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HarshLab

An advanced floating laboratory for the validation and experimentation of materials, components and equipment in real offshore environment

Pablo Benguria

June 22nd 2022

Bizkaia Aretoa (Bilbao)

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Content

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What is HarshLab?

What is HarshLab?

- HarshLab is **Europe's first offshore floating laboratory** for the evaluation of materials and components in real offshore environment.
- A first prototype installed in Bimep area in **Sept. 2018**, in 2022 has been replaced by the final version
- Designed in **a two stages strategy**, sharing the same mooring system:

- ✓ **Small** components and probes testing
- ✓ **Immersion**, **splash** and **atmospheric** zones
- ✓ **No** electric supply

- ✓ **Bigger** and **fully functional** equipment and components testing
- ✓ Additional exposition zones: **seabed** and **confined**
- ✓ Connected to Bimep's submarine cable (2023)

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What is HarshLab?

TECHNICAL SHEET HarshLab2.0

Dimensions: 8,5 m diameter; 7,0 m high, 120tons

Capacity

- Exposition of more than **2000 samples** in atmospheric, splash and immersion zones
- Space for component testing: **120 m²** (60 m² outdoor deck, 57 m² in hold)
- Main crane capacity: **1 ton** @ 5,25 m
- Auxiliar davit capacity: **300 kg** @ 1,5 m
- Maximum payload: **9 ton**.

Grid connected (spring 2023)

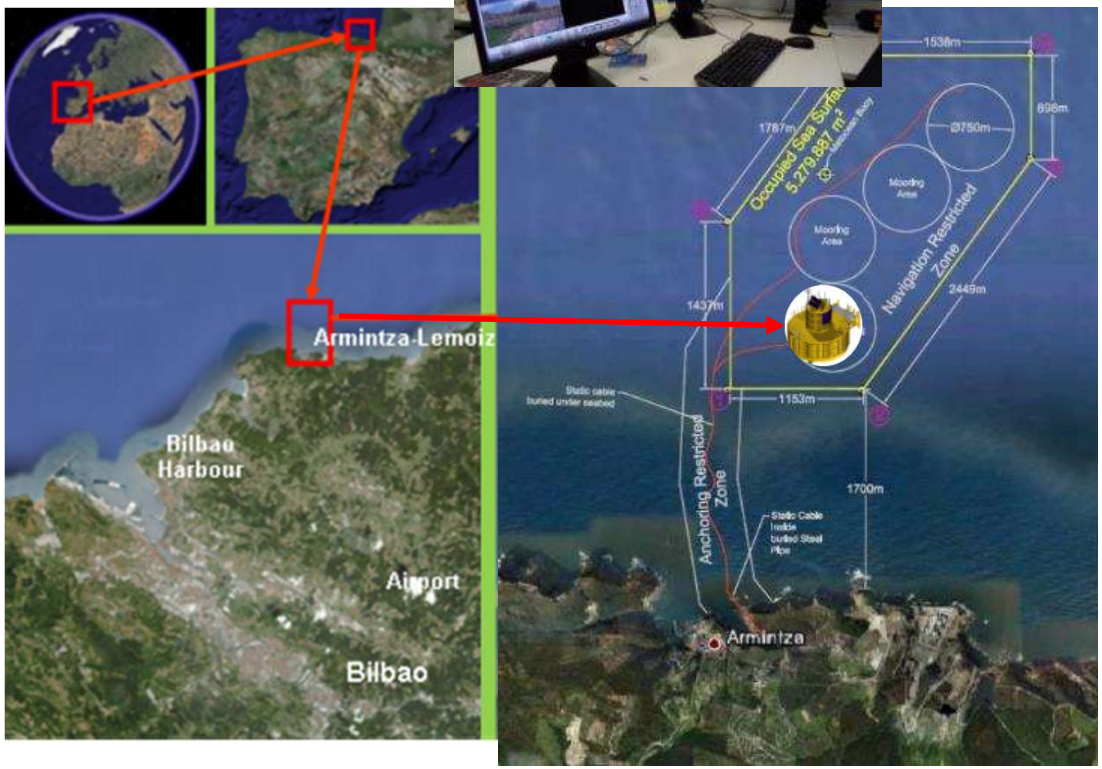
- Umbilical cable for **power and communications**
- Connected to BiMEP's submarine grid at 690V/160 kVA
- Internal working voltage: alternating current at 400V and 230V, and direct current at 24V and 12V
- Local photovoltaic and batteries system for feeding essential equipment onboard (AIS, lantern, etc)
- Designed for connecting third party devices testing in BiMEP area to the submarine grid.

https://harshlab.eu/

What is HarshLab?

- Bimep is an infrastructure for **testing and demonstrating prototype devices** for harnessing ocean energy.
- Located in the Gulf of Biscay, **1,6 nautical miles** away from the village of Armintza (Bizkaia, Spain)
- **5.3 km²** total surface area.
- Fully equipped with **subsea infrastructure** for onshore grid connection:
  - 13,2 kV – 5 MW subsea export cables.
  - Research and Data Centre (Monitoring and control system)
  - **24/7 surveillance**

BiMEP Biscay Marine Energy Platform
https://bimep.com/



- Well communicated with Armintza's port: **quick access** while ensuring **100% offshore conditions**.

