



TELEDYNE TECHNOLOGIES
Everywhereyoulook™

ADVANCES IN UUV SYSTEMS FOR ANTI-SUBMARINE WARFARE SUBSEA AND SEABED WARFARE AND TACTICAL OCEANOGRAPHY

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Teledyne Marine Technology Verticals

SEISMIC

AG Geophysical • Bolt
Geophysical Instruments
Real Time Systems

INTERCONNECT

DGO • Impulse
Impulse PDM • ODI
Storm Cable • VariSystems

IMAGING

BlueView • Bowtech
Odom Hydrographic
PDS • RESON

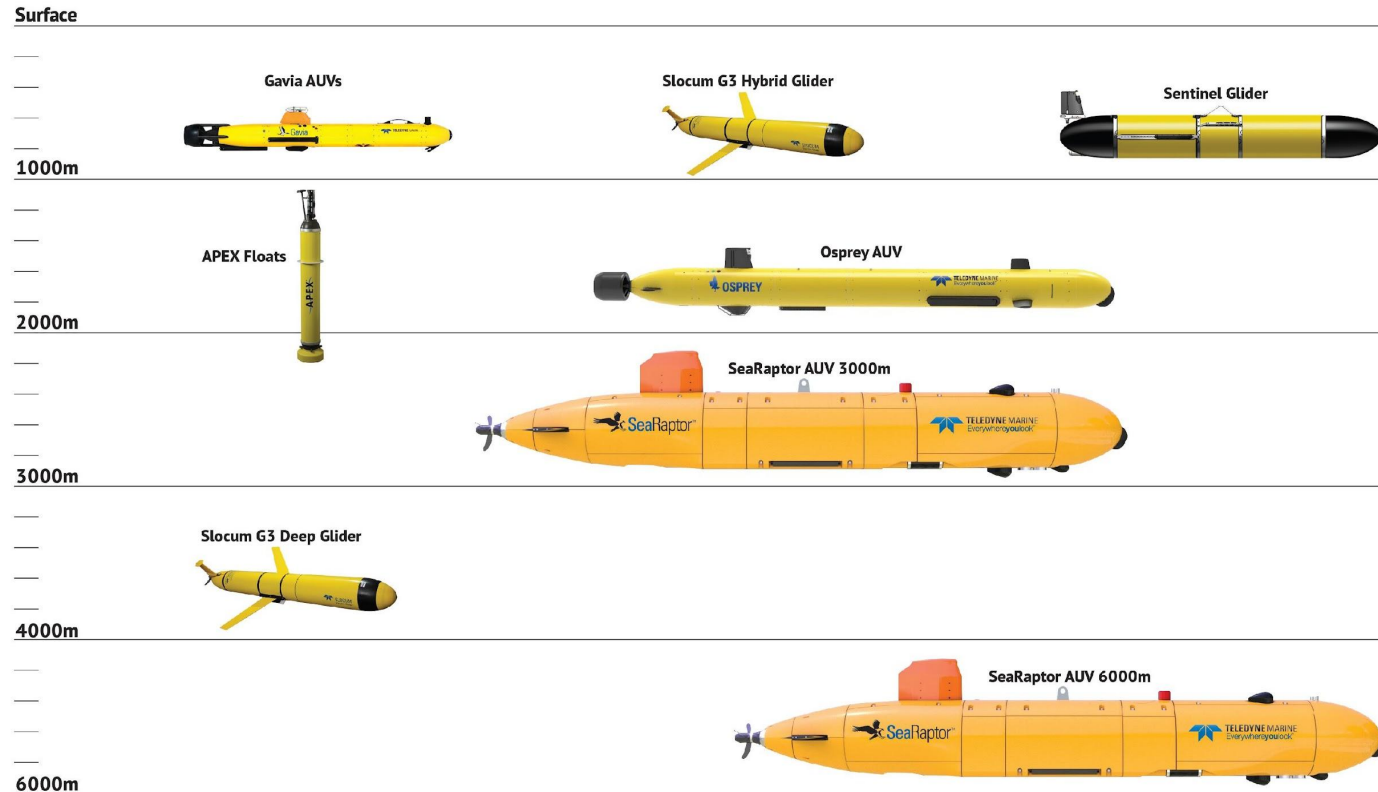
INSTRUMENTS

Benthos • Cormon
RD Instruments • TSS

VEHICLES

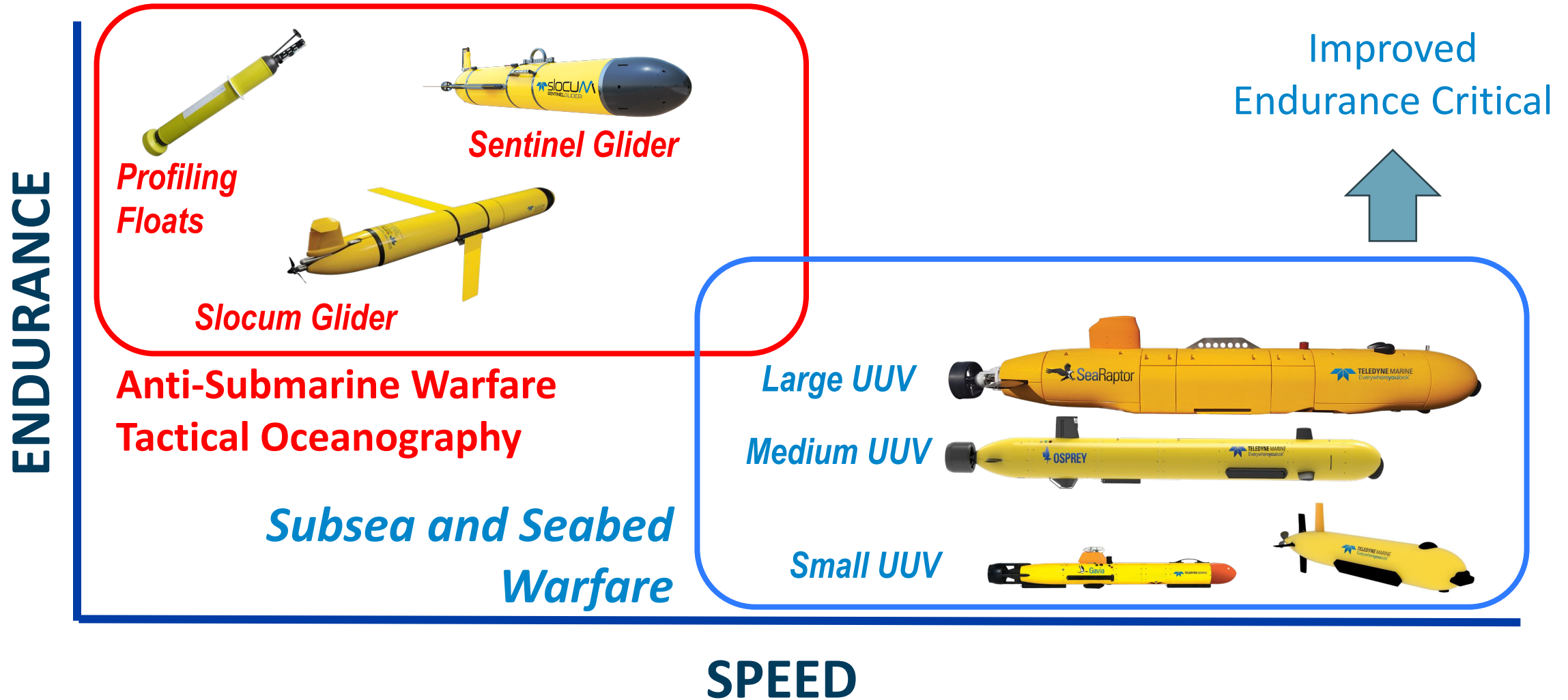
Gavia • Oceanscience
SeaBotix • Webb Research

