NSERC Applied Research and Development grant with partner Acadian Seaplants: “Quantification of Harvestable Seaweed using a Topographic-bathymetric Lidar System”

Tim Webster, Candace MacDonald, Kevin McGuigan, Kate Collins & Nathan Crowell
+ Contributions from Calvin Gough, Tyler Yorke, Sean Dzafovic, David Kristiansen, Matt Roscoe & Ariel Vallis

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Research Scientist

Applied Geomatics Research Group

Centre Of Geographic Sciences

Nova Scotia Community College

NSERC CRSNG

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Acadian Seaplants

AGRG Applied Geomatics Research Group

Centre of Geographic Sciences
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Acadian Seaplants

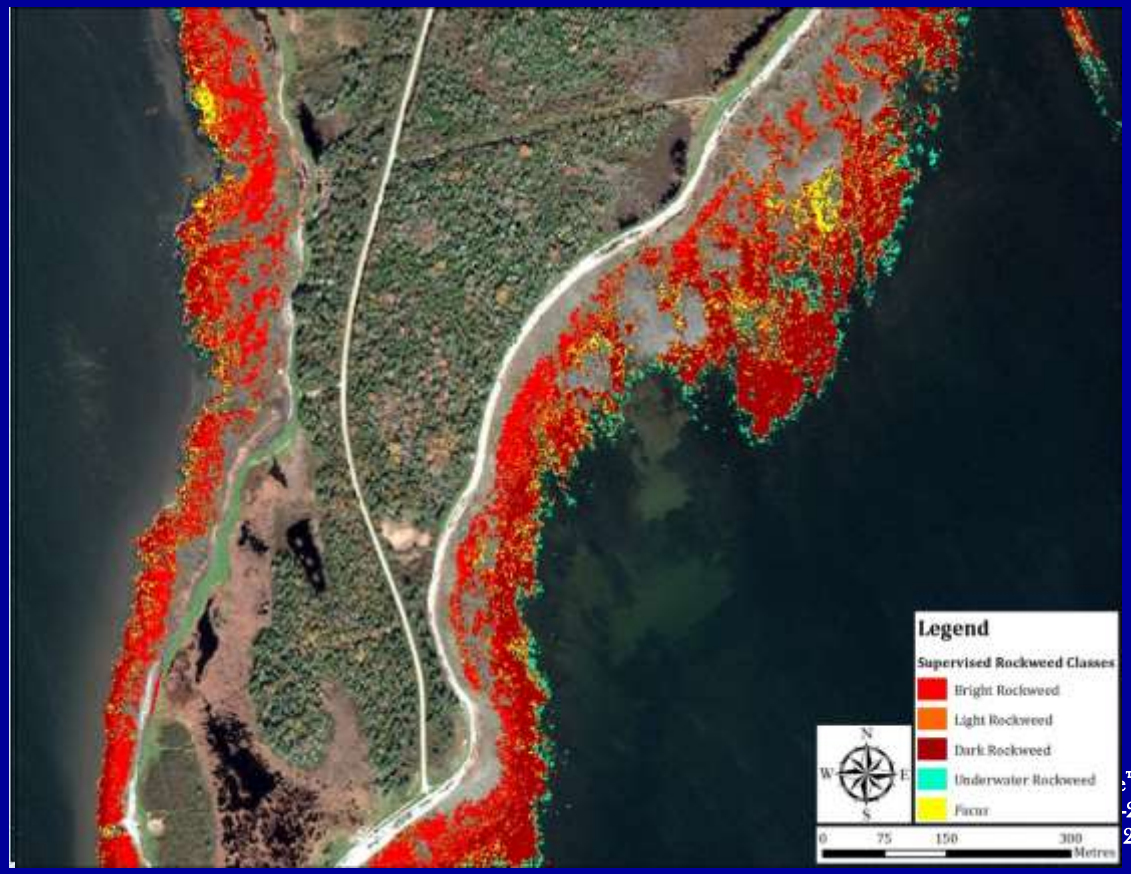
Previous ARD-1 (= Engage) grant, with Bill Livingstone & Candace MacDonald

Mapping Rockweed Seaweed using high-resolution satellite data

- Max. Likelihood classifier
- Four classes of rockweed
- Competitive seaweed *Fucus*

Can calculate the area of exposed rockweed but not the volume, need the height

World leader in *Ascophyllum nodosum* (Rockweed) harvesting for international food, biochemical, agricultural, and agri-chemical markets



Best channel combination for classifying: NIR-1, G, B

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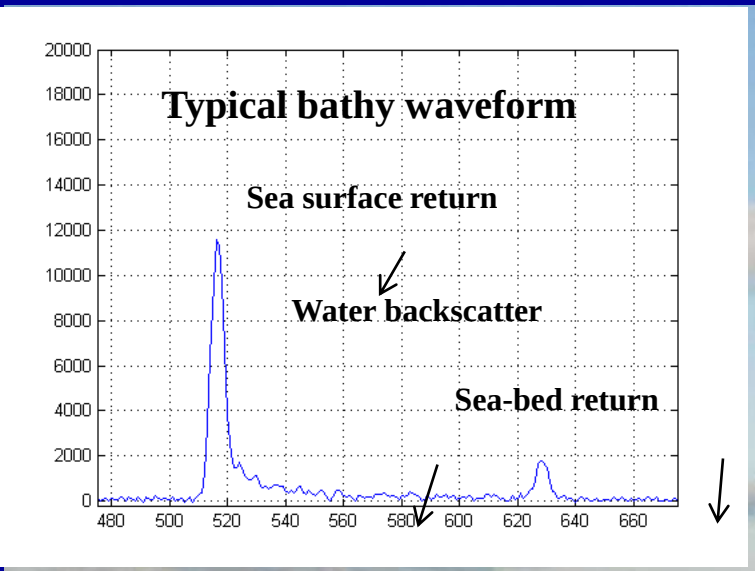
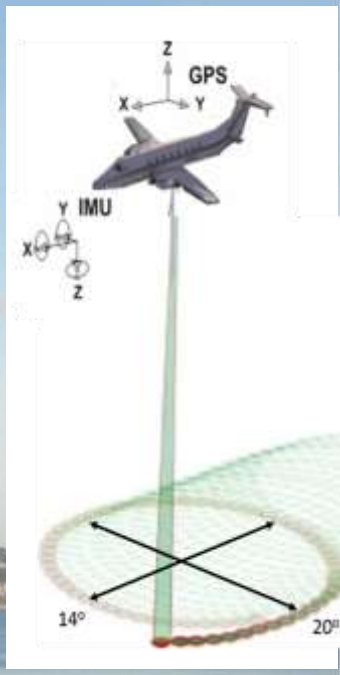
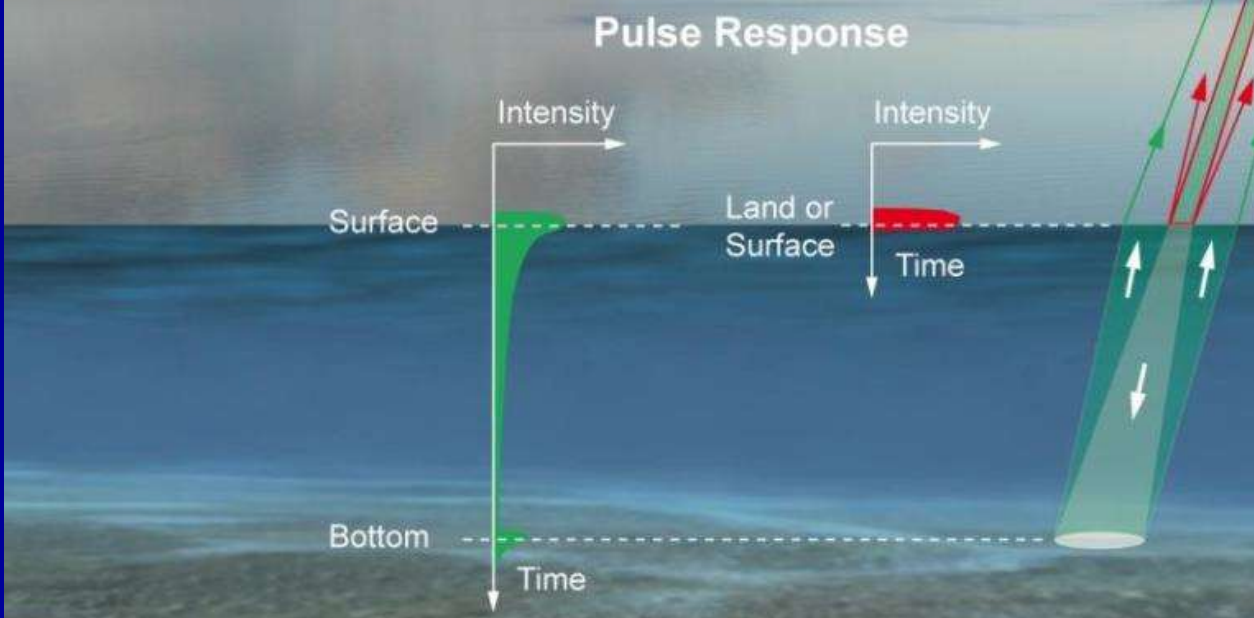
Chiroptera$_{II}$ – Lidar principles



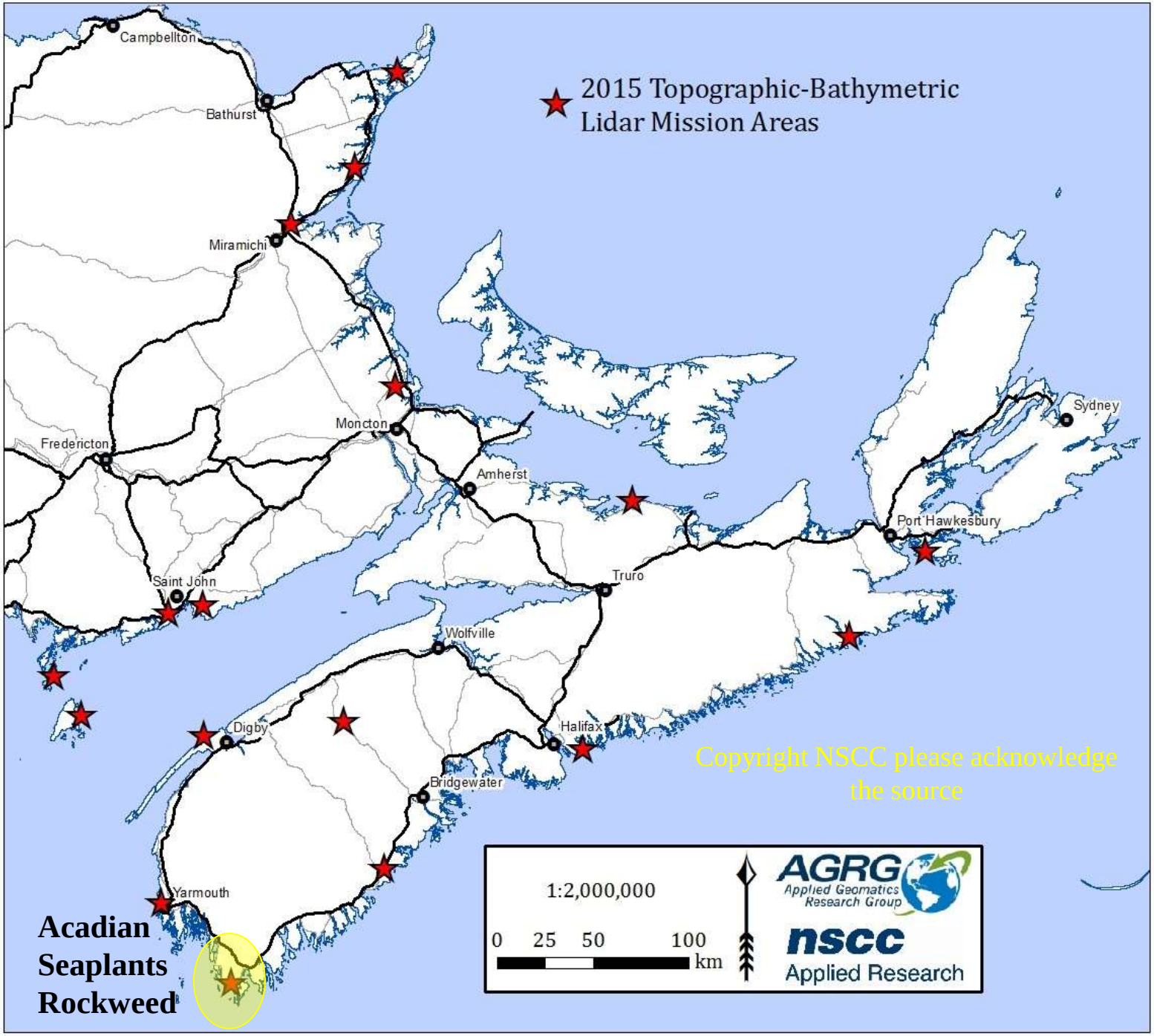
4 sensors
NIR laser 500kHz
Green laser 25 kHz
RCD30 60 MP GRB, NIR
5 MP QA camera





Outline
Intro Topo-bathy lidar
Ground truth surveys
Experiment design
Low & high tide surveys
Preliminary results
Future efforts
Conclude

Source: Leica AHAB


2015 Topographic-Bathymetric
Lidar Mission Areas
Campbellton
Bathurst
Miramichi
Moncton
Fredericton
Amherst
Sydney
Port Hawkesbury
Truro
Saint John
Wolfville
Digby
Halifax
Bridgewater
Yarmouth
Acadian
Seaplants
Rockweed
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the source
1:2,000,000
0 25 50 100
km
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Research Group
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Applied Research

The Experiment

- Because Rockweed has an air filled bladder and floats, it may obstruct the lidar from reaching the ground at high tide, so 2 surveys were conducted
- Low tide covering a large area at 30% overlap flight lines
- High tide – 2 orthogonal directions at 50% overlap flight lines
- Prior and simultaneous ground truthing during the surveys

