Report of the R/V Mirai Cruise Leg 1

--- from Brisbane, Australia to Papeete, Tahiti
August 03rd – September 6th

BLUE EARTH GLOBAL OCEAN EXPEDITION

2003

Submitted by

Kanthi K.A.S. Yapa
Department of Physics
University of Ruhuna, Matara
Sri Lanka

Report of the R/V Mirai Cruise Leg 1
--- from Brisbane, Australia to Papeete, Tahiti

August 03rd – September 6th 2003

Introduction

Oceanographic research vessel Mirai of Japanese Marine Science and Technology Institute (JAMSTEC) is designed to carry out many research activities in world oceans such as studies of thermal circulation in the ocean, understanding air/sea exchange of carbon dioxide and understanding marine ecosystems and environmental changes. Mirai is equipped with many scientific instruments such as a Doppler radar, multi beam echo sounder, acoustic Doppler current profiler, Rosette water samplers, piston corer, air sampler etc. Also, it consists of about 13 labs, each designed for various sampling measurements and analyses. The cruise Leg 1 from Brisbane, Australia to Papeete, Tahiti from 03rd August to 06th September, 2003 was part of the JAMSTEC Southern Hemisphere BEAGLE (Blue Earth Global Ocean Experiment) 2003 expedition. The objectives of the entire cruise is to detect and quantify temporal changes in the Antarctic Overturn System corresponding to the global ocean and the Southern Ocean warming during this century through high quality data along old WHP (World Ocean Circulation Experiment Hydrographic Program) lines, and to estimate the amount of anthropogenic carbon uptake by the Antarctic ocean. The observations in Leg 1 of the cruise included

(i) Measurements of temperature, salinity, oxygen, current profile, fluorescence and transmission using CTD/O_2 with LADCP, fluorescence meter and transmission meter
(ii) RMS water sampling and analysis of salinity, oxygen, nutrients, CFC11, 12, 113, SF_6, total alkalinity, dissolved inorganic carbon (DIC), dissolved organic carbon (DOC) and pH
(iii) Sample water collection for ^{14}C, ^{13}C and $^{3}He/^{4}He$
(iv) Measurements of autotropic biomass (epifluorescence and chlorophyll a) by surface LV
(v) Bio-optical measurements
(vi) Underway measurements of pCO_2, temperature, salinity, nutrients, N_2O, surface current, bathymetry, and meteorological parameters
(vii) ARGO floats deployment

Figure1. The Research Vessel Mirai

R/V Mirai is a very beautiful and a spacious ship with a length of about 128m and a breadth of about 19m. The research vessel Mirai can accommodate up to 80 persons including scientists and technical staff of about 40. The depth of the ship is 10.5m and the two decks, which include most of the sleeping cabins, are located under the surface water level. The lab in which all the bio-optical experiments were carried out is located on the upper deck.

The Chief Scientist of Leg 1 of the Cruise was Dr. Masao Fukasawa from JAMSTEC and the Bio-optical specialist was Mr. Brian Irwin from Bedford Institute of Oceanography, Canada. There were three POGO/IOCCG supported trainees; Dr. (Mrs) Kanthi K.A.S. Yapa (Sri Lanka), Ms. Elena Barbieri (Argentina) and Mr. Andreas Albertino (Indonesia). All other occupants on board Mirai were from Japan except Mr. Mark Rosenberg from Australia.

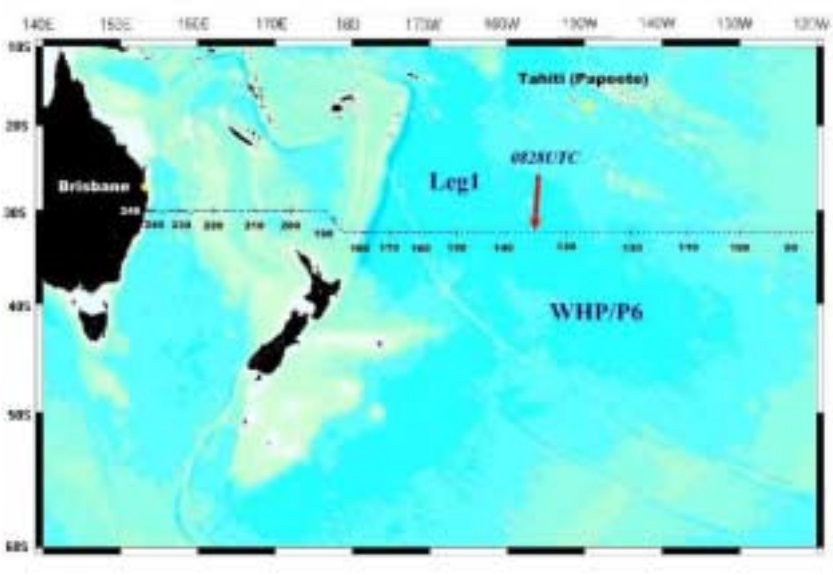

Figure 2. The cruise track of Leg 1

In this report, I would like to include first a brief summary of events that occurred in the first few days on board the ship R/V Mirai with my arrival in Brisbane. The details of the bio-optical experiments that had been carried throughout the Leg 1 of the cruise would be included next. A brief description of the water sampling methods done on board from the CTD Rosette sampler would also be included. Finally, few examples of analysis that were performed on board would be highlighted.

