



SCIENTIFIC PROGRAM REPORT  
2023



## SUMMARY

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## FORWARD

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Every PONANT cruise offers a rare chance to marvel at the wonders of the world. Our regular visits to the most remote regions provide more than just wonder; they serve as a unique data source for the international scientific community, giving an even greater meaning to PONANT's voyages.

Putting our technical and human resources at the service of scientific research aligns with our commitment to raising awareness among our passengers about protecting the planet. This is how PONANT Science was born.

Today with *Le Commandant Charcot*, our commitment to science is officially anchored as a core element of our identity. When we designed this ship, we integrated laboratories in the initial plans, enabling the ship to function both as a polar cruise ship and a scientific research vessel.

Tomorrow, we aim to become even more involved. We plan to welcome aboard more researchers in all regions of the world, directly fund research, and share the scientific data collected by our ships in real time. Additionally, we will continue raising awareness among our passengers about the challenges of climate change and the human impact on ecosystems.

By contributing in expanding knowledge of one of our planet's least understood environments – the very places we love to visit and care to protect – PONANT is taking a step forward in achieving our mission, explore to better understand, share and help to protect.

**Hervé GASTINEL**

Chief Executive Officer and Sustainability Executive Officer of PONANT

# COMPANY PRESENTATION

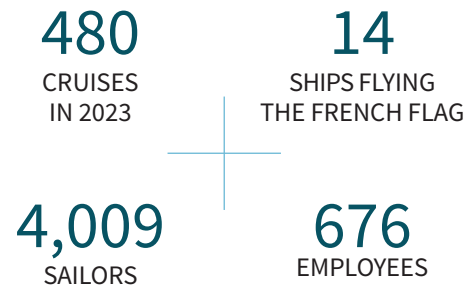
Explore to Inspire: explore to better understand, share and protect.

For over 35 years, PONANT has been committed to more responsible tourism and voyages of exploration which have meaning. The French-flagged fleet comprises 14 small ships equipped with state of the art environmentally friendly equipment.

PONANT was founded by a dozen Merchant Navy officers eager to share their passion for the oceans. The company has been taking guests far from the busy shipping lanes to get as close as possible to nature and experience all her glory and ancestral cultures.

On board, teams of experts including naturalist guides, expedition leaders, lecturers and scientists share their enthusiasm and knowledge with guests.

## Key figures



## Our activities

- 1 Fitting out cruise ships
- 2 Designing cruises
- 3 Developing tourist activities
- 4 Marketing of travel offers
- 5 Organising passenger transport
- 6 Running cruise operations

# COMPANY PRESENTATION

## Certifications



The four Sisterships, six PONANT Explorers, *Le Commandant Charcot* and the sailing yacht *Le Ponant* all obtained **Green Globe** certification in 2023.



*Le Ponant* was the first sailing yacht in the world to earn the **Relais & Châteaux** label in 2023.



100% of the fleet certified **Cleanship** by Bureau Veritas in 2021.



The first cruise line to obtain the certification in 2021, PONANT scored **4.6 out of 5** and achieved level 5 (leadership and excellence) for seven of the eight environmental criteria.

## Commitments and recognitions



Executive member of the **IAATO**<sup>(1)</sup> and **AECO**<sup>(2)</sup> associations, which promote responsible tourism among all those operating in the polar regions.



**SUSTAINABLE CRUISE CHARTER IN THE MEDITERRANEAN**

Joined the charter in 2023. *Le Champlain*, the first ship in the fleet to be audited, achieved a score of 91%.



Signatory in 2021 of the **Global Tourism Plastics Initiative** to ban single-use plastic.



Ranked 2<sup>nd</sup> most environmentally friendly cruise company by the **NGO NABU** in 2023.



**CÉSARS FOR RESPONSIBLE TRAVEL**  
Winner of the 2023 **Prix des Pros** in the Maritime category.

(1) International Association of Antarctica Tour Operators. (2) Association of Arctic Expedition Cruise Operators.



## PONANT SCIENCE PROGRAM

For years, PONANT has worked closely with scientists by helping them to reach inaccessible ecosystems such as polar ice. The company's regular voyages through these remote regions provide a unique data source for the international scientific community.

Through PONANT Science, the team incorporates the work of scientists in PONANT's mission by hosting researchers to collect data for their projects.

The ship *Le Commandant Charcot* is leading the way – and three more ships will follow in the coming years. The first hybridpolar exploration ship powered by liquefied natural gas, *Le Commandant Charcot* was designed with integrated research laboratories dedicated to scientific work including dry and wet labs, both regularly re-equipped and constantly improved according to the specific requirements of the experts on board. Advanced equipment, including an oceanographic winch, moon pool, weather station and underwater drone (ROV) have also been installed.

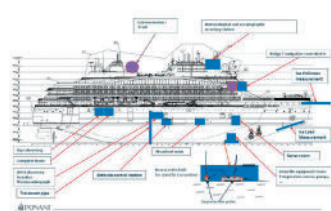
PONANT has created a dedicated Scientific Department to support the scientific work carried out on its ships. Four independent selection committees evaluate every application, and all data collected is open-source and accessible.

This is still only the beginning of PONANT'S scientific adventure, but scientific discovery has become a central part of the company's long-term strategy. By contributing in expanding knowledge of one of our planet's least understood environments – the ocean – PONANT is taking a step forward in achieving its mission to create more meaningful journeys. Explore to better understand, share and protect.



2014

**First scientists on board**  
in passenger conditions



2016

**First laboratory plan** for *Le Commandant Charcot* polar exploration vessel



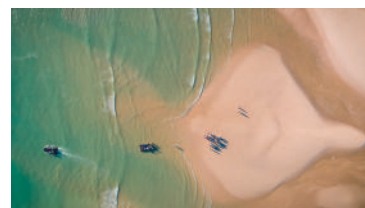
2021

**First polar scientific missions** aboard *Le Commandant Charcot*



2023

**Research with the CNRS\*** on a scientific tool to measure the impact of cruises



2024

Second ship to **host subtropical scientific missions**



2026

**4 ships hosting scientific missions** around the world

\*Centre national de la recherche scientifique

## PONANT SCIENCE PROGRAM

Since the launch in 2021

**2,2 MILLIONS EUROS PER YEAR**

Annual budget dedicated to scientific research.

**149 RESEARCHERS ON BOARD**

Number of scientists and experts hosted since the launch in 2021.

**37 ACADEMIC AND INSTITUTIONAL PARTNERSHIPS**

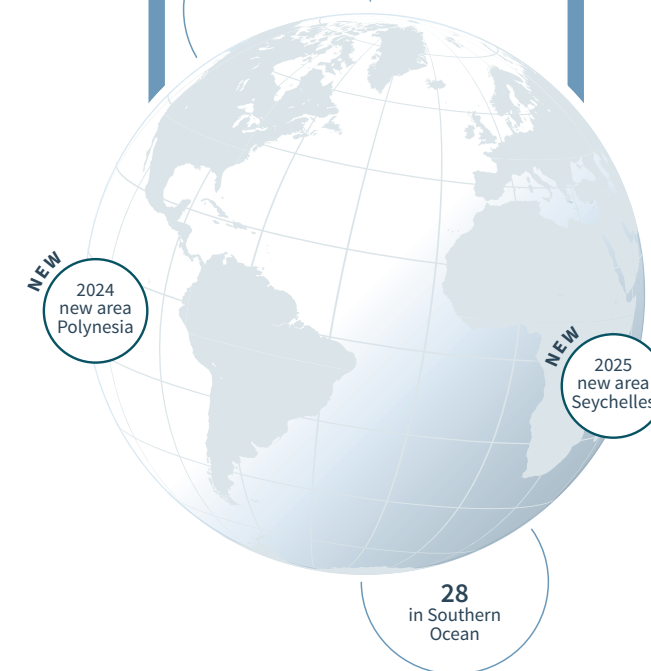
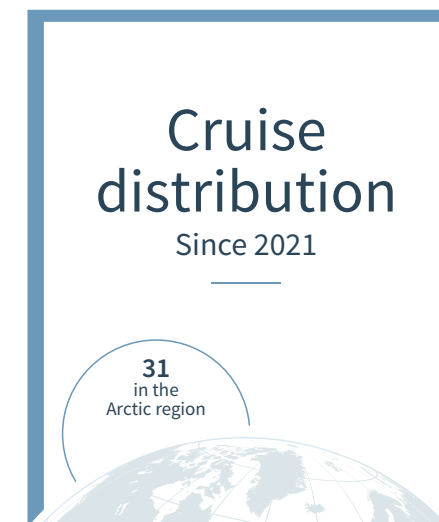
Collaborations with universities, NGOs and research institutes to conduct environmental and marine studies.

