

A Year of World Ocean Science

2021







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An amazing shared tool

“I’ve been with the Commission for Offshore Vessels for ten years, and had the honor of chairing it since 2019. Now I find myself taking stock of where we are and how far we’ve come. The French Oceanographic Fleet is an extremely effective apparatus for ocean research and part of a one-of-a-kind infrastructure. It can handle everything from training the next generation of young researchers to deploying new technologies that help us expand our understandings of ocean dynamics, life, and the planet.

Research cruises can be amazing adventures, too, and I’m always thrilled to head out to sea. I’m sure all my colleagues share this sentiment, be they biologists, chemists, physicists, or geologists—we’re all lucky to have this amazing shared tool at our disposal. Long live the French Oceanographic Fleet!”

Benoît Ildelfonse, researcher at the Centre national de la recherche scientifique and Chair of the Commission for Offshore Vessels

Photo: IODP |



Editorial

2020 saw sharply reduced activity due to COVID-19, but 2021 brought a major resurgence for the French Oceanographic Fleet.



| Photo: Olivier Dugornay / Ifremer

Our open-water vessels completed 470 days of research, compared to just 234 in 2020. Some of the amazing cruises we carried out:

- At the beginning of the year, the SWINGS cruise aboard *R/V Marion Dufresne II* expanded our understanding of how the Southern Ocean's "biological pump" works to regulate the Earth's climate by absorbing atmospheric CO₂.
- GHASS2 took *R/V Pourquoi Pas?* to the Black Sea to assess the threat of decomposing gas hydrates currently trapped as ice at the bottom of the ocean.
- *R/V Côtes de la Manche's* PACMAN cruise used video recordings to analyze the evolution of marine habitats in the vast mudflats of the Bay of Biscay, a crucial reproduction area for many species including sole and hake.

Even with this uptick in activity, we've only barely started to rebound from 2020's delays and cancellations. The pandemic remains a major concern, and everyone has had to adapt: the scientists afloat, the crews from our subsidiary Genavir, and especially the Oceanographic Fleet Division, which has continued to make a commendable effort to adjust the Fleet's programming as circumstances change.

One meeting has been a long time coming: The first "Get to Know the French Oceanographic Fleet" since the fleet's centralization in 2018 was held at the end of March as a videoconference. More than 400 people spent three days discussing the fleet's structure, resources, and activities, and imagining what its future might look like.

We also spent 2021 preparing for things to come. The SEMNA2 project (Multiplatform Expert Autonomous Navigation System), led by iXblue and financed by Bpifrance, saw Ifremer join with Forssea Robotics, Donecle, and the École nationale supérieure maritime to study how unmanned surface vehicles might one day prove useful as part of the Fleet. The initial assessment took place in November 2021 aboard *R/V L'Europe*; more experiments will follow in the next few years.

Meanwhile, after a year's delay due to the pandemic, *R/V L'Atalante* was finally able to head to the Piriou Naval Services dockyard in Concarneau to undergo major refitting and receive new power generators. Ifremer and Genavir technical teams installed new equipment so that the vessel will be able to continue making significant contributions to science until its end of life in 2030. They also took time to fix the root causes of some recurring problems reported over the past several years.

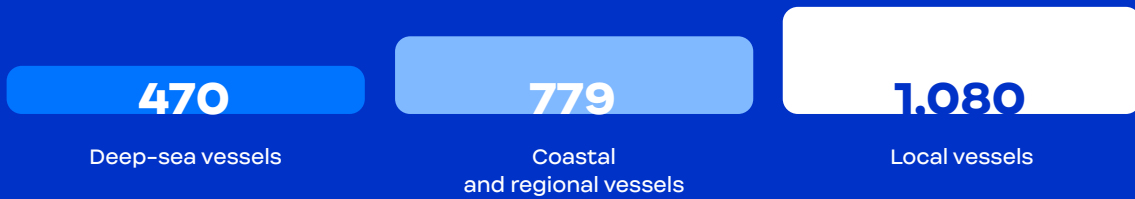
Finally, we are pleased to note that twenty years of Ifremer-Navy expeditions on *R/V Pourquoi Pas?* and *R/V Beautemps-Beaupré* have built a solid foundation of mutual trust between our organizations. Our joint initiatives are as ambitious as ever, and our partnership continues to uncover new possibilities for a shared future. Extending this partnership to cover studying and understanding the seabed will be a welcome challenge in the years to come.

François Houllier

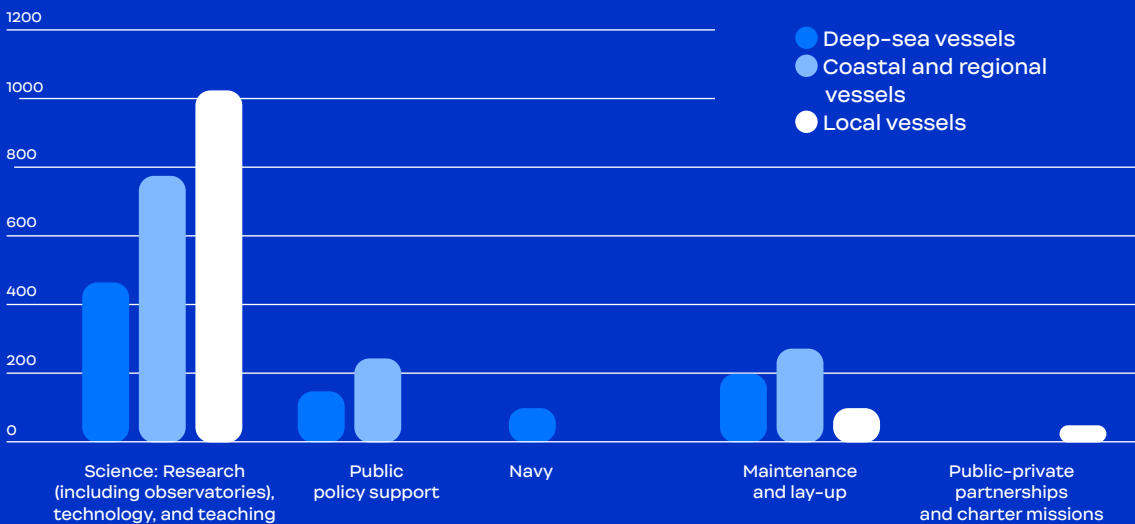
Chief Executive Officer of Ifremer

Key figures

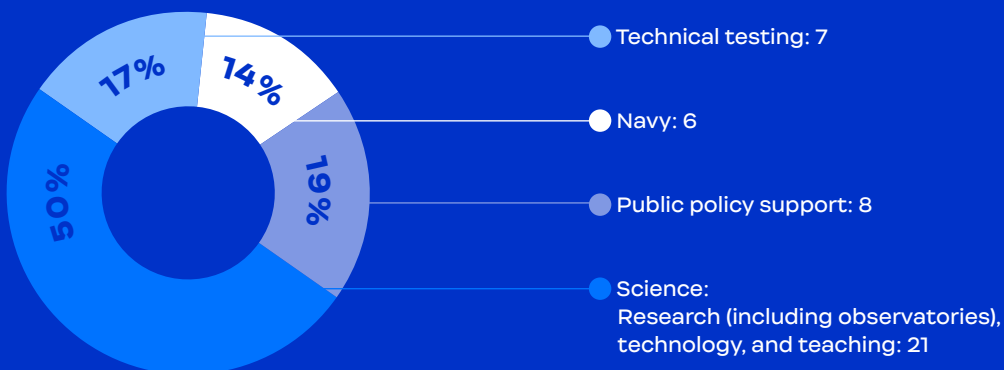
2,329 days of science activity



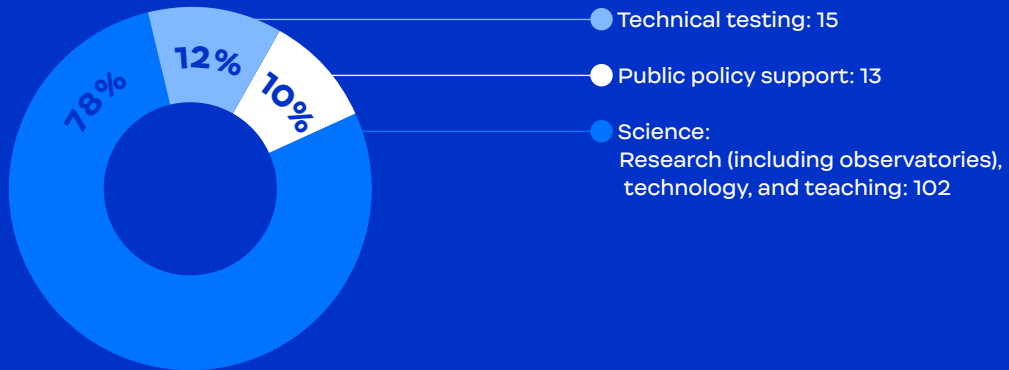
3,368 total days of activity



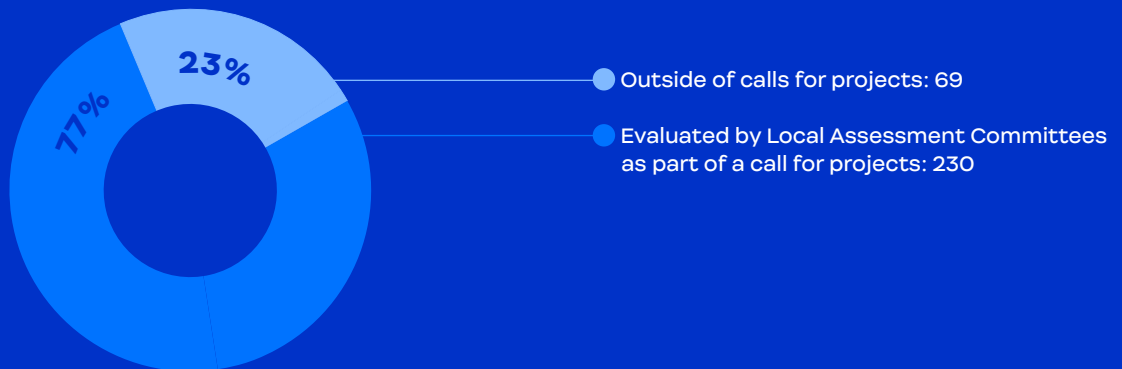
42 missions on deep-sea vessels



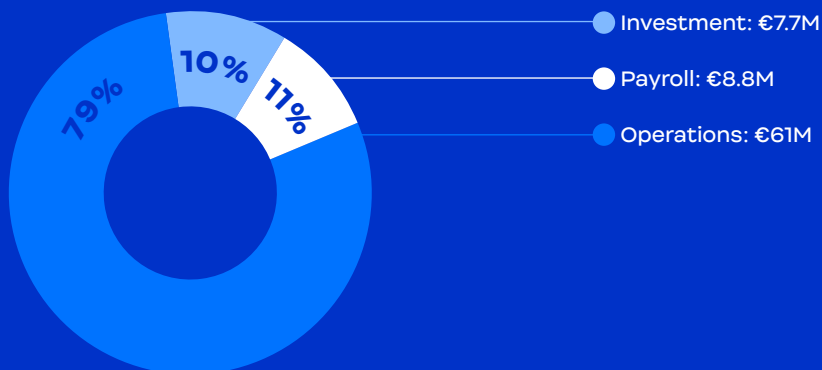
130 missions on coastal and regional vessels



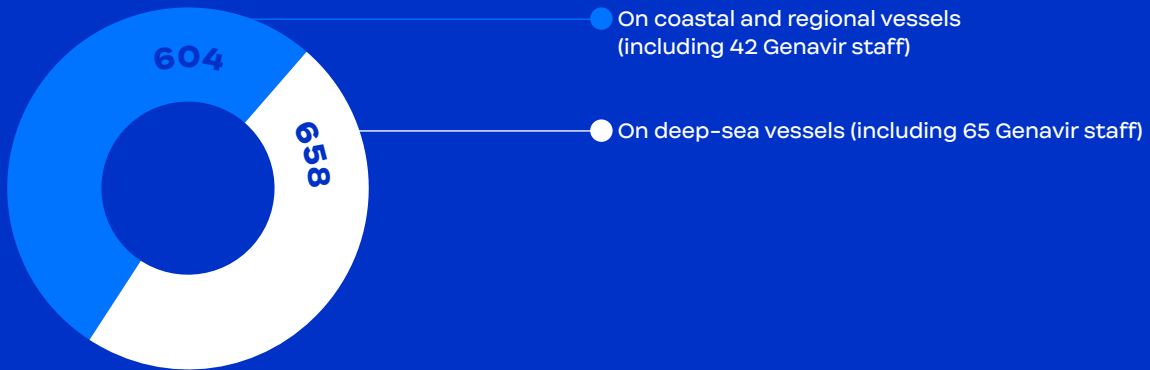
299 missions on local-class vessels



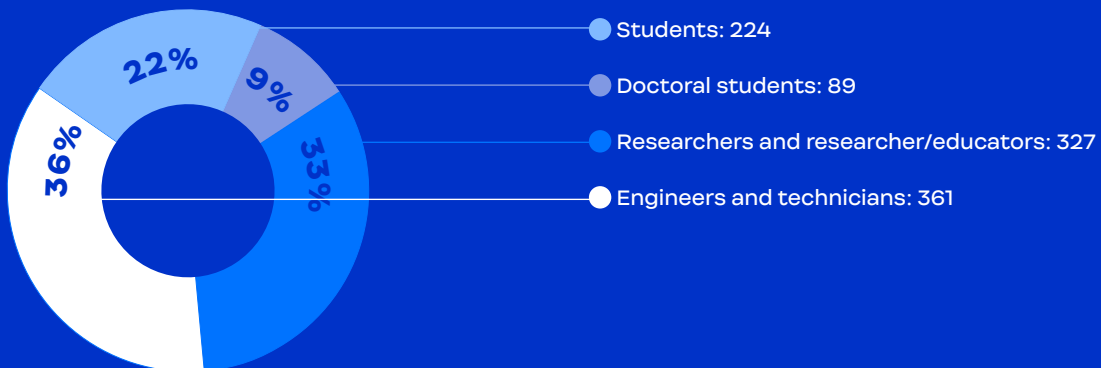
€77.5M in payment appropriations



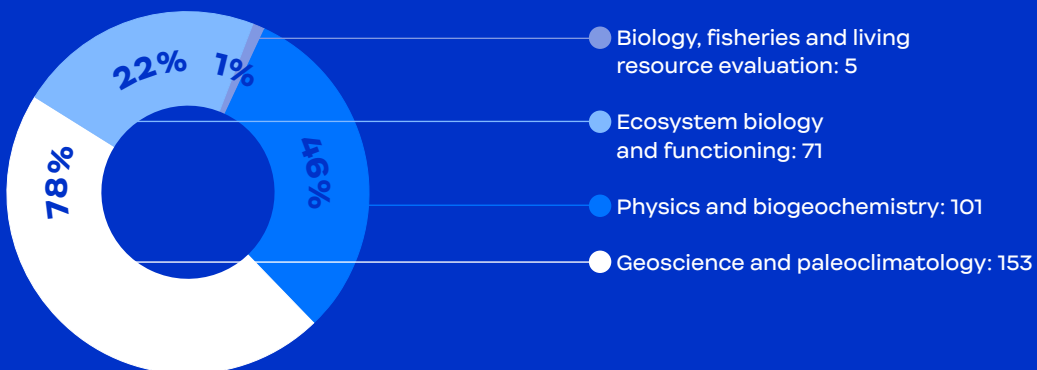
1,262 personnel aboard



1,001 personnel from the Ministry of Higher Education and Research



330 publications in highly ranked journals



2021 highlights

Interview with Christine David-Beausire, Deputy Director and Director of Science for Ifremer's French Oceanographic Fleet

Christine David-Beausire
Photo: Stéphane Lesbats /
Ifremer



Christine David-Beausire joined the Oceanographic Fleet Division alongside director Olivier Lefort on September 1, 2021. The new director of science for the French Oceanographic Fleet was formerly the deputy director of the French Polar Institute Paul-Émile Victor. She sees some clear similarities between the two organizations.

Do you see parallels in what the French Polar Institute and the French Oceanographic Fleet are trying to accomplish?

