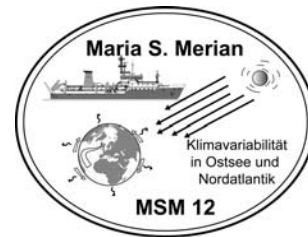


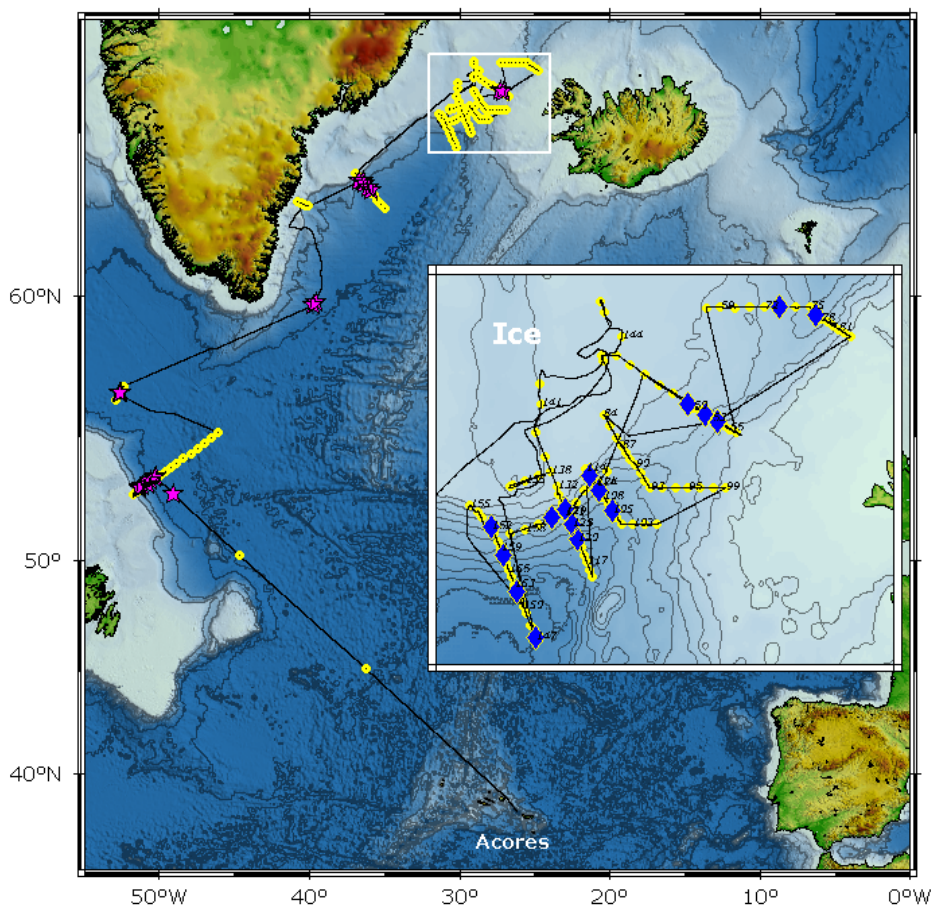
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Summary Cruise Report RV MARIA S. MERIAN Cruise MSM12-1

Pt. Delgada - Reykjavik
12. May – 15. June 2009
Chief Scientist: Detlef Quadfasel
Captain: Karl Friedhelm von Staa



Ship track of RV Maria S. Merian cruise MSM12-1 in the Labrador Sea, Irminger Sea and Greenland Sound with locations of moorings (magenta stars), CTD/IADCP casts (yellow dots) and micro structure casts (blue diamonds) marked.

Objectives

In the present state of our climate the northern North Atlantic is one of the major sources for the deep waters of the World Oceans and thus influences or even determines the global deep ocean circulation. Dense water from the Nordic Seas and the Labrador Sea move southward at depth and is replenished near the surface by a northward flow of warm water. During RV MARIA S MERIAN cruise MSM12-1 we studied the three major sources of North Atlantic Deep Water: the overflow through Denmark Strait, the entrainment of ambient waters into the overflow plume and the production and export of deep water from the Labrador Sea.

