Atmospheric Sciences

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Applications:

1. **Drive Ocean Circulation Models for Use in the Oil Spill Risks Analysis and Other Marine Pollutant Transport;**

2. **Improved and Upgrade Air Quality Modeling for Offshore Air Emission Assessment;**

3. **Support Offshore Wind and Wave Energy Programs in Resource Evaluation, Design and Operation Guideline and Environmental Impact Assessment.**

Partial List of On-going and Planned Atmospheric Sciences Studies

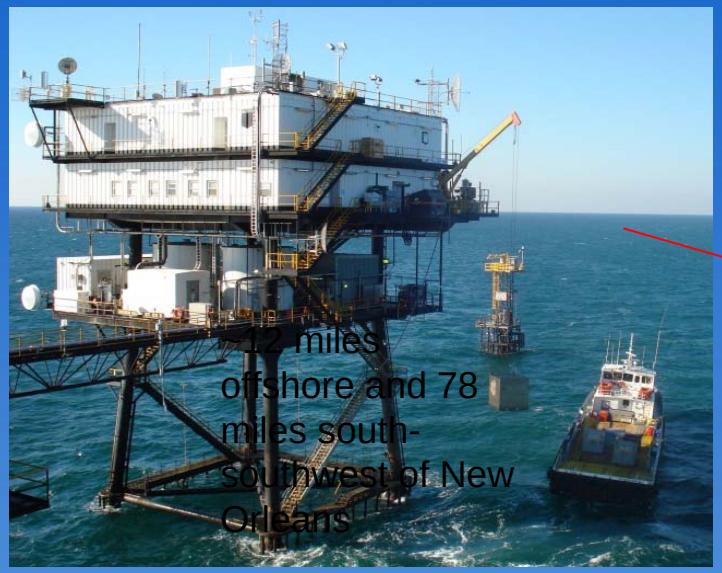
- **Meteorological and Wave Measurements for Improving Meteorological and Air Quality Modeling**
- **Operations of BOEM's Radar Wind Profiler /RASS at the Houston Coastal Center;**
- **Beaufort and Chukchi Seas Meso-scale Meteorology;**
- **Outer Continental Shelf Air Quality Modeling Update (planned study);**
- **Improving Tropical Cyclone Intensity Forecasting (NOPP Program);**
- **Improving Wind Waves Predictions: Global to Regional Scales (NOPP Program).**

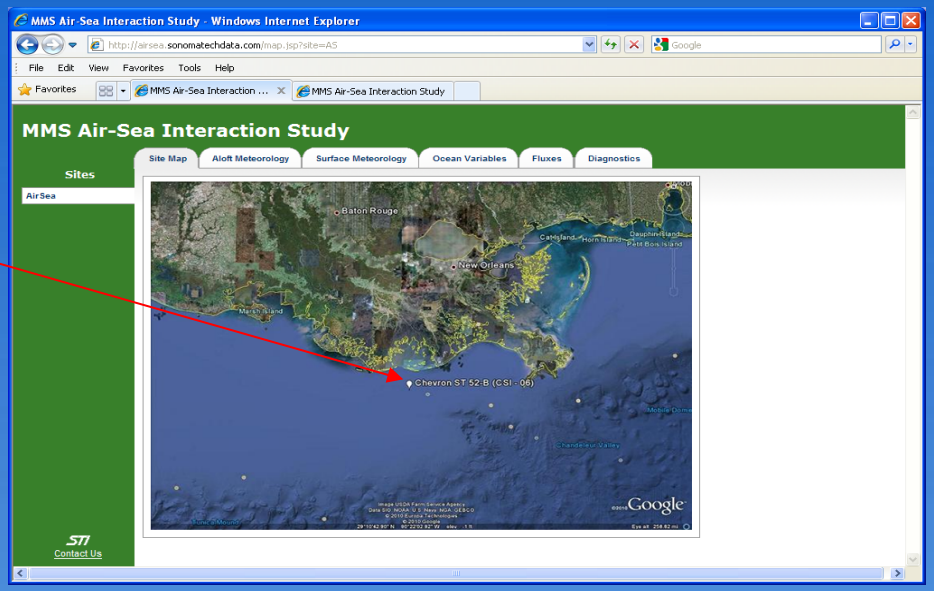
Meteorological and Oceanographic Measurements for Improving Meteorological and Air Quality Modeling

(Challenge in Coastal Meteorology)

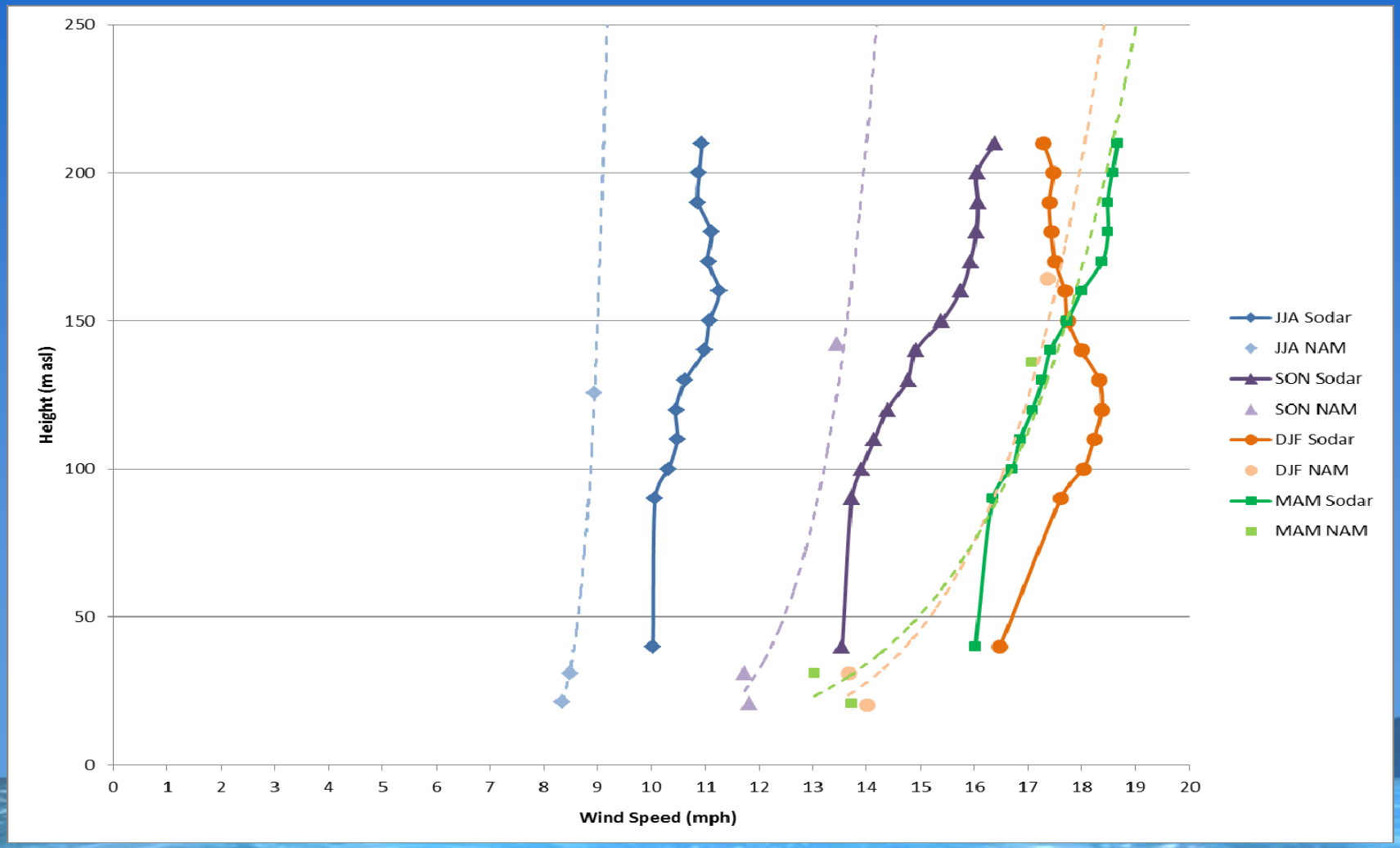
- Key goals are to collect data for use in
  - Improving characterization and predictions of costal boundary layer parameters
  - Improving regional-scale meteorological model predictions (e.g., COARE Air-Sea Fluxes)
  - Providing a framework for advanced offshore measurements to be Applied in Offshore Wind and Wave Energy Program

