
ALSEAMAR

ALCEN

innovation & services at **sea**

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NAVY LEADERS - SEAXPLORER

12 Feb 2025





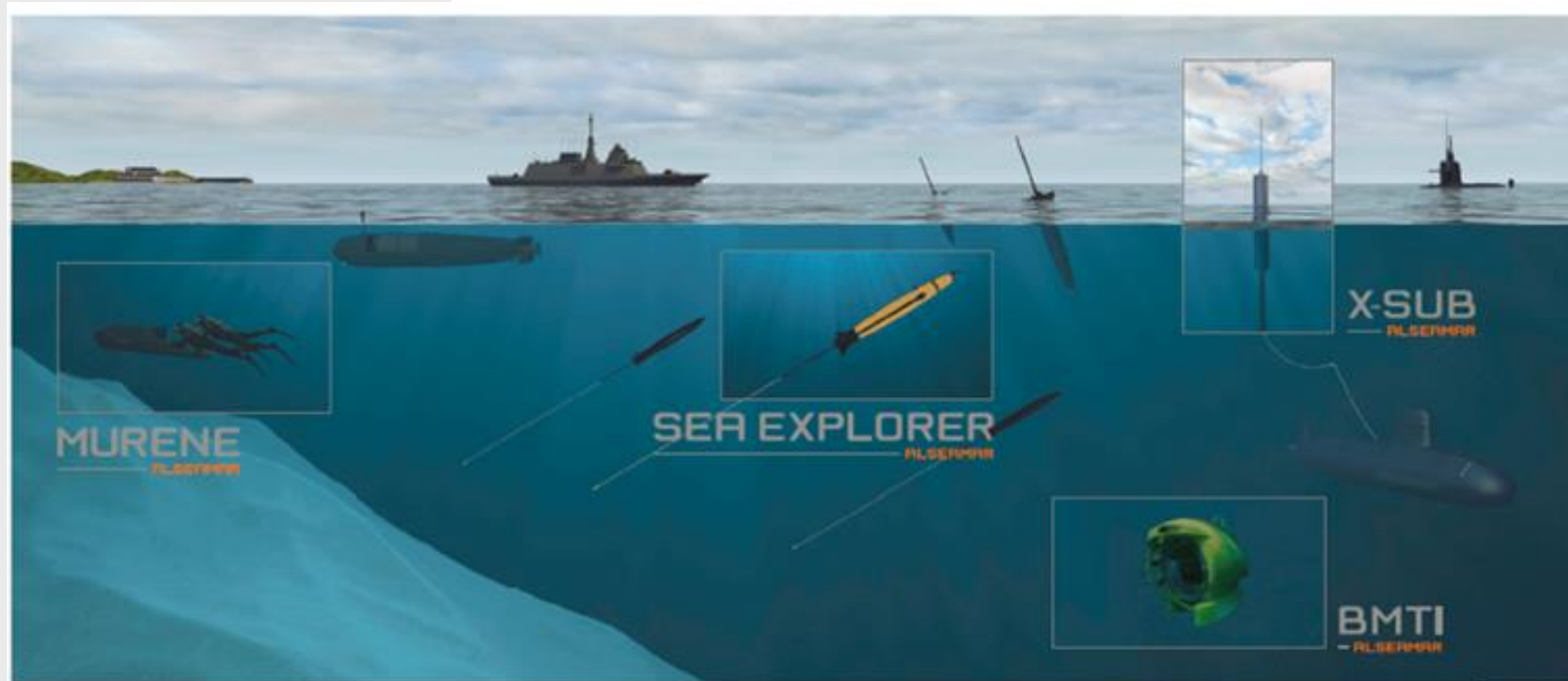
AGENDA

- **ALSEAMAR Company overview**
- **SYSTEM PRESENTATION:**
 - The SEAEXPLORER & friendly web interface GLIMPSE™
- **The Seaexplorer's role in critical undersea infrastructure protection :**
 - How can SEAEXPLORER protect areas
- **Passive acoustics for underwater threat detection :**
 - AURIS solution, a mobile and fixed tool for area interdiction
- **Use case: our capabilities in Northern Europe :**
 - SEAEXPLORER is already ...
- **DISCUSSIONS**



ALSEMAR: company overview

ALCEN, a French group using advanced technologies at service of innovation:



- Proprietary products
- High-level subcontracting
- Associated services

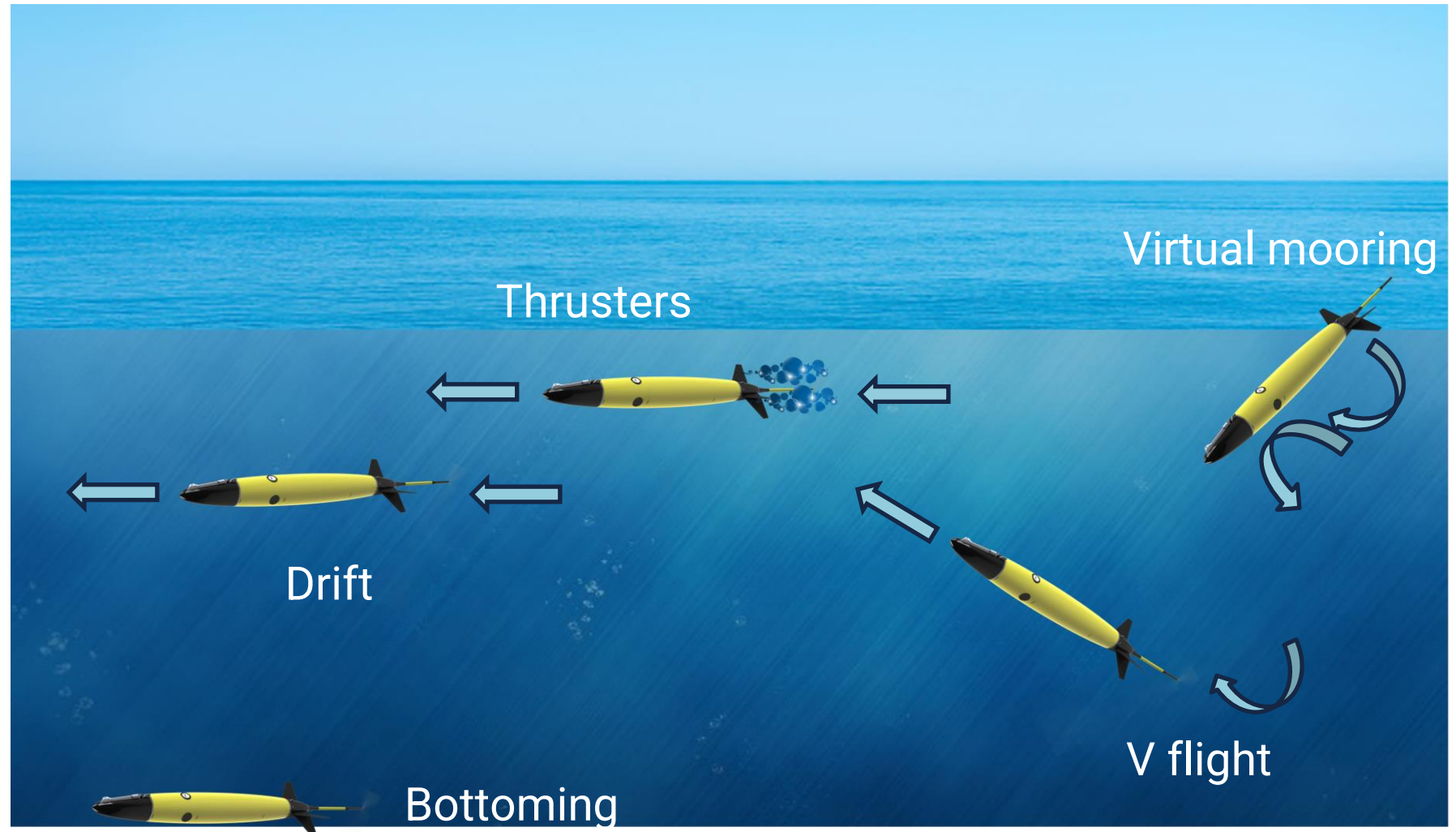
System presentation

- SEAEXPLORER X3 family
- GLIMPSE Software suite



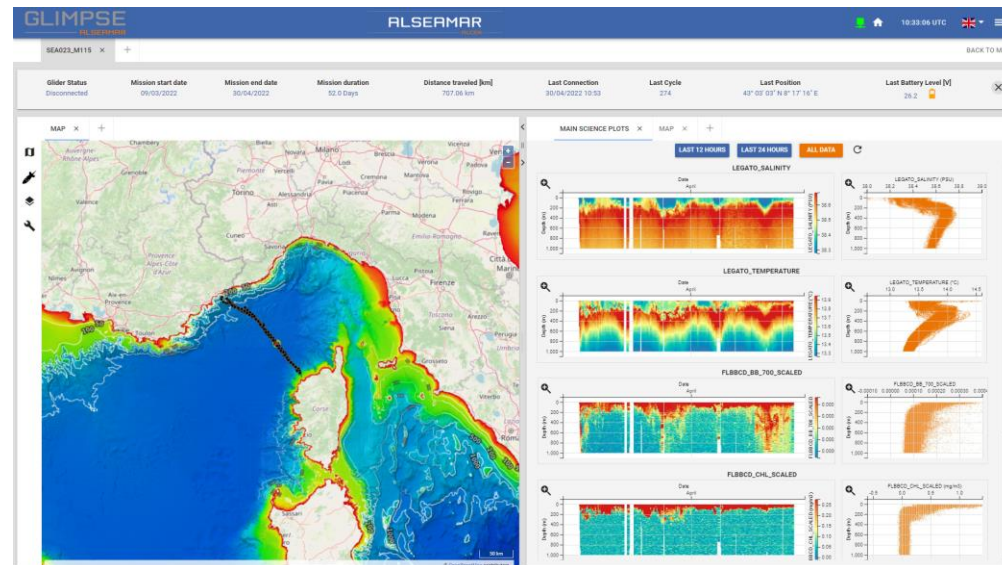
How a glider works?

