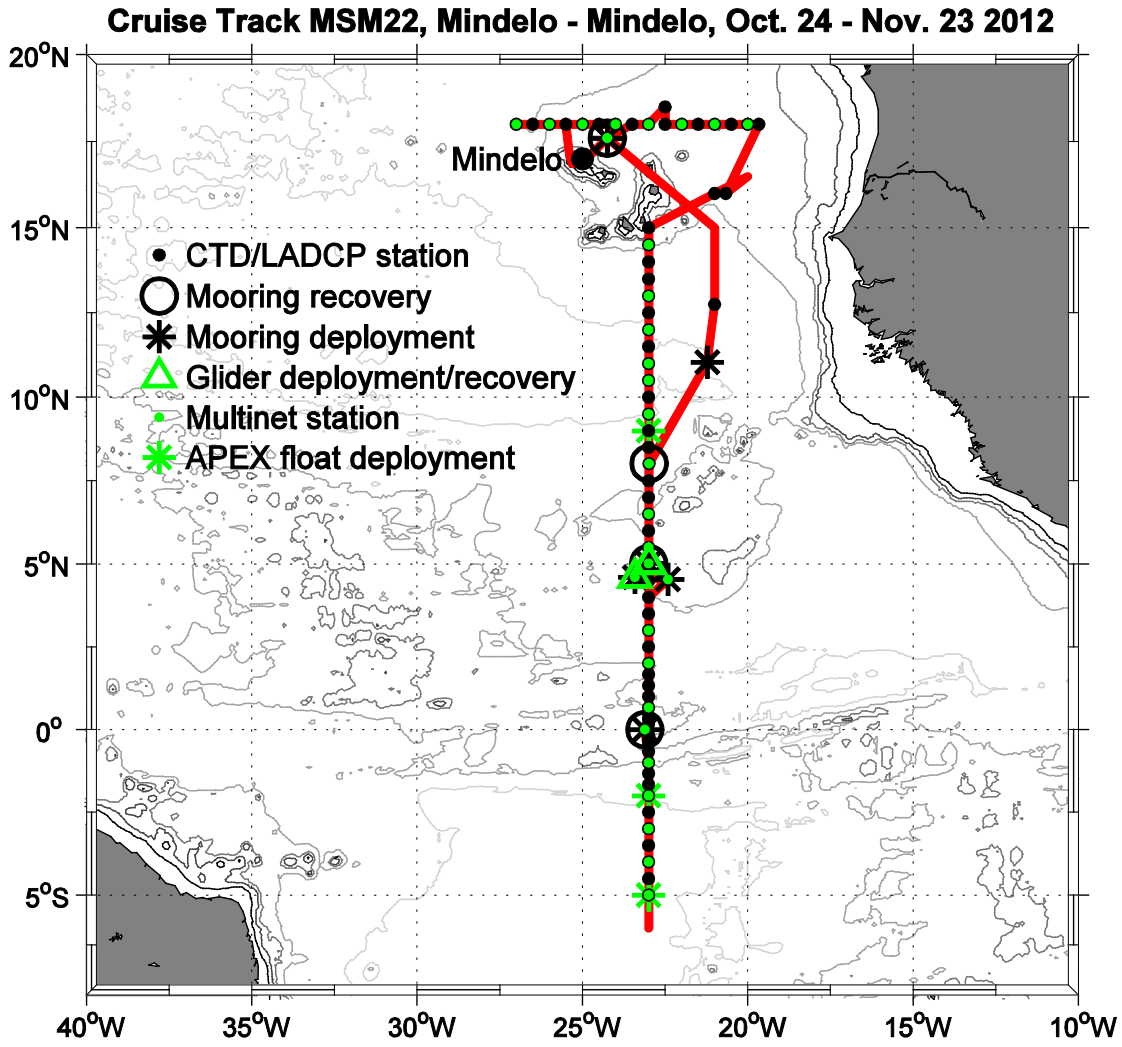
Prof. Dr. Peter Brandt
GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel
Dienstgebäude Westufer
Düsternbrooker Weg 20, Raum B14
D-24105 Kiel
Germany

Tel.: +49 (0)431 600 4105
Fax: +49 (0)431 600 4102
E-Mail: pbrandt@geomar.de

Short Cruise Report
R/V MARIA S. MERIAN MSM22 Mindelo - Mindelo
24th October – 23rd November 2012
Chief Scientist: Prof. Dr. Peter Brandt
Captain: Ralf Schmidt



Ship track of R/V MARIA S. MERIAN cruise MSM22 with locations of CTD/LADCP stations, mooring deployments and recoveries, glider deployments and recoveries, multinet stations, and APEX float deployments.

Objectives

Cruise MSM22 is a joint effort of the Kiel Collaborative Research Centre SFB 754 (”Climate - Biogeochemistry Interactions in the Tropical Ocean“) involving the BMBF joint projects NORDATLANTIK/RACE and SOPRAN as well as of the German-French Cooperative Project AWA. The main goal within the framework of the SFB 754 is the quantification of oxygen supply to the oxygen minimum zone (OMZ). Ventilation processes to be investigated include lateral and vertical mixing and oxygen advection (SP A3 and A4). The role of zooplankton for oxygen consumption and biogeochemical cycles (SP B8) is another focus of this cruise. An additional objective is the identification and investigation of mesoscale eddies which are generated in the coastal upwelling region off West Africa and then migrate westward. Such eddies are frequently characterized by particular physical and biogeochemical properties with a specific role in the tropical oxygen distribution and biogeochemical cycles. Processes within such eddies as well as their evolution will be investigated (BMBF SOPRAN, AWA, SFB754). At the equator, the cruise will focus on the equatorial current system, its interannual to decadal variability and its role in the zonal transport of heat, freshwater, and oxygen (BMBF NORDATLANTIK/RACE, SFB 754). The main goal of this long-term observational effort is a better understanding of the equatorial circulation within tropical Atlantic climate variability. The main tasks during MSM22 will be the recovery and redeployment of several subsurface moorings, a glider swarm experiment at the southern rim of the OMZ, and station work with a CTD/Lowered ADCP/Underwater Vision Profiler (UVP)/Tracer Acoustic Profiling System (TAPS), a microstructure probe and a zooplankton multinet. In addition, underway measurements of upper ocean currents with the two shipboard ADCPs and hydrographic measurements with thermosalinograph, optode, *p*CO2 sensor and gas tension device (GTD) will be performed. During MSM22, three gliders will be deployed and are scheduled for recovery during MSM23.