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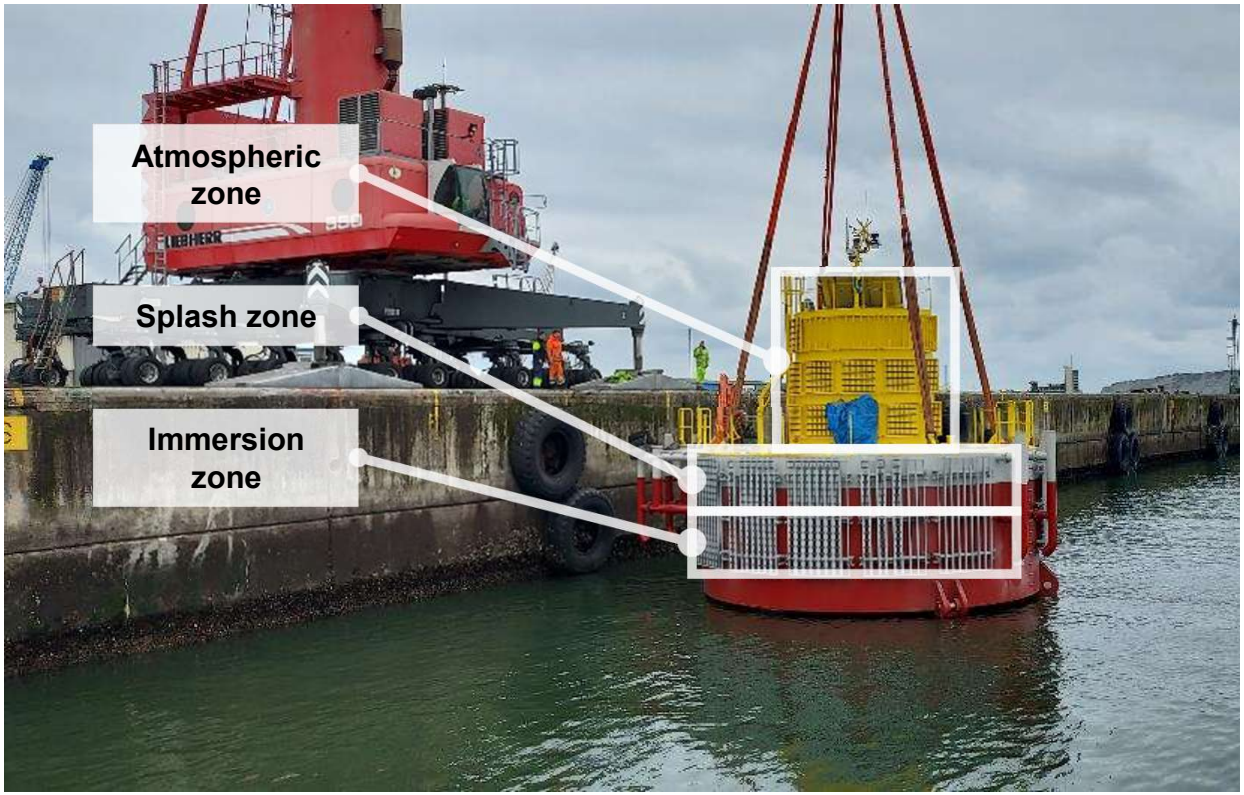
What is HarshLab?



Up to **2000 samples** can be tested at the same time**:**

- **585 in atmospheric zone**
- **704 in splash**
- **704 in immersion**

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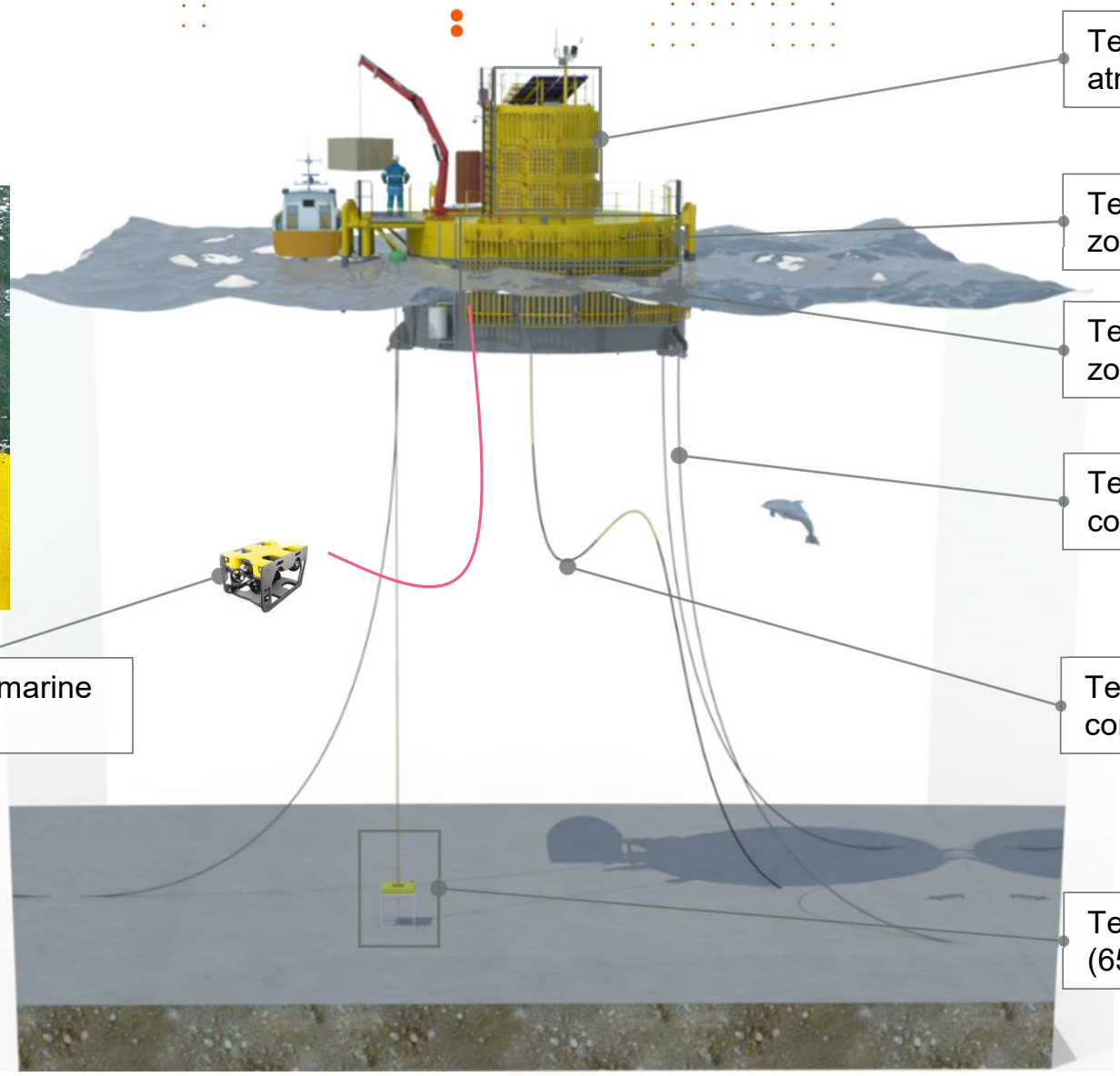
What is HarshLab?