Teledyne Unmanned Vehicle Technology to Acquire Mission Critical Data



- Flexible Systems and Platforms for unique operational profiles and applications in target markets
 - Defense and Security
 - Academic / Oceanographic Research
 - Commercial / Offshore Energy
- Depth, endurance, autonomy, **modularity**, and interoperability

UUV Operational Trade Space



Technology Requirements

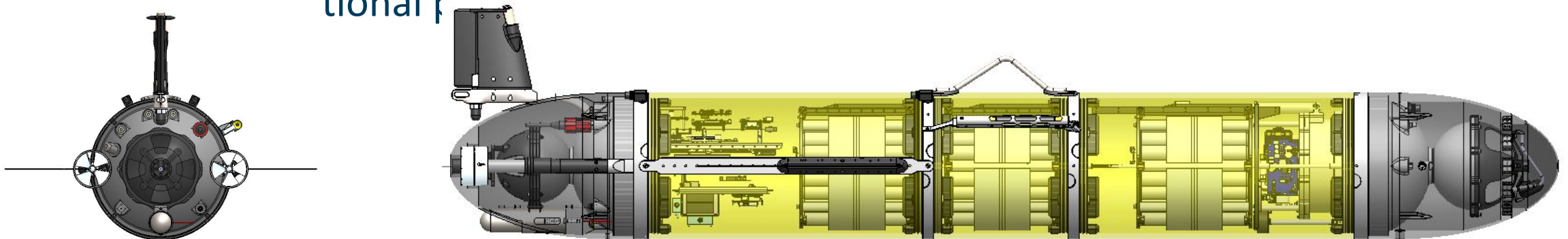
Making UUVs
Operationally
Relevant for
the Mission Set



The Slocum Sentinel Glider - The Next Generation of Persistent Ocean Monitoring

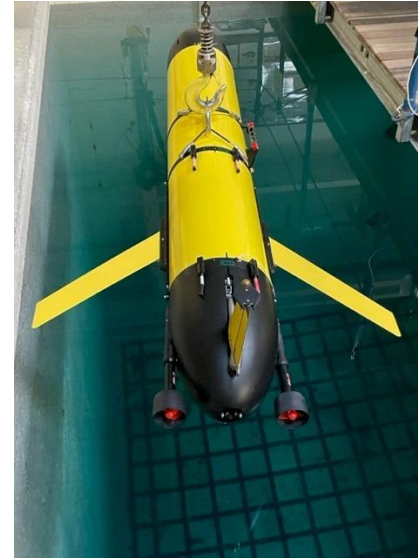
Answers the need for longer-endurance persistent monitoring:

- While operating with higher-energy and greater quantities of hardware/sensors
- Over greater distances and more diverse operational areas
- For longer operational periods



Slocum Sentinel glider – Expanding the Operational Envelope

- Depth rating: 1000 m
- External Diameter: 13 inches (33cm)
- Length: 8.4 feet standard (2.57m)
- Energy: 3.6 times a standard Slocum G3
 - 23 kWh
- Endurance: Up to 2+ years





OSPREY

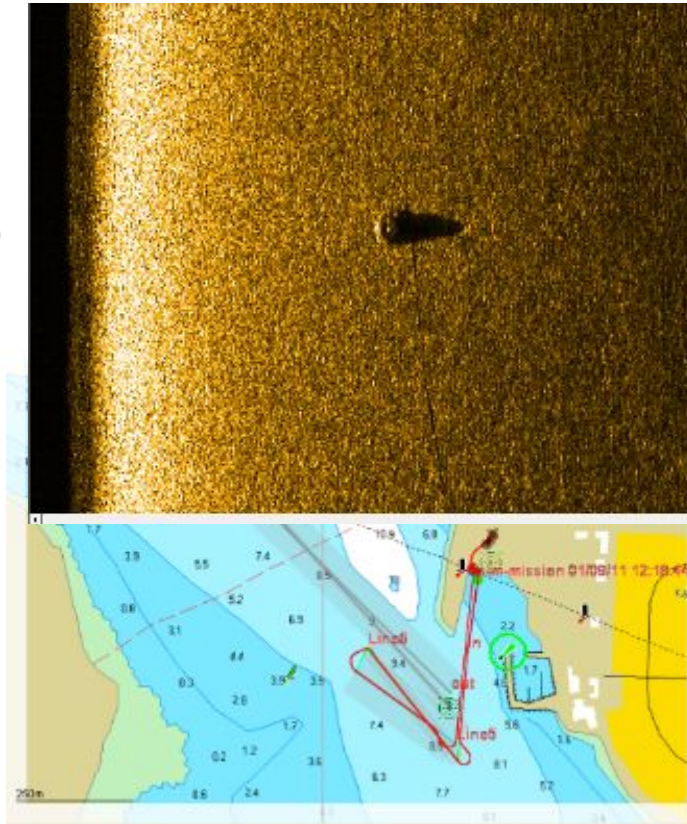
Osprey MUUV

- 324mm / 12 ¾" diameter
- Utilizes proven Gavia Interface
- Utilizes proven Gavia dry modular design in a larger diameter
- 2000 m depth ratings
- Field replace modules

