MODIS Team Member - Quarterly Report
Marine Optical Characterizations
March 1997

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NOAA/NESDIS

SUMMARY

During this reporting period, the Marine Optical Characterization Experiment (MOCE) team provided data for preliminary OCTS initialization results, which were presented at the Second ADEOS Workshop. The Marine Optical Buoy (MOBY) system was successfully recovered, and additional calibration/validation data for OCTS were collected. The completion of the MOBY systems and their operational testing also represented a major accomplishment.

VALIDATION/CALIBRATION

Bio-optical data collected concurrently with an ADEOS/OCTS overpass on November 18, 1996 by the MOCE team were preprocessed and analyzed. The results (Appendix 1) were transmitted to Chuck McClain who, along with Watson Gregg, presented preliminary OCTS initialization results obtained from OCTS calibration adjustments, which were based upon the November 18th *in situ* data, at the Second ADEOS Workshop.

Additional OCTS calibration/validation data were collected by the MOCE team during the MOBY recovery cruise (M204ROBP), February 23- March 2, 1997. Bio-optical data were collected coincident with four ADEOS/OCTS overpasses. These data represent approximately 75% of concurrent at-sea observations available for calibration/validation of OCTS data.

INTERCALIBRATION

During the November 1996 MOBY deployment cruise (M203DOBP), fluorometrically derived chlorophyll a concentrations appeared to be unreasonably high. These concentrations were obtained with a new Turner fluorometer (Model 10-AU-005). In January 1997, a pigment intercalibration exercise was performed at CHORS to verify if there were differences in fluorometrically derived chlorophyll a concentrations between the old Turner fluorometer (Model 10-00R) and the newer fluorometer (Model 10-AU-005). Calibration of both fluorometer was performed using the same Sigma chlorophyll *a* standard. Analysis of 70 samples from the November 1996 cruise and

from the Gulf of California showed that the newer fluorometer (Model 10-AU-005) overestimated chlorophyll *a* concentrations by 5% when compared to the older instrument (Fig. 1).

FIELD OPERATIONS

Members of the MOCE team participated in a single field deployment during this quarter. Team members conducted MOBY retrieval and bio-optical data collection (M204ROBP), MOBY assembly, and MOBY operations site maintenance in Hawaii, February 12- March 10, 1997 (MOBY-L16). The following personnel participated:

NOAA - Dennis Clark, Ed Fisher, Phil Hovey, Ed King, Larisa Koval, Eric Stengel, Marilyn Yuen
MLML - Mike Feinholz, Stephanie Flora, Yong Sung Kim, Yi Liu, Daryl Peters, Mark Yarbrough
CHORS - Dan Sullivan, Chuck Trees
University of Hawaii - Mike Ondrusek
University of Miami -Al Chapin, Ken Voss
University of Florida - Zhong Ping Lee
NASA - David Herring

Prior to the MOBY retrieval cruise (M204ROBP), radiometric calibrations were performed on MOS202 and SIS. A system calibration was performed on the fiber optic spectrometer system, where both the radiance and irradiance sensors were calibrated. The fiber optic irradiance sensor was calibrated using the new standard lamp F-453 (NIST calibrated) and the radiance sensor was calibrated using the integrating sphere OL420M. The Turner fluorometer, model 10-AU-005, was calibrated with a chlorophyll *a* standard provided by Mike Ondrusek, University of Hawaii.

During M204ROBP (February 23- March 2, 1997), CTD casts and radiometric casts were performed while SIS irradiance scans were acquired every 10 minutes during daylight hours (SIS collected data at one minute intervals during all radiometric casts). TSM (Fig. 2a), POC/PON, salinity, dissolved oxygen, and pigment (both fluorometric and HPLC) samples were collected during CTD casts and from the alongtrack water pumping system during four surveys toward and away from the buoy mooring as well as during a 9 km^2 grid survey around the mooring. Most of these data were collected concomitant with four ADEOS/OCTS overpasses. Sun photometer measurements, to derive the spectral transmittances, specifically bracketed each overpass.

Remote sensing reflectance measurements were collected during the retrieval cruise using the fiber optic spectrograph MD-5 (Fig. 2b). These data have been processed and analyzed. The results are being prepared for publication in the NASA technical

memorandum "Remote Sensing Reflectance Measurements According to the SeaWiFS Protocol."

Radiometric data using the Satlantic profiling system were also collected during M204ROBP (Fig. 3). Efforts were made to develop software to process the irradiance and radiance data into smoothed K profiles for all channels, and a comparison of several different smoothing techniques was completed. A review of NASA's TM 104566, "Results of the SeaWiFS Data Analysis Round-Robin, July 1997 (DARR-94)," showed that smoothed K values for relatively clear, near-surface waters without cloud contamination contained little vertical structure and were better than 5% for all smoothing programs which were compared. Mueller's integral method for analyzing irradiance and radiance profiles (1991, CHORS Tech. Mere. 007-91) has been adapted at CHORS so that data collected by the Satlantic free-fall radiometer will be processed with its associated 0.30 m in-water irradiance reference cell.

Diver calibrations were obtained prior to the successful recovery of MOBY202 on March 1, 1997 (Fig. 4). During this MOBY deployment, the multiplexer stepper motor had a shifting problem. Home position tests on four occasions were performed to correct this problem, and positioning parameters were reset via modem. Efforts to determine the amount of data lost due to these multiplexer shifts are now in progress.

The original pumping cable for the Paravane system failed. Previous damage to the cable had resulted in a rupture of the inner hose, and as a result, water was pumping into the exposed internal wiring, causing the pump and the sensor power supplies to short (Fig. 5). The fluorometer power supply was damaged by the high voltage and required replacement.

MOBY202 was returned to Honolulu for postcalibration and refurbishment. The optics were removed and cleaned, and the buoy was pressure washed to remove any remaining biological growth and antifoulant paint. The fiberglass stiffener in the tether was found broken at the MOBY attachment fitting. The multiplexer motor housing was badly corroded with the end cap lifted from the seat, perhaps exacerbating the home position/multiplexer shift problem.

Postcruise radiometric calibrations were performed on MOS202 and SIS as well as on MOBY202 and MOS204. Additional MOBY postcalibrations were performed at fiber optic multiplexer positions two steps below and above optimal in an attempt to salvage scans collected when the multiplexer home position had changed during the deployment. Upon completion of all radiometric postcalibrations, the Optronic OL420M radiance calibration source was shipped to Optronic Laboratories for re-lamp and recalibration.

MOBY201 was reassembled and repainted in preparation for the next deployment, which is currently scheduled for June. New controller boxes were mounted and the solar panels were replaced. Fiber optic collectors were cleaned and fiber collector head

antifoulant tube changes were specified to fix a glass port clearance problem, which was causing breakage of the port windows.

SOFTWARE DEVELOPMENT

Personnel from Moss Landing Marine Laboratories (MLML) continued to fine-tune MLML/NOAA MOBY data processing programs. For example, the reading time for a MOBY raw data file was reduced from five minutes to 30 seconds and another program calculates weighted water-leaving radiances for SeaWiFS, OCTS, and MODIS. Additional programming changes are required, however, to allow more flexible control of the MOS CCD measurements.

Several programs were created and modified to generate the MOBY homepage. MOS2 and MOBY2 ancillary sensor calibrations were updated, compiled, and added to the MOBY calibration files, and data for both MOBY201 and MOBY202 deployments were batch processed with the new sensor calibrations. Batch processing also created new GIF images and HTML text of these updated files for the MOBY homepage.

Quality control flags and algorithms were developed for derived products such as pigment concentration and dissolved organic matter for SeaWiFS and MODIS. Two flags are used to indicate the quality of the water-leaving radiance at various bands. One flag describes the quality of the derived product and the other assesses the overall quality of the computation. A mathematical combination of these flags was developed to simplify the coding cycle.

Development of the MOCE data processing utility program has been completed. The program provides a uniform user-friendly Macintosh interface, and processes all of the data types collected at sea, including chlorophyll a concentration, attenuation coefficient, scattering coefficient, wind speed and direction, atmospheric pressure, air temperature and relative humidity, and seawater temperature and salinity. It includes system calibration and conversion, calculates derived products, averages, merges files, wraps files for printing, and produces spreadsheet ready data files for plotting.

DATA REDUCTION

The solar normalization scheme used to standardize measured water-leaving radiance to values that would be measured for zenith sun angle at mean earth-sun distance with atmospheric effects removed was reinvestigated. The Rayleigh optical thickness calculation suggested by Gregg and Carder (1990, Limnol. & Oceanog., 35:1657-1675), which incorporates an atmospheric path length corrected for nonstandard atmospheric pressure and for the sphericity of the earth-atmosphere system, will be used for data reduction. Ozone optical thickness will be derived according to Gregg and Carder

(1990), with scale height selectable (nominally set at 350 DU) and absorption coefficient taken from Inn and Tanaka (1953, J. Opt. Sot. Am., 43:870-887), between 350-700 nm and exponentially extrapolated from values between 690-700 nm out to 1000 nm. The SIS calibrations and time series data from the September and November 1996 and February 1997 cruises were processed. The surface incident photosynthetically available radiation (PAR) was calculated for use in productivity models.

