TROPICAL ATMOSPHERE-OCEAN (TAO) PROGRAM

FINAL CRUISE REPORT

KA-09-02

Area: Equatorial Pacific between 8°N and 8°S latitude along 165°E Longitude and 8°S to 8°N Latitude along 180° Longitude.

Itinerary:

KA-09-02	*Kwajalein, RMI*	DEP	*June 14, 2009*
	Honolulu, HI	ARR	*July 10, 2009*

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. Fifteen buoys are serviced by JAMSTEC and the remaining 55 buoys 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 Ship *Ka'imimoana*. The buoys' deployment lifecycle are up to 18 months to ensure at least one year of data collection can be completed.

TAO Project Points of Contact:

TAO Program Manager
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TAO Operations Manager
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TAO Cruise Objective and Plan:

The objective of this cruise was the maintenance of the TAO Array along the 165°E and 180° meridians.

The scientific complement for the cruise embarked at ***Kwajalein, RMI*** on ***June 13, 2009***. The ship departed on ***June 14, 2009*** and conducted operations as listed in Section 2.1. The ship arrived in ***Honolulu, HI*** on ***July 10, 2009***.

1.0 PERSONNEL

1.1 *CHIEF SCIENTIST AND PARTICIPATING SCIENTISTS*:

Cruise Lead: Brian Lake

Participating Scientists:

Name	Gender	Nationality	Affiliation
Brian Lake	M	US	NOAA/NDBC
Casey Burge	M	US	NOAA/NDBC
William Thompson	M	US	NOAA/NDBC

2.0 OPERATIONS

2.1 *TAO Data Recovery Summary*

Mooring Operations conducted are shown in the table below. The following provides details on the data recovery efforts for the buoys serviced. All noted time in the summary reports is Coordinated Universal Time (UTC):

Buoy Site: 8N 165E		**Mooring Depth:** 5219m	
Mooring Operation: Repair SSC		**Mooring ID#:** PM768B	
Deployed Location: 8-02.0N 165-08.5E		**Deployed Date:** 9/7/08	
Repair Location: 8-02.8N 165-07.8E		**Repair Date:** 6/15/09	
Previous Repair Date: None			
Sensors/Equipment Lost at Sea: None			
Sensors Damaged: None			
Fishing/Vandalism: None			
Sensors/Tubes Downloaded: Tube downloaded.			
General Comments: Buoy riding well, no signs of vandalism. Replaced SSC.			
Site Sensor	**Date Sensors**	**Why sensors were**	**Field Service**

Failures	Failed	Failed	Observations
None			

Buoy Site: 5N 165E, Refresh	**Mooring Depth:** 4772m
Mooring Operation: Deployment	**Mooring ID#:** DM003
Deployed Location: 5-02.2N 165-03.0E	**Deployed Date:** 6/16/09
Pre-Deployment On Deck Instrument Failures: None	
Sensors/Equipment Lost at Sea: None	
Sensors Damaged: None	
General Comments: Tag line caught on tower leg; small boat was launched to remove it.	

Buoy Site: 5N 165E	**Mooring Depth:** 4779 m
Mooring Operation: Recovery	**Mooring ID#:** PM729B
Deployed Location: 05-01.85N 165-01.06E	**Deployed Date:** 3/14/08
Recovered Location: 5-02.5N 165-00.0E	**Recovered Date:** 6/16/09
Previous Repair Date: 9/8/08	
Sensors/Equipment Lost at Sea: None	
Sensors Damaged/Fouled: SSC, T1, T2, and T3 were fouled with growth	
Fishing/Vandalism: None	
Sensors/Tubes Downloaded: All sensors downloaded successfully.	

