Underwater Inspections – Imaging to Monitor Scour and Scour Countermeasures

consor

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Learning Outcomes

- **SONAR Basics**
- 2D Advantages/Disadvantages
- 3D Advantages/Disadvantages
- Case Study

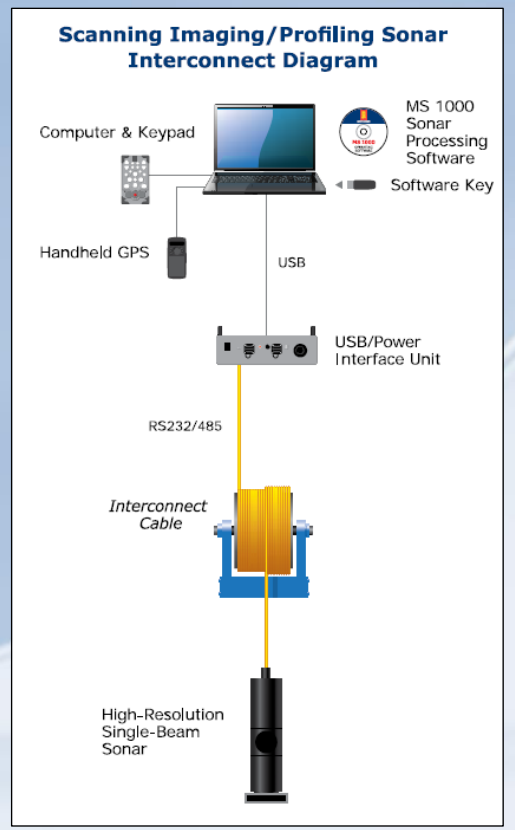
SONAR Basics

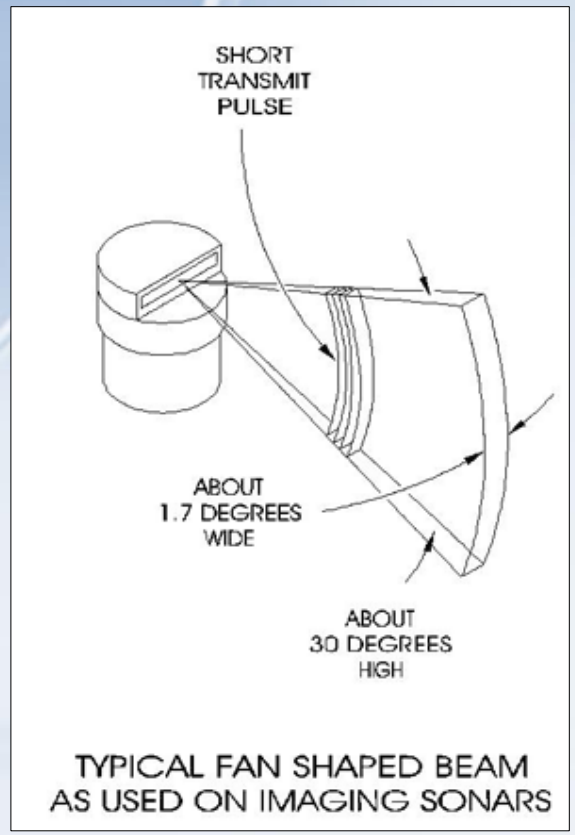
SOund Navigation Ranging

- Transducer emits a sound wave
- Sound travels at known velocity
- Sound bounces off object
- Receiver captures the returned soundwave
- Math = known distance of object from transducer

SONAR Basics

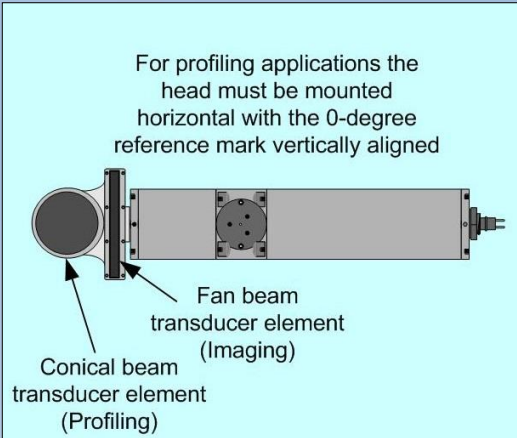
Single Beam – 2D

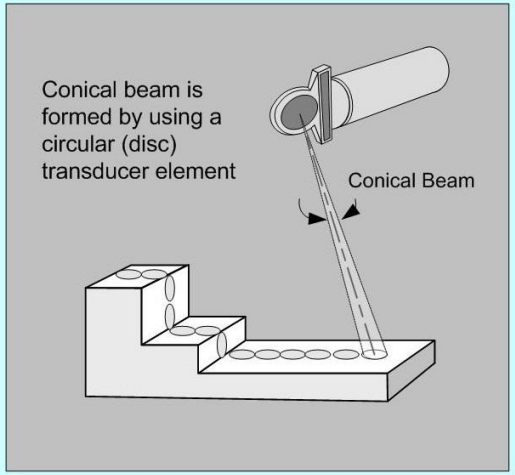


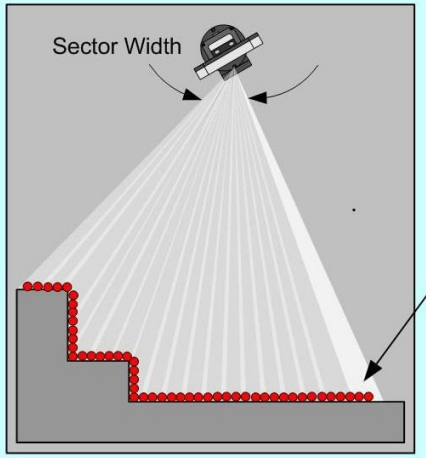


SONAR Basics

Single Beam – 2D





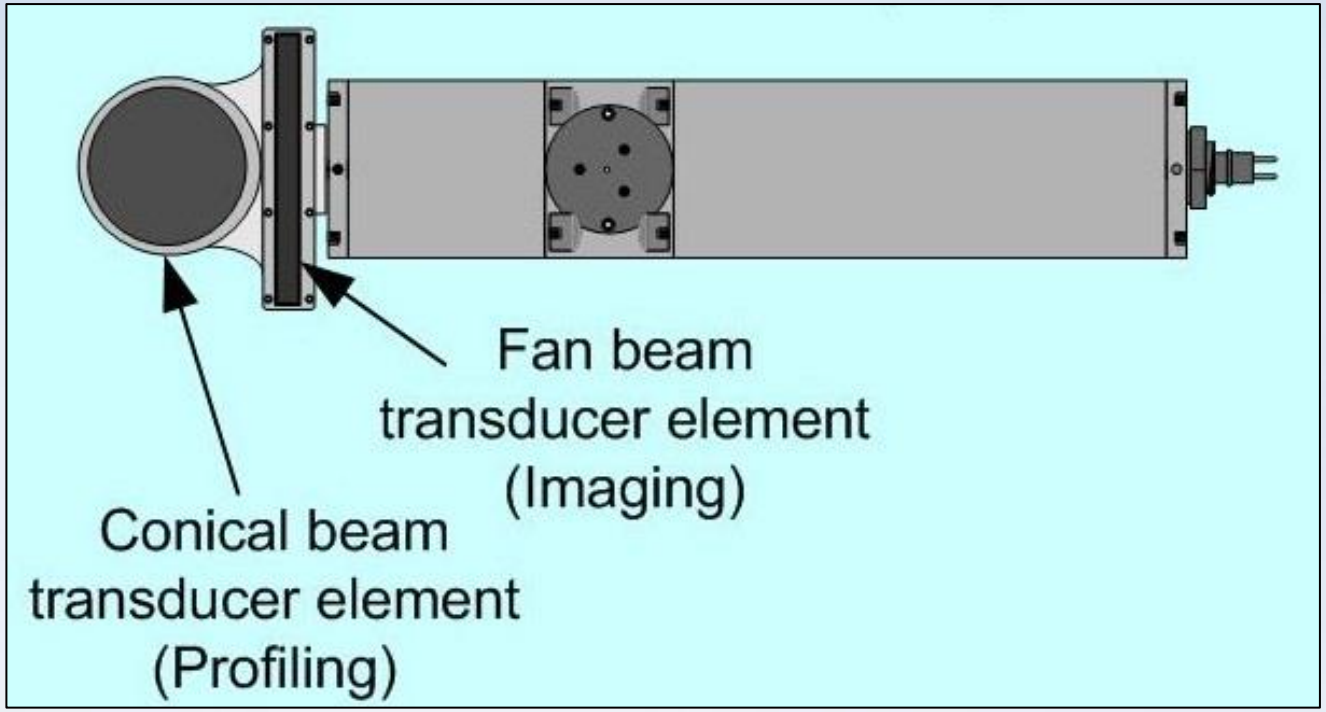


Profile points are generated by an algorithm in the MS 1000 program that detects the echoed return and assigns a range and bearing relative to the sonar transducer and its "0"-degree reference.

The number of profile points on a specific scan is set by the selected MS 1000 "Step Size" - typically this is every 0.45 or 0.9 degrees.

Sector Width and Heading are used to orient the head scan angle and arc of acoustic coverage.

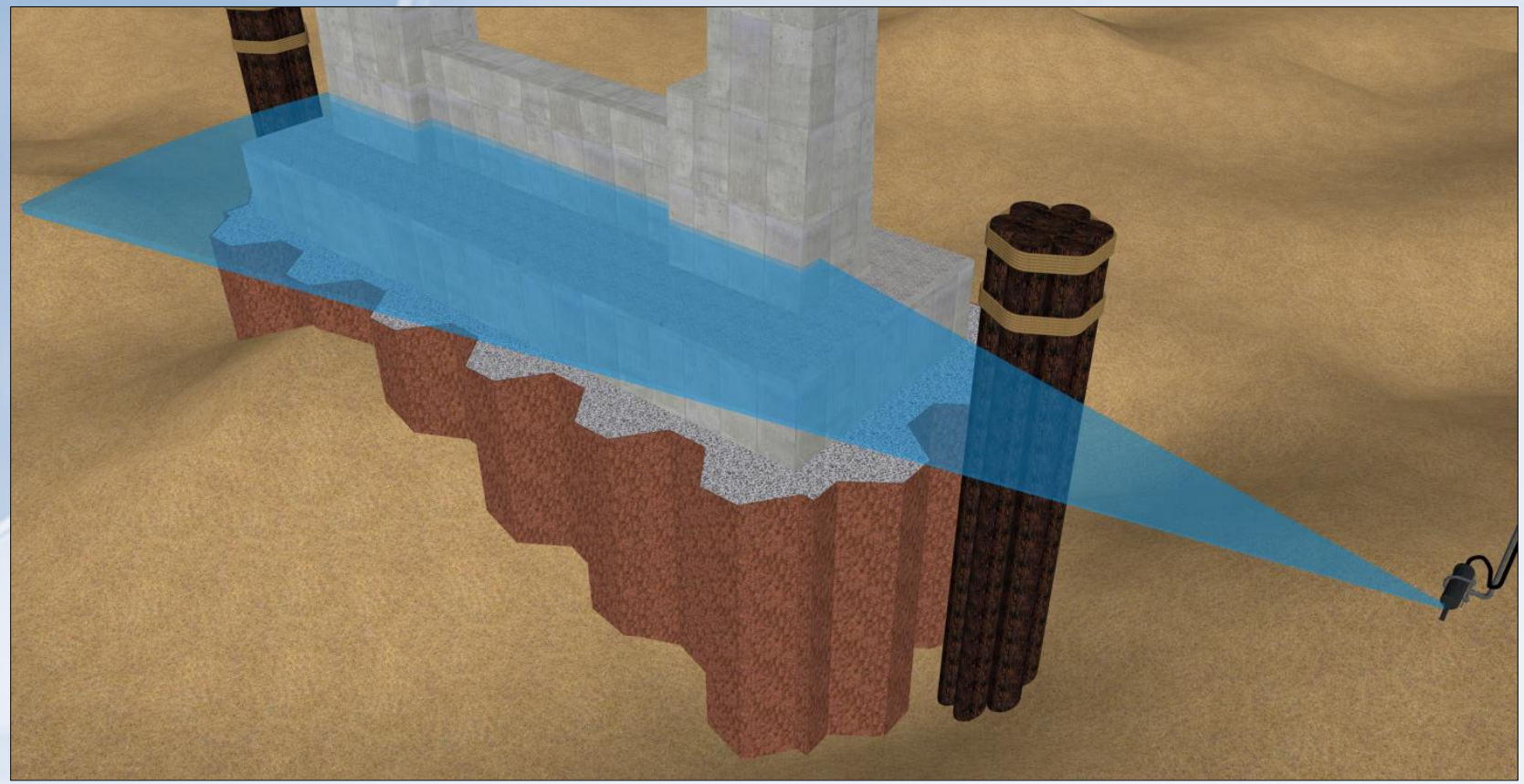
The profile points can be extracted and recorded in real-time or during post processing where different weighting values can be (if desired) applied to the profile point extraction algorithm.



