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The Expedition of the Research Vessel "Polarstern" to the Arctic in 2011 (ARK-XXVI/1)

Edited by
Agnieszka Beszczynska-Möller
with contributions of the participants

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ARK-XXVI/1

15 June - 13 July 2011

Bremerhaven - Longyearbyen

Chief scientist
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Contents

1.	**Überblick und Fahrtverlauf**	**2**
	Summary and itinerary	**6**
2.	**Weather conditions**	**9**
3.	**Oceanic fluxes through Fram Strait and in the entrance to the Arctic Ocean**	**10**
4.	**Plankton ecology and biogeochemistry in a changing Arctic Ocean (PEBCAO)**	**27**
5.	**Arctic pelagic Amphipoda (APA)**	**31**
6.	**Calibration study with recent foraminifera for paleoceanographic reconstructions**	**34**
7.	**Holocene oceanic variability in the Nordic Seas as reconstructed from planktic and benthic foraminiferal isotopes**	**36**
8.	**Higher trophic levels: seabirds and marine mammals at sea**	**38**
APPENDIX		**40**
A.1	**Teilnehmende Institute / participating institutions**	**41**
A.2	**Fahrtteilnehmer / cruise participants**	**42**
A.3	**Schiffsbesatzung / ship's crew**	**44**
A.4	**Stationsliste / station list PS 78**	**46**

1. ÜBERBLICK UND FAHRTVERLAUF

Agnieszka Beszczynska-Möller
Alfred-Wegener-Institut

Der erste Fahrabschnitt der *Polarstern*-Expedition ARK-XXVI/1 in die Arktis begann am 16. Juni 2011. Das Schiff lief von Bremerhaven aus, um Untersuchungen in der Framstraße durchzuführen (Abb. 1.1). Die Arbeiten erfolgten im Rahmen von mehreren Projekten auf einem Schnitt entlang von 78°50'N über die gesamte Framstraße zwischen dem Kontinentalabhang westlich von Spitzbergen und dem ostgrönländischen Schelf. Die Reise endete am 13. Juli 2011 in Longyearbyen.

Die in das EU-Projekt ACOBAR (Acoustic Technology for Observing the Interior of the Arctic Ocean) eingebetteten ozeanographischen Arbeiten hatten zum Ziel, Änderungen des Wassermassen- und Wärmeaustausch zwischen dem Nordpolarmeer und dem nördlichen Atlantik und die Zirkulation in der Framstraße zu quantifizieren. Dafür wurden entlang des Schnitts Temperatur, Salzgehalt und Sauerstoff an 102 Stationen sowie Meeresströmungen quasi-kontinuierlich in den oberen Schichten des Meeres gemessen. Ein Teil der ozeanographischen Verankerungen, die 2010 auf dem Schnitt ausgelegt worden waren, um Temperatur, Salzgehalt, Strömungsgeschwindigkeit und Strömungsrichtung kontinuierlich zu registrieren, wurde aufgenommen und mit neuen Geräten wieder ausgelegt. Damit wurde die mittlerweile 14 Jahre dauernde Langzeitmessung fortgesetzt. Um die Verankerungsmessungen mit hochauflösenden hydrographischen Schnitten zu ergänzen, wurde ein Seaglider für drei Monate in der Framstraße ausgelegt. Zur Navigation des Seagliders unter dem Eis wurden außerdem 4 akustische RAFOS-Schallquellen in der westlichen Framstraße verankert.

Für biologische Untersuchungen wurden an den CTD-Stationen zusätzlich Netzfänge ausgeführt und Sedimentproben genommen. Klimabedingte Veränderungen der Plankton-Zusammensetzung in der Framstraße wurden durch die AWI-Arbeitsgruppe PEBCAO (Phytoplankton Ecology and Biogeochemistry in the Changing Ocean) untersucht. Die Arbeiten der pelagischen Mikrobiogeochemie hatten den Schwerpunkt auf der Untersuchung des Umsatzes organischer Substanz und von Zersetzungsprozessen, um ein besseres Verständnis der biogeochemischen und mikrobiologischen Rückkoppelungsprozesse im Ozean der Zukunft zu erlangen.

Während des gesamten Fahrtabschnitts erfolgten Beobachtungen von Seevögeln und mariner Säugetiere. Ziel der Langzeituntersuchung ist, die *in-situ*-Verteilung dieser Tiere im Zusammenhang mit der Verteilung den ozeanischen Wassermassen, Frontalzonen sowie mit dem Packeis und der Eiskante zu quantifizieren.

Fahrtverlauf

15. Juni	Geplantes Auslaufen 1300 LT. Verzögerung auf Grund technischer Probleme mit dem A-Rahmen und einem der Schiffsmotoren.
16. Juni	Abfahrt von Bremerhaven 1600 LT.
16.-22. Juni	Transit zur ersten Station bei 75°N, Ankunft verzögert durch stürmisches Wetter auf dem Weg.
23. Juni	CTD/Multinet-Station bei 75°N.
24.-25. Juni	Transit entlang der westlichen Schelfkante von Spitzbergen (die Route wurde zur Vogelbeobachtung gewählt) zum Hauptschnitt bei 78°50'N.
25. Juni	CTD-Stationen in der Nacht. Aufnahme der Verankerungen F2, F3, F4 und F5. Aufnahmeversuch der Verankerung F1.
26. Juni	Superstation (CTD, Multinetze, Multicorer) bei 6°E. CTD-Stationen. Superstation bei 7°E.
27. Juni	Aufnahme der Verankerungen F6, F7 and F8. Technische Probleme mit den aufgenommenen ADCPs erkannt. Entschluss, die Auslegung von F1 bis F8 auf die zweite Hälfte der Reise zu verschieben.
28. Juni	CTD-Stationen nach Westen. Superstation bei 4°E. CTD-Stationen. Superstation bei 2°E. CTD-Stationen.
29. Juni	CTD-Stationen. Superstation bei 0°06'E. Transit zur Position der ersten Schallquellen-Auslegung.
30. Juni	Auslegung der RAFOS-Schallquelle FSQ2-3. Transit zur Position der nächsten Schallquelle. Auslegung der RAFOS-Schallquelle FSQ4-1.
1. Juli	CTD-Stationen. Transit zur Position der RAFOS-Schallquelle FSQ3-2 und versuchte Aufnahme. Aufnahme wird wegen starker Eisbedeckung abgebrochen. Auslegung der neuen RAFOS-Schallquelle FSQ3-3 in der Nähe der alten.
2. Juli	CTD-Stationen. Transit zur Position der der Auslegung der RAFOS-Schallquelle FSQ1-3 und Auslegung. Transit nach 11°W.
3. Juli	CTD-Station im Eis zwischen 11° und 7°W.
4. Juli	CTD-Stationen von 7°W nach Osten. Superstation bei 5°20'W. CTD-Stationen. Superstation bei 3°55'W.
5. Juli	CTD-Stationen und Transit zur Auslegungsposition F8.

6. Juli	Auslegung der Verankerungen F8 und F7. In der Nacht CTD-Stationen.
7. Juli	Auslegung der Verankerungen F6, F23 und F22. CTD-Stationen. Glider-Test an Deck.
8. Juli	Auslegung der Verankerungen F5, F21 und F4. In der Nacht CTD-Stationen. Transit zur Auslegungsposition des Gliders
9. Juli	Auslegung des Gliders SG127. CTD-Stationen.
10. Juli	Auslegung der Verankerungen F2 und F3. Superstation bei 8°E. CTD-Stationen. In der Nacht Transit zur Position des driftenden Tops der Verankerung F1.
11. Juli	Aufnahme des driftenden Tops. Transit zurück zur Position F1. Zweiter Versuch der F1-Aufnahme mit Dredgen. In der Nacht CTD-Stationen.
12. Juli	Aufnahme und Auslegung F4. Transit nach Longyearbyen.
13. Juli	Ankunft in Longyearbyen 0800 LT.

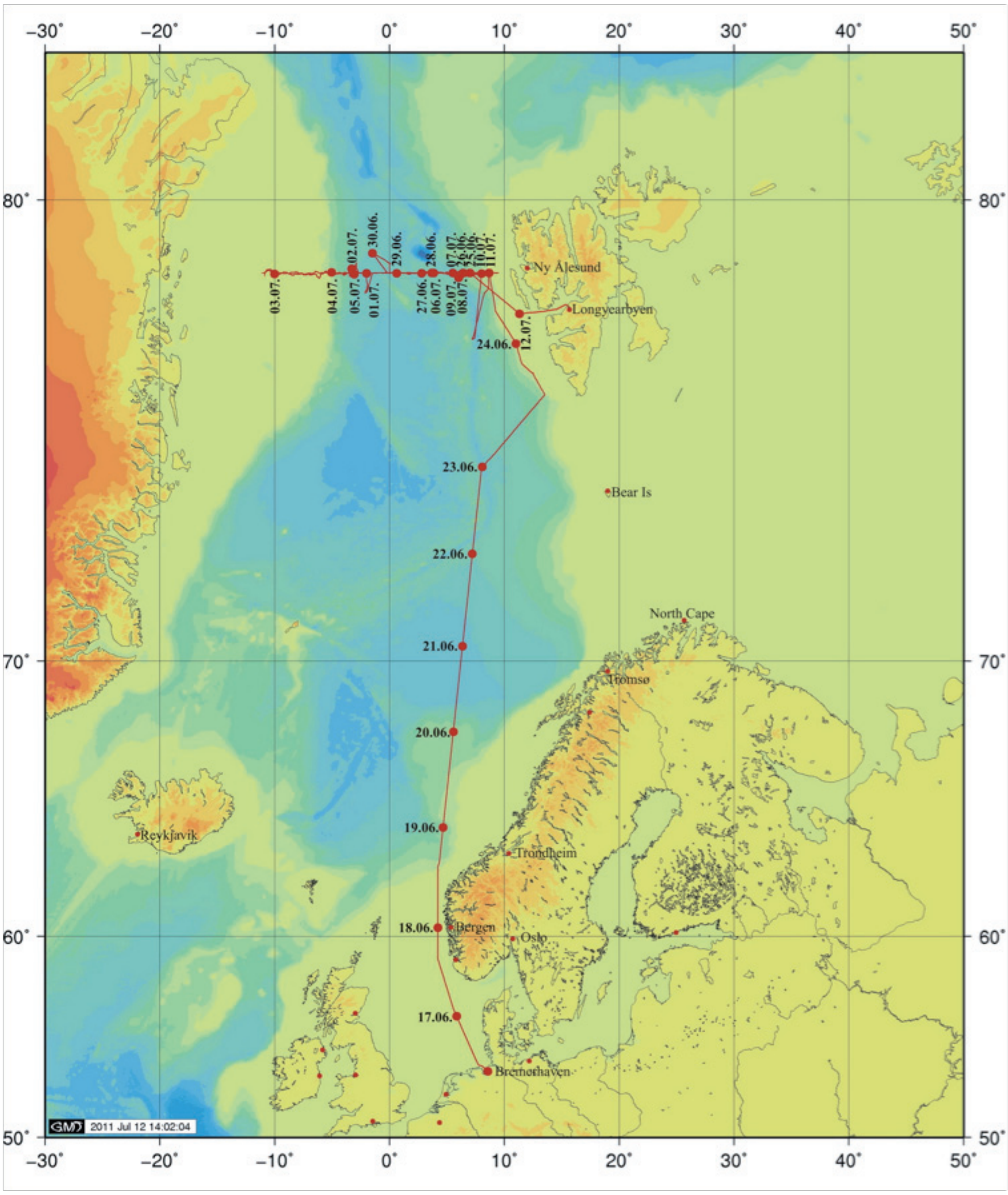

Abb.:1.1. Die Fahrtroute der Polarstern während ARK-XXVI/1

Fig. 1.1: Cruise track of RV Polarstern during the expedition ARK-XXVI/1

SUMMARY AND ITINERARY

Agnieszka Beszczynska-Möller
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The first leg of the *Polarstern* expedition ARK-XXVI/1 to the Arctic started on 16 June 2011. The ship departed from Bremerhaven to conduct research in the northern part of Fram Strait. The field work served different projects and concentrated along the zonal section across the entire Fram Strait from the continental slope west of Spitsbergen to the east Greenland shelf. The cruise ended on 13 July 2011 in Longyearbyen (Svalbard).

The oceanographic measurements in the frame of the EU project ACOBAR (Acoustic Technology for Observing the Interior of the Arctic Ocean) were aimed on the estimation of oceanic volume and heat fluxes though Fram Strait between the northern North Atlantic and the Arctic Ocean with a special emphasis on inter-annual and decadal variability. Hydrographic measurements (temperature, salinity and oxygen) were conducted on 102 stations at the section along 78°50'N and ocean currents in the upper layer were measured both on stations and underway. The moored array, deployed in 2010 for continuous, year-round measurements of temperature, salinity and currents was partially recovered and redeployed with new instrumentation. Measurements at the moored array provided an extension of the existing 14-year long time series of unbroken observations in Fram Strait. To complement the continuous in time but spatially relatively sparse observations by moorings, high resolution hydrographic sections were measured by a Seaglider, deployed during ARK-XXVI/1 for a 3-month long mission in Fram Strait. Four RAFOS sound sources were also deployed in the western, ice-covered part of Fram Strait for under-ice acoustic navigation of the glider.

Hydrographic measurements at selected stations were combined with net sampling, trawls and sediment coring for the biogeochemical studies. Climate-induced changes of plankton communities in Fram Strait were studied by the AWI research group PEBCAO (Phytoplankton Ecology and Biogeochemistry in the Changing Ocean). The pelagic microbiogeochemistry in the Arctic Ocean was examined with a special focus on the turnover of organic matter during production and decomposition processes to achieve better understanding of the biogeochemical and microbiological feedback processes in the future ocean. The calibration study for the palaeo-oceangraphic reconstructions will be conducted to study the correlation between recent variability of the ocean thermohaline structure and the composition of shells of planktonic and benthic foraminifera (calcareous microorganisms).

During the entire cruise leg the continuous observations and counting of seabirds and marine mammals was performed. This long-term study is aimed to quantify *at-sea* distribution these animals in respect to spatial variability of oceanic water masses, frontal zones as well as the concentration of pack ice and the location of sea ice edge.

Itinerary

15 June	Planned departure 1300 LT, delayed due to the technical problems with the A-frame and one of ship's engine.
16 June	Departure from Bremerhaven 1600 LT.
16-22 June	Transit to the first station at 75°N, arrival delayed due to the stormy weather conditions on the way.
23 June	CTD/multinet station at 75°N.
24-25 June	Transit along the shelf edge west of Svalbard (a track dedicated to sea birds observations) to the main section at 78°50'N.
25 June	CTD stations at night. Recovery of moorings F2, F3, F4 and F5. Recovery attempt of mooring F1.
26 June	Superstation (CTD, multinets, multicorer) at 6°E. CTD stations. Superstation at 7°E.
27 June	Recovery of moorings F6, F7 and F8. Technical problem with recovered ADCPs recognized. Decision about shifting the F1 to F8 deployments to the second half of the cruise.
28 June	CTD stations towards west. Superstation at 4°E. CTD stations. Superstation at 2°E. CTD stations.
29 June	CTD stations. Superstation at 0°06'E. Transit to the position of the first sound source deployment.
30 June	Deployment of the RAFOS sound source FSQ2-3. Transit to the next source position. Deployment of the RAFOS source FSQ4-1.
1 July	CTD stations. Transit to the position of the RAFOS source FSQ3-2 recovery. Due to the compact ice cover recovery cancelled. Deployment of the new RAFOS source FSQ3-3 next to the old one.
2 July	CTD stations. Transit to the position of the RAFOS source deployment. Sound source FSQ1-3 deployment. Transit to 11°W.
3 July	CTD station in the ice between 11° and 7°W.
4 July	CTD stations from 7°W eastward. Superstation at 5°20'W. CTD stations. Superstation at 3°55'W.
5 July	CTD stations and transit to the deployment position of F8.
6 July	Deployments of moorings F8 and F7. CTD stations at night.
7 July	Deployments of moorings F6, F23 and F22. CTD stations. Glider test on the deck.
8 July	Deployments of moorings F5, F21 and F4. CTD stations at night. Transit to the deployment position of glider
9 July	Deployment of the glider SG127. CTD stations.

10 July	Deployments of moorings F2 and F3. Superstation at 8°E. CTD stations. At night transit to the position of drifting top of F1 mooring.
11 July	Recovery of the drifting top. Transit back to the F1 position. Second attempt of F1 recovery including dredging. CTD stations at night.
12 July	Recovery and redeployment of F4. Transit to Longyearbyen.
13 July	Arrival to Longyearbyen 0800 LT.

2. WEATHER CONDITIONS

Max Miller, Klaus Buldt
Deutscher Wetterdienst

On Thursday, June 16th 2011 (4:00 pm), RV Polarstern left Bremerhaven for the first Arctic campaign in 2011. Prior to departure the cold front of a storm northwest of Scotland passed Bremerhaven which caused increasing wind up to Bft 7. When we finally set sail the southwest decreased to Bft 4.

Within the North Sea RV Polarstern passed a weak high pressure ridge which caused temporarily light and variable winds. Meanwhile the above mentioned storm had moved to the western Baltic. From there it turned north via Sweden to northern Norway. Between 65°N and 75°N RV Polarstern sailed along the western edge of this low with strong north easterly winds. From June 19th until June 23rd we measured wind from northeast Bft 6 to 7 and at times 8 which caused a swell 4 to 5 meters from ahead.

From June 24th onward weather abated caused by weak high pressure influence. Most of the time wind force 3 to 4 Bft was prevailing, temporary only light and variable wind was registered. Approaching the operation area off the west coast of Svalbard sky cleared up due to a lee effect. Heading further west weak wind and upcoming fog describe the weather situation during the following days best. Approaching the ice edge and even within the ice off Greenland along 78°50’N the fog remained. Only while heading back east on July 3rd a low over Kara Sea caused increasing wind around Bft 5 from northerly directions. This caused an ice drift from the north towards our track.