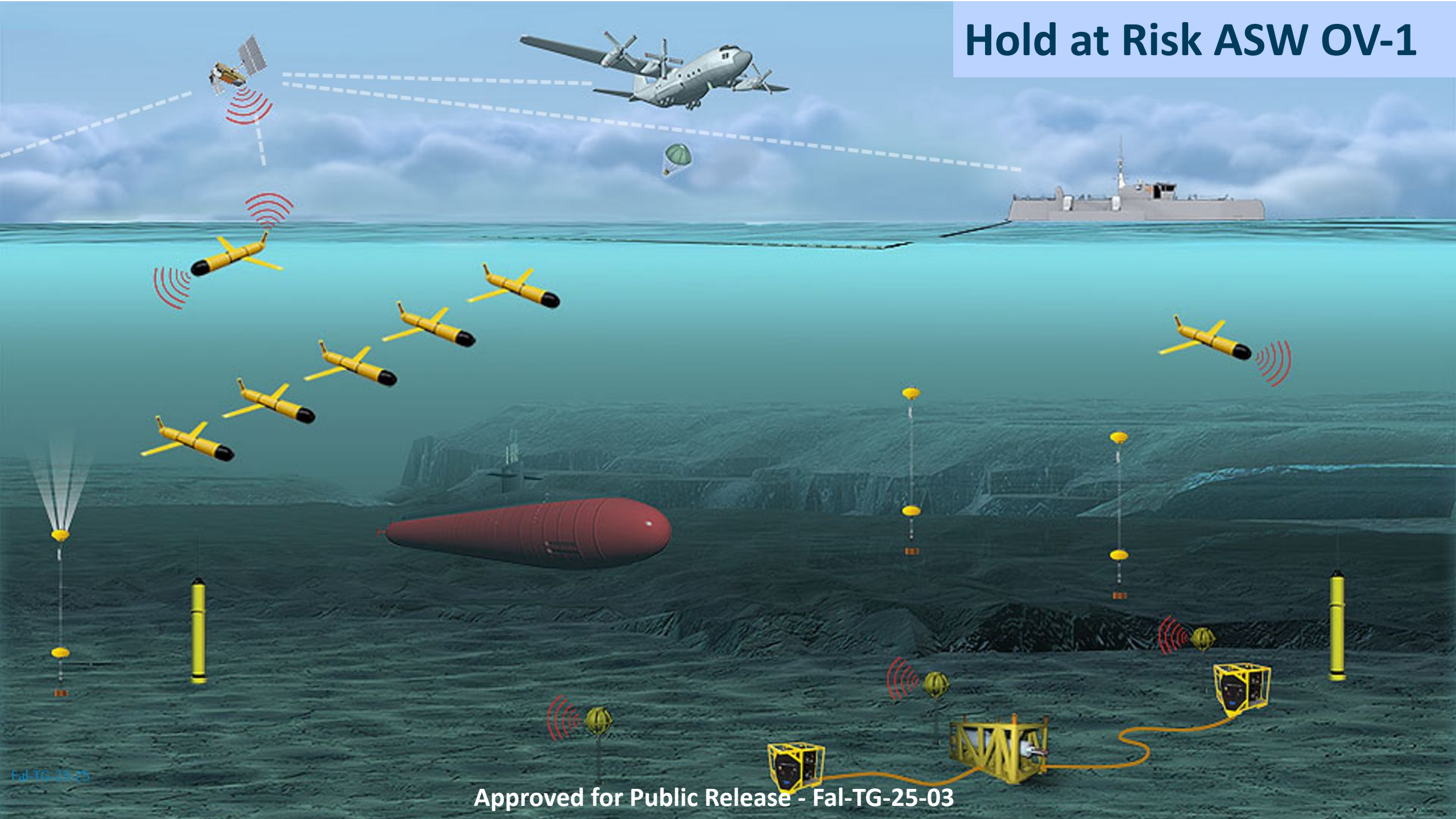


OSPREY Options & Sensors – user defined mission package

- Navigation: iXblue C7 coupled with Teledyne 300 kHz RDI TASMAN DVL W XRT
- Acoustic Comm: Teledyne Benthos ATM series
- USBL: Teledyne / Sonardyne / Kongsberg
- SAS: Kraken MinSAS 120
- Side scan sonar: various options: EdgeTech 2205 (including gapfill) / Klein 3500
- Multibeam echo sounder: Teledyne Reson T20-S
- Camera: various options: Voyis Recon LS / CathX
- Sub-bottom profiler: Teledyne Chirp III
- Environmental Sensors: Sound velocity meter / CTD
- Forward-looking sonar: Teledyne BlueView M900-Mk2 or Seabat F30
- Batteries: Swappable 4.4 kWh battery modules (multiple modules)
- Autonomy and on-board processing: CARIS Onboard



Hold at Risk ASW OV-1



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Swarm Gliders for Cooperative Acoustic Sensing



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MARINE**
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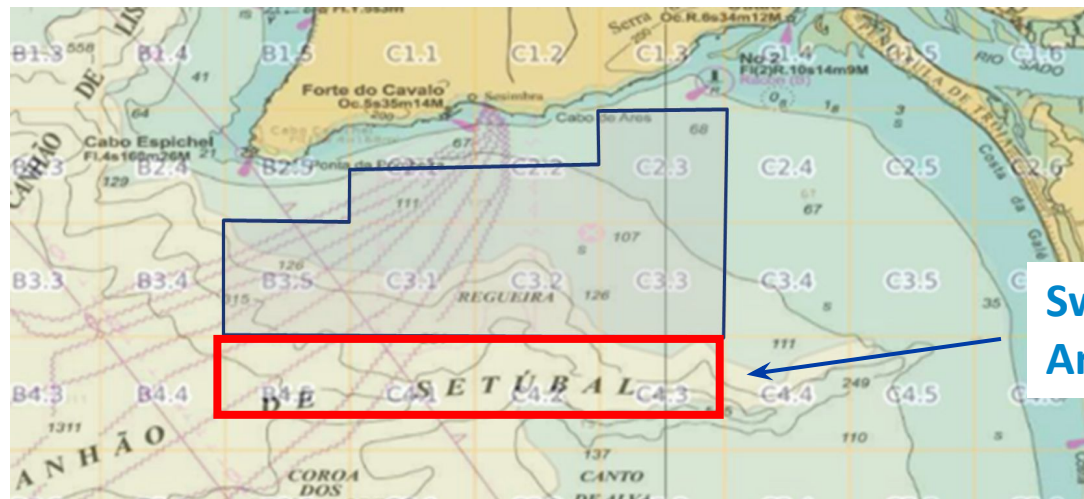
JASCO
APPLIED SCIENCES

BlueOcean
MARINE TECH SYSTEMS





Swarm Glider ASW Results



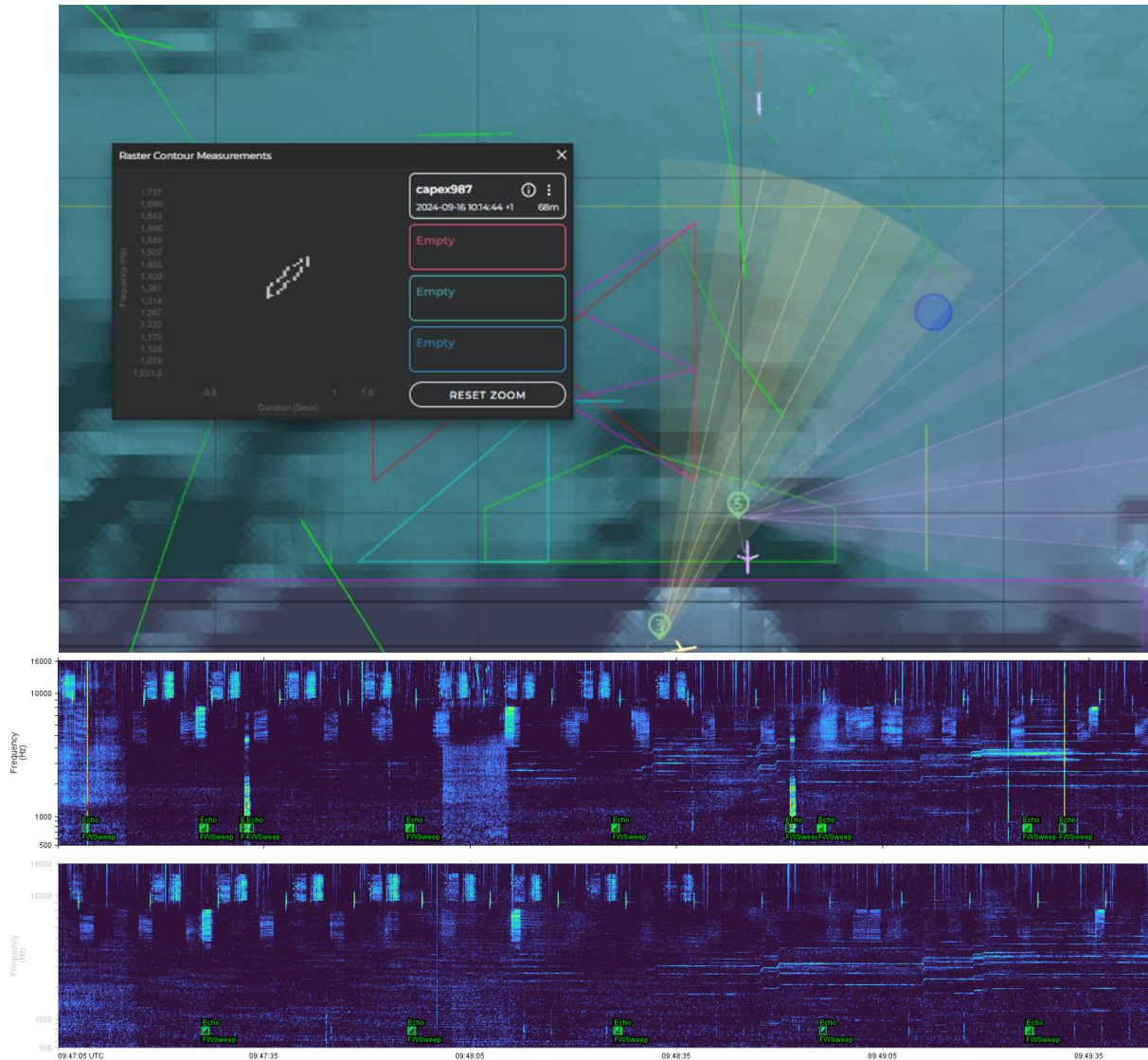
Swarm Glider Ops
Area

- Successful demonstration of Early Warning & Indicating from multiple directional gliders
 - Multiple countries collaborating
- Visualization via Blue Ocean Marine Tech Systems' SeaSuite
- Demonstrated directional detections and rough localizations
- CATL integration was demonstrated
 - Gliders directional detections could be displayed in Ops Room – first for gliders

