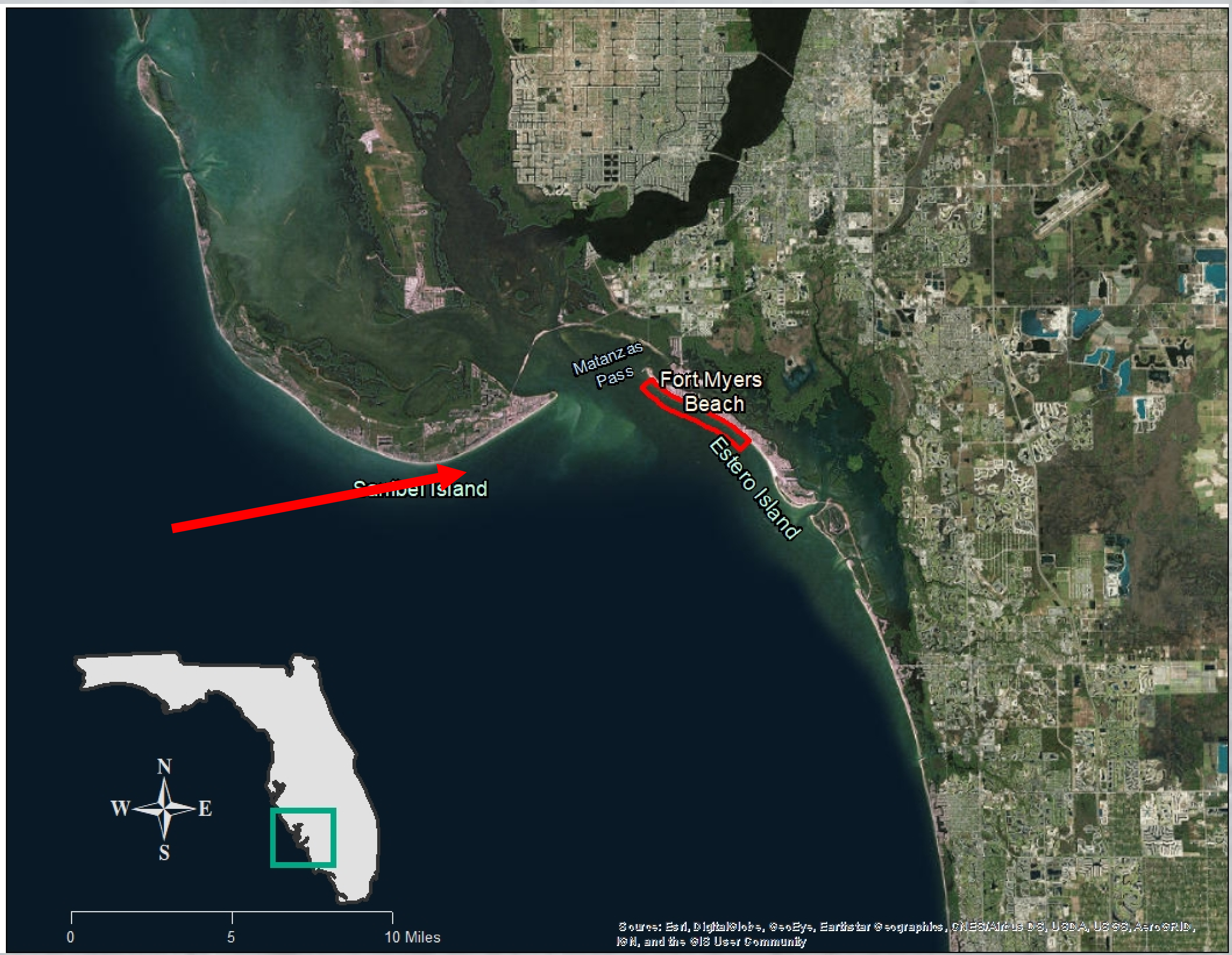
Sedimentological and Morphological Analysis of Artificial Nearshore Berm near Fort Myers Beach, Florida

Sara Ramos, Jason Enfinger, Gary Zarillo

Outline

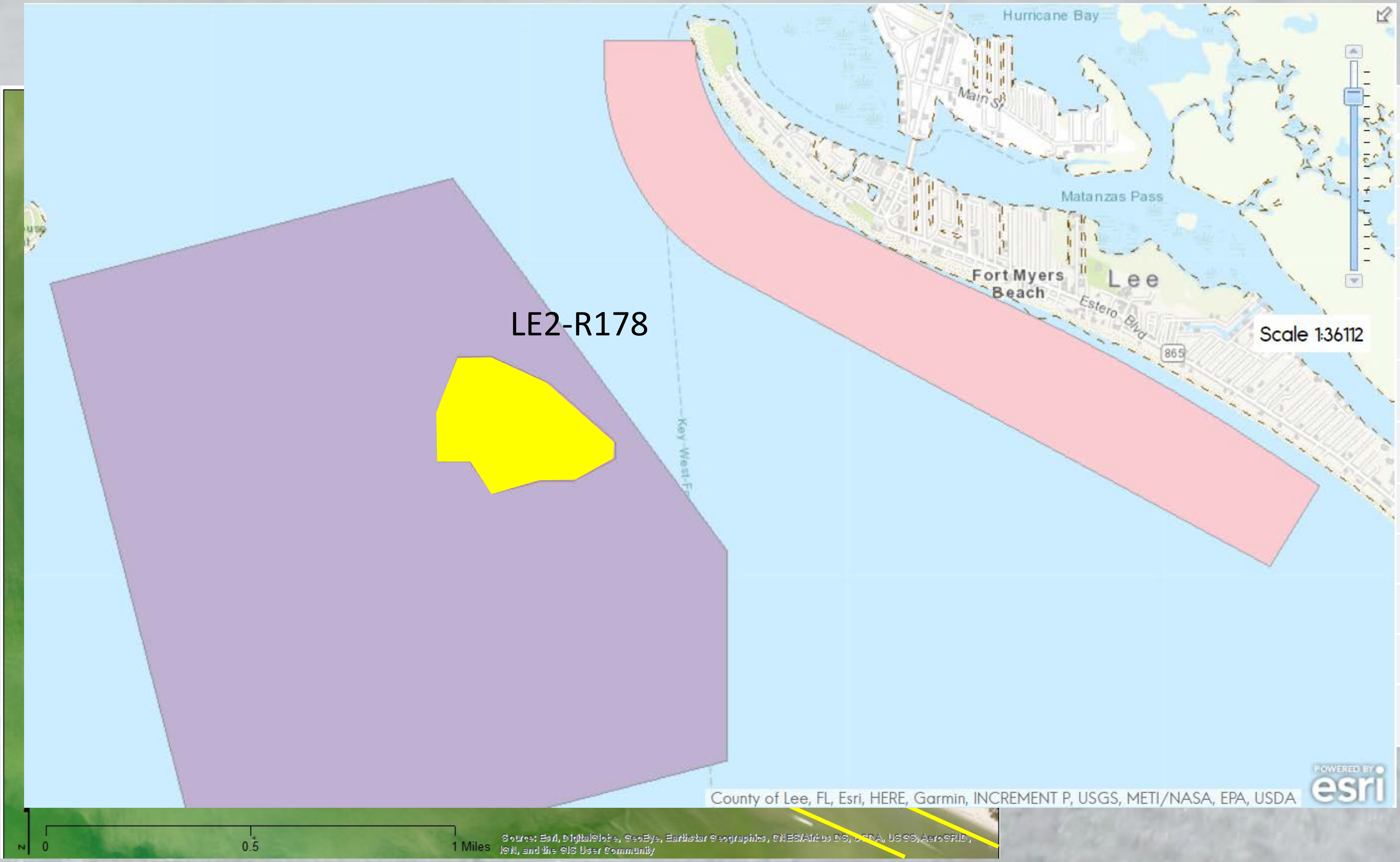
- Introduction
- Methods
- Morphological Analysis
- Topographic Changes
- Sediment Distribution
- Sediment Budget
- Sediment change
- Additional Research
- Conclusion

Study Area


Matanzas Pass
Fort Myers Beach
Estero Island
Island
N
W
E
S
0
5
10 Miles
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Introduction

Study Area History



Nearshore Berm

Previous Studies

USACE (1969)

- Longshore drift
  - There is a nodal point approximately 3km south of Matanzas Pass where longshore drift changes directions

Brutsche et al., (2012) & Brutsche et al., (2014)

- Sedimentological Analysis
  - Fine sediment in the initial construction of the berm did not impact the beach, but was selectively transported offshore.
- Morphological Analysis
  - Southeast control area and berm area in dynamic equilibrium as of 2014

FIT Research

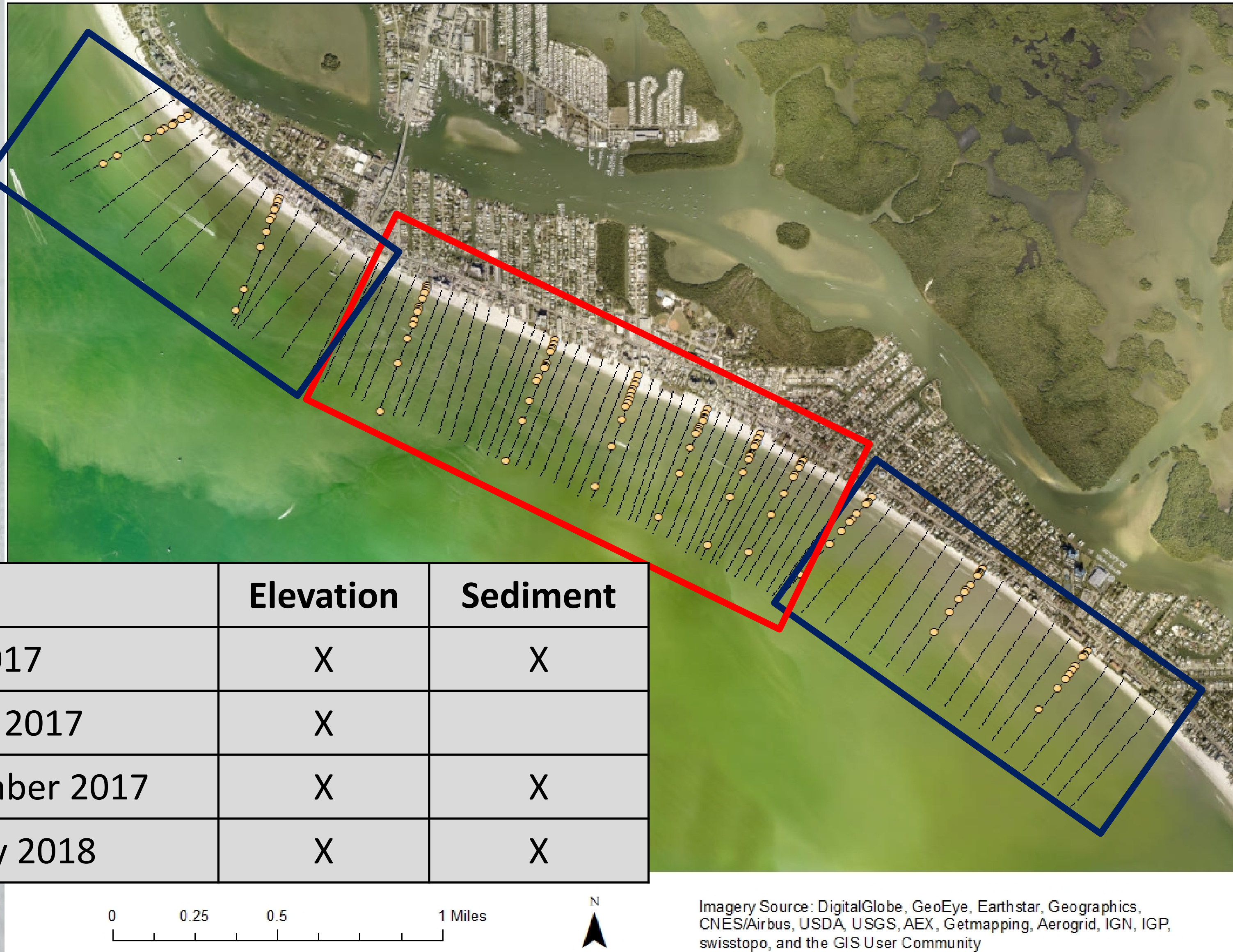
- Morphological Analysis
- Topographic Changes

Jason (2018)

- Sediment Distribution
- Sediment Budget
- Sediment change
- Additional Research

Sara Ramos

Field Collection



Date	Elevation	Sediment
May 2017	X	X
August 2017	X	
September 2017	X	X
January 2018	X	X

