Searching for Potential Features: Marine Debris and more in Airborne Topobathymetirc Lidar

Examples from U.S. East Coast Sandy Data Collections

17th Annual JABLTCX Annual Airborne Coastal Mapping and Charting Workshop, July 2016, Silver Spring, MD

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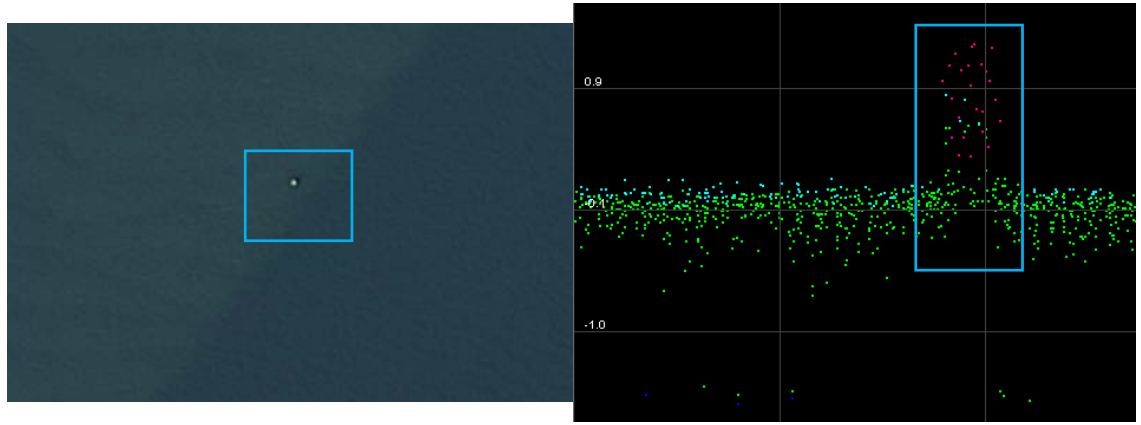
Juliet Kinney, and Andy Armstrong
NOAA Sandy IOCM (ERT Inc.)

Why we are searching for features in lidar

- Explicit contract task for **Sandy IOCM team** is to address "shoreline and bathymetric changes and the presence of submerged features"
  - Using Lidar collected by Federal and State government agencies
  - Features found in lidar may have implications for hydrographic workflow
- Address Non-traditional Data Sources for Potential Sandy (Post-Storm) Ocean Mapping Outputs
  - Are there objects/features in the areas that may be notable?
- Disambiguation of term "features"
  - Versus "objects," "contacts" and "targets"

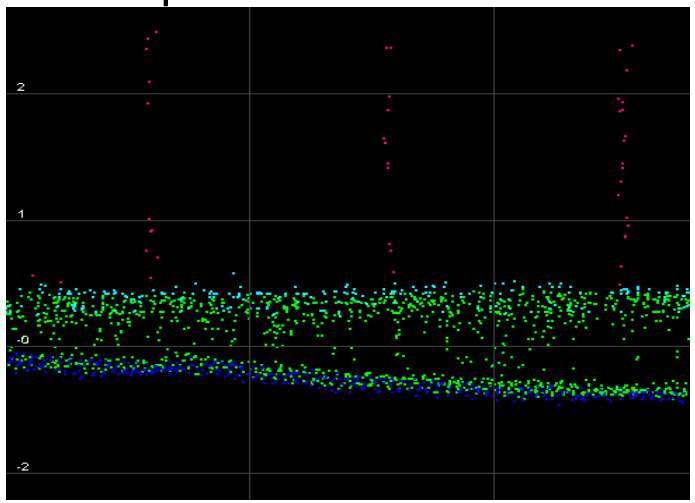


Integrated Ocean and Coastal Mapping approach

- Multiple Products from a Single Dataset
  1) How to incorporate into a hydrographic workflow (OCS, NGS, RSD)
     - Navigationally significant
     - Shoalest Depths from Submerged Features
  2) Documenting Marine Debris (Office of Response and Restoration)
     - Describing marine debris post storm events
       - What remains, what has been removed
- Our goal, "**Maximum use and Re-use of Data**"

Goals for Present Study

- Features: ***Can we find them…***if **YES** then
- Summarize the characteristics of these features
  - What lidar classes are features being found in
    - Bathy, Unclassified, Water Column, Water Surface, Ground etc.
  - Where, with respect to the water column, are they?
    - Submerged features
  - How do we visualize the datasets?
    - 3-D point cloud, vertical profiles, 2-D point cloud, grids/rasters, resolution of point cloud
  - Can we develop a systematic approach to find features?
    - Developing parameters for a feature finding algorithm

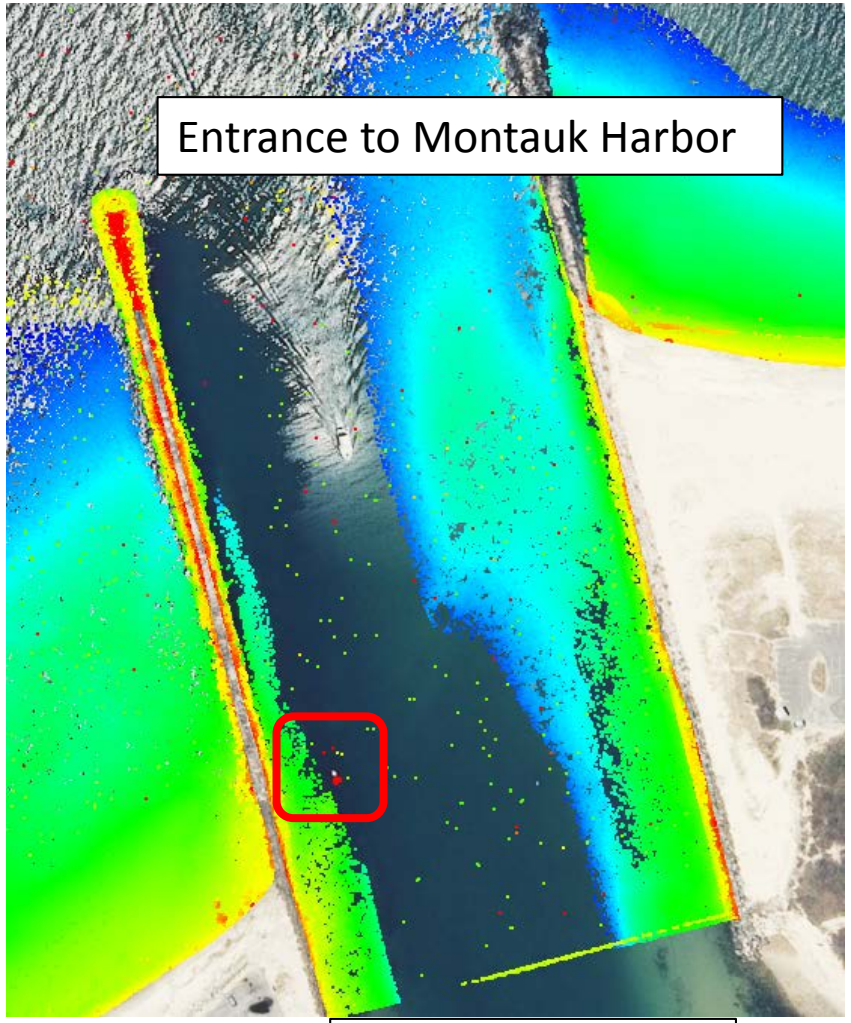


Datasets and Tools

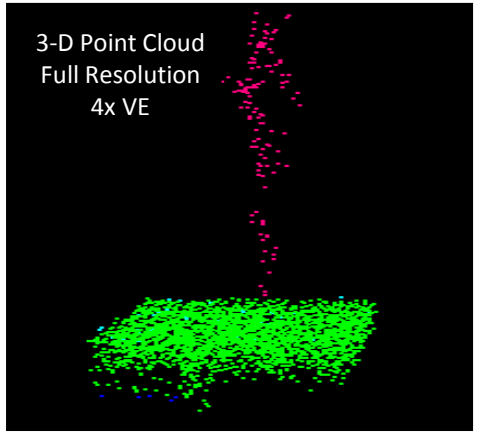
- Collected by NOAA NGS RSD using a Riegl VQ820G
  - Collected 2013-2014
  - New York, North Carolina and Virginia datasets provided to Sandy IOCM by RSD for integration into hydrographic workflow
  - Fisher's Island, was downloaded by request from online data viewer (NOAA)
- *NOT Collected specifically for hydrographic Workflow or to find Marine Debris*

  (Shoreline and habitat mapping)
- Software used: ArcGIS by ESRI, LP360 by GeoCue, CARIS and Fledermaus by QPS

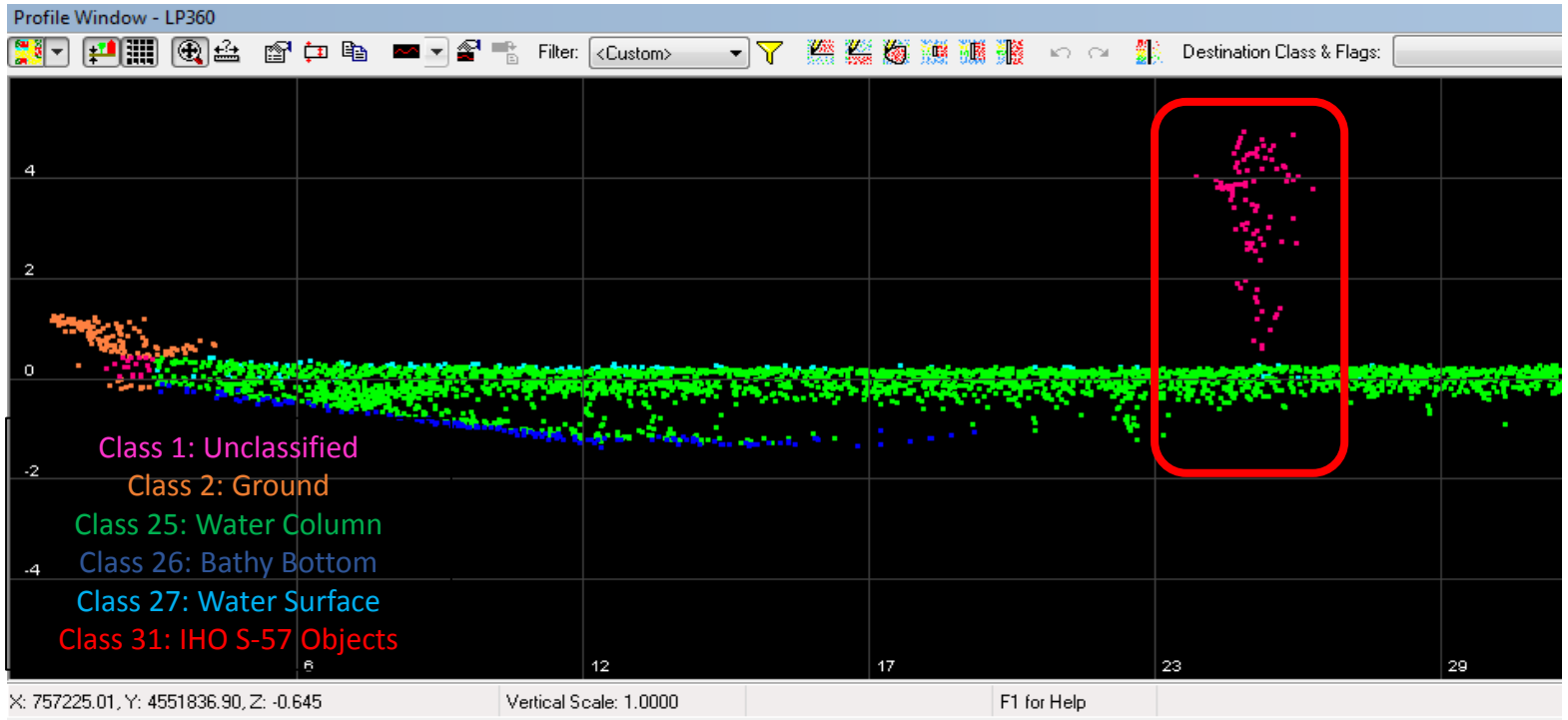
Example (1 of 6)



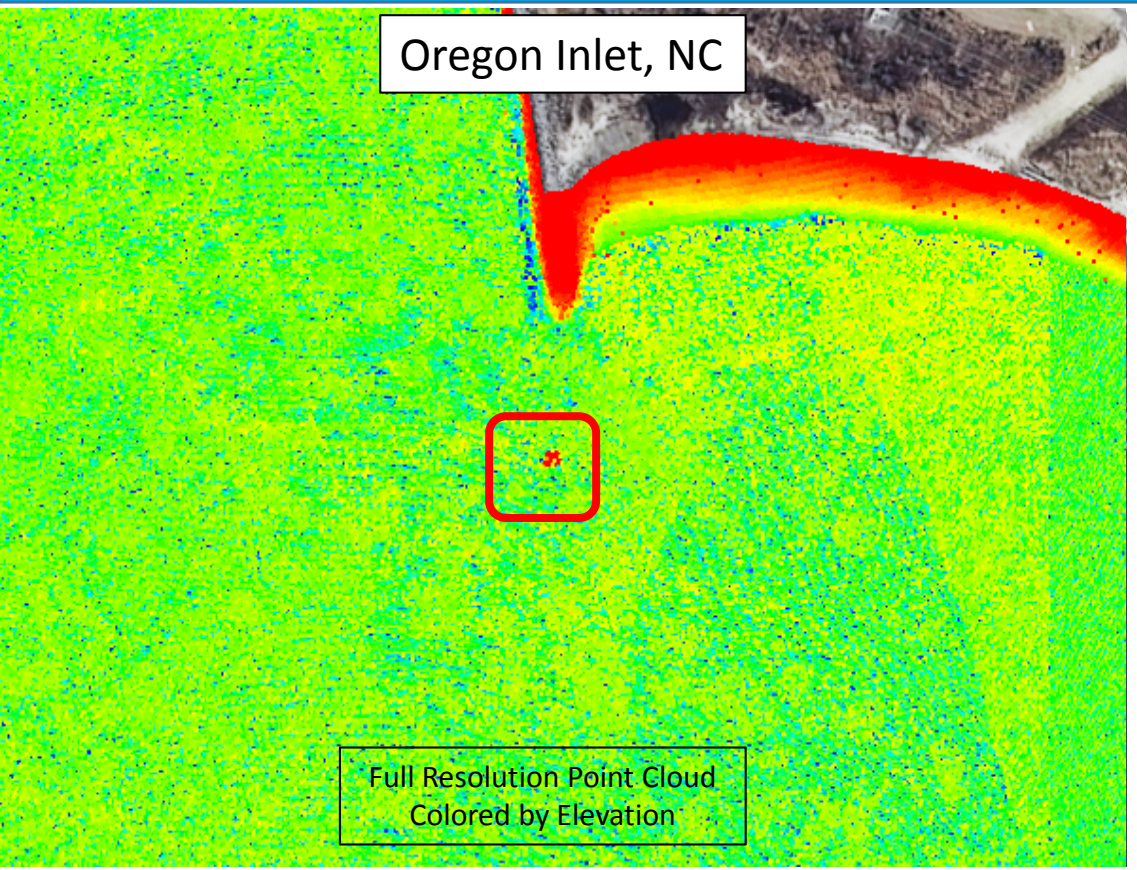
Full Resolution Point Cloud
Colored by Elevation

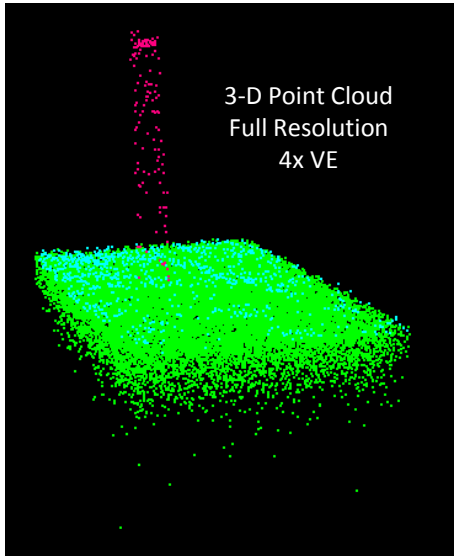


- Potential Pile/ATON
- Seen in Both Lidar and Imagery
- Not Charted
- Only observed ***above*** water surface

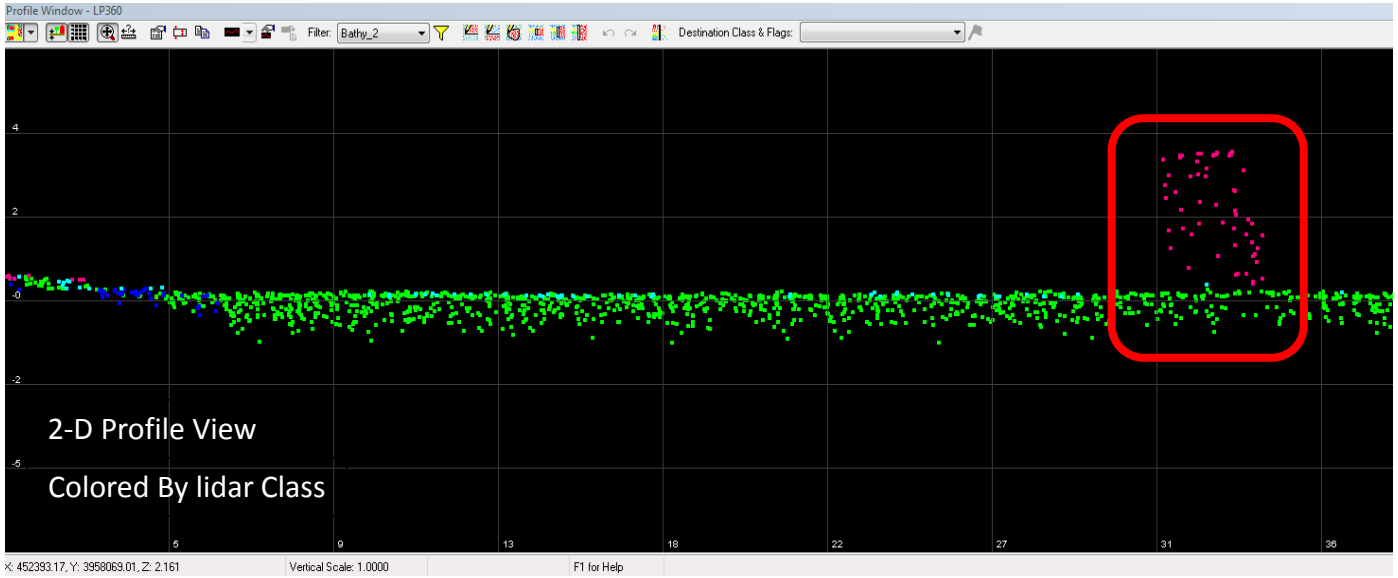


Example (2 of 6)