Narrative

R/V MARIA S. MERIAN departed from Mindelo on October 24, 2012 at 8:30 and headed north between the Cape Verdean islands of São Vicente and Santo Antão. The CVOO (Cape Verde Ocean Observatory) mooring north of São Vicente was recovered as the first activity of the cruise – just 5h after leaving port. All instruments were in place, biofouling of the upper part of the mooring was once again an issue. Following the mooring recovery, several CTD/O_2 stations were carried out which were used for water samples of oxygen, dissolved inorganic carbon and total alkalinity (DIC/TA), nutrients, chlorophyll-a (CHL-a) and salinity. Some of the CTD/O_2 stations were also needed for calibration of different moored instruments, including MicroCATs, optodes, fluorometer, TD (temperature, depth) logger, which were either just recovered or to be deployed in the afternoon of October 25. In between the CTD/O_2 stations, we had an extended microstructure station to determine the strength of diapycnal mixing, and two multinet stations for zooplankton studies. The multinet stations were carried out during the nighttime and daytime hours to observe differences in the vertical migration of the zooplankton. The redeployment of the CVOO mooring started at 14:00 on October 25 and was completed at 18:30. The submergence of the top element could not be

observed due to upcoming darkness. For the first time the CVOO mooring was equipped with satellite telemetry transferring data from the top elements, including an oxygen optode at about 45m depth, to GEOMAR. This would allow us to identify low oxygen events and possibly use the Cape Verdean R/V ISLANDIA to do additional shipboard measurements near the CVOO station. We were notified the next day that all data from the different MicroCATs and the oxygen optode were transmitted properly except those from a single pressure sensor of one MicroCAT.

One of the goals of MSM22 was to identify a mesoscale eddy and observe its physical and biogeochemical structure. Ideally, this eddy should have similar characteristics as the one observed in February 2010 in the CVOO records showing anomalous properties with zero oxygen at 45 m depth just below the mixed layer. However, the inspection of available satellite imagery, including sea level anomalies, sea surface temperature, and a few CHL-a images revealed no clear evidence of a similar eddy north or east of the Cape Verde islands. We decided to investigate an anticyclonic eddy centered at 12°45'N, 21°W. A CTD cast in the core of the eddy as well as shipboard ADCP measurements revealed the presence of a surface-intensified anticyclone without any particular biogeochemical signals. We decided to continue with our regular program and headed toward the position of the next mooring deployment. This position was chosen to be close to the tracer release experiment that will be carried out during the next leg. The mooring with oxygen, temperature and salinity sensors as well as a Longranger ADCP was deployed after lunch on October 27 at 11°02.2'N, 21°13.3'W. The close proximity to the core of the OMZ became evident by CTD measurements near the mooring position, showing very low oxygen concentrations in the deeper part of OMZ.

On October 28, we reached 23°W, 8°N at about noon. The mooring, deployed during MSM18/2 at 8°01'N, 22°59'W, was recovered after lunch. Of particular interest was the performance of the oxygen loggers that were set to a very high sampling rate of 5 min over the last 1.5 years. In fact, all instruments delivered complete datasets which, together with similar temperature and salinity records from MicroCATs, will allow us to study oxygen variability on density surfaces, and thus to delineate different processes in the generation and dissipation of oxygen variance. Along the 23°W section, CTD/LADCP stations were scheduled at 30' latitude resolution and somewhat higher resolution close to the equator. Zooplankton catches with the multinet down to about 1000 m (with five depth ranges: 1000 m to 600 m, 600 m to 300 m, 300 m to 200 m, 200 m to 100 m, and 100 m to the surface), additional shallow CTD casts down to 200 m with the TAPS attached to the rosette, and microstructure measurements down to 800 m were planned with a resolution of 1° latitude. The TAPS instrument was borrowed from French colleagues at IRD, Brest. It can only be used in the upper 200 m due to the prescribed pressure rating of the pressure sensor, and it delivers acoustic backscatter data from 6 different frequencies. A separate TAPS station was conducted typically after each multinet station. Nearly every night the WP2 was used to catch zooplankton for incubation (oxygen consumption) experiments. These measurements commenced right after the mooring recovery along the southward track. Most of the CTD stations were used to calibrate oxygen loggers and MicroCATs, either from the just recovered

mooring or new instruments to be deployed in the mooring array at the southern rim of the OMZ at about 5°N.

On October 30, we recovered the mooring at 5°01'N, 23°00'W. All instruments had full datasets, except for one oxygen logger that came onboard without its end cap and interior electronics. For the second phase of SFB754, we had proposed the installation of a mooring array to study different processes responsible for producing oxygen variance and to quantify the lateral oxygen flux across the southern boundary of the OMZ. This mooring array consists of three similar moorings, each with eight oxygen logger/MicroCAT combinations between 100 and 800 m water depth and a Longranger ADCP covering about the same depth range. The three moorings (including a continuation of the recovered mooring at 5°0.1'N, 23°00'W) were deployed during the next three days. The time between mooring deployments was used for calibration of the large number of instruments to be deployed, microstructure measurements, multinet and CTD/TAPS stations. The southern two moorings of the array had to be deployed over rough topography. The multi beam echo sounder was used to find good positions with well-defined depths. The final mooring positions were at 4°36'N, 23°25'W and 4°32'N, 22°25'W. The third mooring position was the same as before. All moorings went out very smoothly without any problems. The moored observations were accompanied by a glider swarm experiment. The first two gliders, ifm05 and ifm02, were deployed at 5°N, 23°W on October 30 after mooring recovery. The third glider, ifm09, was deployed the next day after the mooring deployment at the southwestern corner of the mooring array. Glider ifm02 (or "deepy") was equipped with a microstructure probe to measure vertical mixing and vertical oxygen fluxes. All three gliders started successfully into their mission. "Deepy" was programmed to circle around the northernmost mooring, while the path of the other two was around the entire mooring array. During the night before the last mooring deployment of the array, we visited the nominal position of the PIRATA buoy at 4°N, 23°W. There was some uncertainty whether or not the buoy was still in place as its data transmission had stopped in May of this year. However, the buoy was there and the buoy and its atmospheric sensors were in good shape. The next service cruise by our U.S. colleagues form NOAA/AOML in Miami is scheduled for December 2012 to reinstall the buoy with satellite data transmission.

After the last mooring deployment at 5°01'N, 23°00'W on November 2, we commenced the cross-equatorial section with deep CTD/UVP/LADCP measurements between 5°N and 5°S. For the lowered ADCP casts we used a downward looking 150 kHz ADCP (20 m bin length) and an upward looking 300 kHz ADCP (10 m bin length). During most of the stations, we were able to come close to the bottom, thereby enhancing the quality of deep velocity measurements with the lowered ADCPs. Both instruments delivered reliable data throughout the cruise. At the same time, the deep cross-equatorial section represented the first test of the Underwater Vision Profiler (UVP) in the abyssal ocean. Our French colleagues from CNRS Villefranche who loaned us the instrument, have used it only down to 3000 m. The instrument was attached to the rosette and took pictures with a sampling rate in the millisecond range. The underwater unit of the UVP counts the particles according to size and additionally stores vignettes of particles larger than 500 μm. The measurements showed nicely the distribution of different particle classes from the surface to the bottom.

