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

EXPEDITION PROGRAMME PS116

Polarstern

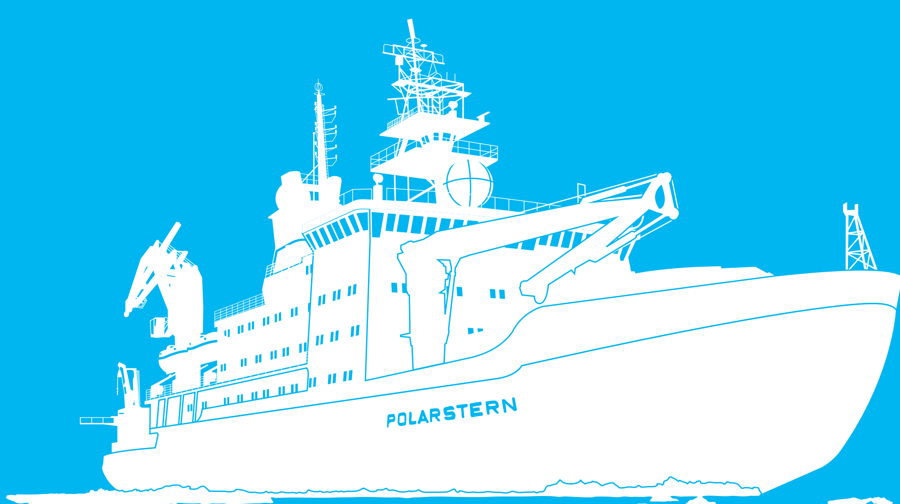
PS116

Bremerhaven - Cape Town

10 November 2018 - 11 December 2018

Coordinator: Rainer Knust

Chief Scientists: Claudia Hanfland
Bjela König



Bremerhaven, November 2018

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Claudia Hanfland
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1. ÜBERBLICK UND FAHRTVERLAUF

Claudia Hanfland
Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung

Der Fahrtabschnitt PS116 ist der erste Abschnitt der antarktischen Forschungs-Saison 2018/19. *Polarstern* verlässt den Heimathafen Bremerhaven am 10. November 2018 und wird Kapstadt, Südafrika, am 11. Dezember 2018 erreichen. Ein Hafenanlauf in Las Palmas, Kanaren, ist für den 18. November 2018 geplant. Hier geht ein Großteil der wissenschaftlichen Besatzung von Bord, während sechs weitere Wissenschaftler zusteigen. In Las Palmas wird *Polarstern* drei Tage für 3D Foto- und Laser-Innenraumaufnahmen im Hafen liegen bleiben. Die Gesamt-Fahrtzeit von vier Wochen umfasst wenige Stunden Stationszeit für die Bathymetrie (Kalibration der Echolotsysteme mittels Wasserschallsonde, Test-Einsatz der Underway-CTD) auf dem Abschnitt Bremerhaven – Kanaren sowie für das Testen eines Schleppsystem-Depressors bei reduzierter Fahrtgeschwindigkeit auf dem Abschnitt Kanaren – Kapstadt. Auf diesem Abschnitt werden zudem fünf Floats bei reduzierter Fahrt ausgesetzt.

Die wissenschaftlichen Tätigkeiten während PS116 gliedern sich in drei große Bereiche: Training von Nachwuchswissenschaftlern an den Echoloten bis zu den Kanaren, wissenschaftliche en-route Arbeiten über den gesamten Fahrtabschnitt sowie Tätigkeiten der Logistik und des Rechenzentrums.

Die wissenschaftlichen Vorhaben im Einzelnen:

- POLMAR-TRAIN: Ausbildung von Masterstudenten der Universität Bremen, Fachbereich Geowissenschaften, und Doktoranden des AWI in geophysikalischen Methoden an den Echoloten
- Plankton-Genomik: Bestimmung von Planktonvergesellschaftungen entlang eines meridionalen Schnittes durch den Atlantik mittels Taxonomie und DNA-Barcoding
- OCEANET: atmosphärische Messungen (physikalische Parameter, Aerosole) mittels Fernerkundung und LIDAR-Technik, Validierung des ESA Satelliten Aeolus, wenn mit Fahrtroute kompatibel
- COSMIC-RAYS: Messung kosmischer Strahlung entlang eines meridionalen Schnittes durch den Atlantik
- NISAAA: Ermittlung der Stickstoffisotopenzusammensetzung über dem Atlantik in Ammonium und Ammoniak
- Test eines Schleppsystem-Depressors
- Ermittlung von Prozessabläufen unter dem Blickwinkel der Arbeitssicherheit an Bord
- Installation von Software und Hardware-Komponenten in Vorbereitung auf das Driftexperiment MOSAiC

