



INTEGRATED OCEAN OBSERVING SYSTEM

Applications of High Frequency Radar Surface Currents for Response to the Deepwater Horizon Oil Spill

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University of Southern Mississippi

GRI PI Workshop

October 25-26, 2011 St. Petersburg, FL



THE UNIVERSITY OF
SOUTHERN MISSISSIPPI

Acknowledgements

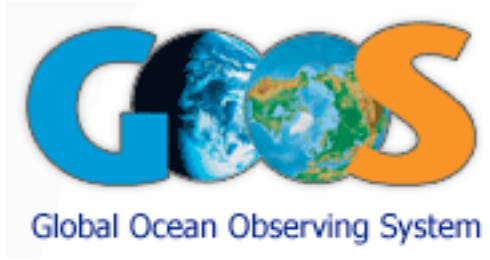
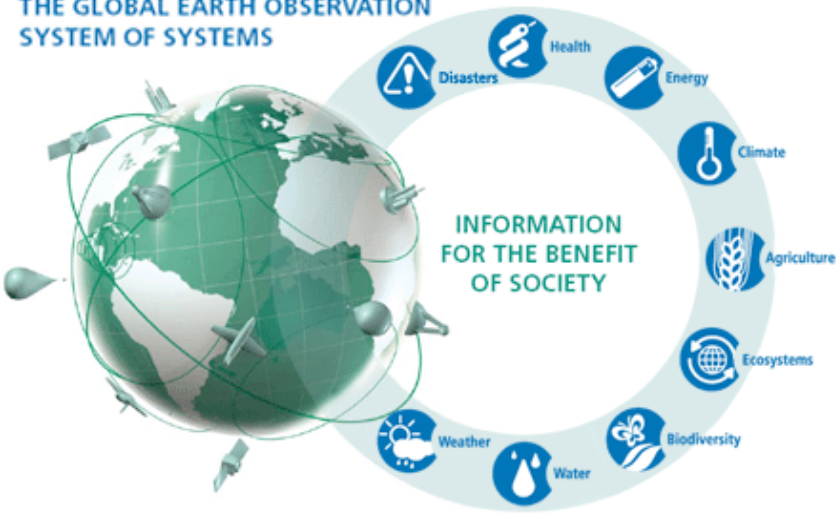
- Richard Slaughter and Jamie Davis of USM
- CODAR Ocean Sensors
- NOAA
 - Coastal Services Center
 - IOOS Office
 - National Data Buoy Center
- Northern Gulf Institute
- Office of Naval Research
- Members of GCOOS and SECOORA



Outline

- IOOS
- IOOS Surface Current Initiative
- Gulf of Mexico Coastal Ocean Observing System Region Association (GCOOS) & Southeast Coastal Ocean Observing Regional Association (SECOORA): Developing the HFR Network in the Gulf
- Central Gulf of Mexico Ocean Observing System (CenGOOS) HFR Network
- Response to Deepwater Horizon
- Post-spill studies

THE GLOBAL EARTH OBSERVATION SYSTEM OF SYSTEMS



Provides the data and information decision makers need to improve safety, enhance our economy, and protect our environment

NOAA IOOS Office Web Site

IOOS® INTEGRATED OCEAN OBSERVING SYSTEM

Home About NOAA Program Our Partners Other Resources Contact Search

U.S. IOOS®: Our Eyes on Our Oceans, Coasts, and Great Lakes.

Providing the data and information needed to improve safety, enhance our economy, and protect our environment.

The Integrated Ocean Observing System (IOOS®) is a federal, regional, and private-sector partnership working to enhance our ability to collect, deliver, and use ocean information. IOOS delivers the data and information needed to increase understanding of our oceans and coasts, so decision makers can take action to improve safety, enhance the economy, and protect the environment.

DATA CATALOG 	DATA MANAGEMENT Data Integration Framework (DIF) Data Management and Communications (DMAC)	COMMUNICATIONS Press Room Calendar of Events Messaging Materials Brochures, Videos, Podcasts Z-grams
REGIONAL PARTNERS Alaska Pacific Northwest North/Central California Southern California Hawaii/Pacific Islands Great Lakes Northeast Gulf of Mexico Southeast U.S. Territories in Caribbean	INTERAGENCY PROGRAMS Ocean Observatories Initiative Marine Protected Areas National Water Quality Monitoring Network more...	GLOBAL OBSERVATIONS Global Ocean Observing System Group on Earth Observations

Of Special Note

- U.S. Integrated Ocean Observing System: A Blueprint for Full Capability Ver 1.0 (pdf, Nov 2010)
- Data Integration Framework (DIF) Final Assessment Report (pdf)
- IOOS Regional Partners
 - Annual Workshop
 - Planning Document (pdf)
- Federal Register Notices:
 - U.S. Integrated Ocean Observing System Advisory Committee (pdf)
 - Certification Standards for Non-Federal Assets (pdf)
- ICOOS Act Progress Report
- FY 2010 Regional Fact Sheets (pdf)
- IOOS Response to Deepwater Horizon Oil Spill
- NOAA's Deepwater Horizon Oil Response
- IOOS Report to Congress (pdf)
- National Surface Current Mapping Plan
- National Operational Wave Observation Plan
- IOOS Animal Telemetry Observations Workshop, Mar 2-3, 2011

11 Regional Associations ensure unique local needs are addressed

IOOS in the Gulf of Mexico



IOOS INTEGRATED OCEAN OBSERVING SYSTEM

GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM DATA PORTAL

Assets Monitoring Direct Data Access DIF SOS LDN SOS URLs Vocabularies Downloads Contact Us

