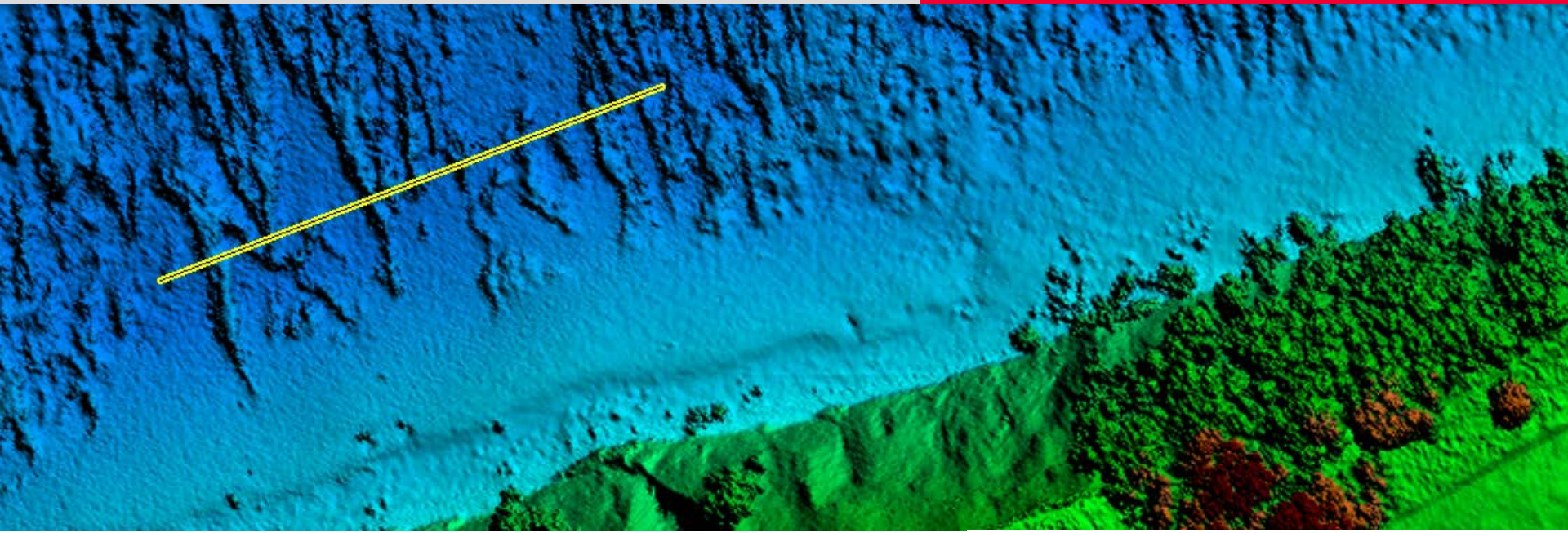

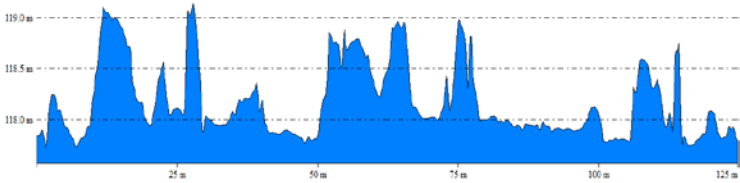


# HawkEye III and Chiroptera II Applications


**Anders Ekelund**

**Vice President, Airborne LIDAR, Leica Geosystems**


**JALBTCX seminar, Silver Springs: 2016-07-19**

PART OF HEXAGON

- when it has to be **right**

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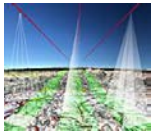
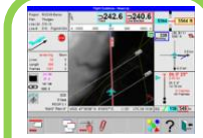
# Geospatial Solution Division - Airborne solutions

ADS100

DMC III


MissionPro


FlightPro

ALS80

DragonEye

RCD30 Oblique

RCD30

Operator and Pilot Displays

Gyro-stabilized Mount

Chiroptera II

HawkEye III

**Airborne Imaging**
Superior Digital Imaging Technology

**Common Peripherals and Comprehensive Airborne Software**

**Airborne LIDAR**
Best-in-Class LiDAR Technology

CityMapper

HxMap – RealCity

**Fused sensors and workflow solutions**
Automatic Smart City Modelling

# Leica Topo Bathy LiDAR portfolio

## Dual DragonEye

Topo: 1000 kHz

Dual Oblique Scanning

Camera: RCD30 RGBN (80 MP)

## Chiroptera II

Topo: 500 kHz

Shallow Bathy: 35 kHz

Camera: RCD30 RGBN (80 MP)

## HawkEye III

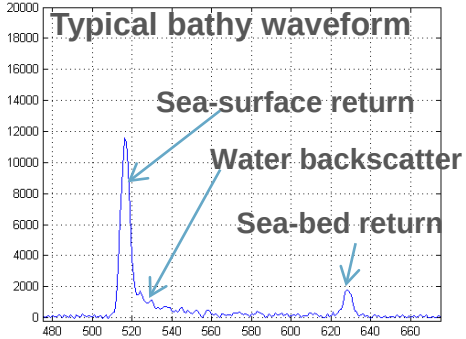
Topo: 500 kHz

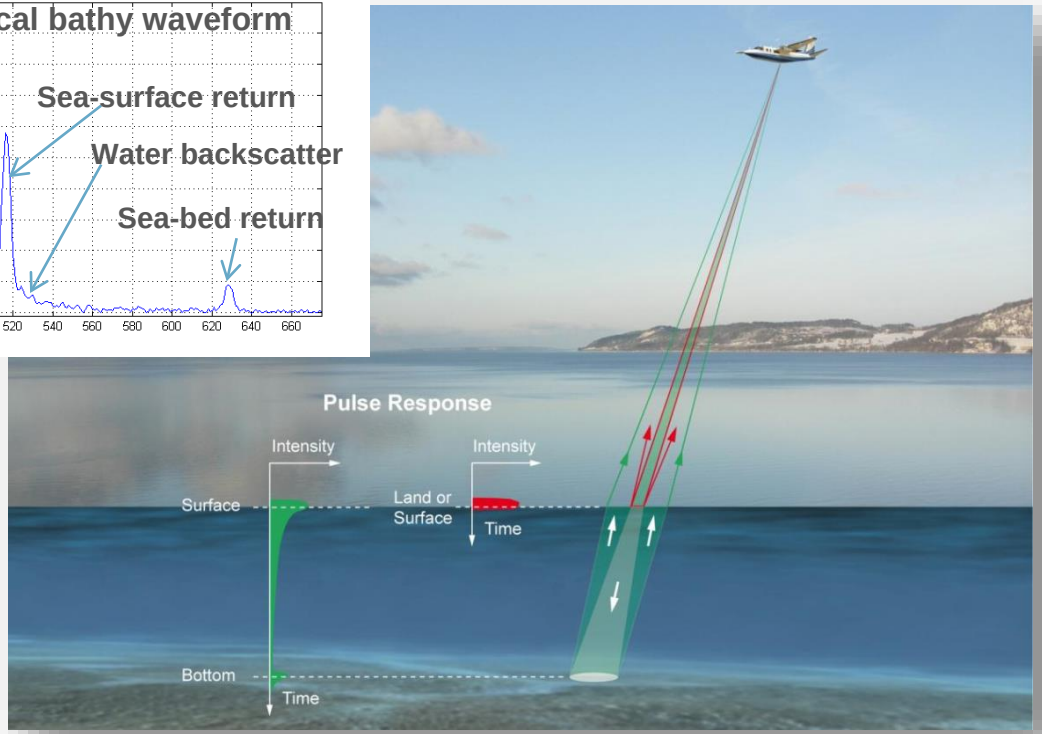
Shallow Bathy: 35 kHz

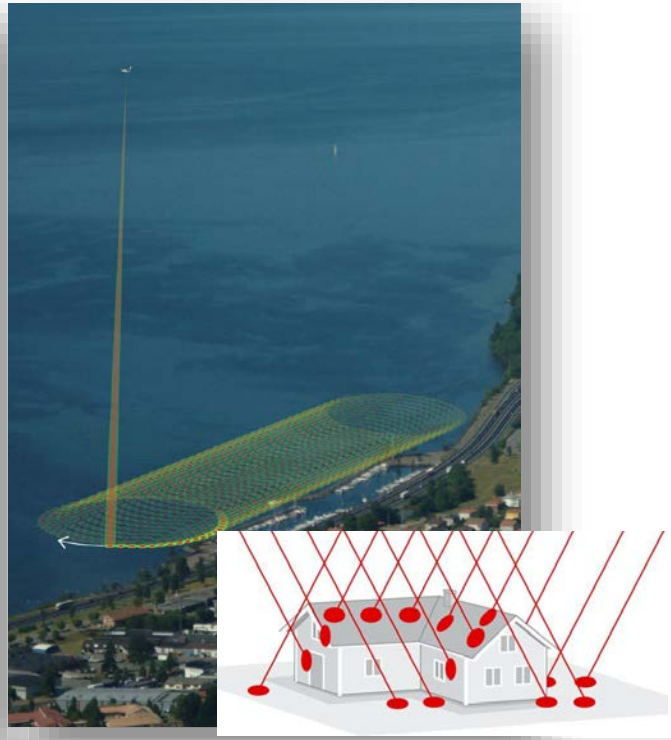
Deep Bathy: 10 kHz

Camera: RCD30 RGBN (80 MP)

# Topo / Bathy LiDAR systems: simultaneous capture of land and sea-floor



# Airborne imaging: high-resolution imagery for airborne LiDAR applications

Image colored by CIR for vegetation mapping

Image colored Near Infrared greyscale raster

Image colored by RGB

# Lidar Survey Studio: “Turn key” solution for ALB

Real-time surface detection

Automatic water reflection correction

Full waveform analysis

Automatic calibration tool

Turbid water enhancement (TWE), reliable performance in non-ideal water condition

Topo, water surface, hydro data automatic processing and classification

Colorization of point cloud in RGB + NIR

3D Viewing and editing

Quality assurance

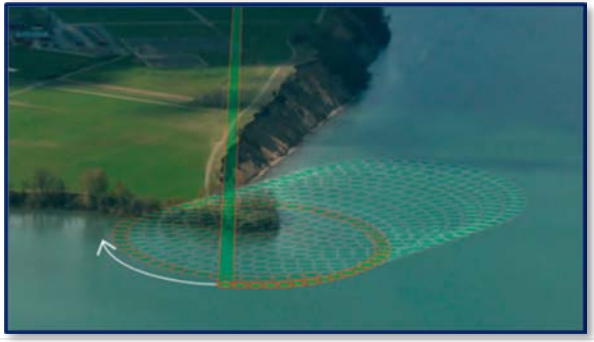
# Monitoring the Coastal Zone of Sylt

To what extend can LiDAR Bathymetry reduce the vessel based hydrographic surveys and terrestrial surveys ?

System: HawkEye III

Customer: Aerodata Netherlands

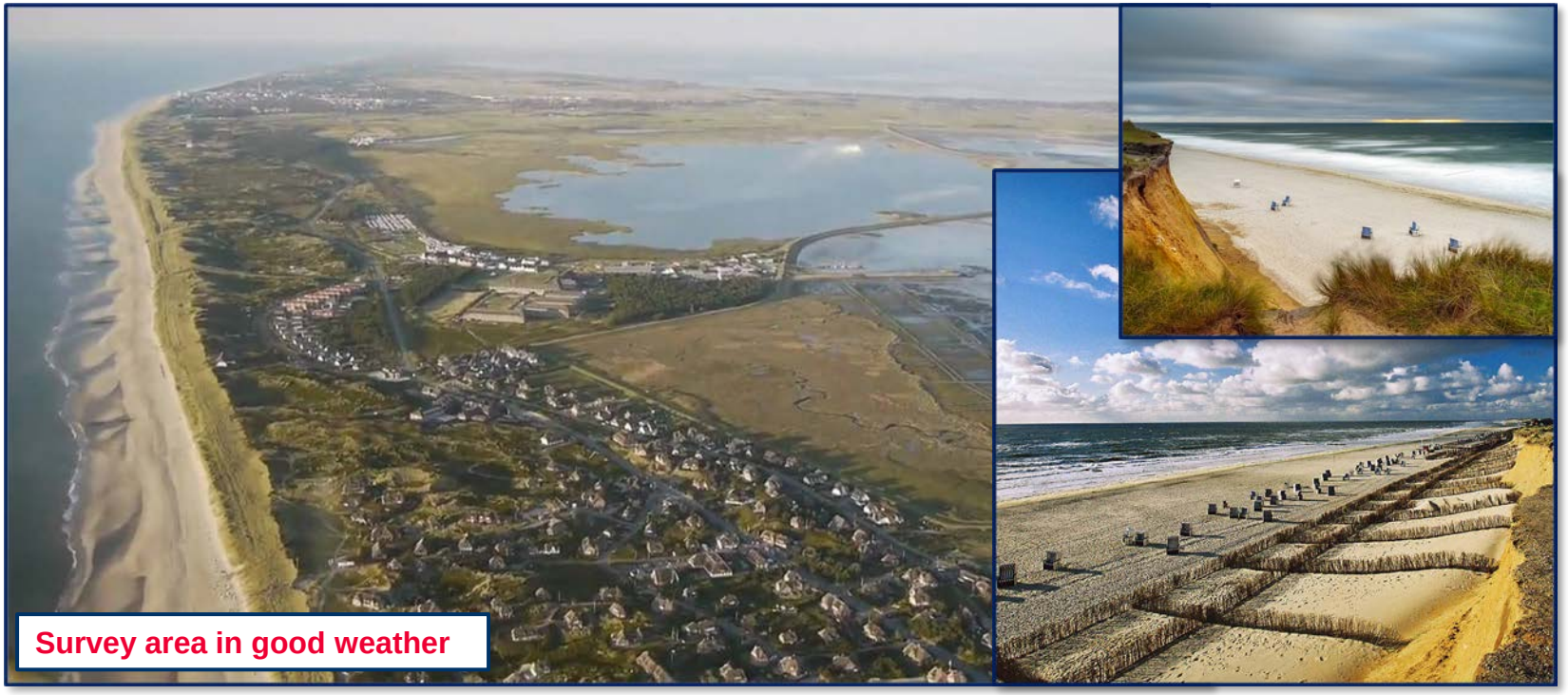
| Laser Characterization | |
|---|---|
| Deep bathy laser [6] | 10 kHz green, full waveform record |
| Shallow bathy laser [6] | 35 kHz green, full waveform record |
| Topo laser [6] | Up to 500 kHz infrared, with full waveform record option |
| Operation altitude | Bathymetry 400 – 600 m AGL<br>Topography up to 1600 m AGL |
| Depth range [1] | Deep bathymetry $D_{max} = 4 / k$ (~ 3.0 Secchi depth)<br>Shallow bathymetry $D_{max} = 2.2 / k$ (~ 1.5 Secchi depth) |
| Scanner pattern | Oblique scanner |
| Field of view | ± 14° front/back, ± 20° left/right |
| Swath width | 70 % of AGL |
| Point density [2] | Deep bathy: 0.4 pts/m²<br>Shallow bathy: 1.5 pts/m²<br>Topo: > 12 pts/m² |
| Bathymetric accuracy | Shallow: 0.15 m (2σ)<br>Deep: $\sqrt{0{,}3^2 + (0{,}013 \cdot depth)^2}$ m (2σ) |
| Topographic accuracy | Ranging accuracy: 2 cm (1σ)<br>Horizontal accuracy: 20 cm (1σ) |



## Sylt

The northernmost island of Germany, well known for the distinctive shape of its shoreline, tourist resorts, 40km long sandy beach and its **ongoing loss** of land during storm tides.