The MOBY201 and MOBY202 pre- and postcalibration data are being processed and procedures are being developed to correct for long-term sensor response drift during these deployments. The MOS2 internal calibration lamp data (Blue LED, Red LED, and incandescent lamp) are being analyzed to determine internal instrument stability over time. Programs are being developed to recognize and flag the step change problem, encountered during the MOBY202 deployment, should it ever occur again.

The historical oceanic data base consisting of 73 stations established from the 1970-80's was reexamined. Water-leaving radiances at SeaWiFS and MODIS bands were calculated and related to chlorophyll a concentrations. A bio-optical algorithm is being established based upon this data set. The accuracy of the data set, water-leaving radiance normalization method, incident irradiance effect, and instrument self-shading effect are being assessed. A preliminary review shows that it is possible to correct the self-shading effect to some degree. New data recently obtained are being added to the data base.

DOCUMENTATION

The first draft of a paper on the design of fiber optic radiance and irradiance collectors has been completed. The paper discusses the optics and the engineering design of these accurate and high efficiency collectors. As has been mentioned in previous reports, the new collectors improved the overall performance of MOBY by at least three-fold.

SUPPORTING COOPERATIVE AGREEMENTS

A three-year cooperative agreement has been awarded to SDSU/CHORS for the proposal entitled *"/n Situ* Bio-optical Measurements for Algorithm Development and Validation in Support of the EOS MODIS Execution Phase."

MEETINGS

Dennis Clark attended the MODIS Team meeting, January 6-8, 1997, in Miami, FL

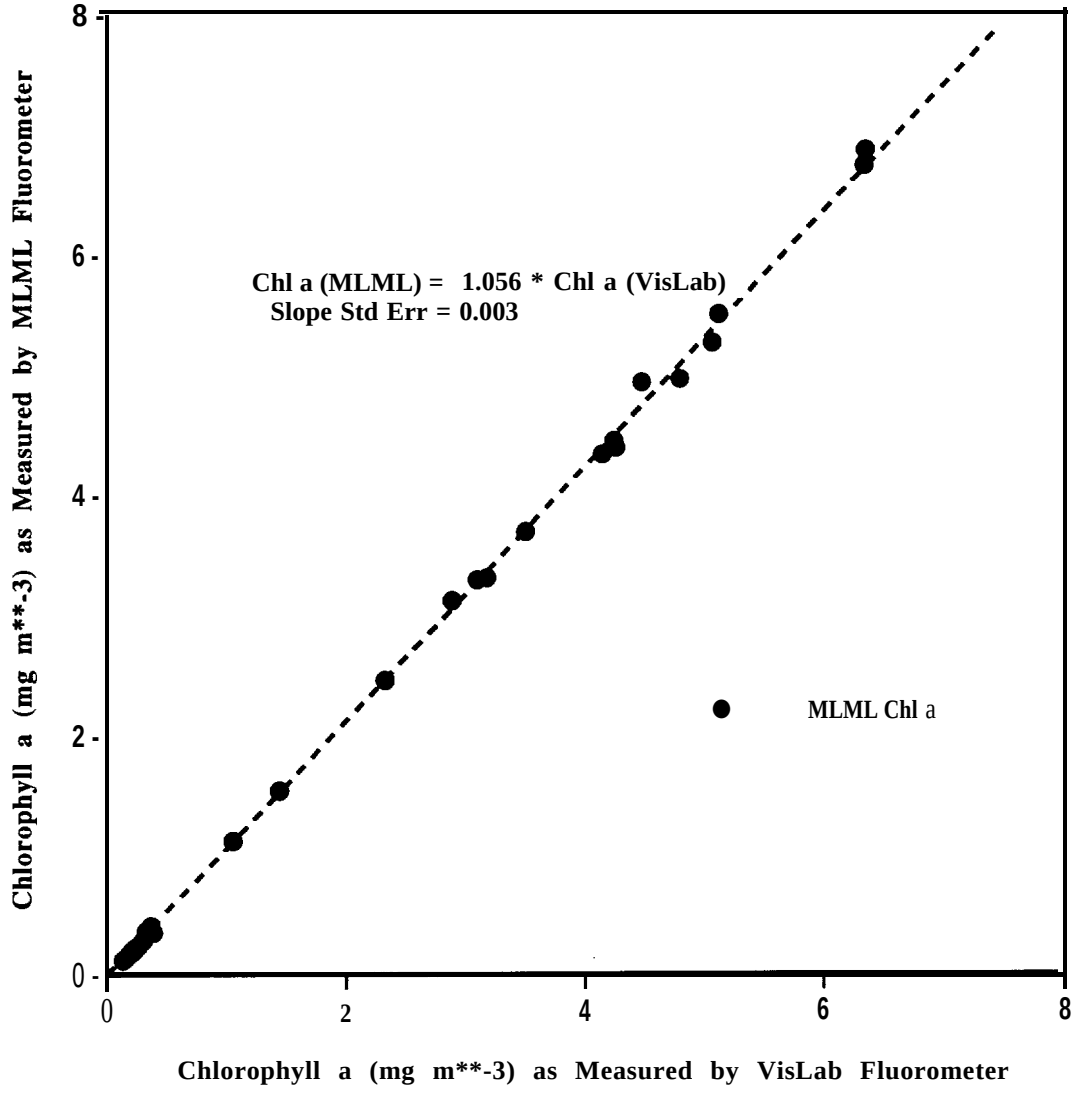


Figure 1. Comparison of fluorometrically determined chlorophyll a using the VisLab Turner Fluorometer (10-00R) and the MLML Turner Fluormeter (10-AU-005). Calibration of the fluormeters was performed with the same chlorophyll a standard. Samples were analyzed from a MOBY Nov 96 cruise and a Gulf of California cruise (Mueller, Nov 96).

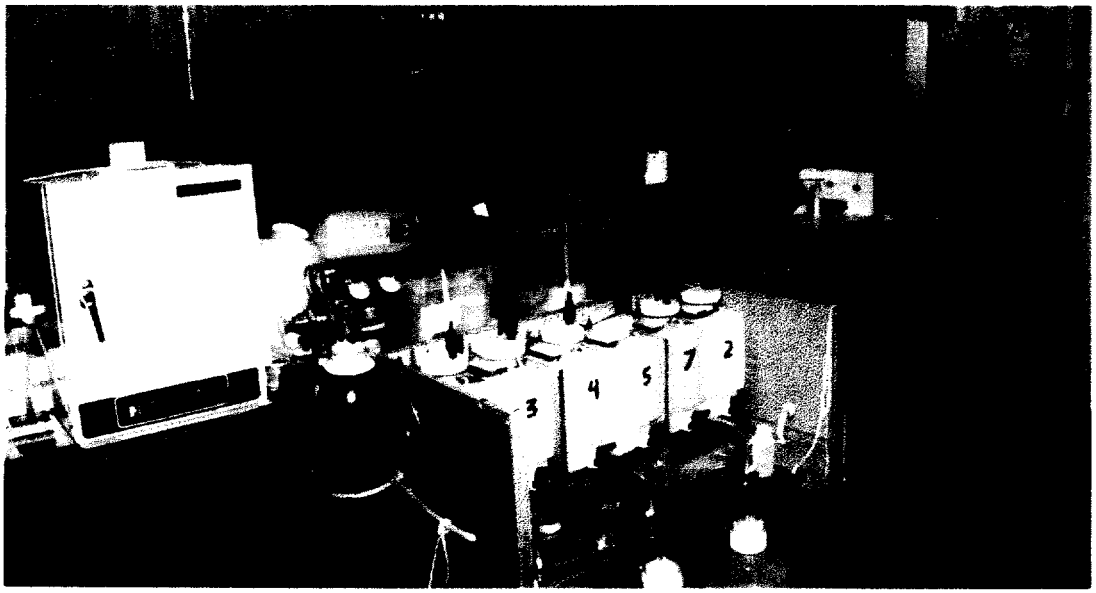


Figure 2a. TSM filtration setup used during the MOBY retrieval cruise, M204ROBP.