3. OCEANIC FLUXES THROUGH FRAM STRAIT AND IN THE ENTRANCE TO THE ARCTIC OCEAN

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Alfred-Wegener-Institut

Objectives

Exchanges between the North Atlantic and the Arctic Ocean result in the most dramatic water mass conversions in the World Ocean: warm and saline Atlantic waters, flowing through the Nordic Seas into the Arctic Ocean, are modified by cooling, freezing and melting to become shallow fresh waters, ice and saline deep waters. The outflow from the Nordic Seas to the south provides the initial driving of the global thermohaline circulation cell. Knowledge of these fluxes and understanding of the modification processes is a major prerequisite for the quantification of the rate of overturning within the large circulation cells of the Arctic and the Atlantic Oceans, and is also a basic requirement for understanding the role of these ocean areas in climate variability on inter-annual to decadal time scales.

The Fram Strait represents the only deep connection between the Arctic Ocean and the Nordic Seas. Just as the freshwater transport from the Arctic Ocean is of major influence on convection in the Nordic Seas and further south, the transport of warm and saline Atlantic water affects the water mass characteristics in the Arctic Ocean which has consequences for the internal circulation and possibly influences also ice and atmosphere.

The complicated topographic structure of the Fram Strait leads to a splitting of the West Spitsbergen Current carrying Atlantic Water northward into at least three branches. One current branch follows the shelf edge and enters the Arctic Ocean north of Svalbard. This part has to cross the Yermak Plateau which poses a sill for the flow with a depth of approximately 700 m. A second branch flows northward along the north-western slope of the Yermak Plateau and the third one recirculates immediately in Fram Strait at about 79°N. Evidently, the size and strength of the different branches largely determine the input of oceanic heat to the inner Arctic Ocean. The East Greenland Current, carrying water from the Arctic Ocean southwards has a concentrated core above the continental slope.

It is our aim to measure the oceanic fluxes through Fram Strait and to determine their variability on seasonal to decadal time scales. Since 1997, year-round velocity, temperature and salinity measurements are carried out in Fram Strait with moored instruments. Hydrographic sections exist since 1980. The estimates of mass and heat fluxes through the strait are provided through a combination of both data sets. From 1997 to 2000 intensive fieldwork occurred in the framework of the EU project VEINS (Variability of Exchanges in Northern Seas). After the end of VEINS it was maintained under national programmes. From 2003 to 2005, the work was carried out as part of the international Programme ASOF (Arctic-Subarctic Ocean Flux Study) and was partly funded in the EU ASOF-N project. In 2006-2009 measurements in Fram Strait were performed under the EU DAMOCLES (Developing Arctic Modelling and Observing Capabilities for Long-term Environment Studies) Integrated Project and since 2009 the observational programme has been continued in the context of the EU ACOBAR project. The mooring line is maintained in close co-operation with the Norwegian Polar Institute (NPI). The results of the measurements will be used in combination with regional models, to investigate the nature and origin of the transport fluctuations on seasonal to decadal time scales.

Work at sea

The oceanographic work at sea during ARK-XXVI/1 included two main activities: the recovery and redeployment of the array of moorings and measurements of CTD (Conductivity, Temperature, Depth) profiles (Fig. 3.1). The standard section in Fram Strait at 78°50’N, which has been occupied regularly since 1997, was measured with the high resolution coverage by 102 CTD stations, extending westward to 11°W.

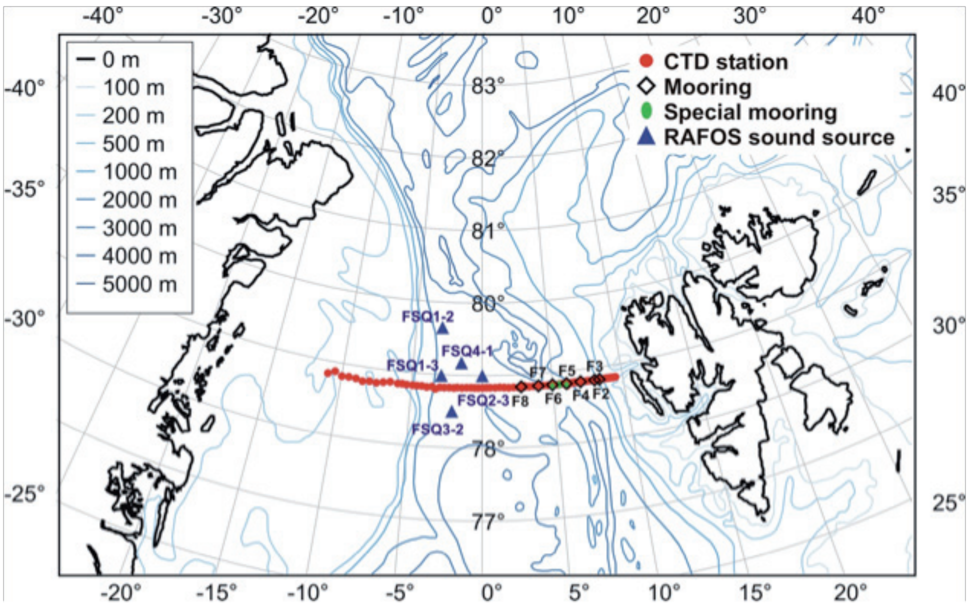


Fig. 3.1: Map with the position of CTD stations and moorings during ARK-XXVI/1

The mooring array covers the entire deep part of Fram Strait between the continental slope west of Spitsbergen to the shelf edge east of Greenland. In 2003 it was extended by NPI on the East Greenland shelf. In July 2011 *RV Polarstern* recovered 7 moorings between 8°20’E and 2°48’E which were deployed in June/July 2010 (Tab.3.1). The remaining four mooring between 2°48’E and 2°W were left for a second year in the water and will be exchanged during the *Polarstern* cruise in June/July 2012. The easternmost mooring F1, located over the upper Spitsbergen continental slope at 8°40’ at the depth of 270 m could not be recovered due to the earlier damage and loss of the buoyancy. Two weeks prior the cruise, the signal of the ARGOS transmitter from F1 was received at the land base, indicating that the upper part of the mooring was broken and drifted at the surface. The most likely reason was breaking the mooring cable by a bottom trawling fishery boat. Two attempts of recovering the F1 mooring were undertook during ARK-XXVI/1, including dredging. However, since the whole length of the mooring cable was gone (indicated by the horizontal position of the releaser, laying on the bottom), both attempts were unsuccessful.

Tab. 3.1: Moorings recovered during ARK-XXVI/1

Mooring	Latitude Longitude	Water depth (m)	Date and time of deployment	Instrument type	Serial number	Instr. depth (m)
F1-13	78°50.00'N 008°40.09'E	232 (DWS) 239 (corr. CTD)	03.07.10 11:00 UTC	Mooring lost		
F2-14	78°50.01'N 08°20.01'E	789 (DWS) 778 (corr. CTD)	03.07.10 08:00 UTC	SBE 16P ADCP WH SBE 37 RCM8 VTP SBE 16 RCM8	1253 1368 7732 10002 319 7727	76 97 98 252 768 769
F3-13	78°50.00'N	1037 (HSW) 1014 (corr. CTD)	03.07.10 06:00 UTC	SBE 16 ADCP QM SBE 37P Holgiphone RCM7 VTP RCM8 VT SBE 16	1973 14088 7730 H18 8403 10004 631	74 248 248 499 756 1002 1003
F4-13	78°50.08'N 07°00.35'E	1436 (HSW) 1435 (corr. CTD)	04.07.10 09:00 UTC	SBE 16 ADCP QM SBE37P RCM11 VTCP RCM8 VTP SBE 16	1975 14087 7728 452 9213 2420	86 247 248 753 1419 1420
F5-13	78°49.97'N 06°00.03'E	2437 (HSW) 2440 (corr. CTD)	04.07.10 13:00 UTC	SBE 37P ADCP QM SBE37P RCM8 VTP RCM8 VT RCM8 VTP	1976 14016 7733 10498 9179 9786	83 254 255 750 1501 2407
F6-14	78°50.01'N 05°00.00'E	2706 (DWS) 2651 (corr. CTD)	02.07.10 17:00 UTC	SBE 37P ADCP QM SBE16 Holgiphone RCM8 VTP RCM8 VT RCM11 VT	243 14090 1977 H11 11613 9182 475	87 246 247 497 749 1500 2644

Mooring	Latitude Longitude	Water depth (m)	Date and time of deployment	Instrument type	Serial number	Instr. depth (m)
F7-10	78°50.00'N 04°00.01'E	2304 (HSW) 2297 (corr. CTD)	11.07.10 06:00 UTC	SBE 16P ADCP QM SBE 37 RCM8 VTP RCM7 VTP RCM8 VT	1167 14086 244 9998 10491 10497	78 243 244 750 1496 2272
F8-11	78°49.99'N	2459 (HSW) 2457 (corr. CTD)	11.07.10 11:00 UTC	RCM8 VT SBE 37P ADCP WH RCM8 VT RCM11 VTP RCM8 VT	8084 7725 951 9184 491 9185	72 92 246 753 1499 2425

Each tall subsurface mooring carried 3 to 7 instruments including rotor and acoustic current meters from Aanderaa Instruments (RCM7, RCM8 and RCM11), acoustic current profilers from RD Instruments (WH and QM ADCP), temperature and salinity sensors from Sea-Bird Electronics Inc. (SBE37 and SBE16) and bottom pressure recorders from Sea-Bird (SBE26). The whale recorder (AURAL M2) and two calibrated hydrophones for passive acoustic recording (H11 and H18) were also included in the moorings located in the eastern part of Fram Strait. The recovery of western moorings (west of 3°W), operated by NPI was done in September 2011 by RV *Lance*.

The recovered moorings F2 to F8 were redeployed in a similar configuration except the mooring F1 which was not deployed again in 2011 (Fig. 3.2, Tab. 3.2). Since F1 was lost during last two deployments due to the increased fishing activities over the upper Spitsbergen continental slope, the planned deployment was cancelled to avoid the risk and for future deployments, the F1 mooring has to be redesigned towards a bottom trawling proof construction. Due to the failure of the QM ADCPs first deployed in 2010 and recovered in 2011 (see following section), the new QM ADCP deployed in 2011 at all moorings were back-up with the additional point current meters located below ADCPs.

To test the near-real time (NRT) data transfer between moorings, three low-frequency long-range acoustic modems, the HAM.nodes manufactured by develogic GmbH, were interfaced to the current meters at selected moorings and deployed in 2009 for one-year long field test in the eastern Fram Strait (Fig. 3.2). Since acoustic data transmission over a typical range between moorings of O(30 km) proved to be unreliable, the distance between long-range modems was reduced by adding a relay-link mooring with additional modem in a half-way between instrumented moorings. These four long-range acoustic modems were recovered in 2010. The results of the 2009-2010 test revealed significant problems related to the high level of ambient noise and low signal-to-noise ratio, resulting in a large number of failed transmissions. Building on this experience, for the deployment of moorings with acoustic modems in 2011 during the ARK-XXVI/1, a tuning inductivity to increase the output amplitude (therefore the range of the modems) was implemented and transmission settings were adjusted (more often transmissions, smaller data packages). Similar as in 2009, four long-range acoustic modems were deployed in 2011: three at the oceanographic moorings and one as a relay link between them. An additional short-range modem was also deployed about 1 km from the westernmost long-range modem for the short-term test. The short-range modem mooring was recovered by KV *Svalbard* in September 2011.

In addition to the long-term array, one new mooring for testing the NRT data transfer to the land station was deployed in 2011 for the short-term test. This communication mooring carried the underwater winch from the NGK Japan equipped with a profiling CTD top, capable of the Iridium data transfer (the adapted NEMO float from Optimare GmbH). The field tests of the winch-profiler system revealed that under the strong currents in the eastern Fram Strait, the drag on the profiler body for the most of time prevents its surfacing and drifting sea ice poses a risk for the profiler when at surface. The communication mooring was also recovered by KV *Svalbard* in September 2011.

For the testing purposes of the under ice acoustic navigation of gliders in Fram Strait, the array of the 260 Hz RAFOS sound sources was deployed in the central and western Fram Strait. Two RAFOS sources deployed earlier in 2009 (Webb sources) were still working in summer 2010 thus their recovery was cancelled (also due to the limited ship time for operations in the ice covered area). In addition four new RAFOS sources were deployed in locations, providing the optimal coverage of the glider operation area in central Fram Strait (Fig. 3.2d). Of the four new sources, one was the prototype developed by develogic GmbH and three were the Rossby RAFOS sources with develogic electronics.

The mooring recovery rate was 97% (7 of 8 moorings). However, of 34 recovered instruments 13 devices did not record any data and 4 of them provided incomplete records (one or more measured parameters were wrong, others werecorrect). Thus, the complete data return rate form the eastern part of the array was 47% for the deployment period 2010-2011. The most serious problem was encountered with eight new QM ADCPs, deployed for the first time in 2010. Due to the battery connectors' failure, none of them recorded any data, despite of the fully correct initial programming and fulfilled pre-deployment tests. After recovery, these instruments were returned to the manufacturer for the repair. Two Aandera RCM8 current meters lost the rotors and in one case, the instrument was blocked in a fixed position. Additionally, one RCM8 current meter was flooded. Two CTD sensors SBE16 and one SBE37 delivered no data. The distribution of instruments and recovered data quality is shown on Fig. 3.2a.

During ARK-XXVI/1 the 4th operational mission of a Seaglider in Fram Strait was launched. The underwater glider is a buoyancy-driven device, which can alternately reduce and expand displaced volume to dive and climb through the ocean, just as do profiling floats. Unlike floats, a glider additionally carries wings and controls its pitch attitude to effectuate a horizontal speed component through the ocean. The Seaglider SN127 deployed in Fram Strait for a 2.5-month mission in the West Spitsbergen Current, was developed by APL group at the University of Washington in Seattle and manufactured by the Seaglider Fabrication Center in Seattle. The vehicle is capable to profile between surface and 1000 m with the horizontal speed 0.1-0.45 m/s and minimum vertical speed of 0.06 m/s. The Seaglider SN127 is equipped with SBE Temperature/Conductivity Sensors, SBE43 dissolved oxygen sensor, Wetlabs BB2SF chlorophyll a, fluorescence and optical backscatter sensors. In addition, RAFOS hardware was installed to test the possibility of the underwater acoustic navigation of the glider in sea ice covered areas. During its mission the Seaglider was operated from the Glider Operation Center in Bremerhaven. The Seaglider was launched on July 9, after series of tests performed onboard and recovered from KV *Svalbard* on September 25.

The CTD measurements in the eastern Fram Strait occurred mostly during the nights between mooring work. Therefore the sequence of stations is rather irregular. Altogether 102 CTD casts were taken at 102 stations and water samples were collected during all casts (Fig. 3.1). One CTD system from Sea-Bird Electronics Inc SBE911+ was used. Mainly CTD probe SN 937 with duplicate T and C sensors (temperature sensors SBE3, SN 5207 (primary) and 5104 (secondary), conductivity sensors SBE4, SN 3290 (primary) and 2470 (secondary) and pressure sensor Digiquartz 410K-105 SN 51197) was in service. The CTD was connected to a SBE32 Carousel Water Sampler, SN 55 (24 12-liter bottles). Additionally Benthos Altimeter Model PSA-916 SN 1229 and Fluorometer Wetlabs FLRTD SN 1365 were mounted on the carousels. Two dissolved oxygen sensors were in use: Rinko-III ARO-CAV (SN 109) and SBE43 (SN 467). The algorithm to compute oxygen concentration requires also measurements of temperature, salinity and pressure. Salinity of 29 water samples was measured using the Optimare Precision Salinometer SN 003 with Standard Water IAPSO Batch P149 for calibration of the salinity sensor.

Underway measurements with a vessel-mounted narrow band 150 kHz ADCP from RD Instruments and a Sea-Bird SBE45 thermosalinograph measurements were conducted along the transect to supply temperature, salinity and current data at a much higher spatial resolution than given through the moorings. Two thermosalinographs were in use, one in 6 m depth in the bow thruster tunnel and one in 11 m depth in the keel. Both instruments are controlled by taking water samples, which are measured on board.

