

COLOMBIAMAR PRESENTATION

REMOTE HYDROGRAPHY

**From technical to legal
solutions!**

Exail



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01 EXAIL GROUP



ECA and iXblue become EXAIL



1500

EMPLOYEES

80

COUNTRIES SERVED WORLDWIDE

20+

% OF TURNOVER
INVESTED IN R&D

24/7

TECHNICAL SUPPORT

2000

COMPANIES SERVED EACH YEAR

250+

MILLION EUROS OF TURNOVER

**A GLOBAL
FOOTPRINT**



EXAIL Expertise



Inertial navigation



**Subsea acoustic
positioning
and imagery**



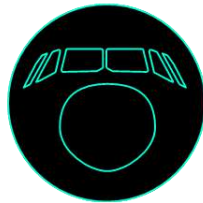
**Autonomous vehicles,
drones systems and AI**



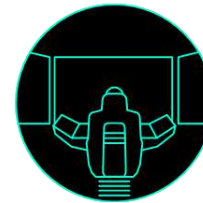
**Ship equipment
and protection**



**Photonics and
quantum**



**On-board electronics
and manufacturing & testing
solutions for aeronautics**

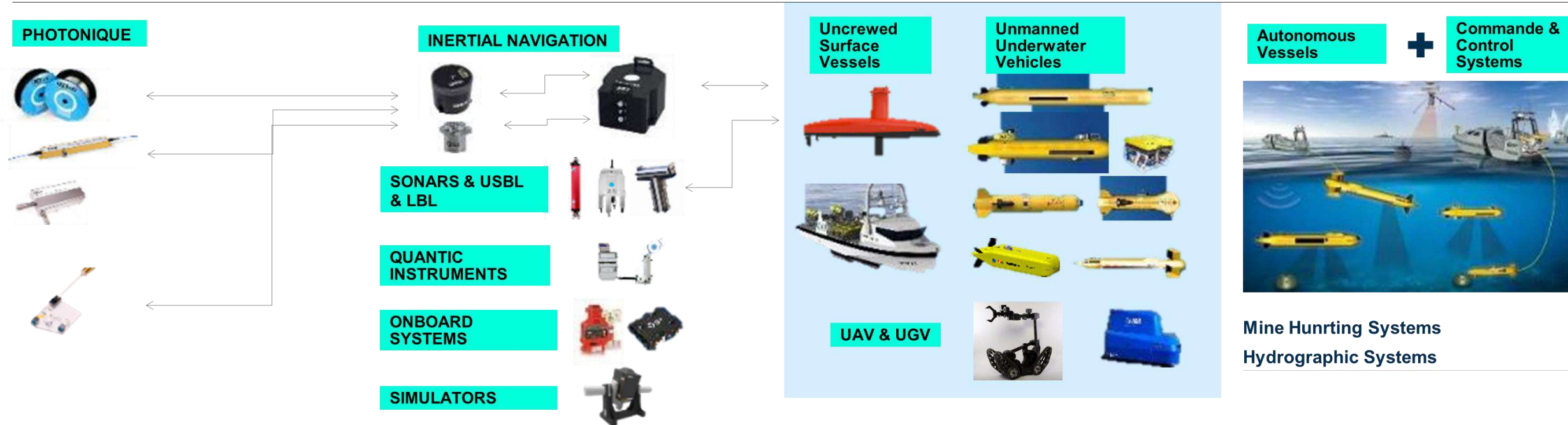
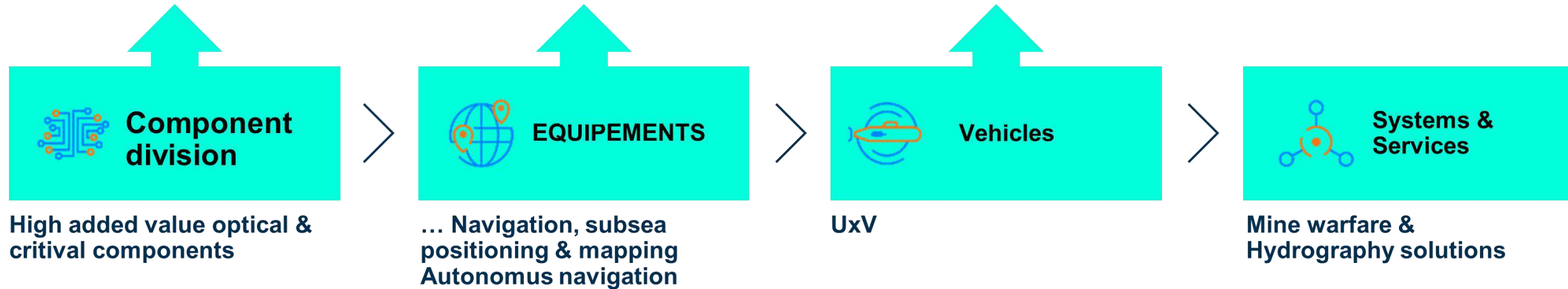


Training simulation



Mechatronics

EXAIL Vertical Integration : from components to complex systems



EXAIL Main applications



Defense & Security

Naval & land navigation
Ship equipment & protection
Mine countermeasures (MCM)
Maritime Domain Awareness (MDA)

Homeland security & land forces
Training simulation



Maritime

Energy & renewables
Hydrography & oceanography
Geoscience
Fishery



Space

Navigation
Communications
Stratospheric balloons



Aeronautics

Maintenance tools (MGSE & EGSE)
Assembly lines
Onboard services
Training simulation



Industry & Logistics

Rail
Tunneling
Material processing
Mobile mapping
Nuclear
Sensing
Autonomous vehicles



Research labs

Quantum
Earth monitoring
Ocean science
Laser facilities
Photonics experiments

02 UNMANNED PLATFORM DRIX



Autonomy allows innovations in the design of the platform: Example of DriX

Main Dimensions

Length Overall (LOA)	7,7 m
Beam:	0,82 m
Draft :	2,0 m
Light Weight :	1,4 Tons
Construction materials	
Hull & Deck & superstructure	Composite material

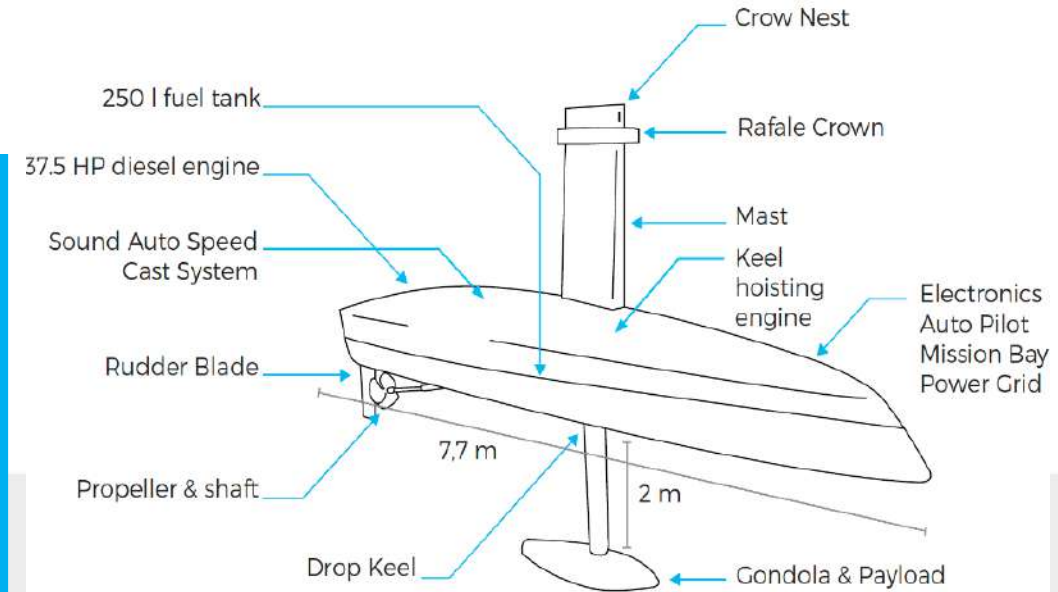
Performance

Maximum Speed :	14 kt
Survey Speed :	8+ kt
Fuel capacity :	250 liters
Fuel Consumption (Survey):	2-3 L/h
Range :	650 nm@ 8kt
Sea keeping:	Seastate 5 in operation

Machinery

STD propulsion:	1 x 38HP diesel engine
Power Generation:	Up to 3 kW

DriX



MISSION EQUIPMENT : Mission software, LIDAR, Video Camera, IR camera

MISSION PAYLOAD: MBES, SBP, Magnetometer, Weather Station, SSS, Environmental Echosounder (EK80, SeapiX), ...

COMMUNICATION: WiFi, Maritime Broadband Radio (MBR) , SATCOM (Starlink),

AUTONOMY: Up to 1000 Nm



Some references



Hydrography, Geophysical survey, Subsea Positioning, AUV C&C, ...

03

LEGAL CHALLENGES IN OPERATING USV



DEFINITION OF A SHIP

- **Definition of a ship:**

- No standard international definition of a ship.
- Only warship definition available in the UN Convention on Law Of the Sea (UNCLOS)

➤ Definition proposal: **floating craft designed to sail and to be exploited at sea for any purpose (commercial, scientific, leisure).**

➤ Critical criteria:

- to be able to sail at sea (not only in internal waters or rivers) and perform maritime crossing
- to be able to sail thanks to its technical capacity (engine, hull design, sail)
- to be exploited for a specific purpose

- **Legal consequences for being a ship:**

- To be bound by all national (or international) legal requirements about shipbuilding and design
- To comply with all international conventions applicable to ships (COLREG, SOLAS, STCW, MARPOL, Hong Kong convention on vessels recycling, LLMC, etc...)
- To benefit from the provisions of UNCLOS while sailing into national waters, EEZ or international waters.
- To be bound by national (or international) restrictions while performing survey or scientific missions in territorial waters, contiguous zones or EEZ.