I think that on a fundamental level, the Fleet and the Institute are very similar indeed. They both aim to provide teams of French scientists with the operational infrastructure needed to conduct large-scale, ongoing research in difficult-to-reach locations far from normal human habitation. In polar regions, you need stations or mobile platforms to create a bubble in the middle of the ice; at sea, and under the sea, you need vessels and underwater vehicles to create a bubble out on the water, or to get down into the marine environment. These platforms are indispensable tools for research in hostile environments where humans can't usually live.

How are you going to approach Ifremer and the French Oceanographic Fleet?

I'm not unfamiliar with the ocean world. For starters, I've been an avid scuba diver for twenty-five years, ever since I was at university. On the professional side of things, I worked at the European Institute for Marine Studies (IUEM) from 2012 to 2018. IUEM is a CNRS/INSU Observatory for the Sciences of the Universe where all the academic marine science labs at the tip of the Brittany peninsula can collaborate, and it includes mixed research units that Ifremer participates in. I was the deputy director there, and my task was to restructure and revitalize IUEM's marine observation systems. A major part of that was our working relationship with Ifremer. As an example, I and a colleague from Ifremer's Laboratory for Ocean Physics and Satellite Remote Sensing co-lead the effort to get the COAST-HF network accredited as a National Observation Service. I also chaired the Local Assessment Committee for IUEM's local-class vessel *R/V Albert Lucas*.

So I already knew Ifremer and the Fleet pretty well from the outside. Back when I was a student, I always wanted to contribute to our understanding of some worldwide environmental issue. The ocean is central to those kinds of discussions today. Ifremer, for its part, is the leading French institution dedicated solely to the marine world. It focuses on both understanding the ocean and figuring out how to use it, and ensures that the latter is always thoroughly grounded in the former. The Fleet is a tool Ifremer operates for the benefit of the entire oceanography community. For me, joining the Fleet meant I could make my own contribution to this collective adventure as we explore all sorts of scientific, technological, operational, environmental, and societal issues.

What are your priorities right now?

I enjoy working for an organization that knows exactly where it wants to go, with a well-defined mission statement and clear objectives. We're taking time now for reflection and consultation, and that covers a wide variety of interesting topics. For myself personally, I'm working to better understand issues in other disciplines and figure out what they mean for the Fleet's operations. My job is to support the French Oceanographic Fleet's scientific outfits and produce indicators for their work, but also to be the liaison between the Fleet and the scientific community. I think of myself as an intermediary between the scientists on one side and the sailors, technicians, and engineers on the other. I'll need to translate between their respective "languages," so that both sides can fully understand each other.

First annual “Get to Know the French Oceanographic Fleet”

The event took place March 29–April 1 and was a resounding success in its very first edition. More than 400 people attended the online conference, strengthening ties between the Fleet and its users and reaffirming the Fleet’s role and goals.



Graphic:
Jérémy Barrault

An overview of the French Oceanographic Fleet, present and future

The conference was, among other things, an opportunity to recall the scale of the French Oceanographic Fleet, one of the five largest research fleets in the world. It explores waters across the globe, coasts and high seas alike, and probes them from the highest surface to the darkest depths. In doing so, it serves a community of scientists more than 3,000 strong. On top of that reminder, the event also highlighted the Fleet’s vital role in gaining new insights and protecting the ocean.

Researchers, educators, engineers, doctoral candidates, students, and other users were invited to come learn, discuss, and debate. They exchanged views on the Fleet’s operations and services, and on the new

possibilities and technological developments it can offer to the field of ocean exploration and research. Nearly 100 people, half of them speakers, showed up to discuss these subjects over the course of five themed half-day sessions. A special session on training oceanography students was also held on March 31.

Completely satisfied participants

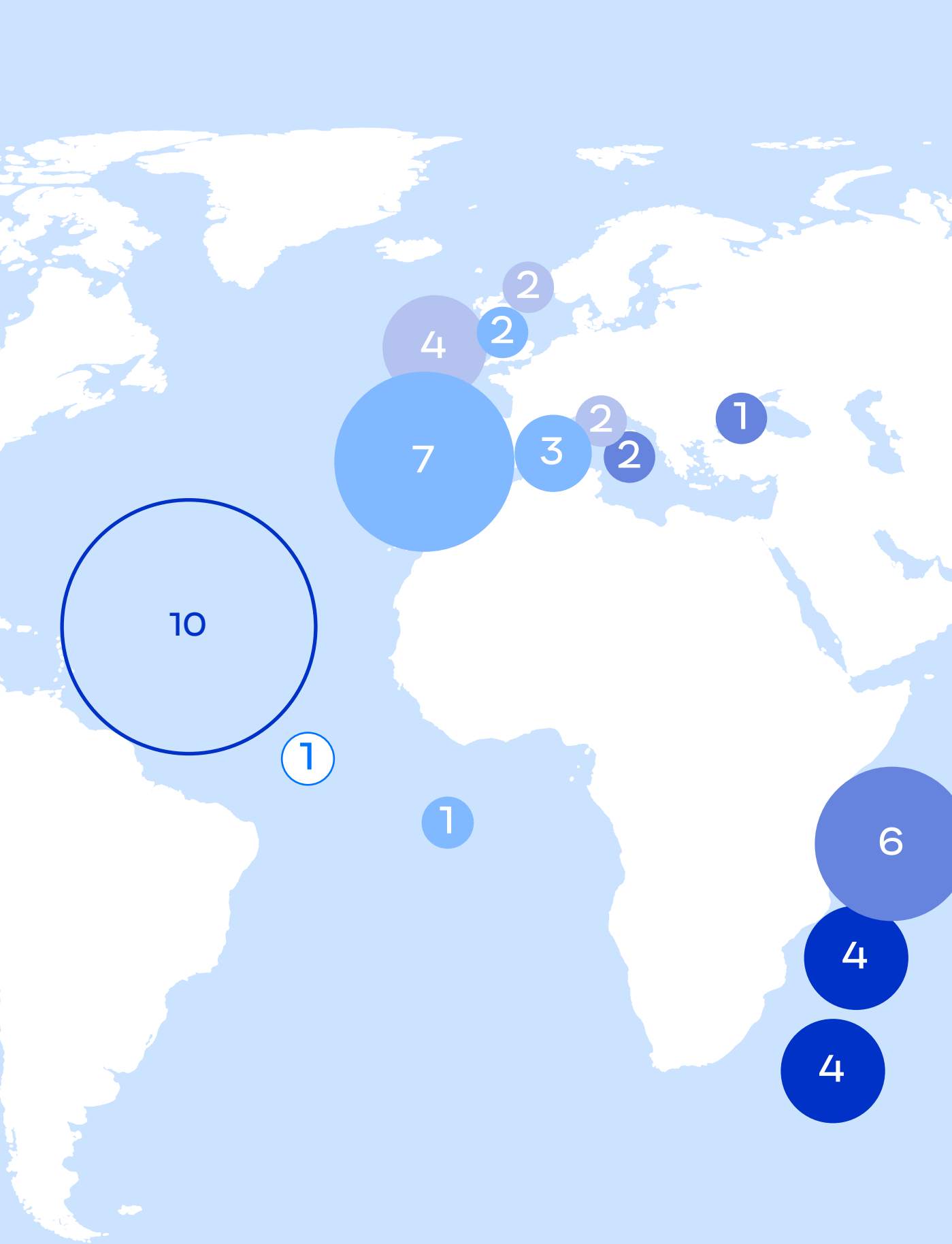
“Get to Know the Fleet” welcomed a total of 429 people. Feedback from a survey sent to attendees indicated high levels of satisfaction with the event. Out of 77 respondents, 98% said they were completely satisfied with this first edition of the conference and hoped that it would be repeated.

Many attendees even offered remarks outside the questionnaire

regarding how often the event should take place, how long it should be, what topics to cover, how much time should be spent on discussion and debate, and more. Some people requested that the event be announced several months in advance so that a wider swathe of the Fleet’s users could participate. These suggestions will help the conference organizers fine-tune the format and contents for the second edition of “Get to Know the French Oceanographic Fleet.”

Schedule: <https://www.flotteoceanographique.fr/Nos-technologies/Actualites-projets-technologiques/Rencontres-de-la-Flotte-2021>

2021 Cruise Maps



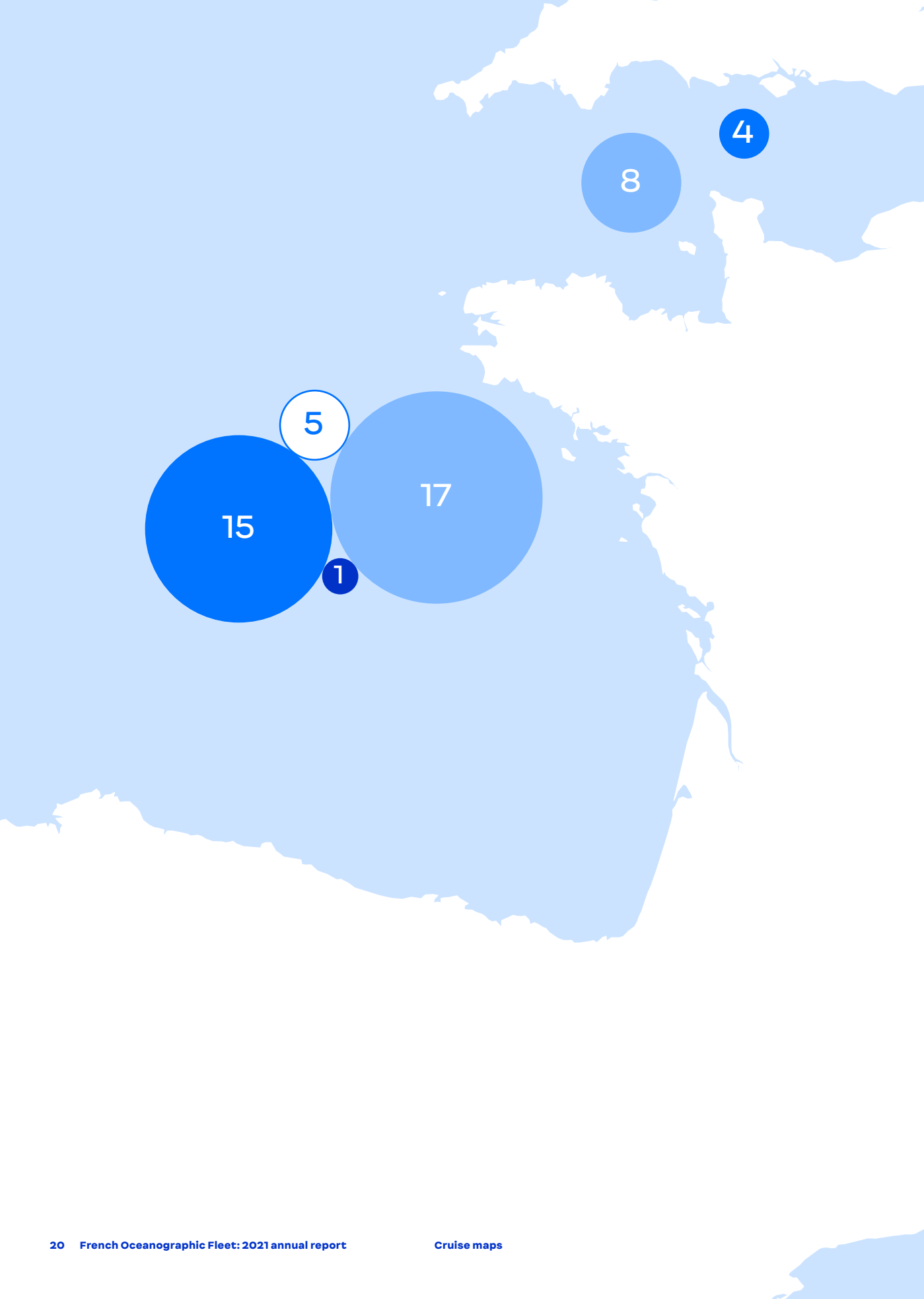
Deep-sea and overseas France cruises

Number of cruises:



1 →

6



Mainland France coastal cruises

Number of cruises:



19

1

46

Ocean exploration: pushing science forward

SWINGS (CNRS): How the Southern Ocean helps regulate Earth's climate

A team of scientists led by two CNRS researchers sailed the Southern Ocean for 52 days aboard R/V *Marion Dufresne II* hoping to better understand the role this region plays in regulating atmospheric CO₂.

SWINGS, led by CNRS researchers Catherine Jeandel and H  l  ne Planquette, traversed the Southern Ocean from the Roaring Forties to the Furious Fifties between January 11 and March 8, 2021, seeking to uncover the ocean's secrets.
Photo: Damien Cardinal / LOCEAN-IPSL



The ocean, and the Southern Ocean in particular, is a key factor in the capture and storage of atmospheric CO₂, one of the main greenhouse gases responsible for climate change. Both ocean circulation and biological activity influence the processes at work: photosynthesis by phytoplankton is what captures the carbon that is then transported down to be sequestered in ocean sediment. One of the objectives of SWINGS (South West Indian GEOTRACES Section) is to evaluate the activity of these microorganisms, whose development depends on the presence of certain chemicals in the water at very low concentrations (silica, nitrates, iron, zinc, thorium, radium, and rare earth elements).

SWINGS, part of the GEOTRACES program, focuses on the origins and transformations of these geochemical indicators. GEOTRACES has been working

since 2010 to create a "chemical atlas" of the world's oceans.

From January 11 to March 8, 2021, R/V *Marion Dufresne II* hosted a team of forty-eight scientists led by two researchers from the Centre national de la recherche scientifique (CNRS), Catherine Jeandel and H  l  ne Planquette. The 120-meter-long vessel boasts 650 square meters of laboratories, a winch system, and a multibeam echosounder, allowing the scientists to take measurements and samples at the surface, within the water column, and even down in the sediment using a small corer. This is the most comprehensive research cruise that has ever taken place in the Southern Ocean.

The expedition was financed by the National Research Agency, the French Oceanographic Fleet (operated by Ifremer), the CNRS's National Institute for

Earth Sciences and Astronomy, and graduate school ISblue. It is supported by the Universit   de Toulouse and the Universit   de Bretagne Occidentale.

The project brought together researchers, researcher/educators, engineers, and technicians from the CNRS, the National Research Institute for Sustainable Development, and several French universities (Sorbonne University, Universit   Toulouse III – Paul Sabatier, Universit   de Bretagne Occidentale, Universit   de Versailles Saint-Quentin, and Universit   d'Aix-Marseille), as well as peers from other countries (Great Britain, the United States, and South Africa).

GHASS2 (Ifremer): Gas hydrates, a hot topic in ocean research

At the Regab pockmark (3,200 m water depth): ROV *Victor 6000*'s claw takes a gas hydrate sample. Photo: Ifremer



Under Ifremer's direction, eighty scientists headed to the Black Sea to assess the threat posed by decomposing gas hydrates trapped as ice at the bottom of the ocean.

At low temperature and high pressure, natural gas can get trapped inside a cage of water and turned into bits of ice. These bits, called gas hydrates, then fill in gaps between sediment formations. They are most often formed from methane, a greenhouse gas that has four times the warming potential of CO₂ despite the fact that it doesn't last as long in the atmosphere. In a worrying development, gas hydrate breakdown has recently started being observed across the planet. The escaping methane can cause landslides, acidify the ocean, and contribute to climate change as the gas reaches the atmosphere.

On the first GHASS cruise in 2015, a team observed the scale of this phenomenon in the Black Sea, where hydrate destabilization caused submarine avalanches. Ifremer eventually organized a second expedition to learn more. On August 16, 2021, a

team of eighty scientists boarded R/V *Pourquoi Pas?*, an open-water French Oceanographic Fleet vessel, and departed for the Black Sea.

The team used crewed submersible *Nautilie* to perform the first ever detailed exploration of the seafloor in this area. They took a number of measurements and samples, including specimens of methane bubbles released from decomposing hydrates. These observations will help locate hydrate layers and describe their morphology, type, and age to create an image of the paths the hydrates take through the sediment. Meanwhile, measurements from the surface and water column will detect signs of submarine landslides and help scientists study biodiversity in these unusual environments.

