

The *Deepwater Horizon* Disaster: 5th Anniversary



University of South Florida
College of Marine Science
20 April, 2015



The DWH Oil Spill: The Largest in U.S. History

11 workers dead, 17 injured, 98 escaped uninjured

4.9 million barrels, (>200 million gallons) oil discharged

Federal Investigations (Presidential Commission on the Oil Spill)

Pending Lawsuits (Clean Water Act and other statutes) USDoJ: NRDA,
Civil Settlements (BP, Transocean, Halliburton)

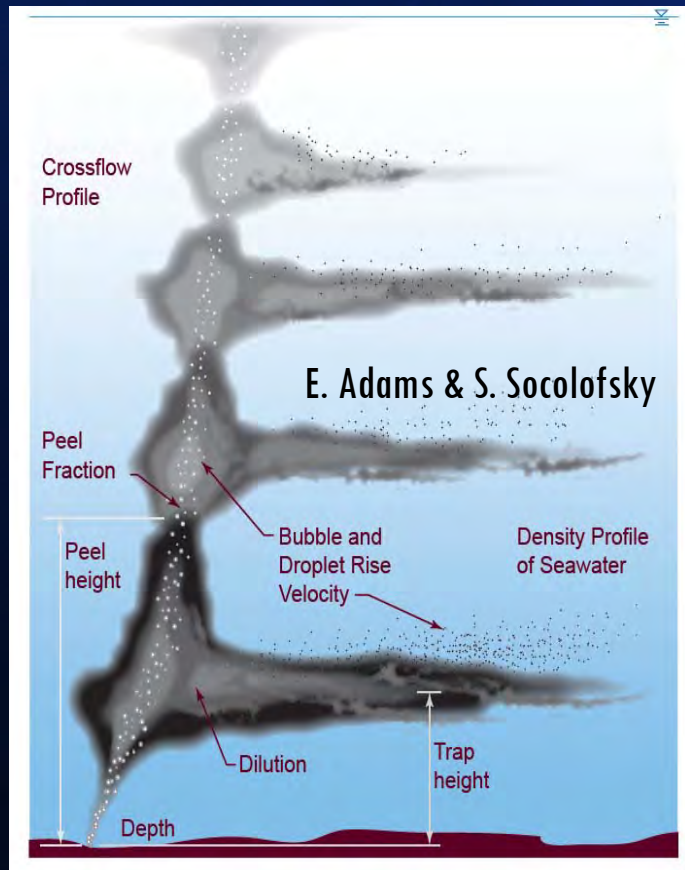


Overview

- ✓ What do we Know Now?
- ✓ What do we Need to Know?
- ✓ What are we Doing?

**What do we Know Now....
that we did NOT Know
Then?**

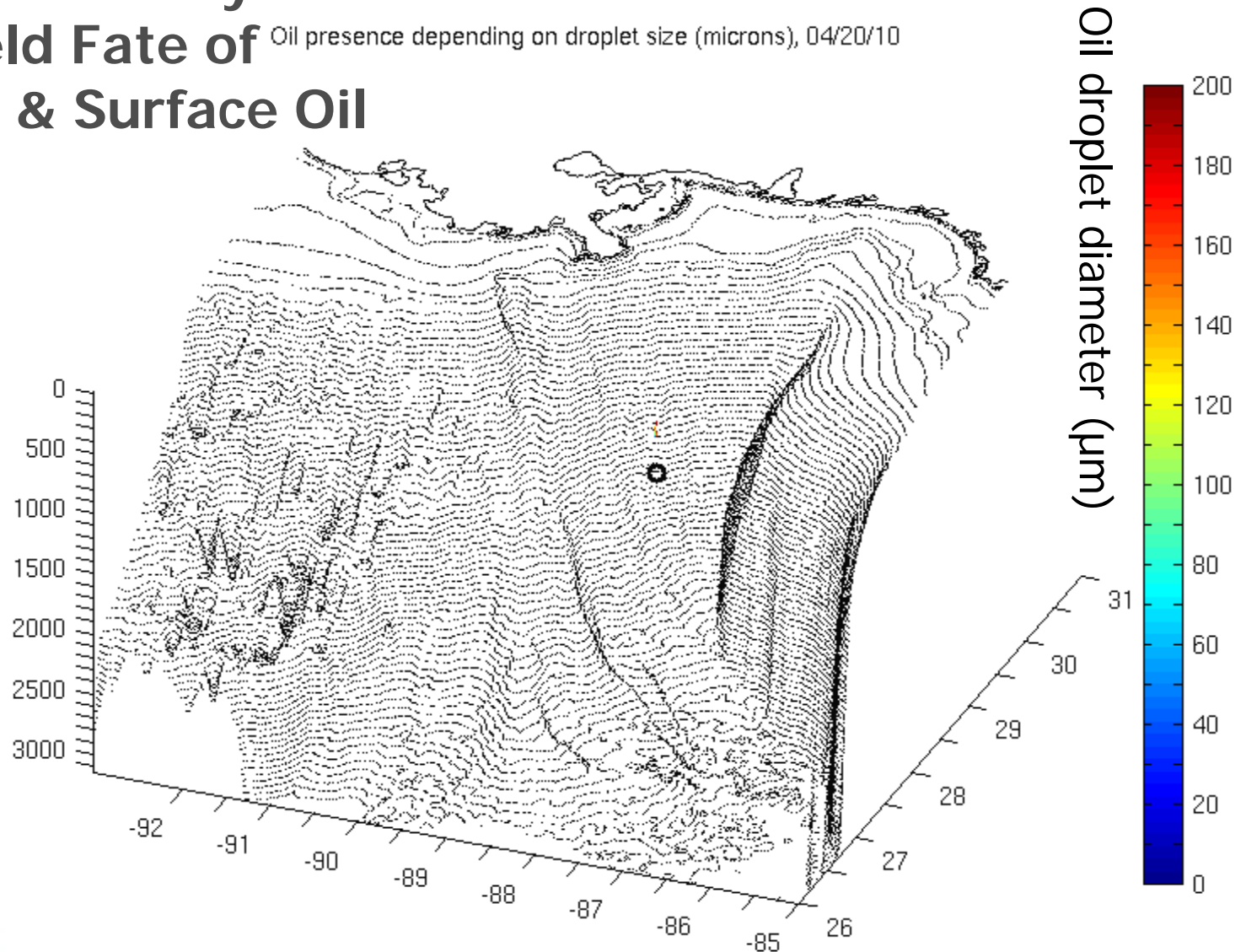
Oil and gas from the ruptured well would create dense clouds of fine droplets that would stay suspended at 900-1200 meters water depth – even without the addition of dispersants at the well head.



Oil Interacting with the walls of Desoto Canyon resulted in an oiled “Bathtub Ring”

Near-Field Plume Dynamics and Far-Field Fate of Subsurface & Surface Oil Modeling

