



MARITIME DRONES AND THE FRENCH OCEANOGRAPHIC FLEET

MARC NOKIN

French Oceanographic Fleet : Vessels and UW vehicles



M. Dufresne - 120m



Pourquoi pas? – 107m



L'Atalante - 85m



Thalassa - 75m



L'Europe – 30m



Thalia – 30m



ALIS – 30m



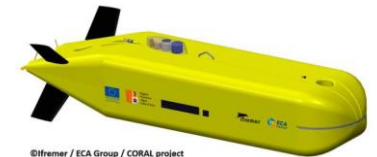
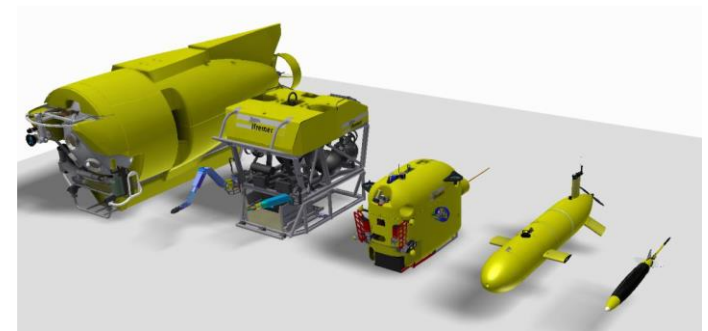
Thétys II - 25m



Côte de la Manche - 25m



Antea – 36m



©Ifremer / ECA Group / CORAL project

And possibly Unmanned Surface Vehicles in the future

➤ **USV's is :**

- An imperfect system that can do what Research Vessels cannot do.
- A system than can replace Research Vessels for some missions.
- A system that complements the Research Vessels :
Data densification and cruise strategy optimisation

➤ **Environmental impact reduction**

- Objectives of a reduction of min 30% of consumption for future Ifremer vessels.
- Daily CO2 Emission of a 50-100m RV = 75 drones (medium size)

➤ **Cruise cost optimization**

- Daily rate of 50-100m RV = 10 drones (medium size)
- Yearly maintenance cost of a 50-100m RV= 100 drones (medium size)



Questions for 2023

- Which concept and for which missions ?
- Which operational model ?
- Which economical model ?



*To learn biking,
you need a good
bike*

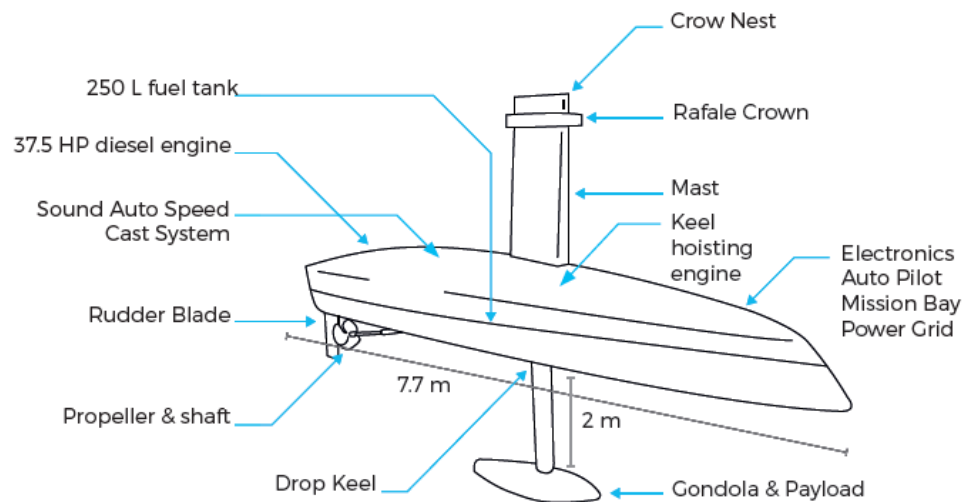


A practical approach

- Learn capacities (performances, payloads....) on scientific applications with an USV DriX