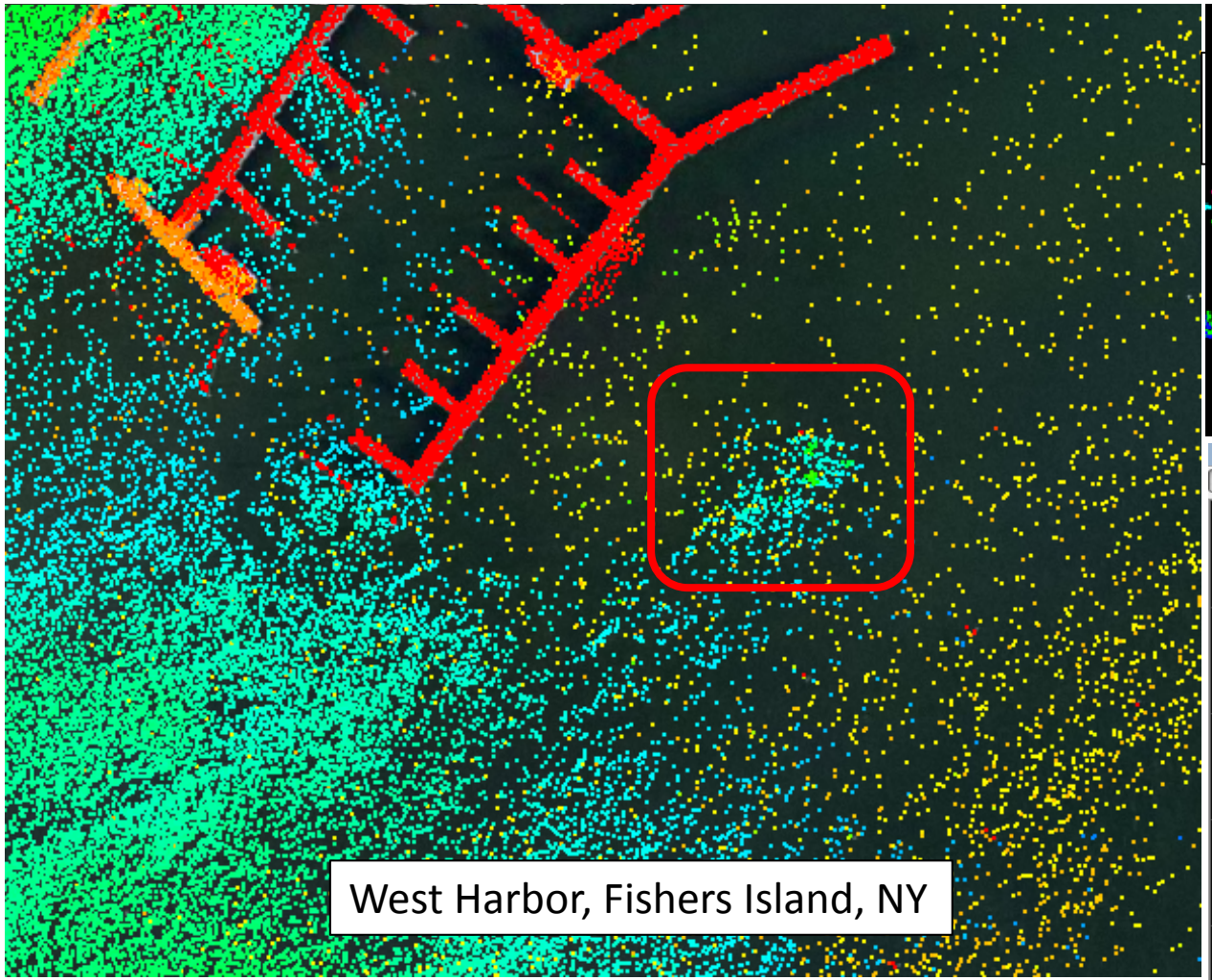


- Freestanding Marine Feature (RSD)
- Seen in Both Lidar and Imagery
- Only observed in ***Unclassified Class (Class 1)***

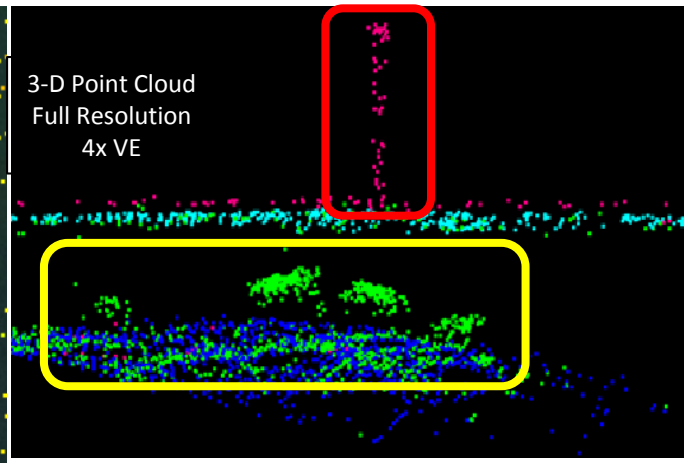


Class 1: Unclassified
Class 2: Ground
Class 25: Water Column
Class 26: Bathy Bottom
Class 27: Water Surface
Class 31: IHO S-57 Objects

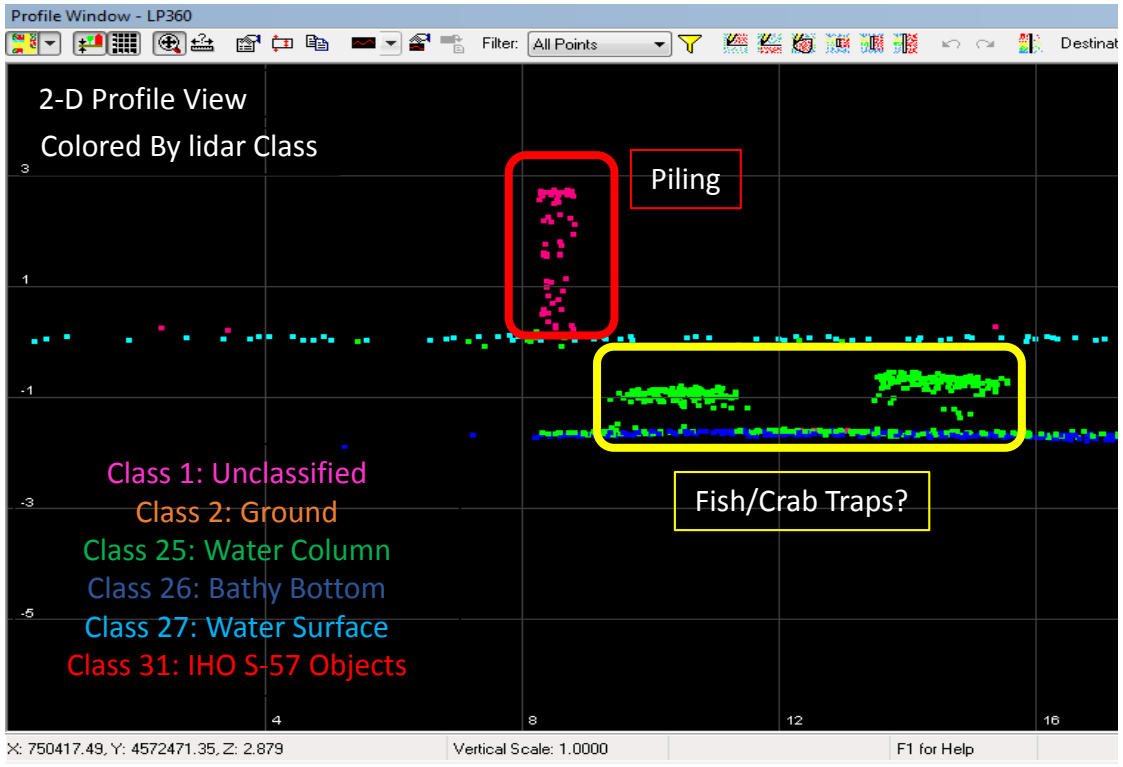
Examples (3 of 6)



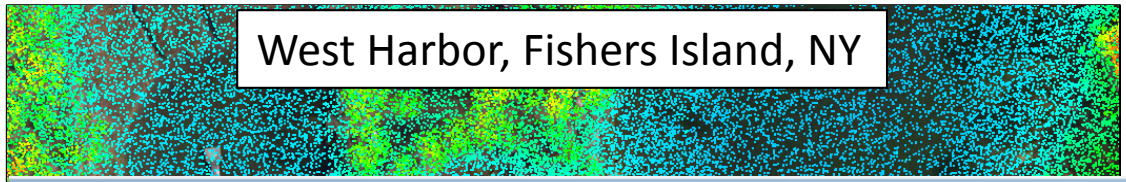
Full Resolution Point Cloud
Colored by Elevation



- Piling and Submerged Features
- Unclassified Class and Water Column Class

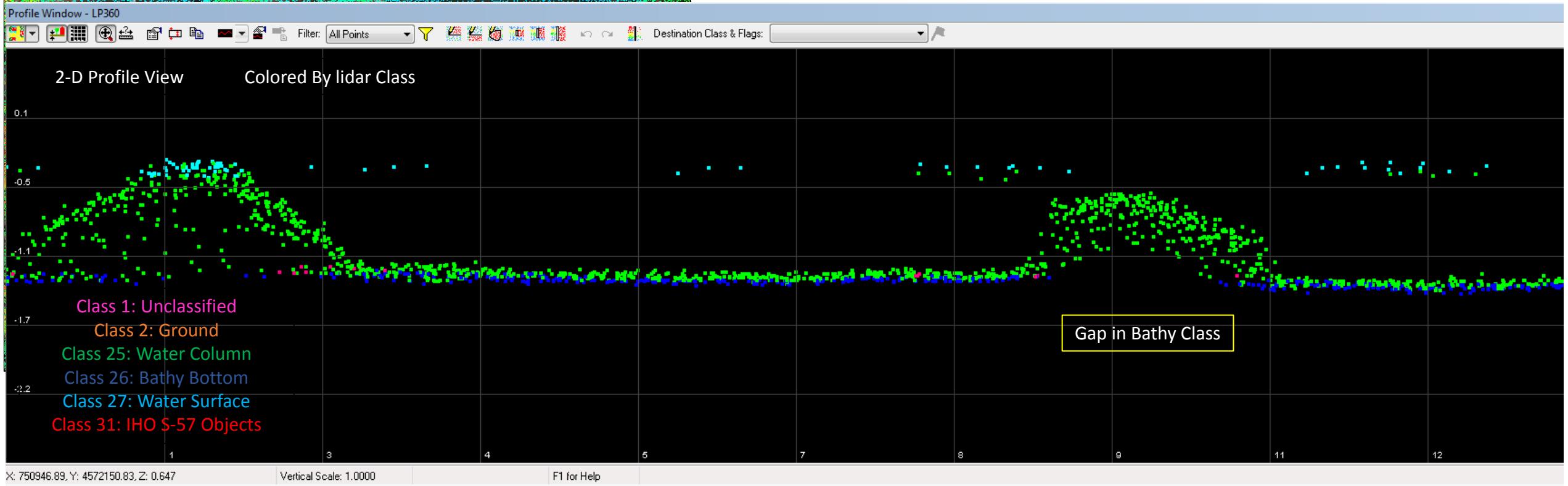


Examples (4 of 6)

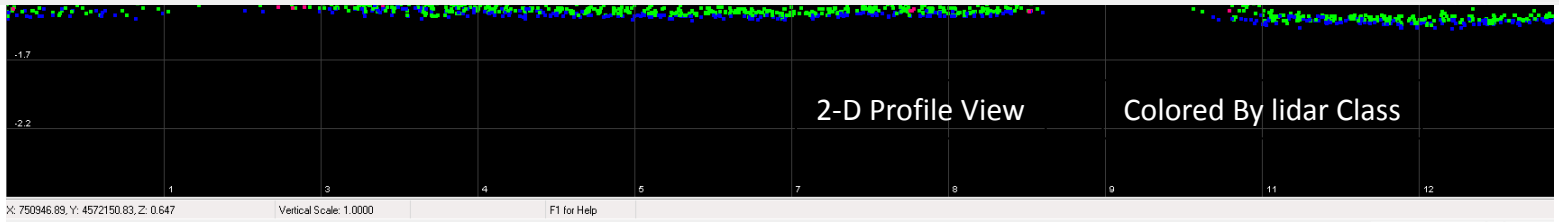


West Harbor, Fishers Island, NY

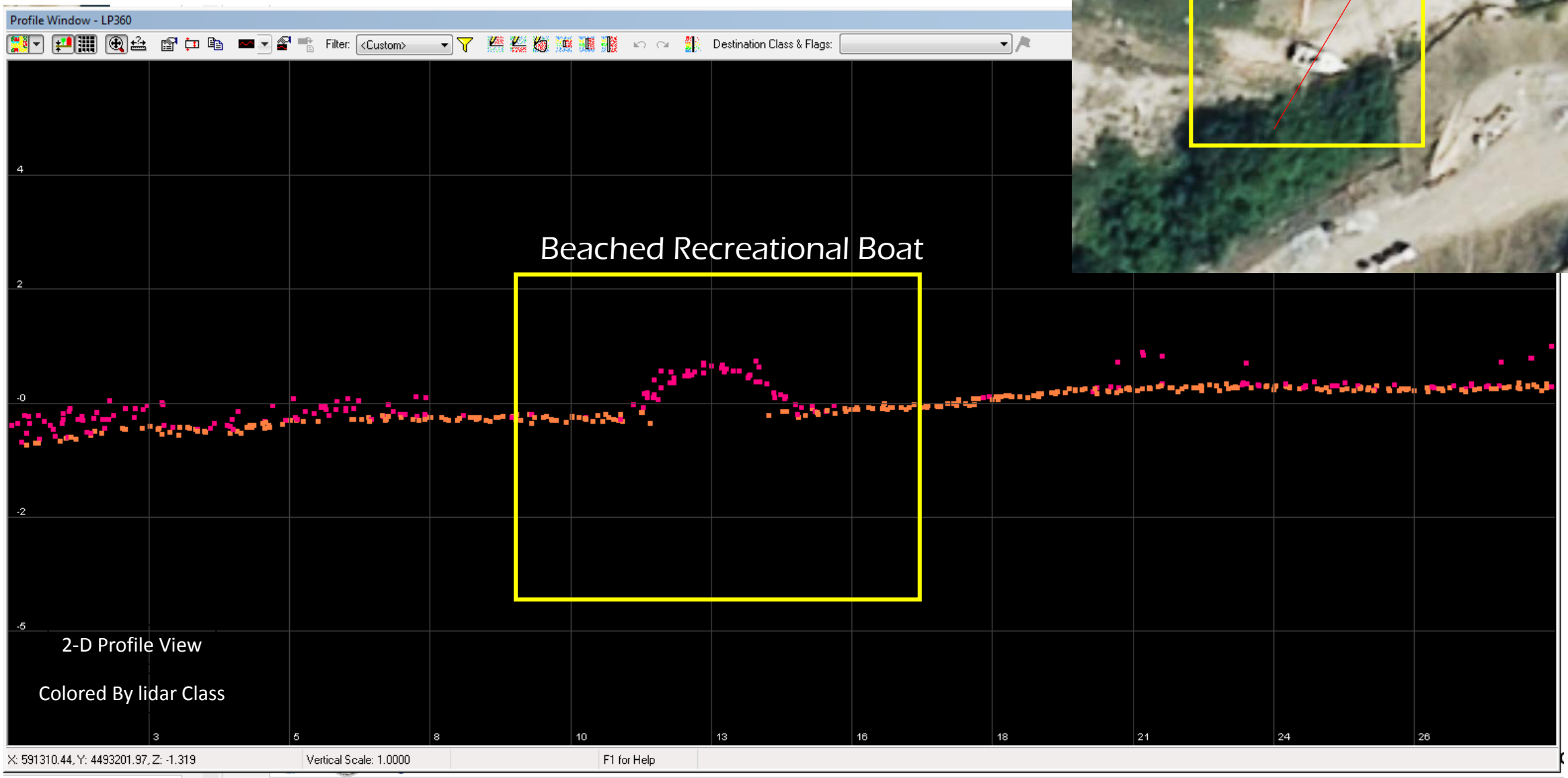
Submerged Rocks in the Water Column Class



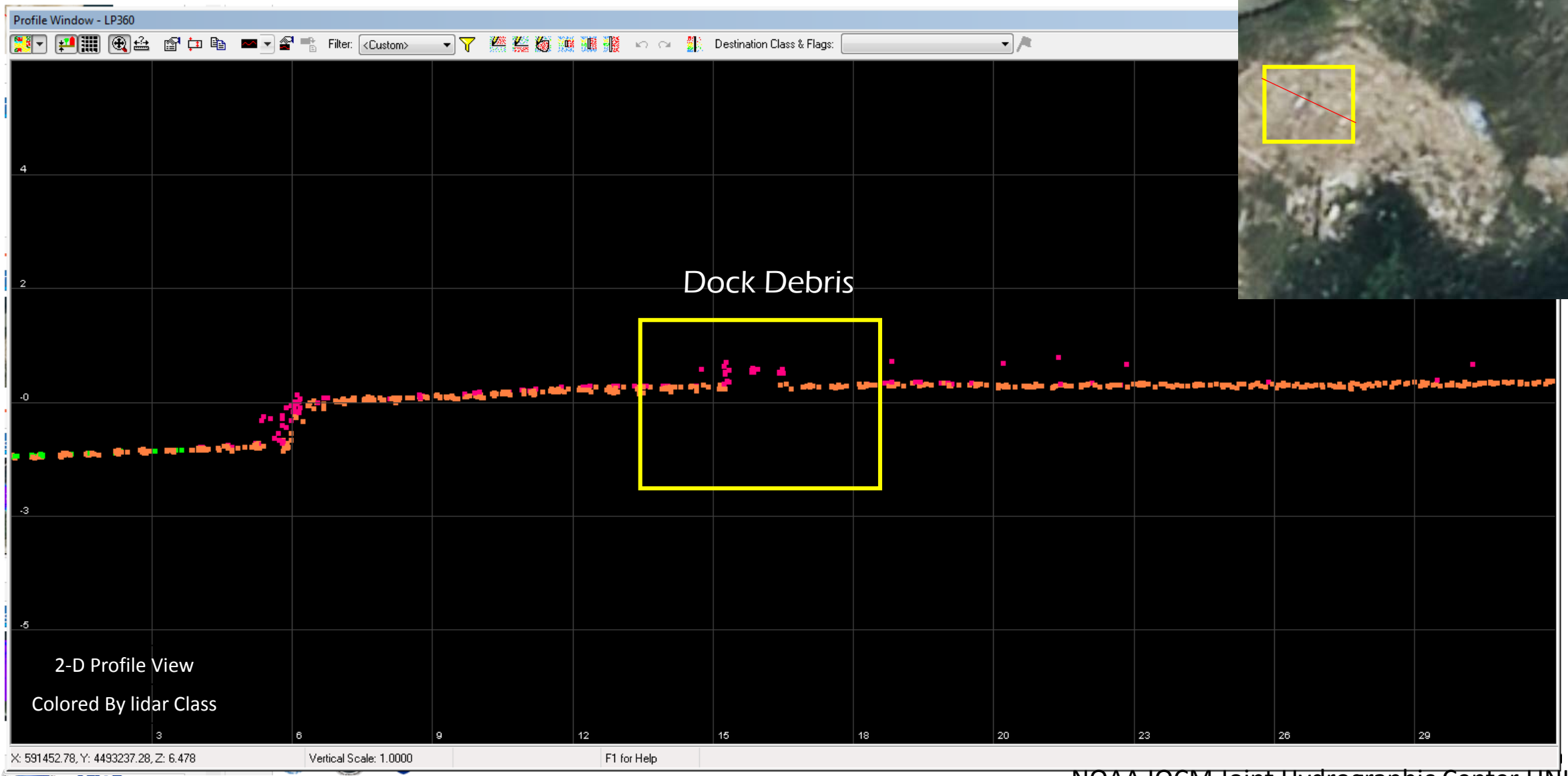
Class 27: Water Surface
Class 31: IHO S-57 Objects



