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One buoy (JASIN W2/WHOI 651) carred a Vector Averaging Wind Recorder (VAWR) and a Vector Measuring Wind Recorder (VMWR); these instruments

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provided 18 days of intercomparison data and 38 days of meteorological data from 30 July to 6 September 1978. The other buoy (JASIN H2) carried a VMWR and gave 25 total days of data from 16 July to 10 August, and from 26 August to 1 September.

A PET computer, hardwired to sensors positioned on the ship, displayed data that were logged during both legs of the cruise. Manual data were gathered by the science watches.

This report describes the PET system, and displays and compares all the data. VAWR hourly meteorological data are listed for the 38 day period.

Scientific interpretation of these data, such as calculations of heat fluxes, will be published separately.

WHOI-79-43

ATLANTIS-II (CRUISE 102) MOORED AND SHIPBOARD SURFACE METEOROLOGICAL MEASUREMENTS DURING JASIN 1978

by

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Richard E. Payne, and Kenneth R. Peal

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Woods Hole, Massachusetts 02543

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TECHNICAL REPORT

Prepared for the National Science Foundation under Grants OCE77-25803 and OCE76-80174, and for the Office of Naval Research under Contract N00014-76-C-0197; NR 083-400 to the Woods Hole Oceanographic Institution.

Approved for Distribution

Valentine Worthington, Chairman
Department of Physical Oceanography

ABSTRACT

During cruise 102 of the R/V Atlantis-II in the Joint Air-Sea Interaction Project (JASIN), surface meteorological data were gathered by Woods Hole Oceanographic Institution personnel from two moored buoys and from the ship.

One buoy (JASIN W2/WHOI 651) carried a Vector Averaging Wind Recorder (VAWR) and a Vector Measuring Wind Recorder (VMWR); these instruments provided 18 days of intercomparison data and 38 days of meteorological data from 30 July to 6 September 1978. The other buoy (JASIN H2) carried a VMWR and gave 25 total days of data from 16 July to 10 August, and from 26 August to 1 September.

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This report describes the PET system, and displays and compares all the data. VAWR hourly meteorological data are listed for the 38 day period.

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INTRODUCTION

The Joint Air-Sea Interaction Project (JASIN; see Pollard, 1978) was an international study of the atmospheric and oceanic boundary layers, of the fluxes within and between them, and of their interaction on the process scale. Nine countries, fourteen ships, and four aircraft participated in the main field experiment from mid-July to mid-September 1978 in an area northwest of Scotland about half-way to Iceland (see Figure I-1).

The R/V Atlantis-II participated as its Cruise 102 with two legs:

Leg 1: Glasgow - Glasgow, 25 July - 16 August

Leg 2: Glasgow - Woods Hole, 21 August - 21 September

The latter part of Leg 1 and the early part of Leg 2 were spent in CTD work at Anton Dohrn Seamount, and the last two weeks of Leg 2 were spent in passage across the North Atlantic. The actual working periods in the central JASIN area, i.e. the vicinity of the Fixed Intensive Array (FIA) near 59°N, 12°30'W, were: 0600Z/27 July to 2400Z/13 August, and 0700Z/24 August to 1400Z/7 September.

During these periods near the FIA, surface meteorological observations were made from the Atlantis-II using a mix of automatic and manually-operated sensors. The automatic system, called PET here because a small PET computer was used as a data acquisition device, are described in Part II of this report. The PET data were logged approximately hourly by the science watch since the 5-minute automatic recording system was not working. The science watch also took certain observations manually, called MANUAL here, on an hourly or 4-hourly (Leg 1) or 3-hourly (Leg 2) basis, depending on the observation. Figure I-2 locates the observations on the ship.

The PET and MANUAL observations from the ship were meant primarily as backup data in case the meteorological data being recorded on buoy W2 (see Figures I-1 and I-3, and Table I-1) were faulty. The meteorological package (Payne, 1974) was a Vector Averaging Wind Recorder. Only the PET Dew Point and the MANUAL Dew Point and Relative Humidity (calculated from wet and dry bulb temperatures; see PSYCHROMETRY section below) were unique observations from the ship; all the other shipborne meteorological data were redundant to buoy data, called BUOY here. Additional data on wind measurements only were obtained from a Vector Measuring Wind Recorder on buoy H2 and supplement the W2 data by starting earlier.

We expect all the buoy data, but especially wind speed and air pressure and temperature, to be of higher quality than the same data from the ship because of the derogatory influence the ship has on its environment. Also, the motivation for these measurements is as supporting data for the array of current meters and thermistors deployed on the moorings in the FIA, so observations from mooring W2 are in any case preferable to those from a roving ship or from mooring H2. Figure I-4 and Table I-2 give the range and bearing from the Atlantis-II to buoy W2 (nominally 59°01.5'N, 12°33.0'W) during Legs 1 and 2; only during the Leg 1 periods 1600Z/2 August to 0500Z/3 August, 1600Z/8 August to 0400Z/9 August, and 1100-2400Z/9 August was the ship consistently within 10 km of the buoy and were there meteorological measurements being made on the ship. These are the periods used for the ship-to-buoy "10 km" scatterplots (see Table III-4, and figures III-35 to 38).

We present here the BUOY data in some detail, including hourly listings, spectra, statistics, etc. The PET and MANUAL dew point estimates from Leg 2 are compared in Figure III-12 and III-33; there seems to be no reason to choose one as preferable to the other except that the PET estimates are probably less subject to the change of the watch.

No derived data, for example wind stress or surface heat flux, are presented in this report. See also Tarbell, Briscoe, and Weller (1979) for the current meter data from the moorings, and Pennington and Briscoe (1979) for the hydrographic (CTD profiles) data.

OBSERVATIONS

The VAWR and VMWR data were handled as normal current-meter data (see Tarbell, et al., 1979) since both instruments are based on the original VACM and VMCM instruments. Figure I-3 shows buoy W2 on which the VAWR and one of the VMWR instruments were mounted; the H2 VMWR instruments were on a different kind of tower structure but were equally exposed and at about the same height. The W2 VAWR and VMWR were mounted 1 m apart at 3.5 m height above the water line. The vane on the buoy kept the two wind recorders on the upwind side of the buoy; there was free exposure of the wind sensors to the wind. Except for the air pressure sensor, the VAWR was as described in Payne (1974). A Digiquartz pressure sensor provided 0.1 mbar accuracy pressures averaged over the 15 minute recording interval of the VAWR. The VMWR was simply a VMCM turned upside down.

The PET data are described in Part II; see also Peal (1979).

The MANUAL data were taken with a variety of instruments. The winds used the ship's anemometer which was mounted on the port forward yardarm. It yielded (relative to the PET measurements) a diminished wind speed when the winds were from 090° relative, i.e. when the winds had to pass the mast to get to the anemometer. More surprisingly, the measurements were biased high when the winds were from between 070 - 085° and 095 - 110°, apparently because of a funneling effect past the mast. The winds were read on an analog dial (one minute visual average) in the wet lab. Ship speed was from the single-axis Sperry doppler log, which was the same instrument the PET was reading; only time of reading and the variability of visual averaging should produce differences between the PET and MANUAL ship speed. Similarly, the ship's gyro repeater provided ship heading. The MANUAL measurements of sea surface temperature came from a standard bucket thermometer. During Leg 1 the bucket was stored in the main lab and consequently was biased high; for most of Leg 2 the bucket was stored on deck. Air pressure came from an aneroid barometer on the bridge; it was of unknown calibration, but presumably would have only an offset. (It proved to be reading 8.5 mbar high, by correlation comparison with the pressure sensor on the buoy.)

The wet and dry bulb air temperatures were obtained with a Bendix 566-3 Psychron, which is a motor aspirated pair of mercury thermometers, one with a wetted wick, one without. It was used on the exposed side of the bridge wing or the flying bridge, depending on the severity of the weather. The calculations of dew point and relative humidity were made using algorithms described below, under PSYCHROMETRY. All MANUAL data were logged by hand on an hourly (wind, sea temperature) or four-hourly (Leg 1: wet and dry bulb temperatures, clouds, air pressure, visual wave observations) or three-hourly (Leg 2) basis. The cloud and wave observations are not reported here: they are subjective visual estimates for the JASIN meteorological reporting forms only.

Editing of all three data sets (MANUAL, PET, BUOY) was done by hand; values clearly in error were replaced by a linear interpolation of adjacent points.

Calibrations

None of the ship's sensors were specially calibrated: the ship speed and direction, wind speed and direction, and bridge barometer were simply used as provided. The sea temperature (bucket with integral mercury thermometer) and wet and dry bulb temperatures used precision thermometers but no additional checks were made.

The PET sensors were calibrated as described in Part II of this report.

The VAWR sensors were calibrated as described in Payne (1974) except for the new pressure sensor, which was checked ashore against a mercury barometer. The cups and vane used the existing calibrations, and the temperature sensors were checked before and after the cruise in the WHOI calibration facility.

Note that the solar radiation values are presented in cal cm^{-2}; in fact, these are values integrated over the 15 minute recording interval of the VAWR and normalized to 1 minute values, so the units should be interpreted as cal cm^{-2} min^{-1}, which is the old (prior to 1947) definition of a langley. For reference,

$$
\begin{aligned}
1 \text{ cal cm}^{-2} \text{ (units on plots)} &= 1 \text{ cal cm}^{-2}\text{min}^{-1} \\
&= 1 \text{ langley (old)} \\
&= 1 \text{ langley min}^{-1} \text{ (new)} \\
&= 697.6 \text{ watts m}^{-2}
\end{aligned}
$$

CALCULATIONS

All calculations and displays were made on a Xerox Sigma-7 computer. In general, the data displayed here were analyzed with standard programs used for current meter data; see Tarbell, et al. (1979) for detail of the procedures. Brief descriptions follow.

Time Series

All the measured variables as well as some derived quantities (true wind, dew point, relative humidity) are presented versus time in Part III. In addition, the buoy winds (Fig. III-7) are presented as stick plots, i.e. 4-hour average vectors whose length is proportional to the wind speed and whose angle shows the wind direction as the direction to which the wind is blowing. Note that 6520SB and 6520WD are on the same buoy (JASIN W2), but that H2S1B and H2S2B are on JASIN H2, 44 km to the north of W2.

Histograms

Each of the variables from the VAWR are shown as frequency of occurrence versus amplitude; the means over the entire record are marked.

Statistics

Various moments (mean, variance and standard deviation, skewness, kurtosis) and extreme values are given for the entirety of each record (Table III-1) and for consecutive 5-day periods (Table III-2) commencing with 0000Z on 30 July; the final "5-day period" is only 4 days and 7 hours long.

Spectra

The spectra are calculated by breaking the record into one or two equal length segments (as long as possible to fit into the record length), and then frequency - band averaging over 3 bands to give a little more statistical reliability to the estimates. The plotting program additionally averages increasing larger groups of estimates together at the higher frequencies. The spectra therefore have a minimum of 6 degrees of freedom at the lowest frequencies, and as many as several hundred degrees of freedom at the highest frequencies. There was no data windowing or prewhitening prior to the Fourier transformation. The integral under the spectrum equals the variance of the record.

Progressive Vectors

The wind displacement vectors (one hour averages) are placed head-to-tail to show the path a perfect particle would have taken if the fluid were perfectly homogeneous with no spatial gradients. The same data are plotted as North versus East scatter plots with a regression line that denotes the principal axis of the cluster of points.

PSYCHROMETRY

Calculations of dew point and relative humidity were made using formulae from the Smithsonian Meteorological Tables (List, 1951). The lithium chloride cell used in the PET measurements (see Part II) read out directly in dew point; the wet and dry bulb temperatures of the Bendix psychrometer used in the MANUAL observations were therefore converted to dew point, for comparison with the lithium chloride cell, and to relative humidity, for general use.

The algorithm for calculation was:

1. Input T_w, T_d, p, where T_w = wet bulb temperature in degrees Celsius, T_d = dry bulb, and p = observed barometric pressure in millibars.
2. Calculate the saturation vapor pressure e_{sw} in mbar for the wet-bulb temperature:

$$e_{sw} = 1013.25 \times 10^{f(T_w + 273.16)} \quad (1)$$

$$\text{where } f(T) = a_1 \left(\frac{T_s}{T} - 1\right) + a_2 \log_{10} \left(\frac{T_s}{T}\right) \quad (2)$$

$$+ a_3 \left(10^{b \left(1 - \frac{T}{T_s}\right)} - 1\right)$$

$$+ a_4 \left(10^{c \left(\frac{T_s}{T} - 1\right)} - 1\right)$$

and T_s = 373.16, a_1 = -7.90298, a_2 = 5.02808,

$a_3 = -1.3816 \times 10^{-7}$, $a_4 = 8.1328 \times 10^{-3}$, b = 11.344,

and c = 3.49149.

3. Calculate the saturation vapor pressure for the dry-bulb temperature:

$$e_{sd} = 1013.25 \times 10^{f(T_d + 273.16)} \quad (3)$$

4. Calculate the mixing ratios for saturated air for the wet and dry-bulb temperatures:

$$r_{sw} = \varepsilon \frac{e_{sw}}{p-e_{sw}} ; \qquad r_{sd} = \varepsilon \frac{e_{sd}}{p-e_{sd}} \quad (4)$$

where $\varepsilon = 0.622$ is the ratio of the molecular weight of water to that of dry air; calculate the mixing ratio for the unsaturated air:

$$r = \frac{r_{sw} L - C_p (T_d - T_w)}{L + C_{pv} (T_d - T_w)} \quad (5)$$

where $L = 597.3$ cal/gm is the latent heat of evaporation, $C_p = 0.240$ cal/(gm°K) is the specific heat of air at constant pressure, and $C_{pv} = 0.432$ cal/(gm°K) is the specific heat of water vapor.

5. Calculate the relative humidity:

$$U = \frac{r}{r_{sd}} \times 100 \quad (6)$$

6. Calculate the vapor pressure for the unsaturated air:

$$e = \frac{r\,p}{\varepsilon + r} \quad (7)$$

7. Using equation (1), iterate on the value of T_w until an e_{sw} is found that is equal to e from equation (7); this value of T_w is the dew point temperature.

8. For reference, because it is needed in the bulk aerodynamic flux formulae, the specific humidity is related to the mixing ratios by

$$q = \frac{r}{1+r}$$

so the specific humidity of the moist air is

$$q = \frac{r}{1+r} \tag{8}$$

where r comes from equation (5), and the specific humidity of the saturated air at the sea surface is

$$q_o = \frac{r_{so}}{1+r_{so}} \tag{9}$$

where the r_{so} comes from equation (4) based on e_{so} from equation (1) evaluated at the sea surface temperature T_o.

These calculations were checked against examples in the Smithsonian Meteorological Tables and (for relative humidity) against tables in the Instruction Manual (No. 509942, revised March 1968) for the Bendix Psychron.

RESULTS

The purpose of these meteorological measurements was to provide the background information needed for calculations of air-sea fluxes, especially of heat and momentum. The observations are of a kind that is appropriate for the use of bulk aerodynamic formulae (e.g., Bunker, 1976) for which the crucial variables are wind speed, sea and air temperatures, and the specific humidities for the moist air and for the saturated air at the sea surface.

The buoy measurements provide our best estimates of wind speed, sea and air temperatures, and the specific humidity at the sea surface. Since the buoy provides no moist air measurement, we have to use the shipborne measurement of dew point (PET) or wet bulb temperature (MANUAL) to supplement the data set.

The MANUAL measurements in general are noisy, only on a 4 or 3-hourly basis, and are more subjective than the other measurements. The uncalibrated aneroid barometer on the bridge was read by the mates on watch and reported verbally to the science watch. The bucket sea-surface temperatures have all the traditional problems with biases introduced by the storing temperature of the bucket, warming by the ship of the water around it when the ship is on station, and evaporative cooling of the water in the bucket while it is being read.

The PET measurements, except for dew point and incidentally ship speed and heading, provide no information that is unavailable from the buoy. For interest, the PET dew point temperature (Figures III-3 and 4) and the calculated MANUAL dew point temperature (Figures III-1b and 2b) are plotted together (Figure III-12) for Leg II of the cruise, and are given as a scatter plot (Figure III-33) that shows the regression line (MANUAL regressed on PET; Table III-4):

$$T_{MANUAL} = 0.581^{o}C + 0.945 \times T_{PET}$$

The standard error of the regression is only 0.5°C, hence it appears that the dew point temperature estimates from the ship are useful to something better than 1°C.

The scatter plots (Figures III-13 to 38) and regressions (Table III-4) display interesting comparisons between the various measurements of the same variable. Some of the comparisons are extraordinarily good, such as the pressure, dew point, and ship speed measurements (Figures III-32 to 34), whereas some are terrible, like BUOY versus MANUAL water temperature (Figure III-26) which is badly biased by the distance between the ship and the buoy (c.f., Figure I-4b). PET versus MANUAL water temperature (Figure III-27), both being made on the ship, compare better with only 0.22°C standard error.

The effect of separation between the buoy and the ship (PET) is minimized in the last four scatter plots, which are restricted to only the periods when the separation is less than 10 km. Unfortunately, these 10 km - plots cannot be directly compared to the other scatter plots because the 10 km - plots are for Leg 1, whereas all the other PET plots are for Leg 2.

A useful number is obtainable from the overall statistics of the BUOY record in Table III-1a. The mean solar radiation is given as 2783 watt-h m^{-2}; it has been normalized to one 24-hour day. In more usual units (divide by 24) the mean insolation during our measurements was

$$116 \text{ watts } m^{-2} = 0.17 \text{ langleys (old)} = 0.17 \text{ langleys (new) } min^{-1}.$$

For comparison, Bunker (1976) gives about 50 watts m^{-2} for this location for the net average annual radiational flux to the ocean, and a sensible heat flux and latent heat flux from the ocean of about 30 watts m^{-2} and 135 watts m^{-2} respectively, for a net loss over the year of about 85 watts m^{-2}; the imbalance in this budget is due to the averaging and contouring used by Bunker (1976), plus the necessity to obtain the numbers by reading small graphs.

ACKNOWLEDGEMENTS

We wish to thank Joe Poirier and Nancy Pennington for instrumental and data processing aspects of the VAWR data on W2, Bob Weller for providing the VMWR data from W2 and H2, and all those watchstanders who acquired the MANUAL and logged the PET data on the Atlantis-II. Sue Slagle is particularly thanked for her continuing, realtime assessment of the quality of the wind data. Nancy Pennington also was responsible for transmission of all the MANUAL and PET data into the computer, and did most of the editing.

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TABLE I-1

Summary of Mooring Locations and Dates

Mooring	Location (°N) (°W)	Cruise A-II-102 Date Set (1978)	Cruise A-II-102 Date Recovered (1978)	Purpose of Mooring	Comment
B1	59°00.4' 12°33.1'	1 Aug.	6 Sept.	meteorology thermistor chain	NOTE 1
B2	59°00.2' 12°27.5'	29 July	6 Sept.	thermistor chain	NOTE 1
B3	59°01.6' 12°27.4'	28 July	6 Sept.	thermistor chain	NOTE 1
B4	59°10.7' 12°31.0'	28 July	3 Sept.	thermistor chain	NOTE 1
W1	59°01.1' 12°32.0'	29 July	7 Sept.	subsurface currents	NOTE 2
W2	59°01.5' 12°33.0'	30 July	6 Sept.	meteorology surface currents	NOTE 2
W3	59°01.1' 12°34.3'	30 July	6 Sept.	spar buoy for surface currents	NOTE 2
K1	58°59.8' 12°30.6'	9 July	6 Sept.	subsurface currents	NOTE 3
H2	59°25.0' 12°30.0'	16 July	3 Sept.	meteorology and and surface currents	NOTE 4

Notes:
1. Oregon State University buoys (W. Burt) deployed and recovered by the A-II.
2. Woods Hole Oceanographic Institution buoys.
3. Institut für Meereskunde, Kiel, F. R. Germany, buoy deployed by Meteor, recovered by Planet.
4. NOAA/PMEL, Seattle, buoy (D. Halpern) deployed by Shackleton, recovered by A-II.

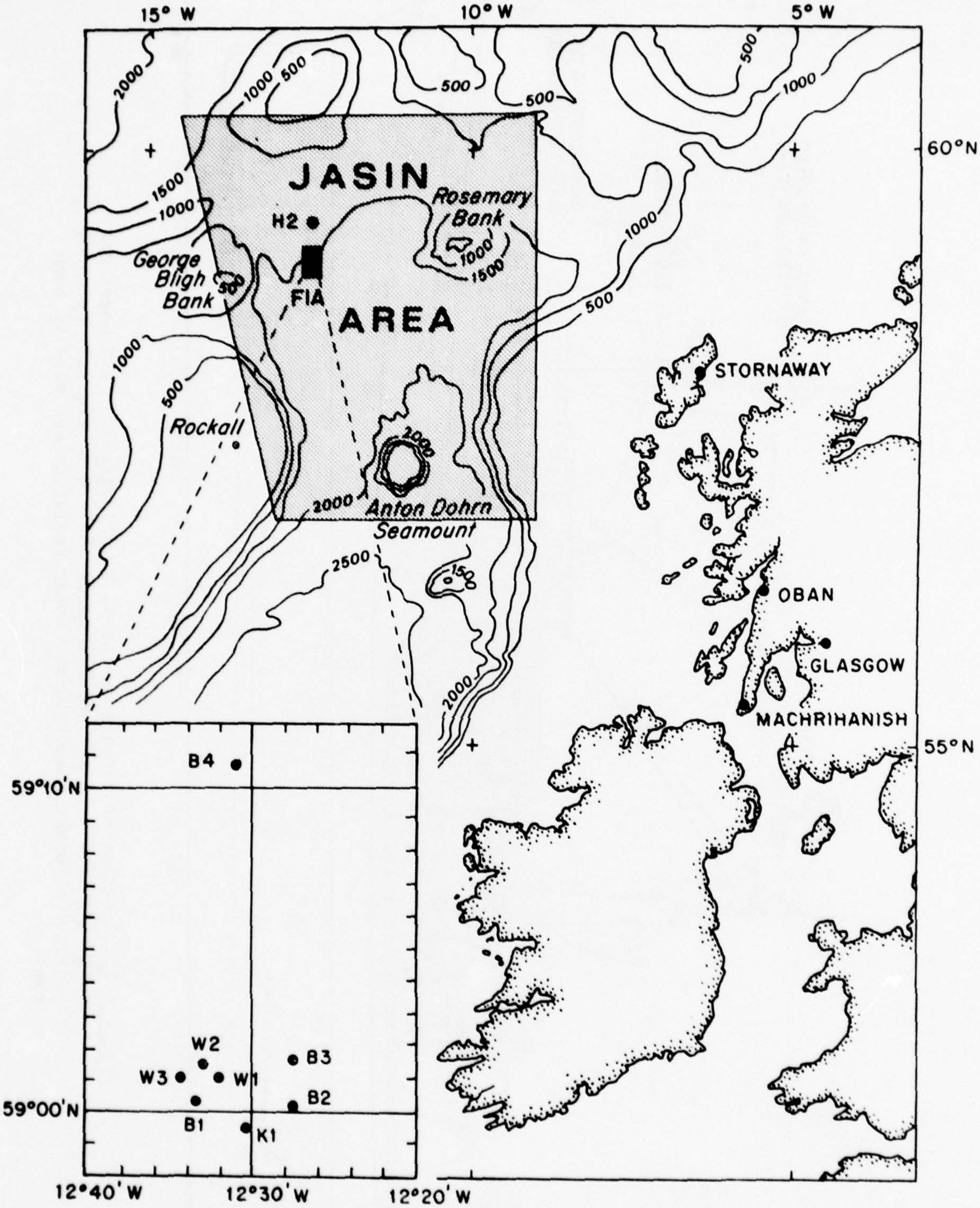

Figure I-1: Chart of the JASIN area. FIA means fixed intensive array, shown in detail at lower left. Glasgow was the main ship port, although Stornaway was also used. Oban was the communications center, and Machrihanish the airfield.

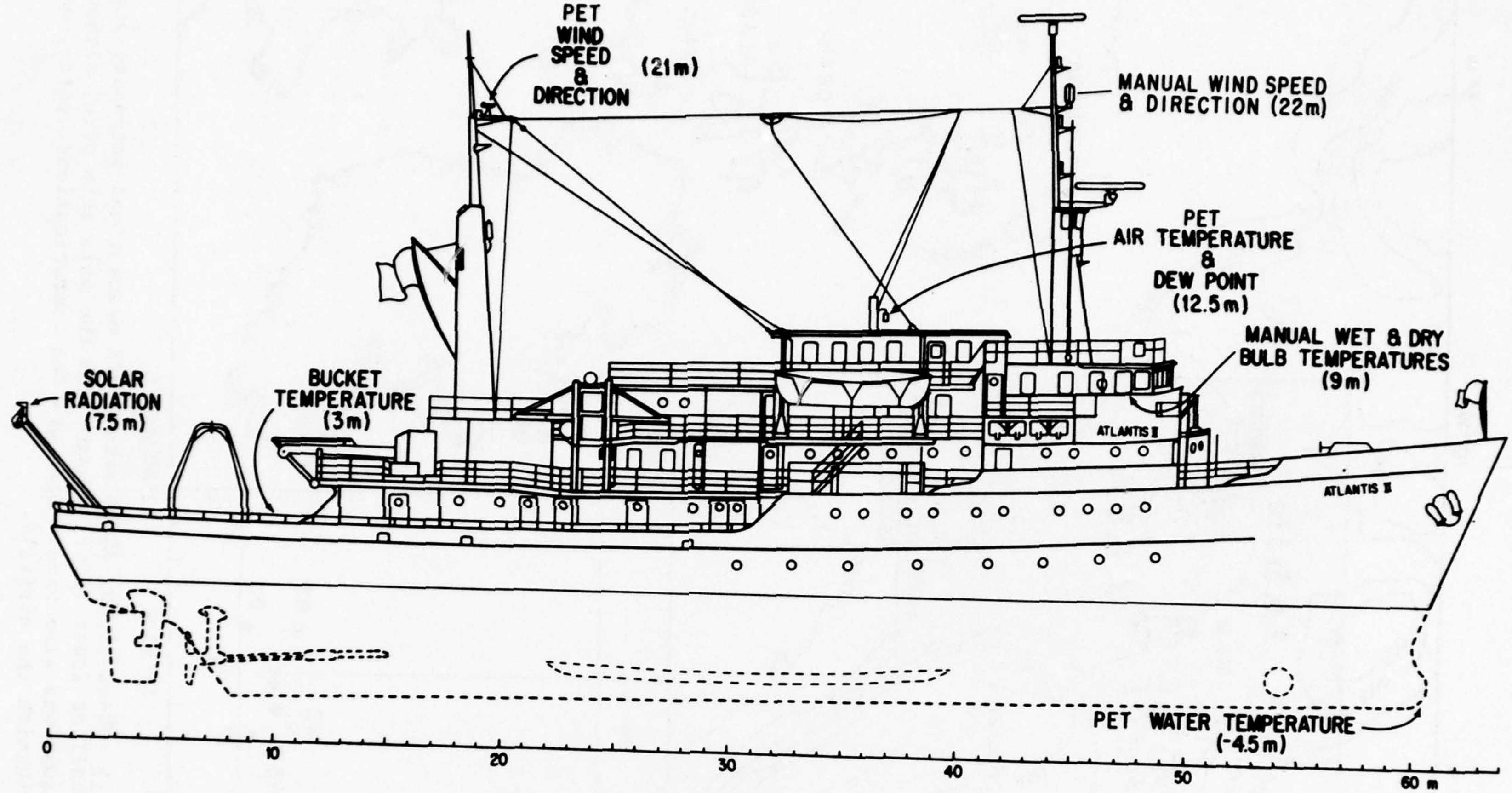

Figure I-2: Location of sensors on the R. V. Atlantis-II. PET means the computer-acquired data set, MANUAL means those data acquired by hand, including the bucket temperature. Solar radiation was read by both systems.

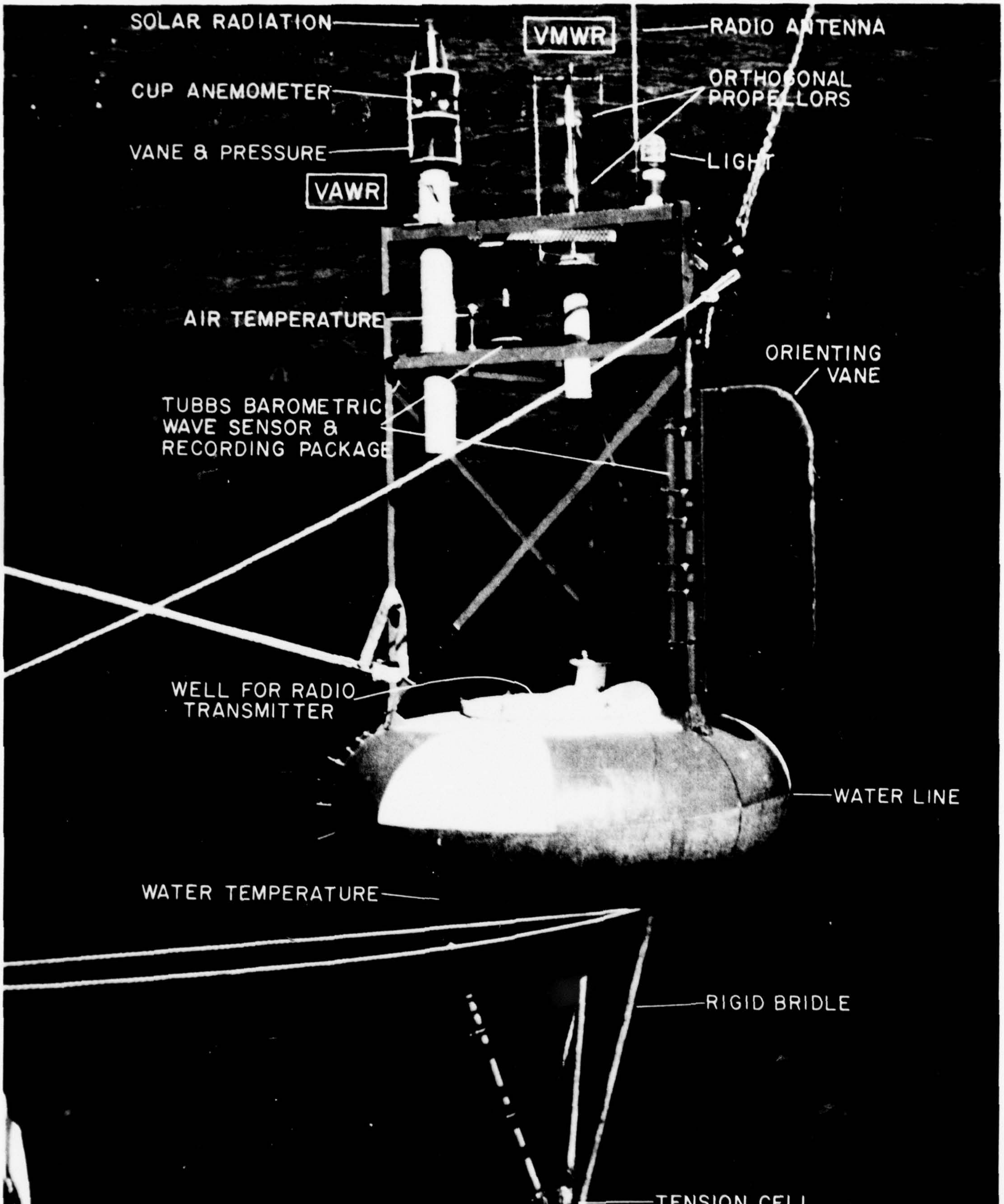

Figure I-3: Detail of buoy W2 and its meteorological sensors. The buoy is 2.4 m in horizontal diameter at its waterline; the wind sensors are at 3.5 m height, and the water temperature sensor is at 60 cm depth.

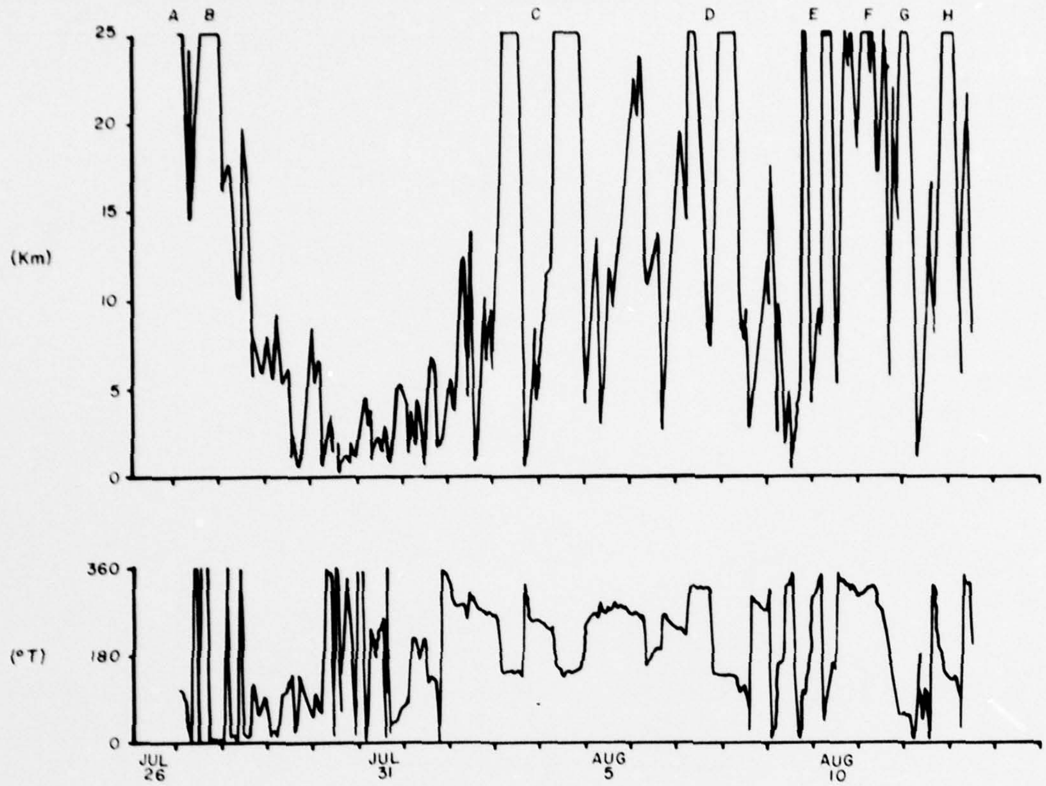

Figure I-4a: Range and bearing from ship to buoy W2.

