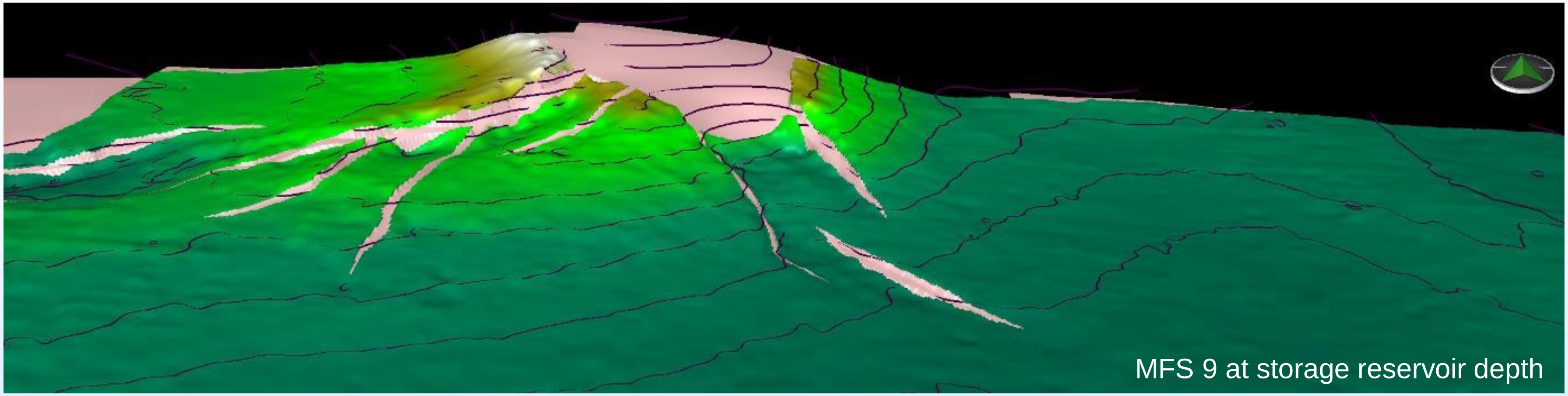
Partnership for Offshore Carbon Storage Resources and Technology Development in the Gulf of Mexico



DE-FE0031558

Susan Hovorka

Co-I Tip Meckel and Ramon Treviño

Gulf Coast Carbon Center, Bureau of Economic Geology

Jackson School of Geosciences The University of Texas at Austin

Darshan Sachde
Trimeric Corporation

U.S. Department of Energy

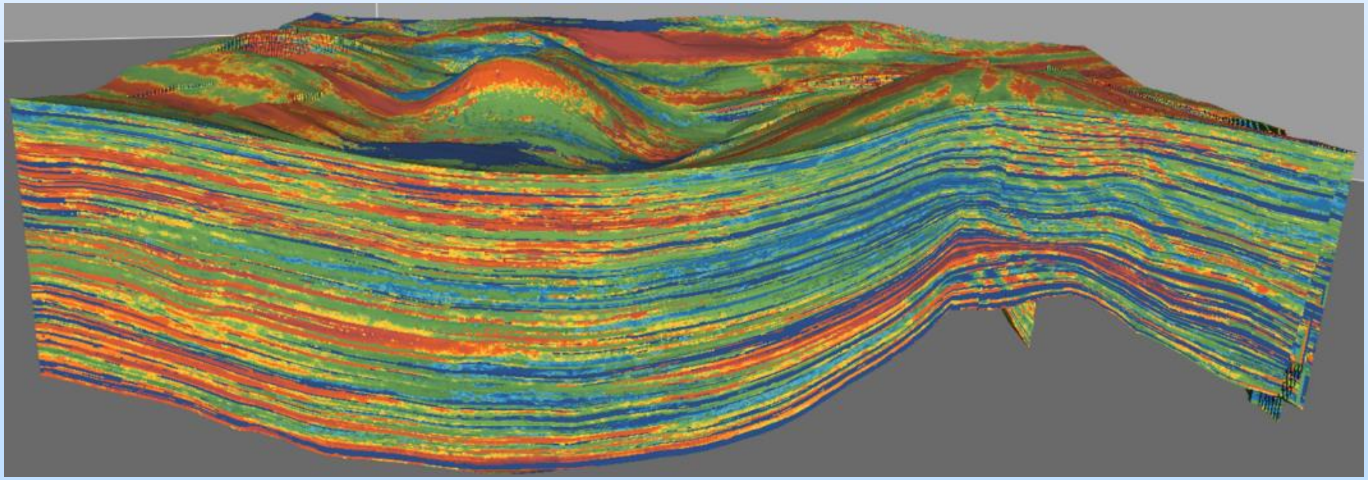
National Energy Technology Laboratory

Carbon Capture Front End Engineering Design Studies and CarbonSafe 2020 Integrated Review Webinar

August-17-19 2020

Program Overview

- Funding
  - DOE: $14 million (5 years)
  - Cost Share: $3.5 million
- Overall Project Performance Dates
  - BP 1 (NCE 3/31/20 → 12/31/20)
  - BP 2 1/1/21 – 3/31/23



New – 3-D porosity volume Melianna Ulfah, GCC and EER –JSG UT

Partnership Participants

Institution	Location	Expertise
University of Texas at Austin		Project Lead
Gulf Coast Carbon Center	Austin, TX	Geo-Sequestration
Gulf of Mexico Basin Synthesis (GBDS)	Austin, TX	GoM Basin Regional Geology
Petroleum & Geosystems Engineering	Austin, TX	Reservoir Simulation
Stan Richards School	Austin, TX	Public Relations
Aker Solutions	Houston, TX	Subsea Infrastructure
Fugro	Houston, TX	MVA Technologies
TDI-Brooks, Intl.	College Station, TX	MVA Technologies
Lamar University	Beaumont, TX	Risk Assessment; Outreach
Trimeric	Buda, TX	Engineering; Infrastructure & Operations
USGS	Reston, VA	Characterization & Capacity Assessment
Louisiana Geological Survey	Baton Rouge, LA	Database Development
Texas A&M (GERG)	College Station, TX	Ocean & Environmental Science
LBNL	Berkeley, CA	Risk Assessment; MVA Technologies
LLNL	Livermore, CA	Risk Assessment

Technical Approach/Project Scope

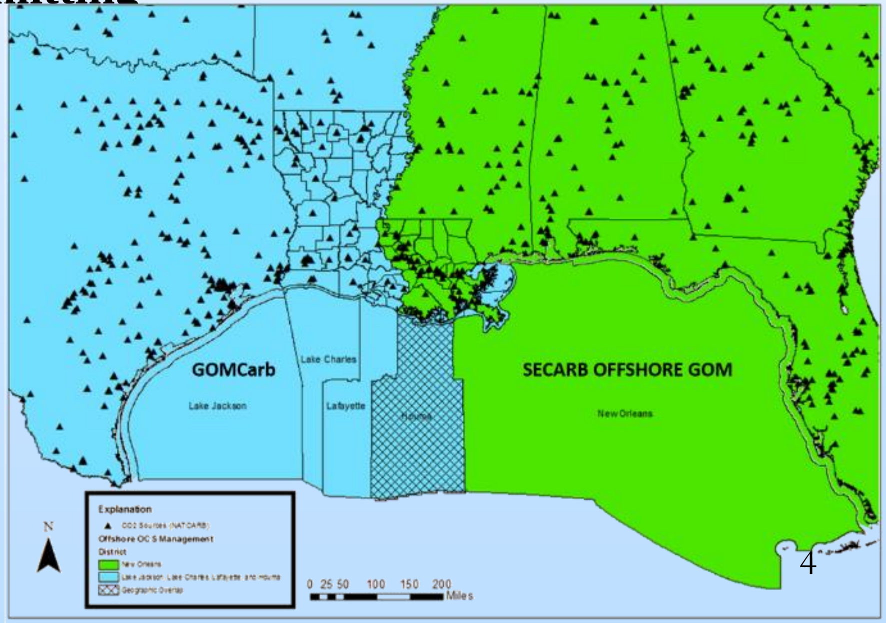
Task 2: Offshore Storage Resource Assessment

Task 3: Risk Assessment, Simulation & Modeling

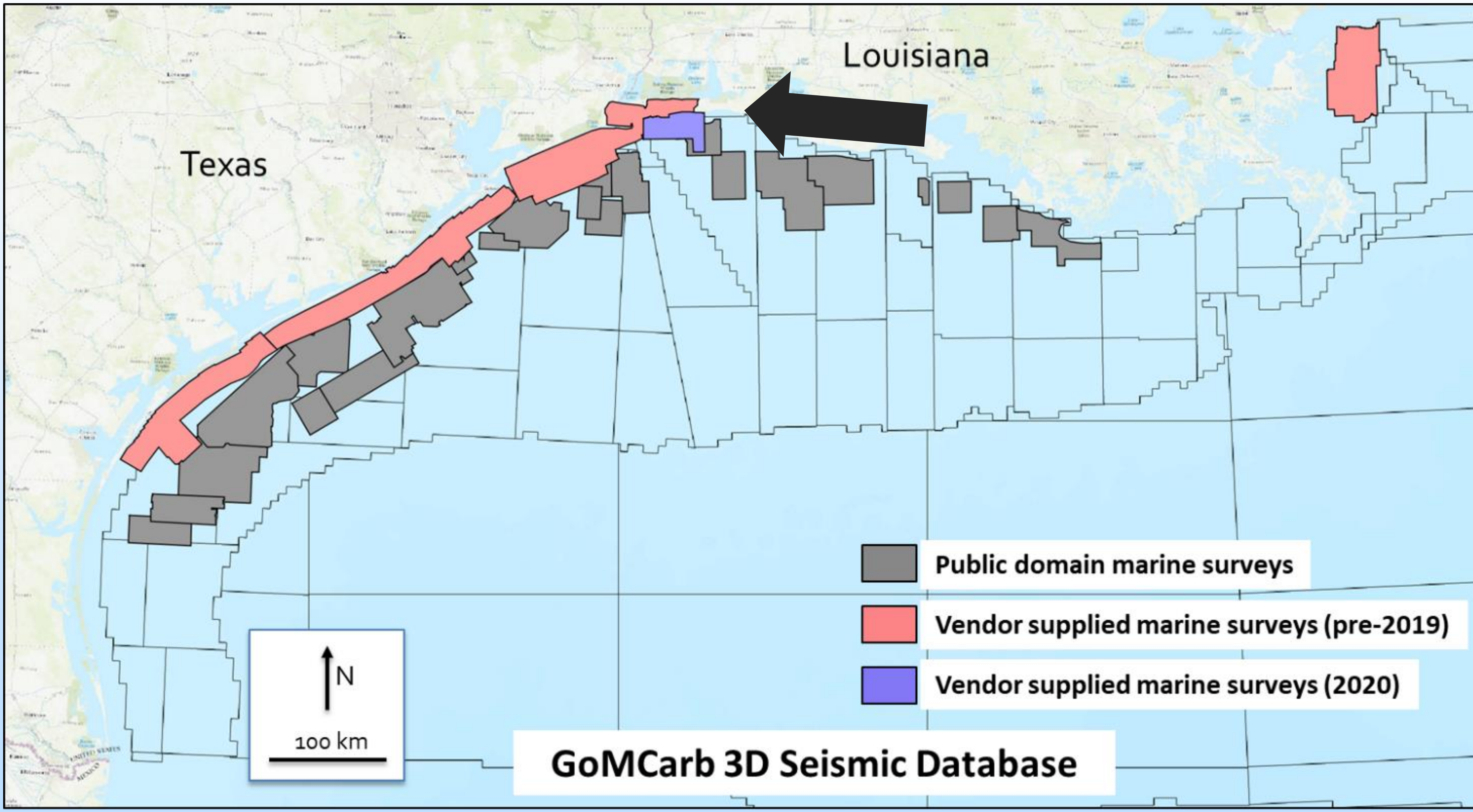
Task 4: Monitoring, Verification & Assessment

