Woods Hole Oceanographic Institution

WHOI-97-13

Technical Report

August 1997

Coastal Mixing and Optics Experiment

Mooring Deployment Cruise Report
R/V *Oceanus* Cruise Number 284
31 July- 11 August 1996

by

Nancy Galbraith • William Ostrom

Bryan Way • Steve Lentz

Steve Anderson • Mark Baumgartner

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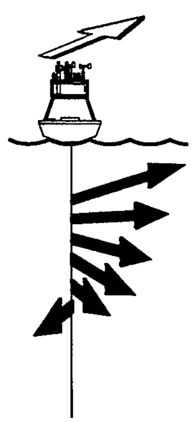

Upper Ocean Processes Group

Woods Hole Oceanographic Institution

Woods Hole, Massachusetts 02543 U.S.A.

UOP Technical Report 97-02

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Approved for Distribution:

Philip L. Richardson, Chair
Department of Physical Oceanography

Abstract

An array of moorings at four sites at a mid-shelf location in the mid-Atlantic Bight was deployed for a period of 10 months beginning in August 1996 as part of the Coastal Mixing and Optics Experiment (CMO), funded by the Office of Naval Research (ONR).

The purpose of this array is to gather information to help identify and understand the vertical mixing processes influencing the evolution of the stratification over the shelf. The observations from this moored array will be used to investigate changes in the stratification in response to atmospheric forcing, surface gravity wave variability, surface and bottom boundary layer mixing, current shear, internal waves, and advection.

This report describes the primary mooring deployments carried out by the Upper Ocean Processes (UOP) Group on the R.V. *Oceanus*, sailing out of Woods Hole during July, August, and September of 1996.

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I: Introduction

The objective of the Office of Naval Research (ONR) Coastal Mixing and Optics (CMO) program is to quantify and understand the role of vertical mixing processes in determining the mid-shelf vertical structure of hydrographic and optical properties and particulate matter. As part of CMO, the Upper Ocean Processes (UOP) Group deployed a series of moorings at a mid-shelf location in the Mid-Atlantic Bight in August 1996, which will be recovered in June 1997. The purpose of the array is to gather information to help identify and understand the vertical mixing processes influencing the evolution of the stratification over the shelf. The observations from this moored array will be used to investigate changes in the stratification in response to atmospheric forcing, surface gravity wave variability, surface and bottom boundary layer mixing, current shear, internal waves, and advection.

The array consists of a central mooring site, at approximately 40.5°N 70.5°W on the 70-m isobath, and three surrounding mooring sites. Relative to the central mooring site, the three surrounding mooring sites are ~10 km onshore at about the 60-m isobath, ~10 km offshore at about the 80-m isobath and ~25 km along isobath to the east. To monitor the ocean variability, each mooring site includes a surface/subsurface mooring pair with Vector-Measuring Current Meters (VMCMs) and temperature and conductivity instruments (SeaCATs) spaced every 5 m in the vertical, spanning the water column. In addition, an Acoustic Doppler Current Profiler (ADCP) is located on both the inshore and offshore subsurface moorings. Most sensors are sampling at intervals of 5–15 minutes, but a subset of the sensors are logging at short (45 sec. -3 min.) intervals to monitor internal wave variability. In order to completely characterize surface forcing and the near surface processes relevant to mixing, the Central Site also includes a pitch-roll buoy to obtain surface wave spectra and a surface-scanning Doppler sonar to image the near surface velocity field to identify Langmuir circulation.

Figure I.1 is a map of the CMO area showing depth contours and mooring locations, and Figure I.2 is a schematic diagram of the 10 instrumented moorings.

The oceanic response on the continental shelf is closely tied to temporal and spatial variability in the atmospheric forcing. To characterize the local atmospheric forcing, a surface buoy at the Central mooring site contains redundant meteorological instruments, Vector Averaging Wind Recorders (VAWRs). Each VAWR measures wind speed and direction, incoming short-wave and long-wave radiation, relative humidity, air temperature, sea-surface temperature, and barometric pressure. In addition, two stand-alone internally logging precipitation gauges and a sonic anemometer, which measures the wind stress using the inertial-dissipation method, are on the buoy. The buoy observations will provide the various parameters necessary for estimating the local surface momentum, heat and buoyancy fluxes. The surface buoys at the three surrounding mooring sites are more sparsely instrumented with the surface buoy at each site supporting a Weatherpak meteorological package which records wind speed and direction, air temperature, relative humidity and barometric pressure.

This report describes the primary mooring deployments carried out by the UOP Group on the R.V. *Oceanus*, sailing out of Woods Hole during July, August, and September of 1996.

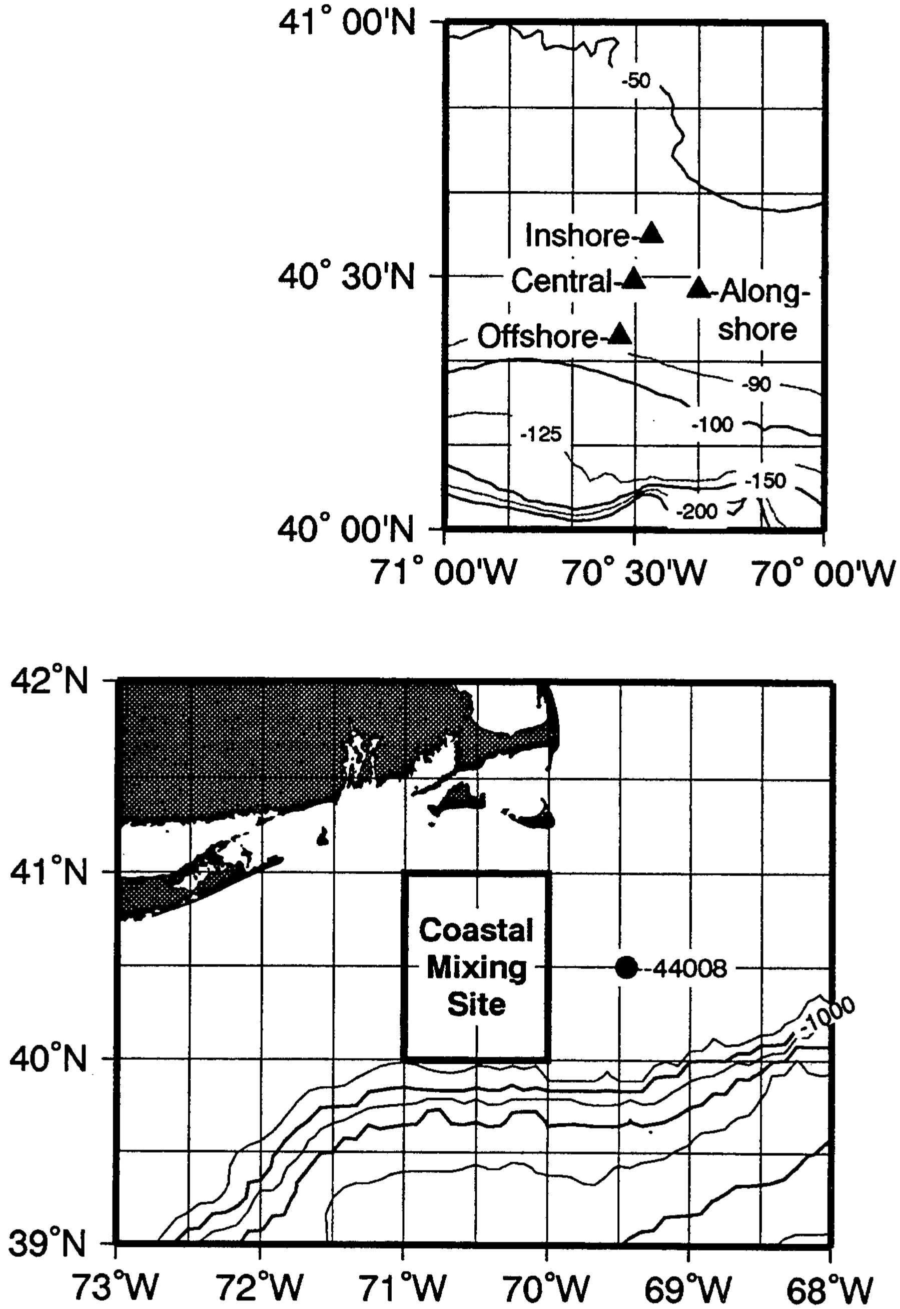


Figure I.1. CMO Site

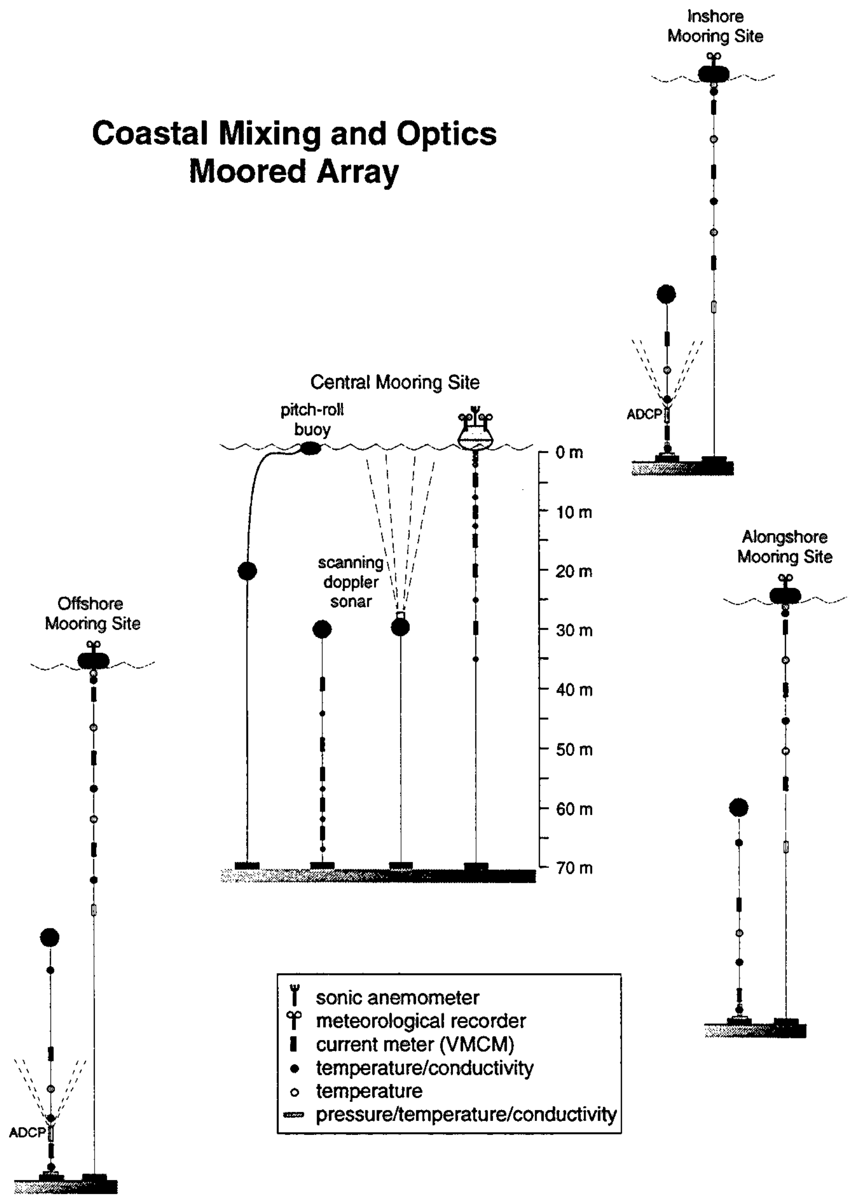


Figure I.2 Mooring Schematic

II: The Deployment Cruise

A. Cruise Chronology

R.V. Oceanus Cruise #284

July 30 The R/V *Oceanus* departed Woods Hole at 0830 (all times are local time unless noted otherwise) on July 29, 1996. We arrived at the Central Site at first light on July 30; weather was excellent, foggy but calm. The two Oregon State University (OSU) moorings and our two guard moorings deployed on Murray Levine's cruise were on station with the lights and the anemometer on the OSU meteorological buoy working fine. We checked the position of the OSU main mooring which is 40°29.52'N 70°30.46'W.

We began setting the deck to deploy the Central Site surface mooring at 0530 hours. Several shackles were added to the mooring to align all the current meters in the same orientation to minimize relative compass errors. We began the Central Site surface Mooring deployment at 0950 hours. The deployment went smoothly and was completed by 1115 (all mooring positions and times are listed in tables in section III.C). Bushings were not put into two swivels on this mooring. Began setting the deck for the Central Site subsurface mooring after lunch, again aligning the chain and instruments to have all the current meters in the same orientation. Began subsurface mooring deployment at about 1330 and finished at 1432 hours.

Visually the mooring looked about halfway between the two guards and slightly toward our surface discus buoy. However, plotting up the positions indicates the mooring was placed too far south and east. Bryan Way was unable to disable the release on this mooring after deployment, despite numerous attempts. We began setting the deck for the Seatex mooring immediately after completing the subsurface deployment. The Seatex mooring deployment started at 1620 and was completed at 1728 after a fairly long steam to get into position. Set the deck for the temporary toroid mooring at the Central Site before dinner. We added Steve Anderson's CHLAM instrument (see Appendix 6) to the mooring at 4 m below the base of the bridle. (Note: we simply added this 4 m shot of chain to the mooring.) The CHLAM was configured to take a point sample every 5 minutes. Began deployment at 1930 and the deployment was completed by 2015. All the deployments went smoothly.

Al Plueddemann and Steve Lentz setup the SeaBird SBE-25 CTD and took four CTD casts (#1–#4, section IV.B) at the Central Site between 2143 and 2231 hours. The CTD profiles looked reasonable, with a strong thermocline in the upper water column and a thick bottom mixed layer. During the CTD station, the sea surface temperature and salinity from the ship's data acquisition system were not functioning. It turned out the water wasn't being pumped through the sensors. This was corrected and the subsequent data looked reasonable.

July 31 We steamed to the Offshore Site during the night and began setting the deck around 0530 for the surface mooring deployment. We steamed over the proposed offshore mooring site and found the water depth was 87 m rather than 84 m. This was a little puzzling as both the chart and a bathymetry survey by Murray Levine indicated it should be 84 m. We steamed north to see how far we would have to go to reach the 84 or 85 m isobath. The 84 m isobath was on the edge of the shipping lane, so we decided to stick with the original mooring site location rather than move closer to the shipping lanes.

The mooring deployment began at about 0830 and finished at 0950 hours. We then set the deck and deployed the southern and northern guard buoys. Each deployment took about half an hour. The light of the northern guard buoy was flashing after we deployed it; the skies were overcast. Deployment of the subsurface mooring at the offshore site began at 1350 and was completed at 1440 hours. There was a slight hold up as one of the lines got stuck just before the subsurface float was to go over the side. Otherwise all the mooring deployments went fairly smoothly. Bryan Way did not get a chance to disable the release as we were anxious to get back to Woods Hole and load the remainder of the moorings.

We began steaming for Woods Hole at about 1450 hours. We made a brief stop at the Central mooring site to take surface water samples for Heidi Sosik and to take a bucket temperature. The samples were taken at 40°29.2' 70°30.1' at 1530 (1930 UT). The bucket temperature was 16.5°C. We arrived in Woods Hole around 2030 hours.

August 1 Loaded the ship in the morning and departed for the Inshore Site at 2130 hours.

August 2 Arrived at the Inshore Site early in the morning. The weather remained calm and foggy. Began preparing the deck at 0530 for deployment of the surface mooring at the Inshore Site. The mooring deployment began at 0830 and was completed at 1000 hours. We then deployed the southern (label P) and northern (label T) guard moorings for the Inshore Site. The deployments both went smoothly, took about 20 minutes each and were completed just after lunch. We set the deck for subsurface mooring and began deployment at 1330 hours. For some unexplained reason the acoustic release fired on deck just as we were beginning the deployment. We brought out a spare release and proceeded with the deployment which went smoothly after that and was completed by 1425 hours.

We took four CTD casts at the Inshore Site (#5–8, Section 4.b), the first at 1535 and the next three from 1710 to 1730 hours.

After completing the CTD casts we proceeded to the Central Site. All the buoys were in place at the Central Site and all the lights were working. We took three CTD casts (#9–11) at this site between 1936 and 1955 hours. Bryan Way was finally able to disable the release on the Central Site subsurface mooring by having the ship move about a mile from the site.

August 3 Weather continues to be ideal. We began setting up to recover the temporary toroid mooring at the Central Site at about 0630 hours. While setting up for the recovery we took three CTD casts (#12–14) at about 0700 hours. The release was fired at 0820 hours. The recovery went smoothly and was completed before 0900 hours. Steve Anderson's CHLAM seemed to work fine. Steve hooked the CHLAM up to the salt water intake to monitor surface chlorophyll during the remainder of the cruise (see Appendix 6).

We then steamed to the alongshore site. Initial bathymetric survey of the planned alongshelf site (40°27.0' 70°20.0') revealed the water was too deep. So we steamed north until we reached the 70-m isobath which was at 40°28.5'. This had the added advantage of putting us closer to the center between the outbound and inbound shipping lanes. The surface mooring deployment began at 1100 hours and was completed just before noon without incident. After lunch we deployed both guards in less than an hour, finishing just before 1400 hours. Deployment of the subsurface mooring began at 1520 and was completed by 1540 hours. This completed the mooring deployment operation which went very smoothly.

We took three CTD casts (#15–17) at the alongshore site between 1638 and 1701 and then proceeded to the offshore site where we also took three CTD casts (#18–20) from about 1830 to 1848 hours. Bryan also communicated with the release from the subsurface mooring at the offshore site because we hadn't done that after deployment as we were anxious to get back to WHOI and reload the deck.

We then steamed offshore to the shelfbreak and at 9:08 pm began a cross-isobath CTD transect of 21 stations (casts 21–41) extending from the 170-m isobath to about the 40-m isobath. Station separation is about 5 km. We divided into three watches: Lentz, Ostrom and Way 4–8; Anderson, Baumgartner, Ray 8–12; and Fischer, Marquette, Ware 12–4.

August 4 The cross-shelf transect was completed by 0845 hours. The temperature and salinity sections look classical for this shelf. There is very warm water (20–17°C) above a sharp thermocline located 10 to 20 m below the surface, with cold pool water (7–8°C) below. The shelfbreak front is clearly visible in salinity (>34 psu offshore of front and < 33 psu inshore), the foot of the front intersects the bottom at the 110 m isobath.

We began an along-isobath survey at 1137 hours. The survey consists of 11 casts per isobath, with casts separated by about 5 km and the transect centered on the mooring line. The survey transects run along the 60, 70, 80, 90, 100 and 125-m isobaths. Near the end of the 60-m isobath transect the CTD stopped recording due to a battery failure. This was a little peculiar because the voltage output according to the instrument status report was 10.7 volts and the manual indicated 10.2 volts as a cutoff. After checking things out we replaced the batteries and the system worked fine.

August 5 Continues to be flat calm and foggy. We haven't seen the sun in several days. The alongshore survey proceeded all day.

August 6 Completed the alongshore survey, including repeating the 70-m transect, at about 1230 hours. There were a total of 80 CTD stations in the alongshelf survey (casts 42–121). We stopped by the alongshore mooring site at 0845 hours. The buoys looked fine. The waterline on the guards was about 6 inches below the bottom of the yellow paint (i.e., about 6 inches of brown was showing). The waterline on the toroid was at the bottom of the W. After completing the alongshore survey, we steamed to the Inshore Site and inspected the buoys. Again everything looked fine, the waterline on the toroid was a few inches below the bottom of the X. We took a CTD station at the Inshore Site (cast 122).

Arrived at the Central Site around 1630 and did a complete tour around the moorings. It was really quite impressive, especially the Wavescan with its green tail. All the buoys were in place and looked fine including both of Levine's. The waterline on the Discus was right at the painted waterline. The sun finally came out as we left the Central Site.

We began the second cross-shelf CTD transect at about 2030 hours. We extended this transect about 10 km further offshore adding two more stations to include more of the slope structure (casts 123–145). We took pictures of the radar images of the lobster pot high-flyers for Jack Barth at some of the CTD stations so they have some idea of the density and location of the lobster pots.

August 7 Finished the second cross-shelf CTD transect at 0830 hours. Water samples were again taken at the Central Site for Heidi Sosik at 0325 hours. The transect looks very similar to the previous cross-shelf transect we took. Arrived in Woods Hole around 1330 and unloaded the ship.

August 8 In port.

August 9 Departed from Woods Hole for Leg 3 at 0915 and steamed to the Central Site to deploy Yogi Agrawal's bottom tripod. Arrived at the Central Site around 1500 hours. Paul Hill checked out his release. We lowered the tripod into the water and Paul disabled it while it was hanging over the side. We then steamed slowly into position and released the tripod at 1524 hours (1924 UT).

We steamed to the offshore end of the cross-shelf CTD transect to repeat that line (casts 146–168). Watches were: Lentz and Barlow 4–8; Hill and Chang 8–12; and Carr and Tran 12–4. Began the CTD transect at 1820 on August 8 and completed the transect at 0600 on August 9.

A very successful cruise. We deployed all the moorings and the tripod and had time to do a rather extensive CTD survey of the region. The success of this cruise is largely due to the skill and cooperation of the crew and scientific party and the calm weather.

B. Shipboard Data Systems

The *Oceanus* was equipped with an Improved Meteorological System (IMET) meteorological package. Data was displayed throughout the ship, and recorded on a Sun SparcStation. Variables available were air temperature, sea surface temperature, barometric pressure, relative humidity, precipitation, short wave radiation, ship-relative winds, and ship's speed over ground, course over ground, and gyro heading. SST measurements were incorrect until July 30, because the pump supplying seawater to the sensor was not powered up. The data has been archived and may be used if needed at a later date.

Two hull-mounted Acoustic Doppler Current Profiler (ADCP) systems were recording during the deployment cruises. Data from these systems was collected, but not analyzed during the cruise.

III: The Moored Array

A. Summary Description

The Central Site includes seven moorings and two bottom tripods in a region roughly 0.5 km square (Figure III.A.1). The basic strategy was to surround the subsurface moorings and tripods with surface moorings and guards in a fairly tight configuration to protect the site from the heavy fishing and shipping activity in the region. The two guards and the OSU surface and subsurface moorings were deployed on a previous cruise. One of the bottom tripods was deployed on a subsequent cruise. The other three moorings were deployed July 30 (Table III.C.4) and one bottom tripod was deployed August 9 on this deployment cruise. Additionally, one of the toroid buoys was deployed approximately 300 m south of the Central discus buoy from July 31 to August 3 to compare wind measurements (Appendix 5).

The three surrounding sites each consisted of four moorings, a toroid, two guards and a subsurface mooring (Figures III.A.2–4). The toroid and two guards form a triangle that is approximately 400 m on a side, with the subsurface mooring in the middle. Deployment times, water depths and positions for the moorings at each of the sites are listed in Table III.C.4. Mooring designs for the toroid and subsurface moorings are shown in Figures III.B.5–6 for the alongshore site, Figures III.B.7–8 for the inshore site, and Figures III.B.9–10 for the offshore site.