At sea cruises with DriX from EXAIL

- Length : 7.71m
- Width : 0.82m
- Weight : 1.38T
- Draft : 2m
- Speed : 14 knts
- Propulsion: inboard 38cv
- Autonomy: ~2,5 jours à 8knt
- Retractable keel
- >20 units sold



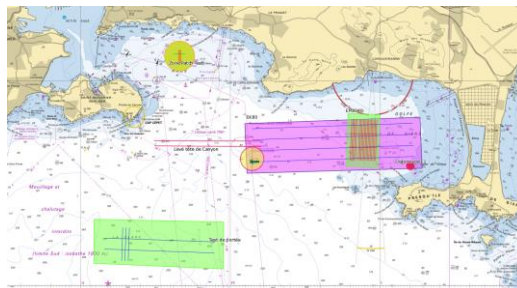
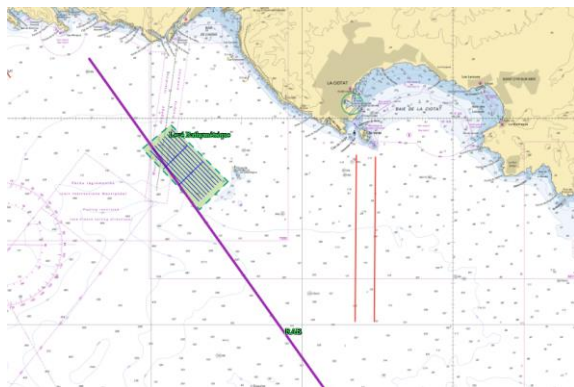
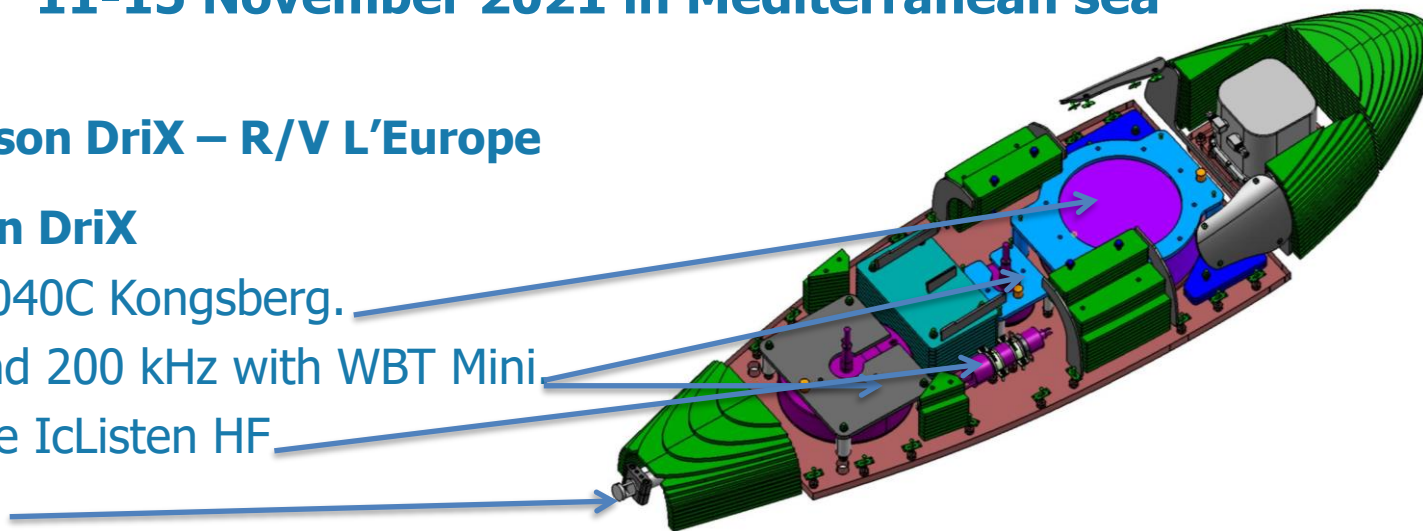
Mission ESSDriX « Fish stock assessment »