Testing in atmospheric zone

Testing in splash zone

Testing in immersion zone

Testing of mooring components

ROV for submarine operations

Testing of umbilicals, connectors and risers

Testing in seabed (65m depth)

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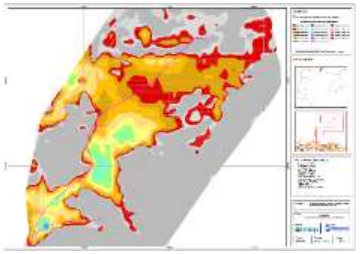
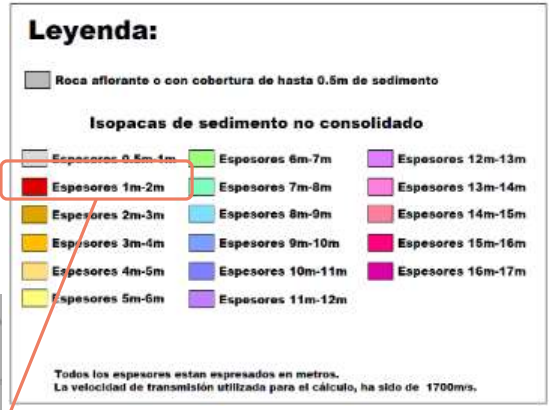
02

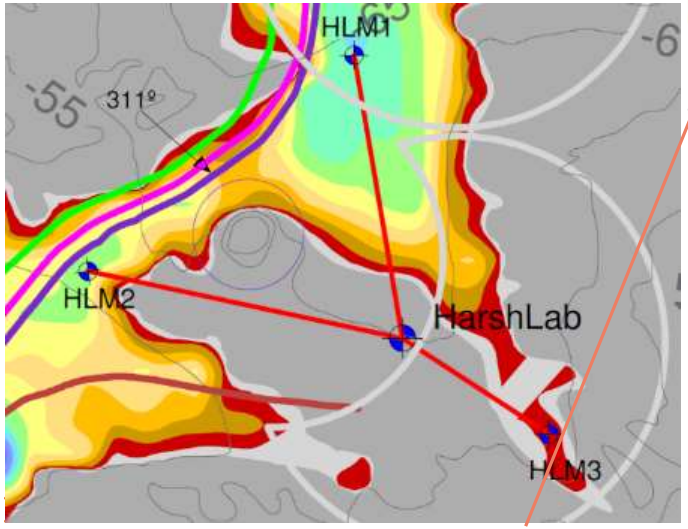
Commissioning HarshLab

Commissioning HarshLab

Challenging sea bottom environment: **mixed sandy-rocky seabed** at **65m depth**







Commissioning HarshLab

Mooring and anchoring system specifically designed for Bimep's seabed conditions, it's composed by 3 mooring lines, each of them composed by:

- Steel wire
  - Steel Wire DN=90mm
  - Total length 70+70+24.5+36.7 = 201.2 m
- Chain
  - Studless R4S, DN=70mm;
  - Total length 332+436+172+8.7 = 948.7 m
- Chain
  - Studlink R4, DN=76mm;
  - **100m for each line** (100x3 = 300m in total)
- Drag Embedment Anchors (STEVSHARK ©REX from VRYHOF)
  - Mass = 4.5+2.4(R)-3.5(FR)-3.5(FL) Tons

CoreMarine supported the design of the maneuvers and logistics for installation

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03

Monitoring HarshLab

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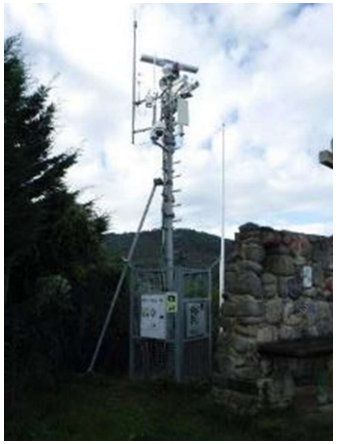
Monitoring HarshLab

