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

EXPEDITION PROGRAMME PS88

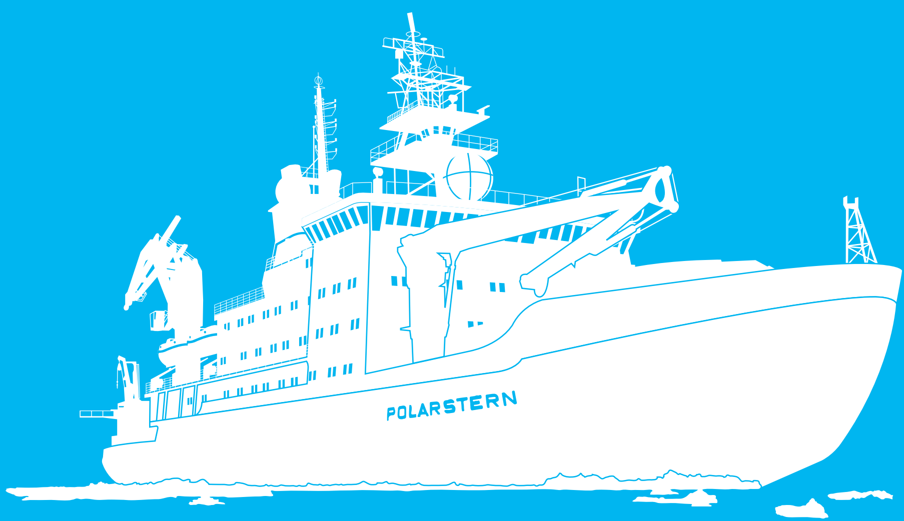
Polarstern

PS88.1
Bremerhaven - Las Palmas
25 October 2014 - 2 November 2014

Chief Scientist: Rainer Knust
Coordinator: Rainer Knust

PS88.2
Las Palmas - Cape Town
2 November 2014 - 29 November 2014

Chief Scientist: Frank Niessen
Coordinator: Rainer Knust



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EXPEDITION PROGRAMME PS88

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1. ÜBERBLICK UND FAHRTVERLAUF

R. Knust, F. Niessen (AWI)

Die Transitfahrt zur dreissigsten Antarktissaison startet am 25.10.2014 in Bremerhaven. Der erste Abschnitt (PS88.1) endet am 02.11.2014 in Las Palmas. Auf diesem Abschnitt wird ein intensives Trainingsprogramm zu hydroakustischen Messverfahren stattfinden, an dem Studenten aus den internationalen Studiengängen der Universität Bremen und des Helmholtz - Graduiertenkollegs POLMAR teilnehmen werden. Die Überfahrt nach Las Palmas wird ebenfalls genützt, um eine neu zu installierende Synchronisationsbox zur Synchronisation der hydroakustischen Geräte zu testen.

Der zweite Abschnitt der 88. Expedition beginnt am 02.11.2014 in Las Palmas. Neben weiteren Gerätetests zur Kalibrierung des EK-60 und des Posidonia-Systems, wird ein ozeanographisches Programm abgearbeitet. Die Arbeiten im Rahmen dieses Programmes sind Teil des Sonderforschungsbereichs SFB754 („Klima – Biogeochemische Wechselwirkungen im Tropischen Ozean“), der BMBF Verbundprojekte SACUS und RACE sowie des Trilateralen (Deutschland, Frankreich, Westafrika) Projektes AWA. Des Weiteren ist geplant auf der Anfahrt nach Kapstadt die Tiefseeverankerung AWI 247-3 zu bergen, verankert auf 20°58.5'S 005°59.1'E. Die Verankerung trägt einen passiv-akustischen Rekorder, SonoVault, um die Anwesenheit der großen Bartenwale in ihren vermuteten, bislang jedoch weitgehend unbestätigten, Brutgebieten zu untersuchen.

Auf dem Weg von Bremerhaven nach Kapstadt werden zwei on-Route Messprogramme durchgeführt: Eine Messkampagne zur Ermittlung von Wolken-, Aerosol- und Wasserparametern (MPI-M, Hamburg), sowie ein Programm zur Messung von kosmischen Strahlen (DESY, Zeuthen).

Die Expedition PS88.2 wird am 2911.2014 in Kapstadt, Südafrika enden.

SUMMARY AND ITINERARY

The transit voyage of the 30th Antarctic Season will begin in Bremerhaven on October 25, 2014. The first cruise leg (PS88.1) will end in Las Palmas on November 2, 2014. During this cruise leg we will conduct an intensive training programme within the field of hydro acoustic measurements. Students from the international courses at the University of Bremen and at the Helmholtz Training Group POLMAR will participate. The transit to Las Palmas will also be used to test a newly installed device for synchronization of hydro acoustic units.

The second leg of the 88th expedition will start in Las Palmas on November 2, 2014. During this leg the EK-60 system and a new Posidonia system will be tested and calibrated. The scientific work will concentrate on an oceanographic program. This work is part of the collaborative research center SFB754 ('Climate-Biogeochemistry Interactions in the Tropical Ocean'), the BMBF joint projects SACUS and RACE as well as the trilateral (Germany, France, NW Africa) project AWA. Steaming towards Cape Town, the deep-sea mooring AWI 247-1, deployed at 20°58.5'S 005°59.1'E, shall be recovered. The mooring hosts a passive acoustic monitoring device, SonoVault, to verify the presence of large Mysticetes species on their supposed, yet largely unconfirmed, breeding grounds.

On the way from Bremerhaven to Cape Town (PS88. + PS88.2), two on-route measuring programs will be carried out: A survey of clouds, aerosol and water measurements (MPI-M, Hamburg) and measurements of galactic cosmic ray induced muons and neutrons (DESY, Zeuthen).

The expedition will end on November 29 in Cape Town.