11-15 November 2021 in Mediterranean sea

Inter comparison DriX – R/V L'Europe

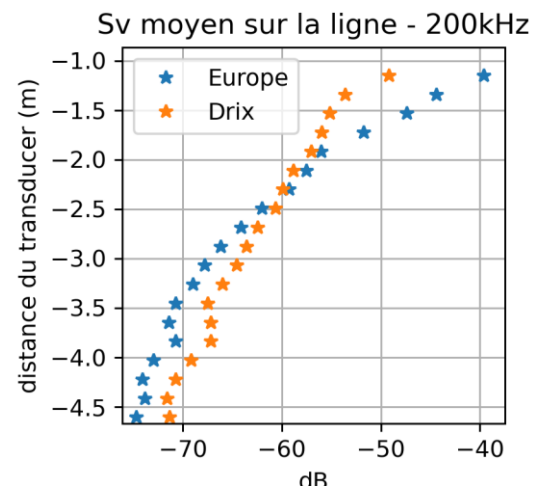
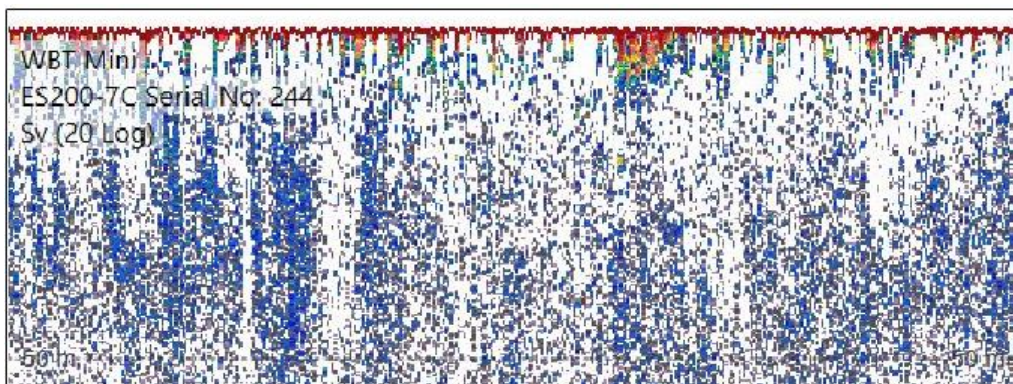
Equipement on DriX

- MBES EM2040C Kongsberg.
- EK80 70 and 200 kHz with WBT Mini
- Hydrophone IcListen HF
- Mini SVS



Bubbles sweep down

Bubbles : % of false pings : **L'Europe 17%, DriX 18% - Similar results**

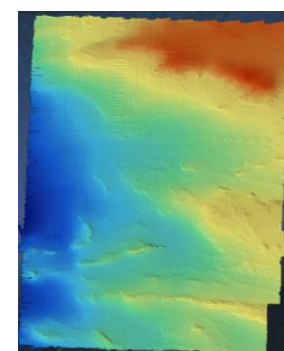
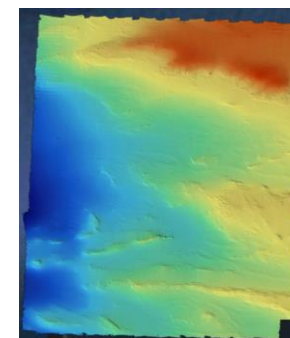
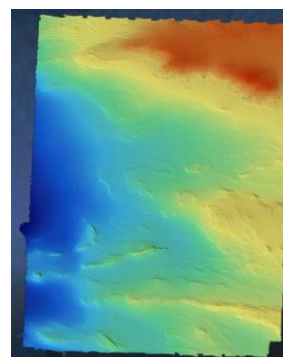
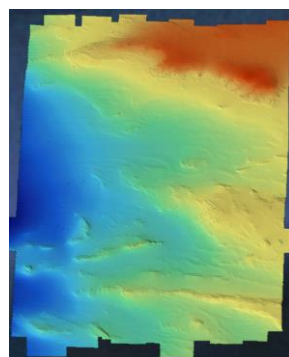