In the morning on November 5, R/V MARIA S. MERIAN reached the equator and the position of our equatorial subsurface mooring (0°00.16'N, 23°06.78'W). Due to problems with the recovery of moorings with very long wire segments without buoyant elements in between, we decided to use the fast rescue boat to pick up the top element. This allows us have some tension on the wire before the benthos group below the profiler reaches the surface, thus reducing the possibility of a twisted wire. The procedure went as planned and the mooring was recovered without problems. However, a first inspection of the McLane profiler showed that instead of profiling between 1000 m and 3500 m depth every four days, it stopped profiling after the first profile, probably due to a loose connection between the main board and the motor. Further inspection in the lab will be required. Aside from this data loss, all other instruments in the equatorial mooring delivered complete datasets. In particular, the velocity time series from the two ADCPs (upward looking 150 kHz ADCP at 200 m depth and downward looking 75 kHz ADCP below) was extended to reach a total length of more than 8 years. During the night, few deep CTD stations were performed and during the following morning, November 6, the equatorial mooring was redeployed without problems. With this mooring deployment, mooring operations during MSM22 have been concluded.

Following the mooring at the equator, R/V MARIA S. MERIAN headed south to continue the deep hydrographic section with CTD/UVP/LADCP, microstructure, multinet, and CTD/TAPS stations. During the microstructure station at 2°S in the evening of November 7, the winch motor was unable to pull the microstructure probe back to the ship. At first, we thought this could be a problem with the motor. However, due to the severe strain on the wire it became clear that the profiler was not free to move. R/V MARIA S. MERIAN slowly moved backward and after about half an hour, we could see the profiler entangled with a fishing line. In fact, we identified a fishing boat a few kilometers away. There was enormous danger of losing the profiler as the Kevlar wire was strongly bent just above the profiler. However, we were able to free the profiler eventually. As there were few fishing lines underneath the ship as well, the captain decided to interrupt the scientific program to visually inspect the pod's propellers the next morning with an underwater camera system. However, the pods were found to be free of fishing lines, and we were able to continue our scientific work.

The southernmost point of our cruise was reached during the night of November 11. R/V MARIA S. MERIAN headed north back to the gliders measuring around 5°N. Along the way, a few CTD and microstructure stations were done to complete the hydrographic section. On November 13, we reached the position of ifm02 and used the fast rescue boat to recover the glider with the attached microstructure probe. Recovery of the glider was necessary to exchange batteries, allowing a deployment until the final recovery during the next leg of R/V MARIA S. MERIAN. An inspection of the microstructure probe showed that water had collected inside the head cone of the probe, a problem that was also encountered during two earlier missions. Still, the microstructure probe delivered a full dataset which we need to analyze to identify possible interference with the water leakage in the head cone. All sensors of the microstructure probe were exchanged or reinstalled, and the glider was prepared for the next deployment. The second glider to be recovered was ifm09. This glider did not send any ARGOS messages and had developed some irregularities with the GPS antenna system. If both positioning systems, ARGOS and GPS, were to fail, it would be nearly impossible to

locate the glider for recovery. Thus we decided to recover the glider and not use it anymore during this cruise. Ifm02 was deployed in the late afternoon of November 13, and R/V MARIA S. MERIAN headed north to continue the 23°W section at 8°N.

Along the section along 23°W between 8°N and 15°N, we had planned to perform CTD/UVP/LADCP stations down to 1300m, MSS measurements as deep as possible (typically down to 700 m), CTD/TAPS, multinet and WP2 net stations. The section started in the morning of November 14 at 8°30'N.

On or about November 14, two seemingly unrelated problems developed with the MSS profiler: For one, the profiler frequently lost its LAN-based data connection, requiring a restart of the deck unit. These failures seemed to be related to the usage of the winch motor of the MSS, or – more likely – caused by the bad cable between the deck unit and the profiler. The other problem was noisy data that were recorded already during the last stations at greater water depth. However, noisy data should not be caused by the wire directly since the data transmission is LAN-based, i.e. digitally. The cable itself consists of 4 separate wires, 2 for the power supply and 2 for data transmission. By visually inspecting the 2km of cable, we found some "buckling" underneath the otherwise smooth plastic mantle at several locations. We cut the cable and found a water leak as well as corrosion on at least 2 of the 4 wires. The water had penetrated not only the cable mantle but also the insulation of the individual wires. Further cutting and testing of the wire revealed that only a 570 m piece of the MSS cable remained intact. This piece was then used for all subsequent microstructure stations during the cruise north of 15°N, confining the MSS measurements to the upper 400 m.

On November 15, the TAPS batteries would not recharge. The instructions by the owner of the instrument were not to open the TAPS, so we stopped with these measurements. The last profile obtained with TAPS was taken at 9°30'N on November 14.

The 23°W section was finished on November 17, with the last station south of the Cape Verdean island of Majo. The last part of the cruise was devoted to the study of the northern boundary of the oxygen minimum zone, and to a search for mesoscale eddies with low oxygen cores. Along the way from 23°W, 15°N to the easternmost point of the 18°N section (near the 200nm-zone off Mauritania), we stopped to take a CTD station at 20°N, 16°N. Velocity data along the ship track indicated that we had encountered the northern part of an anticyclonic eddy, and we decided to do another CTD station in its estimated center position. However, we found only weakly reduced oxygen conditions in its core and thus decided to continue with the 18°N section, starting at 19°41'W on November 18. Along this section, we took CTD/UVP/LADCP profiles down to 1300 m with half-degree resolution, as well as multinet catches and microstructure stations at one degree resolution. With the help of SST satellite imagery provided by our French colleagues in Brest, we were able to identify a cyclonic cold eddy with its center at about 22°30'W, 18°30'N. On November 19 we took a CTD cast at this position which indeed revealed slightly increased production and an enhanced oxygen minimum directly below the mixed layer. After that station the 18°N section was continued westward at 23°W.

On November 20, we arrived at the CVOO mooring position. This mooring was deployed with satellite telemetry transferring data from the upper instruments. As mentioned earlier, the data transfer also revealed that the pressure sensor of the MicroCAT at a nominal depth of 25

m did not work properly. Thus we took the opportunity to exchange the MicroCAT. Using the fast rescue boat, we approached the surface buoy, pulled the telemetry and attached wire into the boat, and exchanged the instrument. The next satellite data transfer now included correct pressure records of the newly installed instrument. On November 21, the frame of the CTD/rosette system broke at several welds and had to be exchanged with the frame of the second CTD/rosette system. We believe that the frame can be welded onboard and should be available for the next leg as a replacement unit. The 18°N section extending from 19°41'W to 27°W was completed on November 22. No further eddy event was observed along this section.

