Does the intertidal oyster reef optimal growth zone (OGZ) vary among tidal regimes?

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RAMCS – Coastal Resilience

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UNC Institute of Marine Sciences

Why should we care about oyster reef growth?

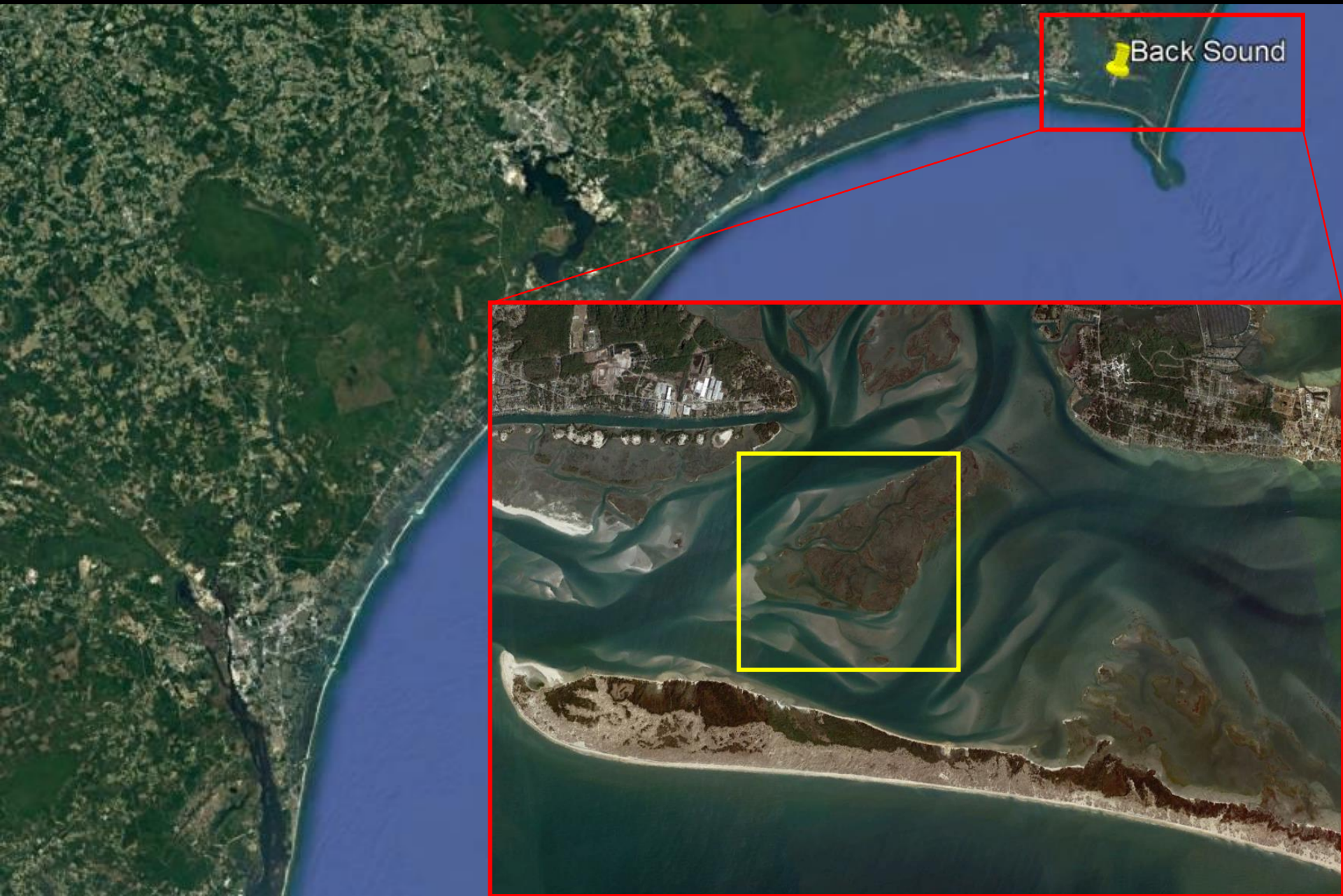
- Water filtration
- Wave attenuation
- Structured habitat utilized by commercially and recreationally important fish species
- Important and growing fishery for North Carolina
- Shown high growth capacity compared to other coastal habitats

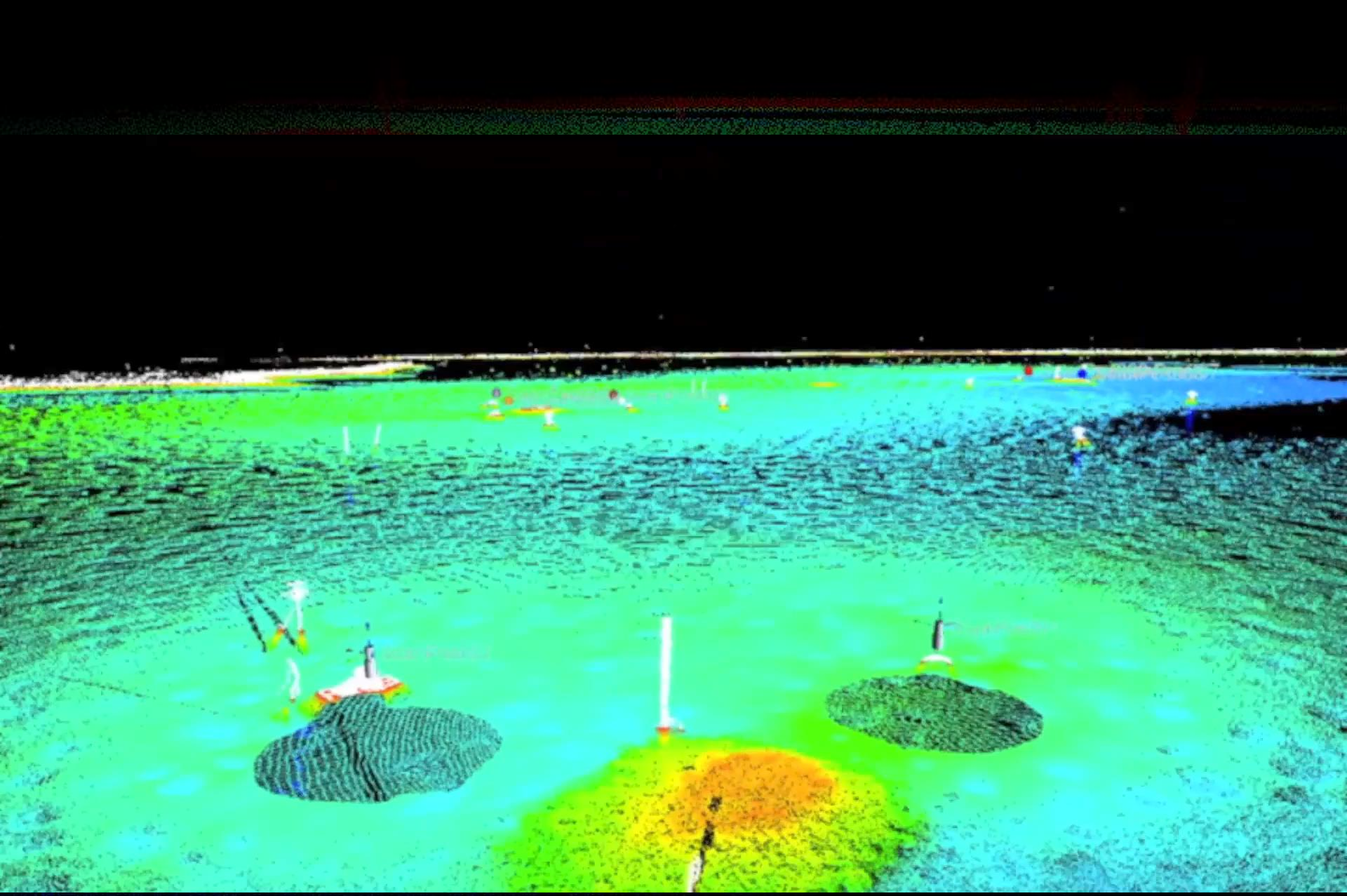
The University of Chicago Marine Biological Laboratory