GHASS2 by the numbers

- 80 scientists and 30 crew members
- 45 days at sea, from August 16 to October 1, 2021
- 1 mission leader and 3 co-leaders from Ifremer: Vincent Riboulot, Stéphan Ker, Stéphanie Dupré and Nabil Sultan
- 12 partnered research organizations: Ifremer; Commissariat à l'énergie atomique et aux énergies alternatives; universities of Montpellier, Grenoble Alpes, Bretagne Occidentale, Bordeaux, Perpignan, and Rennes 1; Sorbonne University; and GeoEcoMar (Romania)

ChEReef (Ifremer): Health checkup for deepwater corals in the Bay of Biscay



Deep-sea cold-water corals in the Bay of Biscay.
Photo: Ifremer

ChEReef is co-led by two members of Ifremer's Deep Sea Laboratory: Lénaïck Menot, a benthic ecology researcher, and Julie Tourolle, an engineer specializing in habitat mapping. Over a period of five years, they will examine the cold-water corals of the Lampaul Canyon to evaluate their health and investigate the pressures impacting them.

Why are you focusing on these corals in particular?

Lénaïck Menot: These corals are one of the species given special protection under the 1992 Habitats Directive. The directive created the Natura 2000 network of protected sites and saw the introduction of research programs. One of those programs was LIFE MarHa, of which ChEReef is part. Our goal is to evaluate the health of the corals and identify any threats to their well-being. Julie Tourolle wrote a thesis on this topic.

Julie Tourolle: We opted to focus on the Lampaul Canyon, 250 kilometers off the coast of Brittany, because prior investigations had shown that it was home to corals. Three species of hard coral (Scleractinia) live on the cliffs there. Plus, they live in a Natura 2000 protected area that has fishing activity on its border, so all that makes for a great research site.

What were the goals for this cruise?

Lénaïck Menot: There were two main objectives that structured the trip: first, to make a very precise map of the area, so that, second, we could set up a seafloor observatory.

Julie Tourolle: Getting the observatory set up was crucial, because it'll let us measure a number of environmental properties (currents, temperature, turbidity, oxygen) and film the corals for fifteen minutes every day over a period of five years. We'll be doing one cruise per year for the next five years to perform maintenance on the observatory and retrieve the data.

How did ChEReef 1 go?

Lénaïck Menot: It went well, but it was stressful. Our 2020 trip got canceled because of COVID-19, which meant we had to get everything done in 2021—both the detailed mapping using ROV *Ariane* and AUV *Idex*, and then deploying the observatory. Then we lost time due to weather, so the observatory didn't get set up until the very end of the last dive. So it was nerve-racking, but that's just how it goes with oceanography cruises. You have to deal with things as they happen. Luckily everyone was fully committed to getting the job done. We had constant support from the crew.

Julie Tourolle: Our observatory is nearly the size of a shipping container (4.20 m × 2.40 m) and we had to wait for calm seas to install it somewhere flat near the corals that live on the cliffs. We managed to find a suitable platform at a depth of 800 meters. It wasn't easy to get the observatory off the boat and place it onto a pretty small target area, deep down, while battling currents. But the bridge crew (the officers and helmsman who pilot the ship) did an excellent job.

We were also testing a new ballast system for placing and retrieving the observatory without leaving anything behind on the seabed. That helps to preserve the site, but it also made for additional difficulties.

ChEReef also had a significant outreach component, didn't it?

Julie Tourolle: Yes, we implemented a telepresence interface so that scientists who weren't on board could follow and annotate the dives as they were happening. For one week, the dives were also streamed to Oceanopolis in Brest. More than 700 people came to watch and ask us questions. We held Q&A sessions twice daily.

Photographer Nicolas Floc'h also joined us for the first leg of the trip. He's been doing seafloor photography for a long time. He installed a camera on the side of the boat for his project *The Colour of Water*, and put another device with a wide-angle lens on *Ariane* to capture panoramic images of the underwater landscape. He's planning to publish a book about ChEReef and cold-water corals.

What comes next?

Lénaïck Menot: We've started processing the data gathered in 2021. In addition to mapping the site and setting up the observatory, we also took core samples, which will help us describe the canyon's sediments; water samples, so we can understand their chemistry; and samples of plankton, larvae, and corals, which are currently being studied.

Julie Tourolle: We're working on organizing ChEReef2 for summer 2022. We'll bring up the station and retrieve the first year's worth of data.



Julie Tourolle and Lénaïck Menot
Photos: Mathilde Chemel / Sorbonne University
and Julie Tourolle / Ifremer

AMAZOMIX (IRD): Studying physical processes and their effects on marine ecosystems at the mouth of the Amazon

Ariane Koch-Larrouy
and Arnaud Bertrand
Photos: IRD and Mercator
Ocean University
of Montpellier



AMAZOMIX is a joint French–Brazilian project led by two researchers from the National Research Institute for Sustainable Development (IRD): Ariane Koch–Larrouy, a physical oceanographer specializing in fine–scale ocean physics at the Laboratory of Space Geophysical and Oceanographic Studies, and Arnaud Bertrand, marine ecologist and Director of Research at the MARBEC mixed research unit (Marine Biodiversity, Exploitation, and Conservation). Their ambitious multidisciplinary investigation has required unexpected determination, but it sheds new light on an important marine region, one that has been poorly studied and remains poorly understood.

What scientific questions did you hope to answer with this cruise?

Arnaud Bertrand: We wanted to study the many different physical, biochemical, and biological phenomena that result from the influx of this enormous mass of fresh water into the ocean from the Amazon, the largest river on Earth by volume. It's a crucial area for the world ocean and for climate regulation. We also wanted to address the issue of contaminants like microplastics and mercury from gold mining.

Ariane Koch-Larrouy: We feel that a multidisciplinary approach is key. I brought to the table my knowledge of the physics aspects, especially the mechanics of the internal waves produced by the very strong tidal currents that can be found at this part of the continental shelf break. Arnaud Bertrand, in turn, brought his knowledge of marine ecosystems and his experience in organizing this kind of multidisciplinary expedition. Then we brought in other specialists to try to cover all our bases.

Did the pandemic make it harder to set up the project?

Arnaud Bertrand: The pandemic meant we had to postpone the trip for a year, and up to the very last minute we weren't sure we'd be able to pull it off. First there were all the usual difficulties involved in any cruise where there are a large number of specialists from a lot of different fields involved, and a huge amount of diverse equipment. Then we had to deal with the hurdles that came with the pandemic—border closures, difficulty getting permits, and so on. For example, we were required to have an observer from the Brazilian Navy on board in order to sail in our target area.

Ariane Koch-Larrouy: We wouldn't have been able to succeed without enormous support from the IRD, the Fleet's Maritime Operations Division, Genavir, the prefect of French Guiana, the consulates and embassies, and our Brazilian colleagues. We were going to be using the French Oceanographic Fleet's R/V *Antea*, which can only accommodate nine scientists. That's not very many for a multidisciplinary cruise like ours that involves a good thirty different scientific fields. So it was a real headache to organize—it took us five years of work. Then there was a whole new challenge trying to get the whole team to the departure point in French Guiana. Flights had been halted, so our Brazilian colleagues had to travel to the vessel overland, getting special permits and incorporating a fifteen-day quarantine into their planning.

How did the cruise end up going?

Arnaud Bertrand: We knew even as we were preparing that our plans were extremely ambitious and that we probably wouldn't be able to finish everything that was on the schedule. But in the end, we were actually able to get it all done, plus some! That was made possible thanks to the extraordinary dedication of all the crew members. From the captain to the deckhands, everyone pulled together to make the cruise work. They were amazing. The captain mentioned, and I agree, that it's thanks to them that we were able to cram in more consecutive operations than anyone thought possible on a research vessel.

Ariane Koch-Larrouy: They did a remarkable job, and we can't thank them enough. We were able to take quite a few measurements and samples by deploying a battery of instruments. Some of those were very fragile, like the VMP, a special profiler that measures horizontal shear in ocean currents. We also got to use a small autonomous underwater vehicle.

Are you satisfied with the results of this cruise?

Arnaud Bertrand: Yes. The preliminary results that we saw on board were already very encouraging, both regarding species taxonomy and regarding the mechanisms of water masses and their impact on various ecosystems. We're going to learn things that will be important not just for this region, but for the whole world ocean. We're also going to be able to fill in a lot of gaps in our current knowledge and describe some new species.

Ariane Koch-Larrouy: There's a decade's worth of work ahead of us. Not to mention a new challenge: we'll probably have to get several dozen students involved to be able to make use of all this data. We really want to get to the bottom of things. We don't want to stop at description; we hope to shed light on how every component of the ecosystem influences the others.

MARBEC mixed research unit (Marine Biodiversity, Exploitation, and Conservation): A mixed research unit primarily supervised by the IRD, Ifremer, the Université de Montpellier, and the CNRS, along with one secondary supervising organization, the National Institute of Agricultural Research.

LEGOS mixed research unit (Laboratory of Space Geophysical and Oceanographic Studies): A mixed research unit supervised by the CNES, the CNRS, the IRD, and the Université de Toulouse Paul Sabatier, located at the Midi-Pyrénées Observatory in Toulouse.

THEMISTO (MNHN): Acoustic study of zooplankton and micronekton distribution in the Southern Ocean

Sharing R/V *Marion Dufresne II* with the SWINGS team, the scientists working on THEMISTO continued their three-dimensional study of how the distribution of zooplankton and micronekton* varies in response to physical and climatic events.

A phronima (*Phronima sedentaria*) sampled by a trawl in subtropical waters during THEMISTO. Photo: Cédric Cotté / Ifremer



The scientists working on THEMISTO continued their three-dimensional study of how the distribution of zooplankton and micronekton* varies in response to physical and climatic events.

The project, coordinated by Cédric Cotté of the LOCEAN mixed research unit**, has spent several years investigating how pelagic (open-sea) ecosystems in the Indian portion of the Southern Ocean are structured by their environment. After analyzing the initial large-scale spatial and seasonal distribution diagrams, the scientists wanted to use acoustic imaging to understand the 3D distribution of zooplankton and micronekton. They used the *Marion Dufresne II*'s acoustic equipment, particularly the five-frequency EK80 echosounder, to take continuous

measurements of the distribution and density of pelagic organisms in the water column (down to 2,000 meters water depth at 18 kHz and down to 200 meters water depth at 200 kHz). The data will complement other group and species identification efforts being carried out concurrently via echosounding and trawling. By comparing these acoustic measurements of 3D distributions to other physical data, like satellite imagery, scientists hope to identify "critical habitats at multiple scales" for key species in the ecosystems of the southern Indian Ocean.

THEMISTO works closely with project OISO (Indian Ocean Observation Service), and in the past has worked with REPCCOAI, a project that participated in OBSAUSTRAL cruises between 2017 and 2019. The diverse data

that has been collected will help deepen understanding of these ecosystems and enrich ecosystem models like the one created by MESOPP (Mesopelagic Southern Ocean Prey and Predators), a European Horizon 2020 cooperation project.

* Fauna measuring between one and ten centimeters that feed on zooplankton.

**LOCEAN mixed research unit (Oceanography and Climate Laboratory; Experimentation and Digital Approaches): A mixed research unit run by the CNRS, the IRD, the Muséum national d'histoire naturelle, and Sorbonne University.

IMPEC (CNRS): Assessing the ecological status of benthic habitats in the Gulf of Lion

Sieving of sediments taken by the Day grab sampler to study benthic macrofauna. (From left to right: Lyvia Lescure and Meryem Mojtahid.)
Photo: IMPEC project consortium



Scientists aboard R/V *L'Europe* surveyed the Gulf of Lion to study the impact of towed-gear fishing (trawling, dredging) on continental shelf seabeds.

Demersal fishing (catching fish by towing a net along the seafloor) is a major economic activity in the Gulf of Lion, but also a significant disrupter of ecosystems. IMPEC (Impact of Fishing on Deep-Sea Benthic Ecosystems) aims to assess the disturbance and create indicators to measure how badly the seabed has been abraded. The project was created in response to a call for proposals by the Office français de la biodiversité in late 2019: "Developments in monitoring and evaluating the health of continental, littoral, and marine aquatic environments."

Céline Labrune, a research engineer with the Centre national de la recherche scientifique at the LECOB* laboratory in Banyuls-sur-Mer, led the science team that sailed aboard the *L'Europe* from July 31 to August

16, 2021. The team used recent fishing maps to place ten stations in locations where they could get useful samples from the area around the Lacaze-Duthiers Canyon. Five more stations were placed in the middle of the continental shelf in the Gulf of Lion Marine Park. The cruise also deployed a variety of research equipment to collect specific data: a multitube corer to look at meiofauna and biogeochemistry, a grab sampler for benthic macrofauna, a towed camera sled (PAGURE 2) for benthic megafauna, and a Sediment Profile Imagery unit and Kullenberg corer for dead foraminifera (fossils).

Studying several faunal groups at once is an unusual approach, but it will provide valuable information about how sensitive various species are to pressures from towed-gear

fishing. Description of the sediment and its geochemical composition will also help better assess the level of pressure and interpret observed trends in the fauna.

* LECOB mixed research unit (Benthic Ecogeochemistry Laboratory): A mixed research unit run by the CNRS and Sorbonne University.

PACMAN (Ifremer): Studying changes in marine habitats in the Bay of Biscay

Launch of remotely operated underwater vehicle *Ariane*.
Photo: Robin Faillettaz / Ifremer



Scientists aboard R/V *Côtes de la Manche* made use of video recordings to analyze changes in marine habitats in an area crucial to the reproduction of certain species.

PACMAN (Optimizing Anthropic Activity for Sustainable Exploitation of the Marine Ecosystems of the Great Mudflat) studies the Bay of Biscay as a key activity area for French fishing fleets. As a spawning ground and nursery, it's vital to species like hake and sole that not only suffer the effects of climate change but also face massive anthropic pressures (fishing, aggregate extraction, offshore wind farms).

The PACMAN cruise was led by Dorothee Kopp (Ifremer) and took place from June 2 to 26, 2021, aboard the *Côtes de la Manche*. Its purpose was to study environmental and human pressures affecting habitats. The scientists chose to focus on recording video, a non-extractive technique, and used recordings from the 1990s as a benchmark. The team used the old data as a basis for nine new recordings, taken at depths of less than 400 meters in the same geographical locations during the same season (spring).

Comparative analysis of the videos will identify changes in species density in the intervening time, and help researchers formulate hypotheses about the role that environmental and anthropic factors have played in these changes. A detailed description of the structure and community as it exists today will also be completed for use in future comparisons. The cruise may additionally provide some methodological insight, as it offers the opportunity to compare two non-extractive sampling techniques (environmental DNA vs. video).

CARESSE (La Rochelle Université and IPGP): Identifying sediment traces from cyclones and tsunamis in the Lesser Antilles

As part of CARQUAKES, a National Research Agency project, CARESSE led R/V *Antea* through the lagoons and nearshores of the Lesser Antilles island arc to follow the tracks of old tsunamis and storms through the sediment.

Transporting coring hardware in the west lagoon of Scrub Island (Anguilla).
Photo: Éric Chaumillon



CARESSE contributes to the “Coastal paleoseismology and tsunami deposits” segment of the National Research Agency’s CARQUAKES project (Large Earthquakes and Tsunamis in the Lesser Antilles Arc). That project aims to fully catalog all of the tsunamis and major earthquakes that have hit the Lesser Antilles through a combination of methods across various scientific disciplines: paleoseismology at the land–sea interface, archaeological and historical studies, and modeling. These large-scale events pose major threats to coastal populations, but remain poorly understood.

Éric Chaumillon of La Rochelle Université and Nathalie Feuillet of the Institut de physique du globe de Paris led a team of eight researchers, supported by the fifteen crew members of R/V *Antea*. Together they explored six islands and eight lagoons to identify “sediment records from tsunamis, vertical crustal movements, and storms.” They produced 112 seismic profiles and took 63 sediment cores totaling 125 meters. The expedition leaders said they were extremely satisfied with the data the trip had yielded, which promises to shed enormous light on “the history of tsunamis and storms in the Antilles, as well as changes

in each bay’s sedimentation over the course of the Anthropocene epoch.” They thanked everyone who participated in this adventure, and praised the strong ties that grew between the science team and the crew of the *Antea*.

The cruise took place from June 23 to July 12, 2021, and focused on the following locations: Antigua (English Harbor), Barbuda (Codrington Lagoon), Anguilla (Scrub Island), Saint Martin (Fish Pond), Martinique (Galion Bay and Robert Bay), and Guadeloupe (Grand Cul-de-Sac and Petit Cul-de-Sac).

