

# Use of in-situ and remote sensors, sampling, and systems for assessing extent, fate, impact, and mitigation of oil and dispersants

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and the In-Situ and Satellite Observation Panel:  
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Joint Subcommittee on Ocean Science and Technology  
Deepwater Horizon Principal Investigator Meeting  
St. Petersburg, Florida  
October 5-6 2010

# Goals

**Provide an overview of some of the observations (in the water column and sediments) that were made to monitor and assess the extent of the oil and dispersants, and also used to investigate and assess their impact on ecosystems in the open ocean and coastal areas.**

**Provide an introduction for further discussions in the breakout group.**



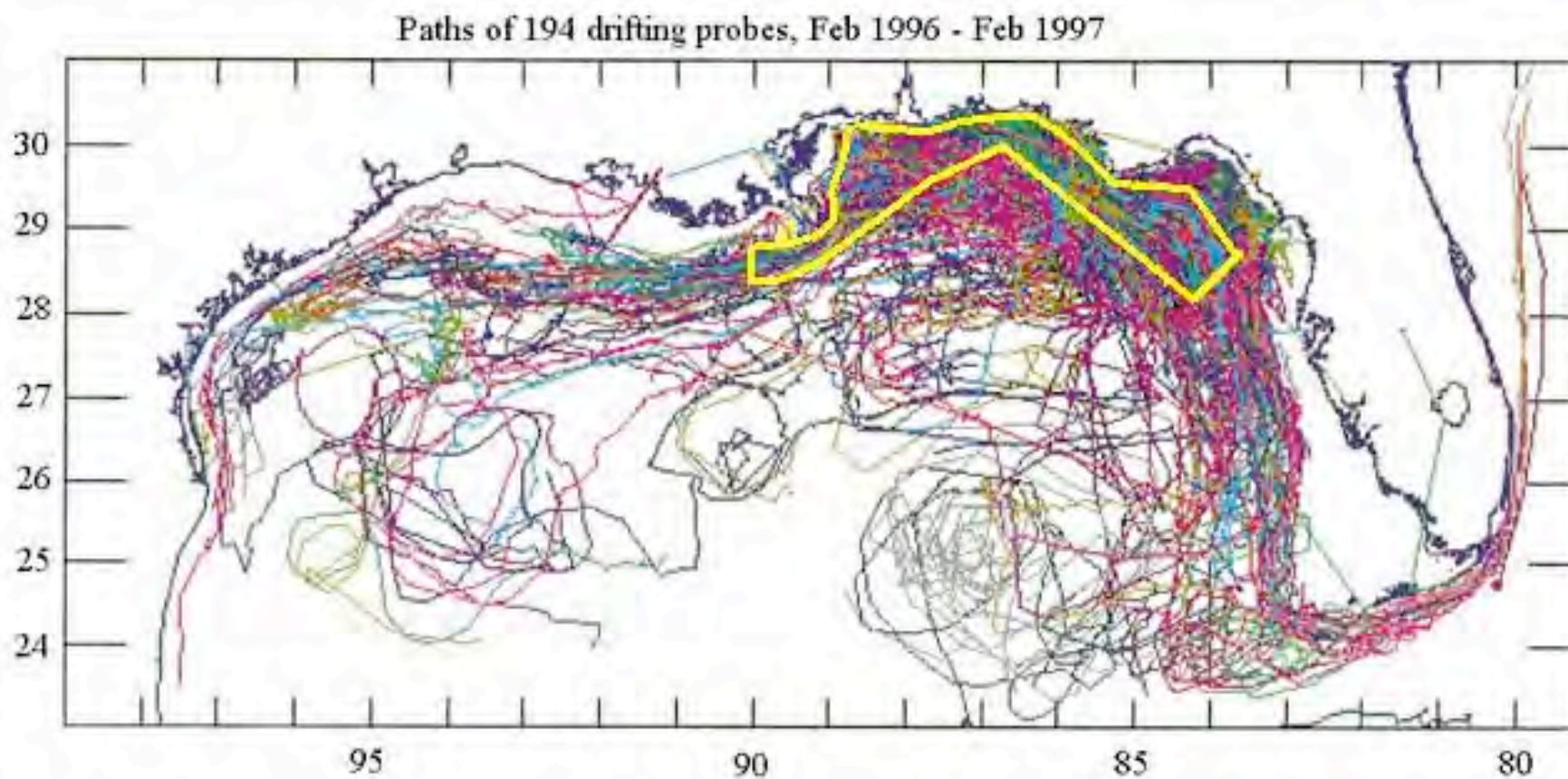
# In Situ observations

## Platforms

## sensors



# Surface drifter observations

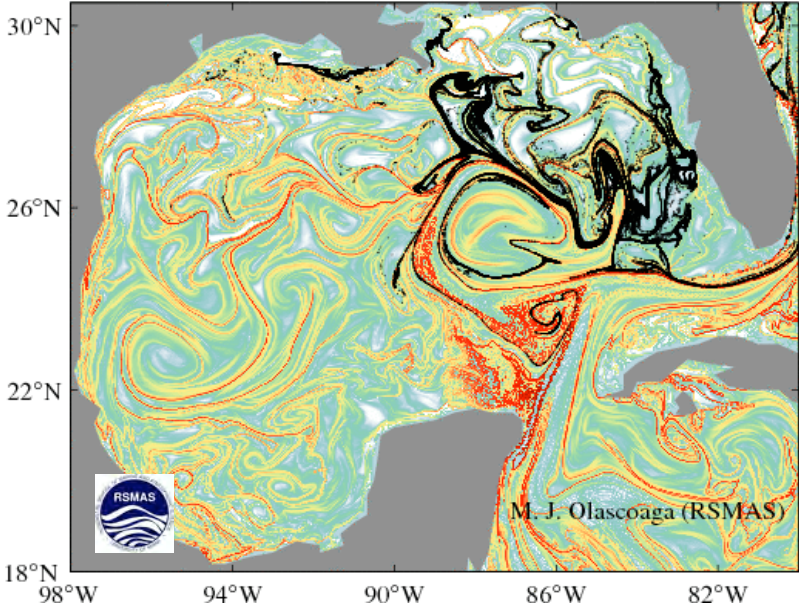


From Yang, H., R. Weisberg, P. Niiler, W. Sturges,  
and W. Johnson, 1999.



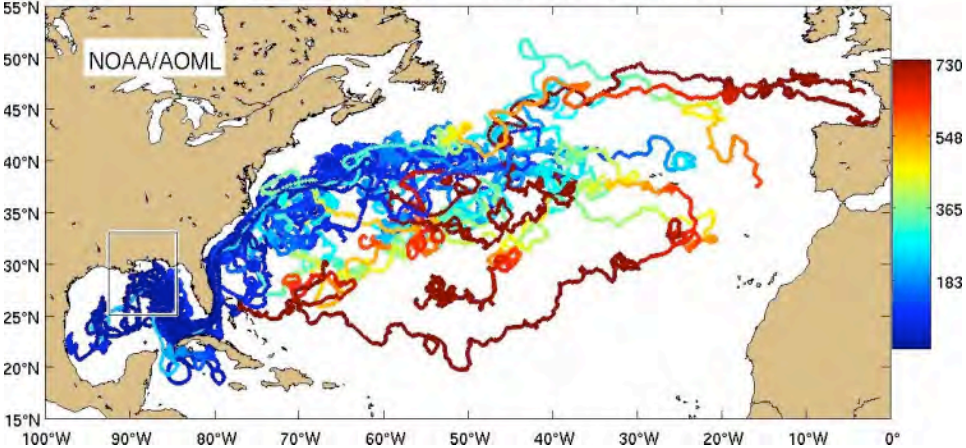
# Model and Observations

01-Jul-2010



Map courtesy of M. J. Olascoaga  
(University of Miami/RSMAS)

