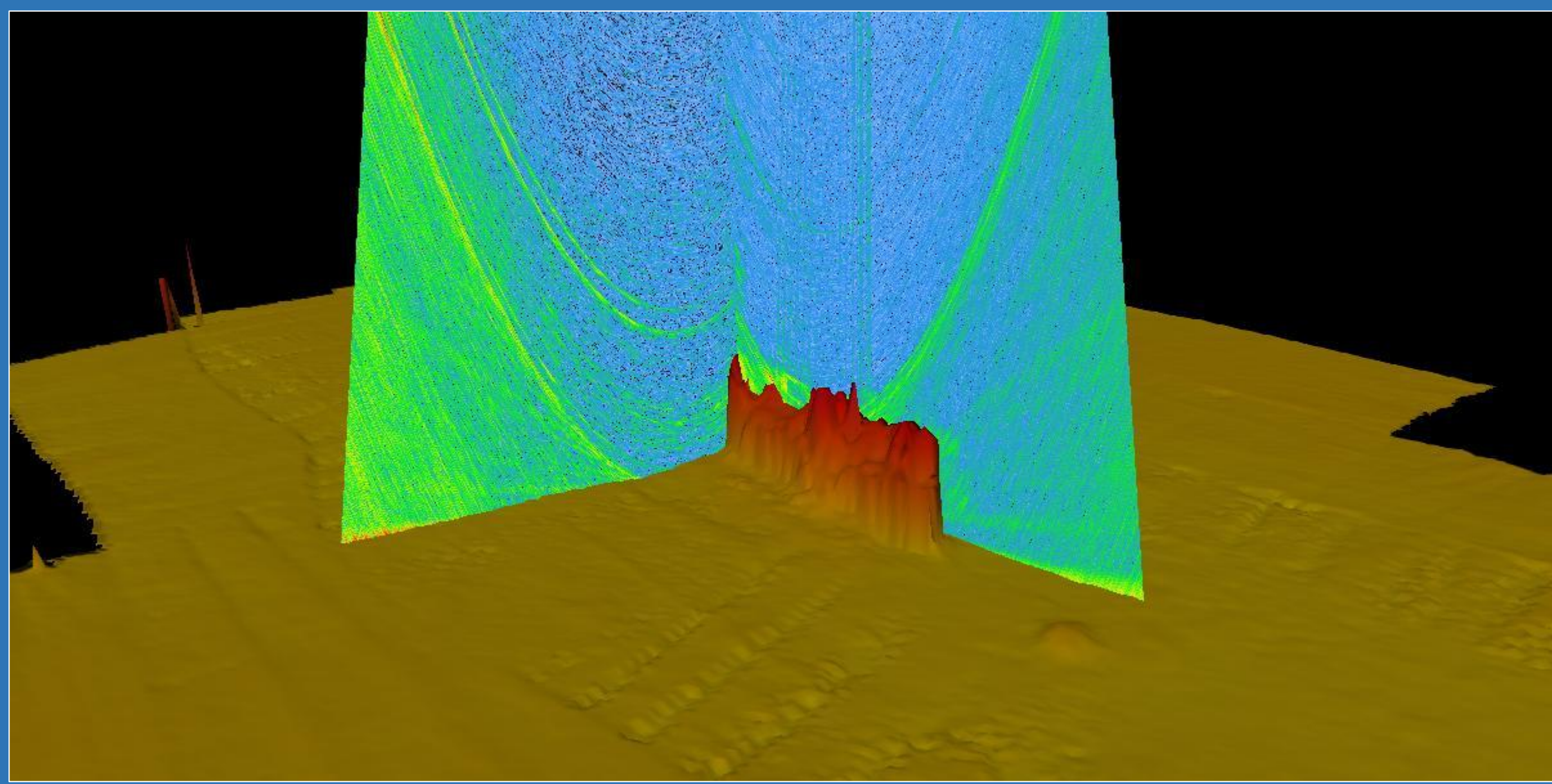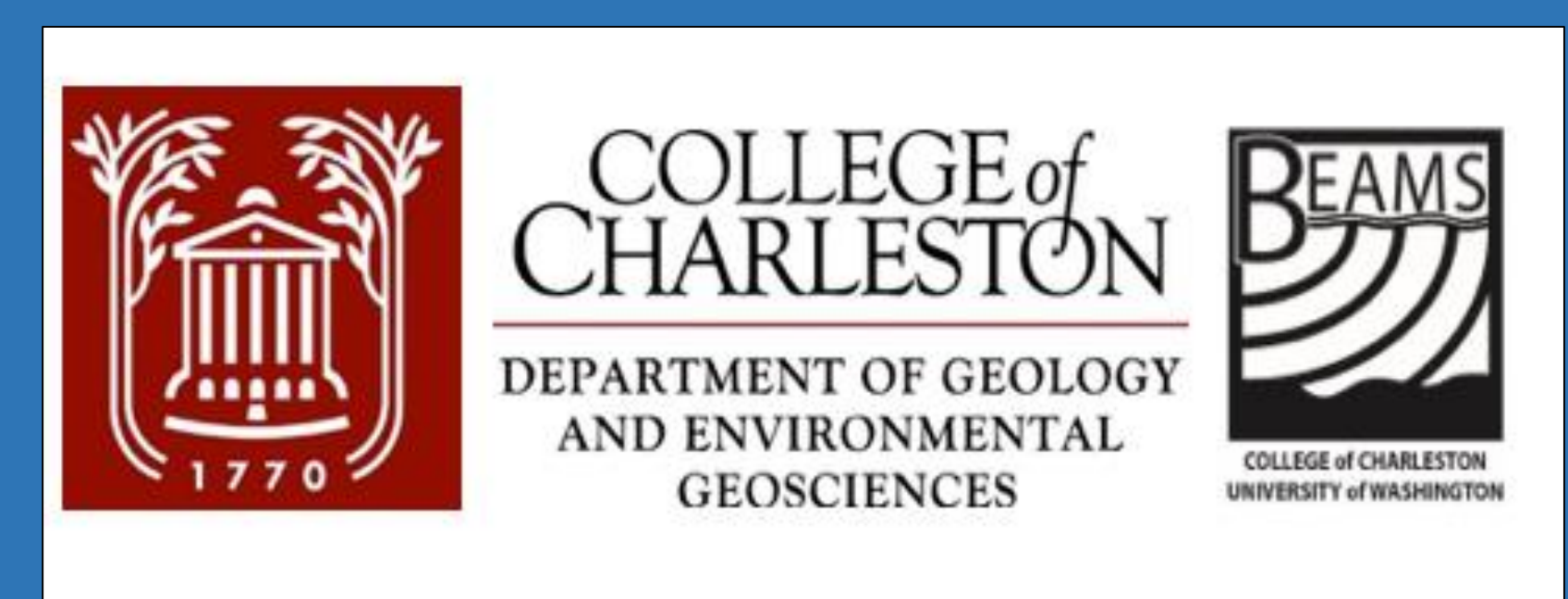