Coastal Review Online

Grabowski *et al 2012;* Rodriguez *et al*. 2014

Previous work on constructed reefs





Video by J. Ridge

Measuring reef growth

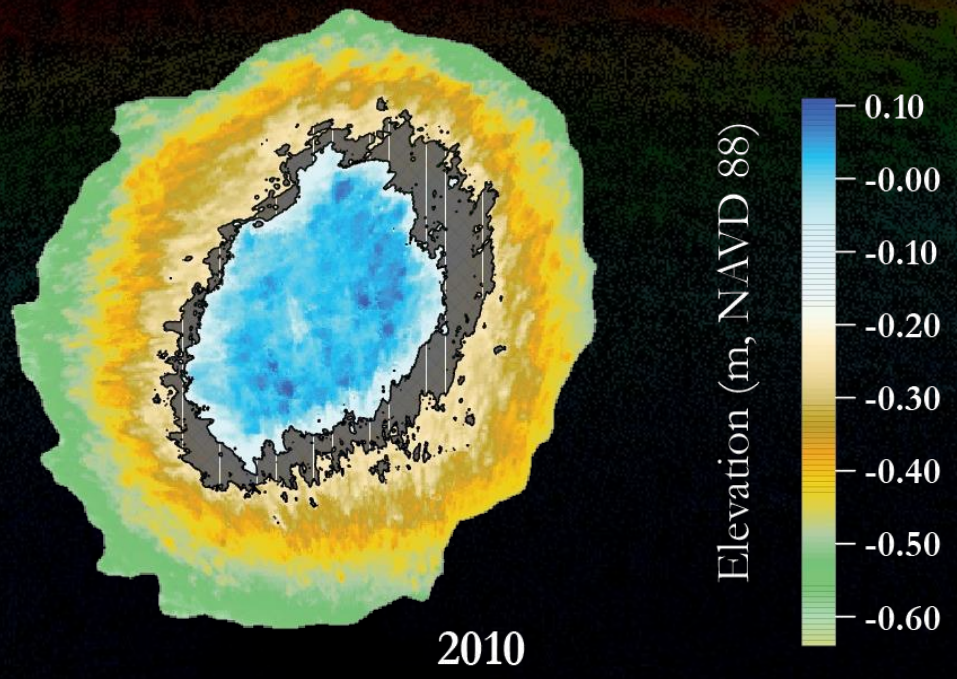


Photo and DEM by J. Ridge

Measuring reef growth

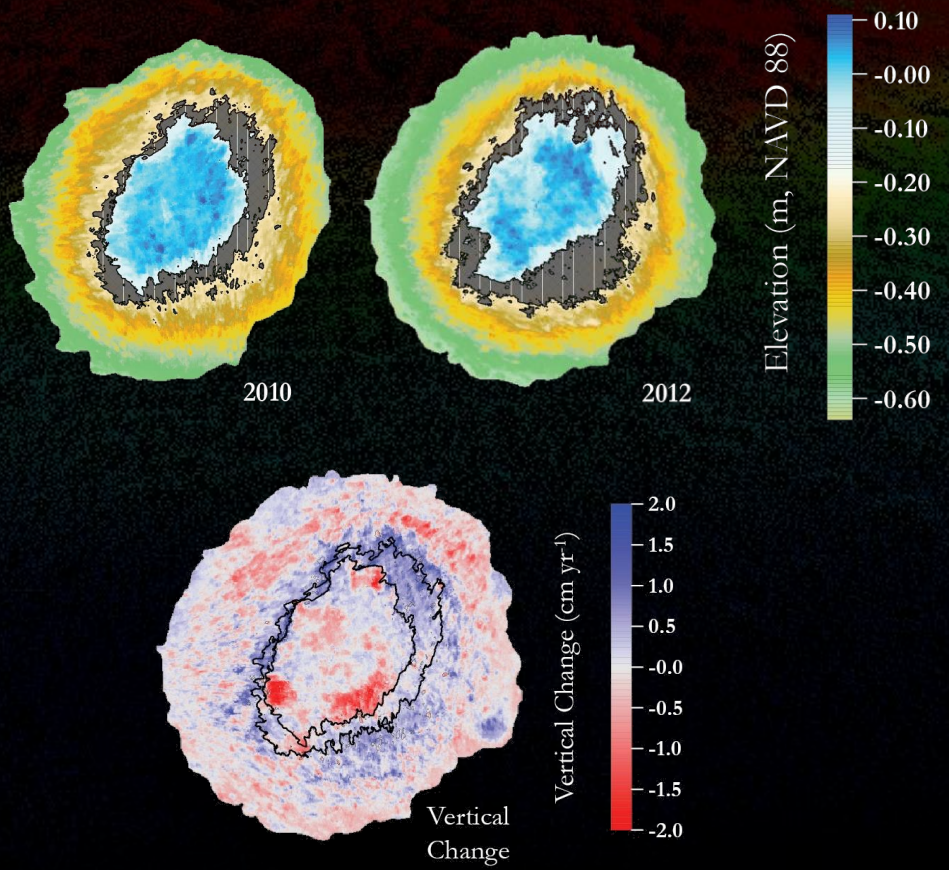
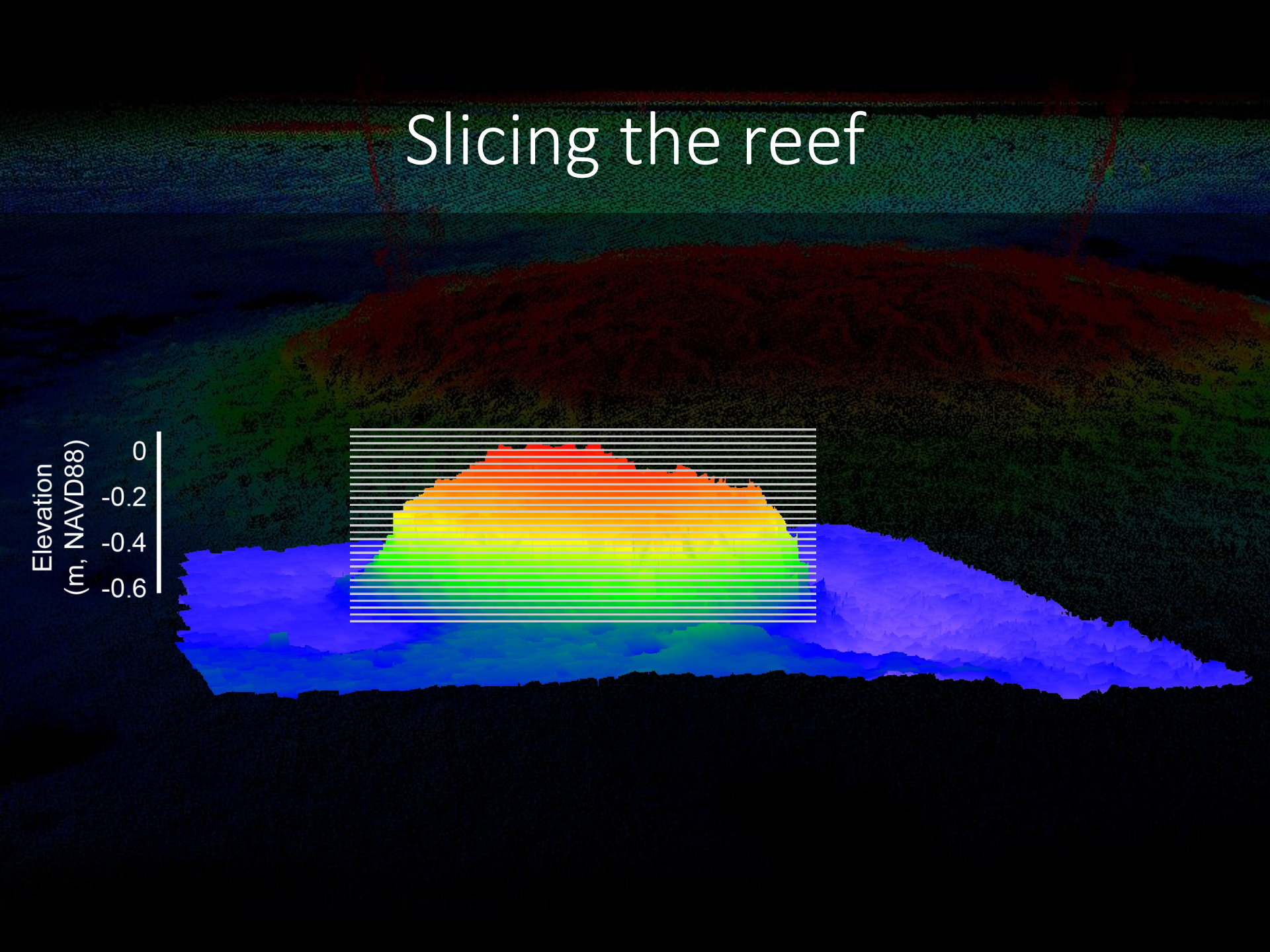
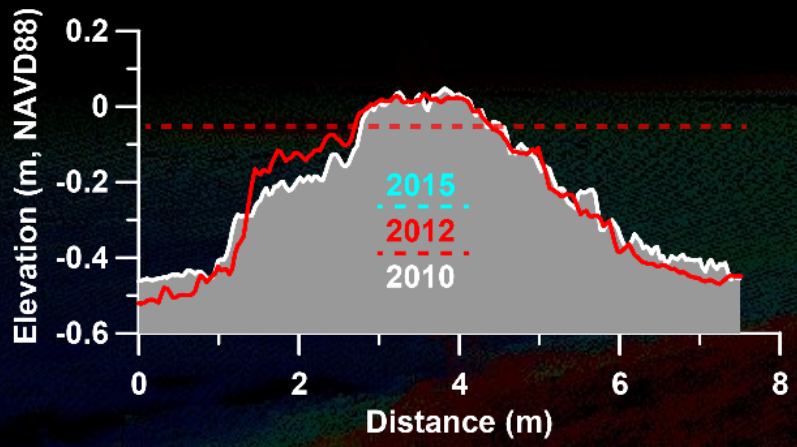


