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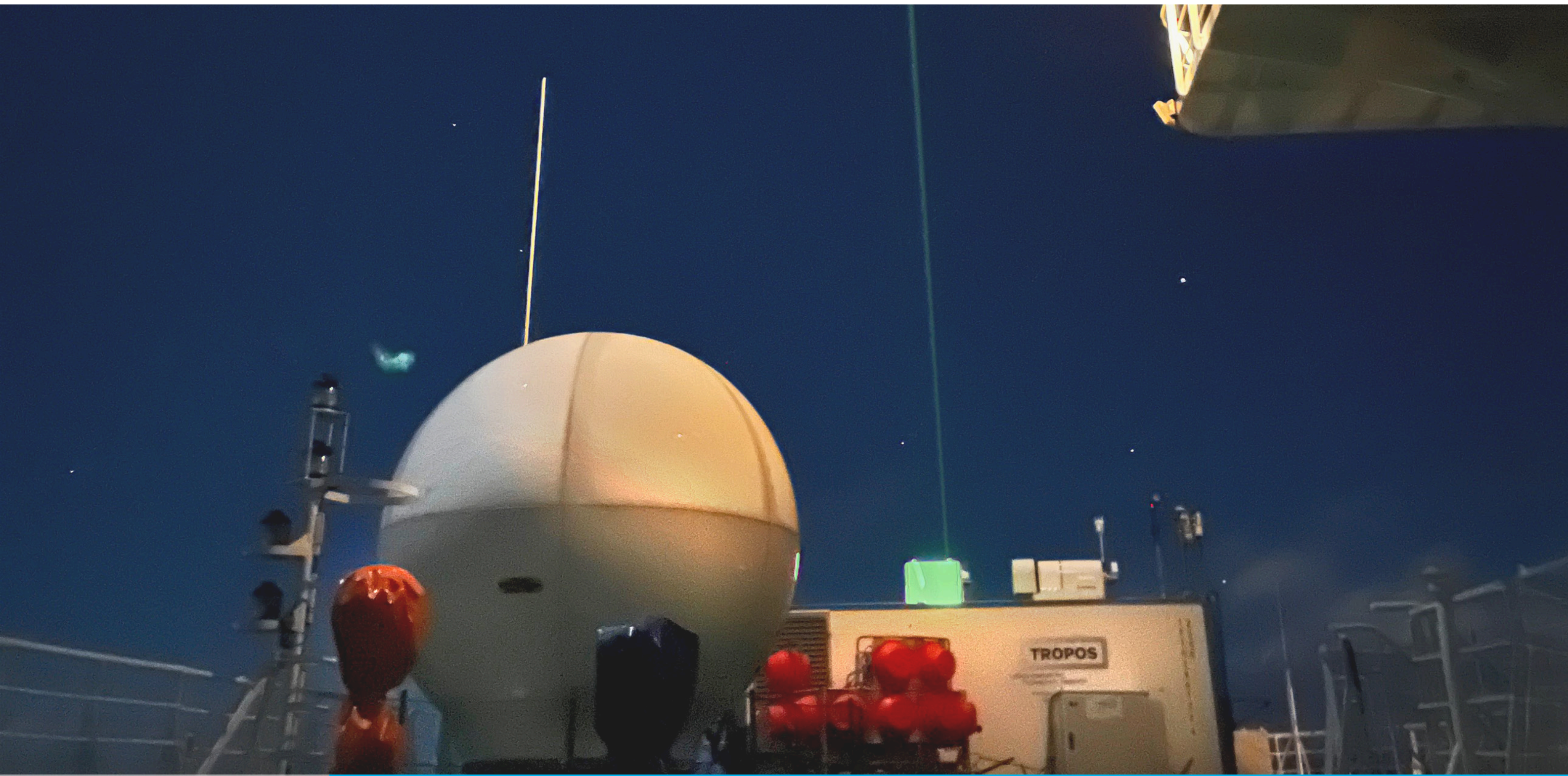

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Reports on Polar and Marine Research

The Expedition PS127 of the Research Vessel POLARSTERN to the Atlantic Ocean in 2021/22

Edited by

Laura Hehemann

with contributions of the participants

HELMHOLTZ

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Titel: Lidar Messung der Aerosole und Wolkenprofile mit Hilfe des grünen Lasers in der Nacht von Bord der Polarstern (Foto: Sonja Stöckle, DWD)

Cover: Lidar measurements of aerosol and cloud profiles visible at night as a green laser from Polarstern (Photo: Sonja Stöckle. DWD)

The Expedition PS127 of the Research Vessel POLARSTERN to the Atlantic Ocean in 2021/22

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PS127

5 December 2021 – 4 January 2022

Bremerhaven – Cape Town

Chief scientist
Laura Hehemann

Coordinator
Ingo Schewe

Contents

1. ÜBERBLICK UND FAHRTVERLAUF

Laura Hehemann DE.AWI

Am 5. Dezember 2021 lief das Forschungsschiff *Polarstern* in Bremerhaven zu der Expedition PS127 mit dem Ziel Kapstadt (Süd Afrika) aus. Nach einem geplanten Hafenanlauf am 16. Dezember in Las Palmas (Kanarische Inseln), erreichte sie Kapstadt am 4. Januar 2022. Die planmäßige Ankunft verzögerte sich um zwei Tage wegen eines Sturms mit bis zu 14 m hohen Wellen außerhalb des Ärmelkanals. Dieser wurde vor Harwich (England) abgewettert. Nachdem sich die Wetterlage beruhigt hatte, setzte *Polarstern* ihr Arbeitsprogramm fort. Dies beinhaltete Tests neuer Geräte, wissenschaftliche Messungen und das Training von Wissenschaftlern im Umgang einiger Messsysteme. In exzellenter Zusammenarbeit von Besatzung und Wissenschaft wurden die Hauptaufgaben der Expedition erfolgreich erledigt.

Während der Expedition zeichneten die dauerhaft auf *Polarstern* installierten Systeme kontinuierlich unter anderem Daten zur pCO_2–Konzentrationen, Algenpigment–Konzentrationen, Salinität und Wassertemperatur auf. Zusätzlich wurden *en-route* Daten für die Hydroakustik und das Oceanet Projekt (TROPOS) aufgezeichnet. Des Weiteren wurden im Rahmen des ARGO Projekts ARVOR Sonden ausgebracht. Diese Sonden liefern autonom kontinuierlich Temperatur- und Salinitätsdaten für die obere Wassersäule bis circa 2.000 m Wassertiefe.

Hydroakustische Messungen wurden im Rahmen geophysikalischer *en-route* Aufzeichnungen erhoben und liefern Informationen über die Topographie und Sedimentarchitektur des Meeresbodens und der oberen Sedimentschichten. Aufgrund des Austausches der im Rumpf installierten Wandler des Fächersonars während der letzten Werftzeit, wurde für das System zusätzlich eine Kalibrierung, ein sogenannter Patch Test, durchgeführt. Während der gesamten Expedition wurden in regelmäßig Abständen mit der Underway CTD Schallgeschwindigkeitsprofile der oberen Wassersäule aufgezeichnet. Dies wurde gemacht, um die erhobenen bathymetrischen Daten zu kalibrieren und akkurate Tiefendaten zu erzeugen. Folgende Tests wurden durchgeführt:

- Bathymetrische Vermessungen
- Underway CTD–Stationen
- Wasserschallgeschwindigkeitsmessungen
- Kalibrierung des Fächersonars (Patch Test)

Die TROPOS–Messungen beinhalteten Strahlungs- und Mikrowellenmessungen sowie Lasermessungen (lidar) von Aerosolen und Wolkenprofilen in der Atmosphäre. Konkret wurden an Bord die folgenden Systeme eingesetzt:

- Mehrkanal Mikrowellen Radiometrie HATRPO. Das Instrument wurde in Las Palmas mit Flüssig-Stickstoff kalibriert
- Total-Sky Imager für Messungen der Wolkenstruktur
- Multifrequenzbereich Polarisations Raman lidar PollyXT

- Tragbares Sonnenphotometer (Microtops) für Aerosole und die optische Wolkendicke
- Vollautomatisiertes spektrales Schattenband Radiometer (GUVis-3511)
- Standardisierte Aufzeichnung meteorologischer und Strahlungsdaten

Eine Rein-CTD wurde zur kontaminationsfreien Beprobung der Wassersäule für Spurenmetallanalysen eingesetzt. Dabei handelt es sich um ein neues Gerät bestehend aus Datenlogger, Wasserschöpfer, einem Windensystem und einem Reinraumcontainer, das unter Realbedingungen getestet wurde. Die Testprozedur beinhaltete folgende Punkte:

- Seeabnahme des Reinraumcontainers
- Einsatz der Rein-CTD
- Funktionstest des Reinraumcontainers
- Test des Kabels und des Windensystems

Nicht nur der Test von Equipment, sondern auch das Training im Umgang mit diesem Equipment ist gängige Praxis an Bord. Auf der Strecke Bremerhaven – Las Palmas wurde ein PARASOUND Training durchgeführt. Dabei wurden Wissenschaftler des AWI im Betrieb dieses Systems und in der Umsetzung standardisierter Arbeitsabläufe geschult. Detaillierte Beschreibungen der Aktivitäten der einzelnen Arbeitsgruppen an Bord folgen in den nächsten Kapiteln.