The Site and Instrumentations

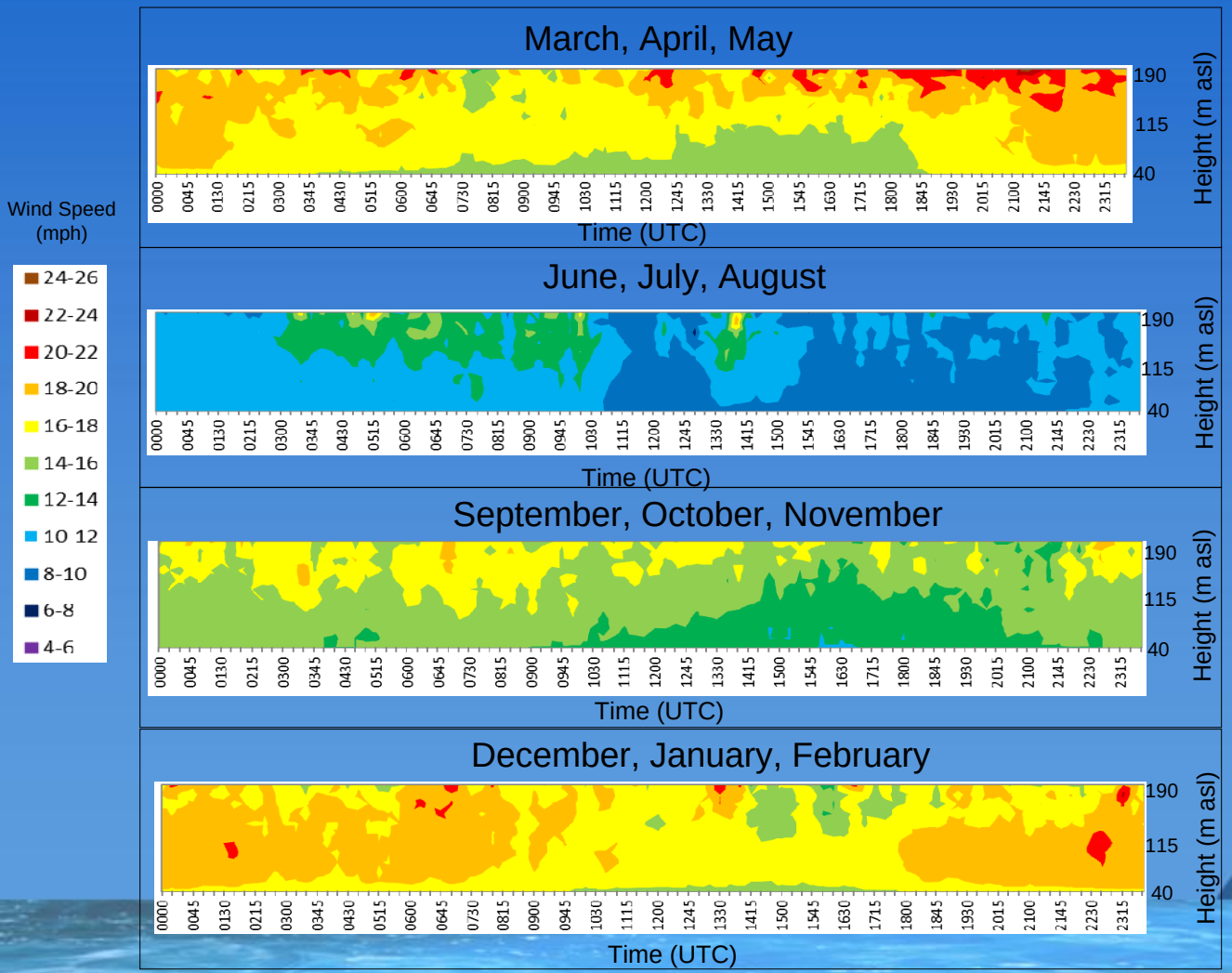




Vertical Profiles of Scalar-Average Observed and Model Wind Speeds by Season



Diurnal Scalar-Averaged Observed Wind Speeds by Season



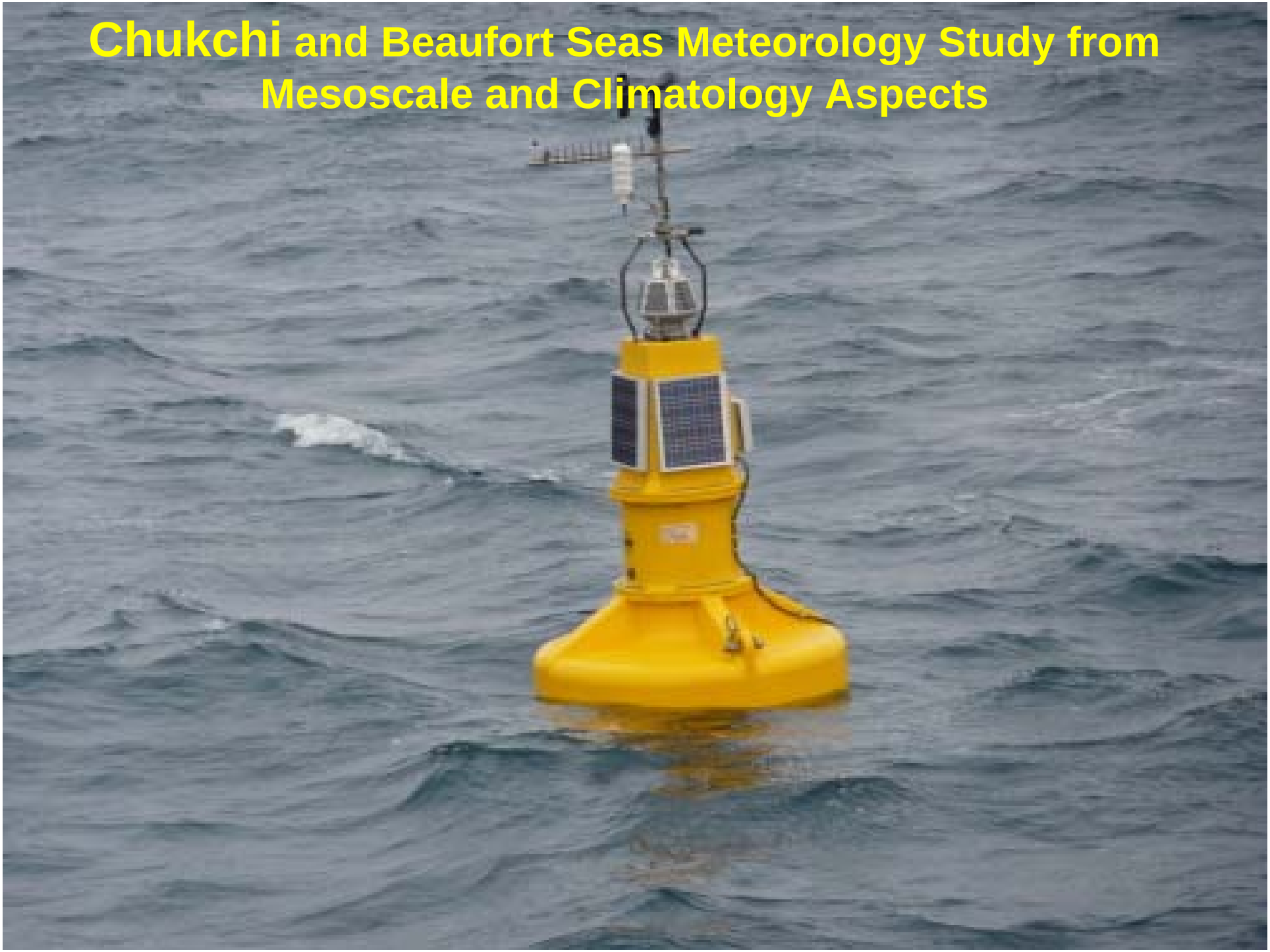
Preliminary Findings

- **The surface and sodar measurements characterize the winds from 40 to ~200 m asl for an entire year;**
- **The NAM (North America Mesoscale Model) wind tends to under estimate lower boundary layer at that location on moderate and low wind fields;**
- **There is diurnal variability in the observed winds;**
- **The model winds do not always capture the vertical structure especially in high wind field;**