Expedition MSM12-1 had two regional components:

- (1) A study of the different branches of the deep circulation in the Labrador Sea and the associated distribution of water masses.
 - Changes of the water mass characteristics in relation to the variability of deep convection in the Labrador Sea.
 - Variability of the export of deep waters from the Labrador Sea.
- (2) A study of the overflow plume of Denmark Strait between the sill and Cape Farewell.
 - Fluctuations in the export of dense Nordic Sea water through Denmark Strait.
 - Changes in water mass composition and plume transport as a result of vertical and horizontal entrainment of ambient waters into the plume.

Both regional studies made use of data collected with long-term moored instrumentation, current profile measurements with a lowered Acoustic Doppler profiler (LADCP) and with the ADCP (Ocean Surveyor) mounted in the ship's hull. CTD-O₂ profiles and Microstructure profiles were taken along several sections to determine the characteristics and distribution and the mixing of water masses.

RV Maria S. Merian cruise MSM12-1 was carried out jointly by the Institut für Meereskunde at the KlimaCampus of the University of Hamburg and IfM-GEOMAR at the University of Kiel. Scientists and technicians from the Lowestoft Laboratory of CEFAS, the Finnish Meteorological Institute and the Shirshov Institute of Oceanology of the Russian Academy of Sciences also participated in the cruise. Six students from the Universities of Hamburg, East Anglia and Paris got their first *in-situ* training.

Narrative

Transit to the Labrador Sea, 13.-18. Mai 2009

RV Maria S. Merian sailed from the port of Pt. Delgada at 9 a.m on May 13th, setting course for the southern Labrador Sea. During this transit instruments were set up, moorings were prepared and a couple of test stations were run. We discussed and defined projects to be tackled by the students during the cruise.

Labrador Sea work, 18.-26. May 2009

Guided by the latest ARGOS position we started the search for the drifting mooring K9 at 6 a.m. on May 18th and were lucky to spot the top buoy just before breakfast. The mooring, or better said, the remains of it, were safely on deck at 10:17 a.m. The wire was entangled and broken at several places, but only one temperature recorder and an Aanderaa current meter was lost. The reason for the premature release of K9 was a corroded ring below the acoustic releasers.

During the following days moorings K10 and K8 were safely recovered. Also here chains and shackles below the acoustic releasers were heavily corroded. The nights between mooring recoveries and deployments were spent on CTD/LADCP work along the mooring section. At the shallow end of the section, near the shelf break, we entered a multiyear ice field that prevented us from proceeding further onto the shelf. The outbound CTD section was started at a water depth of 400 m, in the narrow and shallow buoyancy driven boundary current. The weather services predicted a storm to develop during the evening of May 20th, and we decided to deploy the rest of the moorings during that day. All hands were on deck to assemble the buoyancy packages and the instruments, and to help with the deployments. Our four mooring technicians and the deck crew did a great job during this day: K9 was in the water at 10:51 a.m., DSOW-1 at 12:17 p.m., DSOW-2 at 03:34 p.m. and finally K10 at 08:30 p.m. Winds by that time had increased to 6 Bft, but the mooring array covering the deep western boundary current at the exit of the Labrador Sea was in place in time. It will provide valuable data for the study of long term variability of this important component of the Atlantic Meridional Overturning Circulation.

Shortly after lunch on May 23rd the last CTD of the section was occupied and Merian steamed towards the Central Labrador Sea Mooring K1, located near the site of former weather ship Bravo. When approaching K1 the site was occupied by the Canadian CGS Hudson, taking a CTD station there. This station lies on the former WOCE section AR7E from Greenland to Newfoundland, which is run annually by our Canadian colleague Igor Yashayaev. Via VHF the latest information about the state of the Labrador Sea was exchanged and Merian went westward to occupy a CTD station 15 miles off the mooring site. K1 was recovered on May 25th and re-deployed during the afternoon and after one more CTD cast north of K1 Merian set course for the southern Irminger Sea, where the CIS mooring was to be taken care of.

Irminger Sea work, 27. May – 2. June 2009

The Central Irminger Sea (CIS) mooring in a water depth of 2800 m was reached at 7:30 a.m. on May 27th and recovered in little more than 3 hours. By then the wind had picked up to 8 Bft. and it was not clear whether we could re-deploy or not. In the early afternoon wind speeds dropped a little and we started the deployment at 3:56 p.m. As soon as the first few instruments were in the water the wind picked up again and by the time to the anchor release at 6:53 p.m. it was blowing with force 9. Occasionally waves swept over the aft deck. After the deployment Merian set course to the shelf ADCP mooring near 63° N. Progress towards that mooring was little. Due to head winds of up to 11 Bft we only managed to cover 102 miles during 24 hours. In the evening wind speeds went down to 7 Bft. Unfortunately, it turned out that this mooring was protected by a 3-miles wide barrier of thick multi-year ice and there was no chance to get close to it. After taking the obligatory group photo with the snow covered mountains of Greenland in the background we ran closely spaced CTD stations on a section from the ice edge to the continental slope, covering the shallow and fresh water of the East Greenland Current.