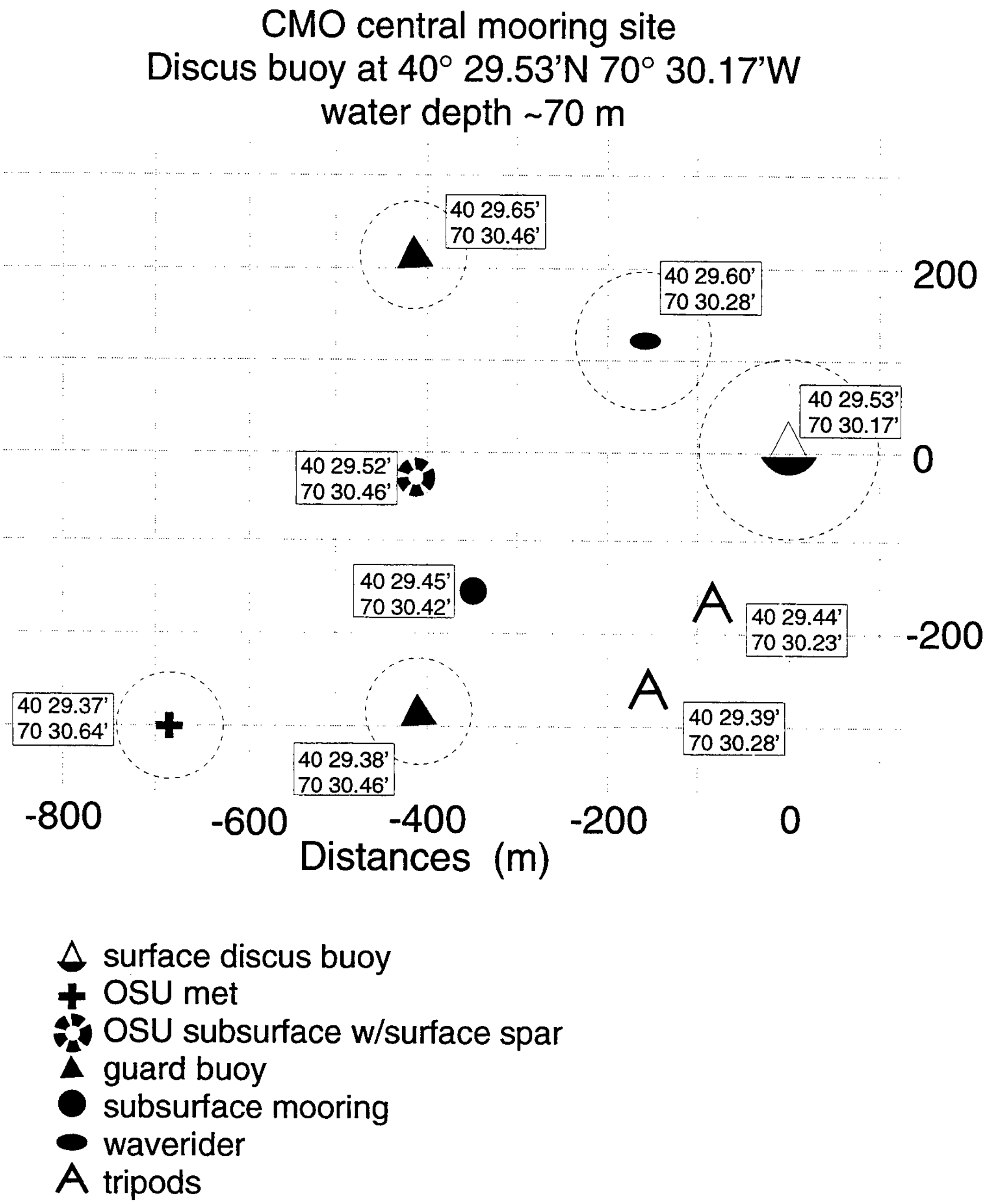


Figure III.A.1. Central Site Plan

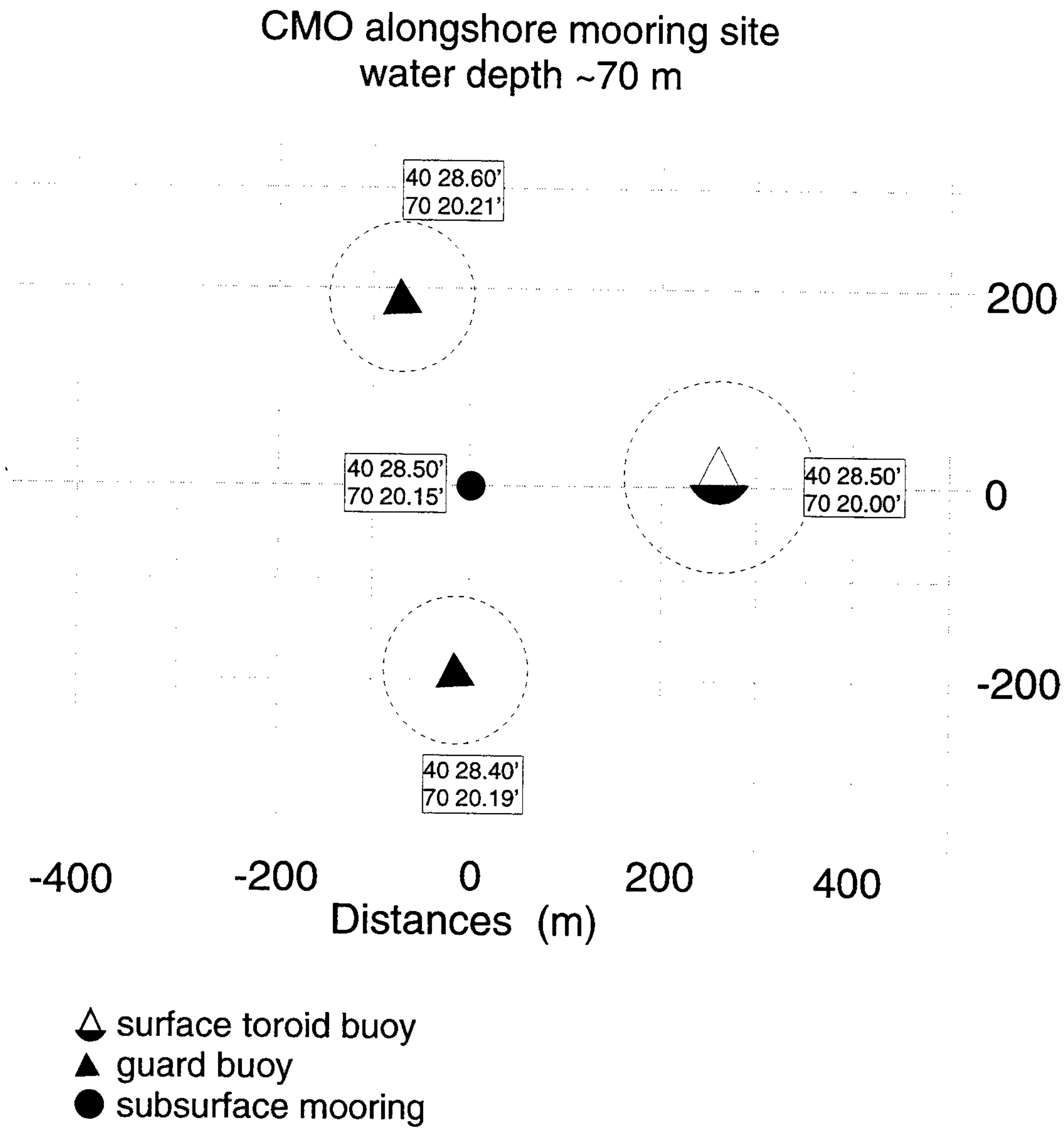


Figure III.A.2. Alongshore Site Plan

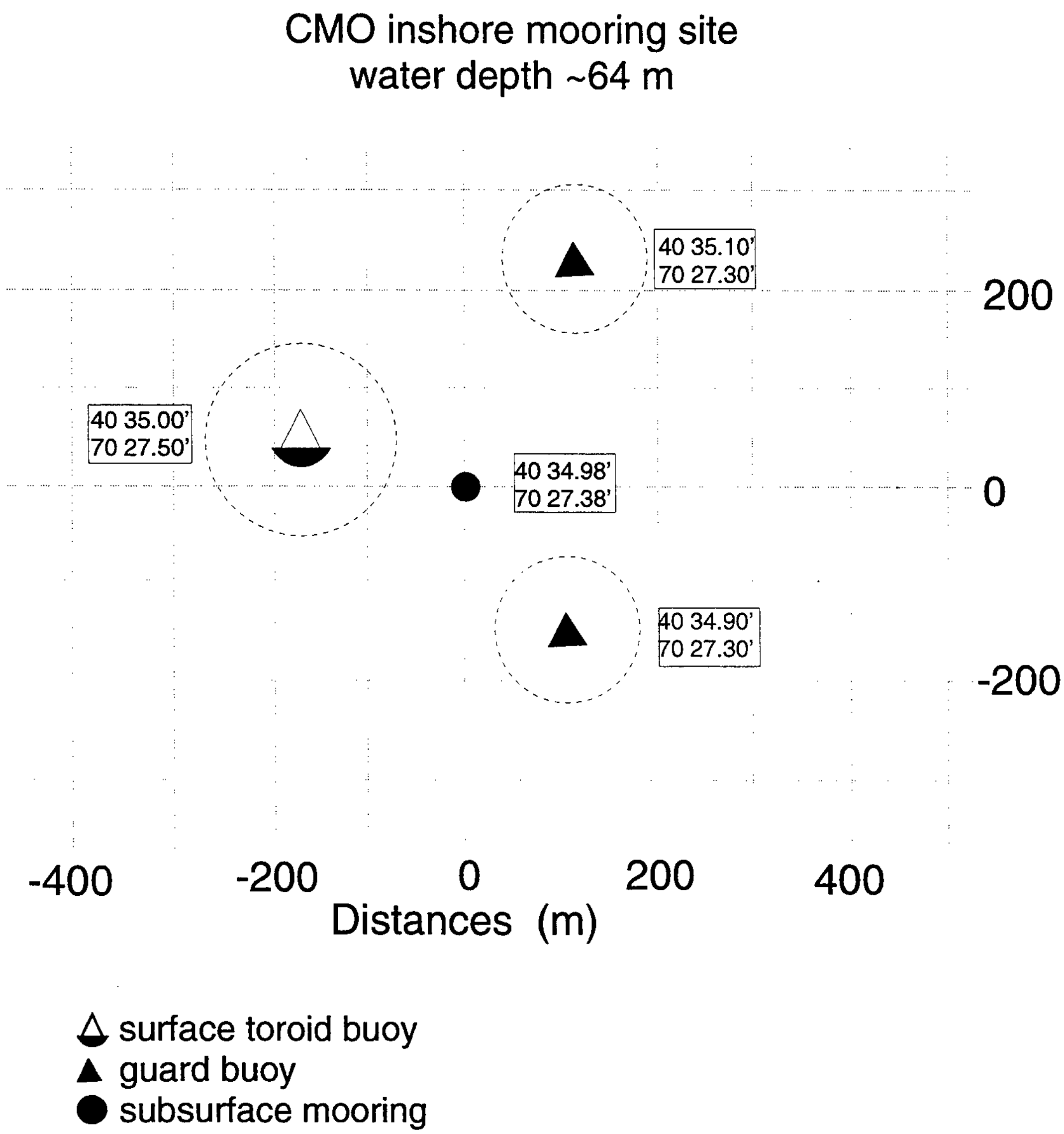


Figure III.A.3. Inshore Site Plan

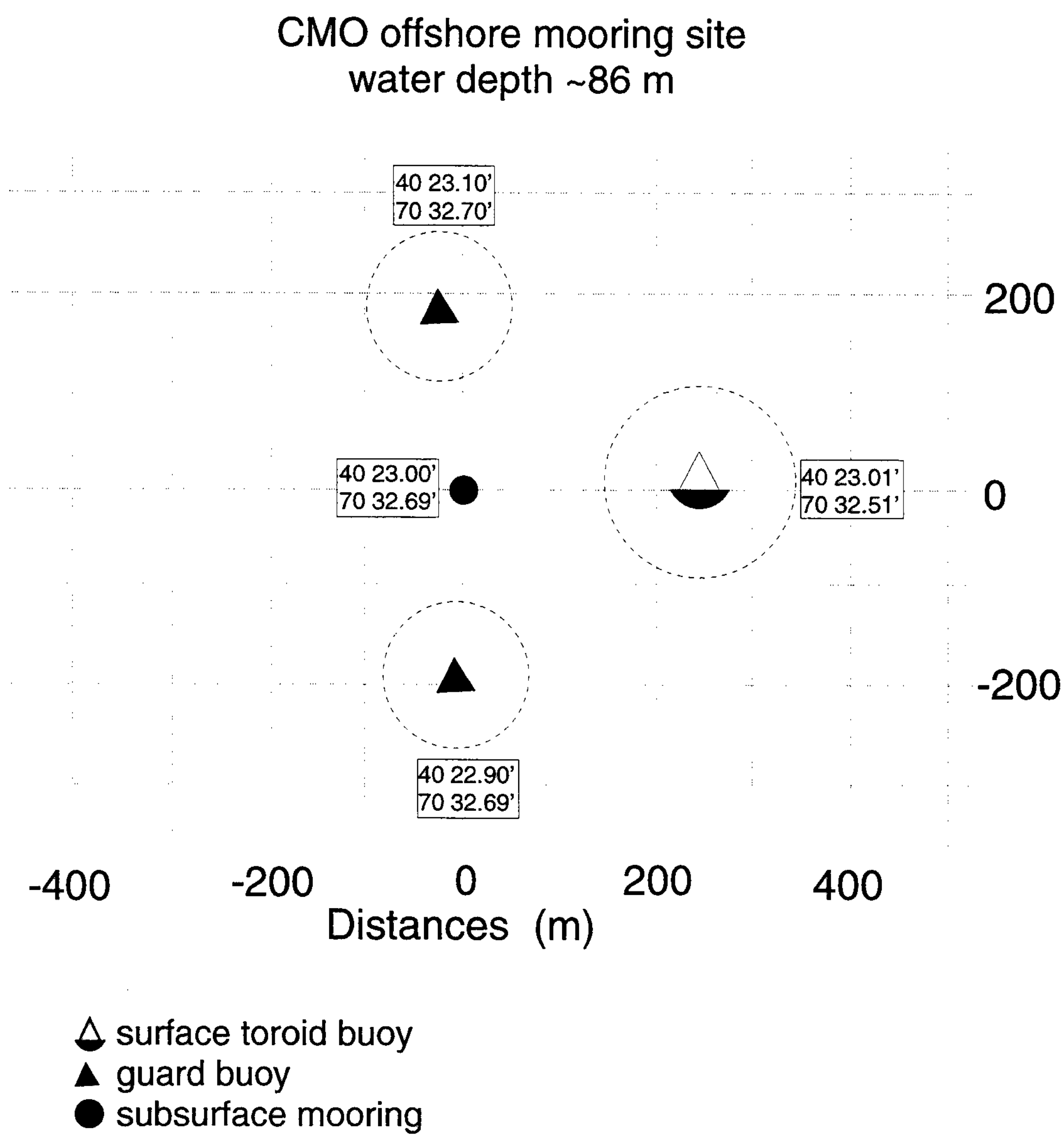


Figure III.A.4. Offshore Site Plan

B. The Moorings

The designs for the discus, toroid, Wavescan, subsurface, and guard moorings are shown in section III.B. Mooring numbers and deployment information are listed in Table III.B.1. Mooring diagrams are illustrated in Figures III.B.1 through III.B.11.

Number	Buoy	Set date	Time	Depth	Lat	Long
1000	Discus	96-07-30	15:14	70.0	40 29.532	70 30.167
1001	Subsurface	96-07-30	18:32	69.9	40 29.453	70 30.416
1002	Seatex	96-07-30	21:28	70.9	40 29.599	70 30.285
1003	Toroid	96-07-31	00:16	70.0	40 29.348	70 30.205
	recovered	96-08-03	12:18			

Number	Buoy	Set date	Time	Depth	Lat	Long
1004	Toroid	96-07-31	13:50	87.0	40 23.009	70 32.509
NA	Guard	96-07-31	15:23	87.0	40 22.898	70 32.691
NA	Guard	96-07-31	16:49	86.0	40 23.102	70 32.704
1005	Subsurface	96-07-31	18:38	86.0	40 23.003	70 32.687

Number	Buoy	Set date	Time	Depth	Lat	Long
1006	Toroid	96-08-02	14:04	64.0	40 35.002	70 27.500
NA	Guard	96-08-02	15:02	64.0	40 34.901	70 27.301
NA	Guard	96-08-02	16:36	64.0	40 35.104	70 27.301
1007	Subsurface	96-08-02	18:25	63.0	40 34.978	70 27.380

Number	Buoy	Set date	Time	Depth	Lat	Long
1008	Toroid	96-08-03	15:51	70.0	40 28.500	70 20.002
NA	Guard	96-08-03	17:18	70.0	40 28.401	70 20.193
NA	Guard	96-08-03	17:57	69.5	40 28.601	70 20.205
1009	Subsurface	96-08-03	19:39	69.5	40 28.504	70 20.147

Table III.B.1. Mooring Deployment Information

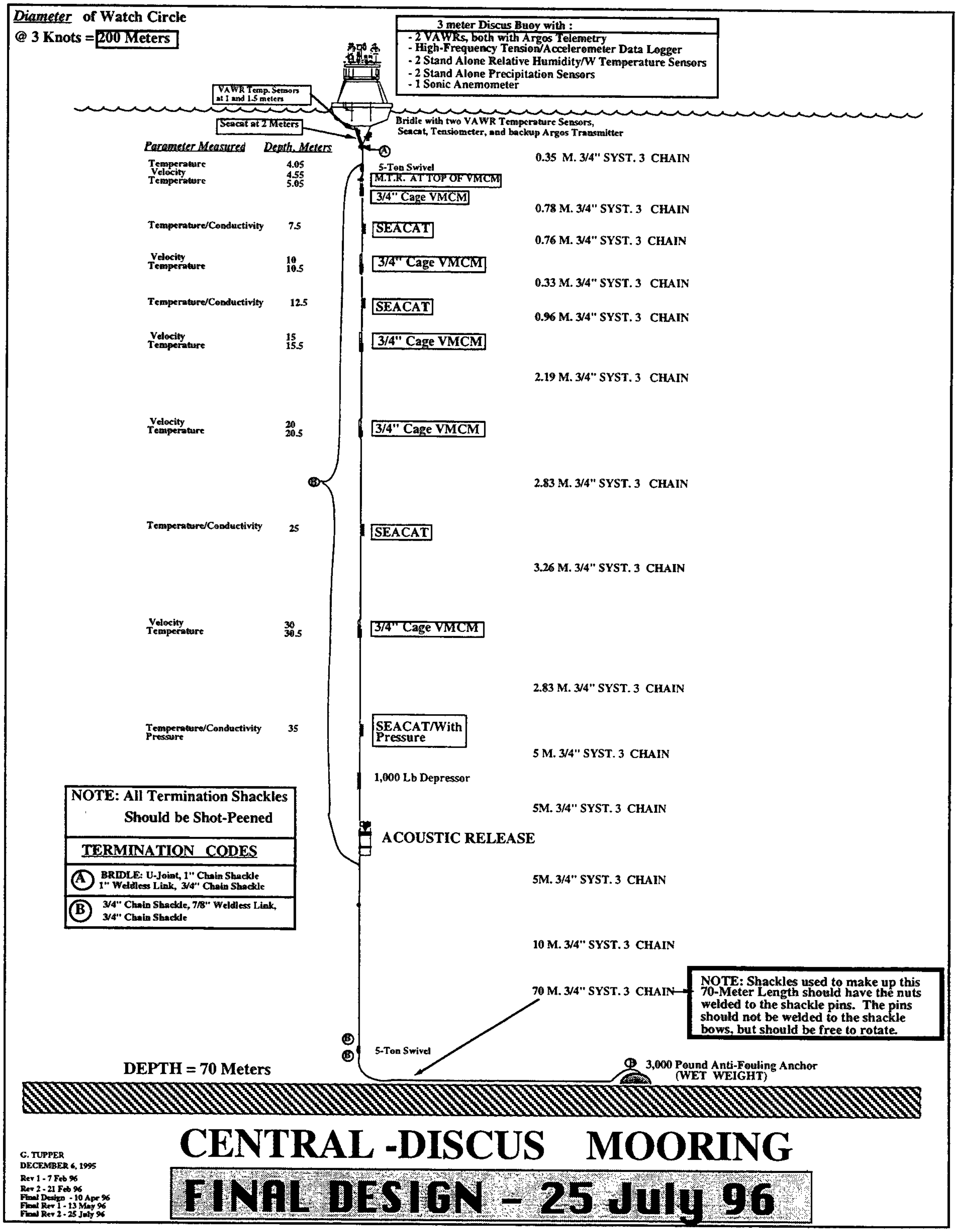


Figure III.B.1: Central Discus Diagram.

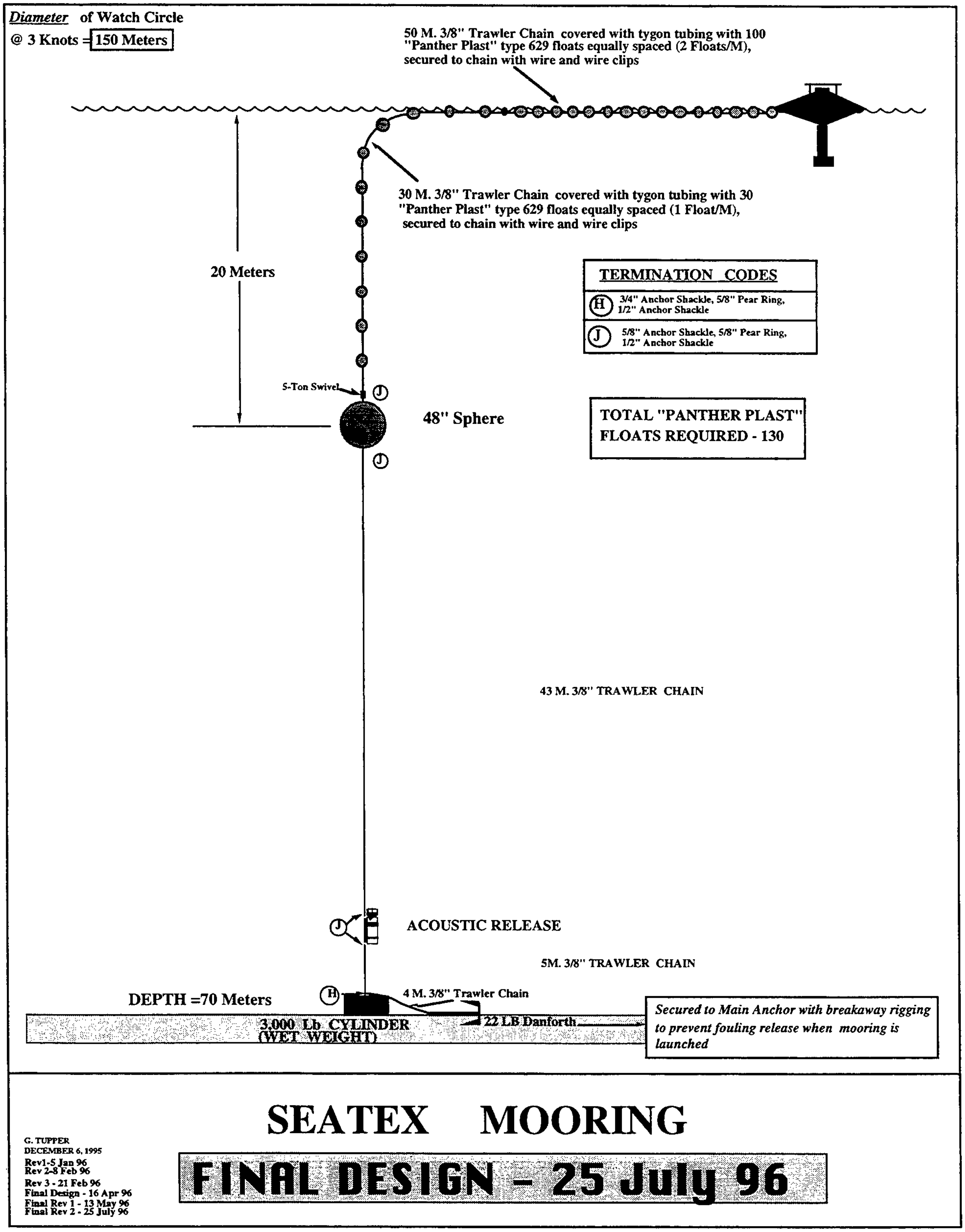


Figure III.B.2: Seatex Wavescan Diagram.

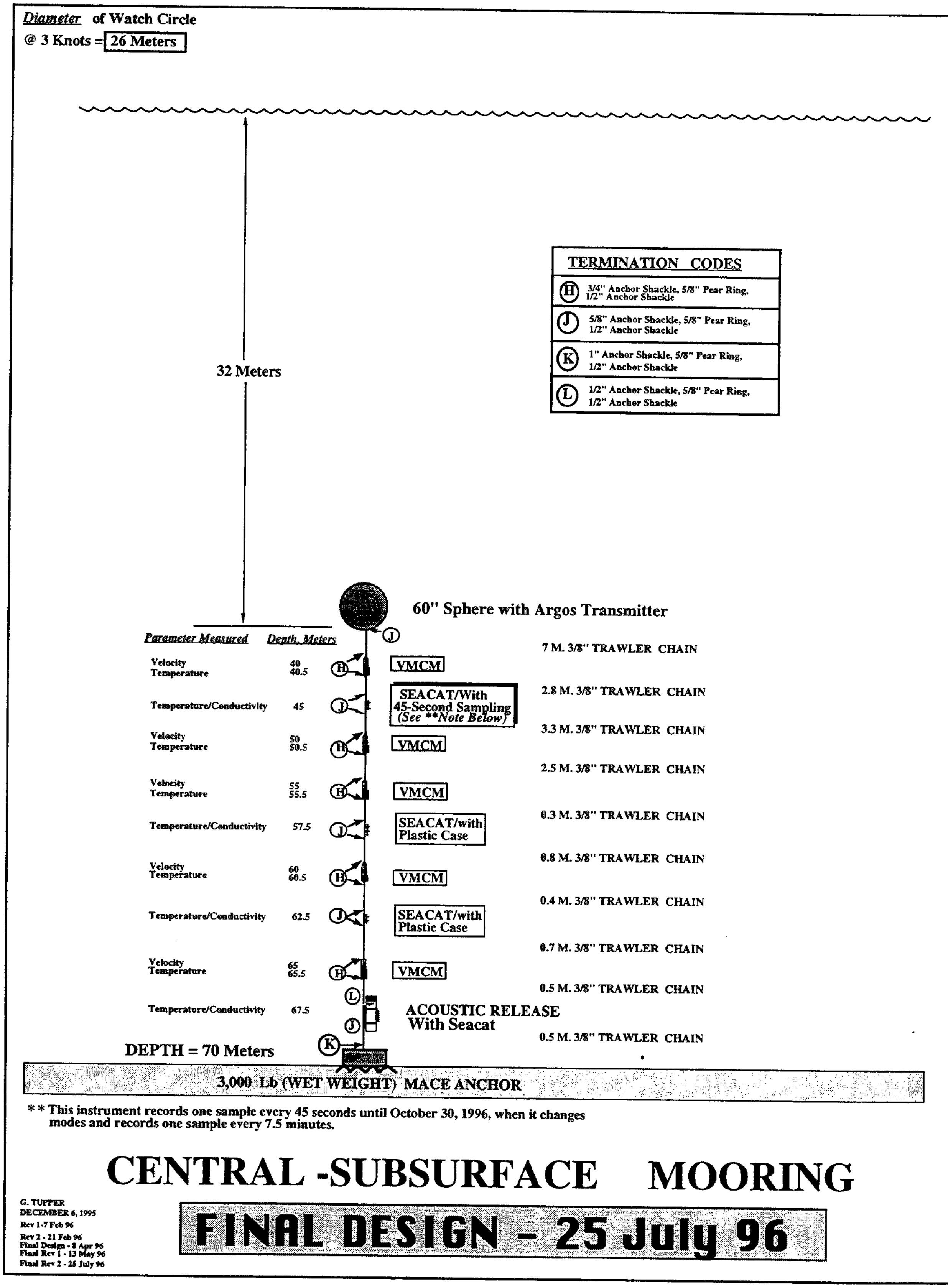


Figure III.B.3: Central Subsurface Diagram.

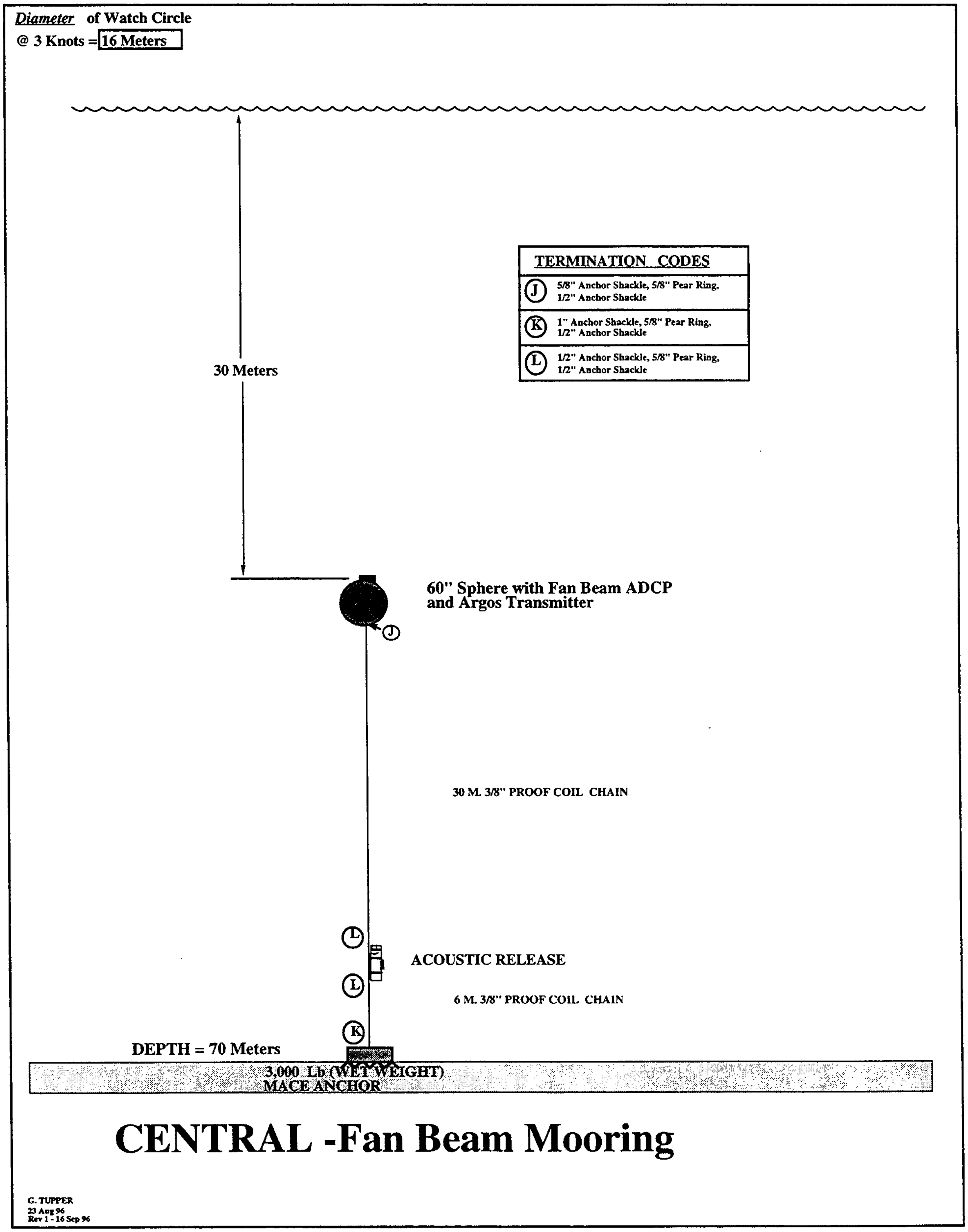


Figure III.B.4: Central Fan Beam Mooring Diagram.