On both the 23°W and 18°N transect, underway data of dissolved gases (O_2, CO_2, total gas pressure) were obtained without major interruptions. On November 7, the cable to the intake temperature sensor had to be repaired after issues with the sensor communication the previous days. The pump attached to the GTD had to be replaced on October 30 and November 04. All other parts worked without problems throughout the cruise. The gas measurements were accompanied by approx. daily sampling for O_2 and DIC/TA for calibration and data quality.

The ship arrived at the port of Mindelo on November 23 at 8:00.

Acknowledgements

We greatly appreciate the cooperative working atmosphere as well as the professionalism and seamanship of crew, officers and Captain of R/V MARIA S. MERIAN, which made this work a success. Financial support came from the German Science Foundation (DFG) as part of the SFB754 (Climate Biogeochemistry Interactions in the Tropical Ocean) and from the German Federal Ministry of Education and Research (BMBF) as part of the Joint Project Nordatlantik (03F0443B) and SOPRAN (03F0462A).

Participants MSM22

1	Brandt, Peter, Prof. Dr.	Chief Scientist	GEOMAR
2	Thomsen, Soeren	Microstructure, glider	GEOMAR
3	Fu, Yao	CTD, moored ADCPs	GEOMAR
4	Funk, Andreas, Dr.	Glider, ADCPs	WTD 71/FWG
5	Hahn, Johannes	Optodes, MicroCATs	GEOMAR
6	Kiko, Rainer, Dr.	Zooplankton ecophysiology	GEOMAR
7	Krahmann, Gerd, Dr.	Glider, LADCP, CTD	GEOMAR
8	Martens, Wiebke	CTD, MicroCAT technology	GEOMAR
9	Vogel, Bendix	CTD, thermosalinograph	GEOMAR
10	Niehus, Gerd	Mooring technology	GEOMAR
11	Papenburg, Uwe	Mooring technology	GEOMAR
12	Kisjeloff, Boris	Optodes, CTD	GEOMAR
13	Hauss, Helena, Dr.	Zooplankton ecophysiology	GEOMAR
14	Bittig, Henry	O_2, pCO_2, optodes	GEOMAR
15	Herrford, Josefine	Salinometer, CTD	GEOMAR
16	Sandel, Vera	Zooplankton	GEOMAR
17	Kopte, Robert	CTD, shipboard ADCPs	GEOMAR
18	Schütte, Florian	Salinometer, CTD	GEOMAR
19	Didwischus, Sven-Helge	Moorings, moored profiler	GEOMAR
20	Müller, Reinhard	Physician	-

GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel, Düsternbrooker Weg 20, 24105 Kiel, Germany, http://www.geomar.de/

WTD 71/FWG Forschungsbereich für Wasserschall und Geophysik, Klausdorfer Weg 2-24, 24148 Kiel, Germany, http://www.bwb.org/wtd71/

Tab. 1.1: Station list of R/V MARIA S. MERIAN cruise MSM22.

Station No. MSM Ship/Science		**Latitude**	**Longitude**	**Time**	**Work**
673-1	KPO_1060	17°36.40'N	24°14.98' W	24.10. 13:40-18:20	**Mooring** recovery
673-2	CTD_1	17°36'N	24°15'W	24.10. 18:40-18:50	**CTD/LADCP** station (100m)
673-2	CTD_2	17°36'N	24°15'W	24.10. 19:20-22:00	**CTD/LADCP** station (3580m), releaser test, TD logger, water sampling for salinometer substandard
673-3	MN_1	17°36'N	24°15'W	24.10. 22:10-23:00	**Multinet**
673-4	CTD_3	17°36'N	24°15'W	24.10. 23:50-00:10	**CTD/TAPS** station (200m), calibration of fluorometer
673-5	CTD_4	17°36'N	24°15'W	25.10. 01:10-4:00	**CTD/LADCP** station (3580m), calibration of MicroCAT
673-6	WP2_1	17°36'N	24°15'W	25.10. 4:10-4:50	**WP2 Net**
673-7	MSS_1	17°36'N	24°15'W	25.10. 5:00-8:50	**Microstructure**
673-8	CTD_5	17°36'N	24°15'W	25.10. 09:30-11:00	**CTD/LADCP** station (1000m), calibration of MicroCAT, optodes
673-9	MN_2	17°36'N	24°15'W	25.10. 11:10-12:00	**Multinet**
673-10	CTD_6	17°36'N	24°15'W	25.10. 12:20-13:10	**CTD/LADCP** station (1000m), calibration of optodes
673-11	KPO_1094	17°36.40'N	24°14.98'W	25.10. 14:00-18:30	**Mooring** deployment
		15°00'N	21°00'W	26.10. 14:30	
674-1	CTD_7	12°45'N	21°00'W	27.10. 00:50-1:00	**CTD/LADCP** station (100m)
674-1	CTD_8	12°45'N	21°00'W	27.10. 01:30-3:00	**CTD/LADCP** station (1300m), calibration of optodes & MicroCATs
675-1	MSS_2	11°03'N	21°13'W	27.10. 11:40-12:40	**Microstructure**
675-2	KPO_1091	11°02.2'N	21°13.3'W	27.10. 13:20-16:40	**Mooring deployment**
675-3	CTD_9	11°00'N	21°15'W	27.10. 17:30-18:10	**CTD/LADCP** station (1000m)
675-4	WP2_2	11°00'N	21°15'W	27.10. 18:20-18:40	**WP2 Net**
676-1	CTD_10	10°21'N	21°39'W	27.10. 22:20-22:40	**CTD/TAPS** stations (200m), CTD fluorometer on/off – UVP test
676-2	CTD_11	10°21'N	21°39'W	27.10. 22:40-23:00	**CTD/TAPS** stations (200m), CTD fluorometer on/off – UVP test
677-1	MN_3	8°00'N	23°00'W	28.10. 11:20-12:10	**Multinet**
677-2	CTD_12	8°00'N	23°00'W	28.10. 12:20-12:30	**CTD/TAPS** stations (200m)
677-3	KPO_1061	8°01.01'N	22°58.97'W	28.10. 12:50-	**Mooring recovery**

