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

EXPEDITION PROGRAMME PS102

Polarstern

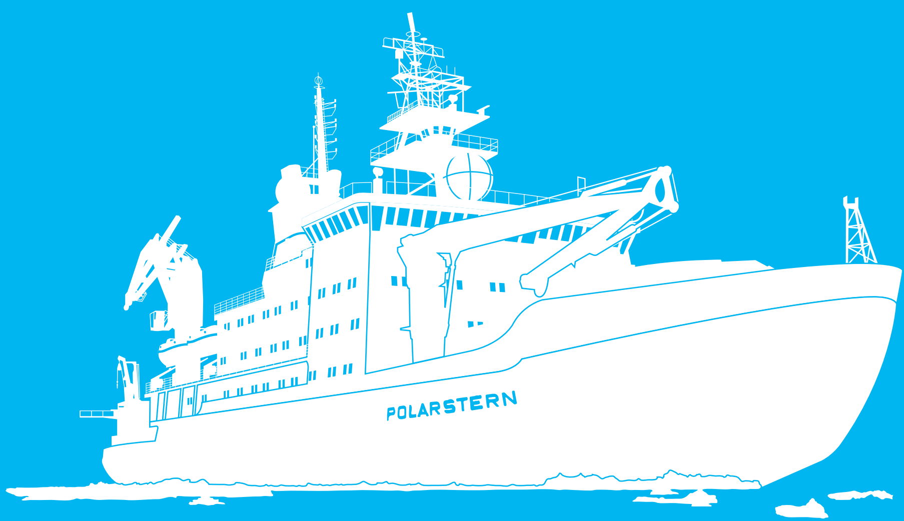
PS102

Bremerhaven - Cape Town

12 November 2016 - 12 December 2016

Coordinator: Rainer Knust

Chief Scientist: Karen Wiltshire



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Contents

1. ÜBERBLICK UND FAHRTVERLAUF

K. Wiltshire, P. Lemke
AWI

Die Transitfahrt von Bremerhaven über Las Palmas nach Kapstadt (Südafrika) startet am 12.11.2016 und ist in zwei Abschnitte geteilt: Bremerhaven - Las Palmas (PS102.1, Fahrtleitung K. Wiltshire) und Las Palmas - Kapstadt (PS102.2, Fahrtleitung K. Wiltshire). Beide Abschnitte stehen ganz im Zeichnen der studentischen Ausbildung. Eine internationale Gruppe von 25 Studierenden aus 18 Ländern wird während einer "schwimmenden Sommerschule" in Techniken der Ozeanographie und der Fernerkundung geschult. Dabei sollen sie Methoden der Probennahme, der Aufarbeitung der Proben und den Umgang mit erhobenen Daten lernen.

Als weitere Aufgabe während der Transitfahrt werden chemische und physikalische Messungen zum Energie- und Massen-Austausch zwischen Ozean und Atmosphäre durchgeführt. Zudem bekommen die Studenten eine Einführung in die Physik des Klimasystems, in die internationalen Klimaverhandlungen und in das Seerecht und seinen Einfluss auf marine Forschungsaktivitäten.

Die "schwimmende Sommerschule" ist ein gemeinsames Projekt zwischen dem Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung, POGO Zentrum für Exzellenz und dem irischen Programm SMART (Strategic Marine Alliance for Research & Training). Die Sommerschule wird durch die Nippon Foundation / POGO Centre of Excellence finanziert und von REKLIM (Helmholtz Verbund Regionale Klimaveränderung) unterstützt.

Während der Überfahrt bis Las Palmas werden diverse hydroakustische Messgeräte getestet und kalibriert werden. Des Weiteren werden Arbeiten an der Satelliten-Standleitung durchgeführt und getestet.

Am 12.12.2016 wird *Polarstern* in Kapstadt einlaufen und beendet damit die Expedition PS102.