Task 6: Knowledge Dissemination

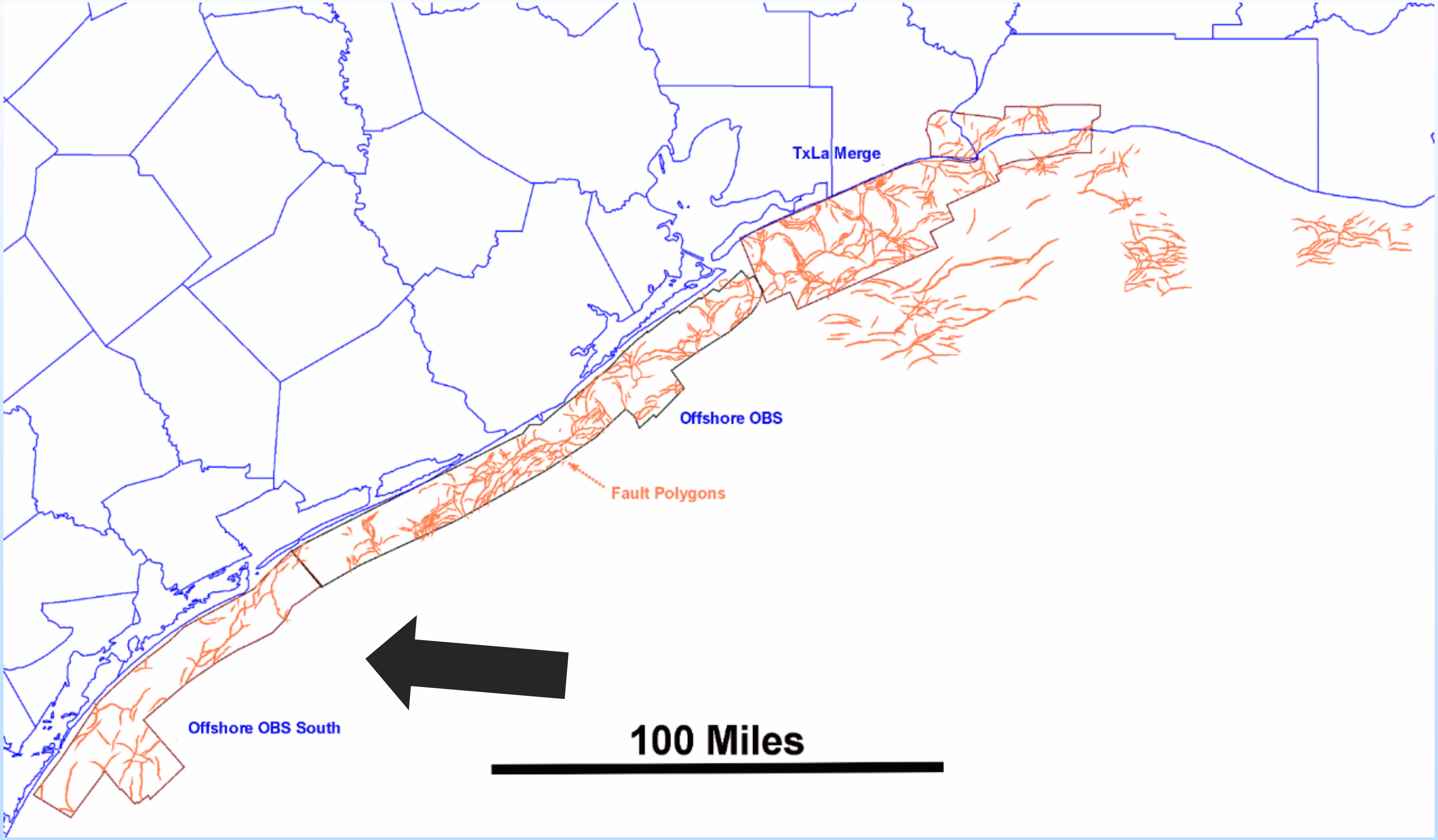
Task 5: Infrastructure, Operations & Permitting



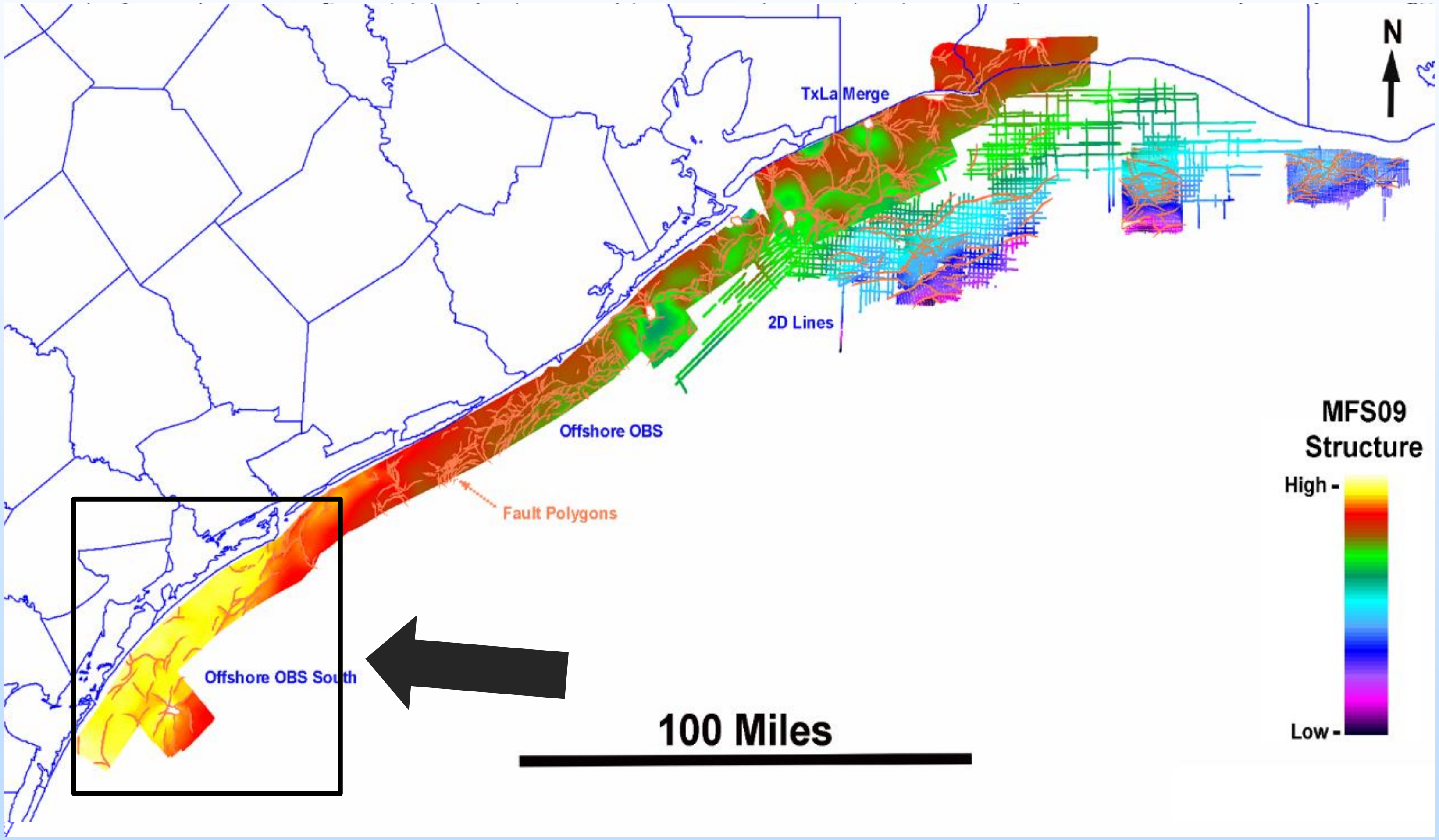
Progress and Current Status
Task 4 -- Offshore Storage Assessment Data



