TROPICAL ATMOSPHERE-OCEAN (TAO) PROGRAM

FINAL CRUISE REPORT

CLIVAR RB-07-11/TAO RB-07-07

November 26, 2007 – January 18, 2008

Area: Equatorial Pacific between 8°N and 8°S latitude along 110°W Longitude.

Itinerary:

RB-07-07	*Departure Port*	DEP	*San Diego, CA*
	Arrival Port	ARR	*Easter Island*

CRUISE DESCRIPTION

The Tropical Atmosphere Ocean (TAO) array consists of 70 buoys utilizing a taut line mooring configuration used to mount data collection sensors for climate research purposes. JAMSTEC services fifteen buoys and one subsurface ADCP float. The remaining 55 buoys and four subsurface ADCP floats from 95°W longitude to 165°E longitude are serviced by National Data Buoy Center (NDBC). Repair and maintenance of the buoys is performed by NDBC contracted personnel on an annual basis utilizing the NOAA Vessel Ka I'mimoana and NOAA Vessel Ron H. Brown. The power systems are designed to operate up to 18 months before power failure occurs and maintenance cycles are timed to perform buoy service operations before the power systems fail when possible.

World Climate Research Program project addressing Climate Variability and Predictability (CLIVAR) was the lead research project during this cruise on the NOAA Vessel Ronald H. Brown. They were the Chief Scientists and conducted CTD casts as one in an ongoing series of decadal repeat hydrographic sections jointly funded by NOAA-Office of Global Programs (OGP) and National Science Foundation-Office of Climate and Environment (NSF-OCE) as part of the CLIVAR/CO2 Repeat Hydrography Program. Provided below is contact information for questions on the CTD measurements taken in association with the CLIVAR Project.

TAO Project Points of Contact:

TAO Project Manager	TAO Operations Manager
Dr. Chung-Chu Teng	Lex LeBlanc
National Data Buoy Center	National Data Buoy Center
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228-688-7101	228-688-7465
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CLIVAR Point of Contact:

Chief Scientist

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TAO Cruise Objective and Plan:

The objective of this cruise was the maintenance of the TAO Array along the 110°W meridian. The scientific complement for the cruise embarked at ***San Diego, CA*** on ***26 November 2007***. The ship departed on ***14 December 2007*** and conducted operations on the 110W line. After completion of operations, **NOAA Ship *Ronald H. Brown*** proceeded to ***Easter Island***, arriving on ***18 January 2008***. All dates and times referred to in this cruise report are in Pacific Standard Time (PST) unless otherwise specified.

1.0 PERSONNEL

1.1 *CHIEF SCIENTIST AND PARTICIPATING SCIENTISTS*:

Chief Scientist: ***John Bullister (CLIVAR)***

Participating TAO Scientists:

Name	Gender	Nationality	Affiliation
James Rauch	M	US	NOAA/NDBC
William Thompson	M	US	NOAA/NDBC

2.0 OPERATIONS

2.1 *TAO Buoy Operations Summary*

TAO buoy operations were conducted from (*8°00'00"N/110°00'00"W*) to (*8°00'00"S/110°00'00"W*). The following mooring operations were completed:

Location	*Mooring Type*	*Date/Time of Service*	*Service Performed*	*Data Recovery*
8n110w	ATLAS	12/24/2007 2349Z	Replaced anemometer and sea surface conductivity/temperature sensor	No delayed-mode tube data was recovered during this cruise.
5n110w	ATLAS	12/26/2007 1415Z	Visit, hawser line attached to buoy	No delayed-mode data downloads performed on this cruise.
2n110w	ATLAS	12/27/2007 2230Z	Recovery and Deployment	All delayed-mode data was recovered.
0110w	ATLAS	12/29/2007 1808Z	Replaced air temperature/relative humidity sensor	No delayed-mode tube data was recovered during this cruise.
0110w	ADCP	12/29/2007 20:33Z	Recovery and Deployment	Delayed data recovered after arrival back at Stennis Space Center
2s110w	ATLAS	12/31/2007 1418Z	Replaced anemometer and air temperature/relative humidity sensor	No delayed-mode tube data was recovered during this cruise.
5s110w	ATLAS	01/02/2008 0343Z	Deployment only, original buoy drifted too far for recovery	Recovery of the original buoy could not be performed, no delayed-mode data recovered during this cruise.
8s110w	ATLAS	01/03/2008 1502Z	Deployment only, could not locate buoy for recovery	Recovery of the original buoy could not be performed, no delayed-mode data recovered during this cruise.

