LSU COLLEGE OF ENGINEERING

FATE OF ERODING CRUDE OIL ASPHALT AND EMULSION IN SHALLOW MARSH EMBAYMENTS

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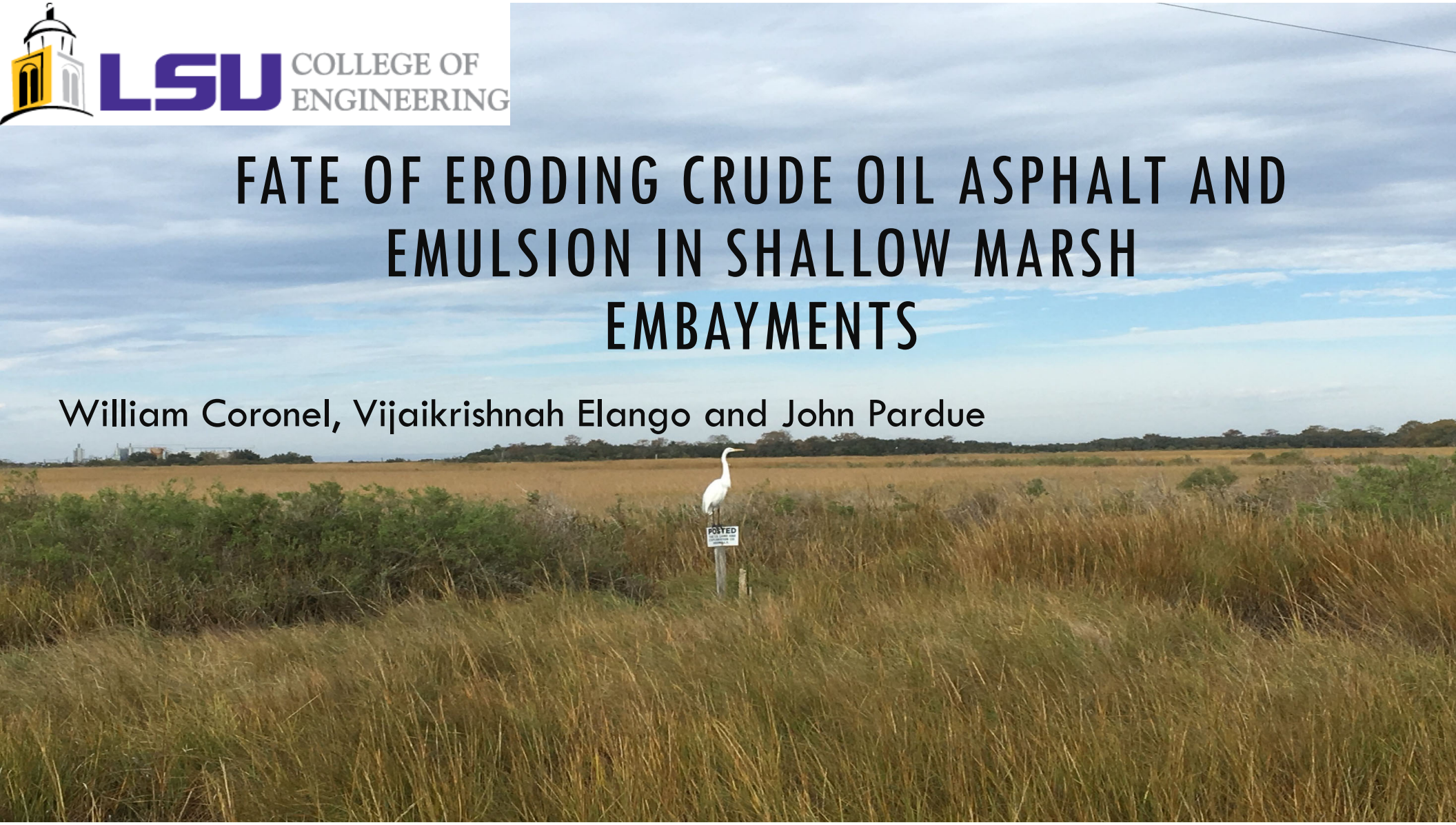
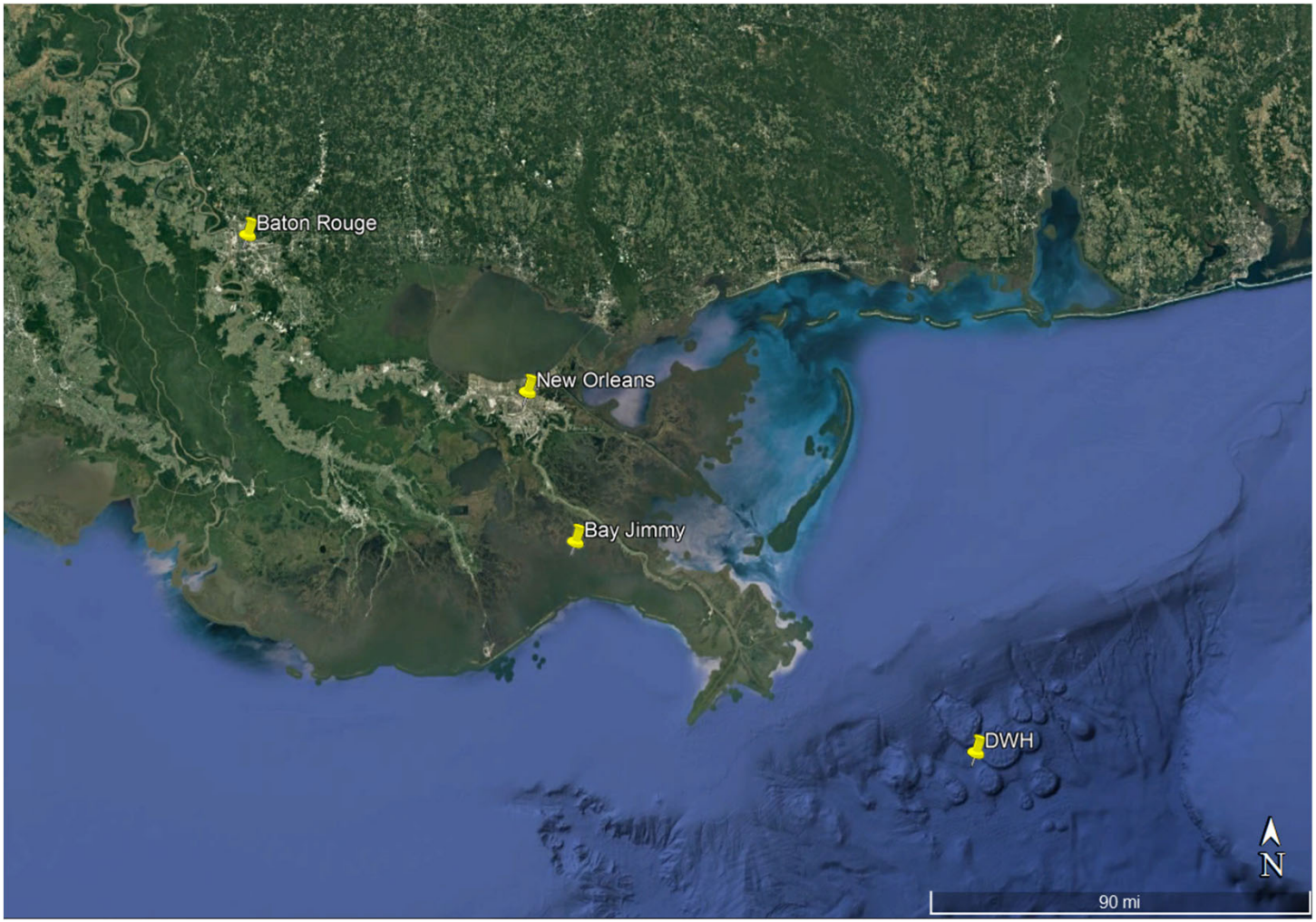
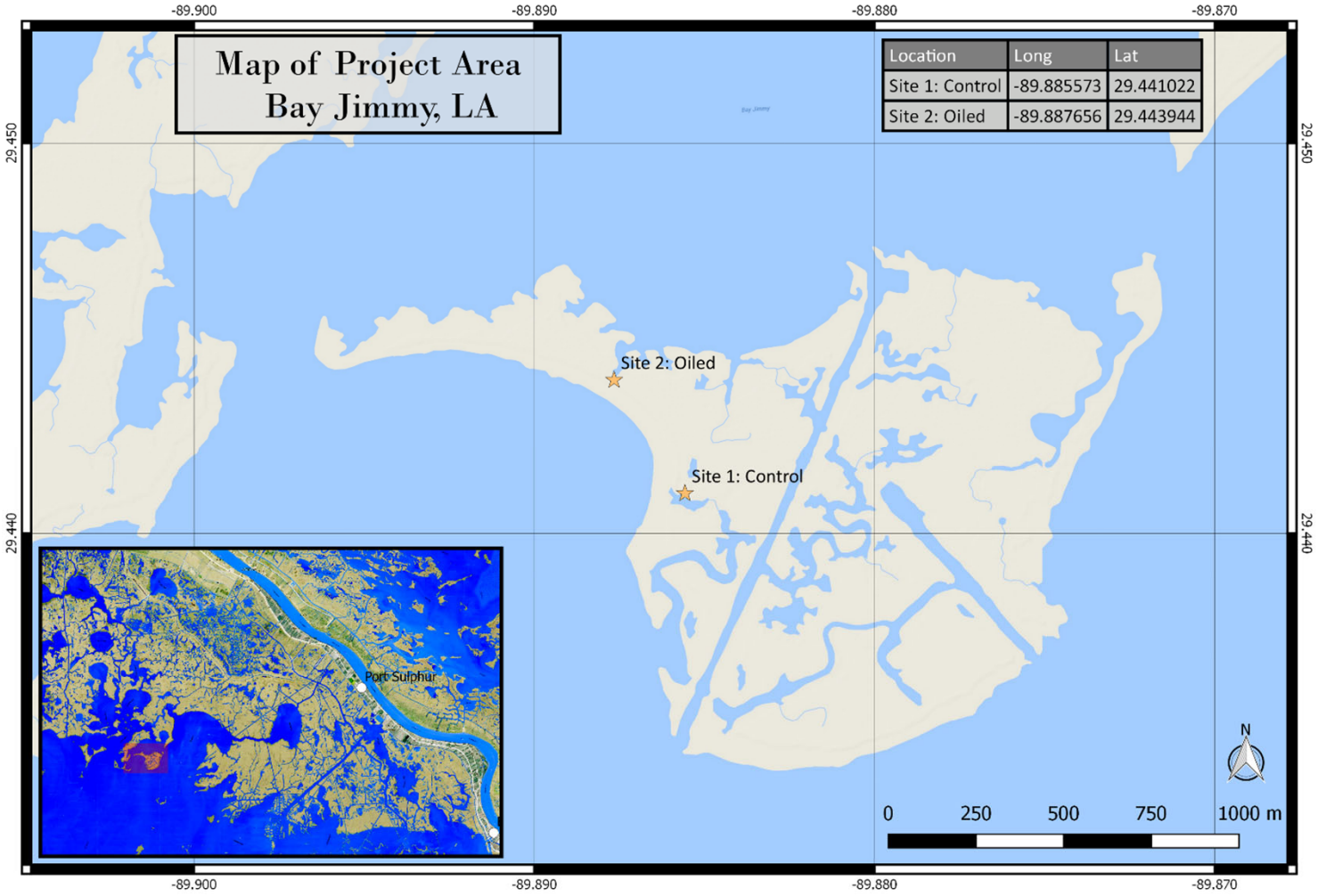