Oil presence depending on droplet size (microns), 04/20/10



UNIVERSITY
OF MIAMI



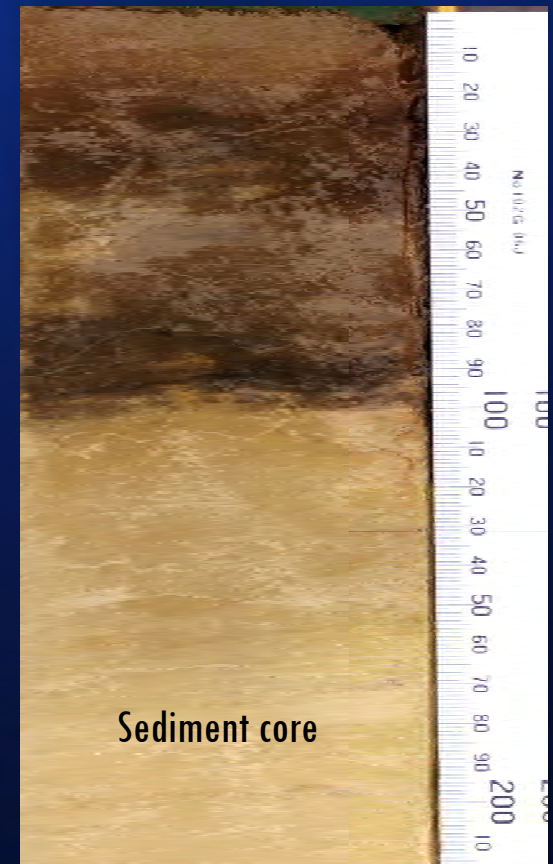
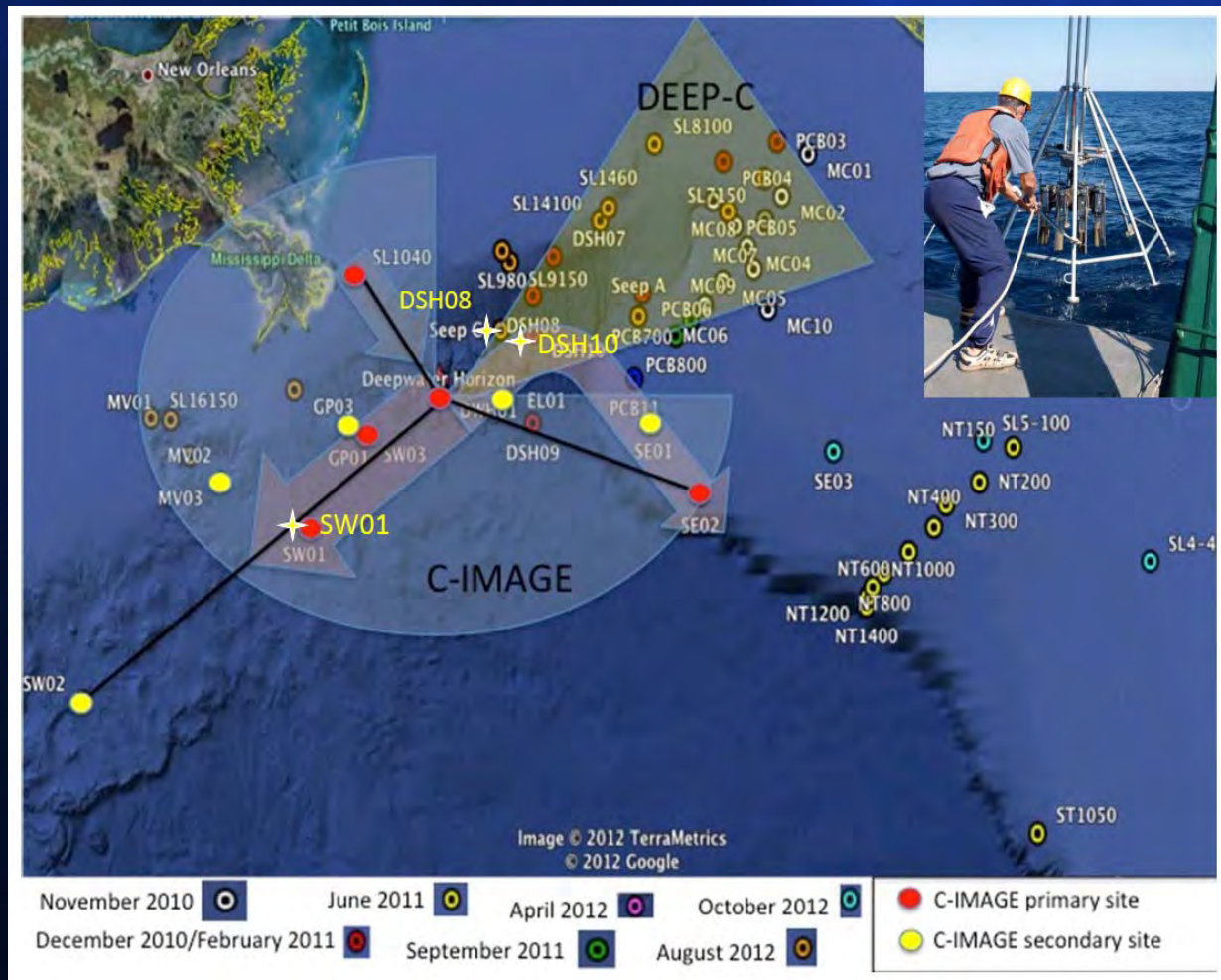
Courtesy: M. Le Henaff, C. Paris, J. Helgers, V. Kourafalou, A. Srinivasan

High Resolution Satellites and Aircraft can be used both to find surface oil and to measure its thickness and therefore quantity

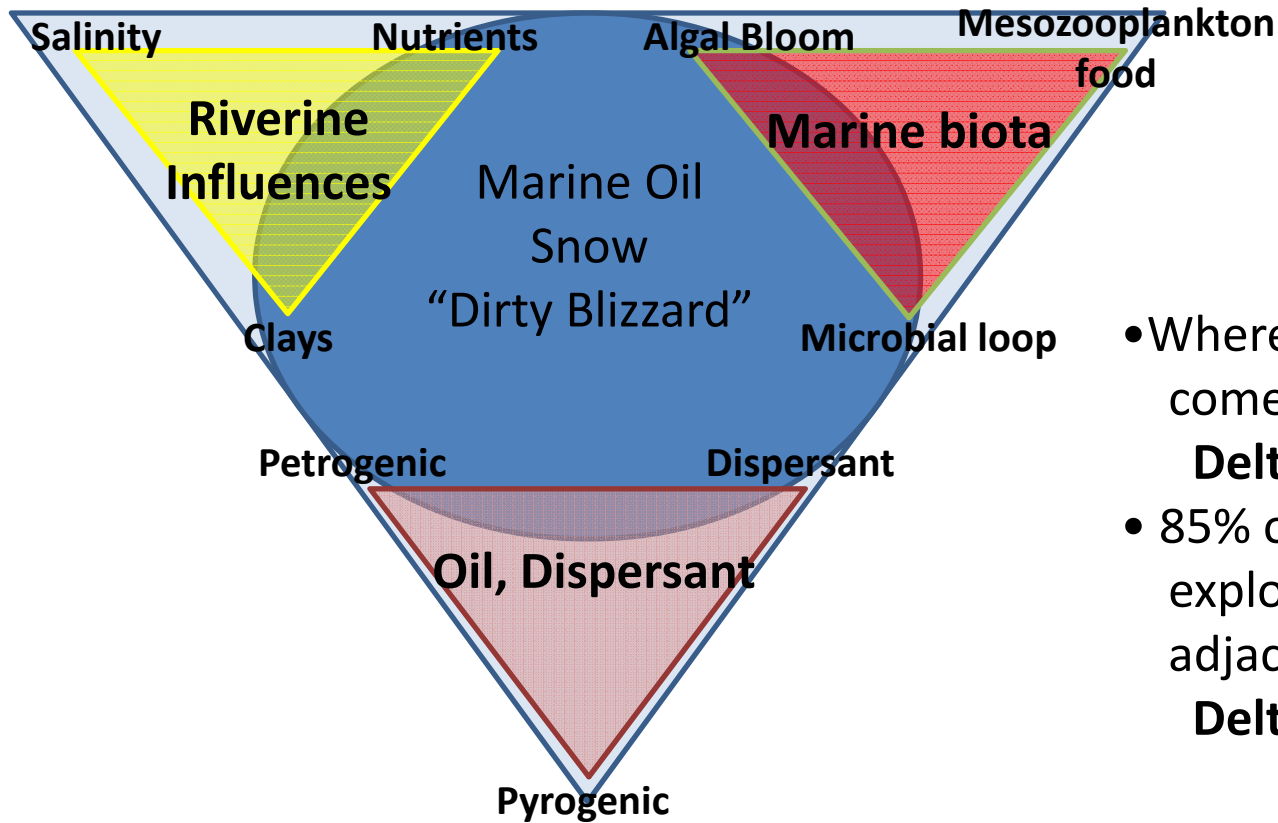


A combination of oil, dispersants, dead plankton and fine clay from river input can result in a “dirty blizzard” of toxic marine snow accumulating on the sea bottom

3 km from Wellhead, 1508 m



WHAT factors control the formation and sinking of oil-associated particles?



- Where can these factors come together?

Deltaic Systems

- 85% of all deep-water exploration is occurring adjacent to:

Deltaic Systems

Microbial mucus snow



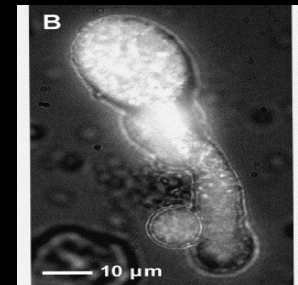
Aggregates coagulation of particles



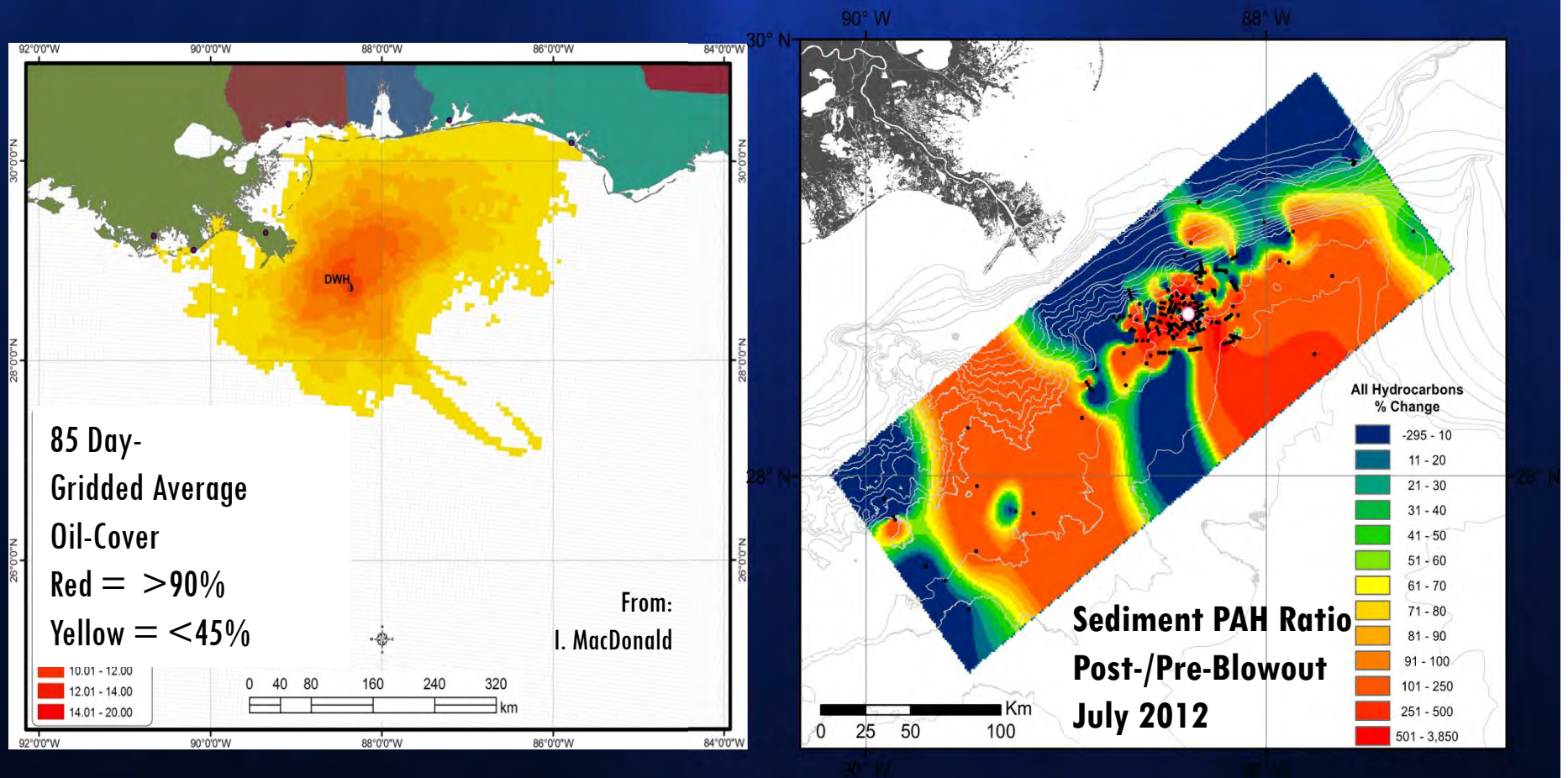
Zooplankton Activity



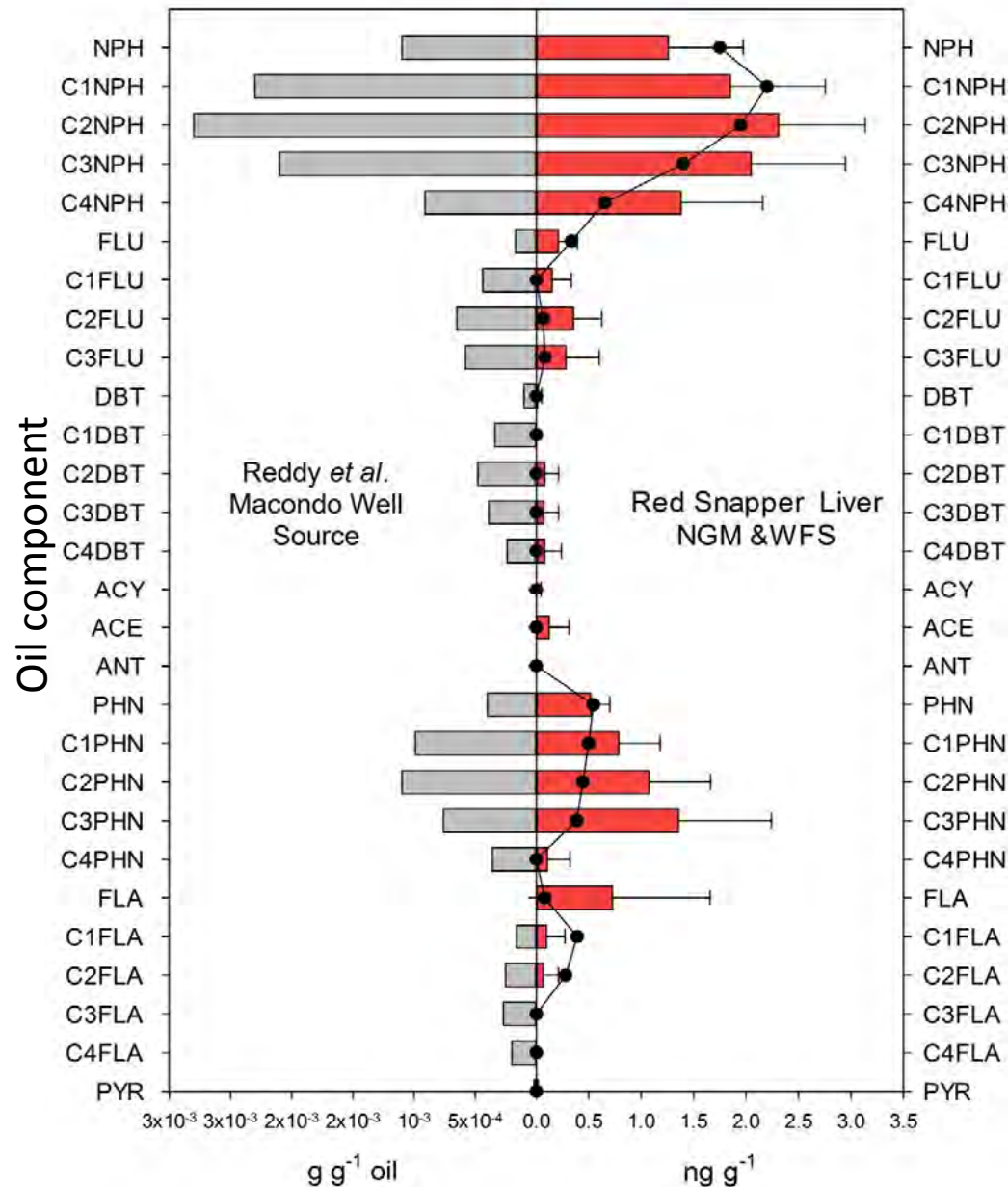
OMA:
Oil mineral aggregates



Oil does not necessarily always float to the surface, and large quantities remain trapped on the bottom in deep water surrounding DWH.

