



SCIENCE OPERATIONAL MANUAL



EXECUTIVE
SUMMARY

Le Commandant Charcot (LCC) is the first-ever cruise expedition vessel designed for extreme polar conditions. She gives the rare opportunity to 200 passengers (maximum) to safely explore remote polar areas while minimizing their impact on the planet through hybrid technology. Le Commandant Charcot is the first hybrid electric ship running on LNG (Liquid Natural Gas). Additionally, LCC uses cutting edge technology for waste control. These advances are major innovations strengthening PONANT's commitment to sustainable tourism.

Due to the ability to sail in very remote, hard-to-access areas, all environmental data gathered is invaluable to the research community. As such, PONANT designed Le Commandant Charcot with integrated equipment and spaces dedicated to scientific research to host scientists conducting experiments. Ponant also created a new position, the science officer, to take care of the researchers and maintain lab equipments.

Thus, le Commandant Charcot is an “**opportunity ship**” for scientific research: it offers a unique versatile platform for observation, research and analysis, and oceanographic data collection. However, it should be clear that the primary mission of *Le Commandant Charcot* is to operate as a cruise ship. Accordingly, the ship's itinerary is designed with passenger experience as the priority. Ponant and the captain of *Le Commandant Charcot* are committed to making every effort to accommodate scientific activities along the cruise route; however, weather conditions or last-minute operational changes take precedence over the scientific program.

Ponant is committed to making its scientific program accessible to passengers. Scientists are asked to present their projects during the cruise. These presentations play an important role in promoting scientific understanding and public engagement.

This document provides a comprehensive overview of the information required for scientists planning to embark on *Le Commandant Charcot* and utilize the vessel's facilities and equipment during its cruises. A general description of the available equipment is included. Please contact the science officer directly for any questions related to onboard equipment and facilities.

Science Officer Contact: sciencecoordinator.commandantcharcot@ponant-ships.com

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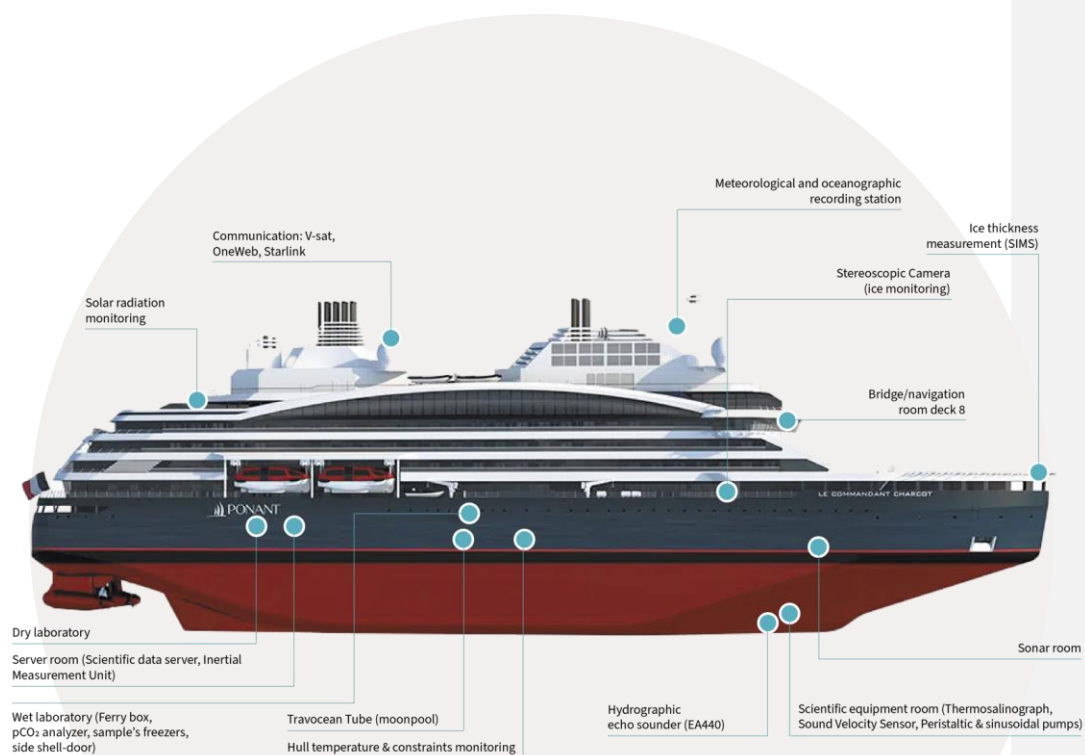