				15:30	
677-4/5	MSS_3	8°01.01'N	22°58.97'W	28.10. 16:10-18:20	**Microstructure**
677-6	CTD-13	8°01.01'N	22°58.97'W	28.10. 19:00-20:30	**CTD/LADCP** station (1300m), calibration of optodes & MicroCATs
677-7	MN_4	8°01.01'N	22°58.97'W	28.10. 20:30-21:20	**Multinet**
677-8	CTD_14	8°01.01'N	22°58.97'W	28.10. 21:30-21:40	**CTD/TAPS** stations (200m)
678-1	CTD-15	7°30'N	23°00'W	29.10. 00:10-01:10	**CTD/LADCP** station (1300m), calibration of optodes & MicroCATs
679-1	MSS_4	7°00'N	23°00'W	29.10. 3:30-4:10	**Microstructure**
679-2	CTD-16	7°00'N	23°00'W	29.10. 4:30-5:40	**CTD/LADCP** station (1300m), calibration of optodes & MicroCATs
680-1	CTD-17	6°30'N	23°00'W	29.10. 8:20-9:50	**CTD/LADCP** station (1300m), calibration of optodes & MicroCATs
680-2	MN_5	6°30'N	23°00'W	29.10. 9:50-10:40	**Multinet**
680-3	CTD_18	6°30'N	23°00'W	29.10. 10:50-11:10	**CTD/TAPS** stations (200m)
681-1	MSS_5	6°00'N	23°00'W	29.10. 13:30-16:40	**Microstructure**
681-2	CTD-19	6°00'N	23°00'W	29.10. 17:00-18:30	**CTD/LADCP** station (1300m), calibration of optodes & MicroCATs
682-1/2	WP2_3	5°30'N	23°00'W	29.10. 21:10-21:30	**WP2 Net**
682-2	CTD-20	5°30'N	23°00'W	29.10. 21:30-22:50	**CTD/LADCP** station (1300m), calibration of optodes & MicroCATs
682-3	MN_6	5°30'N	23°00'W	29.10. 23:00-23:50	**Multinet**
682-4	CTD_21	5°30'N	23°00'W	30.10. 23:50-0:10	**CTD/TAPS** stations (200m)
683-1	MSS_6	5°00'N	23°00'W	30.10. 2:30-6:00	**Microstructure** (keep distance to mooring position!)
683-2	KPO_1062	5°00'N	23°00'W	30.10. 6:30-9:00	**Mooring recovery**
683-3	MN_7	5°00'N	23°00'W	30.10. 10:00-10:50	**Multinet**
683-4	CTD_22	5°00'N	23°00'W	30.10. 11:00-11:10	**CTD/TAPS** stations (200m)
683-5	ifm05	5°01'N	23°00'W	30.10. 11:20-12:00	**Glider deployment**
683-6	ifm02	5°00'N	22°59'W	30.10. 12:30-13:10	**Glider deployment**
683-7	MSS_7	5°00'N	23°00'W	30.10. 13:30-16:10	**Microstructure** (keep distance to gliders!)
683-8	CTD-23	5°00'N	23°00'W	30.10. 16:40-18:20	**CTD/LADCP** station (1300m), calibration of optodes & MicroCATs
683-9/10	Bucket	5°00'N	23°00'W	30.10. 18:20-18:30	**Surface water sampling**
683-11	MSS_8	5°00'N	23°00'W	30.10. 18:50-20:30	**Microstructure**
683-	WP2_4	5°30'N	23°00'W	30.10. 21:10-	**WP2 Net**

12/13				21:30	
683-14	CTD-24	5°00’N	23°00’W	30.10. 21:40-23:00	**CTD/LADCP** station (1300m), calibration of optodes & MicroCATs
683-15	MN_8	5°00’N	23°00’W	30.10. 23:00-23:50	**Multinet**
683-16	CTD_25	5°00’N	23°00’W	31.10. 00:00-00:20	**CTD/TAPS** stations (200m)
684-1	CTD-26	4°36’N	23°25’W	31.10. 3:30-4:40	**CTD/LADCP** station (1300m), calibration of optodes & MicroCATs
684-2		4°36’N	23°25’W	31.10. 5:10-6:30	**Echo sounder** measurements 4°38’N, 23°25’W > 4°34’N, 23°25W > 4°36’N, 23°27’W > 4°36’N, 23°23’W
684-3	KPO_1093	4°36’N	23°25’W	31.10. 8:10-11:30	**Mooring deployment**
684-4	ifm09	4°36’N	23°20’W	31.10. 12:20-12:50	**Glider deployment**
684-5	MN_9	4°36’N	23°20’W	31.10. 13:30-14:30	**Multinet**
684-6	CTD_27	4°36’N	23°20’W	31.10. 14:40-14:50	**CTD/TAPS** stations (200m)
684-7	MSS_9	4°36’N	23°25’W	31.10. 15:10-17:40	**Microstructure**
685-1		4°32’N	22°25’W	31.10. 22:40-00:10	**Echo sounder** measurements 4°32’N, 22°28’W > 4°32’N, 22°22W > 4°35’N, 22°25’W > 4°29’N, 22°25’W
685-2	CTD-28	4°32’N	22°25’W	1.11. 00:40-1:30	**CTD/LADCP** station (1300m), calibration of optodes & MicroCATs
685-3	MN_10	4°32’N	22°25’W	1.11. 1:40-2:40	**Multinet**
685-4	CTD_29	4°32’N	22°25’W	1.11. 3:00-3:20	**CTD/TAPS** stations (200m)
685-5	MSS_10	4°32’N	22°25’W	1.11. 3:30-7:20	**Microstructure**
685-6	KPO_1092	4°32’N	22°25’W	1.11. 8:40-11:50	**Mooring deployment**
685-7	CTD-30	4°32’N	22°25’W	1.11. 12:20-13:50	**CTD/LADCP** station (1300m), calibration of optodes & MicroCATs
685-8	MN_11	4°32’N	22°25’W	1.11. 13:50-14:50	**Multinet**
685-9	CTD_31	4°32’N	22°25’W	1.11. 15:00-15:10	**CTD/TAPS** stations (200m)
686-1	CTD_32	4°00’N	23°00’W	1.11. 19:30-22:10	**CTD/LADCP** station (4050m)
686-2/3	WP2_5	4°00’N	23°00’W	1.11. 22:10-22:30	**WP2 Net**
687-1	CTD_33	4°30’N	23°00’W	2.11. 1:10-3:40	**CTD/LADCP** station (3950m)
688-1	CTD_34	5°00’N	23°00’W	2.11. 6:20-8:50	**CTD/LADCP** station (4040m)
688-2	KPO_1090	5°01’N	23°00’W	2.11. 9:50-13:00	**Mooring deployment**
688-3	MSS_11	5°00’N	23°00’W	2.11. 13:50-15:10	**Microstructure**
		4°02.362’N	22°59.469’W	2.11. 21:00	**PIRATA buoy**