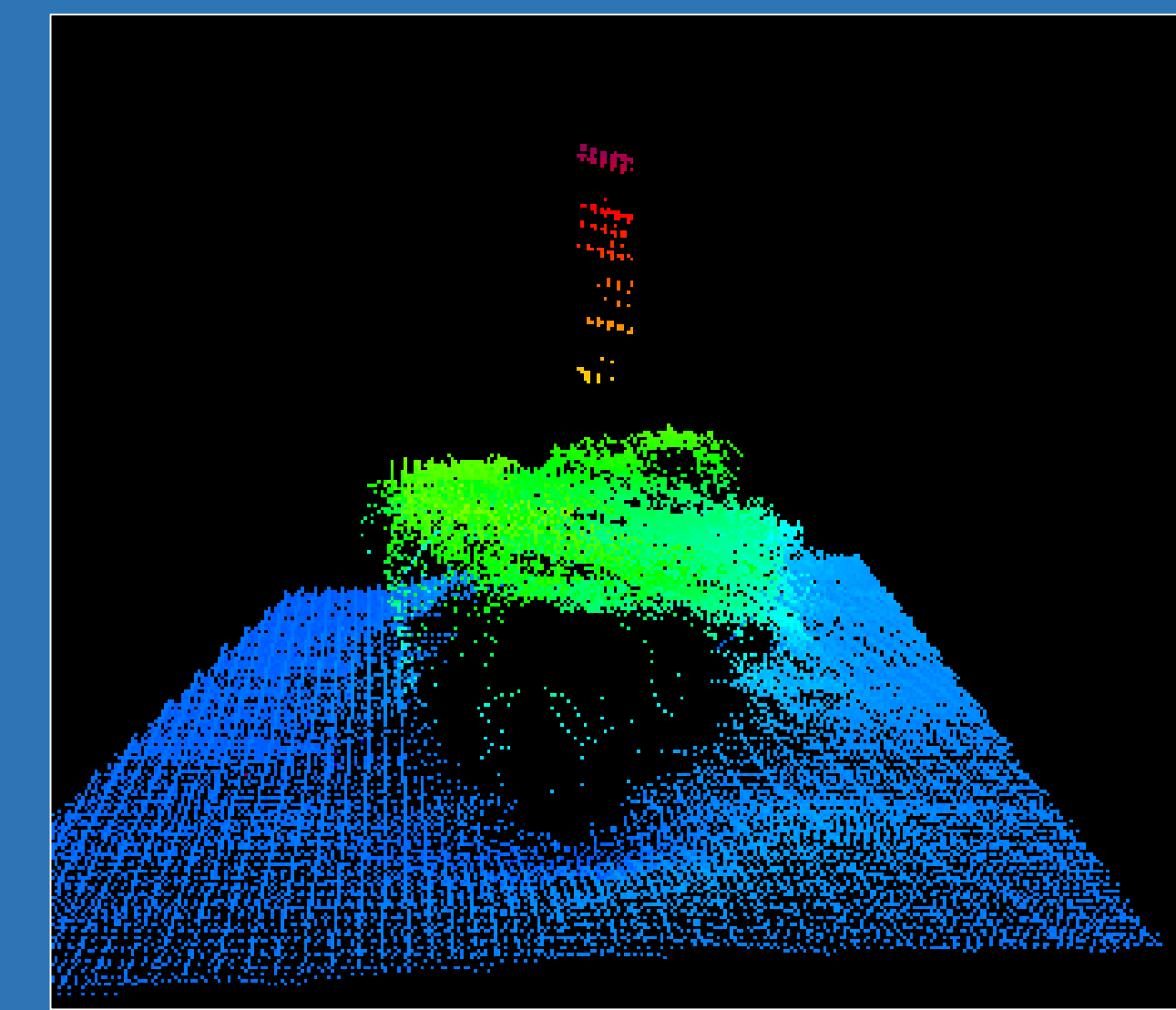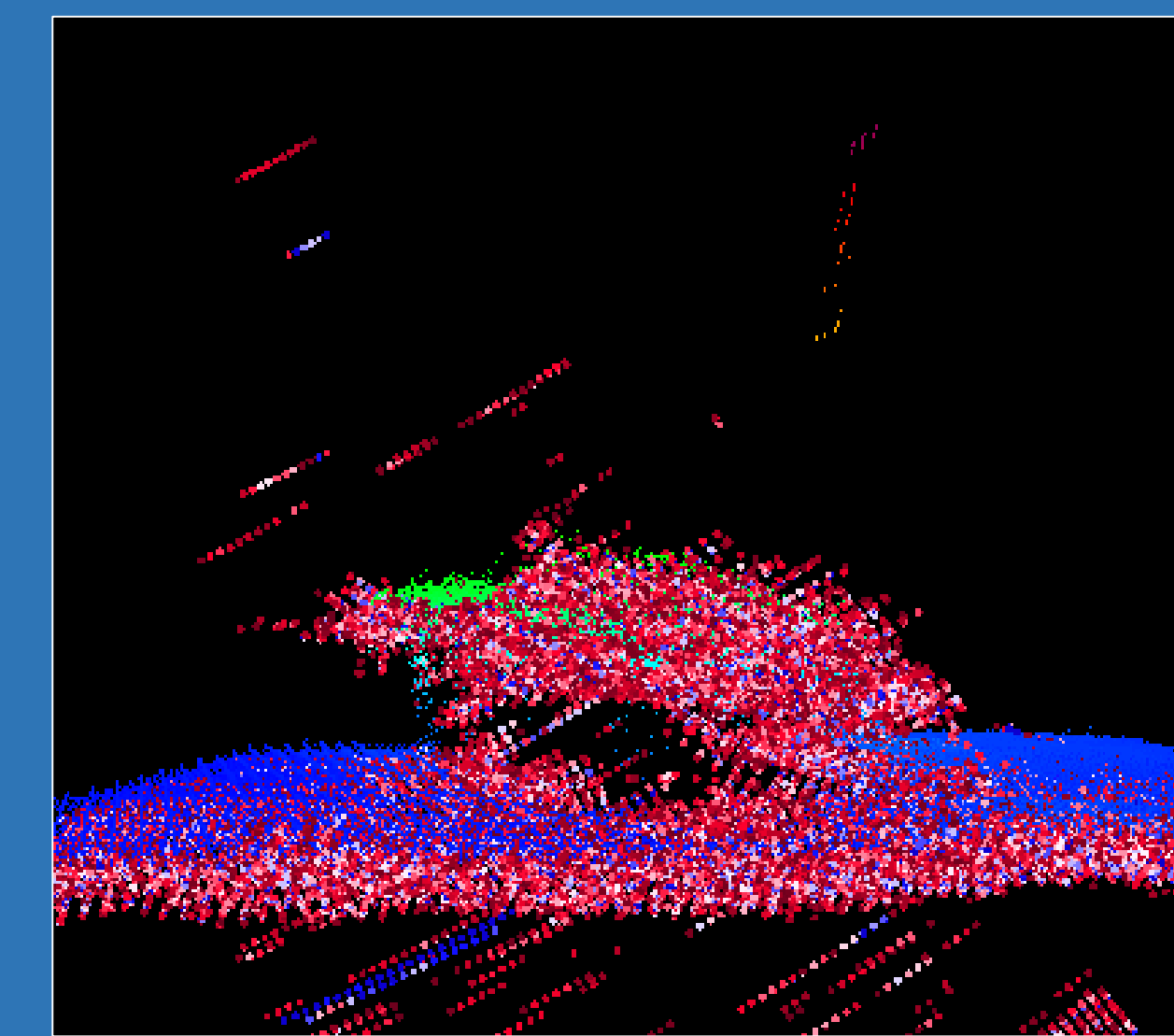# Comparative Analyses of Water Column Data: Investigating Shipwreck Sites off the Irish Coast

