# RESEARCH AND MONITORING TO ENHANCE US RESPONSE TO IMPACTS OF HYDROCARBON AND RELATED POLLUTANTS

# ARISING FROM FOREIGN OIL DRILLING AND PRODUCTION NEAR US WATERS AND COASTAL AREAS

**TO:**

## Interagency Coordinating Committee on Oil Pollution Research (ICCOPR)


**by**

**Dr. John R. Proni**, Executive Director, Applied Research Center (ARC), Florida International University

**Dr. Richard Dodge**, Dean, Nova Southeastern University Oceanographic Center; Executive Director, NSU National Coral Reef Institute


**June 13, 2012**

FIU Applied Research Center
Florida International University

NOVA Southeastern University
Oceanographic Center

NCRI
National Coral Reef Institute

# RESEARCH TO ENHANCE US RESPONSE TO IMPACTS OF HYDROCARBON POLLUTANTSARISING FROM FOREIGN OIL DRILLING TO: ICCOPR, June 13, 2012

**OUTLINE:**

A. Bona Fides of Presenters
B. Urgency of the Problem
C. Limitations of Environmental Studies & Response Planning
D. Purpose of Meeting / Consistency with Mission of ICCOPR
E. Differentiation Factors that Make Situation Unique
F. Proactive Research Needs: Suggested Action
    1. **Monitoring for spills & observing ocean dynamics**
    2. **Establishing biological baseline**
    3. **Toxicity of oil and dispersant to affected organisms**
    4. **Modeling spill trajectories and ecosystem response**
    5. **Synthesis to improve mitigation planning**
G. Rationale: Effective Preparedness/ Oil Spill Commission Findings
H. **Implementation: Proactive Research via Consortium**

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Florida International University

# A. Bona fides of Presenters

## Dr. Proni, Director, Applied Research Center, Florida International University

- 36 yrs. w/ NOAA: Dir. Ocean Chem., Div. & Ocean Acoustics Div.
- Outstanding Scientific Paper award twice from U.S. DOC
- 3 years with Bell Telephone laboratories, AT&T
  - Sensor scientist anti-submarine warfare research
  - Co-developer: Difar air-deployed submarine detector system
- 4 years with Florida International University
- Executive Director Applied Research Center; Oversight of: DOE: Waste Management, Workforce Development, & Oil/Gas Related Efforts
- Underwater sound radiation (1969 – 1972) from oil field sources
- Oil, Gas Seeps/ Drilling fluid releases in the Flower Garden Bank area.
- Plume Pollutant Detrainment in S Fla (1972–2002). Coastal Gulfstream Waters
- Cuban Oil Field Development (2008 – 2012)

# A. Bona fides of Presenters

## Dr. Dodge, Dean Nova Southeastern University Oceanographic Center

- Appointed by Florida Governor to Gulf of Mexico Research Initiative Research Board
- Elected Board Chair of Southeast Coastal Ocean Observing Regional Association (SECOORA = FL, GA, SC, NC)
- Executive Director National Coral Reef Institute
- Board member: Port Everglades Association
- History of oil & dispersed oil research for: EPA, MSRC, Industry
- Science Board:  Smithsonian Institution/MMS: Panama Spill
- Oil & dispersed oil experience in USA, Bermuda, & Panama
- Recently established Center of Excellence in Coral Reef Ecosystems Research, a $45 million dollar facility, funded in part by a competitive NIST award.

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# B. Urgency of the Situation

**Deep-water drilling for oil has begun off the coast of Cuba, initially only 28 nautical miles from the US EEZ**

- Time period between pollutant-release to FL coastal zone-impact can be relatively short, depending on the specific release depths and sites.
- This is true both for event releases and chronic releases.
- Setting is singular in the world and poses potential new and severe chronic risks to the important shores, ecology, and coastal economy of the US.

# C. Limitations of Environmental Studies & Response Planning

## Limitations & Response Planning

- Documents including the recent *Bureau of Ocean Energy Management (BOEM) Environmental Studies Program Studies development Plan FY2013-2015* clearly demonstrate the extensive and comprehensive studies which BOEM presently supports.