L'Europe 8 noeuds

Drix 8 noeuds

Drix 10 noeuds

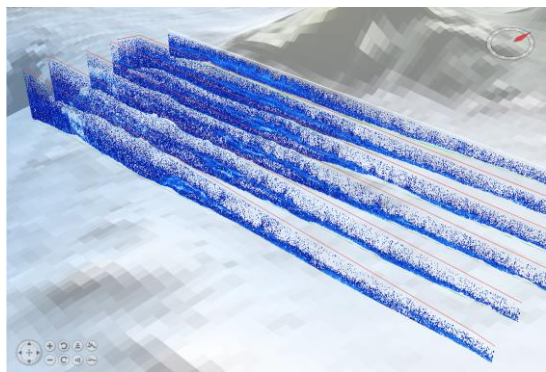
Drix 12 noeuds



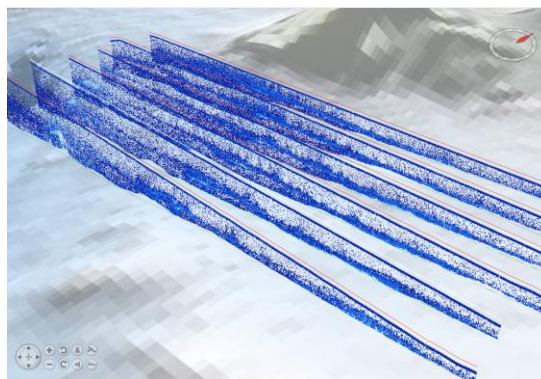
EM2040 bathymetric

Very good results
and higher speed

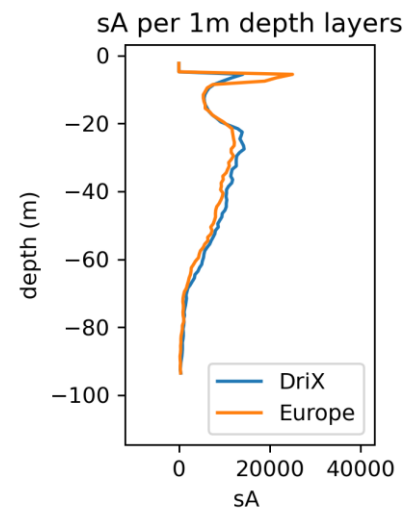
Plancton quantity – EK 80 70kHz : Nice fitting correspondance



DriX



L'Europe



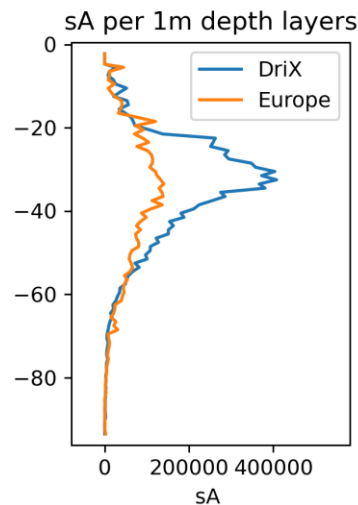
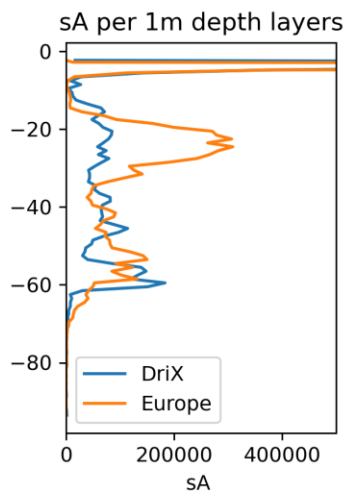
Fish quantity – EK 80 120 kHz