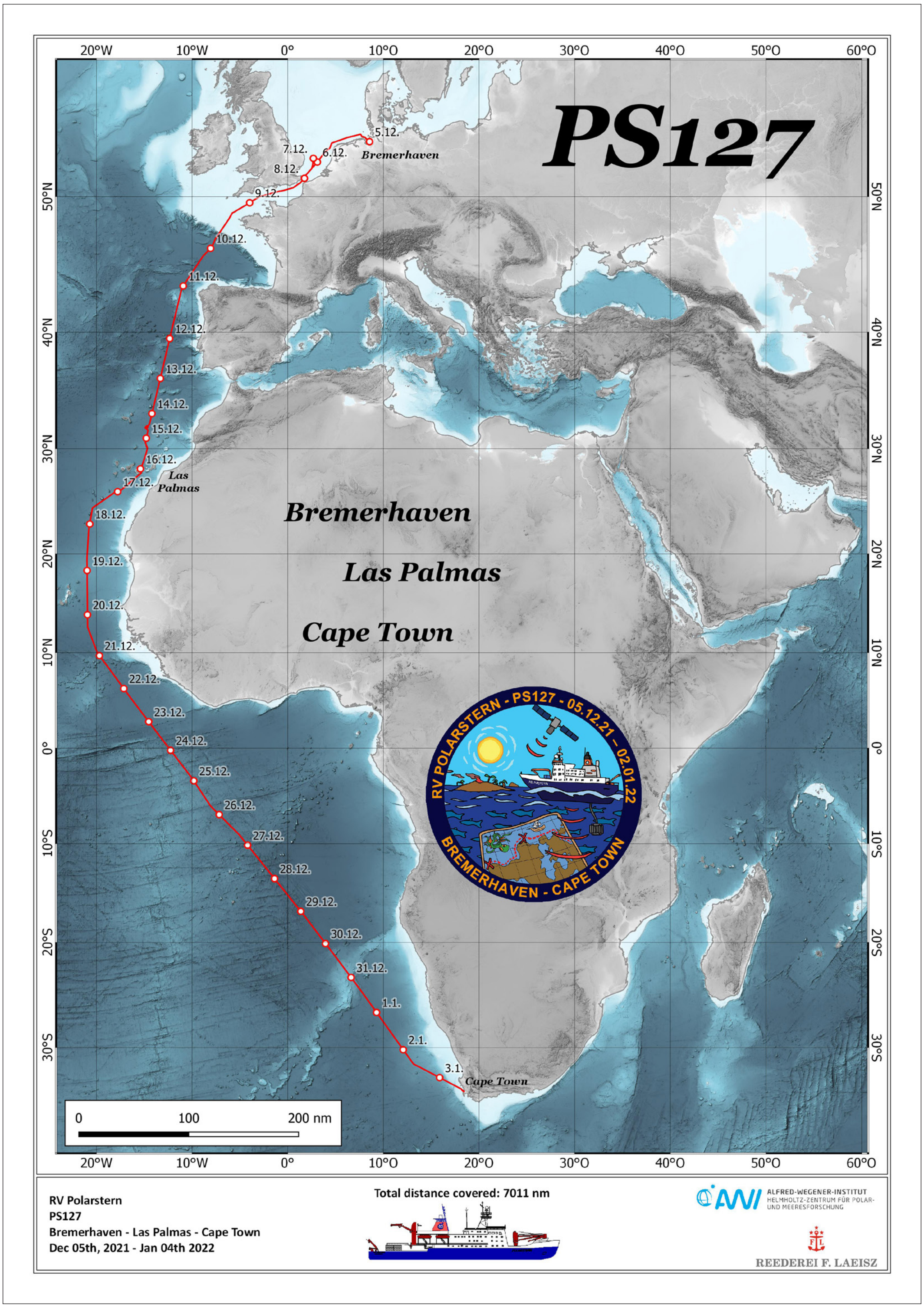

Abb. 1.1: Fahrtverlauf der Expedition PS127 von Bremerhaven nach Cape Town; siehe https://doi.pangaea.de/10.1594/PANGAEA.942569 für eine Darstellung des master tracks in Verbindung mit der Stationsliste für PS127

Fig. 1.1: Cruise track of expedition PS127 from Bremerhaven to Cape Town; see https://doi.pangaea.de/10.1594/PANGAEA.942569 to display the master track in conjunction with the station list for PS127

SUMMARY AND ITINERARY

Polarstern departed 5 December 2021 from Bremerhaven, Germany and arrived on 4 January 2022 in Cape Town (South Africa) with a planned port-call in-between in Las Palmas (Canary Islands) 16 December 2021, on the expedition PS127. Arrival was delayed by two days due to a major storm event with waves reaching 14 m height just beyond the English Channel. Our only option was to wait it out in the deep waters off Harwich (England). Once the weather settled, we continued with the planned expedition programme. The expedition included testing new equipment, scientific measurements and training. With excellent collaboration between crew and scientists, the main tasks for the cruise were successfully completed.

During the expedition, the permanently integrated measurement systems on *Polarstern* allowed for parameters such as pCO_2 concentration, algal pigments, salinity and temperature to be measured continuously during transit. Other underway measurements recorded were from hydroacoustics and the Oceanet project (TROPOS). Additional subsurface ARVOR profiling floats, as part of the ARGO programme, were deployed providing autonomously continuous information on temperature and salinity of the upper water column to roughly 2,000 m water depth.

Hydroacoustic measurements as part of the geophysical underway data collection were acquired for topography and sediment architecture of the seafloor and shallow sub-bottom. Furthermore, during the last revision, transducers of the hull-mounted multibeam were replaced. This required a calibration, a so-called patch test. Throughout the expedition, frequent sound velocity measurements were performed to record accurate bathymetric data, thus providing accurate soundings. The following tests and surveys were carried out:

- Bathymetric survey
- Underway CTD stations
- SVP deployment
- Multibeam echosounder calibration (patch test)

The TROPOS measurements included radiation and microwave recording, as well as laser-based measurements (lidar) of aerosols and clouds profiles in the atmosphere. Specifically, the following measurements were recorded on board:

- Multichannel microwave radiometer HATRPO. The instrument was calibrated with liquid nitrogen in Las Palmas
- Total-sky imager for cloud-structure measurements
- Multiwavelength polarization Raman lidar PollyXT
- Handheld sun photometer (Microtops) for aerosol and cloud optical thickness

- Fully-automated spectral shadow band radiometer (GUVis-3511)
- Standard meteorological and radiation data logging

A Clean CTD was used for trace metal contamination-free sampling of seawater samples in the water column. This new equipment, complete with data logger, water sampler, a winch system and the clean room container, was tested for performance during PS127. The specifically designed equipment underwent the following tests:

- Sea acceptance test of the container
- Deployment of the Clean CTD
- Clean room container functionality test
- Test of the cable and winch system

Testing not only equipment, but also, in applying training programmes for scientists to remain up-to-date in procedures is common practice on board. A PARASOUND training course was carried out between Bremerhaven and Las Palmas to refresh knowledge on operation and to teach standardized processing workflows to AWI scientists.

More detailed descriptions of the activities of the different groups on board follow in the next chapters.

2. WEATHER CONDITIONS DURING PS127

Sonja Stöckle, Frank Otte DE.DWD

Grant No. AWI_PS127_00

Polarstern departed the port of Bremerhaven on Sunday, 5 December 2021 at 12 UTC. The ship was situated at the rear of a weakening low over the southwestern part of the North Sea. Easterly winds blew about 5 Bft. First, it was snowing with temperatures around 0° C due to an occlusion right above the cruise track. The snow transitioned into drizzle later while temperatures were rising up to 5.6° C. On the way towards the English Channel weak high pressure influence dominated the weather conditions including weak easterlies and significant sea state at 2 m.

In the night to Tuesday, 7 December 2021 a severe storm developed rapidly over the northern Atlantic. In the morning the deep low reached Ireland. The pressure minimum was recorded at 957 hPa. *Polarstern* was situated east of England sheltered from the heaviest storm and wave field. During daytime it was sunny and dry with only few clouds. On Tuesday evening the warm front of the storm approached from West. The ship was hit by the storm with southerly winds at 8 to 9 Bft. Gusts were observed up to 11 Bft (29.5 m/s). It also started to rain with light to moderate intensity. The sky was overcast. From Wednesday, 8 December 2021 the storm weakened quickly over the British Isles. But, in the meantime a high over the Azores intensified. Therefore, a steep pressure gradient remained forcing strong north westerlies at 6 to 8 Bft throughout the cruise line until the Bay of Biscay. The weather appeared unsettled with broken clouds and occasionally showers. Along the coast of France few thunderstorms occurred. *Polarstern* reached the western exit of the English Channel during the night to Friday, 10 December 2021. There the highest waves of the whole research campaign had been observed at 5 to 6 m coming from Northwest. Becoming cloudier, it started to rain heavy at times.

On Saturday, 11 December 2021 a high pressure ridge was stretching from the Azores Islands towards the Hebrides. Further, the ridge shifted across *Polarstern* which was sailing along the Bay of Biscay towards Cape Vincent. This leaded to calm winds and eventually clearing skies. In the vicinity of Cape Finisterre some drizzle reduced the visibility slightly. The calm winds remained until Monday, 13 December 2021. The significant sea state decreased to 2 m and consisted mainly of swell from Northwest. The temperature rose from 10 to 17° C.

On Monday evening, 13 December 2021 a cold front associated with a low over the Bay of Biscay moved towards the cruise track of *Polarstern* which was situated northeast of Madeira. Along the frontal line an own low developed during Tuesday, 14 December 2021. That low companied *Polarstern* until entering the port of Las Palmas on Thursday, 16 December 2021 while weakening. Widespread showers and thunderstorms occurred. On Wednesday, 15 December 2021 a couple of supercells developed. In the vicinity of the ship multiple funnel clouds and water-tornados were observed.

After half a day of logistics and bunkering in the port of Las Palmas, *Polarstern* left the Canary Islands on Thursday, 16 December 2021 at 19 UTC towards the South. South of the Canary

Islands weak pressure differences expected us including calm winds and swell at 1 to 2 m from Northwest. While travelling within the Northeast Trade Zone the temperatures climbed up continuously. On Sunday, 19 December 2021 the northeasterly wind began to increase from 4 Bft to 6 Bft later. Also, the significant sea evolved to 2 to 3 m. In addition, a thick stratiform cloud layer approached. But it stayed mostly dry. In the region of the Cape Verde Islands Sahara dust was transported towards *Polarstern*. Moderate visibility resulted which lasted until Tuesday, 22 December 2021. Monday 21 December 2021 the highest temperature at 29.6° C was recorded.

On Wednesday and Thursday 22 and 23 December 2021 *Polarstern* sailed through the Innertropic Convergence Zone (ITC). The highest water temperature was measured at 30.0° C on Wednesday, the 23 December 2021. The ITC appeared rather inactive with broken clouds. Weak winds from easterly directions and swell up to 2 m from North northwest occurred.