- Efforts of USGC and others have been exemplary to prepare a response plan in case of an emergency.

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# D. Purpose of Meeting & Consistency with ICCOPR Mission

**Our purpose in meeting with ICCOPR:**

Present a strategic and proactive plan to address research needs via a public-private Scientific Consortia (academic, government, industry, & NGO).

**This is consistent with ICCOPR's purpose:**

"coordinate a comprehensive program of oil pollution research, technology development, and demonstration among the federal agencies, in cooperation and coordination with industry, universities, research institutions, state governments, and other nations, as appropriate, and shall foster cost-effective research mechanisms, including the joint funding of the research."

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# E. Differentiation Factors That Make Situation Unique

**There are three types of differentiating factors which distinguish the prospective studies concerning Cuban oil development from the studies presently underway or contemplated by BOEM:**

i. Geographic

ii. Fundamental

iii. Informational

# E. Differentiation Factors:
## i. Geographic

- The immediate proximity of the Gulfstream current with the broad area of the prospective Cuban oil field. It is possible that the current will enter into the field development area.

- Important adult and larval coral, fish, & other species are found in the likely impact range of spilled oil and dispersant use.

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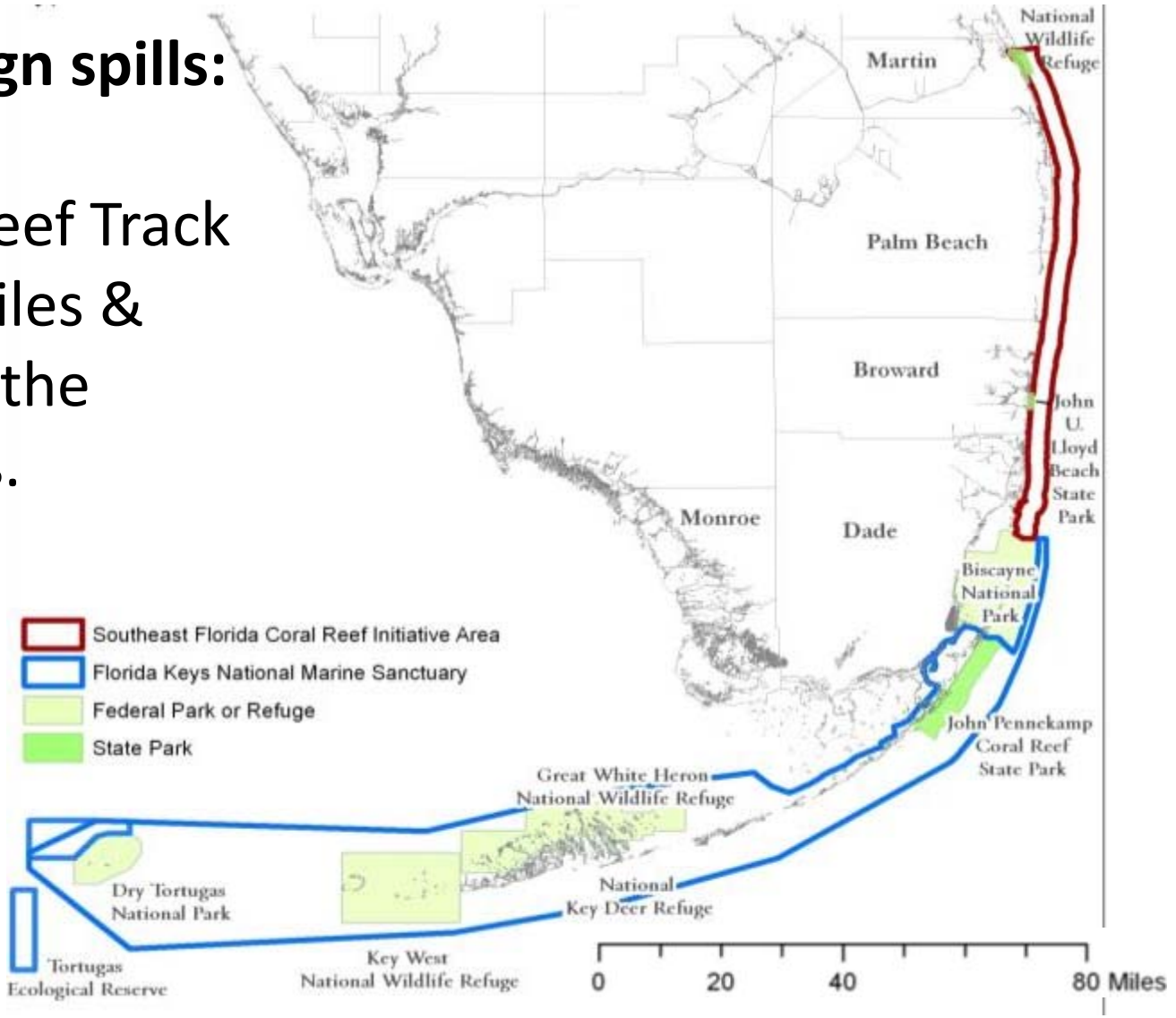
# E. Differentiation Factors:
## i. Geographic