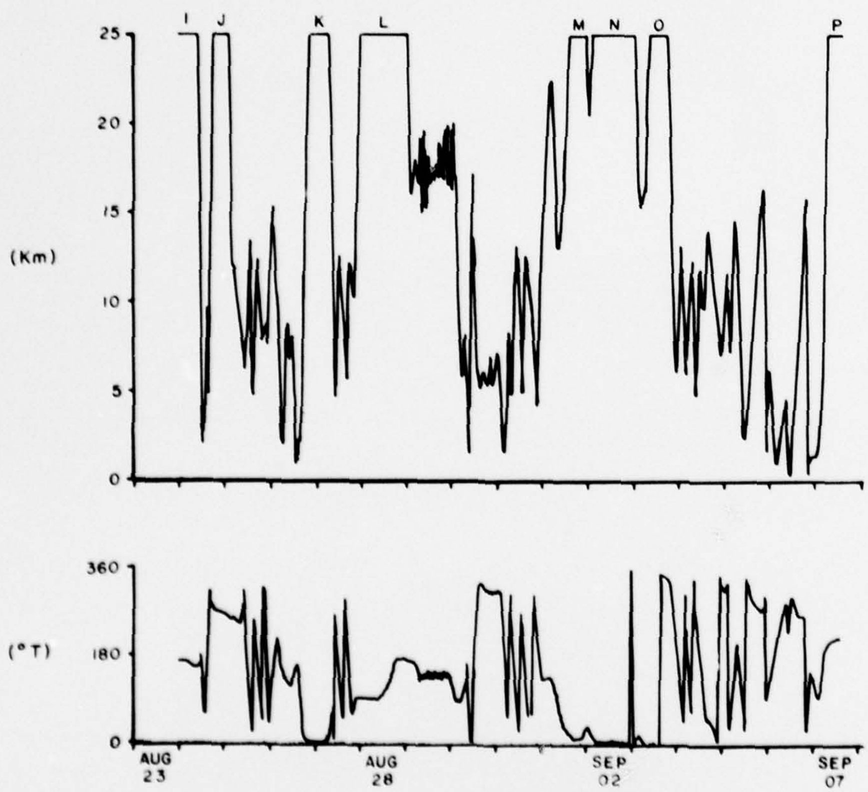

Figure I-4b: Range and bearing from ship to buoy W2.

Table I-2

Range and Bearing from Ship to Buoy W2

(Refers to Figure I-4a,b)

Leg 1		Leg 2	
78-VII-26 to 78-VIII-15		78-VIII-23 to 78-IX-08	
A	Glasgow to JASIN site	I	Glasgow to JASIN site
B	B4 Deployment	J	CTD section (W of FIA)
C	VCM/3 tracking	k	CTD section (heading North)
D	CTD section (NW→SE)	L	CTD section (59°N W→E)
E	XBT section (S→SE)	M	H2 area
F	CTD section (SW of FIA*)	N	Multiship experiment (N of FIA)
G	B4 area	O	B4 recovery
H	CTD section (SE of FIA)	P	Returning to Woods Hole

* Fixed Intensive Array

PART II
PET SYSTEM

INTRODUCTION

The system provides continuous display and a digital record of several parameters relating to shipboard meteorology. It was designed for the Joint Air-Sea Interaction (JASIN) experiment and was used aboard the Atlantis II to supplement buoy-based recording systems. This report describes the sensors used and data collected during the JASIN cruise. However, the design of the system is such that it can support different sensors and other additional sources of data input in future applications.

The parameters measured by the system are as follows:

1. wind speed and direction
2. ship speed and heading
3. solar radiation
4. sea surface temperature
5. air temperature
6. dew point

Sensors are sampled and displayed several times per minute; six minute averages are recorded on digital tape*. During acquisition, steps are taken to remove the influence of the ship on the parameters being measured. For example, two wind sensors are installed, one on each side of the ship. The system selects data from the upwind sensor for use in true wind calculations. True wind is calculated using ship movement data in conjunction with the data from the selected wind sensor.

During the Atlantis II JASIN cruise, in addition to the nearby buoy measurements, extensive manual meteorological observations were taken on the ship. These served as a valuable reference for evaluation of and comparison with the automatically acquired data. Some of the data appear in Part III of this report.

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* The recording system did not function during this test cruise of the prototype system.

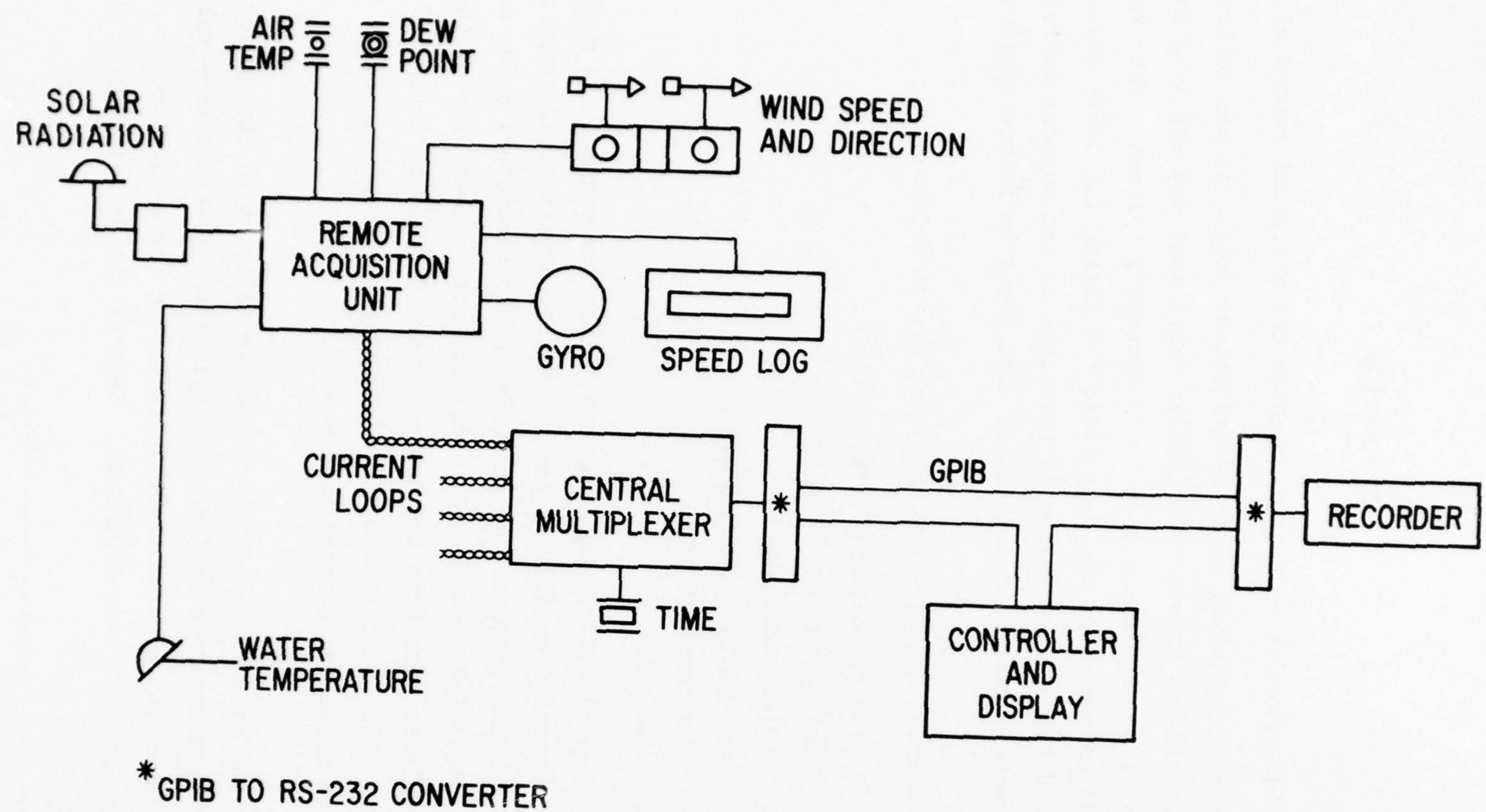

Figure II-1: Block diagram of meteorological data system.

SYSTEM SPECIFICATIONS

The system design described in Peal and Bradley (1978) is based on four main modules as follows (see Figure II-1):

- The remote acquisition unit converts the sensor outputs to digital values and sends the raw numbers to a central location.

- The central multiplexer performs the digital data transmission.

- The controller and display unit controls the data acquisition and recording, and converts the raw data to engineering units for display at the central location and for recording.

- The recorder stores the data for later analysis.

An important feature is the continuously updated display of the measured values converted to engineering units. The display (Figure II-2) is readily understood providing instant access to the data being recorded and verification of system operation.

Another important feature of the system is the ease with which it can transmit data to external devices. Thus, although this system has display and bulk storage capabilities, it can serve as a source of pre-processed real-time data for other systems aboard ship.

The system accuracy for DC imputs is determined by the analog-to-digital conversion in the remote acquisition unit. The conversion is performed by an Analog Devices 7507 multiplexer, a 581 J voltage reference,

Figure II-2: Live data display in main laboratory. Data being recorded are continuously updated.

and a 7550 converter at a clock rate of 614.4 KHz. Figure II-3 shows a calibration of this portion of the system.

This calibration does not apply to devices which are inherently digital since they are read into the system as digits. The ship speed log and gyrocompass are two such devices.

The system is capable of sampling all sensors as frequently as once per second. In this case, the following sample scheme is used:

every 30 seconds
- wind speed (both sensors)
- wind direction (both sensors)
- ship speed
- ship heading
- solar radiation (buffered raw output)

every 6 minutes
- sea surface temperature
- air temperature
- dew point.

A tape record is written every 6 minutes and consists of:
- sequential record number
- time of day
- sea surface temperature
- air temperature
- dew point
- ship speed north and east (average of 12 values)
- wind speed relative to ship, forward and starboard beam vectors (average of 12 values)
- true wind speed north and east (average of 12 values)
- solar radiation (average of 12 values).

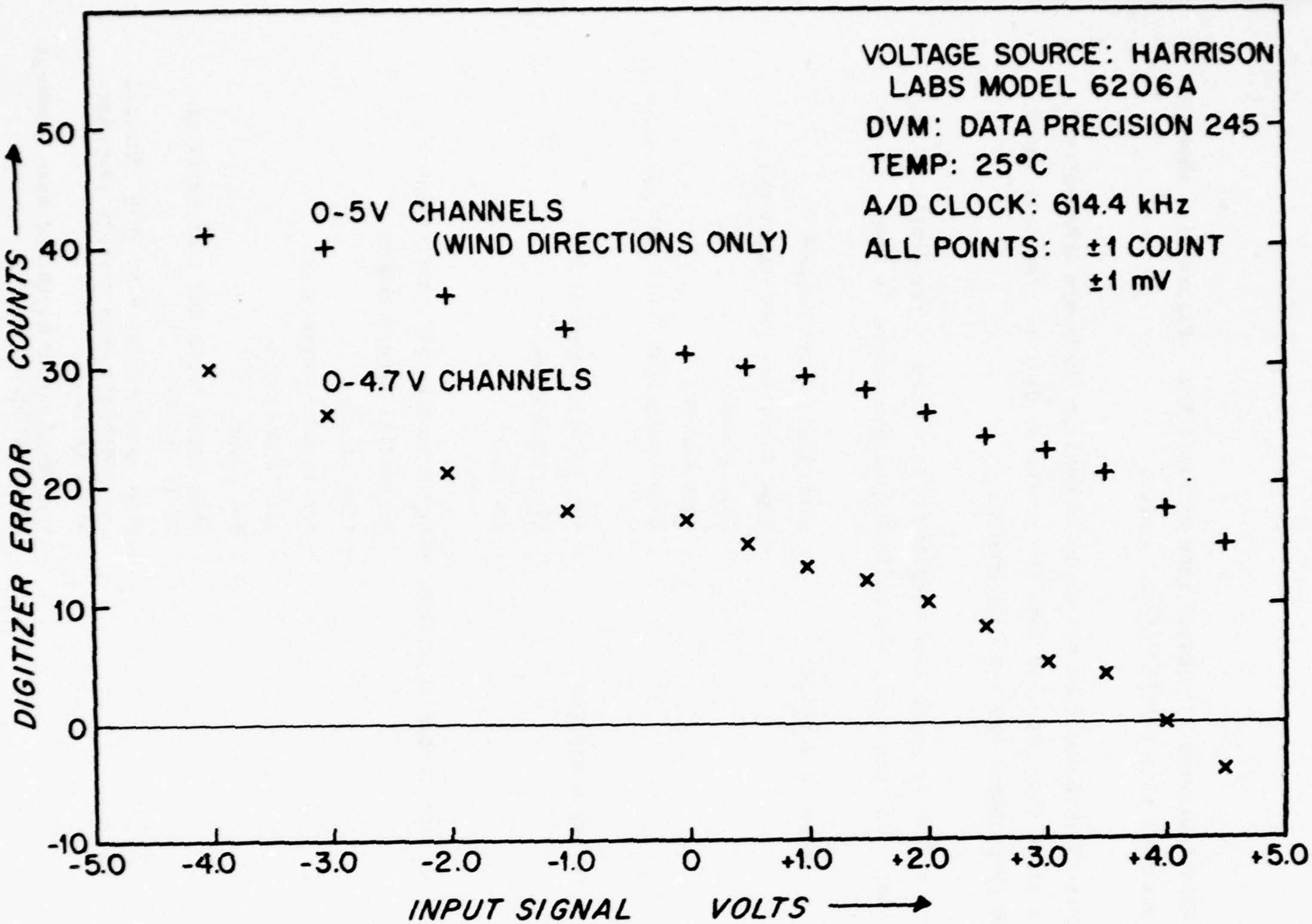

Figure II-3: Calibration of digitizer portion of system.

The data are recorded in a standard code on tape cartridges. In this case, each cartridge holds 468,800 bytes of data, requiring a new cartridge about every 12 days.

SYSTEM OPERATION

Prior to performing data acquisition, it is necessary to initialize the various modules of the system. This process is performed automatically by the control and display unit as a separate program under operator control. Once initialized, the remote acquisition units access all active sensors on a continuous basis. This ensures that current valid data is available for transmission to the central display location at all times.

To perform acquisition, the control and display unit continuously checks the current time of day against a pre-defined sensor acquisition schedule. When a given sensor is to be accessed, a command is sent to the remote acquisition unit which replies with its most recent value. The control display unit performs appropriate conversion and averaging calculations, then displays and records the value in engineering units.

SENSOR SPECIFICATIONS

This section provides specifications for each sensor as used in this system including conversion factors, ranges, accuracy, and response time. A summary is shown in Table II-1.

Wind speed and direction

The anemometer is a vortex counting speed sensor mounted in the tail of a vane which is free to rotate about a vertical axis. Two units are mounted, one on each side of the after mast catwalk approximately 21 meters above the ocean surface. The units are mounted well outboard on each side to minimize the effect of the ship on the wind measurement - see Figure II-4. In the calculation of true wind, the computer uses the data from the upwind anemometer.

Figure II-4: One of two anemometers mounted on after mast catwalk.

<u>**Table II-1**</u>

Summary of measurements made

Parameter	Range	Units	Accuracy	Response	Sensor	Sample period	Data recorded every 6 minutes
Wind speed	0 to 60	m/sec	0.6 m/sec	0.33 cm	J-tec VA 320 sonic	30 sec.	average of 12 rel. vectors and
Wind direction	0 to 358	degrees rel. to ship	±2 degrees	10 m.	J-tec VA 320 vane	30 sec.	average of 12 true vectors (m/sec)
Ship speed	0 to 20	knots	10% (est)	20 sec., integration	Sperry SRD 101	30 sec.	average of 12 true vectors. (m/sec
Ship heading	0 to 359	degree true	1 degree	limited by ship	Sperry Mk37 gyrocompass	30 sec.	
Solar radiation	0 to 5	volts	10% (est)	5 sec. (est)	Eppley/WHOI	30 sec.	average of 12 values
Sea surface temperature	-10 to +40	°C	±0.05 °C	2 min. (est)	RdF platinum	6 mins.	value
Air temperature	-40 to +50	°C	±1 °C	2 min.	General Eastern platinum	6 mins.	value
Dew point	-17.78 to 93.3	°C	±1 °C	3 to 5 mins.	General Eastern LiCl with platinum	6 mins.	value

The unit is a model VA-320, manufactured by J-Tec. The speed sensing unit utilizes the linear relationship between the frequency of vortex formation in the wake of a stationary rod and the speed of the air moving around it. The speed data from the unit is available as a frequency proportional to the rate of vortex shedding and as a voltage which is an analog of the frequency; the voltage is used in this case. The direction output is a linear voltage obtained from a precision, low torque, 358° potentiometer: 0° is wind from dead ahead, 90° is wind from starboard beam, etc.

The speed range is from a threshold of 1 m/sec to 65 m/sec with an accuracy of 0.6 m/sec. The direction range is 0 to 358 degrees with an accuracy of ±2 degrees for speeds above 5 m/sec. The speed distance constant is 0.33 cm; the direction constant is 10 m.

The conversion factors used by the program are as follows:

- speed = 12 x (volts) m/sec
  = 0.01379012 x (counts) m/sec

- direction = 72 x (volts) degrees
  = 1.256637062 x (volts) radians
  = 0.08802207194 x (counts) degrees
  = 0.00153627497 x (counts) radians

Ship speed

Ship speed is measured with a single-axis acoustic doppler log, model SRD101, manufactured by Sperry Marine Systems. A direct interface to the system's data lines reads the speed into the remote acquisition unit.

Speed readings from 0 to ±19.9 knots are possible. These are converted to m/sec in the program by multiplying by 0.508. Using speed and heading information, ship's velocity is determined as north and east vectors. Values in the range 0 to 10.16 m/sec are recorded; other values are recorded as 99.99 m/sec.

Ship heading

The ship uses a Sperry Mark 37 gyrocompass with step-by-step repeaters. The remote acquisition unit monitors the pulses on the three lines going to these repeaters. From these pulses it tracks the ship's heading from an initial heading entered by an operator.

The ship's heading data are thus available directly in degrees true. This is used in determining the ship's north and east velocity and subsequently in determining true wind.

True wind

This is actually a derived parameter but since it is displayed and recorded in real time, the method is described here.

For both anemometers, the apparent wind (i.e., relative to ship) is resolved into along-ship and athwart-ship vectors. For a given observation the sum of the athwart-ship vectors from the two anemometers is computed. If the sum is negative, data from the port anemometer is

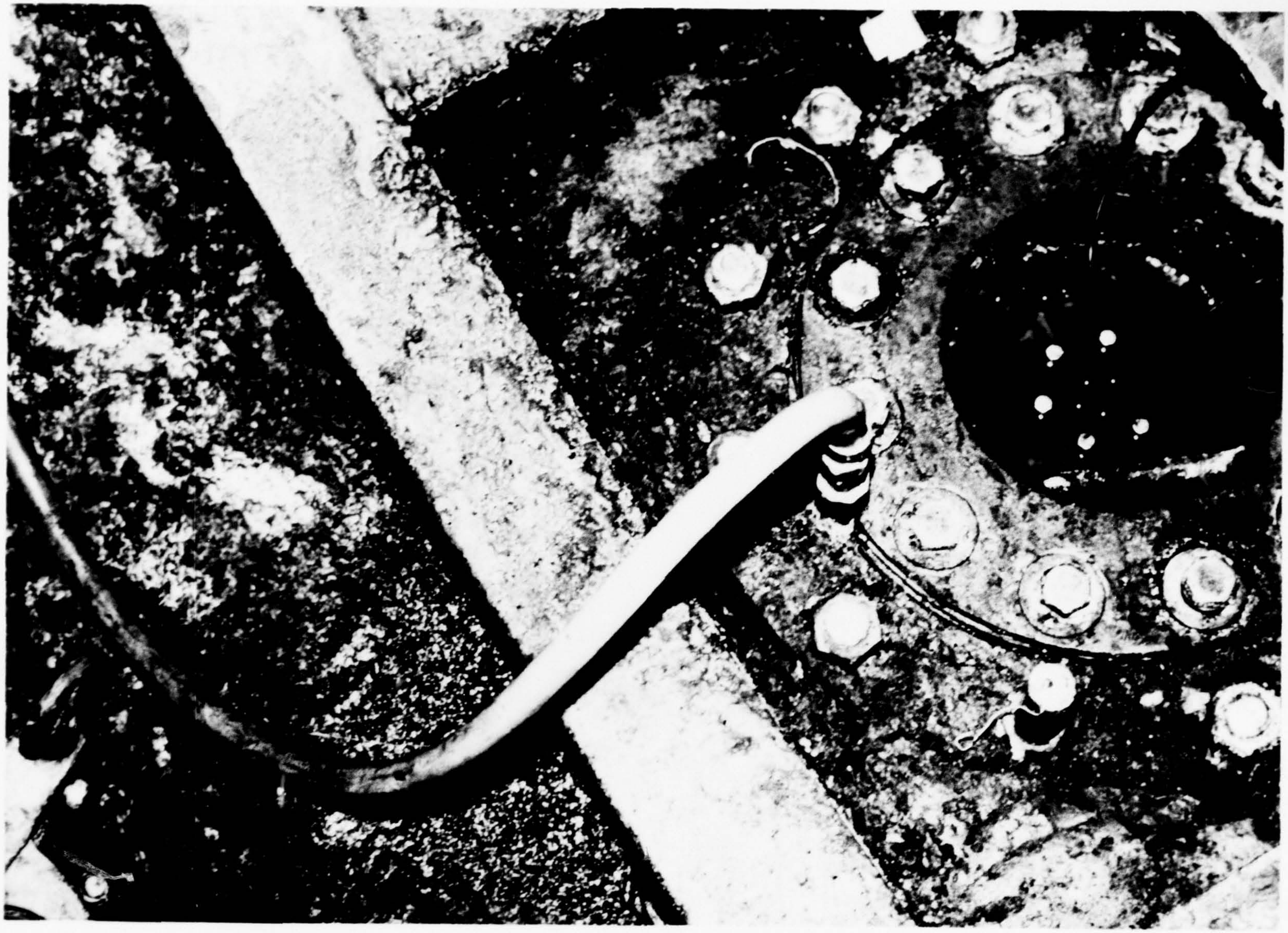

Figure II-5: Sea surface temperature detector mounted in transducer adapter ring in bow chamber.

selected; if it is zero or positive, data from the starboard anemometer is selected. Using ship heading, the selected apparent wind vectors are then resolved to north and east vectors. Finally, the ship's north and east velocities are subtracted leaving true wind.

Note that ship vectors indicate the direction the ship is moving to whereas wind vectors indicate the direction the wind is blowing from.

Solar radiation

The radiation sensor is an Eppley differential thermopile mounted on the top of the stern A-frame about 8 meters above the water surface. The unit is connected to a W.H.O.I.-manufactured device which provides a buffer amplifier with an analog integrator and chart recorder. The 0 to 5 VDC output of the buffer amplifier is digitized and recorded by the computer as a voltage reading. The conversion used for the digitizer output is

$$0.00114918 \times (\text{counts}) \text{ volts.}$$

When the stern frame was tilted from its rest position, the science watch noted the times for later annotation of the solar radiation data series.

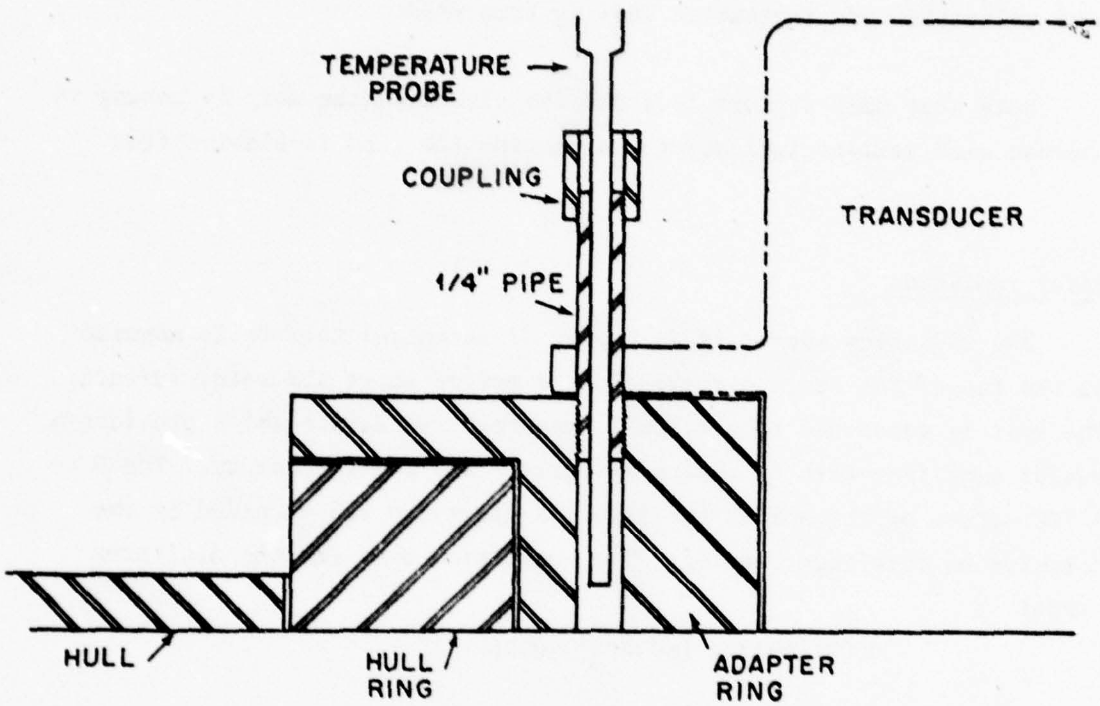

Figure II-6: Detail of mounting arrangement for sea surface temperature detector.

Sea surface temperature

The water temperature sensor is a 100 ohm platinum resistance temperature detector installed in the forward transducer adapter ring in the A-II bow chamber - Figure II-5. The ring is drilled through and tapped for a ¼" pipe; the sensor is mounted in the pipe with its tip flush with the outside surface of the hull as shown in Figure II-6. The measurement is made at about 4.5 meters depth.

The sensor is a 3-wire type 21 connected to a 2-wire transmitter type 2600, both manufactured by RdF Corporation and calibrated for linear output within ±0.05°C over a span of -10° to +40°C. The transmitter output is a direct current between 4 and 20 milliamperes which is proportional to the water temperature. The current output is passed through a Vishay 250 ohm resistor, type S102, tolerance 0.5%, to generate a voltage which is measured by the remote acquisition unit.

The temperature sensor and transmitter were calibrated before and after the JASIN cruise at the W.H.O.I. temperature calibration facility. This was to verify the quoted accuracy and to allow corrections to be applied to the recorded data if additional accuracy is desired. The calibration results are shown in Figure II-7. Additional accuracy can be obtained by applying a correction as shown in Figure II-8 to the recorded data. A further improvement could be obtained by performing a more accurate digitizer calibration.

The conversion factors used by the program are as follows:

- for transmitter output (volts)
  temperature = 12.5 x (volts) - 22.5°C
- for digitizer output (counts)
  temperature = 0.01436471 x (counts) - 22.5°C .

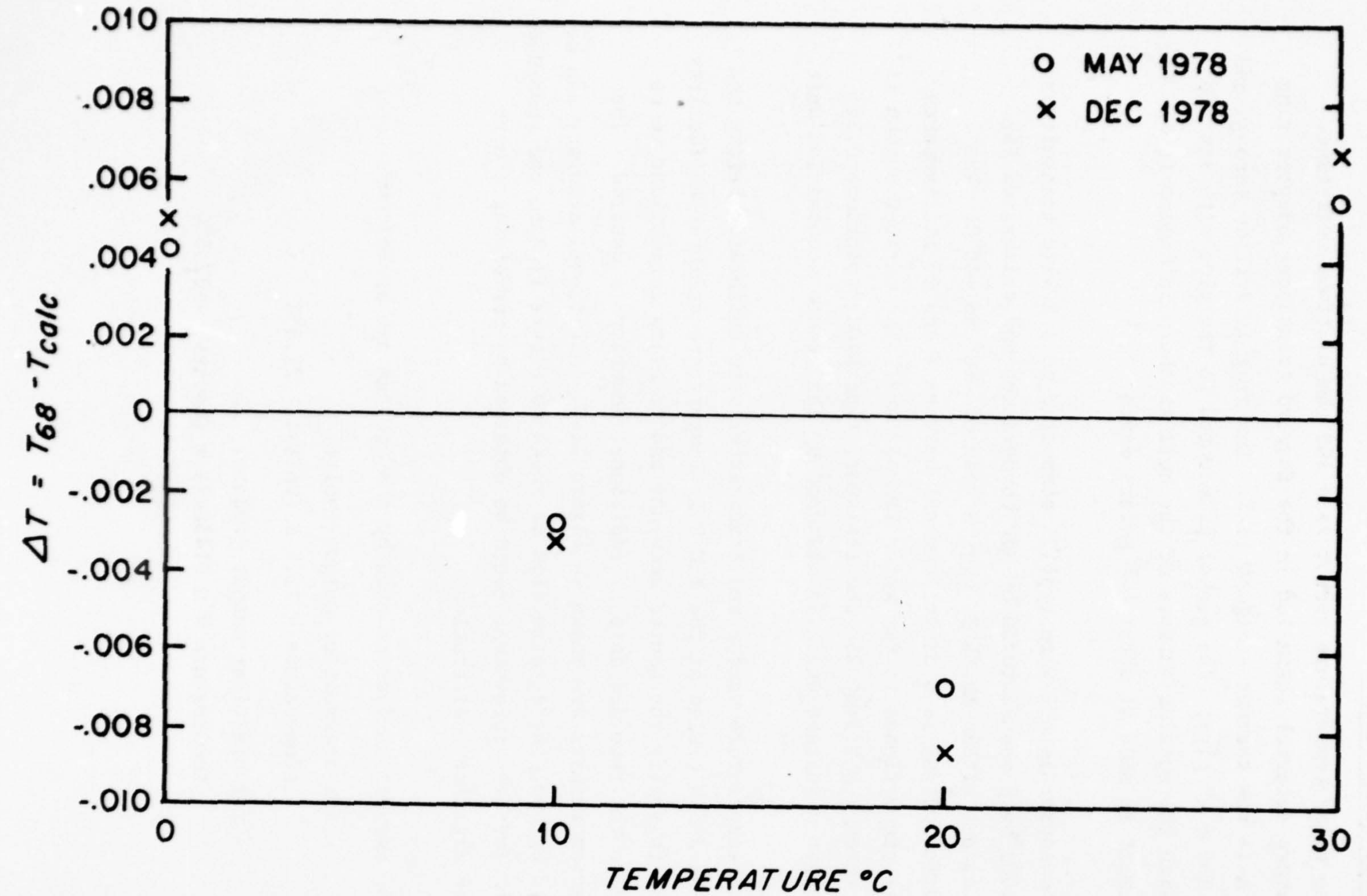

Figure II-7: Calibration of sea temperature detector before and after JASIN cruise. T_{68} is the temperature of the calibration bath, T_{calc} is the temperature calculated from the detector's output.

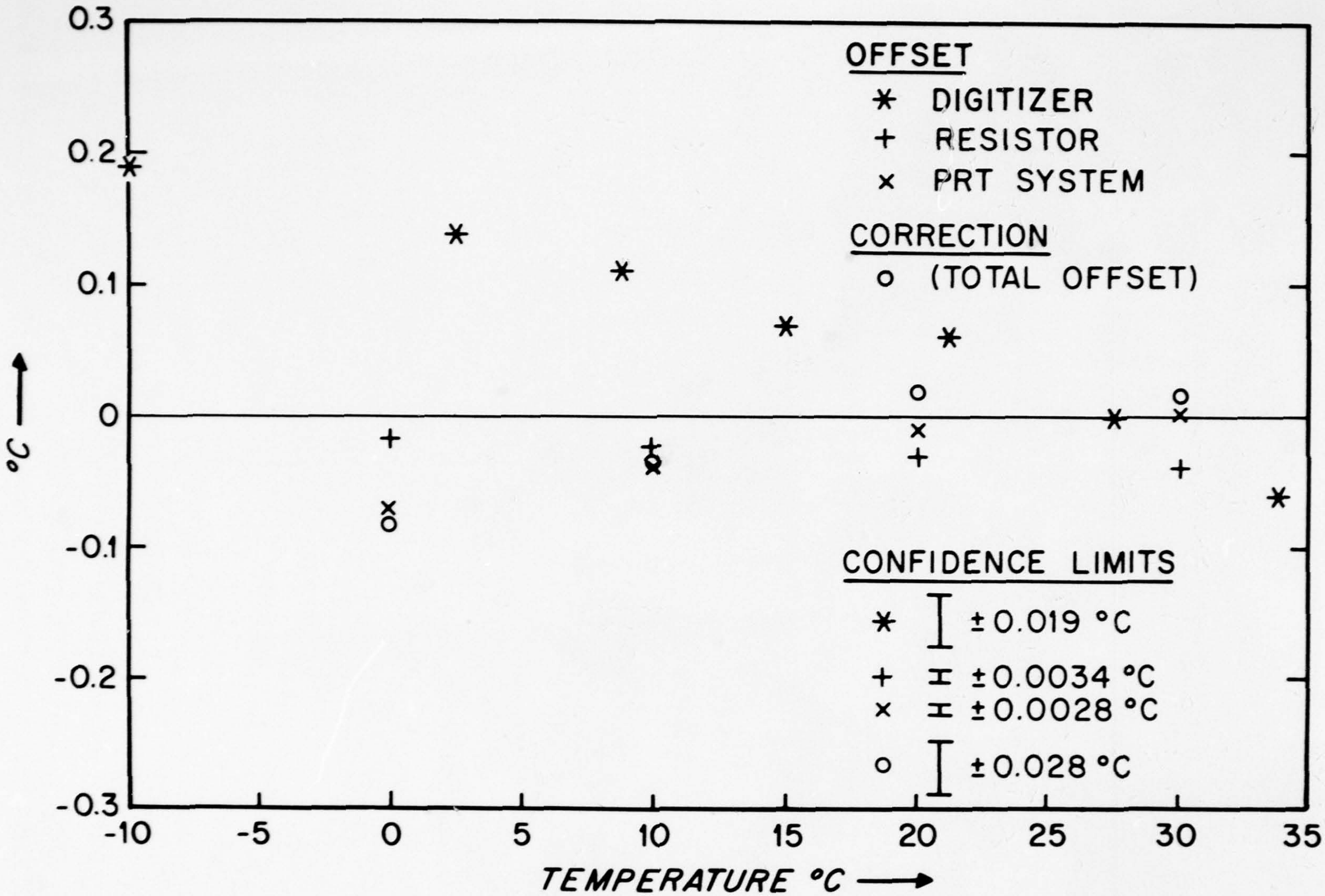

Figure II-8: Net error in observed sea surface temperature caused by digitizer, detector and resistor errors.