8 knots

5 knots

Fishes seems to escape at 5 knots with L'Europe and 8 knots with DriX

L'Europe is optimized for 8knt (10dB increase from 8 to 5 knt)

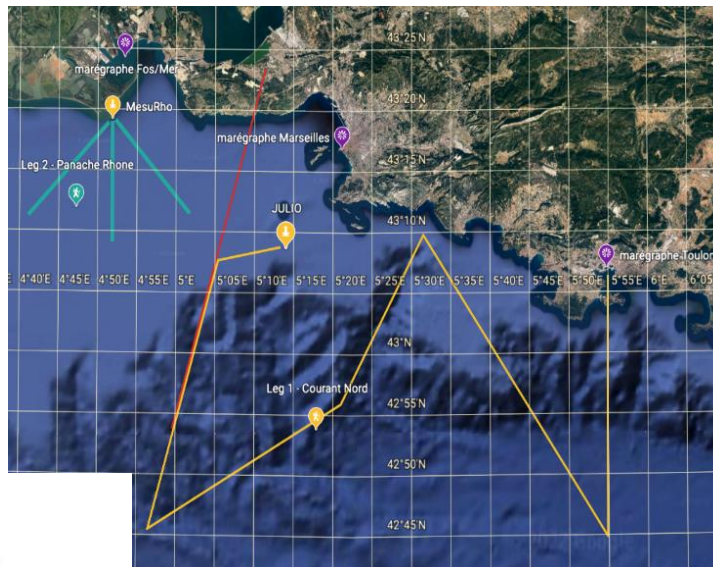


Bubbles sweep down A successful cruise

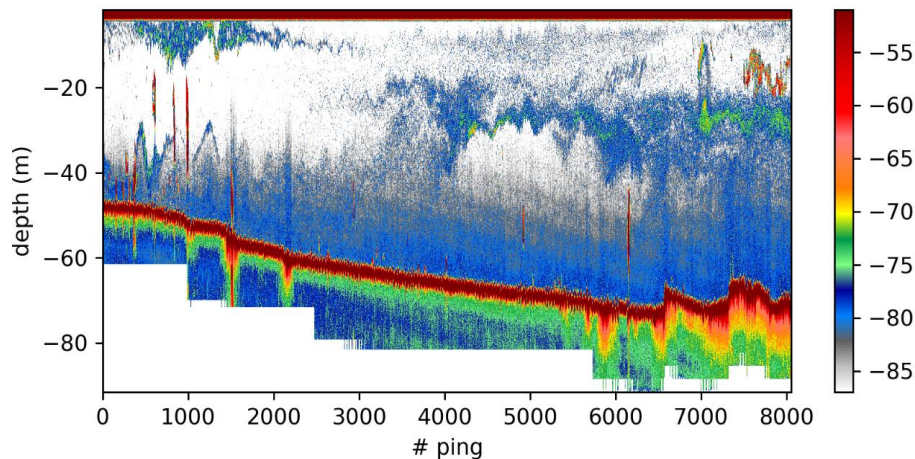
September 21-25, 2022 - 5 days in Mediterranean sea

October 7-9, 2022 : 2.5 days south of Belle Ile – SOLIBO cruise

- ADCP 300kHz
- EK80 70 and 200 kHz
- CTD at the front and at the rear
- Turbidimeter
- CTD on winch
- Meteo station