The Southeast Trade wind zone already began on Christmas Eve at the equator. From the equator until Cape Town southeasterly winds prevailed. Until Wednesday, 29 December 2021 winds at 4 Bft and significant wave height at 1.5 to 2 m were generated. The temperature decreased continuously on the way until the arrival in Cape Town on Tuesday, 4 January 2022 at 03 UTC where it reached 17° C. The sky was mostly covered with scattered to broken clouds. Some almost cloud free phases occurred. It was mostly dry with only a few short showery spells. On Friday, 31 December 2021 a high situated approximately at 40° S and 015° W intensified and shifted eastwards. In the meantime, a thermal low developed over Namibia from Saturday, 1 January 2022. According to the steeper pressure gradient the southeasterly wind was forced to speed up to 7 Bft. A cross sea was formed as well. The significant wave height was observed at 4 m, including a swell about 3.5 m from Southwest. The thermal low moved further across South Africa towards Port Elizabeth while weakening. Southerly winds blew while entering the port of Cape Town on Tuesday, 4 December 2022 at 03 UTC. Until the port, the swell came from Southwest at 2.5 m. The sky was clear and full of stars.

3. BATHYMETRIC MAPPING AND GEOPHYSICAL UNDERWAY MEASUREMENTS

Laura Hehemann[1], Simon Dreutter[1], Johanna Brehmer-Moltmann[1, 2]; not on board: Boris Dorschel[1]

[1]DE.AWI; [2]DE.UNI-Bremen-GEO

Grant No. AWI_PS127_00

Objectives and methods

Accurate knowledge of the seafloor topography from high-resolution bathymetry data, is fundamental in understanding many marine processes. It is of particular importance for the interpretation of scientific data in a spatial context. Bathymetry, hence geomorphology, is furthermore a basic parameter for the understanding of the general geological setting of an area and geological processes such as erosion, sediment transport and deposition. Even information on tectonic processes can be inferred from bathymetry. Supplementing the bathymetric data, high-resolution sub-bottom profiler data of the top 10s of meters below the seabed provide information on the sediments at the seafloor and on the lateral extension of sediment successions.

While world bathymetric maps give the impression of a detailed knowledge of worldwide seafloor topography, most of the world's ocean floor remains unmapped by hydroacoustic systems. In these areas, bathymetry is modelled from satellite altimetry with a corresponding low resolution. Satellite-altimetry derived bathymetry therefore lack the resolution necessary to resolve small- to meso-scale geomorphological features (e.g. sediment waves, glaciogenic features and small seamounts). Ship-borne multibeam data provide bathymetry information in a resolution sufficient to resolve those features. The collection of underway data during PS127 will contribute to the bathymetry data archive at the AWI and therefore contribute to bathymetric world datasets like GEBCO (General Bathymetric Chart of the Ocean).

The main tasks of the bathymetry geophysics group on board *Polarstern* during PS127 were:

- System checks of replacement parts on multibeam
- Collection of bathymetric data, including calibration and correction of the data (sound velocity, systematic errors in bottom detection, etc.)
- Post processing and cleaning of the data
- Collection of sound velocity data
- Deployment of 4 ARVOR floats

Work at sea

Technical description

During the PS127 cruise, a bathymetric survey and a patch test were conducted with the hull-mounted Multibeam Echosounder (MBES) Teledyne Reson HydroSweep DS3. The HydroSweep is a deep water system for continuous mapping with the full swath potential. It operates on a frequency of ~14 kHz. On *Polarstern*, the MBES transducer arrays are arranged in a Mills Cross configuration of 3 m (transmit unit) by 3 m (receive unit). The combined motion, position (Trimble GNSS), and time data comes from an iXBlue Hydrins system and the signal is directly transferred into the Processing Unit (PU) of the MBES to carry out real-time motion compensation in Pitch, Roll and Yaw. With a combination of phase and amplitude detection algorithms the PU computes the water depth from the returning backscatter signal. The system can cover a sector of up to 140° with 70° per side. In the deep sea, an angle of ~50° to both sides could be achieved.

Data acquisition and processing

Data acquisition was carried out throughout the entire cruise between Bremerhaven and the Cape Town.

The MBES was operated with Hydromap Control and for online data visualization, Teledyne PDS was used. The collected bathymetry was stored in ASD and S7K raw files.

Subsequent data processing was performed using Caris HIPS and SIPS. For generating maps, the data were exported to Quantum GIS in GeoTIFF raster format.

Sound velocity profiles

Daily Underway Conductivity Temperature Depth (UCTD) casts were performed by the bathymetry group to measure the water sound velocity in different depths. This is essential as the acoustic signal travels down the water column from the transducer to the seafloor and back to the surface through several different layers of water masses with each a different sound velocity. The sound velocity (SV) is influenced by density and compressibility, both depending on pressure, temperature and salinity. Wrong or outdated sound velocity profiles lead to refraction errors and reduced data quality.

The UCTD measures conductivity, temperature, and depth in the water column while the ship is moving with 5 knots and the probe falls to roughly 800 m depth, before it is winched back on deck. From these parameters, the sound velocity is calculated. The sound velocity profiles obtained by the UCTD were immediately processed and applied within the MBES for correct beamforming during the survey.

One sound velocity profile was additionally conducted with the Valeport MIDAS profiler to a depth of 1,000 m. This was done just before the patch test for multibeam calibration.

Additionally, these profiles were combined/extended with WOA13 (World Ocean Atlas 2013) data to create full ocean depth SV profiles.

Stations

The HydroSweep, underway CTD and Valeport CTD stations are listed in Table 3.1.

Tab. 3.1: List of stations during PS127

Station Number	Descrip-tion	Device	Start	Start Lat	Start Lon	End	End Lat	End Lon
PS127_0_ Underway-13	Multibeam Survey	Hydrosweep DS3	2021-12-09 15:31	49.23	-4.91	2021-12-11 12:41	43.55	-10.97
PS127_2-1	Sound velocity profile	OceanScience Underway CTD	2021-12-11 12:22	43.57	-10.95	2021-12-13 12:44	36.14	-13.35
PS127_5-2	Sound velocity profile	OceanScience Underway CTD	2021-12-14 13:35	33.01	-14.23	2021-12-14 14:02	32.97	-14.24
n/a	Multibeam Survey	Hydrosweep DS3						
PS127_8-2	Sound velocity profile	Valeport MIDAS	2021-12-15 12:57	30.81	-14.83	2021-12-15 13:23	30.77	-14.84
n/a	Multibeam Patch test (calibration of installation parameters)	Hydrosweep DS3						
PS127_9-2	Sound velocity profile	OceanScience Underway CTD	2021-12-17 13:03	26.01	-17.98	2021-12-17 13:26	26.00	-18.02
PS127_10-1	Sound velocity profile	OceanScience Underway CTD	2021-12-18 9:52	23.21	-20.64	2021-12-18 10:19	23.16	-20.65
PS127_11-1	Sound velocity profile	OceanScience Underway CTD	2021-12-18 16:03	22.15	-20.82	2021-12-18 16:24	22.12	-20.82
PS127_12-1	Sound velocity profile	OceanScience Underway CTD	2021-12-19 9:57	18.69	-20.98	2021-12-19 10:23	18.65	-20.98
PS127_13-1	Sound velocity profile	OceanScience Underway CTD	2021-12-19 15:58	17.61	-20.97	2021-12-19 16:22	17.57	-20.97
PS127_14-1	Sound velocity profile	OceanScience Underway CTD	2021-12-20 9:59	14.19	-20.93	2021-12-20 10:45	14.13	-20.93
PS127_15-1	Sound velocity profile	OceanScience Underway CTD	2021-12-20 15:56	13.12	-20.92	2021-12-20 16:19	13.09	-20.92
PS127_16-1	Sound velocity profile	OceanScience Underway CTD	2021-12-21 9:55	9.95	-19.89	2021-12-21 10:25	9.92	-19.86
PS127_17-1	Sound velocity profile	OceanScience Underway CTD	2021-12-21 15:58	9.11	-19.26	2021-12-21 16:48	9.07	-19.22
PS127_18-1	Sound velocity profile	OceanScience Underway CTD	2021-12-22 9:53	6.54	-17.34	2021-12-22 10:20	6.50	-17.32

Station Number	Descrip-tion	Device	Start	Start Lat	Start Lon	End	End Lat	End Lon
PS127_19-1	Sound velocity profile	OceanScience Underway CTD	2021-12-22 15:59	5.63	-16.68	2021-12-22 16:21	5.61	-16.66
PS127_20-1	Sound velocity profile	OceanScience Underway CTD	2021-12-23 9:20	3.05	-14.73	2021-12-23 9:58	3.00	-14.70
PS127_22-1	Sound velocity profile	OceanScience Underway CTD	2021-12-24 8:46	0.17	-12.55	2021-12-23 15:43	2.51	-14.32
PS127_23-1	Sound velocity profile	OceanScience Underway CTD	2021-12-24 15:01	-0.64	-11.93	2021-12-24 9:18	0.13	-12.52
PS127_24-1	Sound velocity profile	OceanScience Underway CTD	2021-12-25 8:49	-3.03	-10.10	2021-12-24 15:24	-0.66	-11.92
PS127_25-1	Sound velocity profile	OceanScience Underway CTD	2021-12-25 15:02	-3.89	-9.52	2021-12-25 9:34	-3.08	-10.06
PS127_26-1	Sound velocity profile	OceanScience Underway CTD	2021-12-26 8:53	-6.58	-7.56	2021-12-25 15:27	-3.91	-9.50
PS127_27-1	Sound velocity profile	OceanScience Underway CTD	2021-12-26 15:00	-7.38	-6.77	2021-12-26 9:21	-6.61	-7.53
PS127_28-1	Sound velocity profile	OceanScience Underway CTD	2021-12-27 8:54	-9.75	-4.52	2021-12-26 15:37	-7.40	-6.74
PS127_29-1	Sound velocity profile	OceanScience Underway CTD	2021-12-27 15:02	-10.59	-3.83	2021-12-27 9:26	-9.79	-4.49
PS127_30-1	Sound velocity profile	OceanScience Underway CTD	2021-12-28 7:19	-12.95	-1.90	2021-12-28 15:26	-10.62	-3.81
PS127_32-1	Sound velocity profile	OceanScience Underway CTD	2021-12-28 15:00	-14.06	-1.00	2021-12-28 7:59	-13.00	-1.87
PS127_33-1	Sound velocity profile	OceanScience Underway CTD	2021-12-29 7:55	-16.39	0.93	2021-12-28 15:27	-14.09	-0.98
PS127_34-1	Sound velocity profile	OceanScience Underway CTD	2021-12-29 14:05	-17.21	1.62	2021-12-29 8:21	-16.44	0.96
PS127_35-1	Sound velocity profile	OceanScience Underway CTD	2021-12-30 7:54	-19.59	3.53	2021-12-29 14:27	-17.24	1.64
PS127_37-1	Sound velocity profile	OceanScience Underway CTD	2021-12-30 8:12	-19.61	3.54	2021-12-30 8:12	-19.61	3.54

ARVOR float deployments

Subsurface profiling floats as part of the ARGO program provide information on temperature and salinity of the upper ocean, roughly 2,000 m. The ARVOR float is the developed by IFREMER and MARTEC using ARGOS satellite system to transmit data. The floats were activated and deployed at the stations listed in Table 3.2.