- **Analysis is needed to fully characterize and understand boundary-layer processes over the GOM and to improve model performance.**

Follow Up:

- Expand the Modeling Efforts in Coastal Meteorology and Fully Utilize the Observed Data;
- Work with an Inter-agency Working Group-Resource to Develop an Offshore Wind Energy Reference Facility (**e.g., Resource Assessment and Design Conditions Groups for Offshore Alternative Energy Program has identifies the data gaps and forms a Consortium to create an Offshore Wind Energy Reference Facility that will measure the long-term air flow from 50-150 m layer and BOEM is an active member of this program.)**

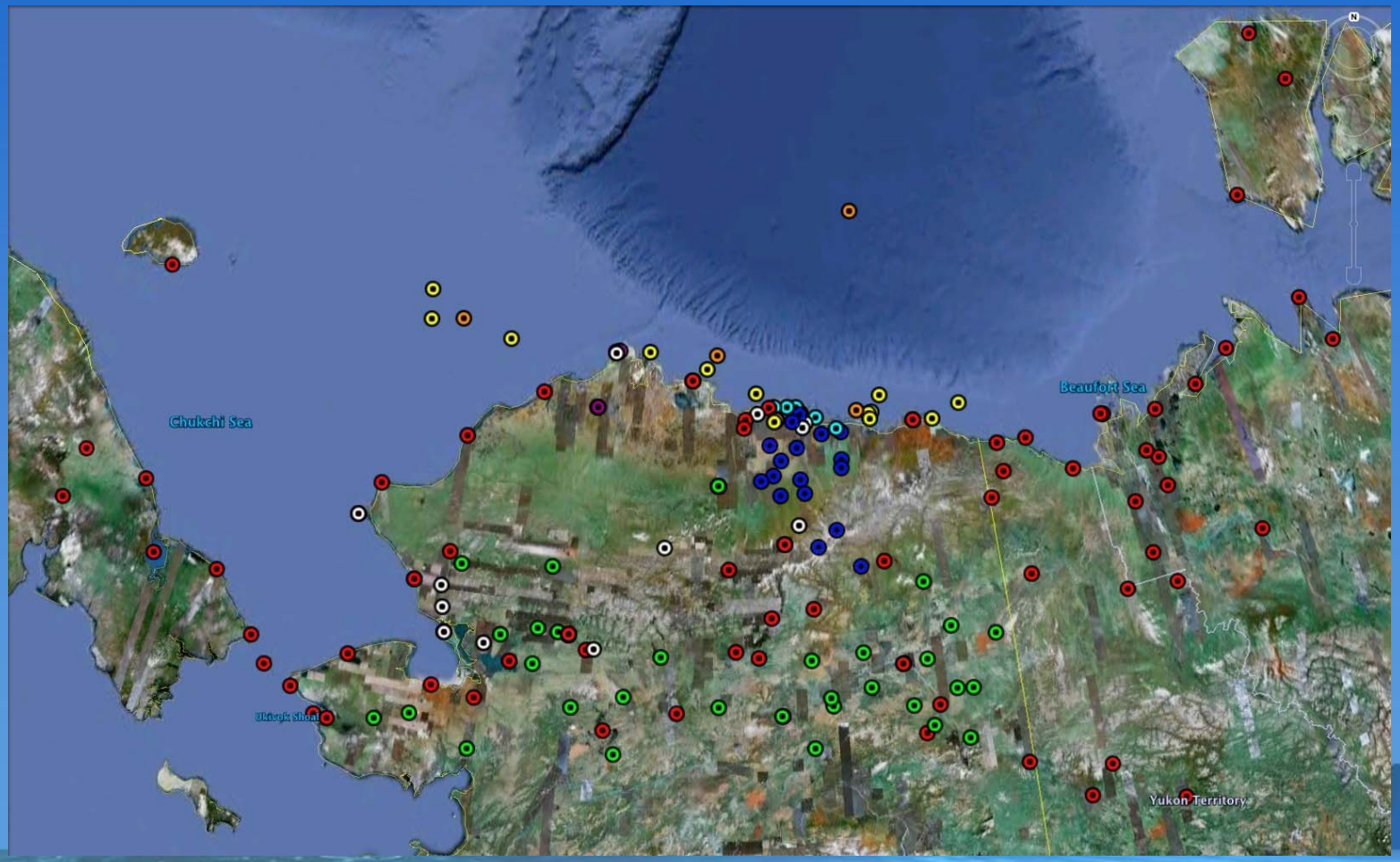
Chukchi and Beaufort Seas Meteorology Study from Mesoscale and Climatology Aspects



