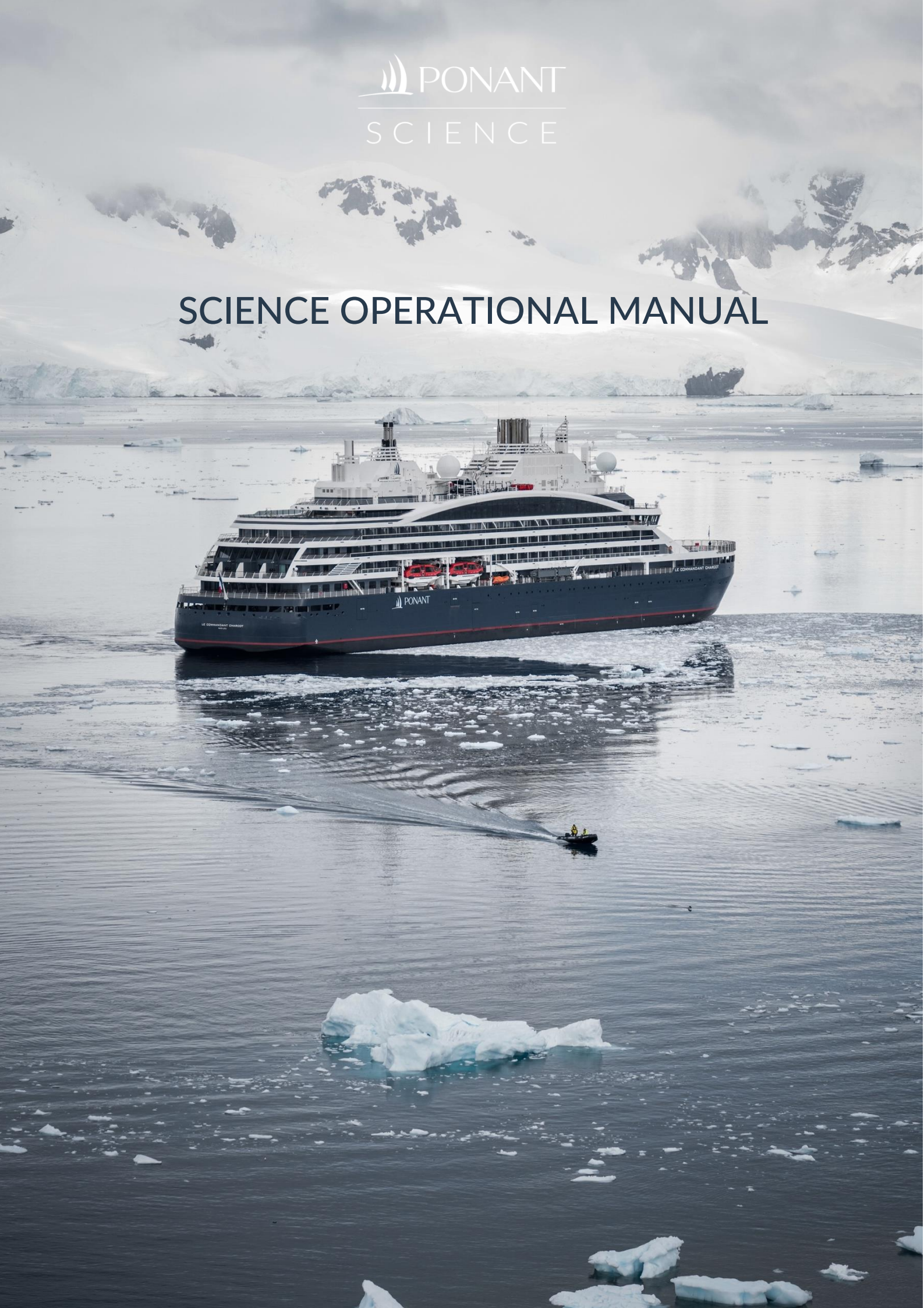




SCIENCE OPERATIONAL MANUAL



EXECUTIVE
SUMMARY

Le Commandant Charcot is the first-ever cruise expedition vessel designed for extreme polar conditions. She gives the rare opportunity to 200 passengers maximum to explore remote polar areas safely while minimizing their impact on the planet by using hybrid technology and a leading edge technology ship for waste control. Actually, Le Commandant Charcot is the first hybrid electric ship running on LNG (Liquid Natural Gas), which is a major innovation strengthening PONANT's commitment to sustainable tourism.

Since she is able to sail in very remote areas, any environmental data gathered there would be invaluable for research and laboratories. As such, PONANT designed Le Commandant Charcot with dedicated research rooms and integrated equipment to host scientists conducting experiments. Ponant also introduced a new position, the science officer, to take care of the researchers and maintain lab equipments.