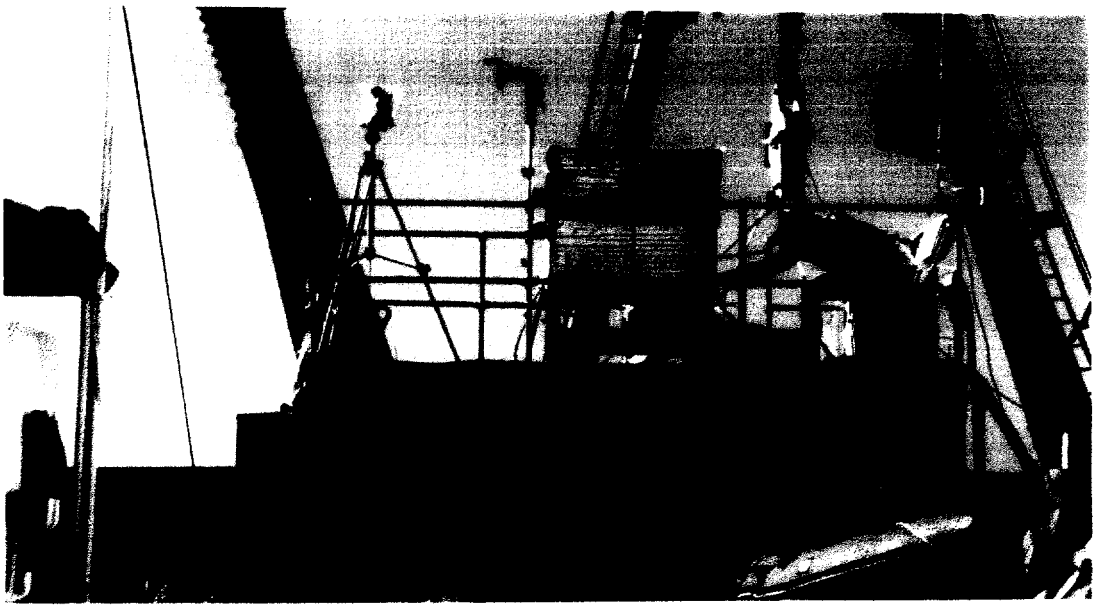


Figure 2b. Remote sensing reflectance fiber optic spectrograph data acquisition setup during M204ROBP.

Figure 3. Deployed Satlantic radiometric profiling system during M204ROBP. The surface irradiance reference sensor is in the foreground and the profiler is in the upper portion of the photograph.

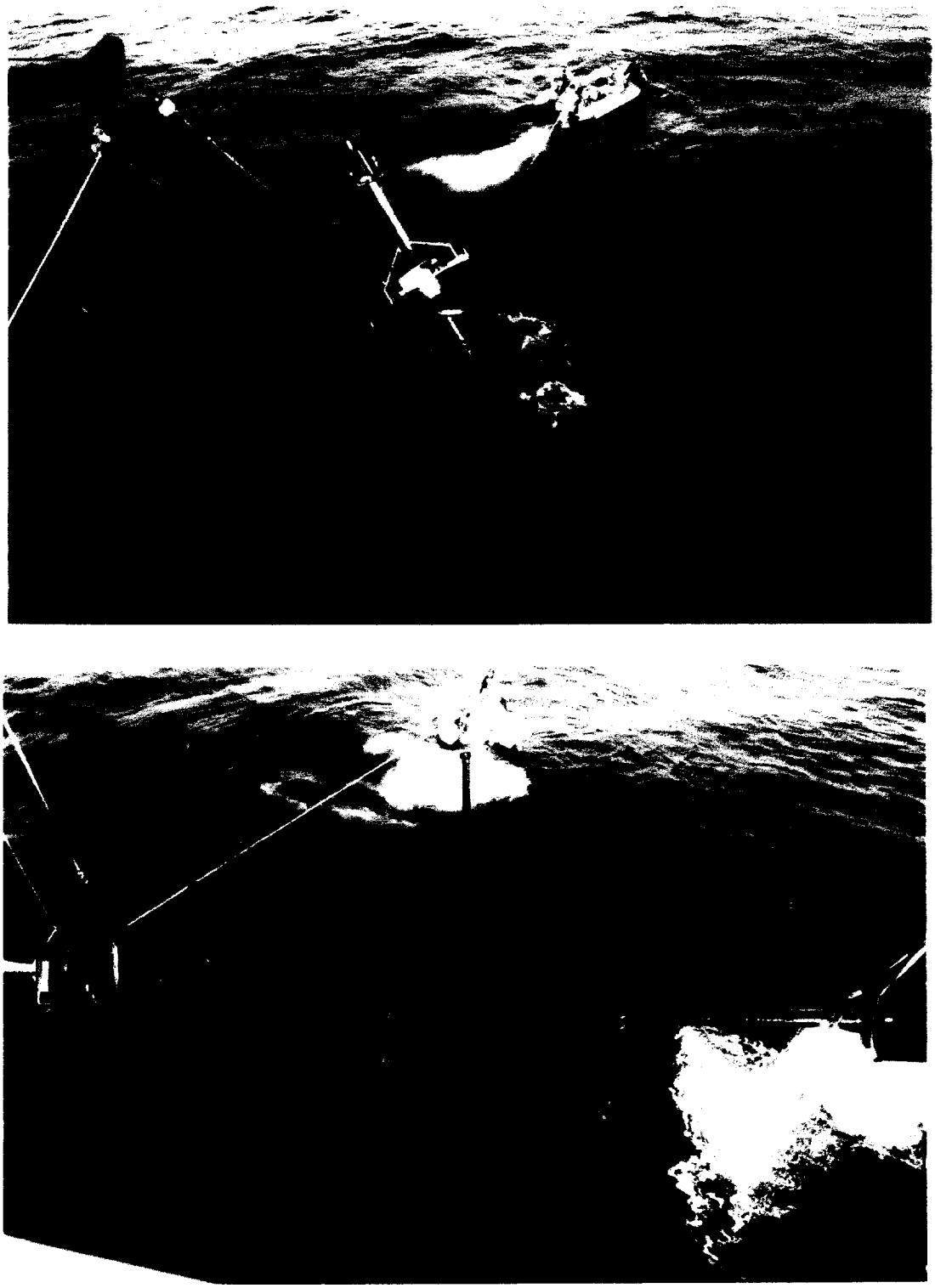


Figure 4. Recovery of MOBY202 on March 1, 1997.

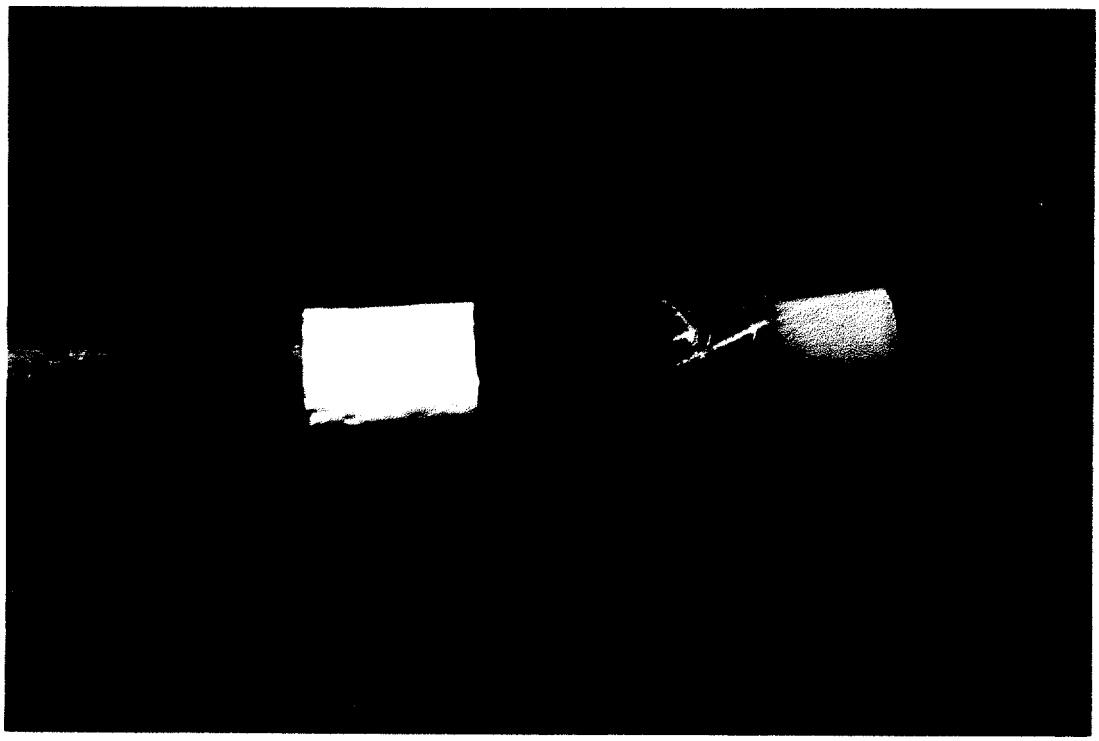


Figure 5. Failed Paravane system water pumping cable

APPENDIX 1

Preliminary Results for Bio-optical Data Collected November 18, 1996

While conducting MOBY operations during October-November, 1996 the MODIS Marine Optical Characterization Experiment team (MOCE) occupied a station off the coast of Lanai during an ADEOS overpass on November 18. The participants on this cruise are listed in Figure 1 and the type of instrument/system deployment and its associated sequence times during this station are depicted on Figure 2. The observations which were acquired directly or derived from these operations are listed in Figure 3. The team has completed reducing most of the data from the 18th and we are enclosing some of these data which, are pertinent to evaluating the OCTS data and for your discussions with the Japanese science team.

