

CENTURY-SCALE (1886 – 2018) BLUFF EROSION: BLOCK ISLAND, RHODE ISLAND, USA



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2022 NEGSA ANNUAL MEETING: T13. Current
Research in Coastal and Marine Processes

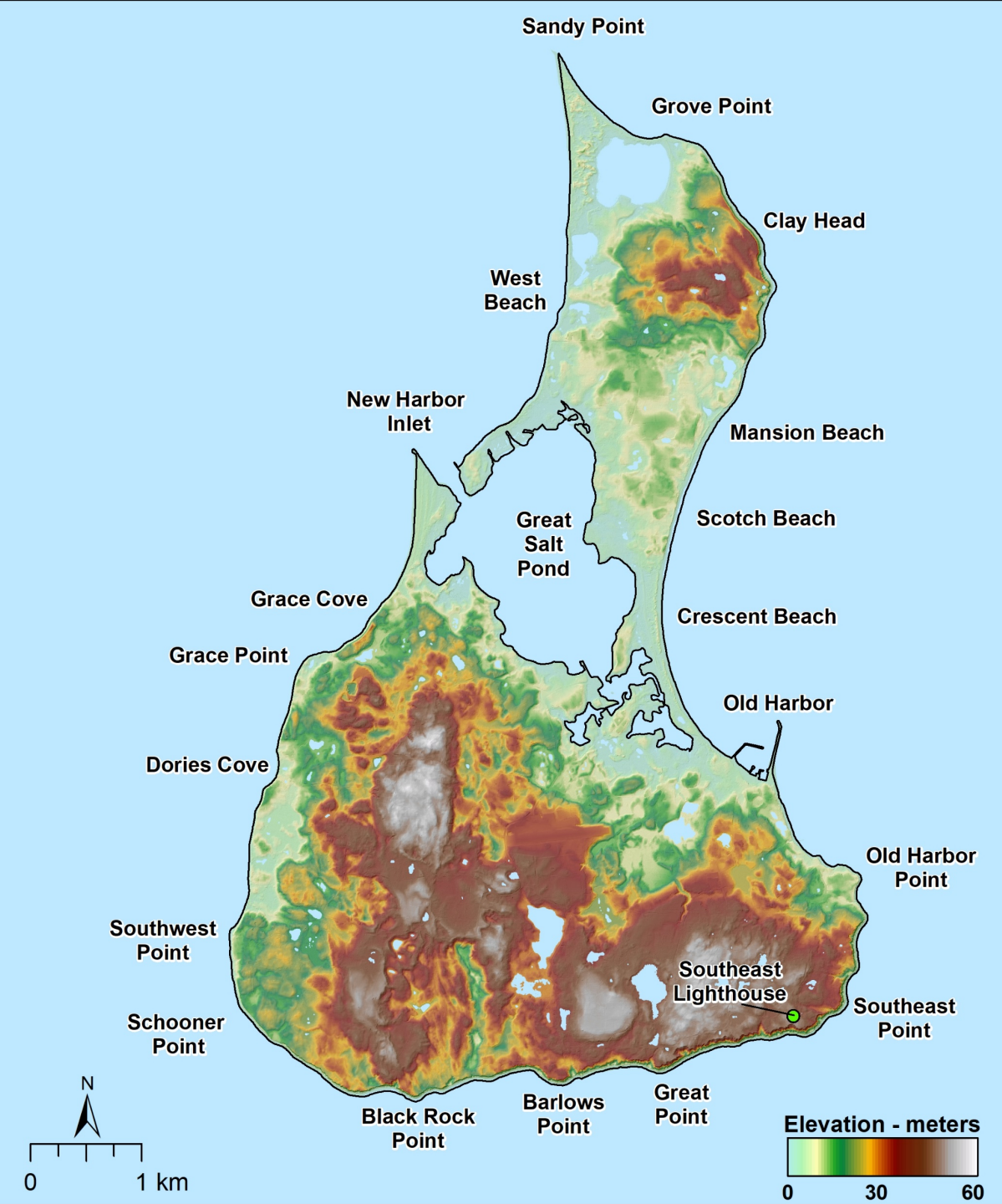
Block Island, Rhode Island

'Sail away on the Block Island Ferry'



Block Island, Rhode Island

- 25 km² Island located 15 km south of mainland RI
- Bluffs vary in height from <2.5 m to > 50 m in relief
- Two segments of moraine connected by barrier spits (complicated stratigraphy)
- Microtidal (<1 m) wave-dominated shoreline



Stratigraphy of a tectonic end moraine Block Island (Mohegan Bluffs)

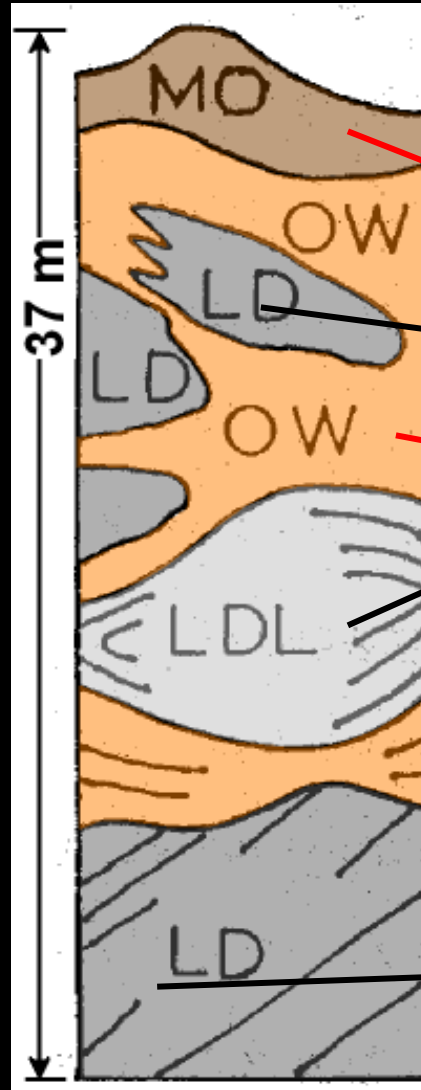
MO = Meltout Till

OW = Outwash (tectonized
w/ older till (LD)
incorporated)

LDL = Older Lakefloor
deposits (varves)
(tectonized)

LD = Older till – in place??

Older “Lower Drift” - (Early
Wisconsinan? Illinoian?)