**At Risk from Foreign spills:**
The CONUS (Continental US) Reef Track of Florida is 360 miles & represents 84% of the nation's coral reefs.

These are already under severe environmental stress.



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# E. Differentiation Factors:
## i. Geographic

**Substantial potential damage could occur to:**

- US beaches, recreation & tourism, desalination plants, ports and harbors.
- At risk are US south and east coast ecosystems: coral reefs, fisheries, breeding grounds, sea grass, mangroves, and rare and endangered species.
- Florida's coastal and ocean economies contribute $592 billion to the state's gross domestic product.
- 3.4 million jobs are in Atlantic coast counties to be impacted by a major spill.

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# E. Differentiation Factors: ii. Fundamental

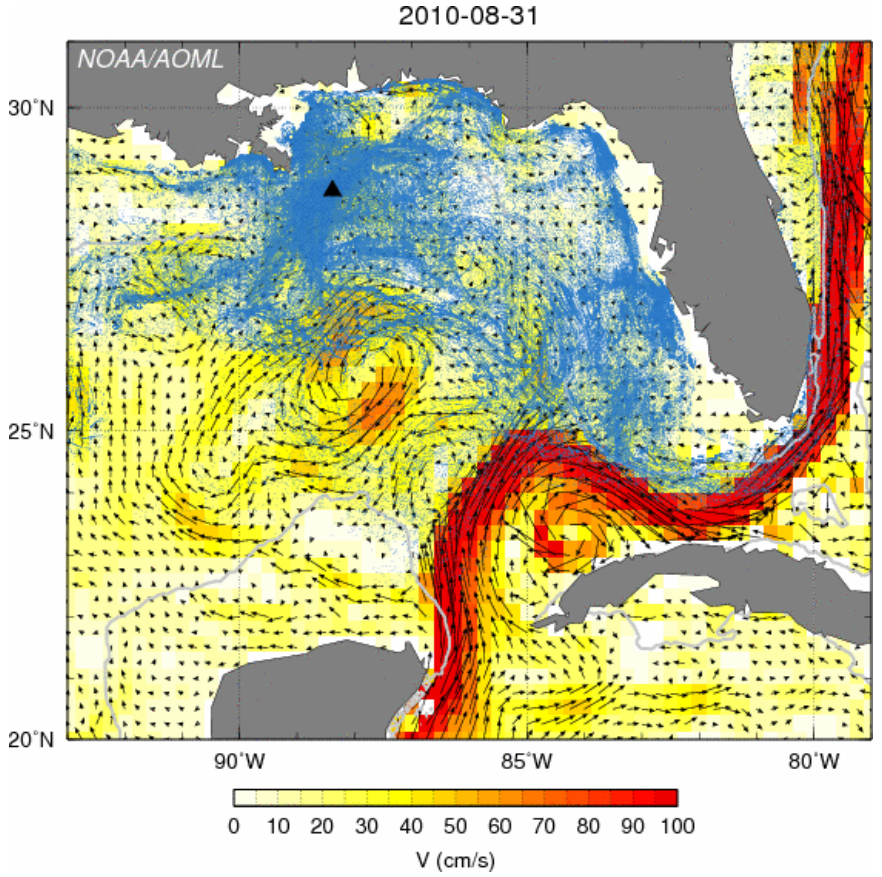
**Highly local detrainment and upwelling effects occur at western boundary of the Florida current resulting in:**