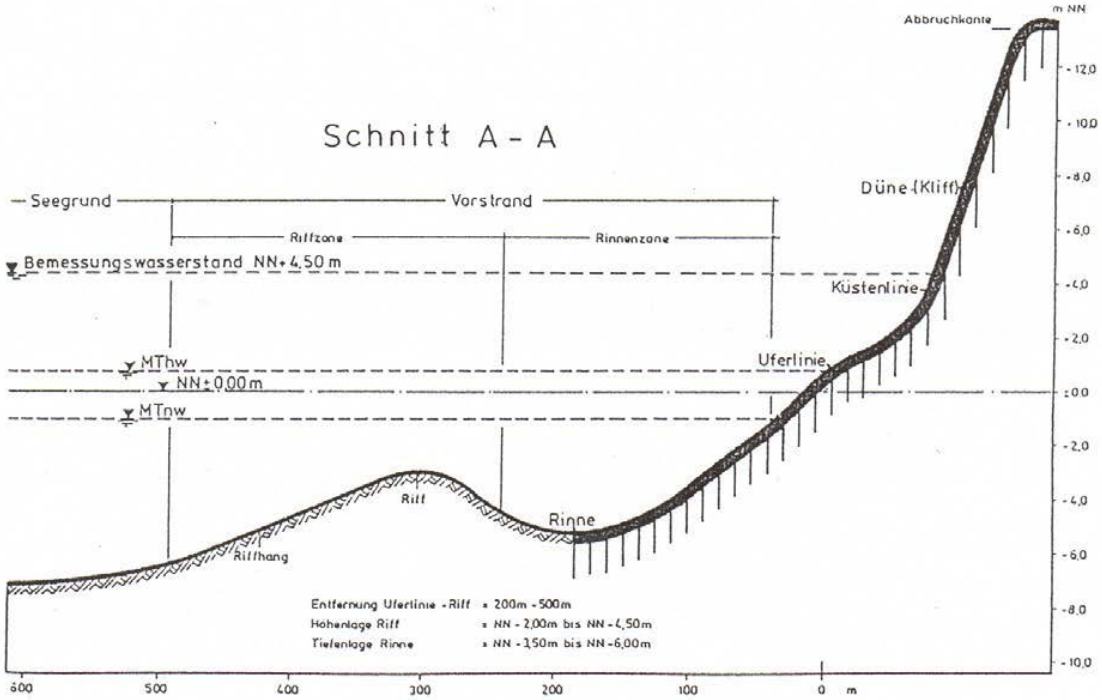
**planning** acquisition processing/quality control delivery



**planning** acquisition processing/quality control delivery

Survey area in bad weather

**planning** acquisition processing/quality control delivery




PART OF HEXAGON

aero data

- when it has to be **right**

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## Survey

Date: 06-08/08/2015, Area: ~ 90km2, Total line length: ~ 423km

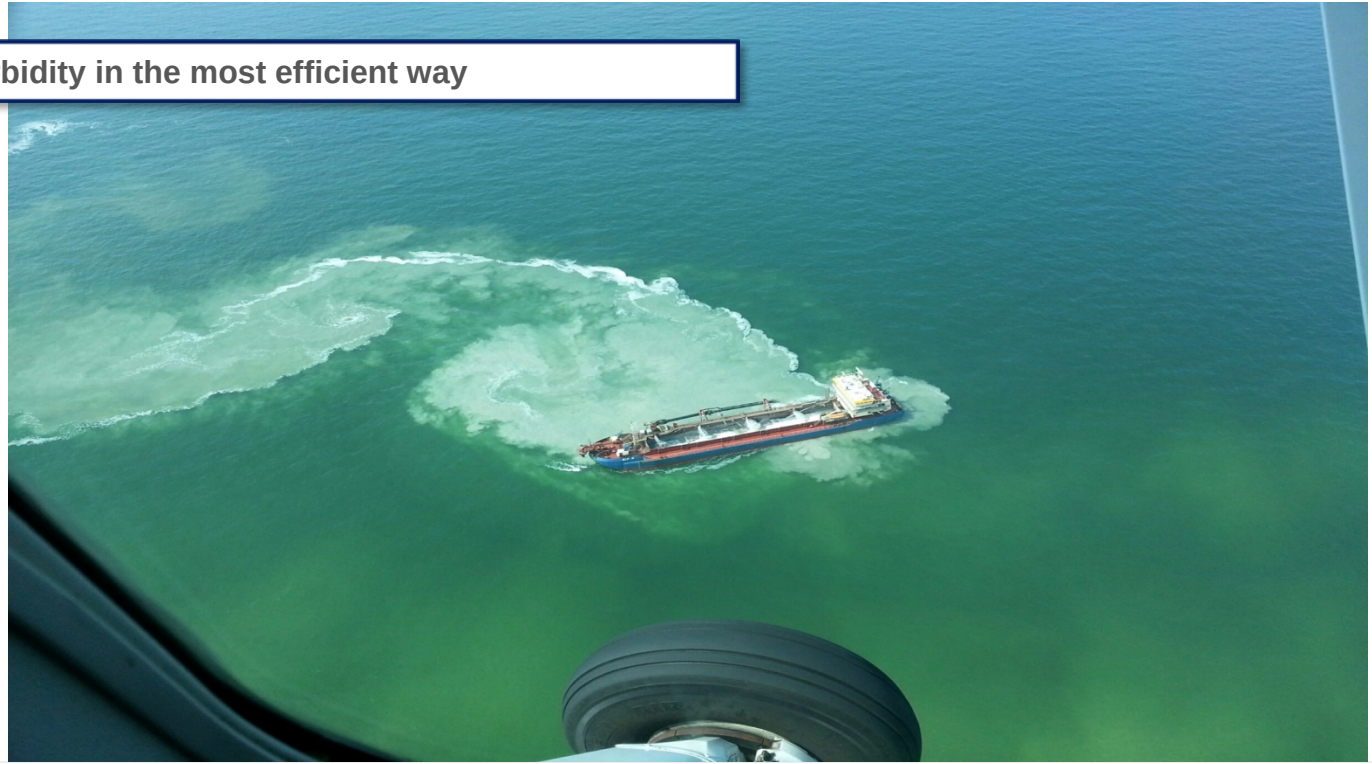
Longest line: 24.2 km, Shortest line: 1.1 km,

Total sensor on-line time: ~5:30min

Challenge: find this 1 out of 3 suitable periods in the season

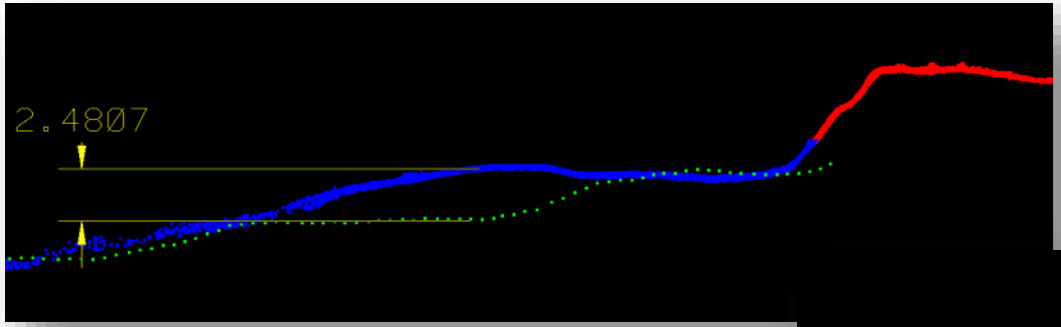
**Oeps !!! Competition looking for the same conditions**

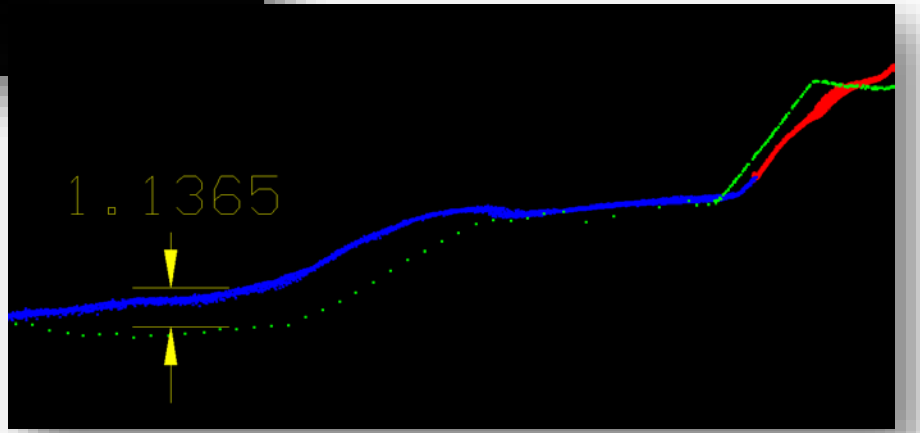
**Creating turbidity in the most efficient way**