Welcome to GCOOS Data Portal

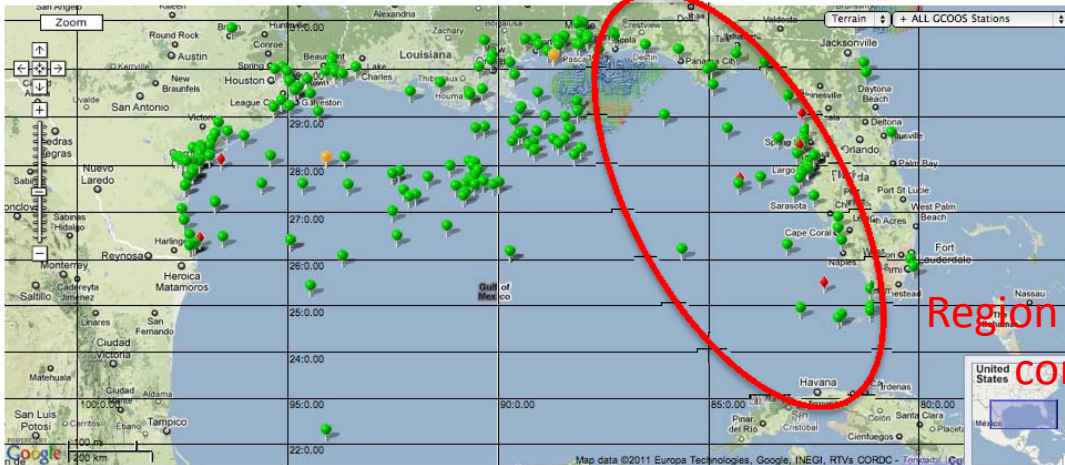
This **Data Portal** provides timely information about the environment of the United States portion of the Gulf of Mexico and its estuaries for use by decision-makers, including researchers, government managers, industry, the military, educators, emergency responders, and the general public. Observing stations in the region are monitored constantly. Please visit the GCOOS main web site at <http://www.gcoos.org/> for more information on this regional association.

Region's Current Condition

The following is an interactive map to display resources and status of coastal and ocean observing stations. Green markers represent stations in full operation, orange markers are those with defective sensors and red-marked stations are those that are currently not transmitting data. Click on the station to view station details. Not all stations may be visible at the current scale. Zoom-in on an area to reveal all the stations. The HF Radar overlay uses Coastal Observing Research and Development Center (CORDC) published [HF RADAR API](#). [Click here](#) to toggle back to 2D mapping from 3D display.

WHAT'S NEW!

- (2011-03-15) OOSTethys parser updated to extract specific observations from the network using new standards with multiple returns. [Click here](#) to try.
- (2011-03-02) Added a vessel tracking tab in [Contact Us](#) page only as a reference.
- (2010-10-05) The GCOOS vocabulary at the [MMJ Ontology Registry and Repository](#) (<http://mmjsw.org/ont/gcoos/parameter>) was updated, referenced by SOS and fully functional.



Region of mutual concern

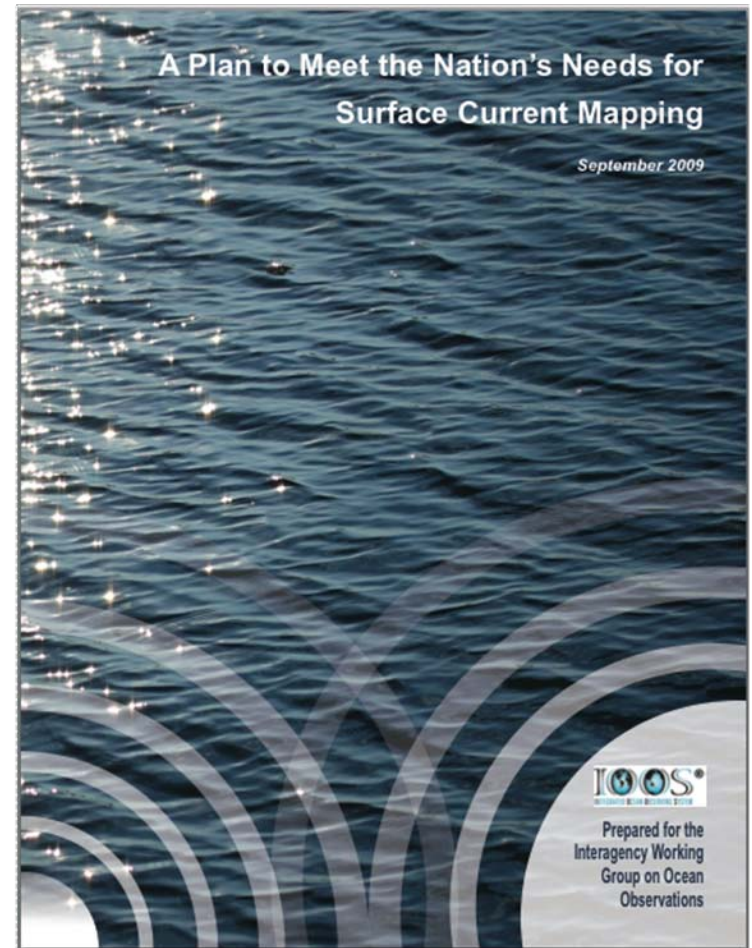
secoora.org

gcoos.org

NOAA/IOOS High Frequency Radar Surface Current Mapping Plan

Released September 2009

- Five Year Build-out
- Cover US Coast in lower 48 with long-range HFR
- Approximately 4 nested higher resolution systems per RA



National HF Server and Architecture Project (NOAA/NOS/NDBC/IOOS)