Arrival in Brisbane

I arrived in Brisbane, Australia on August 01, 2003 around 9.30p.m. and boarded R/V Mirai on the same night. Mr. Richard Ward, the shipping agent for Mirai in Brisbane, received me at the airport and took me to the ship, which was anchored at the Pinkemba Terminal. Dr. Takeshi Kawano and Dr. Masao Fukasawa received me on the ship and directed me to my cabin.

On Board R/V Mirai

On the morning of Aug. 02nd, I met Mr. Brian Irwin and Ms. Elena Barbieri who had already arrived on the ship in the morning of Aug. 01st. We looked around the Bio-optics lab (WET LAB 1), which was located on the upper deck. Mr. Irwin showed us some of the equipment. At lunch we met Mr. Andreas Albertino who had just arrived on the ship. From 1.30pm – 4.00pm in the afternoon was the public open house. Therefore, we decided to go the closest shopping area, the Queen Street Mall, to fetch some food and other essentials to take with us on the ship, as we were provided small refrigerators in our cabins. Though the Japanese food looked good, we felt the need of some familiar food like fruit juices, bread, cheese, some sweets etc. Mr. Richard helped us to get a taxi from the shipyard to the Mall. Elena, Andreas and myself

went to the Mall around 2.00 pm., gathered the things we needed and returned to the ship by about 5.30 p.m.

Figure 3. The first awareness meeting

The first meeting on board the ship was held at 7.00p.m. on the same day in the main conference room. All scientists and the technical staff, the Captain, the Chief Engineer, etc. attended the meeting. There were about 40 persons present at the meeting. Dr. Masao made the introductory remarks and requested all attendees to introduce themselves. A video clip of the ship interior was shown during the meeting to become familiar with all ship decks and the important places of the ship.

The meeting lasted for about one hour. The departure forms were filled and handed over with passports.

The Departure from Brisbane

Aug. 03rd, 2003 was the day of the departure for R/V Mirai from Brisbane. The departure ceremony started at 9.45a.m. The Captain, The Chief Officer from JAMSTEC, The Chief Scientist on Leg1 gave short speeches (in Japanese language). There were few well wishes on board as well, in addition to the ones who were about to sail. A traditional Japanese fare well party had been arranged with handing over the Flag and ceremonial outfits and braking of a large Sake container. The sake was served in special wooden cups which were to be kept as souvenirs. At 11.00a.m. (LST), the ship departed from Pinkemba terminal in Brisbane heading towards south.

Figure 4. Part of Scientists on board for Leg 1

Figure 5. Departing from Brisbane

Around 2.00p.m. in the afternoon, a safety and a fire drill were held. Then a meeting was held to demonstrate the techniques of water sampling from CTD Rosette sampling bottles. A video clip was shown to make clear all the water sampling techniques for dissolved oxygen, salinity, CFCs, dissolved inorganic and organic carbon, nutrients, etc. The POGO trainees were also included in the water-sampling shift. The first test station was arranged for the following morning at 6.00 a.m. (LST).

The First Day of Observations - Aug. 04, 2003

We gathered at the upper deck close to the CTD winch around 6.00a.m. for the training of water sampling. The ship was at station PO6W 246 (30°05.93S 153°28.77E), which was a test station only. The CTD array was already on the deck. We were given instructions on how to draw water from the Niskin bottles to different types of tubes, bottles, vessels, etc. that would be repeated at CTD stations along the cruise track.

At 11.00 a.m.(LST) the ship was at the first sampling CTD station (PO6W 244 - 30°05.05S 153°35.90E). I was included in the sampling shift from 1500 to 0300. We started our first bio-optical measurements at this station. The water was drawn to a 20*l* container from two 12*l* Niskin bottles filled at 5m depth from the Rosette sampler for the bio-optical measurements. The following experiments were repeated at selected stations, which will be listed later in this report.

Bio-optical Experiments

The general objectives of the biological optical experiments of the cruise are

(a) To collect data on chlorophyll, primary production and light observations so that it provides an important database for the Southern Oceans
(b) To use collected data to validate satellite-derived chlorophyll by sensors such as SeaWiFS, MODIS, MERIS, etc.
(c) Bio-optical measurements to validate phytoplankton standing stocks and primary production
(d) To provide a training environment in which trainees could get a hands-on experience in collecting biological optical samples and optical data

Two daily bio-optical experiments, one before local noon and one after local noon as permitted, were performed when the ship stopped at CTD stations. The sampling times varied on many factors, the depth of the CTD stations, weather/wind conditions, the distance between stations etc. The water at 5m depth was taken from the Rosette sampler. When the CTD stations were deeper than 5000m or so, the surface water was collected from a hand held Niskin bottle or from a bucket.

1. Photosynthesis –Irradiance (PI) measurements

(a) The water bath was turned on and the temperature was adjusted to that of surface water.
(b) 9*l* of collected surface water was added to a carboy and was mixed well after adding 9.0 ml of a prepared ^{13}C solution.

(c) Each of the 45 polycarbonate bottles of 125 ml was filled to the rim with this solution and closed tightly with cap. Three of the bottles were covered with tape and were labeled as dark bottles. 42 bottles were placed in the PI box, 6 bottles in a raw, and pieces of rubber horses were placed on the bottles to prevent them floating during incubation. The PI box was closed and locked. The three dark bottles were placed in the water bath and covered the top with aluminum foil to prevent any entrance of light.

