IMAGINONS LA FLOTTE OCÉANOGRAPHIQUE FRANÇAISE À L'HORIZON 2035

"Let's imagine the oceanographic fleet in 2035"

A global foresight exercise

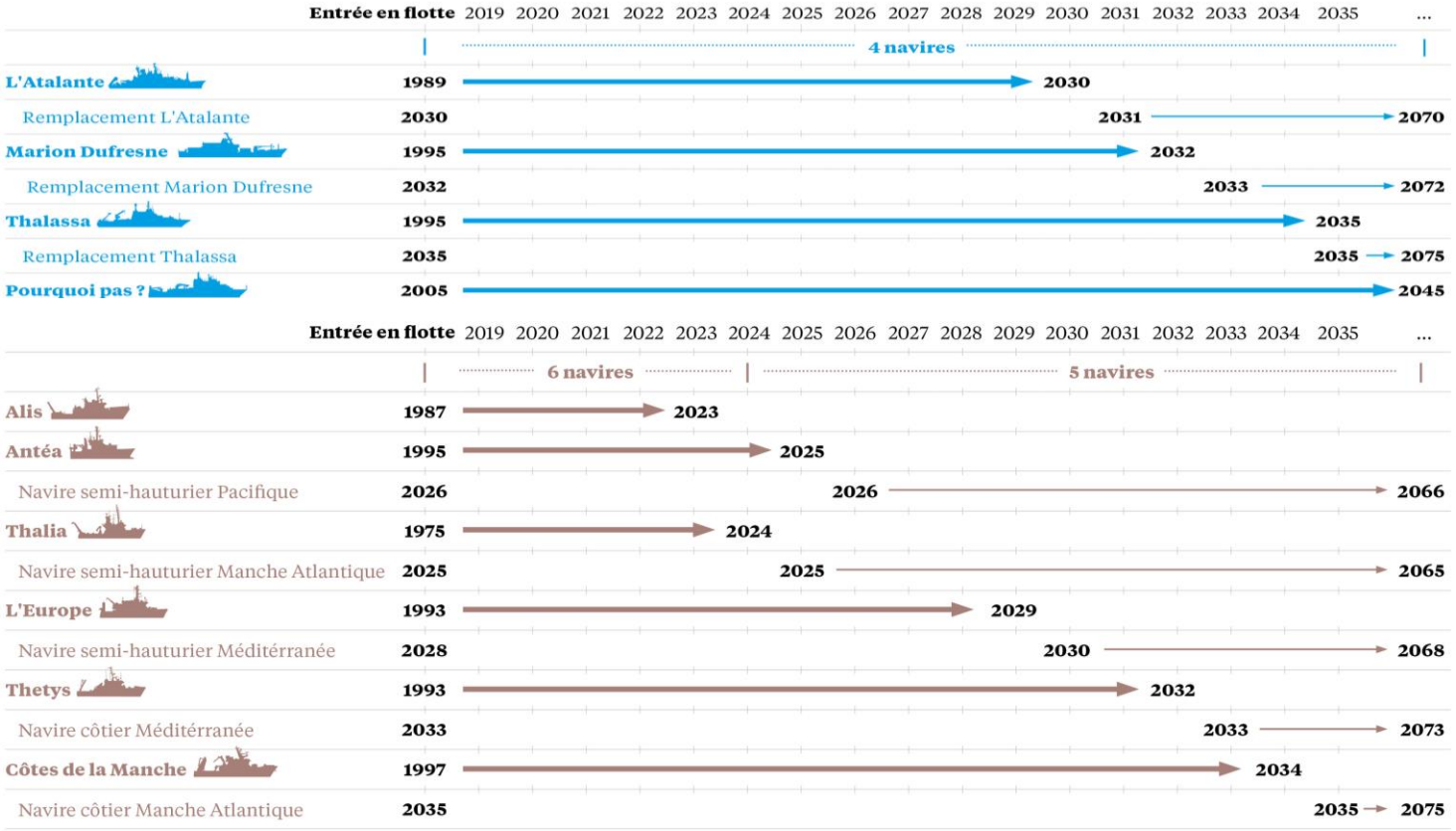
IRSO Meeting 2024

FLOTTE OCÉANOGRAPHIQUE FRANÇAISE PAR L'IFREMER

Let's imagine the oceanographic fleet in 2035" a global foresigth exercise

- Context and method
- Main outcomes
  a) Scientific foresight
  b) Partnerships and activities in support of public policies
  c) What technologies for the future ?
  d) Greenhouse gas emissions
- Conclusions : renewing FOF's facilities and adapting its practices