Howard Meyers, J. Ryan Hawsey and Dr. Leslie Sautter
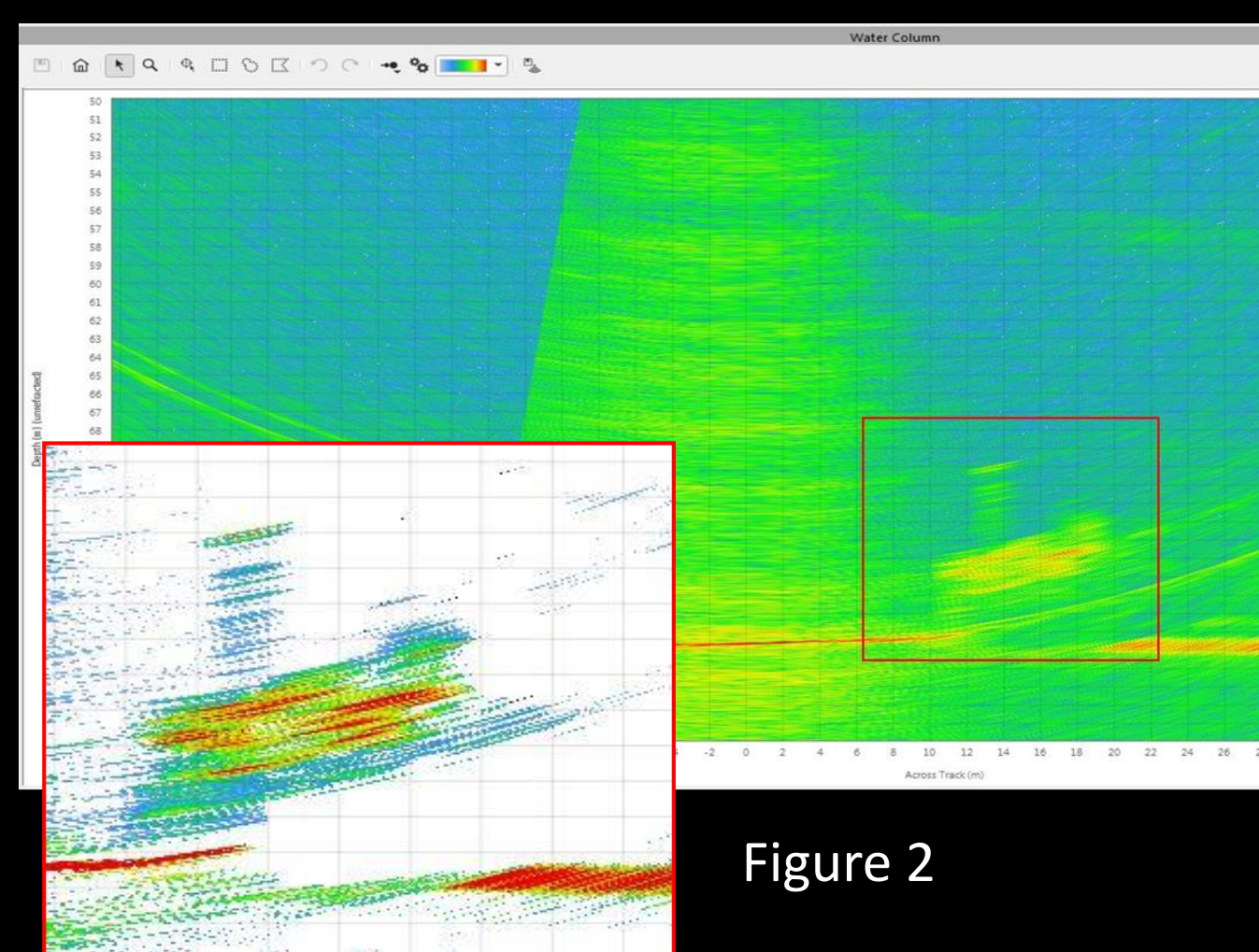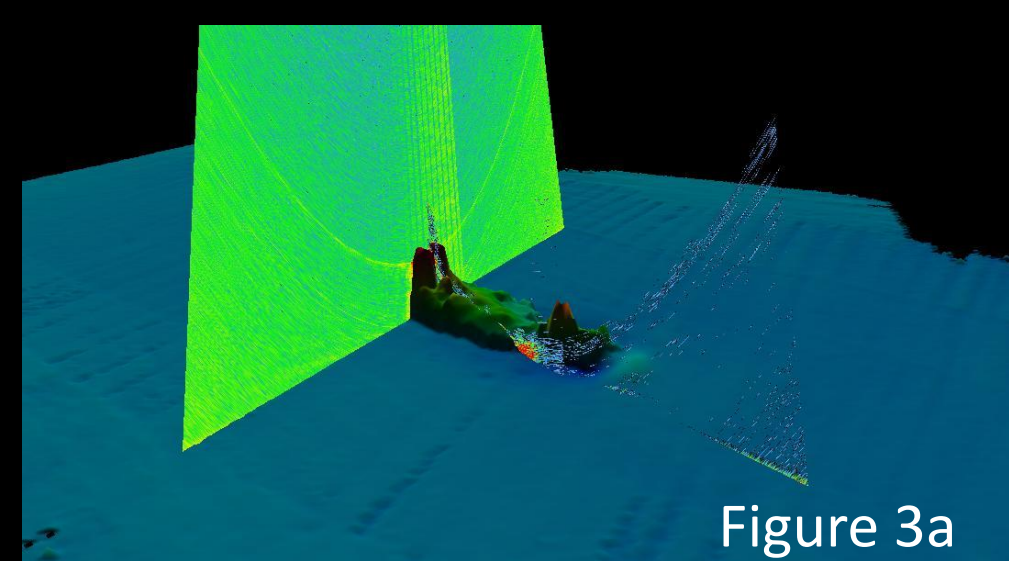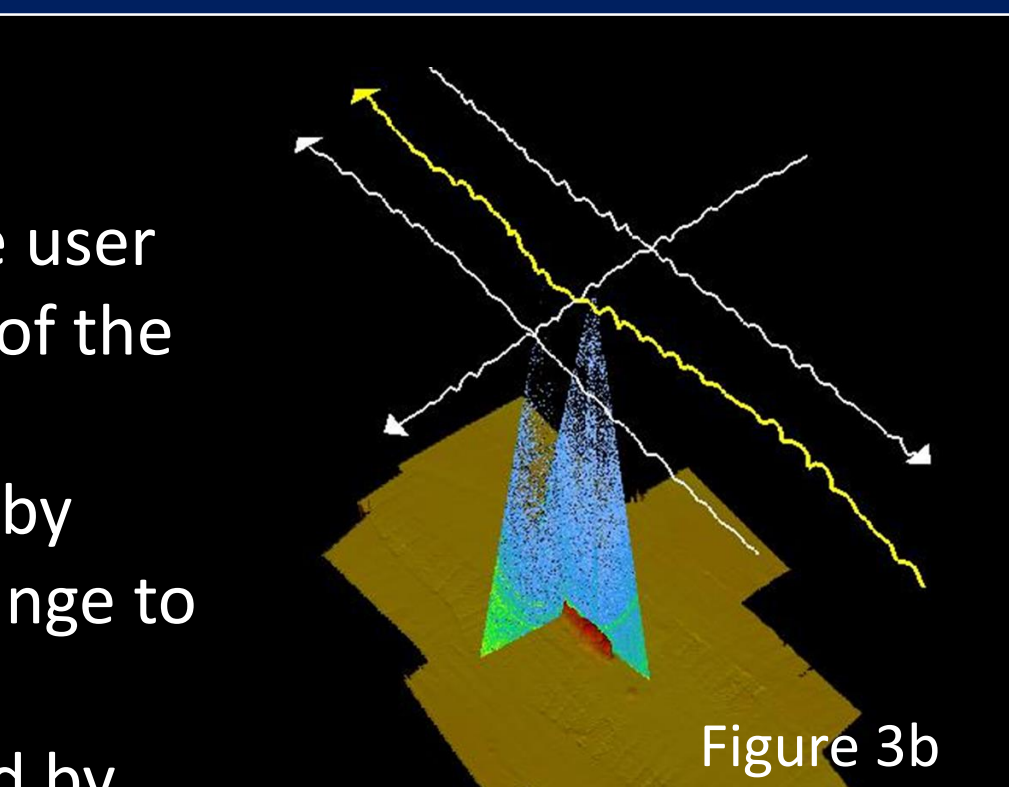Department of Geology and Environmental Geosciences, College of Charleston