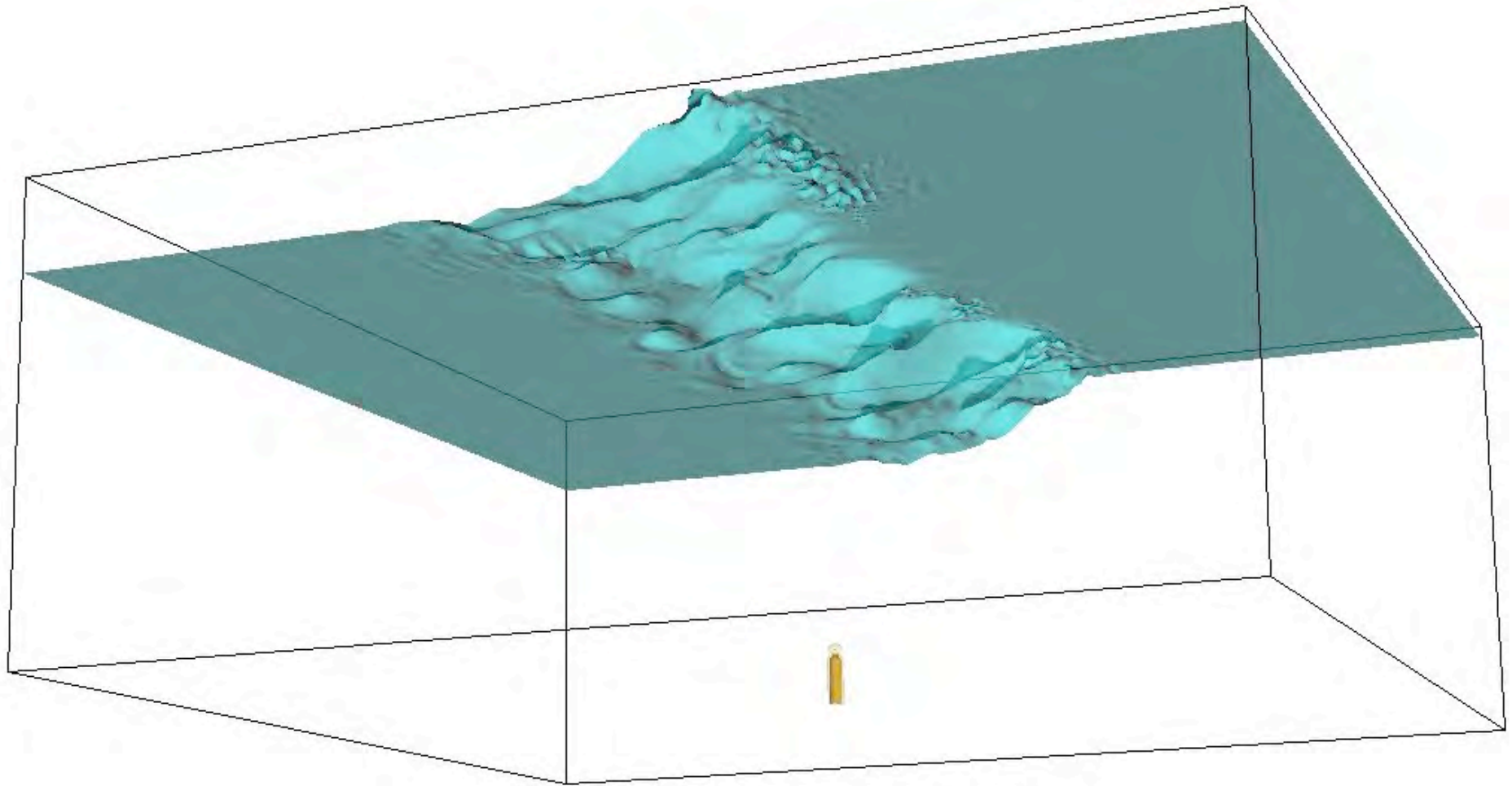
Days after passing closest to center of Gulf box



Map courtesy of R. Lumpkin  
(NOAA/AOML)



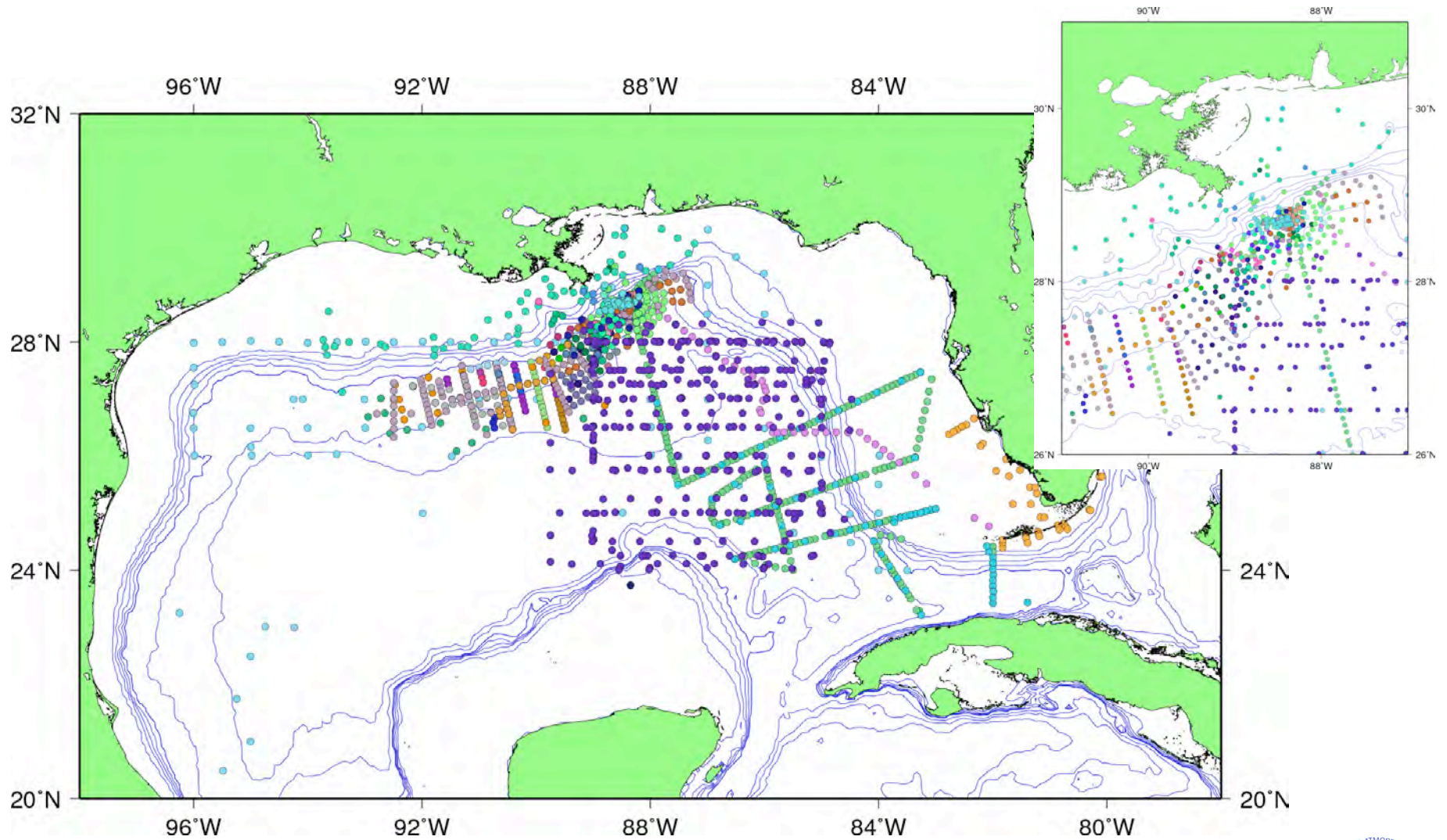
# A 3-Dimensional Problem



Courtesy of Tamay Ozgokmen (University of Miami/RSMAS)



# In Situ Ocean Observations



Source of observation  
locations: NOAA/NODC



# Field Sampling GEOPLATFORM

Research ships

Courtesy of NOAA/ORR

Weather conditions

Field sampling

Field photos

Data reports

Documentation

**WWW.GEOPLATFORM.GOV/GULFRESPONSE**

Information Help Recent Data

**Real or near-real time;**  
**Open source architecture;**  
**Easy to use;**  
**Harvests real-time data via wms feeds;**  
**Easy to share disparate data sets from a variety of groups.**

Layers Legend Query Tool Zoom

Reopening Samples

- Fish, Sep 03, 2010
- Fish, Sep 02, 2010
- Shrimp, Sep 02, 2010
- Fish, Aug 27, 2010
- Shrimp, Aug 27, 2010
- Fish, Aug 10, 2010
- Fish, Jul 22, 2010

All Subsurface Data Points From September 9th 2010 By Vessel (Strike Only)

- ▲ Brooks McCall
- ▲ Cape Hatteras
- ▲ Delaware II
- ▲ Endeavor
- ▲ Ferrel
- ▲ Gordon Gunter
- ▲ Henry Bigelow
- ▲ HOS Davis
- ▲ Jack Fitz
- ▲ Nancy Foster
- ▲ Ocean Veritas
- ▲ Pisces
- ▲ Thomas Jefferson
- ▲ Walton Smith
- ▲ Wes Bordelon
- ▲ Bunny Bordelon
- ▲ Max Skansi

Scale: 1: 7M Zoom Level: 6 Location: 32.06396°,-82.37549°

National Oceanic and Atmospheric Administration | Environmental Protection Agency  
U.S. Department of the Interior | U.S. Department of Homeland Security | University of New Hampshire | Privacy policy | Email Comments

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# Satellite observations: Oil extension