Complexity of Modeling in Arctic Environment

- **Unique environmental conditions:**
  - **Continuous solar irradiance**
  - **Greater Coriolis effect**
  - **Sea-Ice, Snow and Seasonal Opening of Ocean**
  - **Topographic effect from Brooks Range**
  - **Sea Breeze**
  - **Lacking of Wind Measurements of Ocean during opening season**

Data Collection and Analysis



USCGC Healy deployed and recovered UAF/BOEM buoy

The buoy was deployed on 08/05/09 by HLY0409 (Chief Scientist Robert Pickart (WHOI)) and recovered on 09/15/09 by HLY0509 (Chief scientist Larry Mayer (UNH)), revisited by R/V Alpha Helix on 08/27/09 (Michael Macrander (Shell)).


The deployment site has been reached. Liftoff!

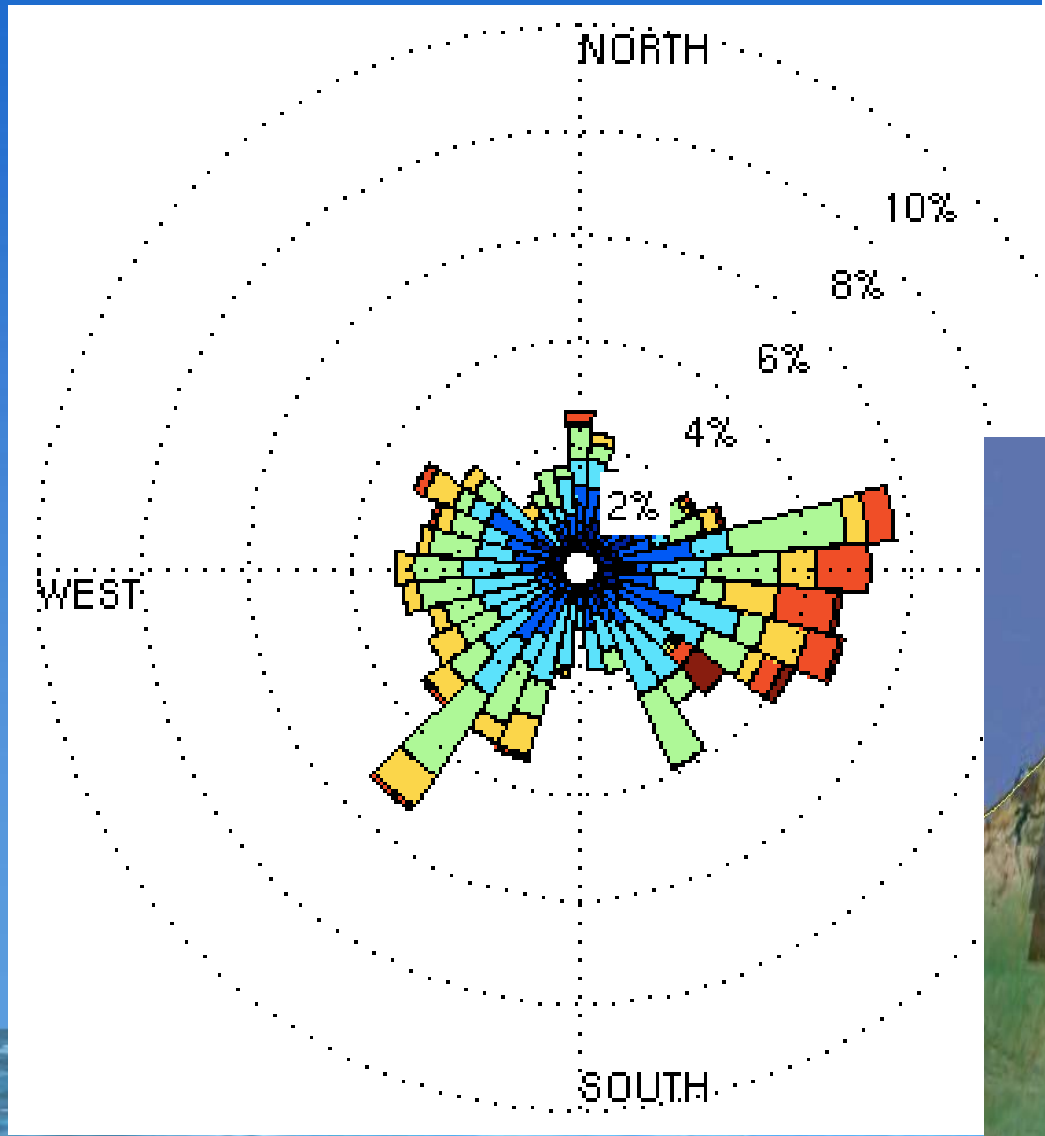

Last minute checks before the buoy's solemn sentinel begins.


