IMPACTS OF WETLAND NOURISHMENT ON COASTAL INLET PROCESSES

TOOLS TO SUPPORT NATURAL AND NATURE-BASED FEATURES

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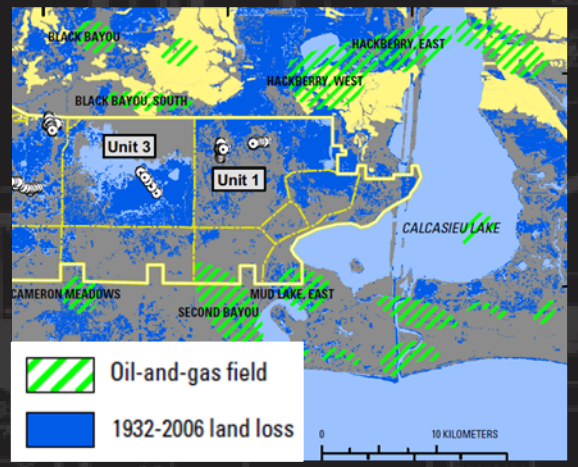
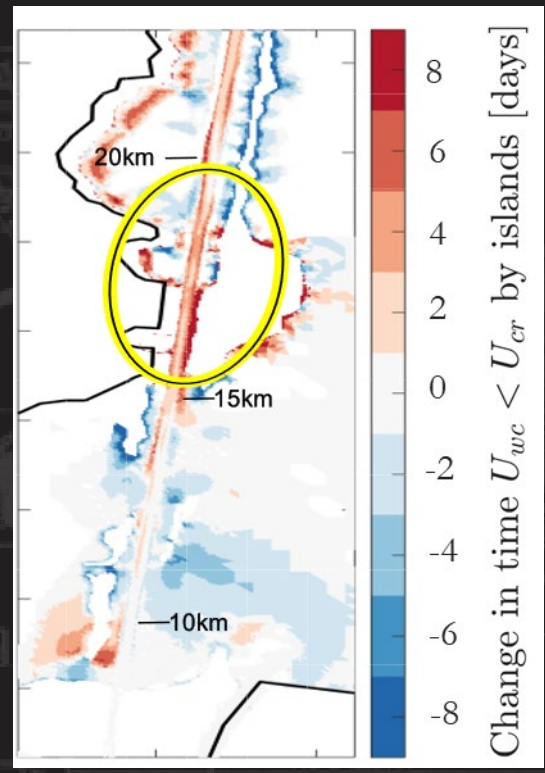
COASTAL INLETS RESEARCH PROGRAM
FY23 IN PROGRESS REVIEW



Bernier et al. 2011 USGS Open File Report 2011-1169



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PROBLEM STATEMENT

Although placement of BUDM within or close to embayments can reduce transport costs, there is limited synoptic understanding of how placement within estuarine systems influences local- to regional-scale hydrodynamics. Generalized guidance is lacking, but essential to anticipate how different placement alternatives consequently modify channel shoaling rates.

Statement of Need: SON-N-1411 Sustainable Dredged Sediment Management Practices to Support Wetlands
SON-N-1322 Near-shore Placement for Wetland Nourishment
SON-N-1970 Multi-scale Analyses of BUDM impacts on long-term navigation channel maintenance

FY23 was Year 3 of 3

Year over year advancements to date
1 SR published and 2 JP manuscripts submitted
1 Conference Presentation (OSM24), 3 CIRP Tech Discussions, 1 CHL Research Forum, and 1 CHL Symposium talk