689-1/2	WP2_6	4°00’N	23°00’W	2.11. 21:30-21:50	**WP2 Net**
689-2	MSS_12	4°00’N	23°00’W	2.11. 22:00-23:30	**Microstructure**
690-1	CTD-35	3°30’N	23°00’W	3.11. 2:10-4:50	**CTD/LADCP** station (4230m)
691-1	MSS_13	3°00’N	23°00’W	3.11. 7:20-8:20	**Microstructure**
691-2	CTD-36	3°00’N	23°00’W	3.11. 8:40-11:40	**CTD/LADCP** station (4230m)
691-3	MSS_14	3°00’N	23°00’W	3.11. 11:40-12:30	**Microstructure**
691-4	MN_12	3°00’N	23°00’W	3.11. 12:40-13:30	**Multinet**
691-5	CTD_37	3°00’N	23°00’W	3.11. 13:40-13:50	**CTD/TAPS** stations (200m)
692-1	CTD-38	2°30’N	23°00’W	3.11. 16:20-19:20	**CTD/LADCP** station (4560m)
693-1	MSS_15	2°00’N	23°00’W	3.11. 21:50-22:50	**Microstructure**
693-2/3	WP2_7	2°00’N	23°00’W	3.11. 23:10-23:30	**WP2 Net**
693-4	MN_13	2°00’N	23°00’W	3.11. 23:30-0:30	**Multinet**
693-5	CTD_39	2°00’N	23°00’W	4.11. 0:30-0:45	**CTD/TAPS** stations (200m)
693-6	CTD-40	2°00’N	23°00’W	4.11. 0:50-3:30	**CTD/LADCP** station (4230m)
694-1	CTD-41	1°40’N	23°00’W	4.11. 5:20-8:10	**CTD/LADCP** station (3960m)
695-1	CTD-42	1°20’N	23°00’W	4.11. 9:50-12:50	**CTD/LADCP** station (4540m)
696-1	MSS_16	1°00’N	23°00’W	4.11. 14:30-15:50	**Microstructure**
696-2	CTD-43	1°00’N	23°00’W	4.11. 16:00-18:40	**CTD/LADCP** station (3050m)
697-1/2	WP2_8	0°40’N	23°00’W	4.11. 20:20-20:40	**WP2 Net**
697-3	CTD-44	0°40’N	23°00’W	4.11. 20:40-23:10	**CTD/LADCP** station (3730m)
696-4	MN_14	0°40’N	23°00’W	4.11. 23:20-0:10	**Multinet**
696-5	CTD_45	0°40’N	23°00’W	5.11. 0:20-0:40	**CTD/TAPS** stations (200m)
698-1	CTD-46	0°20’N	23°00’W	5.11. 2:20-5:00	**CTD/LADCP** station (3750m)
699-1	KPO_1063	0°00.16’N	23°06.78’W	05.11. 7:50-10:50	**Mooring** recovery
699-2	MN_15	0°00’N	23°07’W	5.11. 11:20-12:10	**Multinet**
699-3	CTD_47	0°00’N	23°07’W	5.11. 12:10-12:30	**CTD/TAPS** stations (200m)
699-4	CTD-48	0°00’N	23°07’W	5.11. 12:50-15:20	**CTD/LADCP** station (3780m)

		0°00'N	23°00'W	5.11. 16:00	**PIRATA buoy**
699-5	CTD-49	0°00'N	23°07'W	5.11. 19:00-20:30	**CTD/LADCP** station (1000m), calibration of optodes & MicroCATs
699-6/7	WP2_9	0°00'N	23°07'W	5.11. 20:40-21:00	**WP2 Net**
699-8	MN_16	0°00'N	23°07'W	5.11. 21:00-22:00	**Multinet**
699-9	CTD_50	0°00'N	23°07'W	5.11. 22:20-22:30	**CTD/TAPS** stations (200m)
700-1	CTD-51	0°20'S	23°00'W	6.11. 0:30-3:10	**CTD/LADCP** station (4450m)
701-1	CTD-52	0°40'S	23°00'W	6.11. 5:00-7:10	**CTD/LADCP** station (3400m)
702-1	KPO_1089	0°00.16'N	23°06.78'W	6.11. 10:30-14:10	**Mooring** deployment
703-1	MSS_17	1°00'S	23°00'W	6.11. 19:30-21:10	**Microstructure**
703-2/3	WP2_10	1°00'S	23°00'W	6.11. 21:40-22:00	**WP2 Net**
703-4	CTD-53	1°00'S	23°00'W	6.11. 22:00-0:40	**CTD/LADCP** station (3900m)
703-5	MN_17	1°00'S	23°00'W	7.11. 0:40-1:40	**Multinet**
703-6	CTD_54	1°00'S	23°00'W	7.11. 1:40-2:00	**CTD/TAPS** stations (200m)
704-1	CTD-55	1°20'S	23°00'W	7.11. 3:50-6:50	**CTD/LADCP** station (4680m)
705-1	CTD-56	1°40'S	23°00'W	7.11. 8:50-12:00	**CTD/LADCP** station (4800m)
706-1	MN_18	2°00'S	23°00'W	7.11. 13:50-14:40	**Multinet**
706-2	CTD_57	2°00'S	23°00'W	7.11. 14:50-15:10	**CTD/TAPS stations (200m)**
706-3	APEX 6340	2°00'S	23°00'W	7.11. 15:20	**APEX Float** deployment
706-4	CTD-58	2°00'S	23°00'W	7.11. 15:30-19:30	**CTD/LADCP** station (5000m)
706-5	MSS_18	2°00'S	23°00'W	7.11. 18:30-21:00	**Microstructure**
706-6/7	WP2_11	2°00'S	23°00'W	7.11. 21:40-21:50	**WP2 Net**
707-1	CTD-59	2°30'S	23°00'W	8.11. 8:30-11:40	**CTD/LADCP** station (5000m)
708-1	MSS_19	3°00'S	23°00'W	8.11. 14:20-16:00	**Microstructure**
708-2	CTD-60	3°00'S	23°00'W	8.11. 16:10-19:30	**CTD/LADCP** station (5000m)
709-3	MN_19	3°00'S	23°00'W	8.11. 19:30-20:30	**Multinet**
709-4	CTD_61	3°00'S	23°00'W	8.11. 20:30-20:50	**CTD/TAPS** stations (200m)
709-5/6	WP2_12	3°00'S	23°00'W	8.11. 20:50-21:10	**WP2 Net**
710-1	CTD-62	4°30'S	23°00'W	9.11. 4:30-	**CTD/LADCP** station (5000m)

