High Frequency Observation

An Autonomous ePlatform for Biodiversity Survey and *in situ* Species Identification Through eDNA

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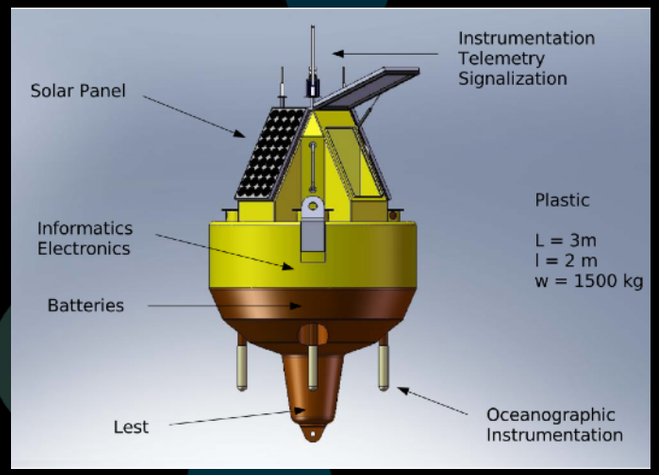
Julia BAUDART, Michel GROC

REMIMED - Technology Platform for Access to a High-Frequency (HF) Instrumented Marine Network

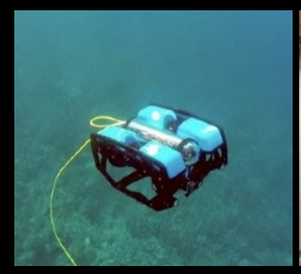
https://www.obs-banyuls.fr/en/oob.html

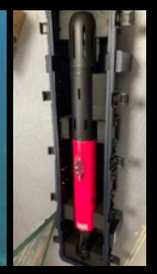
- *Fleet resources (2 vessels with crew, diving service)*
- *Oceanographic instrumentation (ROV, AUV, Rosette/CTD, multiparameter probes…)*
- *2 Oceanographic buoys (SOLA, POEM)*
- *Underwater imaging (photo/video)*
- *1 km submarine cabled network with two instrumented junction boxes (ADCP, multiparameter probes, HD underwater cameras, water samplers, **Cytosub**, hydrophones…)*
- ***Environmental instrumental systems R&D team***



Parameters

- *Battery Status (Voltage / Current / Temperature)*
- *Computer Status (Uptime / CPU Load / ....)*
- *Latitude / Longitude*
- *Pitch / Roll / Heading*
- *Wind Speed / Direction*
- *Air Temperature / Atmospheric Pressure*
- *Pressure / Temperature / Salinity / Fluo / Turbidity*





Technology development to better understand and preserve the health of aquatic ecosystems

OOB: Banyuls Oceanological Observatory

High-Frequency Biological Data

Biodiversity monitoring

Challenges for HF acquisition of biodata

CLASSIC PROCEDURE FOR eDNA-BASED OBSERVATION

FIELD	LABORATORY 1	LABORATORY 2	LABORATORY 3	OFFICE
Ship + crew Niskin bottles Samplers Water containers	Filtering process (single usage) Storage (-80°C)	eDNA/eRNA extraction Sample prep. for NGS sequencing	Sequencing	Data processing, analysis, storage, sharing..

Time/costs

Cost-effective solutions for extended observation coverage

- ★ High-frequency spatio-temporal monitoring of biological variables
- ★ Ocean Augmented Observatories

ePLATFORM Building Blocks

Sampling ▶ **Pre-treatment** ▶ **Treatment** ▶ **Analysis** ▶ **Data transfer**

Environmental Nucleic Acids Sampler
(PCT/FR2024/000035)

Geno-sensor
(PCT/FR2024/000084)

Graphic Interface for programming and edition of steps & cycles (mode expert)

Multisampling recovery (7)