Tab. 3.2: List of ARVOR float stations during PS127

Station No	S/N	WMO ID	Magnet sweep @	Deployed @	Lat	Lon	Ship Speed [kn]	Water Depth [m]
PS127_21_1	AI2600-21DE017	6904129	2021-12-23 10:41	2021-12-23 10:48	2.95	-14.66	5	4753
PS127_31-1	AI2600-21DE019	6904131	2021-12-28 7:12	2021-12-28 7:18	-12.95	-1.90	3.6	5004
PS127_36-1	AI2600-21DE020	6904132	2021-12-29 19:37	2021-12-29 19:40	-17.93	2.20	3.3	5527
PS127_38-1	AI2600-21DE021	6904133	2021-12-30 18:04	2021-12-30 18:10	-20.96	4.64	3.4	4214

Preliminary (expected) results

During 29 days of survey, a track length of 5,809 nm (10,758 km) was surveyed by the swath bathymetry and the sub-bottom profiling system. Figure 3.1 shows the generated bathymetry grid over the Atlantic.

Data management

Bathymetric data collected during PS127 will be archived, published and disseminated according to international standards by the World Data Centre PANGAEA Data Publisher for Earth & Environmental Science (https://www.pangaea.de) within two years after the end of the cruise. By default the CC-BY license will be applied. Furthermore, the data will be provided to mapping projects and included in global bathymetry compilations such as the General Bathymetric Chart of the Ocean (GEBCO). Bathymetric data will also be provided to the Nippon Foundation – GEBCO Seabed 2030 Project. All PARASOUND data will be transferred to AWI after the cruise and stored in the data base of the IT section. Once georeferenced, the data will be linked for external accessibility in PANGAEA. Magnetic data will be stored at the AWI and submitted to PANGAEA.

This expedition was supported by the Helmholtz Research Programme "Changing Earth – Sustaining our Future" Topic 2, Subtopic 2.1, 2.3.

In all publications based on this expedition, the Grant No. AWI_PS127_00 will be quoted and the following publication will be cited: Alfred-Wegener-Institut Helmholtz-Zentrum für Polar -und Meeresforschung (2017) Polar Research and Supply Vessel POLARSTERN Operated by the Alfred-Wegener-Institute. Journal of large-scale research facilities, 3, A119. http://dx.doi.org/10.17815/jlsrf-3-163.

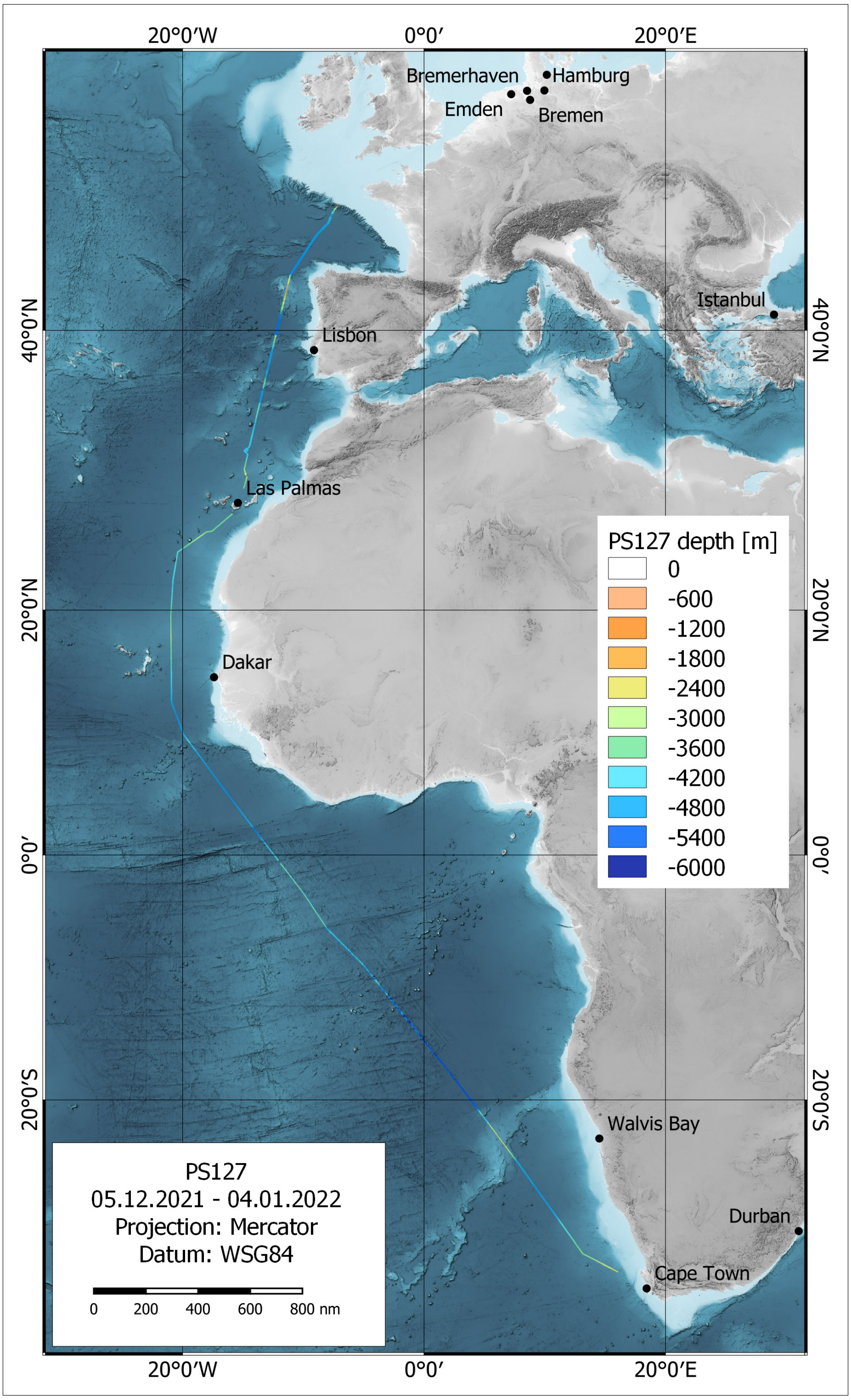

Fig. 3.1: Overview on the bathymetric data acquired during PS127

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

Kevin Ohneiser, Rico Hengst, Majid Hajipour; DE.TROPOS
not on board: A. Andreas Macke, Ronny Engelmann

Grant No. AWI_PS127_00

Objectives

The OCEANET-ATMOSPHERE project delivers valuable atmospheric measurement datasets over the oceans – in regions of the world that are not easily accessible. For the last 11 years, a container-based platform is operated regularly at *Polarstern* to obtain measurements and to contrast atmospheric processes between the anthropogenic polluted northern hemisphere and the more undisturbed southern hemisphere.

Recently, the ESA satellite Aeolus with a wind lidar on board was launched. We obtained some ground-comparison profiles during PS127 in order to calibrate and validate the data within the EVAA project (Experimental Validation and Assimilation of Aeolus observations).

a) Radiation and 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 is 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 it's variability on the co-located measurements of the down welling 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 is measured by means of hand-held sun photometer. As an alternative to the sun photometer, additional radiation measurements are conducted with a multi-spectral shadowband radiometer (GUVis-3511), providing measurements of global, direct and diffuse spectral irradiance and aerosol optical thickness. Most instruments are integrated in the container-based atmosphere observatory.

b) Lidar measurements of aerosol and cloud profiles

Since more than 20 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 multi-wavelength polarization Raman lidar operates inside the 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 depolarization 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 vapor, 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 PS127 the lidar operated with a second large field-of-view depolarization channel. From this data, we were able to determine cloud microphysical properties (effective radius and cloud-droplet number concentration) in the base of liquid water clouds.

Work at sea

Upon departure from Bremerhaven, the container-based atmosphere observatory OCEANET was installed at the deck of *Polarstern*. Most measurements were performed underway and continuously. During the time on board it was mainly taken care of the measurements, calibrations, maintenance of the instruments and early data evaluation. Some Aeolus satellite overpasses were taking place in order to get comparison profiles from the surface and from space for the calibration and validation of the Aeolus products. The following individual instruments were combined:

1. Multichannel microwave radiometer HATRPO. The instrument required a calibration with liquid nitrogen at the port of Las Palmas de Gran Canaria
2. Total-sky imager for cloud-structure measurements
3. Multiwavelength polarization Raman lidar PollyXT
4. Handheld sun photometer (Microtops) for aerosol and cloud optical thickness
5. Fully-automated spectral shadow band radiometer (GUVis-3511)
6. Standard meteorological and radiation data logging

Preliminary (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 down welling 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
5. The volcano on La Palma had its longest active period since record. The aim was to measure the emitted aerosol plume from the volcano in the troposphere with lidar.

Those measurements are rare and would have been beneficial. Unfortunately, due to low clouds, east winds, and a volcanic inactive period it was not possible to get those measurements.

6. A long episode of Saharan dust from 18 – 23 December was recorded. It is aimed for studies focusing on the aerosol cloud interaction. First results can be seen in Figure 4.1, the Saharan dust was mainly located in the lowest 4 km height. It was surrounded by clouds.

7. First results in Figure 4.2 show a layer of Saharan dust and pollution mixture from the surface to 4 km height. Between 5 and 8 km there are liquid water altocumulus clouds. Regarding to the depolarization and lidar ratio measurements, the upper part of the aerosol layer at 3 km height seems to contain a larger fraction of African pollution.

8. Results of Aeolus overpass: The comparison between the Aeolus wind data and the radiosonde wind data is shown in Figure 4.3. Aeolus winds are slightly overestimated. The radiosonde data can be used to calibrate the satellite data.