(d) The light source was turned on and the samples were incubated for three hours.

(e) The light source was turned off after three hours. Bottles 1,2,3 (combined) were filtered through a GF/F filter and rinsed with filtered seawater. The filter was folded in half and placed in a glassine envelope labeled as 1. The sample ID number was also placed on the front of this envelope. This procedure was repeated for all 42 bottles in the PI box in 3 bottle combinations (4,5,6 - #2; 7,8,9 - #3; and so on). Once all the bottles from the PI box were filtered there were 14 envelopes with folded filters marked 1 through 14. The three dark bottles were filtered in same manner and folded filter was placed in the envelope labeled "dark". All the envelopes were bundled with a rubber band and placed on the light source to dry. They were stored in room temperature after drying for later analysis on a mass spectrometer.

Figure 6. P Vs. I box

(f) At the end of each day the light intensities of each bottle position were measured using the QSL 100 light meter. (the bottles were filled with filtered seawater and the light probe was inserted to a bottle filled with distilled (super Q-water) water). The measurements were recorded in the PI sheet.

2. Sample preparation for HPLC pigment determination

2*l* of seawater was filtered through 25mm GF/F filter (the filtration time was about 40-45 min.). The filter was folded in half and wrapped in a labeled tin foil. The ID label was placed on the foil as well. The samples were made in duplicate and they were placed in liquid nitrogen immediately. The phytoplankton pigment composition in the samples will be determined by High Performance Liquid Chromatography (HPLC), later.

3. Particulate Absorption Measurements

Two samples of 2*l* of seawater were filtered through 25mm GF/F filter (the filtration time was about 40-45 min.). One filter was placed on a labeled tin foil and placed in the refrigerator for analysis later using CRAY spectrophotometer on board. The other filter was put in a labeled cryovial (without folding) and placed in liquid nitrogen for later analysis in the lab. (The diameter of the coloured part of the filter was recorded). 2*l* of filtered seawater was filtered

through a 25 mm GF/F filter ("blank" sample) and was placed on the same tin foil which was in the refrigerator. The scanning was done in the evening each day.

Scanning Procedure:

The CRAY spectrophotometer was turned on and left on for about 30 min. to warm up. The scan program was opened and the absorption method file was selected. First the blank filter was wetted with few drops of filtered seawater (ensuring enough hydration) and was placed on the mylar sheet which was taped inside the spectrophotometer facing the detector. The "zero" was clicked first and then the "start" button was clicked. The "blank" sample was given the file name of the type PB followed by the ID number (PB = Particulate Blank) and the scan was saved. As the CRAY spectrophotometer does not have an integrating sphere attachment to collect reflected light, the spectrum looks noisy. To compensate for this, each spectrum was measured 10 times. Then the blank filter was replaced with the sample filter with proper hydration for scanning. The blank filter was placed in the filtration system and about 10 ml of 100% methanol was added and left for few minutes. The sample spectrum was scanned and saved with file name starting with PS (Particulate Sample) then followed by the ID number. Meanwhile, the blank filter, which was in methanol, was filtered through and was again added with another 10 ml of methanol and left for some more time. Finally, the filter was washed with filtered seawater and the de-pigmented filter was placed back in the spectrophotometer for scanning. The files were saved as DB (Detritus Blank) followed by the ID number. A similar procedure was followed with the sample filter and the de-pigmented spectra were saved as DS (Detritus Sample) followed by the ID number.

4. CDOM Absorption Measurements

Filtering of water sample for measurement of coloured dissolved organic material (CDOM) was done immediately after sample collection. The 47mm/0.2 μ m Nucleopore membrane filter soaked in 10% HCl solution was rinsed with super Q-water. The filter was placed on the filter support and filtered about 30ml of Q-water. The filter flask was swirled and water was discarded. This was repeated twice more and rinsing was done with the sample as well. Finally, about 250ml of sample seawater was filtered through and poured into a labeled dark bottle, which was rinsed thoroughly with the filtered sample. The bottle was placed in the refrigerator for scanning, which was done in the evening each day.

Scanning Procedure:

The CRAY spectrophotometer was turned on and left on for about 30 min. to warm up. The scan program was opened and the CDOM method file was selected. (If the mylar sheet was in side the spectrophotometer it was removed before start of the scanning). The sample compartment was cleaned with ethanol and kimwipes. The air baseline was run by clicking on the Baseline toggle (no graph was seen yet). The super Q-water in the cuvette was removed and it was rinsed well with fresh super Q-water. The cuvette was then filled with super Q-water and placed inside the spectrophotometer after wiping outside with kimwipes. The super Q-water sample was then scanned and saved the file as SUPERQ followed by the sample ID number. It was again scanned as a baseline by clicking on Baseline toggle. The cuvette was rinsed well and filled with the sample. It was placed back in the spectrophotometer and scanned and saved the file with the proper ID number. After scanning was done, the cuvette was stored away filling with super Q-water.

