Cruise Instructions

Epic2001

Cruise RB-01-08

September 5, 2001 - October 25, 2001

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Endorsements:

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Boulder, Colorado 80305	**Norfolk, Virginia 23510**

Project Instructions

EPIC2001
Cruise RB-01-08

NOAA Ship RONALD H. BROWN

Itinerary:

Leg 1

Depart: San Diego, CA 5 Sep 2001

Arrive: Puerto Ayora, Santa Cruz Island, Galapagos 6 October 2001

Leg 2

Depart: Puerto Ayora, Santa Cruz Island, Galapagos 9 October 2001

Arrive: Arica, Chile 25 October 2001

Days at sea:

Leg 1 - 32

Leg 2 - 17

1.0 OVERVIEW

NOAA Ship *Ronald H. Brown* (RHB) will participate in the Eastern Pacific Investigation of Climate Processes in the Coupled Ocean-Atmosphere System (EPIC) to study several aspects of the Inter-Tropical Convergence Zone (ITCZ) the Atmospheric Boundary Layer (ABL)/Cold Tongue and the Stratocumulus region during the EPIC 2001 field program. The RHB will be equipped with a suite of instruments for measurements of atmospheric and oceanographic processes. The emphasis will be on observations of precipitating systems, clouds, and atmospheric boundary layer structure and their coupling to oceanic mixed layer structure through the sea surface temperature field.

On the first leg of the cruise, the ship will operate predominantly in the ITCZ region near the TAO buoy at 95 W 10 N for joint measurements with the *R/V New Horizon* and the NCAR C-130 and the NOAA P-3 research aircraft. The RHB will make a transect of the cold tongue region from 10 N to 10 S along the 95 W TAO buoy line with a diversion to the Galapagos Islands to exchange personnel. The second leg of the cruise starts at the Galapagos Islands when the observations will shift focus to the study of the Stratocumulus region. The transect south along 95 W will continue toward 10 S and then track toward 85 W 20 S where the IMET buoy maintained by WHOI will be changed out. The final portion of the EPIC cruise track will be between the IMET buoy and Arica, Chile.

1.1 Summary of Objectives

Objective I. To observe and understand the ocean-atmosphere processes responsible for the structure and evolution of the large-scale atmospheric heating gradients in the equatorial and northeastern Pacific portions of the cold-tongue/ITCZ complex, including
(a) mechanisms governing temperature and salinity field evolution across the oceanic cold tongue through the ITCZ
(b) atmospheric planetary boundary layer structure and evolution from the equator through the ITCZ, primarily in the southerly monsoonal regime; and
(c) the processes determining the existence, character and strength of deep convection in the northeast Pacific ITCZ.

Objective II. To observe and understand the dynamic, radiative and microphysical properties of the extensive boundary layer cloud decks in the southeasterly tradewind and cross-equatorial flow regime and their interactions with the ocean below.

Objective III. Change out the IMET buoy at 20 S 85 W.

1.2 Operating Area: Equatorial East Pacific, South-Eastern Pacific Stratocumulus Zone

1.3 Participating Institutions:

NOAA Environmental Technology Laboratory
NOAA Pacific Marine Environmental Laboratory
NOAA Atlantic Oceanographic and Meteorological Laboratory
University of Washington
CSIRO (Canberra, Australia)
Woods Hole Oceanographic Institute
Colorado State University
Universidad Nacional Autonoma de Mexico
University of Concepcion, Chile
George Mason University
University of California, Santa Barbara
Chilean Navy Hydrographic and Oceanographic Office
INOCAR, Ecuador

1.4 Personnel

Chief Scientist is Chris W. Fairall who is affiliated with the NOAA Environmental Technology Laboratory (ETL). Dr. Robert Weller (Woods Hole Oceanographic Institution) will be Chief Scientist on the Galapagos to Chile cruise leg. All participating scientists will submit a medical history form and be medically approved before embarking. Approximately 25-27 scientists will be on board; a list for each leg is given below.