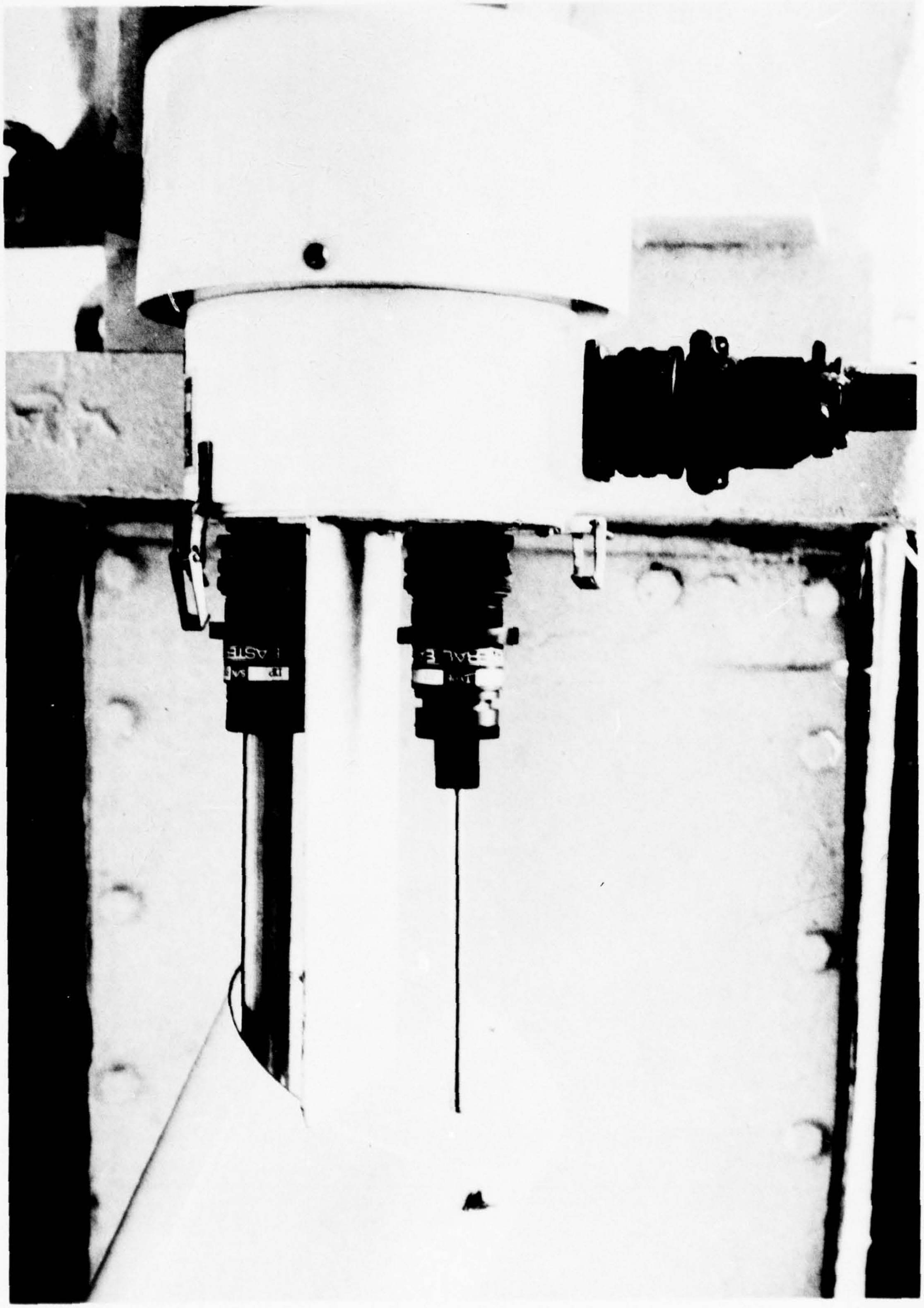

Figure II-9: Dewpoint and air temperature sensors mounted in aspirated sun shield with access cover removed.

Air temperature

The air temperature sensor is a 100 ohm platinum resistance temperature detector mounted in a motor-aspirated sun shield along with the dew point sensor - Figure II-9. The unit is installed on a stanchion on top of the top laboratory about 11.5 meters above the water surface.

The sensor is a model 612A with a model 650 AT transmitter manufactured by General Eastern. The sensor is mounted in a model 706 M aspirated sun shield. The transmitter provides a 0 to 5 VDC output for an air temperature range of -40° to +50° C with an accuracy of ±1°C. With 10 feet per minute aspiration, the response is approximately two minutes.

The conversion factors used by the program are as follows:

- for transmitter output

  temperature = 18 x (volts) - 40°C

- for digitizer output

  temperature = 0.2068519 x (counts) - 40°C

Dew point

The dew point sensor is a 100 ohm platinum resistance temperature detector surrounded by a teflon-sheathed stainless steel bobbin. On the bobbin is an elemental winding of inert platinum wire over a glass wick. The unit is mounted in a motor aspirated sun shield along with the air temperature sensor - Figure II-9. Prior to installation, the wick is coated with a saturated solution of lithium chloride. In operation, the platinum winding is heated to the point where evaporation of water balances condensation. This temperature measured by the platinum detector is a measure of the dew point of the surrounding air.

The sensor is a model 611 A with a model 650 DP transmitter manufactured by General Eastern. The sensor is mounted in a model 706 M aspirated sun shield. The transmitter provides a 0 to 5 VDC output for a dew point range of 0 to 200°F with an accuracy of ±2°F. With 10 feet per minute aspiration the response is 3 to 5 minutes.

The conversion factors used by the program are as follows:

- for transmitter output
  dew point = 18.6666 x (volts) °C
- for digitizer output
  dew point = 0.10725652 x (counts) °C .

RESULTS

The system was operating for acquisition and display a total of 27.7 days during the two legs of the JASIN cruise. During the first leg, the system operated from 0000, 2 August to 0800, 14 August. However, for an 8-hour period on 6 August some data are missing because of a bad dew point sensor. During the second leg the system operated from 1200, 22 August to 1200, 7 September with a 7-hour outage on 30 August when the computer program failed.

When evaluating a system for collecting data in a shipboard environment, component reliability is as important as accuracy of results. Thus, system operation should not be jeopardized by failure of one module.

In this case, the system failed to provide recorded data due to a hardware problem with the tape drive. The data presented here were logged by watchstanders from the CRT display and subsequently keypunched in a standard format for computer processing. In the future, a hardcopy printer will be added to provide access to previous data during the cruise and to serve as a backup for the tape system.

Reliability problems were encountered with certain sensors. Anemometers and air temperature sensors are required to operate in locations subject to high levels of radio frequency radiation. Modifications were necessary to the circuitry mounted in the sensor unit to provide filtering and decoupling in order to prevent damage and incorrect operation.

Lithium chloride dew point cells are relatively inexpensive but can be contaminated by salt deposits. To minimize this problem we provided a closed, aspirated shield for the dew point cell. In addition, we performed frequent inspection of the cell and we carried a spare cell to simplify servicing when required. The unit was serviced only once (6 August) and appeared to operate successfully for long periods - Figure III-12.

Platinum resistance temperature detectors were chosen in all cases for their long term stability. The calibration of the water temperature unit (Figure II-4) appears to support this choice.

In addition to reliability, however, data validity is important. To evaluate the PET data set, scatter plots were produced of several of the parameters against the corresponding parameters in the manual and the buoy data sets. These appear in Part III.

RECOMMENDED IMPROVEMENTS

In the interests of generating a more complete data set, the system should be upgraded to include inputs from a flow-through conductivity system, and from one or more navigation devices such as a satellite navigator or a Loran C receiver.

To simplify changes required for different cruises, the computer program should be changed to perform a running mean instead of a fixed-length average which it now performs.

Finally, an external digital clock should be added to provide better accuracy and display than the internal PET clock used during the cruise.

REFERENCE

Peal, K. R. and A. M. Bradley, Use of Industry Standards for Shipboard Data Systems, IEEE Oceans '78 Conference Record, 78CH1356-6, pp. 547-551, September, 1978.

PART III

METEROLOGICAL DATA

LIST OF FIGURES
(Part III)

LIST OF TABLES
(Part III)

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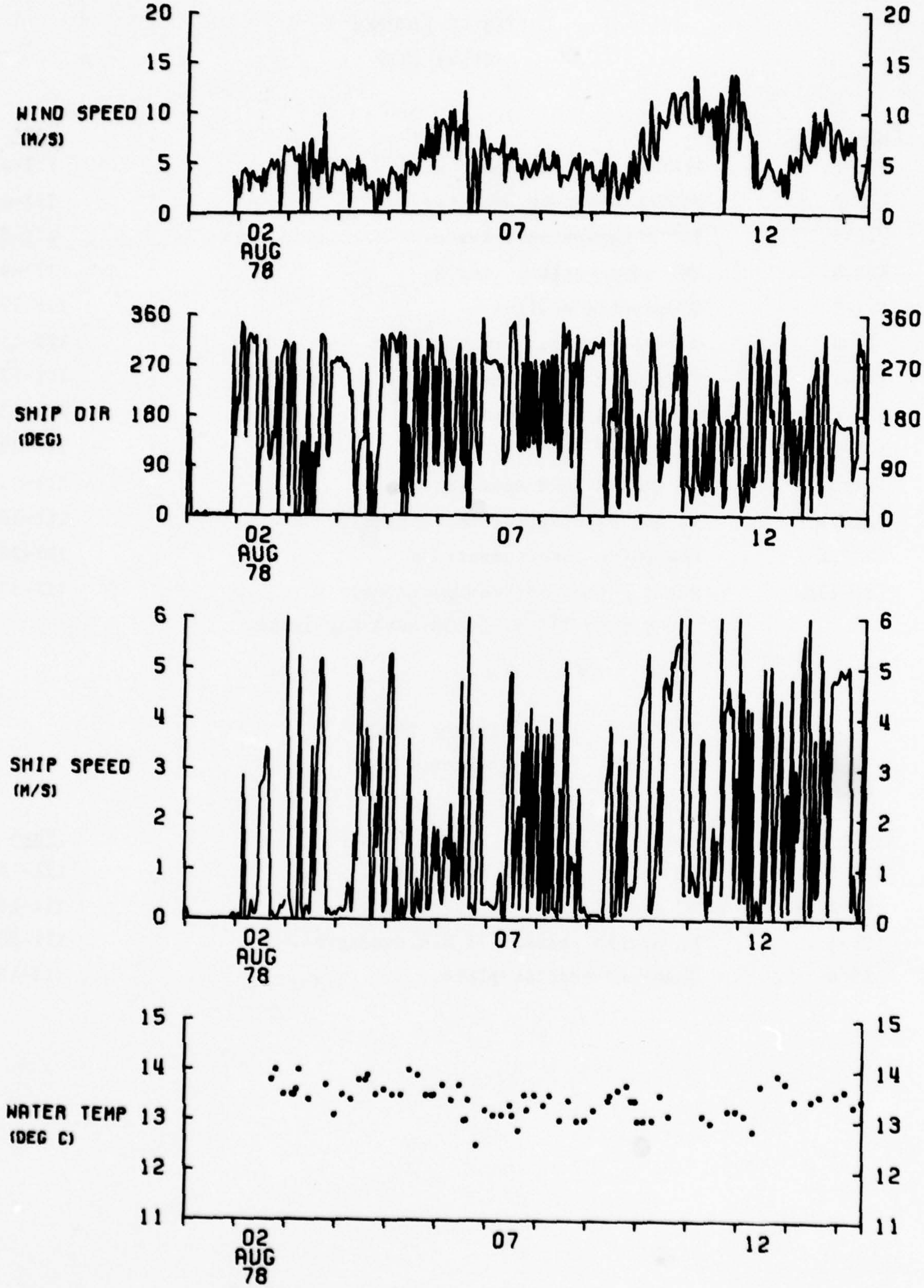


Figure III-1a: Leg 1 MANUAL hourly observations

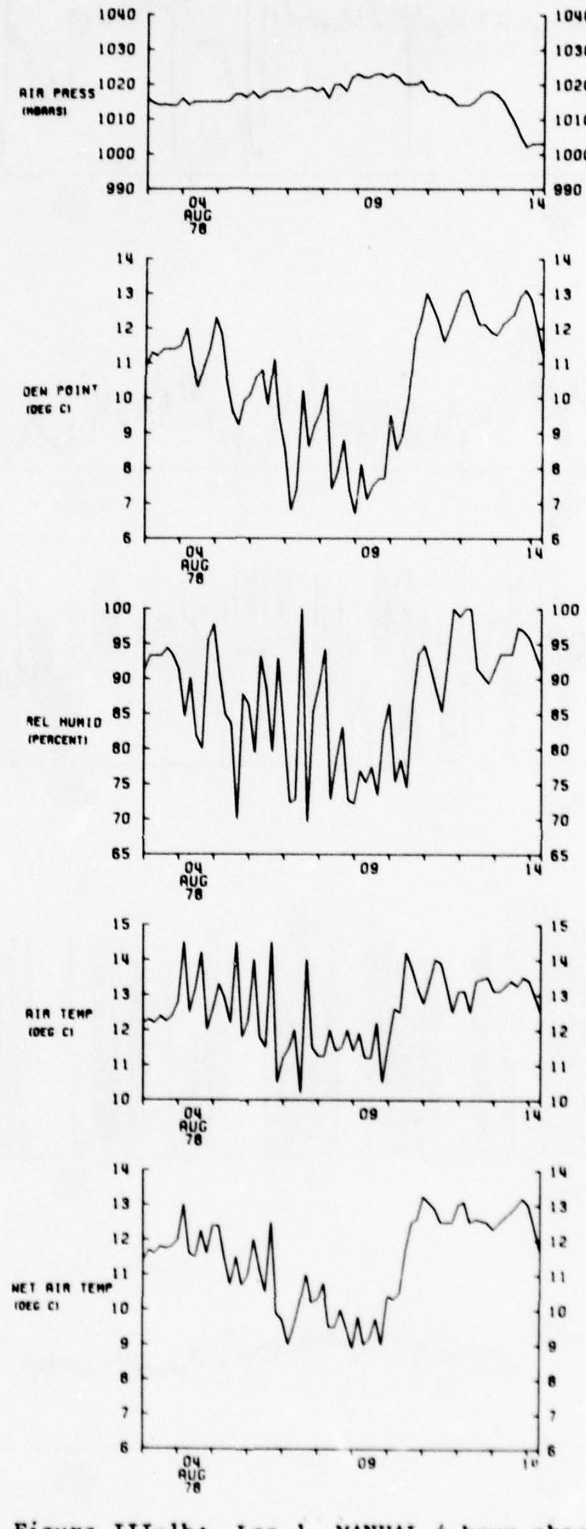


Figure III-1b: Leg 1 MANUAL 4 hour observations

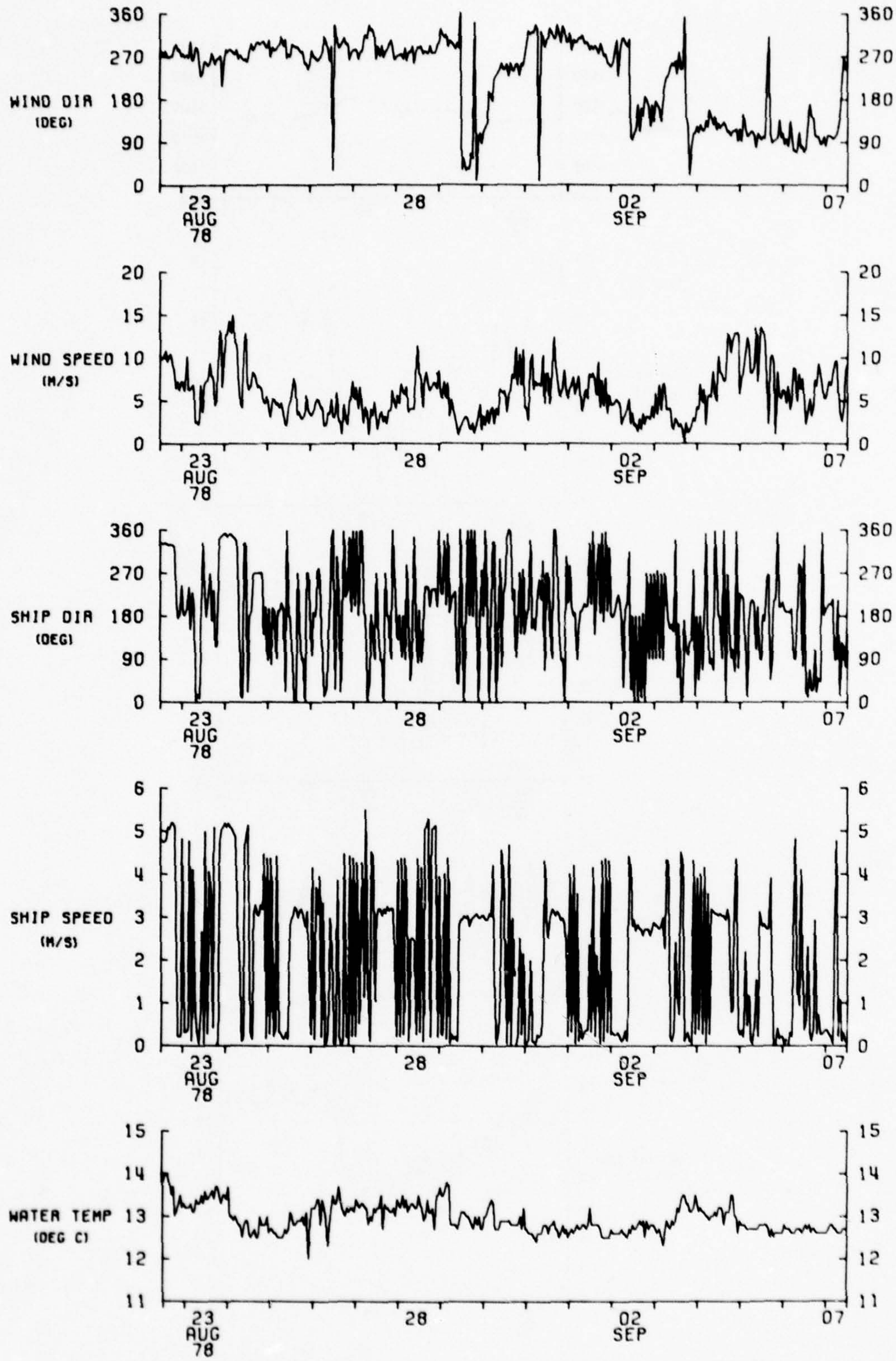


Figure III-2a: Leg 2 MANUAL hourly observations

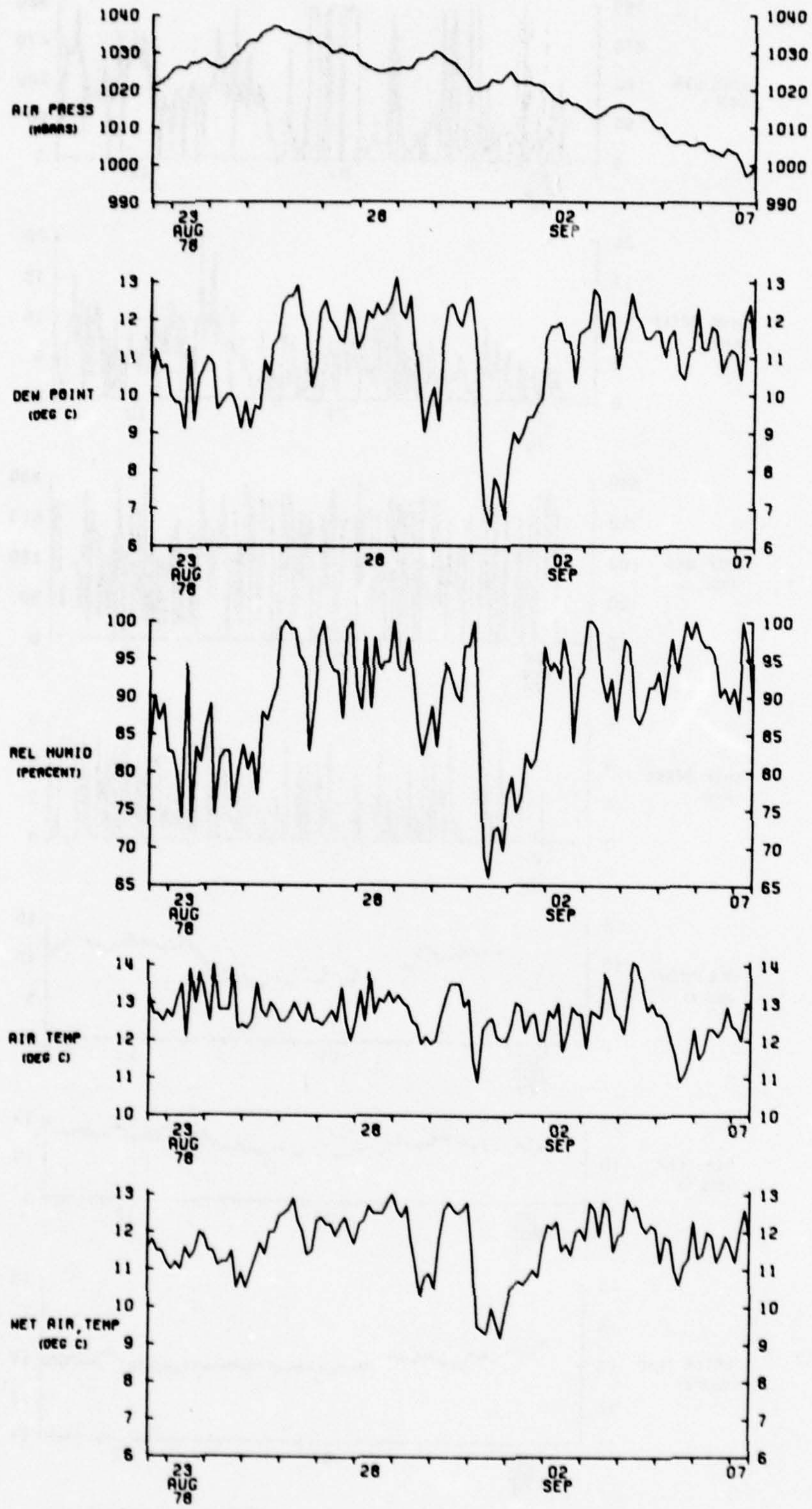


Figure III-2b: Leg 2 MANUAL 3 hour observations

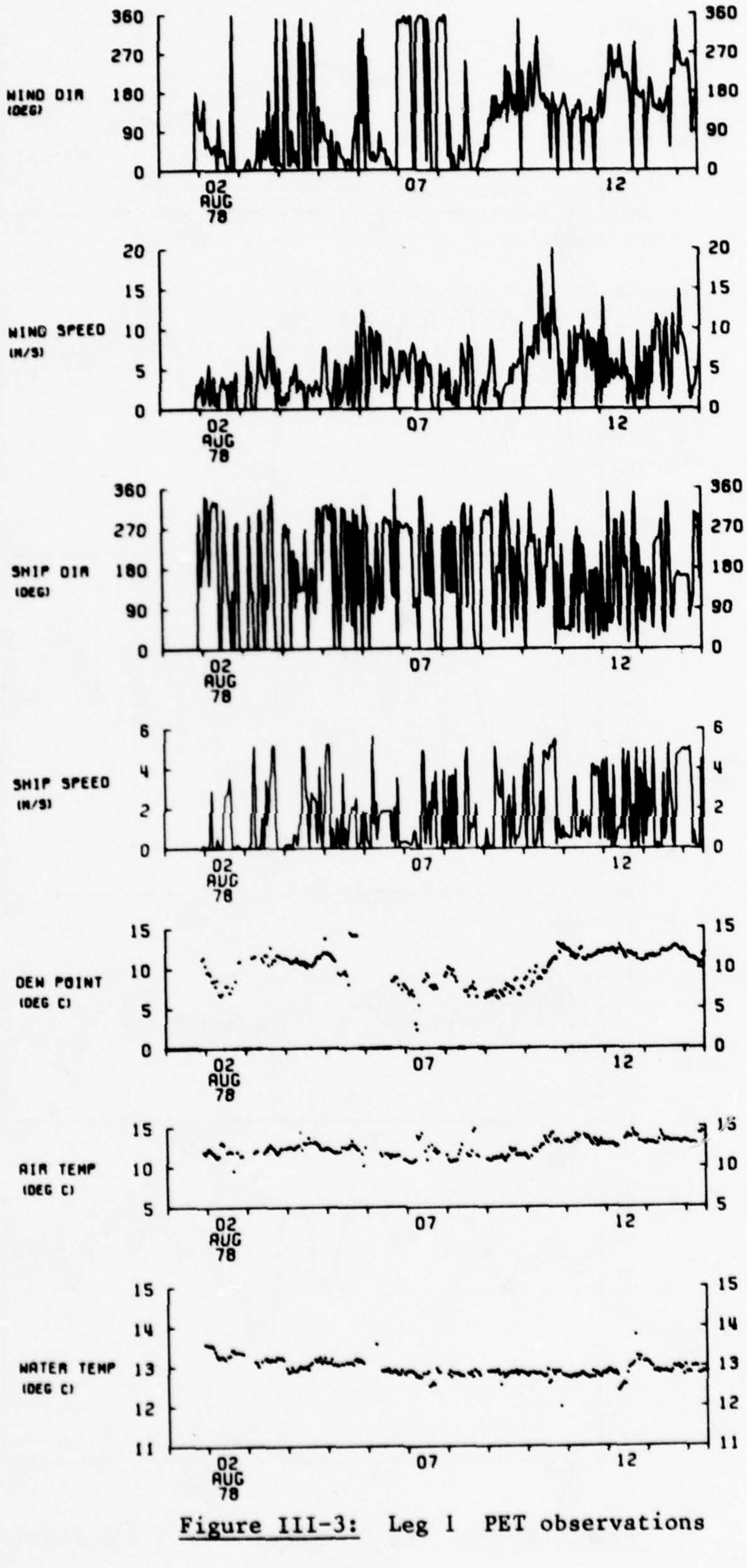


Figure III-3: Leg 1 PET observations

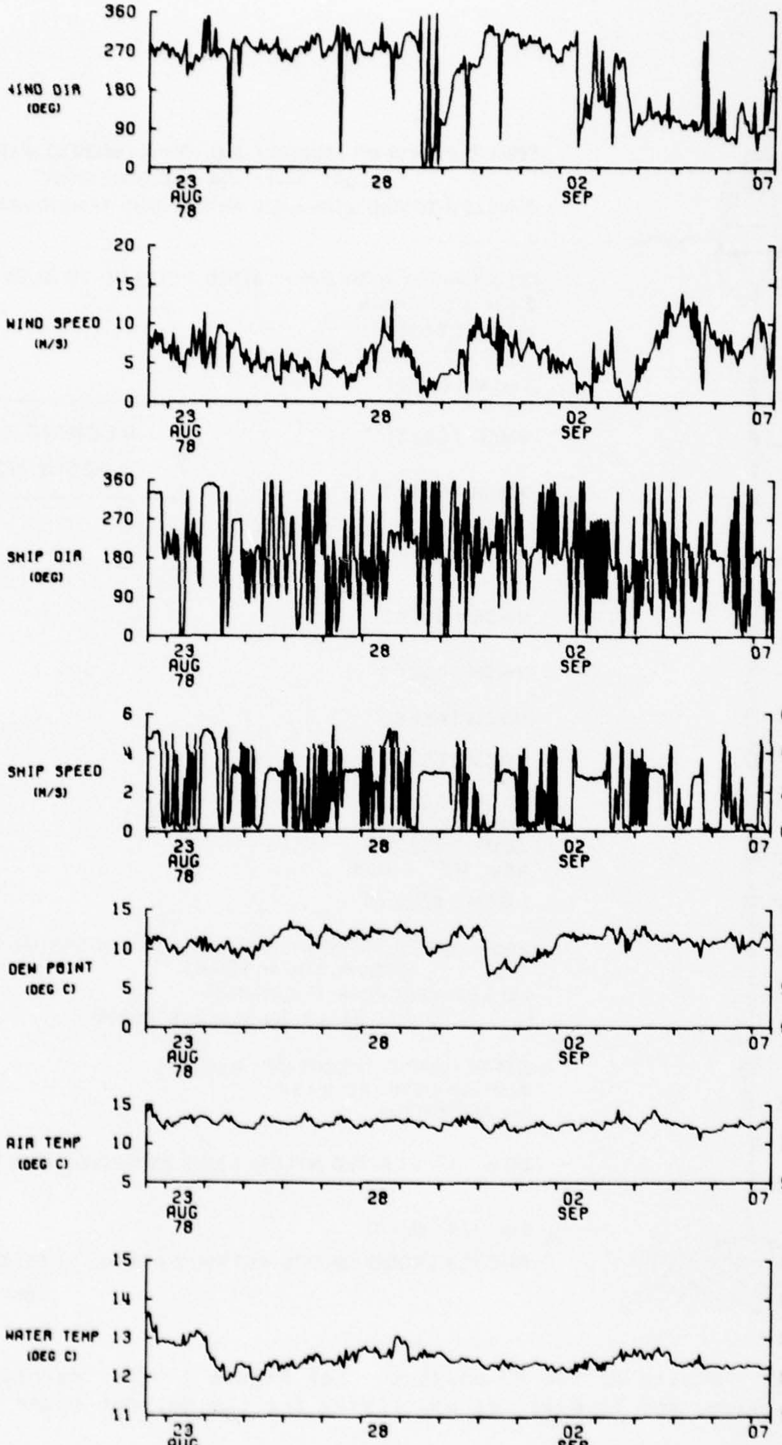


Figure III-4: Leg 2 PET observations

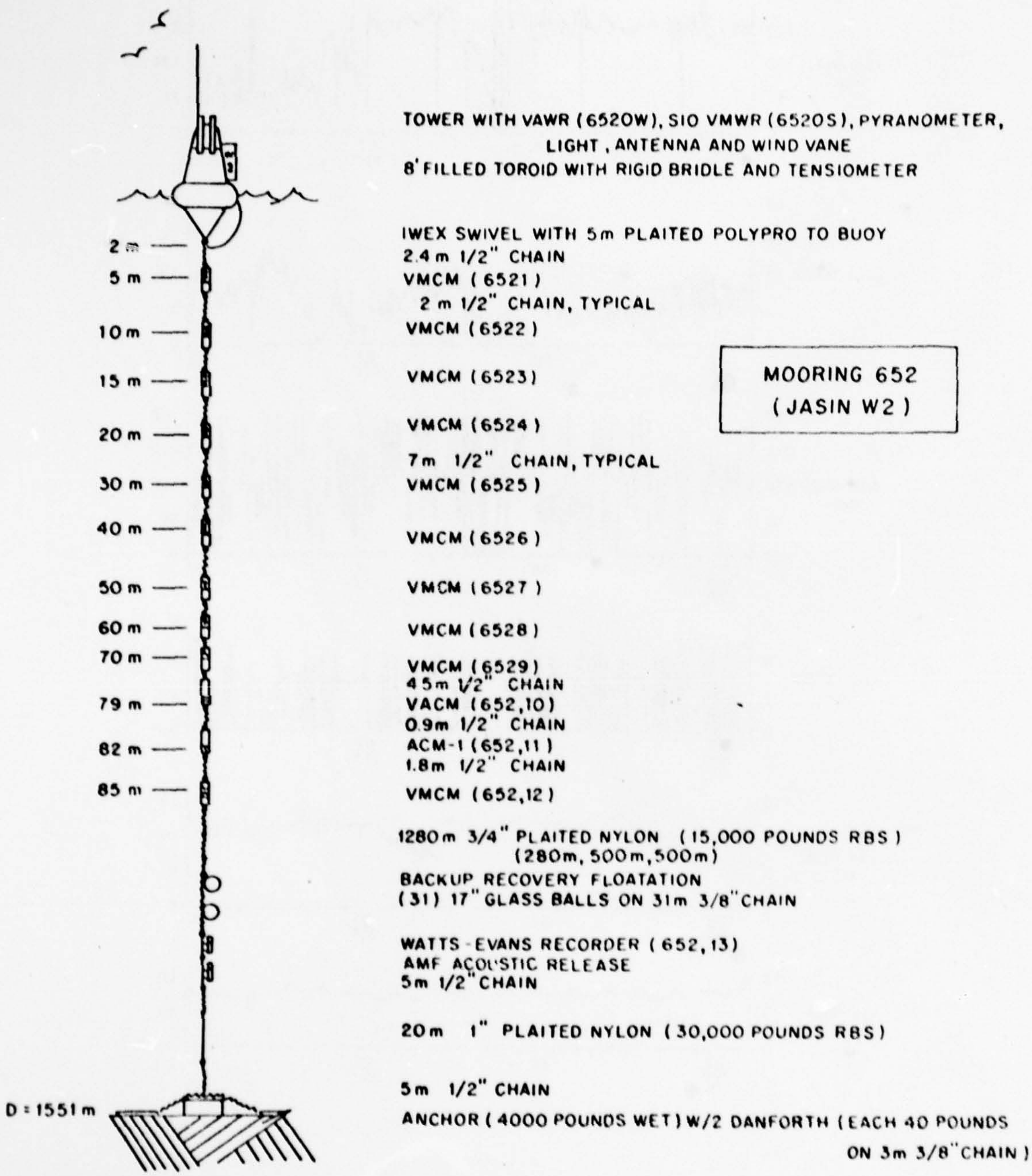


Figure III-5: Design of the W2 mooring. See Figure I-3 for details of the surface buoy, and Tarbell, et al. (1979) for the current meter data.