Graphics Reference: "Echoes and Images" by Mark Atherton

SONAR Basics

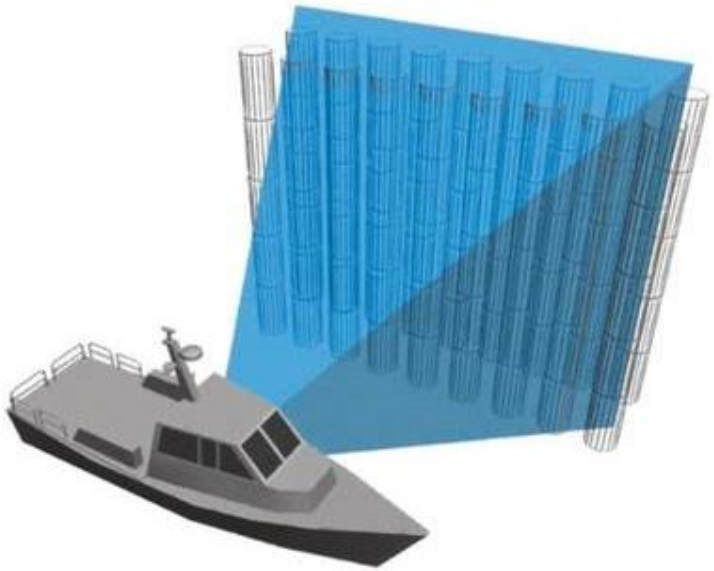
Single Beam – 2D

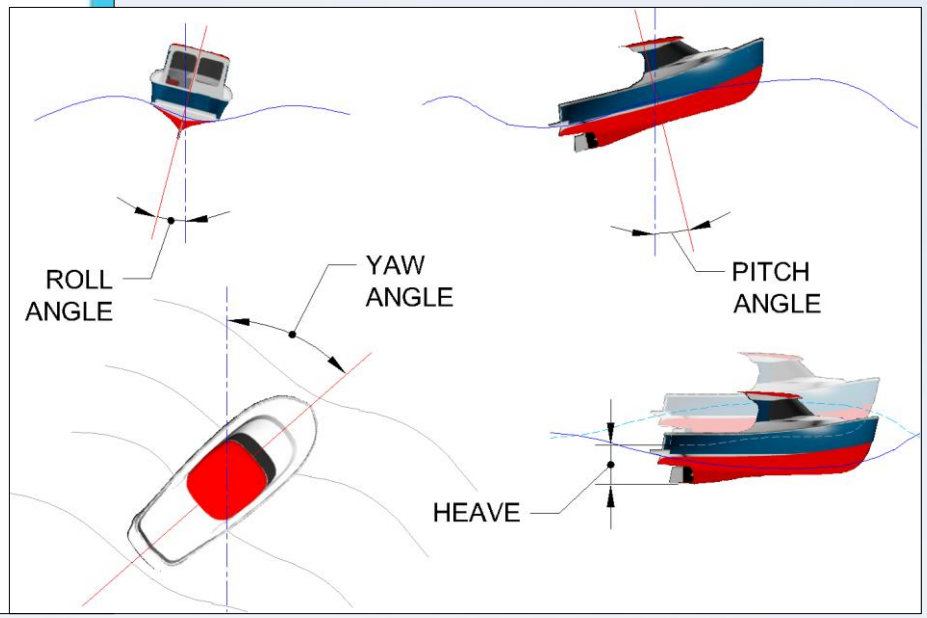


Graphics Reference: FHWA-HIF-18-049 – Underwater Inspection of Bridge Substructures Using Imaging Technology

SONAR Basics

Multi Beam – 3D





Graphics Reference: FHWA-HIF-18-049 – Underwater Inspection of Bridge Substructures Using Imaging Technology

Learning Outcomes

- SONAR Basics
- **2D Advantages/Disadvantages**
- 3D Advantages/Disadvantages
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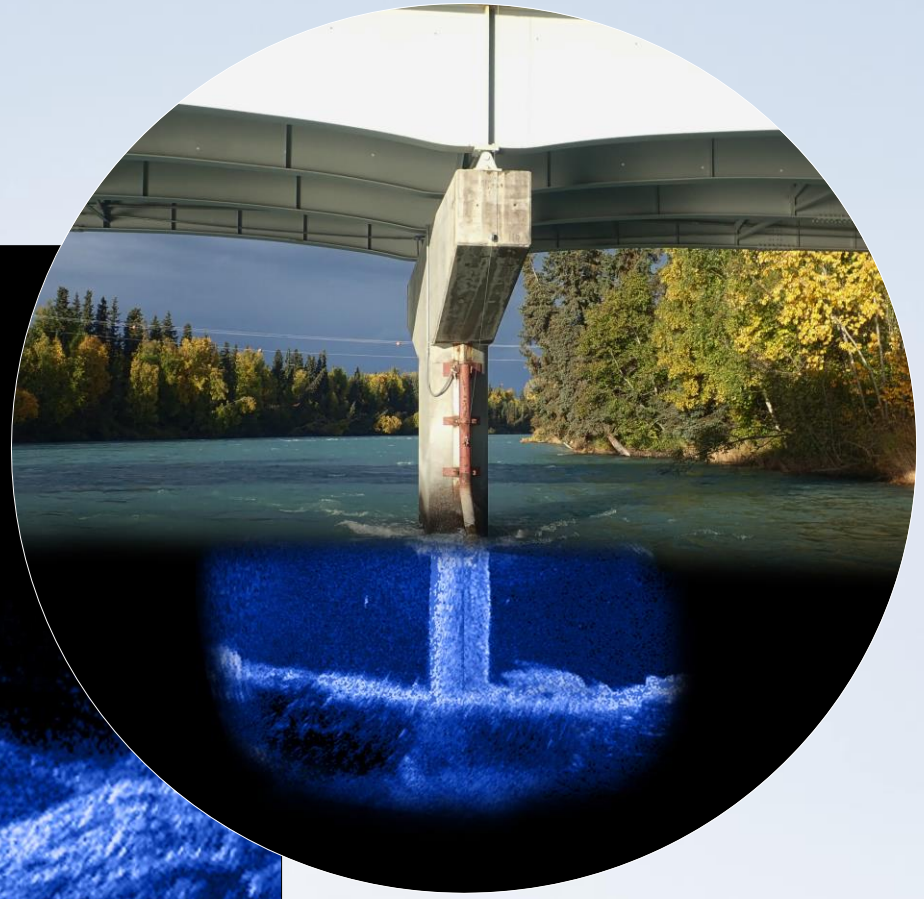
2D SONAR

A Moment in Time

- Quick setup/teardown
- Water depth
  - > 10-ft. desired
- Numerous deployment options
- Water velocity
  - Higher velocity becomes more challenging
- Stationary deployment
- A picture in a single plane

