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**SEQUAL Meteorological Data from Moorings
S2, S5 and S6
(March 1983 - March 1985)**

by

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Technical Report

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ABSTRACT

This report presents meteorological data from three deployments of SEQUAL moorings S5 and S6 (nominal positions 0N,24W and 0N,15W) and also from a post SEQUAL deployment at SEQUAL mooring site S2 at 0N,28W. Parameters recorded include vector averaged wind speed and direction, air and sea surface temperatures, insolation, barometric pressure and relative humidity although not all parameters were recorded on all deployments. All deployments were nominally six months.

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Introduction

The Seasonal Equatorial Atlantic (SEQUAL, see Anon., 1983) experiment was designed to investigate the seasonal cycle in the ocean circulation in the tropical Atlantic Ocean and the driving forces for this cycle. The data described in this report were recorded by the meteorological recorder (MR) on two of the moorings maintained during the experiment.

Development of the MR (Payne, 1987) was begun upon funding by the National Science Foundation in April 1982. The first two units were deployed in March 1983. Two additional units replaced those in September 1983, and the original units, with some improvements, were deployed again in March 1984. In October 1984 one MR was deployed in an extension of SEQUAL.

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

Table I
SEQUAL Deployments and Data Return

Data		SEQ	Buoy								
File	Location	Des	Deployment(Days)	WS	WD	AT	WT	BP	SR	RH	
8301	0-3.4N 23-59.4W	SA5	3/83-9/83(201)	120	15	75	75	0	113	4	
8302	0-1.0S 14-56.5W	SA6	3/83-9/83(201)	36	36	185	185	185	185	0	
8304	0-2.6N 24-00.5W	SB5	9/83-3/84(190)	190	190	123	123	X	0	0	
8305	0-0.7S 14-58.0W	SB6	9/83-3/84(115)	115	115	115	115	X	0	0	
8401	0-3.1N 23-59.3W	SC5	3/84-10/84(183)	0	0	58	47	58	58	X	
8402	0-0.8S 14-58.0W	SC6	4/84-10/84(175)	175	175	175	175	175	175	X	
8406	0-4.0N 28-12.4W	SD2	10/84-4/85(141)	2	2	100	100	X	100	74	

SEQ Des - SEQUAL designation

WS - Vector averaged wind speed

WD - Vector averaged wind direction

AT - Air temperature

WT - Sea surface temperature (1m depth)

BP - Barometric pressure

SR - Insolation

RH - Relative humidity

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

Since the design and construction schedule was so tight, the first deployments were the field tests of the MR. In addition to instrument failures there were several mishaps to the buoys. A ship apparently struck buoy SA6, severely damaging the anemometer and leaving behind paint streaks of an

unappealing green color on both buoy and anemometer. The SB6 surface buoy and instrumentation disappeared after 115 days of the deployment. Evidence of theft was found on the lower part of the mooring which was recovered. For this file (8305) we processed the data transmitted via Service Argos. Since these data are received sporadically (roughly 6-7 times per day on the equator) we generated a 24 hour series only, averaging all the data received during each 24 hour period.

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 was crucial in one instance when the buoy broke loose from its mooring several days before the ship reached the location intending a normal recovery. Using Argos fixes relayed to them the recovery crew were able to find the buoy and recover it with no loss of equipment or data.

During the SEQUAL deployments the MR recorded each 7.5 minutes. 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. 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 ± 0.5 C. We estimate that the accuracy of sea temperature measurement is about ± 0.05 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

Except for file 8305, data were transferred from the digital cassettes directly to disk files, converted to engineering units, and edited to remove launch and retrieval transients. Occasional bad values have been replaced with linearly interpolated values. If a sensor ceased to return good data, all subsequent values of the parameter were set to zero.

With the exception of file 8305, all displays except the stick vector wind plots are of one hour versions computed by averaging eight successive 7.5 minute values. The 24 hour version used for the stick plots were 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 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 the trades existed. A time when the winds "turned on" in the spring was noticeable in the data (Payne, 1984). 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 to heating of the

radiation shield. Diurnal variation in the water temperature is probably from real heating of the surface layer.

Comments on individual files

8301

The compass failed early in the deployment. The ratio of vector to scalar averaged speed for the early part when the compass was working was used to scale the scalar averaged speed for the rest of the file. This ratio is about 0.9 in the tropics.

8302

Again, the compass failed.

