BASTA Project: Boost Applied munition detection through Smart data inTegration and AI workflows

Magnetics on Hovering AUVs – A New Tool for Target Point Investigation

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RESEARCH FOR GRAND CHALLENGES

GEOMAR

Introduction

1) What we **do not** want:

- Map large areas as fast as possible

2) What we **do** want:

- Individually investigate potential targets with magnetic sensors

3) Challenges

- Noise (AUV Thrusters, other devices, → Distance)
- Navigation (Control unit, water currents)

- Outline
  - Magnetic signatures of ferrous UXOs
  - Introduce AUV / Sensor construction
  - Magnetic noise & Sensitivity
  - 1D & 2D results

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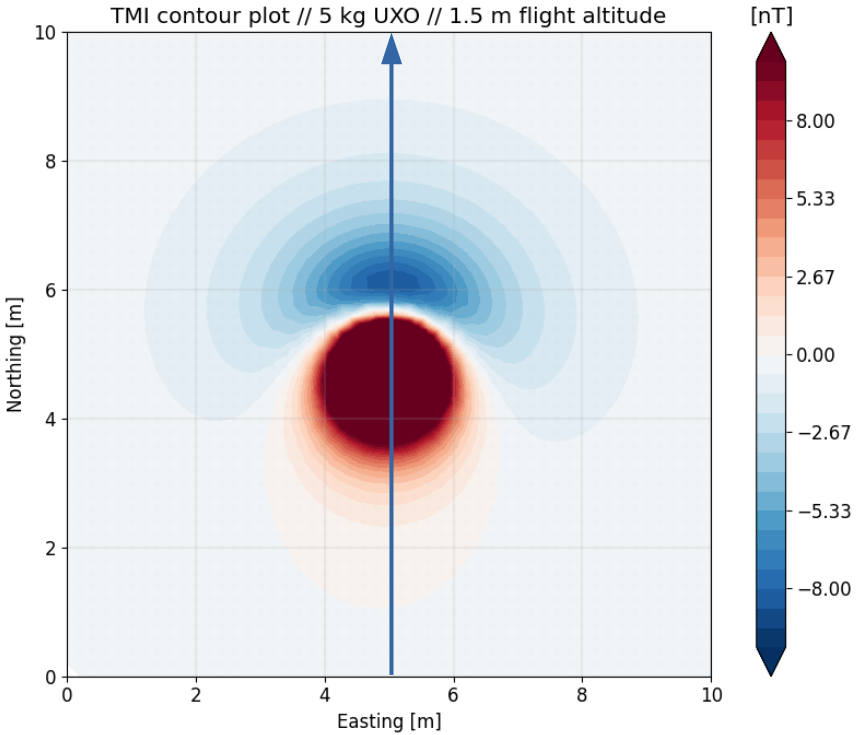
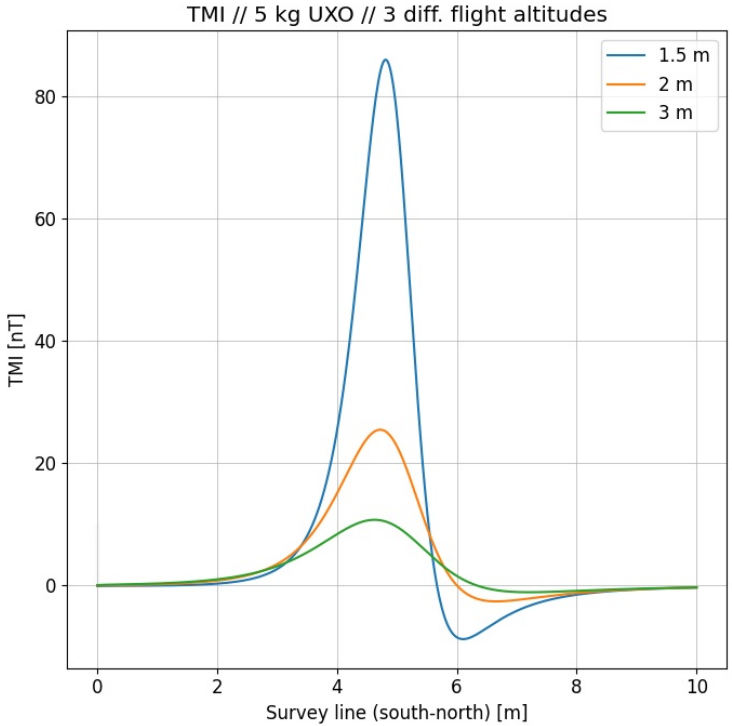
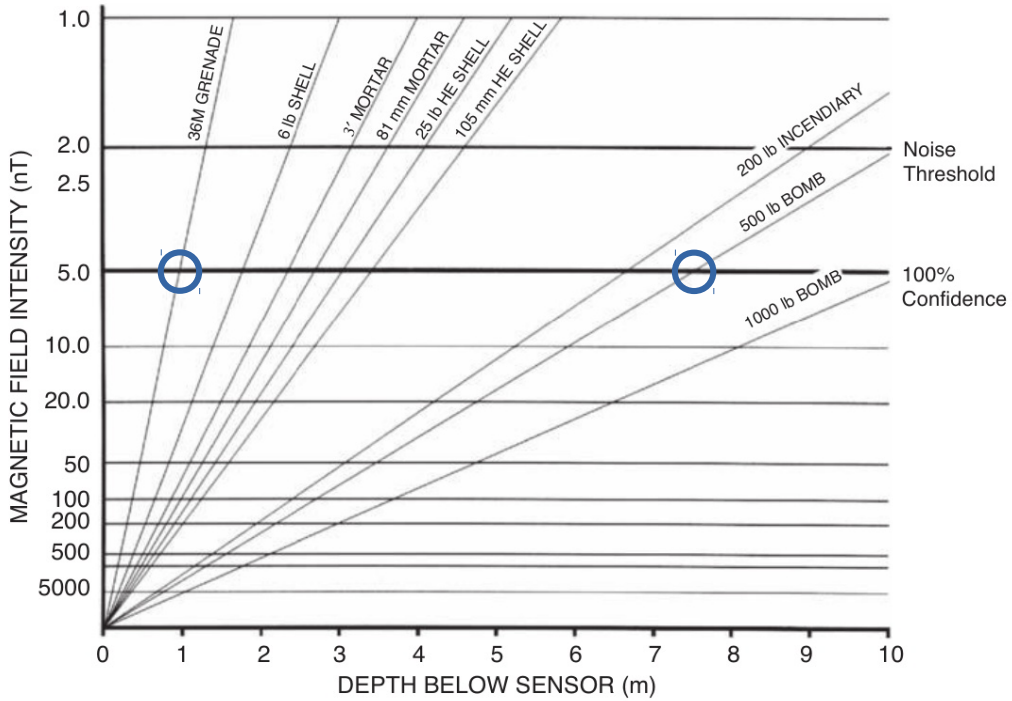
Magnetic Patterns of UXOs (synthetic data for a 5 kg point mass)