Compact and portable system

Filtration area, 5000 cm²
Process volume > 50 L

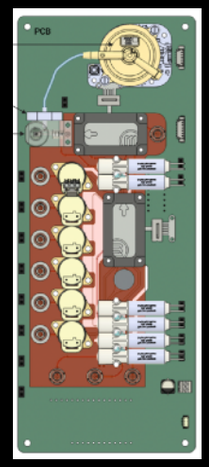
TRL7

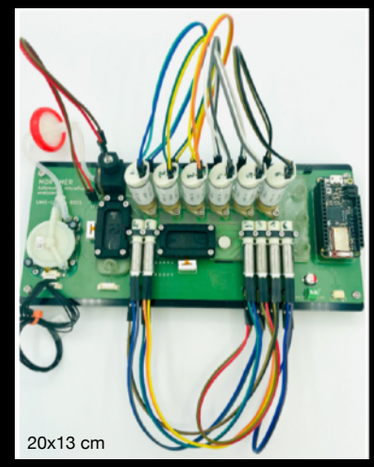
Prototype V1 (2024)
TRL8 (2027-28)

System Integration

Sample to Data

Genosensor Deck

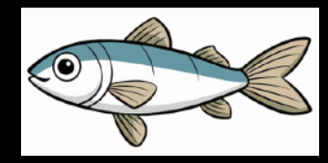




TRL5

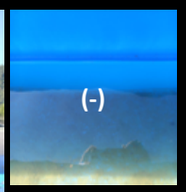
Prototype V1 (2026)
TRL6 (2027)

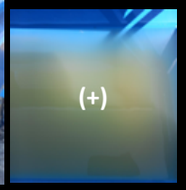
ePLATFORM Technology

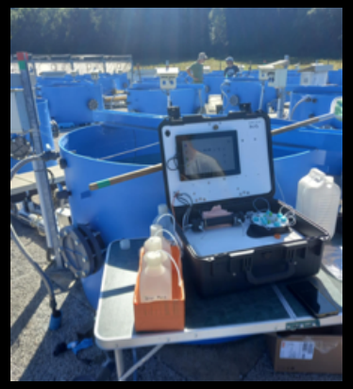


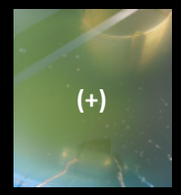
eNA Sampler Application : minnow detection in lotic and lentic systems

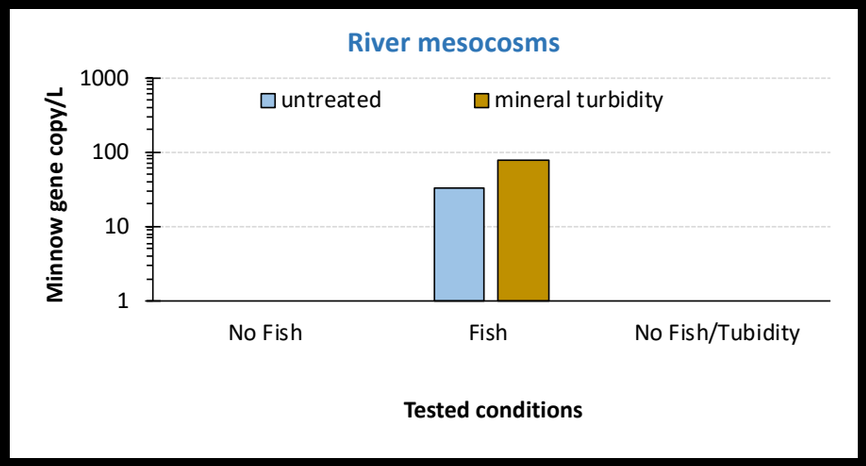
ALIQUOT
Environmental nucleic acids - **eNA**, sentinel molecules for continental hydrosystems (ANR-22-PEXPO-0011).
2024-2028