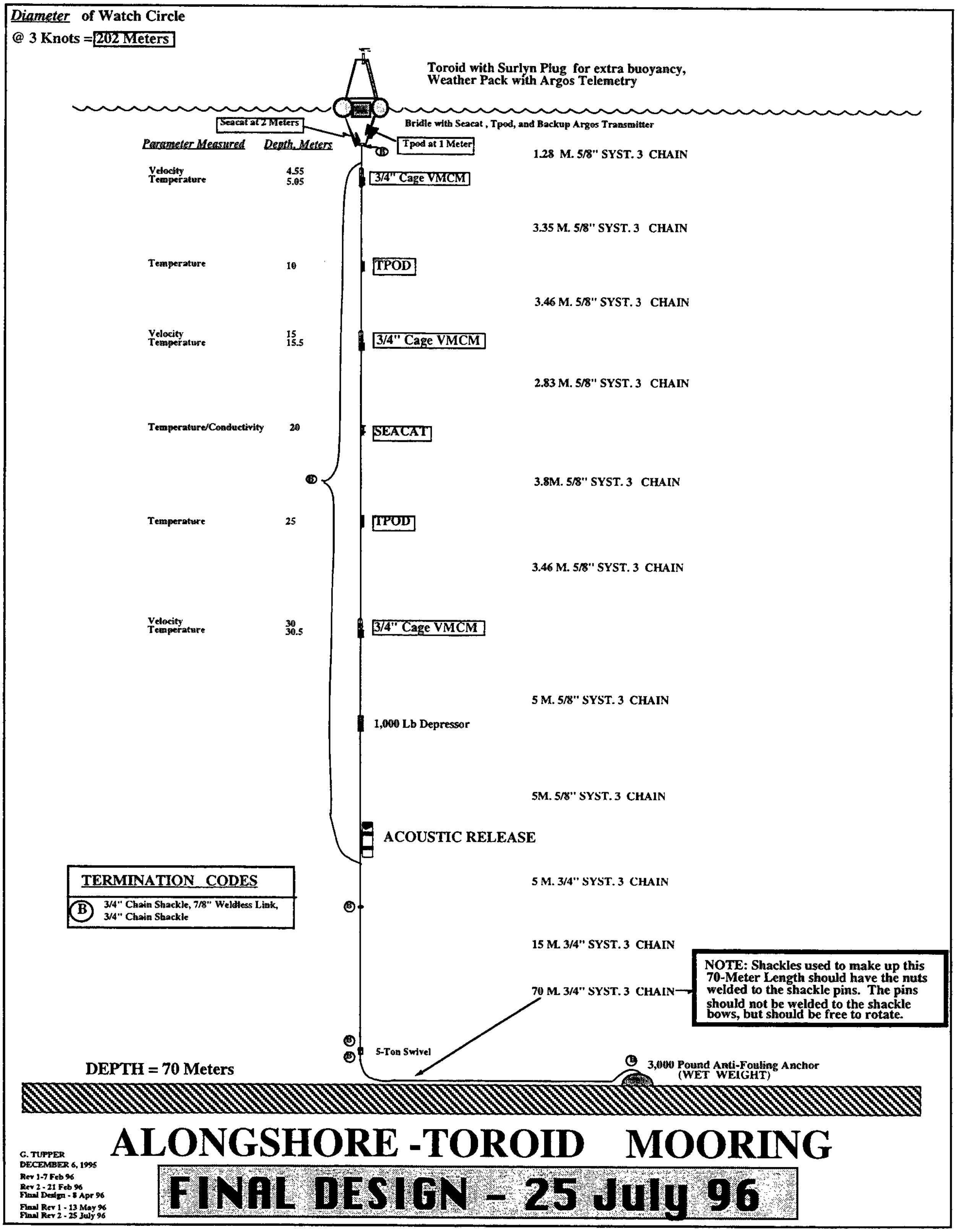


Figure III.B.5: Alongshore Toroid Mooring Diagram.

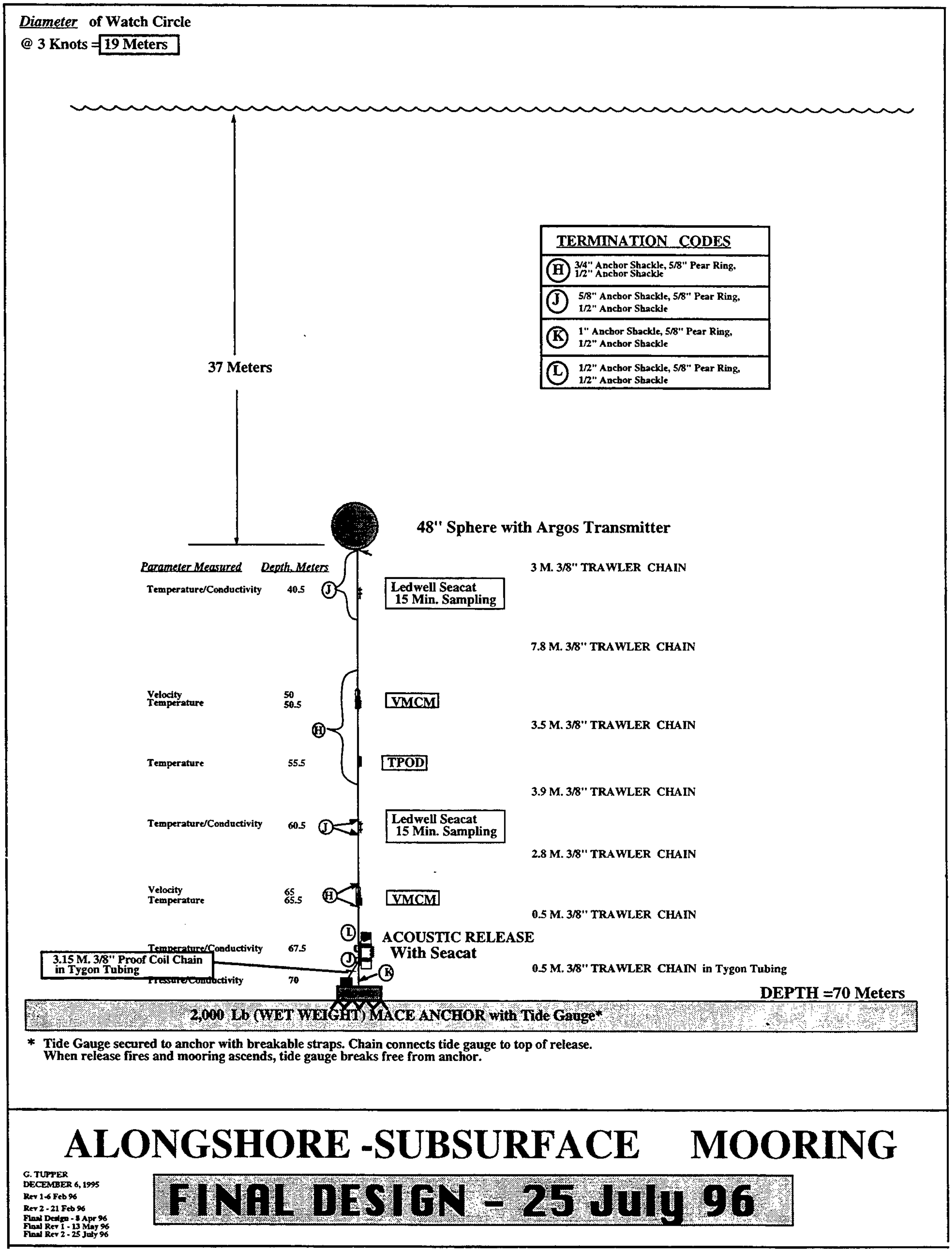


Figure III.B.6: Alongshore Subsurface Mooring Diagram.

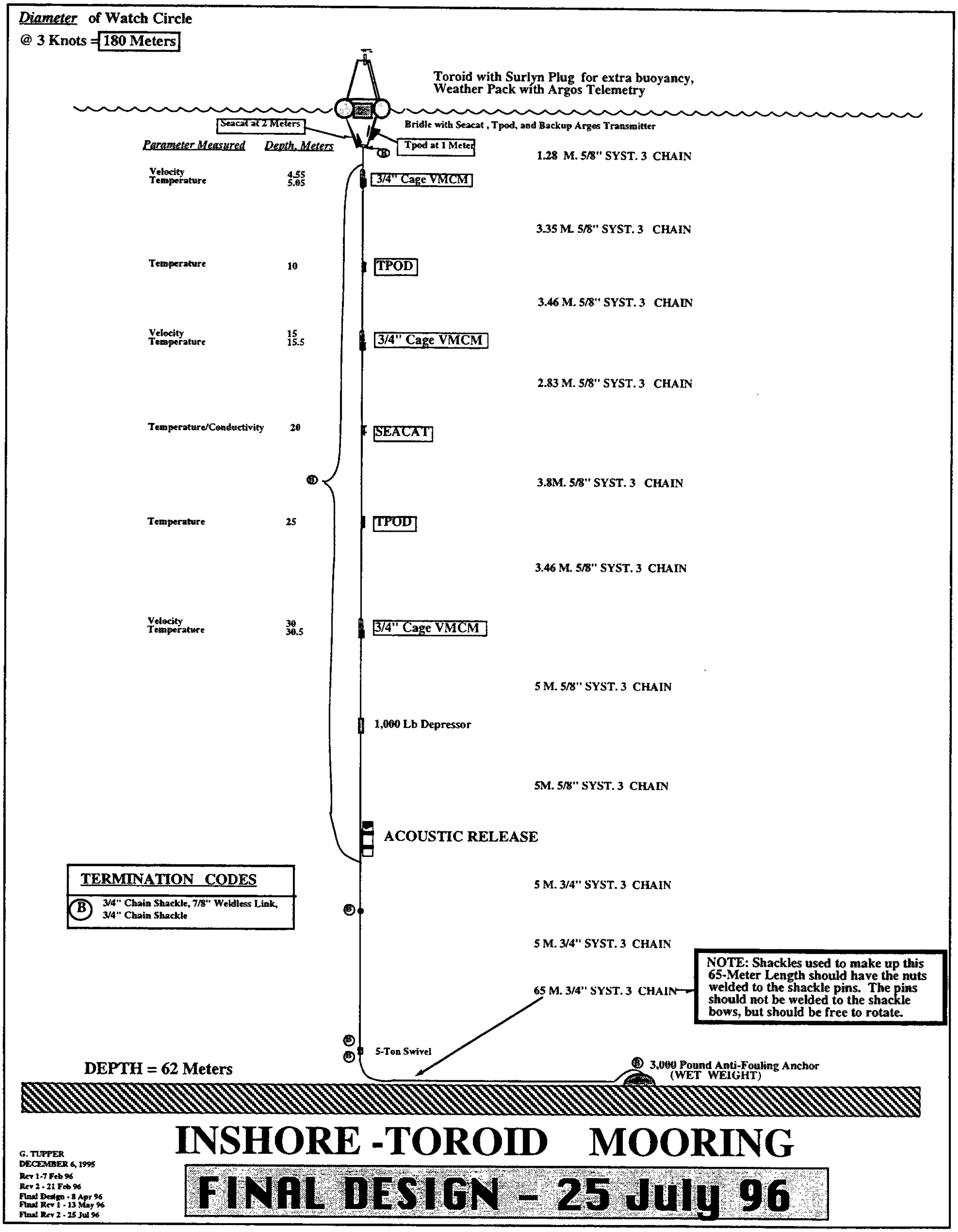


Figure III.B.7: Inshore Toroid Mooring Diagram.

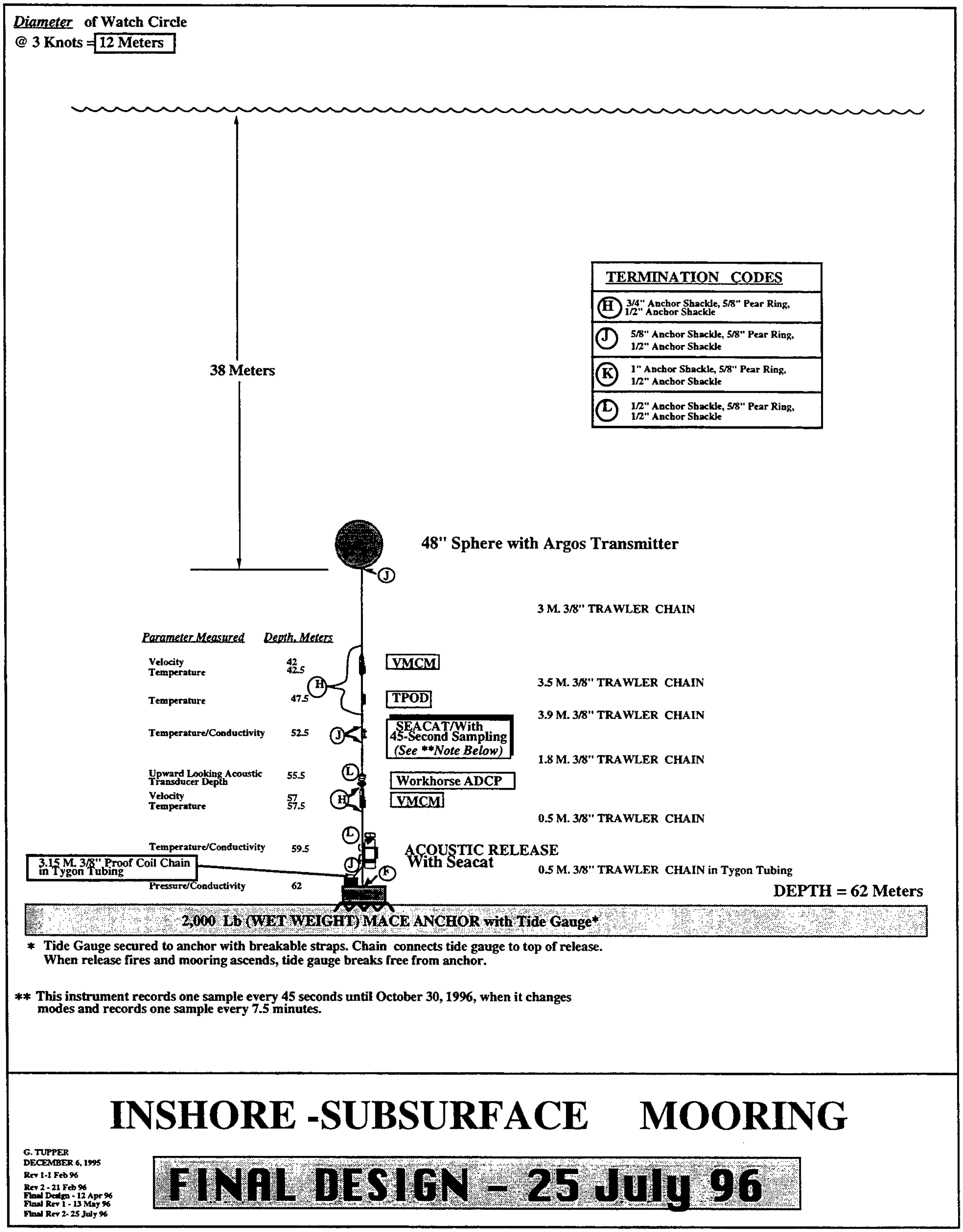


Figure III.B.8: Inshore Subsurface Mooring Diagram.

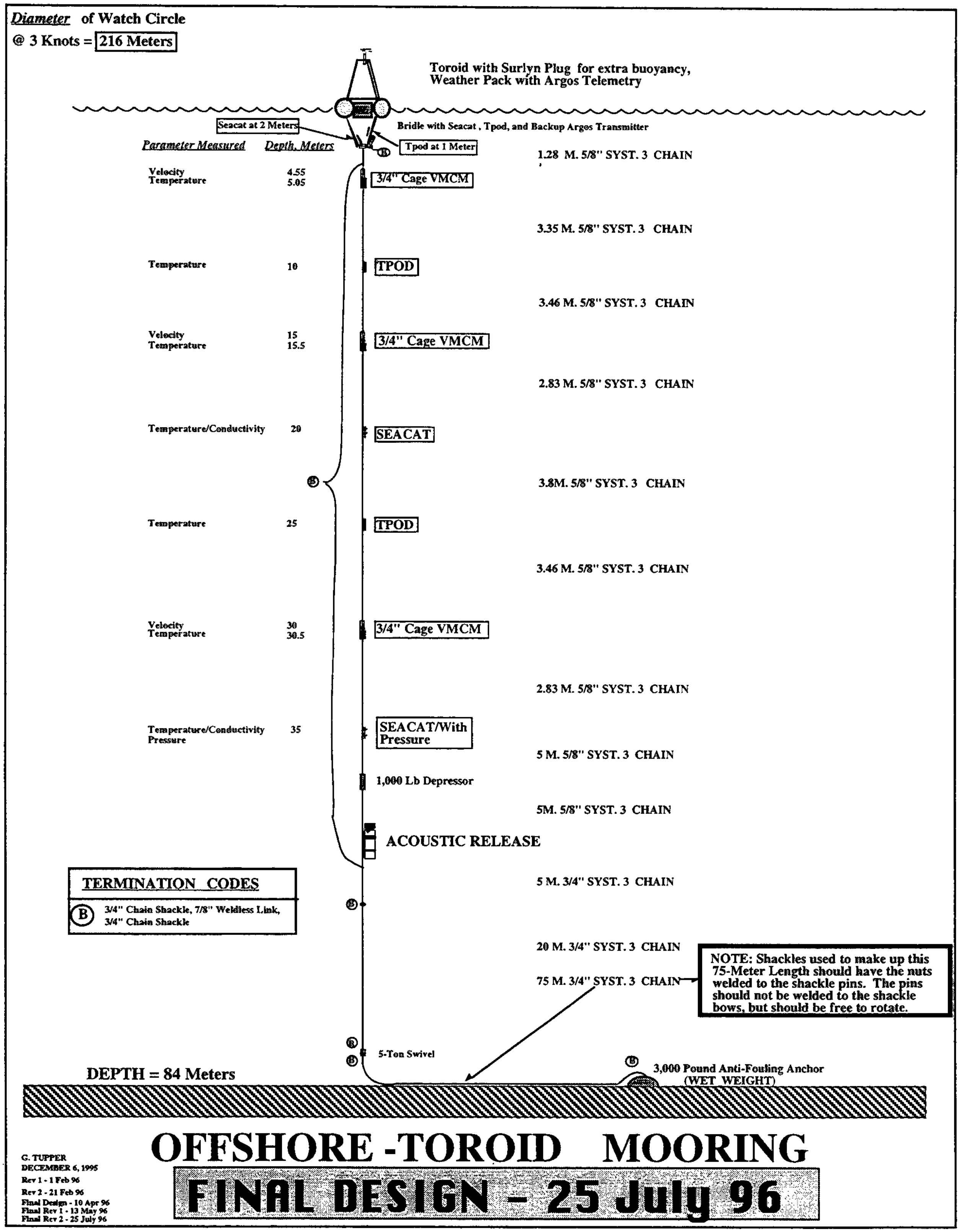


Figure III.B.9: Offshore Toroid Mooring Diagram.

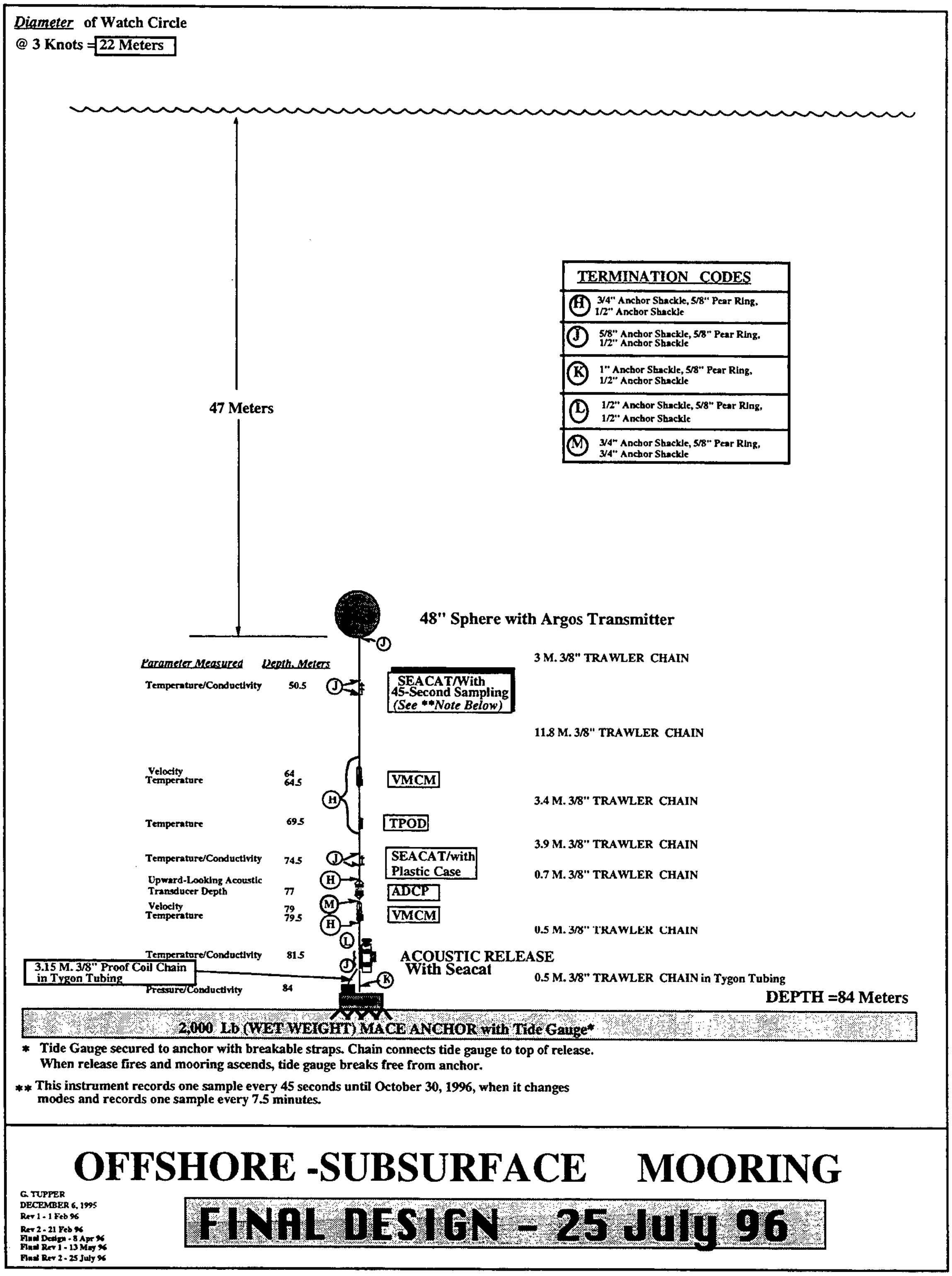
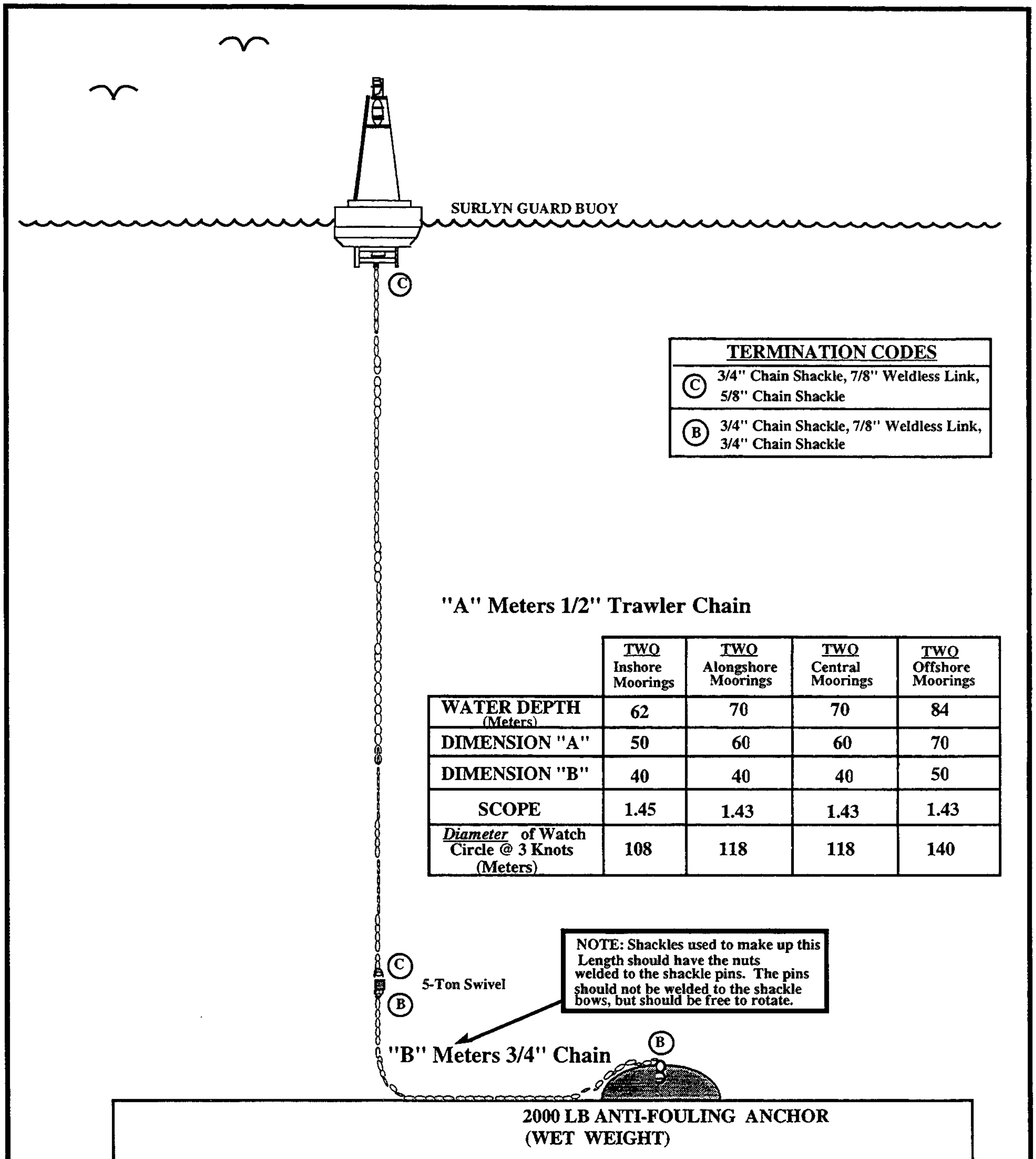


Figure III.B.10: Offshore Subsurface Mooring Diagram.



