



MARITIME DRONES AND THE FRENCH OCEANOGRAPHIC FLEET

MARC NOKIN

French Oceanographic Fleet : Vessels, UW vehicles



M. Dufresne - 120m



Pourquoi pas? - 107m



L'Atalante - 85m



Thalassa - 75m



L'Europe - 30m



Thalia - 30m



ALIS - 30m



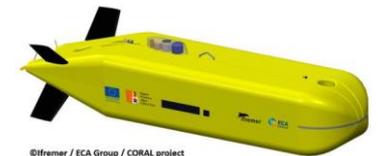
Thétys II - 25m



Côte de la Manche - 25m



Antea - 36m



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+ USV's 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.

➤ **Environmental impact reduction**

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

➤ **Cruise cost optimization**

Daily rate of 50-100m RV = at least 15-20 drones (medium size)

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



Questions for 2022-2023

- 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
- Collaborative project with Ixblue : SEMNA – DriX Ocean : 2022-2024
- National community survey for scientific requirements - 2022

Diesel powered USV's

Medium size (2t typically with) a deep gondola or moonpools : example of streamline shape Drix 8m (1 week cruise, shallow water payload)

Large size and supply design with large working deck : example of Mariner X (1 month cruise, deep water payload)

Very large size, support of deep AUV's : example of Blue essence



which makes these USVs the perfect long-range configurable platform,

High level specifications of a FOF oceanic USV

Wide variety of applications: geosciences, physical oceanography, fish stock assessment, biology,....

Compulsory – oceanic USV

- Sea state 5 in open seas
- Survival mode in bad weather
- Modular design
- Port to port operations

- A few days autonomy
- Shallow water payload (ADCP, MBES, EK80, CTD profiler)
- Mobilisable on research vessels¹

USV category >1 t

- Higher sea state
- A few weeks autonomy
- Deep water MBES

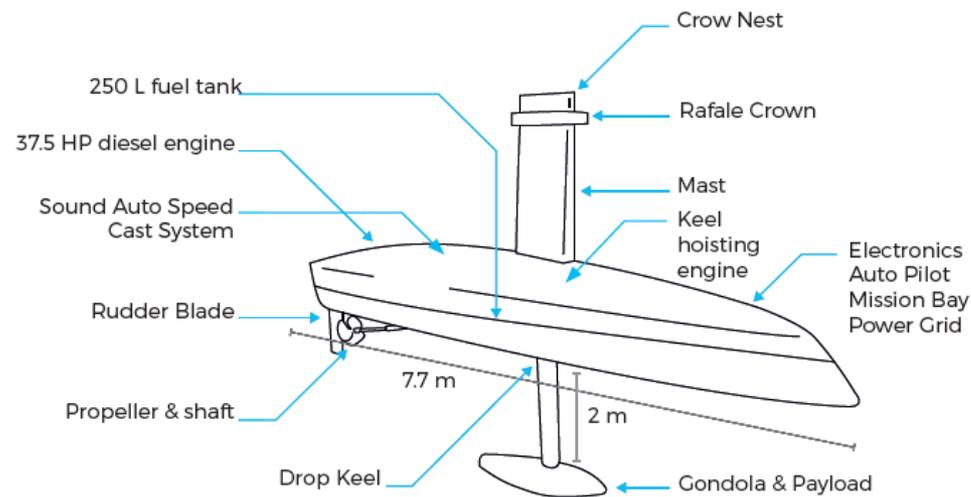
USV category >5 t

At sea cruises

At sea cruises

DriX characteristics

- Length : 7.71m
- Width : 0.82m
- Weight : 1.38T
- Draft : 2m
- Height : 4.76m
- Propulsion : inboard 38cv
- Autonomy : ~2,5 jours à 8knt H24
- Retractable keel



