New Algorithm and Workflow for Multibeam Imagery Processing

Based on a paper by Eli Leblanc, CARIS
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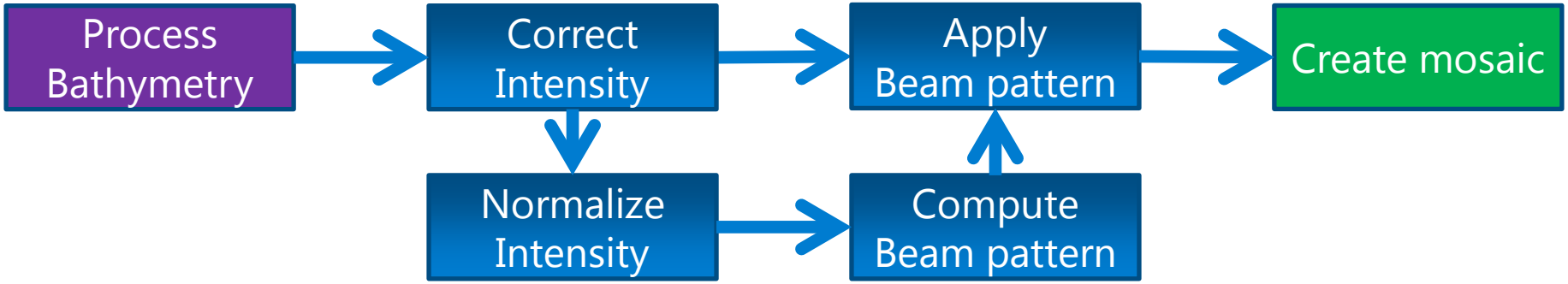
- Introduction
- Required parameters (Inputs)
- Algorithm
- Use Case
- Demonstration
- Conclusion

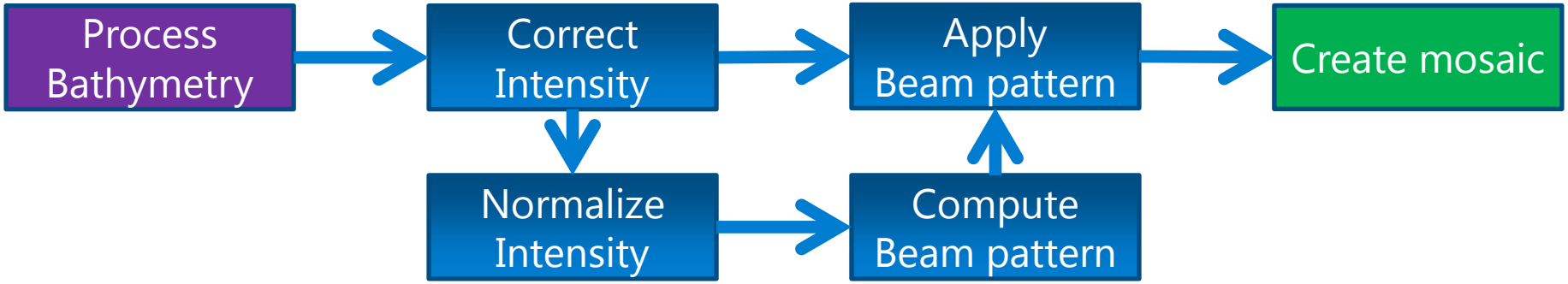
- An alternative to the GeoCoder algorithm which has not worked well enough in the CARIS implementation
- New algorithm in CARIS HIPS and SIPS based on acoustic principles and standard industry techniques
- It builds on work done by the GEOHAB backscatter working group
- The aim is to make Mosaic creation a straight forward process rather than a science project
- Multibeam's can produce high quality imagery, by delivering it we increase the hydrographic value chain

- Direct integration with CARIS tools, providing a simplified configuration
  - Special attention has been taken to limit user inputs needed
- Most parameters specified at acquisition are captured in the raw sonar files and can be read directly by CARIS
  - Frequency
  - Along and across-track beam widths
  - Transmit power and receive gain
  - Pulse duration
  - Nominal spreading and absorption
  - Sound speed
- Utilises the multibeams bathymetric measurements to improve the quality of the backscatter imagery