Sirkin, 1996

Boothroyd and Sirkin, 2002

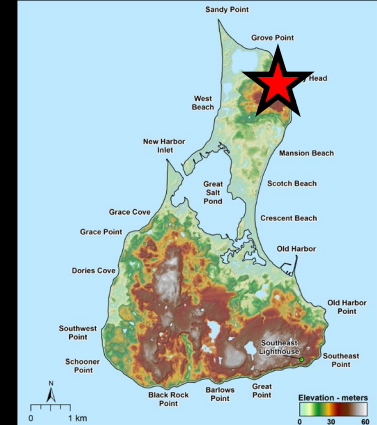
Stratigraphy of a tectonic end moraine Block Island (Side view)



Block Island: Post Sandy (June 2013)

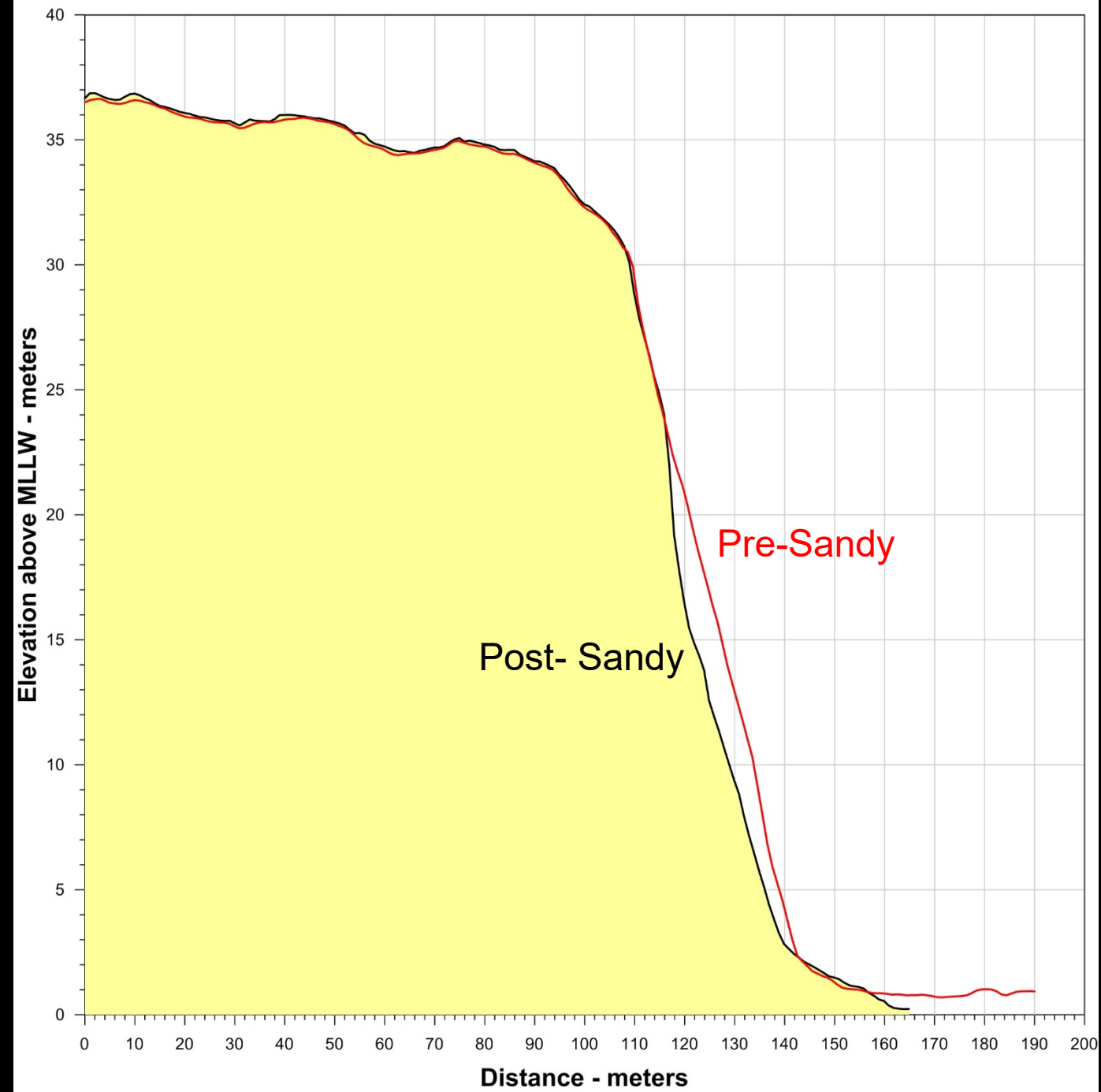


Block Island: Post Sandy (June 2013)