Gliders Detecting and Localizing ASW Targets

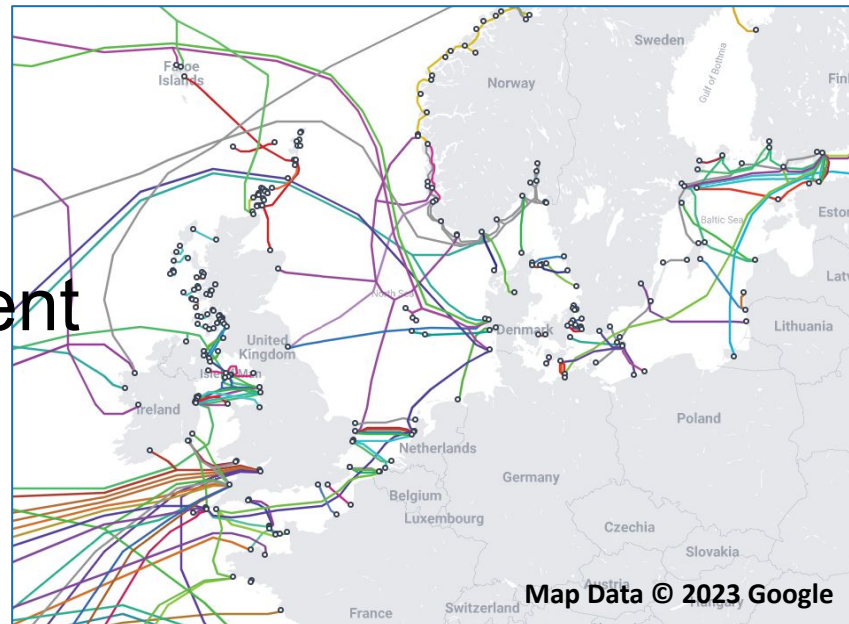


- All three gliders with acoustic sensor detected ground truthed targets
 - Detections ranges were easily up to 10km (out to 20km)
- Royal Danish Navy Gavia with a Sonar Training Module detected at 10-12 km in Near Real Time
- UK01 and UK02 show gliders detecting the Swedish Navy sponsored Saab AUV62

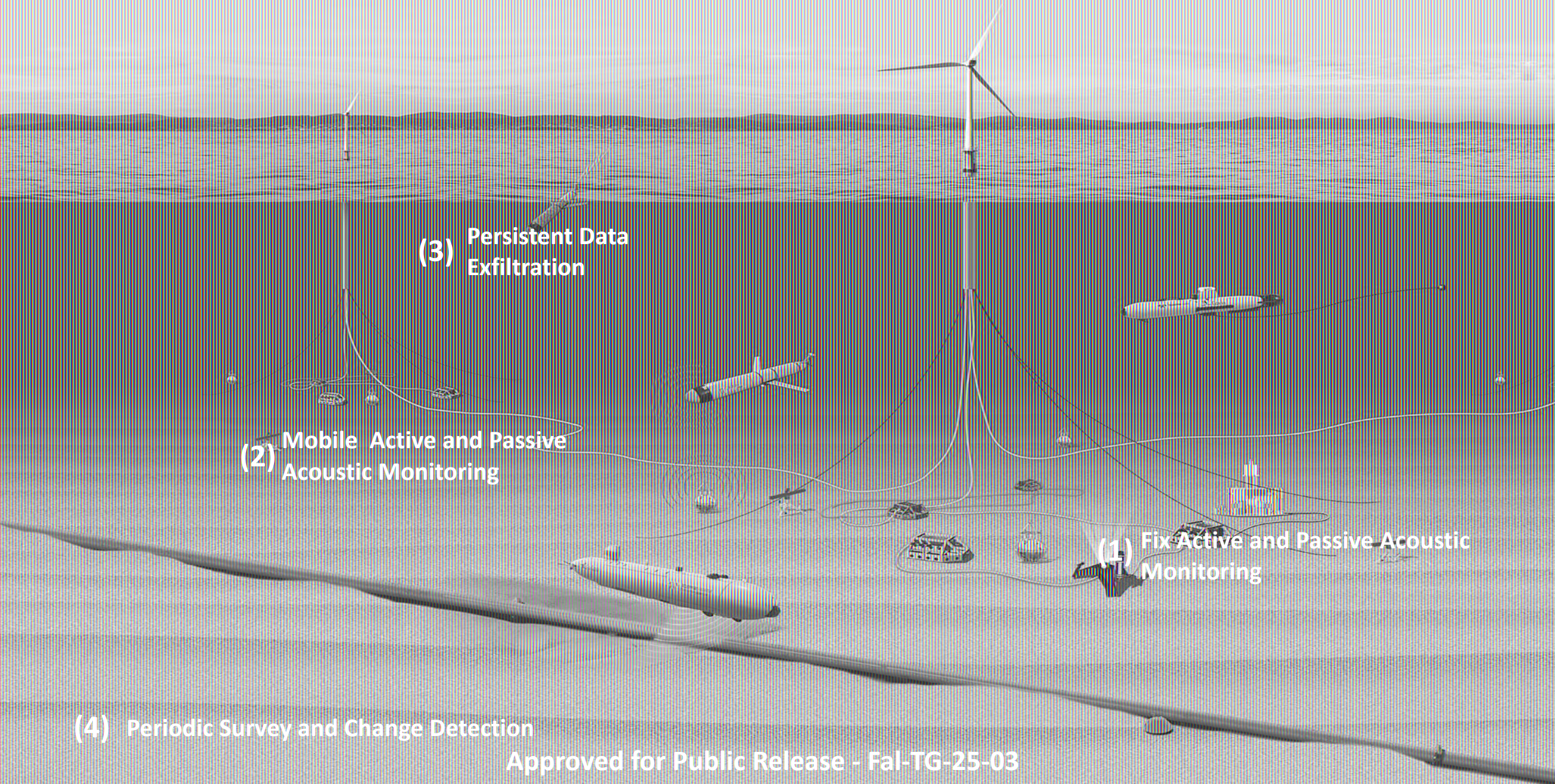


Defensive Subsea & Seabed Warfare or Critical Undersea Infrastructure (CUI) Protection

- Surface and subsurface maritime infrastructure is vulnerable to both state and non-state actor threats
- Significant spatial extent
- Approach for nodal versus linear infrastructure will be different