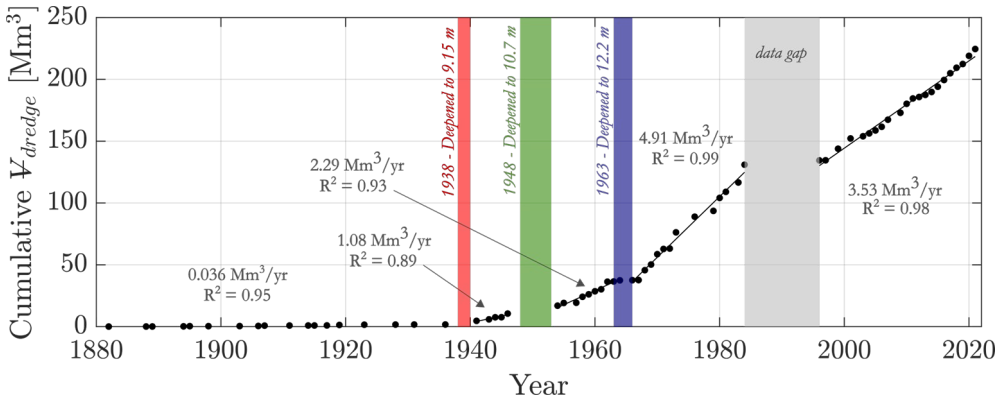
CAPABILITY AND STRATEGIC IMPACT

A sample embayment with historical channel-adjacent BUDM islands demonstrates long term sediment management impacts on navigation channels. Numerical modelling and anthropogenic wetland disruption data complement archival dredging history to help infer long term impacts. Publications from this work demonstrate analysis techniques and discuss findings.

Increased understanding of navigation channel response to BUDM placement from local to basin-scale can guide future placement strategies. More efficiently accounting for both benefits and adverse impacts on navigation channel sedimentation has the potential to expand positive outcomes of BUDM placements.