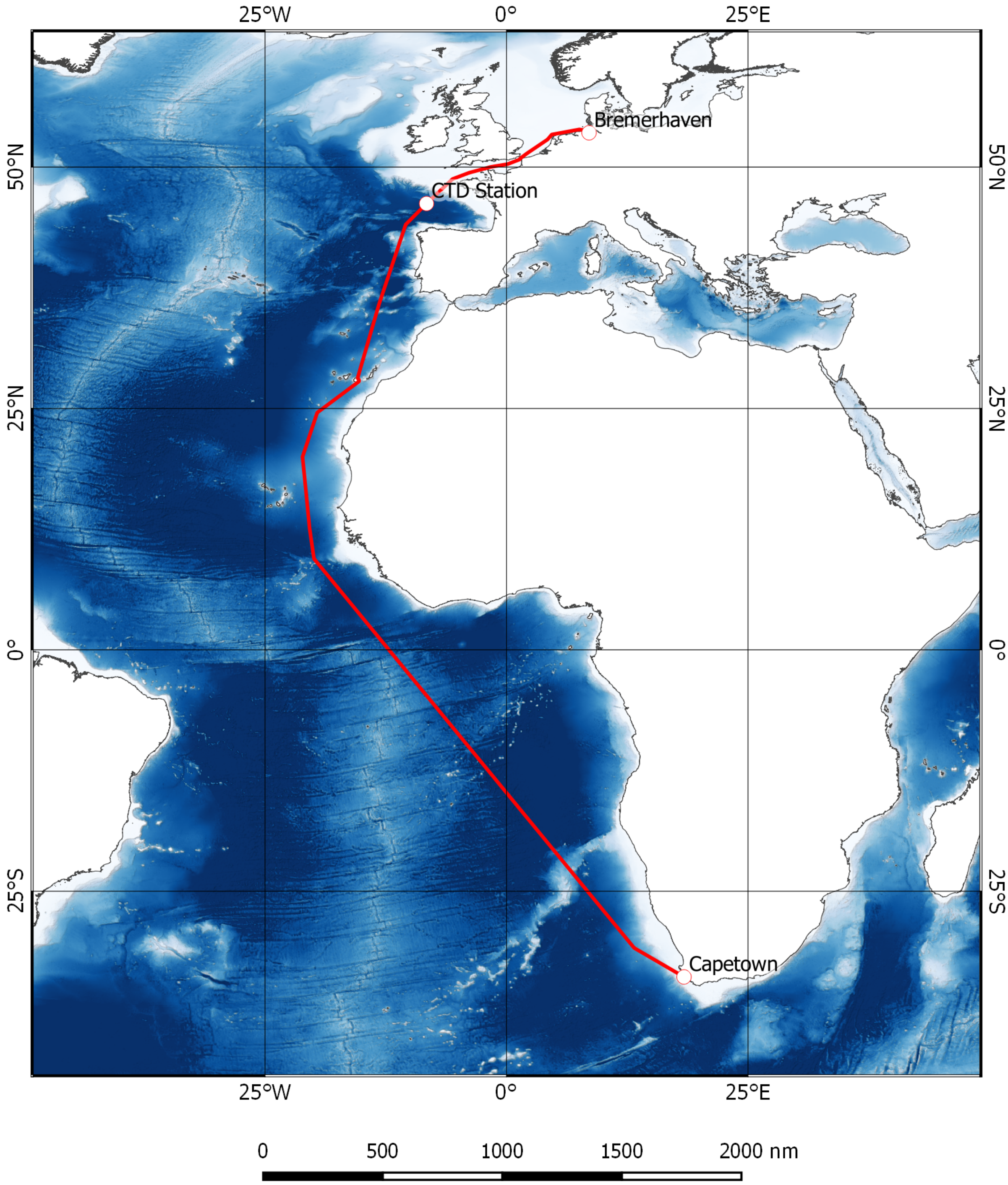

Abb .1.1: Geplante Route PS116. (c) Simon DReutter, AWI
Fig. 1. 1: Planned cruise track of PS116.Picture courtesy to Simon Dreutter, AWI

SUMMARY AND ITINERARY

PS116 is the first leg of the Antarctic season 2018/19. *Polarstern* will leave its port of registry, Bremerhaven, on 10 November 2018 and arrive in Cape Town, South Africa, on 11 December 2018. An intermediate port call will take place on 18 November 2018 in Las Palmas, Canary Islands. Here, the majority of the scientific crew will leave the ship. In addition, six more colleagues will join the cruise. *Polarstern* will remain at the port of Las Palmas for three days in order to carry out 3D photo and Laser imaging of the ship's interior. Ship time will be allocated for calibration of the echosounding systems by means of a sound velocity profiler and deployment of the underway-CTD (section Bremerhaven – Las Palmas). After leaving Las Palmas, a combined launch and recovery system (LARS) and depressor system will be tested. Furthermore, five floats will be deployed on the journey to Cape Town.