Navigation modes



SEA EXPLORER is more than a product, it is a system

- A reliable and flexible glider
- Easy to deploy
- Data processing close data sources
- Friendly display for mission analysis



SeaExplorer as a product

SeaExplorer family is getting bigger

- **SeaExplorer Shallow**

- 200 m

- **X3 SeaExplorer**

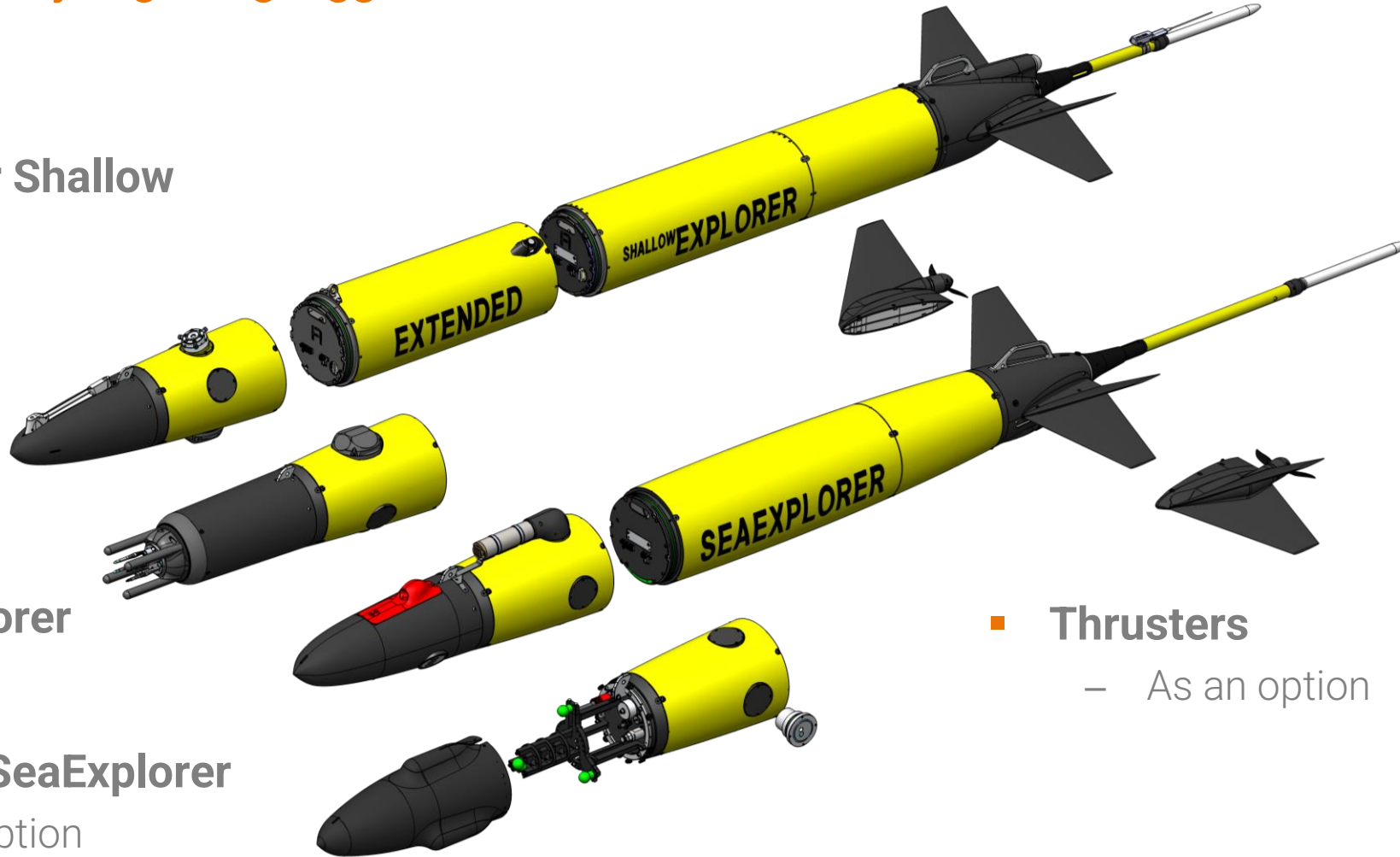
- 1000 m

- **X3 1250m SeaExplorer**

- As an option

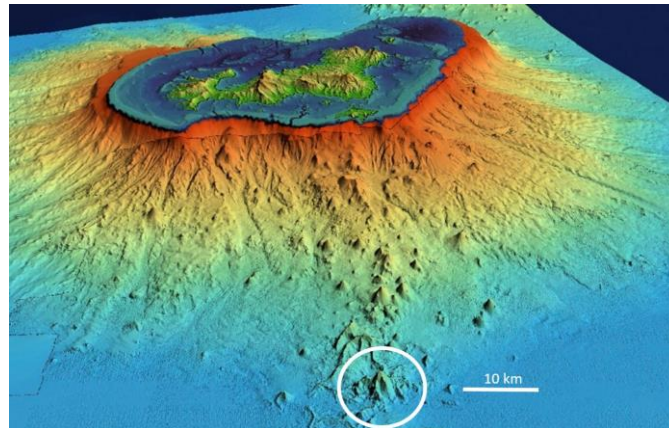
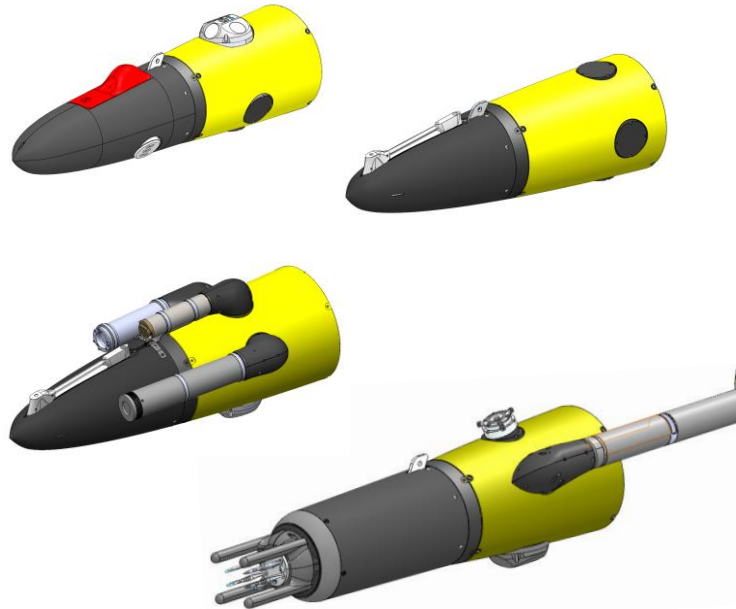
- **Thrusters**

- As an option



SeaExplorer as a product

SeaExplorer a modular glider

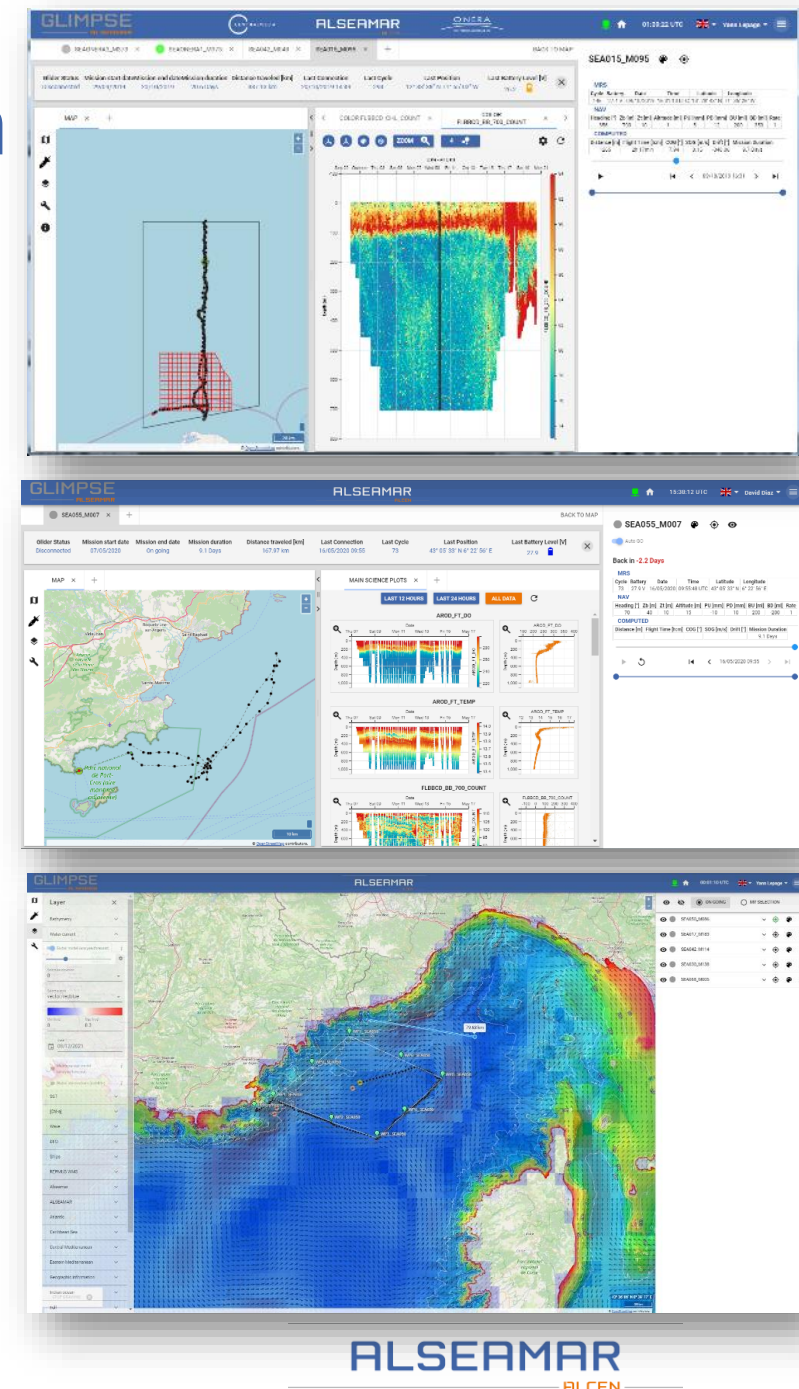


- Rechargeable batteries
- Interchangeable Payload Sections and sensors
 - ✓ Easy and fast rotation of sensors for calibration
- Robustness
 - ✓ No wings, no rudder: no external critical parts
 - ✓ Flexible rubber fins
 - ✓ No vehicle opening
 - ✓ Fast data downloading
- Track record
 - ✓ 3 years monitoring on Fani Maoré volcano

SeaExplorer as part of a system

GLIMPSE™ supervision software suite

- **WEB interface tool**
 - Mission planning
 - Piloting
 - Supervision of multiple vehicles
 - Data analysis
 - Maintenance
 - Numerous additional modules:
 - SMS alerts
 - Emails
 - Data-processing
 - *Automated fleet coordination (development pending)*
 - ...



