Final Cruise Instructions

Date Submitted: February 1, 2010

Platform: NOAA Ship *Ronald H. Brown*

Cruise Number: RB-10-02

Project Title: CLIVAR A13.5 Expedition

Cruise Dates: 7 March- 17 April 2010

Prepared by: _____ Dated: _____
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NOAA/PMEL

Approved by: _____ Dated: _____
Dr. Eddie N. Bernard
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Approved by: _____ Dated: _____
Captain Michael S. Devany, NOAA
Commanding Officer
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CRUISE OVERVIEW

A. Summary

This cruise will be part of a decadal series of repeat hydrography sections jointly funded by NOAA-OGP and NSF-OCE as part of the CLIVAR/CO_2/hydrography/tracer program (http://ushydro.ucsd.edu). Academic institutions and NOAA research laboratories will participate. The program focuses on the need to monitor inventories of CO_2, tracers, heat and freshwater and their transports in the ocean. Earlier programs under WOCE and JGOFS have provided a baseline observational field for these parameters. The new measurements reveal much about the changing patterns on decadal scales. The program serves as a backbone to assess changes in the ocean's biogeochemical cycle in response to natural and/or man-induced activity. Global changes in the ocean's transport of heat and freshwater, which can have significant impact on climate, can be followed through these long-term measurements. The Repeat Hydrography Program provides a robust observational framework to monitor these long-term trends. The goal of the effort is to occupy a set of hydrographic transects with full water column measurements over the global ocean to study physical and hydrographic changes over time. These measurements are in support of:

* Model calibration and validation
* Carbon system studies
* Heat and freshwater storage and flux studies
* Deep and shallow water mass and ventilation studies
* Calibration of autonomous sensors

This program follows the invasion of anthropogenic CO_2, CFCs and other tracers into intermediate and deep water on decadal timescales and determines the variability of the inorganic carbon system, and its relationship to biological and physical processes. More details on the program can be found at the website referenced above.

Full water column CTD/rosette casts will be made along the cruise track (nominally along the prime meridian from 54˚S to 5˚N) with stations at approximately 30 mile spacing. In the equatorial region from 3˚S to 3˚N spacing will decrease to 20 miles to capture the smaller spatial scales of variability in the region. A few Argo profiling CTD floats will be deployed along the section. Near surface seawater (temperature, salinity, pCO_2, ADCP) and atmospheric measurements (CO_2, CFCs and ozone) will be made.

The operations on this cruise will be similar to those on previous CLIVAR Repeat Hydrography cruises completed on NOAA Ship *Ronald H. Brown,* including cruises RB-03-01, RB-04-13, RB-07-11, RB-08-01 and on CLIVAR cruises recently completed on a number of UNOLS research vessels, including *R/V Melville, R/V Thompson* and *R/V Revelle*. On these previous CLIVAR cruises a 36 position, 10-liter bottle rosette was used as the primary sampling package. On RB-10-02, we will use a smaller (24 position) rosette as our primary sampling package.

On the transit leg from Valparaiso - Cape Town, CO_2 near surface seawater (temperature, salinity, pCO_2) measurements will be taken from the scientific seawater line and the hull mounted ACDP

will provide measurement of currents. XBTs and Argo profiling CTD floats will be deployed on the transit as well.

B. Operating Area

The RB-10-02 cruise is comprised of two legs, a transit leg and a scientific leg. The transit from Valparaiso en route to Cape Town will occur from February 6, 2010 to February 26, 2010. The most direct route will be taken that accommodates the deployment of Argo floats in under-sampled areas. The scientific leg (7 March-17 April 2010) will focus on completing a long meridional section through the Eastern part of the South Atlantic, nominally along the prime meridian from 54˚S to 5˚N (See Figure 1). The section repeats part of the Ajax cruise occupied by the *R/V KNORR* in 1983/1984. The upcoming cruise will yield a first comprehensive snapshot of changes in anthropogenic CO_2 and tracer inventories and hydrographic changes in the region over the past 25 years. Full water column CTD stations will be occupied at 30 nautical mile intervals or closer and include collecting water samples from Niskin bottles for a variety of physical, chemical and biological parameters.
During the transit from Cape Town to the start of the line RB-10-02 a few brief (~1-2 hour each) test casts may be performed to check the CTD/rosette package and collect water samples for instrument testing. These tests will involve stopping the ship and lowering the package into the water. The locations of these tests will be chosen once the analytical gear is running, and in consultation with the ship's captain.

C. Participating Institutions:

AOML	Atlantic Oceanographic and Meteorological Laboratory - NOAA
CDIAC	Carbon Dioxide Information Analysis Center
CPO	Climate Program Office – NOAA
ETH	Swiss Federal Institute of Technology
LDEO	Lamont-Doherty Earth Observatory/Columbia University
MLML	Moss Landing Marine Laboratory
NIOMR	Nigerian Institute for Oceanography and Marine Research
Penn State	Pennsylvania State University
PMEL	Pacific Marine Environmental Laboratory - NOAA
Princeton	Princeton University
RSMAS	Rosentstiel School of Marine and Atmospheric Science/University of Miami
SIO	Scripps Institution of Oceanography/University of California at San Diego
TAMU	Texas A&M University
U Colorado	University of Colorado
U Ghana	University of Ghana
U Hawaii	University of Hawaii at Manoa
WHOI	Woods Hole Oceanographic Institution
WS_SA	Weather Service South Africa, Durban Station

D. Data to be collected: Lead PI

ADCP/LADCP:	Jules Hummon - UH
Alkalinity/pH:	Andrew Dickson - SIO
CFC/SF6:	John Bullister - PMEL
CTD:	Gregory Johnson - PMEL/Molly Baringer - AOML
14C/13C:	Robert Key - Princeton/Ann McNichol - WHOI
Data Management:	James Swift - SIO/Kristin Sanborn - SIO
DOC/TDN:	Dennis Hansell - RSMAS
Dissolved Oxygen:	Molly Baringer - AOML/Chris Langdon - RSMAS
Helium/Tritium:	Peter Schlosser - LDEO/William Jenkins - WHOI

Nutrients:	Calvin Mordy, PMEL/Jia-Zhong Zhang - AOML
Observers:	Steve Piotrowicz - CPO
pCO2 (UW & Discrete)	Rik Wanninkhof - AOML
Salinity:	Molly Baringer - AOML
Total CO2 (DIC):	Richard Feely - PMEL/Rik Wanninkhof - AOML
Transmissometry	Wilf Gardner TAMU

Personnel on Transit Leg: (Valparaiso, Chile to Cape Town, South Africa)

	Function	Name		Institution	Nationality
1	XBT/float launches	Gus McKay	M	WS_SA	South Africa

Personnel on RB 10-02: (Cape Town, South Africa to Takoradi, Ghana)

	Function	Name		Institution	Nationality
1	Chief Scientist	John Bullister	M	PMEL	US
2	Co-Chief Scientist	Robert Key	M	Princeton	US
3	Scientist	Kofi Renner	M	NIOMR	Nigeria
4	Scientist	Benjamin Osei Botwe	M	U Ghana	Ghana
5	Data Management	Mary Johnson	F	SIO	US
6	CTD	Kristy McTaggart	F	PMEL	US
7	CTD/Watch	Kyle Seaton	M	AOML	US
8	CTD Helper	Maria Herrmann	F	Penn State	USA
9	CTD Helper	Katherine Morrice	F	MLML	USA
10	Chief Sci helper	Ivy Frenger	F	ETH	Germany
11	ACDP/LADCP	Francois Ascani	M	U Hawaii	France
12	Salinity	James Farrington	M	AOML	US
13	O2	George Berberian	M	AOML	US
14	O2	Chris Langdon	M	RSMAS	US
15	Nutrients	Calvin Mordy	M	PMEL	US
16	Nutrients	Charles Fischer	M	AOML	US
17	DIC	Cynthia Peacock	F	PMEL	US
18	DIC	Alex Kozyr	M	CDIAC	US
19	pCO2 UW & Discrete	Kevin Sullivan	M	AOML	US
20	pCO2 discrete	Geun-Ha Park	F	AOML	South Korea
21	CFC/SF6	David Wisegarver	M	PMEL	US
22	CFC/SF6	Patrick Boylan	M	U Colorado	US
23	Alkalinity	Laura Fantozzi	F	SIO	US
24	Alkalinity	Yui Takeshita	M	SIO	Japan
25	pH	Adam Radich	M	SIO	US
26	pH	Emily Bockmon	F	SIO	US
27	Helium/Tritium	Anthony Dachille	M	LDEO	US
28	DOC/TDN	Darcy Metzler	F	RSMAS	US

E. Administrative

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Clearances:

Research clearance is being requested for Ghana, Argentina, Great Britain, Chile, Norway, and South Africa. The requests are being submitted to the State Department by Wendy Bradfield-Smith <Wendy.Bradfield-Smith@noaa.gov>

OPERATIONS

A. Data to be collected

1. CTD profiles of depth along hydrographic transects. Approximately 129 stations will be completed to full water depth, with an estimated maximum of 5714 meters.
2. Water samples collected in rosette bottles for comparison with the CTD profiles.
3. Profiles of northward and eastward velocity from the LADCP.
4. Salinity of the water samples collected with the bottles.
5. Dissolved oxygen, nutrients, carbon system parameters in the water samples collected with the bottles.
6. Trace gases (chlorofluorocarbons, sulfur hexafluoride, helium) in the water samples collected with the bottles.
7. Continuous recording of ship mounted ADCP data.
8. Heading data from both the MAHRS gyro system and the Seapath GPS system for correction and processing of shipboard ADCP data.
8. Continuous recording of Thermosalinograph (TSG).
9. Continuous recording of Seabeam bathymetry requested (with help from ship Survey Dept.)
10. Nutrient concentrations of the water samples collected with the bottles.
11. Full carbon characterization of the water samples collected with the bottles.