Science personnel for Leg 1: San Diego to Galapagos				
Name	**Title**	**Institution**	**Sex**	**Nationality**
Chris Fairall	Physicist	ETL	M	US
Sergio Pezoa	Engineer	ETL	M	US
Janet Intrieri	Meteorologist	ETL	F	US
Raul Alvarez	Physicist	ETL	M	US
Michelle Ryan	Meteorologist	ETL	F	US
John Shanley	Oceanographer	PMEL	M	US
Michael Gregg	Oceanographer	UW/APL	M	US
Jack Miller	E. Engineer	UW/APL	M	US
David Winkel	Oceanographer	UW/APL	M	US
Earl Krause	Oceanographer	UW/APL	M	US
John Mickett	Student	UW/APL	M	US
Arthur Bartlett	Engineer	UW/APL	M	US
Paul Aguilar	Engineer	UW/APL	M	US
Glenn Carter	Student	UW/APL	M	New Zealand
Robert Cifelli	Radar Scientist	CSU	M	US
Walt Peterson	Radar Scientist	CSU	M	US
Robert Bowie	Radar Tech.	CSU	M	US
Dennis Boccippio	Radar Scientist	CSU	M	US
Carter Ohlmann	Oceanographer	UCSB	M	US
David Menzies	Tech.	UCSB	M	US
Edward F. Bradley	Physicist	CSIRO	M	Australia
Amparo M. Martinez	Meteorologist	UNAM	F	Mexico

Juan Regalado	Meteorologist	INOCAR	M	Ecuador
Jennifer Richards	Teacher	Teacher-at-sea	F	US

Science personnel for Leg 2: Galapagos to Arica, Chile				
Name	**Title**	**Institution**	**Sex**	**Nationality**
Robert Weller	Oceanographer	WHOI	M	US
Jeffrey Lord	Technician	WHOI	M	US
William Ostrom	Engineer	WHOI	M	US
Jason Gobat	Oceanographer	WHOI	M	US
Mark Pritchard	Oceanographer	WHOI	M	UK
Paul Bouchard	Technician	WHOI	M	US
Charlotte Vallee	Oceanographer	WHOI	F	France
Jeffrey Hare	Meteorologist	ETL	M	US
Taneil Uttal	Meteorologist	ETL	F	US
Scott Abbott	Engineer	ETL	M	US
Duane Hazen	Engineer	ETL	M	US
Scott Sandberg	Engineer	ETL	M	US
Brandi McCarty	Res. Asst.	ETL	F	US
Sandra Yuter	Meteorologist	UW	F	US
Kimberly Comstock	Res. Assist.	UW	F	US
Sungsu Park	Res. Assst.	UW	M	S. Korea
Robert Schaaf	Res. Assist.	UW	M	US
Catherine Spooner	Res. Assist.	UW	F	US
David Rivas Camargo	Student	CICESE	M	Mexico
Olga Polyakov	Oceanographer	UCSB	F	US
Toby Westberry	Oceanographer	UCSB	M	US
Wolfgang Schneider	Oceanographer	U. Concepcion	M	Germany
Claudia Valenzuela	Oceanographer	Chilean Navy	F	Chile
Edgar Rivas	Meteorologist	INOCAR	M	Ecuador

Jane Temoshok	Teacher	Teacher-at-sea	F	US
John Kermond	Comm. Direct.	NOAA	M	US
Robert Burgman	Student	COLA	M	US

1.5 Administrative

The Chief Scientist is authorized to revise or alter the scientific portion of the cruise plan as work progresses provided that, after consultation with the Commanding Officer, it is ascertained that the proposed changes will not: (1) jeopardize the safety of personnel or the ship; (2) exceed the overall time allotted for the cruise; (3) result in undue additional expenses; (4) alter the general intent of these instructions. Support for ship time on RHB is provided by NOAA. Scientific support for EPIC2001 is provided by NSF Atmospheric (ATM) & Oceanographic (OCE) and NOAA OGP.

1.5.1 Clearances

Foreign clearance is required in Ecuador and Chile. The Chief Scientist is responsible for ensuring all stipulations of the approved research clearances are met. The cruise plan assumes that clearances to work in the EEZs of these countries will be obtained. The vessel may transect the EEZs of Mexico but clearances are not requested. Scientific data will not be acquired in that region.