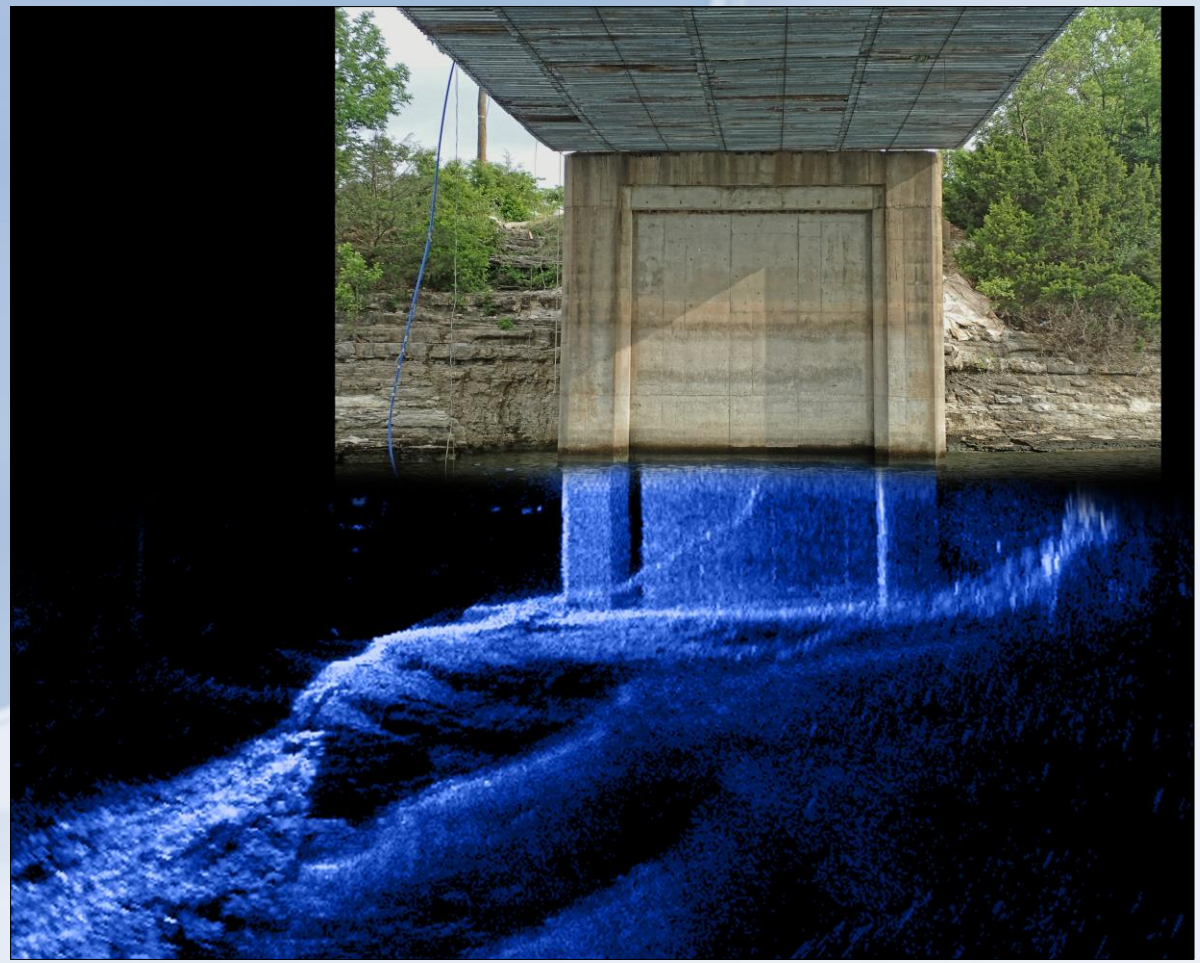
2D SONAR

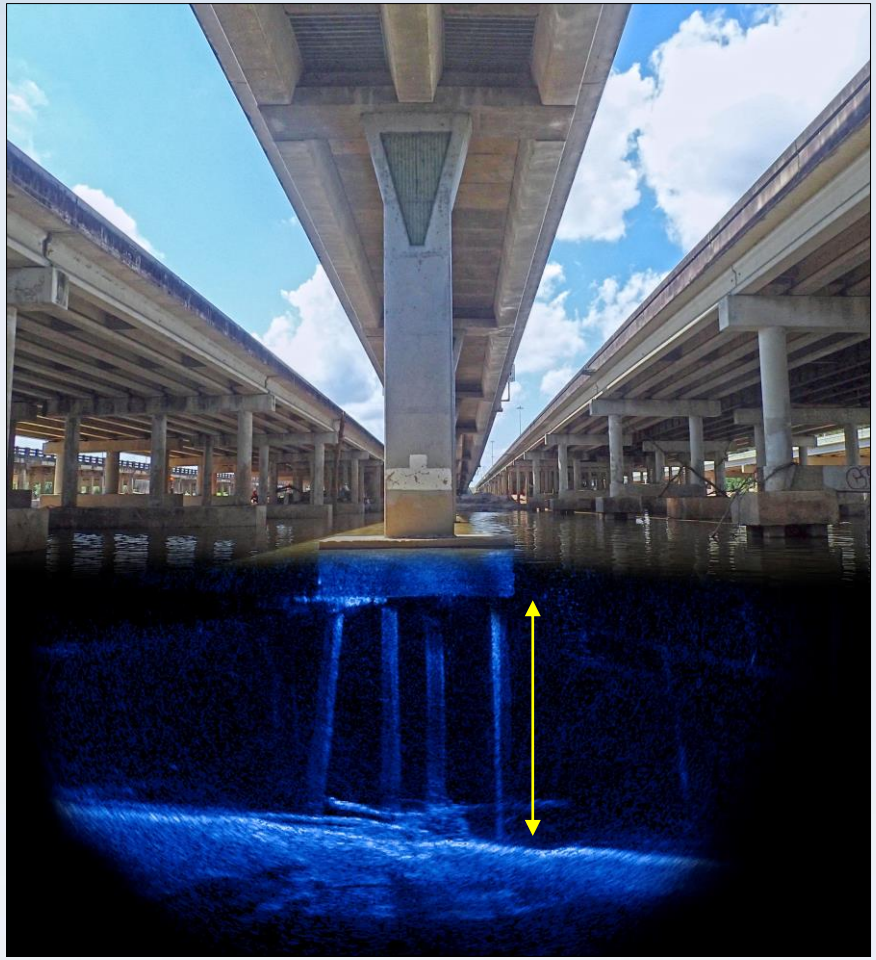
Deployment Options



2D SONAR

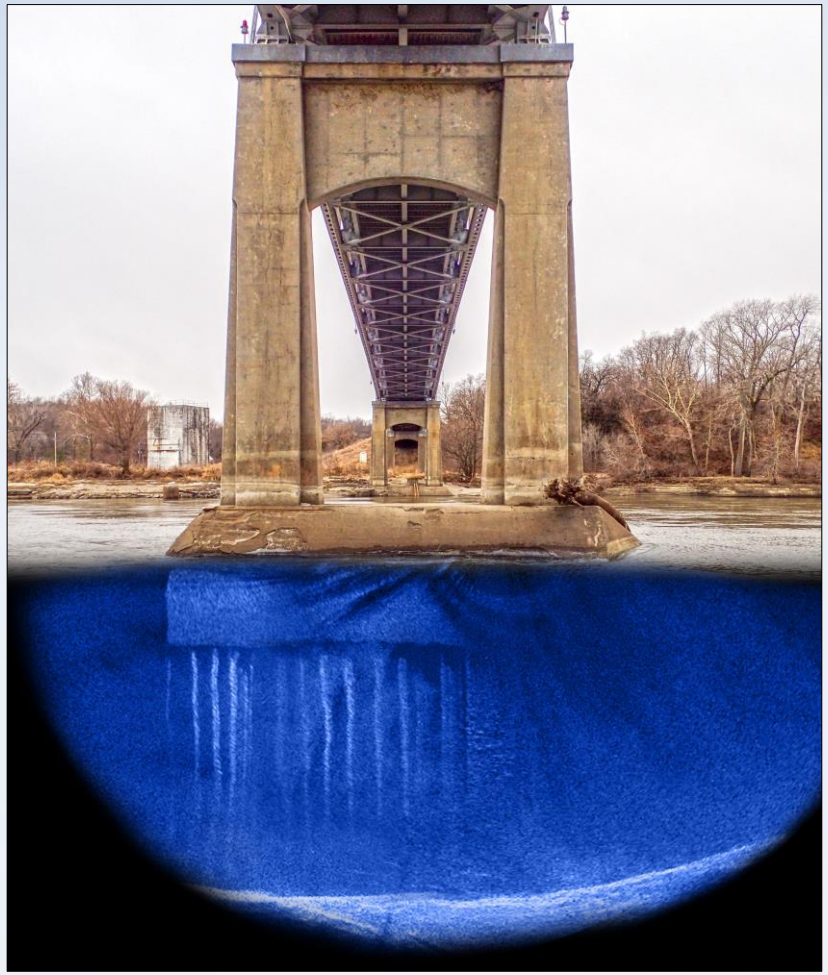
A Moment in Time





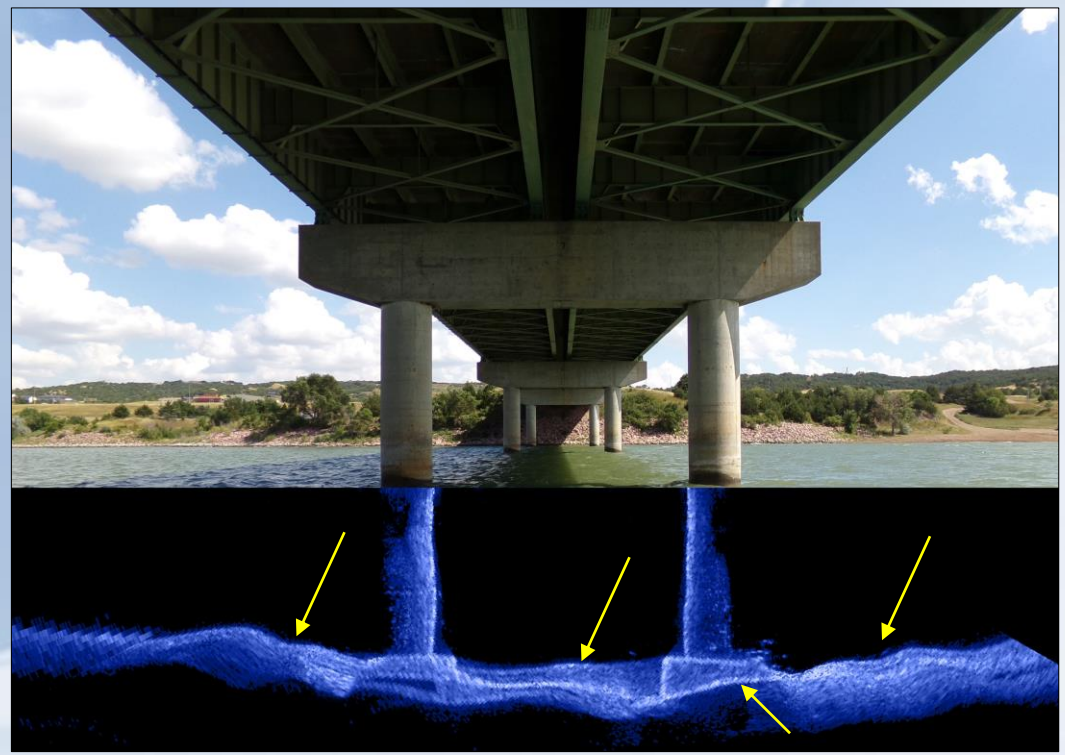
2D SONAR

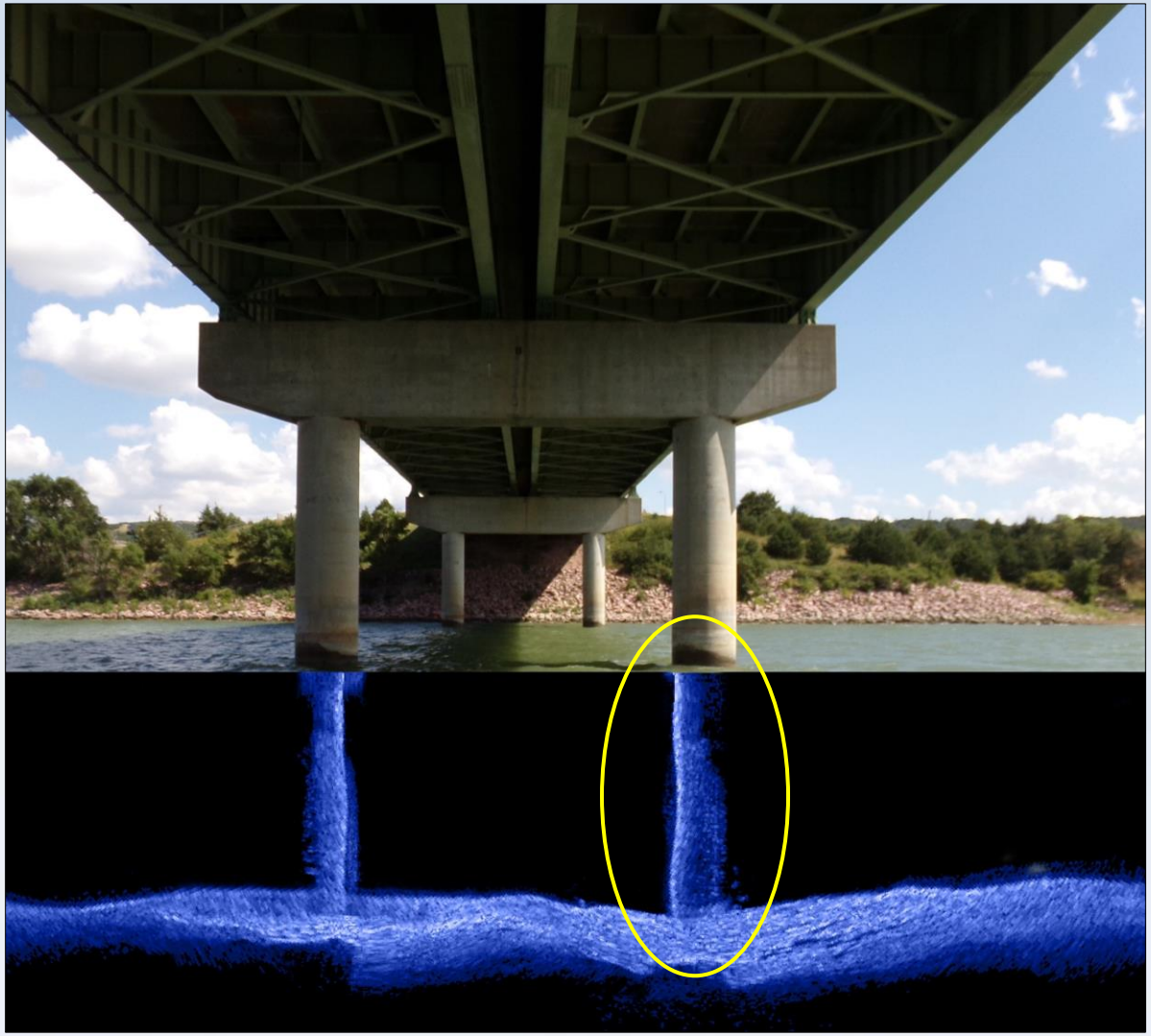
Challenges – Air Bubbles – High Velocity