B. Staging Plan

Staging of the US equipment for the cruise was conducted in Charleston, SC in December, 2009 in consultation with ship and with the chief scientists of preceding and following cruises. Four twenty-foot shipping/laboratory containers with equipment and an additional CTD frame were loaded on the ship. All chemicals were accompanied by MSDS. All chemicals, except compressed gases and those packaged according to DOT regulations in the shipping/laboratory containers, were stored in the HazMat locker. A list of equipment and chemicals brought aboard was provided.

Copies of equipment lists, including country of origin were supplied to the CO and Chief Scientist prior to the departure of the ship from Charleston. It is the responsibility of each group of investigators to arrange for shipping their equipment to and from *Ronald H. Brown*, including preparing all necessary customs or export/import documentation, and transfers to the ship.
The science party will meet the ship in Cape Town. The science party will plan to move aboard on the night before sailing on March 6, 2010. We understand the galley may not be available for science party meals before sailing. Loading by science party and setup will occur throughout the in-port. We will require the assistance of the shipboard ET and Survey Technician and other shipboard personnel for 8 hours on three-days prior to sailing and connect ship power to the laboratory vans,

to install computer systems, and to make terminations for the CTD as well as to aid in the setup of other science equipment.

C. Cruise Plan

NOAA Ship *Ronald H. Brown* (RHB) will depart Valparaiso on February 6, 2010 for a transit to Cape Town with a scheduled arrival of February 26, 2010. During the transit XBTs will be launched at intervals of approximately 1 degree latitude and about 8 Argo floats will be released while the ship is underway. The systems to measure physical (TSG) and chemical parameters (pCO_2) from the underway sampling line, and the ship's ADCP and SCS system will be operational. Periodic water samples will be taken from the underway sampling line during the voyage. No slowdown for scientific operations is anticipated during the transit.

NOAA Ship *Ronald H. Brown* (RHB) will depart Cape Town, on March 7, 2010, to begin scientific operations. The primary goals of the cruise are to sample along previously occupied hydrographic section. All attempts will be made to reoccupy the CTD stations as closely as possible (see station listing below and appendix). The actual hydrographic stations sampling plan may deviate from this proposed plan in both number of stations and their locations.

The cruise will proceed from Cape Town to the start of the line at 54 ˚S, 0 ˚E/˚W, performing one or more test CTD casts en route. The exact location of the test station(s) will be determined in consultation with the Commanding Officer. We will then begin the CTD section along the prime meridian working from south to north. Upon completion of the CTD section at nominally 5^{o} N we will go into port.

We require that the ship suspend pumping and dumping for, at minimum, the last 500m of the CTD upcasts. The ship should also suspend any operations (eg incineration, paint chipping, deck washing, etc.) during this period if these activities lead to release of quantities of material into the surface water in the area where the rosette is recovered.
A map of the A13.5 cruise track is shown in Figure 1.

D. Station Locations

Station Locations are listed in Table 1. A projected schedule is provided in Appendix C. These are subject to change.

Station	Lat		Long		depth
Cape Town	33.92	S	18.46	E	
Test cast	45.00	S	8.00	E	3000
1	54.00	S	0.00	E	2443
2	53.50	S	0.07	E	2548
3	53.00	S	0.14	E	2474
4	52.50	S	0.21	E	2893
5	52.00	S	0.28	E	3236
6	51.50	S	0.35	E	2282
7	51.00	S	0.42	E	1729
8	50.50	S	0.48	E	3406
9	50.00	S	0.55	E	3847

10	49.50	S	0.62	E	3901
11	49.00	S	0.69	E	3882
12	48.50	S	0.76	E	3970
13	48.00	S	0.83	E	3879
14	47.50	S	0.90	E	3941
15	47.00	S	0.97	E	3936
16	46.50	S	1.04	E	4032
17	46.00	S	1.11	E	4347
18	45.50	S	1.18	E	4077
19	45.00	S	1.25	E	4511
20	44.50	S	1.32	E	4405
21	44.00	S	1.35	E	4314
22	43.50	S	1.34	E	4289
23	43.00	S	1.33	E	367
24	42.50	S	1.29	E	3939
25	42.00	S	1.15	E	824
26	41.50	S	1.01	E	2432
27	41.00	S	0.97	E	4279
28	40.50	S	0.98	E	4601
29	40.00	S	0.98	E	4837
30	39.50	S	0.98	E	5032
31	39.00	S	0.98	E	5080
32	38.50	S	0.98	E	5147
33	38.00	S	0.98	E	4778
34	37.50	S	0.99	E	5044
35	37.00	S	1.00	E	5181
36	36.50	S	1.00	E	5160
37	36.00	S	1.01	E	4952
38	35.50	S	1.05	E	4907
39	35.00	S	1.09	E	4789
40	34.50	S	1.16	E	4854
41	34.00	S	1.22	E	4764
42	33.50	S	1.10	E	4713
43	33.00	S	0.98	E	4456
44	32.50	S	1.12	E	4480
45	32.00	S	1.27	E	4387
46	31.50	S	1.42	E	4371
47	31.00	S	1.56	E	4435
48	30.50	S	1.70	E	4142
49	30.00	S	1.83	E	3618
50	29.50	S	1.81	E	3533
51	29.00	S	1.78	E	3724
52	28.50	S	1.75	E	4187
53	28.00	S	1.72	E	4408
54	27.50	S	1.69	E	4650
55	27.00	S	1.66	E	4773

56	26.50	S	1.65	E	4920
57	26.00	S	1.63	E	4769
58	25.50	S	1.59	E	5026
59	25.00	S	1.55	E	5510
60	24.50	S	1.53	E	5034
61	24.00	S	1.50	E	5044
62	23.50	S	1.47	E	5215
63	23.00	S	1.44	E	4906
64	22.50	S	1.41	E	5169
65	22.00	S	1.38	E	5298
66	21.50	S	1.35	E	5385
67	21.00	S	1.32	E	5296
68	20.50	S	1.29	E	5592
69	20.00	S	1.26	E	5401
70	19.50	S	1.24	E	5483
71	19.00	S	1.23	E	5315
72	18.50	S	1.20	E	5332
73	18.00	S	1.18	E	5487
74	17.50	S	1.14	E	5279
75	17.00	S	1.11	E	5517
76	16.50	S	1.06	E	5713
77	16.00	S	1.00	E	5480
78	15.50	S	1.00	E	5550
79	15.00	S	1.00	E	5385
80	14.50	S	0.98	E	5619
81	14.00	S	0.96	E	5555
82	13.50	S	0.94	E	5612
83	13.00	S	0.93	E	5529
84	12.50	S	0.90	E	5574
85	12.00	S	0.87	E	5546
86	11.50	S	0.85	E	5609
87	11.00	S	0.83	E	5600
88	10.50	S	0.80	E	5655
89	10.00	S	0.78	E	5658
90	9.50	S	0.56	E	5033
91	9.00	S	0.14	E	5481
92	8.50	S	0.28	W	4676
93	8.00	S	0.72	W	4851
94	7.50	S	1.15	W	4179
95	7.00	S	1.56	W	4126
96	6.50	S	1.97	W	4213
97	6.00	S	2.41	W	4614
98	5.50	S	2.85	W	4936
99	5.00	S	3.00	W	4741
100	4.50	S	3.00	W	4815
101	4.00	S	3.00	W	4689

102	3.50	S	3.00	W	4788
103	3.00	S	3.00	W	4994
104	2.67	S	3.00	W	4879
105	2.33	S	3.00	W	4897
106	2.00	S	3.00	W	4855
107	1.67	S	3.00	W	4912
108	1.33	S	3.00	W	5035
109	1.00	S	3.00	W	5122
110	0.67	S	3.00	W	5128
111	0.33	S	3.00	W	5160
112	0.00	N	3.00	W	5120
113	0.33	N	3.00	W	5123
114	0.67	N	3.00	W	5142
115	1.00	N	3.00	W	5107
116	1.33	N	3.00	W	5157
117	1.67	N	3.00	W	5124
118	2.00	N	3.00	W	5079
119	2.33	N	3.00	W	5028
120	2.67	N	3.00	W	5039
121	3.00	N	3.00	W	5002
122	3.31	N	3.00	W	4743
123	3.40	N	3.00	W	3988
124	3.47	N	3.00	W	3261
125	3.82	N	3.00	W	2565
126	4.17	N	3.00	W	2500
127	4.43	N	3.00	W	1751
128	4.62	N	3.00	W	1000
129	4.73	N	3.00	W	252

E. Station Operations

The preliminary personnel task assignments are indicated with each operation. The chief scientists and the Commanding Officer will determine final responsibilities.