French Oceanographic Ships replacement overview



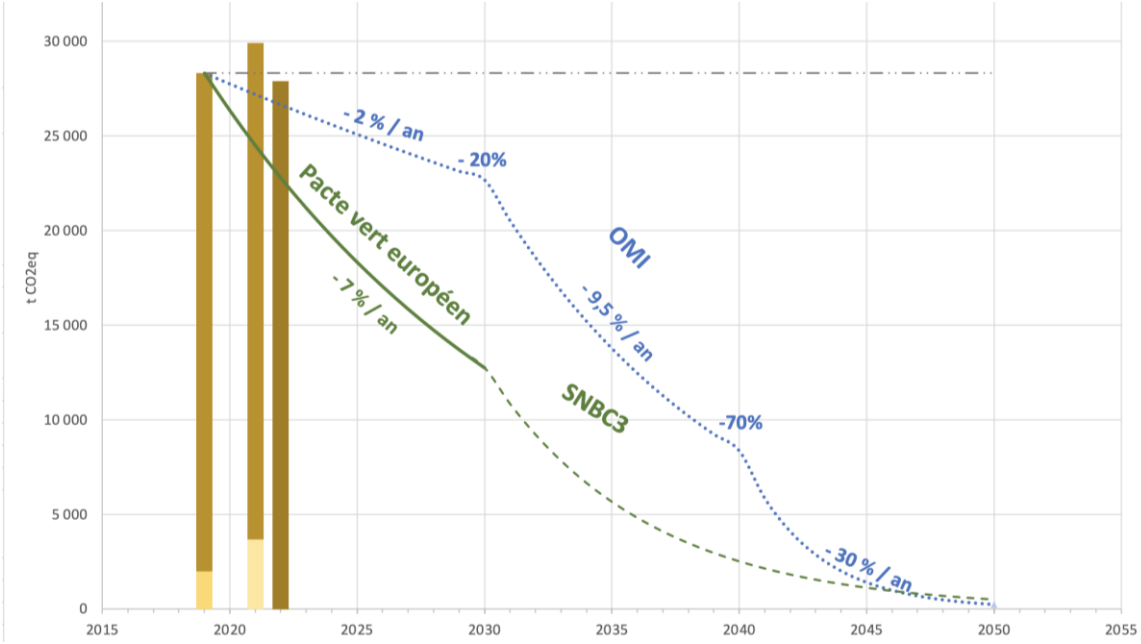
Context and method

Why ?

- Growing **awareness in the research community** of the need to take account of the environmental impact of scientific activities
- **Rising energy prices, shortages and a general increase in costs** make the mid-term plan no longer sustainable

Objective

- *December 2024* : a renewal plan for the French oceanographic fleet that will enable us **to decarbonise our activities while maintaining a high level of service.**



Total GHG emissions from ships are **at least 30 000 teqCO2**, of which :

25 000 t for 4 global class ships

5 000 t. for 6 regional/coastal ships

Context and method : an ambitious and collective work

- ***March 2023*** : kickoff meeting
- ***October - November 2023 :*** workshops to discuss the conclusions of the various scientific communities, the new technologies available and the first elements of the GHG assess : **50 people involved**
- ***January 2024:*** *3 days* seminar in Brest **220 people**
- ***April 2024:*** publication of FOF's first full GHG assessment
- ***March - June 2024:*** consolidation of the conclusions and recommendations from the seminar
- ***June 2024 :*** *start of a modelisation sub-project for GHG emission*
- ***June 2024 from now :*** drafting a White Paper
- ***October 2024:*** final seminar
- ***January 2025:*** publication of a white paper

Context and method : 4 work packages

WP 4 : Improving the assesment of the CO2 footprint

- Including as many emission items as possible in the GHG balance sheet : waste, freight, travel, data storage, …

- Making data available to scientists

- Detailed fuel consumption measurement programs to optimize operations at sea and ship scheduling.