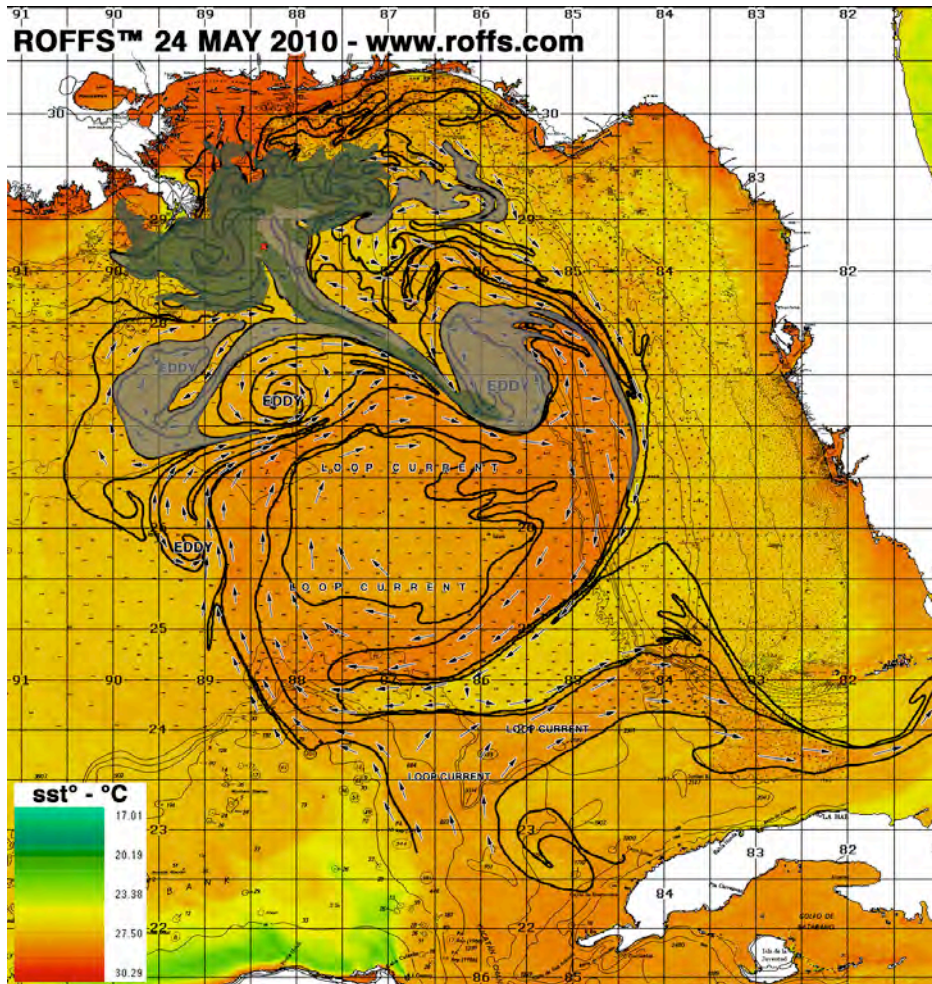


Figure by Mitchell A. Roffer (ROFFS™)

NASA MODIS imagery

April 21, 2010



May 10, 2010



Images courtesy of F. Muller-Karger (USF)