-- Full water column CTD/rosette casts (Ship's and scientific personnel)
-- Sampling the rosette bottles for salinity, oxygen, nutrients, CFCs, helium, tritium, carbon dioxide, alkalinity, DIC, carbon isotopes, chlorophyll (Scientific personnel)
-- Release of Argo floats (Ship and scientific personnel)

a.) **Full water column CTD/Rosette Casts** (Ship's and scientific personnel)
CTD casts will include the user supplied CTD/O2 unit, a Lowered ADCP unit and a 24-position 11-liter bottle Rosette sampler. Approximately 129 casts will be conducted to full water column depth, maximum estimated at 5700 meters. We will require a package tracking system and

display for the CTD operations (Knudsen/Bathy2000/Bathy2010). We request that the ship provide an 8000 + m back-up CTD conducting capable wire for this cruise.

It is of utmost importance to the success of the expedition that the ship be able to hold position at all times during the CTD casts, and that the CTD winch, meter wheel, hydraulic frame, conducting cable and backups function properly during this expedition. Both primary and secondary winches must contain full lengths of CTD conducting cable in good condition and be outfitted to deploy the primary or secondary CTD. That is both should be fully rigged. Skilled ship personnel and adequate spare parts must be available on all legs to assure that this equipment is maintained in good working order. The ship's personnel must be skilled in CTD wire re-terminations, and adequate ship's supplies of materials for CTD wire re-terminations must be available. Since typical steaming time between stations is less than 3 hours, re-terminations of the conducting cable (when required) must be completed within 2-3 hours. The CTD/rosette system will be deployed off the starboard side. During recovery, the CTD/rosette package will be lowered onto platform that can be tugged into the staging bay by the user supplied rail system that was fitted and installed in Charleston. The size and weight of the package and frequent deployment is such that all mechanical components of winch and wire must be in excellent operating condition including optimal fleet angle, wire wrapping, and sheave diameter. In addition to this primary system, at least one other scientific party supplied 24-postion 11-liter water bottle package will serve as back-up. A pinger and altimeter will be mounted on the rosette systems and used during casts to monitor distance from the bottom. We anticipate that during most casts, the CTD/rosette will be lowered within about 10 meters of the bottom. The ship's Precision Depth Recorder (PDR) must be working properly for this purpose.

The winch, wire and meter wheel must be capable of routinely making casts up to 6000-m with these rosette systems. During the casts, if needed and available, ship's personnel will assist the CTD operators monitoring of the bathymetric recorder and pinger signal and to properly assess the distance of the rosette package off the bottom. The ship's electronics technician will share responsibility with the scientific party for maintaining good electrical and mechanical connections between the CTD/rosette system, the conducting cable and winch slip-rings, and to the deck unit for the CTD/rosette system.

Ship's and scientific personnel will mutually assist in the deployment and recovery of the CTD/rosette. A number of members of the scientific party have experience with CTD deployments. Members of the scientific party will be responsible for collecting the water samples from the rosette. Members of the scientific party will also be responsible to collect oxygen, nutrient, carbon, CFC and salinity samples and recording sample ID's. Particular care will be taken in the collection and analysis of water samples to assure that all properties are measured with the greatest accuracy possible. Many of the chemical measurements are sensitive to contamination from soot, oils, solvents, spray cleaners, lubricants, paints, hydraulic fluid, and other substances. The chief scientists and watch stander should be notified prior to the use of these substances. Care must be taken to avoid contamination of the rosette system with these substances. Smoking is prohibited in the area around the rosettes and at all times in the laboratories.

A designated member of the scientific party will be on deck during deployment and recovery to watch wire operations until the CTD/rosette system passes 200-m on the way down and starting when it reaches 200-m on the way up to assure smooth operations. The designee will communicate immediately with chief survey technician or watch lead who has radio contact with winch operator and bridge if something is amiss. The recovery team consisting of the chief survey technician and qualified rope and hook handlers from the scientific party will be assembled on deck by the time the package is 40-m from the surface.

Discharges from holding tanks must be secured 20 minutes prior to the projected time of deployment of the CTD and again 20 minutes prior to recovery of the CTD to the surface layer. The tanks may be pumped when the cast is at depth (>200 meters) but it is preferred that discharge occurs while underway between stations. The bridge must inform the ship's engineers in advance when discharges are to be secured.

b.) **Sampling the rosette bottles** (Scientific personnel):
The usual order for drawing seawater samples on deck will be: CFCs/SF_6, helium, oxygen, pCO_2, DIC, pH, alkalinity, C14/C13, tritium, DOC, nutrients, salinity. Scientific personnel will analyze salinity samples. Two salinity samples will be drawn from the deepest (or next to deepest) bottle at each station to monitor the precision of the sampling/analysis procedures. Salinity samples will be run using *Ronald H. Brown's* Guild line 8600B Autosal instrument, complete with computer interface and laptop computer. The ship must provide a backup salinometer. The salinometers must be checked for accuracy and precision during the last US in-port before the start of the expedition. Salinity samples will be analyzed in the salinity lab off the hydrolab, and variations in laboratory temperature must not exceed 1°C during a 24-hour period. The salinity samples will also be stored in this temperature controlled area for at least 8 hours to allow them to come to ambient temperature. The Autosal will be standardized at least once each station with new vials of standard seawater. Standard seawater will be provided by the scientific personnel for use on this cruise. To maintain the required accuracy, it is advisable to have one person run all salinity samples. We anticipate ~100 samples/day. An accuracy of 0.003 PSS-78 or better is required, and will be monitored by scientific personnel by comparison with CTD and historical data.
Oxygen and nutrient sampling and analysis (Scientific personnel):
Samples will be collected for oxygen and nutrient analysis from each sample bottle at all stations. Nutrients will be run on board ship by members of the scientific party. Refrigerator space will be required in the main lab for nutrient sample storage prior to analysis. Nutrient measurements will be made using an AlpKem RFA system. Dissolved oxygen samples will be "pickled" immediately after drawing using reagents in dispensing bottles located at a strategic location near the rosette. The samples will be run by members of the scientific party.

CFC/SF_6 ('Freon')(Scientific personnel)
Water samples will be drawn for CFC and SF_6 analysis at most stations. CFC samples will be drawn first, ahead of the helium and oxygen samples. The measurements are sensitive to the high CFC levels on board ship and are therefore analyzed in a dedicated van. The chief scientists should be notified prior to any service or maintenance of the air-conditioning system and of any discharge or leakage of CFCs or solvents on the ship.

Helium/tritium samples (Scientific personnel) will be drawn at selected stations and will be extracted and stored for shoreside analysis. (Scientific Personnel) Due to the possibility of contamination, no luminous dial watches that contain tritium may be used on board the ship during this expedition. Dr. Peter Schlosser (LDEO) or his representative must be notified of any proposed use of helium gas on board ship during this expedition.

Dissolved inorganic carbon (DIC), Total Alkalinity (TALK), pH, pCO_2 **C14/C13,** ***Dissolved organic carbon(*****DOC)** (Scientific personnel):
DIC,TALK, pH, pCO_2, C14/C13, TALK and DOC samples will be collected from the 11-L Niskin bottles. A small quantity (~ 0.025 Ml) of a saturated solution of $HgCl_2$ will be added to the DIC, C14/C13 and DOC samples to retard bacterial oxidation of organic matter prior to analysis. DIC samples will be measured by the coulometric titration method and will be done in a temperature controlled van. Discrete pCO_2 samples will be collected from the Niskins into 500

ml volumetric flasks for analyses by IR in the ship's hydro lab. TALK samples will be measured by the potentiometric methods in the main laboratories.

Lowered ADCP (Ship and Scientific personnel):
The lowered ADCP (LADCP) will be used on all CTD/rosette casts. The instrument is a broadband, self-contained, 300 kHz ADCP, which is to be mounted to the 24-position rosette system. The instrument can be used to a depth of 6000 m. The instrument is turned on about 15 minutes prior to the launch of the CTD/rosette package using a removable cable connection to a deck box and PC computer. The deck box should be in a dry area within 10 m of the rosette. After the CTD station, about 30 minutes are required to transfer the data from the instrument and to turn it off. The LADCP may have to be removed from the rosette for repair and possible battery changes.

