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The Expedition of the Research Vessel "Polarstern" to the Antarctic in 2011 (ANT-XXVII/4)

Edited by
Saad El Naggar
with contributions of the participants

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GEMEINSCHAFT

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ANT-XXVII/4

20 April - 20 May 2011

Cape Town - Bremerhaven

Chief scientist

Saad El Naggar

Coordinator

Eberhard Fahrbach

Contents

1. ZUSAMMENFASSUNG UND FAHRTVERLAUF

Saad El Naggar
Alfred-Wegener-Institut

Am 20. April 2011 hat FS *Polarstern* den letzten Fahrtabschnitt der Antarktisreise ANT-XXVII/4 von Kapstadt nach Bremerhaven angetreten. Die Fahrt wurde zur kontinuierlichen Untersuchung atmosphärischer und ozeanischer Eigenschaften sowie der Energie und Stoffflüsse zwischen Ozean und Atmosphäre genutzt. An verschiedenen Stationen wurden Messungen vorgenommen und Geräte getestet. Die Reise endete in Bremerhaven am 20.05.2011 nach einem kurzen Stopp in Las Palmas. Folgende Projekte wurden durchgeführt:

3.1 Autonome Messplattformen zur Bestimmung des Stoff- und Energieaustausches zwischen Ozean und Atmosphäre (OCEANET)

Um die experimentelle Erfassung von Stoff- und Energieaustausch zwischen Ozean und Atmosphäre auf eine solide Basis zu stellen, ist im Rahmen dieses Projektes mittels Vernetzung der Expertisen des IFM-GEOMAR (CO_2-/O_2-Flüsse, photosynthetischer Status, Energiehaushalt, Fernerkundung), des IfT (Lidarmessungen), des GKSS Forschungszentrums („FerryBox", Fernerkundung der marinen Biologie mit ENVISAT/MERIS), und des AWI-Bremerhaven (CO_2-System, marine Infrastruktur von FS *Polarstern*) die Entwicklung autonomer Messsysteme geplant, die langfristig für den operationellen Betrieb an Bord von Fracht- und Forschungsschiffen vorgesehen sind.

3.2 Chemische und physikalische Charakterisierung mariner Aerosole

Austauschprozesse von Gas und marinen Aerosolen sind bis jetzt nicht nicht vollständig geklärt. Mit Hilfe eines LIDAR-Systems und parallelen Messungen an Bord *Polarstern* wurden während dieser Reise neue Messmethoden eingesetzt, um die Aerosole nach ihrer Größe zu analysieren und zu unterscheiden.

3.3 Aerosol-Messungen mit MICROTOPS

Parallel zur Aerosol-LIDAR-Messungen wurden tägliche Messungen von Aerosol-Optische Dichten mit Hilfe von MICROTOPS durchgeführt.

3.4 Messung kosmischer Teilchen zur Untersuchung ihrer Breiten- und Wetterabhängigkeit

Kontinuierliche Messungen der kosmischen Teilchen dienen der Untersuchung der Breitenabhängigkeit auf Grund des Erdmagnetfeldes und der Untersuchung des „kosmischen Wetters". In Verbindung mit Wolkenbeobachtungen soll der Zusammenhang zwischen Wolken und der Anzahl kosmischer Teilchen untersucht werden.

3.5 Erprobung und Test des Fächersonars „HYDROSWEEP DS III“

Zur Erweiterung des Fächersonars Hydroweep DS III von Atlas Hydrographic wurden neue Hard- und Software Komponenten getestet. Hier wurde der Beamformer als Forward-Looking-Sonar (vorausschauend) erweitert und getestet.

3.6 Analyse der Interface-Kompatibilität und Echtzeit-Visualisierung zwischen der HYPACK/HYSWEEP-Software und dem Atlas "HYDROSWEEP DS III" Fächersonar

Hier wurden die Visualisierungs- und die online Datenaufzeichnungs-Software HYPACK im realen Betrieb getestet und auf mögliche Erweiterung geprüft.

3.7 Ausbildung von Studenten am Sediment-Echolot „PARASOUND P-70“

Der Teilabschnitt Las Palmas – Bremerhaven wurde zur Ausbildung von Studenten am Sediment-Echolot "PARASOUND P-70" genutzt. Die Weiterbildung von Personal am Forschungsgerät ist für die Fortführung der Forschung von strategischer Bedeutung.

3.8 Ein neues System zur Kalibrierung des Fischerei-Echolotes EK 60

Das Multifrequenz Fischerei-Echolot EK 60 ist ein wichtiges Forschungsgerät an Bord vieler Forschungsschiffe. Es dient zur zerstörungsfreien Ermittlung von Fischbeständen. Um eine effektive Nutzung des Systems zu erreichen, wurde am AWI ein neues Kalibriersystem entwickelt und auf diesem Fahrtabschnitt getestet.

3.9 Eine neue flexible Kabel-Terminierung für das 18 mm Seekabel

Um den Einsatz von Forschungskabeln flexibler zu gestallten, wurde am AWI eine neue teilbare Kabel-Terminierung entwickelt und während dieser Reise erfolgreich getestet.

3.10 Auswirkung der Klimaveränderung auf Organismen der kalten Region

Lebende Tiere, die während ANT-XXVII/3 für Forschungszwecke gefangen wurden, wurden an Bord auf ANT-XXVII/4 fachgerecht gehältert und versorgt.

Versuche an den Tieren bezüglich der Auswirkung klimatischer Veränderungen, die auf dem vorherigen Fahrtabschnitt begannen, wurden auf diesem Abschnitt fortgeführt.

ITINERARY AND SUMMARY

On 20 April 2011 *Polarstern* started its Atlantic transfer from Cape Town to Bremerhaven as last leg of Antarctic cruise ANT-XXVII/4. The cruise was utilized for continuous investigations of atmospheric and marine properties as well as for energy and material fluxes between ocean and atmosphere. The cruise ended in Bremerhaven on 20 May 2011 after a short stop in Las Palmas. The following projects were carried out:

3.1 Autonomous measurement platforms for energy and material exchange between ocean and atmosphere (OCEANET - Atmosphere & Ocean)

In order to provide a solid basis for the observational monitoring of energy and material exchange between ocean and atmosphere it is planned to develop an autonomous observation system for operational use onboard cargo- and research vessels. The project is based on a network of expertise between IFM-GEOMAR (CO_2-/O_2-fluxes, photosynthetic status, energy budget, remote sensing), IfT (lidar measurements), the GKSS research center (ferry box, remote sensing of marine biology with ENVISAT/ MERIS) and AWI-Bremerhaven (CO_2-system, marine infrastructure of *Polarstern*).

3.2 Chemical and physical characterization of marine aerosols on board Polarstern

Exchange of gases and aerosol particles between ocean and atmosphere is not well understood currently, although it has received considerably and intensively attention. New measurements were carried out here using a LIDAR system to understand the formation mechanism of secondary fraction in marine aerosols particles and to characterize the optical properties of marine aerosols.

3.3 Aerosols measurements using MICROTOPS

In addition to the LIDAR aerosol measurements, optical thickness densities of aerosols were measured by using the MICOROTOPS.

3.4 Rate measurement of cosmic particles in dependence on latitude and weather conditions

Continuous rate measurements of cosmic particles allow estimating their dependency on latitude due to the earth's magnetic field. Simultaneous cloud observations allow investigating whether the concentration of cosmic particles influences cloudiness or vice versa.

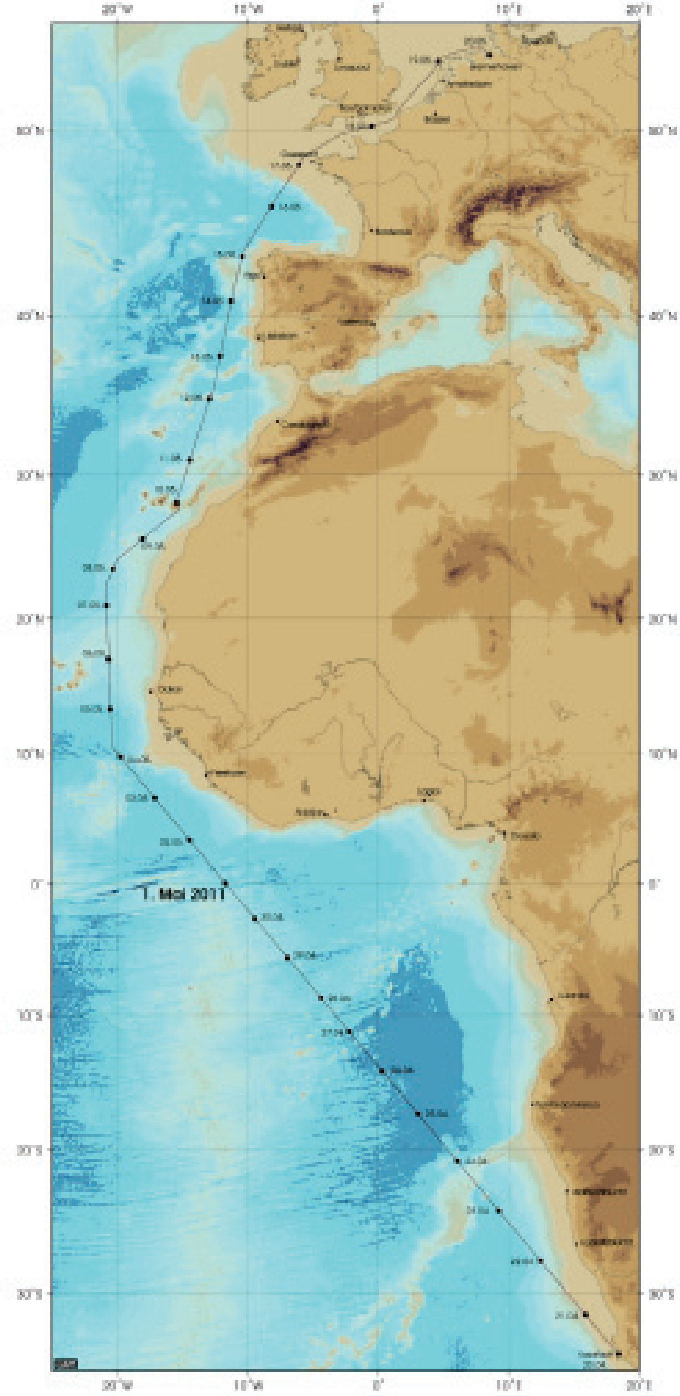

Abb. 1.1: Fahrtroute der Polarstern Expedition ANT-XXVII/4
Fig. 1.1: Cruise track of Polarstern expedition ANT-XXVII/4

3.5 Sea trials and tests of the multibeam sonar "Hydrosweep DS III"

The multibeam sonar "Hydrosweep DS III" was modified by new soft and hardware to enhance the forward looking sonar properties. Sea trials and tests were made during this cruise to develop the new beam former SPM II.

3.6 Analysis of interface compatibility and real-time visualization between HYPACK/HYSWEEP hydrographic software and the Atlas "Hydrosweep DS III" multibeam sonar system

The project aims to offer scientists on board *Polarstern* a hydrographic software package that provides both a real-time and post-processed high resolution bathymetric visualization of the bottom of the ocean that is simple and intuitive for users not familiar with this type of equipment.

HYPACK, Inc. is a software company that provides the interfacing for Hydrographic and Navigation equipment, with the ability to design the survey, collect the data, process it, reduce it, and generate the final products. These tools were tested between Las Palmas and Bremerhaven. A training programme for the responsible scientists and technicians were carried out.