Laboratory Procedures

Sediment

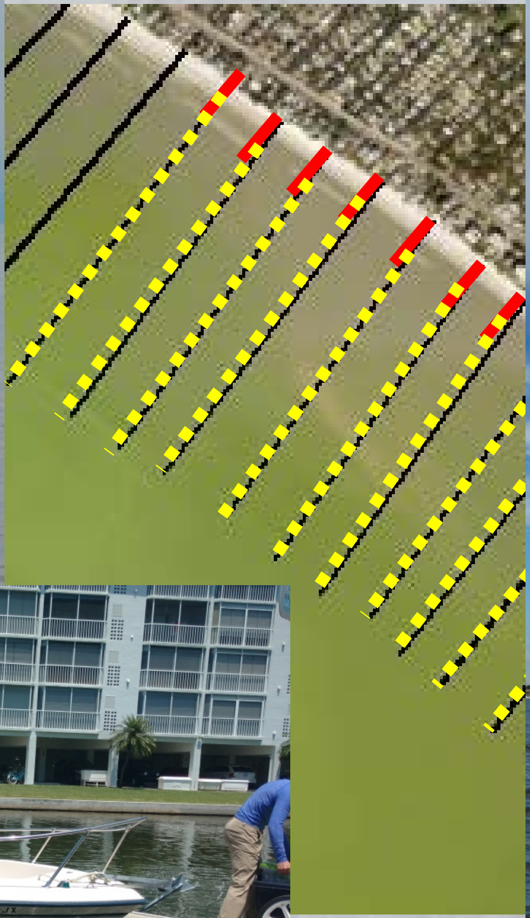
- Sieved
- Loss on Ignition (LOI)
- Qualitative Compositional Analysis
- Energy Dispersive X-Ray Analyzer (EDAX)

Suspended

- Filtered
- Loss on Ignition (LOI)