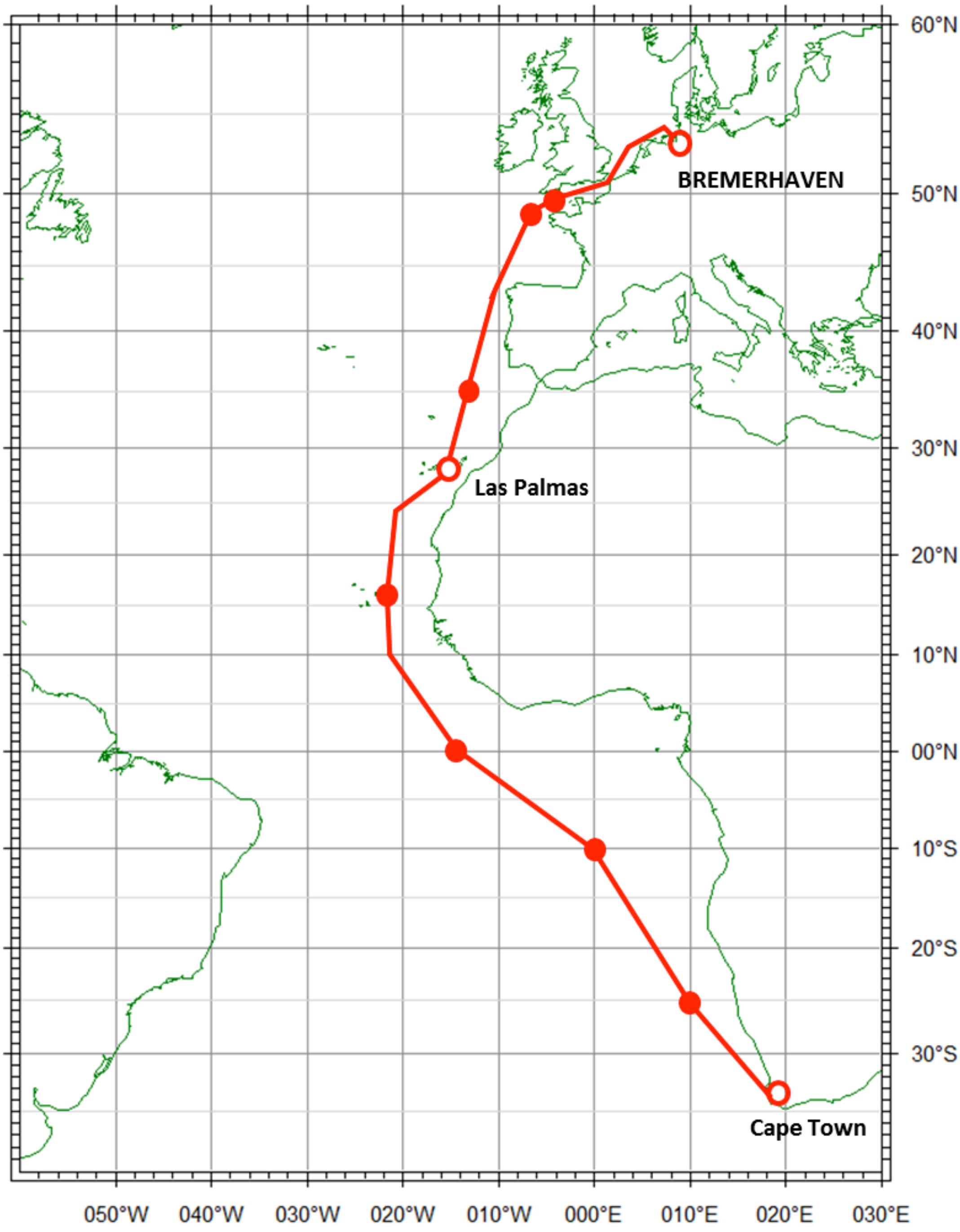

Abb. 1: Der generelle Kurs für PS102
Offene Kreise = Häfen, Gefüllte Kreise = Stationen

Fig. 1: The general course plot PS102
Open circles = ports, Closed circles = stations

SUMMARY AND ITINERARY

The transit cruise from Bremerhaven via Las Palmas to Cape Town (South Africa) will begin on 12.11.2016 and is split into two cruise legs: Bremerhaven to Las Palmas (PS102.1, Chief Scientist K. Wiltshire) and Las Palmas to Cape Town (PS102.2, Chief Scientist K. Wiltshire). Both legs are dedicated to the training of students. During a "floating summer school" an international group of 25 students will be trained in basic techniques of oceanography and remote sensing on a North-South transect from Bremerhaven to Cape Town (North South Atlantic Training; NoSoAT). The participants will learn how to take samples, how to process them and deal with the accompanying data. The main water masses between the North Sea and Cape Town will be characterized in terms of their hydrographic features down to a depth of approx. 500 m.

A further focus during the transit cruise will be physical and chemical measurements for energy and material exchange between ocean and atmosphere (OCEANET). In addition, the students will get an introduction into the physics of the climate system, international climate negotiations and the law of the sea and its impacts on marine research activities.

The floating summer school is a joint project between the Alfred Wegener Institute, the POGO Centre of Excellence and the Irish Strategic Marine Alliance for Research & Training (SMART) program. It is funded by the Nippon Foundation / POGO Centre of Excellence and supported by REKLIM.

During the transit cruise from Bremerhaven to Las Palmas hydro acoustic measuring units are tested and calibrated. *Polarstern* is scheduled to arrive in Cape Town on 12.12.2016 and thus ends the expedition PS102.

2. NORTH SOUTH ATLANTIC TRAINING 2016 (NOSOAT)

K. Wiltshire (AWI), P. Lemke (AWI), P. Croot, P. McGrane(MIG, not on board), E. Brodte (AWI), S. Schlacke (WWU), L. Playford, K. Carstens (AWI), T. Ruhtz (FUB), U. Kuster (FUB), T. Keck (FUB), R. Preusker (FUB), U. Küster (FUB), H. Kalesse (TROPOS), S. Fiedler (MPI- M), M. Haarig (NN), J. Rick (AWI), A. Wilson (AWI)

Objectives

Aim of the floating summer school is to chart and characterize different water bodies along a North-South Atlantic Transect, as part of training exercise for capacity building in oceanography. An international group of 25 students (mostly graduate level and doctoral candidates) will be trained in basic oceanographic principles including seagoing methods and sampling associated with these. The cruise track will cross coastal, shelf and open Atlantic

Ocean waters. Specifically, participants will learn how to sample and analyse the ocean properties, also as “Ground Truth” information for Remote Sensing information.

Intended study objectives of the floating summer school include:

- differentiation of different water masses via temperature, salinity, turbidity etc
- localization of thermocline
- detection of salinity gradients, turbidity
- comparison of ground-truth data with remote sensing
- measurements of atmospheric properties
- studies of climate physics
- discussion of the law of the sea and its impacts on *in-situ* marine observations
- introduction into the international climate negotiations

Work at sea

The maps of the planned stations are shown in Figs. 2 to 4.

