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Tropic Heat MR Meteorological Data (April 1984 - June 1985)

by

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Technical Report

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ABSTRACT

This report presents meteorological data recorded by the MR on the three deployments of Tropic Heat moorings, within 1.5 degrees north and south of the equator at approximately 134°W and 140°W. Parameters recorded included vector averaged wind speed and direction, air and sea temperatures, insolation, barometric pressure, and relative humidity although not all parameters were recorded on all deployments. The deployments were all nominally six months. Data recovery was poor because of instrument and mooring failures.

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Introduction

The Tropic Heat experiment was designed to measure and model the evolution of heat, mass, and momentum budgets of the central Pacific equatorial upper ocean on seasonal and interannual time scales. The data described in this report were recorded by the meteorological recorder (MR) on several of the moorings maintained by the Scripps Institution of Oceanography during the experiment.

Development of the MR (Payne, 1988) was begun in April 1982. Tropic Heat was the second experiment in which the MR was deployed, the first being the Seasonal Equatorial Atlantic (SEQUAL) experiment, 1983 - 1985.

Table I is a summation of the deployments and data return.

Table I

Tropic Heat Deployments and Data Return

Data File	Location	TH Mrng	Buoy Deployment	WS	WD	AT	WT	BP	SR	RH
8307	1-31S 140-31W	TH3	10/83-4/84(188)	8	8	3	3	3	0	0
8308	0-03N 134-09W	TH2	10/83-4/84(182)	49	49	X	X	X	X	X
8403	1-32S 140-29W	TH6	5/84-(Note 1)	6	6	45	45	X	0	X
8404	0-02S 134-09W	TH5	4/84-(Note 1)	14	14	14	14	X	0	X
8405	1-24N 140-27W	TH4	4/84-(Note 1)	0	0	90	90	X	0	X
8407	1-30S 140-30W	TH10	12/84-7/85(210)	194	16	194	188	194	194	194

TH Mrng - Tropic Heat mooring designation

WS - Wind speed

WD - Wind direction

AT - Air temperature

WT - Sea surface temperature (1m depth)

BP - Barometric pressure

SR - Insolation

RH - Relative humidity

Notes:

Numbers in table are days of useful data for that parameter and data file. X means there was no sensor.

1. Buoy sank and was recovered in June/July 1985.

Three of the MRs failed because of electronic or connector failures, three because their buoys were towed under by high currents, and one failed because of human error.

Instrumentation

The MR was developed to record and transmit meteorological data on moored buoys for periods of six months or more. It is a digital system, based on the C-44 bus, which can handle both digital and analog inputs from sensors. The data processing capabilities built into its program are quite flexible, especially in terms of its sampling and averaging capabilities. It includes a digital tape recorder with a capacity of about 40,000 data records and an Argos transmitter. Position information from Service Argos provided assurance that a buoy was still on station.

During the Tropic Heat deployments the MR recorded each 7.5 minutes. Data were averaged continuously between recording times. A subset of the most recently recorded data was transmitted once per minute. The subset included all the parameters which appear in this report.

Digital Sensors

The wind speed and direction sensors (R. M. Young Model 5103 wind monitor), compass, and digital electronics are packaged as a single unit, the wind processor (WP). The WP provides vector averaged wind speed and vector averaged wind direction under control of the digital data logger (DDL). Barometric pressure is provided by an AIR DB barometer which has an absolute accuracy of about 0.5 mb. Its inlet is protected by a port and, in the light winds of the tropics, dynamic effects of the wind probably did not degrade the accuracy to worse than ± 1 mb.

Analog Sensors

Analog data are digitized by a multiplexed A/D converter. A sample from each sensor is digitized once per 7 s and the samples averaged over the recording interval. Since none of our sensors has a time constant less than 5 s, this effectively yields a continuous scalar average.

Air and sea temperatures are measured with thermistors. Accuracy of air temperature is limited by the radiation shield (Payne, 1987). With a passive shield, a combination of low wind speed and high sun altitude can increase the apparent air temperature by as much as 2-3°C. For most of the observations, however, we estimate that the uncertainty is about $\pm 0.5^\circ\text{C}$. We estimate that the accuracy of sea temperature measurement is about $\pm 0.05^\circ\text{C}$.

Insolation is measured with an Eppley Model 8-48 pyranometer mounted on top of the Argos antenna. Sensor accuracy is $\pm 3\%$; overall accuracy is about $\pm 10\%$.

Relative humidity was measured with a Väisälä Humicap sensor. In spite of protecting these sensors with a Gore-Tex shield, we have not had much success with making them work for long periods on buoys and cannot give an accuracy figure for the measurements.