# Oil Trajectory Maps

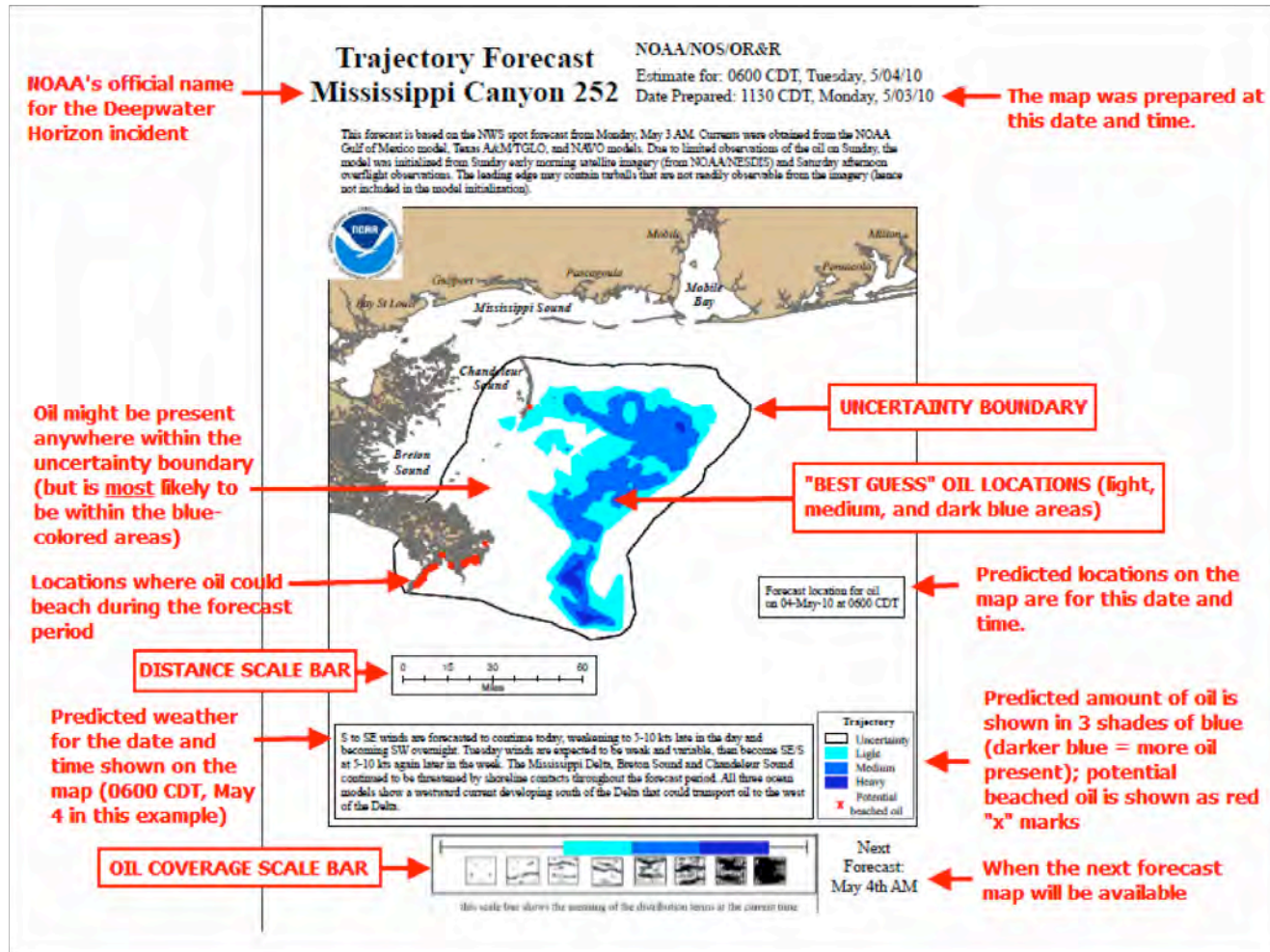


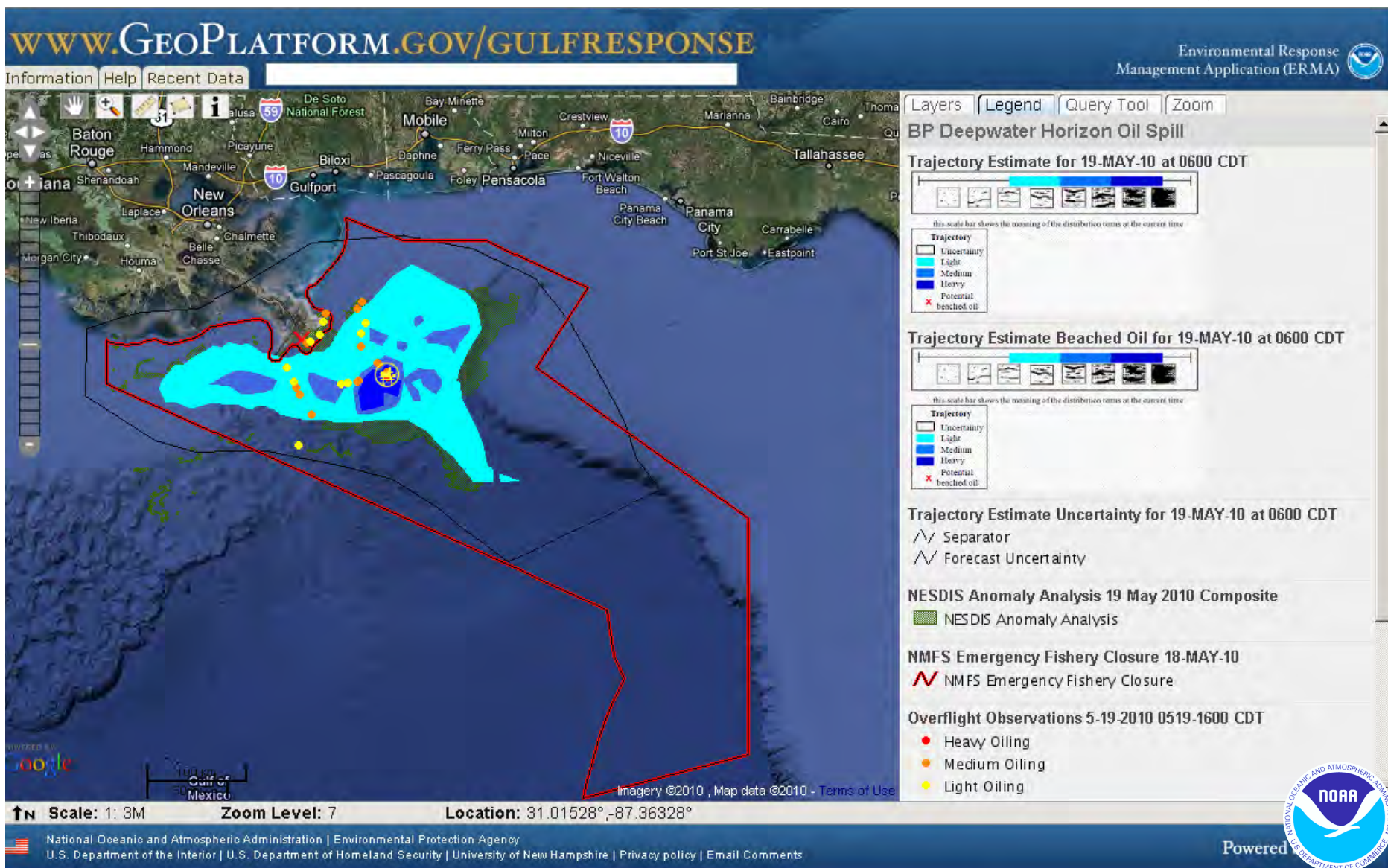
Figure by NOAA/ORR



# Oil Trajectory Maps

## May 19<sup>th</sup>, oil reaches LA

Courtesy of NOAA/ORR



# Surface and subsurface currents

## Satellite and drifter observations

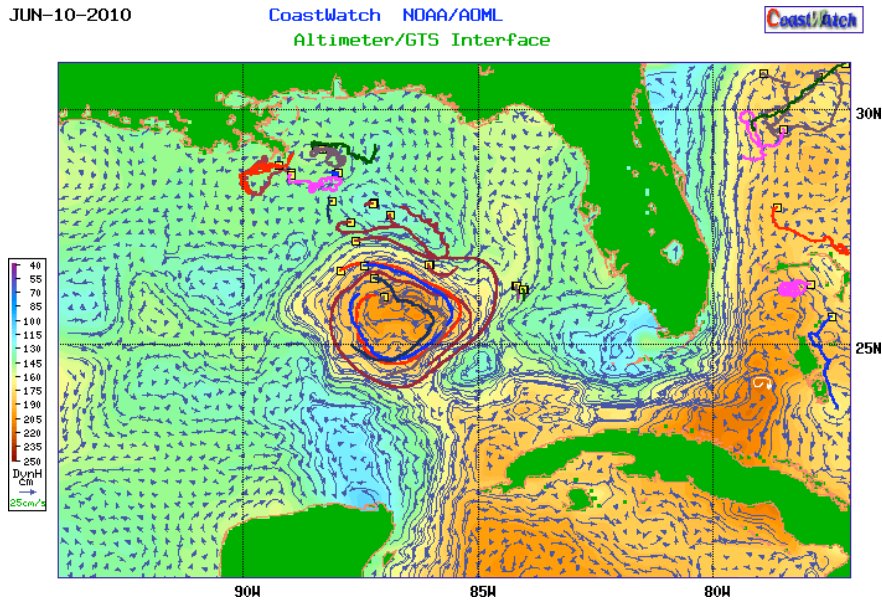


Figure from NOAA/AOML and NOAA/CoastWatch web page

## Numerical Models and temperature sections

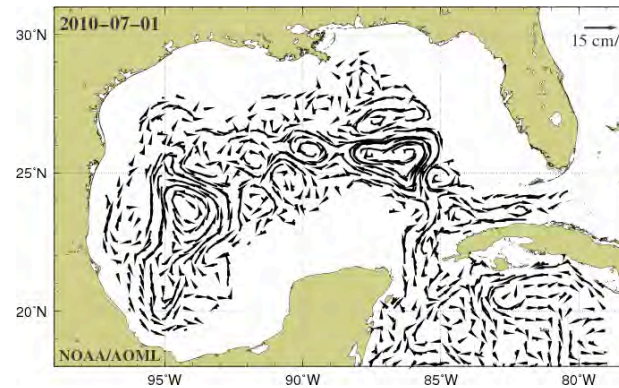


Figure by NOAA/AOML: Ocean currents at 1000m depth from IASNFS model.

AXBT Temperature section at 25.75°N 2010-06-11

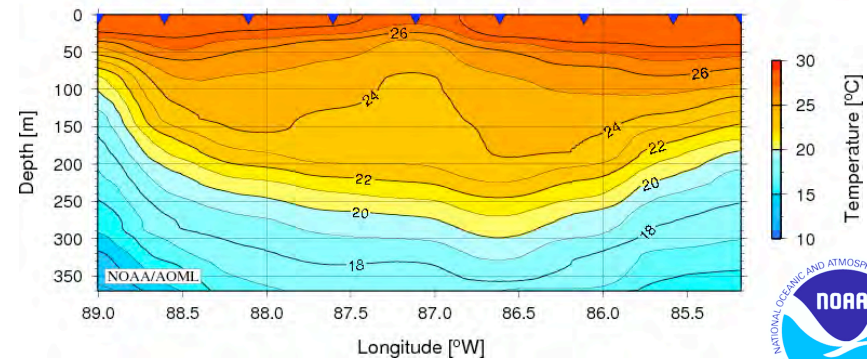
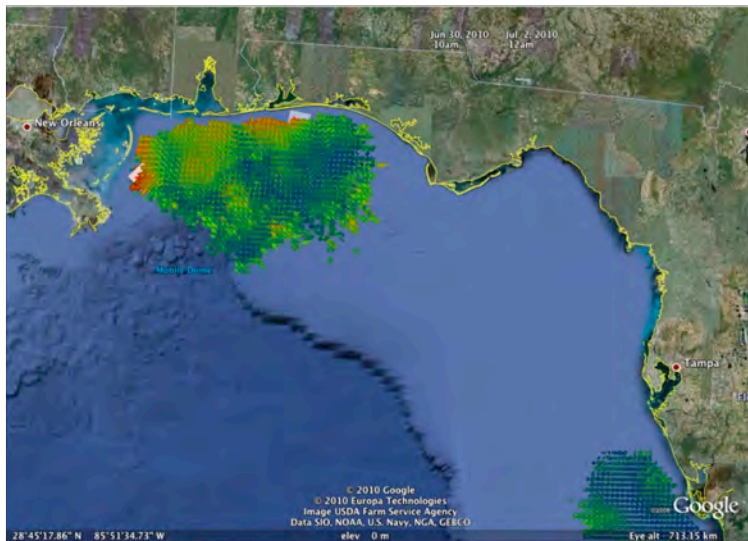