Mooring F1/F2 on the Angmagssalik Array was reached just after lunch on May 30th but failed to respond to the acoustic signals. As the plan was to recover all moorings during the day we continued to UK-1 which came up without hesitation. The good mood was again destroyed when also mooring G1 did not respond, but finally UK-2, the deepest mooring on the section, was safely on deck at 10:15 p.m. The search and dragging gear was prepared to go for the two missing moorings the next day. The night and day were spent with CTD and microstructure profiling, since the mooring gear had to be maintained before re-deployment. After dinner we re-deployed mooring UK-2, which was in the water at 7:32 p.m. During the night the CTD work continued. At 6 a.m. on June 1st Merian reached the position of mooring G1 that had failed to release two days earlier. The dragging gear was deployed, but when it came to connecting the anchor cable with the towing wire, the forerunner broke and the anchors were lost. This was the end of

trying to recover the moorings the hard way, and it will be up to RV Meteor next year to continue the search. CTD work continued after this operation, interrupted by the re-deployments of moorings G1 and F2 further up onto the continental slope. CTD work ended at 2:35 a.m. and this year's work at the Angmassaglik line was completed. During the day we steamed towards the sill section in Denmark Strait that was reached just before midnight.

Greenland Sound work, 3.-14. June 2009

Starting on the East Greenland shelf we occupied the sill section of Denmark Strait with closely spaced CTD and microstructure measurements. The two ADCP moorings that monitor the strength of the overflow were recovered and the Hamburg mooring HHDS2 was re-deployed immediately. Data from the two ADCPs turned out to be very clean, with annual mean speeds of 35 and 50 cm/s in the overflow core including barotropic components of 15 and 30 cm/s. The section was completed at 8 p.m. on June 3rd. The transit time to the northern section was used to baptize 14 members of the scientific and ship's crews on the occasion of the crossing of the Polar Circle.

Work on the northern CTD section started at 1 a.m. and was completed 25 hours later. During this time we also attempted to acoustically read out the data from an Inverted Echo Sounder deployed at the eastern end of that section two years ago. No contact could be made to the instrument mounted in a Lander at the ocean bottom and it was decided to release it. This attempt failed too, and since we did not have any dragging gear, the recovery has to be done with Meteor next year.

Shortly after breakfast on June 5th we re-deployed the Icelandic ADCP mooring DS1 on the sill section. This was the end of the mooring work and the remainder of the cruise was dedicated to hydrographic and microstructure profiling in the overflow plume south of the sill in Denmark Strait, which now - politically correct – is called Greenland Sound. In all about 120 CTD/IADCP and 30 Microstructure profiles were taken along 6 sections crossing the overflow plume. Heavy ice conditions on the East Greenland Shelf prevented us to map the shallow part of the overflow hugging on the shelf break, but in all the survey of the plume was highly successful and provided a wealth of data. The sea passage ended early in the morning on Sunday, June 14th, the Reykjavik pilot came on board at 9 a.m. and RV Maria S. Merian went alongside at 10 p.m. in the old harbour of Reykjavik.

On request by the German Embassy in Reykjavik a reception was held on Sunday afternoon. Among the guests were the Icelandic Foreign minister, several Ambassadors and colleagues from the Icelandic scientific community.

Acknowledgements

We like to thank Captain Friedrich von Staa, his officers and the crew of RV Maria S. Merian for their support of our measurement programme and for creating a very friendly atmosphere on board. We also appreciate that Thor was in a good mood during almost all the time providing us with weather allowing an efficient use of the cruise time.

The ship time of Merian was provided by the Deutsche Forschungsgemeinschaft within the core program METEOR/MERIAN. Financial support for the different projects carried out during the cruise was provided through the EU-Projects EuroSITES and THOR and the German Ministry of Education and Research (Nordatlantik Programm). We also benefited from financial contributions by the research institutes involved. We gratefully acknowledge this support.