WHAT LEGAL QUALIFICATION FOR USV ?

- Should we qualify a USV as a ship?
- NO !



- USV must become a new maritime sui generis category.
- Advantages for not qualifying a USV as a ship:
 - To avoid application of **irrelevant** legal requirements about shipbuilding and design
 - To protect industrial innovation
 - To create a legal framework (whether national or international) fitted for the technical specificities of USV whether for design or for operation at sea

Definition proposal for USV: an unmanned vessel is a surface or submarine vessel remotely operated or on autonomous mode.

=> Important to distinguish **uncrewed vessel** from **unmanned vessel**: an uncrewed vessel could carry passenger

WARSHIP QUALIFICATION ?

- **Warship definition (UNCLOS article 29):** means a ship belonging to the armed forces of a State bearing the external marks distinguishing such ships of its nationality, under the command of an officer duly commissioned by the government of the State and whose name appears in the appropriate service list or its equivalent, and manned by a crew which is under regular armed forces discipline.
- **Military USV:**
 - has no crew onboard
 - Can be on the appropriate service list of a navy
 - Can bear external marks of nationality
 - Operate under the command of officer(s) belonging to the naval forces of the government of a State



Conclusion: USV should benefit from the legal qualification of warship and of all the related rights granted by UNCLOS and law (ex: immunity)

TOOLS AVAILABLE TO OPERATE USV IN SAFE LEGAL CONDITIONS

To date:

- No international legal frame in place.
- Very few national regulations in place or under preparation.

In such context, which tools available to guarantee safe USV operations?

Contractual tools:

- Knock for knock indemnity clauses
- Liability limitation clauses
- Exclusion of responsibility in case of unexpected change of law or regulation about USV

Insurance coverage:

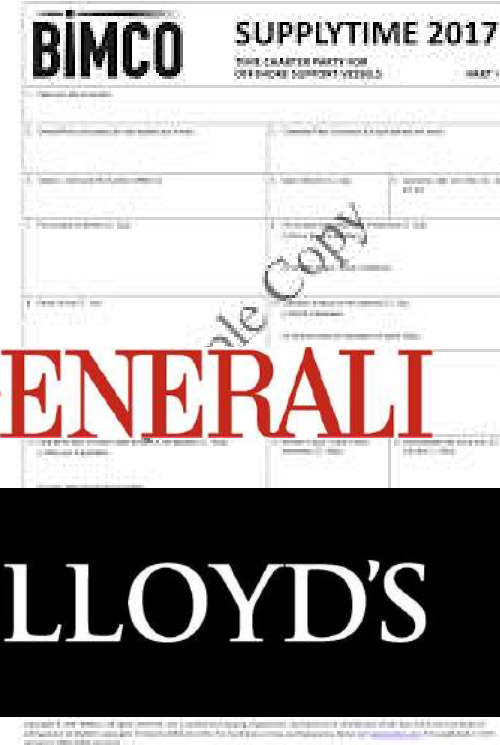
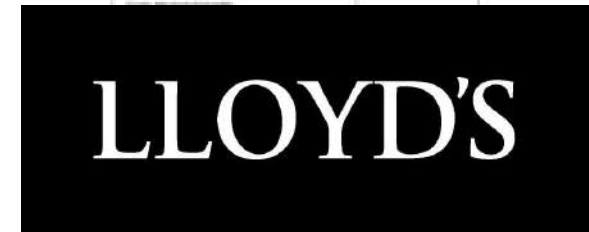
- To negotiate with insurers dedicated insurance coverage for sea operation with USV
- P&I or Hull & Machine traditional insurance could be applicable but are traditionnally designed for manned vessels.
- Recommandation to set up more specific insurance more flexible and more fitted for USV purposes.

**To check the applicability of national legal regulations according to the areas of operations: territorial waters?
Contiguous waters? EEZ ?**

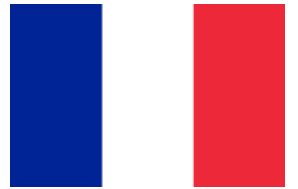
As applicable, transparency, cooperation and good understanding with the local competent maritime authorities



GENERALI



NEW FRANCE LEGAL FRAME FOR USV: A BRIEF HISTORY



Blue Economy Act (“Loi Leroy”) – 2016

- Few legal provisions about USV matriculation and liability conditions while unmanned vessel is used as a tender of the mother vessel => the unmanned vessel can benefit from the liability limit of the mother vessel based on LLMC convention of 1976.

Administrative regulation from 20 May 2020 on conditions to experiment drones in French waters – 2020

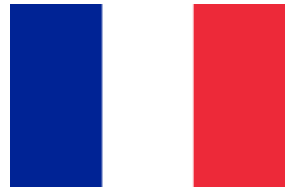
- For drone below criteria (length & width below 10 m, speed below 10 knots, no cargo or passenger) => simple declaration to the maritime authorities.
- For drone above these criteria : prior authorization by the maritime authorities is required to go at sea. Technical file to be instructed.
- *To date, this text remains to date, the sole legal basis available in France to rule the navigation of unmanned vessels in the French waters, until a more complete framework is definitively in place. It shall be replaced by the new decree to come in 2023*

Ordinance law from October 13th, 2021, which set up new main principles for the unmanned vessels - 2021

- New legal definition for maritime drone to distinguish drone and autonomous vessels: a drone is a surface or submarine vessel remotely operated or on autonomous mode, and which does not carry any passenger or cargo.
- Obligation to be registered: process to be defined in subsequent decrees.
- Obligation to bear specific identification marks (“DRN” + name of the drone + port)
- Application of liability limitation based on LLMC convention of 1976 to the owner/charter/captain of the drone.
- Obligation of insurance.

This ordinance law set up main principles. Practical to come in next decrees.

NEW FRANCE LEGAL FRAME FOR USV: NEXT STEPS



Project of decree to complete the Ordinance law – 2023

- Technical definition of drone: < 16m, no cargo and passenger, < 20 knots, gross tonnage < 100 UMS, < 300 KJ
- Beyond 16m, it shall be classified as an autonomous vessel (a new legal category) and no more as a drone.
- Process of registration based on technical file to submit to authorities. Possible control of the shore command center. Once registered, drone is free to be operated in French waters.
- Registration process adapted for mass drone production.
- Definition of a basic technical safety equipment applicable to all types of drones
- Obligation for manufacturer to train the customer prior delivery of USV.
- New permit to operate drone to be required for the operators (with a transition period to allow them to pass this permit).
- Duty to comply with COLREG and with MARPOL

Legal status of autonomous vessel to come – 2023-2025

- France makes distinction between drone and autonomous vessel. Autonomous vessels are longer than 16m, with > 300KJ and can carry passengers or cargo.
- France proposes an experimental permit to operate autonomous vessel with 2 years validity for limited purposes: trials, commercial demo, experimental exploitation

LIABILITY FOR USV OPERATORS & CAPTAINS

USV Operator means to conduct or to supervise the USV navigation

USV Operator = Captain in charge of commanding the USV (even if USV is remotely commanded or under full autonomous mode)

Which law applicable according to the location of the remote operational center ?

- To keep the flag jurisdiction ?
- To chose the jurisdiction of the location of the remote operational center ?

USV Captain faces criminal and/or civil liability.

French law applies LLMC convention on limitation of liability to USV Captain.

As applicable, USV Captain can shift to the owner if is found USV Captain acts under full control of the owner (French law).



EXAIL LEGAL EXPERIENCE RETURN WITH USV

Business operation with USV is becoming reality: first DriX over the horizon survey performed in St Nazaire winform site in April 2022 !

To avoid unnecessary/disproportionate operator certification for USV without cargo or passengers.

Any USV regulation must rely:

- EFFICIENCY
- TRUST
- be drafted in full transparency & cooperation between government and industrial players