				7:40	
711-1	APEX 6341	5°00’S	23°00’W	9.11. 10:20	**APEX Float** deployment
711-2	MSS_20	5°00’S	23°00’W	9.11. 10:30-12:30	**Microstructure**
711-3	CTD-63	5°00’S	23°00’W	9.11. 12:30-15:50	**CTD/LADCP** station (5000m)
711-4/5/6	WP2_13	5°00’S	23°00’W	9.11. 15:50-16:30	**WP2 Net**
711-7	MN_20	5°00’S	23°00’W	9.11. 16:30-17:20	**Multinet**
711-8	CTD_64	5°00’S	23°00’W	9.11. 17:30-17:50	**CTD/TAPS** stations (200m)
		6°00’S	23°00’W	9.11. 19:00	**Shipboard ADCP section**
712-1	MSS_21	4°00’S	23°00’W	10.11. 8:30-10:00	**Microstructure**
712-2/3	WP2_14	4°00’S	23°00’W	10.11. 10:10-10:30	**WP2 Net**
712-4	CTD-65	4°00’S	23°00’W	10.11. 10:30-13:30	**CTD/LADCP** station (5000m)
712-5	MN_21	4°00’S	23°00’W	10.11. 13:40-14:30	**Multinet**
712-6	CTD_66	4°00’S	23°00’W	10.11. 14:30-14:50	**CTD/TAPS** stations (200m)
713-1	CTD-67	3°30’S	23°00’W	10.11. 17:30-20:50	**CTD/LADCP** station (5000m)
713-2/3	WP2_15	3°30’S	23°00’W	10.11. 20:50-21:10	**WP2 Net**
714-1	CTD-68	0°10’S	23°03’W	11.11. 13:00-13:10	**CTD/LADCP** station (100m)
714-2	CTD-69	0°10’S	23°03’W	11.11. 13:50-16:00	**CTD/LADCP** station (3500m)
715-1	MSS_22	0°00’N	23°03’W	11.11. 17:00-18:20	**Microstructure**
716-1	CTD-70	0°10’N	23°03’W	11.11. 19:20-21:40	**CTD/LADCP** station (3800m)
716-2/3	WP2_16	0°10’N	23°00’W	11.11. 21:40-22:00	**WP2 Net**
717-1	MSS_23	1°00’N	23°00’W	12.11. 2:00-4:00	**Microstructure**
718-1	MSS_24	2°00’N	23°00’W	12.11. 9:00-10:30	**Microstructure**
719-1	MSS_25	3°00’N	23°00’W	12.11. 15:40-17:00	**Microstructure**
720-3	MSS_26	4°00’N	23°00’W	12.11. 22:30-0:00	**Microstructure**
721-1	MSS_27	5°00’N	23°00’W	13.11. 5:20-7:30	**Microstructure**
721-2	Ifm02	5°00’N	23°00’W	13.11. 8:10-8:30	**Glider** recovery
721-3	Ifm09	5°00’N	23°00’W	13.11. 9:00-9:10	**Glider** recovery
721-4	CTD-71	5°00’N	23°00’W	13.11. 9:20-11:50	**CTD/LADCP** station (4040m)

721-5	MSS_28	5°00'N	23°00'W	13.11. 12:00-14:50	**Microstructure**
721-3	Ifm02	5°00'N	23°00'W	13.11. 15:50-16:00	**Glider** deployment
722-1/2	WP2_17	5°57'N	23°00'W	13.11. 21:00-21:20	**WP2 Net**
723-1	MSS_29	7°00'N	23°00'W	14.11. 2:30-4:10	**Microstructure**
724-1	CTD-72	8°30'N	23°00'W	14.11. 11:30-13:10	**CTD/LADCP** station (1300m), calibration of optodes and MicroCATs
725-1	APEX 6339	9°00'N	23°00'W	14.11. 15:50	**APEX Float** deployment
725-2	MSS_30	9°00'N	23°00'W	14.11. 16:00-16:20	**Microstructure**
725-3	CTD-73	9°00'N	23°00'W	14.11. 16:30-17:30	**CTD/LADCP** station (1300m)
726-1	MSS_31	9°30'N	23°00'W	14.11. 20:10-20:30	**Microstructure**
726-2/3	WP2_18	9°30'N	23°00'W	14.11. 20:30-20:50	**WP2 Net**
726-4	CTD-74	9°30'N	23°00'W	14.11. 20:50-21:40	**CTD/LADCP** station (1300m)
726-5	MN_22	9°30'N	23°00'W	14.11. 21:40-22:30	**Multinet**
726-6	CTD_75	9°30'N	23°00'W	14.11. 22:40-22:50	**CTD/TAPS** stations (200m)
726-7	MN_23	9°30'N	23°00'W	14.11. 22:50-23:40	**Multinet**
727-1	CTD-76	10°00'N	23°00'W	15.11. 2:30-3:20	**CTD/LADCP** station (1300m)
728-1	CTD-77	10°30'N	23°00'W	15.11. 5:50-6:40	**CTD/LADCP** station (1300m)
728-2	MN_24	10°30'N	23°00'W	15.11. 6:50-7:40	**Multinet**
728-3	CTD_78	10°30'N	23°00'W	15.11. 7:40-8:00	**CTD/TAPS** stations (200m)
729-1	CTD-79	11°00'N	23°00'W	15.11. 10:40-11:30	**CTD/LADCP** station (1300m)
729-2	MN_25	11°00'N	23°00'W	15.11. 11:30-12:20	**Multinet**
729-3	MN_26	11°00'N	23°00'W	15.11. 12:30-13:00	**Multinet**
730-1	CTD-80	11°30'N	23°00'W	15.11. 15:30-16:30	**CTD/LADCP** station (1300m) (PIRATA buoy nearby)
731-1/2	WP2_19	12°00'N	23°00'W	15.11. 20:20-20:40	**WP2 Net**
731-3	CTD-82	12°00'N	23°00'W	15.11. 20:40-21:30	**CTD/LADCP** station (1300m)
731-4	MN_27	12°00'N	23°00'W	15.11. 21:30-22:20	**Multinet**
731-5	CTD_83	12°00'N	23°00'W	15.11. 22:20-22:40	**CTD** stations (200m)
731-6	MSS_32	12°00'N	23°00'W	15.11. 22:40-0:00	**Microstructure**