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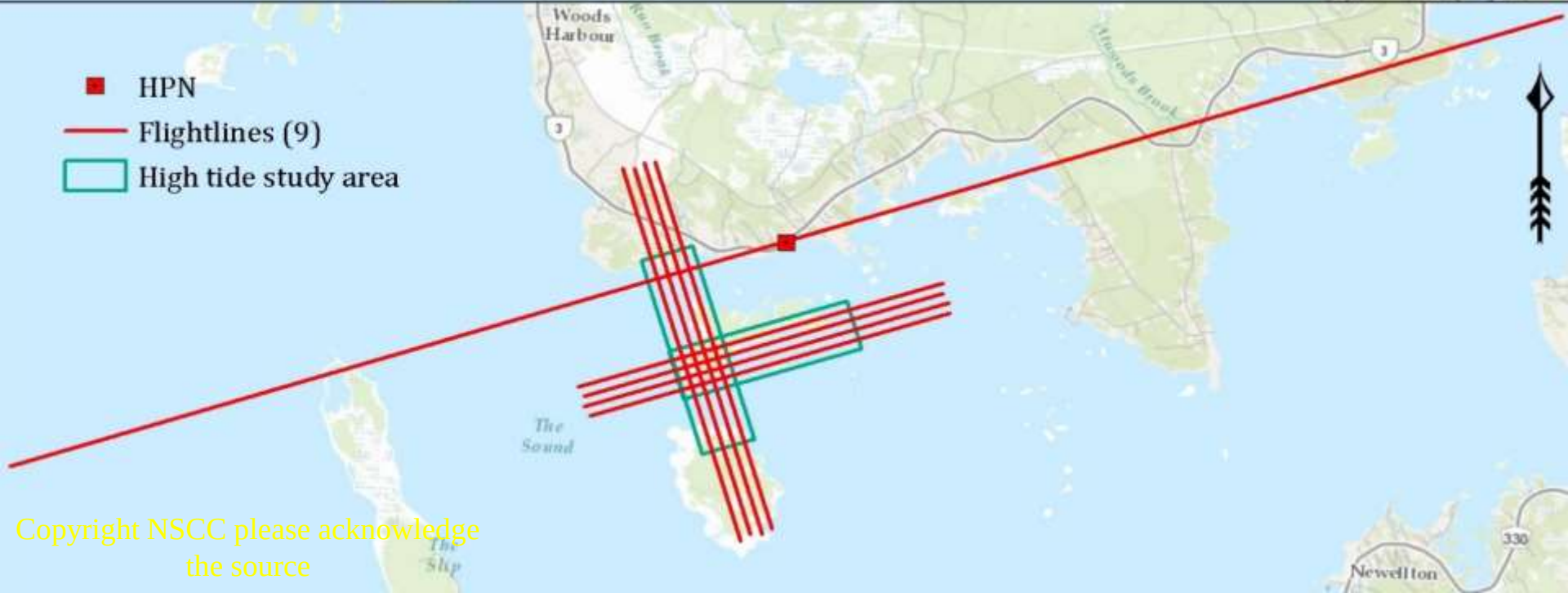

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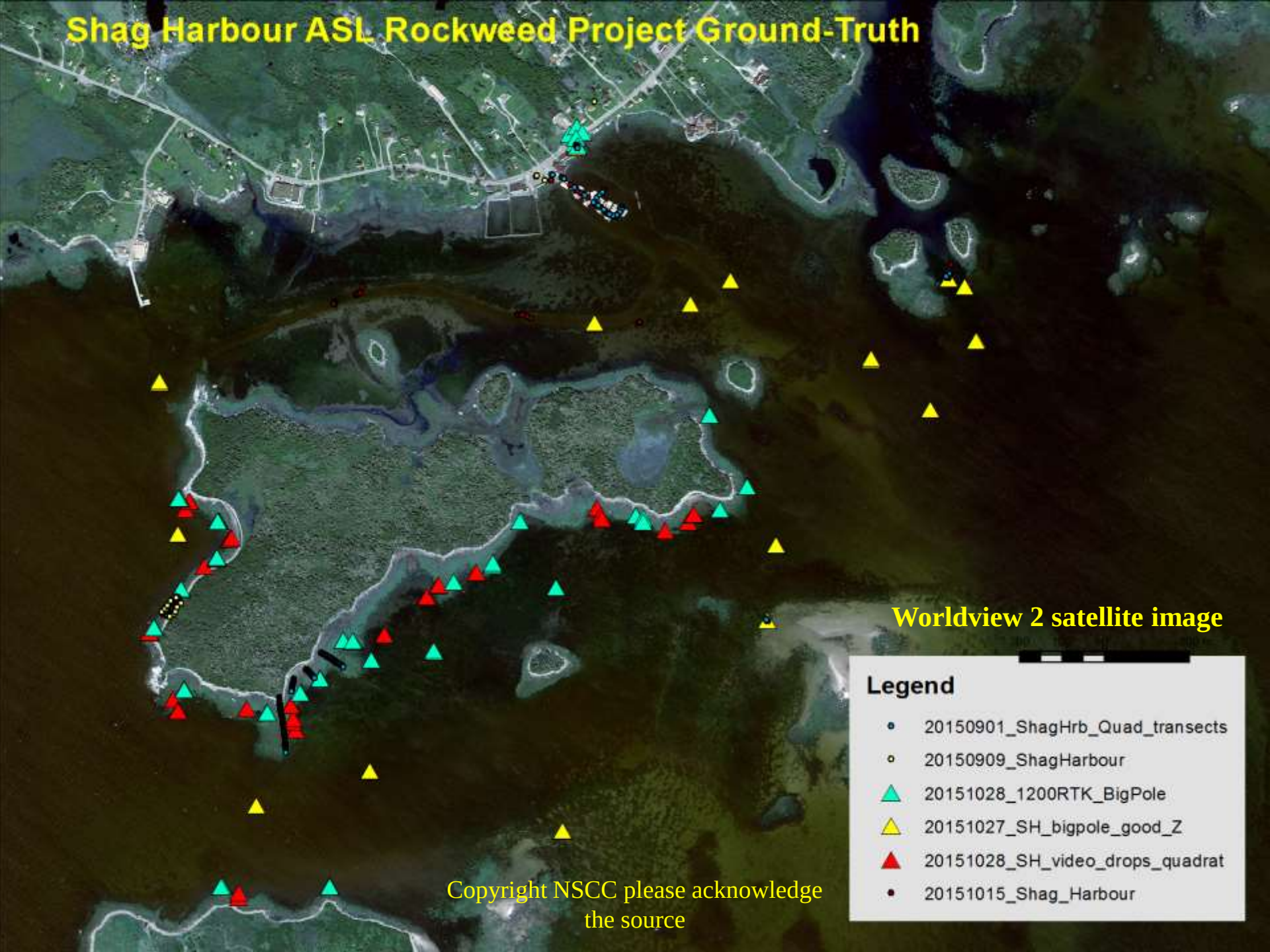
Shag Harbour ASL Rockweed Project Ground-Truth
Worldview 2 satellite image
Legend
20150901_ShagHrb_Quad_transects
20150909_ShagHarbour
20151028_1200RTK_BigPole
20151027_SH_bigpole_good_Z
20151028_SH_video_drops_quadrat
20151015_Shag_Harbour
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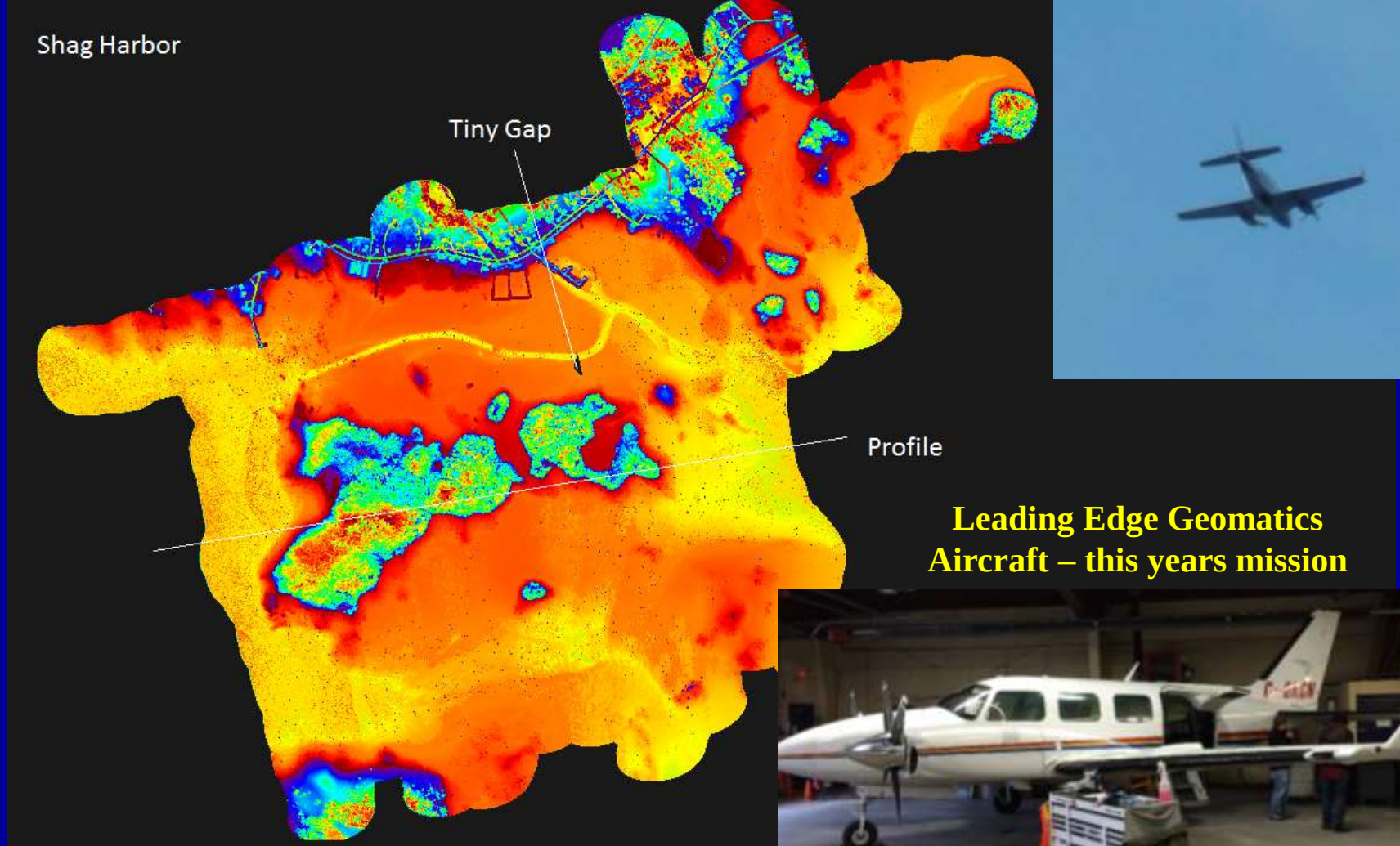
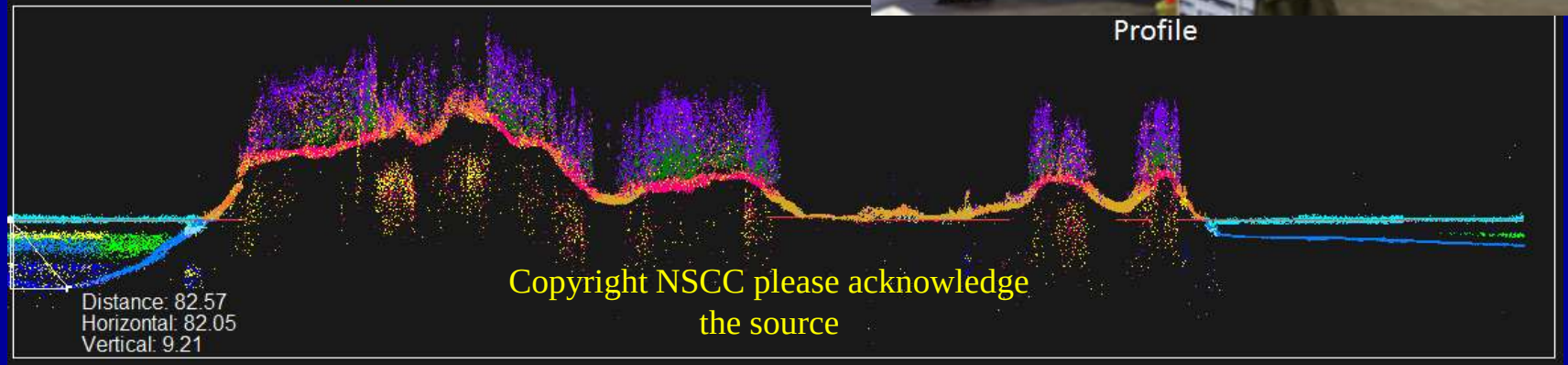


Leading Edge Geomatics Aircraft – this years mission



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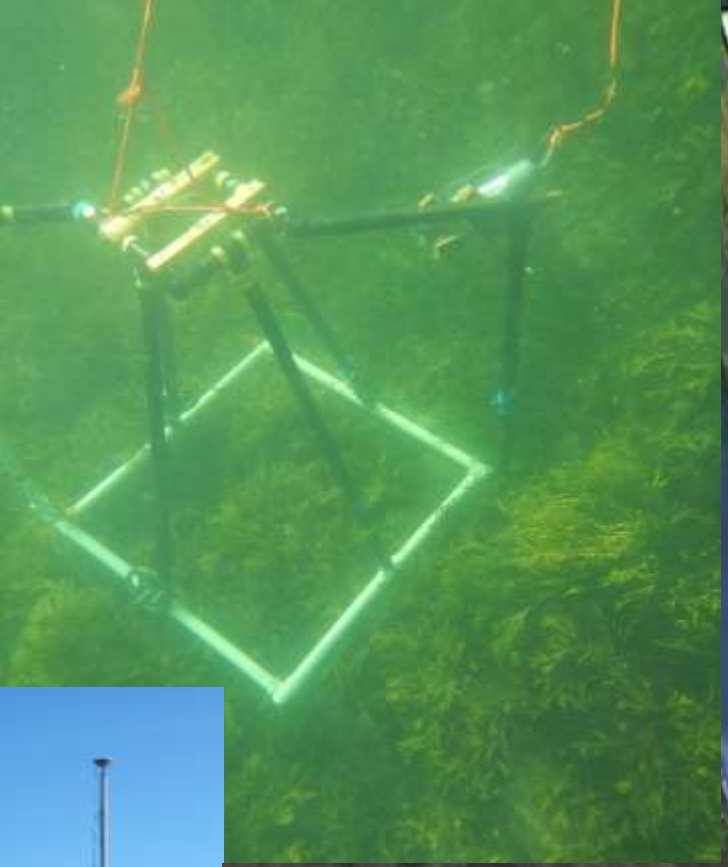