After embarkation, students will present their research projects (Master or PhD) in short talks. They will be provided background literature for the cruise. All participants need to pick a topic to be followed in discussion groups that will take place regularly during the cruise. Topics comprise oceanography, climate & meteorology, remote sensing, ocean governance and art & science. Station work will take place on the Western European Shelf, the Western European Slope, North west off the Ampere Sea Mount, and at least three more stations in the South Atlantic.

Deployed instruments comprise eXpendable Bathy/Thermographs (XBTs), CTD rosette casts, and surface radiance. XBTs will be dropped from the (sailing) ship to measure temperature as they fall through the water. Deployment of XBTs will complement the oceanographic data collected during station work by CTD casts.

CTD Rosette sampling

Investigations of the hydrographic regime will include about 10 CTD casts measuring temperature, salinity and depth coupled with additional sensors to provide information on fluorescence, turbidity, oxygen etc. Water samples from depth will be recovered via Niskin bottles in a rosette frame and analysed for quantitative determination of chlorophyll a concentrations.

XBT Deployments

Physical environmental data will be enhanced by regular deployment of Expendable Bathythermographs (XBTs) to measure the thermal structure of the upper 1.8 km of the water column. XBT probes are ‘fired’ when the vessel is underway at a speed of approximately 6 knots. In order to resolve fine scale shelf features such as fronts and mesoscale eddies XBT probes are generally deployed at a distance of ~25 km. For larger scale ocean processes, distances between deployments are in the order of ~150 km. The position and number of XBT stations for the NoSoAT survey is dependent on a number of factors and station positions will be en route.

Thermosalinograph DAS measurements & sampling

In addition, underway sub-surface (ca. 3 m) temperature, salinity and fluorescence data will be collected using the vessels thermosalinograph unit and underway data acquisition system (DAS).

Data analysis

Simple T/S (CTD) and scatter plots (XBT) will be worked up along the transect to give students a good understanding of differing water mass characteristics and data handling. Section plots will be worked up using open software such as Ocean Data Viewer (ODV) http://odv.awi.de which will be integrated with related data sets (phytoplankton, zooplankton, MODIS SST remote sensing data) to determine different water masses and biogeographic and provinces. Comparison with previous trans-meridional data sets will also be undertaken e.g. http://www.pangaea.de/search?ie=UTF-8&env=All&count=10&q=XBT+Polarstern.

Communication & Ocean Literacy outreach

A pilot Ocean Literacy programme is proposed that is based on questions stated via the *Polarstern* twitter account which will be answered by small video sequences. In cooperation with a local school questions will be arising via tweets and answered onboard by the scholars.

On-board students will be part of creative working groups set up to showcase the NoSoAT through a range of media fora including blogging, vlogging, video production and photography across a range of innovative social media. The technical feasibility of a live video link is currently being examined.

In addition to involvement by NoSoAT partners other confirmed interested partners include:

- the Deutsche Welle
- Dpa Kindernachrichten
- Geolino
- free journalists for university newspapers

This range was chosen to address different target groups from younger children up to university students.

The teaching programme and concept will be presented at the CommOcean 2016 in Belgium.

Preliminary (expected) results

The cruise from Bremerhaven to Cape Town will cover an enormous geographic range as we transit through temperate and sub-tropical regions. During the transect, participants will be trained in the principles of oceanographic, meteorological, and atmospheric interactions and their impacts on climate. Work on-board will focus on active learning and hands-on, practical applied research techniques, supported by a suite of background lectures, exercises and presentations. Participants will gain hands-on training in the set-up and operation of scientific instrumentation and equipment, acquisition and processing of samples and analysis and interpretation of the respective data. In addition, participants will receive training in understanding climate processes, simple climate modelling and the legal framework of ocean governance and its impacts on research activities at sea. Students will also receive training in:

- physics of climate: processes and models
- atmospheric Lidar systems
- physical, chemical and biological oceanography

- remote sensing techniques
- climate advocacy and governance
- the art of ocean science

These data will allow us to categorise regional oceanic and atmospheric patterns and identify biogeographic provinces of the Atlantic. The practical work will be supported by on-board lectures, discussions, practical exercises, data workup sessions and peer-led presentations which will enable interpretation of the respective data.

Data management

All data collected during the expedition will be stored in the PANGAEA data repository at the AWI.

3. GENETIC AND EPIGENETIC CHANGES IN ORGANISMS CARRIED IN BALLAST WATER DURING TRANS-EQUATORIAL TRAVELS IN THE ATLANTIC OCEAN

E. Garcia-Vazquez (UOviedo), A. Zaiko (UKlaip), A. Ardura (UPVD)

Objectives

This project is focussed on two objectives:

1) To identify and quantify the genetic and epigenetic changes experienced by organisms carried inside the ballast tank of the *Polarstern* across the Equator. During the cruise, the work will include sampling ballast water, sorting by species and storing in ethanol the organisms present in the samples, for further molecular analysis in home laboratories.
2) To explore the development of the biofilm/biofouling communities within the ballast tanks, shift in taxonomical composition over the cross-latitudinal transfer and assess their possible contribution to the cross-regional introduction of marine non-indigenous species. The experiment will be conducted onboard, by deploying the settlement plates in the ballast tank and sampling the biofilm for further molecular analysis in home laboratories.