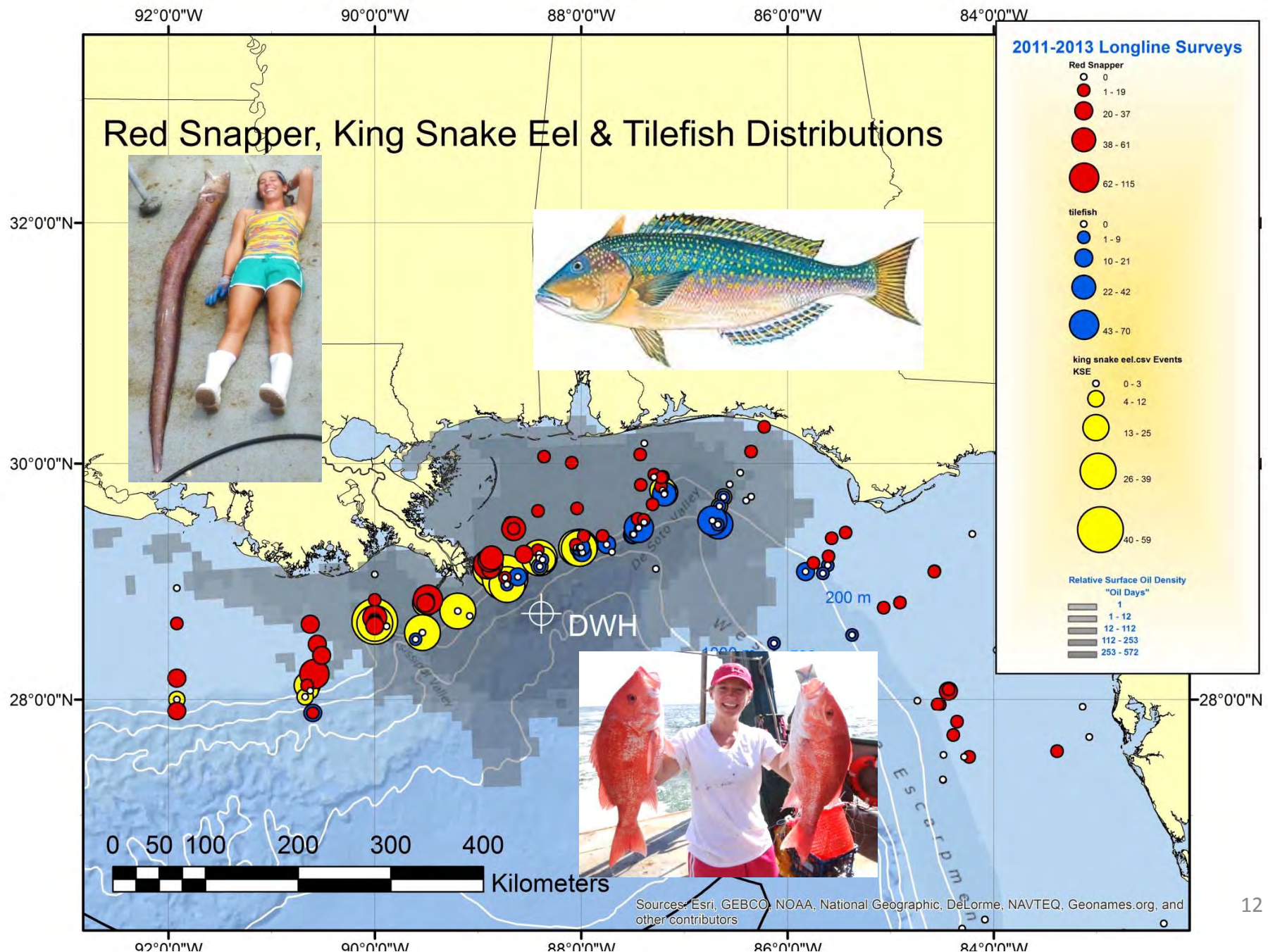


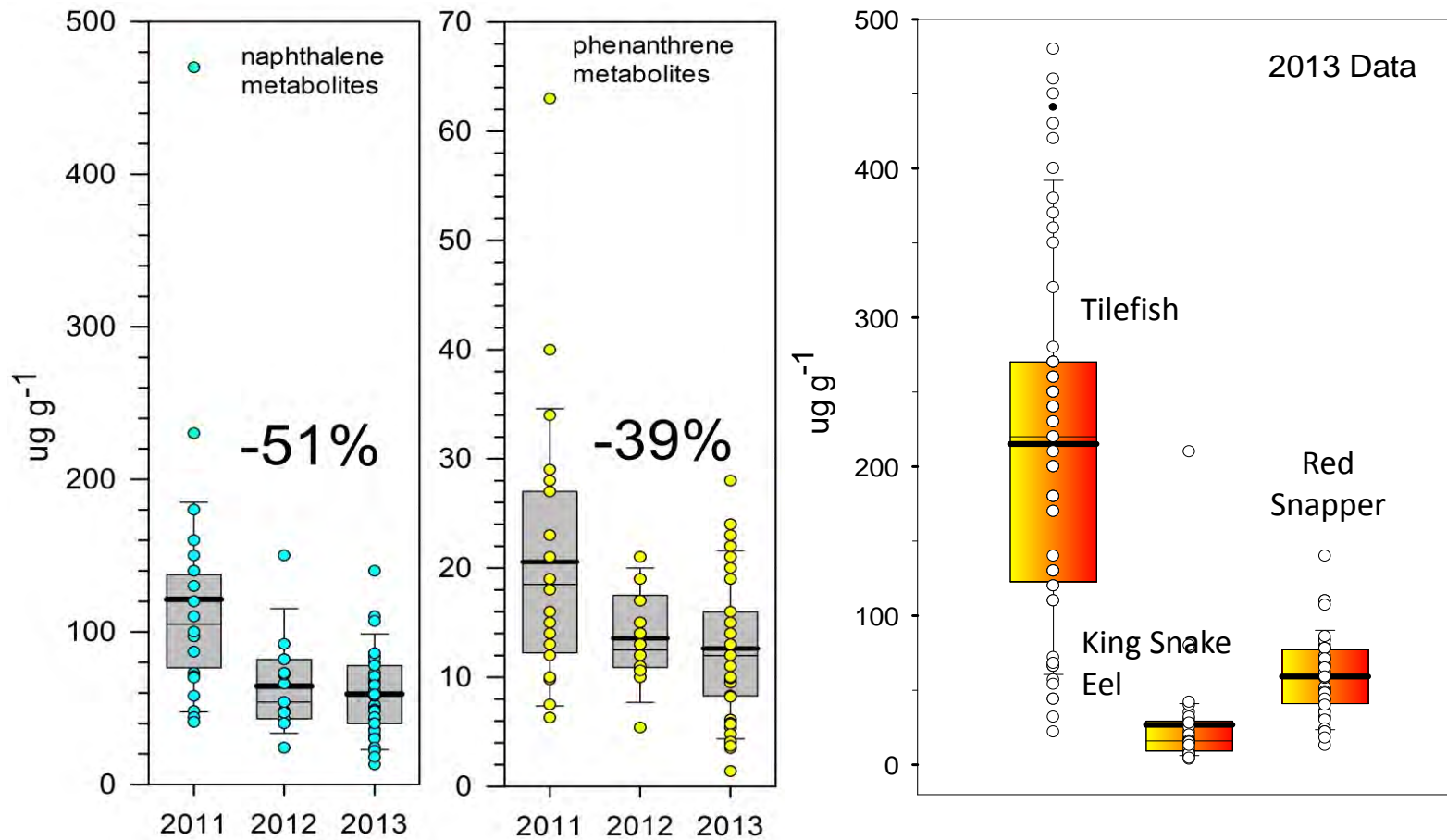
The composition of oil residues in fishes can closely resemble crude oil following a blowout



Very Close Resemblance
between 56 specimens of
Livers of Red Snappers
from NGM and Macondo
oil profiles ($r^2 = 0.82$)

Different species can exhibit different contamination levels, even if taken from the same place





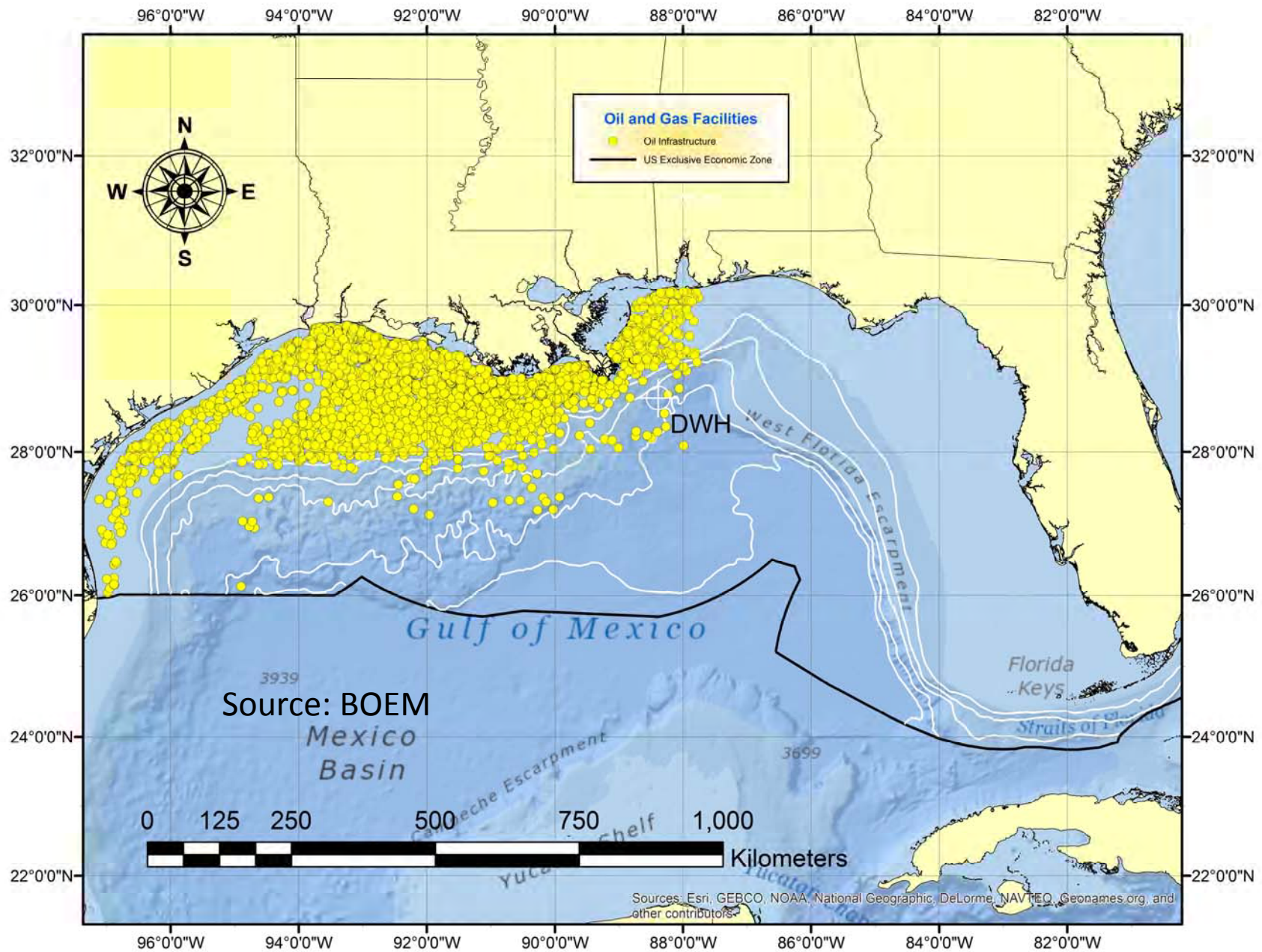
Changes in bile contamination of naphthalene and phenanthrene metabolites in red snapper (left) sampled in the Northern Gulf of Mexico, 2011-2013