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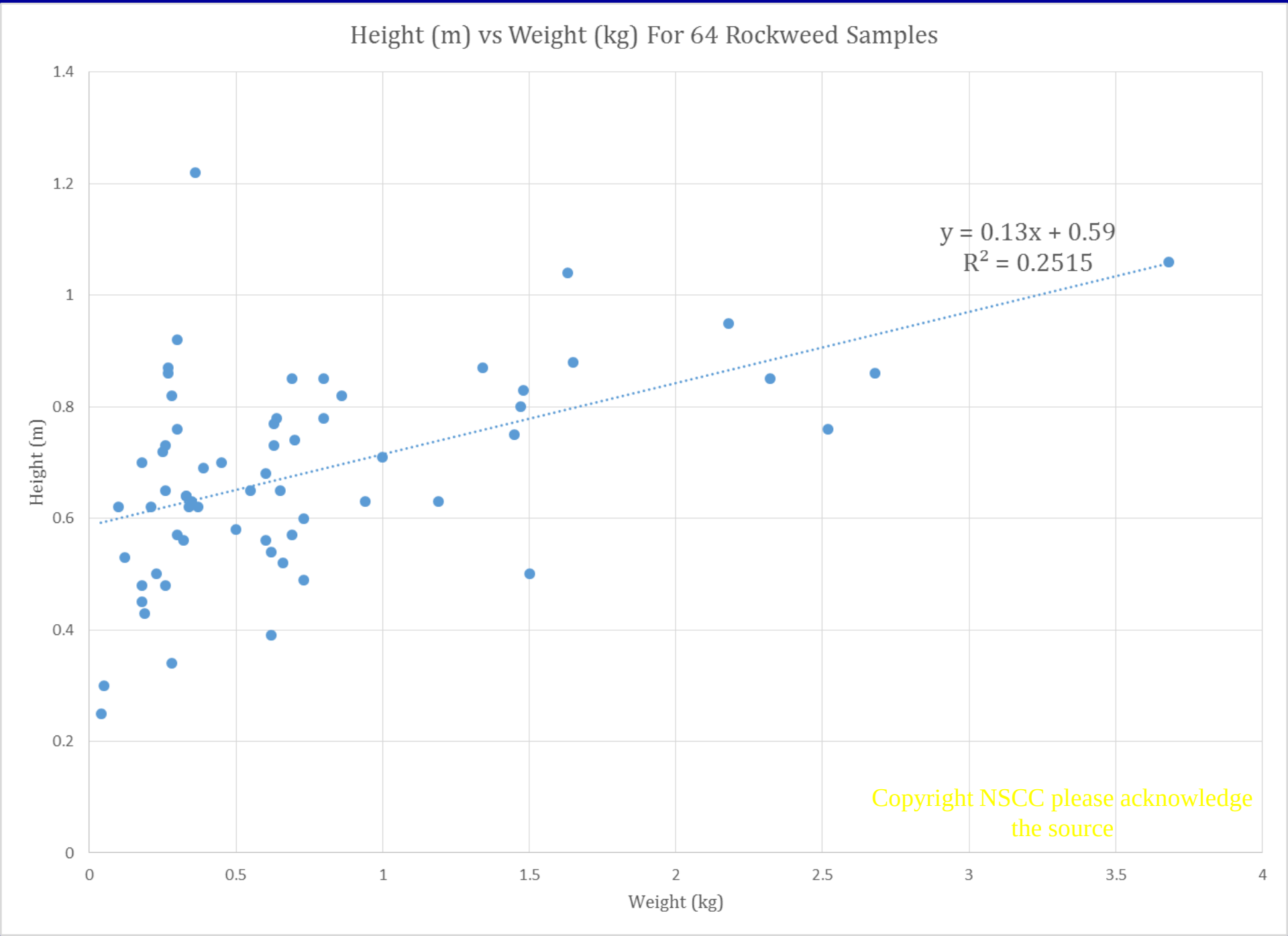
Height (m) vs Weight (kg) For 64 Rockweed Samples
y = 0.13x + 0.59
R² = 0.2515
Height (m)
Weight (kg)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
0
0.5
1
1.5
2
2.5
3
3.5
4
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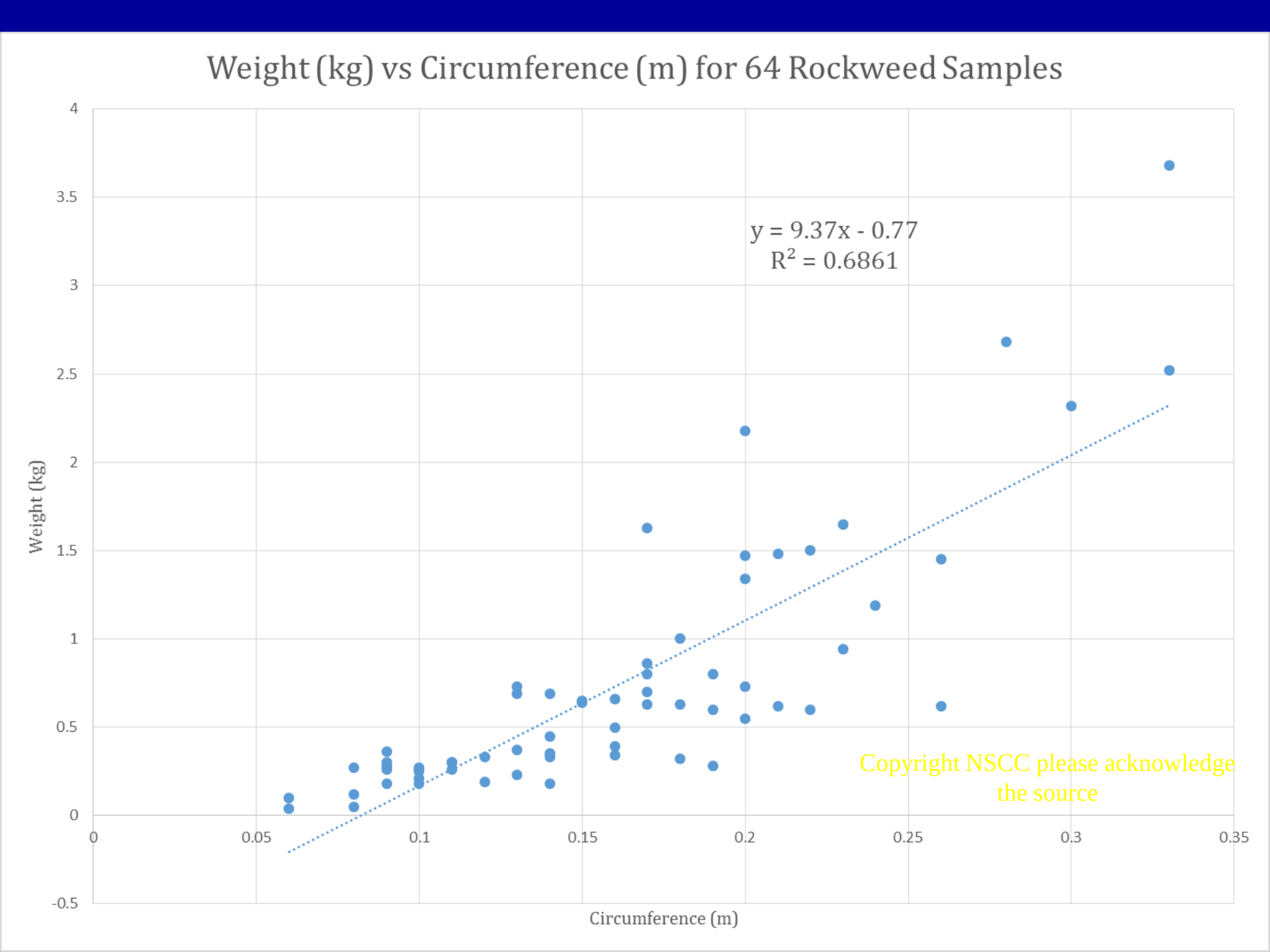
Weight (kg) vs Circumference (m) for 64 Rockweed Samples
y = 9.37x - 0.77
R² = 0.6861
Weight (kg)
Circumference (m)
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
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Combined Cuts and Weights

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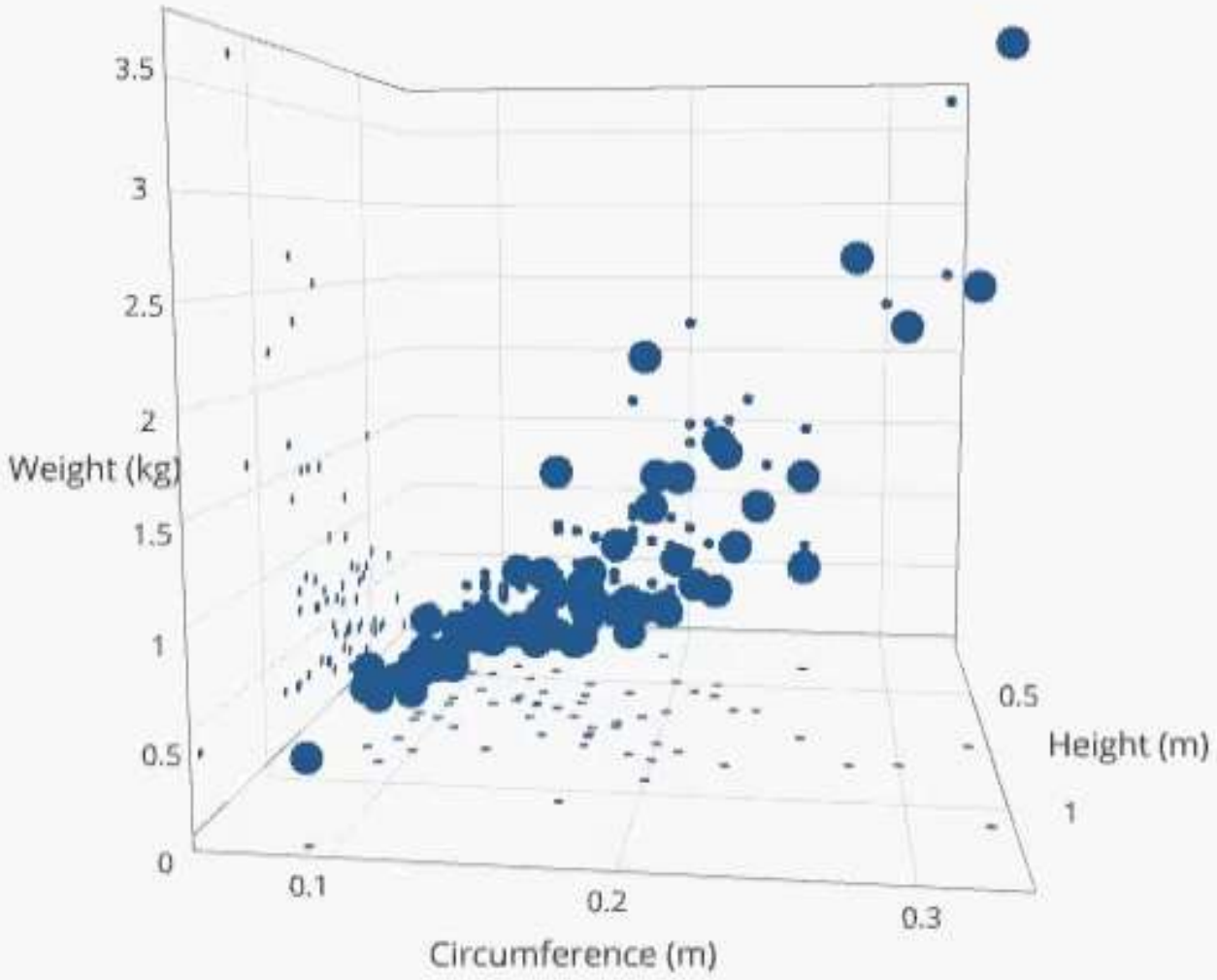
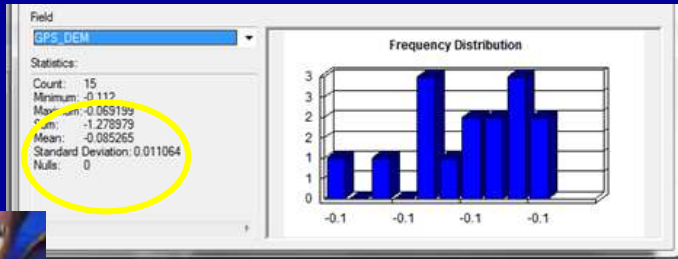
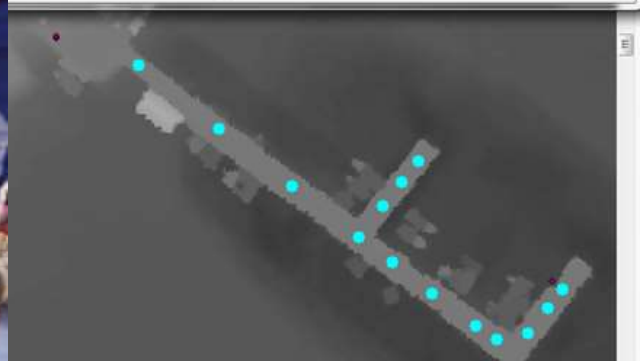


Shag Harbour



High tide



Low tide

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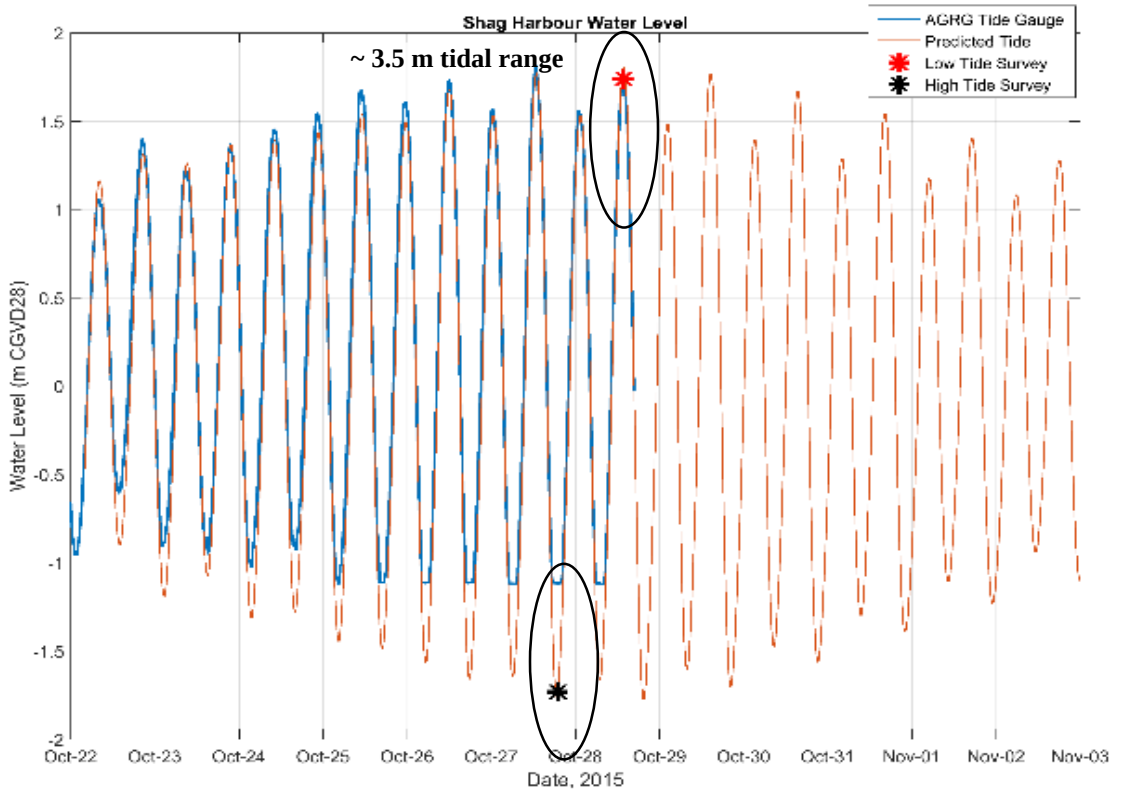