**59 SCIENTIFIC MISSIONS**

since the beginning.

**2,185 NIGHTS ON BOARD**

Number of nights offered onboard to scientists during our partnerships.



## NEW DEVELOPMENTS

### BEEING MORE INVOLVED : TRANSARCTIC EXPEDITION

In September 2024, PONANT will host a TransArctic expedition with science at its heart.

An icebreaker will take 20 researchers from six different projects from Alaska to Norway on this 20-days voyage. They will cross the Pole to reach new areas PONANT hasn't travelled to before. This itinerary has been extended from its usual 10 days to give researchers the rare opportunity to spend even more time in this unique region.

This unique engagement represents the willingness of PONANT to be more involved in research and co-create partnerships with researchers.



INVOLVED



DEVELOP

### EXPANDING TO NEW REGIONS

The focus of PONANT Science is also expanding beyond the Polar regions by introducing new vessels to the program that will facilitate access to other ocean regions, including the tropics.

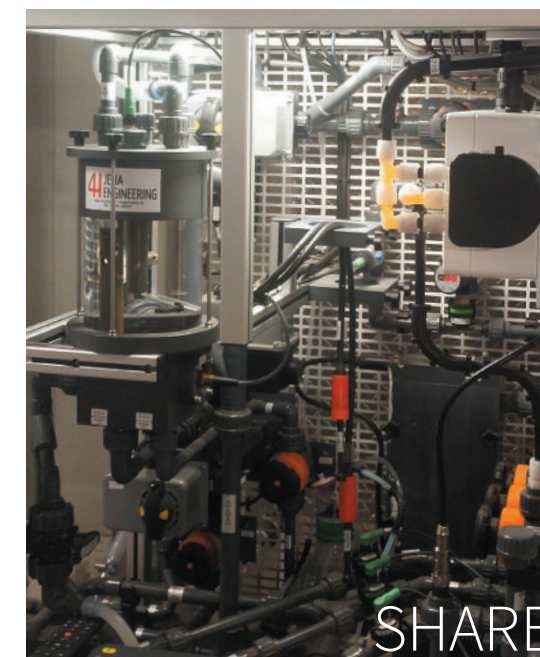
Through a new partnership with the World Ocean Council, which begins in November 2024, PONANT will open up *Le Paul Gauguin* up to scientists in 2024 followed by *Le Bellot* and *Le Jacques Cartier* in 2025. The ships will be equipped with mobile lab equipment to help scientists conduct their research onboard. The call for project applications is now open.

## NEW DEVELOPMENTS

### MAKING THE SCIENTIFIC WORLD MORE ACCESSIBLE

Previously, data generated through the continuous recording equipment on PONANT's cruises was only available to those onboard the ship, accessible with a USB key. There is now an onshore data center that gathers all the data from *Le Commandant Charcot*, which can be made available to anyone around the world who requests access.

This new streamlined process is part of PONANT's overarching goal to make its data open-source and findable, accessible, interoperable and reusable (FAIR).



SHARE



DEVELOP






### NEW PARTNERSHIP WITH POLARIN

PONANT is excited to kick off a new partnership with POLARIN: a Horizon Europe project that brings together an international network of polar research infrastructures and services. This partnership with POLARIN will enable PONANT to select the best and most suitable scientific projects to join its icebreaker voyages. These projects will cover a wide range of research themes.

## GOVERNANCE & STRATEGIC PARTNERS



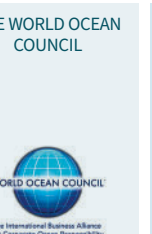


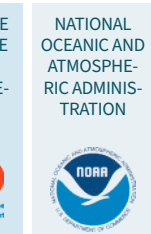






### Our PONANT Science department

Everyone at PONANT shares the sailor spirit and has a deep respect for our oceans, the environment and climate. The company's passionate and experienced team supports researchers in their work and are dedicated to making scientific discovery part of PONANT's purpose.

 Wassim DAOUD CSR Director	 Megan CLAMPITT Head of Science	 Daniel CRON Science Officer	 Eric DUPONT Science Officer	 Hugues DECAMUS Chief Engineer
 Christell HERNANDEZ Science project manager	 Gwenael TRIVIDIC Science Officer	 Jean-Philippe SAVY Science Officer	 Anne SEVESTRE Chief Engineer	

### Our strategic partners

PONANT Science collaborates with a range of strategic partners to ensure the program is of the highest calibre. These include:

SCIENTIFIC COMMITTEES					
ORGANISATION	 THE ARCTIC RESEARCH ICEBREAKER CONSORTIUM	 THE POLAR RESEARCH INFRASTRUCTURE NETWORK	 THE WORLD OCEAN COUNCIL	 THE EXPLORER'S CLUB	CONTRIBUTION Provides an independent committee of scientific experts to evaluate all applications and recommend the most suitable scientific projects.
	 MÉTÉO FRANCE	 INSTITUT DE RECHERCHE POUR LE DÉVELOPPEMENT	 NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	 CONSIGLIO NAZIONALE DELLE RICERCHE	
	 TECHNISCHE UNIVERSITÄT HAMBURG	 LOCEAN	 TECHNISCHE UNIVERSITÄT HAMBURG	 LOCEAN	
	CONTRIBUTION Provides advanced equipment to measure key environmental and oceanographic parameters such as temperature, salinity, ocean currents and emissions, contributing to scientific research and the protection of marine ecosystems.				

## SELECTION PROCESS

PONANT has created a rigorous selection process to ensure the company supports projects with the strongest potential impact.

### How are projects selected?

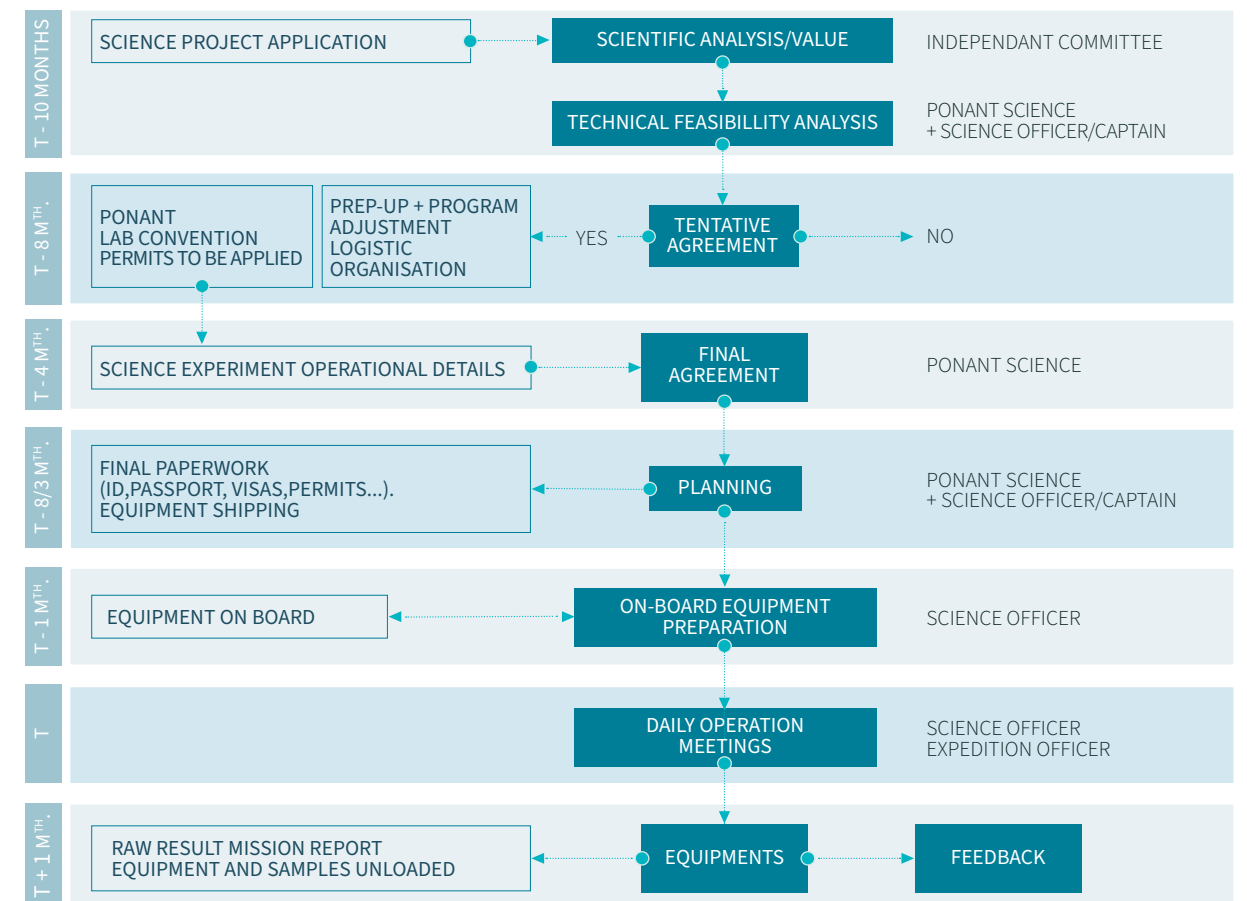
1. An independent committee of scientific experts from scientific consortia evaluates all applications and recommends the most suitable projects
2. PONANT evaluates the technical feasibility of hosting and facilitating their research.
3. Scientists share with our passengers, report after the cruise and publish their results.