R/V Celtic Voyager

INFOMAR — Marine Institute, Foras na Mara — GSI Geological Survey of Ireland

College of Charleston — Department of Geology and Environmental Geosciences — BEAMS

ABSTRACT

During two research cruises in May and July of 2016 multibeam bathymetry and water column data were acquired from the western and southern coasts of Ireland in an average of 100 m water depth. These areas were surveyed and mapped by the Marine Institute of Ireland and Geological Survey of Ireland as part of INFOMAR using the R/V Celtic Voyager outfitted with a Kongsberg EM2040 echosounder. During this cruise more than ten shipwrecks, some of which were previously uncharted, were mapped in high resolution for the first time. Water column data were collected over the wrecks in addition to standard bathymetry data. CARIS HIPS 10.0 and QPS Qimera software were used to post-process both the bathymetric and water column data. Water column data were added to the gridded surface, over the wreck sites to accurately find least depth soundings. This process is done to provide a more complete and accurate image of the wreck site beyond what bottom tracking alone could detect. This poster will compare the workflow and end products produced by QPS Qimera 1.4.3 and CARIS HIPS 10.1-2.

BACKGROUND

In recent years multibeam sonars have gained the ability to record the sonar time series associated with each beam as it travels to the sea floor and back, obtaining an image of the water column along the way. This ability to map the water column along with the seafloor was originally intended to serve fisheries, but now has the function to help many applications. Water column data can serve as a quality control function to get a more accurate model even with competing interference. Interference can come from many things and cause the bottom to be inaccurately represented, and can occurs from other sonars, bubble wash-down, bottom detection failures, thermoclines, fish targets and – the main focus of this poster – false tracking over wrecks. Beginning in the Fall of 2016 the data were worked solely with CARIS HIPS 9.1. During this time some obstacles were encountered, and were re-examined using HIPS and SIPS 10.1 and 10.2. Qimera 1.4.3 was also employed for a comparative analysis. HIPS and SIPS has had the capability of analyzing water column data and add it to the bathymetric data and surface since 2013 (Version 8.0). Qimera 1.4 also includes the capability to analyze water column data.

NOTE: This poster was generated as an honest representation of our research and experience with these two software programs, acknowledging we have no formal training regarding water column processing. Comparisons represent only our findings during this study. Issues encountered may well be repairable.