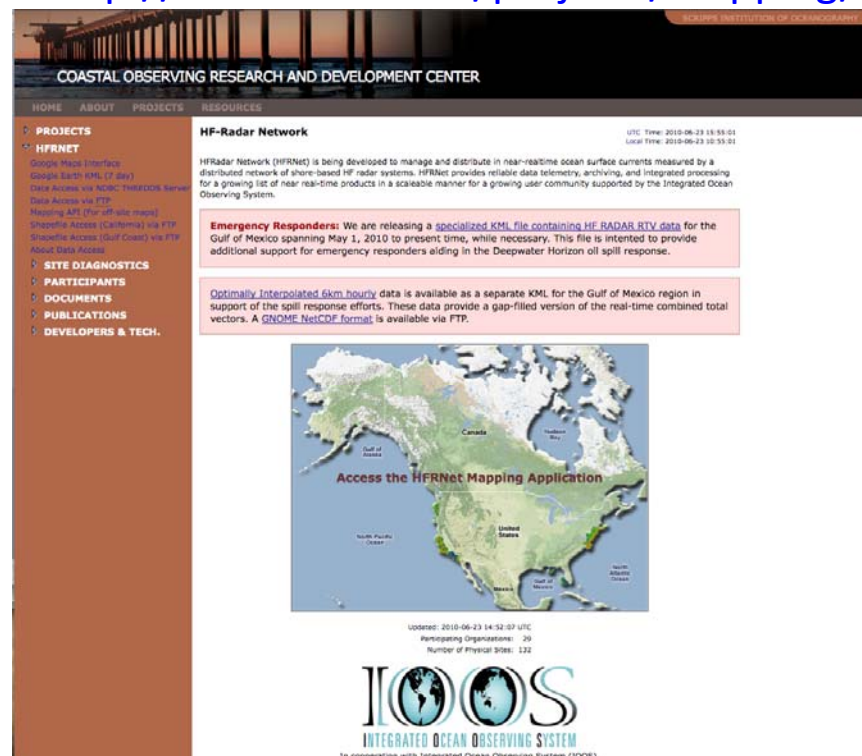
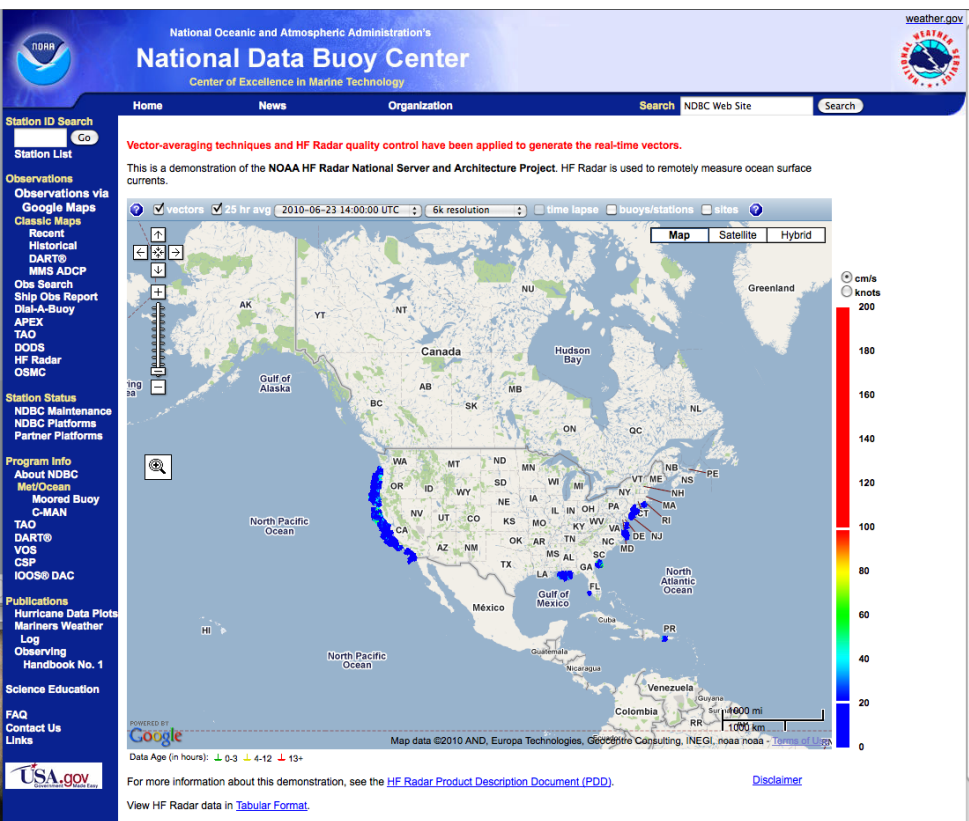
- Integrated National Network for “Radials”
- Scalable and distributed data management system
 - Data Storage
 - Data Access
 - Data Delivery
- Enhancements include:
 - Compute “Totals”
 - Objectively Interpolated “Totals”
- Single source of surface currents for
 - Coast Guard Search and Rescue
 - NOAA ER&R
 - Mariners
 - ...



NOAA HF Radar National Server and Architecture Project

NDBC HF Radar Network Node Page
<http://hfradar.ndbc.noaa.gov/>

Scripps National HF Radar Network Node Page
<http://cordc.ucsd.edu/projects/mapping/>



Where HFR coverage is sufficient, USCG uses this system for search and rescue operations



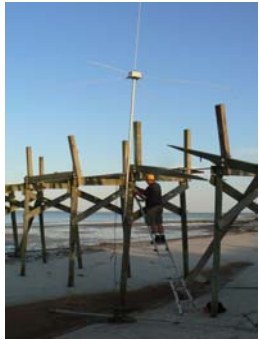
GULF OF MEXICO
COASTAL OCEAN
OBSERVING SYSTEM

GCOOS and SECOORA 5-year HFR Build-out Plan



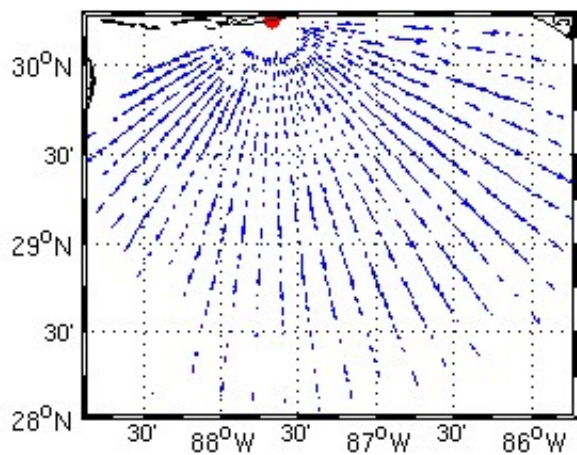


Radial Currents from CODAR Stations of the Central Gulf of Mexico Ocean Observing System CenGOOS

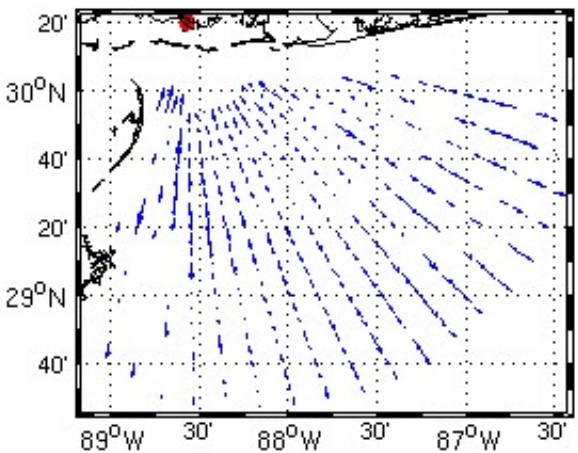
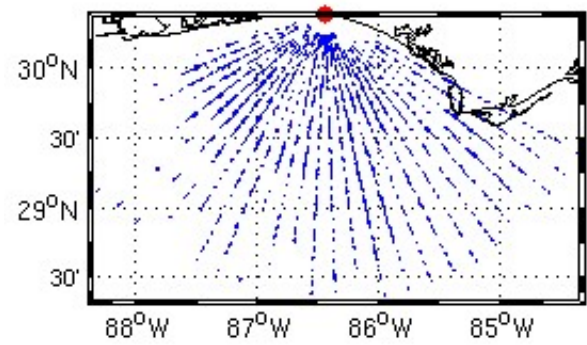