#### OUR RESEARCH THEMES :

This process allows PONANT to select the best projects to support across the following research themes:

- Ecology and climate change
- Biodiversity and conservation
- Anthropogenic impacts and micro-pollution

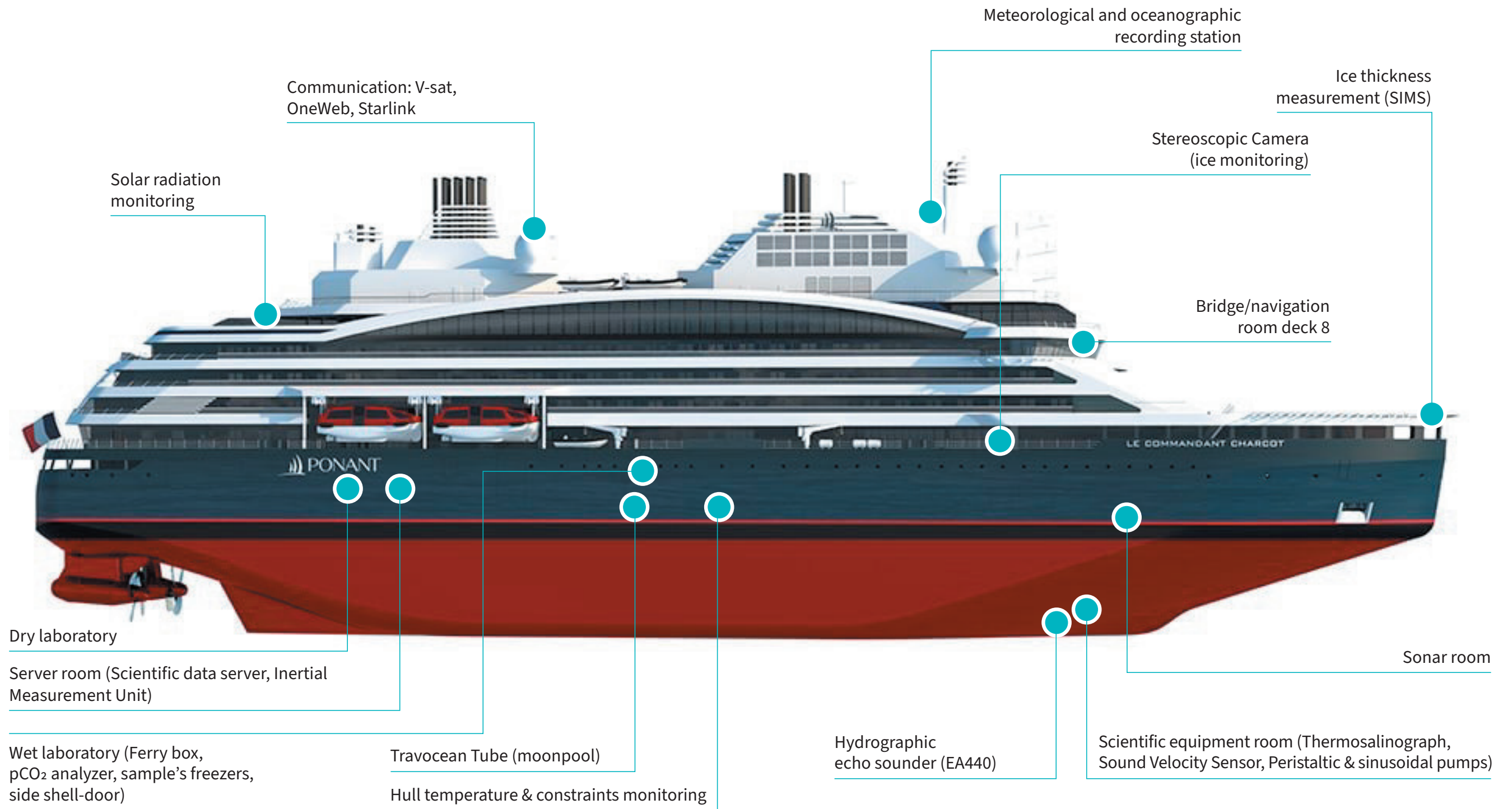
### Project selection process





# AVAILABLE EQUIPMENT

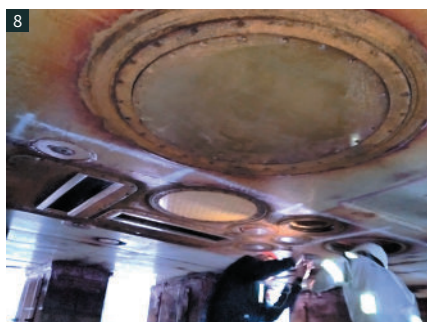
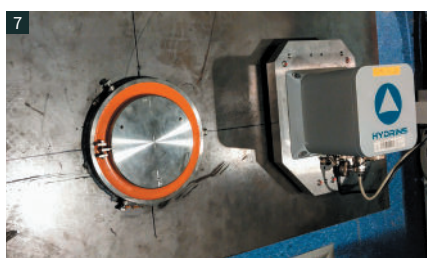
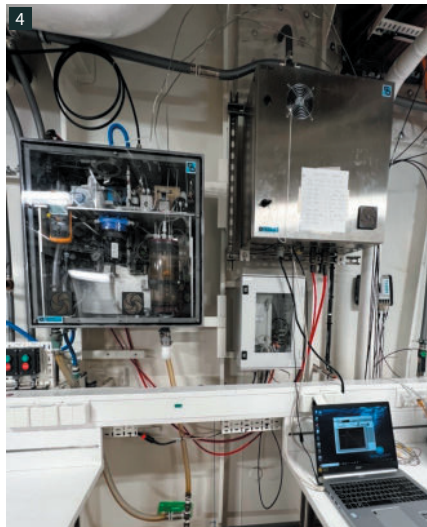
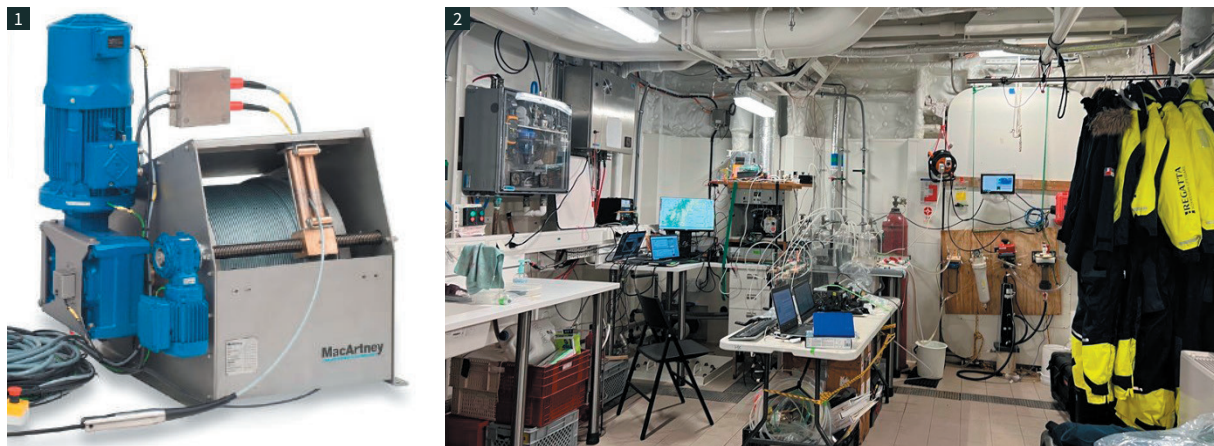
Le Commandant Charcot was built with dry and wet laboratories, constantly improved by pooling equipment's needs according to the specific requirements of scientists on board. The following equipment is currently available on the ship:



# AVAILABLE EQUIPMENT

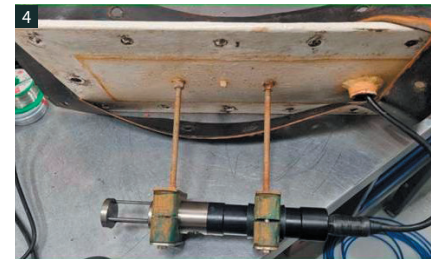
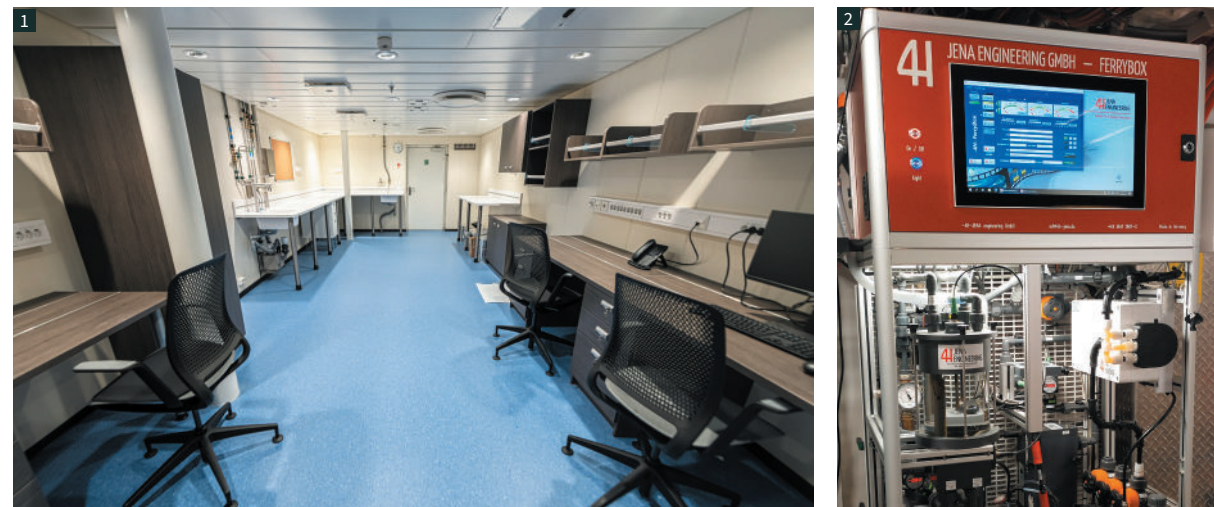


# AVAILABLE EQUIPMENT



1 Oceanographic winch 2 Wetlab  
3 Pyranometer, 4 PCO2 5 Rosette, Carousel Water Sampler 6 Tube TVO moonpool 7 Inertial measurement 8 Scientific echosounder EA440.

# AVAILABLE EQUIPMENT



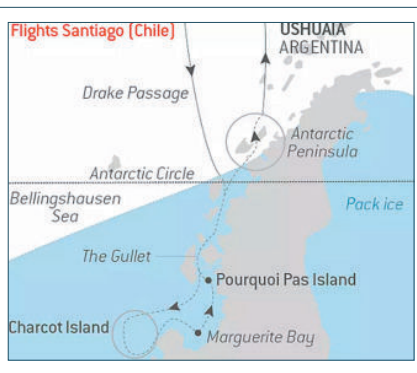
1 Drylab 2 Ferrybox  
3 Deep Trekker Revolution 4 Mini SVS 5 Weather station 6 Sims 7 Underway system.




# 2023 ITINERARIES

PONANT Science is helping researchers to reach hardly accessible ecosystems such as polar ice and the tropical ocean deeps. The itineraries of 2023 were:

USHUAIA/USHUAIA	PROJECT ABOARD
19/12/2022 to 02/01/2023	BASE
02/01/2023 to 16/01/2023	Antibiotic resistance in Antarctica
17/11/2023 to 29/11/2023	EXPLORANT
17/11/2023 to 29/11/2023	Satellite sea surface salinity
17/11/2023 to 29/11/2023	SEASON 3
27/12/2023 to 08/01/2024	C-BIRDS
29/11/2023 to 13/12/2023 13/12/2023 to 27/12/2023 27/12/2023 to 08/01/2024	Autonomous Measurement of primary productivity, photophysiology and climate-active gases in Southern Ocean waters
29/11/2023 to 13/12/2023 13/12/2023 to 27/12/2023	AIR-BIO




LYTTELTON/USHUAIA	PROJECT ABOARD
16/01/2023 to 14/02/2023	Phytoplankton distribution and diversity across poles
14/02/2023 to 12/03/2023	EXPLORANT



REYKJAVIK/ LONGYEARBYEN	PROJECT ABOARD
22/06/2023 to 10/07/2023	GOOD-IMDOS
26/08/2023 to 10/09/2023	ELENO



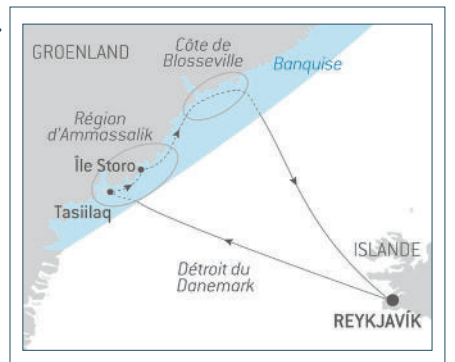
USHUAIA/MONTEVIDEO	PROJECT ABOARD
12/03/2023 to 29/03/2023	Biodiversity of Antarctic and sub-Antarctic Ecosystems (BASE)



# 2023 ITINERARIES

Projects details p.28

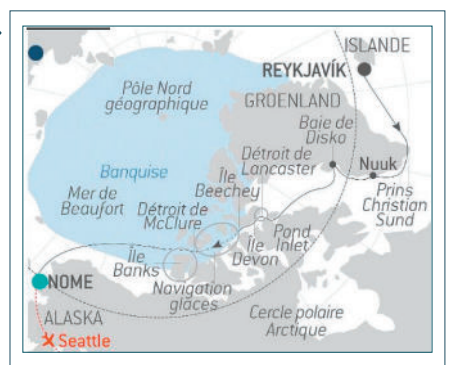
REYKJAVIK/REYKJAVIK	PROJECT ABOARD
15/05/2023 to 25/05/2023	Drivers of trophic interaction structures in Arctic environments
25/05/2023 to 08/06/2023	NANOPLARCTIC
25/05/2023 to 08/06/2023	NFIX




LONGYEARBYEN/ LONGYEARBYEN	PROJECT ABOARD
27/07/2023 to 11/08/2023	PHENOLIGHT
27/07/2022	NANOPLARCTIC
11/08/2023 to 26/08/2023	SEAICE
11/08/2023 to 26/08/2023	PARTICIPATION
11/08/2023 to 26/08/2023	ABPR-FO (long term)



REYKJAVIK / NOME	PROJECT ABOARD
11/09/2023 to 12/10/2023	PhytoChAOs
11/09/2023 to 12/10/2023	ArcticAir



PUNTA ARENAS/USHUAIA	PROJECT ABOARD
03/11/2023 to 17/11/2023	MAPPINGCARBON
03/11/2023 to 17/11/2023	BASE
03/11/2023 to 17/11/2023	MicroWorlds



2023  
PROJECT FOCUS

PONANT Science aims to bring scientists to ecosystems that are difficult to reach to collect unique data. But it's not just a vision. This science program is already underway, inspiring a new vision of exploration. Here are a few of the projects supported in 2023.