Basic Data Processing and Editing

The data were transferred from the digital cassettes directly to disk files, converted to engineering units, and edited to remove launch and retrieval transients. If a sensor ceased to return good data, all subsequent values of the parameter were set to zero. The cassette tapes from 8403, 8404, 8405, surprisingly, did not present a special challenge. After being on the bottom for over a year, they were washed thoroughly in fresh water, dried, and then read without problem.

All displays except the stick vectors are of 450 s versions. The 24 hour version used for the stick plots was generated by using a Gaussian filter with a 24 hour half width and subsampling the resulting series once per day.

Data Displays

Time Series Plots

Scaling of all plots of the same parameter, including time, is the same so that the plots are directly comparable.

Histograms

All parameters are shown as percentage of occurrence vs parameter amplitude.

Spectra

Spectra were produced with the program PROSPECT written by Mary Hunt and in common use for some years at WHOI. Each file was run as a single piece.

General Comments on Plots

The moorings were in the trade winds at all times when they were recording winds. The "fuzz" about the barometric pressure data in the time series plots is real and due to the diurnal atmospheric tide. Diurnal variation in air temperature is probably due mainly to the heating of the radiation shield. Diurnal variation in water temperature is probably from real heating of the surface layer.

Comments on Individual Files and Plots

8307

A connector from one of the sensors to the DDL leaked, corroded, and caused a short circuit which depleted the battery prematurely. The amount of data recorded was too small to plot.

8308

A component failed on the cassette tape recorder control board. This caused many bad records and then finally caused the tape recorder to advance the tape to the end.

8403

The buoy sank after 87 days, towed under by high currents. It appears that it was partially submerged several times before that causing various sensor failures. There was not enough data to plot.

8404

The MR failed suddenly after a few bad data cycles about two weeks into the deployment. We believe that was when the buoy sank.

8405

The battery voltage dropped from 5.1 to 4.1 v 12 hours after deployment. After that only air and sea temperatures were good. We believe the buoy was submerged briefly at that point and that it sank after 90 days when the Argos transmitter died and the tape recorder stopped.

8407

The recording interval was chosen for a nominal six month deployment. This mooring was recovered late, after 210 days. The tape ran out after 194 days. The compass failed after 16 days. We have not included insolation in any of the plots since they would not be illuminating.

8408

The MRs were deployed with zinc-air batteries (Payne, 1988) which require oxygen. The cutting of vent holes in the battery case was overlooked. There was not enough data to plot.

Acknowledgments

Dr. Robert Knox's group at Scripps Institution of Oceanography did an excellent job of designing, constructing, deploying and retrieving the moorings.

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FIGURES

Parameters vs time plots

Figure 1. 8308/TH2 wind variables

Figure 2. 8404/TH5 wind variables

Figure 3. 8404/TH5 AT,WT,RH

Figure 4. 8405/TH4 AT,WT

Figure 5. 8407/TH10 wind variables

Figure 6. 8407/TH10 AT,WT,BP,RH

Spectra plots

Figure 7. 8308/TH2 Rotary and total spectra, east and north

Figure 8. 8404/TH5 Rotary and total spectra, east and north

Figure 9. 8404/TH5 Auto spectra, AT, WT, RH

Figure 10. 8405/TH5 Auto spectra, AT,WT

Figure 11. 8407/TH10 Rotary and total spectra, east and north

Figure 12. 8407/TH10 Auto spectra AT, WT

Figure 13. 8407/TH10 Auto spectra, BP, RH

Histograms

Figure 14. 8308/TH2 WS,WD,North,East

Figure 15. 8404/TH5 WS,WD,North,East

Figure 16. 8404/TH5 AT,WT,RH

Figure 17. 8405/TH4 AT,WT

Figure 18. 8407/TH10 AT, WT, BP, RH

8308 - TH2

Figure 1. 8308/TH2 wind variables

8404 - TH5

Figure 2. 8404/TH5 wind variables

Figure 3. 8404/TH5 AT, WT, RH

8405 - TH4

Figure 4. 8405/TH4 AT,WT

8407 - TH10

Figure 5. 8407/TH10 wind variables

8407 - TH10

Figure 6. 8407/TH10 AT,WT,BP,RH

Figure 7. 8308/TH2 Rotary and total spectra, east and north

Figure 8. 8404/TH5 Rotary and total spectra, east and north

Figure 9. 8404/TH5 Auto spectra, AT, WT, RH

Figure 10. 8405/TH5 Auto spectra, AT,WT

Figure 11. 8407/TH10 Rotary and total spectra, east and north

Figure 12. 8407/TH10 Auto spectra AT, WT

Figure 13. 8407/TH10 Auto spectra, BP, RH

Figure 14. 8308/TH2 WS,WD,North,East

Figure 15. 8404/TH5 WS,WD,North,East

Figure 16. 8404/TH5 AT,WT,RH

Figure 17. 8405/TH4 AT,WT

Figure 18. 8407/TH10 AT, WT, BP, RH

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