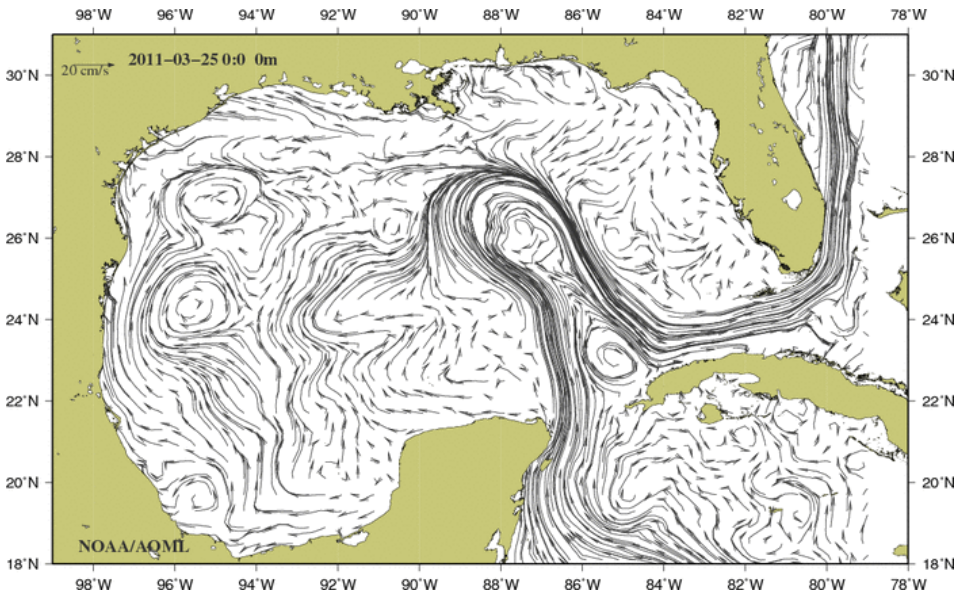
- Cooler, deeper water, arising around the bottom of the vertical extent of the Gulfstream.
- Possibility of oil (& oil+dispersant) bearing waters from depth coming onto Florida corals and inlets and bays.

3-D, high resolution oceanographic current full water column models are needed to augment surface models. These models have already been largely developed for this highly singular environment by the south Florida local oceanographic community.

# E. Differentiation Factors: ii. Fundamental

- Numerical simulations of oceanic flow trajectories show how currents spread released particles
- Inputs can reach the Florida Reef Track, and East Coast of US



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# E. Differentiation Factors: iii. Informational

Informational Differentiation:

- Takes many forms, some of which are the **initial conditions and constituency** of released oils.
- Given the possible impacts of subsurface waters, a greater understanding of the **initial plume** spatial distribution and chemical characteristics is desirable.
- However, the level of information forthcoming and the ability to independently make measurements for plume materials characterization is unknown.