**1** DEFINING KRILL SANCTUARIES FOR WHALES

Recording whale populations to estimate the amount of food they need and guide plankton fishing quotas.



**2** STUDYING OCEAN CIRCULATION AND SEA RISE LEVEL

Using sensors to take seawater samples to understand how the Arctic Ocean is reacting to climate change.



**3** DOCUMENTING THE IMPACT OF NANOPARTICLES

Studying nanoparticles in the Southern Ocean to understand their impact on marine life and the exchange of matter between organisms.



**4** MESURING DEOXYGENATION OF THE ARCTIC OCEAN

Analysing oxygen, zooplankton and microplastic levels to better understand the effects of climate change.

2023  
PROJECT FOCUS

KEY FIGURES 2023

**1,265** NIGHTS ON BOARD

Number of nights offered onboard to scientists during our partnerships.

**24** ACADEMIC AND INSTITUTIONAL PARTNERSHIPS

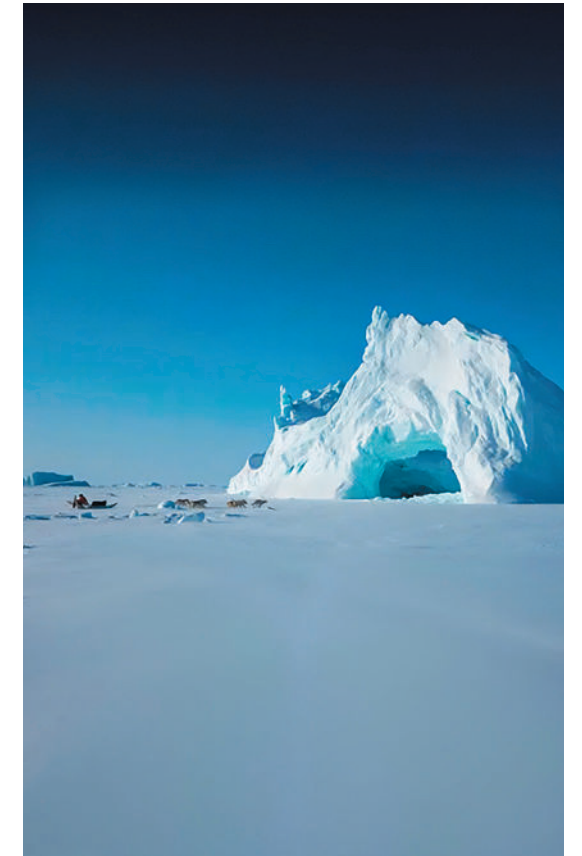
Collaborations with universities, NGOs and research institutes to conduct environmental and marine studies.

**25** SCIENTIFIC EXPEDITIONS

Number of cruises integrating scientific missions and conferences given by experts on board.

**72** RESEARCHERS ON BOARD

Number of scientists and experts invited to take part in cruises to carry out research.



Wassim DAOUD  
CSR Director

“As a pioneer in exploration cruises, PONANT considers science as an important pillar of its sustainable and innovation strategy. That’s why, we decided to fit our last vessel Le Commandant Charcot with two well equipped laboratories. Since 2021, we were happy to welcome almost 200 worldwide scientists and to give support to 60 scientific projects. In 2023, we are recognized as a member of POLARIN consortium for international polar research. Thanks to the commitment of our staff, we continue to work humbly to enhance our scientific contributions and involve our fleet into research programs.”



# PROJECT 1

## DEFINING KRILL SANCTUARIES FOR WHALES



SUMMARY	<b>BALEEN WHALE ABUNDANCE AND DISTRIBUTION IN KEY SOUTHERN OCEAN KRILL FISHING GROUNDS</b>
WHAT	Recording whale populations in the Southern Ocean to estimate how much food they need and introduce fishing quotas for krill to prevent overfishing from depleting the stock.
WHERE	The Southern Ocean
WHO	The University of Tasmania (UTAS), Australia
HOW	The team identified and recorded baleen whales to provide important data on population abundance and distribution.
WHY	Baleen whales play an important role regulating the ocean's food chain and keeping crucial nutrients cycling through the ocean. <i>By understanding their spatial foraging ecology, this project will inform management plans to keep krill harvests at sustainable levels and help whales stay resilient in the face of a changing climate.</i>

12-22

cruises  
enable abundance  
estimates for humpback  
and fin whales<sup>1</sup>

64.83S, 59.15W /  
65.31S, 58.98W  
the coordinates of the most  
southerly occurrence  
of humpback whales in  
the western Weddell Sea<sup>2</sup>

(1) Study published in: *Frontiers in Marine Science*.

(2) Study published in: *Marine Mammal Science*.

## INTERVIEW

### ANGUS HENDERSON

Principal Investigator for Polar Whale Watch and PhD candidate at IMAS

By learning about baleen whale populations in the Southern Ocean, Polar Whale Watch is trying to estimate how much food they need to inform krill fishing management.

#### What was the goal of your project?

The west Antarctic peninsula, below Argentina, is an important krill fishing region and has lots of overlap between fishing, predators, tourism and climate change. As PONANT's ship moves through the ocean, our observers record whale sightings along with data like GPS coordinates and weather conditions. Being able to keep returning to the poles enables us to see changes over time and space.

#### What did you learn through your research?

During our 2021 expeditions, we collected the first humpback sightings in the (newly ice-free) western Weddell Sea, which gives us interesting insights into the impact of global warming. We're writing two more papers: one on how baleen whales overlap with krill fishing, and the other on their climate redistribution. And we've concluded that tourist vessels are a great way of collecting data so we hope to return to the Ross Sea with PONANT for another field season.

“During our 2021 expeditions, we collected the first humpback sightings in the (newly ice-free) western Weddell Sea, which gives us interesting insights into the impact of global warming.”



#### What is it like working with PONANT?

PONANT has been really supportive of our researchers, especially through COVID when it was challenging to get scientists in the field. A lot of other projects fell through but, thanks to PONANT, we were able to get a great dataset for that year.

*Le Commandant Charcot* has private spaces, separated from guest areas, where researchers can conduct their work. There's lots of cool gear and having metrics like GPS, real-time weather and sea surface temperature given to us directly from the ship (more accurate than from satellites) at the end of the voyage was super useful. You don't get that on other ships. We're grateful to PONANT for hosting us so we can get good volumes of useful data for our project.

#### What were your highlights from the field?

It's really cool to see the emperor penguins and crabeater seals – species that are usually hard to reach. The capability of the ship is pretty impressive and you're able to go to places that are rarely surveyed. We also spent some clear, calm Antarctic evenings on the vessel with the sun setting and humpback whales all around the ship. You could even hear them breathing.

#### What are your top tips for researchers who want to apply to join a PONANT vessel?

Working with PONANT is great for projects that are agnostic about exactly where they go. If you're open to collecting data from a region but don't mind the exact site, you'll be well suited. It's good to make the most of opportunities that come up: although you can't expect the ship to stop for your benefit for long periods, if there's time in the schedule for a brief stop, you could collect extra data.



## PROJECT 2

# STUDYING OCEAN CIRCULATION AND SEA RISE LEVEL



SUMMARY	<b>THE ARTIC BOTTOM PRESSURE RECORDER</b>
WHAT	Undertaking the measurement of ocean bottom pressure in the Arctic to collect continuous and comprehensive data on the environmental changes occurring in this region.
WHERE	Geographic North Pole
WHO	The Polar Science Center of the University of Washington (USA) funded by NASA
HOW	The team deployed the Arctic Bottom Pressure Recorder – Follow On (ABPR-FO) at a depth of 4.2km, where it records pressure every 15 minutes for a period of five years, and utilizing the system’s acoustic transducer to transmit data to the ocean’s surface without the need to physically retrieve the instrument through sea-ice.
WHY	The deployment of the Arctic Bottom Pressure Recorder – Follow On (ABPR-FO) at a depth of 4.2km for five years allows for continuous data collection, filling a multi-year gap in observations at the North Pole. The system's acoustic transducer facilitates data transfer without the need for physical recovery through sea-ice. This new data will enhance our understanding of long-term trends in the Arctic and validate observations from the Gravity Recovery and Climate Experiment – Follow On satellite (GRACE-FO), contributing to improved climate change research and predictions.