3.7 Taining of students for self-efficient operation of the sediment echo sounder "PARASOUND P-70"

The training course carried out between Las Palmas and Bremerhaven is part of the education for graduate students of the Helmholtz Graduate School for Polar and Marine Research POLMAR and Earth System Science Research School ESSReS at AWI. Aim of the lecture was to learn how to handle a complex data acquisition system, data storage and management and geological interpretation of sea floor structures.

3.8 A new system for calibration of the fishery multifrequency echo sounder Simrad EK60 on board Polarstern

A proper calibration of the echo sounder is needed, in order to be able to compare measurements at the different frequencies, e.g. for species' identification, and to derive reliable stock estimates from hydro acoustic measurements.

A special calibration system was developed at AWI and tested during this cruise.

3.9 A new flexible cable termination "AWI-GRIP®" for 18 mm sea cable

A new flexible cable termination "AWI-GRIP®" for 18 mm sea cable was developed at AWI to provide more flexibility by using these cable types and to save ship time.

3.10 Impact of climate change on cold adapted organisms

Living animals, which have been caught during ANT-XXVII/3 were kept in the aquarium and laboratory containers at 0°C water temperature and were transferred alive to Bremerhaven. Enzyme activities measurements were started on the leg before (ANT-XXVII/3). These were performed also during this cruise. In addition the water in the aquaria was daily replaced to keep the required water quality.

2. WEATHER CONDITIONS DURING ANT-XXVII/4

Max Miller and Klaus Buldt
Deutscher Wetterdienst (DWD)

In the evening (8 pm) of Wednesday 20 April 2011 *Polarstern* set sail in Cape Town and started its expedition ANT-XXVII/4. During the previous afternoon the cold front of a storm at 45°S / 20°E passed Cape Town with rain. But on departure we had dry conditions and south-easterly wind of Bft 4. The above mentioned storm caused a strong swell (6 meters) off Cape Town.

During the first part of the journey there were short phases of easterly winds force 7, but when we reached the trade wind zone on 23 April *Polarstern* sailed through south-easterly winds of around Bft 5 and a swell around 2 meters for a week.

While approaching the inter tropical convergence zone (ITCZ) on 30 April the wind decreased to light and variable. Some showers occurred but severe thunderstorms did not cross the ship's route.

On 4 May, 2011 *Polarstern* reached the northeast trade winds with prevailing Bft 5 and a swell between 2 and 3 meters. But at some areas off the coast of Mauretania (wind parallel the coast line) force 7 was measured due to a jet like effect.

On 10 May, 2011 (10 am) *Polarstern* arrived at Las Palmas and departed again at 16:30 pm. One more day we cruised the trade winds at 5 Bft. At this time a high developed at 50°N / 40°W. It was to move southeast and to intensify which should cause strong winds off the Iberian Peninsula. The forecasted wind from ahead of Bft 9 with swell between 4 and 5 meters was observed during the night to Sunday (15 May) off Cape Finisterre. A planned rendezvous with RV *Meteor* which was operating off Vigo had to be cancelled due to rough sea.

While sailing into the ridge of the above mentioned high (16 May) in the Bay of Biscay the wind decreased rapidly and final scientific work could be carried out without any problems. Entering the English Channel we approached the west wind zone and during the remaining journey Bft 4 to 5 dominated.

ANT-XXVII/4 ended on schedule in Bremerhaven on Friday 20 May (6 am).

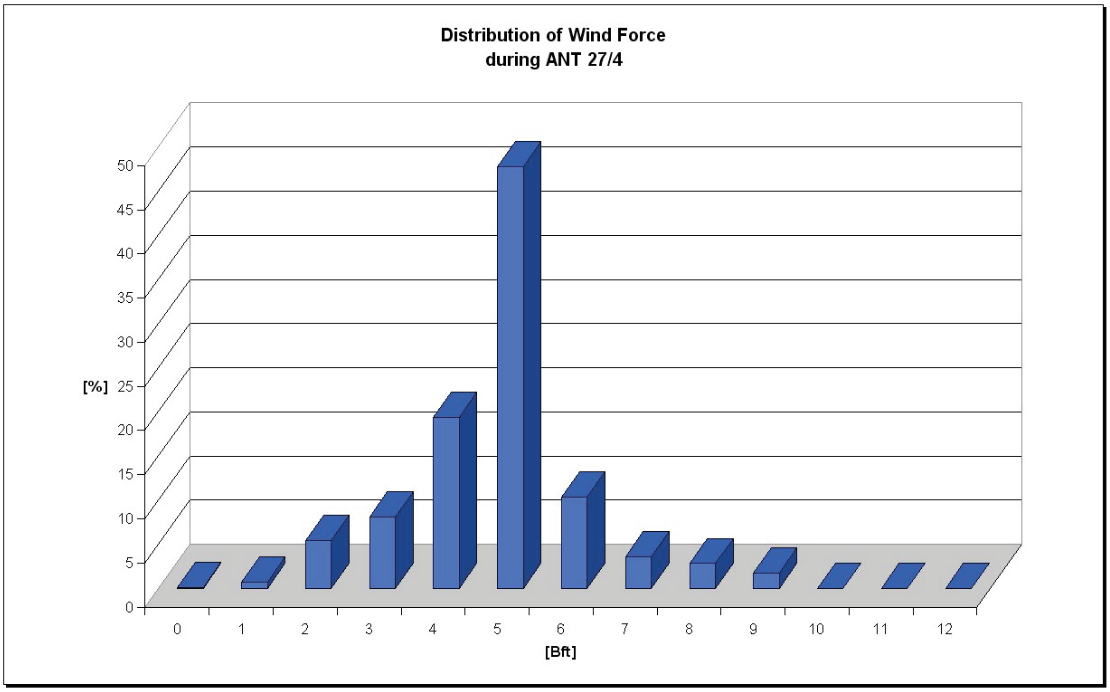

Fig. 2.1: Distribution of wind force during ANT-XXVII/4

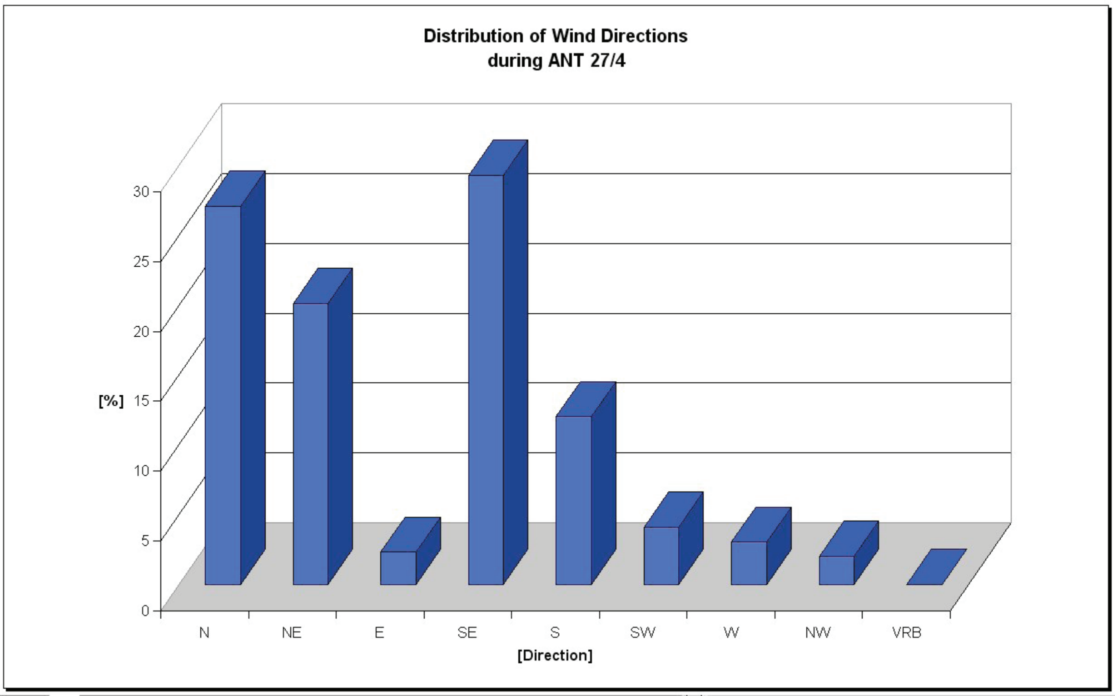

Fig. 2.2: Distribution of wind direction during ANT-XXVII/4

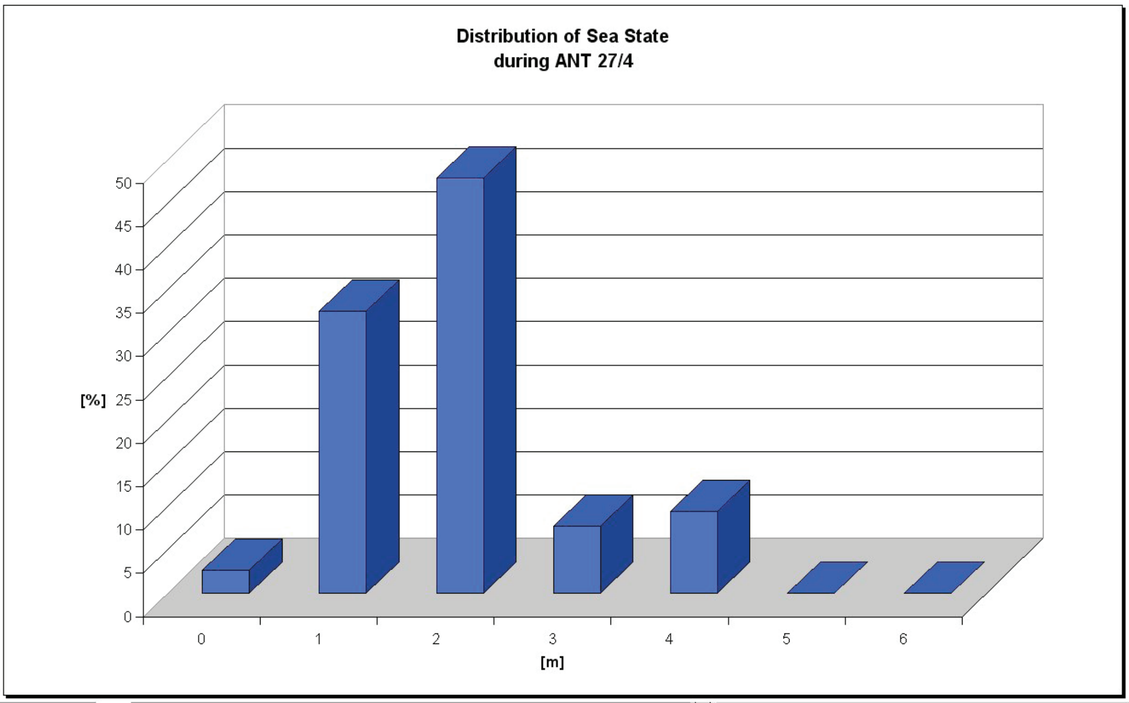

Fig. 2.3: Distribution of sea state during ANT-XXVII/4

3. SCIENTIFIC PROGRAMMES

3.1 Autonomous measurement platforms for energy and material exchange between ocean and atmosphere (OCEANET): Atmosphere

Marlen Brückner
Institute for Tropospheric Research (IfT)

Objectives

Radiation & microwave remote sensing

The net radiation budget at the surface is an important regulator in the climate system of the earth. It is mainly influenced by the complex spatial distribution of temperature and liquid water content in the atmosphere. The complex three-dimensional (3D) microphysical structure of clouds causes systematic errors in active and passive remote sensing of clouds, if the cloud variability is not resolved in radiative transfer models (RTM). Consequently, the retrieved cloud radiative properties and the cloud radiative energy budget might be biased.