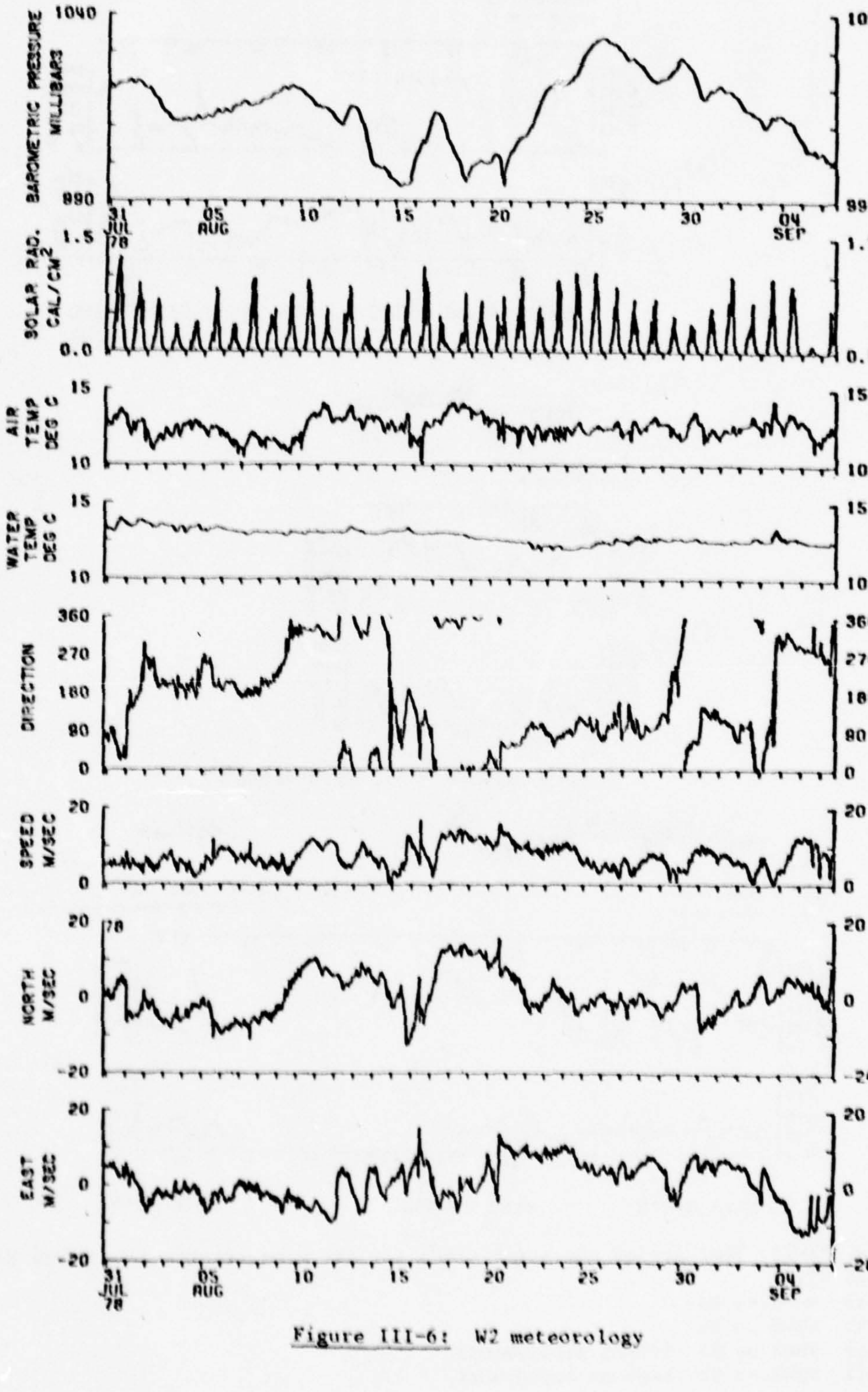


Figure III-6: W2 meteorology

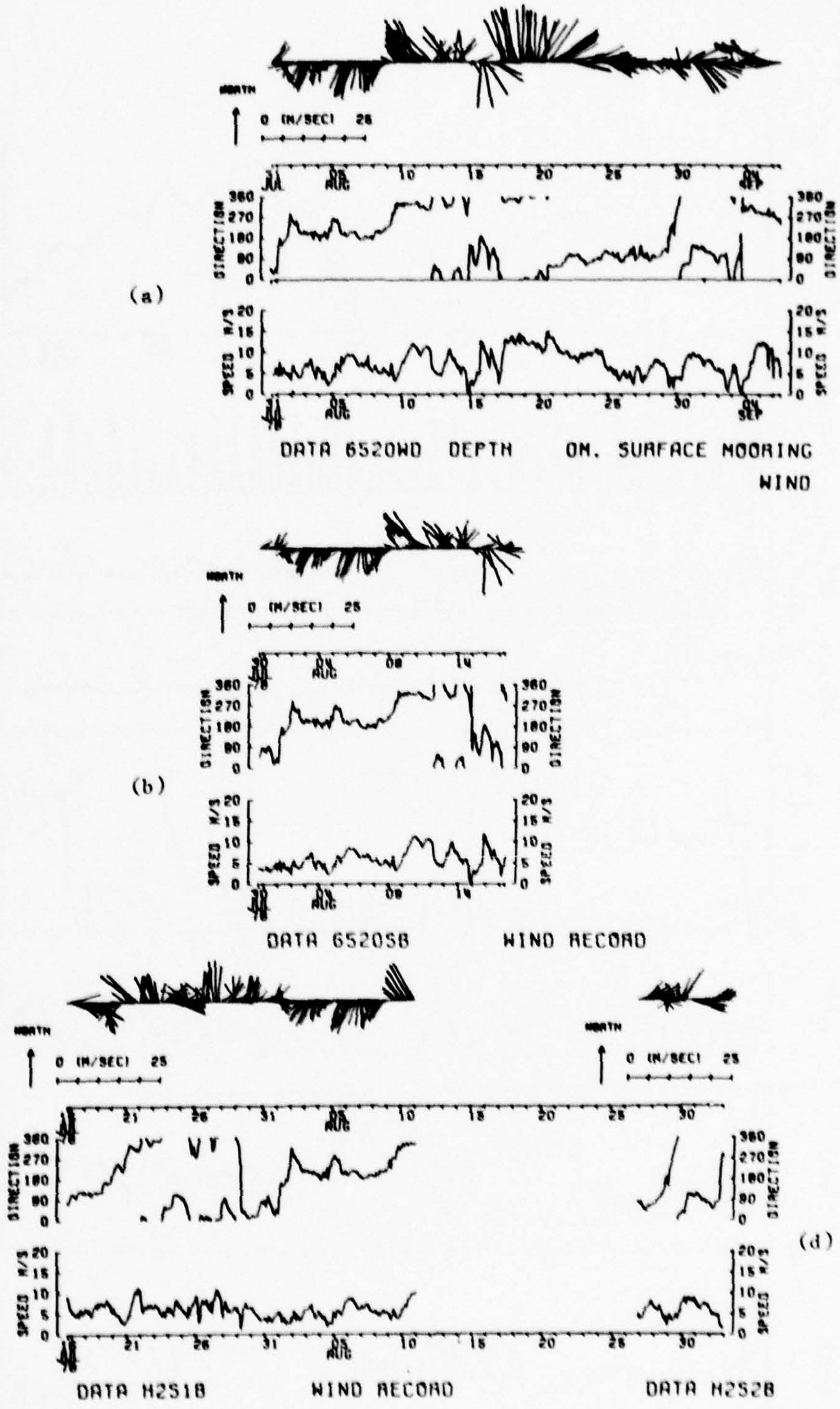


Figure III-7: Time series and stick plots for the wind records from buoys W2 and H2.
(a) VAWR on W2
(b) VMWR on W2
(c) VMWR on H2 (first deployment)
(d) VMWR on H2 (second deployment)

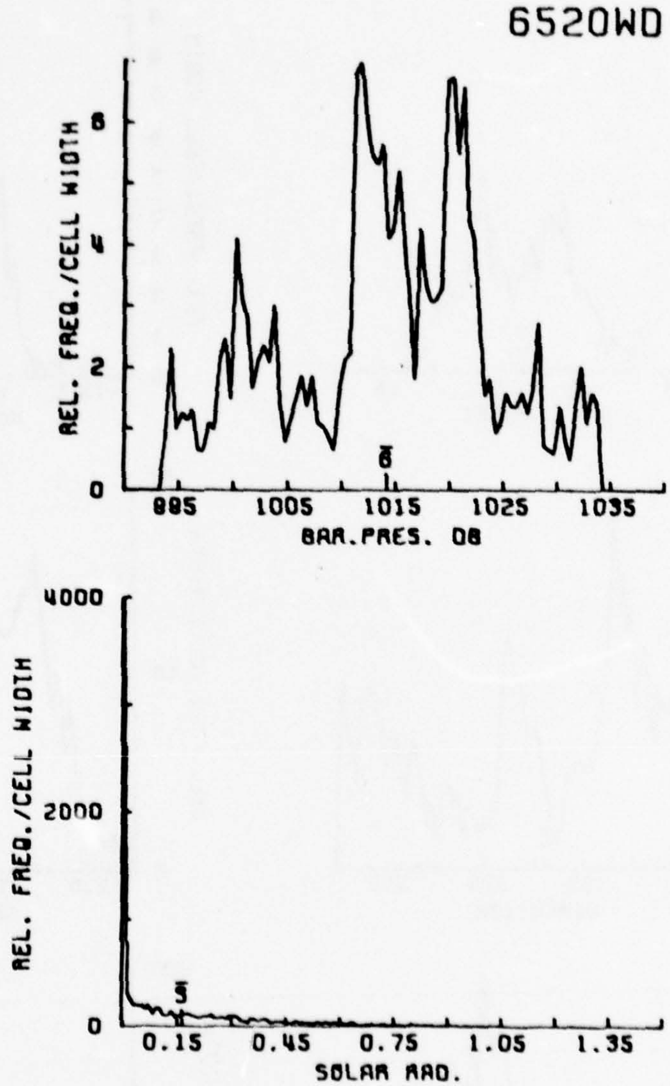


Figure III-8: Histograms of the buoy data from W2 and H2.
(a) VAWR on W2 (6520WD)
(b) VMWR on W2 (6520S)
(c) VMWRs on H2

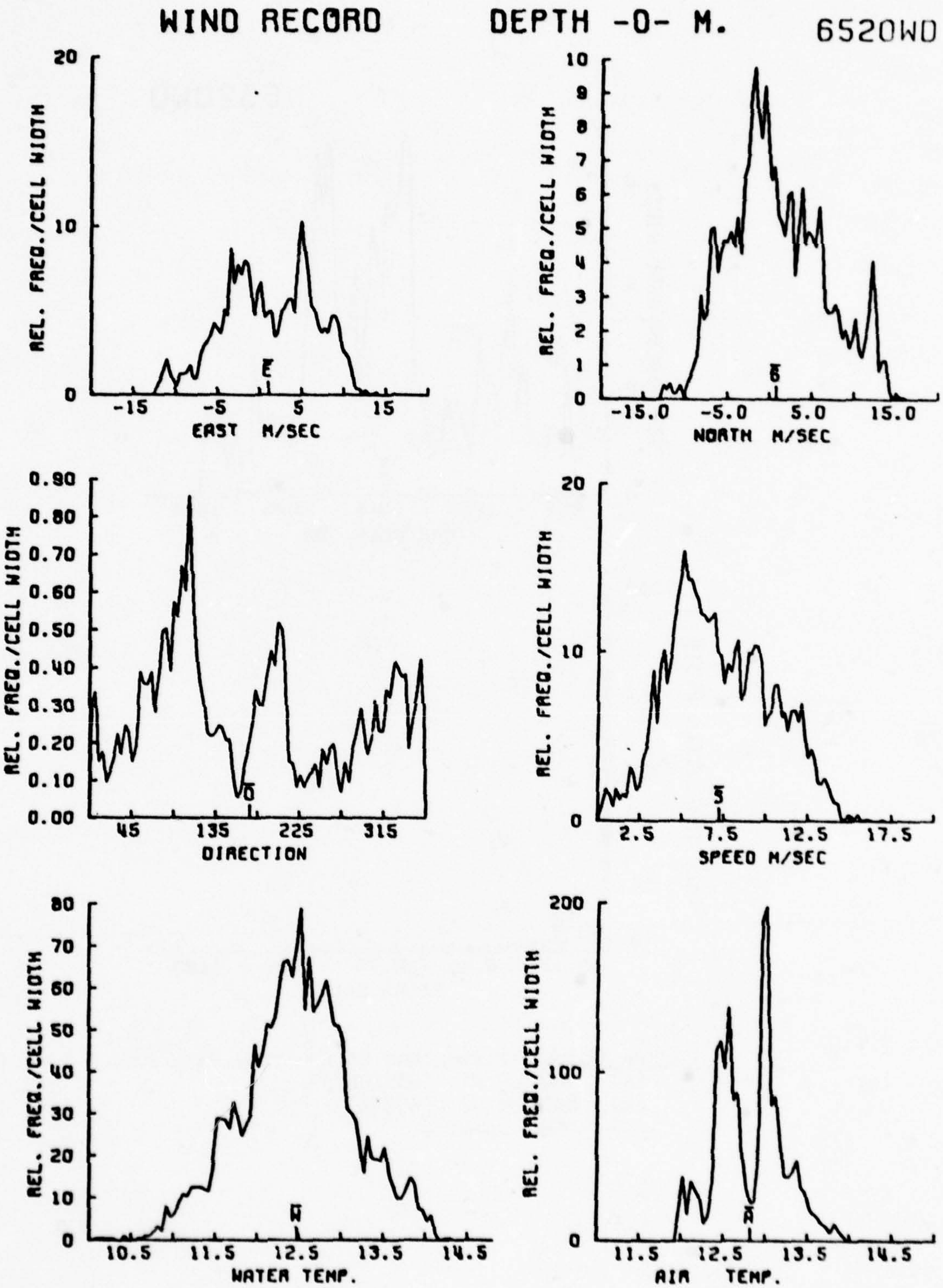


Figure III-8a (continued): VAWR on W2

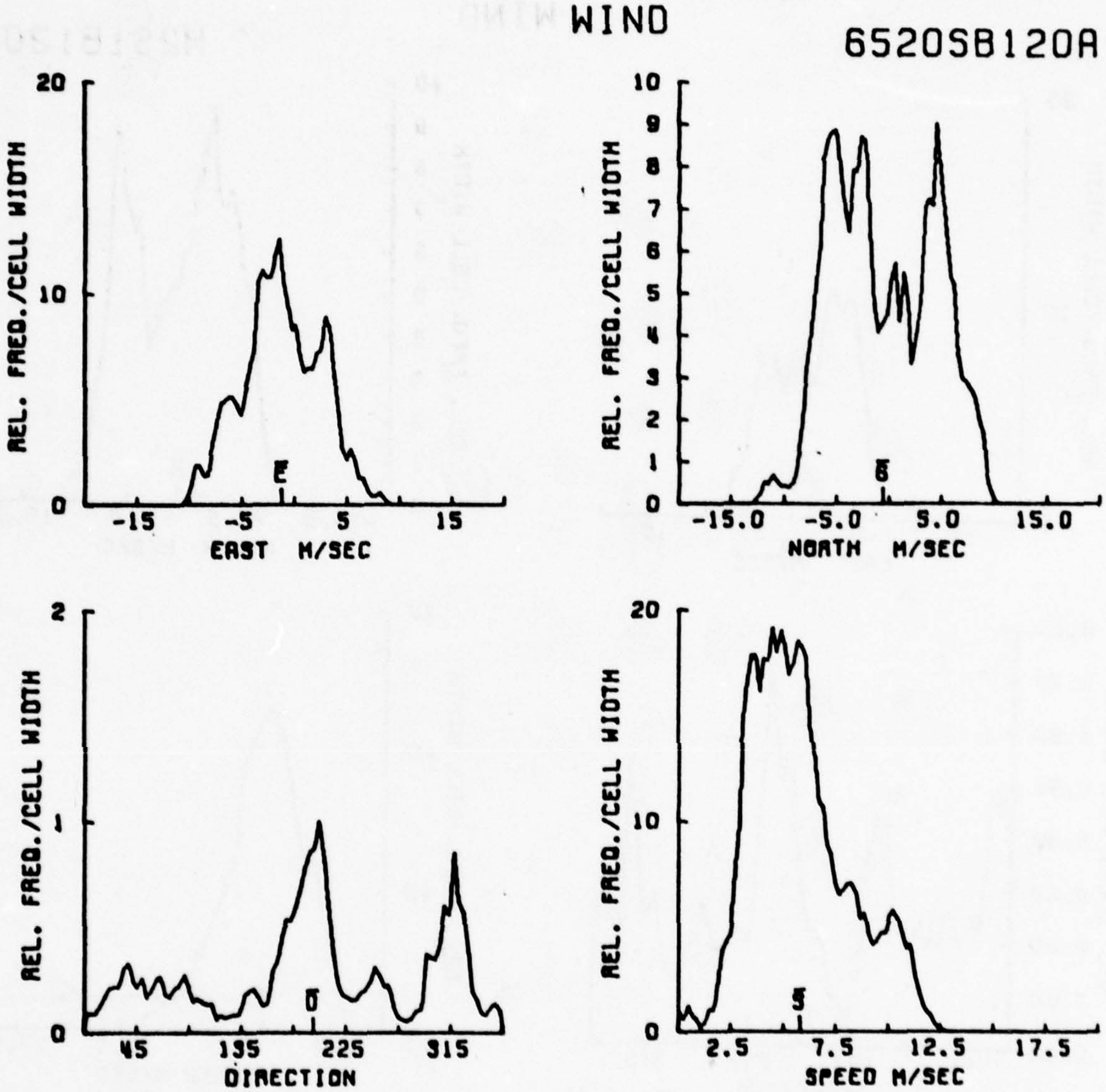


Figure III-8b: VMWR on W2

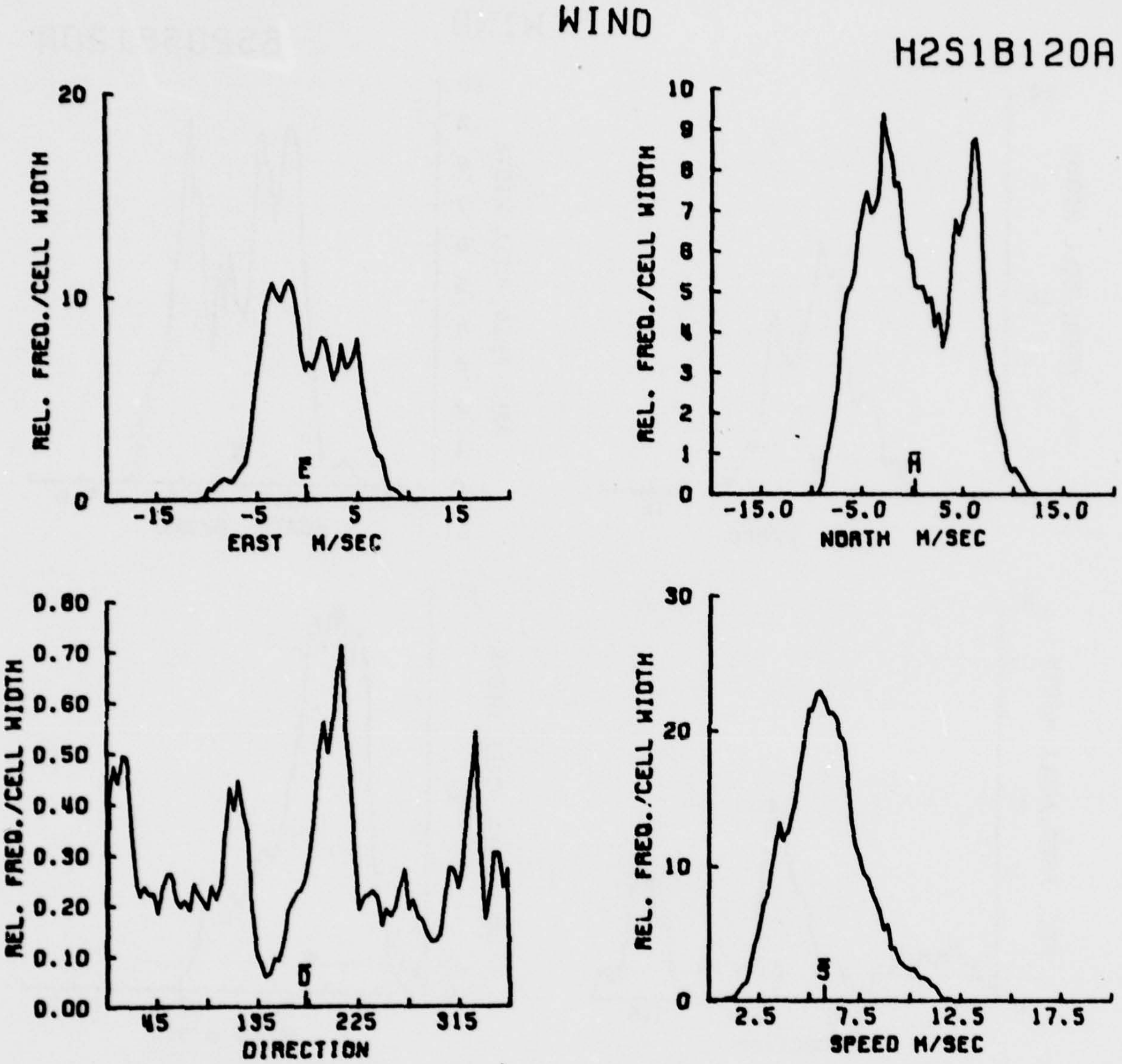


Figure III-8c: First deployment. VMWR on H2.

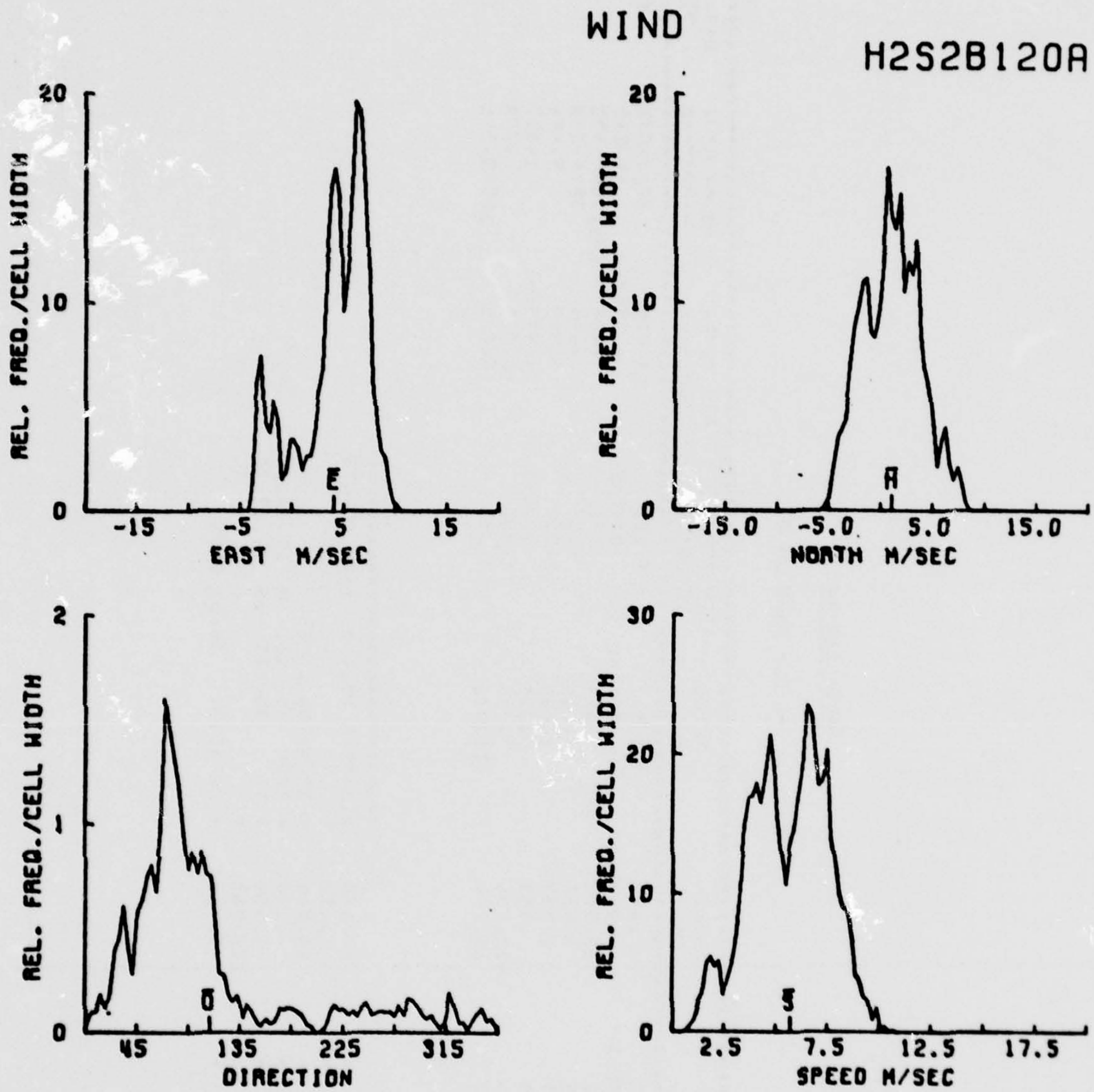


Figure III-8c (continued): Second deployment.

Table III-1a

Statistics for VAWR on W2.

VARIABLE	EAST	NORTH	SPEED	WATER TEMP.	AIR TEMP.	SOLAR RAD.	BAR. PRESS.
UNITS	M/SEC	M/SEC	M/SEC	CELSIUS	CELSIUS	W-HR/M**2	MILLIBARS
MEAN	1.057	.822	7.242	12.823	12.476	2783.098	1014.205
STD. ERR.	.893E-1	.919E-1	.504E-1	.664E-2	.109E-1	64.145	.156
VARIANCE	29.101	30.826	9.275	.161	.434	15010068.150	88.874
STD. DEV.	5.394	5.552	3.045	.401	.659	3874.283	9.427
KURTOSIS	2.317	2.557	2.403	2.558	2.989	5.484	2.464
SKEWNESS	-.165	.353	.235	.902E-1	-.979E-1	1.697	-.194
MINIMUM	-12.496	-12.734	.106	11.835	10.085	.773	993.787
MAXIMUM	15.648	15.774	16.972	13.957	14.295	20953.211	1033.838

EAST & NORTH

COVARIANCE	-4.678
STD. ERR. OF COVARIANCE	.412
STD. DEV. OF COVARIANCE	24.866
CORRELATION COEFFICIENT	-.156
VECTOR MEAN	1.339
VECTOR VARIANCE	29.963
VECTOR STD. DEV.	5.474

SAMPLE SIZE = 3648 POINTS

SPANNING RANGE
FROM 78- VII-30 17.07.30
TO 78- IX -06 17.52.30

DURATION 38.03 DAYS

DATA/ 6520S8120A Table III-1b: Statistics for VMWR on W2.

VARIABLE	EAST	NORTH	SPEED
UNITS	M/SEC	M/SEC	M/SEC
MEAN	-1.210	-.561	5.779
STD. ERR.	.328E-1	.427E-1	.208E-1
VARIANCE	13.796	23.349	5.527
STD. DEV.	3.714	4.832	2.351
KURTOSIS	2.496	1.952	2.813
SKEWNESS	-.116E-1	.112	.582
MINIMUM	-10.582	-12.550	.673E-1
MAXIMUM	9.218	10.287	12.609

EAST & NORTH

COVARIANCE	-4.789	SAMPLE SIZE = 12810 POINTS
STD. ERR. OF COVARIANCE	.173	
STD. DEV. OF COVARIANCE	19.604	SPANNING RANGE
CORRELATION COEFFICIENT	-.267	FROM 78. VII-30 14.30.00
VECTOR MEAN	1.333	TO 78-VIII-17 09.28.00
VECTOR VARIANCE	18.573	
VECTOR STD. DEV.	4.310	DURATION 17.79 DAYS

DATA/ H2S1B120A Table III-1c: Statistics for VMWR on H2 (first deployment).

VARIABLE	EAST	NORTH	SPEED
UNITS	M/SEC	M/SEC	M/SEC
MEAN	-.159	.289	5.767
STD. ERR.	.283E-1	.369E-1	.140E-1
VARIANCE	14.598	22.107	3.553
STD. DEV.	3.821	4.702	1.885
KURTOSIS	2.270	1.861	3.023
SKEWNESS	.976E-1	.129	.366
MINIMUM	-10.544	-10.276	.768E-1
MAXIMUM	10.091	12.250	12.403

EAST & NORTH

COVARIANCE	-1.003	SAMPLE SIZE = 18180 POINTS
STD. ERR. OF COVARIANCE	.116	
STD. DEV. OF COVARIANCE	15.635	SPANNING RANGE
CORRELATION COEFFICIENT	-.558E-1	FROM 78. VII-16 16.30.00
VECTOR MEAN	.330	TO 78-VIII-10 22.28.00
VECTOR VARIANCE	18.353	
VECTOR STD. DEV.	4.284	DURATION 25.25 DAYS

DATA/ H2S2B120A Table III-1d: Statistics for VMWR on H2 (second deployment).

VARIABLE	EAST	NORTH	SPEED
UNITS	M/SEC	M/SEC	M/SEC
MEAN	4.037	1.004	5.660
STD. ERR.	.488E-1	.411E-1	.280E-1
VARIANCE	10.657	7.574	3.509
STD. DEV.	3.264	2.752	1.873
KURTOSIS	2.870	2.486	2.385
SKEWNESS	-.884	.128	-.143
MINIMUM	-3.897	-5.474	.788
MAXIMUM	10.305	8.494	10.752

EAST & NORTH

COVARIANCE	-.168	SAMPLE SIZE = 4480 POINTS
STD. ERR. OF COVARIANCE	.195	
STD. DEV. OF COVARIANCE	13.056	SPANNING RANGE
CORRELATION COEFFICIENT	-.186E-1	FROM 78-VIII-26 15.09.00
VECTOR MEAN	4.160	TO 78- IX -01 23.27.00
VECTOR VARIANCE	9.115	
VECTOR STD. DEV.	3.019	DURATION 6.22 DAYS

Table III-2a: Five-day statistics for VAWR on W2. The five-day periods start at 0000Z/30 July 78; the final period is only 4 days and 7 hours long.

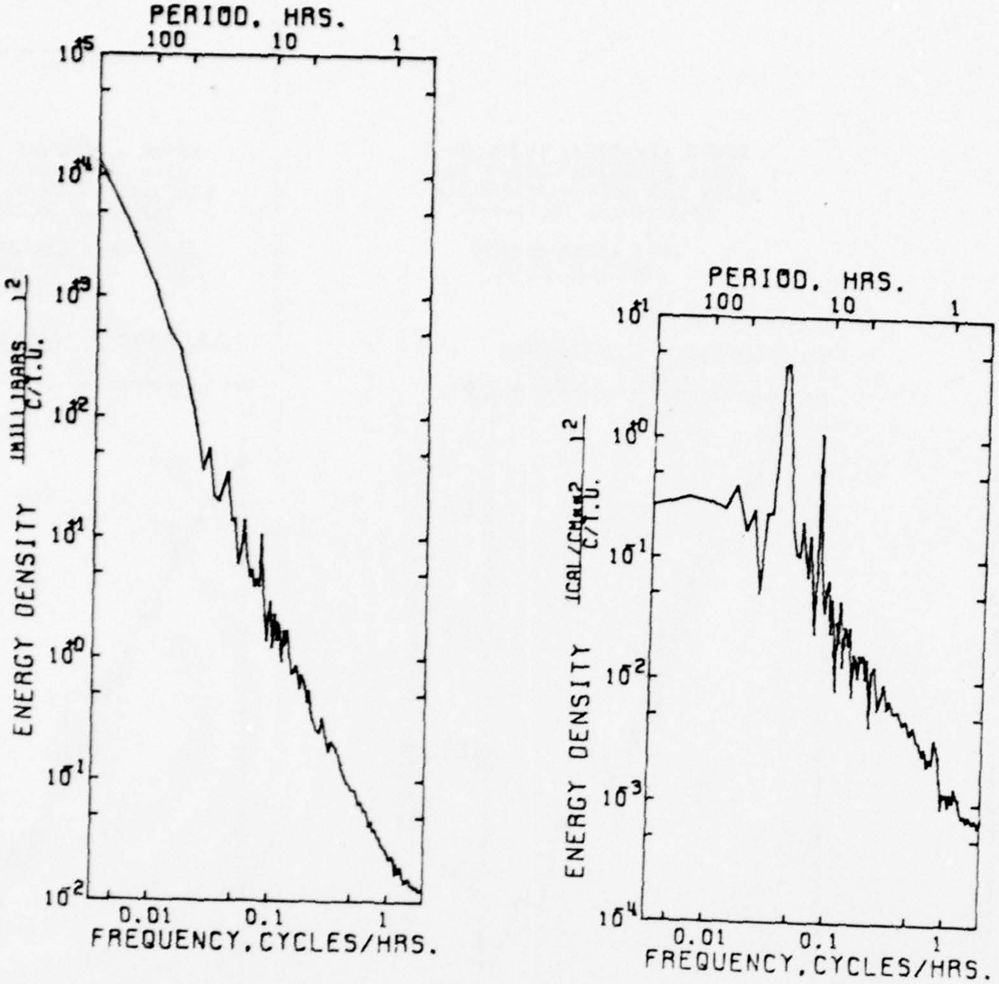
PERIOD			*** 6520W ***				
5 DAYS	EAST M/SEC	NORTH M/SEC	SPEED M/SEC	AIR TEMPERATURE CELSIUS	WATER TEMPERATURE CELSIUS	BARAMETRIC PRESSURE DECIBARS	STATISTIC
(1)	.162	-2.328	5.420	13.465	12.420	1017.744	
(2)	-1.967	-5.371	6.167	13.127	11.894	1014.925	
(3)	-3.489	5.703	7.954	13.040	12.689	1013.884	
(4)	1.122	3.575	8.278	13.021	12.817	1001.649	
(5)	6.784	5.003	10.542	12.385	12.495	1008.759	MEAN
(6)	5.643	-1.106	5.951	12.417	12.488	1027.988	
(7)	4.000	-1.427	5.956	12.575	12.448	1020.291	
(8)	-5.635	2.559	7.472	12.590	12.574	1007.128	
(1)	12.236	12.977	1.287	.043	.430	17.273	
(2)	3.598	5.492	3.777	.022	.286	5.464	
(3)	14.887	10.323	6.651	.011	.731	30.799	
(4)	14.691	56.229	16.432	.011	.614	38.435	
(5)	16.496	26.562	2.970	.049	.268	73.753	VARIANCE
(6)	4.976	1.955	4.576	.057	.084	15.737	
(7)	11.414	12.053	6.028	.009	.183	18.884	
(8)	24.424	5.336	12.227	.041	.343	19.385	
(1)	3.498	3.602	1.134	.209	.656	4.156	
(2)	1.897	2.343	1.944	.148	.535	2.338	
(3)	3.858	3.213	2.579	.107	.855	5.550	
(4)	3.833	7.499	4.054	.109	.785	6.200	STANDARD
(5)	4.062	5.154	1.723	.222	.517	8.588	DEVIATION
(6)	2.231	1.398	2.139	.240	.291	3.967	
(7)	3.379	3.472	2.455	.097	.428	4.346	
(8)	4.942	2.310	3.497	.204	.585	4.403	
(1)	.039	.460	.522	.101	-.058	-.537	
(2)	-.494	.230	-.0845	.656	.010	.257	
(3)	.767	-1.065	-.181	1.139	-.821	-1.089	
(4)	.262	-.283	-.143	.155	-.492	.547	
(5)	-.909	.017	.542	-.365	.351	.328	SKEWNESS
(6)	.476	-.403	.444	-.316	.085	-.137	
(7)	-.872	-.123	-.289	.411	.415	.0588	
(8)	.513	-.222	-.255	1.385	-.015	-.0318	
(1)	1.780	2.028	3.101	2.597	2.266	1.588	
(2)	2.825	2.204	2.651	2.518	2.114	2.033	
(3)	2.627	3.987	1.729	4.602	2.546	3.799	
(4)	2.642	2.088	1.779	4.088	3.285	2.031	
(5)	2.526	1.707	2.984	1.827	2.674	1.576	KURTOSIS
(6)	2.755	2.932	2.600	2.013	2.743	1.621	
(7)	2.692	2.058	2.153	2.575	2.775	2.144	
(8)	2.259	2.199	1.978	4.729	2.811	1.388	
(1)	-7.164	-8.223	2.558	13.046	10.869	1011.086	
(2)	-7.268	-11.074	1.601	12.880	10.441	1011.283	
(3)	-9.551	-4.201	2.400	12.840	10.618	999.080	
(4)	-6.989	-12.734	.106	12.717	10.085	993.787	
(5)	-4.268	-4.327	6.686	11.895	11.139	993.898	MINIMUM
(6)	.573	-5.488	1.543	11.982	11.606	1021.572	
(7)	-4.821	-9.179	.555	12.386	11.512	1011.985	
(8)	-12.496	-3.083	.316	12.381	10.915	1000.457	
(1)	6.262	5.796	8.815	13.957	13.883	1022.466	
(2)	1.611	.096	11.924	13.533	12.922	1020.130	
(3)	5.266	10.775	12.137	13.384	14.016	1020.829	
(4)	15.648	14.181	16.972	13.339	14.107	1013.659	
(5)	13.889	15.774	16.049	12.722	13.613	1021.859	MAXIMUM
(6)	11.191	1.713	11.197	12.871	13.286	1033.838	
(7)	9.152	4.894	10.687	12.835	13.564	1028.480	
(8)	5.877	8.255	12.766	13.379	14.295	1013.237	

Table III-2b: Five-day statistics for VMWR on W2. The five-day periods start at 0000Z/30 July 78; the final (fourth) period is only 3 days 9.5 hours long.