Site Sensor Failures	Date Sensors Failed	Why sensors were Failed	Field Service Observations
None			

Buoy Site: 5N 165E	**Mooring Depth:** 4787 m
Mooring Operation: Deployment	**Mooring ID#:** PM820A
Deployed Location: 5-1.9N 165-00.5E	**Deployed Date:** 6/17/09
Pre-Deployment On Deck Instrument Failures: None	
Sensors/Equipment Lost at Sea: None	
Sensors Damaged: None	
General Comments: Routine deployment	

Buoy Site: 2N 165E	**Mooring Depth:** 4172 m
Mooring Operation: Recovery	**Mooring ID#:** PM695A
Deployed Location: 01-59.9N 165-00.9E	**Deployed Date:** 8/17/07
Recovered Location: 2-01.6N 165-03.1E	**Recovered Date:** 6/18/09

Previous Repair Date: 9/9/08			
Sensors/Equipment Lost at Sea: None			
Sensors Damaged/Fouled: SSC and T1 fouled with growth			
Fishing/Vandalism: Hawser on buoy legs. Weld broken on top ring.			
Sensors/Tubes Downloaded: SSC and T2 – No communications, not downloaded. All other sensors downloaded successfully.			
Site Sensor Failures	**Date Sensors Failed**	**Why sensors were Failed**	**Field Service Observations**
Buoy	2/19/09	Transmission failure.	Mooring vandalized

Buoy Site: 2N 165E	**Mooring Depth:** 4175 m
Mooring Operation: Deployment	**Mooring ID#:** PM821A
Deployed Location: 01-59.9N 165-00.9E	**Deployed Date:** 6/18/09
Pre-Deployment On Deck Instrument Failures: None	
Sensors/Equipment Lost at Sea: None	
Sensors Damaged: None	
General Comments: Deployment line caught on rain gauge; boat ride was needed to remove it.	

Buoy Site: 0 165E		**Mooring Depth:** 4417m	
Mooring Operation: Repair		**Mooring ID#:** PM769B	
Deployed Location: 00-01.5N 165-02.5E		**Deployed Date:** 9/10/08	
Repair Location: 00-01.1N 165-03.2E		**Repair Date:** 6/18/09	
Previous Repair Date: None			
Sensors/Equipment Lost at Sea: None			
Sensors Damaged/Fouled: None.			
Fishing/Vandalism: Hawser tied to buoy leg.			
Sensors/Tubes Downloaded: Tube downloaded.			
General Comments: Replaced ATRH, anemometer and barometer sensors.			
Site Sensor Failures	**Date Sensors Failed**	**Why sensors were Failed**	**Field Service Observations**
50 m Salinity	10/30/08	Salinity too low	None
Wind	6/16/09	Data went to zero.	Nothing obvious

Buoy Site: 0 165E ADCP	**Mooring Depth: 4106**
Mooring Operation: Recovery	**Mooring ID#:** WA009
Deployed Location: 00-00.4N 165-12.39E	**Deployed Date:** 3/16/08
Recovered Location: None	**Recovered Date:** None

Previous Repair Date: None
Sensors/Equipment Lost at Sea: Entire Mooring Lost at Sea
Sensors Damaged/Fouled: None
Fishing/Vandalism: None
Sensors/Tubes Downloaded: No sensors were downloaded.
General Comments: Releases were lying on the bottom horizontally

Buoy Site: 0 165E ADCP	**Mooring Depth:** 4389
Mooring Operation: Deployment	**Mooring ID#:** WA010
Deployed Location: 00-00.5N 165-12.5E	**Deployed Date:** 6/18/09
Pre-Deployment On Deck Instrument Failures: None	
Sensors/Equipment Lost at Sea: None	
Sensors Damaged: None	
General Comments: Routine Deployment	

Buoy Site: 2S 165E	**Mooring Depth:** 4465
Mooring Operation: Recovery	**Mooring ID#:** PM730B
Deployed Location: 02-00.51S 165-00.127E	**Deployed Date:** 3/17/08
Recovered Location: None	**Recovered Date:** None
Previous Repair Date: 9/10/08	
Sensors/Equipment Lost at Sea: Entire mooring Lost at Sea	
Sensors Damaged/Fouled: None	
Fishing/Vandalism: Possibly vandalized, mooring Lost at Sea	
Sensors/Tubes Downloaded: No sensors were downloaded.	
General Comments: Mooring Lost at Sea.	