Communication is lost, and the R/V Alpha Helix revisits the site.


After six solitary weeks, the buoy is relieved of duty. Until next year...

Images by Dale Chayes and Captain John of Alpha Helix

Buoy Measurements



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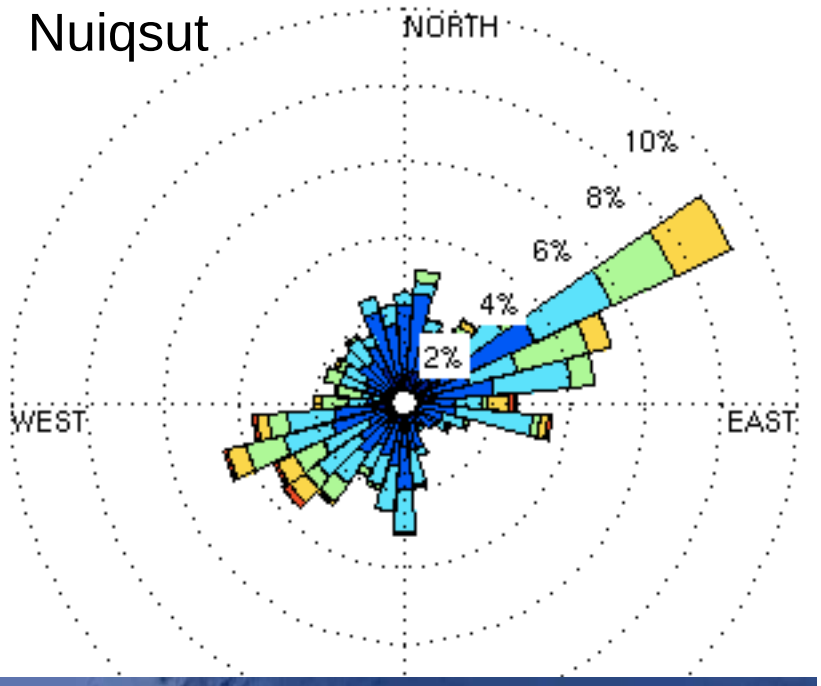


Current Applications

1: Support BOEM's modeling efforts and other on-going disciplinary studies for environmental assessments

2: Support EPA Emission Assessment for issuing permit for Exploration plan

3: Conduct Climate Analysis based 30 years hindcasting runs and focus on recent rapid change

4: Develop mesoscale model for local and scientific community uses

Extending Arctic WRF for Near-Future Studies

- Integrating WRF and Ocean Circulation Models into New Sea-Ice Dynamics Model to Predict Lead and Ridge Formation?
- Integrating WRF into Wave Watch III (WWIII) for Wave and Beach Erosion Study in Arctic Coasts?
- Integrating WRF into Air Quality Model to assess impact of polluted air.

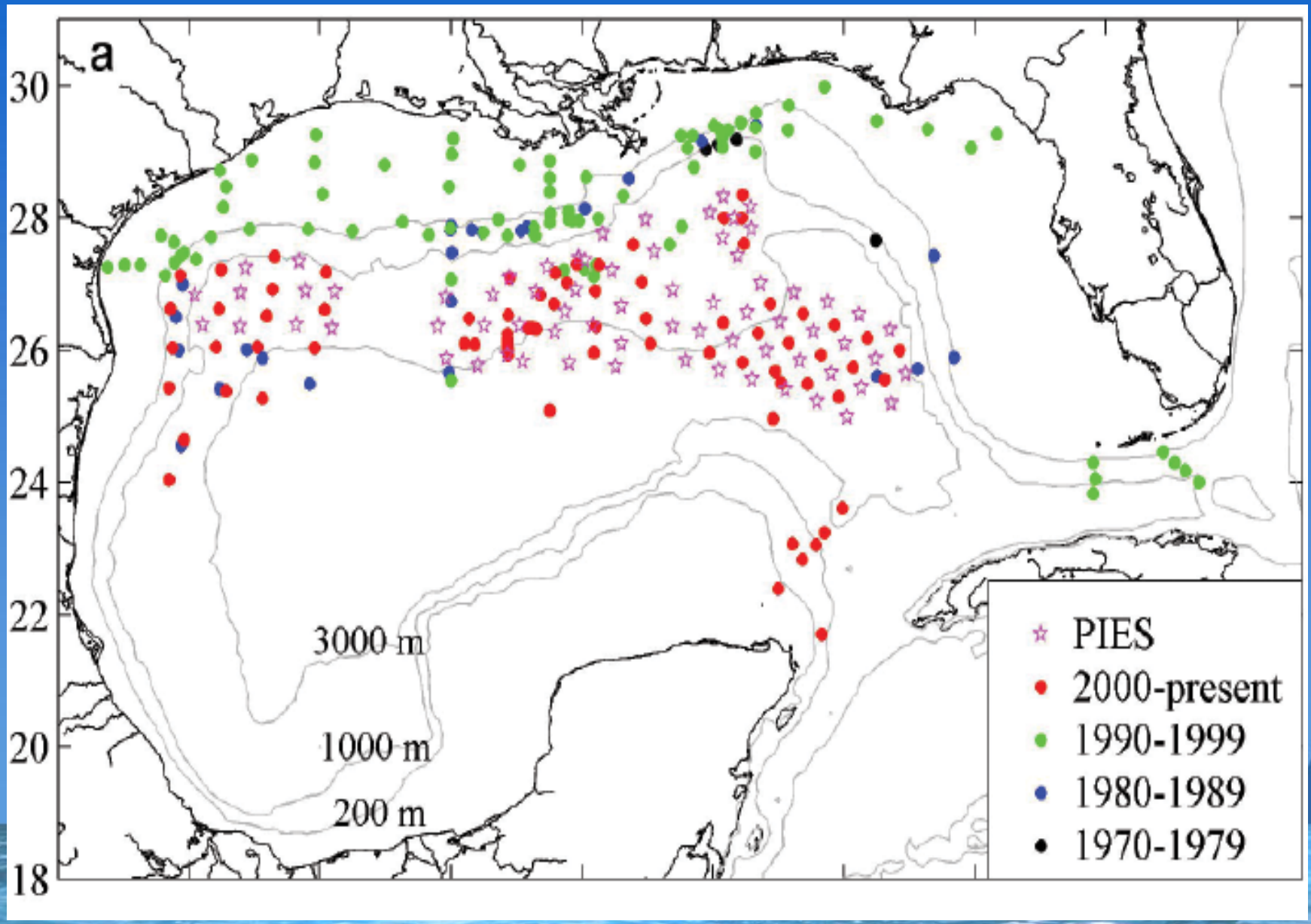
Deepwater Gulf of Mexico Physical Oceanography Studies

