Charting the course for climate change adaptation

Overcoming technological challenges in coastal resilience and ocean science domains

Hamza MAZIH (2nd May 2024)

Global developments… are driving key challenges…

Population growth

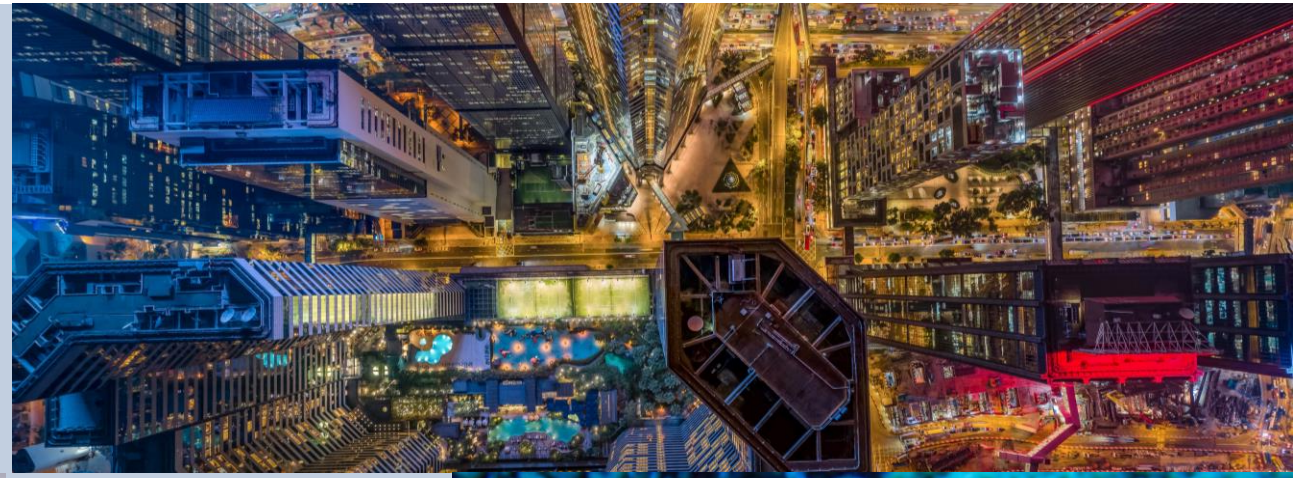
World population projected to reach 9.8 billion by 2050[1]

Growing inequality

Unequal distribution of wealth and resources

Global warming

By 2050, climate change could drive 216 million people to migrate[1]



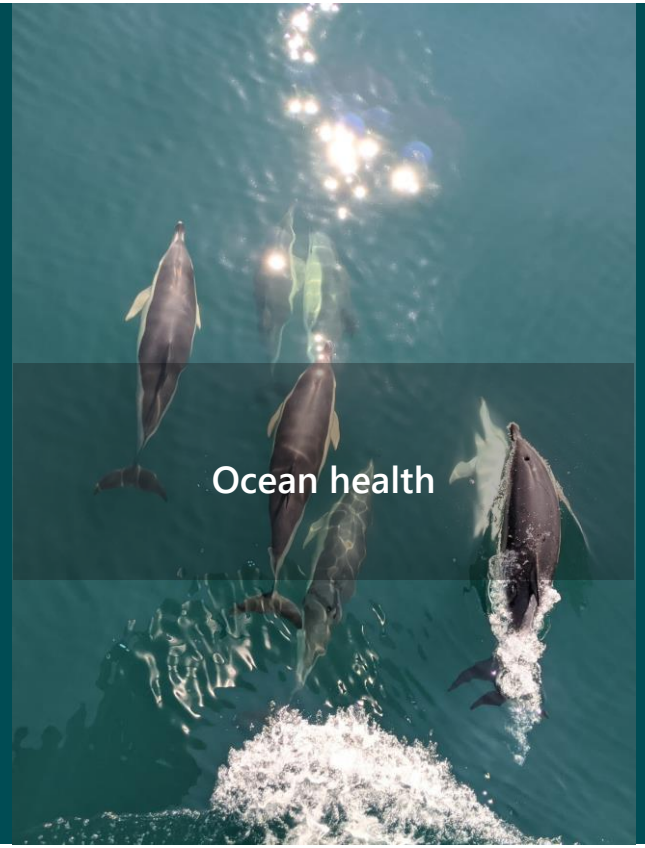
Biodiversity and populations under threat

From Extreme weather, sea level rise, and mega-trends

[1] According to United Nations

[2] Based on data of The World Bank

Investing in our oceans and freshwater systems is vital to keep the planet safe and liveable



SUSTAINABLE DEVELOPMENT GOALS

7 AFFORDABLE AND CLEAN ENERGY

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

11 SUSTAINABLE CITIES AND COMMUNITIES

14 LIFE BELOW WATER

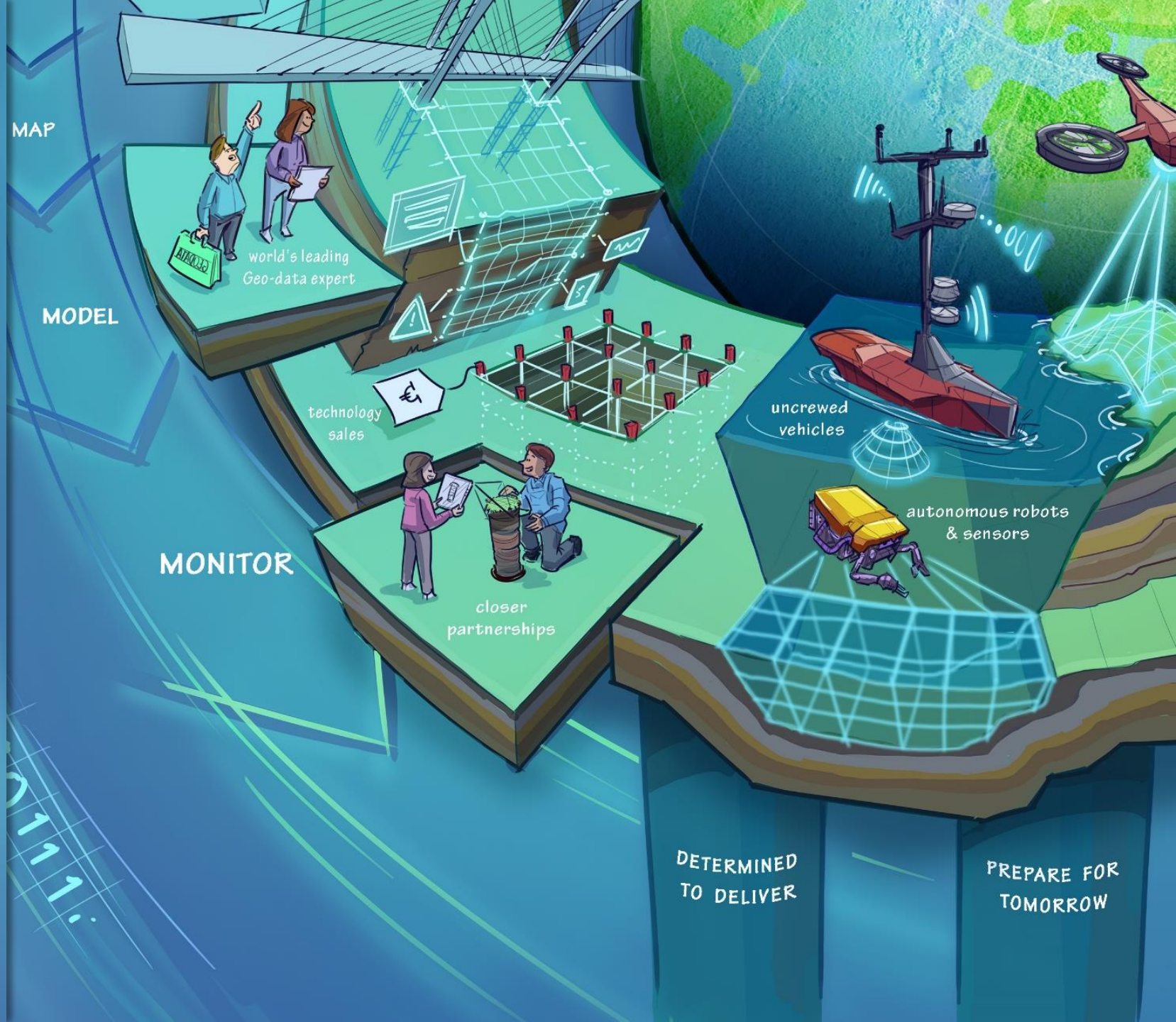
15 LIFE ON LAND

FUGRO

FUGRO
TOGETHER WE CREATE A SAFE & LIVEABLE WORLD
protect the natural environment
remote operations & support
PEOPLE
MAP
MODEL
MONITOR
world's leading Geo-data expert
technology sales
closer partnerships
uncrewed vehicles
autonomous robots & sensors
coastal resilience
WATER
ENERGY
INFRASTRUCTURE
climate change
urbanisation
connected devices
engaged society
population growth
satellite positioning
artificial intelligence
predictive analytics & cloud automation
subscription services
DIGITAL TWIN
DETERMINED TO DELIVER
PREPARE FOR TOMORROW
WE DO WHAT'S RIGHT
WE BUILD TRUST

