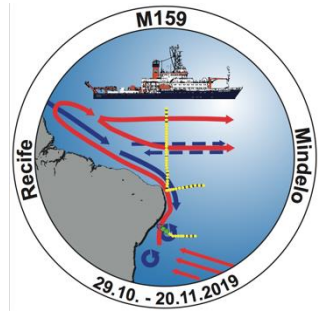
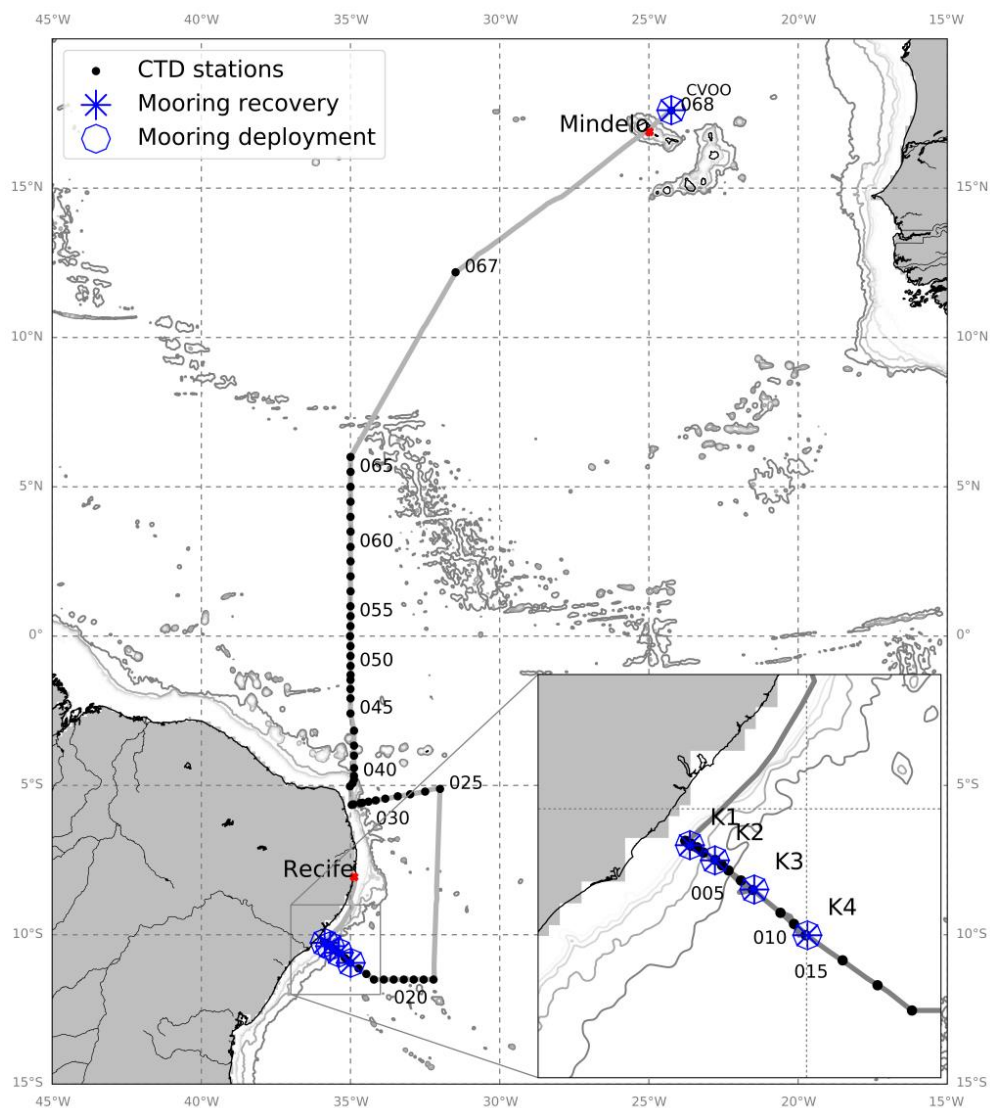


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Short Cruise Report
R/V METEOR M159 Recife - Mindelo
29th Oct - 20th Nov 2019
Chief Scientist: Prof. Dr. Martin Visbeck
Captain: Rainer Hammacher



Objectives

The expedition “Circulation off Brazil” with its interdisciplinary work program was concerned with documenting the variability of the western boundary current systems off Brazil. The deep measurements along 11°S focused on the Atlantic Meridional Overturning Circulation (AMOC). Off the coast of Brazil the research looked at the transport variability of the North Brazil Undercurrent (NBU) – as a part of the AMOC and subtropical cells (STC) – on intra seasonal to decadal time scales. The section along 35°W provided additional information on water mass property changes and the connection to equatorial signals.