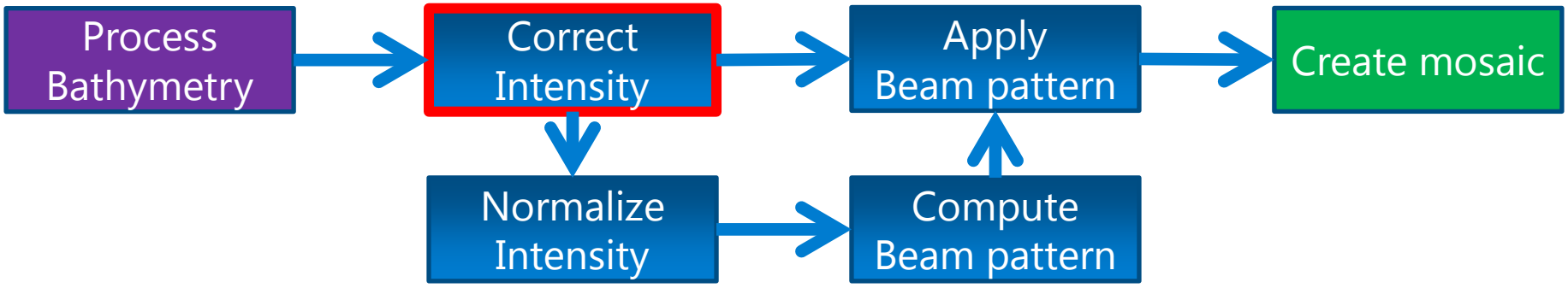
- HIPS processed (merged) bathymetry
- From raw sonar file
  - PARAMETERS:
    - frequency, along/across track beam widths
    - Tx power, Rx gain, pulse duration, nominal spreading and absorption, sound speed
  - DATA:
    - beam angles, ranges, intensities
- Environmental considerations
  - Temperature
  - Salinity



- Basic workflow steps
  - **Geometric corrections** (process multibeam bathymetry)
    - Using traditional processing workflows in HIPS and SIPS
  - **Radiometric corrections** (apply backscatter corrections)
    - Time-varying gain (TVG)
    - Transmission power and reception gains
    - Ensonified area
    - Sonar beam pattern
- Result
  - **Processed Imagery** (bottom reflectivity and angular dependence



- From the user point of view…



1(a) Apply TVG correction

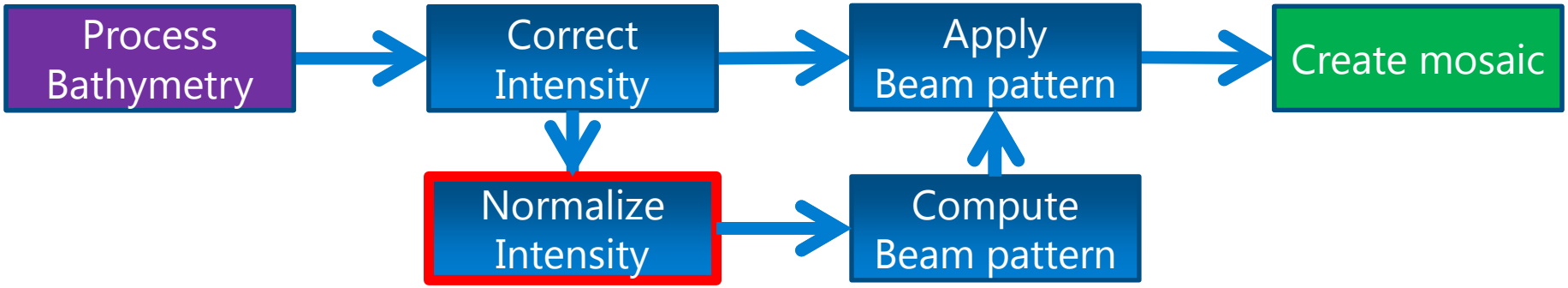
- *Compute TVG used during acquisition*
- *Remove TVG and replace it by the signal loss over the slant rage distance using local absorption*

1(b) Apply Tx power and Rx gain corrections

- *Uses parameters set during acquisition*

1(c) Calculate and correct for the ensonified area

- *Intersection of Tx/Rx footprint on the seafloor, considering the angle of incidence*