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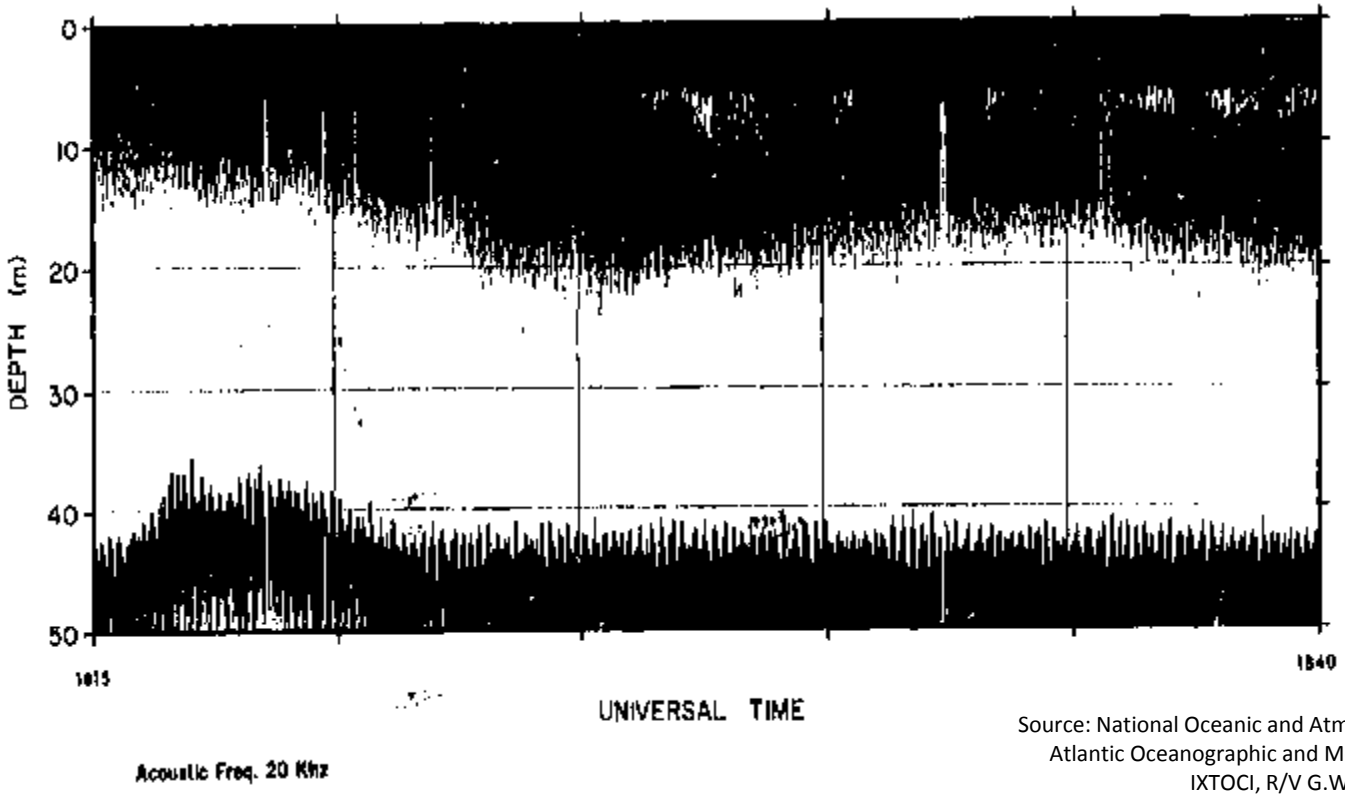
# E. Differentiation Factors: iii. Informational

- Released drilling fluids, escaped oil, gas and produced waters can create **sub-ocean** and **surface plumes**. If the potential transport of oil is to be correctly modeled and understood, the initial ocean surface and sub-ocean water column distribution of oil is needed.
- Extensive **water sampling** of escaped fluids is needed to understand their evolution with time and distance.
- **Underwater** sound can be used to obtain a qualitative horizontal and vertical distribution of the escaped oil.