5. Preparation of samples for Flow Cytometric analysis of phytoplankton and bacteria

Two cryogenic vials with 2 ml capacity were filled with 1.8 ml of the seawater sample using a set pipette. Then 0.2 ml of 10% of paraformaldehyde (PFA) was added into the vial using another set pipette. The vial was tightly closed, shaken well and kept at room temperature for about 10 minutes before placing in the liquid nitrogen freezer.

6. Fluorometric Measurement of Chlorophyll-a using Turner Fluorometer

Three seawater samples of 100ml each were filtered through 25mm GF/F filters on the filtration rig. Each filter was placed in a 20 ml glass scintillation vial containing 10ml of 90% acetone. The vials were stored in the freezer for approximately 24 hours for the extraction of chlorophyll.

Turner measurement:

The vials were removed from the freezer and allowed to warm in the room temperature in the dark. The Turner fluorometer was turned on 30 minutes before use. The acetone blank was measured in the three given ranges (low, medium and high). The cuvette was rinsed and then filled with the sample. The fluorescence reading was recorded in the appropriate range (Rb). Next 2 drops of 10% HCl was added and mixed. The new fluorescence reading was recorded in the same range (Ra). The sample was discarded and the vial was rinsed with acetone. This procedure was repeated for all samples. The data was later entered in the Excel file named "Miraichl".

7. SIMBAD – 07 Radiometer Measurements

The SIMBAD-07 radiometer measures the direct sunlight intensity by viewing the sun, and water-leaving radiance by viewing the ocean surface at 45^{o} from nadir and 135^{o} from sun's vertical plane. The radiometer uses a vertical polarizer to reduce skylight reflection. The spectral bands in the radiometer are centered at 443, 490, 560, 670 and 870nm. The accessories include a GPS antenna, a cable to charge batteries and a RS232 cable to download the data.

This instrument can be used only if the sun appears in the sky without cloud cover. The knob in the back was set to PC position and the instrument was turned on. The GPS antenna was connected to the instrument and it was placed on the deck outside. Until GPS is initialized the two red and yellow lights blink alternatively. When the GPS is initialized the instrument beeps and the lights go off. Before start of measurements this procedure was followed.

There were three different measurements to be taken; the 'dark' current measurement (placing the knob at dark position and pressing red button while covering the collimator with the black lid) l, the 'sun' measurement (placing the knob at sun position and pressing the red button while aiming directly at sun and imaging sun through the two small holes) and the 'sea' measurement (placing the knob at sea position and pressing the red button while aiming at the sea surface 135^{o} from sun's vertical plane and 45^{o} from nadir – two yellow lights go on when the angle is right) . One set of a complete measurement included one 'dark', three 'sun', six 'sea', three 'sun' and one 'dark' measurement in that order. At the end of the day the data were downloaded to the computer.

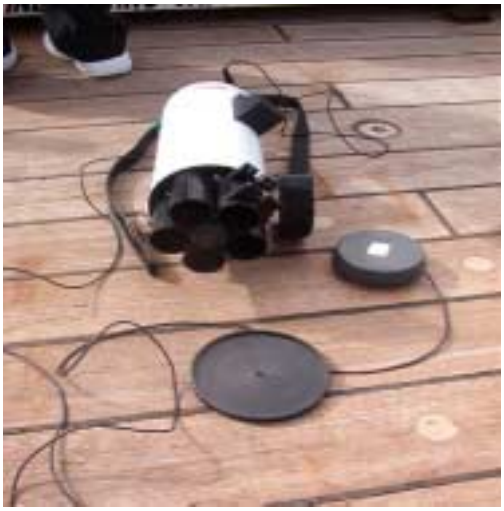

Figure 7. SIMBAD-07 instrument

Figure 8. SIMBADA-21 instrument

8. SIMBADA –21 radiometer measurements

SIMBADA-21 is similar to SIMBAD-07 instrument, but has more spectral channels. It has bands centered at 350, 380, 412, 443, 490, 510, 565, 620, 670, 750, and 870nm. It measures both water leaving radiance and aerosol optical thickness by viewing the sun and the ocean surface. We followed a similar procedure here as the SIMBAD measurements. The GPS antenna is built in to the instrument. The green button on the instrument changes the mode (‘dark’, ‘sun’ or ‘sea’) and the red button needs to be pressed at start of every measurement. The imaging the sun disk is easier on this instrument. At every set of measurements we followed the same sequence as described in the SIMBAD-07 operation. At the end of the day the data were downloaded to the computer.

9. Ocean Optics Hyperspectral Radiometer measurements

Figure 9. Taking measurements on deck

Figure 10. Inclinometer and the spectralon

This instrument measures water leaving remote-sensing reflectance which is determined as the water-leaving radiance (L_W) over the downwelling irradiance (E_d). However, the radiance measured (L_M) as originating from the sea surface composed of water-leaving component as well as the light reflected from the surface. Therefore, the water-leaving component is estimated as $L_W = L_M - \rho L_{sky}$ where ρ is defined as a 'reflectance factor'.

Three measurements need to be taken to determine remote-sensing reflectance, the 'sea' measurement, the spectralon measurement and the 'sky' measurement. The spectralon measurement is used to determine the downwelling irradiance. A fiber optic cable with one end connected to inclinometer and the other connected to the radiometer is used as the spectral sensor.