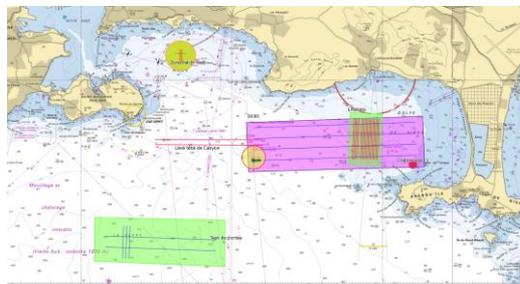
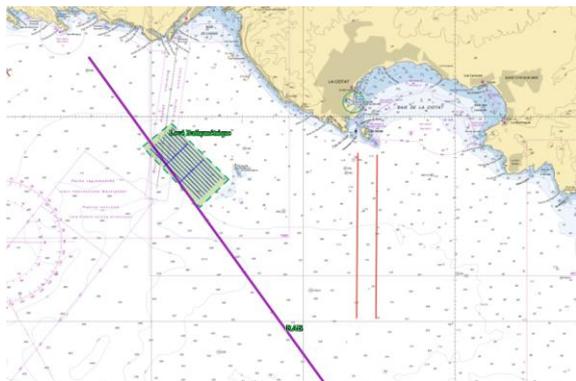
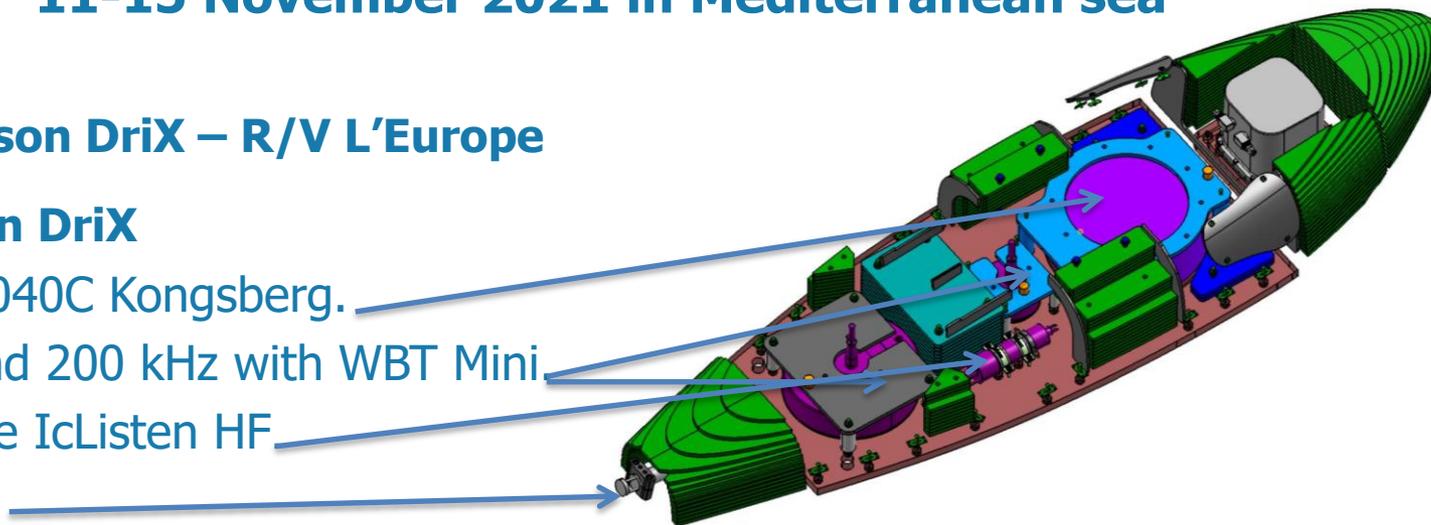
Mission ESSDriX « Fish stock assessment »

11-15 November 2021 in Mediterranean sea

Inter comparison DriX – R/V L'Europe

Equipement on DriX

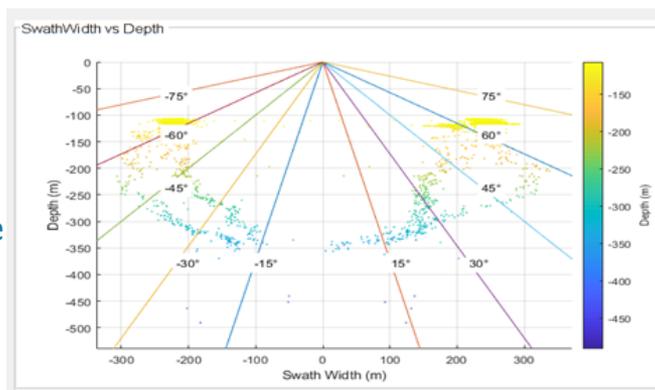
- MBES EM2040C Kongsberg.
- EK80 70 and 200 kHz with WBT Mini
- Hydrophone IcListen HF
- Mini SVS



EM2040 acquisition (detailed analyses in progress)

- Good manoeuvrability allowing efficient survey with low time consuming U-turns.
- Good data quality and range.
- Bathymetric data not impacted by DriX motions.