Introduce remote and digitalised workflows to enable a reduced carbon footprint

Combine people and technology to remain the world's leading Geo-data expert



The world's leading Geo-data specialist

Global player with local presence

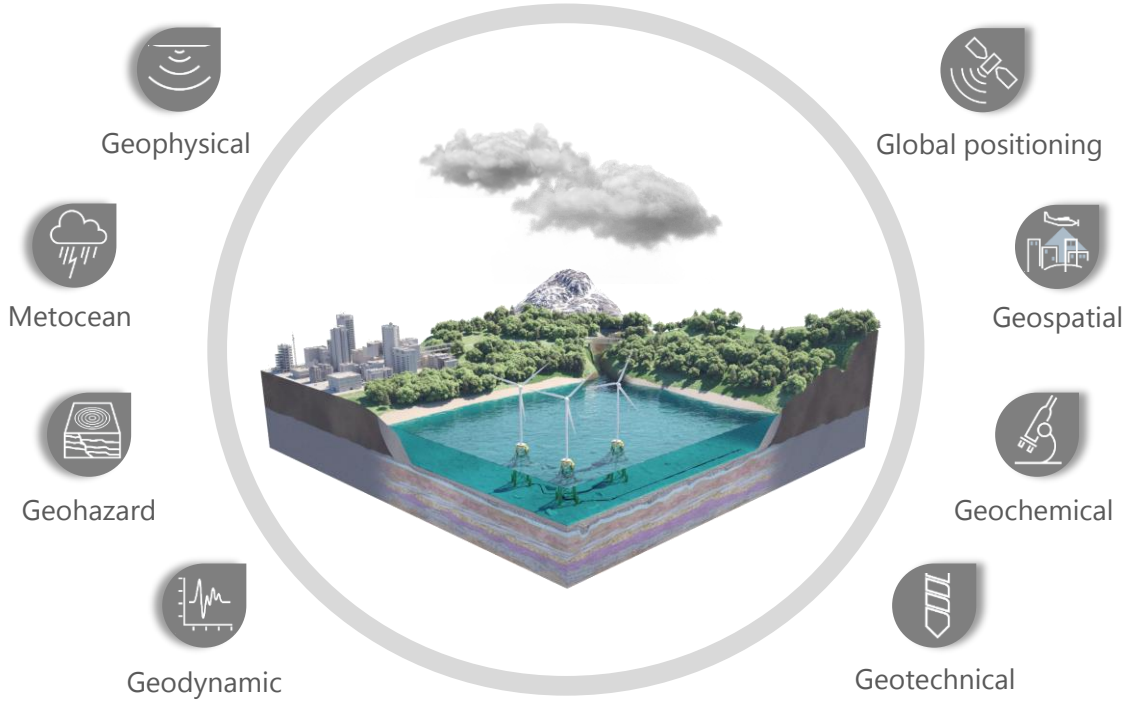
11,009
Employees

57
Countries

#1
in many of our markets

> **Our success is determined by our unique client solutions, highly skilled people, market-agnostic assets and innovative scalable technology**

Fugro portfolio



Some of our market-agnostic assets

easily deployable across global markets

8
uncrewed surface vessels (USVs)

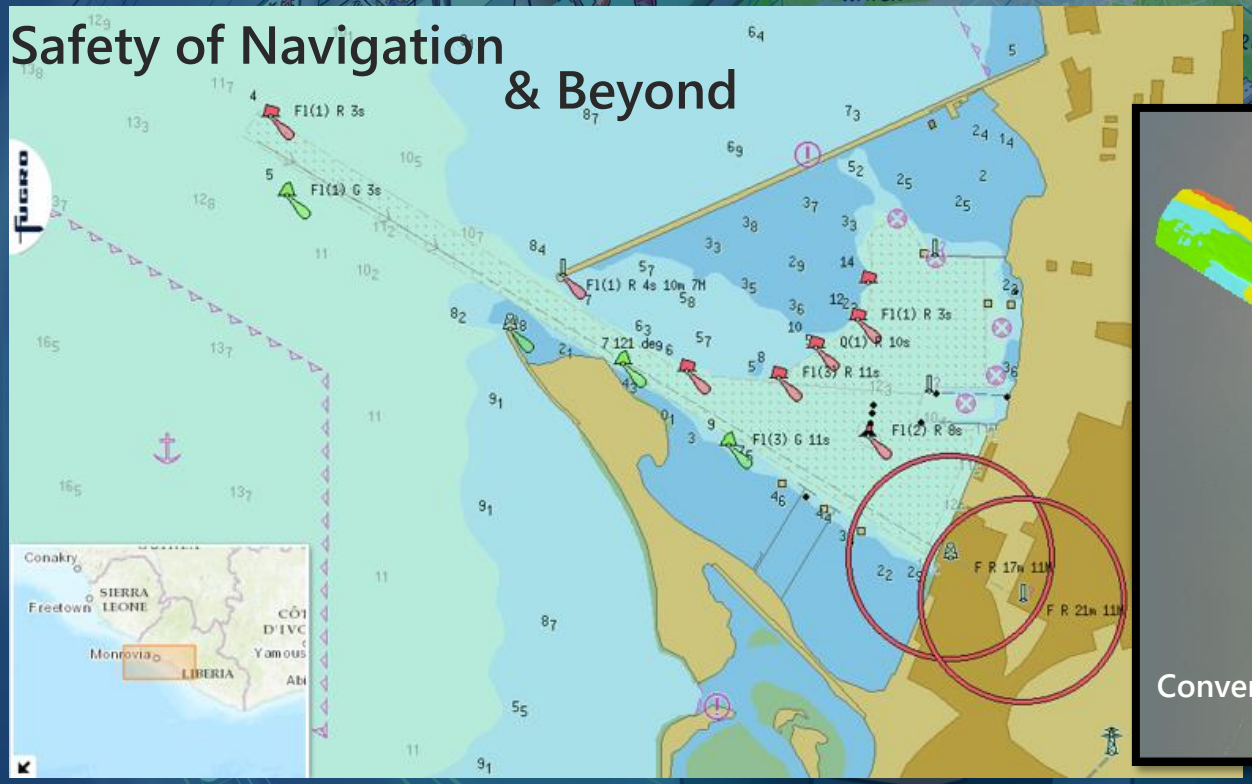
26
specialised service vessels (+8 LT charters)

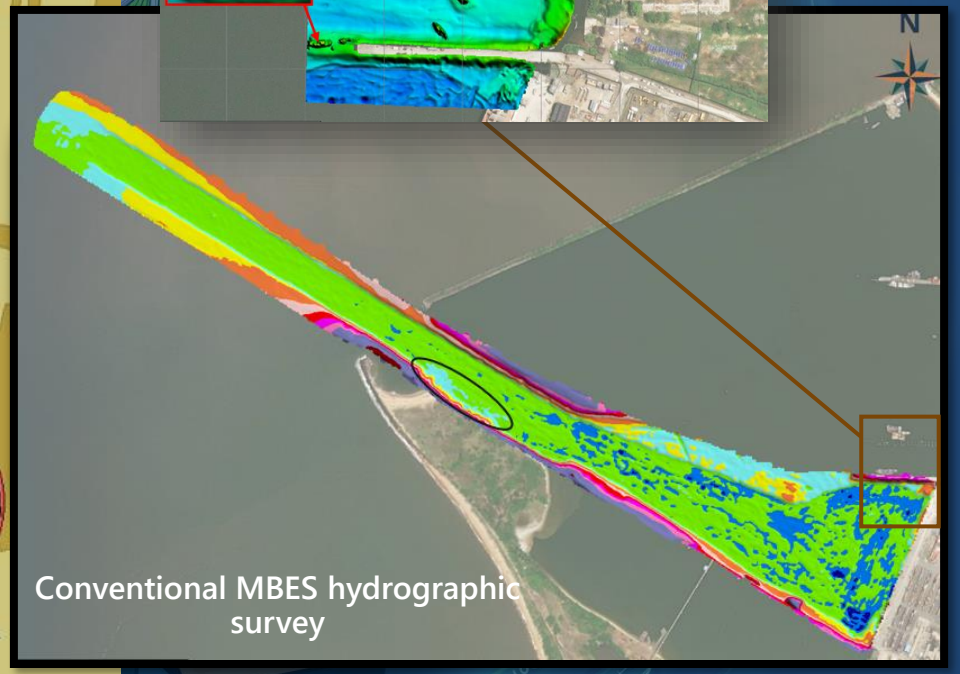
64
remotely operated vehicles (ROVs)