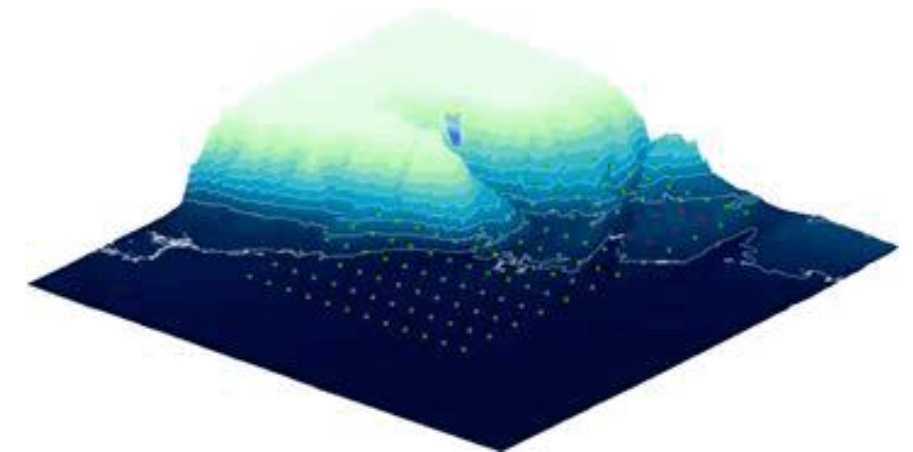
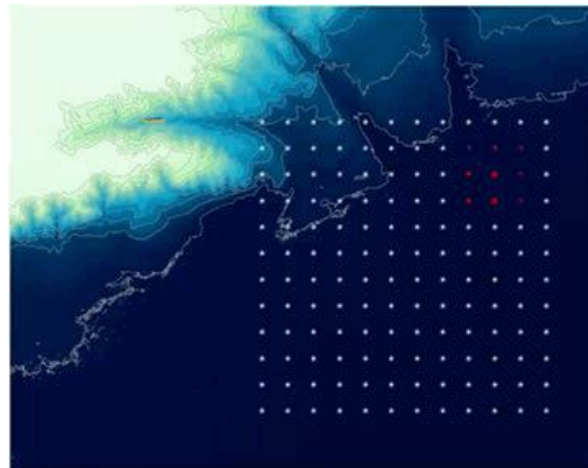
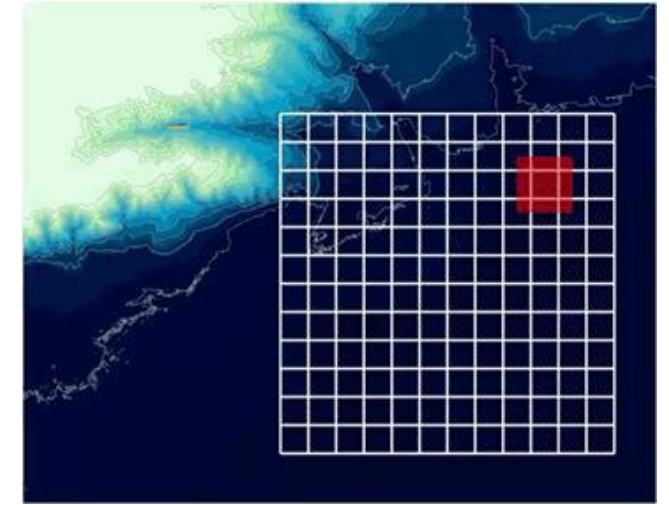
The Seaexplorer's role in critical underwater infrastructure protection



Use of SeaExplorer mobile detection

Better to do it in fleet

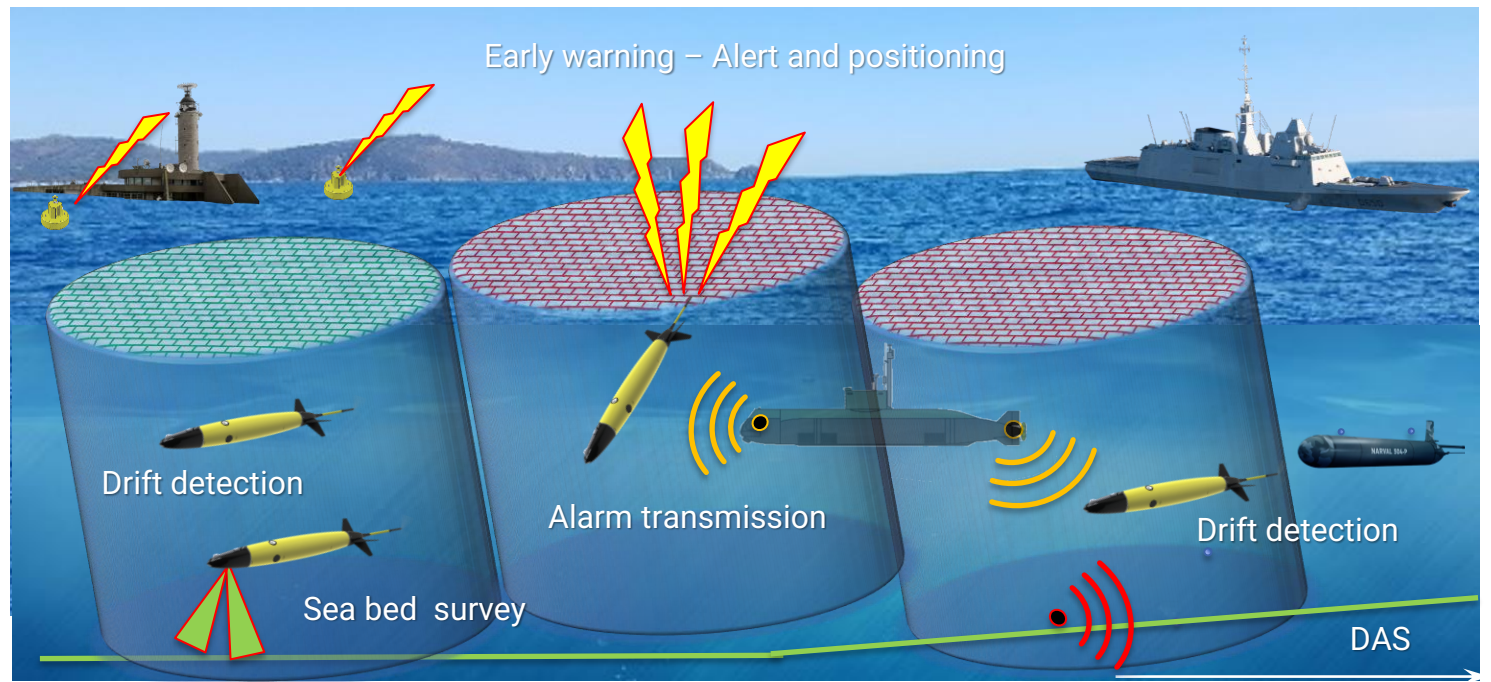
- Advantages of a fleet:
 - Sensors repartition on different units
 - Longer global endurance
 - Larger coverage
 - Shorter duration
 - Intercalibration of measurements
 - 4D surveys



Fleets for early warning

Protection of maritime approaches

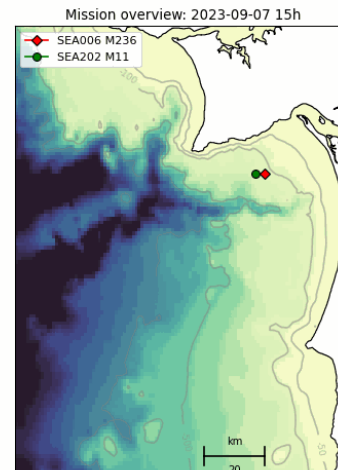
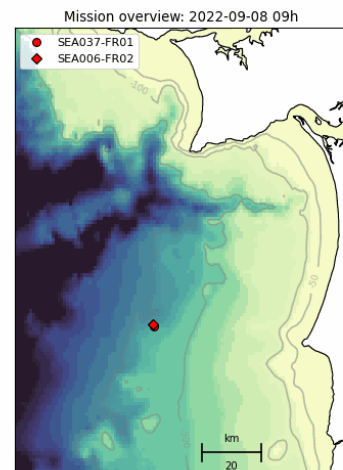
- Area coverage
 - Drift navigation
 - Surface and underwater mobile detection and location
 - Coupling gliders and autonomous stations
 - Possible repositioning of gliders
 - Surveillance of 330 km³ of ocean (10 gliders)