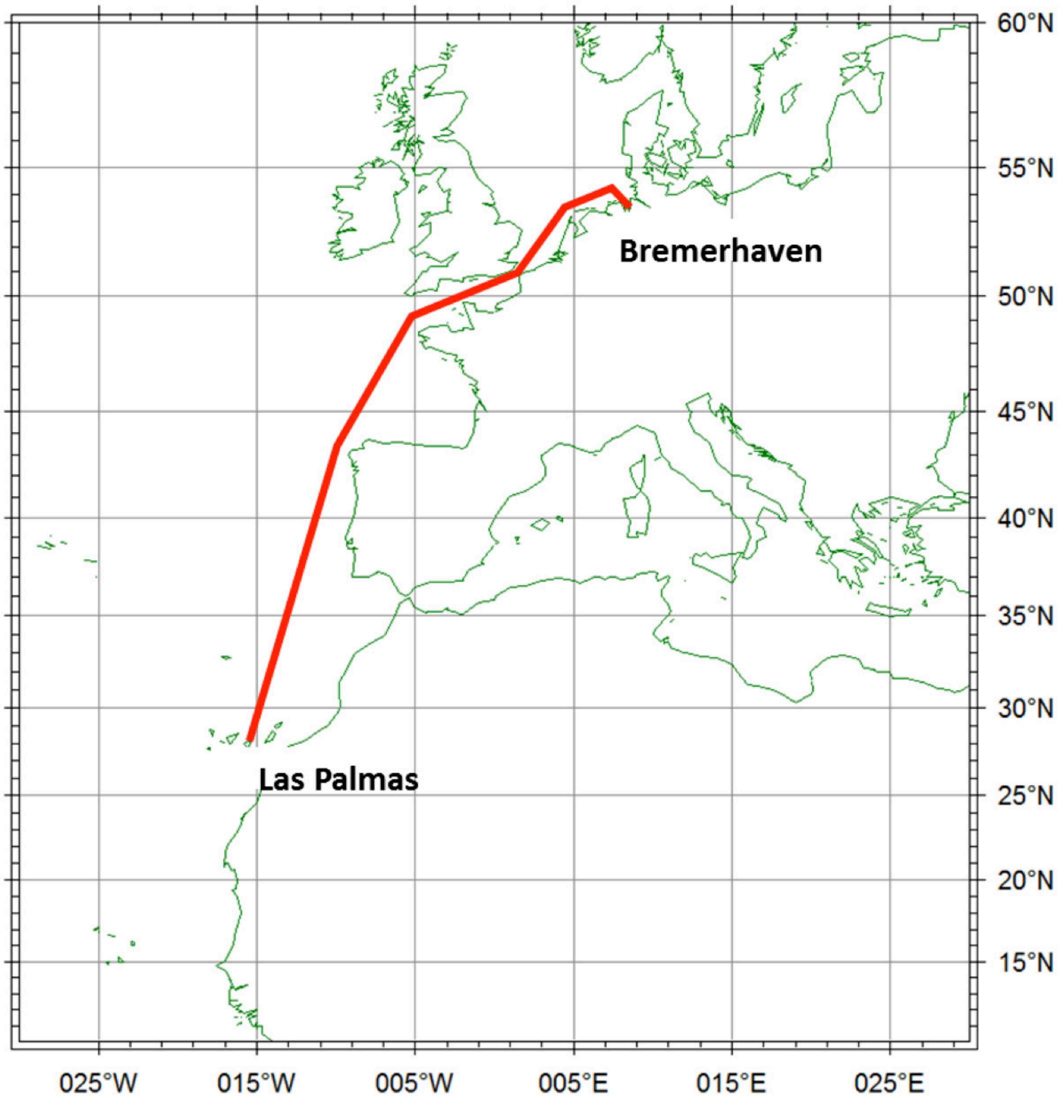

Abb. 1.2: Fahrtverlauf auf dem Abschnitt PS88.1
Fig. 1.1: Course plot leg PS88.1

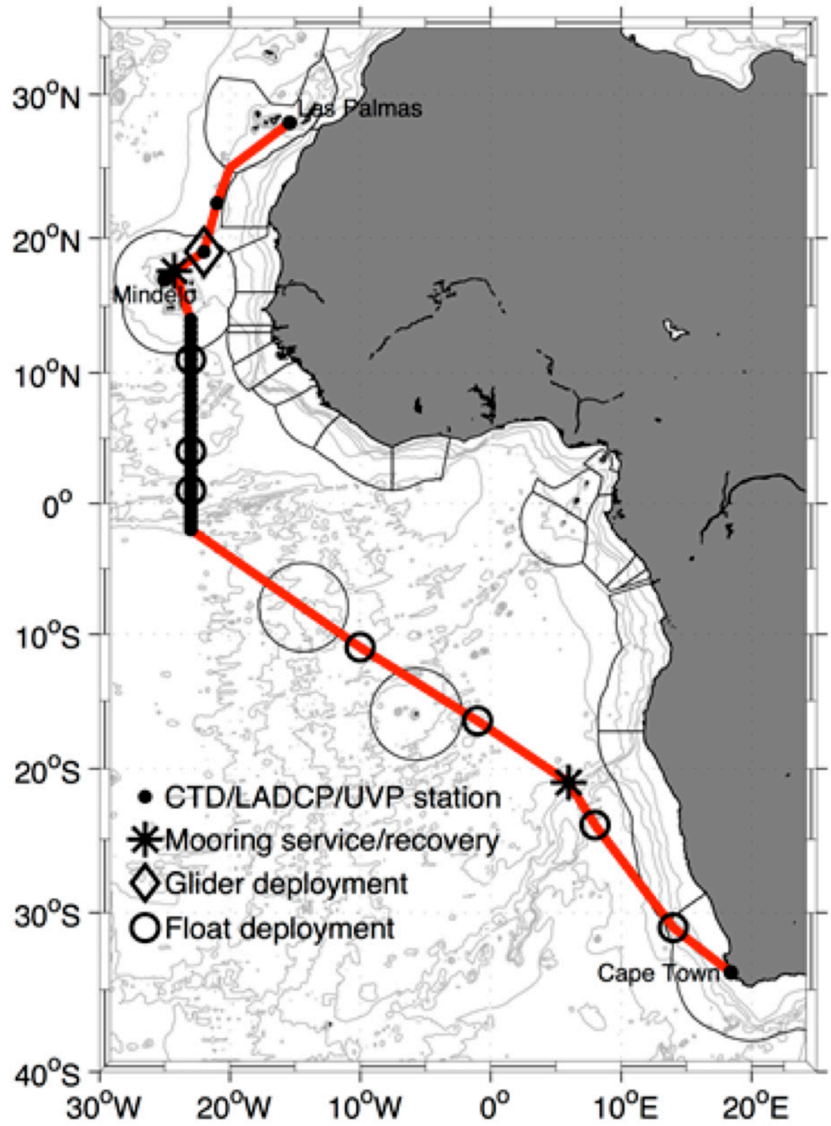

Abb. 1.2: Kurs und Arbeitsgebiete während PS88.2
Fig. 1.2: Course plot and working areas during PS88.2

2. POLMAR-TRAIN: HYDROSWEEP UND PARASOUND TRAINING

C. Hanfland, G. Kuhn, C. Gebhardt, B. Dorschel, J. Klages (AWI)

On the cruise leg between Bremerhaven and Las Palmas (PS88.1), students (both Master and PhD) will be trained to operate the hydro-acoustics systems of RV *Polarstern*. Students will participate in watches, process and edit the data and learn some simple trouble-shooting. They will get familiar with the relevant software and learn to produce maps from the acquired data.

Objectives

The project POLMAR-TRAIN is a course jointly run by the AWI-based Helmholtz Graduate School for Polar and Marine Research (POLMAR) and University of Bremen. It offers Master and PhD students from geosciences a hands-on training in operating the hull-mounted echo sounding systems of RV *Polarstern* (multi-beam echo sounder Atlas Hydrosweep DS3 and sediment echo sounder Parasound P70). Both systems will be operated continuously between Bremerhaven and Las Palmas. The course is part of the programme “Master of Sciences Marine Geosciences” at the University of Bremen as well as of the scientific programme of POLMAR. Both programmes involve ship-based field-work. Lecturers are affiliated with both institutions and jointly offer this training. Students will be trained in data evaluation and interpretation with published and on-route collected examples. One main target is the study of annual migration-rates of the huge sea-floor sand dunes in the British Canal that will be only possible by multiyear data collection.