South Louisiana

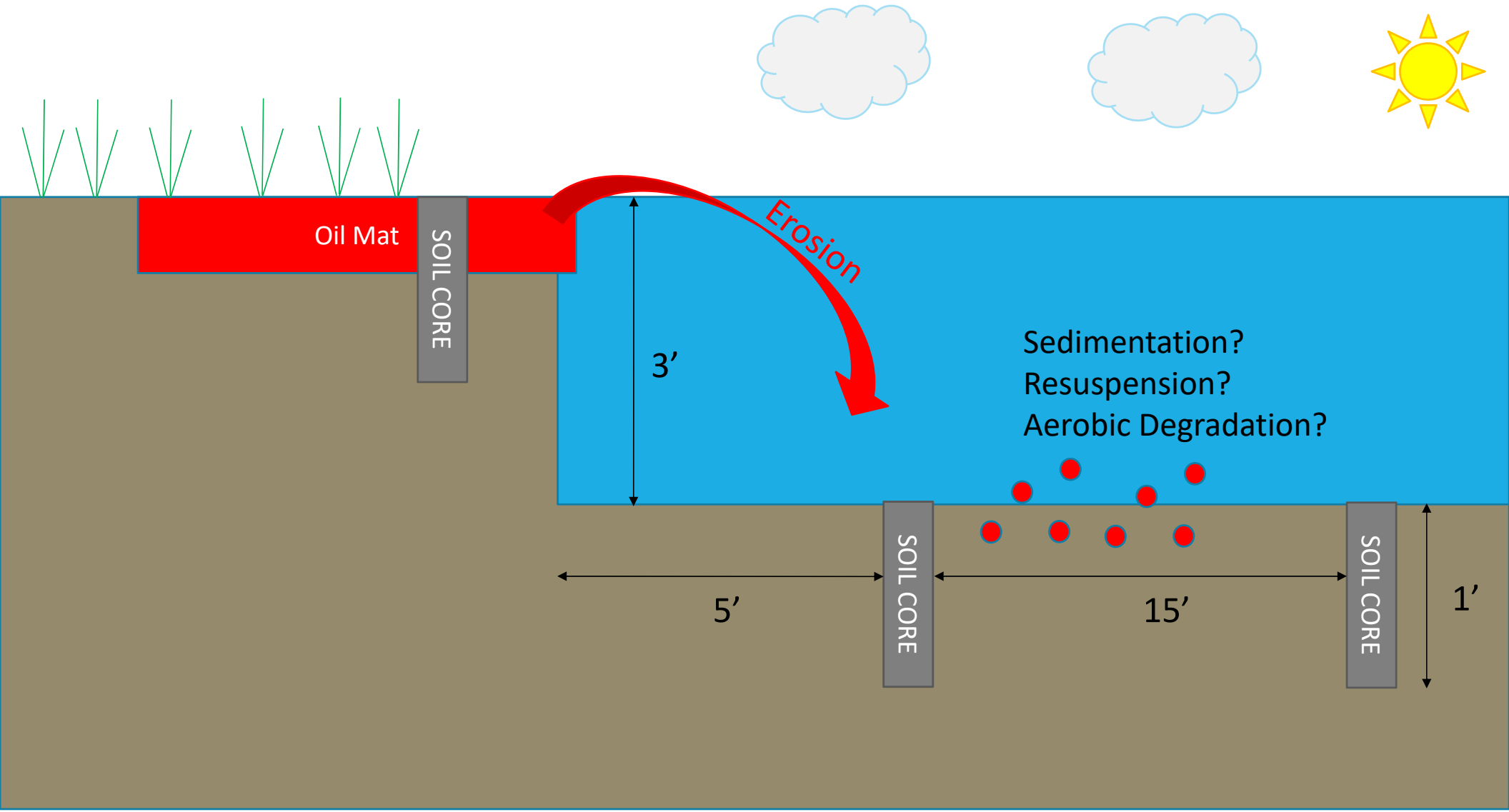


Study Site


Map of Project Area
Bay Jimmy, LA
Location | Long | Lat
Site 1: Control | -89.885573 | 29.441022
Site 2: Oiled | -89.887656 | 29.443944
Site 2: Oiled
Site 1: Control
Port Sulphur
N
0 250 500 750 1000 m
-89.900
-89.890
-89.880
-89.870
29.450
29.440

Study Site


3M
2M
3NS
1M
3OS
2NS
1NS
2OS
1OS
M – Marsh
NS – Nearshore (5’ from marsh)
OS – Offshore (20’ from marsh)
Google Earth
N
200 ft


Oil Mat
SOIL CORE
Erosion
3’
Sedimentation?
Resuspension?
Aerobic Degradation?
SOIL CORE
SOIL CORE
5’
15’
1’

Field Study

- Sediment cores (12-inch) were taken July 2017 across transects on a contaminated marsh in Barataria Bay near Bay Jimmy where oiling occurred on the marsh surface

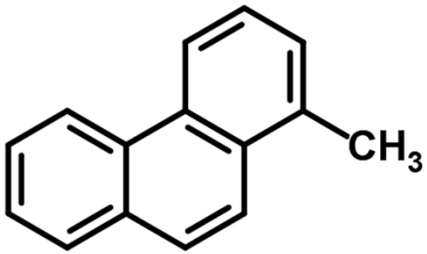
Methods

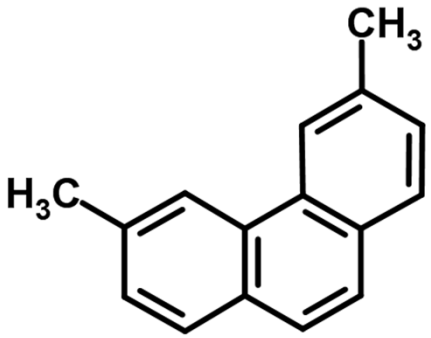
- GC-MS
- *Ilumina* Miseq

PAHs of Interest

Naphthalenes	Phenanthrenes	Dibenzothiophenes	Chrysenes
C_0-Naphthalene	C_0-Phenanthrenes	C_0-Dibenzothiophenes	C_0-Chrysenes
C_1-Naphthalenes	C_1-Phenanthrenes	C_1-Dibenzothiophenes	C_1-Chrysenes
C_2-Naphthalenes	C_2-Phenanthrenes	C_2-Dibenzothiophenes	C_2-Chrysenes
C_3-Naphthalenes	C_3-Phenanthrenes	C_3-Dibenzothiophenes	C_3-Chrysenes
C_4-Naphthalenes	C_4-Phenanthrenes		

Fluorenes	Others
C_0-Fluorenes	Hopanes
C_1-Fluorenes	Fluoranthene
C_2-Fluorenes	Pyrene
C_3-Fluorenes	Acenaphthylene
	Acenapthene