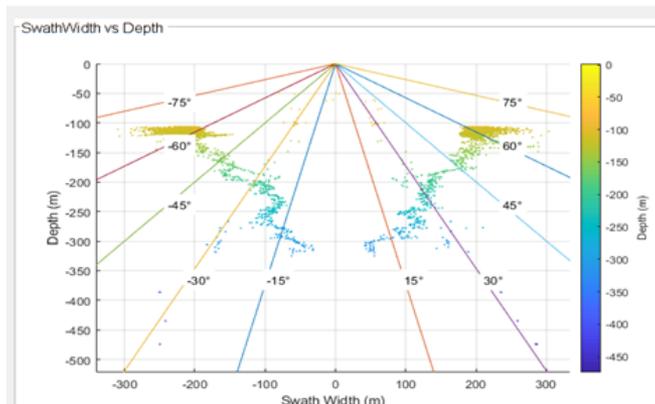
L'Europe



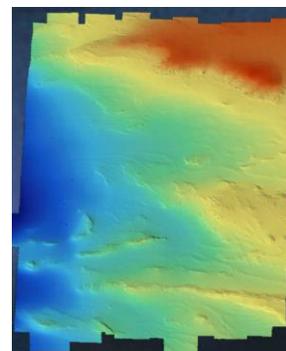
- Slight reduced swath due to electric noise

(Electronic's very compact integration)

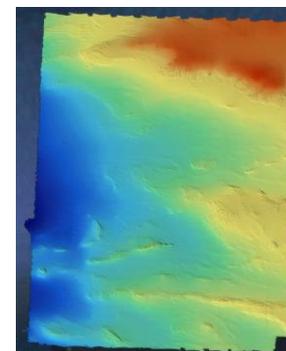
DriX



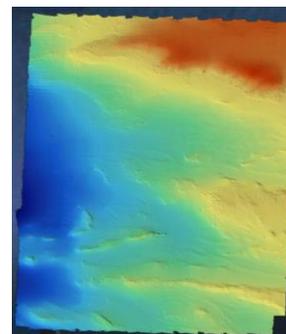
L'Europe 8 noeuds



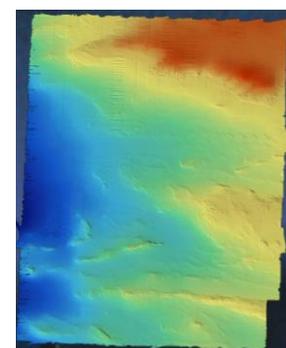
DriX 8 noeuds



DriX 10 noeuds

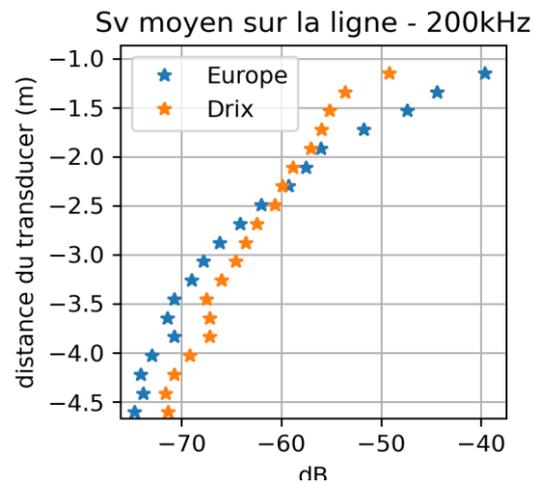
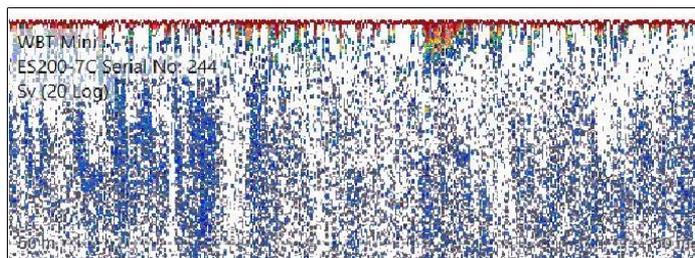