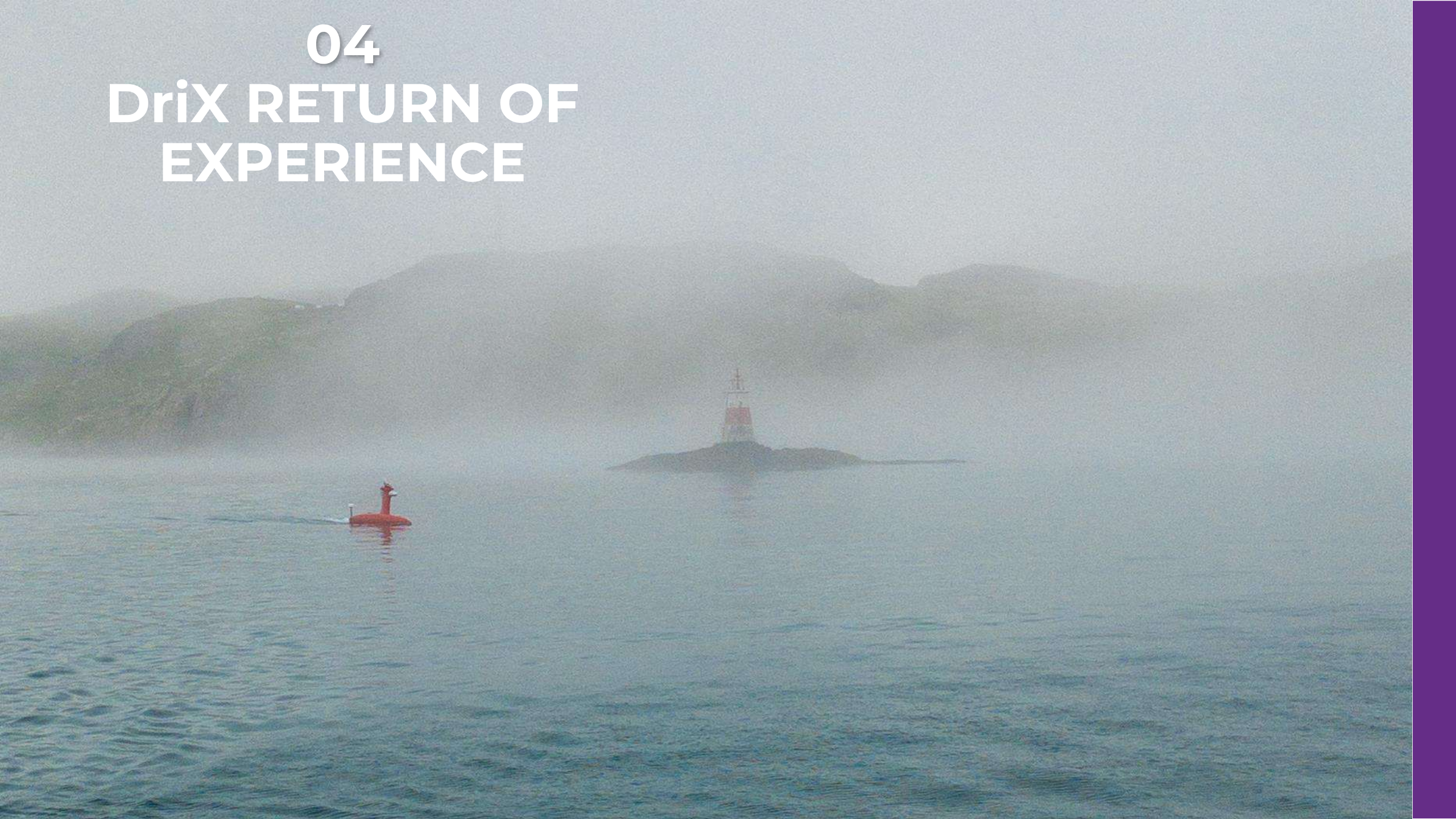
Lack of common regulations between states is becoming a serious obstacle to business (either survey operation or even sale of drones).

We invite close countries administrations to cooperate closely:

- To ensure full equivalence for the legal validity of registration/control process of USV between 2 countries,
- To lift any restriction to operation with USV already registered in another country.

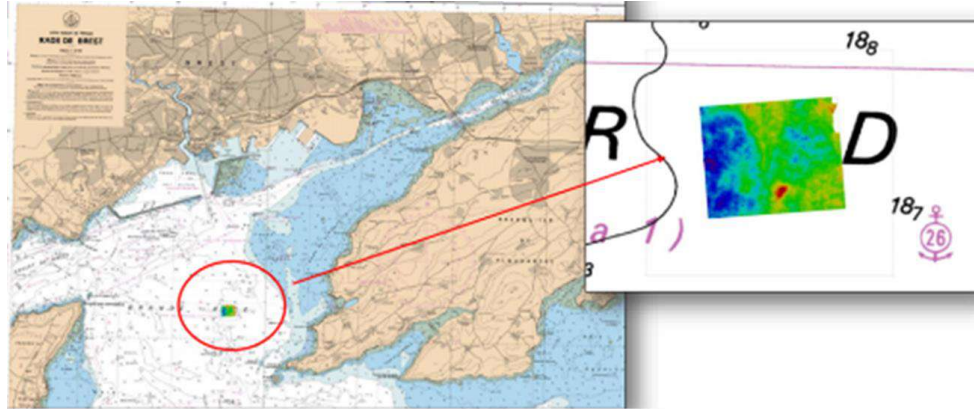


04 DriX RETURN OF EXPERIENCE



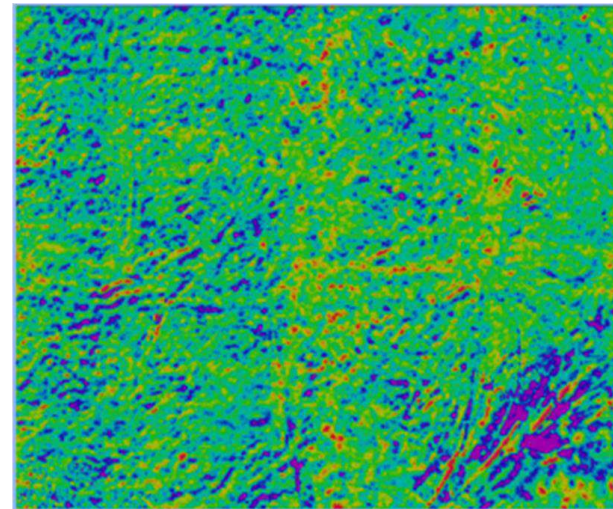
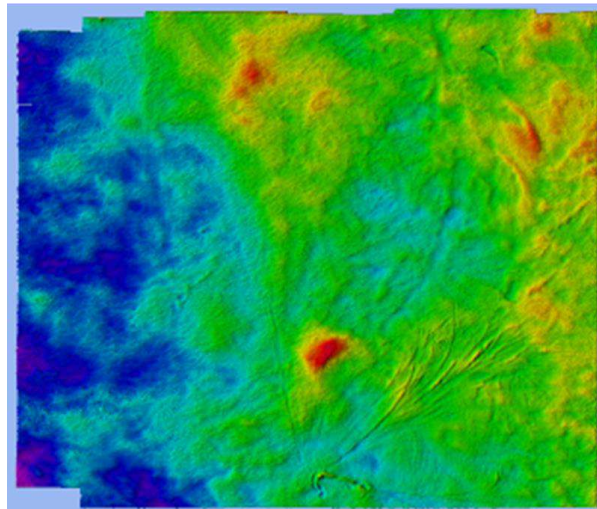
Case Study: Hydrographic Reference Site

Data Qualification on SHOM (French Hydrographic Office)

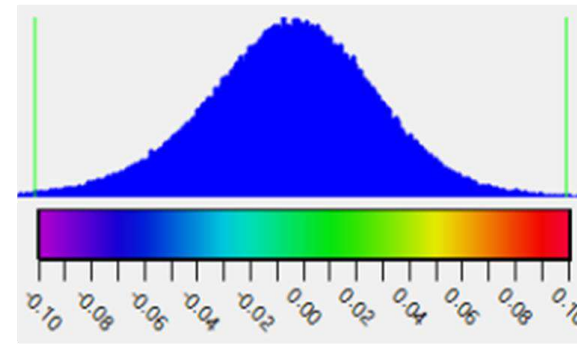


Outstanding achievements on meeting IHO exclusive order requirements for both uncertainty and data density @20m

Mean difference respect to reference	1cm
Mean standard deviation	3cm
Result repeated and valid at speed	4, 6, 8, 10 & 14kts