Cruise participants

Quadfasel, Detlef	Chief Scientist	IfM-ZMAW
Baranov, Vladimir	microstructure	SIO
Drübbisch, Ulrich	moorings	IfM-ZMAW
Esser, Katharina	student	IfM-ZMAW
Gimmerthal, Sönke	student	IfM-ZMAW
Hall, Stewart	student	CEFAS
Karstensen, Johannes	moorings,CTD	IFM-GEOMAR
Kondrashov, Alexey	microstructure	SIO
Kortz, Eike	student	IfM-ZMAW
Milon, Pierre	student	ENSTA
Müller-Michaelis, Antje	CTD	IfM-ZMAW
Needham, Neil	moorings	CEFAS
Niehus, Gerd	moorings	IFM-GEOMAR
Nunes, Nuno	ADCP, JChSc.	IFM-GEOMAR
Paka, Vadim	microstructure	SIO
Papenburg, Uwe	mooring	IFM-ZMAW
Pokuvalov, Alexander	microstructure	SIO
Rudels, Bert	CTD	FMI
Schneehorst, Anja	student	IfM-ZMAW
Verch, Norbert	salinometry, oxygen	IfM-ZMAW
Wasilewski, Thomas	data management	IfM-ZMAW

IfM-ZMAW: Institut für Meereskunde, KlimaCampus,
University of Hamburg, Germany

SIO: P.P. Shirshov Institute of Oceanology, Kalininigrad, Russia

CEFAS: Centre for Environment, Fishery and Aquaculture Sciences
Lowestoft Laboratory, U.K.

IFM-GEOMAR: Leibniz Institut für Meereswissenschaften
University of Kiel, Germany

ENSTA Ecole Nationale Supérieure des Techniques Avancées,
Paris, France

FMI: Finnish Meteorological Institute, Helsinki, Finland

List of Stations

CTD	Conductivity-Temperature-Depth sonde
ROS	Rosette water sampler
LADCP	lowered Acoustic Doppler Profiler
MSS	Microstructure sonde
MOR	Mooring
DRG	Dredging
ADCP profile	profile run with shipboard ADCP
BE	Begin of station
BO	Near bottom reached on station
EN	End of station