Pascagoula MS

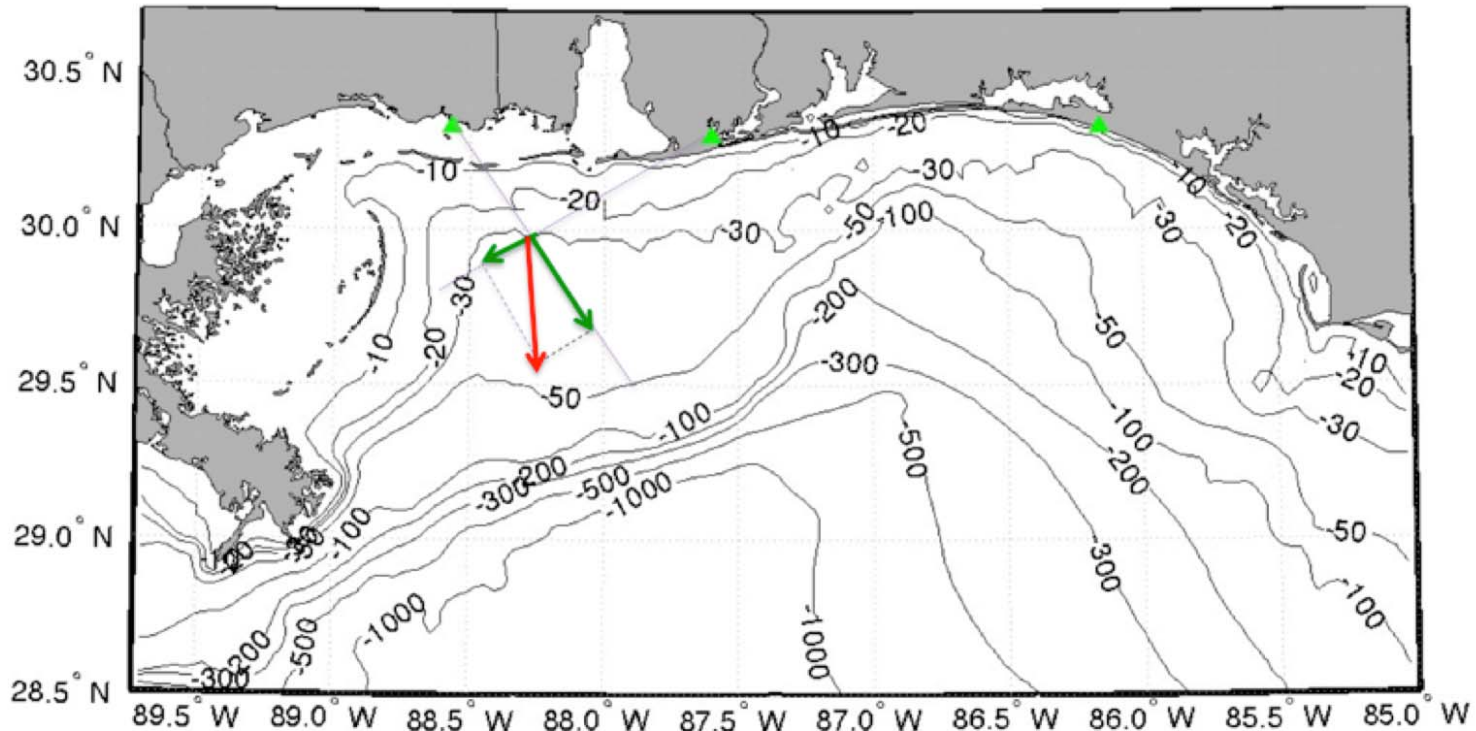
Orange Beach/Gulfshores



Destin



Total Current Vector Estimation



Models can assimilate more accurate radials

April 20, 2011 Deepwater Horizon Drilling Rig Explodes



CenGOOS CODAR on April 20, 2010

- Gulfport station disassembled for move to singing River Island
- Permission to reinstall on Singing River Island received, but installation had just begun
- Central site disassembled since 11/2009 under the direction of Gulf State Park because of a dune replenishment project that was still ongoing
- Destin station satellite communications problematic

