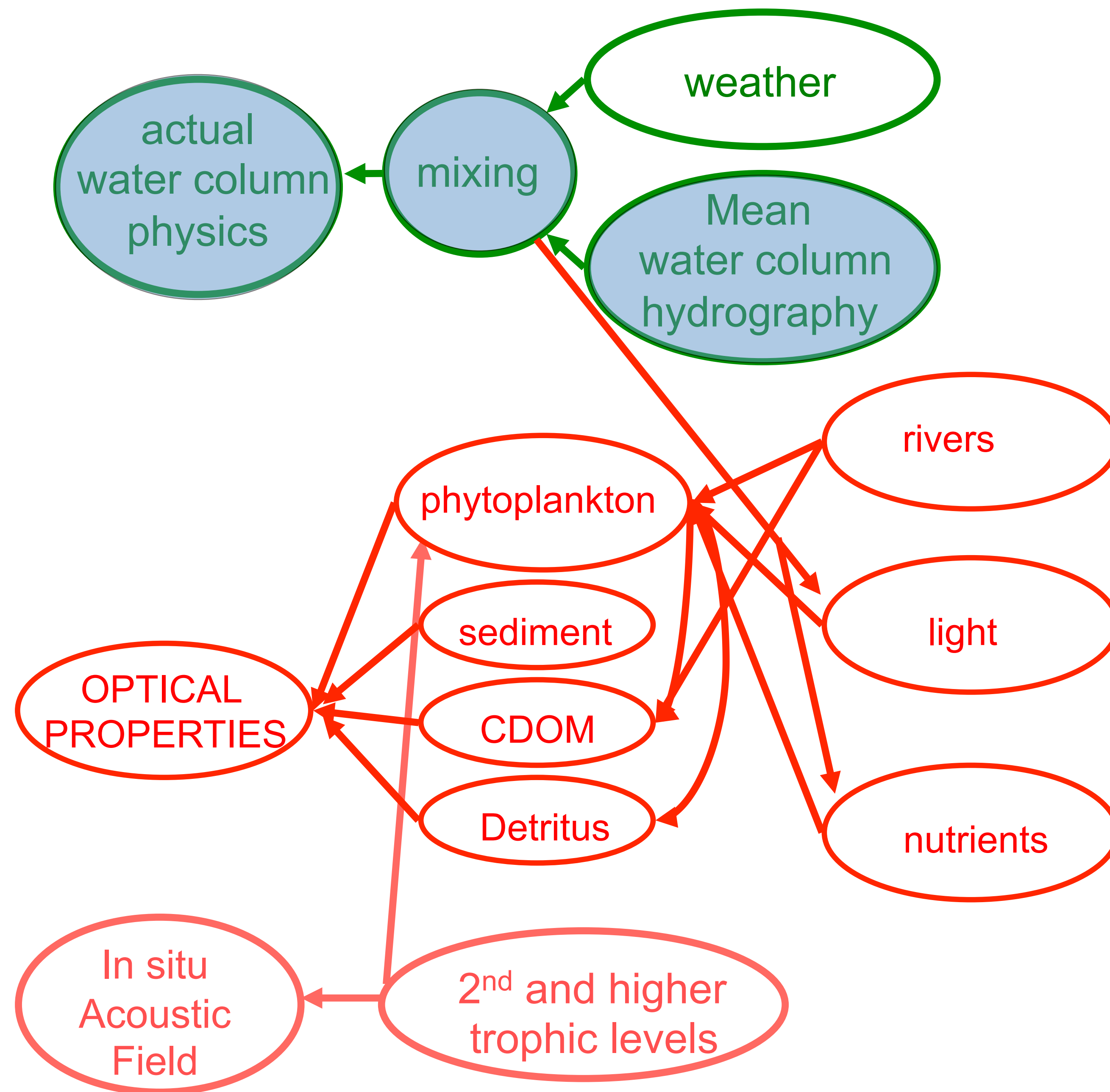


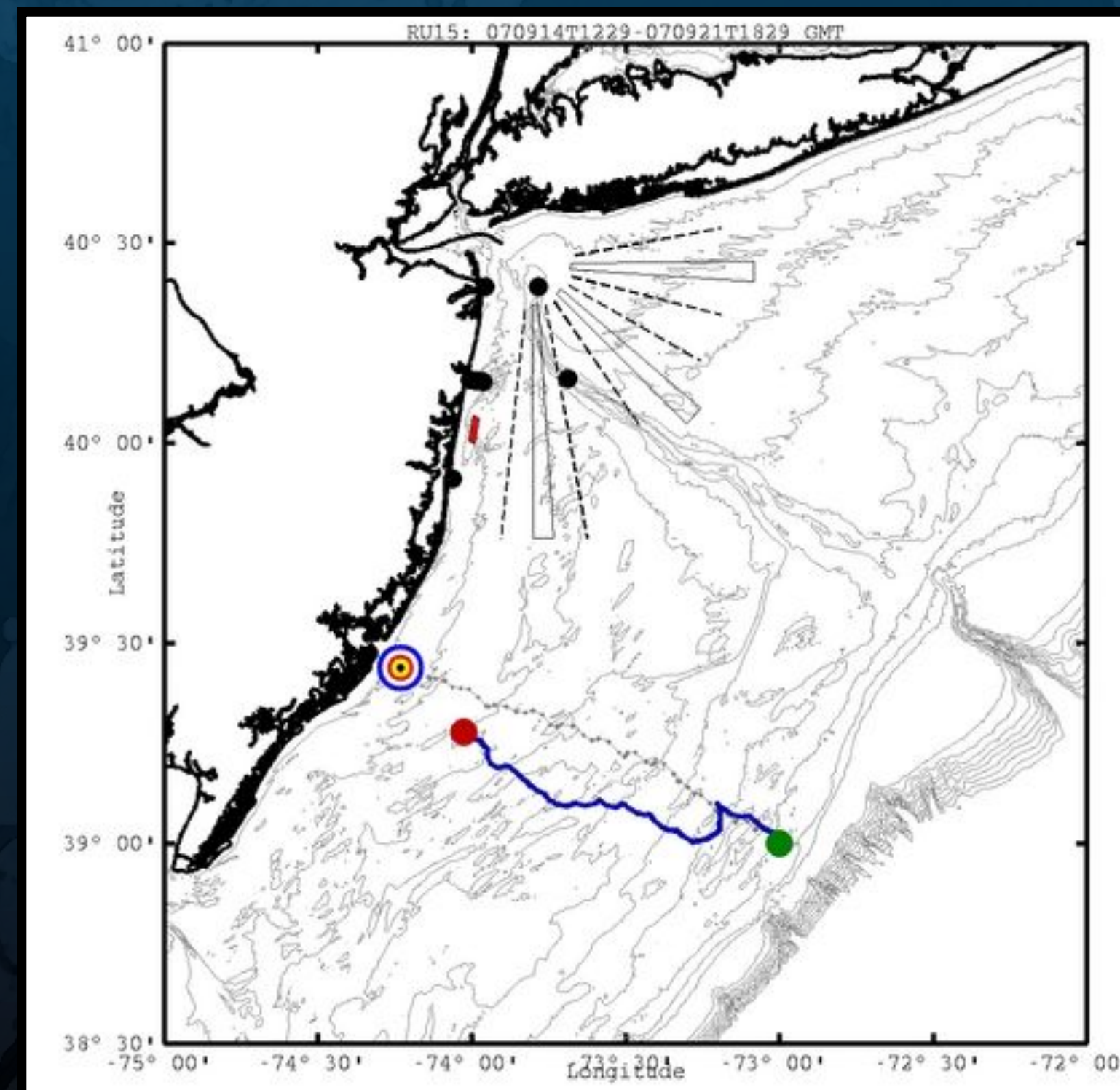
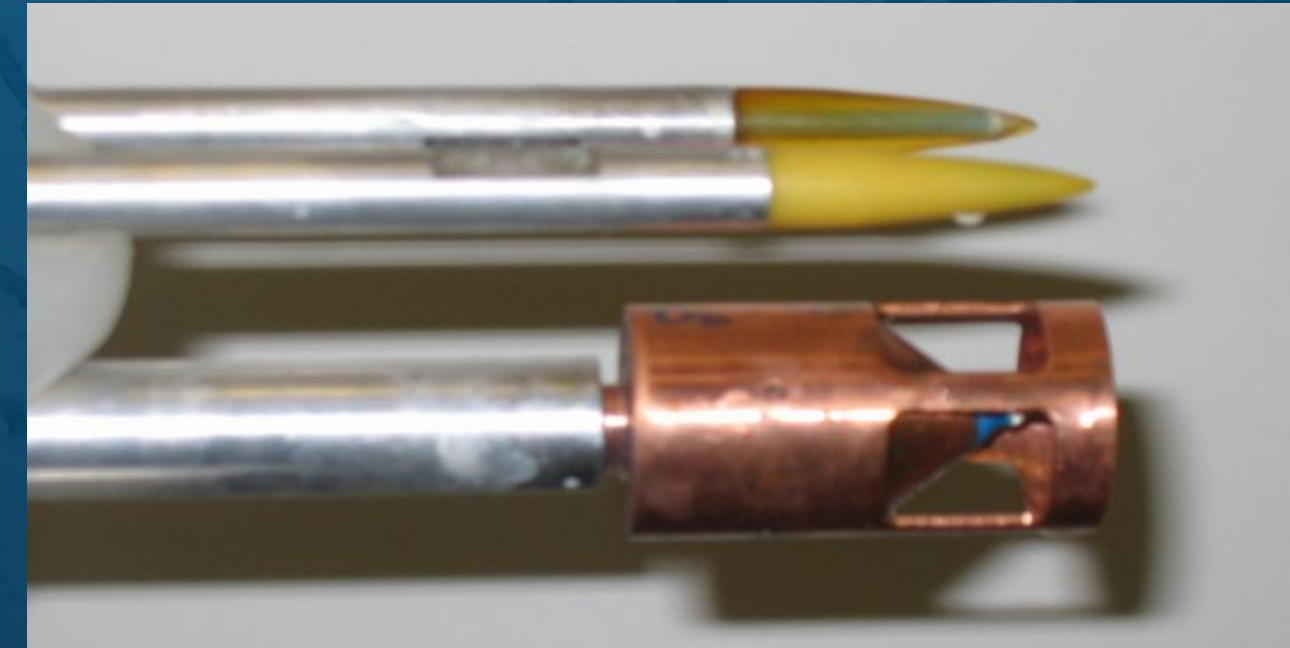


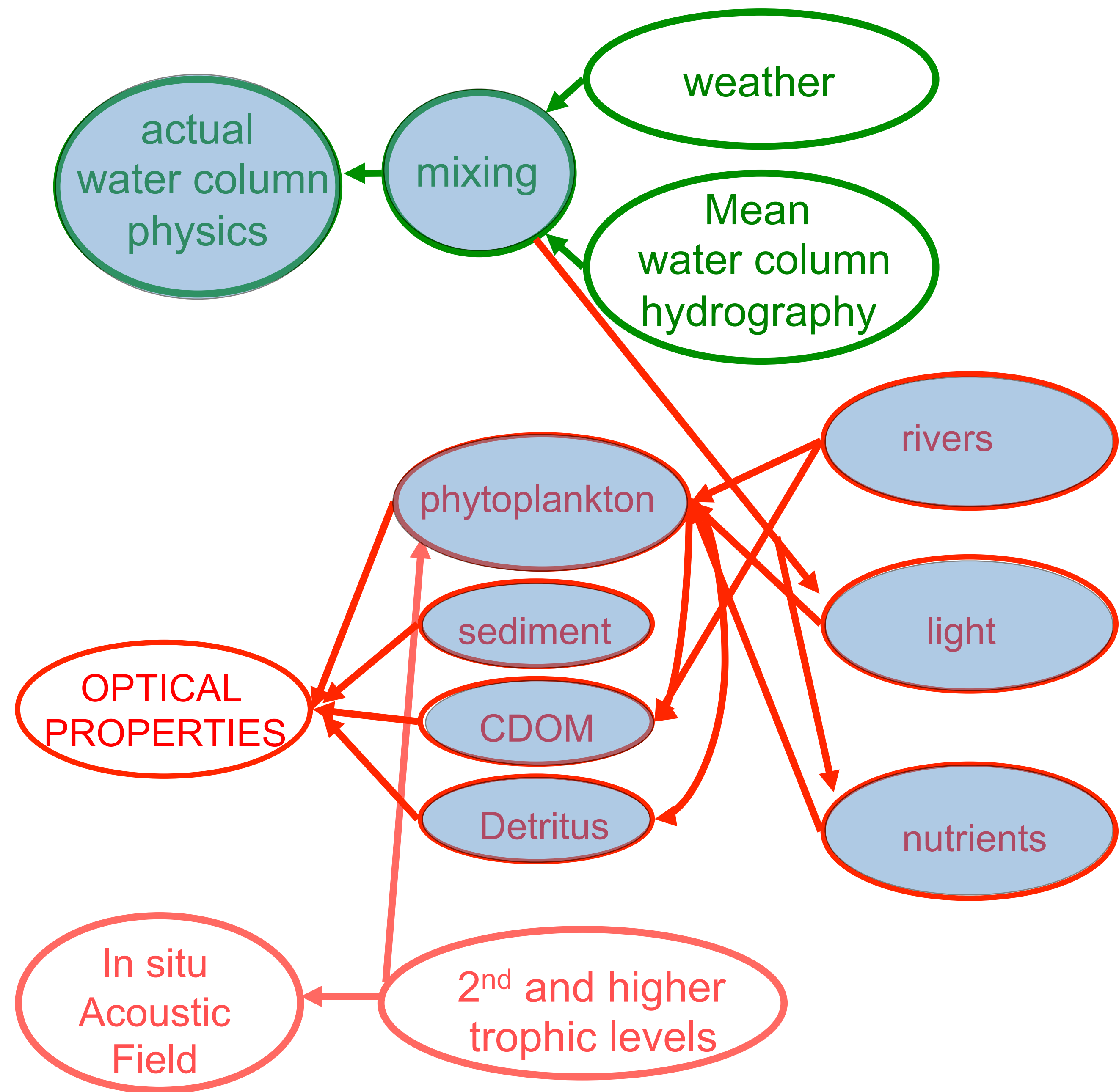


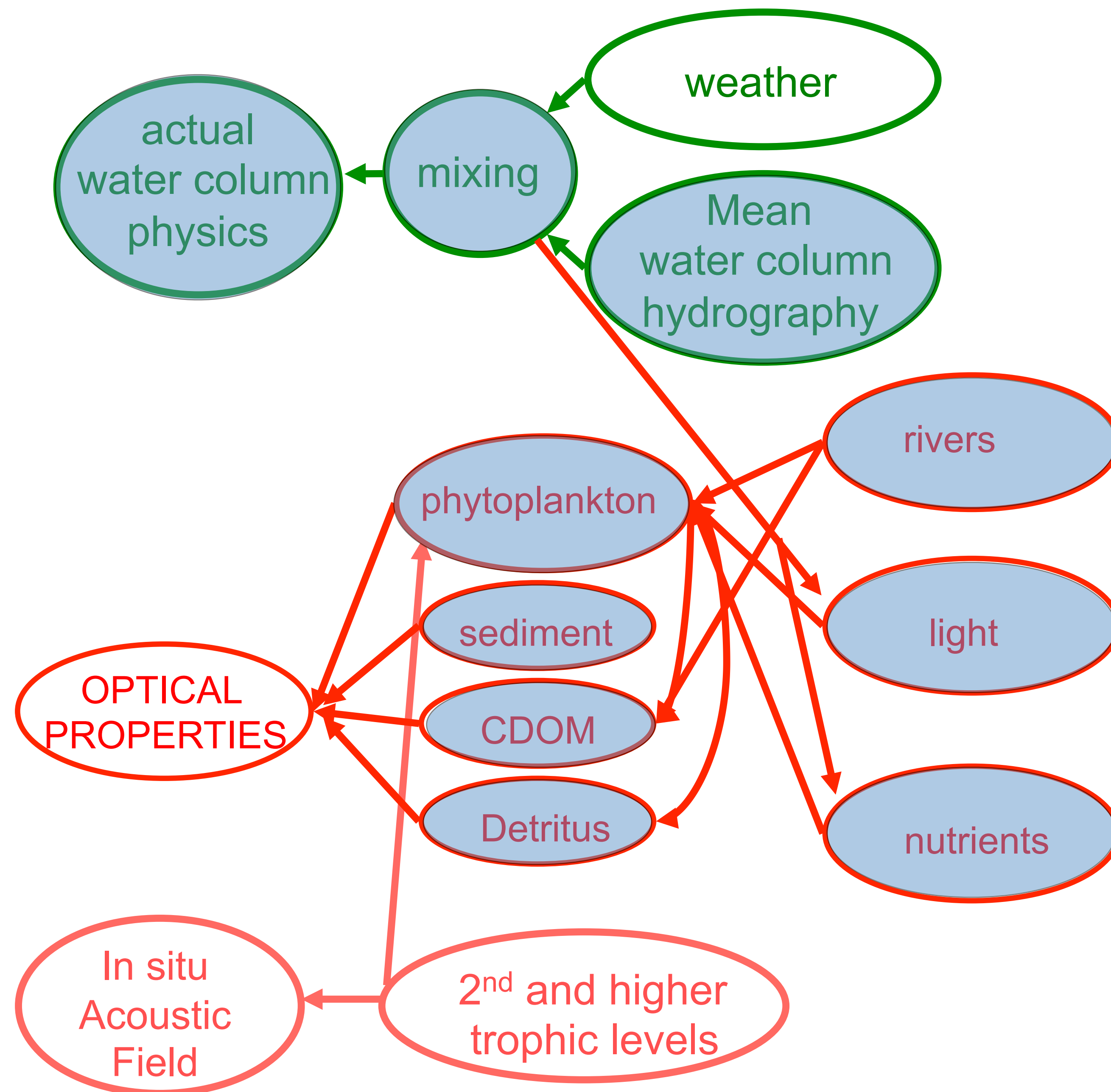




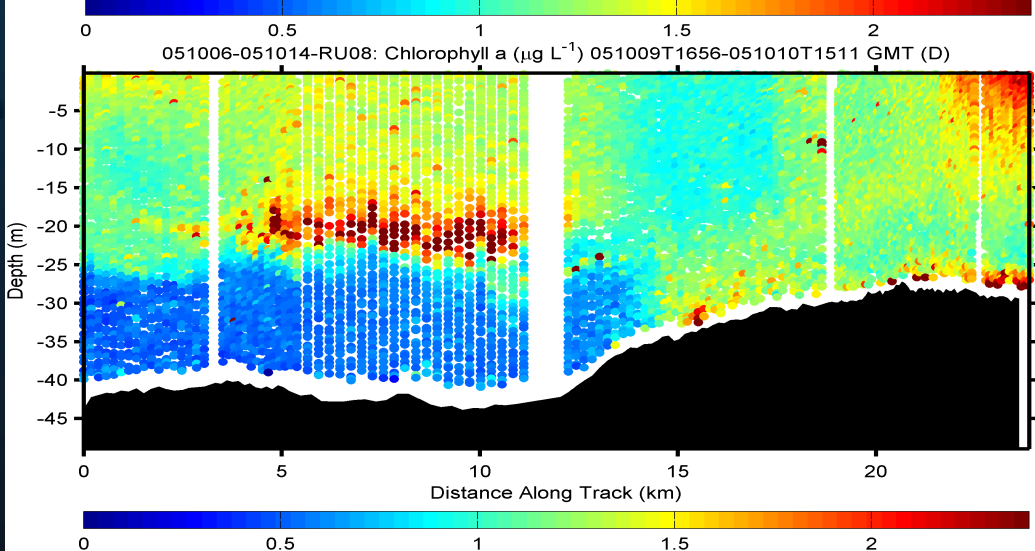
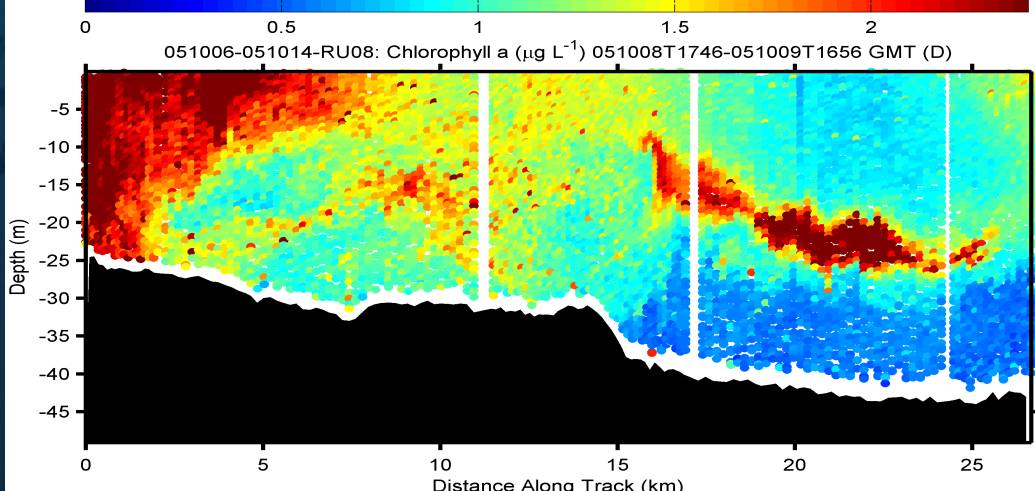
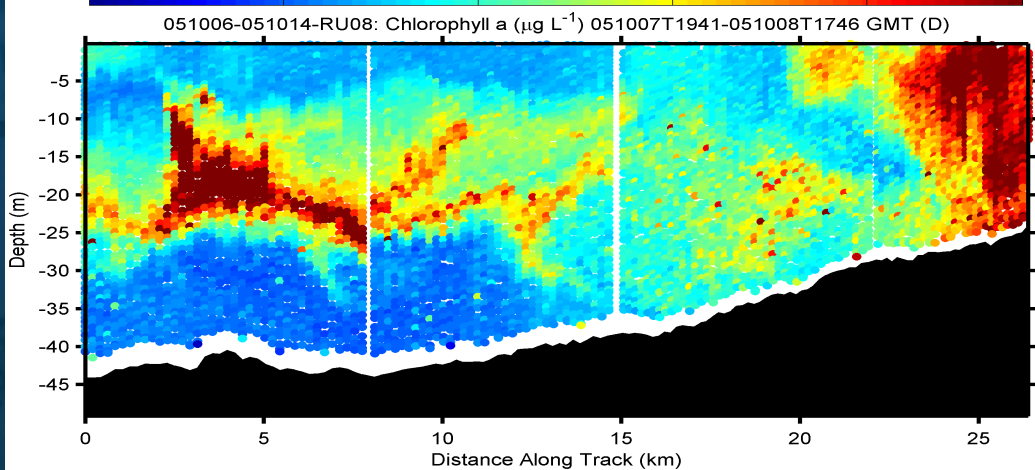
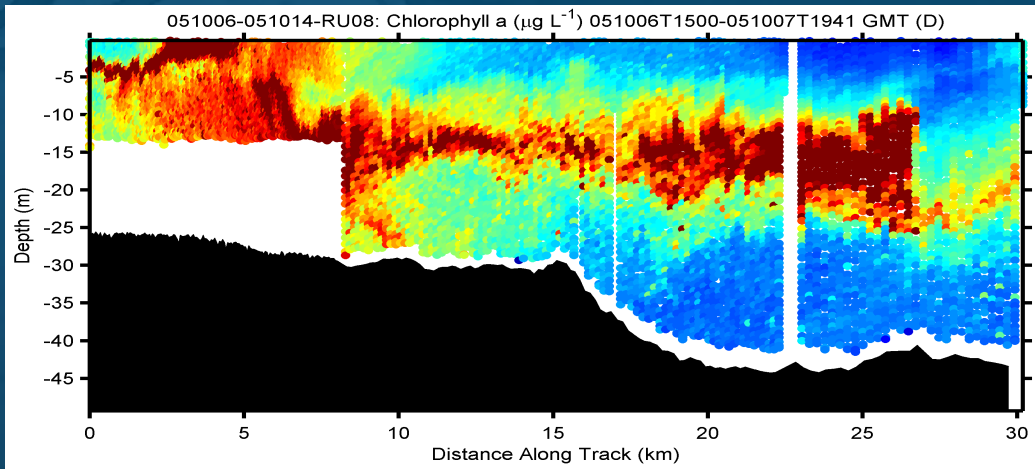
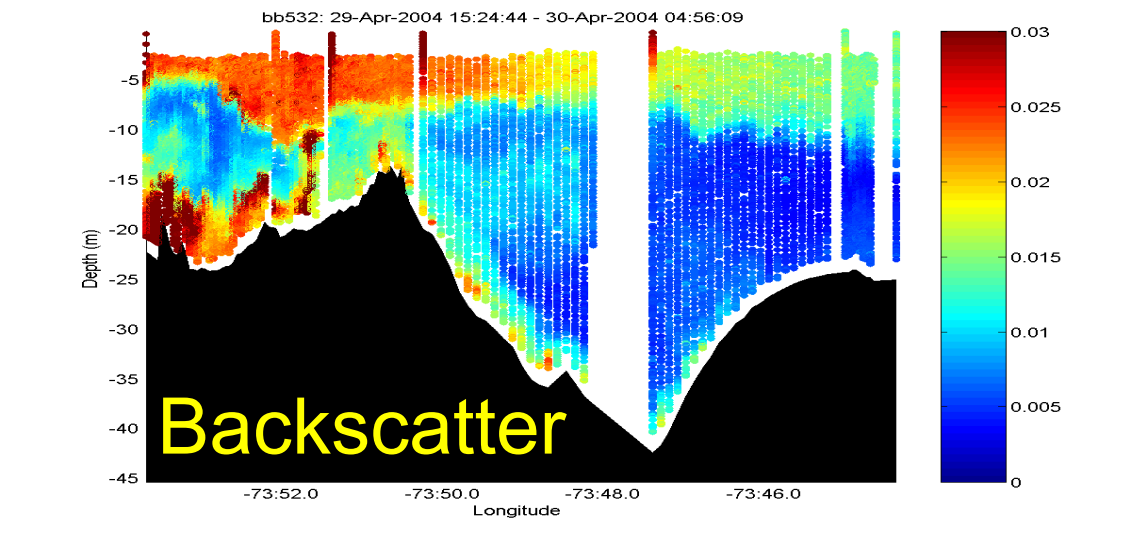
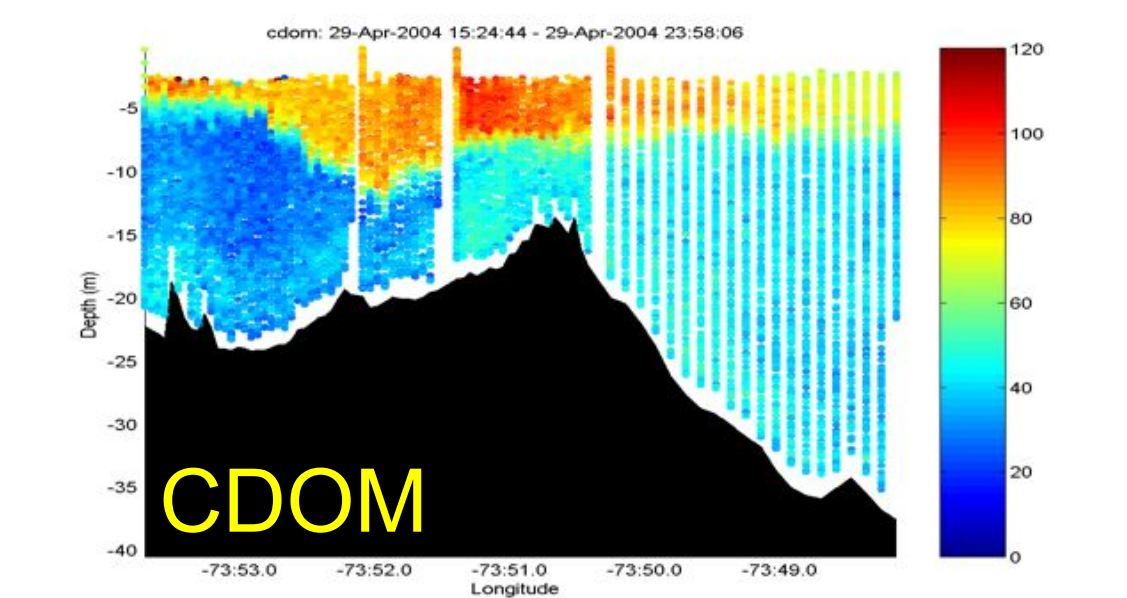
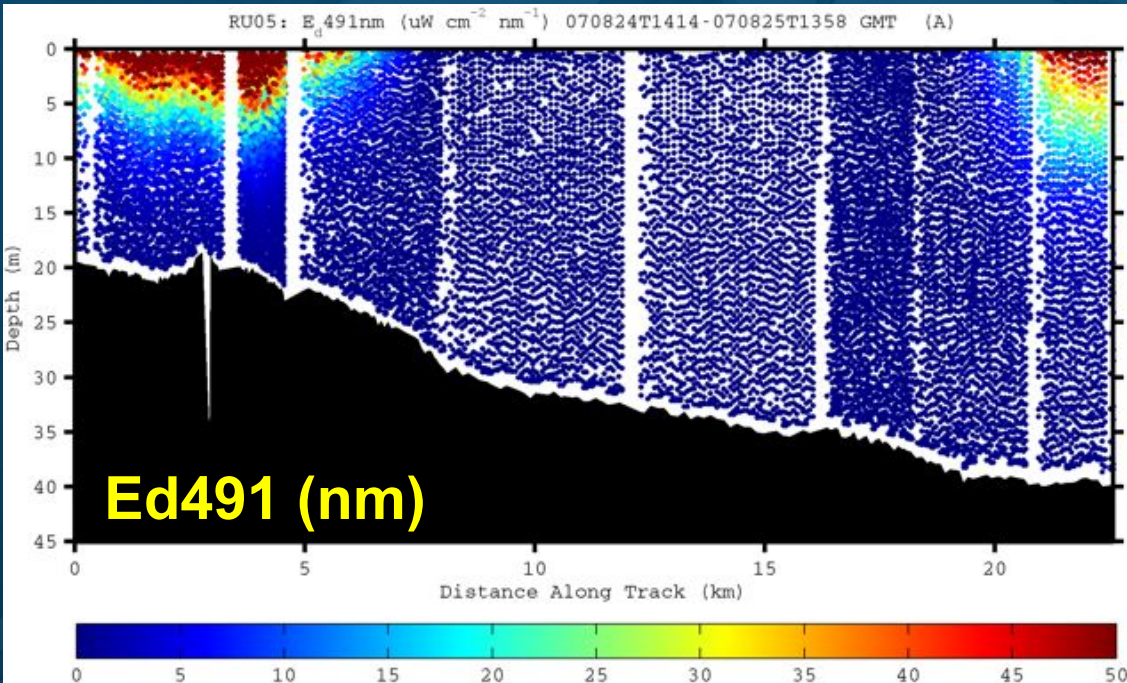




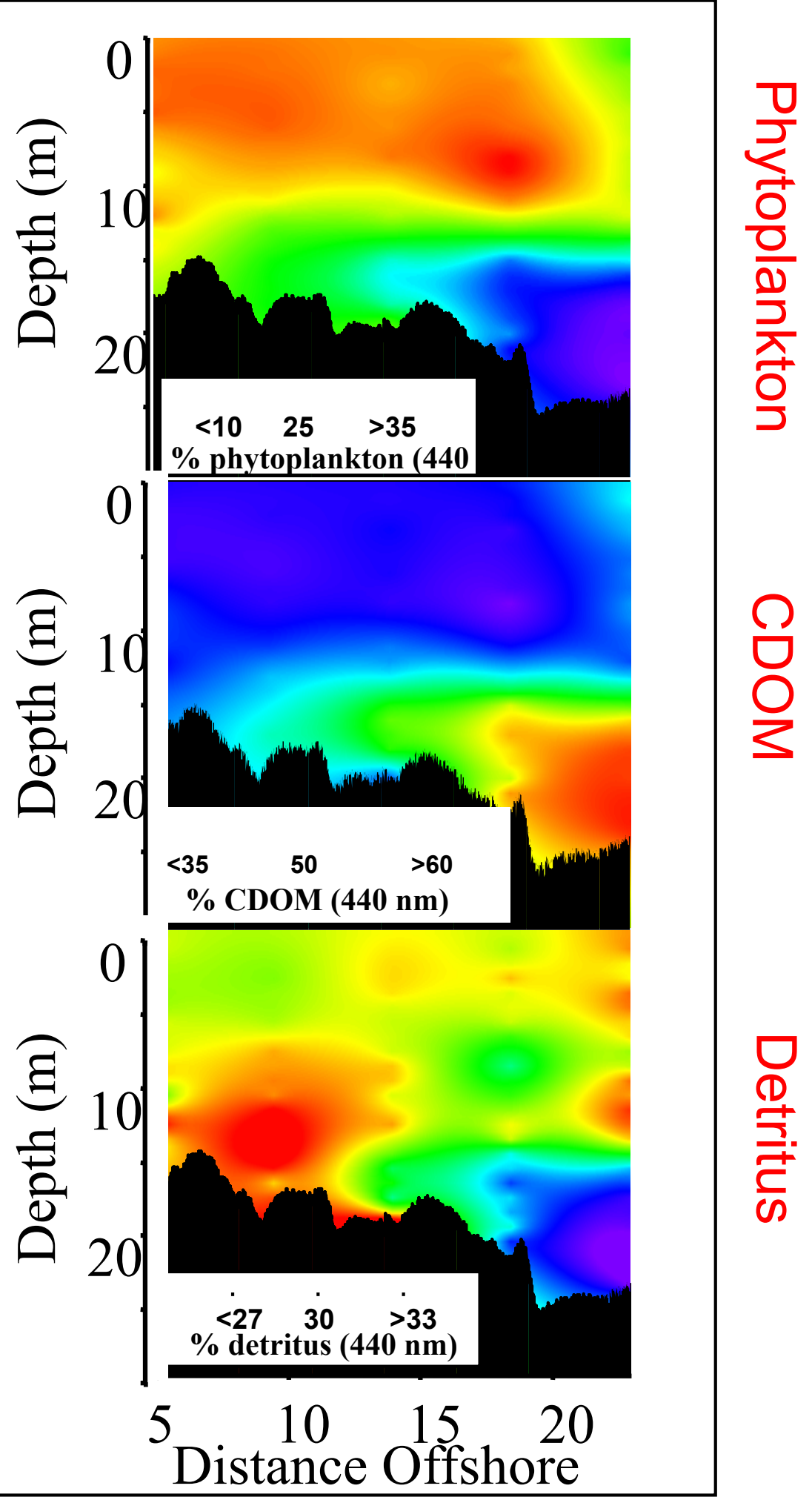
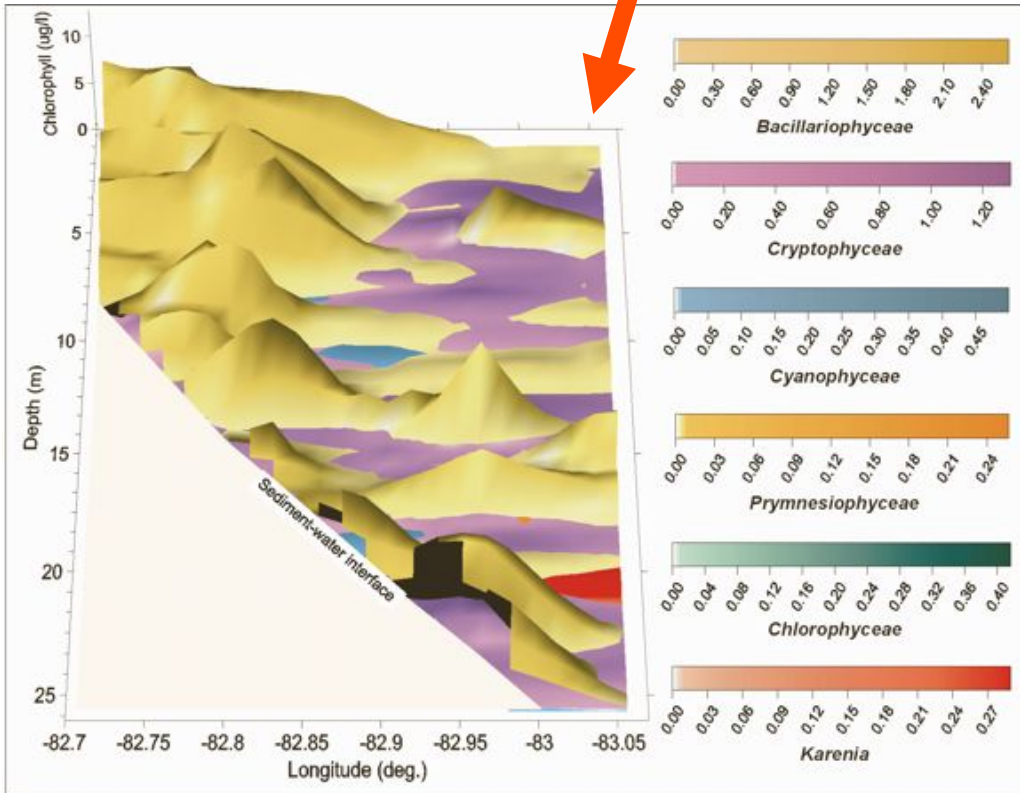
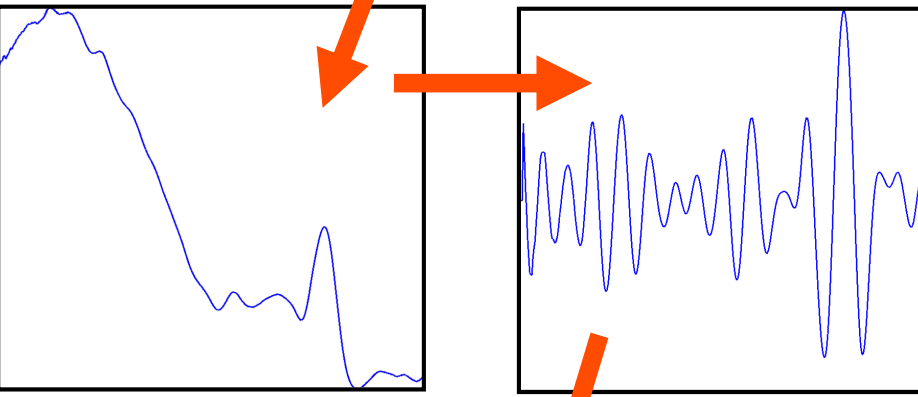
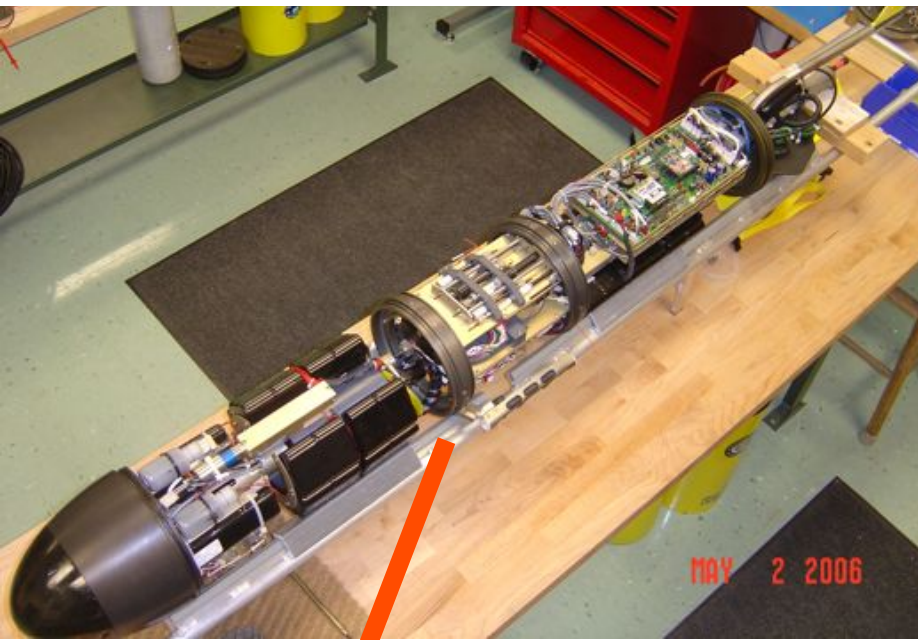


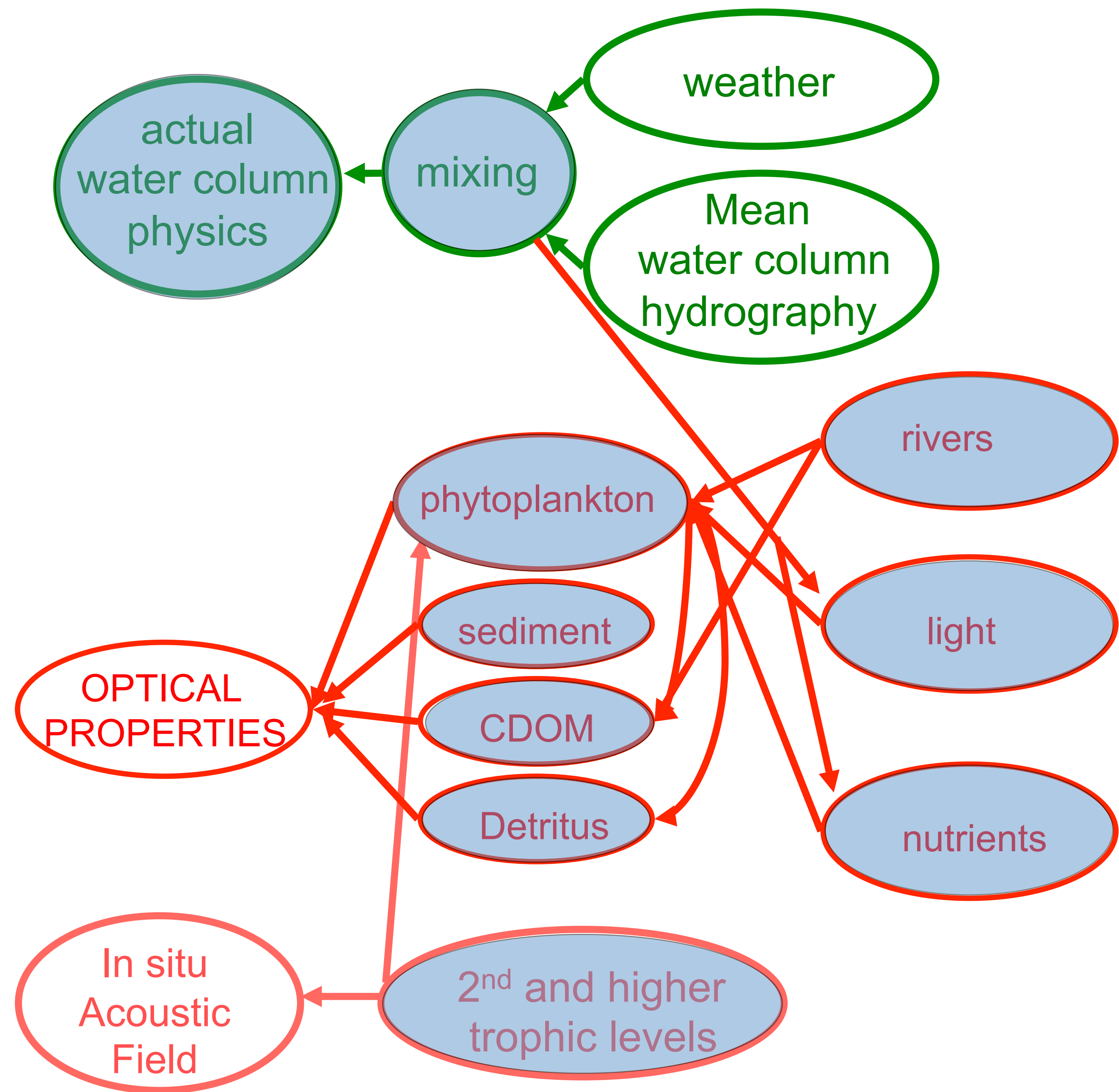


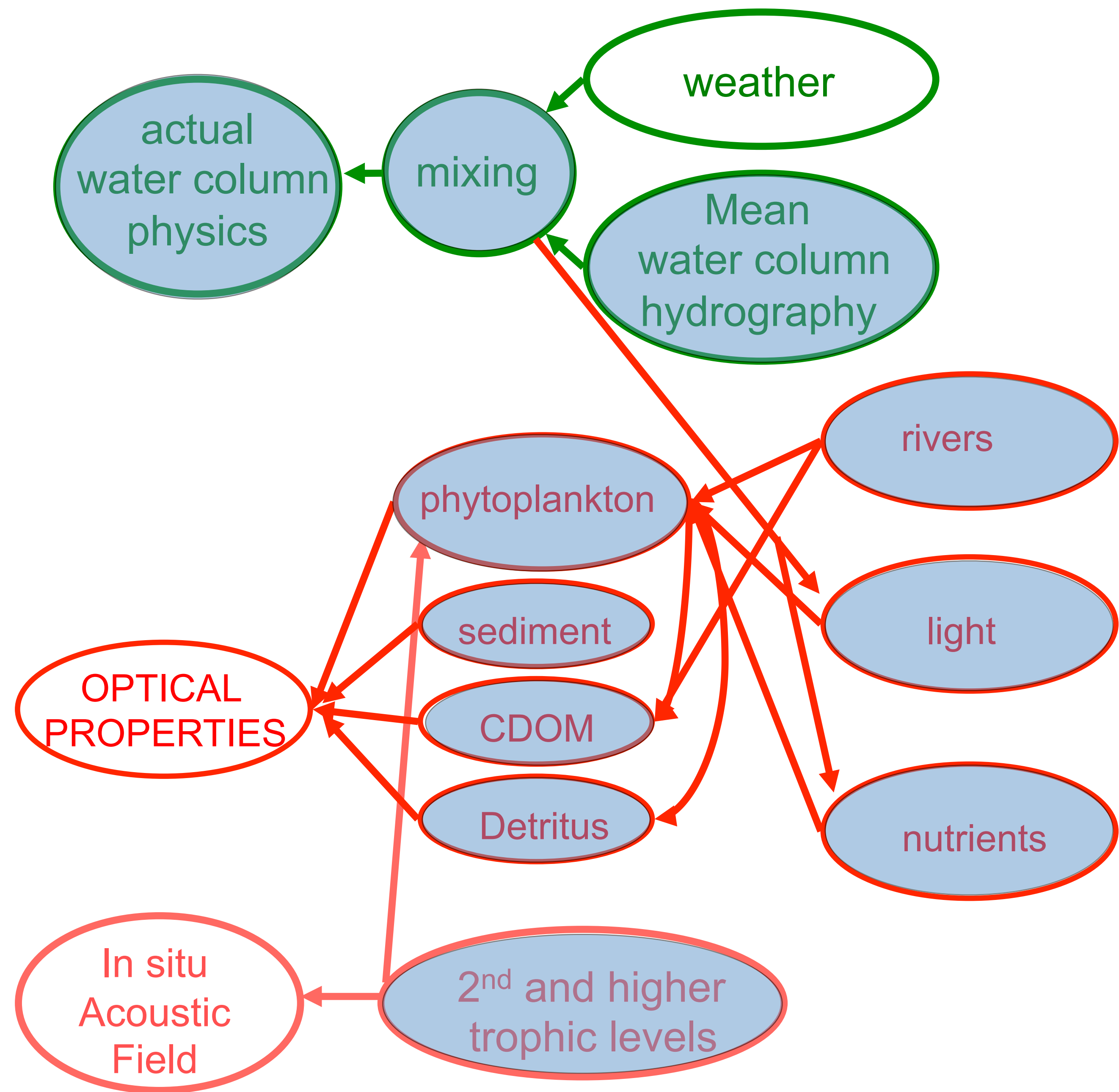
Optical data collected by gliders

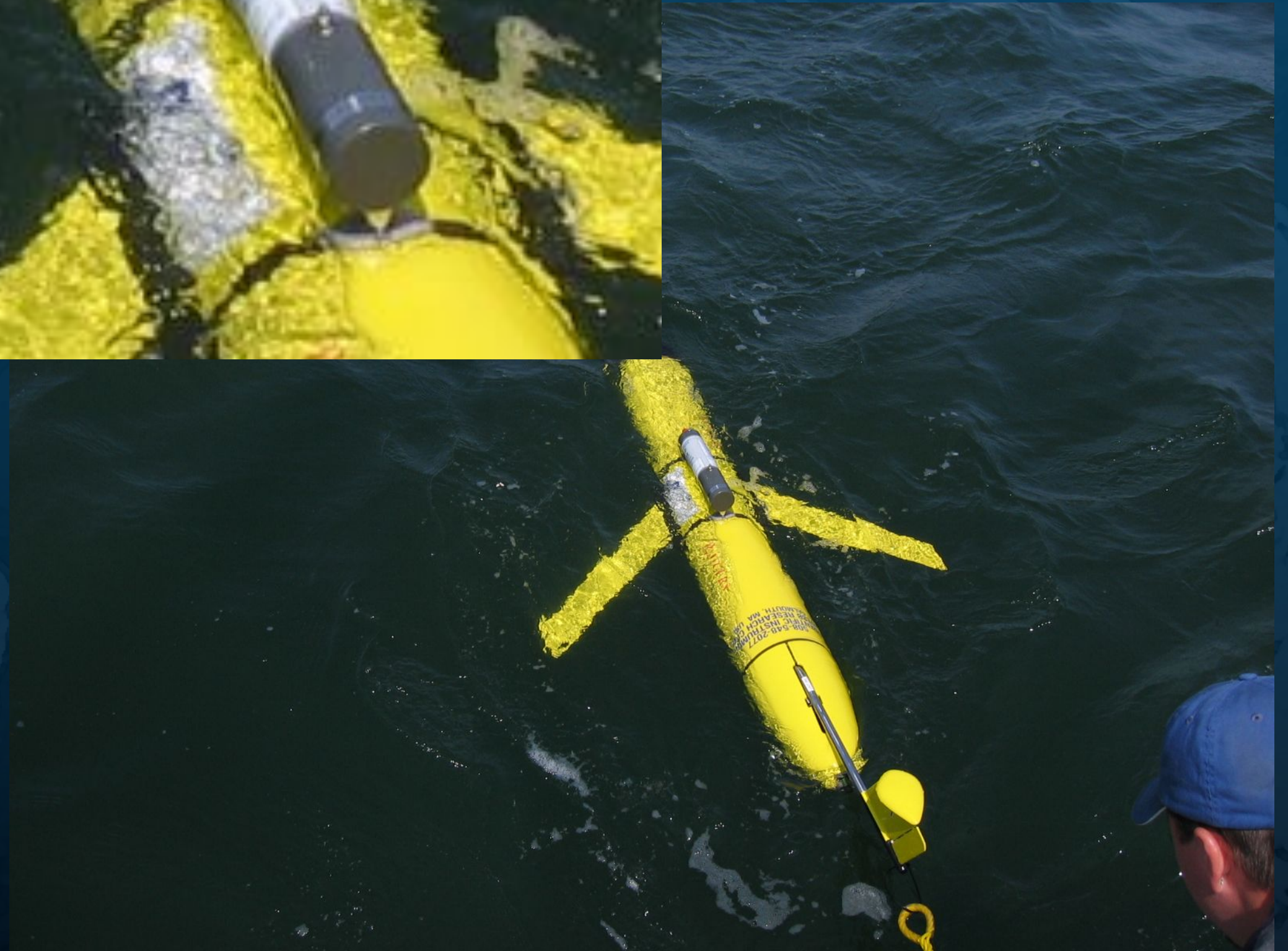
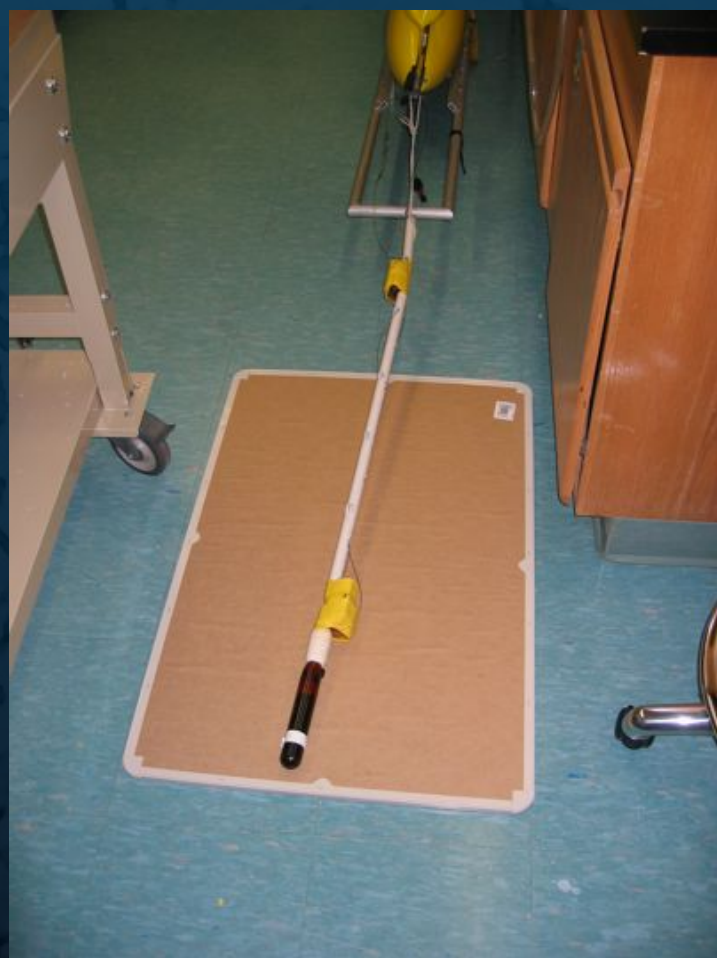