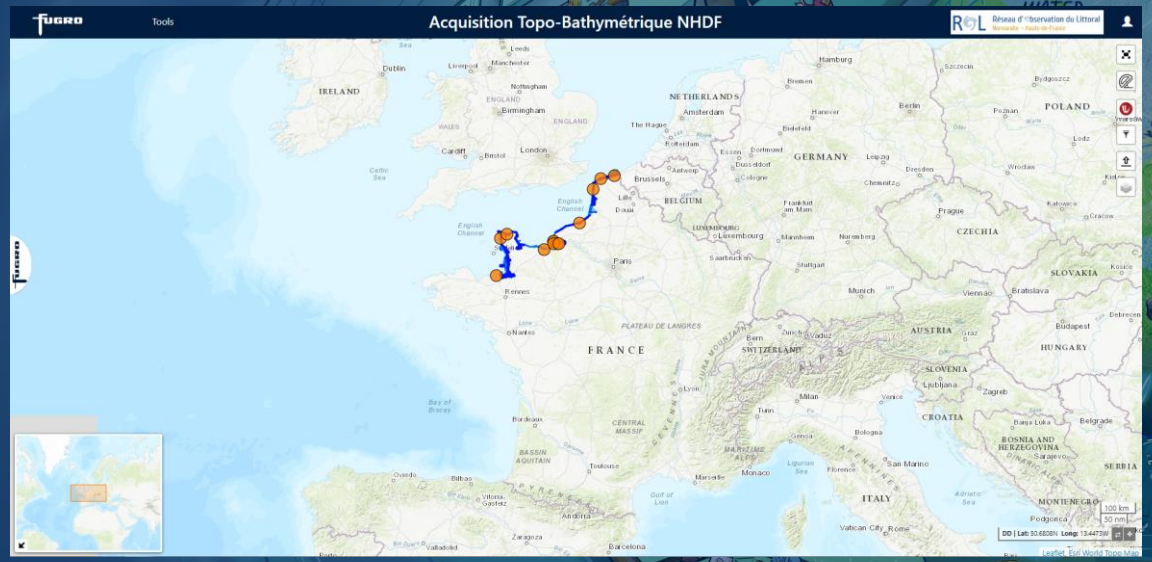
4
autonomous underwater vehicles (AUVs)

Global network of remote operations centres

Safety of Navigation & Beyond

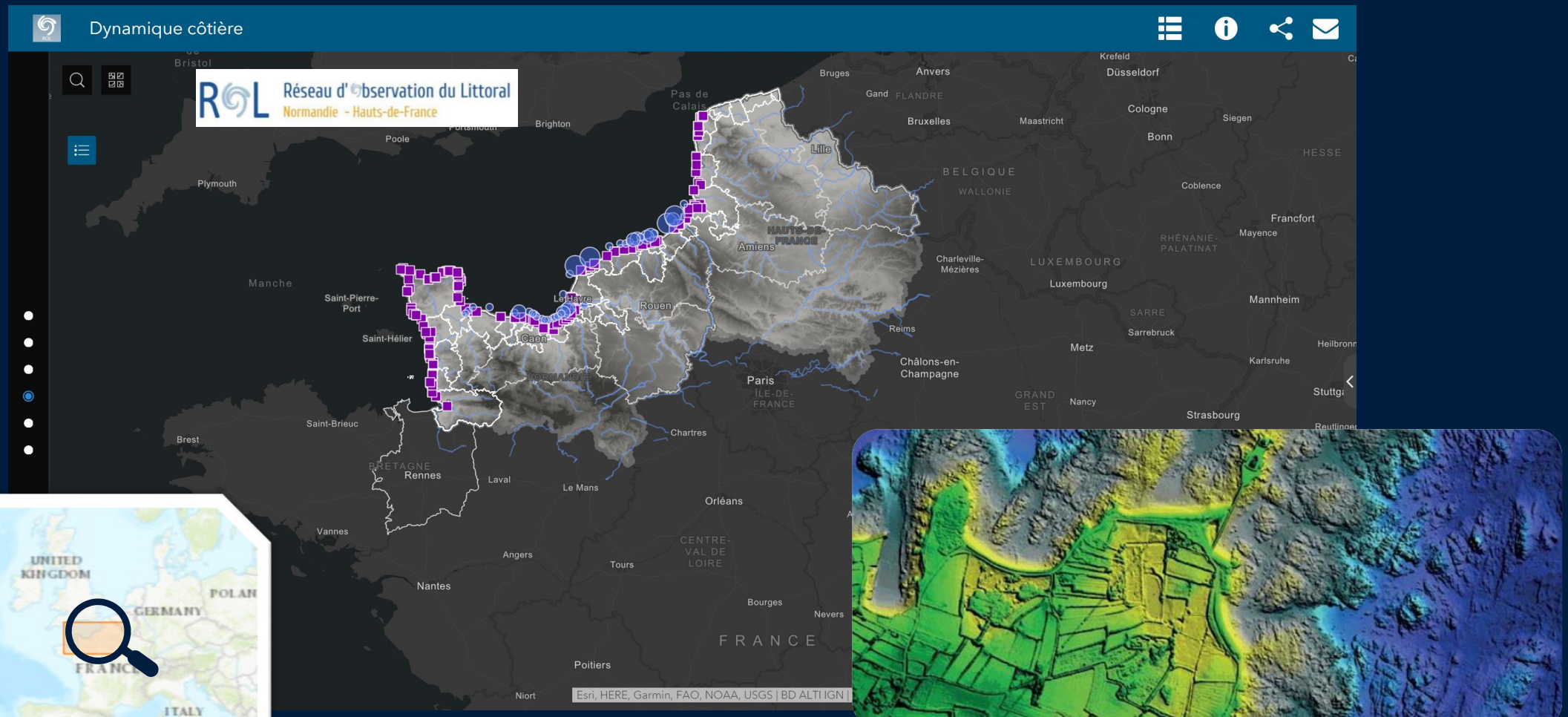


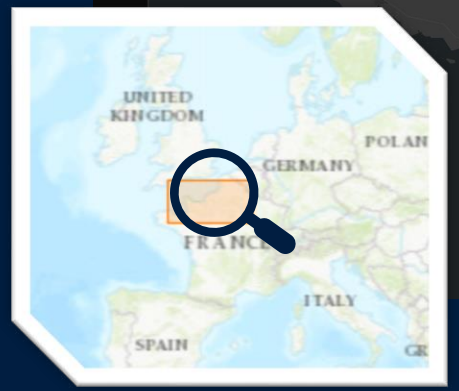



Tools
Acquisition Topo-Bathymétrique NHDF
Réseau d'Observation du Littoral
IRELAND
NETHERLANDS
GERMANY
POLAND
BELGIUM
CZECHIA
SLOVAKIA
AUSTRIA
HUNGARY
FRANCE
SWITZERLAND
SLOVENIA
CROATIA
BOSNIA AND HERZEGOVINA
SERBIA
ITALY
MONTENEGRO
SPAIN

Tools
ISPRA - Mappatura Posidonia
Documentazione
FRANCE
SWITZERLAND
HUNGARY
SLOVENIA
CROATIA
SERBIA
ITALY
SPAIN
TUNISIA
GREECE
ALBANIA
BULGARIA