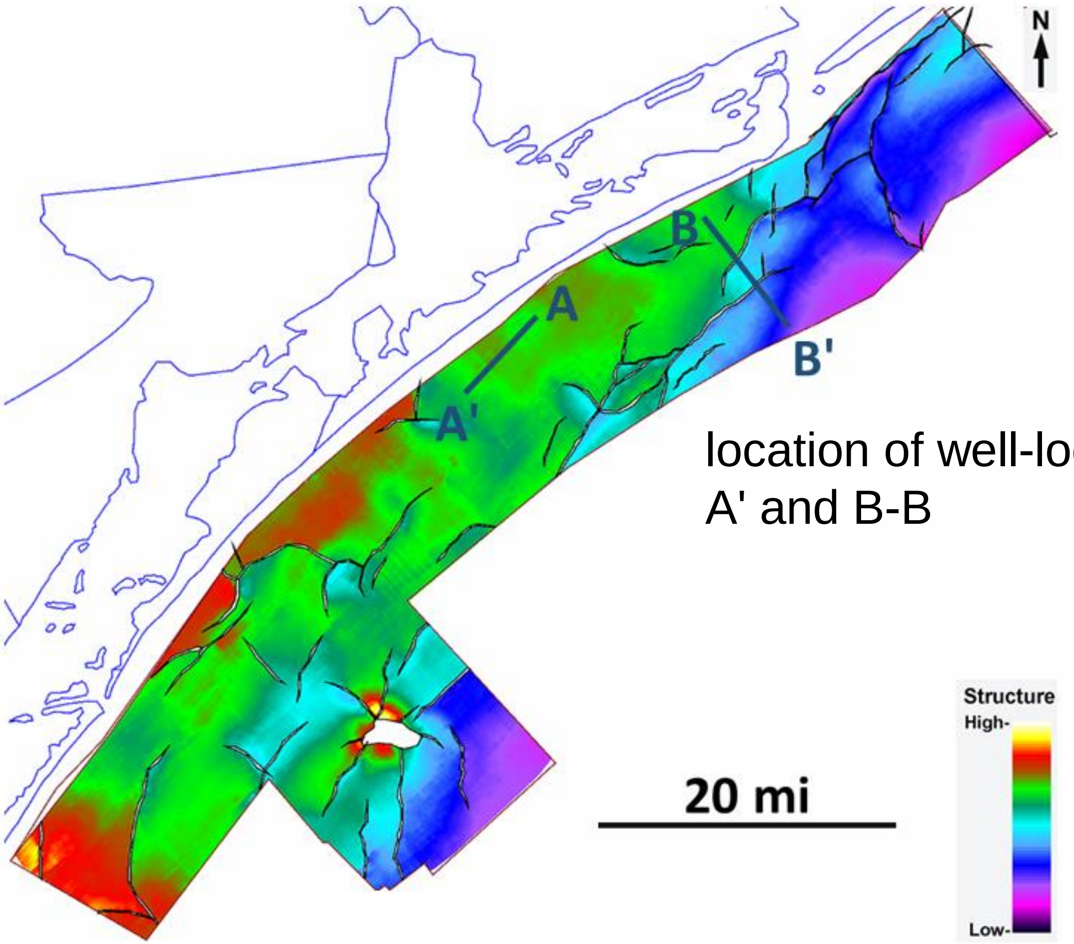
Mapping Fault Compartments



Progress and Current Status
Offshore Storage Assessment



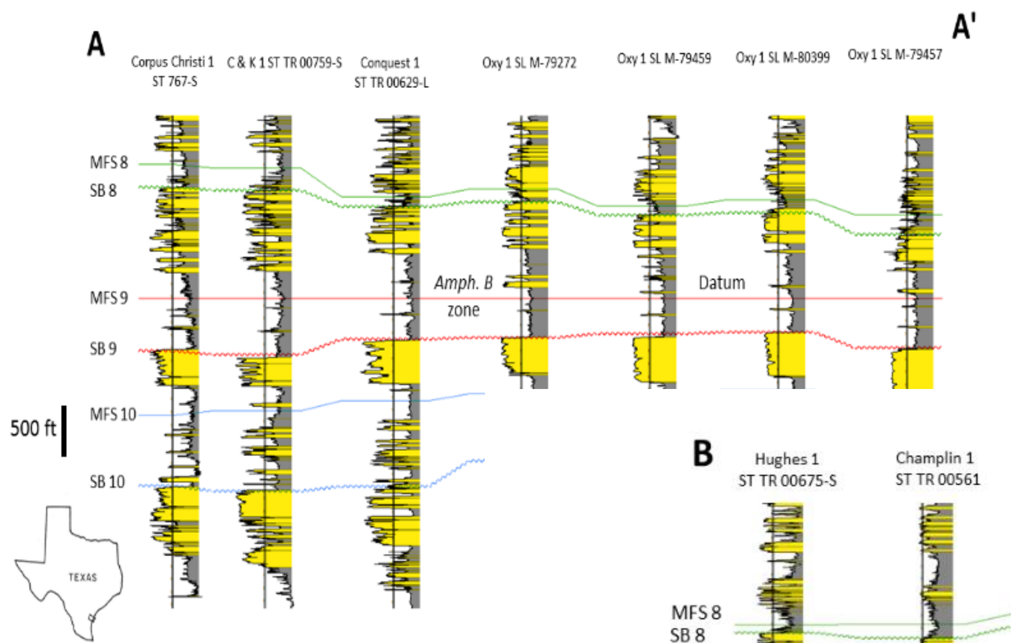
Identifying Storage Leads Example – Mid Texas Coast



location of well-log sections A-A' and B-B

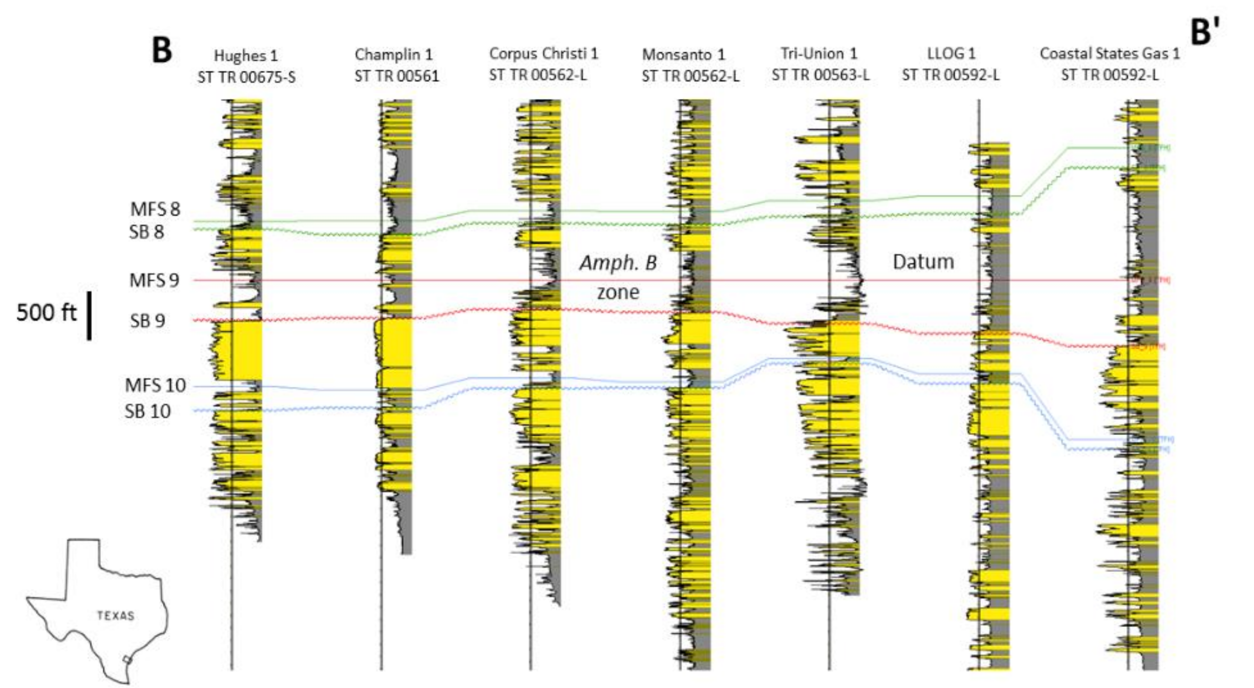
Time structure map on MFS 9. Mike D'Angelo, GCCC