Phytoplankton communities





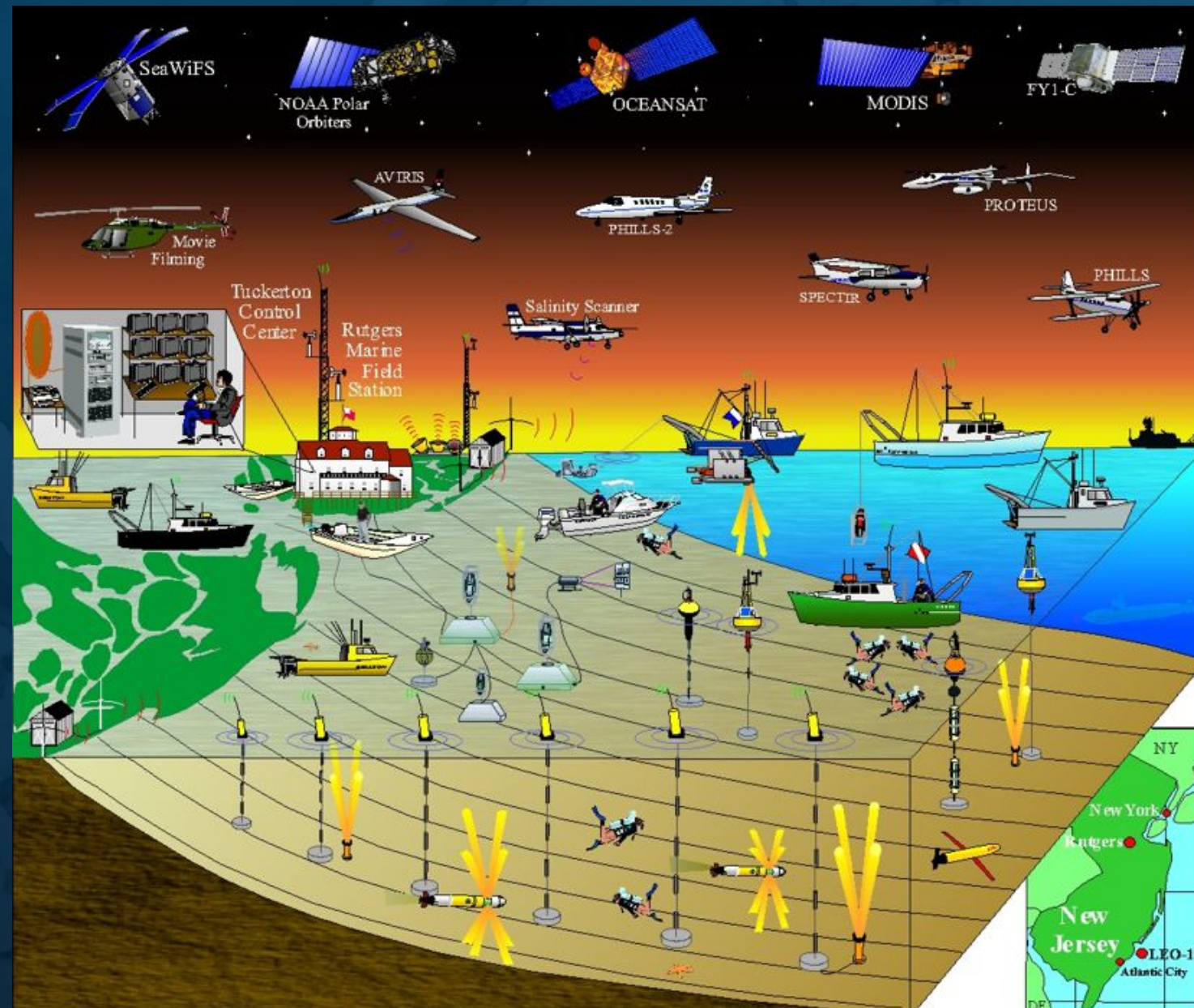




Diverse funding with an evolving suite of questions

Upwelling, hypoxia & coastal predictive skill

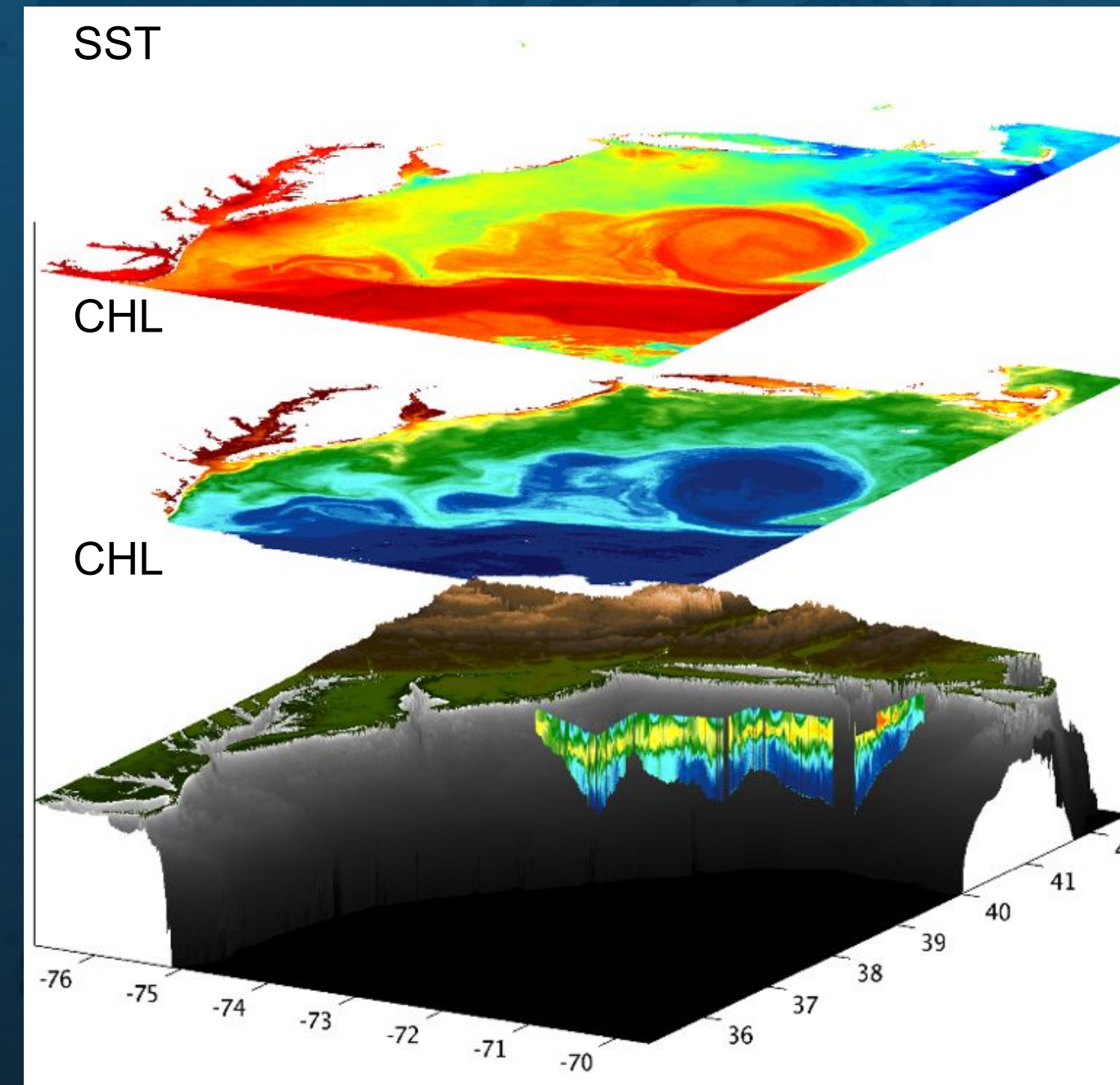
Schofield et al 2002
Glenn & Schofield 2003



1996-2001
Local scale observatories

Shelf transport, land/ocean communication

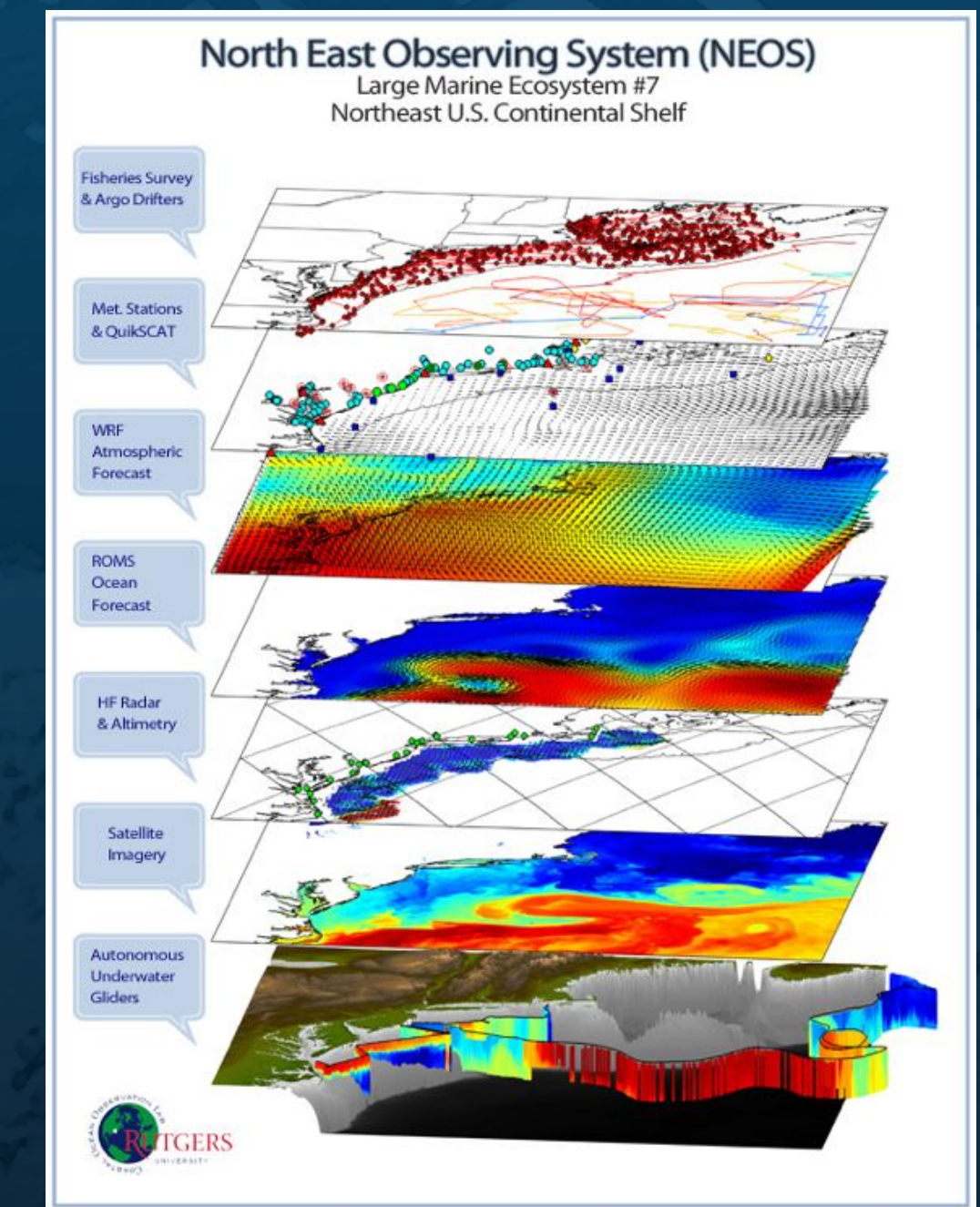
Glenn & Schofield 2009



2001-2006
Regional scale observatories

Ecosystem dynamics, climate scale mediated change

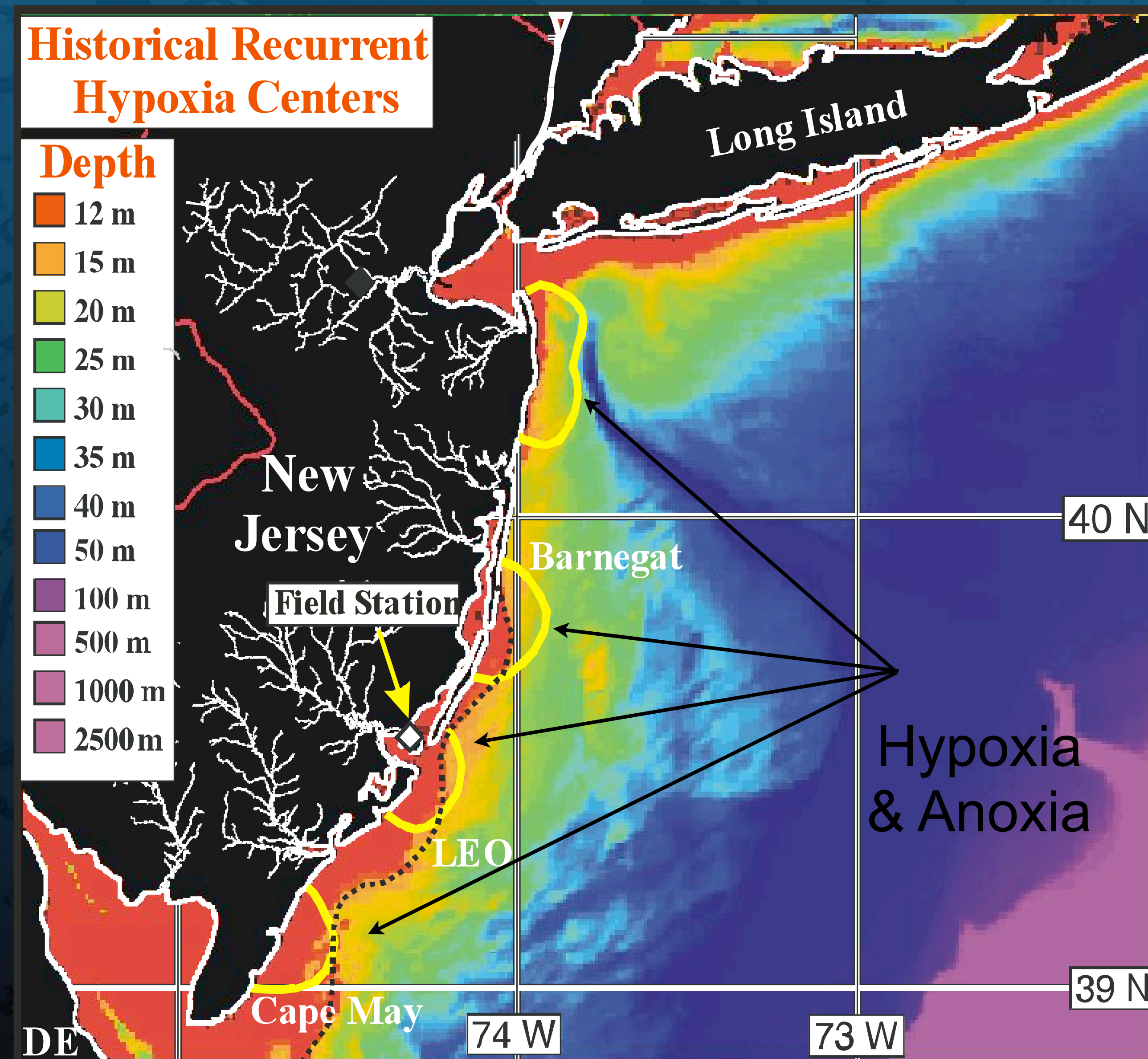
Schofield et al. 2011



2006-2011
Large marine ecosystem observatories

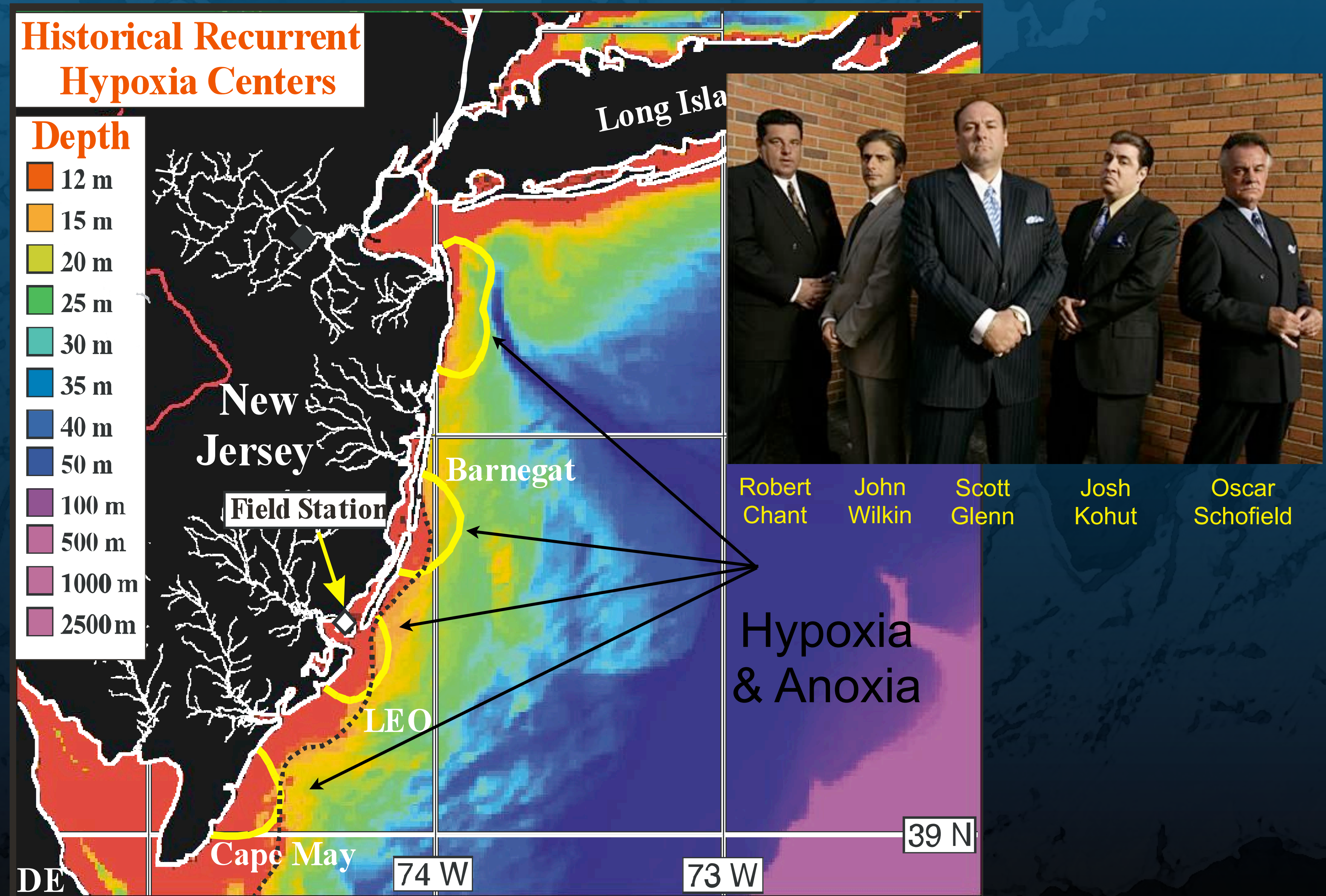
Phase development: The nearshore coastal system

Question driving science deployment: Are humans causing coastal hypoxia?



Phase development: The nearshore coastal system

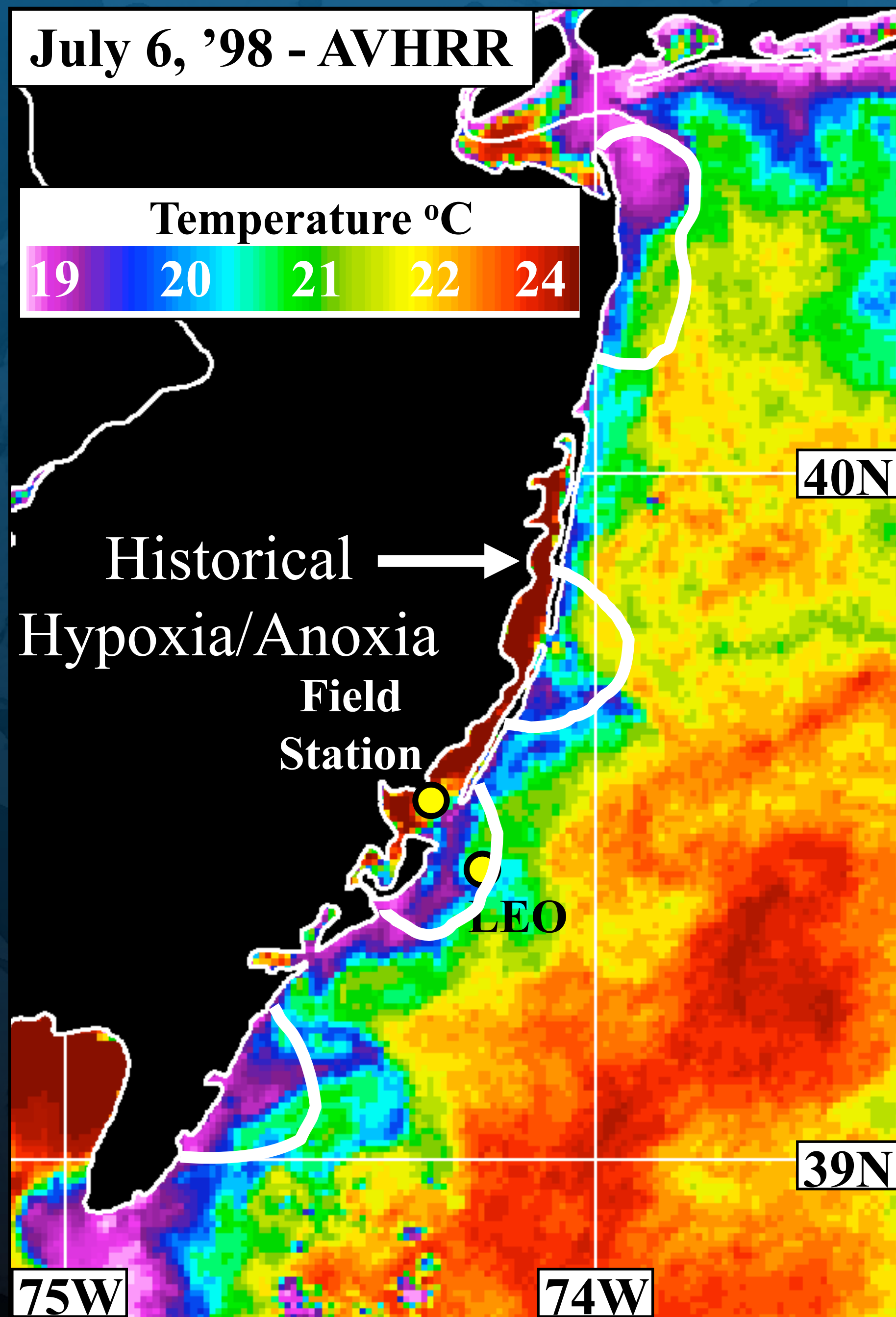
Question driving science deployment: Are humans causing coastal hypoxia?



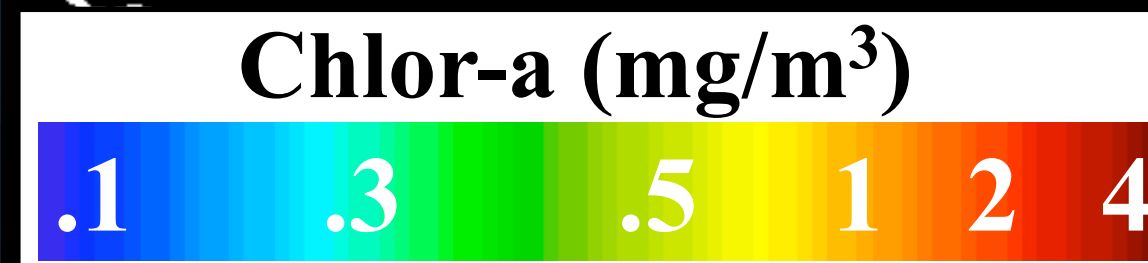
July 6, '98 - AVHRR



Historical →
Hypoxia/Anoxia
Field
Station

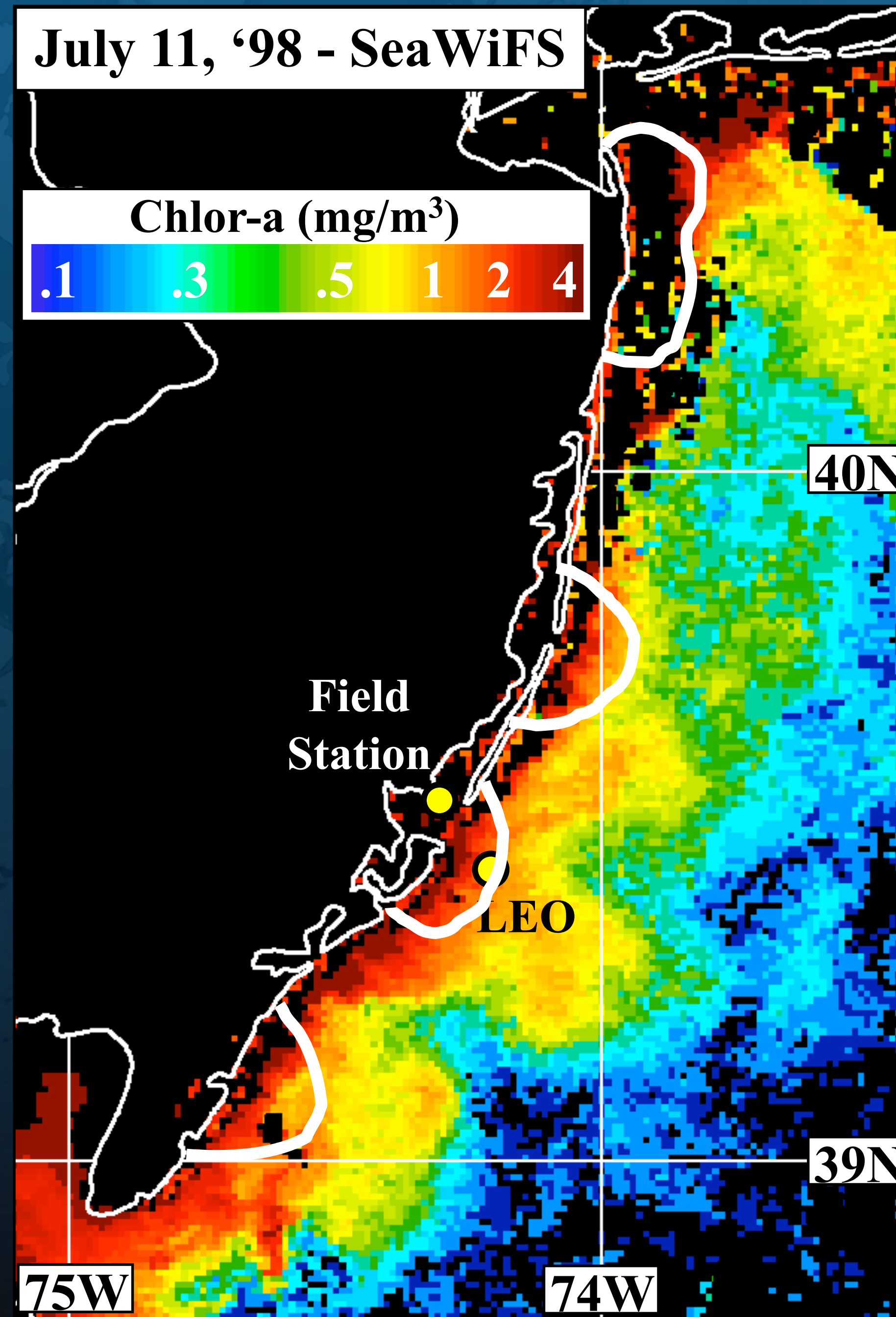


July 11, '98 - SeaWiFS



Field
Station

LEO



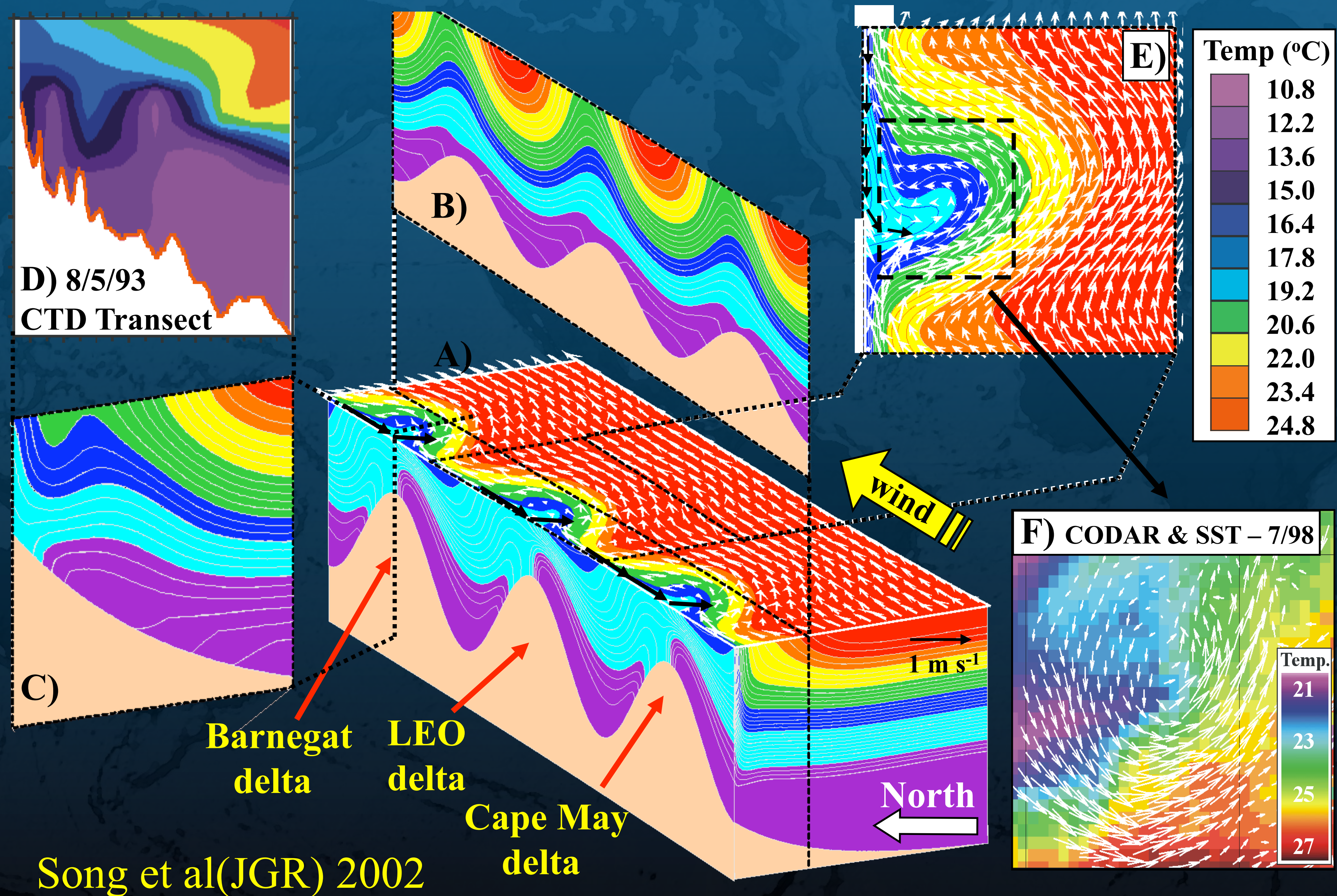
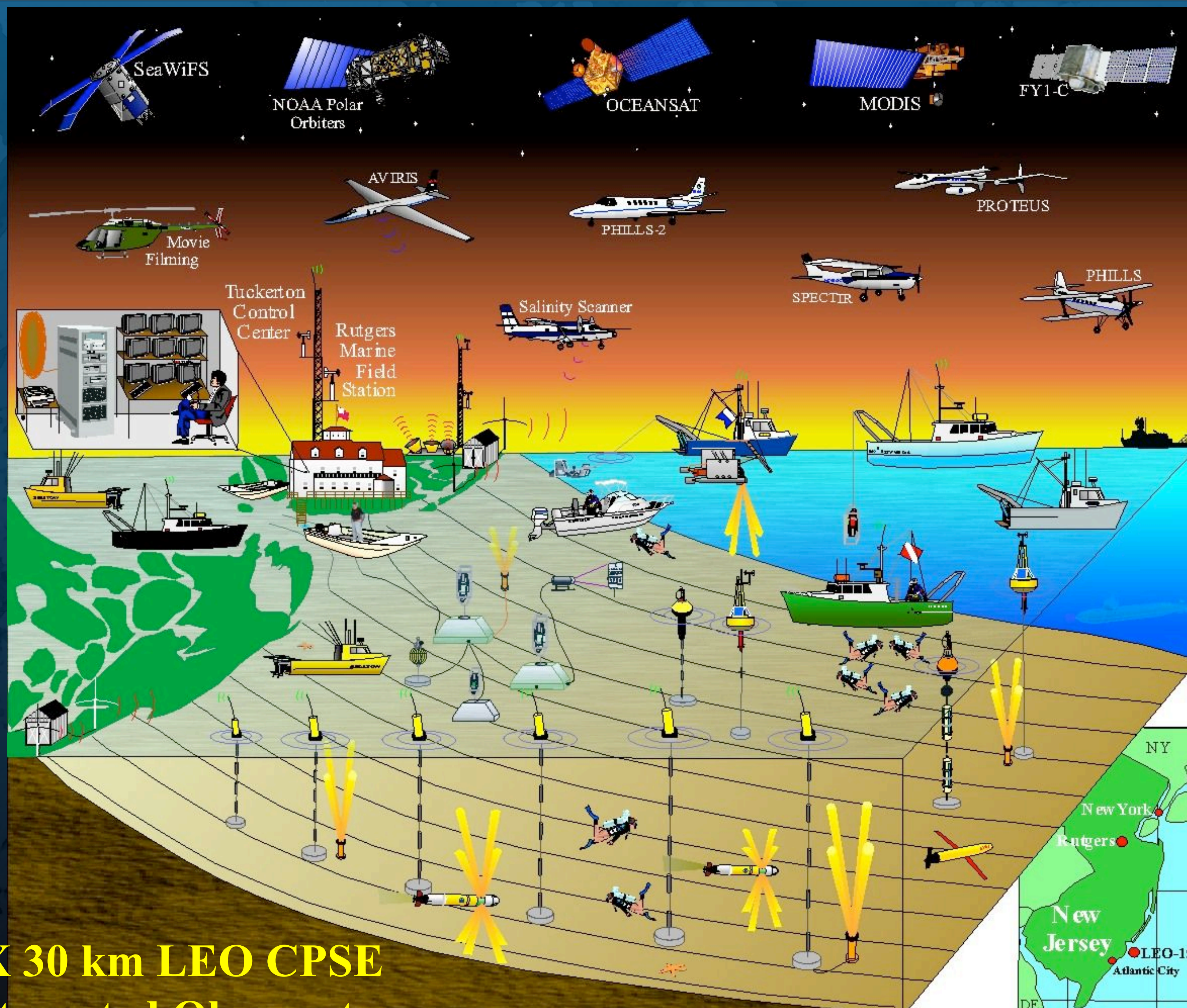


Figure 6

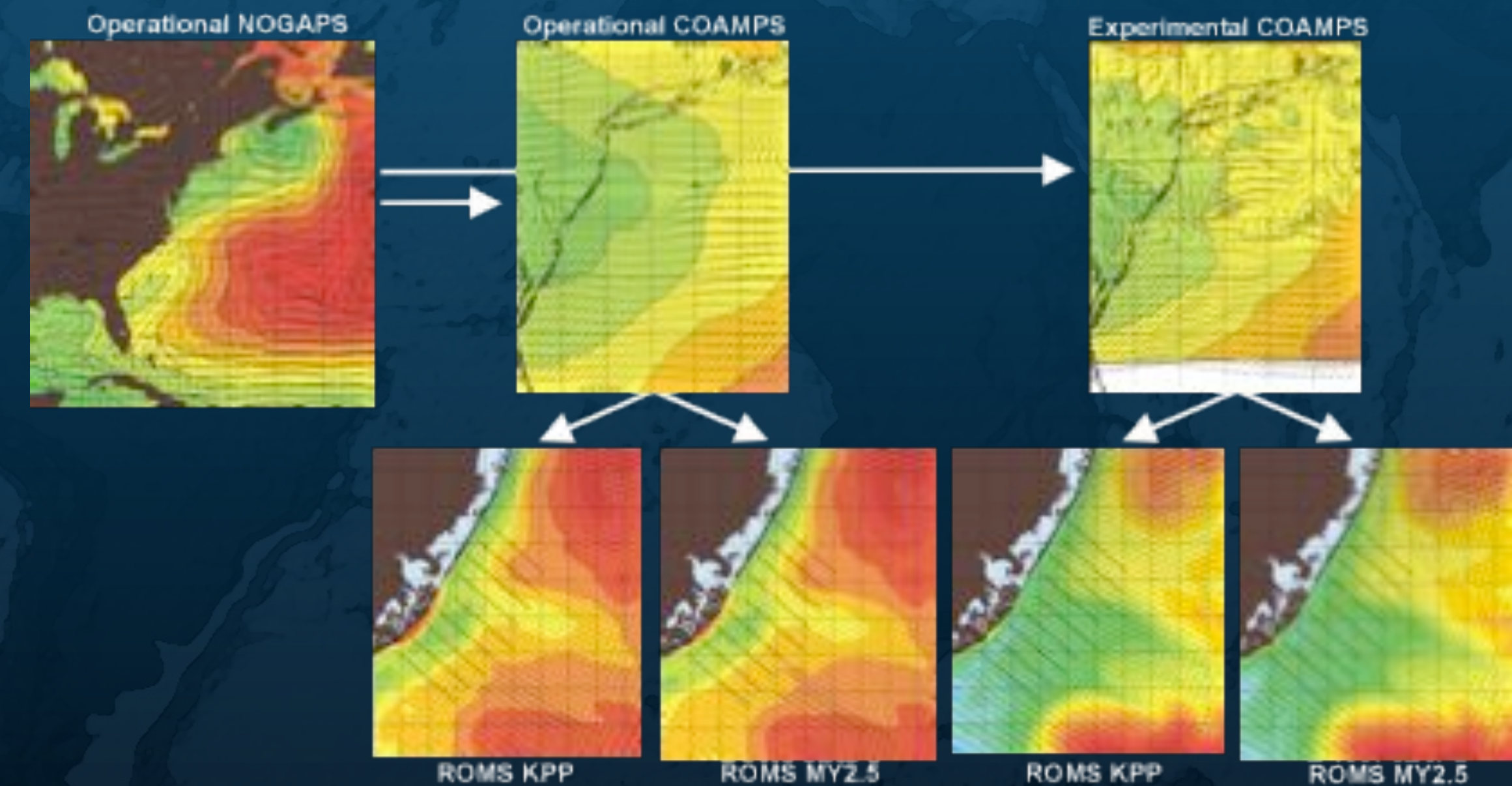


Month Long Experimental Effort

HyCODE 2001 Modeling Forecast Cycles

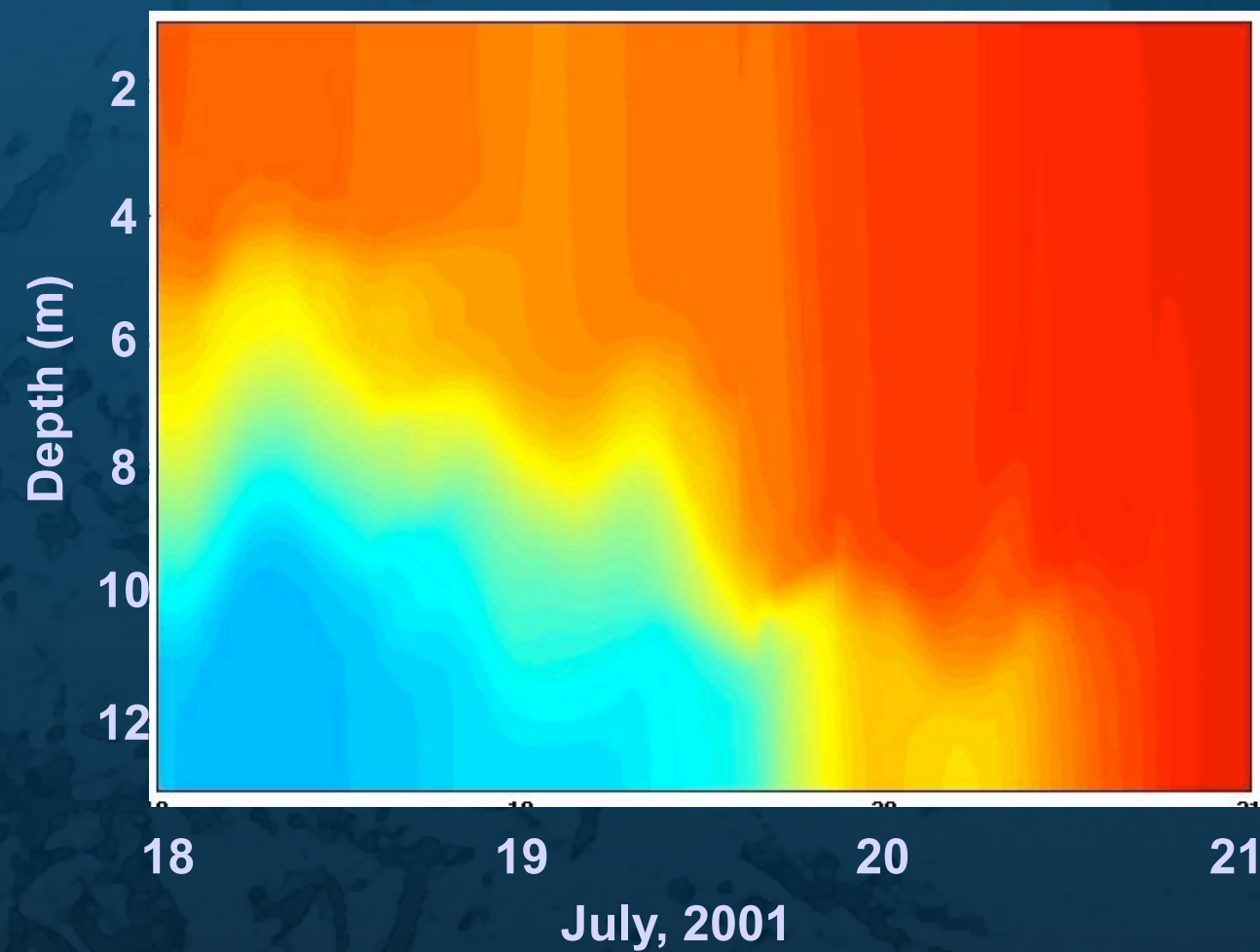
Sun	Mon	Tues	Wed	Thurs	Fri	Sat
July 8	9	10	11	12	13	14
			Forecast Cycle 1			
			Briefing			
15	16	17	18	19	20	21
Forecast Cycle 2			Forecast Cycle 3			
Briefing			Briefing			Black Moon
22	23	24	25	26	27	28
Forecast Cycle 4			Forecast Cycle 5			
Endeavor Arrives			Briefing			
29	30	31	Aug 1	2	3	4
Forecast Cycle 6			Forecast Cycle 7			
Briefing			Briefing			
5	6	7	8	9	10	11
Forecast Cycle 8			Endeavor Departs			
Briefing						

2001 Real-time Ensemble Forecasts



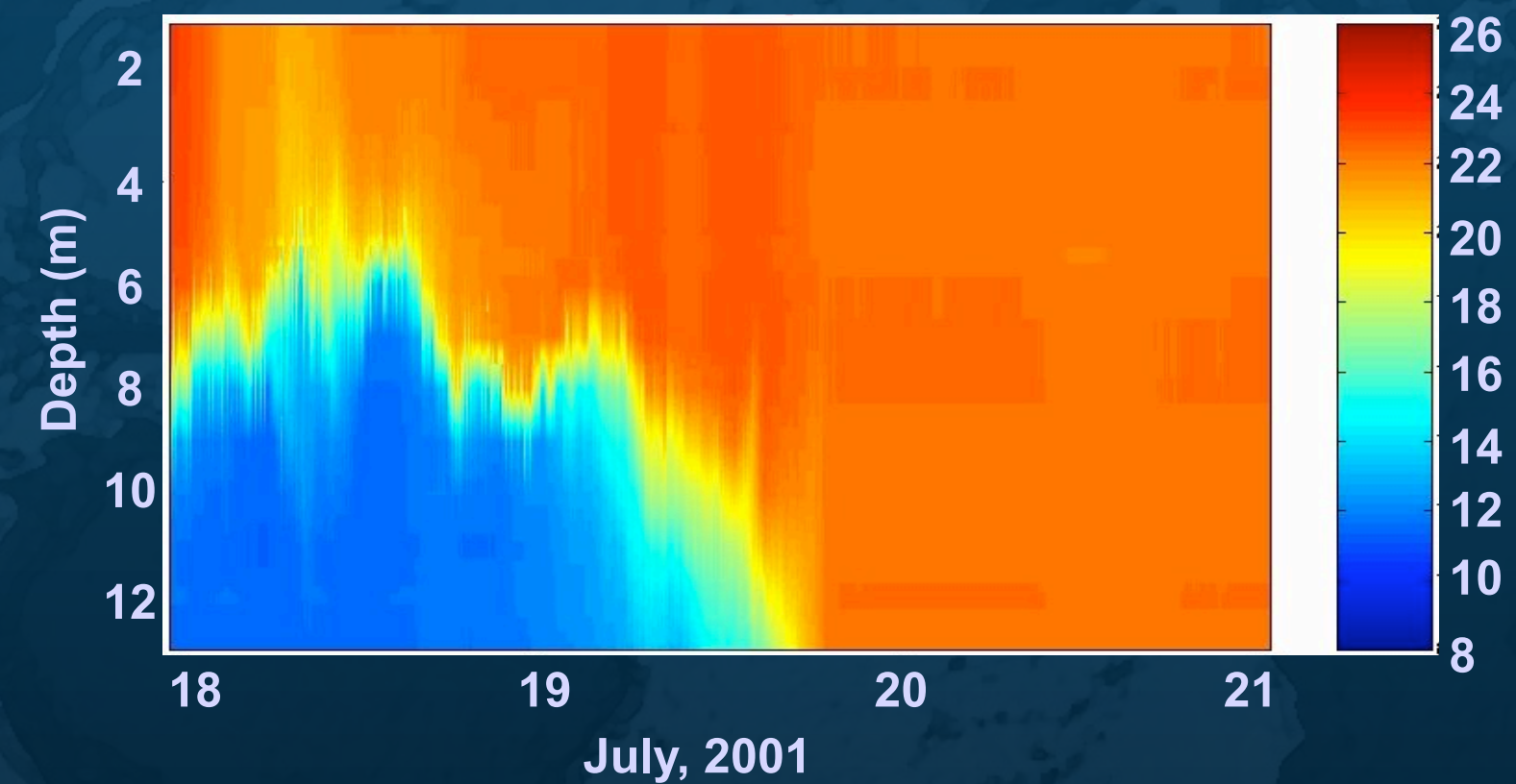
Real-time validation of the ensemble forecasts