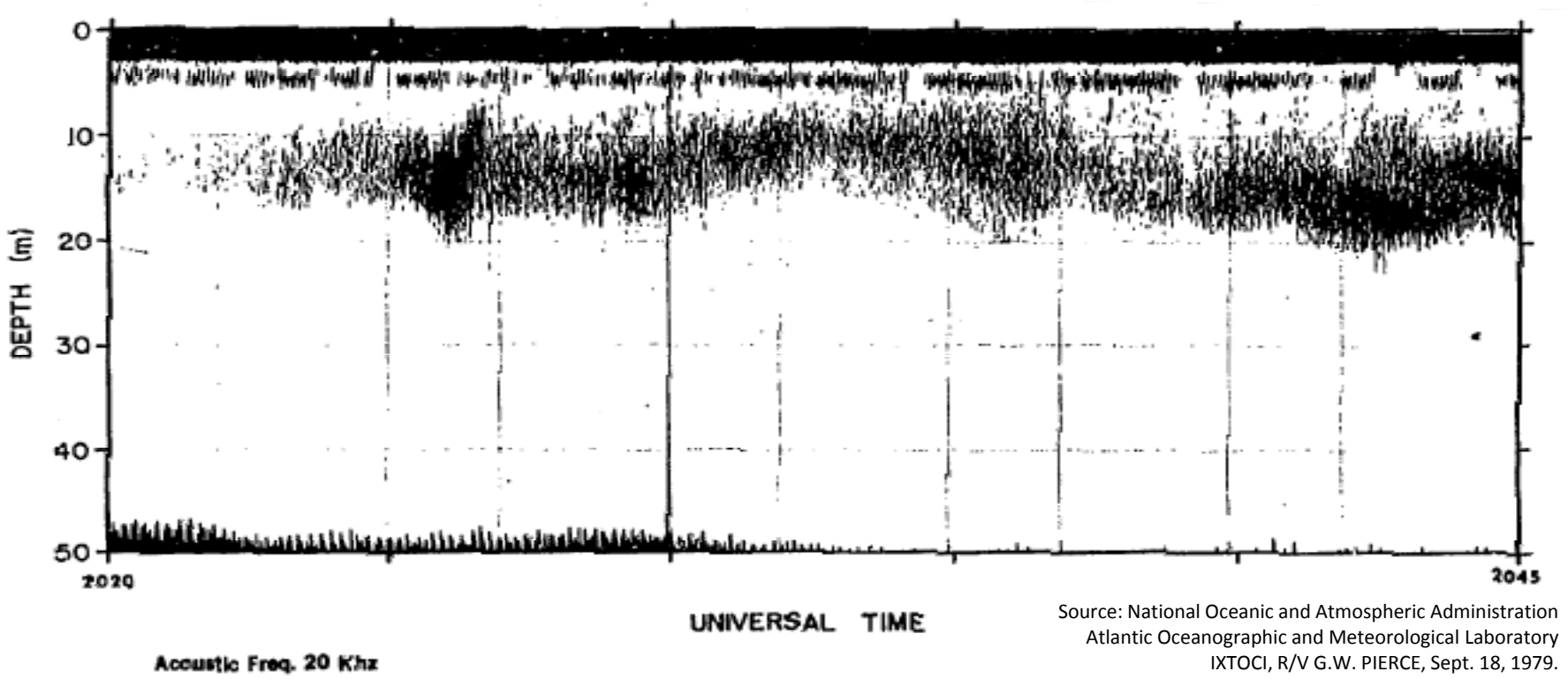
# E. Differentiation Factors: iii. Informational




Source: National Oceanic and Atmospheric Administration
Atlantic Oceanographic and Meteorological Laboratory
IXTOCI, R/V G.W. PIERCE, Sept. 17, 1979.

IXTOX-1 Acoustic data taken on station PO5 approximately 0.5 nautical mile from the blowout.

# E. Differentiation Factors: iii. Informational




Source: National Oceanic and Atmospheric Administration
Atlantic Oceanographic and Meteorological Laboratory
IXTOCI, R/V G.W. PIERCE, Sept. 18, 1979.

IXTOC-1 Acoustic data taken on station PO8 approximately 12 nautical mile from the blowout.

# F. Proactive Research Needs Suggested Actions

**Synopsis: Proximity to the U.S. of drilling operations off Cuba and the Bahamas (outside the oversight and control of U.S. regulators or responders) makes enhanced and additional research for response an urgent priority.**

**The following proactive research is suggested:**

1. Monitoring for spills & observing ocean dynamics
2. Establishing biological baseline
3. Toxicity of oil and dispersant to affected organisms
4. Modeling spill trajectories and ecosystem response
5. Synthesis to improve mitigation planning

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# 1. Monitoring & Ocean Observations

**Use remote and in situ sensing for detection, mapping, and sampling of the surface and sub-surface.**

- **Independent early warning** for earliest notice of impacts (chronic drilling / production as well as of massive).
- Real-time or near real-time.
- **Consistent w/ IOOS, on-going ocean observations** are needed in detail to provide ocean current dynamics at the Yucatan channel and critical points along the South and East US.
- Data also **useful for predictive models** of transport and trajectory.