Argo Float deployment (Ship and scientific personnel):
About 10 Argo floats will be released during this expedition. The chief scientists will co-ordinate this program. These floats require about an hour of preparation prior to deployment. Preparations will be completed while the CTD is in the water. Floats will be deployed at stations immediately following recovery of the CTD and before the ship gets underway. Deployment involves lowering the ~30 kg float by hand into the water from the stern of the ship. One or two persons from the ship and scientific party will be required for preparation and deployment.

Navigation (Ship's personnel):
Navigation shall be based on the best available information including GPS, radar and visual. When GPS control is available, it is the preferred navigation method. Several GPS units must be integrated with the ship's SCS system for ADCP and LADCP measurements.

The CTD/rosette station locations listed in the appendix are nominal positions. Starting station positions along the section need only be within ~1 nautical mile of the listed position and no adjustments need to be made to the ship's position upon approach to the station to bring the starting position closer than ~ 1 nautical mile to the nominal position. Some drift during CTD/rosette casts is acceptable to maintain favorable wire angle. Exceptions will be made to these general guidelines when sampling in regions of rapidly changing bathymetry, when more precise positioning (including on site adjustments to station locations) and more precise station keeping will be required. Navigation information will be recorded on the MOA form. In addition to satellite fixes and other events as they occur, MOA entries shall be made at least once every four hours, and at the time of each course and speed change when the ship is en route between stations (including slowdowns on arrival at the station and speedups on departure).

The numerical MOA entries will suffice for scientific purposes; a cruise plot is not required in the cruise data package. Since copies of the MOA forms will be made and used by various cruise participants, it is important that the entries be checked and made clearly and dark enough for reproduction.

F. Underway Operations:

Where research clearances and conditions permit, underway measurements will be made along the entire cruise track, including the inland waters along the transit from Valparaiso to Cape

Town. The uncontaminated seawater system will normally not be operated in harbors or other polluted areas.

-Underway measurement of sea surface temperature and salinity (Ship's personnel)
-Underway sea surface measurements of carbon dioxide, chlorophyll, and atmospheric measurements of carbon dioxide, CFCs, ozone and aerosols (Scientific personnel)
-ADCP (Scientific and ship's personnel)
-Routine weather observations (Ship's personnel).
-Center-beam Sea Beam data logging (Ship's personnel).

Sea surface temperature and salinity will be recorded continuously with a system accurate to within 0.05°C and 0.1 PSS-78. A copy of the calibration data will be provided to the chief scientists. The Survey Department will translate the data from thermosalinograph to ASCII and plot the data on a daily basis. The thermosalinograph should be calibrated no more than six months before the start of the cruise.

Underway sea surface measurements and sampling (Ship's and scientific personnel):
Continuous water sampling will be made from the ship's bow intake system. Ship's personnel will maintain this pump and provide adequate spare parts. This system must be capable of delivering 120 liters/minute of seawater. The system should be cleaned with bleach and flushed thoroughly at all taps prior to the cruise following the procedures established by the chief survey technician. Seawater will be drawn off this line to a sea/air equilibrator. Care must be taken to prevent contamination from smoke, solvent fumes, cleaning solutions, etc. Continuous underway measurements of pCO_2 will be made from one of the headspace equilibrators utilizing a LICOR NDIR Analyzer. Continuous measurements of chlorophyll will also be made using an in-line fluorometer.

Underway air measurements (Scientific personnel):
Atmospheric sampling will be conducted while underway and on station only when the wind is forward of the beam. It is desirable that the bridge notify the chief scientists if the ship's course will result in winds abaft the beam.
Air inlet cups will be mounted on the foredeck mast for collecting uncontaminated marine air. Air sampling lines will run from these inlets into the laboratory and laboratory vans.

ADCP underway operations (Ship's and scientific personnel):
Data from the ADCP system will be logged continuously while underway.

Weather observations (Ship's personnel):
Observations must be done at each station, and at regular intervals while underway.

Seabeam and PDR (Ship's personnel):
While underway, in place of annotation of the bathymetric (PDR) chart record, Sea Beam (center beam) will be operated to obtain a continuous record of time, position and bottom depth. During CTD stations, the PDR will be required for bottom detection.

Event files

The ship shall collect 1-second heading information from both the MAHRS gyro and SEAPATH GPS system for comparison and testing. We request one file with 1-second data with the following:

GPS time, lat, lon, cog and sog
Seapath heading, pitch and roll
MAHRS heading (and pitch and roll if available)

Gyro heading

We also request that the chief survey technician in consultation with the chief scientist sets up special event files for the groups requesting them.

G. Small Boat Operations

Small boat operations are not anticipated for this cruise

H. De-staging Plan

At the completion of the CLIVAR leg, the bulk of the scientific gear will be packed up on board No de-staging of scientific equipment is planned in Ghana. Because stations will be occupied very near Ghana, time will be required in port to complete sample analysis and packing. Some scientific gear from the RB-10-02 cruise, including the CTD/rosette system, will be used on the following PNE (RB-10-03) cruise. Full de-staging will occur when the ship returns to Charleston. All scientific equipment and remaining chemicals will be offloaded at that time. Storage of equipment and vans on *Ronald H. Brown* during PNE will occur in consultation and permission with chief scientist of PNE and the Commanding Officer.

FACILITIES

A. Equipment and Capabilities Provided by the Ship

The following communications devices are currently on board *Ronald H. Brown*.

1. High Frequency SSB (SEA 330): SEA Inc. 300-watt high frequency transceiver. The transceiver covers a frequency range from 1.6 to 29.9 MHz
2. Furano Global Marine Distress and Safety System (GMDSS)
3. Satellite communication system (INMARSAT -C, -B, -M).
4. VHF radios pre-programmed with a selection of marine band and NOAA frequencies.
5. Cell phones

The electronic instrumentation used for navigation includes:

6. Numerous GPS receivers
7. Sperry Mark 37 Gyro Compass
8. Furuno navigational radars. (S-band radar and an X-band (3 cm) radar.
9. Simrad Robertson Dynamic Positioning System
10. Raytheon model DSN-450 Doppler Speed/distance log

13. NAVTEX receiving and printing the international automated medium frequency (518 KHz) weather warnings

A photocopier (in good working order) and paper

Scientific Equipment requested from the Ship

1. Echo Sounder (Ocean Data Equipment Corporation (ODEC) Bathy 2010 or the Knudsen system) used in 12 kHz mode (to track CTD package to within 10 meters of the bottom) to be used while on CTD station.
2. Continuous Seabeam 2112 (12 kHz) swath bathymetric sonar system sampling while underway between stations.
3. Barometer with calibration files
4. WOCE IMET sensors
5. Hydrographic Winch system and readouts (using 0.322 or 0.375" conducting cable for CTD operations) with at least 8000-m of wire.
6. One backup hydrographic winch system for CTD operations with at least 8000-m of wire.
7. Hull mounted acoustic Doppler current profiler (RD Instruments (RDI), 75 kHz Ocean Surveyor acoustic Doppler current profiler) with gyro input.
8. MAHRS gyro system for acquisition of heading data used by acoustic Doppler current profiler.
9. Seapath GPS system for acquisition of heading data for testing the new MAHRS system.

B.) Equipment, capabilities and supplies provided by scientific party:

Four 20’ container vans were loaded aboard *Ronald H. Brown* for this cruise. See appendix for details. Two of these containers will act as laboratory vans, and must be accessible at all times throughout the expedition. Compressed gas (non-flammable) cylinders will be used in ship's laboratories and laboratory vans.

(a) Two 24 position rosette sampling with 11 (or 12)-liter water sampling bottles and spare parts.
(b) Complete CTD recording and processing system including 2 Sea-Bird CTDs, 2 deck units, connectors, spare parts and consumables.
(c) Chemical analysis instrumentation including gas chromatographs, equilibrators, oxygen titration system, nutrient auto analyzer, coulometer, alkalinity titrator, salinity bottles.
(d) Chemical reagents, compressed gases (approximately 30 cylinders). A listing of chemicals is given in the attached spreadsheet and will be updated prior to departure from Charleston.
(e) Two Benthos pingers with spare batteries, and altimeter.
(f) Strain gage
(g) Milli-Q system, and replacement parts
(h) One 300 KHz lowered ADCP.

DISPOSITION OF DATA AND REPORTS

A. Data Responsibilities

The Chief Scientists will be responsible for the disposition, feedback on data quality, and archiving of data and specimens collected on board the ship for the primary project. As representative of the program manager (Director, Climate Observation Division of the Climate Program Office), the Chief Scientist will also be responsible for the dissemination of copies of these data to participants in the cruise, to any other requesters, and to NESDIS in accordance with NDM 16-11 (ROSCOP within 3 months of cruise completion). The ship may assist in copying data and reports insofar as facilities allow.

The Chief Scientists will receive all original data gathered by the ship for the primary project, and this data transfer will be documented on NOAA Form 61-29 "Letter Transmitting Data". The Chief Scientist in turn will furnish the ship a complete inventory listing all data gathered by the scientific party detailing types and quantities of data.

Individuals in charge of piggyback projects conducted during the cruise have the same responsibilities for their project's data as the Chief Scientist has for primary project data. All requests for data should be made through the Chief Scientist.