Gulf State Park
Orange Beach, AL





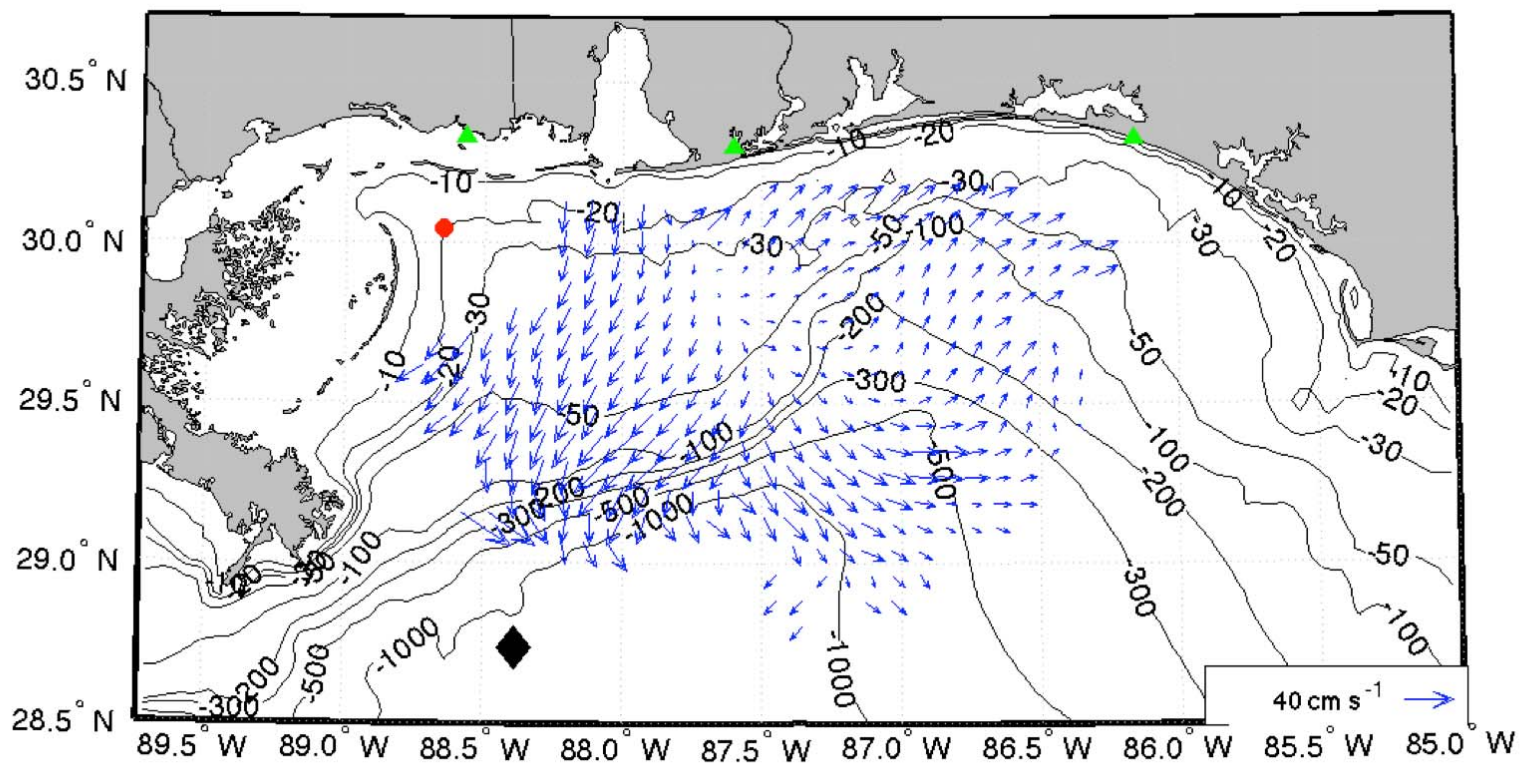
CenGOOS CODAR DwH Timeline

- April 23-25: Singing River Island station installed
- April 28-May 2: Orange Beach station reinstalled and Destin Station communications problems solved
- May 2- August 1: As problems developed they were fixed ASAP.