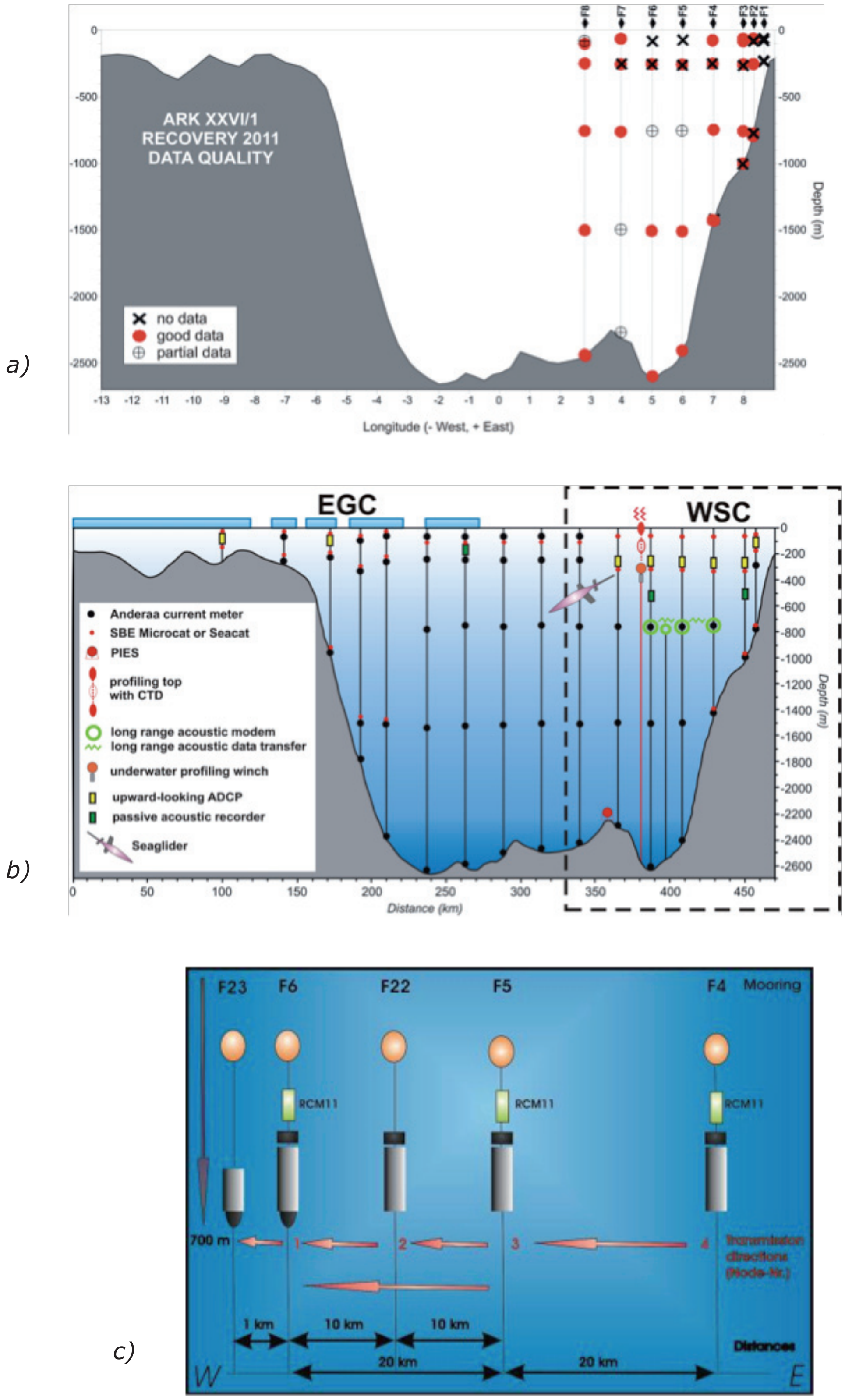


Fig. 3.2: The moored array in Fram Strait: (a) the data quality from recovered instruments, (b) the part of array redeployed in 2011 (marked with a dashed box), (c) a configuration of acoustic modems and

d)

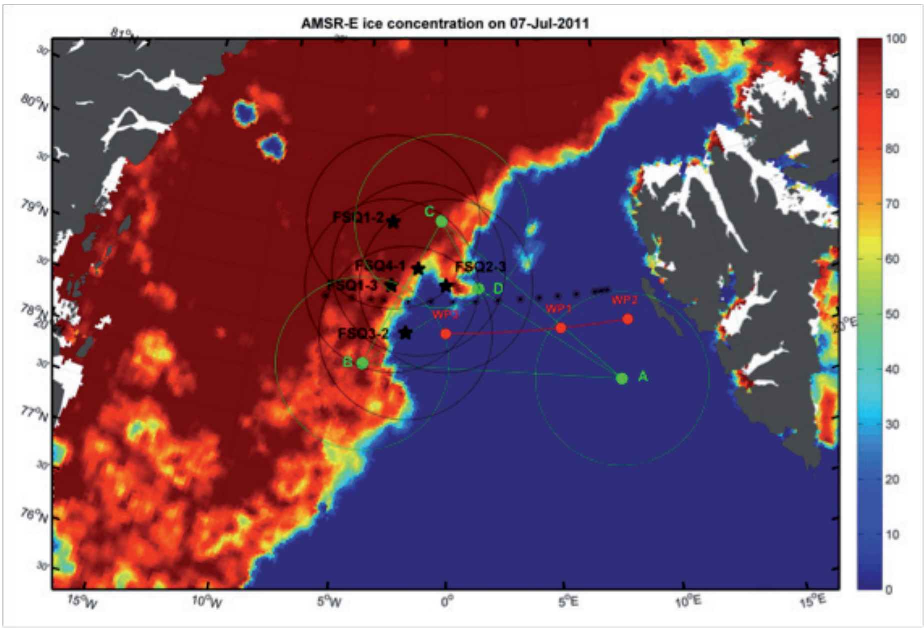


Fig. 3.2 (continued):

(d) positions and nominal ranges of the RAFOS sound sources (black stars) deployed during ARK-XXVI/1.The green dots indicate positions of tomographic sources deployed by NERSC in 2010.

Tab. 3.2: Moorings deployed during ARK-XXVI/1

Mooring	**Latitude Longitude**	**Water depth (m)**	**Date and time of first useful record**	**Instrument type**	**Serial number**	**Instr. depth (m)**
F1-14	Not					
	deployed					
F2-15	78°50.07'N	779	10.07.11	SBE 16	1973	76
(top@58m)	08°20.21'E	(DWS)	07:00 UTC	ADCP QM	14951	528
	78.8345	780		RCM8	10004	529
	8.3368	(corr. CTD)		SBE 16	2420	230
				SBE 37	3813	771
				RCM8	10532	772
F3-14	78°49.99'N	1029	10.07.11	SBE 16	1975	93
(top@60m)	08°00.00'E	(DWS)	09:00 UTC	ADCP QM	14968	264
	78.8332			RCM8	10002	265
	8.0000			SBE 16	1977	266
				Holgiphone	H41	517
				RCM8 VTP	9194	774
				RCM8 VT	10531	1020
				SBE 37	246	1021

Mooring	Latitude Longitude	Water depth (m)	Date and time of first useful record	Instrument type	Serial number	Instr. depth (m)
F4-14	78°50.01'N	1460	08.07.11 14:00 UTC	SBE 16	2413	113
(top@74m)	06°59.93'E	(DWS)		ADCP QM	14969	274
	78.8335			RCM11	452	275
	6.9988		redeployed 12.07.11 14:00 UTC	RCM11 VTP	472	732
				Develogic Modem	516	733
				RCM8 VTP	9783	1451
F5-14	78°50.01'N	2482	08.07.11 08:00 UTC	SBE 16	2419	77
(top@65m)	05°59.98'E	(HSW)		ADCP QM	14970	248
	78.8335	2414		RCM 11 VTP	461	249
	5.9997	(corr. CTD)		SBE 37	7728	250
				RCM11 VTP	458	696
				Develogic Modem	515	697
				RCM8 VTP	9995	1499
				RCM8 VT	9770	2406
F6-15	78°49.96'N	2707	07.07.11 08:00 UTC	SBE16	1976	65
(top@60m)	05°00.09'E	(DWS)		ADCP QM	14971	226
	78.8327	2644		RCM11 VTP	491	227
	5.0015	(corr. CTD)		SBE 37	7733	228
				Holgiphone	H38	478
				RCM 11 VTP	127	686
				Develogic Modem	514	687
				RCM 8 VT	9768	1489
				RCM 11 VT	315	2636
F7-11	78°49.98'N	2335	06.07.11 12:00 UTC	SBE 16	319	92
(top@70m)	04°00.08'E	(DWS)		ADCP QM	15081	253
	78.8330	2292		RCM 8 VTP	11613	254
	4.0876	(corr. CTD)		SBE 37 P	7730	255
				RCM 8 VTP	9204	761
				RCM 8 VTP	9997	1508
				RCM 8 VT	9785	2284
F8-12	78°50.04'N	2495	06.07.11 06:00 UTC	SBE 16	1167	83
(top@65m)	02°46.63'E	(HSW)		ADCP QM	15082	255
		2446		RCM 8	9213	256
		(corr. CTD)		SBE SM 37 P	7732	256
				RCM 8	11892	763
				RCM 8	10004	1510
				RCM 11 VT	475	2438
F20-3	78°47.97'N	2442	08.07.11 12:00 UTC	CTD Profiler		0-98
(top@66m)	06°00.17'E	(corr. CTD		Profiling winch		98
		max. Pres)				

Mooring	Latitude Longitude	Water depth (m)	Date and time of first useful record	Instrument type	Serial number	Instr. depth (m)
F22-2	78°50.00’N	2619	07.07.11 13:00 UTC	Develogic Modem	517	702
(top@93m)	05°30.09’E	(DWS)				
F23-1	78°49.00’N	2698	07.07.11	Develogic Modem	3915	701
(top@89m)	04°59.98’E	(DWS)	11:00 UTC			
FSQ1-3	78°59.09’N	2486	02.07.11	RAFOS source	16	722
(top@713m)	02°56.02’W	(DWS)	11:00 UTC	(Rossby SQ	0008	722
				Develogic Electronic)		
FSQ2-3	78°59.65’N	2590	30.06.11	RAFOS source	36	782
(top@722m)	00°01.01’E	(DWS)	08:00 UTC	(Rossby SQ	19	
				Develogic Electronic)		
FSQ3-2	78°29.98’N	2819	01.07.11	RAFOS source	001	805
(top@705m)	02°05.02’W	(DWS)	08:00 UTC	(Develogic SQ	001	805
				Develogic Electronic)		
FSQ4-1	79°10.00’N	2644	30.06.11	RAFOS source	17	830
(top@694m)	01°30.08’W	(DWS)	12:00 UTC	(Rossby SQ	004	830
				Develogic Electronic)		

Abbreviations:

ADCP WH	RDI Inc. Self-Contained Acoustic Doppler Current Profiler Work Horse 300 Hz
ADCP QM	RDI Inc. Self-Contained Acoustic Doppler Current Profiler Quarter Master 150 Hz
VTP	Aanderaa current meter with temperature and pressure sensor
VT	Aanderaa current meter with temperature sensor
RCM7	Aanderaa current meter type RCM7
RCM8	Aanderaa current meter type RCM8
RCM 11	Aanderaa Doppler current meter with temperature sensor
SBE 16	Seabird Electronics SBE16 recording temperature, conductivity, and pressure
SBE 37	Seabird Electronics SBE37 recording temperature and conductivity (optionally pressure 37P)
RAFOS	RAFOS (Sound Fixing and Ranging - read backwards) sound source

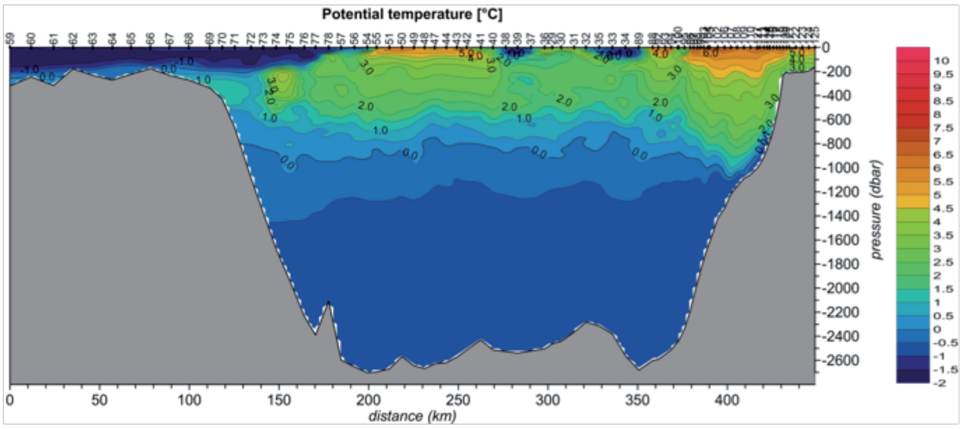
Preliminary results

The data from the moored instruments were read out from the memory cards and preliminary processed onboard but the final processing including the pressure correction in on-going. The analysis of the hydrographic data occurred on the basis of preliminary data available on board. The post-cruise calibration might result in minor changes.

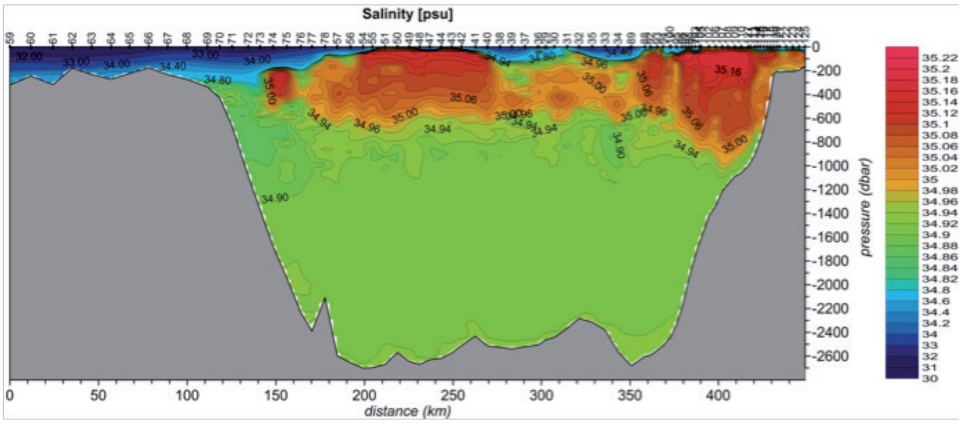
The temperature and salinity sections across Fram Strait are shown in Fig. 3.3. The main core of northward flowing warm and saline Atlantic Water (AW) is found at the eastern side of the transect in the shallow to intermediate layers. The West Spitsbergen Current (WSC) is visible at the eastern slope by downward sloping isolines. The AW layer in the West Spitsbergen Current above the slope was deeper as compared to the previous year, over the upper shelf slope the isotherm 0°C was shifted down to approx. 1000 m (observed at ca. 700 m in 2010). However, the amount of warm AW in the eastern recirculation area (between 1° and 5°E) decreased when compared with observed in 2010. Maximum temperatures of the AW in WSC were higher in 2011 than in 2010 but in the recirculation area they were lower than the year before. In summer 2010 the temperature of the Atlantic Water in the WSC core and in the offshore WSC branch were similar, as opposite to the usually warmer core. The off-shore branch of WSC is well pronounced and reached far to the central part of the strait (ca. 1°30'E). The recirculating Atlantic Water extended further to the west than in the previous years and patches of AW warmer than 3°C were observed as far as west of 3°W. The position of the Polar Front between the Arctic-derived Polar Water and Atlantic Water at the surface was slightly shifted eastward (from 3°W in 2010 to around 2°W in 2011). The Polar water surface layer observed in 2011 was thicker in 2011 than in the year before.

Salinity of the AW water in 2011 was higher than in 2010, in particular in the West Spitsbergen Current and in western recirculation part of the strait. The salinity in 2011 was characterised by a dipole structure in the AW derived layer. The high salinity patterns in the WSC and in the western Fram Strait were separated by the lower salinity in the eastern deep part. Compared to 2010 when a higher salinity was found in the continuous layer reaching so far westward as the East Greenland shelf slope, it may indicate that in 2011 the direct recirculation of AW in Fram Strait was weaker than before while the AW derivatives originating from the short loop in the Nansen Basin (which entered in 2006-2007) were returning through Fram Strait towards the northern North Atlantic. (See also the strongest temperature and salinity anomaly in reference to the long term mean located in the upper 500 m in the western Fram Strait). The warm patches of AW observed in the western Fram Strait around 4°W were also characterised by high salinity, resulting in a strong halocline between Polar- and Atlantic-origin waters over the shelf slope east of Greenland.

The anomalies of temperature and salinity from their long-term means (1997-2011) are shown on Fig. 3.4. In summer 2011 temperature in the WSC core was slightly lower than its long term mean, while in the offshore WSC branch between 6° and 8°E temperature and salinity were significantly higher than their long-term means, particularly in the lower AW layer between 500 and 1000 m. In eastern part of the recirculation area (between 1° and 6°E) the strong negative anomaly of the AW temperature was found in the upper 500 m, accompanied by a salinity, significantly lower than its long-term mean. On the other hand, in the western recirculation area (west of 1°E) the AW temperature was close to the long-term average with stronger positive anomaly only in the upper 100 m, where also a salinity much higher than the average was observed. Above the lower continental slope east of Greenland, the Arctic Atlantic Water subducting below the Polar Water was also slightly warmer than the long-term average, while over the upper continental slope weakly negative temperature anomalies were found in the whole water column. Temperature in the deep layer below 1000 m was close to average at the entire section.

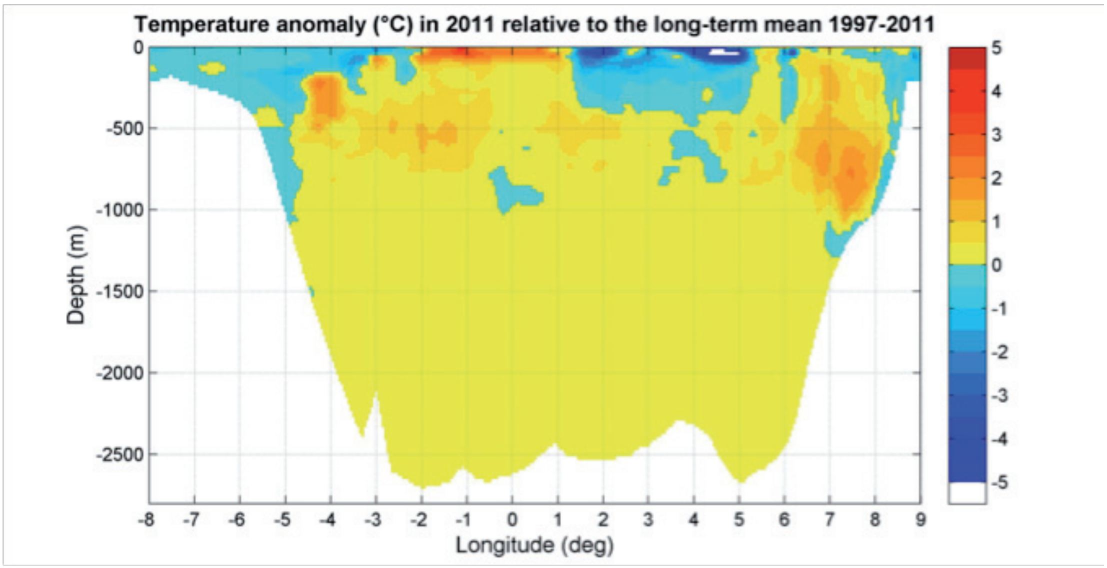


a)



b)

Fig. 3.3: Vertical distribution of potential temperature (a) and salinity (b) at the section across Fram Strait measured during ARK-XXVI/1



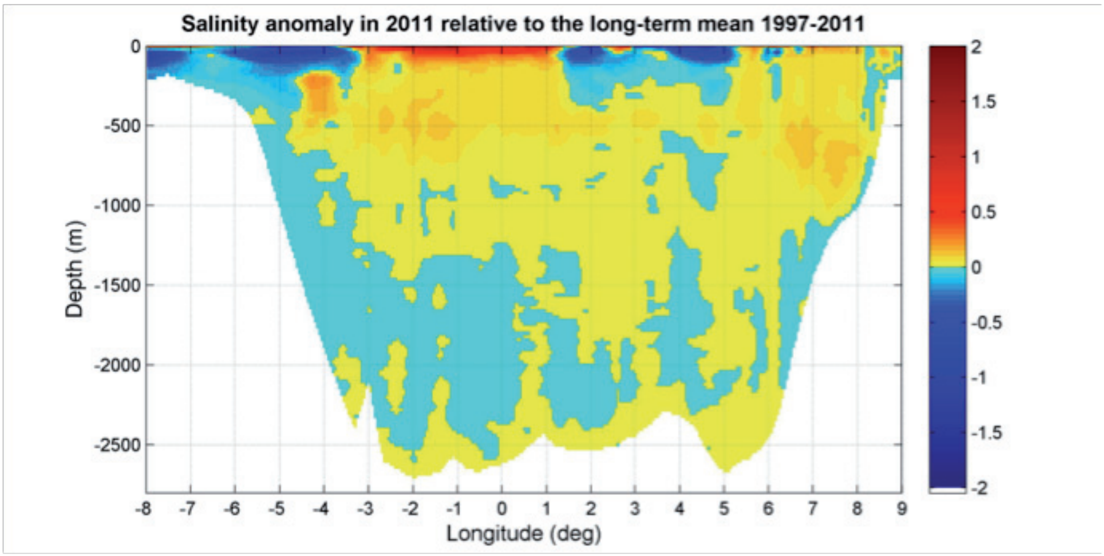


Fig. 3.4: Temperature and salinity anomalies measured in 2011 during ARK-XXVI/1 relative to their long-term means (1997-2011).