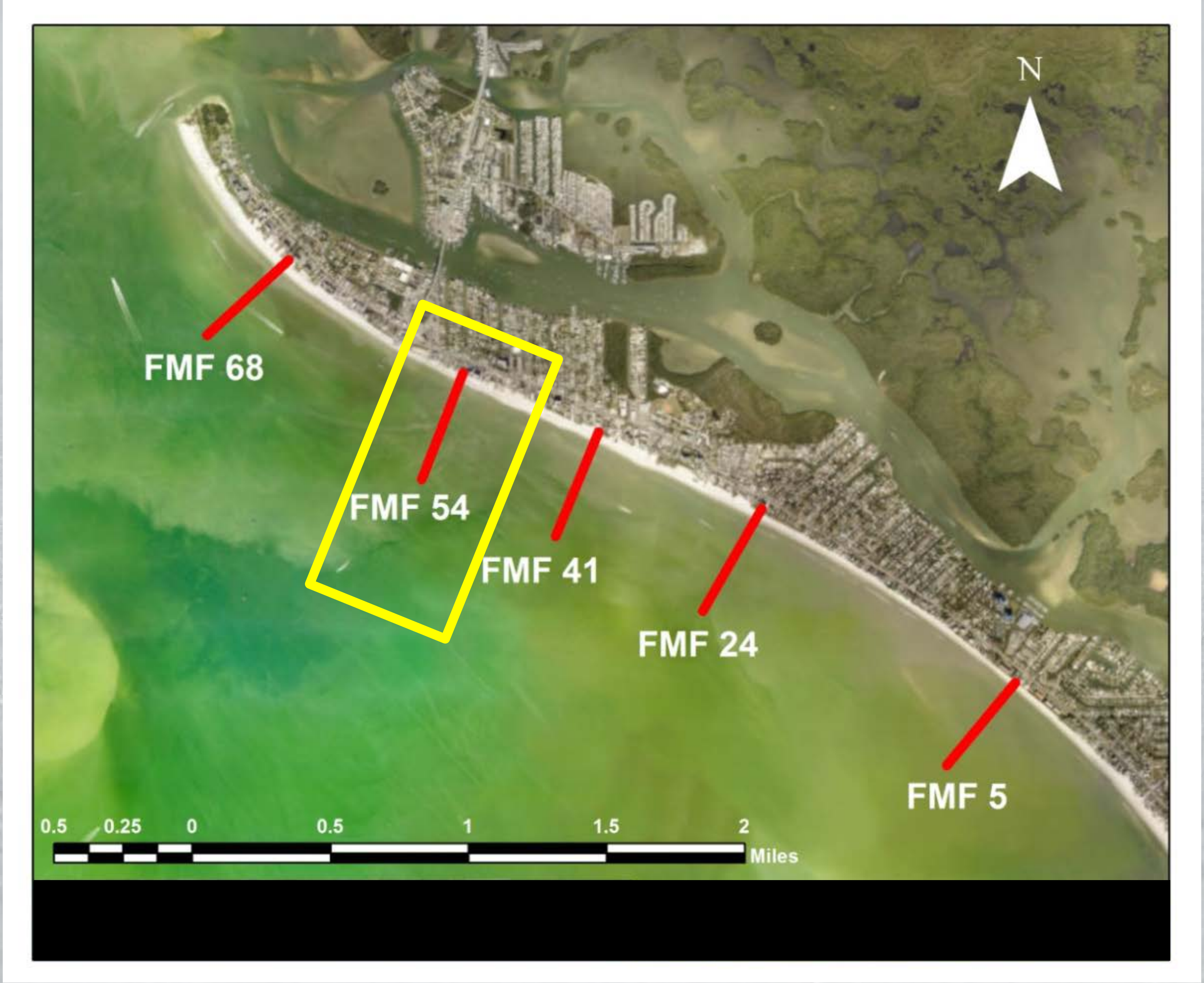
Morphological

Elevation



Profile Analysis

Morphological

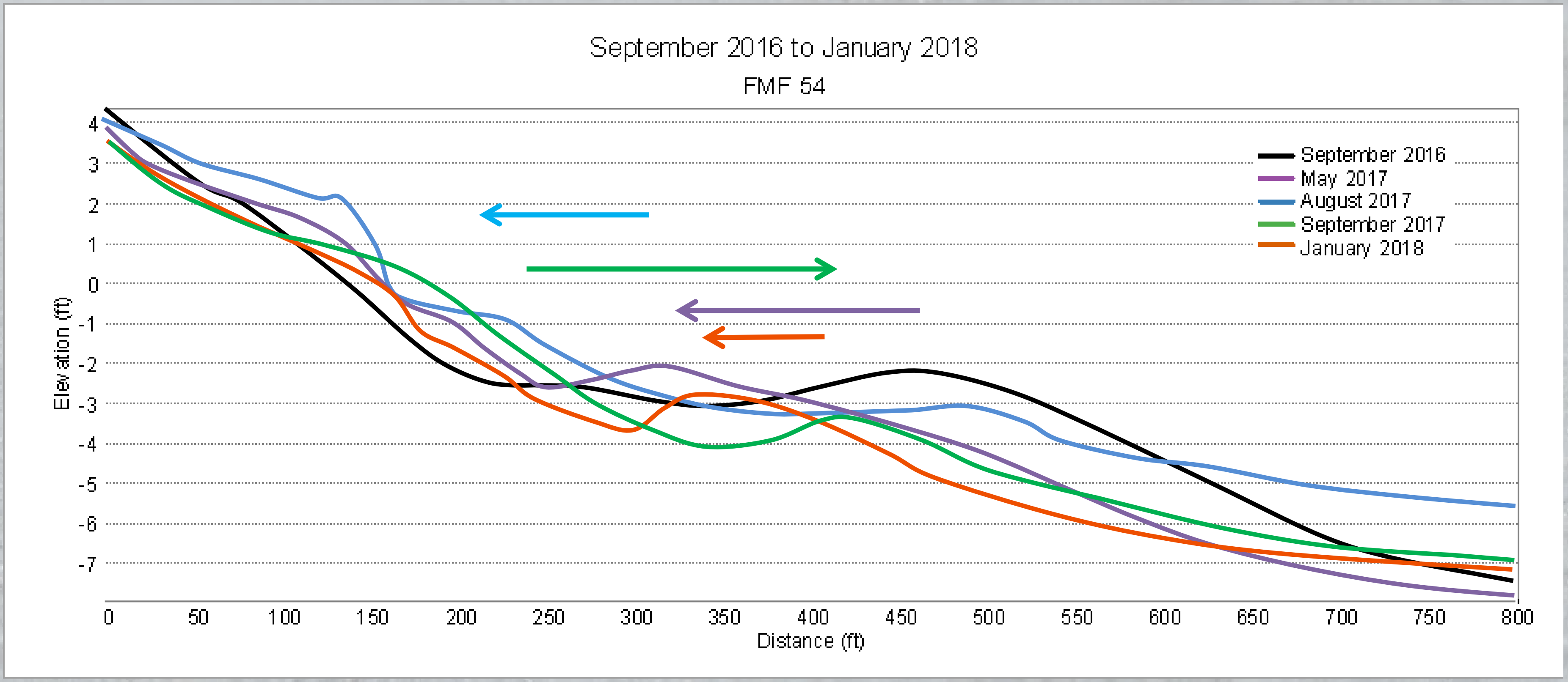


Profile Analysis

Morphological

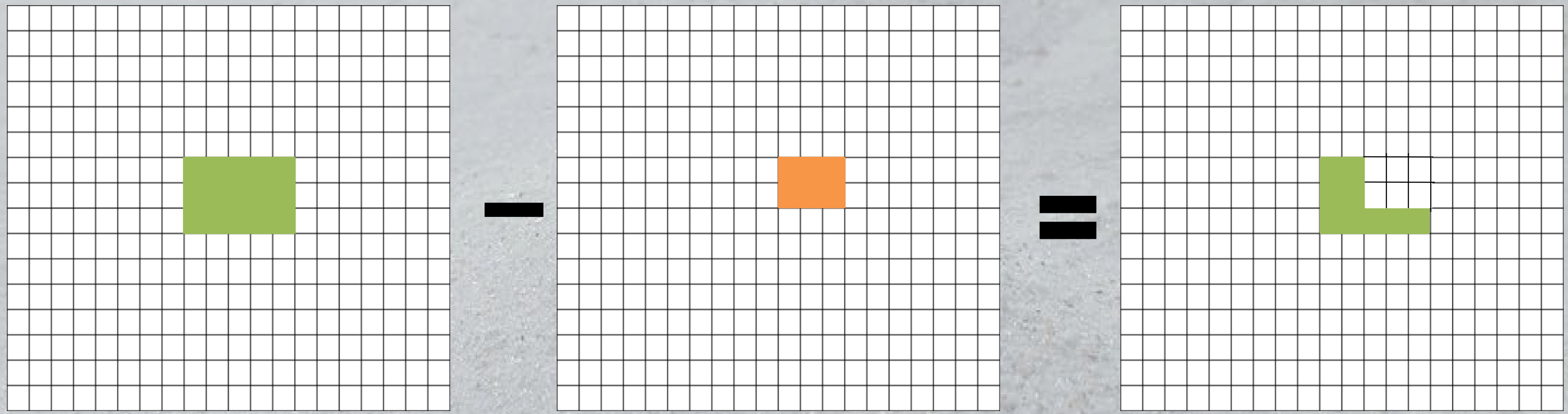
Lower Energy

Higher Energy



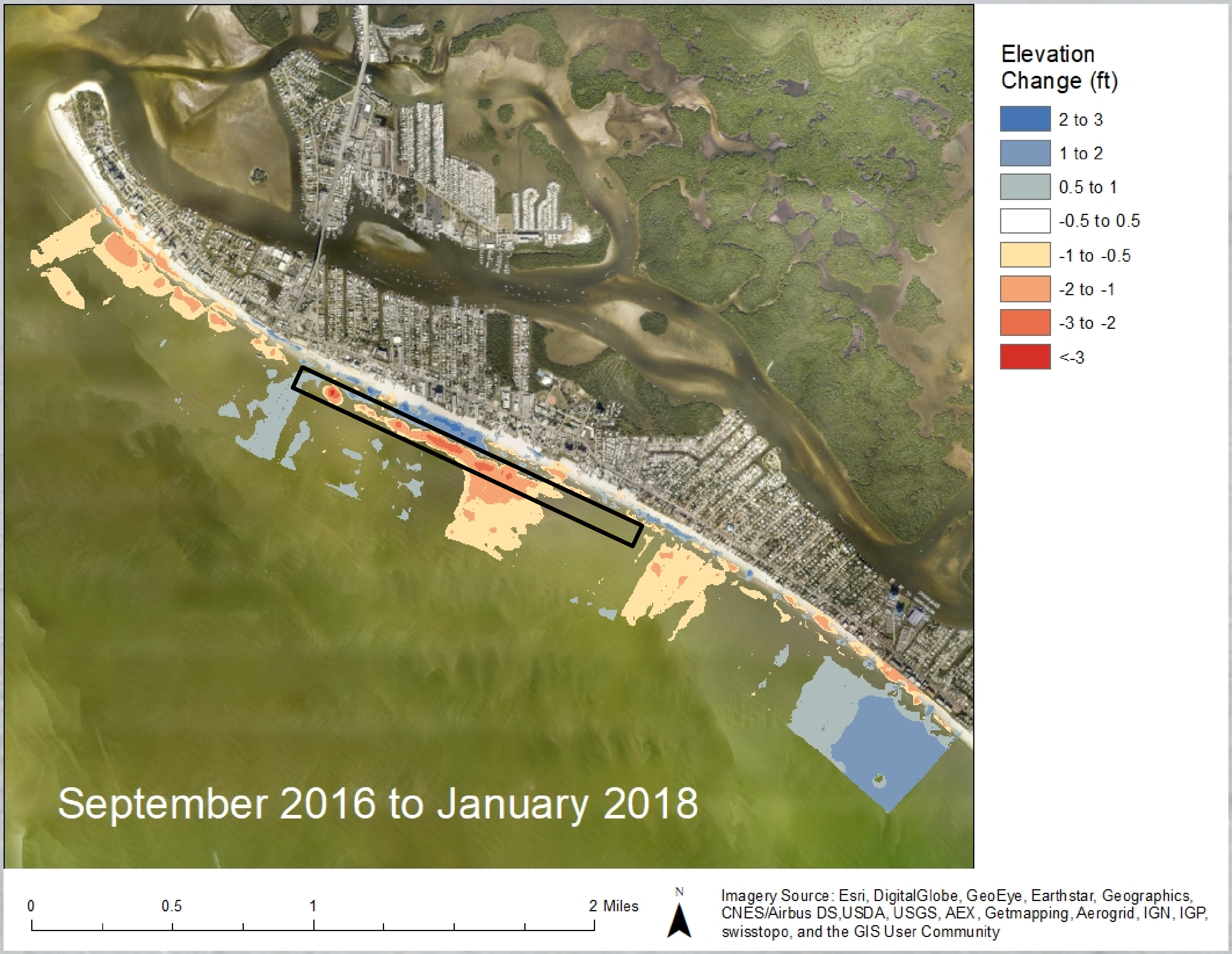
3D Analysis

Topographic



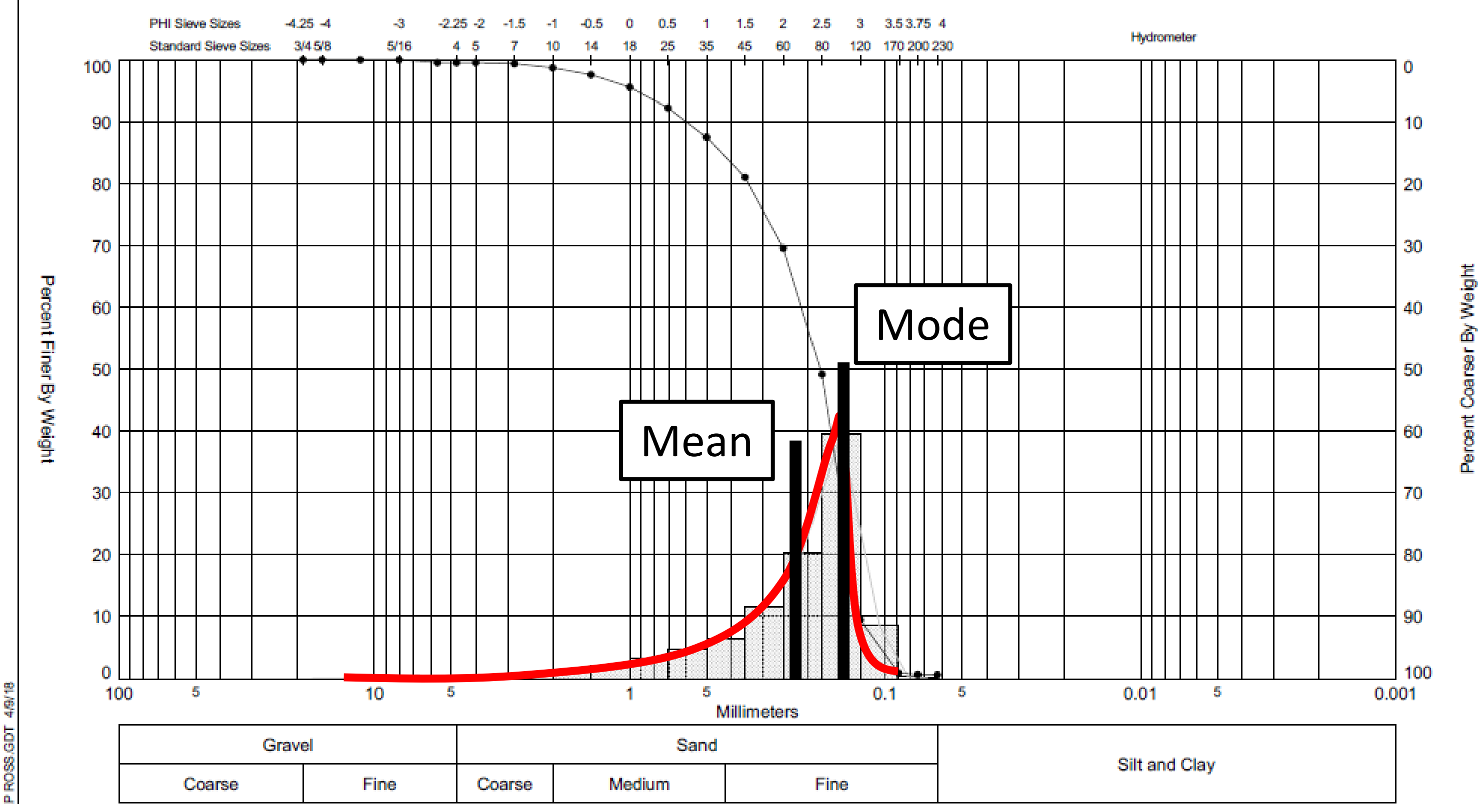
3D Analysis

Topographic



Sediment Analysis

Sed. Distribution



Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
FMF17SS04_0R	—•—		SP	#200 - 0.65 #230 - 0.61			2.48	2.14	-1.72	6.64	0.98

Comments:

Depths and elevations based on measured values

Scientific Environmental Applications
5575 Willoughby Drive
Melbourne, FL 32934
seappinc.com
seapp1@aol.com
(321) 254-2708

Sample Information	
Project Name:	Ft. Myers Sept 2017
Analysis Date:	11-14-17
Analyzed By:	
Easting (X, ft):	678,793
Northing (Y, ft):	766,169
Horizontal System:	NAD 1983
Vertical System:	NAVD 88

SIEVE ANALYSIS BERMSEPT1.GPJ FL DEP ROSS.GDT 4/9/18

Statistical Variance

Two tailed t-Test assuming unequal variance

$$H_o = \overline{X_1} = \overline{X_2}$$
$$H_1 = \overline{X_1} \neq \overline{X_2}$$

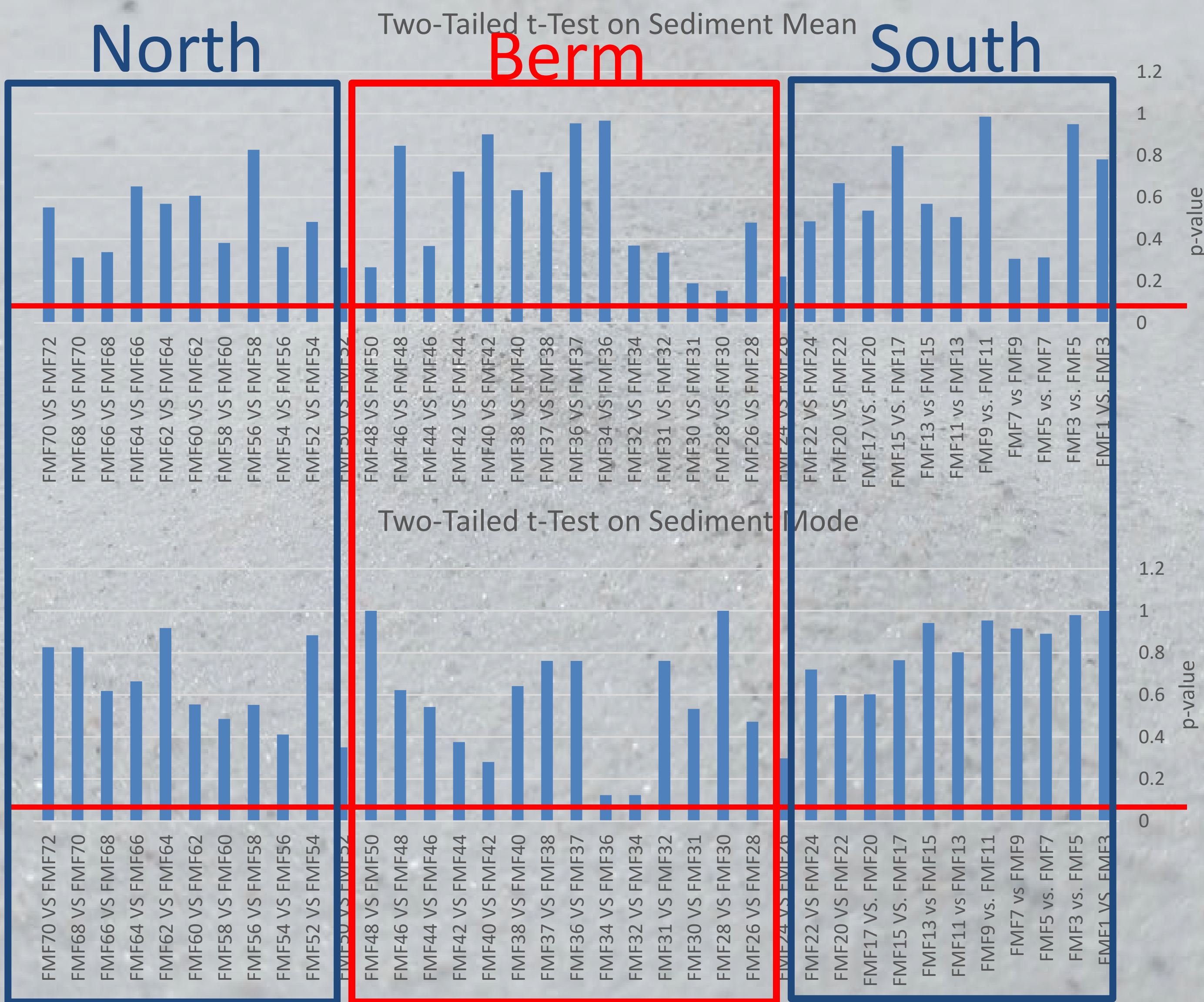
Single Factor Analysis of Variance (ANOVA)

$$H_o = \overline{X_1} = \overline{X_2} = \overline{X_3}$$
$$H_1 = One\ or\ more\ varibles\ are\ different$$