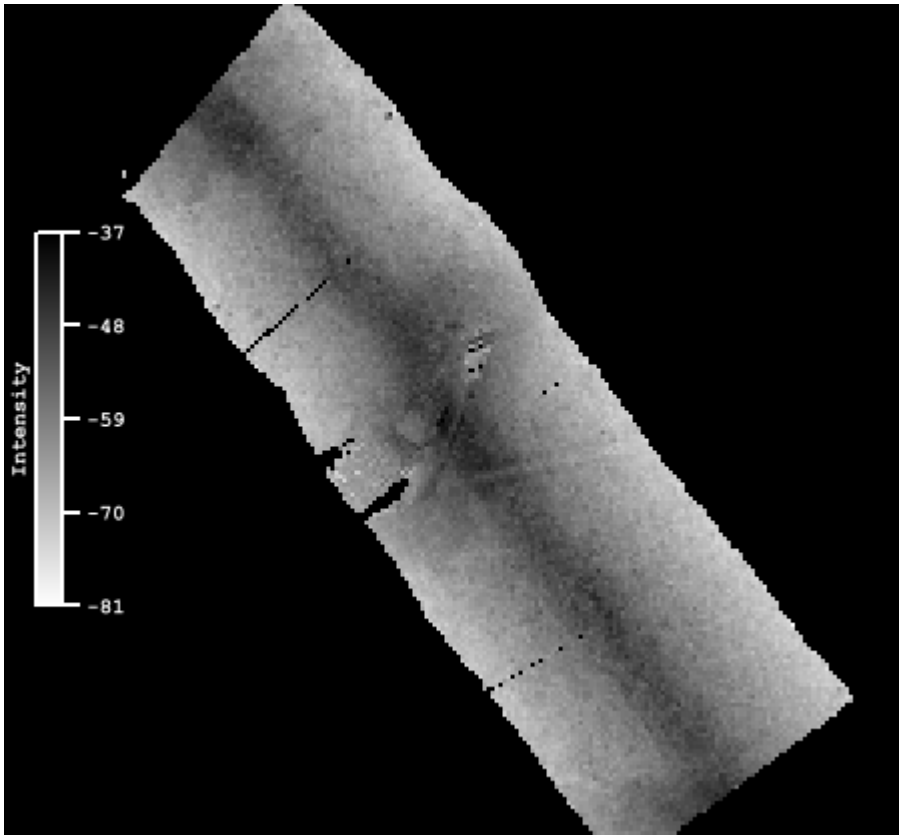
2(a) Variations by incident angle and bottom type

- *Project ensonified area to a plane perpendicular to the beam vector*

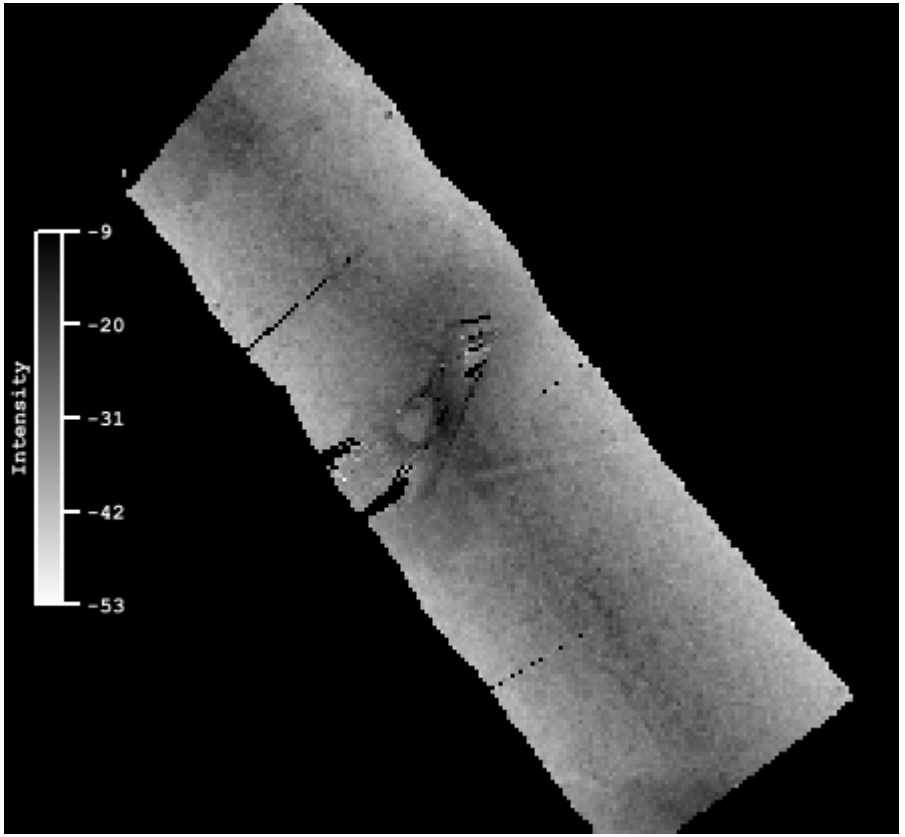
2(b) Variations caused by transmit power and receive

