Sediment Transport and Infilling Processes of Dredge Pits on Louisiana Shelf

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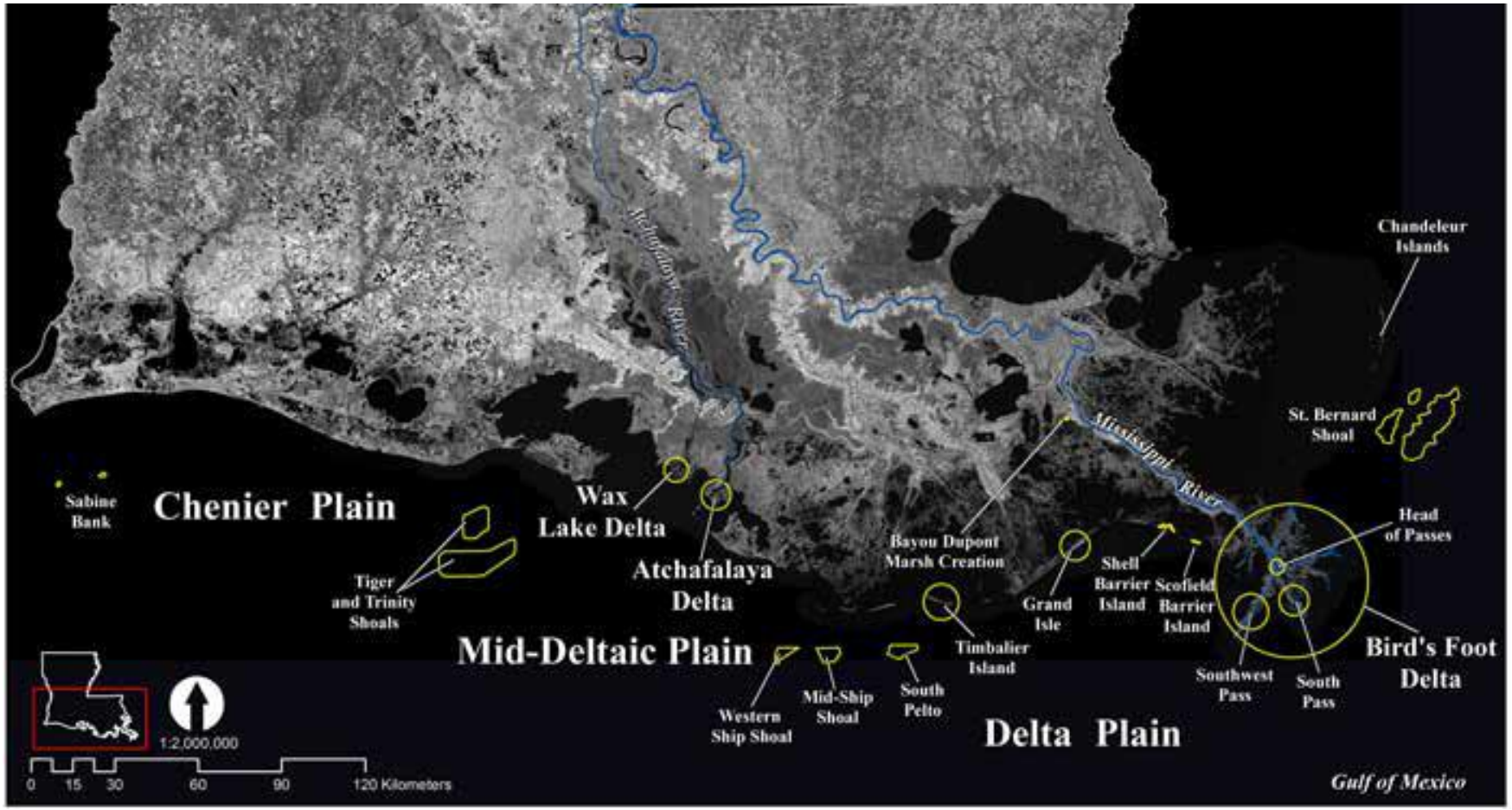


(Syed M. Khalil et al.,2018)

- Cumulative wetland loss has continued at a rate of ~25 km2/yr (Couvillion et al. 2017)
- Sedimentological restoration to restore geomorphic form is critically important to offset land loss
- Inner-shelf shoals offshore Louisiana are one of the sand resource options containing large volumes of restoration quality sand.

Challenge we have

Restoration of coastal Louisiana under changing environmental conditions is a challenge:

- the quantity of sediment resources available for critical restoration projects is likely to decrease, rendering the dredging and utilization of the sediment resources more difficult and costly (Syed M. Khalil et al.,2018).

Types of offshore Sediment Resources

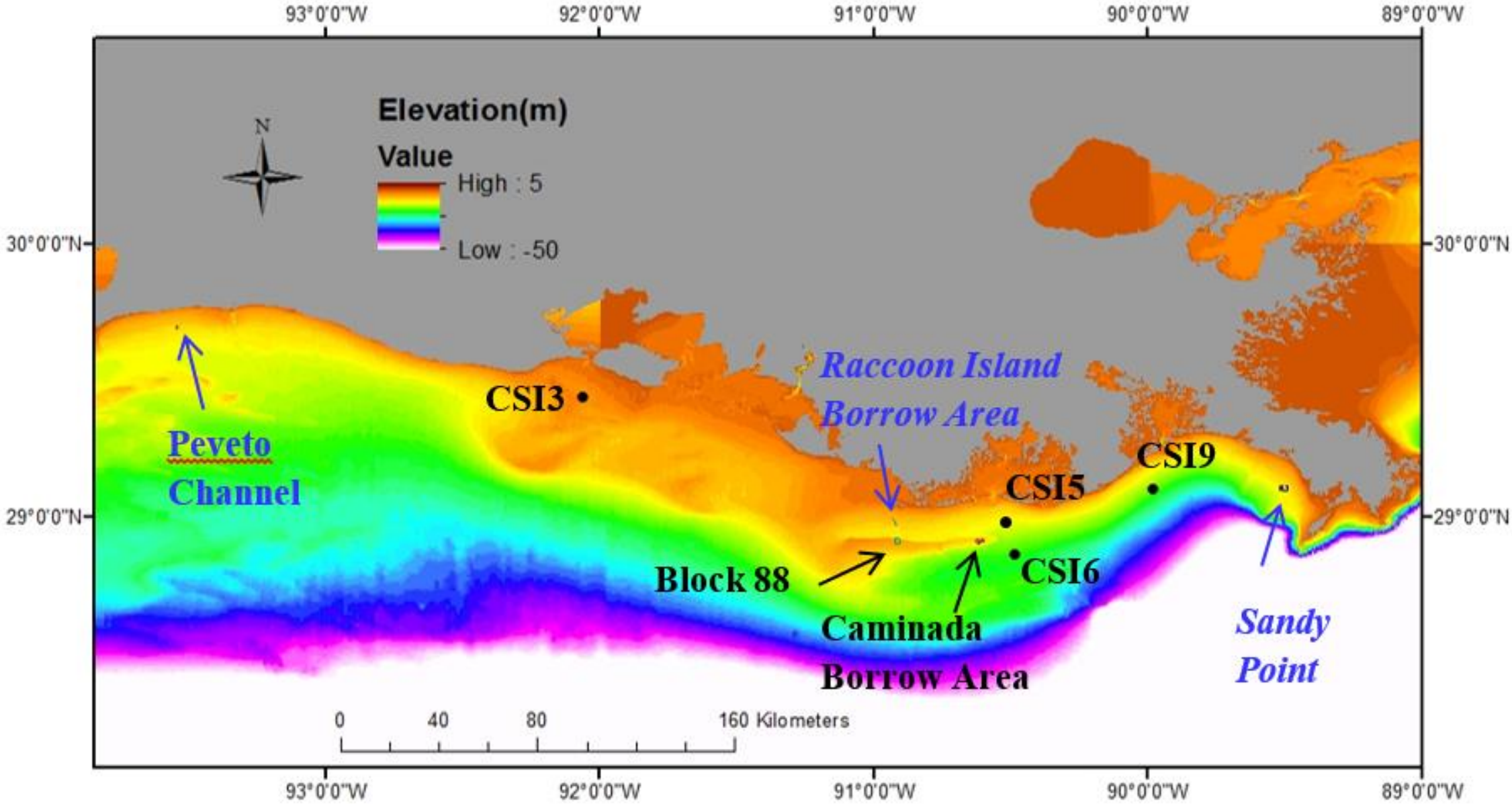
- Paleo river channels

  (small, close to restoration sites)