In the future, the transit times of RV *Polarstern* are planned to be subject for regular ship-based trainings, hence experience from this (and previous) cruises will help to build future proposals, e.g. for future EUROFLEET ship-based training courses in related sciences.

Work at sea

Students will start with two days of introductory lectures at AWI to get familiar with the principles of hydro-acoustic data acquisition, to learn how to use the required software and to be introduced to literature examples. After transfer to the ship, the practical work will start immediately. Participants will be trained in all parts of the system and go on watches (3 x 8 hours in 4-hour shifts). The night watches will be under the responsibility of the students. They will learn about sediment properties, reflector horizons, bottom topography and the principles of sediment acoustics. Practical training on the systems will be complemented through plenary lectures and software training in smaller groups. Participants will also be introduced to survey planning, data handling, editing, and visualization with different kind of profiling and GIS mapping software. Being able to produce a map from originally raw data will be one of the outcomes participants can “take home”.

Besides the watch duty, students will also give a 15 min presentation on their individual research project (Ms or PhD) and the relevance of the course content for their project. Given the composition of participants (Master- and PhD students as well as one Postdoc), participants will greatly benefit from each other. By experience we know that peer-teaching is an added value in every course. Working on a ship will foster this exchange. Master students can further clarify their motivation for their next career step, e.g. whether following a PhD is an option for them.

Expected preliminary results

During the training, data on seabed topography and sediment characteristics will be produced.

Data management

Hydro-acoustic data (multibeam and sediment echosounder) collected during the expedition will be stored in the PANGEA data repository at the AWI. Furthermore, the data will be provided to mapping projects and included in regional data compilations such as IBCSO (International Bathymetric Chart of the Southern Ocean) and GEBCO (General Bathymetric Chart of the Ocean).

References

-none-

3. EASTERN TROPICAL NORTH ATLANTIC OXYGEN MINIMUM ZONE AND EASTERN TROPICAL ATLANTIC CLIMATE VARIABILITY

J. Hahn, Y. Fu, T. Hahn, J. Hauschildt, B. Kisjeloff, T. Klenz, R. Kopte, M. Müller, F. P. Tuchen (GEOMAR), A.-L. Deppenmeier (WU)

The work carried out during this expedition is part of the collaborative research centre SFB754 (‘Climate-Biogeochemistry Interactions in the Tropical Ocean’), the BMBF joint projects SACUS and RACE as well as the trilateral (Germany, France, NW Africa) project AWA. Focus of the SFB754 is the study of the oxygen minimum zones (OMZs) of the eastern tropical North Atlantic (ETNA) and the eastern tropical South Pacific. OMZs are found in all tropical oceans at depths of 100 m - 900 m, where the ETNA OMZ exhibits minimum oxygen concentrations of about 40 µmol/kg. OMZs arise due to the relatively weak ventilation of the eastern boundaries (shadow zones). The oxygen supply to the ETNA OMZ occurs via different ventilation pathways: (i) eastward currents transport oxygen-rich water from the well-ventilated western boundary; (ii) vertical and (iii) lateral mixing contributes to an effective oxygen transport across the boundaries (upper and lower as well as northern and southern boundary) toward the core of the OMZ. In general, measurements, carried out since the 1960s, show a negative oxygen trend in the ETNA OMZ. In addition, repeated ship sections and moored observations, carried out along 23°W since 2008 within the framework of the SFB754, suggest that large-scale oxygen variability in the OMZ also occurs on seasonal to interannual time scales.

The general topic of the projects SACUS, RACE and AWA is the tropical Atlantic climate variability, which is strongly related to the variability of sea surface temperature (SST) in the eastern tropical Atlantic. It has been shown that this SST variability impacts rainfall variability in the tropical Atlantic region and particularly influences the strength and the onset of the West African monsoon thereby affecting droughts and epidemics in West Africa.

The main objective of the expedition is to carry out hydrographic (CTD) and velocity observations (ADCP) along 23°W from 14°N across the equator (minimum until 2°S). In addition, the distribution and abundance of particles, zooplankton and phytoplankton in the water column is measured using an ‘Underwater Vision Profiler 5’ (UVP5), which is attached to the CTD rosette. The UVP data is used to derive a particle-based oxygen consumption rate, which provides an important contribution to the oxygen budget of the OMZ. Continuous underway measurements are carried out to observe temperature, salinity (thermo salinograph) and chemical parameters (underway-system) of the sea surface as well as velocity (ship based ADCP, 150 kHz) and hydrography (Underway-CTD) of the upper water column. Additional tests of oxygen sensors with long-term stability (by attaching them to the CTD rosette) are carried out to characterize their performance.

In the framework of AWA, an autonomous glider is deployed in the upwelling region of the eastern tropical North Atlantic (off Mauritania), which will perform hydrographic measurements in the region between Cape Verde and Senegal in the following 3 months. In comparison to the two previous glider missions, which were carried out during the season of strong coastal upwelling (boreal spring), the currently planned glider deployment is aimed at observing the hydrography during the season with weak coastal upwelling (boreal autumn).

Between the glider deployment and the 23°W section, a CTD cast as well as mooring service (replacement of the top element) at the CVOO (Cape Verde Ocean Observatory) site north of Cape Verde are performed.

During the cruise, 6 floats from BSH (PI Birgit Klein) and one float from GEOMAR (PI Henry Bittig) shall be deployed.

Objectives

The primary goals of the expedition PS88.2 are to investigate:

the connection between hydrographic (oxygen, temperature and salinity) variability and velocity variability in the ETNA OMZ region along 23°W (SFB754)

- the variability of the equatorial current system (at 23°W) with respect to the western boundary current variability (at 11°S) as well as the variability of the poleward, near-coastal flow of water inshore of the Angola Dome (RACE, SACUS), and
- the hydrographic distribution with respect to mesoscale structures in the upwelling region off Mauritania (AWA).

The expedition concerns the following scientific key questions and goals within the framework of the different projects:

- How does subsurface dissolved oxygen in the tropical ocean respond to variability in ocean circulation and ventilation? (SFB754)
- What are the relations and feedbacks linking low or variable oxygen levels and key nutrient source/sink mechanisms in the water column? (SFB754)
- Develop an observing system capable of studying the inter-annual variability in the SACUS region, with a particular focus on the wave responses and advection of water masses from the equatorial region. (SACUS)
- Repercussions of the future circulation on regional heat and freshwater transports and the general interactions between parts of the Atlantic. (RACE)
- Observe physical mechanisms (e.g. eddy formation) and its variability in the upwelling region off Mauritania. (AWA)

Work at sea

At the beginning of the cruise, we will deploy an autonomous glider in the Cape Verdean economic zone. Before the deployment, we will carry out a CTD station further north for sensor calibration. A second CTD station will be done right after the deployment and next to the deployment position.