PERIOD 5 DAYS	EAST M/SEC	NORTH M/SEC	*** 6520S WIND *** SPEED M/SEC	STATISTIC
(1)	-.003	-1.885	4.356	
(2)	-1.668	-4.881	5.608	
(3)	-4.067	4.742	7.456	
(4)	2.111	-.292	5.403	
(5)				MEAN
(6)				
(7)				
(8)				
(1)	7.354	9.476	1.407	
(2)	3.405	4.147	2.698	
(3)	14.775	8.120	6.333	
(4)	10.752	20.792	6.898	
(5)				VARIANCE
(6)				
(7)				
(8)				
(1)	2.712	3.078	1.186	
(2)	1.845	2.036	1.643	
(3)	3.844	2.850	2.517	
(4)	3.279	4.560	2.626	STANDARD
(5)				DEVIATION
(6)				
(7)				
(8)				
(1)	-.130	.309	.715	
(2)	-.415	.311	-.111	
(3)	.743	-1.126	-.0857	
(4)	-.301	-.926	.461	
(5)				SKEWNESS
(6)				
(7)				
(8)				
(1)	1.520	1.955	2.767	
(2)	2.362	2.306	2.542	
(3)	2.561	4.378	1.715	
(4)	2.250	3.198	3.071	
(5)				KURTOSIS
(6)				
(7)				
(8)				
(1)	-6.462	-7.518	1.260	
(2)	-7.300	-9.442	1.475	
(3)	-10.582	-5.753	2.020	
(4)	-6.036	-12.550	.0673	
(5)				MINIMUM
(6)				
(7)				
(8)				
(1)	5.536	5.096	7.981	
(2)	2.733	.487	9.525	
(3)	5.240	10.287	12.180	
(4)	9.218	6.926	12.609	
(5)				MAXIMUM
(6)				
(7)				
(8)				

Table III-2c: Five-day statistics for VMWRs on H2. The five-day periods start at 0000Z/30 July 78. Periods 1-3 are the first deployment, 6-7 the second deployment. Period 3 is only 1 day 22.5 hours long. Period 6 starts late, is only 2 days 6 hours long. Period 7 is only 3 days, 23.5 hours long.

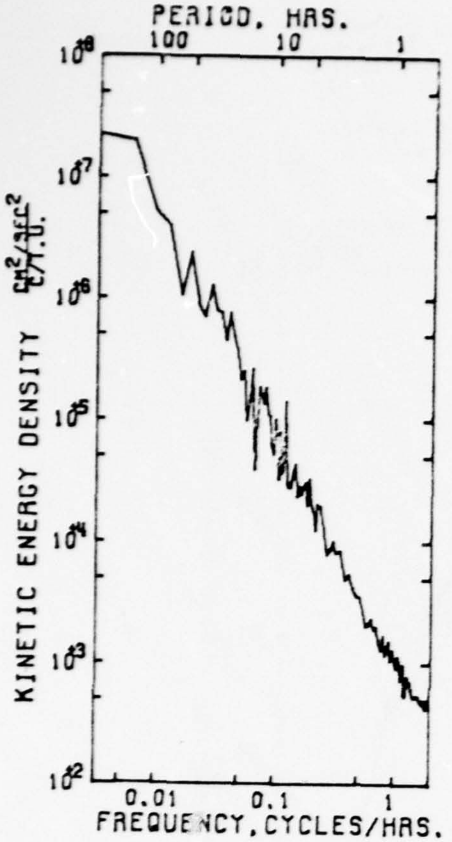
PERIOD 5 DAYS	H2 WIND: EAST M/SEC	H2 WIND: NORTH M/SEC	H2 WIND: SPEED M/SEC	STATISTIC
(1)	-.025	-.667	4.331	MEAN
(2)	-2.233	-4.544	5.538	
(3)	-4.113	3.945	6.423	
(4)				
(5)				
(6)	-.407	.980	5.243	
(7)	3.829	1.018	5.894	
(8)				
(1)	7.817	12.015	1.521	VARIANCE
(2)	2.884	4.985	2.835	
(3)	1.280	12.581	5.088	
(4)				
(5)				
(6)	3.778	5.768	2.437	
(7)	14.417	8.592	3.960	
(8)				
(1)	2.796	3.466	1.233	STANDARD DEVIATION
(2)	1.698	2.233	1.684	
(3)	1.131	3.547	2.256	
(4)				
(5)				
(6)	1.944	2.402	1.561	
(7)	3.797	2.931	1.990	
(8)				
(1)	-.194	.190	.319	SKEWNESS
(2)	-.278	.495	-.0666	
(3)	.414	-.255	.242	
(4)				
(5)				
(6)	-.783	-.395	-.321	
(7)	-.698	.284	-.232	
(8)				
(1)	1.679	1.895	2.469	KURTOSIS
(2)	2.252	2.471	2.692	
(3)	2.984	1.759	1.734	
(4)				
(5)				
(6)	2.974	2.180	2.325	
(7)	2.180	2.457	2.291	
(8)				
(1)	-6.409	-7.247	1.567	MINIMUM
(2)	-6.719	-9.333	.937	
(3)	-7.009	-4.006	2.200	
(4)				
(5)				
(6)	-.791	-4.912	.982	
(7)	-3.897	-5.474	.788	
(8)				
(1)	5.296	8.062	8.886	MAXIMUM
(2)	2.137	1.396	9.577	
(3)	-.353	10.039	11.246	
(4)				
(5)				
(6)	7.723	5.596	8.626	
(7)	10.305	8.494	10.752	
(8)				



AUTO SPECTRUM
652DWD BAR. PRESS.
WIND
78-VII-30 TO 78-IX-06
1 PIECES WITH 1800 ESTIMATES
PER PIECE. AVERAGED OVER
3 ADJACENT FREQUENCY BANDS

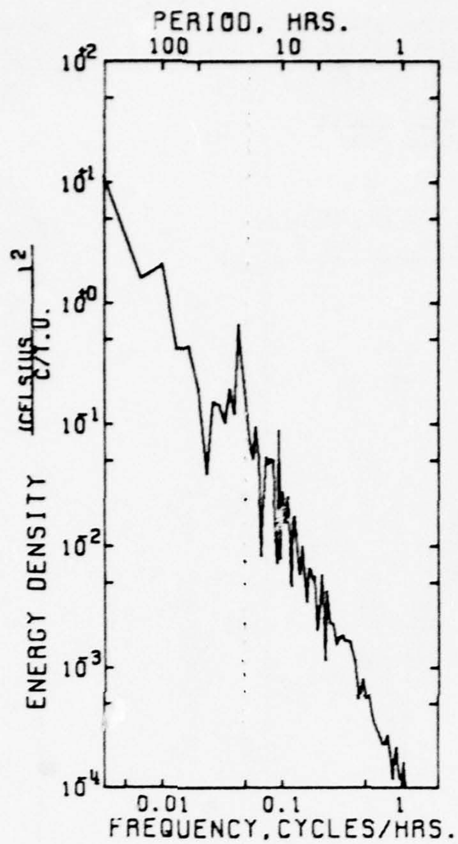
AUTO SPECTRUM
652DWD SOLAR RAD.
WIND
78-VII-30 TO 78-IX-06
1 PIECES WITH 1800 ESTIMATES
PER PIECE. AVERAGED OVER
3 ADJACENT FREQUENCY BANDS

Figure III-9: Spectra from VAWR on W2.



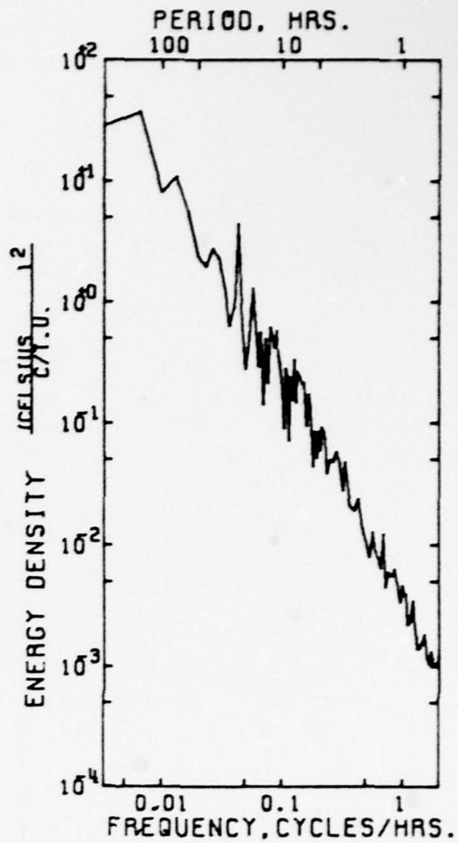
AUTO SPECTRUM
6520WD EAST (W)
6520WD NORTH (W)

78-VII-29 TO 78-IX-06
1 PIECES WITH 1875 ESTIMATES
PER PIECE. AVERAGED OVER
3 ADJACENT FREQUENCY BANDS



AUTO SPECTRUM
6520WD WATER TEMP.

78-VII-30 TO 78-IX-06
1 PIECES WITH 1800 ESTIMATES
PER PIECE. AVERAGED OVER
3 ADJACENT FREQUENCY BANDS



AUTO SPECTRUM
6520WD AIR TEMP.

78-VII-30 TO 78-IX-06
1 PIECES WITH 1800 ESTIMATES
PER PIECE. AVERAGED OVER
3 ADJACENT FREQUENCY BANDS

Figure III-2 (continued)

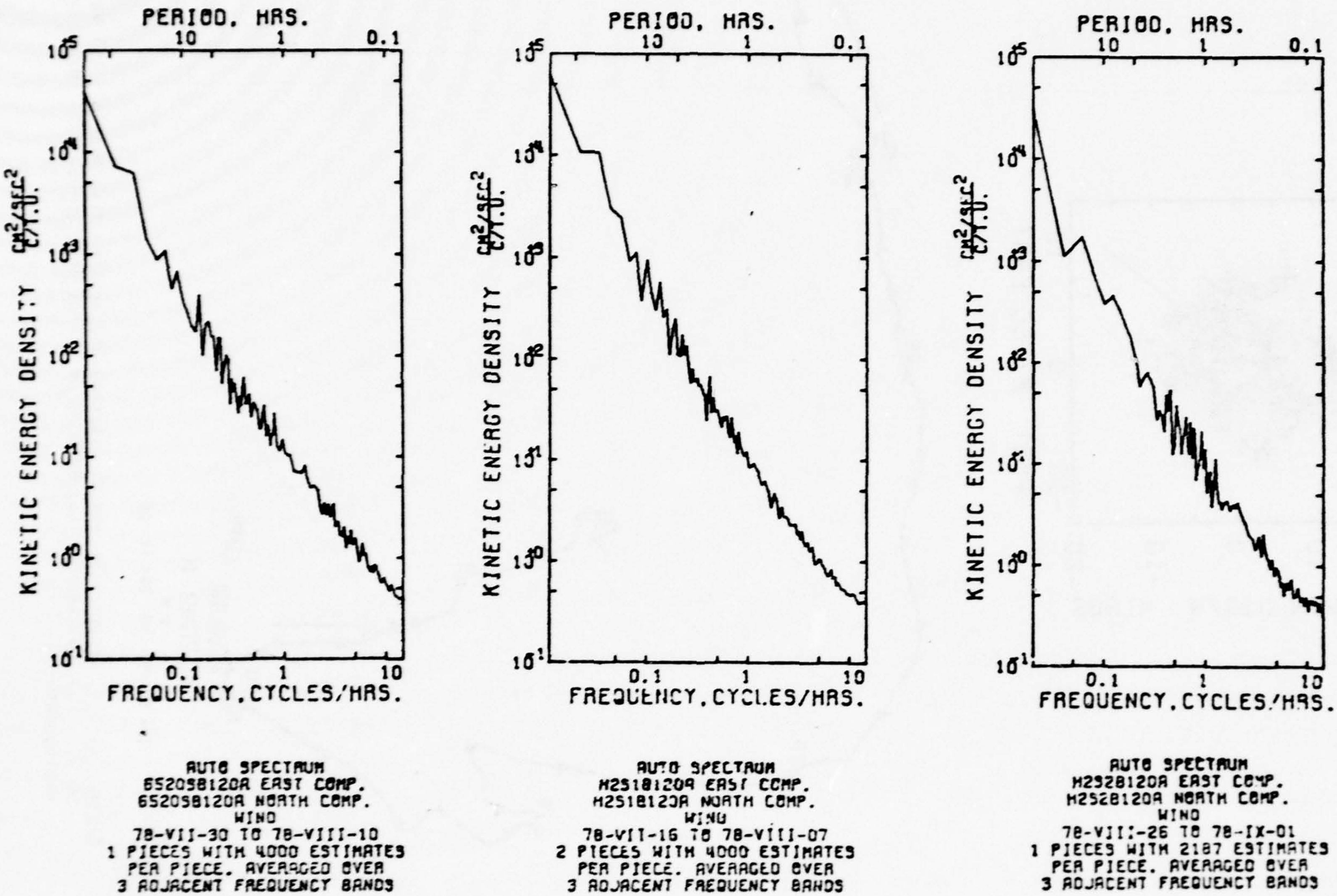
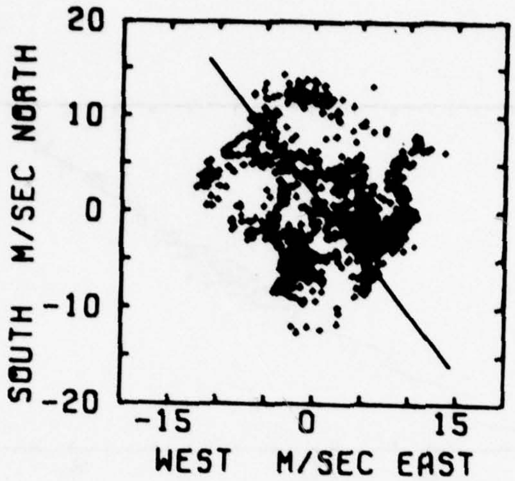


Figure III-10: Spectra from VMCMs on W2 and M2.



(a)

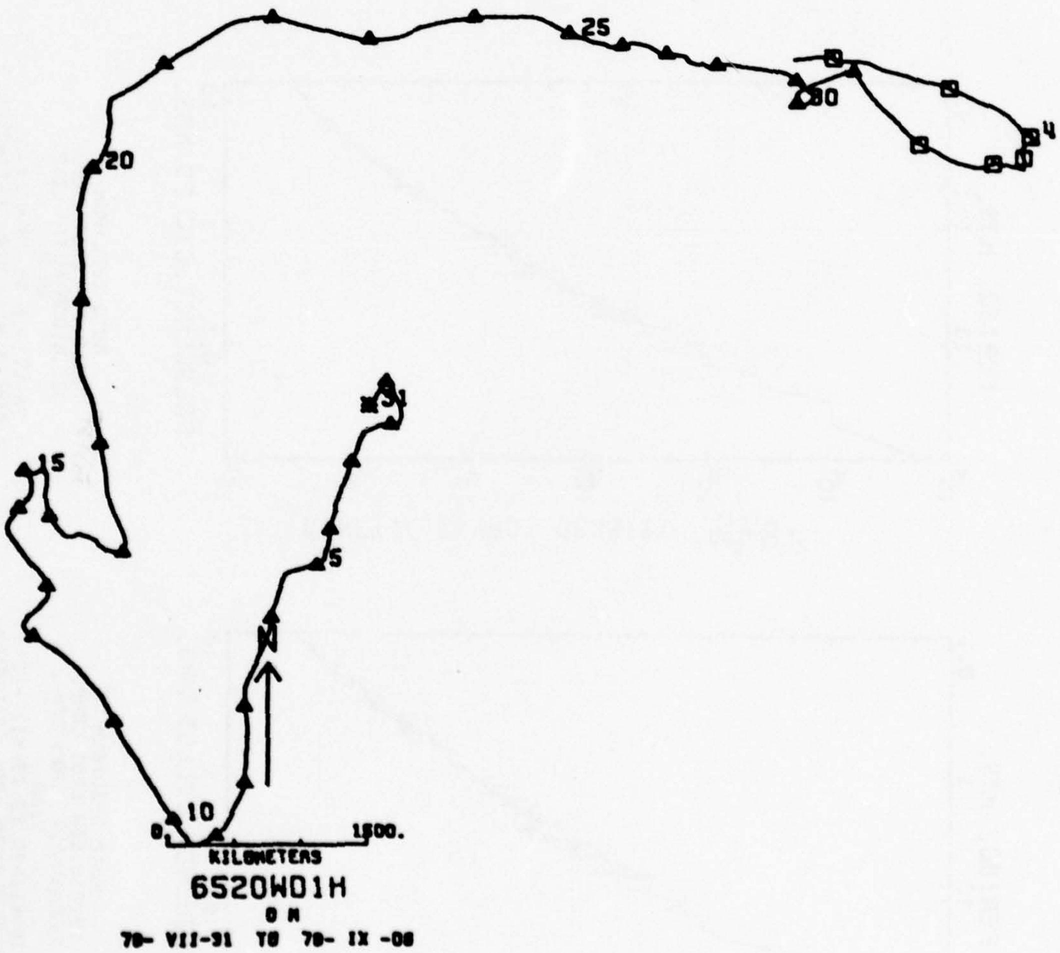


Figure III-11: Progressive vector diagrams and scatter diagrams for (a) VAWR on W2, (b) VMWR on W2, (c) VMWR on H2, first deployment, and (d) second deployment.

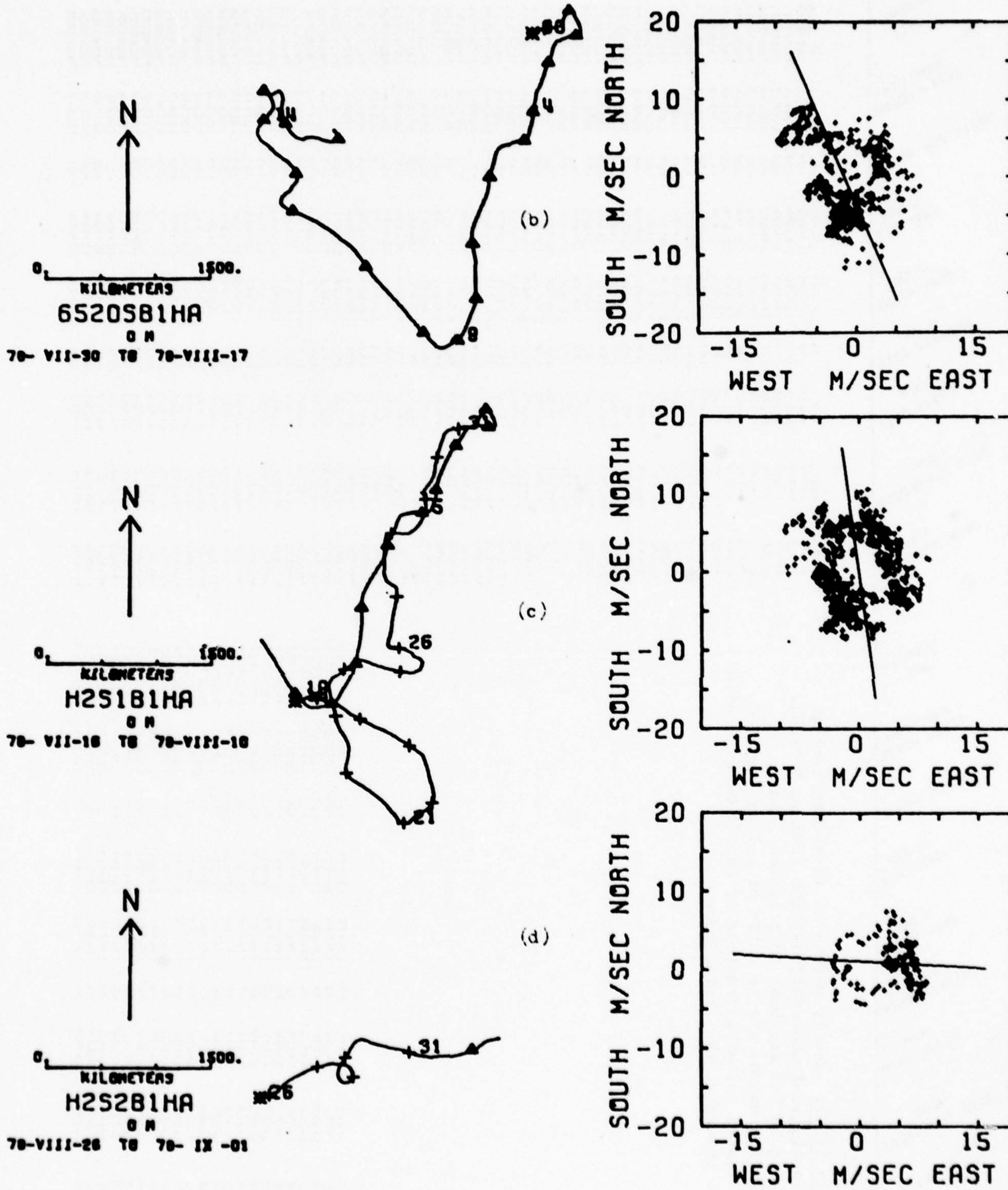

(b)
N
0 1500.
KILOMETERS
6520SB1HA
0 M
78- VII-30 TO 78-VIII-17
20
10
0
-10
-20
-15
0
15
SOUTH M/SEC NORTH
WEST M/SEC EAST
(c)
N
0 1500.
KILOMETERS
H2S1B1HA
0 M
78- VII-18 TO 78-VIII-10
26
21
(d)
N
0 1500.
KILOMETERS
H2S2B1HA
0 M
78-VIII-26 TO 78- IX -01
31

Table III-3: Hourly values of 15 minute average meteorological observations from VAWR on buoy W2. See Figure I-3 for buoy description. Solar radiation values are in units of cal cm^{-2} min^{-1}. The listed values correspond to the 15 minute period that starts at the listed hour.

EASTWARD WIND (M/S)	NORTHWARD WIND (M/S)	WIND SPEED (M/S)	WIND HEADING (DEG T)	WATER TEMP (DEG C)	AIR TEMP (DEG C)	SOLAR RADIATION	BAROM PRESS (MILLIBARS)	TIME (YYMMDDHH)
4.853	.201	4.857	87	13.476	13.428	.07	1020.7	78073020
5.020	.598	5.055	83	13.344	12.901	.00	1021.0	78073021
4.585	1.199	4.739	75	13.286	12.802	.00	1021.0	78073022
4.802	1.004	4.906	78	13.285	12.746	.00	1021.1	78073023
5.046	.568	5.078	83	13.249	12.773	.00	1021.0	78073100
5.256	.287	5.264	86	13.164	12.747	.00	1020.8	78073101
4.453	1.831	4.842	67	13.193	12.669	.00	1020.5	78073102
4.652	2.073	5.093	66	13.182	12.775	.00	1020.2	78073103
5.348	.216	5.352	87	13.194	12.611	.00	1020.5	78073104
5.807	-.485	5.827	94	13.163	12.605	.05	1020.8	78073105
5.263	-.528	5.289	95	13.101	13.114	.24	1020.9	78073106
4.239	.664	4.291	81	13.064	13.155	.40	1021.1	78073107
4.551	1.155	4.695	75	13.069	13.092	.56	1021.4	78073108
5.325	-.920	5.404	99	13.209	12.966	.50	1021.4	78073109
6.178	1.108	6.276	79	13.314	12.913	.98	1021.3	78073110
4.664	2.205	5.177	64	13.421	13.032	1.10	1021.6	78073111
3.744	2.441	4.524	56	13.570	13.342	1.20	1021.6	78073112
3.719	2.421	4.437	56	13.672	13.462	1.00	1021.4	78073113
3.738	3.222	4.935	49	13.715	13.299	.47	1021.5	78073114
2.291	4.680	5.210	26	13.831	13.605	.95	1021.5	78073115
2.553	3.837	4.659	33	13.892	13.673	.81	1021.4	78073116
1.855	4.378	4.758	23	13.930	13.445	.31	1021.4	78073117
2.716	4.170	4.976	33	13.838	13.420	.21	1021.6	78073118
3.039	4.796	5.678	32	13.744	13.249	.09	1022.0	78073119
2.972	5.332	6.104	29	13.720	13.319	.03	1022.1	78073120
4.994	3.665	6.195	53	13.603	13.182	.00	1022.3	78073121
3.266	3.828	5.032	40	13.653	13.090	.00	1022.5	78073122
2.707	3.435	4.373	38	13.554	13.241	.00	1022.3	78073123
2.530	4.140	4.851	31	13.642	12.468	.00	1022.4	78080100
2.563	4.312	5.016	30	13.417	12.625	.00	1022.0	78080101
4.650	-6.802	8.240	145	13.500	12.409	.00	1021.5	78080102
3.569	-5.638	6.672	147	13.469	12.326	.00	1021.3	78080103
3.435	-3.723	5.068	137	13.445	12.214	.00	1021.3	78080104
-.522	-4.381	4.412	186	13.438	12.054	.01	1021.3	78080105
-.186	-3.686	3.691	182	13.379	12.337	.09	1021.7	78080106
1.776	-4.321	4.671	157	13.507	12.807	.20	1022.2	78080107
3.643	-4.668	5.917	142	13.505	12.553	.24	1022.0	78080108
3.014	-5.618	6.377	151	13.514	12.310	.47	1021.9	78080109
2.137	-5.179	5.602	157	13.530	12.230	.56	1021.9	78080110
2.024	-5.313	5.685	159	13.566	12.526	.55	1021.7	78080111
1.116	-5.009	5.132	167	13.652	12.801	.72	1021.6	78080112
.833	-4.667	4.741	169	13.794	12.858	.61	1021.4	78080113
1.442	-4.735	4.950	163	13.831	12.834	.73	1021.1	78080114
.533	-4.394	4.426	173	13.808	12.798	.56	1020.7	78080115
.038	-4.782	4.782	179	13.801	12.767	.37	1020.4	78080116
-.197	-5.480	5.484	182	13.860	12.836	.38	1020.5	78080117
-.358	-4.538	4.553	184	13.859	12.961	.47	1020.3	78080118
-.112	-4.202	4.203	181	13.771	12.922	.21	1020.1	78080119
-2.707	-2.982	4.028	222	13.737	12.909	.07	1020.0	78080120
-5.076	-1.506	5.295	253	13.666	12.638	.00	1020.0	78080121
-3.461	-3.554	4.961	224	13.664	11.597	.00	1020.3	78080122
-4.445	.960	4.548	282	13.626	11.611	.00	1020.2	78080123
-4.460	1.458	4.692	288	13.601	12.145	.00	1019.9	78080200
-5.905	-.449	5.922	265	13.642	12.262	.00	1019.6	78080201
-6.665	-.461	6.681	266	13.602	12.140	.00	1019.0	78080202
-6.717	-1.703	6.929	255	13.586	11.838	.00	1018.7	78080203
-5.457	-.625	5.493	263	13.566	11.550	.00	1018.4	78080204
-5.330	-1.989	5.689	249	13.557	11.277	.02	1017.9	78080205
-3.214	-2.596	4.131	231	13.534	11.172	.06	1017.7	78080206
-4.932	-.949	5.023	259	13.446	11.046	.08	1017.5	78080207
-4.521	-2.610	5.220	240	13.328	11.212	.17	1017.4	78080208
-3.277	-1.945	3.811	239	13.322	11.023	.17	1017.4	78080209
-3.956	-1.174	4.127	253	13.374	11.263	.33	1017.1	78080210
-4.216	-1.935	4.639	245	13.355	11.479	.35	1016.8	78080211
-2.595	-1.798	3.158	235	13.312	11.404	.49	1016.4	78080212
-1.885	-2.305	2.977	219	13.351	11.588	.61	1015.8	78080213
-2.407	-3.170	3.980	217	13.421	11.714	.46	1015.1	78080214
-1.582	-3.795	4.111	202	13.387	11.844	.60	1014.8	78080215
-2.188	-4.022	4.579	208	13.496	11.774	.33	1014.5	78080216
-1.674	-4.248	4.566	201	13.544	11.894	.17	1014.1	78080217
-1.671	-4.200	4.520	201	13.580	11.980	.07	1013.8	78080218
-1.650	-5.599	5.837	196	13.562	11.701	.03	1013.5	78080219
-1.286	-5.919	6.057	192	13.521	11.482	.01	1013.6	78080220
-1.626	-6.023	6.239	195	13.514	11.651	.00	1013.7	78080221
-3.414	-5.996	6.900	209	13.474	11.757	.00	1013.3	78080222
-2.761	-6.262	6.844	203	13.478	11.922	.00	1013.2	78080223
-2.390	-6.603	7.022	199	13.466	12.392	.00	1012.7	78080300
-1.851	-7.111	7.348	194	13.456	12.350	.00	1012.2	78080301
-3.503	-6.238	7.154	209	13.434	12.249	.00	1012.0	78080302
-2.862	-5.857	6.519	206	13.406	11.966	.00	1011.7	78080303
-1.398	-6.126	6.283	192	13.429	11.996	.00	1011.3	78080304
-1.875	-6.498	6.763	196	13.438	12.006	.01	1011.3	78080305

EASTWARD WIND (M/S)	NORTHWARD WIND (M/S)	WIND SPEED (M/S)	WIND HEADING (DEG T)	WATER TEMP (DEG C)	AIR TEMP (DEG C)	SOLAR RADIATION	BAROM PRESS (MILLIBARS)	TIME (YYMMDDHH)
-2.728	-6.640	7.215	202	13.436	11.927	.02	1011.5	78080306
-2.898	-7.031	7.605	202	13.429	11.765	.05	1011.5	78080307
-2.626	-7.550	7.994	199	13.406	11.823	.12	1011.2	78080308
-2.799	-7.699	8.192	199	13.402	11.972	.09	1011.2	78080309
-3.030	-7.610	8.377	201	13.362	12.081	.14	1011.4	78080310
-2.608	-7.012	7.481	200	13.268	12.365	.27	1011.4	78080311
-3.244	-5.695	6.554	209	13.116	12.567	.33	1011.3	78080312
-2.505	-5.265	5.831	205	13.066	12.590	.32	1011.3	78080313
-1.305	-4.543	4.727	196	13.047	12.549	.20	1011.2	78080314
.401	-4.942	4.958	175	13.058	12.538	.14	1011.1	78080315
1.449	-5.725	5.906	165	13.104	11.985	.10	1011.1	78080316
-1.295	-3.181	3.434	202	13.230	11.960	.05	1011.7	78080317
-1.867	-3.095	3.615	211	13.351	11.868	.05	1011.6	78080318
-1.645	-4.240	4.548	201	13.384	11.992	.03	1011.5	78080319
-1.121	-6.617	6.711	189	13.397	12.321	.02	1011.3	78080320
-1.517	-6.072	6.258	194	13.390	12.556	.00	1011.7	78080321
-1.740	-6.080	6.324	195	13.371	12.621	.00	1011.8	78080322
-1.276	-5.794	5.933	192	13.290	12.635	.00	1011.9	78080323
-.926	-5.431	5.509	189	13.140	12.449	.00	1011.9	78080400
-1.014	-5.426	5.520	190	12.971	12.681	.00	1011.8	78080401
-.205	-5.482	5.486	182	13.009	12.700	.00	1011.7	78080402
1.313	-5.246	5.408	165	13.099	12.564	.00	1011.4	78080403
-.296	-4.769	4.778	183	13.141	12.705	.00	1011.3	78080404
-.614	-3.125	3.185	191	13.215	12.814	.01	1011.5	78080405
-1.121	-3.311	3.496	198	13.276	12.825	.05	1011.6	78080406
-.643	-5.335	5.374	186	13.345	12.559	.08	1011.5	78080407
-1.055	-5.030	5.146	192	13.345	12.211	.08	1011.4	78080408
-1.071	-4.424	4.551	193	13.327	12.460	.19	1011.9	78080409
-1.568	-3.542	3.874	203	13.336	12.531	.13	1012.2	78080410
-1.875	-3.273	3.773	209	13.361	12.691	.25	1012.6	78080411
-1.542	-3.717	4.024	202	13.391	12.816	.26	1012.6	78080412
-.257	-1.857	1.875	187	13.379	12.922	.35	1012.2	78080413
-.126	-1.938	1.943	183	13.403	12.838	.37	1012.2	78080414
.104	-2.022	2.025	177	13.454	12.766	.33	1012.2	78080415
.240	-2.078	2.091	173	13.464	12.604	.17	1011.8	78080416
.140	-2.127	2.132	176	13.476	12.581	.15	1011.8	78080417
-1.242	-2.650	2.926	205	13.506	12.816	.07	1011.9	78080418
-1.937	-1.814	2.654	226	13.434	12.545	.04	1011.9	78080419
-1.704	-2.167	2.772	217	13.280	12.363	.02	1012.2	78080420
-.456	-2.631	2.670	189	13.163	12.479	.00	1012.1	78080421
-1.844	-2.385	3.014	217	13.165	12.510	.00	1012.3	78080422
-3.035	-2.333	3.828	232	13.142	12.557	.00	1012.5	78080423
-4.325	-.674	4.377	261	13.115	12.301	.00	1012.7	78080500
-4.520	-.536	4.552	263	13.114	12.265	.00	1012.5	78080501
-4.695	-.626	4.737	262	13.231	12.242	.00	1012.5	78080502
-3.900	.097	3.901	271	13.124	12.035	.00	1012.3	78080503
-4.086	-.784	4.161	259	13.084	12.125	.00	1012.3	78080504
-5.432	-2.470	5.967	245	13.152	12.114	.01	1012.4	78080505
-7.268	-1.913	7.516	255	13.145	11.971	.03	1012.1	78080506
-6.592	-2.143	6.932	251	13.180	12.256	.06	1012.3	78080507
-6.299	-2.166	6.661	251	13.253	12.341	.11	1012.6	78080508
-6.629	-1.232	6.743	259	13.255	12.517	.23	1013.0	78080509
-5.942	-1.640	6.165	254	13.244	12.458	.20	1013.2	78080510
-5.140	-2.272	5.641	246	13.254	12.273	.12	1013.5	78080511
-4.691	-2.420	5.279	242	13.269	12.317	.37	1013.7	78080512
-3.489	-3.531	4.964	224	13.288	12.410	.46	1014.1	78080513
-3.246	-5.331	6.241	211	13.312	12.469	.62	1014.2	78080514
-2.678	-8.319	8.740	197	13.361	12.474	.82	1013.5	78080515
-1.889	-6.784	7.042	195	13.363	12.370	.54	1013.4	78080516
-1.646	-7.070	7.259	193	13.356	12.333	.36	1013.2	78080517