Client Monitoring Program Purpose & Objectives

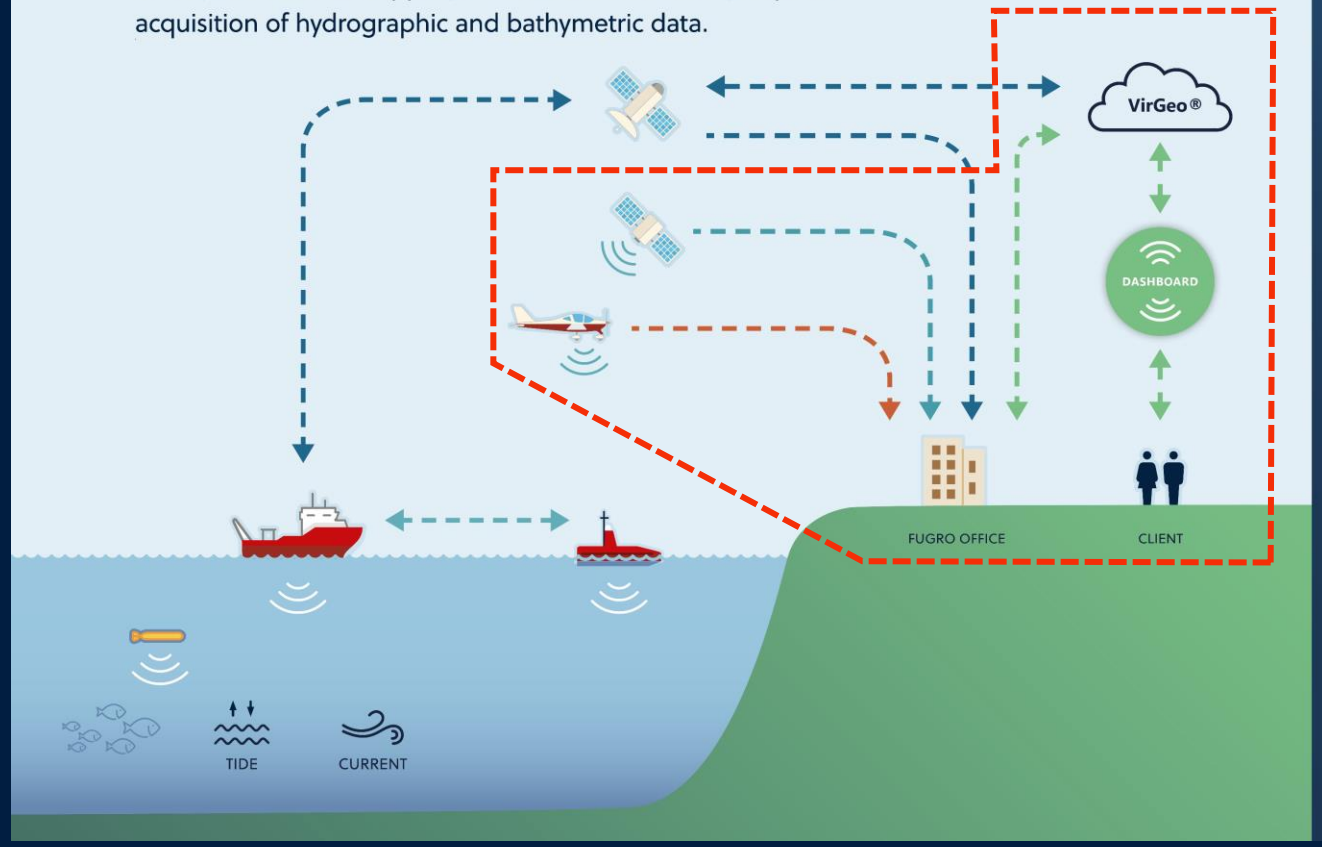




Technical solution portfolio

Hydrographic Solutions

A range of seabed mapping services for fast and high-quality acquisition of hydrographic and bathymetric data.



BENEFITS

- **Satellite imagery analysis** supports bathymetry and environmental mapping of nearshore environments
- Airborne lidar bathymetry captures **fast and high-quality** shallow water bathymetry over large areas
- Vessel based multi beam echo sounder acquires **accurate hydrographic data** reaching all ocean depths
- Integrated **metocean observations** for accurate vertical datum reduction and charting applications
- Autonomous underwater vehicles capture **precise** and **reliable** data for seabed surveys and environmental studies

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RAMMS 2.0

Rapid Airborne Multibeam Mapping System

Enhanced 60 Hz / Machine Learning

Compatible with uncrewed solutions

Dual lasers

Fugro has used RAMMS to map more than 50,000 km^2 in the Americas and Europe, meeting international accuracy standards while also reducing carbon emissions by up to 80%.

3x visual water clarity depth penetration

Full water column

Reflectance imagery

Implementation: Fugro RAMMS ALB Solution

- Depth Performance: 3x Secchi
- Point cloud: 2.5pts/m2 - IHO Order-1a compliant
- Machine Learning Processing
- Topo-Bathy site investigations
- Significant CO_2 emission reduction

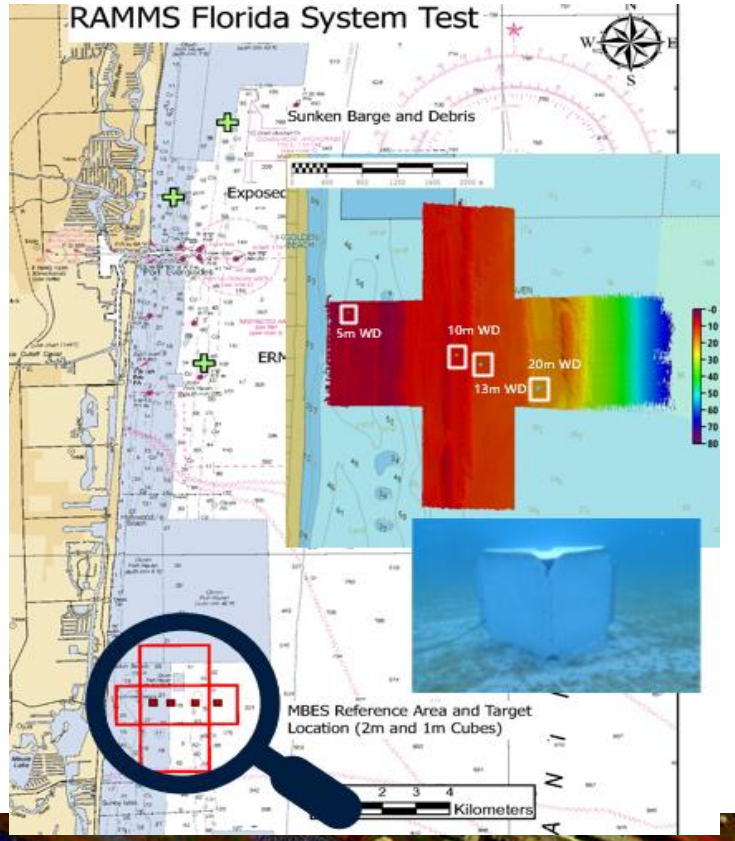
Some applications:

Nautical Charting / Habitat Mapping
Coastal zone mapping for coastal resilience (flooding modeling, etc.)

Feature automatic detection results

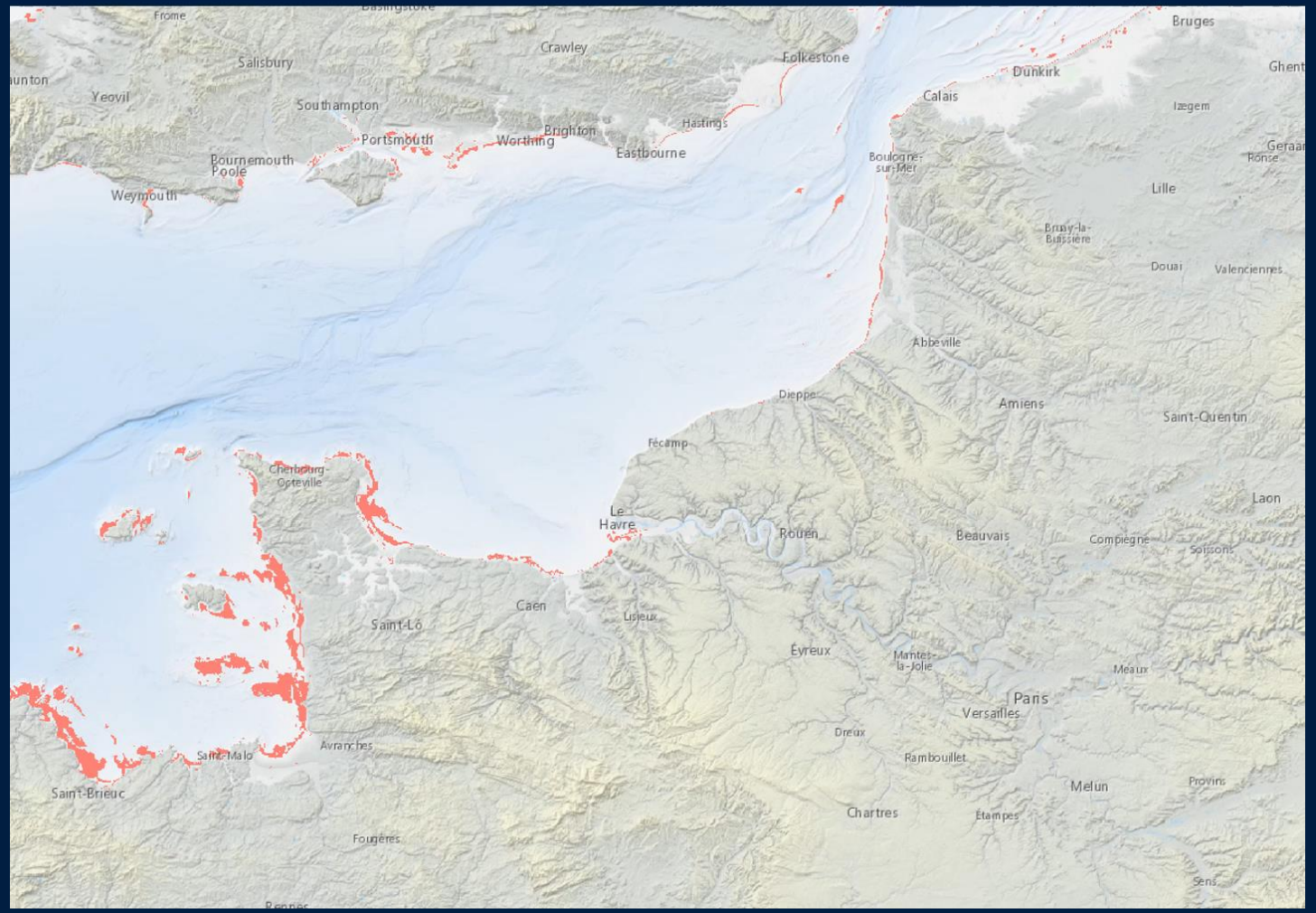
- Survey speed: varying 110-140kts
- Survey altitude: 325 AGL
- ext. depth @ 25 m