With the Atlantic transfers of *Polarstern* it is possible to perform simultaneous observations under different atmospheric conditions in both hemispheres. The radiation budget and the cloud properties were observed in high temporal and even through the motion of the ship in high spatial resolution which provides realistic cloud-radiation interactions for use in remote sensing and climate models. Within the scope of the WGL-Project OCEANET the already existing broadband radiation measurements on *Polarstern* has been extended to spectral solar radiation measurements performing with a ship-based COmpact RAdiation measurement System (CORAS). CORAS simultaneously measures spectral resolved downward radiances and irradiances. Due to the spectral resolution of the spectrometers different contributions from different atmospheric gases and water vapor absorbing regions to the radiative quantities can be identified.

The Microwave Radiometer HATPRO provides continuously vertical profiles of humidity and temperature as well as time series for liquid water path (LWP) and cloud base height over the ocean. In combination with the variability of the downward radiative quantities these time series make it possible to observe small scale atmospheric structures and cloud inhomogeneities.

Lidar observations

The Raman lidar measurement technique is able to provide information about atmospheric aerosol characteristics. It can derive vertical profiles of aerosol particle properties and microphysical parameters. The Raman lidar makes it possible to determine the particle backscatter and also the extinction coefficient of a layer.

Aboard *Polarstern* 24h-measurements with the 3+2+1 Raman lidar system PollyXT were performed to obtain information on optical and microphysical particles properties over the Atlantic Ocean. Particles from certain source regions like Saharan dust, biomass burning in South America or Africa and anthropogenic emissions can be intercontinentally transported over the ocean. To enhance the understanding of the influence of aerosol properties on downward and upward radiation and therefore the calculations of radiative cloud forcings, the research was focused on the determination of optical and microphysical particle data.

Fig. 3.1.1: Aerosol-Container (left) and OCEANET-Container (right) on the observations deck of Polarstern during ANT-XXVII/4

Work at sea

Both OCEANET-Containers (atmosphere right and aerosol left) were located on the observation deck of *Polarstern* (see Fig. 3.1.1). The measurements were performed underway and continuously. The following individual instruments were combined in the two containers:

OCEANET (Atmosphere):

- For the broadband radiation measurements an upward looking Kipp&Zonen pyrgeometer CG 4 and pyranometer CM 21 supported from IFM-GEOMAR were used on this cruise.
- A full sky imager with a camera system manufactured at IFM-GEOMAR was installed to obtain every 15 seconds whole sky images from the current atmospheric situation. This provides detailed information about the existing cloud coverage as well as the cloud type with a high temporal resolution.
- The spectral radiation measurements of downward irradiance and radiance were obtained from CORAS. The optical inlets were installed at the top of the container. The collected radiation was transported to a spectrometer box in the container by optical fibers. The spectrometer splits up the radiation according

to the wavelengths. The spectral range from CORAS is 350 - 2,000 nm. Under good weather conditions, CORAS was calibrated each day with a small Ulbricht-KUGEL. It creates diffuse radiation from a directionally orientated radiation. To obtain the background noise in the data also a dark calibration was performed.

- The multichannel microwave radiometer HATPRO was calibrated in Cape Town with liquid nitrogen. It performs continuously observations of atmospheric humidity and temperature profiles as well as integrated water vapor (IWP) and liquid water path (LWP).
- Standard meteorology devices for obtaining the position of *Polarstern*, speed and course over ground, temperature and humidity as well as pressure in sensor high and sea level were located on the container.
- The portable multichannel Raman lidar PollyXT were placed in the container and was operating continuously except midday and during rain showers.

Preliminary results

Fig. 3.1.2 shows the time series of downward spectral radiance and irradiance in the visible range (VIS) at pixel 500 for 22 April, 2011. On this day there were only a few shallow cumulus clouds present which can be identified by the enhancement of radiance or irradiance. The enhancement results from the diffuse contribution of cloud edge scattering.

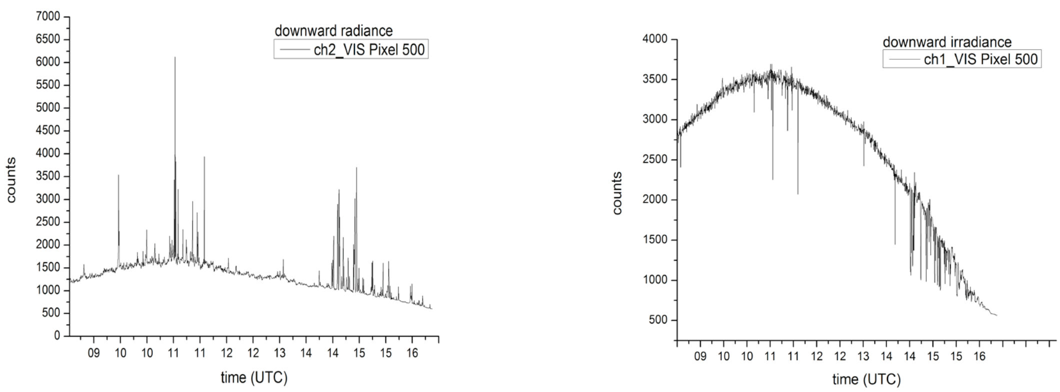

Fig. 3.1.2: Time series of downward radiance (left) and irradiance (right) for VIS at pixel 500 obtained from a measurement on Polarstern on 22 April 2011 (preliminary and uncorrected data).

The scientific goal of this part of the project is to compare the observation on *Polarstern* with different model calculations of the radiative quantities. With the aid of observed and modeled spectral transmitted radiance cloud properties such as cloud optical thickness (τ) and effective radius (reff) were retrieved. The vertical cloud structure is obtained from the lidar and microwave radiometer measurements. The all sky camera provides information on the horizontal cloud variability. To quantify 3D cloud effects on the cloud transmissivity 3D Monte-Carlo radiative transfer simulations will be used. The simulated cloud transmissivity will be compared to simulations with a plan parallel RTM and the measurements of CORAS. Furthermore, cloud optical thickness and effective radius, will be retrieved by using both 3D Monte-Carlo and plan parallel radiative transfer simulations. Differences in the retrieved cloud properties will be systematically classified by cloud fraction and cloud vertical inhomogeneities derived from all sky camera, lidar and microwave.

3.2 Chemical and physical characterization of marine aerosols on board *Polarstern*

Zhijun Wu, Katrin Mildenberger, Shan Huan, Friederike Höpner, Julia Wenzel, Susanne Fuchs
Institute for Tropospheric Research (IfT)

Objectives

Exchange of gases and aerosol particles between ocean and atmosphere is not well understood currently, although it has received considerably and intensively attention. Aerosol particles play an important role in the global climate change because of their effects on the radiation budget. This is particularly true for aerosols from marine environments. Our measurements on board of *Polarstern* are to 1) better understand the formation mechanism of secondary fraction in marine aerosols particles, 2) characterize the optical properties of marine aerosols, 3) investigate the interaction between sub-micron marine aerosols and water vapor, and 4) identify the particle-based exchange of organic compound between ocean and atmosphere.

Work at sea

To achieve the foregoing objectives, the physical laboratory container of IfT equipped with a number of scientific instruments was operated by six scientists during *Polarstern* ANT- XXVII/4 leg from Cape Town to Bremerhaven.

The chemical compositions of marine aerosols were detected by on-line measurement of High-Resolution Time-of-Flight Aerosol Mass Spectrometer (HR-ToF-AMS) and off-line analysis of filter samples from DIGITEL aerosol sampler. The HR-ToF-AMS can measure the chemical composition of aerosol particles with diameter below 1 mm with a high time-resolution up to several minutes. The 24-hour DIGITEL filter sample will be analyzed in the lab to determine the elemental and organic carbon, and water soluble ions of particles below 10 mm.

Particle number size distribution from 10 nm to 20 mm is measured by Scanning Mobility Particle Sizer (SMPS) combining an Aerodynamic Particle Sizer (APS) with the time resolution of 10 min. The interaction between particles and water vapor under sub- and super- saturated conditions are respectively determined by Hygroscopicity Tandem Differential Mobility Analyzer (HTDMA) and Cloud Condensation Nuclei Counter (CCNC). Within these two instruments the hygroscopic growth and the activation behavior of the particles, which mean their probability of forming cloud droplets, can be determined. Additionally, an Integrating Nephelometer and the Multi Angle Absorption Photometer (MAAP) are operated to characterize the particle optical properties in the container. They can measure the particle scattering coefficient and absorption coefficient.

In the beginning of the cruise, the instruments were set up and calibrated. Afterwards, all instruments were running properly. Before crossing the equator, the wind was coming from the back of the ship and resulted in the contamination from the ship exhaust frequently. Since the ship crossed the equator on 1 May, the strong wind coming from ahead brought contamination-free air. On 3 and 4 May, a polluted episode, which may be associated with the outflow from the continental areas, was captured (Fig. 3.2.1). During this episode, the particles dominated by sulphate and organic species showed rather difference with typical marine aerosols. On 10 May, the ship stopped at Las Palmas for couples of hours. Meanwhile, most of instruments were re-calibrated. We have a successful measurement until 17 May on which we start to perform post-measurement calibration and pack the container.

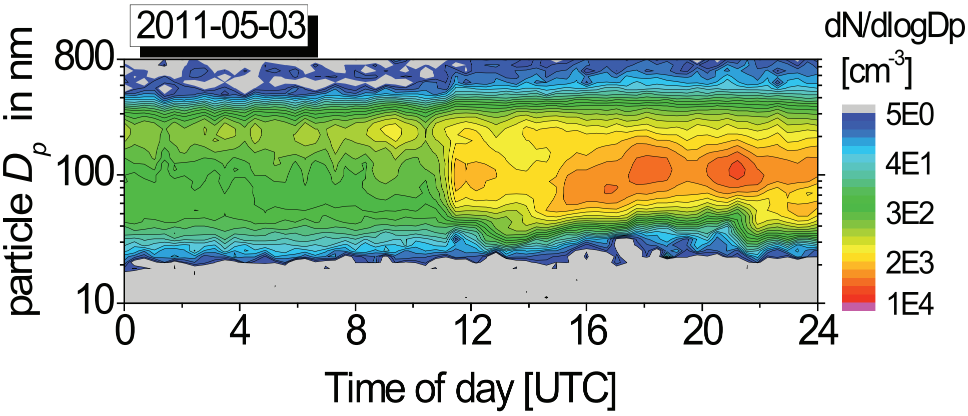

Fig. 3.2.1: Particle distribution on 03.05.2011

In parallel to the chemical and physical characterization of the marine aerosol, water samples are taken to investigate the chemical composition of the ocean surface film once per day. The water samples were collected around 500 m away from the ship by using a small boat. Each time, two water samples were taken in 2 m depth and on water surface, respectively. In total, we took 32 water samples. The water samples are stored at -20°C and will be analyzed in the chemistry lab in Leipzig concerning their organic content.

Expected results

Based on the on-line measurements and off-line analyses, the size-dependent chemical and physical properties of near-surface marine aerosols and the chemical composition of ocean surface films will be obtained.

A detailed analysis on AMS data will provide chemical information of aerosol particles such as the ratio of oxygen to carbon, the relative abundance of hydrocarbon-like structures, and a variety of molecular fragments. Therefore, to some extent, we can gain insight into the formation mechanism of marine aerosols, especially, organic fraction.

The hygroscopic growth and activation measurements can provide information about the particle mixing state, the growth factor, the critical diameter for the activation, and the cloud droplet number distribution of the aerosol particles. By combining the data to the chemical measurements a closure study will be performed.

