ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

EXPEDITION PROGRAMME PS110

Polarstern

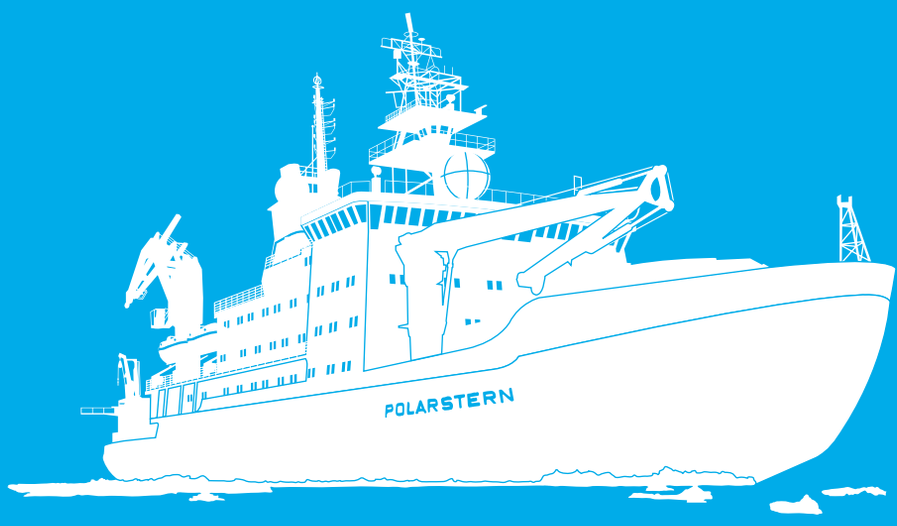
PS110

Bremerhaven - Cape Town

20 December 2017 - 15 January 2018

Coordinator: Rainer Knust

Chief Scientist: Frank Niessen



Bremerhaven, November 2017

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1. ÜBERBLICK UND FAHRTVERLAUF

Frank Niessen
Alfred-Wegener-Institut

Die Überfahrt von Bremerhaven beginnt am 20.12.2017 mit Zwischenstopp in Las Palmas (Kanarische Inseln) am 27.12.2017 und endet am 15.01.2018 in Kapstadt (Südafrika).

Die wissenschaftlichen Arbeiten an Bord sind während der gesamten Reise ausschließlich logistischer Natur in Form von Installationen und Tests neuer sowie erneuerter, erweiterter und/oder reparierter Geräte, die auf den nachfolgenden Expeditionen der *Polarstern* in der südlichen und nördlichen Hemisphäre an Bord eingesetzt werden sollen. Von daher gibt es für PS110 mit Ausnahme der routinemäßig *en route* registrierten Luft- und Wasserparameter (Temperatur/Salinität) kein wissenschaftliches Programm und keine Datenerhebung zu Forschungszwecken.

Von Bremerhaven bis Las Palmas werden Installationen und Tests einer neuen Radiosonde für die Atmosphärenforschung stattfinden, die von der Atmosphärengruppe des AWI durchgeführt werden. Zwischen Las Palmas und Kapstadt werden von der Logistik des AWI-Bremerhaven neue wissenschaftliche Multifrequenzlote (EK80, fest installiert und mobil) sowie ein Mini ROV getestet. Zudem wird die PARASOUND-Anlage ab dem Englischen Kanal bis nach Las Palmas unter der Aufsicht der Geophysik des AWI-Bremerhaven im Dauerbetrieb überprüft. Während ausgesuchter Strecken *en route* bis Kapstadt wird ein Testprogramm für neue PARASOUND-Funktionen durchgeführt und dokumentiert. Ebenfalls entlang der gesamten Strecke von PS110 soll das reparierte Bordmagnetometer von einem Mitarbeiter der Fa. ESYS auf Funktion geprüft bzw. optimiert und neu kalibriert werden. Dazu gehört auch das Fahren eines Doppeldrehkreises vor der südatlantischen Insel St. Helena, auf der das GFZ-Potsdam ein magnetisches Observatorium betreibt, so dass die Kalibrierung validiert werden kann.

Zudem finden Routinearbeiten des DWD in der Bordwetterwarte statt, bei der neben der Stammbesetzung zu Ausbildungs- und Erfahrungszwecken ein zusätzlicher Meteorologe des DWD beteiligt sein wird.