Sv pulse compressed (dB)
2022-10-07 16:10:20 to 16:57:30



DriX equipment

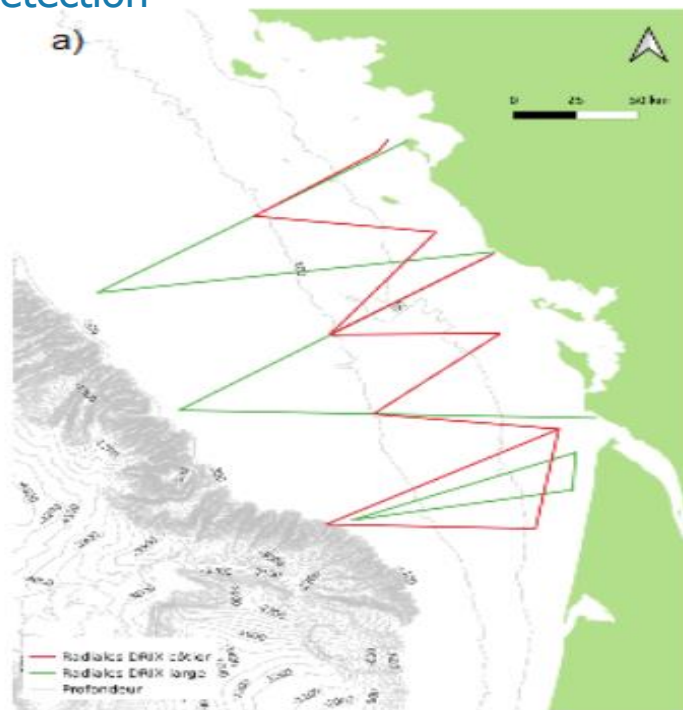
- Physical & optical properties of water
- Currents
- Sea level,
- Backscatter, meteo

Replacement of a ship è DELMOGES-Explanation of mammals accidental capture

Air plane for dolphins detection



Drif survey for fish detection



Green lines : large scale survey

Red lines : coastal survey

- Golf of Bisquay
- February 2023
- 13 days at sea
- 3 days met standby
- 1100 NM at 7-9 knts

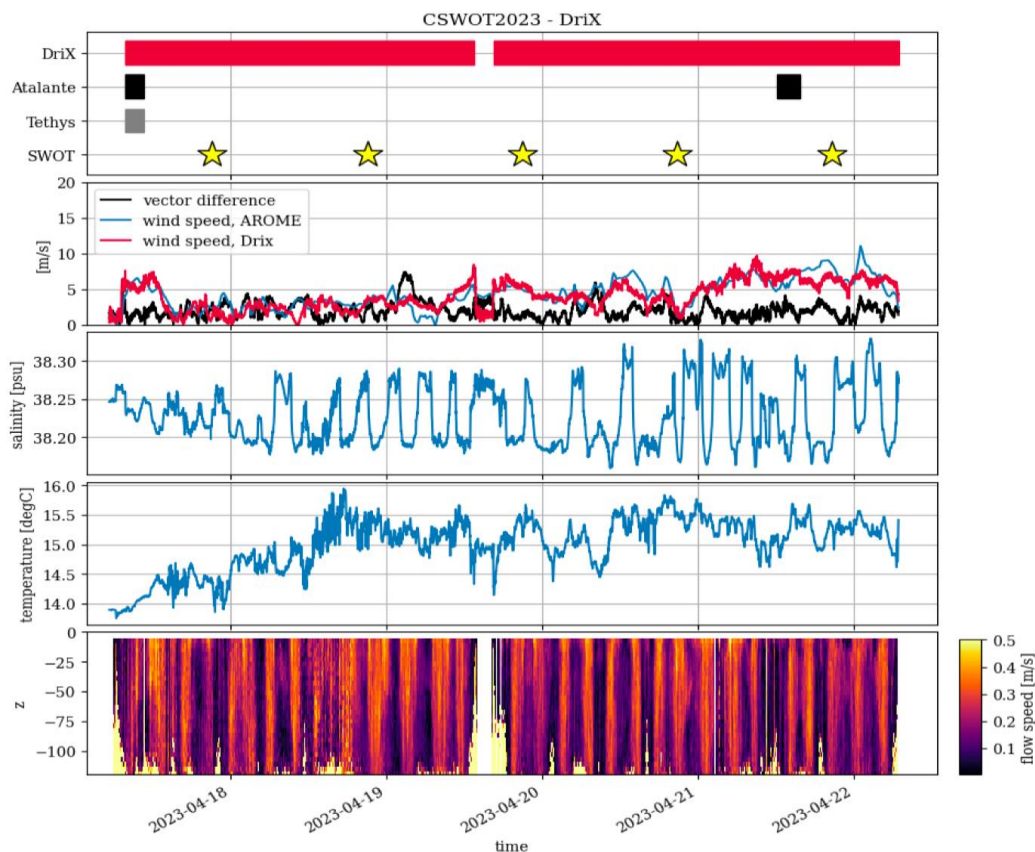
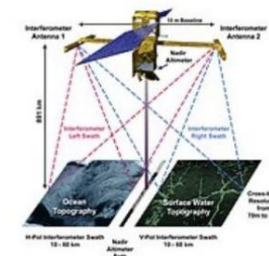
Payload