METHODS

- Data were acquired in the southern Irish Sea with an EM2040 Kongsberg on the R/V Celtic Voyager.
- Wrecks identified were in ~ 100 m of water.
- 3 lines parallel to the wreck were used, with >200% swath cover, plus 1 cross line.
- The swath was narrowed for higher data density.

RESULTS

- There is great similarity between water column fans in Qimera, and HIPS and SIPS' Swath Editor (figure 2, 5). Both software programs show the area of high intensity, which might lead the user to conclude that the feature should be added to the gridded surface.
- Qimera has 2D and 3D views, but HIPS and SIPS Subset Editor has greater ability for broad point cloud type editing.
- Qimera allows the user to overlap fans on the gridded surface to best find the actual shoalest point.
- HIPS and SIPS requires a few more steps than Qimera, and takes significantly longer in processing time. Many steps in HIPS and SIPS require a series of options requiring selection by the user, while some of these steps are automated in Qimera and others do not exist in Qimera (e.g., load tide, compute TPU, and merge).
- HIPS and SIPS allows for more quantitative analyses, and data can be viewed and edited in different editors to allow for a more dynamic interpretation.

REFERENCES

"CARIS releases HIPS and SIPS 8.0 featuring water column data supplementation." Directions Magazine. March 2013. Directions Mag Web. Feb. 2017.
Clarke J.H., Applications of multibeam water column imaging for hydrographic survey. Ocean Mapping Group. University of New Brunswick. 2006.
Lindsay G., Doucet M., Parker D., Weber T., Beaudoin J., Is Multibeam Water Column Data Really Worth The Dish Space? QPS. 2012.

QPS Qimera

QPS — a SAAB group company

Qimera — Hydrographic Processing Evolved — Powered By QINSy — QPS
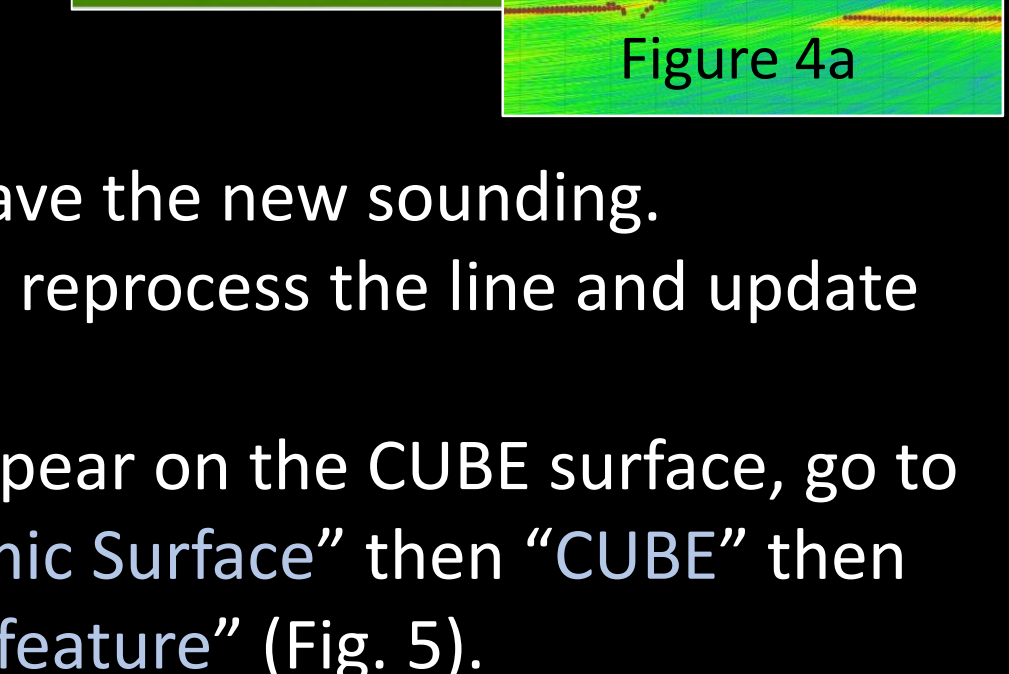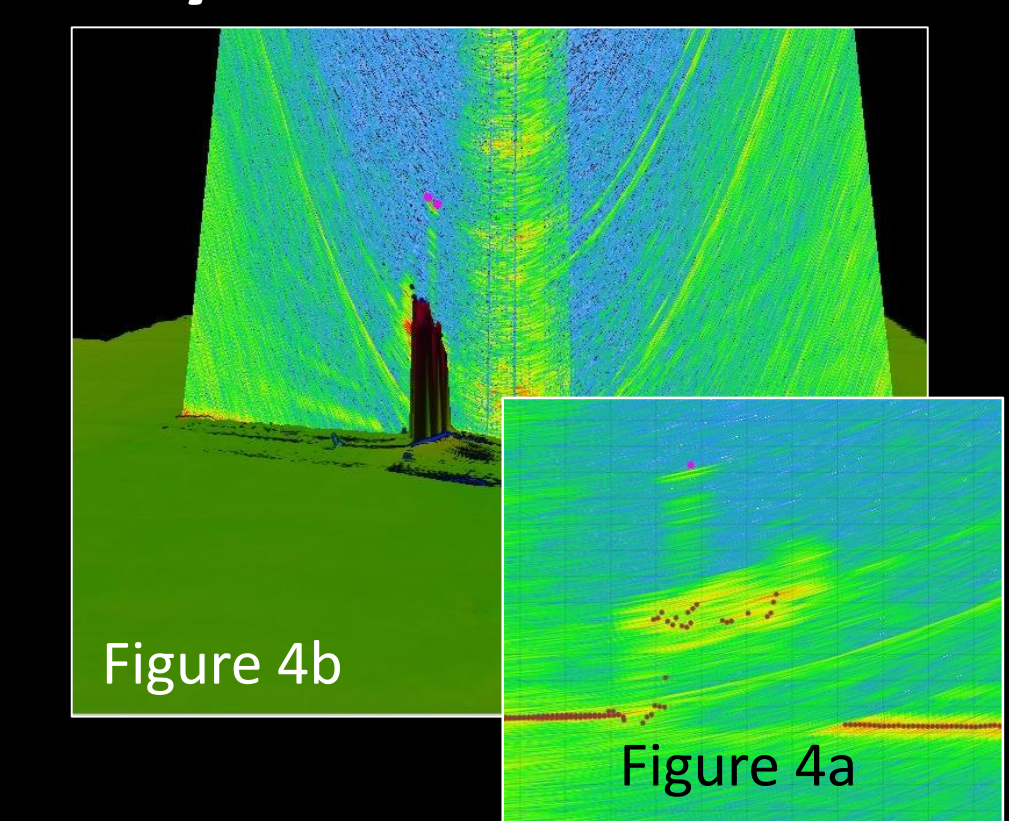
BASIC Workflows