The Commanding Officer is responsible for all data collected for ancillary projects until those data have been transferred to the project's principal investigators or their designees. Data transfers will be documented on NOAA Form 61-29. Copies of ancillary project data will be provided to the Chief Scientists when requested. Reporting and sending copies of ancillary project data to NESDIS (ROSCOP) is the responsibility of the program office sponsoring those projects.

The ship shall record ADCP raw data continuously during the cruise.

The following data products will be produced by the ship and, if requested, will be given to the Chief Scientist at the end of each leg:

a. navigational log sheets (MOAs);
b. salinity determinations;
c. calibration data for Autosals;
d. copy of SEAS data on CD or DVD;
e. CDs or DVDs of Sea Beam and navigational data, including location and depths of acoustic profile locations;
f. SCS data on CD or DVD disk;
g. ADCP raw data on CD or DVD

B. Pre- and Post-Cruise Meetings

Pre-Cruise Meeting: Prior to departure, the Chief Scientist will conduct a meeting of the scientific party to train them in sample collection and inform them of cruise objectives. Some vessel protocols, e.g., meals, watches, etiquette, etc. will be presented by the ship's Operations Officer.

C. Ship Evaluation Report

Within seven days of the completion of the cruise, a Ship Operation Evaluation form is to be completed by the Chief Scientist. The preferred method of transmittal of this form is via email to OMAO.Customer.Satisfation@noaa.gov . If email is not an option, a hard copy may be forwarded to:

Director, NOAA Marine and Aviation Operations
NOAA Office of Marine and Aviation Operations
8403 Colesville Road, Suite 500
Silver Spring, MD 20910

A Ship Operations Evaluation Report will be completed by the Chief Scientist and given to the Director, PMEL, for review and then forwarded to OMAO.

ADDITIONAL PROJECTS

A. MOC Directives

Any additional work will be subordinate to the primary project and will be accomplished only with the concurrence of the Commanding Officer and the Chief Scientist(s).

The following projects will be conducted by ship's personnel in accordance with the general instructions contained in the MOC Directives, and conducted on a not-to-interfere basis with the primary project:

a. SEAS Data Collection and Transmission
b. Marine Mammal Reporting
c. Bathymetric Trackline
d. Weather Forecast Monitoring
e. Sea Turtle Observations
f. Automated Sounding Aerological Program

HAZARDOUS MATERIALS

A. Policy Compliance

The Chief Scientist is responsible for complying with MOCDOC 15, Fleet Environmental Compliance #07, Hazardous Material and Hazardous Waste Management Requirements for Visiting Scientists, released July 2002. Documentation regarding those requirements will be provided by the Chief of Operations, Marine Operations Center, upon request.

By Federal regulations and NOAA Marine and Aviation Operations policy, the ship may not sail without a complete inventory of all hazardous materials by name and the anticipated quantity brought aboard, MSDS and appropriate neutralizing agents, buffers, and/or absorbents in amounts adequate to address spills of a size equal to the amount of chemical brought aboard. The amount of hazardous material arriving and leaving the vessel shall be accounted for by the Chief Scientist.

B. Inventory

The Chief Scientist will provide the Commanding Officer with an inventory indicating the amount, concentrations, and intended storage area of each hazardous material brought onboard, and for which the Chief Scientist is responsible (see appendix). This inventory shall be updated at time of offload, accounting for the amount of material being removed, as well as the amount consumed in science operations and the amount being removed in the form of waste.

The ship's dedicated HAZMAT Locker contains two 45-gallon capacity flammable storage cabinets and one 22-gallon capacity flammable storage cabinet. Unless the packaging of the chemicals meets OSHA/NFPA standards in each van, all HAZMAT, except small amounts for ready use, must be stored in the HAZMAT Locker.

C. MSDS

All hazardous materials require a Material Safety Data Sheet (MSDS). Copies of all MSDSs shall be delivered to the ship at least a week prior to sailing. The Chief Scientist shall have copies of each MSDS available when the hazardous materials are loaded aboard. Hazardous material for which the MSDS is not provided will not be loaded aboard.

D. Radioactive Isotopes

Each scientist working with these materials will be required to wear a lab coat and disposable booties to reduce the likelihood of tracking the substance out of the specified working area.

It will be the responsibility of the investigator to conduct pre-cruise (for background) and post-cruise wipe tests (regardless of whether a spill occurred or not). Wipe tests should also be conducted in the event of a spill, as well as periodically while underway.

A detailed procedural methodology describing the use of these materials should be provided to the Environmental Compliance Officer (ECO) for review at least one month prior to bringing them aboard. A spill contingency plan should also be provided at the same time. Please note that ship's personnel are not first responders in the event of a spill.

A log detailing the type and amount of materials brought aboard and removed from of the ship shall be maintained, along with a record of any spills that occurred.

All radioisotope work will be conducted by NRC or State licensed investigators only, and copies of these licenses shall be provided to the ECO at least one month prior to bringing any materials on board.

Three electron capture detectors (ECDs) mounted in gas chromatographs will be used in the CFC van on the cruise. These are low level sealed sources and 'excepted' materials for commercial transport and use.

MISCELLANEOUS

A. Meals and Berthing Plan

Meals and berthing are required for up to 28 scientists. Meals will be served 3 times daily beginning one hour before scheduled departure, extending throughout the cruise, and ending two hours after the termination of the cruise. Since the watch schedule is split between day and night, the night watch may often miss daytime meals and will require adequate food and beverages (for example a variety of sandwich items, cheeses, fruit, milk, juices) during what are not typically meal hours. Special dietary requirements (e.g., food allergies) for scientific participants will be made available to the ship's command at least seven days prior to the cruise
Berthing requirements, including number and gender of the scientific party, will be provided to the ship by the Chief Scientist. The Chief Scientist and Commanding Officer will work together on a detailed berthing plan to accommodate the gender mix of the scientific party taking into consideration the current make-up of the ship's complement. The Chief Scientist is responsible for ensuring the scientific berthing spaces are left in the condition in which they were received; for stripping bedding and linen return; and for the return of any room keys which were issued. The Chief Scientist is also responsible for the cleanliness of the laboratory spaces and the storage areas utilized by the scientific party, both during the cruise and at its conclusion prior to departing the ship.

All NOAA scientists will have proper travel orders when assigned to any NOAA ship. The Chief Scientist will ensure that all non NOAA or non Federal scientists aboard also have proper orders.

It is the responsibility of the Chief Scientist to ensure that the entire scientific party has a mechanism in place to provide lodging and food and to be reimbursed for these costs in the event that the ship becomes uninhabitable and/or the galley is closed during any part of the scheduled project.

All persons boarding NOAA vessels give implied consent to comply with all safety and security policies and regulations which are administered by the Commanding Officer. All spaces and equipment on the vessel are subject to inspection or search at any time. All personnel must comply with OMAO's Drug and Alcohol Policy dated May 7, 1999 which forbids the possession and/or use of illegal drugs and alcohol aboard NOAA Vessels.

B. Medical Forms and Emergency Contacts

The NOAA Health Services Questionnaire (NHSQ, Revised: 08/08) must be completed in advance by each participating scientist. The NHSQ can be obtained from the Chief Scientist or the NOAA website at NOAA HEALTH SERVICES QUESTIONNAIRE The completed form should be sent to the Regional Director of Health Services at Marine Operations Center. The participant can mail, fax, or scan the form into an email using the contact information below. The NHSQ should reach the Health Services Office no later than 4 weeks prior to the cruise to allow time for the participant to obtain and submit additional information that health services might require before clearance to sail can be granted. Please contact MOC Health Services with any questions regarding eligibility or completion of the NHSQ. Be sure to include proof of tuberculosis (TB) testing, sign and date the form, and indicate the ship or ships the participant will be sailing on. The participant will receive an email notice when medically cleared to sail if a legible email address is provided on the NHSQ.

Contact information:

Regional Director of Health Services
Marine Operations Center – Atlantic
439 W. York Street
Norfolk, VA 23510
Telephone 757.441.6320
Fax 757.441.3760
E-mail: MOA.Health.Services@noaa.gov

Prior to departure, the Chief Scientist must provide a listing of emergency contacts to the Executive Officer for all members of the scientific party, with the following information: name, address, relationship to member, and telephone number.

C. Shipboard Safety

A discussion of shipboard safety policies is in the “Science User’s Guide” which is available on *Ronald H. Brown* and is the responsibility of the scientific party to read. This information is also available on the ship’s web page. A meeting with the Operations Officer will be held for the scientific party at the beginning of the cruise which will include a safety briefing. All members of the scientific party are expected to be aware of shipboard safety regulations and to comply with them.

Wearing open-toed footwear or shoes that do not completely enclose the foot (such as sandals or clogs) outside of private berthing areas is not permitted. Steel-toed shoes are required to participate in any work dealing with suspended loads, including CTD deployments and recovery. The ship does not provide steel-toed boots. Hard hats are also required when working with suspended loads. Work vests are required when working near open railings and during small boat launch and recovery operations. The ship when required will provide hard hats and work vests.