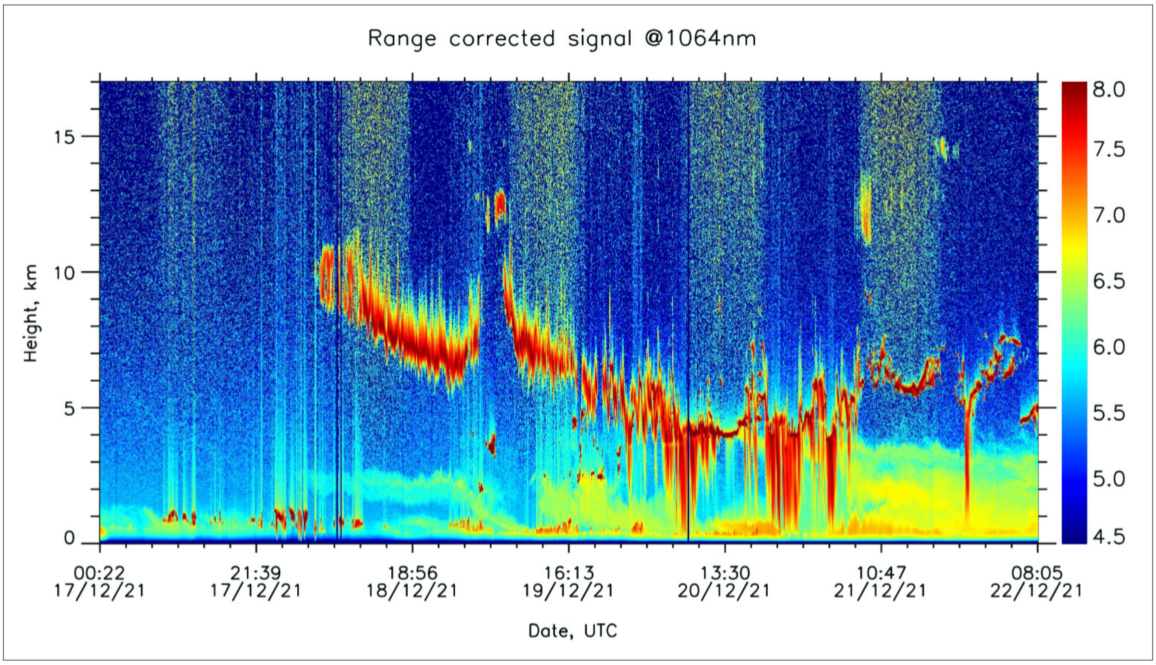

Fig. 4.1: Aerosol and cloud distribution between 17 and 22 December 2021; Saharan dust in the lowest 4 km height; clouds up to 15 km height

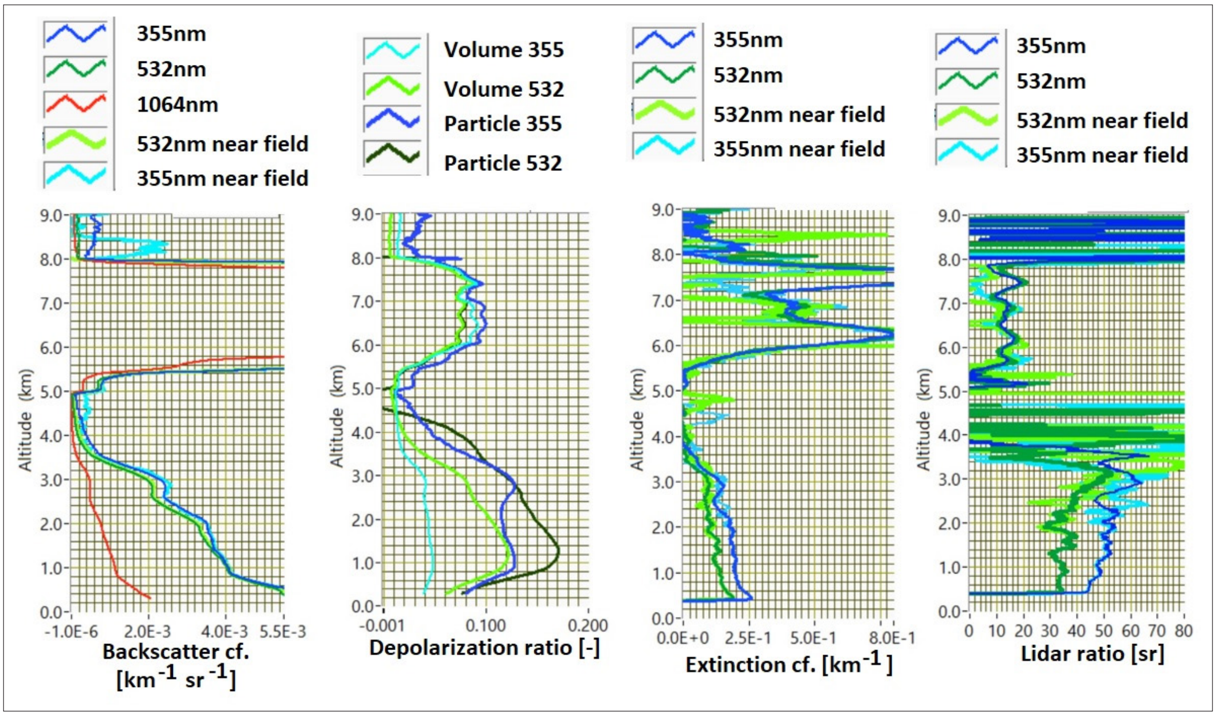

Fig. 4.2: Aerosol optical properties on 22 December 2021, backscatter cf., depolarization ratio, extinction cf., and lidar ratio

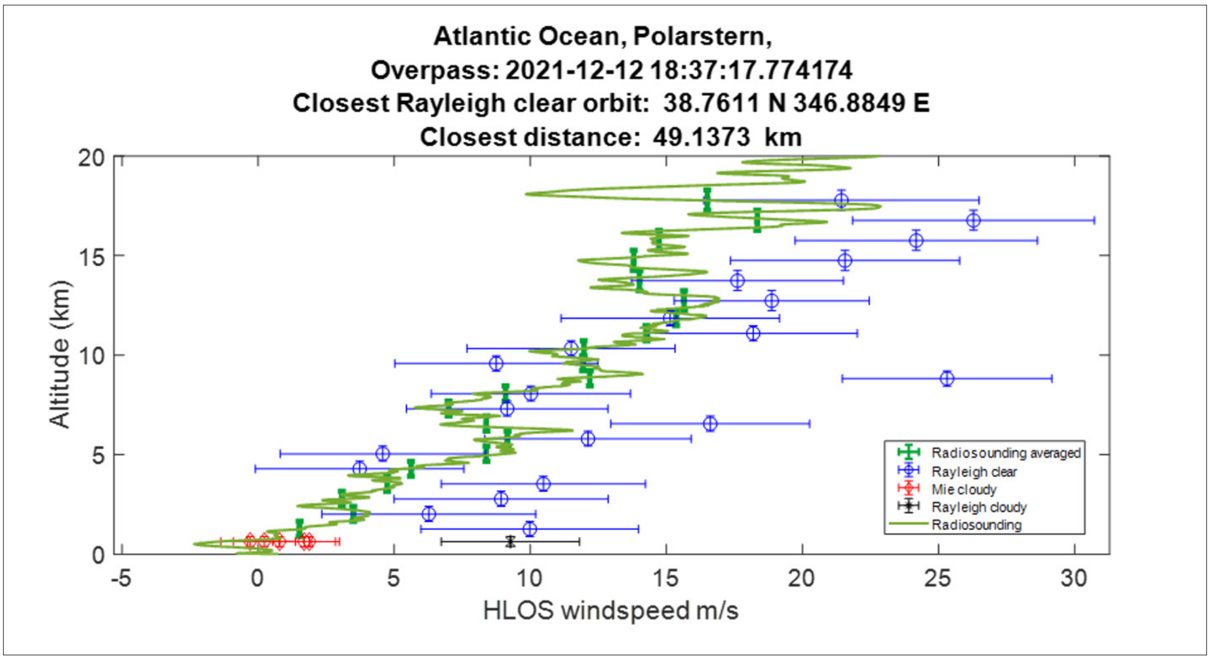

Fig. 4.3: Comparison between the Aeolus wind data and the radiosonde wind data

Data management

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

Additionally, higher-level data are uploaded, archived, published and disseminated according to international standards by the World Data Center PANGAEA Data Publisher for

Earth & Environmental Science (https://www.pangaea.de) under the keyword OCEANET-ATMOSPHERE within two years after the end of the cruise at the latest. By default, the CC-BY license will be applied.

This expedition was supported by the Helmholtz Research Programme "Changing Earth – Sustaining our Future" Topic X, Subtopic Y.

In all publications, based on this cruise, the Grant No. AWI_P127_00 will be quoted and the following *Polarstern* article will be cited:

Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung. (2017). Polar Research and Supply Vessel *Polarstern* Operated by the Alfred-Wegener-Institute. Journal of large-scale research facilities, 3, A119. http://dx.doi.org/10.17815/jlsrf-3-163.

5. TEST CLEAN-CTD

Christian Völkner[1], Florian Koch[1], Ingrid Stimac[1]
Wolfgang Küstner[2], Julien Pautot[3],
Loïc Portere[3]

[1]DE.AWI
[2]DE.SerWarTec
[3]FR.Kley France

Grant No. AWI_PS127_00

Objectives

The main objective of our programme was to perform a sea acceptance test for the newly purchased winch container. For this, the cable routing of the new synthetic conductor CTD cable needed to be setup and checked. Two employees from the manufacture of the winch container (Kley France) were present to perform the test. Besides of the sea acceptance test of the winch container, we also tested the new clean room container. This included the transport of 24 x 12 L GoFlo Bottles from the Clean-CTD to the clean room container using the novel wash station installed in the container as well as the workflow pertaining to our metal clean sampling techniques. All of this was supported by a SerWarTec employee who helped us optimize airflow settings and to assess possible malfunctions.

This test of the newly acquired equipment was essential since it will play a key role on future expeditions. A malfunction of either the winch container or the clean room container during such an expedition would prevent the further use of the Clean-CTD.

Work at sea

The first couple of days were used to setup all the equipment and make sure that all connections to the newly purchased cleanroom and winch container worked as intended. Extra data connections from the winch container on the working deck to the winch control room had to be setup. This included the connection to the deck unit of the clean CTD and the control console of the winch.