HR COAMPS / ROMS

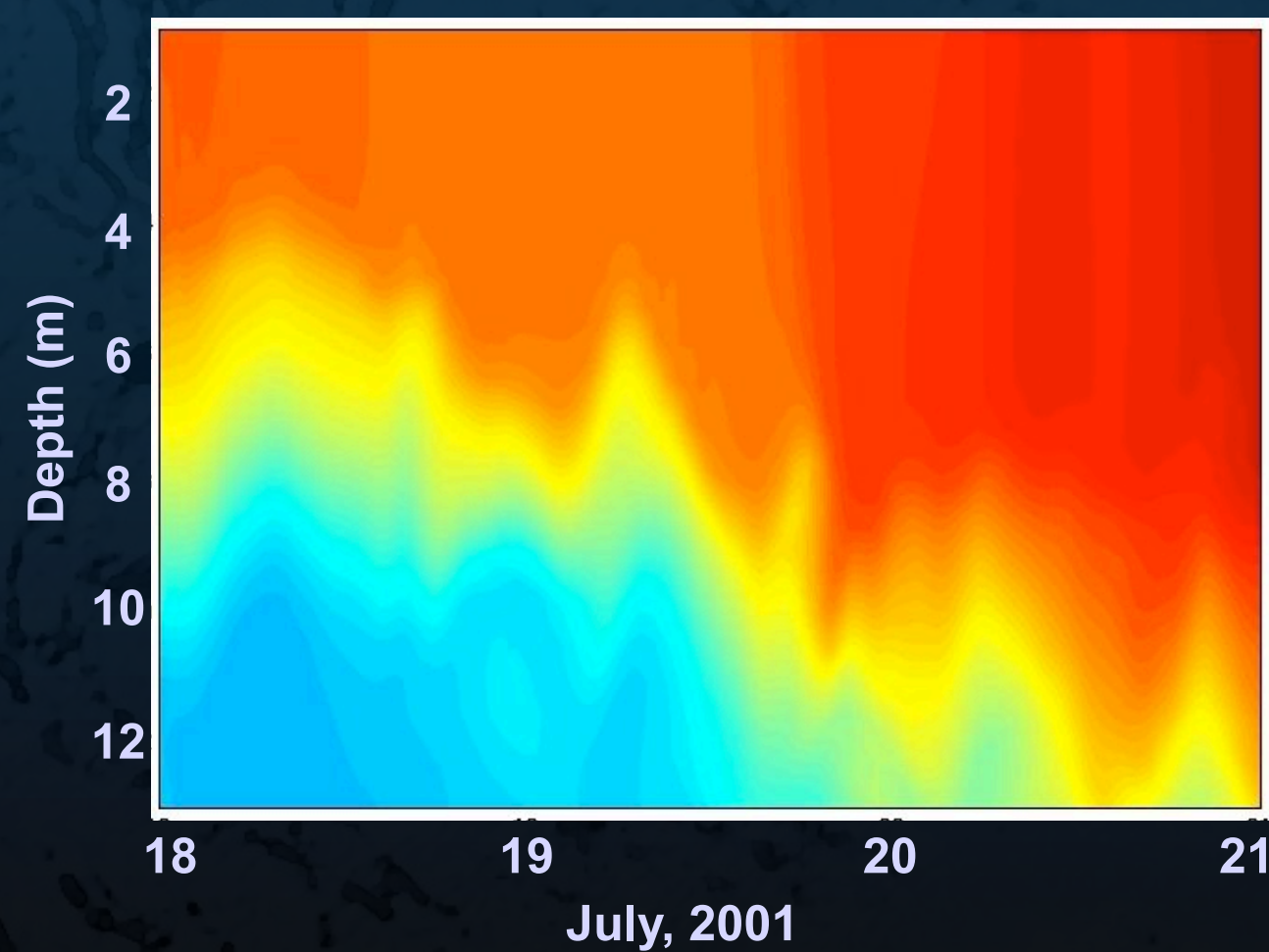


KPP

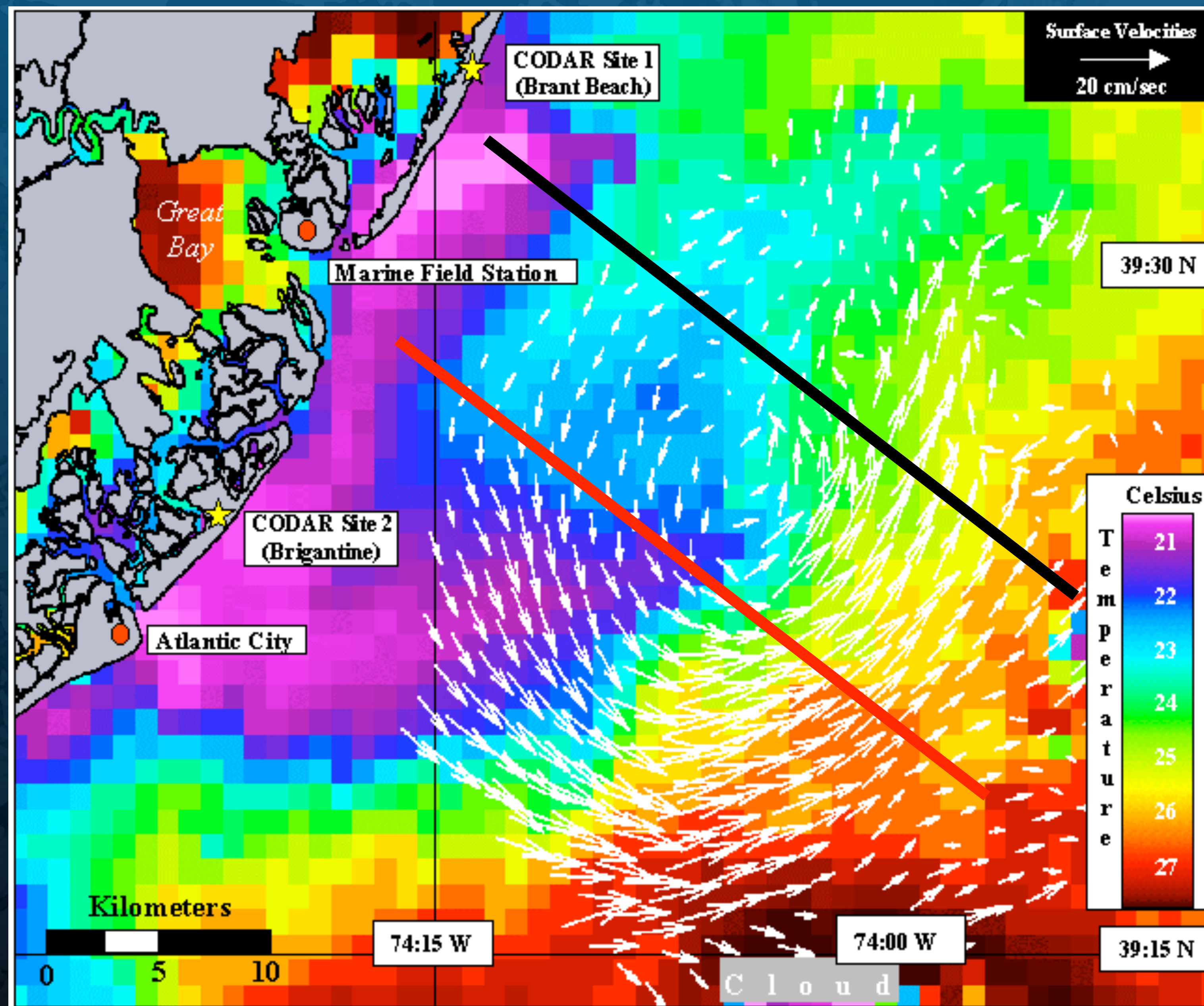
Thermistor



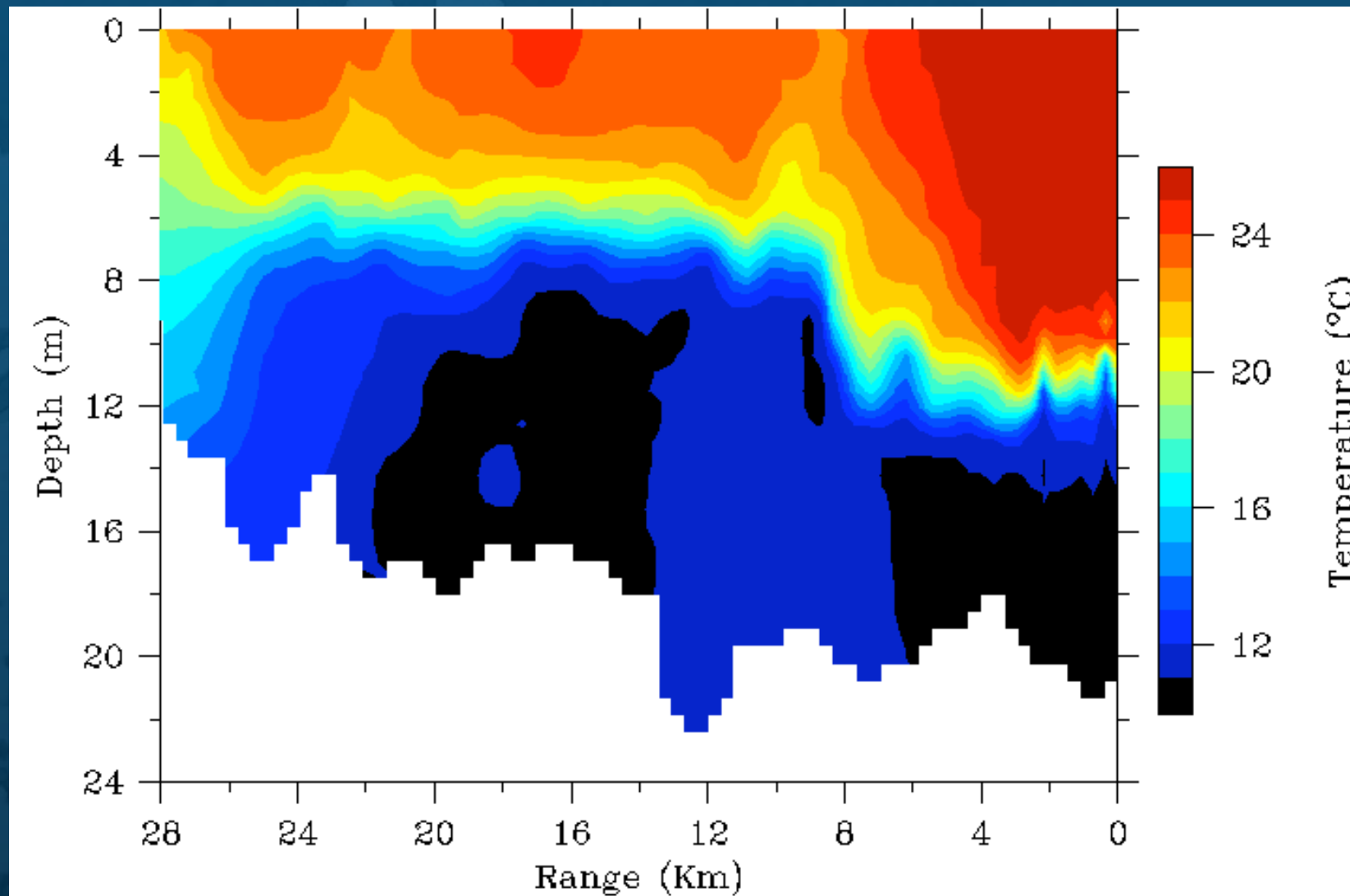
MY2.5



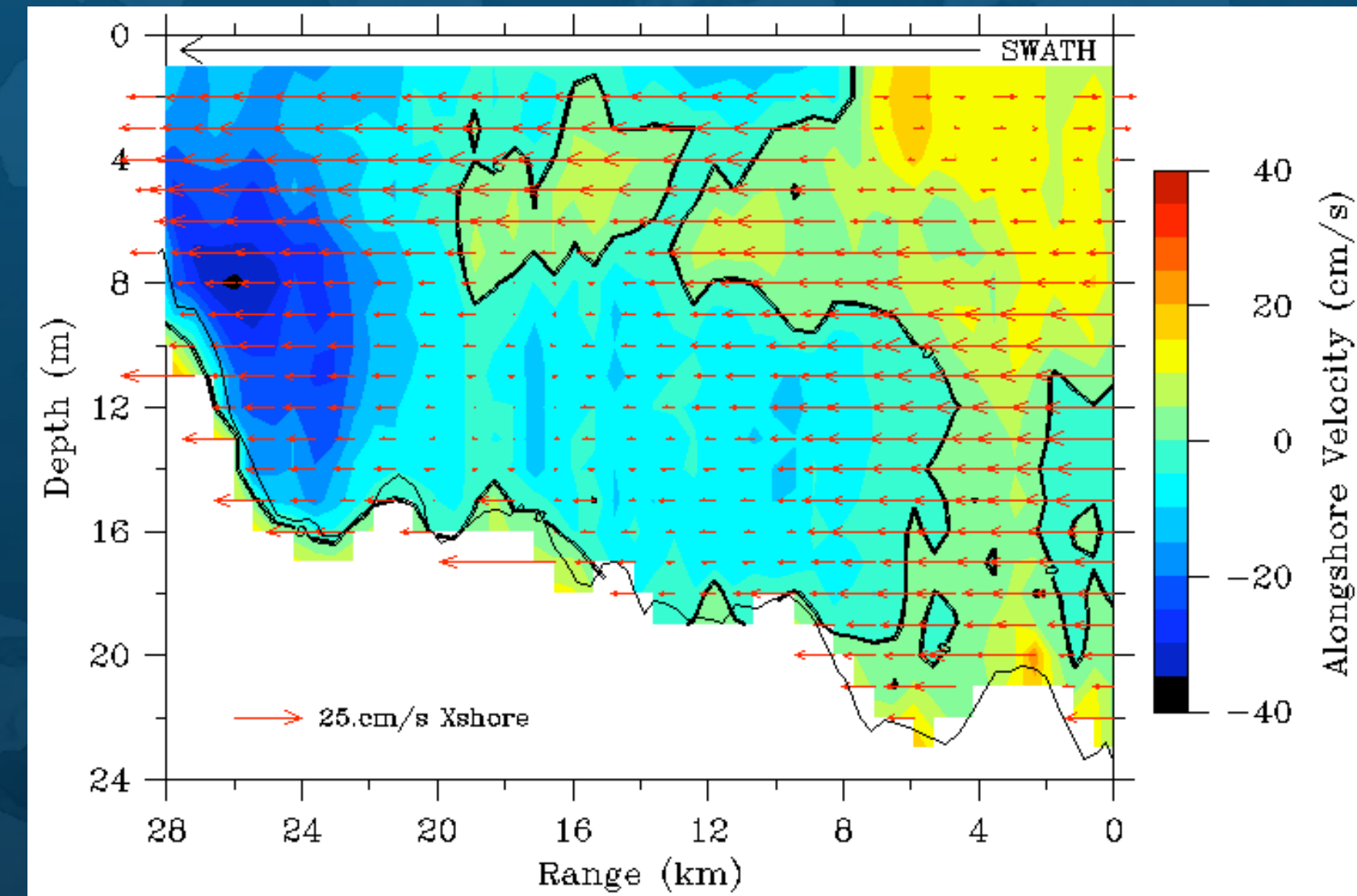
-In an observationally rich environment, ensemble forecasts can be compared to real-time data to assess which model is closer to reality and try to understand why.



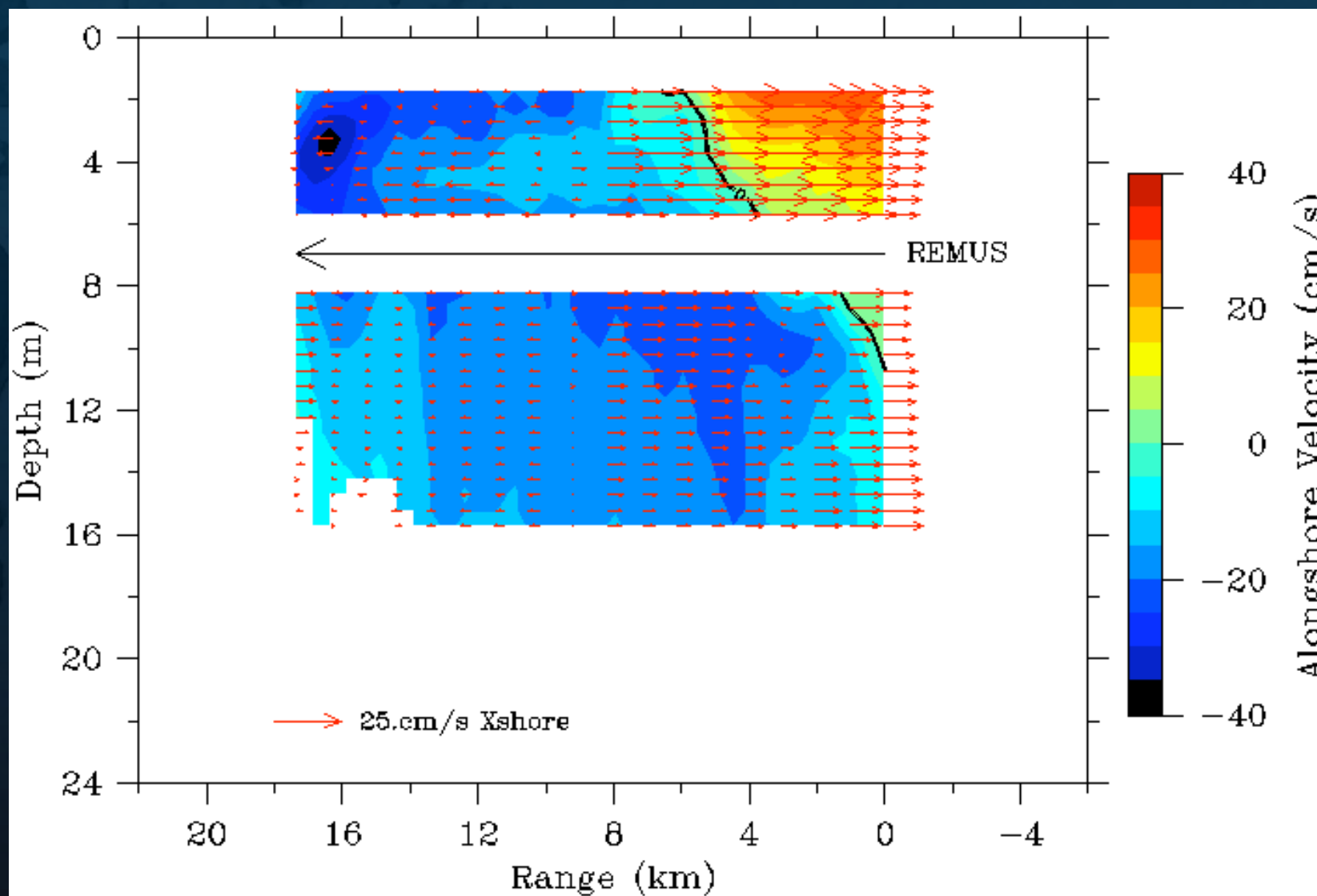
Shipboard surveys



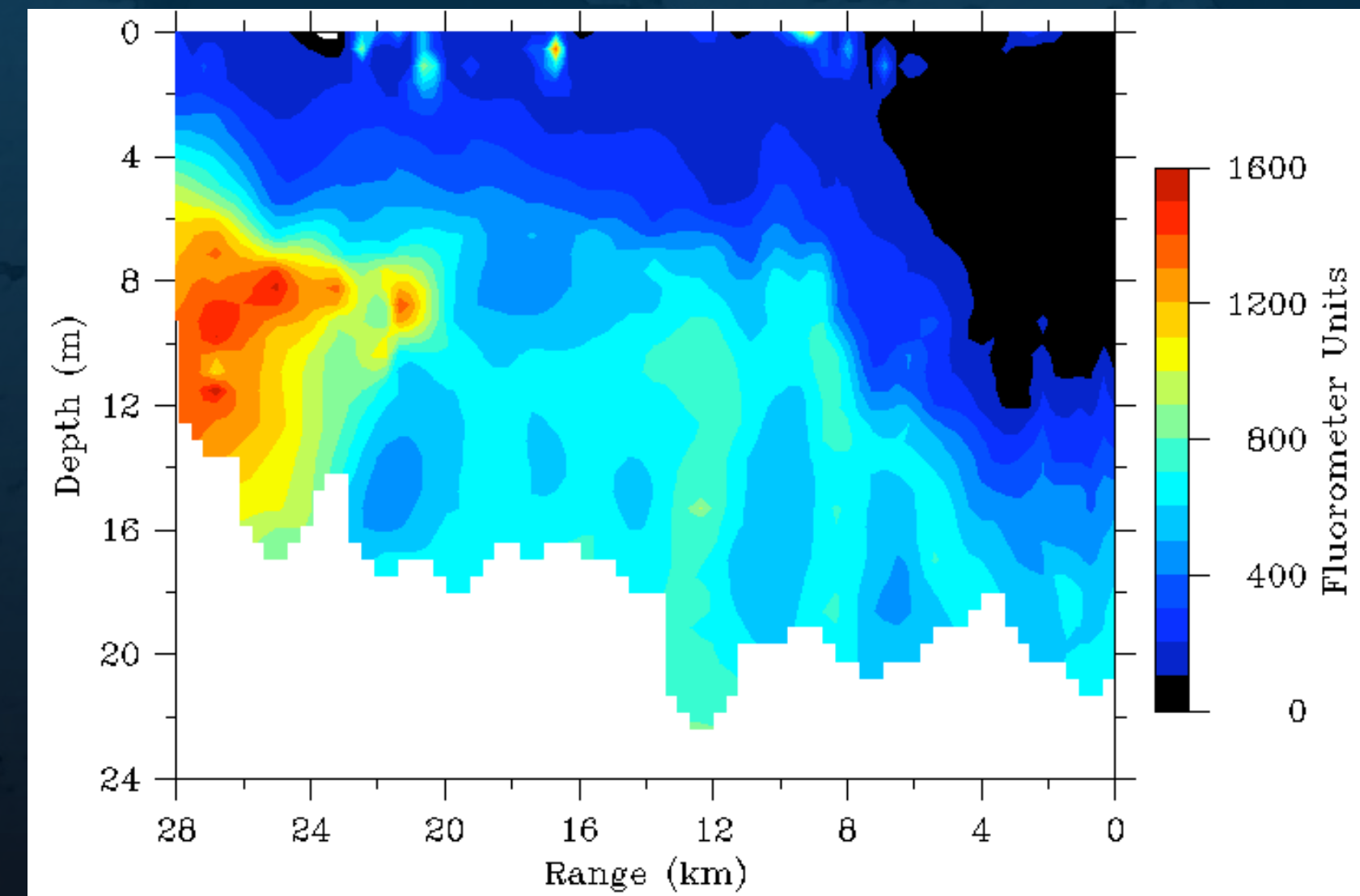
MiniBat Temperature Section: Date: 980723, Leg 3



Surface Towed-ADCP Velocity Section: Date 980723, Leg 03

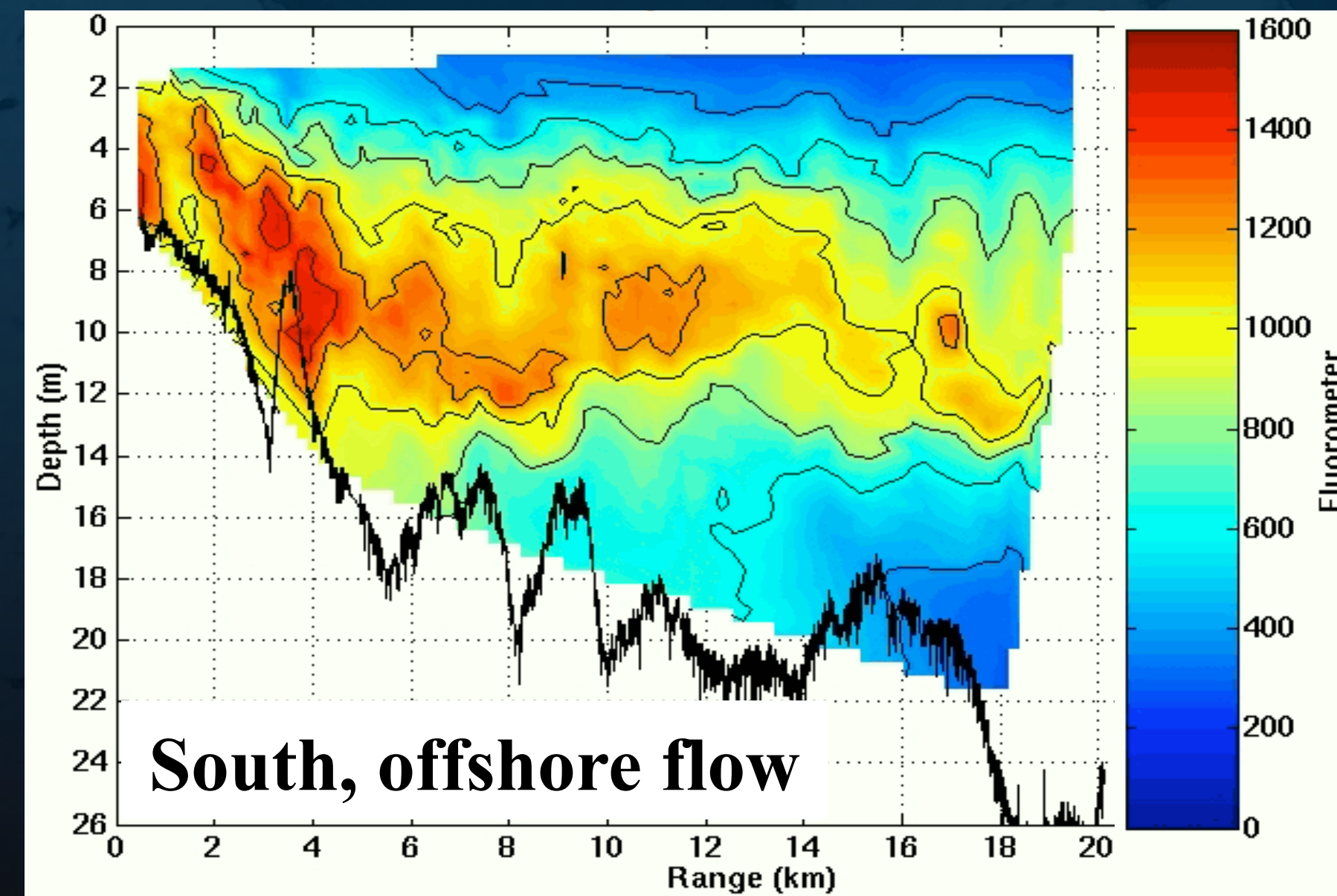
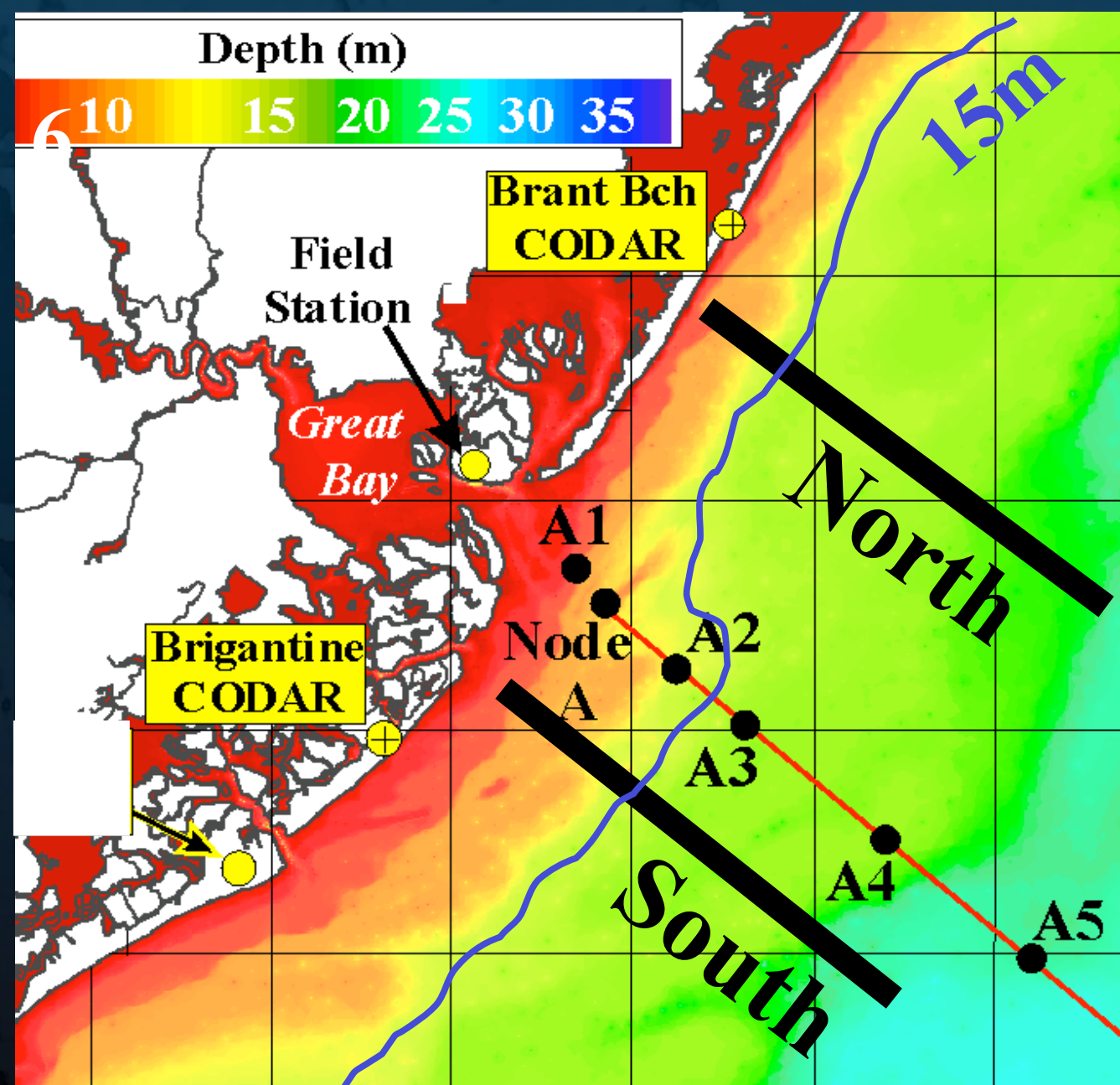
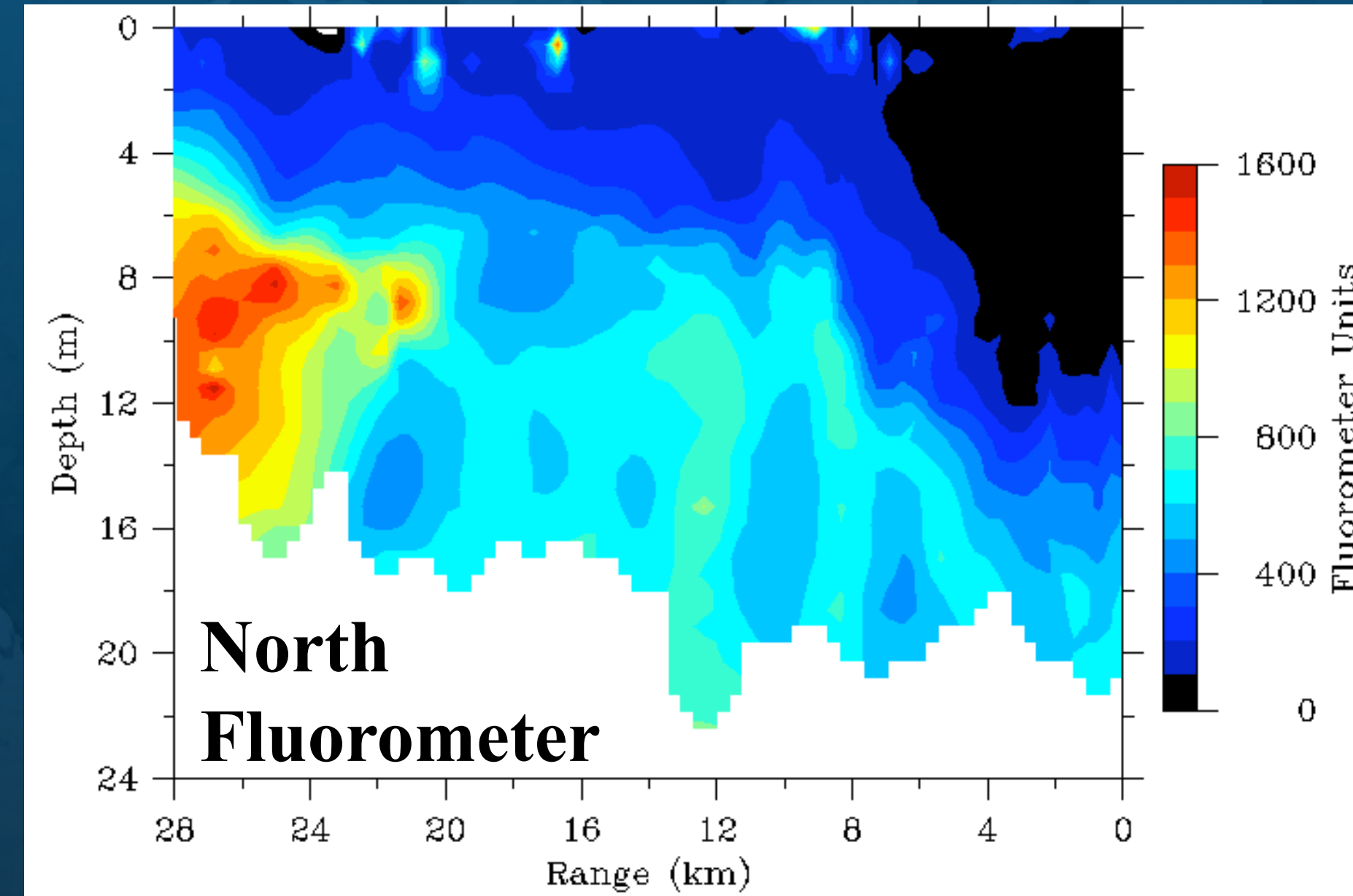
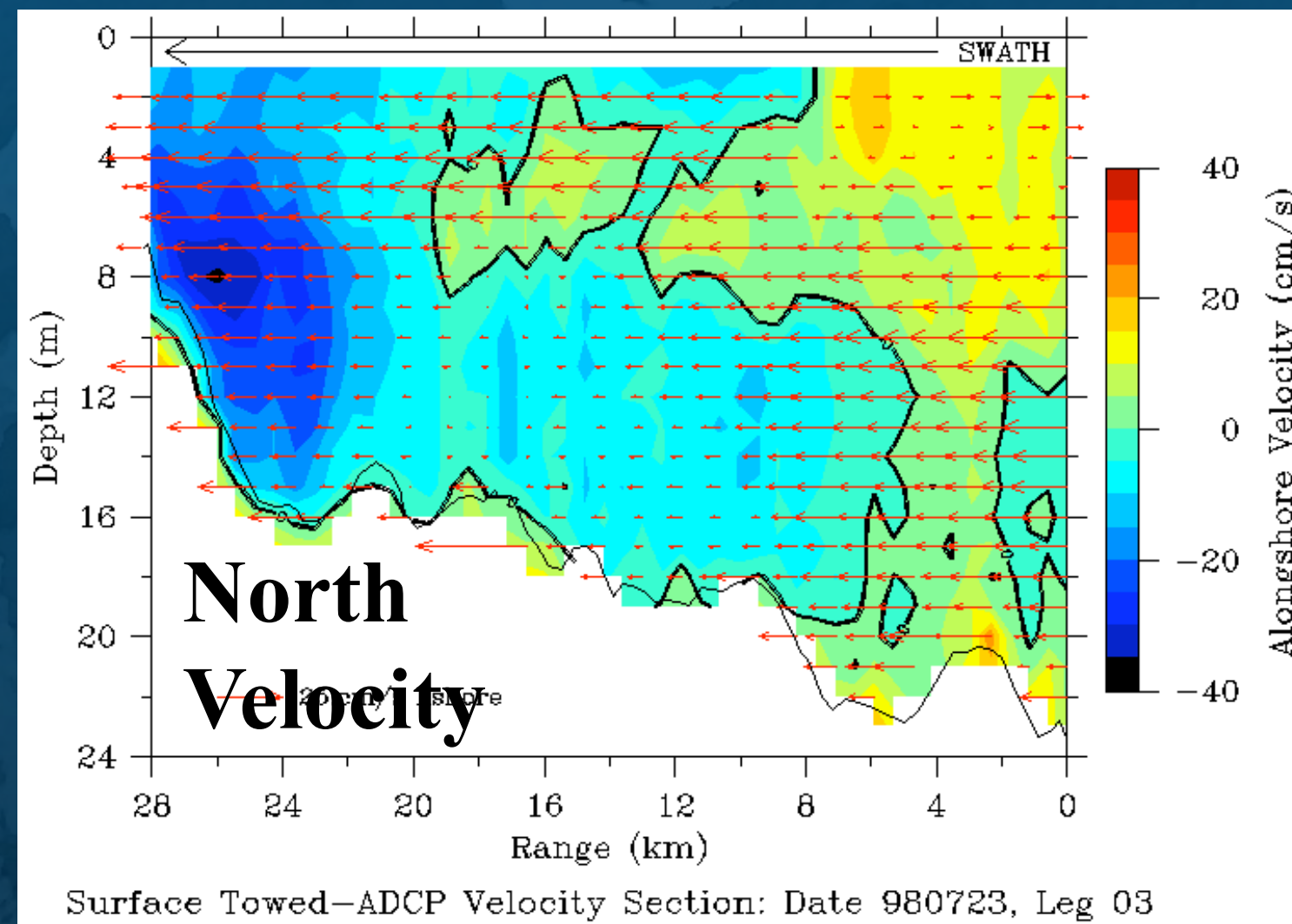


REMUS ADCP Velocity Section: Date 980723

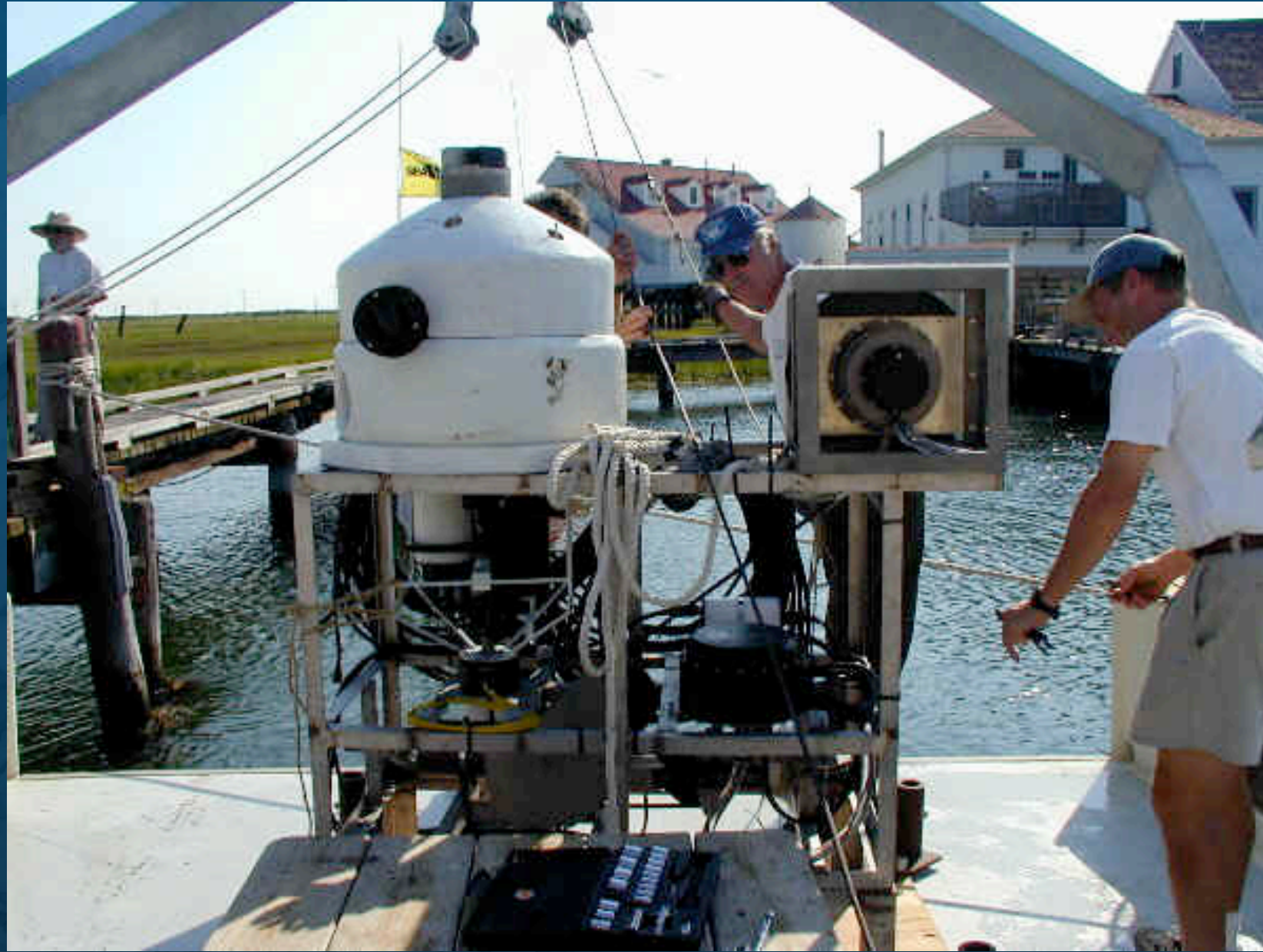


MiniBat Fluorometer Section: Date 980723, Leg 3

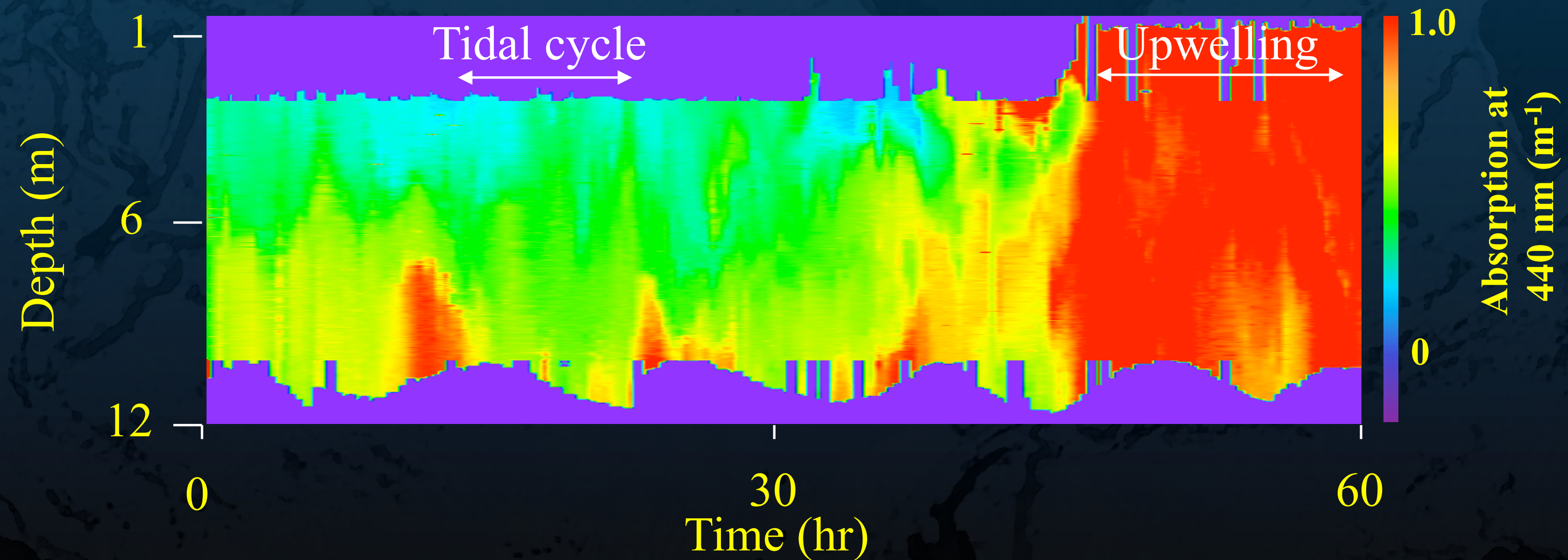
Adaptive Sampling of Resolved Scales- Shipboard & AUV surveys



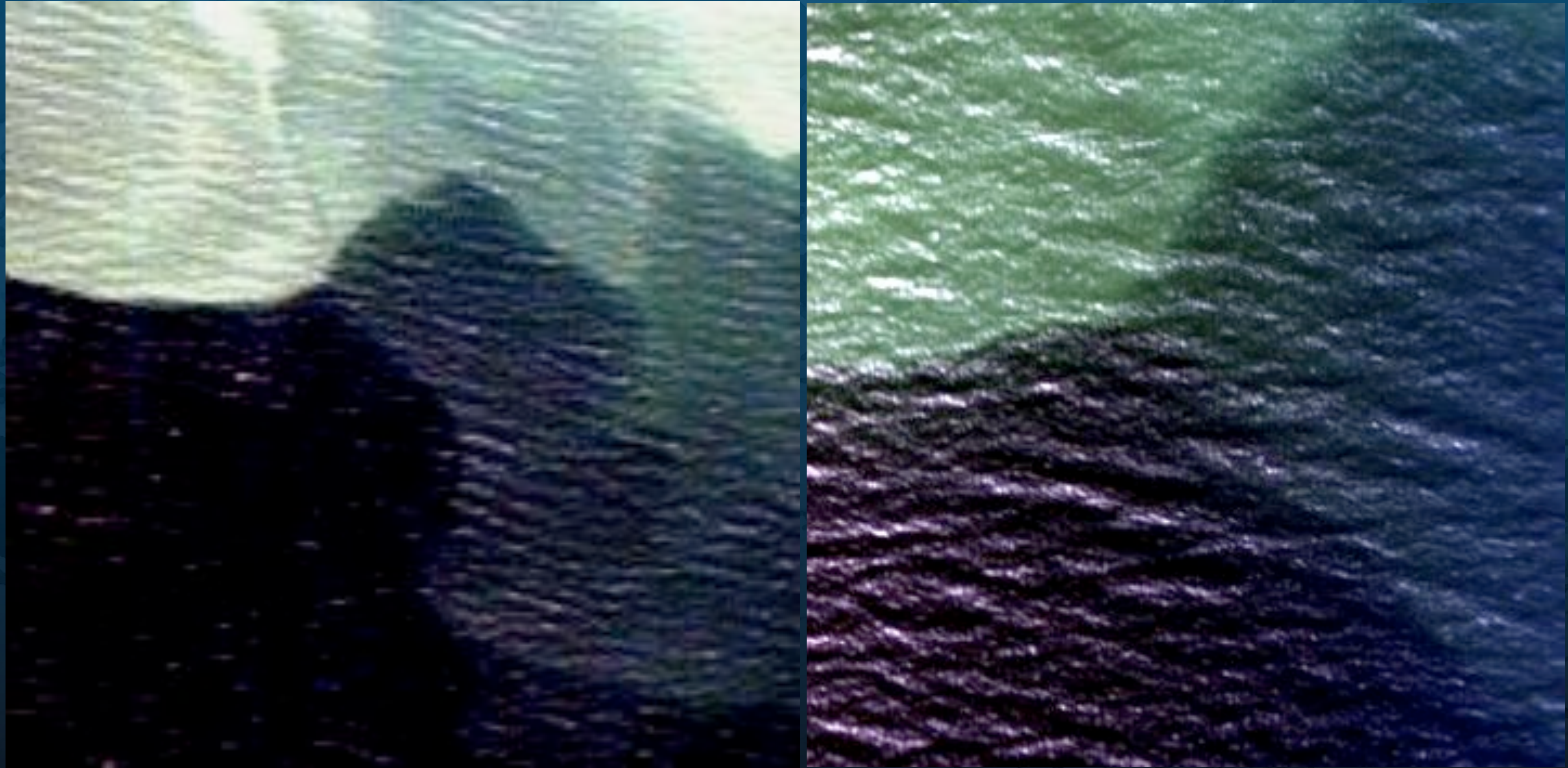
Optical profiler deployed on LEO-15 guest port