	TWO Inshore Moorings	TWO Alongshore Moorings	TWO Central Moorings	TWO Offshore Moorings
WATER DEPTH (Meters)	62	70	70	84
DIMENSION "A"	50	60	60	70
DIMENSION "B"	40	40	40	50
SCOPE	1.45	1.43	1.43	1.43
Diameter of Watch Circle @ 3 Knots (Meters)	108	118	118	140

GUARD BUOY MOORINGS
(EIGHT MOORINGS)
COASTAL MIXING EXPERIMENT

G. Tupper 6 Dec 95
Rev 1-8 Feb 96
Rev 2-15 Feb 96
Final Design - 8 Apr 96
Final Rev 1 - 13 May 96
Final Rev 2 - 25 July 96

FINAL DESIGN - 25 July 96

Figure III.B.11: Guard Buoy Mooring Diagram.

Mooring Redeployments

The Seatex Wavescan buoy went adrift during Hurricane Edouard, on September 2. The Seatex buoy was recovered September 4, by the R/V *Oceanus* (J. Ledwell, chief scientist). The failure was at the buoy, so the remainder of the Wavescan mooring (Figure III.B.2) was still on station. Inspection revealed that a bolt failed in the connection between the buoy and the mooring chain. The mount was redesigned and strengthened, and the Seatex Wavescan was reattached to its mooring chain September 26.

The inshore surface mooring went adrift September 19. The toroid and all the instrumentation was recovered by the R/V *Oceanus* (M. Levine, chief scientist) on September 25. The acoustic release at the bottom of the mooring had apparently fired. The release was replaced and the mooring was redeployed the following day, September 26, at the original location (Table III.C.3).

The alongshore surface mooring went adrift October 10 and was recovered with all instrumentation intact by the crew of the R/V *Oceanus* (G. Weatherly, chief scientist) October 16. The acoustic release had apparently slid down its mounting brackets which caused the release to trigger. The mooring was redeployed at its original location (Figure I.1 and Table III.C.4) on November 3 from the R/V Oceanus (R. Pickart, chief scientist).

Fanbeam ADCP Mooring Deployment

The subsurface mooring intended to house the surface-scanning ("fanbeam") ADCP was not deployed as planned on the July/August *Oceanus* cruise. The desired firmware, which allows burst sampling, and thus a longer operational life, was not available in time. As a result, it was decided to postpone the deployment of this element of the array until the Levine-Dickey mooring turnaround cruise in September. With the cooperation of those involved in the turnaround cruise, the instrument and mooring were successfully deployed during Oceanus cruise 288 on 27 Sept, 1650 UT at 40°29.50'N, 70°30.60'W.

The instrument consisted of standard RD Instruments 300 kHz BroadBand ADCP electronics attached to a custom designed transducer head. The BroadBand sensors included a dual-axis electrolytic tilt sensor and a Precision Navigation TCM-2 flux gate compass. The transducer head contained four bar-shaped transducers (approximately 250 mm by 45 mm by 10 mm) oriented so that the beams were narrow (about 3 degrees) in azimuth and broad (about 24 degrees) in elevation. The beam center lines were angled upwards by 12 degrees and separated by 30 degree increments in azimuth. A burst sampling scheme was used. At the start of a burst a sequence of 37 acoustic transmissions (pings) separated by 1.3 seconds was transmitted. These pings were averaged together to form one ensemble which was recorded to memory. A total of 20 ensembles separated by 1 min were recorded during each 20 min burst. The burst repetition time was one hour, and the burst interval was centered on the hour. Ping-by-ping heading and tilt correction could not be done by the instrument firmware due to the unconventional geometry of the beams. Instead, the averaged "beam" velocities were recorded along with heading, pitch, and roll information (mean and standard deviation) for each ensemble.

The instrument was housed in a 60 inch syntactic foam sphere borrowed from R. Watts at the University of Rhode Island. A specially designed plate and collar held the instrument housing vertically in a hole through the center of the sphere with the transducer head on top. The mooring was deployed in 70 m of water with the top of the sphere at 30 m depth. A subsurface Argos beacon, Platform Transmitter Terminal (PTT) number 27334 was attached to the sphere. A mooring diagram is shown in Figure III.B.4.

C. Instrumentation

A schematic of the timing set-up for all instrument types is presented in Figure III.C.1. A complete list of instrument types and serial numbers on the central, offshore, inshore, and alongshore surface and subsurface moorings is given in Tables III.C.1–III.C.4. Sensor heights for meteorological instruments are listed in Tables III.C.8–III.C.9.

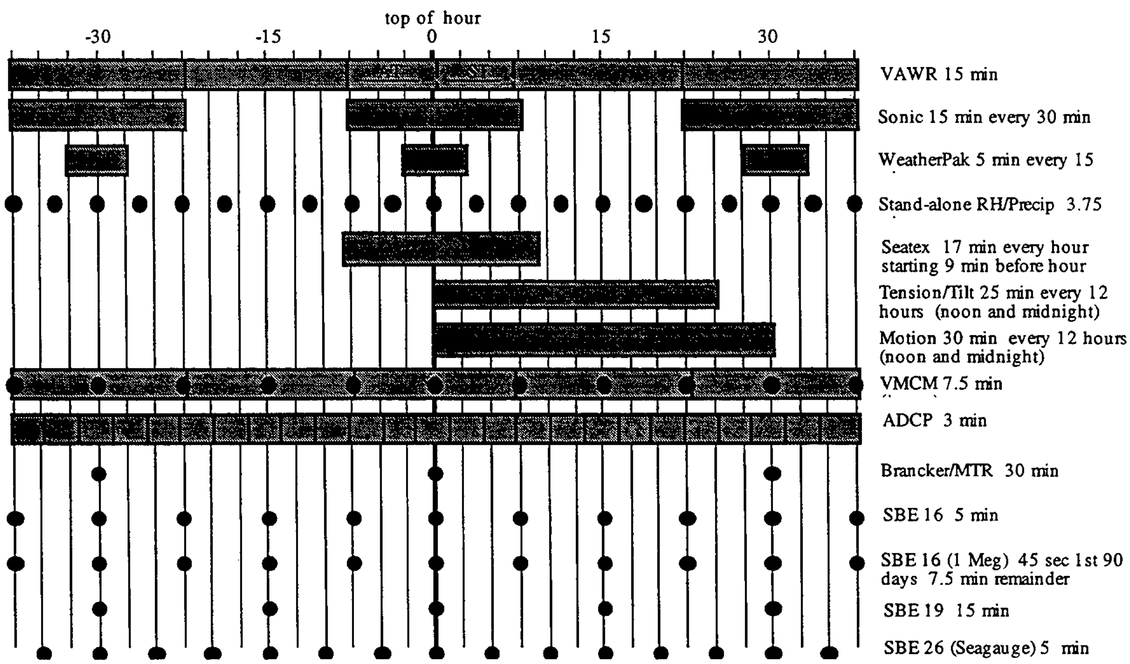


Figure III.C.1. Instrument Timing Schematic.

VAWR

The two meteorological units mounted on the 3 meter discus buoy are Vector Averaging Wind Recorders (VAWRs). The VAWRs are configured to measure the following parameters: Wind Speed, Wind Direction, Short Wave Radiation, Long Wave Radiation, Relative Humidity, Barometric Pressure, Air Temperature, and Sea Surface Temperature.

The VAWRs are recording Long Wave Radiation in the manner developed for the Arabian Sea Project. The three outputs (thermopile, dome temperature and body temperature) are being measured and recorded individually in the VAWR, with Long Wave Radiation calculated in post-processing.

Recording on a cassette tape, the VAWR is sampling at a 15 minute rate. Table III.C.1 shows the sampling strategy for each sensor and the type of sensors used for the meteorological measurements.

Data from the VAWR is telemetered back to WHOI through Service Argos. Each VAWR transmitter has three PTT I.D. numbers for data transmission and one of the numbers is also used for location. Table III.C.2 lists the PTT ids used with the CMO VAWRs.

The VAWR sea surface temperature sensors were mounted on the bridle at depths of 1 meter and 1.25 meters. The cable for these sensors was run from the VAWR down to the bridle through a piece of tubing mounted on the side of the buoy to protect the cable.

On previous tests the cage bars of the VAWR had caused the vane to give erroneous readings, depending where the vane was in relation to the cage bars. This brought about some changes to the VAWR vane for the Arabian Sea experiment, which were retained for CMO.

1. The size of the vane was changed so that the depth from the back of the pivot bar to the back of the vane will be 6.5″. The shape of the vane was not changed.
2. The pivot bar is now slotted and there are two pins locking the vane tail into the bar. Epoxy paste is spread over the bar and vane tail to provide extra strength.
3. The cage bars were left tilted.
4. The new lubber line, for mounting the VAWR on the buoy, is now 15 degrees clockwise off the center of the space between two cage bars.

After the buoy was assembled at WHOI, a buoy spin was completed on both VAWRs to determine the accuracy of each system. The procedure used is shown in Figure III.C.2, and the results are displayed in Figure III.C.3.

Sensor	Type	Accuracy	Sample Strategy
Wind Speed	R.M. Young	+/- 2%	Vector Averaged
	3-cup Anemometer	above 0.7 m/s	
Wind Direction	WHOI/EG&G	+/- 1 bit	Vector Averaged
	Integral Vane w/ follower	5.6 degrees	
Insolation Averaged	Eppley 8-48 Pyranometer	+/- 3%	Averaged
		of reading	
Long Wave Radiation	Eppley PIR Pyrgeometer	+/- 10%	
LWR Thermopile	PIR		Averaged
LWR- Body Temp.		10K @25°C	Note 4
LWR Dome Temp.		10K @25°C	Note 5
Relative Humidity	Variable	+/- 2%	3.515 Second Sample
	Dielectric Conductor		Note 1
	Vaisala Humicap 0062HM		
Barometric Pressure	Digiquartz Quartz crystal	+/- 0.2 mbars	2.636 Second Sample
	Paroscientific Model 215,216	wind< 20 m/s	Note 1
Sea Temperature	Thermistor	+/- 0.005	Note 2
	Thermometrics	4K @ 25°C	
Air Temperature	Thermistor	+/- 0.2°C	Note 3
	Yellow Springs #44034	wind> 5 m/s	
		5K @ 25°C	

Table III.C.1. Sensor Specification for CMO VAWRS

Notes:

1. Relative Humidity and Barometric Pressure are burst samples taken in the middle of the recording interval.

2. Sea temperature is measured during the first quarter of the recording interval, for one quarter of the record time.

3. Air temperature is measured during the second quarter of the recording interval, for one quarter of the record time.

4. LWR body temperature is measured during the third quarter of the recording interval, for one quarter of the record time.

5. LWR dome temperature is measured during the fourth quarter of the recording interval, for one quarter of the record time.

Central Discus		
VAWR 720	6859	position and data
	6860-6861	data
VAWR 704	6550	position and data
	6551-6552	data
bridle	9203	position
Central Seatex	01028	position and data
Central Subsurface	27332	position
Offshore Toroid		
Weatherpak 713	27340	position and data
bridle	5355	position
Offshore Subsurface	27333	position
Inshore Toroid		
Weatherpak 714	27339	position and data
bridle	9209	position
Inshore Subsurface	27331	position
Alongshore Toroid		
Weatherpak 648	27338	position and data
bridle	9207	position
Alongshore Subsurface	27330	position

Table III.C.2. Platform Transmitter Terminals in use on COMIX moorings.

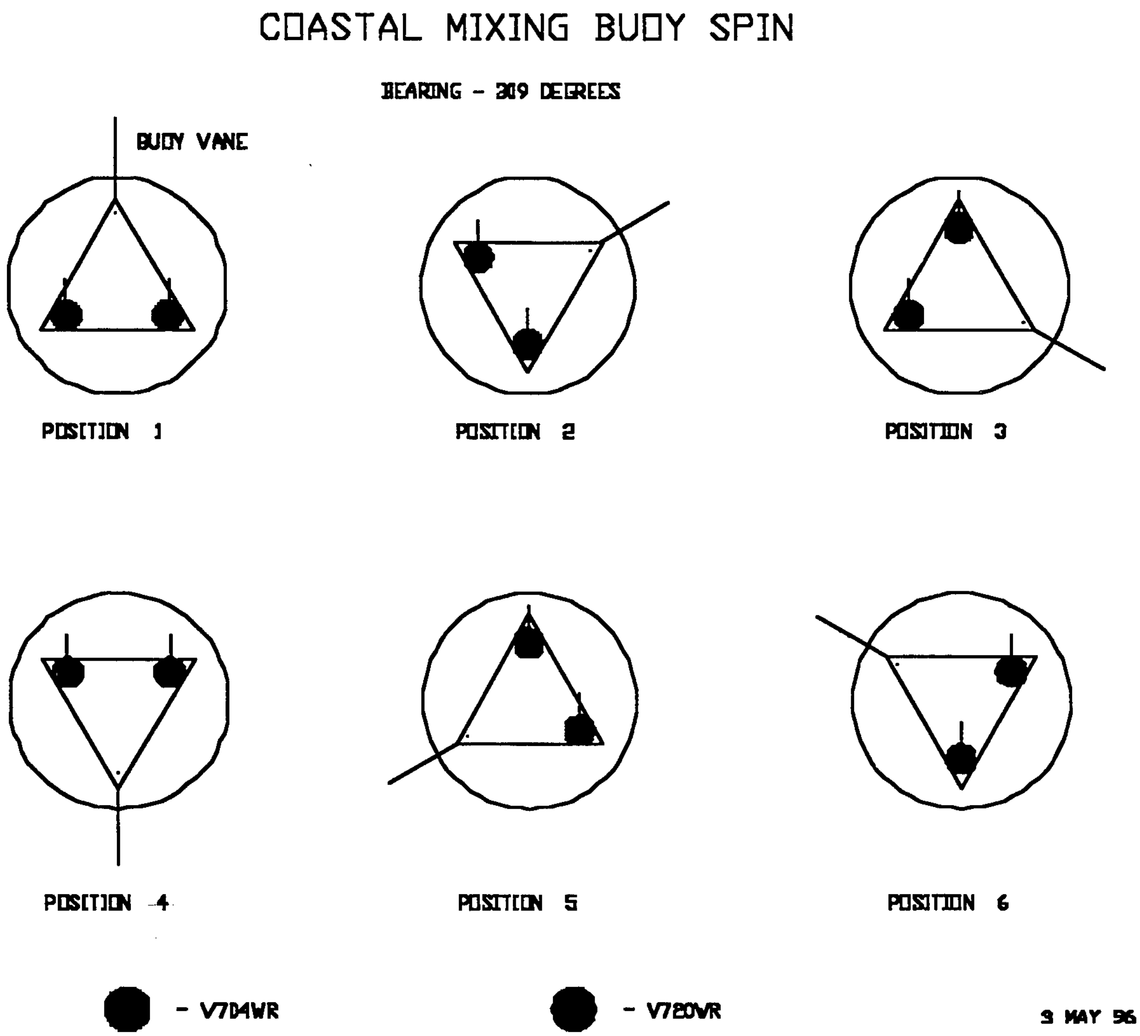


Figure III.C.2. Buoy Spin Procedure.

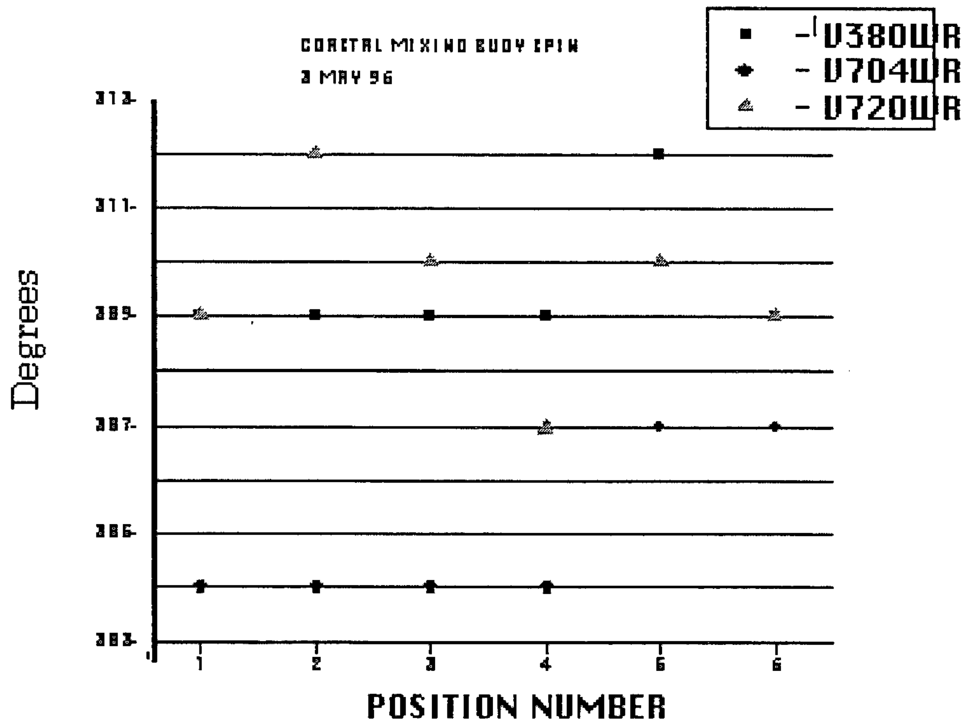


Figure III.C.3. Buoy Spin Results.

RELATIVE HUMIDITY / TEMPERATURE

Two relative humidity/temperature modules that are completely self-contained were mounted on the discus buoy. This instrument was developed and built by the UOP group. The sensor used is a Rotronics MP-100 which takes a single point measurement of relative humidity and temperature at a desired record interval. Both measurements are made inside the protective Gortex shield of the sensor. The logger is a Tattletale Model 4A with expanded memory to 512K. The unit is powered by its own internal battery pack.

The mechanical housing is made up of PVC pipe machined for O-Ring fit end caps. The solar radiation shield is similar to that used on the VAWR RH sensor. The recording interval was set to 3.75 seconds for the Coastal Mixing experiment.

PRECIPITATION

Two precipitation modules that are completely self-contained were mounted on the discus buoy. This module was developed and built by the UOP group. The precipitation sensor used is an R.M. Young model 50202 which takes a single point measurement at a desired record interval. The logger is a Tattletale Model 4A with expanded memory to 512K. The unit is powered by its own internal battery pack.

The mechanical housing is made up of PVC pipe machined for O-Ring fit end caps. The recording interval was set to 3.75 seconds for the Coastal Mixing experiment.

SONIC ANEMOMETER

A three-axis sonic anemometer/thermometer was mounted between the VAWR stacks on the Central mooring. The sonic anemometer is a high frequency device capable of measuring velocity and temperature fluctuations at 20 Hz. Velocity spectra averaged over 15 minute intervals are stored twice an hour (centered on the hour and half past the hour). The remaining time is used to compute velocity and temperature statistics for storage, which include means (averages), variances, and covariances.

The means will be used to supplement the VAWR data and are expected to be particularly useful during extremely low wind conditions when the cup anemometers have a tendency to stall. The velocity spectra will be used to compute estimates of the dissipation rate of turbulent kinetic energy. These dissipation rates will also be used to compute estimates of the wind shear using the inertial dissipation method.

Velocity and temperature signals from the sonic anemometer are being logged twice a day by an altitude measuring unit. If the integration of these two systems is successful, we plan to compute direct covariance flux estimates twice a day during the deployment.

BUOY TENSION LOGGER

Buoy tension was being recorded using a Tattletale Model 6 and a DJ Instruments tension cell. Acceleration is also being recorded using a Summit Instruments three-axis accelerometer. Tension and acceleration are recorded for a period of 23 minutes at a 4 Hz rate every 12 hours at noon and midnight UTC.

Weatherpak

A Weatherpak-2000 Automated Weather Station produced by Coastal Environmental Systems is mounted on each of the three toroid buoys. Each Weatherpak measures wind speed, wind direction, air temperature, barometric pressure and relative humidity. The sampling strategy for the experiment was to sample continuously for the first 5 minutes (Sample Duration Time - T_{dur}) out of every 15 minutes (Sample Interval Time - T_{int}) with the middle of the 5 minute sample falling at the top of the hour. Data from the Weatherpak is being telemetered to WHOI through Service Argos. The Weatherpak transmitter uses a single PTT id number and is buffered for a period of 2 hours, transmitting every 110 seconds. PTT numbers are listed in Table III.C.2.

In order to achieve the desired sampling strategy and data, extensive reprogramming of the Weatherpak's output message was required. Because of design limitations of the instrument, it was necessary to set the Weatherpak's internal clock 2.5 minutes ahead of actual GMT time. This change artificially created the desired sampling effect but will require adjustment to the time stamp in post processing. Because it is not possible to program the Weatherpak to start at a specific time, the middle of T_{dur} can be offset ± 15 seconds from the top of the hour. Processing of Argos data has this correction to the acquisition time applied.

Interface of the Weatherpak with a Seimac Argos transmitter was accomplished by using an Onset Computer Tattletale 4A as a controller that buffers data output from the Weatherpak and then sends the data to the transmitter when necessary. Complete data transmission is accomplished by sending a short message to "wake up" the controller from its low power mode, 18 seconds ahead of the actual data string. Design constraints of the Weatherpak require the data to be transmitted near the end of the 10 minute period which follows the 5 minute sample period where the instrument is not sampling. With reference to T_{int} the wake up message is sent at 14 min 40 seconds and the data message is sent at 14 minutes 58 seconds. The middle of T_{dur} in GMT can be calculated by subtracting 15 minutes from the time word sent with each data record. The sampling schedule is diagrammed in Figure III.C.4.

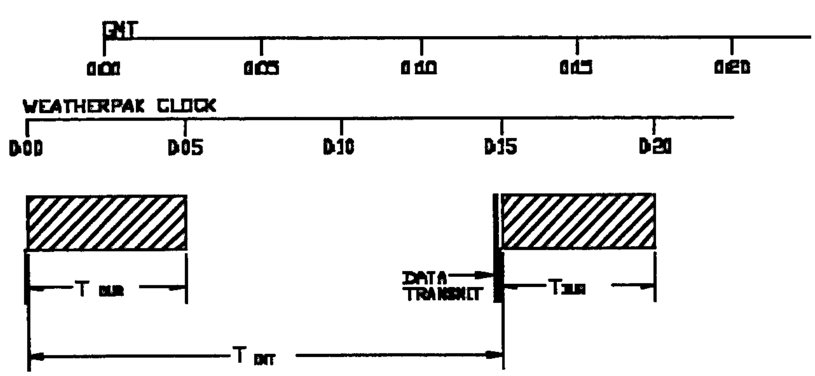


Figure III.C.4. Weatherpak Sampling Schedule

VMCM

Twenty five Vector Measuring Current Meters (VMCMs) were placed at various depths on the subsurface and surface moorings. All the VMCMs had a record rate of 7.5 minutes.

The VMCMs were outfitted with Silicone Nitride bearings, which had been previously tested for a period of 24 months with no failures. The propellers were made from Delrin 100ST. The VMCMs data was stored on a cassette and read with the SeaData Reader.

BRANCKER

A total of 12 Brancker Temperature Data Loggers (TPODs) were deployed at various depths on the moorings. The Brancker takes a single point temperature measurement every record sample. The UOP Branckers were set for a record rate of 30 minutes.

SEA-CAT

There were five UOP group SeaBird Sea-Cats deployed on the Coastal Mixing moorings. The Sea-Cat takes a single point measurement of salinity and temperature at the desired sample rate. The UOP Sea-Cats were configured to sample every 7.50 minutes. On the subsurface moorings the Sea-Cats were mounted to the case of the releases.

MTR

The Miniature Temperature Recorder (MTR) from the Pacific Marine Environmental Laboratory (PMEL) was mounted on the top of the first VMCM on the Central discus buoy at a depth of 4.05 meters. The MTR takes a single point temperature measurement every record sample. The record interval for the MTR was set at 30 minutes.

ADCP

Two ADCPs were deployed, one on the inshore subsurface mooring and one on the offshore subsurface mooring. The inshore instrument was a 300 kHz RD Instruments "WorkHorse" BroadBand ADCP (SN 100) with a dual-axis electrolytic tilt sensor, an RDI designed flux gate compass, and 20 Mbytes of PCMCIA solid state memory. The beams were pointed upwards from 55.5 m depth. A "standard" ensemble sampling scheme was used (no burst sampling). A sequence of 22 acoustic transmissions (pings) separated by 8.15 sec was averaged together to form one ensemble every 3 min. The backscattered signal was processed over time intervals corresponding to a 4 m depth cell length. The depth resolution of the transmitted pulse (pulse length) was also 4 m (no oversampling in depth). Twelve depth cells were recorded, giving a nominal profiling range of 50 m to 5 m depth.

The instrument deployed on the offshore mooring was a 300 kHz RD Instruments NarrowBand ADCP (SN 593) with Humphries pendulum tilt sensors, a KVH flux gate compass, and 18 Mbytes of EEPROM solid state memory. The beams were pointed upwards from 77 m depth. A "standard" ensemble sampling scheme was used. A sequence of 100 pings separated by 1.64 sec was averaged together to form one ensemble every 3 min. The depth cell length was 4 m, while the nominal depth resolution of the transmitted pulse was 8 m. Thus, the data were over sampled in depth and successive depth cells were not independent. Eighteen cells were recorded, giving a nominal profiling range of 80 m depth to the surface (0 m depth).