Scientific activities during PS116 cwill omprise three different field of activities: training of early career scientists at the echosounding system of *Polarstern* (Leg Bremerhaven – Las Palmas), scientific en-route measurements and sampling, and activities and maintenance of logistics and IT department.

In detail, the scientific activities during PS116 will consist of:

- POLMAR-TRAIN: Education and training of Master students of the University of Bremen, Department of Geosciences, and doctoral candidates from AWI, in geophysical methods at the echosounding systems (multibeam echosounder Atlas Hydrosweep DS3 and sediment echosounder Parasound P70)
- Plankton genomics: Determination of plankton communities along a longitudinal gradient across the Atlantic Ocean by means of taxonomy and DNA-metabarcoding
- OCEANET: Atmospheric measurements (physical parametres, aerosols) by means of remote sensing and LIDAR technique. Validation of ESA satellite Aeolus by ground-comparison profiles, ship-track permitting.
- COSMIC-RAYS: Determination of cosmic rays along a longitudinal gradient across the Atlantic Ocean
- NISAAA: Determination of the isotopic composition of nitrogen in ammonium and ammonia over the Atlantic Ocean
- Testing of a depressor system
- Identification of working processes in view of the development of a comprehensive safety concept for scientific work on board
- Installation of software and hardware components in preparation for the drift experiment MOSAiC

2. ECHOSOUNDING TRAINING COURSE POLMAR-TRAIN

F. Niessen (AWI), C. Gebhardt (AWI), J. Klages (AWI), J.-E. Arndt (AWI), S. Dreutter (AWI), C. Hanfland (AWI)

Objectives

The project POLMAR-TRAIN is a training course jointly run by the AWI-based Helmholtz Graduate School for Polar and Marine Research (POLMAR) and University of Bremen, Department of Geosciences. It offers Master and PhD students from geosciences a hands-on training in operating the hull-mounted echosounding systems of *Polarstern* (multibeam echosounder Atlas Hydrosweep DS3 and sediment echosounder Parasound P70). Both systems will be operated continuously between Bremerhaven and Las Palmas / Canary Islands. 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.

This training format has been carried out on a yearly base since 2014, got excellent feedback from the participants and proved to be a cornerstone in marine geoscientific education.

AWI has a clear commitment to use the transit times of *Polarstern* for regular ship-based trainings, hence experience from this (and previous) cruises will help to build future proposals, e.g. for upcoming Summer Schools.

Work at sea

After embarkation, students will start with a half-day introduction to get familiar with the principles of hydro-acoustic data acquisition, to learn how to use the required software and to know how to operate the echosounding systems. Participants will be trained in all parts of the systems and go on watches in 2-hours shifts at day and 4-hours shifts at night. They will learn about sediment properties, reflector horizons, bottom topography and the principles of sediment acoustics. One key objective is the study of the spatial and temporal morphological variability of the huge sea-floor sand dunes in the English Channel.

Practical training on the systems will be complemented through plenary lectures and software training in smaller groups to discuss published case studies. Being able to combine and interpret sediment core and multibeam-bathymetric data with PARASOUND profiles is a further learning outcome.

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 duties, students will give a 15 minute presentation on their individual research project (Ms or PhD) and the relevance of the course content for their project. Given the composition of participants (both Master and PhD students), participants will greatly benefit from each other. By experience we know that peer-teaching is an added value in every course. Working and living together 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.

Data management

Hydro-acoustic data (multibeam and sediment echosounder) collected during the expedition will be stored in a specific file structure to be directly imported 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).

3. PLANKTON-eDNA

E. Garcia-Vazquez (Uni Oviedo), J. Rick (AWI)

Objectives

The scientific aims of the project are:

- To identify and quantify the taxonomic and functional changes of plankton communities in a large latitudinal transect along the Atlantic Ocean, from Bremerhaven to Cape Town, using water samples and a combined approach of visual taxonomy and DNA metabarcoding.
- To develop and validate a simplified method for inventory of relevant species from environmental DNA and NGS, using water samples of small volume.
- To assess the association between environmental parameters and plankton species important for fisheries, principally preys of commercial fish.

For achieving these objectives, water of the upper layer will be sampled daily from Bremerhaven to Cape Town along the PS116 cruise of *Polarstern*. The biota contained in such samples will be determined visually and genetically, using both barcoding and metabarcoding; the community changes occurring across latitudes in this trans-equatorial trajectory will be identified and quantified; the influence of environmental parameters (nutrients, oxygen, temperature) on the plankton community and function will be inferred. The water samples will be taken en-route from underway sampling using the regular pumping system connected to a tap. Ship stops are therefore not necessary. The results will serve to understand the latitudinal variation of planktonic eukaryote and prokaryote communities from a functional perspective, with an emphasis on the potential application to fisheries sciences.