Acquisition of data:

The ocean optics program was opened. The 'time acquisition' was clicked and the 'activate time acquisition' was clicked. The electrical dark and the 'scope mode' were enabled. Then by aiming the inclinometer at the sea at 135° from azimuth and 45° from zenith of the sun adjusted the integration time so that counts on the screen were around 3000. The integration time for the sea measurement varied around 600nm – 1200nm depending on sky conditions. Then the 'configure' button followed by 'configure acquisition' button were clicked and the file name and the file saving time (enough time to acquire about ten files) were entered. Next the dark measurement was taken by first selecting storing dark followed by 'scope minus dark'. Then the sea measurement was taken by clicking on the start button. This procedure was followed for the other two measurements of sky and spectralon.

10. Record Photosynthetic Active Radiation (PAR)

The PAR sensor was mounted outside above the Atmospheric Observation laboratory. The Licor 1400 data logger connected to the sensor reads measurements every 60 seconds and records hourly average on the hour. At the start of the cruise the data logger was connected and at the end of the cruise the data was downloaded to the computer. The memory on the logger was removed and placed back for recording through the next Leg.

Water Sampling from the Rosette

At the beginning of the Leg 1 I was placed in the sampling shift from 1500 to 0300. As there were many bio-optical measurements to be taken during the day my shift was changed to 1100-2300. At each CTD station we were expected to help the sampling from the CTD array, as time permitting. Some of the stations were C stations where sampling needed to be done for all carbon, CFC's, Argon etc., other stations were only N stations (much less sampling were needed). At every station first sampling was done for dissolved oxygen into specially prepared glass bottles after measuring the temperature. Other sampling was done in the following order; Argon, CFC's, salinity, pH, DIC, ^{14}C, alkalinity, nutrients and total organic carbon. Preliminary analyses of most of the samples were carried out on board while others were stored properly for later analysis. It must be stated that the sampling crew were extra careful in following proper sampling procedures at each station as the objectives were to collect very accurate data on the above properties and constituents of seawater.

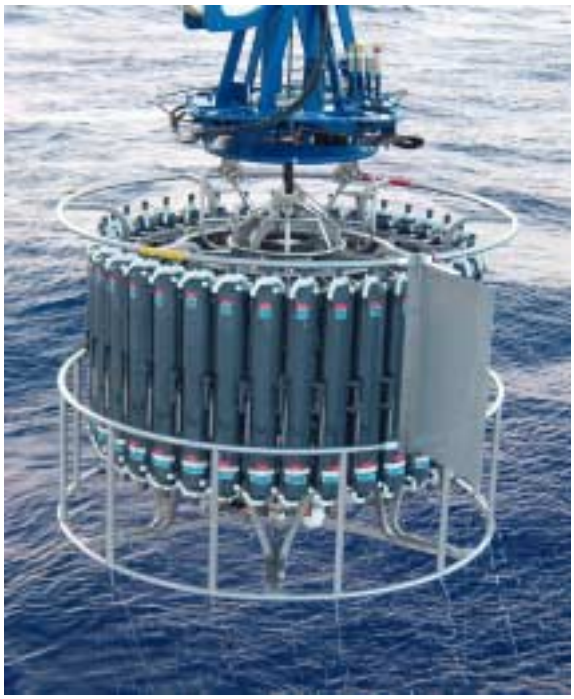

Figure 11. CTD Rosette sampler carried up from water

Figure 12. Sampling basket for C station

Figure 13. Sampling bottle for CFC's

Bio Optical Sampling Stations

The biological and optical measurements were carried out at following stations.

DATE	TIME GMT	STATION #	LATITUDE	LONGITUDE	ID#	ROSETTE	NISKIN	BUCKET
4-Aug	01 00	PO6W-244	30 05.05S	153 35.90E	264001	X		
4-Aug	23 10	PO6W-238	30 05.13S	154 29.80E	264003		X	
5-Aug	22 00	PO6W-234	30 04.97S	156 31.78E	264005	X		
6-Aug	03 15	PO6W-232	30 04.94S	156 55.26E	264006	X		
6-Aug	22 10	PO6W-227	30 04.64S	158 40.96E	264008	X		
7-Aug	02 30	PO6W-226	30 19.93S	159 04.98E	264009	X		
7-Aug	20 50	PO6W-221	30 04.99S	161 30.26E	264011	X		
8-Aug	00 30	PO6W-220	30 05.30S	162 10.00E	264012	X		
8-Aug	21 10	PO6W-215	30 05.06S	164 49.90E	254014	X		
9-Aug	01 45	PO6W-214	30 04.62S	165 24.50E	264015	X		
9-Aug	24 00	PO6W-212**	30 04.65S	166 29.48E	264017		X	
10-Aug	21 30	PO6W-210	30 04.92S	167 29.90E	264019	X		
11-Aug	04 00	PO6W-209	30 04.92S	167 59.90E	264020	X		
11-Aug	20 30	PO6W-205	30 04.82S	169 59.82E	264022	X		
12-Aug	01 00	PO6W-204	30 05.70S	170 29.94E	264023	X		
12-Aug	20 30	PO6W-199	30 04.98S	172 29.92E	264025	X		
13-Aug	00 30	PO6W-198	30 05.06S	172 59.95E	264026	X		
13-Aug	18 10	PO6W-194	30 04.86S	175 10.08E	264028			X