Block Island: Pre and Post Sandy LiDAR

BI - Transect 23



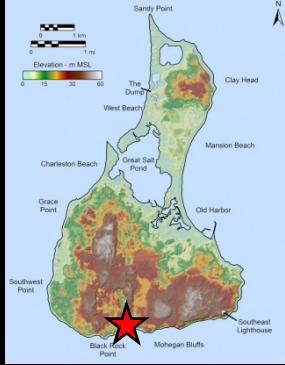
Block Island: June 2015



Drew Hyatt



Block Island: Slump, circa 2000



J. Boothroyd photo; in Kelley (20XX)

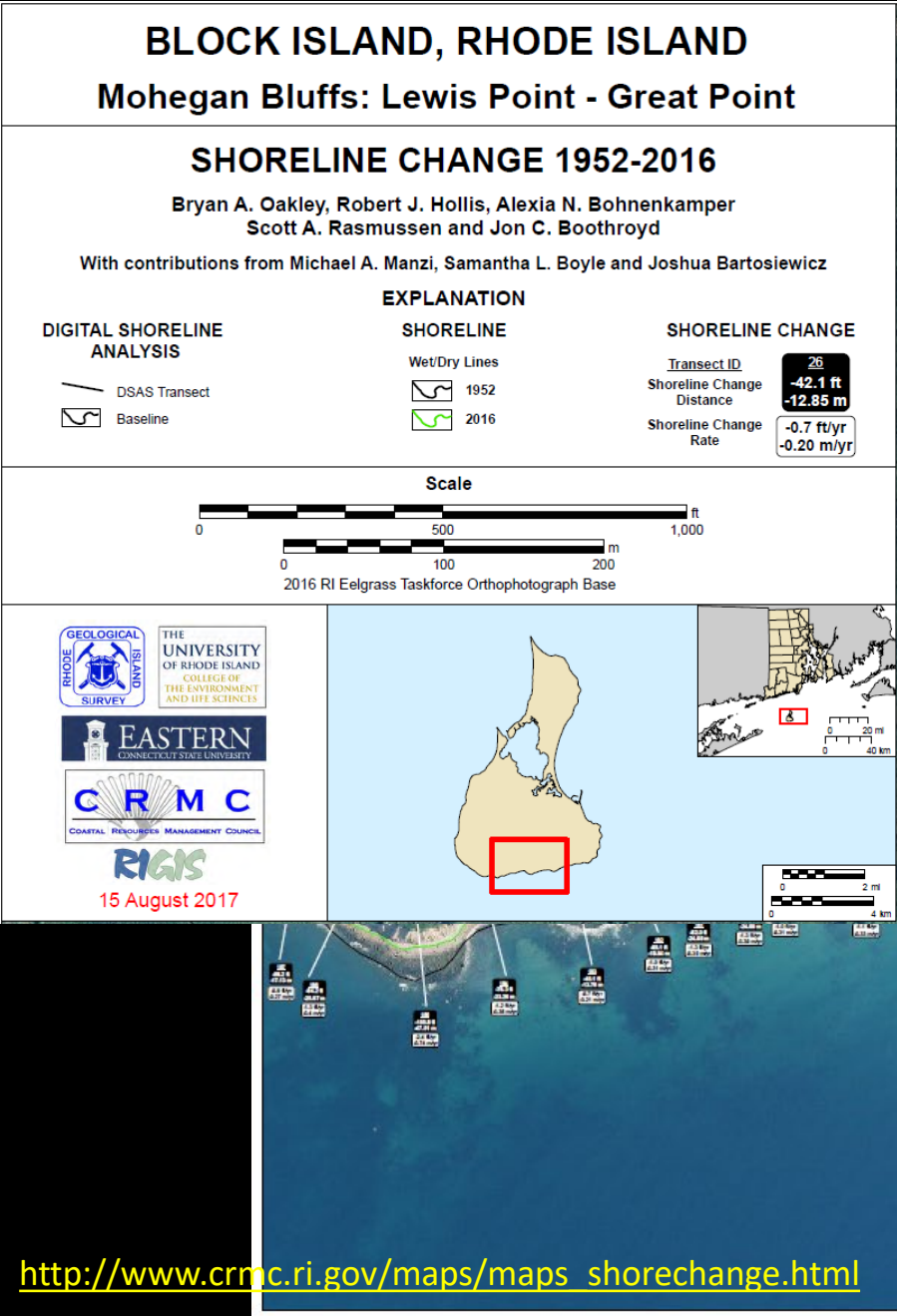
Block Island: Spring 2019 Slump



Block Island: Spring 2019 Slump



Block Island: Shoreline Change Maps



Data and Methods

1886 T-Sheet

- Georeferenced using stonewall intersections
- Uncertainty 2.8 m



Data and Methods: Uncertainty

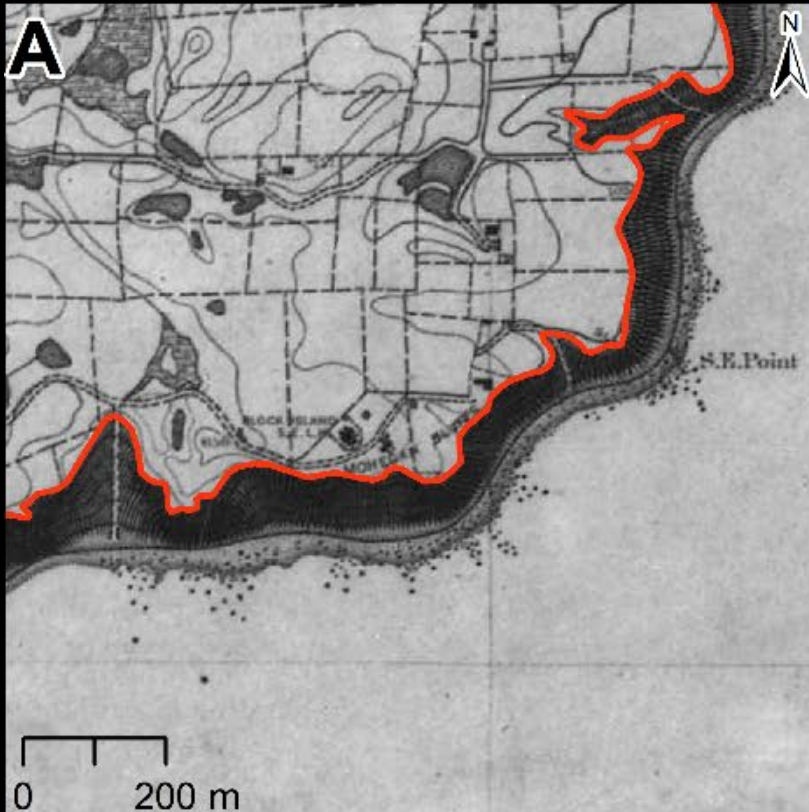
$$E_{sp} = \sqrt{E_g^2 + E_d^2 + E_t^2 + E_l^2}$$

Measurement Uncertainties (meters)	1886 T-Sheet	2018 LiDAR
Georeferencing (E_g)	2.8	N/A
Digitizing (E_d)	1	1
T-sheet survey (E_t)	10	N/A
Lidar position uncertainty (E_l)	N/A	1
Total position uncertainty (E_{sp})	10.4	1.4
Annualized retreat rate uncertainty ($m\ yr^{-1}$)	0.08	