The main work of M159 was the exchange of long term moored ocean observatories and station work. The station work consisted mainly of a combination of CTD and Lowered ADCP system. In addition the ship board ADCP systems provided continuous velocity information and the Thermosalinograph provided near surface water mass information.

The expedition is a contribution to the BMBF collaborative research program RACE – North Atlantic Synthesis, the GEOMAR research program OCEANS, and the BMBF collaborative research program REEBUS.

The cruise was very successful and all objectives were reached and the measurements were carried out as planned.



Scientific party of the cruise M159

Narrative

R/V Meteor cruise M159 from Recife, Brazil to Mindelo, Cape Verde started on Tuesday October 29th, 2019 at 10:00 local time and sailed south to reach the starting point of the 11°S CTD section and the recovery and redeployment of the moored observatory. On the way a shallow test CTD with a bottom depth of 57 m was conducted on the 29th. In the Morning of the October 30th near the first mooring locations we tried to acoustically recover the data from two PIES moorings. However, despite significant efforts to reduce the noise of R/V Meteor we could not establish contact to either of the two PIES. During the following four days we performed CTD casts mostly during the night and recovered and redeployed all four tall moorings that are part of the 10°S moored observatory. All mooring operations ran smoothly and 97% of the instruments provided high quality time series over the 18 months since deployment. Some of the nightly CTD stations were used for the calibration of moored instrumentation. The last CTD/O₂ station of the 11°S transect #24 was completed on November 4th, at 15:00 UTC. On November 4th we exited the Brazilian EEZ at 11° 28.71'S, 32° 48.20'W at 2:21 UTC and entered the Brazilian EEZ on the 4th at 10° 34.24'S, 32° 11.10'W at 17:34 UTC.

From November 5th to 7th we conducted 12 CTD stations along the 5°S section between 5° 07.0' S and 32° 00' W and 5° 39.0' S and 34° 57.6' W. The stations varied between 30nm offshore to less than 10nm near the shelf break.

The meridional section along 35°W began on November 7th and lasted until the 13th. Starting on the Brazilian shelf break at 5° 02' S and 35° 01' W with 30 full ocean depth CTD stations until the northernmost station at 6° 00' N and 35° W. On November 10th the R/V Meteor left the Brazilian EEZ at 0° 43.31'S, 35° 0'W at 6:39 UTC. R/V Meteor reached the equator on Sunday, November 10th around lunchtime. On the equator, the PIRATA buoy was visually inspected and seemed to be featuring the complete sensor set of an ATLAS mooring at the surface.

After finalizing the 35°W section in the night of November 13th, R/V Meteor headed northeast towards the Cape Verde islands. During this transit a 6000m deep CTD station was included in order to respool the CTD wire which had developed spooling errors during the last weeks.

On the evening of November 17th R/V Meteor passed between the Cape Verde Islands of Santo Antão and São Vicente after entering the Cape Verde EEZ on the 16th November on 20:30 UTC at 14°36.58'N, 28°10.85'W. During this passage a Scientist from Portugal came on board in order to support the science crew with the recovery and deployment of the Cape Verde Ocean Observatory mooring (CVOO) at 17° 36.39'N, 24° 14.98'W, which was done on the 18th and 19th of November.

METEOR reached the port of Mindelo, Cape Verde on November, 20 2019.

Acknowledgements

We greatly appreciate the wonderful working atmosphere as well as the professionalism and seamanship of crew, officers and Captain of R/V METEOR, which made this work a success.