Figure by NOAA/AOML, P3 flights by RSMAS and NOAA/AOML



# Surface and subsurface currents

HF Radars



Map from Rutgers; web page by USM and USF

gliders

June 7 - July 26, 2010

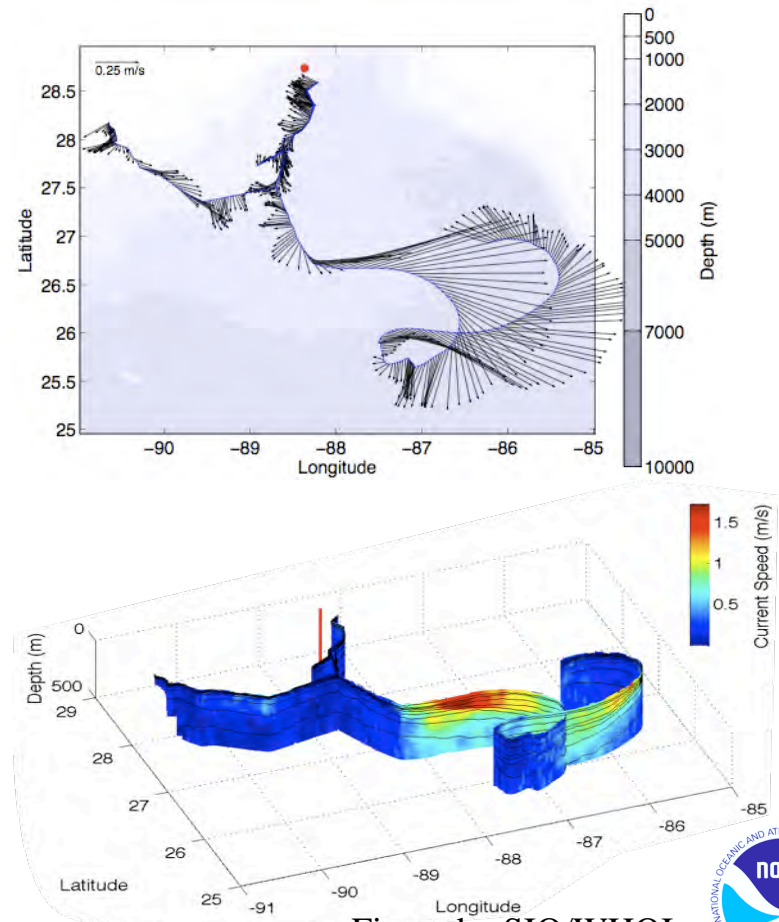


Figure by SIO/WHOI



# Maps of analysis of surface currents

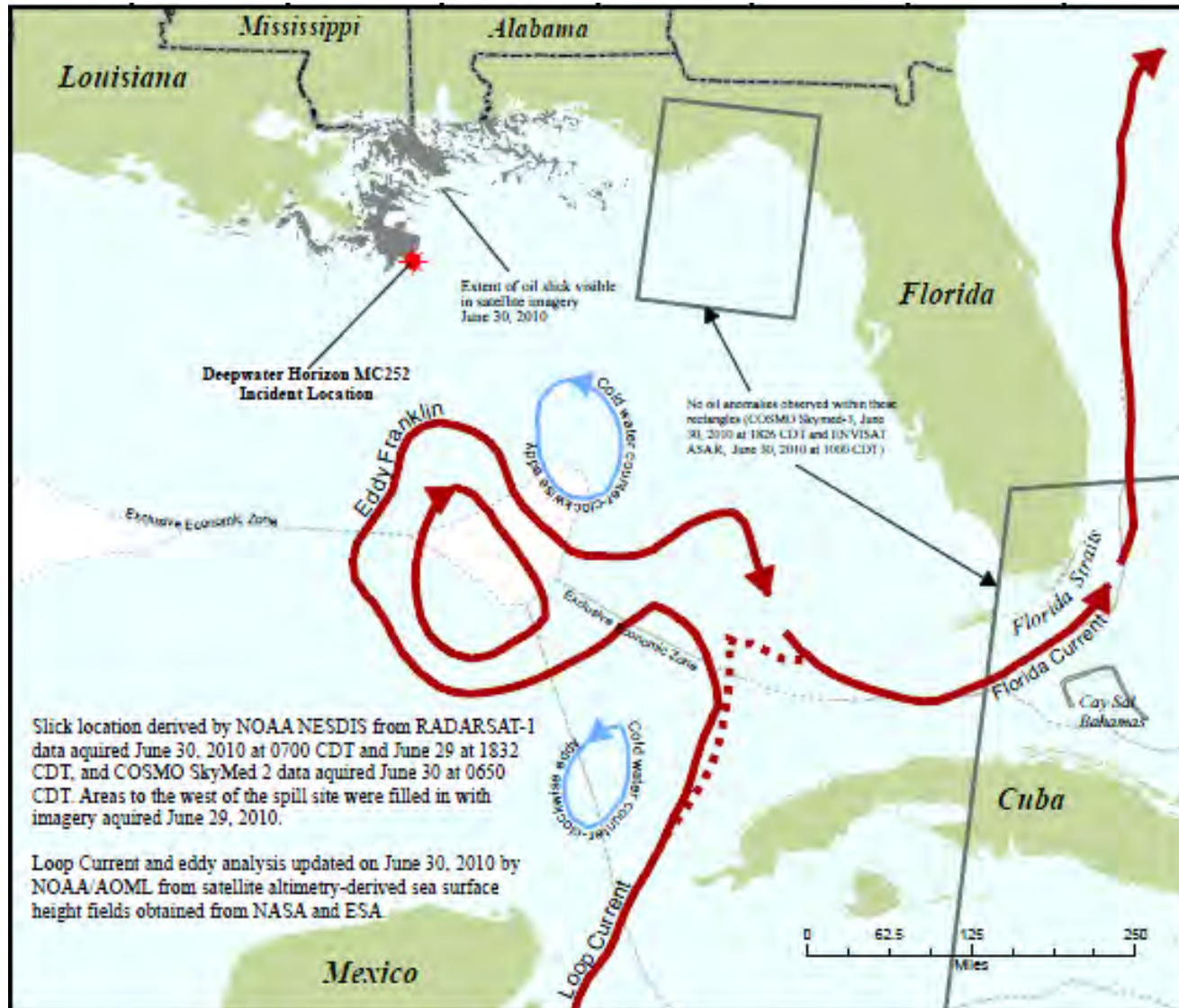


Figure by NOAA/ORR and NOAA/AOML

# F. G. Walton Smith Cruise (May 21- June 6, 2010): Subsurface oil with CDOM and oxygen

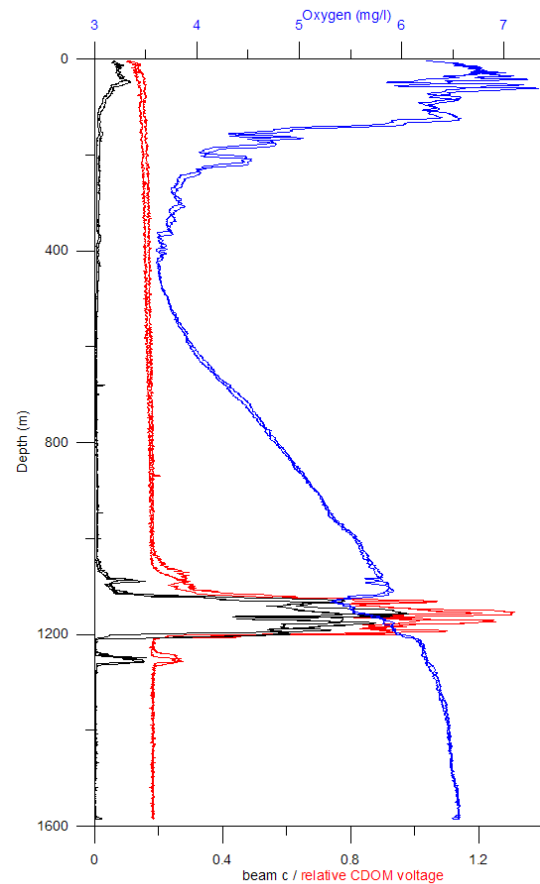


Figure by Vernon Asper (USM)



# Oxygen and Oil observations

## August Pisces cruise; Weatherbird Oil Analysis

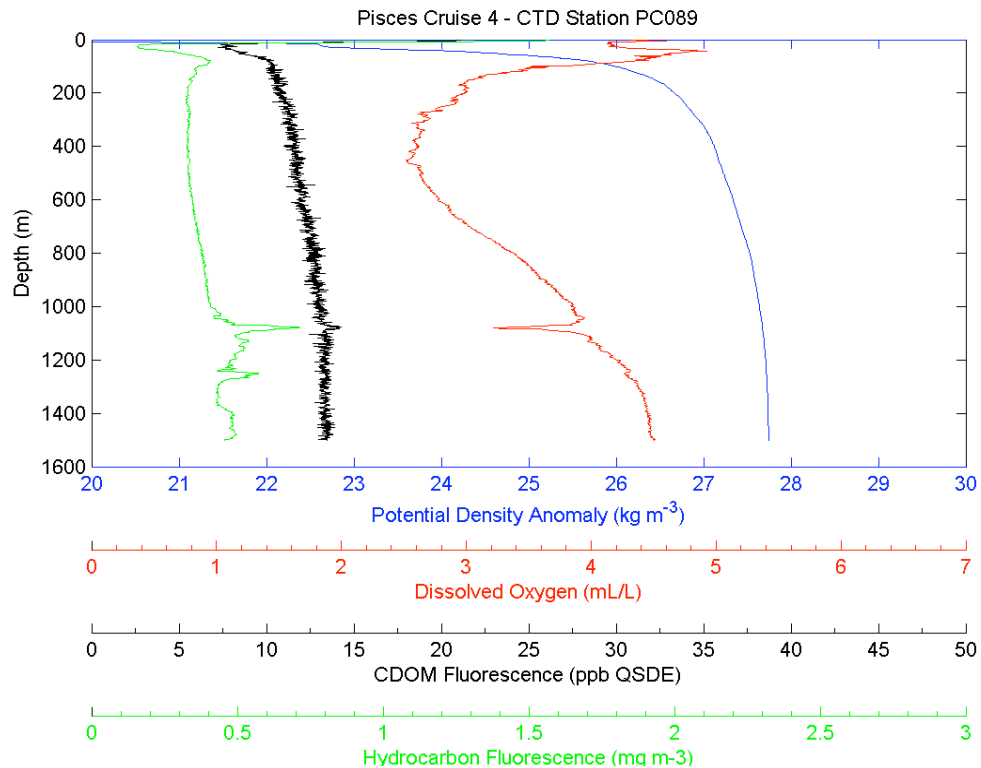


Figure by Arthur (Rost) Parsons  
(NOAA/NODC)