Furthermore, the new additional deck sheave and the head sheave for the synthetic conductor CTD cable were installed (Figure 5.1).

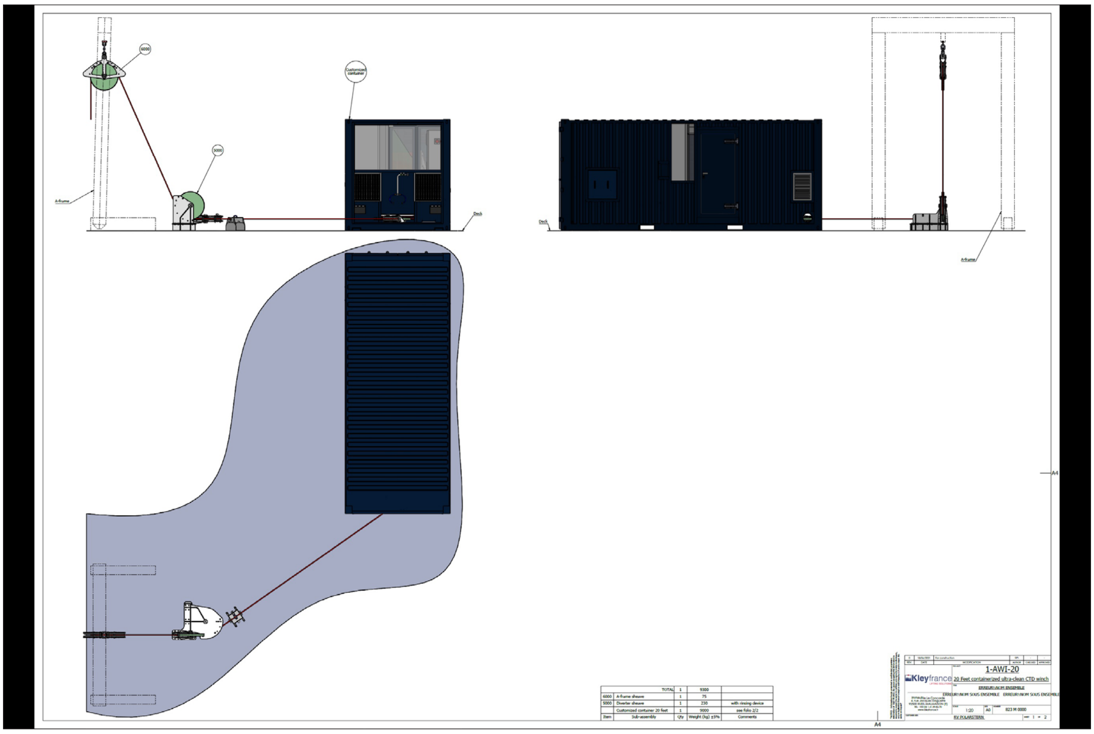

Fig. 5.1: Cable routing

After everything was setup we started with the sea acceptance test of the winch container which includes the visual inspection of the instrument, interconnection and interface checking and the off-load test of the winch. After a successful first part of the SAT, we performed the dynamic test of the winch at the PS127-1 station using our CTD under realistic Southern Ocean conditions (wind and moderate sea). We combined the SAT with a CTD cast down to 2,500 m and, at five different depths, sampled water, which was used to test the workflow in the cleanroom container later that day. The winch performed as expected and passed all points of the dynamic test. During the deployment and the recovery of the CTD, however, we observed, that the cable routing was suboptimal and needed to be revised. The cable was too close to the big sliding beam when the CTD was deployed/recovered and could have been damaged.

The closed GoFlo bottles from the CTD were transported to the cleanroom container and decontaminated by passing them through the rinsing station. In the container the workflow for trace metal clean sampling was tested, included trace metal clean filtration techniques for dissolved and particle trace metal sampling.

Expected results

The Clean CTD, CTD cable and winch container worked fine and can be used during future cruises.

The interconnection of the Clean-CTD, winch container, deck unit and control console worked as expected. We were able to perform the SAT of the winch container under realistic conditions with good results. Only the routing of the synthetic conductive CTD cable needs some optimization. The risk to damage the cable during CTD deployment/recovery prevented us from further tests on the transit to Las Palmas. Our aim was to find a solution for this problem together with Laeisz and the shipyard before the next cruise. With the new clean room container the AWI now has got the needed infrastructure to perform trace metal clean work at sea.

Data management

Environmental data will be archived, published and disseminated according to international standards by the World Data Center PANGAEA Data Publisher for Earth & Environmental Science (https://www.pangaea.de) within two years after the end of the cruise at the latest. By default the CC-BY license will be applied.

In all publications, based on this cruise, the **Grant No. AWI_P127_00** will be quoted and the following *Polarstern* article will be cited:

Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung. (2017). Polar Research and Supply Vessel *Polarstern* Operated by the Alfred-Wegener-Institute. Journal of large-scale research facilities, 3, A119. http://dx.doi.org/10.17815/jlsrf-3-163.

6. ECHOSOUNDER TRAINING COURSE

Catalina Gebhardt, Estella Weigelt, Oliver Esper — DE.AWI

Grant-No. AWI_PS127_00

Objectives

The main objective of the PARASOUND training course between Bremerhaven and Las Palmas/Canary Islands was to refresh knowledge on the operation procedure and to teach and train the standardized subsequent processing workflow to AWI senior scientists. With this hands-on training, the senior scientists will be able to operate the PARASOUND system independently on future expeditions. In addition, PARASOUND data are also collected on the transit between Las Palmas/Canary Islands and Cape Town/South Africa as part of the geophysical underway data collection.

Work at sea

During the echosounder training course between Bremerhaven and Las Palmas/Canary Islands, two senior scientists of AWI Bremerhaven were trained to operate the hull-mounted echosounder PARASOUND system during expeditions. After a theoretical introduction to the system, hands-on training was provided by running the system continuously during the entire first part of PS127. This included practicing the startup and shutdown procedure of the PARASOUND system, adjusting all settings to operate the system in a reasonable manner using the different operation modes, fine-tuning to get optimum results in imaging the sub-seafloor, and training of basic troubleshooting.

The hands-on training also included the subsequent processing steps that are meanwhile established as a standardized workflow. This workflow consists of (a) acquisition of data in the internal PARASOUND ASD and PS3 formats, (b) conversion of PS3 to standard SGY format, (c) extraction of navigation data and conversion to standard UKOOA format, and (d) preparation for storage in Pangaea.

Between Las Palmas/Canary Islands and Cape Town/South Africa, the system was operated to collect underway data.

During the transit from Las Palmas to Cape Town several deep-sea basins and ridge systems were crossed off the coast along West Africa. In general, up to 100 m thick sedimentary sequences and a smooth seafloor surface were imaged in the deep-sea basins. A prominent example was recorded in the Angola Basin at a water depth of about 5,500 m (Figure 6.1). Well stratified sedimentary strata of more than 70 m were penetrated by reflection free pipe-like structures likely presenting rising gas or fluids. In contrast, only a few meters thick sediments and a rough sea-floor topography were recorded on the ridges, as e.g. on a part of the Mid-Atlantic Ridge System (Figure 6.2).

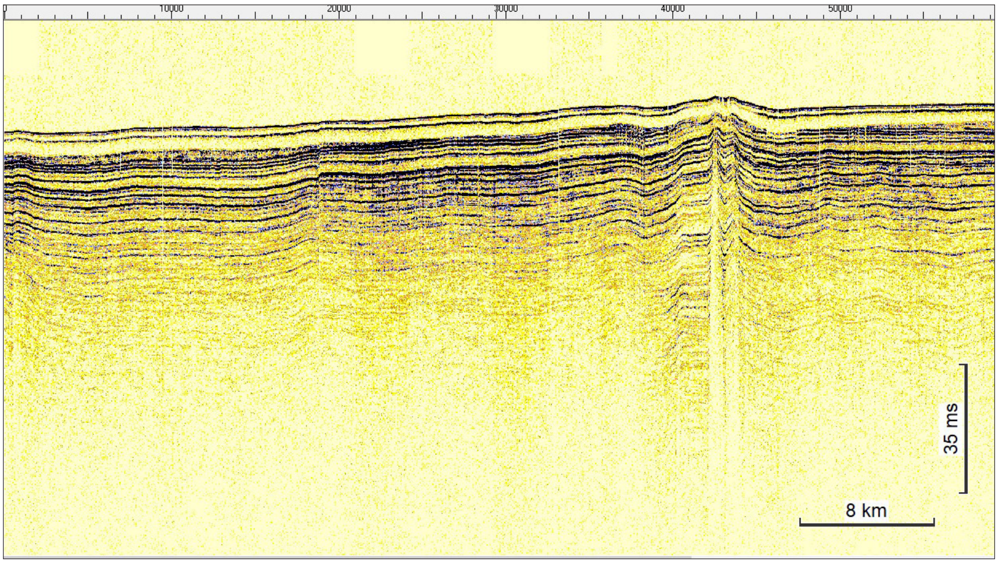

Fig. 6.1: Parasound profile in the Angola Basin imaging about 70 m thick well-layered sedimentary sequences penetrated by pipe-like structures

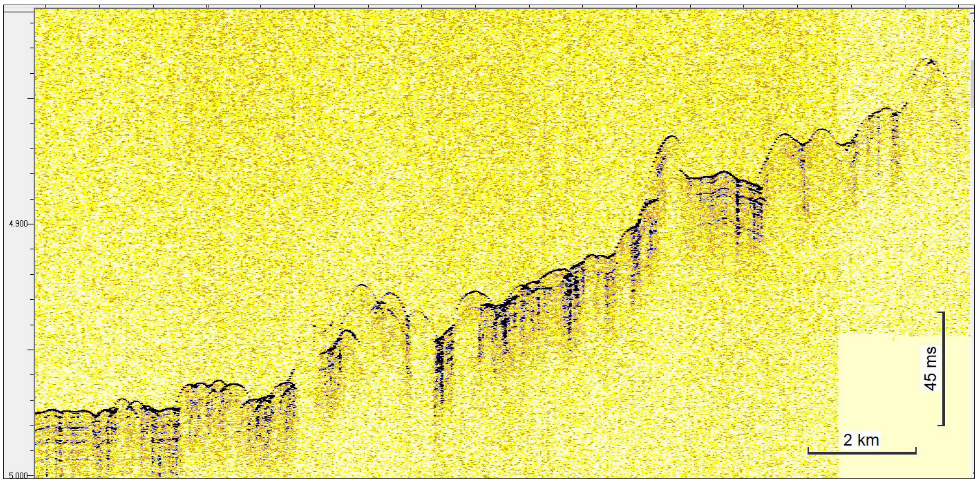

Fig. 6.2: Parasound section across a transform fault of Mid-Atlantic Ridge System imaging only a few meters thick sedimentary cover laying on the rough seafloor topography

Data management

PARASOUND data collected during PS127 were copied to the *Polarstern* data base, from where they will be transferred to the data mass storage at AWI Bremerhaven and linked to the World Data Center PANGAEA Data Publisher for Earth & Environmental Science (https://www.pangaea.de) at AWI.