Work at sea

Water samples will be taken at a minimum of 20 geographical positions evenly distributed along the travel: before, after and one crossing the Equator. *Polarstern* has an underway system for pumping water from outside the vessel into the laboratories through a pipe. The tap will be open for the sufficient time to concentrate two different volumes of water: 50 L and 500 L water, by filtering through a plankton net of 50 µm mesh. From each sample, two sub-samples of 15 L will be pumped and filtered through 0.2 µm pore filters, and further stored in absolute ethanol for DNA metabarcoding.

Onboard, samples will be visually analyzed with the microscope, and individuals will be sorted for visual identification of the species using taxonomic guides, then stored for further molecular analyses.

Physico-chemical parameters will be monitored daily over the cruise: pH, salinity, oxygen concentration (may be important in minimum oxygen zones), temperature, silicate, nitrite, nitrate, phosphates, chlorophyll (if possible, also organic carbon concentration, TN and TP).

Samples will be analysed under the microscope onboard for visual taxonomic identification of the species contained in.

The filters for DNA analysis will be stored in absolute ethanol, as well as subsamples from the samples visually sorted daily. If visual identification cannot be completed onboard, for example in very diverse plankton samples that will take longer to identify, the samples will be stored in a preservative for further analysis in the home laboratories.

Johannes Rick and Eva Garcia-Vazquez will do sampling in collaboration with *Polarstern* crew complying with all onboard health and safety requirements. Sample preparation and visual sorting will be done by the researchers during the travel.

After the cruise, genetic analysis will take place at home laboratories (University of Oviedo, Spain, and AWI). DNA Barcoding (COI, 18S and/or 16S rRNA genes as Barcodes) will be used for species ascertainment from individual samples. This way sequences associated to individual vouchers will be available. NGS Metabarcoding as in Borrell et al. (2017a,b) will serve for describing the plankton community. The Illumina platform (or Ion Torrent) will be employed.

The association between environmental parameters and plankton diversity, function and key species will be modelled and the model tested and validated using state of the art bioinformatics procedures.

Preliminary and expected results

The present study will contribute to understanding the crucial functional features of plankton communities across a long latitudinal trans-equatorial transect, and how they are influenced by environmental conditions. The use of NGS methodology for inventorying higher eukaryotes of interest for fisheries sustainability from plankton communities, at the large geographical and latitudinal scale proposed in this study, has never been published to date, and will compare to other large expeditions such as *Tara Oceans*.

Knowing the composition of planktonic communities is essential for both fundamental and applied purposes. On one hand, the community composition serves to understand how an ecosystem functions, based on the trophic levels and life history of the species assemblages (e.g. Thompson et al. 2015). The equilibrium of plankton communities is delicate. Zooplankton grazes on phytoplankton, and the community equilibrium is affected by their respective abundance and other factors such as pollution and nutrients (Jang et al. 2008). At the same time, the nutrients balance (for example N/P) is governed by the composition of plankton communities (Weber & Deutsch 2010). The balance phytoplankton-zooplankton and their particular species composition, as well as harmful algal blooms, are related with environmental factors including extreme climatic events such as hurricanes (Fuentes et al. 2010), and are expected to change across latitudes (Richardson 2008). Expectations are that diversity is greater near the Equator and decreases as latitude increases (e.g. Roy et al. 1998, Hillebrand 2004, Fuhrman et al. 2008). Some insights about transequatorial community variation, in particular of pelagic ichthyoplankton, have been achieved from the *Polarstern* (Ardura et al. 2016). In that study, the latitudinal pattern of diversity did not exhibit the expected temperate-tropical cline, reflecting instead a decline in low-oxygen zones (Ardura et al. 2016) and showing again the importance of environmental conditions for shaping plankton communities.

On the other hand, plankton analysis is crucial in fisheries sciences. Many commercial fish species have planktonic larvae, but they are so largely unknown that they have been called the “missing biomass” (e.g. Johnson et al. 2011). They feed on other (sometimes the same) plankton species, and are an important part of the trophic chain (e.g., Bulman et al. 2002, Walker et al. 2002). They are especially sensitive to climate change and other environmental alterations (e.g. Boeing & Duffy- Anderson 2008), likely related to alterations in the trophic chain and in particular in their preys, like copepods (e.g. Beaugrand et al. 2003). Larvae of important commercial species such as hakes feed on copepods (e.g. Morote et al. 2011). Copepod diversity exhibits a latitudinal cline associated with temperature (Rombouts et al. 2009), but there are evidences of zooplankton decline in tropical Atlantic waters (e.g. Piontkovski & Castellani 2009), and this can put at risk fisheries sustainability. More large-scale studies are necessary on ichthyoplankton communities and especially on their main preys at tropical latitudes.