Log Cross Sections

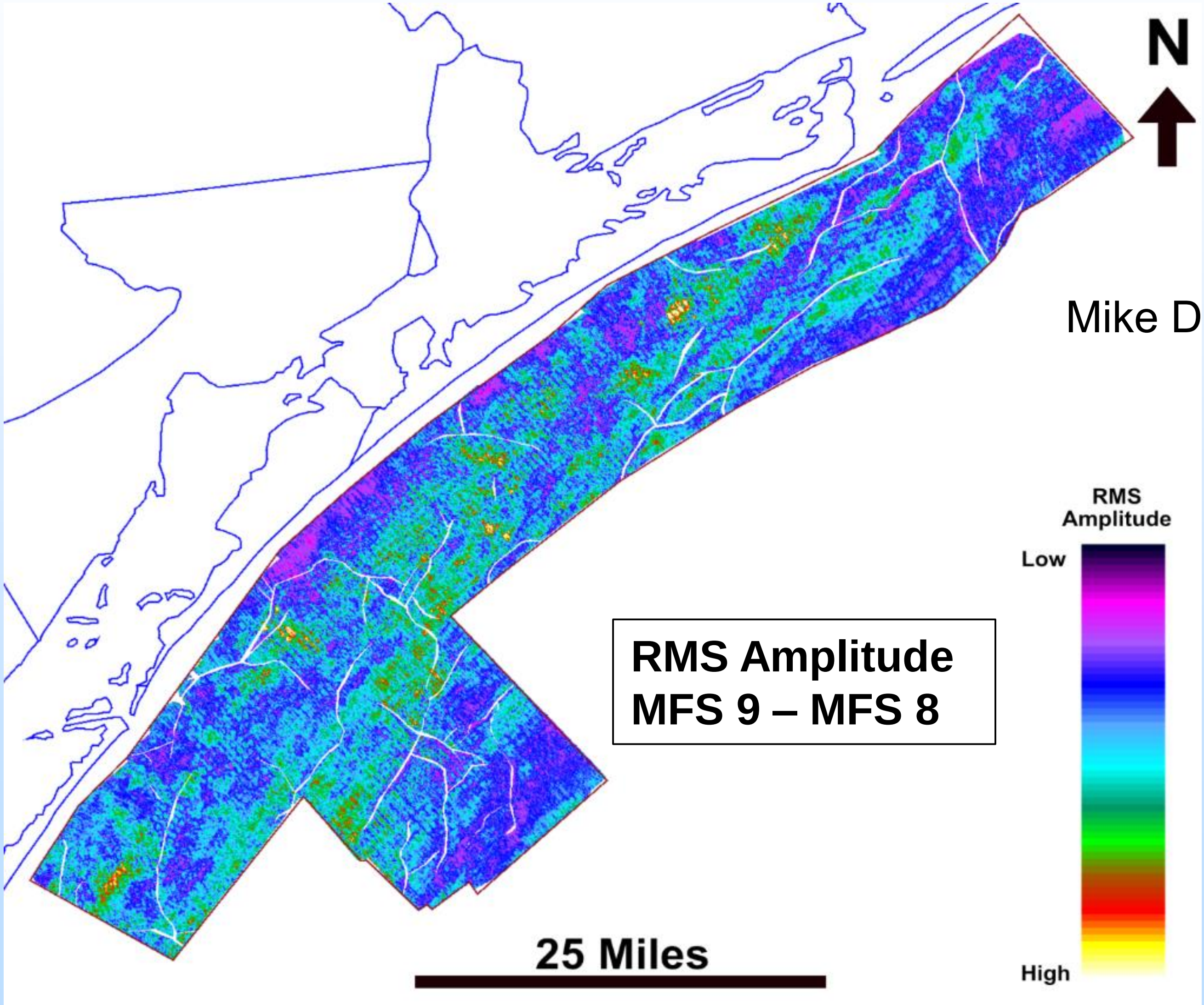


Note stacked sandstone reservoir in part of Miocene assessed

Lateral changes show depositional architecture - impact on storage

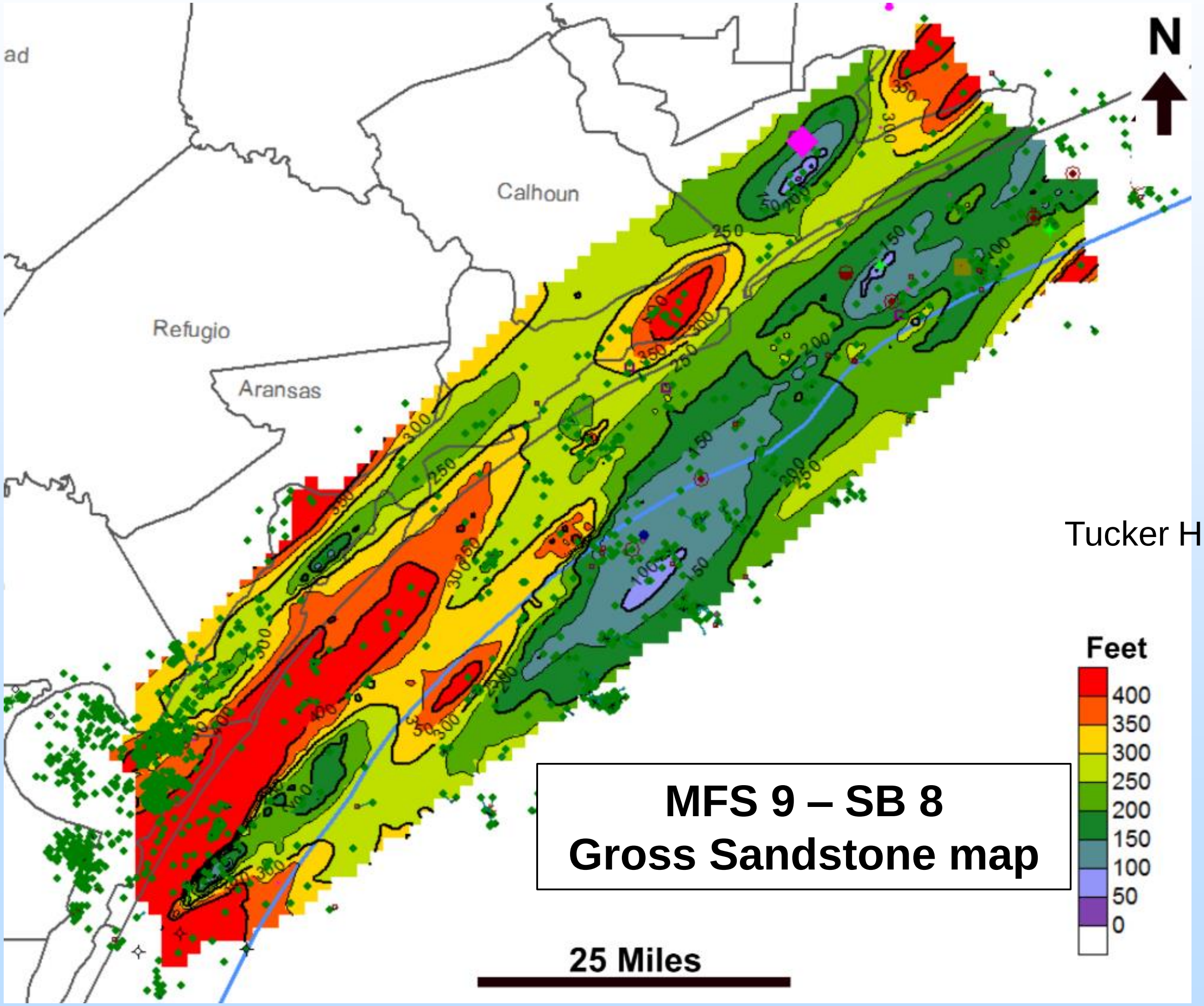


Using seismic amplitude to define facies – storage fairways



Mike D'Angelo, GCCC

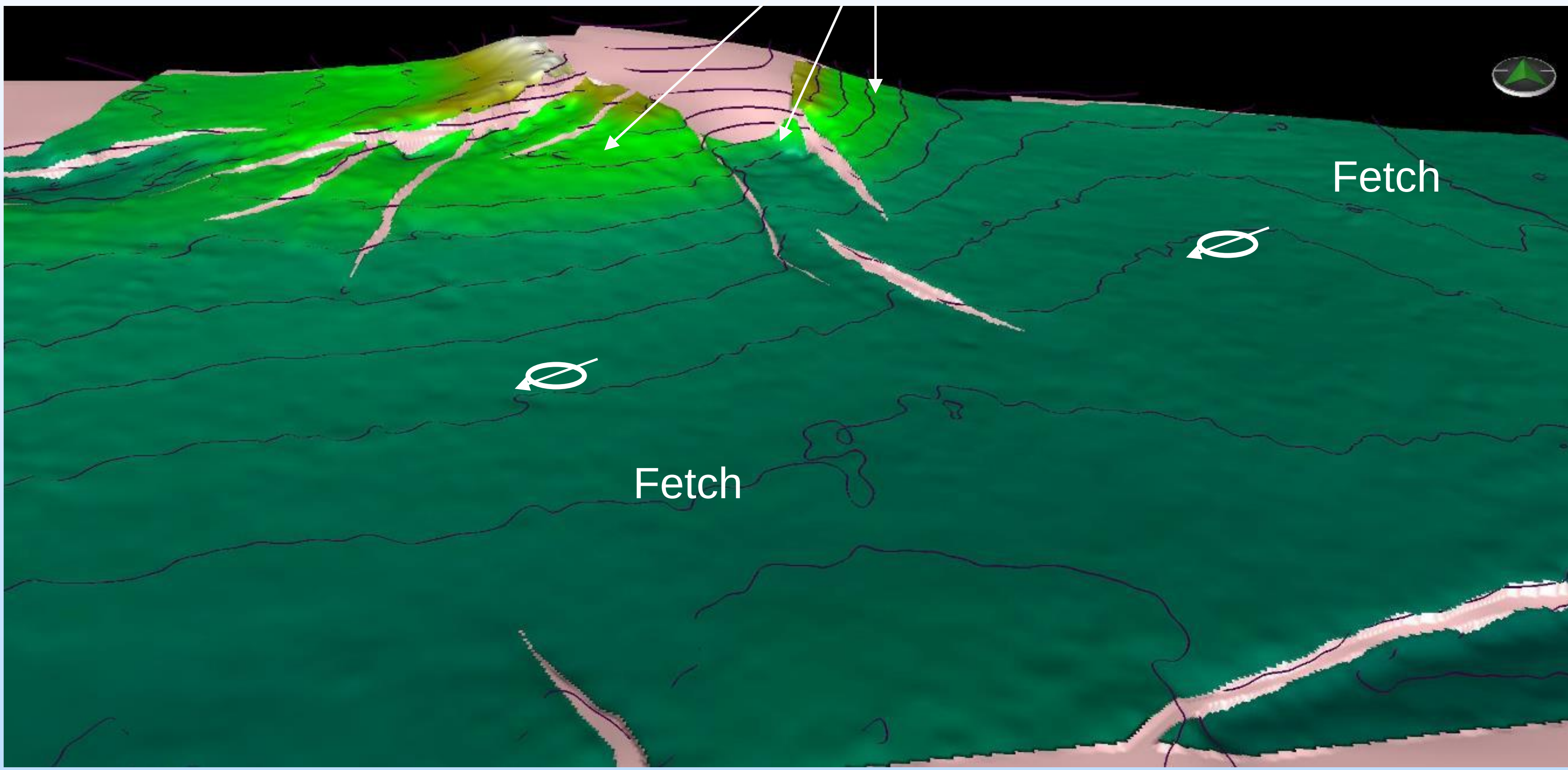
Depositional Systems Interpretations (mid-Tx coast)



Tucker Hentz, BEG UT

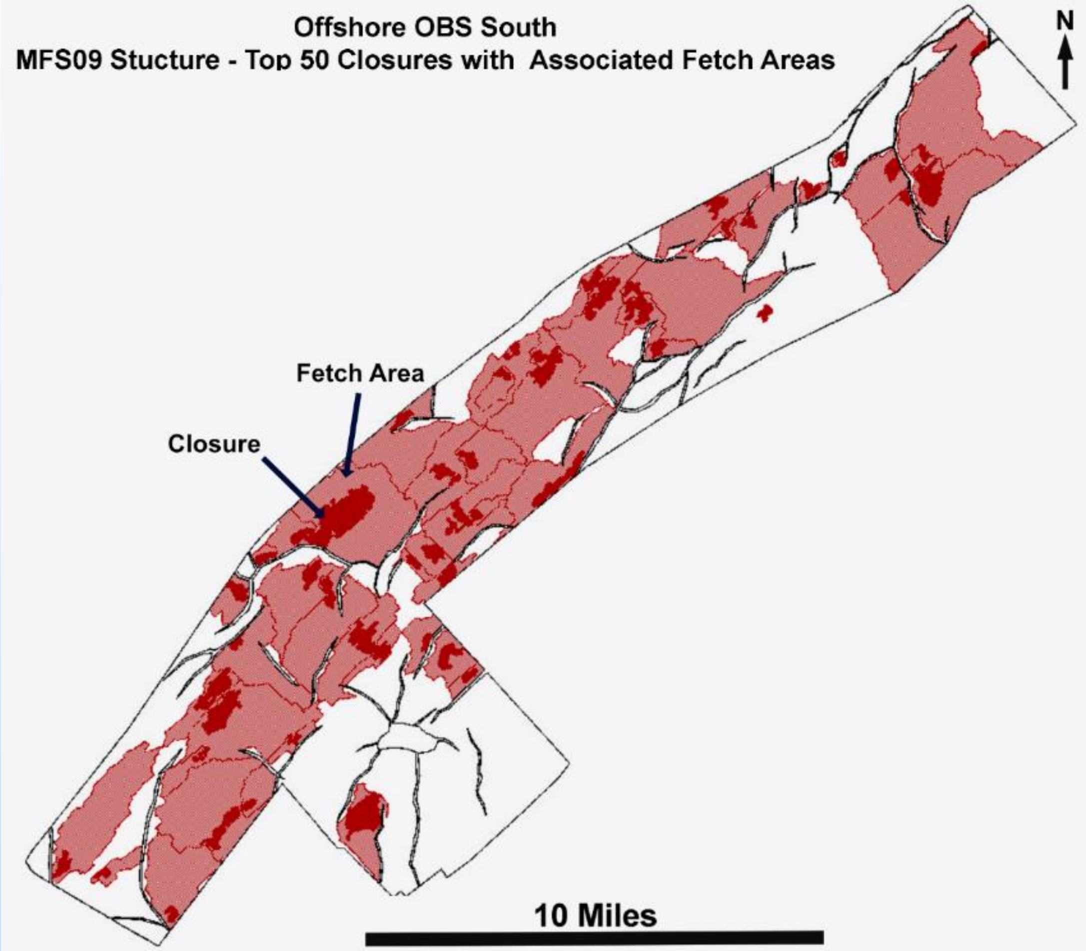
Defining Storage Leads
Fetch & Trap

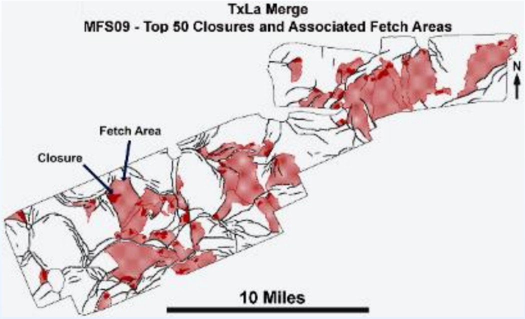
Traps

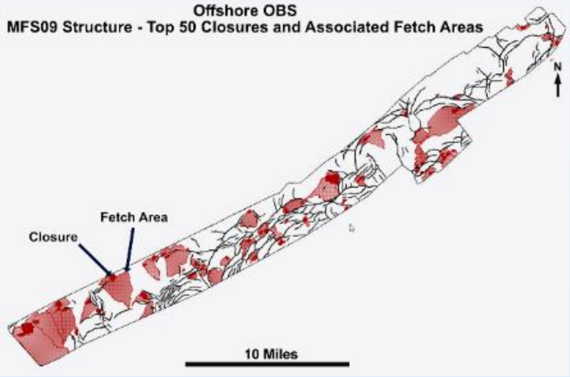


Mike D’Angelo & Dallas Dunlap, GCC/ BEG UT

Identifying Storage Leads

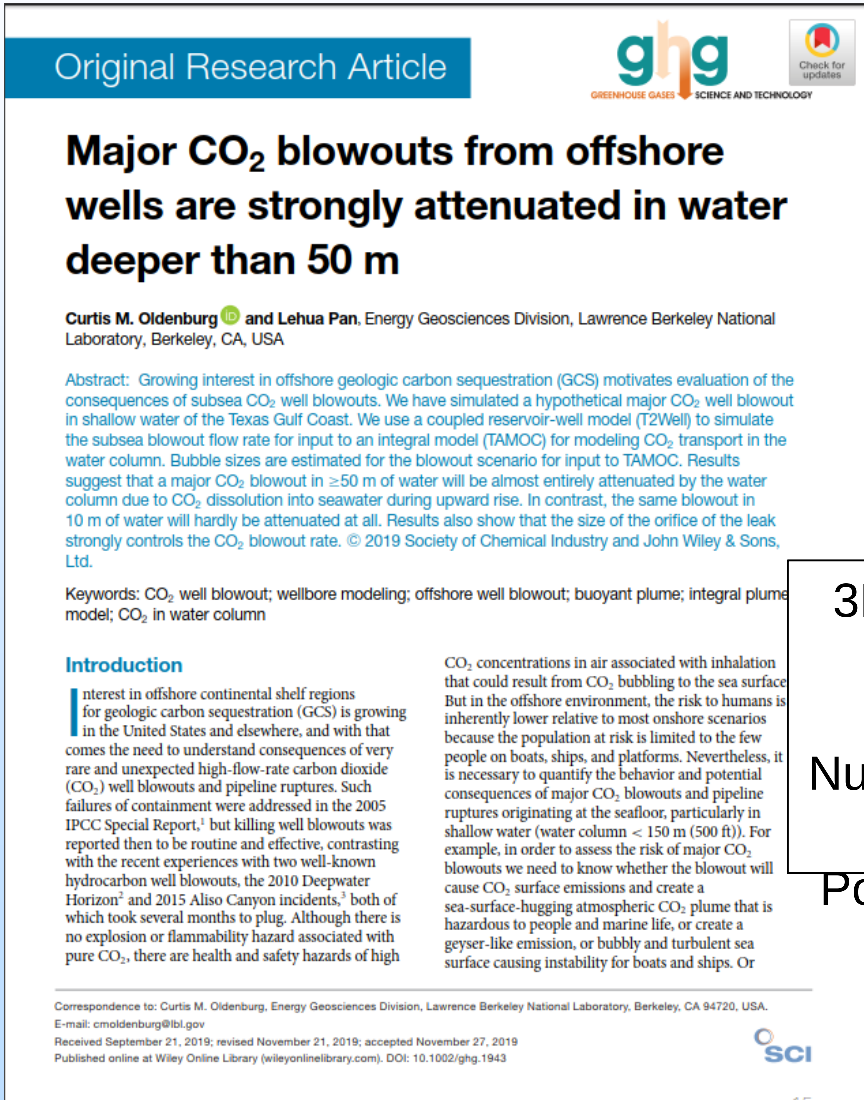






Mike D'Angelo GCC/ BEG UT

Risk Assessment, Simulation & Modeling (Task 3)