ALBACORE (Sorbonne University): Dating major climatic, oceanographic, tectonic, and gravitational events in the Alboran Sea

Left: Sara Lafuerza,
geotechnical specialist
Right: Élia d'Acremont,
marine geologist. Photos:
Y. Korniyenko-Sheremet



Marine geologist Élia d'Acremont and geotechnical specialist Sara Lafuerza are both researcher/educators from Sorbonne University at the Institut des sciences de la terre de Paris. They organized and led ALBACORE to obtain sediment data that will supplement geophysical insights from previous Alboran Sea cruises.

Why is the Alboran Sea a place of interest?

Sara Lafuerza: This basin, situated between Spain and Morocco, is particularly interesting because it's where the relatively cold Atlantic water meets the warmer, denser Mediterranean water. There are active seismic zones in that area, and the seabeds have irregular geomorphology. Both of these factors affect circulation between these two very different water masses, as shown by the presence of special kinds of sedimentary deposits (contourites) that have been affected by numerous submarine landslides over the Quaternary period. We want to look at how all these elements interact.

What were the main goals for ALBACORE?

Élia d'Acremont: We'd observed on previous cruises that the seabed had an extremely complex morphology—eroded folds, active faults, submarine landslides, contourites, and fluid flows. We want to figure out what processes created these structures, how they've changed, and how they've interacted on geological timescales. That means ALBACORE has multiple objectives: to investigate the processes that cause submarine landslides (a potential source of tsunamis), to date tectonic events and assess historical earthquake frequency (three events in the past thirty years), and, finally, to look at sediment systems to find indicators of climatic and oceanographic variation.

Sara Lafuerza: ALBACORE has examined the sediments covering the basin's floor, which is an important addition to the years of largely geophysical data-gathering that's already been done. We need to date these processes and describe their geology, which is where the sediment cores come in. We made the cores as long as possible so we could look far back in time.

How did the coring go?

Sara Lafuerza: The French Oceanographic Fleet provided us with R/V *Pourquoi Pas?* along with a number of instruments. Those were deployed widely to ensure our sampling covered as much ground as possible. We used the Calypso corer, a gravity corer, a rock corer, and an interface corer; that last one let us look at the top few centimeters of seabed sediment. We also set up thermal sensors to study variations in heat flows. Plus, we were lucky enough to have the Penfeld, a penetrometer that can drive up to fifty meters into the sediment, so we could characterize the sediments mechanically.

Élia d'Acremont: Everyone aboard the *Pourquoi Pas?* worked very hard during the cruise. It was quite intense. We published a daily blog during the trip for students K-12 and beyond.

We'd never run a cruise on this vessel before, but the crew and Genavir's shore-based personnel were heavily involved and helped us get each series of tasks done with maximal efficiency so we could gather as much data as possible. They understood how important it was. The captain held daily meetings on the bridge to plan and optimize the operations.

Are you happy with your results?

Sara Lafuerza: We asked for R/V *Marion Dufresne* // at first, because it can take cores up to sixty meters in length. It wasn't available, so we adapted and went for shorter cores and more varied samples. Our initial plans were quite ambitious. We weren't able to complete everything we set out to do, but nonetheless we now have an impressive data set. We're especially curious to see what we'll learn from the Penfeld data.

Élia d'Acremont: The data-processing phase has begun. We've put forward some topics for internships for college and master's students, and we've also submitted a thesis topic. The data we've gathered could be of interest to people in many different fields. The cruise also offered the chance to strengthen our collaborative ties to our colleagues in Spain, Morocco, and Sweden.

ALBACORE at a glance:

- October 14 to November 15, 2021, aboard the *Pourquoi Pas?*
- 67 people, including 27 scientists and 30 crew
- Cruise blog:
- <https://projets-istep.eu/>
- French organizations: MNHN, CNRS, Université de Bretagne Occidentale, Sorbonne University, Université Côte d'Azur
- Partners in Spain, Morocco, and Sweden:
- Consejo Superior de investigaciones científica
- Institut de Ciències del Mar
- Instituto Español de Oceanografía
- Universitat de Barcelona
- Universitat de Salamanca
- Université Abdelmalek Essaâdi
- Université Mohammed Premier Oujda
- Université Mohammed V de Rabat
- Linnaeus University (Sweden)

Partnerships and cooperations

20 years of cooperation with the Navy and SHOM

It's been twenty years since Ifremer, the French Navy, and the Service hydrographique et océanographique de la Marine first began their cooperative efforts, pooling oceanography resources and sharing scientific data. The French Oceanographic Fleet is marking this anniversary by putting some of the key figures in this partnership in the limelight. Their testimony paints an overwhelmingly positive picture and reveals a common desire to continue onward in the same spirit.

Interview with Olivier Lefort, director of the French Oceanographic Fleet

Olivier Lefort
Photo:
Eric Lenglemetz / Ifremer



How did this partnership between Ifremer, the Navy, and the Service hydrographique et océanographique de la Marine (SHOM) come to be?

In the late 1990s, Ifremer was contemplating building a third deep-sea research vessel, the *Pourquoi Pas?*. At the same time, the Navy had two potential projects of its own under consideration.

We both ran into major financing problems, so we got together to discuss the possibility of pooling our efforts and investing jointly in a pair of shared vessels.

These high-level talks eventually resulted in a co-financing agreement: Ifremer covered 5% of the construction costs for R/V *Beautemps-Beaupré*, the Navy's ship, and the Navy contributed 45% of the financing for Ifremer's R/V *Pourquoi Pas?*.

The first acquisition and operating agreements were signed in 2001. Some of the terms and conditions changed over time, but the spirit remained the same. Every year the French Navy "buys" days of use for the *Pourquoi Pas?* (up to 150 days per year) to carry out cruises, mostly for SHOM work. On the other side of things, Ifremer has ten days of credit per year on the *Beautemps-Beaupré*.

How has the partnership worked and changed over time?

It proved to be a sensible match right from the start, since we both use the same kinds of scientific tools. Of course, I do recall—because I was there when this all first started—that in the beginning there were some mutual misunderstandings and perhaps even a bit of competitiveness between Ifremer and SHOM. But as time went on, we got better at working together and came to share a deep trust, to the benefit of everyone involved. SHOM has been able to use the *Pourquoi Pas?* to perform mapping and hydrological measurements in the northern Atlantic every year. In turn, Ifremer has benefited from privileged access to a military vessel, the *Beautemps-Beaupré*, which allows for work to be done in high-risk areas like the waters off the Horn of Africa (VARUNA and CARLMAG). We've also agreed to optimize the use and maintenance of certain rare and costly scientific equipment by sharing feedback and making sure we both learn from it.

What comes next?

Our partnership is continuing forward in very concrete fashion. In 2019, Ifremer and the Navy invested in refitting the *Beautemps-Beaupré*; now the Navy is supporting us as we refit the *Pourquoi Pas?*. We're also having a serious conversation about using surface and submarine drones in cooperation with the Navy and SHOM. And our relationship goes beyond just this team-level cooperation: The Navy's Chief of Staff came to visit our Toulon sites in January 2021.

Remarks from Captain Bertrand Drescher of the French Navy, head of the Navy's Employment and Professional Standards Office.

How do you view this twenty-year partnership with Ifremer?

It's unquestionably an asset for the Armed Forces. The partnership is based on an agreement between the Service hydrographique et océanographique de la Marine (SHOM), the Navy, and Ifremer that states that the Navy and Ifremer have placed their respective hydro-oceanography resources at each other's disposal. SHOM personnel who have the necessary technical skills go aboard French Oceanographic Fleet vessels to perform hydrographic surveys and set up sensors. Such a collaboration has been made possible by our similar equipment needs and compatible procedures. It's been a success because the personnel on both sides have given their all to make things work. There have been some notable events over the years:

- In 2009, after the crash of Air France flight 447, Ifremer let us use R/V *Pourquoi Pas?* to recover black boxes that had landed 4,000 meters below the sea surface.
- In 2019, Ifremer resources helped us find the submarine *Minerve*, which had been missing since 1968; it had sunk in waters 2,700 meters deep off the coast of Toulon.
- In February 2022, the Eledone demonstration used Ifremer equipment to inspect a delicate underwater apparatus near Marseille. This exercise highlighted how our respective deep-sea resources can shore up each other's capacities and operations.

How has the Navy benefited from this arrangement?

For the past twenty years, French Oceanographic Fleet vessels have spent more than 100 days per year collecting hydrographic and oceanographic readings on behalf of the Navy. This data fills our databases and fuels SHOM's military and civilian projects. The Ifremer partnership has allowed the Navy to take advantage of highly effective additional resources that are specifically devoted to measuring the environment. Out of the 850 sea days allocated for SHOM activities, 130 are performed by Ifremer. That's a whole 15% of our ocean survey capacity. On the technical side, the Fleet has looked to SHOM and the Navy for discussion and even sometimes collaboration as it upgrades its equipment.

When SHOM teams set sail on an Ifremer vessel, or vice versa, that always proves to be a catalyst for profitable exchanges of ideas among our respective specialists, as well. SHOM, the Navy, and Ifremer have built a strong foundation of trust. Our dialogue is constructive and responsive, especially when it comes to resource planning and usage. Ifremer is forthcoming and open to sharing its expertise—it's a true partner, scientifically, technically, and operationally, for SHOM and the Navy.

The Navy is planning to replace some of its vessels and reflecting on what future missions might look like. Do you see ongoing potential for collaboration with Ifremer?

The Navy wants to continue the partnership that it has embarked upon with Ifremer, which started out with the *Pourquoi Pas?* usage agreement. SHOM and the Navy want to better understand the geophysical environment, and this relationship helps us meet our objectives.

Replacing BH2-type survey vessels *Laplace*, *Borda*, and *La Pérouse* is part of the "Future Hydrographic and Oceanographic Capacity" program's outfitting operation. That program aims not only to replace old vessels, but also to update their hydro-oceanographic capacities to incorporate new technologies, including drones (AUV, USV, gliders), and to cover new kinds of missions, like seabed exploration. The objective is to have top-of-the-line equipment that can describe the marine environment in order to respond to growing needs in various conflict areas, starting in 2027.

In the coming year, the Navy hopes to work more on seabed exploration and action. The seafloor is a major point of shared interest for both the Navy and Ifremer. That means figuring out how to better understand, monitor, and take action on, from, and toward seabed locations. Our partnership with Ifremer—based on trust, fruitful exchanges, and a shared interest in hydrography, oceanography, and understanding the seabed in general—is a wonderful asset

Remarks from **Mikaël Le Gléau**, head of planning for SHOM sea cruises, and **Élodie Marches**, leader of the SOUSACOU project

Left: Mikaël Le Gléau
Photo: Yannick Sohier
Right: Élodie Marches
Photo: Élodie Marchès /
SHOM



What is SHOM, and what are its goals?

The Service hydrographique et océanographique de la Marine (SHOM) is an Administrative Public Establishment run by the Ministry of the Armed Forces, and a descendant of the world's very first hydrographic service, dating back to 1720. It's the public agency that provides reference information on maritime and coastal geography. SHOM's mission is "to understand and describe the physical marine environment and its relationships with the atmosphere, the seabed, and the littoral zones; to predict how it will change; and to publish related information."

From that mission statement we derive our three cornerstone activities:

- Hydrography of French waters and areas for which France bears cartographic responsibility, to meet needs in surface navigation
- Defense support, in the form of the hydro-oceanographic expertise SHOM brings to the Armed Forces Procurement Agency, as well as operational support provided to the military
- Public policy support on matters related to the sea and the coast. SHOM makes all of its expertise and data on French waters available to public institutions, as well as to any and all ocean and coastal actors.

To ensure the best possible service, SHOM cultivates expertise in the acquisition and processing of data on a wide variety of oceanographic properties. It transforms that data into products and services that suit the differing needs of various users, and delivers them in appropriate formats and via appropriate channels. Areas of expertise include bathymetry, sedimentology, coastal hydrodynamics, oceanography, engineering of marine data collection systems, and ocean and coastal geographic information.

SHOM is special because it's a global actor. It covers the whole value chain, serves both civilian and military clients, offers a wide range of expertise, and has a presence in almost every ocean in the world. And there's another remarkable thing: a significant part of SHOM's activity is operations. It has a sovereign duty to publish nautical information and participate in national defense (e.g. by supporting nuclear deterrence), and it works seven days a week.

What kinds of tasks have you been able to carry out aboard French Oceanographic Fleet vessels?

SHOM generally uses French Oceanographic Fleet vessels for activities involving seabed exploration or physical properties of the marine environment. On the projects I've worked on, we've used high-resolution seismic equipment, pulled samples with a Calypso corer, and set up oceanographic and acoustic mooring lines, among other things. As an example, we've taken regular profiles of target areas to acquire data on seabed morphology (multibeam echosounder), sediment architecture (seismic reflection), and sediment composition (cores).

Meanwhile, the mooring lines gather data on physical properties of the water column. All of this information is then used in a defense technology project in cooperation with the Armed Forces Procurement Agency to respond to future military needs in the realm of submarine acoustic measurements.

What do you think of the services and equipment available on the *Pourquoi Pas?*, and how did your last cruise go?

The Fleet's vessels have everything we could need for my project, AMETISTE. The most recent cruise, SOUSACOU, took place from February 13 to March 30, 2021, aboard the *Pourquoi Pas?* in the Mozambique Channel. The goal was to measure subsoil geo-acoustic properties using seismic sources and observation of the seabed and marine subsoil in order to better identify the effects of gyres, a type of ocean structure present in this region. We hoped to illuminate how properties of the subsoil and the overlying water masses influence acoustic propagation in marine environments.

We surveyed a single area with a multibeam echosounder, a sub-bottom profiler, and a high-resolution seismic imager, in addition to taking six core samples. The initial results showed a complex seabed morphology: numerous canyons around the edge of the plateau, tectonic sedimentary structures, and submarine volcanoes. When we started analyzing the high-resolution seismic data, we found complex sedimentary architecture with paleochannels, large masses from landslides, and buried contourites. Analysis of subsoil velocity profiles also had interesting results: we found massive decreases in the deeper velocity gradients, probably due to the presence of gas in the buried sediment layers. This is a significant result that will help us fine-tune our propagation models for the region.

The trip was also impacted by the pandemic. The vessel got requisitioned to deliver oxygen to Mayotte at the start of the cruise, and some of the scientific equipment didn't arrive in time to be loaded. But despite the need to rush and the pressures of dealing with the unexpected, we got along very well with the entire crew. The absolute professionalism of the deck crew, navigation crew, and captain ensured that we still completed most of our objectives in spite of the unforeseen circumstances. All in all, I'm very happy.

Remarks from Nicolas Chamot-Rooke, researcher at the École normale supérieure's Geology Laboratory, and leader of a civilian mission aboard the *Beautemps-Beaupré*

R/V *Beautemps-Beaupré*, a symbol of the twenty-year partnership between Ifremer, the French Navy, and SHOM
Photo: Stéphane Lesbats / Ifremer



What work have you been able to perform thanks to the *Beautemps-Beaupré*? How has using a military vessel helped you accomplish your goals?

I was lucky enough to have the opportunity to be part of SIMED/MEDOR, one of the very first cruises run cooperatively between Ifremer, the Service hydrographique et océanographique de la Marine (SHOM), and the Centre national de la recherche scientifique (CNRS). That took place in 2004, the first year after Oceanographic Survey Vessel *Beautemps-Beaupré* came into service. It was a multibeam bathymetry survey led by Jean Mascle (CNRS/Géoazur) and Benoît Loubrieu (Ifremer). R/V *L'Atalante* had begun mapping the eastern Mediterranean seabed on previous cruises (MEDEE and ANAXIPROBE in 1995 and PRISMED2 in 1998), and this project allowed us to complete the work. The *Beautemps-Beaupré* gathered some extremely high-quality data that revealed spectacular submarine morphology.

The map was later enhanced by occasional additional missions to specific locations in shallow waters, but the combined efforts of the *L'Atalante* and the *Beautemps-Beaupré* were the main source for the bathymetric grids so widely used today by the Mediterranean scientific community, currently available in the EMODnet database. It's a shame, but most users don't realize that 90% of the deep-sea coverage of the eastern Mediterranean was provided by just those two vessels, collecting data on expeditions that were designed by scientists, validated and materially supported by the French Oceanographic Fleet, and executed by Ifremer, the Navy, and SHOM.