Studying plankton communities from conventional methodology is laborious. It requires sampling large volumes of water, concentrating the plankton through filtration, sorting the individuals visually under the microscope, and classifying them taxonomically, sometimes with the help of DNA for species identification and quantification. For example, Ardura et al. (2016) have shown that DNA Barcoding is a promising methodology for ichthyoplankton inventory, and Fuentes et al. (2008) have applied RT-PCR for quantifying toxic algae, but new developments are still needed for application in large-scale routine surveys. The new methods of high throughput sequencing i.e. Next Generation Sequencing (NGS) on environmental DNA can help in species detection and inventory as has been proven for *Polarstern* ballast water (Zaiko et al. 2015a, b; Ardura et al. 2015), open waters (Zaiko et al. 2015c), estuaries (Borrell et al. 2017a) and others. These methods are very sensitive, and even relatively scarce species can be successfully detected from small water volumes – as small as 3 L, see for example inventories of port species from water in Borrell et al. (2017b). They are employed, for prokaryotes and some specific taxonomic groups like ciliates, in large oceanic expeditions like *Tara Oceans* (e.g. Sunagawa et al. 2015, Gimmler et al. 2016), but have been less applied for whole eukaryotic communities and almost nothing for targeting fish preys, to our knowledge. If these methods are adequately developed and independently validated for specific applications, they could be used for example for locating species of interest for fisheries like preys of commercial fish species, determining the functional equilibrium of planktonic communities (from the trophic level of the different species inventoried), and other applications.

Preliminary work conducted in *Polarstern* PS102 (2016) consisted of sampling water overboard using a 15-L bucket every day, filtered 1.5 L through 0.2 µm mesh filters and stored the filter in ethanol. We have performed DNA extraction from the filters when returning in Oviedo home laboratory. Despite very small water volume, sufficient DNA quantity was extracted from the filters for conducting further NGS employing universal primers. Sequences obtained in different days allowed a robust identification of several species of plankton, that were different in samples taken at different latitudes, as expected. Environmental parameters were registered every day and are available for comparison with the biotic data obtained. The results are being analysed in this moment from different bioinformatics pipelines and will serve as a baseline to be added to the PS116 results.

Data management

At least two peer-reviewed and SCI-indexed scientific publications are expected from this study. The samples will be stored at the University of Oviedo and AWI, available for the scientific community. DNA sequences will be released in public databases within one year after the end of the cruise.

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4. AUTONOMOUS MEASUREMENT PLATFORMS FOR ENERGY AND MATERIAL EXCHANGE BETWEEN OCEAN AND ATMOSPHERE (OCEANET): ATMOSPHERE

K. Hanbuch (TROPOS), A. Herzog (TROPOS), K. Ohneiser (TROPOS), N. Küchler (Uni Köln), A. Macke (not on board), R. Engelmann (not on board),

Objectives

The OCEANET-ATMOSPHERE project delivers valuable atmospheric measurement datasets over the oceans – in regions of the world that are not easily accessible. For the last 9 years, a container-based platform has regularly operated on *Polarstern* to obtain measurements and to contrast atmospheric processes between the anthropogenic polluted northern hemisphere and the more undisturbed southern hemisphere.

Recently, the ESA satellite Aeolus with a wind lidar on board was launched. If possible, we will obtain some of the first ground-comparison profiles during PS116 in order to calibrate and validate the data within the EVAA project (Experimental Validation and Assimilation of Aeolus observations).

a) Radiation & microwave remote sensing

The net radiation budget at the surface is the driving force for most physical processes in the climate system. It is mainly determined by the complex spatial distribution of humidity, temperature and condensates in the atmosphere. The project aims at observing both the radiation budget and the state of the cloudy atmosphere as accurate as possible to provide realistic atmosphere-radiation relationships for use in climate models and in remote sensing. While similar experiments have been performed from land stations, only few data from measurements over ocean areas exist.