# Analysis

Comparison with Profiles from 2014

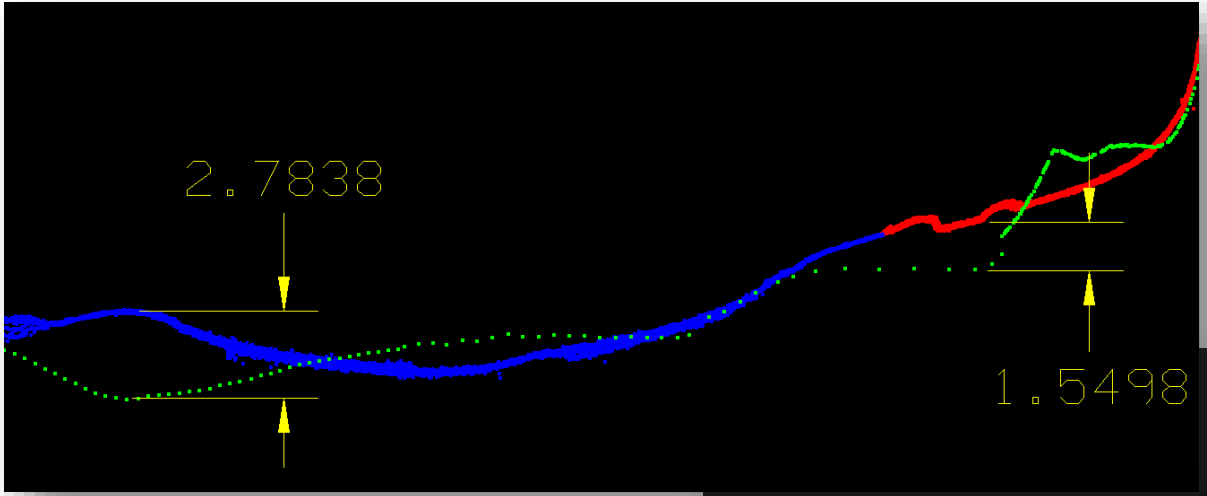


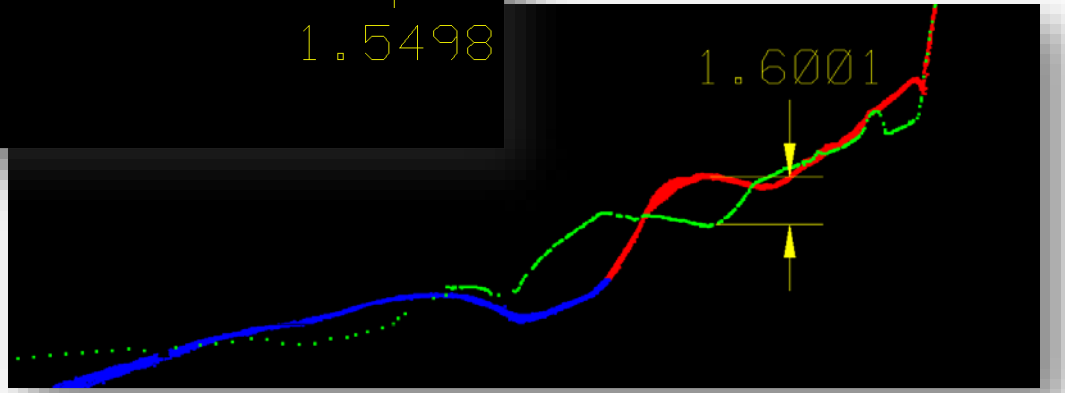




Topographic LiDAR **2015**

Bathymetric LiDAR **2015**

Profiles **2014**

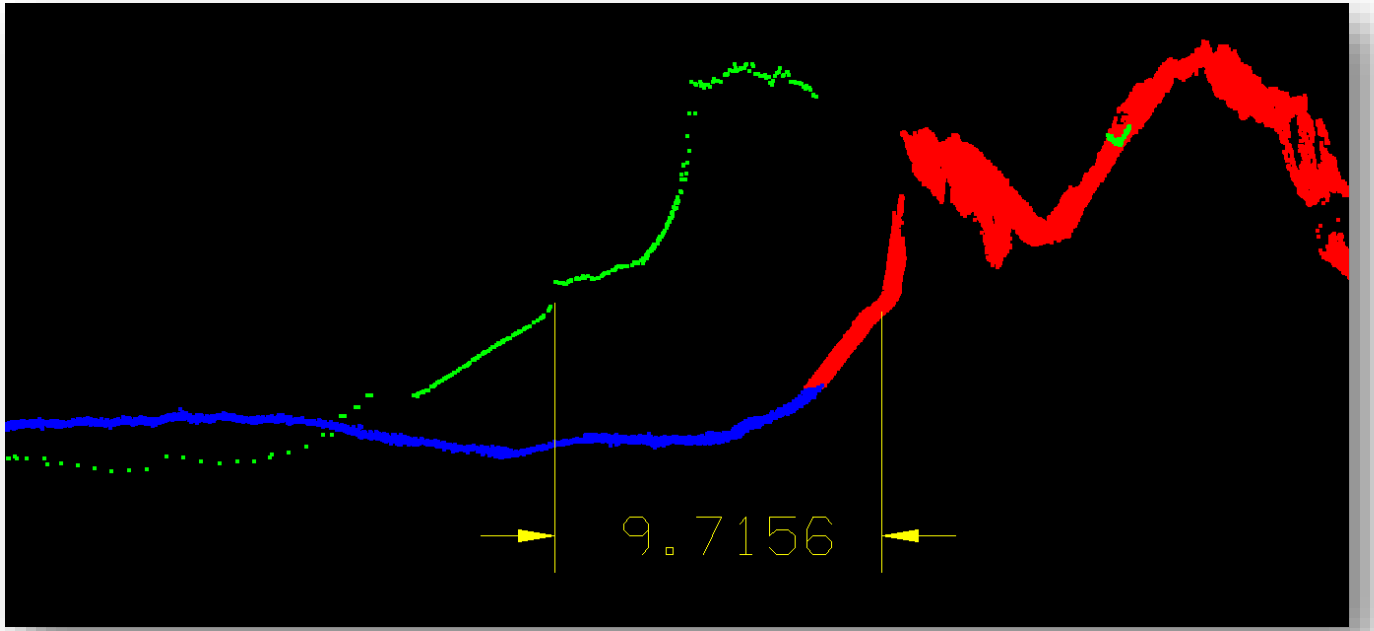



Topographic LiDAR **2015**

Bathymetric LiDAR **2015**

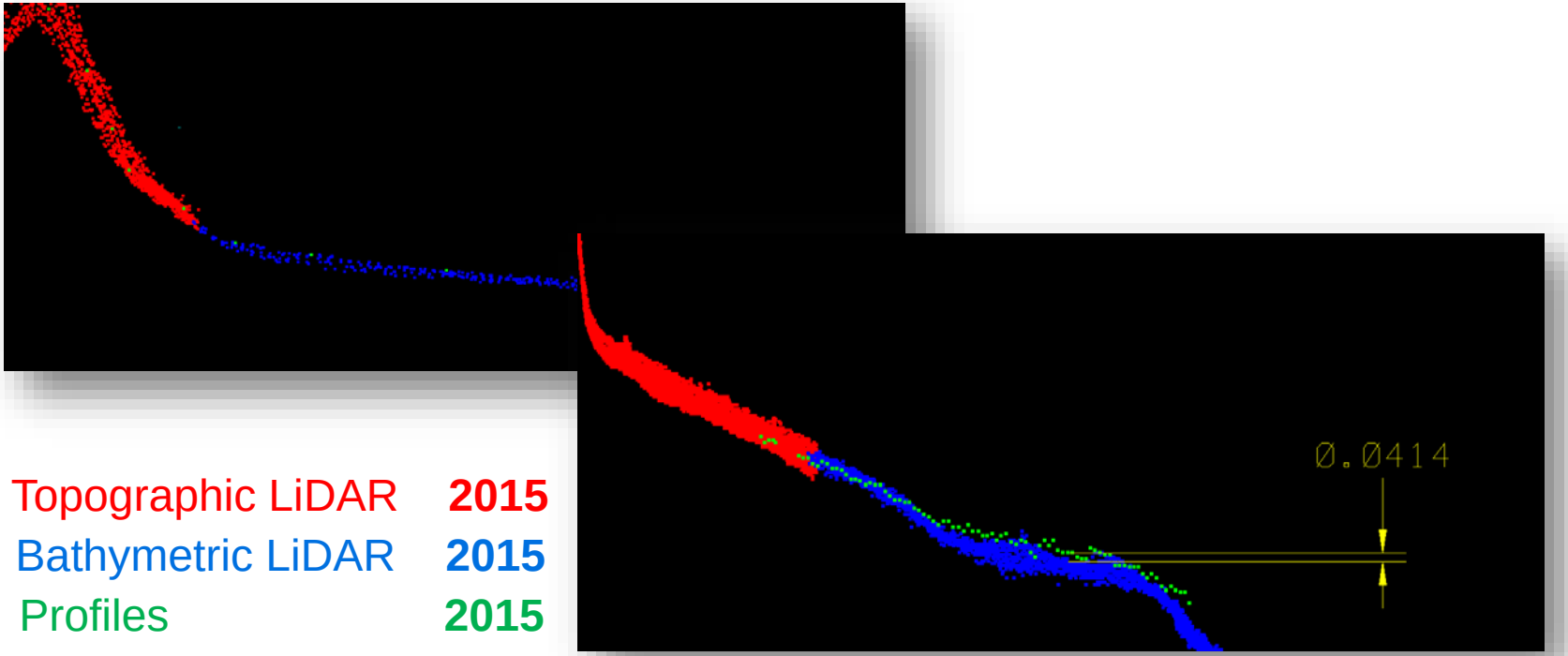
Profiles **2014**




Topographic LiDAR **2015** Bathymetric LiDAR **2015** Profiles **2014**

# Analysis

Comparison with Profiles surveyed 2 months before the LiDAR survey




Topographic LiDAR **2015**

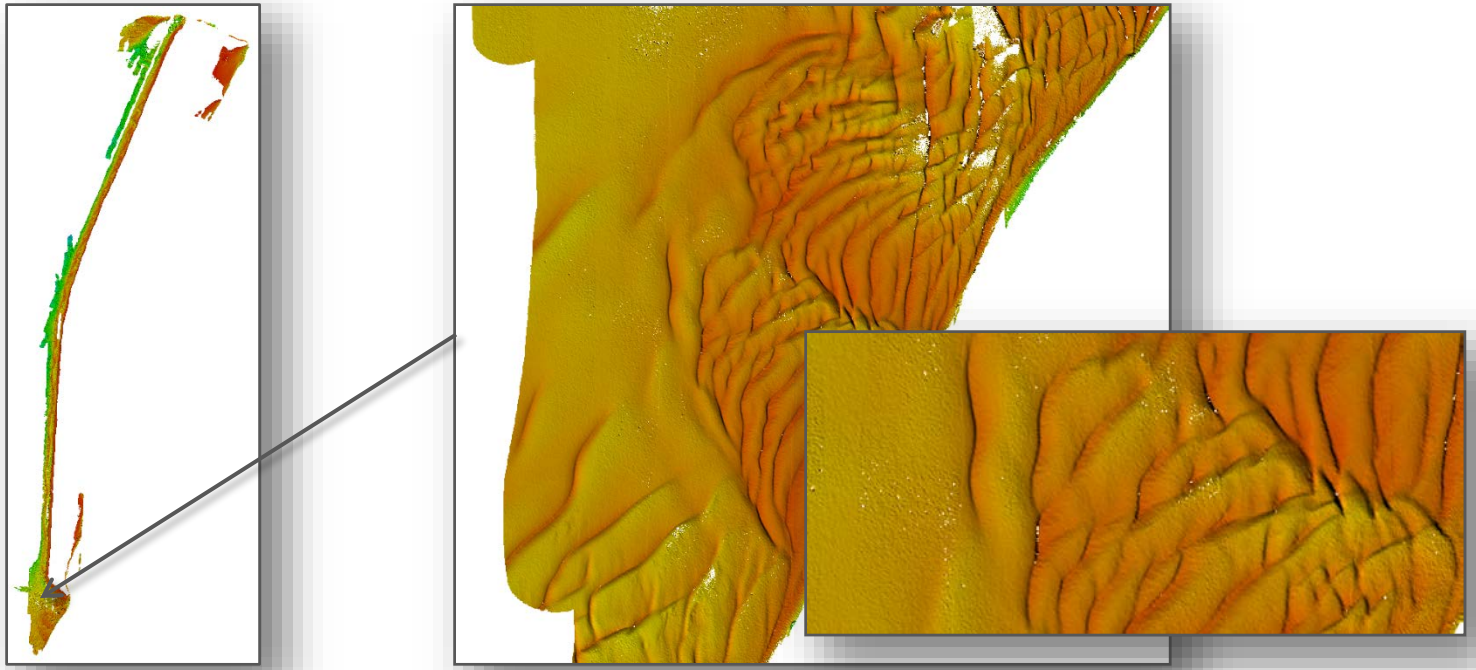
Bathymetric LiDAR **2015**

Profiles **2015**

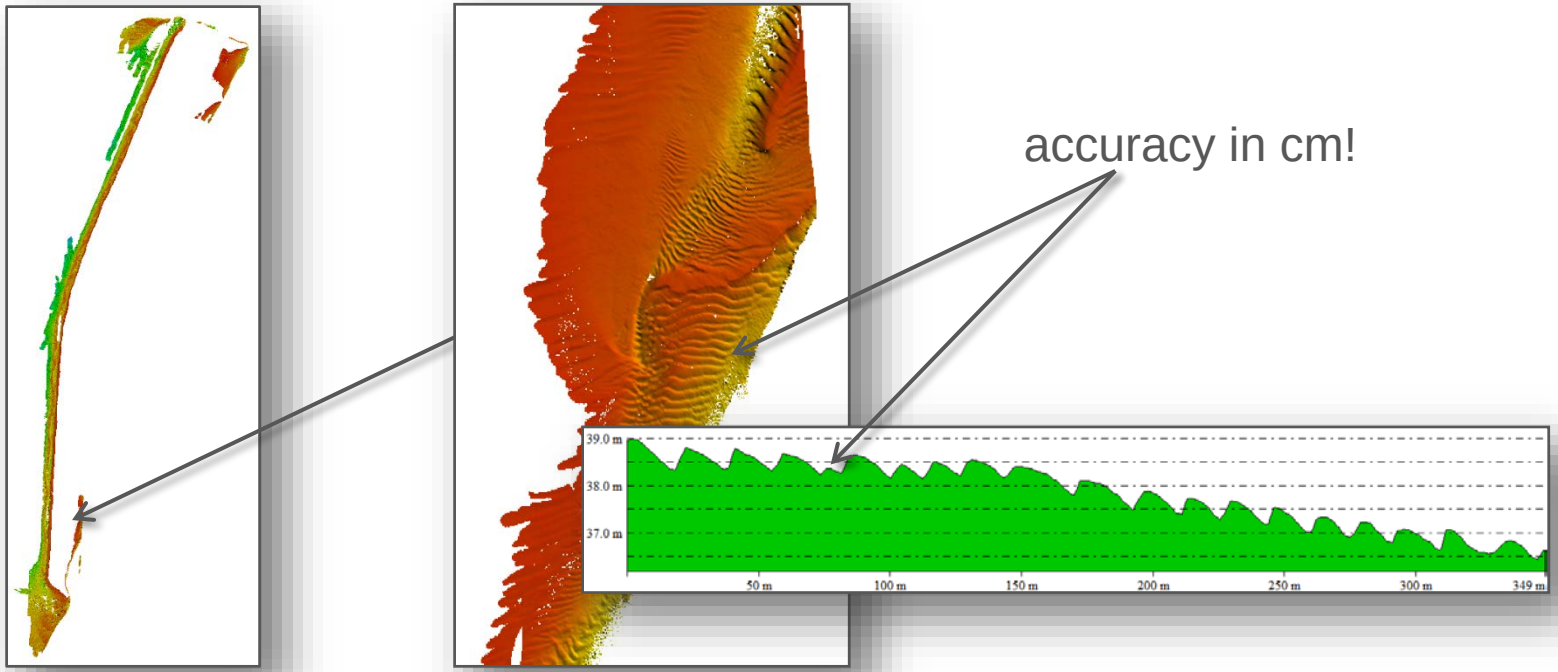
# Deliverables

Seamless high resolution model of the Coastal Zone

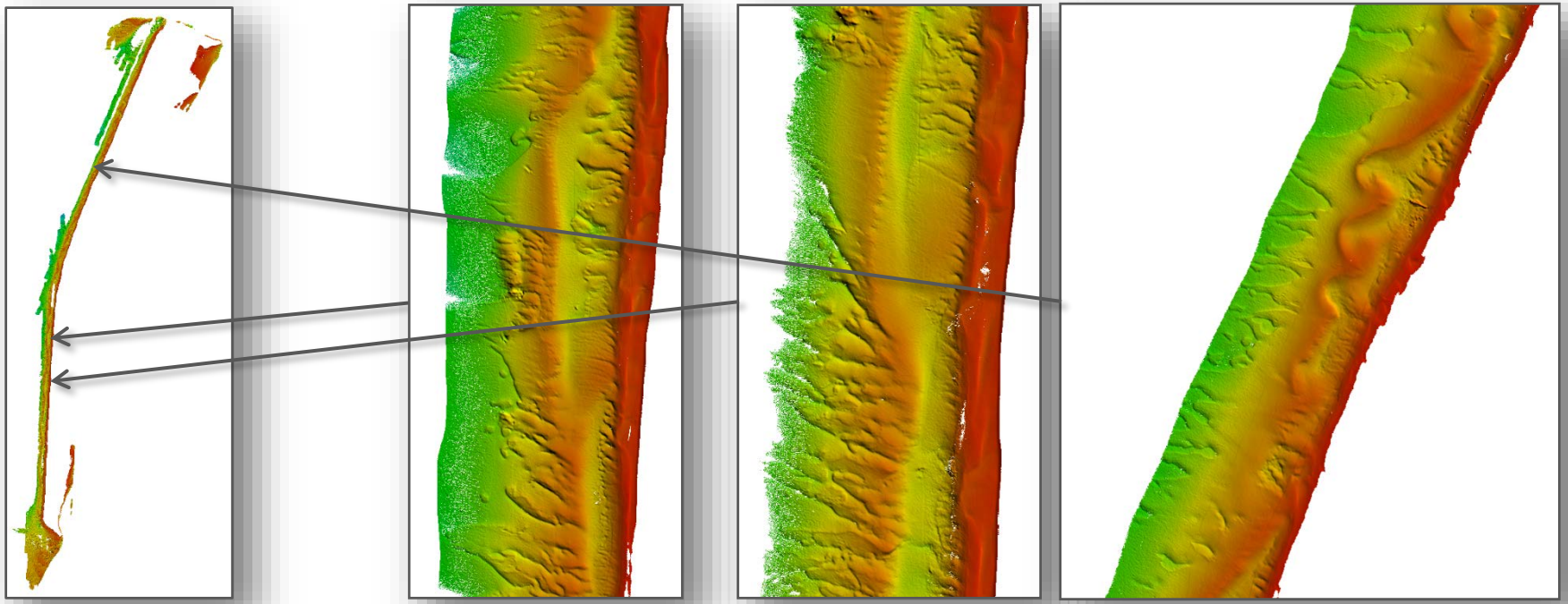
planning acquisition processing/quality control **delivery**

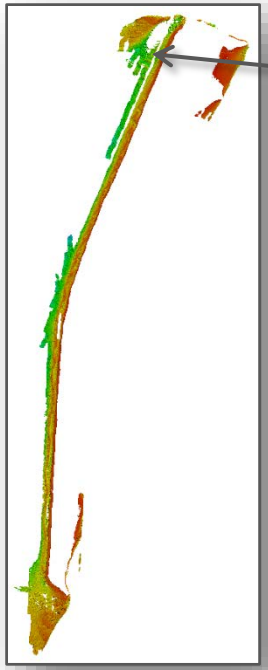


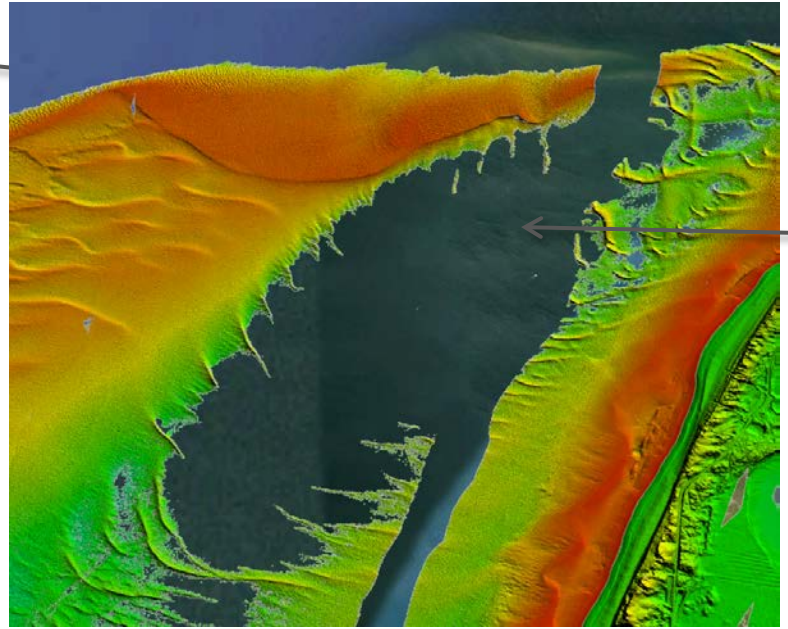
planning acquisition processing/quality control **delivery**



planning acquisition processing/quality control **delivery**







No coverage ???!