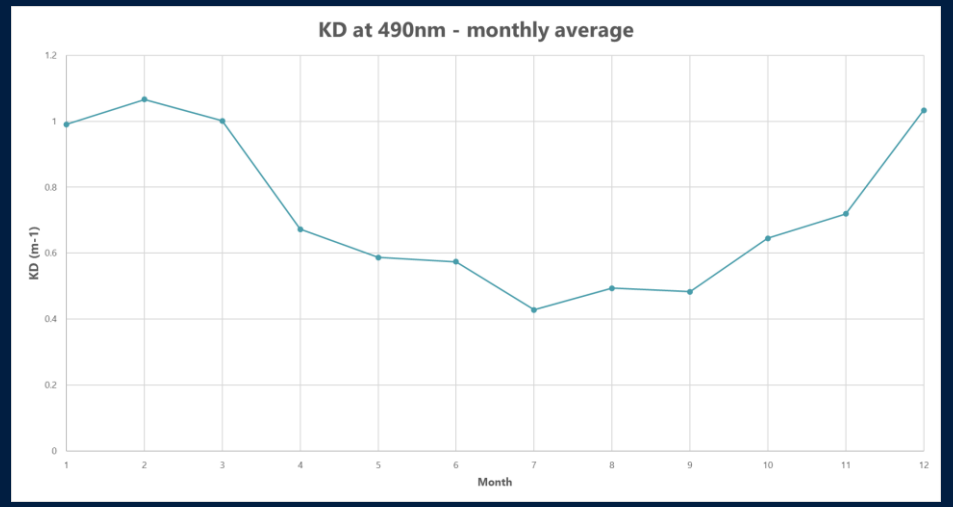
Target size	Line #	Water depth	Feature detection (pass/fail)
Cube 1 m	10001	5.8 m	✓
	10019	5.8 m	✓
	10020	5.8 m	✓
Cube 1 m	10003	9.3 m	✓
	10008	9.3 m	✓
	10009	9.3 m	✓
	10019	9.3 m	✓
Cube 2 m	10002	9.3 m	✓
	10003	9.3 m	✓
	10008	9.3 m	✓
	10009	9.3 m	✓
	10019	9.3 m	✓
	10020	9.3 m	✓
Cube 1 m	10003	13.8 m	✓
	10007	13.8 m	✓
	10019	13.8 m	✓
Cube 2 m	10003	13.8 m	✓
	10007	13.8 m	✓
	10019	13.8 m	✓
	10020	13.8 m	✓
Cube 2 m	10019	19.8 m	✓
	10020	19.8 m	✓