The light extinction at ambient humidity can be predicted from *in-situ* measurements of dry and humidified particle number size distributions, light scattering and absorption coefficients, and size-resolved chemical composition. Optical properties of aerosol particles, and *in-situ* physical and chemical measurements as well as Raman Lidar measurements can be used to establish a connection between *in-situ* ground and columnar aerosol properties.

Acknowledgements

We would like to thank the crew of the *Polarstern* for logistical support, chief scientist Saad El Naggar for organizations, and Klaus Bult and Max Miller for weather service.

3.3 Aerosols measurements using MICROTOPS

Cathy Hohenegger
Max Planck Institute for Meteorology (MPI)

Introduction

Aerosols are small particles suspended in the ambient air. They have two main effects on the Earth system. First, they scatter and absorb solar radiation, thus decreasing the amount of direct solar radiation that reaches the Earth's surface. This effect can be quantified by measuring their optical depth: the more the aerosols in the atmosphere, the larger their optical depth, the smaller the amount of solar radiation that reaches the Earth's surface. Second, aerosols act as cloud condensation nuclei allowing cloud droplets to form.

Work at sea

The measurements that were taken during ANT-XXVII/4, from Cape Town to Bremerhaven, aimed at quantifying the aerosol optical depth (AOD). Since the radiation is the primary driver of the climate system, it is of key importance to obtain reliable estimates of AOD. AOD measurements from ships (or ground-based stations) can be employed to derive aerosol climatologies used in weather and climate models, to calibrate AOD retrievals by satellites, to validate aerosol modules or dust prediction models and for process studies. Accurate predictions of aerosol distribution are also important due to the adverse effects of large aerosol concentration on human activities and health.

The measurements taken during ANT-XXVII/4 are part of the AERONET Maritime Aerosol Network. Since 2004 AOD measurements have been performed on board of numerous research cruises. Fig. 3.3.1 shows an overview of the data that have been collected. All the data are made freely available and can be downloaded from the web at http://aeronet.gsfc.nasa.gov .

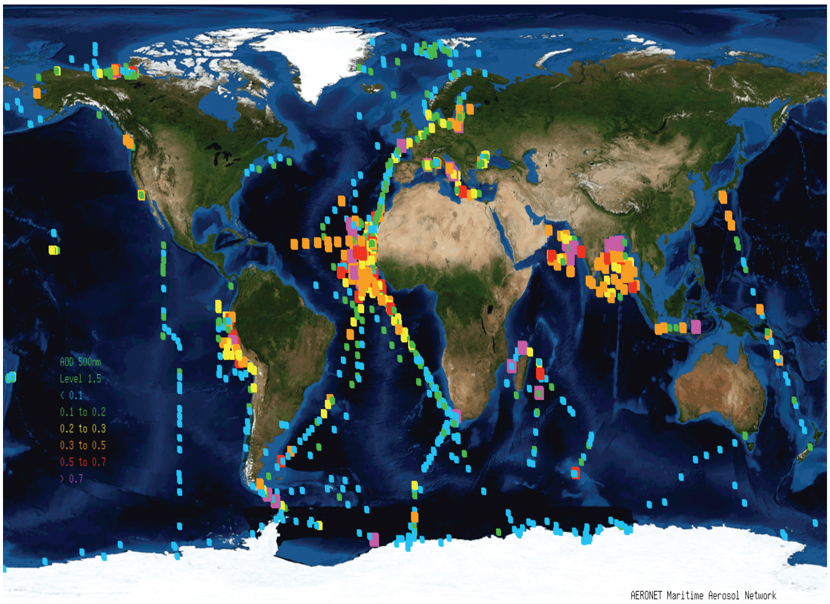

Fig. 3.3.1: The AERONET Maritime Aerosol Network: AOD measurements at 500 nm taken during various ship expeditions. Coloured symbols : <0.1(cyan), 0.1-0.2 (green), 0.2-0.3 (yellow), 0.3-0.5 (orange), 0.5-0.7 (red), >0.7.

Method

Figure 3.3.2 shows the instrument used to measure AOD. The instrument, called MICROTOPS, is a hand-held sunphotometer. It measures direct solar irradiance in five spectral channels by measuring the electrical current produced by the solar radiation hitting the built-in photodiodes and bandpass filtering the signal. Given the Bouguer-Lambert-Beer law and the solar irradiance at the top of the atmosphere, which is known from astronomy calculation, AOD can be derived. As shown in Fig. 3.3.2, a GPS can also be hooked up to MICROTOPS. The GPS retrieves the measurement location, which is needed to compute the solar irradiance at the top of the atmosphere. Finally, the measurements in different channels provide some indirect information about particle sizes and composition.

Hence MICROTOPS uses the fact that aerosols attenuate solar radiation to measure AOD. As such, measurements can only be performed under clear sky conditions to avoid any cloud contamination of the signal.

Fig. 3.3.2: Picture of instrument: left GPS, right MICROTOPS

Results

Measurements were conducted in an approximate time interval of 30 minutes as long as the weather conditions permitted it. From 20 April to 17 May measurements were possible on 19 days.

Figure 3.3.3 shows a summary of the measured AOD on the different days in form of the daily averaged AOD at 500 nm. We can in general recognize the clean marine air south of about 5° N. Values larger than 0.1 are due to some contamination by aerosols transported from the African continent. Towards the Sahara, AOD increases, as expected, with daily mean values at 500 nm reaching up to 0.32. Those are the signature of dust transported from the Sahara. However relatively low aerosol concentrations prevailed right off the Saharan coast. Figure 3.3.4 illustrates the reason for this behavior. It shows trajectories computed for 5 May (high aerosol concentration, 0.3<AOD<0.5) and for 7 May (low aerosol concentration, 0.1<AOD<0.2). On 5 May, some of the trajectories originate from the African continent. This means that dust can be transported from the continent onto the ocean, resulting in higher than normal AOD, as measured. In opposition, the synoptic situation on 7 May with wind blowing from the North below 700 hPa and from the West in higher altitudes, does not allow dust transport but rather implies the presence of relatively clean marine air with low AOD values, also in agreement with our measurements. The resulting high variability in AOD, both temporally and spatially, highlights the need for long-term measurements to obtain reliable aerosol climatologies. Such events are also very good tests for numerical models that try to predict dust outbreak.

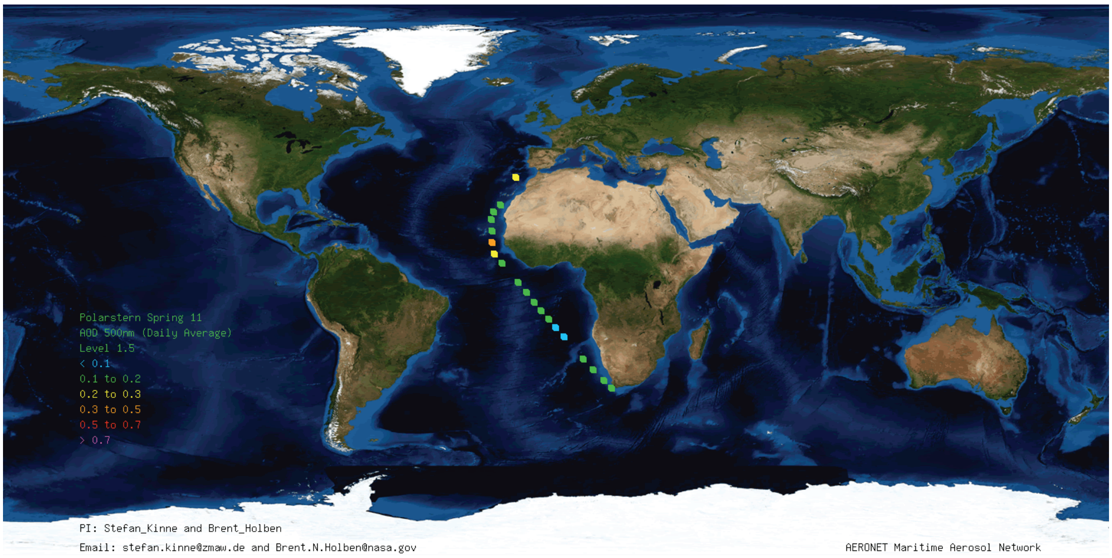

Fig. 3.3.3: AOD measurements at 500 nm (downloaded from the AERONET website)

All the measurements were uploaded on the website of the AERONET Maritime Aerosol Network and are thus available to the wider scientific community. At MPI, they will be processed and incorporated into the aerosol climatology compiled by Stefan Kinne. This climatology is employed in the global climate model ECHAM of the Max Planck Institute for Meteorology, one of the leading models for climate research.

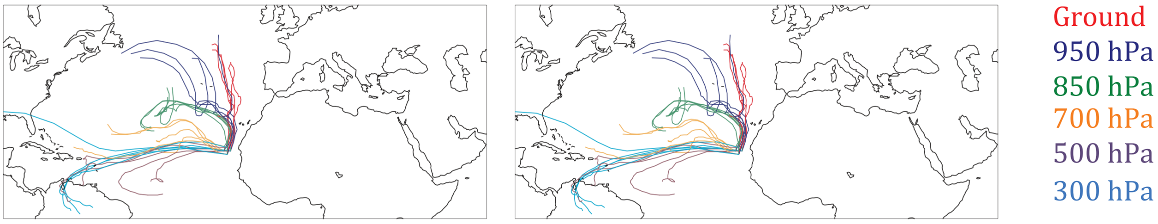

Fig. 3.3.4: Trajectories for 5 May (left) and 7 May (right). The colors correspond to the starting levels as indicated on the right. There are 5 trajectories per level, each of them starting from slightly different initial locations (within a 2° by 2° box).

Conclusions

As part of the AERONET Maritime Aerosol Network, we performed AOD measurements from Cape Town to Bremerhaven with MICROTOPS on board of the *Polarstern*. MICROTOPS is an easy to use and reliable device to retrieve AOD. All the data were made available on the web at http://aeronet.gsfc.nasa.gov. We hope of subsequent measurement campaigns to achieve good spatial and temporal coverage of aerosol concentration in the atmosphere, crucial for weather and climate applications.

3.4 Rate measurement of cosmic particles in dependence on latitude and weather conditions

Robert Peterson[1], Michael Walter[2] (not on board)

[1]) Fermilab, Batavia IL, USA
[2]) DESY, Zeuthen

Objectives

Two cosmic ray data sets are collected from *Polarstern* cosmic ray muon detectors for use by teachers and students.

QuarkNet is a teacher professional development programme managed at Fermi National Accelerator Lab in the United States, funded by Department of Energy and National Science Foundation. The programme focuses on supporting students and teachers engaged in High Energy Particle physics using real data. Along those goals, QuarkNet provides cosmic ray muon detectors (CRMD) to schools throughout the United States and at international locations. The students and teachers share their data using an internet based Cosmic Ray e-Lab designed to support investigations using these cosmic ray data. Students can upload their data to a common server, run analysis tools to look for flux and detector performance, and share their conclusions with online electronic posters. Parallel to the goals of QuarkNet, the Astroparticle Physics Group at DESY, Zeuthen provides very similar outreach programmes for students measuring cosmic ray particles. These two programmes look for ways to collaborate and use the same QuarkNet data acquisition card (DAQ) outputting identical data formats from their detectors.

Work at sea

Cape Town to Bremerhaven

In conjunction with DESY, a second CRMD was placed aboard *Polarstern* to gather cosmic ray data in parallel to the previously installed detector from DESY. The QuarkNet detector consists of four stacked counters and PMTs; the DESY detector uses two stacked counters with two PMTs on each counter. Both use the same DAQ, so the output data format are identical and can be shared between the two education programmes. Previously, data from the *Polarstern* detector was uploaded to the QuarkNet e-Lab. QuarkNet CRMD data will be shared with DESY.