The water-leaving radiances (L_w) were measured by three different systems: the Marine Optical System (MOS), Satlantic's SPMR, and a fiber-optic spectrograph. The MOS data were acquired closest to the overpass time (21:18 GMT) with the L_w's being computed from the 0.7 meter L_u's which were observed at 21:38 (GMT). The K_1's were computed from the 0.7 and 9.1 m L_u measurements. These L_w and K_1 measurements are listed in the following table:

Wavelength	412 nm	443 nm	490 nm	520 nm	565 nm	670 nm
Lw($uw/cm^2 sr\ nm$)	0.5577	0.6331	0.7107	0.4081	0.2581	0.0160
$K_1(m^{-1})$	0.0603	0.0546	0.0473	0.0624	0.0801	0.2301

The approximate ship's position for this measurement time period was 20.679 degrees N latitude and 156.930 degrees W longitude. The winds were from the north at sustained speeds in excess of 12 m/ sec. The atmosphere was very clear and stable. Two Langley calibration data sets were made in the morning and afternoon and demonstrate excellent agreement. The spectral transmittances derived from the HHCRM (sun photometer) measurements bracketing the overpass time are listed in the following tabIe:

Wavelength ı	T[410nm]	T[440nm]	T[490nm]	T[520nm]	T[560nm]	T[670nm]
21:00 GMT	0.614	0.682	0.771	0.788	0.819	0895
22:00 GMT	0.637	0.713	0.798	0.812	0.829	0.914

The tau Rayleigh's were computed from the atmospheric pressures according to the following relationships $t_R = P/P_0\, t_{R0}$; where P_o= 1013.25 mb and $t_{R0} = 0.008569\ \lambda^{-4}(1 + 0.0113\ \lambda^{-2} + 0.00013\ \lambda^{-4})$. The calculated tau's for the atmospheric pressures at 21:00 and 22:00 GMT, 1013.11 and 1012.38 mb respectively, are tabulated as follows:

Wavelength	τ_R[410nm]	τ_R[440nm]	τ_R[490nm]	τ_R[520nm]	τ_R[560nm]	τ_R[670nm]
21:00 GMT	0.3250	0.2427	0.1559	0.1223	0.0903	0.0436
22:00 GMT	0.3248	0.2426	0.1558	0.1222	0.0903	0.0436

The phytoplankton pigments for a surface water sample taken at 22:05 were analyzed by Chuck with fluorometric and HPLC measurement techniques. The HPLC analysis also included the separation and quantification of mono- and divinyl chlorophyll *a* since divinyl chlorophyll *a* is present in significant quantities in these waters. The presence of divinyl causes a significant error in the HPLC chlorophyll *a* determination which normally only accounts for the monovinyl chlorophyll *a* compound. The fluorometric technique yielded a chlorophyll a concentration of 0.230 mg/m^3 and phaeopigment concentration of 0.071 mg/m^3 for total pigment concentration of 0.301 mg/m^3. A plot of fluorometrically determined chlorophyll *a* versus mono- plus divinyl chlorophyll *a* is shown in Figure 4 for surface and vertical samples. The HPLC monovinyl plus divinyl chlorophyll *a* concentration was 0.150 mg/m^3 with no phaeopigments detected. The complete HPLC accessory pigment determinations are tabulated below for the compounds which were present.

Perid.	But.	Fuco.	Hex.	Diadino.	Diatox.	Zea/Lut	Chl. *b*	Mv Chl *a*	Dv Chl *a*
0.0065	0.0075	.	0.0172	0.0130	0.0044	0.1248	0.0163	0.060	0.090

After completion of the station, later that evening, a triangular track was run, towing a para-vane with the fluorometer and pumping system, to investigate the bio-optical variability in the near-surface waters to the east of the station. A plot of that track and the along-track concentrations of mono + divinyl chlorophyll *a* with the beam attenuation (530 nm) for a one-meter pathlength are presented in Figure 5.

We are still in the process of completing these data sets and these data should still be considered preliminary. However, they have been reviewed and I do not expect any major deviations. I hope these results will benefit the OCTS processing algorithms evaluation. The Team has just completed the retrieval of MOBY and during this operation managed, in very high wind conditions, to collect comprehensive bio-optical, atmospheric, and physical data sets concurrent with four OCTS overpasses. Station summaries for these overpasses are listed in Figures 6-9. I would recommend that you request these data from the Japanese during your meeting. Good LUCK and call if you have any questions.

MOBY-II DEPLOYMENT PERSONNEL
NOVEMBER 14-22

PERSONNEL	TITLE
NOAA	**Marine Optics Team**
Dennis Clark	Senior Scientist
Marilyn Yuen	Research Associate
Edward King	Research Technician
Phil Hovey	Research Technician
Eric Stengel	Research Technician
Yuntao Ge	Research Associate
Larisa Koval	Research Associate
Yi Liu	Research Associate
San Jose State University	**Moss Landing Marine Laboratories**
Mark Yarbrough	Senior Research Associate
Mike Feinholz	Research Associate
Drew Gashler	Student - Diver
Stephanie Flora	Student
San Diego State University	**Center for Hydro-Optics & Remote Sensing**
Chuck Trees	Research Professor
Dan Sullivan	Research Technician
University of Miami	**Physics Department**
Ken Voss	Professor
Albert Chapin	Research Technician
University of Hawaii	**Biology Department**
Mike Ondrusek	Student - Diver

Figure 1

STATION 2 - LANAI

STATION DEPLOYMENT SEQUENCE	Start Time	Finish Time	Duration
SATELLITE PASS	11:18 AM		
MOBY OBS.	11:00 AM	12:05 PM	1.08
MOBY CALS.			
PARAVANE TOW			
BIO-OPTICS			
CTDO Cast	8:30 AM 2:29 PM	9:30 AM 3:31 PM	1.00 1.03
SIS	8:00 AM	6:00 PM	10.00
SATATLAN Cast	9:30 AM	10:00 AM	0.50
MOS Cast	10:30 AM	12:30 PM	2.00
RADS-UW	10:45 AM	12:45 PM	2.00
VLST Cast			
SATATLAN Cast	12:30 PM	1:00 PM	0.50
SECCHI DISK	8:47 AM 2:30 PM		
PRODUCTIVITY	5:00 AM	6:45 PM	13.75
P vs I	12:05 PM		
MD5-FIBEROPTIC	12:35 PM	1:02 PM	0.45
ATMOSPHERICS			
HHCRM	7:40 AM	5:30 PM	9.83
RADS-SKY	8:00 AM 2:50 PM	10:15 AM 5:00 PM	2.25 2.17
AUREOLE	8:00 AM 2:50 PM	10:15 AM 5:00 PM	2.25 2.17
SKY CONDITIONS			
PARAVANE TOW	6:12 PM	8:10 PM	1.97