The second place where the *Beautemps-Beaupré* played a pivotal role—as far as my work is concerned, at least—was in the northwest Indian Ocean, off the coast of Oman. A series of attacks by pirates got the whole area declared off-limits to the Fleet's “conventional” vessels.

However, the *Beautemps-Beaupré* is operated by the Navy, which means that it's armed. So it became the only French research vessel allowed to sail in those waters. Three successive cruises (AOC in 2006, OWEN in 2009, and OWEN2 in 2012, all led by Marc Fournier and myself) mapped the triple junction formed by the Sheba Ridge, the Carlsberg Ridge, and the Owen Fracture Zone. Thanks to the exceptional multibeam data from R/V *Beautemps-Beaupré*, we demonstrated that the Owen Fracture Zone was an active fault (AOC cruise), which was a totally unexpected result. Then we were able to map the deformations associated with this active fault along a path more than 800 kilometers long. At the southern end of the active fault, a previously undiscovered basin was christened "Beautemps-Beaupré Basin" (or B3, for those in the know).

On OWEN2 (2012) we got to use the Fleet's low-impact seismic source on the *Beautemps-Beaupré* for the first time. That was a significant innovation. It required modifications to the vessel's deck, so the change was only made possible thanks to upstream collaboration among all the entities involved. The opportunity to use the seismic imager in combination with more traditional geophysics tools was the deciding factor in our choice to pursue this path. More recently, but along the same lines, two other cruises have taken place in the region where the Carlsberg Ridge intersects the Owen Transform Fault (CARLMAG and VARUNA, 2019)—that location has been critical to helping us define transform faults, which play a major role in plate tectonics. The seismic, bathymetric, gravimetric, and magnetic data produced has been extraordinary.

These trips are different from what you're used to with the Fleet. How do you feel about them?

Sailing with the Navy on the *Beautemps-Beaupré* means that we all wear the Navy protective jumpsuit, which is a pretty effective way to get everyone on the same page. As far as the rest of it, everyone knows what they have to do to make sure the trip is a success. The *Beautemps-Beaupré* is a non-combat ship, so it only performs research, whether that's for military or scientific purposes. The scientists on board are vastly outnumbered (there's five or six of us at most), so we're treated as guests, with all the rights and responsibilities that implies. The mission leader, for example, has to participate in the end-of-day briefings with the captain and the officers to recap what they've done that day and plan for the next.

One thing that makes these trips unique is the three-way decision-making by the captain (Navy), the chief hydrography engineer (SHOM), and the mission leader. The captain takes full control in emergencies (like if there were an encounter with the alleged pirates near Masirah Island in Oman) and during any planned military exercises that take place during the trip.

The rest of the time, the chief hydrography engineer is the backbone of the mission. That person is the one who makes sure everyone follows the cruise plan, takes care of logistics, assesses data quality, and organizes on-board preprocessing. Collecting "clean" data is really the domain of the SHOM hydrographers, especially when it comes to multibeam bathymetry (for marine cartography) and gravitational field measurements (for other purposes). The data that the scientists gather on our expeditions is actually a little less than ideal, as far as SHOM is concerned. The scientists are always pressed for time, so they acquire data at ten knots (excluding towed vehicles), whereas SHOM only considers data to be high quality if the nominal acquisition speed is no higher than eight knots. Staying on the topic of data quality assessment, I'd also mention that the team of onboard hydrographers processes their data in near-real-time.

What have your experiences aboard this vessel been like?

In terms of science, our trips on the *Beautemps-Beaupré* are always extraordinary experiences. Every one of the small number of scientists who've had the opportunity recognizes that working with state-of-the-art technology in locations that no other French or foreign vessel can access is a rare privilege. In terms of human relations, you have to make a distinction between the SHOM hydrographers, who share the same concerns as the scientists during the data-gathering phase at sea, and the Navy crewmembers. The science community and the military community have probably both learned a lot from each other. The intersection actually drew interest from *Nature Geoscience*, where we published the results of the AOC cruise (Fournier et al., 2007). That article was published in the very first edition of the journal, which has since become one of the most prestigious in the field of geoscience. It was accompanied by a "backstory" that featured both scientific commentary from a prominent US expert and a photo of the whole science team practicing gymnastics on *Beautemps-Beaupré*'s rear deck, led by athletic members of the military. I think that's a pretty accurate snapshot of the relationship we've built over the years.

Ariane* heads to *La Lune

In collaboration with the Ministry of Culture's Department of Subaquatic and Submarine Archaeology (DRASSM), Ifremer arranged a dive that was livestreamed back to shore with the help of MIMOSA 3, a piece of software created by the Oceanographic Fleet Division's Underwater Systems unit. DRASSM engineer Denis Degez was able to offer notes and steer from a distance as the *Ariane* submersible explored the wreck of *La Lune*.

Ariane on the rear deck of R/V *L'Europe* during transit to the dive site.
Photo: Laurent Artzner / Ifremer



Telework is likely to become increasingly common even in the field of underwater exploration. That's why Ifremer has developed an application that allows for long-distance participation in dives via a normal web browser. This "telescience" program is just one of the services provided by MIMOSA 3, a piece of software currently under development that will control underwater vehicles from the surface. Ifremer and DRASSM worked together to test MIMOSA 3 in real-world conditions. As a case study, they chose the wreck of *La Lune*, an iconic seventeenth-century ship that was the jewel of the Royal Navy under Louis XIV. The ship

sank off the coast of Toulon.

R/V *L'Europe* set sail for the wreck site on October 5. On board were the submersible *Ariane* and all the instrumentation necessary to make MIMOSA 3 work.

The dive was successfully livestreamed. Five dozen people logged in from afar to follow the dive from their homes and offices. DRASSM engineer Denis Degez directed events from a specially outfitted room at Ifremer's La Seyne-sur-Mer site that provided real-time communication with HROV *Ariane*'s pilots aboard the *L'Europe*. He said he was strongly convinced of the potential of this long-distance deep-sea piloting device, not to mention intrigued

by the possibility of documenting a dive in real-time, following it on the navigation map, and displaying multiple camera views at the same time.

A number of features still need work, like communication stability and maximum transmission distance (both seabed-surface and land-sea). Nonetheless, this trip and the feedback received from the users have already created a clear and concrete road map for future versions of the software.

GHASS2's "floating university"

The six "floating university" students and their supervisor on the deck of R/V *Pourquoi Pas?*
Photo: Estelle Leroux / Ifremer



GHASS2, a study of gas hydrates in the Black Sea, hosted a "floating university" aboard R/V *Pourquoi Pas?* that gave six college and master's students the opportunity to immerse themselves in an oceanography cruise. The event was a unique treat for the students and a first for the Fleet.

GHASS2's "floating university" was a collaborative effort by the Université de Montpellier, the Université de Bretagne Occidentale, and Sorbonne University, in partnership with Ifremer and the French Oceanographic Fleet. The event ran from August 15 to September 4, 2021. Six students from these institutions were the lucky participants, all in their final year of an undergraduate degree or first year of a master's in geophysics, marine geochemistry, or marine geology. Coordinators Jacques Deverchère (Bretagne Occidentale) and Jeffrey Poort (Sorbonne) provided onshore support, while Grégory Ballas

(Montpellier) supervised the students aboard. Professor Ballas was full of praise for the event:

"The point of this internship was to help these students develop expertise by giving them hands-on practice with oceanography data collection techniques, like seismic imaging and the geotechnical tools we made use of during this cruise. The students got to actively participate in scientific operations. They joined night shifts and learned the rhythms of working at sea, they interacted daily with scientists and specialized engineers, and they helped perform the initial processing of the bathymetric and seismic data. We also

held a series of thematic conferences while they were on board, creating opportunities for discussion and knowledge-sharing that the whole team enjoyed. A number of articles, posters, and posts for the general public were produced over the course of the cruise and later used at exhibitions, conferences, and science fairs at the participating universities. For the students, both these conversations and the work they did aboard the vessel will be unforgettable experiences in their nascent careers as scientists."

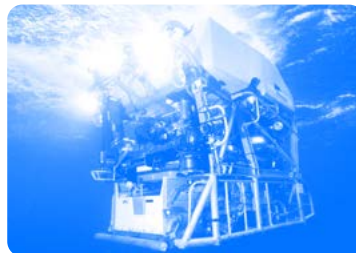
Vessel and vehicle evolution

Upgrading and deploying the *Victor 6000*

Remotely-operated deep-sea exploration vehicle *Victor 6000* is one of the most advanced devices of its type in the world. In 2021, the ROV was launched from *R/V Marion Dufresne II* for the first time. The occasion was used to test some of the technological components of its new upgrades.

ROV *Victor 6000* performs observations and operations at water depths up to 6,000 meters. Photo: Olivier Dugornay / Ifremer

Genavir's *Nautile* team for the 2,000th dive. Photo: Ifremer



Adapting the *Marion Dufresne II* for deployment of *Victor 6000*

The *Victor 6000* can't be brought aboard on a whim. The system and its associated equipment weigh around a hundred tons altogether, so bringing it along requires massive technical support and integration work. The vehicle itself and its ballast are 6.5 tons. The seabed winch installed on the vessel's deck is 25 tons. Then there's the special control center, the containers housing electric and hydraulic power supplies, maintenance bays, storage for spare parts.... Adjustments also have to be made to the vessel so it can properly launch and retrieve the

vehicle, position it dynamically and acoustically, and supply electricity to the whole system.

Deployment of *Victor 6000* aboard *R/V Marion Dufresne II* has been planned since 2019 and was finally tested in operational conditions on the ESSVIC-MD cruise that took place on October 6–27, 2021. All operational modes were tested over the course of several vehicle deployment trials and five 24-hour dives at water depths between 2,000 and 2,500 meters. The tests helped identify some additional adaptations and adjustments that will need to be made in order to fully validate use of *Victor 6000* aboard the *Marion Dufresne II*. Genavir operators

and Oceanographic Fleet Division engineers also took advantage of this cruise to evaluate some of the technology that was carried over during the upgrade process.

2,000th dive for *Nautile* during MoMARSAT

On June 8, 2021, during World Oceans Day, manned submersible *Nautile* performed its 2,000th dive. It entered service in 1984, and at the time was the only vehicle in the world capable of descending to 6,000 meters.

Refitting *L'Atalante*

Ifremer marine engineer Pierre Daelman has helmed the *L'Atalante* refit project from the very first requirements discussions through to completion of the work at the shipyard. The vessel re-entered service on January 27, 2022.

R/V *L'Atalante* is one of four French Oceanographic Fleet open-water vessels that sail the entire globe. Launched in 1989, it underwent a major refit in 2021. Photo: Franck Betermin / Ifremer



Pierre Daelman, marine engineer at Ifremer
Photo: Louise Daelman



Why did this work need to be done?

R/V *L'Atalante* is one of the French Oceanographic Fleet's open-water vessels. It sails all of the world's oceans and regularly crosses the globe. Now it's thirty years old. To be able to keep using it through 2030, we needed to take care of two main problems.

The first was that the diesel alternators that generate all the ship's electricity had reached their end of life. The second was that some of the major equipment (the seabed winch and side gantry) no longer met scientific requirements. Environmental and safety regulations have also changed a lot.

How did you comply with the new environmental regulations?

We added a new ballast water treatment system so that the vessel wouldn't be transporting microorganisms from one place to another all over the planet. The cooling system was replaced with one that uses cleaner gas. We installed four next-generation diesel alternators that perform much better in terms of fuel consumption and discharge. In fact, we actually went above and beyond regulatory requirements and installed a Tier III nitrogen oxide treatment system. We also increased the vessel's capacity for connecting to port power terminals so that it won't have to run the diesel engines while it's docked.

Did you change anything else on the vessel?

Pretty much every part of the ship was upgraded by this refit. We renovated the coring array, updated the alarm management, improved the vessel's dynamic positioning system, and changed the IT, video, and satellite communication systems. The living areas got refurbished (kitchen, cold storage, certain common areas and laboratories), and a ton of maintenance work was done to keep the vessel as a whole in operating condition (replacement of piping, panels, hoists, and portholes). Then at the end we repainted the whole thing from top to bottom with the new branding.

How did you plan this project?

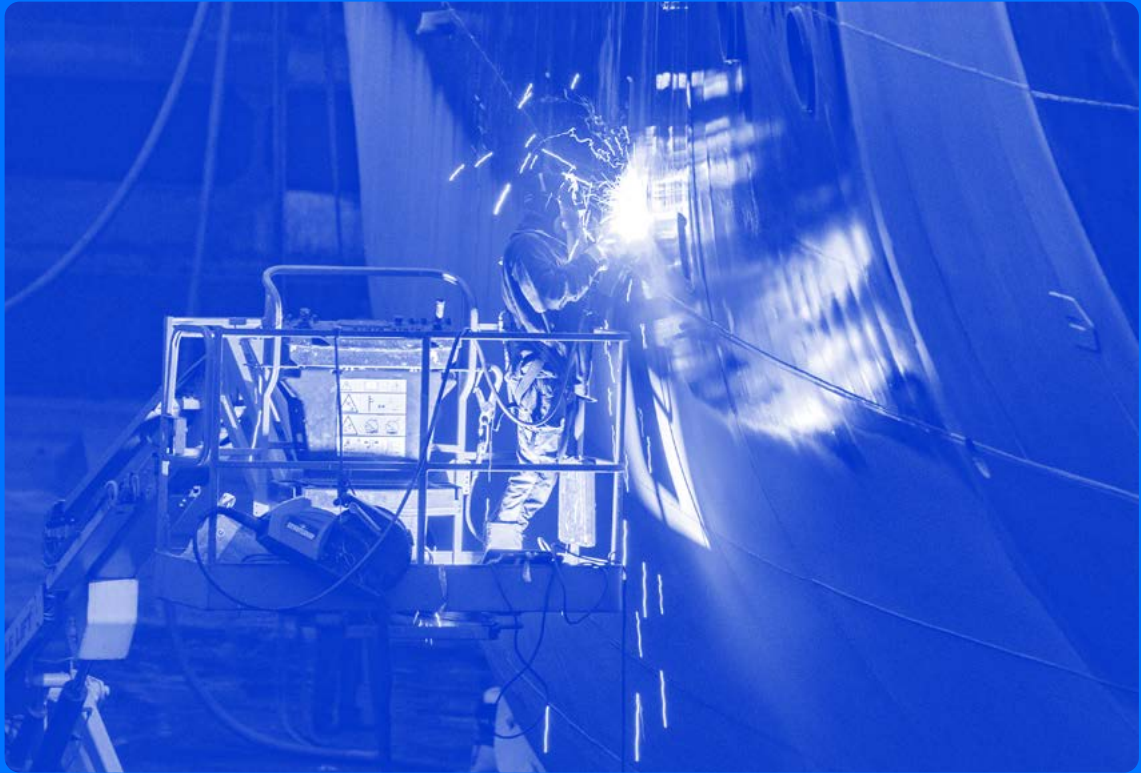
Ifremer and Genavir worked together. The first step was to define what needed to be done and then build the project around that. Then we asked for bids for the work on the major equipment and for a shipyard to do it in. It was the shipyard that handled the engineering and the equipment installation. Obviously there were a lot of discussions, meetings, and reviews of the plans with all the service providers and especially with the shipyard.

Did the refit go as planned?

Refitting a ship that's thirty years old unavoidably brings its share of unforeseen problems, even though we and our colleagues at Genavir did our best to comprehensively predict what the general state of the vessel would be and what work would need to be done. But we met our deadline in the end, despite the pressure of getting all this work done in just a few months. There's some fine-tuning left to be done, most of which will be completed by the end of 2022. The most important thing on that list is the coring system, so that we can offer the high-quality service that the scientific community has rightfully come to expect from the Fleet.

Creating a new Channel-Atlantic regional vessel

As the *L'Atalante* underwent refitting, Oceanographic Fleet Division personnel also spent 2021 defining and structuring plans for the construction of a new regional-class vessel destined to work in the Channel-Atlantic region. Scientist users, engineers from the Vessels and Integrated Systems unit, and seafaring personnel from Genavir got involved to come up with options for the choice of scientific equipment, the optimization of onboard fixtures, and the reduction of the vessel's environmental impact. After the Science Council and the Fleet's executive committee validated the scientific requirements, a call was put out in early November 2021 for bids from shipyards on the construction of this vessel.