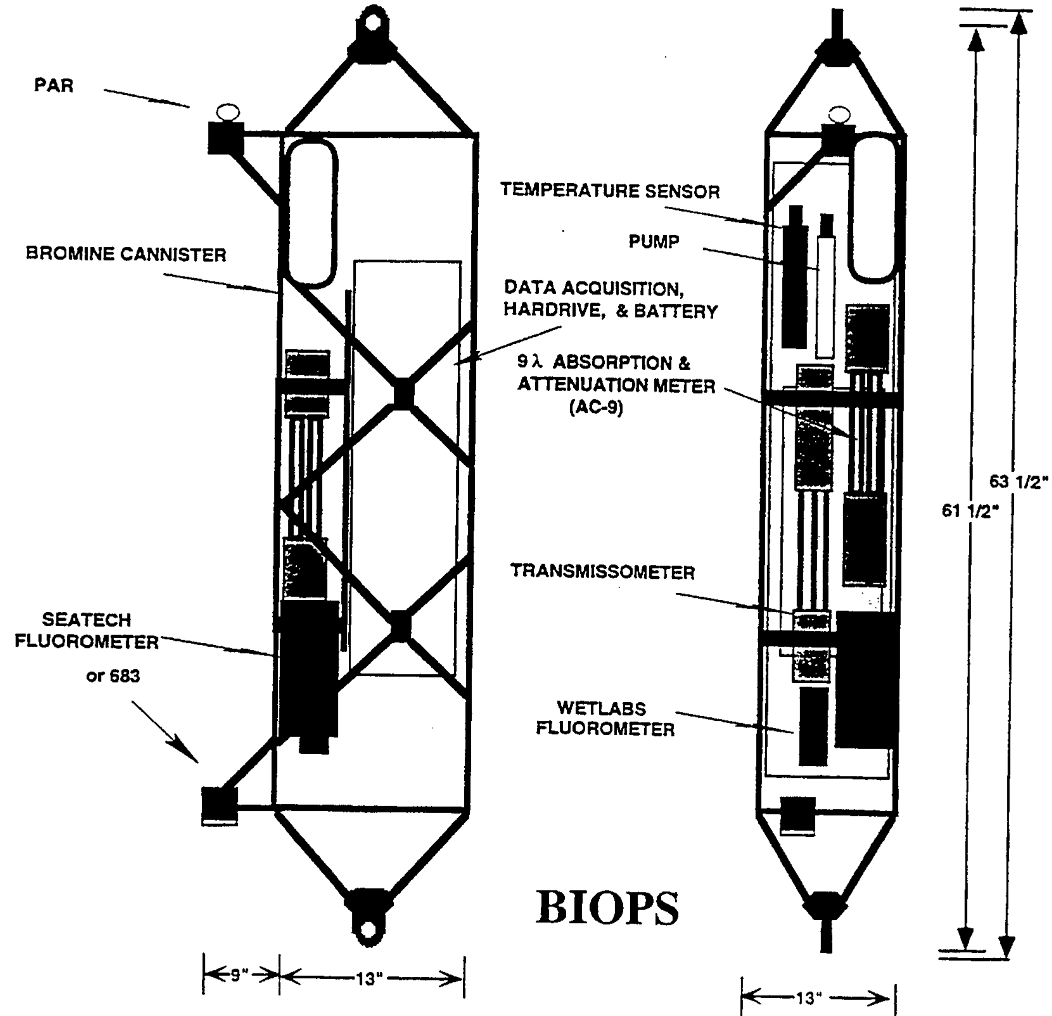
Velocities were corrected for tilt and converted to geographic coordinates by the ADCP firmware prior to ensemble averaging. The manufacturer's estimate of velocity precision for the 3 min ensembles is about 0.6 cm/s for the inshore ADCP and 0.7 cm/s for the offshore ADCP. Experience has shown that actual performance is likely to be 2–3 times this estimate.

RELEASE

An acoustic release is used just above the anchor to free the mooring from the anchor for recovery. It is also used to locate the exact position of the anchor on the sea floor. The releases used on the Coastal Mixing experiment were EG&G model 322 releases.

BIOPS

Three Bio-Optical Systems (BIOPS) were deployed from the Levine/Dickey mooring at 12, 30, and 50 m depths earlier. Another BIOPS was deployed on the Agrawal bottom tripod by Professor Tommy D. Dickey of University of California, Santa Barbara. The BIOPS is an optical system which measures scalar irradiance (PAR), natural (upwelled radiance at 683 nm) and stimulated fluorescence, beam attenuation coefficient at 660 nm, temperature, spectral absorption and attenuation coefficients at 7 wavelengths. Figure III.C.5 is an illustration of the BIOPS.



PRESSURE CASE
7' CYLINDER x 25"
Aluminum Wt in
air=51 lbs

BACKPACK
PVC WT in air=23 lbs

SEATECH
FLUOROMETER
DELRIN WT IN
air=12.5 lbs
4 3/4"x 7 1/2"

SEATECH
TRANSMISSOMETER
DELRIN
WT linair= 6 lbs
2 1/2"x 19"

WETLABS
FLUOROMETER
ALUMINUM WT in
air= 1 lb
2 1/2" x 6"

WETLABS AC-9
ALUMINUM WT IN
air= 15 lbs 4" x 17"

BIOPHERICAL PAR
OR 683
ALUMINUM WT IN
air=1 lb
2 3/4" x 2"

SEATECH
TEMPERATURE
ALUMINUM WT IN
air= 1lb
1 3/4" x 7"

SEATECH PUMP
STAINLESSSTEEL
WT IN air= 1 lb
1 1/2" x 7"

CAGE
STAINLESSSTEEL
WT IN air= 75 lbs

Total weight in air approx.185 lbs

Figure III.C.5. BIOPS

Floc Camera

To quanitfy size distributions of particles larger than 200 um, a floc camera assembly has been deployed on the particle tripod. The assembly consists of a Nikon F4 camera equipped with a Nikkor 50 mm lens and a Nikon MF-24 250-exposure multi-frame back.

The camera is programmed to take a photo every 8 hours. Images are of a $16 \times 10 \times 2$ cm slab of water located 76 cm from the camera and illuminated by a Nikon SB-26 Auto Focus Speedlight. The flash is directed through a fan of aluminum with a 1 cm opening in order to eliminate out-of-focus particles from the images.

The camera and flash are mounted parallel to one another in a frame made of Dexion aluminum.

Argos Transmitters

Platform Terminal Transmitters (PTTs) are being used to provide daily updates of position, meteorological and wave data. Daily satellite transmission is provided by Service Argos, with data being sent to a Sun SparcStaion via ftp. VAWRs have redundant PTTs to improve data coverage. Weatherpaks have single transmitters, as does the Seatex Wavescan.

A sub-surface Argos transmitter is mounted on the bridles of the discus buoy and of each of the toroid bouys. These units are mounted upside-down with an internal mercury switch. If a buoy flips, its bridle transmitter will turn on to permit tracking the buoy's location.

A complete list of instrument types and serial numbers on the central, offshore, inshore, and alongshore surface moorings is given in Tables III.C.1 to III.C.7. Sensor heights for meteorological instruments are listed in Tables III.C.8 and III.C.9.

Site:	Buoy type:	Set date/time:
Central	Discus	96-07-30 15:14

depth	instrument	sn	timing
tower	VAWR	720	15m
	PTT	6859-6861	
	VAWR	704	15m
	PTT	6550-6552	
	rh	004	3.75m
	rh	005	3.75m
	precip	001	3.75m
	precip	002	3.75m
	anemometer		15m every 30m
2	seacat	927	7.5m
	tensiometer		
	PTT	9203	
4.05	mtr	3250	30m
4.55	vmcm	54	7.5m
7.5	seacat	1875	7.5m
10	vmcm	001	7.5m
12.5	seacat	1877	7.5m
15	vmcm	003	7.5m
20	vmcm	041	7.5m
25	seacat	1879	7.5m
30	vmcm	51	7.5m
35	seacat-p	885	15m
45	release	400304	

Table III.C.3. Instrument depths, serial numbers, and timing — **Central Discus.**

Site:	**Buoy type:**	**Set date/time**
Central	Subsurface	96-07-30 18:32

depth	**instrument**	**sn**	**timing**
32	PTT	27332	
40	vmcm	27	7.5m
45	seacat	1182	45s *
50	vmcm	42	7.5m
55	vmcm	43	7.5m
57.5	seacat	73	7.5m
60	vmcm	50	7.5m
62.5	seacat	72	7.5m
65	vmcm	35	7.5m
67.5	seacat	1878	7.5m
67.5	release	901504	

**until 961030, then 7.5min*

Site:	**Buoy type:**	**Set date/time**
Central	Temporary Toroid	96-07-31 00:16

depth	**instrument**	**sn**	**timing**
tower	Weatherpak	648	5m every 15m
tower	PTT	27338	
1	tpod	3274	30m
1.5	PTT	9207	
2	seacat	142	7.5m
7	chlam	0126	
58	release	17962	

Site:	**Buoy type:**	**Set date/time**
Central	Wavescan	96-07-30 21:28

depth	**instrument**	**sn**	**timing**
NA	Seatex	WS 03-91	17 min/hr @Hz

Table III.C.4. Instrument depths, serial numbers, and timing
— Central Toroid and Central Subsurface.

Site:	**Buoy type:**	**Set date/time**
Offshore	Toroid	96-07-31 13:50

depth	**instrument**	**sn**	**timing**
tower	Weatherpak	713	5m every 15m
tower	PTT	27340	
1	tpod	3291	30m
1.5	PTT	5355	
2	seacat	141	7.5m
4.55	vmcm	34	7.5m
10	tpod	3763	30m
15	vmcm	23	7.5m
20	seacat	1873	7.5m
25	tpod	3308	30m
30	vmcm	17	7.5m
35	seacat-p	884	15m
46	release	701072	

Site:	**Buoy type:**	**Set date/time**
Offshore	Subsurface	96-07-31 18:38

depth	**instrument**	**sn**	**timing**
47	PTT	27333	
50.5	seacat	1881	45 s*
64	vmcm	40	7.5m
69.5	tpod	4228	30m
74.5	seacat	70	7.5m
77	adcp	593	3m
79	vmcm	002	7.5m
81.5	seacat	1876	7.5m
81.5	release	600413	
84	tidegauge	45	5m

* *until 961030 then 7.5min*

Table III.C.5. Instrument depths, serial numbers, and timing
— Offshore Toroid and Offshore Subsurface.

Site:	Buoy type:	Set date/time:
Inshore	Toroid	96-08-02 14:04

depth	instrument	sn	timing
tower	Weatherpak	714	5m every 15m
tower	PTT	27339	
1	tpod	3830	30m
1.5	PTT	9209	
2	seacat	146	7.5m
4.55	vmcm	10	7.5m
10	tpod	4493	30m
15	vmcm	45	7.5m
20	seacat	71	7.5m
25	tpod	3301	30m
30	vmcm	22	7.5m
41	release	393	

Site:	Buoy type:	Set date/time:
Inshore	Subsurface	96-08-02 18:25

depth	instrument	sn	timing
38	Argos PTT	27331	
42	vmcm	28	7.5m
47.5	tpod	3271	30m
52.5	seacat	1874	45 sec
55.5	adcp	100	3m
57	vmcm	30	7.5m
59.5	seacat	1880	7.5m
59.5	release	358	
62	tidegauge	46	5m

* *until 961030, then 7.5 min*

Table III.C.6. Instrument depths, serial numbers, and timing — **Inshore Toroid** and **Inshore Subsurface** Moorings.

Site:	Buoy type:	Set date/time:
Alongshore	Toroid	96-08-03 15:51

depth	instrument	sn	timing
tower	Weatherpak	648	5m every 15m
tower	PTT	27338	
1	tpod	3274	30m
1.5	PTT	9207	
2	seacat	142	7.5m
4.55	vmcm	53	7.5m
10	tpod	3837	30m
15	vmcm	55	7.5m
20	seacat	68	7.5m
25	tpod	3299	30m
30	vmcm	24	7.5m
40	release	502290	

Site:	Buoy type:	Set date/time:
Alongshore	Subsurface	96-08-03 19:39

depth	instrument	sn	timing
37	PTT	27330	
40.5	seacat	883	15min
50	vmcm	12	7.5m
55.5	tpod	3833	30m
60.5	seacat	882	15min
65	vmcm	44	7.5m
67.5	seacat	144	7.5m
67.5	release	600986	
70	tidegauge	49	5m

Table III.C.7. Instrument depths, serial numbers, and timing — **Alongshore Toroid** and **Alongshore Subsurface** Moorings.

Sensor Heights

Variable	Measurement Location	Sensor adjustment	Height above deck [m]	Height above est. water line [m]
VAWR 704				
Wind speed	Center of cups	0	2.96	3.30
Wind Direction	Center of Pointer	0	2.68	3.02
Long-wave radiation	Base of Dome	0	3.06	3.40
Short-wave radiation	Base of Dome	0	3.05	3.39
Barometric Pressure	Center of port	0	2.37	2.72
Air Temperature	Lip of top plate	-2	2.29	2.63
Relative Humidity	Lip of top plate	-1	2.34	2.68
Argos Antenna	Top of antenna	0	3.03	3.37
Sea temperature	End of pod	0	-1.80	-1.46
VAWR 720				
Wind speed	Center of cups	0	2.96	3.30
Wind direction	Center of Pointer	0	2.68	3.02
Long-wave radiation	Base of Dome	0	3.06	3.40
Short-wave radiation	Base of Dome	0	3.05	3.39
Barometric Pressure	Center of port	0	2.38	2.72
Air Temperature	Lip of top plate	-2	2.29	2.63
Relative Humidity	Lip of top plate	-1	2.34	2.68
Argos Antenna	Top of antenna	0	3.03	3.37
Sea Temperature	End of pod	0	-1.30	-0.96
Sonic Anemometer	Sensing area Edson	0	2.96	3.30
Standalone Precip 001	Top of openning	0	2.76	3.11
Standalone Precip 002	Top of openning	0	2.76	3.11
Standalone RH - T 004	Lip of top plate	0	2.58	2.93
Standalone RH - T 005	Lip of top plate	-1.25	2.59	2.93
Seacat 927	Temp Probe	0	-2.26	-1.92

Table III.C.8. Sensor Heights, **DISCUS BUOY.**

Variable	Measurement Location	Sensor adjustment	Height above deck [m]	Height above est. water line [m]
Toroid Buoy W				
Weatherpak 648				
Wind Speed and Dir	Prop axle	0	2.858	3.124
Relative Humidity	Sensor	0	2.565	2.832
Air Temperature	Sensor	0	2.553	2.819
Barometric Pressure	Sensor	0	2.540	2.807
PTT 27338				
Brancker 3274	Thermistor end	0	-1.270	-1.005
Seacat 142	Temp probe	0	-2.216	-1.949
Subsurface Argos SIS S/N 4, PTT9207				

Toroid Buoy Y				
Weatherpak 713				
Wind Speed and Dir	Prop axle	0	2.886	3.115
Relative Humidity	Sensor	0	2.594	2.823
Air Temperature	Sensor	0	2.581	2.810
Barometric Pressure	Sensor	0	2.569	2.797
PTT 27340				
Brancker 3291	Thermistor end	0	-1.250	-1.020
Seacat 141	Temp probe	0	-2.248	-2.019
Subsurface Argos WHOI 5355M				

Toroid Buoy X				
Weatherpak 714				
Wind Speed and Dir	Prop axle	0	3.004	3.283
Relative Humidity	Sensor	0	2.699	2.978
Air Temperature	Sensor	0	2.686	2.965
Barometric Pressure	Sensor	0	2.673	2.953
PTT 27339				
Brancker 3830	Thermistor end	0	-1.280	-1.001
Seacat 146	Temp Probe	0	-2.280	-2.001
Subsurface Argos SISS/N 3, PTT 9209				

Table III.C.9. Sensor Heights, **TOROID BUOYS.**

IV: The CTD Survey

A total of 168 CTD profiles were taken during the deployment cruise. This included:

1. CTD stations at mooring sites for comparison with the moored temperature-conductivity measurements.
2. Three cross-shelf transects extending from about the 40-m isobath to slightly beyond the shelfbreak to determine the cross-shelf structure of water properties. The cross-shelf transects consisted of 21–23 CTD stations roughly 5 km apart and took about 12 hours to complete.
3. One along-isobath survey consisting of 11 or 12 stations along the 60, 70, 80, 90, 100, and 125-m isobaths for a total of 67 stations. Again station separation was about 5 km so the total distance along each isobath was about 50 km. The objective of this survey was to characterize along-isobath variability in water properties.

The instrument used was a SeaBird SBE 25-03 internally recording CTD equipped with a pump, a SeaTech transmissometer, and a WetLabs fluorometer. Figure IV.2 shows locations of CTD stations, and Table IV.1 lists more information about each cast. The CTD sampled at 8 Hz. The typical procedure for each CTD cast was as follows. Prior to each cast the battery voltage and memory were checked and data acquisition was initialized using a laptop computer connected to the CTD. The CTD was disconnected from the PC, the transmissometer lens were cleaned with alcohol, and the CTD was turned on. The CTD was lowered into the water and held at the surface for 1 minute to allow air to bleed out of the lines and the pump to turn on. The CTD was then lowered to within 3–5 m of the bottom at a rate of 20–30 m/min. When the cast was completed the CTD was connected to the laptop computer and the data was downloaded.

The CTD data was processed using the SeaBird SeaSoft software. Each profile was examined to look for obvious bad values. Salinity and sigma-theta were calculated. The data was then truncated to extract the downcast beginning at about 2 m and was bin averaged into 1 m samples.

A total of 13 water samples were taken using a single bottle attached to the CTD wire approximately 2 m above the CTD sensors. The bottles were tripped at the bottom of the cast by dropping a messenger down the wire. Water samples were taken on intermittent casts when there had been a relatively thick bottom mixed layer on the previous cast. Comparison of the bottle and CTD salinities are shown in Figure IV.1 (upper panel). With one exception (bottle 3), bottle and CTD salinities differed by less than 0.01 psu when the bottle sample was taken in a mixed layer (Figure IV.1, lower panel).

Figure IV.2 shows the location of the CTD casts. Table IV.1 lists CTD cast information. The three cross-shelf transects taken August 4, 7, and 10 all show a similar structure. Figure IV.3 shows the section taken on August 4. The temperature and salinity sections look classical for this shelf in summer. There is very warm water (20–17°C) above a sharp thermocline located 10 to 20 m below the surface, with cold pool water (7–8°C) below. The shelfbreak front, separating cooler, fresher shelf water from warmer, saltier slope water, is clearly visible in salinity (>34 psu offshore of front and < 33 psu inshore). The foot of the front intersects the bottom at the 110 m isobath. The fluorometer data indicates a chorophyll maximum at 20–30 m depth across the entire shelf, i.e. in the vicinity of the thermocline. This maximum in the fluorometer data corresponds to a local minimum in light transmission. Low light transmission was also observed near the bottom over the inner half of the shelf and across the water column in water depths of less than 50 m.

Maps of near-surface water properties (not shown) based on the along-isobath survey data indicate considerable variability. However, because of the large vertical gradients associated with the pycnocline, it is unclear whether this variability represents spatial patterns, or temporal aliasing of, for example, internal waves. Maps of the temperature and salinity 10 m above the bottom show a spatially uniform structure. The shelfbreak front is again clearly evident as strong temperature and salinity gradients between the 110-m and 125-m isobaths.

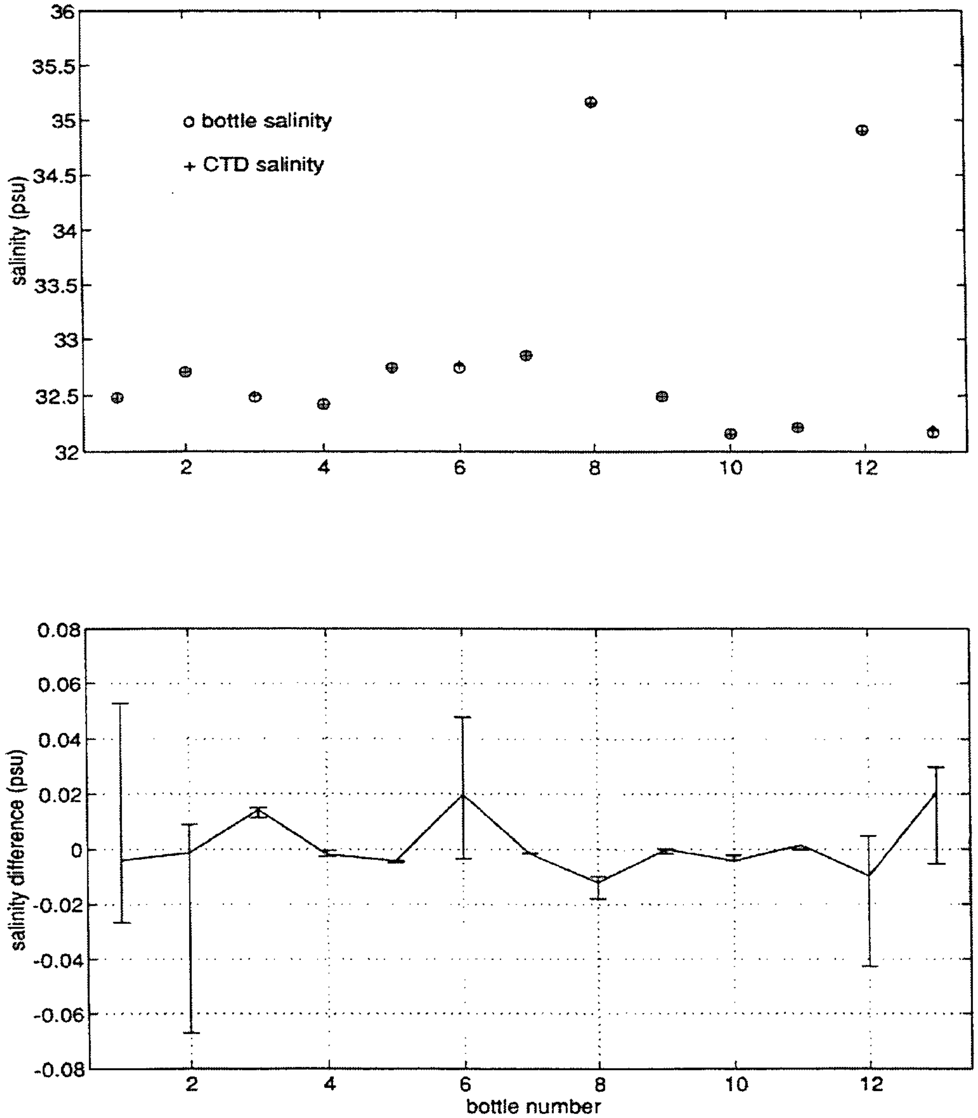


Figure IV.1. Comparison of the 13 bottle salinities with the corresponding CTD salinities at the estimated height of the bottle sample (upper panel). Differences between bottle and CTD salinities. The vertical "error" bars indicate the difference in salinities, from the CTD profile, 1 m above and 1 m below the estimated height of the bottle sample (lower panel). Thus a small range indicates the bottle was taken in a mixed layer that was at least 2 meters thick.