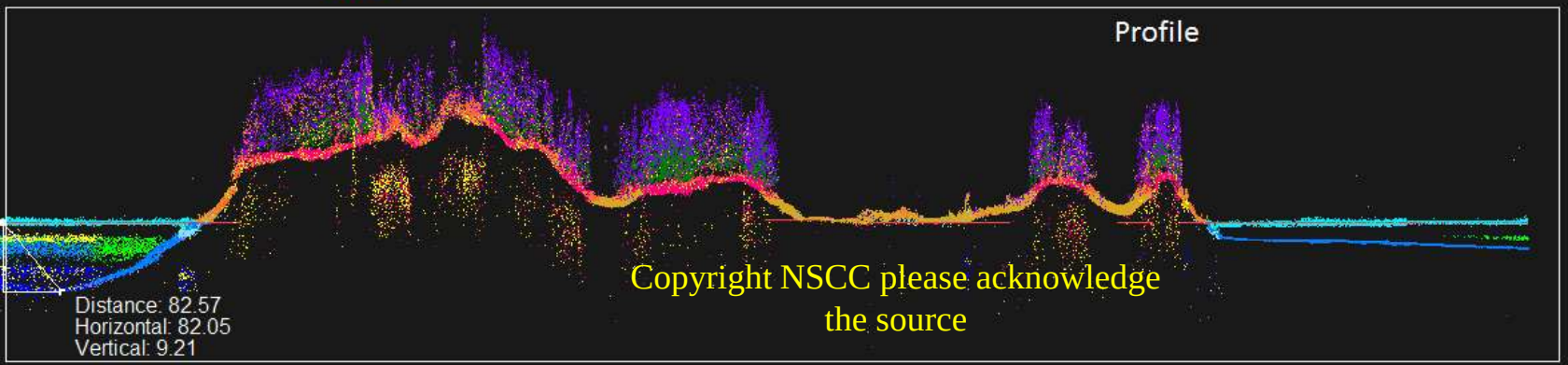
Shag Harbor

Low tide survey

Tiny Gap

Profile

Leading Edge Geomatics Aircraft – this years mission



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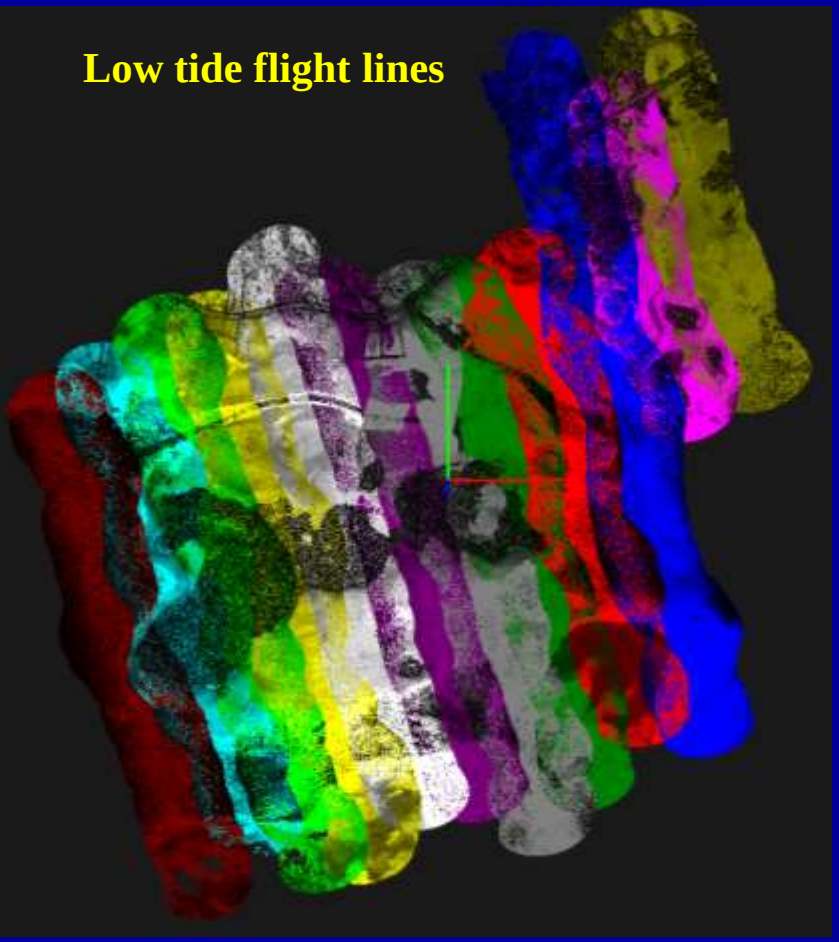
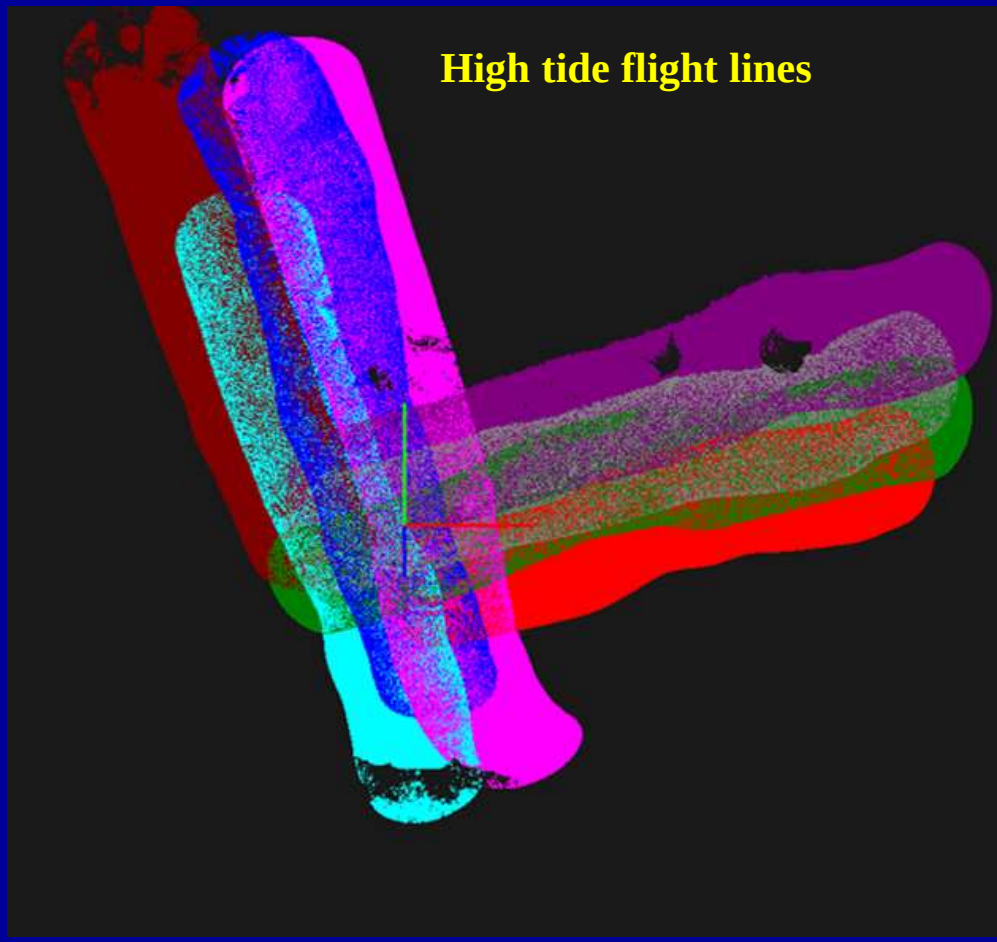
Low tide flight lines



High tide flight lines



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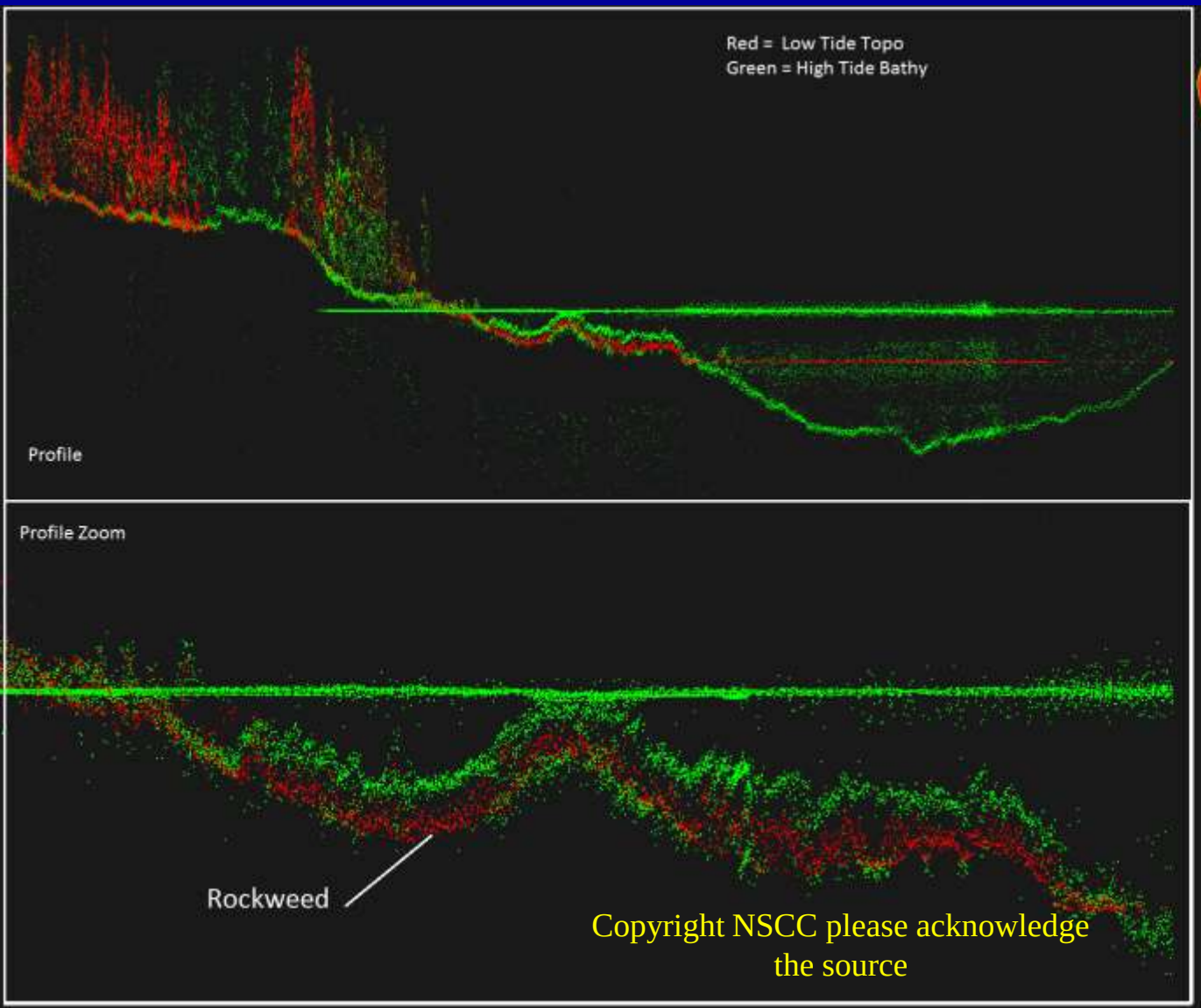
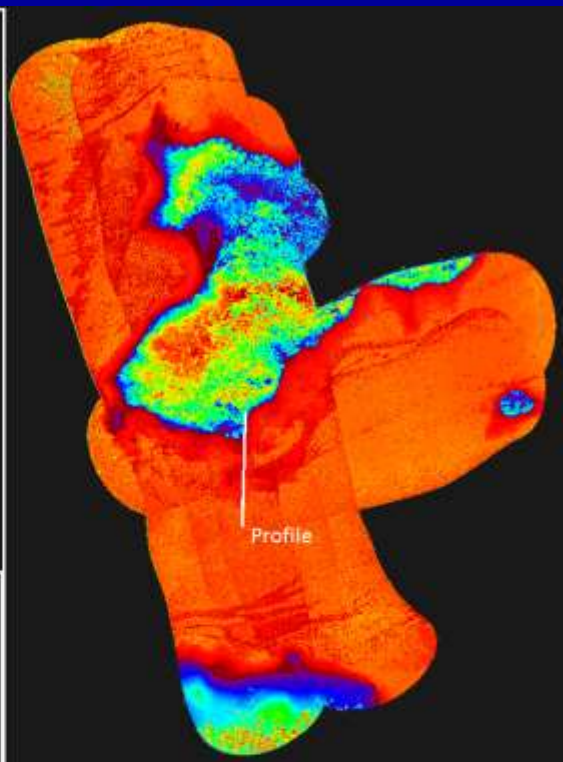
Shag Harbour Low Tide – High Tide to map Rockweed Biomass