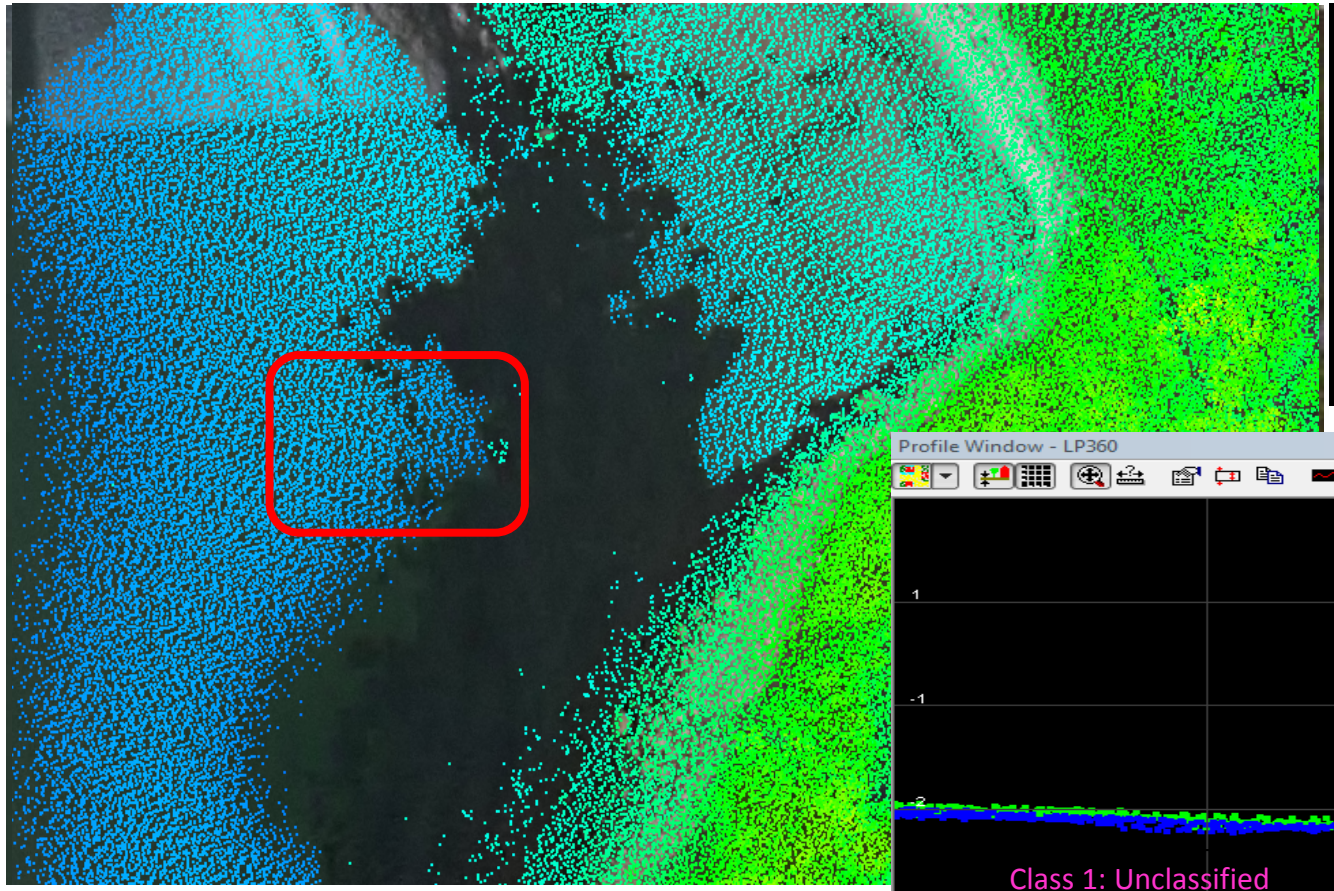
Example (5 of 6) - Marine Debris



Example (6 of 6) - Marine Debris



Challenges in Visualizing Features (1 of 3)



Full Resolution Point Cloud
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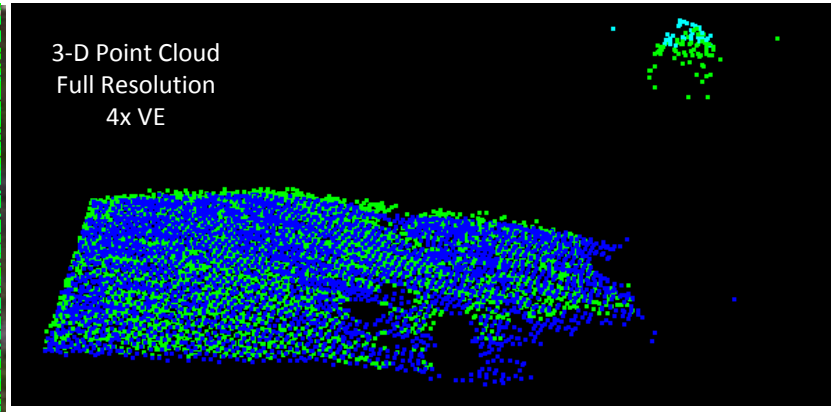
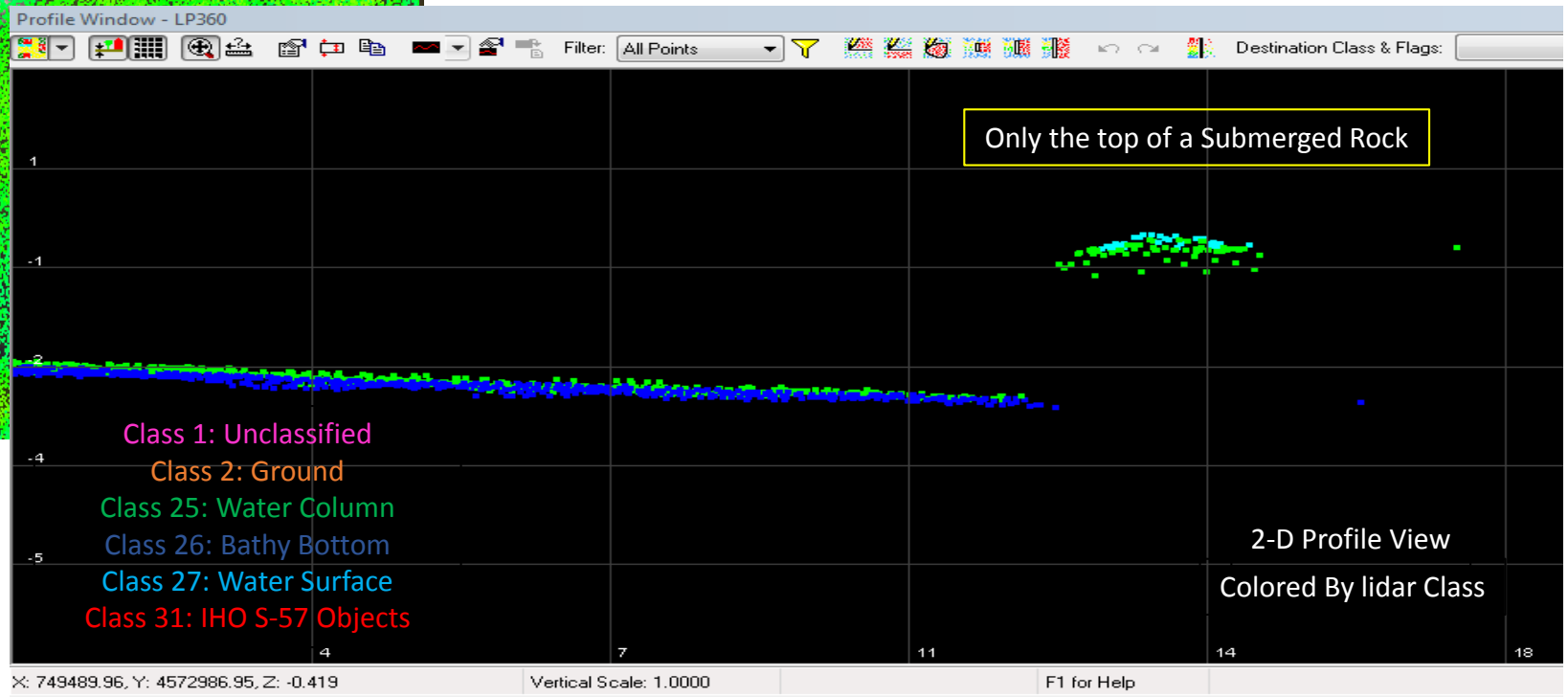
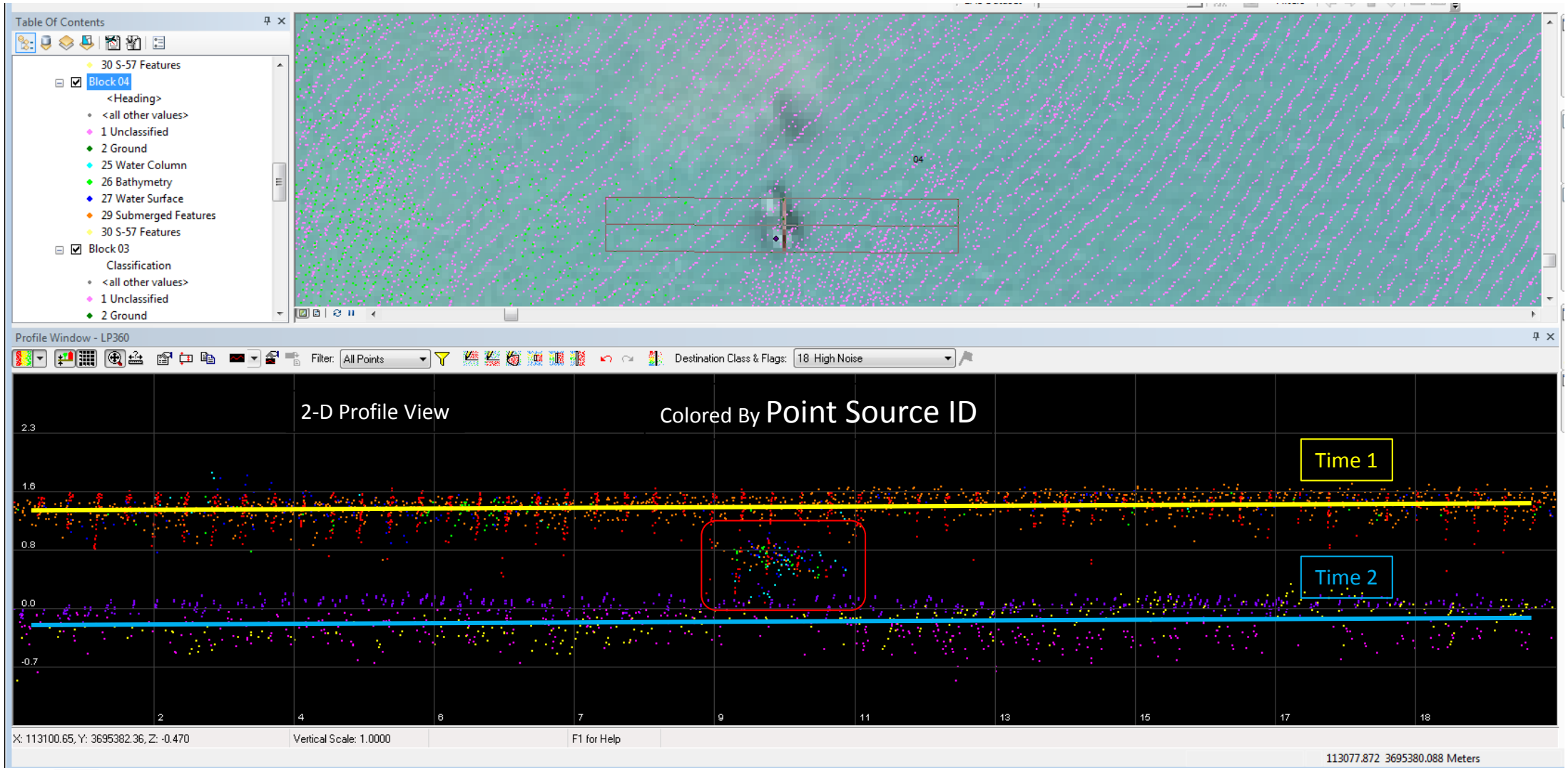


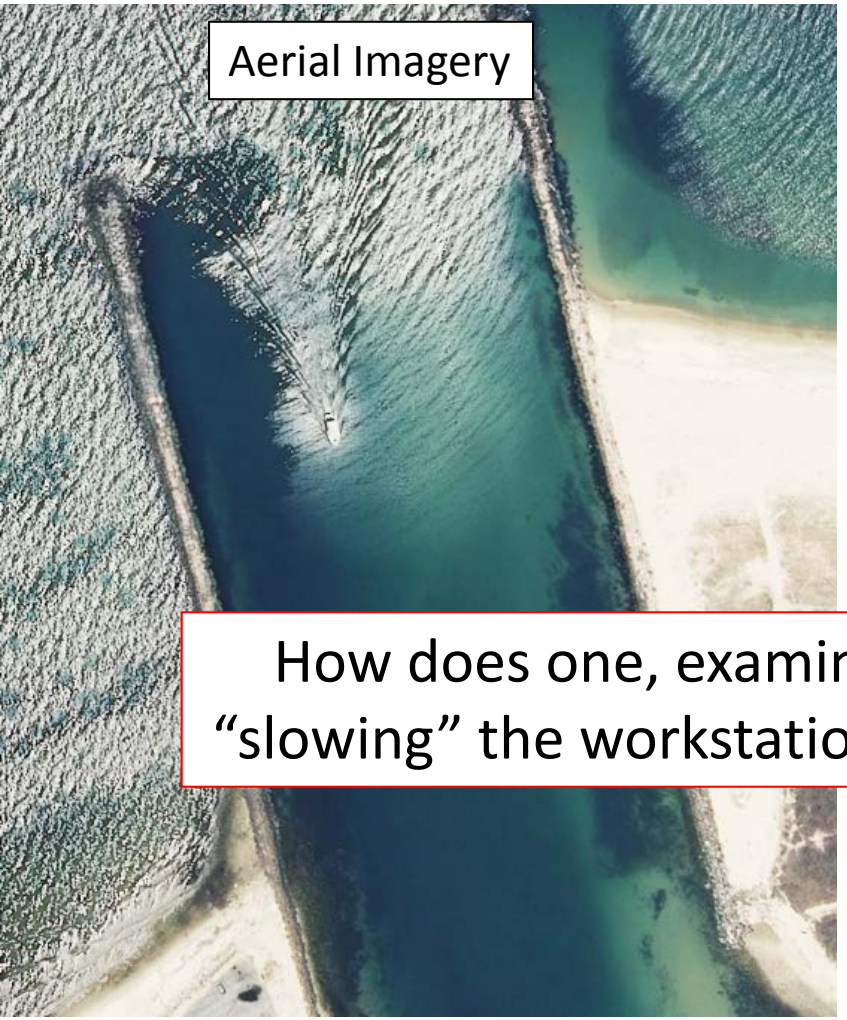


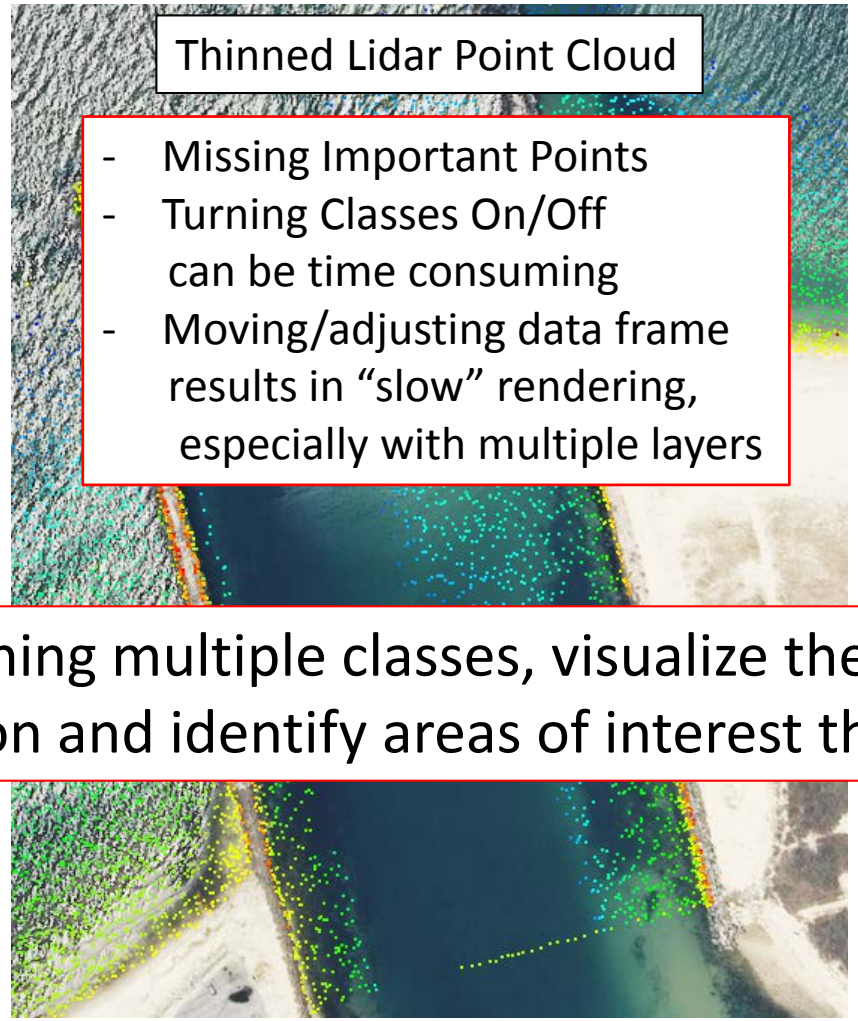
Challenges in Visualizing Features (2 of 3)



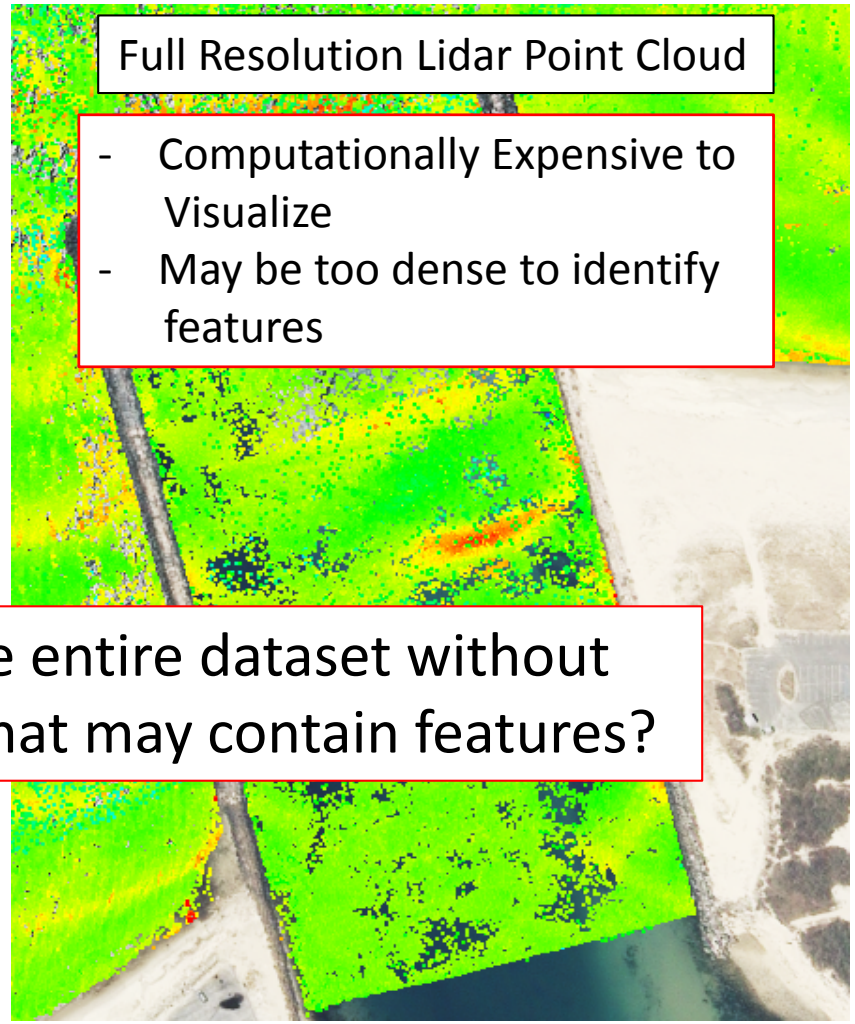
Challenges in Visualizing Features (3 of 3)