  – Many sites
  – Paleo river channels covered by cohesive overburden
  – Raccoon Island dredge pit
- Sandy shoals

  (large, may not be close to restoration sites)

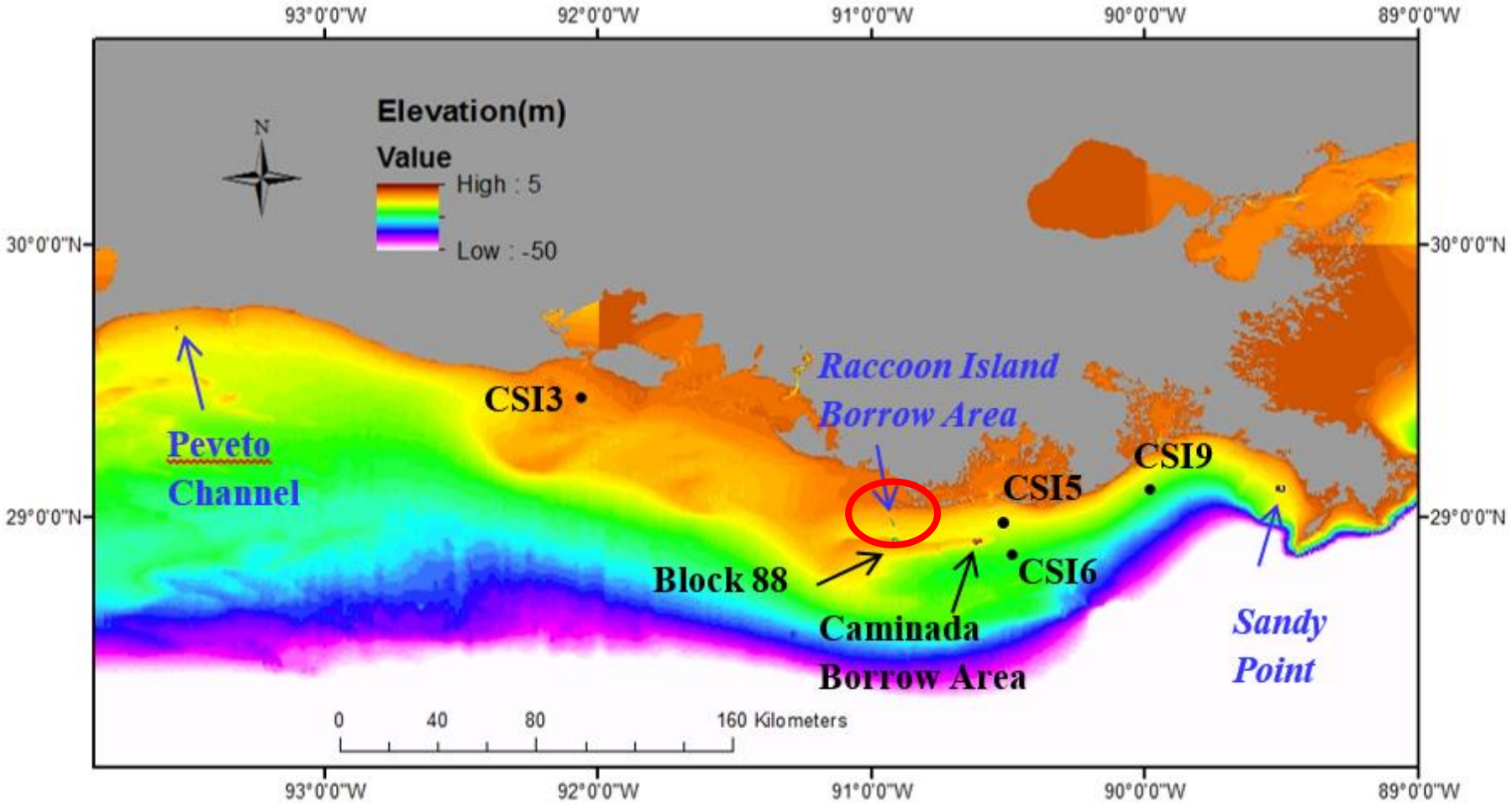
  – Ship Shoal
  – Tiger and Trinity Shoals
  – Sabine Bank


93°0'0"W
92°0'0"W
91°0'0"W
90°0'0"W
89°0'0"W
30°0'0"N
29°0'0"N
N
Elevation(m)
Value
High : 5
Low : -50
Peveto
Channel
CSI3
Raccoon Island
Borrow Area
CSI9
CSI5
CSI6
Block 88
Caminada
Borrow Area
Sandy
Point
0
40
80
160 Kilometers

BOEM funded projects

Projects	PIs	Students	Sites
Paleo River Channel Dredge Pits (2014-2017)	Kevin Xu, Sam Bentley, Chunyan Li, Carol Wilson	Nazanin Chaichitehrani, Meg O'Connor, Jeffrey Obelcz, Jiaze Wang, Patrick Robichaux	Sandy Point, Raccoon Island, Peveto Channel
Ship Shoal Sandy Pits (2016-2019)	Kevin Xu, Sam Bentley, Chunyan Li, Carol Wilson	Haoran Liu, Zehao Xue	Caminada, Block 88
Pit Water Quality (2017-2020)	Kevin Xu, Sam Bentley, George Xue, Kanchan Maiti, Carol Wilson, John White and Sibel Bargu	Haoran Liu, Zehao Xue Ou Yanda	Sandy Point, Caminada