The background of the slide is a deep blue underwater scene. Sunlight rays, known as crepuscular rays, are visible as bright, vertical beams of light filtering down from the surface, creating a sense of depth and tranquility. The water has a slightly grainy texture, and the overall color palette is various shades of blue.

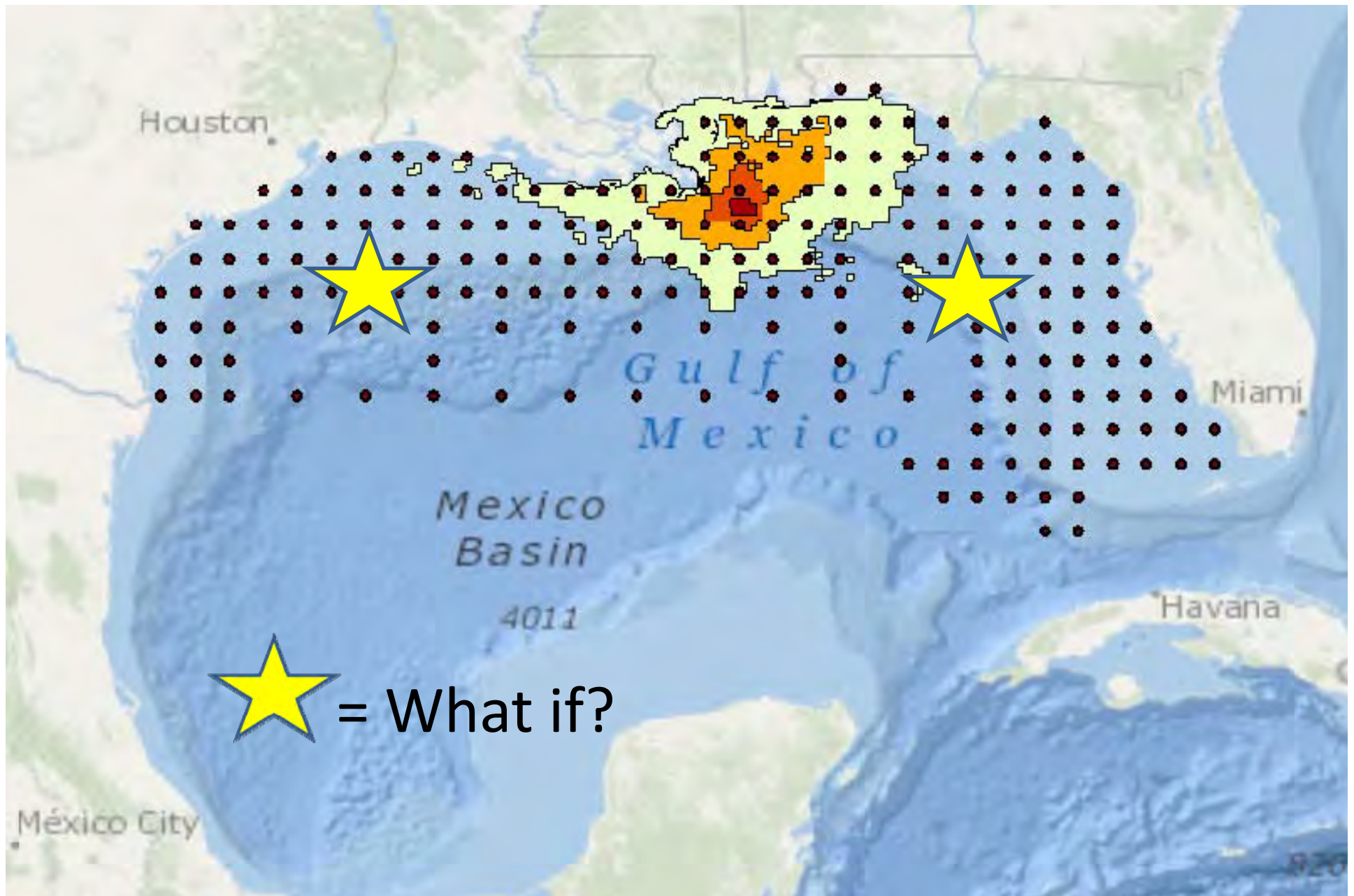
What do we Need to Know?

- What are the Baselines of contamination in sediments, water and biota associated with the ~4,000 oil and gas facilities in the Gulf (and pipeline fields as well)
- How do the depth of the water and specific oil composition affect the efficacy of response measures?
- What resources are at risk from a potential oil spill at any location in the Gulf?
- How would surface and sub-surface oil spills move, at what rates, and in response to what factors?
- What are the environmental consequences of oil spill response measures (burning, dispersants, sand berms, water releases)?
- Can ultra-deep drilling and production be accomplished with greatly reduced risks of environmental damage?

Existing Oil and Gas Production Facilities in the US Portion of the Gulf of Mexico



Fish Larvae Data, 1982-Present vs. Oil Spill Distribution



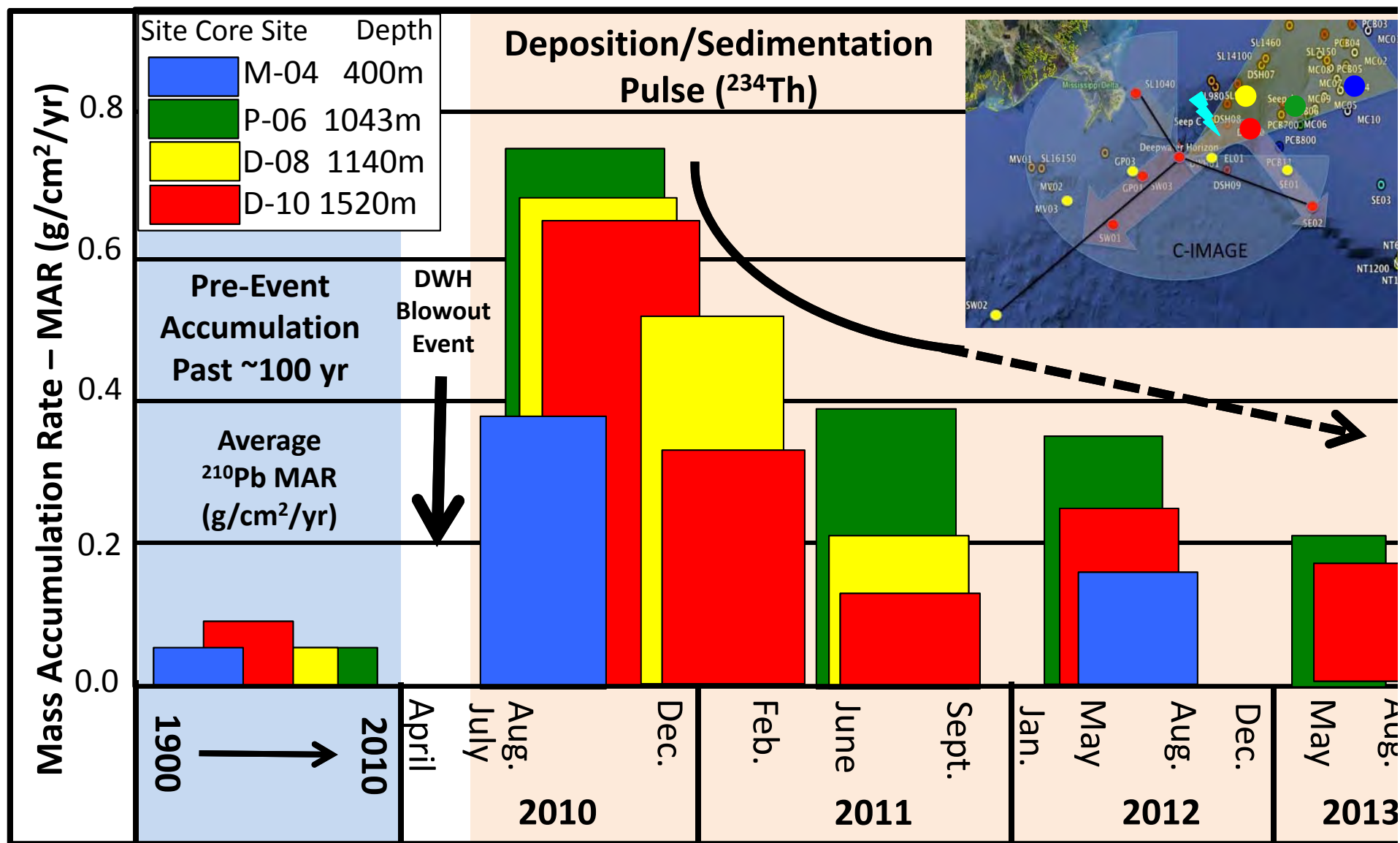
The background of the slide is a deep blue underwater scene. Sunlight rays are visible, filtering down from the surface, creating a serene and somewhat mysterious atmosphere. The rays are more prominent in the upper half of the image, fading into a darker blue towards the bottom.