Entrance to Montauk Harbor





- Missing Important Points
- Turning Classes On/Off can be time consuming
- Moving/adjusting data frame results in “slow” rendering, especially with multiple layers



- Computationally Expensive to Visualize
- May be too dense to identify features

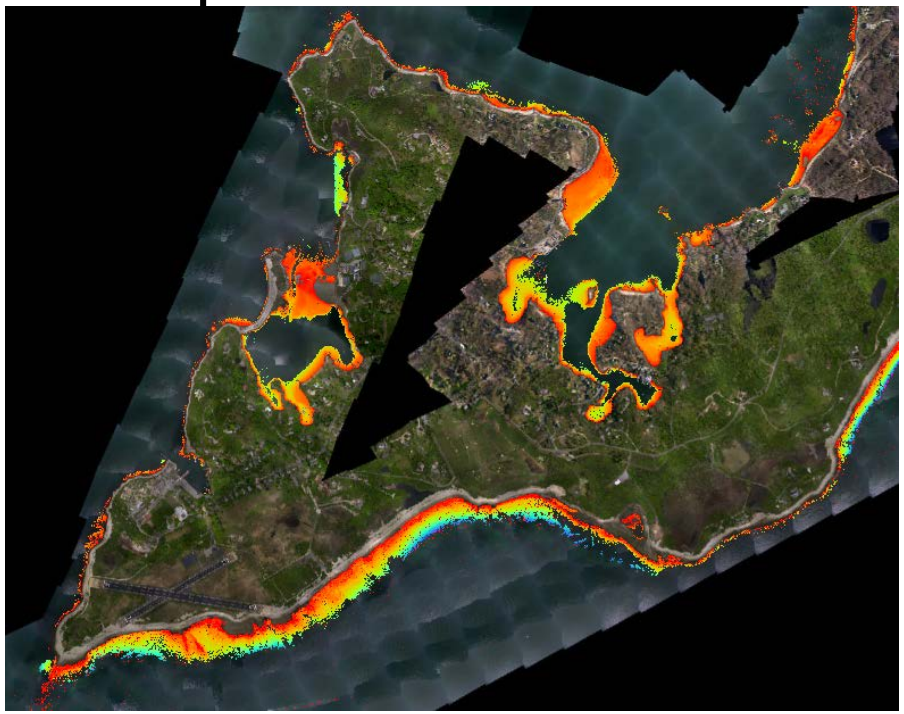
How does one, examining multiple classes, visualize the entire dataset without “slowing” the workstation and identify areas of interest that may contain features?

Gridding Lidar Classes

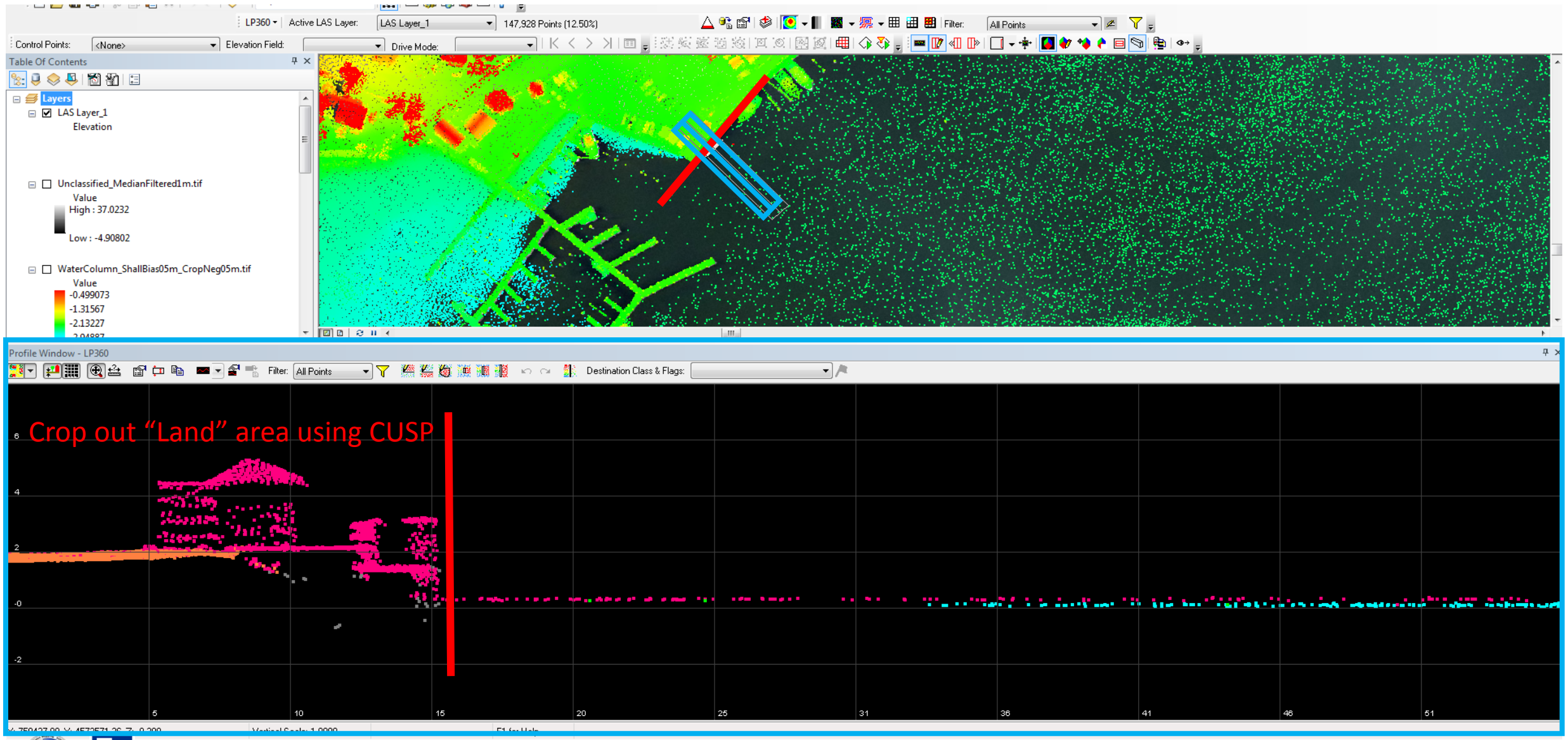
- Incorporates the entire Class
- Allows user to objectively target areas
- Can be exported as GeoTIFFs and other rasters
  - Less computationally expensive to visualize
- Gridded data can also be used to derive additional products
  - Slope and Rugosity Layers, Statistic Layers
- A more methodized approach to combing through lidar data

Class 2: Ground
Class 26: Bathy Bottom

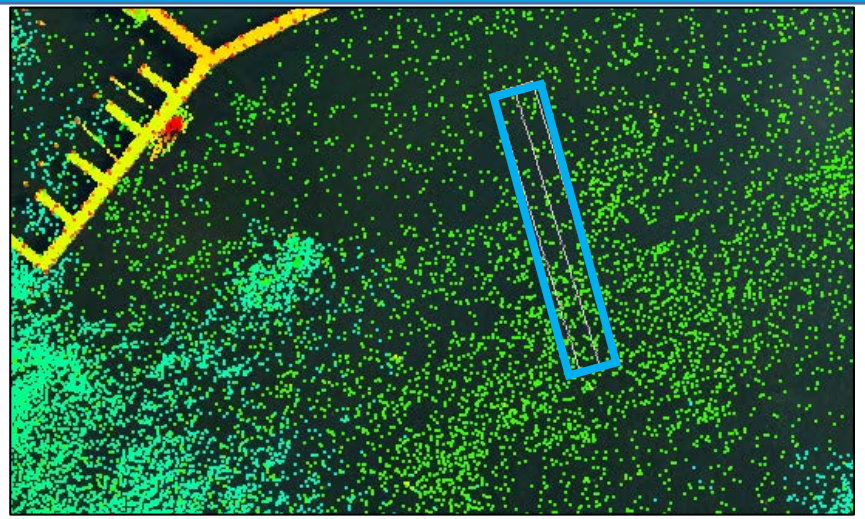
Class 1: Unclassified
Class 25: Water Column
Class 27: Water Surface

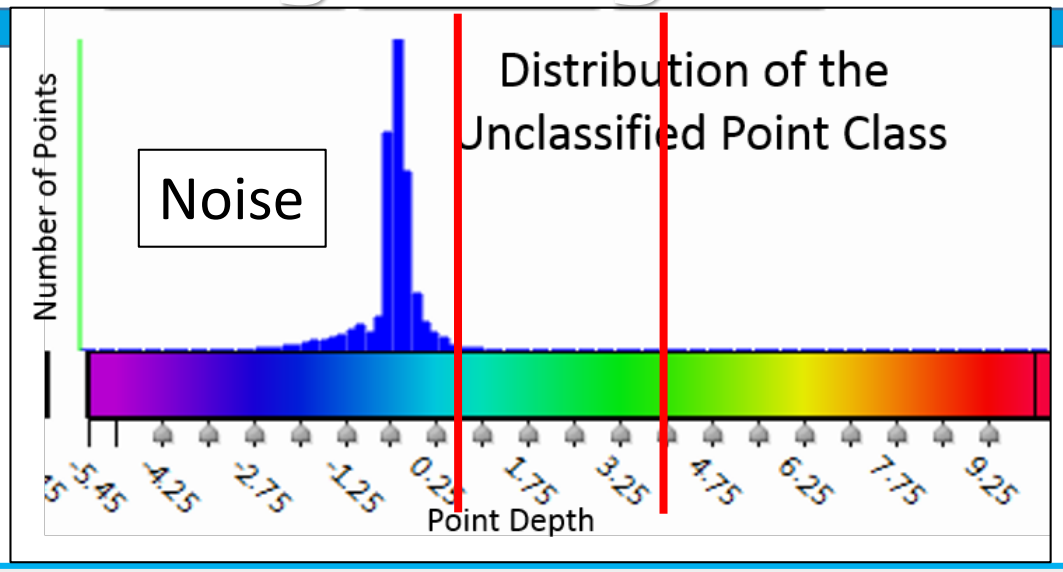


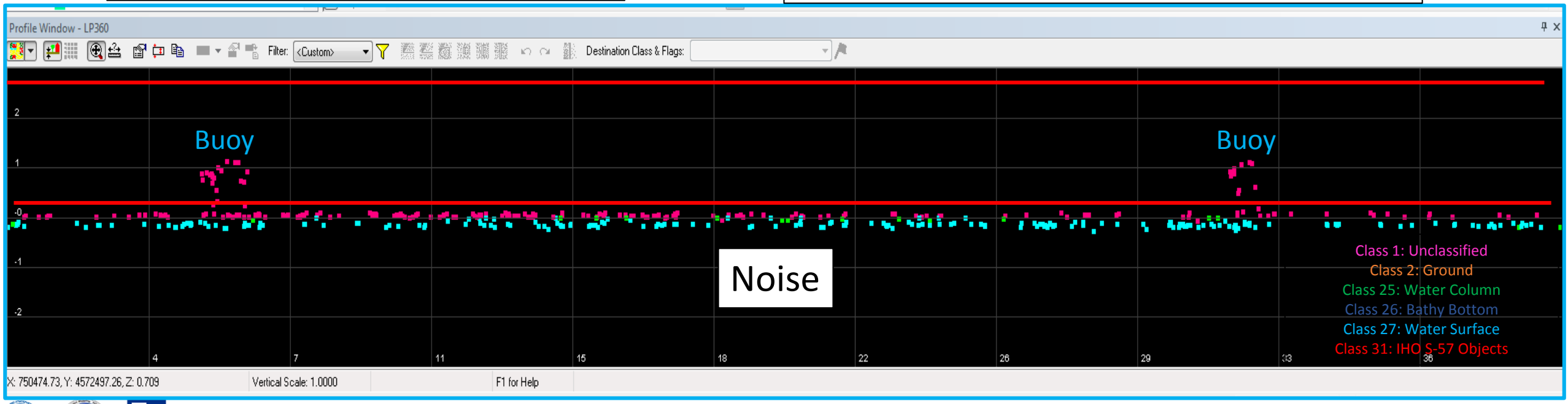
Spatial Selection of LAS points to Grid



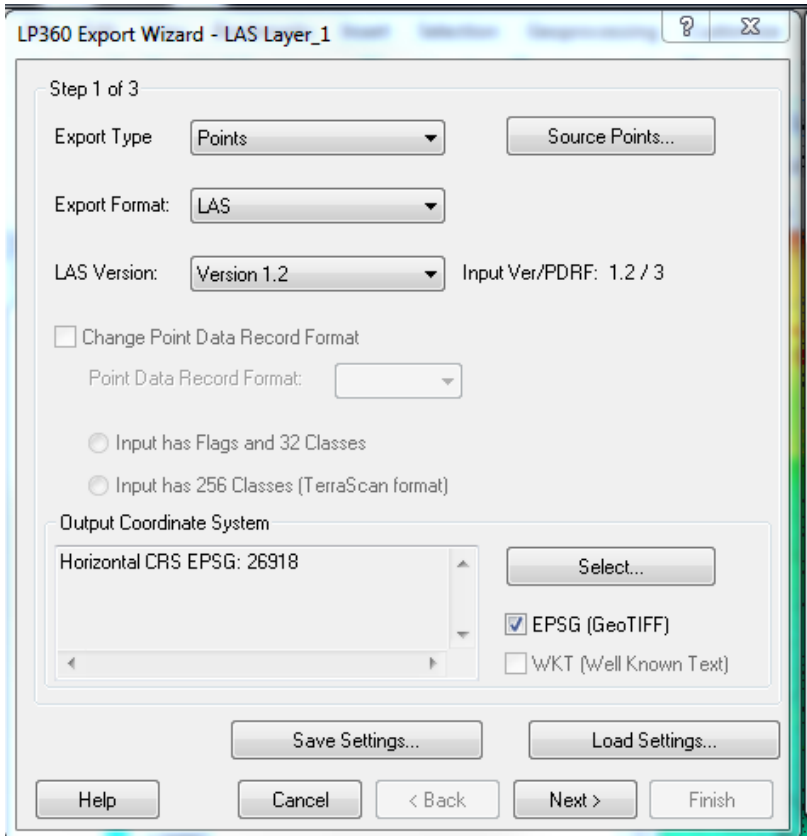
Extraction of LAS Points Using a Height Filter