Hence, le Commandant Charcot is an “**opportunity ship**” for scientific laboratories: it offers a unique versatile platform for observation, research and analysis, and Ocean data collection. However, it must be clear that the first mission of le Commandant Charcot is to be a cruise ship. Hence, the ship's route is designed for passenger's interest. Ponant and the captain of le Commandant Charcot are committed to make their best efforts to accommodate the cruise route for scientific experiment but weather conditions or last-minute change of planning supersede scientific program.

Ponant aims also at sharing this science program with passengers: scientists should be aware that they will have to introduce their project to passengers during plenary session. These short talks are beneficial to science.

This document is reviewing all the necessary pieces of information for Scientifics to come onboard Le Commandant Charcot and use the vessel's facilities and equipment during the ship's cruises.

A general equipment description is provided. The science officer will be more than happy to provide additional details. All research teams are encouraged to contact the Ponant team before starting any new scientific project to ensure feasibility from an operational standpoint.



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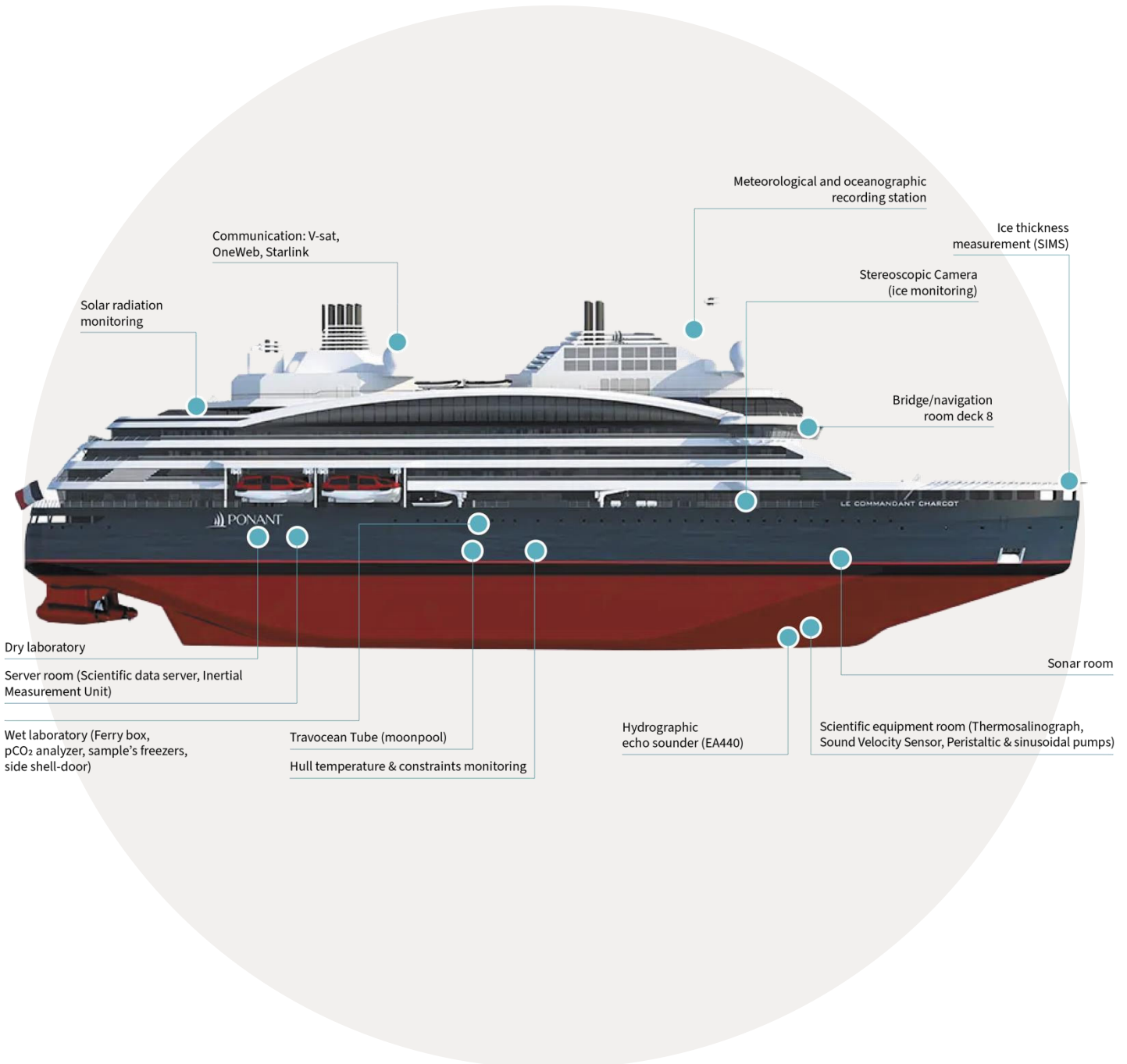
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SHIP'S DATA
GENERAL DATA AND SCIENCE AREAS