What will the Gulf Look like in
5 years, in 30 years?

What are we Doing?



Continued Monitoring of Sediment and Fish Contamination in the Northern Gulf to Evaluate "Return to Baseline"





Expose Four Gulf Fish Species to:

- Chronic (sub-lethal) oil levels
- Acute high level oil
- Chronic then acute oil
- Controls (no oil)



Facility: Mote Aquaculture Park, Sarasota, FL

C-IMAGE-II: "Return to IXTOC"



Distribution of spilled oil in water (black) and shorelines (red)

★ BP
(2010)

- 5,000 ft depth
- 206 million gallons
- 87 days (Apr-Jul)
- 50 miles offshore

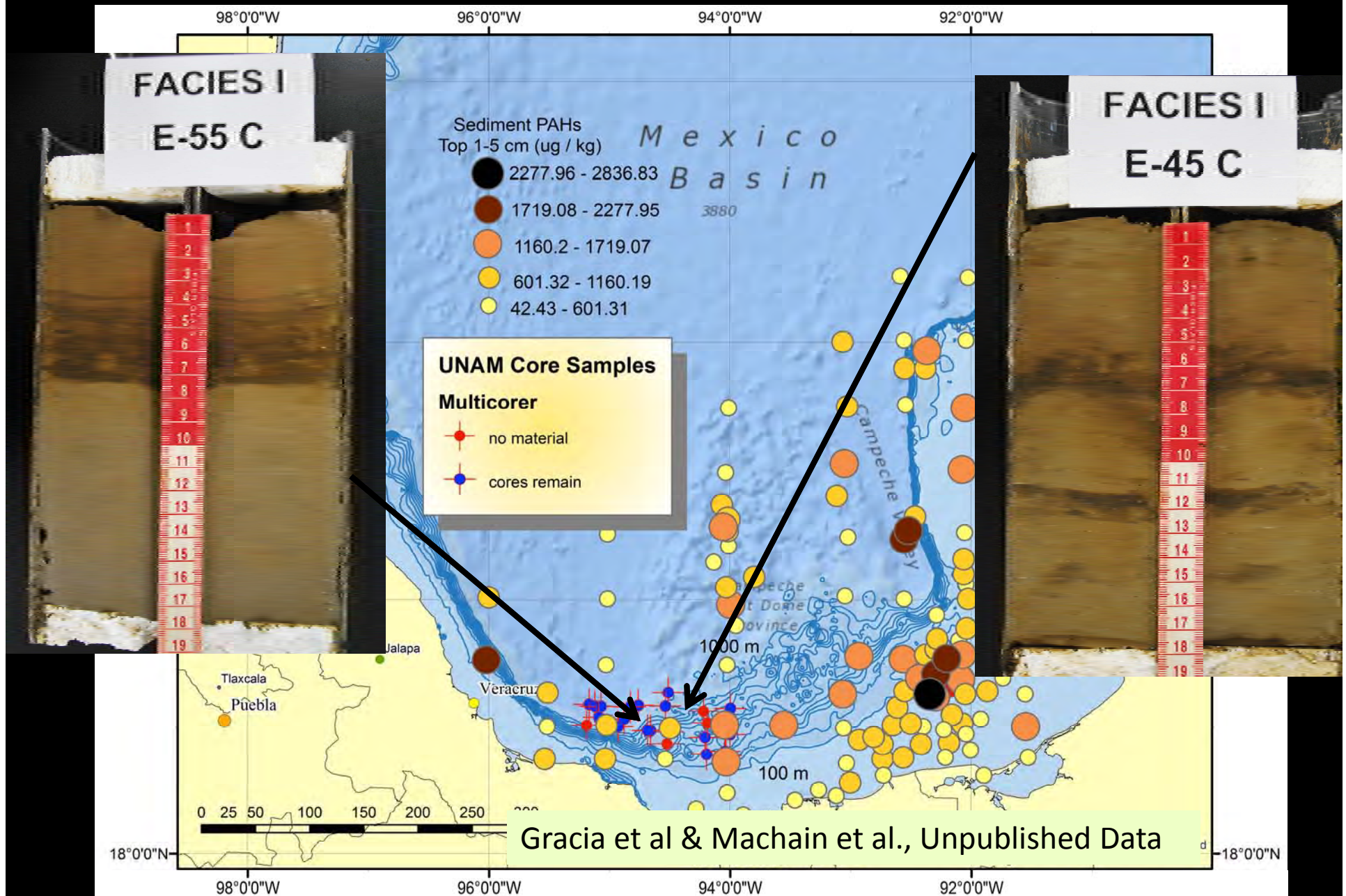
Two spills separated by 30+ years

(1979-80)
Ixtoc

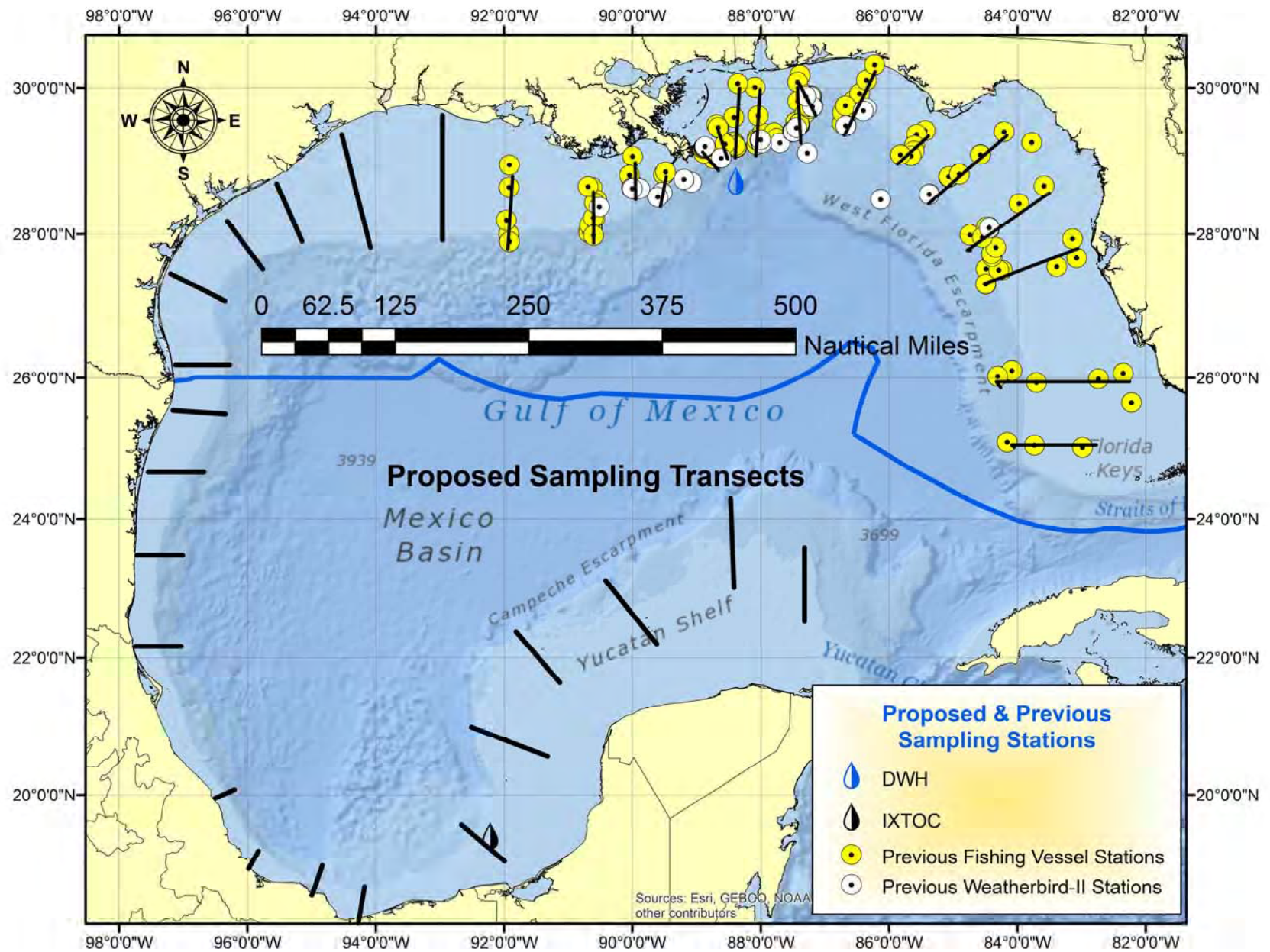
- 170 ft depth
- 140 million gallons
- 9.7 months (Jun-Mar)
- 50 miles offshore