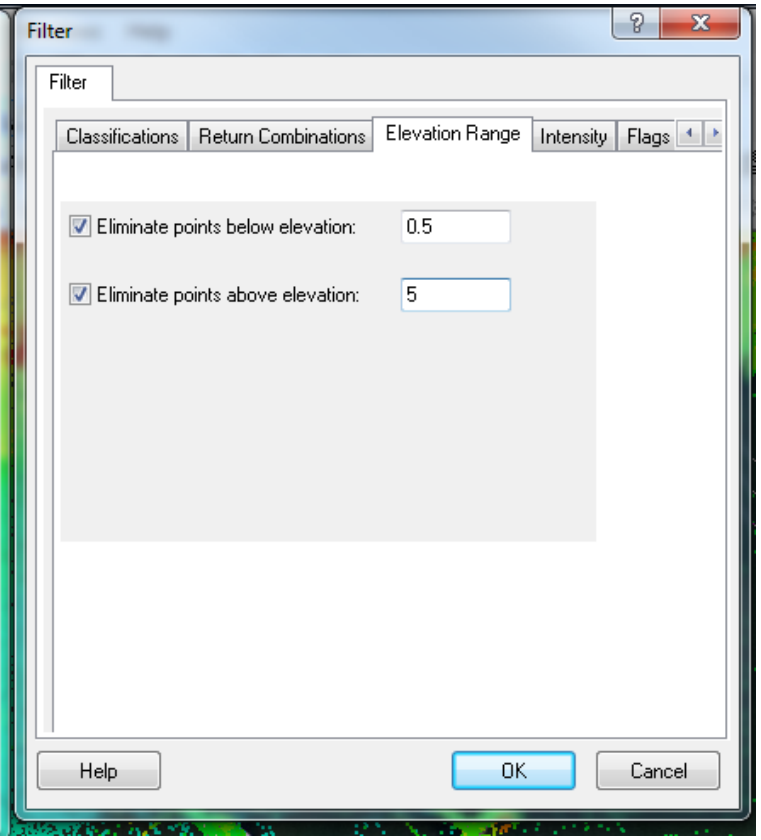


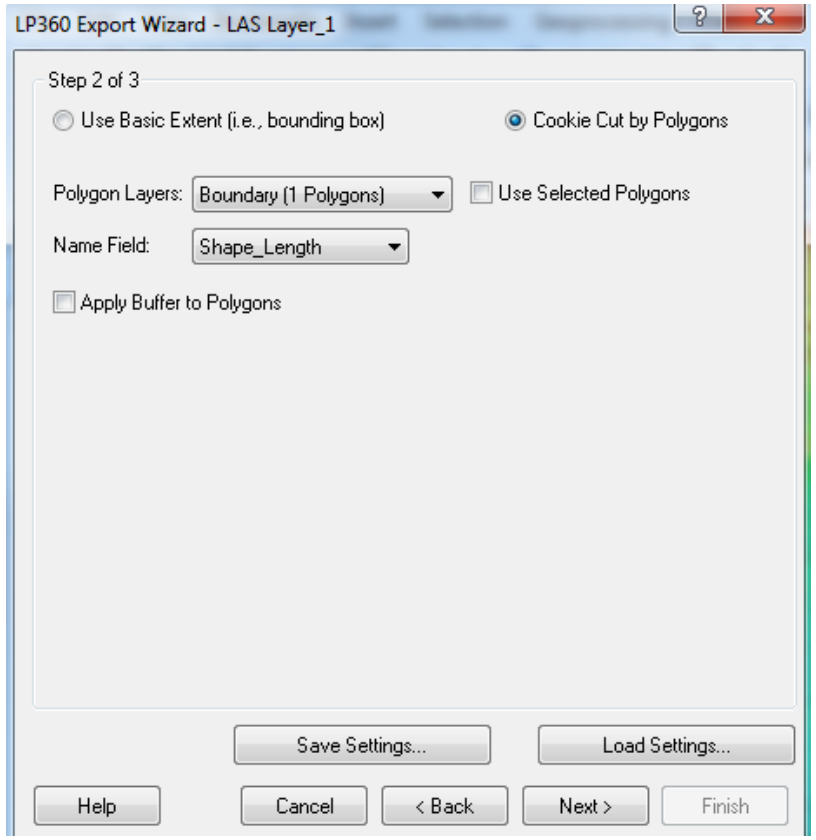




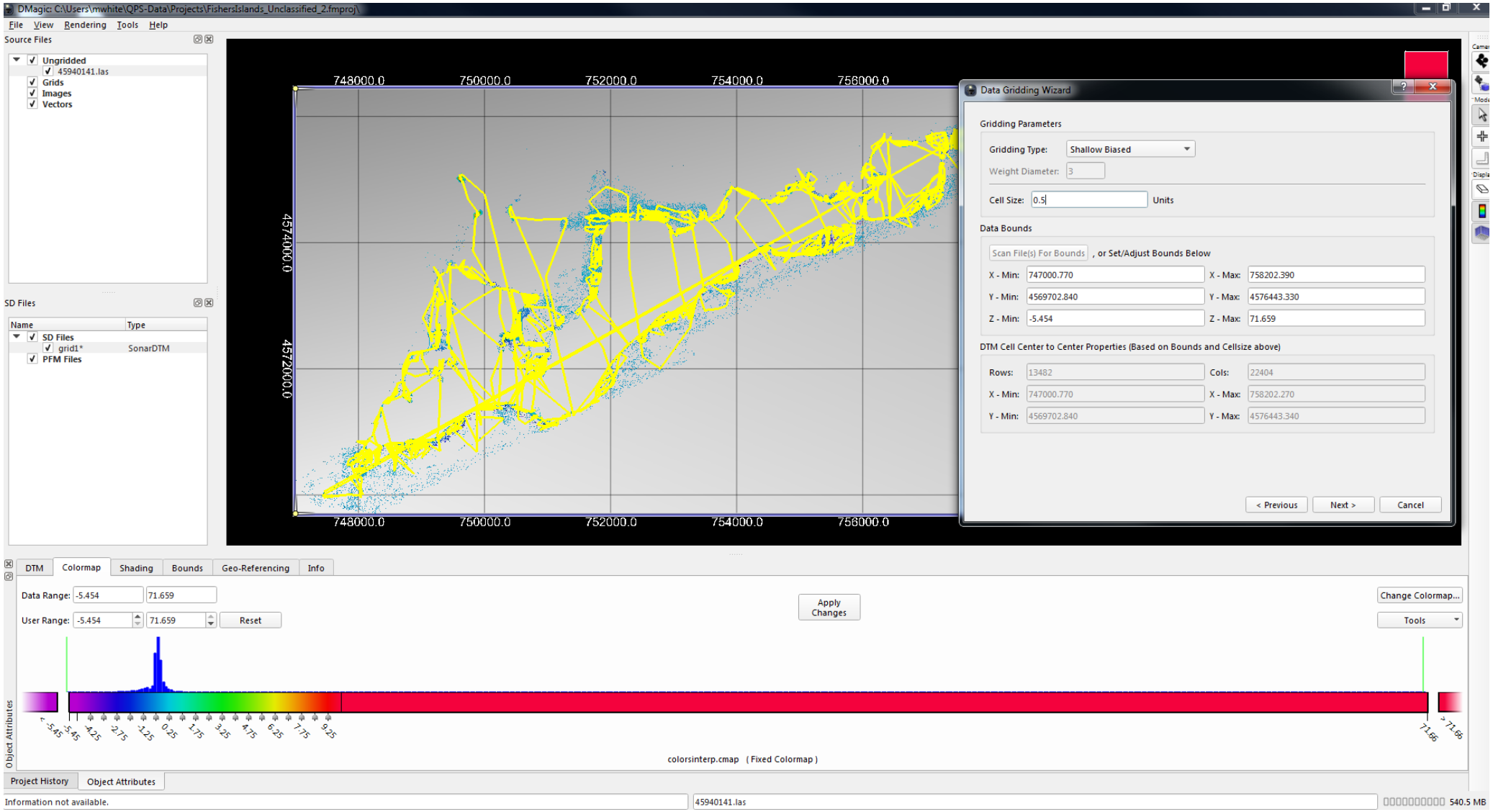
Exporting LAS



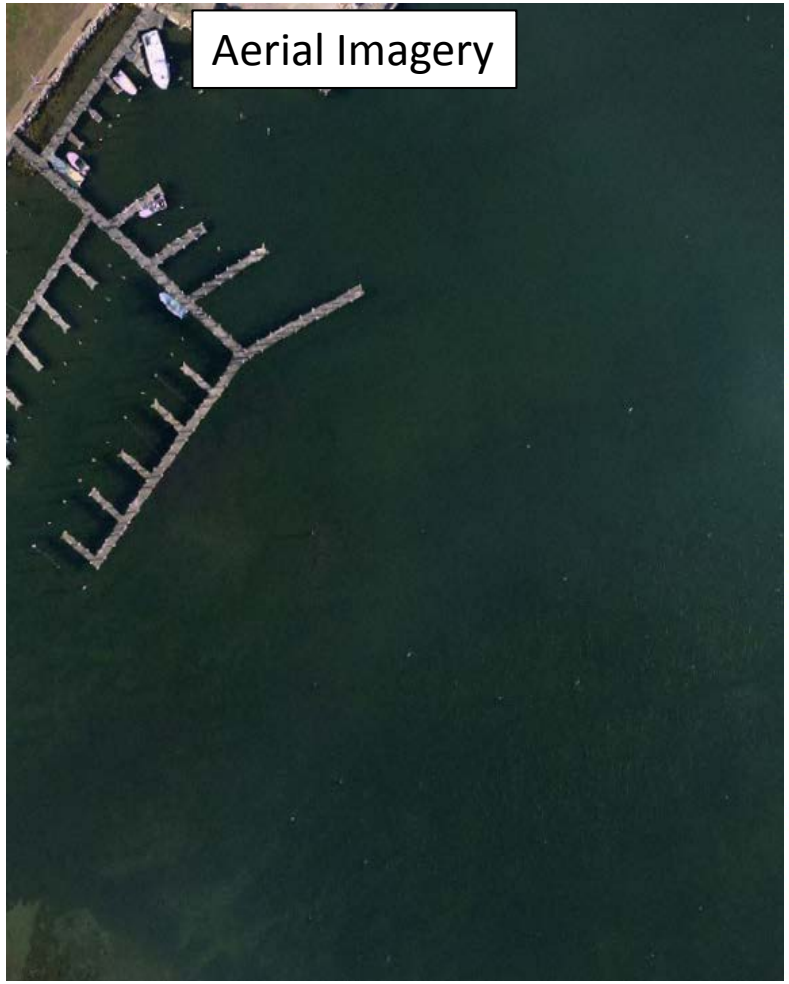


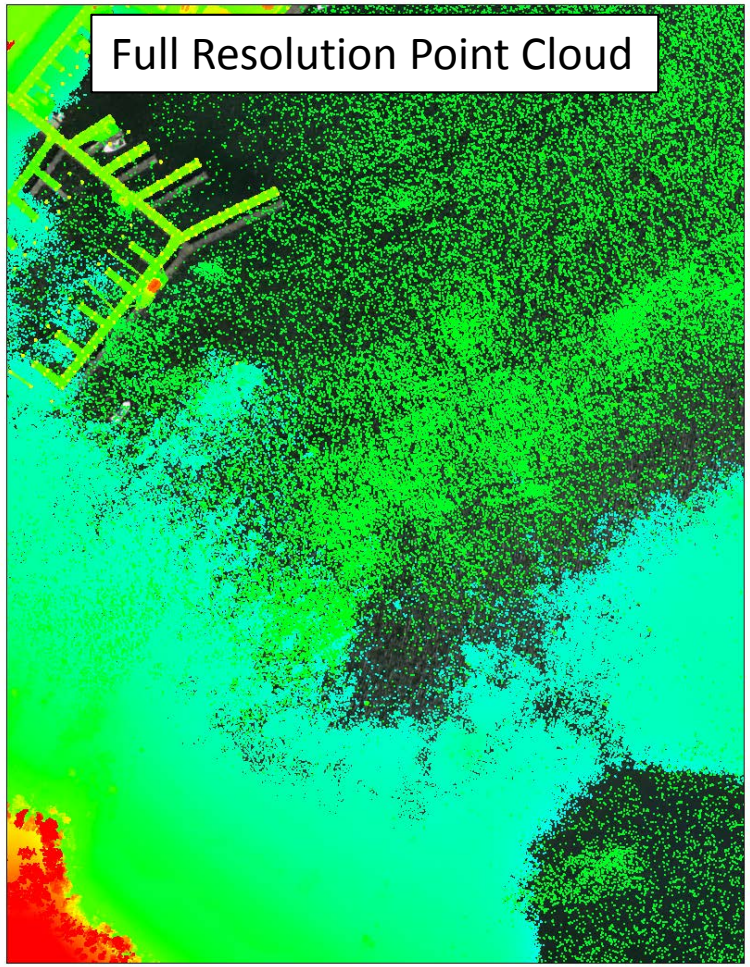


Gridding Algorithms and Resolution



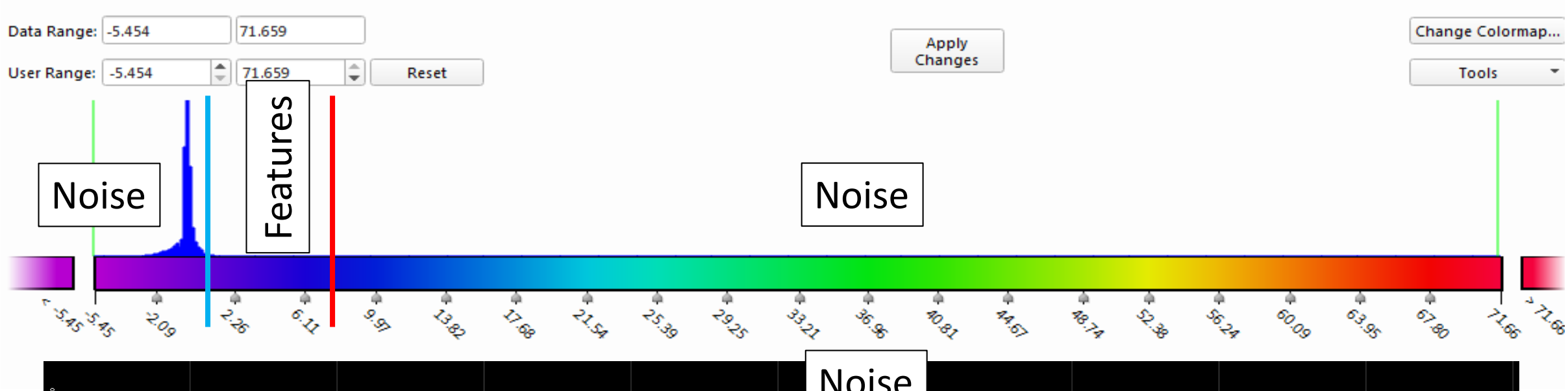
Examples of Grids – Unclassified Class

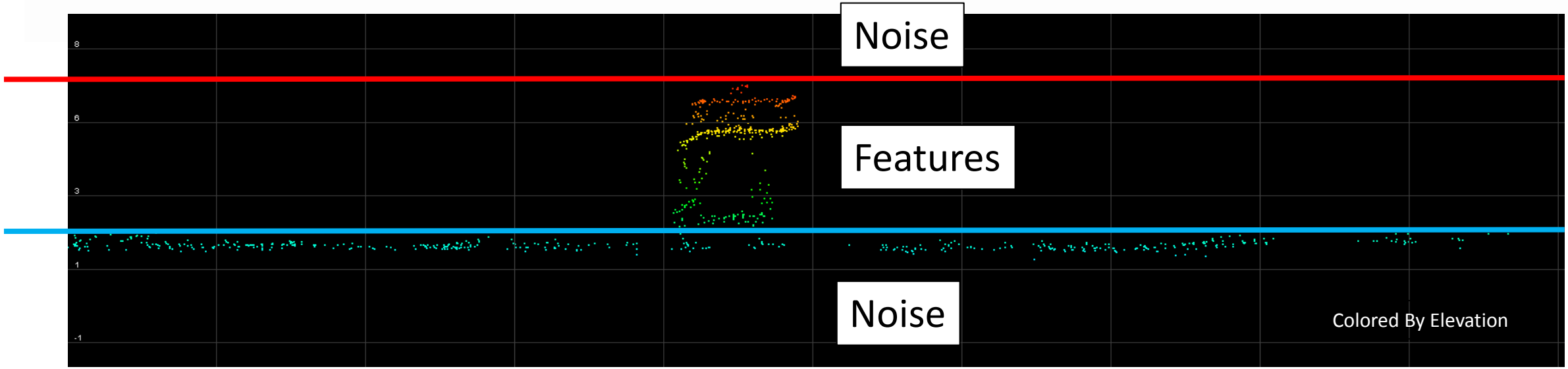




West Harbor – Fishers Island, NY

Gridding the Unclassified Class





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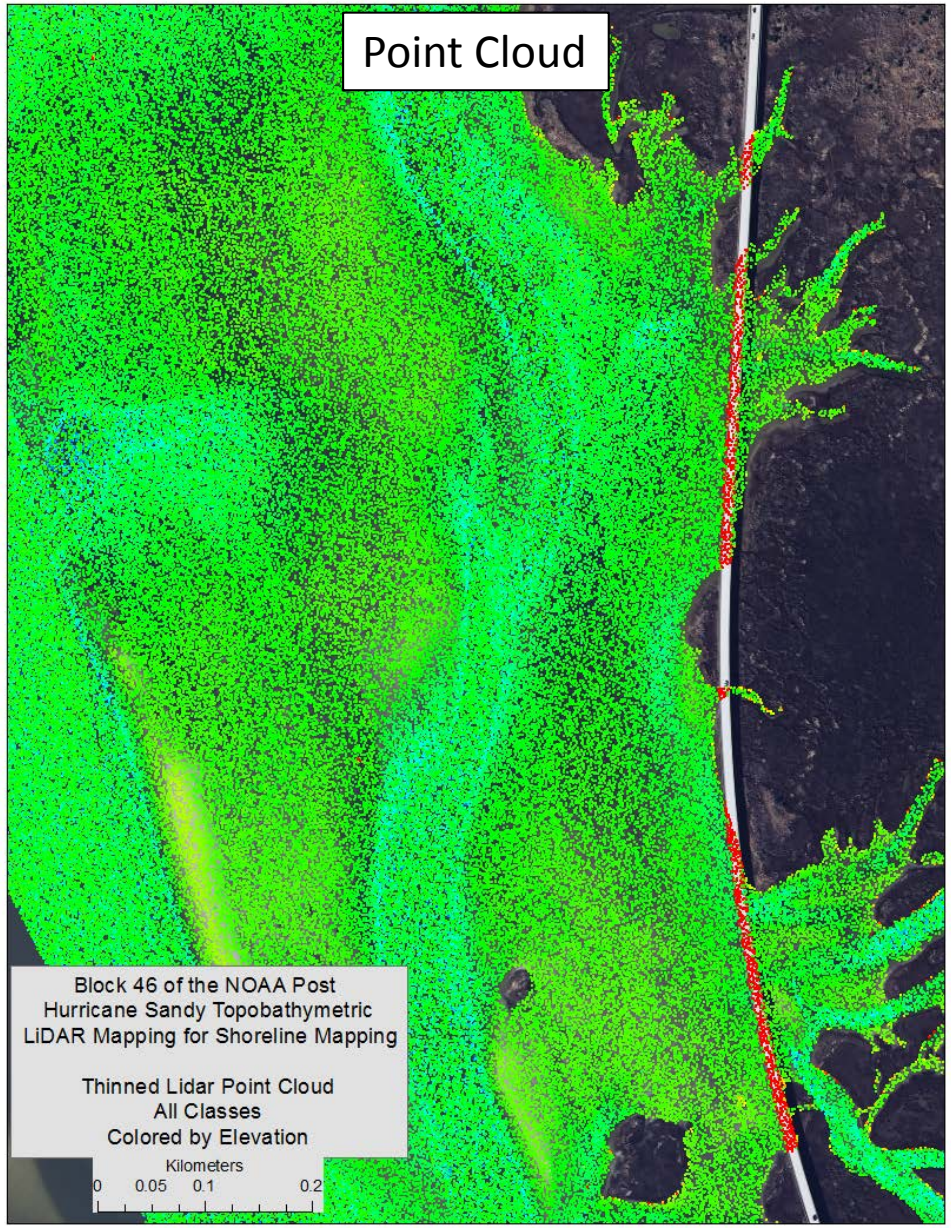
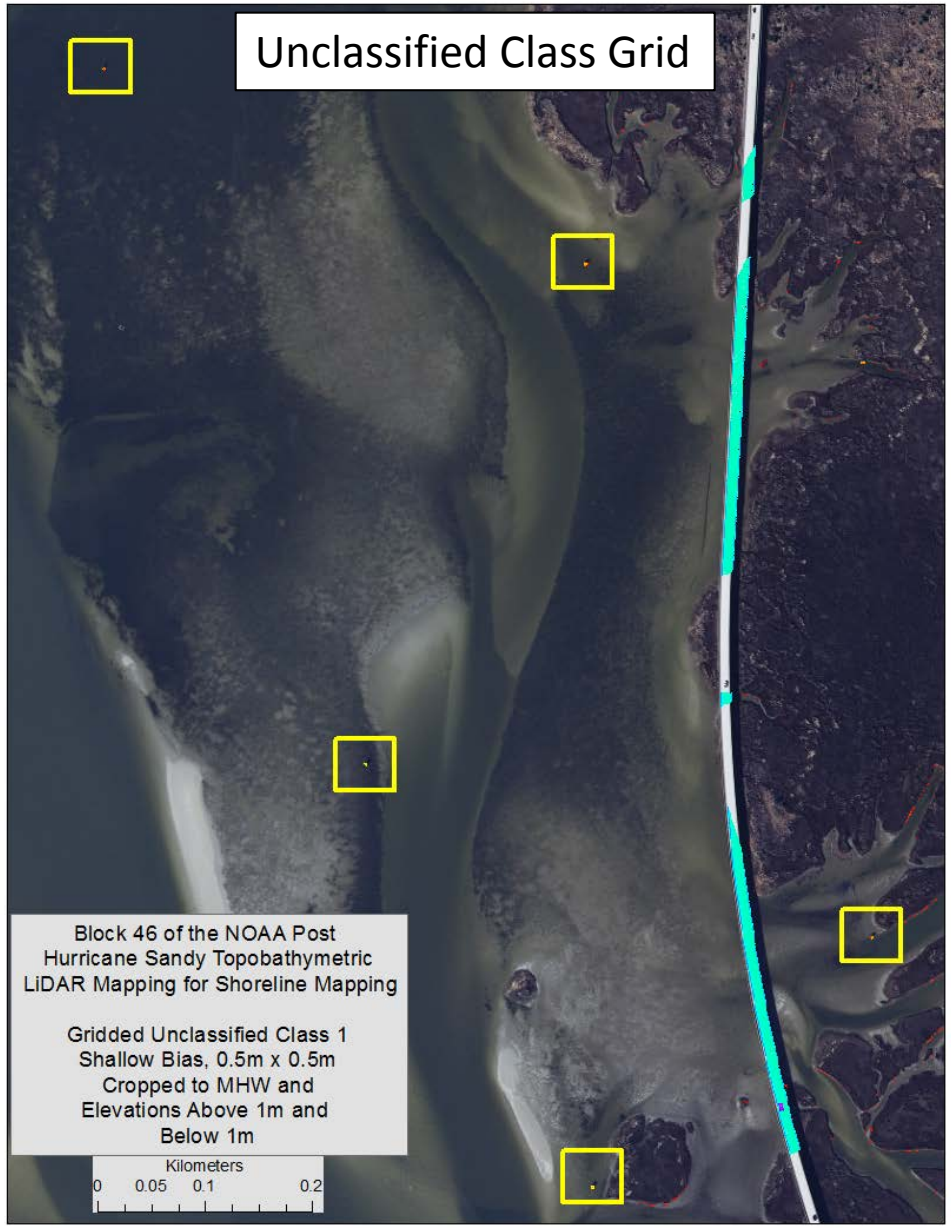
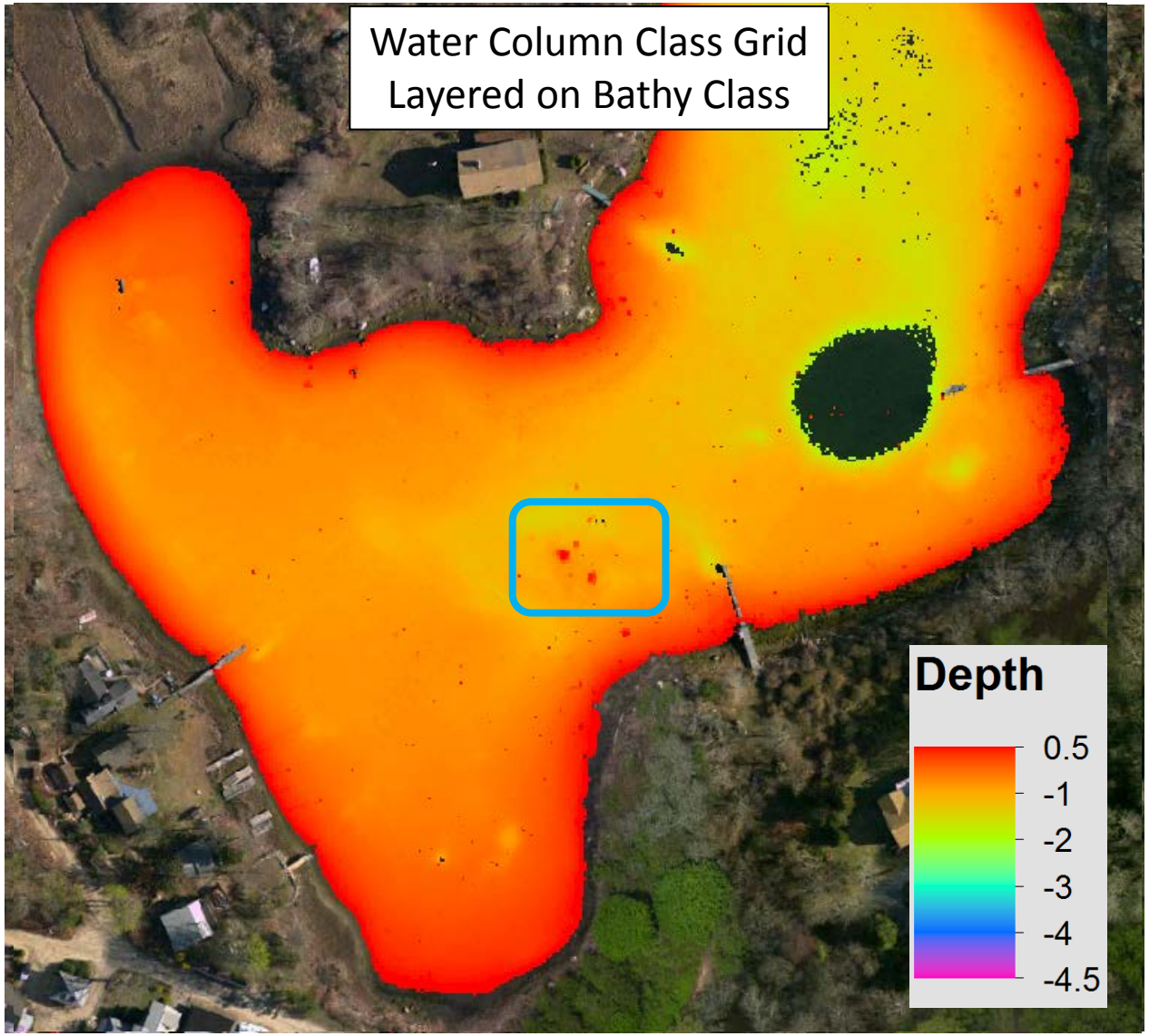
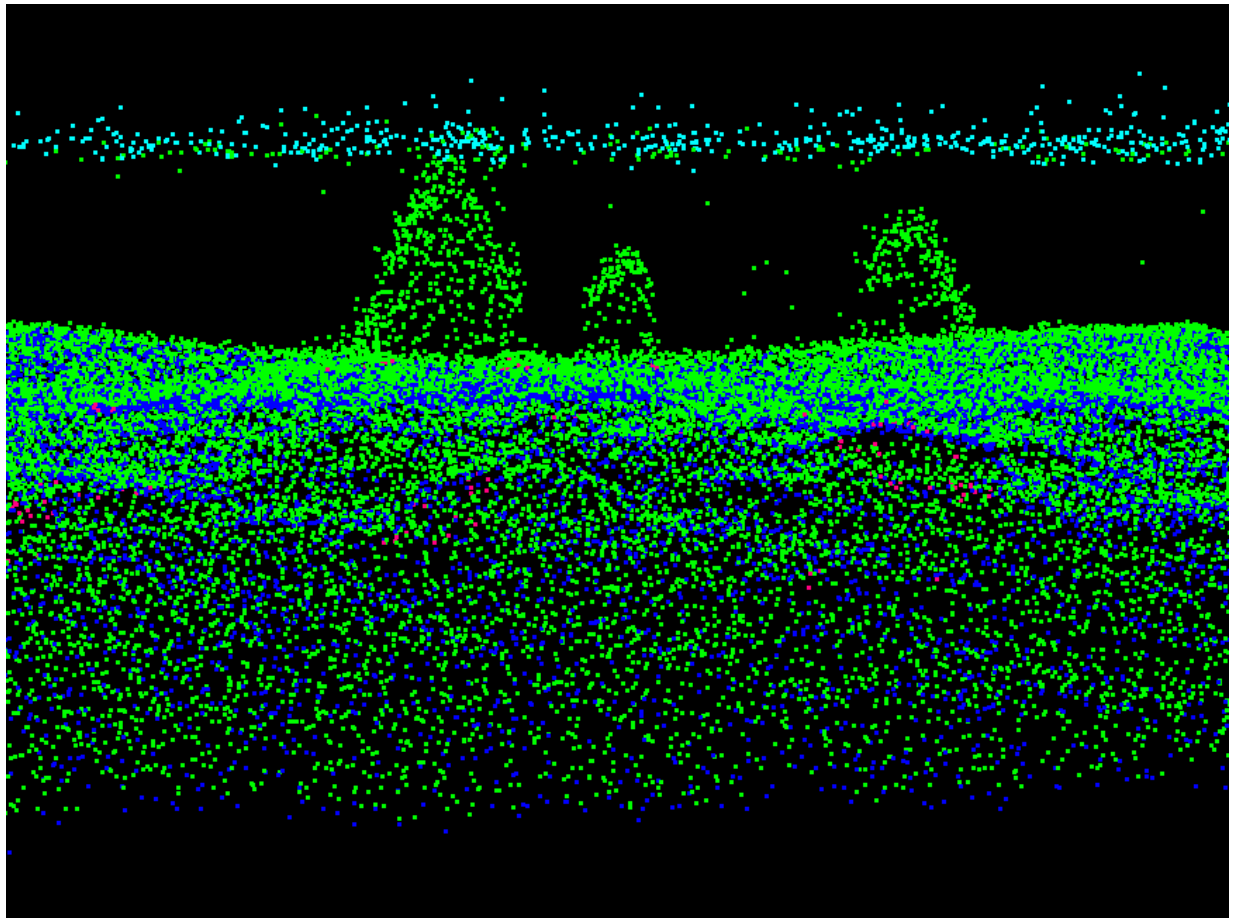