2D SONAR

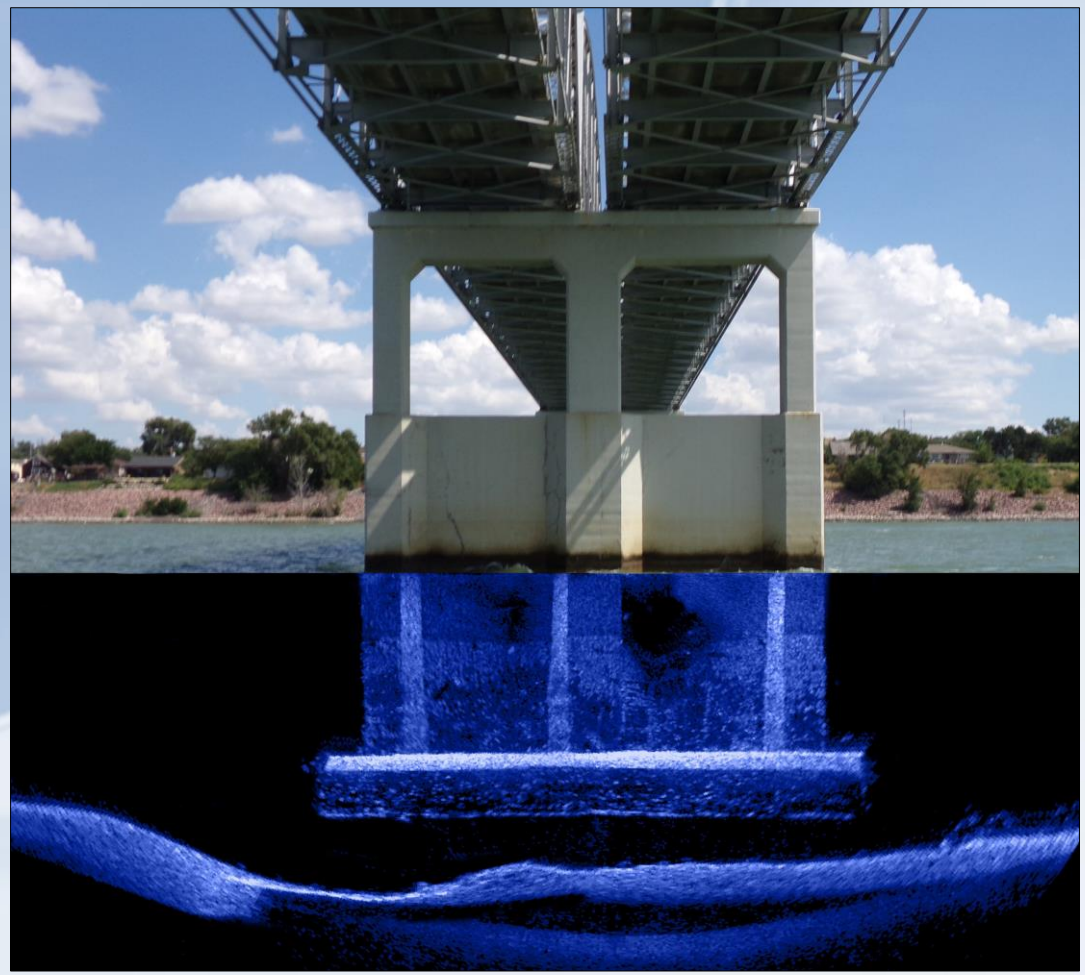
Challenges – Sea State





2D SONAR

Challenges – Depth of Penetration



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- **3D Advantages/Disadvantages**
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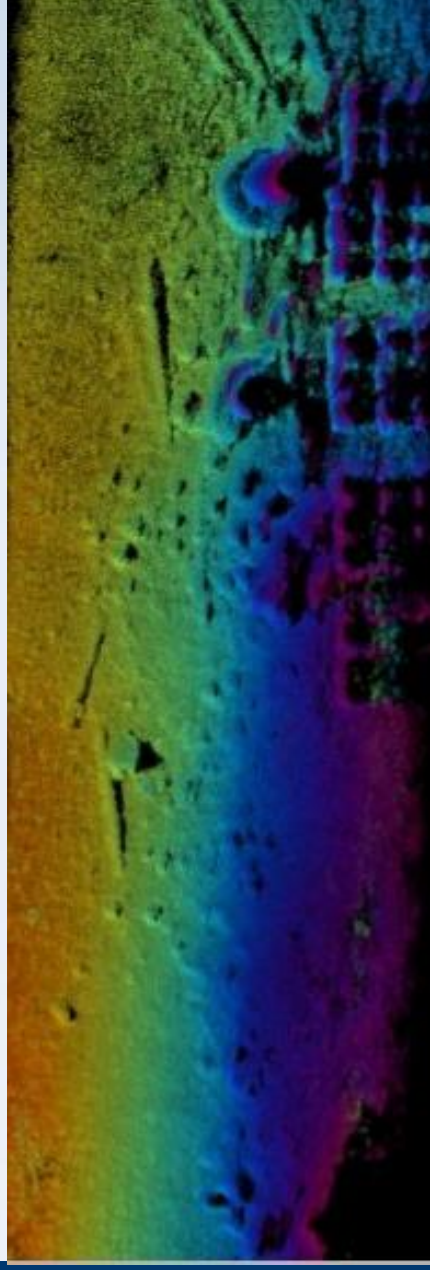
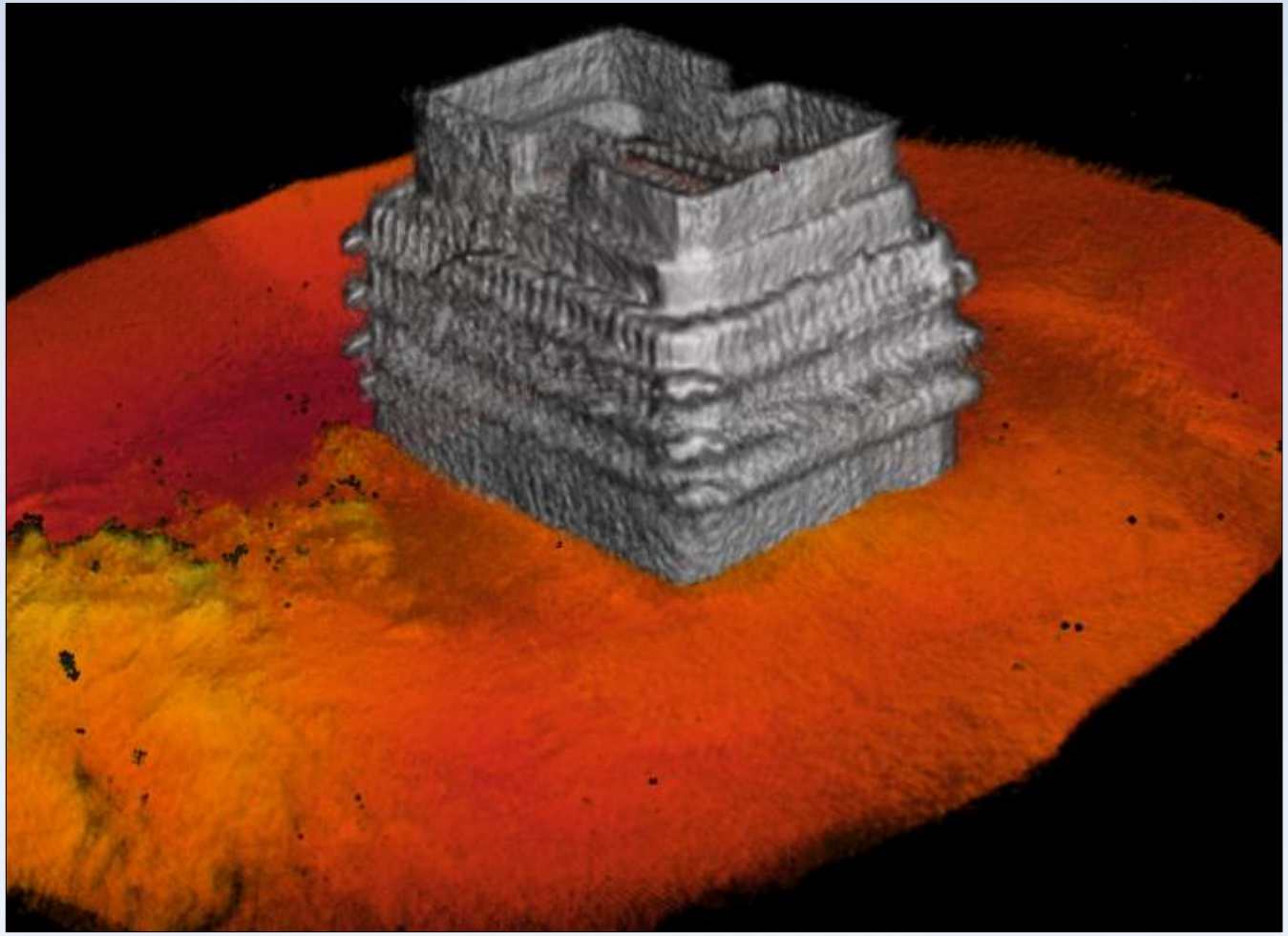


3D SONAR

Georeferenced Point Cloud

- Setup/calibration time – challenge
- GPS – challenging under bridges
- Georeferenced Point Cloud
  - Volumes
- Rough water – not a problem
- See underneath footings
- Cover large areas quickly