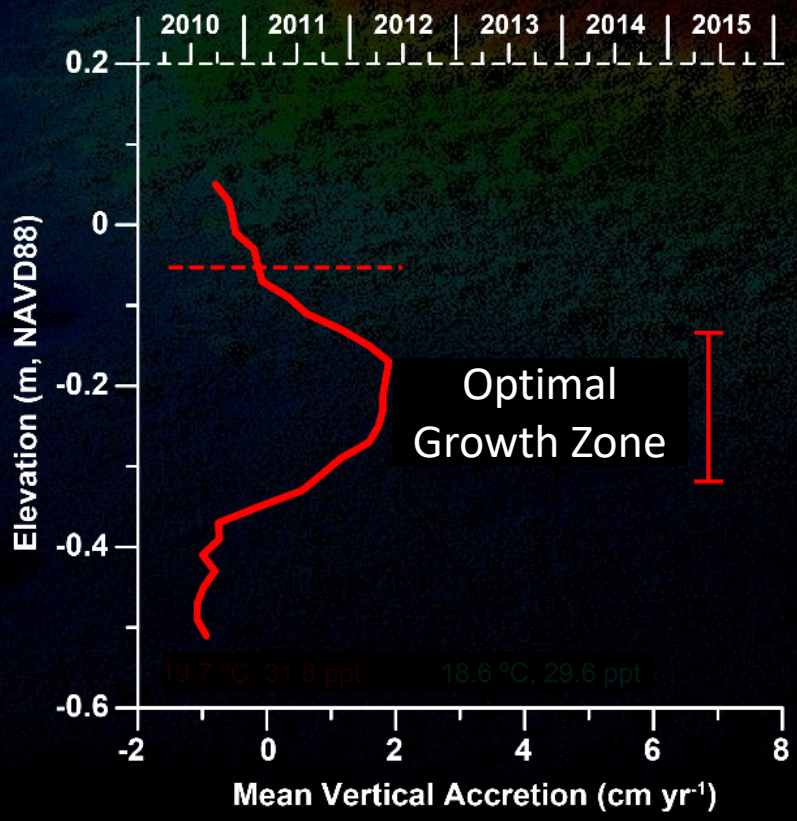
Photo and DEM by J. Ridge

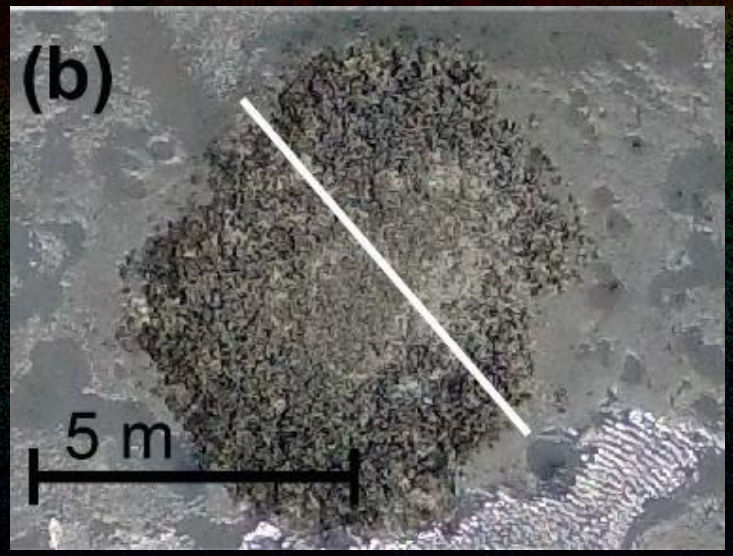
Slicing the reef



Deriving Growth Curves

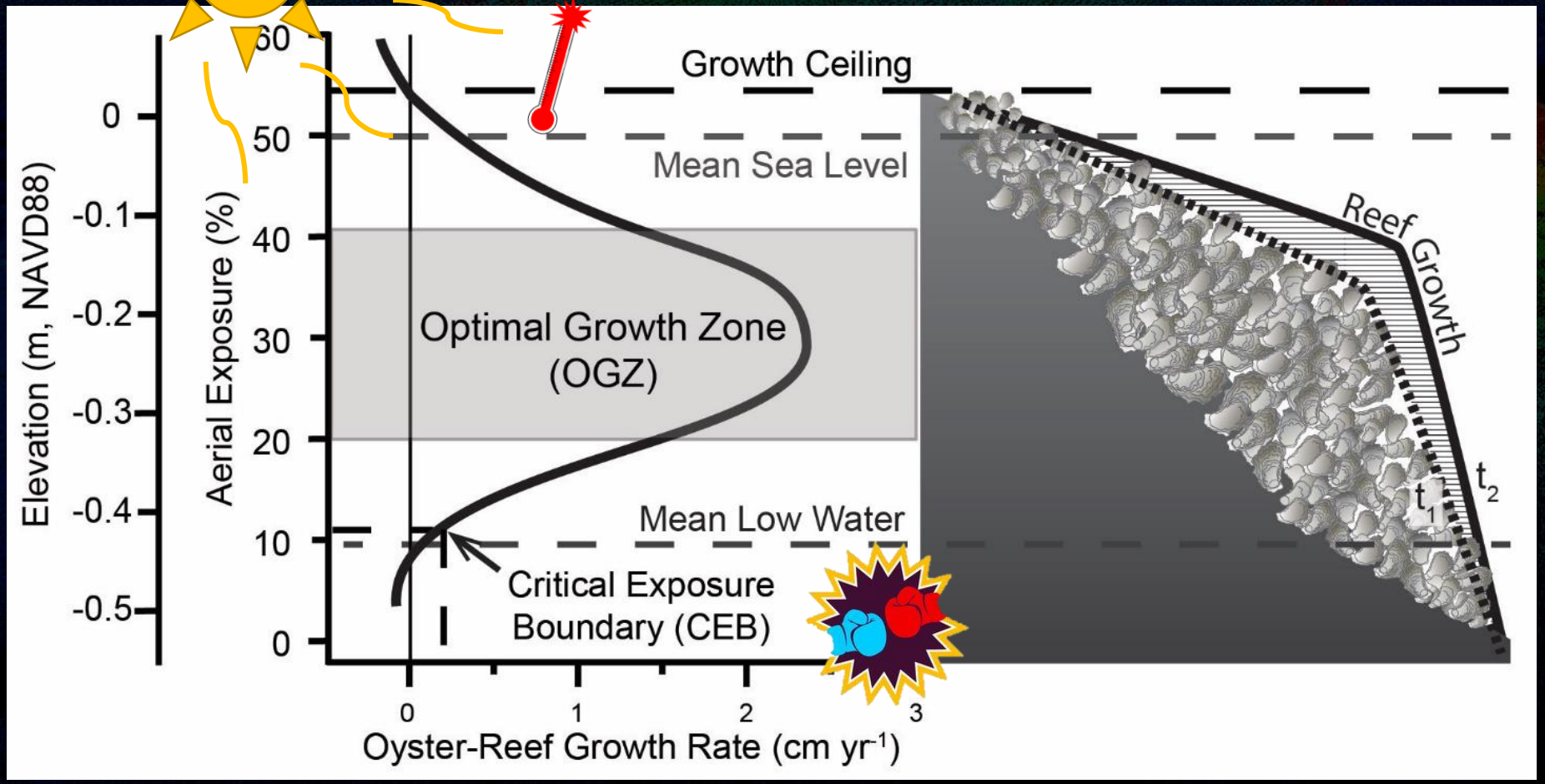






Ridge et al. 2017, *Ecology and Evolution*

Oyster Reef Growth

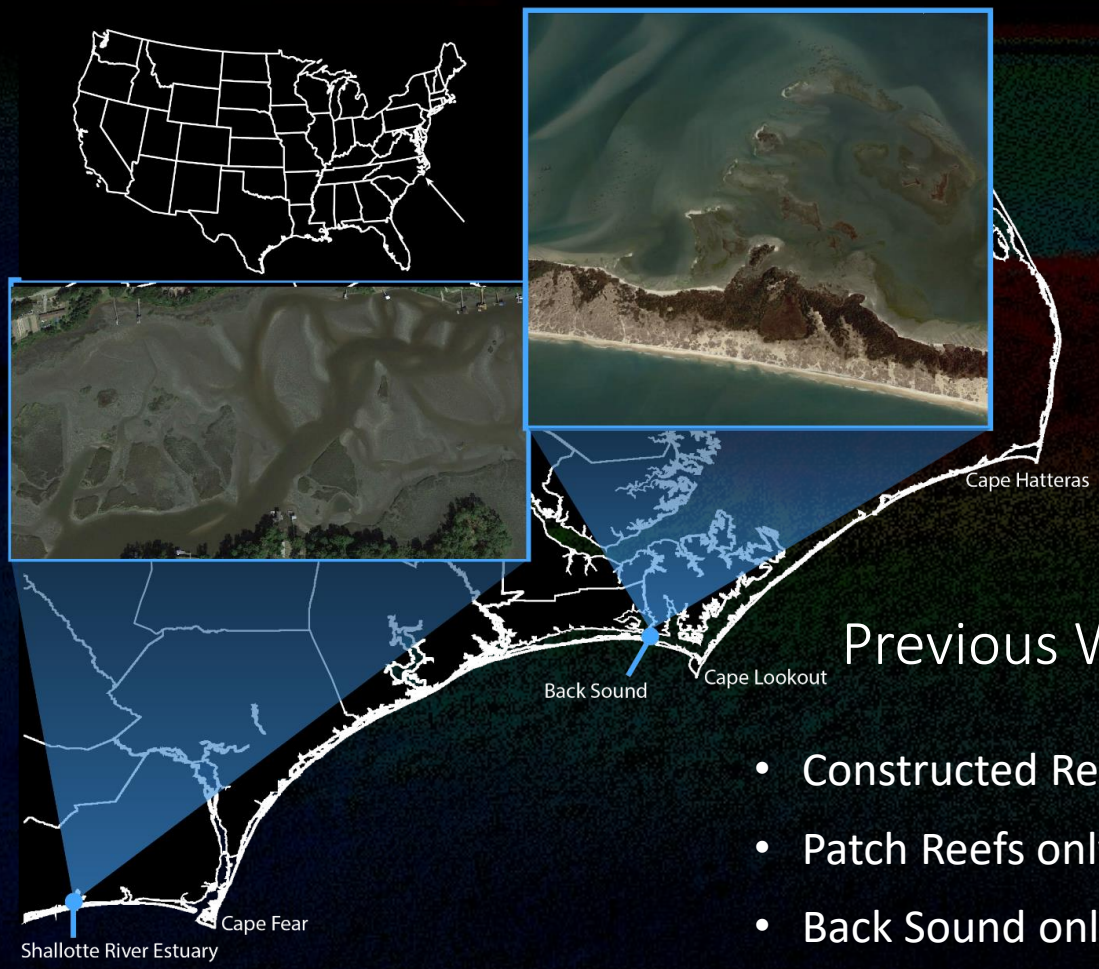


Ridge et al. 2015, *Scientific Reports*

Research Questions:

The Optimal Growth Zone (OGZ) was derived from elevations of highest mean growth on constructed reefs

- Do elevations of the OGZ from constructed reefs compare to those of natural reefs in Back Sound?
- How does the OGZ vary among tidal ranges?



Previous Work vs. This Study

- Constructed Reefs
- Patch Reefs only
- Back Sound only

- Natural Reefs
- Patch AND Fringing Reefs
- Compare two tidal ranges:
  - Back Sound (0.71m)
  - Shallotte (1.4m)