The following provides details on the specific service work performed on each buoy and any discrepancies encountered during the performance of the buoy service to include why primary sensors were not deployed, data not downloaded from recovered sensors and why, missed work, etc.:

8N110W

Buoy ID: PM664A	**Buoy Configuration:** Standard
Buoy Type: ATLAS	**Water Depth:** 4208 meters
Deployed Location: 08° 03.24N 110° 08.92W	**Repair Location:** 08° 03.17N 110° 8.33W
Repair Buoy Start Date: 04/08/2007	**Repair Buoy End Date:** Still Active
Service Description: Buoy was serviced to replace the anemometer and sea surface conductivity/temperature sensor. Upon arrival to the buoy and commencement of sensor replacement, it was noted the anemometer was missing, the locking collar was broken, and cable connector was ripped off. There was no apparent damage to the anemometer stanchion/antenna. A new wind sensor was	

installed and the original anemometer was noted as lost at sea. There were no indicated damages to the sea surface conductivity/temperature sensors but barnacle growth was around the conductivity flow through tube. The handheld computer connection failed resulting in no data recovery. The data will be recovered during the KA-08-04 Cruise in June 2008.

Oceanographers Inputs

Site Sensor Failures	Date Sensors Failed	Why sensors were failed	Field Service Observations
Anemometer	August 09, 2007	Direction was off from QuikSCAT directions and then went to zero values	Missing, the locking collar was broken, and cable connector was ripped off
Sea Surface Conductivity/Temperature	August 10, 2007	Salinity values dropped to unreliable values indicating a fouling condition	Bio-fouling around conductivity tube

5N110W

Buoy ID: PM665A	**Buoy Configuration:** Standard
Buoy Type: ATLAS	**Water Depth:** Not Taken
Deployed Location: 4° 59.60N 110° 04.16W	**Repair Location:** 5° 1.3N 110°5.7W
Repair Buoy Start Date: 04/09/07	**Repair Buoy End Date:** Still Active
Service Description: Buoy was visited and no repairs were necessary. There were no sensor failures and all data transmitted was within quality control limits. On the flyby of the buoy some things were noted: the buoy was sitting low in the water and the near surface current was averaging 2.1 knots and there was a hawser line attached to one of the buoy tower legs. We will be watching the buoy for possible vandalism in the future as the hawser line is evident of a fishing vessel possibly attaching itself to the buoy.	

Oceanographers Inputs

Site Sensor Failures	Date Sensors Failed	Why sensors were failed	Field Service Observations
None	N/A	N/A	2.1kt surface current and hawser line attached to one leg

2N110W

Buoy ID: PM654B	**Buoy Configuration:** Standard
Buoy Type: ATLAS	**Water Depth:** 3765 meters
Deployed Location: 2° 2.96N 110° 01.97W	**Recovered Location:** 1° 57.2N 110°14.5W
Recovered Buoy Start Date: 11/19/06	**Recovered Buoy End Date:** 12/27/07
Service Description: Prior to buoy recovery, the sea surface conductivity/temperature sensor was failed and the anemometer has stopped reporting. During the recovery process some things were noted about the condition of the buoy: the anemometer was missing and the stanchion/antenna was bent at approximately 20 degrees with the mounting bolts pulled through the PVC material and exposing the tube to possible water intrusion. All buoy delayed-mode data was recovered.	

Oceanographers Inputs

Site Sensor Failures	Date Sensors Failed	Why sensors were failed	Field Service Observations
Sea Surface Conductivity/Temperature	July 14, 2007	Salinity data started spiking to abnormally high values	No noted fouling or damage
Anemometer	August 30, 2007	Direction and speed went to "0's"	Anemometer was missing and the stanchion/antenna was bent at approximately 20 degrees

0110W Buoy

Buoy ID: PM666A	**Buoy Configuration:** Flux
Buoy Type: ATLAS	**Water Depth:** 3810 meters
Deployed Location: 00° 01.89N 109° 54.58W	**Recovered Location:** 00° 1.25N 109° 58.85W
Repair Buoy Start Date: 12/29/07	**Repair Buoy End Date:** Still Active
Service Description: Upon approach to the buoy using the RHIB (Rigid Hull Inflatable Boat), it was observed a section of ½" rope was attached to one tower leg. There wasn't any other visible damage to the buoy. The air temperature/relative humidity sensor was successfully replaced. The handheld computer connection failed resulting in no data recovery. The data will be recovered during the KA-08-04 Cruise in June 2008.	