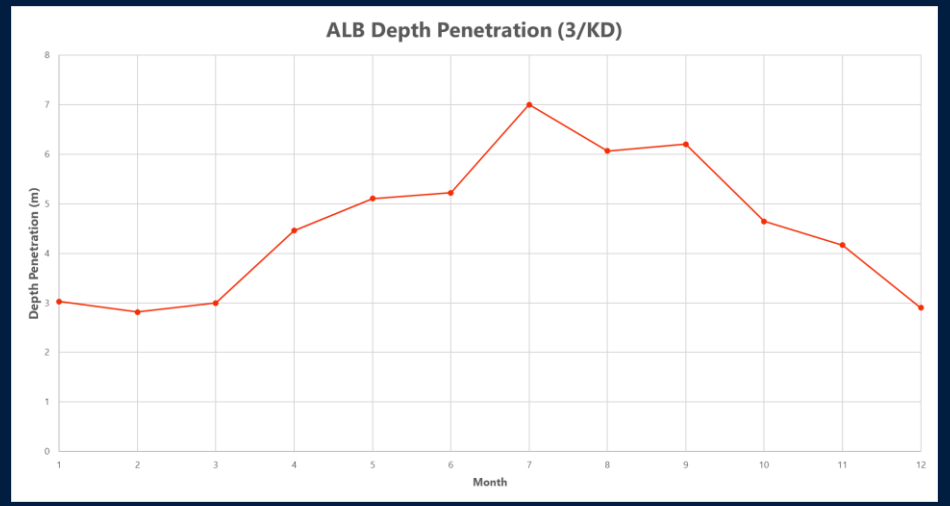


Pre-engagement leveraging from the SatAnalytics tool

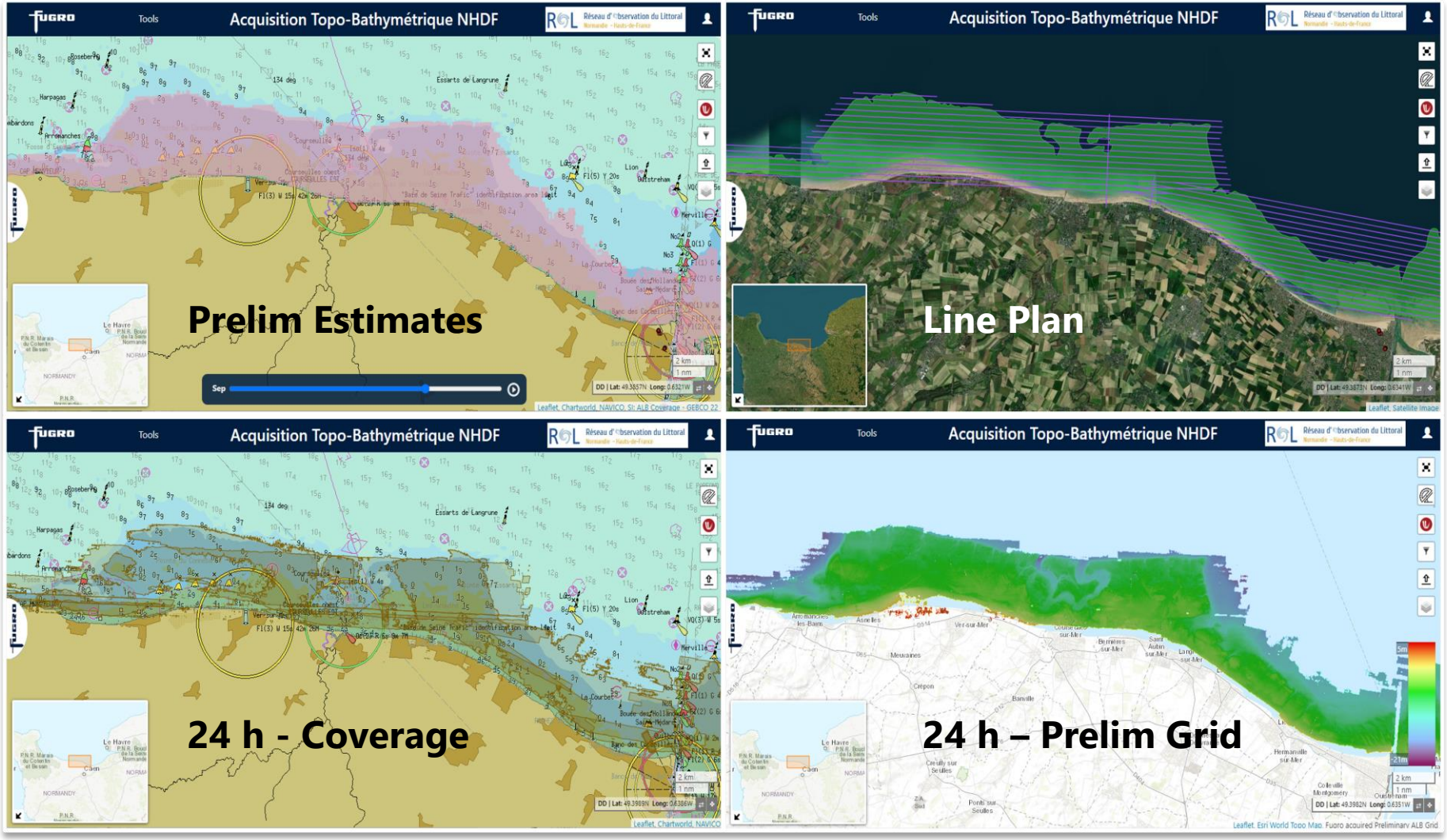
Janvier



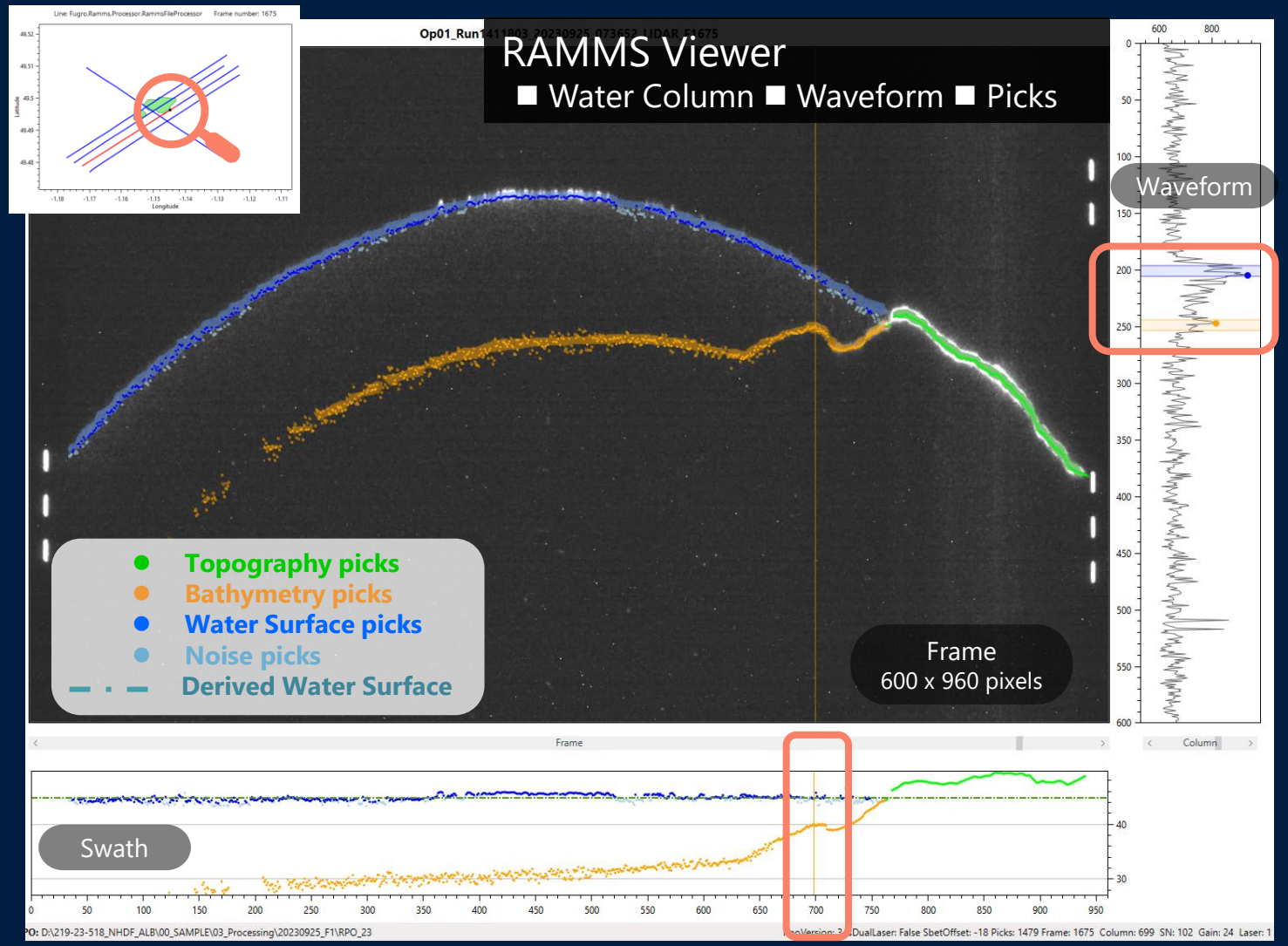


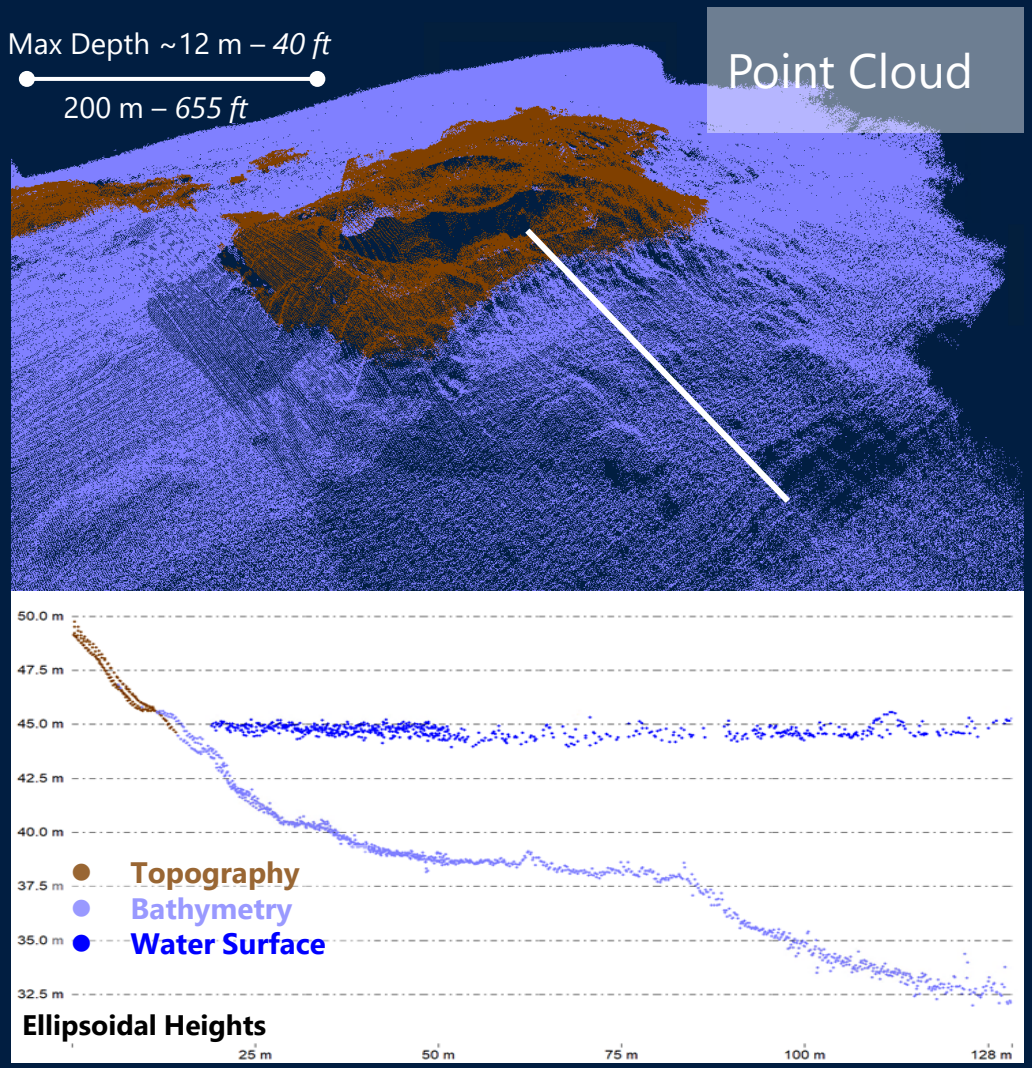


Implementation: VirGeo® WebGIS platform



Machine Learning Data Classification





Réseau d'observation du Littoral Normandie - Hauts-de-France