Back Sound Natural Reefs

Back Sound Natural Reef locations

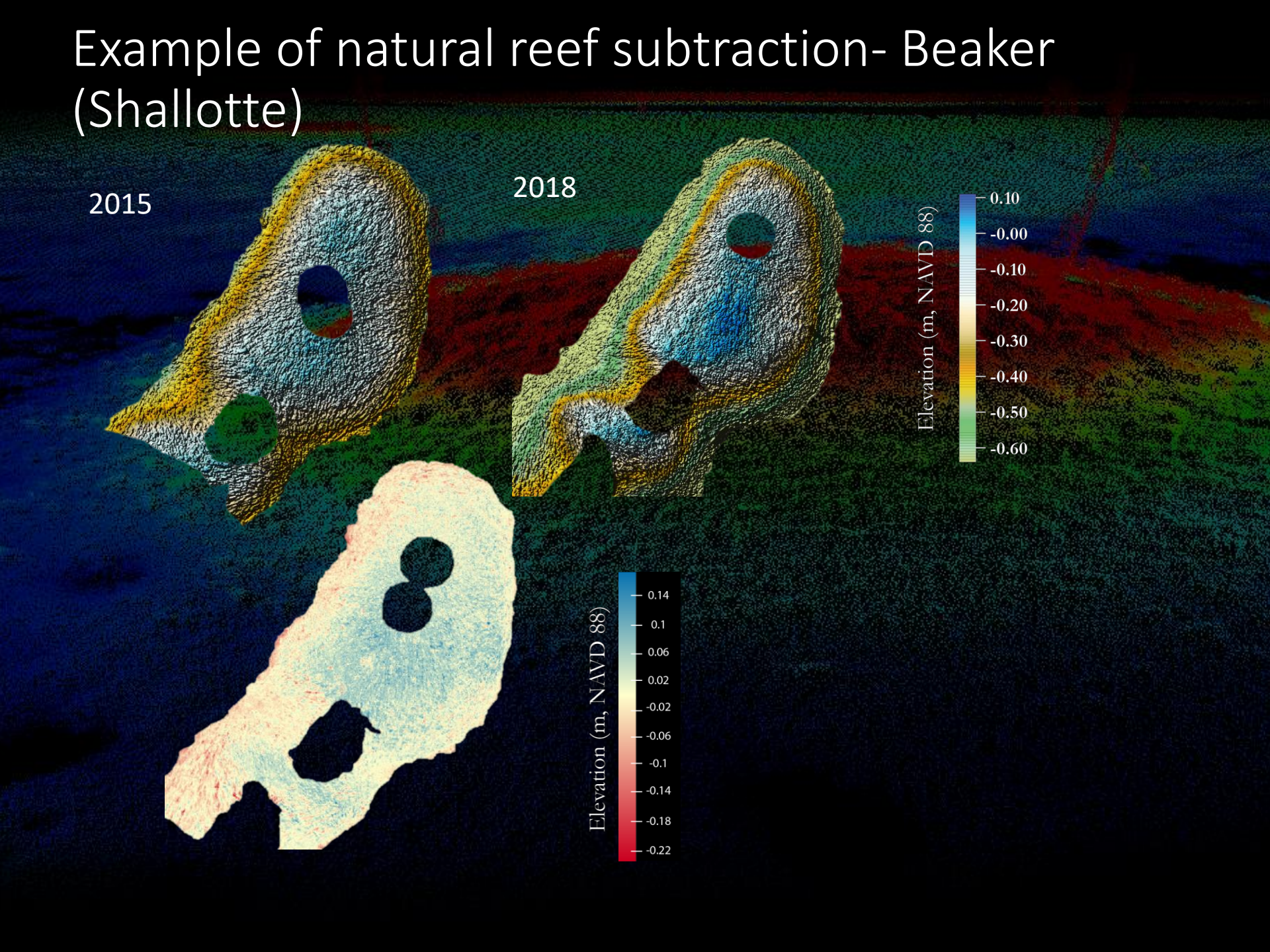
Shallotte Natural Reef locations

Methods

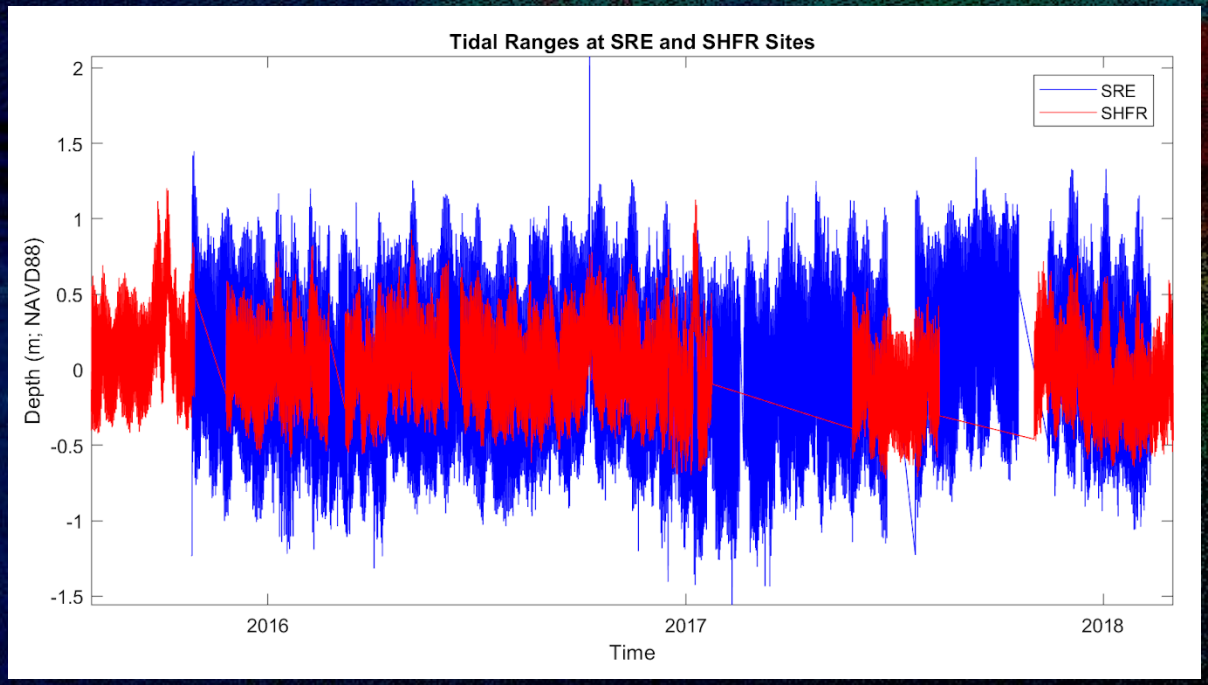
Same methods as previous study:

- Scan each reef twice with the TLS
- Create DEMs from cleaned TLS data
- Subtract DEMs to get change maps
- Use change maps to create growth curves

Example of natural reef subtraction- Beaker (Shallotte)