DriX 12 noeuds

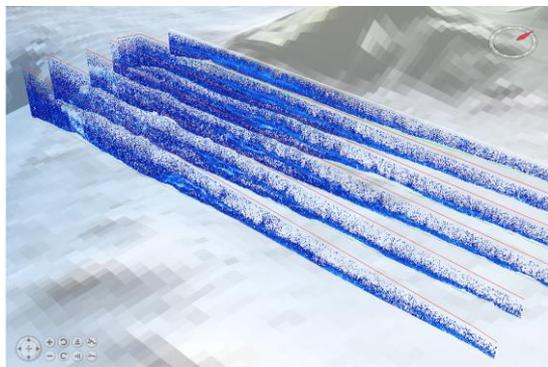


Bubbles sweep down

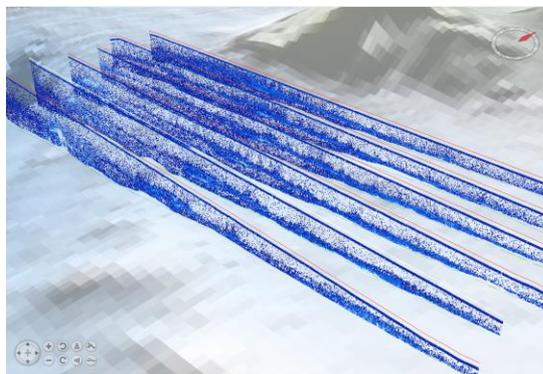
Bubbles : % of pings with more than 2 samples $> -60\text{dB}$ in $[1\text{m}-5\text{m}]$: L'Europe 17%, Drix 18% - Similar results



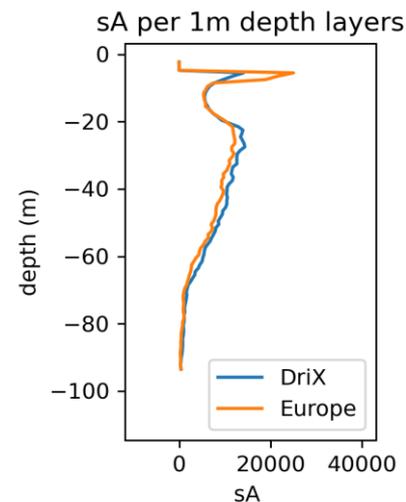
Plancton quantity – EK 80 70kHz : Nice fitting correspondance



DriX



L'Europe



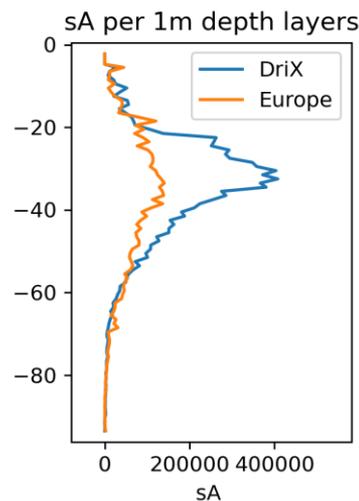
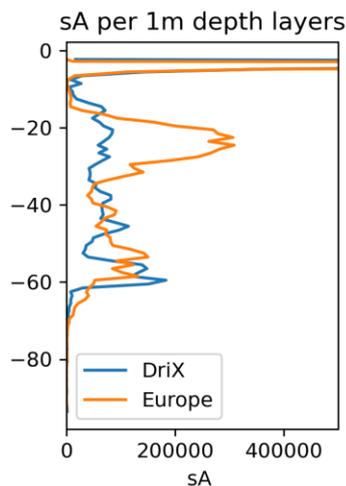
Fishes quantity – EK 80 120 kHz

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)