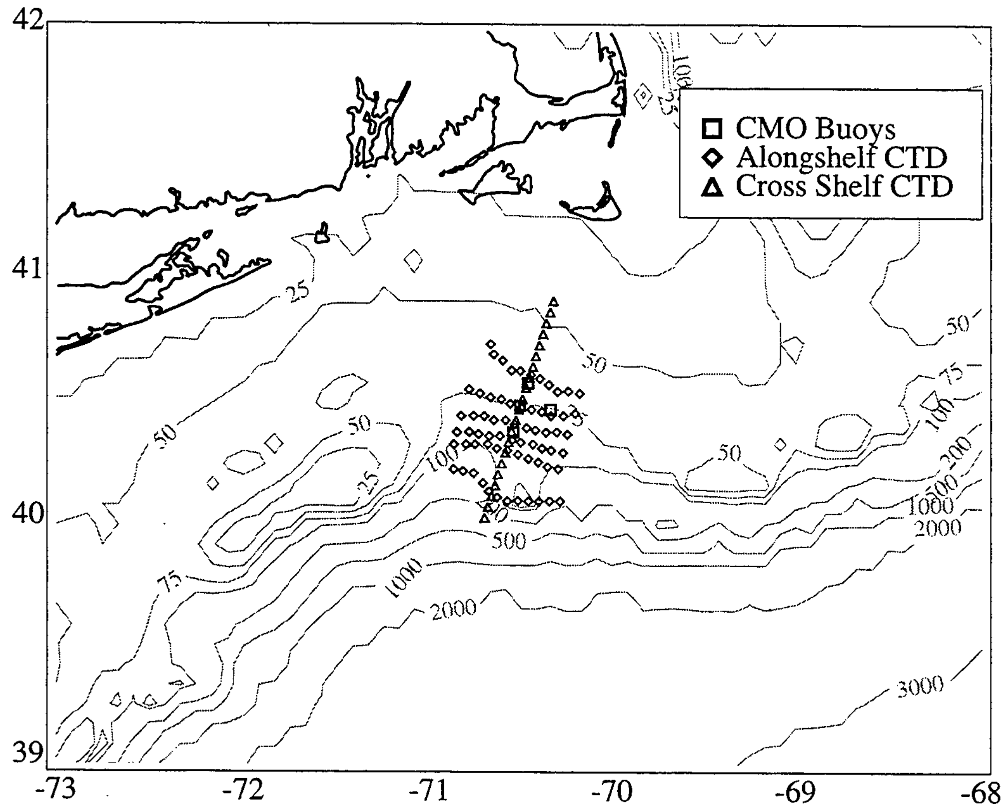


Figure IV.2 CTD station positions

Table IV.1: CTD Station Information

Cast	ReFile Name	Latitude	Longitude	Date/ Time (UTC)		Depth	SST	SSS	Comments
001	CAST001	40° 29.78'N	70° 30.037'W	8/1/96 1:43		71m	°C		light winds
002	CAST02	40° 30.022'N	70° 20.021'W	8/1/96 2:13	- m	70m	°C		light winds
003	CAST03	40° 30.107'N	70° 29.977'W	8/1/96 2:23	- m	71m	°C		light winds, fog
004	CAST04	40° 30.199'N	70° 29.967'W	8/1/96 2:31	- m	70m	°C		calm
005	CAST05	40° 34.59'N	70° 28.77'W	8/2/96 19:35	- m	64m	°C		calm,hazy
006	CAST06	40° 34.86'N	70° 27.798'W	8/2/96 21:09	- m	63m	17.39°C	31.672	
007	CAST07	40° 34.761'N	70° 27.903'W	8/2/96 21:20	- m	63m	17.99°C	31.693	
008	CAST08	40° 34.722'N	70° 27.983'W	8/2/96 21:28	- m	63m	18.034°C	31.693	
009	CAST09	40° 29.711'N	70° 30.713'W	8/2/96 23:36	- m	71m	16.824°C	31.843	
010	CAST010	40° 29.772'N	70° 30.837'W	8/2/96 23:47	- m	71m	16.671°C	31.85	
011	CAST011	40° 29.797'N	70° 30.985'W	8/2/96 23:54	- m	71m	16.616°C	31.85	
012	CAST012	40° 29.784'N	70° 30.777'W	8/3/96 10:56	- m	71m	17.37°C	31.93	foggy
013	CAST013	40° 29.816'N	70° 30.959'W	8/3/96 11:04	- m	71m	17.37°C	31.928	strong subsurface currents
014	CAST014	40° 29.913'N	70° 30.227'W	8/3/96 11:10	- m	71m	17.341°C	31.927	flourometer flaked out during cast
015	CAST015	40° 28.464'N	70° 20.232'W	8/3/96 20:38	- m	69m	17.06°C	31.911	alongshore site
016	CAST016	40° 28.35'N	70° 20.266'W	8/3/96 20:53	- m	69.5m	16.923°C	31.92	alongshore
017	CAST017	40° 28.322'N	70° 20.316'W	8/3/96 21:01	- m	69m	17.003°C	31.921	alongshore
018	CAST018	40° 23.325'N	70° 32.795'W	8/3/96 22:00	- m	85m	17.781°C	31.917	offshore
019	CAST019	40° 23.448'N	70° 32.888'W	8/3/96 22:40	- m	85m	17.8°C	31.92	offshore
020	CAST020	40° 23.539'N	70° 32.946'W	8/3/96 22:48	- m	85m	17.823°C	31.929	offshore
021	XSHF01	40° 1.901'N	70° 42.019'W	8/4/96 1:08	- m	177m	19.404°C	32.525	used 7101, 87865 free
022	XSHF02	40° 4.611'N	70° 40.956'W	8/4/96 2:18	- m	132m	19.927°C	32.765	
023	XSHF03	40° 7.309'N	70° 39.772'W	8/4/96 3:05	- m	128m	20.199°C	33.009	
024	XSHF04	40° 9.969'N	70° 38.599'W	8/4/96 3:46	- m	123m	20.087°C	32.859	
025	XSHF05	40° 12.681'N	70° 37.673'W	8/4/96 4:24	- m	119m	20.071°C	32.78	
026	XSHF06	40° 15.335'N	70° 36.407'W	8/4/96 4:59	- m	115m	17.243°C	31.91	
027	XSHF07	40° 18.011'N	70° 35.169'W	8/4/96 5:30	- m	103m	17.007°C	31.842	
028	XSHF08	40° 20.648'N	70° 34.09'W	8/4/96 6:01	- m	92m	17.007°C	31.842	
029	XSHF09	40° 23.275'N	70° 33.104'W	8/4/96 6:33	- m	83m	17.158°C	31.816	
030	XSHF10	40° 25.969'N	70° 31.646'W	8/4/96 7:06	- m	78m	17.61°C	31.646	backed up to floppy and initialized log
031	XSHF11	40° 28.586'N	70° 30.607'W	8/4/96 7:38	- m	70m	16.322°C	31.966	
032	XSHF12	40° 31.129'N	70° 29.383'W	8/4/96 8:05	- m	68m	16.426°C	31.96	
033	XSHF13	40° 33.975'N	70° 28.205'W	8/4/96 8:45	- m	64.5m	16.97°C	31.741	
034	XSHF14	40° 36.406'N	70° 27.046'W	8/4/96 9:12	- m	63m	16.99°C	31.714	
035	XSHF15	40° 39.051'N	70° 25.885'W	8/4/96 9:42	- m	57.5m	16.76°C	31.725	
036	XSHF16	40° 41.67'N	70° 24.882'W	8/4/96 10:11	- m	53m	16.784°C	31.705	
037	XSHF17	40° 44.323'N	70° 23.738'W	8/4/96 10:44	- m	50m	17.343°C	31.593	
038	XSHF18	40° 47.033'N	70° 22.521'W	8/4/96 11:15	- m	50m	17.664°C	31.535	
039	XSHF19	40° 49.671'N	70° 21.432'W	8/4/96 11:42	- m	49m	17.717°C	31.529	
040	XSHF20	40° 52.326'N	70° 20.136'W	8/4/96 12:12	- m	45.5m	17.254°C	31.549	
041	XSHF21	40° 55.072'N	70° 19.069'W	8/4/96 12:45	- m	42m	14.302°C	31.764	
042	a60m01	40° 32.51'N	70° 10.475'W	8/4/96 15:37	- m	61.5m	17.564°C	31.958	
043	a60m02	40° 33.07'N	70° 14.236'W	8/4/96 16:07	- m	60m	17.486°C	31.955	
044	a60m03	40° 32.96'N	70° 17.707'W	8/4/96 16:34	- m	60m	17.685°C	31.926	
045	a60m04	40° 34.607'N	70° 20.638'W	8/4/96 16:59	- m	60.5m	17.491°C	31.939	
046	a60m05	40° 36.119'N	70° 23.549'W	8/4/96 17:24	- m	60m	16.553°C	31.981	casts 02-05 were held at 8m above the bottom, rest will be held at 5m from the bottom
047	a60m06	40° 37.067'N	70° 26.632'W	8/4/96 17:50	- m	60.2m	16.601°C	31.944	backed up to floppy
048	a60m07	40° 37.987'N	70° 30.131'W	8/4/96 18:18	- m	60m	17.285°C	31.66	
049	a60m08	40° 38.114'N	70° 33.064'W	8/4/96 18:45	- m	59.5m	17.512°C	31.693	vmain - 10.7v
050	a60m09	40° 40.516'N	70° 35.974'W	8/4/96 20:55	- m	60.5m	17.248°C	31.844	new alkaline batteries
051	a60m10	40° 42.041'N	70° 38.994'W	8/4/96 21:24	- m	60.5m	17.695°C	31.882	
052	a60m11	40° 44.52'N	70° 39.986'W	8/4/96 21:49	- m	60m	17.737°C	31.858	end of 60m line
053	a70m01	40° 33.501'N	70° 47.006'W	8/4/96 23:17	- m	71m	17.333°C	31.84	start 70m line
054	a70m02	40° 32.5'N	70° 43.5'W	8/4/96 23:50	K1 - 66m	71.5m	17.623°C	31.94	bottle #1 taken at 66m (2m above bottom or the cast), no position noted on log sheet
055	a70m03	40° 31.541'N	70° 40.051'W	8/5/96 0:25	K2 - 68m	71.5m	17.053°C	31.937	bottle #2 taken at bottom (68m) of cast
056	a70m04	40° 31.038'N	70° 36.456'W	8/5/96 1:04	- m	71m	17.572°C	31.804	
057	a70m05	40° 29.991'N	70° 33.519'W	8/5/96 1:32	- m	72m	16.903°C	31.942	
058	a70m06	40° 29.018'N	70° 29.955'W	8/5/96 2:05	- m	72m	17.19°C	31.962	mised layer at bottom
059	a70m07	40° 28.503'N	70° 26.45'W	8/5/96 2:37	- m	71m	17.625°C	31.954	
060	a70m08	40° 28'N	70° 22.958'W	8/5/96 3:11	K3 - 65m	71m	18.017°C	31.954	bottle #3 taken at 65m overshot target depth and came near (touched?) bottom
061	a70m09	40° 27.013'N	70° 19.942'W	8/5/96 3:44	- m	72m	17.729°C	31.947	data dump
062	a70m10	40° 26.994'N	70° 15.853'W	8/5/96 4:22	- m	71m	18.198°C	31.924	
063	a70m11	40° 27.606'N	70° 11.97'W	8/5/96 4:58	K5 - 65m	69m	17.842°C	31.938	bottle #k-5 taken at bottom ship took off when CTD was 10m from surface on upcast
064	a80m01	40° 22.454'N	70° 14.561'W	8/5/96 5:59	- m	81m	17.957°C	31.926	

065	a80m02	40° 23.036'N	70° 18.036'W	8/5/96 6:24	- m	80.5m	17.994°C	31.945	
066	a80m03	40° 22.935'N	70° 21.561'W	8/5/96 7:09	- m	81m	17.435°C	31.858	
067	a80m04	40° 23.487'N	70° 25.118'W	8/5/96 7:44	- m	80.5m	17.727°C	31.845	
068	a80m05	40° 23.999'N	70° 28.042'W	8/5/96 8:12	- m	82m	17.784°C	31.947	
069	a80m06	40° 24.951'N	70° 32.075'W	8/5/96 8:50	- m	81.5m	17.911°C	31.943	
070	a80m07	40° 25.923'N	70° 35.099'W	8/5/96 9:19	- m	80.5m	16.631°C	31.97	
071	a80m08	40° 25.924'N	70° 39.009'W	8/5/96 9:50	K4 - 76m	82m	17.651°C	31.947	bottle k4 at 76m, 10m think mixed layer at bottom
072	a80m09	40° 26.936'N	70° 42.096'W	8/5/96 10:20	K6 - 75m	81m	17.814°C	31.96	bottle k6 tripped at 75 m, stratified near the bottom
073	a80m10	40° 26.99'N	70° 45.579'W	8/5/96 10:51	- m	81.5m	18.086°C	31.996	
074	a80m11	40° 26.979'N	70° 49.583'W	8/5/96 11:23	- m	82m	17.613°C	31.93	last along 80m isobath
075	a90m01	40° 22.976'N	70° 51.038'W	8/5/96 12:07	- m	91m	17.866°C	31.908	
076	a90m02	40° 23.027'N	70° 47.019'W	8/5/96 12:43	- m	91m	17.596°C	31.867	
077	a90m03	40° 22.517'N	70° 43.982'W	8/5/96 13:11	K7 - 86m	92m	17.509°C	31.826	down to 89m, up 3m and messenger dropped bottle k7
078	a90m04	40° 22.036'N	70° 40.514'W	8/5/96 13:52	- m	92.5m	17.687°C	31.85	
079	a90m05	40° 22.036'N	70° 37.002'W	8/5/96 14:26	- m	91m	17.773°C	31.908	
080	a90m06	40° 20.998'N	70° 33.016'W	8/5/96 15:07	- m	93m	17.573°C	31.891	
081	a90m07	40° 20.49'N	70° 30.043'W	8/5/96 15:41	- m	93m	17.597°C	31.859	transmissometer lenses dried and cleaned completely. good in air values before deployment
082	a90m08	40° 20.064'N	70° 25.947'W	8/5/96 16:20	- m	91m	17.586°C	31.879	transmissometer lens not cleaned prior to deploy
083	a90m09	40° 18.987'N	70° 22.937'W	8/5/96 16:52	- m	93m	17.924°C	31.906	winch sped up to 50m/min for part of the downcast
084	a90m09b	40° 19.069'N	70° 22.966'W	8/5/96 17:07	- m	93m	18.042°C	31.91	winch speed still variable, pdr has shut down
085	a90m10	40° 18.515'N	70° 19.887'W	8/5/96 17:54	- m	92.5m	17.733°C	31.85	pdr and winch now working
086	a90m11	40° 17.942'N	70° 15.943'W	8/5/96 18:31	- m	92m	17.602°C	31.822	
087	a100m01	40° 13.977'N	70° 17.565'W	8/5/96 19:13	- m	100m	17.459°C	31.846	hint of shelf break front near bottom
088	a100m02	40° 14.465'N	70° 21.079'W	8/5/96 19:46	- m	101m	18.289°C	32.129	shelfbreak front event near bottom
089	a100m03	40° 15.641'N	70° 24.184'W	8/5/96 20:19	- m	101m	18.441°C	32.108	
090	a100m04	40° 16.507'N	70° 27.485'W	8/5/96 20:50	- m	101m	18.285°C	31.86	
091	a100m05	40° 17.509'N	70° 30.996'W	8/5/96 21:23	- m	101m	18.16°C	31.83	
092	a100m06	40° 18.485'N	70° 34.481'W	8/5/96 21:57	- m	100m	18.288°C	31.94	
093	a100m07	40° 19.009'N	70° 38.036'W	8/5/96 22:28	- m	101m	18.606°C	31.849	changed batteries just before cast (battery was 10.8V)
094	a100m08	40° 20.015'N	70° 40.978'W	8/5/96 23:05	- m	98m	17.534°C	31.86	
095	a100m09	40° 20.027'N	70° 45.077'W	8/5/96 23:39	- m	100m	19.027°C	31.961	
096	a100m10	40° 20.021'N	70° 48.045'W	8/6/96 0:07	- m	101m	18.06°C	31.913	
097	a100m11	40° 19.974'N	70° 52.04'W	8/6/96 0:44	- m	99m	17.94°C	31.886	
098	a125m01	40° 13.88'N	70° 52.085'W	8/6/96 1:43	- m	125m	18.122°C	31.85	
099	a125m02	40° 13.439'N	70° 48.973'W	8/6/96 2:12	- m	125m	18.545°C	32.072	
100	a125m03	40° 12.944'N	70° 45.549'W	8/6/96 2:47	- m	125m	17.453°C	31.882	
101	a125m04	40° 10.492'N	70° 42.535'W	8/6/96 3:39	- m	125m	17.888°C	31.846	
102	a125m05	40° 8.446'N	70° 40.574'W	8/6/96 4:22	K8 - 120m	126m	17.857°C	31.879	bottle k8 taken at bottom of cast
103	a125m06	40° 6.987'N	70° 37.995'W	8/6/96 4:55	- m	125m	19.243°C	32.339	
104	a125m07	40° 6.044'N	70° 34.462'W	8/6/96 5:34	- m	128m	19.716°C	32.291	
105	a125m08	40° 6.108'N	70° 30.996'W	8/6/96 6:10	- m	126m	19.867°C	32.365	
106	a125m09	40° 6.034'N	70° 27.483'W	8/6/96 6:44	- m	127.5m	18.811°C	32.052	winch speed varies on downcast
107	a125m10	40° 6.01'N	70° 23.938'W	8/6/96 7:19	- m	123m	19.882°C	32.459	
108	a125m11	40° 6.059'N	70° 20.446'W	8/6/96 7:54	- m	125m	19.873°C	32.489	
109	a125m12	40° 6.017'N	70° 16.97'W	8/6/96 8:26	- m	125m	19.301°C	32.226	
110	a70r01	40° 27.505'N	70° 11.974'W	8/6/96 11:01	- m	70.5m	18.022°C	31.946	start of 70m isobath repeat transect
111	a70r02	40° 26.93'N	70° 16.064'W	8/6/96 11:34	- m	71.5m	18.356°C	31.962	temperature and salinity noisy in upper 10m
112	a70r03	40° 26.937'N	70° 20.024'W	8/6/96 12:05	- m	72m	18.089°C	31.944	
113	a70r03a	40° 28.256'N	70° 20.353'W	8/6/96 12:48	- m	69.5m	17.972°C	31.945	alongshore site
114	a70r04	40° 28.012'N	70° 23.035'W	8/6/96 13:19	- m	71m	17.942°C	31.946	
115	a70r05	40° 28.489'N	70° 26.571'W	8/6/96 13:54	- m	71.5m	16.879°C	31.962	
116	a70r06	40° 28.948'N	70° 30.179'W	8/6/96 14:30	- m	73m	17.191°C	31.976	can not find bottom with fathomether, depth from bridge
117	a70r07	40° 29.916'N	70° 33.65'W	8/6/96 15:19	- m	72m	17.701°C	31.706	can not find bottom with fathomether, depth from bridge
118	a70r08	40° 31.053'N	70° 36.511'W	8/6/96 15:50	- m	72m	18.009°C	31.774	
119	a70r09	40° 31.439'N	70° 40.069'W	8/6/96 16:22	- m	73m	17.709°C	31.768	
120	a70r10	40° 32.518'N	70° 43.585'W	8/6/96 16:54	- m	72m	17.846°C	31.747	
121	a70r11	40° 33.497'N	70° 47.166'W	8/6/96 17:25	- m	71.5m	17.963°C	31.775	
122	inshore01	40° 34.963'N	70° 26.911'W	8/6/96 19:29	- m	63m	17.901°C	31.943	
123	yshf01	39° 56.717'N	70° 44.262'W	8/7/96 0:28	- m	408m	21.403°C	32.414	
124	yshf02	39° 59.373'N	70° 43.161'W	8/7/96 1:10	- m	295m	20.933°C	32.339	
125	yshf03	40° 2.061'N	70° 41.944'W	8/7/96 1:40	- m	173m	20.146°C	32.366	
126	yshf04	40° 4.661'N	70° 40.806'W	8/7/96 2:27	- m	132m	20.836°C	32.684	

127	yshf05	40° 7.302'N	70° 39.718'W	8/7/96 3:01	- m	127m	20.488°C	32.245	
128	yshf06	40° 10.043'N	70° 38.478'W	8/7/96 3:40	- m	123m	19.412°C	31.836	
129	yshf07	40° 12.648'N	70° 37.387'W	8/7/96 4:08	- m	118m	18.493°C	32.124	
130	yshf08	40° 15.348'N	70° 36.478'W	8/7/96 4:43	- m	114m	18.526°C	32.153	new batteries before cast
131	yshf09	40° 17.932'N	70° 35.234'W	8/7/96 5:17	- m	103m	17.947°C	31.815	
132	yshf10	40° 20.616'N	70° 34.019'W	8/7/96 5:48	- m	93m	17.808°C	31.855	
133	yshf11	40° 23.278'N	70° 32.916'W	8/7/96 6:20	- m	84m	18.264°C	31.937	slightly off station,near offshore site
134	yshf12	40° 25.915'N	70° 31.542'W	8/7/96 6:51	- m	78m	17.829°C	31.816	
135	yshf13	40° 28.629'N	70° 30.6'W	8/7/96 7:22	K9 - 59m	73m	17.612°C	31.862	surface water samples for heidi, towed ctd at bottom of cast due to 1 kt current to get good wire angle
136	yshf14	40° 31.329'N	70° 29.404'W	8/7/96 7:58	- m	68m	17.883°C	31.923	
137	yshf15	40° 33.812'N	70° 28.193'W	8/7/96 8:27	- m	65m	17.608°C	31.946	
138	yshf16	40° 36.44'N	70° 27'W	8/7/96 8:59	- m	63m	18.219°C	31.92	pdr no longer working
139	yshf17	40° 39.099'N	70° 25.87'W	8/7/96 9:28	- m	58m	18.074°C	31.94	pdr has broken belt
140	yshf18	40° 41.767'N	70° 24.706'W	8/7/96 10:00	- m	54m	17.495°C	31.917	
141	yshf19	40° 44.39'N	70° 23.49'W	8/7/96 10:31	K10 - 45m	51m	17.804°C	31.64	bottle at 45m depth in mixed layer
142	yshf20	40° 47.072'N	70° 22.367'W	8/7/96 11:02	K11 - 45m	51m	18.345°C	31.547	bottle 11 at 45m depth
143	yshf21	40° 49.69'N	70° 21.29'W	8/7/96 11:33	- m	50m	17.277°C	31.82	
144	yshf22	40° 52.351'N	70° 20.174'W	8/7/96 12:01	- m	46m	16.828°C	31.813	depths from bridge
145	yshf23	40° 54.995'N	70° 19'W	8/7/96 12:24	- m	42m	16.642°C	31.913	
146	zshf01	39° 56.633'N	70° 44.279'W	8/9/96 22:22	- m	415m	22.291°C	32.685	
147	zshf02	39° 59.402'N	70° 43.205'W	8/9/96 22:58	- m	295m	22.451°C	32.89	
148	zshf03	40° 2.06'N	70° 42.001'W	8/9/96 23:34	- m	177m	22.323°C	32.928	
149	zshf04	40° 4.677'N	70° 40.796'W	8/10/96 0:08	- m	131m	18.94°C	31.574	
150	zshf05	40° 7.375'N	70° 39.761'W	8/10/96 0:40	- m	128m	19.793°C	31.561	
151	zshf06	40° 9.974'N	70° 38.515'W	8/10/96 1:12	- m	123m	20.219°C	31.584	winch started to squeak on upcast, instrument at 26m and 13m for several minutes
152	zshf07	40° 12.624'N	70° 37.403'W	8/10/96 1:47	K12 - 111m	118m	20.296°C	32.162	bottle k12 taken at bottom of cast, 111m
153	zshf08	40° 15.3'N	70° 36.197'W	8/10/96 2:23	- m	114m	20.712°C	32.298	
154	zshf09	40° 17.928'N	70° 35.054'W	8/10/96 2:53	- m	104m	19.729°C	31.873	
155	zshf10	40° 20.583'N	70° 33.915'W	8/10/96 3:23	- m	93m	19.314°C	31.902	
156	zshf11	40° 23.222'N	70° 32.758'W	8/10/96 3:56	- m	86m	19.332°C	31.766	
157	zshf12	40° 25.888'N	70° 31.653'W	8/10/96 4:25	- m	79m	19.624°C	31.798	
158	zshf13	40° 28.544'N	70° 30.467'W	8/10/96 4:56	- m	72m	19.361°C	31.861	
159	zshf14	40° 31.211'N	70° 29.306'W	8/10/96 5:24	- m	68m	19.19°C	31.849	
160	zshf15	40° 33.794'N	70° 28.175'W	8/10/96 5:52	- m	64m	19.222°C	31.916	
161	zshf16	40° 36.481'N	70° 27'W	8/10/96 6:22	- m	62m	19.071°C	31.895	
162	zshf17	40° 39.12'N	70° 25.907'W	8/10/96 6:51	- m	58m	19.188°C	31.939	
163	zshf18	40° 41.741'N	70° 24.728'W	8/10/96 7:29	- m	53m	19.077°C	31.801	
164	zshf19	40° 44.457'N	70° 23.572'W	8/10/96 8:01	K13 - 44m	51m	19.016°C	31.655	bottle 13 taken at 44m
165	zshf20	40° 47.082'N	70° 22.376'W	8/10/96 8:34	- m	50.5m	19.94°C	31.517	
166	zshf21	40° 49.786'N	70° 21.256'W	8/10/96 9:04	- m	50m	19.084°C	31.594	
167	zshf22	40° 52.424'N	70° 20.114'W	8/10/96 9:31	- m	46.5m	18.097°C	31.787	
168	zshf23	40° 55.165'N	70° 18.886'W	8/10/96 9:57	- m	42m	17.849°C	31.742	

Across Shelf CTD Section on 8/04/96

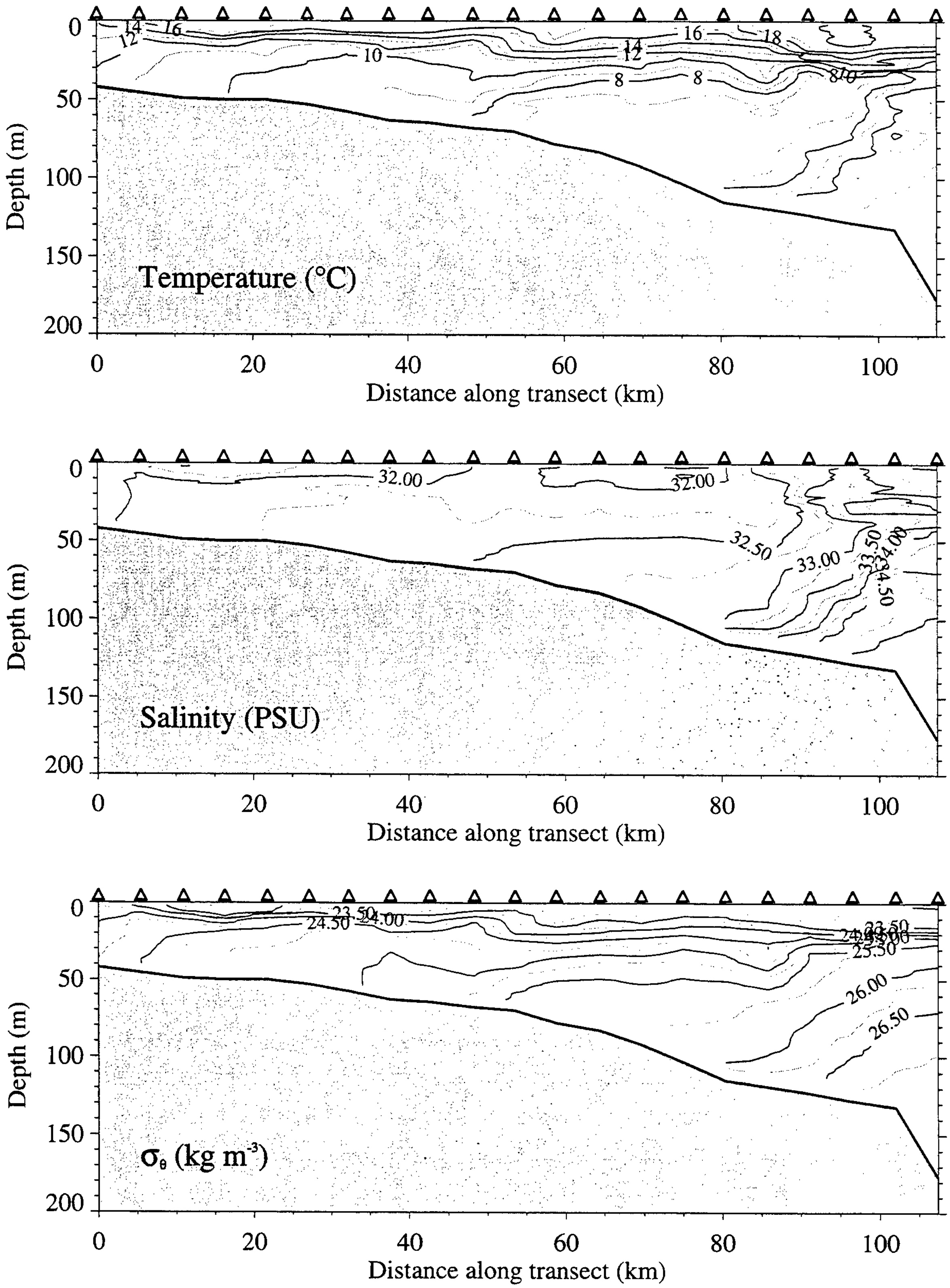


Figure IV.3. Across Shelf CTD Section on 8/04/96.

Acknowledgements

The moorings were expertly designed by George Tupper and carefully prepared by the WHOI Rigging Shop under the direction of David Simoneau.

We are grateful for the skill of Captain Paul Howland and the skillful and willing assistance of the deck crew of the R/V *Oceanus*.

Special thanks go to Chief Scientists Jim Ledwell, Bob Pickart, and Murray Levine for their role in recoveries and redeployments of our gear.

Scott Pegan and Clayton Paulson graciously provided the SeaBird SBE-25 used for the CTD casts taken during the deployment cruise.

We sincerely thank Mary Ann Lucas for her help in preparing this report.