D. Communications

The Chief Scientist or designated representative will have access to ship's telecommunications systems on a cost-reimbursable basis. Where possible, it is requested that direct payment (e.g. by credit card) be used as opposed to after-the-fact reimbursement. Ship's systems include:

1. INMARSAT-B

INMARSAT-B provides high quality voice and fax communications (9600 baud) and high-speed data transmission, including FTP; it is the primary means of transferring email. Cost is $2.60/min for voice and fax; $7.25/min for high speed. INMARSAT-B calls may be made collect or charged to credit card; cost is approximately $2.60/min **.

2. INMARSAT-M

INMARSAT-M (or Mini-M) provides medium quality voice communications. Cost is $2.15/min. INMARSAT-M may be charged to credit card or collect.

4. E-mail

An e-mail account for each embarked scientist will be established by the ship's LET. The account name will use the person's first and last name as listed in Personnel Section. The e-mail address for scientists will use the format:
firstname.lastname.atsea@rbnems.ronbrown.omao.noaa.gov

Example: molly.baringer.atsea@rbnems.ronbrown.omao.noaa.gov

5. Contacts

Important phone numbers, fax numbers and e-mail addresses: (Up-to-date phone numbers can be found on the MOC web site at www.moc.noaa.gov/phone.htm#RB)

Ronald H. Brown (to call from US)

- INMARSAT-B VOICE: 011-OAC-336-899-620 (approx $2.60/min)
- INMARSAT-B FAX: 011-OAC-336-899-621
- INMARSAT "M" VOICE: 011-OAC-761-831-360 (approx $2.99/min)

NOTE: For RB-10-02 cruise, the ship will be operating in range of the Atlantic Ocean Region-East (AOR-E) and West (AOR-W) satellites (with Ocean Area Codes (OAC) = 871 and 874 respectively.

Program contacts

John Bullister	John.L.Bullister@noaa.gov	206-526-6744
Rik Wanninkhof	rik.wanninkhof@noaa.gov	305-361-4379

E-mail addresses:

MOP radio room:	Radio.Room@noaa.gov
Commanding Officer, RHB	CO.Ronald.Brown@noaa.gov
Executive Officer, RHB	XO.Ronald.Brown@noaa.gov
Operations Officer, RHB	Ops.Ronald.Brown@noaa.gov
Medical Officer, RHB	Medical.Ronald.Brown@noaa.gov

E. Port Agent Services/Billing

Contractual agreements exist between the port agents and the Commanding Officer for services provided to NOAA Ship *Ronald H.* Brown. The costs for any services arranged through the ship's agents by the scientific program, in consultation with the Executive Officer , which are considered to be outside the scope of the agent/ship support agreement, will be the responsibility of that program. Where possible, it is requested that direct payment be arranged between the science party and port agent, as opposed to after-the-fact reimbursement to the ship's accounts.

F. Foreign National Guests Access to OMAO Facilities and Platforms

All foreign national access to the vessel shall be in accordance with NAO 207-12 and RADM De Bow's March 16, 2006 memo. National Marine Fisheries Service personnel will use the Foreign National Registration System (FRNS) to submit requests for access to NOAA facilities and

ships. The Departmental Sponsor/NOAA (DSN) is responsible for obtaining clearances and export licenses and for providing escorts required by the NAO. DSNs should consult with their designated NMFS Deemed Exports point of contact to assist with the process.

Refer to: http://www.omao.noaa.gov/foreign.html

The following are basic requirements. Full compliance with NAO 207-12 is required.

Responsibilities of the Chief Scientist:

1. Provide the Commanding Officer with the e-mail generated by the FRNS granting approval for the foreign national guest's visit. This e-mail will identify the guest's DSN and will serve as evidence that the requirements of NAO 207-12 have been complied with.
2. Escorts – The Chief Scientist is responsible to provide escorts to comply with NAO 207-12 Section 5.10, or as required by the vessel's DOC/OSY Regional Security Officer.
3. Ensure all non-foreign national members of the scientific party receive the briefing on Espionage Indicators (NAO 207-12 Appendix A) at least annually or as required by the servicing Regional Security Officer.
4. Export Control - The NEFSC currently neither possesses nor utilizes technologies that are subject to Export Administration Regulations (EAR).

The Commanding Officer and the Chief Scientist will work together to implement any access controls necessary to ensure no unlicensed export occurs of any controlled technology onboard regardless of ownership.

Responsibilities of the Commanding Officer:

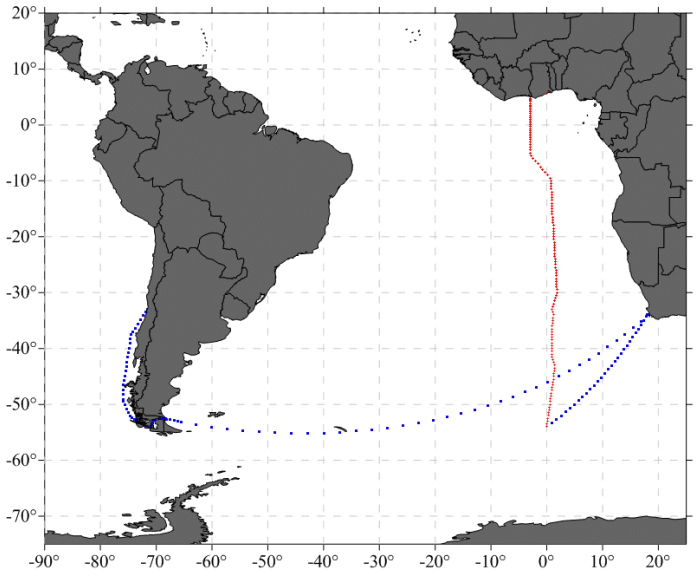
1. Ensure only those foreign nationals with DOC/OSY clearance are granted access.
2. Deny access to OMAO platforms and facilities by foreign nationals from countries controlled for anti-terrorism (AT) reasons and individuals from Cuba or Iran without written NMAO approval and compliance with export and sanction regulations.
3. Ensure foreign national access is permitted only if unlicensed deemed export is not likely to occur.
4. Ensure receipt from the Chief Scientist or the DSN of the FRNS e-mail granting approval for the foreign national guest's visit.
5. Ensure Foreign Port Officials, e.g., Pilots, immigration officials, receive escorted access in accordance with maritime custom to facilitate the vessel's visit to foreign ports.
6. Export Control - 8 weeks in advance of the cruise, provide the Chief Scientist with a current inventory of OMAO controlled technology onboard the vessel and a copy of the vessel Technology Access Control Plan (TACP). Also notify the Chief Scientist of any OMAO-sponsored foreign nationals that will be onboard while program equipment is aboard so that the Chief Scientist can take steps to prevent unlicensed export of Program controlled technology. The Commanding Officer and the Chief Scientist will work together to implement any access controls necessary to ensure no unlicensed export occurs of any controlled technology onboard regardless of ownership.

7. Ensure all OMAO personnel onboard receive the briefing on Espionage Indicators (NAO 207-12 Appendix A) at least annually or as required by the servicing Regional Security Officer.

Responsibilities of the Foreign National Sponsor:

1. Export Control - The foreign national's sponsor is responsible for obtaining any required export licenses and complying with any conditions of those licenses prior to the foreign national being provided access to the controlled technology onboard regardless of the technology's ownership.
2. The DSN of the foreign national shall assign an on-board Program individual, who will be responsible for the foreign national while on board. The identified individual must be a U.S. citizen, NOAA (or DOC) employee. According to DOC/OSY, this requirement cannot be altered.
3. Ensure completion and submission of Appendix C (Certification of Conditions and Responsibilities for a Foreign National Guest) as required by NAO 207-12 Section 5.03.h.

Figure 1. Cruise track for the CLIVAR/CO2 A13.5 Transit leg (blue) and science leg (red).



APPENDICES

A. List of Hazardous Materials

See attached Excel spreadsheet

B. Equipment/Van List

The chief scientist is cognizant that the ship will require accurate van weights for stability calculations. They usually are obtained from the trucking companies enroute after pickup at origin. All Container vans will be ISO fitting compatible, will be in good condition and comply with industry certification and inspection requirements. Investigators will arrange the shipping so that the vans will be delivered for loading on a proscribed date. Co-ordination of a rental crane (if needed) for loading the vans on *Ronald H. Brown* may save costs. Adequate electric power will be needed in the vans at the beginning of the loading period in Cape Town for testing of the analytical instruments.

Container Van dimensions, Locations and Requirements

(Entry door positions given below are when facing the double-doors on end of container)

1) PMEL CFC van
White, , ID: DOCU-000101-2
There are 2 entry doors, one on opposite end of van from double doors, one of left side of van near double doors,

wt	15000 lbs
size	8' x 8' x 20'
power input	480V, 3 phase
location	main deck, starboard side, aft. Double doors should face aft Needs phone (and Ethernet).