Total Surface Currents

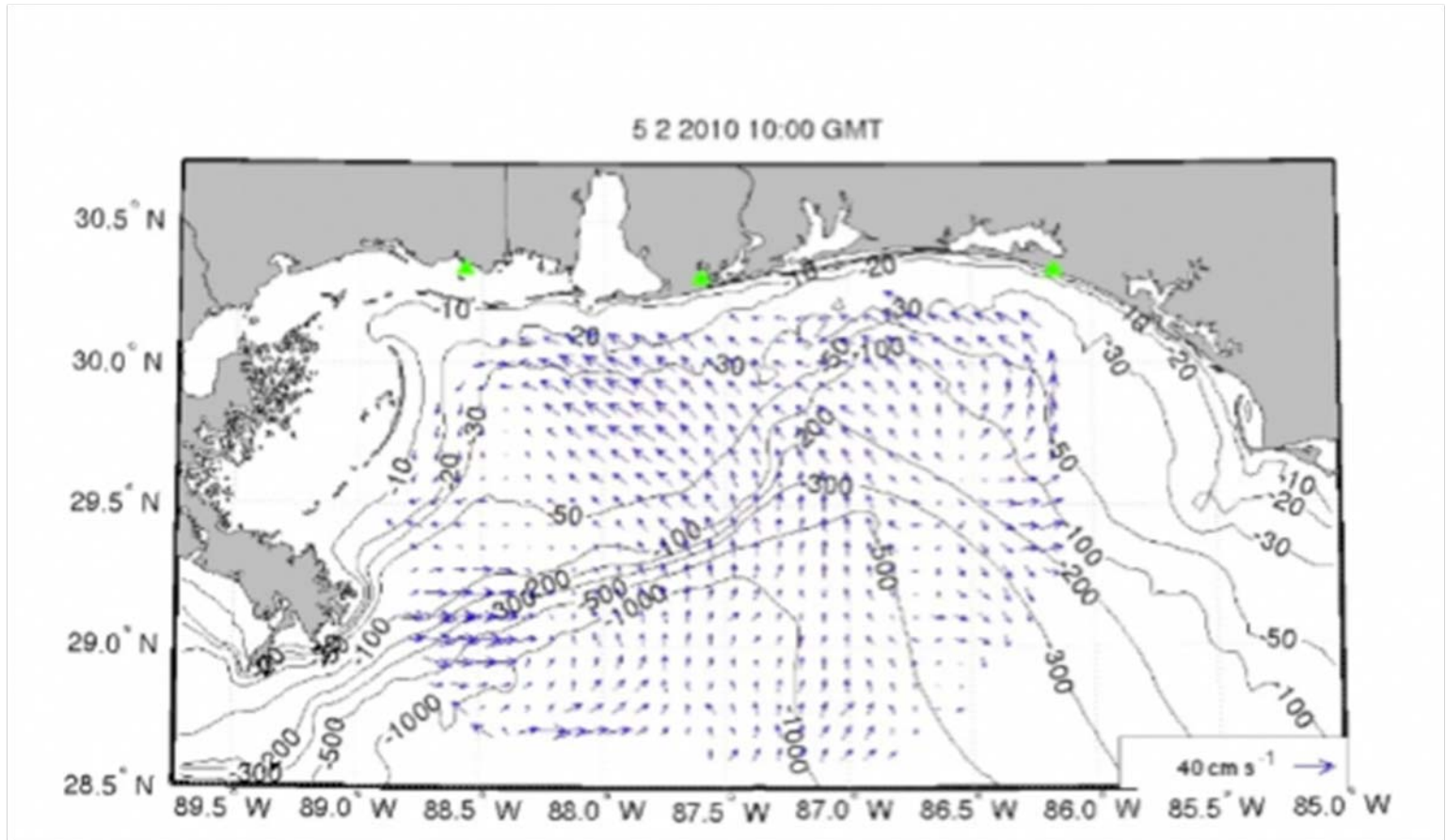
May 20, 2010 00:00 UTC





Total Surface Currents

May 20, 2010 10:00 UTC



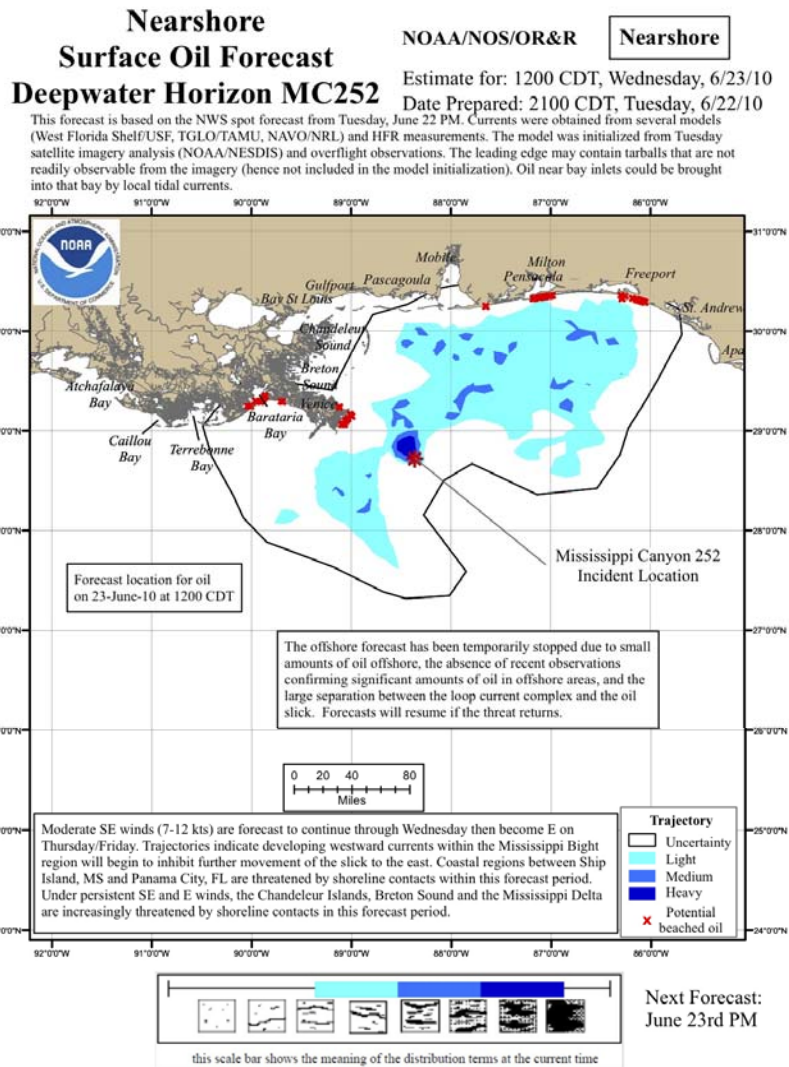
Use of HFR Data by NOAA/Office of Response and restoration/Emergency Response Division (ERD)

- During an ongoing hazardous spill ERD provides scientific expertise for the response.
- A key product of ERD is trajectory forecasts.
- ERD had available multiple operational or near-operational numerical ocean models for the Gulf:
 - NOAA Gulf of Mexico model
 - USF West Florida Shelf model
 - Texas A&M/Texas General Land Office HYCOM model
 - Navy NRL/NAVO NCOM models.

Use of HFR Data by NOAA/Office of Response and restoration/Emergency Response Division (ERD)

- Although previous studies showed that assimilating surface currents improved modeled sub-surface currents, none of these models was set up for assimilating surface current data
- In general, the models produced differing forecasts and it was not obvious which was “best” at any given time.
- ERD was ready to use HFRNet
- HFR currents were used to help guide the use of the models in forecast generation.

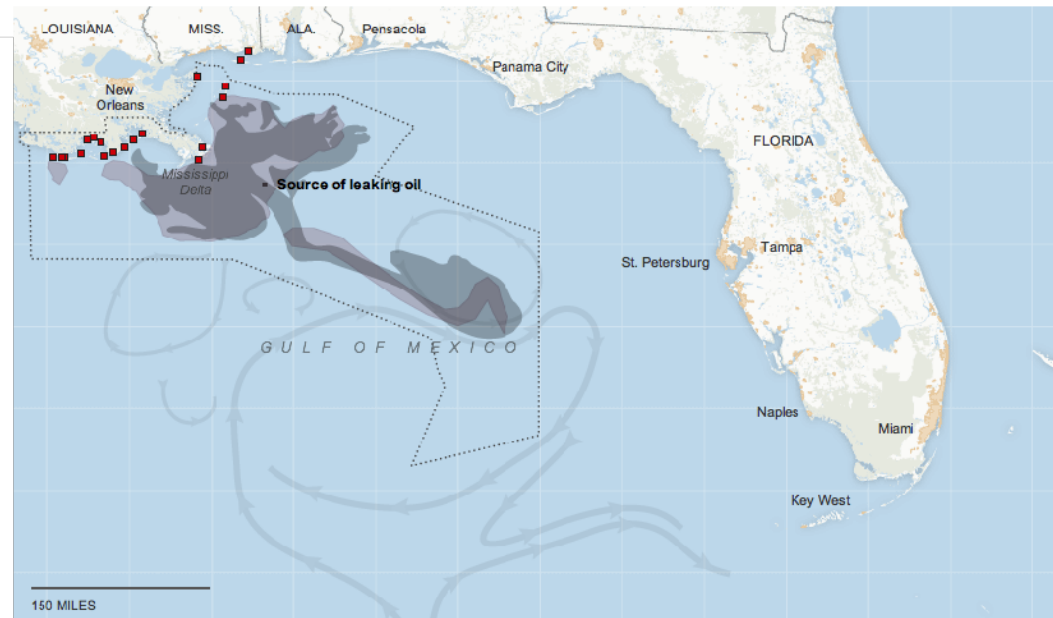
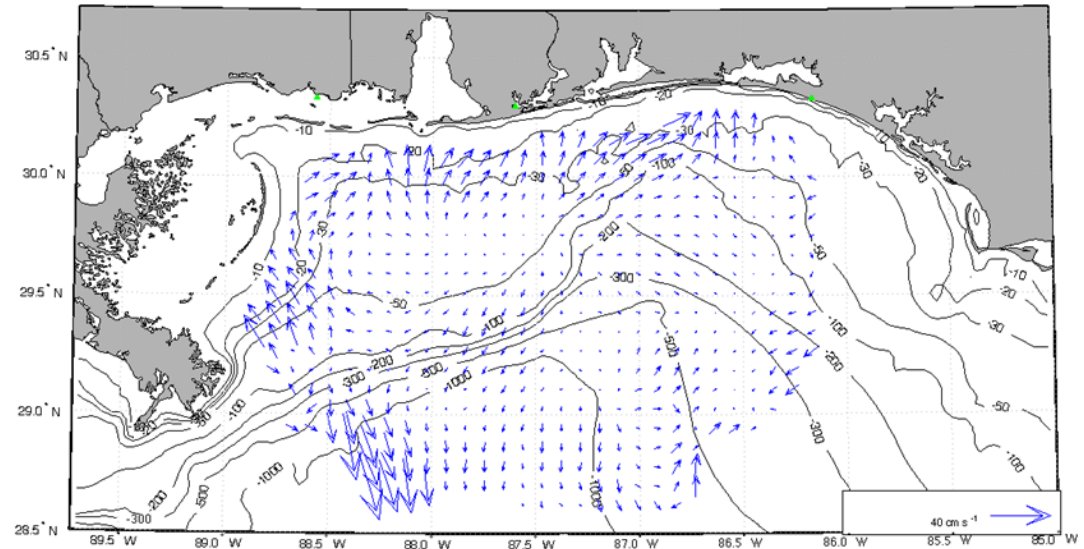
This forecast is based on the NWS spot forecast from Tuesday, June 22 PM. Currents were obtained from several models (West Florida Shelf/USF, TGLO/TAMU, NAVO/NRL) and HFR measurements. The model was initialized from Tuesday satellite imagery analysis (NOAA/NESDIS) and overflight observations. The leading edge may contain tarballs that are not readily observable from the imagery (hence not included in the model initialization). Oil near bay inlets could be brought into that bay by local tidal currents.