SHIP'S DATA

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 approximately 40m². This is the main room used for equipment set-up and filtrations. Several drains help to evacuate sea water to the ship's tanks and the floor is easily washable. The shell door allows for the possibility 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 if the ship is stopped. In this lab, you will find the two main underway instruments: the FerryBox and the pCO₂ system.



SCIENTIFIC LABORATORIES

2. DRY LAB

This is the main room for office work and meetings, open daily from 08:00 to 20:00. Please refer to the *Laboratory and Safety* document for all rules and safety procedures. The lab is equipped with 2 sinks, 2 fume hoods, 2 microscopes, 1 binocular microscope, 1 Milli-Q water system, and 1 refrigerator



3. SERVER ROOM

The server room houses our data center and two desks. In addition, it is used to store equipment and luggage for the research teams coming onboard. Please note that all equipment must be removed following participation in a ponant cruise, we can not store scientific equipment onboard. An Inertial Measurement Unit (IMU) is also located in this room to record the ships motion.



EQUIPMENT 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 (Scientific pump):**

This pump is located at the very bottom of the ship (deck 0) and provides seawater to the ferry box, the pCO₂ wet box, and to all the sinks in the wet lab. Its flow rate is about 5m³/h, e.g., 80l/min. This pump can run 24/7 and we have yet to experience a limitation on the sea water available for external equipment.

The piping is equipped with an SBE 38 (to measure true SST) and a Valeport miniSVS (sound velocity sensor). These data are collected by the FerryBox and the Wet Lab PC running SODA software.



- **Peristaltic pump:**

This pump is also located on deck 0 and uses the same water inlets. This pump provides seawater to sinks located in both the wet and 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 when needed and is capable of continuous operation.



- **Sinusoidal pump:**

This pump is capable of handling larger solids while minimizing damage to cells. The piping is constructed from PVDF, enabling the safe transfer of both neutral and aggressive liquids from seawater intakes to the laboratories. The pump features an adjustable flow rate to accommodate varying operational requirements.



EQUIPMENT AVAILABLE FOR SCIENCE OPERATIONS

2. FERRY BOX

Our ferry box comes from Jena Engineering, and is equipped with 4 sensors:

- **SBE45 and SBE38:**

SBE45 Thermosalinograph (TSG) is installed in the ferry box and the SBE38 Oceanographic Thermometer is installed at deck 0 (at the start of the seawater pipes). Both are calibrated annually and an automatic acid wash is performed daily during operations. The ferry box is stopped whenever the ship is anchored in a harbor.

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- **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.

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- **pCO₂:**

This sensor, provided by Jena Engineering, provides a reliable trend of dissolved CO₂. It is useful for monitoring technical trends in CO₂ levels in conjunction with O₂ measurements. For more accurate and relevant measurements of pCO₂, data from the General Oceanics equipment should be used

- **pH**

This pH measurement is optical and is calibrated as frequently as possible, typically on a weekly basis. It should be noted that this sensor is intended primarily as a technical instrument to monitor the FerryBox acid wash. The pH values obtained are not considered scientific measurements and should be interpreted with caution regarding their accuracy.