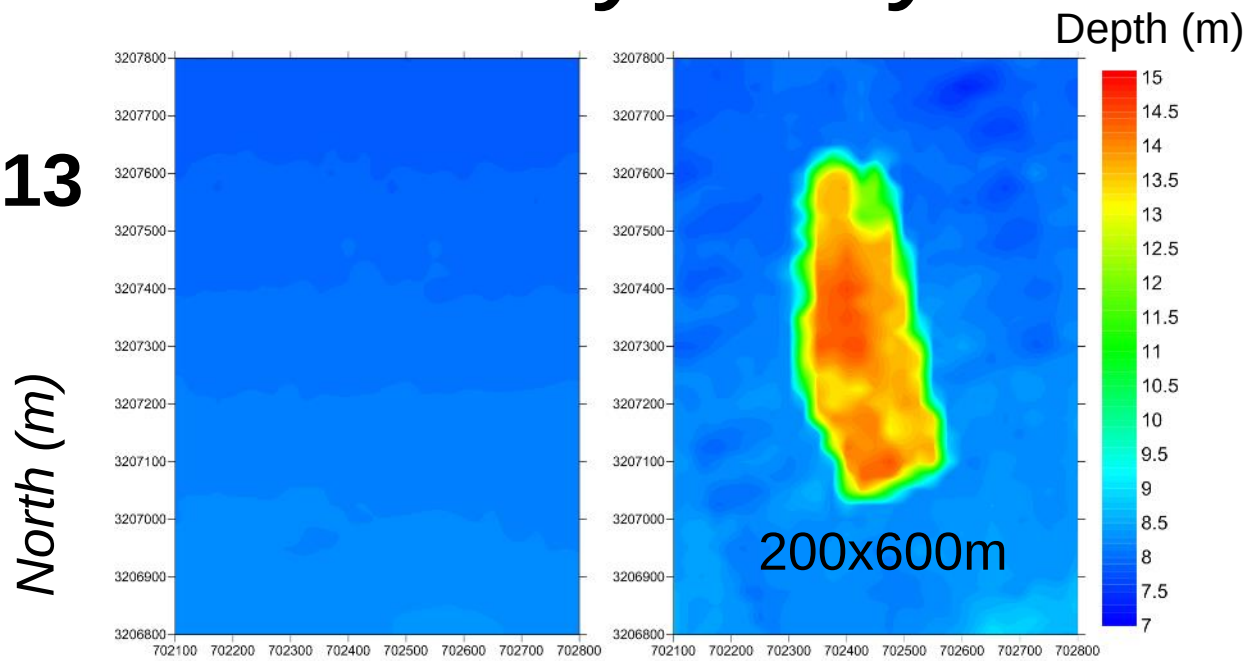
Raccoon Island Dredge Pit



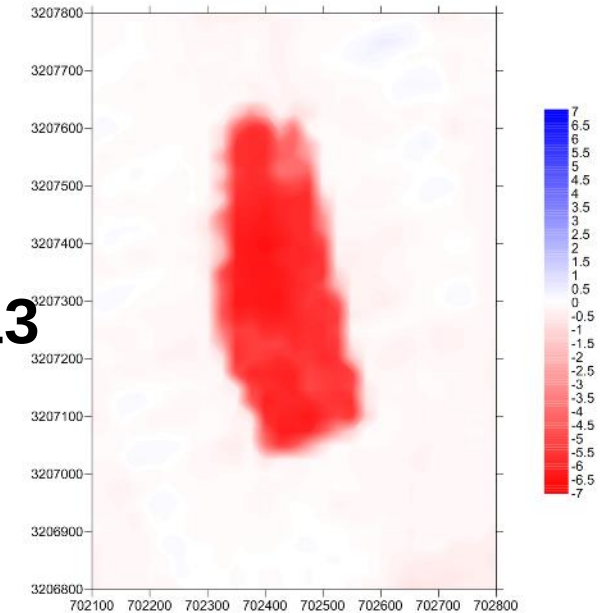
Bathymetry

Jan 2013

Mar 2013



Jan 2013 – Mar 2013



Deposition

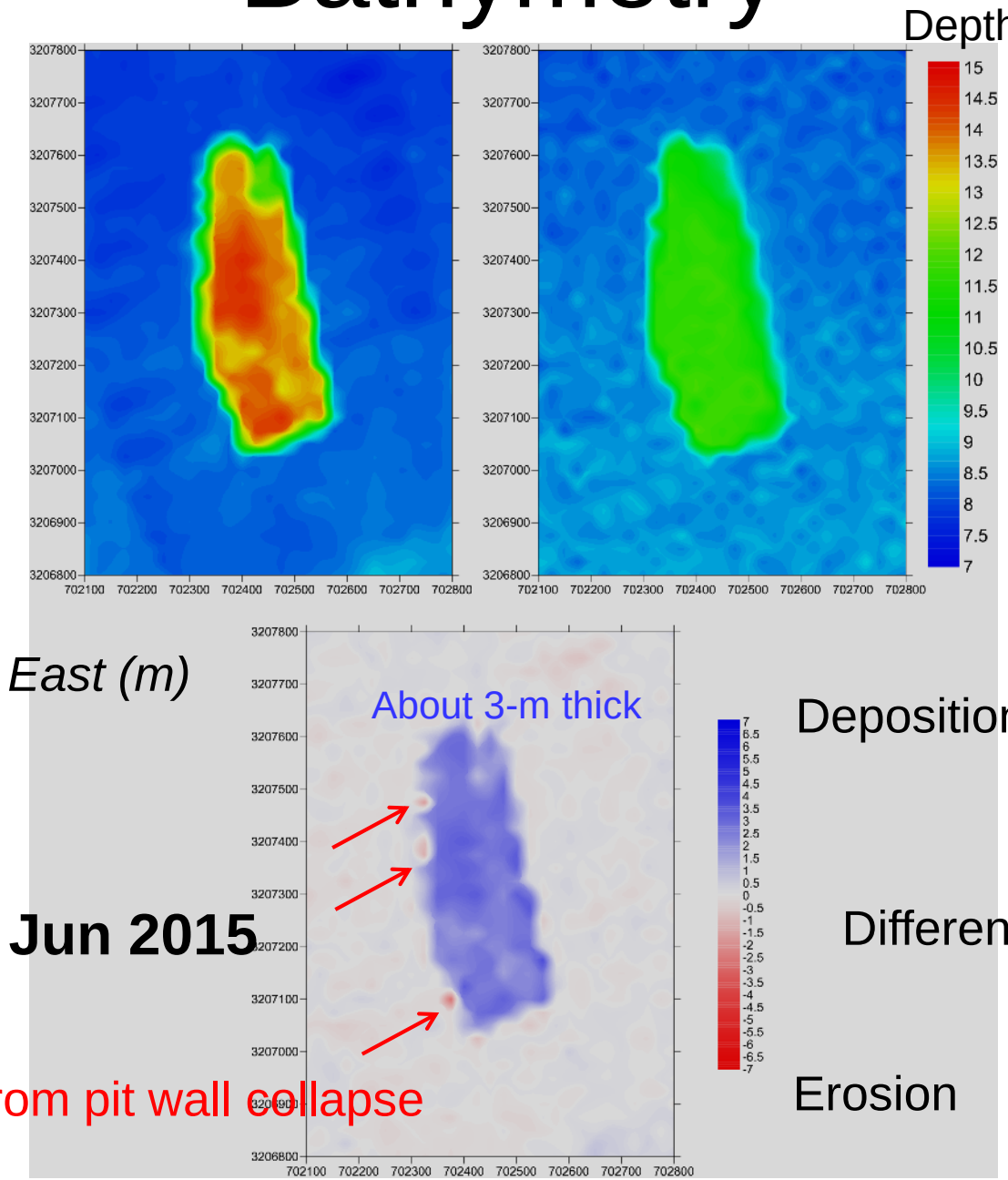
Difference (m)