Data and Methods

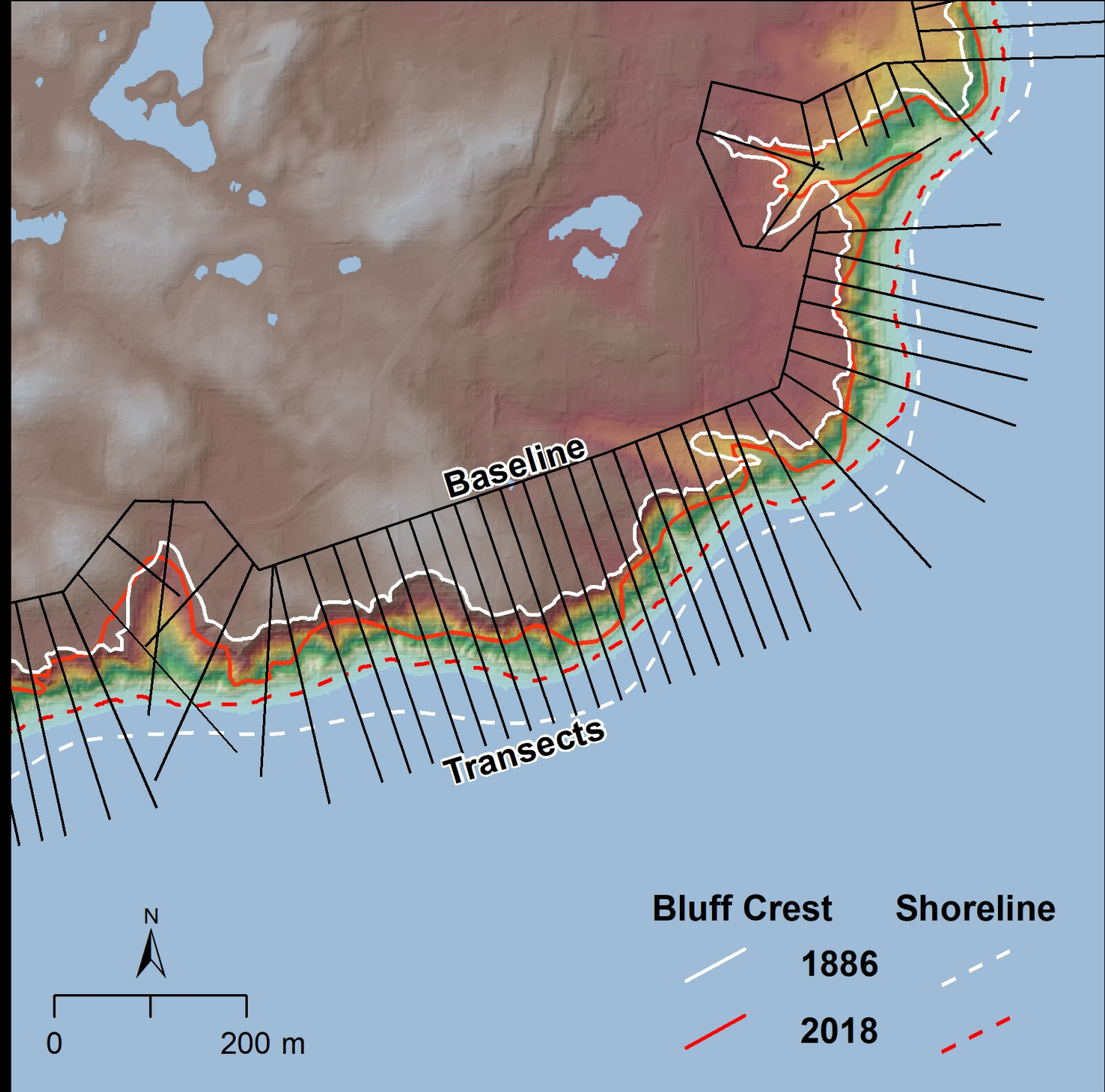
Bluff crest and shoreline digitized
in both 1886 and 2018 LiDAR

1886 T-Sheet



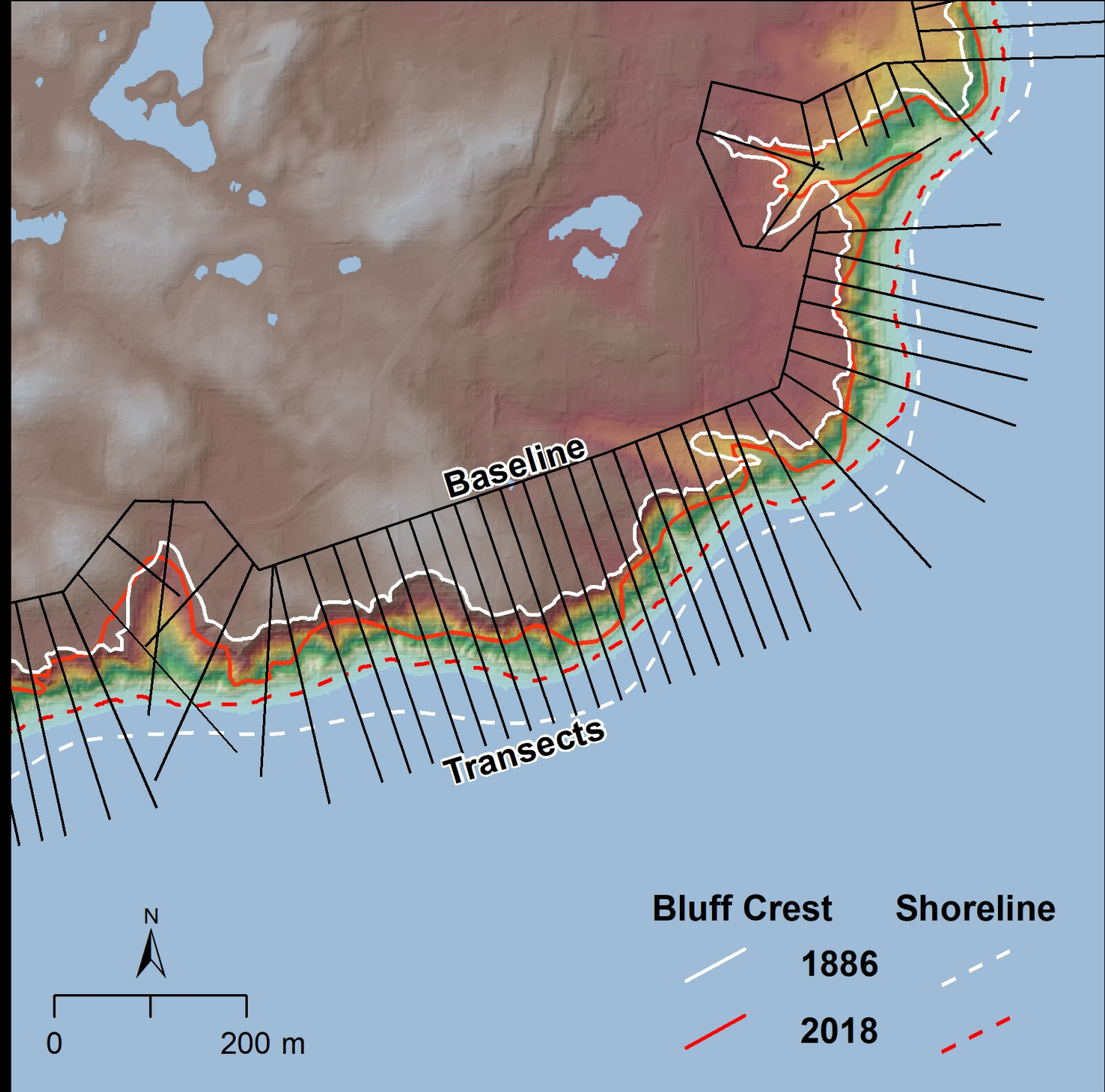
Data and Methods

- Transects Cast at 25 m spacing (n = 630 transects with a bluff)
- Net Shoreline Movement measured 1886 – 2018 for both bluff crest and shoreline