732-1	CTD-84	12°30'N	23°00'W	16.11. 7:20-8:10	**CTD/LADCP** station (1300m)
733-1	MSS_33	13°00'N	23°00'W	16.11. 6:10-7:10	**Microstructure**
733-2	CTD-85	13°00'N	23°00'W	16.11. 7:20-8:10	**CTD/LADCP** station (1300m)
733-3	MN_28	13°00'N	23°00'W	16.11. 8:10-9:00	**Multinet**
733-4	CTD_86	13°00'N	23°00'W	16.11. 9:10-9:30	**CTD** stations (200m)
734-1	CTD-87	13°30'N	23°00'W	16.11. 12:00-12:50	**CTD/LADCP** station (1300m)
735-1	CTD-88	14°00'N	23°00'W	16.11. 15:30-16:30	**CTD/LADCP** station (1300m)
736-1	CTD-89	14°30'N	23°00'W	17.11. 19:10-20:00	**CTD/LADCP** station (1300m)
736-2	MN_29	14°30'N	23°00'W	16.11. 20:10-20:50	**Multinet**
736-3	CTD_90	14°30'N	23°00'W	16.11. 21:00-21:10	**CTD** stations (200m)
736-4/5	WP2_20	14°30'N	23°00'W	16.11. 21:10-21:30	**WP2 Net**
737-1	CTD_91	15°00'N	23°00'W	17.11. 0:20-1:10	**CTD** stations (1300m)
738-1	CTD_92	16°00'N	21°00'W	17.11. 12:20-13:10	**CTD/LADCP** station (1300m)
		16°30'N	20°00'W		**Shipboard ADCP section**
739-1	CTD_93	16°00'N	20°40'W	17.11. 23:20-0:20	**CTD/LADCP** station (1300m)
739-2/3	WP2_21	16°00'N	20°40'W	18.11. 0:20-0:40	**WP2 Net**
739-3	MSS_34	16°00'N	20°40'W	18.11. 0:40-1:00	**Microstructure**
740-1	CTD_94	18°00'N	19°41'W	18.11. 13:40-14:40	**CTD/LADCP** station (1300m)
741-1	MN_30	18°00'N	20°00'W	18.11. 16:20-17:00	**Multinet**
741-2	CTD_95	18°00'N	20°00'W	18.11. 17:00-18:00	**CTD/LADCP** station (1300m)
741-3/4	WP2_22	18°00'N	20°00'W	18.11. 18:00-18:20	**WP2 Net**
741-5	MSS_35	18°00'N	20°00'W	18.11. 18:30-19:20	**Microstructure**
742-1	CTD_96	18°00'N	20°30'W	18.11. 21:50-22:50	**CTD/LADCP** station (1300m)
743-1	MSS_36	18°00'N	21°00'W	19.11. 1:20-2:00	**Microstructure**
743-2	CTD_97	18°00'N	21°00'W	19.11. 2:00-3:00	**CTD/LADCP** station (1300m)
743-3	MN_31	18°00'N	21°00'W	19.11. 3:00-4:00	**Multinet**
744-1	CTD_98	18°00'N	21°30'W	19.11. 6:30-7:30	**CTD/LADCP** station (1300m)
745-1	MSS_37	18°00'N	22°00'W	19.11. 10:00-	**Microstructure**

				10:40	
745-2	MN_32	18°00'N	22°00'W	19.11. 10:50-11:30	**Multinet**
745-3	CTD_99	18°00'N	22°00'W	19.11. 11:40-12:30	**CTD/LADCP** station (1300m)
745-4/5	WP2_23	18°00'N	22°00'W	19.11. 12:40-13:00	**WP2 Net**
746-1	CTD_100	18°00'N	22°30'W	19.11. 15:30-17:00	**CTD/LADCP** station (1300m)
747-1	CTD_101	18°30'N	22°30'W	19.11. 19:40-20:30	**CTD/LADCP** station (1300m)
748-1	MSS_38	18°00'N	23°00'W	20.11. 0:00-0:40	**Microstructure**
748-2/3	WP2_24	18°00'N	23°00'W	20.11. 0:50-1:00	**WP2 Net**
748-4	CTD_102	18°00'N	23°00'W	20.11. 1:10-2:00	**CTD/LADCP** station (1300m)
748-5	MN_33	18°00'N	23°00'W	20.11. 2:10-3:10	**Multinet**
749-1	CTD_103	18°00'N	23°30'W	20.11. 5:30-6:30	**CTD/LADCP** station (1300m)
750-1	KPO_1094	17°36.40'N	24°14.98' W	20.11. 10:30-10:50	**Mooring** instrument exchange
751-1/2	WP2_25	17°37'N	24°14'W	20.11. 11:10-11:40	**WP2 Net**
751-3	CTD_104	17°37'N	24°14'W	20.11. 11:40-13:50	**CTD/LADCP** station (3600m)
751-4	MN_34	17°37'N	24°14'W	20.11. 14:00-14:50	**Multinet**
751-5	MSS_39	17°37'N	24°14'W	20.11. 14:50-16:20	**Microstructure**
751-6	CTD_105/ 106/107	17°37'N	24°14'W	20.11. 16:30-19:40	**CTD/LADCP** station (800m, 2h sampling at 120m, 800m)
751-7	Bucket	17°37'N	24°14'W	20.11. 19:40-19:50	**Surface water sampling**
751-8/9	WP2_26	17°37'N	24°14'W	20.11. 19:50-20:30	**WP2 Net**
751-10	MN_35	17°37'N	24°14'W	20.11. 20:30-21:20	**Multinet**
752-1	MSS_40	18°00'N	24°00'W	21.11. 23:30-0:10	**Microstructure**
752-2	CTD_108	18°00'N	24°00'W	21.11. 0:20-1:10	**CTD/LADCP** station (1300m)
752-3	MN_36	18°00'N	24°00'W	21.11. 1:10-2:00	**Multinet**
753-1	CTD_109	18°00'N	24°30'W	21.11. 4:30-5:20	**CTD/LADCP** station (1300m)
754-1	MSS_41	18°00'N	25°00'W	21.11. 7:50-8:30	**Microstructure**
754-2	MN_37	18°00'N	25°00'W	21.11. 9:20-10:10	**Multinet**
754-3	CTD_110	18°00'N	25°00'W	21.11. 10:30-11:30	**CTD/LADCP** station (1300m)
754-4	Bucket	18°00'N	25°00'W	21.11. 11:30-	**Surface water sampling**

				11:40	
755-1	MSS_42	18°00’N	27°00’W	21.11. 20:30-21:20	**Microstructure**
755-2/3	WP2_27	18°00’N	27°00’W	21.11. 21:20-21:50	**WP2 Net**
755-4	CTD_111	18°00’N	27°00’W	21.11. 21:50-22:50	**CTD/LADCP** station (1300m)
755-5	MN_38	18°00’N	27°00’W	21.11. 22:50-23:40	**Multinet**
756-1	CTD_112	18°00’N	26°30’W	22.11. 2:10-3:10	**CTD/LADCP** station (1300m)
757-1	MSS_43	18°00’N	26°00’W	22.11. 5:40-6:50	**Microstructure**
757-2	CTD_113	18°00’N	26°00’W	22.11. 7:00-7:50	**CTD/LADCP** station (1300m)
757-3	MN_39	18°00’N	26°00’W	22.11. 7:50-8:40	**Multinet**
758-1	CTD_114	18°00’N	25°30’W	22.11. 13:00-14:00	**CTD/LADCP** station (1300m)
759-1	CTD_115	17°34’N	25°26’W	22.11. 18:20-18:30	**CTD/LADCP** station (300m)