- *By using the power in the ping information*

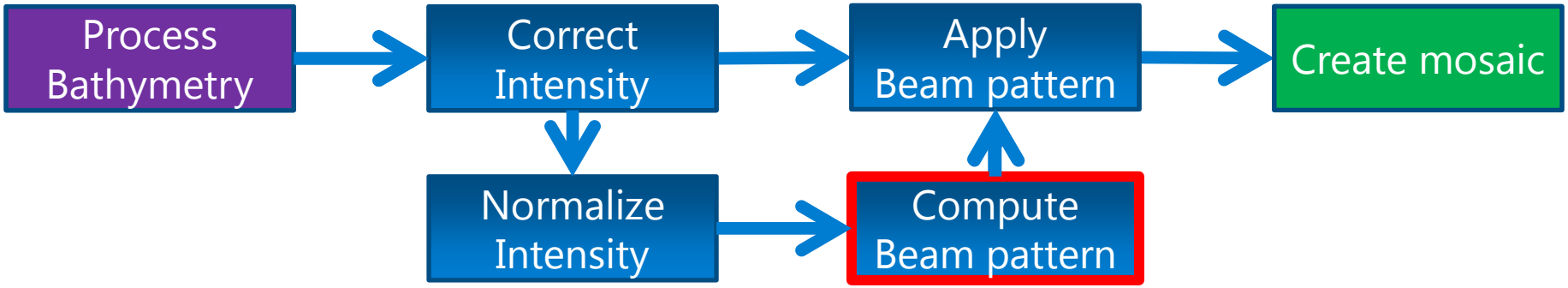
Algorithm – Result after intensity corrections