14-Aug	01 00	PO6W-X14	30 00.50S	176 00.60E	264029	X		
14-Aug	19 30	PO6W-190	31 05.06S	177 32.25E	264031	X		
15-Aug	01 30	PO6C-186	31 34.99S	177 59.20E	264032	X		
15-Aug	19 30	PO6C-182	32 30.00S	179 55.06E	264034	X		
15-Aug	23 20	PO6C-181	32 30.15S	179 34.98W	264035	X		
16-Aug	18 00	XXXXXXXX	31 56.04S	177 19.05W	264037			X
17-Aug	18 00	PO6C-177	32 30.00S	178 17.02W	264039	X		
17-Aug	22 30	PO6C-176	32 30.05S	178 00.03W	264040			X
18-Aug	18 30	XXXXXXXX	31 59.81S	177 19.76W	264042			X
19-Aug	00 30	PO6C-173	32 29.96S	176 45.08W	264043			X
19-Aug	18 10	PO6C-170	32 28.87S	175 15.29W	264045			X
19-Aug	24 00	PO6C-169	32 30.10S	174 50.13W	264046			X
20-Aug	18 40	PO6C-166	32 30.25S	173 39.97W	264048			X
21-Aug	01 10	PO6C-165	32 29.95S	173 10.39W	264049			X
21-Aug	17 40	PO6C-162	32 29.95S	171 55.03W	264056	X		
21-Aug	22 00	PO6C-161	32 30.11S	171 35.07W	264062	X		
22-Aug	19 10	PO6C-X15	32 30.15S	170 00.13W	264069			X
23-Aug	00 45	PO6C-156	32 30.02S	169 30.23W	264075			X
23-Aug	17 15	PO6C-153	32 30.11S	168 00.92W	264082			X
23-Aug	23 00	PO6C-152	32 30.15S	167 29.97W	264088			X
24-Aug	16 20	PO6C-149	32 29.87S	165 49.93W	264095	X		
25-Aug	20 00	PO6C-148**	32 29.98S	165 09.97W	264101			X
26-Aug	02 00	PO6C-148**	32 29.98S	165 09.97W	264108			X
26-Aug	17 45	PO6C-146	32 30.05S	163 50.12W	264110			X
26-Aug	24 00	PO6C-145	32 29.94S	163 10.03W	264116			X
27-Aug	18 00	PO6C-142	32 29.94S	161 09.91W	264123			X
27-Aug	23 40	PO6C-140	32 29.72W	160 29.62W	264129			X
28-Aug	18 20	PO6C-137	32 30.04S	158 09.95W	264136			X
29-Aug	00 50	PO6C-136	32 29.73S	157 19.98W	264142			X
29-Aug	19 40	PO6C-133	32 30.17S	154 50.49W	264149	X		
30-Aug	01 35	PO6C-132	32 30.00S	153 59.69W	264155			X
30-Aug	16 40	PO6C-130	32 29.95S	152 20.05W	264162			X
30-Aug	22 20	PO6C-129	32 29.92S	151 29.62W	264168			X
31-Aug	18 00	PO6C-126	32 29.98S	148 59.94W	264176	X		
1-Sep	00 05	PO6C-125	32 30.13S	148 09.99W	264182			X
1-Sep	18 40	PO6C-122	32 29.97S	145 39.81W	264189	X		
2-Sep	00 50	PO6C-121	32 30.35S	144 49.87	264195			X

Preliminary Analysis

Few examples of some preliminary analysis done on board are presented below.

Turner Chlorophyll measurements

At station 166 the fluorescence meter on the CTD array stopped functioning. Therefore, water samples were collected at depths of 10, 50, 100, 150 and 200m from the Rosstte and were analyzed for Turner chlorophylls. The sample at the surface was collected either from the Rossette or from the bucket. The two examples given below are from station PO6C 169 (when the fluorometer was functioning – Figure 14) and from station PO6C 162 (after fluorometer stopped functioning- Figure 15). The green lines on graphs represent fluorescence (or Turner chl. derived from fluorescence), the blue lines represent temperature and the pink lines represent oxygen measured (both temperature and oxygen measurements were from CTD array).

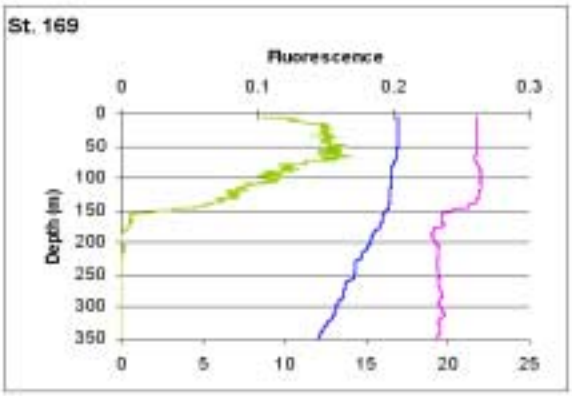

Figure 14. fluorescence, temperature and oxygen profiles at Station 169.

Station# PO6C-162

ID#	DEPTH	CHLOR	PHAEO
264056	0	0.245	0
264057	10	0.242	0
264058	50	0.216	0.015
264059	100	0.154	0.019
264060	150	0.021	0.017
264061	200	0.009	0.008

Table 1. Turner chl. data at Station 162 at depths 0, 10, 50, 100, 150 and 200nm.