Differential map
DriX vs SHOM ref data set

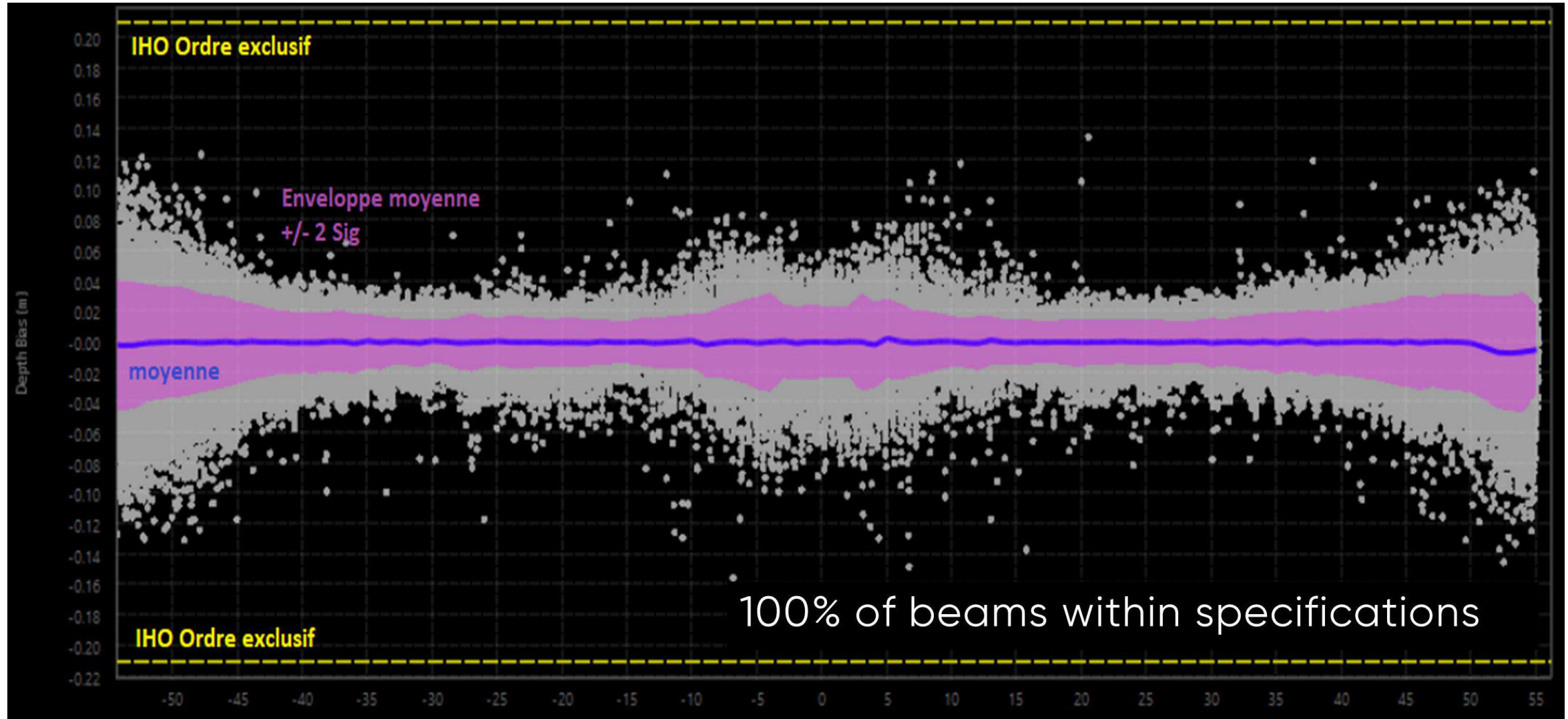


Differential statistic
distribution

Case Study: Hydrographic Reference Site

PROPERTY OF EXAIL

Qualification on reference area



Swath view

Cross line check

Case Study : large scale Hydrographic Survey Canada/France – DriX Return of Experience

North Atlantic
Saint-Pierre et Miquelon and Canada

2 Survey Objectives, 2 Clients

- Archaeological survey
- Sedimentologic model

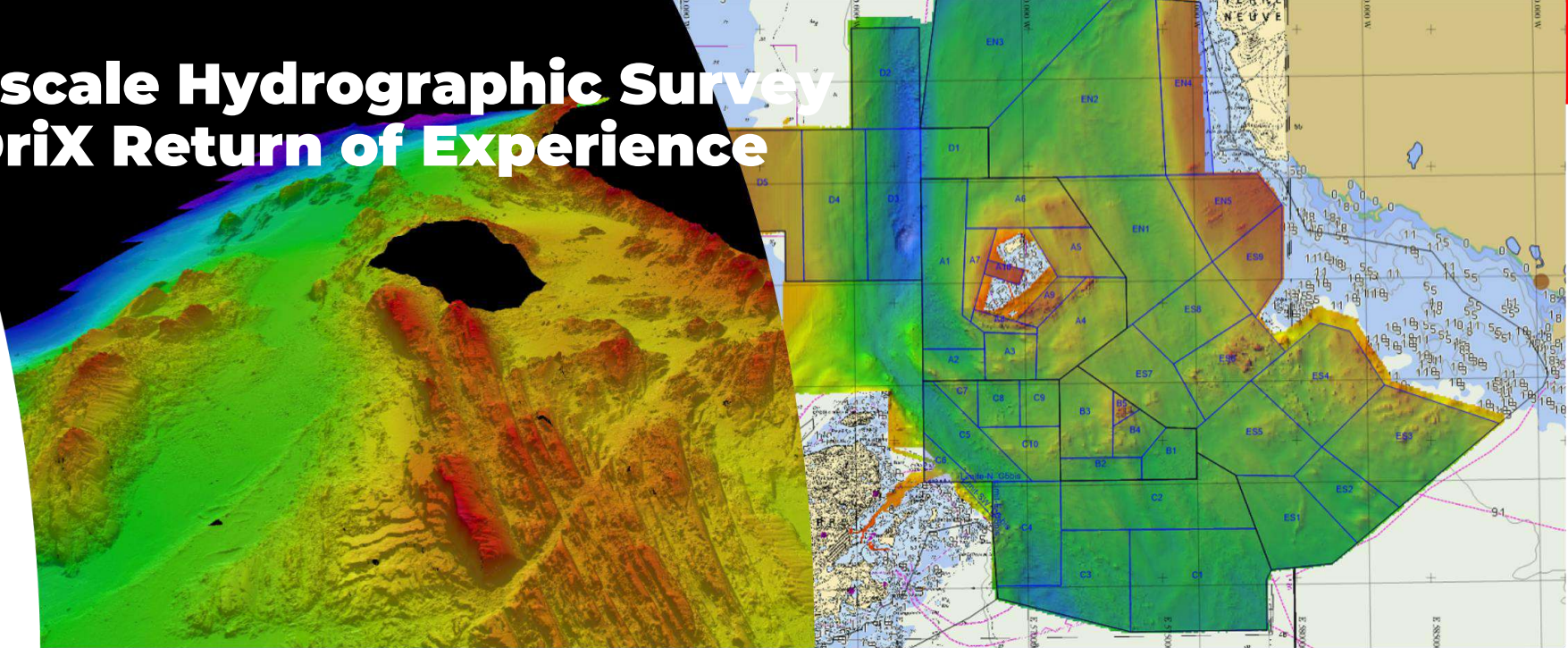
2 unmanned MBES-SBP campaigns
1 Satellite Derived Bathymetry

Manning: 1 engineer, 2 surveyors

Operational observations:

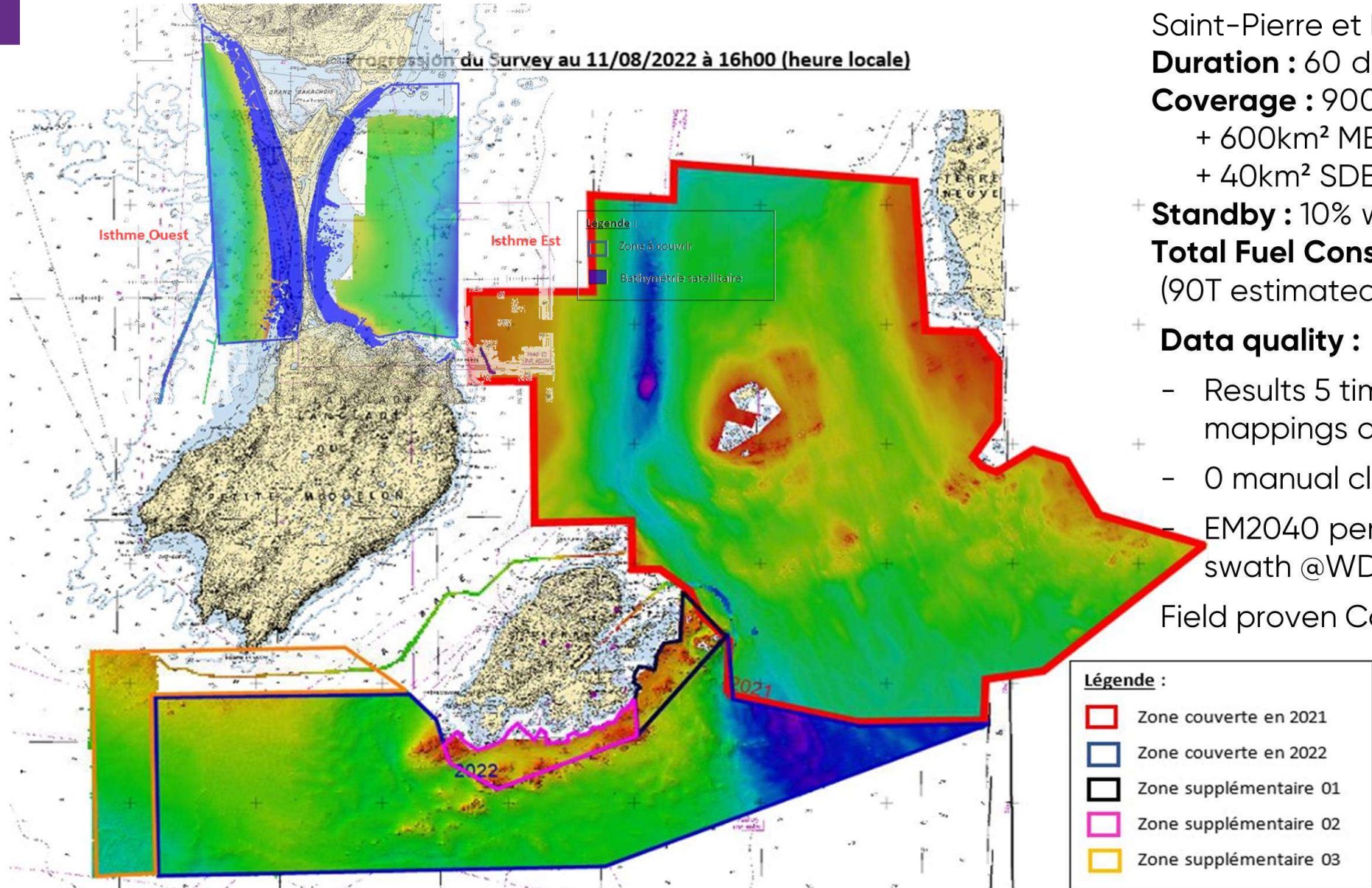
- Av. SeaState 4
- Wind up to 45kts
- Current up to 2.5 kts
- Extremely Bad visibility
- Survey depth : 8 to 270m
- Satellite Derived Bathymetry: 0 to 15m

Data: > 6.0 Terabit



Progression du Survey au 26/08/2022 à 13h00 (heure locale)

Progression du Survey au 11/08/2022 à 16h00 (heure locale)



North Atlantic

Saint-Pierre et Miquelon and Canada

Duration : 60 days

Coverage : 9000 survey Line KM Est.