Original Research Article

ghg GREENHOUSE GASES SCIENCE AND TECHNOLOGY

Check for updates

Major CO_2 blowouts from offshore wells are strongly attenuated in water deeper than 50 m

Curtis M. Oldenburg and **Lehua Pan**, Energy Geosciences Division, Lawrence Berkeley National Laboratory, Berkeley, CA, USA

Abstract: Growing interest in offshore geologic carbon sequestration (GCS) motivates evaluation of the consequences of subsea CO_2 well blowouts. We have simulated a hypothetical major CO_2 well blowout in shallow water of the Texas Gulf Coast. We use a coupled reservoir-well model (T2Well) to simulate the subsea blowout flow rate for input to an integral model (TAMOC) for modeling CO_2 transport in the water column. Bubble sizes are estimated for the blowout scenario for input to TAMOC. Results suggest that a major CO_2 blowout in ≥50 m of water will be almost entirely attenuated by the water column due to CO_2 dissolution into seawater during upward rise. In contrast, the same blowout in 10 m of water will hardly be attenuated at all. Results also show that the size of the orifice of the leak strongly controls the CO_2 blowout rate.

Keywords: CO_2 well blowout; wellbore modeling; offshore well blowout; buoyant plume; integral plume model; CO_2 in water column

Introduction

Interest in offshore continental shelf regions for geologic carbon sequestration (GCS) is growing in the United States and elsewhere, and with that comes the need to understand consequences of very rare and unexpected high-flow-rate carbon dioxide (CO_2) well blowouts and pipeline ruptures. Such failures of containment were addressed in the 2005 IPCC Special Report,[1] but killing well blowouts was reported then to be routine and effective, contrasting with the recent experiences with two well-known hydrocarbon well blowouts, the 2010 Deepwater Horizon[2] and 2015 Aliso Canyon incidents,[3] both of which took several months to plug. Although there is no explosion or flammability hazard associated with pure CO_2, there are health and safety hazards of high CO_2 concentrations in air associated with inhalation that could result from CO_2 bubbling to the sea surface. But in the offshore environment, the risk to humans is inherently lower relative to most onshore scenarios because the population at risk is limited to the few people on boats, ships, and platforms. Nevertheless, it is necessary to quantify the behavior and potential consequences of major CO_2 blowouts and pipeline ruptures originating at the seafloor, particularly in shallow water (water column < 150 m (500 ft)). For example, in order to assess the risk of major CO_2 blowouts we need to know whether the blowout will cause CO_2 surface emissions and create a sea-surface-hugging atmospheric CO_2 plume that is hazardous to people and marine life, or create a geyser-like emission, or bubbly and turbulent sea surface causing instability for boats and ships. Or

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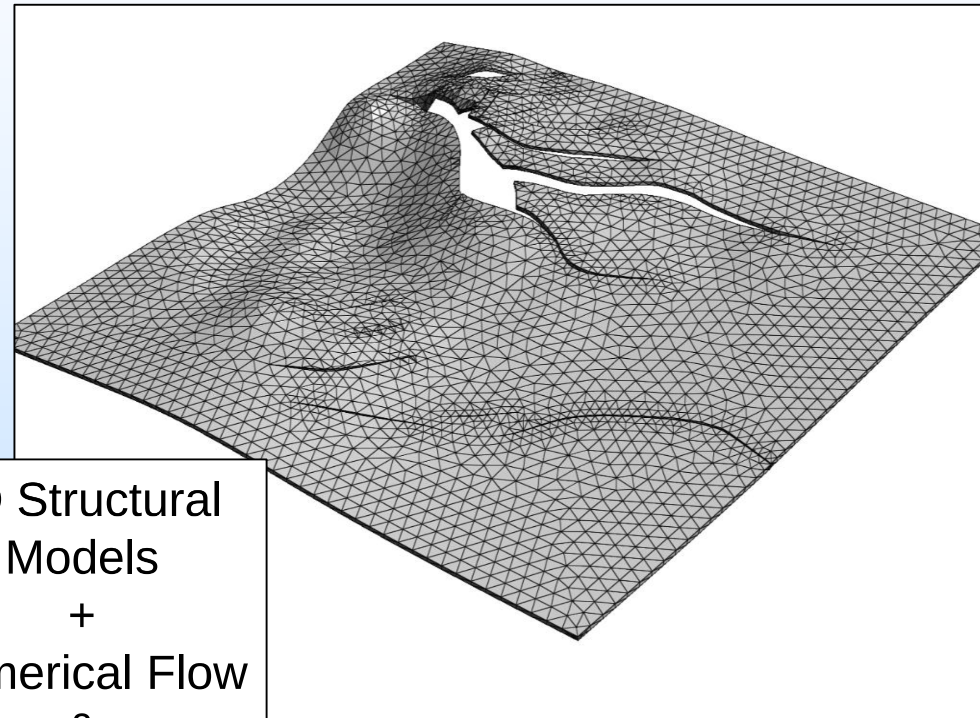
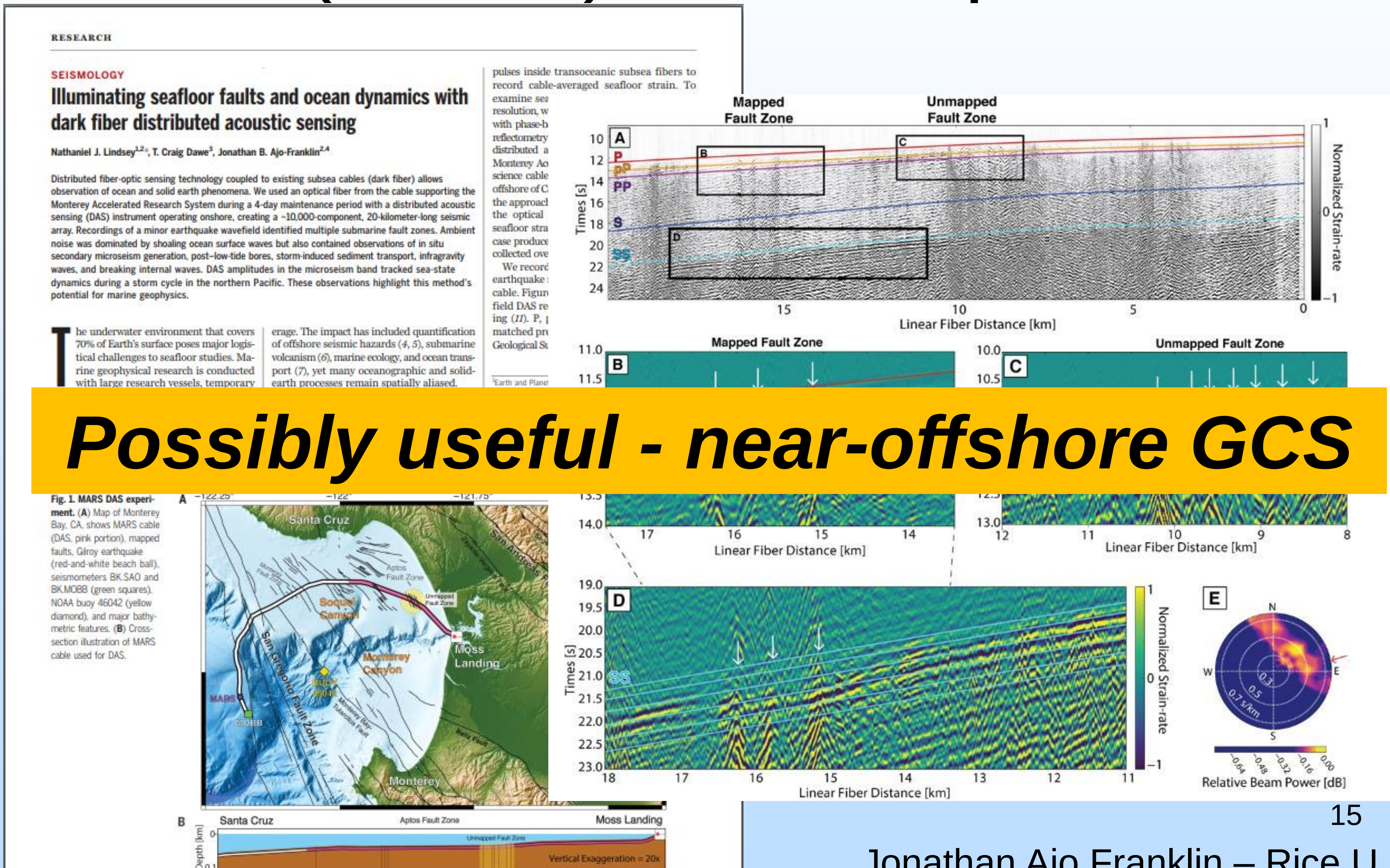


3D Structural Models + Numerical Flow & Poromechanical Eqs.