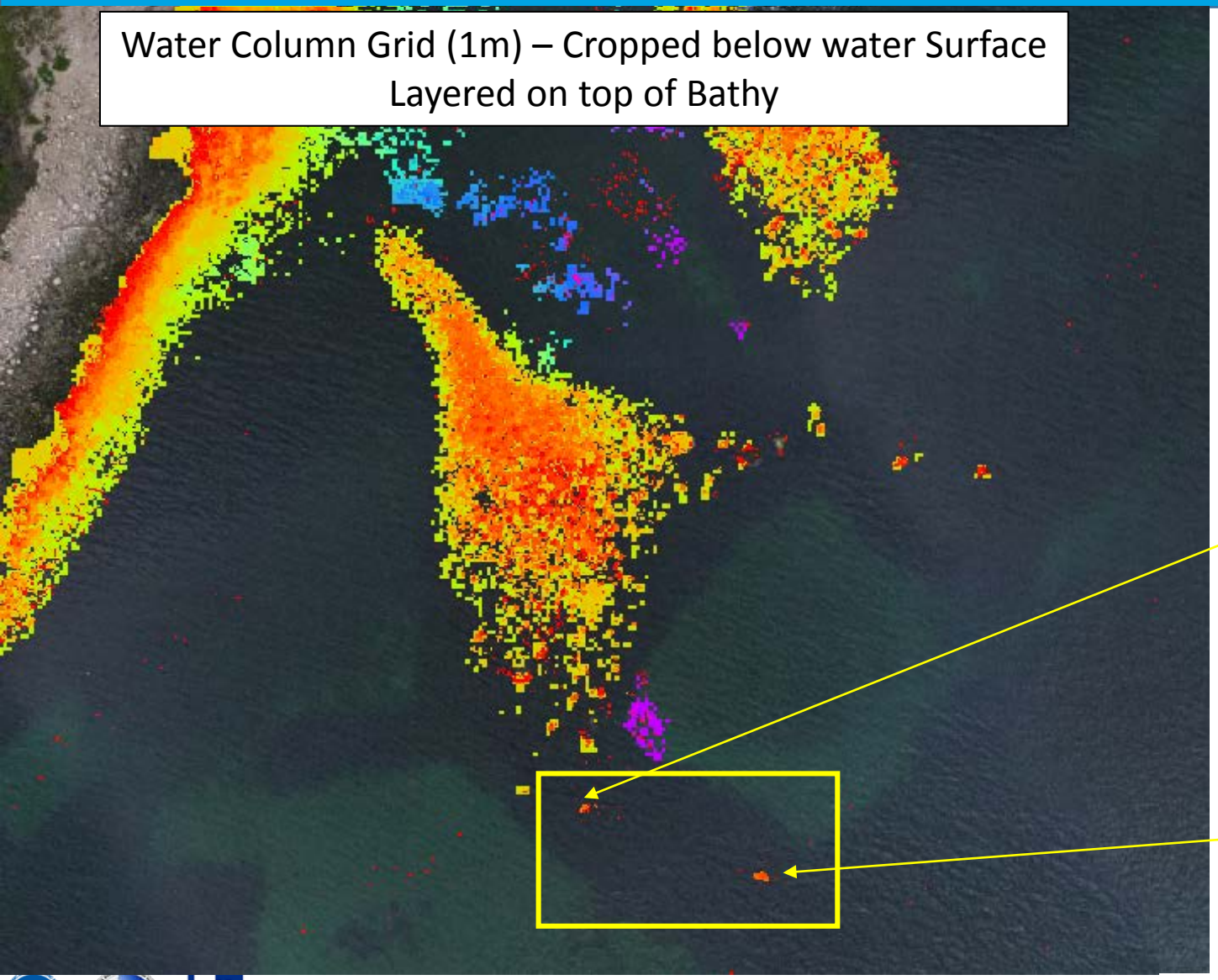
Examples of Grids – Water Column Class



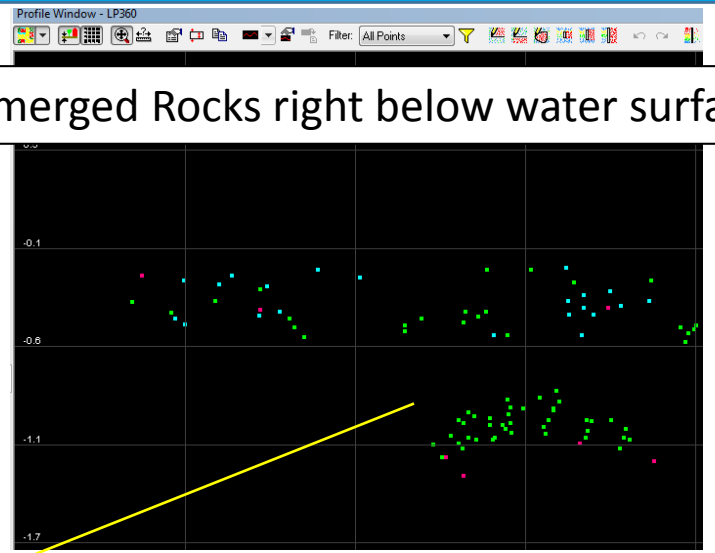


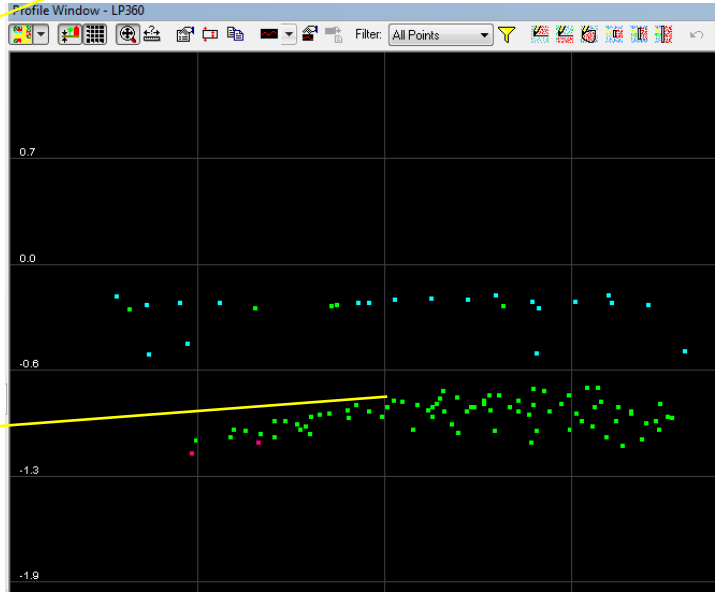
Comparing Water Column and Bathy Grids

Water Column Grid (1m) – Cropped below water Surface
Layered on top of Bathy



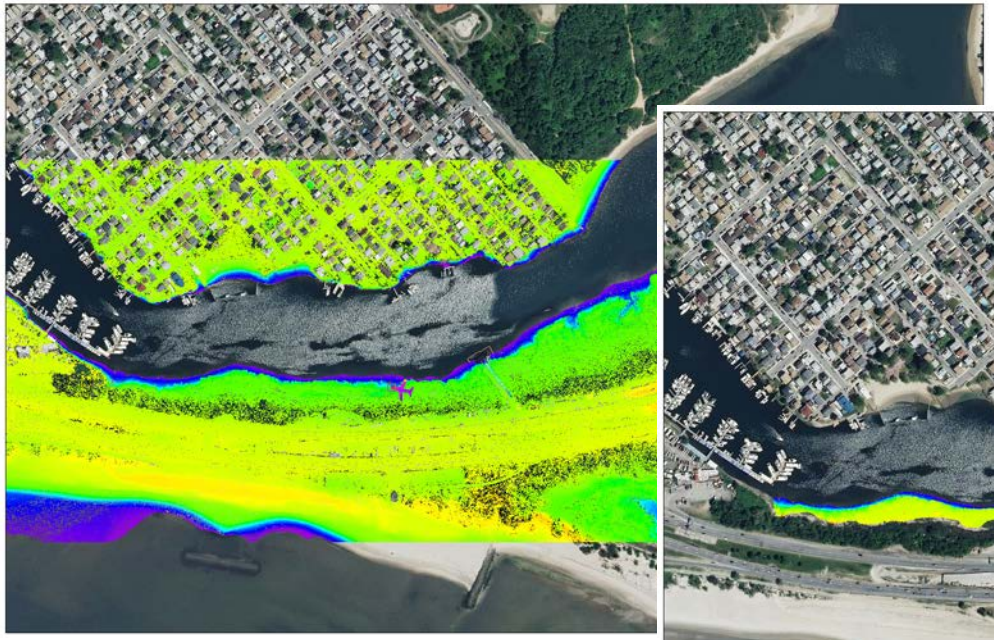
Submerged Rocks right below water surface