PAH Data Analysis

Weathering Ratio:

Weathering Ratio Phenanthrenes

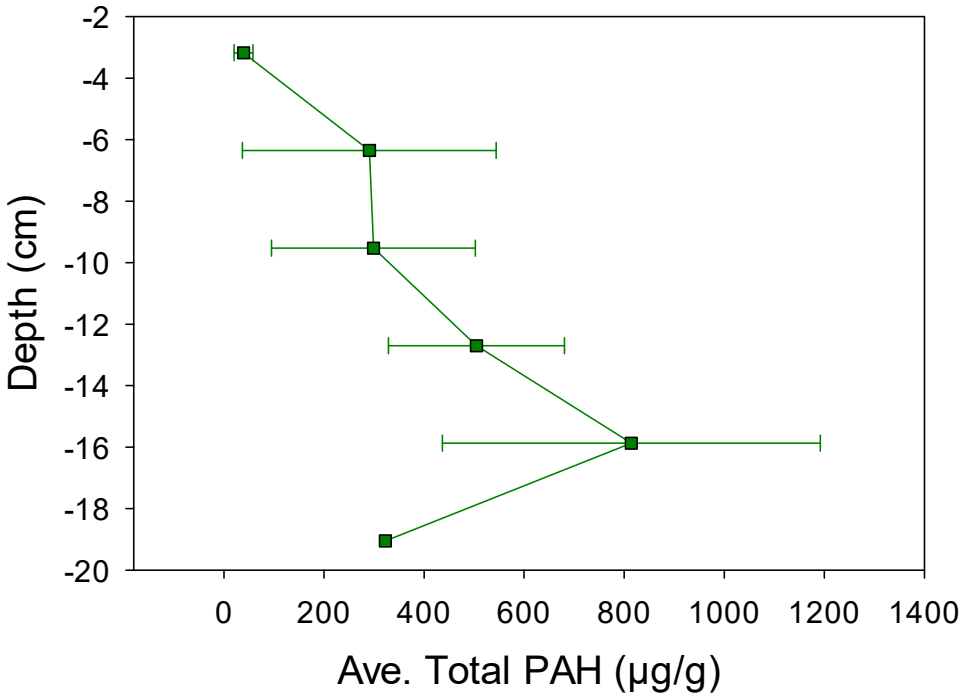
$$\frac{(\Sigma PHEN)}{(\Sigma PHEN + \Sigma CHRY)}$$

Weathering Ratio Dibenzothiophenes

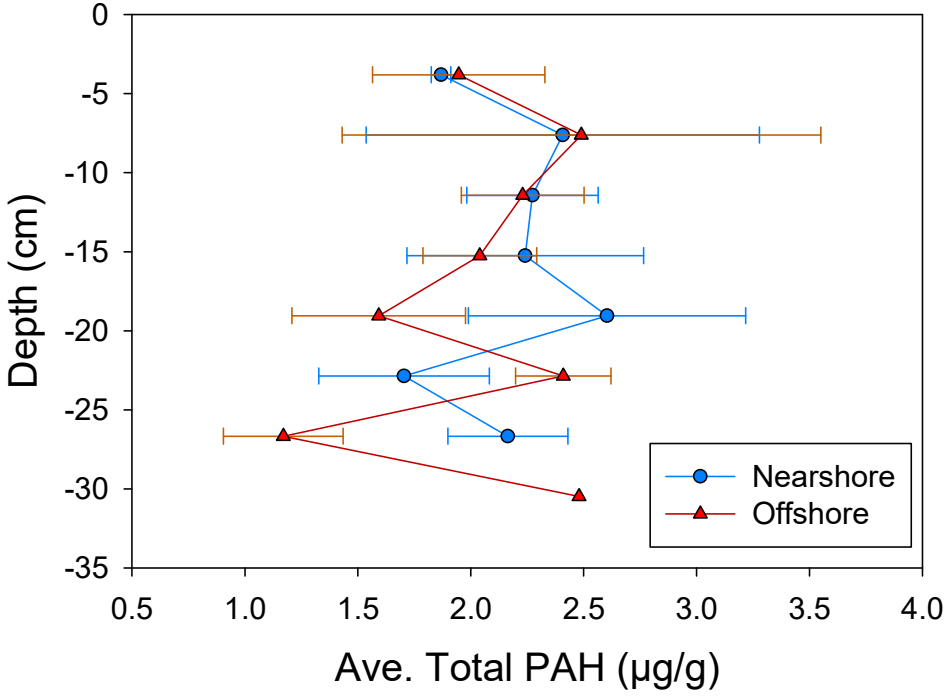
$$\frac{(\Sigma DBZ)}{(\Sigma DBZ + \Sigma CHRY)}$$