Josh White- LLNL

Curt Oldenberg, LBNL

Monitoring **V**erification **A**ccounting (Task 4) – Fiber optic



Possibly useful - near-offshore GCS

Jonathan Ajo Franklin – Rice U

Monitoring **V**erification **A**ccounting
Sea water

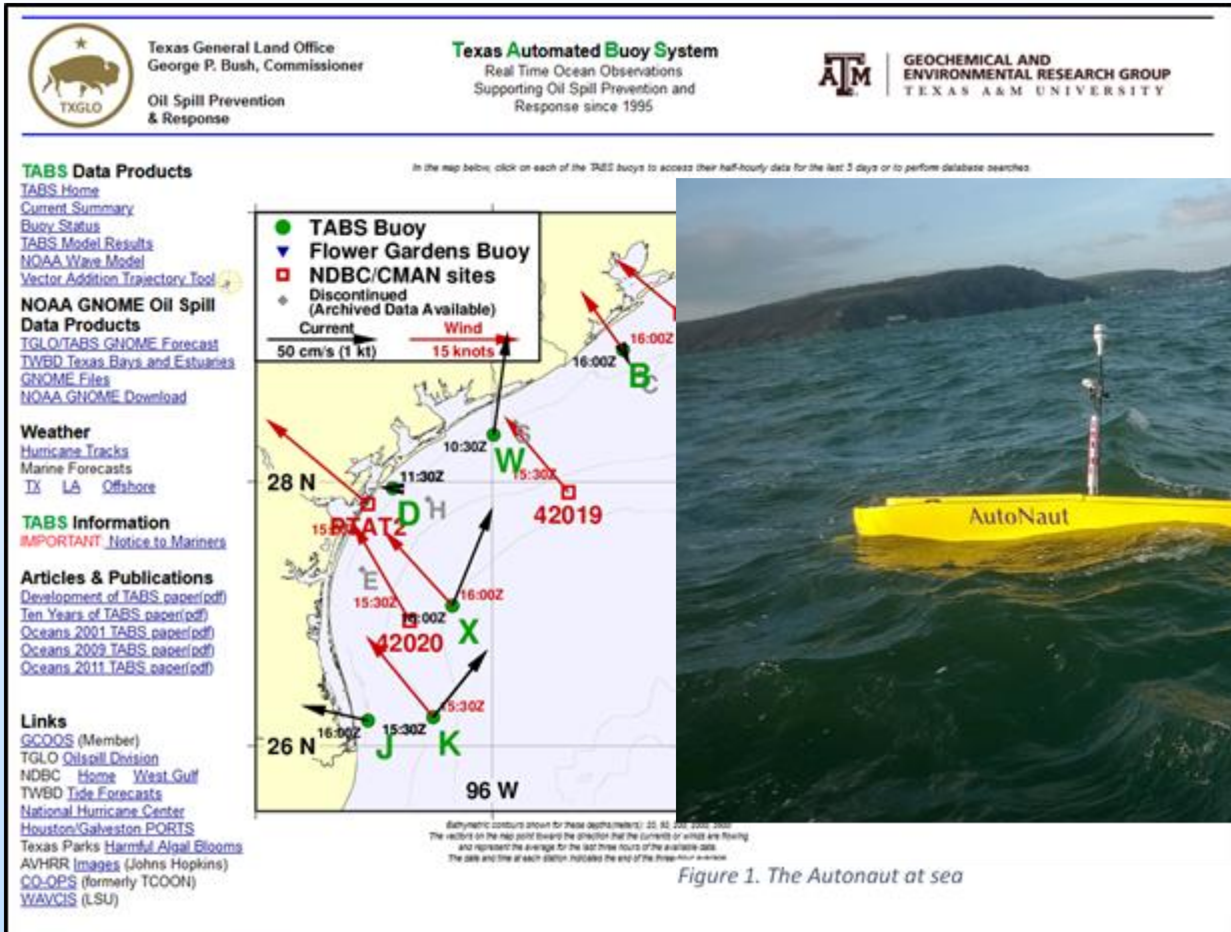


Figure 4.1.2.1. Map of TABS buoys.

Figure 1. The Autonaut at sea

GERG – TX A&M

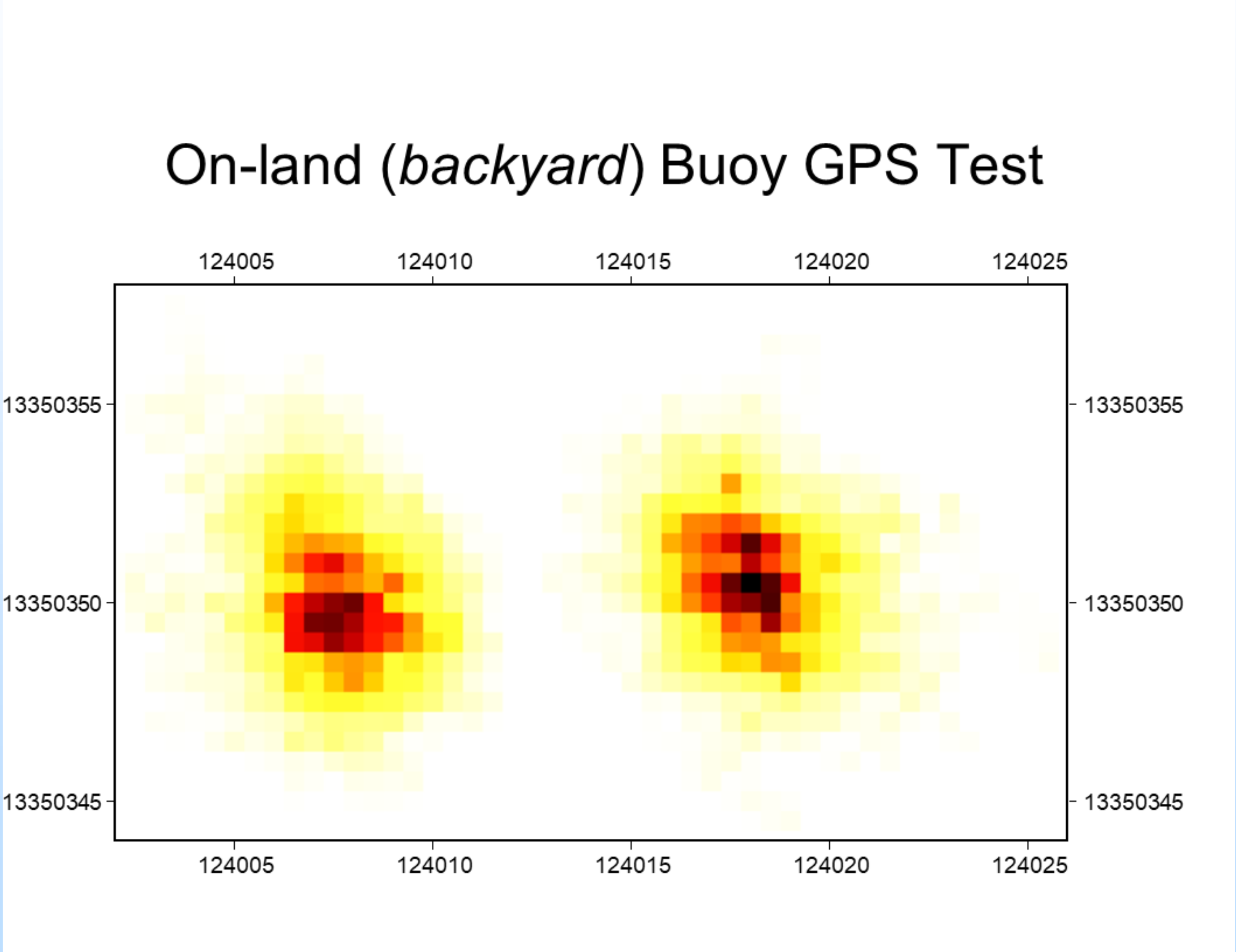
Monitoring **V**erification **A**ccounting (Task 4)