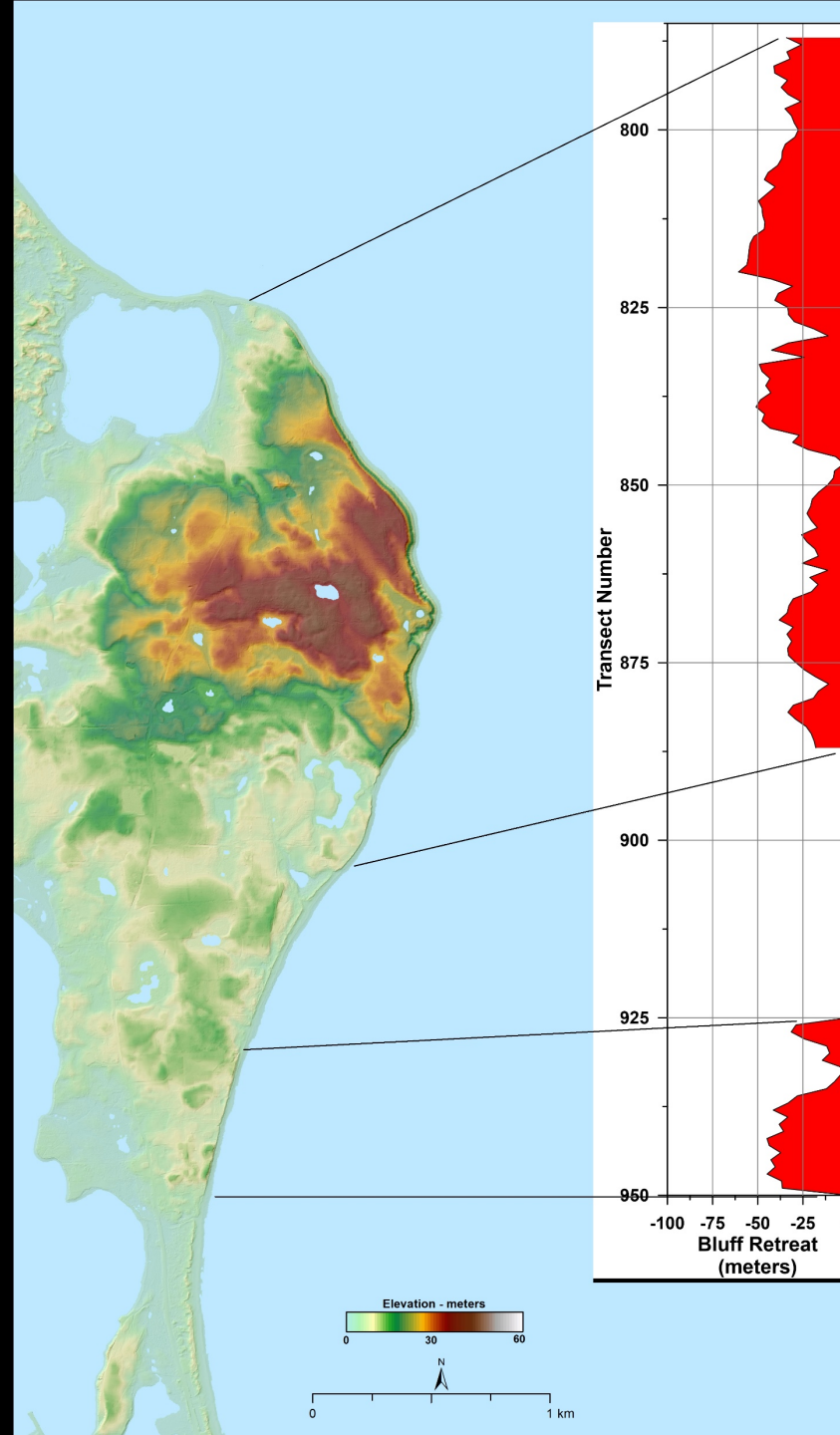
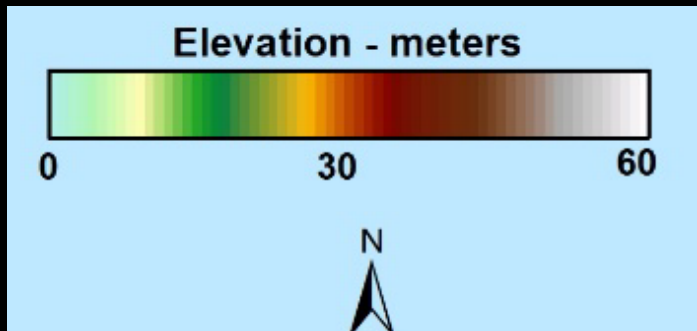