Work at sea

Ballast water (BW) samples will be taken via the sounding pipe, at 11-21 geographical positions evenly distributed along the travel: before, after and one crossing the Equator. At each position, replicate samples will be collected by concentrating ca. 100 L of ballast water by filtering through a planktonnet. Onboard samples will be visually analyzed with the microscope, and specimens of the selected taxa will be sorted for further molecular analyses. The rest of species will be also visually classified from sample aliquots. From each sample, a sub-sample will be stored in absolute ethanol for metabarcoding. Physic-chemical parameters of the ballast water will be monitored at least 2 times per day over the cruise: pH, salinity, oxygen concentration, temperature (if possible, also organic carbon concentration, TN and TP).

Additional parallel experiment in BW will be carried out, addressing the hypothesis that the biofilm/biofouling of BW tank walls might be an important vector of Non-Indigenous Species introduction. Three lines with replicate PVC plates (15x15 cm) will be suspended vertically in the ballast tank on the day of departure. The biofilm from the plates will be sampled 3 times during the voyage (within the first week, the second week and upon arrival to Cape Town). For the sampling, a line will be retrieved from the tank (at a port call or whenever is safe to open the manhole), samples will be collected as in Pochon et al. (2015) and preserved until the further molecular analysis (eDNA, eRNA extraction, metabarcoding) at home laboratories.

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

Preliminary (expected) results

All the samples collected during the *Polarstern* cruise will be split in two halves. Half of them will be safely stored in the Laboratory of Natural Resources of the University of Oviedo and the other half will be stored at Cawthron Institute (New Zealand). They will be placed at the disposal of the scientific community within a maximum of one-year moratorium after the cruise.

The number of organisms expected cannot be estimated before the travel but will reasonable be over 100 of different species. They will be sorted by species and stored in ethanol for preserving DNA quality. They will be available under request, and this particular point will be clearly stated in the scientific publication/s arising from the project. Some individuals may have been completely smashed for DNA extraction, especially small specimens. In such a case, DNA aliquots will be available under request.

DNA Barcoding (COI, 18S and 16S rRNA genes as Barcodes) will be used for species ascertainment from individual samples. NGS Metabarcoding as in Zaiko et al. (2015a,b) will serve for describing the plankton and biofilmcommunity. The 454 platform (or Illumina) will be employed. NGS Metabarcoding from RNA will be used for determining the fraction of the community –and species catalogue- that is alive in each sample.

Data management

The data obtained from the samples will be essentially DNA sequences. The DNA sequences will be obtained, edited and curated within six months after the cruise. They will be submitted to the public repository GenBank (http://www.ncbi.nlm.nih.gov/genbank/). The release date will be six months after submission; therefore they will be fully accessible for the scientific community expectedly one year after the cruise end, at the same time as the samples.

The scientific results obtained from the samples collected in the cruise will be analyzed, interpreted and published in peer-refereed scientific journals indexed in SCI. At least one article will arise from the project. The *Polarstern* crew and the Chief Scientist of the expedition as well as the AWI will be acknowledged in all publications and deliverables that may be obtained from the samples obtained in the project. The authors will strictly adhere to the Good Scientific Practice in Research and Scholarship of the European Science Foundation (http://www.esf.org/fileadmin/Public_documents/Publications/ESPB10.pdf).The intention of the authors is to publish the results in Open Access journals.

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

A. Macke (TROPOS, not on board), R. Engelmann (TROPOS, not on board), H. Deneke (TROPOS, not on board), H. Kalesse (TROPOS), M. Haarig (TROPOS), S. Fiedler (MPI-M)

Objectives

The OCEANET-ATMOSPHERE project delivers valuable atmospheric measurement datasets over the oceans – in regions of the world which are not easily accessible. For the last 7 years a container-based platform has been operated regularly at *Polarstern* to obtain measurements and to contrast atmospheric processes between the anthropogenic polluted northern hemisphere and the more undisturbed southern hemisphere. For the PS102 cruise a renewed container will be used and tested for the first time.

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 a multi-spectral solar radiometer, which also enables the determination of spectrally resolved aerosol and cloud radiative effects. Most instruments are integrated in the container-based atmosphere observatory.

b) Lidar measurements of aerosol and cloud profiles

Since more than 15 years TROPOS develops and operates 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 the PS102 cruise the lidar will be equipped with a dual-wavelength near-range channel in order to observe the aerosol in the shallow marine boundary layer at 355 and 532 nm.

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 of Bremenhaven
2. Whole sky imager for cloud structure measurements
3. Multiwavelength polarization Raman lidar PollyXT
4. Handheld sun photometer (Microtops) for aerosol and cloud optical thickness
5. Standard meteorological and radiation data logging
6. Multispectral shadow-band radiometer

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 management

The data observed onboard will be stored at PANGAEA database.

5. COLUMN-INTEGRATED OPTICAL MEASUREMENTS OF AEROSOL, WATER VAPOUR AND CLOUDS

S. Fiedler (MPI-M), S. Kinne (MPI-M, not on board) and F. Jansen (MPI-M, not on board)

Objectives

Ground-based measurements of aerosol, water vapour, and clouds is typically sparse over remote waters, but important for understanding the Earth radiation budget. Extending the maritime aerosol network (MAN) through measurements during the expedition is an important contribution for maintaining updated reference data for both satellite product development and evaluation of atmospheric models.

The optical data to be submitted to the MAN network are collected with a small handheld instrument that samples the intensity of incoming shortwave radiation (MICROTOPS II instrument). It is combined with a GPS to estimate the irradiance at the top of the atmosphere. Incoming shortwave radiation measured onboard the ship has been reduced by absorption and scattering. Based on associated differences in the radiation fluxes, properties of atmospheric aerosol and water vapour along the atmospheric path of the direct sunlight are derived.