CUI Security – Persistent Systems of Systems OV-1



(3) Persistent Data Exfiltration

(2) Mobile Active and Passive Acoustic Monitoring

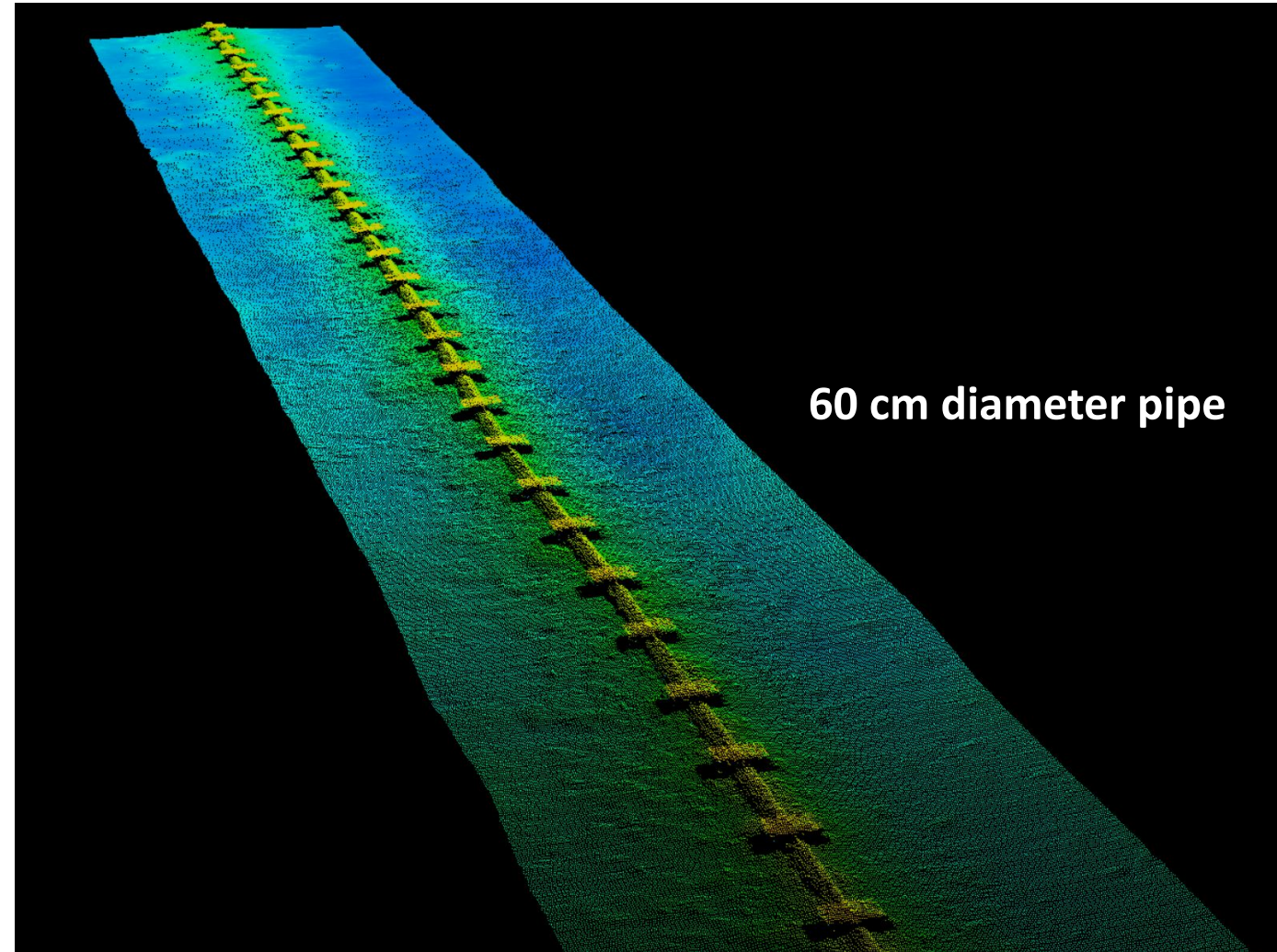
(1) Fix Active and Passive Acoustic Monitoring

(4) Periodic Survey and Change Detection

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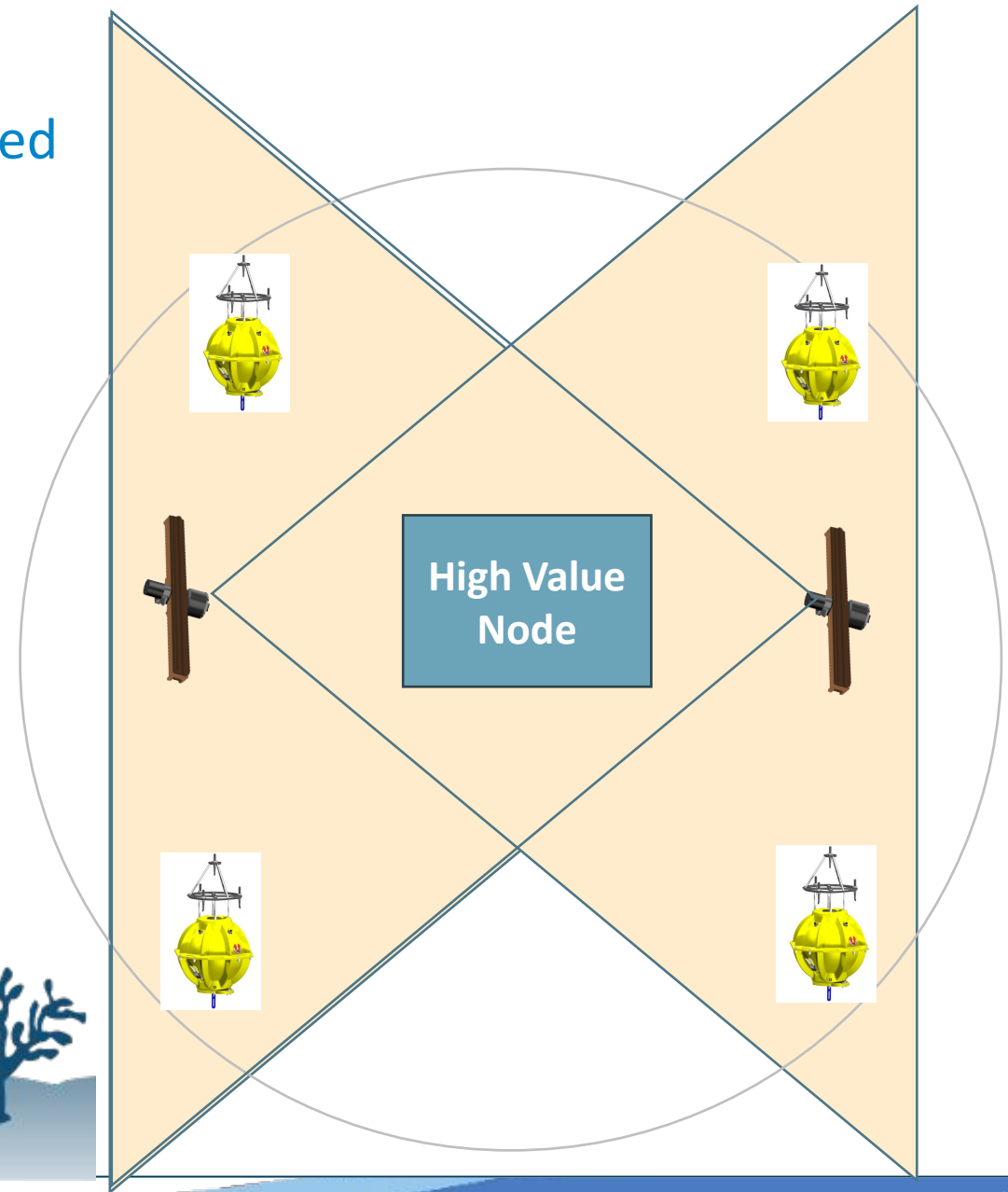
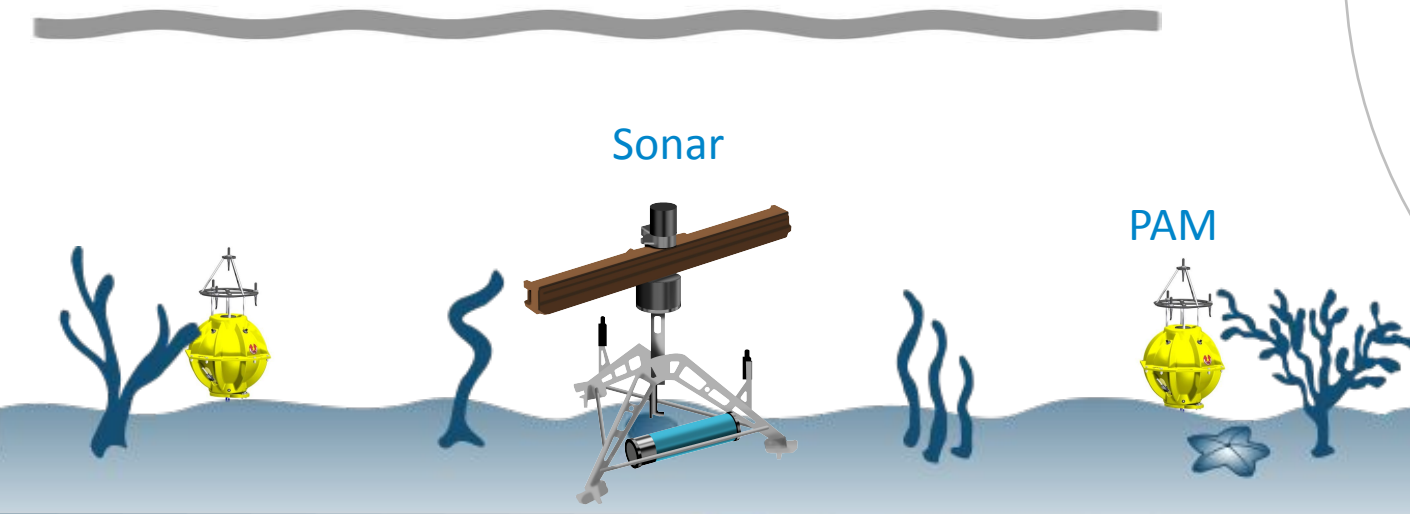
Multibeam UUV Survey of Pipeline using RESON T-20 Module