Erosion

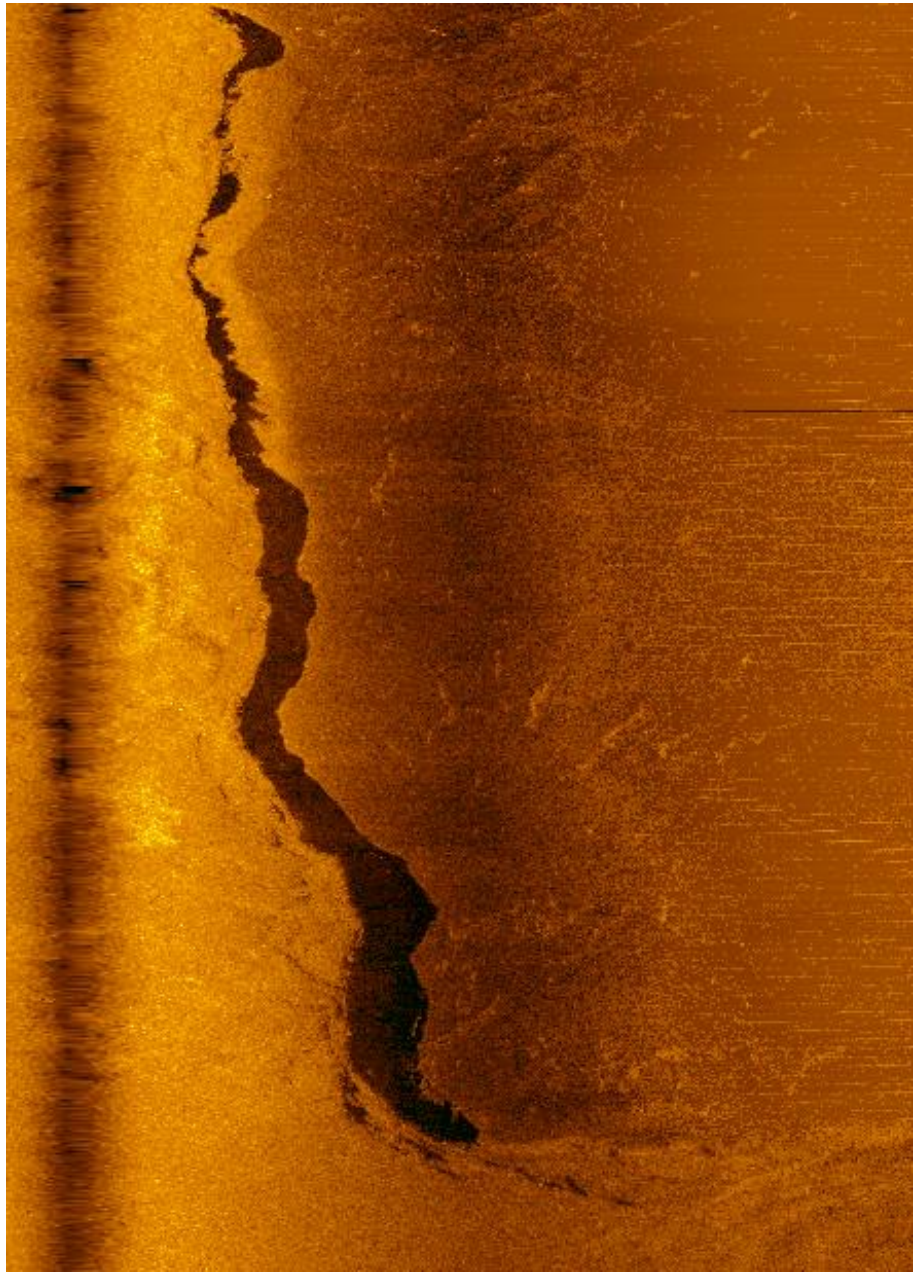
Bathymetry

Mar 2013

Jun 2015



Mar 2013 – Jun 2015

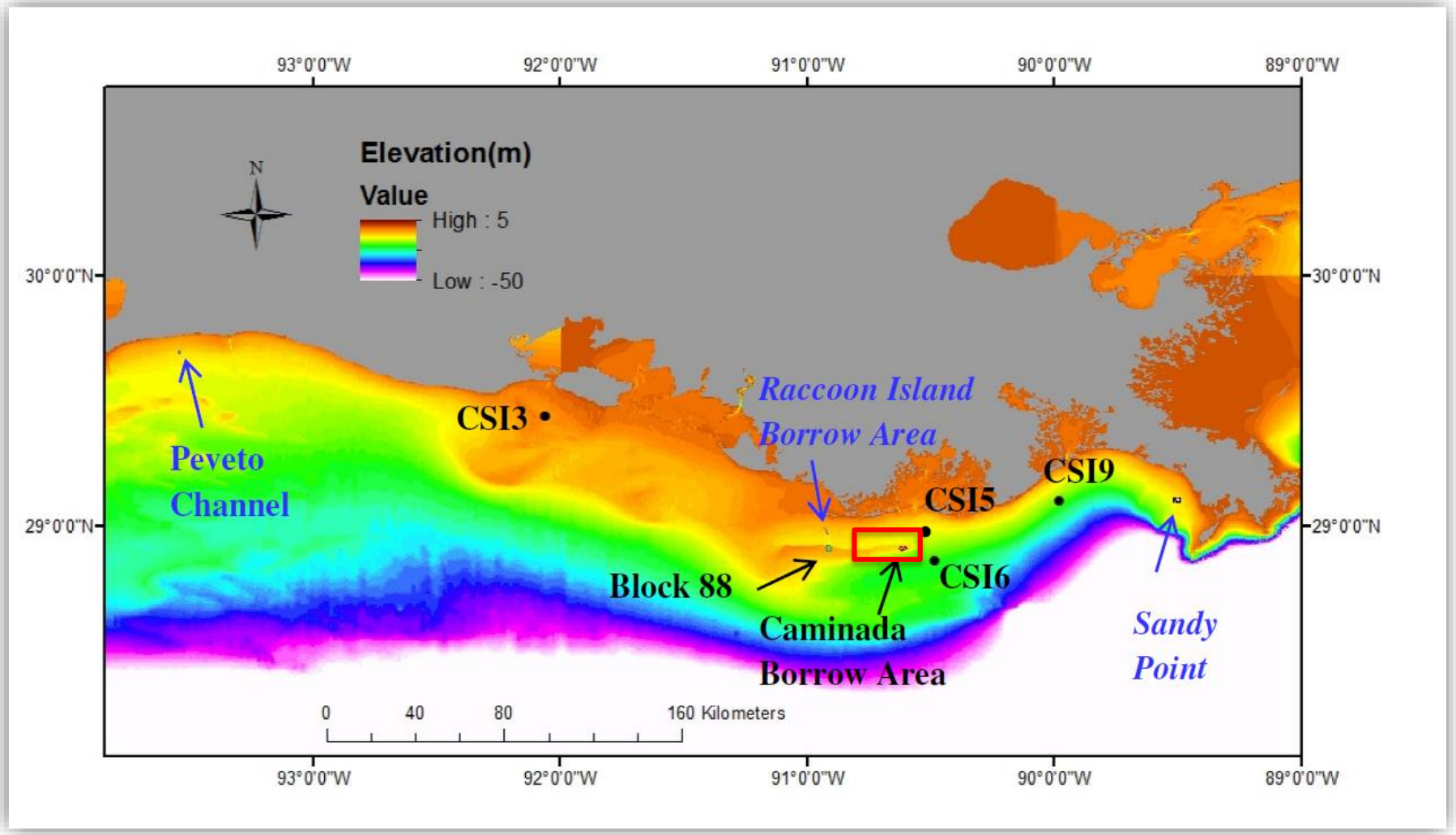


Sidescan data

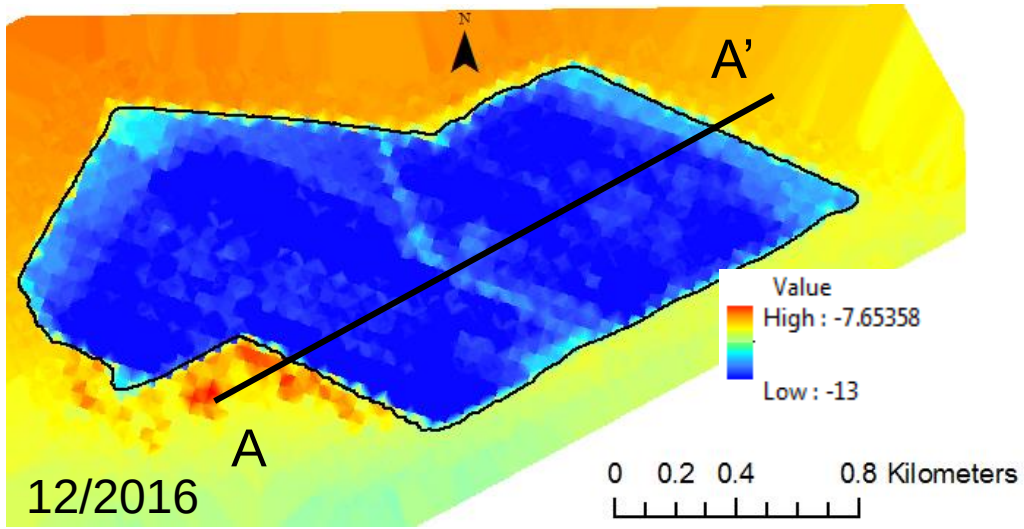
Southwest corner

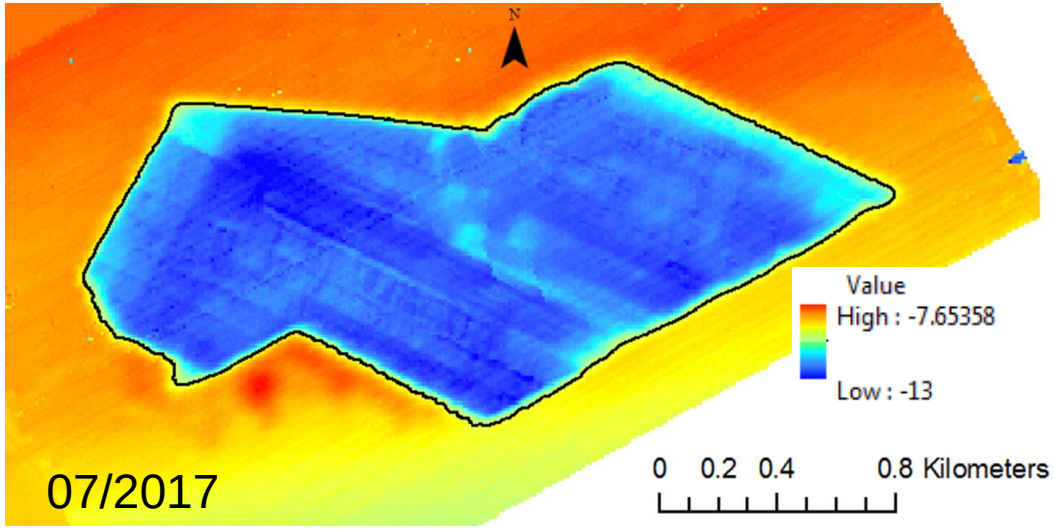
- This muddy pit was filled up in 2018 survey
- The average filling rate is 1.5~2 m/yr