Moreover, a camera system will be operated onboard the ship. The system contains cameras for visible and infrared radiation. Both will be pointed towards the sky to continuously record cloud scenes along the ship track. The infrared camera measures temperature differences that allow to derive cloud characteristics. Comparison to images from the visible camera herein helps to separate clouds from the environment.

Work at sea

The measurements of MICROTOPS rely on direct sun-light such that they will be carried out during day in the absence of clouds in front of the sun. The camera system will be fixed onboard prior to departure and will autonomously operate throughout day and night. All instruments need to undergo regular, but basic maintenance, such as cleaning lenses from settled sea salt. Measurement data will be transferred to a computer, quality-checked and stored on hard disks. Basic analysis of the measurements and comparison to observations from previous expeditions, e.g., regarding differences in weather affecting aerosol loading, will be carried out.

Expected results

The collected data will be useful to determine the characteristics of column-integrated aerosol properties, water vapour, and clouds during the expedition and can be compared to other observations onboard, e.g., OCEANET. The camera images will serve to derive cloud statistics, e.g., cloud fraction and height of cloud base, along the ship track. These will be useful for validating high-resolution cloud models and aid stochastic parameterisation development. Aerosol characteristics from MICROTOPS will be included in the aerosol climatology of MPI-M (MACv2) that largely depends on the MAN network over oceans. MACv2 is used as a reference aerosol climatology in climate modelling.

Data management

MICROTOPS measurements from the expedition will be transmitted to the publicly accessible MAN database (http://aeronet.gsfc.nasa.gov/new_web/maritime_aerosol_network.html). Camera images could be made accessible upon request.

6. STABLE N - ISOTOPES OF AMMONIUM AND AMMONIA IN AND OVER THE ATLANTIC OCEAN

H. Witte-Gaedecke (GAUG), J. Goedecke (GAUG), G. Gravenhorst (GAUG)

Objectives and scientific programme

We want to make field measurements on board to answer the following questions:

1. What 15 N / 14 N-isotope ratios are found in ammonium of size separated airborne particles and in gaseous ammonia over the Atlantic?
2. What differences in NH4 - and NH3 - concentrations and in N - isotope ratios do exist between air over the North Atlantic, the South Atlantic and air over the ice-covered Atlantic?
3. Can we differentiate NH3 -source and - sink regions on the Atlantic?
4. What fingerprint do ammonia and ammonium, dissolved in the surface water of the Atlantic, leave in the atmosphere?
5. What ∂ 34 S values do non – sea - salt airborne particles have in the different size ranges and are they derived from DMS or other SO2 sources?

The ice shield of Antarctica is a huge archive for past global biogeochemical properties and earth system processes. Deposition rates of non-sea-salt-sulphate (NSSS), of non-continental nitrate and ammonium in Antarctica do not seem to differ markedly in glacial and interglacial periods (Kaufmann et al. 2010, Legrand and Delmas 1988). The sources of the ionic constituents in polar firn and ice cores are, therefore, still a matter of debate. The atmosphere is an open system with global connections in space and time. The gateway from the lower latitudes of the Atlantic to Antarctica is, therefore, one special road of interest for understanding traits in Antarctic ice constituents and their relation to earth system processes.

Antarctic ice constituents could have their primary sources in the Southern Ocean (Andreae and Crutzen 1997) and on continents (e. g. Duce et al. 2008, Martínez-Garcia et al. 2012). Sulphate, nitrate, ammonium and sodium are major targets of ice core analyses and their interpretations. The ∂ 34 S isotope ratio as tracer for sulphur in Antarctic and Greenland ice cores has been evaluated. (e. g. Delmas 1995). However N-isotopes of ammonium in ice cores are not measured yet. The source of ammonium in polar firn and ice cores is rather uncertain.

Our aim is, therefore, to determine on the Northern and the Southern Atlantic from northern mid- latitudes to Antarctica the background pattern of the ratios of stable isotopes 15 N / 14 N in NH4+ and in NH3 in the air and in the surface water to characterise possible sources of atmospheric NH4+ and their regional distribution. Ammonia gas (NH3) is the main alkaline gaseous compound in the atmosphere It is the source of ammonium (NH_4^+) in atmospheric particles, droplets and ice cores. Ammonia is emitted into the atmosphere on a global scale mainly by volatilisation from liquid cattle waste. (e.g. Lenhard and Gravenhorst 1980, Dentener and Crutzen, 1994). In the marine atmosphere NH_3 could have its source in the ocean surface water (Bell 2006). The concentrations of gaseous NH_3 and particulate NH_4^+ seem to drop by about one order of magnitude from the open ocean to the sea ice covered ocean (Ibrom et al 1991). NH_3 can flow between the atmosphere and the ocean in both directions (e.g. Schaefer et al 1999, Bell 2006). The ocean was divided to be a sink in high and, therefore, cold latitudes and a source in low and, therefore, warm latitudes (Johnson et al 2008). Maritime airborne ammonium is mainly found in the nucleation and accumulation mode (e.g. Gravenhorst 1978, Gravenhorst et al. 1979, Schaefer et al 1993). Airborne NH_4^+ and non-sea-salt sulfate in remote areas are often closely associated in particle size and concentration. They frequently show molar ratios between 1 and 2 (e.g. Gravenhorst 1978). A reaction of existing acidic sulphate and alkaline ammonia seems to be realistic (Gravenhorst 1978, Beilke and Gravenhorst 1978, Johnson et al. 2008). NH_4-sources for marine samples are rather unknown. NH_4^+ is produced within the ocean via N_2 fixation, ammonification of organic material, denitrification of nitrite and excretion by organisms and leaves the water via assimilation uptake, nitrification within the ocean, reaction of NH_4^+ with NO_2^- (anammox) and by emission of NH_3 into the atmosphere. The free NH_4^+ -N pool in the global ocean is only a small fraction (less than one permil) of the NO_3 –N pool (Gruber 2008, Koide et al. 1986). NH_4^+ sea surface concentrations along a latitudinal transect across the Atlantic was around 10 to 25 nmol / l (Woodward 2006).