Post hoc: Least Significant Difference

$$LSD_{A,B} = t_{0.05/2,DFW}\sqrt{MSW(\frac{1}{n_A} + \frac{1}{n_B})}$$

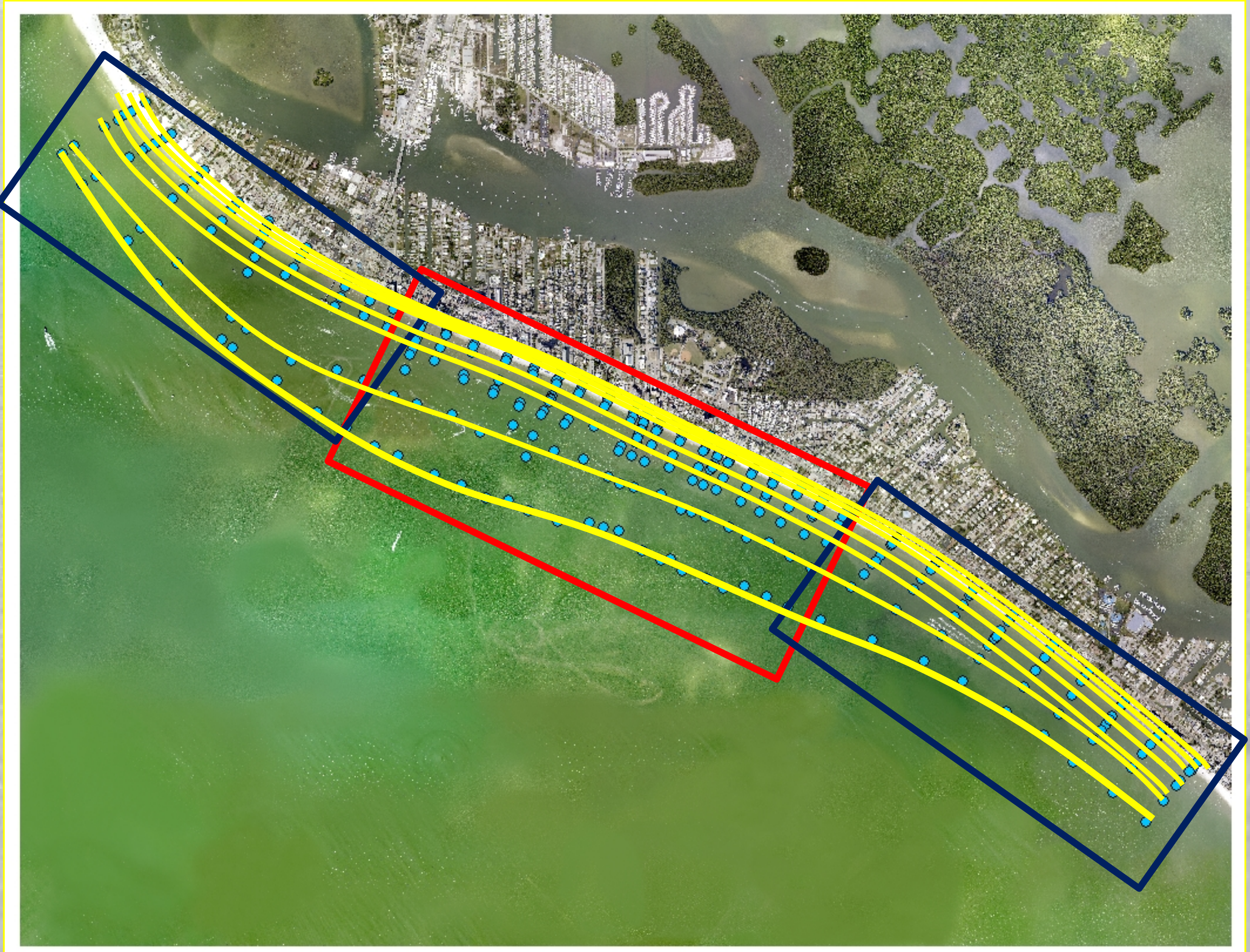
Areas of Interest



ANOVA

Single Factor Anova: Mode				
	P-Value	F-Value	F-Critical	Analysis
May	<0.01	6.31	3.02	Reject the Null
September	0.05	3.04	3.07	Cannot Reject the Null
January	<0.01	26.40	3.02	Reject the Null

Longitudinal ANOVA



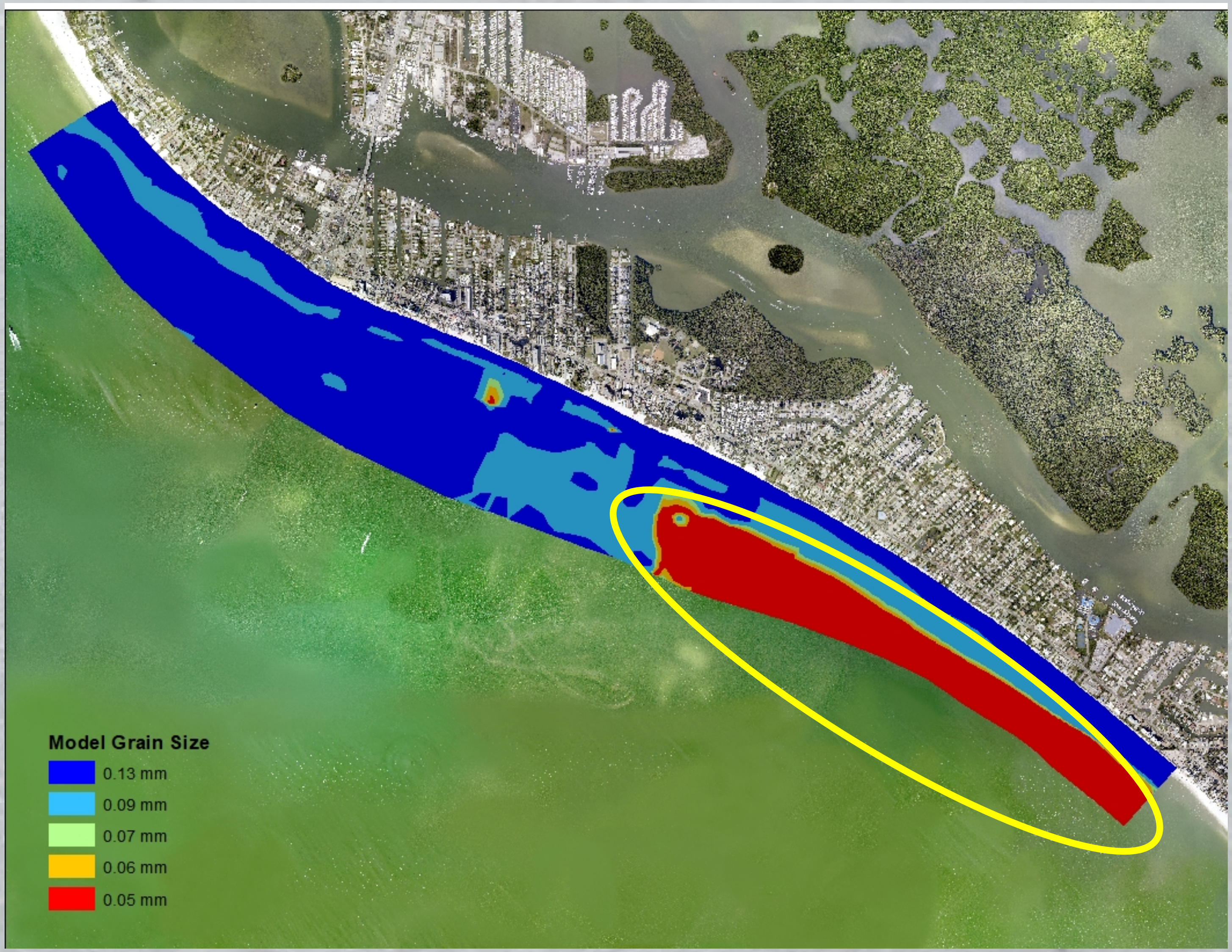
Longitudinal ANOVA

Single Factor Anova: Mode				
May Sediment				
	P-Value	F-Value	F-Critical	Analysis
Dune Toe	0.52	3.27	0.68	Cannot Reject Null
Beach	0.39	0.97	3.23	Cannot Reject Null
Swash Zone	0.11	2.34	3.27	Cannot Reject Null
Trough	0.17	1.85	3.27	Cannot Reject Null
4 feet	0.13	2.14	3.27	Cannot Reject Null
6 feet	0.05	3.20	3.26	Cannot Reject Null
8 feet	<0.01	39.45	3.26	Reject the Null
10 feet	<0.01	43.25	3.27	Reject the Null

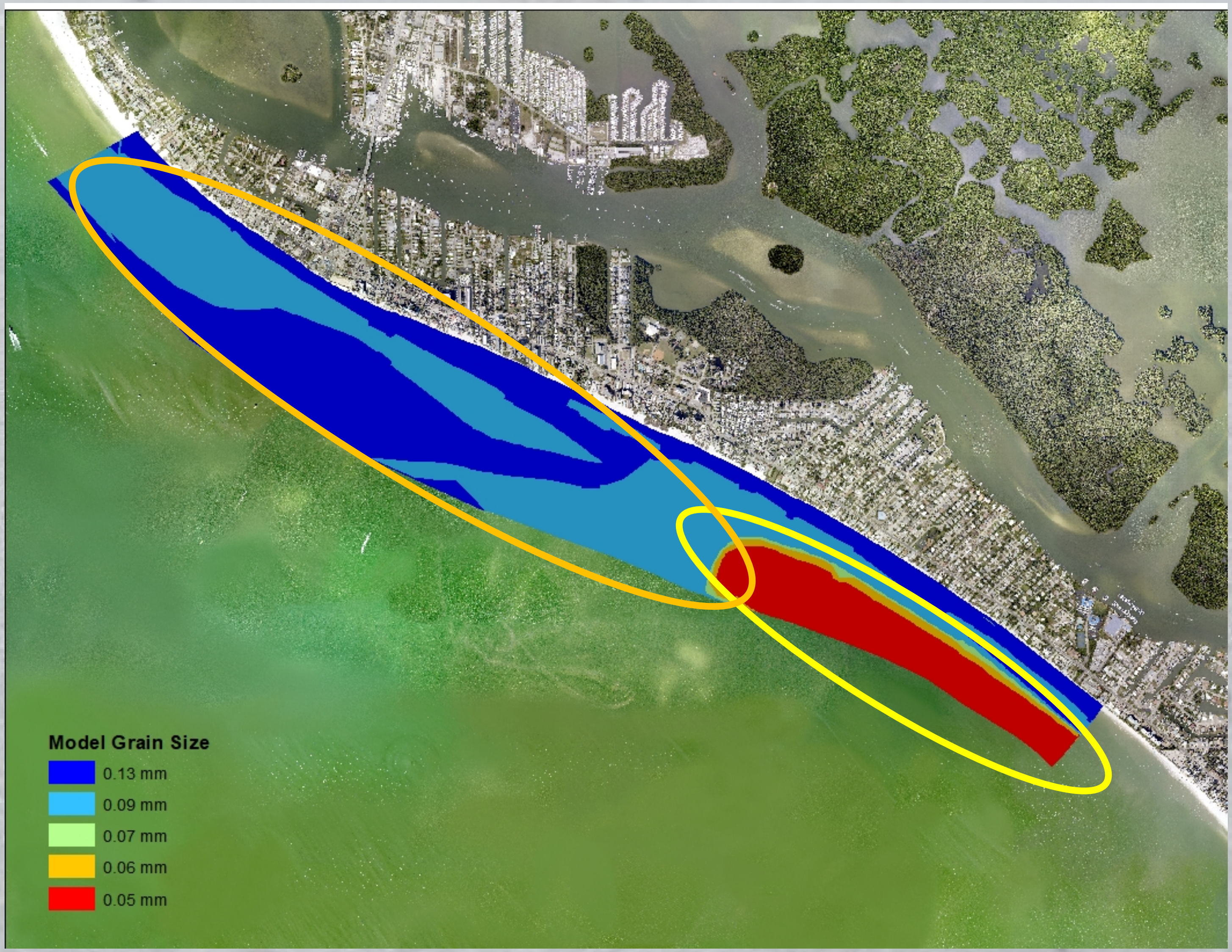
Single Factor Anova: Mode				
January Sediment				
	P-Value	F-Value	F-Critical	Analysis
Dune Toe	0.57	0.57	3.27	Cannot Reject Null
Beach	1.00	52.26	3.30	Cannot Reject Null
Swash Zone	0.08	2.76	3.27	Cannot Reject Null
Trough	0.70	0.36	3.27	Cannot Reject Null
4 feet	0.29	1.29	3.27	Cannot Reject Null
6 feet	<0.01	16.98	3.27	Reject the Null
8 feet	<0.01	58.80	3.28	Reject the Null
10 feet	<0.01	27.93	3.27	Reject the Null

Spatial (May)

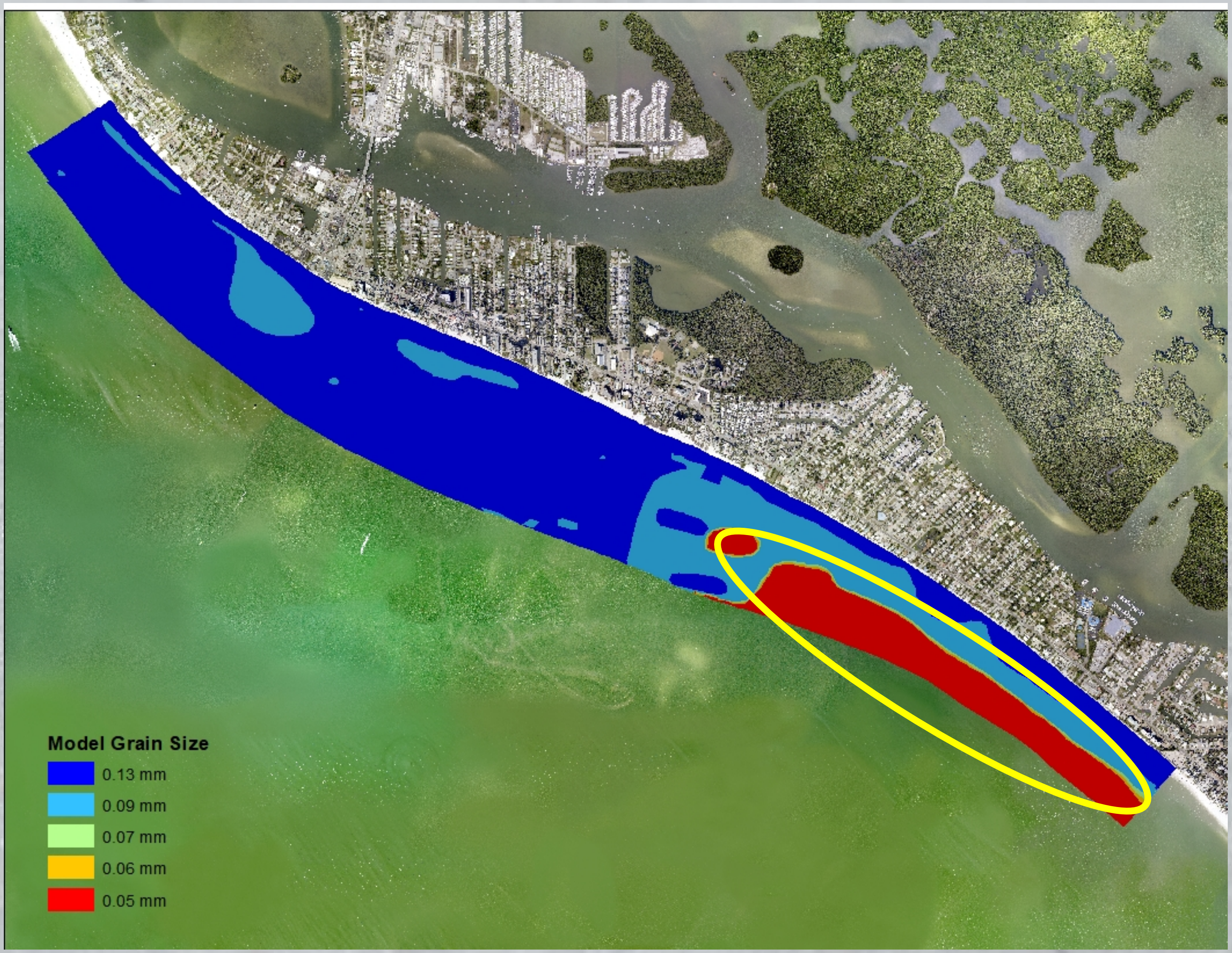
Sed. Distribution



Spatial (September)