The next operating position is the CVOO (Cape Verde Ocean Observatory) site at 17.6°N, 24.3°W. A CTD station will be carried out next to the mooring that is located at this position. In addition, the mooring will be serviced by exchanging its top element (surface buoy with about 30 m cable below).

These activities will be followed by a CTD/LADCP/UVP section along 23°W consisting of about 40 profiles. The section will start at 14°N with shallow CTD casts (1300 m) until 5°30'N at an equidistant grid of 30' resolution (18 stations). Subsequently, we aim at surveying the equatorial current system between 5°N - 5°S with a focus on the regime between 2°N - 2°S. Thus, the CTD/LADCP/UVP section is continued with deep CTD casts (bottom) from 5°N to at least (at maximum) 2°S (5°S) with 20' resolution between 2°N - 2°S and 30' resolution elsewhere (minimum 19 stations). One shallow CTD station in the OMZ region (11°N) will be used for additional sensor calibration. Moreover, sensor tests will be carried out during each CTD station by attaching the sensors to the CTD rosette (no extra time needed).

After having finished the southernmost CTD station, we will leave the 23°W section toward the position 5°59.1'E, 20°58.5'S, where we will recover a mooring with a passive acoustic recorder.

Along the cruise track, 7 floats will be deployed (3 along 23°W, 2 between 23°W and southern mooring position, 2 between southern mooring position and Cape Town).

Underway measurements will be carried out along the whole cruise track. These include Underway-CTD, EK60 echo sounder, shipboard ADCP measurements, and continuous measurements with a pumped system to observe temperature, salinity and chemical parameters (pCO_2 and O_2).

Table 3.1: Mooring positions

ID	Latitude	Longitude	Deployment Date
KPO_1128	17°36.354'N	24°14.976'W	20-Apr-2014
AWI 247-3	20°58.5'S	5°59.1'E	22-Nov-2012 (see chapter 4.)

Data management

The Kiel Data Management Team (KDMT) provides an information and data archival system where metadata of the on board DSHIP-System is collected and made publicly available. This Ocean Science Information System (OSIS-Kiel) is accessible for all project participants and can be used to share and edit field information and to provide scientific data, as they become available. The central system OSIS provides information on granted ship time with information on the scientific program and the general details down to the availability of data files from already concluded cruises. The transparency on the research activities is regarded as an invitation to external scientists to start communication on collaboration on behalf of the newly available data.

The KDMT will serve as data curators to fulfil the proposed publication of the data in a World Data Center (e.g. PANGAEA) which will then provide long-term archival and access to the data. The data publication process will be based on the available files in OSIS and is therefore transparent to all reviewers and scientists. This cooperation with a world data center will make the data globally searchable, and links to the data owners will provide points of contact to project-external scientists. Availability of metadata in OSIS-Kiel (portal.geomar.de/osis): 2 weeks after the cruise; Availability of data in OSIS-Kiel (portal.geomar.de/osis): 6 months after the cruise; Availability of data in a WDC/PANGAEA (www.pangaea.de): 3 years after the cruise.

4. ATLANTIC BREEDING GROUND OF MYSTICETES OF THE SOUTHERN HEMISPHERE

I. van Opzeeland, K. Thomisch, O. Boebel, M. Monsees (AWI, not on board)

Objectives

The large baleen whales of the Southern Hemisphere are migratory inhabitants of the open ocean and hence are not easily accessible for direct observation. They are thought to migrate between summer feeding grounds near Antarctica and winter breeding grounds in the sub-tropical ocean. However, knowledge on summer and particularly winter distribution of true (or Antarctic) blue (*Balaenoptera musculus intermedia*), fin (*Balaenoptera physalus*), sei (*Balae-noptera borealis*) and Antarctic minke whales (*Balaenoptera bonaerensis*) is sparse and mainly based on historic catch data and the Discovery tagging program. The resulting uncertainty is clearly reflected even in contemporary distribution maps. Interestingly, in the southern Atlantic, the evidence at hand points to similar summer breeding grounds for all four species, namely the northern Angola Basin for Antarctic minke whales (7°S 3°W), the central Angola Basin for sei whales (15°S 5°W), and the southern Angola Basin for fin whales (21°S 1°E) and for true (or Antarctic) blue whales (22°S 7°E).

Given that many of the baleen whale species in the Southern Hemisphere have been severe-ly depleted by commercial whaling, knowledge of the locations of their breeding grounds and an improved understanding of migratory routes and behavior of these species is important for conservation measures to aid the recovery of these populations. All species are known to vocalize on the breeding grounds, rendering passive acoustic monitoring techniques therefore a valuable tool to study large baleen whale breeding ground distribution patterns. For blue and fin whales, geographic variation in vocalizations even allows identification of different (breeding) populations. Such information may provide insight into the extent to which each baleen whale species is grouped into separate localities on the breeding grounds.

Autonomous recording devices are battery-powered and record and store acoustic data inter-nally. Dependent on data storage capacity of the device, recording bandwidth and sampling regime, recordings can be obtained over extended periods of time, in some cases up to se-veral years. Best results are obtained when deployed in the so-called SOFAR channel, a sound-duct which is located at about 1000 m depth in the subtropical ocean.

Work at sea

A single oceanographic mooring, AWI 247-3, which was deployed at 20°58.5'S 005°59.1'E on 22.11.2012, hosting a passive acoustic recorder (SonoVault) and a recording CTD shall be recovered by the GEOMAR Team (see chapter 3). The deployment will be coincident with like recordings in the Antarctic summer feeding grounds. The recorder is deployed at a depth of nominally 900 m, the core of the SOFAR channel, where detections ranges are expected to exceed the order of 200 km. This allows monitoring both the suspected fin and blue whale breeding grounds with only a single mooring.