Raw

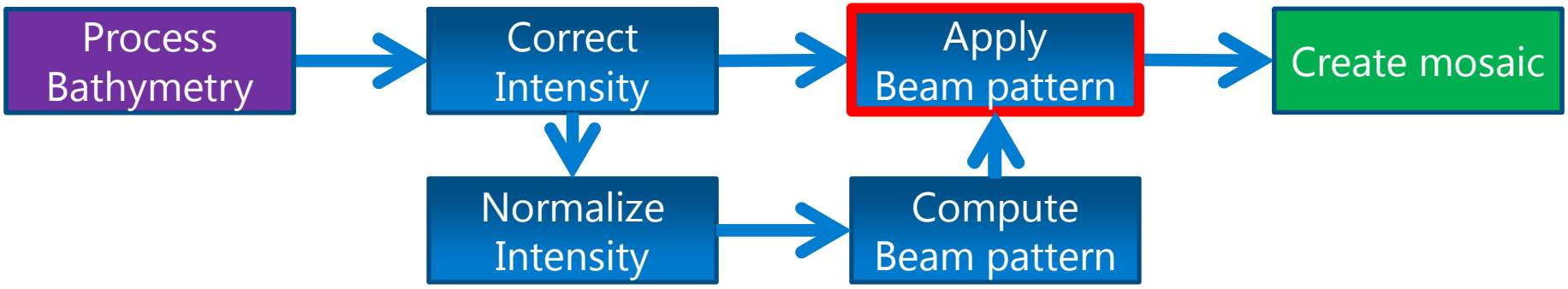


Intensities corrected



3 Compute beam pattern

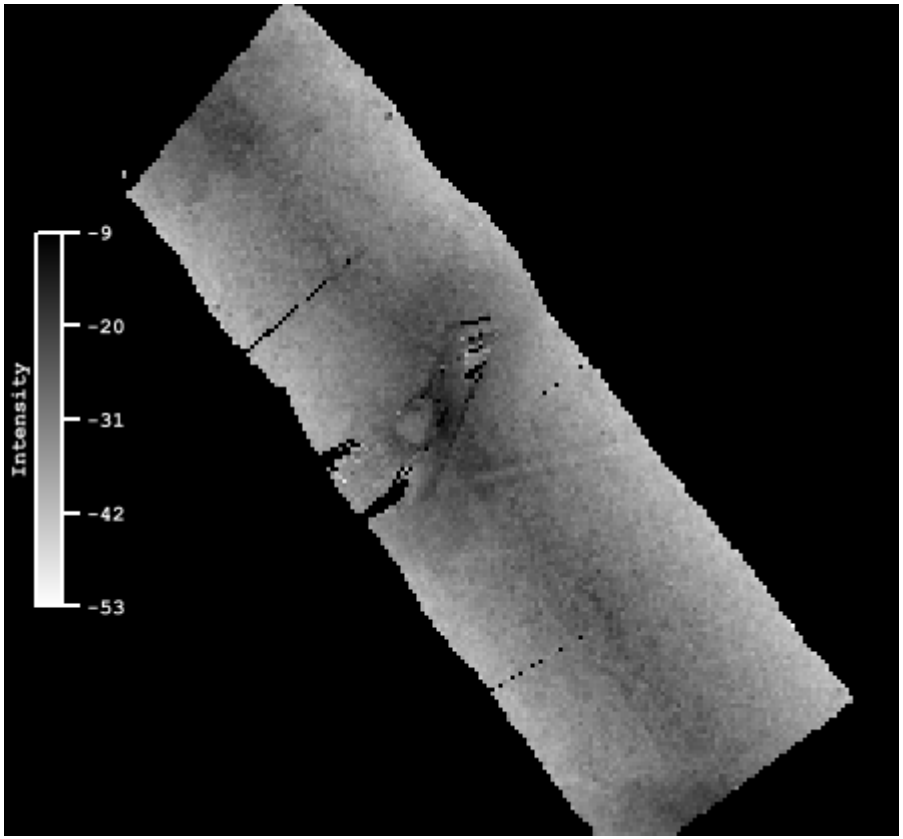
- *The normalized intensities are averaged over successive pings at 0.1 degree intervals*
- *The more data, the better the beam correction*



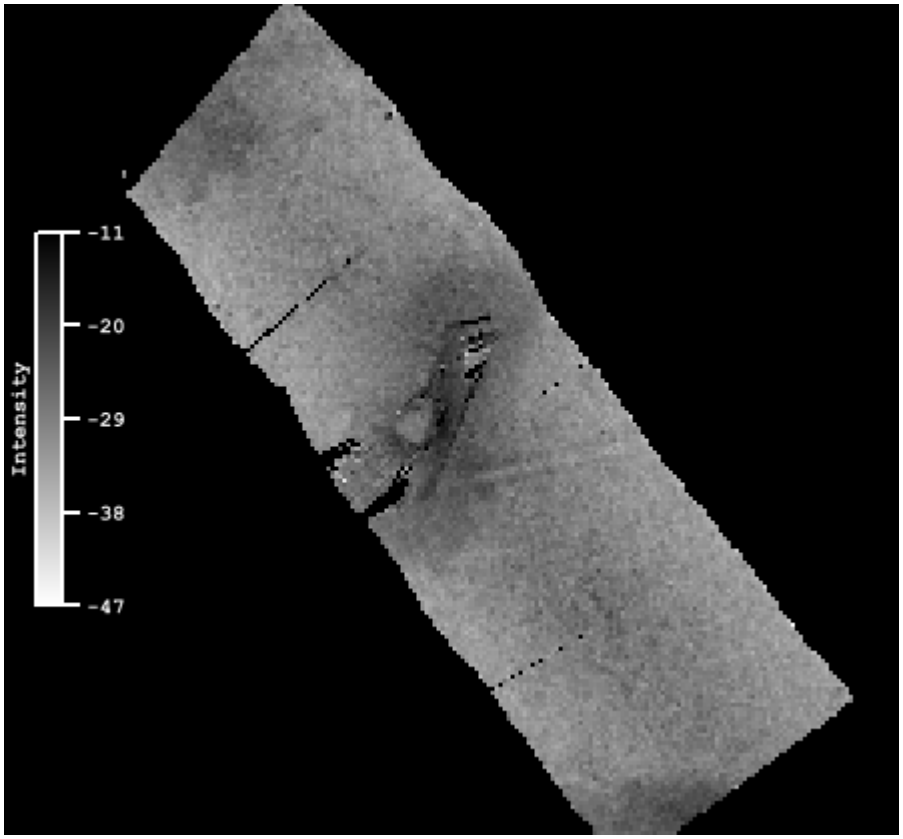
4 Apply beam pattern

- *Remove the beam pattern value from the intensity value using the steering angles*