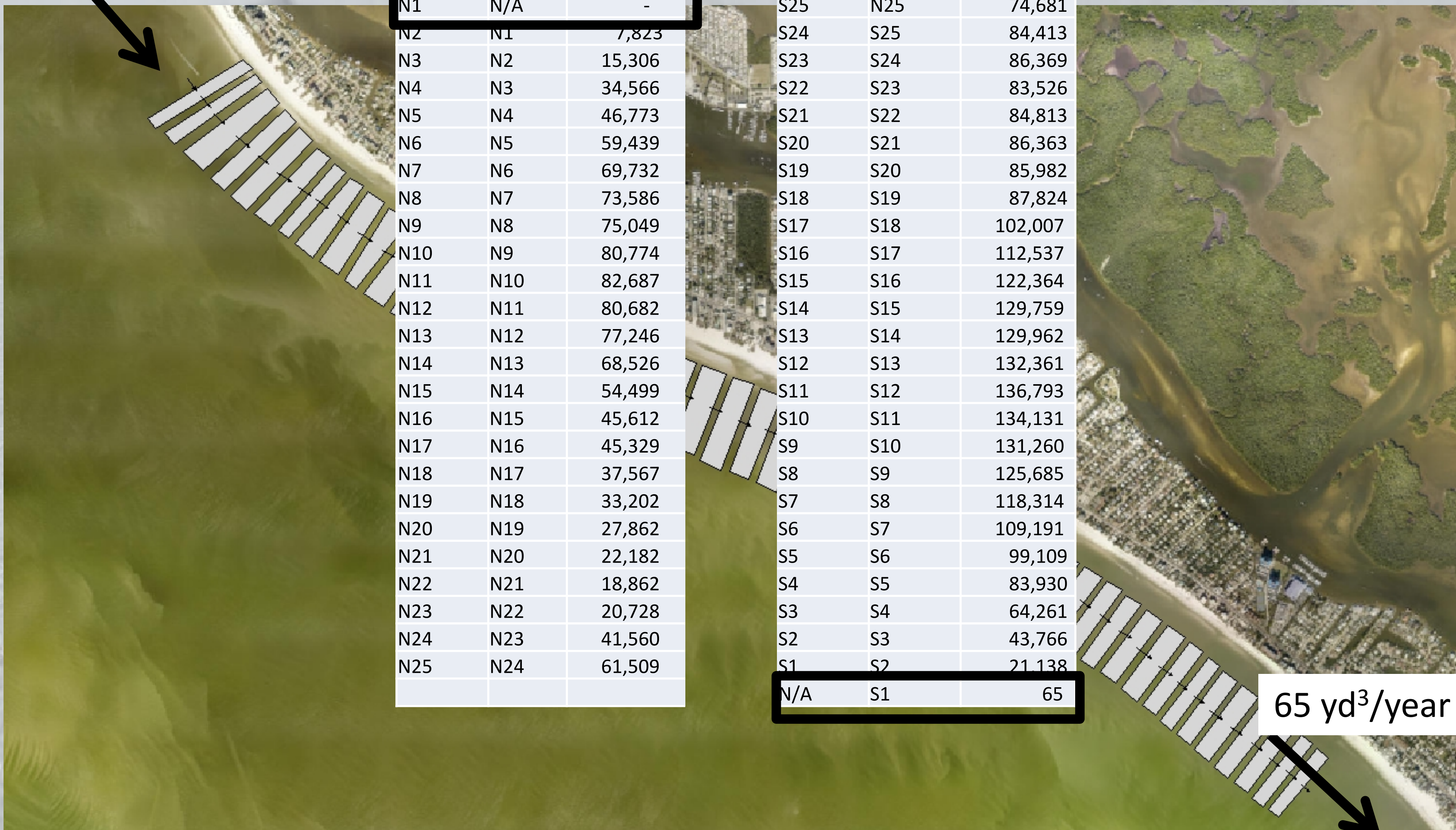
Spatial (January)



Sediment Budget

- $\sum Q_{in} - \sum Q_{out} - \Delta V + P - R = 0$
- $\Delta V = Change\ in\ Volume/Time$

Sediment Budget



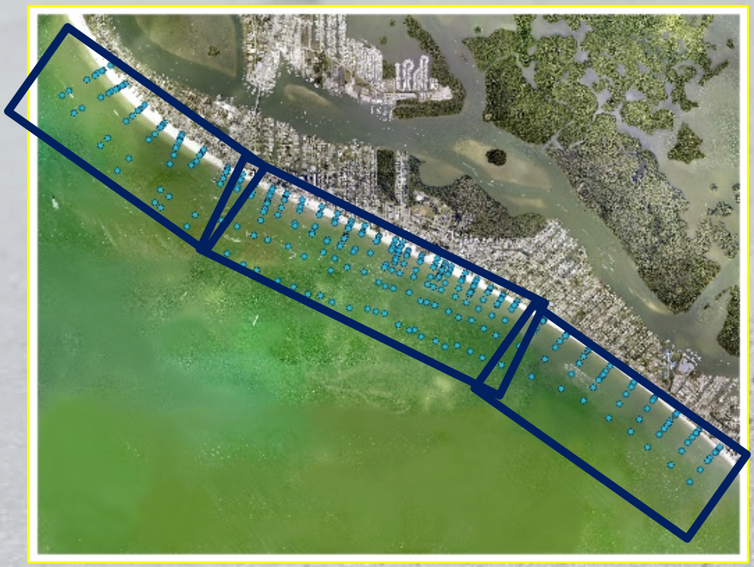
In	Out	Q (yd^3/year)
N1	N/A	-
N2	N1	7,823
N3	N2	15,306
N4	N3	34,566
N5	N4	46,773
N6	N5	59,439
N7	N6	69,732
N8	N7	73,586
N9	N8	75,049
N10	N9	80,774
N11	N10	82,687
N12	N11	80,682
N13	N12	77,246
N14	N13	68,526
N15	N14	54,499
N16	N15	45,612
N17	N16	45,329
N18	N17	37,567
N19	N18	33,202
N20	N19	27,862
N21	N20	22,182
N22	N21	18,862
N23	N22	20,728
N24	N23	41,560
N25	N24	61,509

In	Out	Q (yd^3/year)
S25	N25	74,681
S24	S25	84,413
S23	S24	86,369
S22	S23	83,526
S21	S22	84,813
S20	S21	86,363
S19	S20	85,982
S18	S19	87,824
S17	S18	102,007
S16	S17	112,537
S15	S16	122,364
S14	S15	129,759
S13	S14	129,962
S12	S13	132,361
S11	S12	136,793
S10	S11	134,131
S9	S10	131,260
S8	S9	125,685
S7	S8	118,314
S6	S7	109,191
S5	S6	99,109
S4	S5	83,930
S3	S4	64,261
S2	S3	43,766
S1	S2	21,138
N/A	S1	65

Sed. Change

Area Change

May

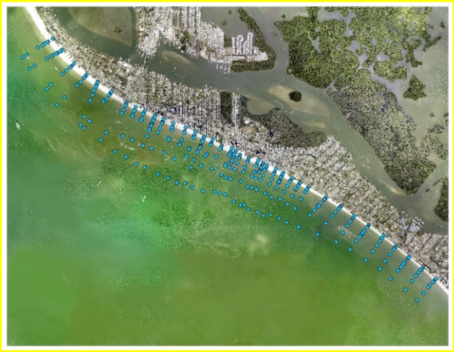


January

Two-tailed t-Test				
Change from May 2017 to January 2018				
	P-Value	t-Stat	t-Critical	Analysis
Northwest control area	0.10	1.65	1.97	Cannot Reject the Null
Berm area	0.12	1.55	1.97	Cannot Reject the Null
Southeast control area	0.16	1.41	1.97	Cannot Reject the Null

Change/Time: ANOVA

Sed. Change



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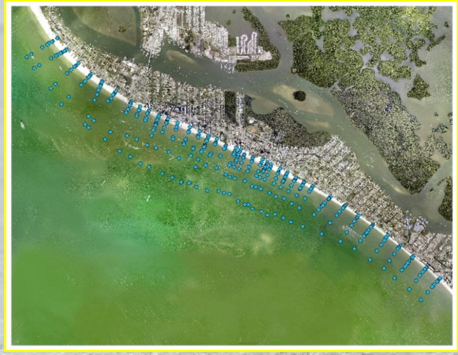

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Single Factor Anova: Mode				
Change in Time				
	P-Value	F-Value	F-Critical	Analysis
May to September	0.44	0.84	3.07	Cannot Reject the Null
September to January	0.22	1.53	3.07	Cannot Reject the Null
May to January	0.01	4.96	3.02	Reject the Null

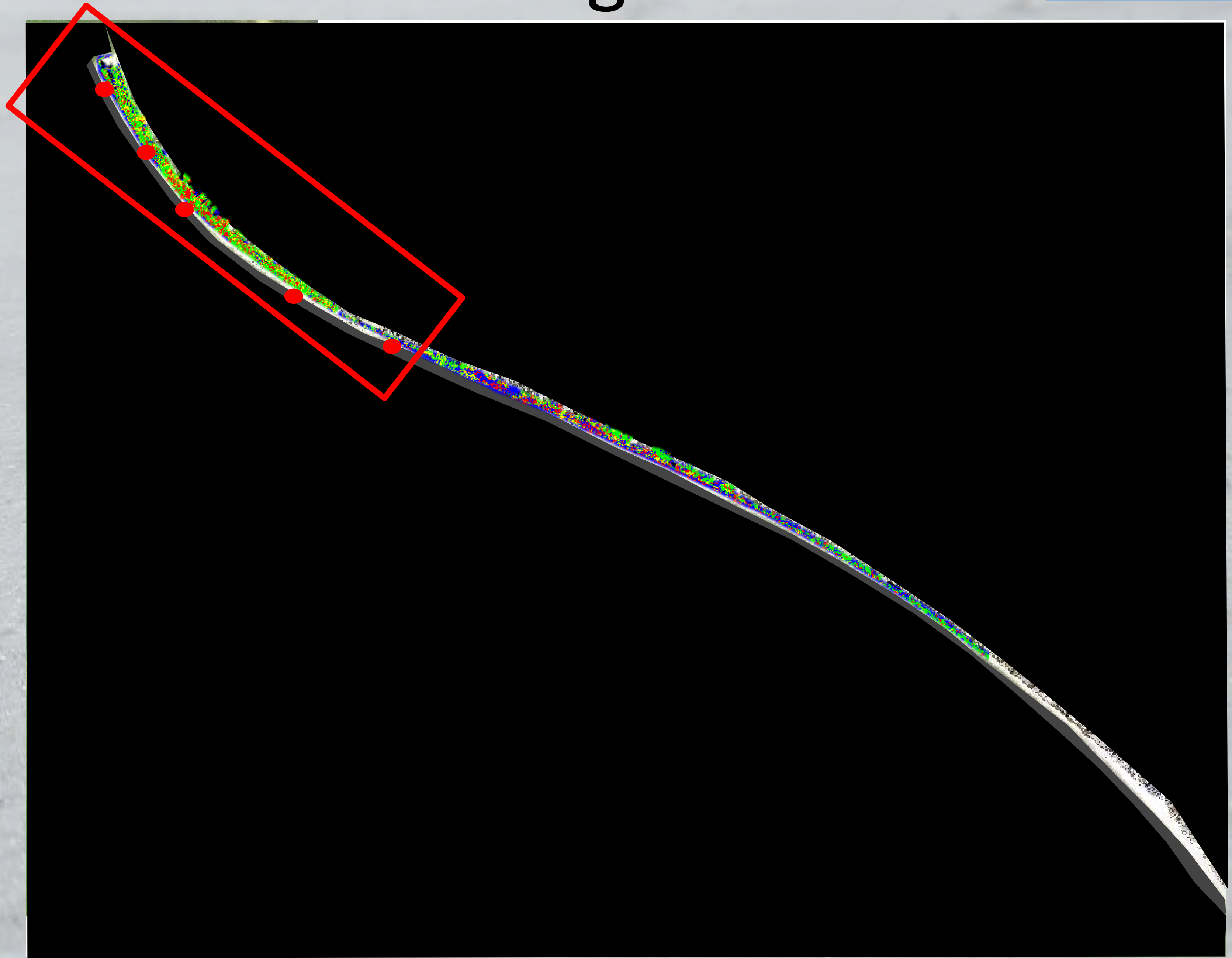
Post hoc: LSD

Least Significant Difference (LSD)			
Groups	Mean Difference	LSD	Results
Berm & North	0.0022	0.0021	Different
Berm & South	0.0097	0.0021	Different
North & South	0.0075	0.0026	Different