- SBES EK80, 70 & 200 kHz
- Hydrophones
- CTD
- Turbidimeter

Data densification SWOT cruise April 2023 - Mediterranean sea

- Calibration of SWOT satellite
- North current variability data

Complementing existing setup : ADCP, CTD, Meteorological observations, Underway sea level data





National scientific survey conducted in 2022-2023

➤ More than 50 use cases collected :

- Coastal/overseas applications - Standalone or with a Research Vessel

➤ Some examples :

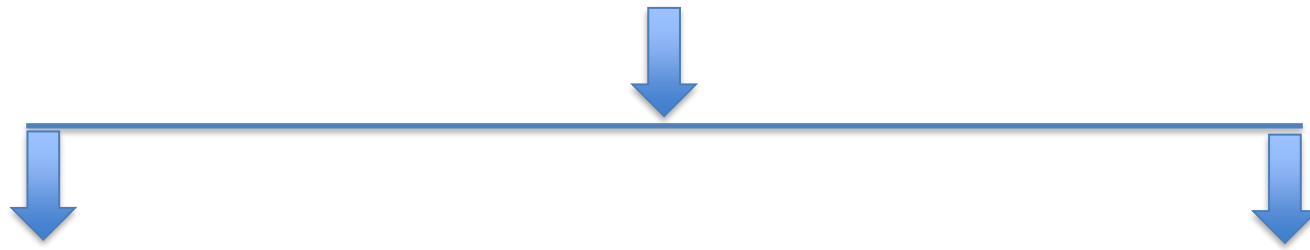
- Fish ressources : fish stock assessment, biology,...
- Physical oceanography : dynamics of the ocean, sea level measurement, geoid measurement, satellite altimetry, ..
- Geosciences : tectonics, methane monitoring, volcano/seismic hazards, bathymetry, geodesy, ..
- Environnement : protected areas monitoring, ...
- Geochemics : organic and metallic contamination detection, ...
- Archeology
- Technics : AUV escort to free , Argo floats launch and recovery, data collection

		
IR* FOF – ENQUÊTE USV		
Envoi mail à : cdavidbe@ifremer.fr	Date limite : 12 avril 2023	
Sujet : Enquête USV Etoffe		
Remplacer les crochets par les informations qui y sont indiquées		
Fiche d'intérêt USV – Proposée par : [Nom, Organisme, Labo]		
Thématique : [thématique scientifique/discipline]		
Objectif(s) : [Décrire en une phrase ou deux les principaux objectifs]		
Navire accompagnateur : [Indiquer : nécessaire, peut-être ou non nécessaire]		
Lieu et saison : <ul style="list-style-type: none"> • [Lister une ou des zones géographiques, profondeurs, distance des côtes et périodes de travail envisagées] • ... 		
Charges utiles : <ul style="list-style-type: none"> • [Lister les équipements requis. Ex. : sondeurs bathymétriques (type, caractéristiques), pompes (caractéristiques), ADCP, stations météo, autres] • ... 		
Scénario(s) d'opérations : <ul style="list-style-type: none"> • [Décrire succinctement les différents types d'opérations à réaliser (ex. : prospections acoustiques, mesures en route, ...), leurs enchaînements, durée, vitesse requise, ...] • ... 		