In all publications based on this expedition, the Grant No. AWI_PS127_00 will be quoted and the following publication will be cited: Alfred-Wegener-Institut Helmholtz-Zentrum für Polar -und Meeresforschung (2017) Polar Research and Supply Vessel POLARSTERN Operated by the Alfred-Wegener-Institute. Journal of large-scale research facilities, 3, A119. http://dx.doi.org/10.17815/jlsrf-3-163.

APPENDIX

A.1 Teilnehmende Institute / Participating Institutions

A.2 Teilnehmer:innen / Cruise Participants

A.3 Schiffsbesatzung / Ship's Crew

A.4 Stationsliste / Station List

A.1 TEILNEHMENDE INSTITUTE / PARTICIPATING INSTITUTIONS

Institution	Address
DE.AWI	Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung Am Handelshafen 12 27570 Bremerhaven Germany
DE.DWD	Deutscher Wetterdienst Seewetteramt Bernhard Nocht Str. 76 20359 Hamburg Germany
DE.LAEISZ	Reederei F. Laeisz GmbH Bartelstraße 1 27570 Bremerhaven Germany
DE.SERWARTEC	SerWarTec GmbH Stueckweg 14 35325 Muecke Germany
DE.TROPOS	Leibniz Institut für Troposphärenforschung Permoserstraße 15 04318 Leipzig Germany
DE.SHIPDESIGN	SDC Ship Design & Consult GmbH Bramfelder Strasse 164 22305 Hamburg Germany
DE.UNI-Bremen-GEO	Universität Bremen Fachbereich Geowissenschaften Klagenfurter Straße 2-4 28359 Bremen
FR.KLEYFRANCE	Kley France 4 rue Jacques Daguerre 92500 Rueil-Malmaison France

A.2 FAHRTTEILNEHMER:INNEN / CRUISE PARTICIPANTS

Name/ Last name	Vorname/ First name	Institut/Institute	Beruf/ Profession	Fachrichtung/ Discipline
Boebel	Tobias	DE.AWI	Scientist	Logistics
Brehmer-Moltmann	Johanna	DE.AWI	Student	Geophysics
Crenan	Brieuc	DE.LAEISZ	Engineer	Shipping Company
Dreutter	Simon	DE.AWI	Technician	Geophysics
Endres	Sonja	DE.AWI	Scientist	Logistics
Esper	Oliver	DE.AWI	Scientist	Geology
Freudenberg	Sascha	DE.SHIPDESIGN	Engineer	Logistics
Gebhardt	Catalina	DE.AWI	Scientist	Geophysics
Gosch	Thomas	DE.SHIPDESIGN	Engineer	Engineering Sciences
Hajipour	Majid	DE.TROPOS	PhD student	Physics
Hehemann	Laura	DE.AWI	Scientist	Geophysics
Hengst	Rico	DE.TROPOS	Scientist	Geo Sciences
Horvath	Esther	DE.AWI	Photographer	Public Outreach
Koch	Florian	DE.AWI	Scientist	Biology
Krocker	Ralf	DE.AWI	Engineer	Logistics
Kuestner	Wolfgang	DE.SERWARTEC	Scientist	Geology
Kühl	Johannes	DE.AWI	Engineer	Logistics
Lapp	Uta	DE.AWI	Observer	Logistics
Maltby	Johanna	DE.AWI	Scientist	Logistics
Meier	Jan	DE.AWI	Engineer	Logistics
Meier-Ewert	Lavinia	DE.AWI	Observer	Public Outreach
Miller	Heinrich	DE.AWI	Scientist	Glaciology
Ohneiser	Kevin Oliver	DE.TROPOS	PhD student	Meteorology
Otte	Frank	DE.DWD	Scientist	Meteorology
Pautot	Julien	FR.KLEYFRANCE	Technician	Logistics
Pluder	Andreas	DE.LAEISZ	Engineer	Shipping Company
Portere	Loic	FR.KLEYFRANCE	Engineer	Engineering Sciences
Rogenhagen	Johannes	DE.LAEISZ	Inspector	Shipping Company
Schierwater	Andrea	DE.AWI	Other	Logistics
Stimac	Ingrid	DE.AWI	Technician	Chemistry
Stöckle	Sonja	DE.DWD	Other	Meteorology
Völkner	Christian	DE.AWI	Engineer	Chemistry
Weigelt	Estella	DE.AWI	Scientist	Geophysics
Wilde	Detlef	DE.AWI	Scientist	Logistics
Ziemann	Olaf Hermann August	DE.LAEISZ	Engineer	Shipping Company

A.3 SCHIFFSBESATZUNG / SHIP'S CREW

No.	Name/Last name	Vorname/First name	Rank
1	Schwarze	Stefan	Master
2	Kentges	Felix	Chiefmate
3	Langhinrichs	Jacob	Chiefmate Cargo
3	Ziemann	Olaf	Chief
4	Strauss	Erik	2nd Mate
5	Fallei	Holger	2nd Mate
6	Hofmann	Jorg Walter	ELO
7	Gössmann-Lange	Petra	Ships doc
8	Brose	Thomas Christian	2nd. Eng.
9	Haack	Michael Detlev	2nd. Eng.
10	Schnurch	Helmut	2nd. Eng.
11	Redmer	Jens Dirk	ELO.
12	Hüttebräuker	Olaf	ELO
13	Frank	Gerhard Ansgar	ELO
14	Krüger	Lars	ELO
15	Nasis	Ilias	ELO
16	Sedlak	Andreas Enrico	Bosun
17	Neisner	Winfried	Carpen.
18	Erlenbach	Colin	MP Rat.
19	Klee	Phillip	MP Rat.
20	Kreutzmann	Lennart	MP Rat.
21	Meier	Jan	MP Rat.
22	Moller	Falko	MP Rat.
23	Backer	Andreas	AB
24	Burzan	Gerd-Ekkehard	AB
25	Wende	Uwe	AB
26	Preußner	Jörg	Starek.
27	Gebhardt	Norman	MP Rat.
28	Hilliger	Maik	MP Rat.
29	Rhau	Lars-Peter	MP Rat.
30	Schwarz	Uwe	MP Rat.
31	Teichert	Uwe	MP Rat.
32	TBN		Cook
33	Silinski	Frank	Cooksm.
34	Zahn	Maren	Cooksm.
35	Pieper	Daniel	Chief Stew.
36	Braun	Maja	Alexandra
37	Arendt	René	2nd Nurse

No.	Name/Last name	Vorname/First name	Rank
38	Chen	Dansheng	2nd Stew.
39	Krause	Tomasz	2nd Stew.
40	Pieper	Daniel	Chief Stew.
41	Silinski	Carmen	2nd Stew.
42	Sun	Yongsheng	Laundrym. Stew.

A.4 STATIONSLISTE / STATION LIST PS127

Station list of expedition PS127 from Bremerhaven to Cape Town;
the list details the action log for all stations along the cruise track.

See https://www.pangaea.de/expeditions/events/PS127 to display the station (event) list for expedition PS127.
This version contains Uniform Resource Identifiers for all sensors listed under https://sensor.awi.de. See https://www.awi.de/en/about-us/service/computing-centre/data-flow-framework.html for further information about AWI's data flow framework from sensor observations to archives (O2A).

Event label	Optional label	Date/Time	Latitude	Longitude	Depth [m]	Gear	Action	Comment
PS127_0_Underway-28		2021-12-05T14:24:06	53.69412	8.34337	6.1	SWEAS	Station start	
PS127_0_Underway-28		2022-01-03T13:05:55	-32.79588	16.09617	2458.1	SWEAS	Station end	
PS127_0_Underway-22		2021-12-06T08:22:40	52.79008	3.73367	17.0	SNDVELPR	Station start	
PS127_0_Underway-22		2022-01-03T13:05:55	-32.79588	16.09617	2458.1	SNDVELPR	Station end	
PS127_0_Underway-12		2021-12-06T08:25:43	52.78274	3.72494	18.0	GRAV	Station start	
PS127_0_Underway-12		2022-01-03T13:05:26	-32.79517	16.09468	2448.6	GRAV	Station end	
PS127_0_Underway-11		2021-12-06T08:26:12	52.78155	3.72350	18.1	MAG	Station start	
PS127_0_Underway-11		2022-01-03T13:05:10	-32.79478	16.09385	2443.1	MAG	Station end	
PS127_0_Underway-14		2021-12-06T08:31:24	52.76947	3.70824	16.7	NEUMON	Station start	
PS127_0_Underway-14		2022-01-03T13:04:52	-32.79436	16.09291	2438.3	NEUMON	Station end	
PS127_0_Underway-6		2021-12-06T08:31:52	52.76837	3.70688	18.0	MYON	Station start	
PS127_0_Underway-6		2022-01-03T13:04:41	-32.79409	16.09234	2434.9	MYON	Station end	
PS127_0_Underway-1		2021-12-06T08:34:24	52.76243	3.69923	17.2	ADCP	Station start	
PS127_0_Underway-1		2022-01-03T13:04:20	-32.79362	16.09128	2430.6	ADCP	Station end	
PS127_0_Underway-2		2021-12-06T08:48:31	52.72935	3.65798	16.5	AFIM	Station start	
PS127_0_Underway-2		2022-01-03T13:03:58	-32.79311	16.09013	2424.3	AFIM	Station end	
PS127_0_Underway-13		2021-12-09T15:30:54	49.23089	-4.90643	88.3	MBES	Station start	
PS127_0_Underway-13		2022-01-03T13:02:37	-32.79132	16.08579	2405.9	MBES	Station end	