The two detectors retrieved data during the cruise from Cape Town to Bremerhaven using similar data criteria to lower the incidence of noise contamination in the data. Embedded in each data set are data for barometric pressure, temperature, and latitude/longitude from detector GPS connection. It's the signal from the GPS satellites that enables precise time stamps attached to each cosmic ray event. These data are timed to within several nanoseconds.

Expected results

The data collected during the cruise (Fig. 3.4.1) await analysis after uploading to the Cosmic Ray e-Lab. The Cosmic Ray e-Lab provide the flux analysis so students can investigate such questions as:

- latitude dependency: It is expected that the flux rate is lowest at the equator and greater at the higher latitudes. This may be caused by atmospheric density and barometric pressure, but geomagnetic effects influence the results. In conjunction with the cosmic ray data, daily balloon soundings provide upper atmospheric data of temperature, pressure, humidity. Students may use these data to quantify interdependency.
- solar flares: The Sun emits low energy cosmic rays (protons) that alter the Earth's magnetic field during severe solar storms. These events cause Aurora phenomena. This upper atmospheric effect changes the flux rate of high energy cosmic rays and students can measure this change with their classroom CRMDs. Stable data sets, such as the onboard *Polarstern* data set, provide statistics background measurements to quantify changes during magnetic field disruptions. During the previous solar maximum, no CRMDs existed in classrooms. This is a rich opportunity for students and teachers to capture data and participate in global science generating large data sets.
- cloud formation: Some studies suggest a connection between cloud/rain formation and cosmic ray flux. During the *Polarstern* cruise concurrent data were taken from microwave sampling of the upper atmosphere. These data combined with the balloon soundings may offer comparison data sets to investigate this relation.

Benefits

Given the limited bandwidth connection to the Internet, these data could not upload to the Cosmic Ray e-Lab during the cruise. This will happen upon arrival to Bremerhaven so later data analysis can be compared between the two data sets. And, the hope is that teachers and students will use these data for their own analysis in their classrooms. The QuarkNet e-Lab contains over 35,000 days of data and users have been doing analysis for several years. Some groups have investigated high-energy cosmic ray showers covering a large Earth footprint, some groups have preformed pin-point flux analysis at one location. Others measure muon lifetime. The *Polarstern* data sets will be used for flux analysis.

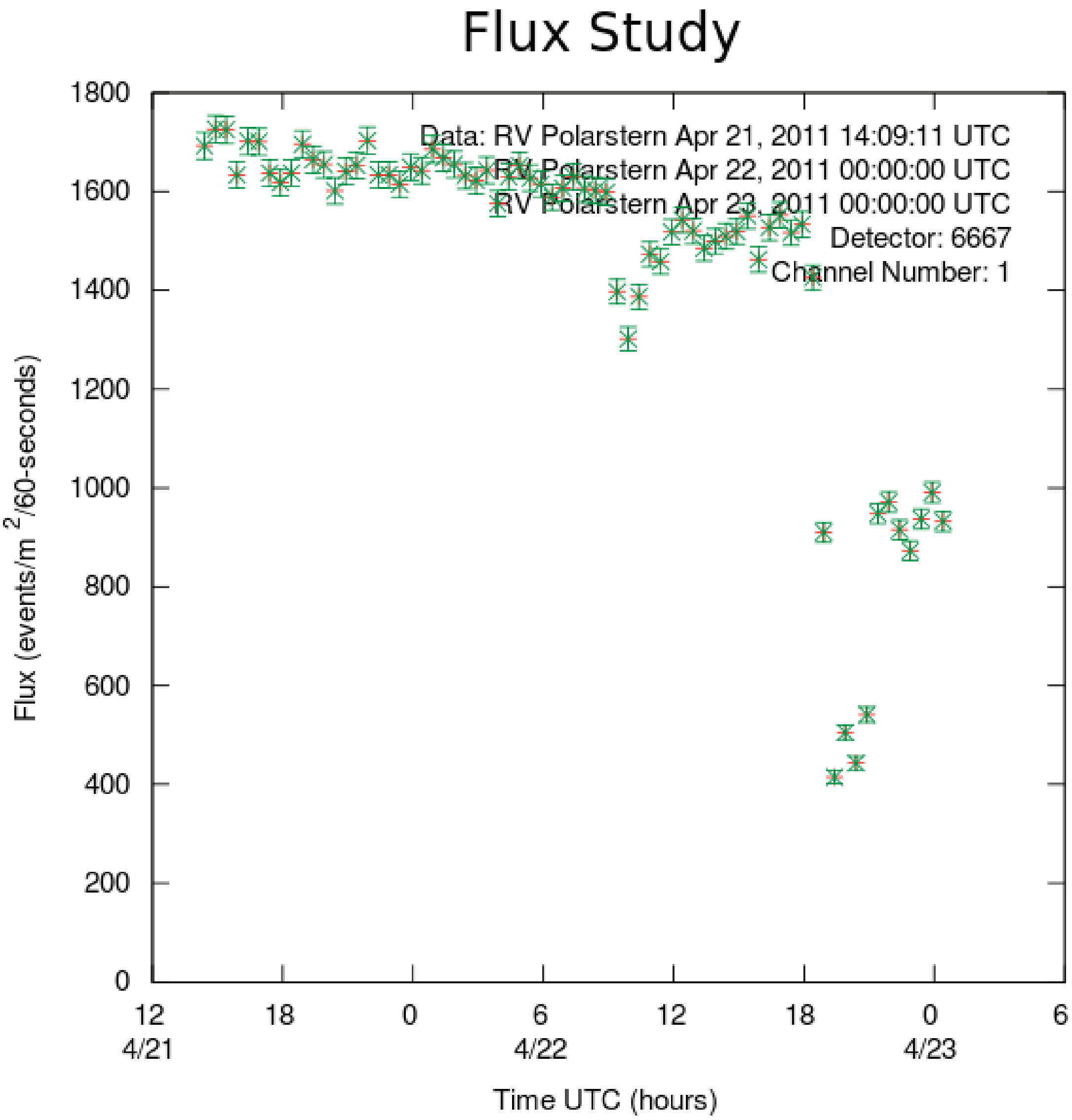

Fig. 3.4.1: Cosmic Rays Flux during ANT-XXVII/4

3.5 Sea trials and tests of the multibeam sonar "Hydrosweep DS III"

Ralf Krocker[1], Patricia Slabon[1], Saad El Naggar[1], Rolf Alfke[2], Jörn Ewert[2],Joe Burnett[3]

[1])AWI
[2])Atlas Hydrographic
[3])Hypack

The bathymetry group as well as the colleagues from ATLAS and the trainer from HYPACK joint the cruise at Las Palmas de Gran Canaria.

The main interest of the bathymetry group was to verify the settings and interfaces of new sonar system HYDROSWEEP DS3 from ATLAS Electronics and its corresponding software packages. The system was installed in October 2010. The Sea Acceptance Test (SAT), which was executed on following cruise ANT-XXVII/1, showed, that there are some uncertainties in the online visualisation of the bathymetry data and in the recorded data files.

During the cruise, we had to share time with the colleagues from ATLAS operating the sonar system, because ATLAS was testing the new beam formers that will perform sending beams in front direction to look ahead and to online calculate actual mean sound velocity.

Arriving on board the colleague from HYPACK was updating the software version 2010 to version 2011. In this new version an updated version of GPS.dll is included, fixing a bug, which was recognized in ANT-XXVII/1 data. Both HYPACK files *.hsx and *.raw must have synchronized time stamps for navigation records, which was not the case in older version.

The format of navigation records (RAW) within *.raw files have also been changed in the new version.

In a meeting with all cruise members working with the sonar system, the bathymetric surveys were discussed and planned crossing the Ampère Seamount in five profiles. Prior to the survey on 12 May a sound velocity profile was executed, using the VALEPORT SVP. Prior to the second profile on 16 May the second SVP profile was executed. The details of both profiles are listed in the table 3.5.1 and displayed in the figure 3.5.1. Depths were calculated from pressure applying formula of Chen and Millero (1977).

Table 3.5.1: Parameter of SVP stations PS77/329-1 and PS77/332-1

Station	**PS77/329-1**	**PS77/332-1**
Position longitude	34° 57.4' N	46° 04.0' N
Position latitude	12° 55.4' W	8° 13.4' W
Water depth	2969 meter	4793 meter
Depth of SVP	1478 meter	1970 meter
Time: in the water	11:10 UTC	06:39 UTC
Time: on depth	11:43 UTC	07:22 UTC
Time: on deck	12:11 UTC	08:02 UTC
Sample interval	1 sec	1 sec

Before importing them into ATLAS Hydromap Control and HYPACK software, both profiles were cut to use downcast only, thinned to ca. 110 significant points (applying Peuker and Douglas Algorithm) and manually extended to water depth of 5,000 meter.

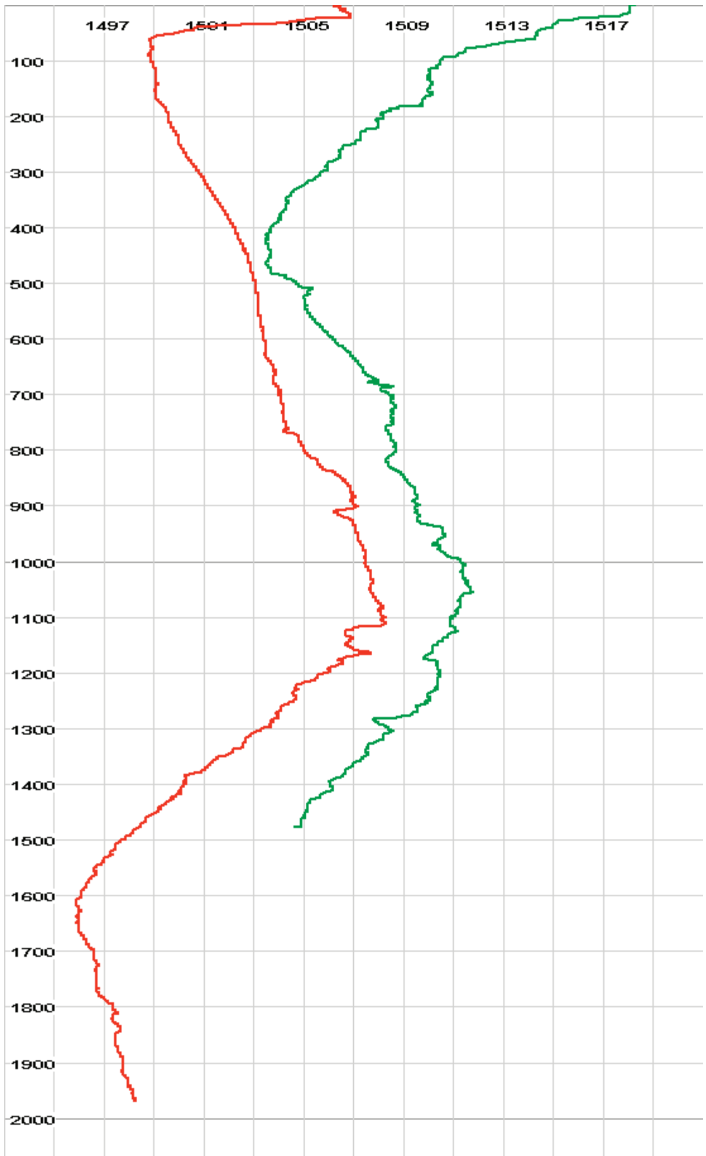

Fig. 3.5.1: Sound velocity profile of station PS77/329-1 (red) and PS77/332-1 (green). Vertical axis shows the water depth in meter, horizontal axis the sound velocity in meter per second.