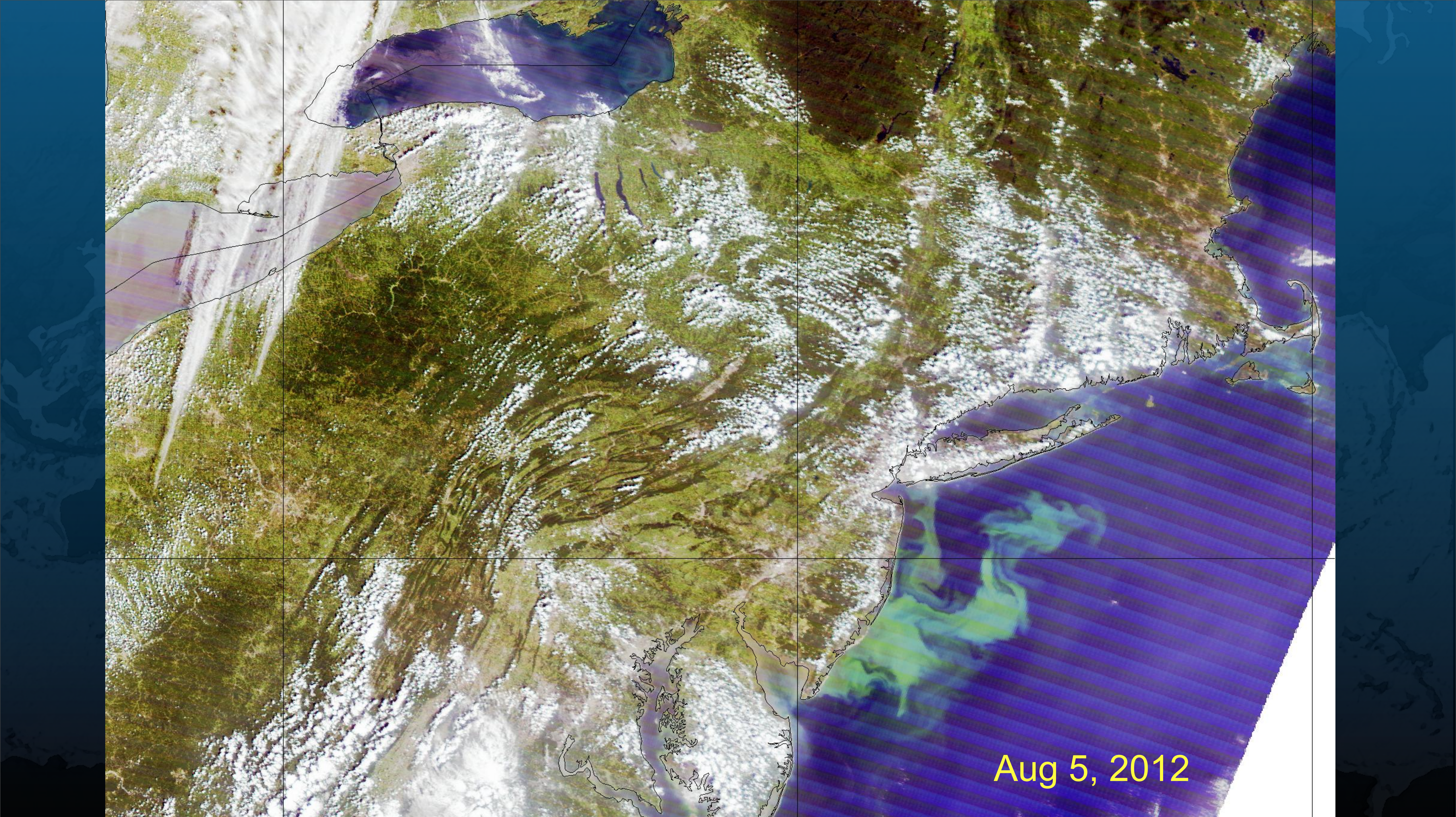


Nerd summer camp

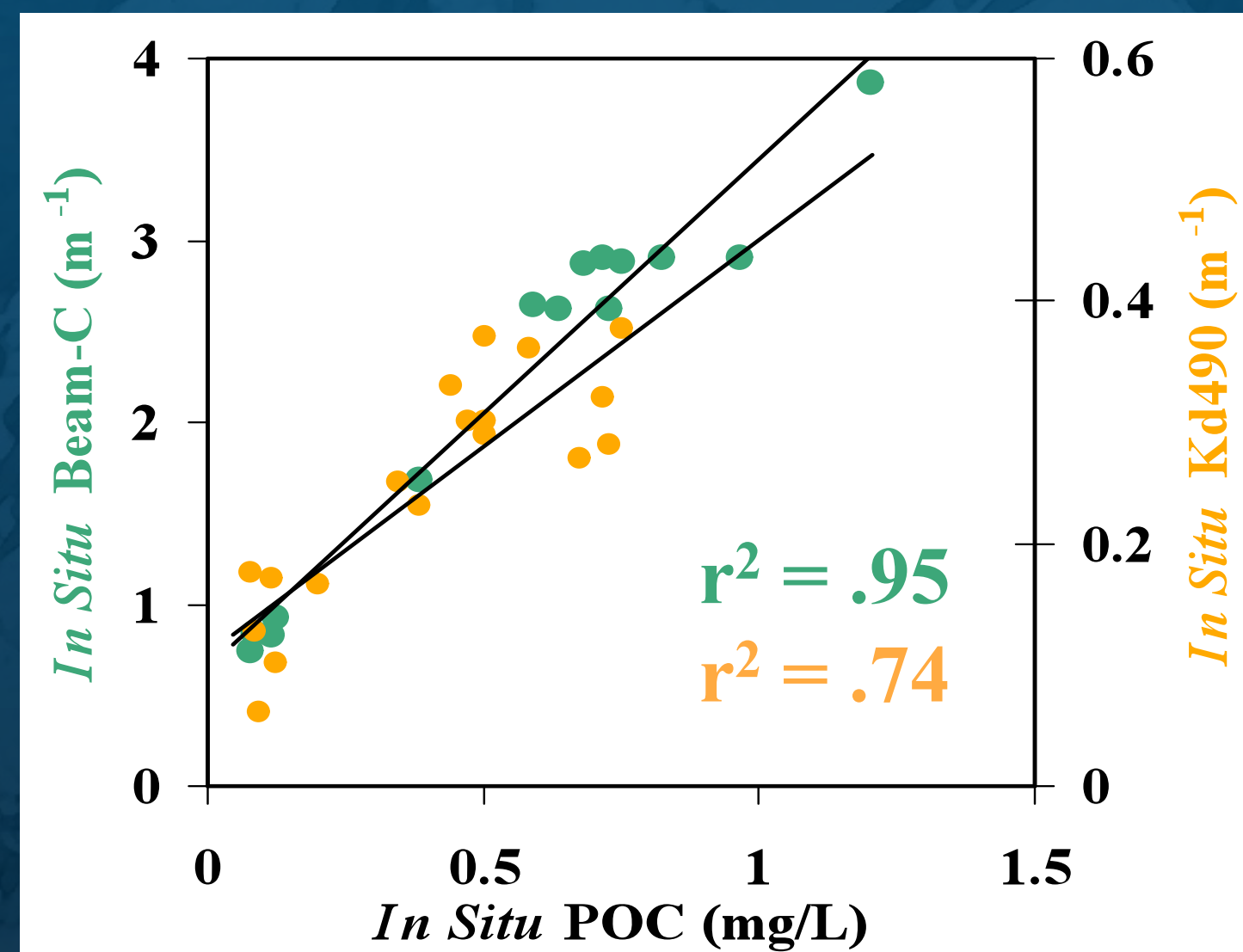


That Pristine Blue NJ Water

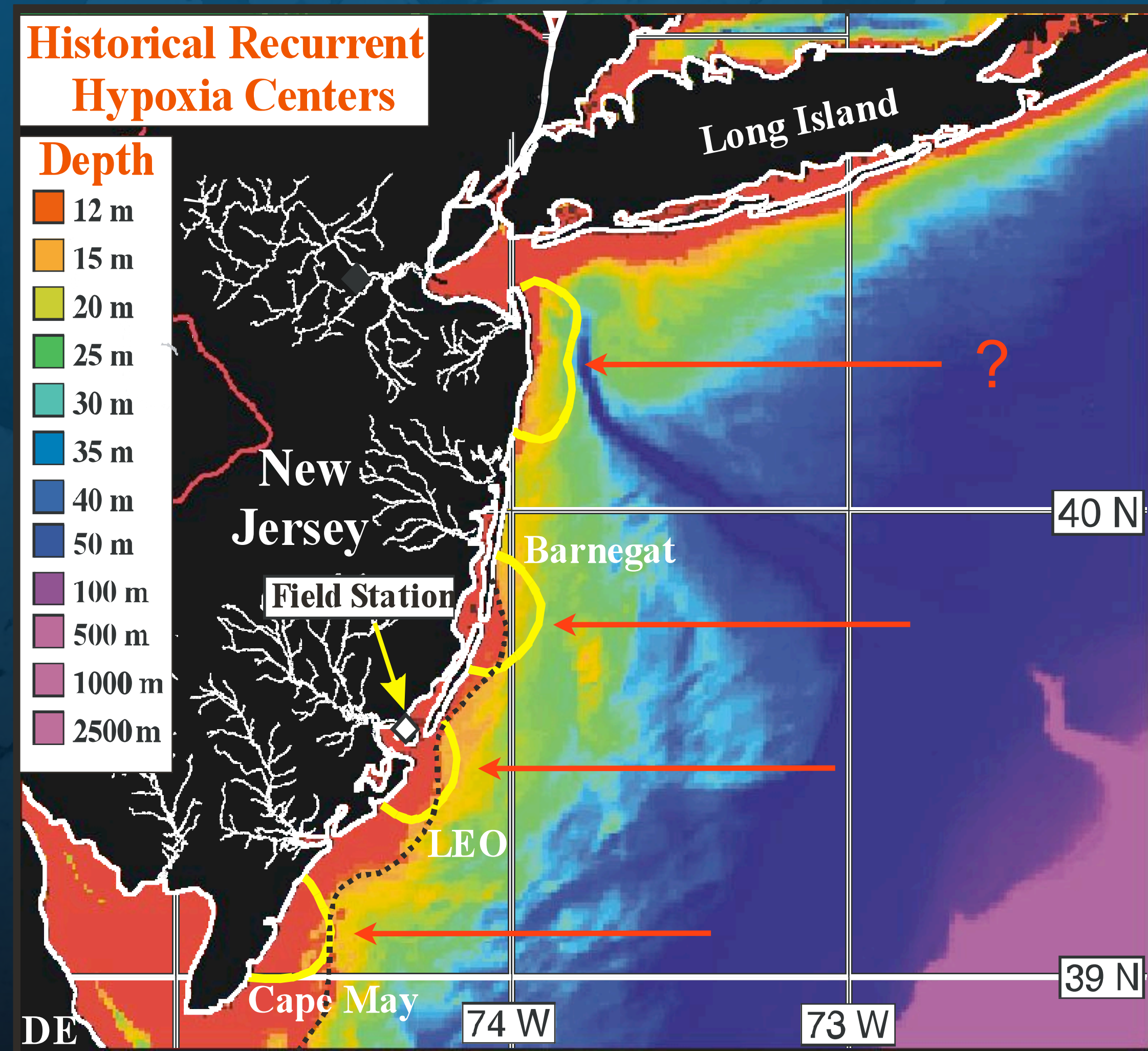




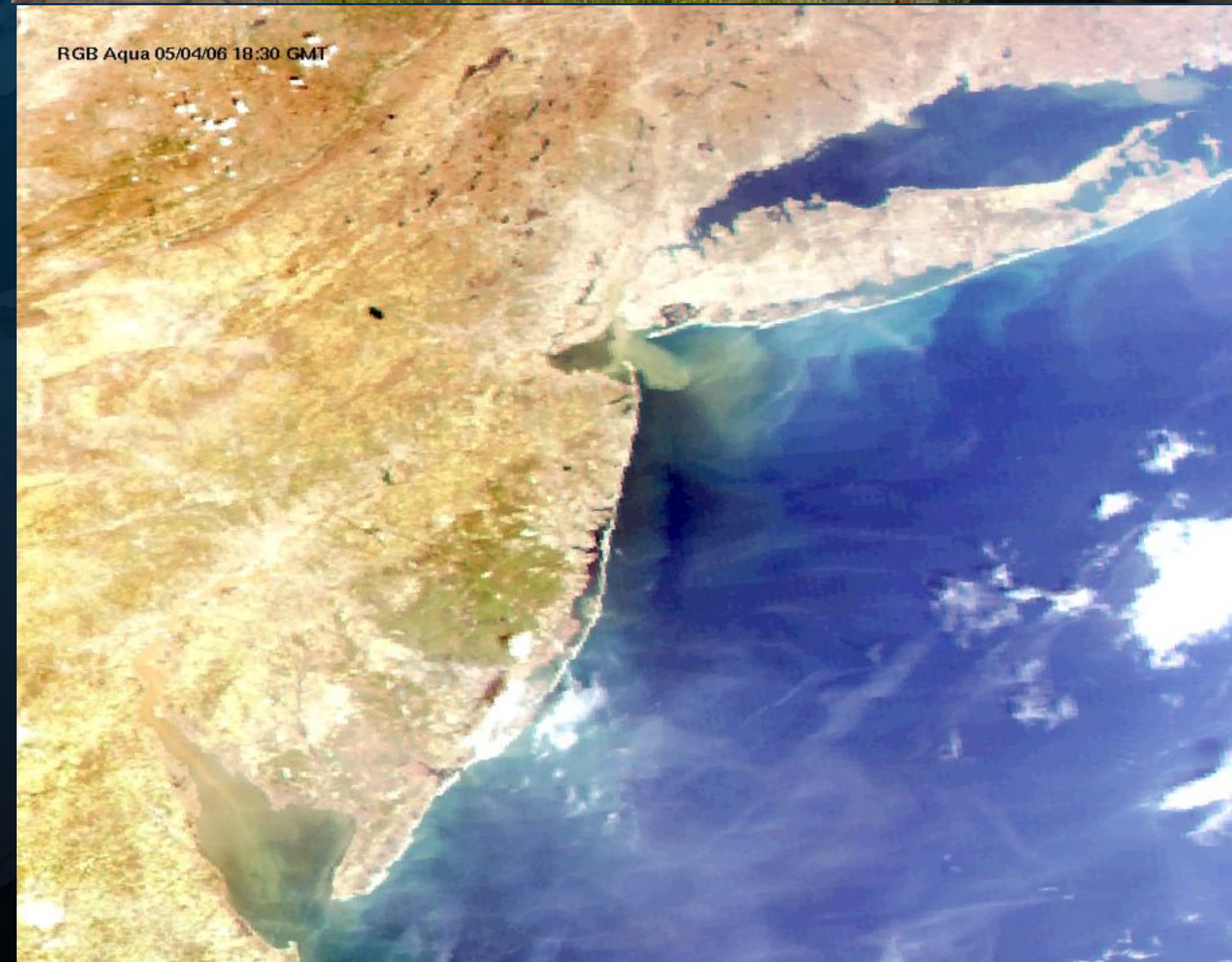
Aug 5, 2012



POC represents potentially
182 $\mu\text{mol oxygen/kg}$
 Upwelling can account
 For spatially distribution
 of recurrent upwelling eddies

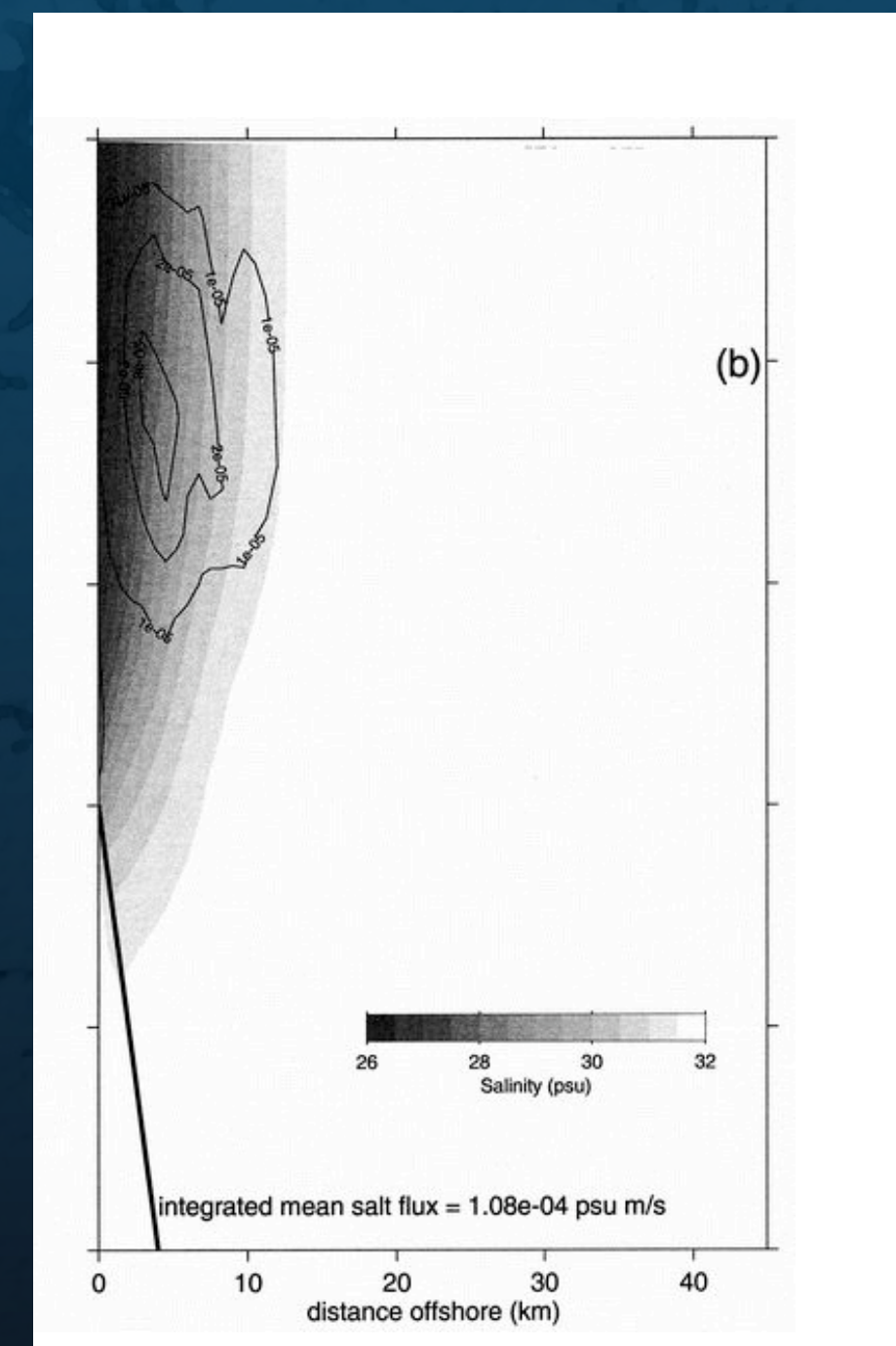


What is happening in the northern zone?



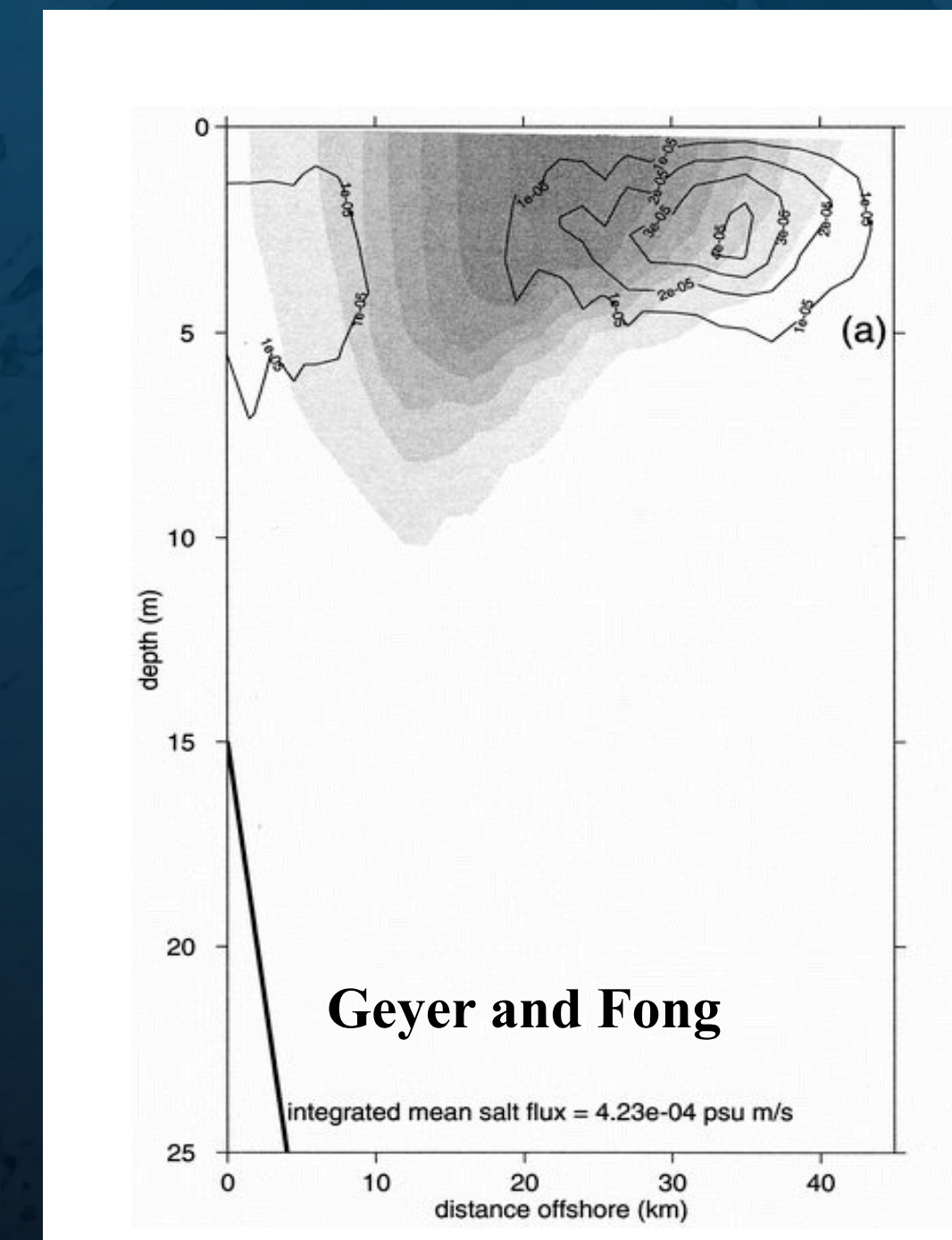
Science focus Land-Ocean: How does the dynamics in the physical oceanography influence the transport and transformation of the particulate and dissolved matter in coastal buoyant plumes?

Downwelling



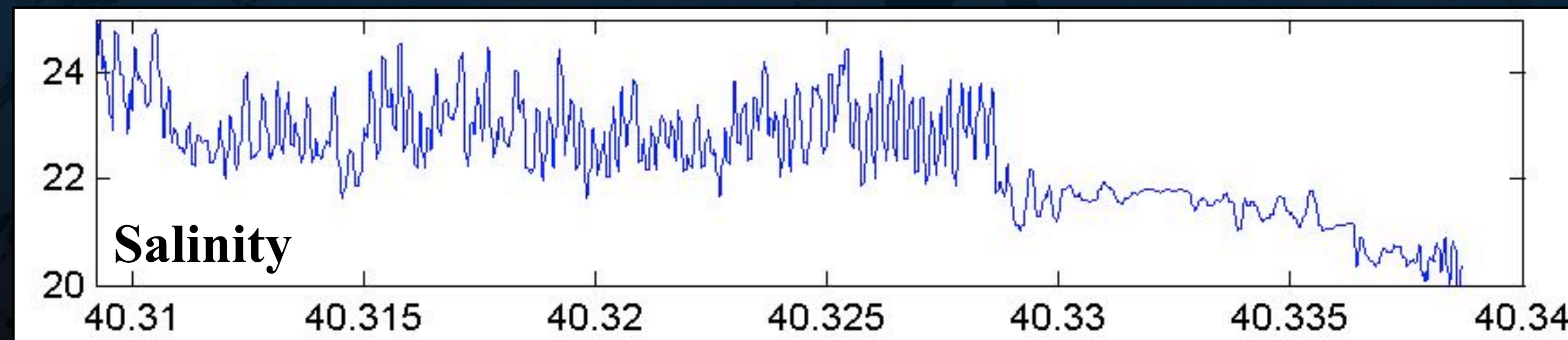
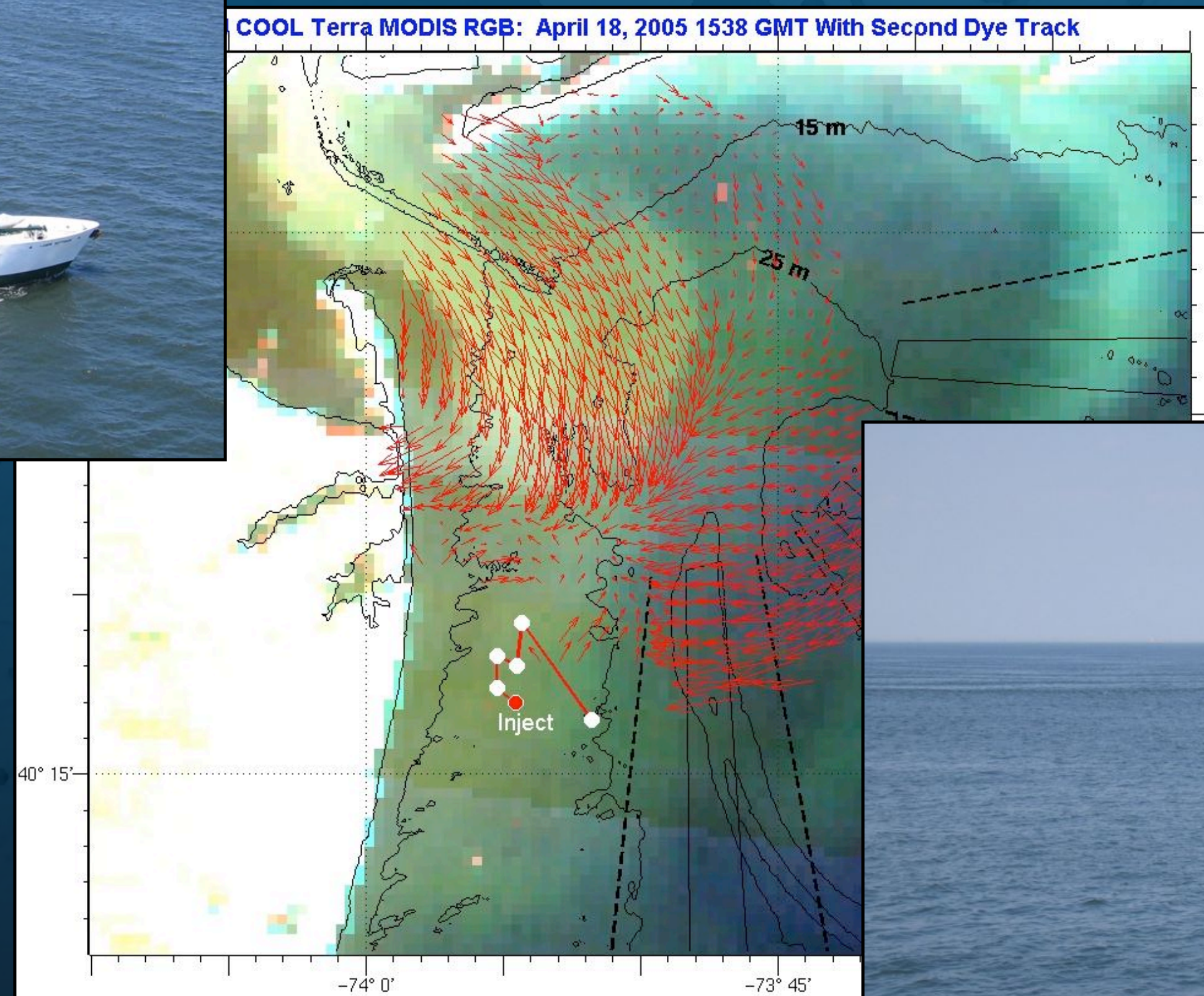
Southern flowing
turbid plume

Upwelling

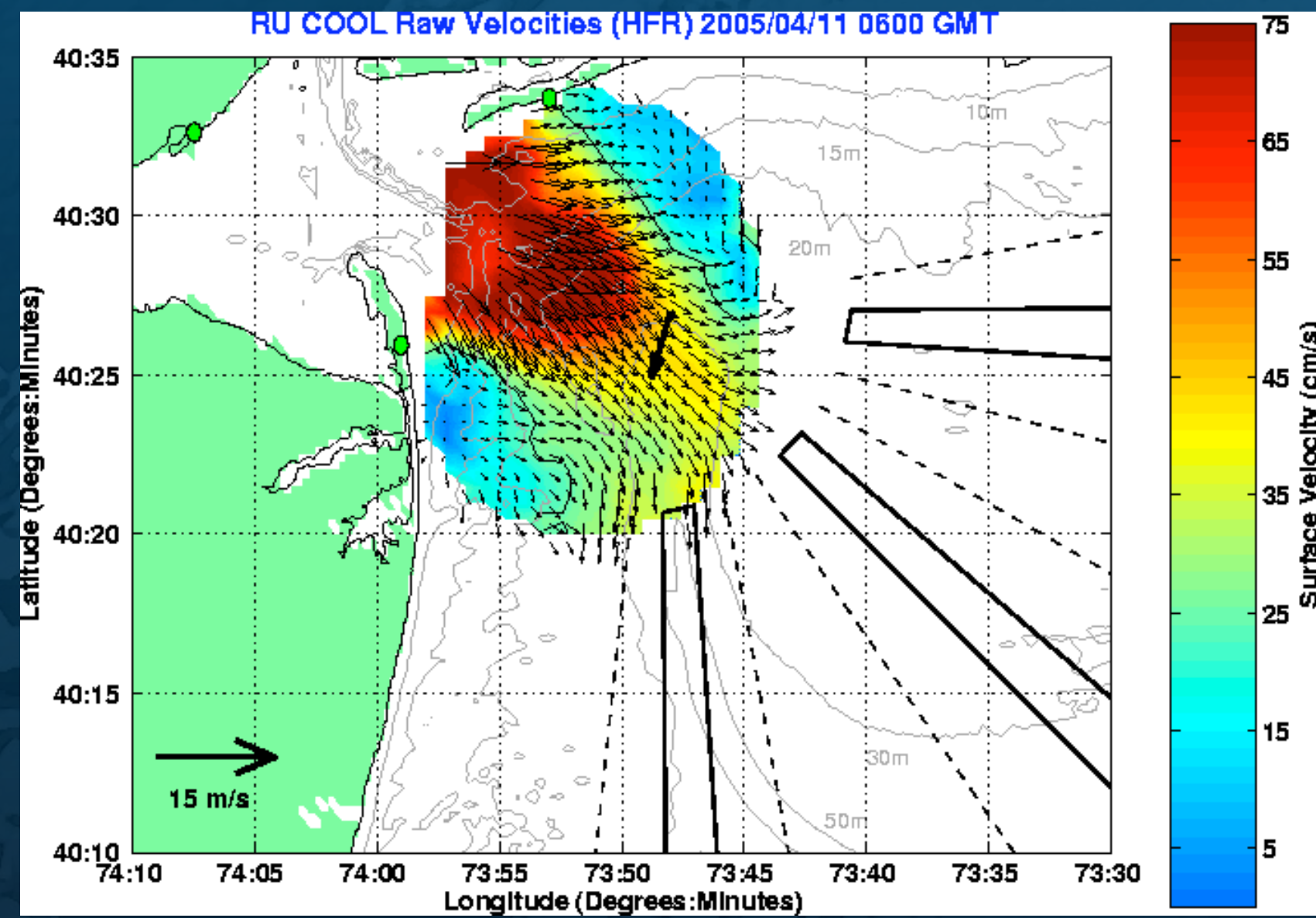


Eastern offshore flowing
shallow turbid plume

Input of organic matter is pulsed to coastal system as floods and punctuated tidal squirts. Example, a tidal bore as it flows past the R/V Cape Hatteras

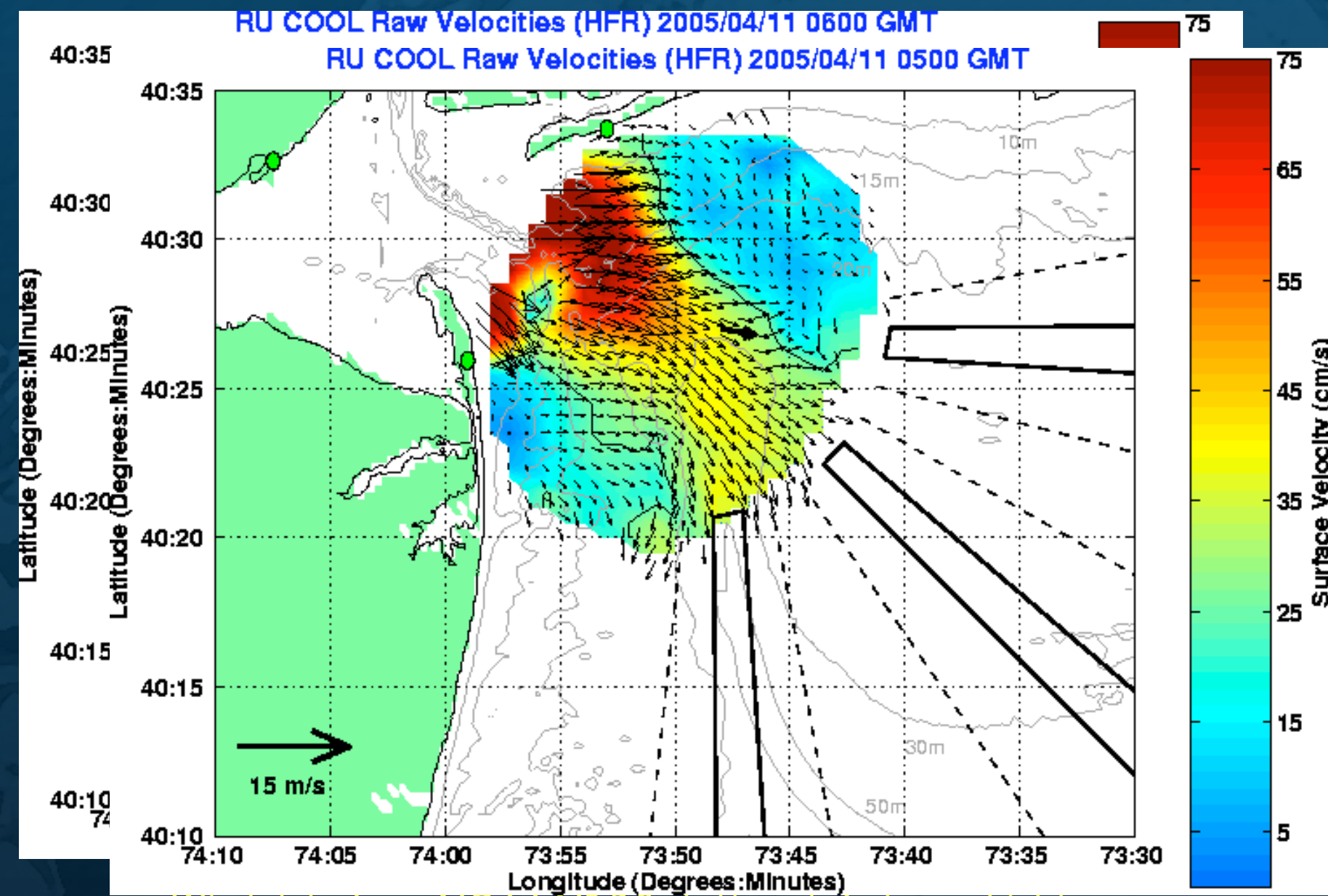


HF RADAR tracking and dye labeling of plume



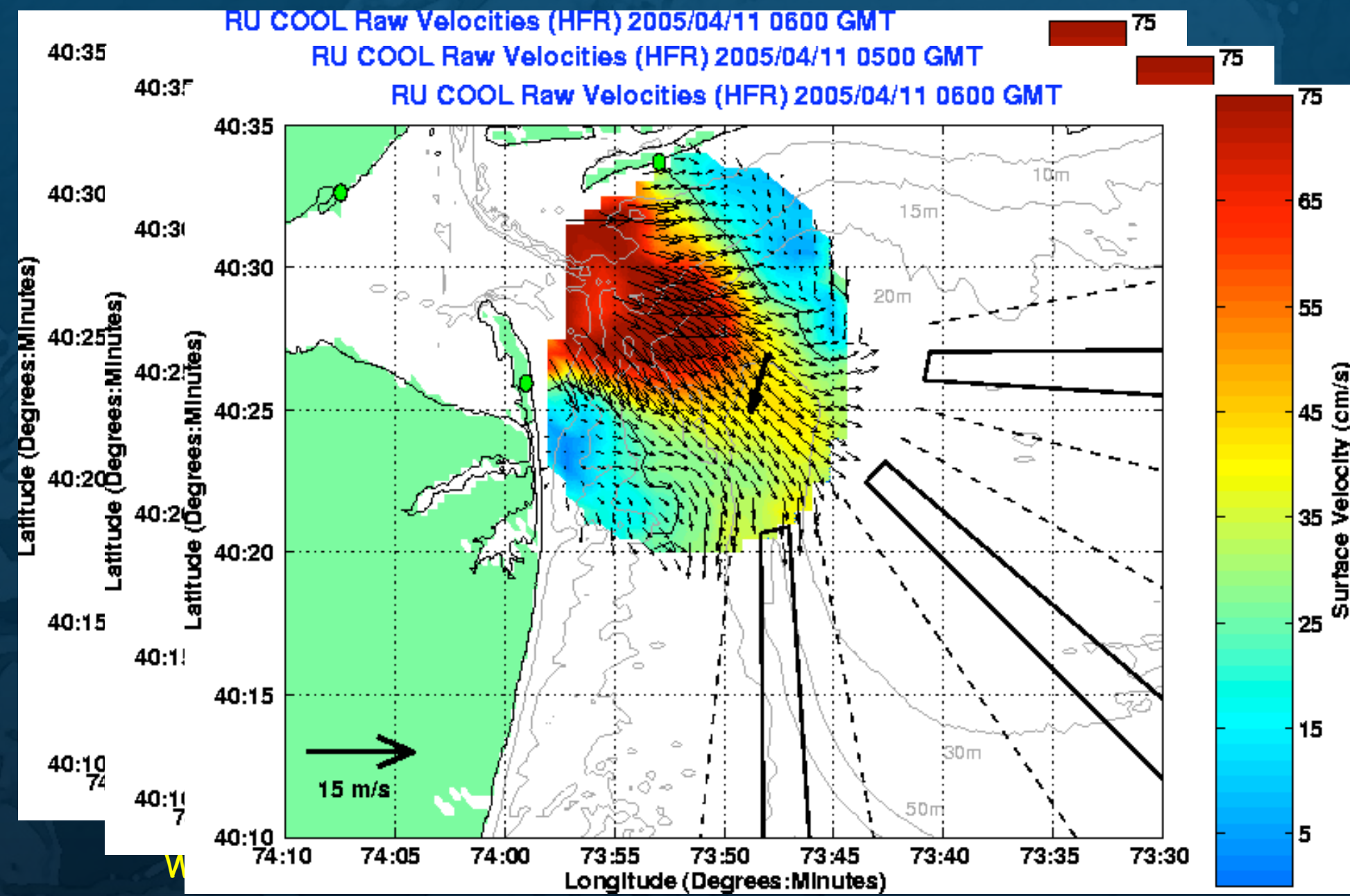
Wind data from NOAA NDBC station at Ambrose Light

HF RADAR tracking and dye labeling of plume

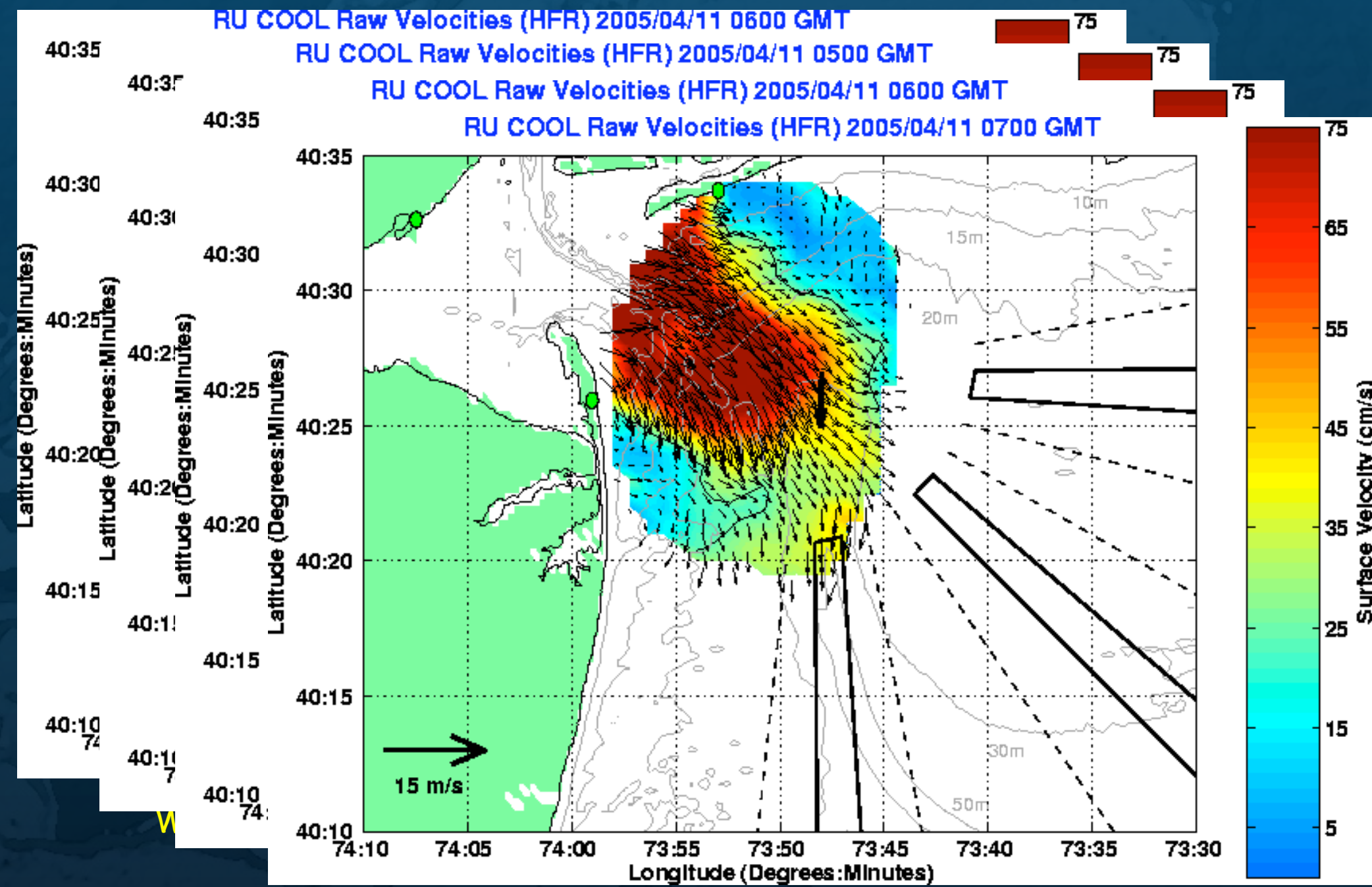


Wind data from NOAA NDBC station at Ambrose Light

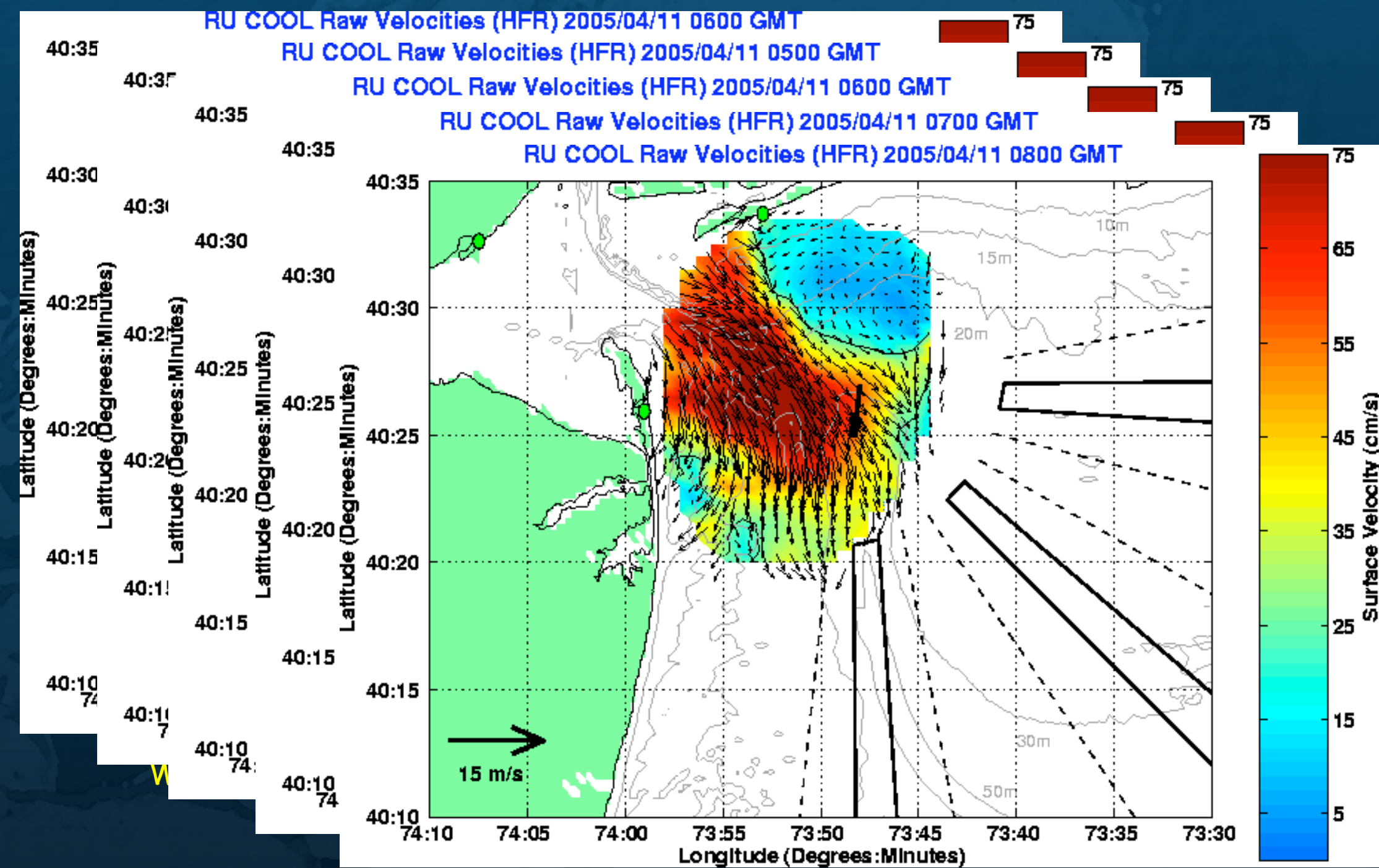
HF RADAR tracking and dye labeling of plume



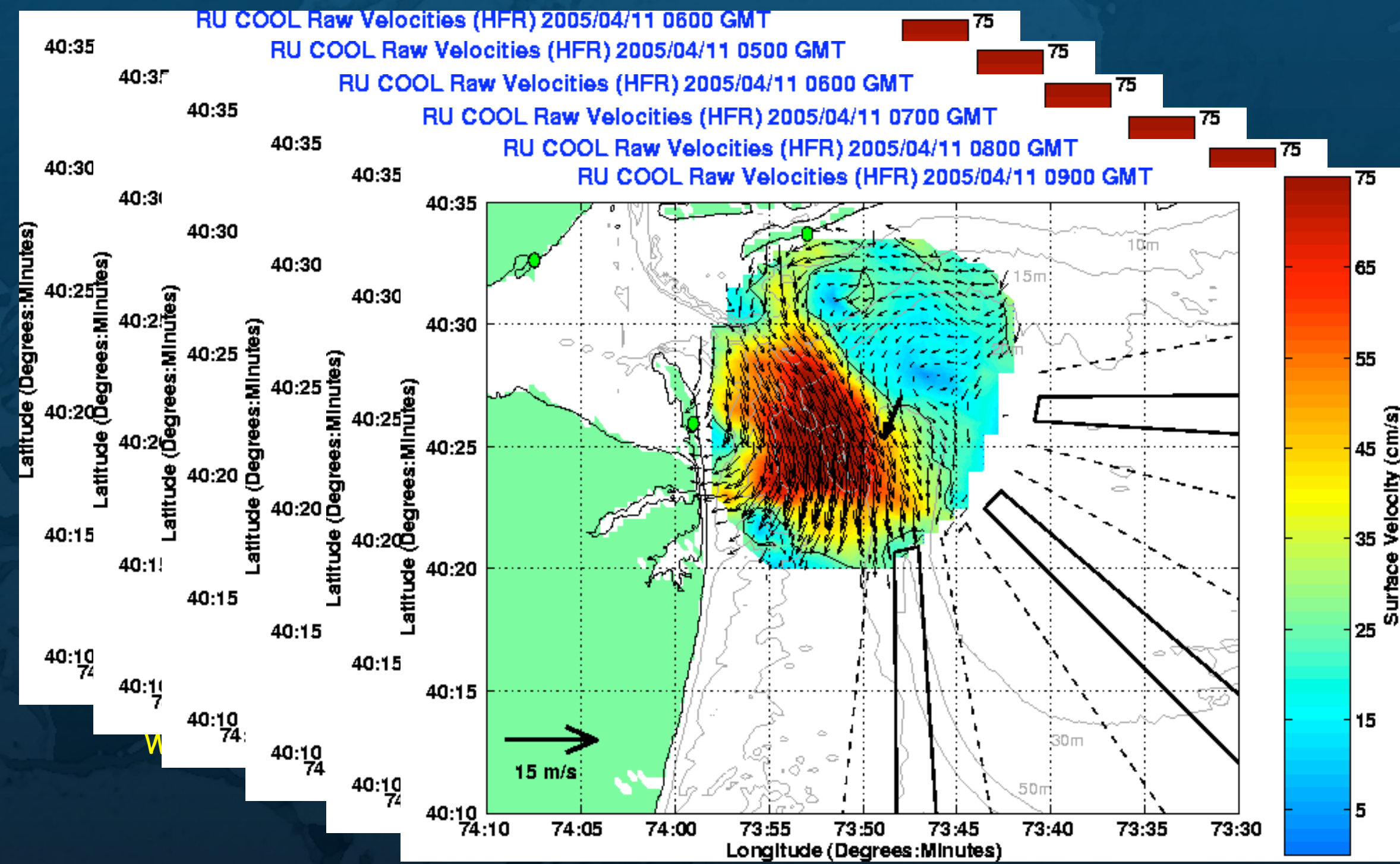
HF RADAR tracking and dye labeling of plume



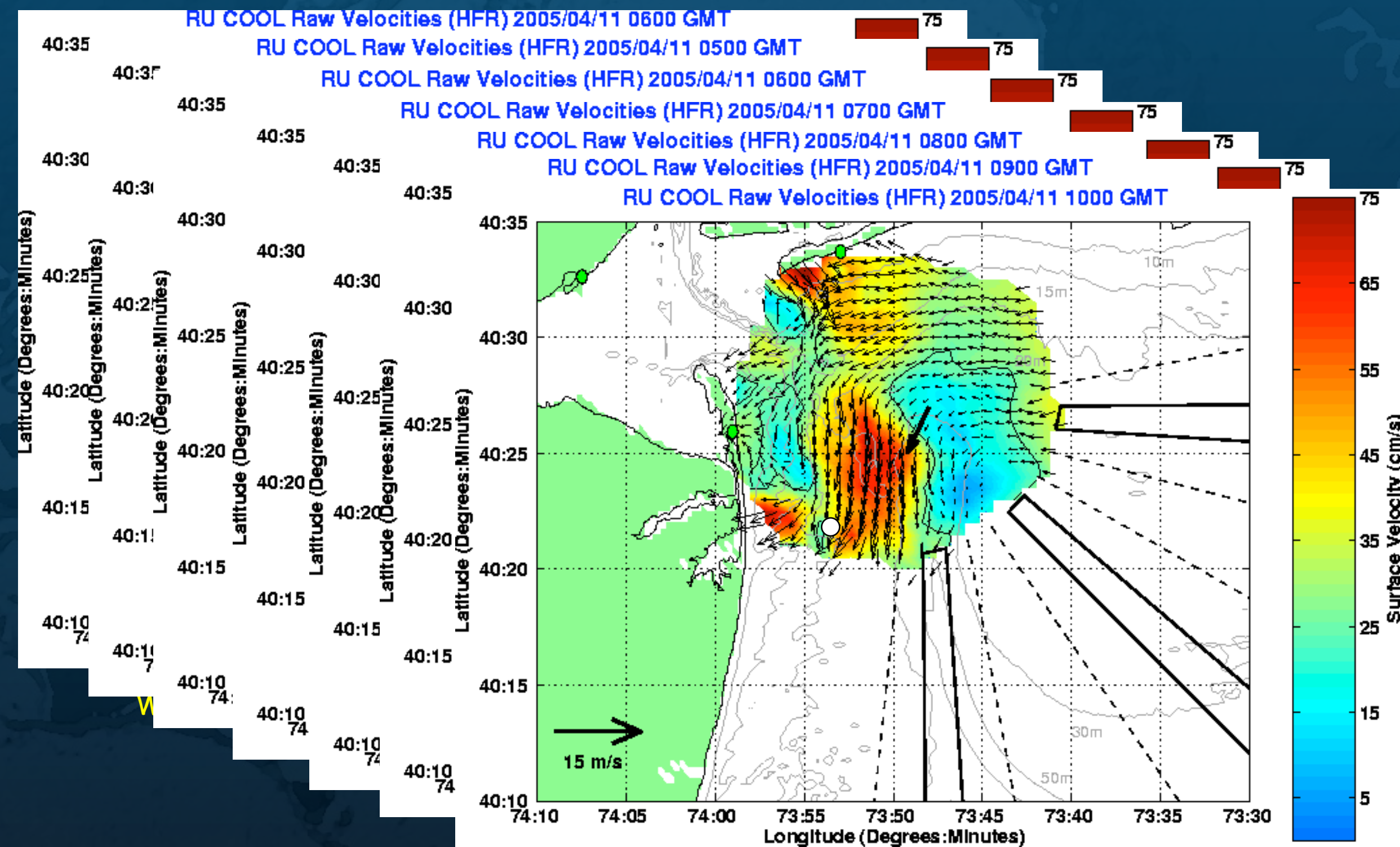
HF RADAR tracking and dye labeling of plume