- High resolution bathymetry to establish baseline
 - Small UUV with true multibeam
- Pipe tracking to optimize survey time
- Change detection can be achieved automatically by comparison of point cloud
 - Baseline survey versus threat response survey



Asset monitoring – Passive & Active

- Passive Acoustic Monitoring (PAM) array placed at the bottom to act as cue sensor
- Bottom mounted multibeam sonar to image/track threat in water column
- Acoustic or wired communication for target data exfiltration



Slocum Glider Helicopter Mission – Rapid Glider Deployment

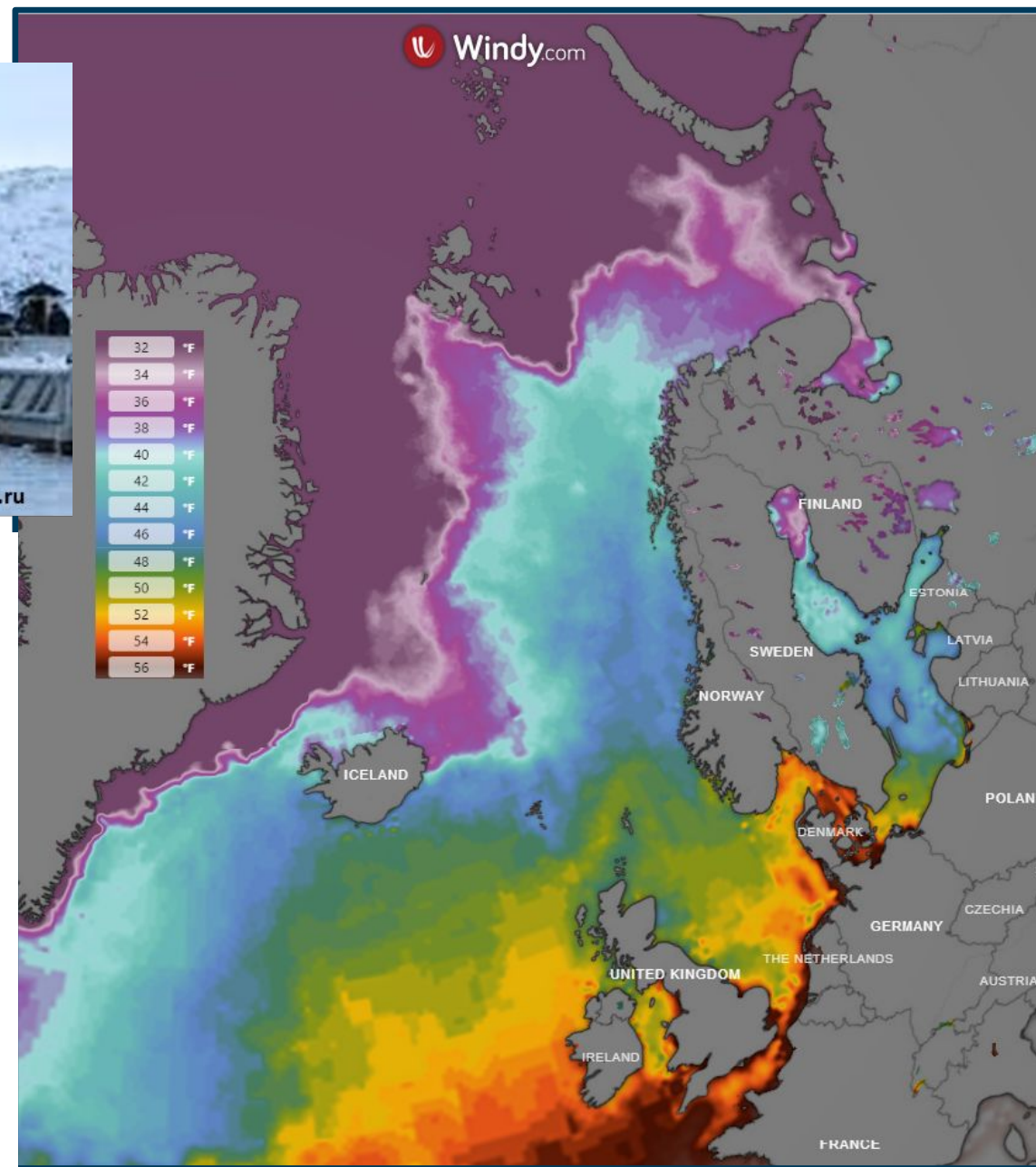


The Need for Undersea Persistent Surveillance to support Tactical Oceanography



**Norwegian Sea –
1.4 million sq. km**

**GIUK Gap
Greenland to Iceland –
~ 320km
Iceland to Scotland
~ 800km**



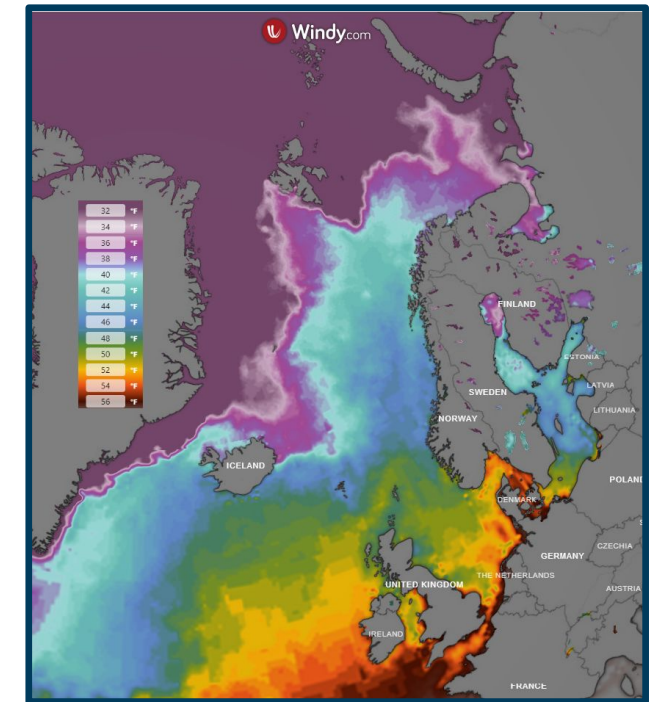
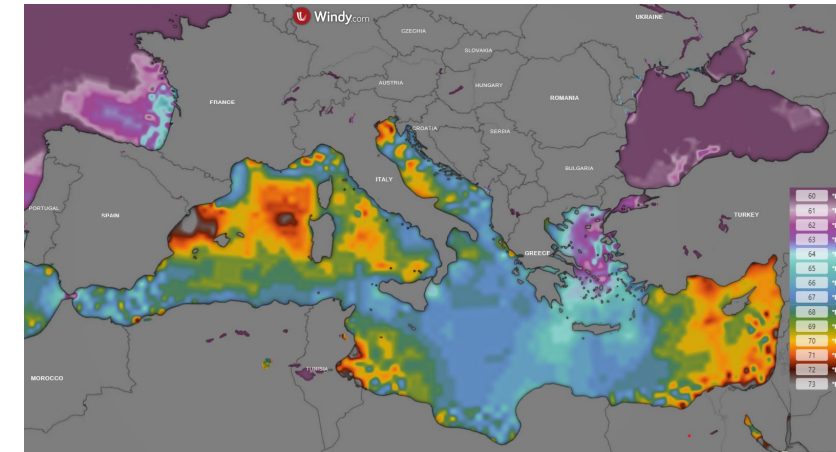
Critical Missions Requiring Persistent Undersea Surveillance