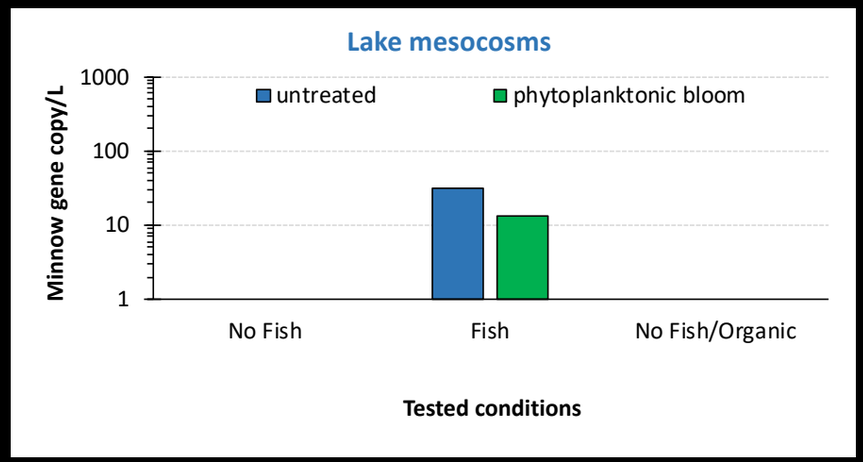






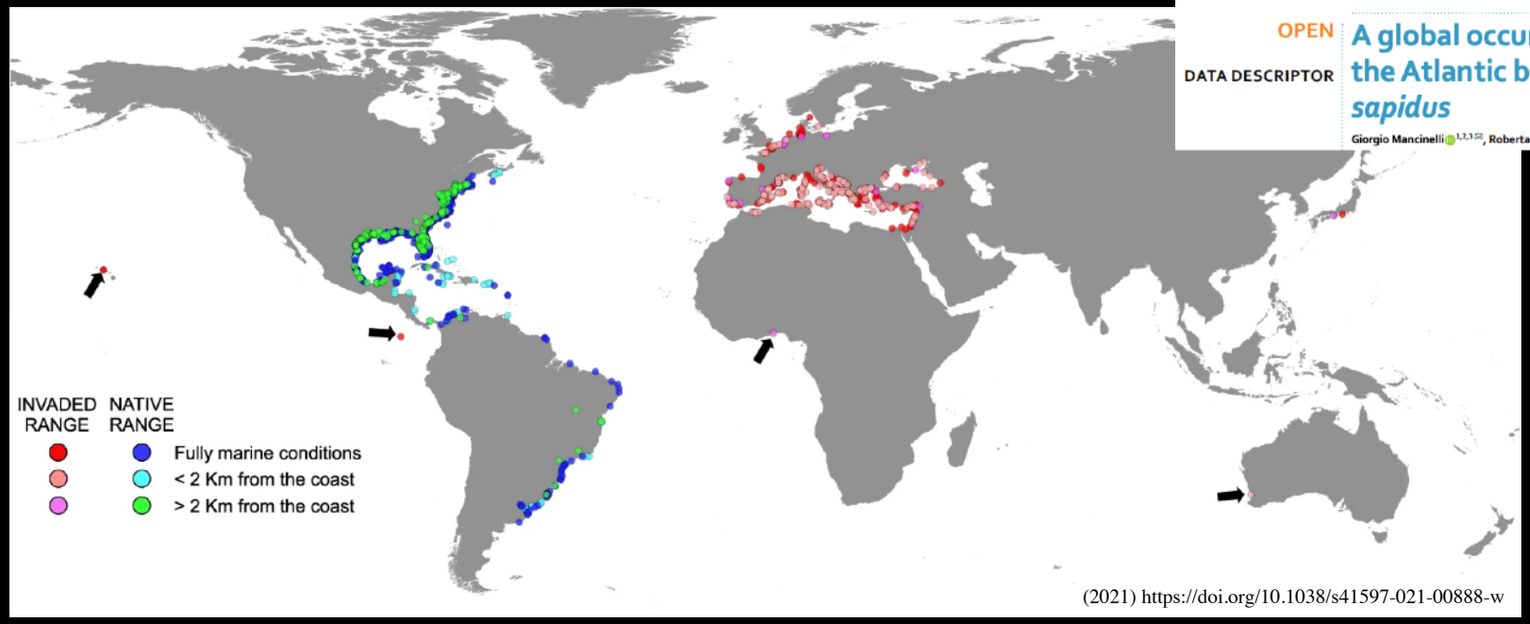






ePLATFORM Technology

eNA Sampler Application : invasive species



SCIENTIFIC DATA

OPEN DATA DESCRIPTOR

A global occurrence database of the Atlantic blue crab *Callinectes sapidus*

Giorgio Mancinelli, Roberta Bardelli & Argyro Zenetos

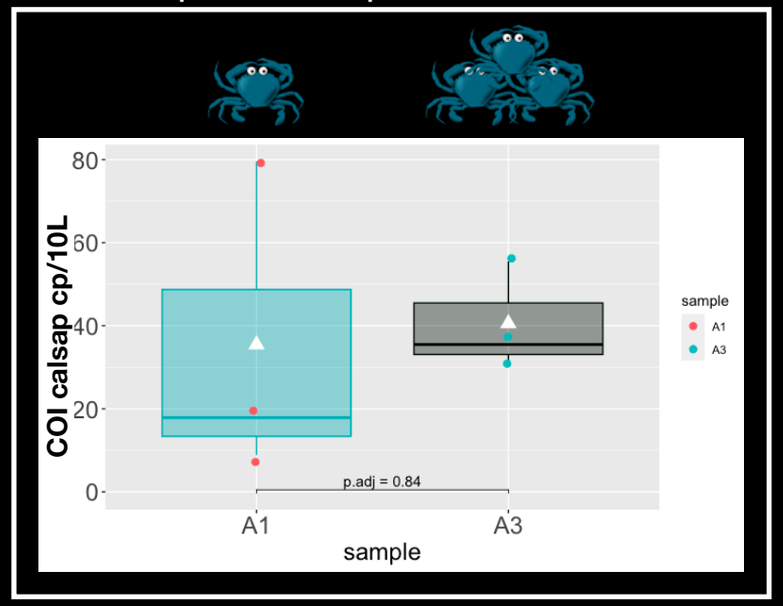
50-80% loss of revenue during summer peaks for small-scale fishermen