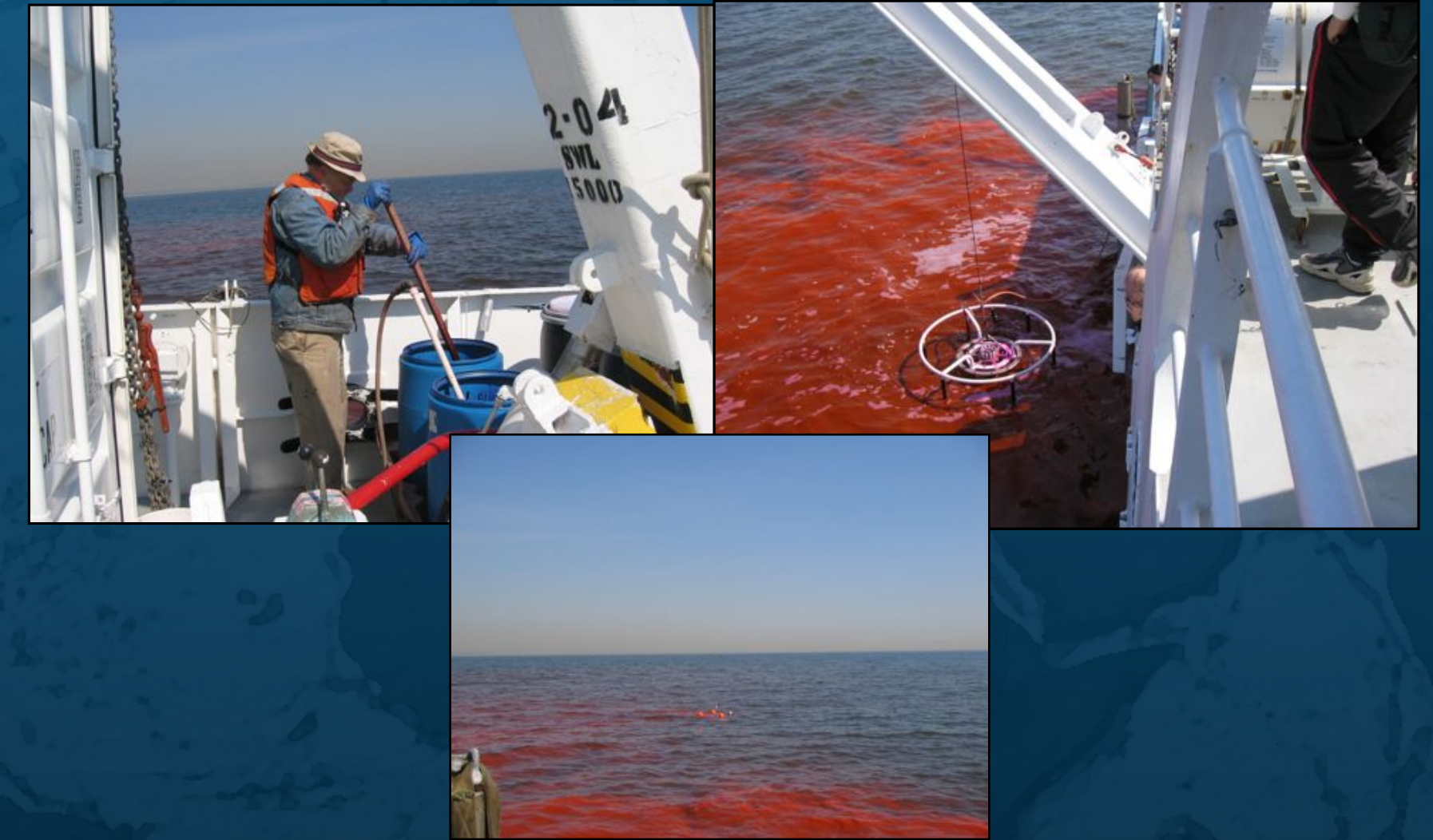
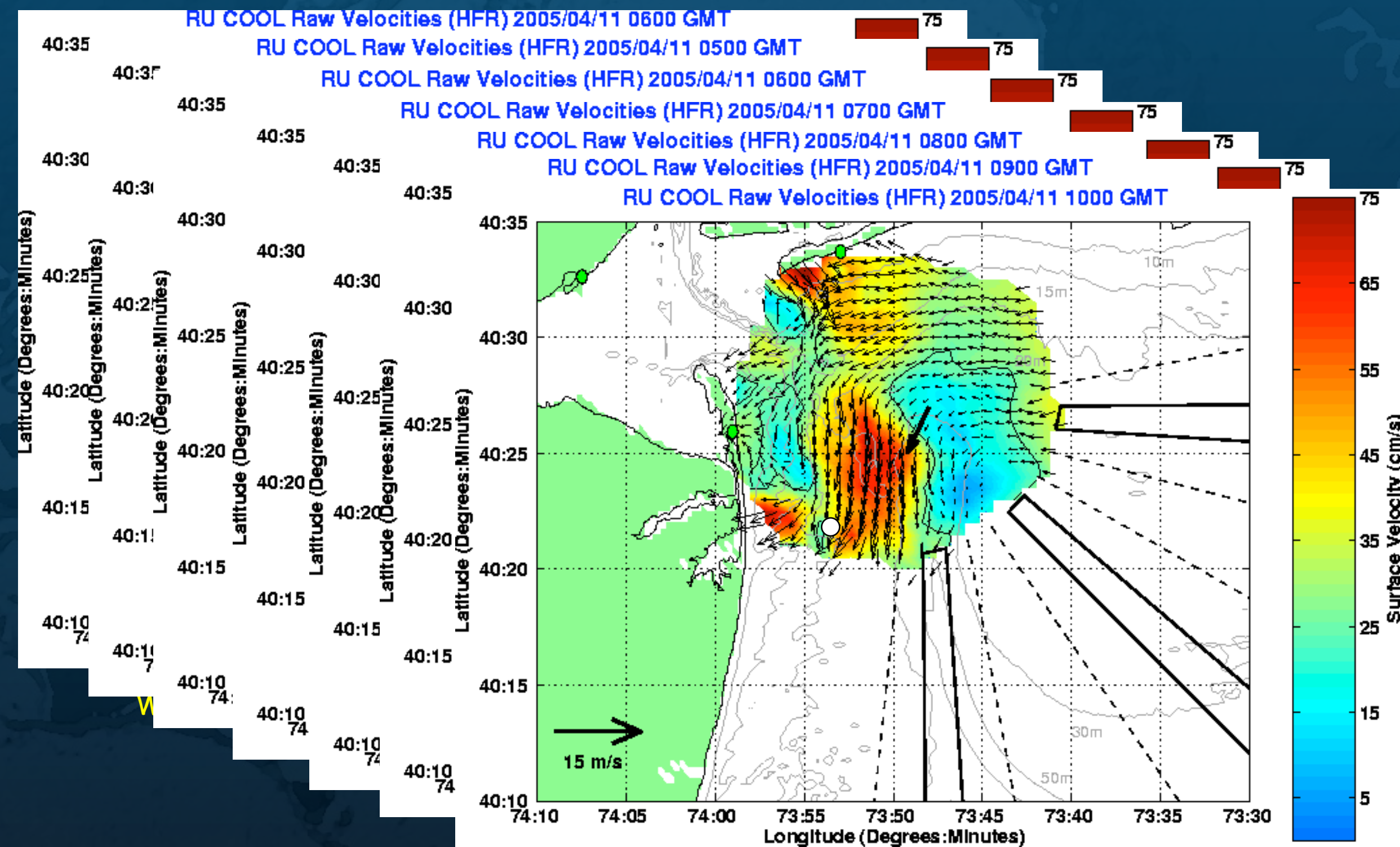
HF RADAR tracking and dye labeling of plume



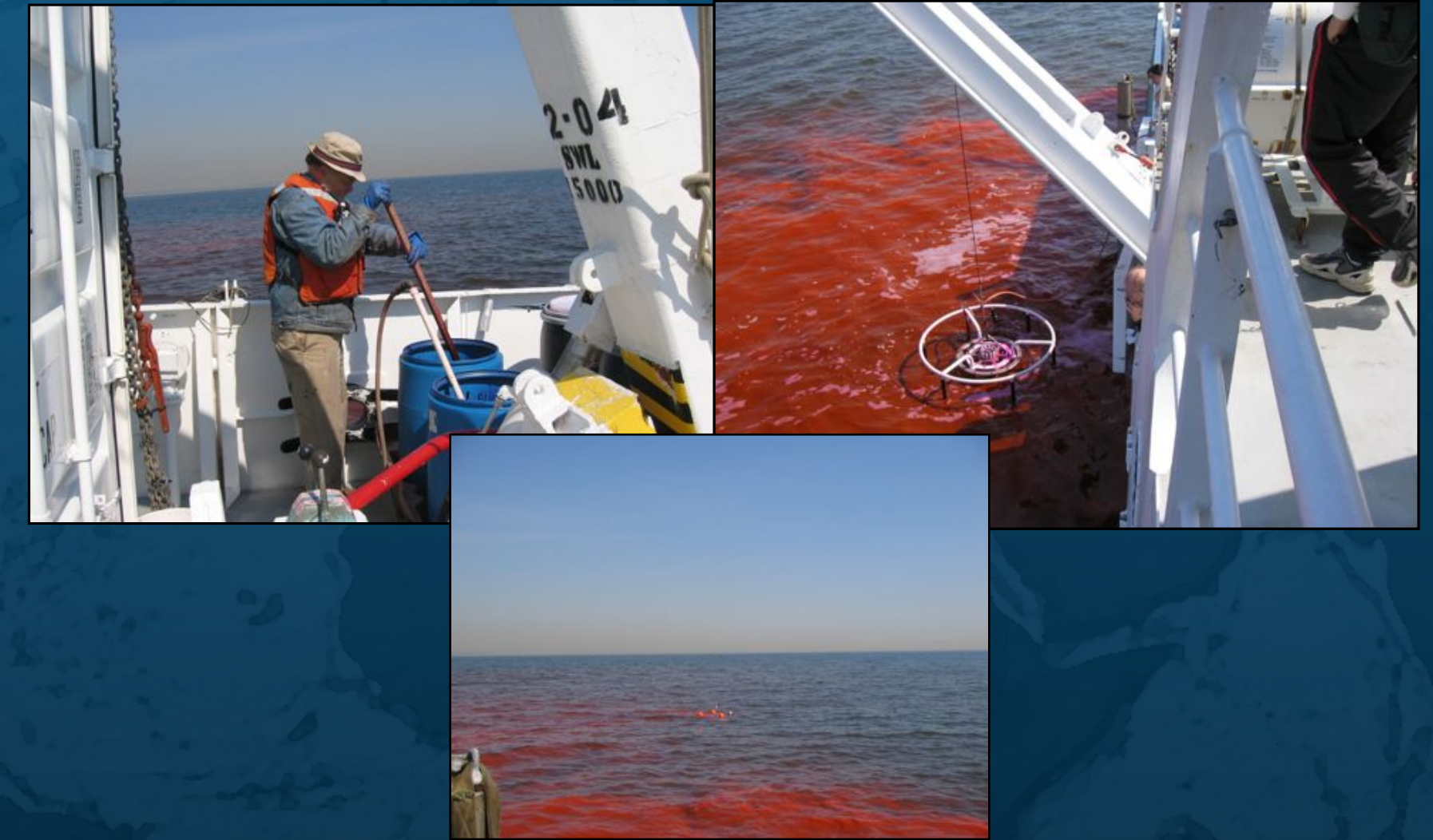
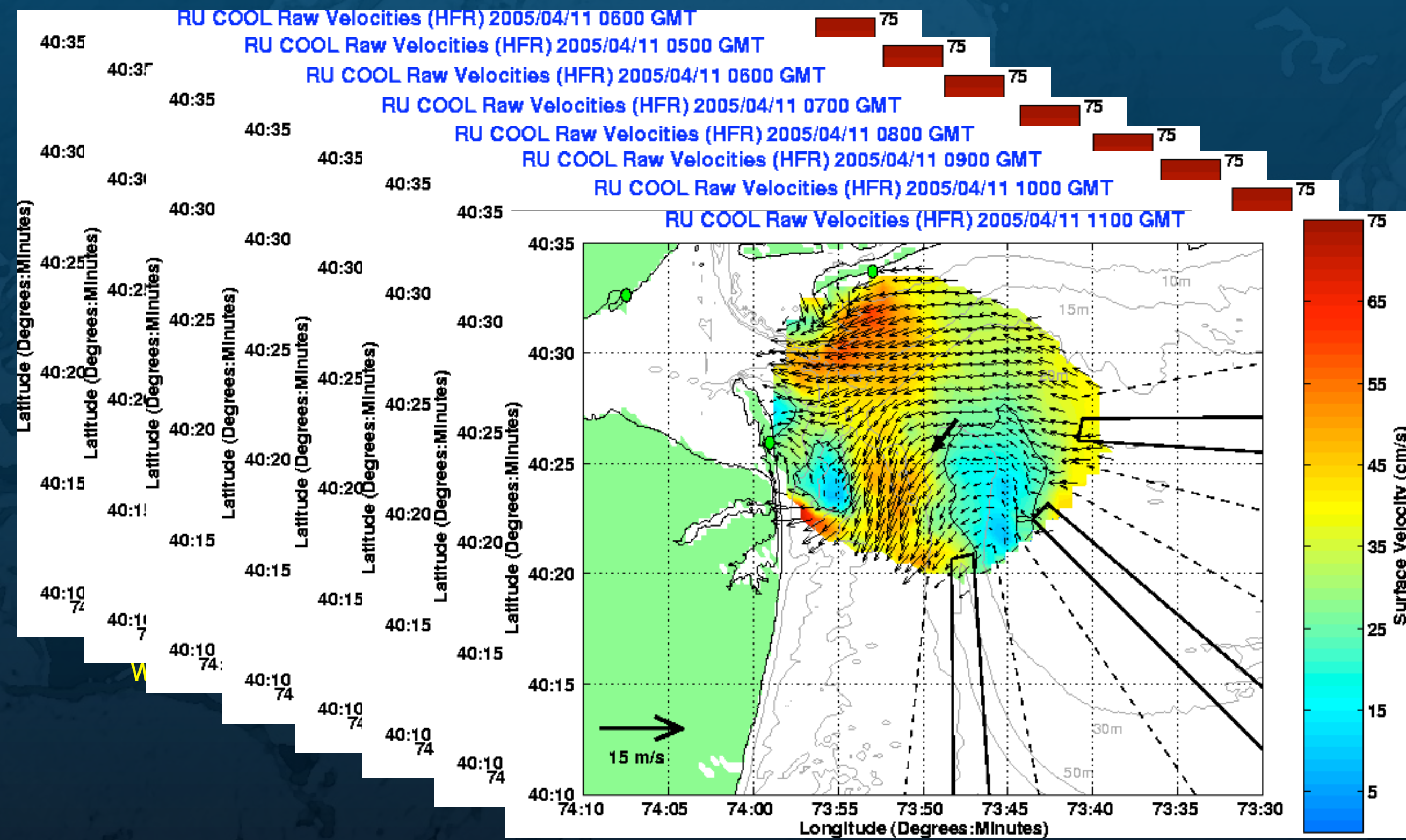
HF RADAR tracking and dye labeling of plume



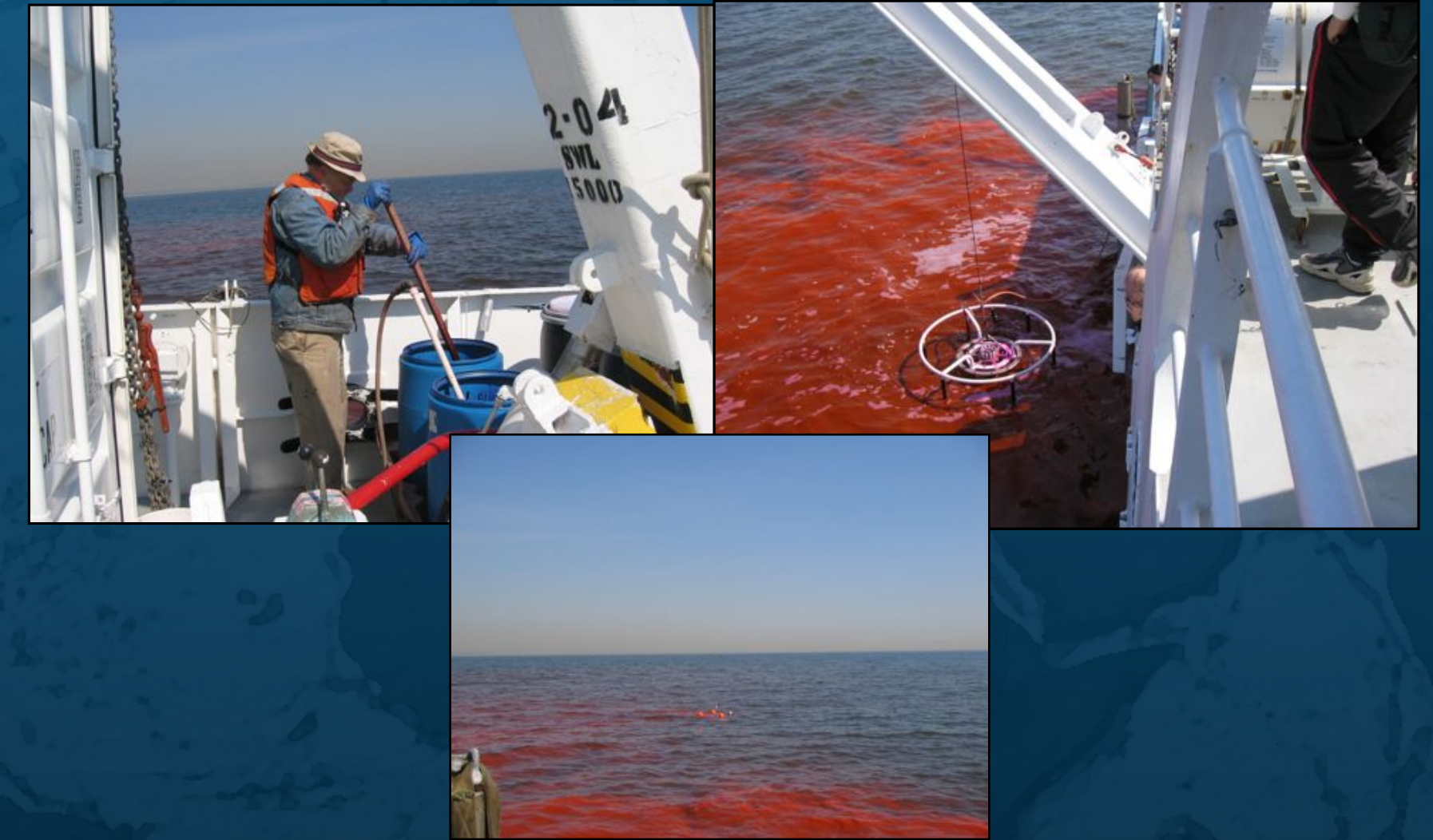
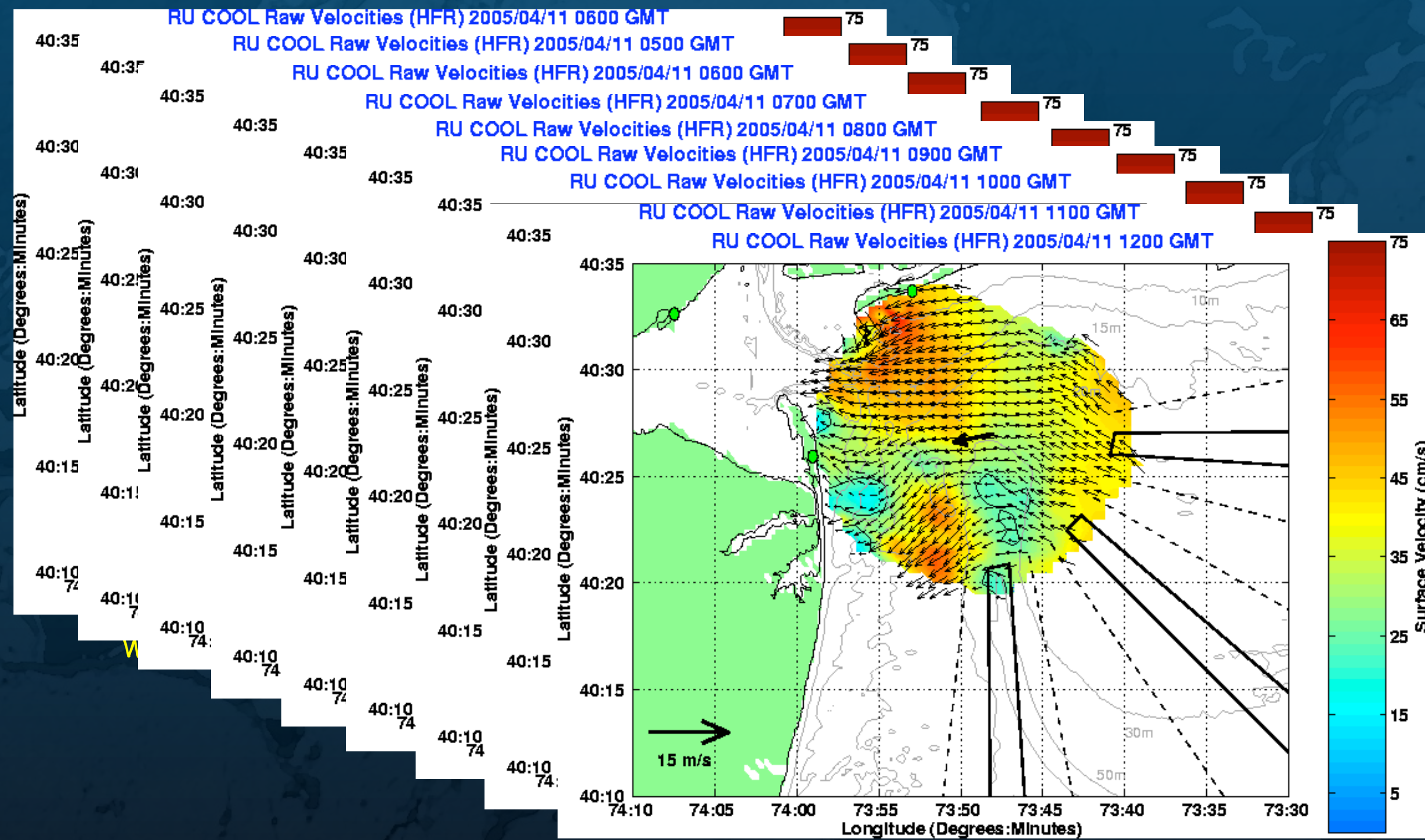
HF RADAR tracking and dye labeling of plume



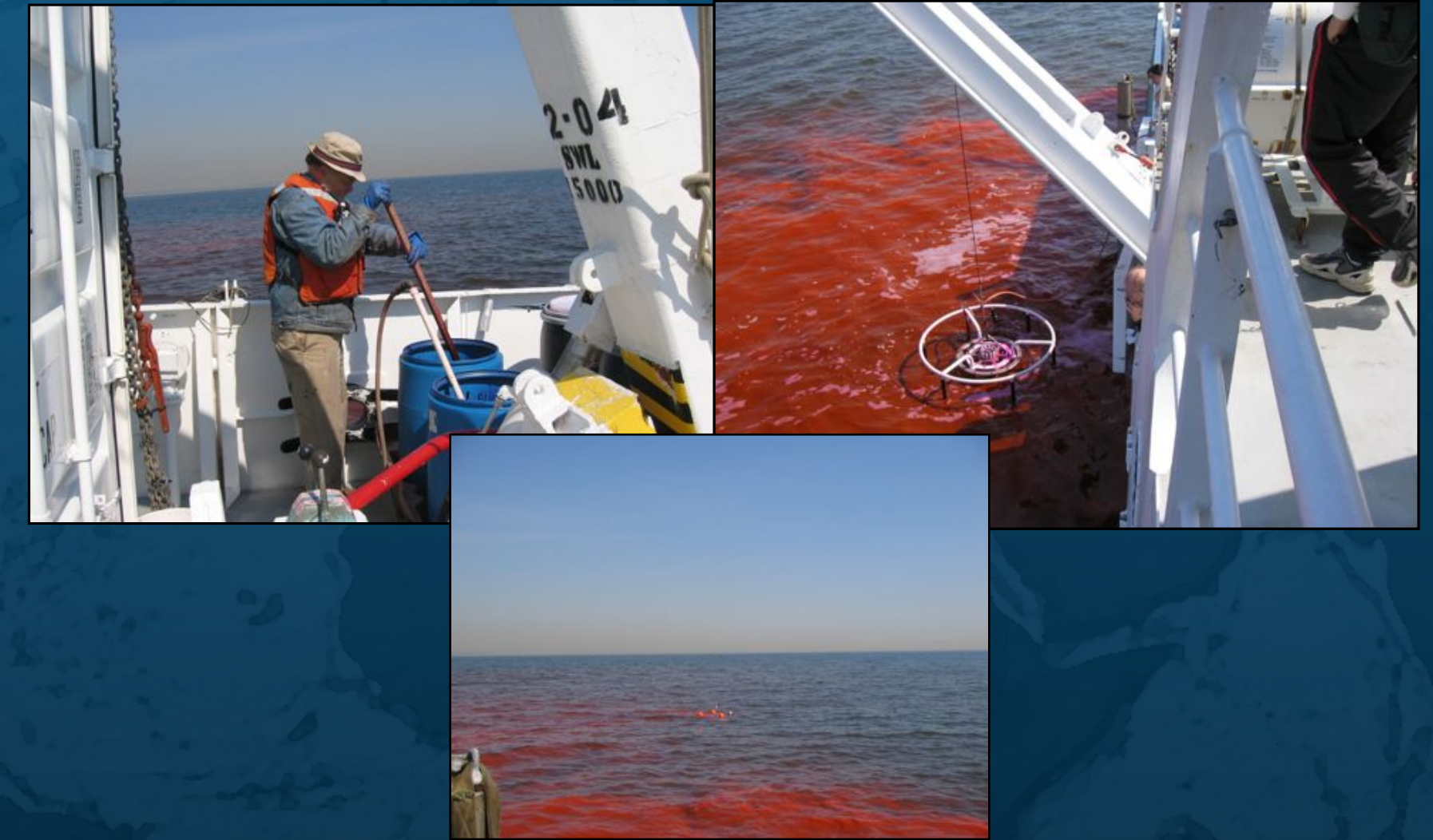
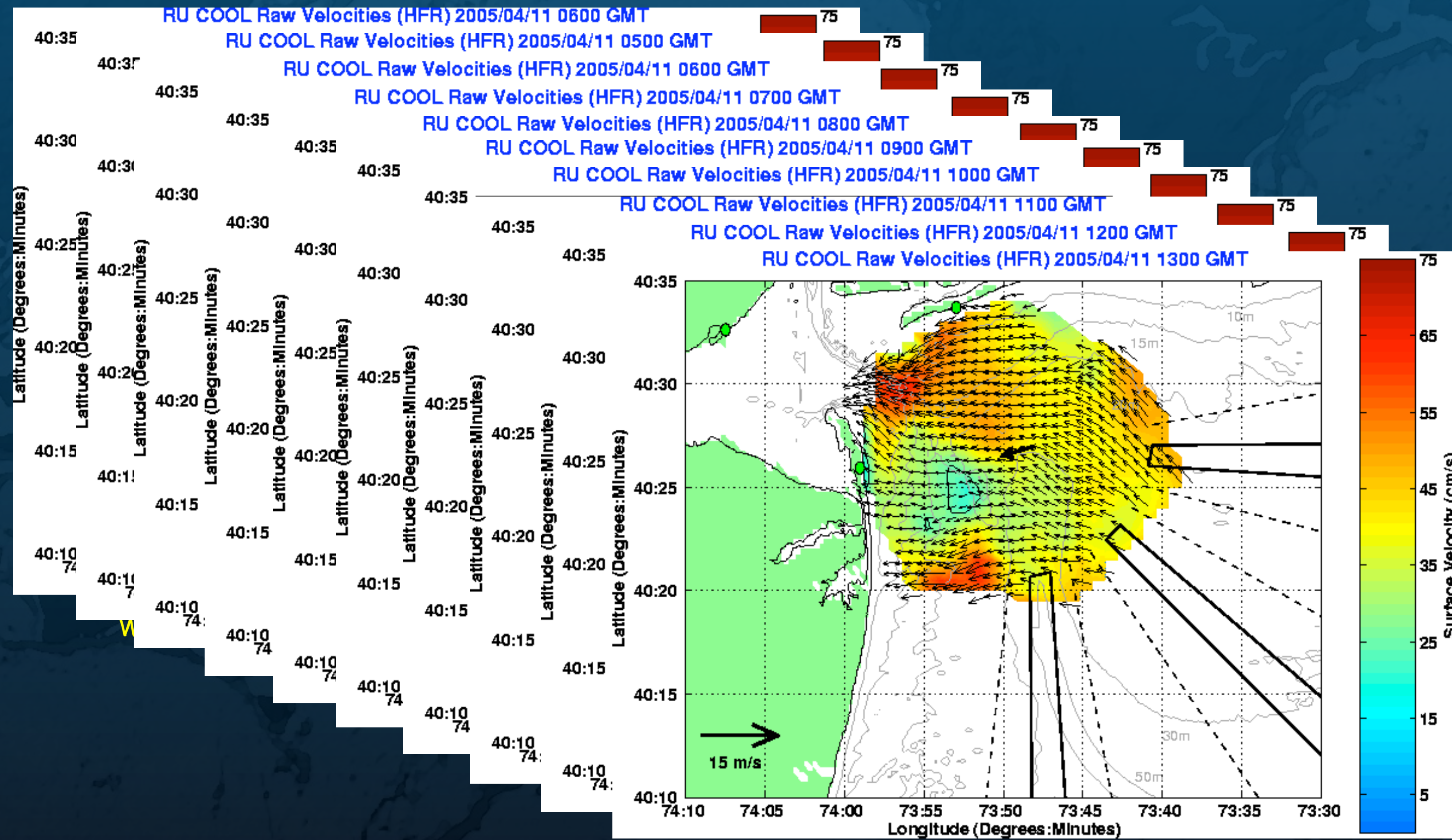
HF RADAR tracking and dye labeling of plume



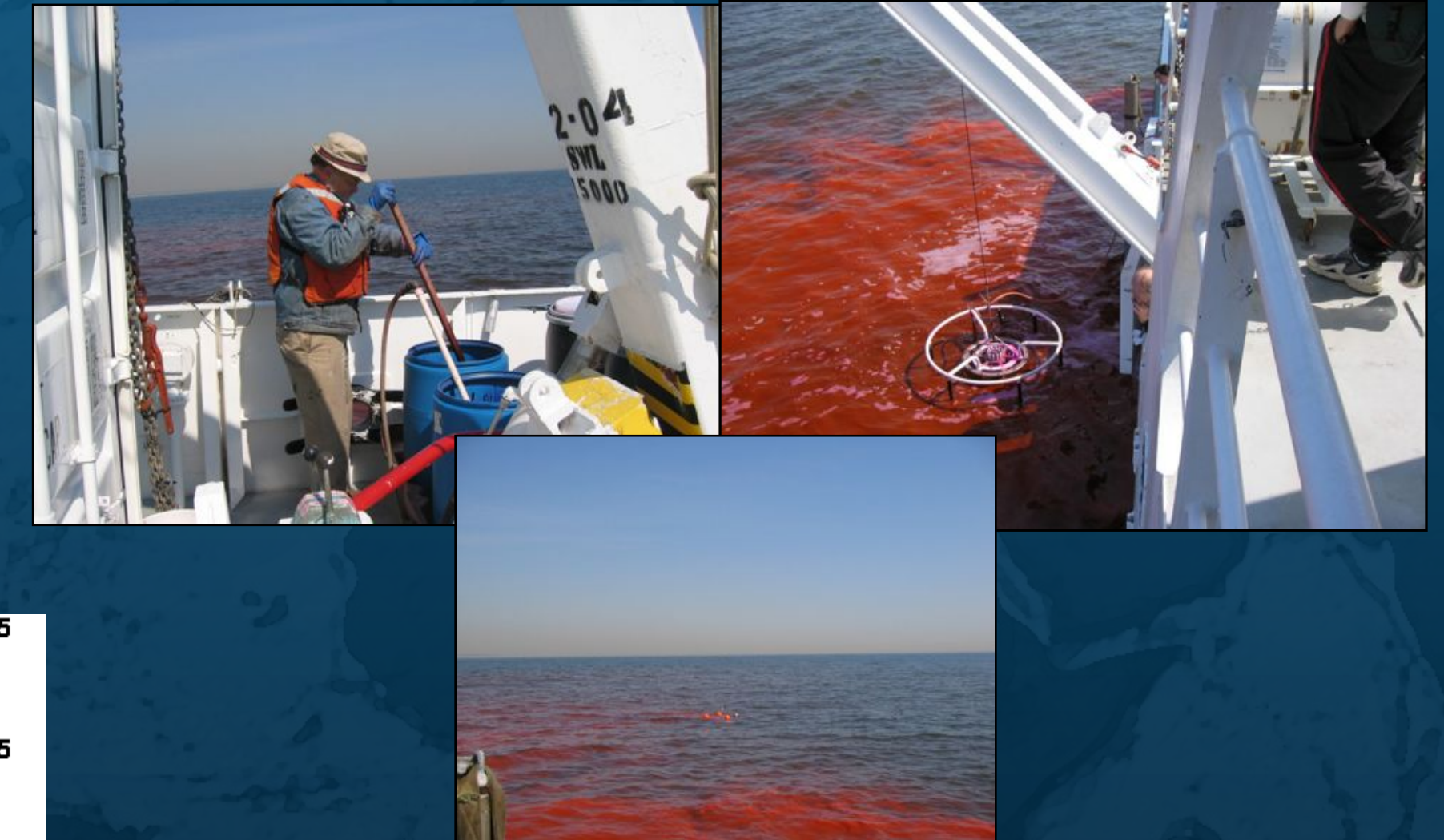
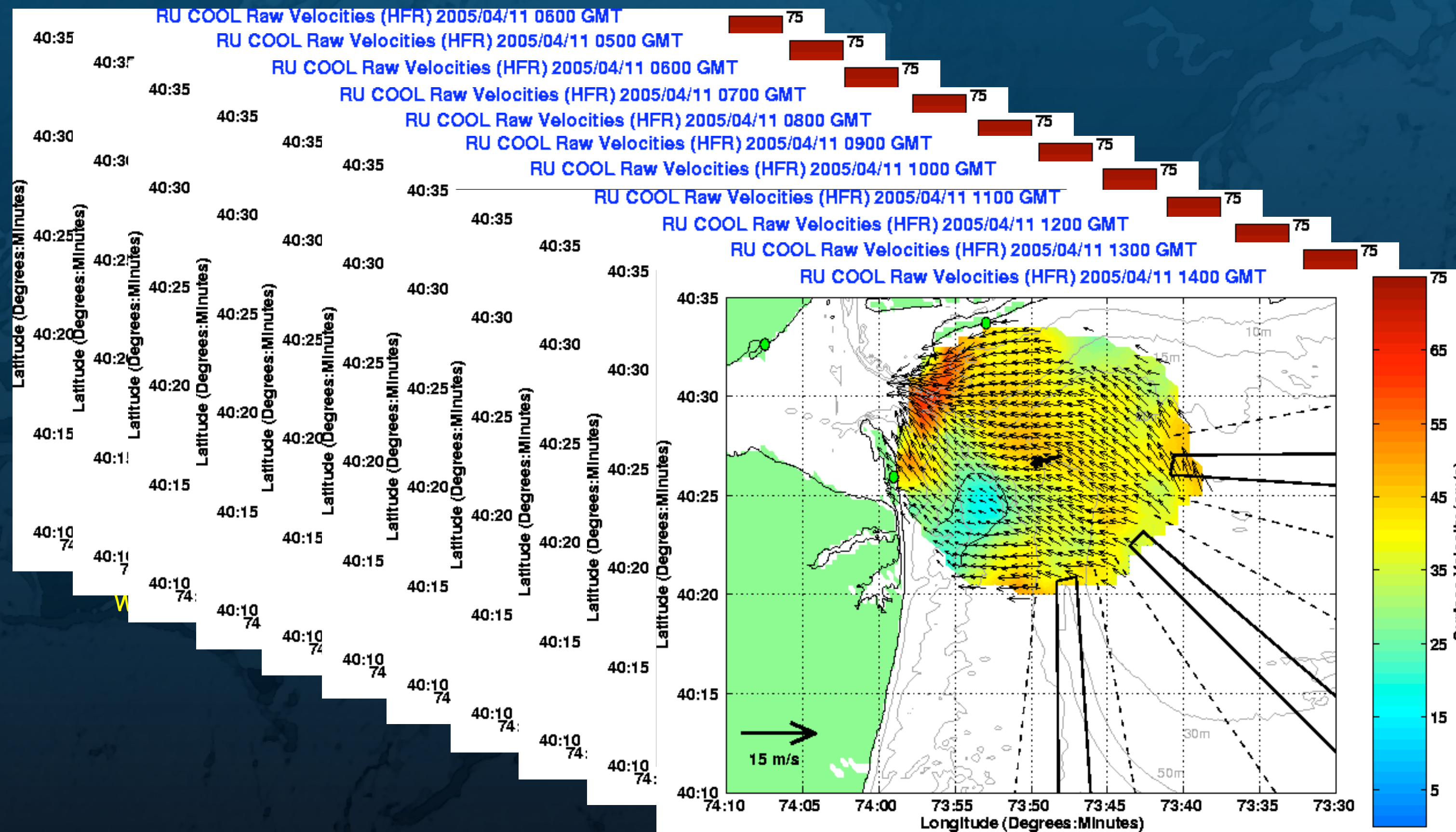
HF RADAR tracking and dye labeling of plume



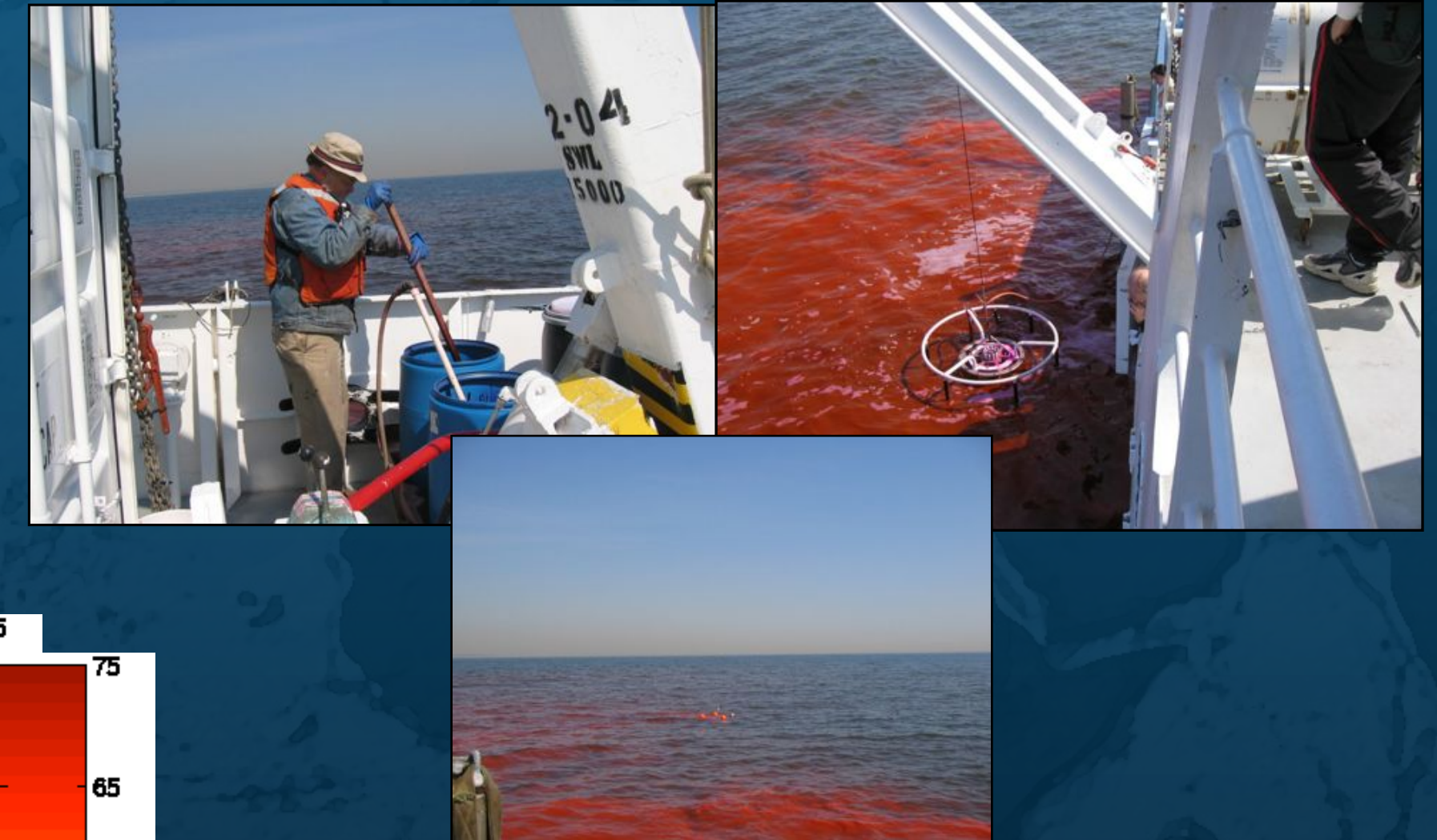
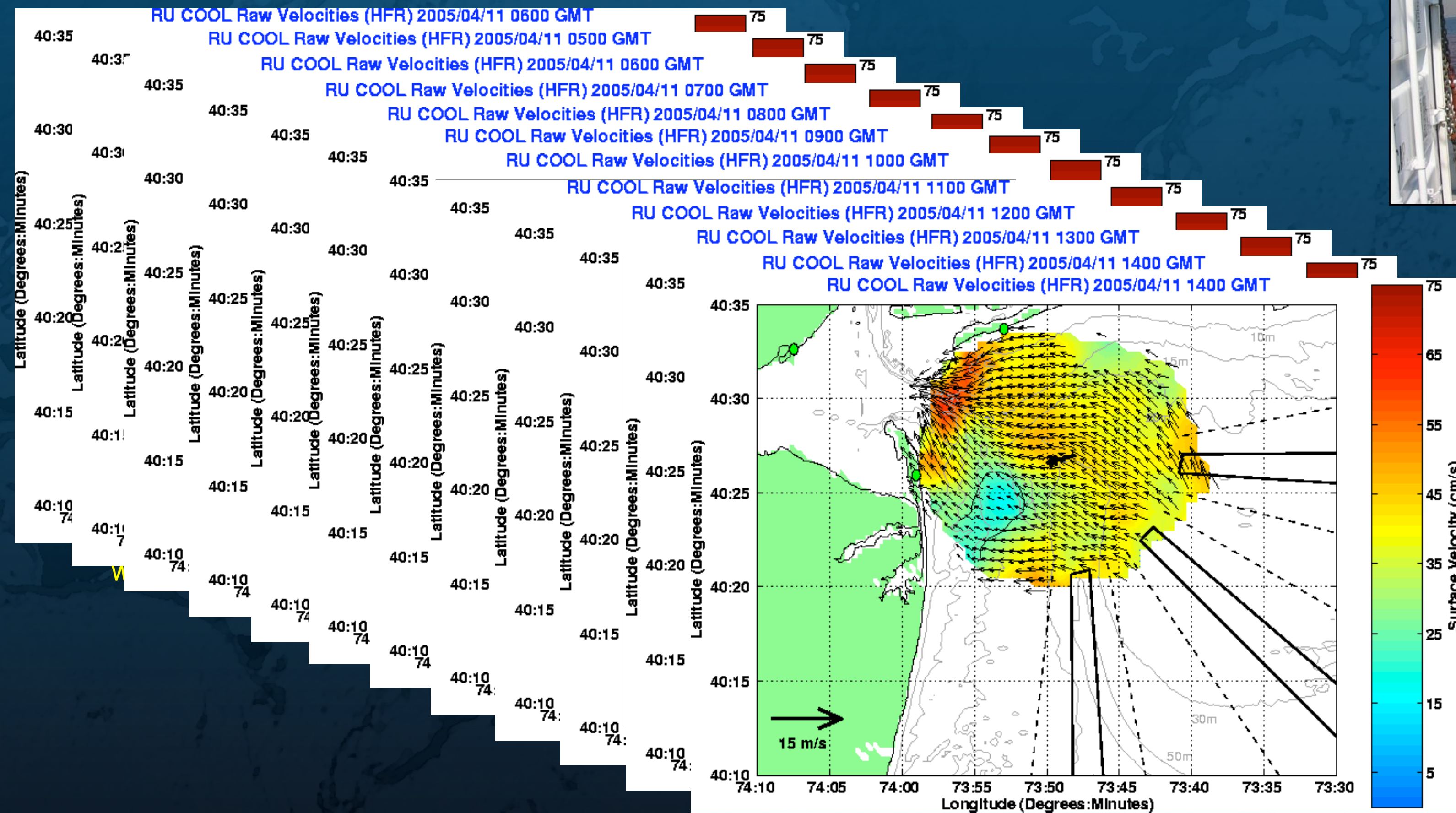
HF RADAR tracking and dye labeling of plume



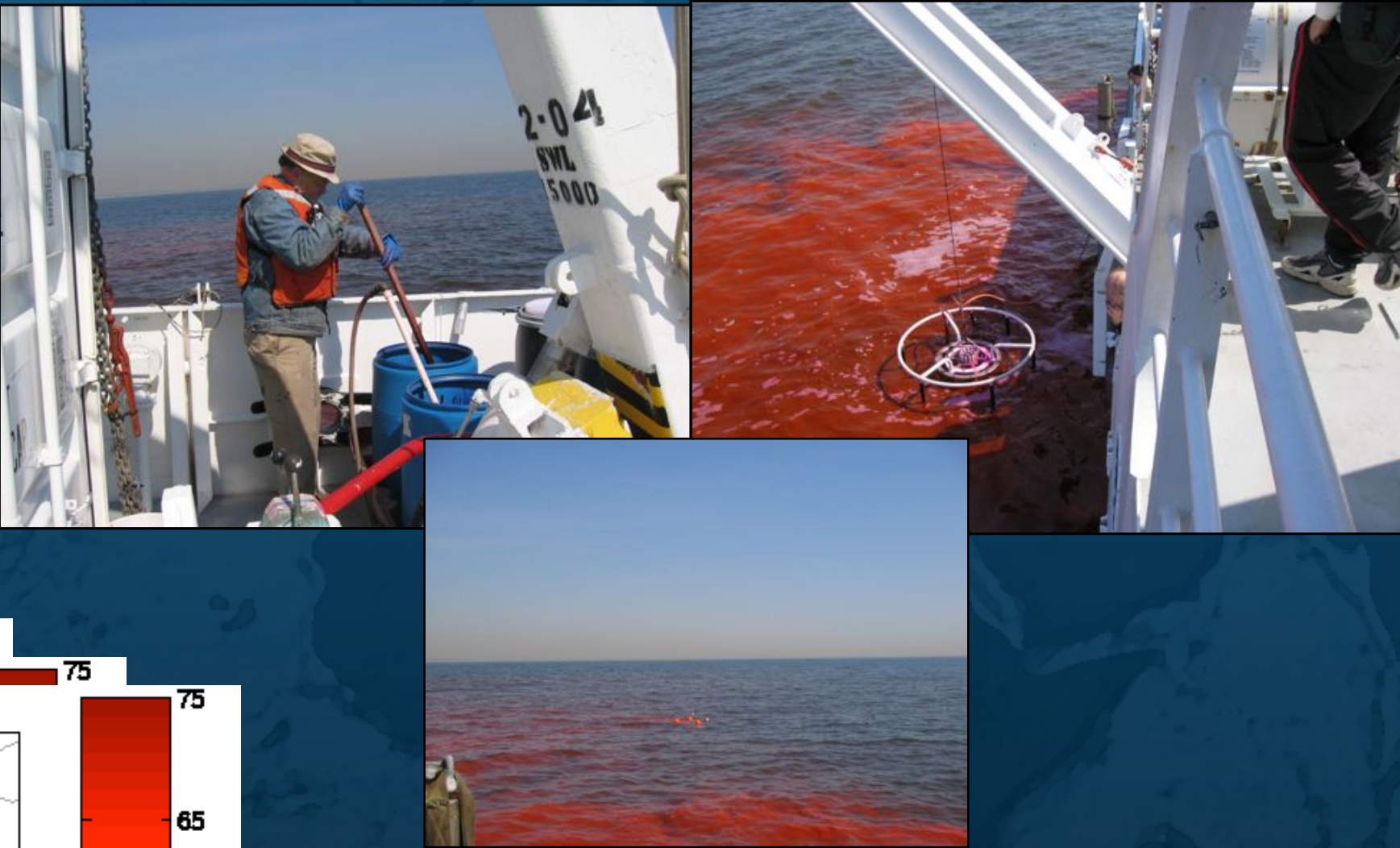
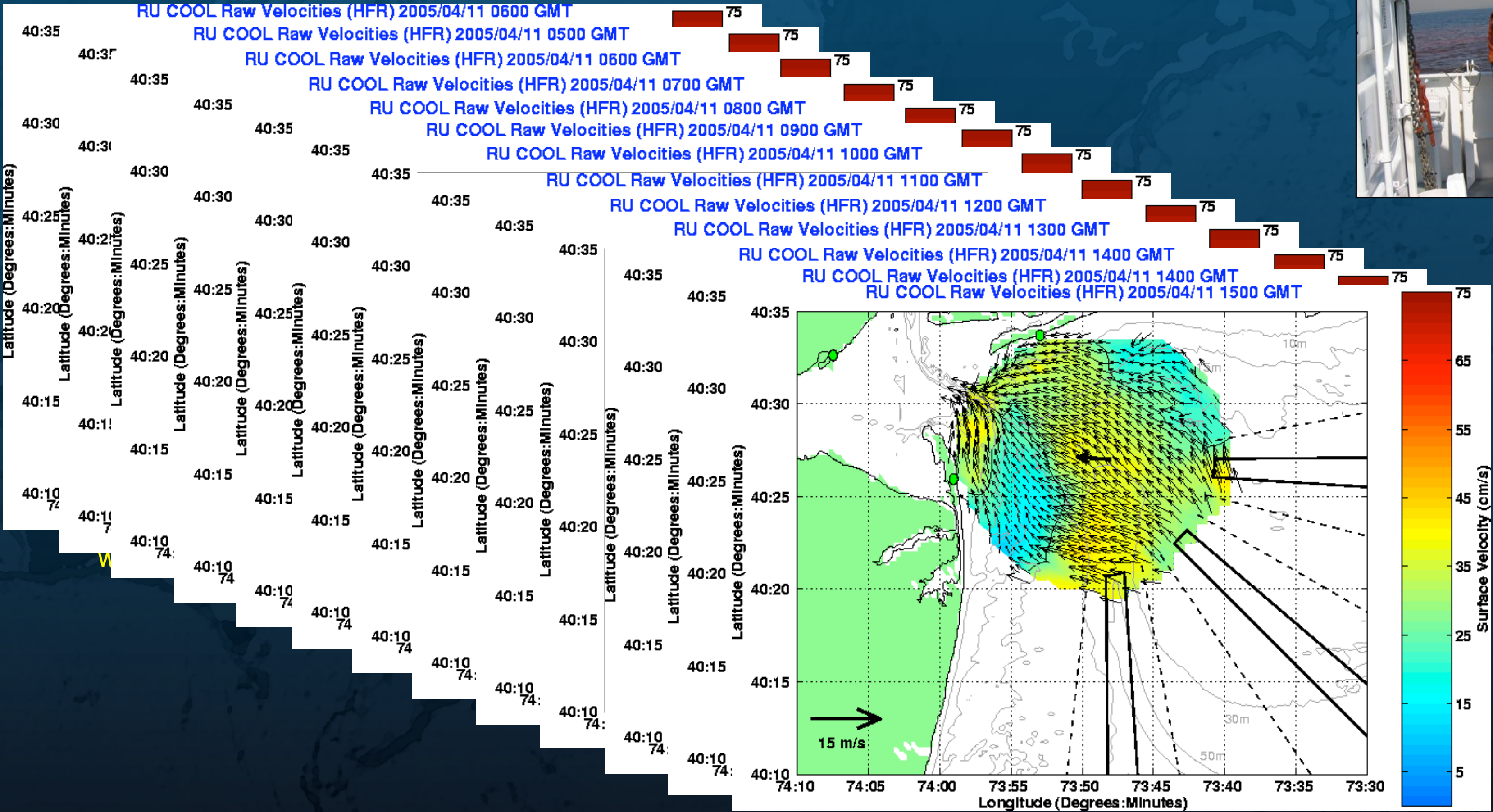
HF RADAR tracking and dye labeling of plume