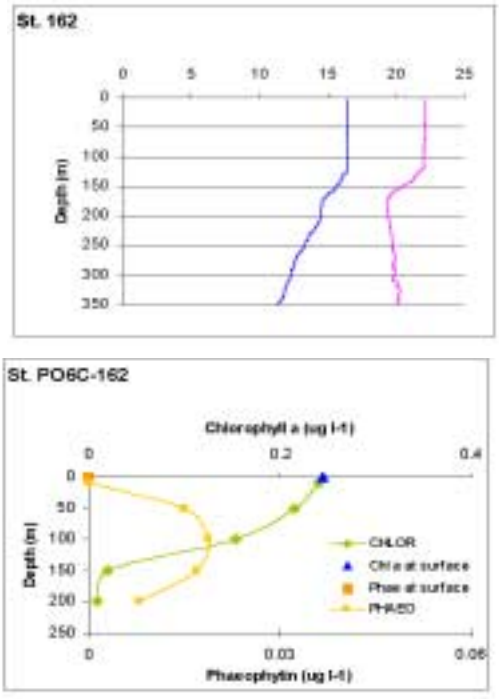

Figure 15. CTD temperature and oxygen and Turner chl. plots at Station 162.

Ocean Optics Hyperspectral Radiometer measurements

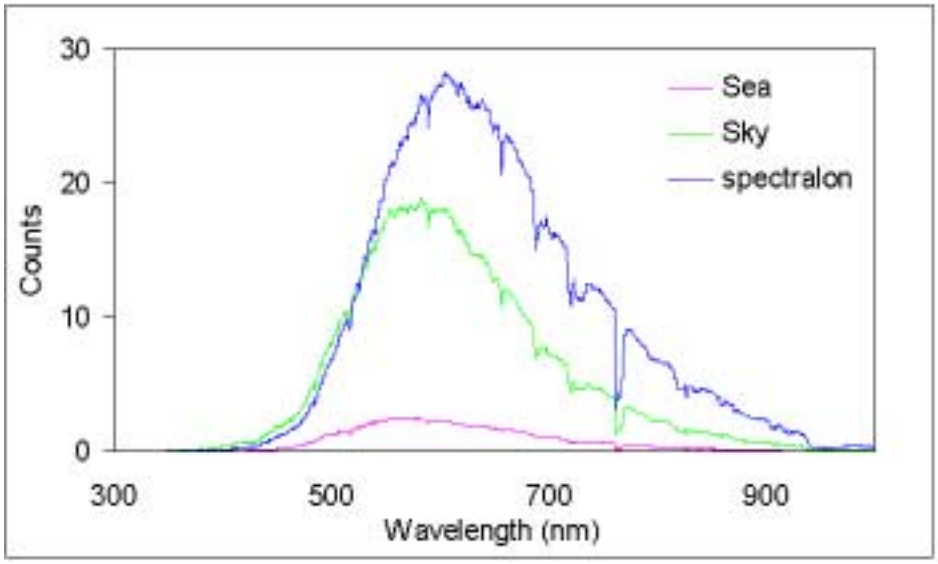

Figure 16. Raw data from Ocean Optics instrument on Aug 12th 2003

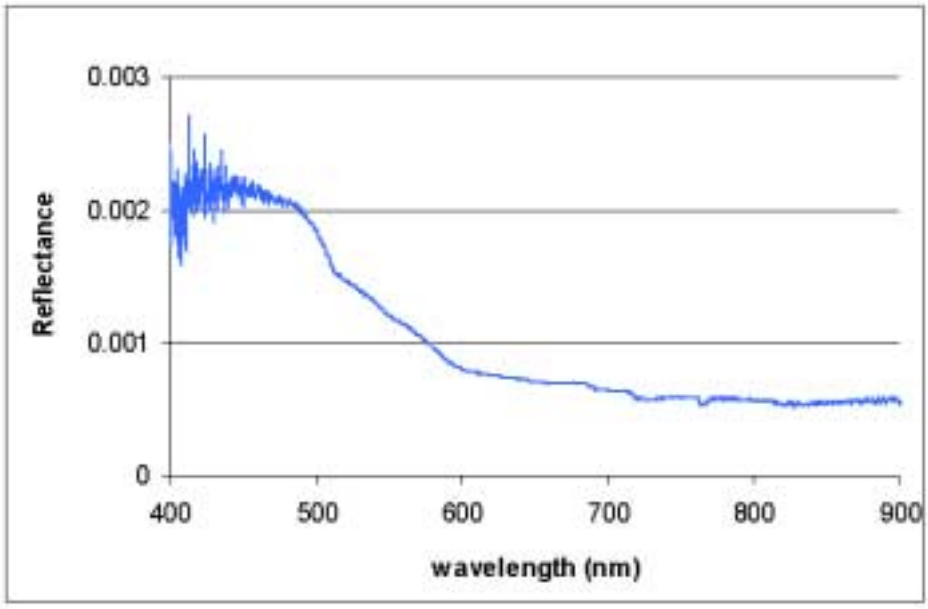

Figure 17. Reflectance on Aug. 12th calculated from raw data in Figure 16

Diurnal Observations of sun and sky variation on Aug. 23rd 2003

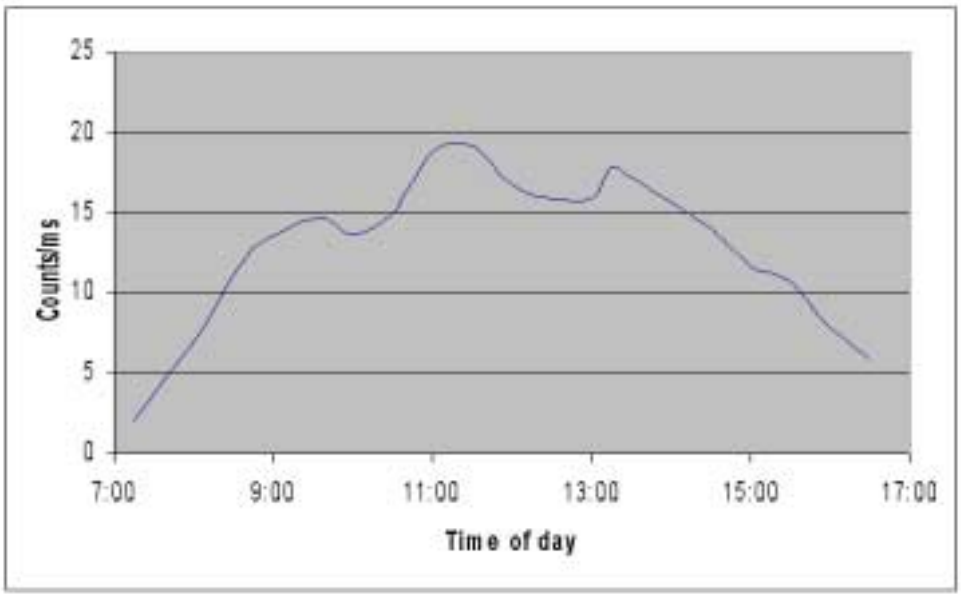

Figure 18. Raw data of diurnal variation of downwelling radiation on Aug. 23rd

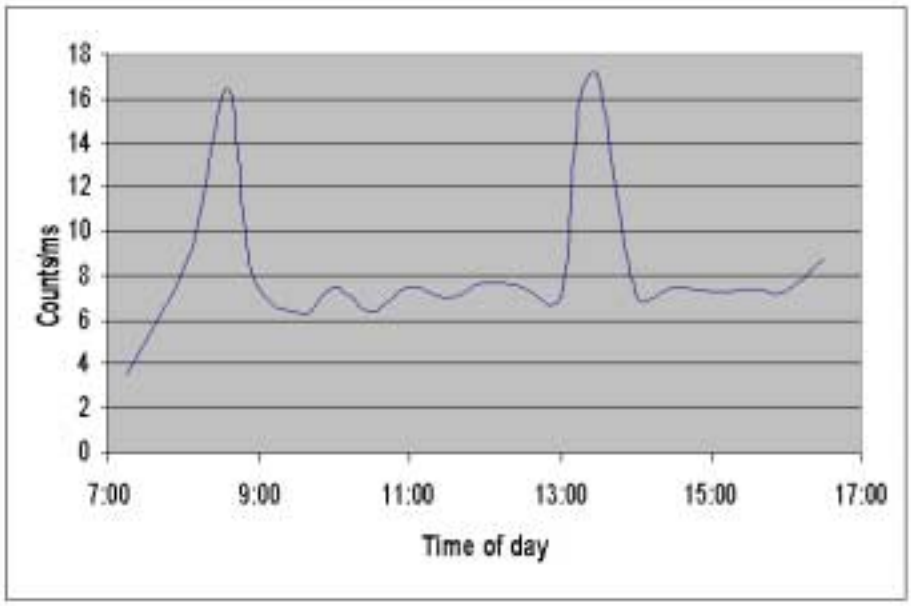

Figure 19. Raw data of diurnal variation of sky radiation on Aug. 23rd

Acknowledgement

First and foremost, I would like to give my sincere thanks and gratitude to Dr. Shubha Sathyendranath of POGO and Dr. Trevor Platt of IOCCG for giving me the opportunity to participate in the Leg 1 of the R/V Mirai cruise of Southern Oceans by selecting me as a trainee and for the encouragement and support throughout the cruise Leg. My gratitude goes to POGO, IOCCG and JAMSTEC for the sponsorship, without it, this dream would never have come true. My thanks also go to Dr. Venitia Stuart and Ms. Tony Payzant of BIO for their continuous support at all times. I would like to convey my thanks to Mr. Richard Ward for his kind assistance in Brisbane. My warmth regards go to Dr. Massao Fukasawa, The Chief Scientist of Leg 1, for providing all necessary facilities and making the cruise a memorable experience. My deep gratitude goes to Mr. Brian Irwin, the Bio-optical specialist on Leg1, for providing us a very comfortable learning environment and for guiding us very patiently using his wealth of experience in the sea. My gratitude also goes to the Captain, Mr. Takaaki Hashimoto and the crew of Mirai for their warmth and kind hospitality and to all scientists and technicians on board Leg 1, for creating a friendly and fine working environment on the ship. Last, but not least, I would like to give my deepest thanks to my two colleagues, Elena Barbieri and Andreas Albertino for their kind and loving support through out the cruise and creating a memorable and happy environment during hard working hours.