Surface Difference Grids – Marine Debris

Ground Class – 0.5 m Grid



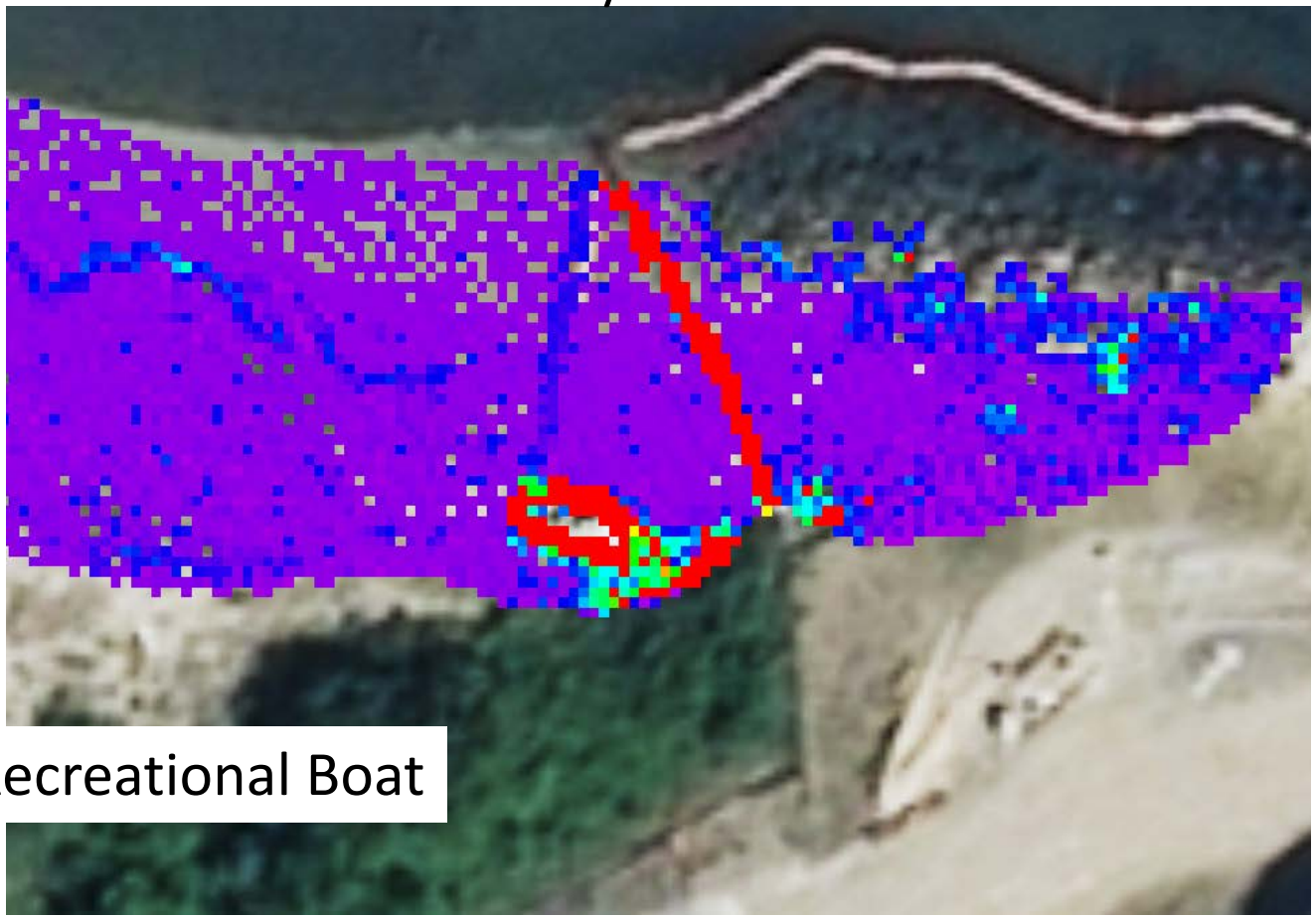
Unclassified Class – 0.5 m Grid

Surface Difference Raster

Surface Difference Grids – Marine Debris

Aerial Imagery

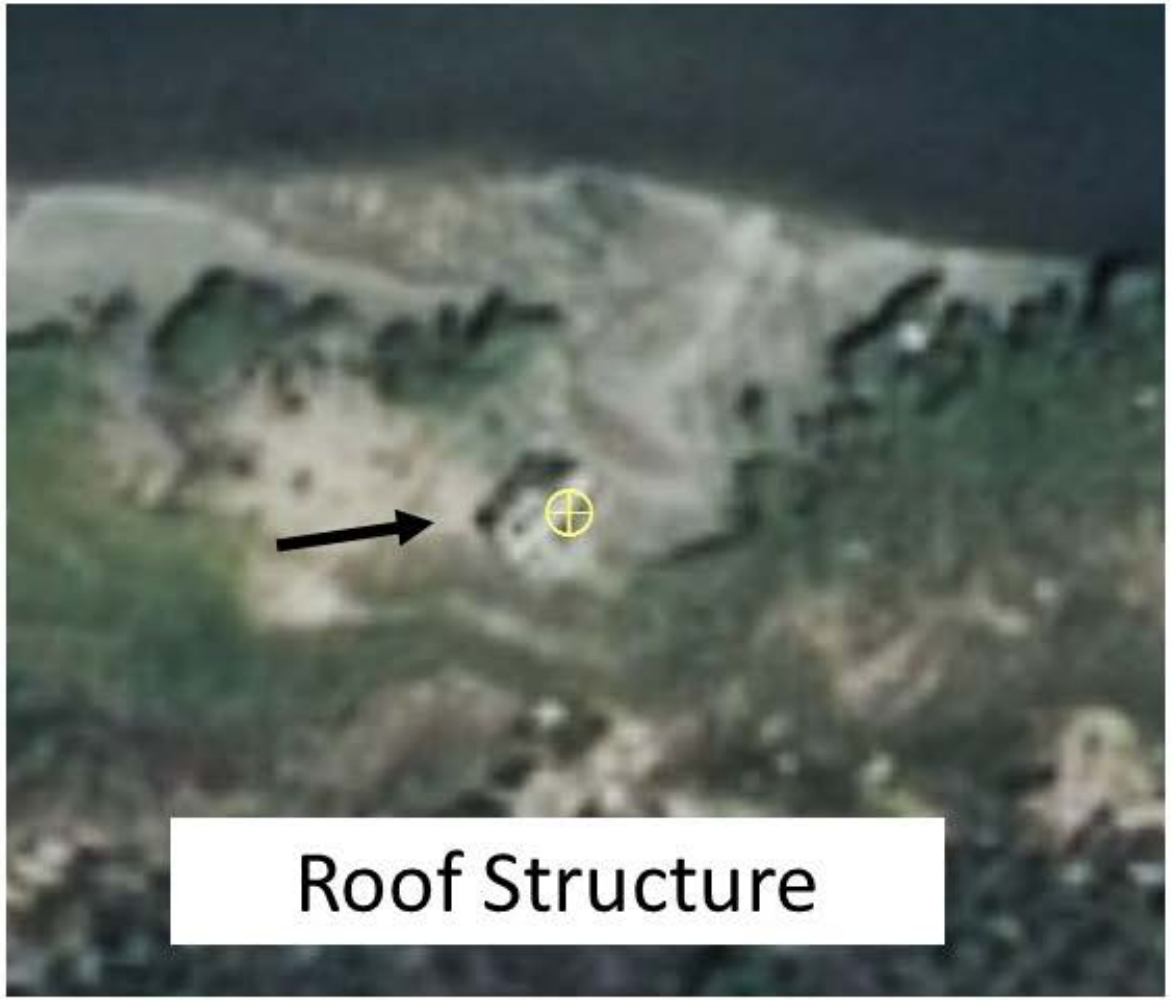
Surface Difference Raster
Unclassified/Ground Classes



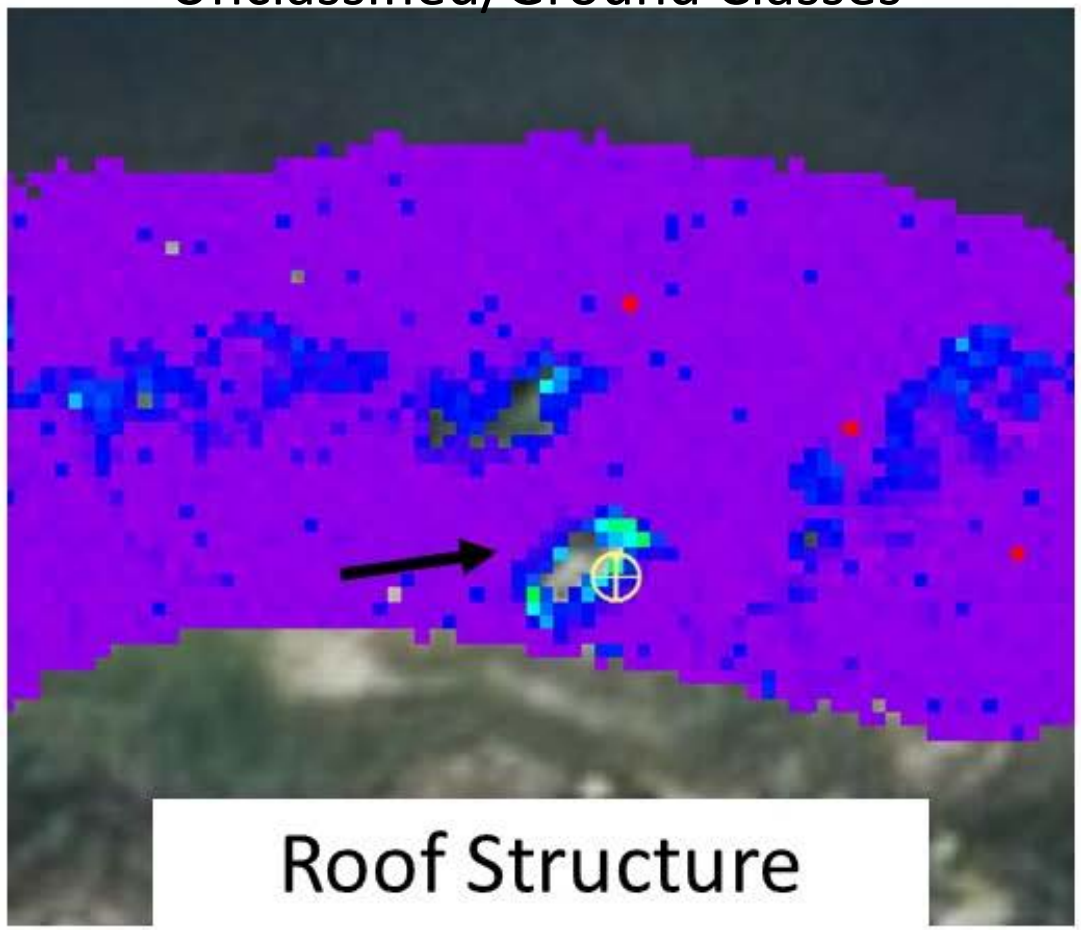
Beached Recreational Boat

Surface Difference Grids – Marine Debris

Aerial Imagery

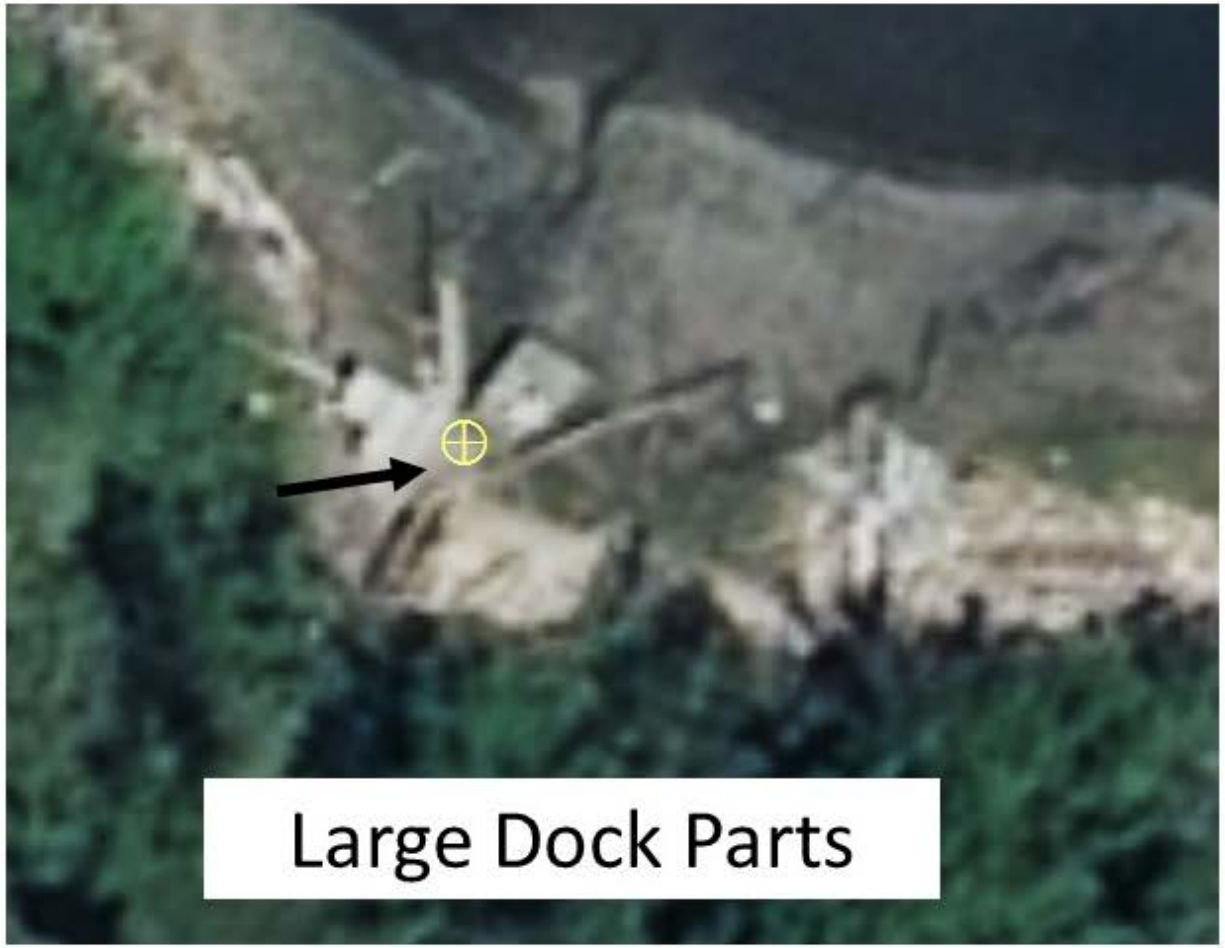


Surface Difference Raster
Unclassified/Ground Classes

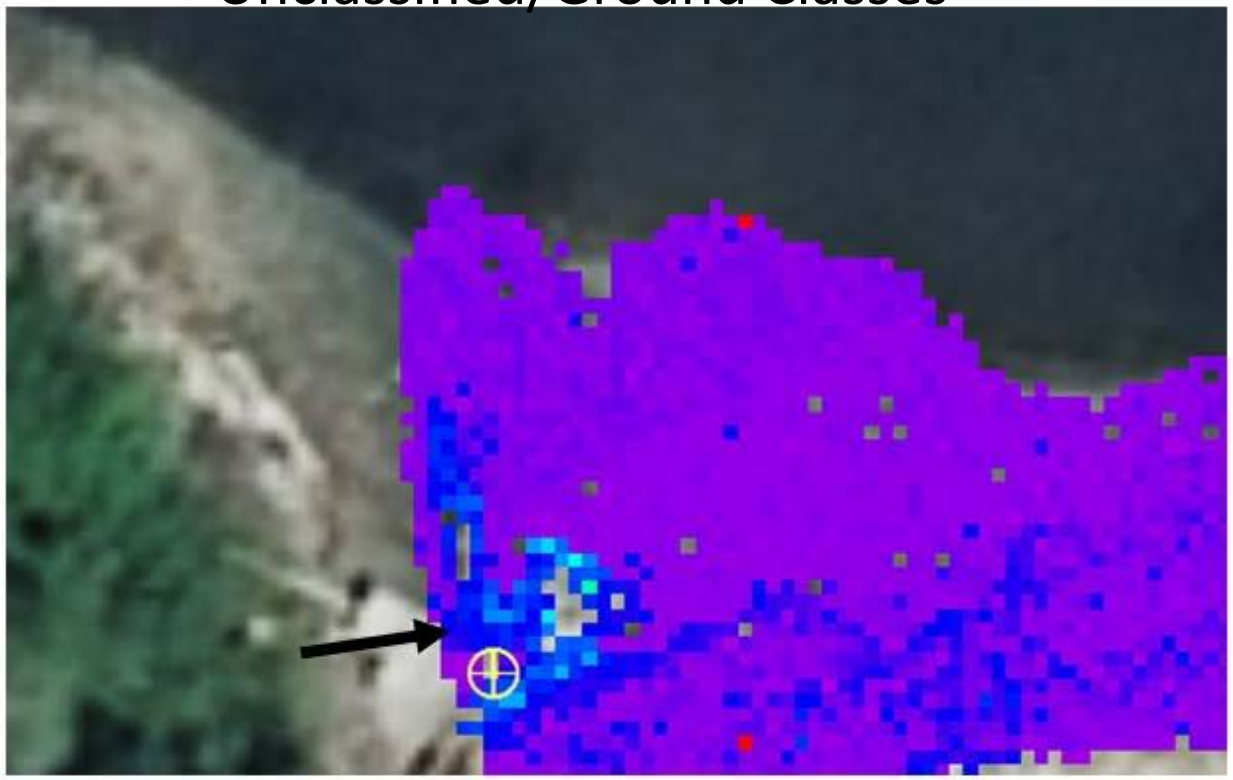


Surface Difference Grids – Marine Debris

Aerial Imagery



Surface Difference Raster
Unclassified/Ground Classes



Large Dock Parts

Summary and Future Work

- Yes! We can find features
  - Unclassified, Water Column and Water Surface Classes
  - Not in the Bathy or Ground Class (automated grounding bare earth alg.)
  - Above water features are relatively easier to find
- Gridding lidar Classes
  - Provides a way to objectively target areas
  - Assists visualization and quick examination of entire class
  - Comparing Grids (Water Column vs. Bathy, Ground vs. Unclassified) enables users to derive additional information
- Additional work will include examining intensity (reflectance) and its relationship to features
  - Further examination of gridding classes and derived products
  - Set parameters for an operation that can automatically identify features

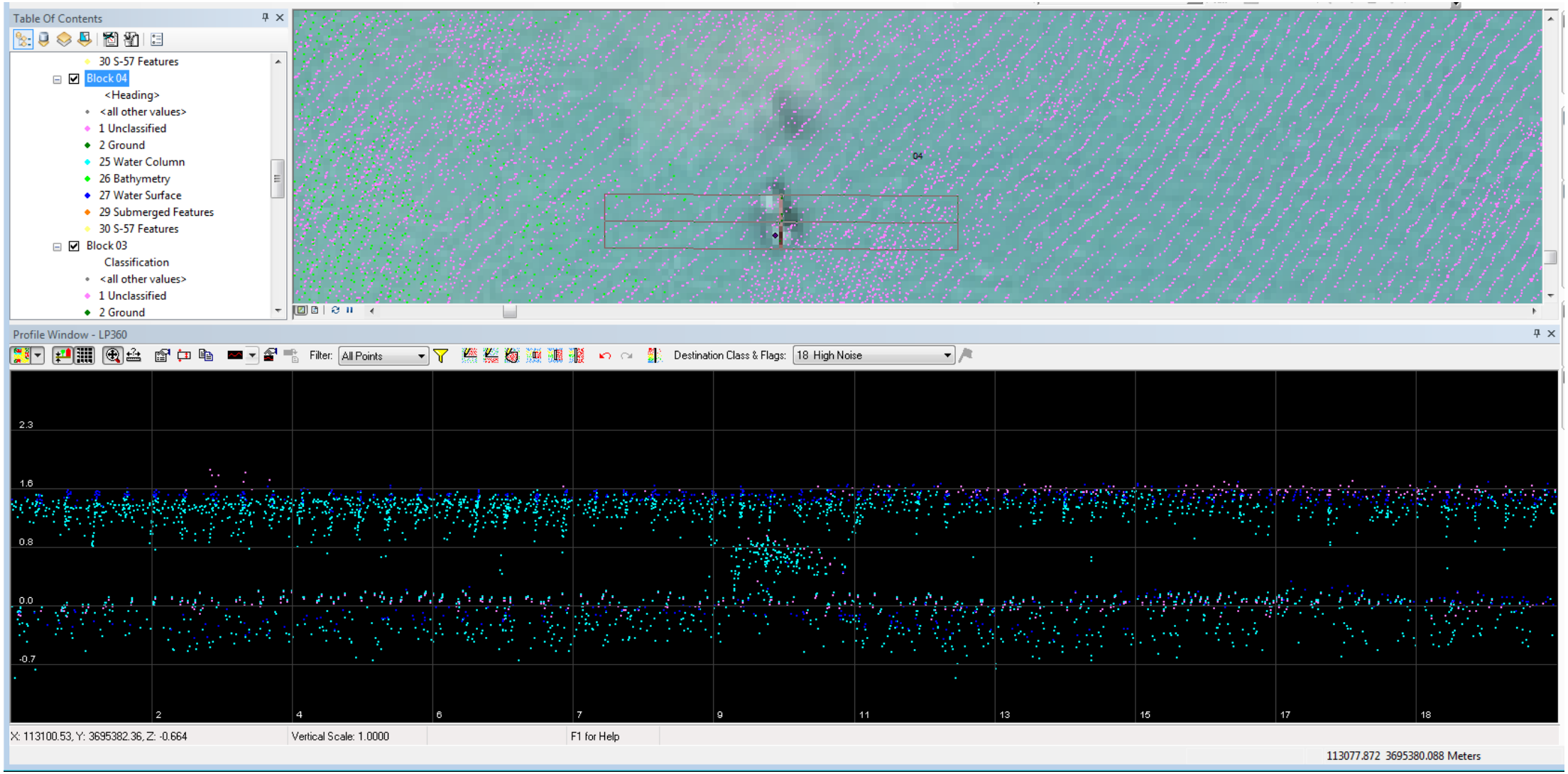
Acknowledgements - Questions?