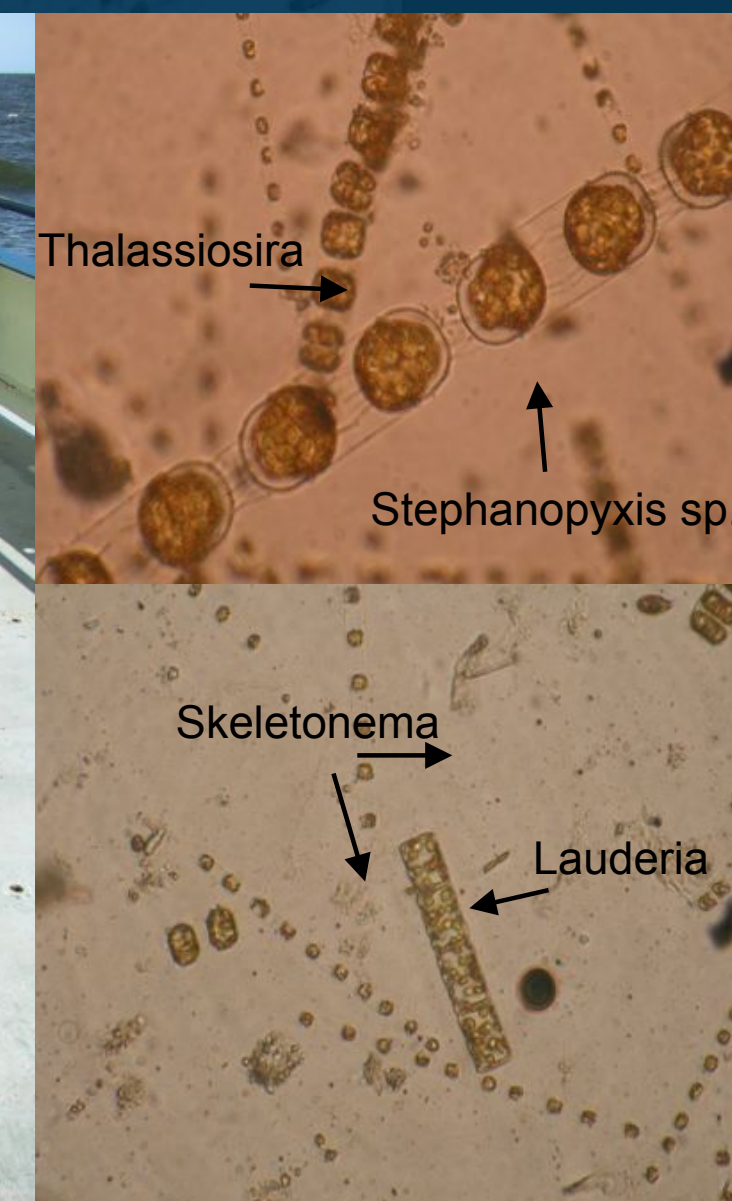
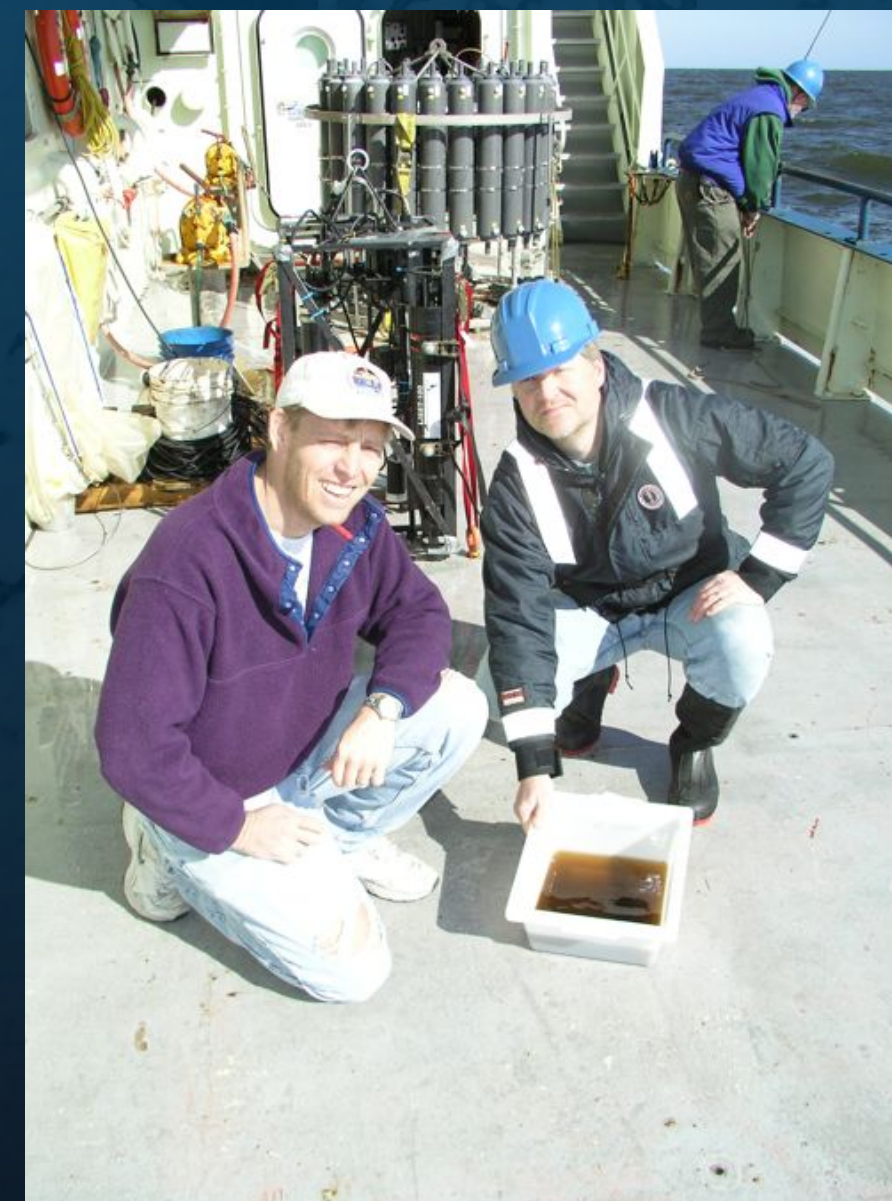
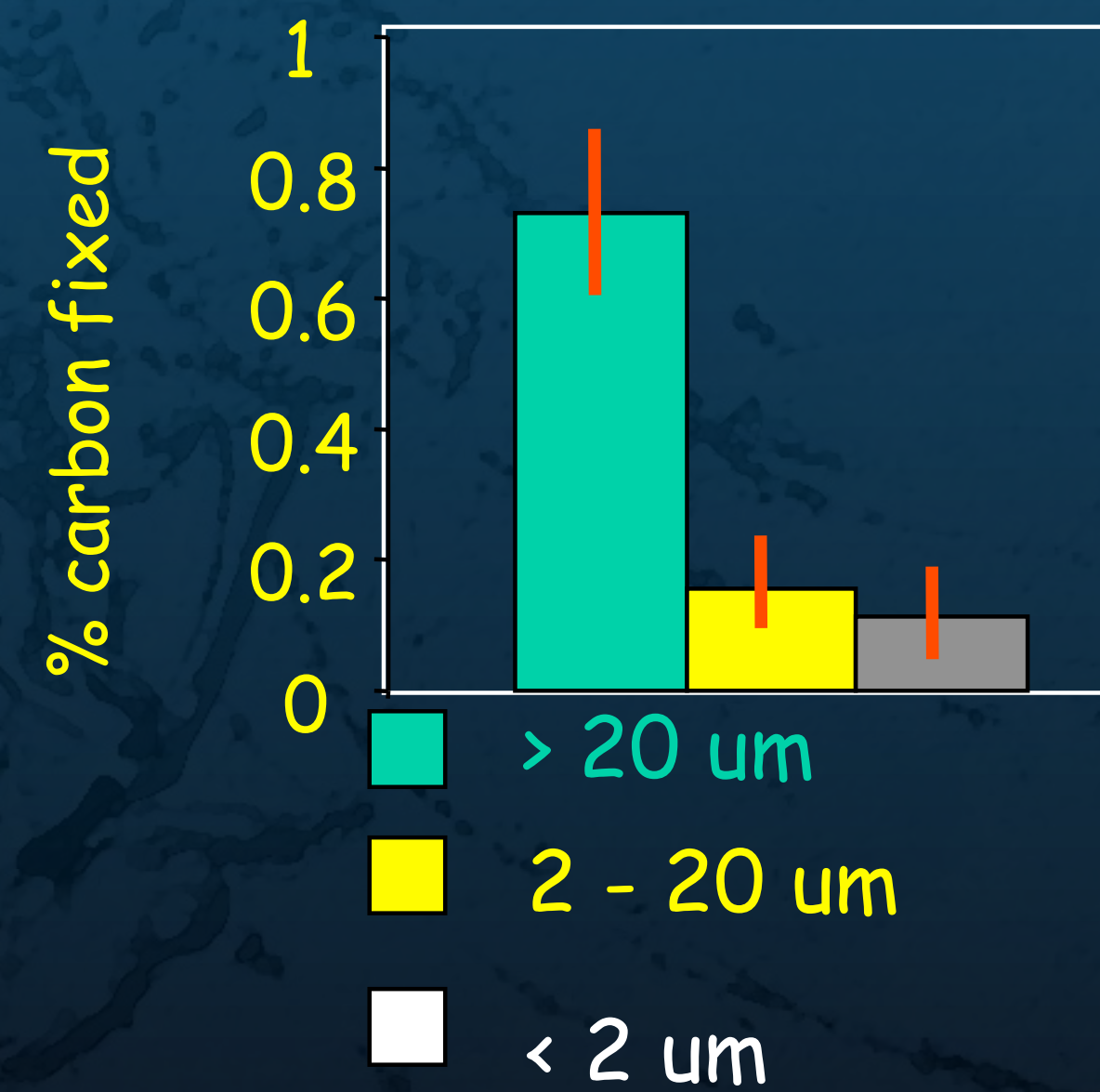
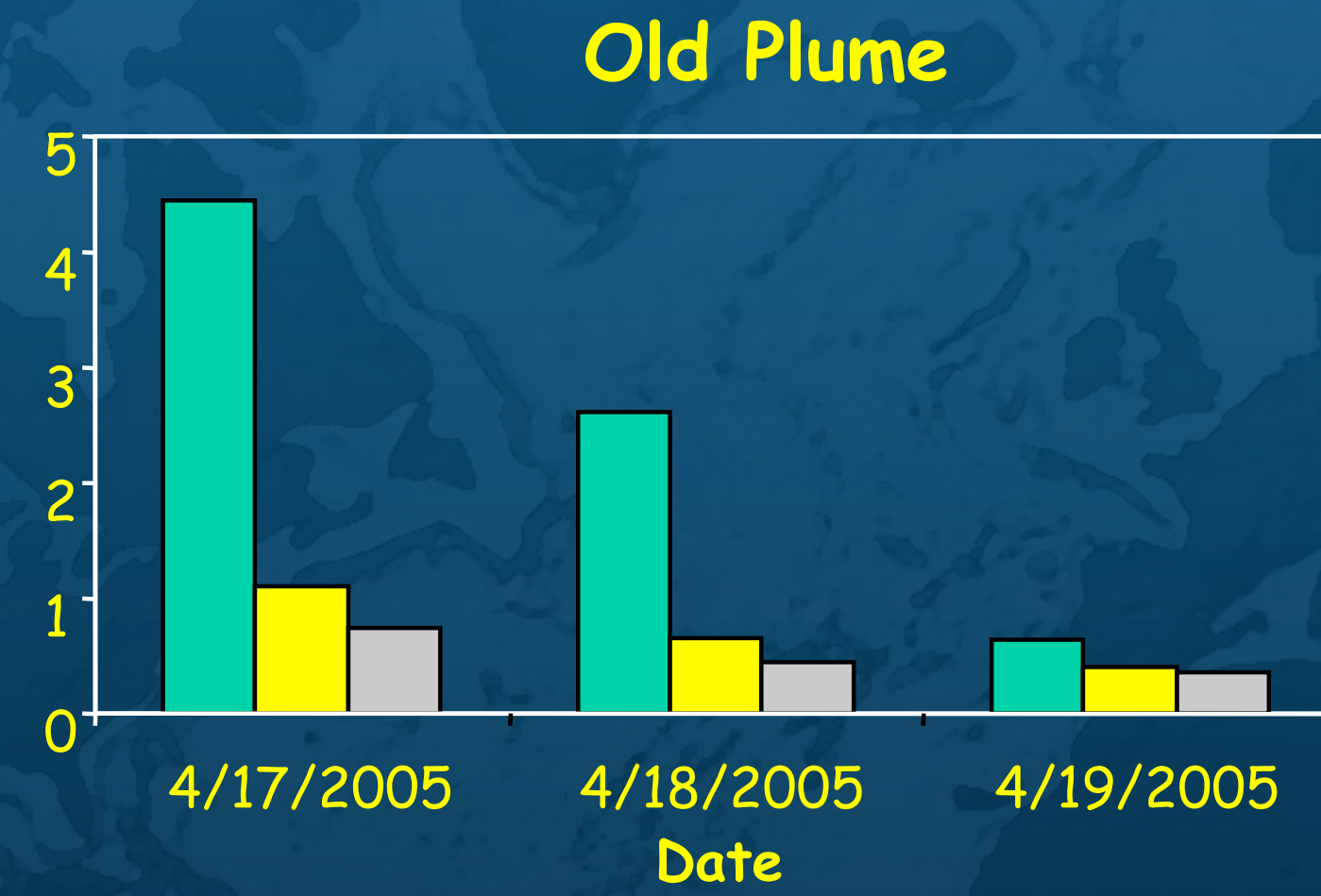
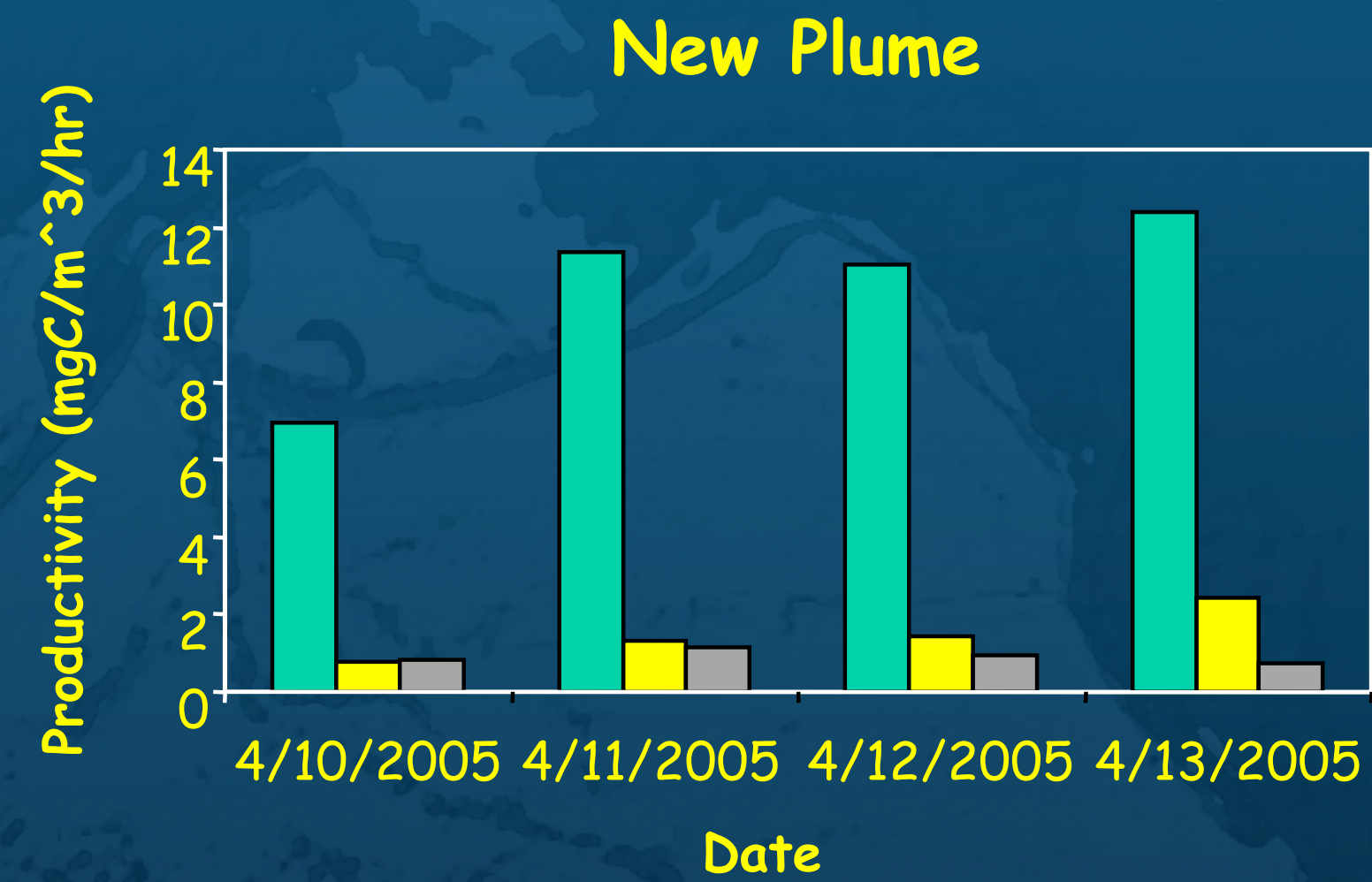


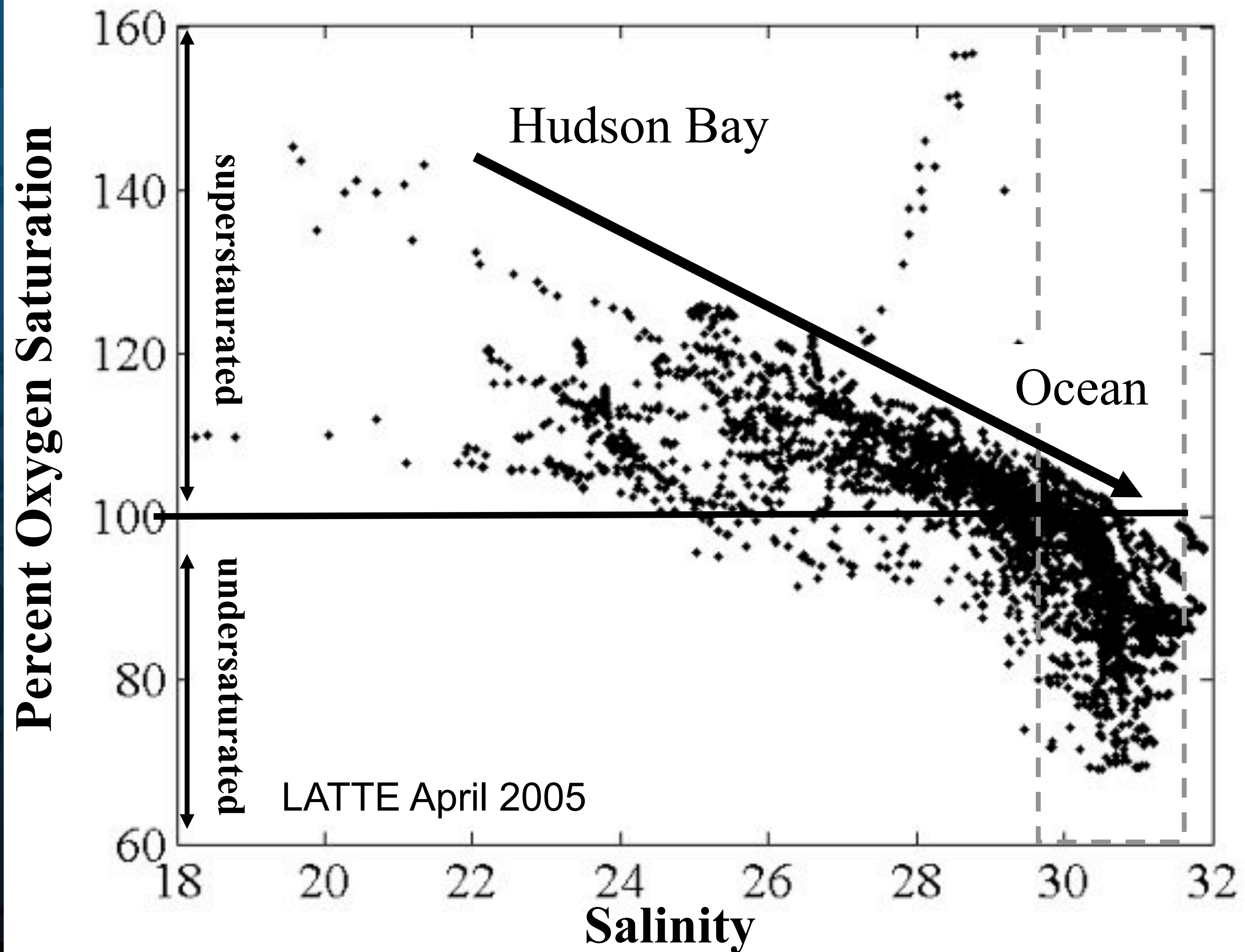
HF RADAR tracking and dye labeling of plume



HF RADAR tracking and dye labeling of plume

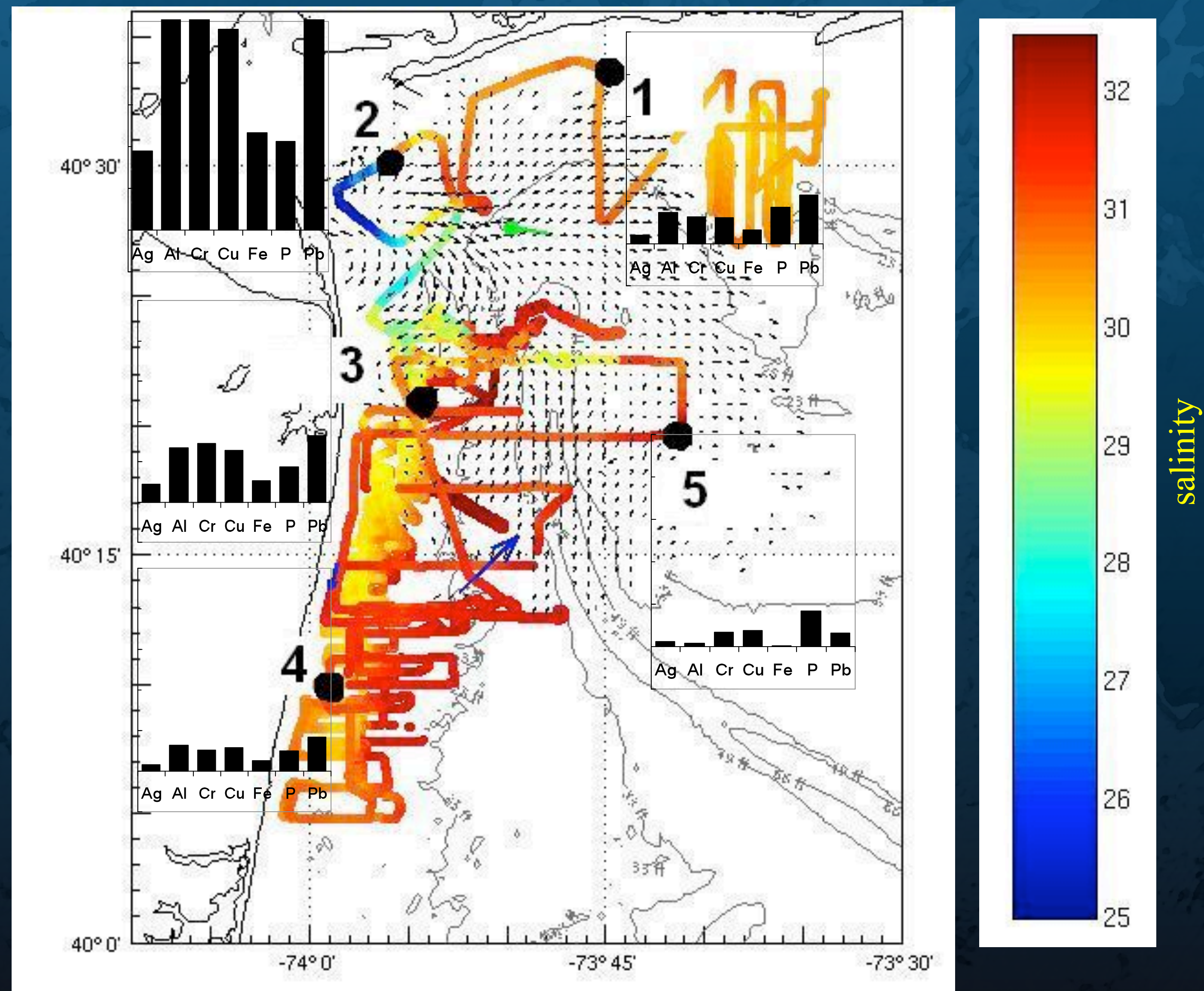




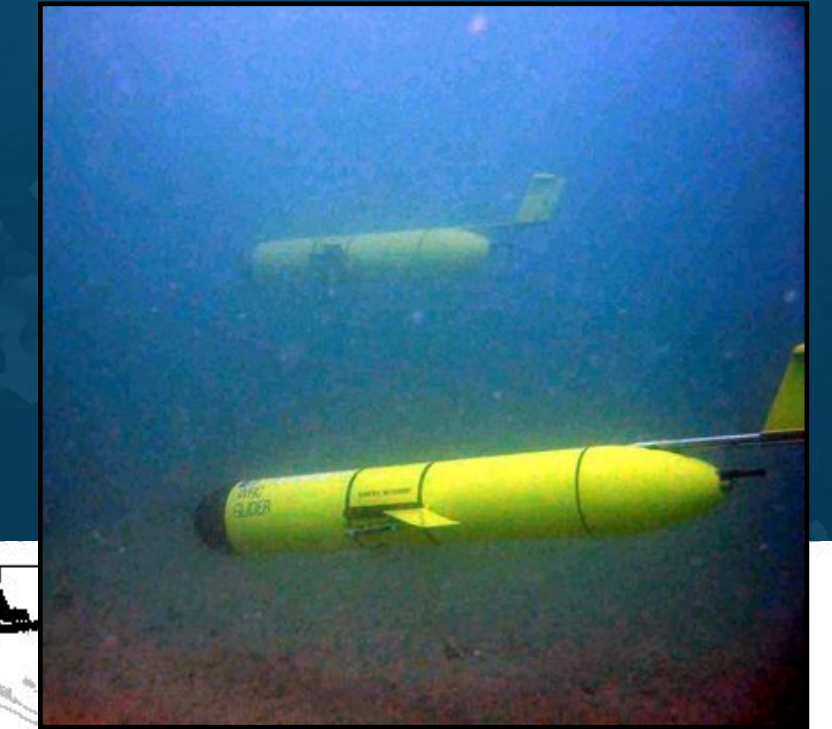
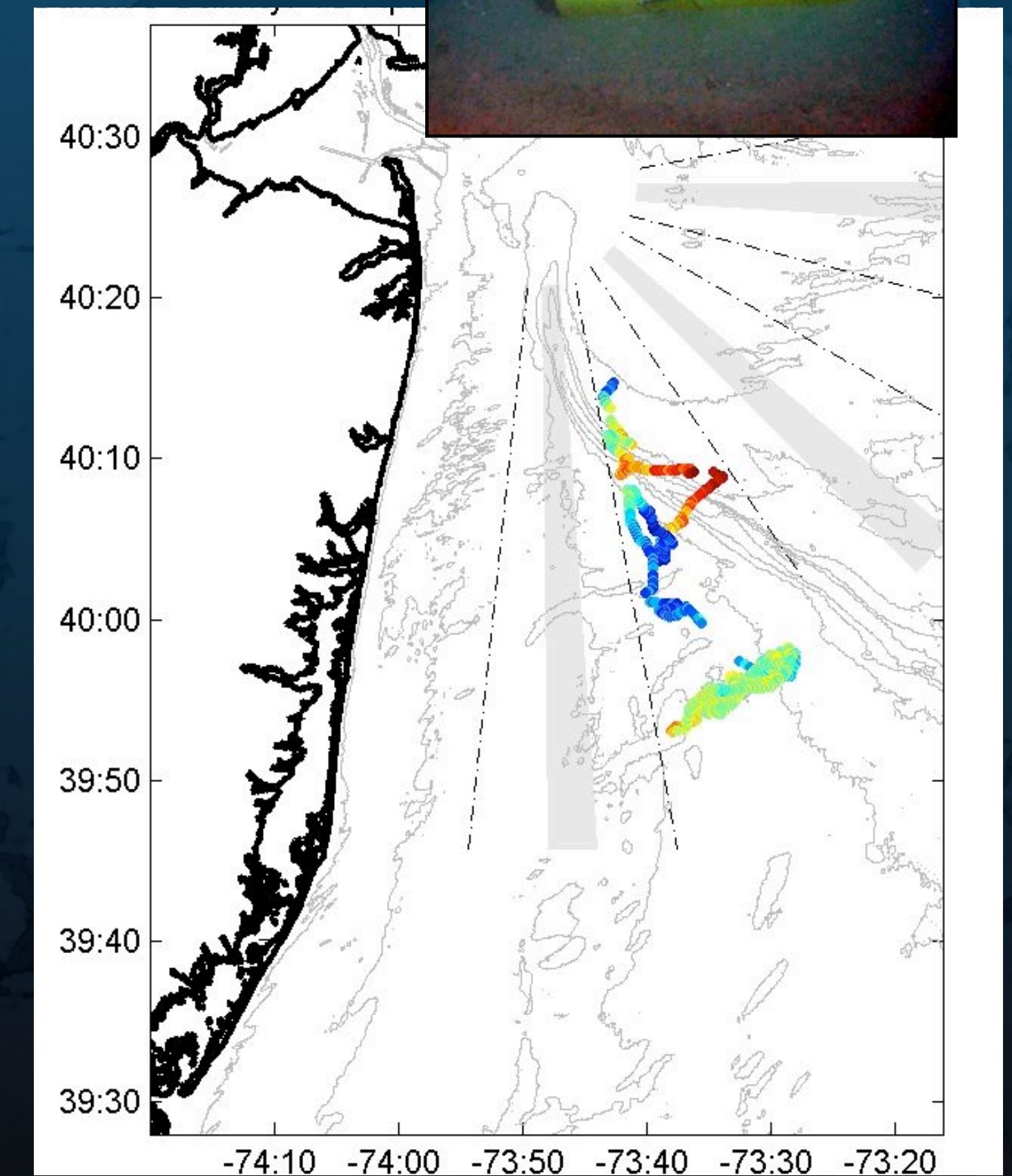
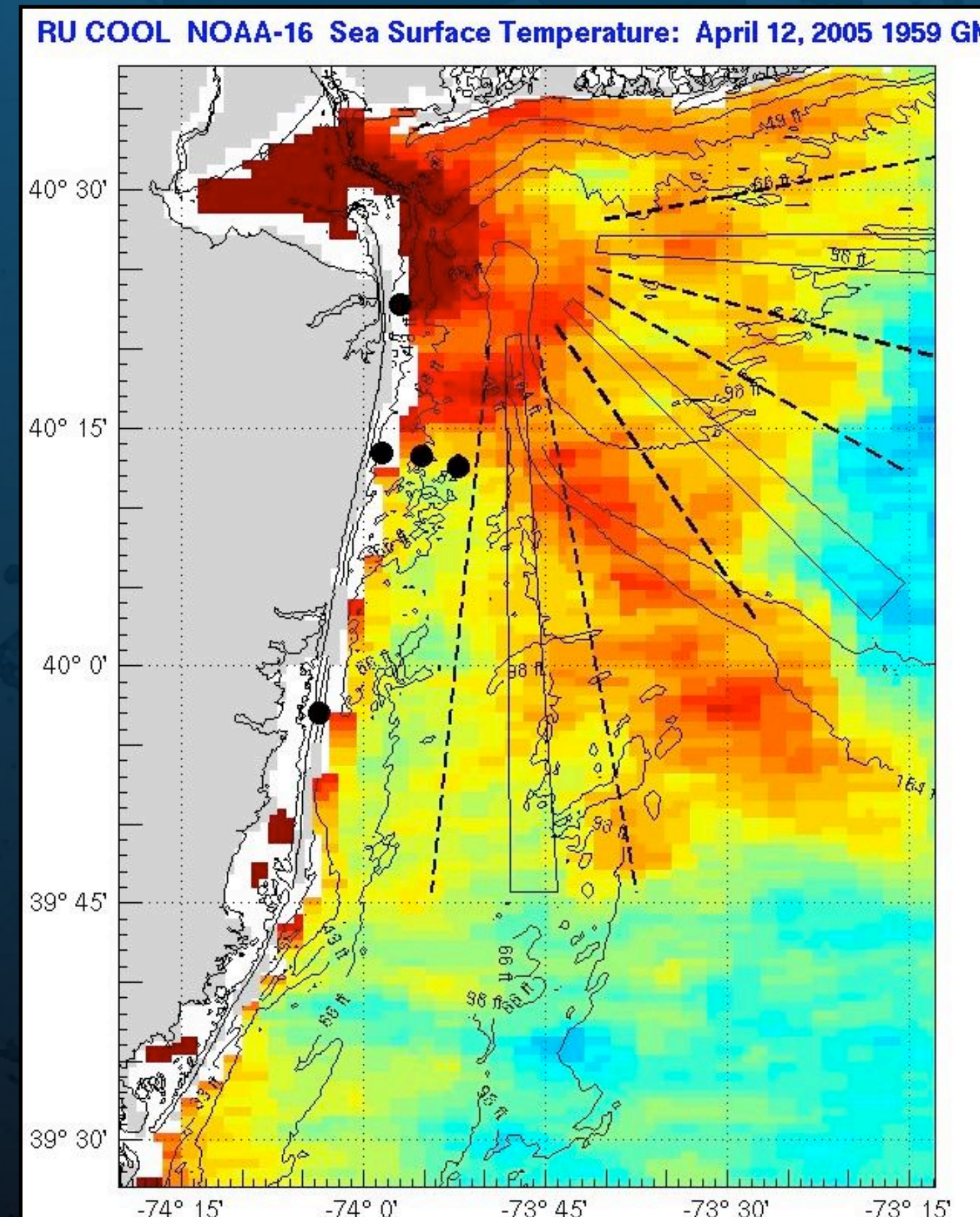
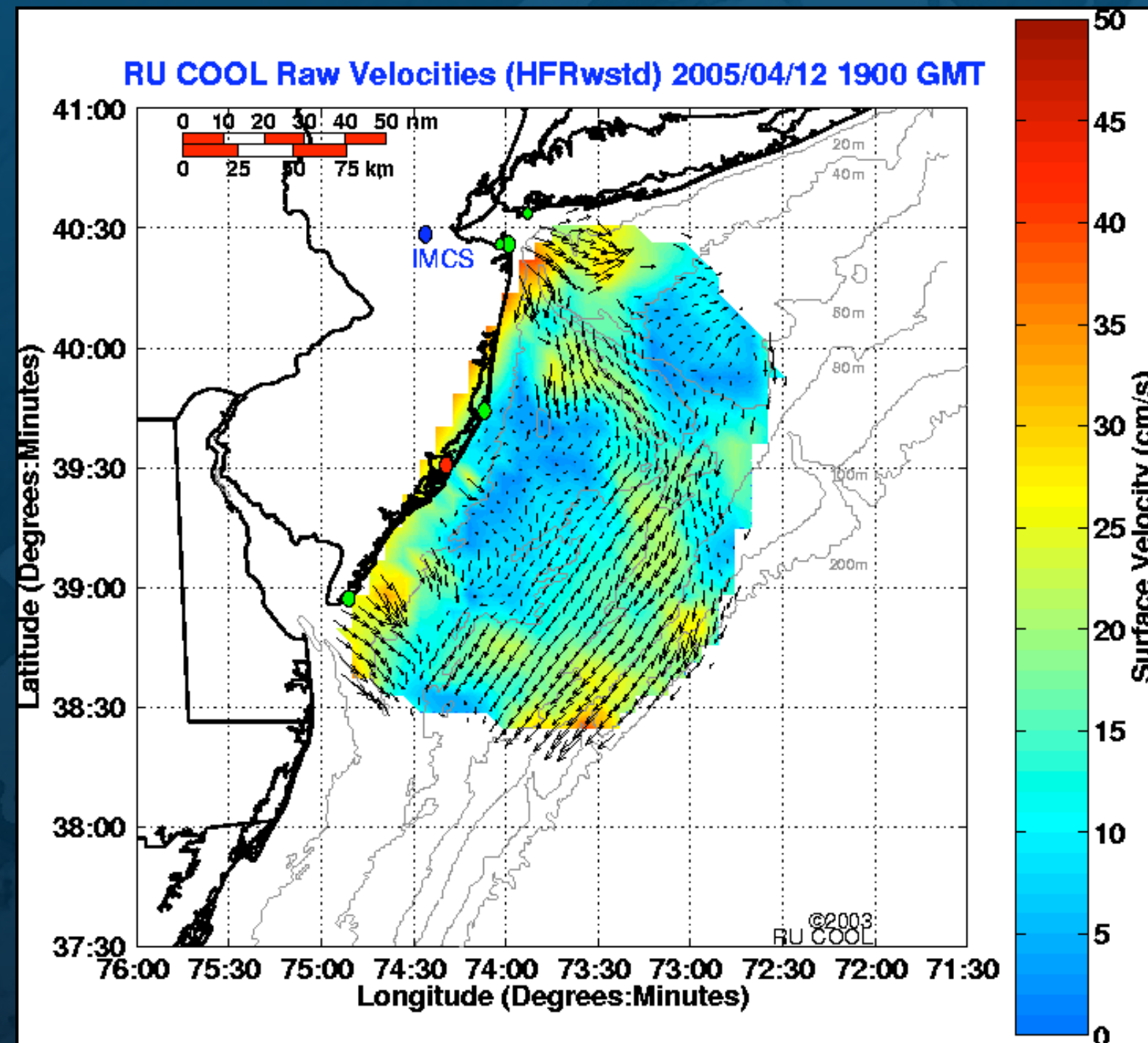


>20 µm particulate trace metals and phosphorus - Ag, Al, Cr, Cu, Fe, P, Pb

50 ng L⁻¹
(Al, Fe, P µg L⁻¹;
Ag x 10, Al x 5, P x 10)



Freshwater Plume Moves Out Across the Shelf: Hudson Shelf Valley



LaTTE 2005 --Post Injection 2 - Final shipboard survey After luring the Cape Hatteras offshore.

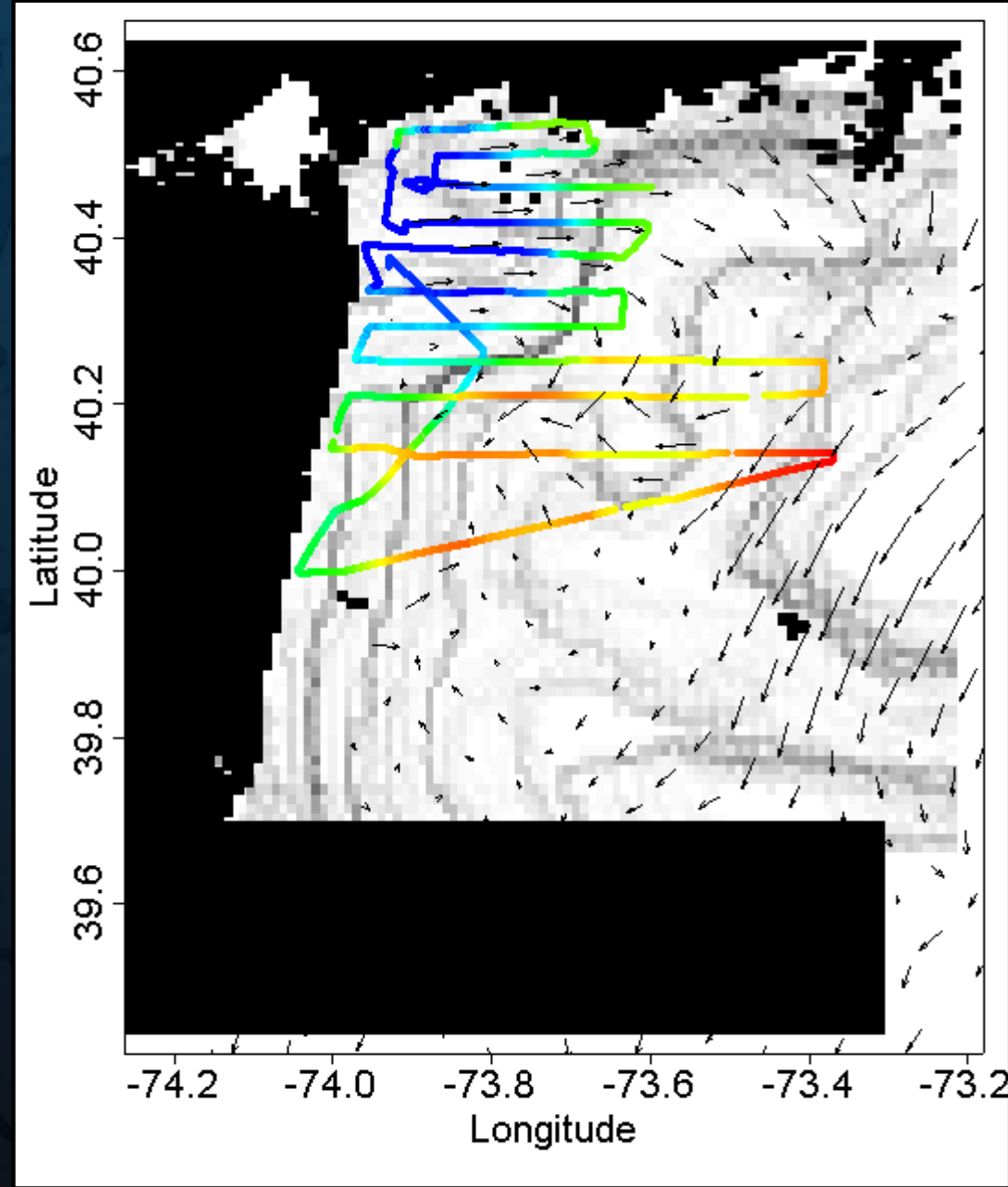
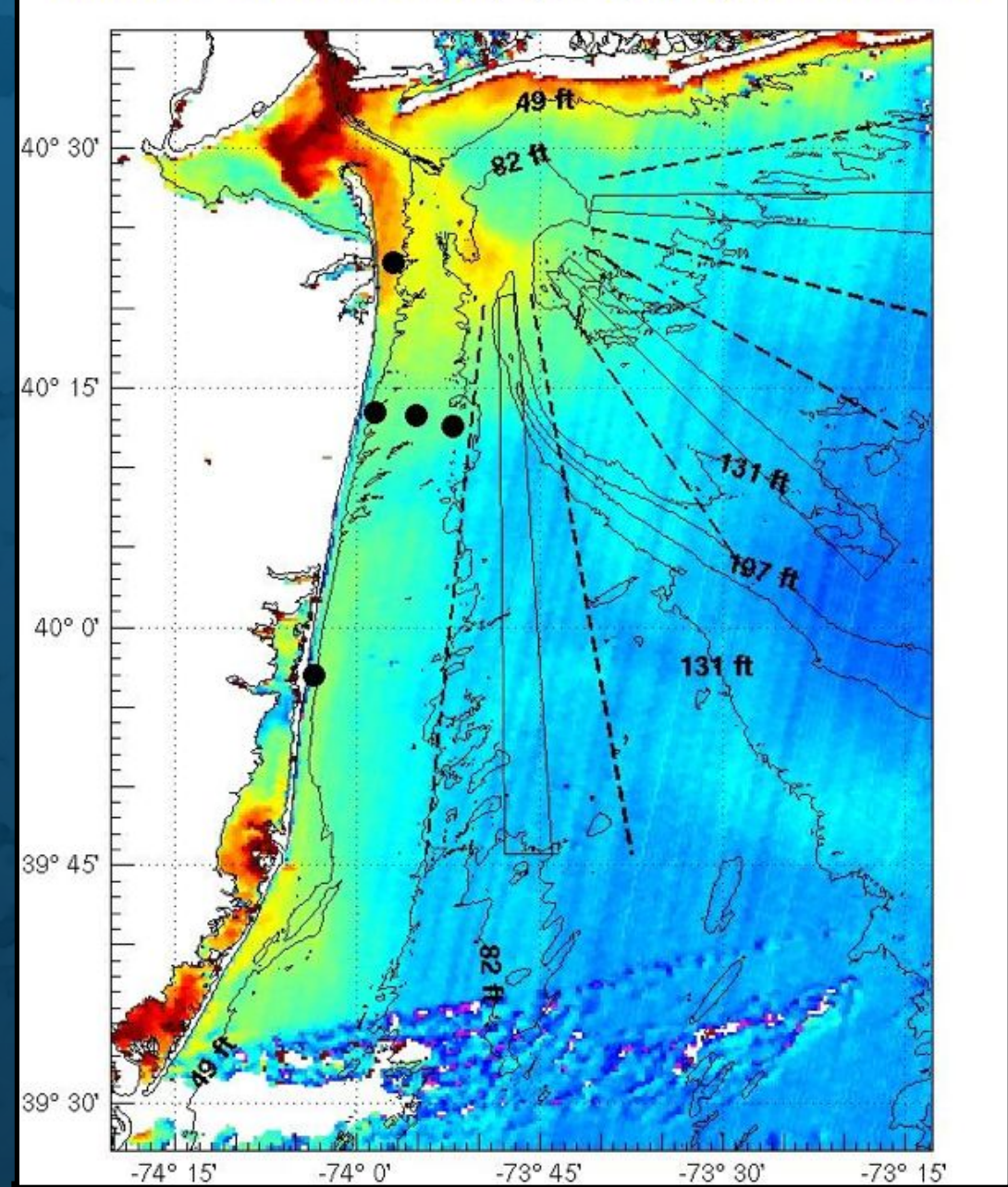


"The survey began on the 'Highway'. We were near the glider when it surfaced. We saw currents ripping southward in a 10 m thick layer of freshwater along the highway -- perhaps the most significant freshwater transport we saw all week."

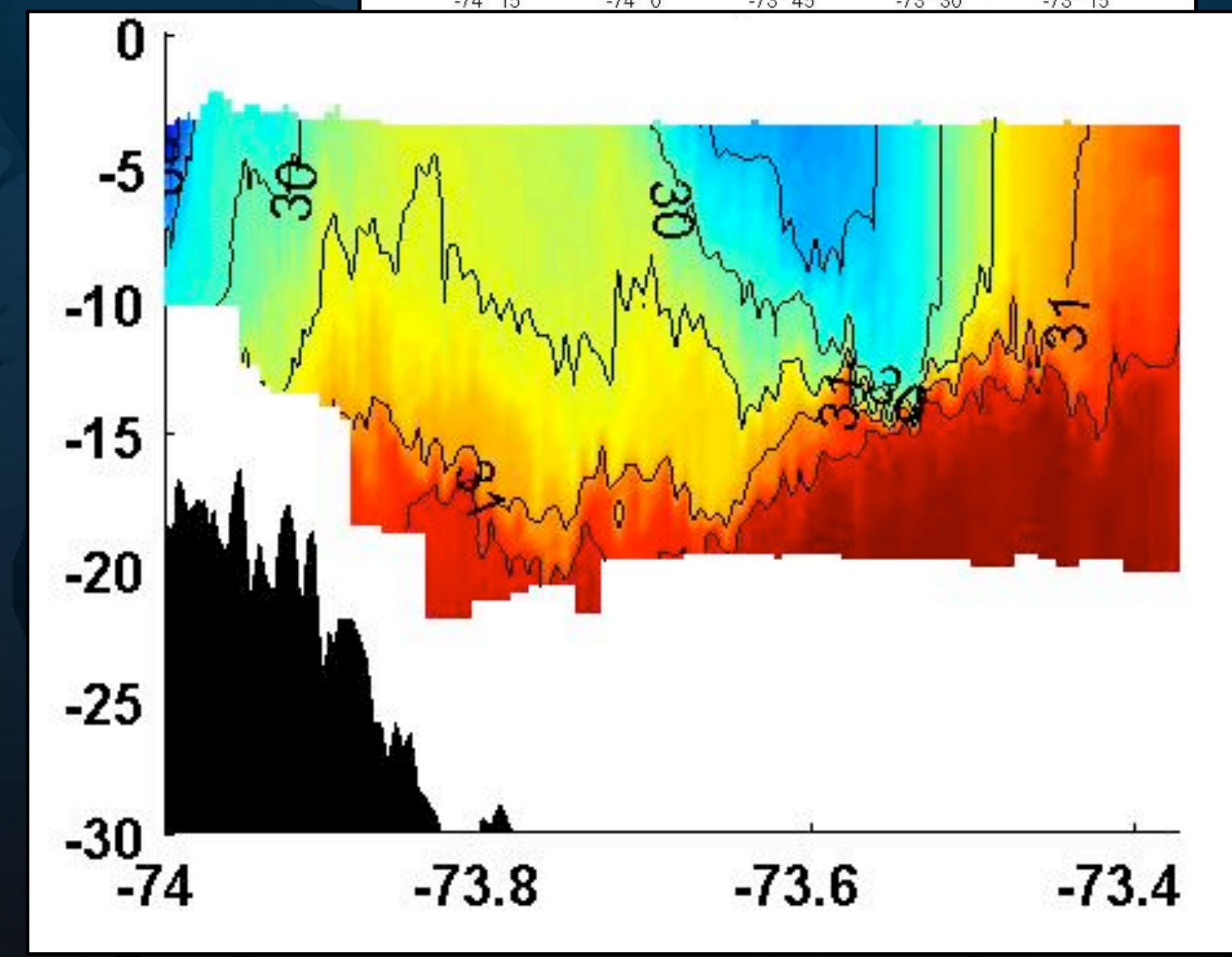
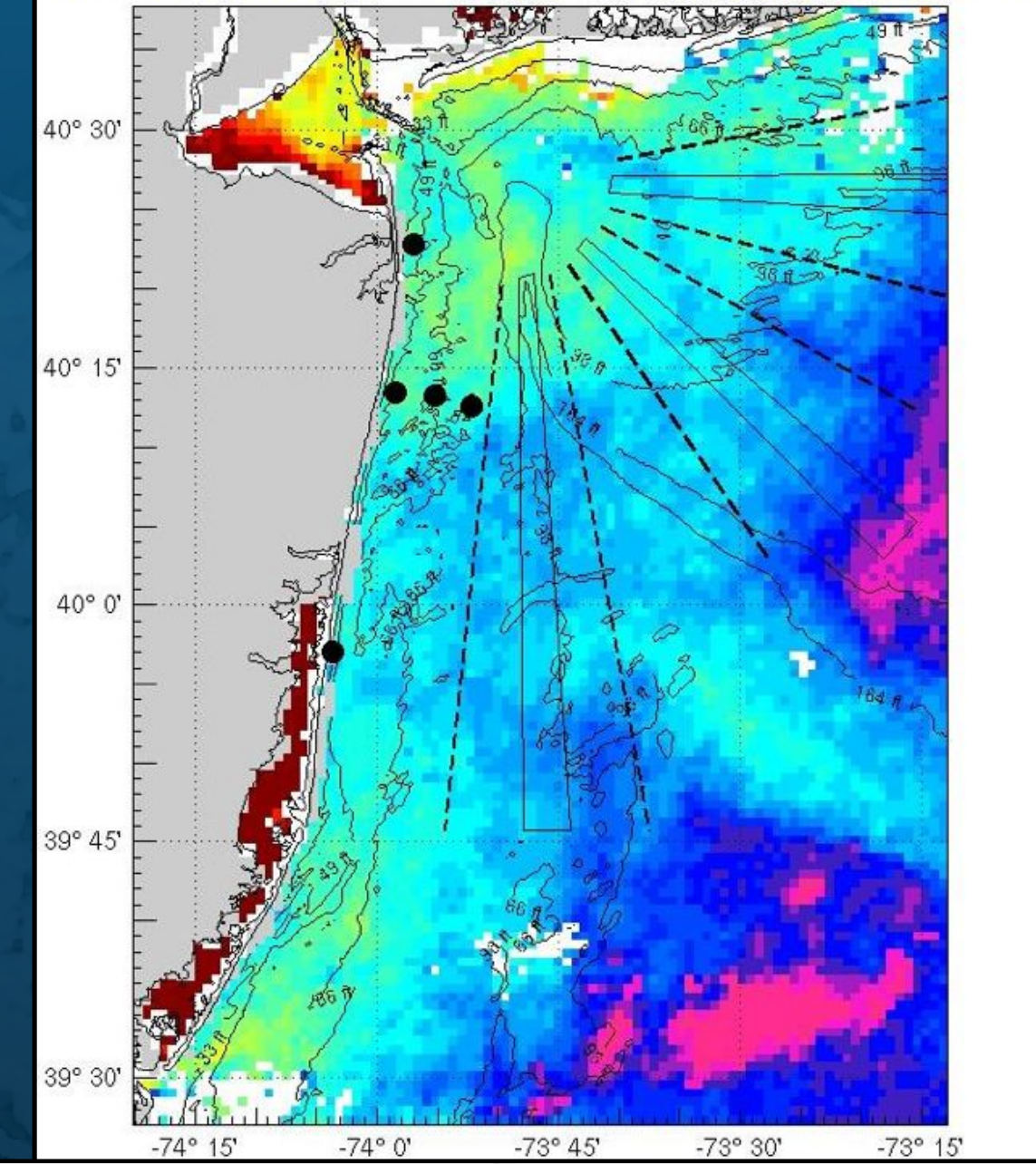
"Perhaps the most perplexing to me is 'the Highway' and why there has been a lack of a strong coastally trapped flow this week."