(e.g., Canet-Saint-Nazaire lagoon - Occitanie, Biguglia lagoon - Corse)

ALIEN-OCCICAT (INTERREG POCTEFA, European cross-border cooperation programme, Pyrenees-Mediterranean Euroregion, 2025-2028), detection of invasive species in the lagoons of the Occitanie region.

Goal: development of biosurveillance tools to improve knowledge of the temporal and spatial distribution of invasive species.

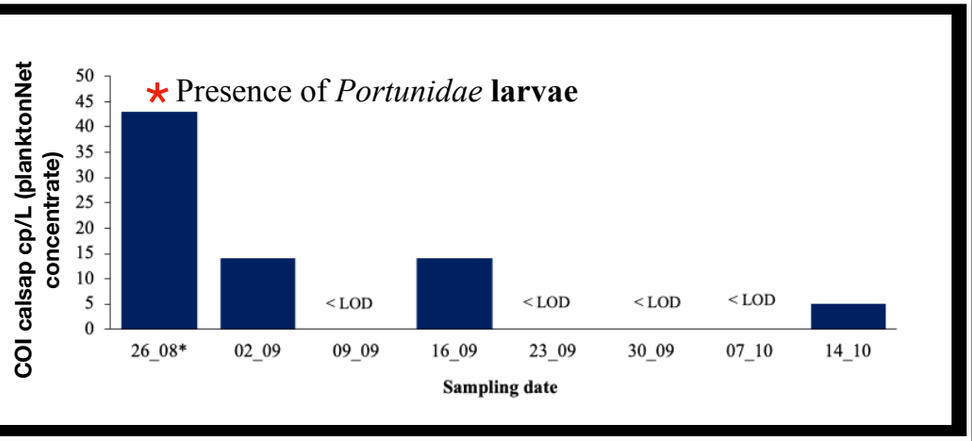
Development of dPCR method for the detection of *C. sapidus* eDNA