A multichannel microwave radiometer will be applied to continuously retrieve the integrated water vapor and the cloud liquid water path over the ocean. Time series of these values will resolve small-scale atmospheric structures as well as the effects of the mean state of the atmosphere and its variability on the co-located measurements of the downwelling shortwave and longwave radiation. These data will be compared to and combined with METEOSAT SEVIRI products for a characterization of atmospheric state and radiative fluxes. Atmospheric aerosol optical thickness will be measured by means of hand-held sun photometer and by a new Cimel photometer, which has been modified for marine conditions. Most instruments are integrated in the container-based atmosphere observatory.

b) Lidar measurements of aerosol and cloud profiles

Since more than 20 years, TROPOS has developed and operated advanced lidar systems in order to study optical and microphysical aerosol properties in the troposphere. The system PollyXT, a semi-autonomous multiwavelength polarization Raman lidar will be operated inside a container, together with the radiation and microwave sensing equipment. The lidar is able to measure independently profiles of particle backscatter at three wavelengths and extinction at two wavelengths, which allows identifying particle type, size, and concentration. Additionally, particle depolarisation is measured in order to discriminate between spherical and non-spherical particles, e.g. biomass-burning smoke vs. mineral dust or water clouds vs. ice clouds. The lidar is equipped with a measurement channel for atmospheric water vapour, too. The data are used to characterize long-range transport of aerosol and identify pollution. The determined height-resolved aerosol extinction completes the radiation measurements. In this way, the radiative influence of single lofted aerosol or cloud layers can be calculated with radiation-transport models.

For PS116, the lidar will operate with a second large field-of-view depolarization channel for the first time. From this data, we will be able to determine cloud microphysical properties (effective radius and cloud-droplet number concentration) in the base of liquid water clouds.

Work at sea

Upon departure from Bremerhaven, the container-based atmosphere observatory OCEANET will be installed at the deck of *Polarstern*. Most measurements will be performed underway and continuously. The following individual instruments are combined:

1. Multichannel microwave radiometer HATRPO. The instrument requires a calibration with liquid nitrogen at the port
2. Total-sky imager for cloud-structure measurements
3. Multiwavelength polarization Raman lidar PollyXT
4. Handheld sun photometer (Microtops) for aerosol and cloud optical thickness
5. Automatic Cimel sun photometer
6. Standard meteorological and radiation data logging

Expected results

1. 2d structure of the clear sky atmosphere and corresponding net radiation budget
2. Horizontal structure of the cloud water path and its effect on the downwelling shortwave and longwave radiation
3. Vertical structure of temperature and humidity as well as its variability for validation of satellite products
4. Vertical profiles of tropospheric aerosols and their effect on radiation

Data policy

All OCEANET raw data from this cruise are stored at the oceanet-archive server of TROPOS. Access can be requested via email to ronny@tropos.de.

Additionally, higher-level data are uploaded at the Pangaea database under the keyword OCEANET-ATMOSPHERE.

5. DATA ACQUISITION OF A COMBINED NEUTRON MONITOR AND MUON TELESCOPE ON BOARD *POLARSTERN*

J. Stachurska (DESY), B. Heber (not on board), M. Walter(not on board)

Objectives

Study the variation of the cosmic neutron and muon spectra in dependence on a large latitude range, to study the dependence of the cosmic ray flux on solar activity and the Earth magnetosphere.

Work at sea

There is a mini-neutron monitor as well as a muon telescope installed on board of *Polarstern*, that measure the fluxes of these secondary particles produced in cosmic ray interactions in the atmosphere. The intensity of galactic cosmic rays entering the atmosphere is modulated by solar activity an the Cut-Off rigidity. As the cut-off rigidity rises from 3 GV at Bremerhaven up to 15 GV in equatorial regions before decreasing again to 5 GV at Cape Town, data taken onboard *Polarstern* during the Atlantic passage can help us to better understand the rigidity spectrum of Ground Level Enhancements. Both detectors monitor the particle fluxes over a long time period, and can measure the modulation of the count rates as a function of the solar cycle. The new muon telescope was installed in 2017, and needs to be calibrated. The calibration will be performed during the first stage of the passage. The data will be corrected for air pressure variations, pre-analyzed on board and compared between the two detectors to ensure data quality. Further, the automatic data transfer from *Polarstern* to DESY via email will be improved. By the end of the voyage, both detectors will work autonomously.

Preliminary (expected) results

The muon and neutron monitoring is a long term process, taking several years. From this passage alone, we expect to improve upon our data taking by calibrating the muon detector. Data obtained will be combined with data from previous and future passages. The earliest predictions for the next solar minimum are in 2019. By continuously monitoring the cosmic ray induced secondary muons and neutrons, we expect to have a better understanding of atmospheric and the geo- magnetic filter over the solar cycle and of the rigidity spectrum of Ground Level Enhancements.

Data management

The data collected with the neutron and muon monitors are stored at DESY and available on the website cosmicatweb.desy.de. Via this website, the data as well as analyzing tools are provided to high school students for scientific projects.