Water from oil mousse

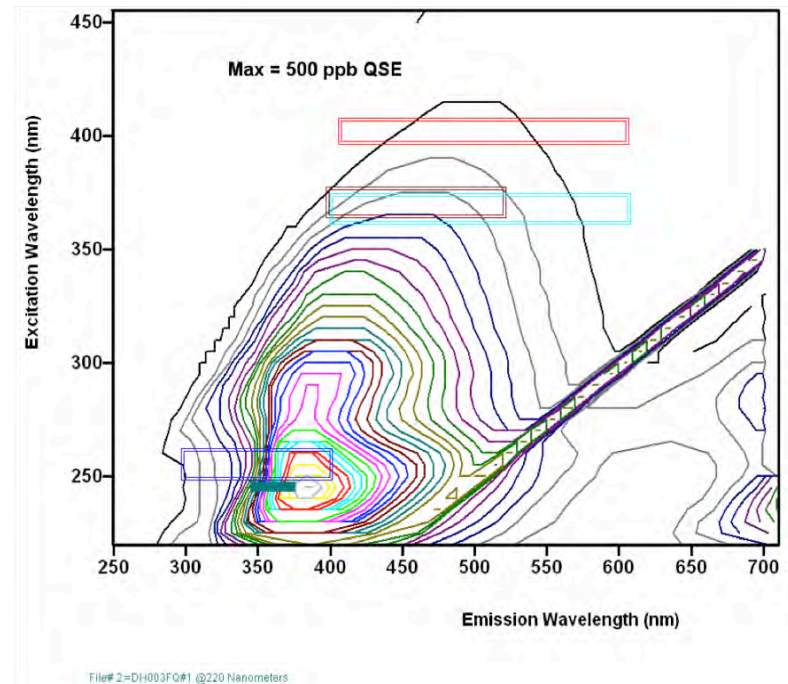


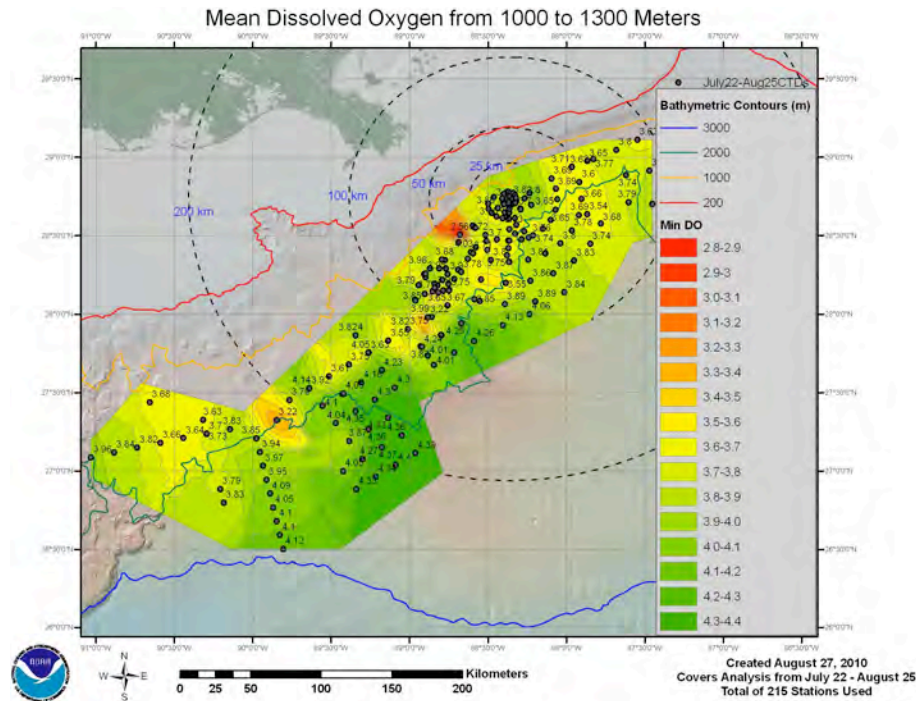
Figure by Paula Coble (USF),  
contours are fluorescence yield,  
colored boxes show region of  
detection for different fluorometers



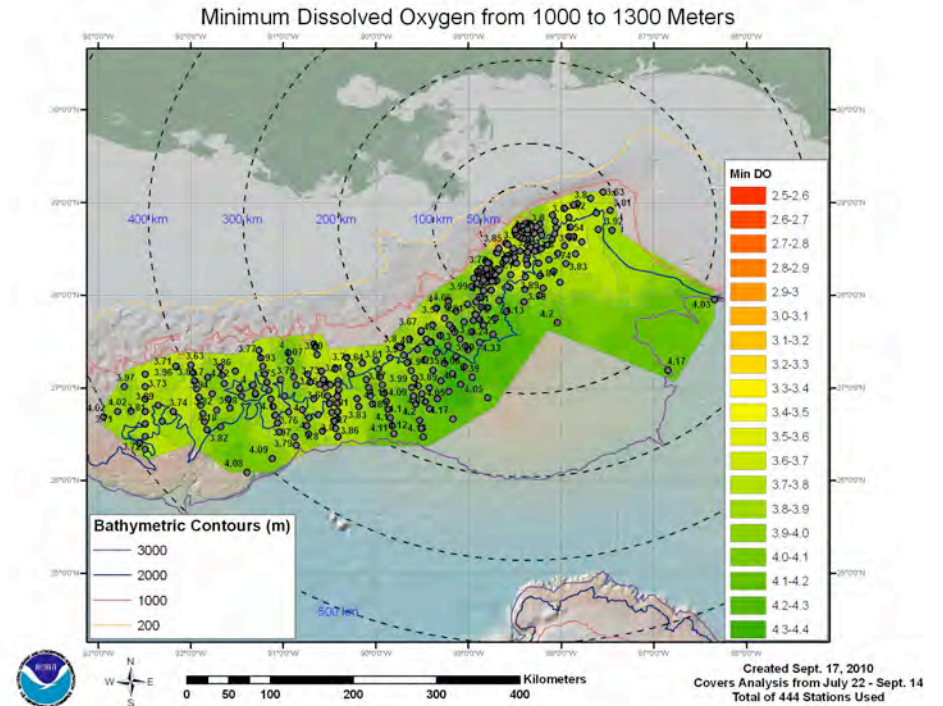


# Oxygen observations

## Through August 25



## Through September 14



Figures by Arthur (Rost) Parsons (NOAA/NODC)





# NOAA SHIP Nancy Foster cruise

## (June 30 – July 18)

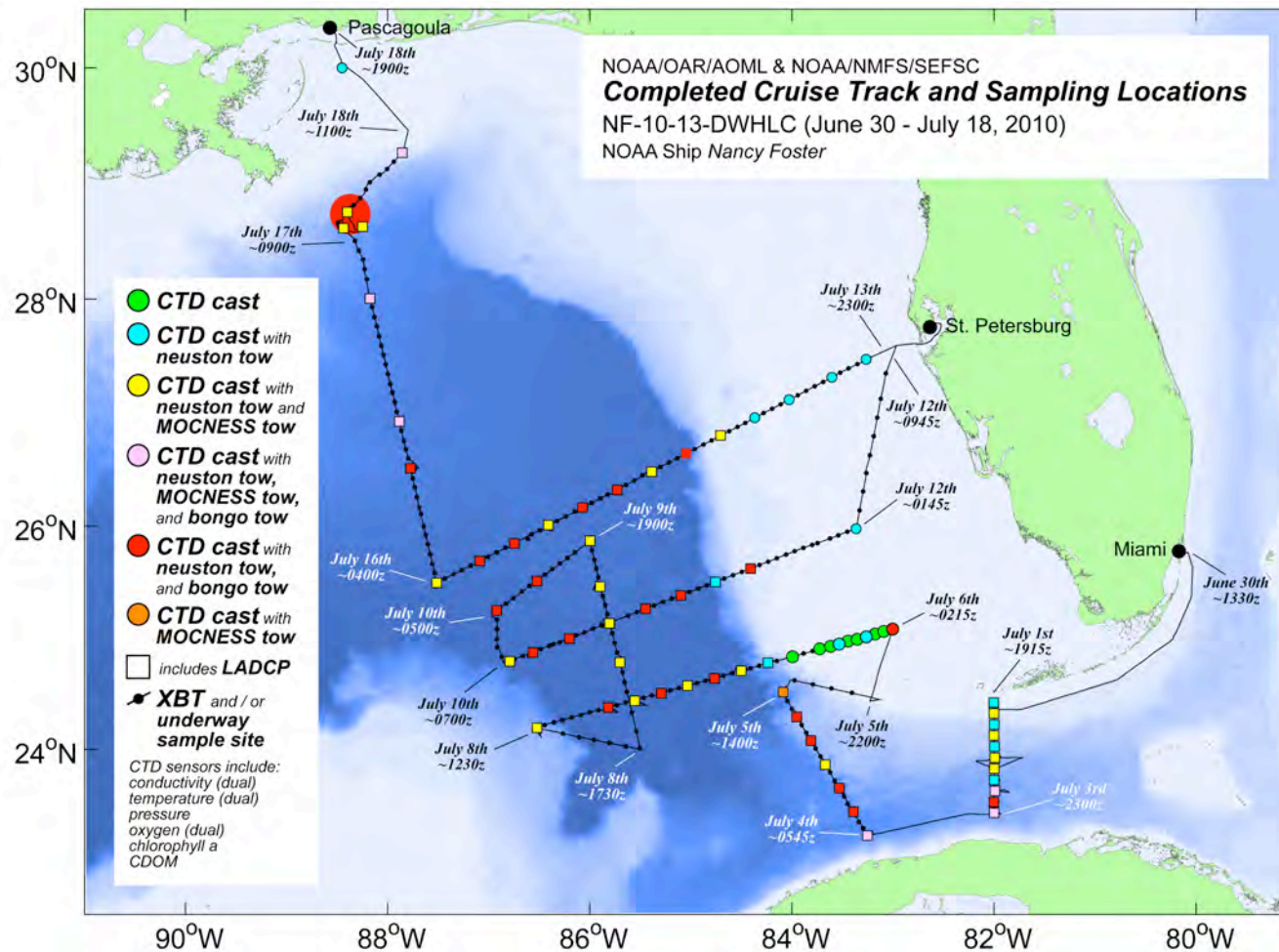


Figure by R. Smith (NOAA/AOML)