Participants

No.	Name	Discipline	Institution
1	Visbeck, Martin, Prof. Dr.	Chief Scientist	GEOMAR
2	Lopes Brum, André	oxygen	FURG
3	Carbajal, Juan Cruz	CTD	CENPAT
4	Dada, Olusegun	CTD	FUTA
5	Galetti, Julia	CTD	UFPE
6	Gonzalez Avalos, Everardo	CTD processing, UVP	GEOMAR
7	Handmann, Patricia, Dr.	Mooring processing, CTD	GEOMAR
8	Herrford, Josefina	MicroCats, CTD	GEOMAR
9	Hundsörfer, Marie	MicroCats, CTD	GEOMAR
10	Jahr, Christin	CTD	GEOMAR
11	Krahmann, Gerd, Dr.	LADCP, CTD processing	GEOMAR
12	Leimann, Ilmar	SADCP	GEOMAR
13	Link, Rudi	CTD technician	GEOMAR
14	Michaelis, Patrick	CTD processing, UVP	GEOMAR
15	Niebaum, Nils	Salinometer, CTD	GEOMAR
16	Papenburg, Uwe	Mooring technician	GEOMAR
17	Sarmiento Trujillo, Luisa F.	CTD	CAU
18	Schmidt, Christina	Mooring processing, CTD, oxygen	GEOMAR
19	Stelzner, Martin	Meteorology	DWD
20	Stramma, Lothar, Dr.	Salinometer, CTD	GEOMAR
21	Trahms, Carola	CTD	GEOMAR
22	Witt, René	LADCP, Mooring technician	GEOMAR
23	De Souza Silva, Ana Emilia	Observer	Brazil Navy
24	Pais Ribeiro Da Cunha, Maria Marina	Microbial growth experiments	UA

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CENPAT (1) Centro Nacional Patagónico, Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Buenos Aires, Argentina

UFPE (1) Federal University of Pernambuco, Recife, Brazil

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Station List: of R/V METEOR cruise M159.

Station		Date	Gear	Time	Latitude	Longitude	Water Depth	Measurements*
M159	CTD	2019		[UTC]	[°]	[°]	[m]	
1-1	Test	29.10	CTD	19:36-19:47	09° 02.065' S	034° 56.332' W	57	
2-1		30.10	Mooring PIES	03:37-05:06	10° 13.494' S	035° 52.626' W	227	failed connection
3-1		30.10	Mooring PIES	05:35-06:15	10° 13.912' S	035° 51.780' W	227	failed connection
4-1	1	30.10	CTD	06:57-08:25	10° 15.566' S	035° 51.642' W	748	LADCP, O2 bottle samples, salinity bottle sample
5-1	2	30.10	CTD	09:06-09:18	10° 14.240' S	035° 54.252' W	83	LADCP, O2 bottle samples
6-1	3	30.10	CTD	09:48-10:06	10° 14.636' S	035° 53.633' W	226	LADCP, O2 bottle samples
7-1	4	30.10	CTD	10:35-11:02	10° 15.336' S	035° 52.614' W	520	LADCP, O2 bottle samples, salinity bottle sample
8-1		30.10	Mooring – KPO 1195 recovered	11:48-12:56	10° 16.065' S	035° 51.735' W	793	Argos, MCP, LR-ADCP, MC, Aquadopp
9-1		30.10	Mooring – KPO 1196 recovered	14:30-16:50	10° 22.448' S	035° 40.508' W	2306	Argos, MCP, LR-ADCP, MC, Aquadopp
10-1		30.10	Mooring – KPO 1211 deployed	19:30-20:36	10° 15.594' S	035° 52.694' W	922	Argos, MCP, LR-ADCP, MC, Aquadopp
11-1	5	30.10	CTD	21:04-21:50	10° 16.460' S	035° 51.794' W	940	LADCP, salinity bottle sample
12-1	6	30.10	CTD	22:28-23:34	10° 17.162' S	035° 48.917' W	1506	LADCP, AZFP, O2 bottle sample, salinity bottle sample
13-1	7	31.10	CTD	00:43-01:53	10° 19.508' S	035° 46.144' W	1716	LADCP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
14-1	8	31.10	CTD	02:59-05:08	10° 22.823' S	035° 40.817' W	2322	LADCP, OPUS, AZFP
15-1	9	31.10	CTD	06:06-07:47	10° 25.189' S	035° 37.777' W	2620	LADCP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
16-1		31.10	Mooring - KPO 1212 deployed	11:25-13:40	10° 22.849' S	035° 43.489' W	2136	Argos, MCP, LR-ADCP, MC, Aquadopp
17-1		31.10	Mooring – KPO 1197 recovered	15:00-18:54	10° 36.440' S	035° 23.840' W	3500	Argos, MCP, LR-ADCP, MC, Aquadopp
18-1	10	31.10	CTD	19:14-22:08	10° 36.167' S	035° 23.967' W	3513	LADCP, OPUS, O2 bottle sample, salinity bottle sample
19-1	11	31.10	CTD	23:12-01:10	10° 32.002' S	035° 29.307' W	3211	LADCP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
20-1	12	01.11	CTD	02:32-04:56	10° 27.461' S	035° 34.931' W	2873	LADCP, OPUS, AZFP
21-1		01.11	Mooring – KPO 1213 deployed	10:08-13:15	10° 37.008' S	035° 29.916' W	3280	Argos, MCP, LR-ADCP, MC, Aquadopp