SUMMARY AND ITINERARY

The passage from Bremerhaven will start on 20 December 2017 with a short stopover in Las Palmas (Canary Islands) on 27 December 2017 and will end in Cape Town (South Africa) on 15 January 2018.

During the entire journey the scientific work on board will be entirely focussed on logistics including installation and testing of new, renewed, upgraded and/or repaired equipment, which is needed for scientific data acquisition during the forthcoming expeditions of *Polarstern* in the southern and northern hemispheres.

From Bremerhaven to Las Palmas, hardware and software upgrades will be performed by AWI engineers and technicians of the radio-sounding system used for atmospheric research. From Las Palmas to Cape Town the AWI Logistics Department will test new scientific multi-frequency echosounders (EK80, ship mounted and mobile) and a mini ROV. Between the English Channel and Las Palmas the recently repaired und upgraded echosounder PARASOUND will be undergone a non-stop running check under the supervision of the Geophysics Section of AWI. In addition, along selected sections of the track to Cape Town, new PARASOUND functions are tested and documented. Along the entire track line of PS110, the re-engineered hull mounted magnetometer system will be tested, optimized and re-calibrated. This includes the performance of turning circles of the vessel, preferentially off the island of St Helena (South Atlantic), where the GFZ in Potsdam is operating a magnetic observatory allowing the validation of the calibration.

Routinely the permanent meteorological station on board is run by the DWD. In addition to the meteorologist and technician a second meteorologist of the DWD will participate for training purposes and to gain experience.

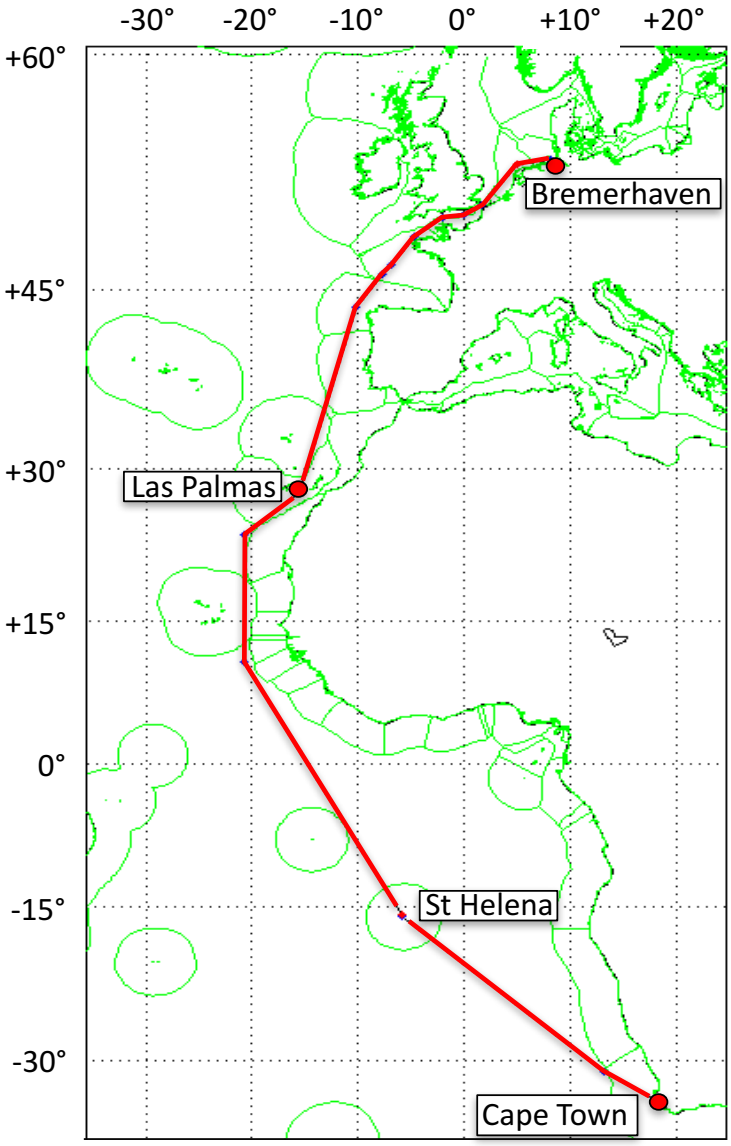

Abb.1.1: Fahrtroute Polarstern während der Expedition PS110 von Bremerhaven über Las Palmas und St. Helena nach Cape Town