L'Atalante: Major work took place in Concarneau in the fall of 2021.
Photo: Franck Betermin / Ifremer

New technologies

Evaluating the potential of unmanned surface vehicles

With SEMNA (Multiplatform Expert Autonomous Navigation System), Ifremer is studying the potential of unmanned surface vehicles and the possibility of introducing them into the French Oceanographic Fleet.

Sea performance tests for *DriX* near the Îles d'Hyères. Sea state 4 at time of photo. Photo: Florian Schattner



Ifremer has joined project SEMNA alongside iXblue (project coordinator), Forssea Robotics, Donecle, and the École nationale supérieure maritime. The project aims to develop a multiplatform marine navigation and piloting system. The ultimate goal is to manage the deployment of drones that can operate as autonomously as possible, and to be able to make them work together and with other vehicles.

The project will develop solutions for task automation, submarine sensor systems, and obstacle management. It will also create designs for three types

of drones (marine, submarine, and aerial), all capable of being launched from sea or sky. Aside from the expected advances in remote control of autonomous vehicles, there are a number of other potential applications, including multivehicle hydrography and geophysics, automated assessment and monitoring of fisheries resources, and inspection of offshore wind farms.

Oceanographic Fleet Division teams have already conducted technical studies to demonstrate how unmanned surface vehicles could be used in seabed hydrography and fisheries monitoring.

R/V *L'Europe* conducted an evaluation from November 10 to 16, 2021, to test how well surface drone *DriX*, developed by iXblue and carrying acoustic equipment, would perform on a research cruise. The test demonstrated that *DriX* can navigate for five days without error and take recordings comparable to those taken from a ship equipped with the same instruments.

VORTEX: Monitoring coral ecosystems in Réunion

With a hyperspectral imager and an ultra-high-definition digital camera, the VORTEX submersible has explored Réunion's corals down to 100 meters and covered areas that are hard to observe.

Optical mapping of coral reefs in Réunion with VORTEX—Récif 3D cross-site project
Photo: All rights reserved / TSMOI



Coral ecosystems are under close scrutiny, threatened as they are by anthropic pressures and climate change. On the southern and western coasts of the island of Réunion, scientists use human divers along with aerial and satellite imagery to look for signs of change. These methods have their limits, however. Beyond ten meters, the layer of water interferes with the quality of the data that can be gathered from sky or space. Beyond twenty meters, it's difficult for scuba divers to investigate because the waves

and currents are strong enough to render some areas nearly inaccessible. That in turn means we know little about those locations.

To overcome this problem, scientists from Ifremer and Université de La Réunion tested a new solution as part of the project Récif 3D. They enlisted the help of VORTEX, a submersible developed by the Oceanographic Fleet Division that can be launched from a small vessel. Recent upgrades allow VORTEX to descend up to 200 meters below the surface, so it was easy

for the device to roam around Réunion's coral reefs. The images it obtained will allow scientists to create a detailed 3D reconstruction of the area and identify different habitats (corals, rocks, sand, algae, etc.) and the species present in each. That information will be extremely valuable in assessing the health of the reefs.

UlyX: Ongoing tests

UlyX, offshore of Toulon,
just before diving
Photo: Olivier Dugornay /
Ifremer



Autonomous underwater vehicle *UlyX* has entered the fine-tuning and maritime testing phase. The system performed two missions aboard R/V *L'Europe* in 2021, a preliminary step toward its first operational launch in summer 2022, to be followed by integration of all payloads and operational transfer to Genavir in 2023.

A series of dives to depths between 50 and 500 meters helped test the tools, trial the launch and retrieval procedures, adjust the piloting settings, validate the safety mechanisms, and fine-tune the general operation of the aerial and underwater communications.

Other improvements were also made, like adding the onboard monitoring software and testing the synthetic-aperture sonar system. These systems will join the equipment already installed on *UlyX* (multibeam echosounder, long-range camera) and undergo further tests in 2022 and 2023.

This work received funding from the PACA Regional Council as part of CORAL (Constructive Offshore Robotics Alliance), a State-Regional Planning Contract project.

Toulon's new hyperbaric testing chamber gets to work

Ifremer's La Seyne-sur-Mer Center replaced one of its two hyperbaric chambers with a larger 1,000-bar model that boasts additional features.

This upgrade will make it possible to perform a wider range of functional tests for certifying equipment that operates under high pressure. The Center can now test full assemblies (regulators, remote manipulator arms) and more varied functions (communication at high pressure, porthole monitoring, etc.)

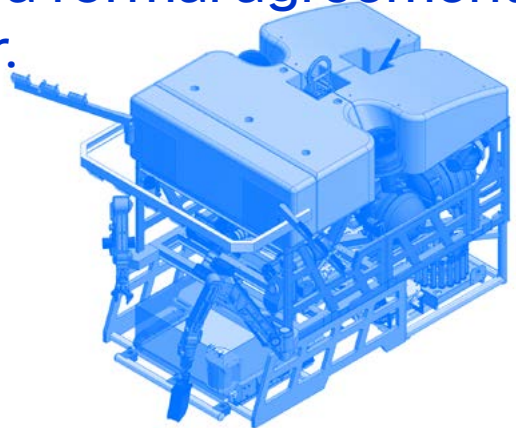
Testing of the hydraulic power unit.
Photo: Christophe Martin / Ifremer



DeepSea'nnovation

DeepSea'nnovation aims to improve seabed exploration devices. First proposed in 2020 as an Équipements structurants pour la recherche/EquipEx+ project, it was accepted in 2021, and a formal agreement was signed in October.

Preliminary rendition of a future deep-sea ROV bearing DeepSea'nnovation equipment.
Illustration: Ifremer



DeepSea'nnovation acquires and develops scientific equipment for the instrument arrays on deep-sea ROVs belonging to the French Oceanographic Fleet, enhancing the vehicles with cutting-edge capacities in data gathering, observation, sampling, and deep-sea exploration methods. The project is part of the Fleet's larger upgrade plan for its deep-sea exploration vehicles; the *Victor 6000* modernization was first on that list, and next up will be the development of a new ROV with greater performance and expanded scientific capacities. DeepSea'nnovation has developed new scientific payload assemblies for ROVs. These multidisciplinary assemblies will cover a wide range of applications including geophysics, geology, biology, geochemistry, and sedimentary studies.

The instruments will be integrated into the vehicle in modular fashion to create a multidisciplinary instrument assembly that can perfectly meet the needs of a variety of scientific cruises. This integrated approach will allow a single dive to cover multiple exploration phases: site investigation, *in situ* physical and chemical analyses, and sample collection (rocks, sediments, biological materials, fluids).

The DeepSea'nnovation consortium is a close collaborative effort among the Oceanographic Fleet Division and its partner teams, matching relevant scientific expertise to technological development skills. Participants include Ifremer (technical units DFO/SM and REM/RDT, mixed research unit 6197 BEEP), labs within the Centre national de la recherche scientifique (research support units

855 DT-INSU and 831 OMP, mixed research units 6538 GéoOcéan, 7144 AD2M, 8212 LSCE, 7294 MIO, and 5563 GET), and universities (Sorbonne University's mixed research unit 7193 IStEP, Université de Bretagne Occidentale, and Université de recherche PSL's mixed research unit 8538 LG-ENS). Other laboratories are not directly involved in technology development but contribute by analyzing needs, instrument usage modes, etc. The consortium thus encompasses a wide community that represents the full range of deep-sea sciences.

The project launch meeting was held on January 26, 2022.

2021 Research Cruises

BICHECALIS

Serge Andrefouet — IRD, UMR Entropie

- Coastal scientific research
- Ecosystem biology and functioning
- South Pacific Ocean

Assessment and estimation of stocks of sea cucumbers in northern New Caledonia, and initiation of monitoring.

FishCode

Laurent Vigliola — IRD, UMR Entropie

- Coastal scientific research
- Ecosystem biology and functioning
- South Pacific Ocean

Creation of a genetic library for analyzing environmental DNA from marine fish; development of artificial intelligence technology for automatic recognition of fish.

KANARECUP

Karine Olu — Ifremer, UMR BEEP

- Coastal scientific research
- Ecosystem biology and functioning
- South Pacific Ocean

Material sampling and data collection on the hydrologic and hydrodynamic conditions of benthic communities on two seamounts in the Coral Sea via long-term moorings; identification of propagules collected near the seafloor.

ReefAdapt

Véronique Berteaux-Lecellier — CNRS, UMR Entropie

- Coastal scientific research
- Ecosystem biology and functioning
- South Pacific Ocean

Selection of corals adapted to specific environmental conditions (fluctuating temperatures, high sedimentation rates, bright light, etc.) to conserve and preserve coral reefs.

SPANBIOS

Sarah Samadi — MNHN, UMR ISYEB

- Deep-sea scientific research
- Ecosystem biology and functioning
- South Pacific Ocean

Filling gaps in knowledge of the biodiversity and deep habitats of New Caledonia's marine park and island slopes by collecting data on unknown or little-known habitats and geographic areas; analysis of evolutionary processes that explain the diversity of New Caledonia's deep-sea life at different timescales.

WARMALIST

Christophe Menkes — IRD, UMR Entropie

- Deep-sea scientific research
- Marine chemistry and biogeochemistry
- Pacific Ocean

Study of oceanographic conditions structuring micronekton and zooplankton populations in the Pacific in support of sustainable management of pelagic fish resources.

AMAZOMIX

Ariane Koch-Larrouy — IRD, UMR LEGOS

- Coastal scientific research
- Ecosystem biology and functioning
- North Atlantic Ocean

Innovative study describing internal waves and turbulent processes and the impact thereof on the marine ecosystems and environments around the Amazon Plume.

CARESSE

Éric Chaumillon — Univ. La Rochelle, UMR LIENSs

- Coastal scientific research
- Marine geoscience
- North Atlantic Ocean

Identification of sediment records from tsunamis, vertical movements, and cyclones along shores in lagoon and nearshore areas, aiming to describe storm-related sediment records to better distinguish them from tsunamis and estimate how often extreme hurricanes occur.

ESSTECH-AN 2021

Frédéric Danjon — Genavir, DTN

- Technical testing
- North Atlantic Ocean

Tests of scientific equipment following technical stop: ER60, current meter, shiplog, acoustic tests, operational validation of winches and fish sensors.

FIBROSAINTEs

Yann Hello — CNRS, UMR Géoazur

- Coastal scientific research
- Marine geoscience
- North Atlantic Ocean

First step in building the OSMOS optical underwater marine observatory at Les Saintes, extending the network of instruments taking seismic and geodesic measurements in the waters around the Antilles; the aim is to better identify mechanical processes at work in seismically and volcanically active regions and improve earthquake prediction models for the area.

LINKS

Aurore Regaudie de Gioux — Ifremer, Pelagic Ecology Laboratory

- Coastal scientific research
- Ecosystem biology and functioning
- Atlantic Ocean

Contributions of various feeding patterns among nanophytoplankton communities off the coast of French Guiana that receive limited light and nutrients.

PEGUY

Fabien Paquet — BRGM

- Coastal scientific research
- Marine geoscience
- North Atlantic Ocean

Acquisition of monotraces, very-high-resolution marine seismic reflection data for geophysical exploration of the French Guianan continental shelf.

PIGUY

Erwan Gensac — Université de Bretagne Sud, UMR GéoOcéan

- Coastal scientific research
- Marine geoscience
- North Atlantic Ocean

Off the coast of French Guiana: Identification of current sandy and muddy sediment stocks between 15 and 50 m below the surface that could be moved by swells and currents (mapping), refinement of conceptual models, study of impacts of rising sea levels on coastal areas since the last marine transgression (2D/3D description of seabeds, volumes).

TV-AMATLANTE-C

Felipe Artigas — Université du Littoral Côte d'Opale, UMR LOG

- Observation
- Ecosystem biology and functioning
- Atlantic Ocean

Automatic measurement and optical description of subsurface phytoplankton communities, both during transits and as a supplement to data from geology and physics cruises off the coast of French Guiana and the mouth of the Amazon River.

TV-AMATLANTE-H 2021-1

Felipe Artigas — Université du Littoral Côte d'Opale, UMR LOG

- Observation
- Ecosystem biology and functioning
- Atlantic Ocean

Continuous recording of optical features of phytoplankton communities (as a whole or at the cell or colony level) using a multi-spectral fluorometer and an automated flow cytometer.

ESSTECH-CDLM-2021

Tangui Le Breton — Genavir, DOL

- Technical testing
- North Atlantic Ocean

Technical testing following technical stop.

MAGMA 1

Bruno Deflandre — Université de Bordeaux, UMR EPOC

- Coastal scientific research
- Marine chemistry and biogeochemistry
- North Atlantic Ocean

Study of structuring, function, and (in)organic contamination (sediment, biota) of the benthic habitats of the West Gironde mudflats, including description of particle inputs (and their reactivity) as water moves from the Gironde estuary to the mudflats.

MAGMA 2

Bruno Deflandre — Université de Bordeaux, UMR EPOC

- Coastal scientific research
- Marine chemistry and biogeochemistry
- North Atlantic Ocean

Study of structuring, function, and (in)organic contamination (sediment, biota) of the benthic habitats of the West Gironde mudflats, including description of particle inputs (and their reactivity) as water moves from the Gironde estuary to the mudflats.

MASTER IGL GEOPHY 2021

Bernadette Tessier — CNRS, UMR M2C

- Education
- Marine geoscience
- English Channel

Course for the Marine Geoscience – Geophysics master's program at Université de Bretagne Occidentale.

MSTULR 21

Eric Chaumillon — Université de La Rochelle, UMR LIENSs

- Education
- Marine geoscience
- North Atlantic Ocean

Introduction to methods in marine geology for first-year master's students.

ORHAGO 21

Yann Coupeau — Ifremer, Fisheries Biology Technology Laboratory

- Coastal public interest
- Biology, fisheries
- North Atlantic Ocean

Beam trawl survey to supplement several indicators of sole abundance and benthic ichthyological population status in the Bay of Biscay.

PACMAN

Dorothee Kopp — Ifremer, Fisheries Biology Technology Laboratory

- Coastal public interest
- Biology, fisheries
- North Atlantic Ocean

Assessment of diversity in the Bay of Biscay.

PHRESQUES 2021

David Le Berre — Ifremer, Hydro-Sedimentary Dynamics Laboratory

- Observation
- Physical oceanography, chemistry, marine biogeochemistry
- English Channel

Maintenance and calibration of a buoy within the COAST-HF National Observation Service network, coordinated optical and acoustic observations of SPM, SPM dynamics and primary production.

REBELRED

Edouard Metzger — Université d'Angers, UMR LPG

- Coastal scientific research
- Marine chemistry and biogeochemistry
- North Atlantic Ocean

What happens to nutrients and related metals in the Loire estuary.

SELISEINE 2021

Aourel Mauffret — Ifremer, Marine Ecosystem Chemical Contamination Unit

- Coastal public interest
- Biology, fisheries
- Atlantic Ocean

MSFD monitoring of the effects of biological contamination. Fishing for flatfish to analyze biomarkers and levels of chemical contaminant permeation.

SOGIR 2021

Hervé Derriennic — Université de Bordeaux, UMR EPOC

- Observation
- Ecosystem biology and functioning
- North Atlantic Ocean

Annual survey of water masses and ecology at four hydrological stations in the Gironde estuary by two cooperating programs. Monitoring is part of SOMLIT, an official INSU National Observation Service since 1997; ecological tracking of the CNPE Blayais site (coordinated by Ifremer) began in 1978.

SOLIBOB 2021

François Dufois — Ifremer, Hydro-Sedimentary Dynamics Laboratory

- Coastal scientific research
- Marine geoscience
- North Atlantic Ocean

Study of internal wave and soliton impacts on the sediment dynamics of the Bay of Biscay.

TPGIRONDE 21

Bertrand Lubac — Université de Bordeaux, UMR EPOC

- Education
- Instrumentation
- North Atlantic Ocean

On-board practicum: Introducing students in Marine Science or Marine Environments and Resources Plus master's programs to modern coastal oceanography observation methods.

TPINT 2021-01

Emmanuel Poizot — CNAM, Intechmer

- Education
- Instrumentation
- English Channel

Practicum: Oceanographic data acquisition techniques.

BATHY-DELTA-RHONE-H

Céline Cordier — Ifremer, Hydro-Sedimentary Dynamics Laboratory

- Coastal scientific research
- Marine geoscience
- Western Mediterranean

Updating high-resolution bathymetry of the Rhône prodelta to spatialize more local data and analyze short-term dynamics in relation to hydrological and meteorological events.