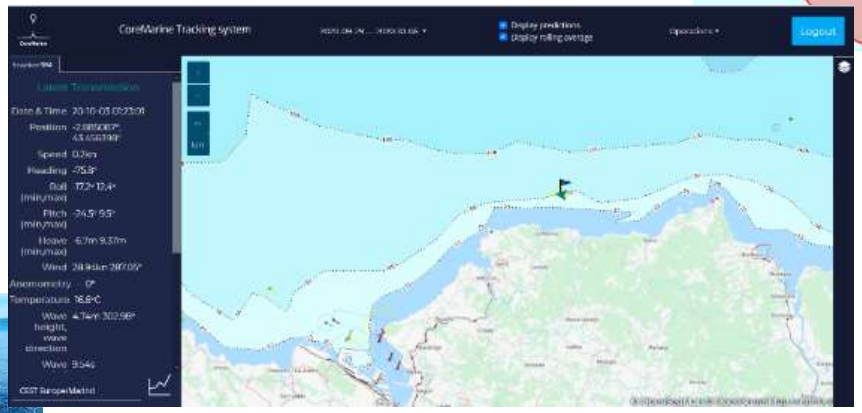
Position and behaviour

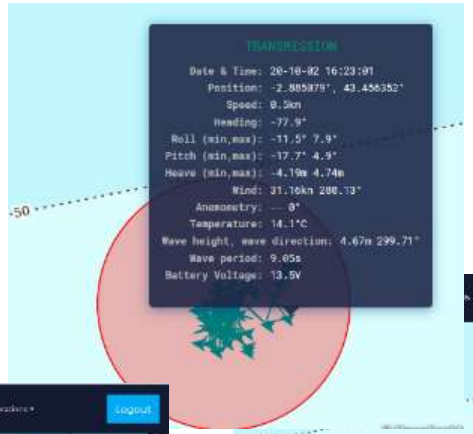
Remote surveillance of HarshLab through three strategies:

1. BiMEP control centre



2. GPS based tracker onboard





3. ZuniSOS

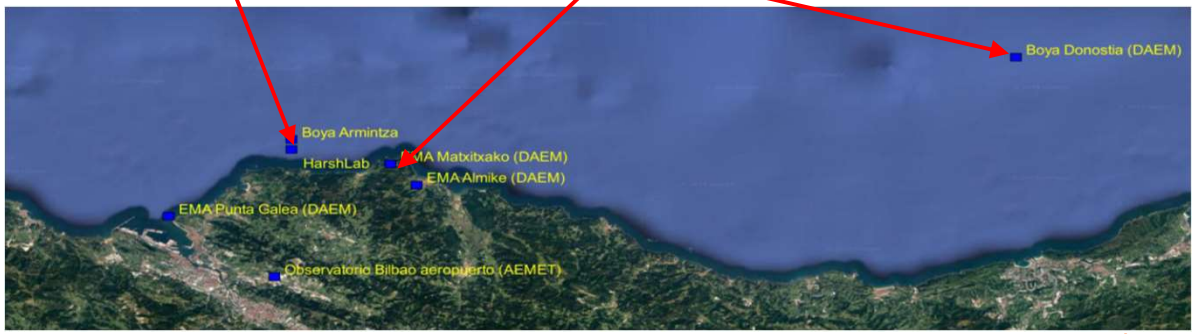
ZUNIBAL

Monitoring HarshLab

Metoceanic conditions


Oceanographic buoys

Coastal meteorological station (Matxitxako)




Onboard meteorological station

Monitoring HarshLab

METEOROLOGICAL DATA

- Annual precipitation:1500 mm/year..
- Mean interannual temperature: 13ºC.
- Average interannual max temperature: 16ºC.
- Average interannual min temperature: 10ºC.
- Average insolation: 1825 hours/year.
- Average annual wetting time (Hr>80%, Tª>0º): 5.690 hours

OCEANOGRAPHIC DATA

- Water temperature min/max: 11ºC (Jan) - 22ºC (Aug).
- Significant wave height min/med/max: 1,15 m / 1,67 m / 9,62 m.
- Average salinity: 35 USP.
- Average dissolved O_2: 6 mL/l.
- Average transmittance: 88%

MAIN IDENTIFIED **BIOFOULING** SPECIES

- *Bryozoan*
- *Perforatus perforatus*
- *Anomia ephippium*
- *Hiatella arctica*
- *Mytilus galloprovincialis*
- …

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Testing at HarshLab

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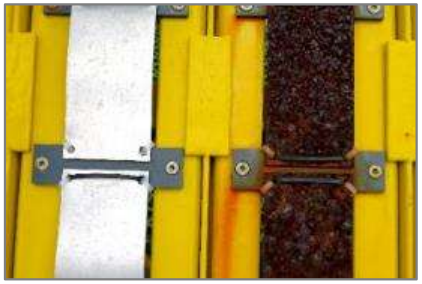
Testing at HarshLab



CORROSION TESTING

Atmospheric and splash zones have a corrosivity classification of **CX**. Immersion zone is classified as **Im2,** so both ensure the highest corrosion rate.

AGEING TESTING

Not only nude and coated metallic surfaces can be tested in our platform, but also other non-metallic materials that need to withstand harsh marine conditions while maintaining their properties (flexibility, aesthetic, etc).

TESTING OF **OFFSHORE COMMUNICATION SYSTEMS**

Telecommunications via cable, meteorological station, GPS based tracking system, submarine modem for communications of submerged devices with Surface and a small ROV for inspections.