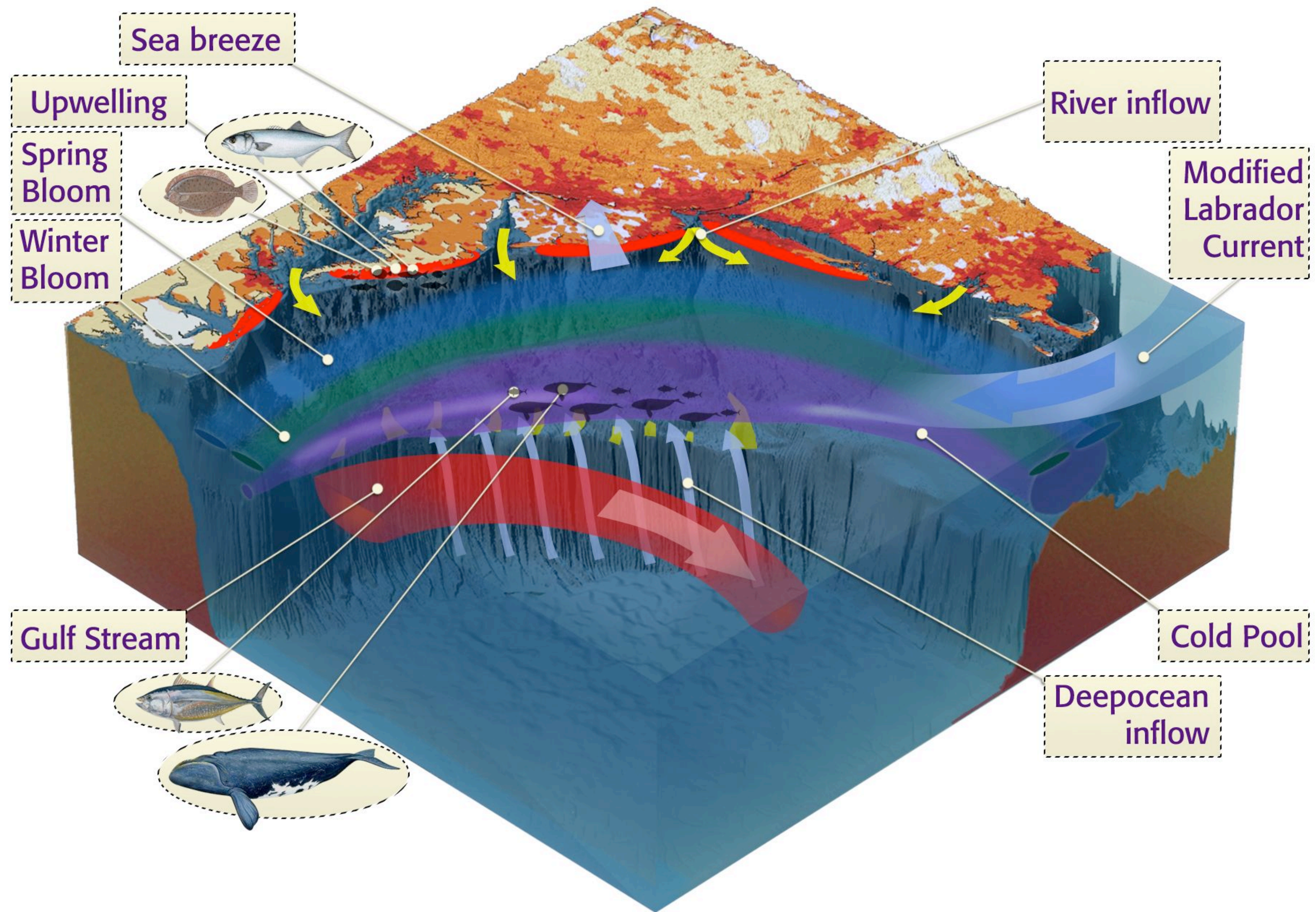
--- Bob Chant aboard the Cape Hatteras, April 21, 2005

RU COOL Oceansat Chlorophyll: April 13, 2005 1713 GMT

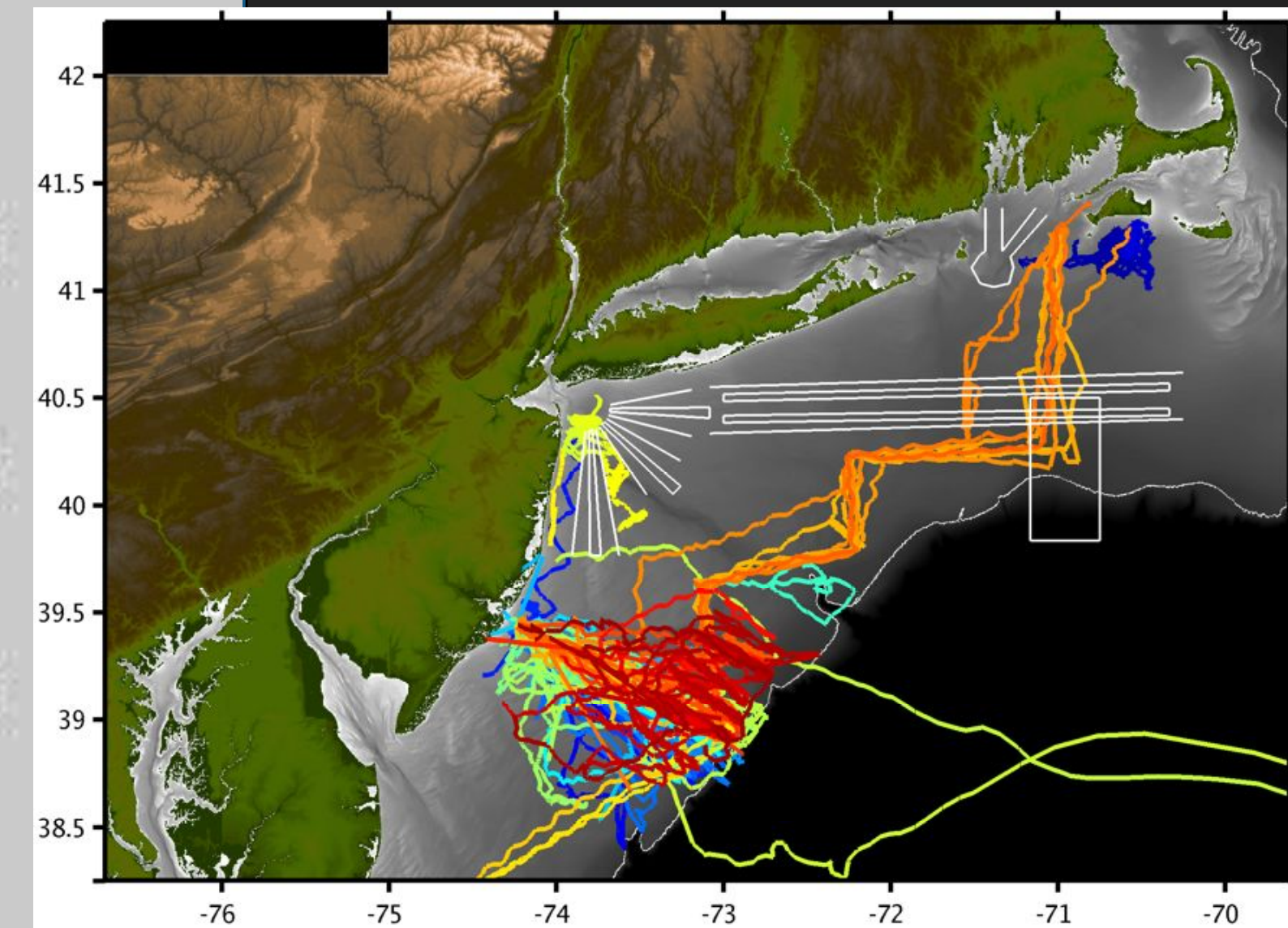
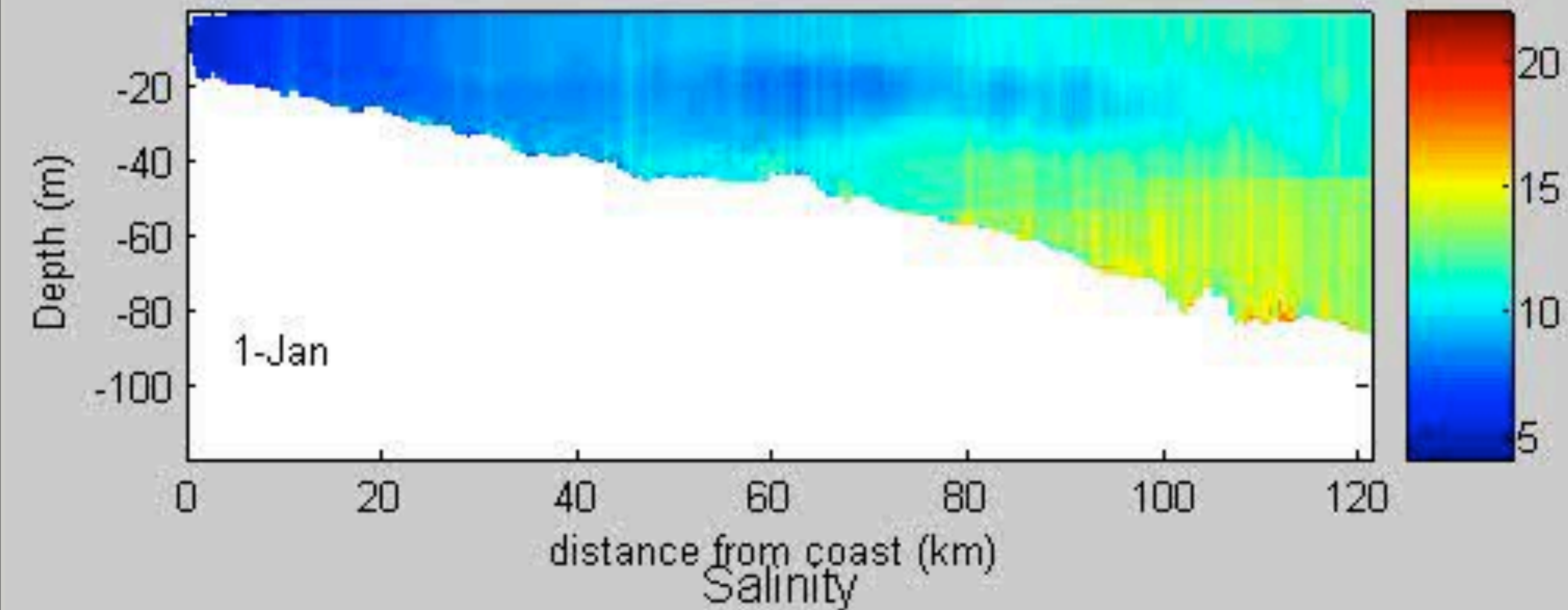


RU COOL NOAA-17 Sea Surface Temperature: April 13, 2005 1546 GMT





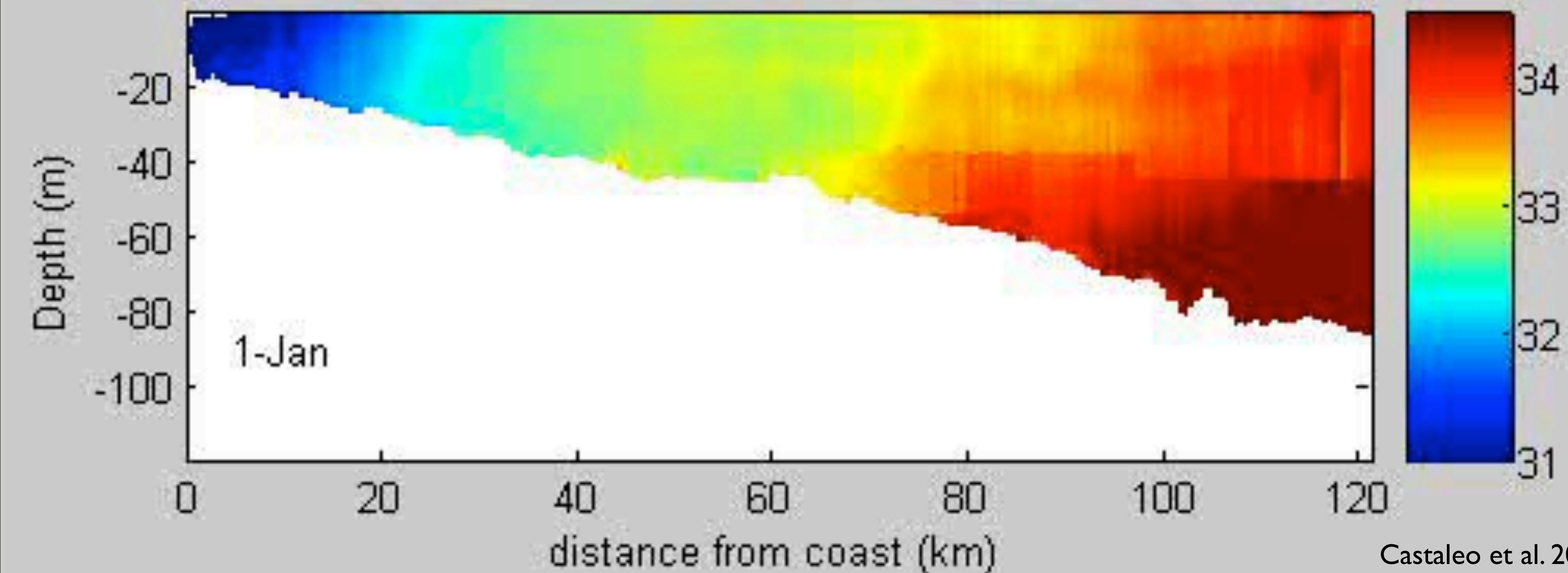
Temperature



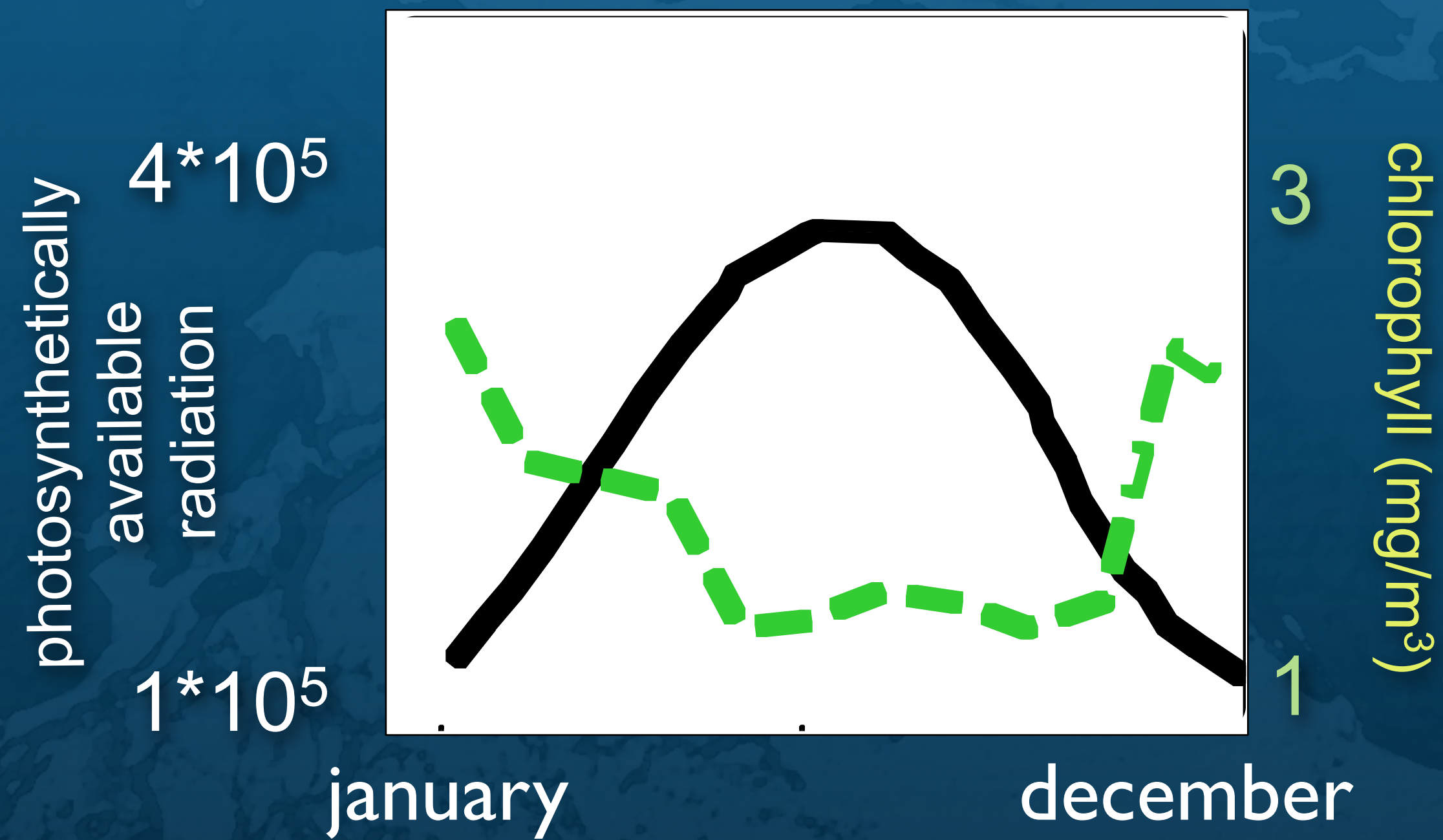
MAB stratification dominates the hydrography of the shelf.

Temperature stratification extreme, 25 to 8 degrees in a only three meters

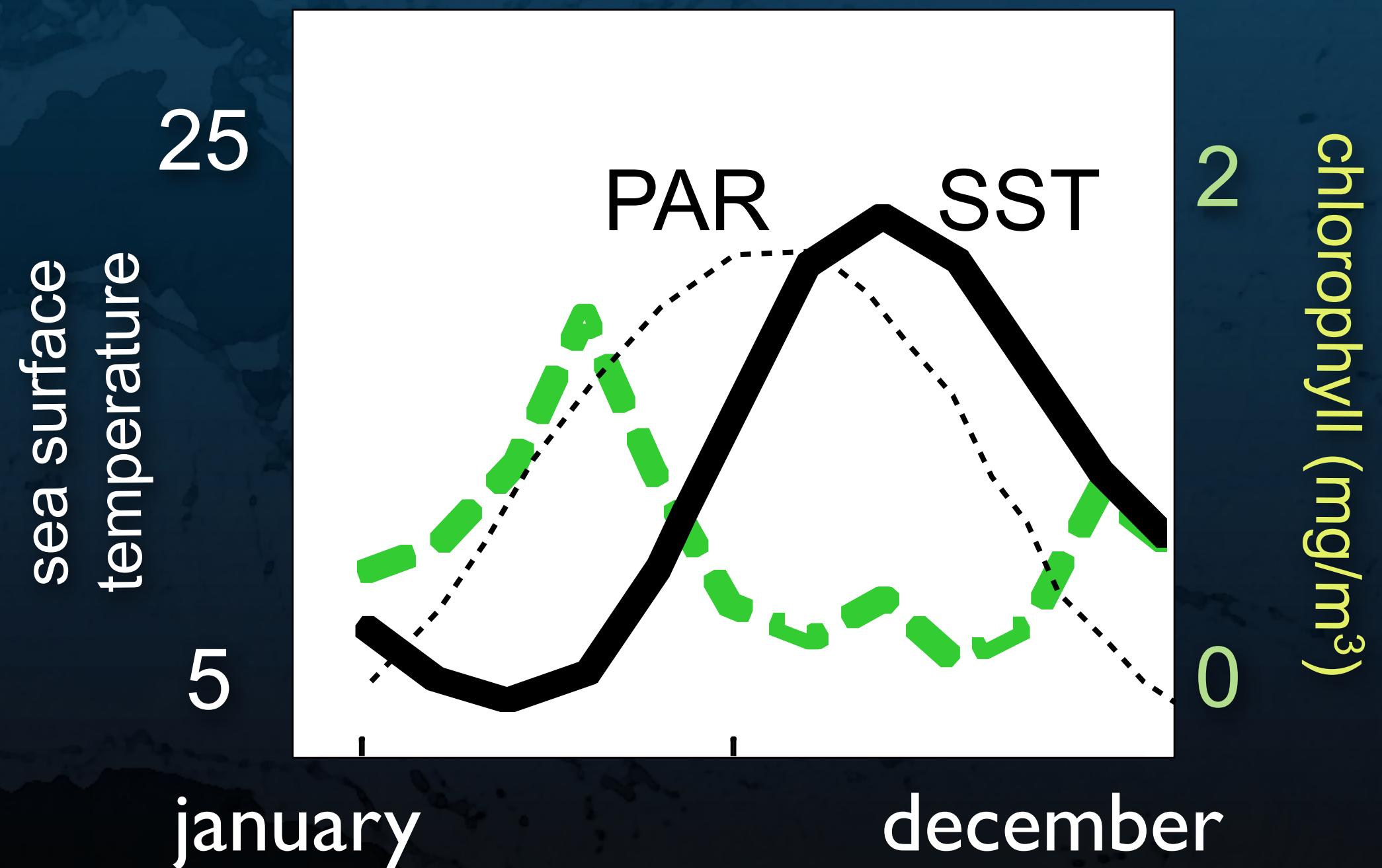
Salinity gradients show inshore and offshore gradients



Castaleo et al. 2008, 2010

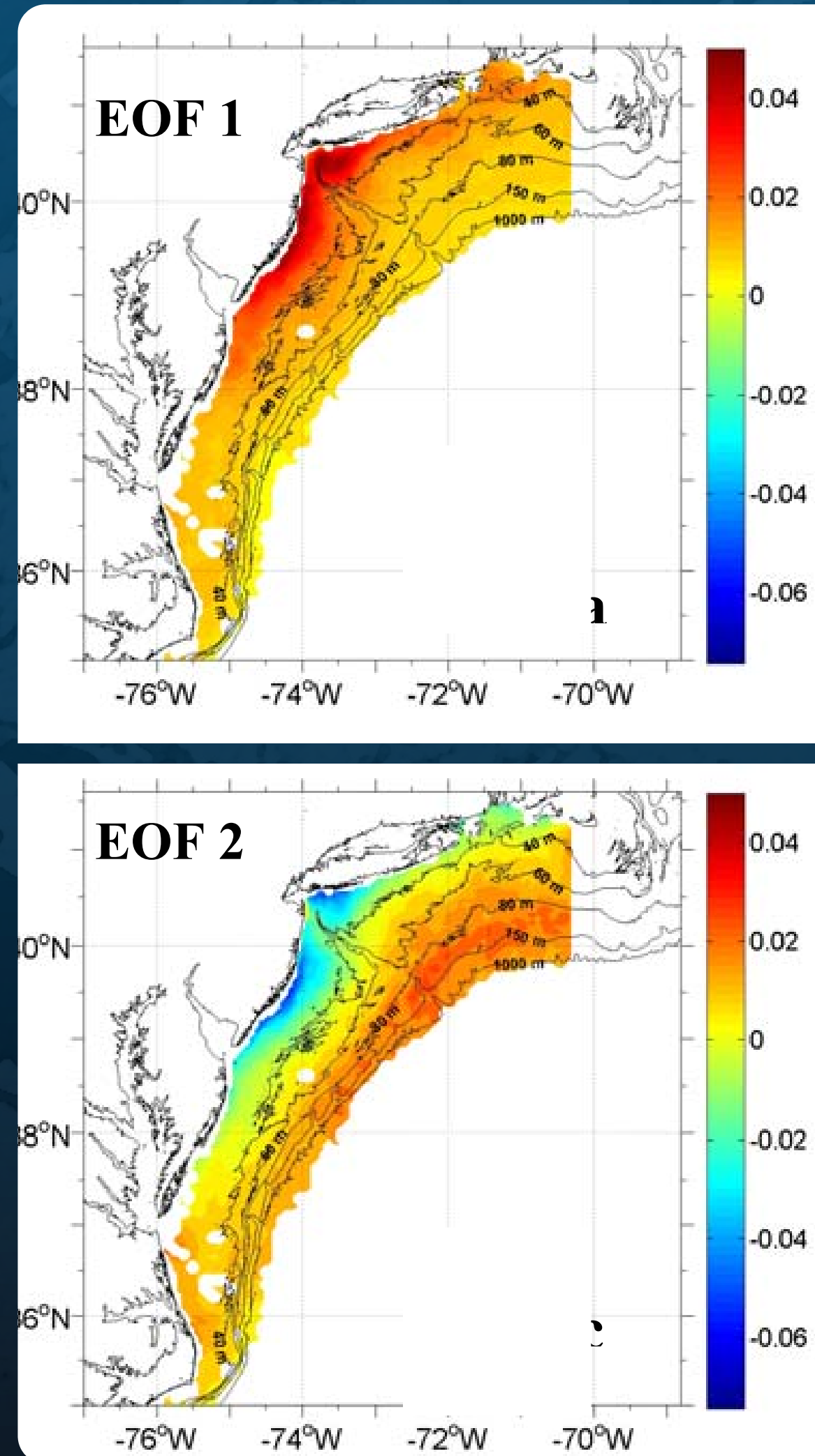


Mode 1: Largest and most recurrent bloom. Occurs during the dimmest months of the year which is interesting.

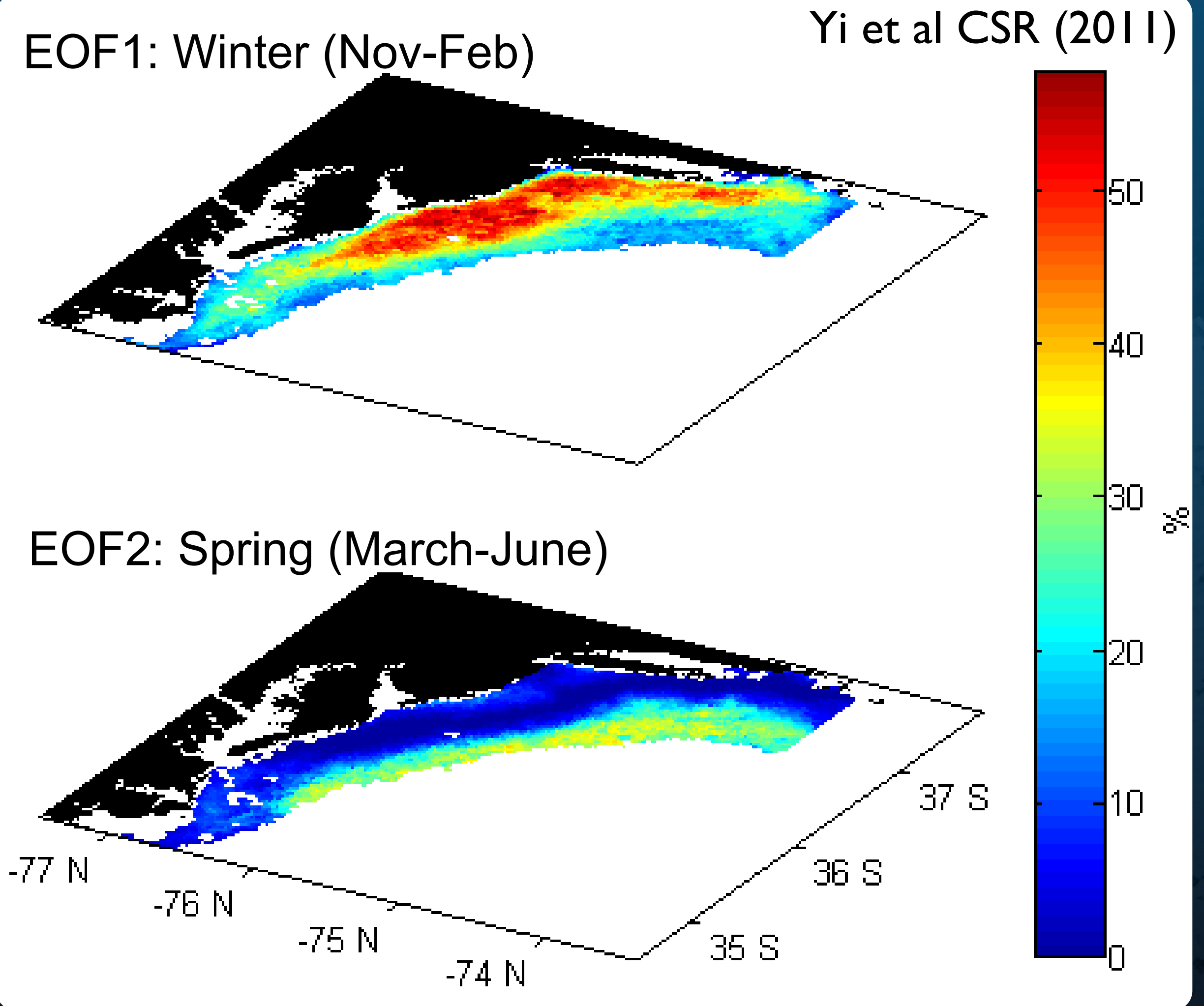


Mode 2: The canonical spring bloom which occurs prior to strong shelf stratification.

Dynamics in phytoplankton variance is described by 2 modes. Mode 1 occurs in the winter on the inner shelf. Mode 2 occurs in spring on the outer shelf. Summer phytoplankton explain little of the shelf-wide variance however is extremely important to the nearshore coastal ecosystems



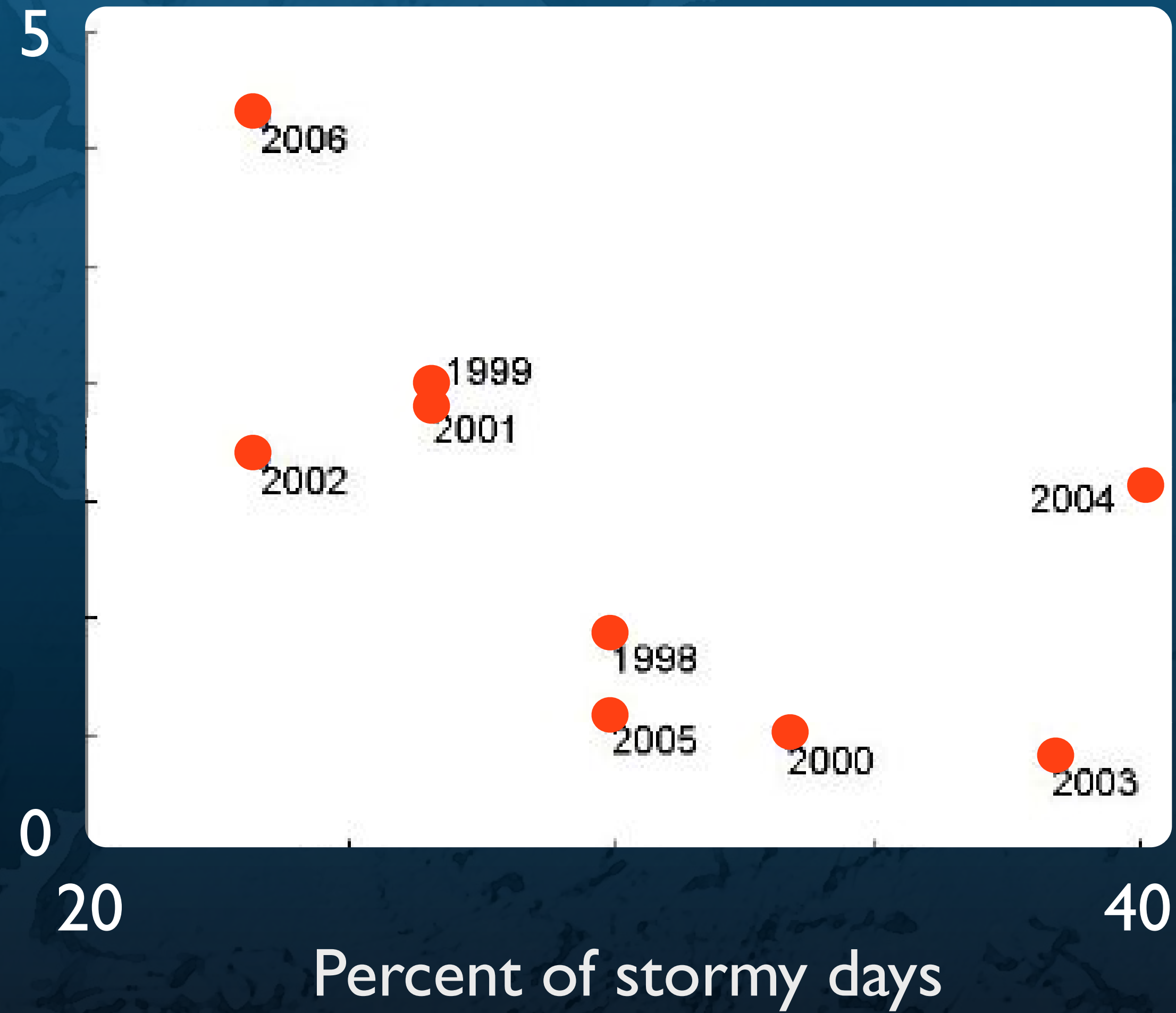
Two major EOF modes



% of Variance explained by the two major EOF modes as a function of space



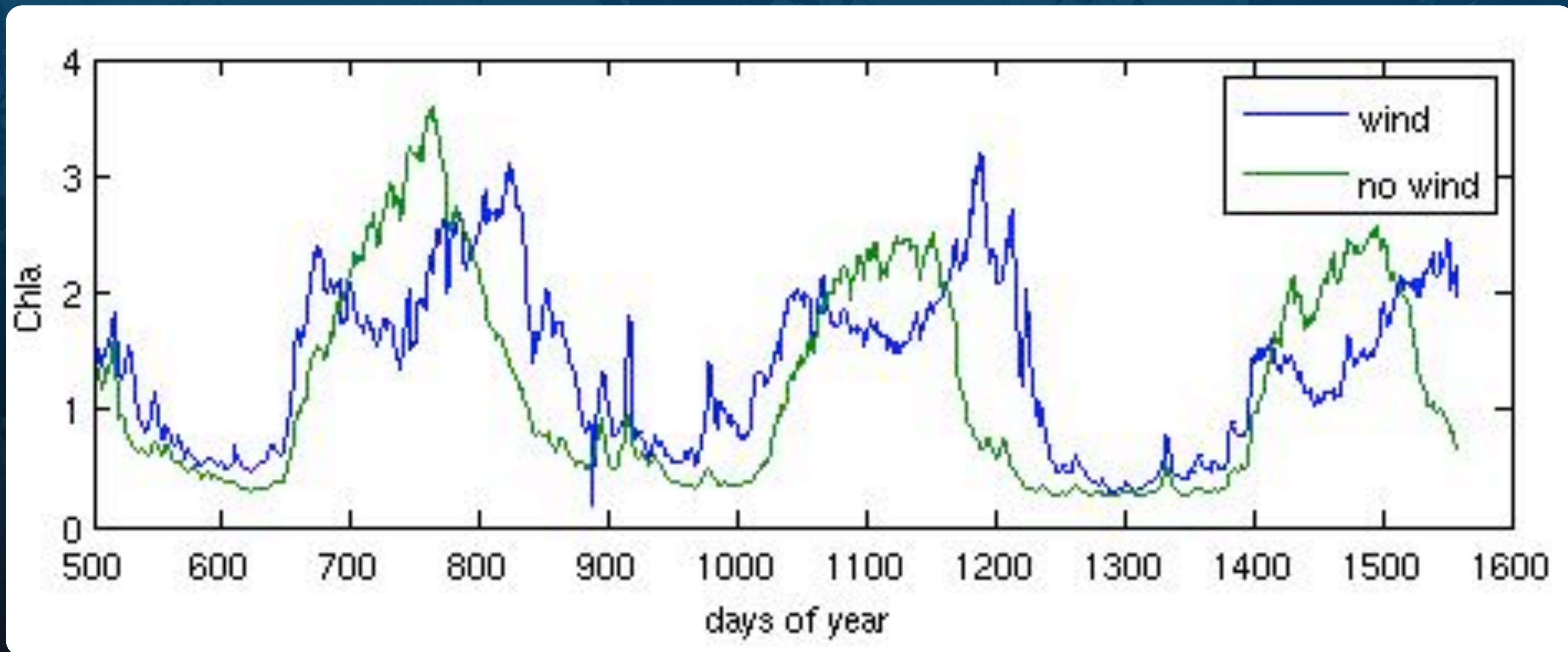
Maximum winter chlorophyll
concentration



Numerical experiment: Measured wind and no wind in Zone I

No wind condition, later bloom, larger bloom during darkest winter months, but integrated productivity over the winter is smaller by ~20%

Yi et al submitted

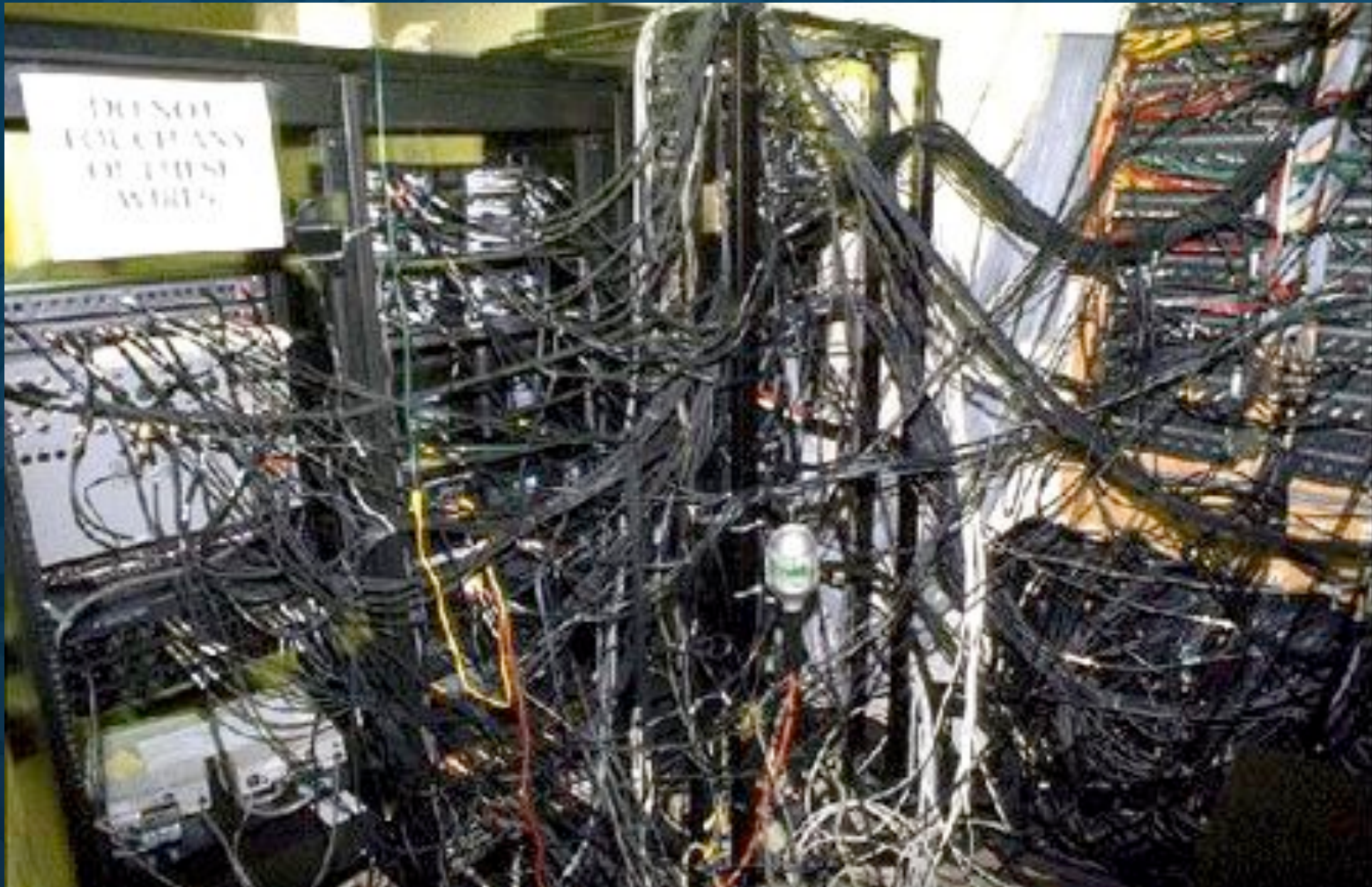




WHERE DO WE GO FROM HERE?

WHERE DO WE GO FROM HERE?

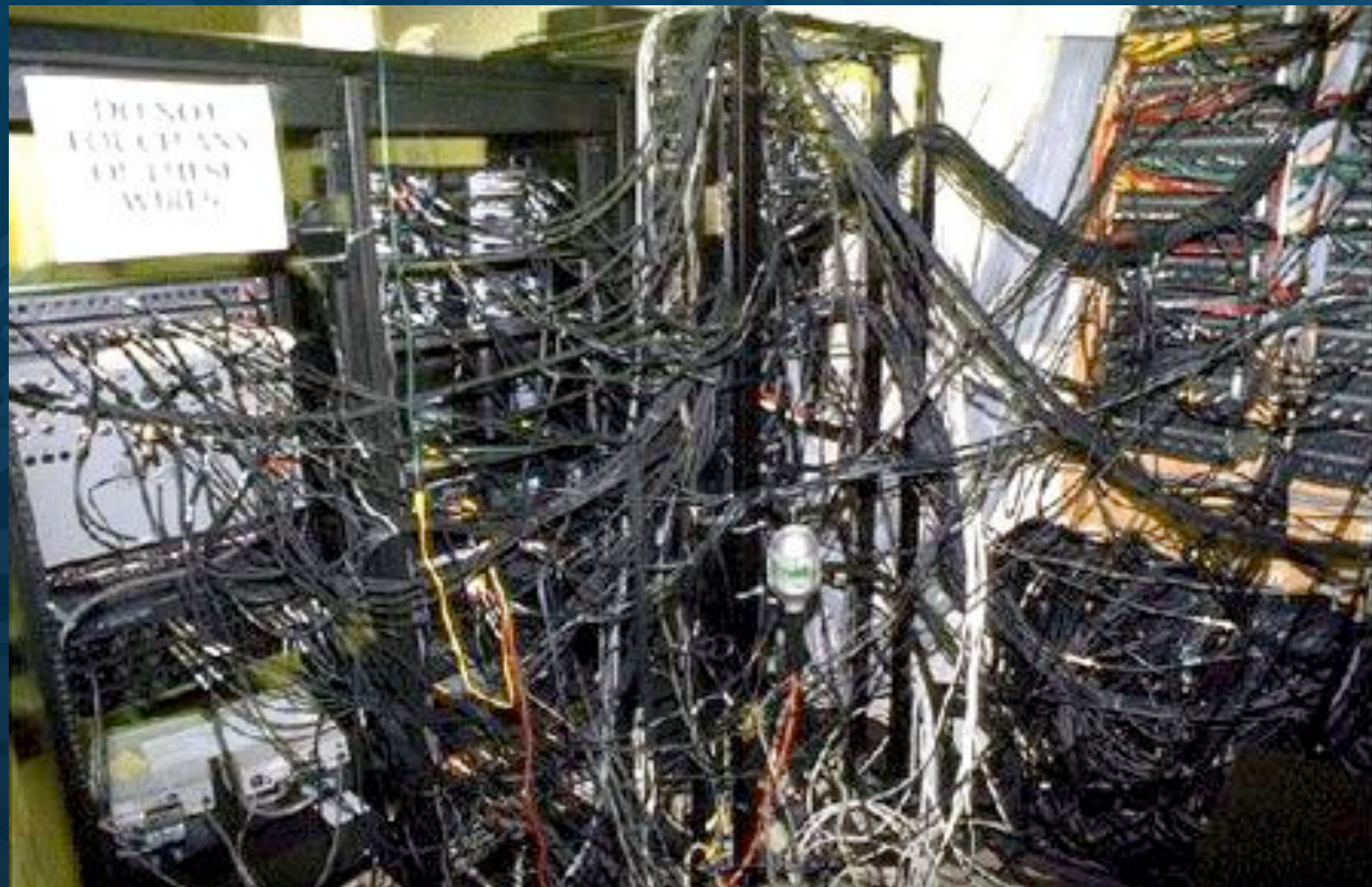
Machines have improved



A technicians solution
in integrating the observatory
components

WHERE DO WE GO FROM HERE?

Machines have improved



A technicians solution
in integrating the observatory
components

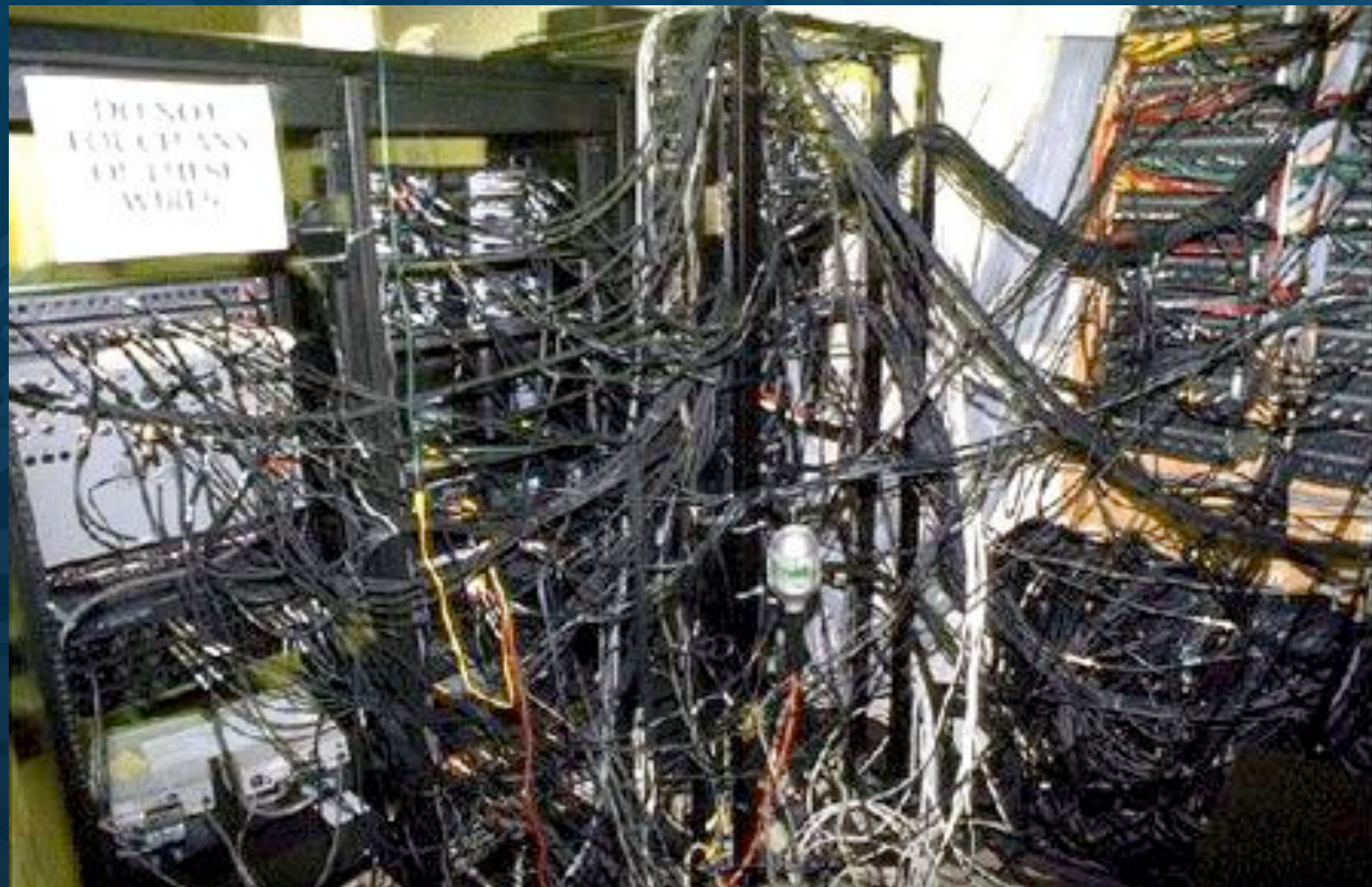
People need to sleep
and are fragile



Humans become the
bottle neck for
collecting data bytes

WHERE DO WE GO FROM HERE?

Machines have improved



A technicians solution
in integrating the observatory
components

People need to sleep
and are fragile



Humans become the
bottle neck for
collecting data bytes

Scientists need time
to think



Oscar tries to
reintegrate into
society after the field
experiments

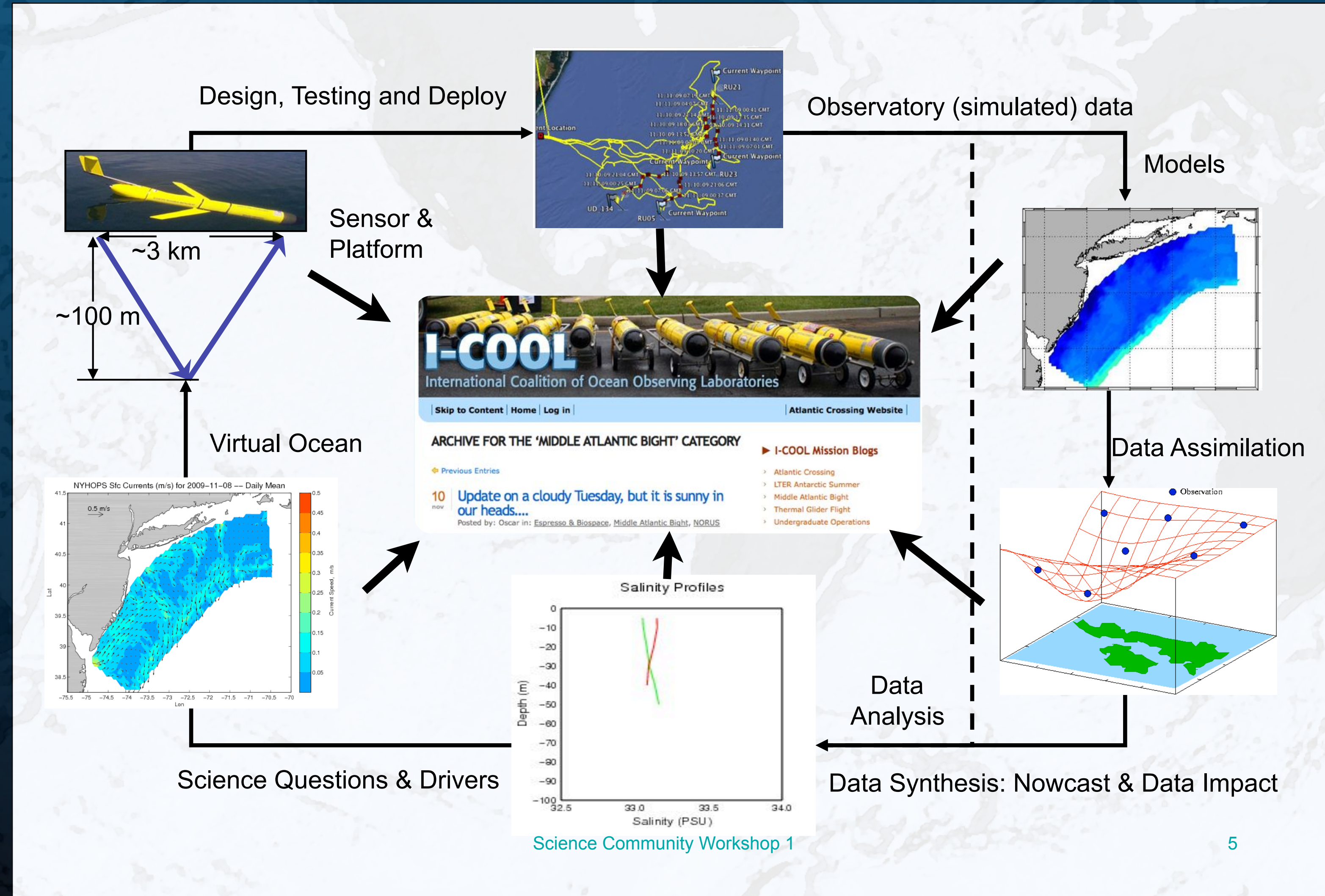
The OOI Observing System Experiment (OSE)

Nov 2 to Nov 13 2009

Idea of Test
(May 2009)

↓
Virtual Test
(Sep 2009)

↓
Wet Test
(Nov 2009)




The OOI Observing System Experiment (OSE) Nov 2 to Nov 13 2009

Scientists were distributed throughout the country & interacted in real-time

Community Blog

RUTGERS

JERSEY ROOTS, GLOBAL REACH



I-COOL
International Coalition of Ocean Observing Laboratories

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Atlantic Crossing Website |

ARCHIVE FOR THE 'MIDDLE ATLANTIC BIGHT' CATEGORY

Previous Entries

10
NOV

Update on a cloudy Tuesday, but it is sunny in our heads....
Posted by: Oscar in: [Espresso & Biospace](#), [Middle Atlantic Bight](#), [NORUS](#)

We had a great telecon yesterday. I look forward to another great call today! The decision was to conduct two experiments. The first experiment which was championed by Pierre was to send one glider North to survey the Hudson Canyon which shows some interesting features. Pierre's plan and reasoning was laid out in some figures which I have posted below.