Site Sensor Failures	Date Sensors Failed	Why sensors were Failed	Field Service Observations
Rain	12/14/08	Erratic data.	None
Air Temperature	12/17/08	Downward drift.	None
Wind	12/19/08	Speed went to zero.	None
Buoy	5/27/09	Transmission failure.	Mooring lost at sea

Buoy Site: 2S 165E	**Mooring Depth:** 4468 m
Mooring Operation: Deployment	**Mooring ID#:** PM823A
Deployed Location: 2-00.3S 165-00.7E	**Deployed Date:** 6/20/09
Pre-Deployment On Deck Instrument Failures: None	
Sensors/Equipment Lost at Sea: None	
Sensors Damaged: None	
General Comments: Routine Deployment	

Buoy Site: 5S 165E	**Mooring Depth:** 2505m
Mooring Operation: Visit	**Mooring ID#:** PM770A
Deployed Location: 4-59.0S 165-09.3E	**Deployed Date:** 9/12/08
Visit Location: 4-59.0S 165-09.3E	**Visit Date:** 6/20/09
Previous Repair Date: None	
Sensors/Equipment Lost at Sea: None	
Sensors Damaged/Fouled: None.	
Fishing/Vandalism: None	
Sensors/Tubes Downloaded: None	
General Comments: Visit only. Buoy riding well, no signs of damage or vandalism.	

Buoy Site: 8S 165E, Refresh	**Mooring Depth:** 3895m
Mooring Operation: Deployment	**Mooring ID#:** DM004
Deployed Location: 08-02.5S 164-44.8E	**Deployed Date:** 6/21/09
Pre-Deployment On Deck Instrument Failures: None	
Sensors/Equipment Lost at Sea: None	
Sensors Damaged: None	
General Comments: Routine deployment.	

Buoy Site: 8S 165E, Legacy	**Mooring Depth:** 3893 m
Mooring Operation: Recovery	**Mooring ID#:** PM731B
Deployed Location: 08-01.977S 164-47.09E	**Deployed Date:** 3/19/08
Recovered Location: 08-01.794S 164-47.032E	**Recovered Date:** 6/21/09
Previous Repair Date: 9/13/08	
Sensors/Equipment Lost at Sea: Anemometer missing, rain gauge destroyed.	
Sensors Damaged/Fouled: SSC, T1-T3 fouled with growth.	
Fishing/Vandalism: Fishing long line fouled in Nilspin from 150m – 500 m. 1/3 top ring torn off.	
Sensors/Tubes Downloaded: All sensors downloaded successfully.	
General Comments: Recovered buoy with extensive fishing damage both surface and subsurface instruments were affected. SSC missing both top and bottom poison pucks.	

Site Sensor Failures	Date Sensors Failed	Why sensors were Failed	Field Service Observations
Salinity	11/9/08	Downward drift.	Sensor fouled
Wind	3/5/09	Speed too low.	Anemometer missing
SST	4/9/09	Erratic data.	Sensor fouled

Buoy Site: 8S 165E, CO2	**Mooring Depth:** 3895 m
Mooring Operation: Deployment	**Mooring ID#:** PM824A
Deployed Location: 8-02.6S 164-46.7E	**Deployed Date:** 6/22/09
Pre-Deployment On Deck Instrument Failures: None	
Sensors/Equipment Lost at Sea: None	
Sensors Damaged: None	
General Comments: Routine deployment, site is now CO2 mooring.	

Buoy Site: 8S 180	**Mooring Depth:** 5538 m
Mooring Operation: Recovery	**Mooring ID#:** PM732B
Deployed Location: 07-58.929S 179-50.979W	**Deployed Date:** 3/23/08
Recovered Location: 7-59.6S 179.52.1W	**Recovered Date:** 6/26/09
Previous Repair Date: 9/16/08	
Sensors/Equipment Lost at Sea: Anemometer missing. T4 missing.	
Sensors Damaged/Fouled: SSC, T1-T2 fouled with growth.	
Fishing/Vandalism: Hawser with float tied to bridle. Fishing long line from TP500 to the end of Nilspin.	
Sensors/Tubes Downloaded: T4 not downloaded (missing). All other sensors downloaded successfully.	
General Comments: Routine recovery.	