3D SONAR

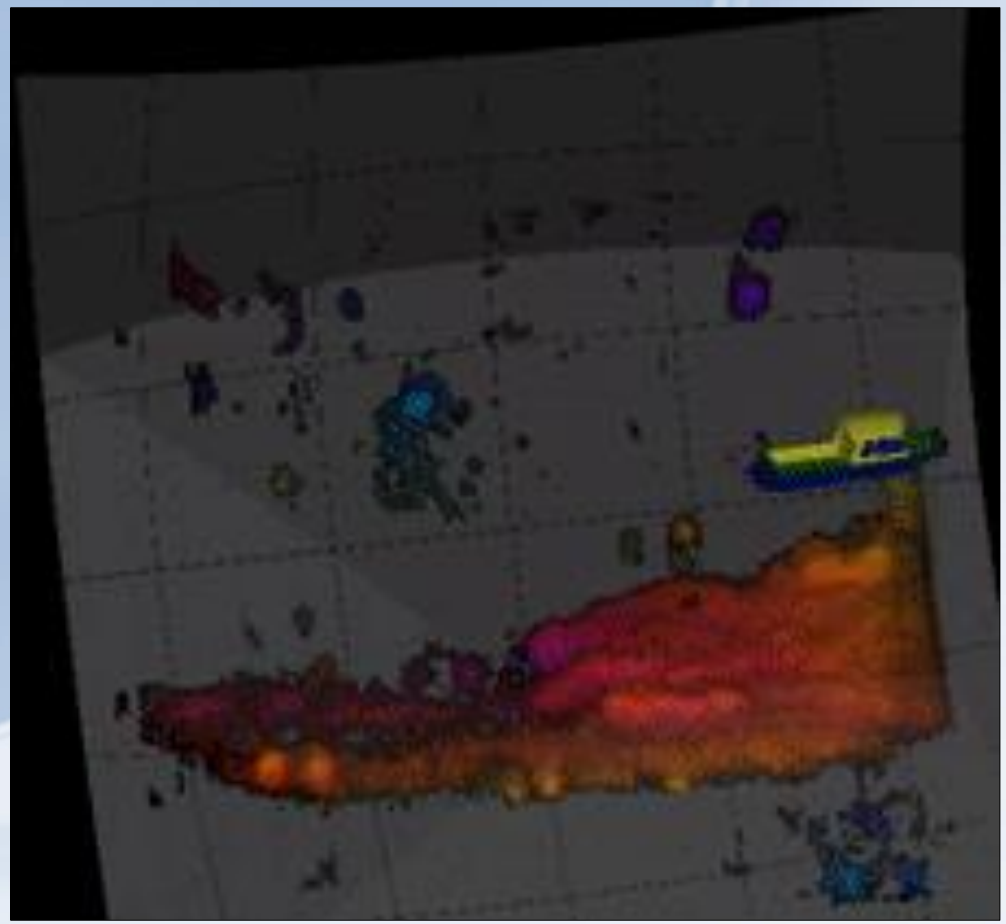
Challenges – Dolphins

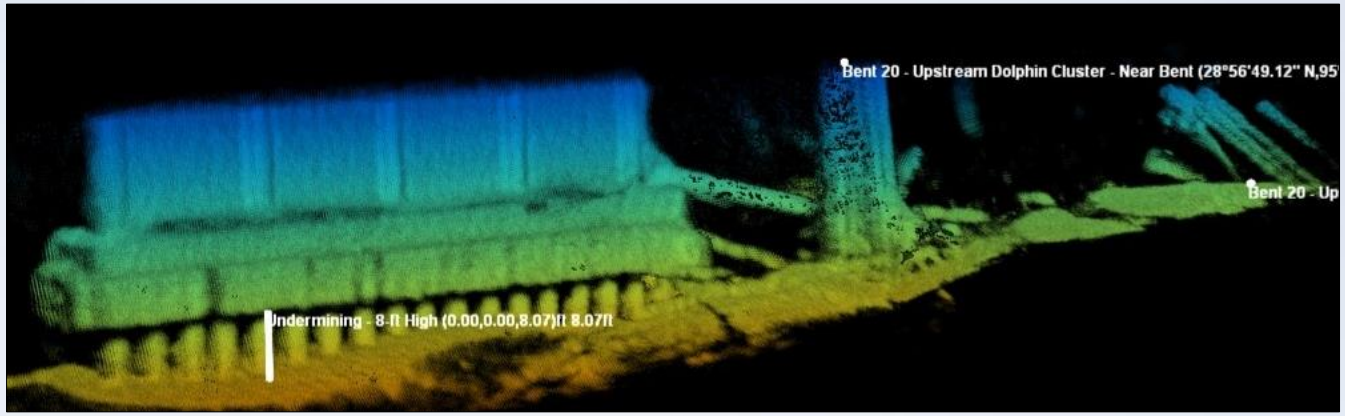
3D SONAR

Challenges – Dolphins

3D SONAR

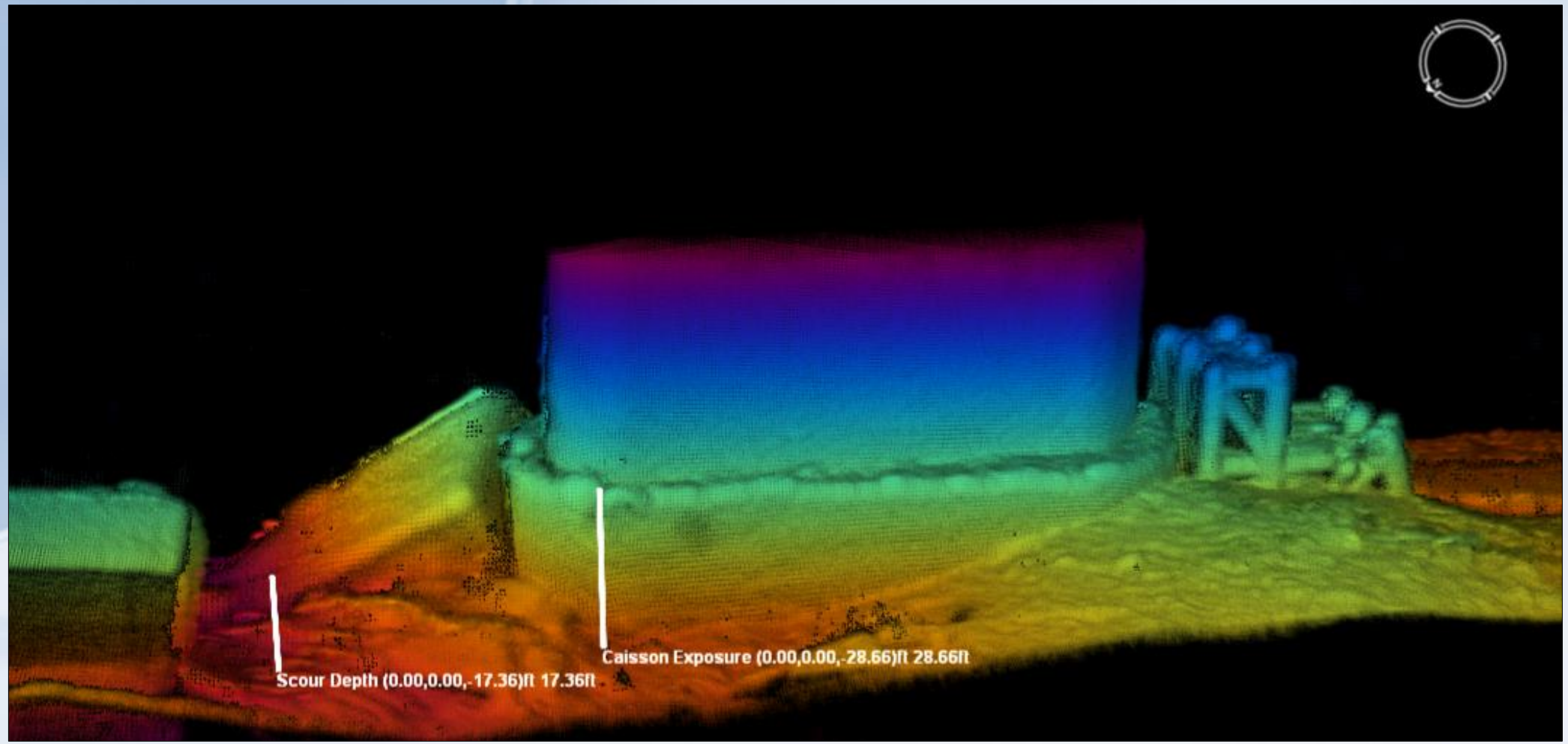
Georeferenced Point Cloud





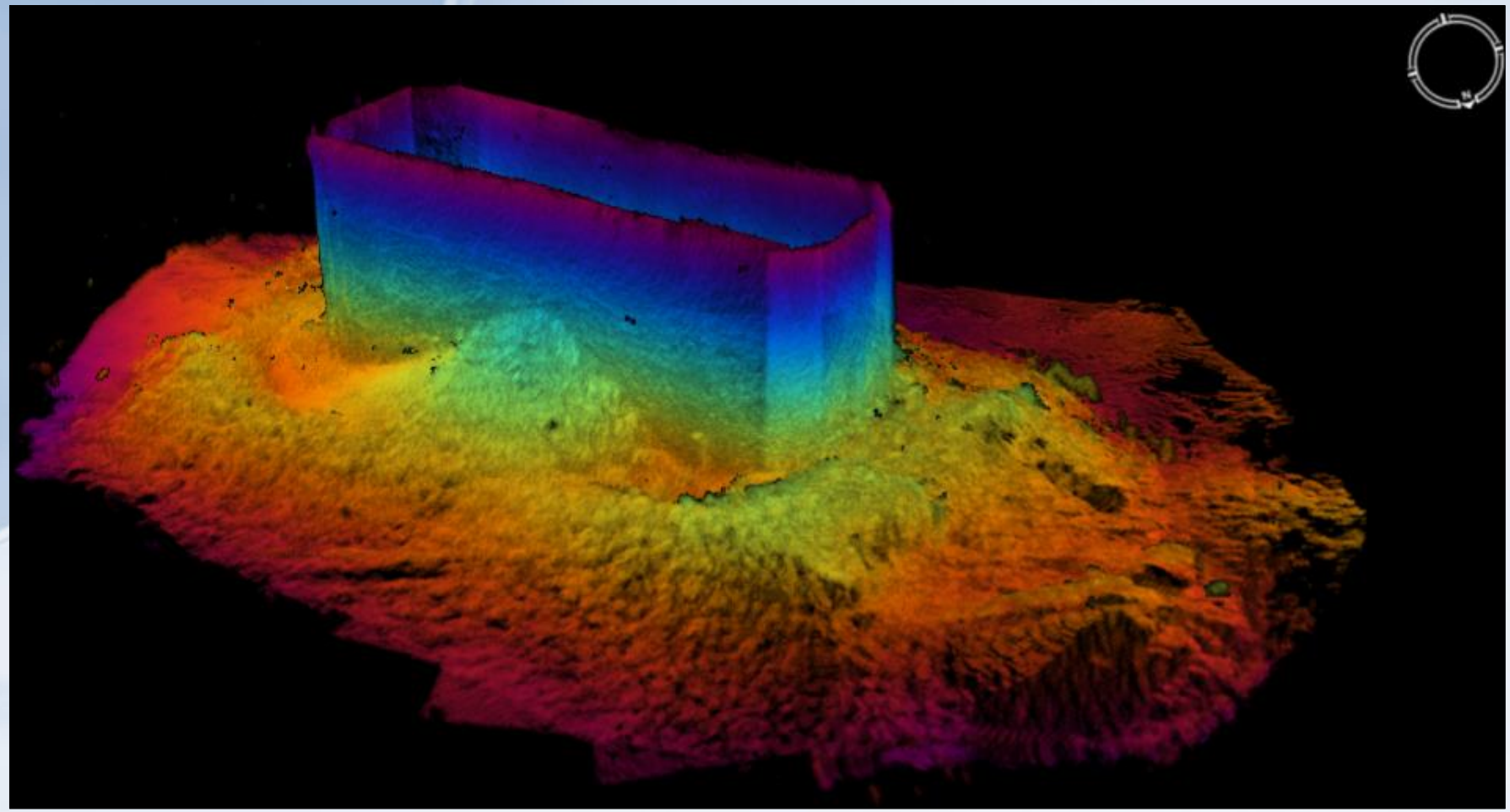
3D SONAR

Georeferenced Point Cloud



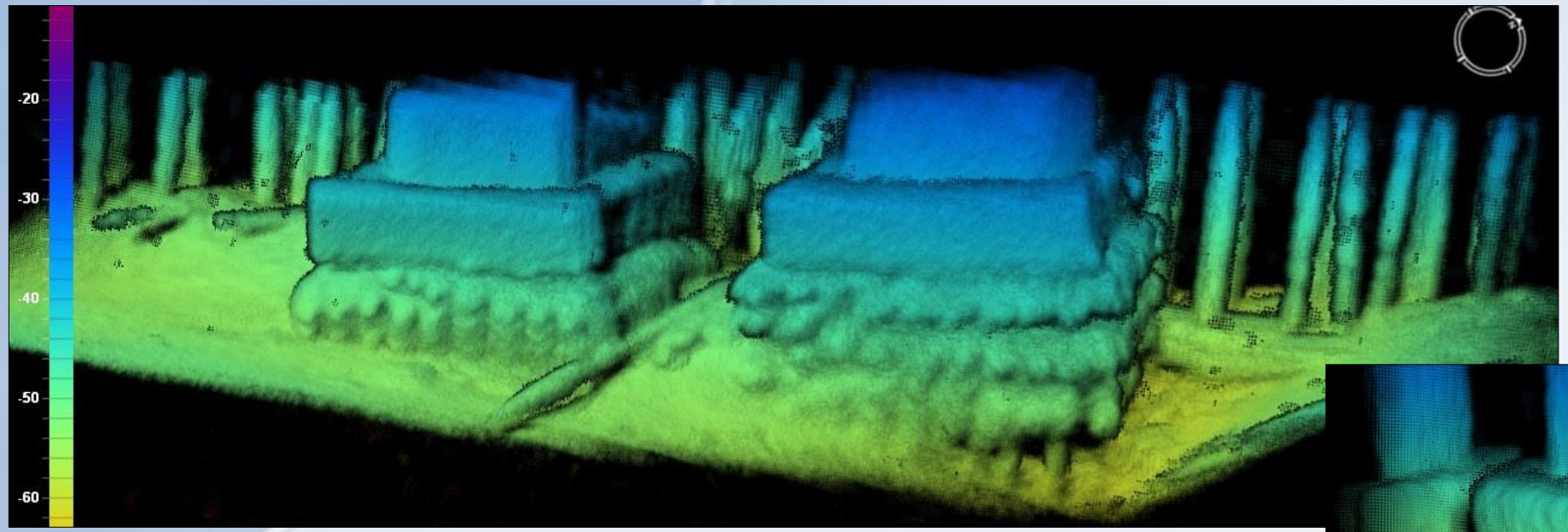
3D SONAR

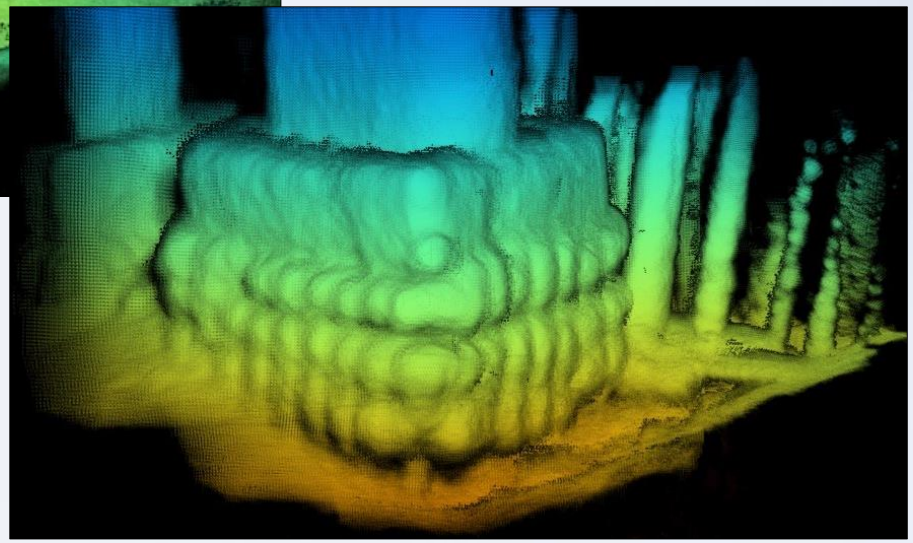
Georeferenced Point Cloud



3D SONAR

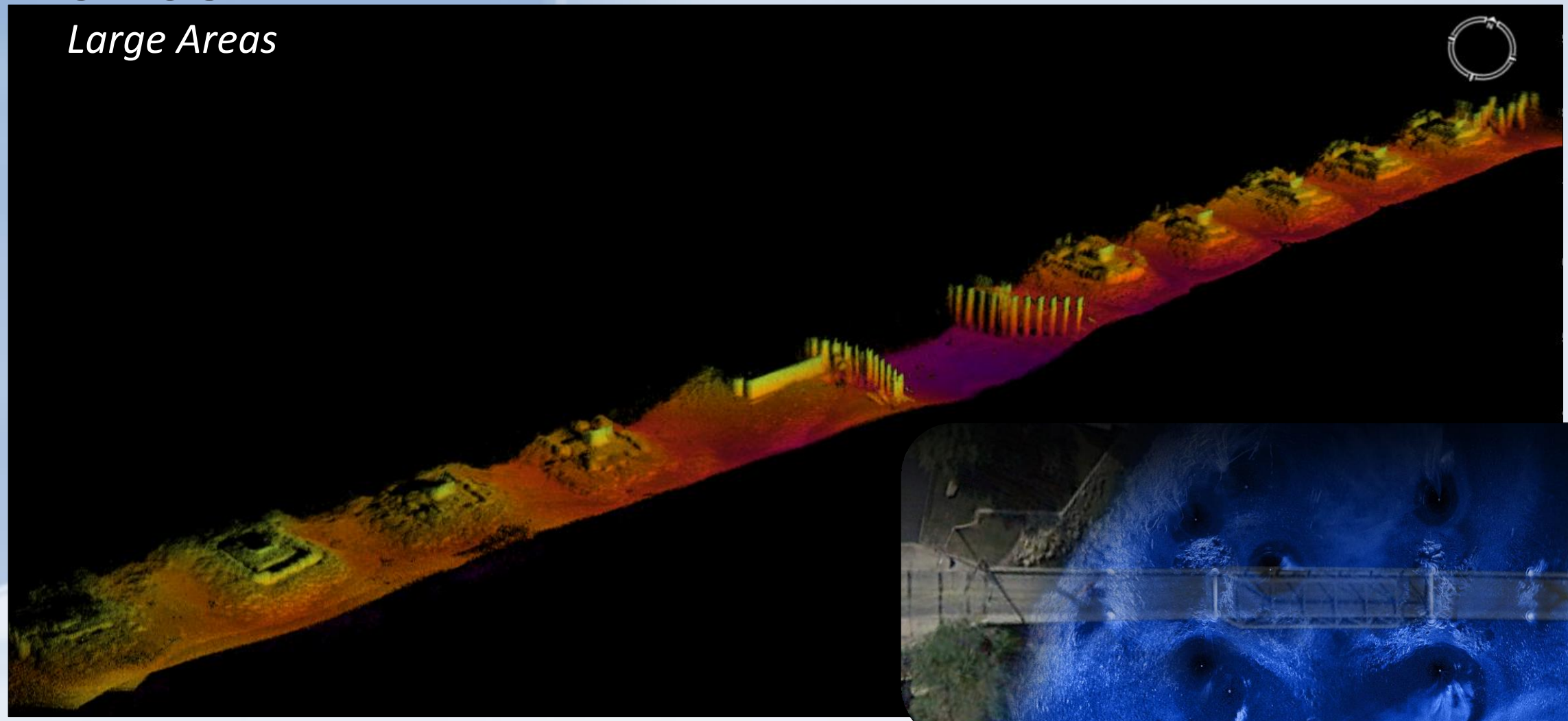
View From Many Angles





3D SONAR

Large Areas



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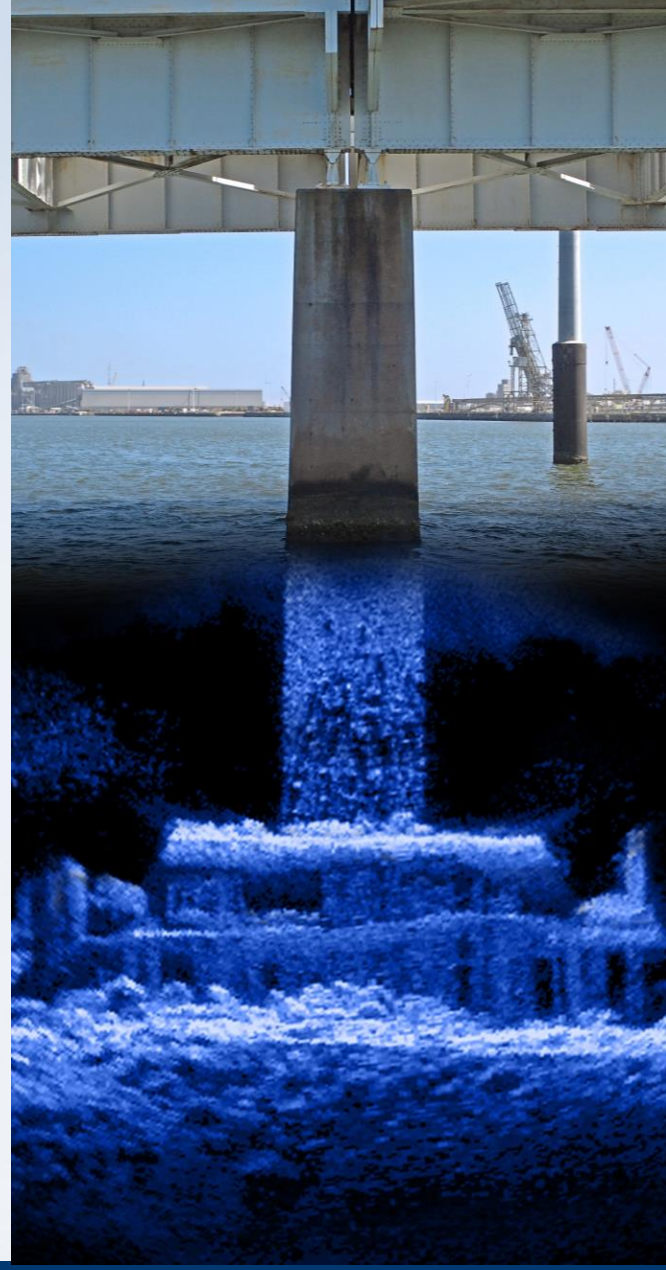
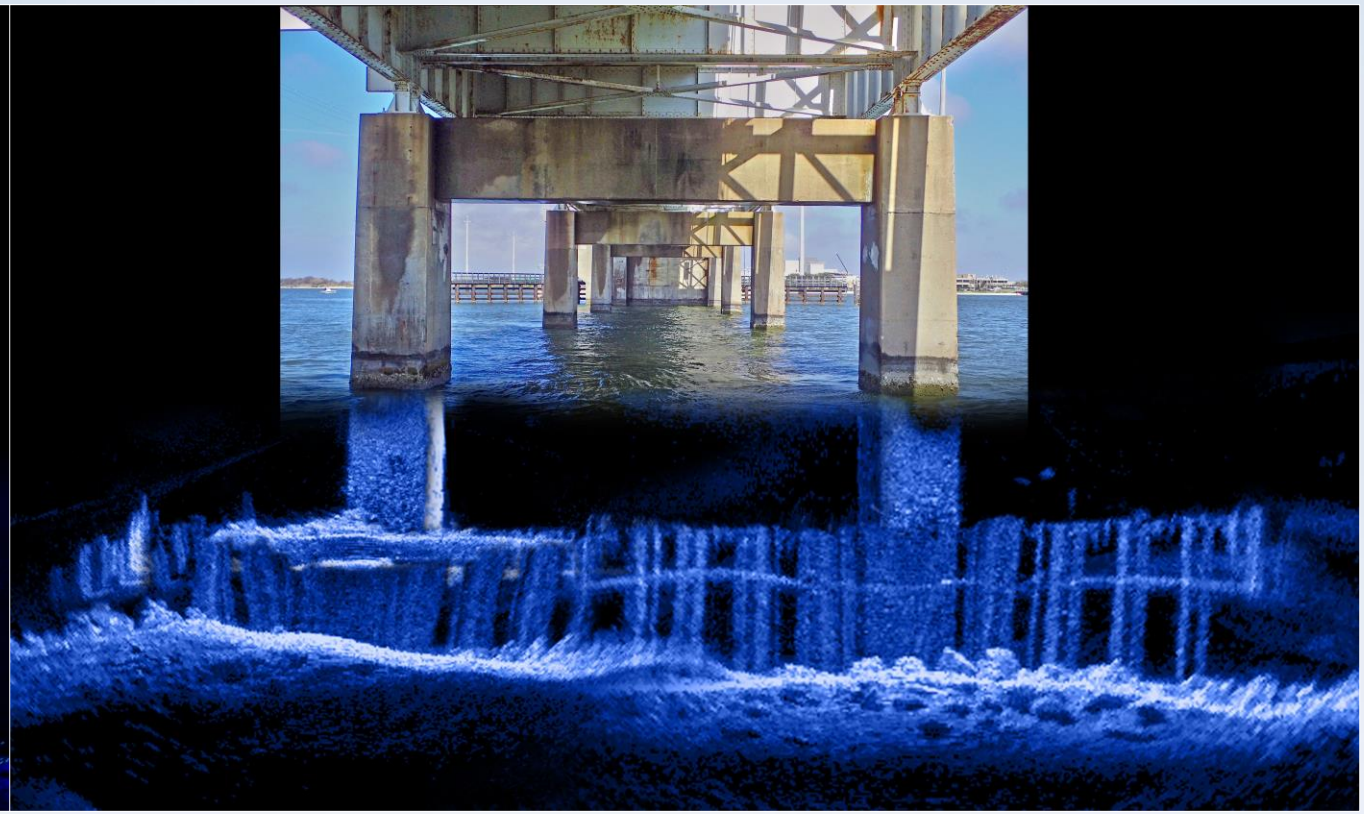