+ 600km² MBES coverage

+ 40km² SDB product

+ **Standby :** 10% weather, No eq downtime

Total Fuel Consumption : 2.5Tons

(90T estimated for conventional vessel)

Data quality :

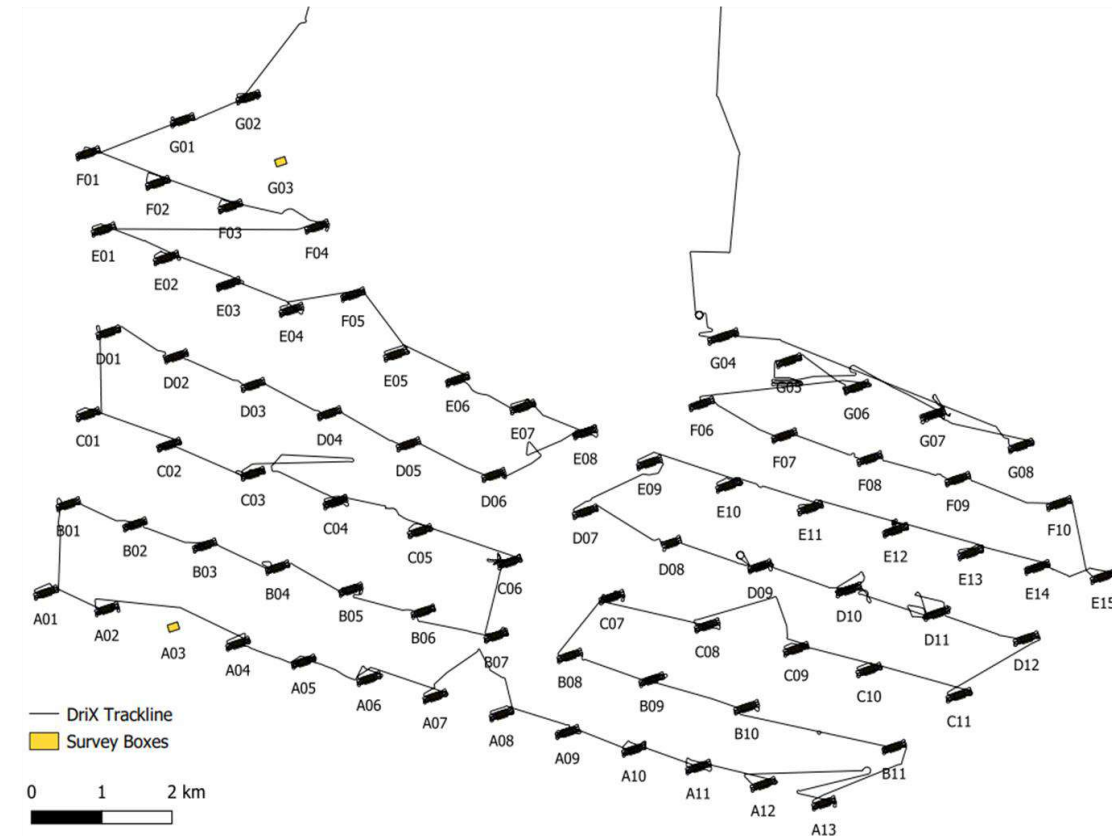
- Results 5 times better than previous seabed mappings of the area
- 0 manual cleaning
- EM2040 performed 30% better / 200m swath @WD 270m with the 400kHz

Field proven ColReg equipment

Case Study : Civil engineering geophysical survey

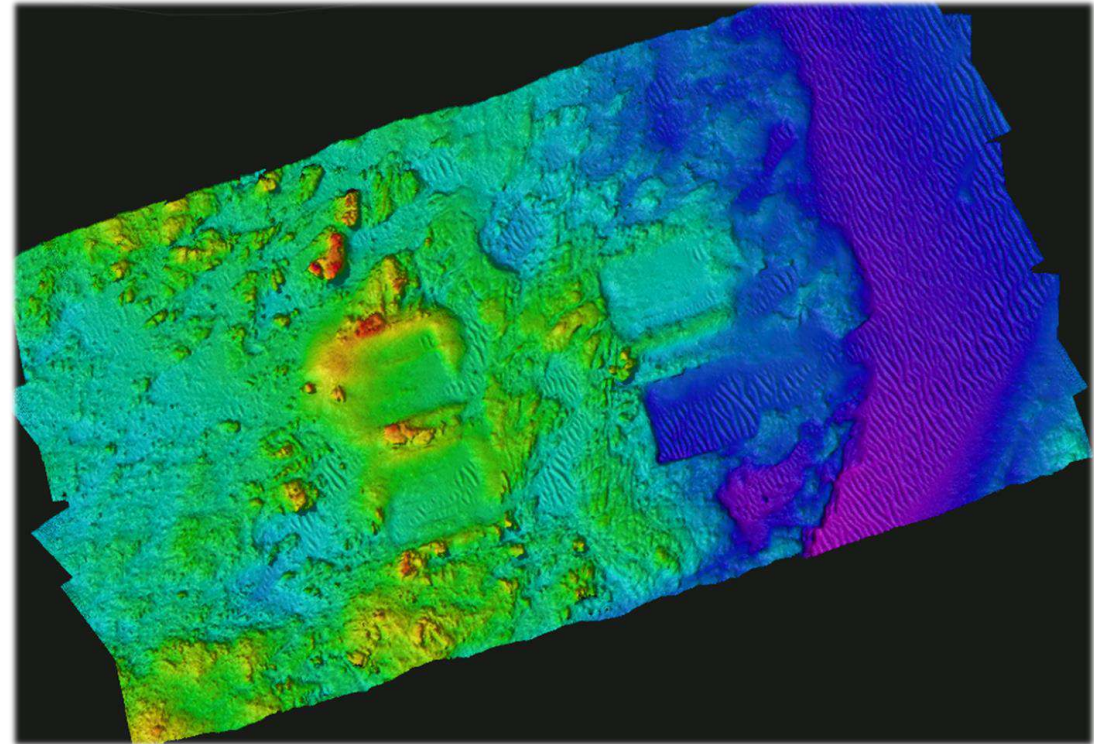
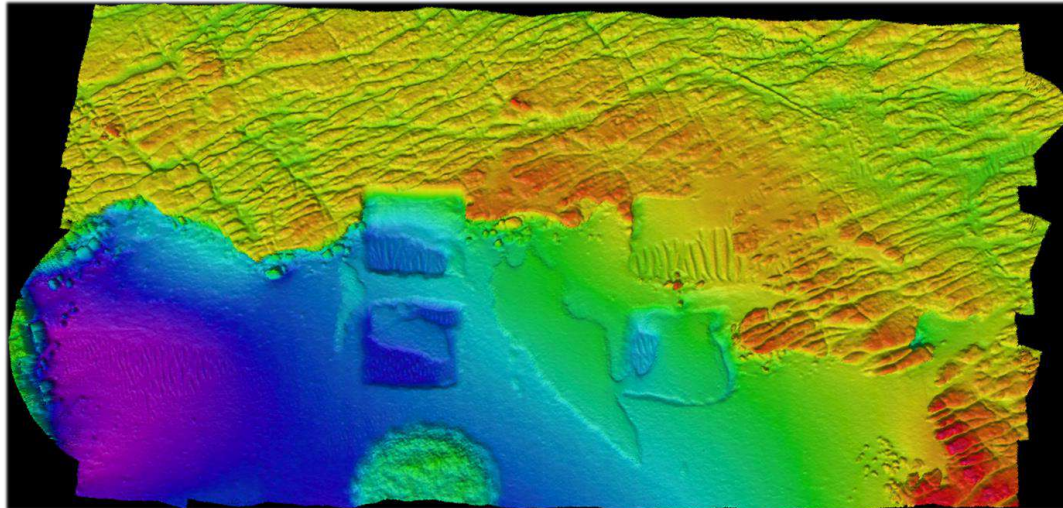
Offshore wind turbine

- 80 WTG - 200mx200m boxes to survey with MBES only
- Scouring and seabed inspection survey around wind turbine foundations.
- Over the horizon operation conducted in Saint-Nazaire (Fr) from La Ciotat (Fr) 800km away.