Site Sensor Failures	Date Sensors Failed	Why sensors were Failed	Field Service Observations
SST	4/9/09	Erratic data.	Anemometer missing

Buoy Site: 8S 180	**Mooring Depth:** 5538 m
Mooring Operation: Deployment	**Mooring ID#:** PM826A
Deployed Location: 7-59.0S 179-50.8W	**Deployed Date:** 6/27/09
Pre-Deployment On Deck Instrument Failures: None	
Sensors/Equipment Lost at Sea: Wind bird destroyed by deployment line, replaced with a boat ride.	
Sensors Damaged: Wind bird destroyed by deployment line, replaced with a boat ride.	
General Comments: Wind bird destroyed by deployment line, replaced with a boat ride.	

Buoy Site: 5S 180	**Mooring Depth:** 5662m
Mooring Operation: Visit	**Mooring ID#:** PM773A
Deployed Location: 04-57.05S 179-48.76W	**Deployed Date:** 9/18/08
Visit Location: 04-58.5S 179-52.6W	**Visit Date:** 6/28/09

Previous Repair Date: None
Sensors/Equipment Lost at Sea: None
Sensors Damaged/Fouled: None.
Fishing/Vandalism: None
Sensors/Tubes Downloaded: None
General Comments: Visit only. Buoy riding well, no signs of damage or vandalism.

Buoy Site: 2S 180	**Mooring Depth:** 5333 m
Mooring Operation: Recovery	**Mooring ID#:** PM733B
Deployed Location: 01-59.64S 179-52.44W	**Deployed Date:** 3/26/08
Recovered Location: 02-00.0S 179-55.5W	**Recovered Date:** 6/28/09
Previous Repair Date: 9/19/08	
Sensors/Equipment Lost at Sea: None	
Sensors Damaged/Fouled: SSC, T1-T4 fouled with growth	
Fishing/Vandalism: Long line fouling T125.	
Sensors/Tubes Downloaded: None	
General Comments: Routine recovery	

Site Sensor Failures	Date Sensors Failed	Why sensors were Failed	Field Service Observations
None			

Buoy Site: 2S 180	**Mooring Depth:** 5338 m
Mooring Operation: Deployment	**Mooring ID#:** PM827A
Deployed Location: 01-59.5S 179-53.3W	**Deployed Date:** 6/29/09
Pre-Deployment On Deck Instrument Failures: None	
Sensors/Equipment Lost at Sea: None	
Sensors Damaged: None	
General Comments: Deployed tower has 1/3 top ring missing, but is in otherwise good shape.	

Buoy Site: 0 180	**Mooring Depth:** 5393 m
Mooring Operation: Repair	**Mooring ID#:** PM775B
Deployed Location: 00-01.1N 179-54.2W	**Deployed Date:** 9/20/08
Repair Location: 00-01.15N 179-55.3W	**Repair Date:** 6/29/09
Previous Repair Date: None	
Sensors/Equipment Lost at Sea: None	
Sensors Damaged/Fouled: None	
Fishing/Vandalism: None	
Sensors/Tubes Downloaded: None	
General Comments: Replaced rain gauge.	

Site Sensor	Date Sensors	Why sensors were	Field Service

Failures	Failed	Failed	Observations
Rain	12/1/08	Erratic data.	None

Buoy Site: 2N 180		**Mooring Depth:** 5485m	
Mooring Operation: Repair		**Mooring ID#:** PM776B	
Deployed Location: 02-00.93N 179-47.61W		**Deployed Date:** 9/21/08	
Repair Location: 02-01.3N 179-47.0W		**Repair Date:** 6/30/09	
Previous Repair Date: None			
Sensors/Equipment Lost at Sea: None			
Sensors Damaged/Fouled: None			
Fishing/Vandalism: None			
Sensors/Tubes Downloaded: Tube not downloaded.			
General Comments: Installed new SSC.			
Site Sensor Failures	**Date Sensors Failed**	**Why sensors were Failed**	**Field Service Observations**
Salinity	4/12/09	Erratic data.	None