- Scenarii and modelisation to predict various path for decarbonation

WP 1 - Identifying future scientific needs

- 7 working groups : Physical ocean and biogeochemistry, Paleoclimatology, Marine geosciences, Marine biology, Fisheries science, Atmospheric measures Teaching

WP 2 – Future technologies and ships

- **Ship decarbonization technologies :** state of the art
- **Unmanned surface vehicule (USV)** : state of the art and tests at sea
- **Telepresence** working group
- **Underwater systems** : working group on deep-sea intervention

WP 3 - Updating our partnership strategy

- at national level : specific dialogue with partners
- at international level, with a global analysis of the deployment of oceanographic fleets in the Indian, Pacific and polar regions
- Analysis of global landscape of private initiative of ocean exploration

a) Scientific foresight: what will be the needs of the scientific communities that use FOF ?

We identify "**essential scientific needs"** for the coming decades:

- Long core drilling
- High-throughput data: eDNA, omics
- Deployment of heavy equipment: ROV, Nautile, corers and access to great depths (6,000 meters)
- Operating in coastal areas and very shallow waters
- Clean lab and equipment on board to measure trace elements in ocean waters
- Atmospheric measurement and associated adaption of the ships
- ….

b) Partnerships and activities in support of public policies [1/2]

1. **Partnership with the French Navy** : a balanced partnership set to deepen with new areas of common interest :
   - **Underwater vehicle** – France's seabed warfare strategy, published in 2022, specified a requirement to achieve capacity to operate at 6,000 metres by 2026 -
   - **Unmanned surface vehicle**, particularly for hydrography
2. **Support for public policies : a global need that is increasing**
   - **Fisheries stock assessment** : a significant increase in the need to monitor fisheries resources
   - **Environmental monitoring :** optimization with cruises dedicated to fisheries resources
   - **Marine renewable energies :** the FOF is not requested, but there is a shortage of (coastal) naval resources capable of carrying out monitoring on behalf of operators.
   - **Ifremer-International Seabed Authority exploration contracts** : difficult to predict the State's long-term strategy
   - **Volcanological and seismic monitoring** of the island of Mayotte, a new activity for the FOF since 2018

FOF and French Navy share a agreement on mutual access to Pourquoi Pas and Beautemps-Beaupré

EVHOE cruises conducted by the FOF contribute to the assesment of about 10 population of demersal fish

b) Partnerships and activities in support of public policies [2/2]

3. **Partnership with the French Southern and Antarctic Territories : *Marion Dufresne***
   - provides a vessel in the Indian with one of the best long-core drilling capacities in the world
   - however, need fore more flexibility and more days at sea to cover scientific
4. **"Europeanisation' of oceanographic fleets :**
   - A challenge that is making slow progress despite the investment of many people and States: Eurofleets projects, ERVO, OFEG, etc.
   - **Next step: setting up a Eurofleets infrastructure in the form of an international non-profit association (AISBL).**
5. **International partnerships :** specific partnerships per ocean basin are being developed
   - Arctic Ocean : Agreement with Université Laval /Amundsen Science for access to *NGCC Amundsen*
   - Pacific Ocean : FOF is associated with the RVONZA group (Research Vessels Of New Zealand and Australia)
6. **Private exploration initiatives:** there are partnership opportunities that could be worth seizing because of complementary facilities at sea, fostering decarbonisation, sponsorship, etc., …

c) What technologies for the future ?[1/2]

Ships

1. **Substitute fuels for diesel** : no change in engines to be planned
   - Biodiesels are an uncertain way forward: 1st generation biodiesels compete with food resources and generate deforestation, 2nd generation biodiesels (recycled oils) are still not widely available. 38 to 40% higher costs.
   - Synthetic fuels : "promising" fuels for the maritime and aviation industries if renewable energy is used to produce them, industrial sectors not yet in place. 2035 ? 2040 ?
2. **Wind propulsion**
   - Several technologies are available for rigs and sails
   - Very interesting solution, particularly as at least **35% of the fuel used by FOF is consumed in transit.**

*Anemos, **80 metres**, sailing cargo ship*

*Canopée, **121 metres**, hybrid wind-powered industrial cargo ship to transport Ariane 6 from Europe to Kourou*