Event label	Optional label	Date/Time	Latitude	Longitude	Depth [m]	Gear	Action	Comment
PS127_1-1		2021-12-10T13:05:29	46.38574	-8.0582	4737.6	CTD-RO	max depth	
PS127_0_Underway-7		2021-12-10T15:53:24	46.37575	-8.0752	4741.4	FBOX	Station start	
PS127_0_Underway-7		2022-01-03T13:03:38	-32.79262	16.08903	2416.1	FBOX	Station end	
PS127_0_Underway-18		2021-12-10T15:55:28	46.376	-8.0747	4741.0	pCO2	Station start	
PS127_0_Underway-18		2022-01-03T13:03:15	-32.79211	16.0878	2410.4	pCO2	Station end	
PS127_0_Underway-17		2021-12-10T15:56:11	46.37606	-8.0745	4740.5	pCO2	Station start	
PS127_0_Underway-17		2022-01-03T13:02:14	-32.79082	16.08449	2406.7	pCO2	Station end	
PS127_2-1		2021-12-11T12:22:45	43.57481	-10.94945	5007.5	CTD-UW	Station start	
PS127_2-1		2021-12-11T12:41:26	43.55141	-10.97058	5011.7	CTD-UW	Station end	
PS127_3-1		2021-12-12T13:02:24	39.31082	-12.38983	3762.3	CTD-RO	max depth	
PS127_0_Underway-23		2021-12-12T14:42:48	39.03222	-12.47407	4033.7	TSG	Station start	
PS127_0_Underway-23		2022-01-03T13:01:46	-32.7902	16.08299	2401.8	TSG	Station end	
PS127_0_Underway-24		2021-12-12T14:43:10	39.03102	-12.47438	4033.2	TSG	Station start	
PS127_0_Underway-24		2022-01-03T13:01:11	-32.7894	16.08113	2397.3	TSG	Station end	
PS127_4-1		2021-12-13T12:23:41	36.16707	-13.32621	4733.9	CTD-UW	Station start	
PS127_4-1		2021-12-13T12:44:53	36.14369	-13.34735	4751.0	CTD-UW	Station end	
PS127_5-2		2021-12-14T13:35:49	33.00818	-14.22886	4342.0	CTD-UW	Station start	
PS127_5-2		2021-12-14T14:02:06	32.97192	-14.23918	4331.8	CTD-UW	Station end	
PS127_8-2		2021-12-15T12:57:13	30.80607	-14.82643	3524.5	CTD-UW	Station start	
PS127_8-2		2021-12-15T13:23:00	30.76953	-14.83598	3485.2	CTD-UW	Station end	
PS127_9-2		2021-12-17T13:03:17	26.00615	-17.98008	3445.8	CTD-UW	Station start	
PS127_9-2		2021-12-17T13:26:52	26.0003	-18.01757	3435.5	CTD-UW	Station end	
PS127_10-1		2021-12-18T09:52:10	23.20552	-20.64457	4202.2	CTD-UW	Station start	
PS127_10-1		2021-12-18T10:19:23	23.16141	-20.65249	4208.1	CTD-UW	Station end	
PS127_11-1		2021-12-18T16:03:34	22.14754	-20.81577	4279.9	CTD-UW	Station start	
PS127_11-1		2021-12-18T16:24:26	22.11864	-20.81801	4279.3	CTD-UW	Station end	
PS127_12-1		2021-12-19T09:57:39	18.69158	-20.97717	3173.7	CTD-UW	Station start	

Event label	Optional label	Date/Time	Latitude	Longitude	Depth [m]	Gear	Action	Comment
PS127_12-1		2021-12-19T10:23:38	18.6548	-20.97697	3175.8	CTD-UW	Station end	
PS127_13-1		2021-12-19T15:58:00	17.60876	-20.96674	3244.9	CTD-UW	Station start	
PS127_13-1		2021-12-19T16:22:22	17.573	-20.96679	3265.2	CTD-UW	Station end	
PS127_14-1		2021-12-20T09:59:15	14.19129	-20.93404	4328.5	CTD-UW	Station start	
PS127_14-1		2021-12-20T10:45:50	14.12762	-20.93399	4341.9	CTD-UW	Station end	
PS127_15-1		2021-12-20T15:56:58	13.11994	-20.92388	4646.7	CTD-UW	Station start	
PS127_15-1		2021-12-20T16:19:15	13.08577	-20.92404	4653.7	CTD-UW	Station end	
PS127_16-1		2021-12-21T09:55:31	9.9526	-19.88985	4563.7	CTD-UW	Station start	
PS127_16-1		2021-12-21T10:25:34	9.91795	-19.86402	4532.5	CTD-UW	Station end	
PS127_17-1		2021-12-21T15:58:22	9.11483	-19.25551	4669.2	CTD-UW	Station start	
PS127_17-1		2021-12-21T16:48:44	9.07116	-19.22312	4669.7	CTD-UW	Station end	
PS127_18-1		2021-12-22T09:53:29	6.53508	-17.34261	4941.5	CTD-UW	Station start	
PS127_18-1		2021-12-22T10:20:06	6.50359	-17.31955	4943.5	CTD-UW	Station end	
PS127_19-1		2021-12-22T15:59:43	5.63149	-16.67854	4997.0	CTD-UW	Station start	
PS127_19-1		2021-12-22T16:21:19	5.60892	-16.66259	4998.8	CTD-UW	Station end	
PS127_20-1		2021-12-23T09:20:44	3.04646	-14.73065	4751.8	CTD-UW	Station start	
PS127_20-1		2021-12-23T09:58:05	3.00369	-14.69789	4760.5	CTD-UW	Station end	
PS127_21-1		2021-12-23T10:48:32	2.94952	-14.65707	4753.2	FLOAT	max depth	
PS127_22-1		2021-12-23T15:20:15	2.50569	-14.32139	4706.3	CTD-UW	Station end	
PS127_22-1		2021-12-23T15:20:15	2.529	-14.34025	4691.3	CTD-UW	Station start	
PS127_23-1		2021-12-24T08:46:50	0.13093	-12.51984	4375.6	CTD-UW	Station end	
PS127_23-1		2021-12-24T08:46:50	0.16877	-12.54835	4133.9	CTD-UW	Station start	
PS127_24-1		2021-12-24T15:01:36	-0.65697	-11.91623	4215.5	CTD-UW	Station end	
PS127_24-1		2021-12-24T15:01:36	-0.63592	-11.93213	4218.3	CTD-UW	Station start	
PS127_25-1		2021-12-25T08:49:40	-3.08484	-10.0575	4179.7	CTD-UW	Station end	
PS127_25-1		2021-12-25T08:49:40	-3.03396	-10.09597	4022.7	CTD-UW	Station start	
PS127_26-1		2021-12-25T15:02:13	-3.91305	-9.50071	3571.0	CTD-UW	Station end	

Event label	Optional label	Date/Time	Latitude	Longitude	Depth [m]	Gear	Action	Comment
PS127_26-1		2021-12-25T15:02:13	-3.88878	-9.51659	3525.4	CTD-UW	Station start	
PS127_27-1		2021-12-26T08:53:41	-6.61241	-7.53375	4430.7	CTD-UW	Station end	
PS127_27-1		2021-12-26T08:53:41	-6.58186	-7.56301	4250.8	CTD-UW	Station start	
PS127_28-1		2021-12-26T15:00:31	-7.40048	-6.74334	4445.8	CTD-UW	Station end	
PS127_28-1		2021-12-26T15:00:31	-7.37536	-6.76817	4610.6	CTD-UW	Station start	
PS127_29-1		2021-12-27T08:54:28	-9.7873	-4.48764	5138.5	CTD-UW	Station end	
PS127_29-1		2021-12-27T08:54:28	-9.75223	-4.51542	5051.0	CTD-UW	Station start	
PS127_30-1		2021-12-27T15:02:00	-10.61714	-3.81301	4176.9	CTD-UW	Station end	
PS127_30-1		2021-12-27T15:02:00	-10.59286	-3.83321	4104.7	CTD-UW	Station start	
PS127_31-1		2021-12-28T07:18:42	-12.95248	-1.90459	5004.3	FLOAT	max depth	
PS127_32-1		2021-12-28T07:19:18	-12.95295	-1.90422	4991.6	CTD-UW	Station start	
PS127_32-1		2021-12-28T07:59:40	-12.9966	-1.86908	4852.8	CTD-UW	Station end	
PS127_33-1		2021-12-28T15:00:38	-14.05677	-0.9957	5203.5	CTD-UW	Station start	
PS127_33-1		2021-12-28T15:27:12	-14.08982	-0.97627	5189.4	CTD-UW	Station end	
PS127_34-1		2021-12-29T07:55:02	-16.3949	0.93349	5437.5	CTD-UW	Station start	
PS127_34-1		2021-12-29T08:21:10	-16.4394	0.95784	5636.7	CTD-UW	Station end	
PS127_35-1		2021-12-29T14:05:51	-17.21329	1.62239	5406.1	CTD-UW	Station start	
PS127_35-1		2021-12-29T14:27:29	-17.2361	1.64191	5463.2	CTD-UW	Station end	
PS127_36-1		2021-12-29T19:34:32	-17.92522	2.1933	5519.5	FLOAT	max depth	testing starts
PS127_37-1		2021-12-30T07:54:32	-19.59498	3.52982	5488.2	CTD-UW	Station start	CTD lost, station cancelled
PS127_37-1		2021-12-30T08:12:30	-19.61368	3.54473	5488.2	CTD-UW	Station end	CTD lost, station cancelled
PS127_38-1		2021-12-30T18:04:06	-20.95868	4.63254	4224.3	FLOAT	max depth	testing starts
PS127_39-1		2021-12-31T15:22:35	-23.89198	6.99614	3006.5	FLOAT	max depth	testing the device, device not working, not deployed

** Comments are limited to 130 characters. See https://www.pangaea.de/expeditions/events/PS127 to show full comments in conjunction with the station (event) list for expedition PS127*

Abbreviation	Method/Device
ADCP	Acoustic Doppler Current Profiler
AFIM	AutoFim
CTD-RO	CTD/Rosette
CTD-UW	CTD, underway
FBOX	FerryBox
FLOAT	Floater
GRAV	Gravimetry
MAG	Magnetometer
MBES	Multibeam echosounder
MYON	DESY Myon Detector
NEUMON	Neutron monitor
SNDVELPR	Sound velocity probe
SWEAS	Ship Weather Station
TSG	Thermosalinograph
pCO2	pCO2 sensor

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