The second aim of the bathymetry group of this cruise was getting experiences and deeper insight in new software package HYPACK. Therefore the HYPACK employee Joseph Bernett gave some presentations and practical advice, taking into account the main requirements of scientists on board of *Polarstern*. The experiences were used to update and extend the HYDROSWEEP/HYPACK tutorial, written by Laura Fillinger on cruise ANT-XXVII/1.

Specifications for the software by means of data recording and online visualisation were made in the call for tender of the new system. During cruise ANT-XXVII/1 some of these functionalities were under discussion and needed a consolidation. Therefore a HYPACK employee participated to this cruise to check all settings and support the error detection.

The bathymetry staff and the colleague from HYPACK registered all functionalities, which were defined prior of installation of the system to be satisfied. As result, HYPACK was tested to be able to provide nearly all requested functionalities. Some suggestions for easier handling have been made.

Some remarks must be made concerning the online visualisation of recorded data. To visualize data as coloured terrain model (with or without shading) a matrix file need to be defined by means of bounding box extension and cell spacing. The settings must be made manually, what may cause problems to inexperienced users. In the next version of HYPACK a new feature called Matrix-Server will be incorporated, that will provide a lot of additional functionalities for example, the automatic matrix generation and gap interpolation what will satisfy the two most important open requirements.

During the cruise some updates of AWI-bathymetry software applications have been executed to provide interfaces to the new HYPACK raw data, matrix and line formats.

Reference

Chen-Tung C. and Frank J. Millero (1977). Speed of sound in seawater at high pressures, Journal of the Acoustical Society of America, 1977, 62(5):1129-1135.

3.6 Analysis of interface compatibility and real-time visualization between HYPACK/HYSWEEP hydrographic software and the Atlas Hydrosweep DS3 Multibeam Sonar System

Joe Burnett
(HYPACK, Inc., Middletown, CT, USA)

Objectives

The aim of the project was to provide to the scientists on-board the *Polarstern* a Hydrographic Software Package that provides both a Real-Time and Post-Processed High Resolution Bathymetric Visualization of the bottom of the Ocean, that is simple and intuitive for users not familiar with this type of equipment.

HYPACK, Inc. is a software company that provides the interfacing for Hydrographic and Navigation equipment, with the ability to design the survey, collect the data, process it, reduce it, and generate the final products. With these tools, AWI will be able to provide to the scientists the software necessary to complete the requirements they are seeking.

Work at sea

Las Palmas to Bremerhaven

In conjunction with Atlas personnel, Rolf Alfke and Jorn Ewert, an interface between HYPACK's software and the Atlas Hydrosweep DS3 Multibeam System was performed and data was collected and analyzed. There were no interfacing problems between the HYPACK/HYSWEEP software and Atlas sonar. However, an issue with the timing of the GPS positions was realized, and with the cooperation of myself, the Atlas personnel, and Werner Dimmler (*Polarstern*), it was determined that the Network Interface between the MINS-1 Inertial System and the Atlas and HYPACK computers, was causing the problem. Werner is going to create "direct" connections between the MINS-1 and the Atlas and HYPACK computers, to resolve this issue.

During the Expedition, I provided training for Ralf Krocker (AWI) and Patricia Slabon (AWI-Student), in the general and the advanced capabilities of the HYPACK/HYSWEEP software packages.

Prior to the Expedition, HYPACK was provided with a list of 15 requirements that AWI would expect from the system. After the testing and training with HYPACK/HYSWEEP and the Atlas Hydrosweep DS3, additional requests and suggestions from Ralf and Patricia were taken.

I prepared a document with HYPACK's capability to meet these 15 requirements, and presented them to the Atlas and AWI personnel. This document is attached to the end of this Report. Upon my return to the States, this Report, along with the complete list, will be submitted to Mr. Pat Sanders, owner of HYPACK, Inc, for review and implementation into the expansion of the software.

The only requirement that HYPACK could not fully fulfill, was the ability to provide a Real-Time Bathymetric Display that has the ability to Auto-Scale the Colors of the Soundings, and both, Auto-Scale the Visual Resolution of the Soundings, and Auto-Interpolate between small gaps in the data points coming from the Hydrosweep DS3.

HYPACK does have the capability to allow the User (AWI), to create an unlimited number of Color Files (HYPACK *.hcf files), that can be implemented in a manner of seconds, simultaneously with the collection of the data.

HYPACK also has the ability to create a 'Matrix-style Format' that will allow the User (AWI), the option of setting a 'fixed' Visual resolution (Matrix) around the area that the data is being collected. HYPACK 2011 also has the ability to set up and collect Multiple Matrices in the Survey Programme. This will allow the vessel to run continuous from one Matrix to another, without an operator at the computer, manually loading and unloading the Matrix files.

HYPACK also has the ability to immediately post-process the data, and provide a High Resolution view (Matrix) of the recently collected data. The steps to accomplish this have been provided to both Ralf Krocker and Patricia Slabon. They are in the Survival Guide that was updated by Patricia and myself. That Survival Guide is in a separate attachment and also available from Patricia.

The requirements that are not currently, fully compliant with the requests from AWI, were submitted by email to Mr. Pat Sanders, this week, and I have received this reply from him, "We are currently working on the real time 3D views and automatic generation of MTX (Matrix Visualization) files and I think it will be a part of the 2012 release." These are two of the main focus points for AWI. The majority of the other additional requests and suggestions were minor convenience issues. As soon as Mr. Sanders has had a chance to review all of the requests, we will let the AWI personnel know his answers.

Expected Results

It is our hope at HYPACK, Inc., that we can provide these requirements to AWI, in a timely manner, so that they can be implemented on their next expedition.

3.7 Training of students for self-efficient operation of the sediment echo sounder "PARASOUND P-70"

Gerd Kuhn, Frank Niessen, Jens Matthiessen
Alfred-Wegener-Institut (AWI)

Background

Sea floor and sub-bottom reflection patterns obtained by the deep sea sediment echo sounder PARASOUND (ATLAS HYDROGRAPHIC, Bremen, Germany) characterize the uppermost sediments of the Ocean in terms of their acoustic behavior down to about 200 m below the sea floor. This can be used to study depositional environments on larger scales in terms of space and time and to identify suitable coring locations.

The area at sea along the routine course track from Bremerhaven to Las Palmas, or vice versa, is particularly suitable for PARASOUND-system testing and training because the range of sea-floor topography, sediment penetration and water depth (shallow water to more than 5,000 m) allows using all possible modes of operation.

The PARASOUND system was first installed on *Polarstern* in 1989. In the last few years major upgrades and updates of the system were carried out in terms of hardware and software improvements. These include:

Hardware and software upgrades DS-2 to DS-3 (P70), first test at sea (ARK-XXII/1 and /2, Bremerhaven - Tromsö 2007)

Sea trial and testing of the DS-3 (P70) (ANT-XXIV/1, Bremerhaven – Las Palmas/ Cape Town 2007)

Software update of DS-3 (P70) and final sea trial (ANT-XXIV/4, Las Palmas – Bremerhaven, 2008)

Software update of DS-3 (P70) and test of motion compensation (ANT-XXV/5, Las Palmas – Bremerhaven, 2009)

Hardware (new PC hard discs) and software updates of DS-3 (P70) and test of operation modes (pulse train and quasi equidistant) and system stability (ANT-XXVI/1, Bremerhaven - Las Palmas, 2009).

The technical specifications of the upgraded system, the new functions as well as technical problems are described in the cruise reports of the legs above.

On two of the cruises mentioned above (ANT-XXV/5 and ANT-XXVI/1), students were trained on the PARASOUND system.

In addition, in 2010 the HYDROSWEEP System on board *Polarstern* received a major upgrade from system DS-2 to DS-3 including hardware and software, which was first tested at sea during cruise ANT-XXVII/1 without PARASOUND operation.

Objectives

There are the following objectives for using PARASOUND on ANT-XXVII/4:

- to train five students for self-efficient operation of the PARASOUND system P-70
- to test the system for different operational modes together with the new HYDROSWEEP system DS -3 running at the same time
- to update the system with new software versions.

The training course is part of the education for graduate students of the Helmholtz Graduate School for Polar and Marine Research POLMAR and Earth System Science Research School ESSReS at AWI. Aim of the lecture was to learn how to handle a complex data acquisition system, data storage and management and geological interpretation of sea floor structures. Furthermore it will ensure sufficient PARASOUND surveys for geological projects carried out on forthcoming expeditions of *Polarstern* in 2011, where some students will participate and PARASOUND will have to be used.

Work at sea

On 10 May, the group of 9 people came on board in Las Palmas to work with the PARASOUND system. The training course included an introduction about the system, switching the system off and on, watch keeping, depth control, working with different modes of pulse transmission, data acquisition in manual and automatic modes, storage, printing, data visualization, processing, replay, data management and book keeping. The participants were trained to operate the system self efficiently, learned first geological interpretation of seafloor structures and were prepared for trouble shooting. PARASOUND was switched off on 18 May at 17:10 UTC, at the eastern end of the British Channel. No survey or research was carried out. Stored data were deleted from the system at the end of the cruise. During the passage the system had to be switched off temporarily for a few times or was reduced to single-pulse mode due to testing requirements of the new HYDROSWEEP system. Finally both systems were run in parallel without major acoustic interference. However, minor interference was recorded in equidistant and pulse-train modes and, in particular, at high sounding rates in shallow water. No system crashes were reported. West of the Spanish Peninsula at times with high swell, it was noted that a small portion of the ships motion is still not fully compensated. Noise disturbing the SLF records was noted from the sewage water pump on the port side in the lower bow-thruster room. This pump should be acoustically isolated from the ships hull. The replay of all three data formats (asd, ps3 and segy) was tested successfully. On very high lateral resolution, the online track plot revealed that some PARASOUND positions are still slightly incorrect indicated by sudden unrealistic lateral offsets in the track line. The same is notable in replayed data. A change of one MINS interface from where the GPS positions are imported should solve this problem.

At the end a CM update was carried out to V 1.38.58 and tested. Currently the system operates with AHS V 2.1.0, AHC V 2.2.5 (setup 2.2.6), and Parastore V 3.3.9 last updated in October 2010.

The documentations on “Parasound data storage”, “Parasound switch on” and the “Handbuch für Parasound” were updated.

Conclusions

On *Polarstern* PARASOUND DS-3 runs stable and requirements for research and site survey are fulfilled. Minor problems were listed and will be solved if possible. Minor acoustic interference between PARASOUND and HYDROSWEEP should be further monitored on forthcoming cruises. The participants of the PARASOUND course consider the training a success and as very useful for preparing PARASOUND operators prior to expeditions.

3.8 A new system for calibration of the fishery multifrequency echo sounder SIMRAD EK60 on board *Polarstern*

Sören Krägefsky[1], Erich Dunker[1], Saad El Naggar[1], Lena Wöhlke[2]

1) AWI
2) Haus der Wissenschaft, Bremen

Introduction and objectives

Transmission of sound and listening to echoes due to sound scattering caused by inhomogeneities, particles and organisms, is the principle of a set of basic measuring techniques in physical and biological marine science. Active hydroacoustic measurements allow surveying the distribution of organisms in the size range of small macrozooplankton to large nekton with a very high temporal and spatial resolution, not achieved with any other survey method. Multifrequency echosounder measurements are routinely used for biomass stock estimates and are a highly valuable tool for behavioural studies (e.g. for surveying vertical migration behaviour and species interaction within the water column). In fishery science, hydroacoustic surveys are defined as the standard stock assessment tool for purpose of fisheries management, including krill stock assessment and management in the Antarctic Ocean. On board *Polarstern* a scientific multifrequency echosounder (Simrad EK60) with four frequencies (38, 70, 120, 200 kHz) is used for these survey tasks.