DYSACOTE-SUD

Alain Henaff — Université de Bretagne occidentale, UMR LETG

- Coastal scientific research
- Marine geoscience
- North Atlantic Ocean

Imaging of sediment thickness and seabed morphology to fill gaps in existing data needed to understand sediment transport.

ESSTECH-HA 2021-2

Xavier Morin — Genavir, DEC

- Technical testing
- North Atlantic Ocean

Technical testing of acoustic equipment and related sensors: GeoSwath.

ESSTECH-HA 2021-1

Xavier Morin — Genavir, DEC

- Technical testing
- North Atlantic Ocean

Technical testing of acoustic equipment and related sensors: GeoSwath, sub-bottom profiler, EK60/RoxAnn, Hydrins, HDS800 (Orpheon mode), CINNA, and Valeport sound velocity profiler.

GeoGolfe

David Menier — Université de Bretagne Sud, UMR GéoOcéan

- Coastal scientific research
- Marine geoscience
- North Atlantic Ocean

Role(s) of structural inheritance in Quaternary sedimentary architecture and sediment dynamics at the entrance to the Gulf of Morbihan.

TIDE&GAS

Agnès Baltzer — Université de Nantes, UMR LETG

- Coastal scientific research
- Marine geoscience
- North Atlantic Ocean

Observation of gas upwelling in sediments across a tidal cycle.

ESSNAUT-ATA 2021

Jean-Paul Justiniano — Genavir, DSM

- Technical testing
- Western Mediterranean

Technical testing for R/V *Nautile*.

ESSTECH-ATA 2021

Remy Balcon — Genavir, DOL

- Technical testing
- North Atlantic Ocean

Testing of CTD probe on R/V *L'Atalante*.

MOMARSAT2021

Pierre-Marie Sarradin — Ifremer, UMR BEEP

- Deep-sea scientific research
- Marine chemistry and biogeochemistry, ecosystem biology and functioning
- North Atlantic Ocean

Annual maintenance of the EMSO-Azores seabed observatory, which aims to understand hydrothermal, tectonic, and volcanic processes as well as the ecosystems at an active site on the Mid-Atlantic Ridge.

MOUILLAGES SHOM

Pierre-Antoine Dumont — Navy SHOM/GHOA

- Navy
- Physical oceanography
- North Atlantic Ocean

Deployment and maintenance of certain permanent moorings in the Bay of Biscay installed by SHOM.

NARVAL 2021

Pierre-Antoine Dumont — Navy SHOM/GHOA

- Navy
- Physical oceanography
- North Atlantic Ocean — Norwegian Sea

Identification of oceanographic structures and analysis of their impact on acoustic propagation. Bathymetric survey in accordance with International Hydrographic Organization standards to ensure safety while sailing the North Atlantic.

PERLE4

Xavier Durrieur de Madron — CNRS, UMR CEFREM

- Deep-sea scientific research
- Marine chemistry and biogeochemistry, ecosystem biology and functioning
- Western Mediterranean

Formation and dispersion of Levantine Intermediate Water, and its role in distributing nutrients and structuring plankton ecosystems in the Mediterranean.

SUMOS

Peter Sutherland — Ifremer, UMR LOPS

- Deep-sea scientific research
- Physical oceanography, atmosphere
- Atlantic Ocean

In situ observations to calibrate and validate the China-France Ocean Satellite, which measures winds and the directional spectra of waves via a pair of radar instruments: SWIM (France's contribution, handling waves) and SCAT (China's contribution, handling wind).

BATHY-DELTA-RHONE-E

Romarc Verney — Ifremer, Hydro-Sedimentary Dynamics Laboratory

- Coastal scientific research
- Marine geoscience
- Western Mediterranean

Updating high-resolution bathymetry of the Rhône prodelta to spatialize the localized data and analyze short-term dynamics in relation to hydrological and meteorological events.

EMSO KM3NeT 2021

Carl Gojak — CNRS, DT INSU

- Coastal technology research
- Technology
- Western Mediterranean

Technology at the EMSO KM3NeT observatory (acoustic positioning, georeferenced mapping, and ROV interoperability with seabed infrastructure).

ESSCORAL 21

Lorenzo Brignone — Ifremer, DFO/SM

- Technical testing
- Western Mediterranean

Operational validation of Ifremer's new 6,000-meter AUV: three separate work phases in 2020 and one postponed to 2021 due to the pandemic.

ESSDRIX 2021

Emeline Veit — Ifremer, DFO/NSE

- Technical testing
- Western Mediterranean

Technical testing

ESSHROV 2021

Laurent Artzner — Ifremer, DFO/SM

- Technical testing
- Western Mediterranean

Validation of technical changes and how they function with remote operation (working live, remotely, with teams on land).

ESSTECH-EU-MVP 2021

Maxime Monfret — Genavir, DSM

- Technical testing
- Western Mediterranean

Technical testing following technical stop.

ESSTECH-EU 2021-2

Loïc Treluyer — Genavir, DTN

- Technical testing
- Western Mediterranean

Calibration tests for scientific equipment following technical stop in preparation for MEDITS and PELMED cruises: MARELEC ME70 and EK80 echosounder system, all fishing equipment (sensors, winches, hydraulics), fish-finding echosounder calibration system.

ESSTECH-EU 2021-3

Hervé Bisquay — Genavir, DEC

- Technical testing
- Western Mediterranean

Testing of Bassop.

FLUID 3D

Sébastien Migeon — CNRS, UMR Géoazur

- Coastal scientific research
- Marine geoscience
- Western Mediterranean

Analysis of the impact of fluid flows in setting off submarine landslides near Nice-Côte d'Azur Airport.

GRAVIMOB

Charles Poitou — CNRS, UMR GéoOcéan

- Coastal technology research
- Technology
- Western Mediterranean

Technical testing of a gravimetric sensor for use with an AUV: AUV dives at two deepwater locations off the coast of Toulon.

IMPEC

Céline Labrune — CNRS, UMR LECOB

- Coastal scientific research
- Ecosystem biology and functioning
- Western Mediterranean

Impact of fishing on deep-sea benthic ecosystems: assessment of the ecological status of benthic habitats in the circalittoral zone of the Gulf of Lion with regard to pressure from demersal fishing using towed gear.

MEDITS 2021

Angélique Jadaud — Ifremer, Mediterranean Fisheries Laboratory

- Coastal public interest
- Biology, fisheries
- Western Mediterranean

Fulfill Ifremer's public service duty to observe and monitor the fishing sector via annual trawl surveys as part of a cooperative European program dating back to 1994.

PELMED 2021

Jean-Hervé Bourdeix — Ifremer, Mediterranean Fisheries Laboratory

- Coastal public interest
- Biology, fisheries
- Western Mediterranean

Assessment of small pelagic fish stocks and collection of as much data as possible on all components of the pelagic ecosystem.

PHYOCE 2021

Bruno Zakardjian — Université de Toulon, UMR MIO

- Education
- Instrumentation
- Western Mediterranean

Teaching cruise to train students in how to plan and execute an expedition at sea and how to use the instruments most commonly used in oceanography (CTD rosette, ADCP, floats, etc.).

ROV 3G

Frédérique Leclerc — Université de Côte d'Azur, UMR Géoazur

- Education
- Marine geoscience
- Western Mediterranean

Université Côte d'Azur's master's degree in geology and geophysics research, 3G track (geological resources, geohazards, and geotechnics): morpho-tectonic study of the Ligurian coast via geological observations.

SUCHI Med 2021 leg 1

Marc Bouchoucha — Ifremer, Provence-Azur-Corse Environmental Resources Laboratory

- Coastal public interest
- Marine chemistry and biogeochemistry
- Western Mediterranean

Monitoring of chemical contamination under the WFD, the MSFD, and the Barcelona Convention.

Marion Dufresne II

CALIBRATION-MD

Karine Le Drezen — Genavir, DEC/QAE

- Technical testing
- Indian Ocean

EK80 calibration and cable reel tests.

MAYOBS

Emmanuel Rinnert — Ifremer, UMR GéoOcéan

- Fisheries public interest
- Marine geoscience
- Indian Ocean — Mozambique Channel

Monitoring the ongoing seismic and volcanic activity that has been affecting the island of Mayotte since May 2018.

ESSVIC

Christophe Duchi — Ifremer, DFO/SM

- Technical testing
- Indian Ocean

Technical testing of the *Victor 6000* ROV on R/V *Marion Dufresne II*; validation of Victor system's implementation aboard the ship and of the vessel adaptations; training and instruction for operational teams on how to deploy the system; prevalidation of changes to *Victor* (log, optical payload, control station integration).

OHA-SIS-BIO-12

Jean-Yves Royer — CNRS, UMR GéoOcéan

- Observation
- Marine chemistry and biogeochemistry
- Indian Ocean — Mozambique Channel

Annual long-term survey of CO₂ and hydrological and biogeochemical properties associated with the carbon cycle in the southern and southwestern Indian Ocean.

OISO32

Claire Lo Monaco — Sorbonne University, UMR LOCEAN

- Observation
- Marine chemistry and biogeochemistry
- Indian Ocean — Mozambique Channel

Annual long-term survey of CO₂ and hydrological and biogeochemical properties associated with the carbon cycle in the southern and southwestern Indian Ocean.

SCRATCH

Carole Berthod — Université Clermont Auvergne, UMR LMV

- Deep-sea scientific research
 - Ecosystem biology and functioning, marine geoscience
 - Indian Ocean — Mozambique Channel
- Multidisciplinary study (biology, paleoclimatology, sedimentology, and volcanology) in French territorial waters around the Glorioso Islands, Mayotte, Tromelin Island, and Réunion.
-

SWINGS

Catherine Jeandel — CNRS, UMR LEGOS

- Deep-sea scientific research
- Marine chemistry and biogeochemistry
- Southern Indian Ocean

Determining the distribution, behavior, and transportation of trace elements and isotopes in identified water masses along the path outlined by Réunion, the Prince Edward Islands, the Crozet Islands, and the Kerguelen Islands, and continuing to the south of Heard Island to connect with the Antarctic K-Axis region.

THEMISTO

Cédric Cotte — MNHN, UMR LOCEAN

- Observation
- Ecosystem biology and functioning
- Southern Indian Ocean

Study of 3D distribution of zooplankton and micronekton and how it varies with physical and climatic events, using continuous acoustic measurements during transit periods.

Pourquoi pas ?

ALBACORE

Élia d'Acremont — Sorbonne University, UMR ISteP

- Deep-sea scientific research
- Marine geoscience
- Western Mediterranean

Dating major climatic, oceanographic, tectonic, and gravitational events in the Alboran Sea. Studying interactions between tectonics and sedimentation and between deep-sea and surface processes in an inverted basin.

CARAPASS 2021

Pierre-Antoine Dumont — Navy SHOM

- Navy
- Marine geoscience
- Indian Ocean

Improvement of seismic, bathymetric, and sedimentological data about this region.

GeoFLAMME

Emmanuel Rinnert — Ifremer, UMR GéoOcéan

- Deep-sea scientific research
- Marine chemistry and biogeochemistry
- Indian Ocean

Study of the volcanic earthquakes in French waters around Mayotte: biogeochemical impacts of an eruption plume, particularly via the water column; local and regional impacts of fluid circulation on sediment geochemistry. Initial conditions and biological colonization of the area.

GHASS2

Vincent Riboulot — Ifremer, UMR GéoOcéan

- Deep-sea scientific research
- Marine geoscience
- Black Sea

Multidisciplinary examination of the Black Sea near Romania aiming to describe the entire gas hydrate system from its origin point in the sediment up through to the atmosphere, and to understand how the hydrates have changed over time (since the last glacial period) in order to determine their effect on submarine landslides on both sides of the Danube Canyon.

MAROLIS PENFELD

Sébastien Garziglia — Ifremer, UMR GéoOcéan

- Deep-sea scientific research
- Marine geoscience
- Western Mediterranean

Detection of the first signs of submarine landslides and evaluation of their potentially catastrophic consequences offshore near Nice Airport.

MAYOBS

Emmanuel Rinnert — Ifremer, UMR GéoOcéan

- Fisheries public interest
- Marine geoscience
- Indian Ocean — Mozambique Channel

Monitoring the ongoing seismic and volcanic activity that has been affecting the island of Mayotte since May 2018.

SISMAORE

Isabelle Thinon — BRGM

- Deep-sea scientific research
- Marine geoscience
- Indian Ocean — Mozambique Channel

Understanding the current Mayotte volcanic earthquakes: geology (deformation, geodynamics, dating surface rocks and sediment) and hazards (earthquakes, volcanic eruptions, instabilities).

SAGA9W-ZAFLOATS

Christine Provost – CNRS, UMR LOCEAN/OFEG

- Physical oceanography
- Atlantic Ocean

OFEG collaboration between France and Spain for a hydrography expedition: deployment of Argo profiling floats to document circulation at two depths (1,000 m and 3,000 m) and water masses at depths from 0 to 4,000 m in the Argentine Basin and especially the Zapiola Anticyclone. Deep-sea hydrographic measurements taken upon deployment of profiling floats.

BOUSSOLE 2021

Melek Golbol — Sorbonne University, IMEV

- Coastal scientific research
- Ecosystem biology and functioning
- Western Mediterranean

Maintenance of BOUSSOLE buoy and collection of additional data to establish a long-term series of bio-optical parameters in order to calibrate satellite observations of ocean color, validate products derived from those observations (chlorophyll concentration, reflectance, etc.), and augment basic understandings in optics.

DEO2M 2021

Laure Mousseau — Sorbonne University, UMR LOV

- Education
- Ecosystem biology and functioning
- Western Mediterranean

First-year course for Sorbonne University's master's program in marine science.

ECHAPLN

Céline Labrune — CNRS, UMR LECOB

- Coastal scientific research
- Ecosystem biology and functioning
- Western Mediterranean

Sampling of several sediment cells to inform a new ecosystemic approach to assessing the conservation status of soft-substrate benthic habitats, using the Port-la-Nouvelle logistics site as a case study.

EMSO ANTARES

Frédéric Le Moigne — CNRS, UMR MIO

- Coastal scientific research
- Marine chemistry and biogeochemistry
- Western Mediterranean

Study of vertical flows of organic carbon. Collection of water and particulate samples (CTD, optical module cluster, bottle-nets, Marine Snow Catcher).

ESSTECH-TTS 2021

Karine Abel-Michaux — Genavir, DEC

- Technical testing
- Western Mediterranean

Technical testing following technical stop.

FE2M 2021

Laure Mousseau — Sorbonne University, UMR LOV

- Education
- Ecosystem biology and functioning
- Western Mediterranean

First-year course (MR4MU28) for Sorbonne University's master's program in marine science.

FOCUS G1

Jean-Yves Royer — CNRS, UMR GéoOcéan

- Coastal scientific research
- Marine geoscience
- Mediterranean Sea

Seafloor geodesy measurements using previously deployed seabed acoustic beacons in the Ionian Sea near Sicily as part of ERC project FOCUS (2018-2023).

GEOMAST 2021

Jean-Xavier Dessa — Sorbonne Université, UMR Géoazur

- Education
- Marine geoscience
- Western Mediterranean

Tectonic and sediment dynamics on the northern Ligurian coast via low-impact seismic imaging.

GEONICE 2021

Boris Marcaillou — Université Côte d'Azur, UMR Géoazur

- Education
- Marine geoscience
- Western Mediterranean

Tectonics of the northern Ligurian coast.

IADO 2021

Jean-Olivier Irisson — Sorbonne University, UMR LOV

- Education
- Ecosystem biology and functioning
- Western Mediterranean

Student training in oceanography instruments.

LASAIL 2021

Julien Bailleul — LaSalle Beauvais, Geosciences/B2R

- Education
- Marine geoscience
- Western Mediterranean

Land-sea geoscience field school.

MAGIRAA 2021

Sylvain Pichat — ENS Lyon, UMR LGL-TPE

- Education
- Marine geoscience
- Western Mediterranean

Reflection seismic survey field school.

MOOSE 2021 (ANTARES)

Dominique Lefevre — CNRS, UMR MIO

- Observation
- Marine chemistry and biogeochemistry
- Ecosystem biology and functioning
- Western Mediterranean

Long-term observation of hydrological, biogeochemical, and biological features in the Northwest Mediterranean.