Aquarium Experiments 2025

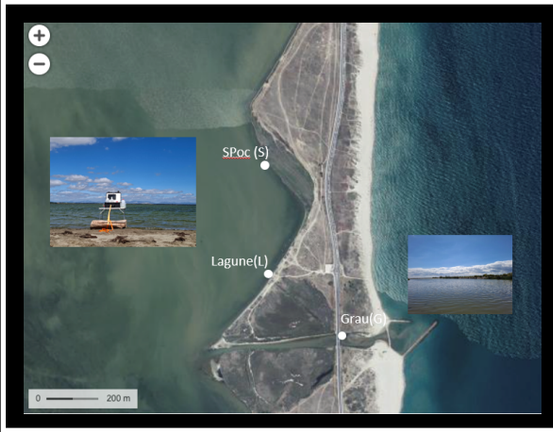


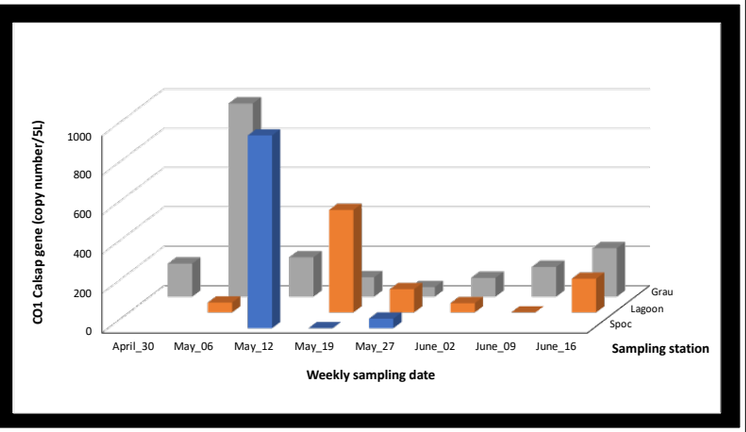
Detection of *C. sapidus* eDNA in planktonic samples