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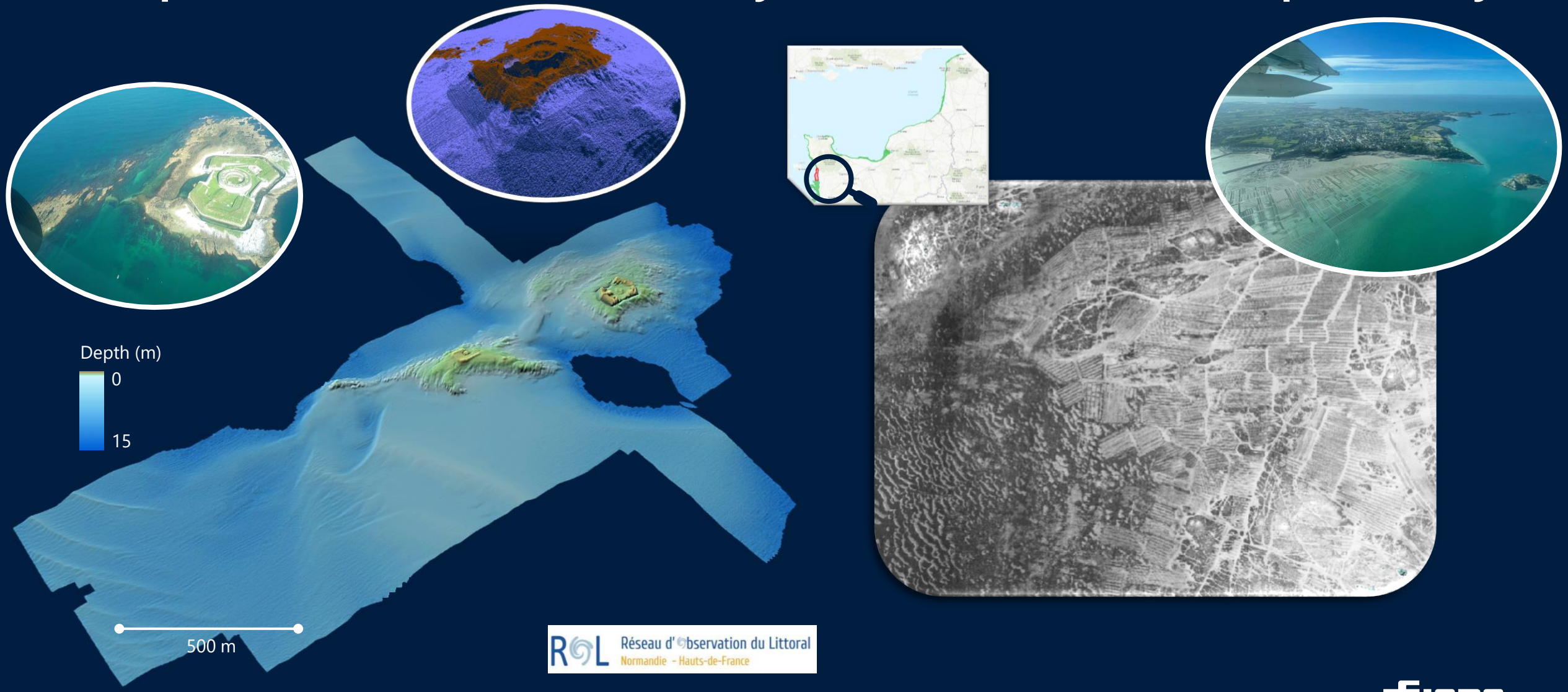
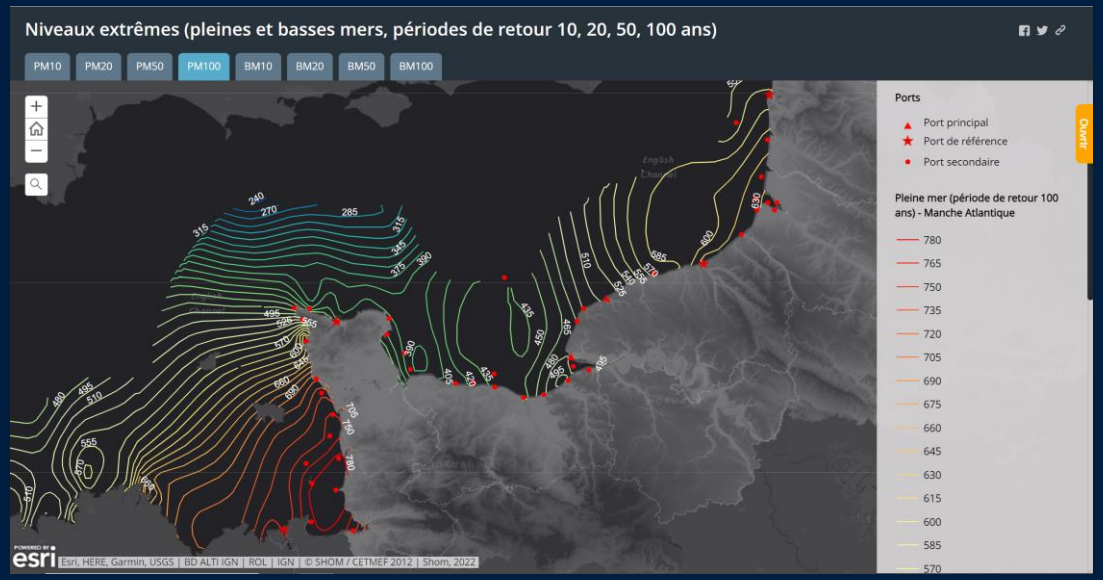
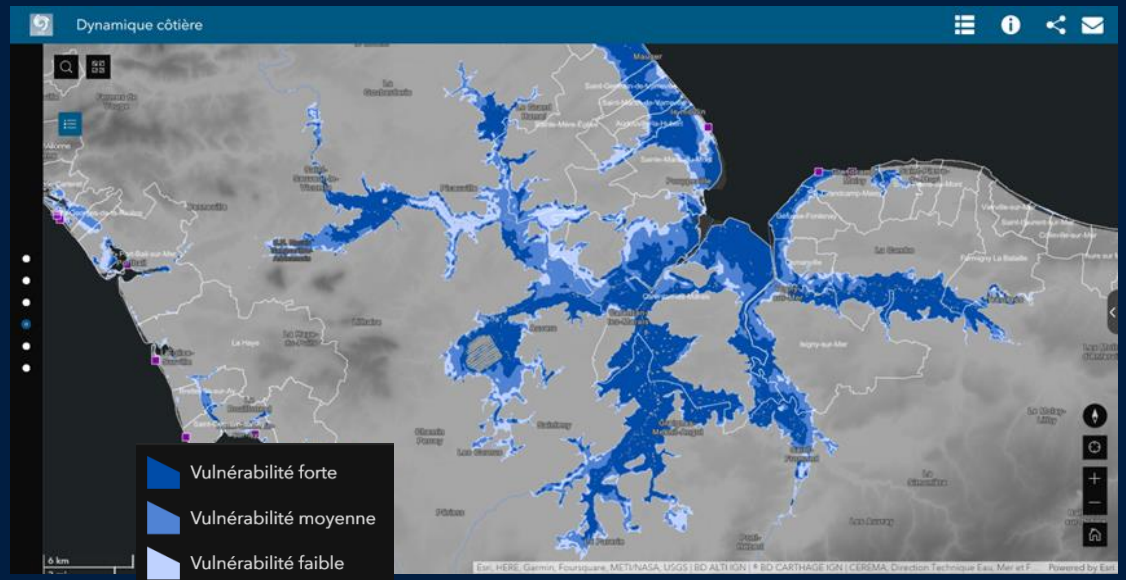
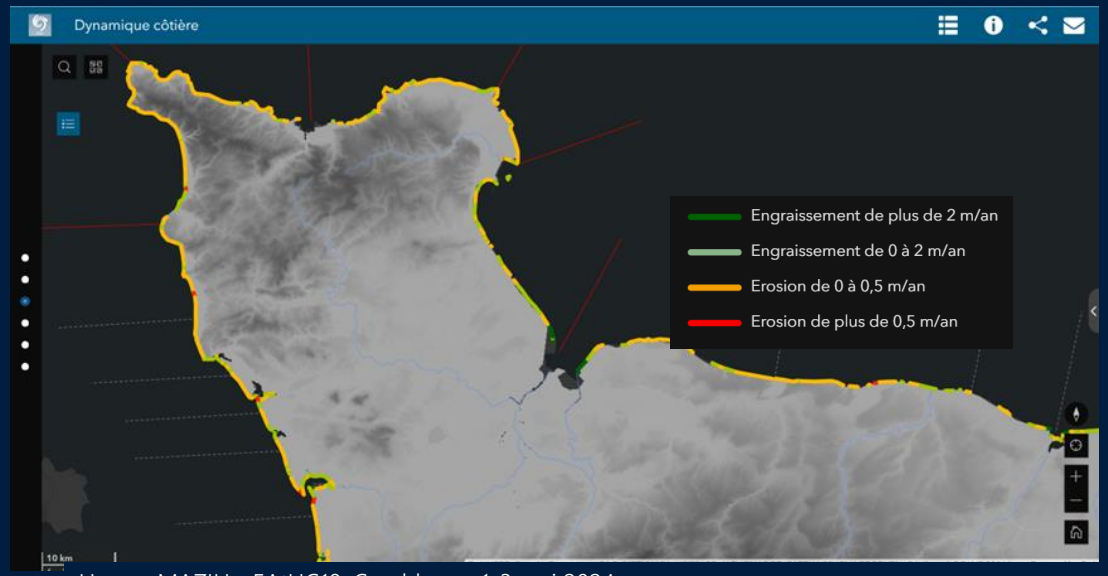
Implementation: Preliminary Results (Seamless topo-bathy)



What are Fugro data enabling?



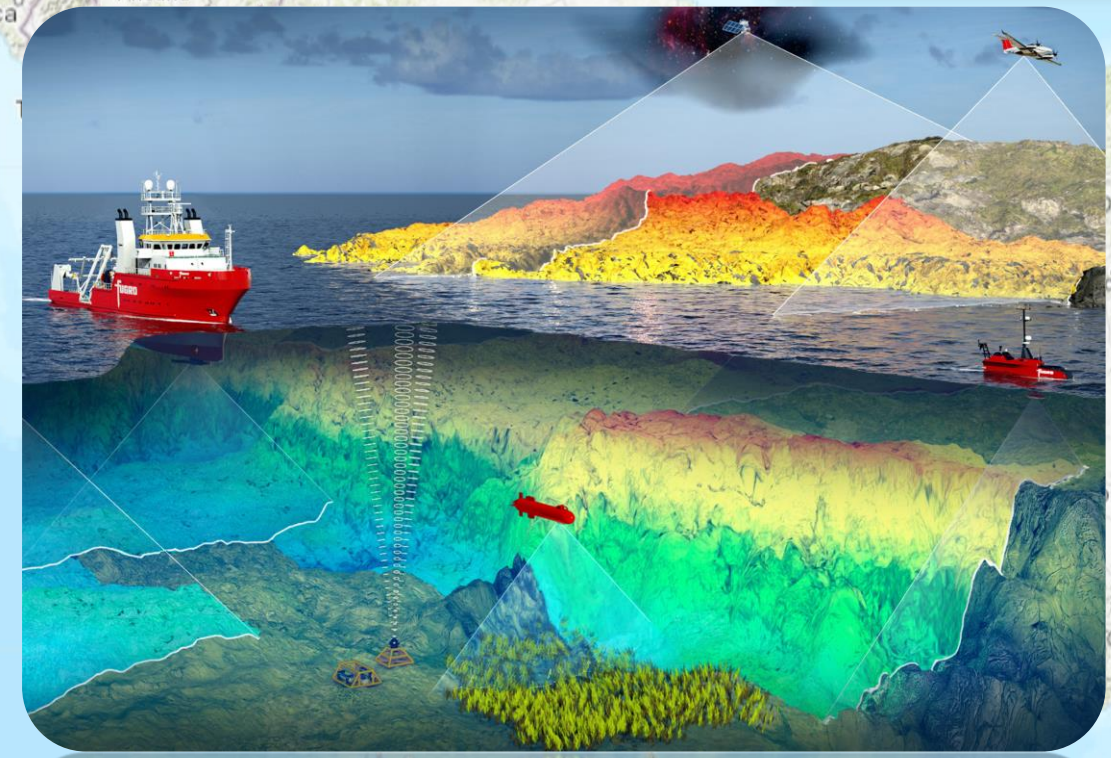




Next steps – Solution Development for Marine Habitats

Seagrass:

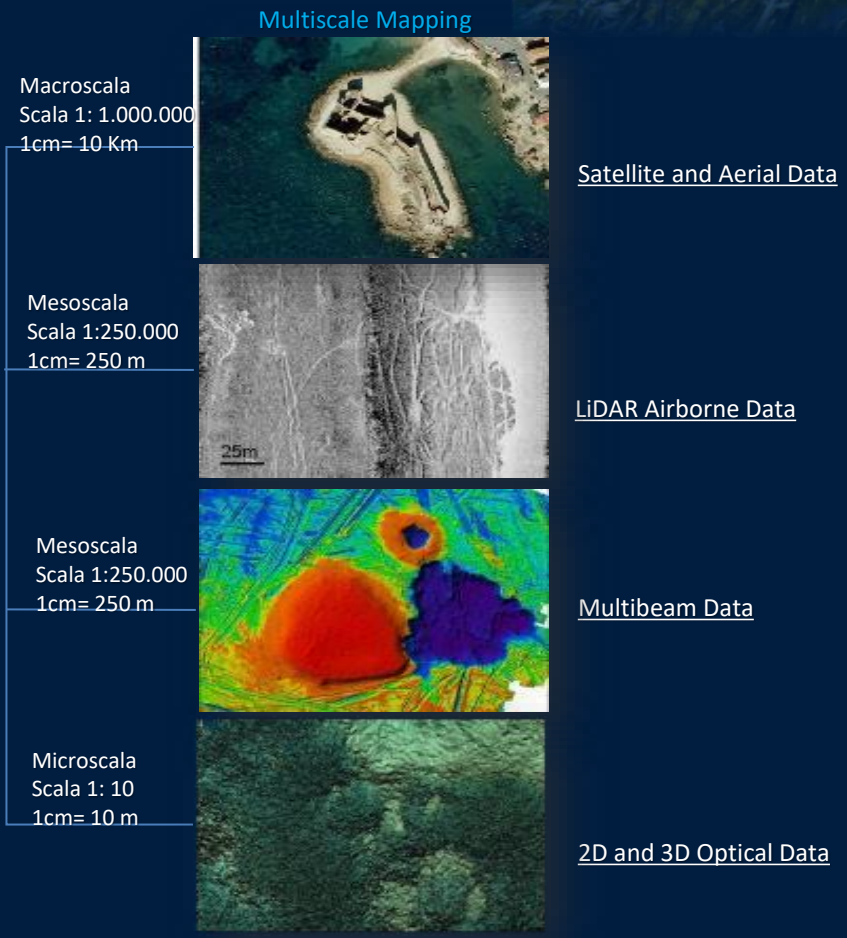
- Incredible ally in the fight of climate change
- Captures carbon up to 35 times faster than tropical rainforest
- Account for 10-18% of the total ocean carbon storage despite covering less than 0.1% of the seafloor
- Provides food and habitat for marine life



Fugro maps seagrass around Italy in a groundbreaking ecosystem restoration project

Project requirements Overview

- A Topographic LIDAR
- B Bathymetric LiDAR
- C Satellite Earth Observation
- D RGB-NIR imagery
- E Hyperspectral Imagery
- F MBES bathymetry
- G AUV gound truth survey
- H Gravimetry (Airborne / strapdown)
- I GNSS campaigns (Positioning)
- M Web GIS Platform
- L Data Classification service

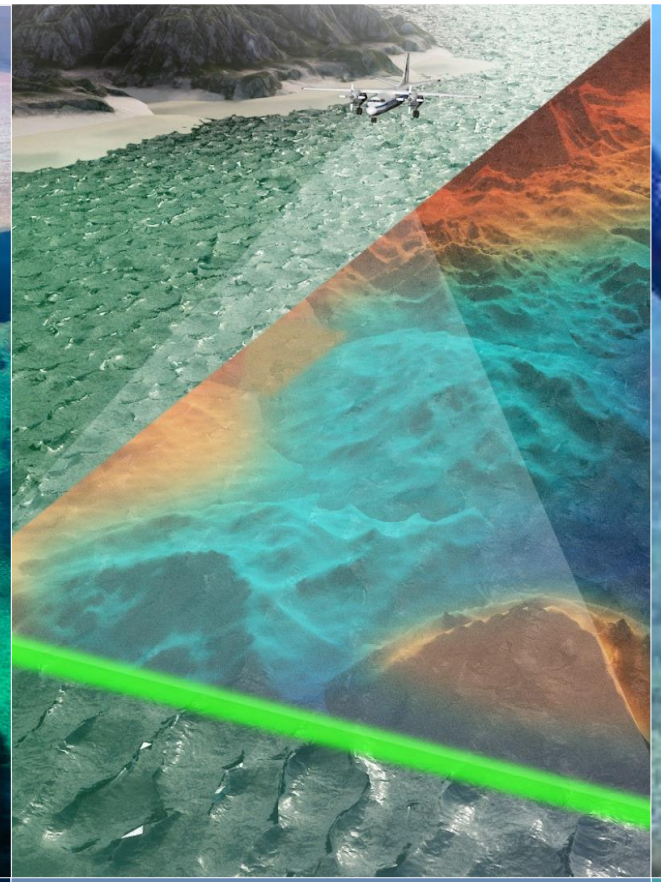


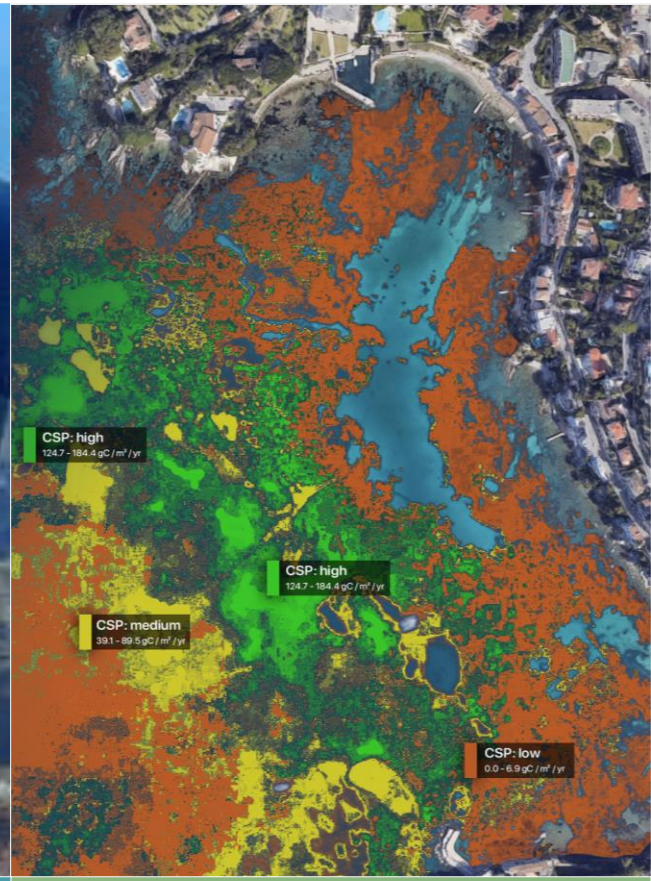
Fine/Micro –scale: in situ observer in situ diver (Scale cm)

Large-scale

Tiered approach for seagrass characterisation

Localised





Satellite EO
(Large scale monitoring)

Airborne Lidar Bathymetry / MBES
(High resolution baseline)

ROV-mounted hyperspectral cameras (ground-truthing)

AI analytics e.g. carbon sequestration potential

Seabed 2030

Fugro has been leading private-sector support for The Nippon Foundation-GEBCO Seabed 2030 Project (Seabed 2030) since its early planning stages

FUGRO

Unlocking **Insights**
from **Geo-data**

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