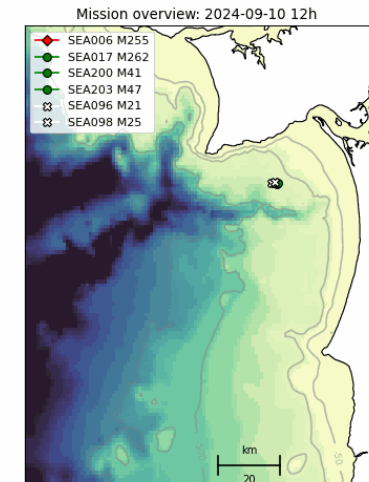
An exemple and a long partnership

Participation in the REP(MUS) exercises

- Participation within the REA group in 2021, 2022, 2023, and 2024
- Provision of various types of oceanographic and acoustic payloads
- Demonstrated new features in an operational context
- REP(MUS) 2024 : deployment and recovery of 6 gliders in under 2 hours by the Navy



ese Navy



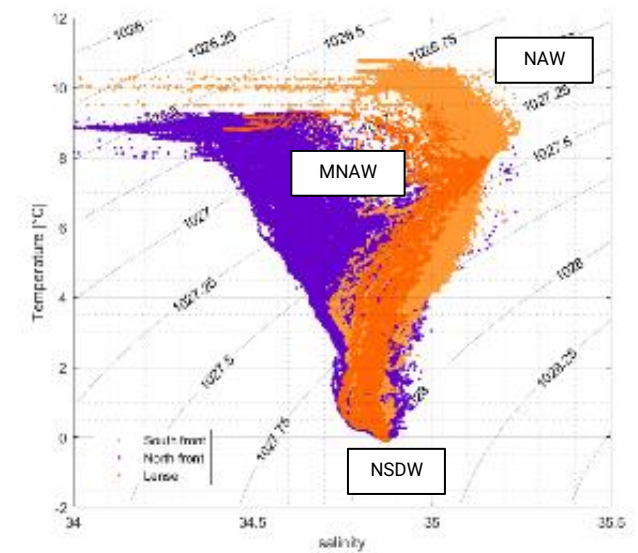
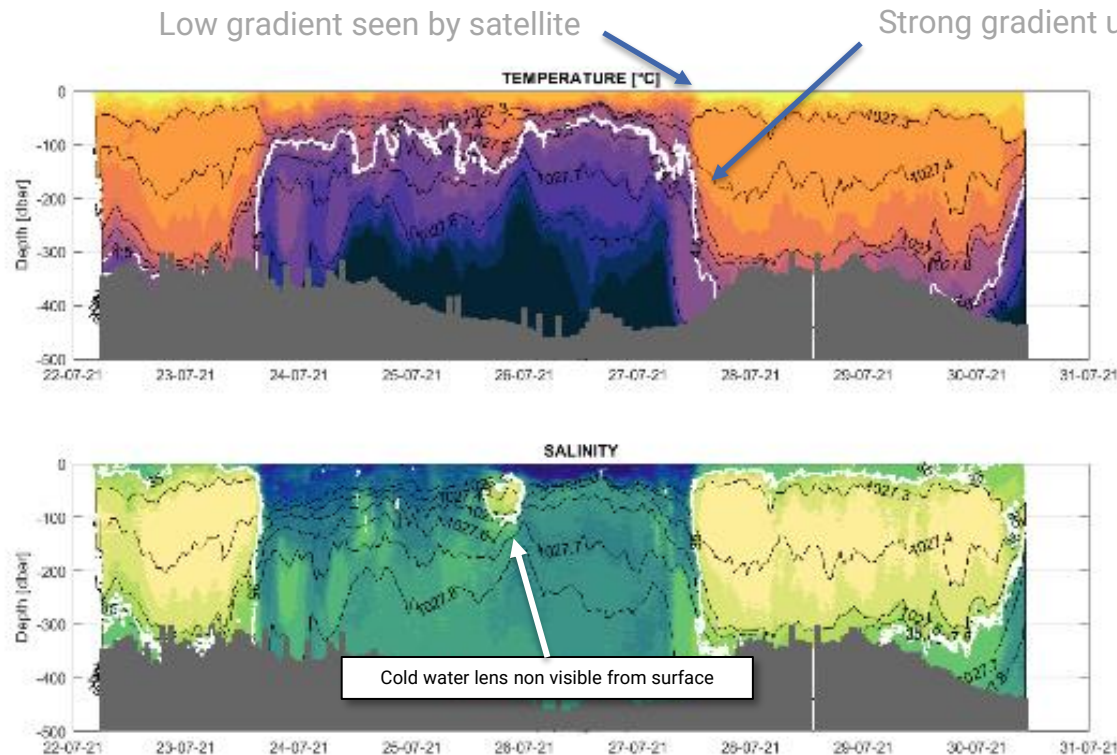
Passive acoustics for underwater threats detection



Use of SeaExplorer for REA

Sonar propagation assessment

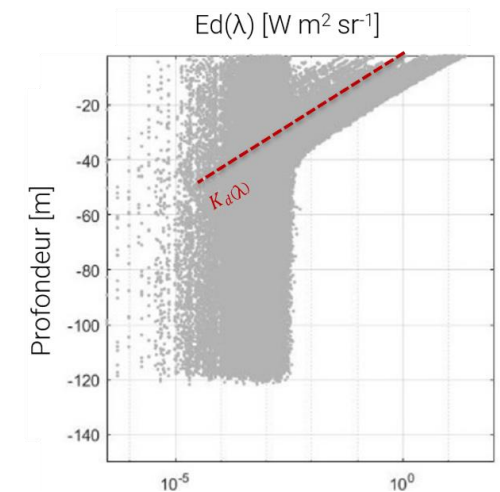
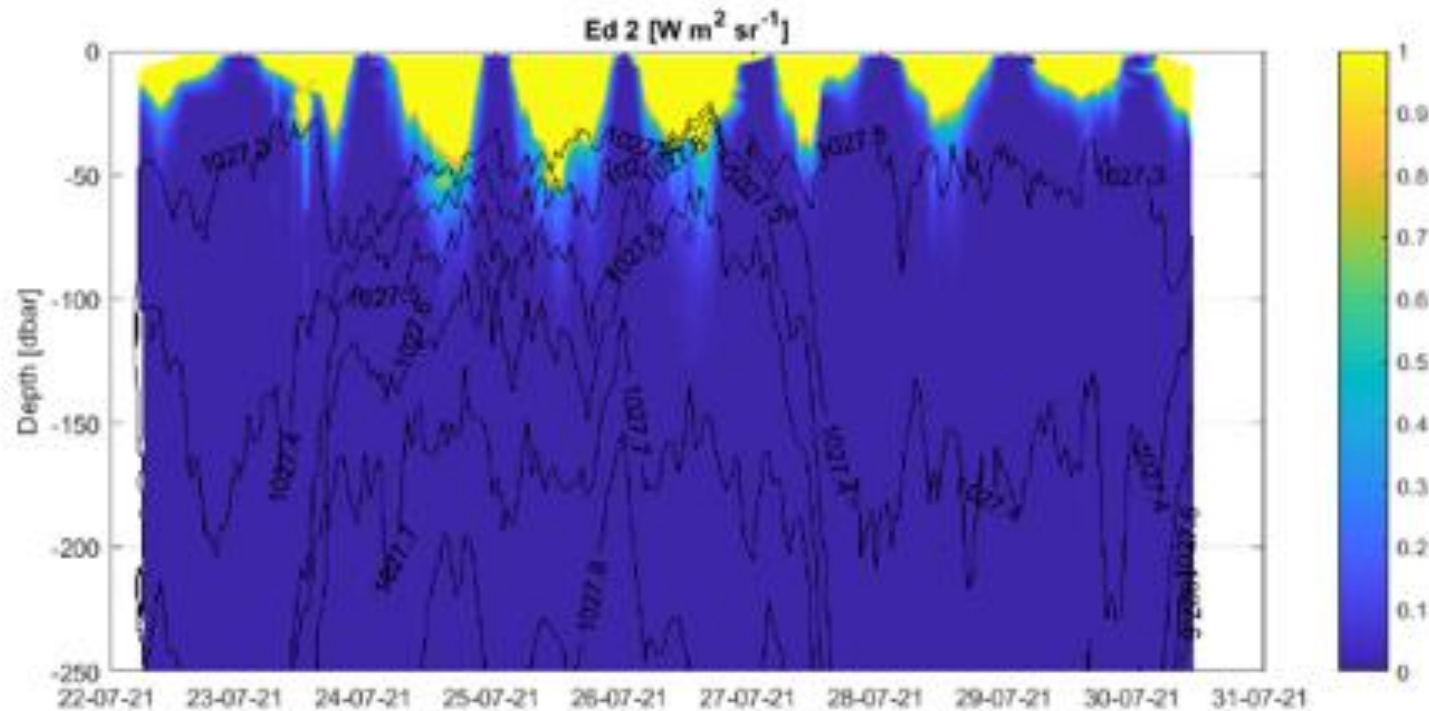
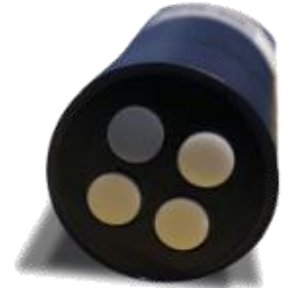
- Typical Payload: CTD (Conductivity, Temperature and Depth)
- Example of survey: Interface between cold and warm waters:



Use of SeaExplorer for REA

Light penetration assessment

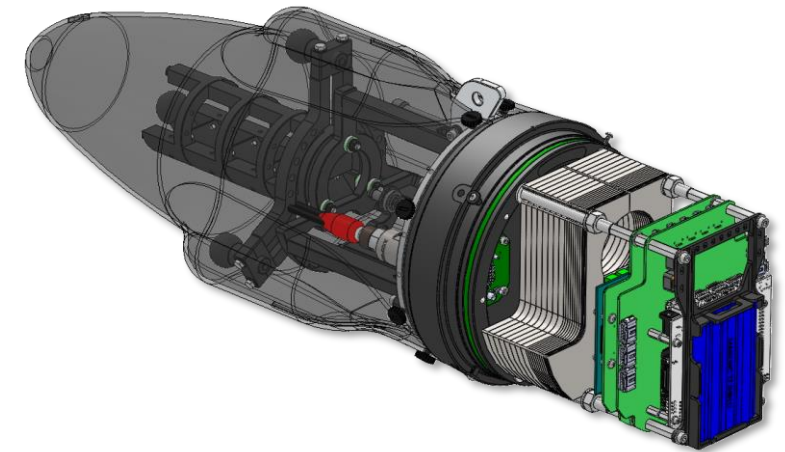
- Typical Payload: Radiometer
- Application: Visual detection (Satellite/Airplane) limit depth assessment



AURIS -Acoustic Underwater Recorder and Intelligent System

STANDARD AURIS ACOUSTIC PAYLOAD (Subject to export license)