Oil map by W. Tunnell
and F. Moretzsohn
Basemap by J. Gibeaut,
Harte Research Institute

Is the “Dirty Blizzard” a General or Specific Result?



Conduct a Complete Gulf of Mexico Survey of shelf fishes and sediments for the first ever comprehensive baseline

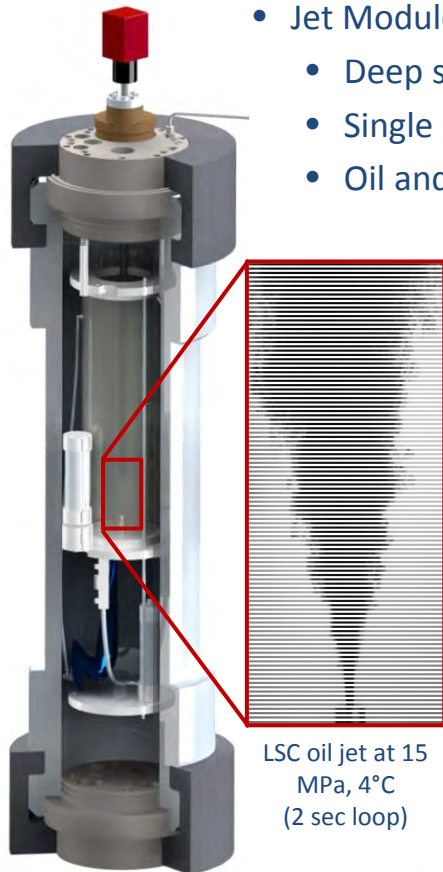


Conduct High-Pressure Experiments with and without Dispersants

To determine if and how much deep dispersant use contributed

High pressure labs for jet investigations

- Jet Module
 - Deep sea environment simulator
 - Single gas bubbles and oil droplets
 - Oil and gas jets



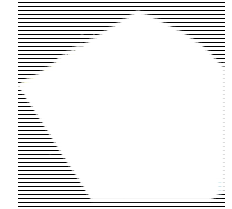
- New endoscopic measurement system for determination of Particle Size Distributions (PSD)¹

High pressure reactors for biodegradation

- Artificial deep sea environment
- Prototype high pressure reactor with
 - Inline high-pressure sampling
 - O₂ & CO₂ sensors²



Oxygen sensing via sapphire windows



Partitioning Device

- Partition behavior of xenobiotic compounds between saline water and methane-charged crude oil
- Pressure (2-17 MPa) and temperature (4-30 °C) variation corresponding to changing depth in the water column



Hamburg, Germany, Calgary, Canada, Perth, Australia



Training the Next generation of Oil Spill Scientists and Responders

Informing the Public about the risks and consequences of oil extraction policies



A large offshore oil rig is engulfed in a massive fire, with thick black smoke billowing into the sky. Several fireboats are positioned around the burning rig, directing high-pressure water jets onto the flames from multiple angles. The scene is set in the middle of the ocean under a clear sky.

In Memoriam

Shane Roshoto

Dewey Revette

Karl Kepplinger, Jr.

Jason Anderson

Roy Wyatt Kemp

Aaron Dale Burkeen

Keith Blair Manuel

Adam Weise

Donald Clark

Stephen Ray Curtis

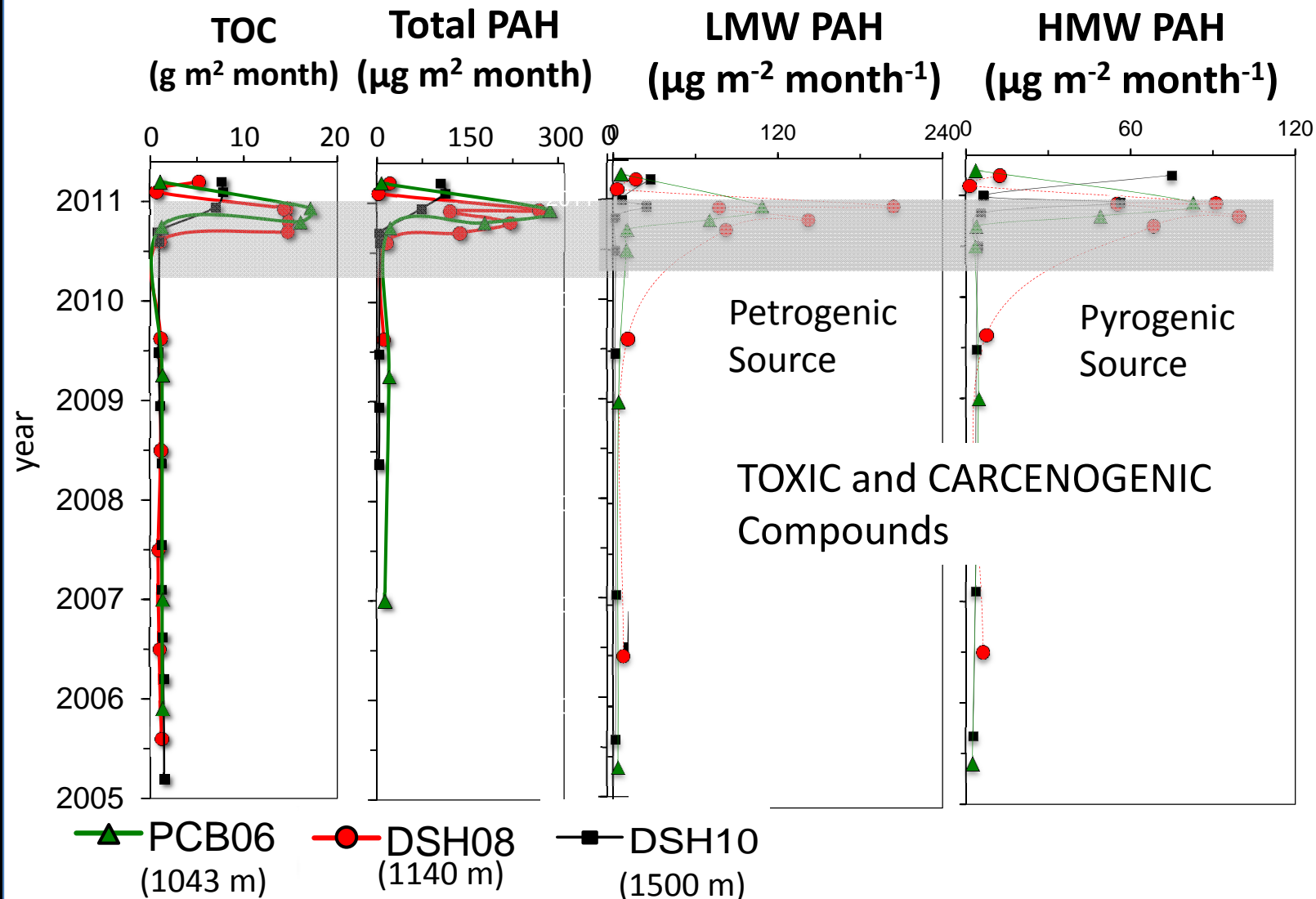
Gordon Jones

A photograph of an offshore oil rig at sea under a twilight sky. A full moon is visible in the upper left, and clouds are tinged with pink and orange. The rig is silhouetted against the horizon.