Case Study : Civil engineering geophysical survey

- 35 hours operation incl. transit from port to port
- 425 km line km
- Seastate 3 to 4
- Obstacles avoidance system ON
- And... outstanding bathymetric data quality



« Différence moyenne sur zone de référence client : 0 cm »

« Moyenne de 30 sondes / cellule de 0.5mx0.5m »

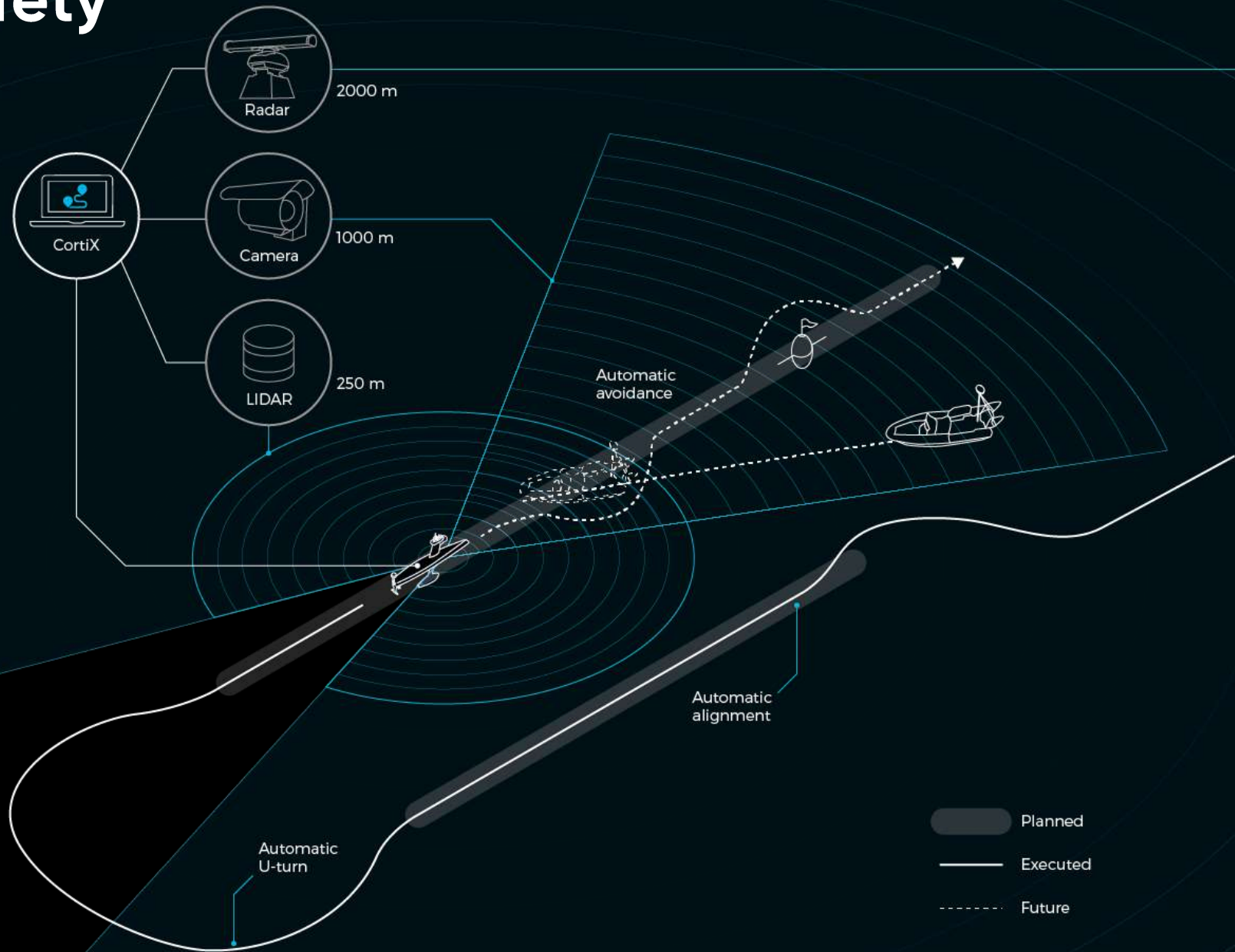
Maintenance MBES SCOPE	DRIX (OTH Ops)	Opportunity Vessel
	80 WTGs	
MOB / Demob	2 days Drix Pre Checked & Cal Transit by Road	<ul style="list-style-type: none"> • 4 to 5 days TT • 2 days Vessel In/Out (Transit at least 2 days) • 2 day days of mob / Checks + 0.5 day Calibration at sea + 1 day Demob
Bathy Ops Speed limited by bathy Spec (5kts) No Xlines	35 hours 8 lines per WTGs	24/24 Ops – 4 days + 2 days weather tolerance 12/24 Ops – 8 days + 7 days weather tolerance
Fuel (Diesel)	50l/d 75l TT	1 500l/d (24h) 9 000l TT Incl. 2d Transit In/Out & Cal at sea
CO² Equ 1l = 2.6kg equ CO²	0.2 To CO²	23.4 To CO² x120 times
Staffing on site <ul style="list-style-type: none"> • For MBES scope only 	2	minimum : 6 crew + 2 survey
Man Hour Exposed at Sea (24h/24h at sea)	8h Launch & Recovery period	About 1050 h x130 times
Survey Efficiency factor	Line U-turn (2min MBES) No Re-Run SVP on the fly	Line U-turn (5 to 10min U-turn) Possible Re-Run due to pilot mistake 5 to 15 min to replace MBES and WTS

05

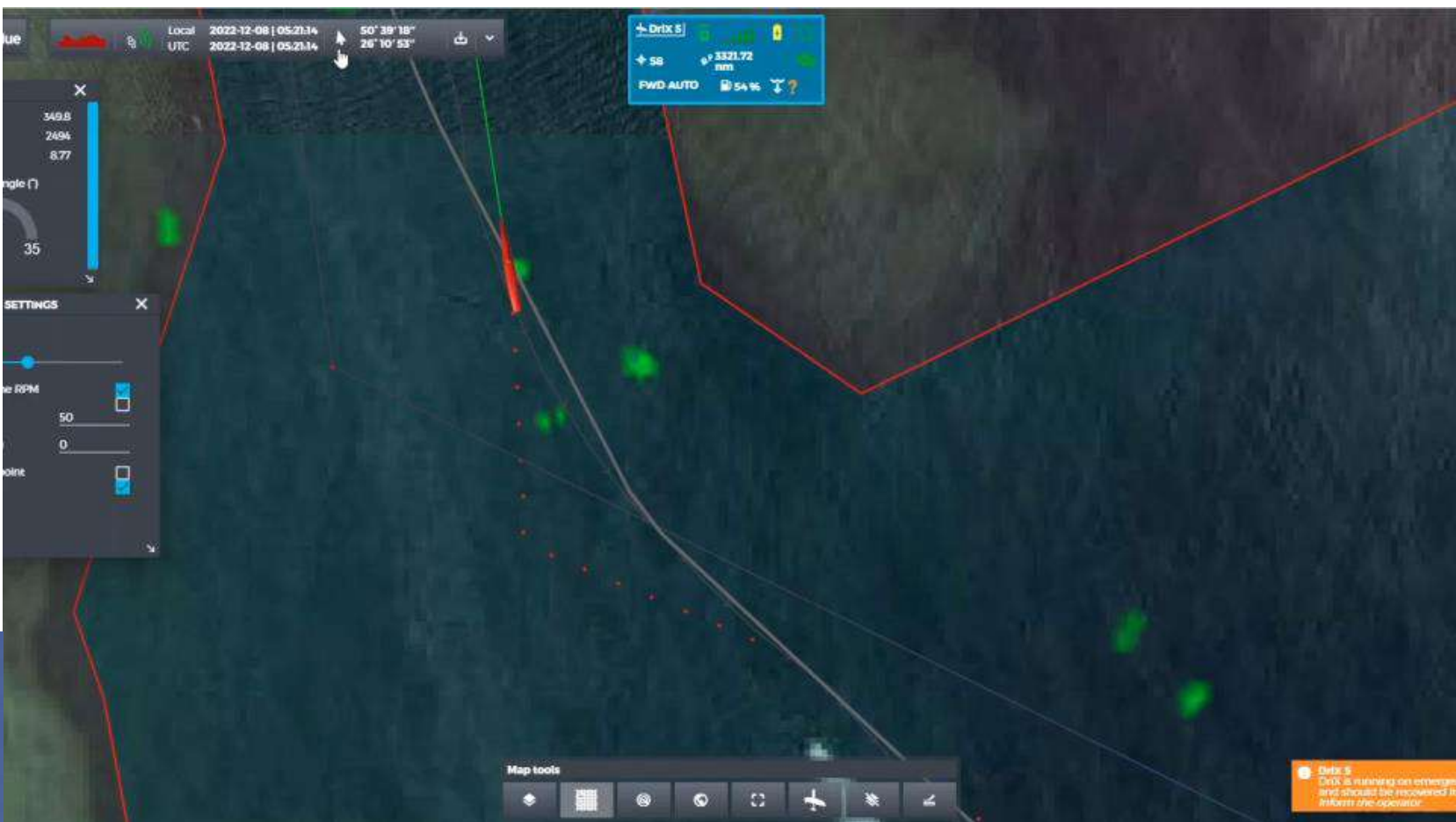
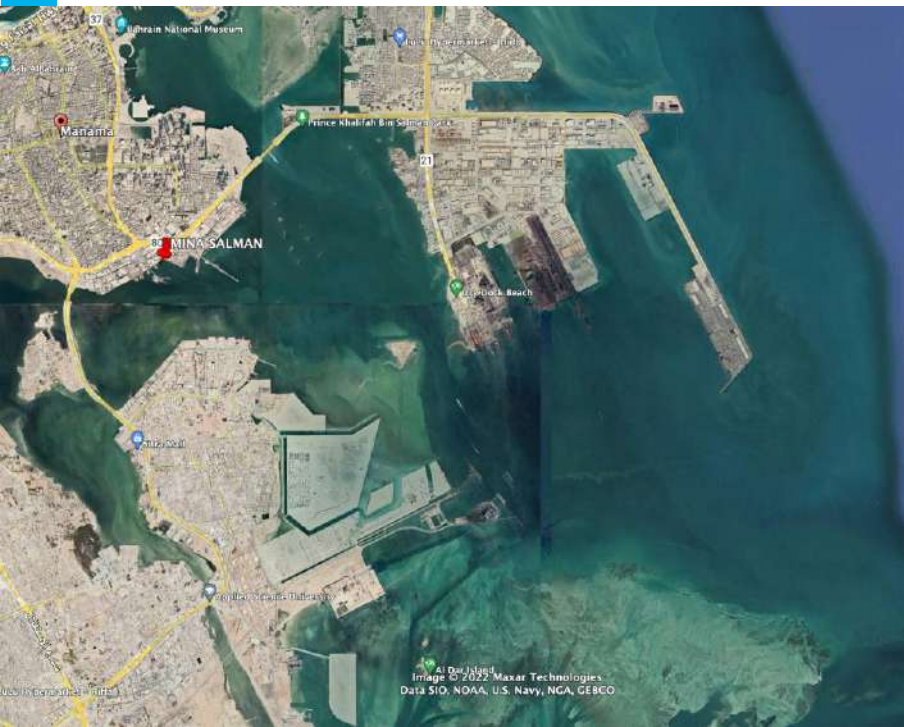
Technical solutions Navigation safety & supervision