Oceanographers Inputs

Site Sensor Failures	Date Sensors Failed	Why sensors were failed	Field Service Observations
AT/RH	June 15, 2007	Hourly data indicated RH measurements above 100%	No noted physical damage to sensor

0110W ADCP

Mooring ID: EO014	**ADCP Configuration:** narrowband
Mooring Type: ADCP	**Water Depth:** 257 meters
Deployed Location: 00° 00.92N 110° 04.77W	**Recovered Location:** 00° 00.92N 110° 04.77W
Recovered Mooring Start Date: 11/21/06	**Recovered Mooring End Date:** 12/29/07
Service Description: No ADCP data was recovered during the cruise because communications could not be established due to failure of circuit board six. Data will be recovered after ADCP returns to Stennis Space Center, MS.	

Oceanographers Inputs

Site Sensor Failures	Date Sensors Failed	Why sensors were failed	Field Service Observations
None	N/A	N/A	ADCP circuit board six is shorted out.

2S110W

Buoy ID: PM667B	**Buoy Configuration:** Standard
Buoy Type: ATLAS	**Water Depth:** 3920
Deployed Location: 01° 58.62S 109° 58.630W	**Repair Location:** 01° 55.34S 110° 04.22W
Repair Buoy Start Date: 04/12/07	**Repair Buoy End Date:** Still Active
Service Description: A buoy repair was performed to replace the anemometer and air temperature/relative humidity sensor. Upon approach to buoy using the RHIB, it was noted two tow lines were attached to the buoy and the anemometer was broken off and missing. The anemometer stanchion/antenna was not damaged and there were no noted damages to the buoy. Both sensors were replaced without incident. The handheld computer connection failed resulting in no data recovery. The data will be recovered during the KA-08-04 Cruise in June 2008.	

Oceanographers Inputs

Site Sensor Failures	Date Sensors Failed	Why sensors were failed	Field Service Observations
Anemometer	July 10, 2007	Direction and speed went to "0's"	Anemometer was missing
AT/RH	RH=July 22,2007 AT=December 06, 2007	Data went erratic and then missing after vandalism event	No noted physical damage to sensor

5S110W

Buoy ID: PM657	**Buoy Configuration:** Standard
Buoy Type: ATLAS	**Water Depth:** 3611 meters
Deployed Location: 4° 59.31S 109° 59.10W	**Recovered Location:** **Adrift**
Recovered Buoy Start Date: 11/24/06	**Recovered Buoy End Date:** Still Active
Service Description: The buoy was scheduled for recovery and deployment, but due to the buoy being adrift and drifting to far from the deployment site to be recovered with the time allowed; only a deployment was completed. Deployment operations were completed without incident. Tentative recovery attempt will occur in May 2005.	

Oceanographers Inputs

Site Sensor Failures	Date Sensors Failed	Why sensors were failed	Field Service Observations
Buoy	Adrift	Buoy moved on May 02, 2007 and left watch grid on September 11, 2007	Buoy was not on site and too far from the operations area to recover

8S110W

Buoy ID: PM658A	**Buoy Configuration:** Standard
Buoy Type: ATLAS	**Water Depth:** 3422
Deployed Location: 7° 59.56S 110° 4.14W	**Recovered Location:** **Missing**
Recovered Buoy Start Date: 11/25/06	**Recovered Buoy End Date:** **Missing**
Service Description: The buoy was scheduled for recovery and deployment. Buoy communications had ceased on 2 July 2007 and was projected to be missing. Upon approach, the buoy was confirmed missing. The acoustic release was sounded for but no communications were established. Recovery operations	

were cancelled and deployment operations were performed without incident.

Oceanographers Inputs

Site Sensor Failures	Date Sensors Failed	Why sensors were failed	Field Service Observations
Buoy PTT	June 30, 2007	Buoy moved on June 29, 2007; transmissions ceased June 30, 2007	Buoy was missing

2.2 *CTD Casts Completed*

A Sea-Bird 911plus CTD with dual temperature and conductivity sensors was provided by the program. Temperature and conductivity sensors are calibrated yearly at Sea-Bird and sent in for diagnostics as necessary. A Sea-Bird 24-position carousel and twenty four 5-liter Niskin bottles were used to collect water samples for the analysis of salinity.