ANTIFOULING SOLUTIONS

BiMEP is an open sea area especially prone to biofouling growth, so test immersion and splash zones of HarshLab are particularly suitable for testing experimental antifouling solutions under real offshore conditions.

VALIDATION OF **RISERS, CONECTORS and UMBILICALS**

HarshLab offers two available connectors in the hull, which poses an excellent opportunity for the validation of innovative connection systems in real conditions before they enter in service.

TESTING EQUIPMENT **IN SERVICE**

Able to host validation of grid connected prototypes in service in immersion, deck or in hold.

Testing at HarshLab

Not limited to testing probes, but **open to other research activities.** Some examples:

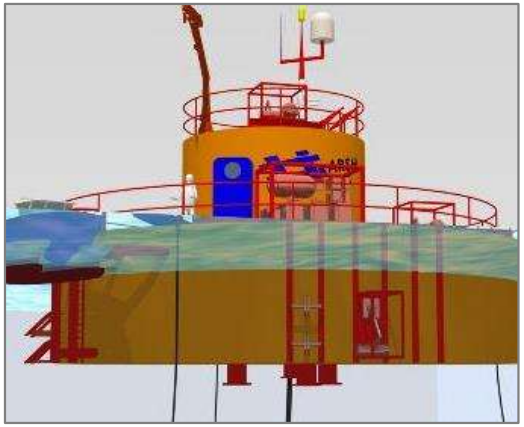
- **Tracker system** for navigation and monitoring floating structures
- Submarine **identification and communication** systems
- Testing novel **sensors** for offshore applications
- New **methodologies for mooring** offshore structures
- Testing **submarine handling** systems
- Novel oceanographic **radars**
- …

Testing at HarshLab

- ✓ Open to any **company or research organization** interested in performing ageing test in real offshore environment, both in **public funded** (eg: H2020) and **private** projects.
- ✓ **Many private partners** tested or are testing their materials and components
- ✓ Tecnalia is testing its **own developments** in HarshLab as well, including **two patents** on new coatings
- ✓ **More than samples** already tested, along with other prototypes

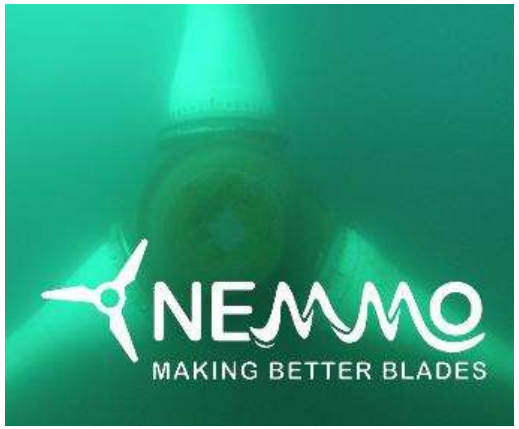
Testing at HarshLab

Some R&D projects performed so far:



Technologies for the design, advance manufacturing and validation of components for energy facilities in offshore environments (HARSH).
http://www.clusterenergia.com/harsh-en

Marine renewables Infrastructure network for enhancing energy technologies (MaRINET 2)
http://www.marinet2.eu/



Next Evolution in Materials and Models for Ocean Energy (NEMMO). http://nemmo.eu/

Innovation Ecosystem to Accelerate the industrial uptake of advanced surface nano-technologies. *https://www.newskin-oitb.eu/*

Funding organisms

EUSKO JAURLARITZA GOBIERNO VASCO
GRUPO spri TALDEA
ENERGIAREN EUSKAL ERAKUNDEA
ENTE VASCO DE LA ENERGÍA
EUROPEAN UNION
European Regional Development Fund

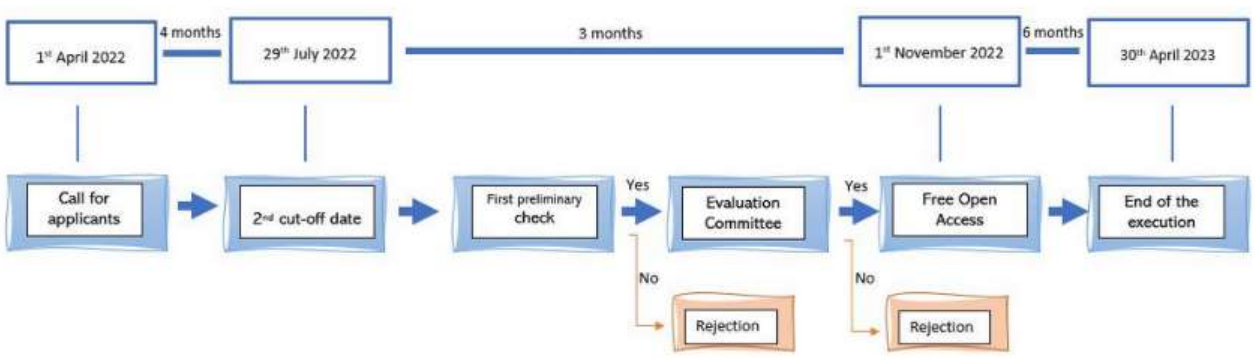
Testing at HarshLab

Open Calls in Newskin OITB

- ✓ The NewSkin project aims to create an Open Innovation Test Bed (OITB) to provide the European Innovation Ecosystem with the necessary technologies, resources and services to uptake a set of game-changing, efficient and cost-effective **innovative processes** to manufacture nano-enabled industrial and consumer products, as well as the necessary **testing capabilities** to demonstrate the features of nano-enhanced goods.