HR3D

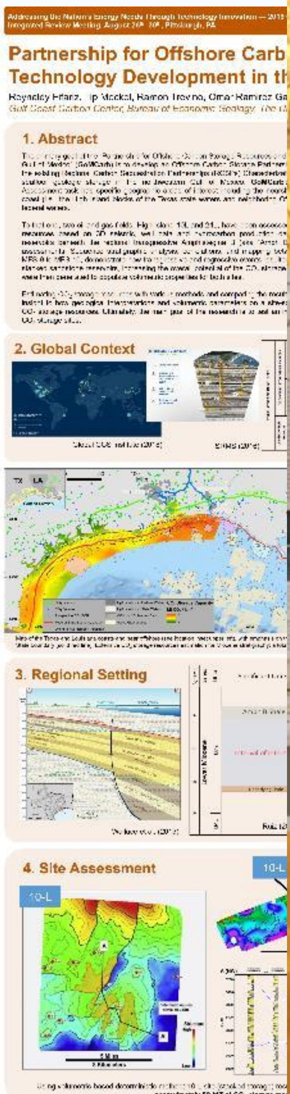
Seismic

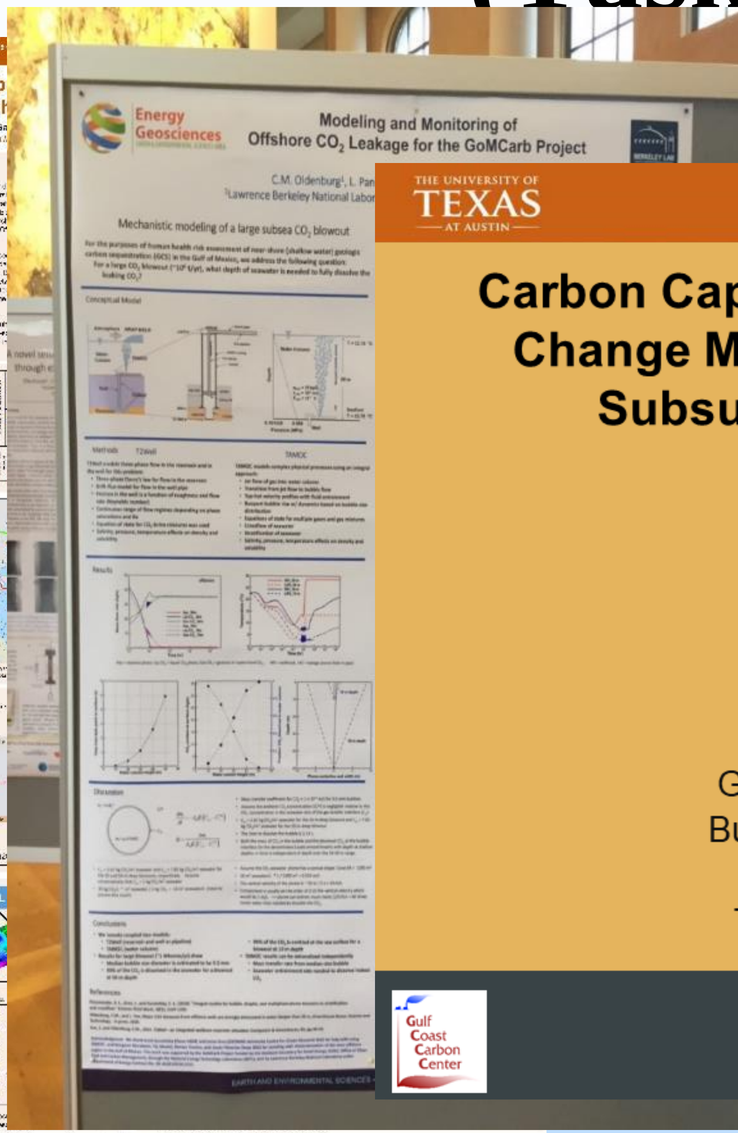
Tail Buoy

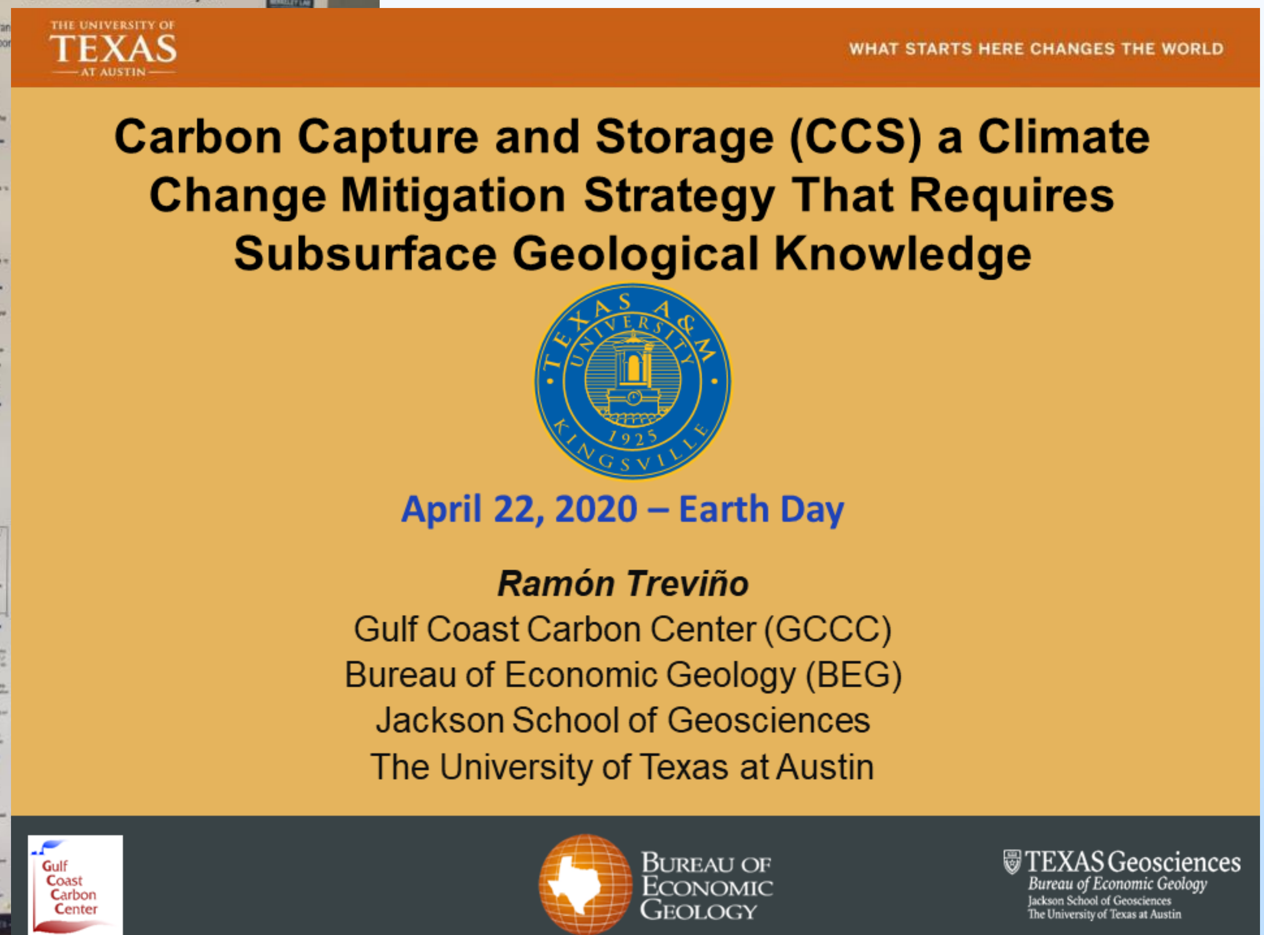
Testing



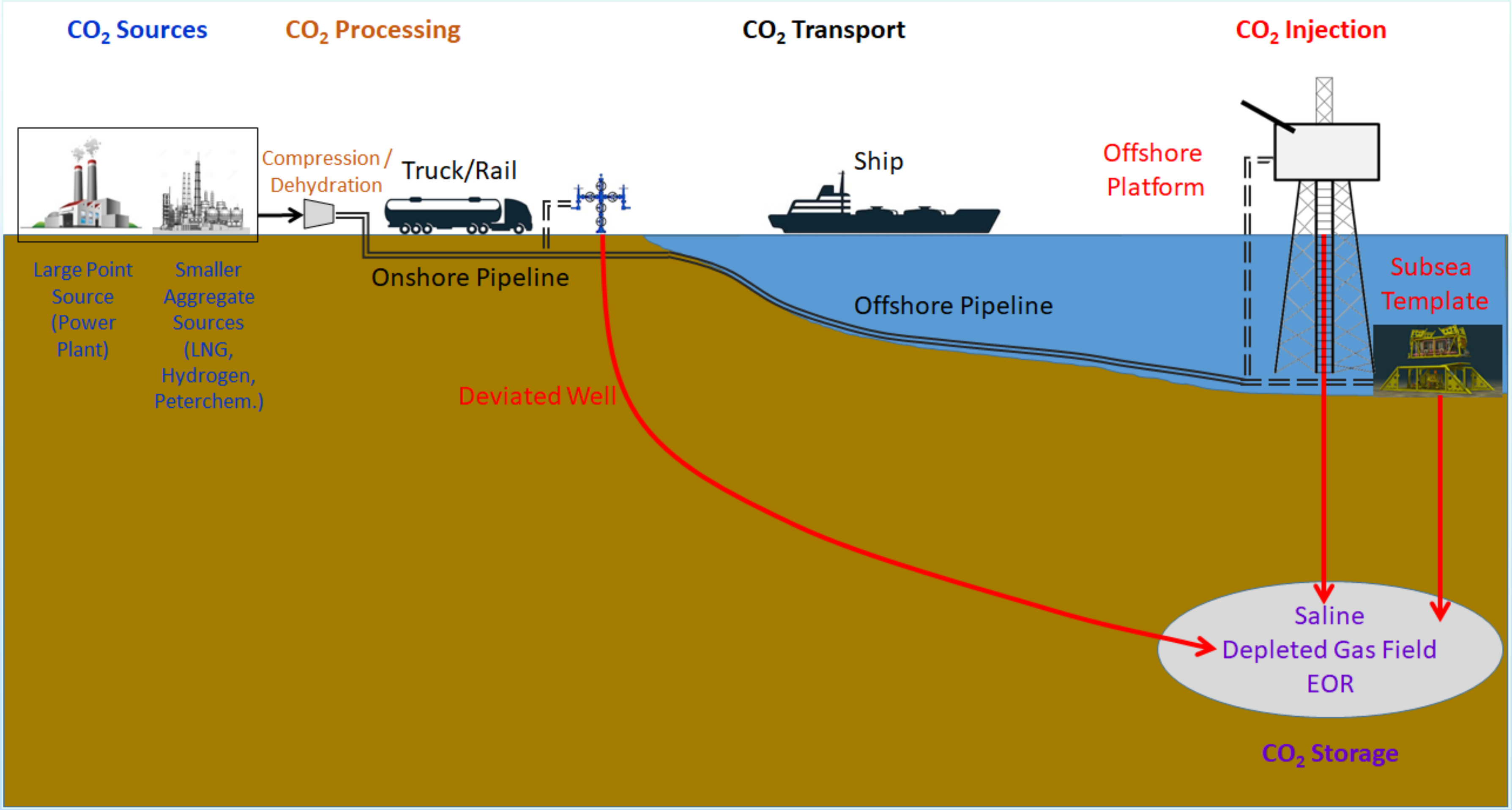
Knowledge Dissemination (Task 6)







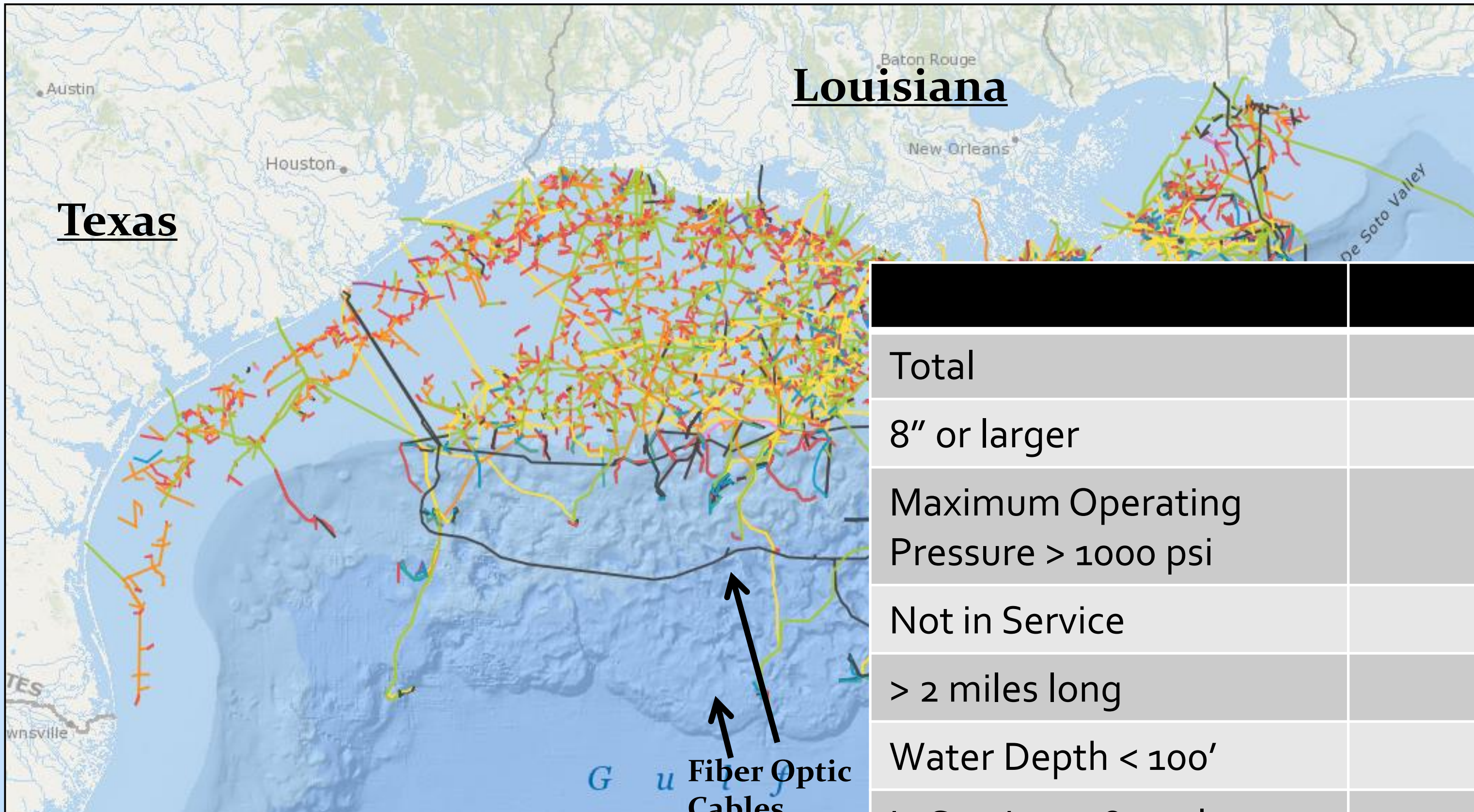
Progress and Current Status of Project (Task 5: Infrastructure, Operations, & Permitting)



Infrastructure Re-use Overview

- Wells, Pipelines, and Platforms for Oil and Gas Production = Potential Re-use Targets
- Goals:
  - Develop screening criteria to assess the scale of the opportunity
  - Identify high priority opportunities for more detailed assessment
  - Identify data gaps/needs/challenges

Infrastructure Re-use: Pipeline Screening



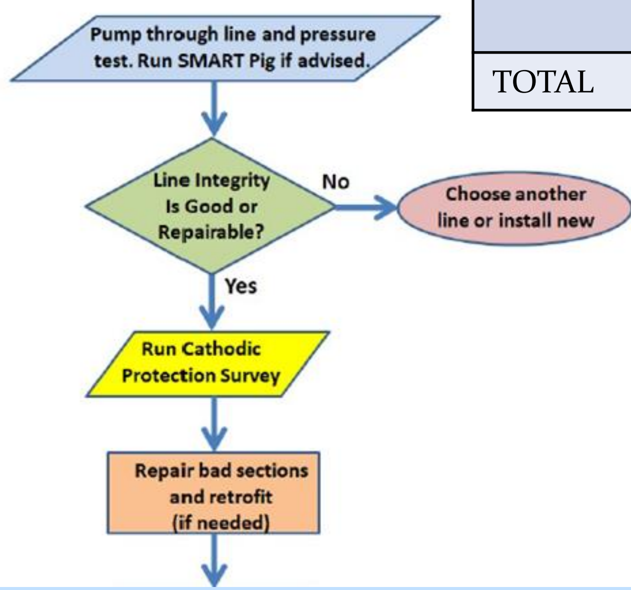
	# Segments
Total	20,274
8" or larger	4,614
Maximum Operating Pressure > 1000 psi	3,875
Not in Service	1,927
> 2 miles long	951
Water Depth < 100'	520
In Service 1980 or later	355
Key Segments*	11