To identify the longer-term variability, time series of mean temperatures and salinities for typical water masses were derived for the depth interval from 50 to 500 m (Fig. 3.5). Three characteristic areas were distinguished in relation to the main flows: the West Spitsbergen Current (WSC) between the shelf edge and 5°E, the Return Atlantic Current (RAC) between 3°W and 5°E, and Polar Water in the East Greenland Current (EGC) between 3°W and the Greenland Shelf. The spatially averaged means of temperature and salinity were higher in 2011 than in 2010 only in the WSC while in the RAC and EGC they were lower than the year before. In the RAC the decrease of temperature and salinity in its eastern part overcame the increase in both properties in the western part, so on average the RAC was colder and less saline in 2011 than in 2010. Temperature in the EGC in 2011 slightly decreased in comparison to 2010 while spatially averaged salinity was significantly lower, mostly due to the thicker upper layer of the Polar-origin water.

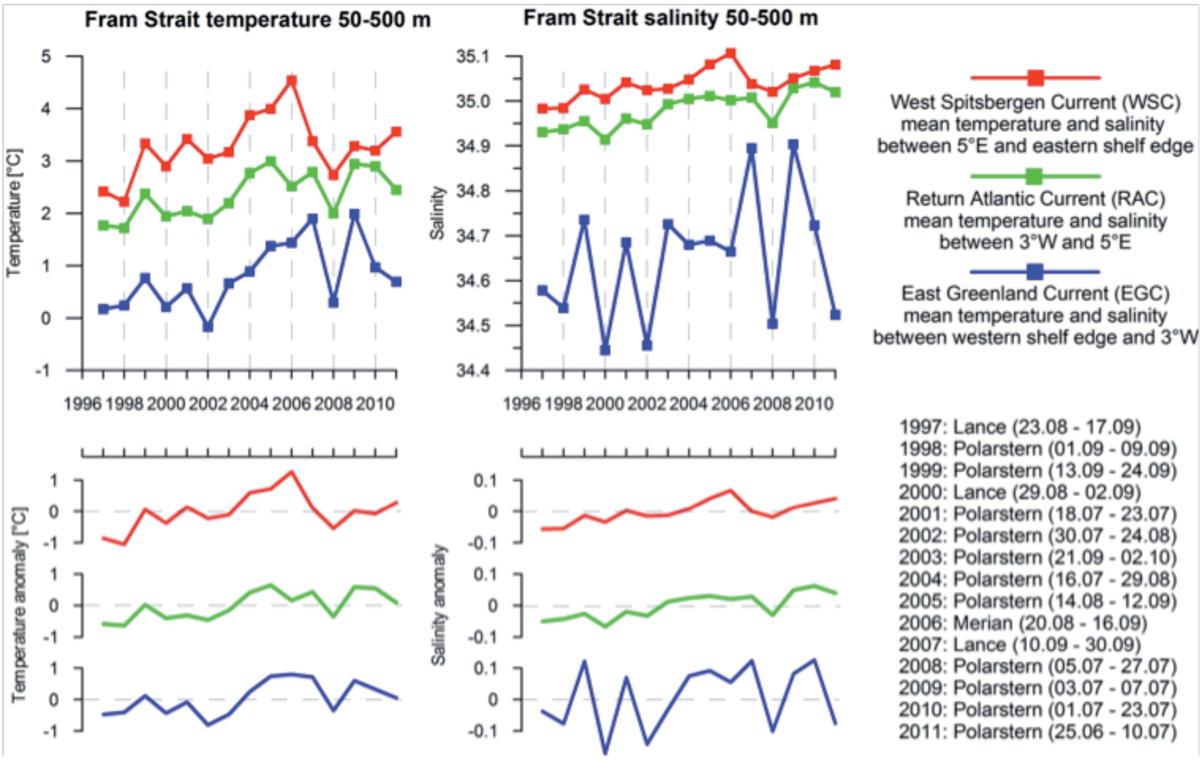
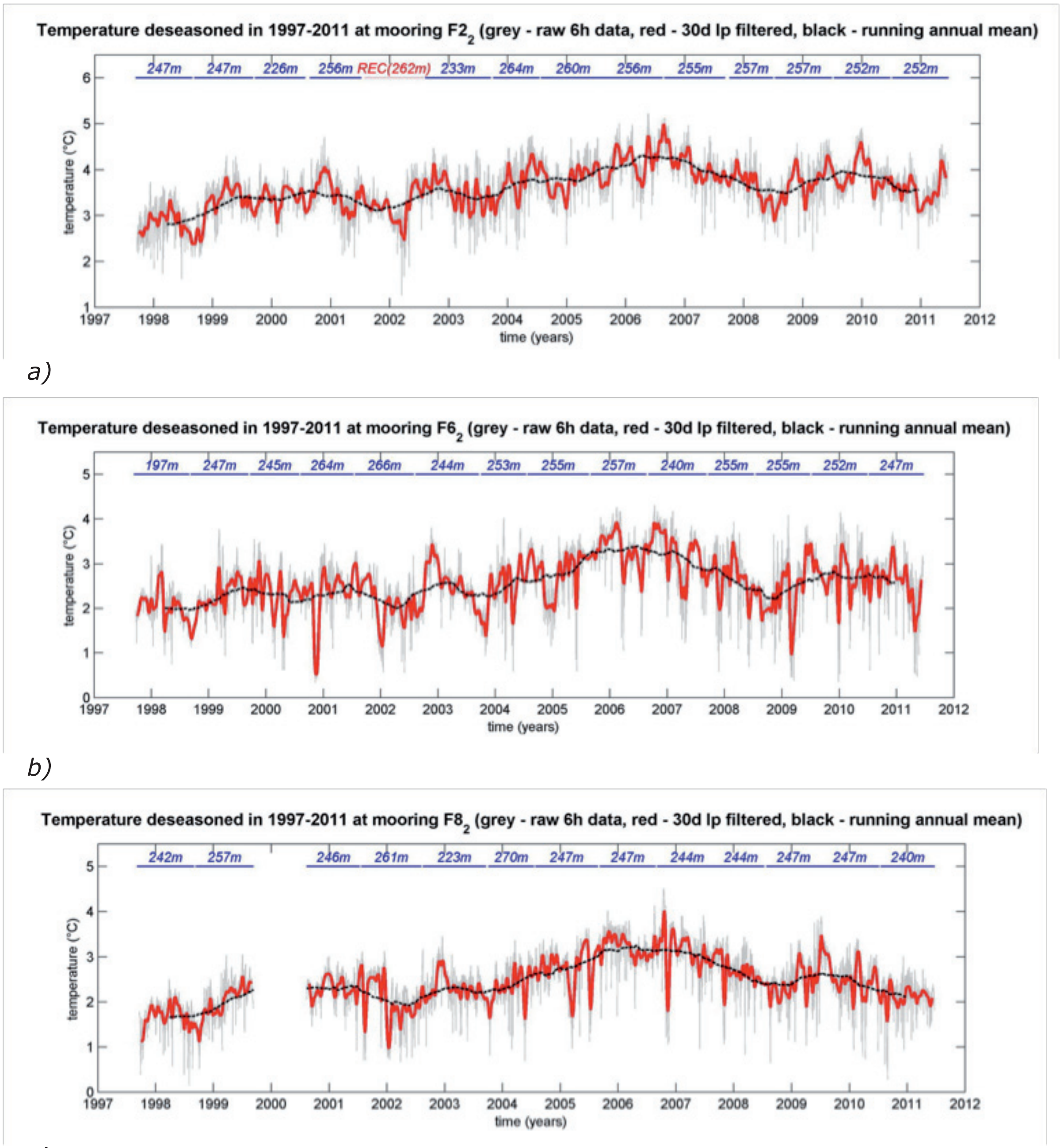


Fig. 3.5: Interannual variations of the mean temperatures and salinities in the Fram Strait in the West Spitsbergen Current (WSC), Return Atlantic Current (RAW) and East Greenland Current (EGC).

The preliminary results obtained from the moored array confirm findings from the hydrographic snapshot. Since only a part of moorings was recovered in 2011, the estimates of the volume and heat transport through the strait will be available after the full recovery in summer 2012. The long-term time series of temperature in the Atlantic Water (at the nominal depth of 250 m) at three selected moorings in the core of the WSC (F2), at the western WSC edge (F6) and in the AW recirculation area (F8) are presented on Fig. 3.6. The continuous measurements at moorings show that the temperature in the WSC core had been decreasing through 2010 (after the moderate maximum at the end of 2009) and has increased again only since spring 2011. At the western boundary of the WSC the temperature was relatively stable through 2010 and has been significantly decreasing in the early winter to early summer period. Due to missing records from ADCPs and three other current meters, the analysis of the flow variability in 2010-2011 has to be partially based on the statistic relationships between existing records and missing points. This analysis is currently on-going and its results as well as the updated estimates of fluxes will be available in the second half of 2012.



c)

Fig. 3.6: Time series of the Atlantic Water temperature (a) in the West Spitsbergen Current core, (b) at the West Spitsbergen Current western edge and (c) in the AW recirculation branch in 1997-2011, measured by CTD sensors or T sensors at current meters at the nominal depth 250 m

A trajectory of the glider mission in summer 2011 is shown on Fig. 3.7 together with vertically averaged current vectors for the upper 1000 m measured by the glider. Four long zonal sections between 2°W and 9°E were accomplished in this period together with several shorter sections in the central Fram Strait close to the ice edge. Averaged current vectors reveal a coherent, strong northward flow in the

West Spitsbergen Current and strong variability in the central part of Fram Strait. During the summer 2011 mission the glider covered a distance of 1567 km and completed 350 dives (mostly deep dives down to 1000 m), measuring pressure, temperature, salinity, dissolved oxygen and light transmission. The temperature and salinity distributions measured in the upper 1000 m during the whole length of the glider mission are shown on Fig. 3.8. During its summer mission the glider covered the area between 2°W and 9.5°E and for the short time went under the ice during the north-westernmost dives. However, the ice edge significantly retracted to the west during the glider summer mission, which excluded a longer under ice detour along the planned section, due to shallower depth in the western Fram Strait where the ice edge was located. SG127 collected RAFOS receptions from RAFOS sources located in the central and western Fram Strait (Fig. 3.9) and calculated navigational solutions based on RAFOS signal using the built-in RAFOS hardware and the dedicated firmware from APL-UW. Altogether the glider collected 298 RAFOS receptions with correlation over the threshold (> 60). The highest number of valid receptions were for the RAFOS sources FSQ1-2 (84 receptions), FSQ3-2 (116) and from the tomographic source A (72). There were no valid receptions from the RAFOS sources FSQ1-3, FSQ4-1 and tomographic sources B and C during the summer mission.

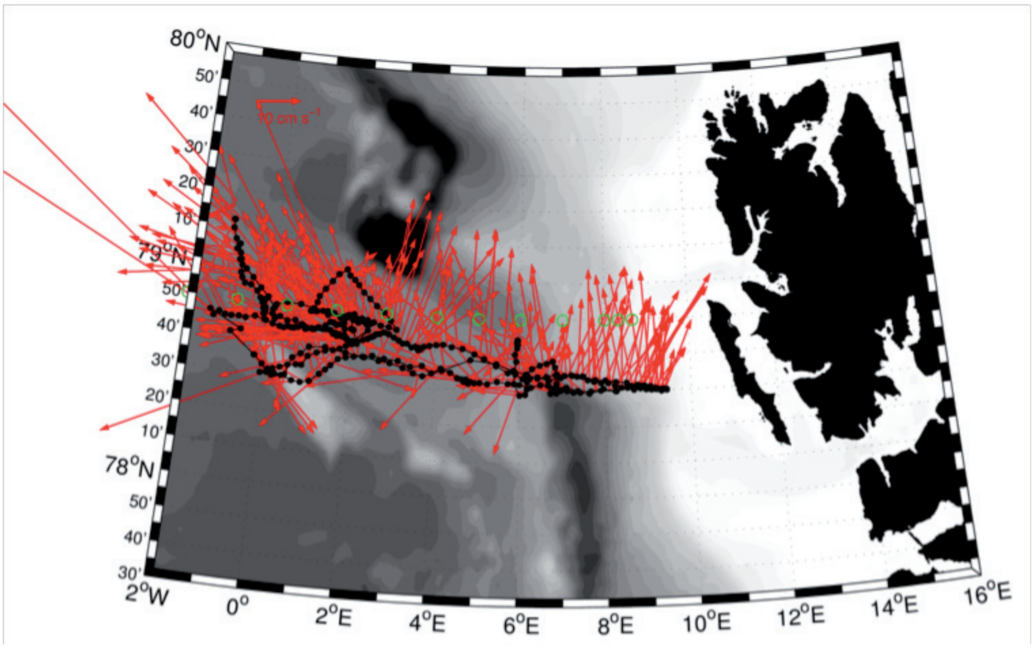
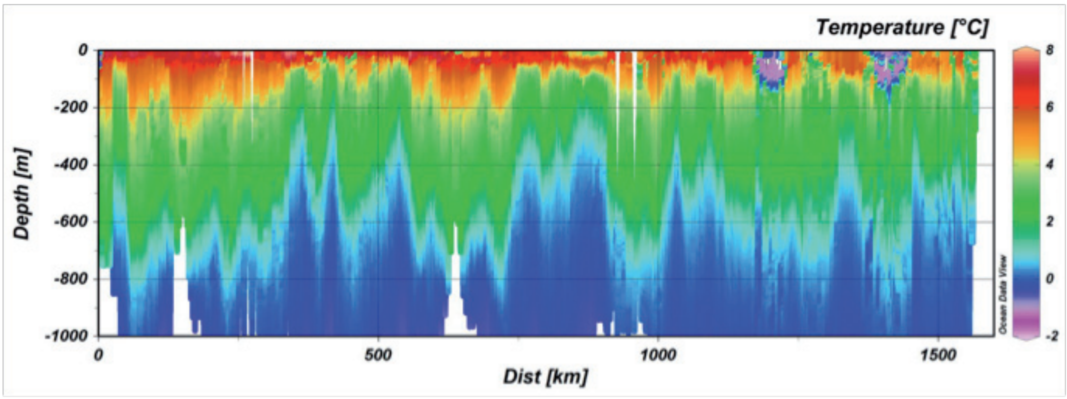
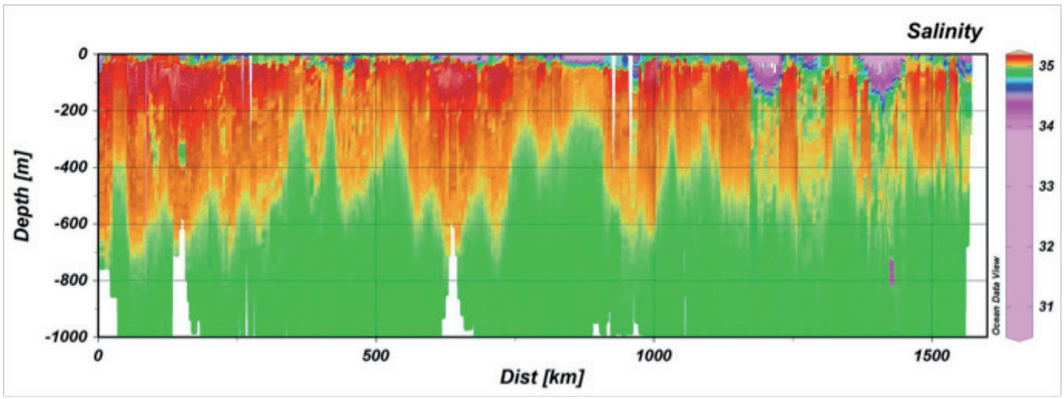


Fig. 3.7: Locations of the Seaglider surfacing positions between successive dives and vertically averaged currents during the summer mission 2011 in the eastern and central Fram Strait from July 9 to September 25



a)



b)

Fig. 3.8: (a) Temperature and (b) salinity measured by the glider SG127 during the total duration of the summer mission 2011.