NAME	LE COMMANDANT CHARCOT
TYPE	PASSENGER SHIP
IMO NUMBER	9846249
OWNER	PONANT
SHIPYARD	VARD (NORWAY)
KEEL LAYING	14 DECEMBER 2018
DELIVERY	1ST HALF 2021
CLASS SOCIETY	BUREAU VERITAS
CLASS NOTATION	HULL MACH, Unrestricted Navigation, Passenger Ship - SRTP - DUALFUEL - POLAR CAT A, AUT-PORT, AUT-UMS, VeriSTAR-HULL, POLAR CLASS 2 (partly: Icebreaker 3 bow; Icebreaker 4 stern), COLD (H -15°C, E -25°C) PMS, INWATERSURVEY, CLEANSHIP, BWT, AWT-A/B, COMF-NOISE-1, COMFVIB-1, ERS-S, HYBRID
LENGTH OVER ALL	149.9 m
BEAM	28 m
DRAUGHT	10 m
PEOPLE ON BOARD	200 PASSENGERS + 190 CREW (including 4 Scientists and 1 Science Coordinator)
TEMPERATURE	Designed for operation from +35°C to -25°C.
PROPULSION POWER	2 x ELECTRICAL AZIPODS ABB (2 x 17 MW)
VESSEL SPEED	Maximum speed achievable in open water 18 knots Cruising speed in open water 12 knots Cruising speed in Ice according to Ice concentration and thickness
ELECTRICAL PRODUCTION	DUAL FUEL WARTSILA ENGINES: 2 x 5335 kW + 4 x 7450 kW
BATTERY	ELECTRIC HYBRID ENERGY STORAGE SYSTEME 4520 KW

SHIP'S DATA GENERAL DATA AND SCIENCE AREAS



SCIENTIFIC LABORATORIES

There are 3 spaces on board dedicated to science. All labs are supplied with 220V/50Hz power and “Europlug type F” sockets.

1. WET LAB

Located on deck 3, this lab is about 40m². This is the main room used for big set-up and filtrations. Several drains help to evacuate sea water to ship’s tanks and floor is easily washable. The shell door enables to launch scientific equipment outboard (about 3 meters above sea surface), such as plankton nets or ARGO buoys. A telescopic boom can help in deploying such equipment in the water when ship is stopped. In this lab, you will find the 2 main underway equipment (Ferry box & pCO₂) as well as the “TVO room” giving access to sea water through a moonpool.



SCIENTIFIC LABORATORIES

2. DRY LAB

This laboratory is dedicated to analysis and data processing. There are 2 desks available for scientists. This is the main room for office work and meeting since there is no desk in stateroom allocated for scientist. This lab is open 24/7. There are 2 sinks, 2 hoods, 2 microscopes, 1 binocular, 1 MiliQ water equipment, 1 fridge.



3. SERVER ROOM

This server room includes our data center and 2 desks. In addition, we use this room to store equipment and luggage from science team coming on board. Since the room is pretty tiny, we can't store that equipment for a long time. Usually, we accept to store equipment one month before the cruise and one month after the cruise. Newly installed is an IMU (Inertial Measurement Unit) in order to record all ship's motions and later (2026) to link it with an ADCP (Acoustic Doppler Current Profiler).



EQUIPMENTS AVAILABLE FOR SCIENCE OPERATIONS

ON-BOARD OPERATIONS

1. PUMPS FOR UNDERWAY MEASUREMENT

Underway system provides sea water from 2 intakes (3- or 10-meters depth) and is equipped with 3 different pumps:

- **Centrifugal pump so-called « scientific pump »:**

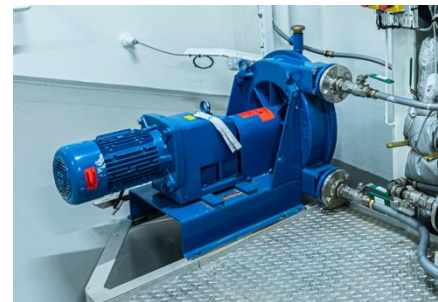
This pump is located at deck 0, very bottom of the ship and is providing seawater to the ferry box, to the pCO₂ wet box, and to all the sink located in the wetlab. Its flow is about 5m³/h, e.g., 80l/min. We never experienced a limitation on the sea water availability for external equipment. This pump can run 24/7.

Piping is equipped with a SBE 38 (to get the true SST) and a Valeport miniSVS (sound velocity sensor). Those datas are collected by the Ferry box and Wet lab's PC running SODA software.



- **Peristaltic pump:**

This pump is located at deck 0 as well and is using the same water inlets. This pump is providing seawater to sinks located in the wet lab, and in the dry lab. Its flow is about 3 m³/h. This pump is mainly used for biology experiment (plankton analysis...). This pump is switched ON only on purpose and can be run continuously.



- **Sinusoidal pump:**

Newly installed this pump can handle superior solids and limit damage to cells. The piping is in PVDF material for transferring neutral & aggressive liquids from sea water intakes to both laboratories. Its variable flow can be adjusted.