Results

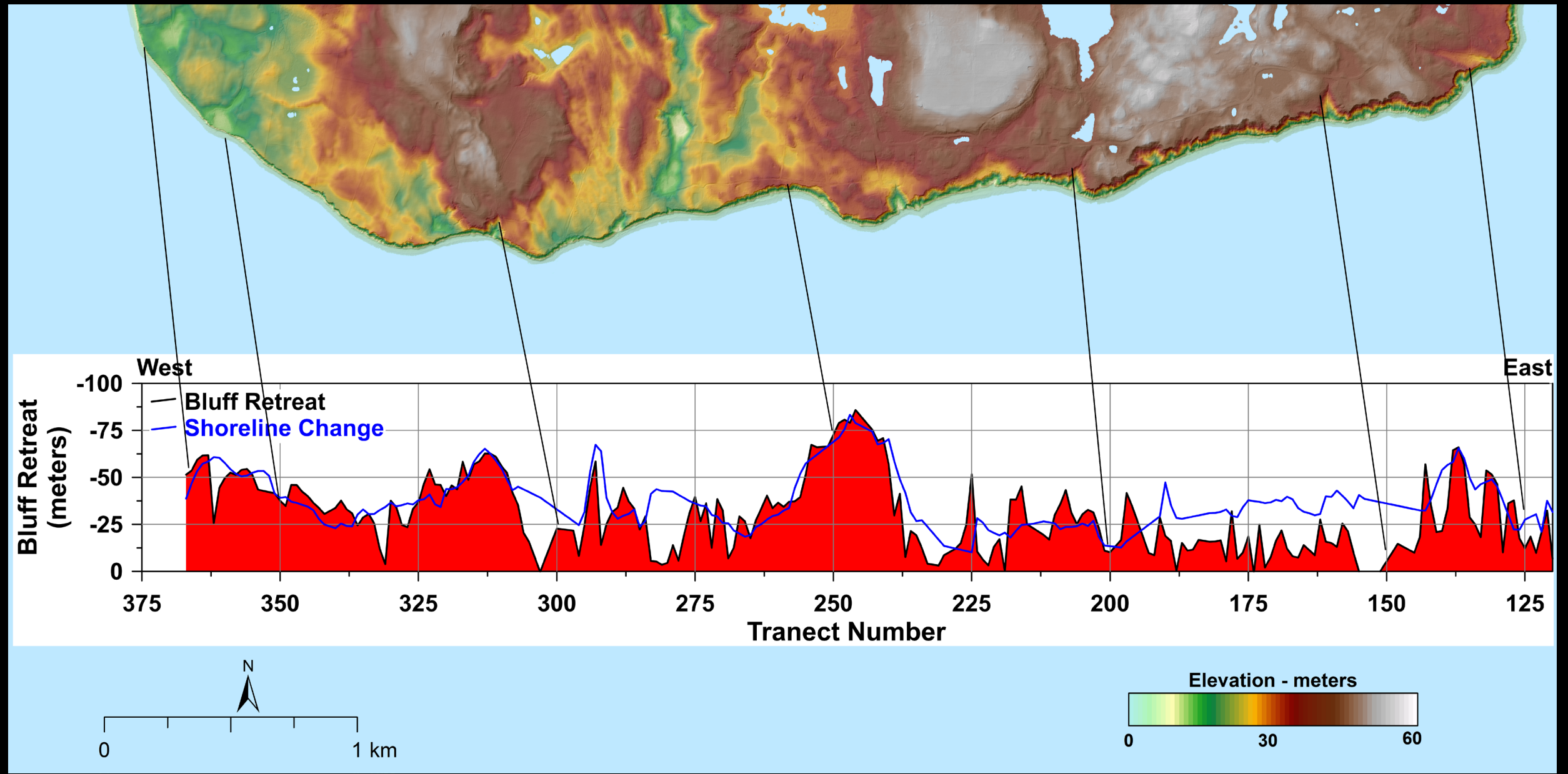
- 1.2% of Transects showed 'accretion' ($n = 8$) along gullies
- 86% of transects ($n = 545$) exceeded the positional uncertainty
- Mean retreat 28 m;
maximum retreat 98 m



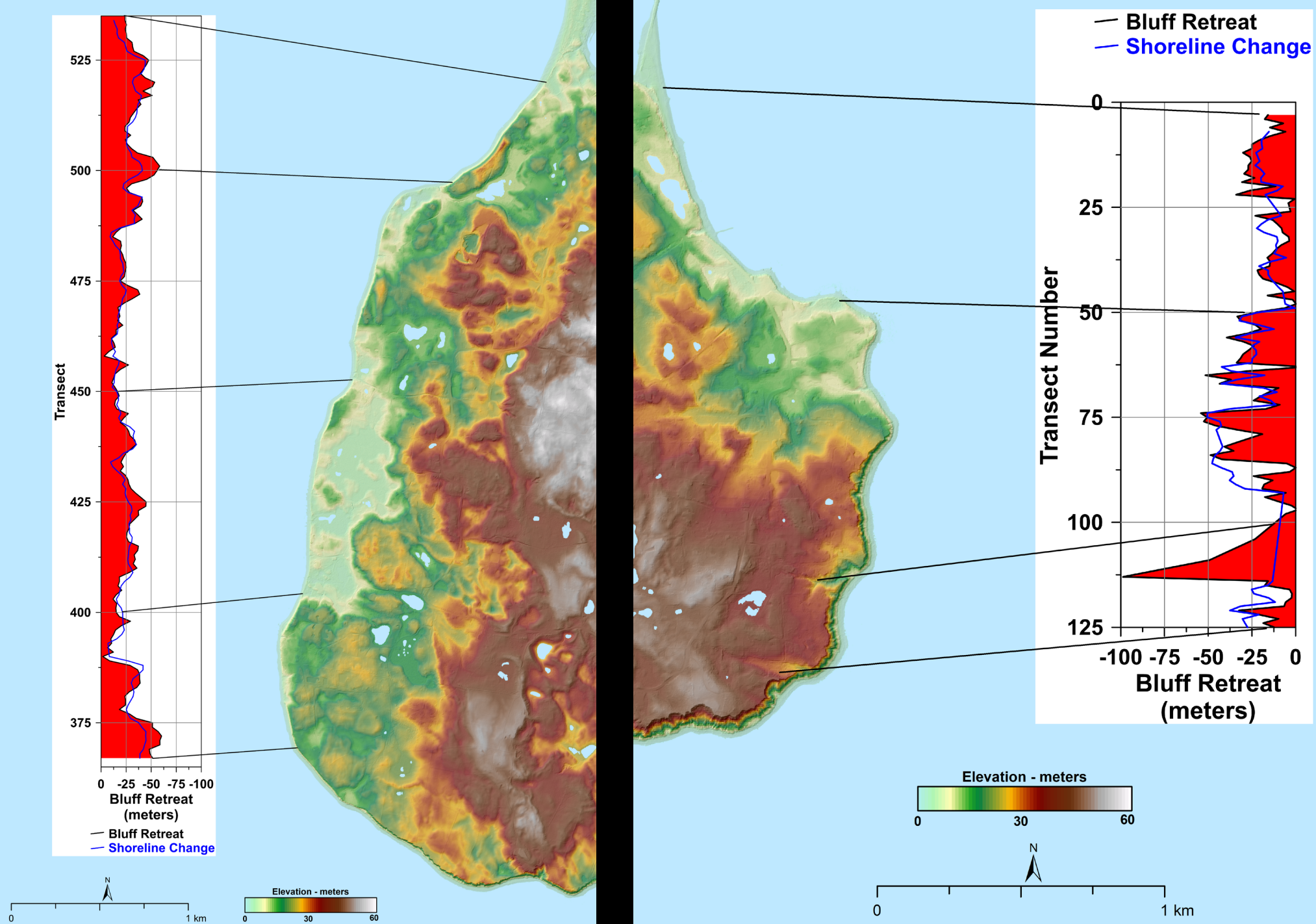
Results: Clay Head (Northeast shoreline)