- NOAA NGS Remote Sensing Division
- UNH CCOM

Thank you,

Michael.White@noaa.gov

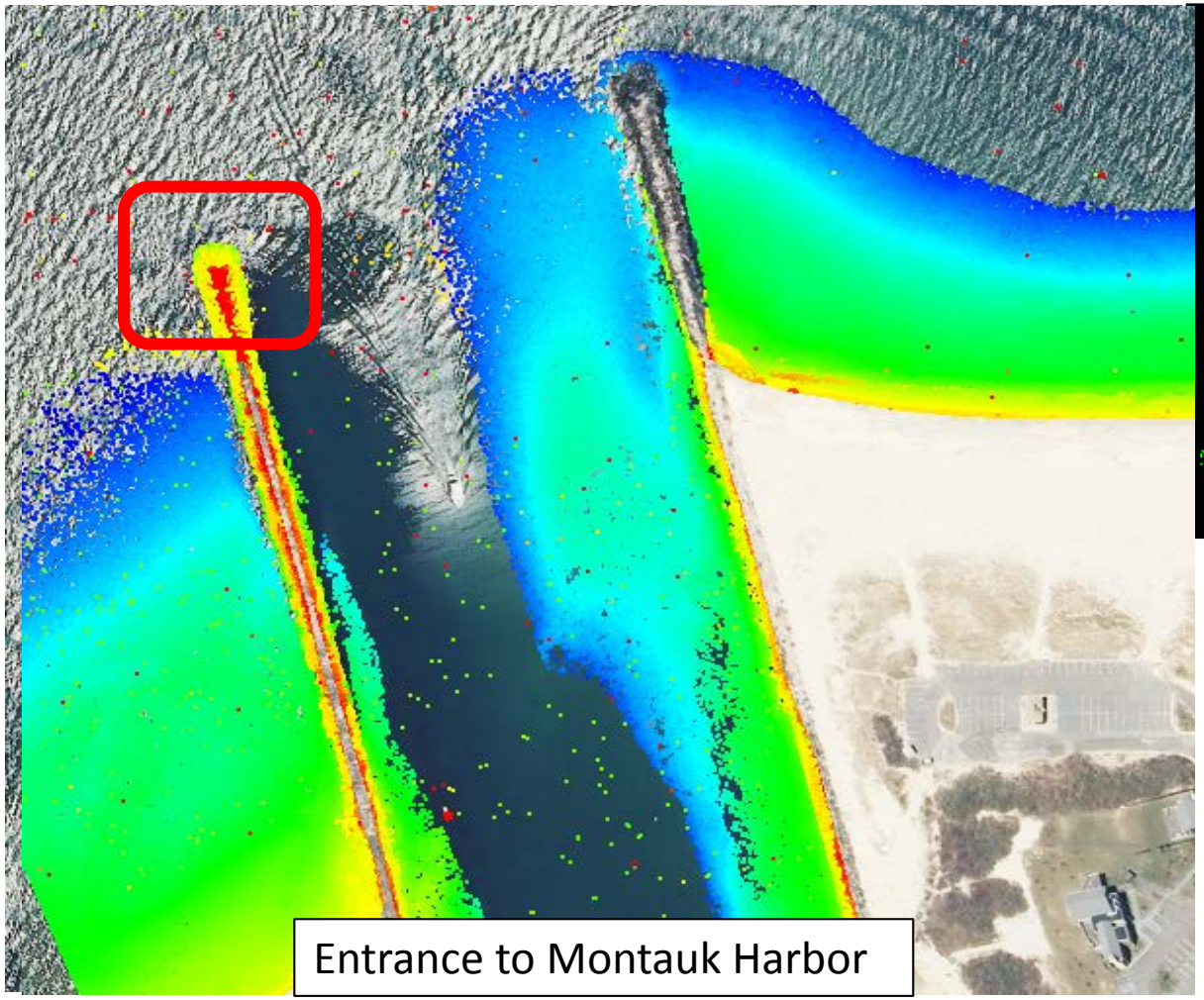
Challenges in Visualizing Features (2 of 3)



Datasets and Tools

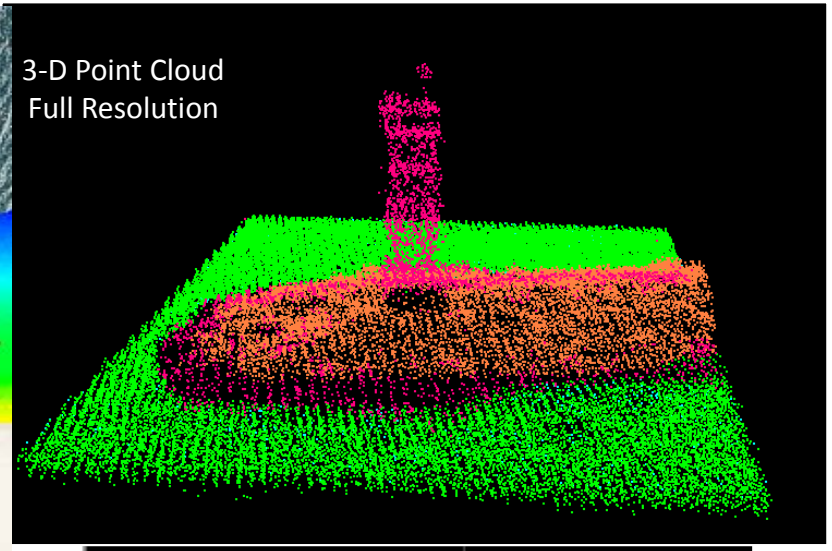
- http://vislab-ccom.unh.edu/~tbutkie/LensTest/Block46.html

Features in the Unclassified Class



Entrance to Montauk Harbor

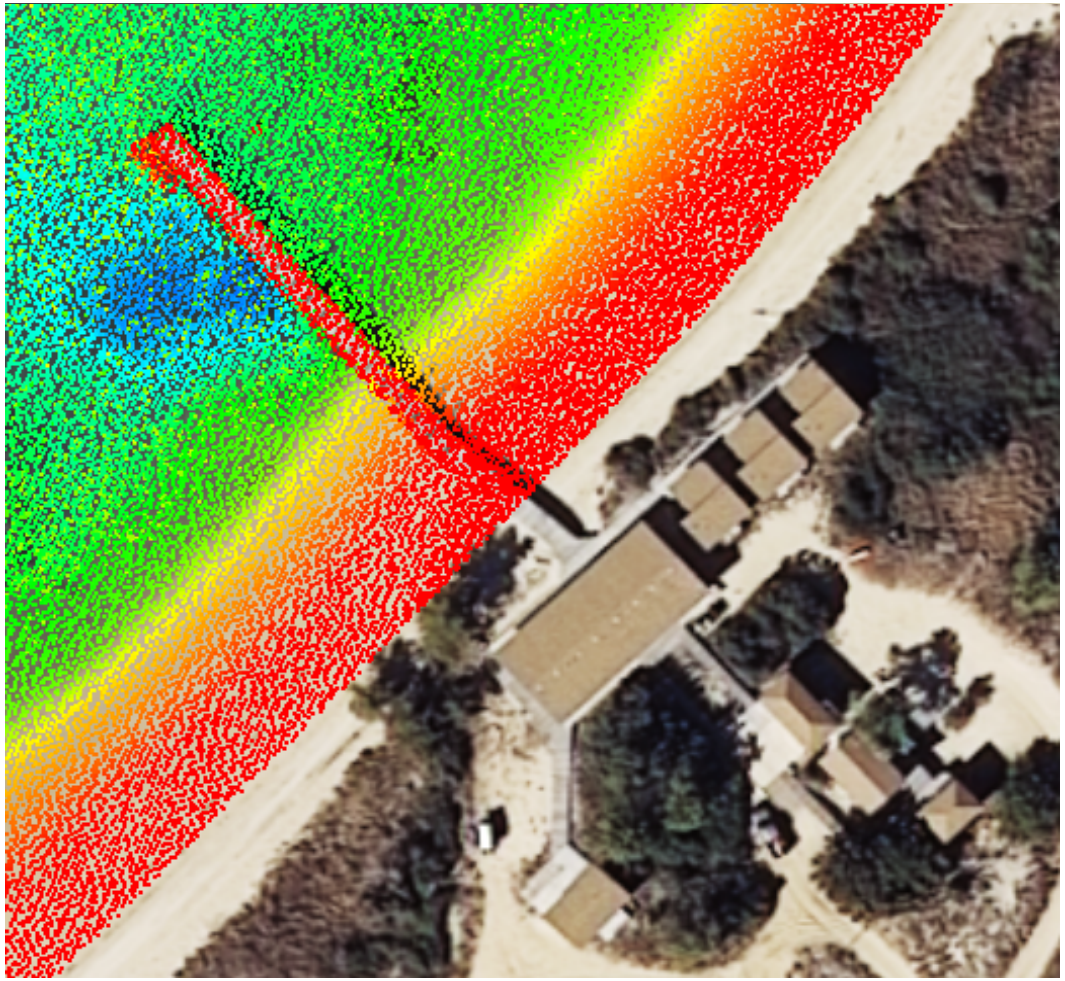
Full Resolution Point Cloud
Colored by Elevation

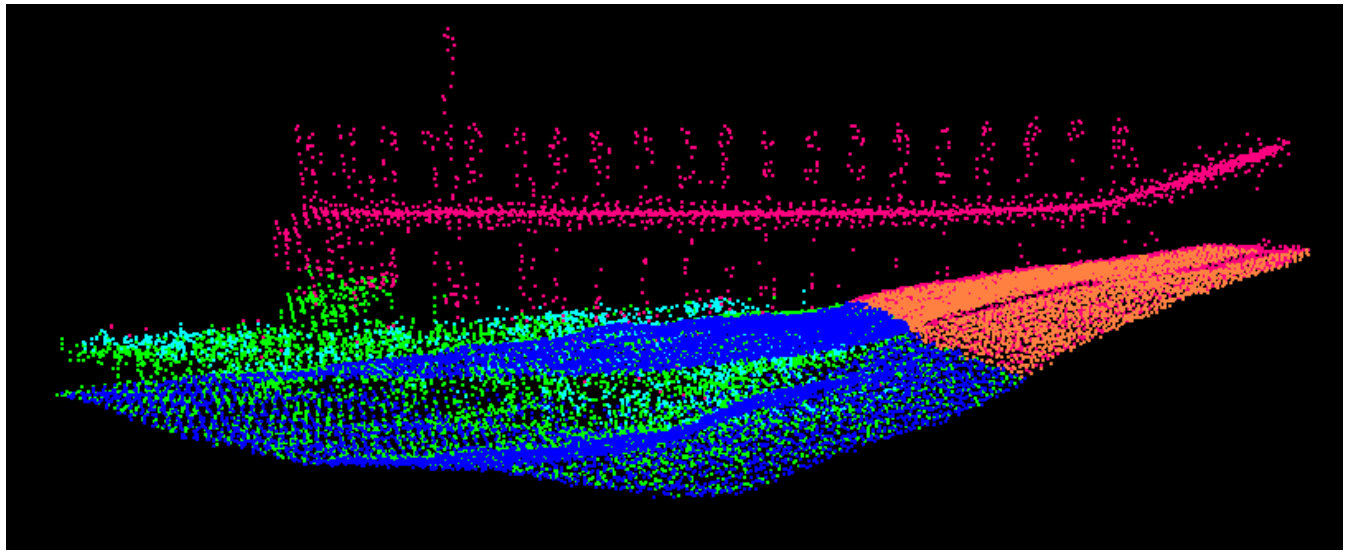


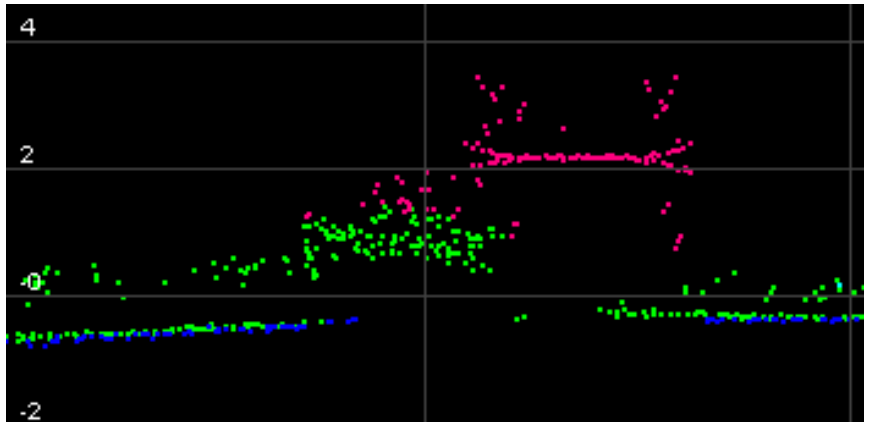
Class 1: Unclassified
Class 2: Ground
Class 25: Water Column
Class 26: Bathy Bottom
Class 27: Water Surface
Class 31: IHO S-57 Objects

Marine Light/Tower

Datasets and Tools







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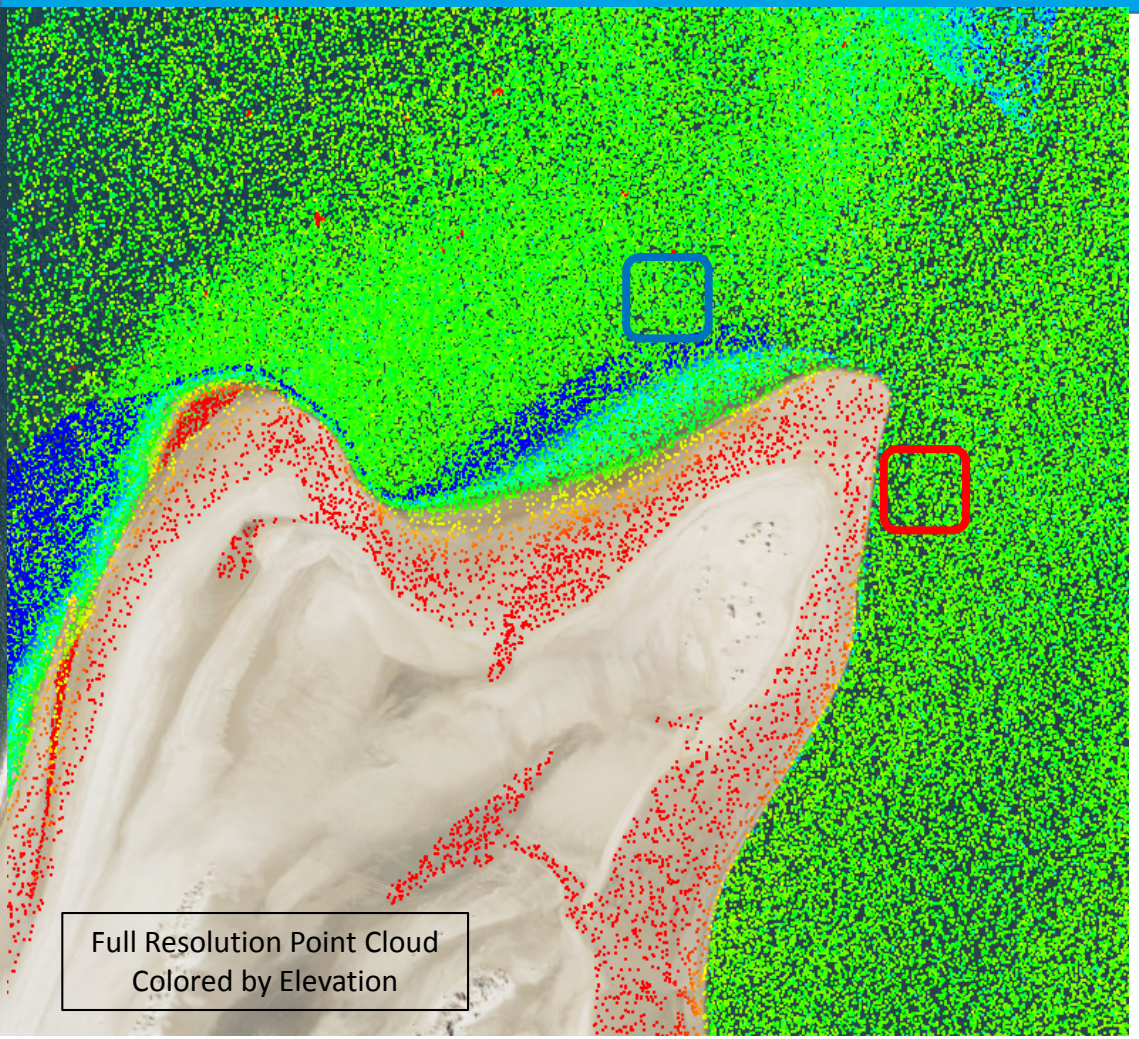
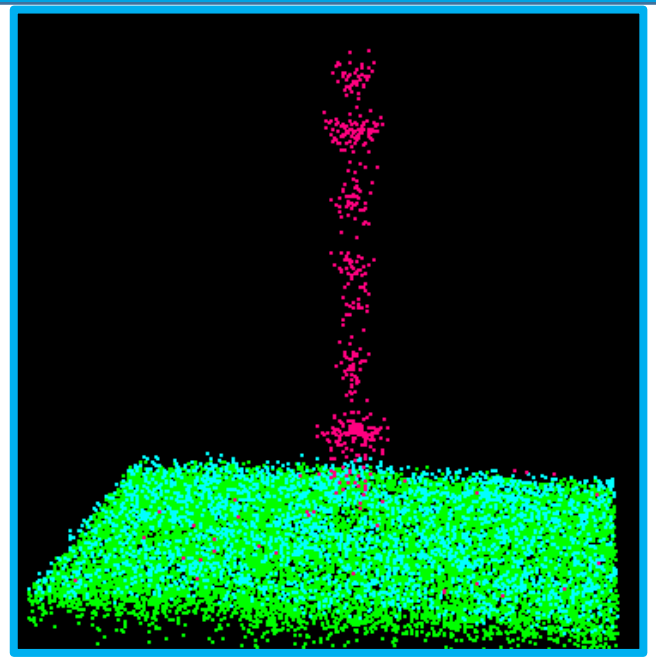
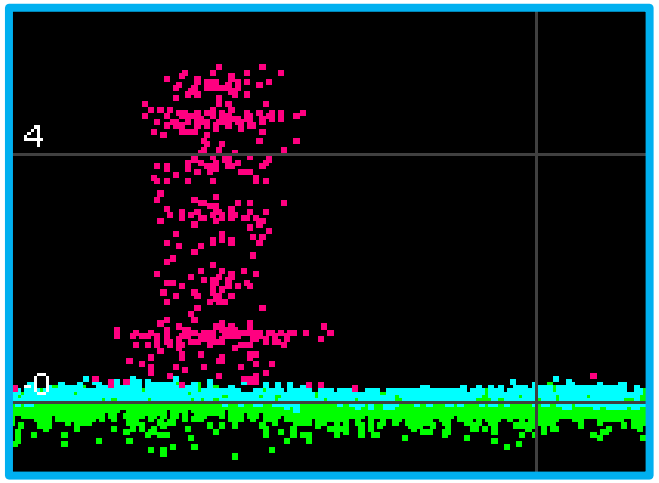
Datasets and Tools

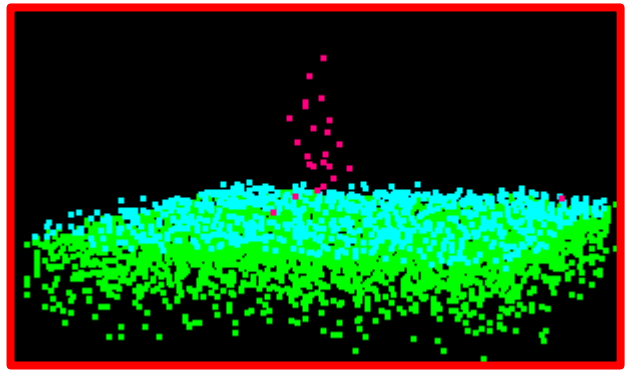


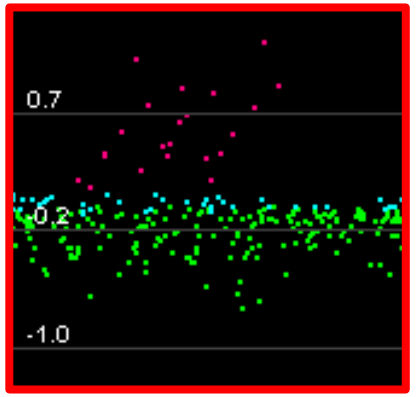
Cape Lookout, NC



Buoys







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