06/MSM12/1	618	1	156 CTD/ROS/LADCP	11.06.09	0:58:00	BE	65° 03.00	N 30° 42.96	W 1819			
06/MSM12/1	618	1	156 CTD/ROS/LADCP	11.06.09	1:36:00	BO	65° 03.00	N 30° 42.97	W 1820	1814	1.7	
06/MSM12/1	618	1	156 CTD/ROS/LADCP	11.06.09	2:12:00	EN	65° 03.00	N 30° 42.96	W 1819			
06/MSM12/1	619	1	157 CTD/ROS/LADCP	11.06.09	2:40:00	BE	65° 06.02	N 30° 46.03	W 1722			
06/MSM12/1	619	1	157 CTD/ROS/LADCP	11.06.09	3:12:00	BO	65° 06.02	N 30° 46.03	W 1723	1710	4.7	
06/MSM12/1	619	1	157 CTD/ROS/LADCP	11.06.09	3:44:00	EN	65° 06.02	N 30° 46.03	W 1722			
06/MSM12/1	620	1	158 CTD/ROS/LADCP	11.06.09	4:13:00	BE	65° 09.02	N 30° 49.01	W 1556			
06/MSM12/1	620	1	158 CTD/ROS/LADCP	11.06.09	4:46:00	BO	65° 09.02	N 30° 49.01	W 1556	1540	7	MSS cast failed (not released)
06/MSM12/1	620	1	158 CTD/ROS/LADCP	11.06.09	5:36:00	EN	65° 09.02	N 30° 49.01	W 1556			
06/MSM12/1	621	1	159 CTD/ROS/LADCP	11.06.09	6:31:00	BE	65° 11.98	N 30° 51.99	W 1416			
06/MSM12/1	621	1	159 CTD/ROS/LADCP	11.06.09	7:02:00	BO	65° 11.98	N 30° 51.99	W 1416	1400	7	
06/MSM12/1	621	1	159 CTD/ROS/LADCP	11.06.09	7:32:00	EN	65° 11.98	N 30° 51.99	W 1416			
06/MSM12/1	622	1	160 CTD/ROS/LADCP	11.06.09	8:00:00	BE	65° 14.99	N 30° 55.00	W 1250			
06/MSM12/1	622	1	160 CTD/ROS/LADCP	11.06.09	8:27:00	BO	65° 14.99	N 30° 55.00	W 1250	1237	6	
06/MSM12/1	622	1	160 CTD/ROS/LADCP	11.06.09	9:13:00	EN	65° 14.99	N 30° 55.03	W 1251			
06/MSM12/1	623	1	161 CTD/ROS/LADCP	11.06.09	9:58:00	BE	65° 17.98	N 30° 57.95	W 1101			
06/MSM12/1	623	1	161 CTD/ROS/LADCP	11.06.09	10:23:00	BO	65° 17.98	N 30° 57.95	W 1103	1082	9	
06/MSM12/1	623	1	161 CTD/ROS/LADCP	11.06.09	10:45:00	EN	65° 17.98	N 30° 57.95	W 1101			
06/MSM12/1	624	1	162 CTD/ROS/LADCP	11.06.09	11:25:00	BE	65° 20.96	N 31° 00.88	W 934			
06/MSM12/1	624	1	162 CTD/ROS/LADCP	11.06.09	11:47:00	BO	65° 20.96	N 31° 00.88	W 937	917	8	MSS fired at 640 db
06/MSM12/1	624	1	162 CTD/ROS/LADCP	11.06.09	12:23:00	EN	65° 20.95	N 31° 00.88	W 935			
06/MSM12/1	625	1	163 CTD/ROS/LADCP	11.06.09	13:48:00	BE	65° 24.68	N 31° 11.12	W 729			
06/MSM12/1	625	1	163 CTD/ROS/LADCP	11.06.09	14:08:00	BO	65° 24.01	N 31° 11.35	W 735	716	7.3	
06/MSM12/1	625	1	163 CTD/ROS/LADCP	11.06.09	14:24:00	EN	65° 24.58	N 31° 11.50	W 745			
06/MSM12/1	626	1	164 CTD/ROS/LADCP	11.06.09	15:15:00	BE	65° 27.23	N 31° 15.73	W 581			
06/MSM12/1	626	1	164 CTD/ROS/LADCP	11.06.09	15:30:00	BO	65° 27.11	N 31° 15.80	W 594	575	6.8	
06/MSM12/1	626	1	164 CTD/ROS/LADCP	11.06.09	15:43:00	EN	65° 27.00	N 31° 16.14	W 609			
06/MSM12/1	627	1	165 CTD/ROS	11.06.09	16:38:38	BE	65° 29.70	N 31° 23.33	W 405			
06/MSM12/1	627	1	165 CTD/ROS	11.06.09	16:55:00	BO	65° 29.53	N 31° 23.89	W 438	425	8.5	
06/MSM12/1	627	1	165 CTD/ROS	11.06.09	17:07:00	EN	65° 29.38	N 31° 24.32	W 468			
06/MSM12/1	628	1	166 CTD/ROS/LADCP	11.06.09	21:52:00	BE	64° 47.99	N 30° 27.90	W 2195			
06/MSM12/1	628	1	166 CTD/ROS/LADCP	11.06.09	22:36:00	BO	64° 47.77	N 30° 27.43	W 2202	2196	5	Microcats calibration