Case Study

Diving Inspection

Case Study

2D Imaging in a Single and Multi Plane



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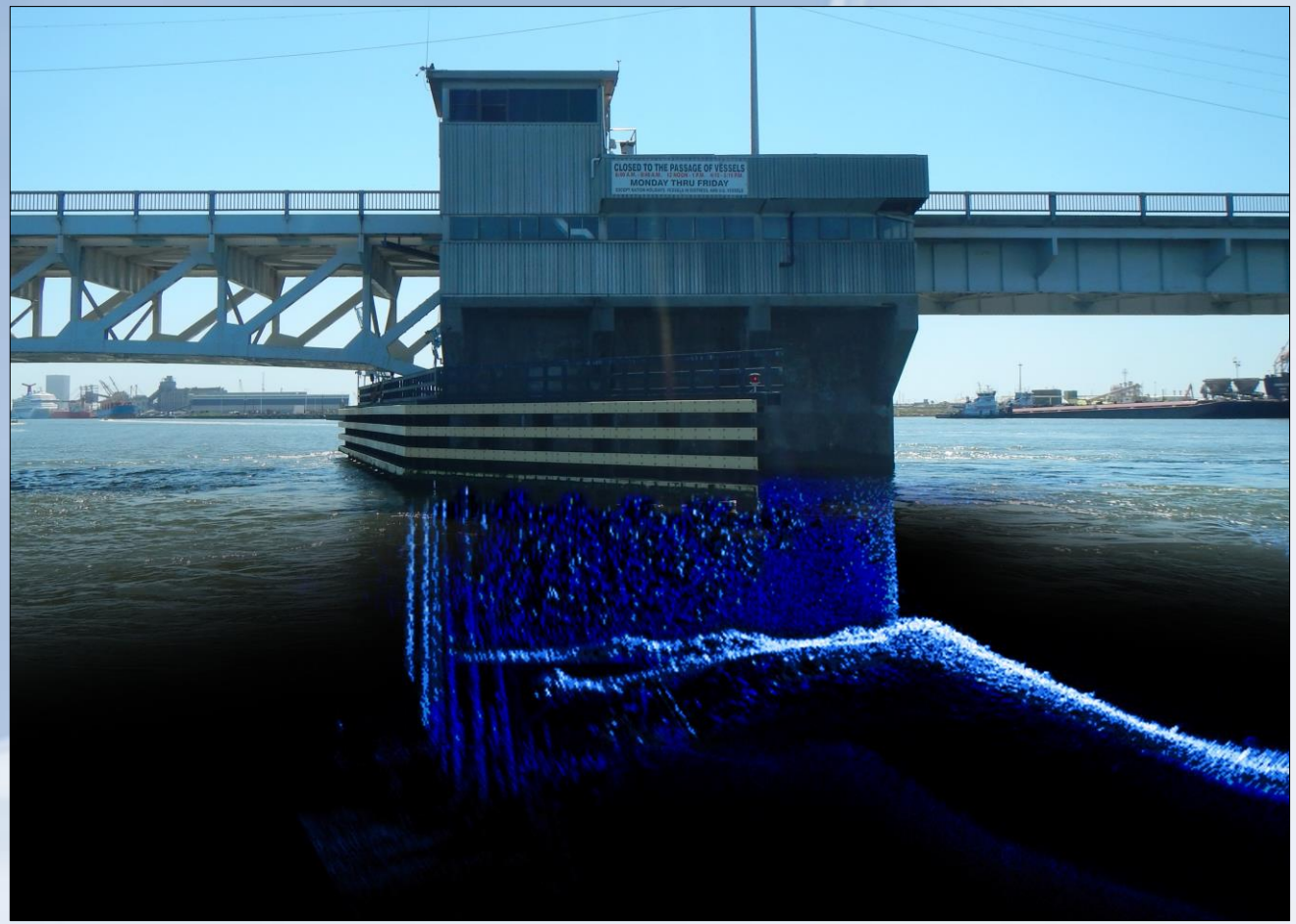
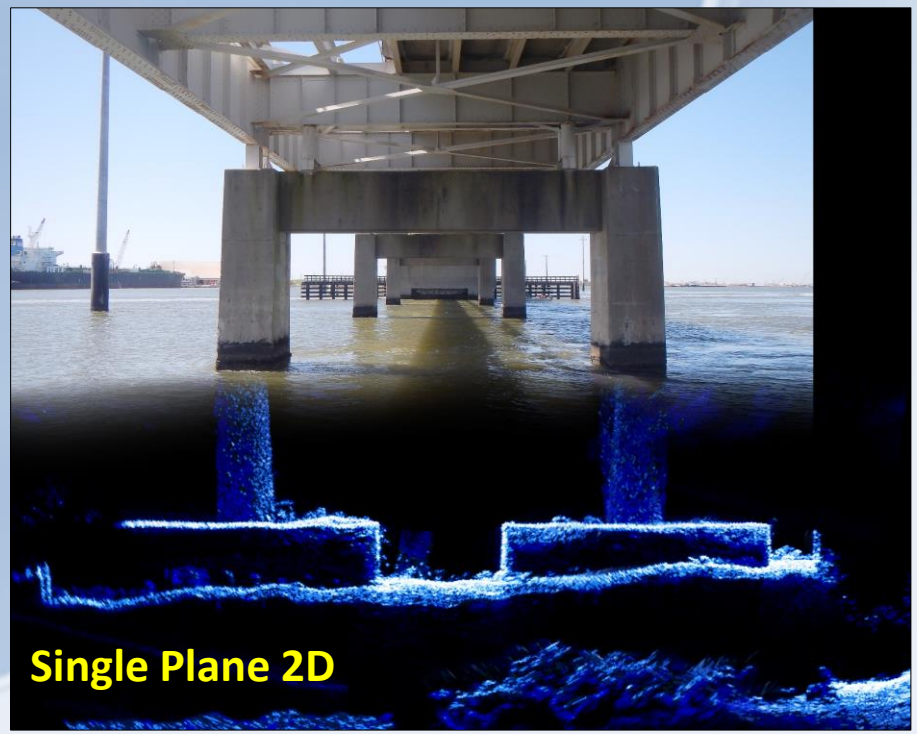
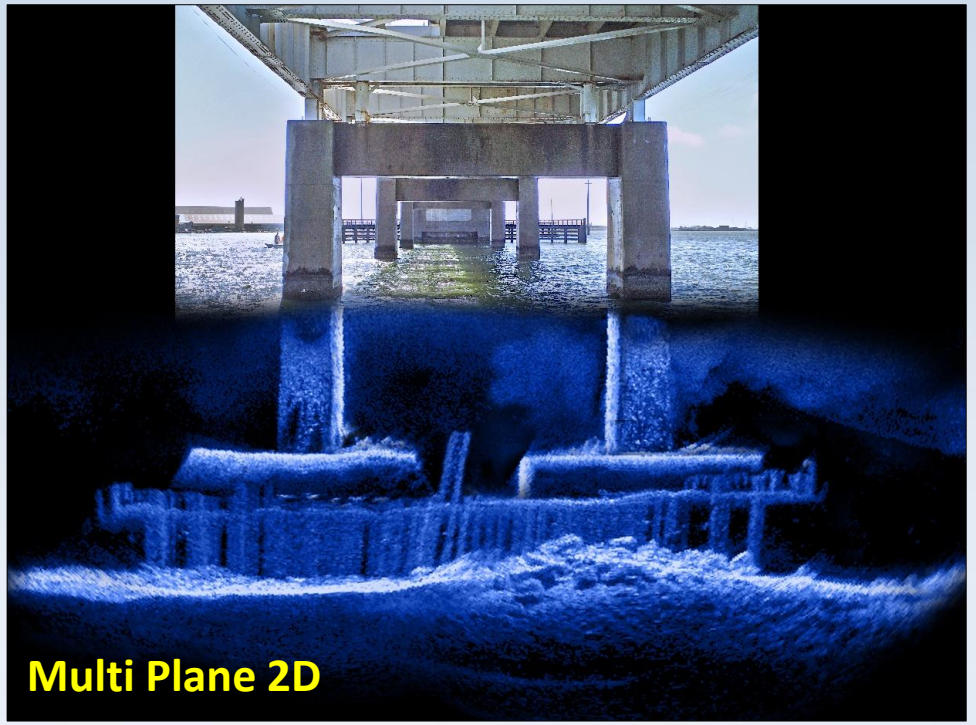
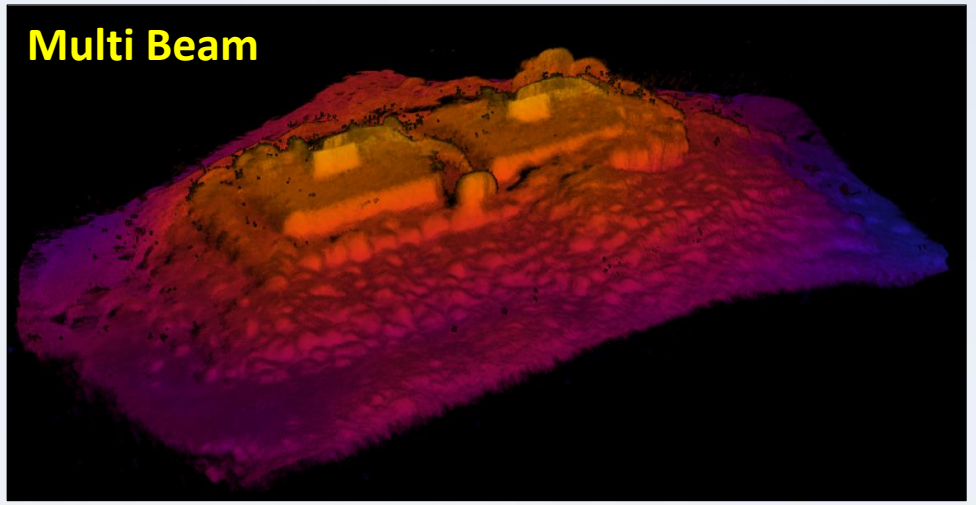