EQUIPMENTS AVAILABLE FOR SCIENCE OPERATIONS

2. FERRY BOX

The brand of our ferry box is from Jena Engineering, and is loaded with 4 sensors:

- **SBE45 and SBE38:**

SBE45 Thermosalinograph (TSG) is set into the ferry box and the SBE38 Oceanographic Thermometer is set at deck 0 at the start of seawater pipes. Both are calibrated each year and an automatic acid wash is set on a daily basis during the operations. The ferry box is stopped when the ship is anchored in a harbor.

[LEARN MORE](#)

- **Optode:**

This O₂ sensor is a 4835 Aanderaa sensing foil. This sensor is calibrated every year. In addition, a winkler titration is done versus scientist experts on board with Hg availability.

[LEARN MORE](#)

- **pCO₂:**

This sensor is from jena company and indicates a pretty good trend in dissolved CO₂. This measure is convenient to get a technical trend of CO₂ in conjunction with the O₂ measurement. Otherwise, it's more relevant to get the pCO₂ measure from the general oceanics equipment.

- **pH**

For further more information this pH measurement is an optical measurement and is calibrated as often as possible, e.g., every week. It must be understood that this sensor is a technical sensor to control the acid wash of the ferry box. The pH measurement is not a scientific value and should be taken with cautious about its accuracy.

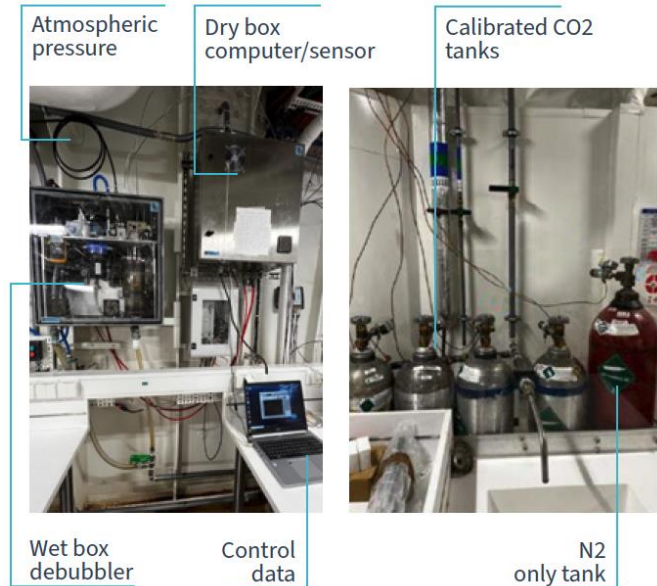


EQUIPMENTS AVAILABLE FOR

SCIENCE OPERATIONS

3. pCO₂

This equipment is from General Oceanic. It has been set up by Denis Pierrot from NOAA. Denis is the main point of contact for this equipment, its maintenance and calibration. The accuracy of this equipment is exceptional: 2ppm. Its calibration is done every 6 hours using calibrated tank stored in the wet lab. The data are sent over to NOAA lab through iridium network but is also recorded by our DSHIP network every minute. This pCO₂ measure the dissolved CO₂ in the sea water and the atmospheric CO₂ concentration as well.



LEARN MORE

4. CAROUSEL

This carousel is the 32C model, the compact version of the seabird carousel product line. It embarks 12 Niskin bottle that have an 8-liter capacity. A seabird CTD sensor is embedded on the frame with a full HW and SW interface to program the Niskin sampling. The Carousel provides water sampling and real-time CTD data acquisition via an electro-mechanical cable. It can also be operated autonomously in case of failure by programming its "underwater unit" to close bottles at selected depths, using non-electrical wire. The carousel is deployed from ship's aft mooring station using a "[CORMAC M5](#)" winch (1200m cable length, speed 60m/mn, pulling 500 kg) and a tangoon.

LEARN MORE



EQUIPMENTS AVAILABLE FOR SCIENCE OPERATIONS

5. FREEZER

There are 2 freezers available to store samples from science operation:

- **-80deg freezer:**

this freezer is from Thermofisher company. It's a TSX series and its volume is 730l. Despite this rather comfortable volume, this freezer is very utilized by science projects. As such, all stored samples must be unloaded as soon as possible, even if the ship is not in Europe. Ponant can help by providing its port agent to laboratories for logistic matters.

- **-20deg freezer:**

This freezer is also a Thermofisher freezer and has a 530l volume. The same unload process must be followed: scientist must unload samples as soon as possible.



6. OVEN



This convection oven is located in the dry lab and is available to all scientists for drying samples.

The available volume is 65 liters and temperature is adjustable from 50°C to 250°C.



EQUIPMENTS AVAILABLE FOR SCIENCE OPERATIONS

7. VACUUM PUMPS

Vacuum pumps are mainly utilized for filtering sea water. There are 3 vacuum pumps available for science experiment.

[LEARN MORE](#)



8. ACCUMETER

Rarely used for science operations, this accumulator is available for controlling basic measures such as pH or ORP.



9. STIRRER

There are 2 stirrers available, located in the dry lab.