ANOVA Results		
Groups	Average (mm)	Variance (mm^2)
South	0.0037	0.0003
Berm	-0.0060	0.0008
North	-0.0038	0.0004

Remote Sensing

Add. Research



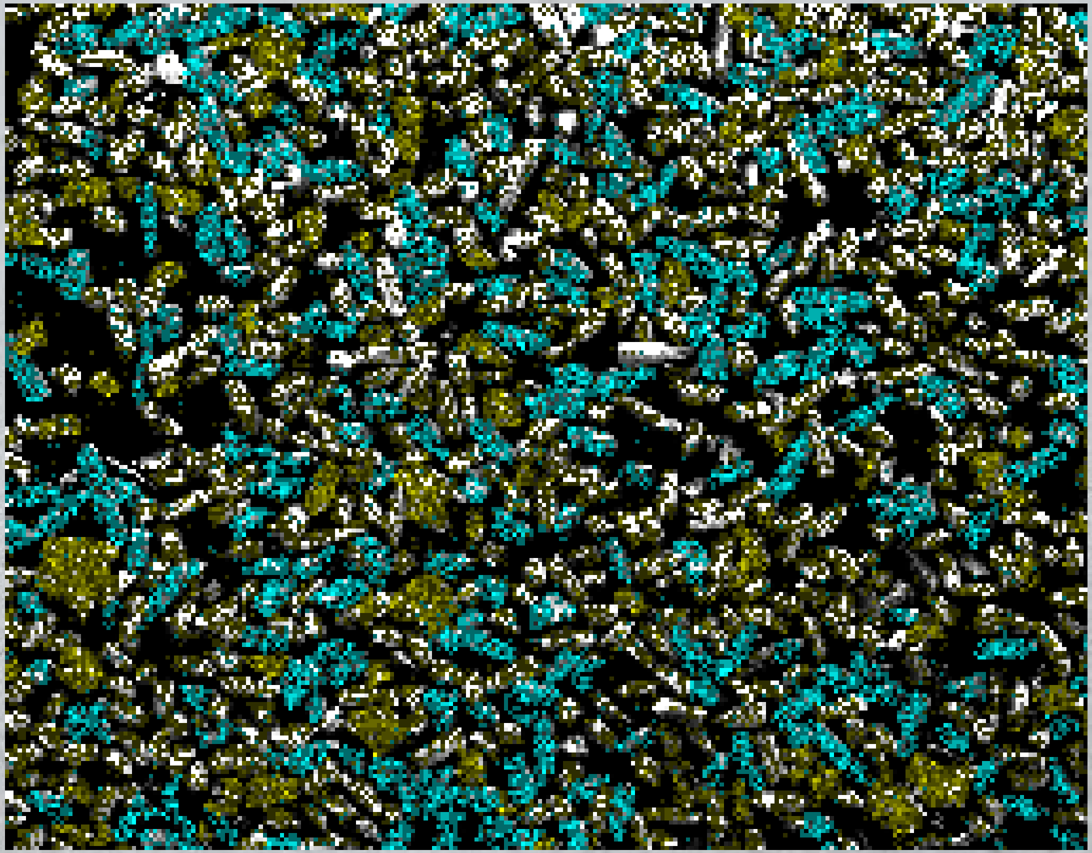
Remote Sensing

Add. Research

SEM-EDAX

Add. Research

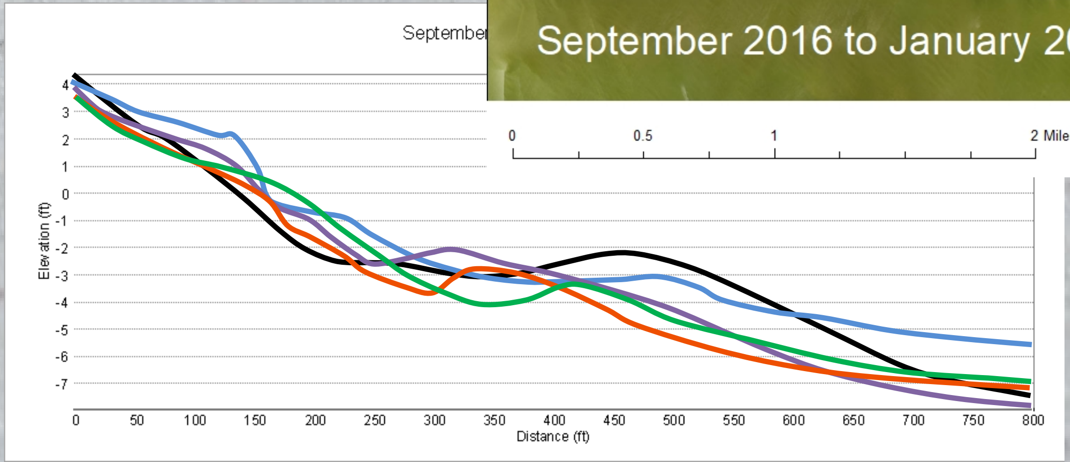
Silica — Quartz – SiO_2
Titanium — Ilmenite – $FeTiO_3$



Morphology

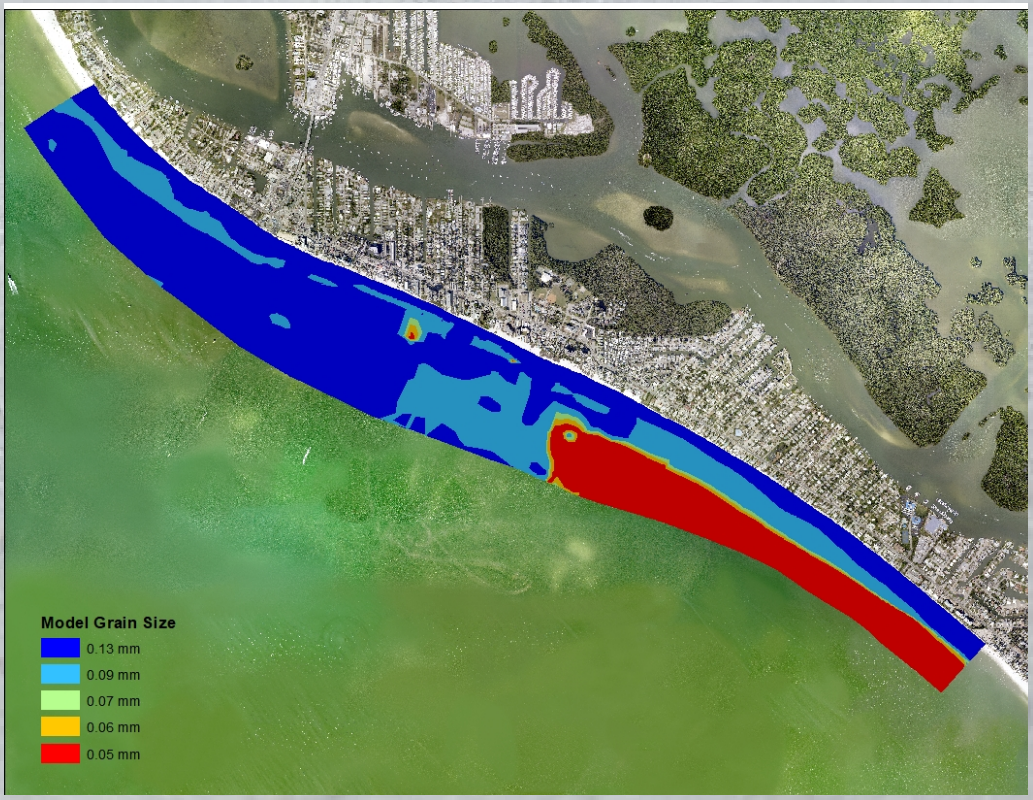
Conclusion

- Largest Accretion around berm
- Onshore to offshore berm movement indicates equilibrium

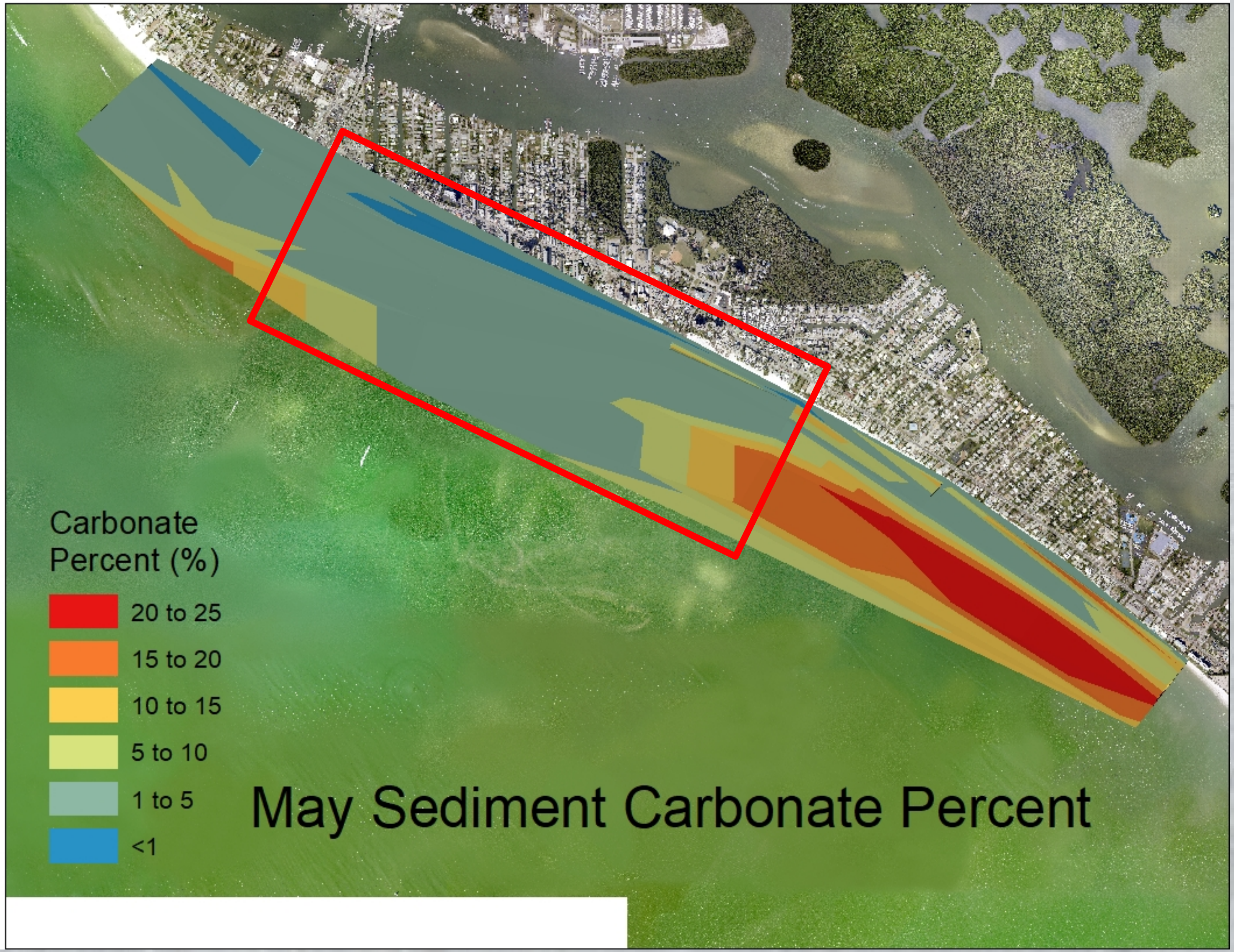


Sediment

- Large fine-grained area not related to berm deposition.
- The ANOVA and LSD on sediment changes over time indicates the system is in dynamic equilibrium, although sediment does change differently in southern area.