Case Study

2D and 3D

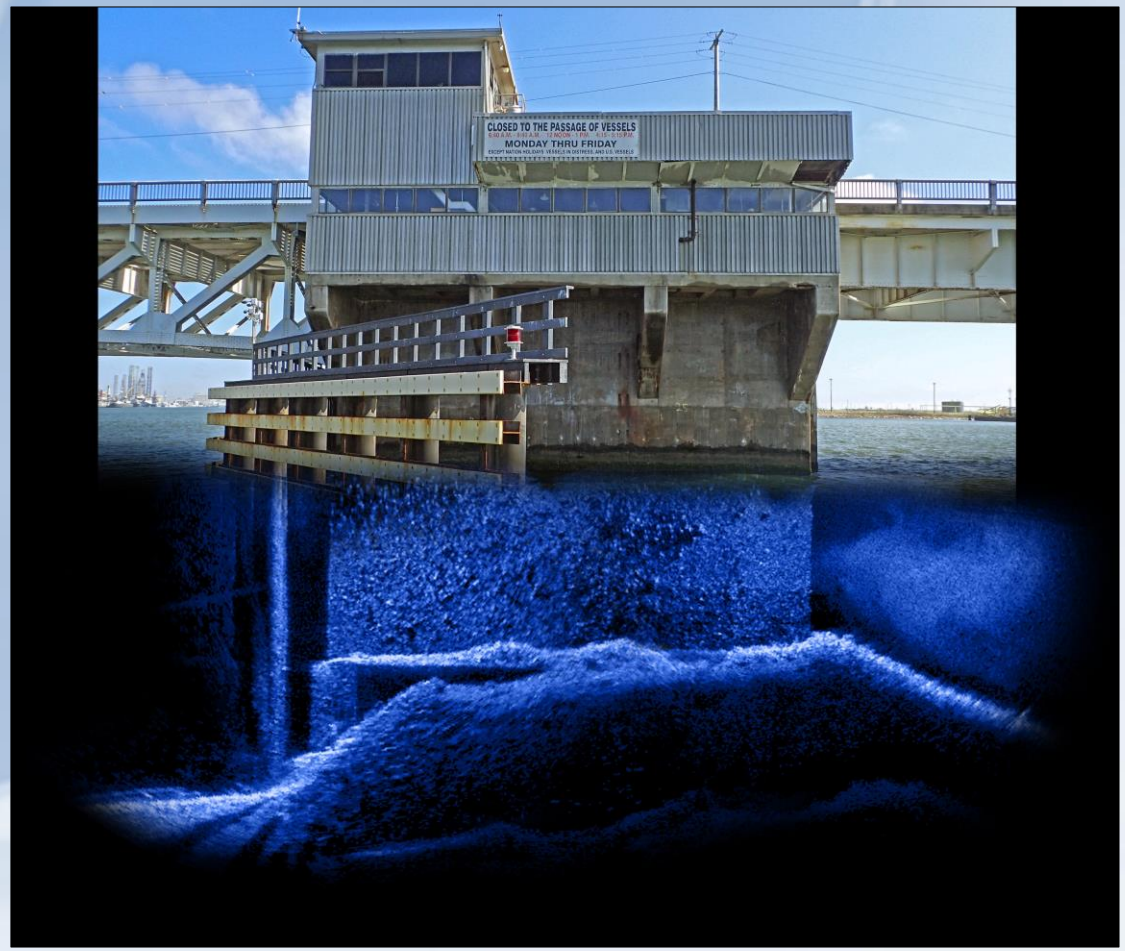


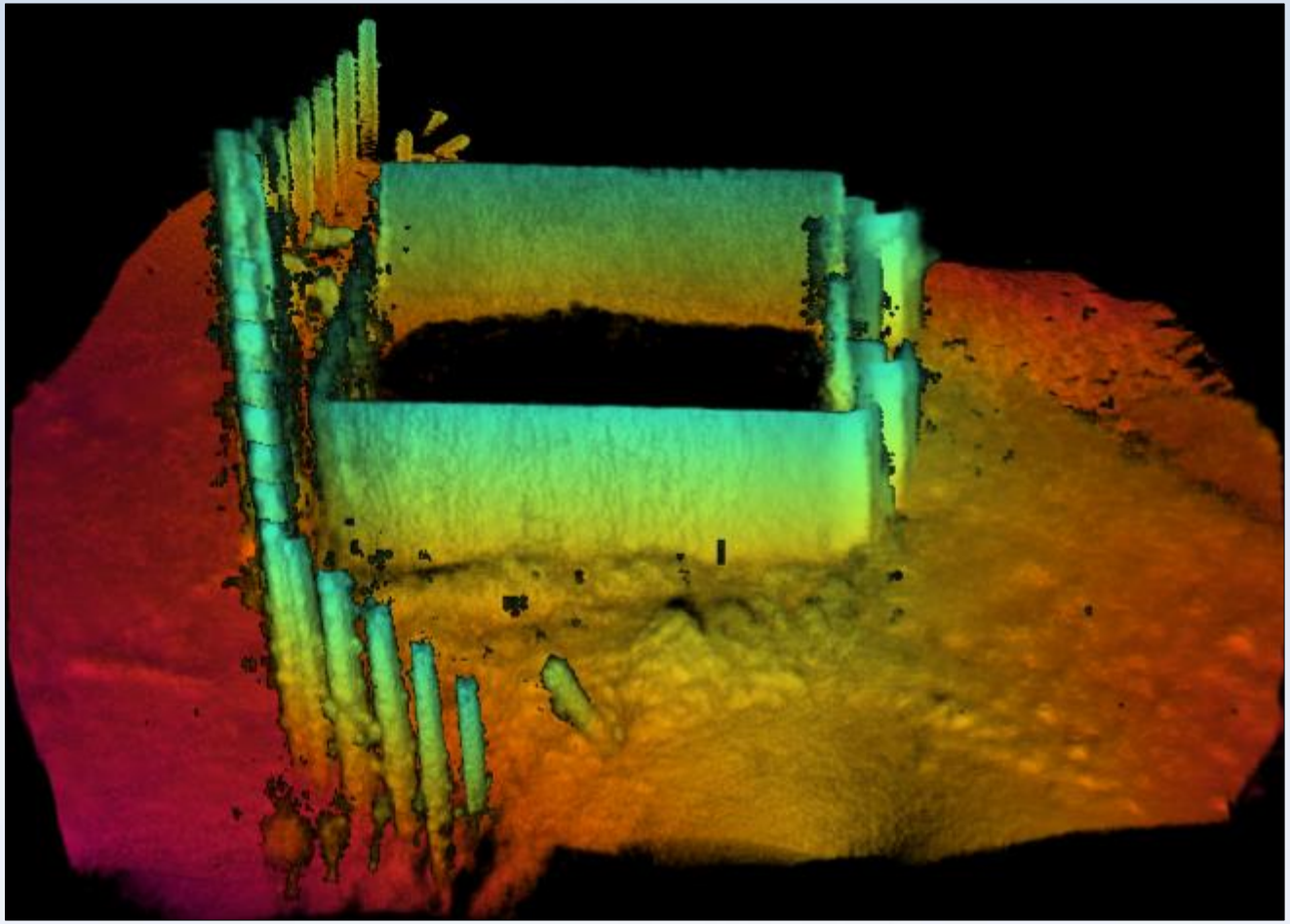




Case Study

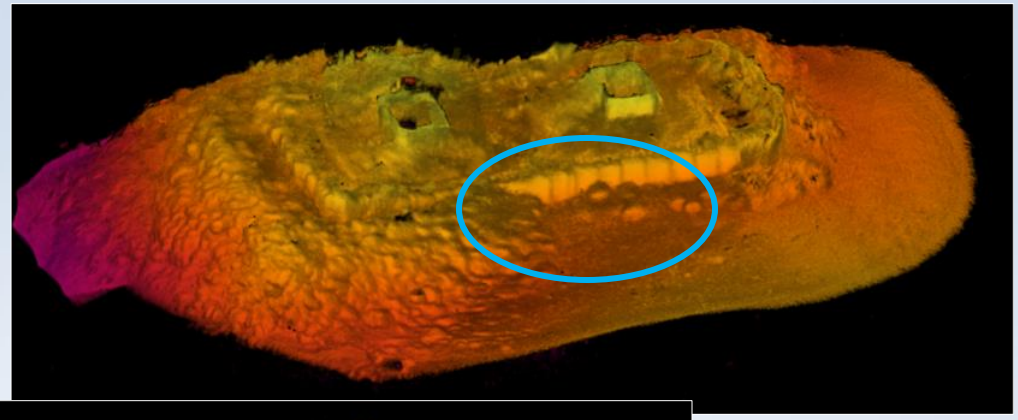
2D and 3D

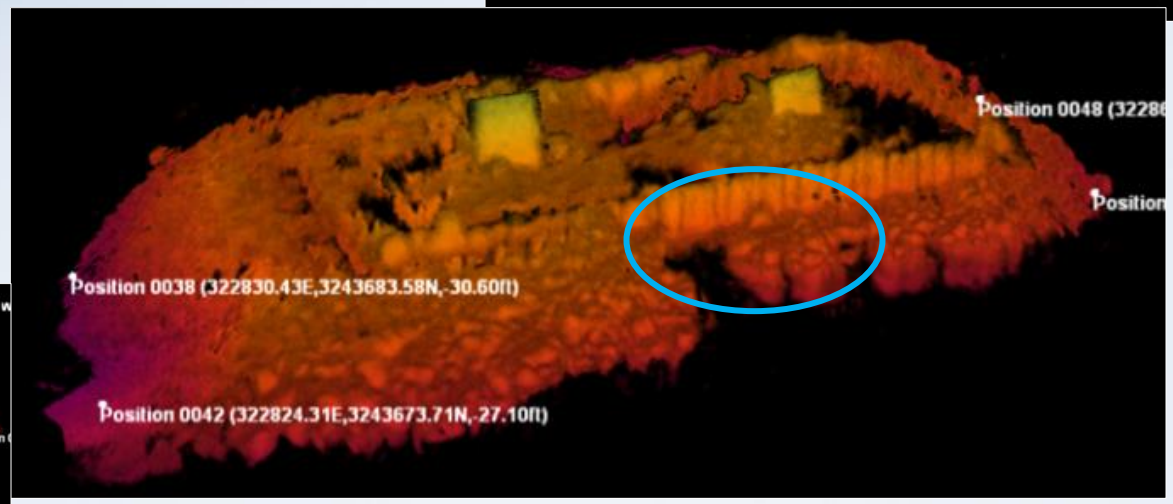


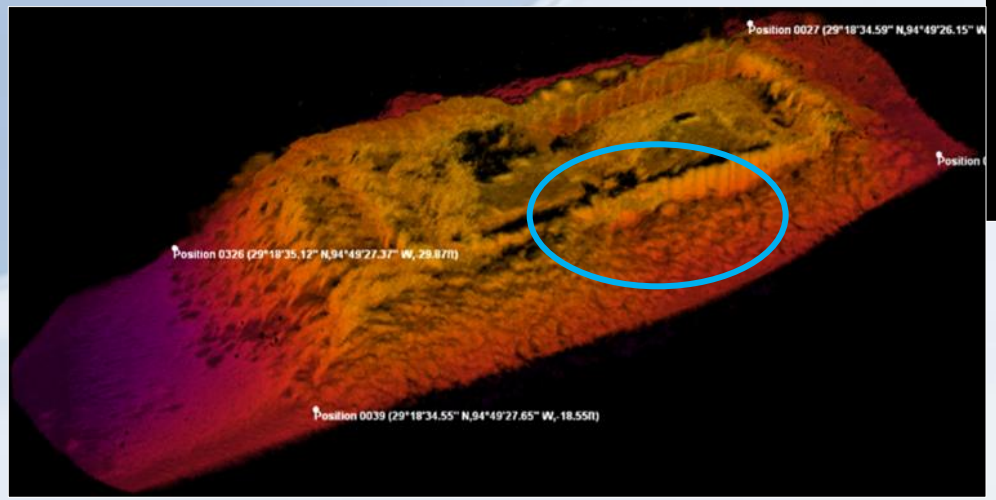


Case Study

3D Imaging over Time

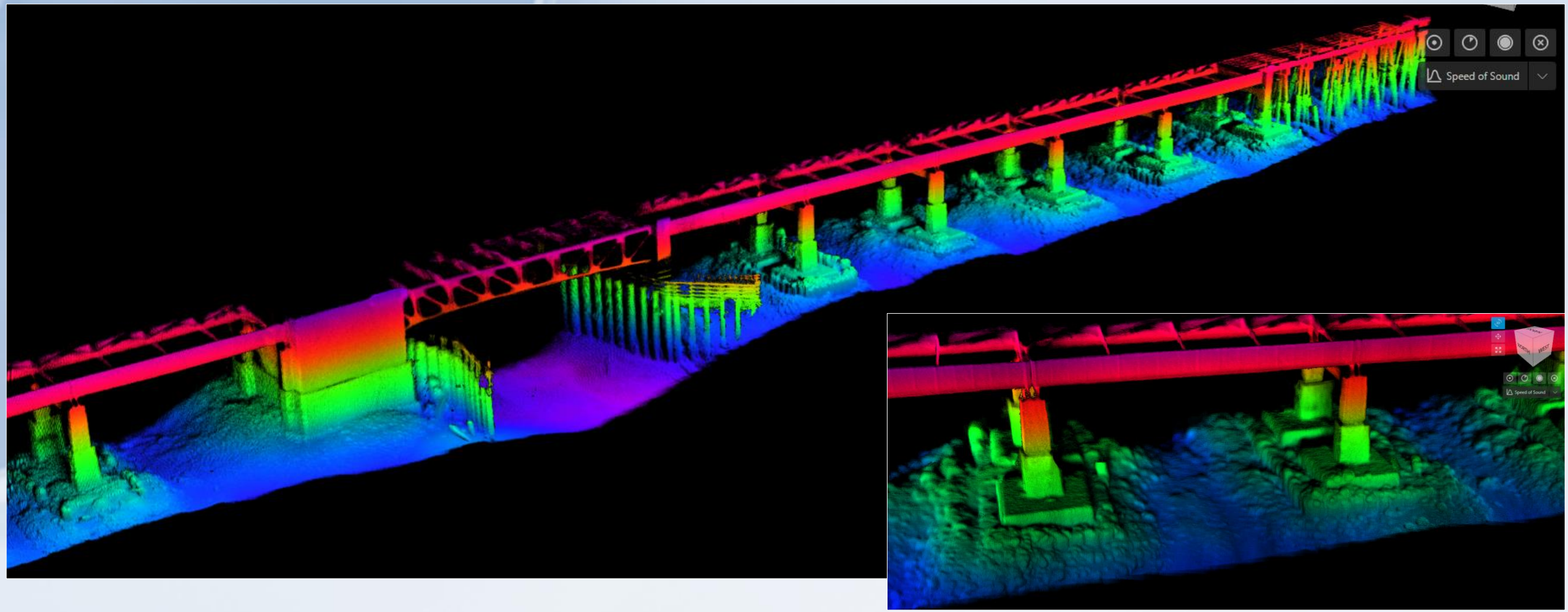






Case Study

Combined Point Clouds



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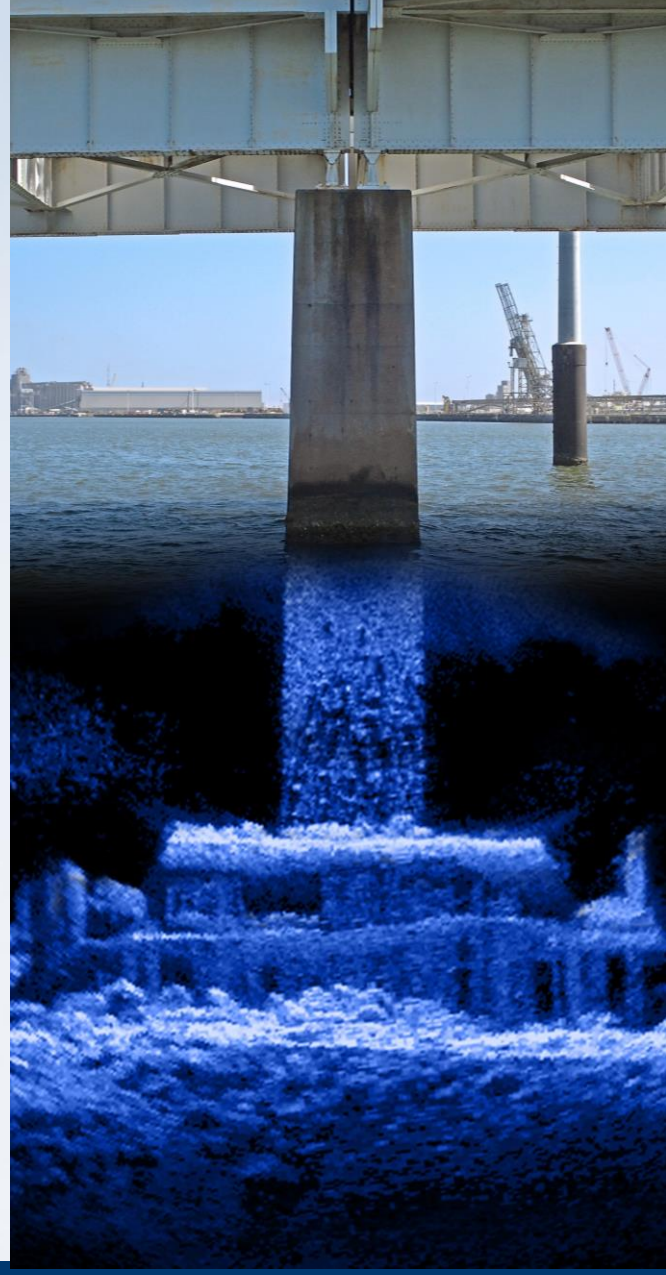