06/MSM12/1	628	1	166 CTD/ROS/LADCP	11.06.09	23:54:00	EN	64° 47.44	N 30° 26.74	W 2204			
06/MSM12/1	629	1	167 CTD/ROS/LADCP	12.06.09	2:41:00	BE	65° 18.00	N 30° 41.02	W 1073			
06/MSM12/1	629	1	167 CTD/ROS/LADCP	12.06.09	3:04:00	BO	65° 18.00	N 30° 41.01	W 1075	1062	6	MSS fired at 710 db
06/MSM12/1	629	1	167 CTD/ROS/LADCP	12.06.09	3:42:00	EN	65° 18.00	N 30° 41.02	W 1075			
06/MSM12/1	630	1	168 CTD/ROS/LADCP	12.06.09	4:48:00	BE	65° 19.99	N 30° 26.06	W 984			
06/MSM12/1	630	1	168 CTD/ROS/LADCP	12.06.09	5:11:00	BO	65° 19.99	N 30° 26.06	W 986	970	10	
06/MSM12/1	630	1	168 CTD/ROS/LADCP	12.06.09	5:33:00	EN	65° 19.99	N 30° 26.06	W 985			
06/MSM12/1	631	1	169 CTD/ROS/LADCP	12.06.09	6:28:00	BE	65° 22.01	N 30° 12.04	W 931			
06/MSM12/1	631	1	169 CTD/ROS/LADCP	12.06.09	6:50:00	BO	65° 22.02	N 30° 12.21	W 930	916	7	
06/MSM12/1	631	1	169 CTD/ROS/LADCP	12.06.09	7:12:00	EN	65° 22.02	N 30° 12.64	W 929			
06/MSM12/1	632	1	170 CTD/ROS/LADCP	12.06.09	8:00:00	BE	65° 25.01	N 29° 58.05	W 877			
06/MSM12/1	632	1	170 CTD/ROS/LADCP	12.06.09	8:20:00	BO	65° 25.03	N 29° 58.45	W 870	855	10	MSS fired at 502 db
06/MSM12/1	632	1	170 CTD/ROS/LADCP	12.06.09	8:58:00	EN	65° 24.89	N 29° 59.45	W 875			
06/MSM12/1	633	1	171 CTD/ROS/LADCP	12.06.09	10:21:00	BE	65° 26.47	N 29° 44.36	W 929			
06/MSM12/1	633	1	171 CTD/ROS/LADCP	12.06.09	10:41:00	BO	65° 26.42	N 29° 44.53	W 932	917	7.8	
06/MSM12/1	633	1	171 CTD/ROS/LADCP	12.06.09	11:02:00	EN	65° 26.33	N 29° 44.82	W 927			
06/MSM12/1	634	1	172 CTD/ROS/LADCP	12.06.09	11:56:00	BE	65° 31.00	N 29° 32.02	W 849			
06/MSM12/1	634	1	172 CTD/ROS/LADCP	12.06.09	12:15:00	BO	65° 30.94	N 29° 32.43	W 849	842	1.2	
06/MSM12/1	634	1	172 CTD/ROS/LADCP	12.06.09	12:31:00	EN	65° 30.80	N 29° 33.07	W 851			
06/MSM12/1	635	1	173 CTD/ROS/LADCP	12.06.09	13:21:00	BE	65° 35.98	N 29° 24.01	W 729			
06/MSM12/1	635	1	173 CTD/ROS/LADCP	12.06.09	13:40:00	BO	65° 35.74	N 29° 24.32	W 734	718	10	MSS fired at 360 db
06/MSM12/1	635	1	173 CTD/ROS/LADCP	12.06.09	14:13:00	EN	65° 35.18	N 29° 25.24	W 748			
06/MSM12/1	636	1	174 CTD/ROS/LADCP	12.06.09	15:44:00	BE	65° 39.01	N 29° 11.30	W 845			
06/MSM12/1	636	1	174 CTD/ROS/LADCP	12.06.09	16:03:00	BO	65° 38.86	N 29° 11.48	W 836	836	1.5	
06/MSM12/1	636	1	174 CTD/ROS/LADCP	12.06.09	16:22:00	EN	65° 38.56	N 29° 11.79	W 849			
06/MSM12/1	637	1	175 CTD/ROS/LADCP	12.06.09	18:16:00	BE	65° 44.01	N 29° 00.01	W 790			
06/MSM12/1	637	1	175 CTD/ROS/LADCP	12.06.09	18:36:00	BO	65° 44.08	N 29° 00.18	W 785	768	8	MSS fired at 460 db
06/MSM12/1	637	1	175 CTD/ROS/LADCP	12.06.09	19:10:09	EN	65° 44.20	N 29° 00.77	W 774			
06/MSM12/1	638	1	ADCP Profil	12.06.09	22:59:00	BE	66° 24.00	N 28° 20.01	W 340			Kurs 122°
06/MSM12/1	638	1	ADCP Profil	13.06.09	5:33:00		65° 58.94	N 26° 39.75	W 292			Kursänderung Kurs 302°
06/MSM12/1	638	1	ADCP Profil	13.06.09	12:29:00		66° 24.15	N 28° 20.70	W 340			Kursänderung Kurs 122°
06/MSM12/1	638	1	ADCP Profil	13.06.09	17:07:00	EN	65° 59.17	N 26° 40.67	W 122			Profilende