Results: Southern Shoreline



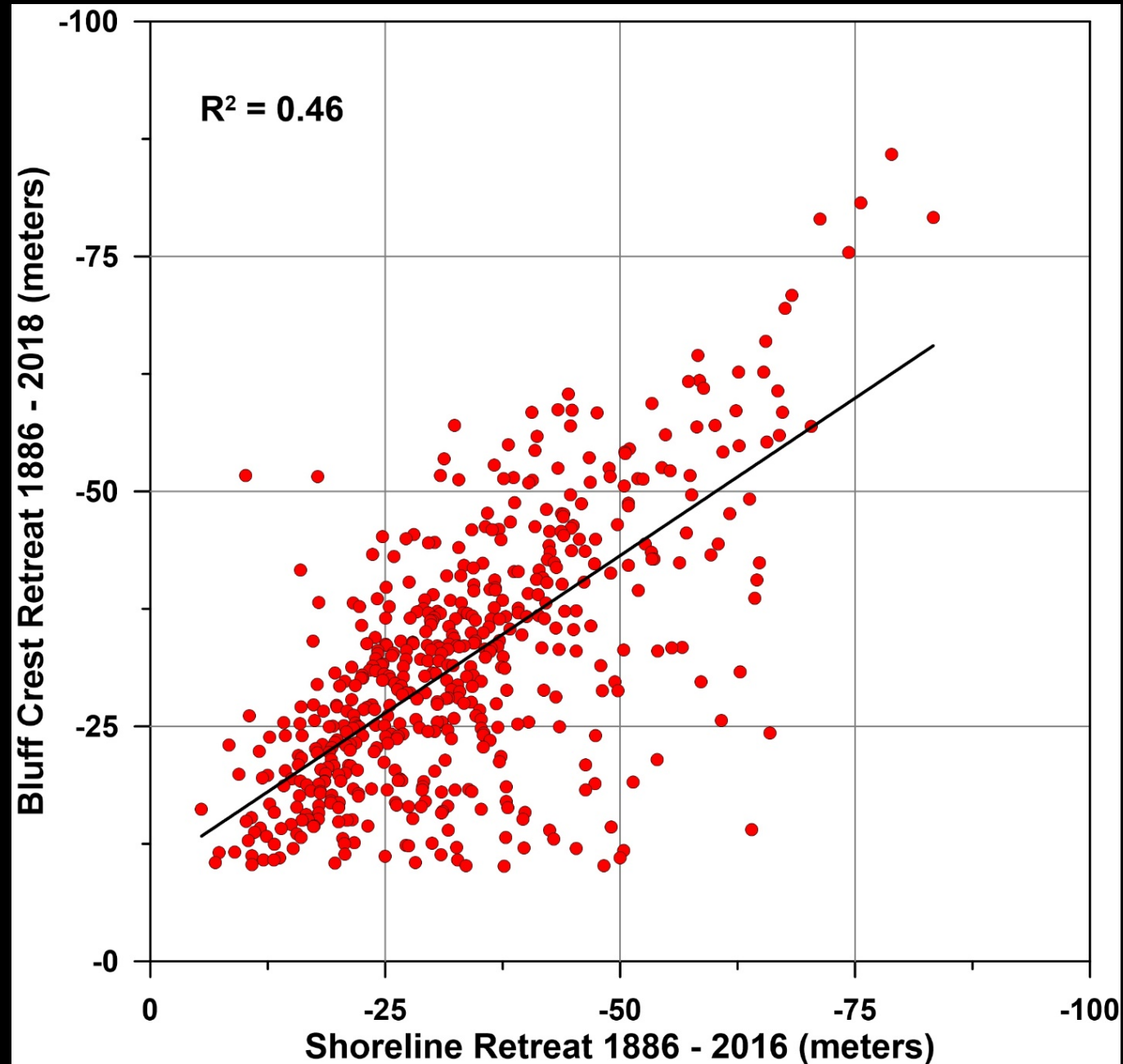
Results: Southeast & Southwest



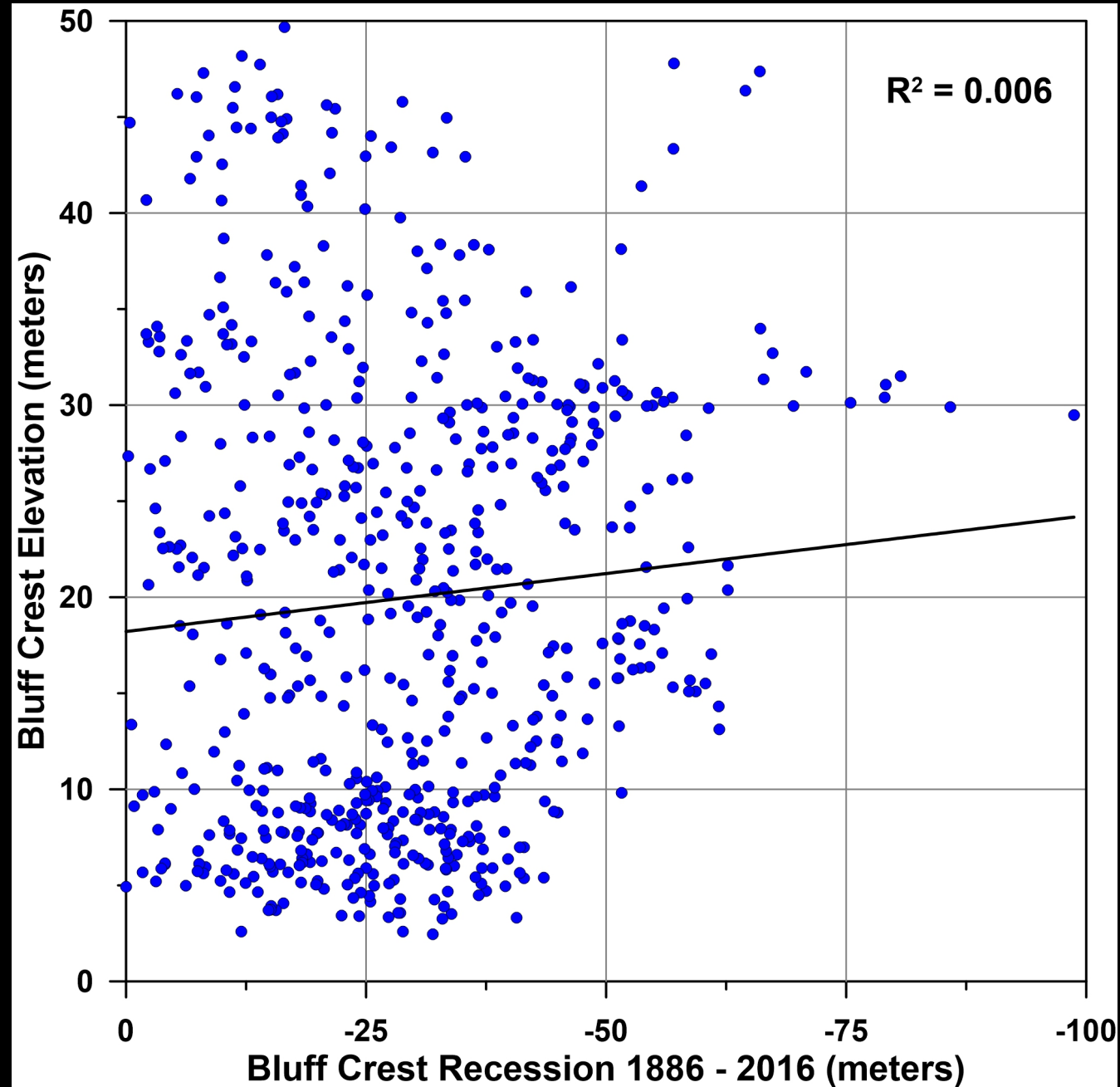
Results: Obligatory Data Table

Location	# of Transects	Ave Bluff Height (m)	Ave Bluff NSM (m)	Ave Bluff EPR (m yr ⁻¹)	Ave Shoreline NSM (m)	Ave Shoreline EPR (m yr ⁻¹)
Grove Point to Mansion Beach	101	20.8	-31.9	-0.24	-38.2	-0.29
Scotch Beach	25	8.6	-26.3	-0.20	-44.9	-0.34
Old Harbor to Southeast Point	104	14.9	-20.4	-0.15	-21.7	-0.17
Southeast Point to Schooner Point	225	30.0	-30.4	-0.23	-37.8	-0.29
Schooner Point to Grace Cove	167	11.4	-28.5	-0.22	-25.3	-0.19
Overall	622	20.1	-28.3	-0.21	-32.1	-0.25

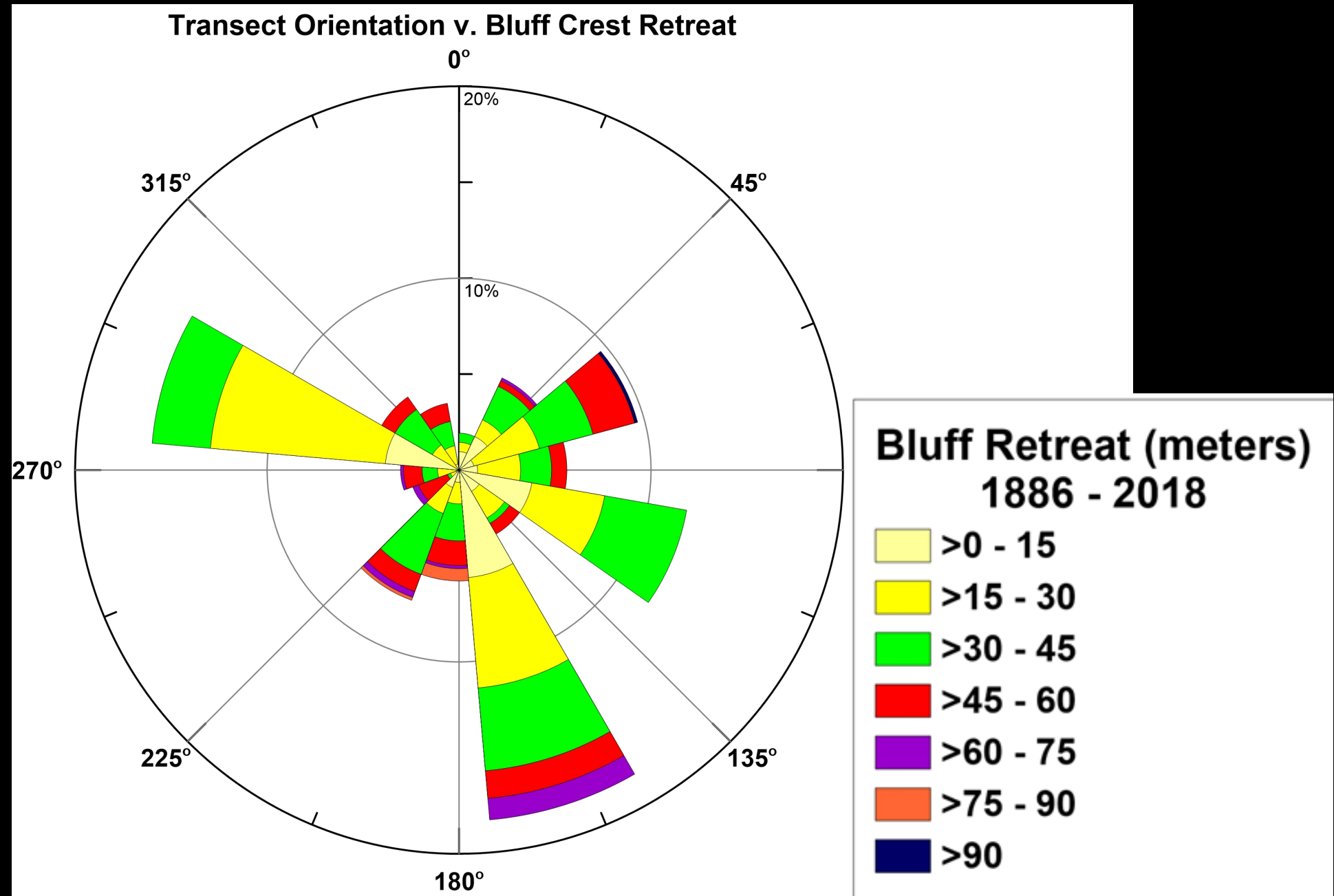
Results: Obligatory Graph – Shoreline vs. Bluff Retreat



Results: Bluff Height v. Bluff Retreat



Results: Transect Orientation v. Retreat



Conclusions and Future Work

- Bluff Retreat for Block Island varied between 'no change' and >98 m
- Some slight variation in average retreat for different areas of the island (generally



Conclusions and Future Work

- Comparing the bluff retreat to shoreline retreat showed.....
- No clear trend with Bluff Height and Retreat



Conclusions and Future Work

- Finish this part of the project
examining other aspects
affecting retreat
- Continue examining processes
using LiDAR and SfM

Questions?



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