Algorithm – Result after beam pattern correction

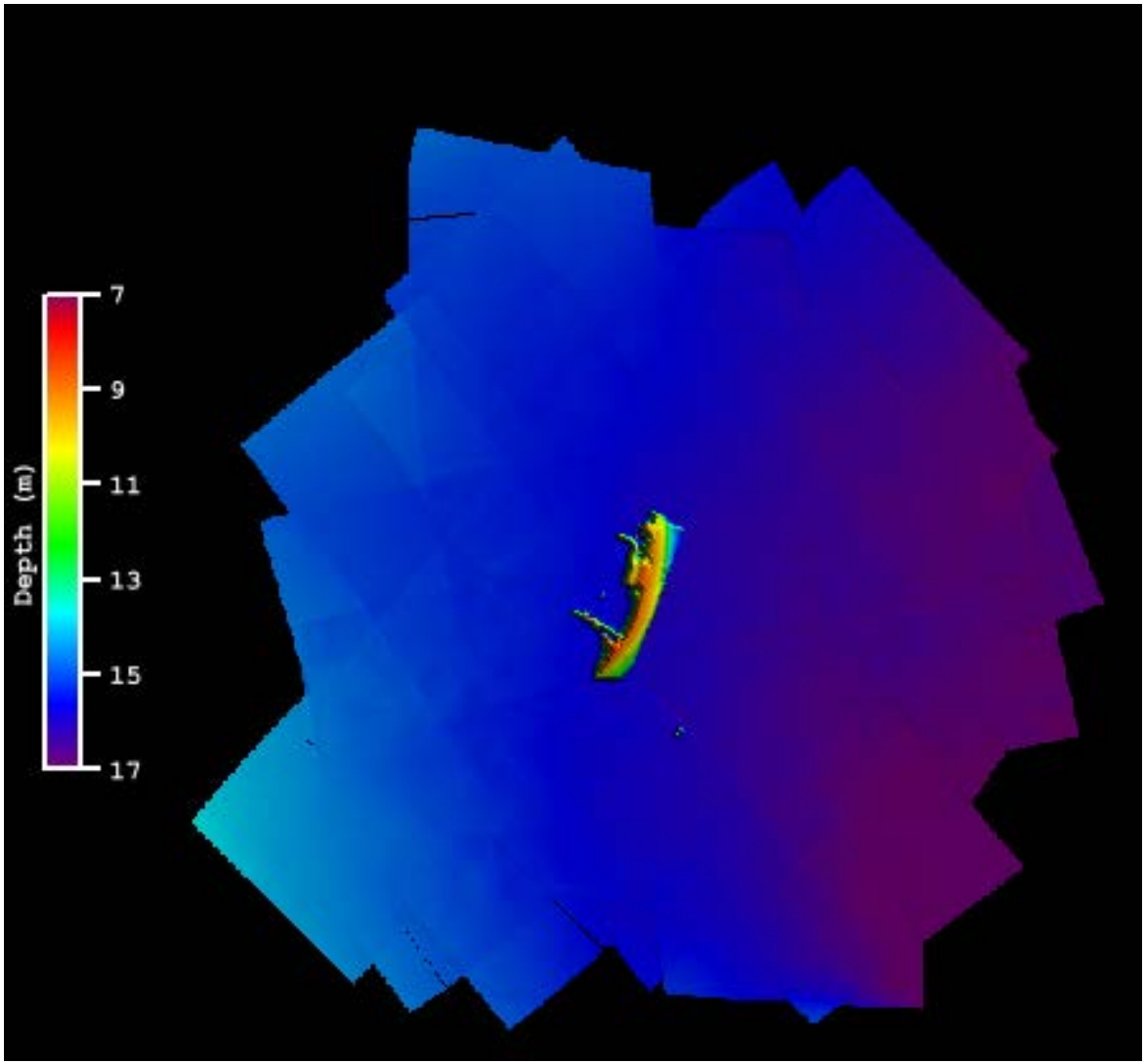


Intensities corrected

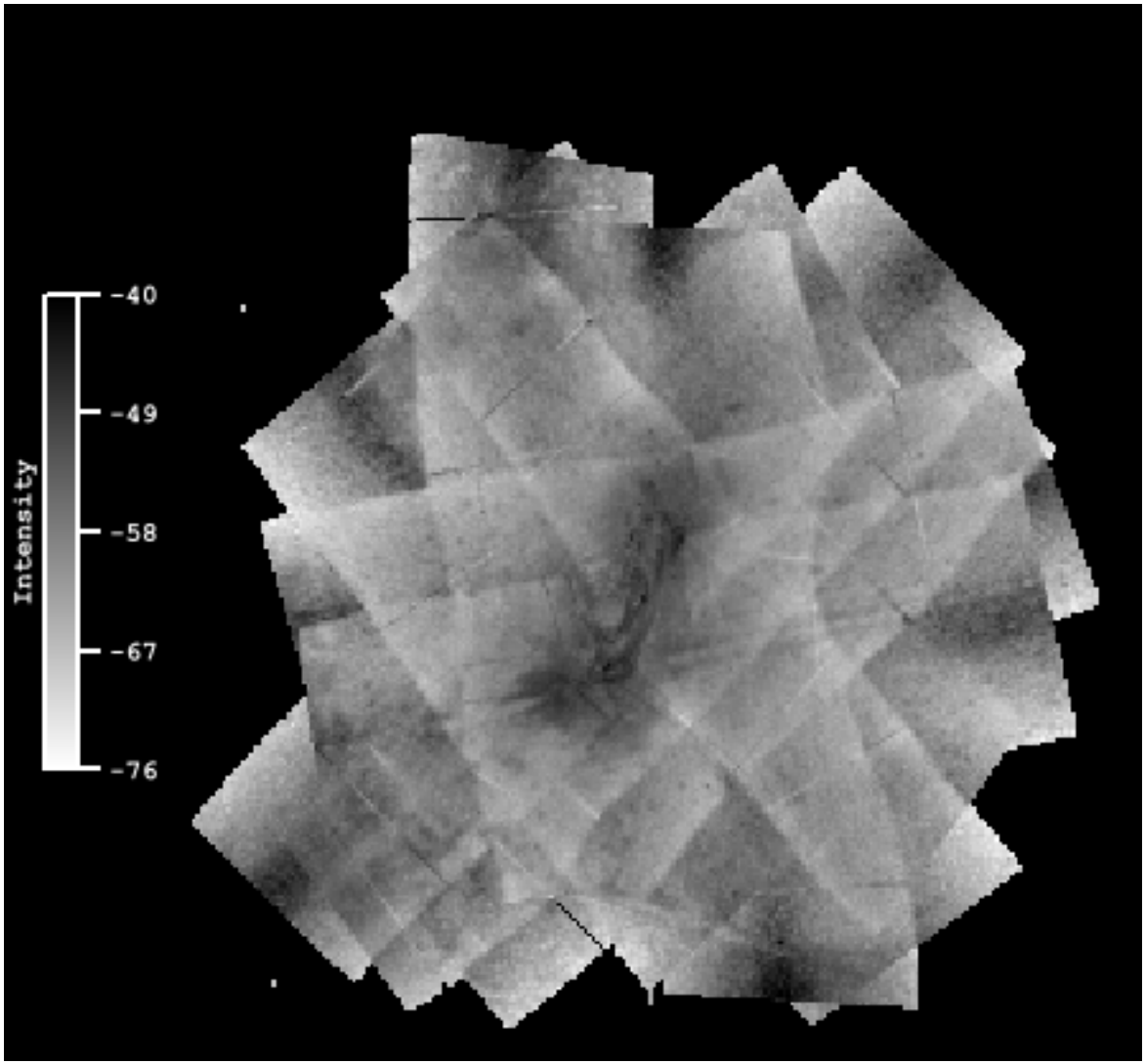


Beam pattern corrected

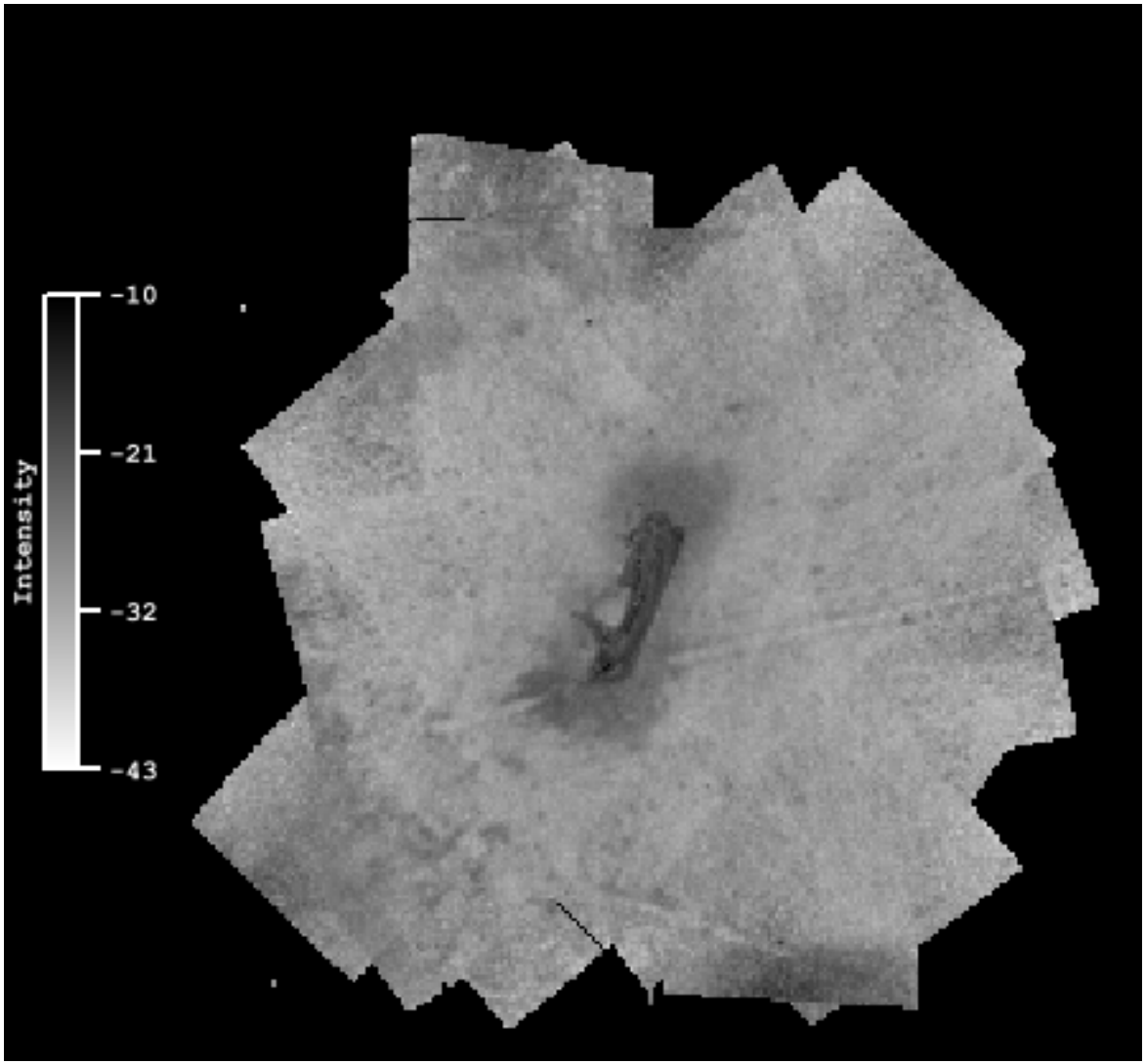
- Ship wreck in Women’s Bay, Alaska



- Uncorrected backscatter data



- Fully corrected using new process and algorithm



- Demo

- New, documented algorithm for multibeam backscatter imagery processing
- Rigourous computation with simple workflow
- No homogenous bottom type assumption when computing the beam pattern
- Creating a good mosaic is a straight forward process rather than a science project
- Multibeam’s can produce high quality imagery, by delivering it we increase the hydrographic value chain

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