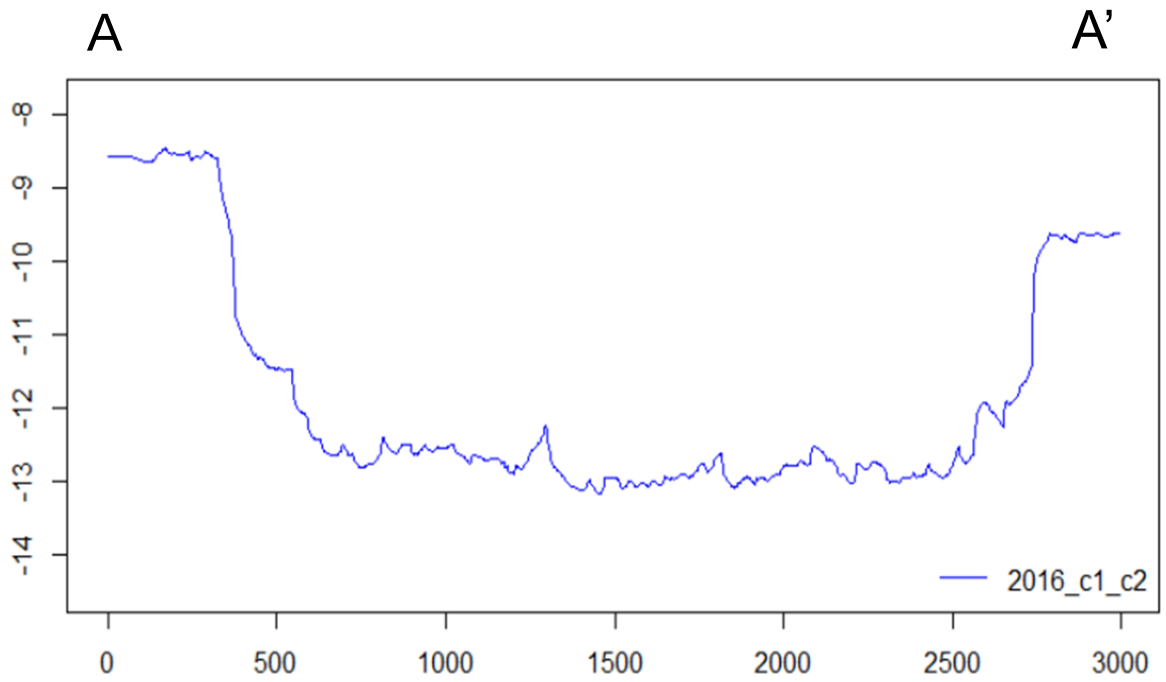
Ship Shoal Dredge Pit



Bathymetry

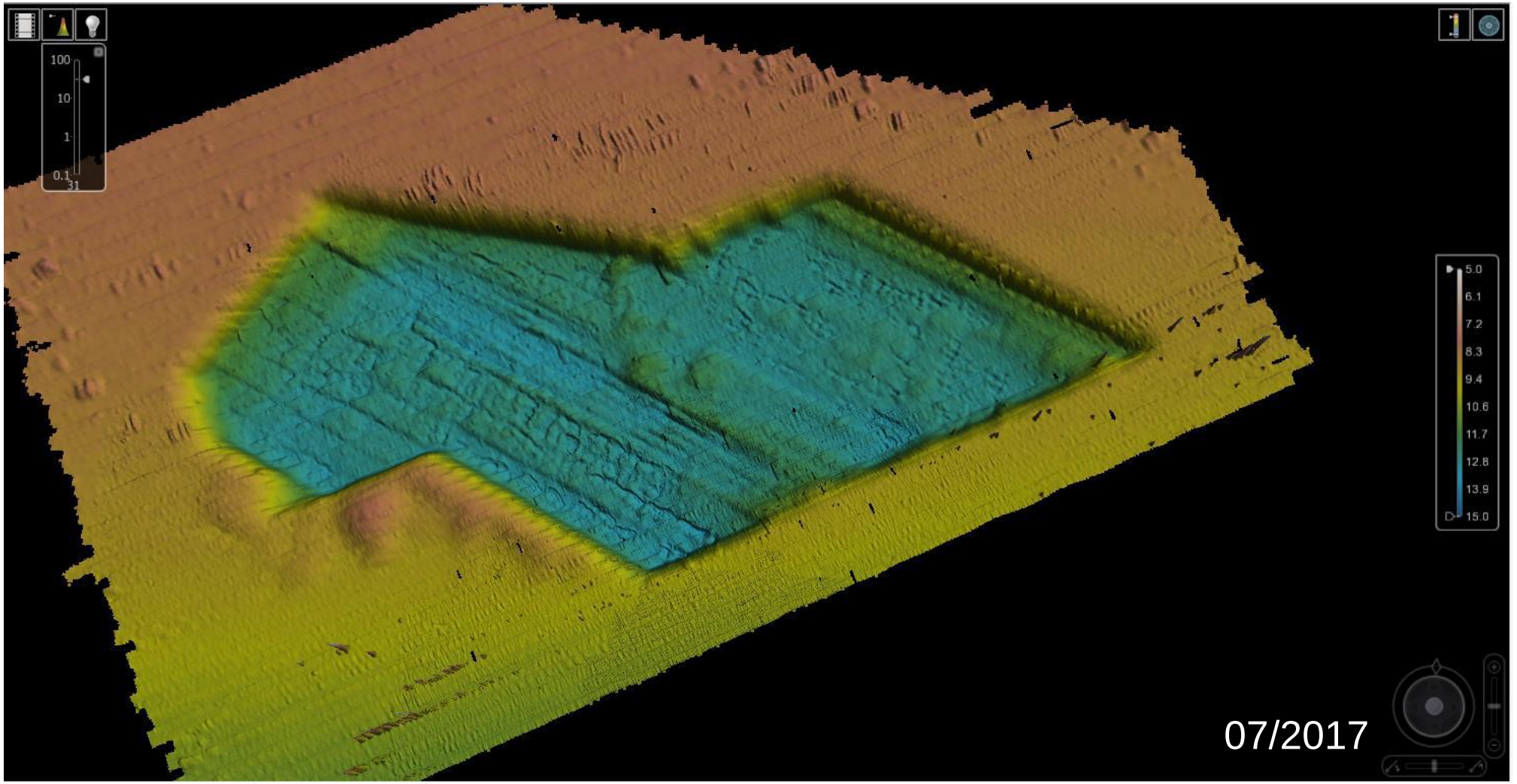






- pit is still not reaching the equilibrium.
- The maximum pit depth is ~13m, with comparing to ~7.6m of the surrounding floor.