Pressure measured  
**4.2km deep**  
Every 15 minutes  
For 5 years<sup>1</sup>

The ABPR-FO system is  
1.3m tall  
1m diameter wide (at its anchor base)  
~30cm diameter wide (above the anchor)  
~145kg heavy in air

(1) Marine Technology Society Journal.

## INTERVIEW

### DR. ANA CECILIA PERALTA FERRIZ & DR. JOHN GUTHRIE

Principal Research Scientists for ABPR-FO

By measuring changes in the ocean bottom pressure (OBP) at the North Pole seafloor, ABPR-FO hopes to end a multi-year gap in observational data and better understand the Arctic’s changing conditions.

**What was the goal of your project?**

**Cecilia:** This project follows on from a larger program that ended in 2015 which, among other things, used an Arctic Bottom Pressure Recorder that sat on the seafloor close to the North Pole and measured changes in pressure over time – think of it like measuring the weight of the water column and air above the device. This sensor validated data collected by a satellite called GRACE (the Gravity Recovery and Climate Experiment).

Thanks to NASA funding, we’ve been able to restart these observations – this time building the sensor ourselves – to validate the new satellite: GRACE Follow-On. We call this instrument the Arctic Bottom Pressure Recorder – Follow On (ABPR-FO) and it’s designed to last for five years. We hope it can be used in combination with future instruments like this one to give us a pressure record at the North Pole continuously for over 10 years, collecting long-term observations that help us understand changes in the Arctic, such as sea level rise and ocean circulation.

Each year, we need to return to the North Pole to collect the data acoustically. Joining PONANT’S cruises has allowed us not only to deploy the instrument at the North Pole, but also to get right on top of the instrument to get the information on a yearly basis.

**What did you learn through your research?**

**Cecilia:** It was a brilliant surprise that we didn’t have any data gaps in our first year of results. You usually have to pull this type of instrument out of the water to collect the data but our battery lasts for five years so, if we can return every year, we’ll be able to produce long-term observations without any gaps in our dataset. So far, our data correlates outstandingly with the satellite data, which is really promising.

**What was it like working with PONANT?**

**John:** Previously, we’ve worked from Russian ice camps but weather conditions and geopolitical events have meant this wasn’t possible for the past few years. So, when we learned *Le Commandant Charcot* was going to the North Pole, we saw a fantastic opportunity to continue our project – people go to the North Pole occasionally, but it’s hard to find a research program that visits every year.

**Cecilia:** Working with PONANT has been a great choice for our project. We’ve been very lucky that the expedition team has opened their doors for us to join them and their guests on these voyages. The ship is beautiful, the conditions are amazing, and the labs are really well equipped.

**What were your highlights from the field?**

**John:** I’ve been to the Arctic a lot but I think the only time I’ve seen a bowhead whale was from *Le Commandant Charcot* in 2022. That was wonderful. It’s also nice to spend some time in some of the more remote fjords, which is something we aren’t usually able to do with our work. And cruising along on a ship that’s so capable of busting through the sea ice is certainly one of the highlights.

**What are your top tips for other researchers considering applying to join a PONANT vessel?**

**Cecilia:** It’s good to be flexible on these types of voyages. There are many things that can change plans – weather, ice conditions, illness etc. – and you’ll need to adapt. Communicate as clearly and openly as you can, especially with the science coordinator and the captain. Also, respect the fact that we’re not paying passengers. Taking this opportunity means that some of the rules are different from those of a research vessel.





## PROJECT 3

# DOCUMENTING THE IMPACT OF NANOPARTICLES



<b>SUMMARY</b>	<b>NANO(SOUTH)GATE</b>
<b>WHAT</b>	Studying nanoparticles (including plastic, Titanium dioxide and soot) in the Southern Ocean.
<b>WHERE</b>	The Great Arctic
<b>WHO</b>	International Research Laboratory Takuvik, University Laval and Centre National de la Recherche Scientifique
<b>HOW</b>	The team collected sea ice, snow, sediment, organic particles and seawater using pumps, ice corers, snow tanks and marine snow catchers. Samples were stored and taken to the Takuvik laboratory where they analysed them to detect, identify and characterise the size, shape and source of anthropogenic nanoparticles (ANPs).
<b>WHY</b>	There is currently no data on ANPs in the Southern Ocean but it is believed they are more likely to accumulate and concentrate here than the Arctic Ocean because of the Antarctic Circumpolar Current (ACC). This project is addressing the urgent need to document the presence, distribution, movement and effects of ANPs as well as their impact on living organisms and the food web.

**The team took:**  
280 litres of seawater samples  
60 litres of snow samples  
& 23 ice cores

**20 litres of seawater is filtered to produce 100ml of concentrated water after 12 hours of filtration**

**Study published in:**  
Environmental Science and Technology (Jul 2024)

## INTERVIEW

### JULIEN GIGAULT

Principal Investigator for NANOPLARCTIC

Studying and characterising the densities of nanoparticles in the polar region.

**What was the goal of your project?**

As humans, we're putting a lot of pressure on the Arctic and we're not sure what the side effects will be. NANOPLARCTIC came from a larger project that tried to document the presence of anthropogenic particles (ANPs), such as nanoplastics, nano ashes and inorganic nanoparticles in the Arctic basin.

The first stage of our project is to document as much as we can about the distribution of nanoparticles in different regions. This involved deploying an instrument from the ship to collect large amounts of water and this was then concentrated to extract the nanoparticles. The samples were taken back to the lab so we could try to measure and categorise the particles.

This documentation will help us with the next step, which is to publish our recommendations on policies that can protect this important ecosystem.

**What did you learn through your research?**

We're still in the process of analysing all our particles. We're particularly focused on trying to determine which particles have come from local sources, which includes community practices such as mining activities and some tourist boats, and which have been brought to the sub-Arctic area by air or oceanic currents.

We're also building a library of the different particles and categorising them by source: did they come from wildfires, urban fires, plastic, mining, shipping, cruising or another human activity. We're looking forward to disseminating this information when it's ready to be published.

**What was it like working with PONANT?**

We applied to the ARICE platform to find an icebreaker in the area of the Arctic basin that we wanted to target and were invited to partner with PONANT.

For each leg of the journey, we have a coordinator who helps us organise and manage all the sampling tools, equipment and installation in the lab. The scientific coordinator (the Science officer), deck team and expedition team were helpful and the scientific instruments installed in the lab were very good.

Although we're joining a tourist vessel (and so our itinerary was driven by the passenger requirements – we didn't decide where to go), our scientific work was kept separate from the passenger expeditions: we went out separately on a different boat and had a different snowmobile to get onto the ice. With ARICE we have submitted a 3-year project that will support the ANR project that we obtained in 2023.

**What were your highlights from the field?**

We were working really hard on our voyage so there wasn't much time to take in the sights of the Arctic. But, from a scientific point of view, it was a great trip because we were able to achieve what we wanted for our project. Documenting nanoplastics for the first time in this unique region was very exciting – these are precious samples that could help us generate important data for our project.



*Our project aims to document nanoparticle distribution in the Arctic by deploying instruments from the ship to collect and extract samples.*

**What are your top tips for other researchers considering applying to join a PONANT vessel?**

Communication is really important – both before and during your trip. Be really clear with PONANT's scientific officer about what you need for your research and they will be able to help you. You'll be introduced to the PONANT team several weeks before your departure so there's plenty of time to plan everything with them.

There's important scientific work to be done during your trip so, even though this is a tourist vessel, stay professional and focus on your science.