EASTWARD WIND (M/S)	NORTHWARD WIND (M/S)	WIND SPEED (M/S)	WIND HEADING (DEG T)	WATER TEMP (DEG C)	AIR TEMP (DEG C)	SOLAR RADIATION	BAROM PRESS (MILLIBARS)	TIME (YYMMDDHH)
-1.673	-6.436	6.649	194	13.322	12.357	.33	1013.3	78080518
-1.510	-7.323	7.477	191	13.319	12.340	.07	1013.3	78080519
-1.987	-7.850	8.098	194	13.288	12.002	.02	1013.6	78080520
-4.696	-6.896	8.343	214	13.283	12.202	.00	1013.9	78080521
-3.349	-8.119	8.782	202	13.270	12.162	.00	1014.3	78080522
-3.137	-8.346	8.916	200	13.246	12.155	.00	1014.3	78080523
-1.063	-9.356	9.416	186	13.219	12.134	.00	1014.3	78080600
-.869	-9.343	9.383	185	13.207	11.915	.00	1013.9	78080601
-.515	-9.569	9.582	183	13.200	11.693	.00	1013.9	78080602
-1.420	-8.898	9.010	189	13.179	11.847	.00	1013.7	78080603
-1.492	-8.962	9.085	189	13.163	11.995	.00	1013.6	78080604
-2.706	-8.540	8.959	197	13.155	12.011	.00	1013.6	78080605
-3.323	-8.399	9.033	201	13.152	12.019	.03	1013.8	78080606
-4.462	-8.109	9.256	208	13.145	11.611	.04	1014.0	78080607
-4.027	-8.228	9.161	206	13.130	11.545	.05	1014.6	78080608
-4.101	-8.310	9.267	206	13.124	11.473	.09	1014.8	78080609
-3.620	-8.270	9.028	203	13.130	11.392	.16	1014.9	78080610
-3.261	-8.214	8.837	201	13.125	11.486	.21	1015.2	78080611
-4.096	-7.576	8.612	208	13.131	11.567	.24	1015.4	78080612
-3.562	-8.332	9.062	203	13.118	11.536	.30	1015.6	78080613
-3.949	-7.043	8.075	209	13.088	11.338	.24	1015.5	78080614
-3.931	-7.135	8.146	208	13.086	11.542	.21	1015.5	78080615
-3.399	-7.279	8.033	205	13.079	11.542	.14	1015.5	78080616
-3.364	-6.919	7.693	205	13.068	11.369	.10	1015.5	78080617
-2.046	-7.422	7.699	195	13.050	11.206	.07	1015.4	78080618
-1.537	-6.645	6.820	193	13.032	10.699	.07	1016.0	78080619
-.756	-7.132	7.172	186	13.045	11.171	.01	1016.2	78080620
.190	-6.703	6.706	178	13.052	11.144	.00	1016.4	78080621
.132	-6.581	6.583	178	13.050	11.115	.00	1016.5	78080622
-.041	-6.663	6.663	180	13.040	11.153	.00	1016.5	78080623
.482	-6.477	6.495	175	13.031	11.092	.00	1016.5	78080700
1.611	-7.252	7.428	167	13.016	11.049	.00	1016.4	78080701
.117	-7.775	7.776	179	12.999	10.859	.00	1016.3	78080702
.676	-6.600	6.634	174	12.971	10.823	.00	1016.1	78080703
1.159	-7.186	7.279	170	12.933	11.236	.00	1015.7	78080704
.383	-7.393	7.403	177	12.931	11.320	.01	1015.5	78080705
-.621	-5.554	5.589	186	12.905	11.250	.04	1015.4	78080706
1.129	-6.244	6.346	169	12.880	11.529	.08	1015.5	78080707
1.247	-6.257	6.380	168	12.906	11.743	.14	1015.5	78080708
-1.076	-7.808	7.882	187	12.906	11.788	.26	1015.3	78080709
-1.670	-7.531	7.714	192	12.929	11.983	.58	1015.5	78080710
.226	-6.697	6.701	178	12.963	11.968	.56	1015.7	78080711
-.324	-8.128	8.135	182	12.979	12.016	.88	1015.8	78080712
1.429	-8.775	8.891	170	13.004	12.123	.80	1015.9	78080713
-.893	-6.424	6.486	187	13.023	11.771	.70	1016.0	78080714
-.171	-6.152	6.154	181	13.024	11.764	.33	1015.9	78080715
.585	-6.324	6.351	174	13.042	12.090	.91	1016.0	78080716
.731	-5.624	5.672	172	13.079	12.027	.48	1015.9	78080717
-.853	-5.713	5.776	188	13.050	11.733	.10	1016.0	78080718
.061	-5.232	5.232	179	13.047	11.787	.06	1016.3	78080719
-.967	-5.030	5.122	190	13.040	11.803	.04	1016.5	78080720
-.010	-5.614	5.614	180	13.031	11.574	.00	1016.8	78080721
-.472	-5.419	5.439	184	13.030	11.434	.00	1017.1	78080722
.876	-6.080	6.143	171	13.039	11.648	.00	1017.1	78080723
-.314	-5.859	5.867	183	13.036	11.503	.00	1017.1	78080800
-1.018	-6.533	6.611	188	13.053	11.303	.00	1017.2	78080801
-.798	-6.893	6.939	186	13.061	11.559	.00	1017.1	78080802
-3.215	-5.355	6.246	210	13.056	11.309	.00	1017.1	78080803
-3.669	-5.127	6.305	215	13.020	11.399	.00	1017.2	78080804
-1.346	-4.257	4.477	198	13.025	11.706	.01	1017.3	78080805

EASTWARD WIND (M/S)	NORTHWARD WIND (M/S)	WIND SPEED (M/S)	WIND HEADING (DEG T)	WATER TEMP (DEG C)	AIR TEMP (DEG C)	SOLAR RADIATION	BAROM PRESS (MILLIBARS)	TIME (YYMMDDHH)
-2.235	-3.811	4.443	210	13.030	10.965	.03	1017.5	78080806
-2.318	-4.447	5.050	207	13.011	11.733	.13	1017.6	78080807
-1.346	-3.835	4.319	207	13.003	11.665	.22	1017.7	78080808
-2.697	-4.272	5.052	212	12.961	11.592	.24	1017.8	78080809
-1.440	-3.386	3.675	202	12.950	11.641	.32	1018.1	78080810
-1.681	-4.820	5.105	199	12.954	11.545	.32	1018.3	78080811
-1.845	-4.124	4.535	204	12.973	11.516	.47	1018.6	78080812
-1.345	-4.498	4.695	196	12.979	11.487	.40	1018.8	78080813
-2.460	-4.257	4.925	209	12.990	11.586	.40	1018.9	78080814
-2.256	-5.476	5.922	202	12.999	11.593	.30	1018.9	78080815
-1.879	-5.455	5.770	199	12.999	11.609	.31	1018.9	78080816
-2.849	-6.579	7.169	203	13.007	11.621	.56	1018.9	78080817
-3.924	-3.873	5.514	225	12.994	11.494	.16	1019.1	78080818
-2.764	-4.842	5.576	209	13.005	11.563	.09	1019.0	78080819
-3.571	-4.694	5.897	217	12.984	11.418	.02	1019.3	78080820
-3.250	-3.353	4.690	224	13.000	11.291	.00	1019.5	78080821
-4.054	-3.663	5.464	227	12.981	11.341	.00	1019.6	78080822
-4.619	-3.514	5.804	232	12.966	11.231	.00	1019.8	78080823
-3.903	-4.201	5.734	222	12.964	11.226	.00	1020.1	78080900
-3.518	-2.664	4.413	232	12.973	11.166	.00	1020.3	78080901
-3.134	-1.893	3.705	239	12.967	10.975	.00	1020.2	78080902
-3.453	-2.750	4.415	231	12.942	11.242	.00	1020.3	78080903
-4.454	-1.703	4.796	249	12.927	11.143	.00	1020.1	78080904
-5.710	-3.147	6.520	241	12.914	11.333	.01	1019.9	78080905
-7.203	-3.462	7.992	244	12.878	11.214	.04	1019.6	78080906
-6.251	-2.097	6.593	251	12.840	10.934	.12	1019.9	78080907
-5.891	-.899	5.959	261	12.844	10.847	.16	1020.1	78080908
-4.145	-.769	4.216	259	12.862	10.918	.20	1020.5	78080909
-3.094	2.458	3.951	308	12.851	10.864	.22	1020.6	78080910
-3.858	2.242	4.462	300	12.872	10.764	.30	1020.7	78080911
-3.321	1.392	3.600	292	12.916	10.984	.63	1020.7	78040912
-3.316	.615	3.372	280	12.994	10.885	.41	1020.6	78080913
-1.882	2.430	3.074	322	13.034	11.100	.72	1020.6	78080914
-2.358	4.158	4.780	330	13.049	11.518	.43	1020.3	78080915
-1.988	4.069	4.528	333	13.040	11.647	.31	1020.2	78080916
-2.528	3.093	3.994	320	13.025	11.562	.22	1020.1	78080917
-3.545	3.747	5.186	316	13.031	11.627	.15	1020.0	78080918
-3.531	4.735	5.907	323	13.018	11.554	.10	1019.9	78080919
-2.922	5.386	6.128	331	13.042	11.620	.01	1020.0	78080920
-3.491	3.920	5.249	318	13.012	11.672	.00	1020.0	78080921
-2.723	5.643	6.266	334	12.992	11.612	.00	1019.7	78080922
-3.441	6.651	7.507	332	12.984	11.470	.00	1019.7	78080923
-3.444	5.677	6.640	328	12.976	11.955	.00	1019.6	78081000
-5.466	5.339	7.641	314	12.974	11.650	.00	1019.4	78081001
-4.227	6.381	7.655	326	12.974	12.126	.00	1019.2	78081002
-3.566	5.693	6.717	327	12.950	11.220	.00	1019.0	78081003
-3.428	6.587	7.426	332	12.957	11.575	.00	1018.6	78081004
-5.429	5.749	7.937	316	12.929	11.901	.01	1018.4	78081005
-4.923	7.459	8.937	326	12.914	11.849	.06	1018.2	78081006
-4.264	7.622	8.734	330	12.895	12.309	.08	1018.1	78081007
-3.809	8.263	9.099	335	12.913	12.384	.13	1018.1	78081008
-4.072	8.568	9.487	334	12.939	12.653	.42	1017.9	78081009
-4.920	8.060	9.443	328	12.977	12.850	.71	1017.7	78081010
-5.021	8.404	9.790	329	13.043	12.918	.78	1017.5	78081011
-5.426	8.802	10.340	328	13.077	12.897	.54	1017.3	78081012
-5.954	8.792	10.618	325	13.106	13.054	.79	1017.1	78081013
-5.851	9.506	11.163	328	13.119	13.159	.55	1016.8	78081014
-5.354	9.241	10.680	329	13.096	13.265	.50	1016.6	78081015
-5.319	9.576	10.954	330	13.069	13.278	.22	1016.3	78081016
-6.341	9.988	11.831	327	13.052	13.317	.30	1015.8	78081017

EASTWARD WIND (M/S)	NORTHWARD WIND (M/S)	WIND SPEED (M/S)	WIND HEADING (DEG T)	WATER TEMP (DEG C)	AIR TEMP (DEG C)	SOLAR RADIATION	BAROM PRESS (MILLIBARS)	TIME (YYMMDDHH)
-6.544	9.526	11.557	325	13.067	13.318	.14	1015.6	78081018
-6.547	9.940	11.925	326	13.071	13.425	.02	1015.3	78081019
-6.662	10.111	12.108	326	13.076	13.311	.01	1015.2	78081020
-6.168	9.840	11.613	327	13.066	13.188	.00	1015.1	78081021
-5.428	10.024	11.399	331	13.110	13.162	.00	1015.3	78081022
-5.118	10.256	11.462	333	13.121	13.286	.00	1015.2	78081023
-4.245	10.365	11.201	337	13.103	13.387	.00	1015.1	78081100
-3.613	10.384	10.994	340	13.081	13.454	.00	1014.7	78081101
-4.066	10.141	10.926	338	13.065	13.331	.00	1014.9	78081102
-4.270	9.989	10.863	336	13.048	13.573	.00	1015.0	78081103
-4.402	9.327	10.314	334	13.037	13.653	.00	1014.9	78081104
-5.005	9.147	10.427	331	13.032	13.800	.02	1014.8	78081105
-4.954	8.308	9.675	329	13.026	13.990	.13	1014.7	78081106
-5.863	7.526	9.540	322	13.001	13.979	.17	1014.7	78081107
-6.489	6.765	9.374	316	12.987	13.734	.20	1014.5	78081108
-7.014	6.275	9.414	311	12.999	13.574	.27	1014.2	78081109
-6.298	7.591	9.864	320	13.003	13.885	.35	1014.2	78081110
-6.047	7.457	9.601	320	13.011	13.839	.41	1013.9	78081111
-6.644	7.370	9.923	317	13.017	13.613	.24	1013.8	78081112
-6.586	8.390	10.666	321	13.018	13.501	.18	1013.7	78081113
-7.272	7.933	10.762	317	13.025	13.306	.18	1013.5	78081114
-7.861	7.594	10.930	314	13.026	13.049	.15	1013.2	78081115
-8.474	7.698	11.448	312	13.030	13.001	.13	1012.8	78081116
-8.443	7.156	11.067	310	13.035	12.740	.08	1012.4	78081117
-8.912	7.248	11.447	309	13.045	12.754	.04	1012.2	78081118
-9.309	6.443	11.321	304	13.044	12.704	.02	1011.9	78081119
-9.418	6.255	11.306	303	12.990	12.830	.01	1011.8	78081120
-9.237	5.937	10.980	302	13.027	13.072	.00	1011.5	78081121
-9.193	6.258	11.121	304	13.040	13.036	.00	1011.3	78081122
-8.819	5.909	10.615	303	13.041	12.993	.00	1011.1	78081123
-8.654	5.850	10.446	304	13.037	12.940	.00	1010.8	78081200
-8.311	5.902	10.193	305	13.032	12.960	.00	1010.6	78081201
-8.090	6.166	10.172	307	13.024	13.052	.00	1010.3	78081202
-7.087	5.656	9.067	308	13.025	12.988	.00	1010.2	78081203
-2.417	6.039	6.504	338	13.021	12.954	.00	1010.2	78081204
2.481	6.345	6.813	21	13.009	12.799	.01	1010.8	78081205
3.009	6.054	6.761	26	13.004	12.926	.04	1011.3	78081206
3.314	4.948	5.956	33	13.019	12.930	.16	1011.9	78081207
3.445	4.963	6.041	34	13.044	13.049	.26	1012.5	78081208
4.316	3.484	5.546	51	13.053	12.963	.27	1012.9	78081209
4.769	2.029	5.183	66	13.068	12.983	.30	1013.6	78081210
5.121	2.617	5.751	62	13.098	13.195	.41	1014.2	78081211
3.408	2.581	4.275	52	13.126	13.350	.44	1014.6	78081212
2.715	3.530	4.453	37	13.189	13.527	.64	1015.1	78081213
3.192	3.889	5.031	39	13.224	13.595	.77	1015.3	78081214
2.671	3.394	4.319	38	13.296	13.565	.42	1015.1	78081215
3.037	3.727	4.808	39	13.374	13.868	.75	1015.1	78081216
3.777	3.786	5.348	44	13.384	13.695	.45	1015.0	78081217
3.368	2.955	4.481	48	13.361	13.836	.34	1015.0	78081218
3.422	4.301	5.496	38	13.338	13.250	.12	1015.0	78081219
1.593	4.039	4.342	21	13.297	13.100	.03	1014.8	78081220
.508	3.953	3.985	7	13.270	12.985	.00	1014.7	78081221
-.115	4.867	4.868	358	13.249	12.947	.00	1014.5	78081222
-.304	5.311	5.320	356	13.234	12.988	.00	1014.1	78081223
-.694	5.334	5.379	352	13.214	13.011	.00	1013.8	78081300
-1.743	5.971	6.221	343	13.194	13.016	.00	1013.2	78081301
-2.275	5.918	6.340	338	13.170	13.014	.00	1012.5	78081302
-3.016	7.008	7.629	336	13.158	12.990	.00	1011.8	78081303
-3.600	7.571	8.383	334	13.144	12.881	.00	1011.0	78081304
-4.636	5.819	7.440	321	13.125	12.898	.00	1011.0	78081305

EASTWARD WIND (M/S)	NORTHWARD WIND (M/S)	WIND SPEED (M/S)	WIND HEADING (DEG T)	WATER TEMP (DEG C)	AIR TEMP (DEG C)	SOLAR RADIATION	BAROM PRESS (MILLIBARS)	TIME (YYMMDDHH)
-4.313	6.450	7.759	326	13.082	12.665	.02	1010.5	78081306
-5.847	6.355	8.635	317	13.054	12.464	.03	1009.8	78081307
-6.592	6.028	8.933	312	13.049	12.348	.11	1009.2	78081308
-6.596	7.592	10.058	319	13.042	12.551	.09	1008.0	78081309
-6.044	9.044	10.880	326	12.981	12.682	.15	1006.9	78081310
-5.972	8.570	10.446	325	12.968	12.825	.08	1006.3	78081311
-6.574	8.505	10.750	322	12.965	13.075	.25	1005.2	78081312
-5.999	7.762	9.810	322	12.973	13.195	.17	1004.3	78081313
-5.650	7.784	9.619	324	12.972	13.102	.02	1003.9	78081314
-6.632	6.896	9.568	316	12.972	13.015	.17	1002.0	78081315
-4.134	5.857	7.169	324	12.961	13.064	.04	1001.3	78081316
-3.076	7.499	8.105	337	12.978	13.150	.05	1000.4	78081317
.192	8.175	8.177	1	12.973	13.246	.05	1000.2	78081318
1.920	8.054	8.280	13	12.965	13.188	.04	999.8	78081319
3.663	7.943	8.747	24	12.955	13.127	.01	999.5	78081320
5.119	5.868	7.787	41	12.946	12.767	.00	999.3	78081321
4.333	5.929	7.343	36	12.951	13.077	.00	999.3	78081322
4.669	5.715	7.392	39	12.961	13.152	.00	999.1	78081323
3.761	5.612	6.756	33	12.963	13.223	.00	999.1	78081400
5.136	4.111	6.579	51	12.959	13.122	.00	999.2	78081401
3.579	4.599	5.827	37	12.951	13.112	.00	998.9	78081402
4.654	5.256	7.020	41	12.943	13.039	.00	998.8	78081403
5.165	3.660	6.331	54	12.949	13.005	.00	998.9	78081404
4.749	3.985	6.199	49	12.960	12.889	.00	998.6	78081405
3.482	3.399	4.866	45	12.963	12.872	.03	998.7	78081406
2.080	3.707	4.251	29	12.951	12.811	[illegible]	998.8	78081407
.810	5.300	5.361	8	12.968	12.678	.11	998.9	78081408
.262	6.233	6.238	2	12.986	12.378	.15	998.9	78081409
.437	6.737	6.751	3	13.006	12.328	.20	998.3	78081410
-1.582	6.252	6.449	345	13.016	12.267	.21	998.3	78081411
-.794	5.837	5.891	352	13.027	12.326	.28	998.1	78081412
-1.890	5.993	6.270	342	13.058	12.520	.41	997.6	78081413
-2.588	5.244	5.844	333	13.080	12.619	.60	997.6	78081414
-2.539	4.670	5.340	331	13.130	12.589	.53	997.1	78081415
-2.677	3.304	4.253	320	13.152	12.430	.27	996.4	78081416
-3.761	2.441	4.484	302	13.155	12.286	.18	995.8	78081417
-2.071	.714	2.191	289	13.162	12.590	.14	995.8	78081418
-.360	.439	.568	320	13.162	12.889	.06	995.6	78081419
-.428	-.238	.490	240	13.156	12.873	.01	995.5	78081420
.229	.579	.623	21	13.151	12.638	.00	995.3	78081421
-.128	-.222	.256	209	13.148	12.480	.00	995.0	78081422
.413	.074	.420	79	13.152	12.492	.00	994.9	78081423
1.109	-2.398	2.640	155	13.147	12.367	.00	994.8	78081500
1.547	-2.388	2.845	147	13.143	12.152	.00	994.4	78081501
2.090	-2.380	3.168	138	13.129	12.265	.00	994.2	78081502
2.120	-2.706	3.438	141	13.115	12.231	.00	994.0	78081503
1.232	-2.355	2.658	152	13.104	12.264	.00	993.8	78081504
2.125	-.526	2.[illegible]9	103	13.112	12.364	.01	993.9	78081505
2.049	-.153	2.054	94	13.119	12.508	.05	994.0	78081506
2.520	.502	2.570	78	13.117	12.551	.07	994.1	78081507
2.575	1.084	2.794	67	13.129	12.684	.20	994.4	78081508
3.143	1.233	3.376	68	13.138	12.412	.14	994.5	78081509
3.287	1.461	3.597	66	13.151	12.500	.29	994.3	78081510
3.915	3.047	4.962	52	13.165	12.510	.26	994.3	78081511
4.237	2.210	4.832	62	13.182	12.460	.44	994.3	78081512
4.758	1.302	4.933	74	13.221	12.850	.49	994.3	78081513
3.936	-.254	3.945	93	13.236	13.087	.60	994.4	78081514
5.072	-2.790	5.789	118	13.298	13.288	.55	994.5	78081515
3.722	-3.451	5.075	132	13.296	13.141	.24	994.8	78081516
1.248	-5.863	5.995	167	13.336	13.308	.20	995.1	78081517

EASTWARD WIND (M/S)	NORTHWARD WIND (M/S)	WIND SPEED (M/S)	WIND HEADING (DEG T)	WATER TEMP (DEG C)	AIR TEMP (DEG C)	SOLAR RADIATION	BAROM PRESS (MILLIBARS)	TIME (YYMMDDHH)
-.843	-12.702	12.730	183	13.272	11.639	.08	995.4	78081518
-2.285	-12.734	12.938	190	13.181	11.117	.05	996.6	78081519
-1.214	-11.927	11.989	185	13.143	11.741	.01	997.9	78081520
.233	-12.582	12.584	178	13.103	11.503	.00	999.0	78081521
1.722	-11.892	12.016	171	13.075	11.948	.00	1000.1	78081522
3.852	-11.039	11.692	160	13.038	11.737	.00	1000.9	78081523
1.907	-9.293	9.487	168	13.017	11.621	.00	1001.8	78081600
3.352	-9.615	10.183	160	13.005	11.610	.00	1002.2	78081601
5.378	-8.051	9.682	146	13.001	11.605	.00	1002.8	78081602
4.702	-8.850	10.021	152	12.983	11.482	.00	1003.1	78081603
6.431	-6.629	9.235	135	12.971	11.221	.00	1003.8	78081604
5.740	-6.954	9.016	140	12.972	11.685	.01	1004.2	78081605
7.106	-5.096	8.745	125	12.975	11.732	.11	1004.9	78081606
6.408	-3.228	7.175	116	12.972	11.764	.15	1005.4	78081607
7.619	.633	7.645	85	12.971	11.224	.12	1005.6	78081608
4.373	2.800	5.193	57	12.970	10.085	.15	1006.1	78081609
2.238	4.714	5.218	25	12.958	10.422	.13	1005.9	78081610
12.396	-5.276	13.472	113	12.983	12.310	.80	1005.3	78081611
9.182	-2.575	9.537	105	12.985	12.557	.74	1006.3	78081612
8.713	-3.659	9.450	112	12.975	12.228	.34	1006.3	78081613
9.339	-3.179	9.865	108	12.992	12.829	.56	1007.1	78081614
7.833	-5.042	9.316	122	13.012	12.870	.95	1008.2	78081615
5.154	-6.778	8.515	142	13.032	12.523	.79	1008.8	78081616
5.970	-5.077	7.837	130	13.044	12.550	.55	1009.7	78081617
5.895	-3.919	7.079	123	13.031	12.620	.30	1010.3	78081618
6.124	-2.885	6.769	115	13.018	12.546	.10	1011.0	78081619
6.524	-1.279	6.648	101	13.014	12.474	.02	1011.9	78081620
7.058	-1.575	7.231	102	13.009	12.554	.00	1012.4	78081621
5.625	.309	5.633	86	13.004	12.535	.00	1012.9	78081622
5.877	.781	5.928	82	12.999	12.586	.00	1013.3	78081623
4.603	.192	4.607	87	12.995	12.664	.00	1013.6	78081700
2.961	.013	2.961	89	12.992	12.964	.00	1013.6	78081701
.970	2.124	2.334	24	12.991	12.908	.00	1013.4	78081702
.031	3.005	3.005	0	12.975	12.861	.00	1013.4	78081703
1.313	4.483	4.672	16	12.977	12.880	.00	1013.3	78081704
2.919	4.798	5.616	31	12.988	12.884	.01	1013.3	78081705
-.231	4.989	4.994	357	12.995	12.959	.08	1013.1	78081706
-1.403	7.284	7.418	349	13.000	12.901	.18	1012.7	78081707
-1.986	8.929	9.147	347	13.000	12.875	.31	1012.3	78081708
-3.733	8.896	9.647	337	13.012	12.615	.15	1011.9	78081709
-4.682	9.662	10.737	334	13.012	12.870	.15	1011.1	78081710
-4.461	10.355	11.275	336	13.014	13.031	.19	1011.0	78081711
-5.273	11.052	12.245	334	13.017	13.241	.21	1009.9	78081712
-5.825	11.158	12.587	332	13.013	13.238	.06	1009.1	78081713
-4.122	12.209	12.886	341	13.003	13.284	.08	1008.4	78081714
-3.239	12.291	12.710	345	12.998	13.400	.11	1007.3	78081715
-2.922	12.065	12.414	346	12.990	13.457	.10	1006.6	78081716
-1.659	11.998	12.112	352	13.007	13.584	.07	1006.0	78081717
-1.157	11.641	11.698	354	13.018	13.719	.05	1005.7	78081718
-1.367	12.689	12.763	353	13.013	13.902	.04	1005.3	78081719
-2.107	12.347	12.526	350	13.001	13.864	.00	1004.9	78081720
-2.484	12.115	12.366	348	12.987	13.813	.00	1004.5	78081721
-2.528	12.656	12.906	348	12.994	13.902	.00	1004.1	78081722
-3.192	13.236	13.615	346	12.999	14.075	.00	1003.4	78081723
-1.939	13.752	13.888	351	13.000	14.053	.00	1003.0	78081800
-.982	13.658	13.693	355	12.990	14.012	.00	1002.7	78081801
-1.855	13.389	13.517	352	12.971	14.038	.00	1002.3	78081802
-2.213	12.582	12.775	350	12.946	13.754	.00	1001.7	78081803
-2.019	12.358	12.522	350	12.933	13.608	.00	1001.4	78081804
-2.290	11.760	11.981	348	12.930	13.496	.00	1001.1	78081805

EASTWARD WIND (M/S)	NORTHWARD WIND (M/S)	WIND SPEED (M/S)	WIND HEADING (DEG T)	WATER TEMP (DEG C)	AIR TEMP (DEG C)	SOLAR RADIATION	BAROM PRESS (MILLIBARS)	TIME (YYMMDDHH)
-1.383	11.872	11.953	353	12.971	13.487	.02	1001.1	78081806
-2.756	11.048	11.387	345	12.978	13.486	.02	1000.7	78081807
-3.842	11.672	12.288	341	12.959	13.756	.06	1000.0	78081808
-4.481	11.516	12.357	338	12.948	13.842	.11	999.3	78081809
-5.615	12.070	13.313	335	12.943	13.813	.16	998.5	78081810
-6.137	12.544	13.964	333	12.947	13.891	.20	997.6	78081811
-5.290	12.529	13.600	337	12.955	13.815	.25	996.6	78081812
-5.312	13.312	14.333	338	12.958	13.906	.18	995.8	78081813
-3.377	13.954	14.357	346	12.943	14.107	.14	995.1	78081814
1.064	10.870	10.922	5	12.903	13.826	.77	996.2	78081815
.465	12.736	12.745	2	12.877	13.909	.63	996.3	78081816
-.513	13.962	13.971	357	12.838	13.860	.45	996.1	78081817
-.163	14.069	14.070	359	12.814	13.840	.28	996.4	78081818
-.001	13.525	13.525	359	12.812	13.746	.10	996.8	78081819
.615	13.422	13.436	2	12.787	13.748	.01	997.5	78081820
.770	13.880	13.902	3	12.752	13.796	.00	998.0	78081821
1.282	12.688	12.753	5	12.723	13.695	.00	998.7	78081822
1.523	12.109	12.204	7	12.723	13.635	.00	999.2	78081823
1.632	11.604	11.719	8	12.718	13.537	.00	999.4	78081900
.557	11.619	11.632	2	12.715	13.509	.00	999.6	78081901
1.343	12.045	12.120	6	12.693	13.529	.00	999.6	78081902
.966	11.599	11.639	4	12.677	13.448	.00	999.9	78081903
.867	12.129	12.160	4	12.660	13.310	.00	999.8	78081904
1.077	11.359	11.410	5	12.651	13.347	.01	1000.1	78081905
-.138	11.496	11.497	359	12.662	13.404	.13	1000.3	78081906
-1.207	12.071	12.131	354	12.666	13.366	.19	1000.4	78081907
-1.593	11.760	11.868	352	12.661	13.423	.33	1000.6	78081908
-1.244	11.885	11.950	354	12.647	13.436	.30	1000.7	78081909
-1.724	12.193	12.314	351	12.648	13.530	.43	1000.6	78081910
-1.660	12.173	12.286	352	12.654	13.572	.53	1000.6	78081911
-1.111	12.591	12.640	354	12.664	13.613	.64	1000.4	78081912
-.472	12.036	12.045	357	12.673	13.577	.35	1000.4	78081913
-.231	12.006	12.008	358	12.670	13.344	.24	1000.3	78081914
.263	11.457	11.460	1	12.669	12.901	.22	1000.4	78081915
.456	11.565	11.576	2	12.667	13.022	.24	1000.1	78081916
1.574	11.762	11.867	7	12.672	13.013	.19	1000.2	78081917
2.297	11.193	11.426	11	12.665	13.149	[illegible]	1000.2	78081918
2.632	10.634	10.955	13	12.647	13.190	[illegible]	1000.4	78081919
1.345	10.587	10.672	7	12.624	13.256	.01	1000.4	78081920
2.410	11.917	12.153	11	12.601	12.832	.00	1000.1	78081921
3.448	11.688	12.186	16	12.592	12.906	.00	1000.1	78081922
4.818	9.820	10.938	26	12.588	12.812	.00	1000.6	78081923
5.662	9.005	10.637	32	12.585	12.951	.00	1001.0	78082000
7.401	9.163	11.778	38	12.582	[illegible]	.00	1001.7	78082001
6.869	8.065	10.593	40	12.570	[illegible]	.00	1002.2	78082002
5.358	9.036	10.503	30	12.574	[illegible]	.00	1002.4	78082003
4.709	9.160	10.299	27	12.580	[illegible]	.00	1002.4	78082004
4.600	8.509	9.673	28	12.588	12.688	.01	1002.5	78082005
3.196	9.781	10.290	18	12.590	12.825	.06	1002.3	78082006
2.452	9.667	10.168	13	12.587	12.872	.07	1002.2	78082007
1.195	10.362	10.430	6	12.581	12.933	.14	1002.0	78082008
4.717	9.059	10.214	27	12.565	11.668	.11	1001.7	78082009
.865	9.962	10.001	5	12.563	12.521	.35	1001.2	78082010
-.050	10.850	10.851	359	12.559	[illegible]	.25	1000.2	78082011
-2.590	12.228	12.499	348	12.556	12.065	.25	998.3	78082012
-3.846	12.872	13.434	343	12.550	12.175	.23	996.4	78082013
-.069	15.194	15.194	359	12.551	12.688	.24	994.3	78082014
13.834	6.220	15.168	65	12.555	11.917	.64	995.4	78082015
12.704	6.490	14.266	62	12.535	11.608	.23	997.1	78082016
10.909	7.084	13.007	57	12.524	12.124	.33	998.3	78082017

EASTWARD WIND (M/S)	NORTHWARD WIND (M/S)	WIND SPEED (M/S)	WIND HEADING (DEG T)	WATER TEMP (DEG C)	AIR TEMP (DEG C)	SOLAR RADIATION	BAROM PRESS (MILLIBARS)	TIME (YYMMDDHH)
11.471	6.079	12.983	62	12.516	12.640	.27	999.2	78082018
10.579	7.377	12.897	55	12.512	12.489	.09	1000.1	78082019
11.279	7.368	13.472	56	12.494	12.529	.01	1000.9	78082020
11.156	7.513	13.449	56	12.486	12.515	.00	1001.5	78082021
10.331	7.625	12.960	52	12.475	12.545	.00	1002.2	78082022
10.804	8.022	13.456	53	12.461	12.620	.00	1002.7	78082023
10.798	8.114	13.507	53	12.450	12.376	.00	1002.9	78082100
10.695	7.647	13.150	54	12.476	12.216	.00	1003.3	78082101
10.405	7.160	12.631	55	12.476	12.330	.00	1003.6	78082102
9.870	6.904	12.061	55	12.476	12.428	.00	1004.1	78082103
10.046	6.476	11.986	57	12.475	12.501	.00	1004.4	78082104
10.232	4.848	11.377	64	12.468	12.306	.01	1004.9	78082105
10.228	5.293	11.516	62	12.453	12.376	.05	1005.4	78082106
8.969	6.415	11.028	54	12.436	12.238	.11	1005.8	78082107
8.859	5.975	10.685	56	12.432	12.232	.29	1006.2	78082108
8.689	6.156	10.649	54	12.439	11.961	.49	1006.4	78082109
7.177	4.296	8.364	59	12.440	11.280	.18	1006.7	78082110
8.736	5.814	10.494	56	12.449	12.373	.56	1006.9	78082111
8.459	5.670	10.208	56	12.463	12.210	.50	1007.0	78082112
8.766	5.114	10.149	59	12.481	12.342	.40	1007.1	78082113
8.673	5.425	10.229	57	12.444	12.543	.99	1007.3	78082114
8.243	5.108	9.697	58	12.402	12.606	.53	1007.1	78082115
9.010	3.449	9.662	68	12.411	12.464	.51	1007.3	78082116
8.496	2.748	8.930	72	12.408	12.573	.24	1007.4	78082117
9.263	1.872	9.450	78	12.407	12.571	.14	1007.5	78082118
9.745	1.632	9.881	80	12.408	12.562	.07	1007.8	[illegible]
9.961	1.540	10.046	80	12.406	12.543	.01	1008.1	78082120
9.740	2.004	9.944	78	12.443	12.495	.00	1008.5	[illegible]
10.086	1.637	10.218	80	12.463	12.430	.00	[illegible]	[illegible]
10.542	-.489	10.553	92	12.454	12.072	.00	[illegible]	[illegible]
9.492	-1.232	9.572	97	12.407	11.855	.00	[illegible]	78082200
9.547	-.297	9.551	91	12.359	12.154	.00	[illegible]	[illegible]
10.423	-2.764	10.783	104	12.326	11.856	.00	[illegible]	[illegible]
8.971	-2.448	9.299	105	12.290	11.832	.00	1011.0	[illegible]
8.880	-2.684	9.276	106	12.162	11.768	.00	1011.2	[illegible]
7.860	-3.023	8.421	111	12.027	11.805	.00	1011.7	[illegible]
8.268	-3.391	8.936	112	12.010	11.696	.05	1012.3	[illegible]
8.140	-1.853	8.349	102	12.028	12.077	.06	1012.9	[illegible]
8.569	-1.082	8.637	97	12.034	12.488	.16	1013.6	[illegible]
8.660	-2.083	8.907	103	12.031	12.028	.21	[illegible]	[illegible]
8.543	-2.049	8.785	103	12.160	12.649	.32	[illegible]	[illegible]
8.443	-2.278	8.745	[illegible]	12.259	12.654	.43	[illegible]	[illegible]
8.868	-1.939	9.077	102	12.256	12.534	.38	[illegible]	[illegible]
9.025	-1.377	9.129	98	12.218	12.489	.34	1016.5	[illegible]
9.445	-2.344	9.731	103	12.065	12.042	.29	[illegible]	[illegible]
7.715	-2.148	8.009	105	12.047	11.835	.31	[illegible]	[illegible]
8.266	-3.276	8.892	[illegible]	11.895	11.569	.26	[illegible]	[illegible]
7.620	-1.938	7.862	104	12.192	11.869	.13	[illegible]	[illegible]
7.882	-2.615	8.305	108	12.205	11.981	.10	[illegible]	[illegible]
8.523	-3.771	9.319	113	12.231	11.837	.03	[illegible]	[illegible]
8.140	-1.857	8.340	102	12.232	11.589	.00	[illegible]	[illegible]
7.102	-1.089	7.185	98	12.233	12.370	.00	[illegible]	[illegible]
7.793	-1.305	7.901	99	12.220	12.283	.00	[illegible]	[illegible]
8.968	-.824	9.005	95	12.198	12.175	.00	[illegible]	[illegible]
9.463	.186	9.465	88	12.164	12.280	.00	[illegible]	[illegible]
9.893	1.083	9.952	83	12.171	12.338	.00	1020.5	[illegible]
10.696	-.292	10.700	91	12.183	12.412	.00	1020.5	[illegible]
7.961	.530	7.979	86	12.195	12.240	.00	1020.7	78082303
8.220	.865	8.265	83	12.136	12.242	.00	1020.6	78082304
9.350	.504	9.364	86	12.067	12.273	.00	1020.8	78082305