# Conclusions

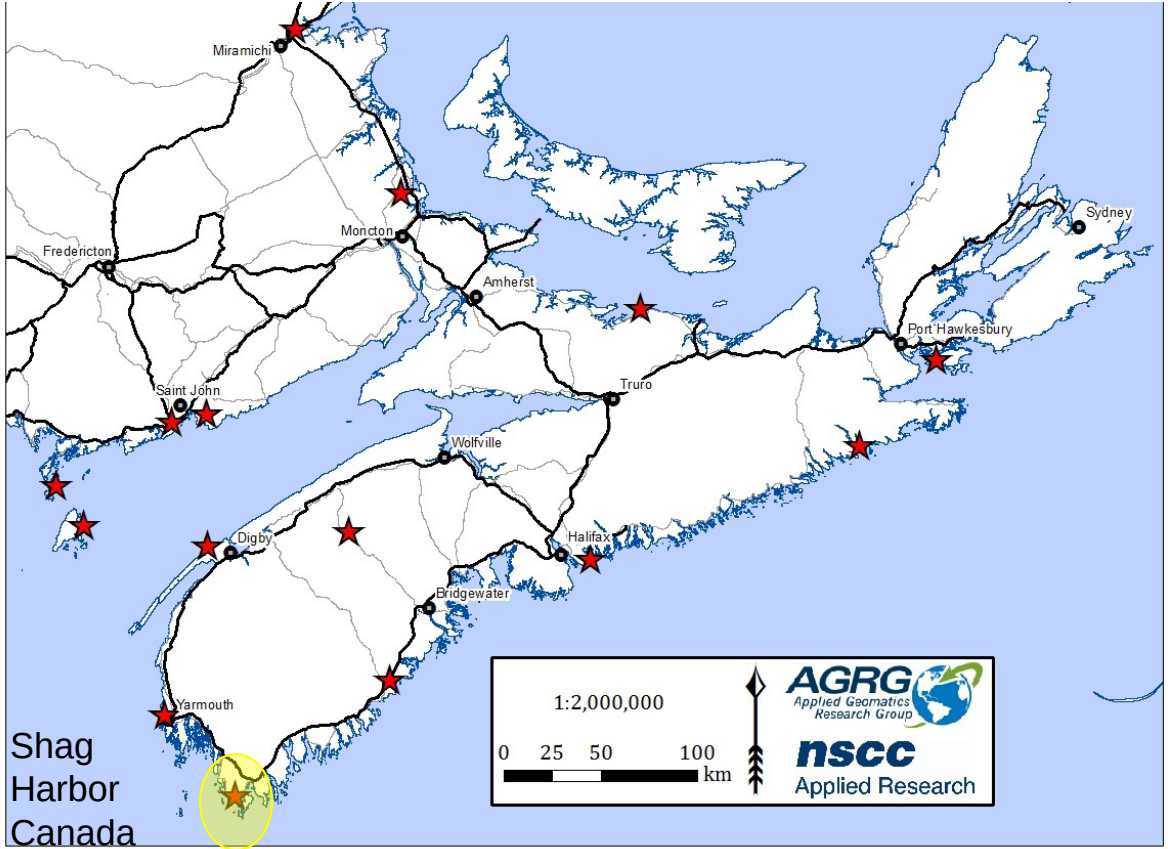
- The largest part of the west coast of Sylt could be measured with LiDAR Bathymetry
- Accurate depth measurements of 10m were achieved.
- Favourable acquisition windows are very limited (turbidity, breaking waves, low clouds, wind direction) → operational challenges ! with cost implications !

# Experience with Mapping Rockweed in Maritime Canada

Can bathymetric LIDAR be used for measuring underwater biomass of Rockweed?

Systems: Chiroptera II

Customer: Applied Geomatics Research Group, Nova Scotia Community College




Shag Harbor Canada

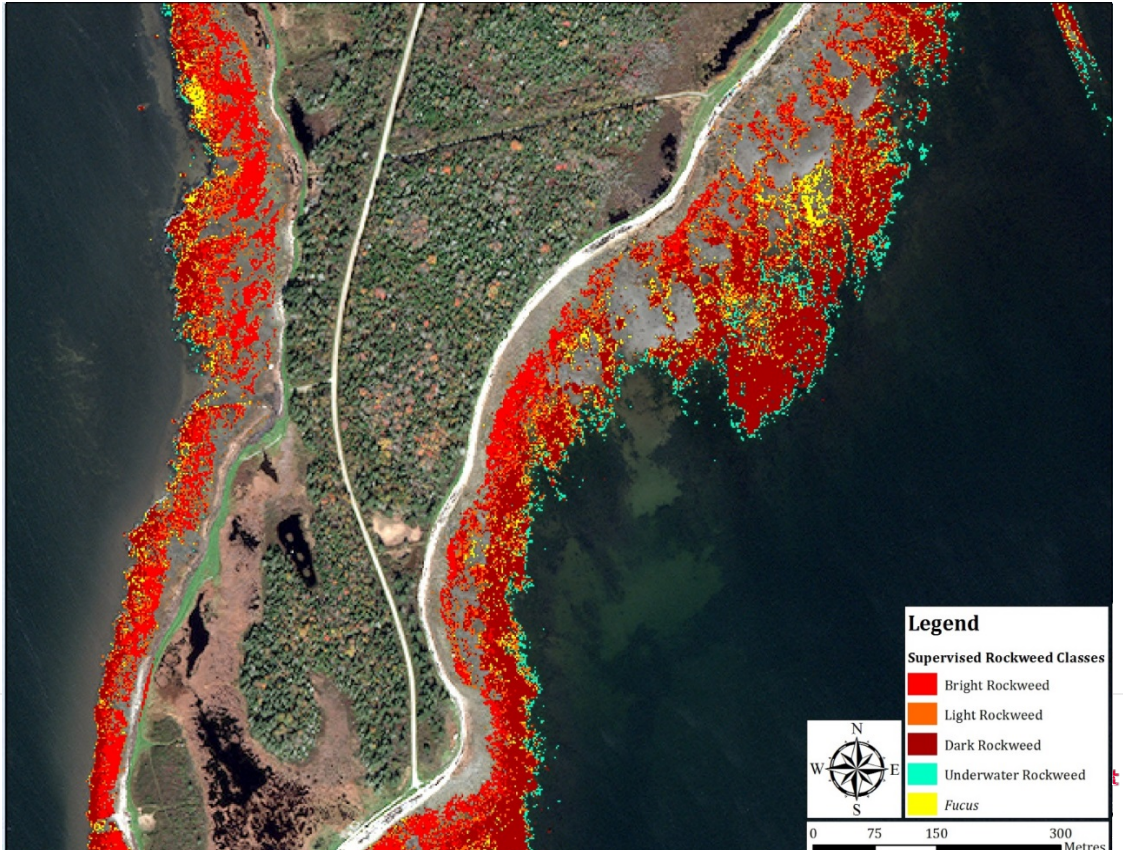
# Mapping Rockweed Seaweed

Acadian Seaplants

AGRG Applied Geomatics Research Group

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




- Max. Likelihood with NULL class = best results
- Four classes of rockweed
- Competitive seaweed *Fucus*

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

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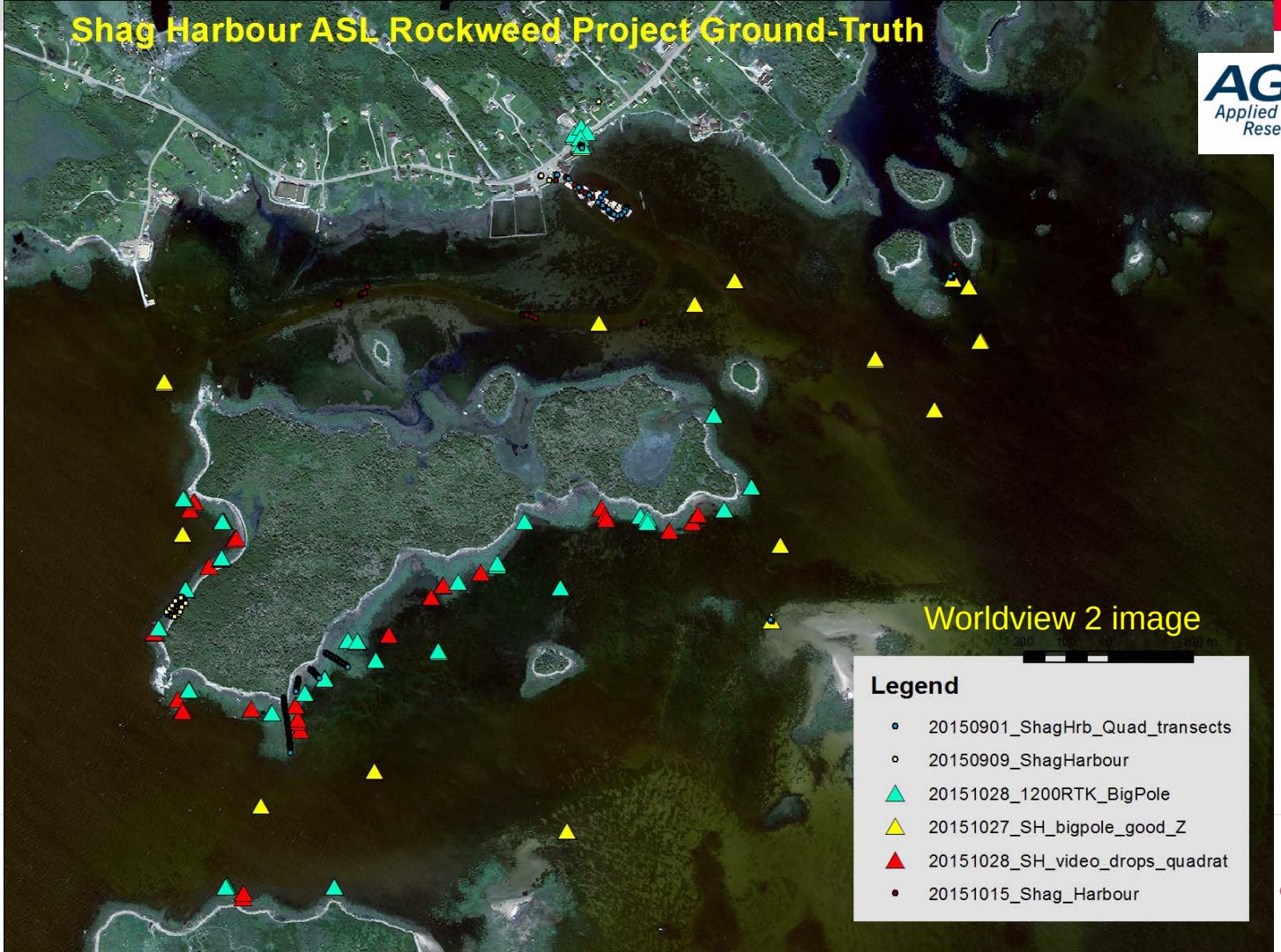
# The Experiment

- 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

# Shag Harbour ASL Rockweed Project Ground-Truth

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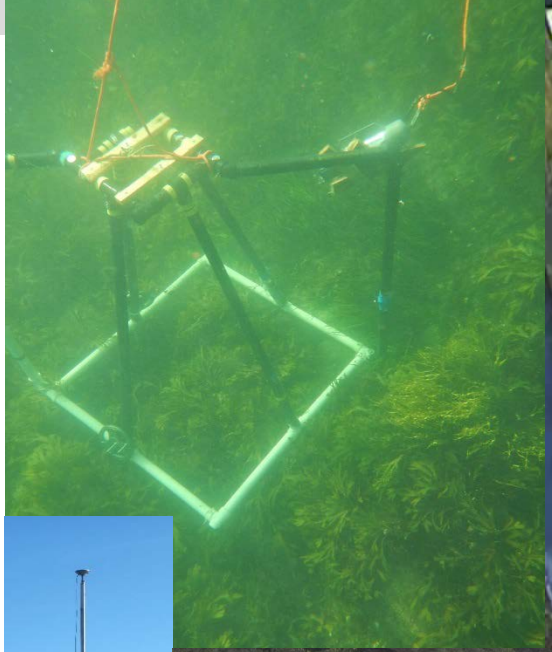