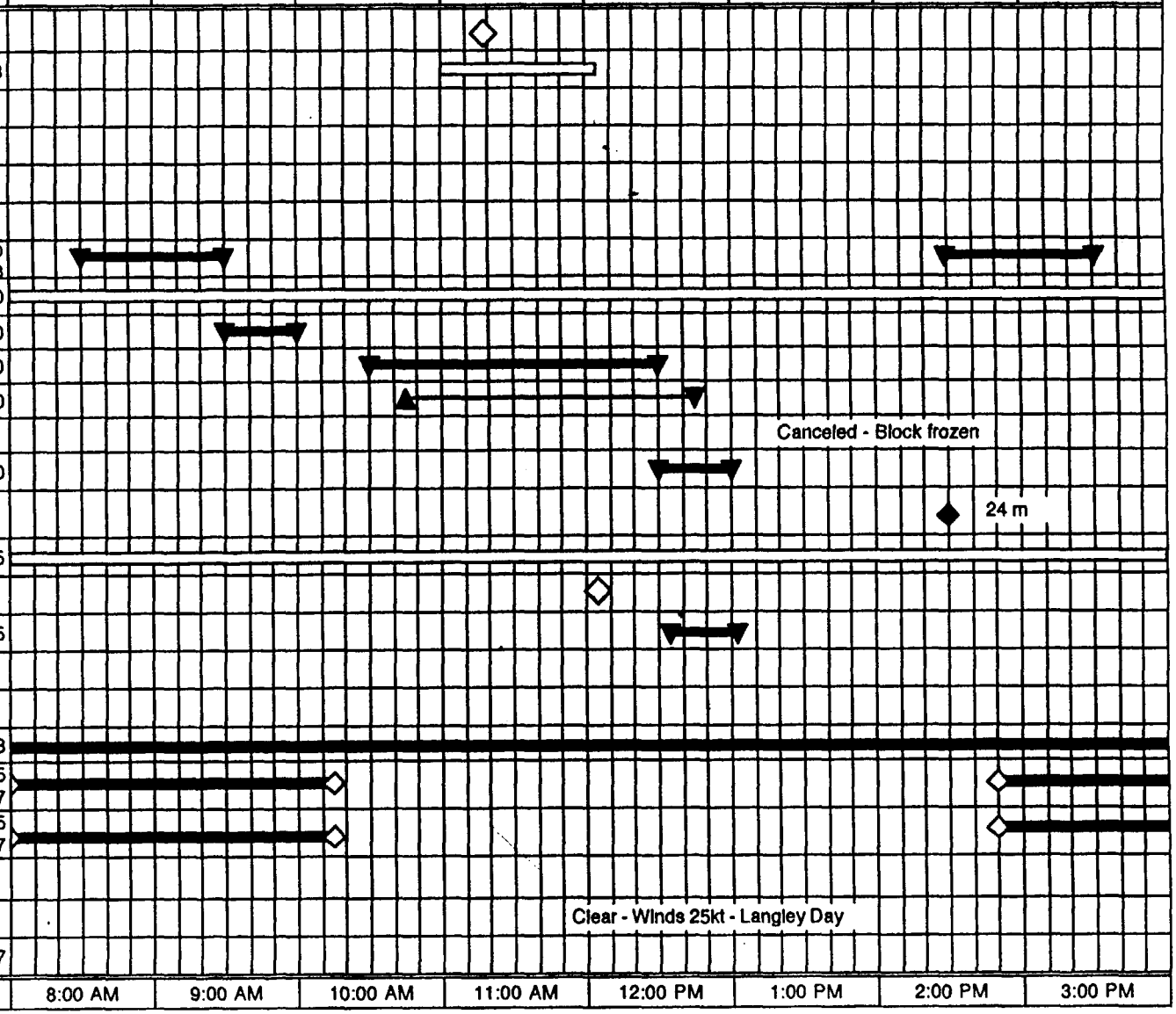


Figure 2

Lanai 15 At-Sea Observations

Marine Optical Characterization Experiment Team

- Incident Spectral Irradiance
- Downwelled Spectral Irradiance
- Upwelled Spectral Irradiance
- Upwelled Spectral Radiance
- Upwelled Spectral Radiance Distribution
- Sky Radiance & Polarization Distribution
- Spectral Solar Atmospheric Transmission
- Water-Leaving Radiance
- Attenuation Cofficients Downwelled Irradiance
- Attenuation Cofficients Radiance
- Spectral Reflectance
- Beam Spectral Attenuation Profiles
- Phytoplankton Pigments (HPLC)
- Phytoplankton Pigments (Fluorimetric)
- Fluorescence Profiles
- Chlorophyll a Profiles
- Oxygen & Salinity Profiles
- Atmospheric Pressure
- Relative Humidity

Trackline Salinity
Trackline Temperature
Trackline Beam Attenuation (530 nm)
Trackline Fluorescence
Trackline Chl a
Total Suspended Material
Inorganic Suspended Material
Particle Spectral Absorption Coefficients
Detritus Spectral Absorption Coefficients
Pigment Spectral Absorption Coefficients
CDOM Absorption Coefficients
Particle Size Frequency Distribution
Particulate Organic Carbon
Particulate Organic Nitrogen
Primary Productivity
Phytoplankton Speciation Videos
Secchi Disk Depth
Wind Velocity
Sea & Sky State Photographs

Figure 3

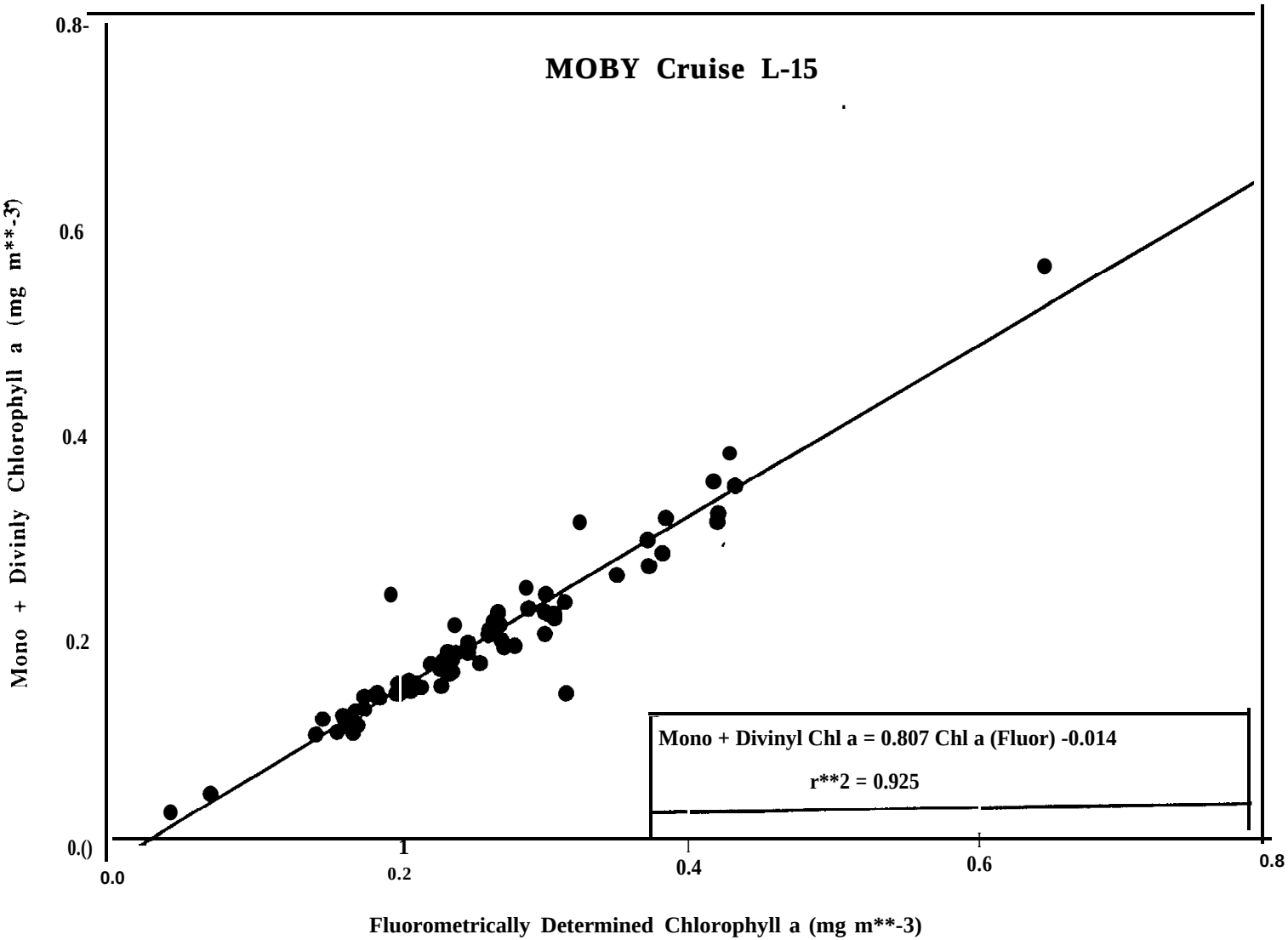
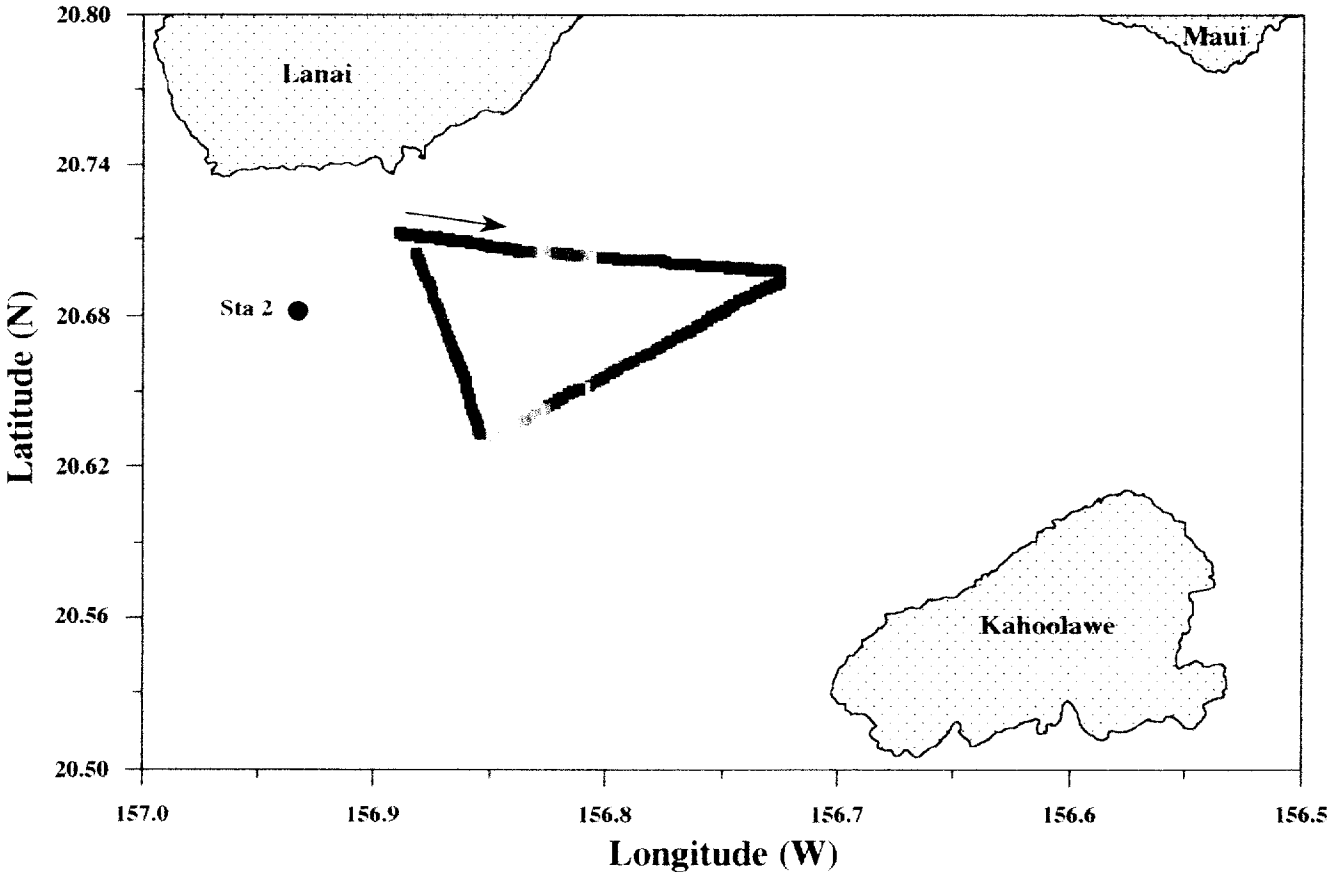