1.5.2 POC's

RHB arrived in Seattle on 1 August 2001 and is scheduled to depart at 1000 on Monday, 27 August 2001. Scientists and other EPIC 2001 participants may check with Marine Operations Center - Atlantic (MOA) in Norfolk, VA (http://www.moc.noaa.gov/amc.htm, Tel: 757-441-6208) or the ship's homepage (http://www.moc.noaa.gov/rb/index.htm) for updates on planned arrival and departure times of RHB for Seattle, San Diego, the Galapagos, and Arica, Chile. Travelers should allow for possible flight delays due to weather, holidays, or other considerations.

The ship's e-mail address is Noaa.Ship.Ronald.Brown@noaa.gov. In addition, the Field Opeartions Officer's(FOO), LT Robert Kamphaus, e-mail address is: Robert.A.Kamphaus@noaa.gov

The ship's e-mail system will be changed over from a ccmail server to a netscape server in mid-August, therefore e-mail addresses containing 'ccmail.rdc.noaa.gov' will no longer be valid. Updated e-mail address will be provided as soon as they are verified.

Contact Information:

Ship Operations:

MOA Operations, Atlantic
CDR Jon Rix, NOAA
439 W. York St.
Norfolk, VA 23510-1114
757-441-6842
-6495 (fax)
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RONALD H. BROWN

In Seattle (until 8/27/01): 206-553-4794, 206-553-4795, fax 206-910-3584

Cellular:	757/635-0678 (206-910-3584)
CO:	Capt. Donald A. Dreves
FOO (Field Ops Off):	LT Robert Kamphaus
XO:	CDR George White
Ch. Survey Tech:	Jonathon Shannahoff
Navigation:	ENS Catherine Martin

Details on operations, safety, facilities, etc on RHB can be found at
http://www.moc.noaa.gov/rb/science

2.0 OPERATIONS

2.1 Data to be Collected

*Visit/repair TAO moorings along 95°W at 8 S-12 N, as needed and time permits.

*CTD stations (approximately 120 casts will be made) for water column profiles of temperature, salinity, conductivity, and optical properties.

*Continuous observation of near-surface meteorological parameters, upper ocean currents, sea surface temperature and salinity.

*At 10 N 95 W, continuous observations of oceanic turbulence and optical profiles from the surface to 200 m depth. Also, a special high density temperature profile array will be mounted on the nearby TAO buoy.

*Upper air sounding of temperature, humidity, and wind vector profiles (4-8 per day).

*Continuous observations of atmospheric profiles of temperature, humidity, wind vector, aerosol backscattering, precipitation, and turbulence using ship-based radar and lidar remote sensors.

*Continuous observations of turbulent and solar/IR radiative fluxes.

*GDP, ARGO, and SOLO surface drifter float deployments.

*Recover WHOI IMET surface and subsurface mooring and data records at 20 S 85 W; deploy replacement mooring.

The basic scientific instruments are summarized in the following table.

Table 1. Instruments and measurements for air-sea interaction, cloud, and precipitation studies in EPIC-2001. Wave hatching denotes ship system.

Item	System	Measurement
1	Air-sea flux system	Motion corrected turbulent fluxes
2	Pyranometer & Pyrgeometer	Downward solar radiative, IR flux
3	Bulk meteorology	SST, Tair, RH, wind speed
4	Ceilometer	Cloud-base height
5	0.92 GHz Doppler radar profiler	Wind & Precipitation Profiles
6	Raingauges	Rainrate
7	35 GHz Doppler cloud radar	Cloud microphysical properties
8	20, 31 GHz μwave radiometer	Integrated cloud liquid water, total vapor
9	Upward pointed IR thermometer	Cloud-base radiative temperature
10	Mini-MOPA Doppler Lidar	Sub-cloud air motions
11	DIAL Lidar (also Mini-MOPA)	Water vapor profiles
12	BNL Portable Radiative Flux Pack	Direct/diffuse solar, IR fluxes
13	Atmospheric Particle Samplers	Aerosols
14	Modular Microstructure Profiler (MMP)	T, Sal., velocity fluctuations

15	Ocean Profiling Radiometer (SPMR)	Optical properties
16	Rawinsonde	Wind, temperature, humidity prof.
17	Scanning C-band Doppler radar	Precipitation 3-D structure
18	CTD	Ocean T, S profiles
19	ADCP	Ocean current profiles
20	Terrascan Satellite receiving system	NOAA AVHRR, GMS, GOES, SeaWiFS
21	IMET	Meteorology
22	Scientific Computer System (SCS)	All ship's sensors
23	Thermosalinograph	Near-surface T, S
24	AOML underway CO2 system	Water-air CO2 concentrations + O2
25	AOML Turner Designs Flurometer	Chrlorophyll concentration

Most instruments are designed to take data unattended and continuously. A functional summary of the instruments is given in the APPENDIX A.