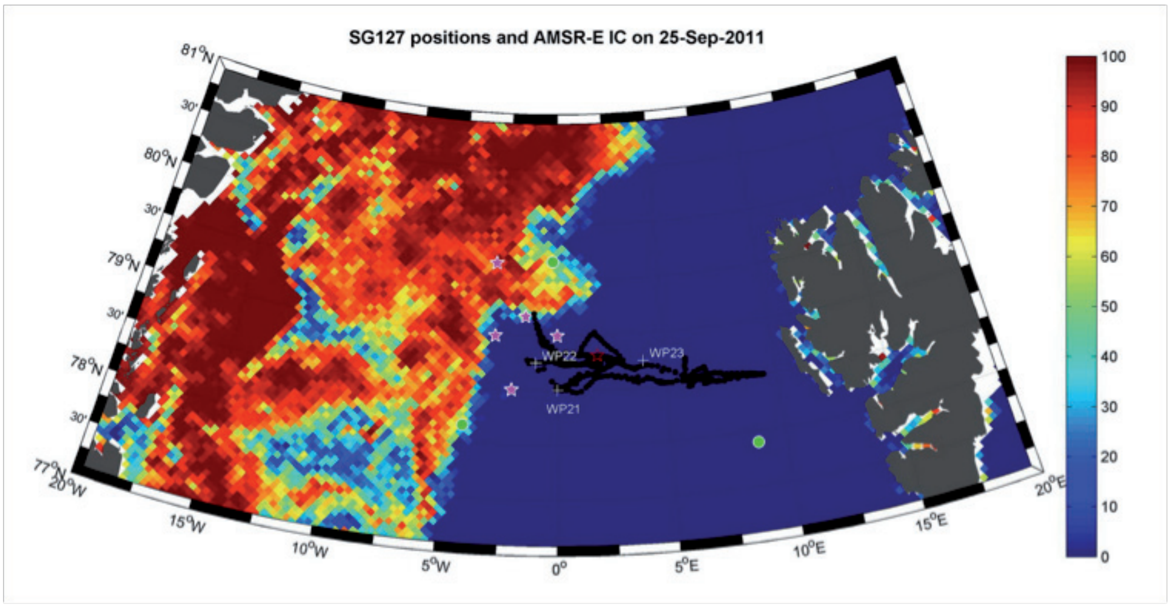


Fig. 3.9: The glider SG127 track shown in relations to the sea ice concentration during the recovery.

4. PLANKTON ECOLOGY AND BIOGEOCHEMISTRY IN A CHANGING ARCTIC OCEAN (PEBCAO)

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Objectives

The project PEBCAO (Plankton Ecology and Biogeochemistry in a Changing Arctic Ocean) is focused on the plankton community and the microbial processes relevant for biogeochemical cycles of the Arctic Ocean. The Arctic Ocean is highly sensitive to climate change. The decline in seawater pH is amplified by an increasing freshwater input from melting sea ice and river discharge that reduces alkalinity and hence the buffering capacity of the sea. In order to understand and track potential consequences for the pelagic ecosystem in the Arctic Ocean both long-term field observations and experimental work with Arctic plankton species and communities are needed to gain knowledge about the biological feedback potential of pelagic communities in the future Arctic Ocean. During this cruise leg, samples have been collected along a west-east transect across the Fram Strait where cold and warm water masses originating from the southward flowing East Greenland Current and the northward flowing West Spitsbergen Current meet. A frontal zone separating both is more or less pronounced in consecutive seasons and years, respectively.

Biogeochemistry & Phytoplankton

Recent investigations have shown that rising temperatures as well as freshening of surface waters promote a shift in phytoplankton community towards a dominance of smaller cells. A change in size of the primary producers could have significant consequences for the entire food web in polar waters as well as for the cycling and sequestering of organic matter. An increase in ice free water surface as well as CO_2- and temperature-related changes in the carbonate chemistry of the ocean will also affect the cycling of biogenic elements. Because of the vast spatial dimensions of the oceanic system, even small changes in the biological pump could significantly affect atmospheric CO_2 concentration.

Bacterioplankton

The bioreactivity of particulate and dissolved organic matter is determined by its biochemical composition and diagenetic state. The loss of organic matter within and below the euphotic zone is mainly mediated by the degradation activity of heterotrophic bacteria, colonizing sinking particles and their surroundings (Cho; Azam 1988; Karl et al. 1988; Smith et al. 1992). Hence, bacterial activity codetermines the efficiency of carbon export to the deep ocean. Furthermore, bacterioplankton plays a fundamental role at the basis of microbial foodwebs. Dissolved organic matter is almost exclusively accessible for bacterial cells that make it available for higher trophic levels by the production of bacterial biomass. Effects of increasing temperature and decreasing pH on bacterial communities and their activity are thereby of outstanding importance, but yet hardly considered. Studies conducted in the past decades revealed strong physiological responses of marine bacteria to changing temperature and pH, but their relevance for biogeochemical cycles in the future ocean is only poorly investigated.

Zooplankton

Zooplankton organisms are associated with different water masses. Thus, the community composition and depth distribution of zooplankton species change over the Fram Strait, as relatively warm Atlantic water masses encounter cold polar waters. With increasing Arctic water temperatures, a shift in the community composition of the zooplankton may occur. This could have severe consequences for the ecosystem functioning.

Work at sea

Biogeochemistry & Phytoplankton

We sampled seawater of 5-8 depths by a CTD/rosette sampler along the West – East transect across the Fram Strait to determine the impact of microbial processes on the aggregation of sedimentation of organic matter. Samples have been taken for biogeochemical parameters such as chlorophyll a and pigments (HPLC), seston, dissolved and particulate organic carbon (DOC and POC), dissolved and particulate organic nitrogen (DON and PON) and particulate biogenic silica (PbSi). Additionally samples were taken by CTD casts and hand net to examine the phytoplankton and protozooplankton abundance. All samples are preserved or frozen at -20°C or -80°C. Samples for carbohydrates and amino acids were collected and stored at -20°C. Concentrations will be determined by the use of IC and HPLC, respectively. Samples for transparent exopolymer particles (TEP) and Coomassie stainable particles (CSP) were taken and stored at -20°C until analysis by photometry and microscopy back at the institute. Samples for dissolved organic carbon (DOC) and total alkalinity (TA) were collected at all stations and stored refrigerated. Additionally, water samples were collected from the CTD from the top 100 m depth in order to assess differences in the phytoplankton community composition by automated ribosomal intragenic spacer analysis (ARISA) and 454-next generation sequencing. The samples were fractionated by three filtrations on 10.0 µm, 3.0 µm and 0.2 µm filters and stored at -80°C. Because the molecular methods are lab-based the samples will be analyzed back at the Alfred Wegener Institute.

Bacterioplankton

During ARK-XXVI/1 three onboard experiments were conducted to investigate potential effects of expected changes in temperature and pH of the Arctic Ocean on the turnover of organic carbon by the in-situ bacterioplankton communities. For this purpose bioassays amended with different carbon sources were incubated at different temperatures and pH values. Samples were collected to analyse bacterial growth and degradation activity as well as changes in the community composition. Furthermore, the transect at 78°50' N was sampled to better understand interacting effects of temperature and substrate availability on bacterial activity and diversity in the Fram Strait. At 18 stations samples were taken to determine bacterioplankton community composition (ARISA, FISH), rates of extracellular enzymes, bacterial biomass production and concentrations of sugars and amino acids.

Zooplankton

We investigated the mesozooplankton community (size range: 0.2 – 20 mm), focussing on the species composition and depth distribution as well as the nutritional status of dominant mesozooplankton species along the transect at 78°50' N. Abundance was studied by use of a multi net equipped with 5 nets (mesh size 150 µm). At nine stations five depth strata (1500-1000-500-200-50-0 m) were sampled by vertical net hauls. The samples were immediately preserved in formalin buffered with hexamethylentetramin for analyses at the AWI laboratories in Bremerhaven. For biochemical and enzyme activity analyses, bongo net hauls (mesh size 300 or 1000 µm) were conducted. Live individuals of the dominant copepod species, i.e. Calanus hyperboreus and C. finmarchicus were sorted in cooling containers and immediately deep-frozen. Their carbon and nitrogen content as well as citrate synthase and digestive enzyme activities will be analysed at the AWI.

Bongo net samples revealed that Calanus spp., i.e. C. finmarchicus, C. hyperboreus and C. glacialis, dominated the mesozooplankton community in the Fram Strait. C. finmarchicus, which inhabits Atlantic water masses, dominated in samples taken at the eastern stations of the transect. C. glacialis, which is typical of Polar waters, was only found at the westernmost stations at 6°, 4° and 2° W. Calanus hyperboreus was sampled at nearly all stations in the Fram Strait but showed a peak at the central stations of the Fram Strait.

Preliminary results

Biogeochemistry & Phytoplankton

Species composition of unicellular microplankton

Along the west to east transect, phytoplankton and protozooplankton abundance and composition were examined in net samples taken with an Apstein net (mesh-size 20 µm), the upper 10 m of the water column. Samples were stored refrigerated until the further examination with the microscope within the following 24 hrs. Identification of species was done at least to genus level and the occurrence was noted. Diatoms, dinoflagellates and tintinnids dominated the samples.

The prymnesiophyte Phaeocystis is a cosmopolitan, ecologically important and bloom-forming genus of the phytoplankton containing two colony-forming cold water species: P. pouchetii in the Arctic and P. antarctica in the Southern Ocean. The phytoplankton sampling on board was focussed on the Arctic key micro algal species P. pouchetii. Surface water samples were taken with an Apstein net at 10 m depth. 93 isolates and 163 field samples were achieved in total to establish new cultures for studying genetic diversity of P. pouchetii within the Fram Strait and to compare it to its direct sister species P. antarctica in the Southern Ocean. Only four isolates were successfully isolated in the western part of the 78° 50`N transect where diatoms were most abundant. The successful isolation of colonies concentrated on 3° to 6°E. The cultures will be used for population genetic studies and ecophysiological experiments to evaluate whether genetic differences are reflected in different ecophysiological response patterns which could well explain specific biogeographic distribution patterns of this micro alga.

All other samples have to be analysed in the home laboratory at AWI.

Bacterioplankton

First results of acidification experiments reveal that degradation activity of bacterioplankton communities in the Fram Strait was sensitive to moderate changes in seawater pH. Rates of extracellular b-glucosidase and bacterial growth rates increased in acidified incubations. Also a temperature increase of 4°C that is projected for the near future had stimulating effects on bacterial growth and activity. These results suggest impacts of global change on heterotrophic carbon turnover in the Arctic Ocean.

Zooplankton

The abundance and distribution of mesozooplankton (i.e. passively drifting organisms that range between 0.2 & 20 mm in size) in the Fram Strait was investigated by vertical multinet hauls at 9 stations from 5 different depth strata up to 1500 m depth. Additionally, a bongo net was used to investigate the nutritional compositions and enzyme activities of the dominant species in the upper water column (up to 250 m depth) in order to estimate their role in the Arctic marine food web. The bongo net samples were dominated by the copepod genus Calanus spp. with the species C. finmarchicus, C. hyperboreus and C. glacialis. The preliminary results of the sampling indicate that the different Calanus species are clearly associated with different water masses in the Fram Strait. C. finmarchicus dominated in the samples from the eastern stations of the transect, whereas C. glacialis is associated with the polar water at the westernmost stations. C. hyperboreus (the largest Calanus species occurring in the Fram Strait) was mainly sampled at central stations.

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5. ARCTIC PELAGIC AMPHIPODA (APA)

Angelina Kraft, Nadine Knüppel,
Ulrich Bathmann, Eva-Maria Nöthig (not on board)

Alfred-Wegener-Institut

Objectives

Among the Arctic zooplankton community, pelagic amphipods are expected to play a key role in marine ecosystems, providing a central link between small herbivore plankton organisms like copepods and higher trophic levels. However, their role in the polar ecosystems, especially in ice-covered Arctic seas, is still poorly understood.

Nowadays, the amphipods in the Arctic are faced with a drastically changing environment including increasing ocean temperatures and acidification as well as a rapidly declining sea ice cover. As the sea ice disappears, we expect that typical large cold water amphipods, such as the Arctic specialist *Themisto libellula*, will be replaced by smaller and more temperature tolerant Atlantic generalists. With the opportunity to collect amphipods onboard the research icebreaker *Polarstern*, we aim to investigate the geographical and depth distribution of dominant pelagic amphipod species in the northern Fram Strait and address their nutritional value for marine sea-birds and mammals. In detail, the BMBF-funded 'Arctic pelagic Amphipoda' project investigates the following aspects:

1.) What are the species composition patterns of Arctic pelagic Amphipoda in the northern Fram Strait area and how do they relate to changes of the environment?

Thereby, the results from plankton net samples taken during ARK-XXVI/1 will be compared to the amphipod samples from moored sediment traps since the year 2000 in order to investigate possible changes in the population structure and life cycles of these organisms.

2.) Determine differences in nutritional ecology (lipid biomarkers & gut content) of the dominating pelagic Amphipoda *Themisto libellula*, *T. abyssorum*, *T. compressa* and *Cyclocaris guilelmi.*

To address this objective we test the following hypothesis: *Themisto libellula*, *T. abyssorum*, *T. compressa* and *Cyclocaris guilelmi* have different feeding and overwintering strategies leading to differences in gut content and lipid content compositions. Hence, investigations on lipid biomarkers & gut contents will be carried out in the home laboratory in order to understand differences of the utilization of food and on the nutritional value for higher trophic levels.

Work at sea

Along the main transect at 78°50'N in the northern Fram Strait a total of 10 net sampling stations were investigated. At each station, stratified mesozooplankton samples were routinely collected by multiple opening/closing net hauls (multinet, Type Maxi, Hydro-Bios Kiel, mesh size: 1000 µm). The sampling included vertical hauls from 2,000 m to the surface concentrated with discrete sampling intervals of 2,000–1,500–1,000–800–600–400–200–100–50–0 m depth in order to analyse the occurrence of pelagic amphipods at the different depth horizons. From the collected zooplankton samples all amphipods were sorted out, determined to a species level, counted, measured and frozen at -80° C for the later analyses of their gut content and lipid composition at the AWI home laboratory. The other collected zooplankton groups were preserved in a 4% formaldehyde/seawater solution and will later be analyzed with regard to abundance, biomass and species composition in order to describe the macro- and mesozooplankton community structure.

Preliminary results

With the on-board dataset, a first analysis of the densities and vertical amphipod distributions was started. In total, 10 different amphipod species from 7 families (Table 5.1) were found along the transect. The collected amphipods included the epipelagic target species *Themisto abyssorum*, *T. libellula* and *T. compressa*, typical deep-water species (e.g. *Cyclocaris guilelmi*) and ice-associated amphipods.

Tab. 5.1: The collected amphipod composition in 10 multinet hauls along the 78°50’N transect in the northern Fram Strait during ARK-XXVI/1.

Family Hyperiidae	*Themisto abyssorum*
	Themisto compressa
	Themisto libellula
Family Eusiridae	*Eusirogenes arctica*
	Eusirus holmii
Family Lanceolidae	*Lanceola clausi*
Family Lysianassidae	*Cyclocaris guilelmi*
Family Uristidae	*Onisimus nanseni*
Family Scinidae	*Scina borealis*
Family Stilipedidae	*Astyra longipes*

At all 10 net sampling stations along the 78°50’N transect, the sub-arctic species *Themisto abyssorum* was the most prominent species in the epipelagic amphipod community (Fig. 5.1). This free-swimming amphipod is known to be widely distributed in Atlantic, Polar Front and Arctic waters; however it is predominant in Atlantic water masses. The highest density of *T. abyssorum* was recorded at the easternmost sampling station (8°00’ E), with 260 ind. 1000 m^{-3}. Another frequently observed amphipod was *Themisto libellula*, which is an Arctic species predominantly known to be associated to Arctic water masses. Consequently, its highest appearances were recorded at stations close to sea ice or in ice covered waters (1°55’ E to 2°01’ W) with densities ranging from 20 to 31 ind. 1000 m^{-3}.

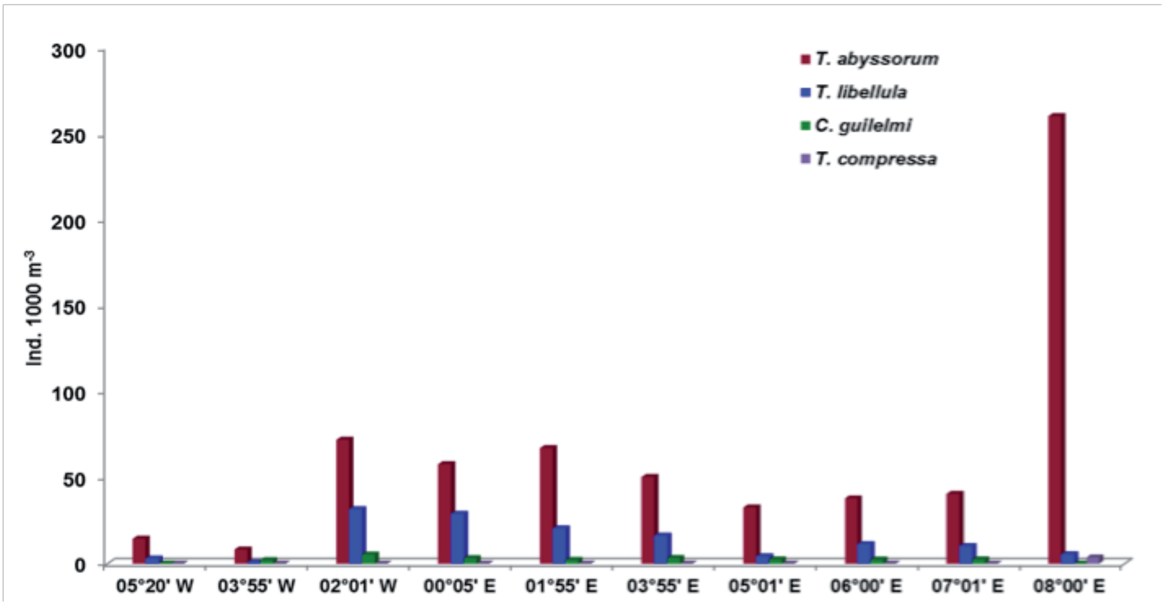

Fig. 5.1: Density (Ind. 1000 m^{-3}) of the four amphipod key species recorded at 10 sampling stations along the 78°50′ N transect in the northern Fram Strait.