MOBY Cruise L-15
Mono + Divinly Chlorophyll a (mg m**-3)
0.8
0.6
0.4
0.2
0.0
0.2
0.4
0.6
0.8
Mono + Divinyl Chl a = 0.807 Chl a (Fluor) -0.014
r**2 = 0.925
Fluorometrically Determined Chlorophyll a (mg m**-3)

Figure 4


Lanai
Maui
Kahoolawe
Sta 2
20.80
20.74
20.68
20.62
20.56
20.50
Latitude (N)
157.0
156.9
156.8
156.7
156.6
156.5
Longitude (W)

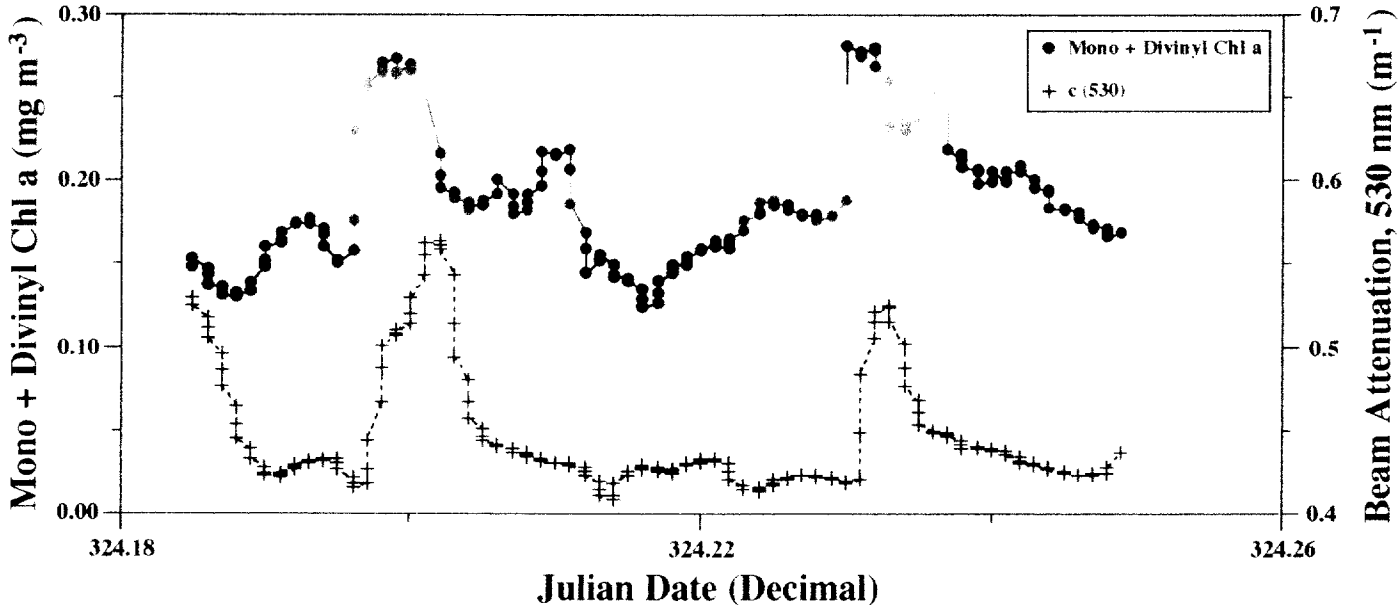

Mono + Divinyl Chl a
c (530)
0.30
0.20
0.10
0.00
Mono + Divinyl Chl a (mg m-3)
0.7
0.6
0.5
0.4
Beam Attenuation, 530 nm (m-1)
324.18
324.22
324.26
Julian Date (Decimal)

Figure 5

STATION 1 - BARBERS PT. OAHU

STATION DEPLOYMENT SEQUENCE	Start Time	Finish Time	Duration
SATELLITE PASS	11:15 AM		
MOBY OBS.	11:00 AM	12:05 PM	1.08
MOBY CALS.			
PARAVANE TOW			
BIO-OPTICS			
CTDO Cast	12:00 PM	12:38 PM	0.63
SIS	11:18 AM	2:54 PM	3.60
SATLAN Cast	11:06 AM	11:23 AM	0.28
MOS Cast	12:18 PM	2:21 PM	2.05
RADS-UW			
VLST Cast			
SATLAN Cast	10:56 AM	11:26 AM	0.50
R S R	11:28 AM 12:57 PM 2:27 PM	11:40 AM 1:05 PM 2:36 PM	0.20 0.13 0.15
WHITECAP RAD	10:00 AM	3:00 PM	5.00
SECCHI DISK	1:15 PM		
PRODUCTIVITY			
P vs I			
ATMOSPHERICS			
HHCRM	11:00 AM	5:25 PM	6.42
RADS-SKY	11:00 AM	4:30 PM	5.50
AUREOLE	11:00 AM	4:30 PM	5.50
MPL LIDAR	8:30 AM	11:59 PM	15.48
SKY CONDITIONS			
PARAVANE TOW	6:45 PM	8:00 PM	1.25