OOI-OSSE09: Hudson Valley Adaptive Sampling Plan
Pierre Lermusiaux et al, 2009

Rutger Thompson

I-COOL Mission Blogs

> Atlantic Crossing

> LTER Antarctic Summer

> Middle Atlantic Bight

> Thermal Glider Flight

> Undergraduate Operations

Historic Blogs

> Across the Pond

> Espresso & Biospace

> Flight to Halifax

> NORUS

> NURC Med Cruise 09

> Spain Summer 2008

Data Portal

November 2009

Su	M	T	W	Th	F	S
01	02	03	04	05	06	07
08	09	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

☐ Observation

☐ SST

☐ Blended with gap

☐ In-Situ

☒ Satellite

☐ HF Radar

☐ 6-km

☐ Atmosphere Forcing

☐ NAM

☐ Ocean Forecast

☐ HOPS-PE_SHELF

☐ NYHOPS

☐ COAWST

☐ ROMS-ESPreSSO

☐ Data vs Model

☐ SST

☐ HF Radar 6-km

☐ Glider Profiles

☐ Ensemble Forecast

☐ Equal Weighting

☐ Objective Weighting

☐ Glider☐ Locations & Path☐ Earth Observing-1☐ Hyperion hyperspectral

CI OSSE Field Experiment

The Cyberinfrastructure (CI) component of the Ocean Observing System (OOI) will conduct an Observing System Simulation Experiment (OSSE) to test the capabilities of the OOI CI to support field operations in a distributed ocean observatory in the Mid-Atlantic Bight. [more](#)

Executive Summary of 11/11/2009

Winds have increased out of the north and northeast to over 20 knots as forecast yesterday by the NAM model. These winds are forecast to continue through Thursday with some further increase in strength. Excellent SST images are obtained again on Monday, including data from the microwave sensors. A four-band structure is again seen in the blended SST field and also in each of the individual satellite sensor observations. SST comparisons consistently suggest a band of warm model bias at the shelf break, probably due to the mislocation of the SST front there. The HF radar data for yesterday, though a bit sparse, suggest a northeastward flow on the southern shelf, and an offshore flow (toward the southeast) in the northern part of the domain. While the equally weighted ensemble forecast shows only very weak offshore flow in the north, the objectively weighted ensemble forecast reproduces this feature somewhat better. The objectively weighted ensemble forecast also shows better agreement with the glider salinity profiles than the equally weighted ensemble forecast.

Click [here](#) to view a more detailed CI daily summary.

Recent locations for the observational assets during the last 24 hours are shown below.

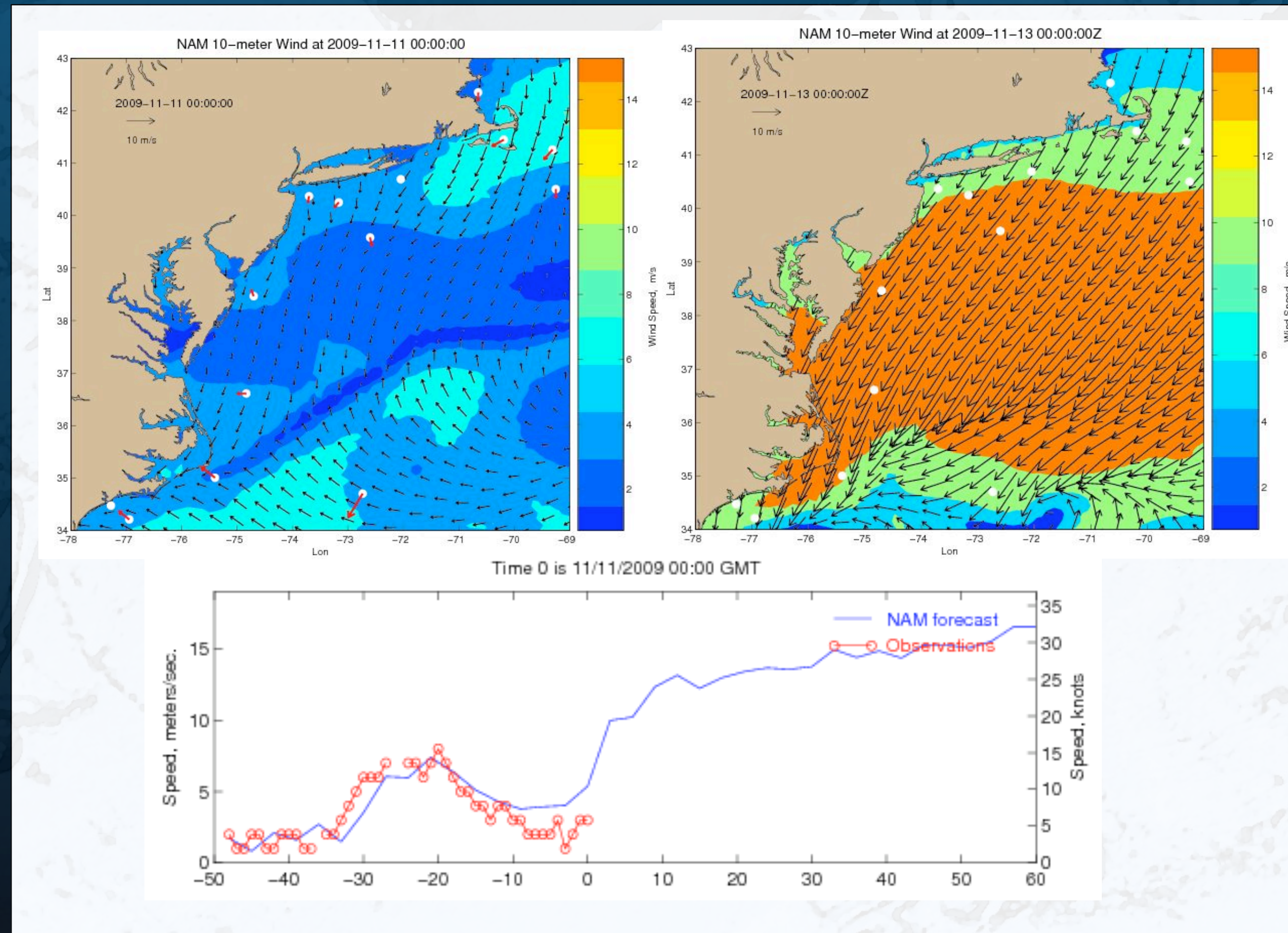
Location of Assets 20091111



The OOI Observing System Experiment (OSE)

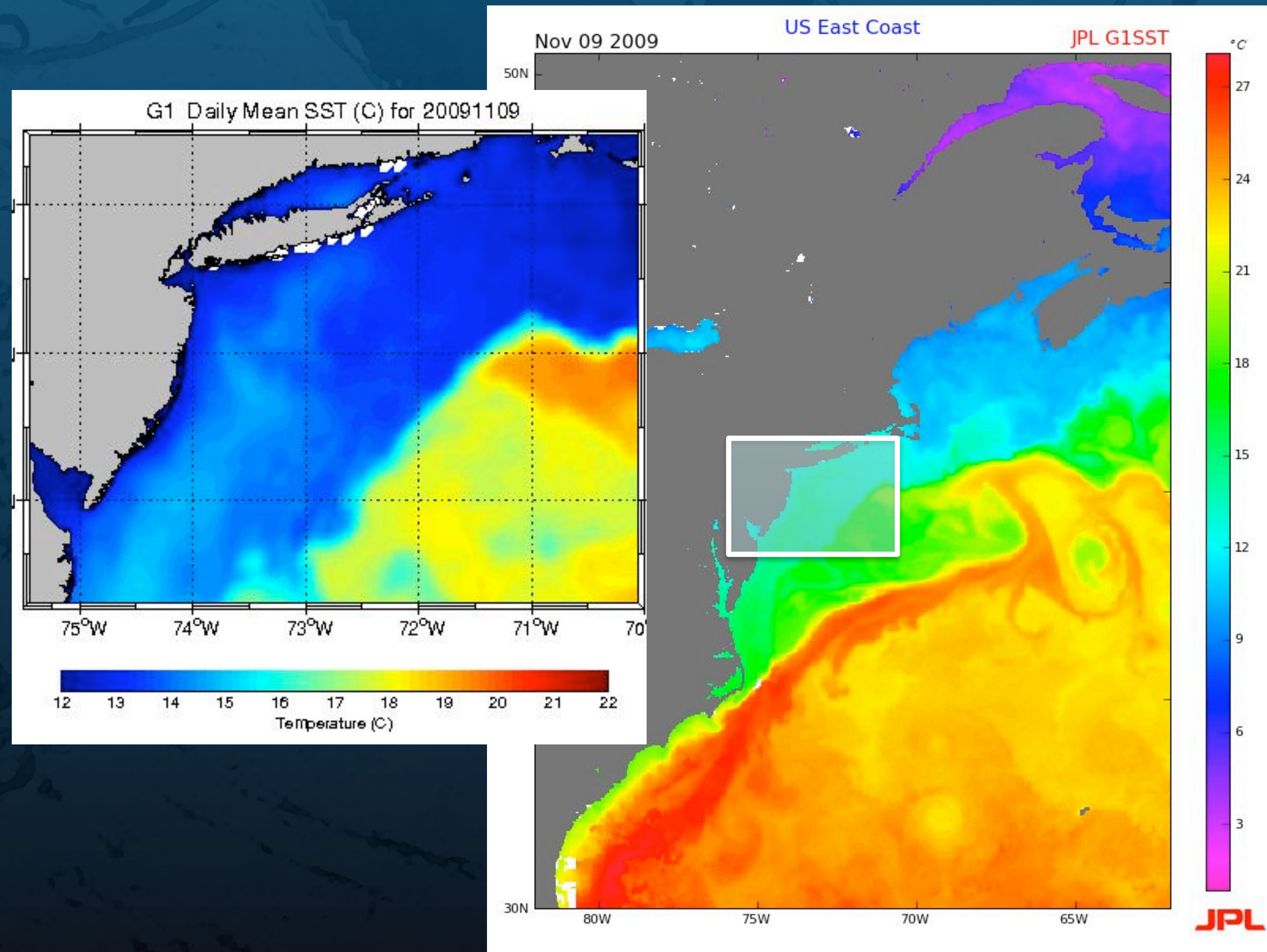
Nov 2 to Nov 13 2009

Weather Forecasts



The OOI Observing System Experiment (OSE)

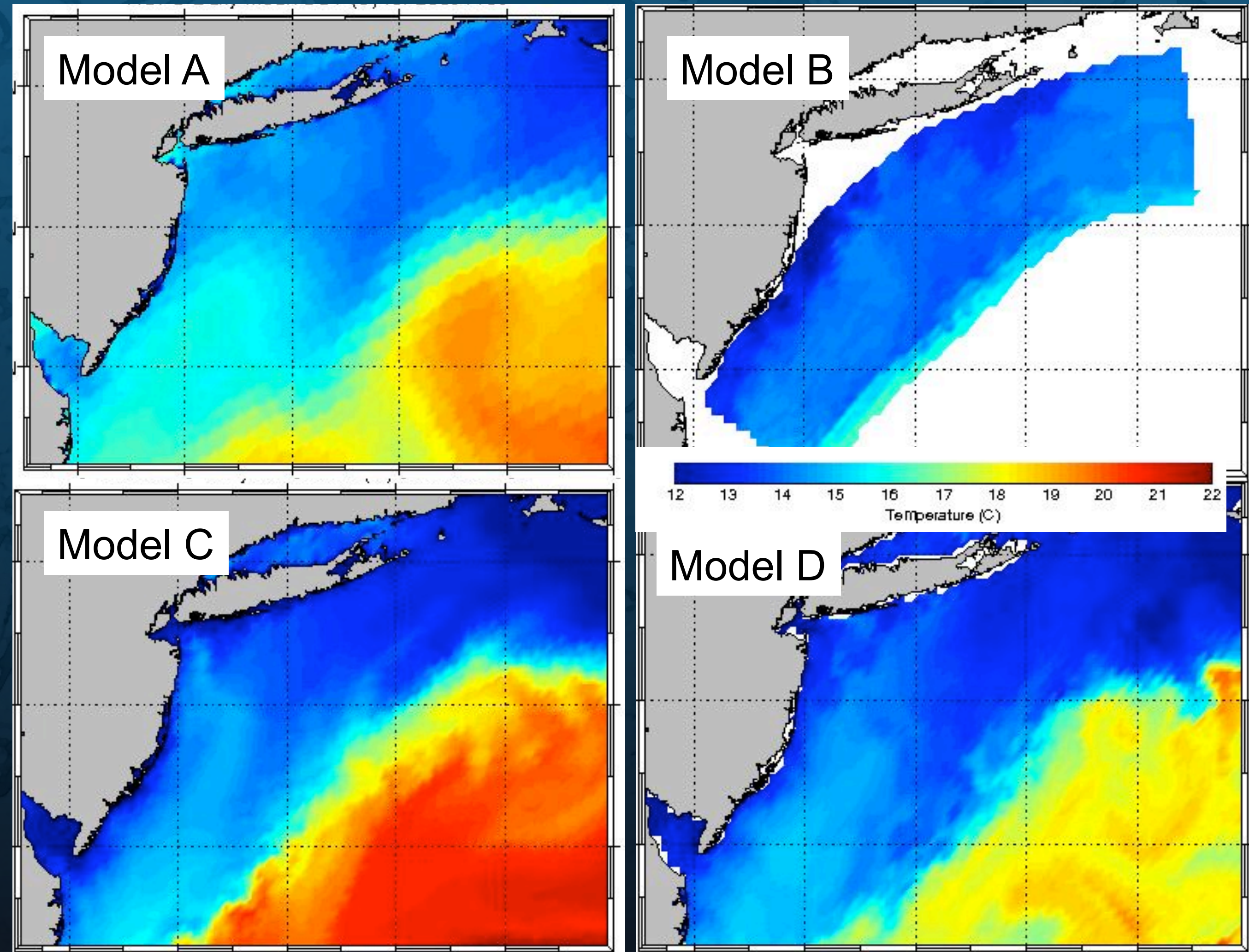
5 different
satellite
sensors



The OOI Observing System Experiment (OSE)

5 ocean numerical
models run in
forecast mode:

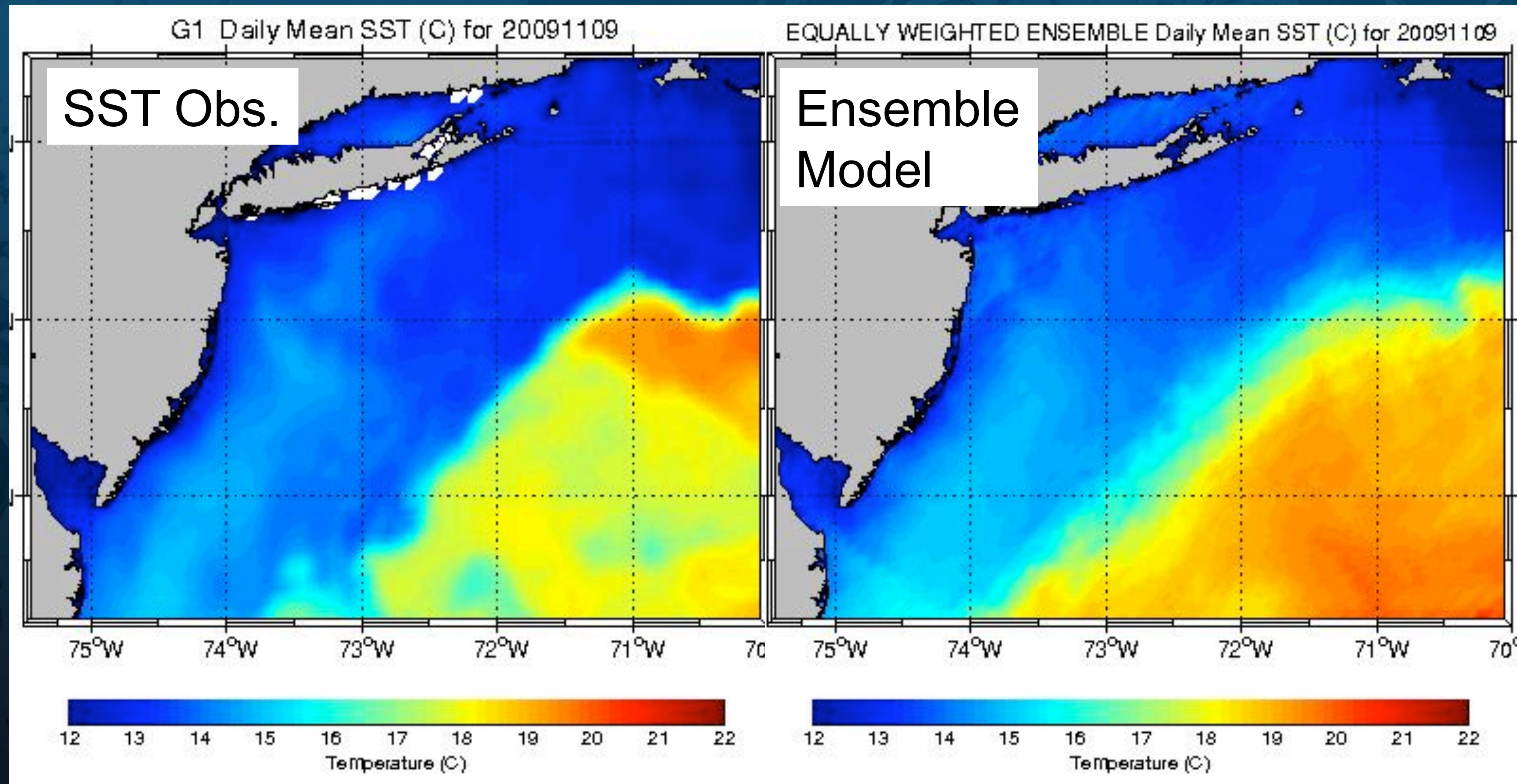
2 versions of ROMS
2 versions of HOPs
1 version of POM



The OOI Observing System Experiment (OSE)

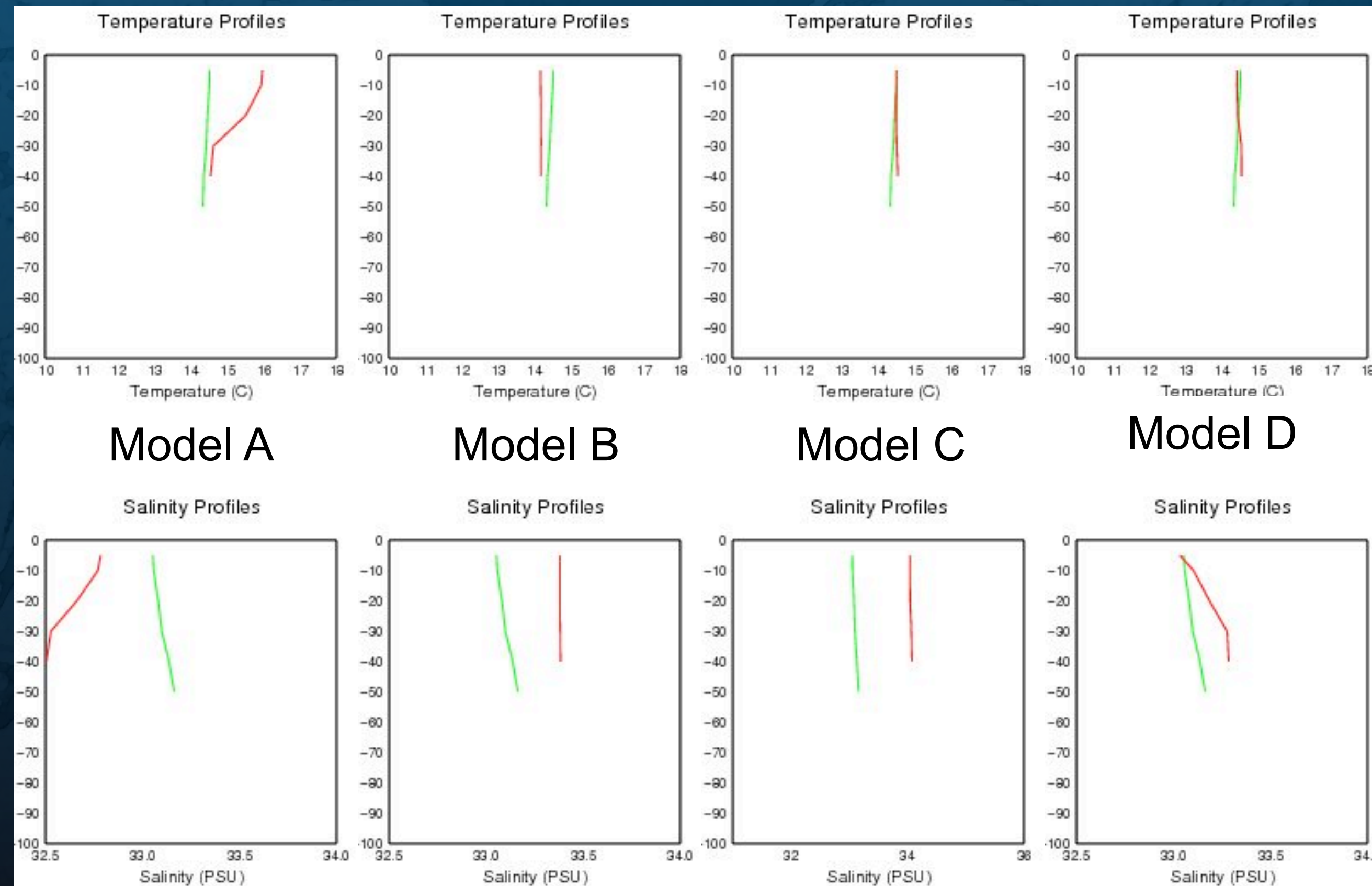
Nov 2 to Nov 13 2009

Scientists could compare observations (single platform or means) with models (individual or means)



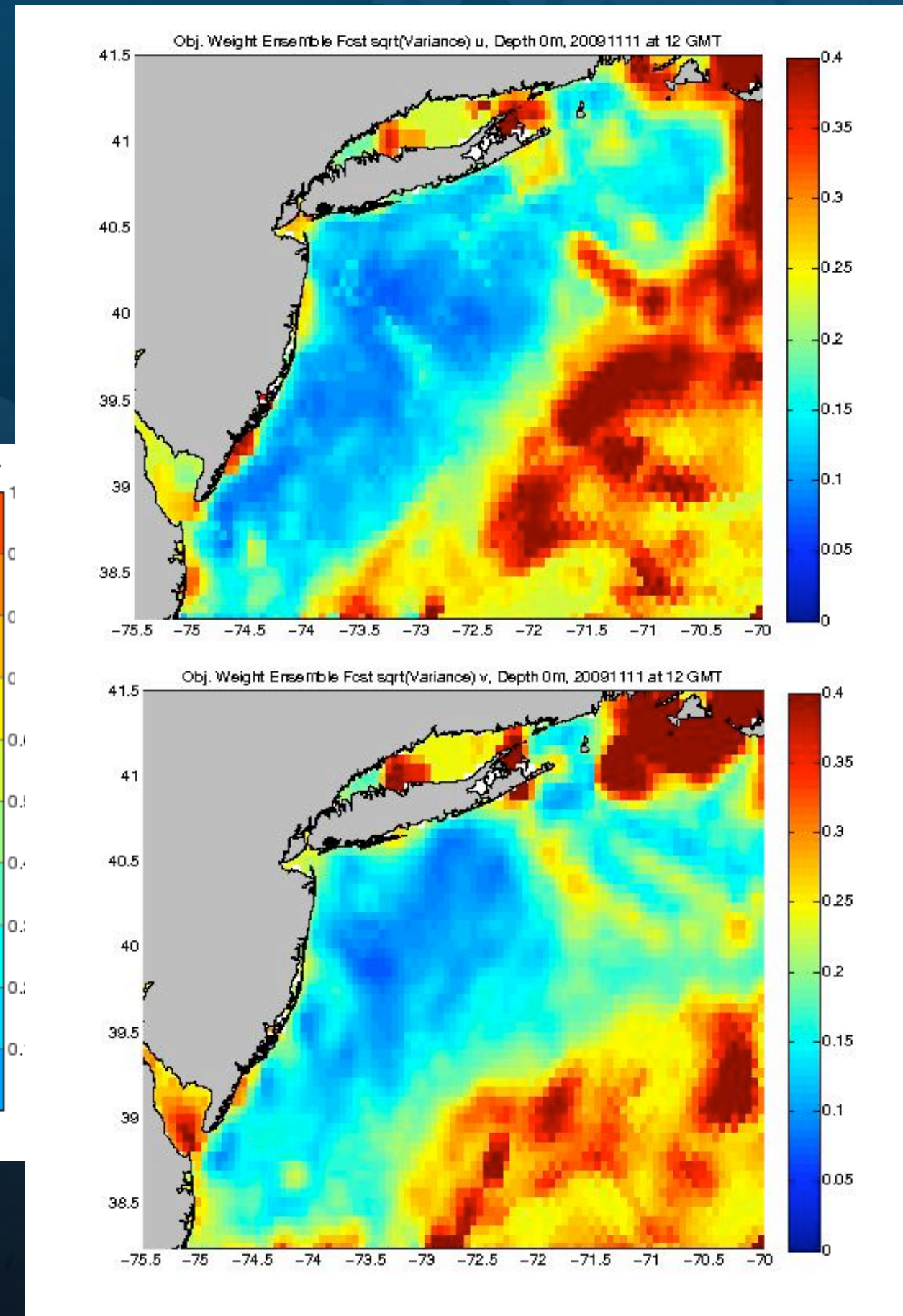
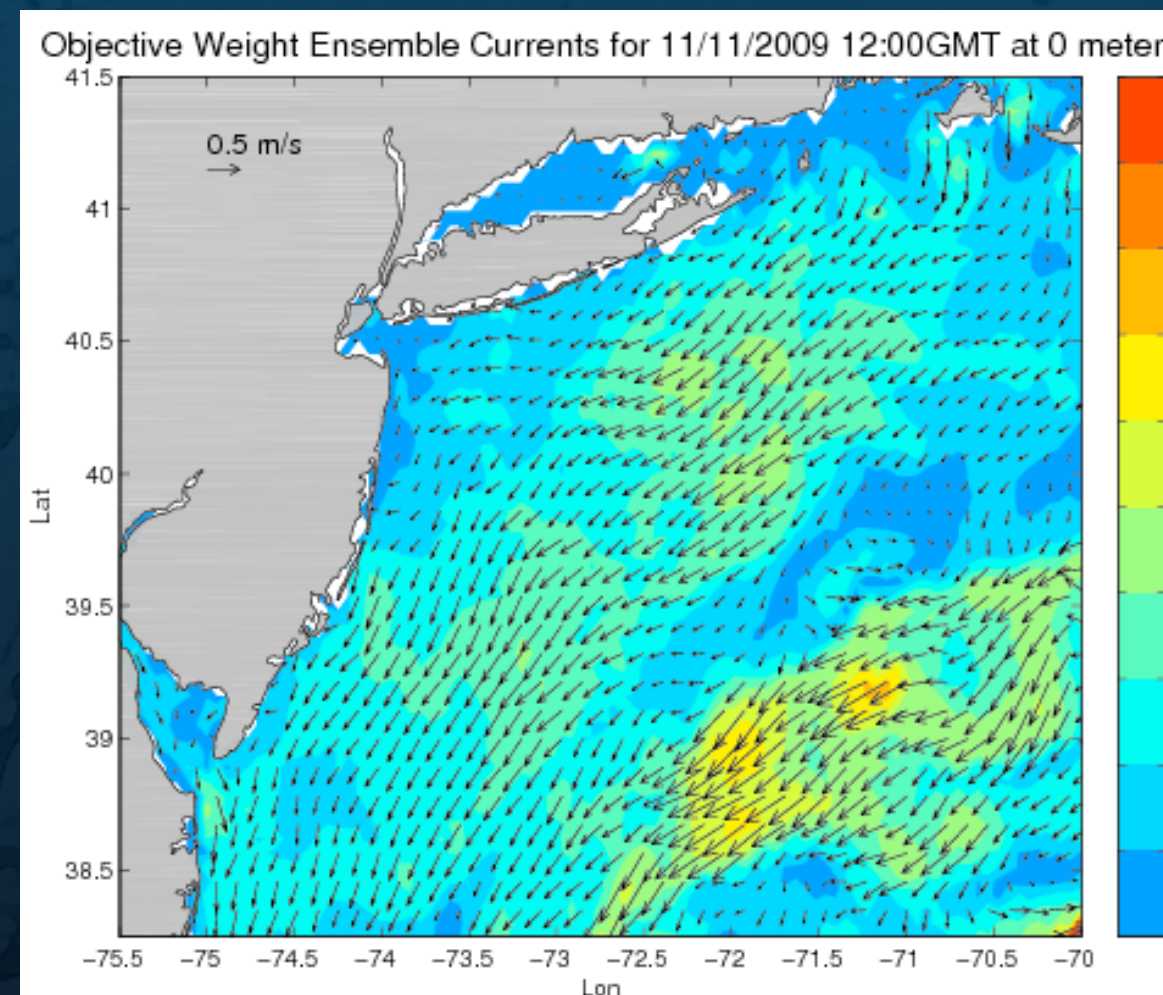
The OOI Observing System Experiment (OSE) Nov 2 to Nov 13 2009

The same for *in situ* measurements



The OOI Observing System Experiment (OSE) Nov 2 to Nov 13 2009

Ensemble mean
model

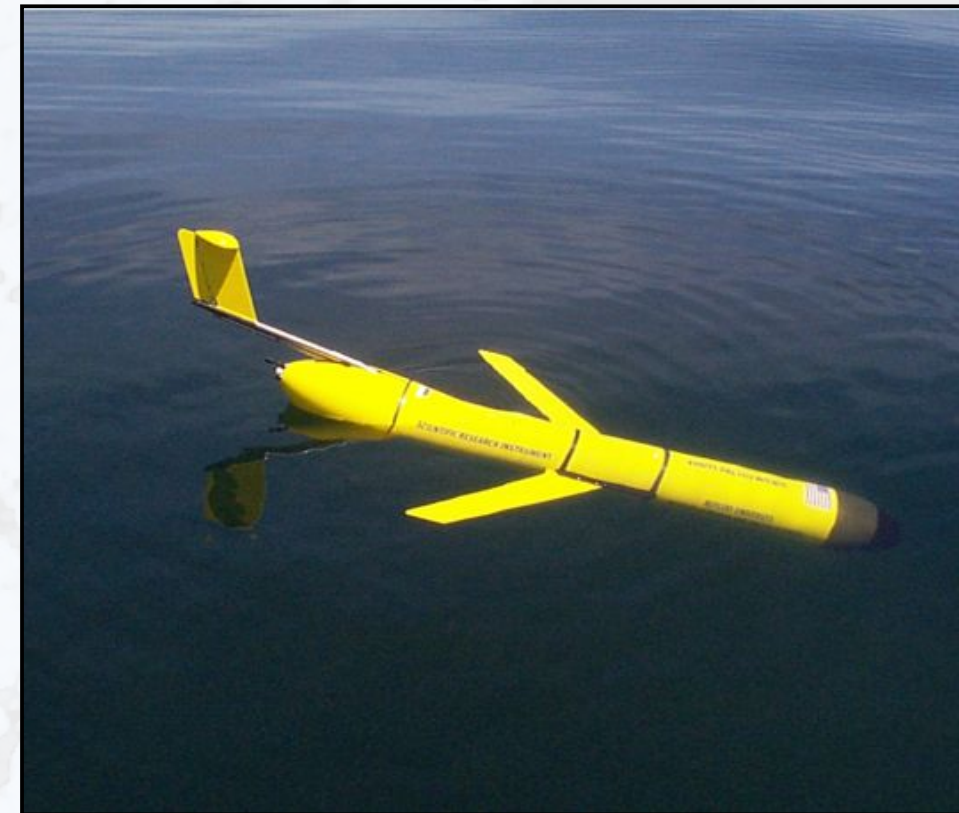


Variance in u velocity
component

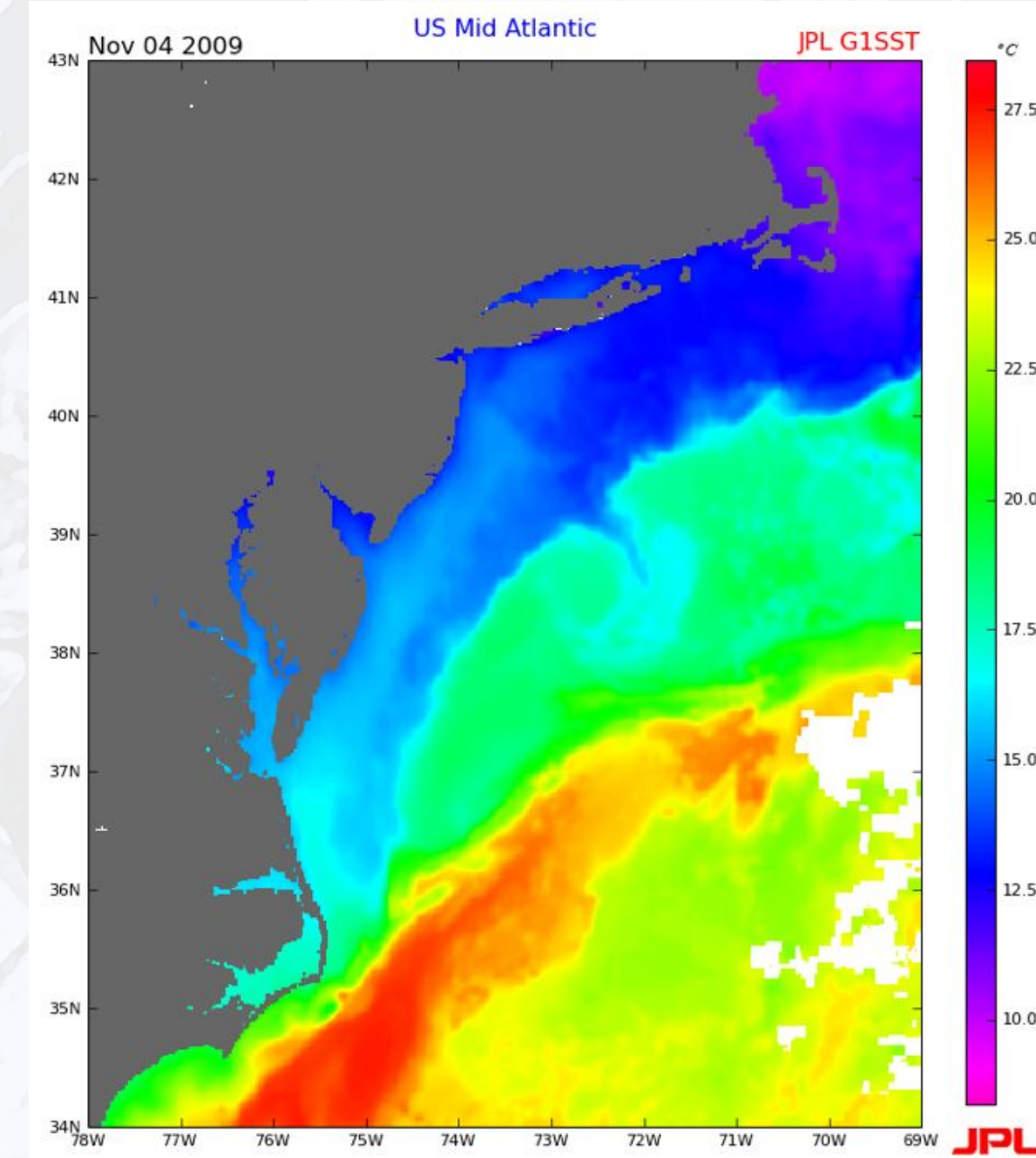
Variance in v velocity
component

The OOI Observing System Experiment (OSE)

Nov 2 to Nov 13 2009



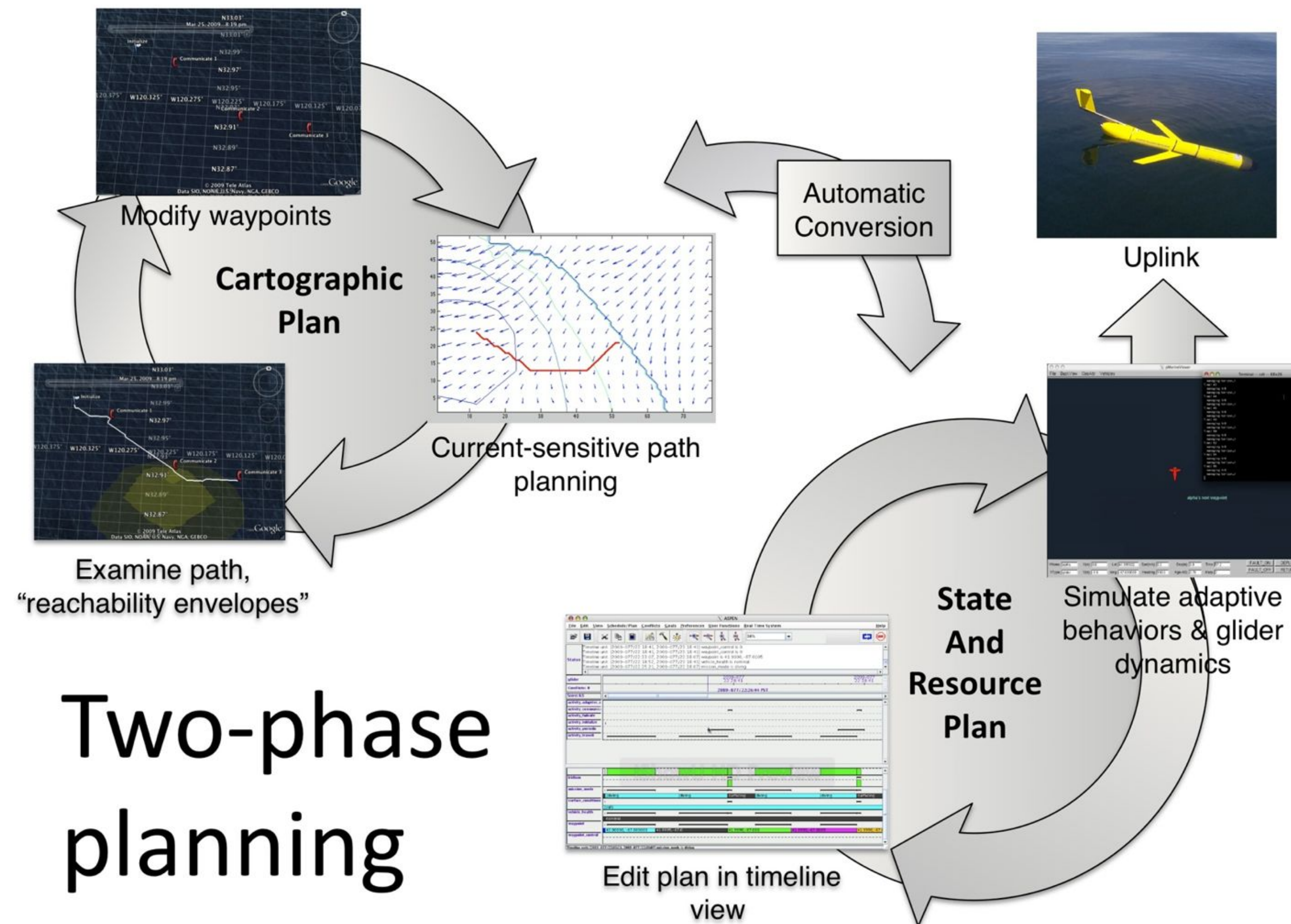
- Known constraints (slow 0.5 knot, Battery, shipping lanes)
- Uncertain constraints (time-varying 3D currents)
- Operate autonomously & re-plan daily



- From A to B in the shortest time
- Follow a time-varying feature (shelf-slope salinity intrusion)

The OOI Observing System Experiment (OSE)

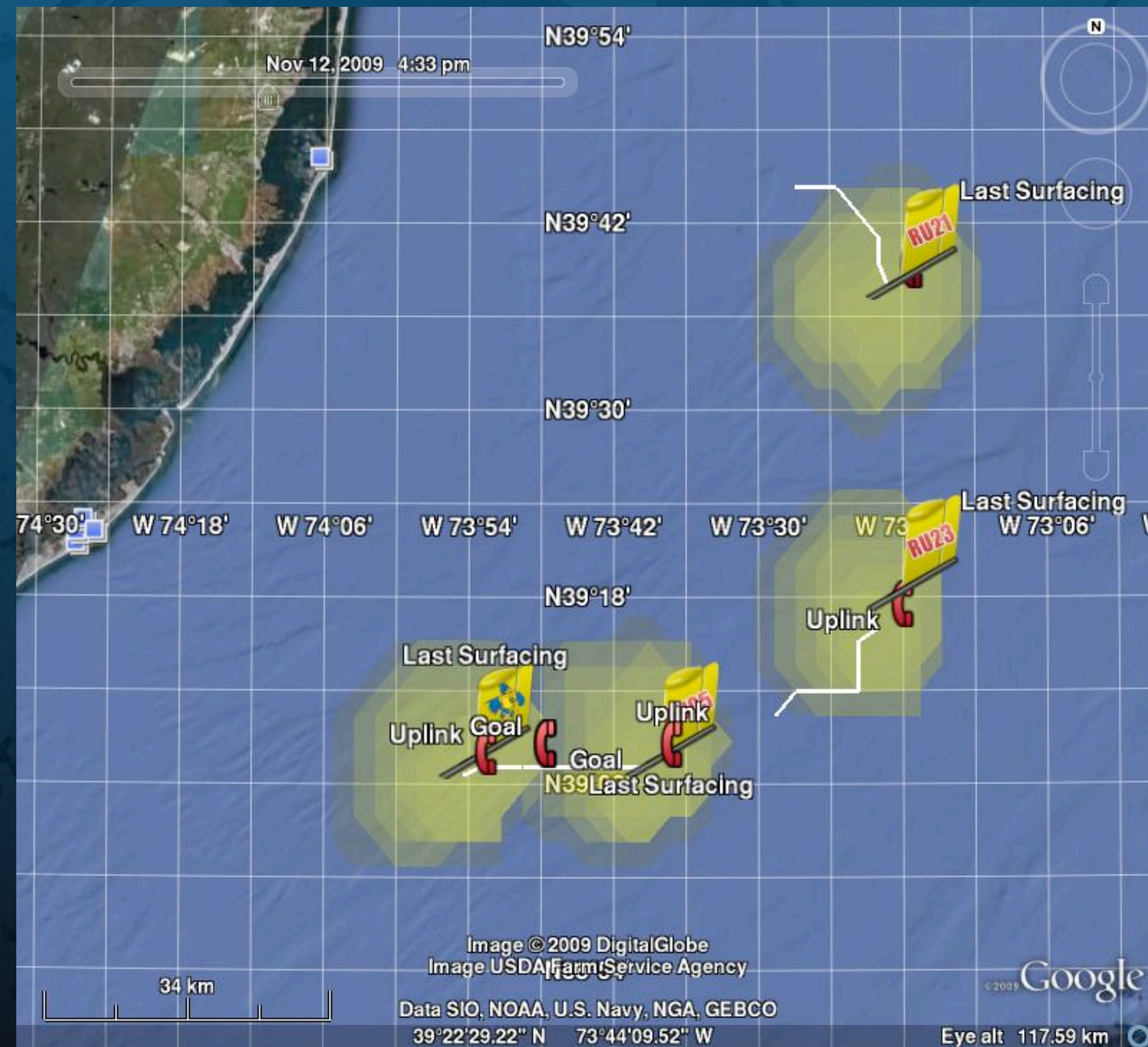
Scientific
community



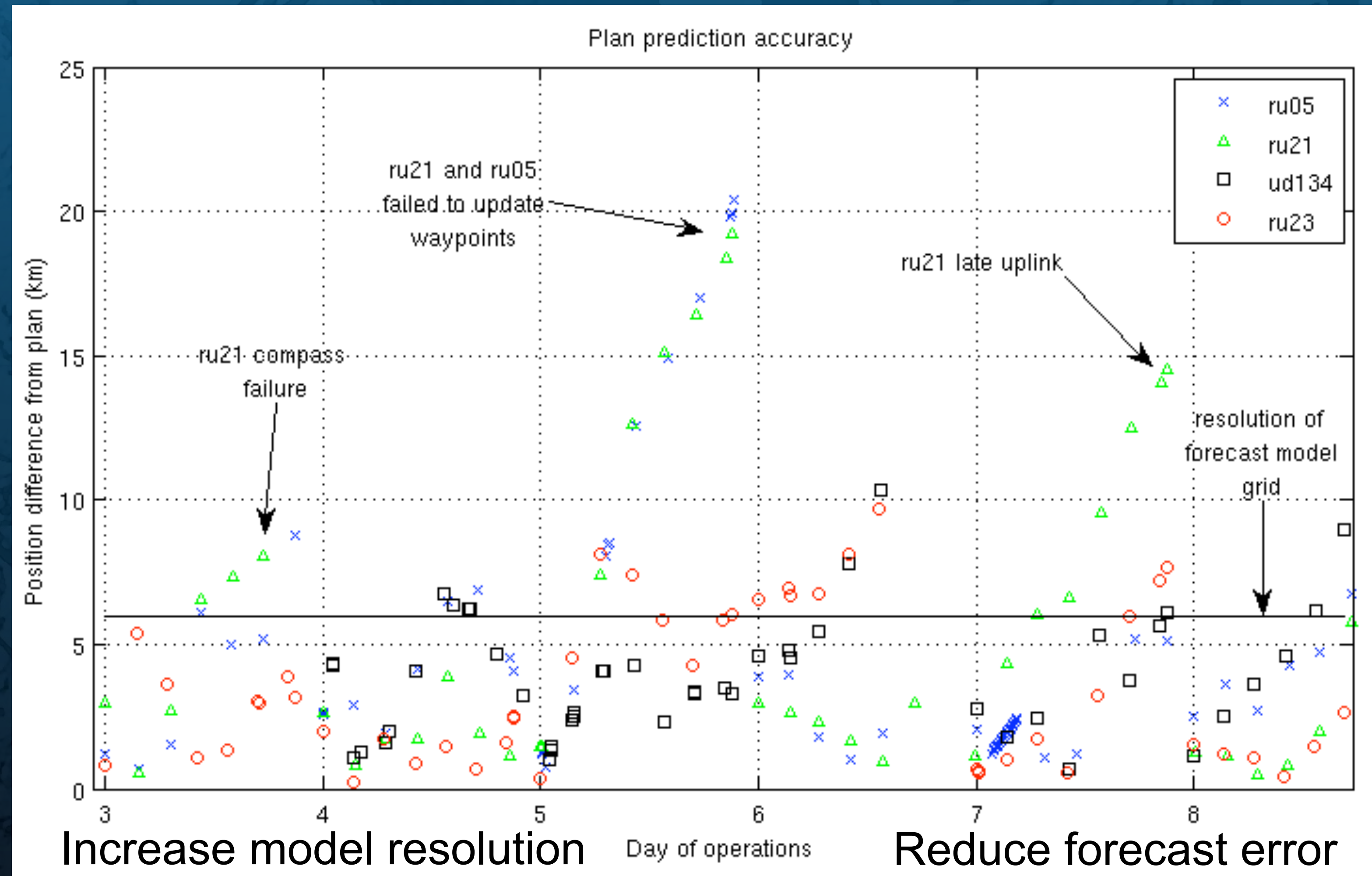
Marine
operators

The OOI Observing System Experiment (OSE)

Distributed decision making using live web service tools

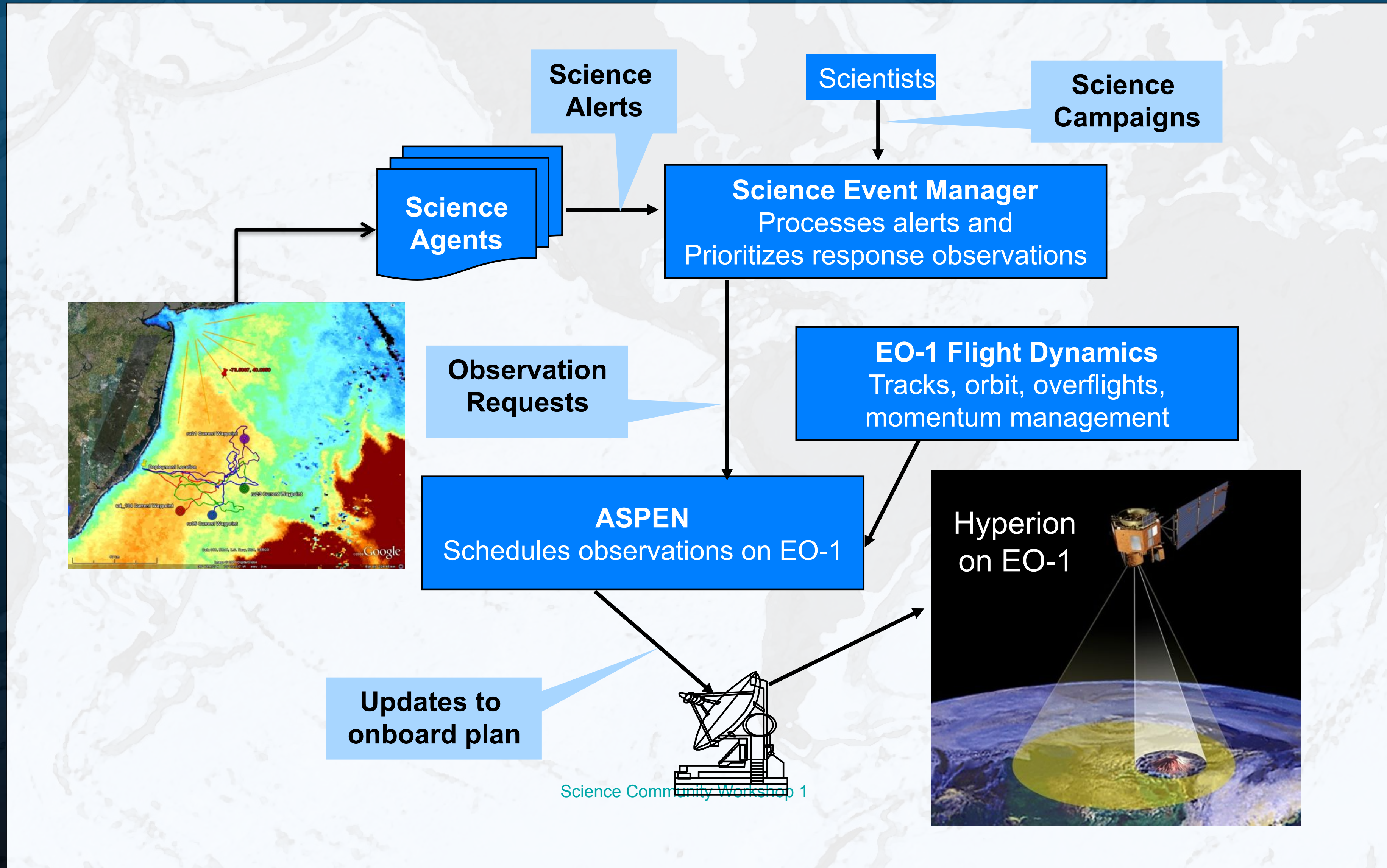


The OOI Observing System Experiment (OSE)



How well
did we do?

The OOI Observing System Experiment (OSE)



The OOI Observing System Experiment (OSE) Nov 2 to Nov 13 2009

Hyperion on EO-1
7.5 km by 100 km
(30 m resolution)