The vertical amphipod distribution varied among the stations, with the presence of mostly juvenile individuals of *T. abyssorum* and *T. libellula* in the upper 50-100 m and 0-50 m of the water column, respectively. Most adult individuals of both species could be found at a water depth of 100-600 m. Below 600 m, the amphipod density decreased rapidly and pelagic deep-water amphipods became more prominent in the species composition. Among these samples *Cyclocaris guilelmi* appeared to be the most important representative (Fig. 5.2).

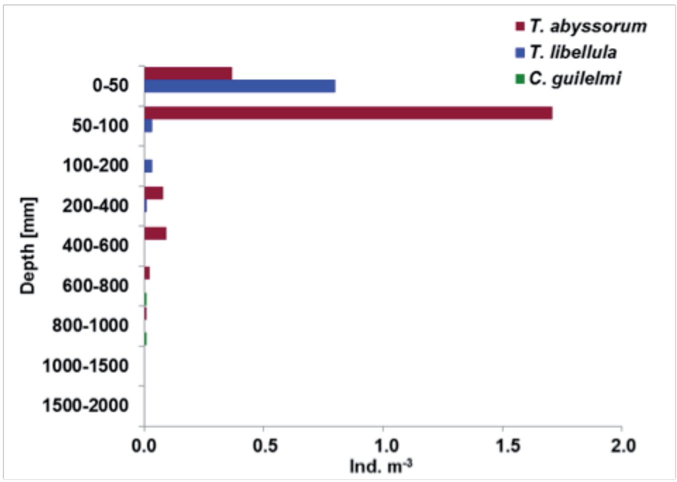

Fig. 5.2: Vertical distribution (Ind. m^{-3}) of Themisto abyssorum, T. libellula and Cyclocaris guilelmi at 78°50‘ N, 01°55' E In the northern Fram Strait.

A detailed analysis of abundances as well as length-frequencies and the relation to temperature and salinity data is expected to provide new insights regarding the vertical migration capacity and population structure of the genera *Themisto* and *Cyclocaris* along the Fram Strait transect.

6. CALIBRATION STUDY WITH RECENT FORAMINIFERA FOR PALEOCEANOGRAPHIC RECONSTRUCTIONS

Theodora Pados
Leibniz Institute of Marine Sciences at the Christian-Albrechts Universität Kiel (IFM-GEOMAR)

Objectives

Isotopic and geochemical analyses and abundances of fossil foraminifera are common tools for paleoceanographic reconstructions. Oxygen isotopic ($\delta^{18}O$) records of sediment cores provide information about variation in sea surface temperatures and salinities in the past, while carbon isotopic ($\delta^{13}C$) records refer to e.g., paleoproductivity and stratification. However, for a correct interpretation of the fossil data it is important to improve our understanding of the correlation between recent oceanic variability and the composition of shells of living calcareous microorganisms. The aim of the studies performed during ARK-XXVI/1 is to investigate how *in-situ* conditions like salinity, temperature, and stable isotopic ratios of the ambient water are reflected in the tests of living foraminifera. Furthermore, the species distribution will be investigated to determine changes related to the variability of water temperature and salinity, water mass structure, and ice coverage. For a precise correlation of proxies used for paleoceanographic reconstructions and the water properties to be obtained from CTD measurements, plankton tows, water samples, and sediment surface samples were collected from identical positions. Analysed proxies comprise the faunal distribution, the oxygen and carbon isotopic composition and the Mg/Ca ratio of the calcareous shells of planktic and benthic foraminifera.

Work at sea

During ARK-XXVI/1 plankton samples were collected by multinet sampler at 10 stations along a transect, at 78°50´N across the Fram Strait. The nets of 63 µm mesh size were towed vertically on regular depth intervals (500-300 m, 300-200 m, 200-100 m, 100-50 m, 50-0 m). The plankton samples were sieved with a sieve of 500 µm mesh size and fixed with ethanol on board. Temperature and salinity of the water column was measured by CTD. Water samples for stable isotope analyses were taken from the rosette sampler, directly after arriving on the deck to minimize the exchange of contained CO_2 with the atmosphere. Water samples for $\delta^{13}C$ analysis were poisoned to stop biochemical reactions which may alter the carbon isotopic composition of CO_2. Sediment surface samples were obtained from multicorer deployments of M. Telesinski performed for paleoenvironmental studies. All samples have been stored cool (4°C) and will be analyzed at IFM-GEOMAR in Kiel.

Preliminary results

It is known from previous studies (e.g. Carstens et al., 1997) that in the Fram Strait the planktic foraminiferal species composition is dominated by the polar

Neogloboquadrina pachyderma (sin.), and the subpolar *Turborotalita quinqueloba*. The ratio between abundances of these two species at the stations and in different depths will be determined. The species distribution is expected to be affected by the hydrographic settings (temperature and salinity of the water mass, ice coverage).

Due to the different hydrographic regimes along the transect, and the calcification depth of the shells, variation of $\delta^{18}O$ and $\delta^{13}C$ values of living foraminifera is expected. The aim of this study is to investigate how precise the correlation between the stable isotope composition of the tests and recent oceanic variability is. Effects of *in-situ* conditions like salinity, temperature, stratification, and stable isotopic ratios of the ambient water on the $\delta^{18}O$ and $\delta^{13}C$ values of the shells will be examined.

References

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7. HOLOCENE OCEANIC VARIABILITY IN THE NORDIC SEAS AS RECONSTRUCTED FROM PLANKTIC AND BENTHIC FORAMINIFERAL ISOTOPES

Maciej Telesinski
Leibniz Institute of Marine Sciences at the Christian-Albrechts Universität Kiel (IFM-GEOMAR)

Objectives

The Holocene has been long described as a period of relatively stable oceanographic and climatic conditions, especially compared to the highly variable Pleistocene. However, more studies show significant environmental fluctuations also within the present interglacial. Their spatial and temporal distribution is however not known well enough.

The Nordic Seas are an important location to study the paleoceanographical variability during the last 10,000 years. In this region, a crucial area is the Fram Strait as it is the main and narrow way for the exchange of both surface and deep waters between the Nordic Seas (and therefore the entire North Atlantic) and the Arctic Ocean. Even minor changes in the currents strength, the water masses, the sea ice cover etc. are amplified in this area and therefore should be easier to observe in the sediment record.

The main focus of the study during ARK-XXVI/1 are the oxygen and carbon isotopes from planktic and benthic foraminifera and the planktic foraminiferal species distribution, as they yield diverse information on multiple environmental parameters, such as temperature, salinity, current strength, sea ice cover, bioproductivity etc.

Work at sea

During ARK-XXVI/1 the multicorer was deployed at 11 stations along the 78°50'N transect (at the same locations as the multinet stations of T. Pados plus one station at 8°30'E) in water depths ranging between 589 m (8°30'E) and 2713 m (2°W). Up to eight core tubes were retrieved at each station. The longest core from each station (usually reaching between 30 and 40 cm) was subsequently subsampled at 1 cm intervals. The samples were stored at 4°C and will be used for the paleoceanographic reconstruction (using the oxygen and carbon isotopes from planktic and benthic foraminifera, the planktic foraminiferal species distribution etc. as proxies). Furthermore, 2 surface sediment samples (0-1 cm) from each station were treated with Rose Bengal and stored at 4°C. Those will be used for the comparison of the stable isotopes composition of the planktic foraminiferal shells in the water column and in the sediment by T. Pados (IFM-GEOMAR). One surface sediment sample from each station was stored at -20°C and will be used for biomarkers studies by the group of R. Stein (AWI). The surface sediment samples from the remaining cores were stored at 4°C and are available for other studies.

Preliminary results

The following preliminary observations were made during sampling:

Most of the cores (excluding those from the two easternmost stations) consist of fine-grained, deep-sea sediments, mainly of the clay to silt fraction.

Ice rafted debris (IRD) of sizes up to several centimeters and of variable petrology was found in most of the samples. Generally, the fragments were distributed randomly throughout the cores. In some cases however, layers richer in IRD were observed, indicating events or periods of increased ice rafting.

The colour of sediments was brown to dark brown in the upper layers and dark brown to olive grey in the lower layers.

Burrows as well as macrofauna (e.g. Crustaceans) were observed, indicating the possibility of bioturbation.

In most of the cores, benthic foraminifera (*Pyrgo* spp.) were found in the uppermost centimeters.

After washing and sieving of the sediments, samples will be prepared for oxygen and carbon stable isotopes analysis. Furthermore, the planktic foraminiferal abundance and species distribution (and, perhaps, other proxies, e.g. IRD distribution) will be studied. The foraminiferal material will be dated using the AMS ^{14}C method.

It is expected that the collected material covers (at least partly) the Holocene period, allowing a high-resolution paleoceanographical reconstruction of Holocene environmental changes on a transect across the Fram Strait.

8. HIGHER TROPHIC LEVELS: SEABIRDS AND MARINE MAMMALS AT SEA

Claude R Joiris, Dominique Verbelen, Griet Nijs, Gerald Driessens and David Monticelli
Laboratory for Polar Ecology (PolE)

Objectives

In the frame of our long-term study on the at-sea distribution of seabirds and marine mammals, our main aims were first, to confirm and study in more detail the mechanisms influencing their distribution: water masses, fronts, pack ice and ice edge, as well as local eddies (Joiris and Falck, 2010). Second, to detect populations changes due to diminishing ice coverage, as well as modifications in the extent of water masses, an indirect possible consequence of climatic change (Joiris, in press).

Work at sea

The methodology consists in continuous counts from the bridge on transect, since stationary ships can attract a lot of birds and so bias the interpretation of the data. Often, but not continuously, counts were realised from the crow's nest in order to compare the two platforms and try to detect the effect of height on the efficiency of counting (this is why we asked for more participants than usual).

Preliminary results

During this first leg of ARK-XXVI, counts started on the second day, but these data mainly allowed an unification of the methods used by the different participants and will not be included in the statistics (for 3 of the participants, this was the first stay on *Polarstern*).

Similarly, during the long North transect off the coasts of Norway, some "nice" observations were made, without concerning the actual Arctic (Greenland Sea and Fram Strait): we can cite 3 pods of killer whales, of which 1 with calf. Birds were fulmars and kitiwakes following *Polarstern*, sometimes for very long periods (hours): these data again will not be included in the calculation of densities. All skua species were encountered in small numbers: great, pomarine, Arctic and long-tailed, as well as gannet and Arctic tern.

Farther north, west of Spitsbergen, a special transect was run as proposed by this team, along the slope of the continental shelf, both from the ship and from helicopter flights. The main event was the presence of cetaceans, mainly fin whales (about 50 in total, including a few calves) and occasional humpback, sperm, minke and blue whales and a few white-sided dolphins. As often observed in Arctic marine ecosystems with low biodiversity, the patchiness of their distribution is very high (Joiris, 2011). High numbers of large whales were encountered in the Norwegian and Greenland seas from 2005 on, then the year with lowest ice coverage. Our interpretation is that such a huge increase (by more than one order of magnitude between 2003 an 2005) cannot be due to natural population growth (maximum 10% per year for large whales and close to 7% per year for bowhead), but resulted from a massive inflow from the larger populations (stocks) from the Pacific Ocean into the extremely low populations in the NE Atlantic, both the NE and NW Passages being open as a consequence of low ice coverage (Joiris, in press). Most - if not all - of the large whales were actively sub-surface "lunge" feeding, without clear movement nor very deep dives. From the helicopter a group of at least 2 humpbacks were using the "bubble net" technique.

Along the 78°50'N transect, most of the expected species were noted but in relatively low numbers: the Arctic ivory gull (100 in total) and Sabine's gull (3 in total), polar bear (3 of which 2 with a recent seal kill), bowhead (2 of which 1 confirmed not only from the blow, but the silhouette of head, neck and back as well). The other species were regularly encountered, but in low numbers as well: little auk, Brünnich's guillemot, black guillemot and glaucous gull. More ubitiquous were fulmars, light and dark forms, including a few very dark (DD) ones in the western part of the transect, and kittiwakes.

Many of those were immature in different plumages and state of moult, which provided contact with a few less photographed plumages, and probably reflects the distribution of non-breeding animals far from the colonies: black and Brünnich's guillemots, kittiwakes, 4 ivory gulls at the same station together with 3 adults, as well as harp seals among the pinnipeds. Fascinating was that immature Brünnich's guillemots seemed to be accompanied by one or two adults, giving the impression of family bonds almost one year after fledging: an original observation to be confirmed. At the eastern end of the transect in contrast, adult breeding Brünnich's guillemot were clearly joining their Spitsbergen breeding colonies, often with fish in the beak: an indication that eggs were hatched, and chicks to be fed. An adult gannet was observed far North of its normal range, at 78°N, 7°40E in Atlantic Water (high temperature and salinity): this rarely happened already during previous years from *Polarstern* and might reflect a future northerly extension of its distribution.

An unexpected visitor among passerines was the presence on board of an Arctic redpoll in the mid of the transect, supposingly originating from the E Greenland population.

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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
AWI	Stiftung Alfred-Wegener-Institut für Polar- und Meeresforschung in der Helmholtz-Gemeinschaft Postfach 120161 27515 Bremerhaven Germany
DWD	Deutscher Wetterdienst Geschäftsbereich Wettervorhersage Seeschifffahrtsberatung Bernhard Nocht Str. 76 20359 Hamburg Germany
HeliService	Heli Service International GmbH Am Luneort 15 27572 Bremerhaven Germany
IFM-GEOMAR	Leibniz-Institut für Meereswissenschaften an der Christian-Albrechts Universität zu Kiel Wischofstr. 1-3 24148 Kiel Germany
PolE	Laboratory for Polar Ecology Rue du Fodia 18 B-1367 Ramilles Belgium

A.2 FAHRTTEILNEHMER / CRUISE PARTICIPANTS

Name/ Last name	**Vorname/ First name**	**Institut/ Institute**	**Beruf/ Profession**
Allen	GongXun	AWI	PhD Student/Oceanography
Beszczynska- Möller	Agnieszka	AWI	Oceanographer
Büchner	Jürgen	Heliservice	Pilot
Buldt	Klaus	DWD	Meteorologist
Driessens	Gerald	PolE	Biologist
Federwisch	Luisa	AWI	Student/Biology
Gäbler-Schwarz	Steffi	AWI	Biologist
Gall	Fabian	Heliservice	Mechanic
Haid	Verena	AWI	PhD Student/Oceanography
Hardge	Kristin	AWI	Student/Biology
Heckmann	Marcus	Heliservice	Mechanic
Joiris	Claude R.	PolE	Biologist
Knüppel	Nadine	AWI	Technician/Biology
Kraft	Angelina	AWI	Biologist
Menzel	Uta	AWI	Student/Oceanography
Miller	Max	DWD	Meteorologist
Monczak	Agnieszka	AWI	Student/Oceanography
Monticelli	David	PolE	Biologist
Nijs	Griet	PolE	Biologist
Pados	Theodora	IFM-GEOMAR	PhD Student/ Paleoceanography
Piontek	Judith	AWI	Environmental scientist
Rettig	Stefanie	AWI	Engineer/Oceanography
Schier	Felix	Heliservice	Pilot
Sperling	Martin	AWI	PhD Student/Biology
Strothmann	Olaf	AWI	Technician/Oceanography
Telesinski	Maciej	IFM-GEOMAR	PhD Student/ Paleoceanography
Thomisch	Karolin	AWI	Student/Biology
Verbelen	Dominique	PolE	Biologist

Name/ Last name	Vorname/ First name	Institut/ Institute	Beruf/ Profession
Walter	Jörg	AWI	Technician/Oceanography
Wang	Xuezhu	AWI	PhD Student/Oceanography
Wekerle	Claudia	AWI	PhD Student/Oceanography
Winkler	Maria	AWI	Student/Biology
Xu	Xu	AWI	PhD Student/Oceanography

A.3 SCHIFFSBESATZUNG / SHIP'S CREW

Name	Rank
Wunderlich Thomas	Master
Spielke Steffen	1. Offc.
Ziemann Olaf	Ch. Eng.
Fallei Holger	2. Offc.
Janik Michael	2. Offc.
Peine Lutz	2. Offc.
Grägel Eberhard	Doctor
Koch Georg	R. Offc.
Kotnik Herbert	2. Eng.
Schnürch Helmut	2. Eng.
Westphal Henning	2. Eng.
Holtz Hartmut	Elec. Eng.
Feiertag Thomas	ELO
Fröb Martin	ELO
Stronzek David	ELO
Winter Andreas	ELO
Clasen Burkhard	Boatsw.
Neisner Winfried	Carpenter
Burzan Gerd-Ekkehard	A.B.
Hartwig-Lab Andreas	A.B.
Kretzschmar Uwe	A.B.
Moser Siegfried	A.B.
Schröder Norbert	A.B.
Schröter Rene	A.B.
Schultz Ottomar	A.B.
Wippich Reinhard	A.B.
Wolf Alexander	A.B.
Beth Deltef	Storek.
Breitung Steven	Mot-man
Dinse Horst	Mot-man
Fritz Günter	Mot-man

Name	Rank
Krösche Eckhard	Mot-man
Watzel Bernhard	Mot-man
Fischer Matthias	Cook
Tupy Mario	Cooksmate
Völske Thomas	Cooksmate
Dinse Petra	1. Stwdess
Hennig Christina	Stwdess/N.
Chen Quan Lun	2. Steward
Gaude hans-Jürgen	2. Steward
Hischke Peggy	2. Stwdess
Hu Guo Yong	2. Steward
Wartenberg Irina	2. Stwdess
Ruan Hui Guang	Laundrym.