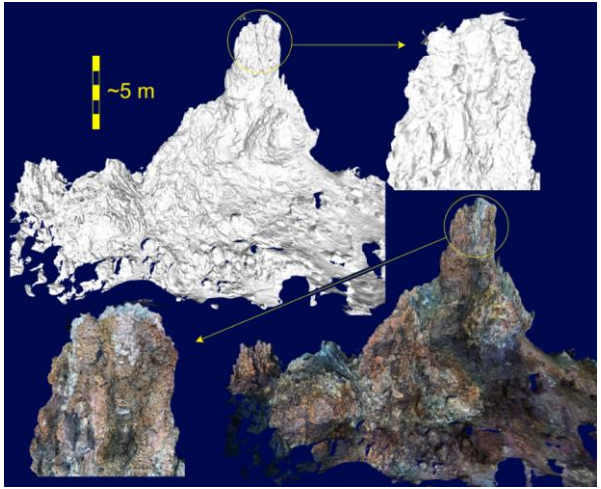
c) What technologies for the future ? [2/2]

Underwater vehicule and equipments

3. **Underwater vehicles.** The FOF is involved in a number of major R&D areas
   - Autonomous decision-making for AUVs, in particular through the use of AI
   - Manipulation with interactive intervention (ROV)
   - 3D perception of the underwater environment
   - On-board instruments,
   - Remote operation

4. **Unmanned surface vehicule (USV).** Trials of a USV (DriX, 8m. 1.6 t.) confirm the potential of this type of equipment for the FOF**.**

3. **Remote operating** and real time collaboration beween ship and shore-telepresence - may be of interest for certain operations

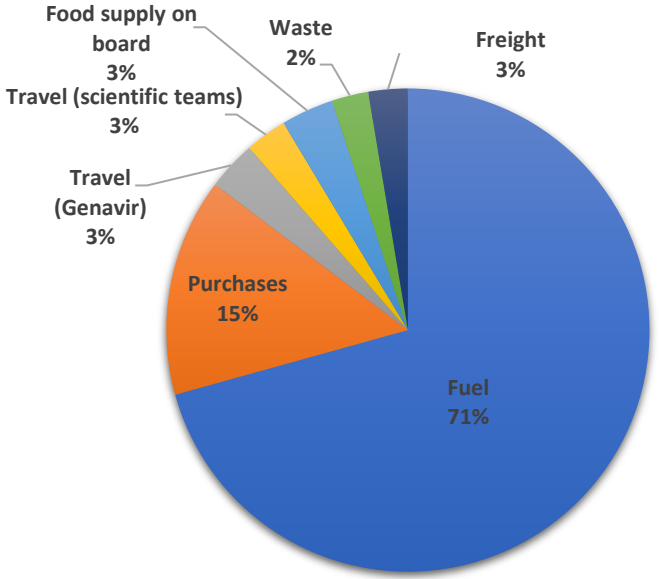


3D reconstruction of an active hydrothermal edifice, Arnaubec et al. 2023

AUV 6000 m. Ulyx lauched in 2023

d) Greenhouse gas emissions

- The 2022 GHG emissions assessment has led to the definition of a method to **take into account all GHG emissions: from mission preparation to data storage**.
- Fuel accounts for the largest share of CO2 emissions with the world-class vessels accounting for 75 to 80% of total fuel consumption
- Average allocation of fuel consumption to 3 states suggest to use different levers to decarbonize
  - **Dock : 13%** -> power supply when docking
  - **Transit : 35%** -> speed reduction, wind propulsion, …
  - **Operation : 51%** -> adapt operation, hotel load, Energy saving, batteries, …



Share of GHG emissions in 2022 - 43,000 etCO2 -

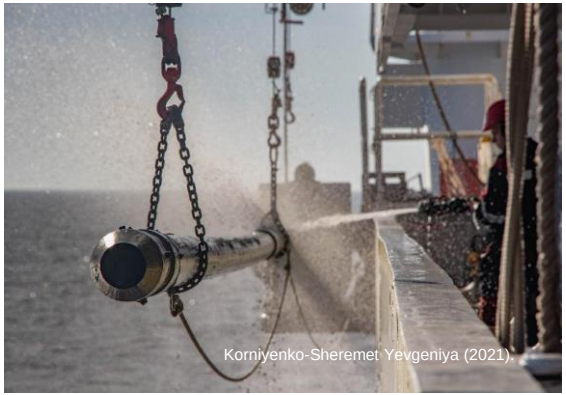
Conclusions : renewing FOF's facilities and adapting its practices