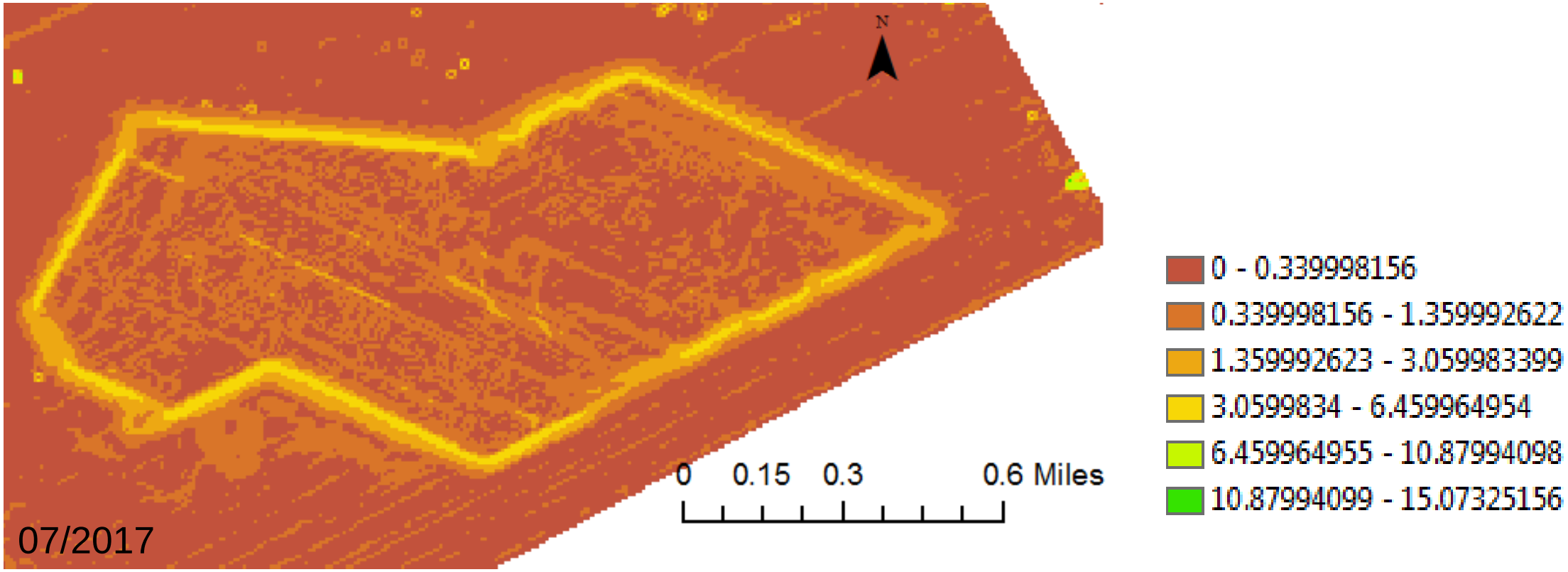
Morphology



Vertical exaggeration is 32 times

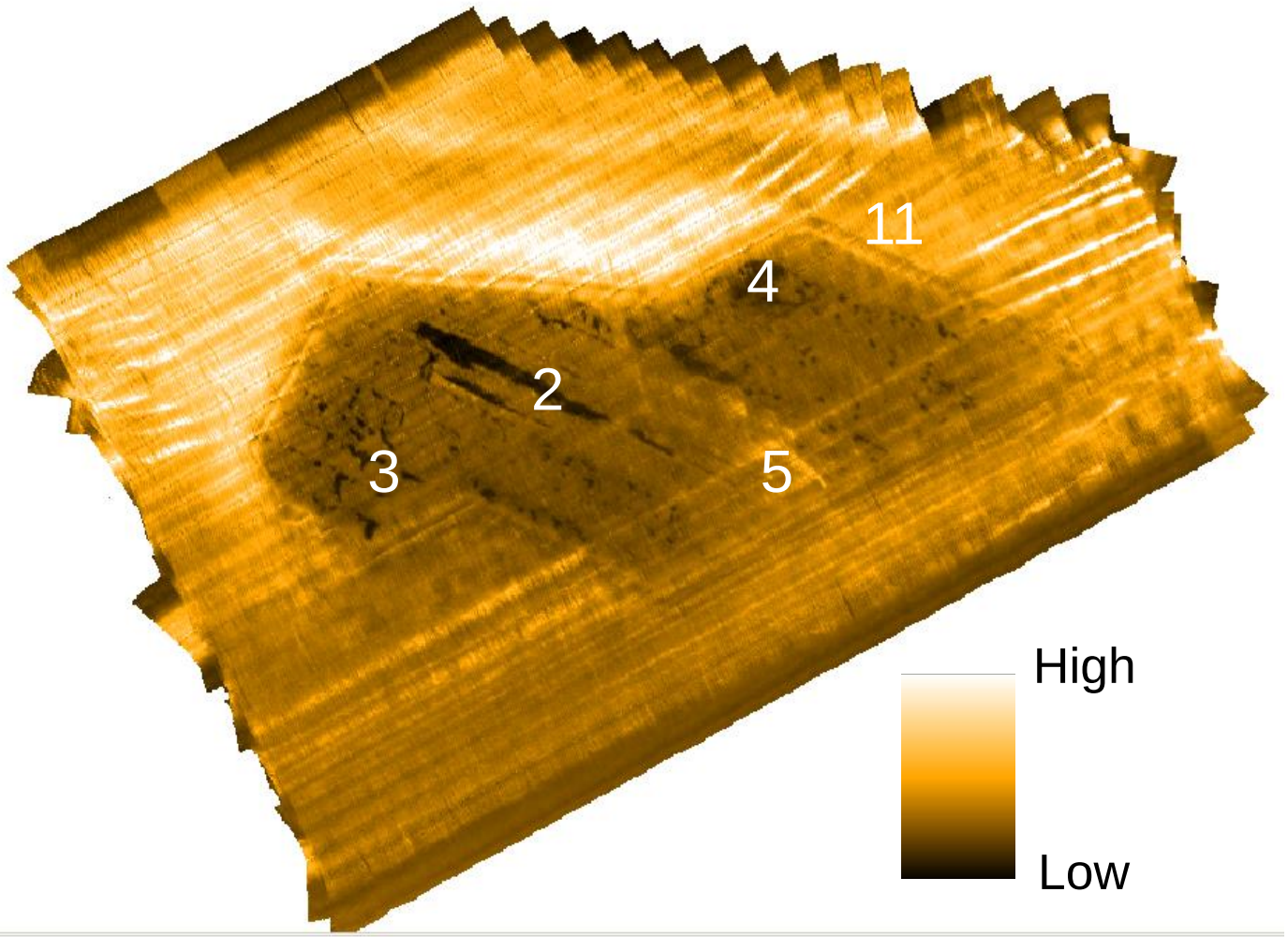
- Dredging sequence and muddy patches
- Topography low is prone to muddy sediment

Slope



- Compared with muddy dredge pits at Sandy Point (5.7~9.7degree from Obelcz, 2017) and Peveto (7~16 degree from Robichaux, 2017) in the same temporal stages (1-3 years after dredging) , ship shoal has more gentle slopes(1.3~5.4) on pit walls

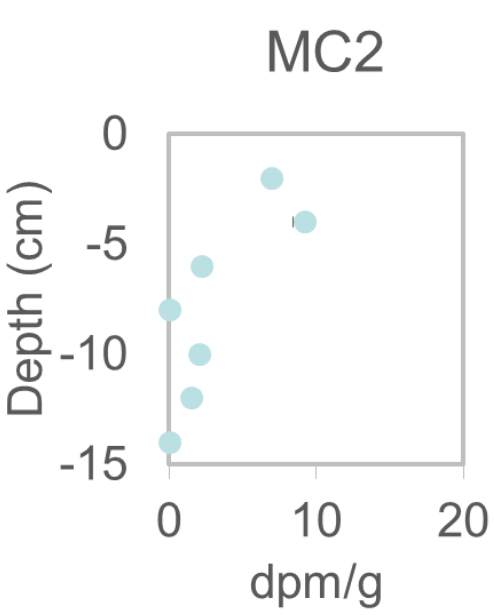
Sidescan and coring data



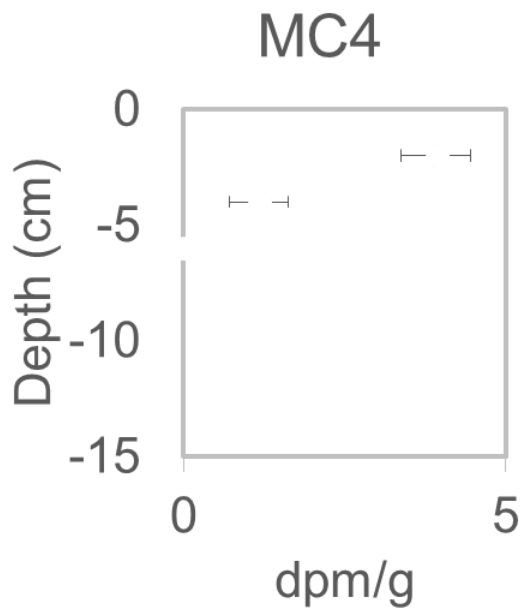
- Cores 2 and 4 contain muddy sediments, 3 contains mixed sand and mud, and cores 5 and 11 contain mainly sandy sediments

- Infilling sediment is dominantly sandy, with some mud patches on bathymetric depressions.