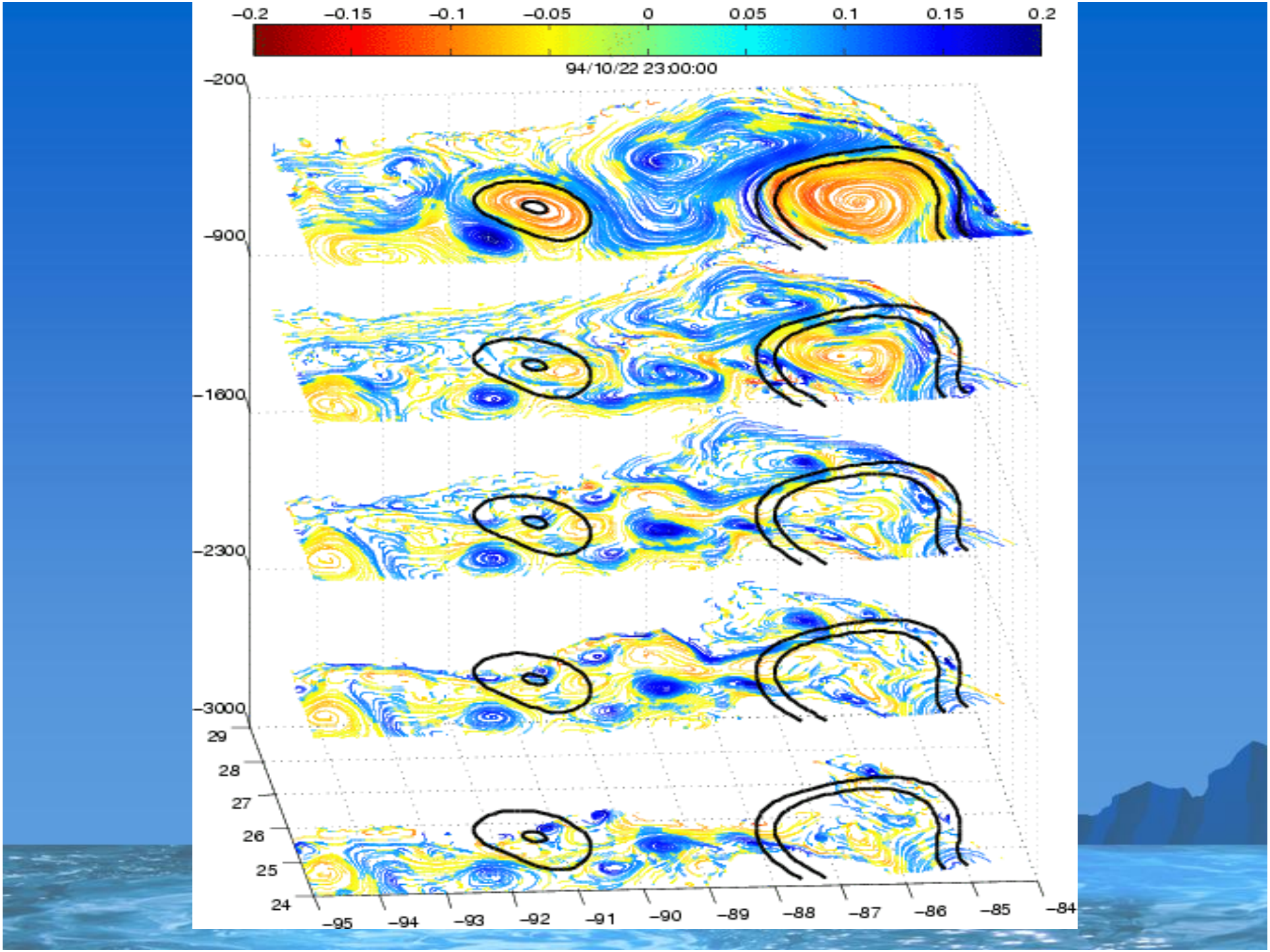
- **To Investigate:**
  - **Loop Current Dynamics (expansion and retraction)**
  - **Loop Current Eddies (shedding and re-attach mechanism, propagation and dissipation)**
  - **Deepwater Circulation and Cool Eddies Formation, propagation and dissipation**
  - **Topography Rossby Waves (Propagation, reflection and dissipation)**
  - **Subsurface high speed jets**
  - **Initial flows (generation, penetration and dissipation)**

Partial List of Completed and On-Going Studies

- Exploratory Study of Deepwater Currents in the Gulf of Mexico
- Survey of Deepwater Currents in the Northwestern Gulf of Mexico
- Exploratory Study of Deepwater Currents in the Eastern Gulf of Mexico
- Ultra-Deepwater Circulation Processes in the Gulf of Mexico (modeling efforts)
- Dynamics of Loop Current in the Gulf of Mexico
- A Lagrangian Approaches to Study the Gulf of Mexico's Deep Circulation