- ✓ A total of **4 different Open Calls** for applicants will be completed.

- ✓ The next Open Calls application **deadlines** are scheduled in **July 2022**, **December 2022** and **June 2023**.



Second Open Call is **closing on July 29th!** More info at.

https://platform.newskin-oitb.eu/pages/open-calls

Contact us for further info

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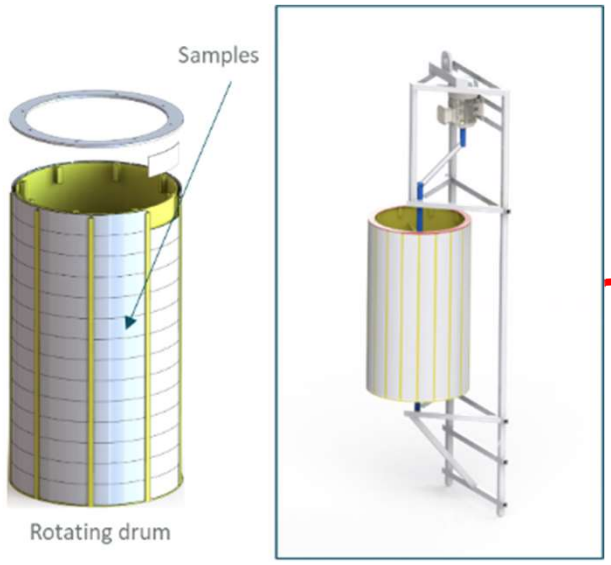
05

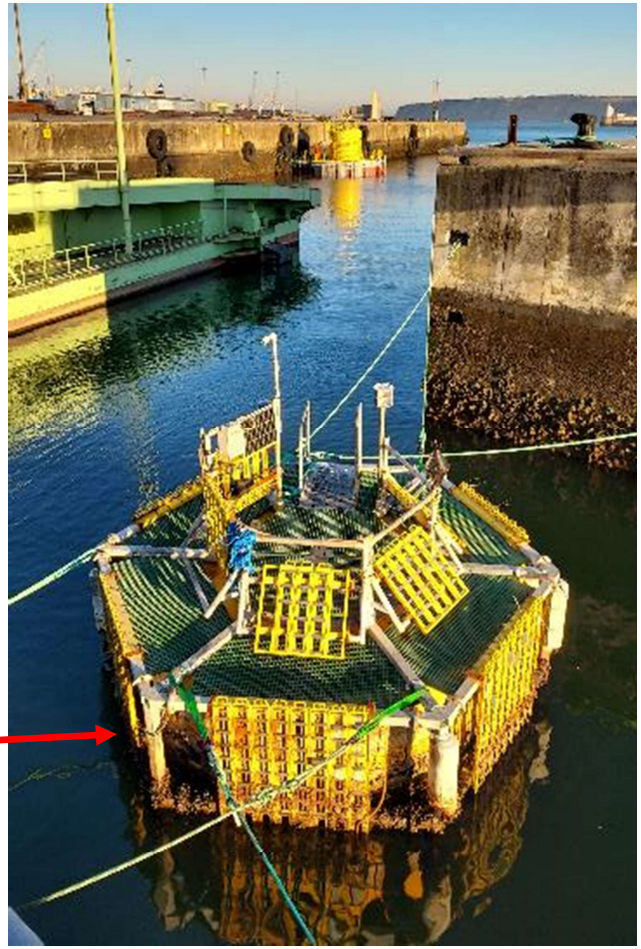
Real-environment tests beyond HarshLab

DANTE (Dynamic Antifouling Test)

- Testing antifouling coatings under **static and dynamic conditions**
- Performing test under **ASTM 4939-89 (2020)** Subjecting marine antifouling coating to biofouling and fluid shear forces in natural seawater:
  - Running in **HarshLab**, moored in the port of Bilbao
  - Speed of **up to 15 knots**
  - **Max capacity**: around 120 samples
- Expected to be fully functional **by the end of 2022**