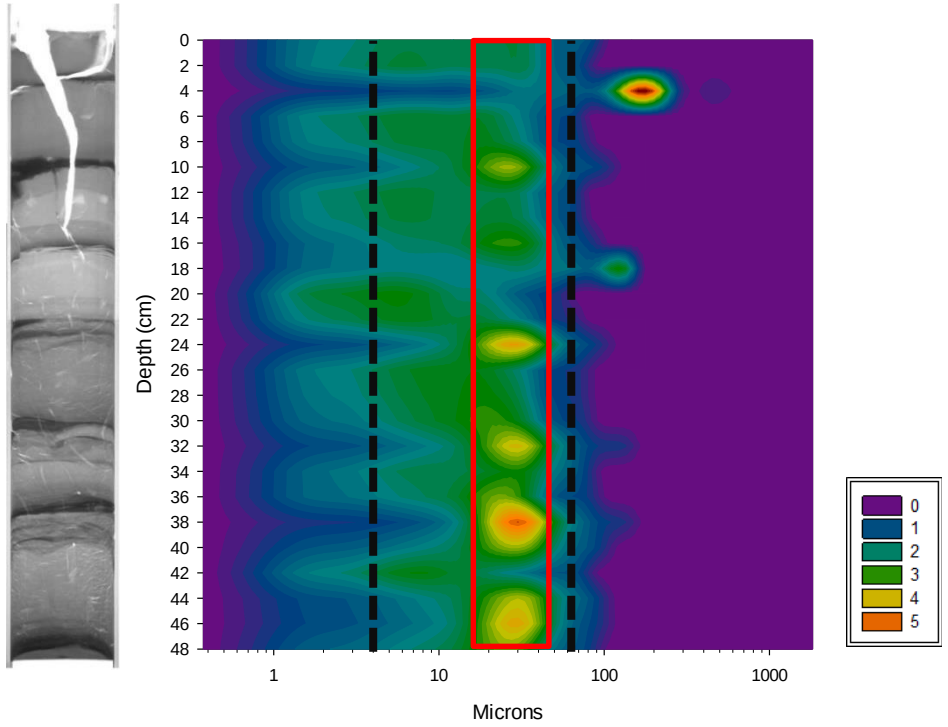
Pit Sedimentation Rates



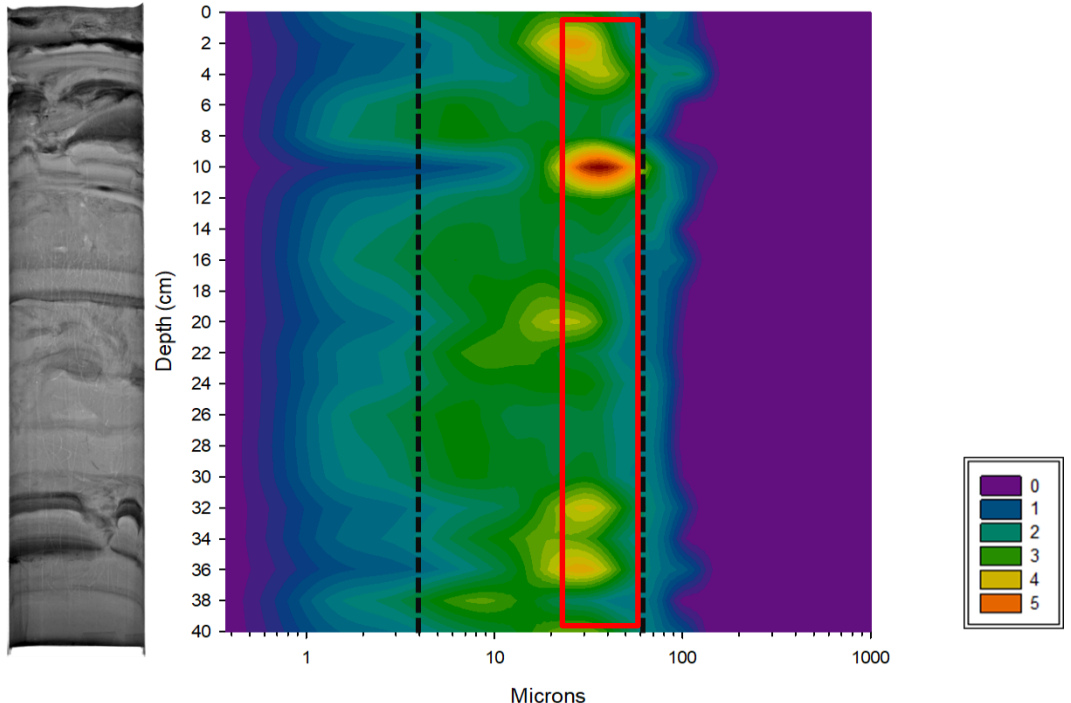
- Gamma results show ^{7}Be penetration from 4cm to 12 cm in muddy and mixed sandy/muddy sediments
- Preliminary average sediment accumulation rates are S ≈ 0.04~0.09 cm/d