Summary of Moorings




−0.2
−0.15
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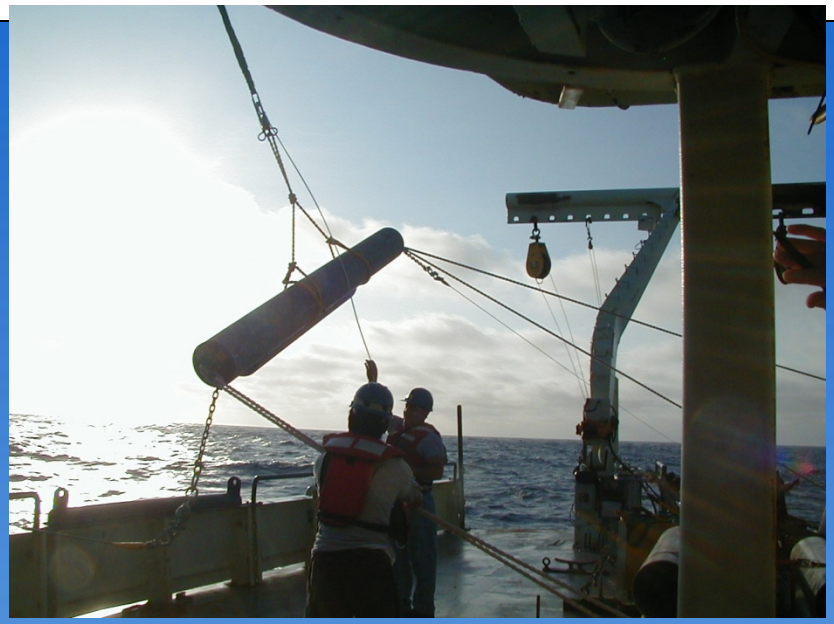
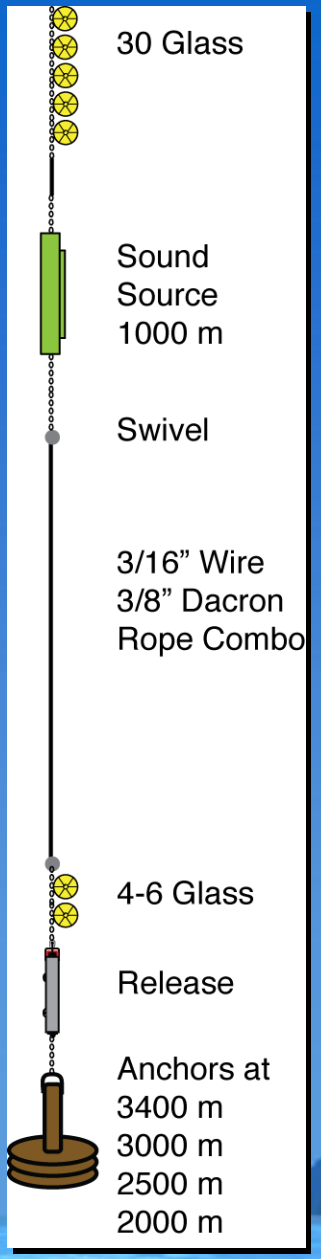
A Lagrangian Approach to Study the Gulf of Mexico's Deep Circulation

- Dynamics of the Deep Circulation of the Gulf using Floats
- This 5-year study includes 3-years field observations
- 4 sound sources have been deployed and total of 120 RAFOS floats and 8 of APEX floats will be deployed in two years interval at 1500 m and 2500 m depths

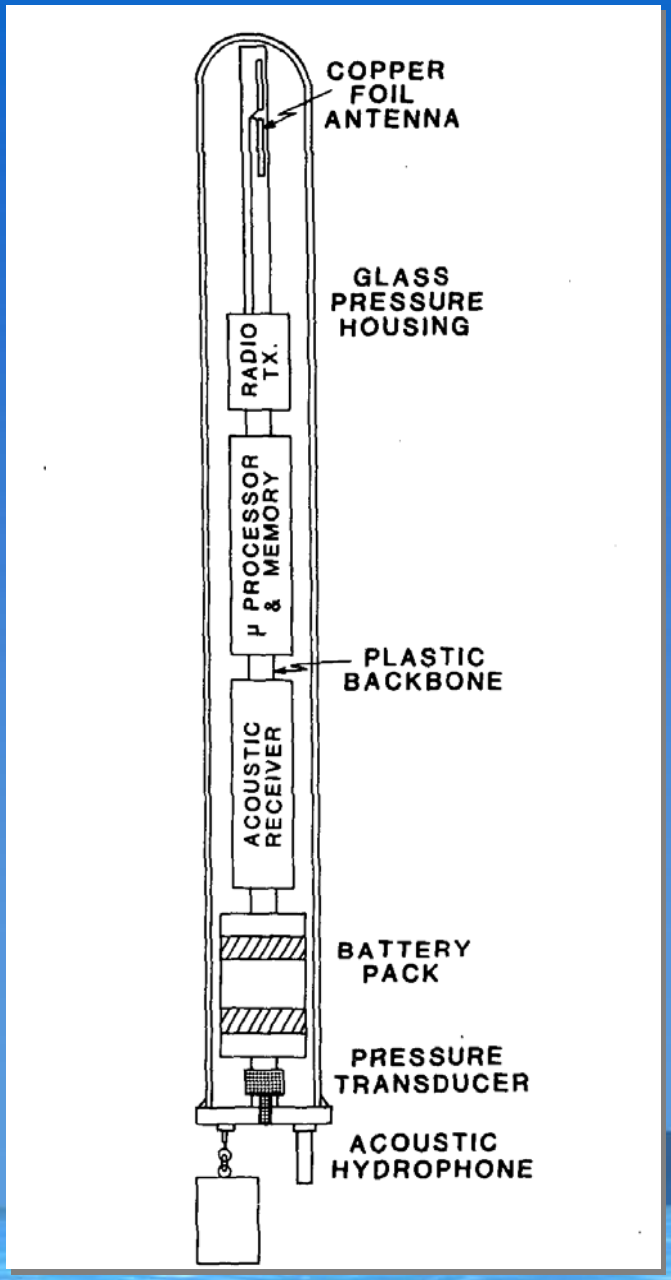
Sound Sources



- Deploy total of 4 sound sources
  - Purchase 2 new from TWR
  - Build 1 at WHOI (URI design)
  - Refurbish 1 TWR source
- Standard 260-Hz RAFOS sources
- Lifetime of 4000 pongs (3.7 years)