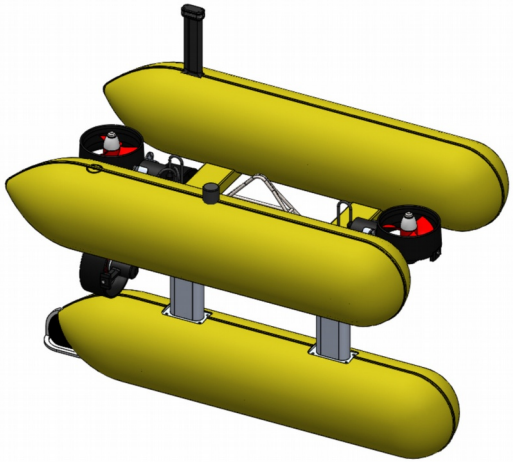


Magnetics: Typical UXO Amplitudes

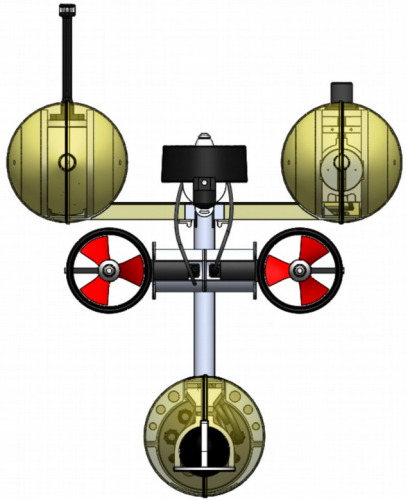


[Reynolds, 2011]