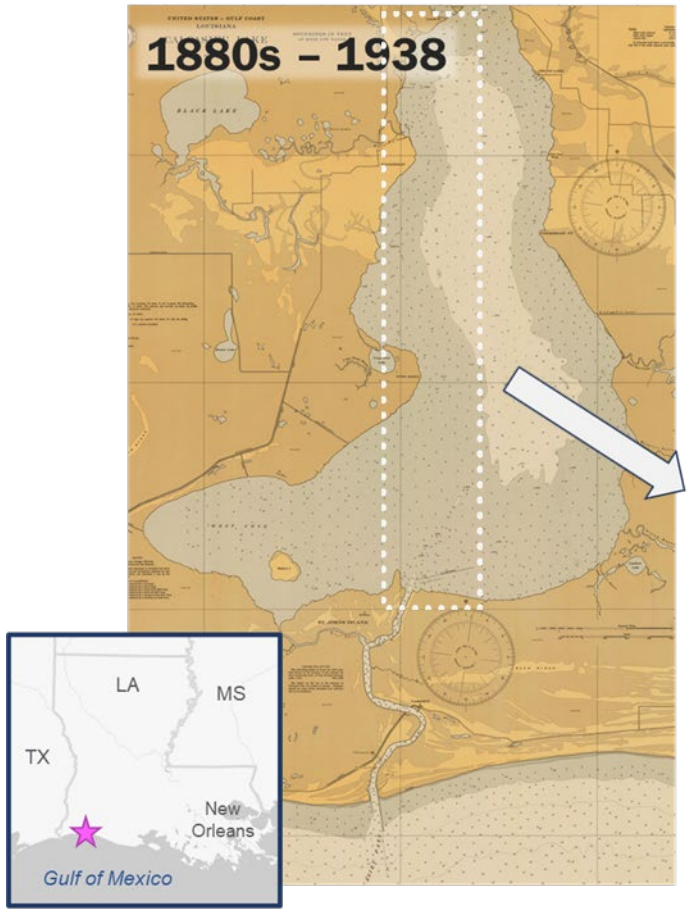
TECHNICAL APPROACH

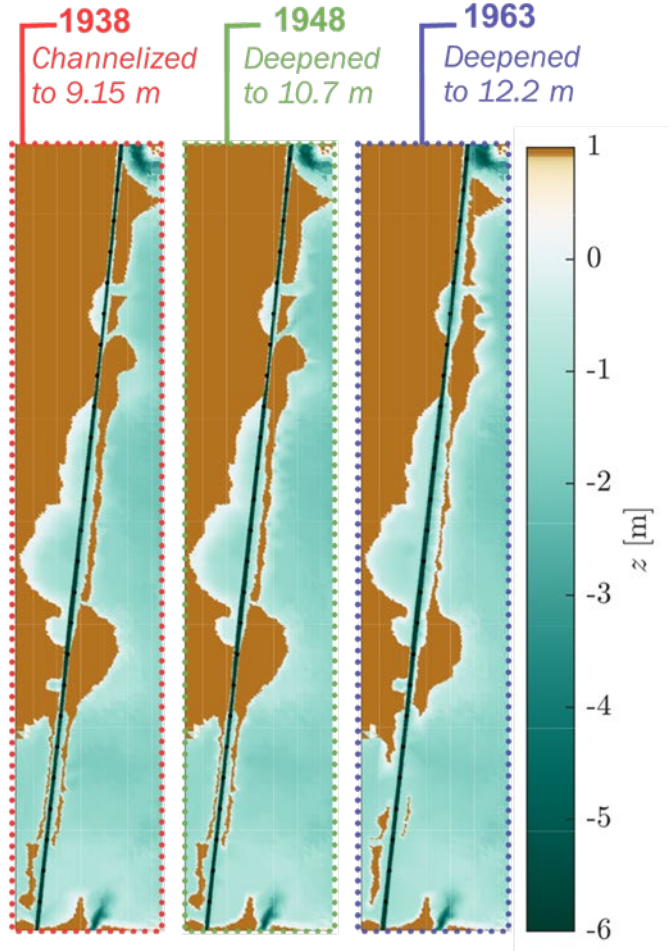
Can we use a numerical model to distinguish between the role of channelization and deepening vs. parallel islands *on shoaling mechanisms and pathways*?



Tested bathymetries

Pre-modification	**9.15m (30ft)** draft	**10.7m (35ft)** draft	**12.2m (40ft)** draft
	9.15m (30ft) draft, *no islands*	**10.7m (35ft)** draft, *no islands*	**12.2m (40ft)** draft, *no islands*