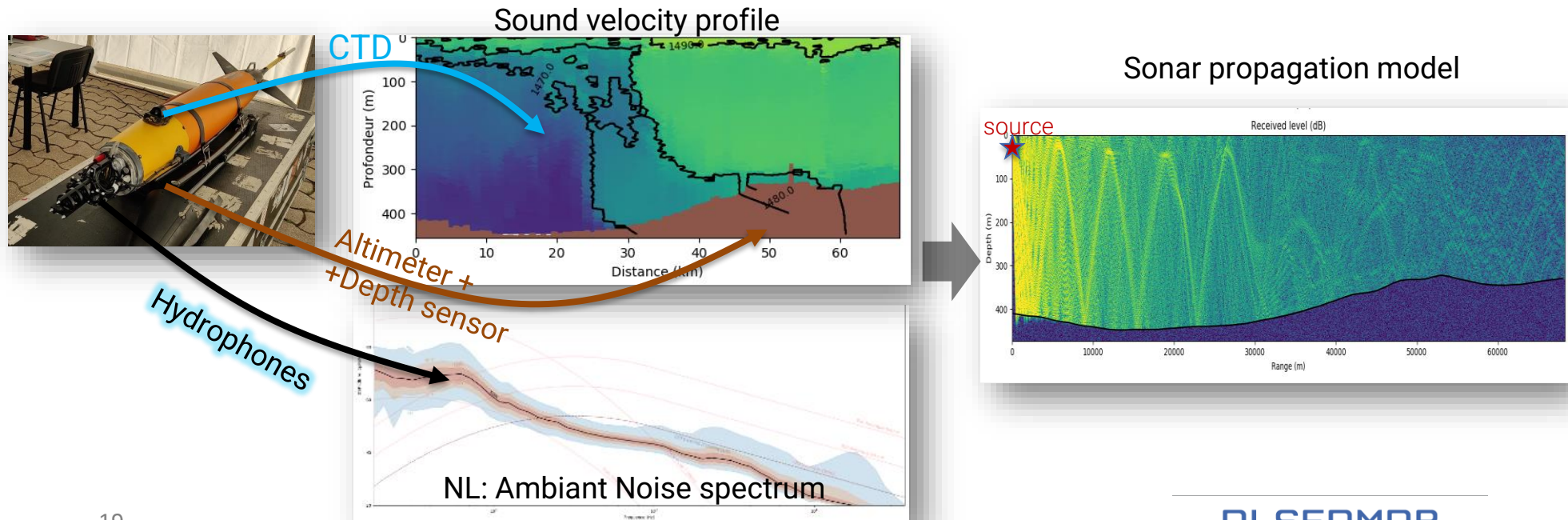
- Hardware: 4 Hydrophones in tetrahedral configuration within nose cone:
 - No flow-noise on Hydrophones
 - Direction-Of-Arrival assessment
 - 6dB Gain (Directivity Index)
- Software:
 - Included:
 - Recorder
 - 1/3 octave ambient noise real-time analysis
 - Options:
 - Marine Mammals detection
 - Surface Ship Traffic detection
 - Blackbox ULB localization
 - ...
 - Open ROS-based Platform for custom signal processing in Python by the customer



Use of SeaExplorer for ASW

Sonar propagation assessment

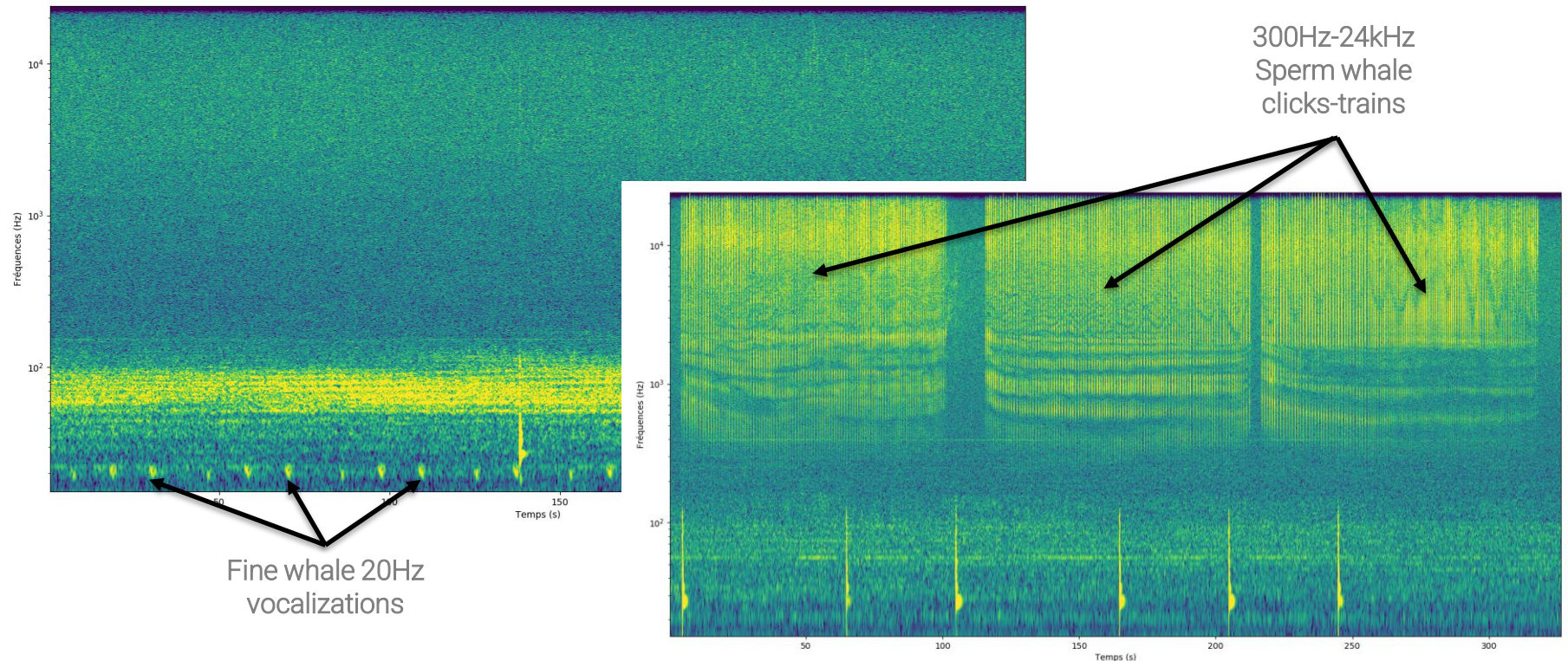
- Principle: Feeding sonar propagation models with all the parameters needed:
 - Bathymetry (From depth and altitude)
 - Sound Velocity profiles (from CTD)
 - Ambient noise (from Hydrophones)
- Output: estimation of Active and passive Sonar range



Use of SeaExplorer for ASW

Sonar propagation assessment

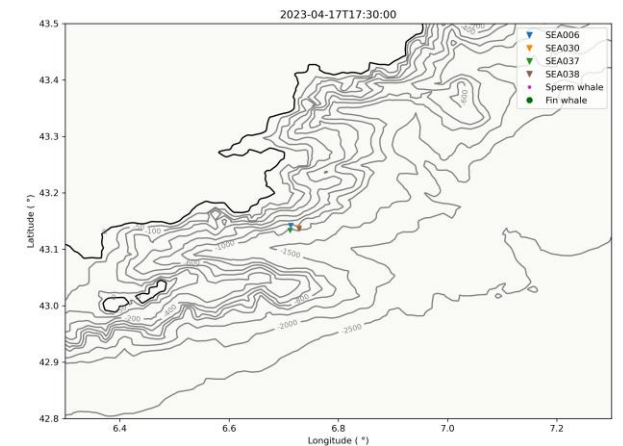
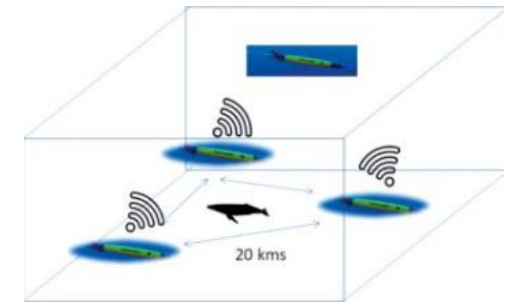
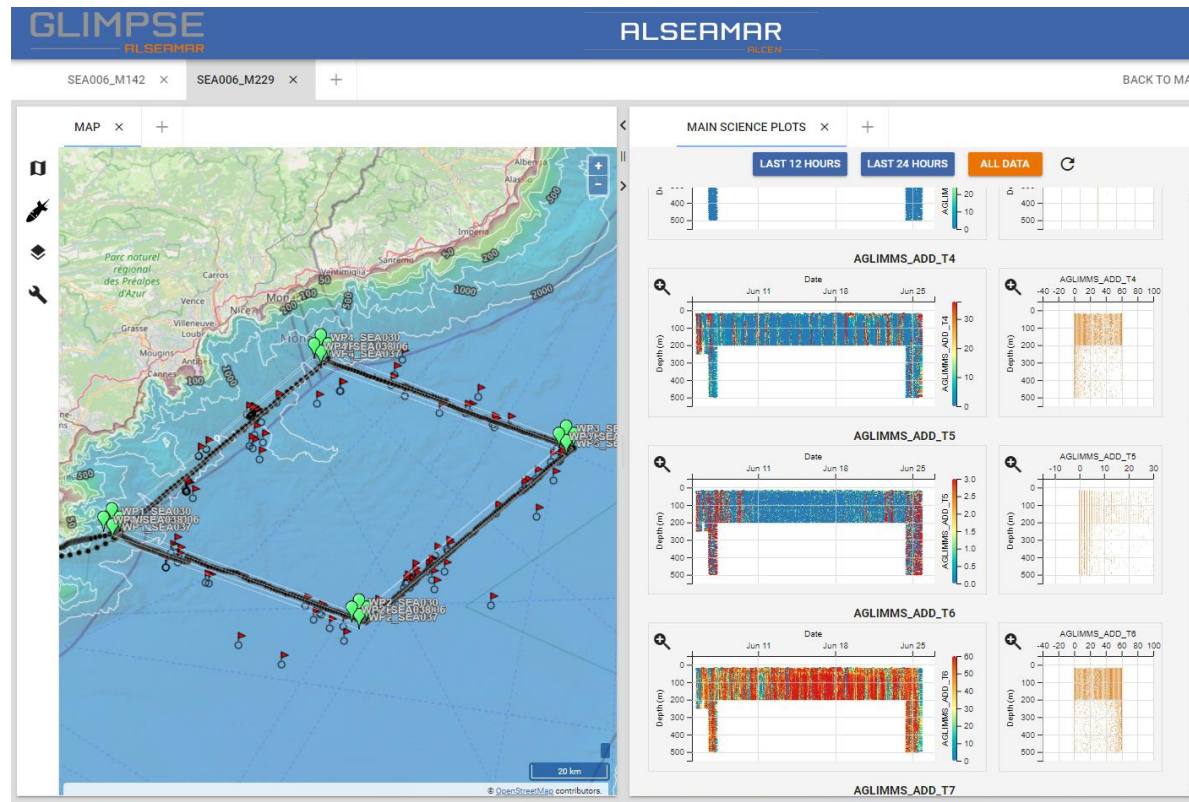
- Passive acoustic monitoring systems
 - AURIS: full frequency range detection.