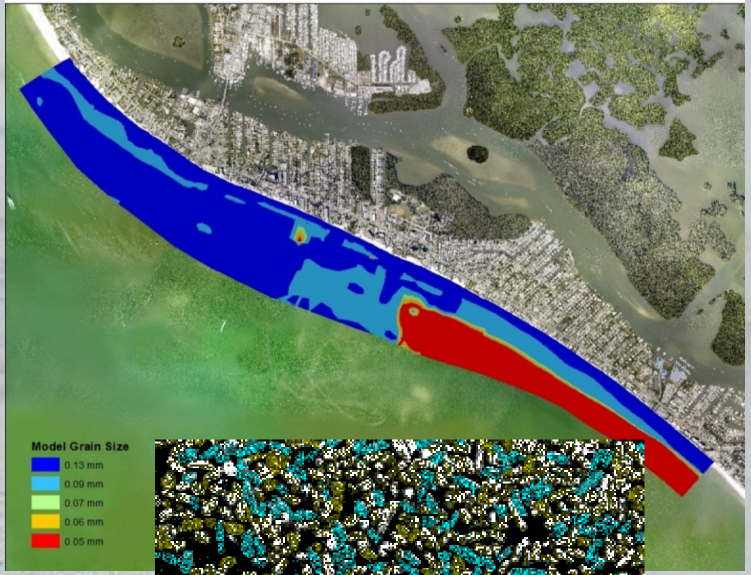


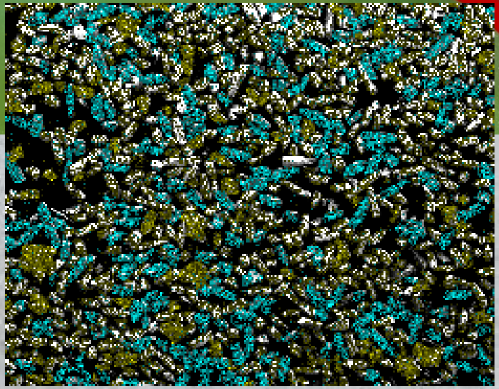
May Carbonate Distribution



Further Research

- Compare present sediment attributes to historical data to determine source of fine-grained material
- Calculate Compositional percentage in order to calculate remote sensing error matrix.
- Correlate wave data to model sediment movement and correlate to elevation data.





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Field Collection

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- Kaleigh Dinoto

Laboratory Processing

- Kerri Allen
- Julia R Mokuy
- Kaleigh DiNoto
- Emily Perron
- Carlos Rivera

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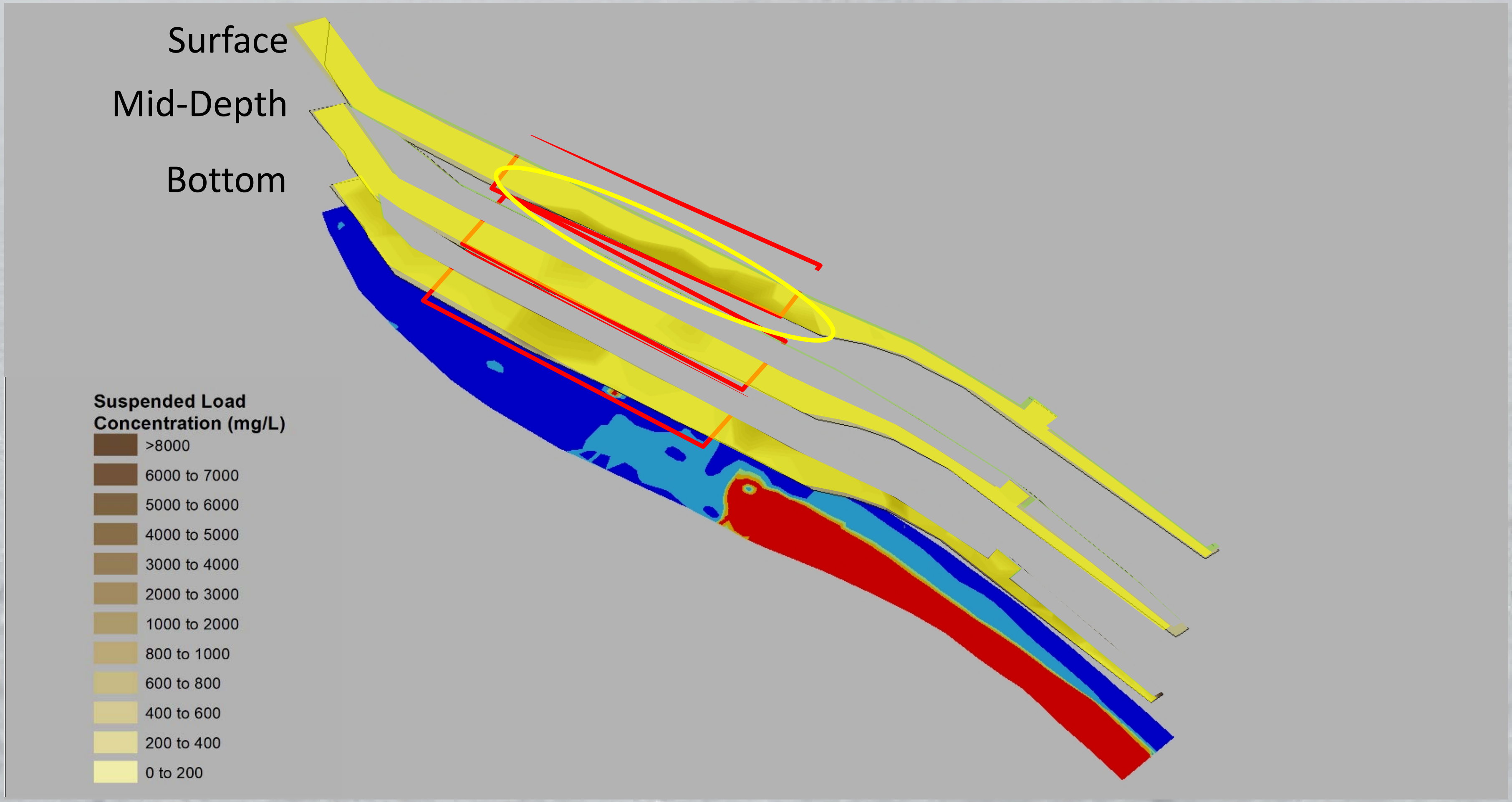
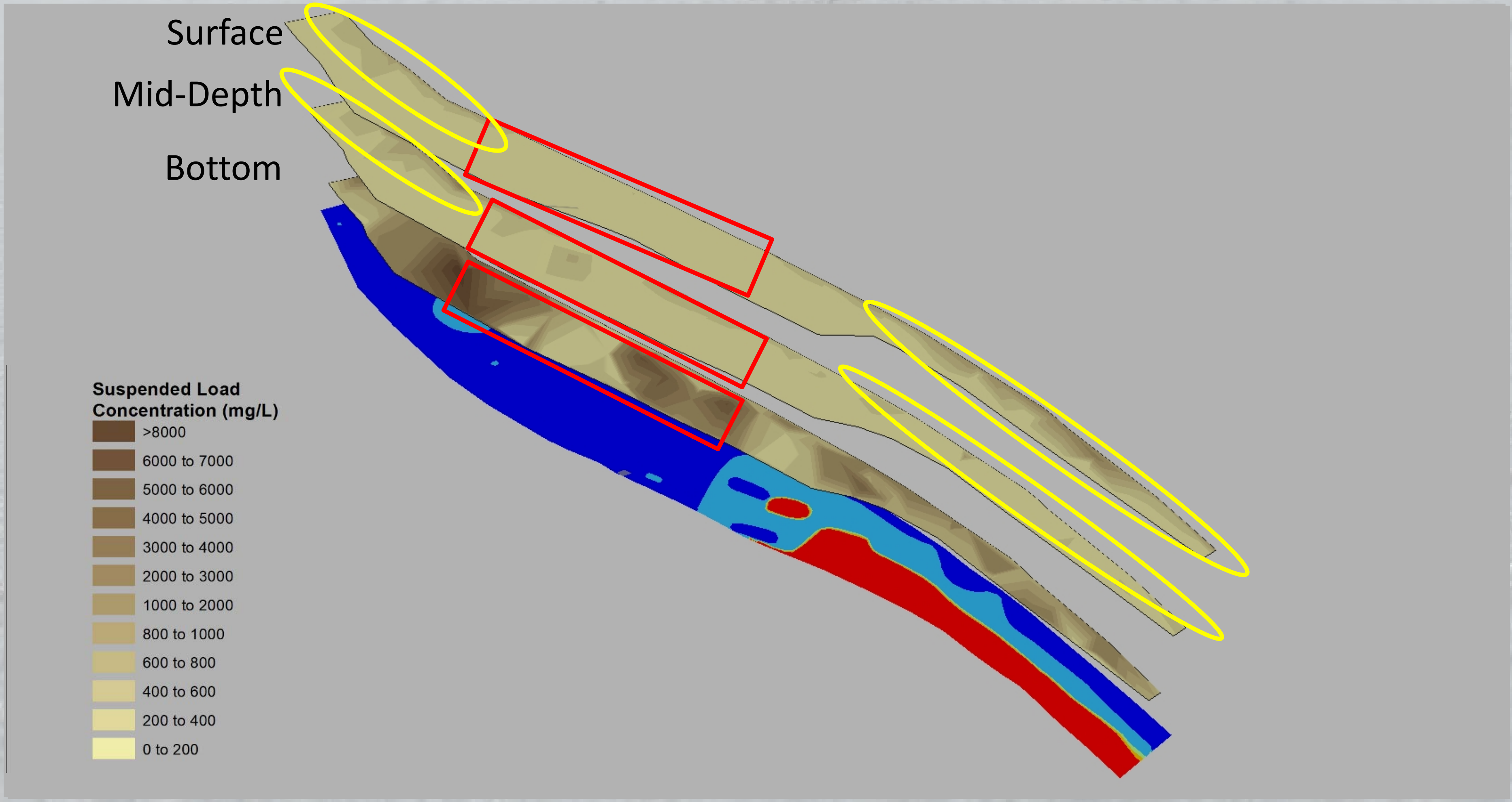
May-January Sediment Size Change