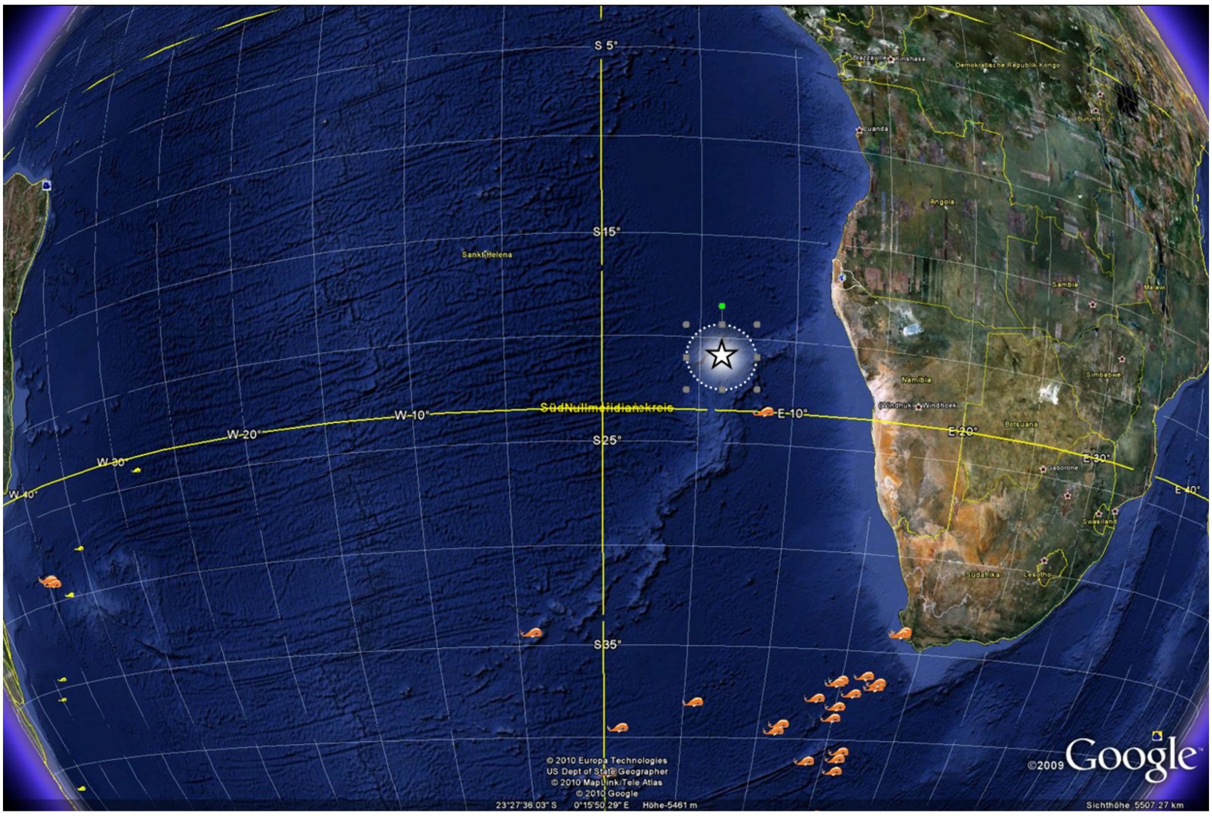

Fig. 4.1: Mooring position at 20°58.5'S 005°59.1'E (white star) close to the northern edge of Walvis Ridge. The white circle indicates a (minimum) listening circle of 200 km. Whale symbols indicate positions of whale sightings from onboard RV Polarstern.

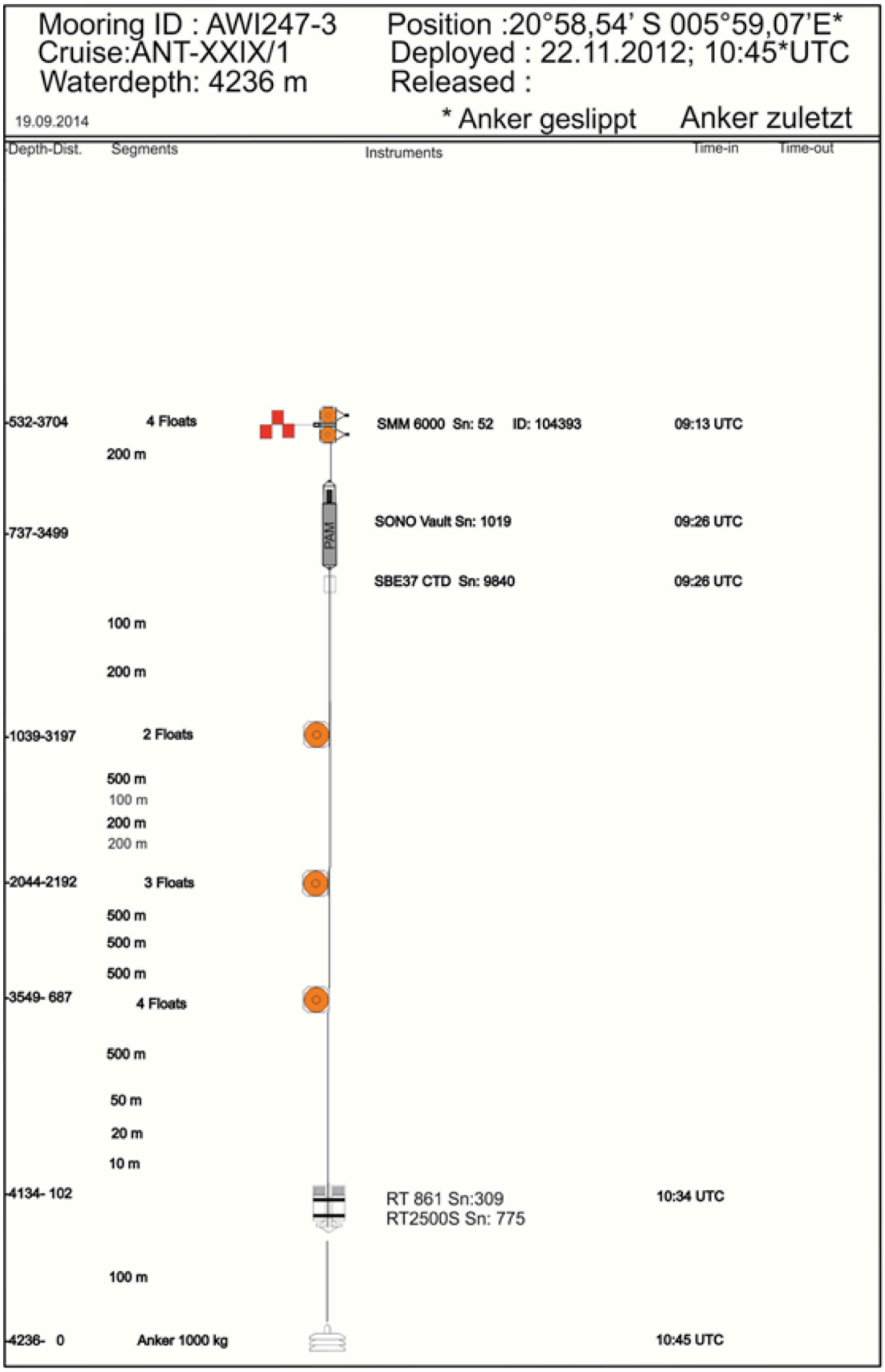

Fig. 4.2: Schematic of mooring AWI 247-3 (to be recovered)

5. SURVEY OF CLOUDS, AEROSOL AND WATER

S. Kinne (MPI-M, not on board), T. Becker (MPI-M)

Objectives

Transit-voyages, as with the RV *POLARSTERN* from Europe into the Southern Hemisphere (and vice versa), allow the survey of atmospheric properties. These measurements also offer needed ocean reference data for satellite remote sensing from space. The proposed equipment (see Fig. 5.1) is an Infratec IR-cloud camera and a handheld MICROTOPS-II radiometer (in combination with a GPS unit).