Acoustic use case – PIAQUO project

PIAQUO project and surface targets during a demo for Navies.

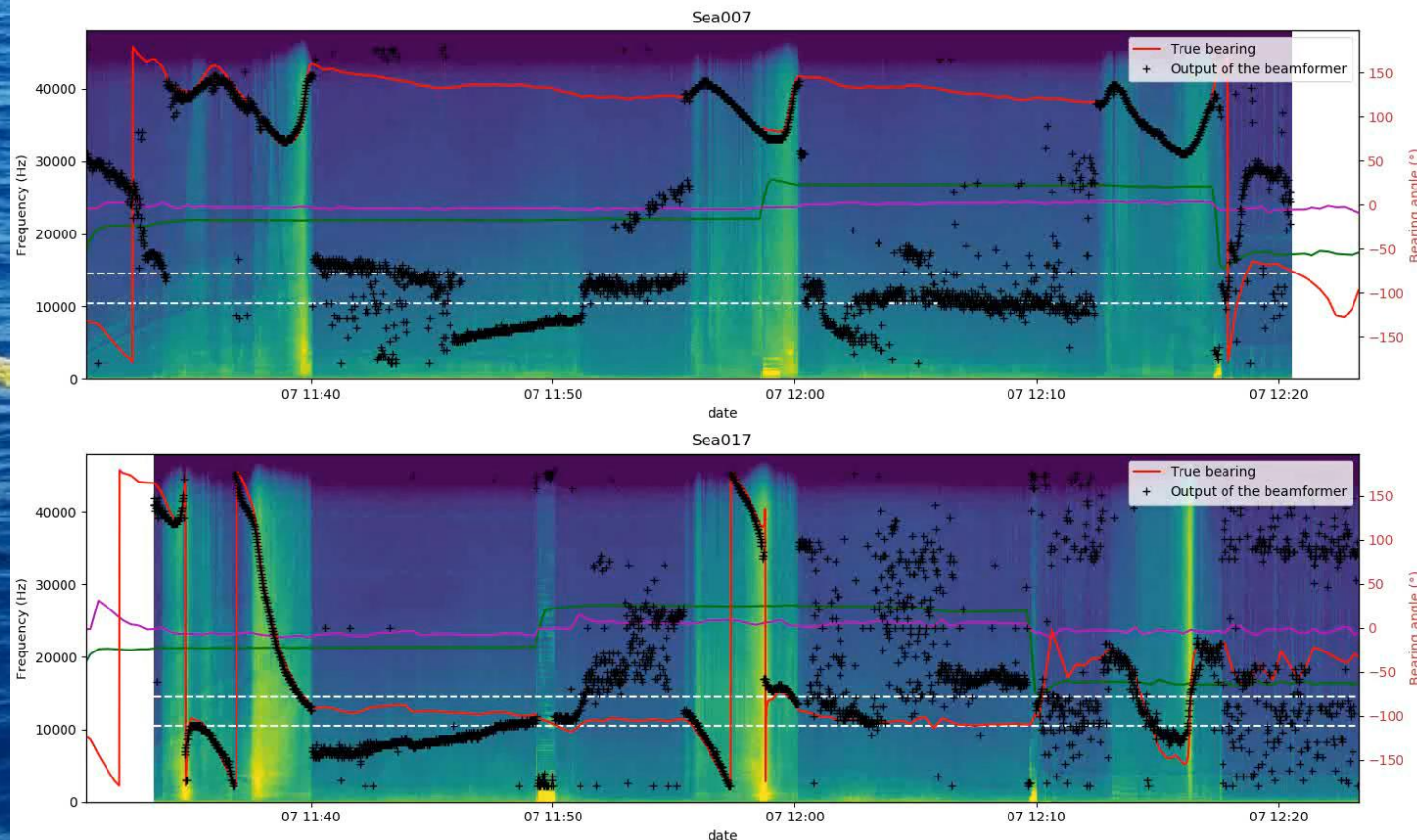
- Detection classification and tracking in real time, sperm whales and fin whales detection (in circle with the flag on the map)



Use of SeaExplorer for localisation

Passive localisation of surface ship

- Passive Localisation of a RIB by two Seaexplorers equipped with a 3D acoustic array:

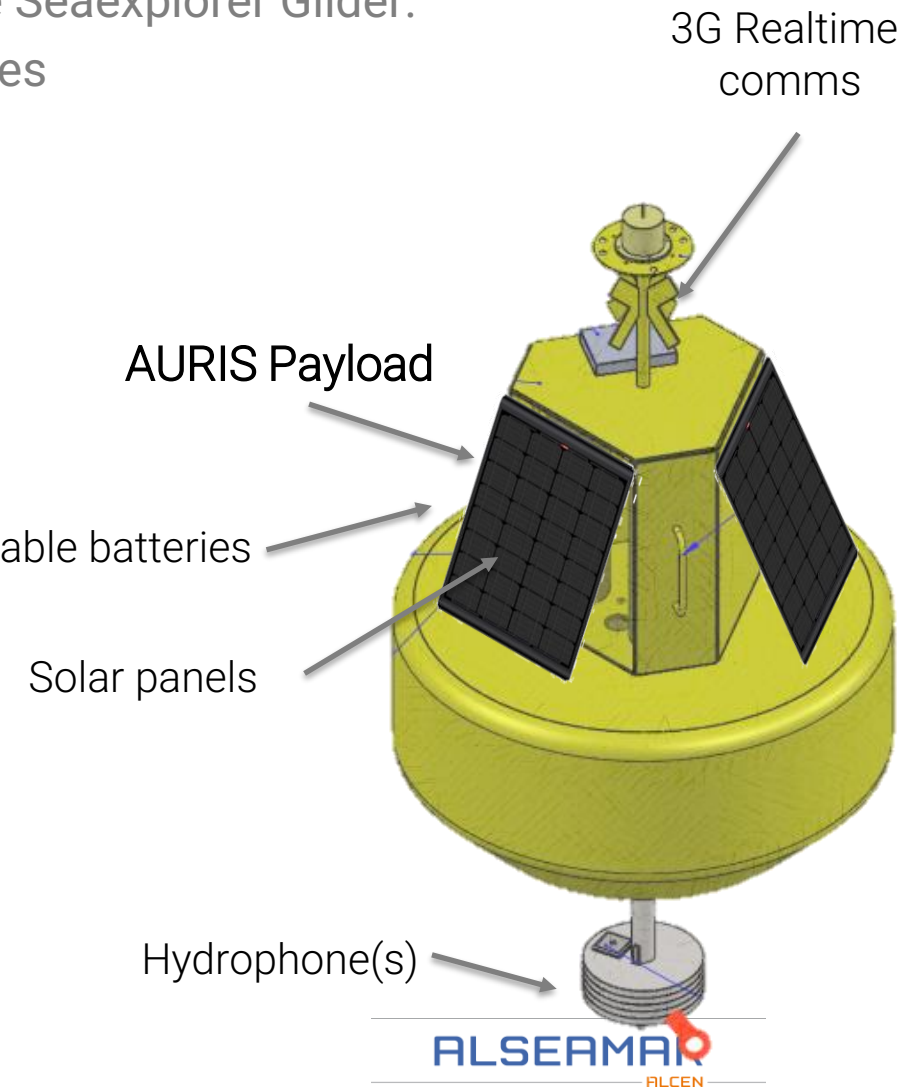


- Red on map: vessel position
- Red on spectrum: Directions measures by gliders
- Black: Computed directions
- Green arrow on map: Position and heading of Seaexplorer #1
- White arrow: Target detection calculated
- Blue arrow on map: Position and heading of Seaexplorer #2
- White arrow: Target detection calculated

Standard AURIS Buoy (New)

Main principle

- Same AURIS Acoustic payload than on the Seaexplorer Glider:
 - Real-time passive acoustics anomalies
- Dedicated to shallow waters (anchored)
- **Will be connected to Glimpse**
(single interface for both platforms)
- **Custom development possible:**
 - Surface Cameras
 - AIS receiver



Distributed Acoustic Sensing (DAS)