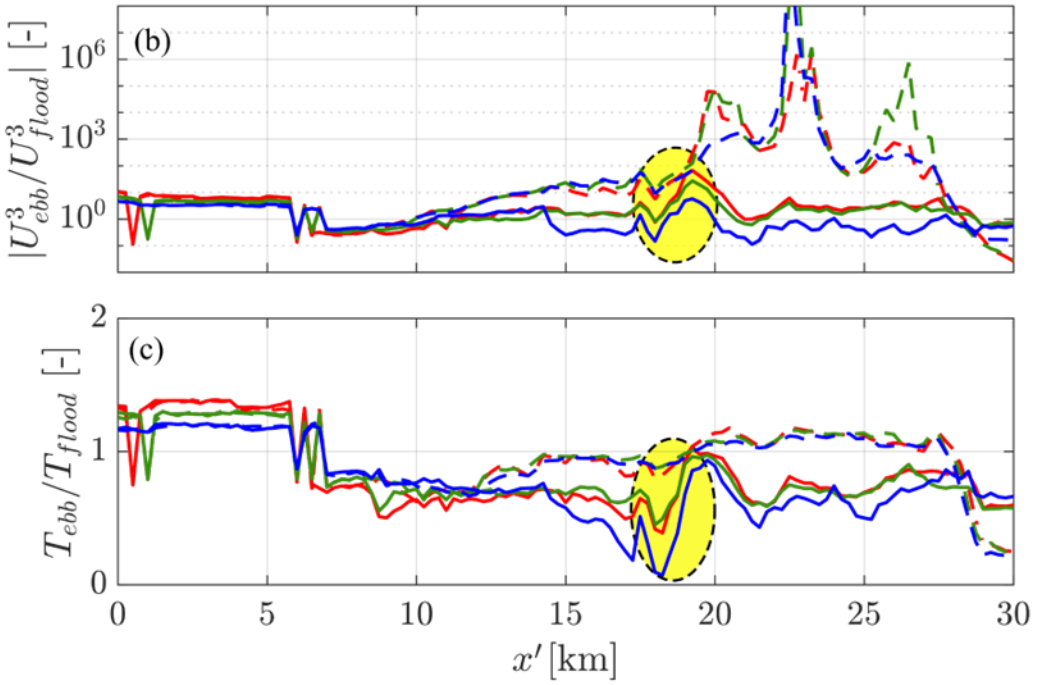


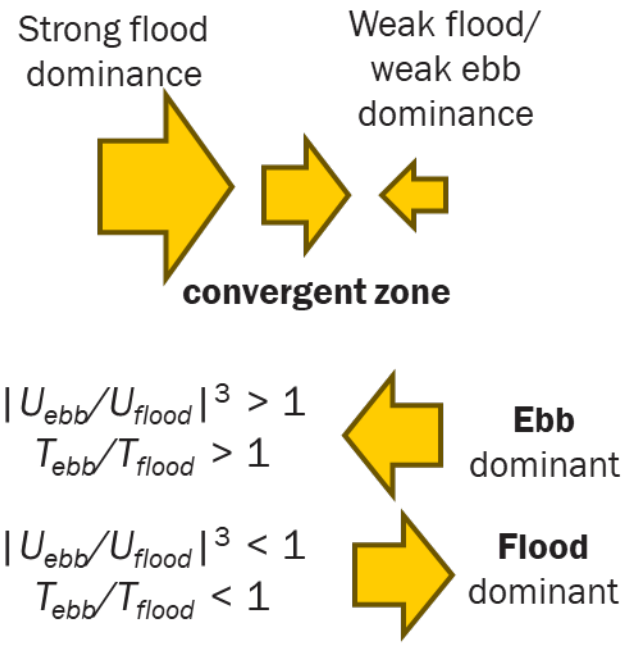
TECHNICAL APPROACH (1 OF 4)

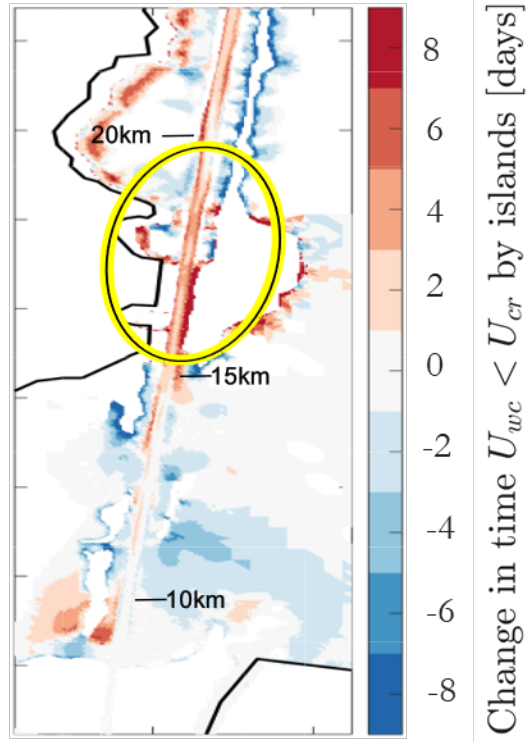
Used the Coastal Modeling System (CMS) to identify sediment transport mechanisms and pathways

- CMS-Flow coupled with CMS-Wave, 30-day simulation
- Constant: tides, spectral waves, streamflow (NOAA, USGS); Time-varying: wind (periodic fronts)