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# 2. Biological Baseline

**Comprehensive biological baseline of marine ecosystems (shallow & deep reefs & related ocean and estuaries) between Cuba and US critical:**

- **Pre-spill status** to evaluate future effects
- **Limited baseline** of Gulf ecosystems in DWH **hampered** prioritization of response.
- **Claim** actions
- Data for **predictive models**
- Improved habitat maps, fish. & plankton census
- **Guide for experiments**/modeling to evaluate impacts
- Study of **past** (e.g., Ixtoc) spill **effects**

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# 2. Biological Baseline

- **Update habitat & reef maps** for spill response with remote sensing, *in situ* assessment, and additional bathymetry.
- **Quantitative study for key** fish, invertebrates, plants, and plankton at fixed and random locations.
- **Recruitment larvae & adult movement**: community diversity and resilience critically dependent. There is close proximity of Cuban and Florida coral reefs.

➢ **Models of biological connectivity** based on Surface currents for requires testing for foreign oil spill impacts prediction on Florida reefs.

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# 3. Toxicity of Spill Products

**Toxicity levels of oil, dispersed oil, dispersant, and degradation products allows understanding of effects on keystone reef and other organisms:**

- Corals, octocorals, sponges, and fishes
- **Vital** to **mitigation response** that uses dispersants
- **Via** ecotoxicology lab & mesocosm **dose response**

**NOAA (Oil Spills in Coral Reefs: Planning and Response Considerations, 2nd edition NOAA Office of Response and Restoration, 2010)** : *"Spill **impacts vary in severity** …at a given **spill**, including oil **type and quantity**, species **composition**, and the nature of oil **exposure**….*

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# 3. Toxicity of Spill Products

- ***Longer exposure to lower*** *levels of oil may* ***kill*** *corals as well as* ***shorter exposure to higher*** *concentrations.*
- ***Evaluation*** *of oil toxicity …****not*** *an* ***easy*** *task… each spill presents a unique set of physical, chemical, and biological conditions. …*
- *"Oil" includes substances that are chemically very different, …****highly toxic****…, to less toxic but persistent …*
- ***Different species and life stages*** *within a species have varying sensitivities and thus may respond very differently to oil exposure. …*

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# 3. Toxicity of Spill Products

In summary: not enough is known about effects.

- **Corals**: Short exposure to floating oil survivable; Longer and/or chronic oil exposure leads to:
  - ✓Excessive mucous production; Behavioral changes
  - ✓Reproductive failure; Bleaching; Morality
- **Mangroves:**
  - Degradation & Mortality
  - Chronic sediment & re-oiling

**Dispersed Oil** especially toxic for Coral Reefs

✓High morality (corals, sponges, crustaceans)

✓Mangroves and sediments saved

# 4. Modeling

## 4.1 Physical Oceanographic

Using Oceanographic 3-D high-resolution current models for the entrainment, transport, and detrainment of spilled oil.

## 4.2 Ecological

Couple above with bioecological models to predict effects to organisms under various scenarios.

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# 4.1 Modeling: Physical

**Oceanographic 3-D high-resolution current models for the entrainment, transport, & detrainment of spilled oil.**

- **Modeling of ambient currents of Cuba** (north & western Cuba and the Yucatan) and of Florida Straits passages is fundamental to understanding of the transport of released drilling fluids and spilled oil.
- Challenging aspects are the requirements for **water column current** modeling in a wide **range of spatial and temporal scales** and modeling of currents linking major flows, e.g. the Gulf Stream, to currents between the Gulf Stream and coasts.

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# 4.1 Modeling: Physical

- **Outstanding modeling capabilities** for flows in the Gulfstream Florida Cuba environment (years of data and experience) lie **within proposed scientific consortium**.
- High-resolution, non-hydrostatic models can be imbedded at critical locations in an **existing coastal circulation now cast/forecast model** for the Yucatan Chanel, Gulf of Mexico, Straits of Florida, and South Atlantic Bight.
- Advantage can be taken of **existing models and in expanding modeling** efforts.