Fig. 1.1: Planned track of Polarstern during PS110 from Bremerhaven via Las Palmas and St Helena to Cape Town

2. UPGRADE OF HARD- AND SOFTWARE OF THE RADIO SOUNDING SYSTEM ON *POLARSTERN*

L. Probst (AWI), J. Graeser (AWI), H. Deckelmann (AWI)

Objectives

On this cruise, the currently installed radio sounding system will be upgraded to the MW41 system. To be compatible with the new software, both processing PC's (operating and spare) will be replaced by new hard- and software which is programmed for the special needs onboard *Polarstern*. Both DIGICORA (operating and spare) systems will get a software upgrade.

Work at sea

The anticipated work will include validation of the results generated by the new system under real use conditions as well as monitoring the behaviour of the new software to prevent misbehavioTr in the future. In addition to that, verification of the system interaction with the network and fixing any occuring early stage problems will be carried out.

Expected results

The aim is to provide a stable, operational system to continue the radio soundings on *Polarstern* which is compatible with the new type of radiosonde manufactured by Vaisala.

3. CALIBRATION AND TESTING OF THE SHIP-MOUNTED MAGNETOMETER SYSTEM ON *POLARSTERN*

C. Kopsch (ESYS), G. Eagles (AWI, not on board)

Objectives

During *Polarstern* expeditions the ship-mounted vector magnetometer system is routinely used for surveying geomagnetic anomalies below the sea floor. The location of the board magnetometer is the platform of the "crow's nest" above the bridge. The magnetometers are installed in form of gradients. Vector magnetometers (3-component digital fluxgate magnetometers) were developed by MAGSON GmbH (Berlin) and adapted for using it specifically on *Polarstern*. From October to November 2017, the magnetometer has been taken off the ship for maintenance and re-engineering and is being reinstalled on board prior to leg PS110. For future accurate determination of geomagnetic components of the sea floor it is necessary to detect and remove transient interferences from the magnetosphere and ionosphere together with temporary induced remanent magnetizing effects of the ships. This requires a complete reset, re-calibration and testing of the system at sea in order to accurately determine the calibration coefficients.

Work at sea

In addition to testing and monitoring data acquisition of the system *en route* PS110, it is necessary to let the vessel perform turning circles. The data acquired during circles are needed to detect changes of the magnetic properties of the ship including the carried cargo and/or slow-growing magnetization of the hull. This is only possible if the magnetic field of the earth is known at the location when of the turning circle is performed. Under normal conditions the International Geomagnetic Reference Field (IGRF) of the Earth is used. This can be critical,

however, if the calculations of the geomagnetic field below the ship are based on data from IGRF stations, which are long distances away from the actual position of the vessel. For a sophisticated new calibration of the system it is necessary to perform the turning circles in the neighbourhood of a geomagnetic observatory. Thus, we plan to let the vessel perform turning circles with geomagnetic data acquisition off the island of St Helena, where the GFZ-Potsdam operates a geomagnetic observatory (15.961 S, 5.747 W). The requirement is a “double-8-circle” a the ships velocity of 5 kn, one full circle each with a diameter of 2 nm over starboard and portside, respectively. The sampling rate of the geomagnetic system is 1 second. During acquisition data are transferred from the magnetometers to an industrial PC located in the ship's data centre via a fibre optic cable. *En route* the PC is also receiving navigation data through the data network of the vessel. Data output is twofold, (i) as graphical plots onto the display of the PC, and, (ii) into the main ship-data base (DShip) for further downloading according to scientific requirements.

Expected Results

- Successful operation of the magnetic data acquisition including correct entanglement with shipboard navigation data and storage.
- Determination of geomagnetic calibration coefficients of *Polarstern* using both data acquired during turning circles and simultaneously monitored by the observatory.
- Leaving behind a fully operational and calibrated shipboard magnetic observation system for forthcoming *Polarstern* expeditions.