Shag Harbor
Oct 27 - Low Tide
Oct 28 - High Tide

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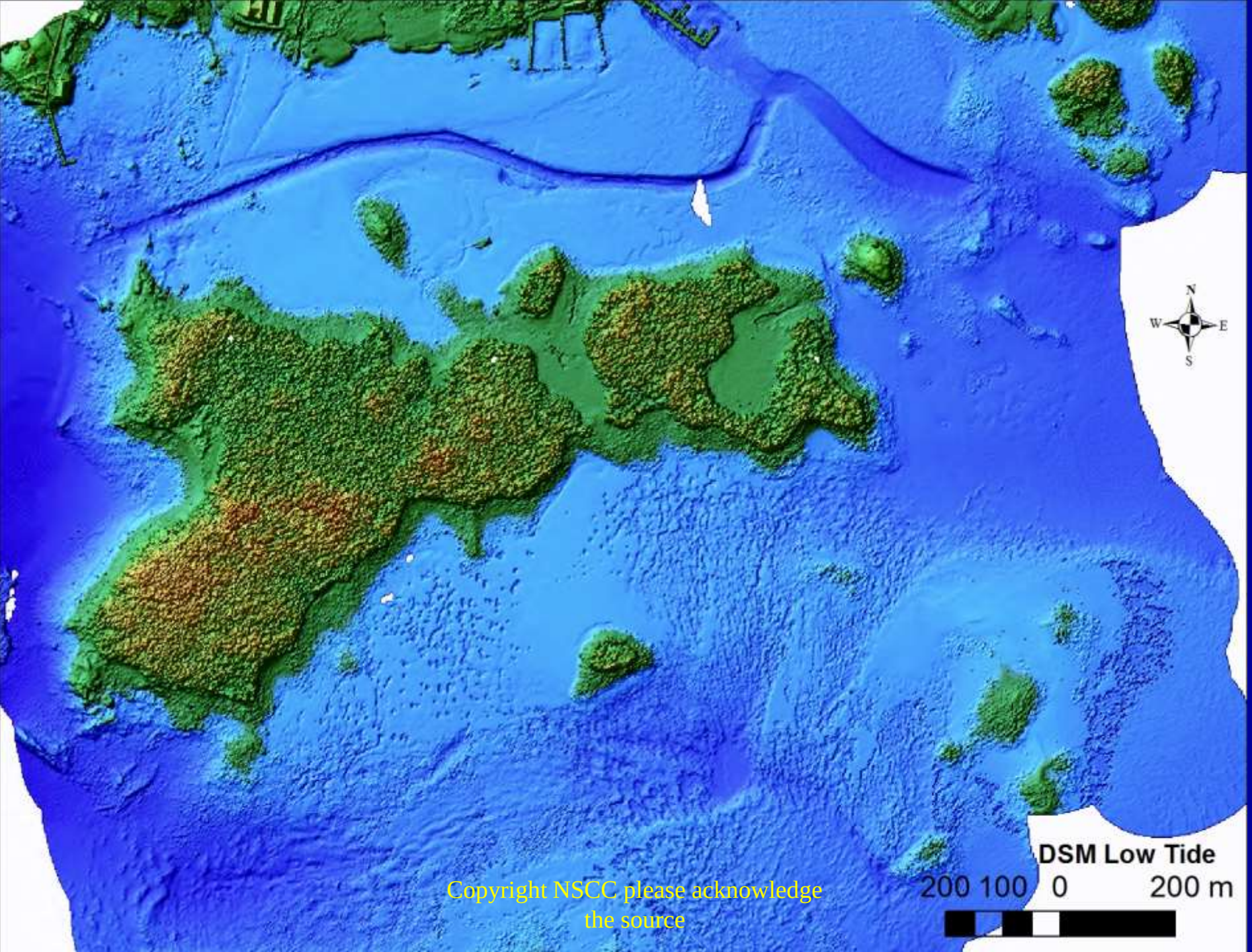

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RCD30 Low Tide
200 100 0 200 m
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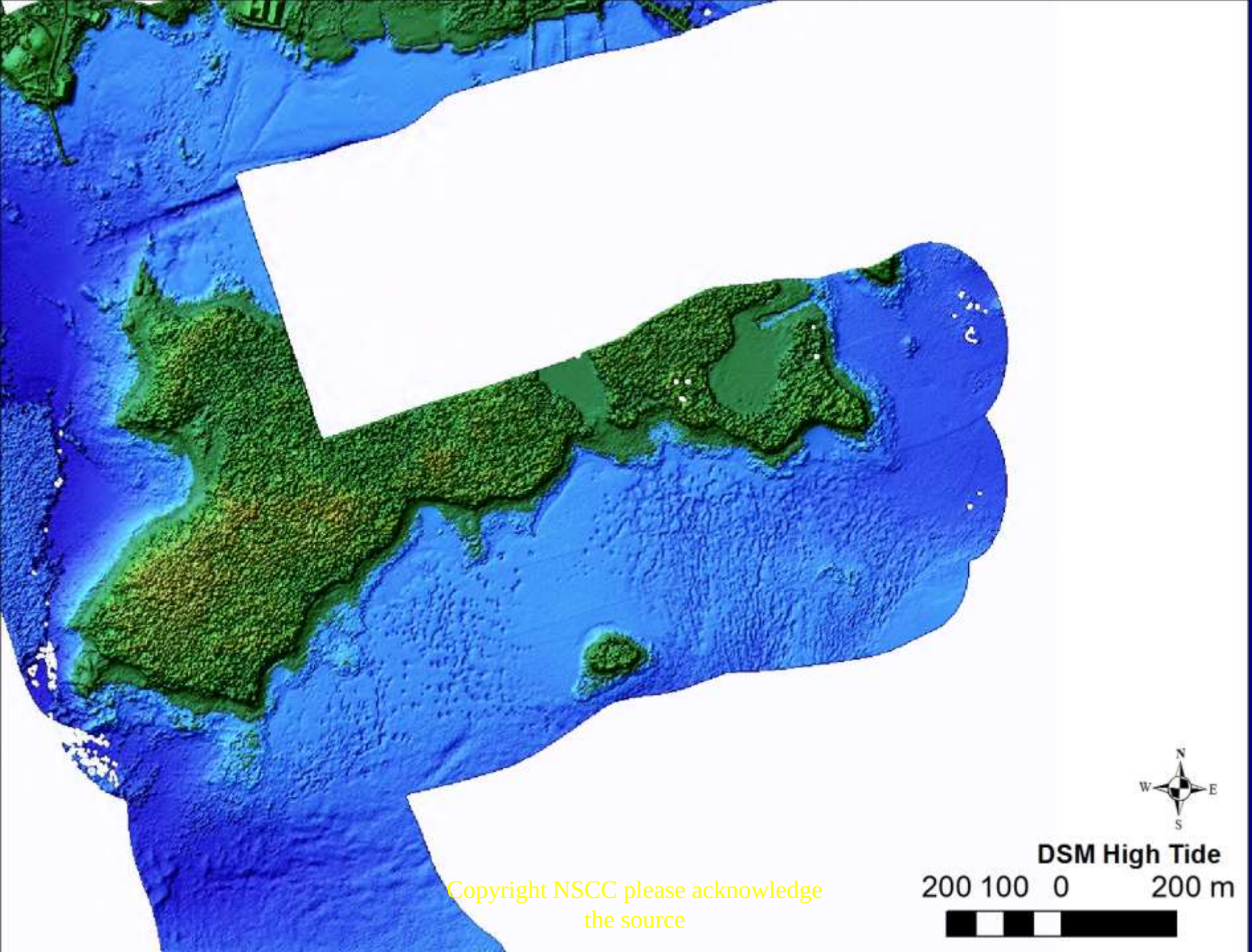

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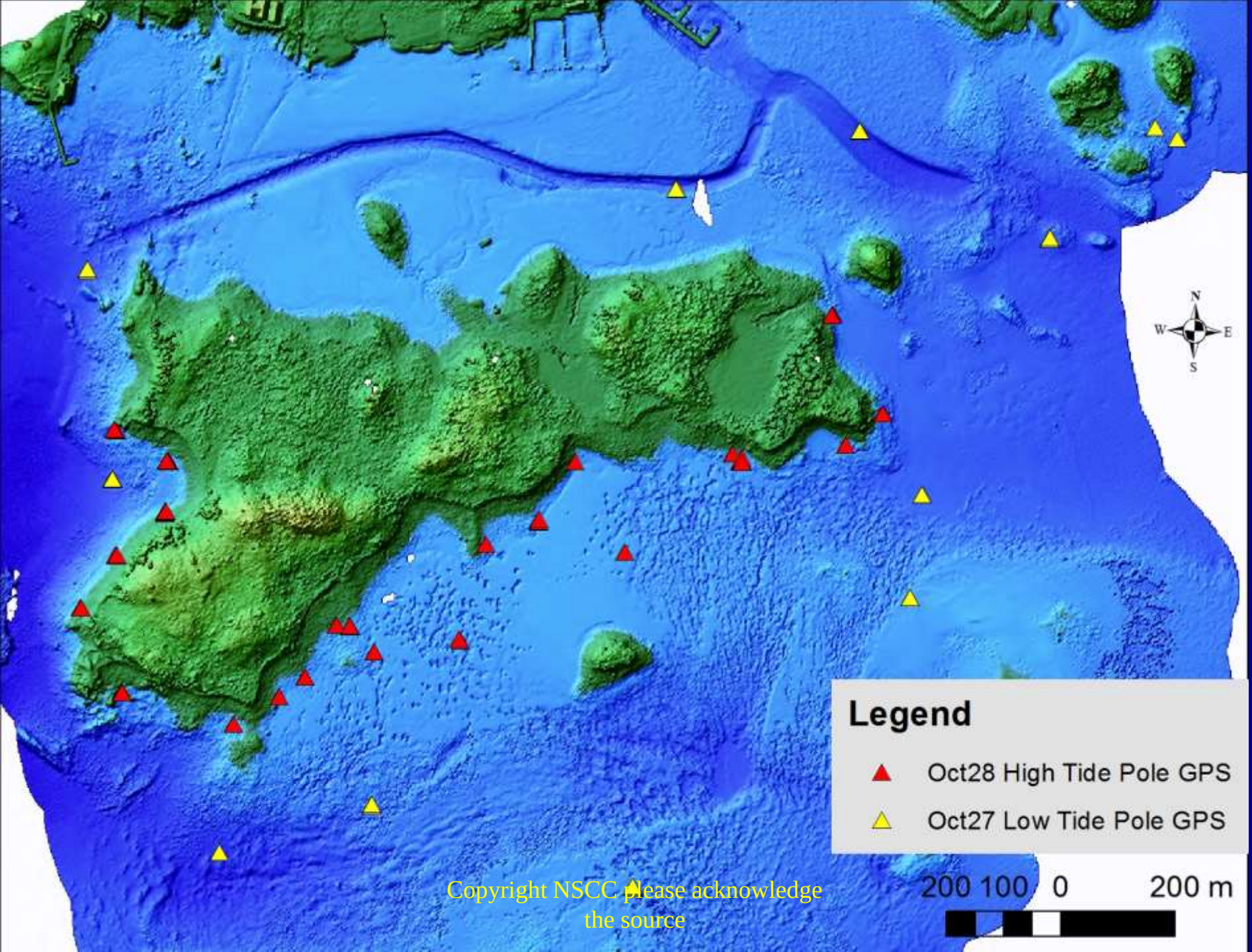
N
W
E
S
Legend
Oct28 High Tide Pole GPS
Oct27 Low Tide Pole GPS
200 100 0 200 m
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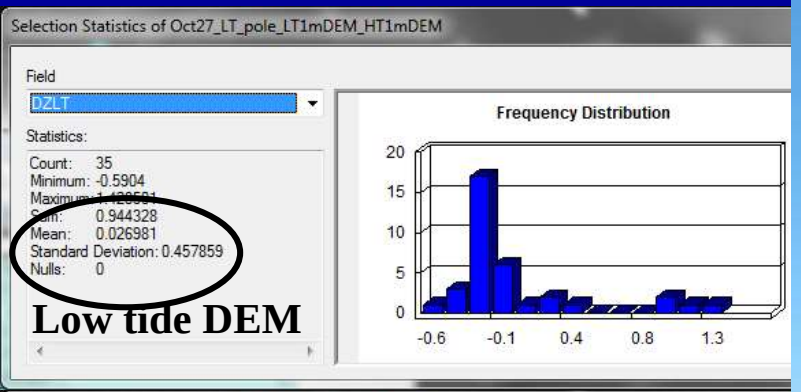
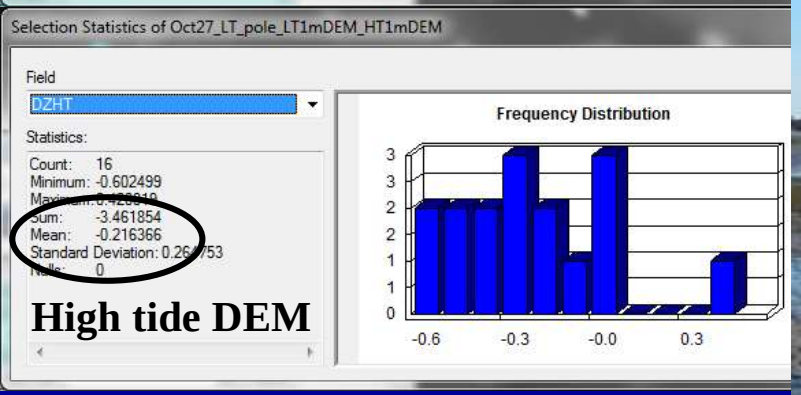
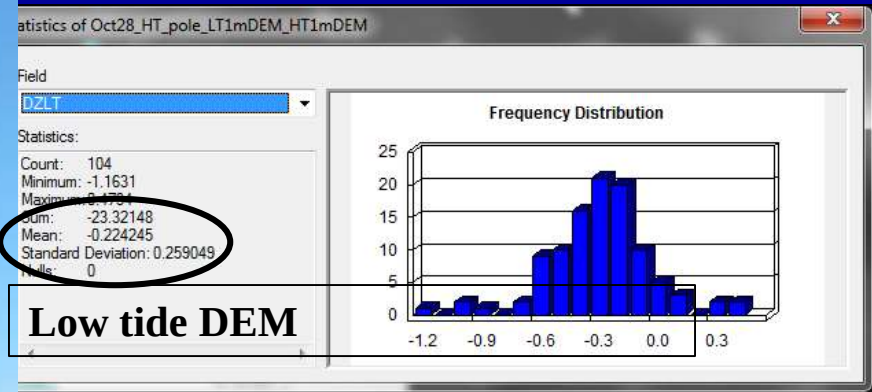
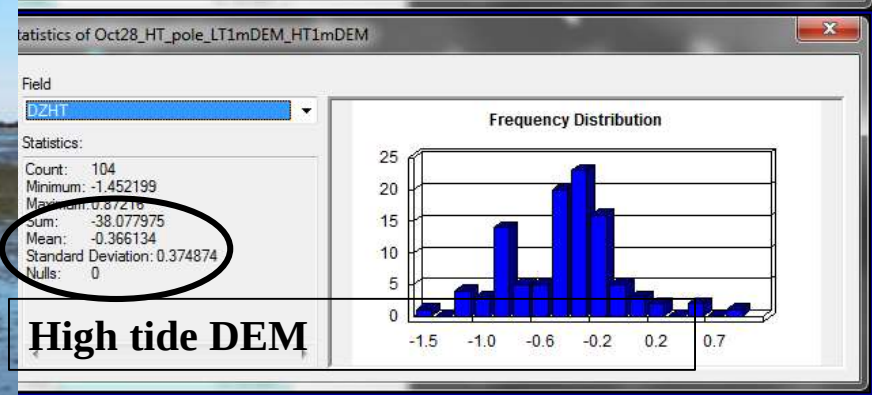
Pole GPS during low tide survey