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Appendices

Appendix 1: Cruise Participants

Leg 1
Steven J. Lentz (Chief Scientist)
Steven Anderson
William Ostrom
Bryan Way
Nan Galbraith
Al Plueddemann
James Edson
Neil McPhee
Jonathan Ware
Craig Marquette
Jim Kirklin (Marine Technician)

Leg 2
Steven J. Lentz
Steven Anderson
William Ostrom
Bryan Way
Jonathan Ware
Craig Marquette
Nan Galbraith
Andrea Ray
Mark Baumgartner
Albert Fischer
Jim Kirklin

Leg 3
Steven J. Lentz
Yogesh C. Agrawal
Paul S. Hill
Henry C. Pottsmith
Ngoc T. Tran
Grace C. Chang
Anna M. Barlow
Matthew Carr
Jim Kirklin

Appendix 2: Mooring Deployment Procedures

The Central discus and toroid surface moorings were deployed in the following manner. The Central discus buoy was positioned on deck with the buoy's ridge bridle pointing foreward and outboard. Figure A.2.1 details the position of the discus on the fantail. A 75 meter 7/8" diameter nylon tag line was lead from the capstan through the center of the aframe out around the stern of the ship and up along the starboard rail to the deployment area. This tag line was reeved through a fair lead block secured to the deck, positioned aft of the capstan and a trawl block hanging in the center of the aframe. The end of this line was then shackled to the free end of the 5 meter shot of 5/8" chain attached to the bottom of the depressor weight. The Central surface mooring is illustrated in Figure III.B.1. Three line handlers were required to tend this line around the outboard side of the ship during the lowering of the upper 35 meters of instrumentation and deployment of the discus buoy.

The ship's crane boom was extended 6 meters over the depressor weight to be deployed. A 3/4" chain grab was attached to the crane whip hook . This hook was then attached to the upper 5 meters shackled to the top of the depressor weight. The crane whip raised the depressor weight off the deck and lowered it over the starboard side. The tag line running out board around the ship was paid out simultaneously as the depressor was lowered. The 3/4" chain hooked by the crane whip was stopped off at approximately 1 meter above the deck, using a 3/4" chain grab shackled to a 1 1/4" diameter nylon bull rope. This line was reeved around the capstan. The hanging mooring tension was then transferred to the bull rope and the chain grab attached to the crane whip removed. The 35 meter Seacat was shackled onto the free end of the stopped off 5 meter shot. The 3/4" chain grab attached to the crane whip was then hooked onto the 2.83 meter length of 3/4" chain shackled to the top of the Seacat. The crane was raised taking up the tension being held by the bull rope. The bull rope was removed and the crane whip lowered the Seacat over the side of ship. This procedure was repeated for each instrument up to the discus bridle.

The crane was repositioned over the discus so that the crane's whip hung over the discus lifting bail. A Release-O-Matic quick release hook was attached to the crane whip and hooked onto the discus's lifting bail. Three slip lines were reeved thru the discus tower, hull and bridle bails. These line were used to control the swing of the buoy during the lift off the deck and into the sea. The free end of the .35 meter 3/4" chain shackled to the shallowest VMCM was then shackled to the apex of the apex bridle. The bull rope was then eased off and removed, transferring the mooring tension to the discus. The crane whip raised the discus up and swung it out board. The slip lines were paid out keeping the discus from swinging out of control. The tower and bridle slip lines were removed once the discus hull had passed clear of the ship's rail. The crane whip lowered the discus into the sea so that the hull was completely afloat. The quick release hook and hull slip line were removed, casting the discus adrift. The hull slip line was pulled clear just following the quick release. This line maintained the correct orientation of the hull to allow the release hook to be released. As the discus drifted around the stern of the ship the line handlers cast off the 7/8" tag line. This line was reefed around the capstan. The tag line was hauled in, pulling up to deck level the 5 meter shot of 3/4" chain shackled to the bottom of the depressor weight. A 1" diameter stopper line with a 3/4" chain grab attached was hooked onto the 5 meter chain and stopped off onto a deck cleat. The capstan tag line was then eased off. The top of the acoustic release was shackled to the stopped off 3/4" chain. A 5 meter length of 3/4" chain was shackled to the bottom of the release and secured with another stopper line. The mooring tension was transferred to this stopper. A 3/4" chain grab shackled to the 7/8" tag line was hooked onto the 3/4" chain 1 meter from the bottom end of the release and tension taken up raising the release off the deck. With the release off the deck the stopper line and a-frame were shifted out allowing the release to pass out board. Once the release cleared of the stern of the ship, the capstan paid out the tag line lowering the release. The 5 meter shot of chain shackled to the bottom of the release was cleated and the capstan tag line removed.

75 meters of 3/4" chain was faked out on deck through the aframe. The inboard fleet of each length of chain had been tied off with rotten stops made from 3/8" Dacron line. These rotten stops were tied to a length of 3/8" chain that had been secured to deck eye bolts, perpendicular to the fleets. The purpose of securing the 3/4" chain in this fashion was to prevent the chain from becoming tangled as the chain was paid out, one fleet at a time over the stern. The stopped off 3/4" chain was shackled to the top end of the 75 meter length of 3/4" chain. The remainder of the mooring up to the anchor was paid out in bights by alternately using two stopper lines. The anchor was positioned on a bridled steel flip plate and cast over the side using the ship's crane.

All the surface moorings with the exception of the 6 guard and the Seatex moorings were deployed using the instrument-lowering first technique. These surface moorings, because of their lack of subsurface instrumentation, were deployed buoy first over the starboard side.

The subsurface moorings were deployed anchor first, because of the close proximity of the acoustic release to the anchor being .5 meters and the attachment of a tide gauge positioned on the top of the anchor and chained to the top of the release. Figures III.B.3, III.B.6, III.Bb.8 and III.B.10 detail this segment of the moorings. The ship's aframe, trawl winch and a 4 meter long vertical chain stopper rigged in the aframe were utilized for these deployments. The offshore subsurface mooring (Figure III.B.10) was deployed utilizing the following technique.

The trawl wire was reeved thru the Gifford block located in the center of the aframe. The end of the trawl wire was then shackled to the top end of the .5 meter shot of 3/8" chain attached to the top of the release. A .5 meter length of 3/8" chain was shackled to the anchor and the bottom of the acoustic release. Tension was brought up so that the release and chain were taut to the anchor. The tide gauge was connected to the top pear ring shackled to the top of the release using a 3.14 meter length of 3/8" chain encased in 11/2" I.D. tygon tubing down to the tide gauge frame sitting on the top of the anchor. The tubing was used for chafe protection against the acoustic release as the chain parallel its instrument case as well as, prevent the chain from fouling around the anchor prior to the mooring being released. This chain segment was secured to the tension rod, .5 meter anchor chain and tide gauge frame with tie wraps.

The trawl winch hauled in the trawl wire lifting the release and anchor into the center of the aframe. The aframe swung outboard and the trawl wire paid out lowering the release and anchor parallel to the vertical chain stopper. The stopper was hooked onto the 3/8" chain shackled to the top of the release and the trawl wire was removed. A 2 meter long LiftAll sling was passed thru the top of the 79.5 meter VMCM load cage. The ends of the sling were then shackled to the trawl wire. The trawl wire was hauled in lifting the VMCM into a position over the vertical chain stopper. The trawl winch lower the instrument in order that the loose end of the stopped off chain could be shackled to the bottom bail of the VMCM. Tension was brought on by the trawl winch allowing the vertical chain stopper to be removed. The trawl wire lowered the VMCM until the vertical chain stopper could be passed thru another sling reeved on the top of the instrument and hooked back onto itself. The trawl wire and sling were removed. The trawl wire was shackled to the free end of the .7 meters of 3/8" chain attached to the top of the ADCP and raised up over the suspended VMCM. The two instruments were shackled together. The trawl winch wound in taking the tension off the vertical stopper. The stopper and sling were removed. The free end of the vertical chain stopper was shackled with a 1/2" chain grab. The trawl winch lowered the mooring .5 meters above the hanging 1/2" chain grab. The stopper was hooked onto the 3/8" chain and the trawl winch eased the tension to the vertical stopper and removed. The trawl wire was then shackled to the free end of chain connected to the next instrument in line. This procedure was repeated up to the top flotation sphere.

Deployment of the top flotation utilized the trawl wire shackled a S.S Brailer quick release hook. This hook is designed to release by pulling the trip line vertically. The Release-O-Matic hooks used for deploying the surface buoys would not work because this hook requires the trip line to be near 90° off the lift line angle to release. The trip line was reeved thru a separate block hung on the aframe and cleat to the prior to the start of the deployment operation. The length of line was pre-set to release the sphere 2 meters below the surface.

The Brailer quick release was hooked onto the lifting bail of the sphere. The trawl winch wound in the trawl wire lifting the sphere up out of its cradle and into the center of the aframe, approximately 1 meter off the deck. The 3 meter length of 3/8" chain shackled to the top of the 50 meter Seacat was stopped off with the vertical stopper, so that there was 2 meters of loose chain hanging from the chain grab. The loose end of the chain was shackled to the suspended 48" sphere and the trawl winch wire was hauled in taking the tension off the vertical stopper. The stopper was removed, and the aframe swung outboard. The trawl winch paid the trawl wire and lowered the mooring down until the trip line took the load causing the mooring to be released.

Because of the large amount of gear required for these moorings, deck space was carefully planned in advance of the deployment cruises. Figures A.2.1 and A.2.2 show how the gear was laid out on deck for the deployment cruises.

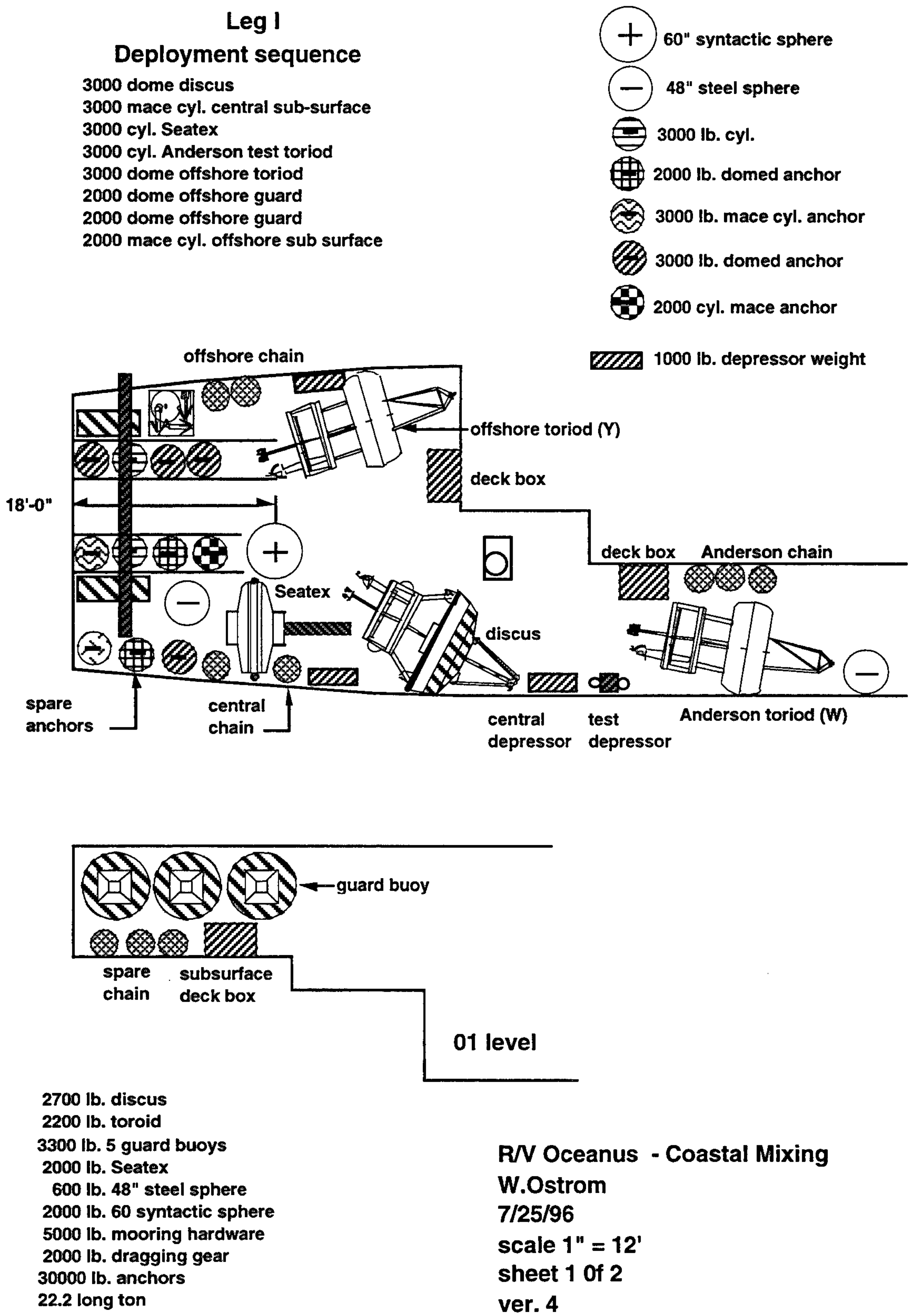


Figure A.2.1. Oceanus Deck Layout, Leg 1.

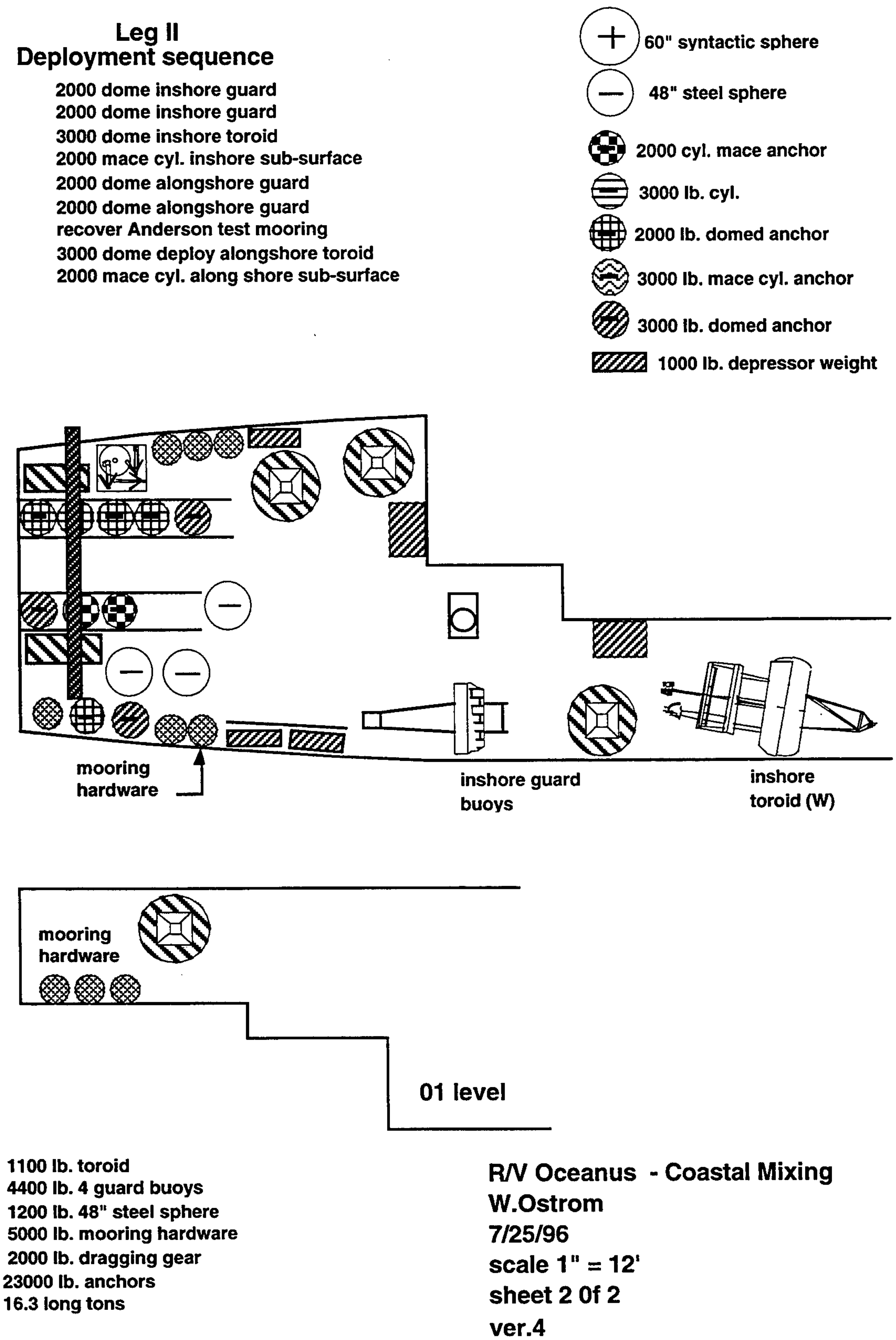


Figure A.2.2. Oceanus Deck Layout Leg 2.

Changes to hardware

Modifications were made to some hardware components of moorings at deployment time. Shackle sizes were changed as needed on bridles, swivels, and releases to accommodate fittings that were of a different size than anticipated.

Shackles were added to some shots of chain in an effort to keep VMCM compasses aligned. For each mooring, all instruments were laid out on deck with chain and shackles in place, orientation was checked by marking chain, shackles and cages, and shackles added as needed to maintain alignment of VMCMs. The additional shackles matched the shackles specified on the mooring diagrams at the points where they were added.

On the Central Discus mooring, a 3/4" shackle was added below the 10, 15, and 20 m VMCMs. On the Central Subsurface mooring, an extra 3/4" shackle was added below the 55 and 60 m VMCMs. On the temporary Central Toroid mooring, the Chlam was added along with an additional 4' shot of chain.

On the Offshore Toroid, a 1" shackle was used under the bridle in place of the 3/4" shackle called for on the mooring design. Both the Offshore Subsurface and Inshore Toroid were deployed as designed. One 5/8" shackle was added below the 52.5 m SeaCat on the Inshore Subsurface mooring. On the Alongshore Toroid, one 3/4" shackle was added below the top (5 m) VMCM. There were no bushings for the swivel. The Alongshore Subsurface mooring was deployed as designed.

Appendix 3: Antifouling Paint test

The Central Surface mooring's discus hull was used as a test platform for an inter-comparison of antifouling paints. The hull was painted with three antifouling paints, Ameron 635, NoFoul ZDF and Pettit Alumicoat II. The Ameron 635 has been the antifouling coating of choice for the Upper Oceans Processes Group for the past 6 years having proven to be an effective antifouling paint. This antifouling paint has recently been put out of production, however, so an alternative coating had to be found.

The biocide in the Ameron 635 and the Pettit Alumicoat II is tributyltin. Tributyltin is a federally controlled substance that is regulated in its application and usage. The Nofoul ZDF from E Paint Co. uses zinc oxide in the paint as the antifoulant agent. This paint is not regulated.

The discus buoy hull was painted with all three antifouling paints. Figure A.3.1 details the painting scheme used on the hull. Separating the three antifouling paints are 2 non-antifouled painted control stripes. These control areas were positioned along the hull so that the mean current flows would be from the forward to aft ends of the discus. There are two additional control areas measuring 12 inches square opposing each other midway on the chine between the forward and aft end of the buoy. The three antifouling coatings were applied on 6/25/96 using a hand roller. The finished surface thickness for each of the coatings was approximately 8 mils. Each of the discus's three bridle legs were painted individually with each type antifouling paint.

At the conclusion of the ten month deployment, the antifouling coatings will be evaluated visually for ablation rate, biofouling type, biofouling adhesion and evidence of galvanic corrosion.

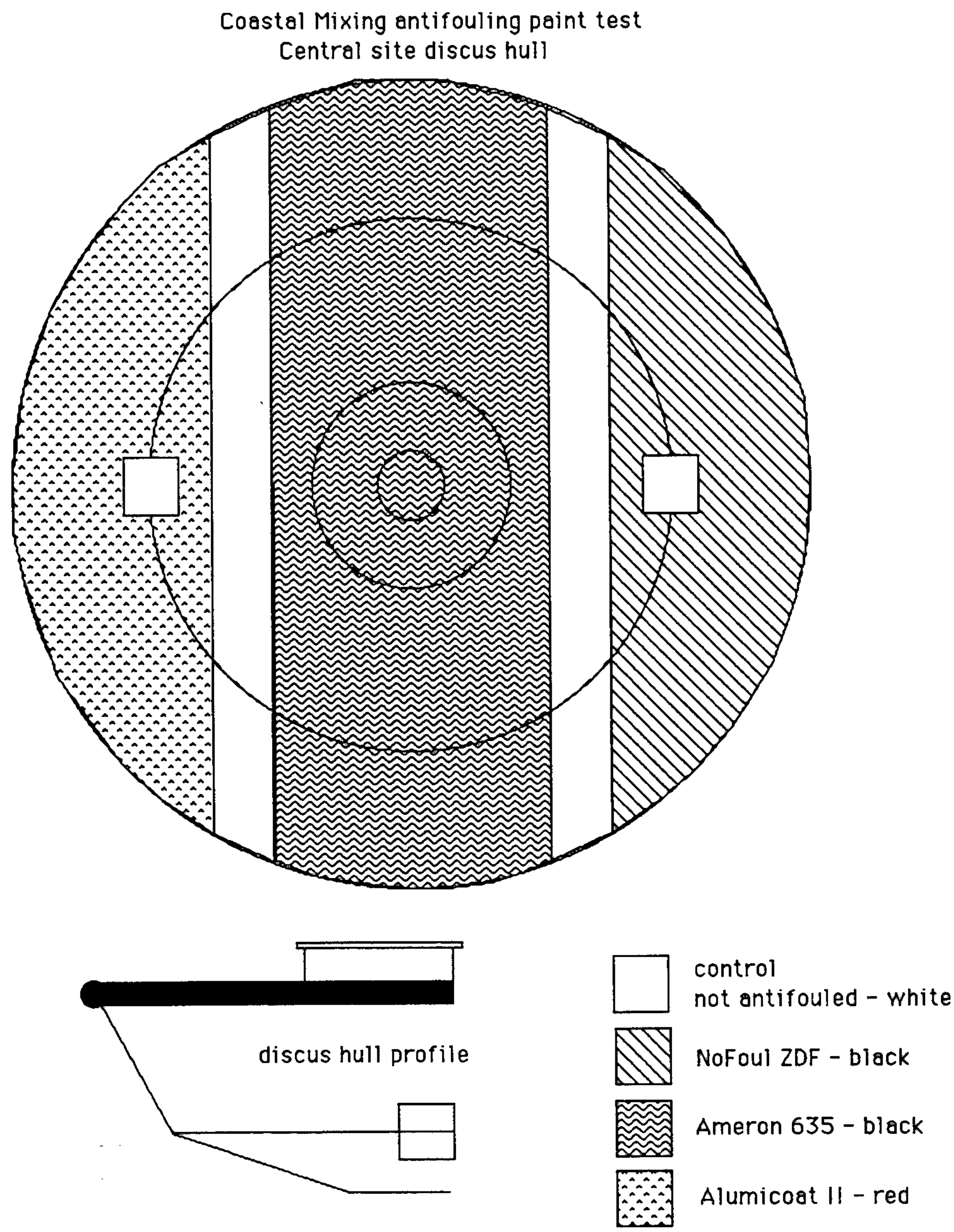


Figure A.3.1. Hull Paint Test.

Appendix 4: CHLAM: Chlorophyll Absorption Meter

WET labs Chlorophyll Absorption Meter (CHLAM) Model number 9510005, serial number ACH0126. The CHLAM was mounted on a frame that fits inside a standard VMCM cage. A SeaBird pump draws water through a mesh filter, the CHLAM, and a brominating canister. Data is logged to a WET labs MPAK data logger. The complete system is powered by two 10 D-cell alkaline battery packs. The CHLAM/MPAK records a reference and signal from three optical wavelengths, 650, 676 and 712 nm, and an internal temperature. It was noted in earlier burn-in testing that Channel 1 (650nm) was noisy compared to the other two. On July 5, 1996, a WET Labs technician (Doug) was at WHOI and prepared the CHLAM for moored deployment by applying sacrificial anodes.

Temporary CHLAM deployment

The CHLAM was deployed on the temporary surface mooring at the Central Site for 3.5 days starting on 30 AUG 1996 2345UTC. A 4 m piece of chain separated the CHLAM from the bridle placing the sampling depth at approximately 6m. The sample interval was 5 minutes taken on the hour. At each sample, the pump is turned on for 10 sec to flush the system then 10 sec of sampling with the 10 sec average of signal and reference stored in the MPAK. The internal temperature and optical absorptions are given in Figure A.4.1. Note that channel 1 (a650) has noise in the raw data record that has been removed in the chlorophyll calculation. Also, the calibration constants used are from a post deployment calibration from a sample of distilled water. Values of chlorophyll absorption are low (0.01 to 0.03 m^{-1}) but in the range expected for coastal surface waters. Profiles taken with the fluorometer show a subsurface chlorophyll maximum close to 30m, well below these observations.

Surface sampling

After the CHLAM was recovered, the flow tube was placed in line with the ship's saltwater intake and thermosalinograph. The approximate depth of sampling is 3 m. The MPAK sample interval was 2 minutes and the CHLAM lenses were cleaned prior to sampling. This allowed for automated sampling of surface chlorophyll during the CTD survey. The sampling started at 4 AUG 1996 0018UTC and continued until just prior to reaching the dock at 7 AUG 1996 1618UTC. There is a 24 hour time gap during the along shelf survey (4 AUG 1996 1240UTC to 5 AUG 1996 1240UTC) that occurred when the logging did not restart after a data dump from the MPAK. The surface chlorophyll concentrations at each of the cross shelf

CTD stations is shown in Figure A.4.2 along with the surface temperature and salinity observations. Note that the chlorophyll concentrations nearly double moving from offshore to inshore.