## PROJECT 4

# MESURING DEOXYGENATION OF THE ARCTIC OCEAN



SUMMARY	<b>GLOBAL OCEAN OXYGEN DECADE-INTEGRATED MARINE DEBRIS OBSERVING SYSTEM (GOOD IMDOS)</b>
WHAT	Analysing the role of warming and meltwater on oxygen levels and ocean acidification, monitoring zooplankton, documenting microplastics and providing critical new knowledge into these areas.
WHERE	The Atlantic sector of the Arctic Ocean
WHO	GEOMAR Laboratory (Germany)
HOW	The team measured salinity, temperature and dissolved oxygen in the surface layers of the water, took water samples and collected microplastics. They also took high-res images of zooplankton to study distribution patterns.
WHY	The Arctic is one of the most rapidly warming regions on the planet. This causes melting sea ice, deoxygenation and ocean acidification which has a significant impact on the whole food chain. <i>This project will try to better understand the impacts of climate change and pollution on the Arctic so we can find ways of protecting it.</i>

**26**  
sampling  
stations

**Oxygen saturation levels were unexpectedly low**  
Often below 95% in the surface layers of the East Greenland Current

**The UVP6**  
Captured images at ~10 Hz & could identify particles of organisms between approx. 1 to 100 mm

**Microplastics detected**  
in 32 of 66 individual net tow & at all but 5 stations

## INTERVIEW

**AARON BECK**  
Microplastics Lead for GOOD-IMDOS

Over a five-year period, the GOOD-IMDOS team is monitoring and analysing oxygen saturation levels, zooplankton distribution and microplastic pollution in the Atlantic sector of the Arctic Ocean. This work aims to provide critical knowledge on deep ocean oxygen levels as well as how climate change and marine litter affects marine life and biogeochemistry in the high latitudes.

**What was the goal of your project?**

Our project explores the impacts of climate change and pollution in the Atlantic sector of the Arctic Ocean. In particular, we are exploring how the dynamics of zooplankton, microplastics and ocean oxygen change over time within the region, ideally over a five-year time series.

The polar regions are one of the areas where we see many effects of climate change most strongly. This is an interesting part of the world oceanographically because of the link between the North Atlantic Ocean and the Arctic. These interfaces between different ocean basins – and water exchange between the surface ocean and the deep – is where all sorts of interesting things happen.

**What did you learn through your research?**

We're still in the process of taking our measurements but we have found lower oxygen levels than expected, which was interesting. Over the coming years, it will be exciting to see if we can verify those results and understand the implications.

We've also seen a significant difference between plastic pollution levels in different areas: we saw very low levels of plastic pollution around the Greenland coast while Svalbard was heavily polluted, particularly from fishing gear. It probably had the most plastic material I've ever sampled!

**What was it like working with PONANT?**

It's an interesting idea that you can do good scientific work from a non-scientific platform, especially with PONANT's efforts to build labs into the infrastructure of the ships.

Being able to access these regions on small ships and with short timescales is unique. Most research trips have to be planned at least a year or two ahead and it's normal to have a relatively constrained regional focus. I don't know of any other research platform where you can keep returning to these regions over several years to sample different locations without long planning lead times.

We also enjoyed the level of passenger interest in our work. Once the guests learned we were studying plastic debris, they would do cleanups on every beach visit. We'd come back to the lab and find piles of plastic or fishing nets that passengers had collected for us!

**What were your highlights from the field?**

This was the first time I've ever been to the Arctic and it was phenomenal to be on the sea ice. I also loved sampling the varied ecosystems surrounding Svalbard: the glaciers, fjords, rocky coasts and cliffs. The voyage enabled us to access lots of interesting areas for our microplastics work and generate a nice dataset for the initial phase of our project. We wouldn't have been able to do that without joining PONANT's cruises. Oh, and the food is very good!



*“We found significant differences in plastic pollution levels between areas, with Greenland showing low levels and Svalbard heavily polluted, particularly from fishing gear.”*

**What are your top tips for other researchers considering applying to join a PONANT vessel?**

Be aware that some scientific initiatives work better with the tourism program than others. For example, we could easily collect microplastic samples while passengers were out but lowering CTD casts to collect water column samples takes much longer and there's not always enough time to stop, especially if the sampling location is less interesting for passengers.

Be prepared to be flexible even more than you would on a research vessel because the science has to fit in with the passenger schedule.



## 2023 PROJECTS

HEAD INSTITUTION, COUNTRY CODE	TITLE	EXPEDITION METRICS	GEOGRAPHIC AREA
Millennium Institute	Biodiversity of Antarctic and sub-Antarctic Ecosystems (BASE)	<ul style="list-style-type: none"> <li>• 4 participants</li> <li>• 14 days</li> <li>• Ushuaia/Ushuaia</li> <li>• 19/12/22 to 02/01/23</li> </ul>	Weddell sea
Centre Hospitalier Hyères	Antibiotic resistance in Antarctica	<ul style="list-style-type: none"> <li>• 3 participants</li> <li>• 14 days</li> <li>• Ushuaia/Ushuaia</li> <li>• 02/01/23 to 16/01/23</li> </ul>	Charcot Island & Peter 1st Island
Oregon State University (BB Cael) + Ulaval	Phytoplankton distribution and diversity across poles	<ul style="list-style-type: none"> <li>• 3 participants</li> <li>• 28 days</li> <li>• Ushuaia/Lyttelton</li> <li>• 16/01/23 to 14/02/23</li> </ul>	Charcot Island & Peter 1st Island & Ross sea & Subantarctic Islands
EXPLORANT II	EXPLORANT (EXPLORing the marine ANTArctic realm)	<ul style="list-style-type: none"> <li>• 3 participants</li> <li>• 26 days</li> <li>• Lyttelton/Ushuaia</li> <li>• 14/02/23 to 12/03/23</li> </ul>	Charcot Island & Peter 1st Island & Victoria Land & Subantarctic Islands
Millennium Institute	Biodiversity of Antarctic and sub-Antarctic Ecosystems (BASE)	<ul style="list-style-type: none"> <li>• 4 participants</li> <li>• 17 days</li> <li>• Ushuaia/Montevideo</li> <li>• 12/03/23 to 29/03/23</li> </ul>	Weddell Sea & Sandwich Islands & South Georgia
Biodiversity Research Institute (IMIB), ES	Drivers of trophic interaction structures in Arctic environments	<ul style="list-style-type: none"> <li>• 2 participants</li> <li>• 10 days at sea</li> <li>• Reykjavik/Reykjavik</li> <li>• 15/05/23 to 25/05/23</li> </ul>	Greenland North East
Takivik laboratory	NANOPLARCTIC- characterize the presence of nanoparticles in multiple abiotic compartments in the North Pole area.	<ul style="list-style-type: none"> <li>• 2 participants</li> <li>• 14 days at sea</li> <li>• 25/05/23 to 08/06/23</li> <li>• Reykjavik/Reykjavik</li> <li>• 2 participants</li> <li>• 15 days at sea</li> <li>• 27/07/23 to 11/08/23</li> <li>• Longyearbyen/Longyearbyen</li> </ul>	Greenland North East North Pole
Duke University, USA	NFIX: Response of Nitrogen Fixation in Lichens and Mosses to a Rapidly-Changing Arctic Environment	<ul style="list-style-type: none"> <li>• 2 participants</li> <li>• 14 days at sea</li> <li>• 25/05/23 to 08/06/23</li> <li>• Reykjavik/Reykjavik</li> </ul>	Greenland North East