Pole GPS during high tide survey









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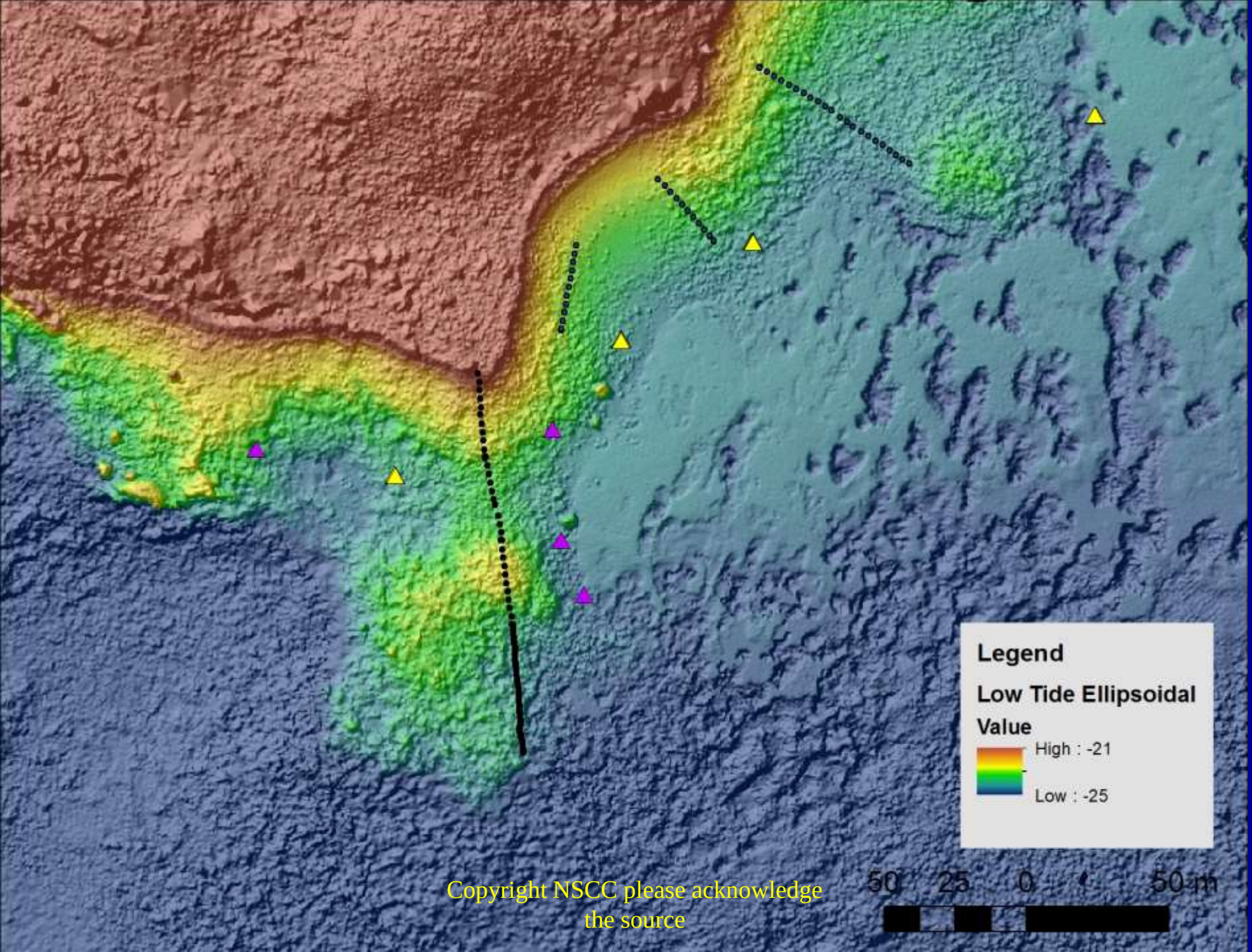

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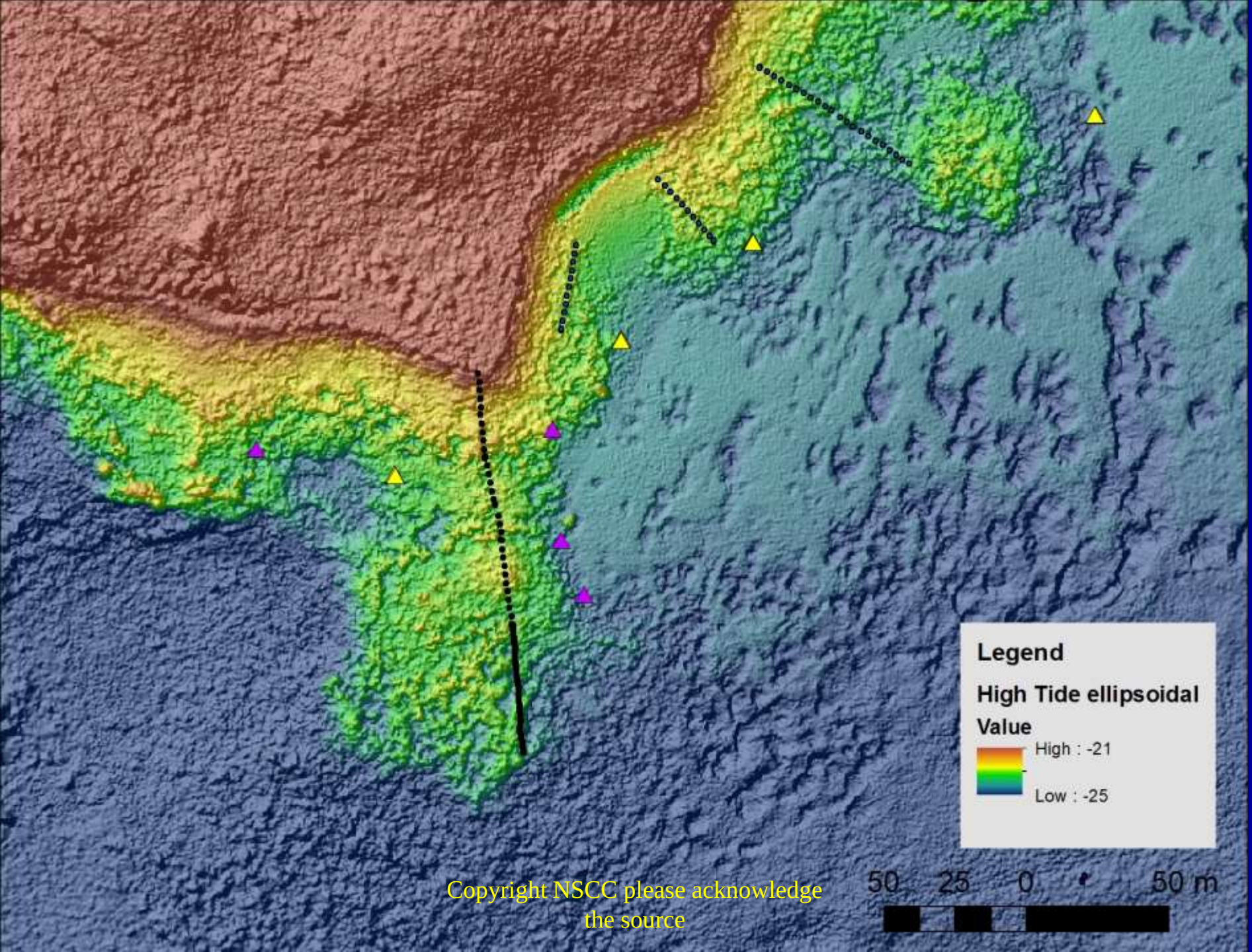

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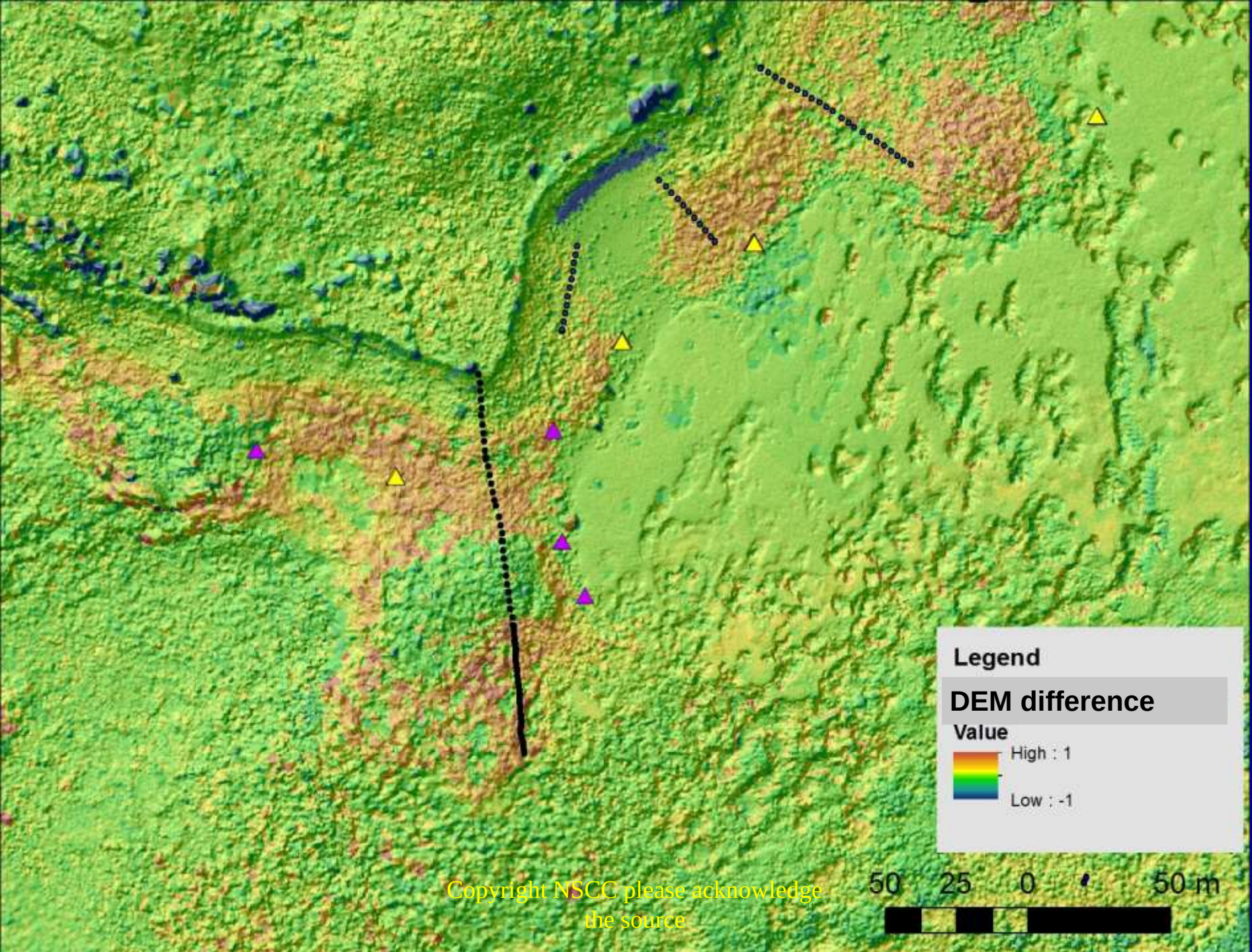

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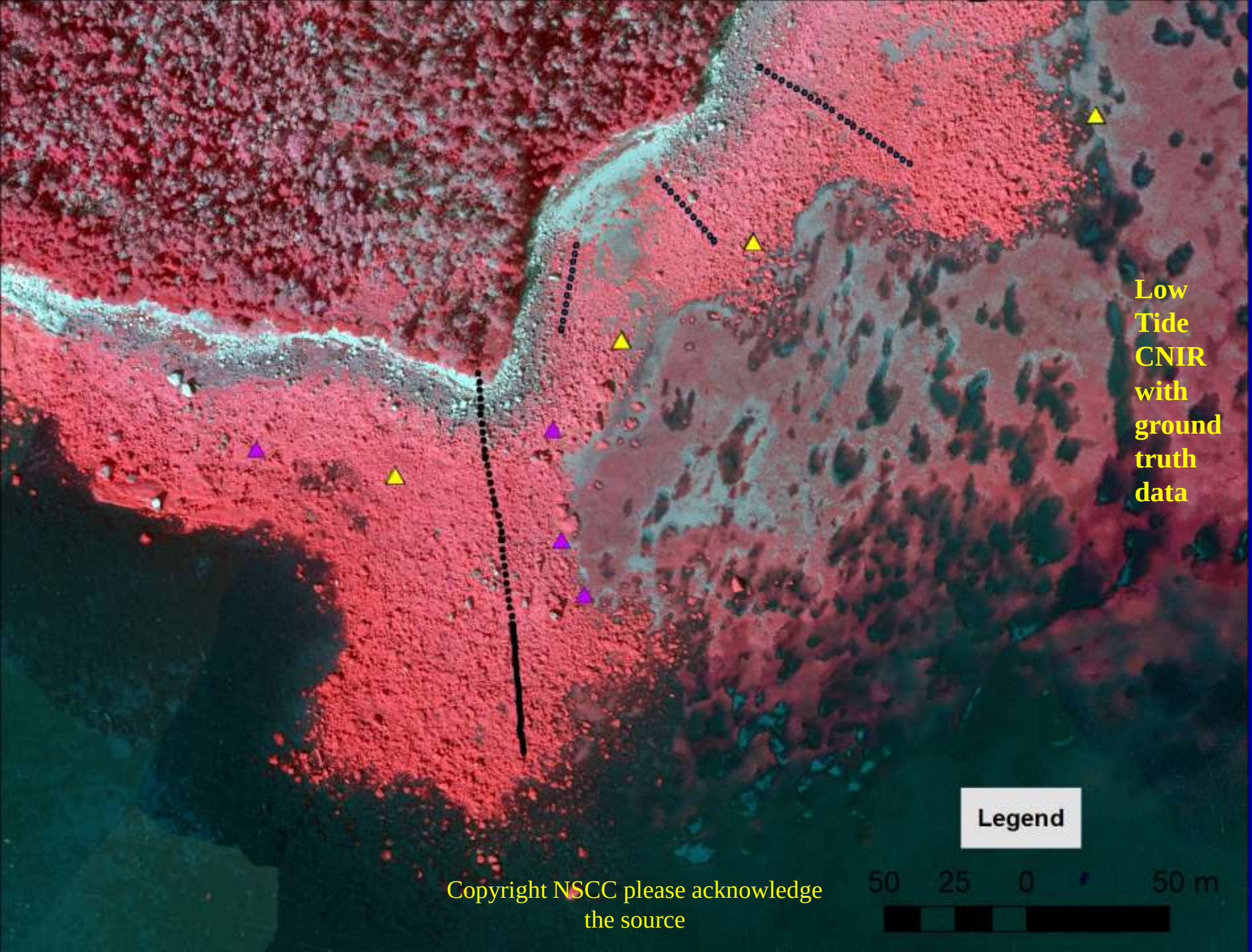