The following outlines the CTD casts completed during the cruise:

Date	Lat/Lon	Approximate Depth	Completion Time	Notes
12/23/07	12.08N 110.00W	3700 Meters	0402Z	CLIVAR Project
12/23/07	11.50N 110.00W	3800 Meters	1108Z	CLIVAR Project
12/23/07	10.92N 110.00W	3900 Meters	1831Z	CLIVAR Project
12/23/07	10.33N 110.00W	2500 Meters	2355Z	CLIVAR Project
12/24/07	9.75N 110.00W	3700 Meters	0603Z	CLIVAR Project
12/24/07	9.17N 110.00W	4700 Meters	1243Z	CLIVAR Project
12/24/07	8.58N 110.00W	4000 Meters	1914Z	CLIVAR Project
12/25/07	8.00N 110.00W	3700 Meters	0533Z	CLIVAR Project
12/25/07	7.42N 110.00W	4000 Meters	1139Z	CLIVAR Project
12/25/07	6.83N 110.00W	3500 Meters	1720Z	CLIVAR Project
12/26/07	6.25N 110.00W	3400 Meters	0009Z	CLIVAR Project
12/26/07	5.67N 110.00W	3900 Meters	0626Z	CLIVAR Project
12/26/07	5.03N 109.99W	4000 Meters	1309Z	CLIVAR Project
12/26/07	4.50N 110.00W	4000 Meters	2003Z	CLIVAR Project
12/27/07	4.00N 110.00W	3900 Meters	0216Z	CLIVAR Project

12/27/07	3.50N 110.00W	3900 Meters	0759Z	CLIVAR Project
12/27/07	3.00N 110.00W	3900 Meters	1349Z	CLIVAR Project
12/27/07	2.50N 110.00W	3800 Meters	1925Z	CLIVAR Project
12/28/07	2.04N 110.03W	3800 Meters	0924Z	CLIVAR Project
12/29/07	1.50N 110.00W	3800 Meters	0313Z	CLIVAR Project
12/29/07	1.00N 110.00W	3800 Meters	0934Z	CLIVAR Project
12/29/07	00.50N 110.00W	3800 Meters	1529Z	CLIVAR Project
12/30/07	00.00N 109.98W	3800 Meters	0733Z	CLIVAR Project
12/30/07	00.33S 110.01W	3800 Meters	1311Z	CLIVAR Project
12/30/07	00.67S 110.00W	3900 Meters	1900Z	CLIVAR Project
12/31/07	1.00S 110.00W	4000 Meters	0053Z	CLIVAR Project
12/31/07	1.50S 110.00W	3900 Meters	0721Z	CLIVAR Project
12/31/07	1.92S 110.04W	4000 Meters	1341Z	CLIVAR Project
12/31/07	2.50S 110.00W	3900 Meters	2310Z	CLIVAR Project
01/01/08	3.00S 110.00W	3000 Meters	0526Z	CLIVAR Project
01/01/08	3.50S 110.00W	4000 Meters	1122Z	CLIVAR Project
01/01/08	4.00S 110.00W	3800 Meters	1724Z	CLIVAR Project
01/01/08	4.50S 110.00W	3600 Meters	2342Z	CLIVAR Project
01/02/08	5.01S 110.00W	3600 Meters	1055Z	CLIVAR Project
01/02/08	5.42S 109.42W	3500 Meters	1803Z	CLIVAR Project
01/03/08	5.83S 108.84W	3500 Meters	0100Z	CLIVAR Project
01/04/08	6.25S 108.26W	3000 Meters	1212Z	CLIVAR Project
01/04/08	6.67S 107.68W	3200 Meters	1853Z	CLIVAR Project
01/05/08	7.08S 107.10W	3200 Meters	0154Z	CLIVAR Project
01/05/08	7.50S 106.51W	3200 Meters	0826Z	CLIVAR Project
01/05/08	7.92S 105.93W	3550 Meters	1507Z	CLIVAR Project
01/05/08	8.33S 105.34W	3600 Meters	2154Z	CLIVAR Project

The following outlines the scheduled CTD casts not completed and why:

All CTD casts were completed.

2.3 *Ancillary Science Projects Completed on the Cruise*

The following outlines the ancillary science work performed in conjunction with the TAO operations on the cruise:

Pacific Marine Environmental Laboratory (PMEL) Argo Profiling CTD Floats

2 Argo floats were scheduled for deployment on this cruise. The chief scientist verified and briefed the Operations Officer on the deployment positions prior to the start of the cruise. All Argo Float deployments were completed as scheduled.

Questions concerning ARGO Floats should be directed to:

Gregory Johnson, NOAA/PMEL
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E-mail: pmel_floats@noaa.gov

or

Elizabeth Steffen, NOAA/PMEL
Tel: (206) 526-6747
E-mail: pmel_floats@noaa.gov

The following outlines the Argo floats deployed during the cruise:

Serial Number	Location	Date	Time GMT
3403	0° 0' 0" S 109° 58' 0"W	12/20/2007	0558Z
3362	0° 58' 52”S 109° 59' 59”W	12/21/2007	0054Z

Ancillary Science Project

CLIVAR was the lead project on this cruise. TAO was the ancillary project for this cruise.