4. TESTING OF A MINI ROV (BLUEROV2) WITH WATERLINK SYSTEM OPERATED FROM SHIP'S WORKING BOAT

S. Krägefsky (AWI)

Objectives

BlueRov2 is an open-source Mini ROV with a high propulsions performance showing very active development in underwater positioning and maneuvering of the vehicle. This Mini ROV, among others, may serve as a working (e.g. line deployment) and inspection tool during demanding echosounder calibration exercises. Objective of the work at sea is to test the performance of the Waterlink underwater positioning system and maneuvering performance of the BluRov2 while being operated from ship's working boat and exposed to ship's sound.

Work at sea

Tests of the performance of the Waterlink underwater positioning system and of the BluRov2 maneuvering performance will be performed with help of the ship's working boat, carrying the hydrophone array of the Waterlink underwater positioning system. Tests include defined travel to different positions in the horizontal and vertical plane performed at different distances to the ship and with different orientations relative to the flow direction.

Expected results

Assessment of the performance of the Waterlink underwater positioning system, BlueRov2 maneuvering performance and operational capability operated with the ship's working boat.

5. TESTING OF THE MULTI-FREQUENCY ECHOSOUNDER SIMRAD EK80

S. Krägefsky (AWI)

Objectives

Measurements with Simrad EK60 are the international quasi standard for stock assessment of fish and krill. This echosounder is no longer commercially available and has been replaced by the Simrad EK80. Besides measurements in continuous wave mode ("EK60 mode"), the EK80 allows operation in frequency-modulation mode (FM mode), potentially allowing a highly improved species identification based on scattering response of surveyed organisms over a wide frequency band. In addition, measurements in FM mode should allow specific de-noising of the data record in the further.

Objective of the work at sea is to test the performance of the ship-mounted Simrad EK80 and a mobile Simrad EK80 WBT tube after major firmware and software update, implementing among others new signal forms during operation. Additional aim is the examination of the self-noise of the echosounders and assessment of the impact of ship's noise on measurements in different measuring modes.

Work at sea

Measurements with the ship-mounted Simrad EK80 will be performed during ship transit with a set of signal form settings in active and passive mode.

At station, the Simrad EK80 WBT tube (mobile Simrad EK80) will be deployed to the side of the ship while the ship is slowly drifting with the current. A small sphere attached with lines to the mounting frame of the mobile Simrad EK80 serves as a reference target for the measurements. Measurements will be performed with different signal form settings in active and passive mode. Alternating measurements will be performed with the ship-mounted Simrad EK80. During these measurements comparative measurements will be made by means of a hydrophone bow side near the ship-mounted EK80 transducer and near the mobile EK80 during active and passive operation.

Expected results

Assessment of the performance of ship-mounted and a mobile (WBT tube) scientific multi-frequency echosounder Simrad EK80 after major firmware and software update, including the impact on measurements by echosounders's self-noise and ship's noise.

6. PARASOUND SEDIMENT ECHOSOUNDER UPGRADE PS3MK2: TESTING AND ADAPTATION

F. Niessen, S. Hanisch (AWI)

Objectives

On *Polarstern* the ship-mounted parametric echosounder PARASOUND is a highly sophisticated acoustic tool for exploring marine sedimentary environments and for surveying sea-floor and sub-bottom sampling stations during expeditions in both hemispheres. In June 2017 the standard system PS3-P70 was successfully upgraded to PS3MK2-P70 by Teledyne

RESON, which includes significant modifications in both hardware and software components. These modifications require further and intensive testing at sea in different sedimentary environments, where PARASOUND data from previous expeditions exist, such as along the track of PS110 from Bremerhaven to Cape Town. One major modification in hardware and software is the implementation of the frequency-modulated (chirped) wave for water depth of more than 150 m in addition to the previously used continuous waves. A major objective is to carry out numerous tests in different environments to explore optimal adjustments for pulse control, pulse extensions and frequency ranges in order to achieve better penetration and/or resolution of sub-bottom data. Further objectives are (i) a reliability test for long-term operation after a major electronic failure during the previous expedition PS114, and (ii), the documentation of newly available features of the system in terms of handling and scientific relevance.