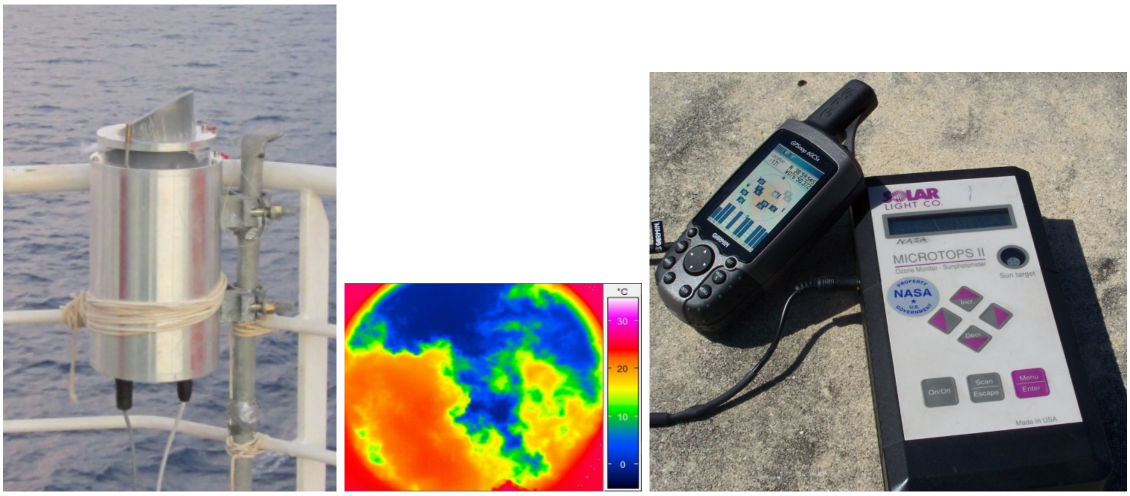

Fig. 5.1: IR (or thermal) cloud-camera with a cloud (warmer temperatures) image example for the cloud survey and the MICROTOPS sun-photometer (with a GPS) for the aerosol and water vapor survey.

The cloud camera of the MPI-M is fixed at a ship location where the camera's 30 degree field of view is (mostly) unobstructed. The thermal camera surveys (1) the overhead cloud structure also as a function of time (e.g. daily cycles), (2) the cloud structure movement (by capturing images in regular intervals of ca 10 seconds) and (3) the approximate cloud altitude via the (detected cloud base) temperature.

The MICROTOPS is calibrated unit of NASA-GSFC and is lent to the MPI-M as part of AERONET's MAN effort: http://aeronet.gsfc.nasa.gov/new_web/maritime_aerosol_network.html.

For each sample (of many measurements) the instrument's solar spectral sensors are pointed for a few seconds directly into the sun-light at assured cloud-free conditions. From the sensed atmospheric solar sub-spectral attenuation (as the incoming radiation at the top of the atmosphere [defined by time and latitude] is reduced by solar atmospheric scattering and absorption processes) the atmospheric column load for aerosol and water vapor is derived. Since the aerosol attenuation is determined at different wavelengths also information on the characteristic aerosol size is offered, indirectly also pointing to the dominant aerosol type.

Work at sea

The instruments are placed (cloud camera) and manually operated on the ship's upper deck to assure unobstructed views of the sky and of the sun.

The cloud camera records automatically in a freeze frame mode. However exposure to direct sunlight must be avoided to avoid damage to the optics. Thus, at higher sun-elevations the instrument's optics needs to be covered. Also a protective foil on top of the optics (to prevent water damage or signal contamination) needs to be regularly cleaned or/and replaced. After extended measurement periods (ca 14 hours) the data need to be downloaded on a storage facility (e.g. external hard-drive) and data need to be converted from an instrument internal format into (jpeg) images and (ascii) data-files.

The MICROTOPS measurements are labor intensive. Not only a correct pointing into the sun is required (if possible in 15min block of 10 consecutive samples), but also any contaminations by clouds need to be avoided. This is particular important and difficult in events of hardly visible cirrus clouds. Thus, a continuous monitoring of the sky near the sun-disk is required (which also for documentation should be supported by video images). Due to the limited storage capability of a MICROTOPS (max 500 samples) data need to be downloaded (at least daily) onto a laptop and sent via e-mail to Dr. Smirnov at NASA-GSFC (Alexander.Smirnov-1@nasa.gov), who will provide immediate feedback on data quality and who will upload the data onto:

http://aeronet.gsfc.nasa.gov/new_web/maritime_aerosol_network.html.

Data management

The data for the cloud-camera are collected and archived immediately after the cruise at the Max-Planck Institute for Meteorology (Hamburg). These data can also be copied to a data-server related to that cruise. Output is offered both as images and as digital data, which can be quite voluminous (on the order of 500 GB).

The data of the MICROTOPS-II are send to a NASA (-GSFC) archive where the (preliminary) aerosol and water-vapor measurements become visible and accessible via the web with days. After a past-voyage re-calibration of the MICROTOPS at NASA, a higher quality data version of the cruise data will be offered in addition.

References

Smirnov, A., B. N. Holben, I. Slutsker, D. M. Giles, C. R. McClain, T. F. Eck, S. M. Sakerin, A. Macke, P. Croot, G. Zibordi, P. K. Quinn, J. Sciare, S. Kinne, M. Harvey, T. J. Smyth, S. Piketh, T. Zielinski, A. Proshutinsky, J. I. Goes, N. B. Nelson, P. Larouche, V. F. Radionov, P. Goloub, K. Krishna Moorthy, R. Matarrese, E. J. Robertson, and F. Jourdin (2009), Maritime Aerosol Network as a component of Aerosol Robotic Network, J. Geophys. Res. 114, D06204, doi:10.1029/2008JD011257.

6. MEASUREMENTS OF GALACTIC COSMIC RAY INDUCED MUONS AND NEUTRONS

B. Heber (CAU, not on board), H. Moraal (NWP, not on board), M. Walter (DESY) (not on board), A. Stoessl (DESY)

Objectives

Galactic cosmic rays are high-energy charged particles, mainly protons, doubly ionized helium, and other fully ionized nuclei originating in the galaxy and bombarding the Earth from all directions. They are a direct sample of material from far beyond the solar system. Measurements by various particle detectors have shown that the intensity varies on different timescales, caused by the Sun's activity and geomagnetic variation. The role of Interplanetary Coronal Mass Ejections (ICMEs) in causing Forbush decreases, and Corotating Interaction Regions causing recurrent decreases in the GCR intensity observed at Earth, has been well established since the last twenty years. However, these interplanetary disturbances cause space weather effects, which warrant a more detailed study. Most of the research on GCR intensity variations is based on the analysis of ground-based neutron monitors and muon telescopes. Their measurements depend on the geomagnetic position, and the processes in the Earth's atmosphere.

Beside the modulation of cosmic rays in the heliosphere there are two possible lines of defense: while the atmosphere shields life against cosmic radiation uniformly, the Earth magnetosphere acts as a rigidity filter. Before the primary particles can enter the atmosphere they are subject to the deviations in the magnetic field in the vicinity of the Earth, and as a consequence the intensity of charged particles on top of the atmosphere is reduced with respect to interplanetary space. To estimate this shielding effect of the magnetic field it is helpful to characterize particles by their magnetic rigidity rather than their energy as the impact of the Lorentz force on a charged particle is related to the former quantity. Particles reaching the top of the atmosphere will undergo interaction with the atmospheric constituents, leading to ionization and secondary particle production to form a cascade of secondary particles. Neutron monitors are able to record these secondary cosmic rays, mainly the neutrons, with energies about a decade higher than detected by most spacecraft. Muon telescopes are able to measure the rate of the surviving muon component of the secondary cosmic rays at ground level and complement the neutron monitor measurements and provide a source of calibration data for the neutron monitors.