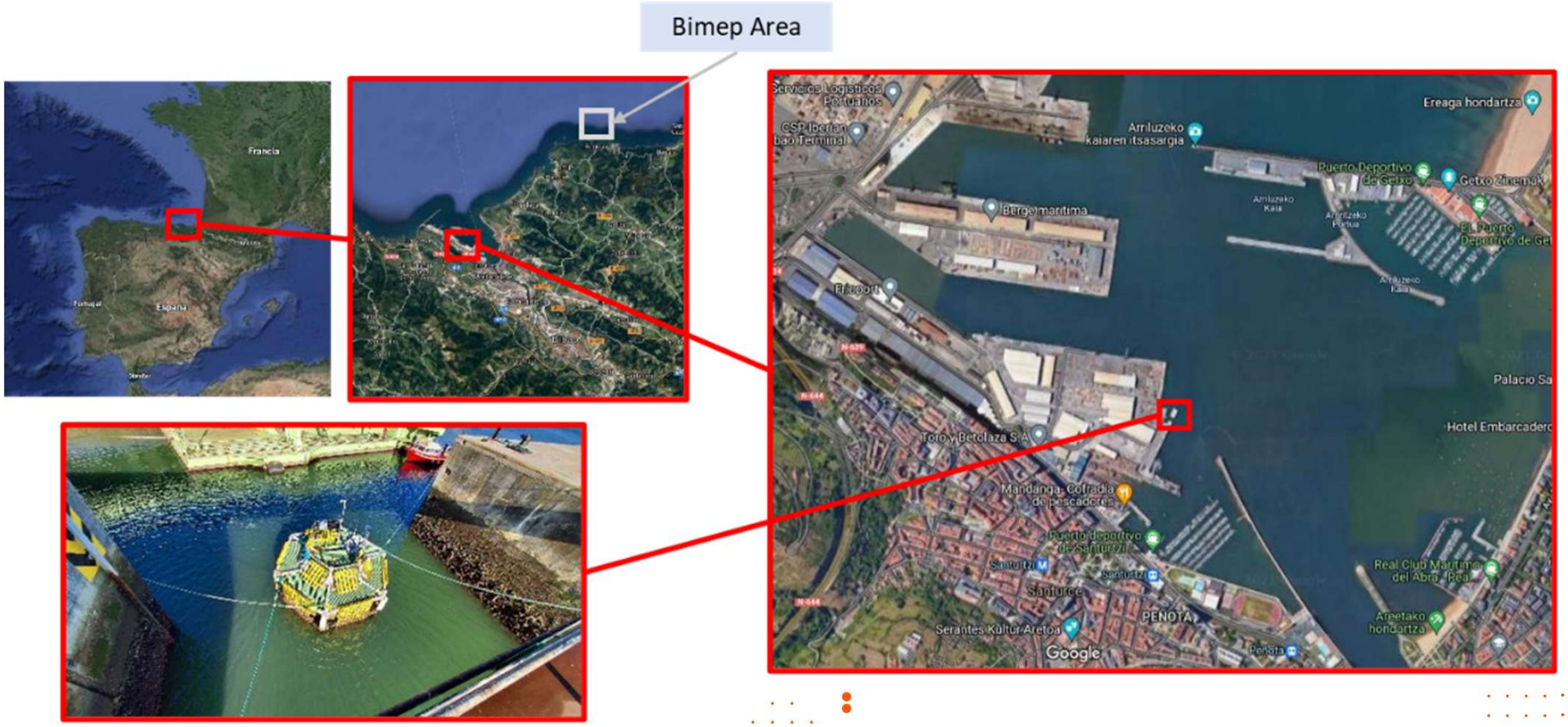


Size samples	Value	units
High	150	mm
Wide	80	mm
Surface	12.000	mm2



DANTE (Dynamic Antifouling Test)

- Detailed design of Dynamic Antifouling Testing rig (**DANTE**) under work
- To be installed in the former **version of HarshLab**, moored in the **Port of Bilbao**

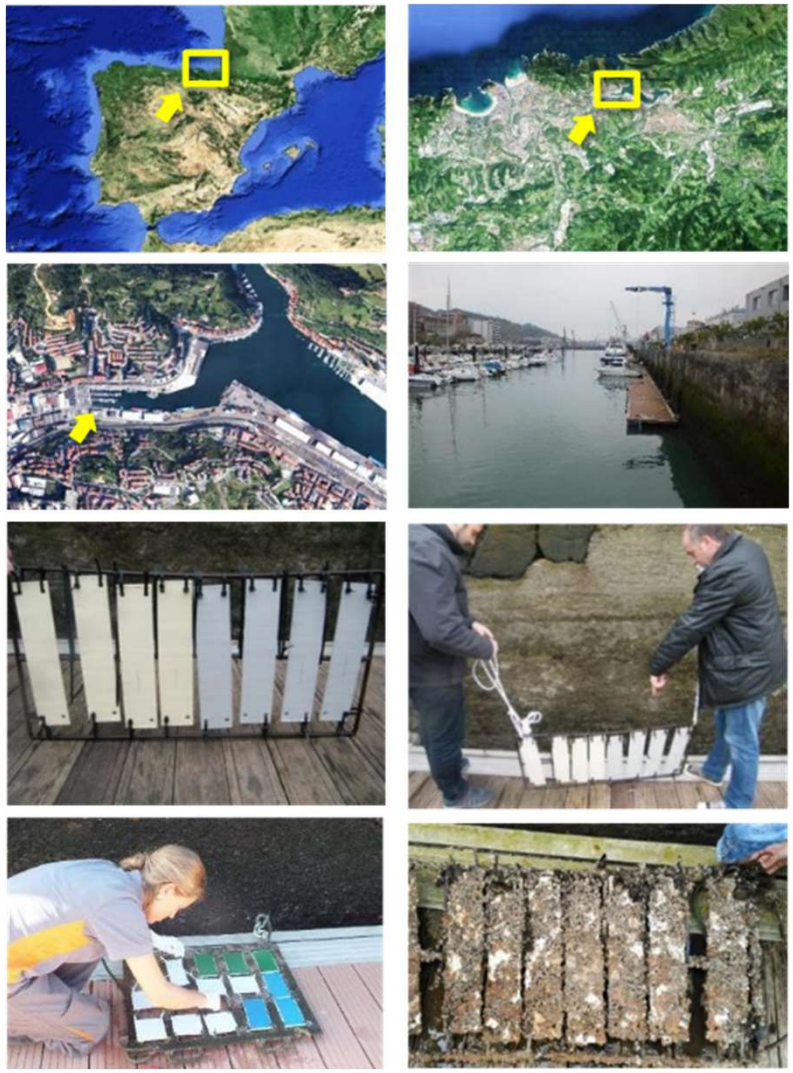


Floating dock at Pasaia

- **Estuarine port conditions** with a **mix of sea water** (Bay of Biscay) **and fresh water** (Oiartzun river).
- **Immersion zone** in floating jetty (no tidal).
- **Easy access** and **monitoring** of environmental parameters.
- Average environmental conditions:

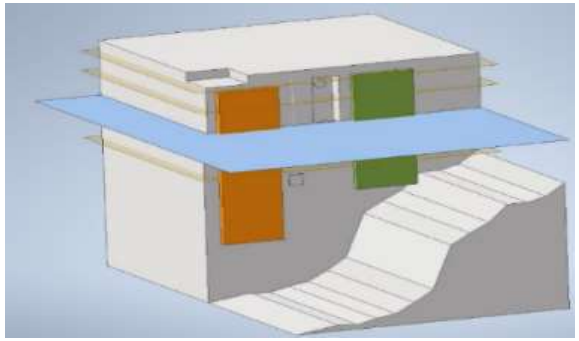
• Salinity:	27,4 usp
• Water temperature:	16,8 ºC
• Dissolved oxygen:	69,0 % sat
• pH:	8,0
• Transparency:	1,1m

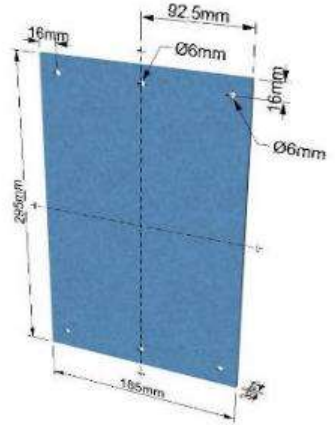
- Due to its high nutrient loads and high-water retention time, **the growth of biofouling is very quick.**



PLOCAN (Plataforma Oceánica de Canarias)

- **Collaboration agreement** signed between PLOCAN and Tecnalia
- **Subtropical climate** in the mouth of Taliarte's port (Atlantic Ocean)
- A total of **140 samples** in **splash**, **tidal** and **immersion** zones.
- **Oceanographic station** nearby






Samples exposition during high tide


Samples exposition during low tide

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06

Testing at the lab

Testing at the lab

Offshore test are only part of a wider variety of **corrosion tests** in the lab, climatic chambers or under mechanical solicitation to be performed according to **standardized or specific demands,** including**:**

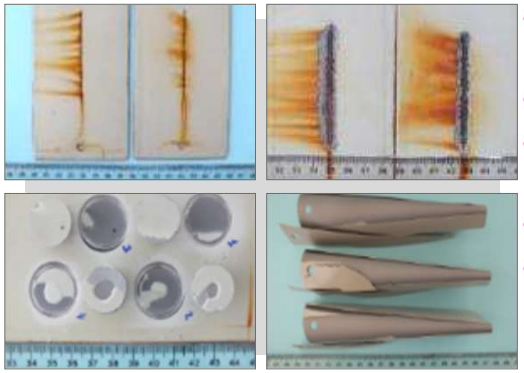
Accelerated testing

- Salt spray, Cyclic testing, Kesternich Test
- Climatic chambers
- Condensation testing (humidity)
- Accelerated weathering test (UV-Condensation)
- Immersion and alternate Immersion test
- Solid particle impingement test.

General corrosion testing facilities

- General, pitting and crevice corrosion testing
- Corrosion fatigue
- 3 & 4 Point Bend Testing
- Intergranular corrosion test

Coating Laboratory Testing

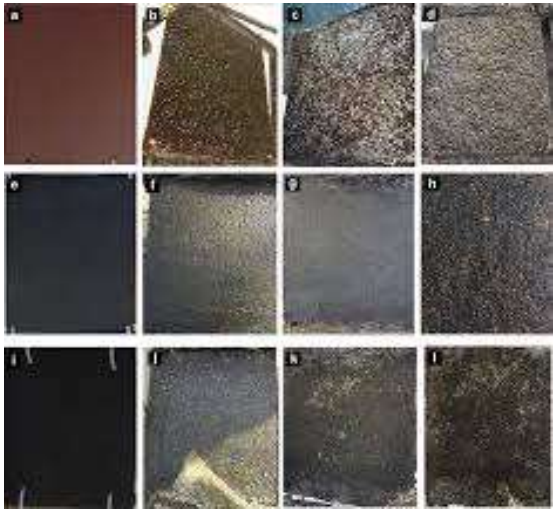


- Optical microscope techniques
- Electrochemical Impedance Spectroscopy
- Cathodic disbondment tests
- Fourier Transform Infrared Spectroscopy
- Coating Failures and Defects
- Impact test
- Abrasion test
- Chemical resistance
- Coating characterization tests: flexibility, tensile strength and elongation, film thickness, color & gloss measurements, film hardness, film adhesion

Testing at the lab

Antifouling Standards and specifications

ASTM D3623: Standard Test Method for Testing Antifouling Panels in Shallow Submergence



- Procedure for testing **antifouling compositions in shallow marine environments** and a standard antifouling panel of known performance to serve as a control in antifouling studies.

- This method is designed as a **screening test** in evaluating antifouling coating systems.

ASTM D6990: Standard Practice for Evaluating Biofouling Resistance and Physical Performance of Marine Coating Systems

Coating systems are evaluated in terms of:

- **fouling rating**, describing the percent coverage of the coating system by fouling organisms,

- **physical deterioration rating**, describing the percentage area of the coating system affected by physical coating damage/failure.

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Pablo Benguria
Pablo.benguria@tecnalia.com
+34 667 178 853

Visit our LinkedIn:
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