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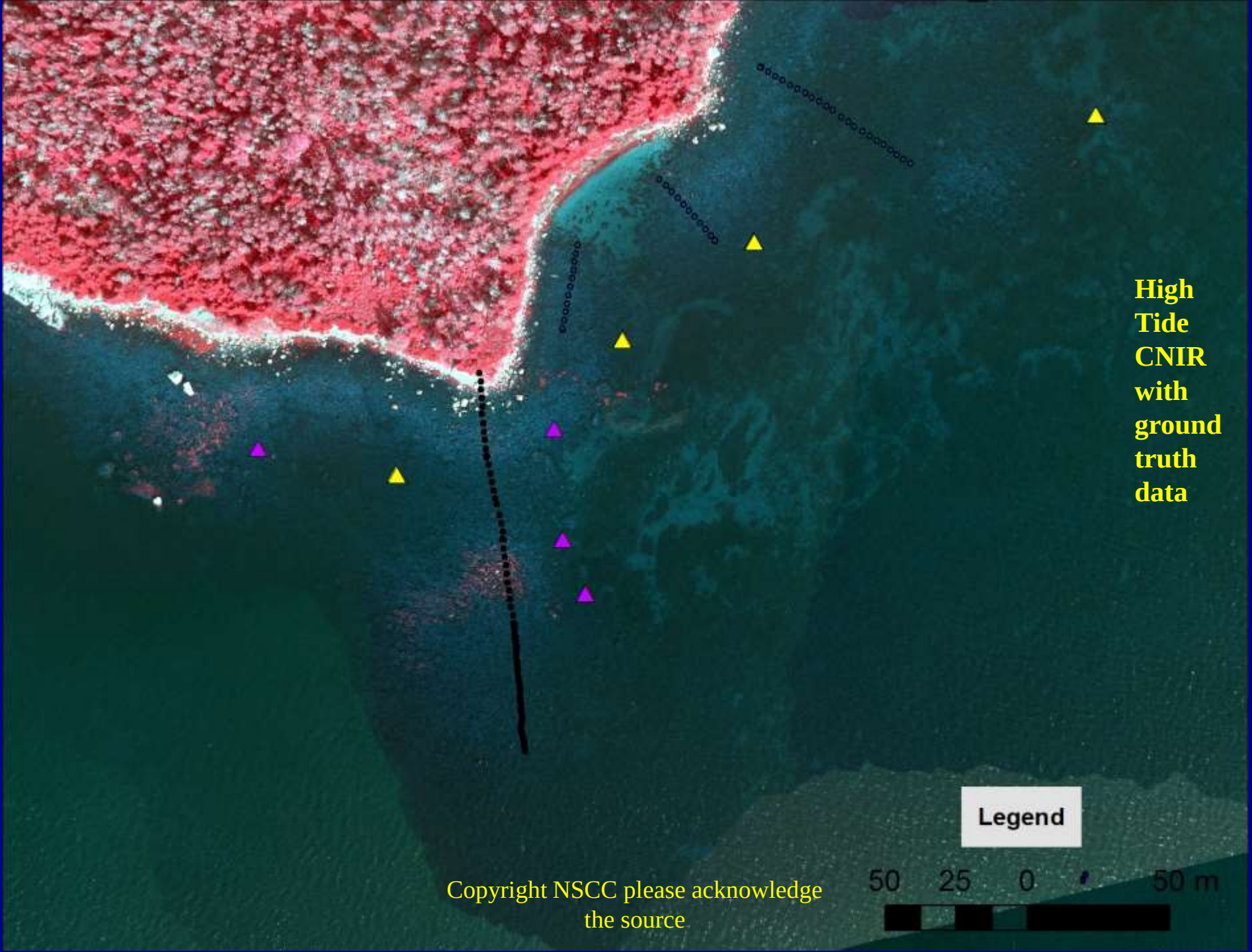

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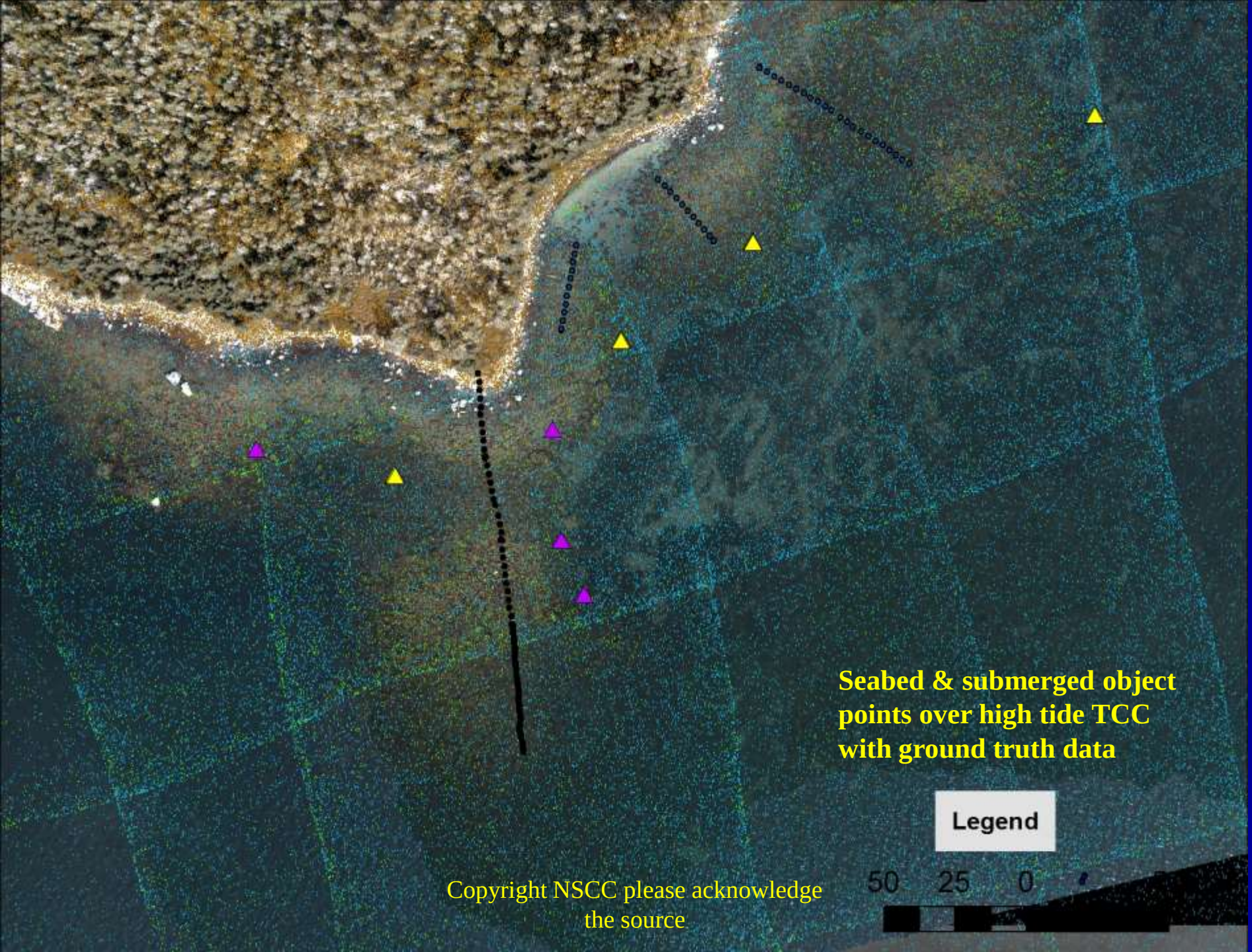

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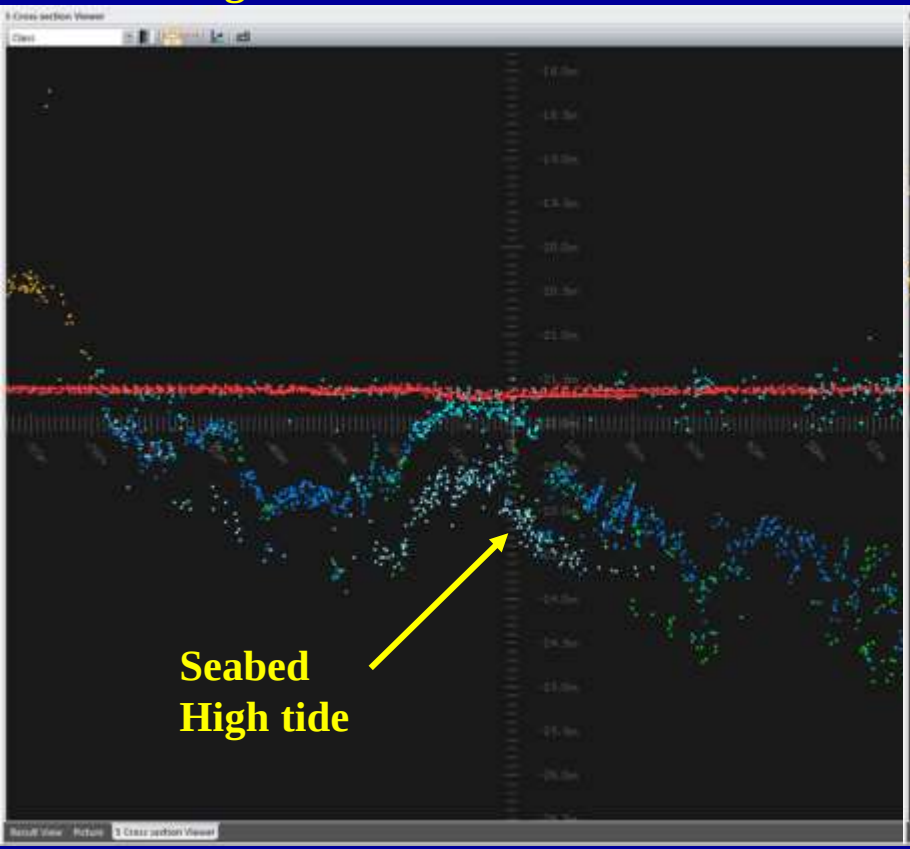
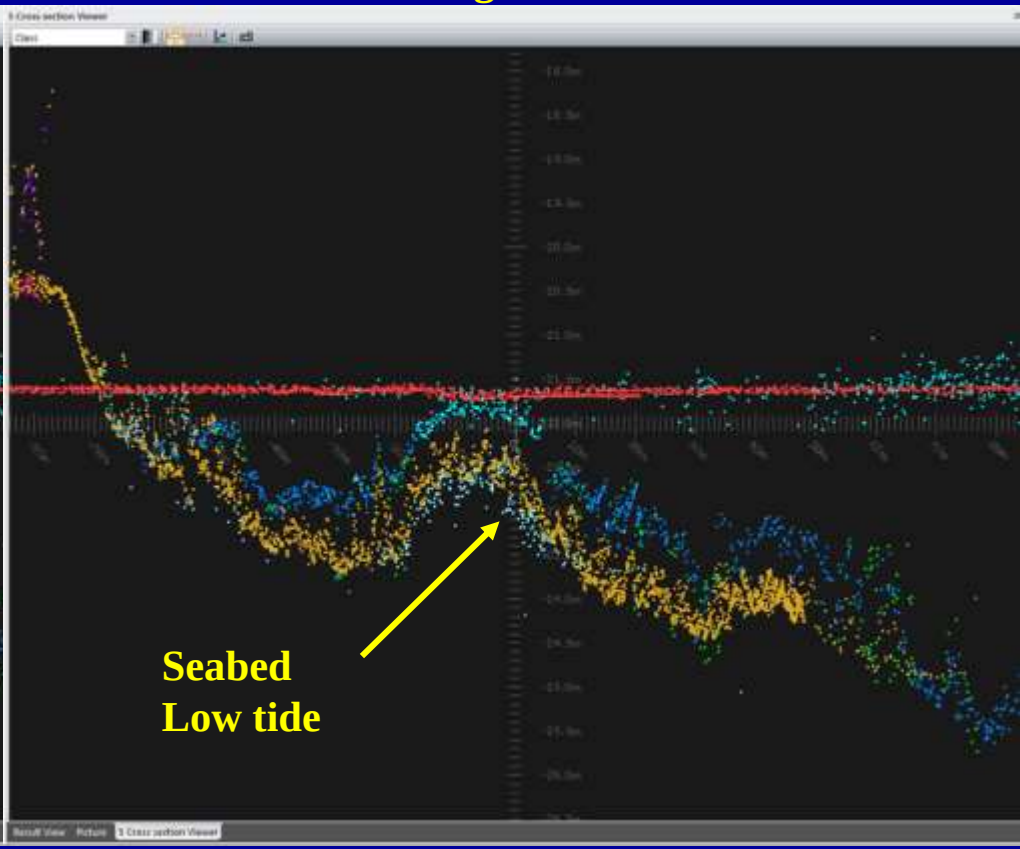
High Tide cross-section



Low tide – brown + High Tide cross-section



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Floating rockweed during the survey

NIR RCD30 photo captures it & confirms lidar point cloud

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RTK GPS points for 50 cm x 50 cm quadrats, metric on 3 seaweed plants measured:
 # plants
For 3 random samples
Height
Circumference
Mass