∂ 15 N ratios of ammonia and ammonium in the atmosphere ratios of 15 N- NH_4^+ and 15N-NH_3 isotope values in atmospheric samples are very rare. A generalized interpretation of the ∂ 15 N values is proposed here: NH_3-source material (manure, urine, faces) have a high ∂ 15 N value in a range of about + 0 ‰, compared to gaseous NH_3 in the atmosphere of about -20 ‰. The particulate ammonium in the atmosphere has a high ∂ 15 N value similar to the ∂ 15 N value of the NH_3-source material. The rain ∂ 15N-NH_4^+ value seems to fall between ∂ 15 N values for gaseous airborne NH_3 and for particulate airborne NH_4^+. All NH_3 and NH_4^+ and their isotopes in updrafts at cloud base will be incorporated into cloud droplets and subsequent into rain drops (Gravenhorst 1983). So that ∂ 15N values in rain could develop as weighted means of ∂ 15N values of NH_3 gas and of NH_4^+ -particles. ∂ 15 N values of ammonia and ammonium in sea water. The N-cycle in the ocean is connected to the atmosphere (e.g. Duce 1986, Schaefer et al 1999, Voss et al. 2013). N cycling has been characterized with ∂ 15 N values in different transformation processes (e.g. Sigman et al. 2009). NH_4^+ is involved in physicochemical pathways within the oceanic food web (e.g. Gruber 2008). We want to measure actual concentrations of sea water NH_4^+ and NH_3 x H_2O and their 15N -isotope ratios (Holmes et al. 1998, Woodward 2006, Watson et al. 2005) in comparison with atmospheric particulate NH_4^+ and gaseous NH_3. Activities on board Concentrations of gaseous NH_3 and particulate NH_4^+ in the lower atmosphere as well as physically dissolved NH_3 x H_2O and NH_4^+ in the surface sea water will be determined on the latitudinal transects of "RV *Polarstern*" from Bremerhaven to Filchner shelf ice and further Punta Arenas and back from Punta Arenas to Bremerhaven.

Work at sea

For NH_3- and NH_4^+ concentration and δ 15N-NH_3 and δ 15 N- NH_4^+ isotope measurements the NH_4^+ and NH_3-gas molecules will be accumulated on filter pack systems (90 mm diameter). The filter pack system consists of one teflon-membrane filter in front to collect particles and three acidified membrane filters behind to absorb gas phase ammonia. Five individual standalone systems (filter pack, gas pump, gas meter, wind direction controller) will be installed on the deck above the bridge. For the case of wind blowing from the tail a similar filter pack system will be installed on the stern. Depending on the NH4+ mass found on each NH4 + - particle filter and on each NH3 ammonia filter the solutions of filters will be clumped or kept individually and used for NH4-N - and NH3-N isotope analyses on land according to Watson et al. 2005, Holmes et al. 1998, Woodward (2006). Two identical high – volume samplers (ca 70 m 3 / h) will collect size – fractionated airborne particles with a 5 stage impactor (Marple and Willeke 1976). The 5 stages of the impactor (ca < 10 µm to > 0.1 µm radius) will be covered by a teflon foil and backed up with a teflon membrane filter (filter Ø = 20 cm, particle r < 0.1 µm radius). The impactors will be installed on the deck above the bridge. About 5000 m^3 sample sizes (3 days of sampling) are necessary to collect enough NH4+- N , and SO4= - S for isotope analyses for the different particle seize ranges.

To determine the ∂ 15N values of the sea water sum of (NH4+ + NH3 x H2O) a sea water sample will be purged with air in a closed cycle. The expelled NH3 will be collected on an acidified quartz filter (r =7.5 mm), which will be analysed for ∂ 15 N at Kompetenz- Zentrum Stabile Isotope (KOSI) in Goettingen.

Data management

The data observed onboard will be stored at PANGEA database.

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7. EN-ROUTE TEST OF UPGRADED SHIP DATA MANAGEMENT SYSTEM DSHIP

P. Gerchow (AWI); C. Schirnick (GEOMAR); R. Günther, R. Löwenberg, T. Tomczak (WERUM)

Objectives

The ship data management system DSHIP from firm WERUM will be upgraded to version 3 during ship yard time of RV *Polarstern* in October/November 2016. During the following cruise PS102 from Bremerhaven to Las Palmas the configuration of the system will be finished and the correct installation and functionality of the system will be tested and confirmed.

Work at sea

During the cruise all associated sensors and devices will be switched on to acquire data as usual. The correct receive and storage of these data will be supervised. All tools (e.g. station book, etc.) will be tested and used under real conditions. If necessary, adjustments of configuration and runtime settings as well as the completion of variable settings will be performed.

Expected results

After completion of the tests and adjustments the upgrade will be finished.