A.4 STATIONSLISTE / STATION LIST PS 78

Station	Date	Time	Position Latitude	Position Longitude	Depth (m)	Gear Abbr.	Action
PS78/ 0001-1	19.06.2011	12:14:00	64° 24,93' N	4° 39,76' E	1436	CTD/RO	on ground/ max depth
PS78/ 0002-1	20.06.2011	12:22:00	67° 47,22' N	5° 33,22' E	1294	CTD/RO	on ground/ max depth
PS78/ 0002-2	20.06.2011	13:05:00	67° 47,10' N	5° 33,20' E	1299	MN	on ground/ max depth
PS78/ 0002-3	20.06.2011	13:26:00	67° 47,08' N	5° 33,37' E	1302	MN	on ground/ max depth
PS78/ 0002-4	20.06.2011	13:41:00	67° 47,02' N	5° 33,35' E	1311	MN	on ground/ max depth
PS78/ 0003-1	23.06.2011	07:15:00	75° 0,24' N	7° 59,04' E	3276	CTD/RO	on ground/ max depth
PS78/ 0003-2	23.06.2011	07:36:00	75° 0,24' N	7° 59,13' E	3282	APSN	on ground/ max depth
PS78/ 0003-3	23.06.2011	09:32:00	75° 0,20' N	7° 58,08' E	3233	MN	on ground/ max depth
PS78/ 0003-4	23.06.2011	11:12:00	75° 0,70' N	7° 57,08' E	3266	BONGO	on ground/ max depth
PS78/ 0004-1	24.06.2011	04:00:00	76° 35,19' N	13° 30,52' E	943	APSN	on ground/ max depth
PS78/ 0005-1	24.06.2011	07:11:00	77° 0,35' N	12° 29,22' E	372	APSN	on ground/ max depth
PS78/ 0006-1	24.06.2011	11:48:00	77° 34,83' N	10° 59,81' E	355	APSN	on ground/ max depth
PS78/ 0007-1	24.06.2011	16:25:00	78° 10,01' N	9° 14,69' E	700	APSN	on ground/ max depth
PS78/ 0008-1	24.06.2011	21:25:00	78° 49,87' N	8° 39,28' E	271	MOR	on ground/ max depth
PS78/ 0009-1	24.06.2011	22:48:00	78° 49,99' N	9° 29,80' E	177	CTD/RO	on ground/ max depth
PS78/ 0010-1	24.06.2011	23:53:00	78° 49,76' N	9° 19,43' E	199	CTD/RO	on ground/ max depth
PS78/ 0011-1	25.06.2011	00:26:00	78° 49,95' N	9° 9,82' E	219	CTD/ RO/ MUC	on ground/ max depth
PS78/ 0012-1	25.06.2011	01:01:00	78° 49,87' N	8° 59,52' E	217	CTD/RO	on ground/ max depth
PS78/ 0013-1	25.06.2011	01:33:00	78° 50,07' N	8° 49,65' E	226	CTD/RO	on ground/ max depth
PS78/ 0014-1	25.06.2011	02:28:00	78° 49,96' N	8° 29,90' E	586	CTD/RO	on ground/ max depth
PS78/ 0014-2	25.06.2011	03:06:00	78° 50,08' N	8° 29,81' E	589	MUC	on ground/ max depth
PS78/ 0015-1	25.06.2011	04:52:00	78° 50,06' N	8° 39,25' E	259	MOR	on ground/ max depth
PS78/ 0016-1	25.06.2011	05:33:01	78° 50,18' N	8° 20,27' E	790	MOR	on ground/ max depth
PS78/ 0017-1	25.06.2011	07:05:00	78° 50,14' N	7° 59,50' E	1035	MOR	on ground/ max depth
PS78/ 0018-1	25.06.2011	09:45:00	78° 50,01' N	6° 59,49' E	1472	MOR	on ground/ max depth

Station	Date	Time	Position Latitude	Position Longitude	Depth (m)	Gear Abbr.	Action
PS78/ 0019-1	25.06.2011	12:36:00	78° 50,00' N	6° 0,87' E	1892	MOR	on ground/ max depth
PS78/ 0019-2	25.06.2011	15:22:00	78° 49,86' N	6° 0,44' E	2466	MN	on ground/ max depth
PS78/ 0019-3	25.06.2011	17:16:00	78° 50,05' N	6° 0,32' E	2471	MN	on ground/ max depth
PS78/ 0019-4	25.06.2011	18:17:00	78° 50,23' N	6° 1,06' E	2464	APSN	on ground/ max depth
PS78/ 0019-5	25.06.2011	19:08:00	78° 50,23' N	6° 1,74' E	2458	MN	on ground/ max depth
PS78/ 0019-6	25.06.2011	21:09:00	78° 50,00' N	6° 1,36' E	2460	CTD/RO	on ground/ max depth
PS78/ 0019-7	25.06.2011	22:20:00	78° 49,78' N	6° 0,14' E	2468	BONGO	on ground/ max depth
PS78/ 0019-8	26.06.2011	00:41:00	78° 49,35' N	5° 56,34' E	2494	MUC	on ground/ max depth
PS78/ 0020-1	26.06.2011	03:14:00	78° 50,00' N	6° 10,48' E	2358	CTD/RO	on ground/ max depth
PS78/ 0021-1	26.06.2011	05:07:00	78° 50,00' N	6° 20,77' E	2174	CTD/RO	on ground/ max depth
PS78/ 0022-2	26.06.2011	06:56:00	78° 49,90' N	6° 29,70' E	1987	APSN	on ground/ max depth
PS78/ 0022-1	26.06.2011	06:57:00	78° 49,90' N	6° 29,70' E	1987	CTD/RO	on ground/ max depth
PS78/ 0023-1	26.06.2011	08:55:00	78° 50,06' N	6° 39,64' E	1787	CTD/RO	on ground/ max depth
PS78/ 0024-1	26.06.2011	10:28:00	78° 50,04' N	6° 50,92' E	1605	CTD/RO	on ground/ max depth
PS78/ 0025-2	26.06.2011	11:43:00	78° 50,04' N	7° 0,12' E	1461	APSN	on ground/ max depth
PS78/ 0025-1	26.06.2011	11:59:00	78° 50,05' N	7° 0,20' E	1460	CTD/RO	on ground/ max depth
PS78/ 0025-3	26.06.2011	13:35:00	78° 49,85' N	7° 0,25' E	1468	MN	on ground/ max depth
PS78/ 0025-4	26.06.2011	14:40:00	78° 49,73' N	7° 0,82' E	1465	MN	on ground/ max depth
PS78/ 0025-5	26.06.2011	16:15:00	78° 49,53' N	7° 1,54' E	1461	MN	on ground/ max depth
PS78/ 0025-6	26.06.2011	17:09:00	78° 49,41' N	7° 2,24' E	1452	CTD/RO	on ground/ max depth
PS78/ 0025-7	26.06.2011	17:31:00	78° 49,35' N	7° 2,36' E	1453	BONGO	on ground/ max depth
PS78/ 0025-8	26.06.2011	18:09:00	78° 49,27' N	7° 3,30' E	1433	MIC	on ground/ max depth
PS78/ 0026-1	26.06.2011	21:08:00	78° 49,92' N	5° 0,39' E	2704	CAL	on ground/ max depth
PS78/ 0026-1	26.06.2011	22:12:00	78° 50,05' N	5° 0,23' E	2704	CAL	profile start
PS78/ 0026-1	27.06.2011	03:15:59	78° 50,00' N	4° 59,36' E	2704	CAL	profile end
PS78/ 0026-2	27.06.2011	05:49:00	78° 49,54' N	5° 2,05' E	2684	MOR	on ground/ max depth
PS78/ 0027-1	27.06.2011	07:11:00	78° 49,82' N	3° 59,98' E	2334	MOR	on ground/ max depth
PS78/ 0028-1	27.06.2011	10:02:00	78° 49,92' N	2° 48,46' E	2491	MOR	on ground/ max depth

Station	Date	Time	Position Latitude	Position Longitude	Depth (m)	Gear Abbr.	Action
PS78/ 0029-1	27.06.2011	13:06:00	78° 49,40' N	2° 46,59' E	2501	CTD/RO	on ground/ max depth
PS78/ 0030-2	27.06.2011	14:45:00	78° 49,95' N	2° 59,72' E	2465	APSN	on ground/ max depth
PS78/ 0030-1	27.06.2011	15:21:00	78° 49,87' N	3° 0,15' E	2463	CTD/RO	on ground/ max depth
PS78/ 0031-2	27.06.2011	17:29:01	78° 49,91' N	3° 20,27' E	2389	APSN	on ground/ max depth
PS78/ 0031-1	27.06.2011	17:42:00	78° 49,88' N	3° 20,28' E	2389	CTD/RO	on ground/ max depth
PS78/ 0032-1	27.06.2011	19:50:00	78° 50,03' N	3° 38,84' E	2309	CTD/RO	on ground/ max depth
PS78/ 0033-1	27.06.2011	22:18:00	78° 49,96' N	4° 19,72' E	2405	CTD/RO	on ground/ max depth
PS78/ 0034-2	28.06.2011	00:00:00	78° 50,03' N	4° 39,66' E	2577	APSN	on ground/ max depth
PS78/ 0034-1	28.06.2011	00:40:00	78° 49,88' N	4° 39,79' E	2536	CTD/RO	on ground/ max depth
PS78/ 0035-1	28.06.2011	03:11:00	78° 49,85' N	3° 59,17' E	2333	CTD/RO	on ground/ max depth
PS78/ 0035-3	28.06.2011	04:34:00	78° 50,04' N	3° 59,66' E	2340	APSN	on ground/ max depth
PS78/ 0035-2	28.06.2011	05:00:00	78° 50,07' N	3° 59,28' E	2336	MN	on ground/ max depth
PS78/ 0035-4	28.06.2011	06:18:00	78° 50,25' N	3° 59,32' E	2341	BONGO	on ground/ max depth
PS78/ 0035-5	28.06.2011	07:56:00	78° 50,36' N	3° 59,60' E	2348	MN	on ground/ max depth
PS78/ 0035-6	28.06.2011	09:35:00	78° 50,23' N	4° 0,99' E	2352	MN	on ground/ max depth
PS78/ 0035-7	28.06.2011	11:01:00	78° 49,67' N	4° 1,12' E	2352	MUC	on ground/ max depth
PS78/ 0036-1	28.06.2011	14:19:00	78° 49,62' N	2° 34,96' E	2525	CTD/RO	on ground/ max depth
PS78/ 0037-2	28.06.2011	16:22:00	78° 49,84' N	2° 13,60' E	2543	APSN	on ground/ max depth
PS78/ 0037-1	28.06.2011	16:40:00	78° 49,83' N	2° 13,56' E	2543	CTD/RO	on ground/ max depth
PS78/ 0038-1	28.06.2011	19:34:00	78° 49,91' N	1° 34,44' E	2547	CTD/RO	on ground/ max depth
PS78/ 0039-2	28.06.2011	21:43:00	78° 49,85' N	1° 53,64' E	2559	APSN	on ground/ max depth
PS78/ 0039-1	28.06.2011	22:08:00	78° 49,65' N	1° 52,79' E	2558	CTD/RO	on ground/ max depth
PS78/ 0039-2	28.06.2011	23:17:00	78° 49,15' N	1° 49,41' E	2556	BONGO	on ground/ max depth
PS78/ 0039-3	28.06.2011	23:58:00	78° 48,94' N	1° 46,64' E	2554	MN	on ground/ max depth
PS78/ 0039-4	29.06.2011	02:19:00	78° 50,06' N	1° 51,24' E	2560	MN	on ground/ max depth
PS78/ 0039-5	29.06.2011	04:12:00	78° 50,34' N	1° 44,88' E	2557	MN	on ground/ max depth
PS78/ 0039-6	29.06.2011	05:40:00	78° 50,34' N	1° 42,22' E	2558	MUC	on ground/ max depth
PS78/ 0040-1	29.06.2011	08:07:00	78° 50,22' N	1° 14,91' E	2534	CTD/RO	on ground/ max depth

Station	Date	Time	Position Latitude	Position Longitude	Depth (m)	Gear Abbr.	Action
PS78/ 0041-2	29.06.2011	09:44:00	78° 50,02' N	0° 57,79' E	2464	APSN	on ground/ max depth
PS78/ 0041-1	29.06.2011	10:20:00	78° 49,98' N	0° 55,92' E	2435	CTD/RO	on ground/ max depth
PS78/ 0042-1	29.06.2011	12:33:00	78° 49,98' N	0° 34,37' E	2544	CTD/RO	on ground/ max depth
PS78/ 0043-1	29.06.2011	14:36:00	78° 50,05' N	0° 18,75' E	2594	CTD/RO	on ground/ max depth
PS78/ 0044-2	29.06.2011	17:57:00	78° 49,92' N	0° 3,66' E	2636	APSN	on ground/ max depth
PS78/ 0044-1	29.06.2011	18:25:00	78° 49,83' N	0° 2,45' E	2637	CTD/RO	on ground/ max depth
PS78/ 0044-3	29.06.2011	19:54:00	78° 50,16' N	0° 4,91' E	2631	BONGO	on ground/ max depth
PS78/ 0044-4	29.06.2011	21:00:00	78° 49,87' N	0° 3,79' E	2633	MN	on ground/ max depth
PS78/ 0044-5	29.06.2011	22:18:00	78° 49,95' N	0° 5,07' E	2629	MN	on ground/ max depth
PS78/ 0044-6	30.06.2011	00:16:00	78° 49,84' N	0° 2,51' E	2637	MN	on ground/ max depth
PS78/ 0044-7	30.06.2011	02:26:00	78° 50,25' N	0° 4,48' E	2631	MUC	on ground/ max depth
PS78/ 0045-1	30.06.2011	07:19:59	78° 59,65' N	0° 1,01' E	2595	MOR	on ground/ max depth
PS78/ 0045-2	30.06.2011	07:21:00	78° 59,65' N	0° 0,95' E	2595	APSN	on ground/ max depth
PS78/ 0046-2	30.06.2011	10:52:00	79° 10,00' N	1° 29,96' W	2645	APSN	on ground/ max depth
PS78/ 0046-1	30.06.2011	11:50:59	79° 9,96' N	1° 29,95' W	2645	MOR	on ground/ max depth
PS78/ 0047-2	30.06.2011	15:55:00	78° 49,95' N	0° 13,63' W	2645	APSN	on ground/ max depth
PS78/ 0047-1	30.06.2011	16:35:00	78° 49,90' N	0° 15,54' W	2649	CTD	on ground/ max depth
PS78/ 0048-1	30.06.2011	18:51:00	78° 49,88' N	0° 31,40' W	2686	CTD/RO	on ground/ max depth
PS78/ 0049-1	30.06.2011	21:05:00	78° 50,11' N	0° 47,61' W	2662	CTD/RO	on ground/ max depth
PS78/ 0050-2	30.06.2011	22:46:00	78° 49,97' N	1° 5,68' W	2550	APSN	on ground/ max depth
PS78/ 0050-1	30.06.2011	23:22:00	78° 49,89' N	1° 6,27' W	2576	CTD/RO	on ground/ max depth
PS78/ 0051-1	01.07.2011	01:40:00	78° 49,73' N	1° 25,73' W	2683	CTD/RO	on ground/ max depth
PS78/ 0053-1	01.07.2011	07:52:00	78° 29,98' N	2° 5,02' W	2819	MOR	on ground/ max depth
PS78/ 0054-2	01.07.2011	12:20:00	78° 49,59' N	2° 0,03' W	2717	APSN	on ground/ max depth
PS78/ 0054-1	01.07.2011	12:27:00	78° 49,51' N	2° 0,06' W	2736	CTD/RO	on ground/ max depth
PS78/ 0054-2	01.07.2011	14:00:00	78° 50,01' N	2° 0,75' W	2713	BONGO	on ground/ max depth
PS78/ 0054-3	01.07.2011	15:42:00	78° 49,64' N	2° 3,34' W	2712	MN	on ground/ max depth
PS78/ 0054-4	01.07.2011	17:13:00	78° 49,96' N	1° 59,69' W	2715	MN	on ground/ max depth

Station	Date	Time	Position Latitude	Position Longitude	Depth (m)	Gear Abbr.	Action
PS78/ 0054-5	01.07.2011	18:47:00	78° 49,79' N	2° 0,21' W	2715	MN	on ground/ max depth
PS78/ 0054-6	01.07.2011	20:25:00	78° 50,01' N	2° 0,63' W	2713	MUC	on ground/ max depth
PS78/ 0055-1	01.07.2011	22:41:00	78° 49,85' N	1° 45,74' W	2711	CTD/RO	on ground/ max depth
PS78/ 0056-1	02.07.2011	02:41:00	78° 49,76' N	2° 20,00' W	2673	CTD/RO	on ground/ max depth
PS78/ 0057-1	02.07.2011	05:19:00	78° 49,58' N	2° 40,52' W	2617	CTD/RO	on ground/ max depth
PS78/ 0058-2	02.07.2011	10:04:00	78° 59,69' N	2° 54,36' W	2485	APSN	on ground/ max depth
PS78/ 0058-1	02.07.2011	10:41:59	78° 59,07' N	2° 56,06' W	2487	MOR	on ground/ max depth
PS78/ 0059-2	03.07.2011	08:16:00	78° 49,90' N	11° 0,40' W	348	APSN	on ground/ max depth
PS78/ 0059-1	03.07.2011	08:19:00	78° 49,91' N	11° 0,35' W	340	CTD/RO	on ground/ max depth
PS78/ 0060-1	03.07.2011	10:22:00	78° 52,56' N	10° 30,64' W	263	CTD/RO	on ground/ max depth
PS78/ 0061-2	03.07.2011	12:18:00	78° 49,54' N	9° 59,12' W	316	APSN	on ground/ max depth
PS78/ 0061-1	03.07.2011	12:24:00	78° 49,57' N	9° 59,16' W	324	CTD/RO	on ground/ max depth
PS78/ 0062-1	03.07.2011	14:41:00	78° 49,90' N	9° 29,07' W	196	CTD/RO	on ground/ max depth
PS78/ 0063-1	03.07.2011	16:29:00	78° 49,67' N	8° 58,67' W	247	CTD/RO	on ground/ max depth
PS78/ 0063-2	03.07.2011	16:36:01	78° 49,63' N	8° 58,45' W	471	APSN	on ground/ max depth
PS78/ 0064-1	03.07.2011	18:11:00	78° 48,20' N	8° 28,90' W	291	CTD/RO	on ground/ max depth
PS78/ 0065-1	03.07.2011	20:09:00	78° 48,93' N	8° 0,43' W	461	CTD/RO	on ground/ max depth
PS78/ 0066-1	03.07.2011	21:46:00	78° 48,62' N	7° 30,54' W	202	CTD/RO	on ground/ max depth
PS78/ 0066-2	03.07.2011	21:53:00	78° 48,55' N	7° 30,77' W	204	APSN	on ground/ max depth
PS78/ 0067-1	04.07.2011	00:17:00	78° 49,65' N	7° 1,35' W	250	CTD/RO	on ground/ max depth
PS78/ 0068-1	04.07.2011	02:06:00	78° 50,62' N	6° 31,76' W	288	CTD/RO	on ground/ max depth
PS78/ 0069-1	04.07.2011	03:53:00	78° 50,04' N	5° 59,51' W	356	CTD/RO	on ground/ max depth
PS78/ 0069-2	04.07.2011	03:59:00	78° 50,08' N	5° 59,60' W	355	APSN	on ground/ max depth
PS78/ 0070-1	04.07.2011	05:04:00	78° 50,14' N	5° 40,17' W	451	CTD/RO	on ground/ max depth
PS78/ 0071-1	04.07.2011	06:16:00	78° 49,87' N	5° 20,89' W	706	CTD/RO	on ground/ max depth
PS78/ 0071-2	04.07.2011	06:20:00	78° 49,88' N	5° 20,85' W	688	APSN	on ground/ max depth
PS78/ 0071-3	04.07.2011	07:23:00	78° 49,99' N	5° 20,09' W	707	MN	on ground/ max depth
PS78/ 0071-4	04.07.2011	08:24:00	78° 50,02' N	5° 19,62' W	715	MN	on ground/ max depth