EQUIPMENTS AVAILABLE FOR SCIENCE OPERATIONS

9. HOODS

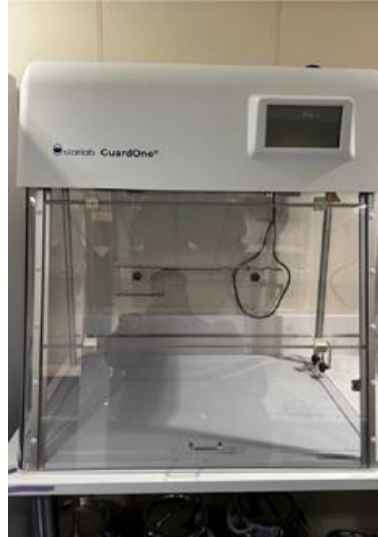
There are 2 different hoods, both located in the dry lab:

- [Laminar Hood:](#)

This hood is mainly used for melting ice samples or manipulating non-bio samples.

- [Chemical Hood:](#)

This hood is used for chemical or bio sensitive manipulations. The anemometer is calibrated every year.



11. ULTRAPURE WATER

This equipment is connected to the distilled water provided by the ship. It enables to get pure water for scientific experiments. The cartridge is regularly replaced. The water inlet is connected on the distilled water pipe supplied by the ship.

[LEARN MORE](#)

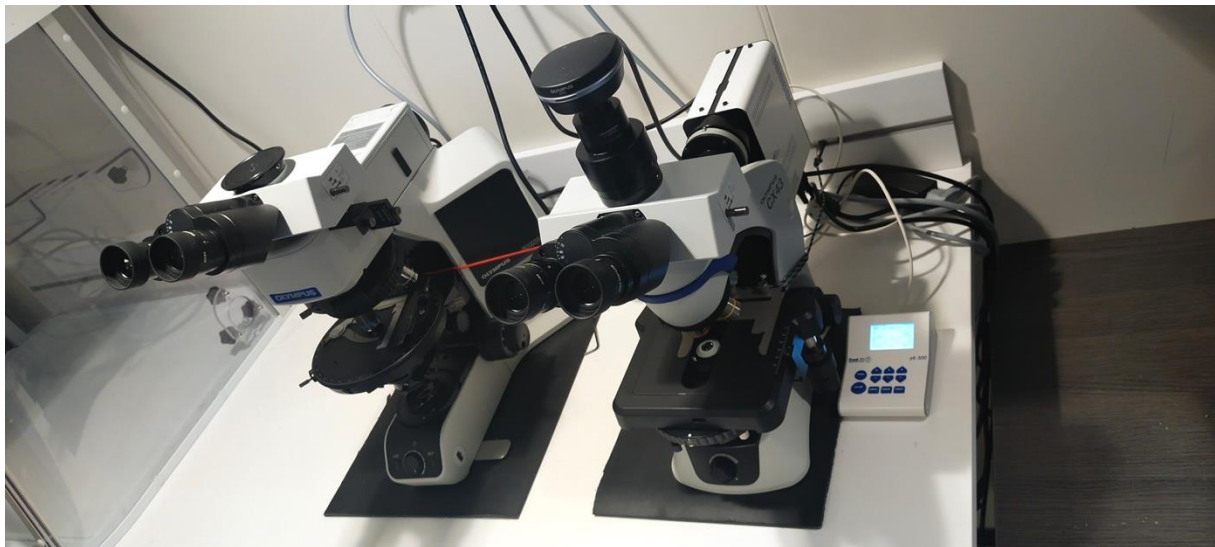


EQUIPMENTS AVAILABLE FOR SCIENCE OPERATIONS

12. MICROSCOPES

1 Biological Microscope: "[Olympus CX43](#)" with "[CoolLED's pE-300lite](#)" illumination for fluorescence microscopy and 1 Industrial Microscope: "[Olympus BX53M](#)" (Microscope Frame : BX53MTRF-S Illuminator :BX3M-KMA-S) are available and located in the dry lab. They are loaded with the DP23 system that enables to record pictures and video. In addition of these 2 microscopes, an [Olympus SZ61](#) with a DP23 camera is available.

This simpler equipment is very relevant for zooplankton or microplastic analysis.



13. WEATHER STATION

An EUCAWS (Shipborne European Common Automatic Weather Station) from French Weather Forecast company METEO FRANCE is set up at Deck10. This station measures temperature, humidity and pressure. All these datas are available on the DSHIP network.