8304

Something caused the temperatures to be bad during daylight hours. Insolation amplitude is incorrect but is adequate to determine what temperatures are good.

8305

The buoy was stolen after 115 days, leaving us with only the Argos transmitted data. In the tropics, 6-7 transmissions a day are received. Twelve hour averages were made from all data received within the 12 hour period. Air and sea temperatures are plotted from the 12 hour series. Histograms look spiky because of the small number of values. Wind parameters are plotted from a 24 hour series derived by vector averaging the 12 hour series.

8401

This unit functioned only for about two months and not at all well then. The only good data are from the barometer although we have plotted air and water temperatures also.

8402

Data are predominantly good although the first two months of air temperature and the last month of water temperature have a lot of peculiar values for which we have no explanation.

8406A

The wind processor worked only for about three days. Data from the other sensors lasts for about two months. The relative humidity sensor failed so a post-deployment calibration was not possible. We do not know whether the slow change in relative humidity is real or due to a calibration drift.

8406B

The relative humidity sensor failure caused it to draw an inordinate amount of current from the batteries for about two weeks which caused the

other scalar parameters to be digitized incorrectly during that interval. This file contains the data recorded after the relative humidity sensor failed completely and ceased affecting the other parameters. Even so, only water temperature and insolation look reasonable. Air temperature has suspicious negative spikes.

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Dr. Robert Weisberg's group at North Carolina State University did an excellent job of designing, constructing, deploying and retrieving the moorings. Paul Fucile went on several cruises to deploy and recover the MRs.

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REFERENCES

Anon., 1983.

SEQUAL - A study of the equatorial Atlantic Ocean.
EOS, Transactions, American Geophysical Union, 63, 218.

Payne, R. E., 1984.

Surface wind measurements in SEQUAL I.
Geophysical Research Letters, 11, 719-721.

Payne, R. E., 1987.

The MR, a meteorological data sensing, recording, and telemetering package for use on moored buoys.
Journal of Atmospheric and Oceanic Technology, submitted.

FIGURES

Parameters vs time plots

- Figure 1. 8301/SA5 wind variables
- Figure 2. 8301/SA5 AT,WT,BP,SR
- Figure 3. 8302/SA6 wind variables
- Figure 4. 8302/SA6 AT,WT,BP,SR
- Figure 5. 8304/SB5 wind variables
- Figure 6. 8304/SB5 AT,WT,SR
- Figure 7. 8305/SB6 wind variables
- Figure 8. 8305/SB6 AT,WT
- Figure 9. 8401/SC5 AT,WT,BP,SR
- Figure 10. 8402/SC6 wind variables
- Figure 11. 8402/SC6 AT,WT,BP,SR
- Figure 12. 8406A/SD2 wind variables
- Figure 13. 8406A/SD2 AT,WT,BP,SR
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Spectra plots

- Figure 15. 8301/SA5 WS,AT,WT,BP
- Figure 16. 8302/SA6 AT,WT
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- Figure 18. 8305/SB6 WS,AT,WT
- Figure 19. 8401/SC5 AT,WT,BP
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Histograms

- Figure 21. 8301/SA5 WS,WD,N,E
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- Figure 25. 8304/SB5 WS,WD,N,E
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- Figure 27. 8305/SB6 WS,WD,N,E
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- Figure 32. 8406A/SD2 WS,WD,N,E
- Figure 33. 8406A/SD2 AT,WT,RH
- Figure 34. 8406B/SD2 AT,WT

Figure 1

8301 - SA5

Figure 2

Figure 3

8302 - SA6

Figure 4

Figure 5

8304 - SB5

Figure 6

8305 - SB6

Figure 7

8305 - SB6

Figure 8

8302 - 2028

17
8401 - SC5

Figure 9

8402 - SC6

Figure 10

8402 - SC6

Figure 11

Figure 12

8406A - SD2

Figure 13

8406B - SD2

Figure 14

Figure 15

Figure 16

Figure 17

Figure 18

Figure 19

Figure 20

8301/SA5

Figure 21

8301/SA5

Figure 22

8302/SA6

Figure 23

8302/SA6

Figure 24

8304/SB5

Figure 25

8304/SB5

Figure 26

8305/SB6

Figure 27

8305/SB6

8401/SC5

Figure 28

8402/SC6

Figure 29

8402/SC6

Figure 30

8406A/SD2

Figure 31

8406A/SD2

Figure 32

8406B/SD2

Figure 33

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