Contract Person: Dave Wisegarver, PMEL (david.wisegarver@noaa.gov)

2) PMEL CO_2 van
White, , ID: DOCU-000201-9
There is one entry door. It is inside the double doors and therefore requires that the double doors remain open, facing aft.

wt	13500 lbs
size	8' x 8' x 20'
power input	Square D, 30HTH: 30 amps, 3 phase, and 480v.
location	main deck, port side, outboard. Double doors should face aft

Needs compressed air, fresh water, phone and Ethernet.
Contact Person: Dana Greeley, PMEL (dana.greeley@noaa.gov)

3) AOML Storage van
Blue
wt 12000 lbs
size 8' x 8' x 20'
power input none
location main deck, port side, inboard of PMEL DIC van, double doors face aft
Contact Person: Bob Castle, Robert.Castle@noaa.gov, AOML

4) WHOI Storage van
Gray,, E51 - N744
wt 10000 lbs
size 8' x 8' x 20'
power input none
location 0-1 level, double doors face aft
Contact Person: Bob Castle, Robert.Castle@noaa.gov, AOML

5) WHOI Buoy van
wt 10000 lbs
size 8' x 8' x 20'
power input none
location location 0-1 level, double doors face aft
Contact Person: Bob Castle, Robert.Castle@noaa.gov, AOML

PMEL CTD Rosettes with LADCP (2)

WT: 1 ton (each)
SIZE: 4'L x 4'W x 6'H
SITE: Standard CTD Location

1. 3- Seabird 9 CTDs, 8”x8”x36”, 90 lbs total
2. 1 – LADCP 300 kHz system plus batteries, 24”x24”x6’200 lbs
3. 2 – CTD frames, underwater sampling package, 6.5’x48”diameter, 1300 lbs/each
4. 4 boxes CTD sensors, 16”x18”16, 60 lbs total

Appendix C. Schedule of stations

(see Excel spreadsheet file for more details)

Sta #	Lat	Lon	wire time (hr)	Extra time (hr)	Arrival Date: Time	Departure Date: Time	steam time (hr)	ship spd (kt)	total days
CPT	33.92S	18.46E	0	0		3/7/2010 12:00	0	0	0
Test	45S	8E	1.7	1.3	3/10/2010 8:25	3/10/2010 11:23	68.4	12	3.5
1	54S	0E	1.4	1.3	3/12/2010 15:16	3/12/2010 17:56	51.9	12	5.7
2	53.5S	0.07E	1.4	1.3	3/12/2010 20:56	3/12/2010 23:39	3	10	6
3	53S	0.14E	1.4	1.3	3/13/2010 2:40	3/13/2010 5:20	3	10	6.2
4	52.5S	0.21E	1.6	1.3	3/13/2010 8:21	3/13/2010 11:15	3	10	6.5
5	52S	0.28E	1.8	1.3	3/13/2010 14:16	3/13/2010 17:22	3	10	6.7
6	51.5S	0.35E	1.3	1.3	3/13/2010 20:23	3/13/2010 22:57	3	10	7
7	51S	0.42E	1	1.3	3/14/2010 1:57	3/14/2010 4:13	3	10	7.2
8	50.5S	0.48E	1.9	1.3	3/14/2010 7:14	3/14/2010 10:25	3	10	7.4
9	50S	0.55E	2.1	1.3	3/14/2010 13:26	3/14/2010 16:52	3	10	7.7
10	49.5S	0.62E	2.2	1.3	3/14/2010 19:53	3/14/2010 23:21	3	10	8
11	49S	0.69E	2.2	1.3	3/15/2010 2:22	3/15/2010 5:49	3	10	8.2
12	48.5S	0.76E	2.2	1.3	3/15/2010 8:50	3/15/2010 12:20	3	10	8.5
13	48S	0.83E	2.2	1.3	3/15/2010 15:21	3/15/2010 18:48	3	10	8.8
14	47.5S	0.9E	2.2	1.3	3/15/2010 21:49	3/16/2010 1:18	3	10	9.1
15	47S	0.97E	2.2	1.3	3/16/2010 4:19	3/16/2010 7:48	3	10	9.3
16	46.5S	1.04E	2.2	1.3	3/16/2010 10:49	3/16/2010 14:22	3	10	9.6
17	46S	1.11E	2.4	1.3	3/16/2010 17:22	3/16/2010 21:05	3	10	9.9
18	45.5S	1.18E	2.3	1.3	3/17/2010 0:06	3/17/2010 3:40	3	10	10.2
19	45S	1.25E	2.5	1.3	3/17/2010 6:41	3/17/2010 10:29	3	10	10.4
20	44.5S	1.32E	2.4	1.3	3/17/2010 13:30	3/17/2010 17:15	3	10	10.7
21	44S	1.35E	2.4	1.3	3/17/2010 20:15	3/17/2010 23:57	3	10	11
22	43.5S	1.34E	2.4	1.3	3/18/2010 2:57	3/18/2010 6:38	3	10	11.3
23	43S	1.33E	0.2	1.3	3/18/2010 9:38	3/18/2010 11:08	3	10	11.5
24	42.5S	1.29E	2.2	1.3	3/18/2010 14:08	3/18/2010 17:38	3	10	11.7
25	42S	1.15E	0.5	1.3	3/18/2010 20:42	3/18/2010 22:27	3.1	10	11.9
26	41.5S	1.01E	1.4	1.3	3/19/2010 1:31	3/19/2010 4:10	3.1	10	12.2
27	41S	0.97E	2.4	1.3	3/19/2010 7:10	3/19/2010 10:51	3	10	12.5
28	40.5S	0.98E	2.6	1.3	3/19/2010 13:51	3/19/2010 17:42	3	10	12.7
29	40S	0.98E	2.7	1.3	3/19/2010 20:42	3/20/2010 0:42	3	10	13
30	39.5S	0.98E	2.8	1.3	3/20/2010 3:42	3/20/2010 7:47	3	10	13.3
31	39S	0.98E	2.8	1.3	3/20/2010 10:47	3/20/2010 14:55	3	10	13.6
32	38.5S	0.98E	2.9	1.3	3/20/2010 17:55	3/20/2010 22:04	3	10	13.9
33	38S	0.98E	2.7	1.3	3/21/2010 1:04	3/21/2010 5:01	3	10	14.2
34	37.5S	0.99E	2.8	1.3	3/21/2010 8:02	3/21/2010 12:08	3	10	14.5
35	37S	1E	2.9	1.3	3/21/2010 15:08	3/21/2010 19:18	3	10	14.8
36	36.5S	1E	2.9	1.3	3/21/2010 22:18	3/22/2010 2:28	3	10	15.1
37	36S	1.01E	2.8	1.3	3/22/2010 5:28	3/22/2010 9:31	3	10	15.4
38	35.5S	1.05E	2.7	1.3	3/22/2010 12:32	3/22/2010 16:33	3	10	15.7
39	35S	1.09E	2.7	1.3	3/22/2010 19:34	3/22/2010 23:31	3	10	16
40	34.5S	1.16E	2.7	1.3	3/23/2010 2:33	3/23/2010 6:32	3	10	16.3
41	34S	1.22E	2.6	1.3	3/23/2010 9:33	3/23/2010 13:30	3	10	16.6
42	33.5S	1.1E	2.6	1.3	3/23/2010 16:34	3/23/2010 20:29	3.1	10	16.9
43	33S	0.98E	2.5	1.3	3/23/2010 23:33	3/24/2010 3:19	3.1	10	17.1
44	32.5S	1.12E	2.5	1.3	3/24/2010 6:24	3/24/2010 10:12	3.1	10	17.4
45	32S	1.27E	2.4	1.3	3/24/2010 13:17	3/24/2010 17:01	3.1	10	17.7
46	31.5S	1.42E	2.4	1.3	3/24/2010 20:07	3/24/2010 23:50	3.1	10	18
47	31S	1.56E	2.5	1.3	3/25/2010 2:56	3/25/2010 6:42	3.1	10	18.3
48	30.5S	1.7E	2.3	1.3	3/25/2010 9:47	3/25/2010 13:23	3.1	10	18.6
49	30S	1.83E	2	1.3	3/25/2010 16:28	3/25/2010 19:46	3.1	10	18.8
50	29.5S	1.81E	2	1.3	3/25/2010 22:46	3/26/2010 2:02	3	10	19.1
51	29S	1.78E	2.1	1.3	3/26/2010 5:02	3/26/2010 8:24	3	10	19.4
52	28.5S	1.75E	2.3	1.3	3/26/2010 11:25	3/26/2010 15:02	3	10	19.6
53	28S	1.72E	2.4	1.3	3/26/2010 18:03	3/26/2010 21:47	3	10	19.9
54	27.5S	1.69E	2.6	1.3	3/27/2010 0:48	3/27/2010 4:41	3	10	20.2
55	27S	1.66E	2.7	1.3	3/27/2010 7:41	3/27/2010 11:38	3	10	20.5