2.2 *CTD Casts Completed*

A Sea-Bird 911plus CTD with dual temperature and conductivity sensors was provided by the NMAO. Temperature and conductivity sensors are calibrated yearly at Sea-Bird and sent in for diagnostics as necessary. A Sea-Bird 12-position carousel and twelve 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:

CTD Operations			
Site	**Date**	**Cast #**	**Comments**
8N 165E	6/15/09	KA20011	3000 m
7N 165E	6/15/09	KA20021	1000 m
6N 165E	6/16/09	KA20031	1000 m
5N 165E	6/17/09	KA20041	1000 m
4N 165E	6/17/09	KA20051	1000 m
3N 165E	6/17/09	KA20061	1000 m
2N 165E	6/18/09	KA20071	1000 m
1N 165E	6/18/09	KA20081	1000 m
0 165E	6/19/09	KA20091	3000 m
1S 165E	6/19/09	KA20101	1000 m
2S 165E	6/20/09	KA20111	1000 m
3S 165E	6/20/09	KA20121	1000 m

4S 165E	6/20/09	KA20131	1000 m
5S 165E	6/20/09	KA20141	1000 m
6S 165E	6/21/09	KA20151	1000 m
7S 165E	6/21/09	KA20161	1000 m
8S 165E	6/22/09	KA20171	3000 m
8S 180	6/26/09	KA20181	3000 m
7S 180	6/27/09	KA20191	1000 m
6S 180	6/27/09	KA20201	1000 m
5S 180	6/28/09	KA20211	1000 m
4S 180	6/28/09	KA20221	1000 m
3S 180	6/28/09	KA20231	1000 m
2S 180	6/29/09	KA20241	1000 m
1S 180	6/29/09	KA20251	1000 m
0 180	6/29/09	KA20261	3000 m
1N 180	6/30/09	KA20271	1000 m
2N 180	6/30/09	KA20281	1000 m

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

Three 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
Tel: (206) 526-6806
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:

ARGO Floats		
Position	**Date**	**Comments**
0001.953S 16513.606E	6/19/09	SN 4182
0000.965N 17955.050W	6/29/09	SN 4178
1S 180	6/29/09	SN 4177
0100.740N 17950.655W	6/30/09	SN 4179

Atlantic Oceanographic and Meteorological Laboratory (AMOL) Surface Drifting Floats

Twelve AOML Surface Drifters 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 AOML Surface Drifter deployments were completed as scheduled.

Questions concerning AOML Surface Drifters should be directed to:

Shaun Dolk, NOAA/AOML
Global Drifter Center,
Tel: (305) 361-4546
Fax: (305) 361-4436
E-mail: shaun.dolk@noaa.gov

The following outlines the AOML Drifting floats deployed during this cruise:

AOML Floats		
Position	**Date**	**Comments**
5N 165E	6/17/09	SN 81965
3N 165E	6/17/09	SN 81970
2S 165E	6/19/09	SN 81946
2S 165E	6/19/09	SN 81954
3S 165E	6/20/09	SN 81950
5S 165E	6/20/09	SN 81948
5S 180	6/28/09	SN 81982
3S 180	6/28/09	SN 81976
0 180	6/29/09	SN 81981
0 180	6/29/09	SN 81975
5N 175E	7/1/09	SN 81974
10N 178E	7/3/09	SN 81979

PCO2 and Nitrate Mapping System and Nutrient Samples

Twenty-eight 30ml water samples were collected on this cruise. The chief scientist verified and briefed the Operations Officer on the specifications of the water samples to be collected during CTD casts prior to the start of the cruise. All water samples were collected as scheduled.

Questions concerning Nutrient Samples should be directed to:

Cathy Cosca
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7600 Sand Point Way NE
Seattle, Washington 98115

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