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# 4.2 Modeling: Ecological

**Couple Physical with Bioecological models: predict effects under various scenarios.**

- Ecosystem **response** to aspects and effects of oil and dispersed oil are **unclear**. **Hampers mitigation**.
- **Research** on exposures, reef connectivity, and past effects used **for predictive ecological model**s to oil and dispersed oil spill scenarios.
- Empirical work to provide **scaled information** (across several levels) of oil and climate change impacts on tissue, cellular, organismal, and population levels.
- Explicit by **dynamical equations** that recreate the cascade of impacts.

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# 4.2 Modeling: Ecological

- Choice of model to depend on **life-history** information of the key organisms (i.e. stage or size-explicit life tables versus only general survivability information).
- Leslie-matrices measure life-history event likelihood using Markov chains, and differential equations.
- Parameterized experimental and connectivity results
- **Result: a master ecological model** for numerical experimentation with pollution scenarios.
- Verified by **hind casting** against known trajectories (experiments).
- **Goal: Concordance and forecasting.**

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# 5. Mitigation Planning

**Models and strategies can be developed specifically to enhance the ability of the US Coast Guard and other agencies to better understand:**

- Where a spill is **going in space and time**?
- What are likely **ecological and environmental effects for improved response** and mitigation of a spill related to Cuban oil drilling activities?
- **Overall purpose** is to utilize in-situ and remote sensing observations, knowledge of effects, oceanographic and bio-physical numerical modeling, and data assimilation to trace oil spills, understand effects, and mitigate their impact on sensitive ecosystems.

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# F. Proactive Research Needs Suggested Actions SUMMARY

**What Should Be Done Now: <u>Develop a strategic plan and fund research to address the following needs:</u>**

1. **MONITORING**
   - *1.1 Early Warning of spills*
   - *1.2 Ocean Observations of Dynamics*
2. **BIOLOGIAL BASELINE**
3. **TOXICITY** *(Oil, Dispersant, Dispersed Oil)*
4. **MODELING**
   - *4.1 Oceanographic (transport, 3D, high resolution)*
   - *4.2 Ecosystem Response Prediction*
5. **SYNTHESIS MITIGATION RESPONSE PLANNING**

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# G. Rationale: Effective Preparedness

**Why?**

**In its final 2011 report on the Deepwater Horizon event, the U.S. Coast Guard notes that effective preparedness begins before drilling starts and urges:**

***"If the public and Congress expect significant improvements in this nation's ability to respond to catastrophic oil spills, additional funding will be needed for improvements, which include research and development… [to] effectively address an offshore Spill of national significance."***

# G. Rationale: Oil Spill Commission Findings

## OIL SPILL COMMISSION ACTION REPORT: Recommendations of National Oil Spill Commission, April 17, 2012:

- *In …past 10 months, at least 3 offshore oil and gas rigs around the world have experienced significant leaks,* ***demonstrating*** *again… **how risky this is** …emphasizing the need for the types of controls and protections…*
- *The **risks …increase** as drilling moves into **deeper waters** with harsher, less familiar environmental conditions…*
- ***Delays** in taking the necessary **precautions** threaten **new disasters**, and their occurrence could, in turn, seriously **threaten the nation's** energy security.*

# H. Implementation: Proactive Research via Academia, Industry, Government Public Private Consortium

**We urge implementation of a public-private scientific consortium to expand proactive research:**

- FIU FLORIDA INTERNATIONAL UNIVERSITY & NOVA SOUTHEASTERN UNIVERSITY Oceanographic Center
- University of Miami (RSMAS)
- Roffs Ocean Fishing Forecasting Service Inc.
- NOAA, SECOORA, GCOOS, & FIO
- Other Florida industries and institutions.
- in-depth expertise, local knowledge, and data: most effective in unique oceanic and coastal environments.

# RESEARCH TO ENHANCE US RESPONSE TO IMPACTS OF HYDROCARBON POLLUTANTSARISING FROM FOREIGN OIL DRILLING

## TO: ICCOPR, June 13, 2012

## THANK YOU!


**FROM:**

**Dr. John R. Proni**, Executive Director, Applied Research Center (ARC), Florida International University

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