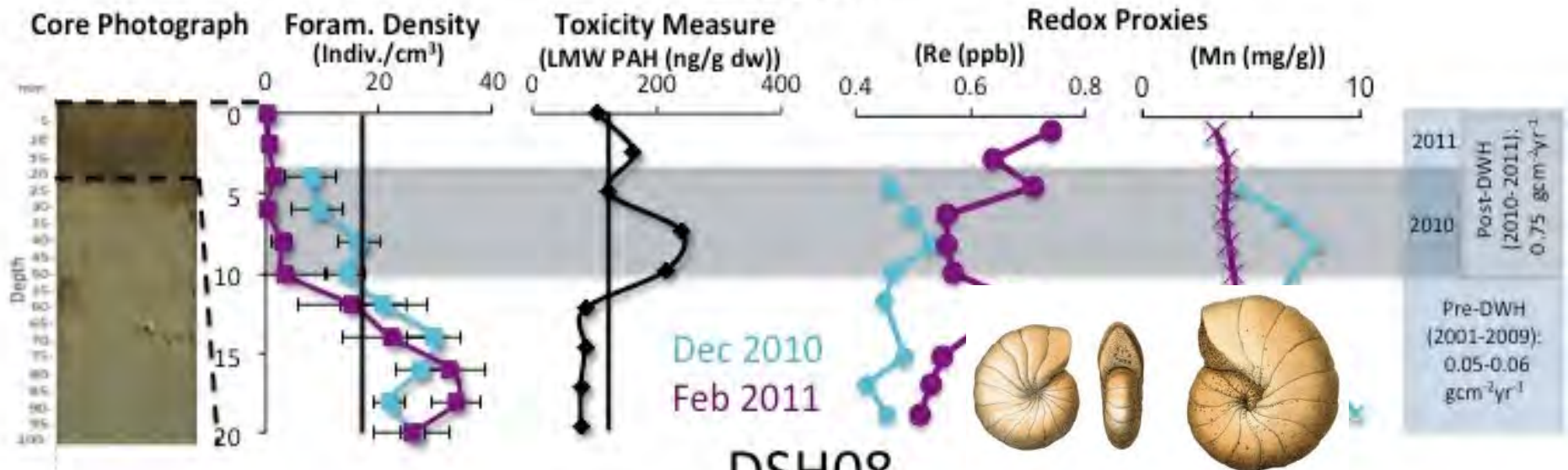
Questions?

Backup

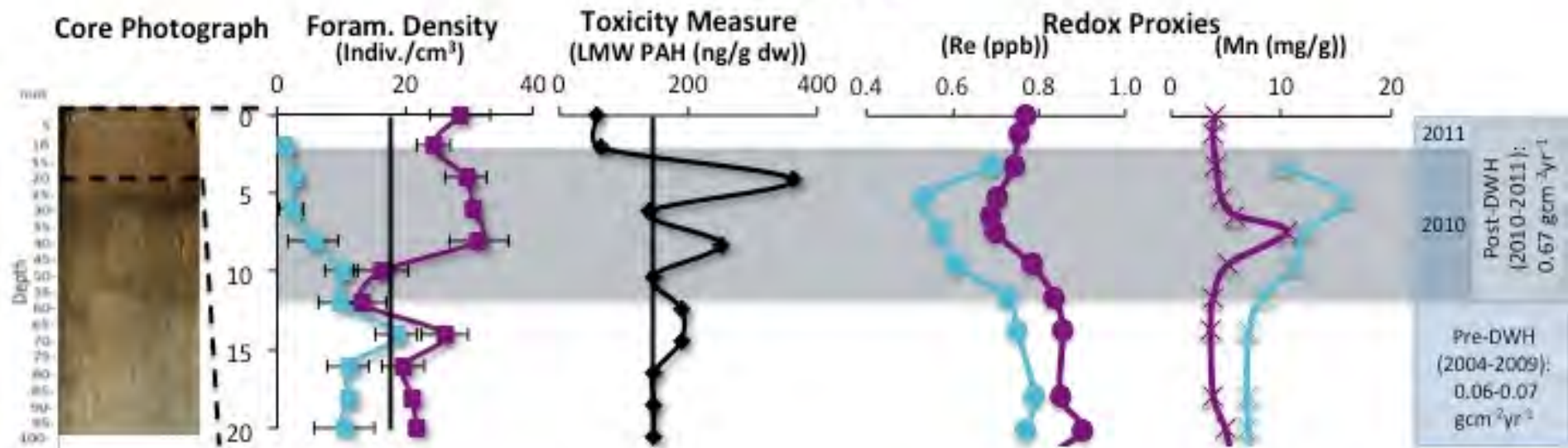
High deposition rates: Organic-C & PAHs: LMW- Petrogenic and HMW- Pyrogenic



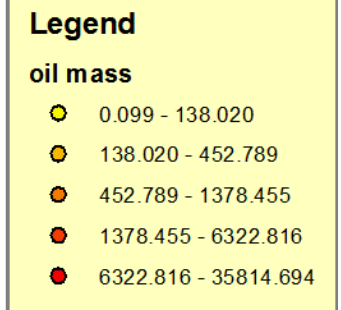
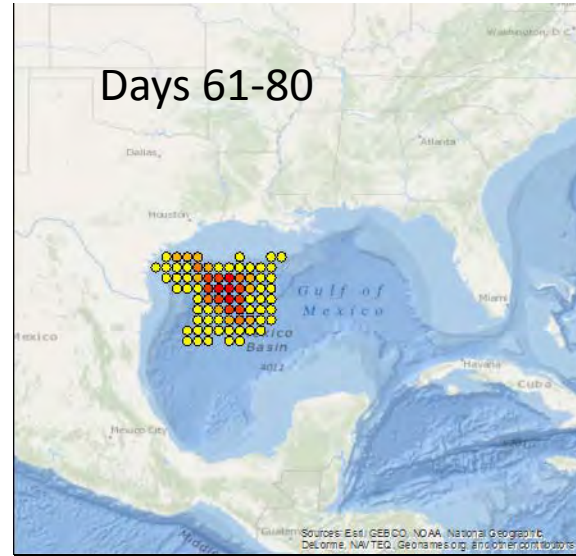
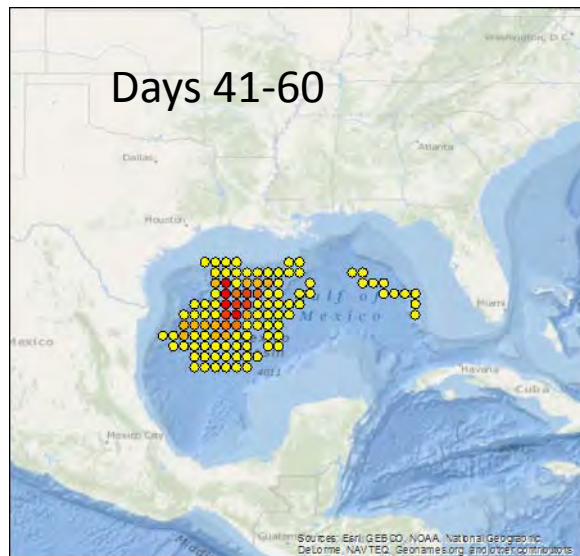
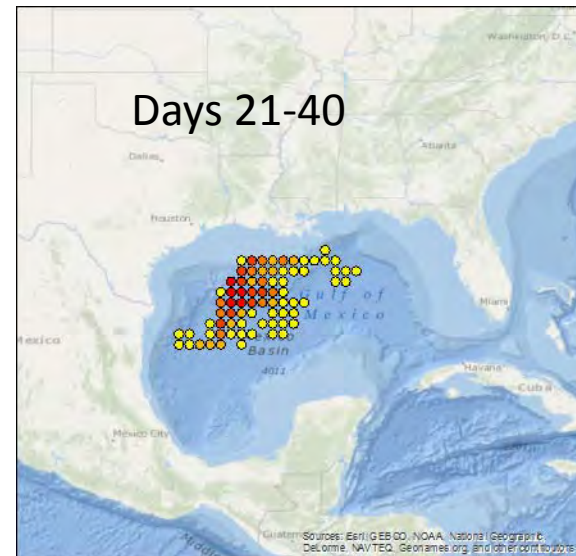
PCB06



DSH08



Scenario 2 - 27N and 93.5W



CMS Simulations
D. Lindo &
C. Paris

Policy-Relevant Issues

- The level of monitoring and regulation of deep drilling is not commensurate with the increasing risks of serious accidents in waters > 2 miles deep
- In the advent of a serious accident, does the responsible party have sufficient resources to effectively respond? If they do not, is the state prepared to respond?
- How can we gather relevant baseline information (pre-impact) to judge chronic and acute impacts? Who pays?
- How do adjoining countries collaborate on the exploitation of shared oil/gas formations? Fight oil spills? High seas beyond national jurisdiction?
- Is Arctic oil/gas development a good idea? Can it be done safely? What special protections and precautions?