Mean Currents May 20--May 26, 2010

Oiling at:

- Pas a Loutre
- Raccoon Island
- Wine Island
- Terrebonne Bay West
- Terrebonne Bay North
- Terrebonne Bay East
- East Timbalier Island
- Grand Isle
- Elmers Island
- Barataria Bay South, Brush Islands
- Chandeleur Islands south and north
- Horn Island



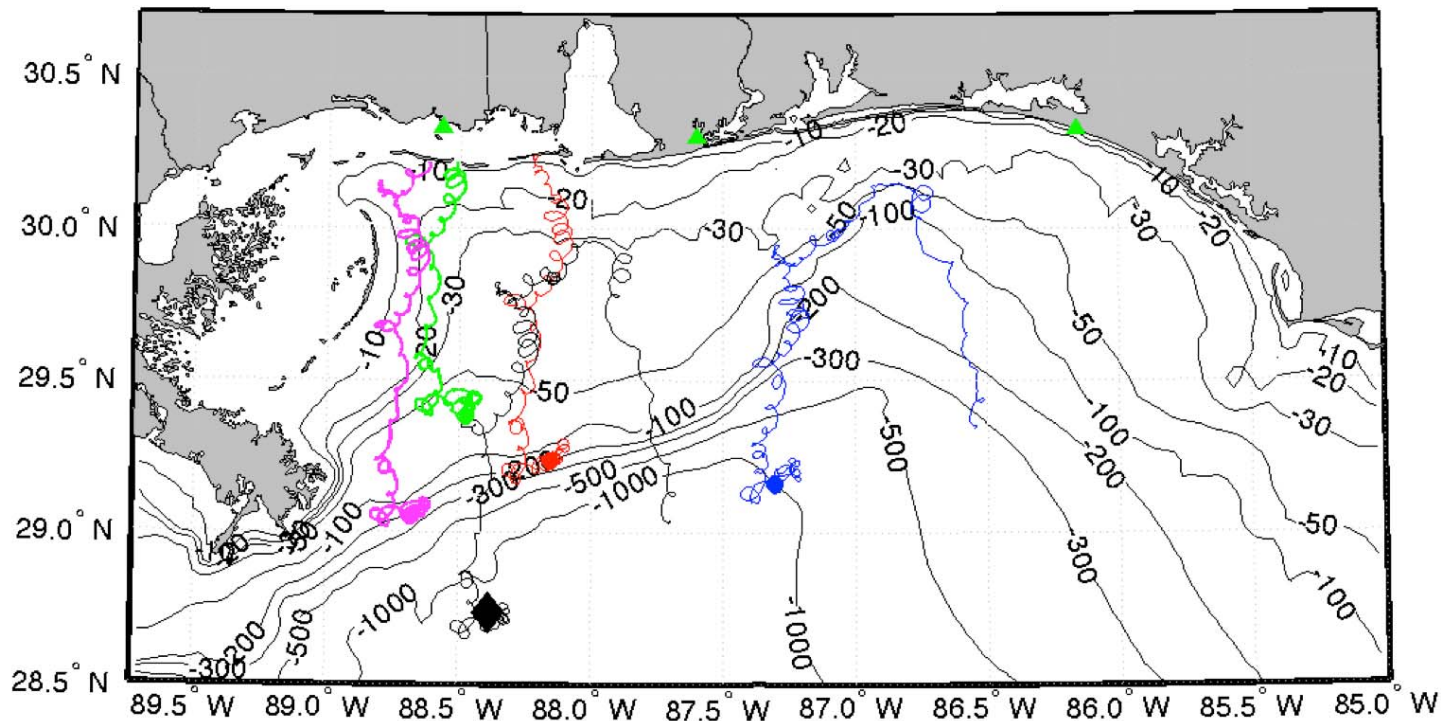
Post Spill Studies

- Advection pathways
- Integrated surface transport
- Investigations of role of circulation in ecosystem changes since DWH:
 - Turtle mortality
 - Food web changes