2.2 Staging Plan

Loading and setup of scientific equipment for this cruise will take place in Seattle, Washington between August 15 and August 24, 2001. Please note that all loading and setup that requires the assistance of ship's personnel should be completed prior to 1600L on Friday, 24 August 2001. Disposition of containers and mooring components on the decks is given in APPENDIX B. Loading cannot take place during fueling. The two Ethernet connections (one each to ship's network and radar network) into the Biolab need to be available and working by 24 August 2001 for pre-cruise staging of UW/CSU computers. A large group of EPIC scientists will be on board from Seattle to San Diego to test systems and train people. Details are provided in the cruise instruction for that cruise (RB-01-07).

In addition to equipment loaded in Seattle, some additional instruments and/or shipping cases may be brought on board in San Diego between September 3, 2001 and September 5, 2001. Because of other planned activities and loading of ship's stores, etc, no large storage vans or seatainers will be loaded in San Diego. The following is a list of cargo planned for loading in San Diego:

ETL lidar group: One 650L liquid nitrogen container will be topped off or exchanged.
UW/APL: laptop computers
ETL flux group: about 5 hand-carried shipping cases
UCSB: about 15 hand-carried shipping cases
CSU: 1-2 hand-carried shipping cases

The ship will make an intermediate stop at Puerto Ayora, Santa Cruz Island, Galapagos Islands, Ecuador October 6-9, 2001. Personnel and **hand-carried** equipment may be exchanged. Since the ship will 'anchor out', all personnel and equipment will be transferred to the ship by small boat; therefore, all items will be limited to the capacity of the small boat or contracted water taxi.

Copies of equipment lists, including serial numbers and country of origin, must be supplied to the Executive Officer (XO) and Chief Scientist prior to arrival in the Galapagos. It is the responsibility of each group of investigators to arrange for shipping their equipment to and from RHB, including all customs requirements, documentation, and transfers between the receiving dock and the ship. Any modification to the ship's equipment or special requirements for this cruise should be brought to the attention of the ship's Field Operations Officer (FOO) and the Chief Scientist as soon as possible. A list of equipment and vans is given in APPENDIX B; discussion of equipment placement is given in APPENDIX C.

2.3 Cruise Plan

See below for cruise track way points and APPENDIX D for chartlet.

2.4 Way Points:

LEG 1

Way Point	Lat.	Long.	Naut. Miles	Ave. Sp	Hrs	Arr Date	Dep Date	Comments
1	32.7 N	117.2 W	–	0 .0	–	9/3	9/5	San Diego
2	20.0 N	110.0 W	862	12.5	69.0	9/8	9/8	
3	12.0 N	95.0 W	1005	12.5	80.0	9/11	-	
4	12.0 N	95.0 W	--	0. 0	4.0	-	9/11	Repair buoy
5	10.0 N	95.0 W	120	9.0	13.0	9/12	9/12	
6	10.0 N	95.0 W	--	0.0	464.0	-	10/1	ITCZ ops
7	8.0 N	95.0 W	120	9.0	13.0	10/2	-	
8	8.0 N	95.0 W	--	0.0	4.0	-	10/2	Repair Buoy
9	5.0 N	95.0 W	180	9.0	20.0	10/3	-	
10	5.0 N	95.0 W	--	0.0	4.0	-	10/3	Repair Buoy
11	3.5 N	95.0 W	90	9.0	10.0	10/3	-	
12	3.5 N	95.0 W	--	0.0	4.0	-	10/3	Repair Buoy
13	2.0 N	95.3 W	90	9.0	10.0	10/4	-	
14	2.0 N	95.3 W	--	0.0	8.0	-	10/4	Replace Buoy
15	0.0 N	95.0 W	120	9.0	13.0	10/5	10/5	
16	0.0 N	95.0 W	--	0.0	8.0	-	10/5	Replace Buoy
17	1.2 S	90.3 W	302	12.5	24.0	10/6	10/9	Galapagos Is.