# NOAA SHIP Nancy Foster cruise (June 30 – July 18)

## Observations carried out July 17

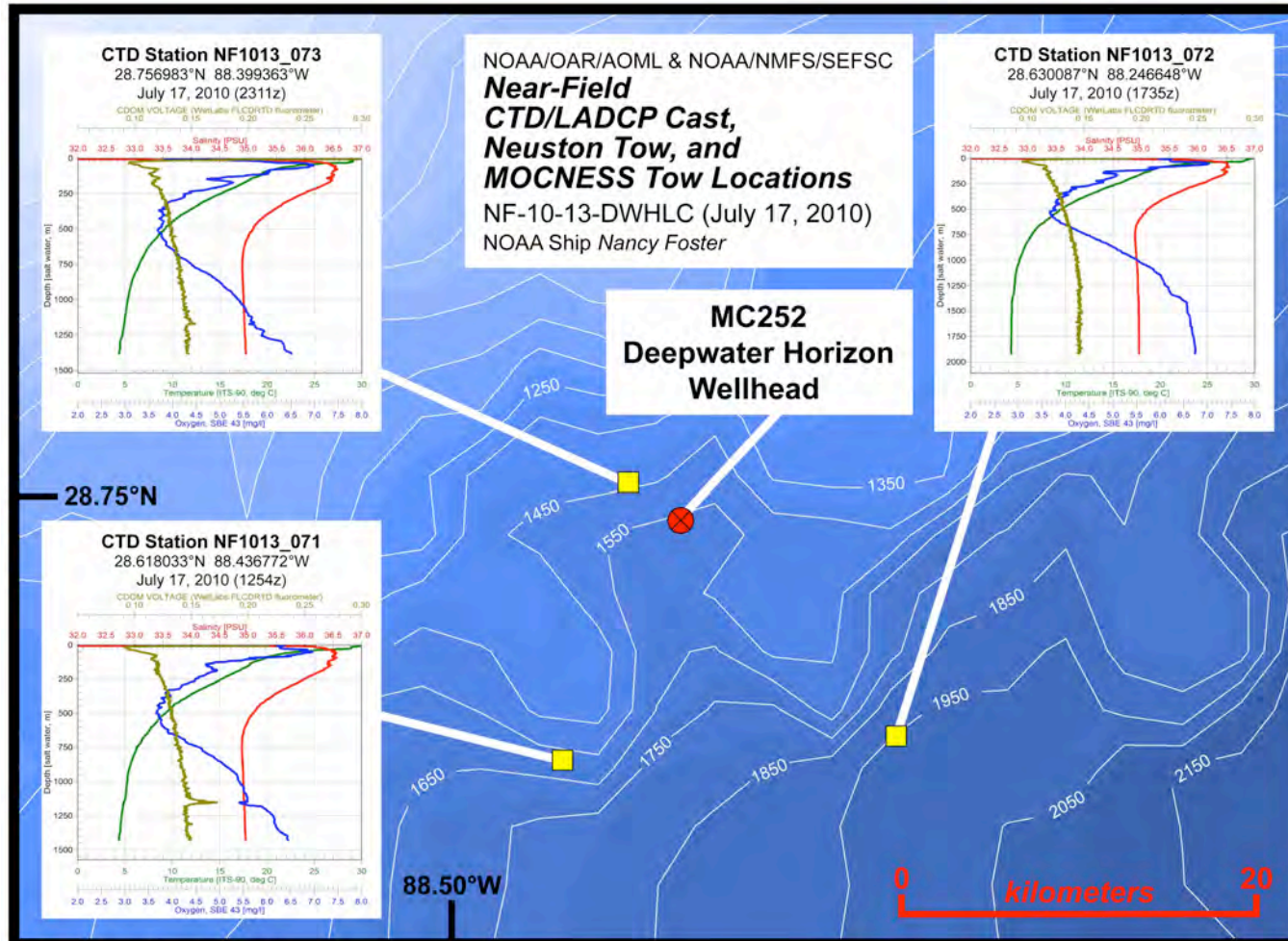
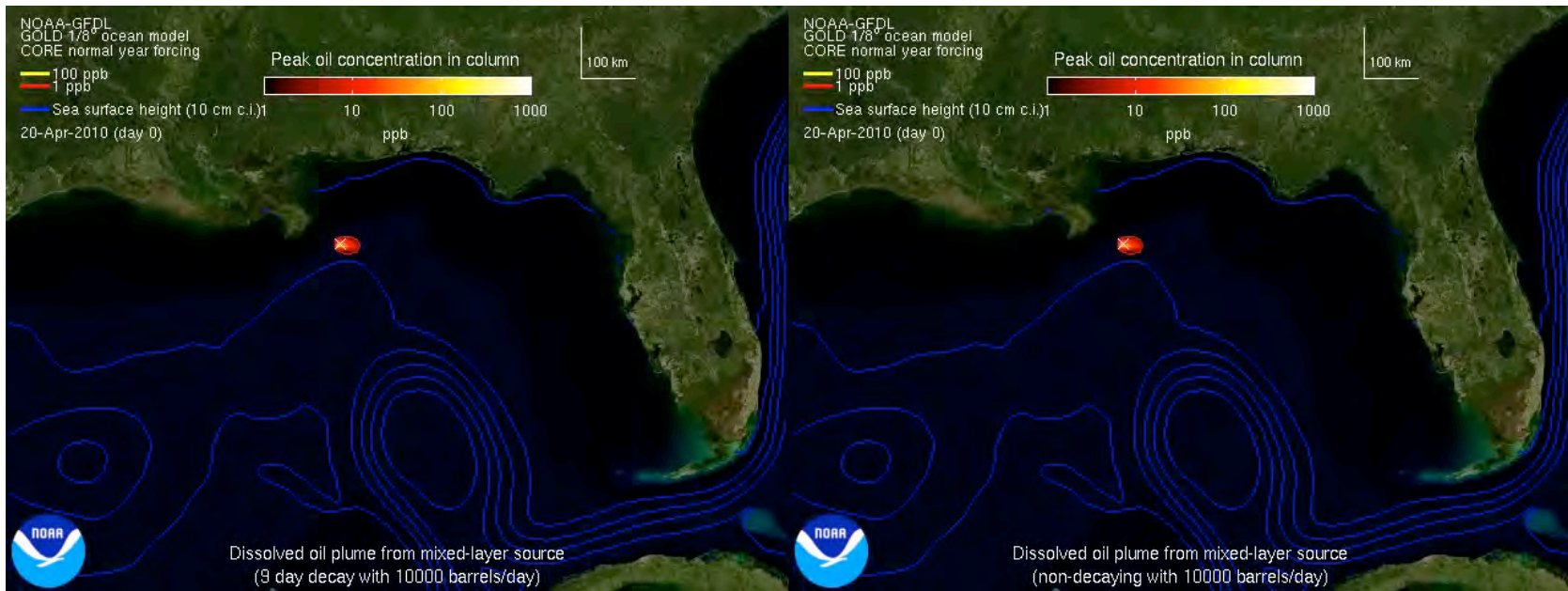


Figure by R. Smith (NOAA/AOML)