Navigation safety



Example of autonomous navigation in restricted waters



Dec 8, 2022, autonomous entry and collision avoidance in Mina Salman, Barhein (Speed 10 kt, video speed x20). CPA setting 100 yards

Client in Confidential

06

Technical solutions to increase the Hydrospatial data gathering

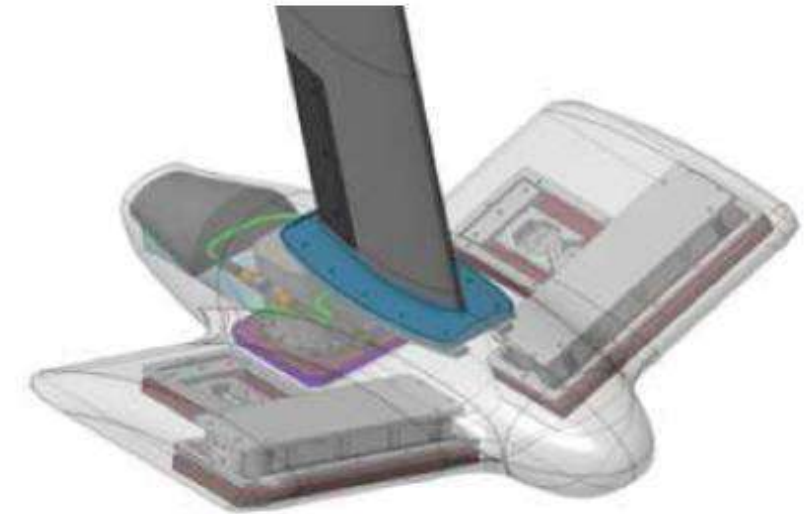
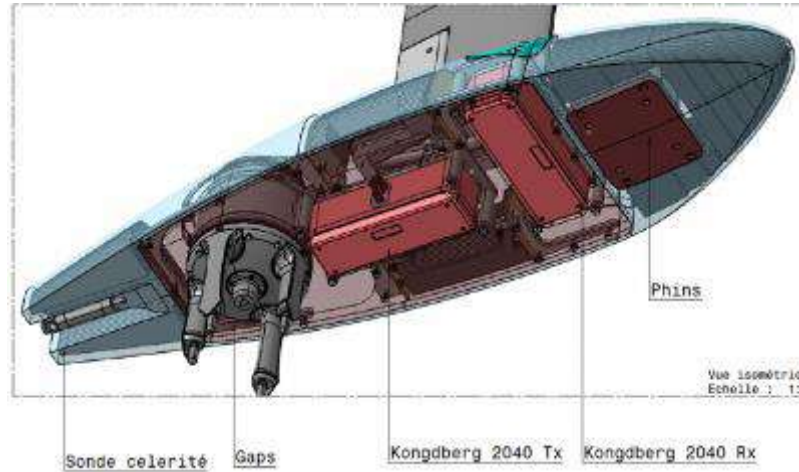


A universal platform

A gondola to house any type of relevant sensor – a serious track record

Example of standard combination

Various sizes and shapes



A GAPS USBL and a MBES

Integration track record:

- Multiple brands of MBES
- Side Scan Sonar
- Sub bottom profiler

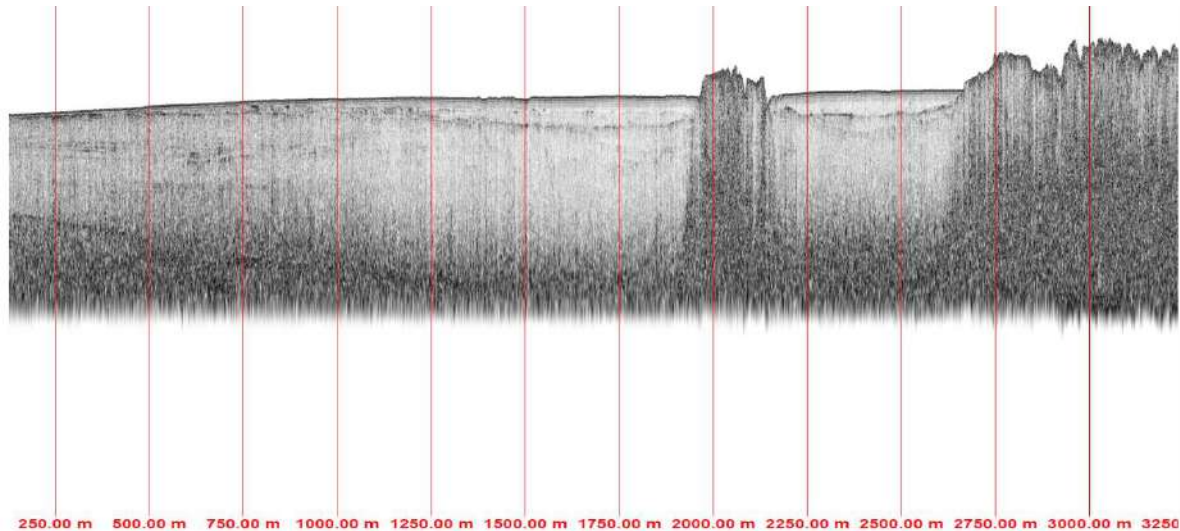
- USBL
 - Acoustic modem
- All customers requirement within

Geophysical survey MBES & SBP simultaneous acquisition

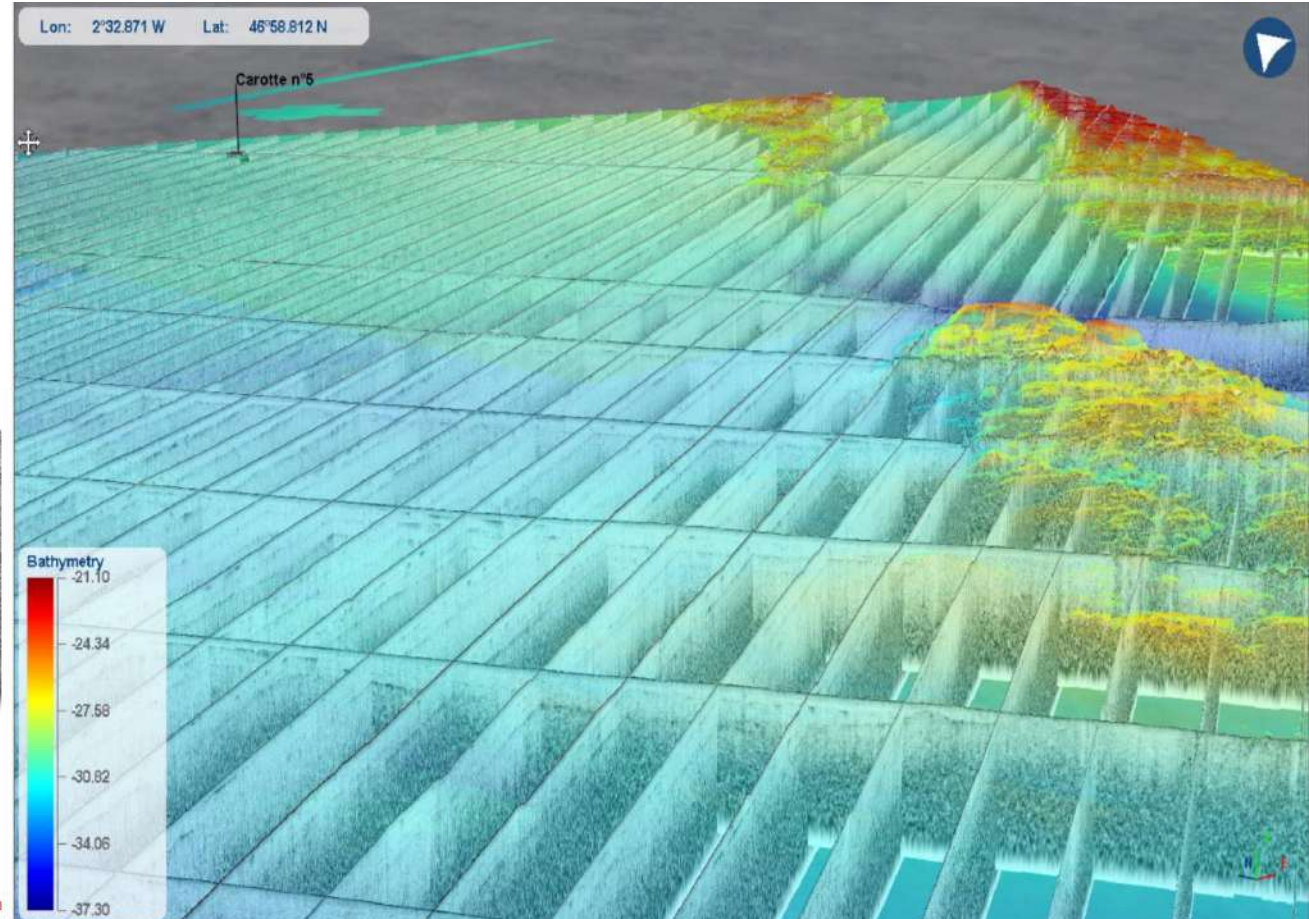
Large, high resolution sub-bottom survey to assess aggregate extraction / dredging activities

Reduce cost and impact of routine survey assessment

Increase data quality : line keeping, low noise environment, well known motion compensation.