Time-averaged hydrodynamics







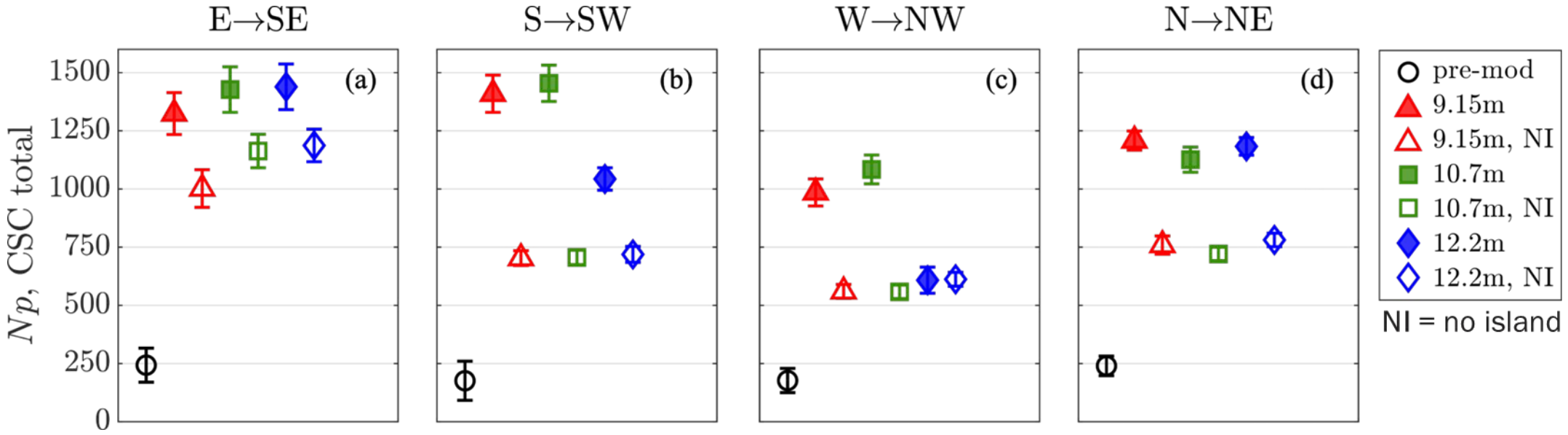
TECHNICAL APPROACH (2 OF 4)

Used the Coastal Modeling System (CMS) to identify sediment transport mechanisms and pathways

- CMS-Flow coupled with CMS-Wave, 30-day simulation
- Constant: tides, spectral waves, streamflow (NOAA, USGS); Time-varying: wind (periodic fronts)

Particle tracking model (PTM)

- Particle retention within CSC dependent on wind direction and size/distribution of gaps in islands



TECHNICAL APPROACH (3 OF 4)

As the channel was deepened and BUDM islands were constructed, extensive oil and gas production occurred, and large areas of land converted to open water.
Are these related to changes in dredging requirements?

Spearman's rank correlations and Granger Causality were used to compare:
H: hurricane occurrence
D: authorized channel depth
V: dredging volume
O: oil produced
G: gas produced
Q: river discharge
LA: land area
NW: new wells
NF: new fields