EQUIPMENTS AVAILABLE FOR SCIENCE OPERATIONS

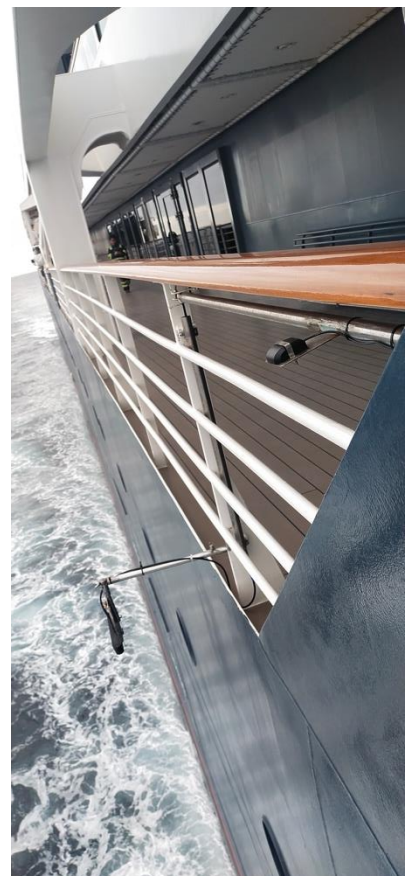
14. SOLAR RADIATION MONITORING

4 sensors (pyranometer, pyrgeometer, ...) installed by italian "CNR" aft of deck 10 to be as much possible free of obstructions. Measuring solar and thermal radiation, UV-A/B, and cloudiness conditions, all those datas are available on DSHIP network.



15. STEREOSCOPIC CAMERA

Installed on deck 5, onward starboard side, this camera records visually tilted ice flows as ship sails through. Datas are recorded on a dedicated interface in the broadcast room.



EQUIPMENTS AVAILABLE FOR SCIENCE OPERATIONS



16. HYDROGRAPHIC ECHO SOUNDER

"Kongsberg EA440" is a high performance hydrographic wide band single beam echo sounder. The echo sounder is developed for hydrographic use in shallow to medium depth waters. It supports portable and hull mounted sidescan. With its 4-channel standard WBT, the EA440 operates across a range of 10 kHz to 500 kHz, transmitting and receiving data simultaneously.

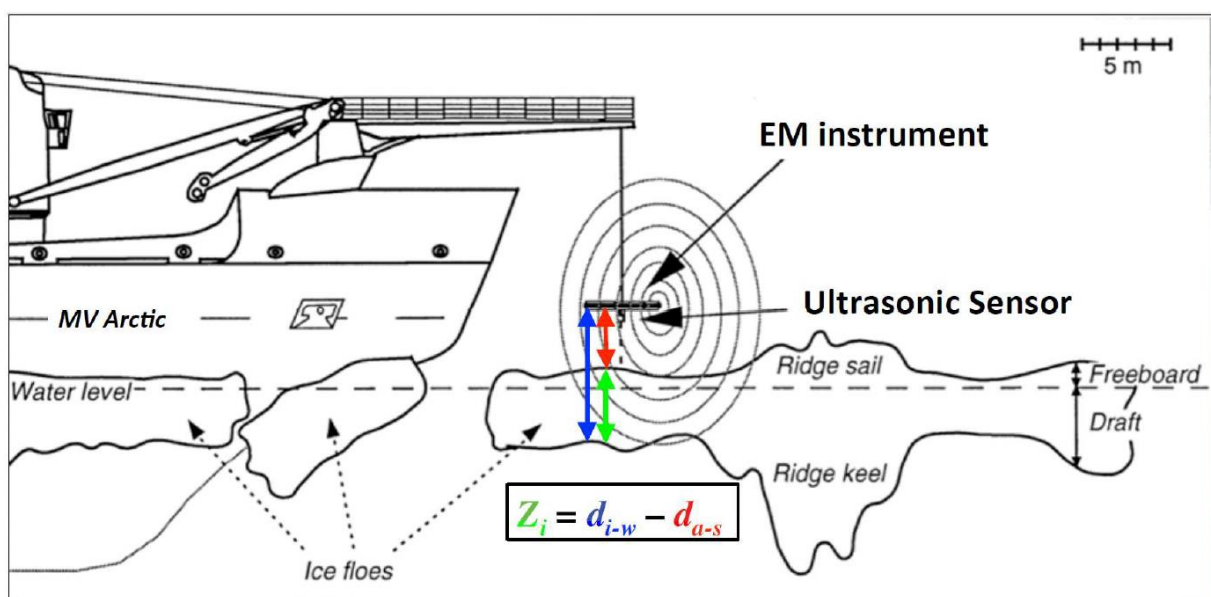
[LEARN MORE](#)

17. SIMS

An electromagnetic sensor coupled with an acoustic doppler is suspended 6-8m in front of the ship allowing to measure the ice thickness.

The data is viewable in real time and downloadable afterwards through DSHIP network.

This equipment is deployed only during ice navigation and requires a 30min set up with 6 people.



EQUIPMENTS AVAILABLE FOR SCIENCE OPERATIONS

OUTDOOR OPERATIONS

1. CTD

For further more information

This equipment is light and easy to operate. The model is a "[RBRmaestro3](#)" equipped with a "[RBRtridente](#)" optical sensor designed to go up to 2000m with a titanium frame datas as salinity, temperature, pressure and dissolved oxygen are monitored, as well as turbidity, backscatter, fDOM, and chlorophyll. The data are acquired through the RBR SW ruskin, either with our tablet (wireless) or with the desktop located in the wetlab. All ruskin files can be exported in excel format and are uploaded on our scinote drive. The sensors are calibrated once a year by the manufacturer.