## 2023 PROJECTS

HEAD INSTITUTION, COUNTRY CODE	TITLE	EXPEDITION METRICS	GEOGRAPHIC AREA
GEOMAR, DE	GOOD-IMDOS : Global Ocean Oxygen Decade – Global Ocean Observing System	<ul style="list-style-type: none"> <li>• 4 participants</li> <li>• 18 days at sea</li> <li>• 22/06/23 to 10/07/23</li> <li>• Reykjavik/Longyearbyen</li> </ul>	Greenland North East & Spitzberg
Yale University, USA	PHENOLIGHT : Phenomenology of light in the Arctic environment: ethnography of expedition	<ul style="list-style-type: none"> <li>• 1 participant</li> <li>• 15 days at sea</li> <li>• 27/07/23 to 11/08/23</li> <li>• Longyearbyen/Longyearbyen</li> </ul>	North West Passage
Université de Washington	ARCTIC BOTTOM PRESSURE RECORDER : ABPR-FO (long term)	<ul style="list-style-type: none"> <li>• 2 participants</li> <li>• 15 days at sea</li> <li>• 11/08/23 to 26/08/23</li> <li>• Longyearbyen/Longyearbyen</li> </ul>	North Pole
Alfred Wegener Institute (AWI), DE	Sealce: Arctic and Antarctic Sea Ice – Thickness variability and Change, Ice Loads and Navigability	<ul style="list-style-type: none"> <li>• 1 participants</li> <li>• 15 days at sea</li> <li>• 11/08/23 to 26/08/23</li> <li>• Longyearbyen/Longyearbyen</li> </ul>	North Pole
University of Oulu, FI	PARTICIPATION: Advancing visitors' participation in citizen science: the new appeal for the Arctic?	<ul style="list-style-type: none"> <li>• 2 participants</li> <li>• 15 days at sea</li> <li>• 11/08/23 to 26/08/23</li> <li>• Longyearbyen/Longyearbyen</li> </ul>	North Pole
Institute of Polar Sciences (CNR-ISP), IT	ELENO : Habitat template, microbial signatures and iconic life in a changing Arctic ocean	<ul style="list-style-type: none"> <li>• 4 participants</li> <li>• 15 days at sea</li> <li>• 26/08/23 to 10/09/23</li> <li>• Longyearbyen/Reykjavik</li> </ul>	North Pole
Alfred Wegener Institute (AWI), DE	PhytoChAOs Assessing impacts of phytoplankton community changes in two climate-sensitive arctic ecosystems	<ul style="list-style-type: none"> <li>• 4 participants</li> <li>• 31 days at sea</li> <li>• 11/09/23 to 12/10/23</li> <li>• Reykjavik/Nome</li> </ul>	North West Passage
Northumbria University, UK	ArcticAir: characterize airborne communities in the Arctic region and the risks of microbial invasion	<ul style="list-style-type: none"> <li>• 2 participants</li> <li>• 31 days at sea</li> <li>• 11/09/23 to 12/10/23</li> <li>• Reykjavik/Nome</li> </ul>	North West Passage

## 2023 PROJECTS

HEAD INSTITUTION, COUNTRY CODE	TITLE	EXPEDITION METRICS	GEOGRAPHIC AREA
Universidad Mayor, Faculty of Sciences Center for Genomics, Ecology and the Environment, CL	Biodiversity of Antarctic and sub-Antarctic Ecosystems (BASE)	<ul style="list-style-type: none"> <li>1 participant</li> <li>14 days at sea</li> <li>Punta Arenas/Ushuaia</li> <li>(03/11/2023 to 17/11/2023)</li> </ul>	Snowhill Island & Weddell Sea
CSIRO Oceans and Atmosphere, AU	MAPPINGCARBON: Mapping the carbon stocks of kelp forests in the Snowhill Islands and Weddell Sea	<ul style="list-style-type: none"> <li>3 participants</li> <li>14 days</li> <li>Punta Arenas/Ushuaia</li> <li>03/11/2023 to 17/11/2023</li> </ul>	Snowhill Island & Weddell Sea
Millennium Institute	Biodiversity of Antarctic and sub-Antarctic Ecosystems (BASE)	<ul style="list-style-type: none"> <li>4 participants</li> <li>14 days at sea</li> <li>Punta Arenas/Ushuaia</li> <li>03/11/2023 to 17/11/2023</li> </ul>	Snowhill Island & Weddell Sea
EXPLORANT III	EXPLORing the marine ANTArctic realm	<ul style="list-style-type: none"> <li>3 participants</li> <li>12 days</li> <li>Ushuaia/Ushuaia</li> <li>14/02/23 to 12/03/23</li> </ul>	Snowhill Island & Weddell Sea
Institute of Marine Sciences (ICM-CSIC), ES	SATELLITE SEA SURFACE SALINITY: Satellite Sea	<ul style="list-style-type: none"> <li>2 participants</li> <li>12 days at sea</li> </ul>	Snowhill Island & Weddell Sea
Sciences (ICM-CSIC), ES	Surface Salinity assessment close to the ice edge in the Southern Ocean	<ul style="list-style-type: none"> <li>Ushuaia/Ushuaia</li> <li>17/11/2023 to 29/11/2023</li> </ul>	
University of Tasmania, AU	SEASON 3: Baleen whale abundance and distribution in key Southern Ocean krill fishing grounds	<ul style="list-style-type: none"> <li>2 participants</li> <li>12 days at sea</li> <li>Ushuaia/Ushuaia</li> <li>17/11/2023 to 29/11/2023</li> </ul>	Snowhill Island & Weddell Sea
Department of Earth, Ocean and Atmospheric Sciences, University of British Columbia, CA	Autonomous Measurement of primary productivity, photophysiology and climate-active gases in Southern Ocean waters	<ul style="list-style-type: none"> <li>2 participants</li> <li>14 days at sea</li> <li>Ushuaia/Ushuaia</li> <li>29/11/23 to 13/12/23</li> </ul> <ul style="list-style-type: none"> <li>2 participants</li> <li>14 days at sea</li> <li>Ushuaia/Ushuaia</li> <li>13/12/23 to 27/12/23</li> </ul> <ul style="list-style-type: none"> <li>2 participants</li> <li>12 days at sea</li> <li>Ushuaia/Ushuaia</li> <li>27/12/23 to 08/01/24</li> </ul>	Charcot Island & Bellingshausen Sea Charcot Island & Bellingshausen Sea Weddell Sea

## 2023 PROJECTS

HEAD INSTITUTION, COUNTRY CODE	TITLE	EXPEDITION METRICS	GEOGRAPHIC AREA
Queen Mary University of London, UK	AIR-BIO: The atmospheric ecosystem over Antarctica	<ul style="list-style-type: none"> <li>2 participant</li> <li>14 days at sea</li> <li>Ushuaia/Ushuaia</li> <li>29/11/2023 to 13/12/2023</li> </ul> <ul style="list-style-type: none"> <li>2 participant</li> <li>14 days at sea</li> <li>Ushuaia/Ushuaia</li> <li>13/12/2023 to 27/12/2023</li> </ul>	Charcot Island &  Bellingshausen Sea
École Pratique des Hautes Études (EPHE), FR	C-BIRDS - Counting seabirds from Cruising ships: A protocol for monitoring climate change impacts on Antarctic biodiversity	<ul style="list-style-type: none"> <li>2 participant</li> <li>12 days at sea</li> <li>Ushuaia/Ushuaia</li> <li>27/12/2023 to 08/01/2024</li> </ul>	Weddell Sea Charcot Island & Peter 1st Island & Victoria Land & Subantarctic Islands
UMR MARBEC (Université de Montpellier, CNRS, IRD, Ifremer), FR	ANITA: Pathogens and ANTibioresistance associated to plastic: Threat in Antarctic waters?	<ul style="list-style-type: none"> <li>2 participants</li> <li>12 days at sea</li> <li>Ushuaia/Ushuaia</li> <li>27/12/2023 to 08/01/2024</li> </ul>	Weddell Sea
University of Oulu, FI	PARTICIPATION: Advancing visitors' participation in citizen science: the new appeal for the Arctic?	<ul style="list-style-type: none"> <li>2 participants</li> <li>15 days at sea</li> <li>11/08/23 to 26/08/23</li> <li>Longyearbyen/ Longyearbyen</li> </ul>	North Pole
Institute of Polar Sciences (CNR-ISP), IT	ELENO : Habitat template, microbial signatures and iconic life in a changing Arctic ocean	<ul style="list-style-type: none"> <li>4 participants</li> <li>15 days at sea</li> <li>26/08/23 to 10/09/23</li> <li>Longyearbyen/ Reykjavik</li> </ul>	North Pole
Alfred Wegener Institute (AWI), DE	PhytoChAOs Assessing impacts of phytoplankton community changes in two climate-sensitive arctic ecosystems	<ul style="list-style-type: none"> <li>4 participants</li> <li>31 days at sea</li> <li>11/09/23 to 12/10/23</li> <li>Reykjavik/Nome</li> </ul>	North West Passage
Northumbria University, UK	ArcticAir: characterize airborne communities in the Arctic region and the risks of microbial invasion	<ul style="list-style-type: none"> <li>2 participants</li> <li>31 days at sea</li> <li>11/09/23 to 12/10/23</li> <li>Reykjavik/Nome</li> </ul>	North West Passage





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