High level specifications of a FOF survey USV

Compulsory

- Operable in sea state 4/5 in open seas
- Modular design
- High speed (>7 knts)
- Manoeuvrable
- Easily transportable (container, truck trailer,..)



➤ **Costal USV**

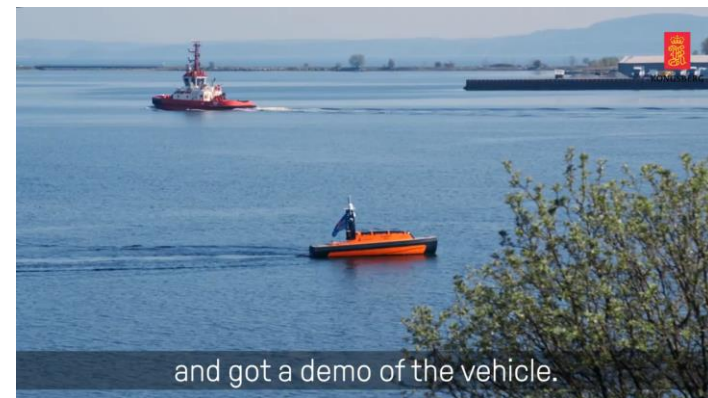
- Close to base
- Operated from port to port
- A few days autonomy at high speed
- Shallow water (MBES, SBES, ADCP, CTD)
- Mobilisable on an ocean class Research Vessels

➤ **Oceanic USV**

- Far from base
- Operated from port to port
- 30 days autonomy
- Higher sea state
- Deep water MBES + AUV

Potential coastal USV's

- Streamline shape Drix (EXAIL), 8m, 1.5t, 2-3 days autonomy à 8 knts, shallow water payload
- Mini-supply Mariner X (Maritime Robotic), 9m, 7t, (20 days autonomy at 5 knts, shallow water water payload
- Classic boat design Sounder (Kongsberg), 8m, 5t, 30 days autonomy at 5 knts, shallow water payload

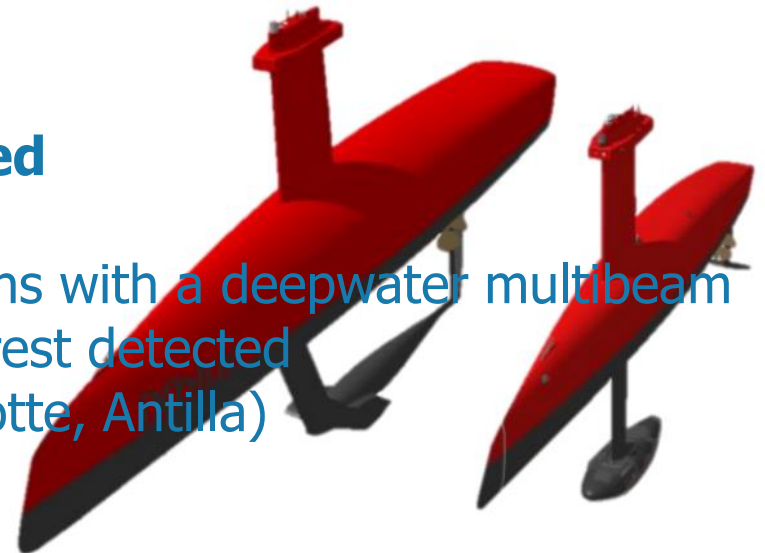


Oceanic drone - SEMNA Project

- Collaborative project 2022-2024 with EXAIL
- Development of DriX Ocean : 15 m long, >5t, 1 month autonomy, deep water payload, ROV L/R

Objectives : Scientific cruise proposed

- Exploration of unexplored abyssal plains with a deepwater multibeam
- Deployment of an AUV if point of interest detected
- Survey of volcano-seismic fields (Mayotte, Antilla)



Merci

A detailed illustration of a fountain pen nib, showing the gold-colored metal and the black resin body, positioned as if it has just finished writing the word "Merci".