Notes:

A) Assumes 12.5 knot ship speed, earth-relative, during transit to and from experimental area. Assumes 9.0 knot average ship speed (12.5 knot underway and stopping for 3/4 hour every 30 nm to do a CTD) during transits in experimental area.

B) Operations at buoy locations will be repair of TAO surface mooring, as required. Actual requirements will be determined by Meghan Cronin just after departing San Diego. A temperature profile array will be installed by ship's divers on the buoy at 10 N 95 W.

C) Main operations will be conducted at 10 N which is expected to be near the center of the ITCZ.

LEG 2

Way Point	**Lat.**	**Long.**	**Naut. Miles**	**Ave. Sp**	**Hrs**	**Arr Date**	**Dep Date**	**Comments**
1	1.2 S	90.3 W	–	--	70.0	10/6	10/9	Galapagos Is.
2	2.0 S	95.0 W	296	12.5	18.0	10/10	10/10	
3	8.0 S	95.0 W	360	9.0	40.0	10/11	10/11	CTD section
4	20.0 S	85.0 W	932	10.0	93.0	10/15	--	CTD section
5	20.0 S	85.0 W	–	0.0	137.0	--	10/21	IMET mooring
6	20.0 S	72.0 W	756	9.0	84.0	10/24	10/24	CTD section
7	18.3 S	70.3 W	141	12.5	8.0	10/25	-	Arica, Chile

Notes:

A) Assumes 12.5 knot ship speed, earth-relative, during transit to and from experimental area. Assumes 9 knot average ship speed (12.5 knot underway and stopping for 3/4 hour every 30 nm to do a CTD) or 10 kts (12.5 knot underway and stopping for 3/4 hour every 60 nm to do a CTD).

B) Main site activities include recovery of WHOI/IMET mooring.

C) Time lost due to adverse weather or other operational delays will be made up by terminating the southern leg (waypoint 5) early or decreasing time spent on CTDs.

2.5 Station Operations

EPIC2001 will have two kinds of station operations: (1) long term stations at 10 N 95 W (about 20 days - referred to as the *ITCZ station*) on Leg I and 20 S 85 W (about 6 days - referred to as the *IMET station*) Leg II and (2) regular stops during transits for CTD's (these will be referred to as *CTD stations*).

2.5.1 ITCZ Station Operations

2.5.1.1 TAO buoy repairs

As part of the East Pacific Investigation of Climate Processes in the Coupled Ocean-Atmosphere System (EPIC), the 95°W TAO/TRITON line has been enhanced with extra sensors and moorings to monitor heat, moisture, and momentum fluxes, and upper ocean temperature, salinity and horizontal currents from the stratus deck region at 8°S through the cold tongue and north of the intertropical convergence zone (ITCZ). The measurements will have sufficient temporal resolution and duration to define the diurnal- to-interannual evolution of the cold tongue / ITCZ system. These measurements are a vital component of theEPIC2001 process study as they provide large-scale context as well as localized high resolution time series of surface and subsurface variability. [Contact: Dr. Meghan Cronin, PMEL, TAO Project Office]

The objective of the TAO/EPIC component of this cruise is the maintenance of the TAO/EPIC 12°N, 8°N, and 10°N, 95° W TAO/EPIC moorings. PMEL will load mooring equipment for both the EPIC cruise as well as the following TAO cruise (RB-01-09) onto the *RHB* in Seattle, Washington, during their in port period August 2 through 27. TAO/EPIC buoy repair operations will be the first operations on the EPIC cruise in order to ensure comprehensive buoy data collection during the following EPIC experiments. After completion of the first leg of operations, *RHB* will arrive on October 6, 2001 in Santa Cruz, Galapagos to disembark John Shanley and embark additional scientific personnel.

The buoy repair operations will depend on the condition of the buoys at the three sites upon arrival. Time is allotted for up to two ATLAS II-E recovery deployments and a mooring repair at the remaining site.