EASTWARD WIND (M/S)	NORTHWARD WIND (M/S)	WIND SPEED (M/S)	WIND HEADING (DEG T)	WATER TEMP (DEG C)	AIR TEMP (DEG C)	SOLAR RADIATION	BAROM PRESS (MILLIBARS)	TIME (YYMMDDHH)
9.564	1.021	9.623	83	11.952	12.310	.02	1021.0	78082306
9.133	2.146	9.391	76	11.961	11.771	.05	1021.2	78082307
9.262	2.026	9.481	77	12.099	11.961	.09	1021.4	78082308
7.573	3.939	8.536	62	12.152	12.191	.25	1021.0	78082309
7.281	5.272	8.990	54	12.162	12.334	.21	1020.9	78082310
10.004	3.502	10.603	70	12.168	11.973	.38	1021.1	78082311
8.053	4.280	9.119	62	12.224	12.443	.88	1021.3	78082312
9.274	3.405	9.879	69	12.213	11.876	.42	1021.5	78082313
8.326	2.540	8.705	73	12.222	12.435	.84	1021.5	78082314
8.532	2.007	8.765	76	12.195	11.951	.82	1021.5	78082315
8.904	1.828	9.090	78	12.190	12.484	.35	1021.4	78082316
10.193	1.854	10.360	79	12.152	12.006	.24	1021.4	78082317
10.303	1.155	10.367	83	12.006	11.787	.05	1021.4	78082318
8.594	1.629	8.747	79	12.010	12.361	.05	1021.7	78082319
9.743	2.871	10.157	73	12.031	12.596	.00	1021.4	78082320
9.191	.521	9.205	86	12.029	12.565	.00	1021.3	78082321
9.177	1.397	9.282	81	12.014	11.929	.00	1021.7	78082322
9.019	2.338	9.317	75	12.008	12.365	.00	1021.7	78082323
10.504	.189	10.505	88	11.999	12.489	.00	1021.7	78082400
10.152	.570	10.168	86	11.987	12.545	.00	1021.8	78082401
11.111	-.731	11.135	93	11.983	12.496	.00	1022.1	78082402
10.961	-1.008	11.007	95	11.983	12.315	.00	1022.3	78082403
10.830	.900	10.867	85	11.986	12.220	.00	1022.4	78082404
10.536	.167	10.537	89	11.995	12.120	.00	1022.6	78082405
10.011	-1.647	10.146	99	11.997	12.032	.03	1022.8	78082406
9.023	.074	9.024	89	12.003	12.160	.08	1023.1	78082407
9.469	-.283	9.473	91	12.015	12.246	.17	1023.6	78082408
9.472	1.668	9.618	80	12.026	12.430	.41	1023.3	78082409
9.530	.523	9.545	86	12.033	12.426	.37	1023.6	78082410
9.722	1.175	9.792	83	12.029	12.547	.64	1023.9	78082411
10.285	.143	10.286	89	12.054	12.594	1.09	1024.4	78082412
10.024	-.774	10.054	94	12.082	12.683	.90	1025.0	78082413
9.338	-2.942	9.790	107	12.087	12.764	.87	1025.7	78082414
7.629	-3.472	8.382	114	12.102	12.764	.66	1026.1	78082415
7.504	-3.032	8.094	112	12.119	12.861	.68	1026.6	78082416
7.604	-3.690	8.452	115	12.131	12.851	.47	1026.8	78082417
6.791	-4.038	7.901	120	12.143	12.759	.29	1027.0	78082418
5.958	-3.525	6.923	120	12.143	12.457	.09	1027.6	78082419
5.409	-3.791	6.606	125	12.151	12.285	.01	1028.4	78082420
4.864	-3.327	5.976	123	12.138	12.250	.00	1029.0	78082421
5.300	-2.933	6.058	118	12.127	12.190	.00	1029.5	78082422
5.039	-2.816	5.772	119	12.123	12.126	.00	1029.6	78082423
5.280	-2.676	5.919	116	12.115	12.114	.00	1030.1	78082500
5.125	-1.901	5.466	110	12.115	12.093	.00	1030.2	78082501
5.741	-1.787	6.013	107	12.117	12.071	.00	1030.4	78082502
5.912	-2.045	6.256	109	12.114	12.107	.00	1030.9	78082503
6.301	-1.775	6.546	105	12.134	12.110	.00	1031.0	78082504
6.781	-1.619	6.972	103	12.099	12.078	.00	1031.2	78082505
5.019	-1.914	5.372	110	12.104	12.238	.09	1031.8	78082506
5.154	-2.649	5.802	119	12.132	12.320	.20	1032.1	78082507
4.069	-3.183	5.167	128	12.204	12.346	.42	1032.2	78082508
4.555	-1.316	4.741	106	12.249	12.378	.55	1032.2	78082509
4.498	-.612	4.540	97	12.268	12.375	.51	1032.5	78082510
5.142	-.165	5.144	91	12.287	12.515	.80	1032.6	78082511
4.985	-.712	5.036	98	12.349	12.538	1.07	1033.1	78082512
6.072	-.582	6.079	95	12.377	12.520	1.05	1033.0	78082513
4.998	-1.243	5.150	104	12.426	12.588	.82	1033.3	78082514
4.836	-1.343	5.019	105	12.460	12.664	.73	1033.4	78082515
3.837	-2.192	4.416	119	12.481	12.613	.40	1033.4	78082516
3.077	1.668	3.509	118	12.499	12.491	.25	1033.6	78082517

EASTWARD WIND (M/S)	NORTHWARD WIND (M/S)	WIND SPEED (M/S)	WIND HEADING (DEG T)	WATER TEMP (DEG C)	AIR TEMP (DEG C)	SOLAR RADIATION	BAROM PRESS (MILLIBARS)	TIME (YYMMDDHH)
3.573	-.071	3.574	[illegible]	12.448	12.506	.12	1033.7	78082518
3.351	-.045	3.351	[illegible]	12.385	12.494	.03	1033.7	78082519
2.905	.251	2.915	85	12.448	12.514	.01	1033.7	78082520
3.485	.948	3.612	74	12.515	12.501	.00	1033.7	78082521
3.217	.726	3.298	77	12.509	12.358	.00	1033.7	78082522
3.296	1.273	3.534	68	12.436	12.425	.00	1033.5	78082523
4.926	.503	4.952	84	12.432	12.379	.00	1033.4	78082600
4.763	[illegible]	4.776	85	12.420	12.407	.00	1033.3	78082601
4.484	1.102	4.627	75	12.432	12.409	.00	1033.1	78082602
5.485	1.479	[illegible]	75	12.421	12.459	.00	1032.8	78082603
5.625	[illegible]	[illegible]	85	12.390	12.429	.00	1032.4	78082604
4.963	-.257	[illegible]	92	12.409	12.463	.00	1032.4	78082605
4.527	-1.106	[illegible]	103	12.401	12.493	.02	1032.6	78082606
3.965	-.626	4.014	98	12.349	12.455	.06	1032.3	78082607
3.480	-.709	3.552	101	12.325	12.435	.12	1032.3	78082608
[illegible]	-.429	3.419	97	12.331	12.413	.19	1032.2	78082609
4.137	-.852	4.224	101	12.323	12.356	.24	1031.8	78082610
4.239	-1.711	4.571	111	12.407	12.461	.41	1031.9	78082611
3.185	-.584	3.239	100	12.442	12.684	.61	1032.3	78082612
5.266	-.960	5.353	100	12.564	12.626	.44	1031.9	78082613
4.421	-3.573	5.684	128	[illegible]	12.743	.74	1031.8	78082614
3.426	-2.631	4.319	127	12.602	12.708	.55	1031.7	78082615
3.643	-1.310	3.872	109	12.622	12.929	.40	1031.3	78082616
4.411	-1.119	4.551	104	12.555	12.772	.20	1030.9	78082617
2.453	-1.685	2.976	124	12.546	12.701	.12	1030.5	78082618
1.359	-2.961	3.258	155	12.556	12.539	.04	1030.4	78082619
1.068	-1.114	1.543	136	12.596	12.049	.00	1030.5	78082620
1.611	-1.738	2.369	137	12.565	12.296	.00	1030.3	78082621
3.022	-.466	3.058	98	12.556	11.828	.00	1030.1	78082622
5.415	.819	5.477	81	12.552	11.984	.00	1029.7	78082623
5.084	.726	5.135	81	12.533	12.128	.00	1029.4	78082700
5.782	-.068	5.783	90	12.498	12.086	.00	1029.1	78082701
6.459	-.361	6.469	93	12.491	12.176	.00	1028.9	78082702
6.552	-.662	6.585	95	12.468	12.182	.00	1028.5	78082703
6.435	-1.143	6.536	100	12.478	12.263	.00	1028.2	78082704
6.565	-1.538	6.743	103	12.456	12.227	.00	1027.7	78082705
5.942	-1.005	6.026	99	12.313	12.307	.03	1028.0	78082706
4.902	-2.386	5.452	115	12.328	12.364	.08	1028.2	78082707
2.269	-5.167	5.643	156	12.509	11.938	.14	1028.2	78082708
2.477	-3.915	4.633	147	12.591	11.752	.36	1028.2	78082709
3.076	-1.755	3.543	119	12.503	12.198	.34	1028.2	78082710
2.655	-1.746	3.177	123	12.560	12.749	.56	1028.5	78082711
2.008	-.522	2.075	104	12.611	12.958	.24	1028.4	78082712
2.810	-.466	2.848	99	12.667	12.847	.27	1028.1	78082713
2.971	-.743	3.073	104	12.752	12.988	.51	1027.8	78082714
4.627	-.087	4.628	91	12.801	12.788	.40	1027.6	78082715
3.973	-.377	3.991	95	12.747	12.760	.25	1027.4	78082716
3.039	.194	3.045	86	12.759	12.694	.33	1027.3	78082717
3.376	-2.376	4.128	125	12.871	12.442	.04	1026.6	78082718
3.704	-1.678	4.066	114	12.869	12.373	.02	1026.8	78082719
3.783	-1.469	4.059	111	12.856	12.252	.00	1026.6	78082720
5.205	-.778	5.263	98	12.810	12.121	.00	1026.4	78082721
4.696	.498	4.722	83	12.675	12.288	.00	1026.0	78082722
5.044	1.106	5.164	77	12.667	12.409	.00	1025.6	78082723
5.381	1.385	5.557	75	12.649	12.437	.00	1025.3	78082800
5.738	1.048	5.833	79	12.617	12.517	.00	1025.1	78082801
6.352	.410	6.365	86	12.590	12.512	.00	1024.8	78082802
6.786	.804	6.833	83	12.570	12.416	.00	1024.4	78082803
6.844	.412	6.857	86	12.558	12.306	.00	1024.0	78082804
6.041	-1.885	6.328	107	12.561	12.656	.00	1023.8	78082805

EASTWARD WIND (M/S)	NORTHWARD WIND (M/S)	WIND SPEED (M/S)	WIND HEADING (DEG T)	WATER TEMP (DEG C)	AIR TEMP (DEG C)	SOLAR RADIATION	BAROM PRESS (MILLIBARS)	TIME (YYMMDDHH)
6.153	-1.308	6.291	102	12.585	12.741	.03	1023.7	78082806
6.174	-.742	6.219	96	12.584	12.810	.09	1023.5	78082807
7.153	-1.260	7.263	94	12.612	12.830	.17	1023.0	78082808
7.404	-.946	7.464	97	12.535	12.857	.17	1022.8	78082809
8.313	-.360	8.321	92	12.502	12.931	.18	1022.5	78082810
7.900	-.575	7.920	94	12.537	12.900	.22	1022.5	78082811
8.086	-.910	8.137	96	12.554	12.849	.16	1022.5	78082812
6.930	-.414	6.977	96	12.601	13.104	.57	1022.3	78082813
8.260	-1.085	8.337	97	12.728	13.071	.35	1022.2	78082814
7.519	-1.130	7.604	98	12.653	13.286	.71	1022.3	78082815
7.854	-1.411	7.930	100	12.553	13.106	.17	1021.8	78082816
7.673	-1.035	7.743	97	12.562	13.087	.08	1021.9	78082817
7.310	-1.716	7.513	103	12.702	12.771	.02	1022.1	78082818
6.700	-1.436	6.852	102	12.727	12.682	.01	1022.4	78082819
6.661	-2.536	7.128	110	12.748	12.798	.00	1022.4	78082820
6.643	-2.007	6.978	106	12.701	12.765	.00	1022.7	78082821
6.125	-3.193	6.907	117	12.663	12.779	.00	1022.7	78082822
5.404	-4.267	6.885	128	12.658	12.662	.00	1022.6	78082823
6.047	-4.037	7.270	123	12.651	12.769	.00	1022.6	78082900
5.064	-4.756	6.947	133	12.626	12.712	.00	1022.8	78082901
5.392	-4.665	7.263	132	12.594	12.731	.00	1022.8	78082902
4.263	-4.277	6.039	135	12.585	12.705	.00	1022.9	78082903
4.702	-4.704	6.651	135	12.573	12.729	.00	1023.0	78082904
3.848	-3.948	5.570	135	12.566	12.749	.00	1023.0	78082905
3.860	-2.642	4.677	124	12.567	12.800	.02	1023.4	78082906
4.702	-2.005	5.111	113	12.583	12.787	.02	1023.8	78082907
4.728	-1.852	5.078	111	12.593	12.680	.05	1023.8	78082908
-.793	-3.298	3.392	193	12.596	12.106	.07	1024.2	78082909
.442	-1.019	1.127	154	12.583	12.084	.19	1024.5	78082910
-.078	-1.516	1.518	182	12.605	12.211	.21	1024.9	78082911
-.710	-1.389	1.560	207	12.673	12.479	.22	1025.1	78082912
-2.944	-2.527	3.910	229	12.709	12.340	.30	1025.2	78082913
-2.638	-2.990	3.987	221	12.695	12.163	.24	1025.5	78082914
-2.001	-3.157	3.738	212	12.694	12.191	.27	1025.6	78082915
-3.465	-2.206	4.107	237	12.681	11.968	.22	1026.1	78082916
-2.644	-1.066	2.851	248	12.692	12.035	.14	1026.2	78082917
-2.060	-1.623	2.622	231	12.701	12.042	.06	1026.9	78082918
-.429	-.755	.868	209	12.670	12.111	.02	1027.3	78082919
-1.256	-1.024	1.620	230	12.719	12.238	.00	1027.8	78082920
-4.552	-.327	4.564	265	12.715	11.771	.00	1028.0	78082921
-3.784	-.068	3.749	268	12.675	11.715	.00	1028.5	78082922
-3.663	1.291	3.884	289	12.647	11.712	.00	1028.3	78082923
-3.380	1.614	3.745	295	12.626	11.761	.00	1028.1	78083000
-2.493	2.705	3.679	317	12.595	11.828	.00	1027.8	78083001
-1.709	3.373	3.781	333	12.608	11.911	.00	1027.4	78083002
-1.066	3.747	3.896	344	12.611	11.963	.00	1027.3	78083003
-.277	4.261	4.270	356	12.615	11.864	.00	1026.8	78083004
1.042	3.660	3.816	16	12.613	12.135	.00	1026.6	78083005
1.172	2.945	3.216	21	12.606	12.392	.01	1026.3	78083006
2.698	2.334	3.568	49	12.604	12.541	.14	1026.1	78083007
2.349	2.194	3.244	47	12.647	12.818	.20	1025.8	78083008
2.817	2.341	3.663	50	12.675	12.865	.14	1025.5	78083009
3.291	2.616	4.204	51	12.656	13.057	.25	1025.4	78083010
5.686	2.703	6.296	64	12.631	13.149	.19	1025.0	78083011
5.637	2.580	6.199	65	12.628	13.195	.18	1024.7	78083012
4.573	3.733	5.903	50	12.628	13.207	.25	1024.2	78083013
5.652	3.103	6.448	61	12.726	13.367	.27	1023.6	78083014
7.294	2.630	7.754	70	12.738	13.543	.26	1022.9	78083015
7.746	2.534	8.150	71	12.723	13.527	.10	1022.5	78083016
7.491	3.323	8.195	66	12.718	13.513	.11	1021.9	78083017

EASTWARD WIND (M/S)	NORTHWARD WIND (M/S)	WIND SPEED (M/S)	WIND HEADING (DEG T)	WATER TEMP (DEG C)	AIR TEMP (DEG C)	SOLAR RADIATION	BAROM PRESS (MILLIBARS)	TIME (YYMMDDHH)
7.890	3.519	8.639	65	12.684	13.419	.03	1021.4	78083018
8.437	2.936	9.312	71	12.644	13.176	.01	1021.0	78083019
8.074	4.196	9.099	62	12.608	12.841	.00	1020.3	78083020
8.644	4.041	9.542	64	12.569	12.833	.00	1019.4	78083021
9.026	3.154	9.561	70	12.534	12.775	.00	1019.0	78083022
9.152	2.055	9.380	77	12.521	12.840	.00	1018.1	78083023
8.456	-.735	8.487	94	12.535	12.916	.00	1017.9	78083100
6.209	-4.724	7.802	127	12.541	12.776	.00	1017.5	78083101
4.471	-6.689	8.045	146	12.521	12.532	.00	1017.5	78083102
5.472	-9.179	10.687	149	12.581	11.582	.00	1017.4	78083103
5.723	-8.611	10.339	146	12.568	12.201	.00	1017.5	78083104
6.191	-7.279	9.556	139	12.541	12.048	.00	1017.9	78083105
4.109	-7.904	8.908	152	12.518	11.820	.01	1018.3	78083106
5.472	-7.715	9.459	144	12.501	11.834	.04	1018.6	78083107
6.438	-6.558	9.190	135	12.491	11.897	.10	1018.9	78083108
5.131	-7.886	9.409	146	12.492	12.254	.24	1019.1	78083109
7.500	-6.460	9.898	130	12.501	12.227	.49	1019.4	78083110
7.315	-6.961	10.098	133	12.502	12.108	.40	1019.8	78083111
6.416	-5.445	8.415	130	12.512	12.277	.52	1020.0	78083112
7.651	-4.904	9.088	122	12.524	12.428	.51	1019.7	78083113
7.271	-6.221	9.569	130	12.510	12.335	.32	1019.5	78083114
6.317	-6.703	9.211	136	12.506	12.462	.39	1019.5	78083115
6.066	-6.977	9.246	138	12.507	12.464	.30	1019.6	78083116
6.191	-6.008	8.627	134	12.504	12.092	.10	1019.9	78083117
4.332	-6.979	8.214	148	12.503	12.145	.07	1020.3	78083118
6.057	-5.552	8.217	132	12.494	12.027	.02	1020.4	78083119
5.231	-6.133	8.061	139	12.487	11.966	.00	1020.6	78083120
5.282	-5.510	7.633	136	12.471	11.920	.00	1020.9	78083121
3.345	-4.972	5.992	146	12.460	12.034	.00	1020.9	78083122
5.004	-5.030	7.095	135	12.466	11.971	.00	1020.8	78083123
5.100	-3.013	5.923	120	12.471	12.000	.00	1020.7	78090100
6.330	-3.366	7.169	118	12.459	12.106	.00	1020.5	78090101
7.565	-3.465	8.321	114	12.450	12.028	.00	1020.0	78090102
6.607	-3.845	7.644	120	12.433	12.264	.00	1019.9	78090103
6.597	-3.087	7.283	115	12.419	12.143	.00	1019.7	78090104
7.093	-2.948	7.681	112	12.394	12.311	.00	1019.4	78090105
6.988	-4.448	8.284	122	12.385	12.292	.03	1019.5	78090106
6.895	-4.519	8.245	123	12.390	12.278	.11	1019.7	78090107
6.590	-3.704	7.560	119	12.410	12.348	.32	1019.7	78090108
7.602	-2.769	8.091	110	12.437	12.248	.26	1019.6	78090109
7.821	-3.046	8.393	111	12.453	12.224	.54	1019.6	78090110
6.349	-3.174	7.098	116	12.455	12.197	.55	1019.6	78090111
7.013	-2.694	7.513	111	12.483	12.210	.54	1019.6	78090112
7.259	-2.311	7.618	107	12.503	12.199	.57	1019.4	78090113
6.721	-2.364	7.125	109	12.527	12.347	.95	1019.2	78090114
6.679	-1.836	6.926	105	12.560	12.407	.55	1018.6	78090115
6.402	-1.772	6.642	105	12.571	12.728	.66	1018.6	78090116
5.493	-1.673	5.742	106	12.571	12.416	.28	1018.4	78090117
6.165	-.210	6.169	91	12.566	12.194	.12	1018.3	78090118
5.613	.794	5.669	81	12.550	12.126	.03	1018.2	78090119
5.449	.096	5.450	88	12.534	12.152	.00	1018.1	78090120
5.556	1.504	5.755	74	12.520	12.372	.00	1017.6	78090121
5.104	2.072	5.512	67	12.493	12.358	.00	1017.3	78090122
5.898	1.804	6.167	72	12.487	12.552	.00	1017.1	78090123
6.182	1.403	6.339	77	12.495	12.204	.00	1016.8	78090200
6.369	1.944	6.659	73	12.508	12.419	.00	1016.3	78090201
5.534	-.597	5.567	96	12.505	12.551	.00	1016.0	78090202
4.942	-1.709	5.229	109	12.499	12.606	.00	1015.5	78090203
4.946	-2.013	5.377	111	12.491	12.619	.00	1015.0	78090204
4.953	-1.515	5.149	106	12.491	12.649	.00	1014.8	78090205

EASTWARD WIND (M/S)	NORTHWARD WIND (M/S)	WIND SPEED (M/S)	WIND HEADING (DEG T)	WATER TEMP (DEG C)	AIR TEMP (DEG C)	SOLAR RADIATION	BAROM PRESS (MILLIBARS)	TIME (YYMMDDHH)
5.692	-.745	5.706	97	12.491	12.614	.01	1014.7	78090206
5.891	-1.635	6.113	105	12.491	12.629	.06	1014.5	78090207
5.544	-1.713	5.841	107	12.501	12.648	.16	1014.3	78090208
5.140	-1.544	5.364	106	12.504	12.675	.20	1014.3	78090209
4.705	-.917	4.742	100	12.531	12.713	.23	1014.3	78090210
3.806	-.850	3.902	102	12.556	12.731	.26	1014.2	78090211
3.709	-1.398	3.964	110	12.563	12.766	.34	1014.3	78090212
2.527	-1.302	2.843	117	12.608	12.785	.26	1014.1	78090213
1.504	-.137	1.510	95	12.649	12.972	.40	1013.8	78090214
1.502	.192	1.514	82	12.713	13.320	.67	1013.6	78090215
.659	.177	.682	74	12.793	13.305	.30	1013.3	78090216
1.396	1.699	2.199	39	12.832	12.813	.14	1013.0	78090217
.650	.576	.868	48	12.802	12.779	.08	1012.9	78090218
.099	1.403	1.406	4	12.786	12.682	.02	1012.9	78090219
.043	3.505	3.506	1	12.766	12.708	.00	1012.8	78090220
-.160	3.209	3.213	357	12.766	12.735	.00	1012.7	78090221
-.161	4.435	4.418	357	12.694	12.498	.00	1012.6	78090222
-.702	3.774	3.839	349	12.632	12.627	.00	1012.4	78090223
-1.042	5.013	5.120	348	12.627	12.562	.00	1011.9	78090300
-.921	5.304	5.383	350	12.617	12.048	.00	1011.6	78090301
-4.006	6.210	7.390	327	12.542	12.076	.00	1011.0	78090302
-2.153	5.802	6.193	339	12.520	12.517	.00	1010.2	78090303
3.348	5.432	6.381	31	12.518	13.015	.00	1009.8	78090304
5.119	4.916	7.097	46	12.551	13.044	.00	1009.6	78090305
5.701	4.555	7.298	51	12.553	13.022	.01	1009.8	78090306
4.456	3.350	5.599	53	12.564	12.880	.10	1010.3	78090307
4.478	2.058	4.928	65	12.591	12.957	.14	1010.8	78090308
4.330	-.362	4.345	94	12.591	12.622	.31	1010.9	78090309
2.960	-.310	2.977	95	12.575	12.272	.44	1011.2	78090310
3.189	-1.015	3.343	107	12.566	12.425	.41	1011.9	78090311
1.974	-.897	2.168	114	12.619	13.086	.75	1012.6	78090312
1.252	-.206	1.269	99	12.824	13.506	.99	1012.9	78090313
1.144	.100	1.148	85	13.019	13.786	.63	1012.6	78090314
-.130	-.621	.634	191	13.096	14.089	.38	1012.3	78090315
-.321	-.185	.371	240	13.207	13.731	.16	1012.2	78090316
.169	-.416	.449	157	13.136	13.070	.09	1012.2	78090317
-1.493	.406	1.547	285	13.238	13.120	.03	1012.8	78090318
-1.050	.778	1.307	306	13.253	13.086	.02	1013.1	78090319
-2.606	2.041	3.310	308	12.865	12.928	.00	1013.1	78090320
-2.450	2.900	3.797	319	12.999	12.912	.00	1013.2	78090321
-2.965	2.156	3.666	306	12.845	12.850	.00	1013.1	78090322
-3.415	1.653	3.794	295	12.645	12.550	.00	1013.1	78090323
-3.059	.770	3.155	284	12.710	12.472	.00	1013.1	78090400
-3.631	1.784	4.045	296	12.655	12.459	.00	1012.7	78090401
-3.359	2.360	4.113	305	12.690	12.274	.00	1012.6	78090402
-3.104	1.379	3.396	293	12.697	12.704	.00	1012.2	78090403
-3.210	2.217	3.901	304	12.601	12.816	.00	1011.8	78090404
-3.556	2.739	4.497	307	12.603	12.982	.00	1011.6	78090405
-2.990	4.687	5.560	327	12.629	13.037	.02	1011.6	78090406
-3.230	4.898	5.867	326	12.691	13.081	.08	1011.6	78090407
-4.059	4.716	6.222	319	12.754	13.239	.27	1011.7	78090408
-4.906	5.605	7.449	318	12.755	13.181	.35	1011.3	78090409
-5.359	5.263	7.511	314	12.734	13.248	.35	1011.1	78090410
-5.785	5.147	7.743	311	12.783	13.469	.89	1011.3	78090411
-5.204	4.912	7.156	313	12.706	13.382	.59	1010.9	78090412
-6.025	4.578	7.567	307	12.749	13.443	.76	1010.7	78090413
-7.158	4.645	8.533	302	12.767	13.253	.63	1010.2	78090414
-8.105	4.750	9.394	300	12.768	13.092	.59	1009.5	78090415
-9.693	4.588	10.724	295	12.742	12.982	.49	1008.7	78090416
-10.193	3.789	10.874	290	12.785	12.839	.28	1008.4	78090417

EASTWARD WIND (M/S)	NORTHWARD WIND (M/S)	WIND SPEED (M/S)	WIND HEADING (DEG T)	WATER TEMP (DEG C)	AIR TEMP (DEG C)	SOLAR RADIATION	BAROM PRESS (MILLIBARS)	TIME (YYMMDDHH)
-10.275	3.486	10.850	288	12.668	12.700	.14	1008.1	78090418
-11.302	3.679	11.949	288	12.602	12.672	.02	1007.7	78090419
-10.973	4.545	11.877	292	12.603	12.723	.00	1007.4	78090420
-11.144	5.347	12.361	295	12.620	12.997	.00	1006.9	78090421
-10.657	5.076	11.813	295	12.590	12.977	.00	1006.7	78090422
-11.179	4.998	12.245	294	12.570	12.934	.00	1006.2	78090423
-10.677	3.910	11.370	290	12.559	13.012	.00	1006.1	78090500
-10.812	4.274	11.626	291	12.533	12.957	.00	1005.9	78090501
-10.421	4.310	11.277	292	12.537	12.790	.00	1005.5	78090502
-11.081	3.551	11.636	287	12.505	12.709	.00	1004.8	78090503
-12.032	2.577	12.304	282	12.473	12.637	.00	1004.1	78090504
-12.293	2.240	12.496	280	12.502	12.640	.00	1003.6	78090505
-12.044	3.242	12.472	285	12.449	12.654	.01	1003.6	78090506
-11.599	3.760	12.193	287	12.438	12.635	.02	1003.6	78090507
-11.534	4.505	12.383	291	12.447	12.481	.03	1003.8	78090508
-10.826	2.763	11.173	284	12.465	12.259	.03	1003.9	78090509
-11.393	2.266	11.616	281	12.440	12.085	.05	1003.6	78090510
-11.997	2.549	12.265	281	12.444	12.061	.10	1003.4	78090511
-11.195	3.598	11.759	287	12.454	11.943	.10	1003.7	78090512
-11.431	2.692	11.744	283	12.451	11.997	.09	1003.3	78090513
-8.951	4.619	10.099	297	12.447	11.995	.04	1003.9	78090514
-1.365	4.996	5.185	344	12.421	11.187	.02	1004.2	78090515
-8.764	2.797	9.199	287	12.415	11.783	.02	1003.8	78090516
-9.756	1.406	9.856	278	12.406	11.596	.02	1003.2	78090517
-10.161	.566	10.177	273	12.391	11.626	.02	1002.7	78090518
-11.404	.626	11.421	273	12.405	11.676	.00	1002.6	78090519
-10.355	.667	10.377	273	12.411	11.683	.00	1002.7	78090520
-11.006	1.375	11.092	277	12.410	11.714	.00	1002.9	78090521
-10.979	1.463	11.076	277	12.408	11.563	.00	1002.9	78090522
-8.532	2.299	8.836	285	12.413	11.484	.00	1003.3	78090523
-2.886	2.026	3.528	305	12.407	11.455	.00	1003.4	78090600
-6.842	1.179	6.943	279	12.405	11.775	.00	1003.4	78090601
-8.087	.660	8.114	274	12.407	12.079	.00	1003.1	78090602
-7.700	.692	7.731	275	12.395	11.837	.00	1002.7	78090603
-8.256	-.522	8.272	266	12.429	11.819	.00	1002.4	78090604
-8.544	-1.677	8.707	258	12.414	12.100	.00	1001.7	78090605
-8.156	-1.871	8.368	257	12.396	12.192	.01	1001.4	78090606
-8.202	-1.307	8.306	260	12.384	12.274	.02	1001.2	78090607
-8.523	-1.399	8.637	260	12.382	12.374	.06	1001.1	78090608
-7.479	-.421	7.491	266	12.385	12.295	.11	1001.1	78090609
-8.152	-1.319	8.258	260	12.391	12.114	.08	1001.0	78090610
-6.884	-1.077	6.967	261	12.395	12.570	.49	1001.0	78090611
-4.864	-2.979	5.704	238	12.408	12.264	.31	1000.8	78090612
-1.749	1.065	2.047	301	12.414	12.446	.27	1000.5	78090613
-3.321	4.043	5.232	320	12.413	12.432	.14	1000.5	78090614
-1.961	8.255	8.489	346	12.415	12.281	.35	1000.9	78090615
-4.426	5.842	7.329	322	12.414	12.534	.27	1001.3	78090616
-6.177	3.132	6.926	296	12.429	12.811	.47	1000.8	78090617