May Suspended Load

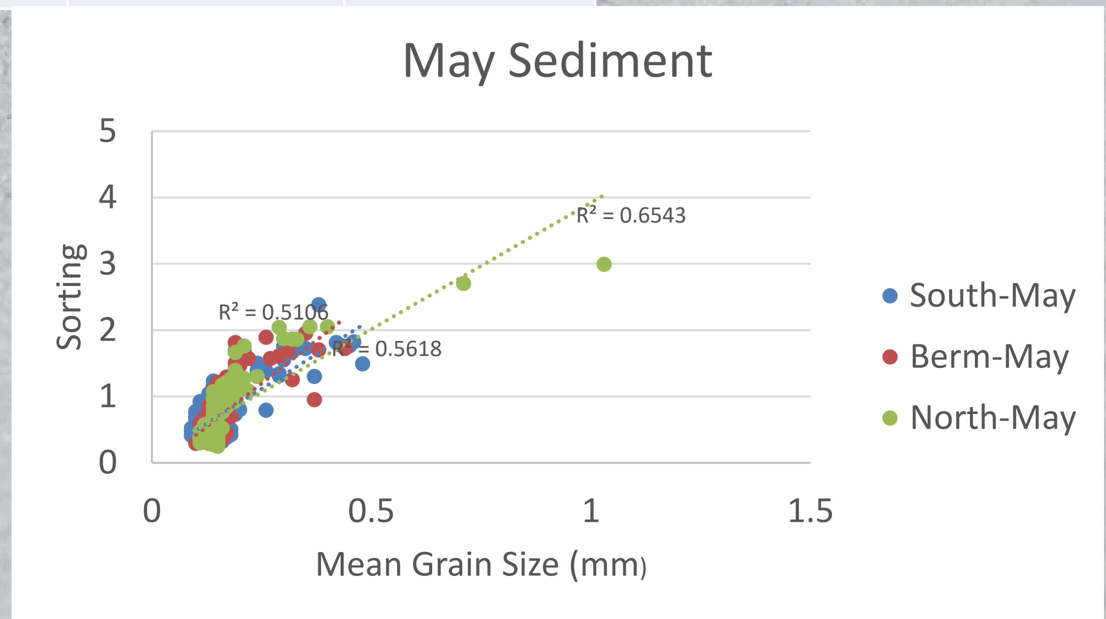


January Suspended Load

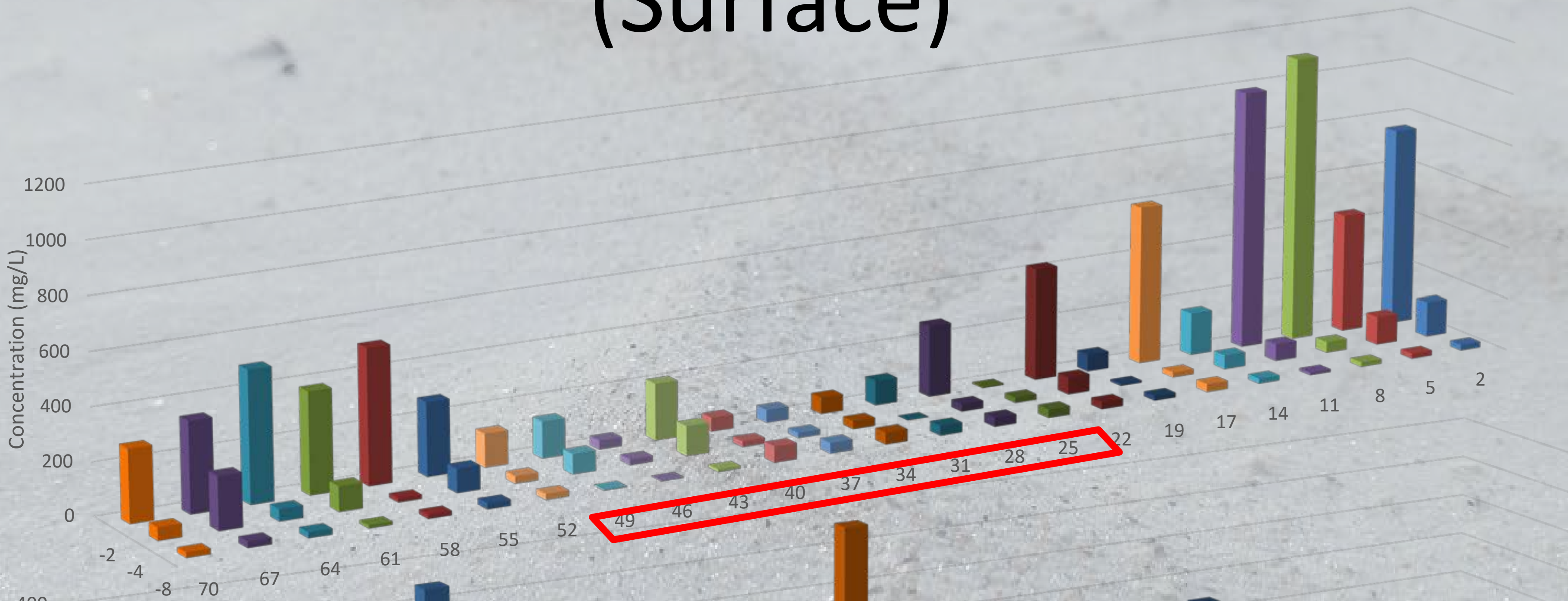


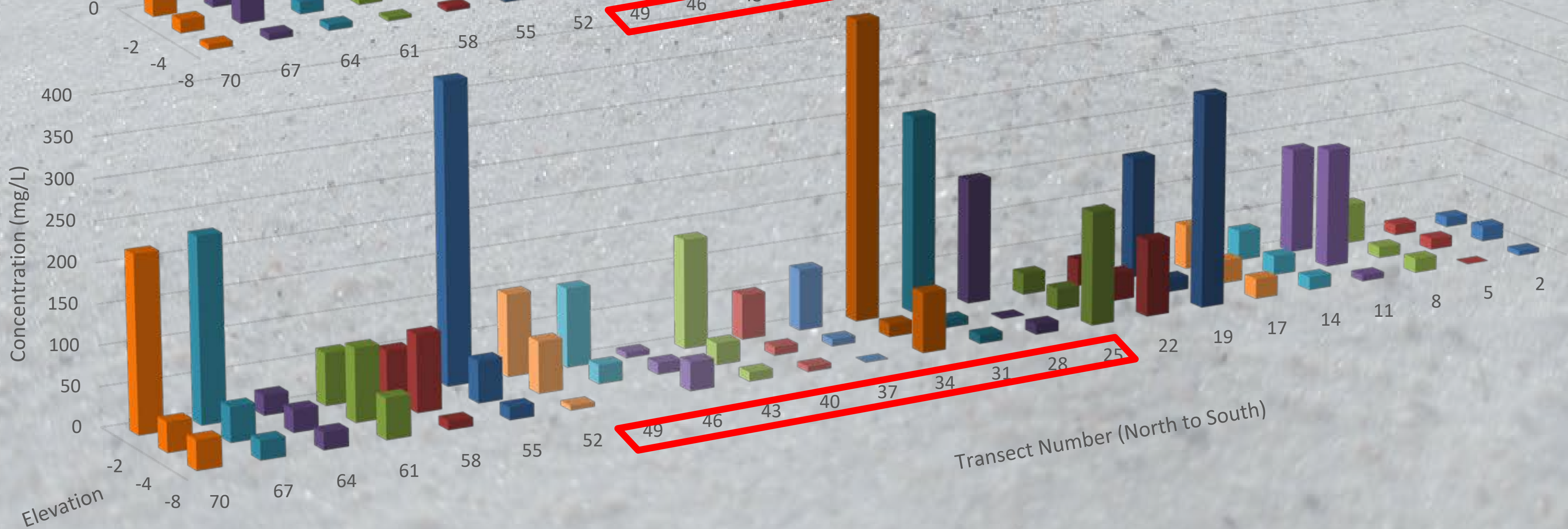
Correlating Suspended to Sediment

R^2 values for Regression Analysis			
	Mean Grain Size (mm)	% Fines	Skew
Surface Concentration	0.0225	0.0055	0.006
Mid-depth Concentration	0.0064	0.0229	0.0012
Bottom Concentration	0.0464	0.0151	0.0348

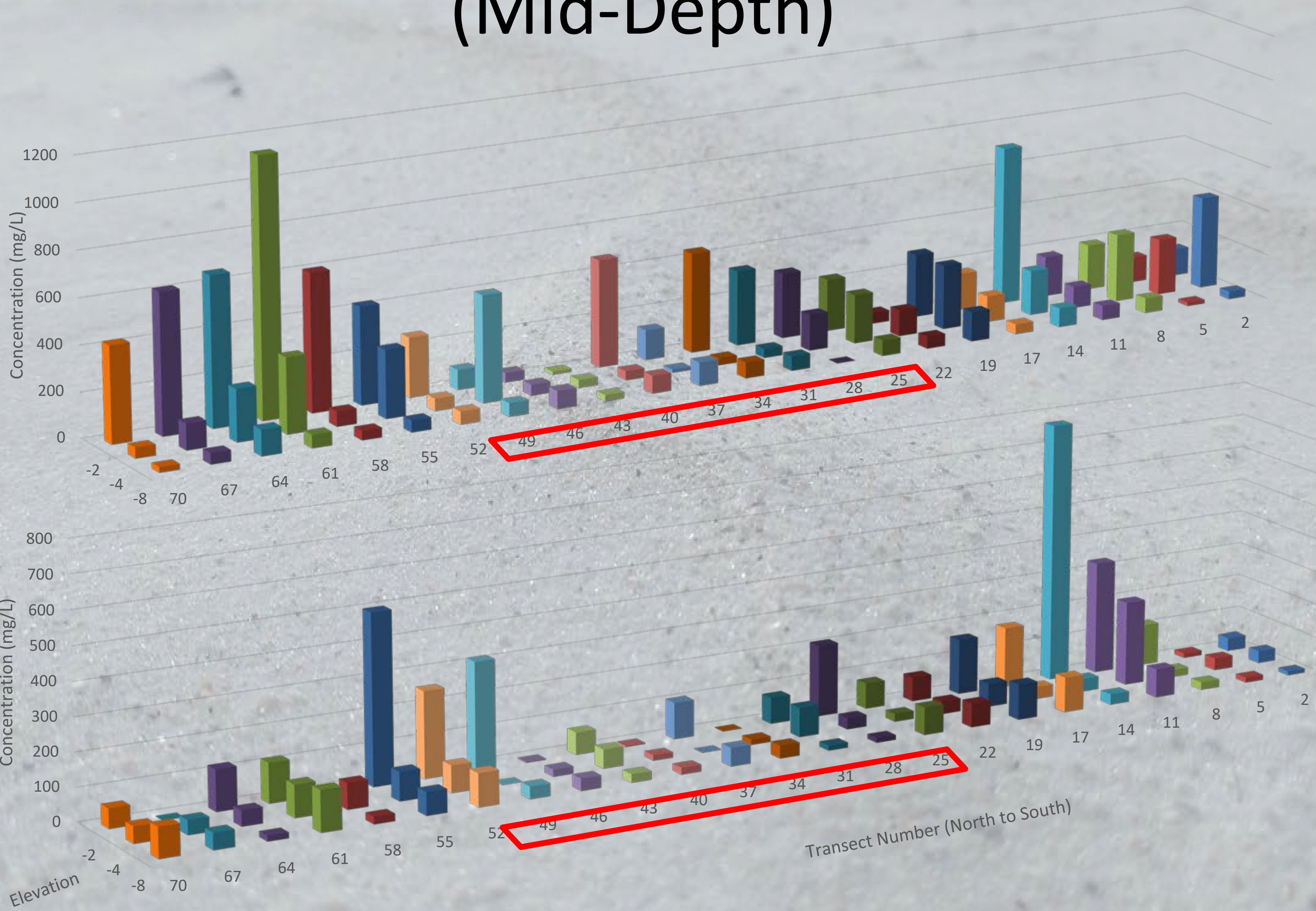


Suspended Spatial Analysis (Surface)

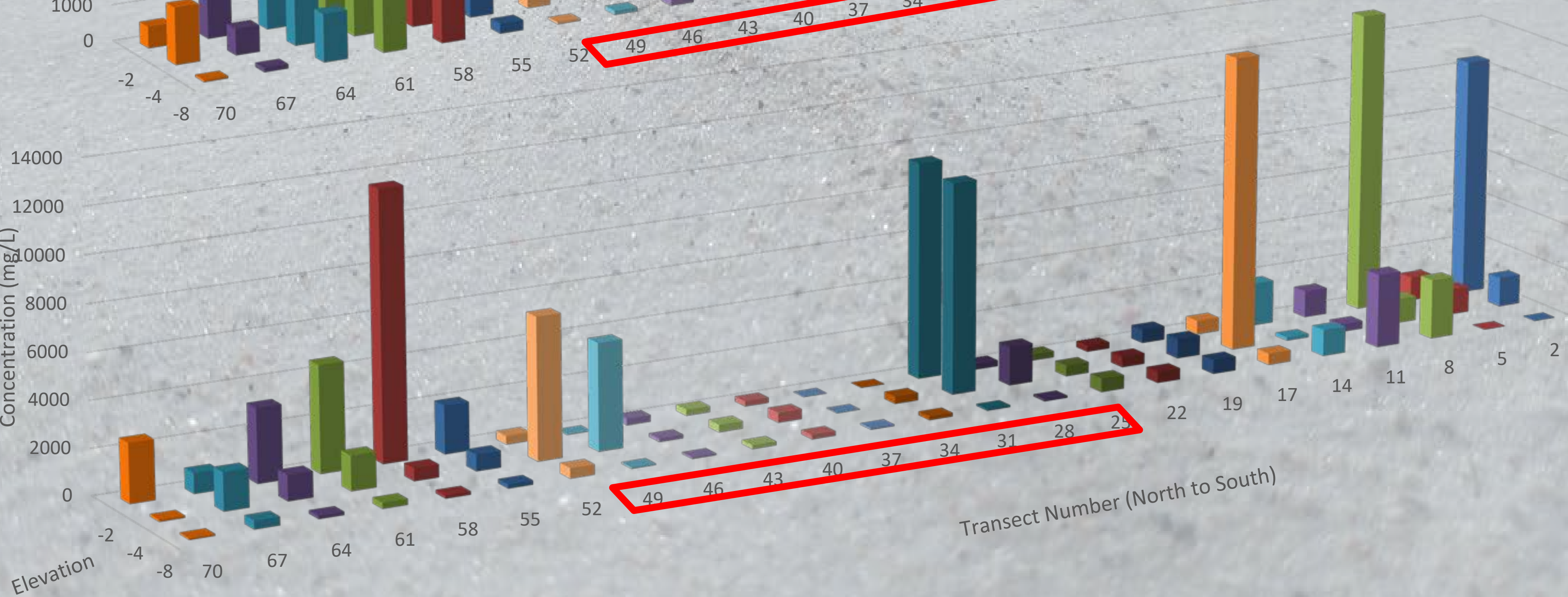




Suspended Spatial Analysis (Mid-Depth)



Suspended Spatial Analysis (Bottom)



May Carbon Distribution