- **Tactical Oceanography supports Rapid Environmental Assessment (REA)**

- Provide real time ocean properties
 - Deliver high density decision quality products
 - Conductivity-Temperature-Ocean forecasts
 - Sound Speed and Sound Propagation

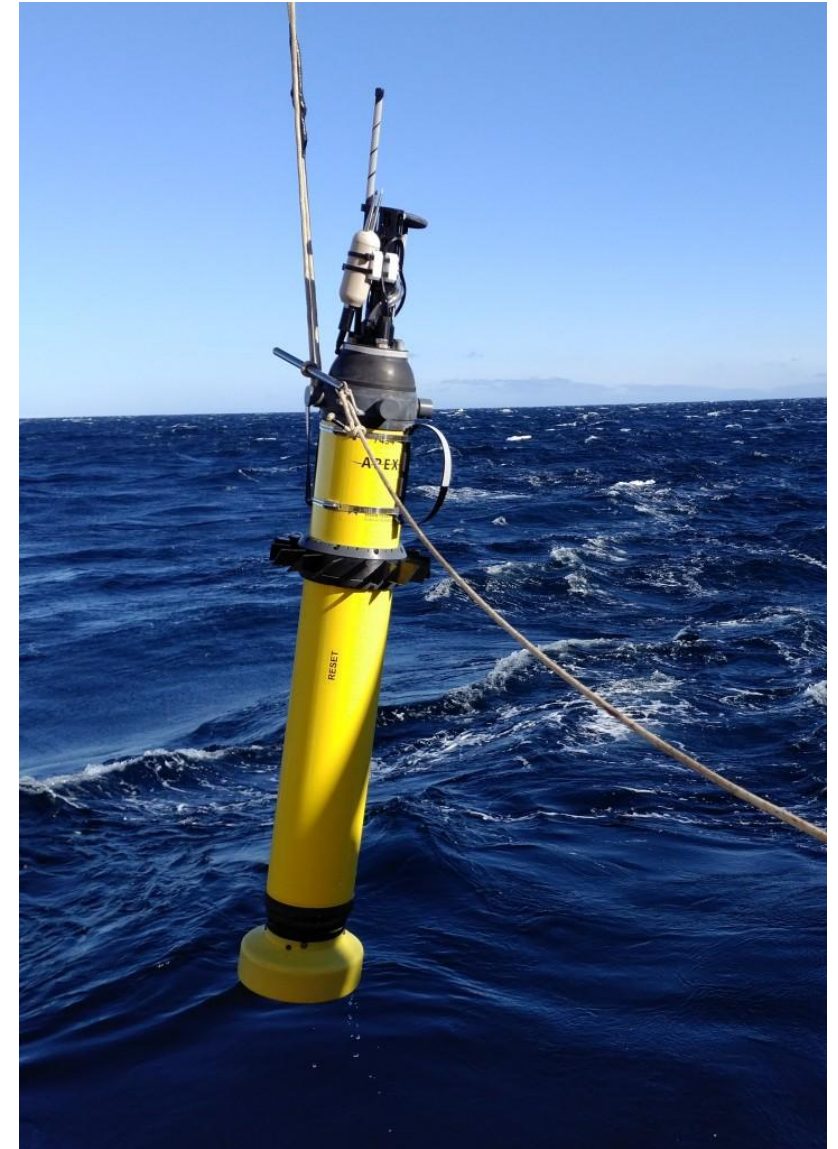
- **Enabler for Improved Anti-Submarine Warfare (ASW)**

- Hold at risk – barrier at choke point
- Large area surveillance



Water Column Sensor Platforms (REA)

- Underwater gliders can maintain a presence for month to a year
- Profiling floats (lagrangian drifters) provide multiyear oceanographic and environmental acoustic information



Uncrewed Systems at Scale

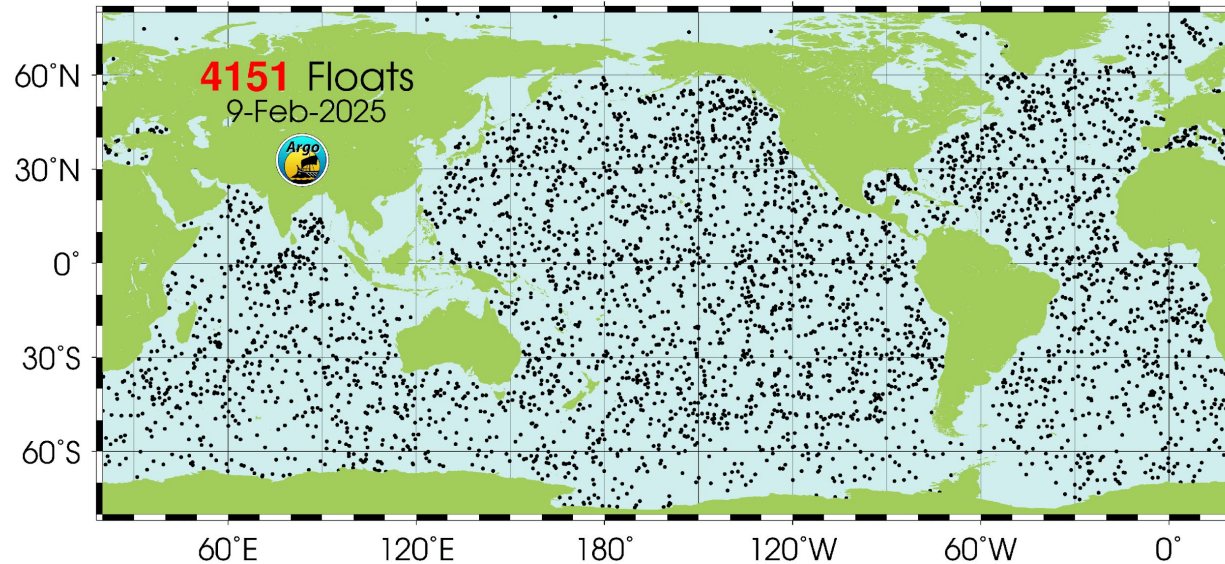
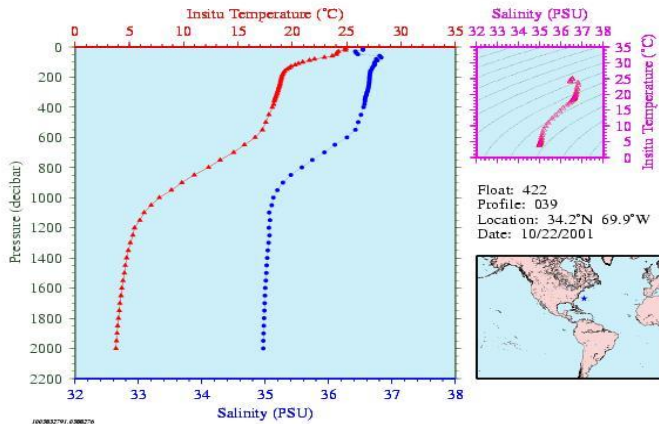
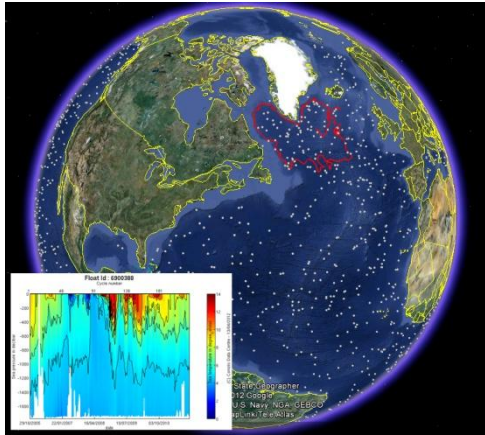
- U.S. Navy has deployed over 100 underwater gliders during a single operation
- Minimal staffing required – Oversight/ manage by exception



"The appearance of U.S. Department of Defense (DoD) visual information does not imply or constitute DoD endorsement."