SOLA Observation site (nearshore) 2025



Canet Lagoon 2026





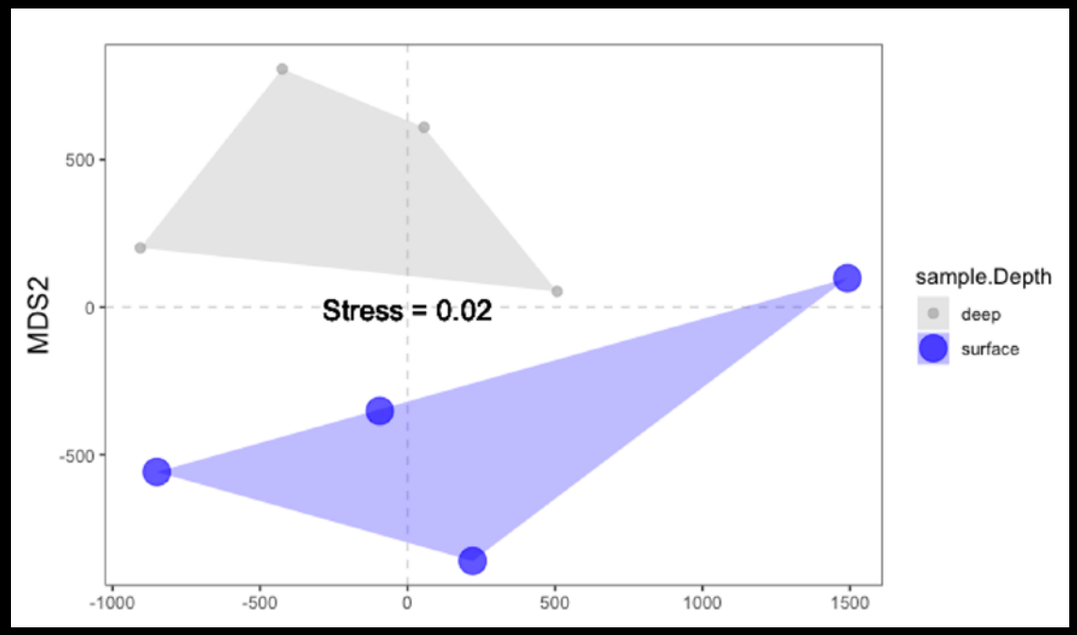
ePLATFORM Technology

Application : spatio-temporal diversity of microbial communities

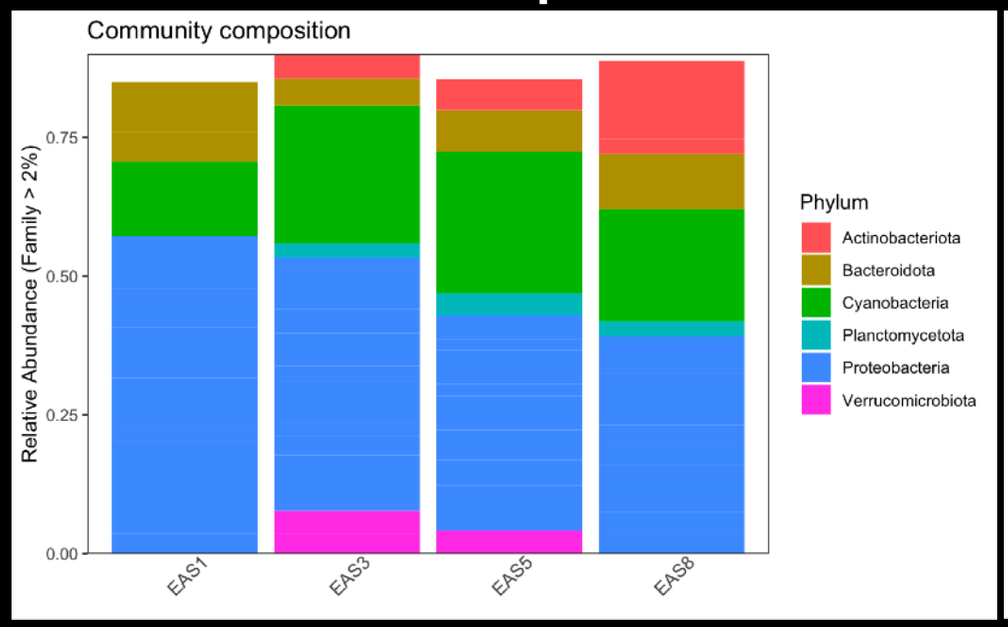
SOLA Observation Site, 13Jun23-07Jul23

Spatial distribution of Microbial communities

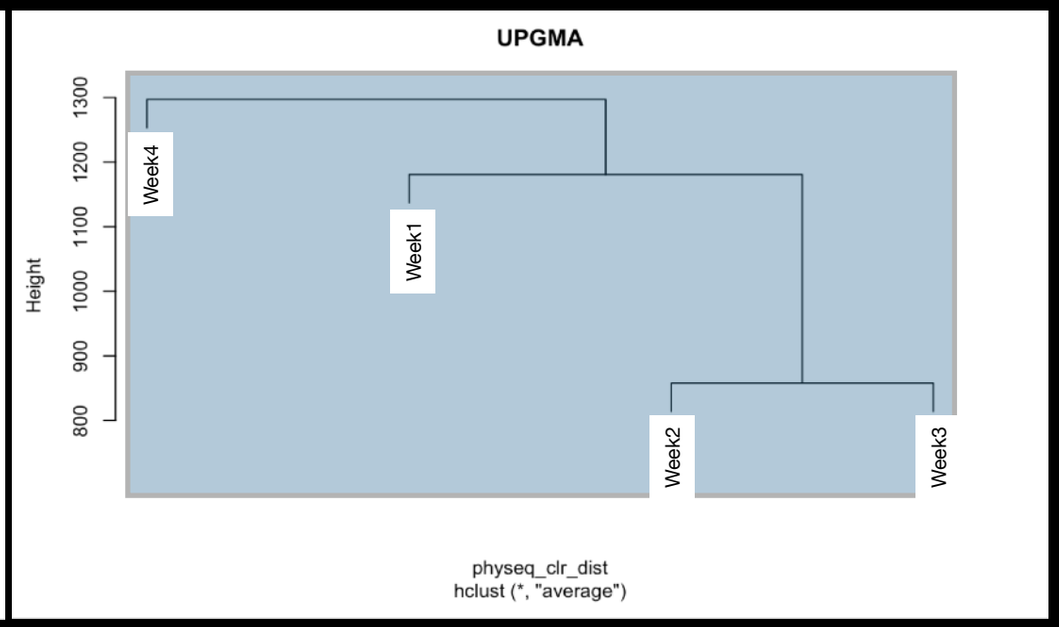
16S rRNA Metabarcoding Analysis