56	26.5S	1.65E	2.7	1.3	3/27/2010 14:38	3/27/2010 18:40	3	10	20.8
57	26S	1.63E	2.6	1.3	3/27/2010 21:40	3/28/2010 1:37	3	10	21.1
58	25.5S	1.59E	2.8	1.3	3/28/2010 4:38	3/28/2010 8:43	3	10	21.4
59	25S	1.55E	3.1	1.3	3/28/2010 11:44	3/28/2010 16:05	3	10	21.7
60	24.5S	1.53E	2.8	1.3	3/28/2010 19:06	3/28/2010 23:11	3	10	22
61	24S	1.5E	2.8	1.3	3/29/2010 2:12	3/29/2010 6:18	3	10	22.3
62	23.5S	1.47E	2.9	1.3	3/29/2010 9:18	3/29/2010 13:30	3	10	22.6
63	23S	1.44E	2.7	1.3	3/29/2010 16:30	3/29/2010 20:32	3	10	22.9
64	22.5S	1.41E	2.9	1.3	3/29/2010 23:32	3/30/2010 3:42	3	10	23.2
65	22S	1.38E	2.9	1.3	3/30/2010 6:42	3/30/2010 10:57	3	10	23.5
66	21.5S	1.35E	3	1.3	3/30/2010 13:57	3/30/2010 18:15	3	10	23.8
67	21S	1.32E	2.9	1.3	3/30/2010 21:15	3/31/2010 1:30	3	10	24.1
68	20.5S	1.29E	3.1	1.3	3/31/2010 4:30	3/31/2010 8:54	3	10	24.4
69	20S	1.26E	3	1.3	3/31/2010 11:55	3/31/2010 16:13	3	10	24.7
70	19.5S	1.24E	3	1.3	3/31/2010 19:13	3/31/2010 23:34	3	10	25
71	19S	1.23E	3	1.3	4/1/2010 2:34	4/1/2010 6:49	3	10	25.3
72	18.5S	1.2E	3	1.3	4/1/2010 9:49	4/1/2010 14:05	3	10	25.6
73	18S	1.18E	3	1.3	4/1/2010 17:05	4/1/2010 21:26	3	10	25.9
74	17.5S	1.14E	2.9	1.3	4/2/2010 0:26	4/2/2010 4:40	3	10	26.2
75	17S	1.11E	3.1	1.3	4/2/2010 7:40	4/2/2010 12:02	3	10	26.5
76	16.5S	1.06E	3.2	1.3	4/2/2010 15:03	4/2/2010 19:32	3	10	26.8
77	16S	1E	3	1.3	4/2/2010 22:33	4/3/2010 2:53	3	10	27.1
78	15.5S	1E	3.1	1.3	4/3/2010 5:53	4/3/2010 10:16	3	10	27.4
79	15S	1E	3	1.3	4/3/2010 13:16	4/3/2010 17:34	3	10	27.7
80	14.5S	0.98E	3.1	1.3	4/3/2010 20:34	4/4/2010 0:59	3	10	28
81	14S	0.96E	3.1	1.3	4/4/2010 3:59	4/4/2010 8:23	3	10	28.3
82	13.5S	0.94E	3.1	1.3	4/4/2010 11:23	4/4/2010 15:48	3	10	28.7
83	13S	0.93E	3.1	1.3	4/4/2010 18:48	4/4/2010 23:10	3	10	29
84	12.5S	0.9E	3.1	1.3	4/5/2010 2:10	4/5/2010 6:34	3	10	29.3
85	12S	0.87E	3.1	1.3	4/5/2010 9:35	4/5/2010 13:57	3	10	29.6
86	11.5S	0.85E	3.1	1.3	4/5/2010 16:58	4/5/2010 21:23	3	10	29.9
87	11S	0.83E	3.1	1.3	4/6/2010 0:23	4/6/2010 4:47	3	10	30.2
88	10.5S	0.8E	3.1	1.3	4/6/2010 7:48	4/6/2010 12:14	3	10	30.5
89	10S	0.78E	3.1	1.3	4/6/2010 15:14	4/6/2010 19:41	3	10	30.8
90	9.5S	0.56E	2.8	1.3	4/6/2010 22:57	4/7/2010 3:03	3.3	10	31.1
91	9S	0.14E	3	1.3	4/7/2010 6:56	4/7/2010 11:17	3.9	10	31.5
92	8.5S	0.28W	2.6	1.3	4/7/2010 14:24	4/7/2010 18:18	3.1	10	31.8
93	8S	0.72W	2.7	1.3	4/7/2010 22:15	4/8/2010 2:15	4	10	32.1
94	7.5S	1.15W	2.3	1.3	4/8/2010 6:12	4/8/2010 9:49	4	10	32.4
95	7S	1.56W	2.3	1.3	4/8/2010 13:42	4/8/2010 17:17	3.9	10	32.7
96	6.5S	1.97W	2.3	1.3	4/8/2010 21:10	4/9/2010 0:48	3.9	10	33
97	6S	2.41W	2.6	1.3	4/9/2010 4:46	4/9/2010 8:38	4	10	33.4
98	5.5S	2.85W	2.7	1.3	4/9/2010 12:37	4/9/2010 16:39	4	10	33.7
99	5S	3W	2.6	1.3	4/9/2010 19:48	4/9/2010 23:44	3.1	10	34
100	4.5S	3W	2.7	1.3	4/10/2010 2:44	4/10/2010 6:42	3	10	34.3
101	4S	3W	2.6	1.3	4/10/2010 9:42	4/10/2010 13:36	3	10	34.6
102	3.5S	3W	2.7	1.3	4/10/2010 16:36	4/10/2010 20:34	3	10	34.9
103	3S	3W	2.8	1.3	4/10/2010 23:34	4/11/2010 3:39	3	10	35.2
104	2.67S	3W	2.7	1.3	4/11/2010 5:39	4/11/2010 9:39	2	10	35.4
105	2.33S	3W	2.7	1.3	4/11/2010 11:39	4/11/2010 15:40	2	10	35.7
106	2S	3W	2.7	1.3	4/11/2010 17:40	4/11/2010 21:40	2	10	35.9
107	1.67S	3W	2.7	1.3	4/11/2010 23:40	4/12/2010 3:42	2	10	36.2
108	1.33S	3W	2.8	1.3	4/12/2010 5:42	4/12/2010 9:48	2	10	36.4
109	1S	3W	2.8	1.3	4/12/2010 11:48	4/12/2010 15:57	2	10	36.7
110	0.67S	3W	2.8	1.3	4/12/2010 17:57	4/12/2010 22:05	2	10	36.9
111	0.33S	3W	2.9	1.3	4/13/2010 0:05	4/13/2010 4:15	2	10	37.2
112	0N	3W	2.8	1.3	4/13/2010 6:15	4/13/2010 10:24	2	10	37.4
113	0.33N	3W	2.8	1.3	4/13/2010 12:24	4/13/2010 16:33	2	10	37.7
114	0.67N	3W	2.9	1.3	4/13/2010 18:33	4/13/2010 22:42	2	10	37.9
115	1N	3W	2.8	1.3	4/14/2010 0:42	4/14/2010 4:51	2	10	38.2
116	1.33N	3W	2.9	1.3	4/14/2010 6:51	4/14/2010 11:00	2	10	38.5
117	1.67N	3W	2.8	1.3	4/14/2010 13:00	4/14/2010 17:09	2	10	38.7
118	2N	3W	2.8	1.3	4/14/2010 19:09	4/14/2010 23:17	2	10	39
119	2.33N	3W	2.8	1.3	4/15/2010 1:17	4/15/2010 5:22	2	10	39.2
120	2.67N	3W	2.8	1.3	4/15/2010 7:22	4/15/2010 11:28	2	10	39.5
121	3N	3W	2.8	1.3	4/15/2010 13:28	4/15/2010 17:33	2	10	39.7

122	3.31N	3W	2.6	1.3	4/15/2010 19:24	4/15/2010 23:21	1.9	10	40
123	3.4N	3W	2.2	1.3	4/15/2010 23:53	4/16/2010 3:24	0.5	10	40.1
124	3.47N	3W	1.8	1.3	4/16/2010 3:51	4/16/2010 6:57	0.5	10	40.3
125	3.82N	3W	1.4	1.3	4/16/2010 9:03	4/16/2010 11:46	2.1	10	40.5
126	4.17N	3W	1.4	1.3	4/16/2010 13:52	4/16/2010 16:33	2.1	10	40.7
127	4.43N	3W	1	1.3	4/16/2010 18:07	4/16/2010 20:23	1.6	10	40.8
128	4.62N	3W	0.6	1.3	4/16/2010 21:32	4/16/2010 23:23	1.1	10	41
129	4.73N	3W	0.1	1.3	4/17/2010 0:00	4/17/2010 1:27	0.6	10	41.1
Tako	4.9N	1.75W	0	0	4/17/2010 7:44	4/17/2010 7:44	6.3	12	41.3