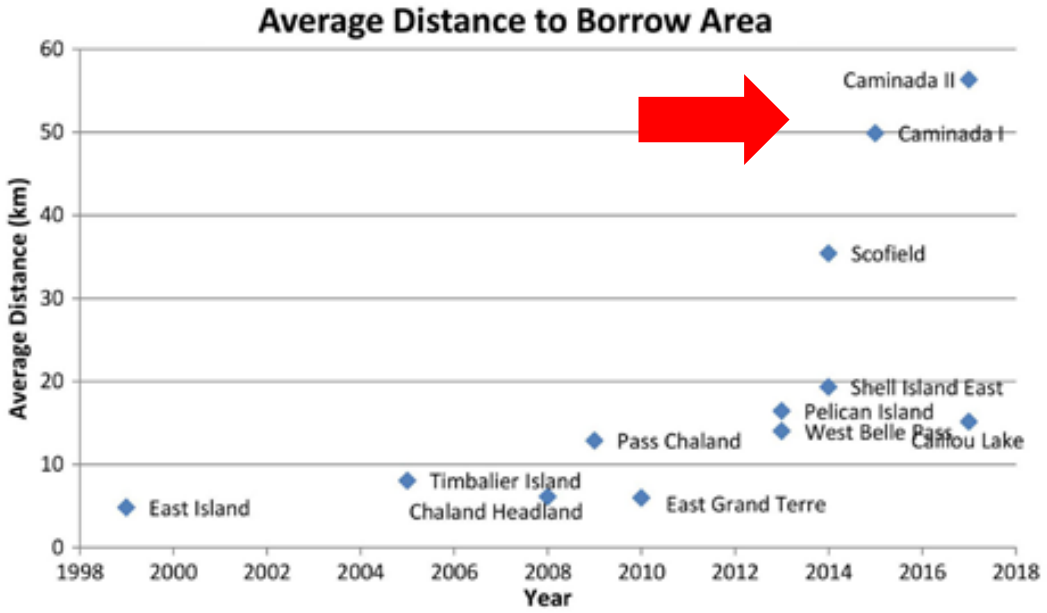


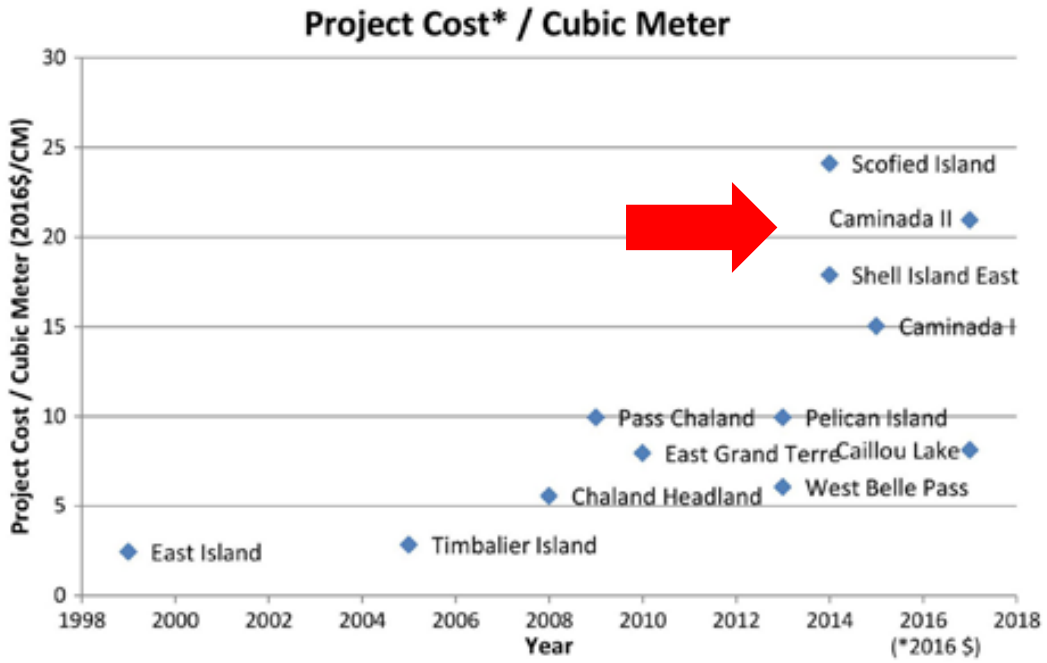
CA17-MC2



CA17-MC4







- Offshore sand has the long borrow distance but with high quality sand

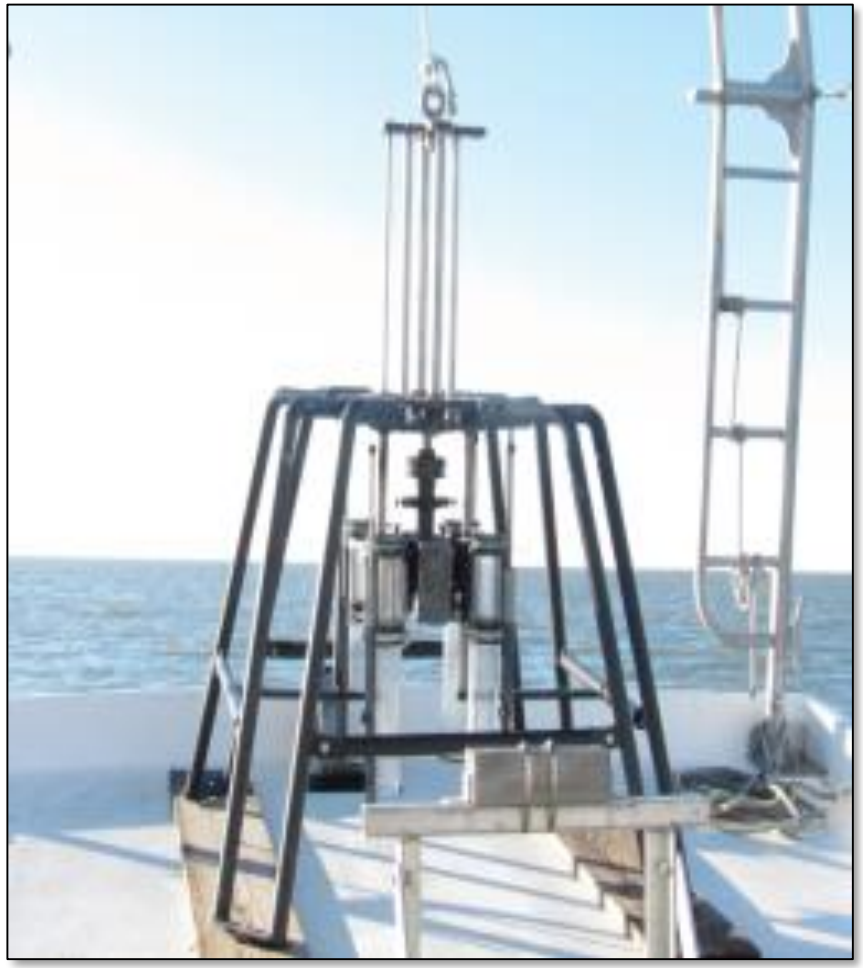
Mississippi River Delta.org

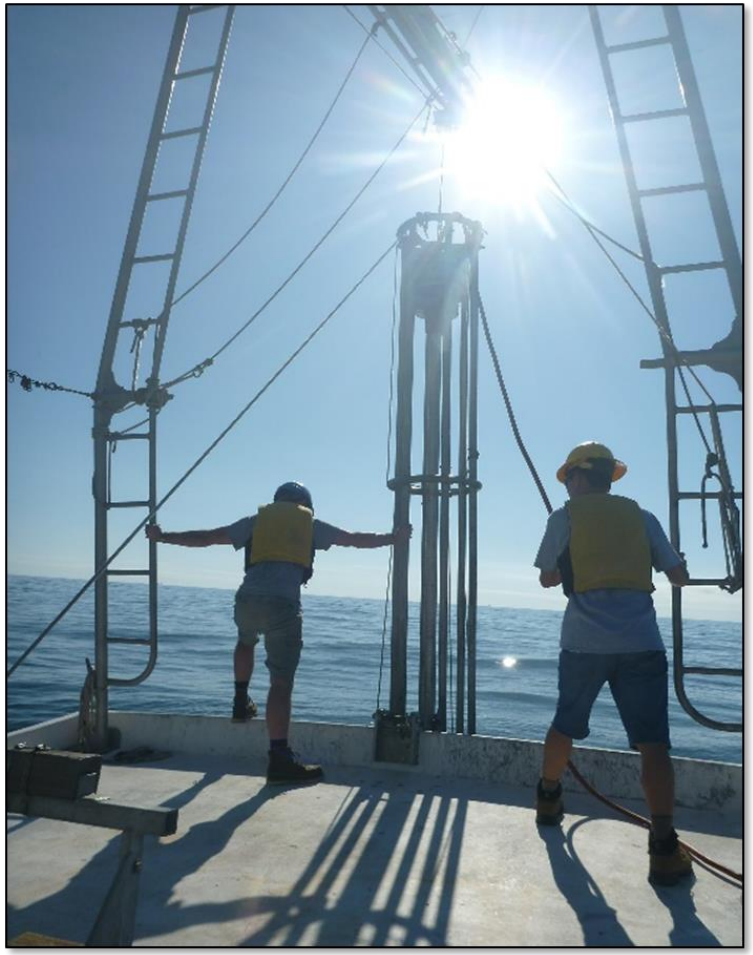
(CEC 2015, 2017)

Summary

- Efficient sediment traps.
- Pit walls are relatively stable, < 10s m horizontal migration of walls.
- Cohesive overburden prevents widespread pit wall collapse and helps preserve the localized pit morphology
- Pits in sand shoal has more gentle slopes on pit walls

Field work and method





- Multicoring (to 50 cm depth) is used for stratigraphic and grain size analysis and calculation of sedimentation rates using Beryllium-7 (7Be). Sub-samples of 2cm interval were dried, ground up, weighed, sealed into petri dishes and analyzed by Canberra LEGe or BEGe gamma ray detectors. Activities at 477 keV were recorded and plotted to depth.

- Vibracoring allows for up to 3-5m penetration using an electric motor. Cores will be used for sedimentary analysis across the region. 10 vibracores were retrieved from 7 locations to be processed for density and sonic logging, stratigraphy, and grain size.

Field work and method

(a) Illustrations of the bow-mounted Edgetech 4600 swath system owned by LSU-CSI on the R/V Coastal Profiler. (b) The Edgetech DSS 2000 system: Combined Sidescan
Sonar & Sub-bottom Profiler (from www.edgetech.com).(c) The Edgetech DSS 512 system. (d) Laser grain size analyser.