RAFOS Floats



tracked acoustically with sound sources

measure temperature, pressure and acoustic travel times three times daily

ballasted for 1500 (80%), 2500 (20%) meters

230 float-years of high-resolution trajectories

Iridium telemetry

Profiling Floats

Sea Bird CTD

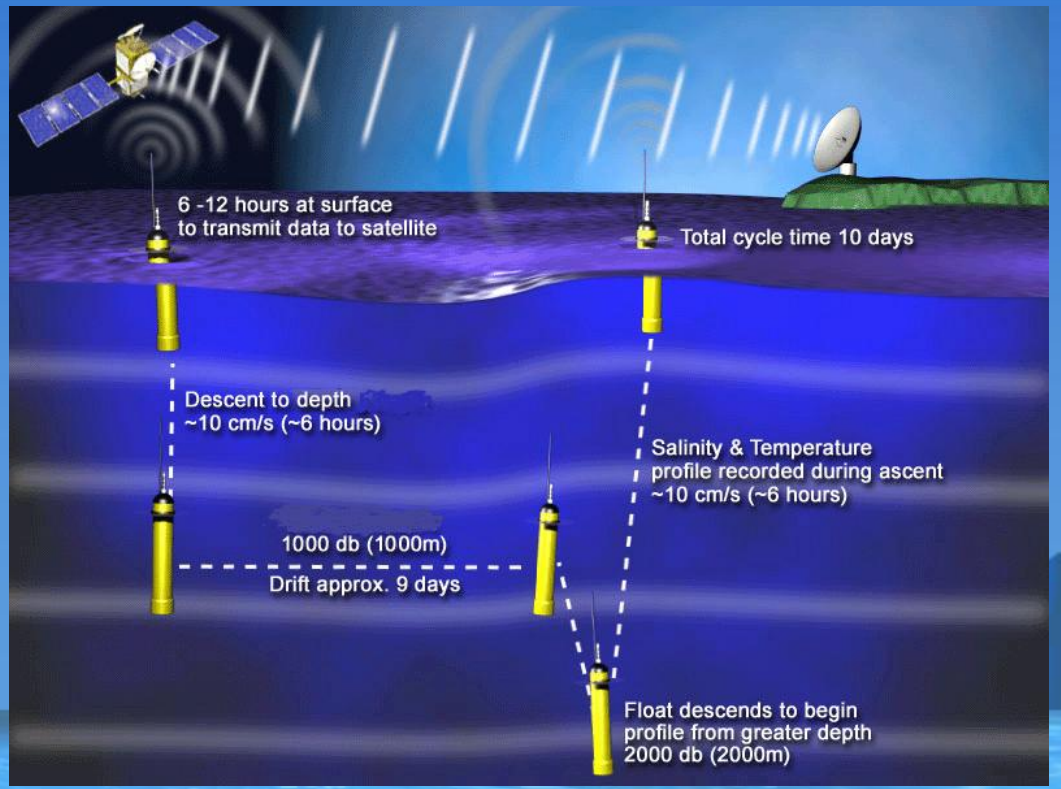
WET Labs Optical Sensor Package

Iridium telemetry

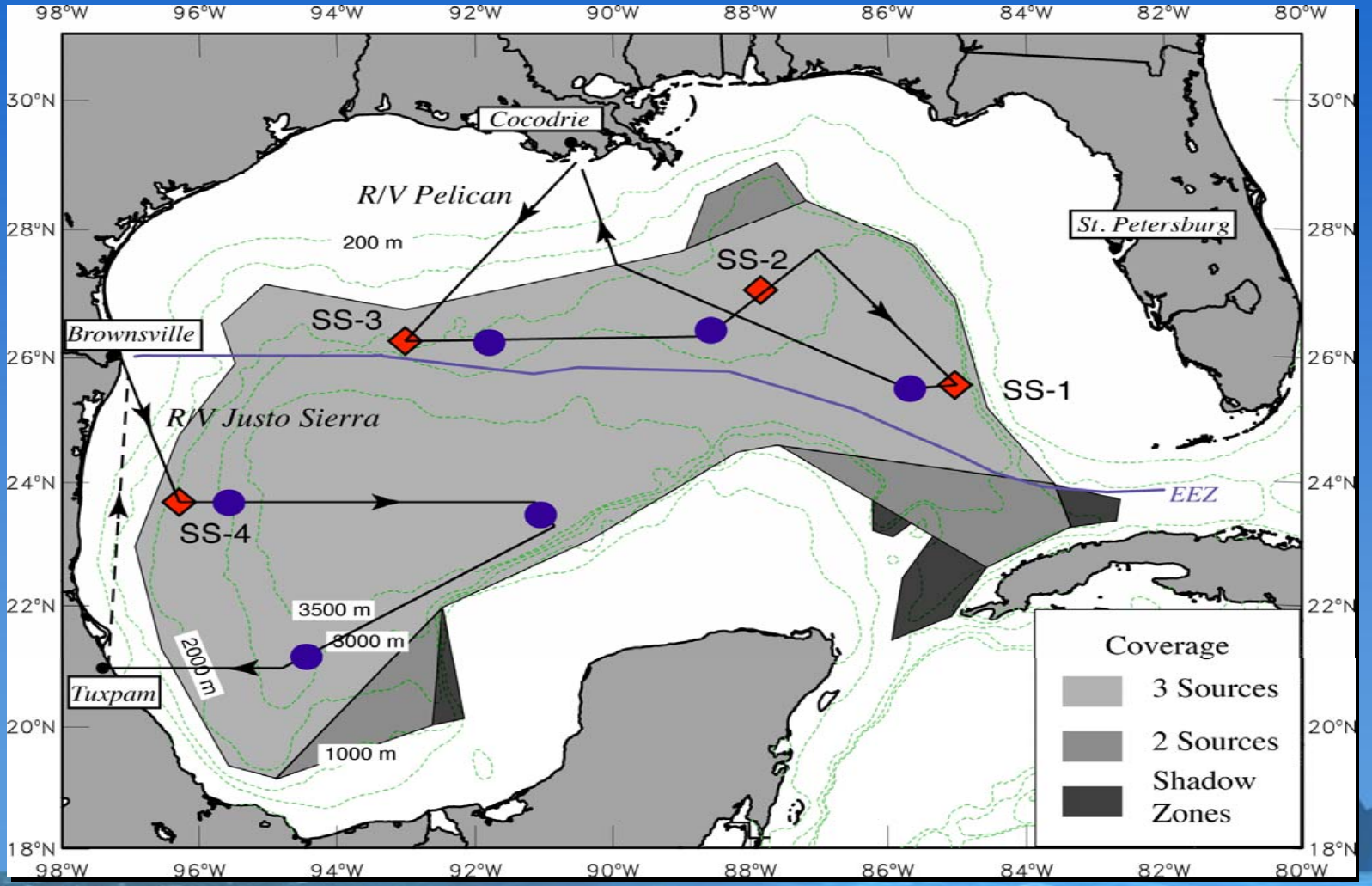
Acoustic receiver

Lithium batteries

Good for 150 profiles



Profiling Float Deployment Locations



Summary

- **An Exciting New Study using Lagrangian Floats to:**
  - Map Lower-Layer Deep Currents throughout the Gulf
  - Statistically Characterize these Currents
  - Generate Random Water Column Profiles for:
    - Water Mass Characterization
    - BioGeochemical Data in the Deep Basins
  - Investigate Deep Lagrangian Dispersion
  - Investigate Upper-Lower Layer Coupling & Dynamics
  - Provide an Important Database for Model Studies

Opportunity

- Design other Lagrangian Study using existing sound sources;
- Investigate Lagrangian characteristics by using available tracking data sets?
- Work with recently funded GRI (Gulf Research Initiative) studies to maximize the results;
- Others?

Environmental Studies Program

- Develops and oversees applied scientific studies required for making responsible decisions for managing energy and marine mineral resources on the U.S. Outer Continental Shelf

BOEM
Bureau of Ocean Energy Management

Applied Science for Informed Decisions on Ocean Energy