Girona 500 - Hovering AUVs (Anton & Luise)



- Size: 1 x 1 x 1.5 m^3
- Weight in air: from 140 kg
- Maximum depth: 500 m
- Propulsion system: 5 thrusters
- Endurance: up to 8 hours
- Maximum Velocity: 1.0 m/s (0.4)
- Minimum Altitude: 1 m
- Open Software Architecture (Based on ROS)
- Hover-able
- Additional devices: DVL, INS, USBL, WiFi, GPS, CTD
- 12.3 MP Camera with 8 high power LEDs (ground-truthing)

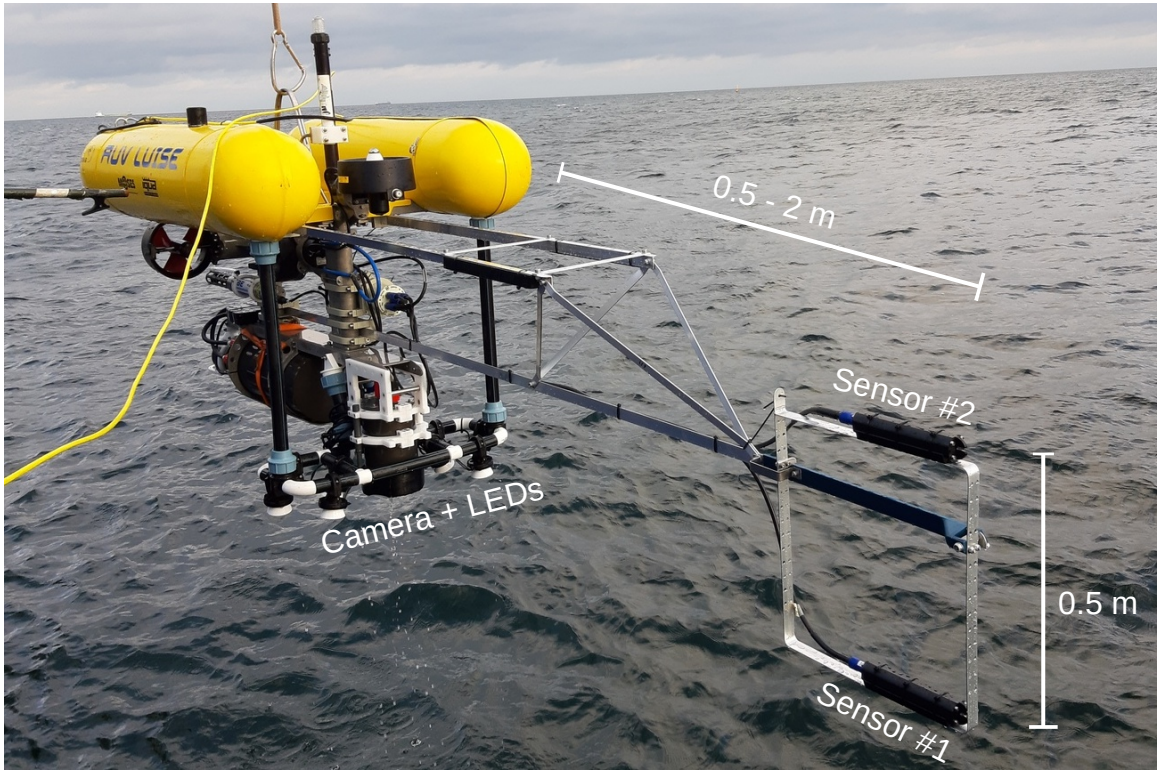


Submersible Magnetometers

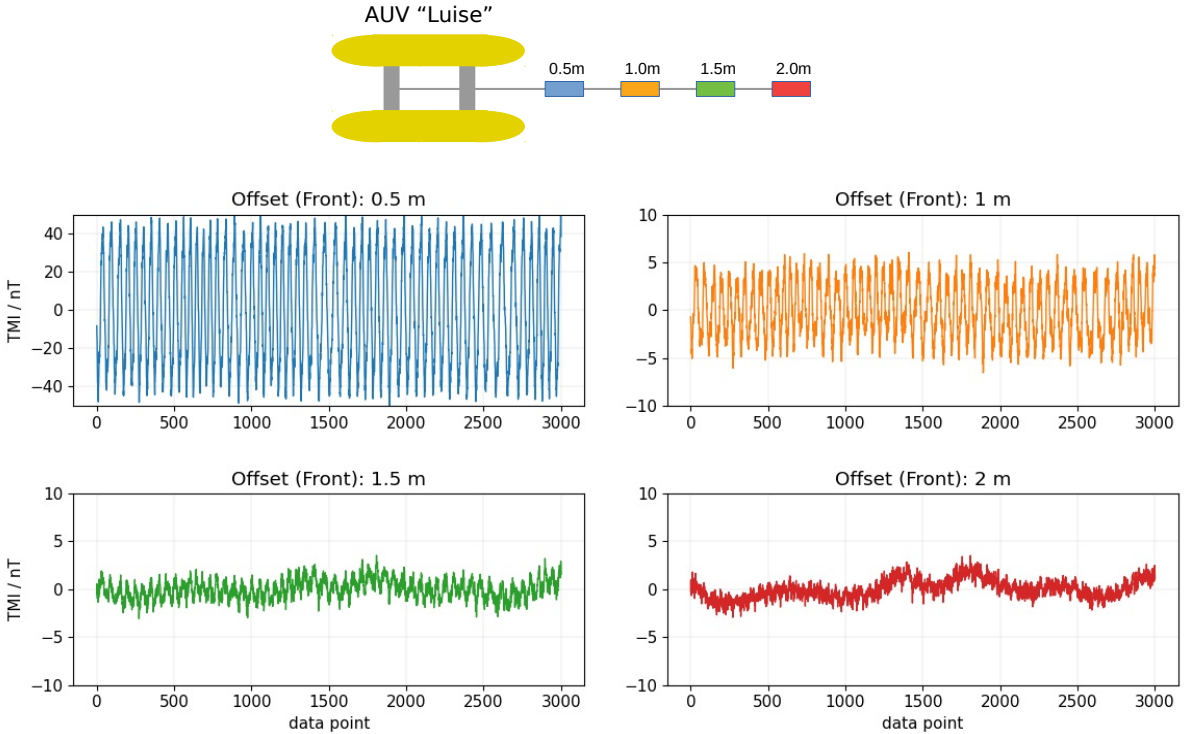
[SENSYS GmbH]

- Two Sensys 3-axis Fluxgate Magnetometers (FGM3D UW)
- Vertical Gradiometer (0.5 m)
- Data Acquisition Unit (DAU)
- Depth rating: 300 m
- Sampling rates: 200 Hz - 10 kHz