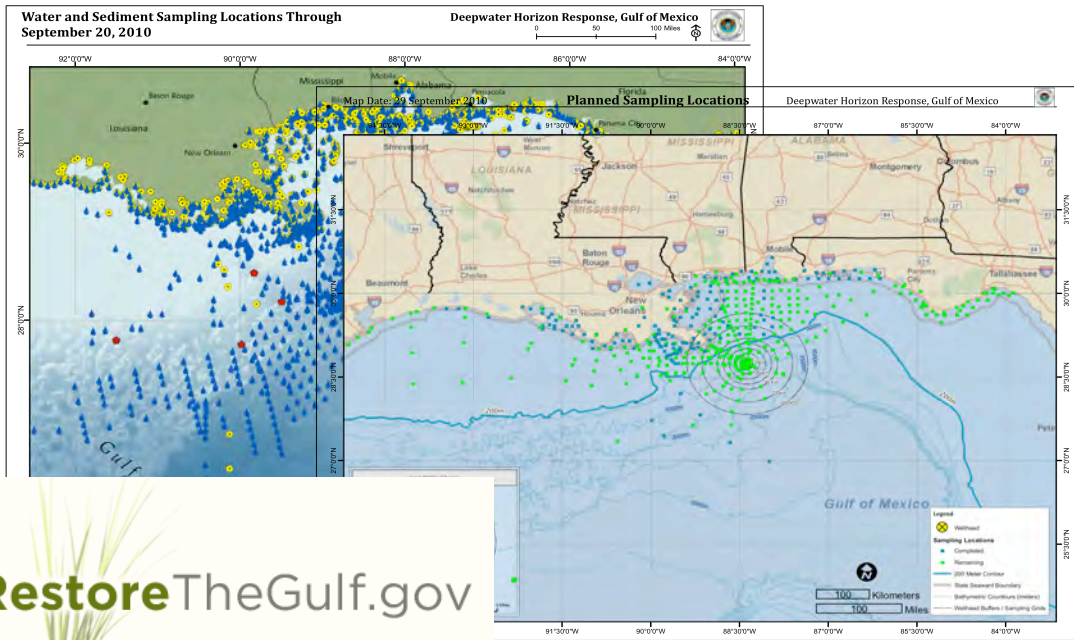
# Why the oil/dispersants never reached the Florida Straits ?



Courtesy of Robert Hallberg (NOAA/GFDL)



# Monitoring of sediments



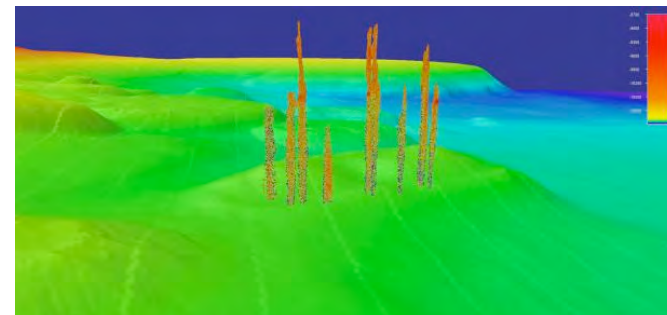
RestoreTheGulf.gov



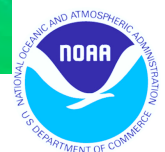
NOAA subsurface monitoring web page

## NOAA Ship Pisces:

- CTD
- Core sampling
- Camera-tow operation
- Mapping of natural hydrocarbon seeps



Figures from NOAA/ORR web site

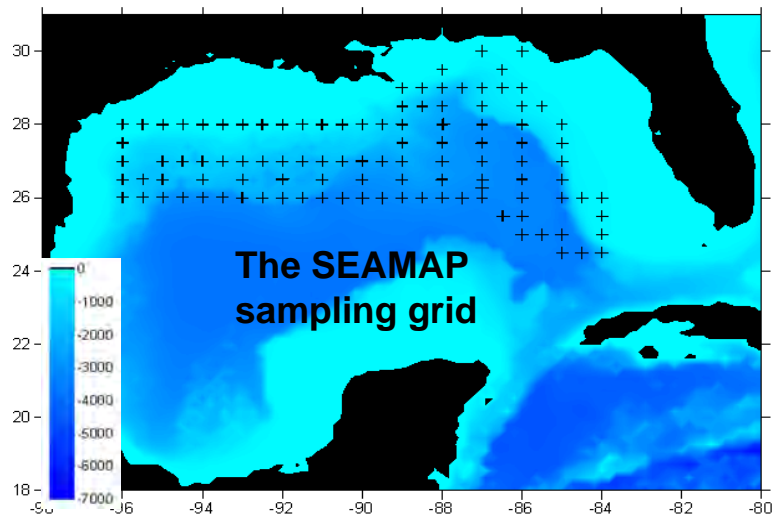


# Biological Observations

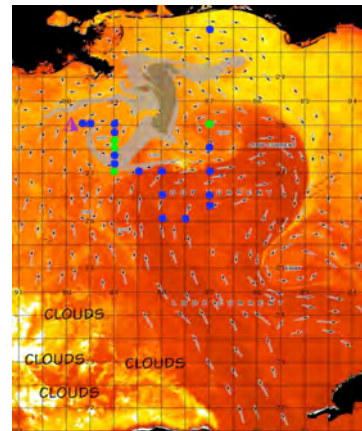
**U. S. Fish and Wildlife Service:** provide consolidated fish and wildlife reports.

## Nancy Foster cruise far field observations: No oil observed

- Convergence zones, ichthyoplankton; birds;
- 12 species of marine birds, very few terrestrial migrant, and marine mammals
- 209 zooplankton samples from 28 MOCNESS, 65 surface neustons, and 29 subsurface tows to investigate physiological condition, abundance, and diversity.
- Larval fish samples were collected to measure bio-indicators of cardiac toxicity of crude oil; bio-indicators were developed at NWFSC over the last 8 years.



John Lamkin (NOAA/SEFSC)



John Lamkin (NOAA/SEFSC).  
SST analysis by Mitchell A.  
Roffer (ROFFS™)

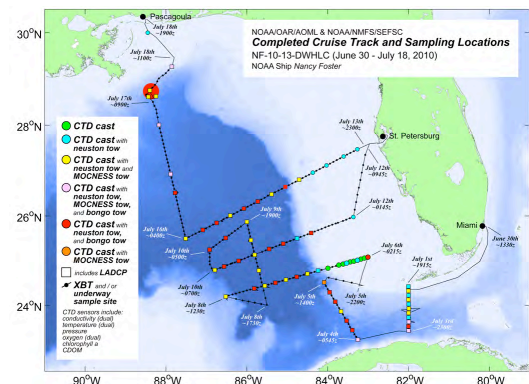


Figure by R. Smith  
(NOAA/AOML)



# Inventory of observations and data distribution

## IOOS - GCOOS



Integrated Ocean Observing System (IOOS)  
Gulf of Mexico Coastal Ocean Observing System  
(GCOOS)

<http://gcoos.org>

**Goal:** To develop automated and largely unattended data systems to deliver high-quality data and products to consumers.





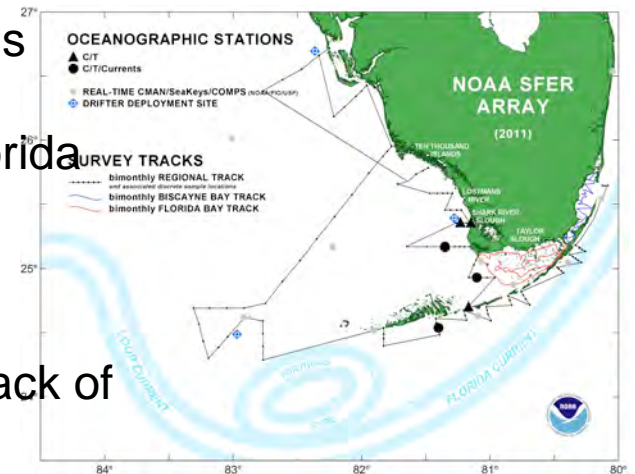
# Sustained Environmental observations in the Gulf of Mexico

Need for an interdisciplinary observing system to respond to extreme events (oil spills, hurricanes, harmful algal blooms).

**in the near field**, to investigate impact of oil on sediments, ecosystems, coastal regions, and  
**in the far field**, to investigate the impact on ecosystems (larvae, fish, mammals, corals, coastal regions, etc.) in areas including the west Florida shelf, Florida keys, Florida Bay, and western Gulf.

Some regional observing systems are already in place, although some risking being discontinued because of lack of funding.

Use current experience as starting point for its design and implementation.



# Future Work

- 1) **3D analysis of pathways and extension of oil, dispersants, and tar balls;**
- 2) **Evaluate various instruments to measure oil and conduct val/cal experiment so fluorescence data from response period can be properly interpreted;**
- 3) **Assess impact on ecosystems (near and far field);**
- 4) **Evaluate impact of bacteria in oil decay;**
- 5) **Assess the impact of different observations (including gaps and error estimates):**
  - **Have we measured all the key parameters ?**
  - **Have we measured them correctly ? (right location, right instrumentation, etc)**
  - **Are all the data and metadata properly accounted for and stored ?**
  - **Are we using (or did we use) all available data in the analysis ?**
  - **How have these data contributed to numerical modeling efforts ?**
- 6) **Use gained knowledge for future responses - Sustained ocean observations**



# Conclusions and Future Work

**The scientific community (government agencies, academia, and private industry) has made an impressive effort responding to DWH oil spill by collecting and analyzing an unprecedented number of interdisciplinary observations.**

- **Some observing systems and/or observations already in place to implement observing network in Gulf of Mexico;**
- **Real-time data transmission and analysis;**
- **Blending interdisciplinary observations, including satellite observations;**
- **Need for strong numerical modeling capability.**