8. TEST OF NEW SEA WATER SUPPLY AND TEST OF ATTACHED SENSORS

R. Krocker (AWI), M. Gehrung (HZG), S. Raimund (SubCtech), S. Krägefsky (AWI, not on board)

Objectives

During last shipyard time of RV *Polarstern* in May/June 2016 the room G-707 was arranged to be laboratory for water analysis by devices FerryBox from firm 4H-Jena and pCO2 analyzers from firm General Oceanics and from firm SubCtech. During ship yard time in October/November 2016 these installations will be finished and scientific devices will be relocated from previous place, namely wet-laboratory 1, to the new room. These arrangements were recommended to significantly reduce length of pipes providing sea water and finally to reduce possible chemical or physical processes within sea water prior to the analyzers. During ship yard time the usual operation of the systems can not be executed, because the harbour water is polluted by sediments. A temporarily installed provisoy fresh water supply will allow rudimentary flow tests only. But the real operation must be tested on sea.

Work at sea

The correct installation of sea water supply, fresh water supply, reference gases and network connections will be testet under real conditions. The several valves will be adjusted to provide sea water with appropriate flow rate and pressure for each analyzer. The correct functionality of the systems will be tested and confirmed. The data will be analyzed for quality assessment.

Expected results

After the completion of tests and adjustments the three analyzers will work proper as before with the new water supply. The previous water supply in wet laboratory 1 will not be deinstalled to be available as backup or for additional other sensors.

9. INTEGRATION OF NEW MOTION SENSORS IXBLUE HYDRINS (PART 2)

R. Krocker (AWI), J. Kaessbohrer (FIELAX)

Objectives

During ship yard time of RV *Polarstern* in May/June 2016 two new motion sensors HYDRINS from firm IXBLUE were installed to replace existing sensors MINS from firm Raytheon Anschütz. The provision of motion data for hydroacoustic sensors was already performed in June. As the number of output interfaces of HYDRINS devices is limited, not all necessary data formats for recipient devices can directly be provided. For this reason interface boxes have been created by firm FIELAX to duplicate and reformat the output strings of the motion sensor for the associated recipients.

Work at sea

All sensors receiving new established input data streams will be operated. The correct receive of these data streams and the correct functionality of these devices will be tested.

Expected results

All necessary data streams can be provided by interface boxes. The correct functionality of all associated sensors will be confirmed. No sensor will be connected to previous installed sensors of type MINS anymore. Both MINS sensors will stay on board as backup system.

10. TEILNEHMENDE INSTITUTE / PARTICIPATING INSTITUTIONS

	Address
AWI	Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung Am Handelshafen 12 27570 Bremerhaven Germany
CAU	Christain-Albrechts-Universität Kiel Christian-Albrechts-Platz 4 24118 Kiel Germany
DWD	Deutscher Wetterdienst Geschäftsbereich Wettervorhersage Seeschifffahrtsberatung Bernhard Nocht Str. 76 20359 Hamburg Germany
FIELAX	FIELAX Gesellschaft für wissenschaftliche Datenverarbeitung mbH Schleusenstr. 14 D-27568 Bremerhaven Germany
FUB	Freie Universität Berlin Kaiserswerther Str. 16-18 14195 Berlin Germany
GAUG	Georg-August-Universität Göttingen Wilhelmsplatz 1 37073 Göttingen Germany
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MPI-M	Max Planck Institute for Meteorology Bundesstrasse 53 20146 Hamburg Germany
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NUIG	National University of Ireland Galway, University Road, Galway Ireland
PU	Plymouth University Drake Circus PL4 8AA Plymouth United Kingdom
RSHU	Russian State Hydrometeorological University Malookhtinskaya naberezhnaya 98 St Petersburg Russia
SubCtech	SubCtech GmbH Wellseedamm 3 24145 Kiel Germany
TROPOS	Leibniz Institute for Tropospheric Research, Leipzig Permoserstrasse 15 04318 Leipzig Germany
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UCC	University College Cork Western Road Cork Ireland
UGhent	University Ghent St. Pietersnieuwstraat 33 9000 Gent Belgium
UHB	Universität Bremen Bibliothekstraße 1 28359 Bremen Germany
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UKeny	University Kenyatta Kenya Drive Nairobi City Kenya

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UPVD	University of Perpignan Via Domitia 52 Av. Paul Alduy 66100 Perpignan France
UWien	University of Vienna Universitätsring 1 1010 Wien Austria
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11. FAHRTTEILNEHMER / CRUISE PARTICIPANTS

Leg 1

Name/ Last name	Vorname/ First name	Institut/ Institute	Beruf/ Profession
Wiltshire	Karen	AWI	Biologist
Lemke	Peter	AWI	Physicist
Adeleye	Adedayo	ZEU	PhD student
Amorim	Katherine	UAlg	Student
Brodte	Eva-Maria	AWI	Biologist
Carstens	Kristine	AWI	Technician, biologist
Copeland	William	UiT	Student
Cronin	Abigail	UCC	Student
Croot	Peter	NUIG	Biologist
Curran	Michelle	NUIG	Student
Daly	Eoghan	NUIG	Student
Deschepper	Inge	UGhent	Student
Ehrhardt	Sophie	UHB	Student
Espinosa Lagunes	Carla	UHB	Student
Fielder	Stephanie	MPI-M	Meteorologist
Gajigan	Andrian	UPD	Student
Garcia-Vazquez	Eva	Uni Oviedo	Biologist
Gehrung	Martina	HZG	Biologist
Geisen	Carla	UPMC	Student
Gerchow	Peter	AWI	Engineer
Giunta	Valeria	UdBA	Student
Goedecke	Julia	GAUG	Scientist
Gregory	Clynton	NUIG	PhD student, biology
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Haarig	Moritz	TROPOS	Scientist
Höpker	Sebastian	UHB	Student
Kaessbohrer	Johannes	FIELAX	Scientist
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Krocker	Ralf	AWI	Engineer
Löwenberg	Ralf	WERUM	Computer Scientist
Maarouf	Rabie	UAlex	PhD student
Magalhães Loureiro	Clara	UdA	PhD student
N.N.		DWD	Meteorologist
N.N.		AWI	