Work at sea

For the purpose of system testing PARASOUND will be in continuous operation from Bremerhaven to Las Palmas, and on parts of the track from Las Palmas to Cape Town (documentation only, no data storage while track is within EEZ). This work will include:

1. Adjustments of previously used settings (continuous wave) in new software windows Basic Settings, Watch Keeping and Applied Date for Single Pulse, Quasi-Equidistant and Pulse Train transmission
2. Testing numerous variations in frequency modulated mode (frequency range, pulse length, pulse width)
3. Documentation of software bugs, tentative improvements
4. Documentation of optimal settings in different environments
5. Documentation of handling new software components for users on board
6. Comparisons of test results with previous data along the track.

Expected results

We expect information about the reliability of the system under expedition conditions. The use of previous system settings and optimal chirp settings will be provided in documented form for the users of the forthcoming expeditions PS111 to PS115 during some of which PARASOUND will be used extensively.

7. TEILNEHMENDE INSTITUTE / PARTICIPATING INSTITUTIONS

	Address
AWI	Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung Postfach 120161 27515 Bremerhaven Germany
DWD	Deutscher Wetterdienst Geschäftsbereich Wettervorhersage Seeschifffahrtsberatung Bernhard Nocht Str. 76 20359 Hamburg Germany
ESYS	ESYS GmbH Hardware & Software Schwedter Str. 34a 10435 Berlin Germany

8. FAHRTTEILNEHMER / CRUISE PARTICIPANTS

Name/ Last name	**Vorname/ First name**	**Institut/ Institute**	**Beruf/ Profession**	**Fachbereich/ Discipline**
Deckelmann	Holger	AWI	Technician	Atmospheric Physics
Graeser	Jürgen	AWI	Technician	Atmospheric Physics
Hanisch	Sabine	AWI	Scientist	Geophysics
Hempelt	Juliane	DWD	Technician	Meteorology
Jens	Holger	DWD	Scientist	Meteorology
Kopsch	Conny	ESYS	Engineer	Geophysics
Krägefsky	Sören	AWI	Scientist	Logistics
Miller	Max	DWD	Scientist	Meteorology
Niessen	Frank	AWI	Chief Scientist	Geophysics
Probst	Lewin	AWI	Engineer	Atmospheric Physics

9. SCHIFFSBESATZUNG / SHIP'S CREW

No.	Name	Rank
01.	Schwarze, Stefan	Master
02.	Grundmann, Uwe	1.Offc.
03.	Farysch, Bernd	Ch. Eng.
04.	Langhinrichs, Moritz	EO Ladung
05.	Fallei, Holger	2.Offc.
06.	Fischer, Tibor	2.Offc.
07.	Rudde-Teufel	Doctor
08.	Christian, Boris	Comm.Offc.
09.	Grafe, Jens	2.Eng.
10.	Krinfeld, Oleksandr	2.Eng.
11.	Haack, Michael	2. Eng.
12.	Brehme, Andreas	Elec.Techn
13.	Frank, Gerhard	Electron.
14.	Hüttebräucker, Olaf	Electron.
15.	Nasis, Ilias	Electron.
16.	Himmel,Frank	Electron
17.	Loidl, Reiner	Boatsw.
18.	Reise, Lutz	Carpenter
19.	Hagemann, Manfred	A.B.
20.	Winkler, Michael	A.B.
21.	Scheel, Sebastian	A.B.
22.	Bäcker, Andreas	A.B.
23.	Brück, Sebastian	A.B.
24.	Wende, Uwe	A.B.
25.	Klee, Philipp	A.B.
26.	Löscher, Steffen Andreas	A.B.
27.	Preußner, Jörg	Storek.
28.	Teichert, Uwe	Mot-man
29.	Rhau, Lars-Peter	Mot-man
30.	Lamm, Gerd	Mot-man
31.	Schünemann, Mario	Mot-man
32.	Schwarz, Uwe	Mot-man
33.	Schnieder, Sven	Cook
34.	Silinski, Frank	Cooksmate
35.	Möller, Wolfgang	Cooksmate
36.	Czyborra, Bärbel	1.Stwdess
37.	Wöckener, Martina	Stwdss/KS
38.	Dibenau, Torsten	2.Steward
39.	Silinski, Carmen	2.Stwdess
40.	Golla, Gerald	2.Steward
41.	Arendt, Rene	2.Steward
42.	Sun, Yong Shen	2.Steward
43.	Chen, Dan Sheng	Laundrym.