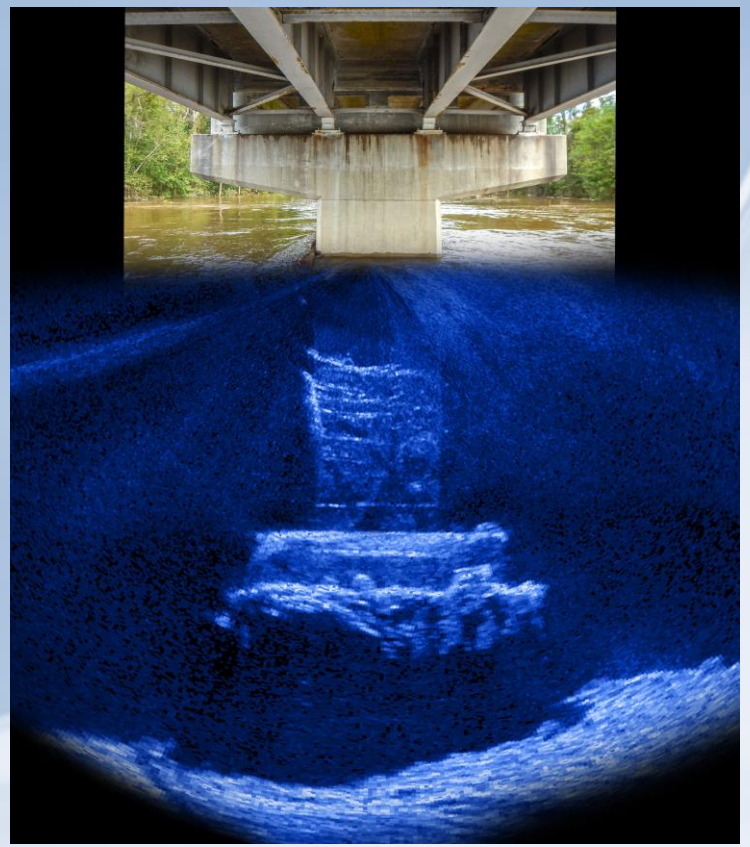
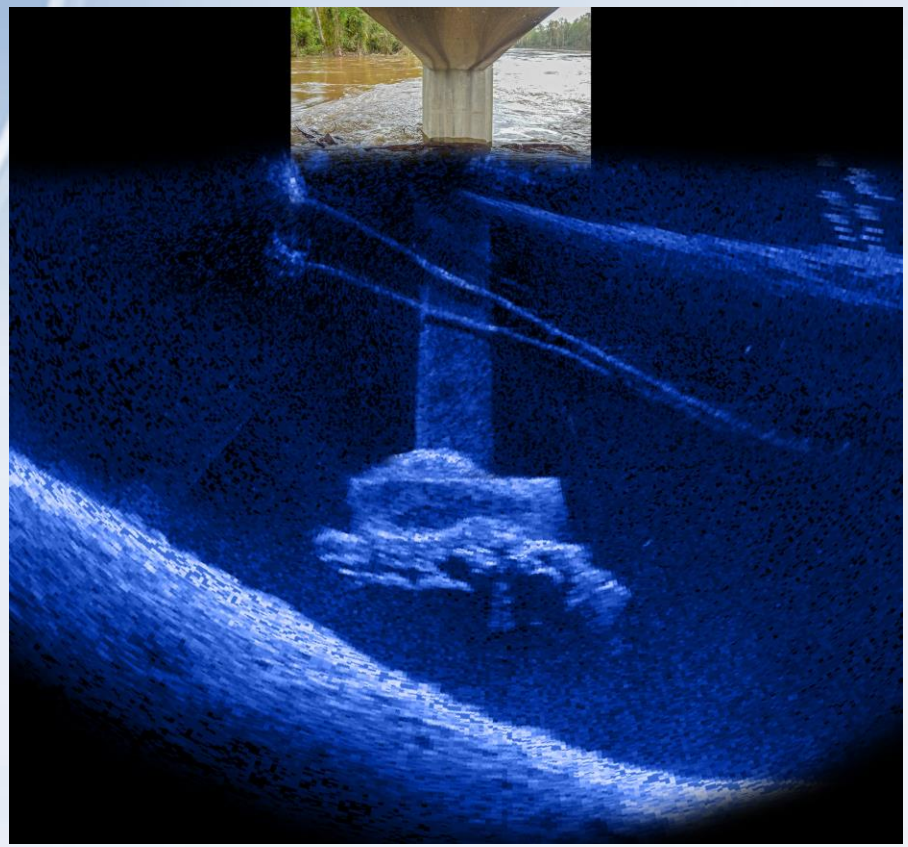


Scour Examples





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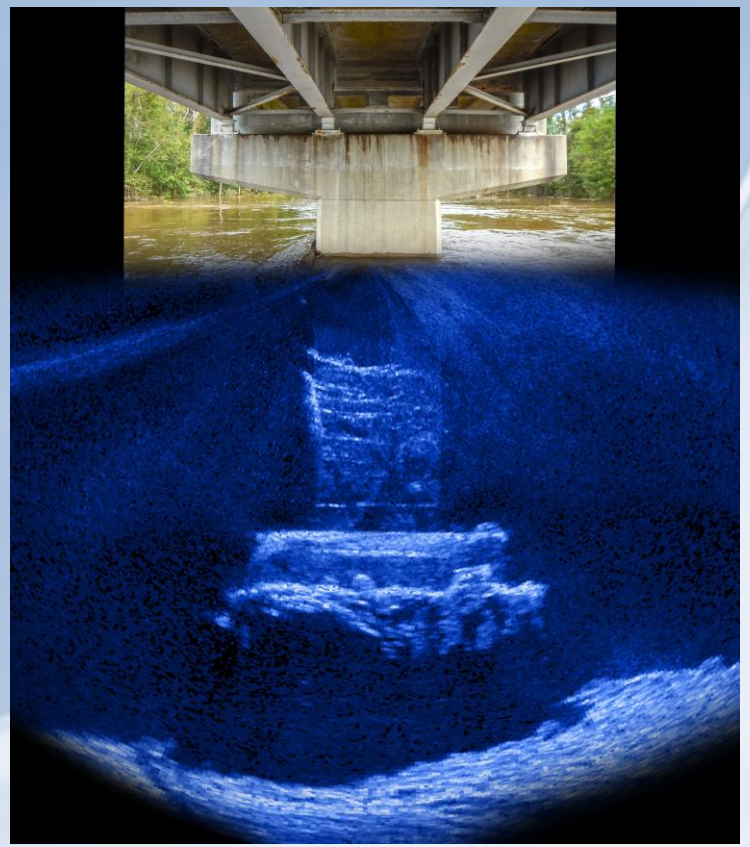

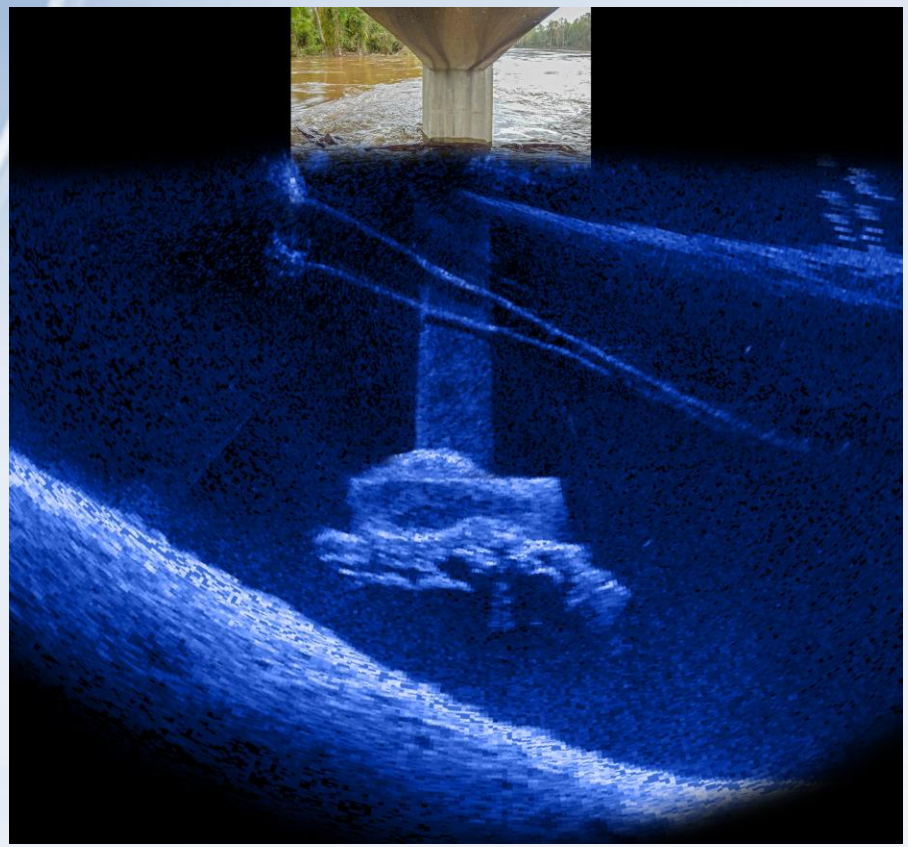

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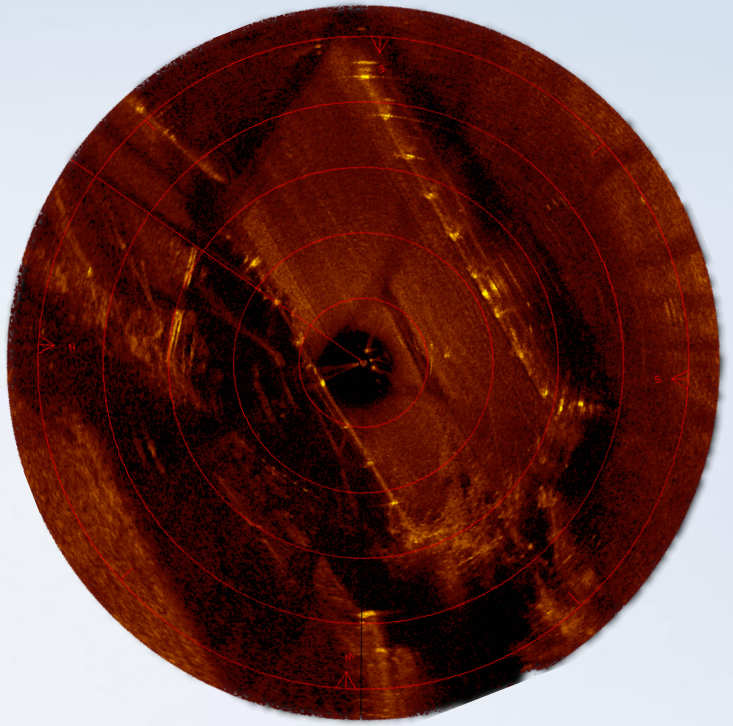

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