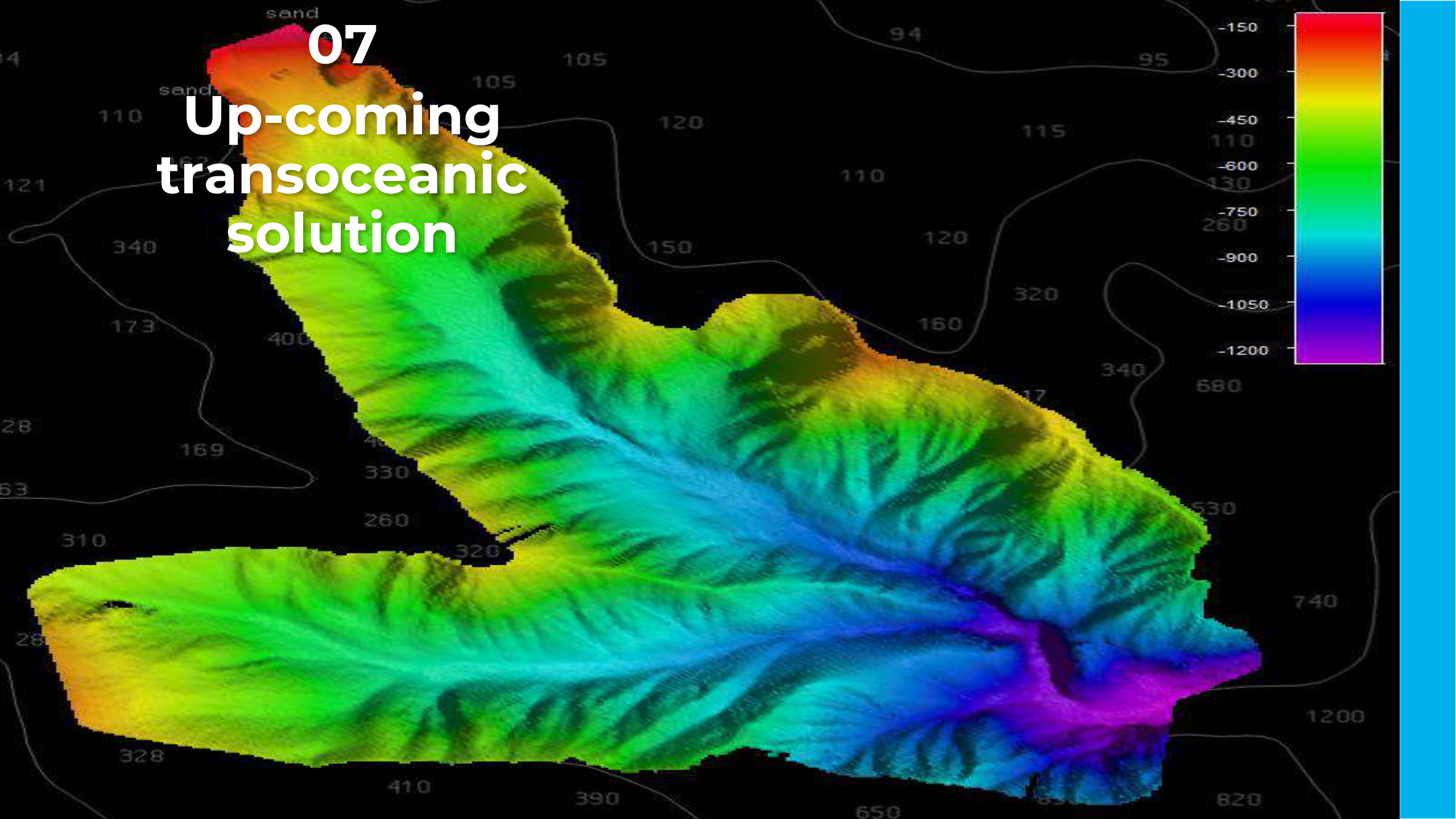
SBP profil



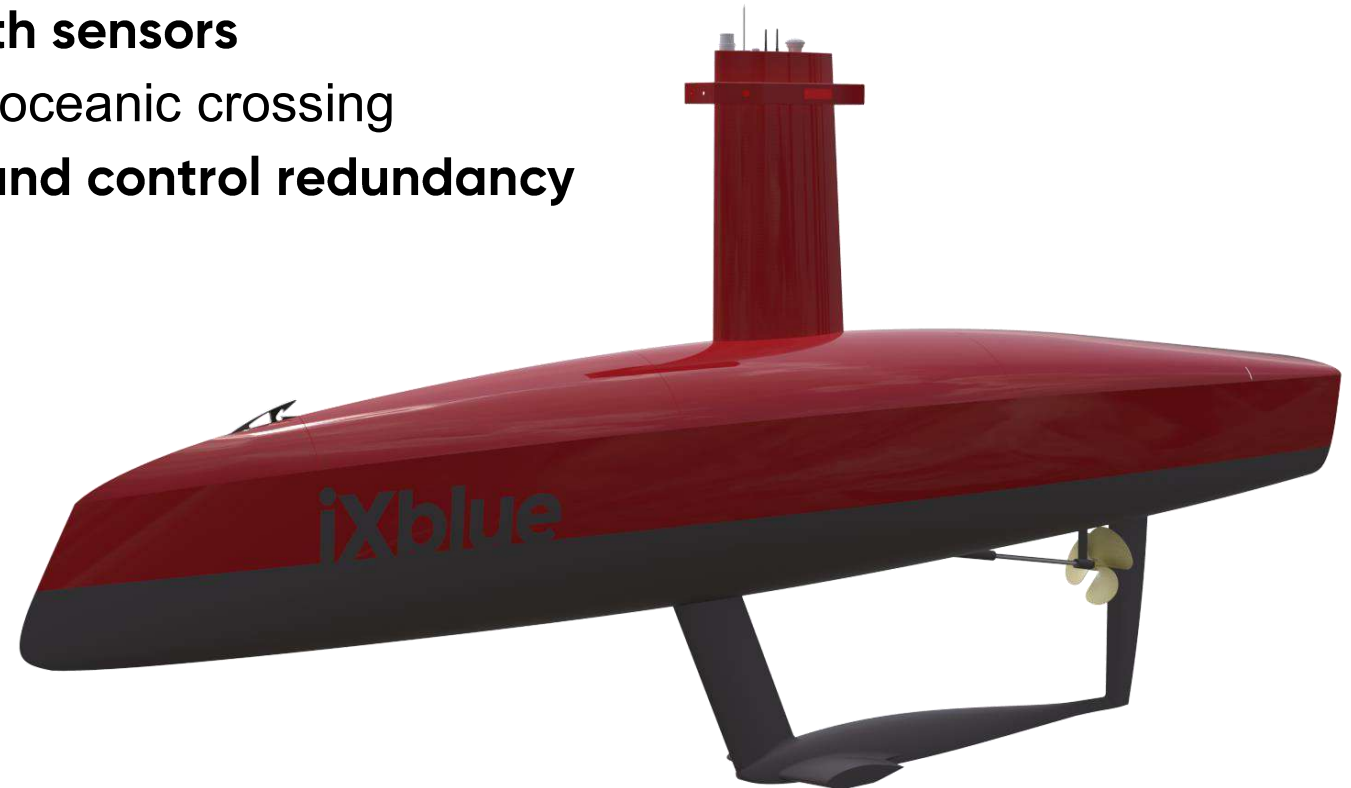
Merged SBP / MBES top of the rocky layer

07

Up-coming
transoceanic
solution



- Moving towards long range (>20 days) capabilities
 - To keep the **dynamic** and the key **differentiators** observed on DriX
 - To keep **low manning**
 - To enhance the **large payload offer** (higher power, heavier and larger payload)
 - Be capable to carry **full ocean depth sensors**
 - To offer **longer endurance** for transoceanic crossing
 - To offer **full propulsion and command control redundancy**





CONCLUSION

KEY DIFFERENTIATORS VS A CONVENTIONAL SURVEY VESSEL

CONVENTIONAL SURVEY VESSEL

VESSEL: 25-50 m
Crew: 15 - 20 pax
Energy: 1.5 - 5 Tons diesel / day
CO2: 35 kg/Nm

Investment: 5 to 20M€

Maintenance: 500 k€/year

Line Change: 5 – 15 min
Weather Tolerance : SS 3 to 4

Heavy Crew changes
Human exposure to risk



DriX

USV: 8 m
2 engineers + 3 supervisors
Energy: 50 litres diesel / day
CO2: 1.5 kg/Nm

Investment: 3 M€

Maintenance: 30 k€/year

Line Change: 1 – 2 min
Weather Tolerance : SS 5

Operational support from a shore control station or a mother vessel.



Muchas gracias

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<https://www.ixblue.com/maritime/maritime-autonomy/uncrewed-surface-vehicles/>

Exail