Photo by [Rebecca Eckhoff](#)
Courtesy of DVIDS

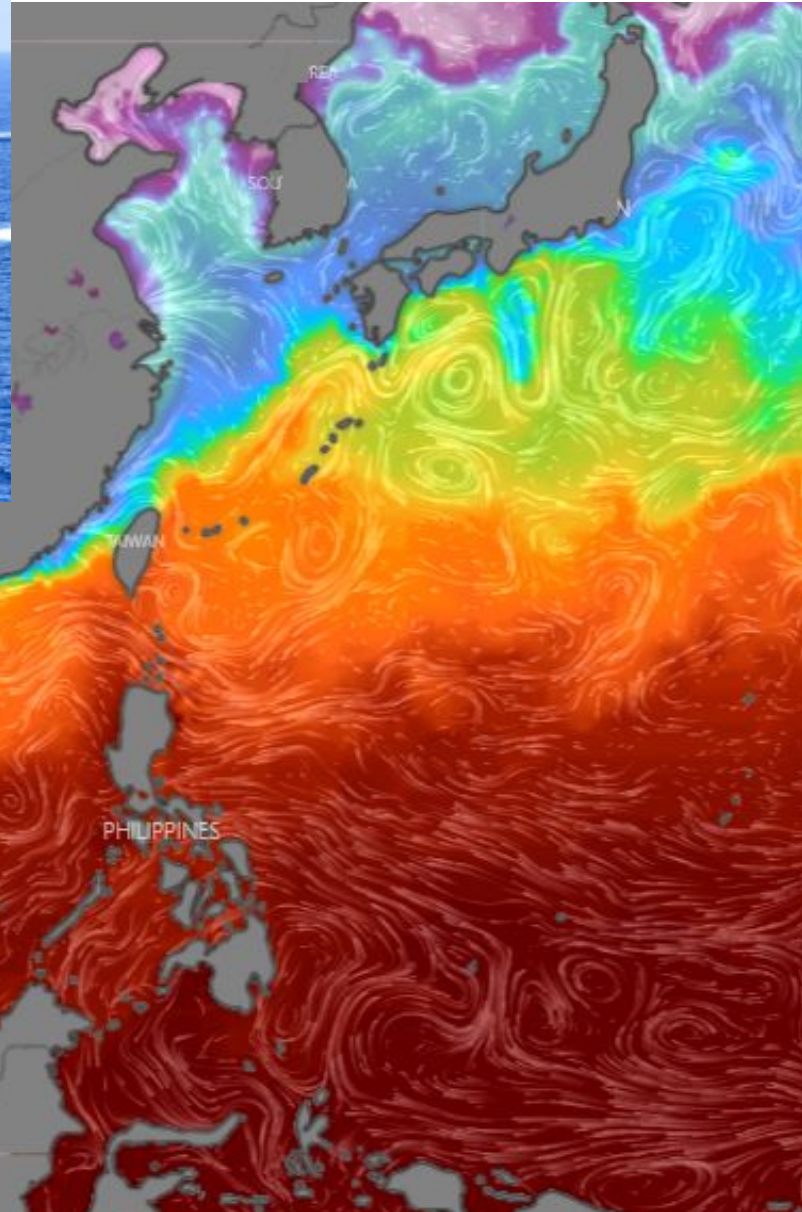
Global Argo Program

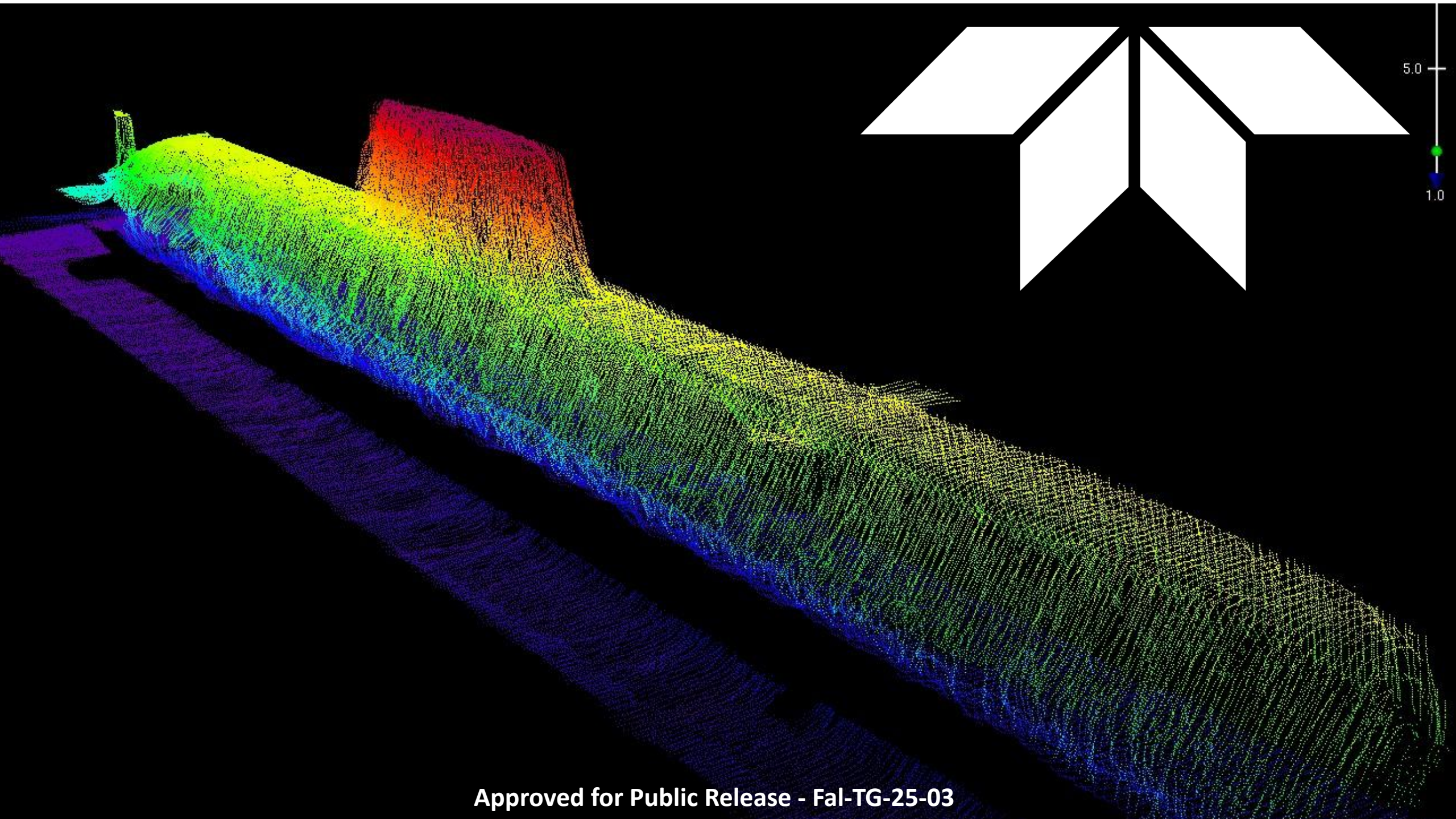


Installed
array
-\$100M
USD

Annual
upkeep
\$20M
USD

Persistent UUVs and Profilers Will Ensure High Density REA for the Theater Commander





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