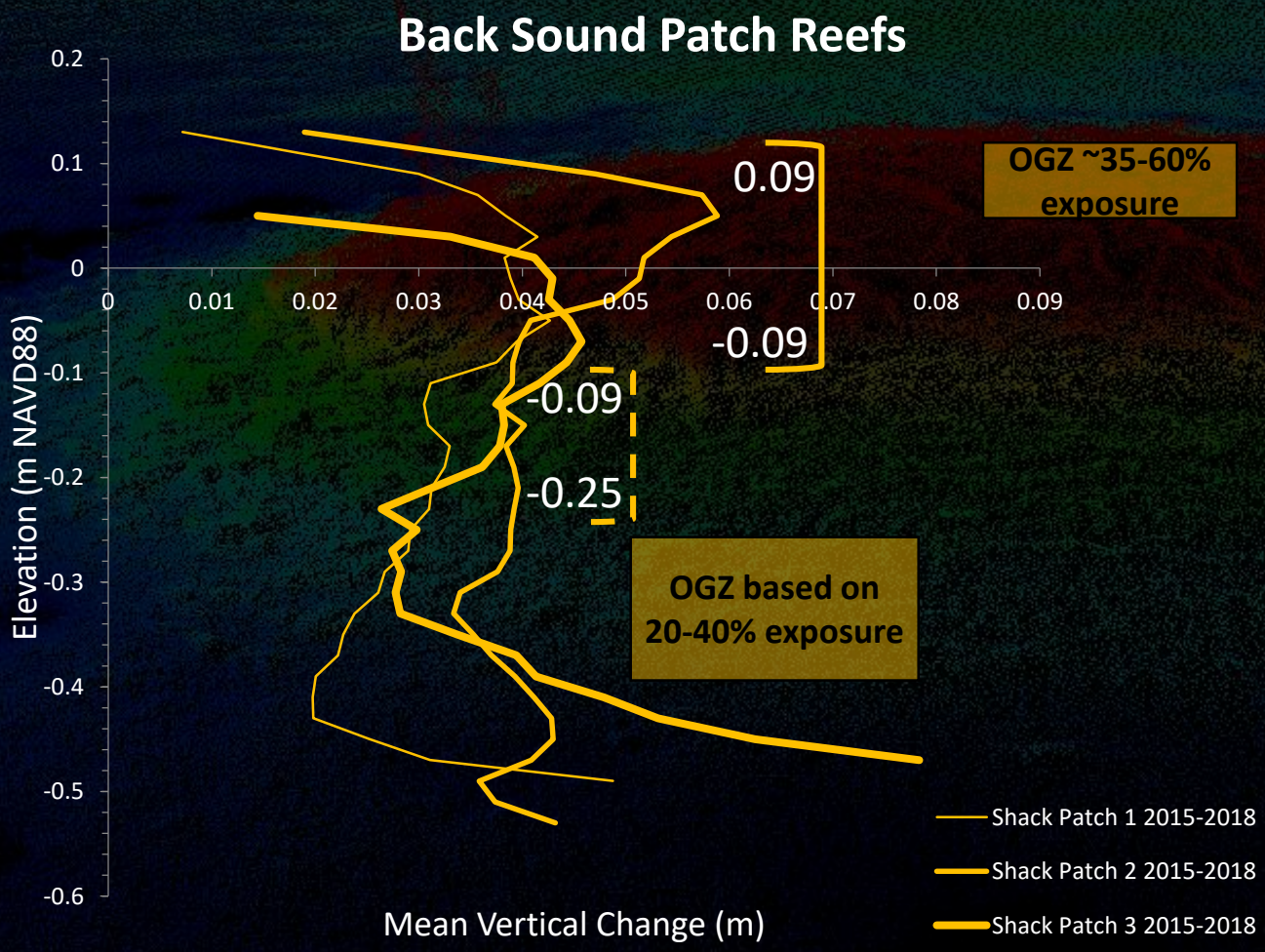


Water level data

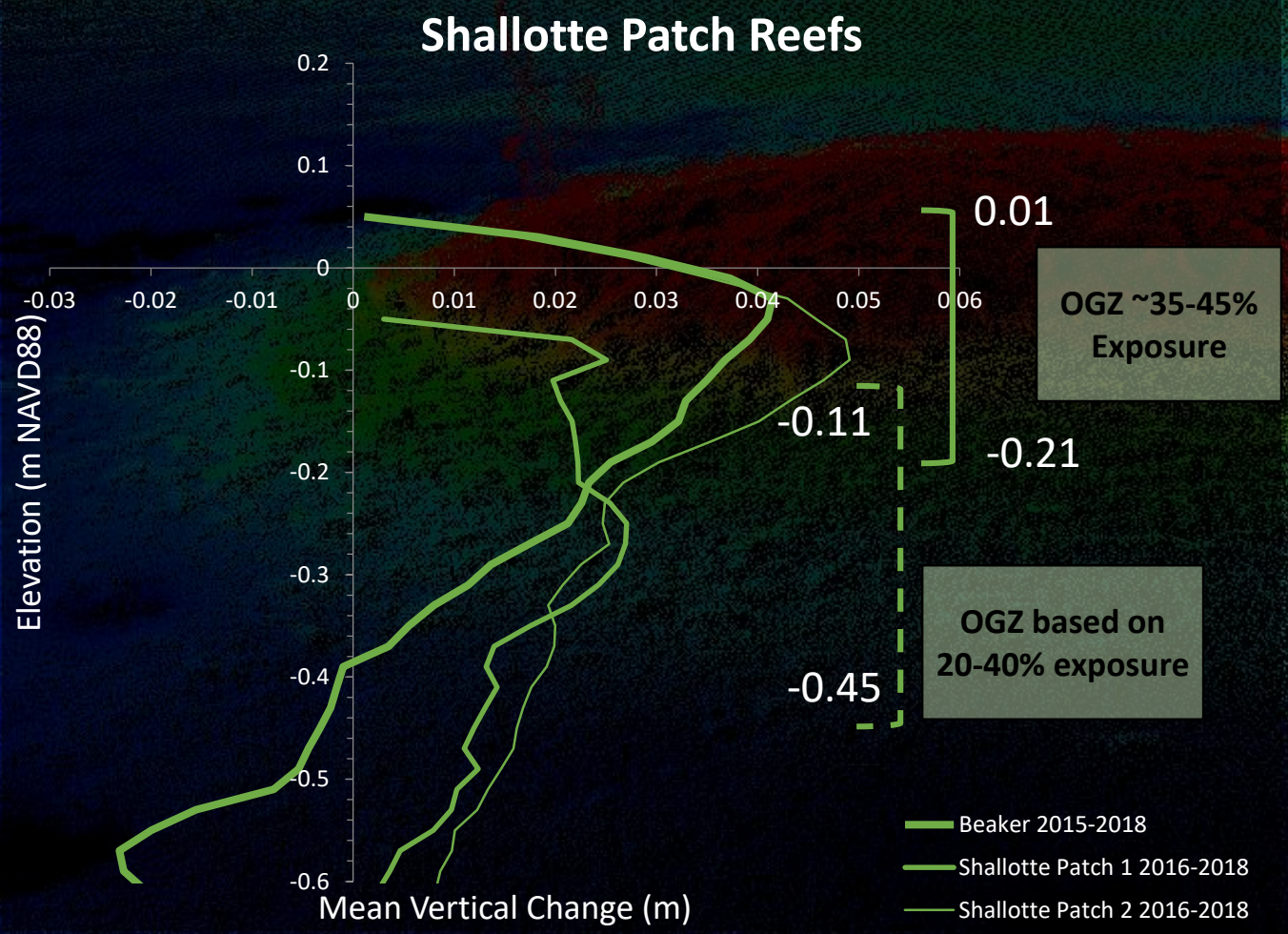


- Found local tidal amplitudes
  - Back Sound (0.71m)
  - Shallotte (1.4m)
- Found % Aerial Exposure for each elevation bin

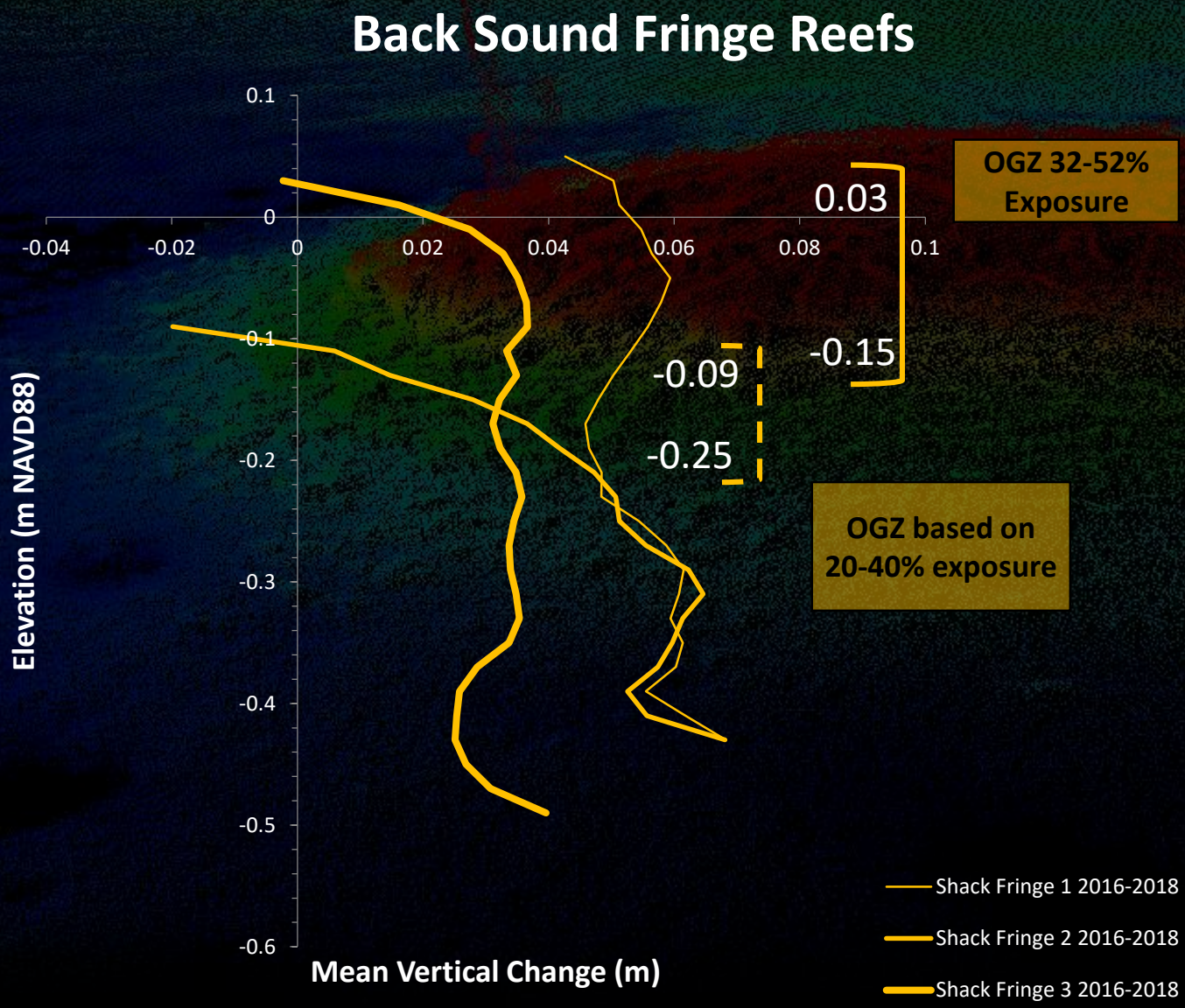
Results


Back Sound Patch Reefs
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
Elevation (m NAVD88)
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.09
-0.09
-0.09
-0.25
OGZ ~35-60% exposure
OGZ based on 20-40% exposure
Mean Vertical Change (m)
Shack Patch 1 2015-2018
Shack Patch 2 2015-2018
Shack Patch 3 2015-2018