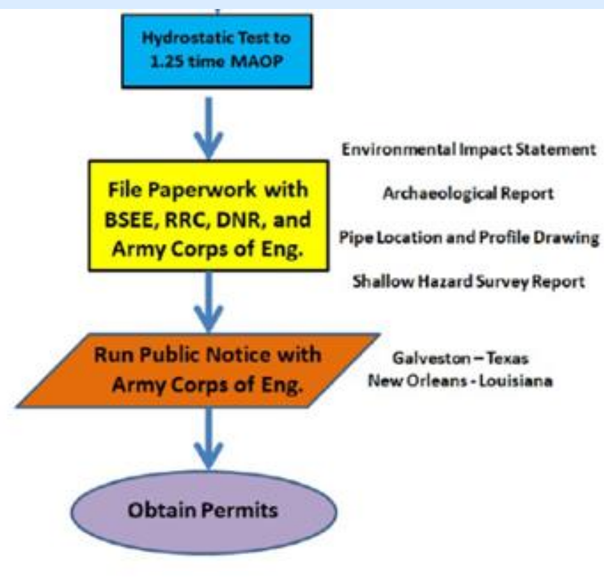
**Key Segments = Come onshore & terminate near state waters*

Sources: BSEE/BOEM
Prepared by Darrell Davis for Trimeric Corporation

Infrastructure Re-use: Pipeline Workflow

Item	Estimated Cost	Comments
Diving Support Vessel	$250,000	10 days
Inline Inspection (SMART Pig)	$150,000	<25 miles
Cathodic Protection Survey	$100,000	~15 miles
Hydrostatic Test	$75,000	
Purge Line With Nitrogen	$100,000	~15 miles
Miscellaneous Services	$75,000	
TOTAL	$750,000	

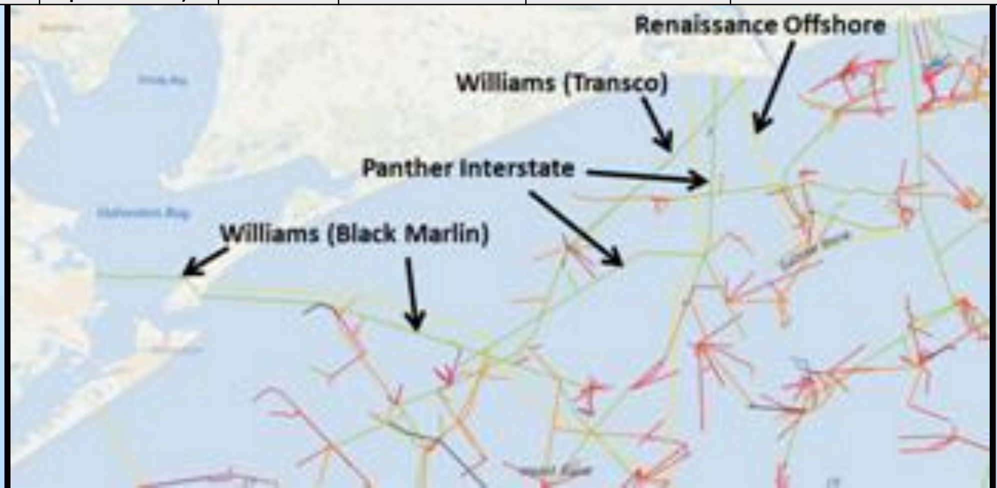




Infrastructure Re-use: Pipeline Case Studies

Region/Location	Line ID	Last Owner	In Service Date	Size	MAOP (psi)	Length (miles)	Water Depth (feet)	Status	Comments
Texas (High Island)	5958	Renaissance Offshore	5/28/1981	8"	1440	15.99	39 - 50	OOS	Discrepancy between database operating pressure and documentation
Texas (High Island)	4073 5381 4613 4590	Williams TRANSCO	12/13/1979 1/28/1980	12" 24"	1392 - 1440	84 (system length)	43-75	Proposed Abandonment & Active	
Texas (Galveston)	7199 3489	Williams Black Marlin	12/1/1984	16"	1367	23.87	48-61	Proposed Abandonment	
Texas (High Island)	3493 5895	Panther Interstate Pipeline Energy	12/17/1981	16"	1200 (working pressure)	26.27	35 - 51	Pending Abandonment	
Louisiana (Vermillion/ White Lake)	5434	Columbia Gas Transmission	11/14/1984	36"	1253 (working pressure)	6.27	10 - 32	Abandoned In Place	Right of Way relinquished to U.S. gov't

Mid & Upper Texas Coast



Infrastructure Re-use: Emerging Opportunities

- Pipeline analysis illustrates value & limitations of “free” data

- Next Steps: Leverage Commercial Interest
  - Unsolicited contacts generated by GoMCarb research:
    - Three “project development” companies interested in 45Q CCS projects
    - O&G E&P Companies Evaluating CCS Projects
    - O&G Service Companies Looking to Leverage Expertise to support CCS projects
    - Multiple LNG Facilities evaluating CCS business case
      - LNG Facilities = Concentrated CO_2 = Low Cost of Capture

- Opportunity to provide value to commercial entities (GoMCarb research) with the goal of industry driving the next steps of evaluation
  - Examples: Detailed study of specific pipelines, development of project cost assessments, etc.
  - Coordinating the next stage of evaluation will be critical to avoid duplicative efforts, efficient use of industry resources and expertise

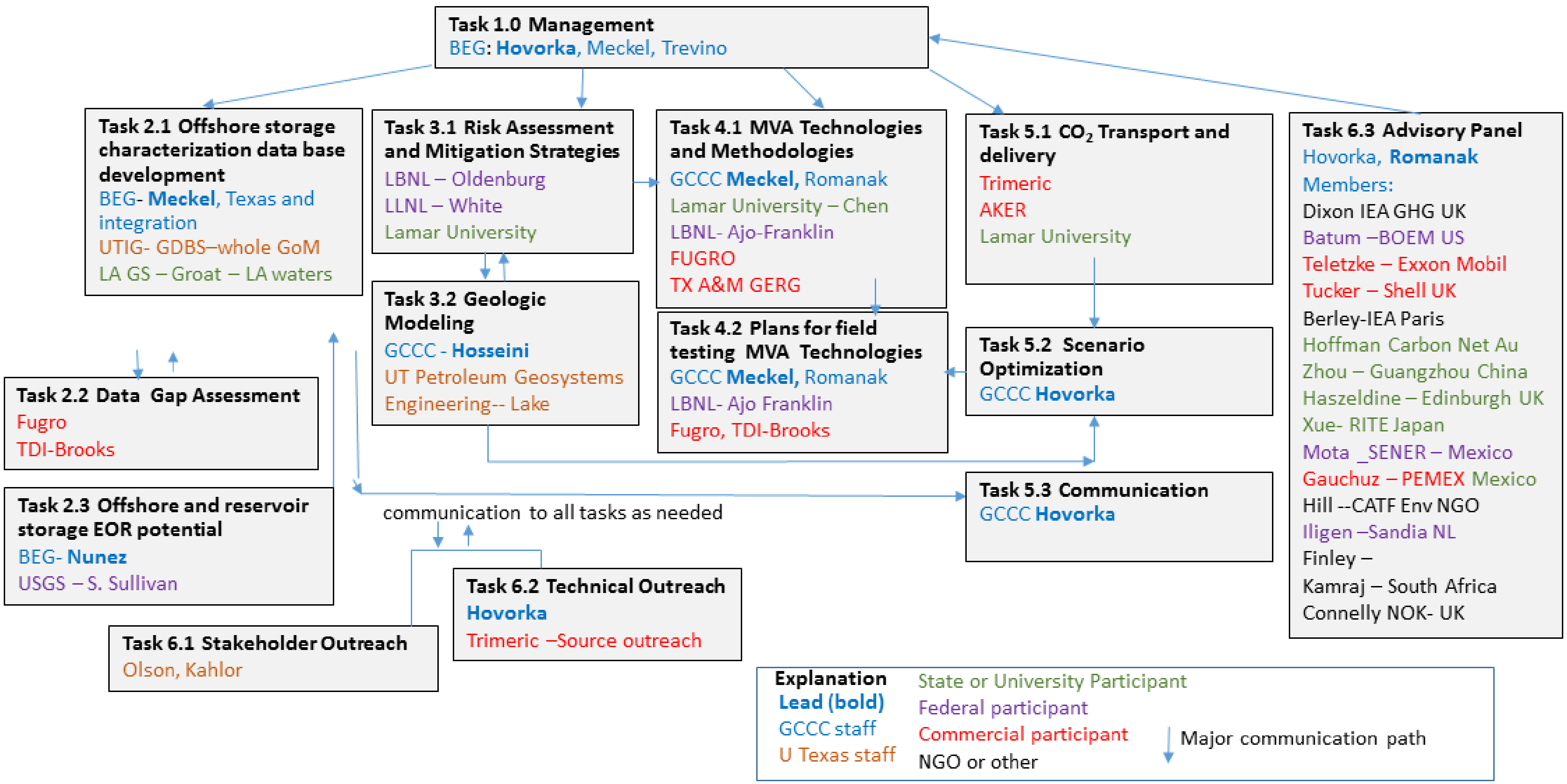
Summary

- **Offshore GoM storage interest growing**
  - **Commercial / State**
- Positive interactions with land owners and regulators
  - TX General Land Office
  - LA Fish and Wildlife and DEQ
- Dialog with several major GC CO_2 emitters
- Industries entering or expanding into carbon markets considering offshore
- Dialog with vendors
  - Equipment, well-retrofits
  - Platforms and pipelines

Appendix

– These slides will not be discussed during the presentation, but are mandatory.

Organization Chart



Gantt Chart

Partnership for Offshore Carbon Storage Resources and Technology Development in the Gulf of Mexico		BUDGET PERIOD 1											BUDGET PERIOD 2								
		2018			2019				2020				2021				2022				2023
Task	Tasks	qtr2	qtr3	qtr4	qtr 1	qtr2	qtr3	qtr4	qtr 1	qtr2	qtr3	qtr4	qtr 1	qtr2	qtr3	qtr4	qtr 1	qtr2	qtr3	qtr4	qtr 1
		A-M-J	J-A-S	O-N-D	J-F-M	A-M-J	J-A-S	O-N-D	J-F-M	A-M-J	J-A-S	O-N-D	J-F-M	A-M-J	J-A-S	O-N-D	J-F-M	A-M-J	J-A-S	O-N-D	J-F-M
1	**Project Management, Planning, and Reporting**	**M1**		**M2**																	**M11**
	Revision and Maintenance of Project Management Plan								**G-NG**												
	Progress Report	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
2	**Offshore Storage Resources Characterization**						**M4**			D2.1a		D2.2a	D2.3a		**M8**						
2.1	Database Development				**M3**																
2.2	Data Gap Assessment																				
2.3	Offshore EOR Potential																				
3	**Risk Assessment, Simulation and Modeling**				3.1a				**M5**		**M6**				D3.2a						
3.1	Risk Assessment and Mitigation Strategies																				
3.2	Geologic Modeling																				
4	**Monitoring, Verification, Accounting (MVA) and Assessment**					D4.1a							**M7**				D4.2a				
4.1	MVA Technologies and Methodologies																				
4.2	Plans for Field Testing of MVA Technologies																				
4.3	Testing MVA Technologies																				
5	**Infrastructure, Operations, and Permitting**						D5.1a						D5.2a							D5.3a	
5.1	CO2 Transport and Delivery																				
5.2	Scenario Optimization																				
5.3	Communication																				
6	**Knowledge Dissemination**			6.1a				6.2a			D6.3a					D6.3b	**M9**		**M10**		
6.1	Stakeholder Outreach																				
6.2	Technical Outreach																				
6.3	Advisory Panel																				

Q = Quarterly Report; A = Annual Report; M = Milestone; DP = Decision Point; D = Deliverable; G-NG = Go/no-go decision point; FR = Final Report