➢ ***Research Ships***

- **Continue to renew the fleet of coastal and mid-shore vessels :** these vessels have many strong points: versatility, ease of deployment, etc, ... and are expected by the scientific community.
- **Maintain the capacity of the FOF in world-class research ships** providing access to great depths :
  - these ships are irreplaceable for deploying heavy equipment in "extreme" oceanic environments
  - **This is crucial to rapidly build a first "decarbonized" world-class research ships , in replacement of L'Atalante, in order to preserve the potential for action on the high seas and take a significant step towards decarbonization.**
- **Preserve the capacity for long coring operations** on at least one ship

3D view of the new mid-shore ship for the French Oceanographic Fleet, built by the Spanish Freire Shipyard in Vigo, Spain.
© Freire Shipyard

The "Calypso" corer, on board *Marion Dufresne,* can be used to take sediment cores up to 70 m deep.

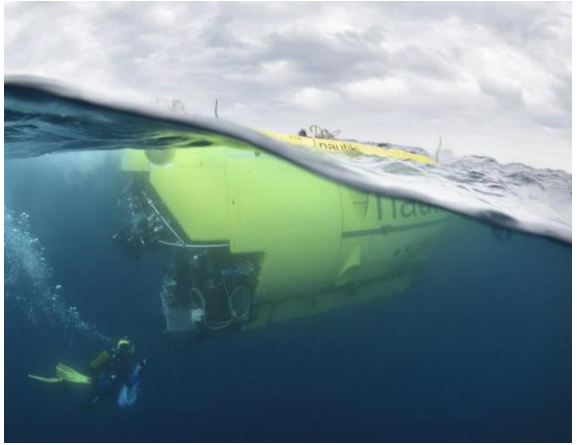


Conclusions : renewing FOF's facilities and adapting its practices

➢ ***Equipments***

- **Deep-sea intervention.** (1) Upgrade capabilities of HOV Nautile and ROV Victor and (2) prepare for their replacement (2035) by a new generation
- **Underwater vehicles for coastal areas.** Discuss and identify needs with the coastal scientific community
- **Develop and implement new autonomous or remotely operated vehicles.** Provid the FOF with an initial fleet of 3 coastal USV and an offshore USV
- **Develop remote operations and telepresence technology/infrastructure** where possible (and relevant)
- Ensure that the **human resources and engineering capacity** are consistent with France's national and international ambitions in the ocean sciences [rec. 8].

The HOV 6000 Nautile launched 40 years ago has made more than 2,100 dives. As part of the France 2030 national investment plan, it will be modernised and remain in commission until 2035.



ROV 6000 Victor is regularly upgraded. It will remain in commission until 2037.

Conclusions : renewing FOF's facilities and adapting its practices

➢ ***Facilitating, anticipating and optimising access to FOF***

- Encourage and support **young researchers** in their ability to use the tools of the FOF
- **Anticipate the deployment of world class ships.** Provide advance notice of the geographical deployment of these facilities 5 to 7 years in advance in order to reduce transit and give visibility to the scientific community
- **Optimize the deployment of FOF facilities** : suggest mission recombinations, systematise acquisition of data during transits, etc…
- Continue efforts to prepare applications for clearance to access the waters of coastal States ; suggest an interministerial action plan

➢ ***Reinforcing requirements for recording and using data and samples***

- **Samples.** Systematize the tracking of all types of samples in order to make the associated data "FAIR" [rec.16]
- Make the use data acquired during previous cruises as a condition for programming the next cruise [rec. 17]