CHLAM calibration

The factory calibrations did not make sense. They yielded negative chlorophyll concentrations. After the deployment, the instrument was returned to the UOP lab. The lenses and flow were cleaned and the flow was filled with distilled water. Ten minutes of data were taken using the MPAK with a 2 minute sample interval. This yielded new clean water offsets which were different than the factory calibrations. These new offsets were used to calculate chlorophyll absorption.

```
%-----------------------------------------------
% FACTORY CALIBRATIONS 11/30/1995 FOR CHLAM S/N ACH0126
% THIS INFORMATION CAN BE FOUND IN "ACH0126.DEV"
%-----------------------------------------------
%CLEAN WATER OFFSET at TCAL with temperature corrections
%a650_water_cal=6.823793; %1/m LtRed
%a676_water_cal=6.775119; %1/m Red
%a710_water_cal=6.330919; %1/m Brown

%-----------------------------------------------
% SPA AUG 13 1996 DIST H2O CAL FOR CHLAM S/N ACH0126
% COMPLETED IN UOP LAB
%-----------------------------------------------
%CLEAN WATER OFFSET at TCAL with temperature corrections
a650_water_cal=6.81509335699192; %1/m LtRed
a676_water_cal=6.76450776670313; %1/m Red
a710_water_cal=6.32947145104063; %1/m Brown
```

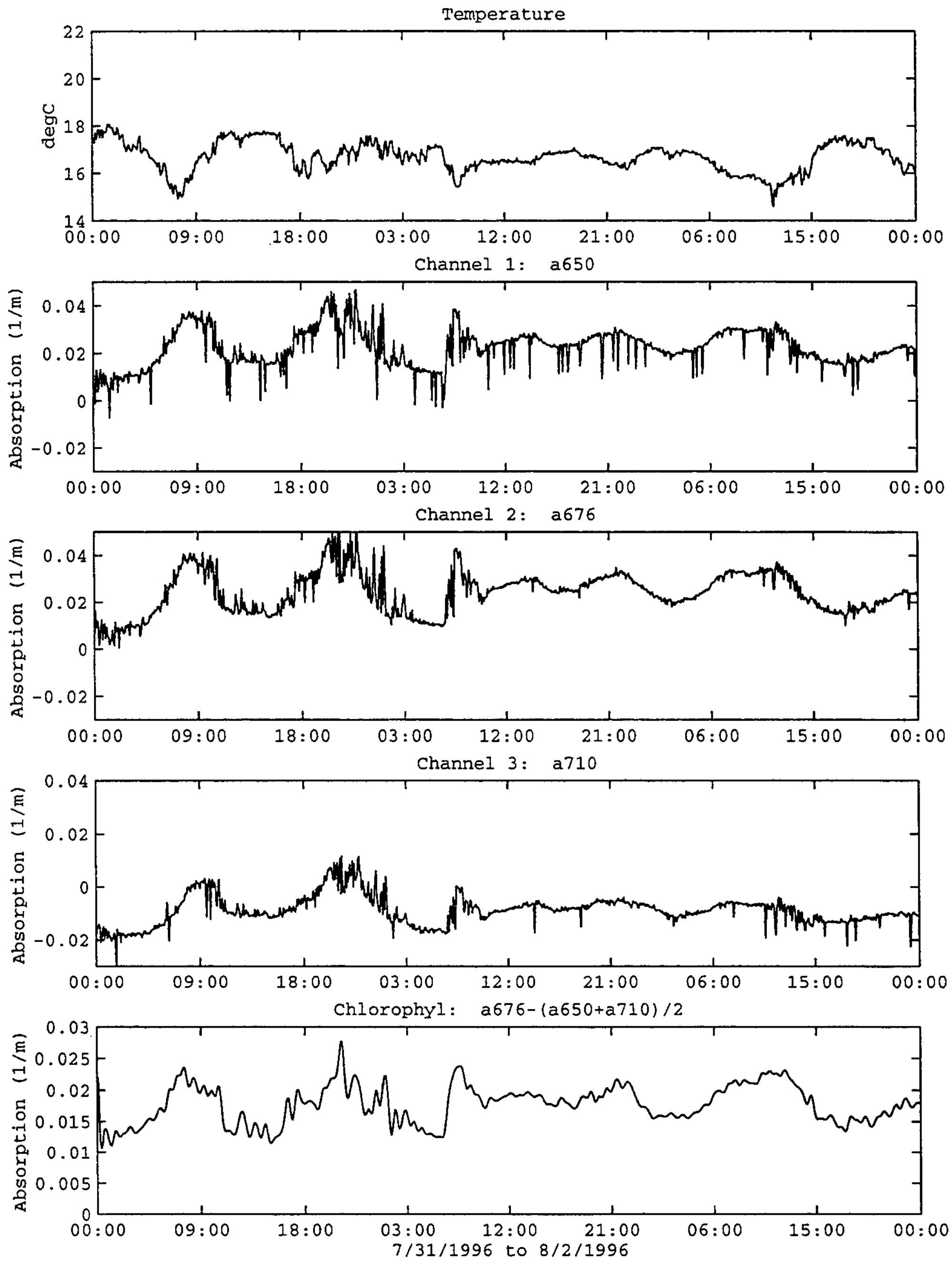


Figure A.4.1: Internal temperature and optical absorption from CHLAM during temporary deployment at Central Site.

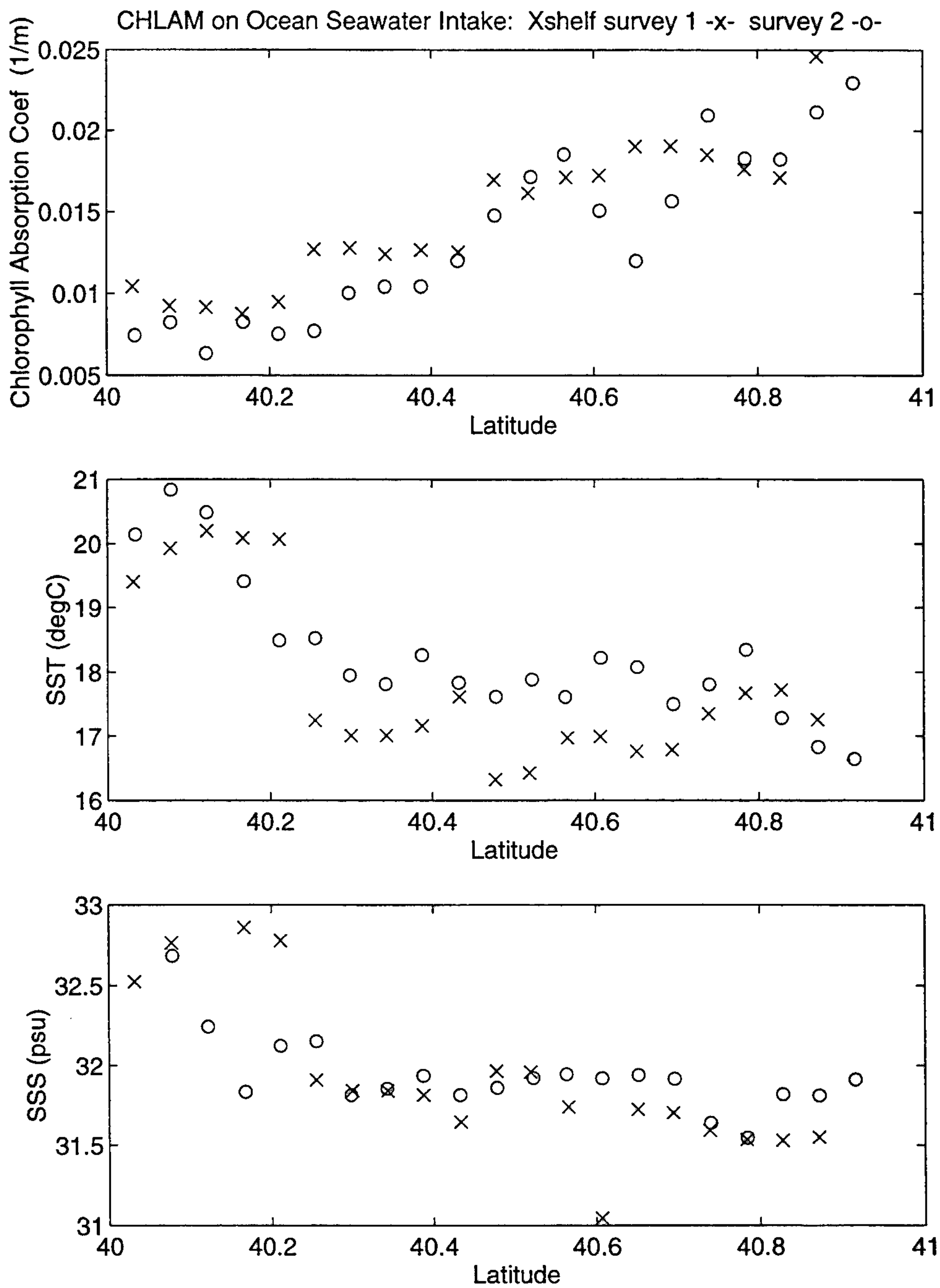


Figure A.4.1: Surface chlorophyll concentrations, temperature and salinity at each of the cross shelf CTD stations.

MATLAB routine to calculate chlorophyll absorption.

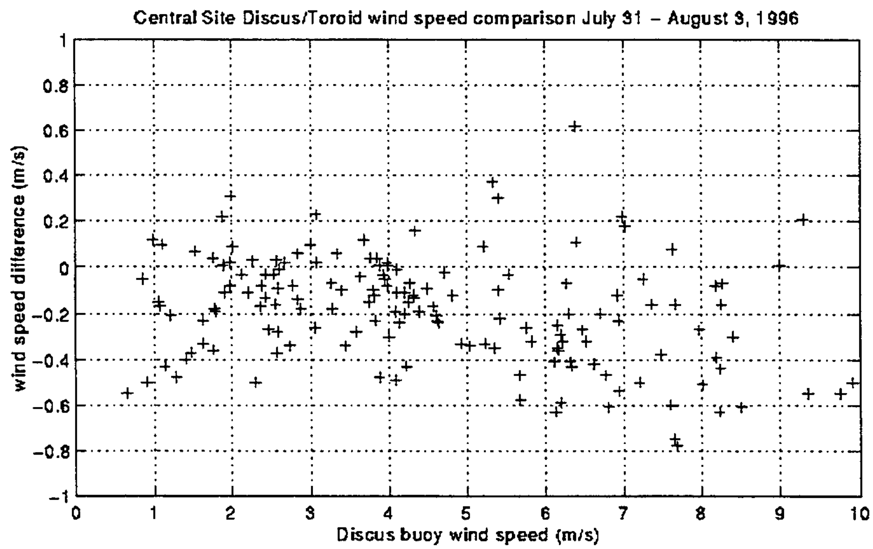
```
%-----------------------------------------------
% SPA AUG 13 1996 DIST H2O CAL FOR CHLAM S/N ACH0126
%  COMPLETED IN UOP LAB
%-----------------------------------------------
%CLEAN WATER OFFSET at TCAL with temperature corrections
a650_water_cal=6.81509335699192; %1/m  LtRed
a676_water_cal=6.76450776670313; %1/m   Red
a710_water_cal=6.32947145104063; %1/m  Brown

TCAL = 22.2;  %degC ; water temperature in flow tubes at calibration
ICAL = 24.0;  %degC ; insturment internal temperature at calibration
To   = 25.0;  %degC ; temperature offset
a650_air_cal=-0.2198;  %1/m AIR VALUES
a676_air_cal=-0.2527;  %1/m
a710_air_cal=-0.6760;  %1/m

a650_kt=-0.00141;  %1/m TEMPERATURE COEFFICIENTS (KT):
a676_kt=-0.00155;  %1/m
a710_kt=-0.00154;  %1/m

a650_air_std=0.0003;  %1/m PRECISION IN AIR GIVEN BY FACTORY
a676_air_std=0.0002;  %1/m
a710_air_std=0.0002;  %1/m

path_length = .25;  %m
%-----------------------------------------------

% CALCULATE TEMPERATURE
a3_Temp = counttotemp(T_raw)';

% CALCULATE RAW ABSORBTION
a_raw =  log(csig./cref)/path_length;  %1/m

% REMOVE CLEAN WATER CALIBARTION OFFSETS FROM EACH OF THE CHANNELS
a650_water = (a650_water_cal) - a_raw(:,1);  %1/m  SPA JULY 1996, CORRECT
a676_water = (a676_water_cal) - a_raw(:,2);  %1/m
a710_water = (a710_water_cal) - a_raw(:,3);  %1/m

% APPLY THE TEMPERATURE CORRECTION TO THE ABSORPTION COEF
a650 = a650_water + (a3_Temp - ICAL)*a650_kt;  %1/m
a676 = a676_water + (a3_Temp - ICAL)*a676_kt;  %1/m
a710 = a710_water + (a3_Temp - ICAL)*a710_kt;  %1/m

% REMOVE AIR ABSORPTION COEF
%a650 = a650 - a650_air_cal;
%a676 = a676 - a676_air_cal;
%a710 = a710 - a710_air_cal;

% CALCULATE CHLOROPHYLL ABSORPTION
a_chl = a676 - (a650 + a710)/2;
```

Appendix 5: Wind Speed Comparison

Wind sensors are mounted on both the Central discus buoy and the surrounding toroid buoys to examine spatial variability in the wind field. The discus buoy is equipped with two Vector-Averaging Wind Recorders which use a cup/vane sensor to measure winds (Figure III.B.1). The toroid buoys are equipped with Coastal Climate Weatherpaks which use a propeller/vane sensor to measure winds (Figure III.B.5). To determine whether there were significant differences in wind speed measurements due to differences in the wind sensors or buoy configurations, one of the toroid buoys was deployed near (~300 m south) the Central discus buoy for 3.5 days, 0:00 July 31 to 12:00 August 3, 1996, during the deployment cruise. Figure A.5.1 shows the wind speed comparison. Wind speed differences between the discus and toroid measurements were less than 0.8 m/s over a range of wind speeds from 0 to 10 m/s based on Argos transmitted data. A statistical summary indicates that differences in the measurements of wind speed and direction, barometric pressure, relative humidity and air temperature from the two buoys were generally small and well within expected accuracies of the measurement systems (Table A.5.1).

variable (units)	**mean**	**st. dev.**	**max**	**min**	**npts**
wind speed (m/s)	0.19	0.23	0.78	-0.62	158
wind direction (degrees)	-0.07	4.83	17.40	-15.70	158
barometric pressure (mb)	0.68	0.34	1.50	-0.30	150
relative humidity (%)	-2.06	1.60	3.80	-4.80	152
air temperature (deg C)	0.01	0.17	0.82	-0.81	152

Table A.5.1. Statistics of time series differences between meteorological variables measured from a VAWR (#704) mounted on the Central discus buoy and a Coastal Climate Weatherpak mounted on a toroid buoy. The two buoys were deployed about 300 m apart at the Central Mooring site from 0:00 July 31 to 12:00 August 3, 1996. Data are 15 minute samples intermittently transmitted via Argos.



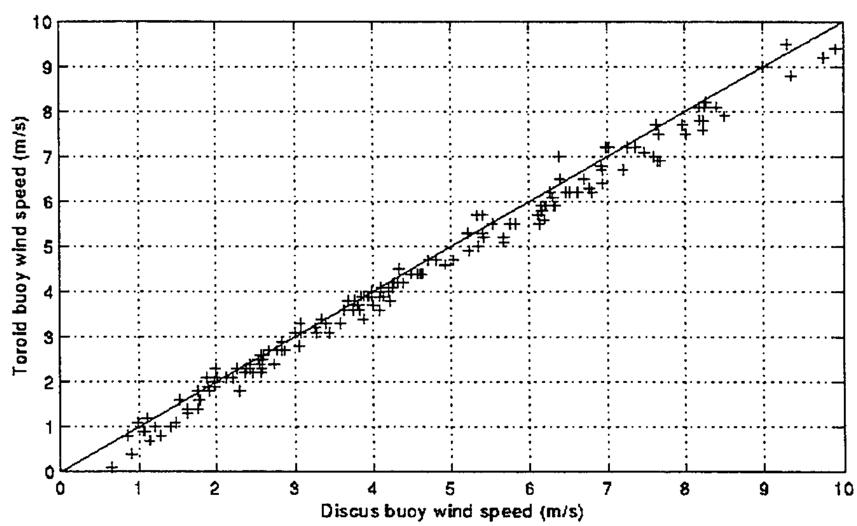


Figure A.5.1. Wind Speed Comparison at Central Site.

Appendix 6: Remote Products

RUC Model

The RUC model products from the National Meteorological Center (NMC) are obtained via the Internet Data Delivery (IDD) system maintained by Unidata (UCAR) as they become available. The RUC model is run every 3 hours and forecast products from hours 0, 6, 9 and 12 are acquired. All products are on a 93×65, 80 km grid mapped to a Lambert conformal conic projection (Figure A.6.1a). The products (Table A.6.1) are obtained and archived in NetCDF format.

Product	Units
East wind at 10m	m s^{-1}
North wind at 10m	m s^{-1}
Temperature at 2m	°C
Relative humidity at 2m	%
Pressure at surface	mbar
Mean sea level pressure (MAPS reduction)	mbar
Total precipitation over accumulation interval	kg m^{-2}
Precipitation accumulation interval	hours

Table A.6.1. Products obtained from the RUC model.

Eta Model

The Eta model products from the NMC are also obtained via the IDD as they become available. The Eta model is run twice daily and forecast products from hours 0, 6, 12, 18 and 24 are acquired. All products are on a 93×65, 80 km grid mapped to a Lambert conformal conic projection (Figure A.6.1a). The products (Table A.6.2) are obtained and archived in NetCDF format.

Product	Units
East wind at 10m	m s^{-1}
North wind at 10m	m s^{-1}
Temperature at 2m	°C
Relative humidity at 2m	%
Pressure at surface	mbar
Mean sea level pressure (ETA model reduction)	mbar
Total precipitation over accumulation interval	kg m^{-2}
Precipitation accumulation interval	hours
Surface convective inhibition	J kg^{-1}
Surface convective available potential energy	J kg^{-1}

Table A.6.2. Products obtained from the Eta model.

RUC Fluxes

Forecast heat and freshwater flux fields computed in the RUC model are obtained from the NMC every 3 hours via the File Transfer Program (FTP). All products are on an 81×62, 60 km resolution grid mapped to a polar stereographic projection (Figure A.6.1b). This is the native projection and grid of the RUC model. Table A.6.3 lists the RUC flux products that are acquired from the NMC. Files are received in GRIB format and reformatted to NetCDF.

Product	Units
Potential temperature	°C
East wind	m s^{-1}
North wind	m s^{-1}
Mean sea level pressure	mbar
Surface air temperature	°C
Sensible heat flux	W m^{-2}
Latent heat flux	W m^{-2}
Net radiation	W m^{-2}
Precipitation rate	kg m^{-2} s^{-1}
Large scale precipitation (non-convective)	kg m^{-2}
Convective precipitation	kg m^{-2}
Precipitable water	kg m^{-2}
Convective available potential energy	J kg^{-1}
Convective inhibition	J kg^{-1}

Table A.6.3. Flux Products obtained from the RUC model.

RUCS Analysis

Hourly data from the RUCS analysis are obtained from the NMC twice a day via FTP. All products are on an 81×62, 60 km resolution grid mapped to a polar stereographic projection (Figure A.6.1b) and are reformatted from GRIB to NetCDF. The products acquired from the RUCS analysis are listed in Table A.6.4.

Product	Units
Potential temperature	°C
East wind	$m\ s^{-1}$
North wind	$m\ s^{-1}$
Mean sea level pressure	mbars
Surface air temperature	°C
Dew point temperature	°C
Specific humidity	$kg\ kg^{-1}$

Table A.6.4. Products obtained from the RUCS analysis

NDBC Buoy reports

Reports from select National Data Buoy Center (NDBC) buoys in the mid-Atlantic (Figure A.6.2) are obtained once each day via FTP. The acquired data are at least two days old and have been quality controlled by NDBC. Two product suites are obtained for each buoy: an hourly meteorological dataset (Table A.6.5) and a high resolution (10 minute) wind dataset (Table A.6.6). Data files are received as standard ASCII and converted to NetCDF. The locations of the buoys from which the data is acquired are listed in Table A.6.7.

Product	Units
Wind direction	°
Wind speed	m s^{-1}
Wind gust speed	m s^{-1}
Significant wave height	m
Dominant wave period	s
Average wave period	s
Mean wave direction of dominant period	°
Sea level pressure	mbar
Air temperature	°C
Sea temperature	°C
Dewpoint temperature	°C

Table A.6.5. Products obtained from the NDBC meteorological dataset.

Products	Units
Wind direction	°
Wind speed	m s^{-1}
Wind gust direction	°
Wind gust speed	m s^{-1}
Minute past hour of gust	minutes

Table A.6.6. Products obtained from the NDBC 10 minute wind dataset.

Buoy ID	Latitude	Longitude	Water depth	Watch radius
44004	38° 27' 23" N	70° 41' 23" W	3,163m	2,638m
44008	40° 30' 0" N	69° 25' 0" W	62	100
44009	38° 27' 49" N	74° 42' 7" W	28	64
44011	41° 5' 0" N	66° 35' 0" W	88	209
44025	40° 15' 1" N	73° 10' 0" W	40	76
44028	41° 23' 47" N	71° 5' 6" W	22	68

Table A.6.7. Locations of NDBC buoys.

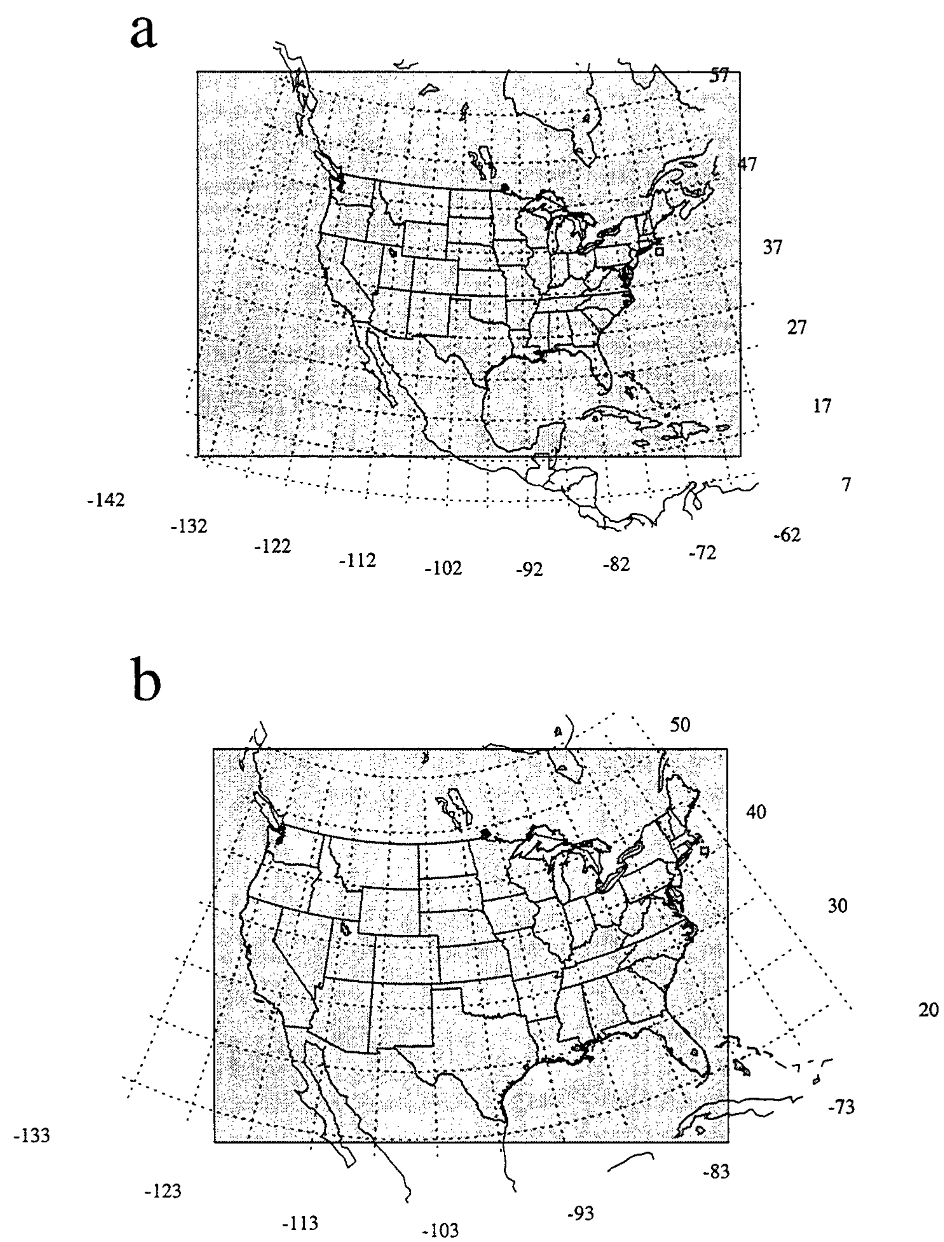


Figure A.6.1. (a) Domain of the RUC and Eta models. The grid is 93 × 65 at 80 km resolution on a Lambert conformal conic projection. (b) Domain of the RUC fluxes and RUCS analysis products. The grid is 81 × 62 at 60 km resolution on a polar stereographic projection.

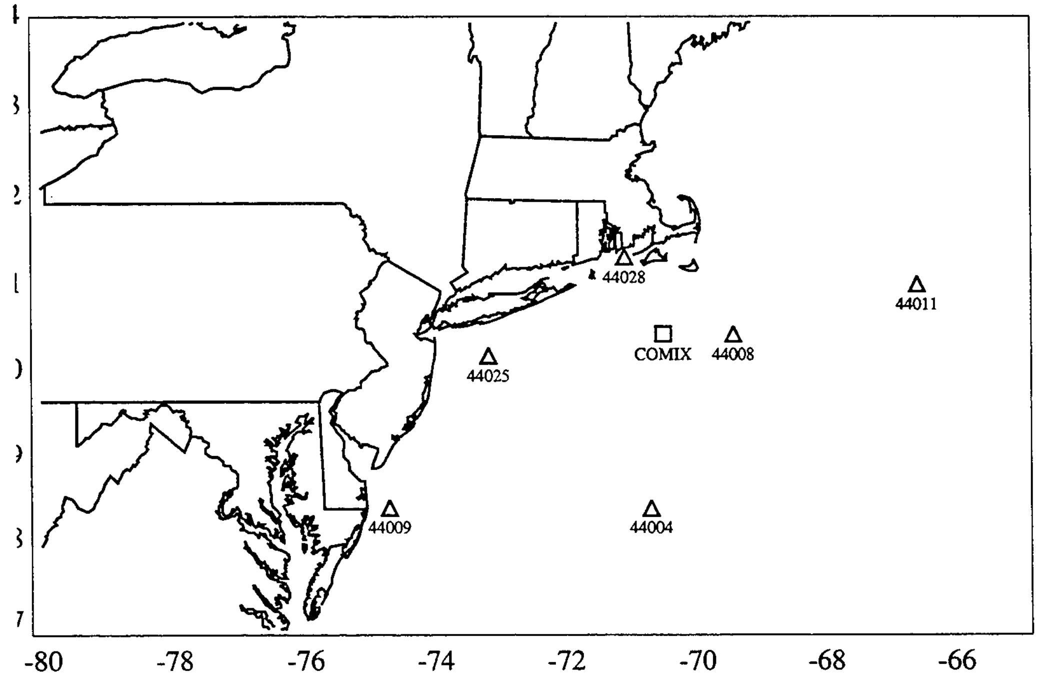


Figure A.6.2. Locations of the NDBC buoys (triangles) with respect to the COMIX array (square).

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16. Abstract (Limit: 200 words)

An array of moorings at four sites at a mid-shelf location in the mid-Atlantic Bight was deployed for a period of 10 months beginning in August 1996 as part of the Coastal Mixing and Optics Experiment (CMO), funded by the Office of Naval Research (ONR).

The purpose of this array is to gather information to help identify and understand the vertical mixing processes influencing the evolution of the stratification over the shelf. The observations from this moored array will be used to investigate changes in the stratification in response to atmospheric forcing, surface gravity wave variability, surface and bottom boundary layer mixing, current shear, internal waves, and advection.

This report describes the primary mooring deployments carried out by the Upper Ocean Processes (UOP) Group on the R/V *Oceanus*, sailing out of Woods Hole during July, August, and September of 1996.

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