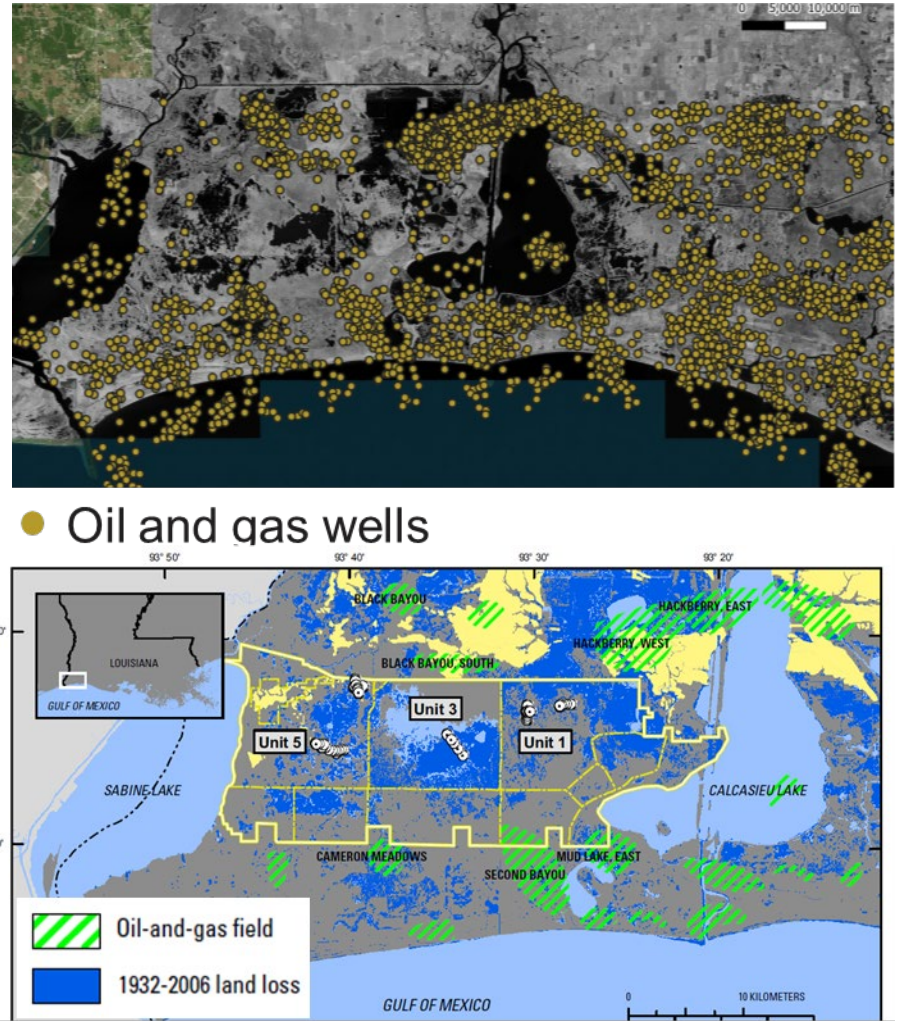
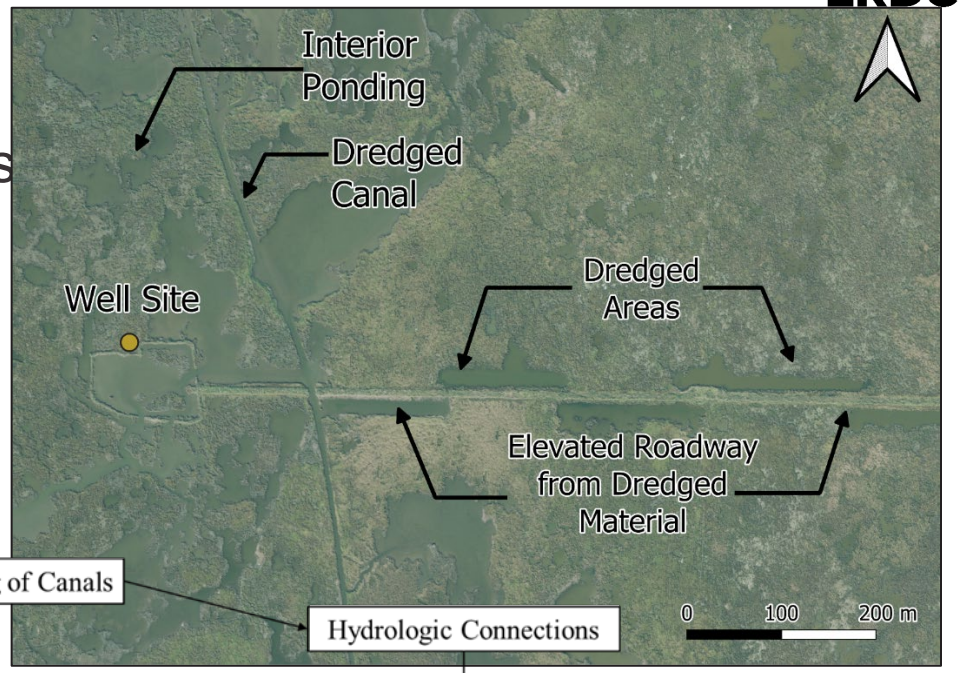