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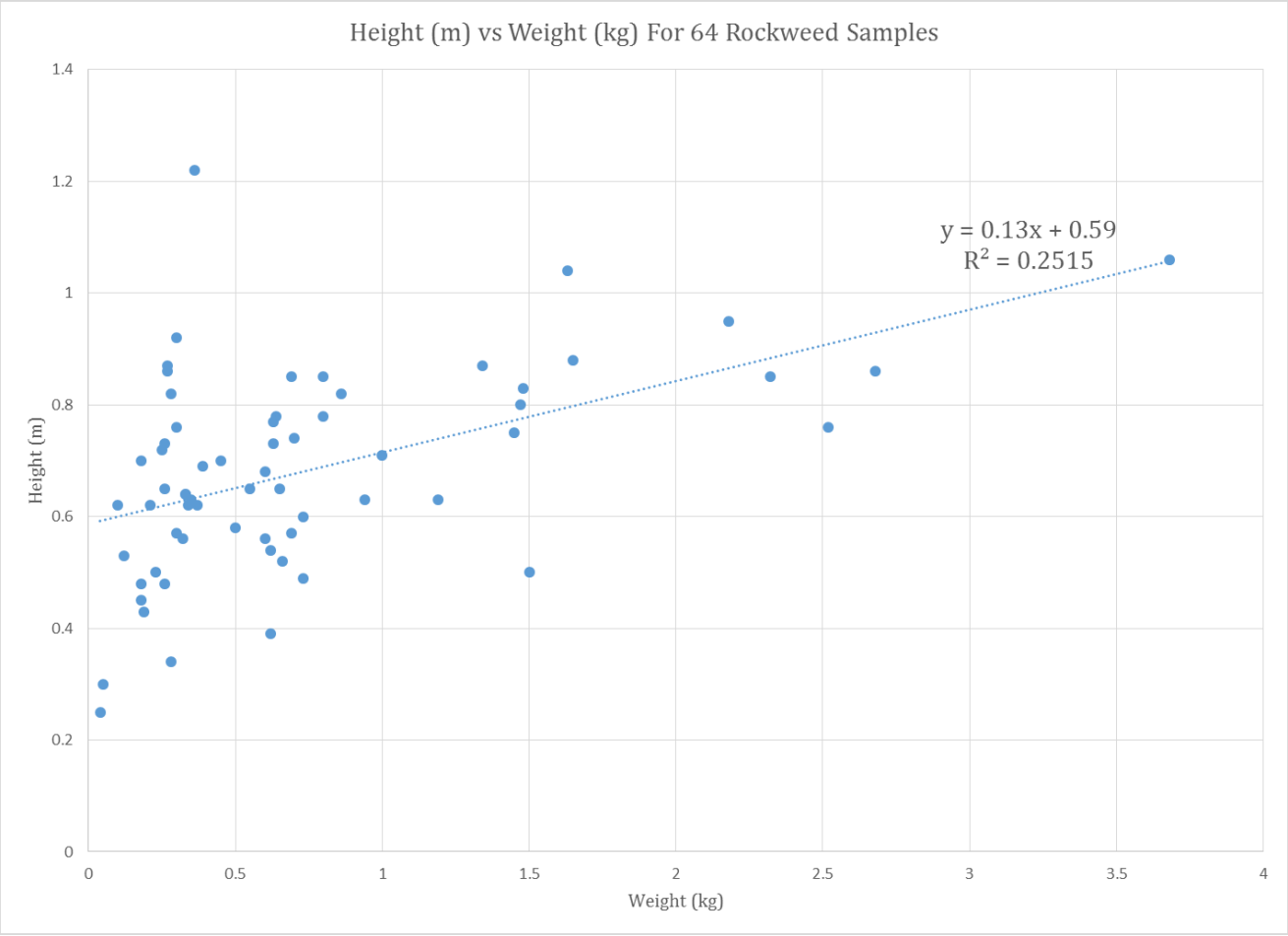


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- when it has to be right

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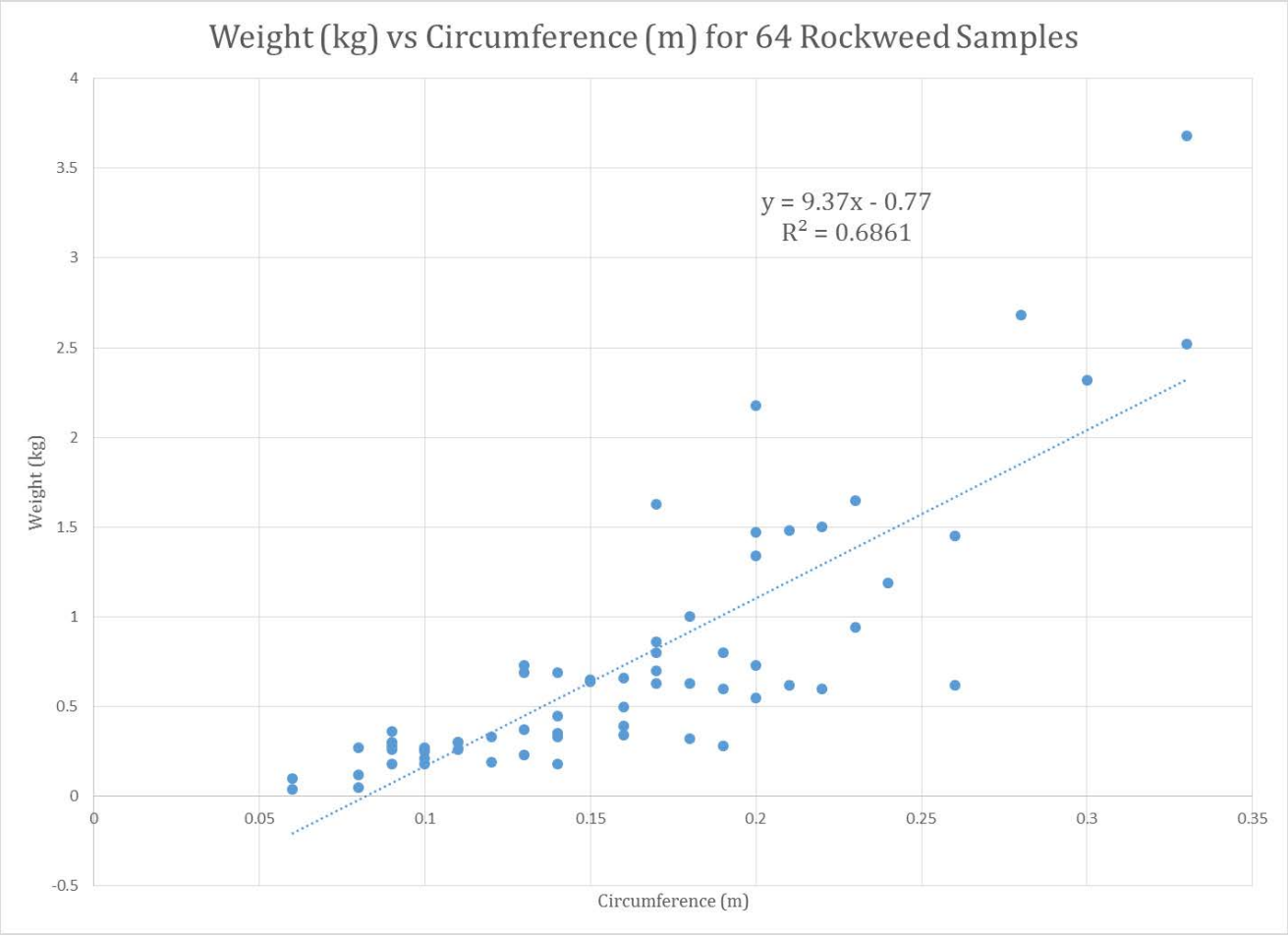


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- when it has to be right

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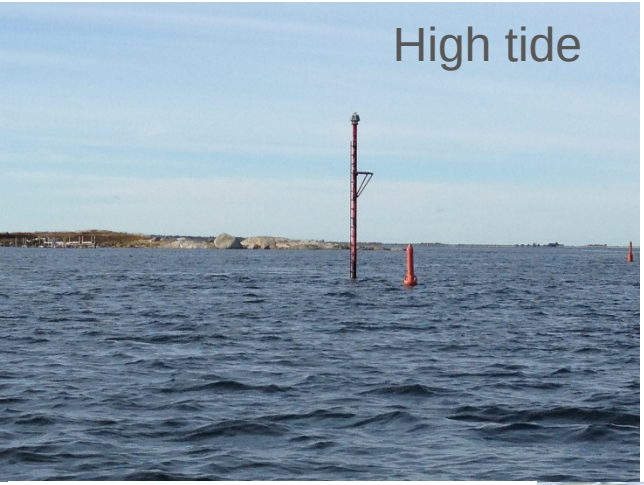
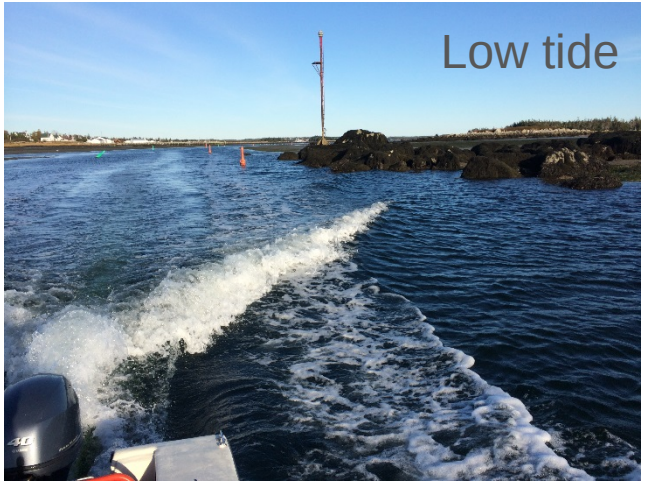
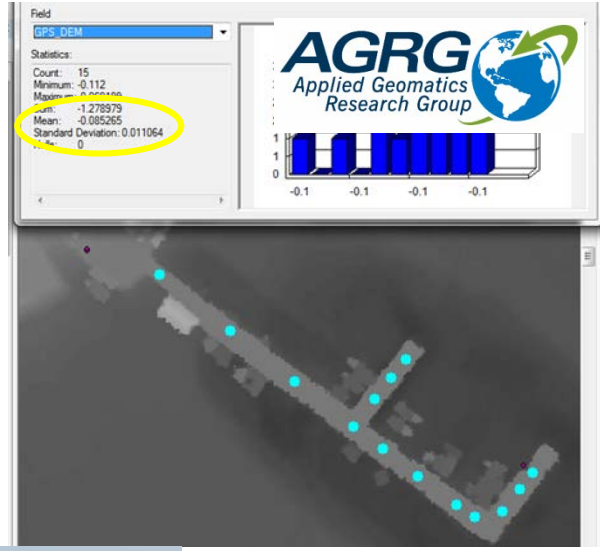
PART OF HEXAGON