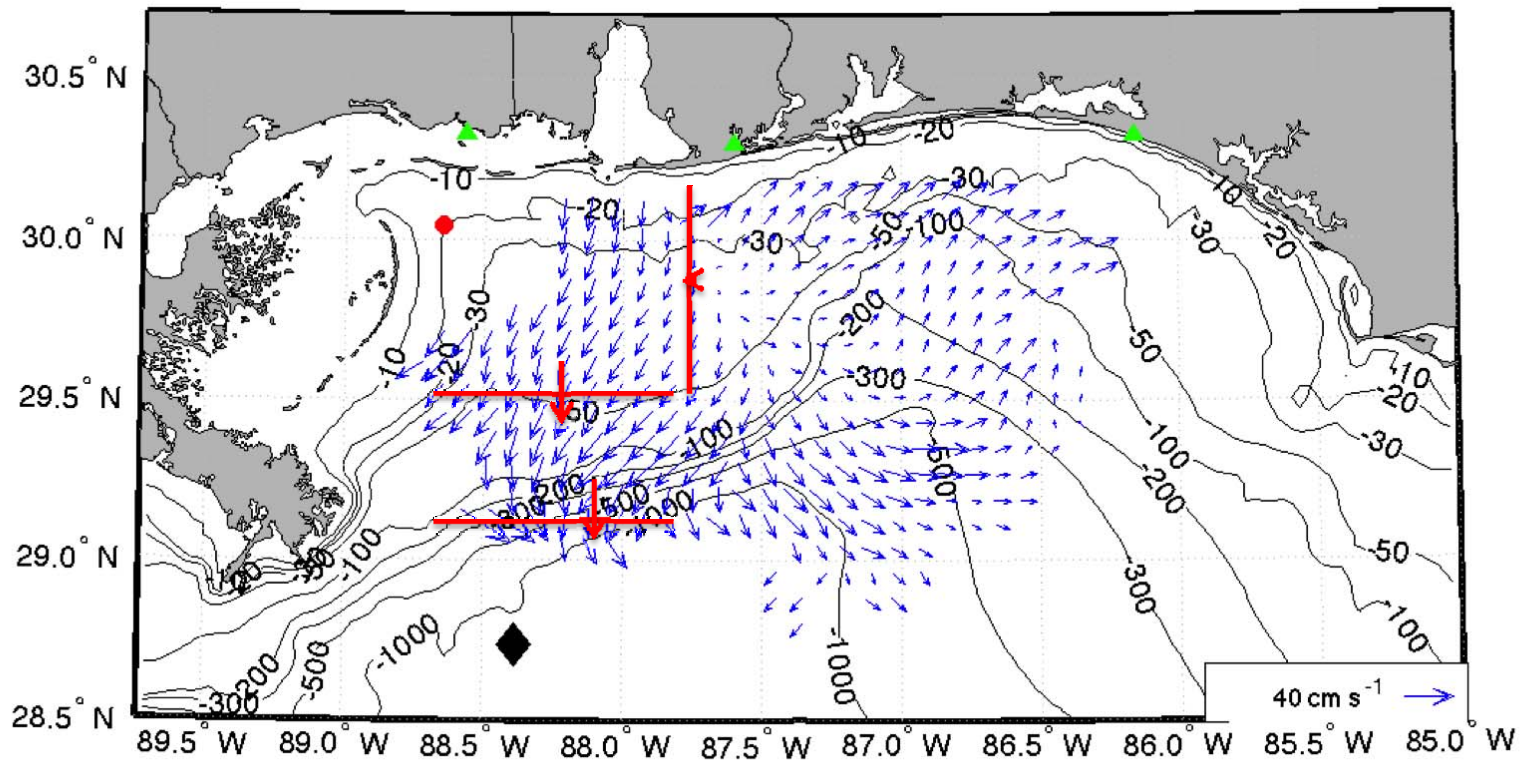
Sample Trajectories from CODAR Totals

All start on May 20, 2010





Surface Transport for Advection



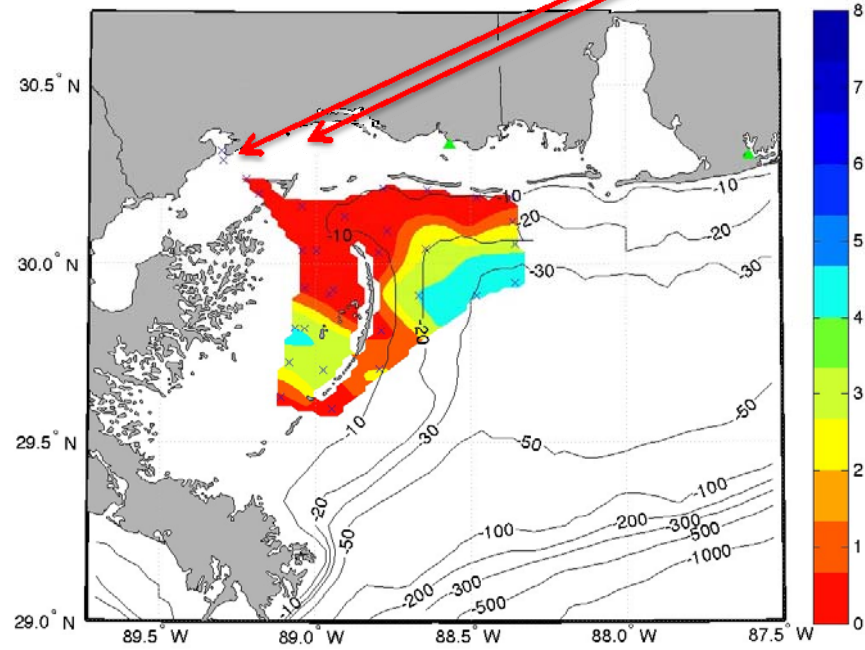
2011 Summer Flooding and Hypoxia: Another Large Perturbation to Northwest Mississippi Bight

Bonnet Carre
Spillway Opening
2011



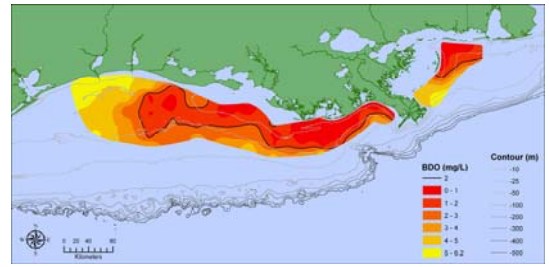
Image Source:
<http://www.pbase.com/septembermorn/image/95461352>
Colleen Perilloux Landry

2 25 MHz CODAR
SeaSondes



Bottom dO [mg/l] August
16-18, 2011

Gundersen, et
al., (2011)



Rabalais (2011)



Thank You!