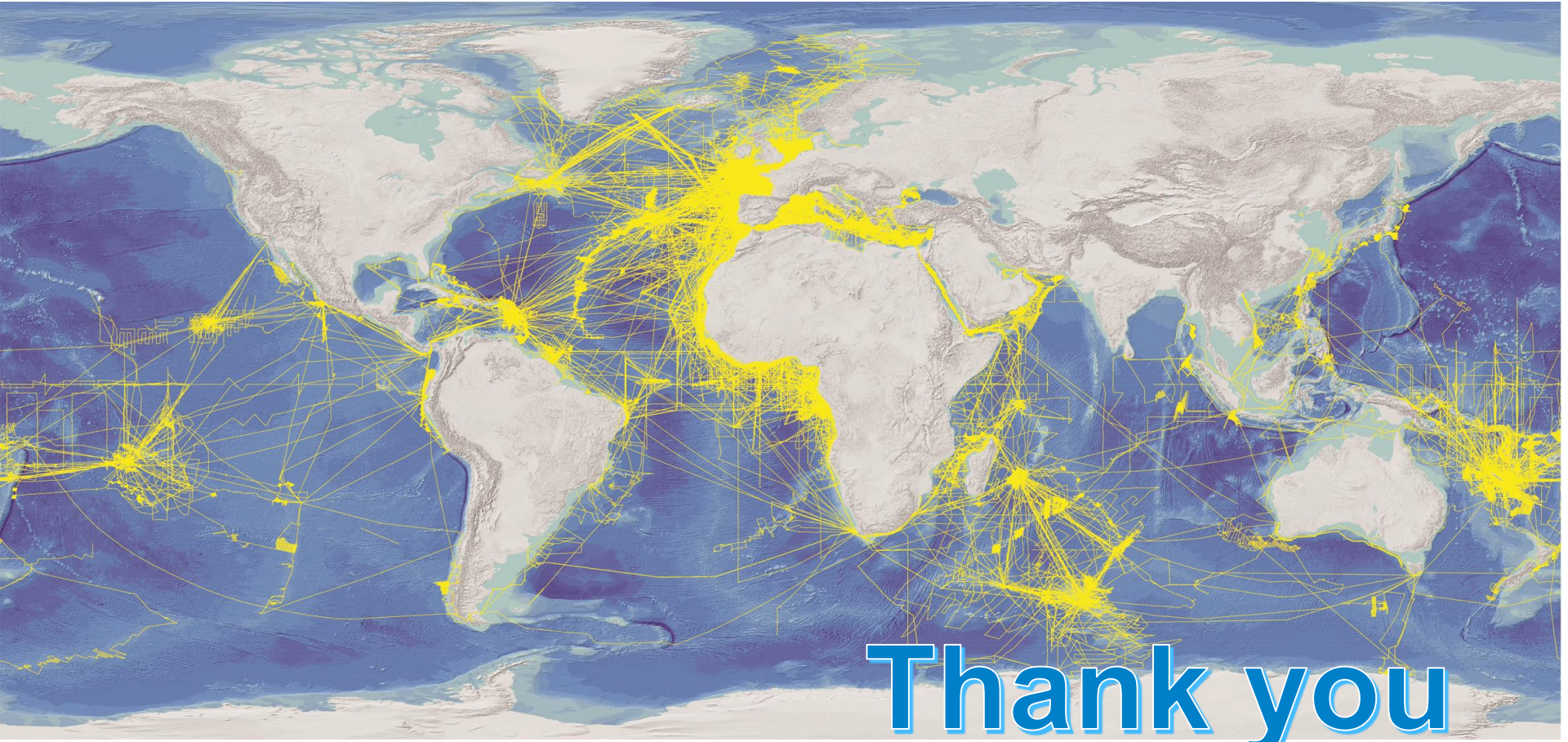
Conclusions : renewing FOF's facilities and adapting its practices

➢ ***Decarbonising***

- Structural actions to be initiated as soon as possible
  1. Reduce the speed of ships in transit (inter- and intra cruises)
  2. Support the development and/or transfer of certain operations carried out by ships to other vectors such as USV.
  3. Modify existing ships to switch systematically to shore power
  4. Initiate the definition of hybrid wind propulsion vessels, by conducting studies to define the best technological solutions.
- Include a paragraph in cruise application form devoted to assessing the environmental impact of the project, **in particular GHG emissions ; these assessment of GHG emissions should not be a evaluation criteria**

➢ ***Partnership***

- To engage as a founding members of a European infrastructure for oceanographic fleets: Eurofleets RI
- Continue to structure international partnerships around : Indian, Pacific, polar zones
- Open up the possibility of partnerships with private ocean exploration initiatives after examining ethical criteria



Thank you