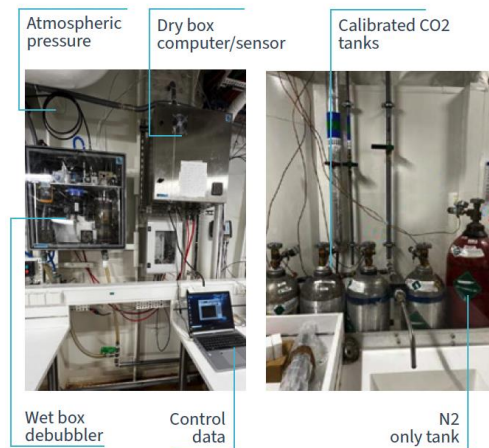
EQUIPMENT AVAILABLE

SCIENCE OPERATIONAL MANUAL

SCIENCE OPERATIONS

3. pCO₂

This equipment is provided by General Oceanic and was installed by Denis Pierrot from NOAA, who remains the primary point of contact for its operation, maintenance and calibration. The instrument provides exceptional accuracy, with a precision of ± 2 ppm. Calibration is performed every six hours using a calibrated tank stored in the Wet Lab. Data are transmitted to the NOAA laboratory via the Iridium network and are also recorded locally on the DSHIP network at one-minute intervals. This system measures both dissolved CO₂ in seawater and atmospheric CO₂ concentrations.


[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 SBE9+ 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.

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EQUIPMENT AVAILABLE FOR SCIENCE OPERATIONS

5. FREEZER

There are 2 freezers available to store research samples

- **-80deg freezer:**

This freezer is a Thermo Fisher TSX series with a capacity of 730 L. Despite its relatively large volume, it is widely used by most research teams. Therefore, all stored samples must be removed directly following a cruise. Ponant can assist by coordinating with its port agents to support laboratories with logistical arrangement.

- **-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 immediately following their cruise.



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.

EQUIPMENT AVAILABLE FOR SCIENCE OPERATIONS

7. VACUUM PUMPS

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

[LEARN MORE](#)

8. ACCUMETER

Rarely used for science operations, this accumulator is available for trolling 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 ships distilled water supply and provides purified water for scientific experiments. The purification cartridge is replaced regularly. The water inlet is connected directly to the ships distilled water piping.

[LEARN MORE](#)

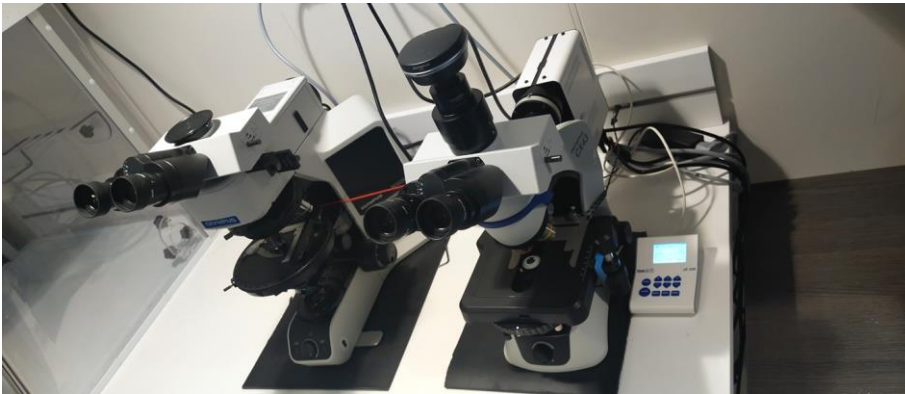


EQUIPMENT AVAILABLE FOR SCIENCE OPERATIONS

12. MICROSCOPES

- **1 Biological Microscope:** *Olympus CX43* with *CoolLED pE-300lite* illumination for fluorescence microscopy.
- **Industrial Microscope:** *Olympus BX53M* (Microscope Frame: BX53MTRF-S; Illuminator: BX3M-KMA-S).

Both microscopes are located in the Dry Lab and are equipped with the DP23 system, which enables image and video recording. In addition, an *Olympus SZ61* stereo microscope with a DP23 camera is also available.