Work on sea

Monitoring and surveillance of the muon telescope and the neutron monitor on board *Polarstern*. Calibration of the devices as well as installing and testing a recently developed software optimized for streamlining monitoring and data analysis tasks. Analysis of the measured data.

Expected results

The combined measurement of the rate of cosmic ray induced neutrons and muons at sea-level is sensitive to a large variety of atmospheric and geomagnetic effects, as well as the solar activity.

Selected references

Stoker, Pieter H. and Dorman, Levl. and Clem, John M. (2000), Neutron Monitor Design Improvements,Space Sciences Series of ISSI,Cosmic Rays and Earth, DOI 10.1007/978-94-017-1187-6_17

B. Heber, C. Schwerdt, M. Walter, G. Bernade, R. Fuchs, H. Krüger, H. Moraal Neutron monitor measurements on the German research vessel *Polarstern* * First results, DPG 2014, Berlin

7. TRAINING, CALIBRATION AND TESTS OF SCIENTIFIC INSTRUMENTS

Due to the relative short length of the cruises PS88.1 and PS88.2 these legs are predestined for technical staff to test and calibrate new or maintained sensors and devices. During the leg from Bremerhaven until Las Palmas de Gran Canarias a new synchronization unit K-Sync for hydro acoustic devices will be tested parallel to the POLMAR course, whereat some lecturers will additionally participate in the tests of the K-Sync. The tests will be continued during the second leg with changed staff.

The calibration of new deployable antenna for underwater positioning will take place during the second leg because POLMAR course will have been finished by then and the calibration process will not interfere with hydro acoustic measurements.

The training on use of the calibration system for EK60 sounders will be held during second part of the cruise as well, so this stationary work does not stay in conflict with the needs of the POLMAR course. The EK60 calibration process requires calm waters, i.e. low sea state, which appearance might be more likely during the longer second leg.

7.1. Briefing and training on use of the recently developed EK60 calibration system

S. Krägefsky (AWI)

Objectives

Scientific hydro acoustic survey of abundance of marine zooplankton and nekton with the multi-frequency echo sounder (Simrad EK60) of RV *Polarstern* requires a regular calibration of the echo sounder with standard calibration spheres. The calibration spheres have to be placed and moved in a controlled manner within sound beam below the ship. Due to the ships construction and dimensions of FS *Polarstern* such calibration is a demanding and time-consuming task. A system for supporting calibration of the Simrad EK60 was developed, allowing for a relatively fast and semi-automatic calibration of the Simrad EK60 or similar echo sounders while facilitating the calibration process. The calibration unit consists of a deck unit and synchronized, electronically controlled underwater winches. A briefing and training should enable potential users and electronics engineers of RV *Polarstern* to use the calibration system and on the same time improve the efficiency of the calibration process.

Work at sea

Briefing and training will be carried out during a real calibration exercise of the Simrad EK60. After installation of the deck unit and underwater winch-system, a calibration sphere will be lowered underneath the ship attached to the end of the ropes of the underwater winches. The calibration sphere will be moved through the sound beams of the single transducers in a controlled manner by means of the underwater winch-system. Use of the calibration system and use of the echo sounder software during calibration will be shown and trained. Calibration results will be discussed.

Expected results

Trainings-Calibration of the multi frequency echo sounder (Simrad EK60) of FS *Polarstern*.

7.2 Calibration of underwater positioning system POSIDONIA

R. Krocker (AWI); J. Rogenhagen (RFL, not on board)

Objectives

To achieve more redundancy in underwater positioning a new deployable antenna from company IXBLUE has been bought. To achieve best quality in positioning, the antenna needs to be calibrated. For the calibration a transponder has to be lowered to the seafloor with depth of ca. 2,000 meter.

Work at sea

Calibration work will be done during the transit from Las Palmas de Gran Canarias to Cape Town in combination with a mooring station. If the moorings signal is still powerful enough, it will be used for calibration otherwise a transponder will be lowered to provide the requested signals.

Prior to the calibration a sound velocity profile must be sampled at that location reaching beyond a depth more than 2,000 meter.

To perform the calibration, the new antenna needs to receive transponder's signals from different views/angles in azimuth and inclination. For this reason the ship will sail a track of two circles like a figure of an "eight". The contact point of the two circles is located above the mooring/transponder. As the system has a receiving angle of 30° from nadir, the diameter of circle must not exceed 0.6 times the water depth.

After this track has been finished, the calculation will executed to adjust the systems parameters. After parameter adjustment the survey will be repeated to confirm the settings.

Finally the mooring and/or transponder will be released and picked up.

Expected results

As result of calibration measurement the quality by means of standard deviation of positioning will be calculated.

7.3 System test of the Kongsberg synchronization unit

B. Dorschel (AWI), R. Krocker (AWI) G. Kuhn (AWI) C. Gebhardt (AWI), S. Krägefsky (AWI), R. Krocker (AWI), F. Niessen (AWI), J. Rogenhagen (RFL, not on board);

Objectives

On board RV *Polarstern* there are several sonar systems installed working with similar or overlapping frequencies. To avoid disturbances and interferences of the sonar systems the synchronization unit K-Sync will be installed for testing and evaluation. Main objective of these tests will be, if communication of all the considered sonar systems with the sync unit will work as requested. Furthermore several parameter settings will be tested representing different scientific survey modes emphasizing different sonar systems. For the test the acoustic doppler current profiler (ADCP), single beam echo sounder (EA-500 DWS), sediment echo sounder (P70), multi-beam echo sounder (HS-DS3) and multi-frequency echo sounder (EK-60) will be synchronized.

Work at sea

Prior to the cruise, during the ship yard time, the sync unit will be installed. Initial parameter settings will be done and first tutorials will be given.

During the transit from Bremerhaven to Las Palmas de Gran Canarias, a technician from Kongsberg will participate to support the tests. All possibilities of the sync unit will be investigated including the special survey modes typically executed on board *Polarstern*. The settings of ping sequences need to be adjusted until no mutual disturbance of the systems can be detected anymore. The tests will be performed in different water depths from shallow waters to deep sea, confirming the functionality of the sync for depth depending time intervals.

Expected results

If the requested functionality is given and the several requested operation modes could be tested successfully, a recommendation for the purchase and permanent installation of that device can be stated.