Sediment Core: Total PAH

Marsh

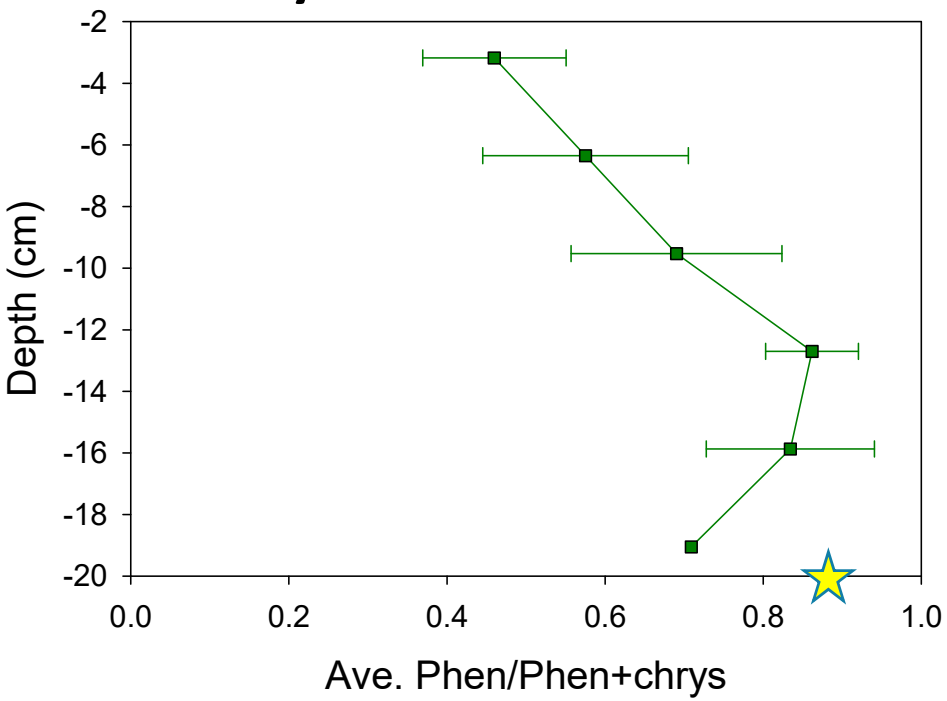


Nearshore and Offshore

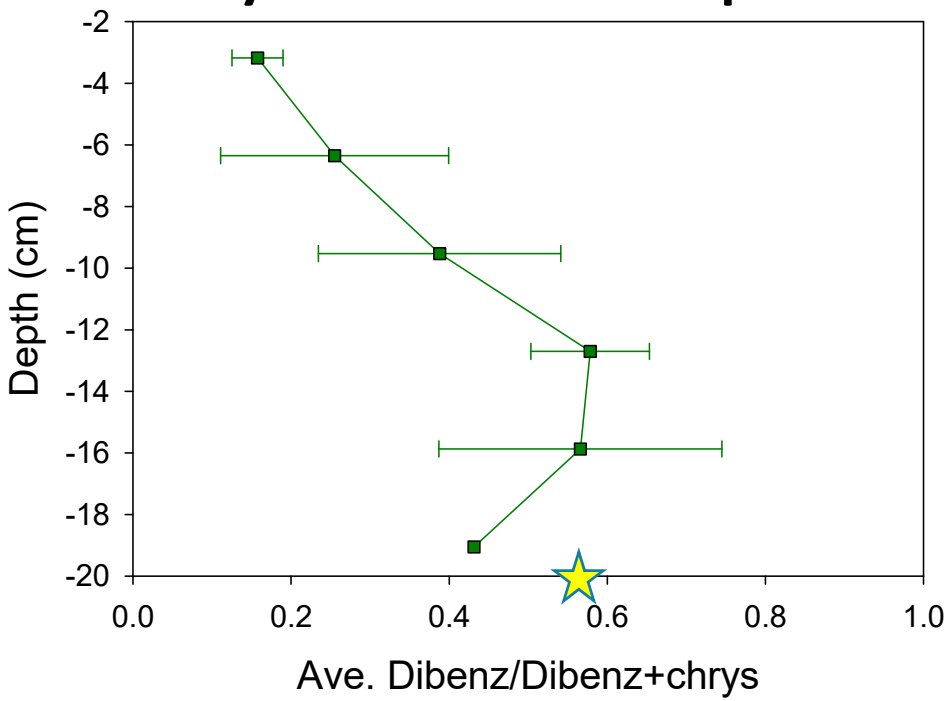


Sediment Core: Marsh Weathering Ratio

Alkylated Phenanthrenes

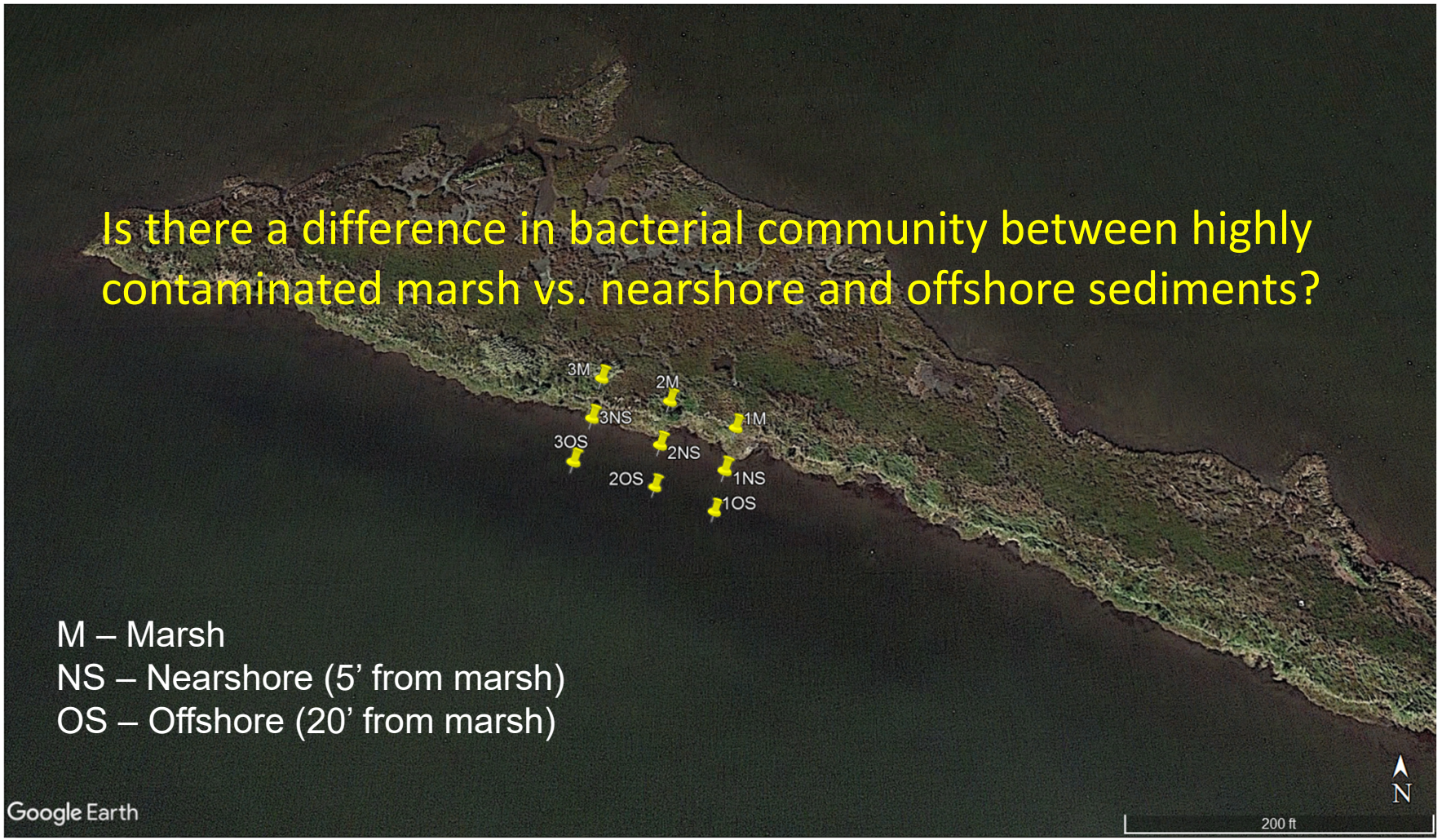


Alkylated Dibenzothiophenes

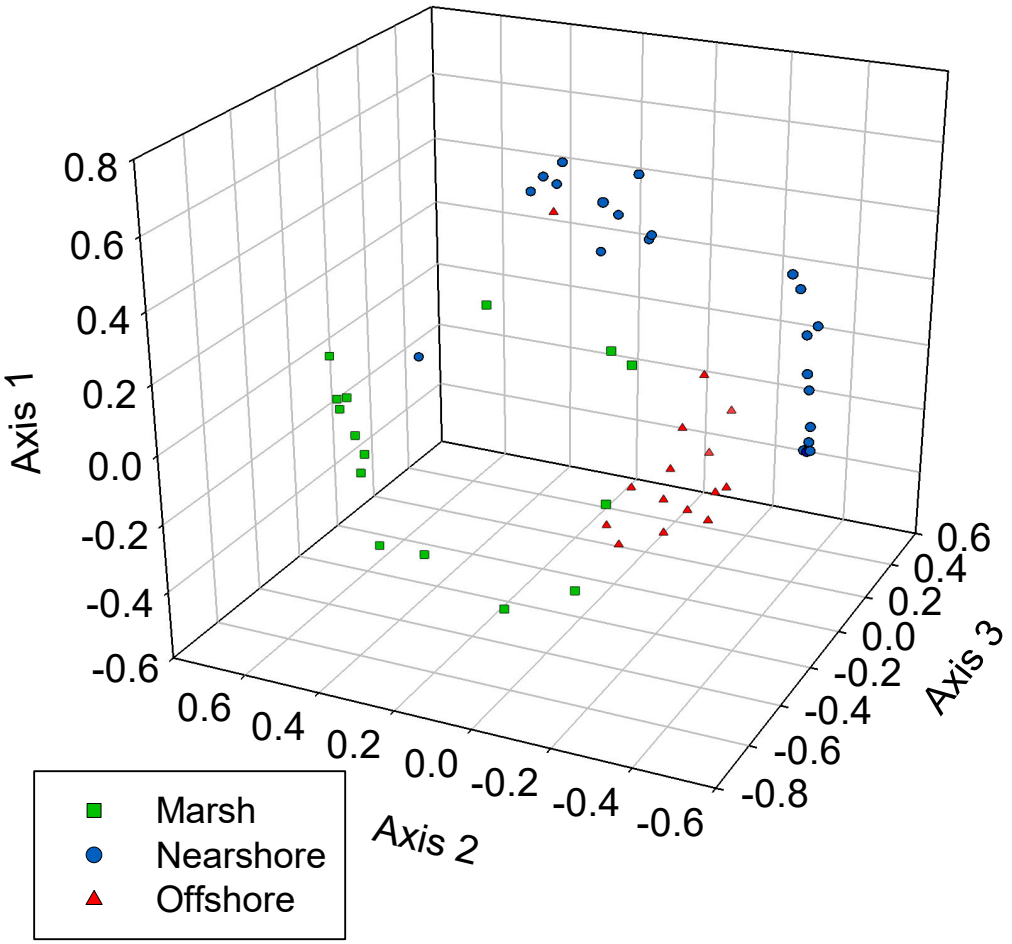


= Reference sample from Diercks et al. (2010) MC252 oil at the ocean surface near the well head

Bacterial Community Clustering



Bacterial Community Clustering



Analysis of Molecular Variance

Comparison	p-value
Marsh vs. Nearshore	<0.005
Marsh vs. Offshore	<0.005
Nearshore vs. Offshore	<0.005

Bacterial Community Clustering Field Study

Marsh vs. Nearshore

% Abundance	Class
17	*Gammaproteobacteria
6.2	*Deinococci
4.9	*Deferribacteres
1.9	Campylobacteria
7.8	Actinobacteria
7.3	*Bacilli
4.4	*Anaerolineae
3.0	Spirochaetia
1.7	Clostridia
1.1	Calditrichia

Marsh vs. Offshore

% Abundance	Class
17	*Gammaproteobacteria
6.2	*Deinococci
4.9	*Deferribacteres
1.9	Campylobacteria
4.1	Actinobacteria
3.6	Spirochaetia
2.8	*Anaerolineae
2.7	Atribacteria
1.5	Deltaproteobacteria

Nearshore vs. Offshore

%Abundance	Class
3.3	*Anaerolineae
1.7	Clostridia
1.1	Calditrichia
2.7	Atribacteria
1.7	Anaerolineae
1.5	Deltaproteobacteria

Phylotypes above 1% abundance with statistical significance (α = 0.005)