This CTD can be deployed from zodiac (100m depth cast maximum) or from the ship (1000m depth cast maximum).



2. NISKIN BOTTLES

There are 7 Niskin of 8-liter capacity available on the ship. They can be deployed from the zodiac or from the ship. We are using messengers for multiple Niskin operations sliding on a 6mm dyneema cable.

On this picture, 8 bottles are shown, but one bottle is out of order and will not be repaired. These equipments are now mainly used for plan B or only for zodiac deployment since the purchase of the new carousel.

3. SIPPICAN

This neotek product is able to launch and acquire data from any sippican probes: XBT, XSV, XCBT. It enables to launch sippican probes from a remote location with no power outlet, for example from a zodiac or from the sea ice.



4. ROV



There are 2 ROV on the ship. The first one is a mini ROV, chasing pro- 2. This one is for fast deployment and used for hull inspection. The second one is a revolution deeptrekker.

The revolution ROV can dive up to 300m depth and is equipped with a multi-tool device including arm, caliper, and sediment/water sampler. The deployment of this ROV is not easy and required a certified pilot with specific weather conditions. Current and visibility need to be checked before a cast. This ROV can be deployed either from the ship or from the zodiac. The autonomy of this ROV in good condition is about 30min.

[LEARN MORE](#)

EQUIPMENTS AVAILABLE FOR SCIENCE OPERATIONS

5. MANTA NET

This net is used for microplastic transect and is deployed from a zodiac. The mesh size is 300um. A sieve of 300um is also available for screening plastic particles. The transect are recorded with our tablet and navigation software: time, position, tracks.



6. SEDIMENT GRAB

This Vanveen grab has a 2,500 cm³ volume and can be deployed from the zodiac or from the ship.



EQUIPMENTS AVAILABLE FOR SCIENCE OPERATIONS

7. ICE CORER & AUGERS

An electric drilling motor (StrikeMaster, 40 volts) is available either for the [ice auger \(8"\)](#) or for the ice corer (Kovacs Mark VI) retrieving a 9cm diameter [ice corer](#) & up to 3.5 meters long with extensions. Also available is "[ice thickness kit](#)" with extensions (auger's diameter 2" and up to 4m deep). Electric drill and adaptor available.



8. HYDROPHONE

A simple but efficient hydrophone is available for mammals call recording. This equipment must be deployed at least 3nm away from the ship to avoid too much noise.

Hydrophones Cetacean Research Technology



1. Hydrophone
2. Enregistreur voix / hydrophone
3. Enceinte Bluetooth / Jack
4. Diffuseur sans fil
5. Câble Jack MM >> enregistreur – HP
6. Câble Jack MM >> enregistreur – diffuseur
7. Câble Jack – RCA >> enregistreur – chaîne HIFI
8. 3 câbles USB – mini USB
9. Adaptateur allumecigare _ USB



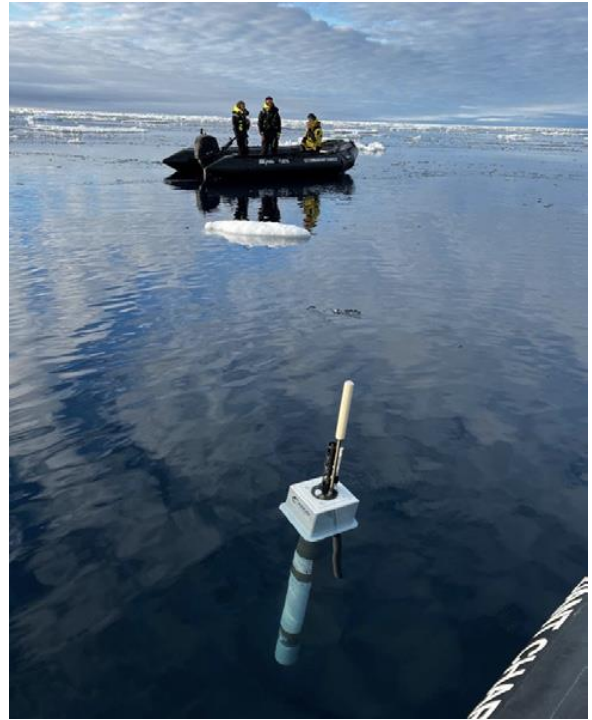
Configuration de base :
Hydrophone + Enregistreur + HP

EQUIPMENTS AVAILABLE FOR SCIENCE OPERATIONS

9. ZODIAC

The ship is loaded with 14 markV milpro zodiac. These zodiacs are equipped with a 70cv Yamaha outboard engine. The science officer is the skipper and is allowed to sail up to 3nm from the ship on a regular basis. The skipper has a portable navigation equipment (GPS + marine chart), AIS VHF and iridium phone for security matters. If the weather conditions are very gentle, with a CAVOK situation, the science officer could be authorized to sail further, depending on the captain decision.