Temporal distribution of Microbial communities



Week1 Week2 Week3 Week4



ePLATFORM Development

AUTONOMY

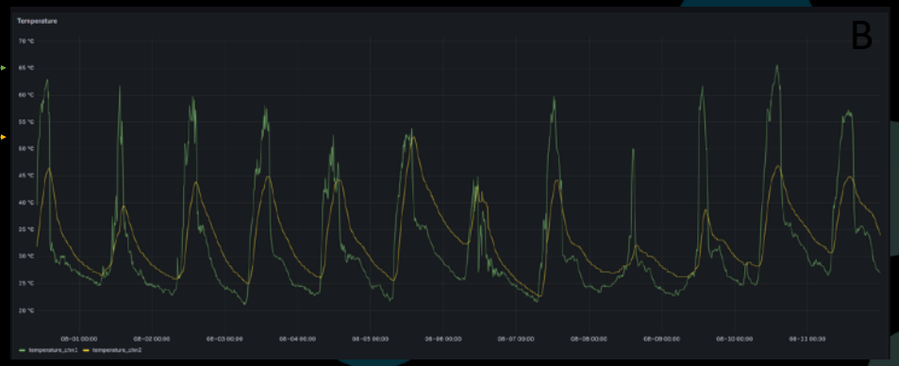
T_{ext} = 50 ^{o}C →
T_{int} = 46 ^{o}C →

BUILT IN BATTERY
(Lithium)

AUTONOMY

10h

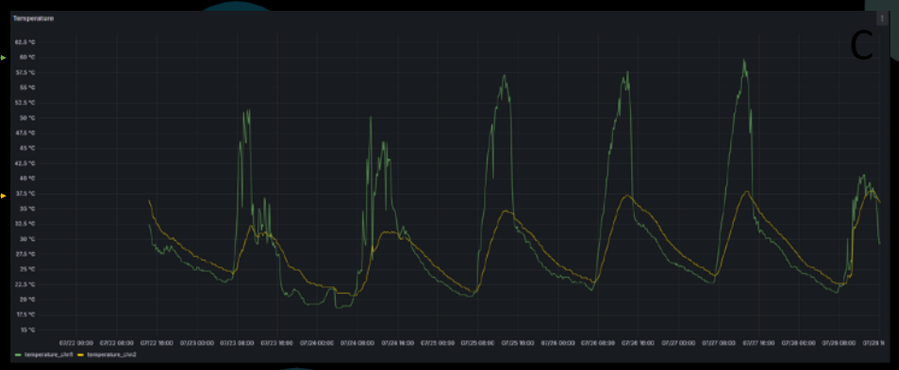
T_{ext} = 65 ^{o}C →
T_{int} = 52 ^{o}C →



EXTERNAL BATTERY
(Gel DYNO EUROPE
DGY12-100EV 12V 105 Ah)