Main principle

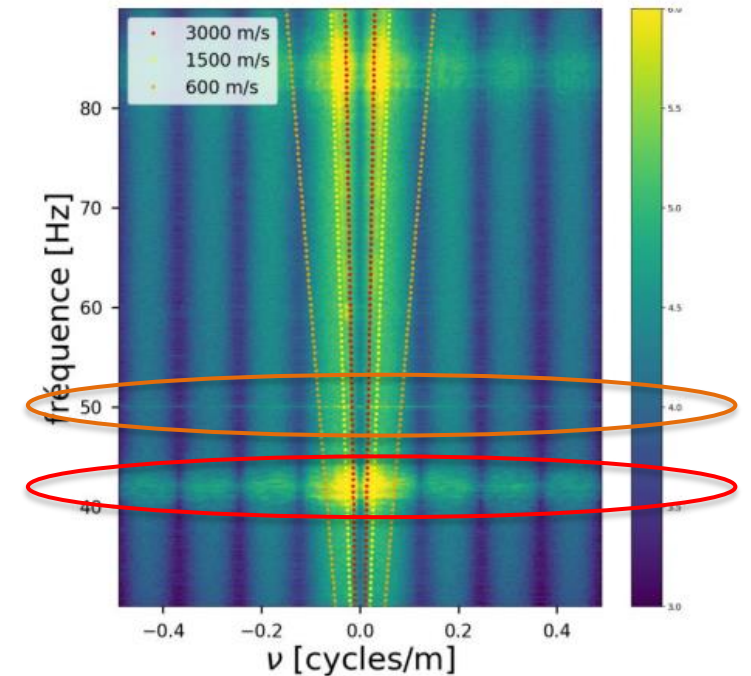
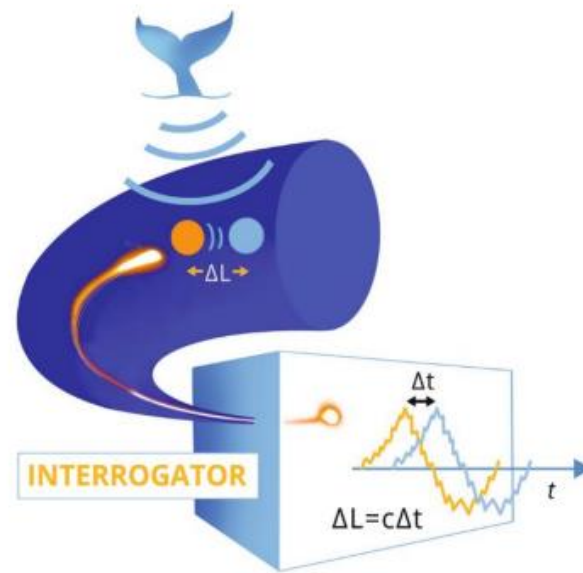
- Using an existing network to build a large-scale passive sonar
- Cooperation with submarine networks companies :
 - Network company interrogator hardware
 - Real-time detection software from ALSEAMAR
- Advantages:
 - no deployment at sea (large number of cables already in place)
 - Large coverage (>70km)
 - Realtime information
- Drawback:
 - Not as sensitive as a standard Hydrophone



Distributed Acoustic Sensing (DAS)

Results

- Use of fiber optic as acoustic sensors over >70km range



- Detection results : Ships speed & heading, ships right/left side distinction, electric installations, UUV sonar or pinger, impacts, swell...
- Calculation of RPM.
- Target identification

Use case: Our capabilities in Northern Europe



VOTO Foundation: an example of SeaExplorer's effectiveness in the Baltic Sea



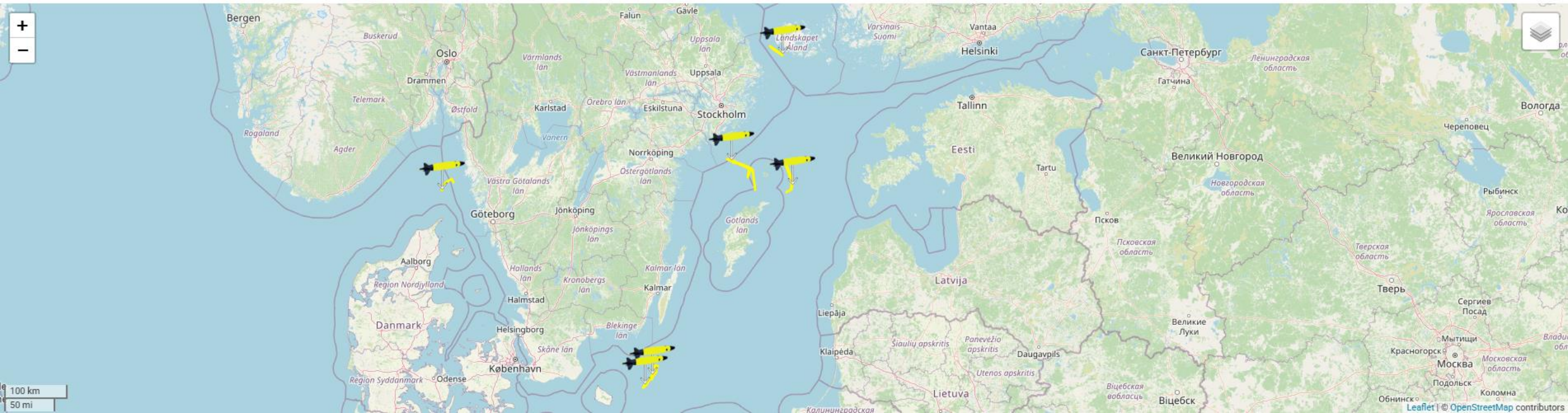
- 15 gliders dedicated to scientific surveys, always 5 at sea for continuous data collection
- Coastal monitoring now possible thanks to our new glider designed for shallow waters

Observations Portal

Our 15 gliders have recorded **431,905** profiles during **15 years 83 days** at sea, covering **136,710 km**.

Our 4 sailbuoys have spent **1 years 78 days** at sea sailing **21,117 km**.

Live platform locations

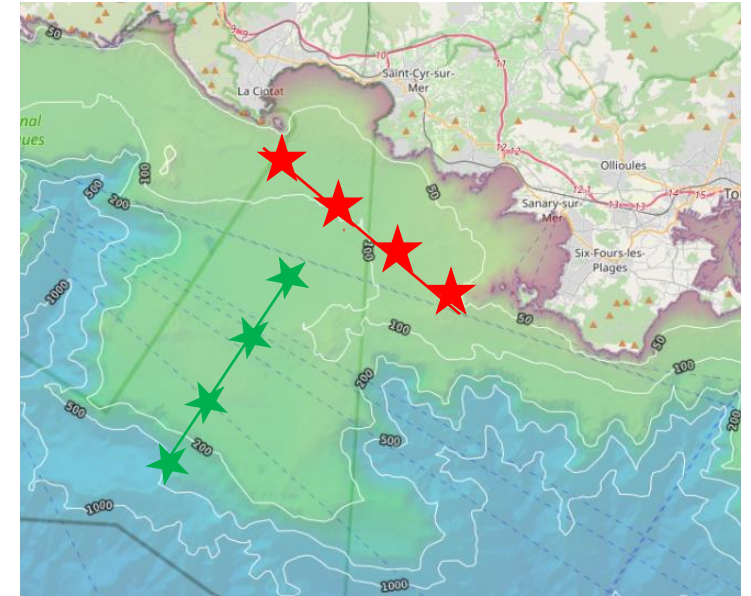
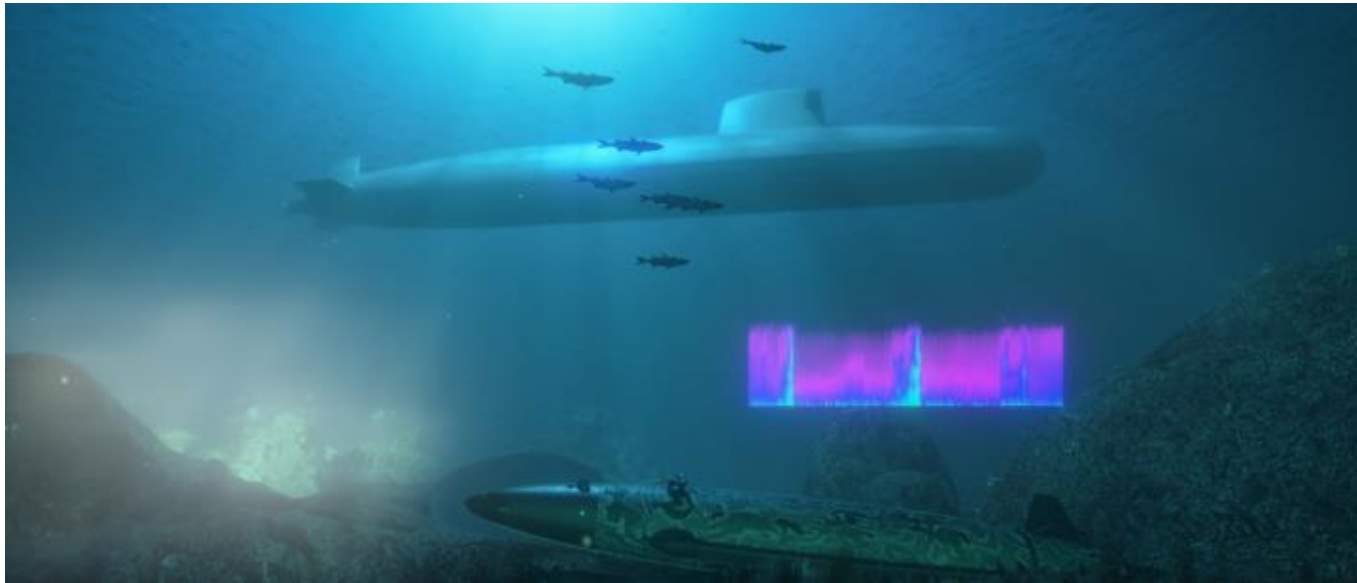


Defence applications : acoustint

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- Detection of submarines, surface vessels or other underwater assets thanks to our acoustic payload and the deployment of multiple gliders in barrier.
- Several gliders can be left on the seabed and programmed to glide up only when an abnormal acoustic signature is detected.