- After the Dynamic Surface has been created and edited, the user opens swath editor, then in the window at the bottom of the screen selects the water column tab.
- Once in swath editor it is best to select to show the surface by intensity by clicking and holding down the button to change to intensity.
- In the water column window the whole swath can be moved by clicking the space bar or clicking on the surface to jump to that spot.
- Use the "A" and "D" key to move one ping at a time.
- Once in water column selecting the button allows you to adjust the intensity histogram in order to clip low intensities from the echogram and highlight areas of high intensity. Here it is also possible to apply side lobe suppression to reduce interference.

Figure 3b

The step below can enhance the water column fan from a hazy image of the wreck (Fig. 1) to a much clearer image (Fig. 2).
- Using the button you can add an image of the water column fan to the gridded surface (Figs. 3a & 3b). This step is useful to take more than one fan from different lines to find overlapping areas to add 'user additional soundings' for least depths of wrecks.

Figure 3a

Figure 2

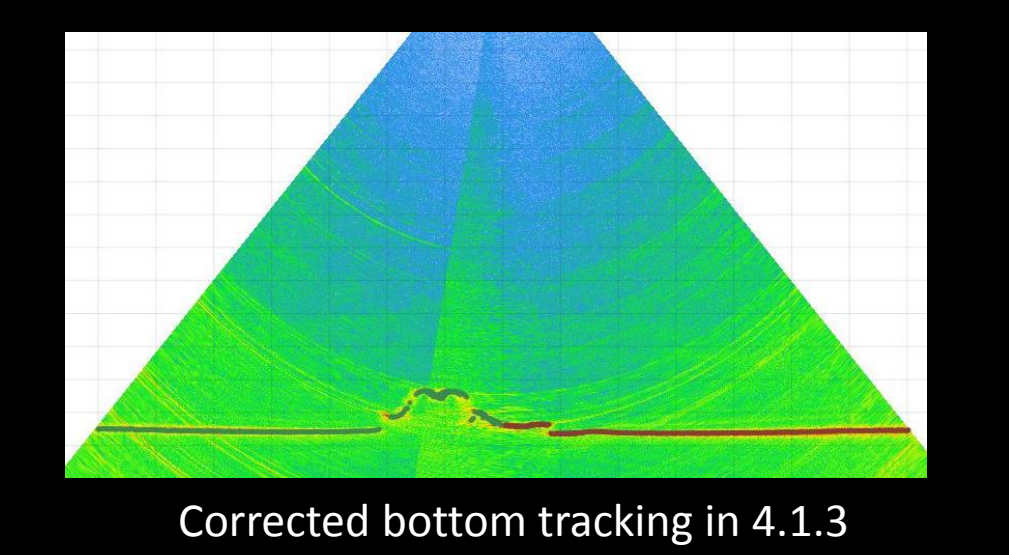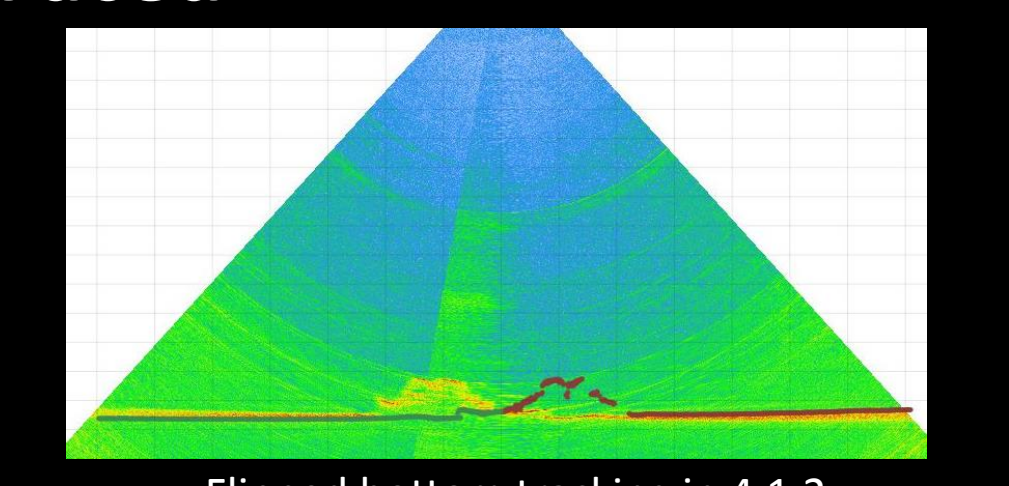### Adding Soundings to Bathymetry