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6. N-ISOTOPES OF AMMONIA AND AMMONIUM OVER THE ATLANTIC (NISAAA)

D. Boy (Uni Hannover), F. Heims (Uni Göttingen), J. Dykmans (not on board), G. Gravenhorst (not on board)

Objectives

Shipborne sampling and analyses at home of airborne ammonia and airborne ammonium will be made to answer the following questions:

1. What concentrations of gaseous ammonia and particulate ammonium are found on the North and South Atlantic between 50°N and 34°S along the west coast of Europe and Africa?
2. What ratios of stabile N-isotopes are found in maritime airborne ammonia and ammonium trace compounds?
3. What hypothesis can be put forward to explain found concentrations and isotope ratios of ammonia and ammonium in the air?
4. Are the properties of ammonia and ammonium related to air mass properties, e.g. trade winds from the Sahara or South Africa?

Work at sea

The aerosol will be sampled by means of membrane filters for total particles and for size separated particles by means of rectangular impactors and analysed for ammonium and sodium cations. Gaseous ammonia will be absorbed on cellulose filters acidifies by citric acid and kept humidified by glycerol. The collection efficiency for gaseous ammonia will be determined by three filters aligned behind each other. To separate particulate ammonium from gaseous ammonia a teflon membran filter will preceded the ammonia absorbing filter. This ammonium - ammonia filter pack system will be run in parallel with similar systems to collect enough material for analyses and to get replicas. The samplers will be installed at the observatory deck and operated by wind vane directions to collect clean air from the bow not contaminated by air parcels coming from all ship openings like e. g. carpentry, storerooms, ventilation openings, kitchen, toilets, cabins etc. In case the relative wind is coming from the rear auxiliary sampling systems will be run at the rear most site on the working deck. The filters will be stored until analyses between 1°C and 5°C to reduce biological activity and not to lyses biological cells. Besides ammonium ion sodium, calcium and sulfate will be analysed to identify a main counterion and potentially associated source material.

The N-isotopes will be determined in converting chemically ammonium into N_2O, which will be analysed in an IR mass spectrometer (Liu et al. 2014).

Back trajectories of sampled air masses will be determined via NOAA hysplit model. Air mass properties will be estimated via MACC modelling of vertical integration of airborne particles concentrations of mineral dust, biomass burning, secondary sulfate and sea salt.

Expected results

We expect different concentrations of ammonia and ammonium in air masses of different origins and above different marine ecosystems. If continents dominate the air mass origin particulate ammonium mass will probably dominate ammonia, if the ocean dominates the air mass origin ammonia will probably override ammonium in its concentrations. Particulate ammonium mass will concentrate in particles of the accumulation mode at ca 0.5 µm diameter, whereas sodium mass will concentrate as sea salt in the much larger size range of about 2 µm to 5 µm diameter. The non-sea-salt sulfate component will have its main mass part associated with ammonium and another part as absorbed SO_2 on alkaline sea salt particles. These results will extend older works on ammonia and ammonium of the group of Gravenhorst (e.g. Georgii and Gravenhorst 1975, Gravenhorst 1978, Gravenhorst et al 1979, Boettger and Gravenhorst, 1980, Gravenhorst 1983, Ibrom et al. 1991, Schaefer et al.1995).

The N-isotopes of gaseous ammonia will be lighter than the ones of particulate ammonium. The further away from the ammonia source the lighter should be ammonia and ammonium remaining in the air, but still ammonia will be lighter than ammonium.

Data management

The gained data will be incorporated and interpreted in university degree works.

The numerical data and information will be deposited in PANGAEA Data Publisher for Earth & Environmental Science. The combined results will be reported in a journal related to atmospheric - maritime trace substances.

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7. TESTING OF A COMBINED LAUNCH AND RECOVERY SYSTEM (LARS) AND DEPRESSOR WITH UNDERWATER PULLEY FOR TOWED VEHICLES AND OTHER TOWED MEASURING SYSTEMS FOR UNDER ICE SURVEYS

S. Krägefsky (AWI), J. Lemburg (AWI), C. Otto (not on board), V. Abel (AWI)

Objectives

Towed undulating vehicles are valuable instruments for multi-disciplinary survey allowing for simultaneous measurements of physical, chemical and biological parameters, indispensable for an understanding of oceanic processes. The cable connection allows among others for high payload, energy demanding sensors and long survey periods. Use of a towed measuring system under partial ice cover, however, needs technical measures to protect the cable from being damaged or ripped off by the ice. During the expedition PS116 a combined LARS and depressor system with underwater pulley will be tested, assessing the flight behaviour and depressor performance.

Work at sea

The system will be deployed in different mechanical configurations with help of the A-Frame of *Polarstern*. Tests of its flight behaviour will be performed at different towing speeds (1,5, 2,5 and 3,5 knots). A dummy simulating a towed vehicle (drag) will be attached to the combined launch and recovery and depressor system during the test. Forces and flight behaviour parameters will be recorded.