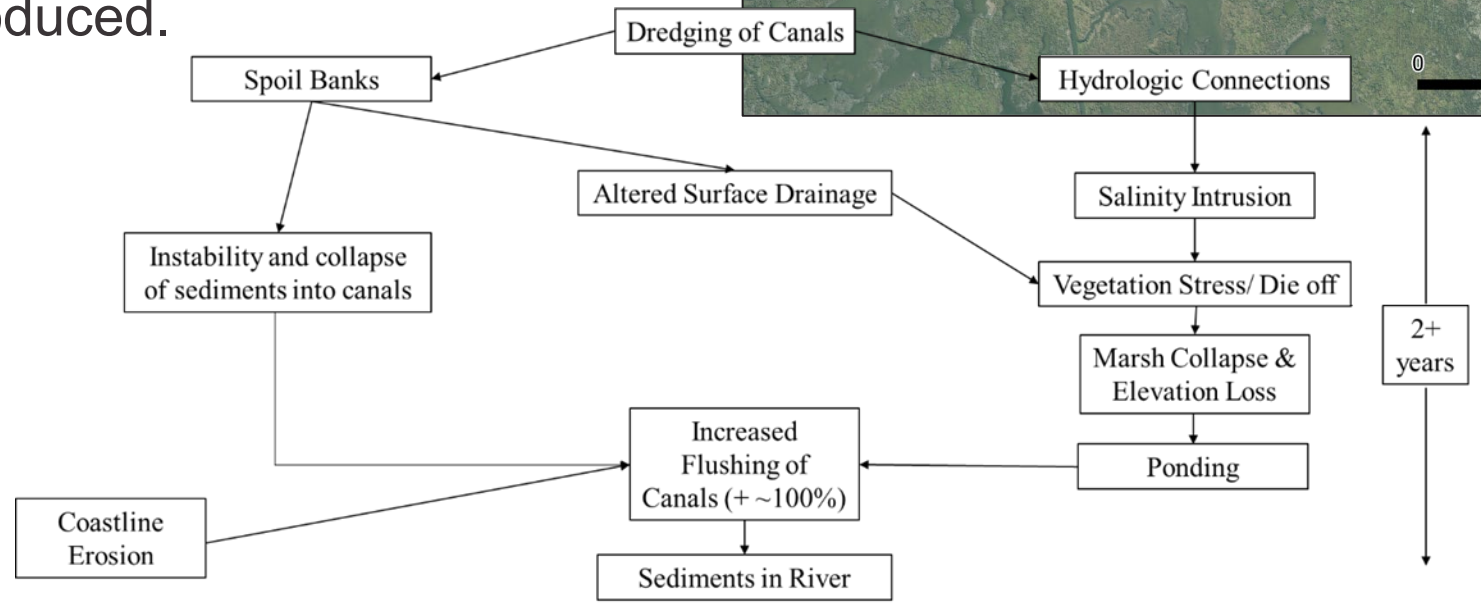
Figure 2 from Bernier et al. 2011 USGS Open File Report 2011-1169

TECHNICAL APPROACH (4 OF 4)

Positive correlations: cumulative volumes of navigation dredging are positively correlated with cumulative oil and gas production and well creation.

Negative correlations: land area is negatively correlated with (i.e. land loss is correlated with) cumulative gas produced, cumulative dredging volume, cumulative number of wells, and cumulative oil produced.





SUMMARY

FY23 Major Advancements in Capability

- BUDM islands lining main channel can retain material/increase shoaling needs; but maintaining sufficient gaps can reduce negative impacts
- Depositional portions of channel are well-correlated with tidal convergence zones, which can be modeled, for some* systems
- Statistical correlations between wetland loss and navigation dredging were demonstrated.
- A theoretical framework connecting infrastructure, wetland loss, and dredging is hypothesized.

FY23 Major Products & Collaborations

1 JP submitted on the apparent relationship between wetland loss, navigation dredging, and energy activity
1 JP submitted on using CMS to identify changes to sediment transport mechanisms and pathways related to large-scale BUDM island construction on 11 March 2024 (JWPCOE)
2 CIRP Tech Discussions
1 CHL Research Seminar