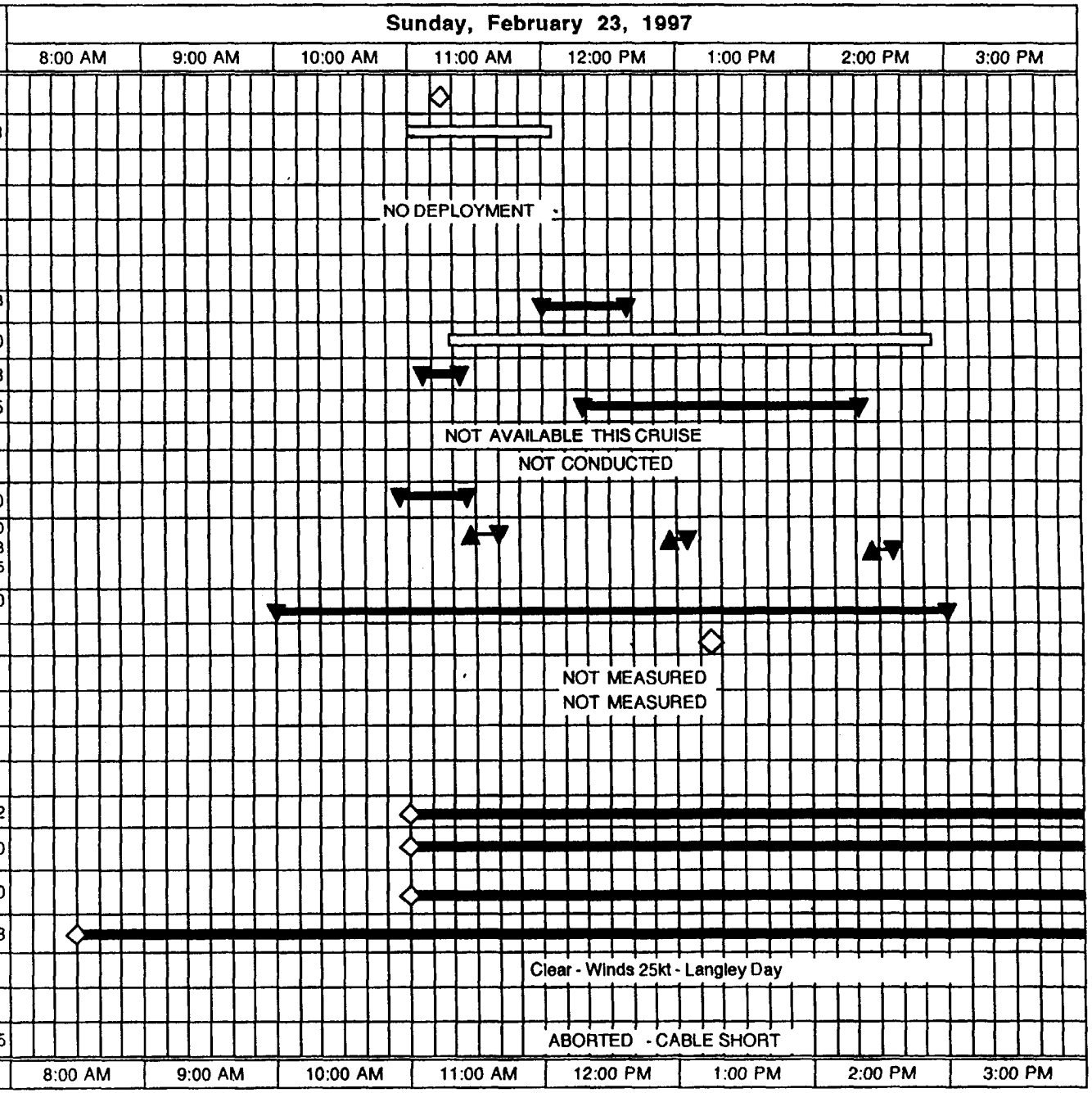


Figure 6

STATION 2 - KAUMALAPAU HARBOR LANAI

STATION DEPLOYMENT SEQUENCE	Start Time	Finish Time	Duration
SATELLITE PASS	11:15 AM		
MOBY OBS.	11:00 AM	12:05 PM	1.08
MOBY CALS.			
PARAVANE TOW			
BIO-OPTICS			
CTDO Cast	12:40 PM	1:18 PM	0.63
SIS	11:18 AM	2:54 PM	3.60
SATLAN Cast	1:02 PM	1:30 PM	0.47
MOS Cast			
RADS-UW			
VLST Cast			
SATLAN Cast	1:02 PM	3:06 PM	2.07
R S R	1:00 PM	1:09 PM	0.15
WHITECAP RAD	10:00 AM	4:30 PM	6.50
SECCHI DISK			
PRODUCTIVITY			
P vs I			
ATMOSPHERICS			
HHCRM	11:00 AM	5:25 PM	6.42
RADS-SKY	8:50 AM	9:30 AM	0.67
AUREOLE	8:50 AM	9:30 AM	0.67
MPL LIDAR	12:00 AM	11:59 PM	23.98
SKY CONDITIONS			
PARAVANE TOW			

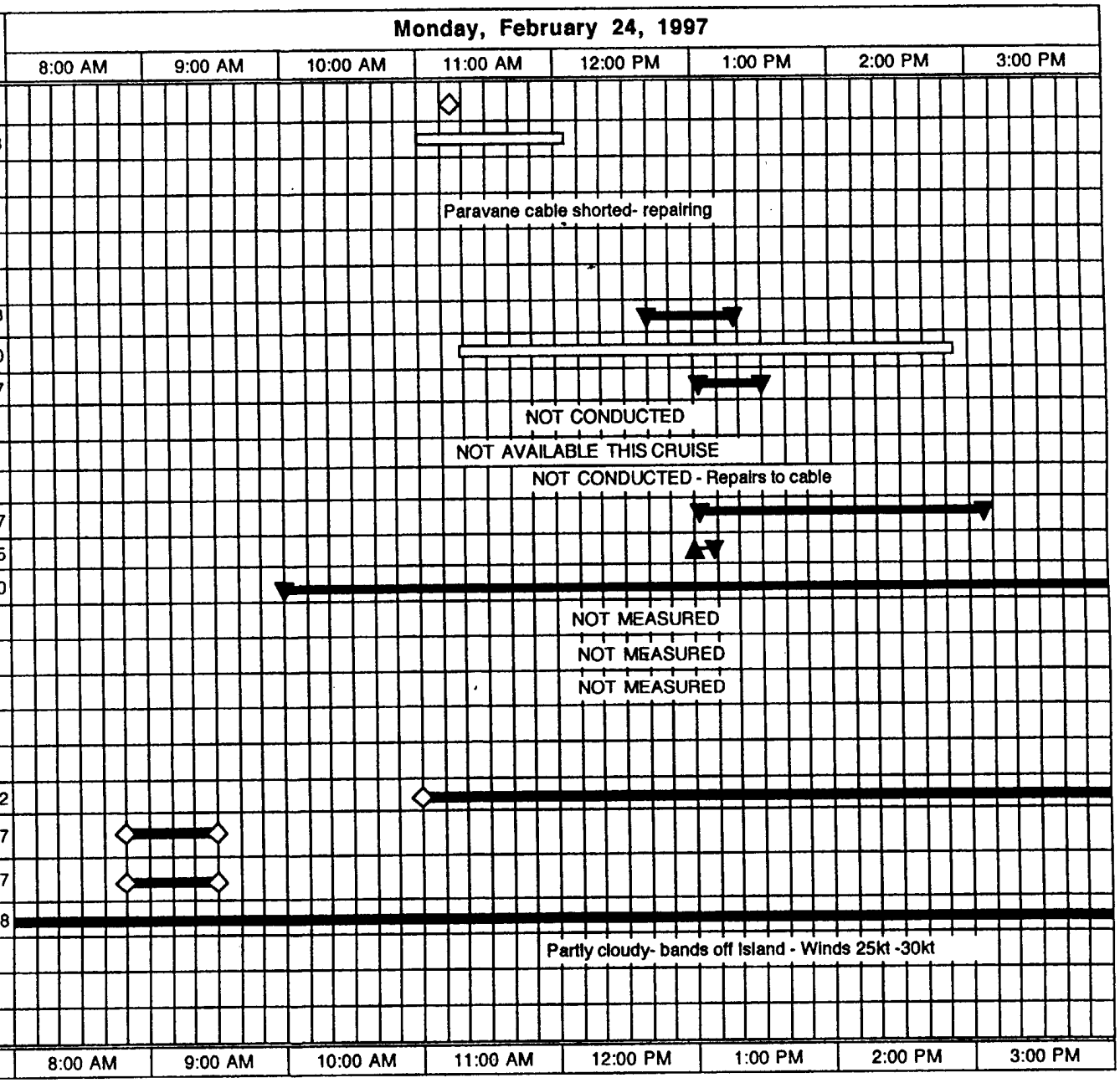


Figure 7

STATION 5- MOBY SITE

STATION DEPLOYMENT SEQUENCE	Start Time	Finish Time	Duration
SATELLITE PASS	11:08 AM		
MOBY OBS.	11:15 AM	12:15 PM	1.00
MOBY CALS.			
PARAVANE TOW			
SEA CHEST	12:00 AM	11:59 PM	23.98
BIO-OPTICS			
CTDO Cast	9:30 AM 11:30 AM	10:00 AM 11:50 AM	0.50 0.33
SIS	6:15 AM	7:00 PM	12.75
SATLAN Cast	10:51 AM	11:15 AM	0.40
MOS Cast	11:39 AM	2:02 PM	2.38
RADS-UW			
VLST Cast			
SATLAN Cast	2:11 PM	2:29 PM	0.30
R S R	11:22 AM	11:37 AM	0.25
WHITECAP RAD	10:30 AM	3:00 PM	4.50
SECCHI DISK	12:55 PM		
PRODUCTIVITY	5:00 AM		
P vs I	11:55 AM		
ATMOSPHERICS			
HHCRM	12:00 PM	1:55 PM	1.92
RADS-SKY	12:00 PM	1:45 PM	1.75
AUREOLE	12:00 PM	1:55 PM	1.92
MPL LIDAR	12:00 AM	11:55 PM	23.92
SKY CONDITIONS			