- The user can add additional soundings (user additional soundings) to the surface with 6 steps.
- Use the different fan snap shots to decide which fan shows the feature the best then go to that slice in the water column window.
- Select the drop down menu and make sure "set user picks as feature" is checked.
- Then select add sounding and click on the shoalest point of the feature in the fan (Fig. 4a & 4b).
  - Close swath editor and save the new sounding.
  - Click auto process to reprocess the line and update the dynamic surface.
  - To make the sounding appear on the CUBE surface, go to drop down menu "Dynamic Surface" then "CUBE" then "Create hypothesis from feature" (Fig. 5).

Figure 4b

Figure 4a

Figure 5

Ease of Use and Problems Faced

- In Qimera the user only has to take 4 steps to progress from raw data to looking at the water column fan, resulting in a very stream-lined process. The program prompts the user via a Dynamic Workflow to do all the steps from the time the program is opened until the gridded surface is created. The user only has to open the swath editor.
- A few problems were encountered with user additional soundings added in the water column fan. This was a bug that was a fix from 4.1.2 to 4.1.3 (see images at right).
- Overall, Qimera has a very user friendly interface that helps the user get to the final product quickly.

Flipped bottom tracking in 4.1.2

Corrected bottom tracking in 4.1.3

CARIS

BASIC Workflows

Swath Editor

Figure 5a

5b

Water Column Across / Across Track (m)

Subset Editor

Figure 6a

6b

- With HIPS and SIPS, raw water column data must be stored as .wcd files next to the .all line files in the preprocess folder. They will not however be visible when lines are imported through Conversion Wizard.
- After Creating a BASE Surface, to view Water Column Data, Swath Editor is first used.
- Water Column data will automatically appear in the "Across View" and "Along View" tabs.
- The data fan can be filtered by intensity to isolate features consistent with the ship wreck (figure 5a, 5b).
- When selecting data, all points seen in the fan will be added so it is important to filter the intensity to where only the most intense returns show.
- A surface or specific points can be added in Swath Editor to HIPS Data under an "additional bathymetry" layer.

- Subset Editor allows for the 3D editing of data brought in using water column in Swath Editor.
- Points are rejected, or accepted and later included in the gridded surface (figure 6).
- Raw water column data can also be viewed in Subset Editor.
- Figure 8 shows a point cloud surface of bathymetry, water column points that have been accepted in swath editor (red box), and raw water column data loaded in subset.

Figure 7

Figure 7 shows a 3D view of the accepted water column data.

Similarly to Swath Editor, data can be filtered by intensity and given a color map.

Addition of WCD to Bathymetry

Figure 8

- Comparing water column between Swath and Subset Editors shows there is an inconsistency between what could be a feature of the shipwreck in Swath Editor (figure 5), and what is shown in Subset Editor.
- When examined in Subset Editor, and the intensity range is set equal to what was used in Swath Editor to add the points, Subset Editor does not show any return in the area (figure 8).
- The red box (figure 8) highlights the points that were added to the bathymetry using Swath Editor. Note how there is no new data from Subset Editor.
- To add to a gridded surface, a new "Regular Gridded Surface" is created and the additional bathymetry is included.

Ease of Use and Problems Faced

- Initially, when HIPS and SIPS 10.1 was used the addition of water column data did not overlay properly with the gridded surface and resulted in a vertical offset (figures 9a and b).
- A shipwreck resting upside down was chosen as a control, as the ship's hull has a defined intensity and smooth surface, which made for accurate definition of water column data.
- We were not able to fix vertical offset issue using 10.1, however many changes have been made to water column processing in HIPS and SIPS 10.2.

- Our preliminary trials with HIPS and SIPS 10.2 has not corrected the vertical offset and ability to incorporate additional bathymetry to the gridded surface. We will continue to work with 10.2 and hope that our improved ability will solve our original problems.
- In CARIS HIPS and SIPS 10.1, the user must complete a total of seven steps, from starting a new project to being able to view and edit water column data.

Figure 9a

Figure 9b

Howard Meyers
meyershg@g.cofc.edu

Ryan Hawsey
hawseyrr@g.cofc.edu