OUTPUT DATA SPAN PERIOD

FROM 78- VII-30 20.07.30
TO 78- IX -06 17.07.30
WITH 3600.000 SECONDS BETWEEN CYCLES

NUMBER OF OUTPUT DATA CYCLES = 910

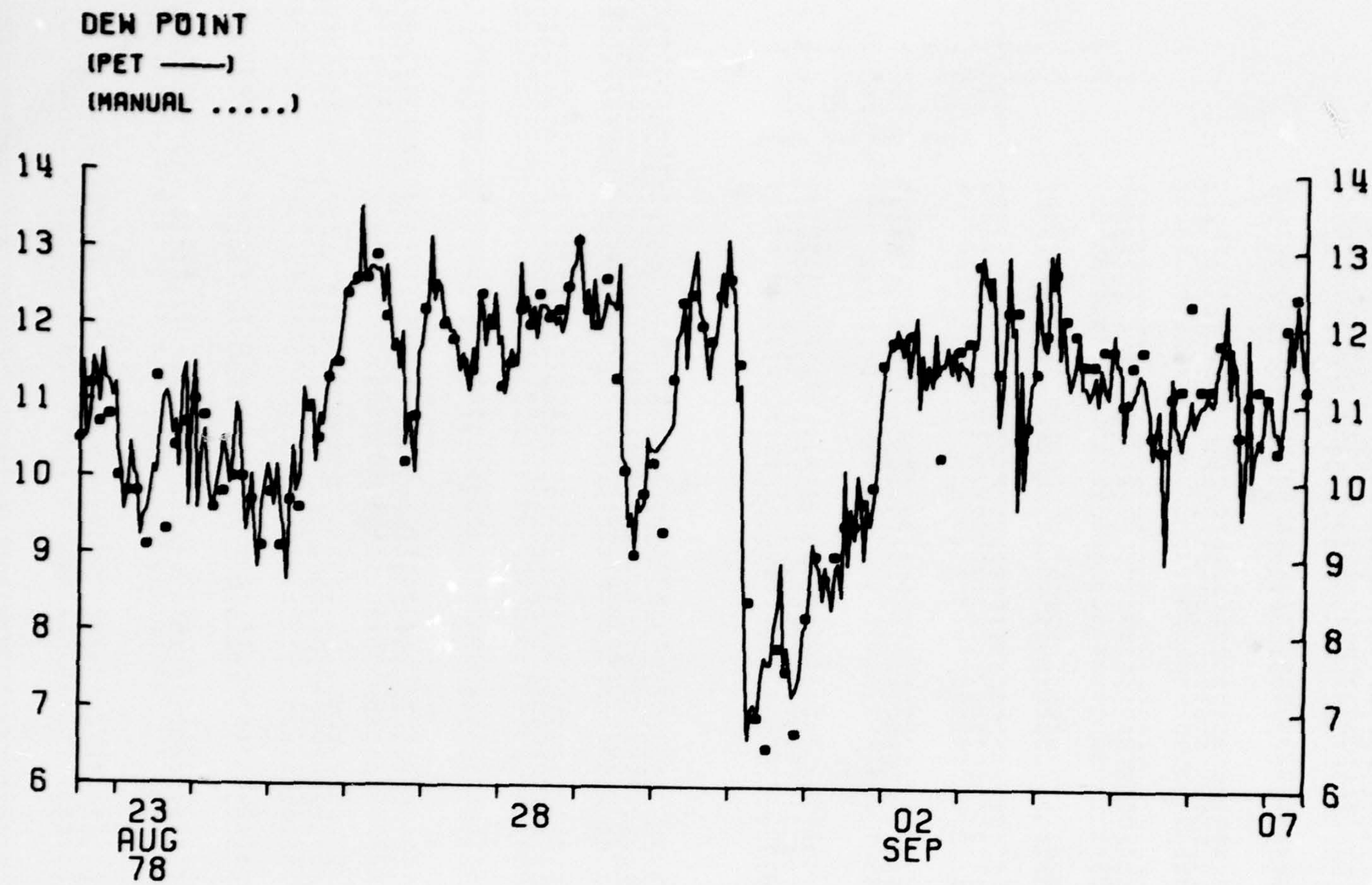
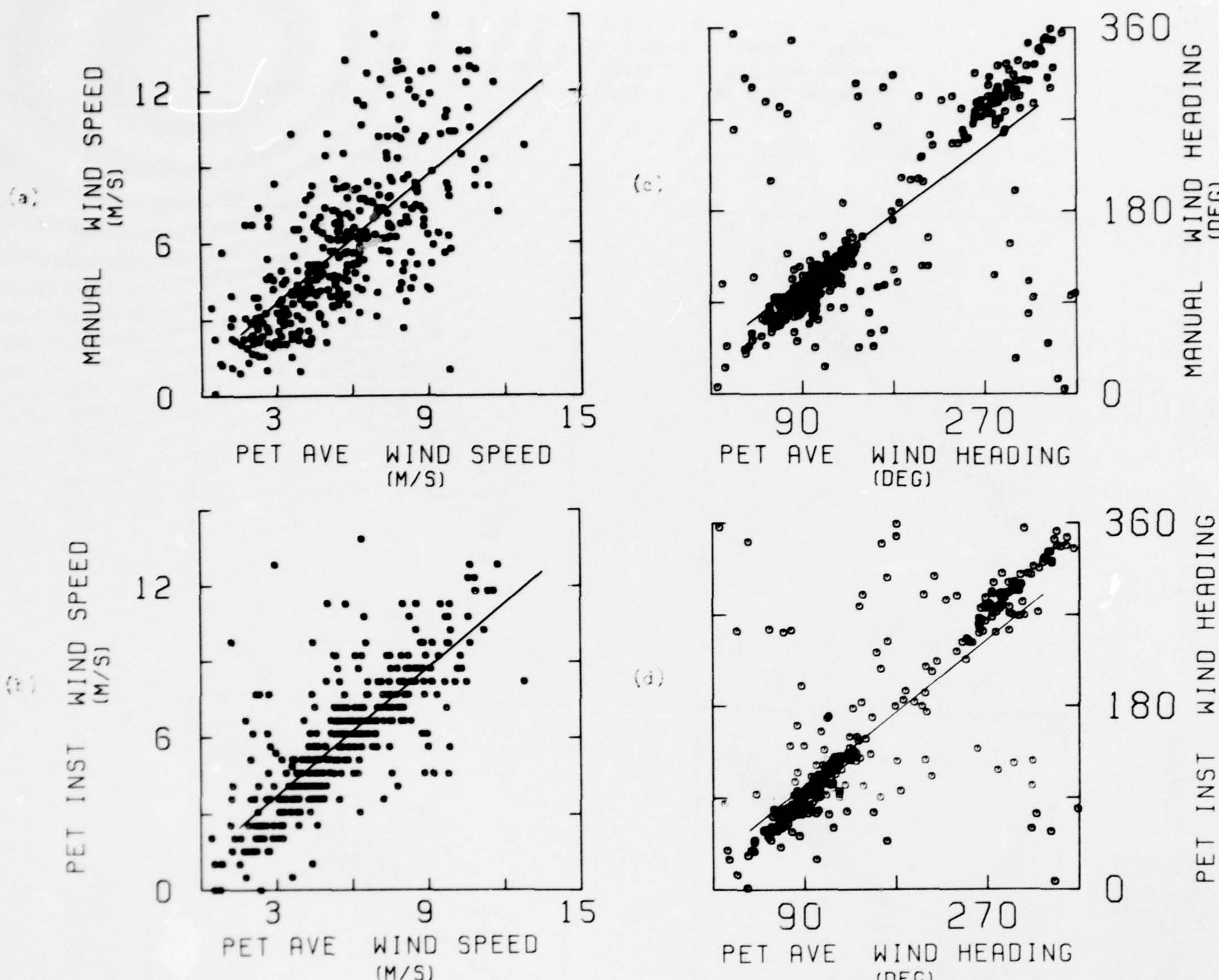
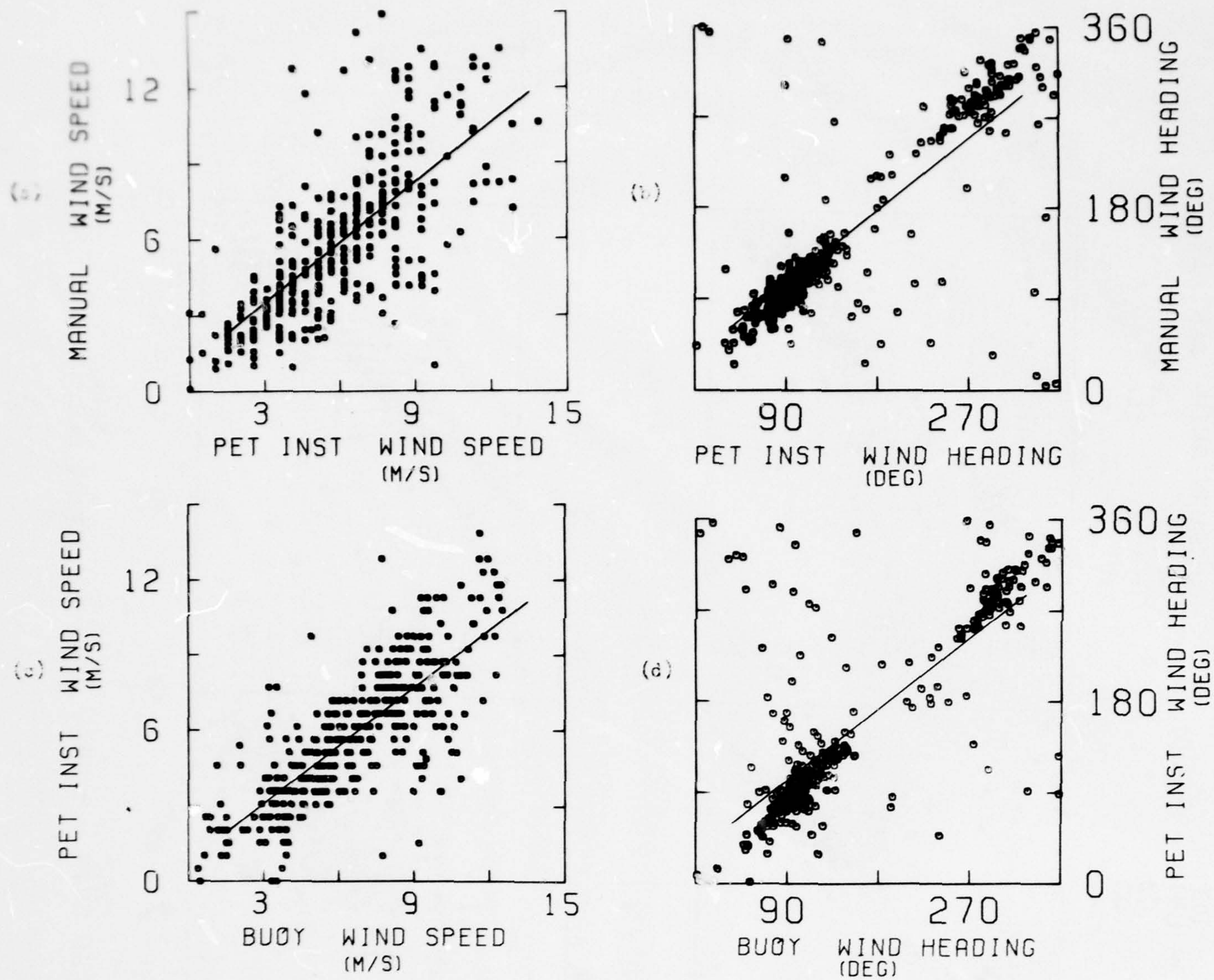


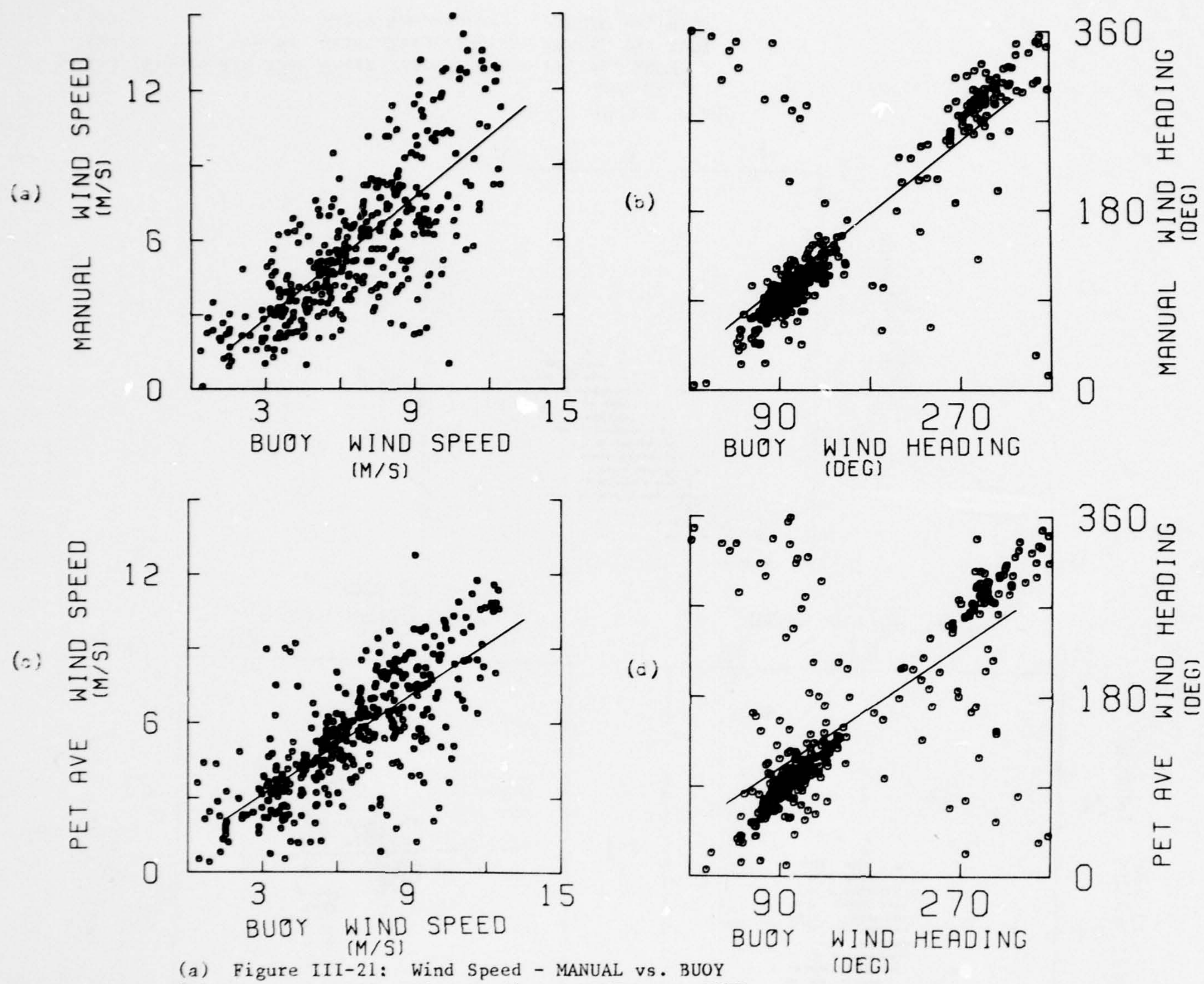
Figure III-12: Leg II Dew Point Intercomparison. PET reading from lithium chloride cell, MANUAL reading from Bendix psychometer and conversion to dewpoint (see text).



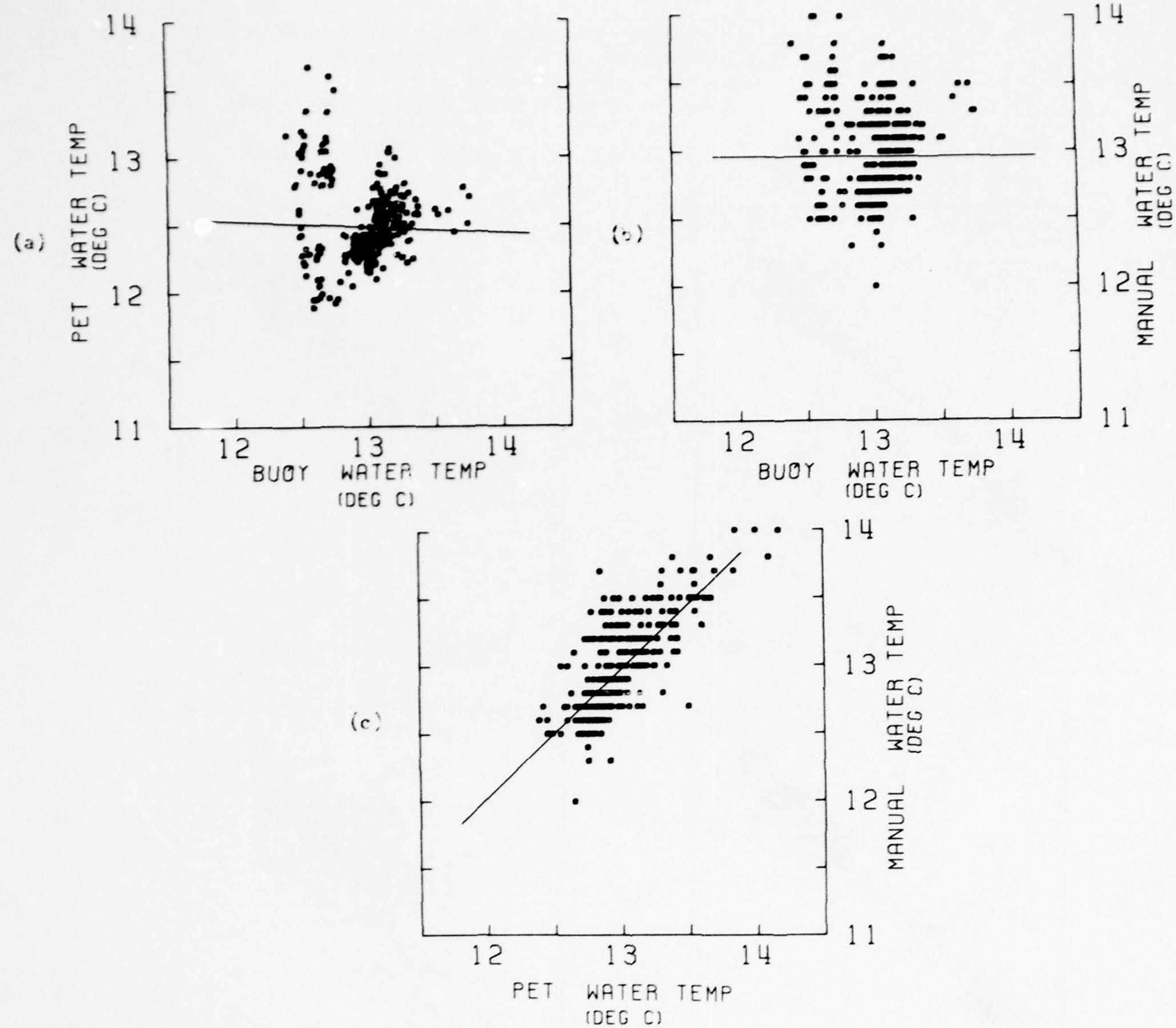
(a) Figure III-13: Wind Speed - MANUAL vs. PET Average
(b) -14: Wind Heading - MANUAL vs. PET Average
(c) -15: Wind Speed - PET Instantaneous vs. PET Average
(d) -16: Wind Heading - PET Instantaneous vs. PET Average



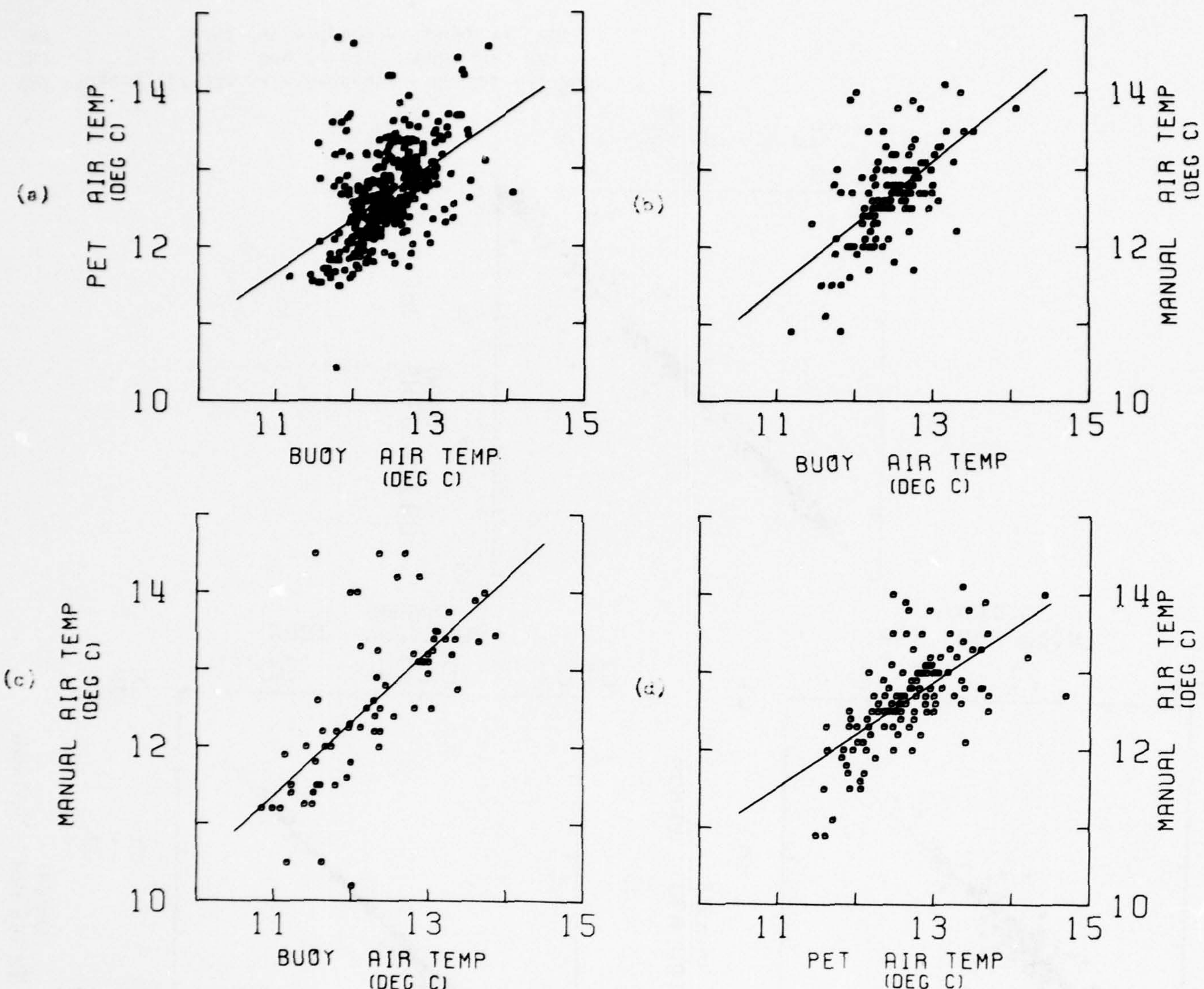
(a) Figure III-17: Wind Speed - MANUAL vs. PET Instantaneous
(b) -18: Wind Heading - MANUAL vs. PET Instantaneous
(c) -19: Wind Speed - PET Instantaneous vs. BUOY
(d) -20: Wind Heading - PET Instantaneous vs. BUOY



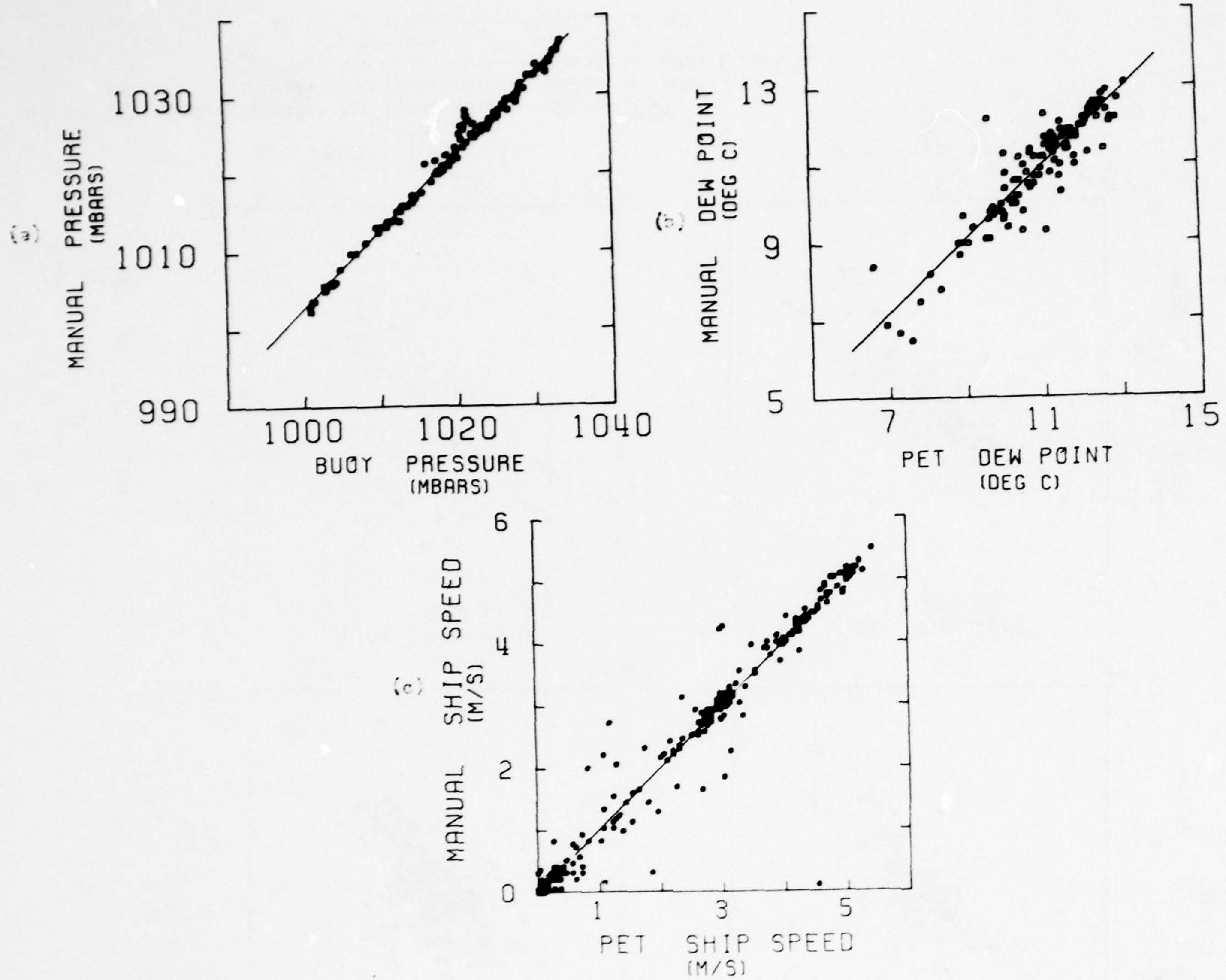
(a) Figure III-21: Wind Speed - MANUAL vs. BUOY
(b) -22: Wind Heading - MANUAL vs. BUOY
(c) -23: Wind Speed - PET Average vs. BUOY
(d) -24: Wind Heading - PET Average vs. BUOY



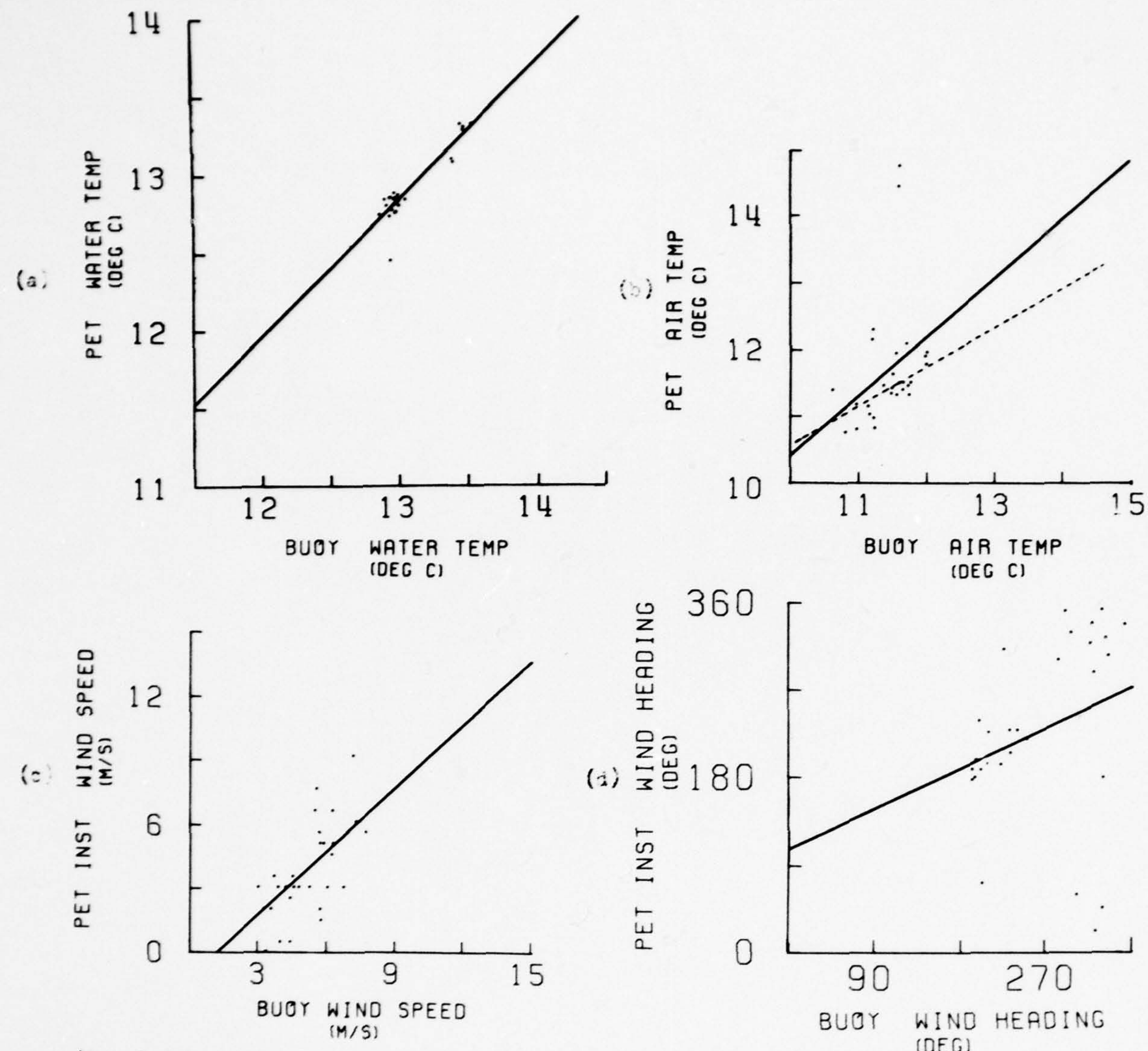
(a) Figure III-25: Water Temperature - PET vs. BUOY
(b) -26: Water Temperature - MANUAL vs. BUOY
(c) -27: Water Temperature - MANUAL vs. PET



(a) Figure III-28: Air Temperature - PET vs. BUOY
(b) -29: Air Temperature - MANUAL vs. BUOY
(c) -30: Air Temperature - MANUAL vs. BUOY (Leg 1, 4 h samples)
(d) -31: Air Temperature - MANUAL vs. PET



(a) Figure III-32: Air Pressure - MANUAL vs. BUOY
(b) -33: Dew Point - MANUAL vs. PET
(c) -34: Ship Speed - MANUAL vs. PET



(Leg-1 Intercomparisons when ship was within 10 km of the buoy)
(a) Figure III-35: Water Temperature - PET vs. BUOY
(b) -36: Air Temperature - PET vs. BUOY
(c) -37: Wind Speed - PET Instantaneous vs. BUOY
(d) -38: Wind Heading - PET Instantaneous vs. BUOY

Table III-4: Index to Scatterplots (Y = A + BX) for Leg-2 Data (except as noted)

Page No.	Figure No.	Variable	Y-Axis	X-Axis	Units	A	Standard Error	B
III-37	III-13	Wind Speed	MANUAL	PET Avg.	$m\ s^{-1}$	1.15	2.12	0.833
	-14	Wind Heading	MANUAL	PET Avg.	deg	41.97	61.12	0.744
	-15	Wind Speed	PET Inst.	PET Avg.	$m\ s^{-1}$	1.20	1.68	0.842
	-16	Wind Heading	PET Inst.	PET Avg.	deg	30.03	55.81	0.802
III-38	III-17	Wind Speed	MANUAL	PET Inst.	$m\ s^{-1}$	1.13	2.08	0.792
	-18	Wind Heading	MANUAL	PET Inst.	deg	33.71	54.15	0.798
	-19	Wind Speed	PET Inst.	BUOY	$m\ s^{-1}$	0.81	1.66	0.766
	-20	Wind Heading	PET Inst.	BUOY	deg	32.13	58.61	0.784
III-39	III-21	Wind Speed	MANUAL	BUOY	$m\ s^{-1}$	0.43	1.96	0.808
	-22	Wind Heading	MANUAL	BUOY	deg	32.69	55.68	0.802
	-23	Wind Speed	PET Avg.	BUOY	$m\ s^{-1}$	1.12	1.69	0.671
	-24	Wind Heading	PET Avg.	BUOY	deg	48.01	66.98	0.677
III-40	III-25	Water Temperature	PET	BUOY	°C	13.05	0.27	-0.045
	-26	Water Temperature	MANUAL	BUOY	°C	13.00	0.34	-0.003
	-27	Water Temperature	MANUAL	PET	°C	1.07	0.22	0.953
III-41	III-28	Air Temperature	PET	BUOY	°C	4.15	0.54	0.682
	-29	Air Temperature	MANUAL	BUOY	°C	2.51	0.49	0.814
	-30(1)	Air Temperature	MANUAL	BUOY	°C	1.10	0.75	0.933
	-31	Air Temperature	MANUAL	PET	°C	4.04	0.47	0.680
III-42	III-32	Air Pressure	MANUAL	BUOY	mbar	8.49	1.01	0.994
	-33	Dew Point	MANUAL	PET	°C	0.58	0.50	0.945
	-34	Ship Speed	MANUAL	PET	$m\ s^{-1}$	0.02	0.34	0.992
III-43	III-35(2)	Water Temperature	PET	BUOY	°C	1.46	0.99	0.876
	-36(3)	Air Temperature	PET	BUOY	°C	1.60	5.52	0.881
	-37(2)	Wind Speed	PET Inst.	BUOY	$m\ s^{-1}$	-1.20	1.34	0.987
	-38(2)	Wind Heading	PET Inst.	BUOY	deg	106.92	82.86	0.460

Notes
(1) Leg 1 data, 4 h samples
(2) Leg 1 data, periods 1600Z/2 Aug to 0500Z/3 Aug, 1600Z/8 Aug to 0400Z/9 Aug, and 1100-2400Z/9 Aug; ship-to-buoy W2 separation less than 10 km.
(3) Dashed line is regression with two outliers (PET temp > 14°C) removed; constants are A = 4.74, Std Err = 2.23, B = 0.588.

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ATLANTIS-II (CRUISE 102) MOORED AND SHIPBOARD SURFACE METEOROLOGICAL MEASUREMENTS DURING JASIN 1978 by Melbourne G. Briscoe, Carol A. Mills, Richard E. Payne, and Kenneth R. Peal. 80 pages. December 1979. Prepared for the National Science Foundation under Grants OCE77-25803 and OCE76-80174, and for the Office of Naval Research under Contract N00014-76-C-0197; NR 083-400.

During cruise 102 of the R/V Atlantis-II in the Joint Air-Sea Interaction Project (JASIN), surface meteorological data were gathered by Woods Hole Oceanographic Institution personnel from two moored buoys and from the ship.

One buoy (JASIN W2/WHOI 651) carried a Vector Averaging Wind Recorder (VAWR) and a Vector Measuring Wind Recorder (VMWR); these instruments provided 18 days of intercomparison data and 38 days of meteorological data from 30 July to 6 September 1978. The other buoy (JASIN H2) carried a VMWR and gave 25 total days of data from 16 July to 10 August, and from 26 August to 1 September.

A PET computer, hardwired to sensors positioned on the ship, displayed data that were logged during both legs of the cruise. Manual data were gathered by the science watches.

This report describes the PET system, and displays and compares all the data. VAWR hourly meteorological data are listed for the 38 day period. Scientific interpretation of these data, such as calculations of heat fluxes, will be published separately.

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