13. WEATHER STATION

An **EUCAWS** (Shipborne European Common Automatic Weather Station) from the French weather forecasting company **Météo-France** is installed on Deck 10. This station measures temperature, humidity, and atmospheric pressure. All data are accessible via the DSHIP



network

EQUIPMENT AVAILABLE FOR SCIENCE OPERATIONS

14. SOLAR RADIATION MONITORING

4 Four sensors (pyranometer, pyrgeometer, etc.) have been installed by the Italian Research Center (**CNR**) and are located on Deck 10 (to minimize obstructions). They measure solar and thermal radiation, UV-A/B, and cloud cover. All data are available on the DSHIP network



15. STEREOSCOPIC CAMERA

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



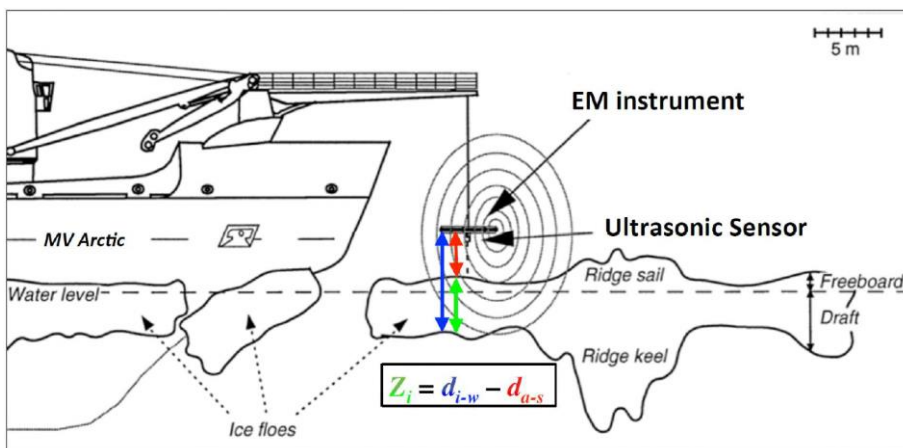
EQUIPMENT AVAILABLE FOR SCIENCE OPERATIONS

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.



EQUIPMENT AVAILABLE FOR SCIENCE OPERATIONS

OUTDOOR OPERATIONS

1. CTD

This equipment is light and easy to operate. The model is a "[RBR Concerto](#)" equipped with a "[RBRtridente](#)" optical sensor designed to go up to 2000m with a titanium frame. Data such 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. 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

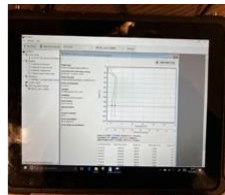
There are 7 Niskin of 8-liter capacity available on the ship. They can be deployed from the zodiac or from the ship. We are using messengers for multiple Niskin operations sliding on a 6mm dyneema cable.

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.

EQUIPMENT AVAILABLE FOR SCIENCE OPERATIONS

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.

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EQUIPMENT 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.



EQUIPMENT 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 allume-cigare – USB



Configuration de base :
Hydrophone + Enregistreur + HP

EQUIPMENT AVAILABLE FOR SCIENCE OPERATIONS

Commented [MC1]: Transport Methods

9. ZODIAC

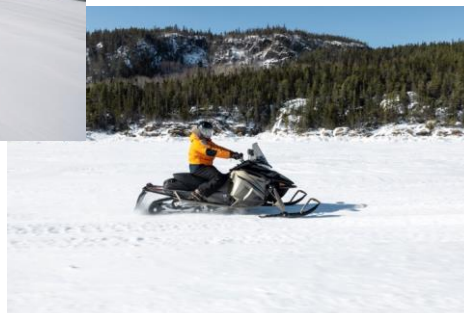
The ship is loaded with 14 markV milpro zodiac. These zodiacs are equipped with a 70cv Yamaha outboard engine. The science officer is the skipper and is allowed to sail up to 3nm from the ship on a regular basis. The skipper has a portable navigation equipment (GPS + marine chart), AIS VHF and iridium 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.



Dship Access - Werum Data NetWORK

DSHIP ACCESS

Overview of DSHIP

DSHIP is a data management and display platform designed for research vessels like *Le Commandant Charcot*. Through DSHIPs, researchers can connect to the scientific and nautical sensors on board to collect and process data. Users can display and analyze this data in real-time via a user-friendly interface. This system ensures that scientific and operational data are captured, monitored, and accessible to all scientists on board.