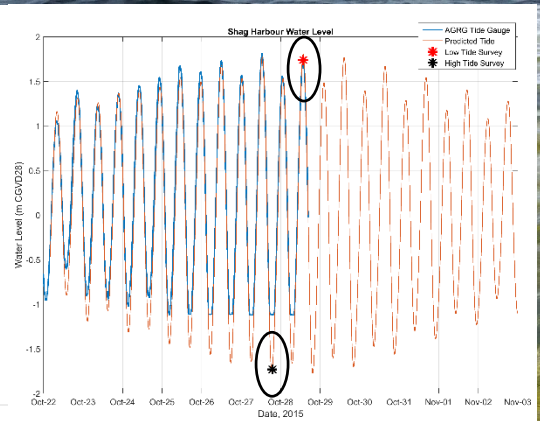
s to be right

Leica Geosystems

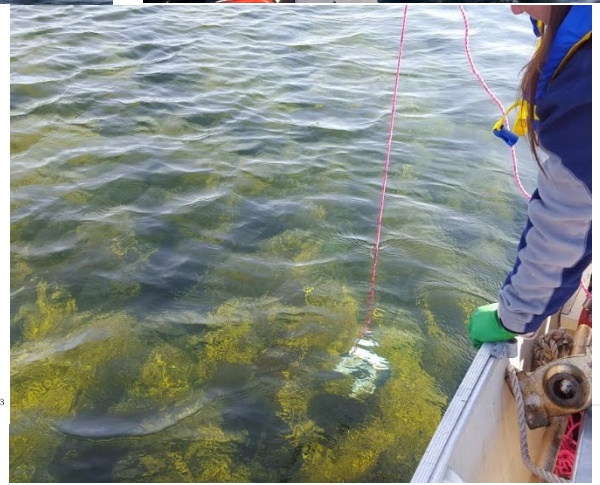


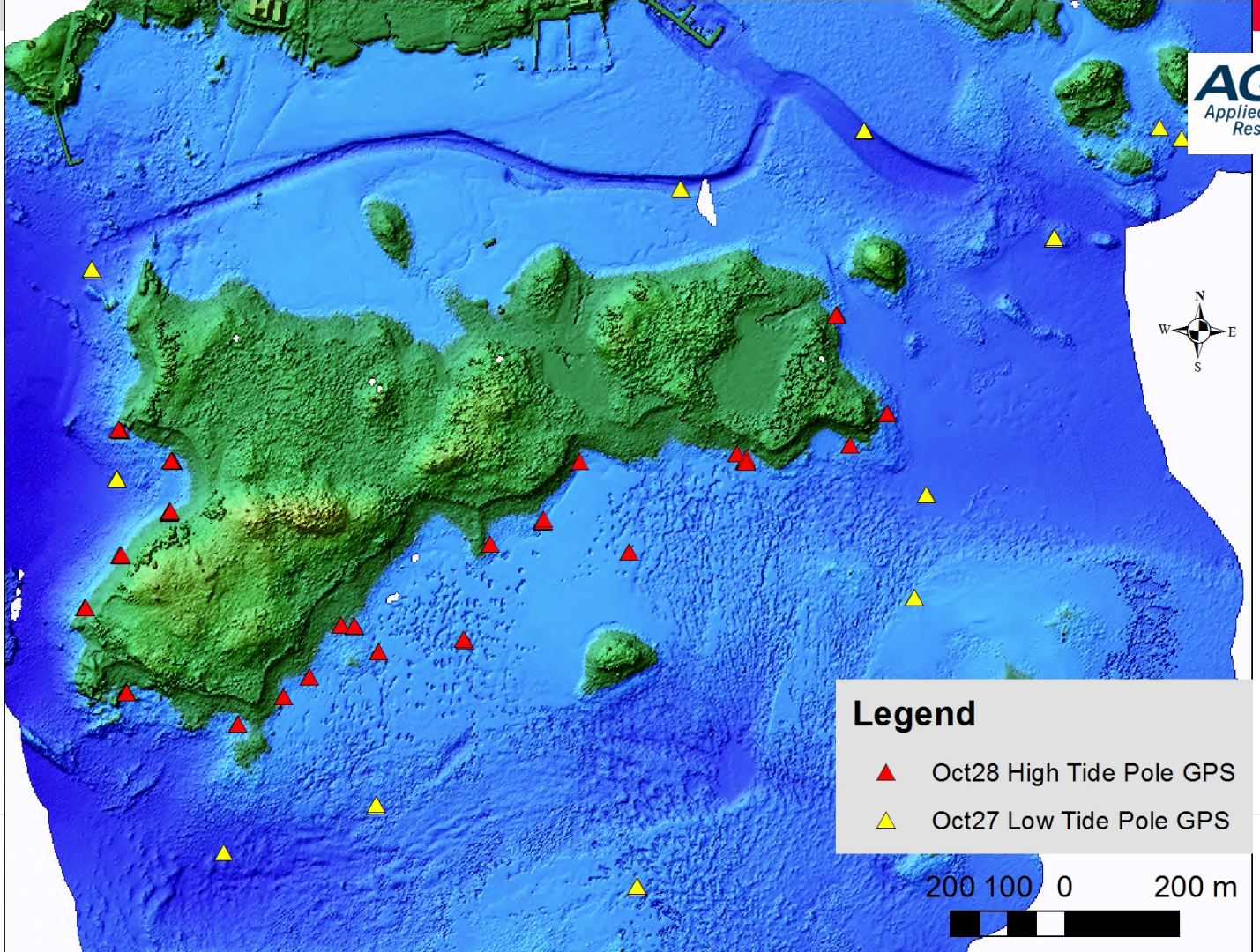




~ 3.5 m tidal range



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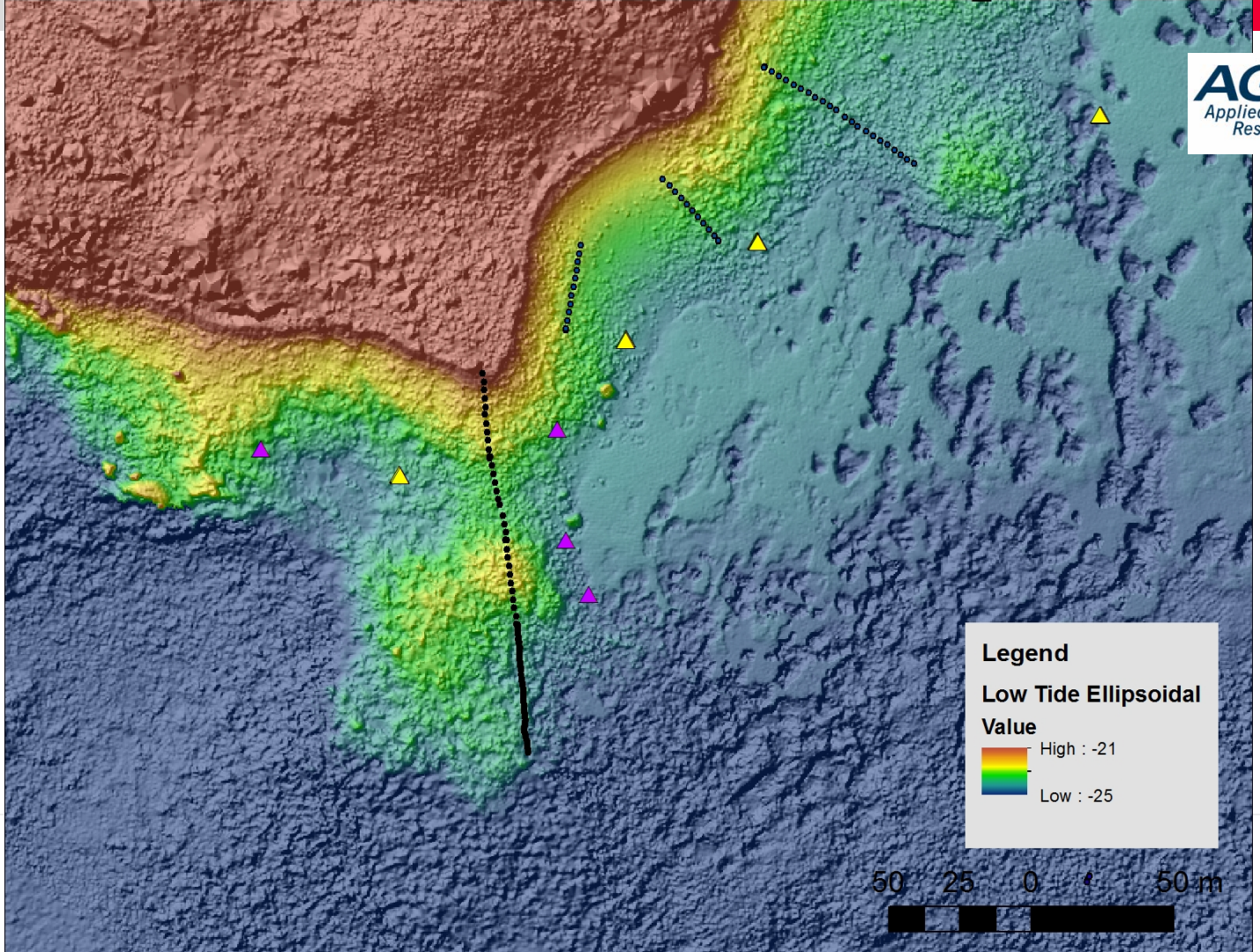


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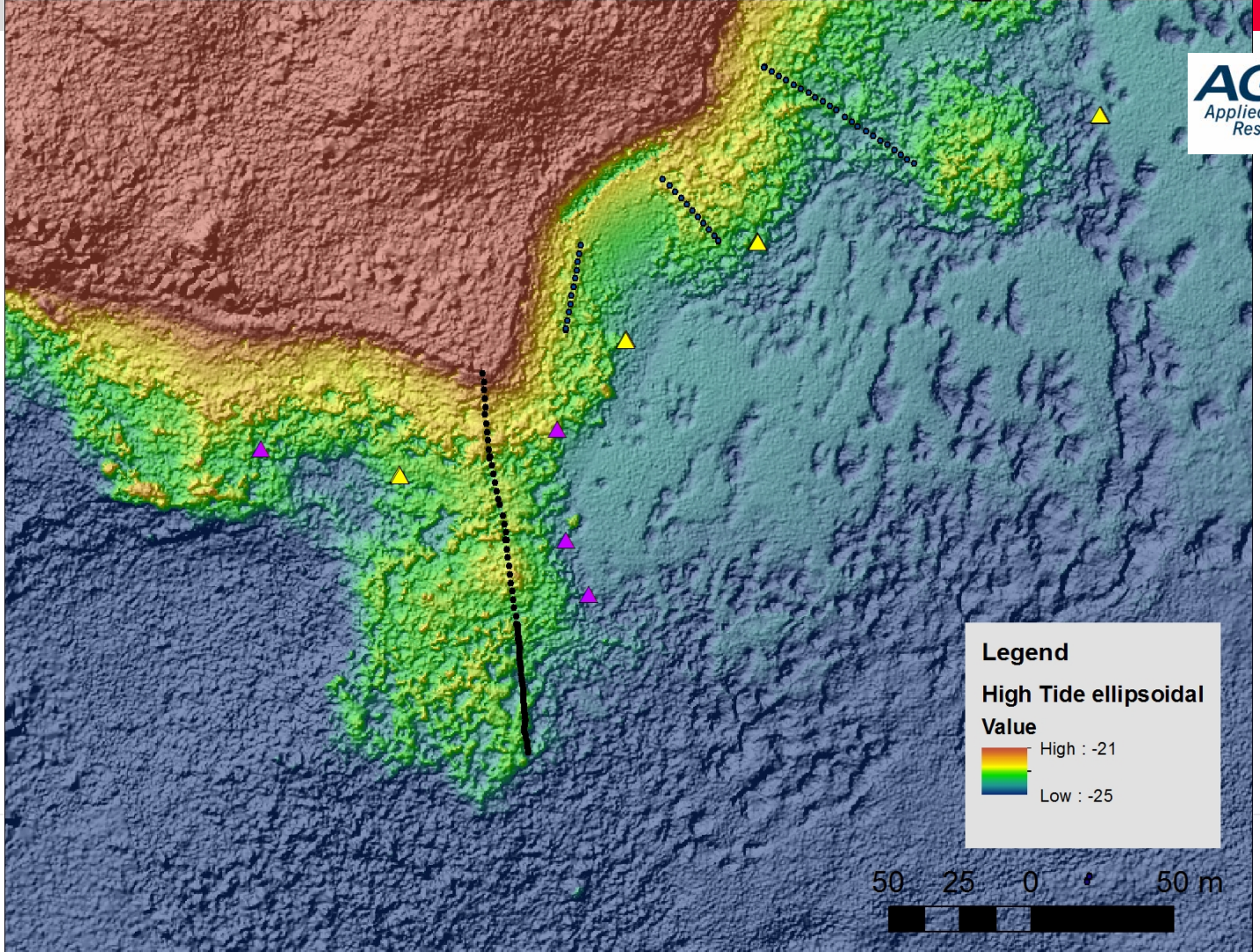


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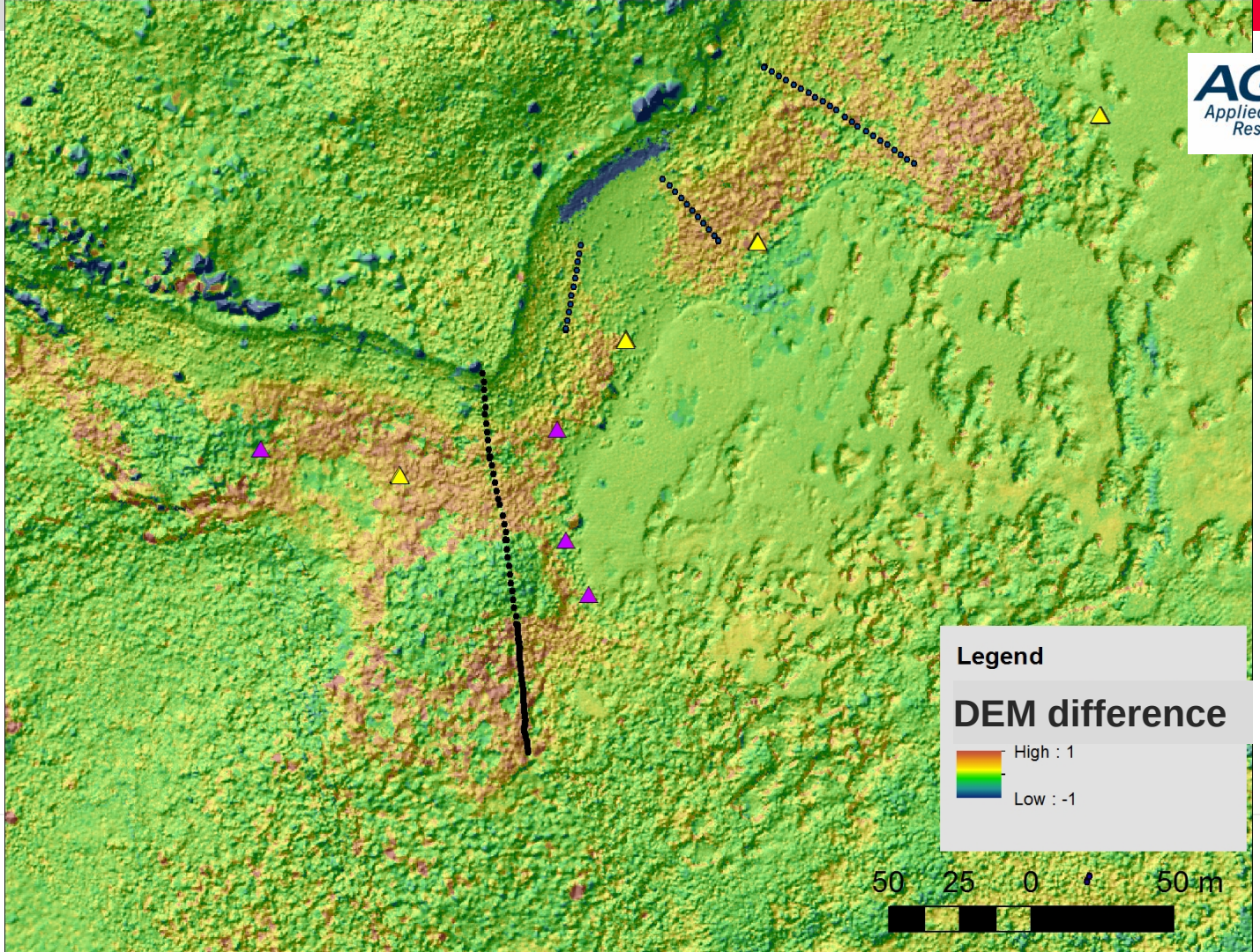