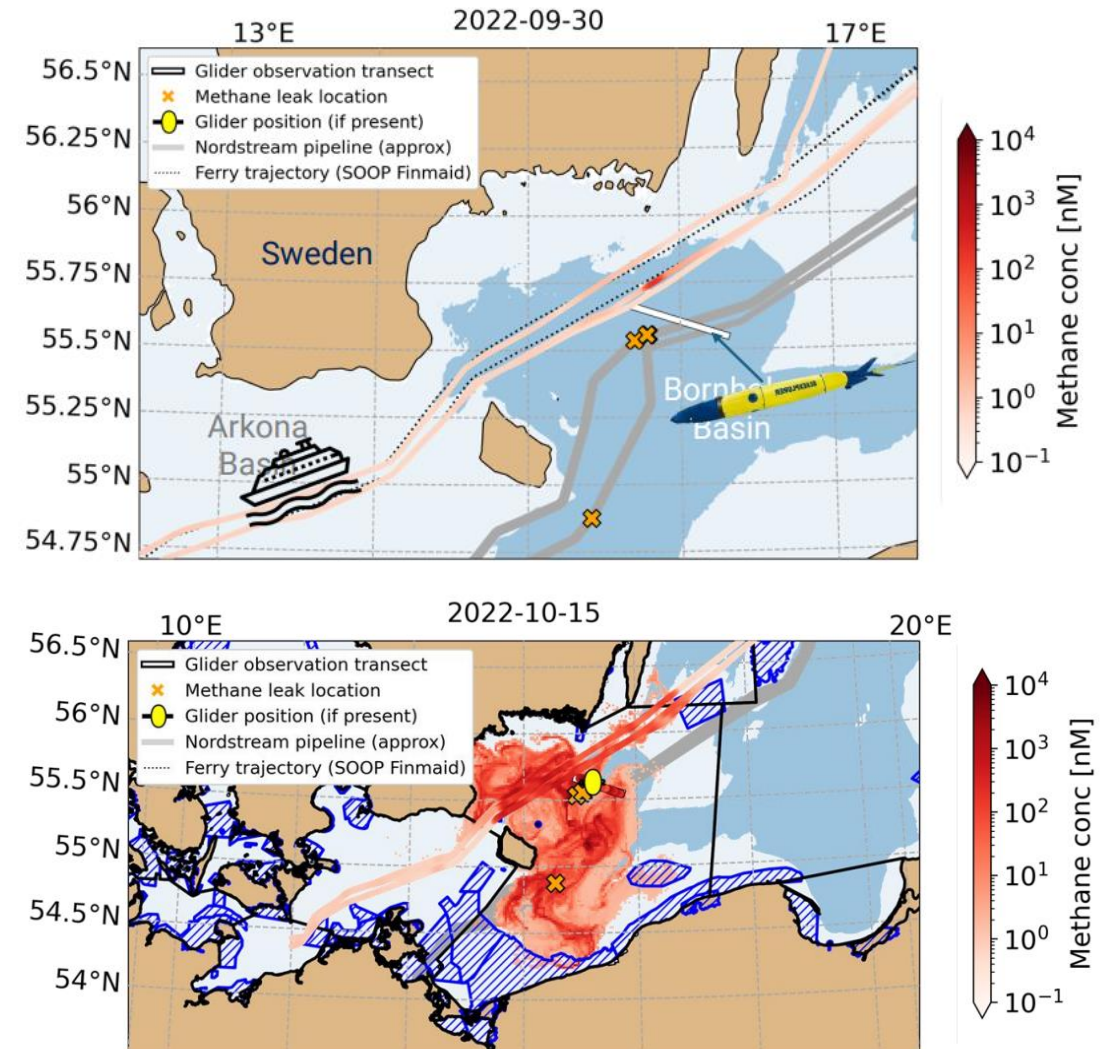


Example of shallow & deep monitoring missions with multiple SeaExplorer gliders equipped with passive acoustic payloads (AURIS).

Defence applications : example of critical underwater cable monitoring

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- The sabotage of the Nord Stream 1 and Nord Stream 2 gas pipelines in 2022 have led to significant environmental consequences.
- In order to determine the extent of methane exposure at sea following the pipelines explosions, our partner the Voice of the Ocean Foundation (VOTO) deployed one of their SeaExplorer in the Baltic Sea.
- Thanks to the data measured by the glider, the foundation and researchers from Göteborgs universitet were able to analyze significant results on the concentration of methane remaining in dissolved form in the sea.

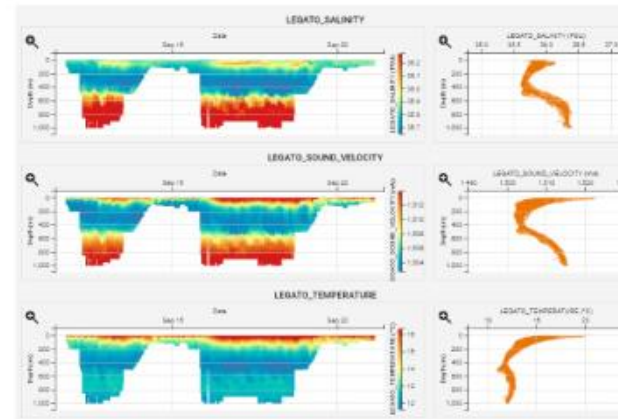


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Defence applications : Rapid Environmental Assessment (REA)

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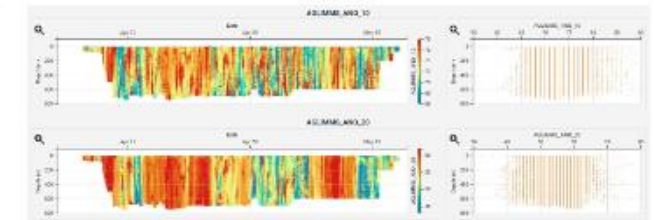
- Monitoring & surveillance of underwater infrastructures, ports and pipelines.
- Gas leaks detection using specific sensors (methane, hydrocarbons, O2...).
- The SeaExplorer can then be used to detect anomalies. Other assets will then have to be used to precisely identify the threat and deal with it if necessary.



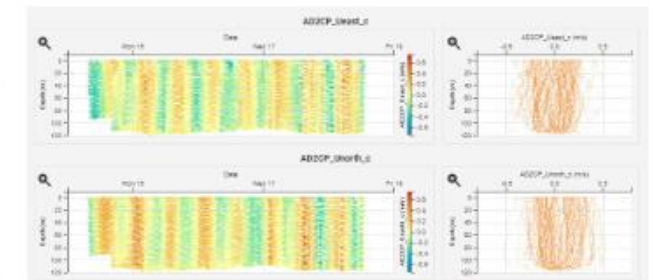
Sound velocity profiles (CTD)



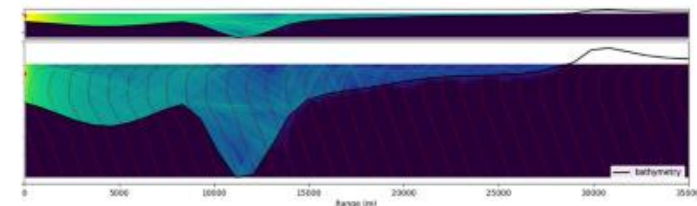
Light penetration (PAR)



Acoustic levels at different frequencies



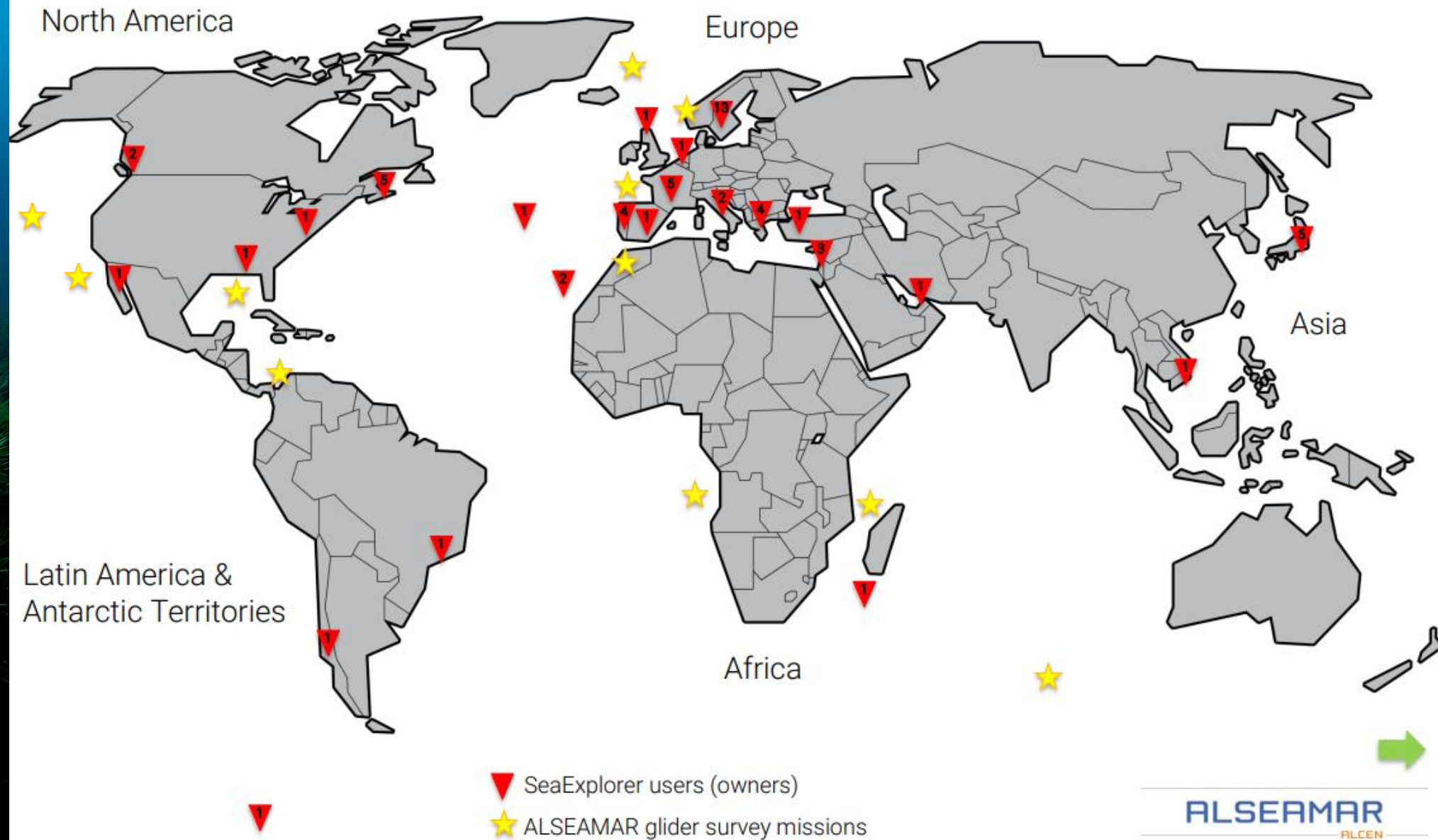
Underwater currents (ADCP)



Sonar Propagation Assessment based on CTD data

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Community of users





TAKE HOME MESSAGE

USING BUOYS AND/OR DAS IN SHALLOW WATERS SURVEY

- Critical infrastructure protection, location and early warning

USING GLIDERS FOR BLUE WATERS SURVEY

- A silent platform, robust & easy to use
- Long distance endurance at sea
- Surveillance of 330 km³ of ocean with a fleet of 10 gliders,
- Communication means gliders, buoys, ship, helicopters...



WICH FUTURE ?

- AI and fleet deployment
- XL-UUV & USV integration
- DAS network development



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