***Sum of the % abundance of multiple species under same class**

Lab Study

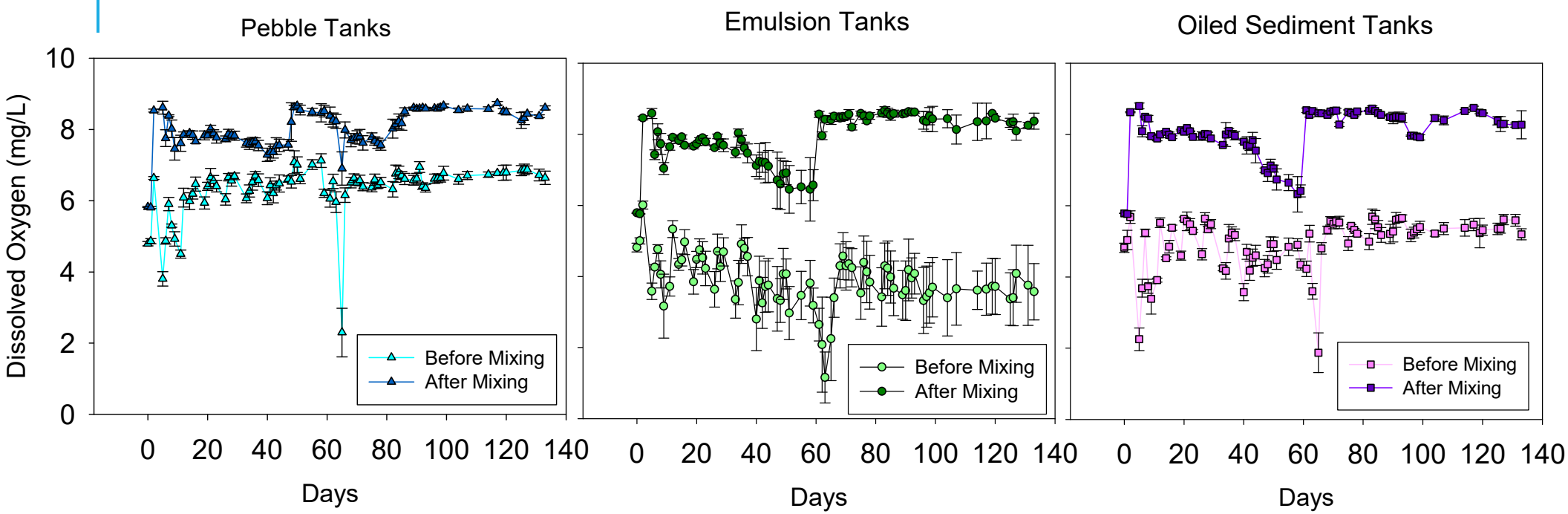
Pebble

Emulsion

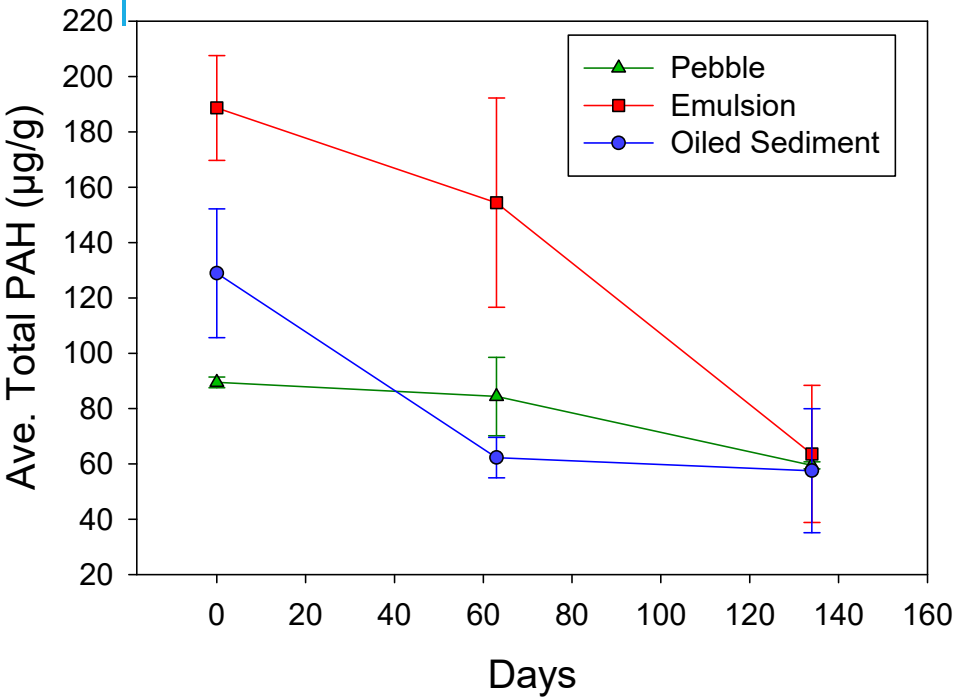
Oiled Sediment

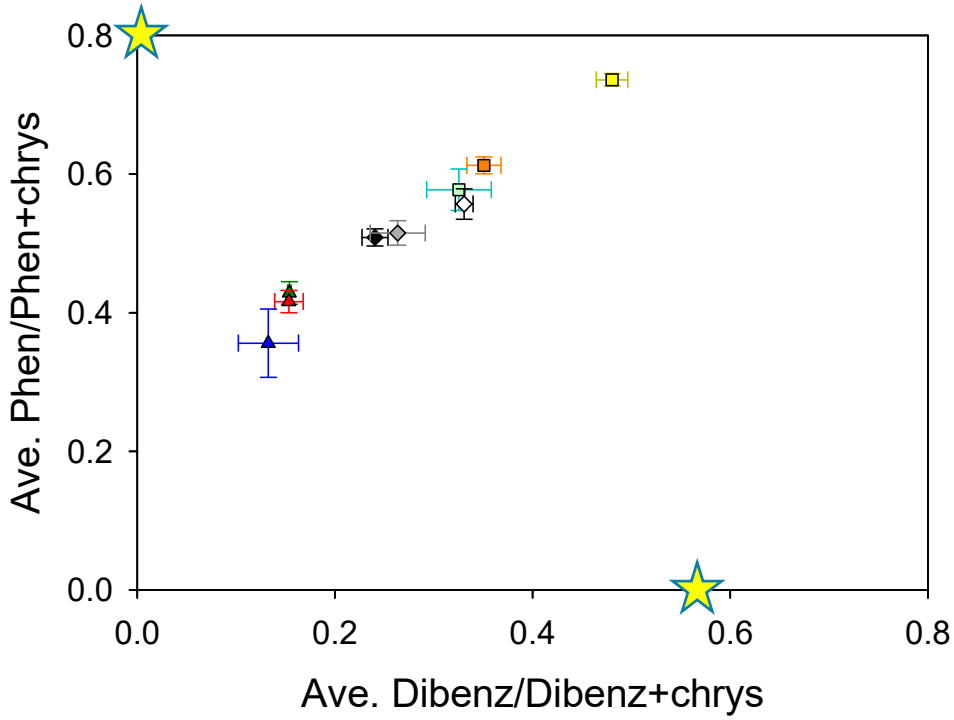
Lab Study

Dissolved Oxygen



Lab Study: Total PAH and Double Ratio Plot

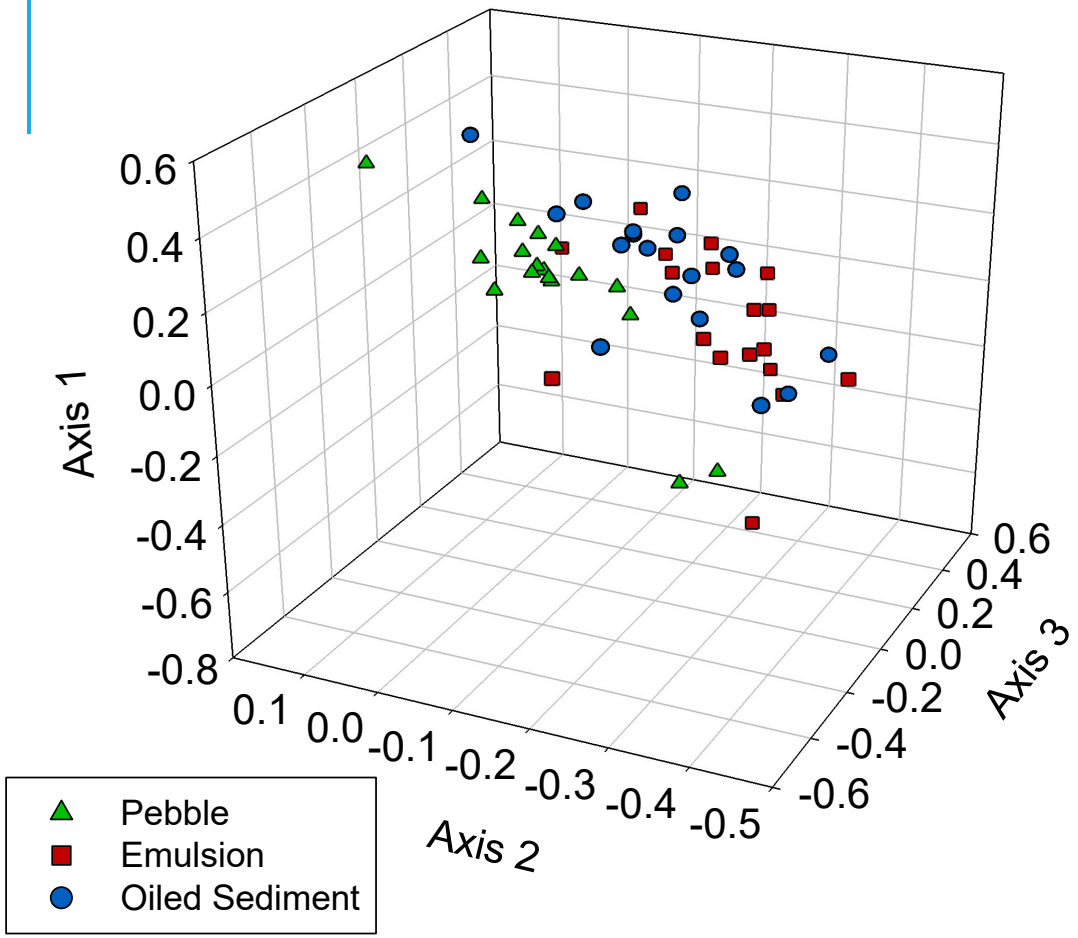




Pebble - Day 0
Pebble - Day 63
Pebble - Day 134
Emulsion - Day 0
Emulsion - Day 63
Emulsion - Day 134
Oiled Sediment - Day 0
Oiled Sediment - Day 63
Oiled Sediment - Day 134

= Reference sample from Diercks et al. (2010)
MC252 oil at the ocean surface near the well head

Bacterial Community Clustering Lab Study



Analysis of Molecular Variance

Comparison	p-value
Oiled Sediment vs. Pebble	<0.005
Pebble vs. Emulsion	<0.005
Emulsion vs. Oiled Sediment	<0.005

Bacterial Community Clustering Lab Study

Oil Sediment vs. Pebble

% Abundance	Class
2.6	Deinococci
1.6	Gammaproteobacteria
1.5	Anaerolineae
1.4	Deltaproteobacteria
1.0	Deferribacteres
7.9	Gammaproteobacteria
1.1	Alphaproteobacteria

Pebble vs. Emulsion

% Abundance	Class
27	*Gammaproteobacteria
7.5	Deferribacteres
1.5	Actinobacteria
1.4	Bacteroidia
1.1	Alphaproteobacteria
12	*Gammaproteobacteria
3.0	*Deltaproteobacteria
2.3	Deferribacteres
1.1	Anaerolineae

Emulsion vs. Oil Sediment

%Abundance	Class
1.0	Gammaproteobacteria
7.5	*Gammaproteobacteria
5.1	Deferribacteres
2.6	Deinococci
1.9	Actinobacteria
1.3	Bacteroidia
1.12	Deferribacteres

Phylotypes above 1% abundance with statistical significance ($\alpha = 0.005$)

***Sum of the % abundance of multiple species under same class**

Summary

- Marsh sediments were highly contaminated with PAHs and alkylated phenanthrenes, dibenzothiophenes and chrysenes accounted for majority of the measured PAH
- Significant difference in microbial community was observed between marsh, nearshore, and offshore sediment samples
- Measurable amount of total PAH was observed in all three oil forms from marsh: Emulsion, pebble and oil sediments
- The Emulsion had the highest level of total PAHs and most decrease in laboratory study over 4 months
- Microbial communities significantly differed between pebble, emulsion, and oiled sediment and Gammaproteobacteria was the dominant phylotype in all oil forms

Questions?