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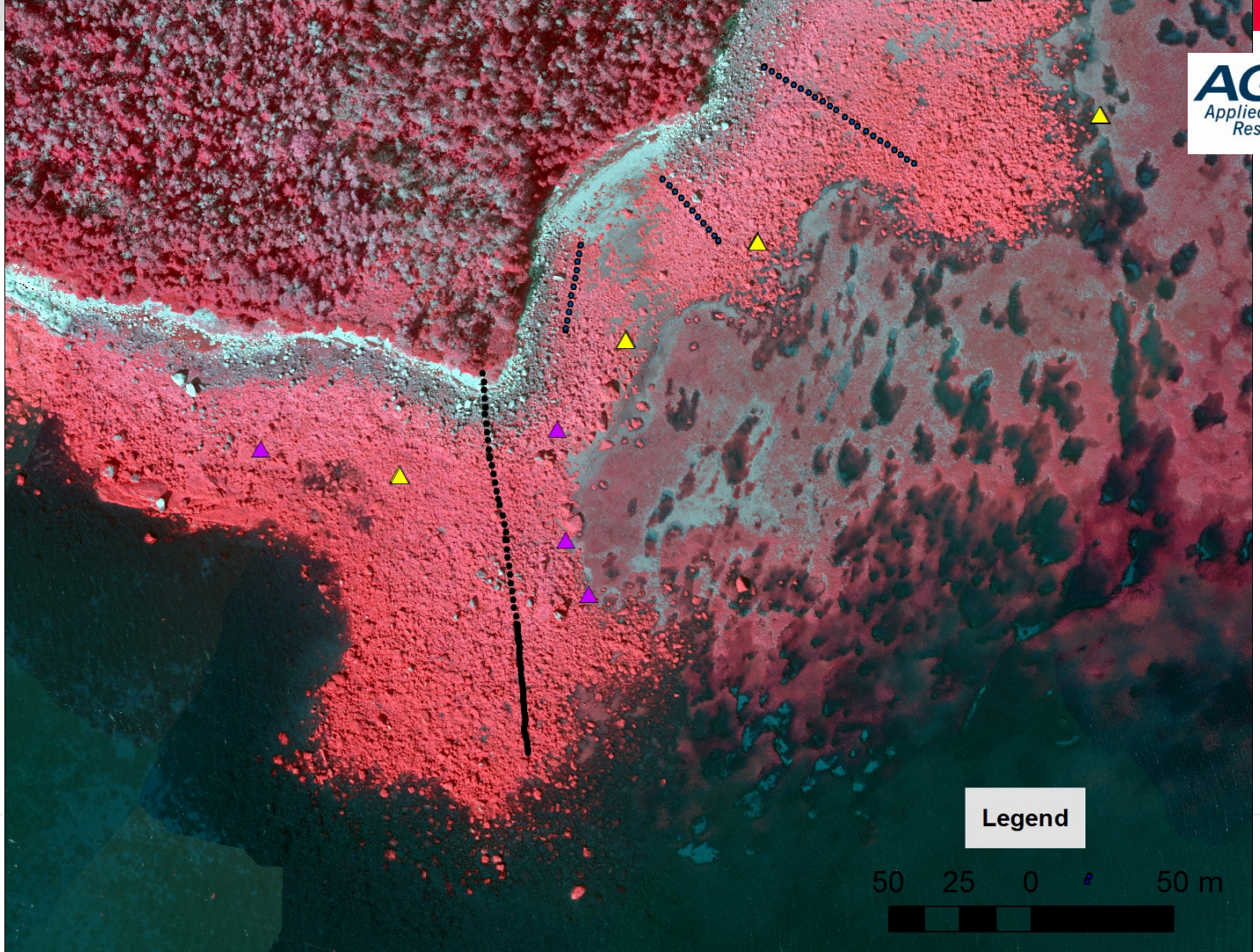
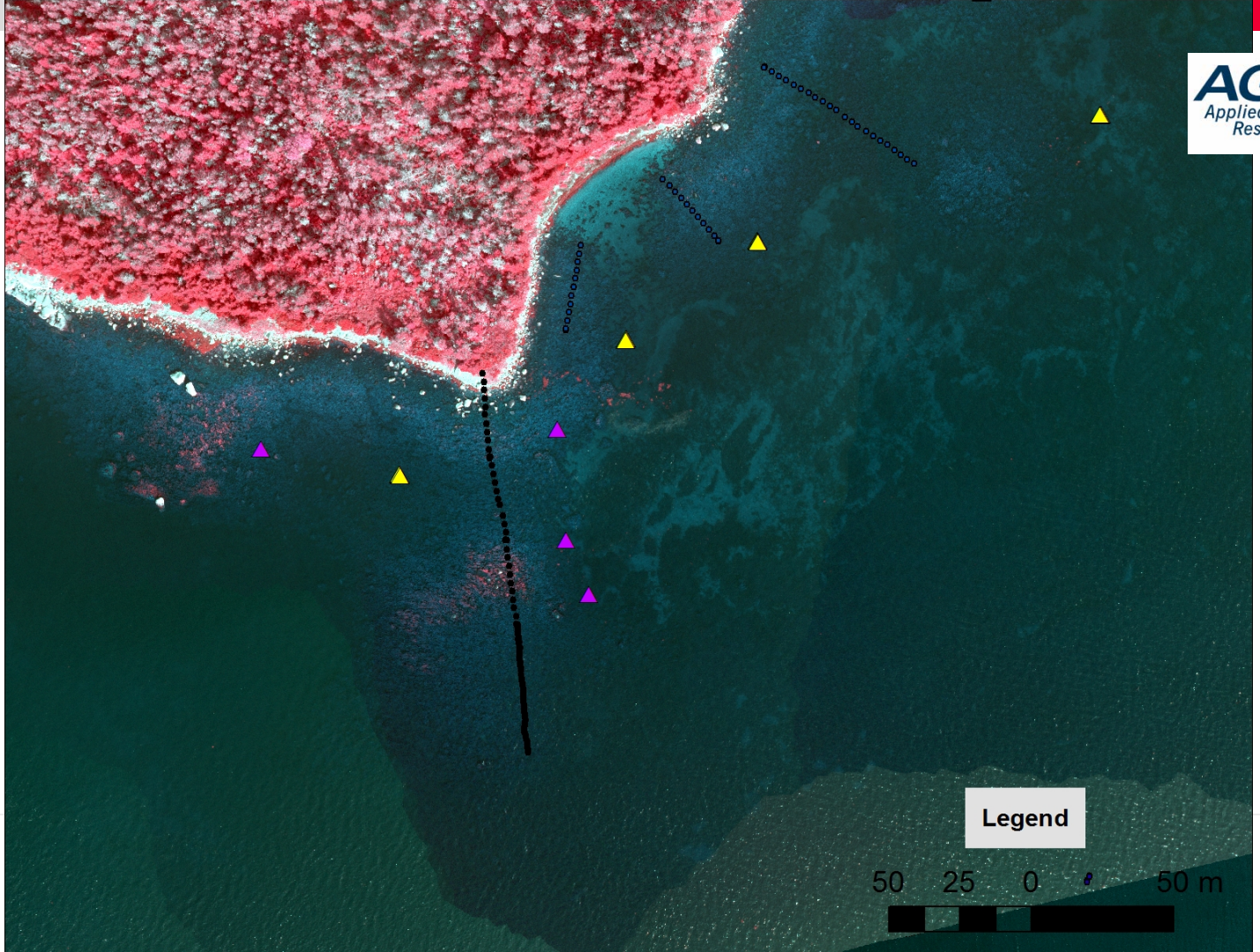
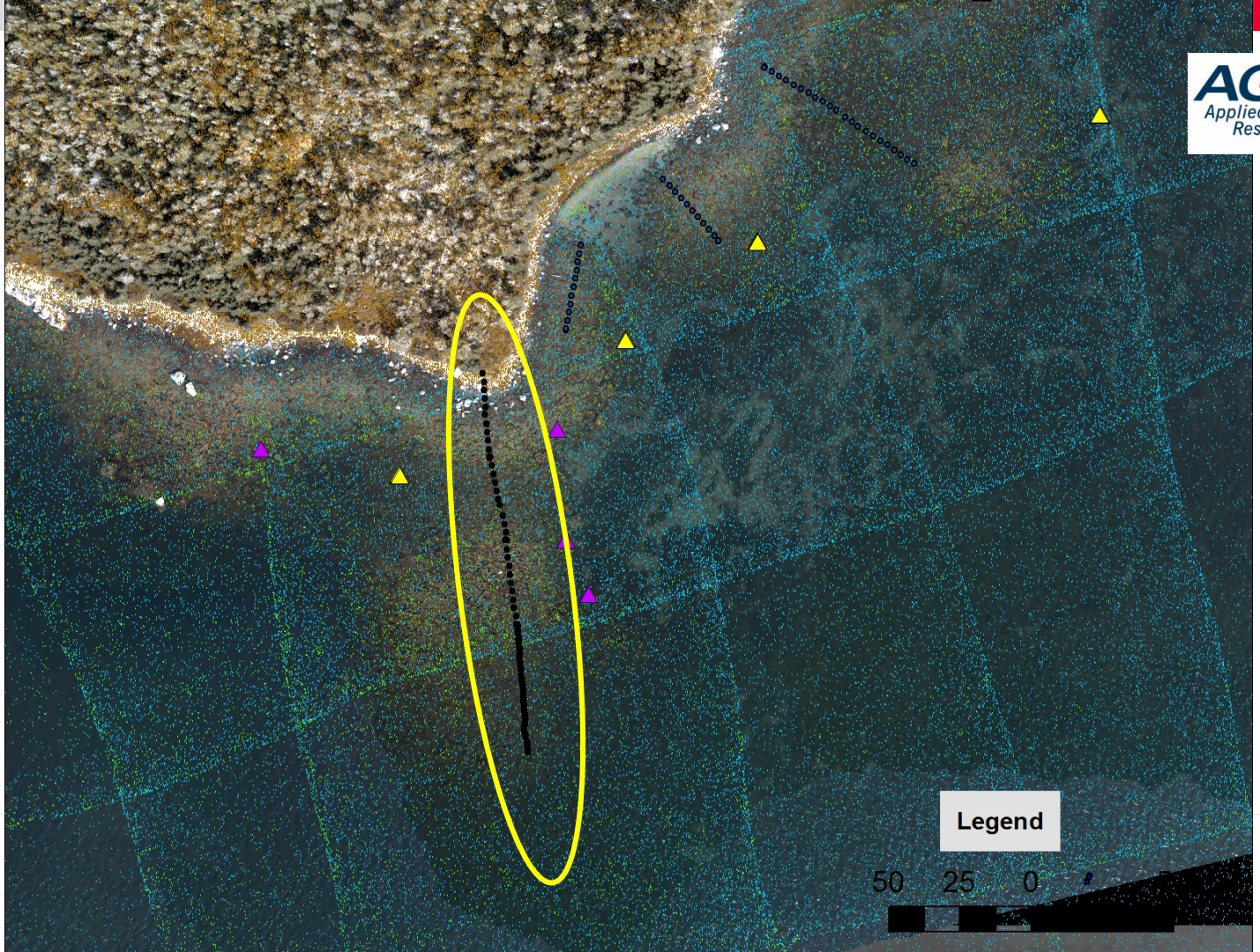