12 d

T_{ext} = 58 ^{o}C →
T_{int} = 37 ^{o}C →



OUTLET

> 7 d

ePLATFORM Development

AUTONOMY

Banyuls Harbor

HARBOR OUTLET

BATTERY

2026

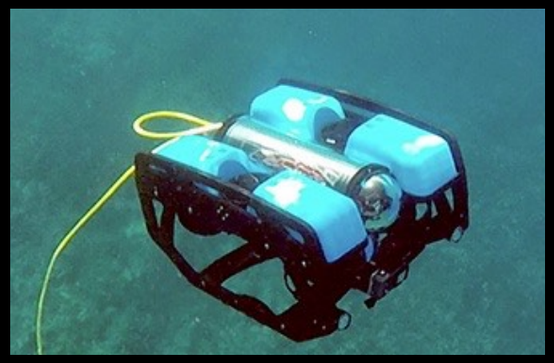
SOLA

2026/2027

ePLATFORM Technology

DEPLOYMENT

Mobile/robotic vector integration - ROV / AUV / gliders



eNA sampler

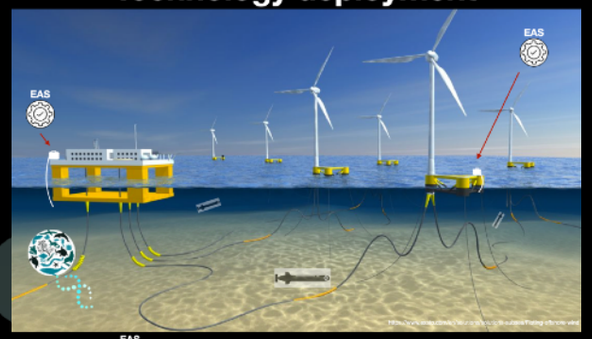
Underwater Adaptative Design
2025-2026

MISSION 6
Establishment of a multidimensional environmental data atlas in two key oceanic zones: the northwestern Mediterranean Sea (Ligurian Sea / Gulf of Lions) and French Polynesia using underwater drones. **2026-2030**

FRANCE 2030

HORIZON-CL5-2026-02

Technology deployment



Life-Wind
Transform sustainable offshore wind energy deployment by assessing lifecycle cumulative impacts.
2027-2031

Augmented Observatories

Technological & Methodological LOCKS	Unlocking with ePlatform
• Costly and time consuming classic pre-analytical procedures, • Accessibility issues	• Increase spatio-temporal coverage using ePlatform technology • Technology is designed for remote use
• Lack of HF monitoring systems to improve knowledge of the spatio-temporal dynamics of biological variables	• Deploying an innovative autonomous sampler for eNAs fit for purpose
• Need for biological survey of invasive/ dangerous species	• In situ molecular sensors deployment

9 R&D&I PROJECTS 2019 -

2025 Innovation Prize Winner

TEAM

Renaud VUILLEMIN (RE)
Carmem-Lara MANES (RE)
Michel GROC (RE)
Julia BAUDART (AP)

BUDGET

2 Mi €

Cécile VILLETTE (AE)

Pierre GROC (RE)

Eva AGRANIER (PhD student)

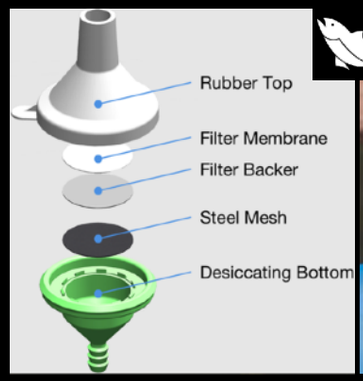
Alexis CROS (E)

Rachid BACCHIERI (T)

Isabel DIAZ (E)

MERCI

Filtration area, 10 cm²
Process volume 1 - 2 L

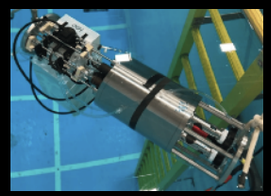


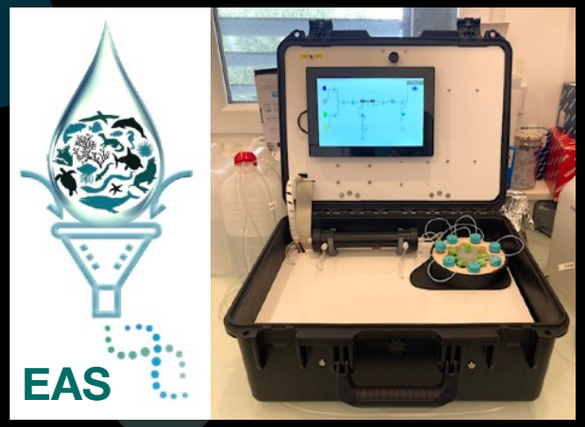
Filtration area, 17.4 cm² / Process volume 3 - 5 L

Filtration area, 600 cm² / Process volume 10 - 50 L

D.O.T. = 100 - 500 mL
(Filtration area, 5 cm²)

RoCSI (McLane) = 1 - 2 L
(Filtration area, 10 cm²)





Filtration area, 5000 cm²
Process volume > 50 L