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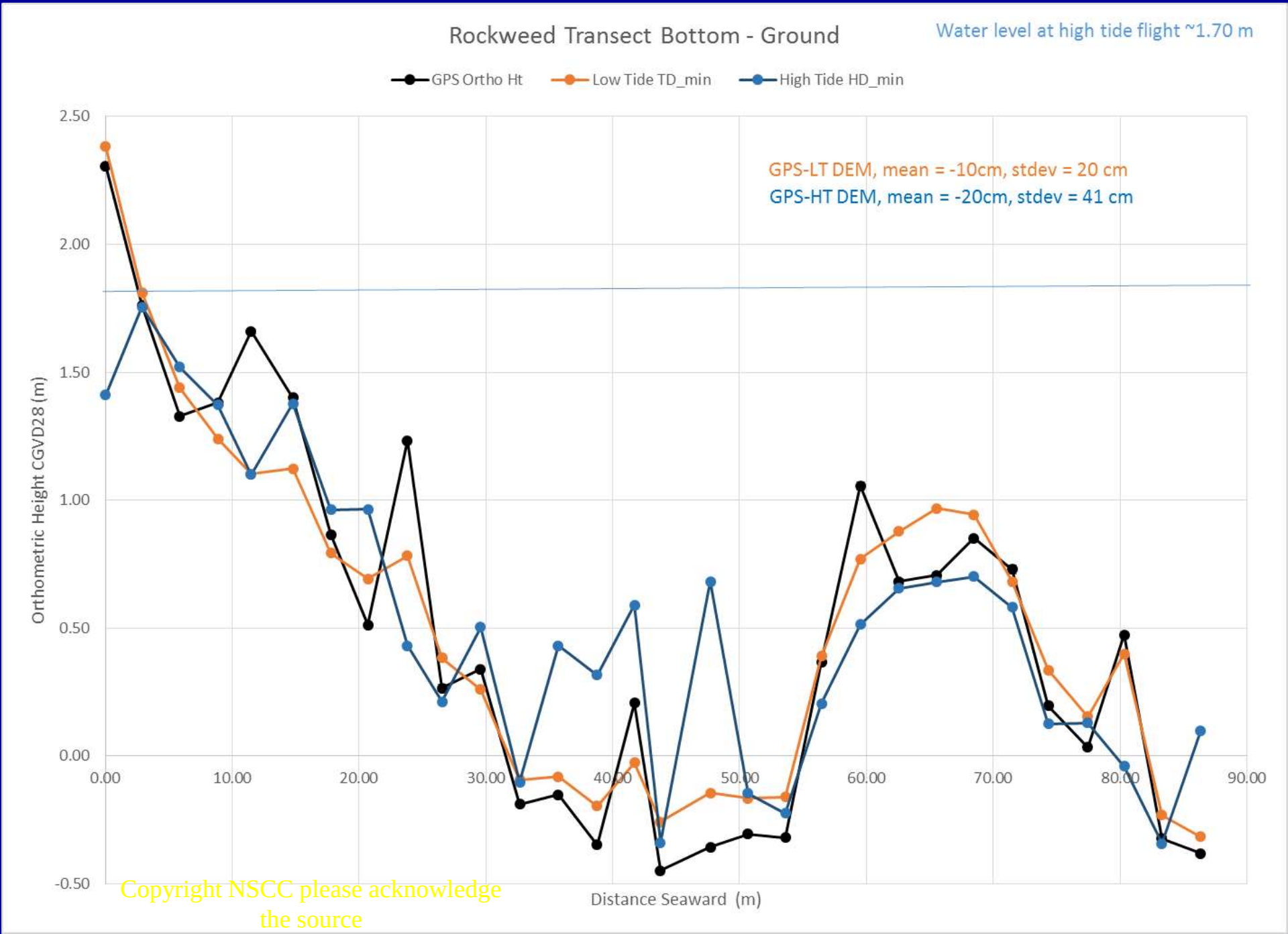

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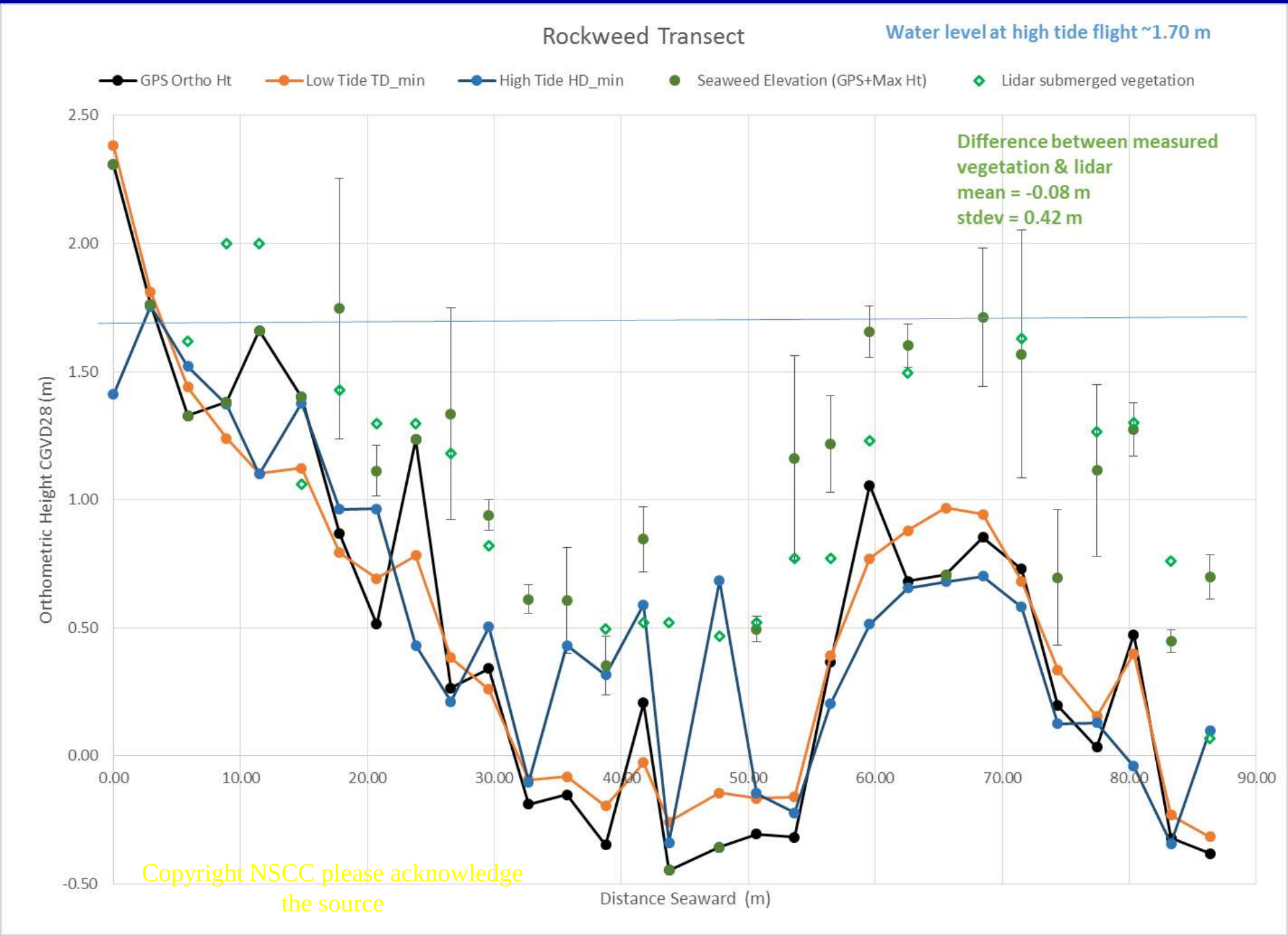

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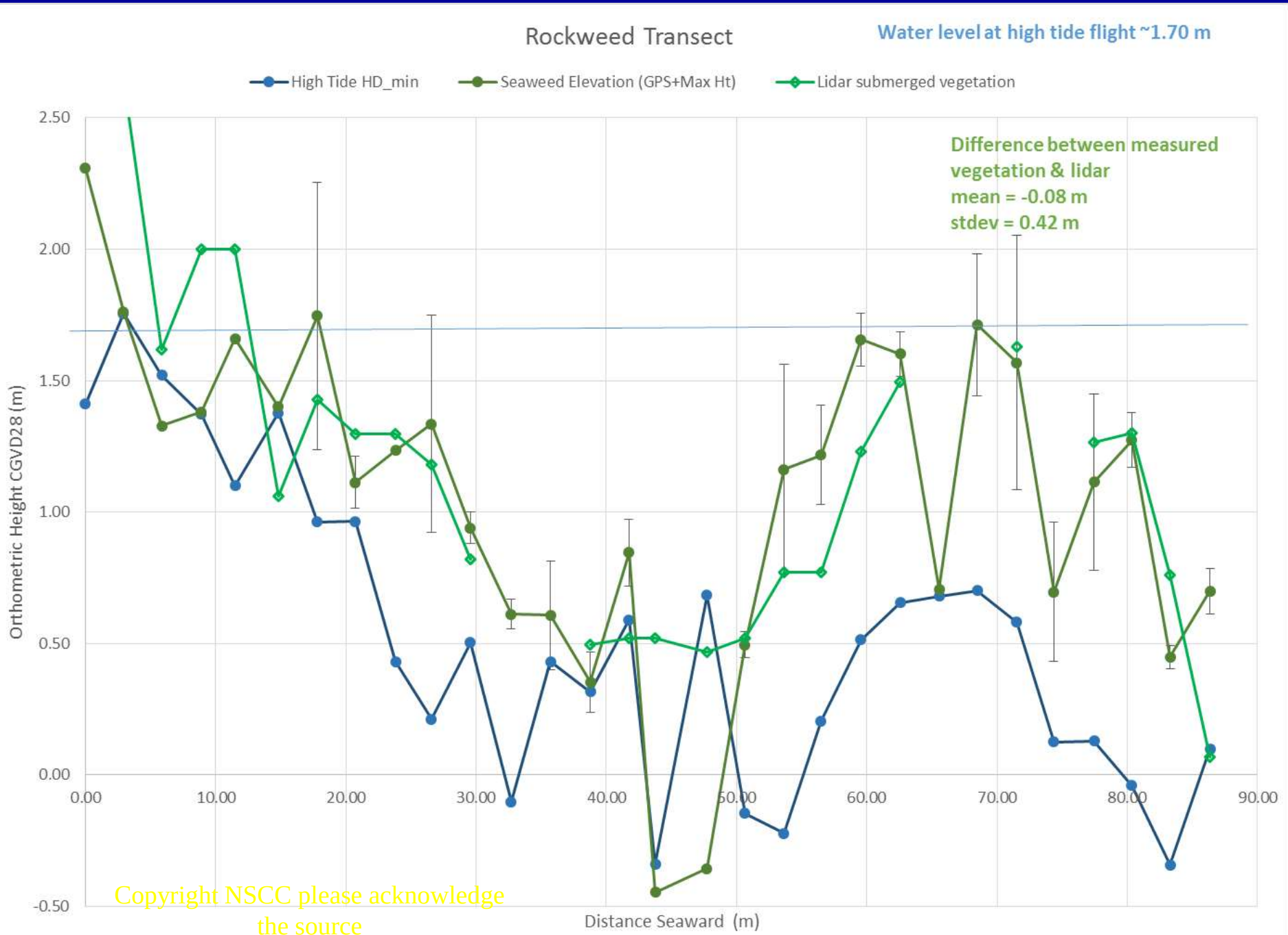

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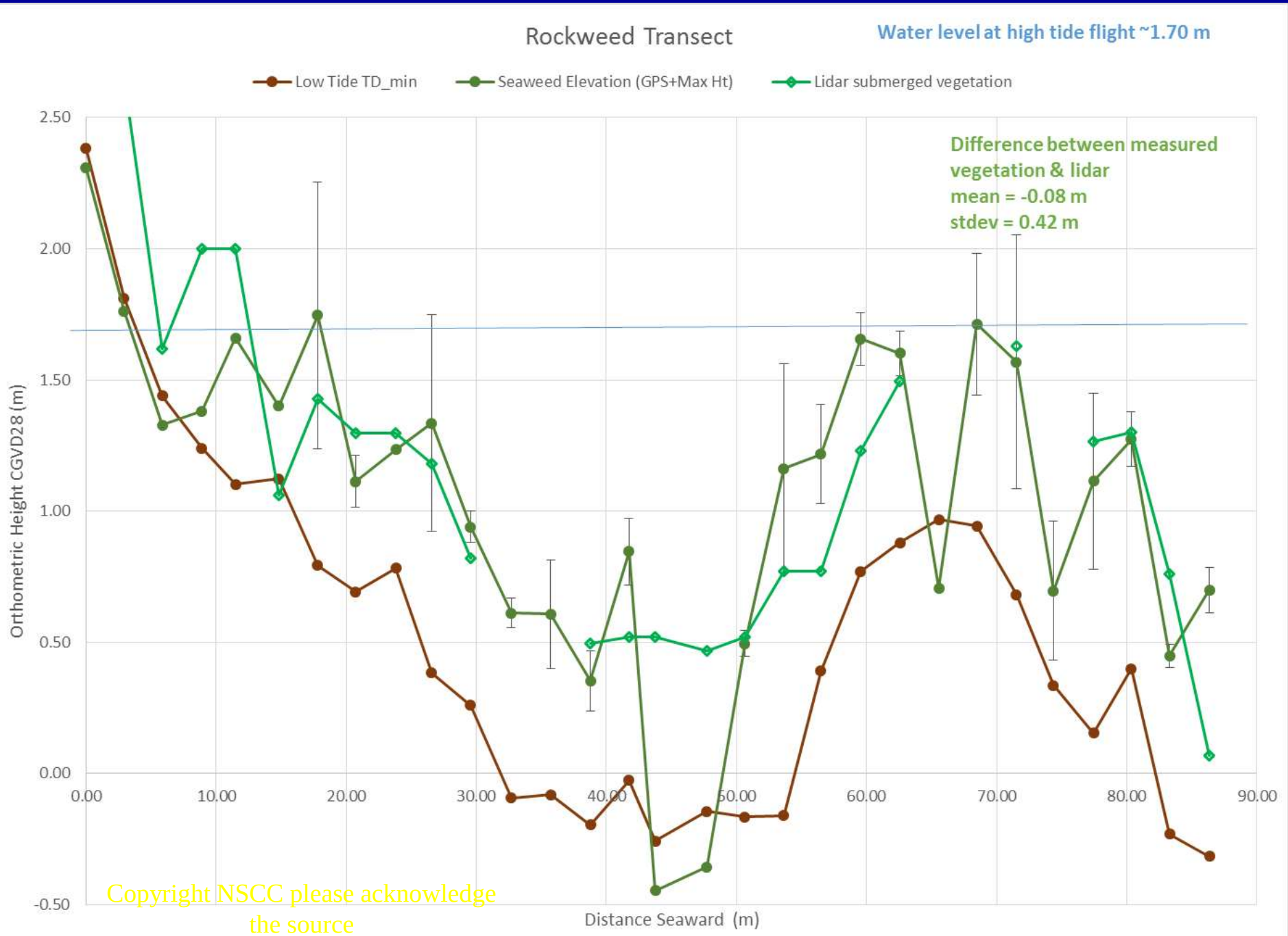

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Conclusions

- Preliminary processing indicates the low tide survey provided a more accurate and detailed DEM than high tide survey for the ground in the intertidal area under the rockweed.
- Mean error between Low Tide and High Tide DEM < 15 cm.
- Bathy lidar at high tide captured the floating rockweed with a mean height error of 8 cm stdev = 42 cm compared to maximum ground truth height.
- Results suggest we should be able to estimate biomass volume from lidar and with better accuracy than current approach.
- Still need to improve the point classification routines & eventually derive more points from the bathy laser waveforms.

Acknowledgement: equipment support

Special thanks to ASL's
Dr. Alan Critchley
Dr. Jean-Sebastien Lauzon-Guay

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