Station	Date	Time	Position Latitude	Position Longitude	Depth (m)	Gear Abbr.	Action
PS78/ 0071-5	04.07.2011	09:34:00	78° 49,94' N	5° 19,91' W	711	MN	on ground/ max depth
PS78/ 0071-6	04.07.2011	10:28:00	78° 49,87' N	5° 20,87' W	688	BONGO	on ground/ max depth
PS78/ 0071-7	04.07.2011	11:02:00	78° 49,84' N	5° 21,37' W	682	MUC	on ground/ max depth
PS78/ 0072-1	04.07.2011	12:48:00	78° 49,88' N	4° 55,59' W	1117	CTD/RO	on ground/ max depth
PS78/ 0073-2	04.07.2011	14:20:01	78° 49,70' N	4° 36,63' W	1411	APSN	on ground/ max depth
PS78/ 0073-1	04.07.2011	14:41:00	78° 49,57' N	4° 36,82' W	1396	CTD/RO	on ground/ max depth
PS78/ 0074-1	04.07.2011	16:47:00	78° 49,73' N	4° 16,74' W	1695	CTD/RO	on ground/ max depth
PS78/ 0075-2	04.07.2011	18:28:00	78° 49,46' N	3° 55,65' W	1967	APSN	on ground/ max depth
PS78/ 0075-1	04.07.2011	18:47:00	78° 49,19' N	3° 55,37' W	1969	CTD/RO	on ground/ max depth
PS78/ 0075-3	04.07.2011	20:43:00	78° 49,26' N	3° 53,73' W	1993	MN	on ground/ max depth
PS78/ 0075-4	04.07.2011	22:50:00	78° 50,53' N	3° 53,76' W	2018	MN	on ground/ max depth
PS78/ 0075-5	05.07.2011	00:47:00	78° 49,65' N	3° 54,50' W	1996	MN	on ground/ max depth
PS78/ 0075-6	05.07.2011	02:22:00	78° 49,96' N	3° 49,98' W	2051	BONGO	on ground/ max depth
PS78/ 0075-7	05.07.2011	03:17:00	78° 49,79' N	3° 52,26' W	2021	MUC	on ground/ max depth
PS78/ 0076-1	05.07.2011	05:04:00	78° 49,71' N	3° 33,46' W	2265	CTD/RO	on ground/ max depth
PS78/ 0077-1	05.07.2011	07:11:00	78° 48,00' N	3° 18,52' W	2407	CTD/RO	on ground/ max depth
PS78/ 0078-2	05.07.2011	10:26:00	78° 50,28' N	2° 59,22' W	2128	APSN	on ground/ max depth
PS78/ 0078-1	05.07.2011	10:59:00	78° 49,57' N	2° 59,83' W	2135	CTD/RO	on ground/ max depth
PS78/ 0079-1	05.07.2011	13:52:00	78° 49,90' N	1° 59,52' W	2490	APSN	on ground/ max depth
PS78/ 0080-1	05.07.2011	15:45:00	78° 49,95' N	1° 0,14' W	2550	APSN	on ground/ max depth
PS78/ 0081-1	05.07.2011	17:38:00	78° 50,28' N	0° 0,30' E	2644	APSN	on ground/ max depth
PS78/ 0082-1	05.07.2011	20:26:00	78° 50,17' N	0° 58,83' E	2489	APSN	on ground/ max depth
PS78/ 0083-1	05.07.2011	22:46:00	78° 49,99' N	1° 57,78' E	2556	APSN	on ground/ max depth
PS78/ 0084-2	06.07.2011	01:13:00	78° 50,04' N	2° 47,67' E	2496	APSN	on ground/ max depth
PS78/ 0084-1	06.07.2011	01:56:00	78° 50,26' N	2° 45,67' E	2499	CTD/RO	on ground/ max depth
PS78/ 0084-3	06.07.2011	05:23:01	78° 50,04' N	2° 46,63' E	2499	MOR	on ground/ max depth
PS78/ 0085-1	06.07.2011	08:07:00	78° 49,87' N	3° 59,70' E	2336	CTD/RO	on ground/ max depth
PS78/ 0085-2	06.07.2011	10:20:00	78° 50,03' N	4° 0,50' E	2343	APSN	on ground/ max depth

Station	Date	Time	Position Latitude	Position Longitude	Depth (m)	Gear Abbr.	Action
PS78/ 0086-1	06.07.2011	11:36:00	78° 49,98' N	4° 0,08' E	2341	MOR	on ground/ max depth
PS78/ 0087-2	06.07.2011	13:16:00	78° 50,47' N	3° 0,16' E	2455	APSN	on ground/ max depth
PS78/ 0087-1	06.07.2011	14:01:00	78° 50,72' N	3° 0,42' E	2451	CTD/RO	on ground/ max depth
PS78/ 0087-3	06.07.2011	15:24:00	78° 50,85' N	2° 59,76' E	2451	MN	on ground/ max depth
PS78/ 0087-4	06.07.2011	16:50:00	78° 51,35' N	3° 0,56' E	2447	MUC	on ground/ max depth
PS78/ 0088-2	06.07.2011	21:41:00	78° 49,78' N	5° 21,07' E	2622	APSN	on ground/ max depth
PS78/ 0088-1	06.07.2011	21:56:00	78° 49,63' N	5° 21,92' E	2615	CTD/RO	on ground/ max depth
PS78/ 0089-2	06.07.2011	23:54:00	78° 49,92' N	5° 0,64' E	2703	APSN	on ground/ max depth
PS78/ 0089-1	07.07.2011	00:16:00	78° 49,94' N	5° 0,63' E	2704	CTD/RO	on ground/ max depth
PS78/ 0089-3	07.07.2011	02:21:00	78° 49,61' N	5° 2,69' E	2683	MN	on ground/ max depth
PS78/ 0090-1	07.07.2011	07:19:00	78° 49,96' N	5° 0,09' E	2705	MOR	on ground/ max depth
PS78/ 0091-1	07.07.2011	09:08:00	78° 49,00' N	4° 59,98' E	2689	MOR	on ground/ max depth
PS78/ 0092-2	07.07.2011	10:54:00	78° 50,00' N	5° 30,10' E	2610	APSN	on ground/ max depth
PS78/ 0092-1	07.07.2011	11:15:00	78° 50,01' N	5° 30,40' E	2609	CTD/RO	on ground/ max depth
PS78/ 0092-3	07.07.2011	12:58:00	78° 50,00' N	5° 30,09' E	2610	MOR	on ground/ max depth
PS78/ 0093-2	07.07.2011	14:24:00	78° 50,15' N	5° 41,05' E	2571	APSN	on ground/ max depth
PS78/ 0093-1	07.07.2011	14:26:00	78° 50,15' N	5° 41,03' E	2571	CTD/RO	on ground/ max depth
PS78/ 0094-1	07.07.2011	16:17:00	78° 50,23' N	5° 50,25' E	2532	CTD/RO	on ground/ max depth
PS78/ 0095-1	07.07.2011	18:21:00	78° 50,10' N	6° 10,70' E	2353	CTD/RO	on ground/ max depth
PS78/ 0096-1	07.07.2011	20:06:00	78° 49,95' N	6° 19,24' E	2205	CTD/RO	on ground/ max depth
PS78/ 0097-1	07.07.2011	21:43:00	78° 49,96' N	6° 24,93' E	2083	CTD/RO	on ground/ max depth
PS78/ 0098-1	07.07.2011	23:17:00	78° 50,19' N	6° 30,43' E	1960	CTD/RO	on ground/ max depth
PS78/ 0099-1	08.07.2011	00:38:00	78° 50,19' N	6° 35,42' E	1866	CTD/RO	on ground/ max depth
PS78/ 0100-1	08.07.2011	02:54:00	78° 50,16' N	6° 0,99' E	2464	CTD/RO	on ground/ max depth
PS78/ 0100-2	08.07.2011	04:13:00	78° 50,32' N	6° 1,78' E	2460	MUC	on ground/ max depth
PS78/ 0100-3	08.07.2011	07:25:00	78° 50,01' N	5° 59,98' E	2470	MOR	on ground/ max depth
PS78/ 0101-1	08.07.2011	08:46:00	78° 47,96' N	6° 0,18' E	2456	CTD/RO	on ground/ max depth
PS78/ 0101-2	08.07.2011	11:34:00	78° 47,97' N	6° 0,17' E	2455	MOR	on ground/ max depth

Station	Date	Time	Position Latitude	Position Longitude	Depth (m)	Gear Abbr.	Action
PS78/ 0102-1	08.07.2011	13:57:00	78° 50,02' N	7° 0,02' E	1459	MOR	on ground/ max depth
PS78/ 0102-2	08.07.2011	14:55:00	78° 50,91' N	7° 0,82' E	1440	CTD/RO	on ground/ max depth
PS78/ 0103-1	08.07.2011	16:36:00	78° 50,26' N	6° 40,18' E	1777	CTD/RO	on ground/ max depth
PS78/ 0104-1	08.07.2011	18:00:00	78° 50,11' N	6° 46,56' E	1664	CTD/RO	on ground/ max depth
PS78/ 0105-1	08.07.2011	19:19:00	78° 50,04' N	6° 49,57' E	1630	CTD/RO	on ground/ max depth
PS78/ 0106-1	08.07.2011	20:57:00	78° 49,91' N	7° 10,20' E	1347	CTD/RO	on ground/ max depth
PS78/ 0107-1	08.07.2011	22:09:00	78° 50,10' N	7° 20,08' E	1232	CTD/RO	on ground/ max depth
PS78/ 0108-1	08.07.2011	23:28:00	78° 50,03' N	7° 29,59' E	1169	CTD/RO	on ground/ max depth
PS78/ 0109-1	09.07.2011	00:37:00	78° 49,99' N	7° 40,22' E	1104	CTD/RO	on ground/ max depth
PS78/ 0110-1	09.07.2011	01:48:00	78° 49,86' N	7° 50,14' E	1076	CTD/RO	on ground/ max depth
PS78/ 0111-1	09.07.2011	02:57:00	78° 49,99' N	8° 4,77' E	987	CTD/RO	on ground/ max depth
PS78/ 0112-2	09.07.2011	07:08:00	78° 45,12' N	6° 0,38' E	2341	APSN	on ground/ max depth
PS78/ 0112-1	09.07.2011	07:09:00	78° 45,12' N	6° 0,39' E	2341	CTD/RO	on ground/ max depth
PS78/ 0112-3	09.07.2011	11:40:00	78° 44,91' N	6° 0,21' E	2325	GLD	on ground/ max depth
PS78/ 0113-1	09.07.2011	16:37:00	78° 49,99' N	8° 10,78' E	930	CTD/RO	on ground/ max depth
PS78/ 0114-1	09.07.2011	17:37:00	78° 50,05' N	8° 15,57' E	866	CTD/RO	on ground/ max depth
PS78/ 0115-1	09.07.2011	18:32:00	78° 50,01' N	8° 19,74' E	798	CTD/RO	on ground/ max depth
PS78/ 0116-1	09.07.2011	19:20:00	78° 50,02' N	8° 24,97' E	703	CTD/RO	on ground/ max depth
PS78/ 0117-1	09.07.2011	20:06:00	78° 50,08' N	8° 30,11' E	583	CTD/RO	on ground/ max depth
PS78/ 0118-1	09.07.2011	20:47:00	78° 49,98' N	8° 34,82' E	452	CTD/RO	on ground/ max depth
PS78/ 0119-1	09.07.2011	21:21:00	78° 50,01' N	8° 40,16' E	244	CTD/RO	on ground/ max depth
PS78/ 0120-1	09.07.2011	21:47:00	78° 49,97' N	8° 45,13' E	219	CTD/RO	on ground/ max depth
PS78/ 0121-1	09.07.2011	22:21:00	78° 50,06' N	8° 49,76' E	227	CTD/RO	on ground/ max depth
PS78/ 0122-1	09.07.2011	23:01:00	78° 50,05' N	8° 59,94' E	219	CTD/RO	on ground/ max depth
PS78/ 0123-1	09.07.2011	23:37:00	78° 50,01' N	9° 10,05' E	221	CTD/RO	on ground/ max depth
PS78/ 0124-1	10.07.2011	00:15:00	78° 49,97' N	9° 20,01' E	204	CTD/RO	on ground/ max depth
PS78/ 0125-1	10.07.2011	00:50:00	78° 49,95' N	9° 29,65' E	172	CTD/RO	on ground/ max depth
PS78/ 0126-1	10.07.2011	02:51:00	78° 50,14' N	8° 19,60' E	801	CTD/RO	on ground/ max depth

Station	Date	Time	Position Latitude	Position Longitude	Depth (m)	Gear Abbr.	Action
PS78/ 0126-2	10.07.2011	06:39:00	78° 50,07' N	8° 20,13' E	792	MOR	on ground/ max depth
PS78/ 0127-1	10.07.2011	08:04:00	78° 49,99' N	7° 60,00' E	1031	MOR	on ground/ max depth
PS78/ 0127-2	10.07.2011	08:56:00	78° 49,82' N	8° 1,00' E	1021	CTD/RO	on ground/ max depth
PS78/ 0127-3	10.07.2011	08:57:00	78° 49,81' N	8° 0,99' E	1021	APSN	on ground/ max depth
PS78/ 0127-4	10.07.2011	09:44:00	78° 49,65' N	8° 1,49' E	1018	BONGO	on ground/ max depth
PS78/ 0127-5	10.07.2011	10:33:00	78° 49,67' N	8° 1,10' E	1021	MN	on ground/ max depth
PS78/ 0127-6	10.07.2011	11:57:00	78° 49,55' N	8° 0,66' E	1027	MN	on ground/ max depth
PS78/ 0127-7	10.07.2011	13:06:00	78° 49,42' N	8° 0,23' E	1027	MN	on ground/ max depth
PS78/ 0127-8	10.07.2011	14:29:00	78° 49,41' N	7° 59,99' E	1029	MUC	on ground/ max depth
PS78/ 0128-1	10.07.2011	23:50:00	77° 39,84' N	7° 14,89' E	2796	MOR	on ground/ max depth
PS78/ 0129-1	11.07.2011	10:58:01	78° 50,08' N	8° 39,50' E	251	MOR	on ground/ max depth
PS78/ 0130-1	11.07.2011	14:03:00	78° 50,03' N	9° 0,09' E	220	CTD/RO	on ground/ max depth
PS78/ 0131-1	11.07.2011	14:54:00	78° 49,93' N	8° 40,16' E	245	CTD/RO	on ground/ max depth
PS78/ 0132-1	11.07.2011	15:36:00	78° 49,98' N	8° 30,39' E	574	CTD/RO	on ground/ max depth
PS78/ 0133-1	11.07.2011	16:27:00	78° 49,96' N	8° 20,23' E	784	CTD/RO	on ground/ max depth
PS78/ 0134-1	11.07.2011	17:47:00	78° 49,94' N	8° 0,07' E	1029	CTD/RO	on ground/ max depth
PS78/ 0135-1	11.07.2011	19:07:00	78° 50,04' N	7° 40,02' E	1106	CTD/RO	on ground/ max depth
PS78/ 0136-1	11.07.2011	20:36:00	78° 50,14' N	7° 20,14' E	1233	TEST	on ground/ max depth
PS78/ 0136-2	11.07.2011	21:56:00	78° 49,94' N	7° 20,32' E	1232	CTD/RO	on ground/ max depth
PS78/ 0137-1	11.07.2011	23:28:00	78° 50,12' N	6° 59,77' E	1459	CTD/RO	on ground/ max depth
PS78/ 0137-2	12.07.2011	00:06:00	78° 50,11' N	6° 59,57' E	1462	MOR	on ground/ max depth
PS78/ 0137-3	12.07.2011	00:52:00	78° 50,52' N	6° 59,75' E	1453	MOR	on ground/ max depth
PS78/ 0137-4	12.07.2011	05:26:01	78° 50,01' N	6° 59,93' E	1460	MOR	on ground/ max depth

Abbreviation list:
CTD/RO – CTD cast with water samples
MOR – Mooring recovery or deployment
MUC – Multicorer cast
MN – Multinet cast
BONGO – Bongo net cast
APSN - Apstein net cast
GLD – Glider deployment or recovery
CAL – Posidonia calibration

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