Sound backscattering by the different marine organisms is a function of their shape, size and material properties and sound frequency, causing characteristic species or group specific differences in backscattering properties at different frequencies. These differences can be used for species (or group) discrimination and identification.

A proper calibration of the echosounder is needed, in order to be able to compare measurements at the different frequencies, e.g. for purpose of species identification, and to derive reliable stock estimates from hydroacoustic measurements. Such calibration is performed by measuring the backscattering strength (target strength) of a small copper sphere (with known target strength) with a sufficient number of measurements covering the full area of the sound beam. Due to the shape and dimensions of *Polarstern*, it is not possible to perform a calibration in the standard way by moving the copper sphere with three connected lines lowered at one location at starboard and two locations at backboard or vice versa (triangle configuration) without any further supporting/guiding structure. Only deployment of three "plumblines" (ropes with 15 kg weights attached) carrying rings for guiding the single lines toward the plain of calibration enables stable placement and targeted movement of the small sphere within the sound beam. Coupling of the "plumblines" by the connected lines attached to the copper sphere act to damp uncontrolled movement caused by ships roll and pitch, building a stabilised plain for calibration (Fig. 3.8.1). Until recently, moving of the calibration spheres was done by fishing reels veering out or heaving the line.

The "plumbline" technique enables a proper calibration of the Simrad EK60 echosounder on board *Polarstern*, and thus is a strong improvement of the calibration procedure. However, calibration is still a very time consuming and demanding task, particularly under the harsh condition in polar seas.

In order to shorten ships time needed for calibration and to improve handling, we developed a new calibration system (Fig. 3.8.1, Fig. 3.8.2), consisting of electronically controlled underwater winches allowing targeted movement of the calibration sphere by synchronized winch motion. This movement is controlled by computer (joystick). Underwater winches can be lowered and hieved by electrical winches (Fig. 3.8.2). The towing cable is used for power supply and data communication (control of the underwater winch). The underwater which system is encased in a torpedo shaped housing serving as weight and winch protection, by minimizing drag and allowing unhindered movement of the line. Small lead balls attached to the line serve as position markers, automatically detected by the underwater winch system, signalizing reaching the respective length of the line to the centre of the sound beam. Our aim during the cruise ANT-XXVII/4 was to test the new calibration system for the Simrad EK60.

Work at sea

The test of the calibration system has been performed on 26 April 2011 and 27 April 2011 for 2 and 10 hours respectively. The test had involved proving the handling of the underwater winch systems (deployment), its streamline and submerging behaviour (underwater winch casing), testing functioning of the mechanical and electrical parts of the underwater winches (e.g. mountings, motors, sensors) and cable winches, and data communication (direct connection between deck units and underwater winches and communication over ship's LAN). After testing basic functioning of the system, the calibration system was deployed, i.e. the calibration sphere was connected to the lines of the three underwater winches and lowered underneath the ship. Functioning of the software and synchronisation of the winches for targeted movement of the calibration sphere via graphical user interface and joystick, respectively, and furthermore motion stability of the connected underwater winch system (impact of ships movement and currents) were tested performing a test calibration of the 120 kHz transducer.

Results

The test calibration was successful, despite poor weather (wind) and sea state (swell and waves) condition for calibration. The (coupled) underwater winch system was only moderately affected by the strong movements of the ship (pitch and roll) during calibration, thus damping effectively ships motion. The synchronized winch control had allowed targeted movement of the calibration sphere within the sound beam via joystick and computer.

However, *in-situ* testing points out some problems concerning data communication between winches, deck units and control software, the winch reeling, and the submerging performance of the underwater winches at the water surface. Besides improving data communication performance, the test results suggest few mechanical modifications (e.g. perforation of the casings) and some functional enhancements. Functional enhancements include, for example, introduction of a small camera for optical control of the winch unit and detection of a set of colour-coded marks at the line (waypoints).

In conclusion, the new procedure means a significant simplification of the calibration and thus saving of ship's time.

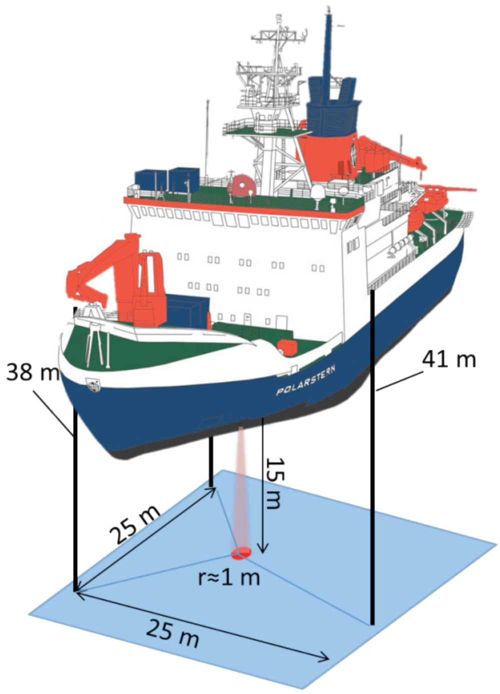

Fig. 3.8.1: Location of deployment of the three underwater winches or 'plumblines' (black vertical lines), respectively, and plain of calibration (blue area). Blue thin lines represent the lines connected to small calibration sphere. The red circle marks the sound beam area (radius ca. 1 m) in 15 m depth underneath the ship.

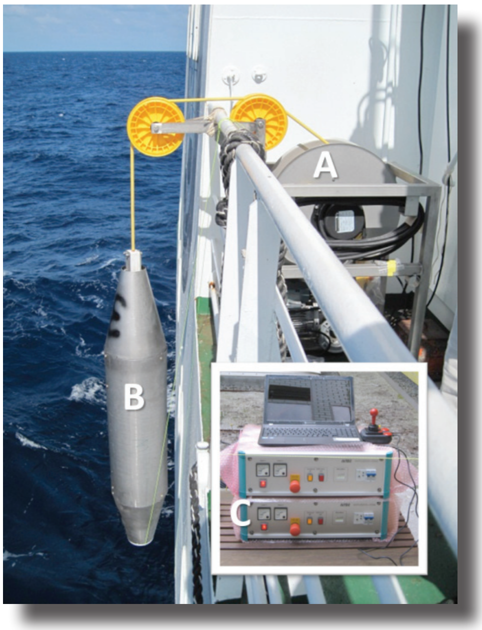

Fig. 3.8.2: Cable winch (A), underwater winch with casing (B) and deck units (C) of the new calibration system

3.9 A new flexible cable termination “AWI-GRIP®” for 18 mm sea cable

Saad El Naggar, Erich Dunker
Alfred-Wegener-Institut (AWI)

Objectives

A new flexible cable termination “AWI-GRIP®” for 18 mm sea cable was developed at AWI to provide more flexibility by using these cable types and to save ship time.

The new termination is dispersible constructed from full stainless steel. It is based on the same clamping principle of the EVERGRIP-Termination of the PMI Company used before (Fig. 3.9.1) and using the same Rods and the same clamping insert used by EVERGRIP. This new kind of termination offers more flexibility by using the 18 mm cable and could save ship time, due to the short assembling and disassembling time needed.

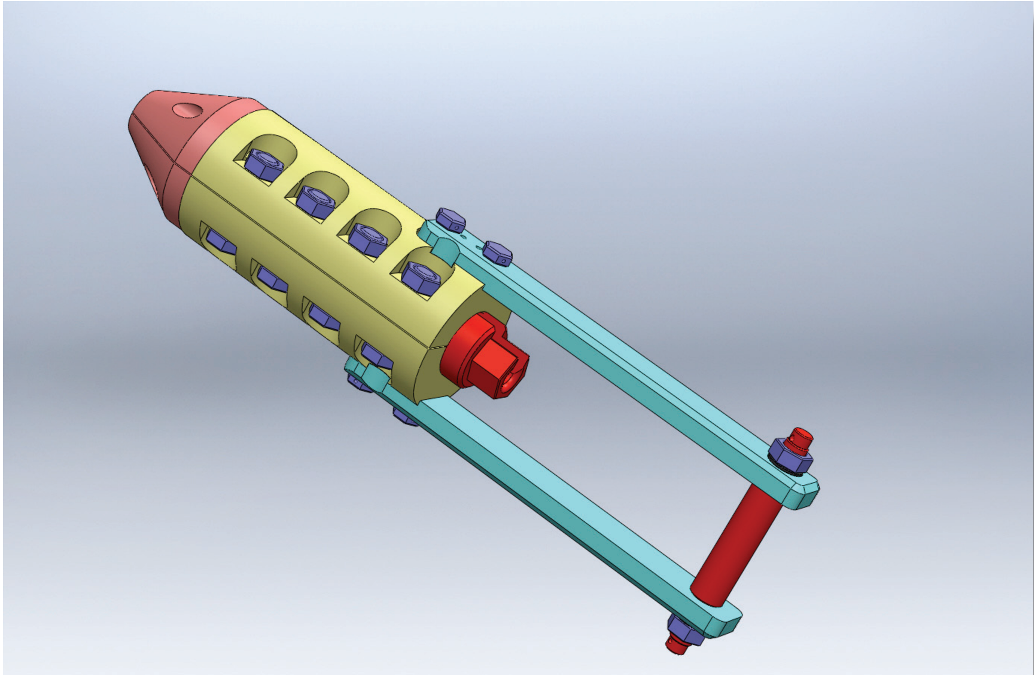

Fig. 3.9.1: The "AWI-GRIP®" termination

The new development was necessary to exchange the 18 mm cable including the under water plug from one beam to another one. The original EVERGRIP termination is too thick to pass throw the pulley of the beams. The dispersible new termination (Fig. 3.9.2) could be removed quickly from the cable without dismantling or cutting the expensive under water plug. The termination was tested and certified by the GL (Germanischer Lloyd) for 15 to load. The working load at termination is maximum 5 to.

Fig. 3.9.2: The disassembled "AWI-GRIP®" termination

The technical data of the termination are given in table 3.9.1.

Tab. 3.9.1: Technical data

Constructer and Producer	AWI - Bremerhaven, scientific workshop
GL-Certification Nr.	65622 BH
GL-Test Load	15 to
Material	Stainless steel 4571 (V4A)
Total Length	685 mm
Body Length	265 mm
Body Diameter	130 mm
Maximal width on Tension Bolt	214 mm
Weight	38 kg

Work at sea

- Preparation of material and clamping
- Execute the test on the 18 mm fibre optical cable at 0, 5, and 10 to
- Monitoring the load and cable electrical and optical characteristics for the different loads
- Analysis and report.

Results

- The tests show that the termination is easy to mount and to dismount (within 2 hours).
- No change in the electrical and optical characteristics was recognized up to 5 to load.
- One of the fibre optical guides was damaged at 10 to load. The other one was still operational.

3.10 Impact of climate change on cold adapted organisms

Katja Mintenbeck[1], Tina Sandersfeld[1], Timo Hirse[1], Julian Mönnich[1], Lena Rath[2]

[1)]AWI
[2)]UHH-IHF

Objectives

Climate change is not a future scenario but a fact in many marine systems all over the world, including the Southern Ocean which represents one of the most unique marine environments. General geographical and physical conditions have been more or less stable since more than 20 million years, and allowed for the evolution of exceptional living communities with species that are adapted to cold water conditions. Any kind of change in this formerly stable system might significantly impact condition and survival of individuals. Organisms might be affected directly by alterations in abiotic conditions (e.g. temperature) and/or indirectly by alterations in prey availability and composition.