MOOSE 2021 (DYFAMED)

Émilie Riquier Diamond — CNRS, IMEV

- Observation
- Marine chemistry and biogeochemistry
- Ecosystem biology and functioning
- Western Mediterranean

Long-term observation of hydrological, biogeochemical, and biological features in the Northwest Mediterranean.

PHYBIO 2021

Thibault Wagener — Université Aix-Marseille, UMR MIO

- Education
- Physical oceanography
- Marine chemistry and biogeochemistry
- Western Mediterranean

Education in marine physics and biogeochemistry for the marine science master's program at Université Aix-Marseille.

SEAFOOD2

Yann Hello — CNRS, UMR Géoazur

- Coastal scientific research
- Marine geoscience
- Western Mediterranean

Redeployment of fiber-optic device installed in 2019 and subsequently vandalized. Release pulses from a mini-GI gun to record distributed acoustic sensing/distributed vibration sensing.

SIMGAP

Hélène Carton — IPGP

- Education
- Marine geoscience
- Western Mediterranean

Reflection seismic profile acquisition within and at the edge of the Ligurian Basin. This cruise constitutes the at-sea portion of the marine seismic imaging course for the IPGP's master's program in applied geophysics.

SUCHI Med 2021 leg 2

Marc Bouchoucha — Ifremer, Provence-Azur-Corse Environmental Resources Laboratory

- Coastal public interest
- Marine chemistry and biogeochemistry
- Western Mediterranean

Monitoring of chemical contamination under the WFD, the MSFD, and the Barcelona Convention.

TECNOSS

Nicolas Kolodziejczyk — Université de Bretagne occidentale, OSU IUEM/UMR LOPS

- Coastal technology research
- Technology
- Western Mediterranean

Comparison of NOSS sensors (measuring absolute salinity and designed for integration into Argo floats) to CTDs and measurements of nutrients. Rating of NOSS sensor.

WATER2

Frank Chanier — Université de Lille, UMR LOG

- Coastal scientific research
- Marine geoscience
- Mediterranean Sea

Ultra-high-resolution seismic acquisition to map recent deformations and activity in the Aegean Sea.



CALADU 2021

Marie Claire Fabri — Ifremer, LITTORAL

- Coastal scientific research
- Ecosystem biology and functioning
- Western Mediterranean

Study of cold-water coral distribution at different scales via acoustic and optical mapping.

CGFS 2021

Carolina Giraldo — Ifremer, Fisheries Resources Laboratory of Boulogne

- Fisheries public interest
- Biology, fisheries
- English Channel

Assessment of fish stocks, ecosystemic approach to fisheries, monitoring of plankton and nekton communities, biodiversity.

ChEReef

Lenaïck Menot — Ifremer, UMR BEEP

- Deep-sea scientific research
- Ecosystem biology and functioning
- North Atlantic Ocean

Assessment and monitoring of cold-water coral reef conservation status. Investigation of the role of geomorphology, hydrodynamics, and sediment-related factors in habitat distribution. Surface and site approach.

DEPLOYMENT AND RETRIEVAL OF INSTRUMENTED MOORINGS

Émilien Debonnet — Navy SHOM/GHOA

- Navy
- Physical oceanography
- North Atlantic Ocean

SHOM research cruise.

ESSTECH-TL 2021-1

Frédéric Danjon — Genavir, DTN

- Technical testing
- Atlantic Ocean

Testing and calibration of equipment following technical stop: current meter range, bathymetric multibeam echosounders, USBL positioning system, EK80, trawl sensors, measurement of radiated noise.

ESSTECH-TL 2021-2

Laurent Berger — Ifremer, DFO/NSE

- Technical testing
- Atlantic Ocean

Sensor technical testing.

ESSTECH-TL 2021-3

Yves Le Gall — Ifremer, DFO/NSE

- Technical testing
- Western Mediterranean

Thalassa upgrades, vessel noise radiation.

EVHOE 2021

Pascal Laffargue — Ifremer, Fisheries Ecology and Modeling Laboratory

- Fisheries public interest
- Biology, fisheries
- North Atlantic Ocean

Assessment of fisheries resources, impact of fishing on populations, living resources observatory, habitat mapping, biodiversity.

IBTS

Arnaud Auber — Ifremer, Fisheries Resources Laboratory of Boulogne

- Deep-sea scientific research
- Biology, fisheries
- English Channel and North Sea

Fisheries monitoring to assess fish stocks and evaluate the health of the eastern Channel and North Sea ecosystem.

MOOSE-GE 2021

Pierre Testor — CNRS, UMR LOCEAN

- Observation
- Marine chemistry and biogeochemistry, ecosystem biology and functioning
- Western Mediterranean

Observation of the physics, biogeochemistry, and biology of the northwestern Mediterranean Basin.

PELGAS 2021

Mathieu Doray — Ifremer, Fisheries Ecology and Modeling Laboratory

- Fisheries public interest
- Biology, fisheries
- North Atlantic Ocean

Assessment of resources and of the pelagic ecosystem.

PIRATA FR31

Bernard Bourles — IRD, IMAGO

- Deep-sea scientific research
- Marine chemistry and biogeochemistry
- Atlantic Ocean, Gulf of Guinea

Climate studies in the tropical Atlantic as part of PIRATA (a national and international observatory), supported by international programs CLIVAR (Climate Variability and Predictability) and GOOS (Global Ocean Observing System) and contributing to European H2020 programs TRIATLAS and EuroSea.

ASPEX 2021

Louis Marie — Ifremer, UMR LOPS

- Coastal scientific research
- Physical oceanography
- North Atlantic Ocean

Maintenance of two ARVOR-C profiling floats on the Bay of Biscay continental shelf.

COMOR 2021

Éric Foucher — Ifremer, Fisheries Resources Laboratory of Port-en-Bessin

- Coastal public interest
- Biology, fisheries
- English Channel

Assessment of great scallop populations.

COSB 2021

Nicolas Caroff — Ifremer, Fisheries Biology Laboratory

- Coastal public interest
- Biology, fisheries
- English Channel

Assessment of great scallop abundance in Saint-Brieuc Bay and inventory of associated fauna.

DCE 2021

Aurélié Foveau — Ifremer, Environmental Resources Laboratory of North Brittany

- Coastal public interest
- Biology, fisheries
- English Channel

Monitoring of coastal masses and transition under the Water Framework Directive (benthic macroinvertebrate metrics).

DITRECAUX

Aurélié Foveau — Ifremer, Environmental Resources Laboratory of North Brittany

- Coastal public interest
- Marine geoscience
- English Channel

Biological, morphological, and sedimentary study of coastal waters between Dieppe and Le Tréport as part of monitoring the Penly nuclear power plant under Ifremer's IGA program (Impact of Major Developments).

EchoSonde 2021-1

Mathieu Doray — Ifremer, Fisheries Ecology and Modeling Laboratory

- Coastal scientific research
- Biology, fisheries
- North Atlantic Ocean

Monitoring of the pelagic environment around a marine renewable energy production site.

ESS-SOURCE 2021

Anne Pacault — Ifremer DFO/NSE

- Technical testing
- North Atlantic Ocean

Technical testing.

ESSTECH-TH 2021

Hervé Bisquay — Genavir, DEC

- Technical testing
- North Atlantic Ocean

Technical testing of acoustic equipment and related sensors for 2021 cruises using Bassop: EM2040 multibeam echosounder, Peskavel sub-bottom profiler, SIG sparker, EK60 single-beam echosounder and RoxAnn software, Hydrins auxiliary sensors, HDS800 (Orpheon mode), CINNA, thermosalinograph, and XBT.

ESSTRACTSO

Yohann Kergoat — Genavir, DEC

- Technical testing
- North Atlantic Ocean

Seismic source towing tests.

NURSE 2021

Anik Brind'Amour — Ifremer, Fisheries Ecology and Modeling Laboratory

- Coastal public interest
- Biology, fisheries
- North Atlantic Ocean

Monitoring of coastal nurseries: a series of recurring cruises providing public policy support by consolidating information about coastal areas (under the MSFD).

PHRESQUES 2021

David Le Berre — Ifremer, Hydro-Sedimentary Dynamics Laboratory

- Observation
- Physical oceanography
- Marine chemistry and biogeochemistry
- English Channel

Maintenance and calibration of a buoy within the COAST-HF National Observation Service network, coordinated optical and acoustic observations of SPM, SPM dynamics and primary production.

REBELRED

Edouard Metzger — Université d'Angers, UMR LPG

- Coastal scientific research
- Marine chemistry and biogeochemistry
- North Atlantic Ocean

What happens to nutrients and related metals in the Loire estuary.

REM 2040 2020

Ridha Fezzani — Ifremer, DFO/NSE

- Coastal technology research
- Technology
- North Atlantic Ocean

Methodological research on describing seabeds via multifrequency, multi-angle acoustic imaging; calibration of the Fleet's multibeam echosounders.

RESISTE 2021

Laure Simplet — Ifremer, UMR GéoOcéan

- Coastal scientific research
- Ecosystem biology and functioning
- North Atlantic Ocean

Investigating biological and physical resiliency on the inner continental shelf at a former marine aggregate extraction site.

ROCCHSED 21

Anne Grouhel-Pellouin — Ifremer, Marine Ecosystem Chemical Contamination Unit

- Coastal public interest
- Marine chemistry and biogeochemistry
- North Atlantic Ocean

Assessment of chemicals in coastal marine sediments on the western English Channel for international water quality protection programs.

SOGIR 2021

Hervé Derriennic — Université de Bordeaux, UMR EPOC

- Observation
- Ecosystem biology and functioning
- North Atlantic Ocean

Annual survey of water masses and ecology at four hydrological stations in the Gironde estuary by two cooperating programs. Monitoring is part of SOMLIT, an official INSU National Observation Service since 1997; ecological tracking of the CNPE Blayais site (coordinated by Ifremer) began in 1978.

TPINT 2021-02

Emmanuel Poizot — CNAM, Intechmer

- Education
- Instrumentation
- English Channel

Practicum: Oceanographic data acquisition techniques.

Appendices

Oceanographic Fleet Division

Director

Olivier Lefort

Deputy Director

Christine David-Beausire

Assistant

Nadine Rossignol

Maritime Operations

Goulwen Peltier

Underwater Systems Unit

Jan Opderbecke

Mechanics and Operation

Engineering Department

Marie-Edith Bouhier

Positioning, Robotics, Acoustics,

and Optics Department

Lorenzo Brignone

On-board Electrical and

Electronic Systems Department

Christian Marfia

Vessels and Integrated Systems Unit

Marc Nokin

Underwater Acoustics and Information

Processing Department

Yves Le Gall

Vessels and Equipment Department

Sarah Duduyer

Members of the Executive Committee

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Ifremer: **François Houllier**

IRD: **Olivier Pringault**

CNRS-INSU: **Nicolas Arnaud**

Marine universities: **François Lallier**

Invited members:

Chairs of the National Fleet Commissions:

Benoît Ildefonse

(Commission for Offshore Vessels)

Dominique Lefèvre

(Commission for Coastal Vessels)

Ifremer, Oceanographic Fleet Division:

Olivier Lefort, Christine David-Beausire

Science Council

International (4 members)

Uwe Nixdorf

(Deputy Director of AWI, Bremerhaven, Germany) Physics, polar regions

Penny Holliday

(NOC, Southampton, United Kingdom) Physics

Manuel Ruiz-Villareal

(IEO, CSIC, Spain) Coastal observation

Daniel Toal

(University of Limerick, Ireland) Smart vehicles

France (8 members)

Catherine Jeandel

(CNRS, LEGOS Toulouse) Marine chemistry and biogeochemistry

Catherine Kissel

(CEA, LSCE, Gif-sur-Yvette) Paleomagnetism

Emmanuelle Ducassou

(Lecturer, EPOC Bordeaux) Geoscience

Anik Brind'Amour

(Ifremer, Nantes) Fisheries

Cécile Guieu

(CNRS, LOV, Villefranche) Marine chemistry and biogeochemistry

Ronan Fablet

(Telecom Bretagne, Brest) Data retrieval, analysis, and processing

Georges Ceuleneer

(CNRS, GET Toulouse) Geoscience

Sophie Bertrand

(IRD, MARBEC, Sète) Marine ecology, fisheries

Commission for Offshore Vessels

Benoît Ildefonse,

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Anne Godfroy,

Vice-Chair (Ifremer Brest) Ecology, microbiology

Sophie Cravatte,

Vice-Chair (IRD Toulouse) Physics

Nadine Rossignol,

Secretary (Ifremer Brest)

Véréna Trenkel

(Ifremer Nantes) Systems biology

Daniela Zeppili

(Ifremer Brest) Biology, benthic ecology

Stéphane Hourdez

(CNRS Banyuls) Biology, physiology

Laure Corbari

(MNHN Paris) Biology, ecology

Jean-François Ternon

(IRD Sète) Biogeochemistry and food webs

Mireille Laigle

(CNRS Géoazur Nice) Geophysics

Maryline Moulin

(Ifremer Brest) Geodynamics, geophysics, tectonics

Louise Watremez

(Université de Lille) Geophysics

Valérie Ballu

(CNRS La Rochelle) Geodynamics

Sébastien Zaragosi

(Université de Bordeaux) Sedimentology, paleoclimatology

Vincent Riboulot

(Ifremer Brest) Sedimentology

Valérie Chavagnac

(CNRS Toulouse) Petrogeochemistry

Aline Govin

(CNRS Gif-sur-Yvette) Paleoenvironments

Hélène Planquette

(IUEM-Lemar Plouzané) Biogeochemistry

Eric Machu

(IRD Brest) Biogeochemistry

Andrea Doglioli

(Université Marseille) Physics

Christophe Maes

(IRD Brest) Physics

Guillaume Saint-Onge

(ISMER Québec) Geoscience

Gaye Bayrakci

(NOC Southampton) Marine seismology

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Geoscience

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Fisheries, food webs

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Coral reef benthic biology

Urania Christaki

(ULCO Wimereux)
Pelagic biology,
observation, microbiology

Dominique Davoult

(Sorbonne)
Pelagic biology, teaching

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(Université Arcachon)
Pelagic biology, observation

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Chemistry, biogeochemistry

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Chemistry, biogeochemistry

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Chemistry, biogeochemistry

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Fisheries resources

Vincenzo Velluci

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Technology

Loïc Dussud

(Ifremer Brest)
Technology

Local Assessment Committees for local vessels

Local Assessment Committee of Bordeaux

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Xavier de Montaudouin, Université de Bordeaux
Bruno Deflandre, Université de Bordeaux
Yolanda Del Amo, Université de Bordeaux
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Felipe Artigas, ULCO Wimereux
Alain Lefebvre, Ifremer Boulogne
Hubert Loisel, ULCO Wimereux
Alain Trentesaux, Université de Lille
Vincent Bouchet, Université de Lille

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Dominique Davoult, Sorbonne University Roscoff
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Cécile Cabresin, Sorbonne University Roscoff
Jacques Grall, UBO Brest
Laurent Lévêque, CNRS/INEE Roscoff

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Anne Lebourges-Dhaussy, IRD Brest
Gérard Thouzeau, CNRS/INSU Brest
Erwan Amice, CNRS/INSU Brest
Véronique Cuq, CNRS/INEE Brest
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Céline Labrune, CNRS Banyuls
Eric Martinez, CNRS Banyuls
François Charles, CNRS Banyuls

Local Assessment Committee of Marseille

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Laetitia Licari, Aix-Marseille Université
Pierre Chevaldonne, CNRS Marseille
Nagib Bhairy, CNRS Marseille
Jean-Luc Fuda, CNRS Marseille
Sabine Charmasson, IRSN Cadarache

Local Assessment Committee of Villefranche-sur-Mer

Stéphane Gasparini, Chair,
SU Villefranche-sur-Mer
Emilie Diamond Riquier, CNRS/INSU
Villefranche-sur-Mer
Frédéric Gazeau, CNRS/INSU Villefranche-sur-Mer
March Picheral, CNRS/INSU Villefranche-sur-Mer
Delphine Thibault Botha, MIO Marseille

Colophon

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Our thanks to everyone who helped create this annual report.

Cover: Built in 1989 and refitted in 2009, deep-sea R/V *L'Atalante* got work done at a major construction site in Fall 2021. Photo: Ifremer / Franck Betermin

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et commercial

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