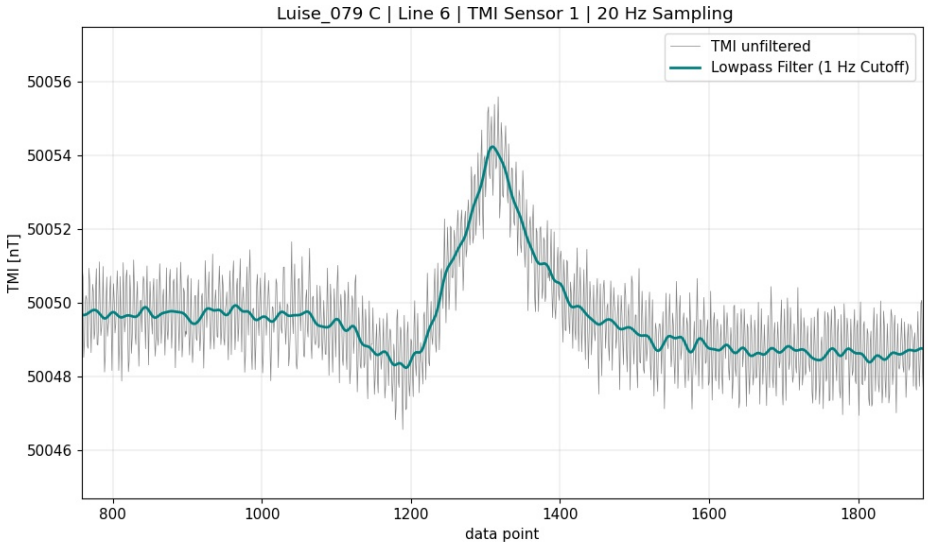
GEOMAR Aluminium Construction

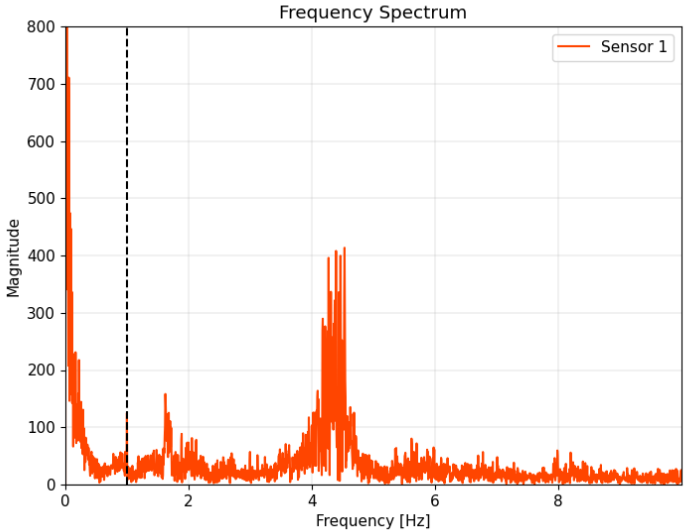


Noise Levels – Depending on Distance



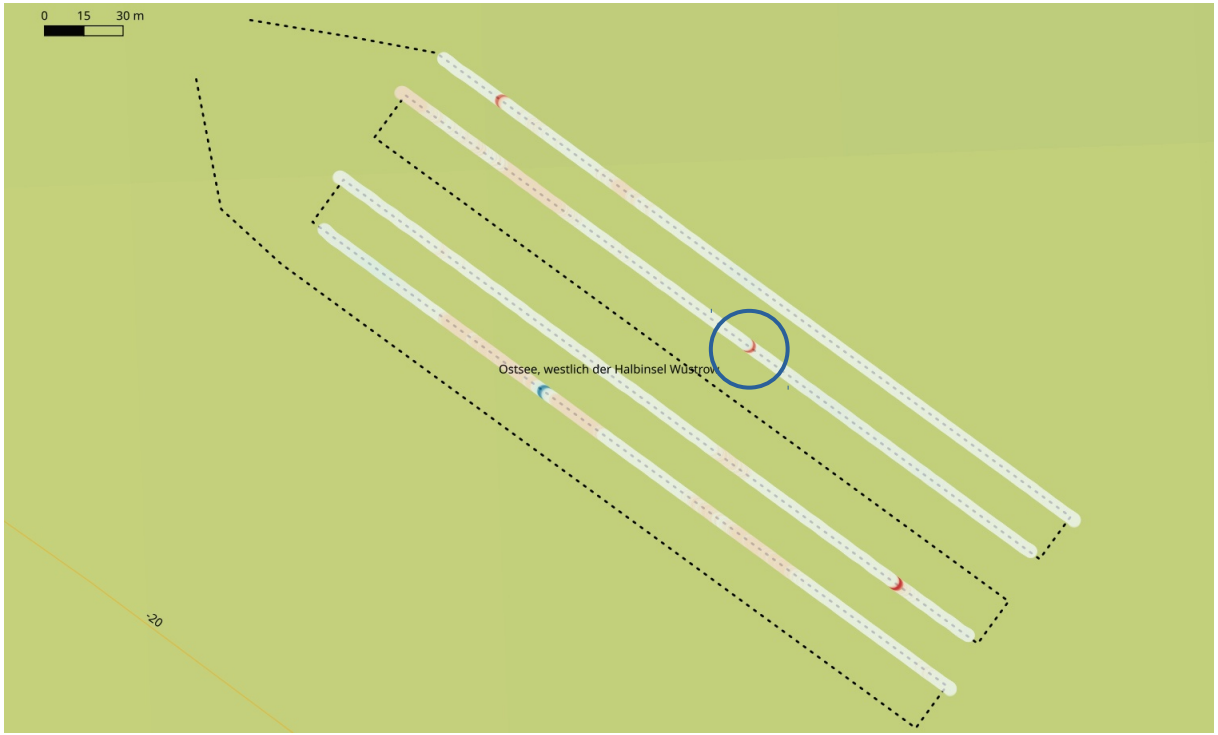
Field Data: Noise / Sensitivity





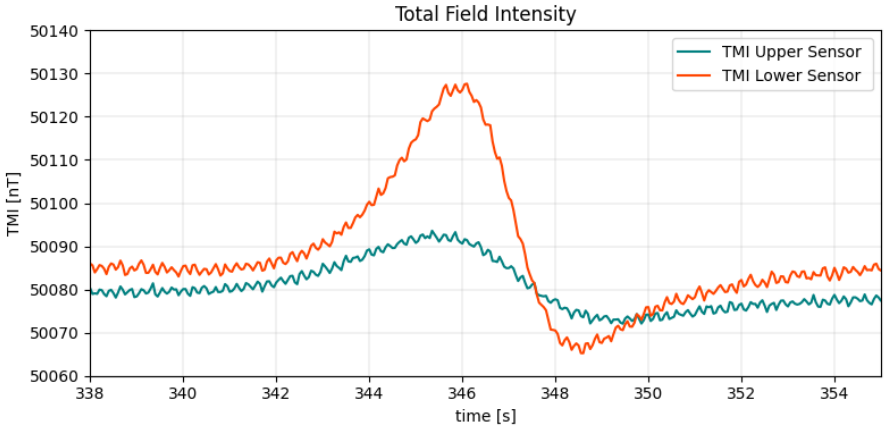
- Potential sensitivity: Only a few nT!

1D Field Data: Trollegrund



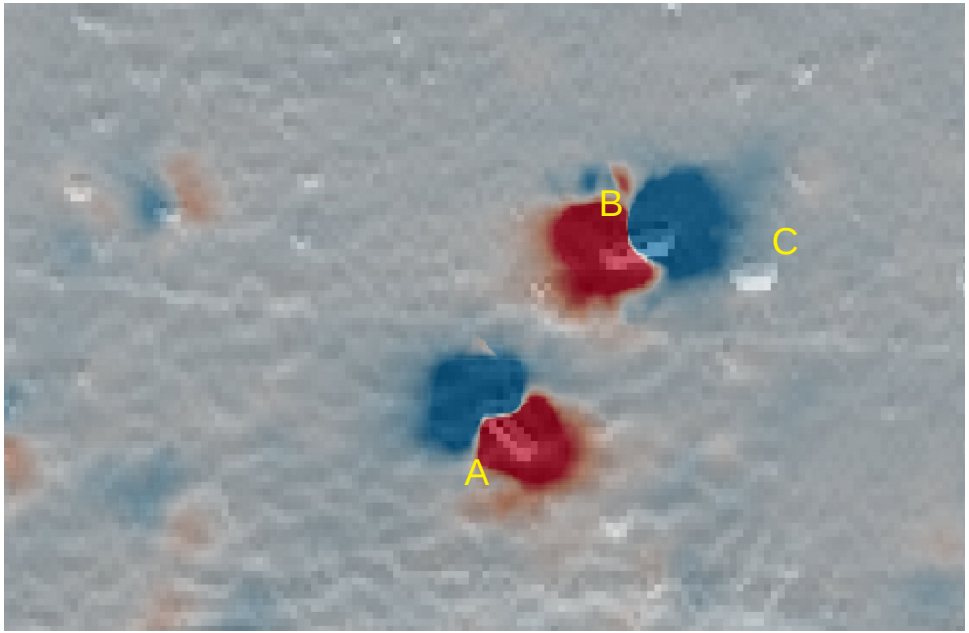
- Trollegrund: Between Wismar and Rostock
- 3 km from the shore
- Test mission (no target investigation)
- 6 lines: 300 m
- 1.2 m altitude
- 0.4 m/s velocity
- 4 anomalies detected!

1D Field Data: Trollegrund



10.5 or 12.8 cm Flak grenade (13 or 22 kg metal)

2D Field Data: Kolberger Heide



(Dimensions: 35 x 20 m², Flight altitude: 1.2 m, Velocity: 0.4 m/s, Line Spacing: 1 m)

Conclusions & Outlook

- Conclusions:
  - Successfully installed magnetometers on an AUV
  - Sensitivity of “a few” nT
  - Supporting camera images
- Outlook:
  - Automated search for UXO patterns in the recorded magnetic data
  - Develop a “backseat driver” to automatically control the AUV based on in-situ measurements

Thank you for your attention