Fishes take a central position in the Southern Ocean food web as they provide a major trophic link between small-sized invertebrates and warm-blooded top predators. Therefore, the capacity of Antarctic fish species to adapt to different temperature regimes and changes in prey availability and composition is of outstanding interest.

Work at sea

During the current cruise leg the experiments started during ANT-XXVII/3 were continued and completed. Fishes belonging to the perciform suborder Notothenioidei were caught in Potter Cove (King George Island, Antarctic Peninsula) and the eastern Weddell Sea during the expedition ANT-XXVII/3. Fishes were held in tanks in cooling containers at a water temperature of about 0°C.

The impact of increasing water temperatures on fish metabolism (inferred from oxygen consumption) and feeding behaviour, as well as feeding behaviour and efficiency depending on prey density and prey size was studied on individuals held in separated tanks. For the improvement of tissue extraction methodology first measurements of key enzyme activity (Succinat-Cytochrom C Oxidoreductase) were carried out on white muscle tissue of *Trematomus nicolai*.

Preliminary results

Several experiments on fish feeding behaviour (*Notothenia coriiceps, N. rossi*) and oxygen consumption (*N. coriiceps, Trematomus hansoni*) at different water temperatures were carried out successfully. Studies on feeding efficiency of *N. coriiceps* and *N. rossii* depending on prey size indicated that visual detection and feeding efficiency of small prey varies with fish size. Feeding activity of *N. coriiceps* furthermore significantly increased with increasing temperature (0°C vs. 6°C). Data on oxygen consumption and enzyme activity will be analysed at the AWI.

APPENDIX

A.1 PARTICIPATING INSTITUTIONS

A.2 CRUISE PARTICIPANTS

A.3 SHIP'S CREW

A.4 STATION LIST

A.1 TEILNEHMENDE INSTITUTE / PARTICIPATING INSTITUTIONS

	Address
Atlas Hydrographic	Atlas Hydrographic Kurfürstenallee 130 28211 Bremen Germany
AWI	Stiftung Alfred-Wegener-Institut für Polar- und Meeresforschung in der Helmholtz-Gemeinschaft Postfach 120161 27515 Bremerhaven Germany
DESY	Deutsches Elektronen-Synchrotron DESY Platanenallee 6 15738 Zeuthen Germany
DWD	Deutscher Wetterdienst Geschäftsbereich Wettervorhersage Seeschifffahrtsberatung Bernhard Nocht Str. 76 20359 Hamburg Germany
FermiLab	Fermilab Batavia, Illinois USA
Fielax	Fielax Gesellschaft für wissenschaftliche Datenverarbeitung mbH Barkhausenstr. 4 27568 Bremerhaven Germany
GKSS	GKSS Research Center Max-Planck-Straße 1 21502 Geesthacht Germany
HYPACK	HYPACK, Inc. 56 Bradley Street Middletown, CT 06457 USA
IFM-GEOMAR	Leibniz-Institute for Marine Sciences Düsternbrooker Weg 20 24105 Kiel Germany

	Address
IfT	Institute for Tropospheric Research Permoserstraße 15 04318 Leipzig Germany
Laeisz	Reederei F. Laeisz (Bremerhaven) GmbH Brückenstr. 25 D-27568 Bremerhaven Germany
MPI	Max-Planck-Institut für Meteorologie Bundesstrasse 53, 20146 Hamburg Germany
University of Hamburg	University of Hamburg, Institute for Biogeochemistry, 20146 Hamburg Germany
University of Heidel- berg	Institute of Environmental Physics University of Heidelberg Im Neuenheimer Feld 229 69120 Heidelberg Germany

A.2 FAHRTTEILNEHMER / CRUISE PARTICIPANTS

Name/ Last name	**Vorname/ First name**	**Institut/ Institute**	**Beruf/ Profession**
Alfke	Rolf	Atlas Hydro	Engineer
Brückner	Marlen	IfT	Meteorologist
Bult	Klaus	DWD	Technician
Dunker	Erich	AWI	Technician
Burnett	Joe	Hypack	Engineer
El Naggar	Saad	AWI	Chief Scientist, Physicist
Ewert	Jörn	Atlas Hydro	Engineer
Fuchs	Susanne	IfT	Technician, biology
Hirse	Timo	AWI	Technician
Hofmann	Jörg	Fielax	Meteorologist
Hohenegger	Cathy	MPI	Meteorologist
Höpner	Friederike	IfT	Student, Meteorology
Huang (Mrs)	Shan	IfT	PhD student, Meteorology
Kollaske	Tina	AWI	Geographer
Kopsch	Conrad	AWI	Engineer
Krägefsky	Sören	AWI	Biologist
Krocker	Ralf	AWI	Engineer
Kuhn	Gerhard	AWI	Geologist
Matthiessen	Jens	AWI	Geologist
Mildenberger	Katrin	IfT	Meteorologist
Miller	Max	DWD	Meteorologist
Mintenbeck	Katja	AWI	Biologist
Mönnich	Julian	AWI	Student, Biology
Niessen	Frank	AWI	Geologist
Peterson	Robert	Fermi-Lab	Physicist
Rath	Lena	Uni-HH	Student, Biology
Sanderfeld	Tina	AWI	Student, Biology
Slabon	Patritcia	AWI	PhD student, Geology
Sobiech	Jennifer	AWI	PhD student, Geology
Schärz	Michael	AWI	Geologist
Wenzel	Julia	IfT	Student, Meteorology
Wittenberg	Nina	AWI	PhD student, Geology
Wöhlke	Lena	Haus der Wiss.	Biologist
Wu (Mr.)	Zhijun	IfT	Physicist
Zhang (Mr.)	Xu	AWI	Student, Geology
Zou (Mr.)	Hao	AWI	Student, Geology

A.3 SCHIFFSBESATZUNG / SHIP'S CREW

Name	Rank
Schwarze, Stefan	Master
Janik, Michael	1. Offc.
Krohn, Günter	Ch. Eng.
Fallei, Holger	2. Offc.
Gumtow, Philipp	2. Offc.
Reinmiedl, Judith	Doctor
Hecht, Andreas	R. Offc.
Minzlaff,Hans-Ulrich	2. Eng.
Sümnicht, Stefan	2. Eng.
Holst, Wolfgang	3. Eng.
Scholz, Manfred	Elec. Eng.
Dimmler, Werner	ELO
Himmel, Frank	ELO
Muhle, Helmut	ELO
Riess, Felix	ELO
Loidl, Reiner	Boatsw.
Reise, Lutz	Carpenter
Brickmann, Peter	A.B.
Hagemann, Manfred	A.B.
Kreis, Reinhard	A.B.
Reichert, Jörg	A.B.
Schmidt, Uwe	A.B.
Schröter, René	A.B.
Wende, Uwe	A.B.
Winkler,Michael	A.B.
Preußner, Jörg	Storek.
Elsner, Klaus	Mot-man
Pinske, Lutz	Mot-man
Schütt, Norbert	Mot-man
Teichert, Uwe	Mot-man
Voy, Bernd	Mot-man
Müller-Homburg, R.-D	Cook
Silinski, Frank	Cooksmate
Völske, Thomas	Cooksmate
Czyborra, Bärbel	1. Stwdess
Wöckener, Martina	Stwdess/N.
Hu, Guo Yong	2. Stwdess
Silinski, Carmen	2. Steward
Streit, Christina	2. Stwdess
Sun, Yong Sheng	2. Steward
Vogt, Alexander	2. Stwdess
Yu, Kwok Yuen	Laundrym.

A.4 STATIONSLISTE / STATION LIST PS 77

Station	Date	Time (start)	Time (end)	Gear	Position (Lat.)	Position (Lon.)	Water Depth (m)
PS77/0313-1	23.04.2011	11:05	11:21	Rubber boat, Zodiak	24°24,47‘ S	9° 18,50‘E	4522,2
PS77/0314-1	24.04.2011	12:04	12:30	Rubber boat, Zodiak	20°48,90‘S	6°4,26‘E	4279,2
PS77/0315-1	25.04.2011	12:30	12:17	Rubber boat, Zodiak	17°22,89‘S	3°2,86‘E	5461
PS77/0316-1	26.04.2011	08:11	09:55	Calibrati-on Fishery Sounder	14°27,39‘S	0°31,24‘E	5447
PS77/0317-1	27.04.2011	08:30	17:01	Calibrati-on Fishery Sounder	11°16,42‘S	2°12,15‘W	5097,2
PS77/0318-1	28.04.2011	12:05	12:13	Rubber boat, Zodiak	8°42,44‘S	4°22,05‘W	4495,5
PS77/0319-1	29.04.2011	13:02	13:20	Rubber boat, Zodiak	5°30,22‘S	7°3,21‘W	4129,7
PS77/0320-1	30.04.2011	13:02	13:29	Rubber boat, Zodiak	2°29,84‘S	9°33,70‘W	4110
PS77/0321-1	01.05.2011	09:05	09:17	Rubber boat, Zodiak	0°0,75‘S	11°37,64‘W	4461,2
PS77/0322-1	02.05.2011	13:01	13:23	Rubber boat, Zodiak	3°32,22‘N	14°33,95‘W	4752,2
PS77/0323-1	03.05.2011	13:04	13:22	Rubber boat, Zodiak	6°45,68‘N	17°14,39‘W	4872,7
PS77/0324-1	04.05.2011	13:01	13:31	Rubber boat, Zodiak	9°52,69‘N	19°50,63‘W	4508,5
PS77/0325-1	05.05.2011	13:04	13:22	Rubber boat, Zodiak	13°32,49‘N	20°31,61‘W	4498,2
PS77/0326-1	08.05.2011	13:03	13:20	Rubber boat, Zodiak	23°39,87‘N	20°15,97‘W	3927,5
PS77/0327-1	09.05.2011	12:00	12:26	Rubber boat, Zodiak	25°39,95‘N	18°3,28‘W	3209,5
PS77/0328-1	10.05.2011	17:28	18:41	Magnetic Turn Circle	28°19,79‘N	15°27,59‘W	3021,2
PS77/0329-1	12.05.2011	11:10	12:11	Sound Velo-city Profiler	34°57,58‘N	12°55,40‘W	2915
PS77/0329-2	12.05.2011	12:19	12:31	Rubber boat, Zodiak	34°57,29‘N	12°55,29‘W	3014
PS77/0330-1	12.05.2011	16:34	20:52	HydroS-weep/Para-Sound profile	35°9,69‘N	12°50,57‘W	2442,9
PS77/0331-1	13.05.2011	12:00	12:22	Rubber boat, Zodiak	37°34,94‘N	12°5,52‘W	4920,2
PS77/0332-1	16.05.2011	06:38	08:02	Sound Velo-city Profiler	46°4,05‘N	8°13,45‘W	4792,8
PS77/0332-2	16.05.2011	08:07	08:23	Rubber boat, Zodiak	46°3,95‘N	8°13,41‘W	4794,8

Station	Date	Time (start)	Time (end)	Gear	Position (Lat.)	Position (Lon.)	Water Depth (m)
PS77/0313-1	23.04.2011	11:05	11:21	Rubber boat, Zodiak	24°24,47‘ S	9° 18,50‘E	4522,2
PS77/0333-1	16.05.2011	09:03	19:36	HydroSweep/ParaSound profile	46°4,03‘N	8°13,50‘W	4823
PS77/0334-1	17.05.2011	03:40	06:45	HydroSweep/ParaSound profile	47°20,81‘N	7°0,08‘W	2553,9

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