Low Tide CNIR with ground truth data

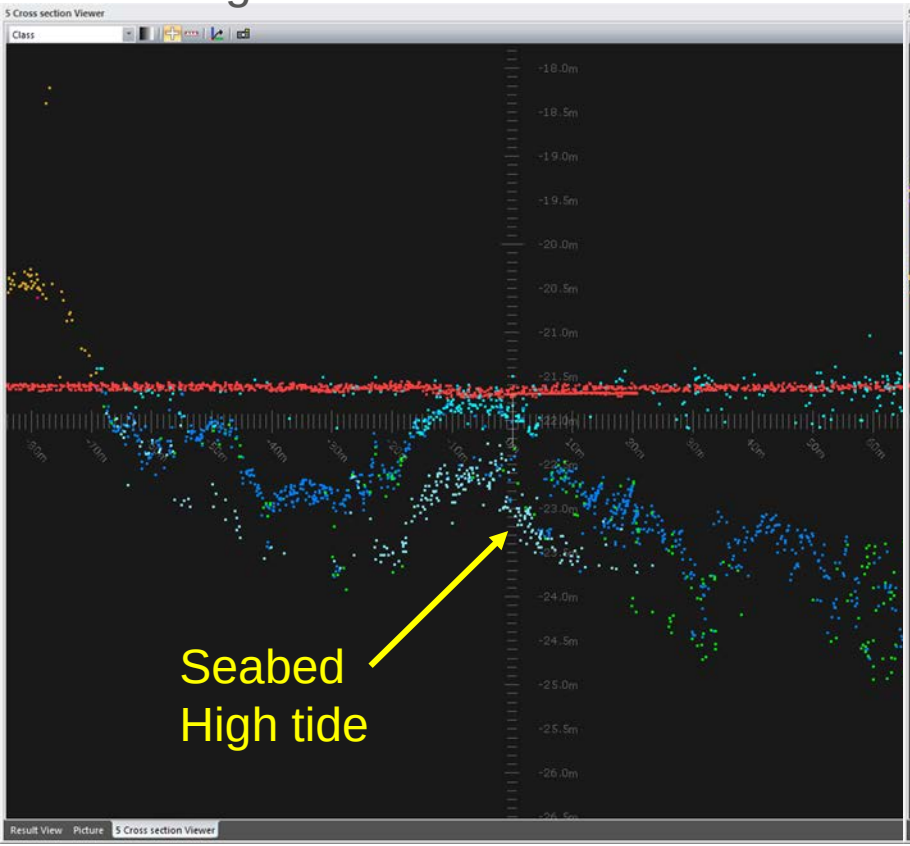



High Tide CNIR with ground truth data

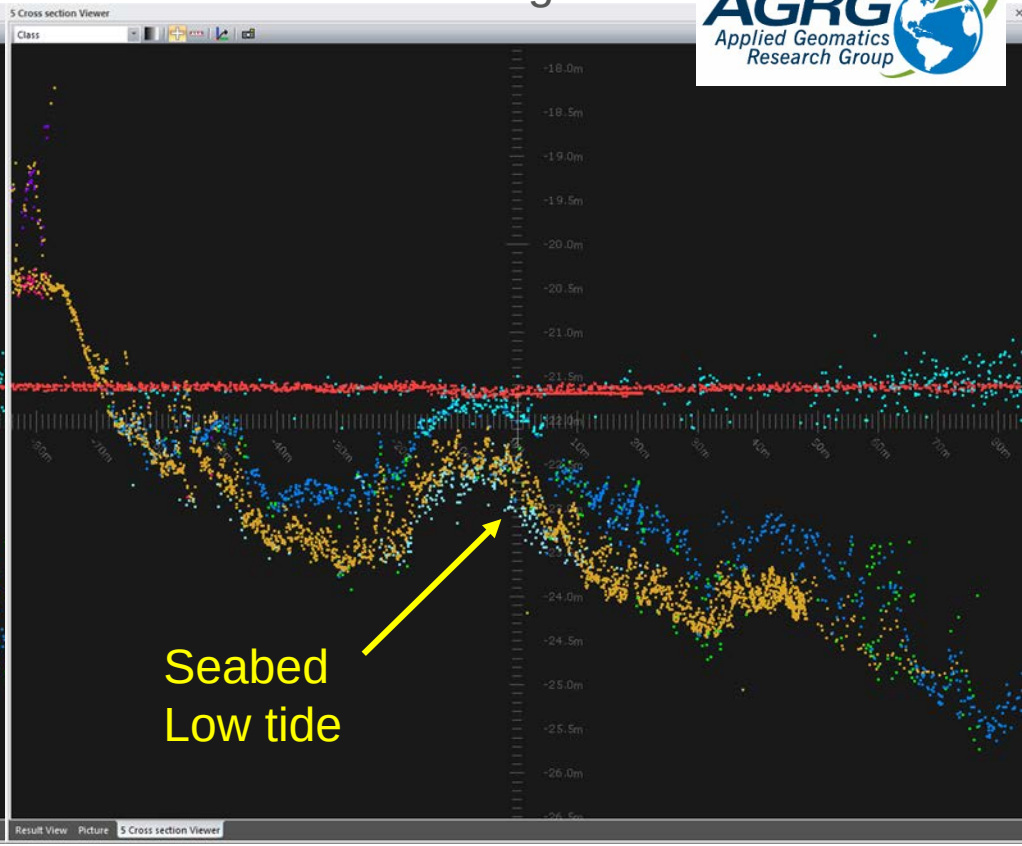


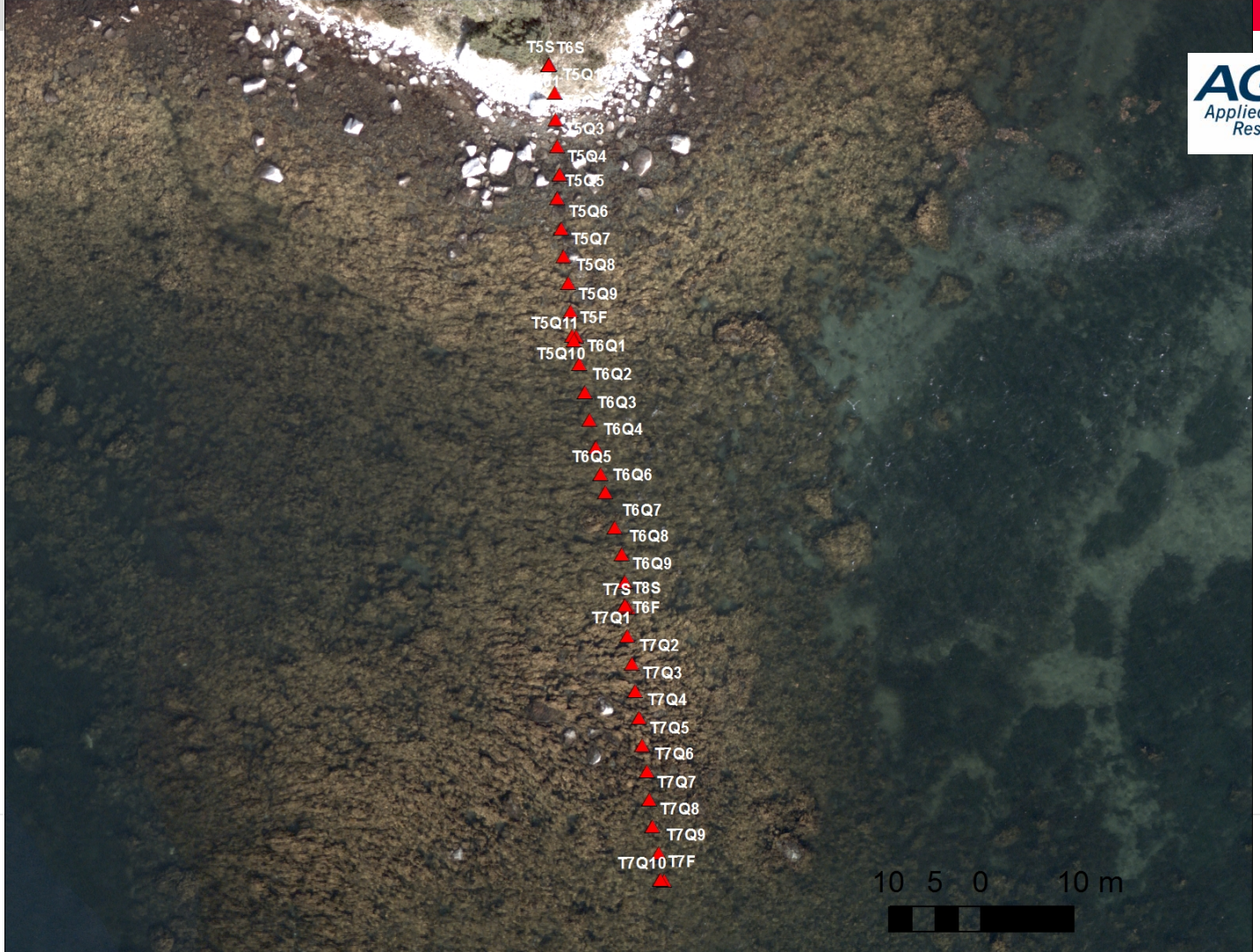

Seabed & submerged object points over High tide TCC with ground truth data

## High Tide cross-section

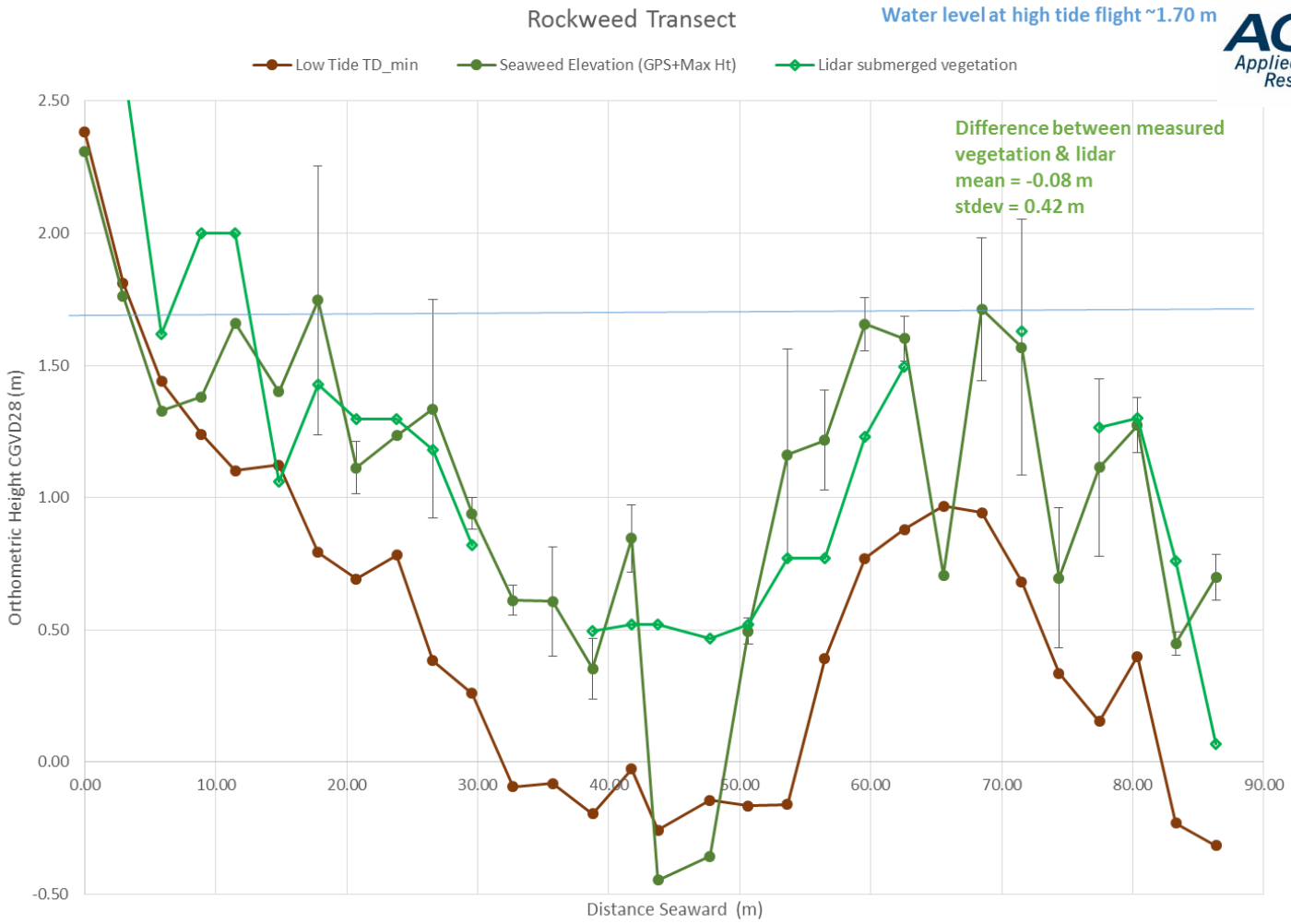



## Low tide – brown + High Tide






RTK GPS points for 50 cm x 50 cm quadrats, metric on 3 seaweed plants measured


Rockweed Transect
Water level at high tide flight ~1.70 m
Low Tide TD_min
Seaweed Elevation (GPS+Max Ht)
Lidar submerged vegetation
Difference between measured vegetation & lidar
mean = -0.08 m
stdev = 0.42 m
Orthometric Height CGVD28 (m)
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
Distance Seaward (m)

# Conclusions – Preliminary results

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.

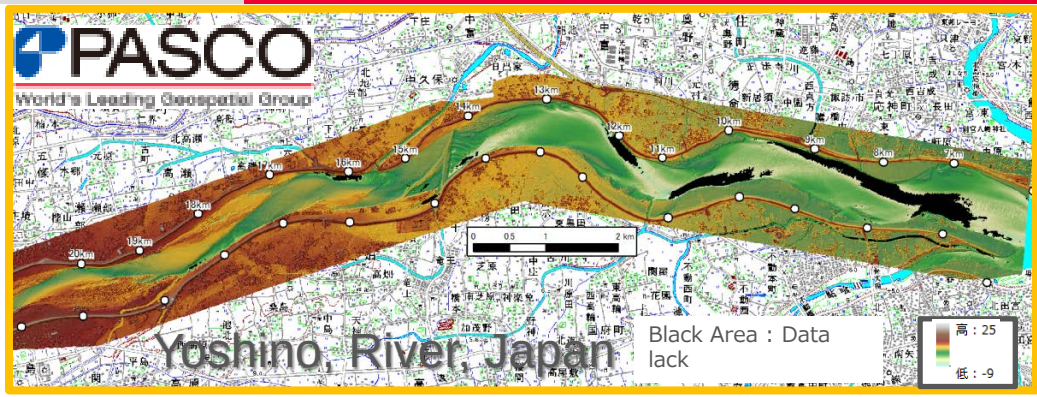
Bathy lidar at high tide captured the floating rockweed with a mean height error of 8 cm stdev = 42 cm compared to maximum ground truth height.

Results suggest we should be able to estimate biomass volume from lidar and with better accuracy than current approach.

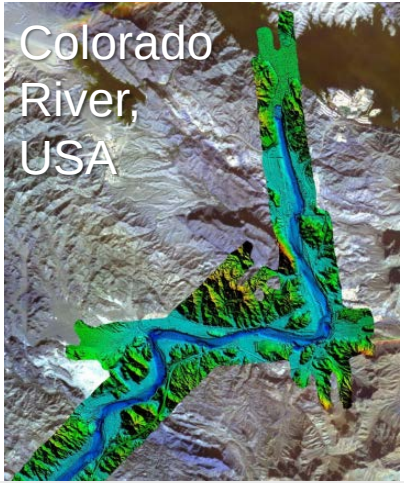
Still need to improve the point classification routines & eventually derive more points from the bathy laser waveforms.

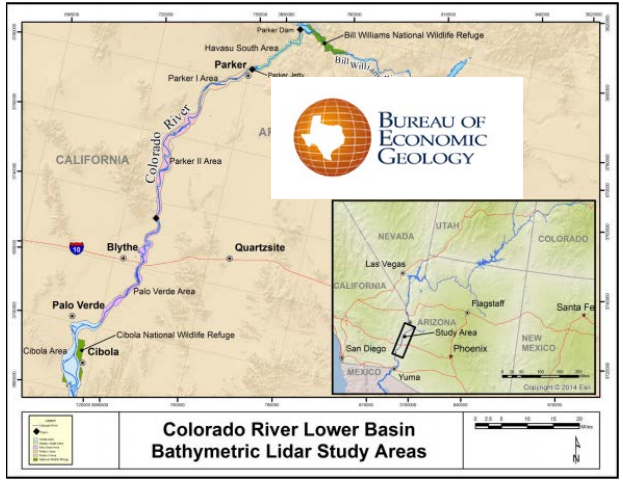
# River survey

- Pasco, Yoshino River, Japan



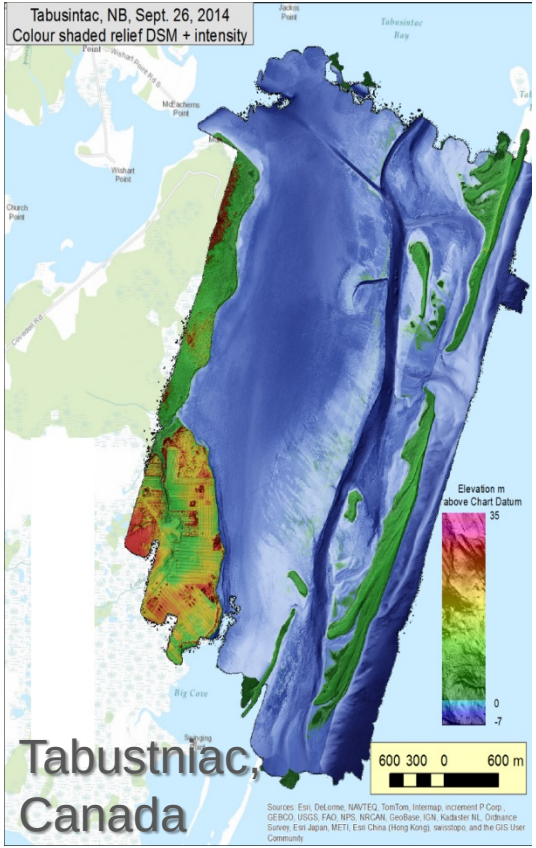

- Bureau of Economic Geology, Colorado river, USA

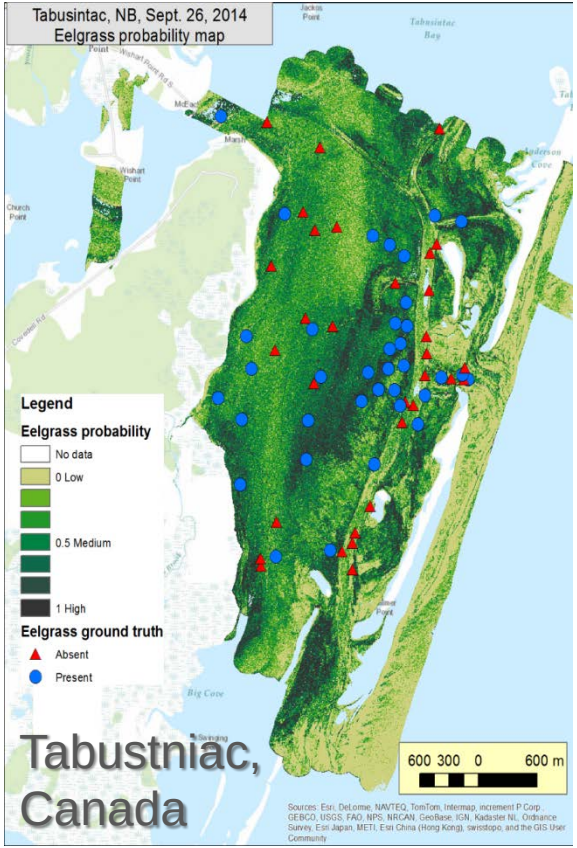


# Eelgrass mapping

NSCC, Eelgrass mapping and automatic classification Tabustniac, Canada




AGRG Applied Geomatics Research Group

# Coastal mapping

Coastal IHO order 1A surveys

- Finnish Transport Agency – Complex coastal arichipelago and inland waters, Finland
- Dreal (SHOM) – Languedoc Russilion coastline, France

# Thanks for providing material to this presentation

Aerodata Netherlands

Nova Scotia Community College, Applied Geomatics Research Group

Pasco

Bureau of Economic Geology, University of Texas at Austin

Finnish Transport Agency

Meritaito

Shom

# Thank You!

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