22-1		01.11	Mooring – KPO 1198 recovered	16:00-19:40	10° 56.614' S	035° 00.209' W	4113	Argos, MCP, LR-ADCP, MC, Aquadopp, RCM11, RCM8, Argonaut
23-1	13	01.11	CTD	20:13-23:06	10° 56.420' S	035° 00.362' W	4119	LADCP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
24-1	14	02.11	CTD	00:45-03:12	10° 46.388' S	035° 11.675' W	3880	LADCP, OPUS, AZFP, salinity bottle sample
25-1	15	02.11	CTD	04:43-07:41	10° 51.375' S	035° 05.605' W	3968	OPUS, AZFP, O2 bottle sample, salinity bottle sample
26-1		02.11	Mooring – KPO 1214 deployed	10:19-13:48	10° 54.659' S	035° 02.724' W	4052	Argos, MCP, LR-ADCP, MC, Aquadopp
27-1	16	02.11	CTD	15:52-18:34	11° 07.629' S	034° 43.929' W	4271	LADCP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
28-1	17	02.11	CTD	20:43-00:20	11° 18.774' S	034° 28.299' W	4641	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
29-1	18	03.11	CTD	02:24-05:16	11° 30.003' S	034° 12.980' W	4583	LADCP, UVP, OPUS, AZFP, O2 bottle sample
30-1	19	03.11	CTD	07:23-10:26	11° 29.992' S	033° 52.999' W	5847	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
31-1	20	03.11	CTD	13:12-16:17	11° 30.027' S	033° 33.270' W	4975	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
32-1	21	03.11	CTD	18:40-21:21	11° 30.022' S	033° 12.982' W	5641	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
33-1	22	03.11	CTD	23:25-01:41	11° 30.042' S	032° 52.981' W	3641	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
34-1	23	04.11	CTD	03:49-06:42	11° 30.006' S	032° 32.957' W	4607	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
35-1	24	04.11	CTD	08:48-12:29	11° 30.103' S	032° 13.134' W	4952	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
36-1	25	05.11	CTD	22:23-01:01	05° 07.009' S	032° 00.073' W	4614	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
37-1	26	06.11	CTD	04:34-07:31	05° 12.373' S	032° 30.109' W	4607	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
38-1	27	06.11	CTD	10:24-13:56	05° 17.705' S	033° 00.029' W	4561	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample

39-1	28	06.11	CTD	16:41-19:30	05° 21.714' S	033° 25.085' W	4486	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
40-1	29	06.11	CTD	21:54-00:31	05° 26.585' S	033° 50.101' W	4325	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
41-1	30	07.11	CTD	02:33-05:22	05° 30.161' S	034° 10.060' W	4122	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
42-1	31	07.11	CTD	06:52-09:21	05° 32.670' S	034° 24.027' W	3767	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
43-1	32	07.11	CTD	10:39-12:51	05° 34.738' S	034° 36.070' W	3384	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
44-1	33	07.11	CTD	14:07-15:58	05° 36.552' S	034° 46.049' W	2639	LADCP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
45-1	34	07.11	CTD	17:06-18:33	05° 37.967' S	034° 54.032' W	1463	LADCP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
46-1	35	07.11	CTD	19:13-19:49	05° 38.210' S	034° 55.931' W	1440	LADCP, OPUS, O2 bottle sample
47-1	36	07.11	CTD	20:27-20:49	05° 38.993' S	034° 57.620' W	403	LADCP, OPUS, UVP, O2 bottle sample
48-1	37	08.11	CTD	00:00-00:28	05° 01.891' S	035° 01.120' W	463	LADCP, OPUS, UVP, AZFP, O2 bottle sample
49-1	38	08.11	CTD	01:31-02:10	04° 55.025' S	034° 55.132' W	830	LADCP, OPUS, UVP, AZFP, O2 bottle sample
50-1	39	08.11	CTD	03:06-03:55	04° 47.955' S	034° 53.007' W	1020	LADCP, OPUS, UVP, AZFP, O2 bottle sample
51-1	40	08.11	CTD	04:56-06:39	04° 40.059' S	034° 53.098' W	28	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
52-1	41	08.11	CTD	08:09-10:19	04° 24.974' S	034° 53.029' W	3362	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
53-1	42	08.11	CTD	12:41-15:00	03° 59.943' S	034° 53.073' W	3564	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
54-1	43	08.11	CTD	17:08-19:14	03° 39.991' S	034° 53.069' W	3459	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
55-1	44	08.11	CTD	22:03-00:14	03° 09.943' S	034° 52.961' W	3821	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample

56-1	45	09.11	CTD	03:43-06:10	02° 35.002' S	035° 00.030' W	3963	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
57-1	46	09.11	CTD	09:04-11:35	02° 04.952' S	035° 00.038' W	4051	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
58-1	47	09.11	CTD	13:39-16:08	01° 45.017' S	035° 00.049' W	4110	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
59-1	48	09.11	CTD	17:58-20:38	01° 27.937' S	035° 00.041' W	4321	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
60-1	49	09.11	CTD	22:00-00:31	01° 18.006' S	034° 59.976' W	4362	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
61-1	50	10.11	CTD	02:24-05:02	00° 59.976' S	035° 00.031' W	4399	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
62-1	51	10.11	CTD	07:03-09:43	00° 39.968' S	035° 00.085' W	4471	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
63-1	52	10.11	CTD	15:32-18:28	00° 00.058' S	035° 00.861' W	4548	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
64-1	53	10.11	CTD	22:37-01:29	00° 20.011' S	035° 00.043' W	4515	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
65-1	54	11.11	CTD	05:15-08:00	00° 20.023' N	035° 00.088' W	4547	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
66-1	55	11.11	CTD	09:58-13:58	00° 40.110' N	035° 00.024' W	4557	LADCP, UVP, OPUS, O2 bottle sample, salinity bottle sample
67-1	56	11.11	CTD	15:34-17:50	01° 00.008' N	035° 00.107' W	3583	LADCP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
68-1	57	11.11	CTD	20:33-23:18	01° 30.067' N	035° 00.031' W	4049	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
69-1	58	12.11	CTD	02:06-05:20	02° 00.087' N	034° 59.951' W	4183	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
70-1	59	12.11	CTD	08:02-10:22	02° 30.184' N	034° 59.942' W	3559	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
71-1	60	12.11	CTD	13:10-15:46	03° 00.118' N	034° 59.904' W	3819	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample

72-1	61	12.11	CTD	18:29-21:14	03° 29.894' N	034° 59.846' W	3962	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
73-1	62	13.11	CTD	00:05-02:14	04° 00.130' N	034° 59.743' W	3481	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
74-1	63	13.11	CTD	05:32-07:46	04° 29.966' N	034° 59.837' W	3879	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
75-1	64	13.11	CTD	10:49-13:14	05° 00.072' N	035° 00.011' W	3739	LADCP, UVP, OPUS, AZFP, O2 bottle sample, salinity bottle sample
76-1	65	13.11	CTD	16:22-18:52	05° 30.035' N	034° 59.963' W	3946	LADCP, UVP, OPUS, AZFP, O2 bottle sample
77-1	66	13.11	CTD	21:48-00:26	06° 00.042' N	034° 59.962' W	4237	LADCP, UVP, OPUS, AZFP, O2 bottle sample
78-1	67	15.11	CTD	17:05-21:20	12° 11.200' N	031° 27.546' W	6113	OPUS
79-1		18.11	Mooring – KPO 1202 recovered	07:51-12:32	17° 36.094' N	024° 15.325' W	3585	Iridium Float, MCP, MC, ADCP, Aquadopp, O2-Logger, VR2W, Argos, XEOS-XMA, Opt. Logger, Contros-O2, SAMI, Plankton Sampler, Sediment Trap
80-1	68	18.11	CTD	16:29-18:47	17° 36.029' N	024° 14.871' W	3598	OPUS, UVP
81-1		19.11	Mooring – KPO 1216 deployed	09:39-17:05	17° 28.681' N	024° 21.146' W	3596	MCP, MC, ADCP, Aquadopp, O2-Logger, VR2W, XEOS XMA, Opt. Logger, Argos, SAMI, Plankton Sampler, Sediment Trap, ABeck Vane, Elipse, Fluorometer

* permanent measurements: salinity, fluorescence, temperature, oxygen