Reasons of differences are known and solved

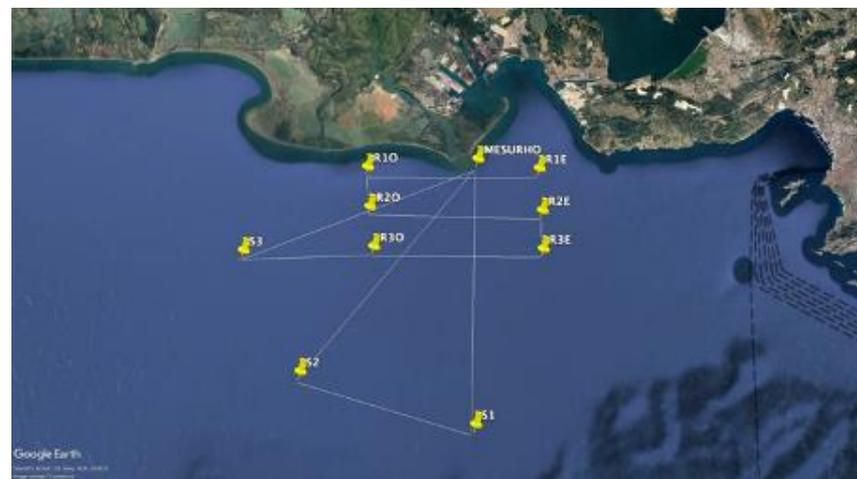
Physical Oceanography

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

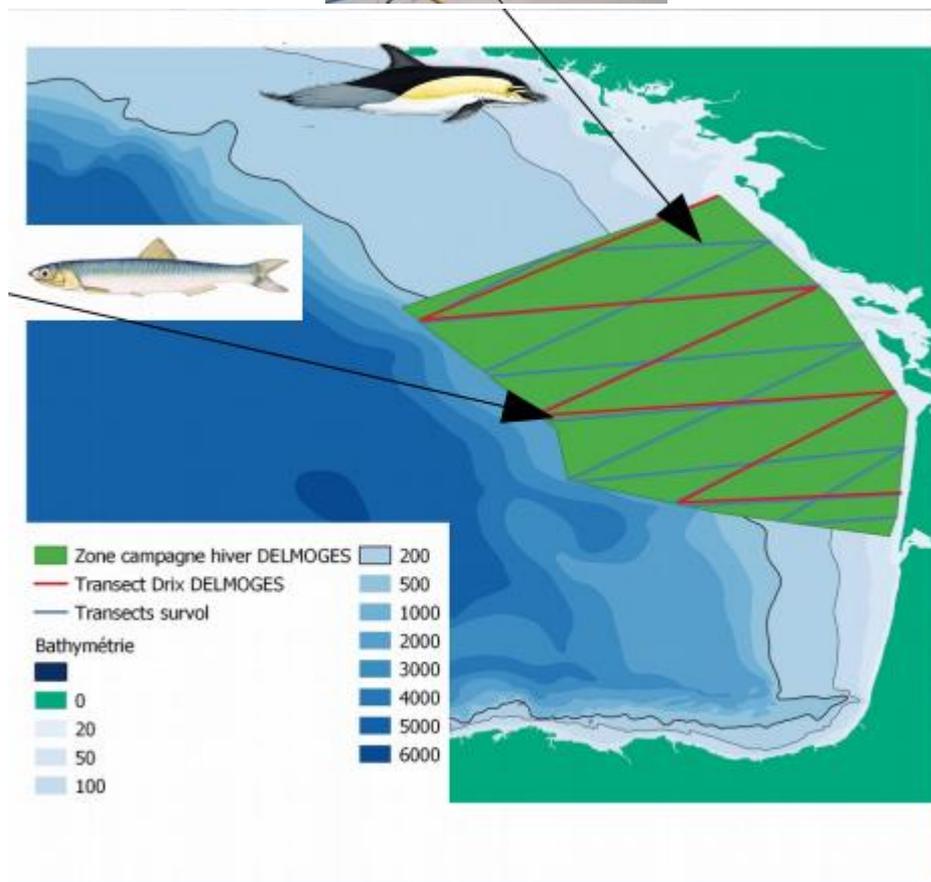
October 7-9, 2022 : 2.5 days south of Belle Ile – SOLIBO cruise

DriX equipment

- ADCP RDI Workhorse Monitor 300kHz
- EK80 70 and 200 kHz with WBT Mini
- CTD at the front : RBR Legato3
- CT at the rear : Valeport Mini CT
- Turbidimeter : Campbell OBS3+
- CTD on winch : Valeport Swift CTD
Meteo station Maximet GMX501



DELMOGES WP1 - Co-occurrence of small pelagic fishes and dolphins to explain accidental capture

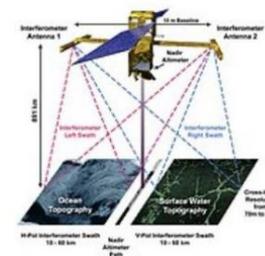


February 2023 – Gulf of Bisquay - 22 days

- 500 NM * 3 surveys
- 6 days at 7 kots, 12h/24h by survey

SWOTH cruise April 2023 - Mediterranean sea

- Calibration of SWOTH satellite
- North current variability data



Complementing existing experimental setup with DriX

- Additional upper ocean ADCP measurements to strength synopticity and/or to enlarge the spatial footprint of experiments.
- Additional underway CTD.
- Additional meteorological observations.
- Underway sea level data.





Merci

A close-up of a fountain pen nib, showing the gold-colored metal and the black ink reservoir.