It is planned to test three different mechanical configurations, at three different ship speeds and two different rope lengths for a time period of 20 minutes each (6 hours in total).

Assuming 10 KN as speed of *Polarstern* during transit, transit is retarded by about 4,5 hours due to slowing down ships speed during test. Additional time is needed for launch and recovery. This time is estimated to be ½ hours each for the three subsequent deployments of the system in different mechanical configurations.

Expected results

The tests will allow assessment of the handling during deployment and recovery, the flight behaviour, depressor performance and forces involved at different stages impacting on the cable and thus on the towed vehicle. The results will help to improve the system under development.

8. LOGISTICS & SAFETY

V. Mohaupt (AWI), B. König (AWI)

Objectives

Three members of the AWI Logistics department will join *Polarstern* on the way from Las Palmas to Cape Town to get to know the existing processes on board regarding research work. Main goal is the development of a standardized safety concept for the MOSAiC project and expeditions in general.

Work at sea

The main work will be observation of all research related processes on board and development of a wording for the expedition handbook.

Preliminary (expected) results

Expedition handbook, containing all requirements and necessary information for cruise leaders, co-leaders and participants.

Data management

There will be no data acquisition for scientific outcomes.

9. LOGISTICS ACTIVITIES DURING PS116 FROM BREMERHAVEN UNTIL LAS PALMAS

S. Frickenhaus (AWI), R. Koppe (AWI), J. Matthes (AWI), T. Dinter (AWI), P. Gerchow (AWI)

The team of computer specialists must integrate parts of the O2A (Observation to Archive) software and hardware components into the *Polarstern* IT-infrastructure in preparation for the MOSAiC drift experiment. Tests must be done under realistic conditions with incoming Data during ship movements. The MCS (MOSAiC Central Storage) will be configured and tested during this cruise. The DShip-System will be connected to the Sensor-Metadata-Information System. A marketplace to configure on the fly virtual machines is part of the new computer hardware for the scientist during the drift experiments. A new communication satellite link based on the Kepler system will be tested on sea. Transfer rate for satellite data products from AWI to Polarstern will be evaluated. Representation of these products will be implemented on the Mapviewer-System for navigation and scientific purposes.

10. TEILNEHMENDE INSTITUTE / PARTICIPATING INSTITUTIONS

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11. FAHRTTEILNEHMER / CRUISE PARTICIPANTS

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36*	Mattes	Jörg	AWI	Engineer	Engineering Sc.

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(*) in Las Palmas von Bord
(§) in Las Palmas an Bord

13. SCHIFFSBESATZUNG / SHIP'S CREW

No.	Name	Rank
	Wunderlich, Thomas	Master
	Langhinrichs, Moritz	EO
	Ziemann, Olaf	Ch. Eng.
	Kentges, Felix	EO Ladung
	Fischer, Tibor	2.Offc.
	Neumann, Ralph Peter	2.Offc.
	Rudde-Teufel	Doctor
	Dr. Hofmann, Jörg	Comm.Offc
	Grafe, Jens	2.Eng.
	Krinfeld, Oleksandr	2.Eng.
	Haack, Michael	2. Eng.
	Redmer, Jens Dirk	Elec.Techn
	Frank, Gerhard	Electron.
	Hüttebräucker, Olaf	Electron.
	Nasis, Ilias	Electron.
	Himmel,Frank	Electron
	Loidl, Reiner	Boatsw.
	Reise, Lutz	Carpenter
	Bäcker, Andreas	AB.
	Brück, Sebastian	AB.
	Möller, Falko	AB.
	Neubauer, Werner	AB.
	Hans, Stefan	AB.
	Wende, Uwe	AB.
	Klee, Philipp	AB.
	Peper, Sven	Azubi 3.LJ
	Preußner, Jörg	Storek.
	Plehn, Markus	Mot-man
	Rhau, Lars-Peter	Mot-man
	Gebhardt, Norman	Mot-man
	Luckhardt, Arne	Mot-man
	Schwarz, Uwe	Mot-man
	Schnieder, Sven	Cook
	Silinski, Frank	Cooksmate
	Möller, Wolfgang	Cooksmate
	Czyborra, Bärbel	1.Stwdess
	Wöckener, Martina	Stwdss/KS

No.	Name	Rank
	Dibenau, Torsten	2.Steward
	Silinski, Carmen	2.Stwdess
	Nagel, Jens	2.Steward
	Arendt, Rene	2.Steward
	Sun, Yong Sheng	2.Steward
	Chen, Dan Sheng	Laundrym.
	Kreuzmann, Lennart	Azubi 1.LJ