Concerning the communication, 2 handheld VHF are available for the science team in addition to the AIS VHF dedicated to the science officer.



10. SKIDOO

3 Yamaha skidoo are on board. Only one is available for science, since the ship needs to keep the 2 others for passenger's security purpose. With a sledge, only 2 seats are available for scientist: one seat on the skidoo and one seat on the sledge. The pilot is the science officer. He will have the GPS navigation equipment, AIS VHF and iridium phone.



EQUIPMENTS AVAILABLE FOR SCIENCE OPERATIONS

11. SHERP

This industrial vehicle can be used for science operations in certain conditions. It can load 4 scientists and go further than the regular 3 nm distance away from the ship. It is strong enough to load heavy equipment and can offer shelter for adverse weather condition or against polar bear. The science officer or the expedition officer are the pilot of this vehicle.



12. DATA NETWORK

DSHIP is a software developed by the WERUM company. It is the same application used on the polarstern scientific ice breaker. All sensors on board are connected to this network: ferrybox data, pCO₂, weather station, inertial platform for roll and pitch.

However, RBR data, gpx/kml tracks, tablet data, sippican data, are not integrated in this network. DSHIP is loading a local server with all science data that will be available through a ftp server in 2024 for remote access.

The position of the ship is continuously recorded.

The route is also recorded using open CPN application and the final gpx/kml file is loaded on our sicknote drive.

Scinote is a drive-like application and gather all data from each cruise, including RBR, weather station, route, sippican, ship attitude data.

Science team will have to ask the science officer the login email and the associated password.



The science project presentations are also loaded on scinote.

The URL is the following: <https://ponantscience.scinote.net/>

EQUIPMENTS AVAILABLE FOR SCIENCE OPERATIONS

13. PERSONAL EQUIPMENT

Some personal equipments are available for the scientists:

- Science parka
- Regatta suit for cold operations
- Boots.
- Lab coat

It is recommended to bring waterproof pants, polar fleece, waterproof and hot gloves, hat, sun glasses. In some cases, there could not enough jacket for all scientists. As such, it is also recommended to bring your own warm waterproof jacket.



DAILY LIFE ON BOARD

Le Commandant Charcot is a ship but above all is a 5-star hotel. As such, we must pay attention to our behavior and follow the standard rules of the ship. Scientists are not part of the crew and are considered as invited passengers. Hence, they have access to almost all passengers' areas. However, on certain conditions, the hotel manager can restrict access to some areas or set specific time for lunch and dinner.

For all events with passengers (conferences, special dinner) a more formal cloth is mandatory: jacket/tie for men and a dress for women. Bare foot and shorts are prohibited. Before the cruise departure, the science officer is setting up a ship tour and an introductory meeting to introduce the ship rules and the science team organization.

Here under, we present the different rules introduced at the beginning of the cruise to each scientist:

SCIENTIST BOARDING MEMO

- The Science Officer is in charge of your safety, comfort and experiment organization.
- We have a briefing each day at 6.30 pm at the dry lab- deck 3:
 - How was your day: report any hurdles you've experienced?
 - Explain your experiment requirements for the day after: zodiac/ CTD, hike, ice core, underway sampling... to plan your operations with the bridge.
 - Each outdoor experiment needs a bridge permit.
- Do not manipulate ship equipment without Science Officer approval, especially the pump switch located in the wet lab.
- Be careful when plugging your electrical equipment:
 - 10A maximum for the same set of outlets
 - 220V only
 - Plug only PC or laptop on UPS outlet.
- Clean / Rinse labs and equipment after each experiment (ice corer/ CTD/ auger/...).
- There is no housekeeper for science labs, except us.
- Please try to respect the labelled trash bin: plastic vs paper. For other waste, just go to the garbage room and use the appropriate bin.
- Science VHF channel is 68 and Science officer phone number is: 9964. You can use any phone located in the labs to call the Science Officer.
- You are considered as "invited passengers": you have to follow all security and safety announcement dedicated for passengers, i.e. evacuation drill.
- All PAX areas are open to scientists except spa and swimming pool.
- All meals (breakfast, lunch and dinner) are taken at Deck 9: dress code is casual wear (shirt, docker-like pant)
- Deck 9 bar is open vs PAX affluence: seats close to window are for passengers
- If you're invited at restaurant deck 5, the dress code is more formal: blazer and tie for men, dress for women.
- Laundry is possible (free of charge)- deck 4
- A full "regatta" suit is available for long outdoor experiment
- Dunlop boots are available: must be stored in the Wet lab
- Life jacket is mandatory for all outdoor operation
- Wet lab PC is available for the science team. PW: CCHK64//
- A 10 to 15 min presentation of your project is required Day 2 or 3.
- You are allowed to participate to PAX

APPENDIX

PROJECT SELECTION PROCESS