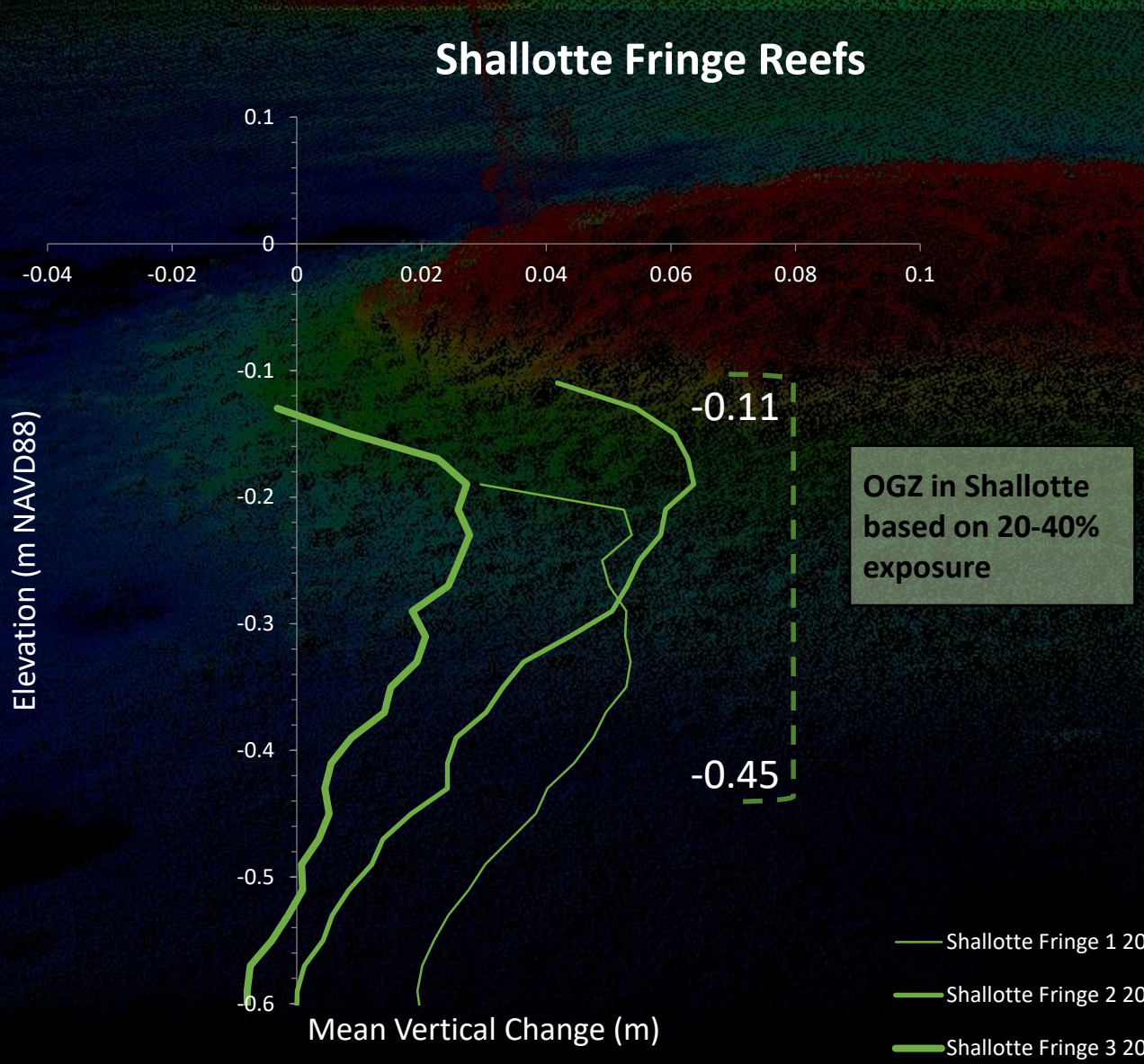
Results


Shallotte Patch Reefs
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.03
-0.02
-0.01
0
0.01
0.02
0.03
0.04
0.05
0.06
Elevation (m NAVD88)
Mean Vertical Change (m)
0.01
-0.11
-0.21
-0.45
OGZ ~35-45% Exposure
OGZ based on 20-40% exposure
Beaker 2015-2018
Shallotte Patch 1 2016-2018
Shallotte Patch 2 2016-2018

Results


Back Sound Fringe Reefs
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.04
-0.02
0
0.02
0.04
0.06
0.08
0.1
Elevation (m NAVD88)
Mean Vertical Change (m)
0.03
-0.15
-0.09
-0.25
OGZ 32-52% Exposure
OGZ based on 20-40% exposure
Shack Fringe 1 2016-2018
Shack Fringe 2 2016-2018
Shack Fringe 3 2016-2018

Results


Shallotte Fringe Reefs
0.1
0
-0.04
-0.02
0
0.02
0.04
0.06
0.08
0.1
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
Elevation (m NAVD88)
Mean Vertical Change (m)
-0.11
-0.45
OGZ in Shallotte based on 20-40% exposure
Shallotte Fringe 1 2016-2018
Shallotte Fringe 2 2016-2018
Shallotte Fringe 3 2016-2018

Going back to research questions

- Do elevations of the OGZ from constructed reefs compare to those of natural reefs in Back Sound?
  - The OGZ on natural reefs occurred higher in the tidal frame but across a smaller range of elevations as compared to constructed reefs
- How does the OGZ vary among tidal ranges?
  - The OGZ in larger tidal range span larger range of elevations

Management Implications

There is no one project design that maximizes restored oyster-reef growth rates everywhere.

Need to consider:

Reef Morphology- Patch or Fringing

Tidal Range

Elevation in tidal frame

Age of reefs and reef area may play a roll

Acknowledgements

- Funding- NC DEQ CRFL
- Justin Ridge
- Rodriguez lab past and present

NORTH CAROLINA
Environmental Quality

NC COASTAL RECREATIONAL FISHING LICENSE


Questions?

References

- Grabowski *et al* (2012).Ecosystem Services Provided by Oyster Reefs, *BioScience, 62,* 10.
- Rodriguez *et al* (2014). Oyster reefs can outpace sea-level rise. *Nature Climate Change, 4,* 493-497.
- Ridge *et al* (2017). Evidence of exceptional oyster-reef resilience to fluctuations in sea level. Ecology and Evolution, 10409-10420.
- Ridge *et al* (2015). Maximizing oyster-reef growth supports green infrastructure with accelerating sea-level rise. *Scientific Reports, 5,* 14785

Growth Rates

Reef Name	Accretion rate mm/yr
Beaker	4.07
Shall Patch 1	6.26
Shall Patch 2	9.62
Shall Fringe 1	10.55
Shall Fringe 2	7.96
Shall Fringe 3	1.37
Shack Patch 1	9.61
Shack Patch 2	13.85
Shack Patch 3	13.22
Shack Fringe 1	23.43
Shack Fringe 2	18.83
Shack Fringe 3	15.52