Selected references

Report of RRS James Clark Ross cruise JRtri006, June-July 2011, BAS Archive Reference Number: ES6/1/2011/1

K-Sync product description, Kongsberg Maritime AS, 2005

8. BETEILIGTE INSTITUTE / PARTICIPATING INSTITUTES

Adresse	Address
AWI	Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung Am Alten Hafen 26 27568 Bremerhaven Germany
CAU	Christian-Albrechts-Universität zu Kiel 24098 Kiel Germany
DESY	Deutsches Elektronen-Synchrotron DESY Zeuthen Platanenallee 6 15738 Zeuthen Germany
DWD	Deutscher Wetterdienst Bernhard-Nocht-Str. 76 20359 Hamburg Germany
ETH	ETH Zürich Rämistrasse 101 8092 Zürich Schweiz
GEOMAR	Helmholtz-Zentrum für Ozeanforschung Kiel Wischhofstraße 1 – 3 24148 Kiel Germany
KONGSBERG	Kongsberg Maritime Kirkegårdsveien 45 3616 Kongsberg Norway
NWP	Nort-West University Potchefstroom South Africa
MPI-M	MPI-Meteorology Bundesstraße 53 20146 Hamburg Germany

Adresse	**Address**
RFL	Reederei F. Laeisz GmbH Brückenstr. 25 2752 Bremerhaven Germany
UNI-HB	Universität Bremen Bibliothekstraße 1 28359 Bremen Germany
WU	Wageningen University Droevendaalsesteeg 4 6708 PB Wageningen The Netherlands

9. FAHRTTEILNEHMER / CRUISE PARTICIPANTS

NO	NAME	GIVEN NAME	INSTITUTE	PROFESSION	DISCIPLINE
	PS88.1 + PS88.2	**Bremerhaven - Cape Town**			
1	Becker	Tobias	MPI-M	scientist	meteorology
2	Hempelt	Juliane	DWD	technician	meteorology
3	Krocker	Ralf	AWI	engineer	geo sciences
4	Miller	Max	DWD	scientist	meteorology
5	Stößl	Achim	Desy Zeuthen	scientist	physics
	PS88.1	**Bremerhaven - Las Palmas**			
6	Albers	Elmar	Uni-HB	student	geo sciences
7	Biller Teixeira	Tiago José	Uni-HB	student	geo sciences
8	Biskaborn	Boris	AWI	scientist	geo sciences
9	Blaise Ngundam	Ngwana	Uni-HB	student	geo sciences
10	Brückner	Nils	Uni-HB	student	geo sciences
11	da Silva	Mariucha	Uni-HB	scientist	geo sciences
12	Dorschel	Boris	AWI	scientist	geo sciences
13	Ehmen	Tobias	Uni-HB	student	geo sciences
14	Gatti	Susanne	AWI	scientist	biology
15	Gebhard	Catalina	AWI	scientist	geo sciences
16	Hanfland	Claudia	AWI	scientist	geo sciences
17	Heinecke	Liv	AWI	PhD student	geo sciences
18	Heredia Barión	Pablo	AWI	PhD student	geo sciences
19	Klages	Johann Philipp	AWI	scientist	geo sciences
20	Klimm	Frederic	Uni-HB	student	geo sciences
21	Knust	Rainer	AWI	chief scientist	biology
22	Kuhn	Gerhard	AWI	scientist	geo sciences
23	Lautenschläger	Olaf	KONGSBERG	engineer	electronics
24	Meyer	Vera Dorothee	AWI	PhD student	geo sciences
25	Monkenbusch	Johannes	Uni-HB	student	geo sciences
26	Radosavljevic	Boris	AWI	PhD student	geo sciences
27	Reusch	Anna-Lena	ETH	PhD student	geo sciences
28	Rippert	Nadine	AWI	PhD student	geo sciences
29	Ronge	Thomas	AWI	PhD student	geo sciences
30	Rösner	Alexander	Uni-HB	student	geo sciences
31	Schlegel	Rebecca	Uni-HB	student	geo sciences
32	Tanski	George	AWI	PhD student	geo sciences
33	Waßmuth	Saskia	Uni-HB	student	geo sciences
34	Wengler	Marc	AWI	PhD student	geo sciences

	PS88.2	**Las Palmas - Cape Town**			
6	Deppenmeier	Anna-Lena	WU	PhD student	meteorology
7	Fu	Yao (Mr.)	Geomar	PhD student	phy. oceanography
8	Hahn	Johannes	Geomar	scientist	phy. oceanography
9	Hahn	Tobias	Geomar	student	chemistry
10	Hanisch-Niessen	Sabine	AWI	scientist	geo sciences
11	Hauschildt	Jaard-Okke	Geomar	student	phy. oceanography
12	Kisjeloff	Boris	Geomar	technician	phy. oceanography
13	Klenz	Thilo	Geomar	student	phy. oceanography
14	Kopte	Robert	Geomar	PhD student	phy. oceanography
15	Krägefsky	Sören	AWI	scientist	biology
16	Müller	Mario	Geomar	engineer	phy. oceanography
17	Niessen	Frank	AWI	scientist	geo sciences
18	Tuchen	Franz Philip	Geomar	student	phy. oceanography

10. SCHIFFSBESATZUNG / SHIP'S CREW

	Name	Rank
01.	Wunderlich, Thomas	Master
02.	Spielke, Steffen	1.Offc.
03.	Ziemann, Olaf	Ch.Eng.
04.	Lauber, Felix	2.Offc.
05.	Kentges, Felix	2.Offc.
06.	Hering, Igor	2.Offc.
07.	Spilok, Norbert	Doctor
08.	Hofmann, Jörg	Comm.Offc.German
09.	Schnürch, Helmut	2.Eng.
10.	Westphal, Henning	2.Eng.
11.	Rusch, Torben	2.Eng.
12.	Brehme, Andreas	Elec.Tech.
13.	Ganter, Armin	Electron.
14.	Dimmler, Werner	Electron.
15.	Winter, Andreas	Electron.
16.	Feiertag, Thomas	Electron.
17.	Schröter, Rene	Boatsw.
18.	Neisner,Winfried	Carpenter
19.	Clasen, Nils	A.B.
20.	Burzan, Gerd-Ekkehard	A.B.
21.	Schröder, Norbert	A.B.
22.	Moser, Siegfried	A.B.
23.	Hartwig-L., Andreas	A.B.
24.	Kretzschmar, Uwe	A.B.
25.	Müller, Steffen	A.B.
26.	Gladow, Lothar	A.B.
27.	Sedlak, Andreas	A.B.
28.	Beth, Detlef	Storekeep.
29.	Plehn, Markus	Mot-man
30.	Fritz, Günter	Mot-man
31.	Krösche, Eckard	Mot-man
32.	Dinse, Horst	Mot-man
33	Watzel, Bernhard	Mot-man
34.	Meißner, Jörg	Cook
35.	Tupy,Mario	Cooksmate
36.	Völske, Thomas	Cooksmate
37.	Luoto, Eija	1.Stwd.
38.	Westphal, Kerstin	Stwdss/KS
39.	Mack, Ulrich	2.Steward
40.	Hischke, Peggy	2.Stwdess
41.	Wartenberg, Irina	2.Stwdess
42.	Hu, Guo Yong	2.Steward
43	Chen, Quan Lun	2.Steward
44.	Ruan, Hui Guang	Laundrym.