Name/ Last name	Vorname/ First name	Institut/ Institute	Beruf/ Profession
O'Donovan	Sarit	UAlg	Student
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Raimund	Stefan	SubCtech	Scientist
Reichardt	Aurelia	UHB	Student
Rick	Johannes	AWI	Biologist
Ruhtz	Thomas	FUB	Scientist
Sagero	Philip	UKeny	PhD student
Sarker	Subrata	JUB	PhD student
Schirnick	Carsten	GEOMAR	Scientist
Schlacke	Sabine	WWU	Lawyer (Env. Law)
Shestakova	Elena	RSHU	Student
Sonnabend	Hartmut	DWD	Meteorologist
Thabet	Walaa	UAlex	Student
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Leg2

Name/ Last name	Vorname/ First name	Institut/ Institute	Beruf/ Profession
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Amorim	Katherine	UAlg	Student
Brodte	Eva-Maria	AWI	Biologist
Carstens	Kristine	AWI	Technician, biologist
Copeland	William	UiT	Student
Cronin	Abigail	UCC	Student
Croot	Peter	NUIG	Biologist
Curran	Michelle	NUIG	Student
Daly	Eoghan	NUIG	Student
Deschepper	Inge	UGhent	Student

Name/ Last name	Vorname/ First name	Institut/ Institute	Beruf/ Profession
Ehrhardt	Sophie	UHB	Student
Espinosa Lagunes	Carla	UHB	Student
Fielder	Stephanie	MPI-M	Meteorologist
Gajigan	Andrian	UPD	Student
Garcia-Vazquez	Eva	Uni Oviedo	Biologist
Geisen	Carla	UPMC	Student
Giunta	Valeria	UdBA	Student
Goedecke	Julia	GAUG	Scientist
Gregory	Clynton	NUIG	PhD student
Haarig	Moritz	TROPOS	Scientist
Höpker	Sebastian	UHB	Student
Kalesse	Heike	TROPOS	Scientist
Kuster	Ulrich	FUB	Scientist
Maarouf	Rabie	UAlex	PhD student
Magalhães Loureiro	Clara	UdA	PhD student
N.N.		DWD	Meteorologist
N.N.		WERUM	Computer Scientist
O'Donovan	Sarit	UAlg	Student
O'Sullivan	Hugh	PU	Student
Playford	Lionel	NU	Artist, PhD Student
Preusker	Rene	FUB	Scientist
Reichardt	Aurelia	UHB	Student
Rick	Johannes	AWI	Biologist
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Sarker	Subrata	JUB	PhD student, biology
Schlacke	Sabine	WWU	Lawyer (Env. Law)
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Witte-Gaedeke	Heidi	GAUG	Scientist
Yirgaw	Daniel Gebregiorgis	GEOMAR	PhD student
Zaiko,	Anastasija	UKlaip	Biologist
Zambalos	Helena	UWien	Student

12. SCHIFFSBESATZUNG / SHIP'S CREW

No.	Name	Rank
01.	Wunderlich, Thomas	Master
02.	Lauber, Felix	1.Offc.
03.	Ziemann, Olaf	Ch.Eng.
04.	Spielke, Steffen	2.Offc.
05.	Kentges, Felix	2.Offc.
06.	Peine, Lutz	2.Offc.
07.	Scholl, Thomas	Doctor
08.	Hofmann, Jörg	Comm.Offc.
09.	Schnürch, Helmut	2.Eng.
10.	Buch, Erik-Torsten	2.Eng.
11.	Rusch, Torben	2.Eng.
12.	Brehme, Andreas	Elec.Tech.
13.	Ganter, Armin	Electron.
14.	Markert, Winfried	Electron.
15.	Winter, Andreas	Electron.
16.	Feiertag, Thomas	Electron.
17.	Schröter, Rene	Boatsw.
18.	Neisner,Winfried	Carpenter
19.	Clasen, Nils	A.B.
20.	Schröder, Norbert	A.B.
21.	Burzan, Gerd-Ekkehard	A.B.
22.	Hartwig-Labahn, Andreas	A.B.
23.	Fölster, Michael	A.B.
24.	Müller, Steffen	A.B.
25.	Brickmann, Peter	A.B.
26.	Sedlak, Andreas	A.B.
27.	Beth, Detlef	Storekeep.
28.	Plehn, Markus	Mot-man
29.	Klein, Gert	Mot-man
30.	Krösche, Eckard	Mot-man
31.	Dinse, Horst	Mot-man
32.	Watzel, Bernhard	Mot-man
33.	Meißner, Jörg	Cook
34.	Tupy,Mario	Cooksmate
35.	Möller, Wolfgang	Cooksmate
36.	Wartenberg, Irina	1.Stwdess
37.	Schwitzky-Schwarz,Carmen	Stwdss/KS
38.	Hischke, Peggy	2.Stwdess
39.	Grigull, Elke	2.Stwdess
40.	Krause, Tomasz	2.Steward
41.	Hu, Guo Yong	2.Steward
42.	Chen, Quan Lun	2.Steward
43.	Ruan, Hui Guang	Laundrym.