Accessing DSHIPs Onboard

Scientists on board can access DSHIP through the ship's scientific network. Any computer connected to the network can open the DSHIP interface for data visualization and extraction without requiring a separate login.

- **Main Display Interface:** <http://dship1:8080/dship-web> – This link provides displays for viewing real-time data from various sensors (e.g., GPS coordinates, weather station data, ferrybox data).
- **Data Extraction:** <http://dship1:8080/dship-extraction> – Data collected from past cruises can be extracted via this link. Scientists can retrieve data for further analysis without needing additional access credentials.

Note: The login prompt that may appear when accessing displays is optional. It is only necessary if users have saved specific display configurations or require admin options. For general access and data retrieval, you can ignore the login prompt and proceed without credentials.

External Access to the DSHIP Archive

This access allows for the retrieval of archived data once back onshore allowing for long-term data storage and further data handling post-expedition.

- **DSHIP Web Archive:** <https://charcot.werum.de>

Example Parameters Captured by DSHIP

The DSHIP system collects a wide range of parameters from multiple onboard sensors, organized by device type. Here are some examples:

- **GPS Sensors:** Longitude, latitude, speed, magnetic variation.
- **Weather Station:** Air pressure, relative humidity.
- **Ferrybox System:** pH, conductivity, salinity

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. Information on how to access DSHIP Can be found at the end of this guide. The position of the ship is continuously recorded. The route is also recorded using open CPN application.



EQUIPMENT AVAILABLE FOR SCIENCE OPERATIONS

13. PERSONAL EQUIPMENT

Some personal equipment is available for the scientists to borrow:

- Science parka
- Boots.
- Lab coat

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



DAILY LIFE ON BOARD

Le Commandant Charcot is first and foremost a five-star hotel. Accordingly, all personnel must conduct themselves appropriately and adhere to the standard rules of the ship. Scientists are considered as invited passengers; however they do not have access to all passenger areas and facilities. Please be aware that hotel manager may, under certain circumstances, restrict access to specific areas or designate particular times for lunch and dinner. Please see the predeparture guide for more details. It is important to note that all events with passengers (conferences, special dinner) require formal clothing (i.e. a jacket/tie for men and a dress or suit for women). Shorts are prohibited. At the start of the cruise, the Science Officer will organize a ship tour as well as present the ship's rules and the organization of the science team along with presentations to the captain and directors onboard.

Please note the following information:

SCIENTIST BOARDING MEMO

- The Science Officer is in charge of your safety, comfort and experimental organization.
- As invited passengers, you are required to comply with all safety and security instructions issued for passengers, including participation in evacuation drill
- Typically, a daily briefing will be conducted at 6.30 pm in the dry lab (deck 3):
 - How was your day: report any difficulties 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.
 - Please note that all outdoor operations need to be validated by the bridge crew (via a bridge permit)
- No ship equipment is to be used without prior approval of the science officer, especially the pump switch located in the wet lab.
- Be careful when plugging in your electrical equipment:
 - 10A maximum for the same set of outlets
 - 220V only
 - Plug only PC or laptop on UPS outlet.
- Clean / Rinse equipment after each use (ice corer/ CTD/ auger/...).
- Please keep science spaces tidy -there is no housekeeper for science labs, except us.
- Please ensure that waste is sorted according to the labeled bins: plastic versus paper. For all other types of waste, please use the appropriate bins in the garbage room
- 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.
- 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 business casual
 - Please leave seats closest to the windows for paying passengers
- If you're invited at restaurant deck 5, the dress code is formal i.e. blazer and tie for men, dress for women.
- Laundry is possible (free of charge)- deck 4
- Dunlop boots are available: must be stored in the Wet lab
- Life jacket is mandatory for all outdoor operations
- Wet lab PC is available for the science team. PW: CCHk64//
- A 15-30 min presentation of your project is required at the start of the cruise