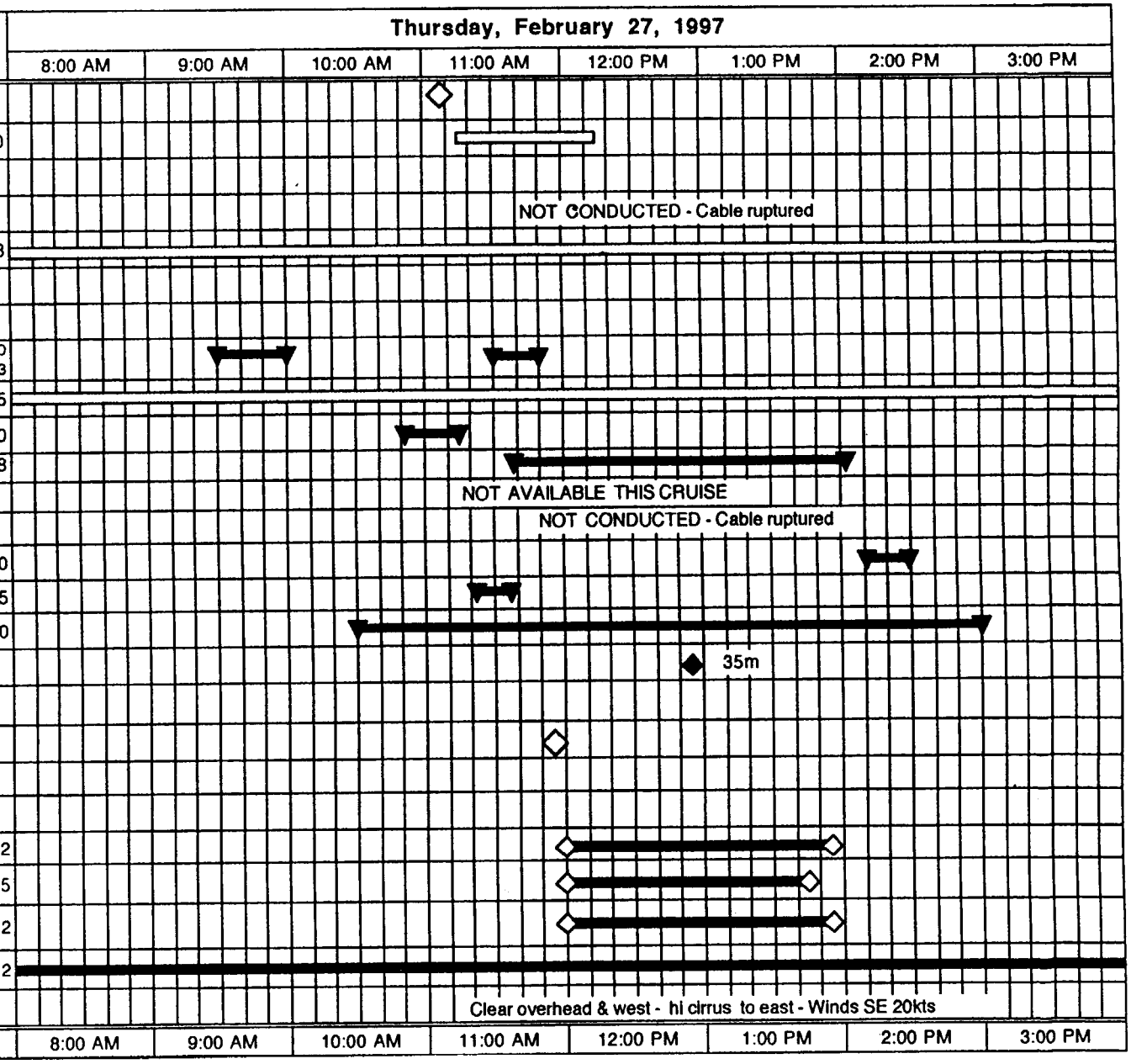


Figure 8

STATION 8 - MOBY SITE

STATION DEPLOYMENT SEQUENCE	Start Time	Finish Time	Duration
SATELLITE PASS	11:28 AM		
MOBY OBS.			
MOBY CALS.			
PARAVANE TOW			
SEA CHEST	12:00 AM	5:44 PM	17.73
STATION GRID	4:58 AM	8:48 AM	3.83
BIO-OPTICS			
CTDO Cast	9:30 AM	10:00 AM	0.50
SIS	6:36 AM	5:58 PM	11.37
SATLAN Cast	10:24 AM	10:41 AM	0.28
MOS Cast	11:07 AM	1:01 PM	1.90
RADS-UW			
VLST Cast			
SATLAN Cast	1:10 PM	1:22 PM	0.20
R S R	1:05 AM	1:20 AM	0.25
WHITECAP RAD	10:00 AM	1:00 PM	3.00
SECCHI DISK	12:00 PM		
PRODUCTIVITY			
P vs I	11:41 AM		
ATMOSPHERICS			
HHCRM	10:50 AM	12:50 PM	2.00
RADS-SKY	9:30 AM	12:51 PM	3.35
AUREOLE			
MPL LIDAR	12:00 AM	5:00 PM	17.00
SKY CONDITIONS			

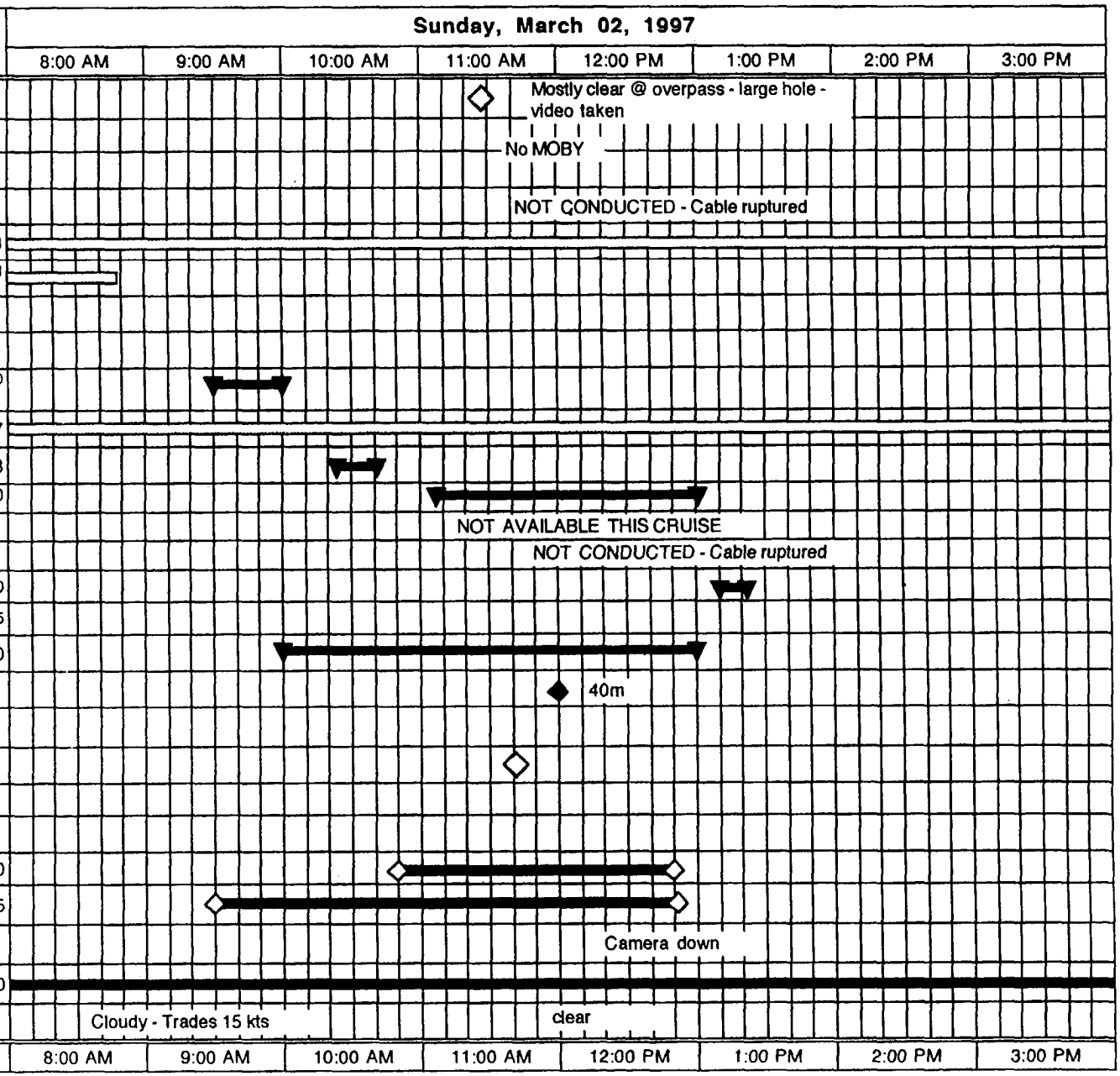


Figure 9