Mooring Operations

Mooring operations may include recovery/deployments and servicing of the Tautline ATLAS Next Generation-Enhanced (ATLAS II-E) type of mooring. The following mooring operations may be required depending on the state of the mooring upon arrival at the site. The work may be changed by direction of the Chief Scientist, in consultation, with the Commanding Officer.

Location	Mooring Type	Operation
12°N 95°W	Tautline ATLAS II-E	Recover/Deploy or Repair
8°N 95°W	Tautline ATLAS II-E	Recover/Deploy or Repair
10°N 95°W	Tautline ATLAS II-E	Recover/Deploy or Repair

Diver Installed Acoustic Rain Gauge at 8N/95W

An acoustic rain gauge (developed by the University of Washington Applied Physics Laboratory) to be attached to the Nilspin cable at 18 m (can be attached between 18m and 10m water depth, 18 meters is preferred). Dive to be completed only if weather permits. Ship's diver support is requested for this operation. [Contact: Jeff Nystuen, UW Applied Physics Laboratory]

Diver Installed Temperature Sensors at 10°N/95°W

Additional temperature sensors are required on the mooring at 10°N 95°W. Sensors are a clamp on type and will be placed at two meters below the surface on a pre-existing customized handle on the toroid, and at one meter increments between 3 m and 10 m. The presently deployed Nilspin cable is pre-marked at one meter increments. Ship's diver support is requested to install sensors during the first day on station at 10N, and to collect sensors prior to departing 10N, 20 days later. [Contact: Dr. Carter Ohlmann, UCSB]

2.5.1.2 MMP

Modular Microstructure Profilers (MMPs)

The University of Washington Applied Physics Laboratory will operate the Modular Microstructure Profiler (MMP) to measure profiles of temperature, salinity, and velocity (current) while the ship is on station. Both slow (mean) and high speed (microstructure) data will be acquired. This instrument samples oceanic turbulence in the mixed layer and below. The instrument is dropped and pulled back repeatedly while the ship goes slow ahead. Periodically (every 3-4 hours), the probe is brought aboard and the ship repositions at full speed to the original starting point. The probe is redeployed with fresh batteries and sampling starts again.

When on station near 10N, 95W UW/APL will take microstructure profiles as frequently as possible to measure small-scale turbulence in the upper 300 m of the ocean. A family of three instruments known as Modular Microstructure Profilers (MMPs) is used. The MMPs are loosely-tethered, i.e., they are attached to the ship by thin Kevlar lines that are kept loose while the instrument descends to isolate it from ship motion. Otherwise, it would not be possible to detect centimeter-scale turbulent fluctuations. The tether contains thin twisted-pairs that transmit data in real time. An operator from the UW/APL group mans the winch to ensure that line is played out fast enough to keep a loose coil on the surface behind the ship. For this cruise, the instruments are ballasted to fall at approximately 0.65 m/s. Tracking has shown that the instruments descend much as free vehicles and are displaced laterally by subsurface currents as they fall. They will routinely descend to 300 m before being recovered by pulling the line in with the winch. With the ship moving at 1 knot, a drop will take about 20 minutes. Because the

MMPs are relatively light tubes, they rise to the surface far aft and then come in along the surface when being recovered.

After the instrument is pulled back to the ship, another profile is usually made without bringing it on board. This sequence will be continued until the ship reaches the end of its track or it is necessary to change batteries or a probe. Batteries usually last 4 hours. The winch operator has an open intercom to the data logging station in the main lab and initiates profiles only when told to by the person logging the data. Unless sea conditions are unusually difficult, MMPs are recovered while the ship maintains its slow ahead course and speed.

<u>Ship Operations During Microstructure Profiling</u>

Wind directions from the bow sector are required for clean sampling of atmospheric turbulence and aerosols. Consequently, during MMP sampling the ship should move slowly along tracks about a central location for microstructure profiling, keeping the wind within 45^{o} of the bow. When the end of the line is reached, the MMP will be recovered and the ship will reposition as quickly as possible.

Because the Z-Drives are close to the stern and the cable is thin and easily cut, it is imperative that the cable not go under the ship. On the other hand, the faster the ship goes the greater the amount of line paid out during a drop and the longer the interval between profiles. Many profiles are needed to average over the large statistical intermittence characteristic of turbulence. We request, therefore, that the ship operate at a safe steerage speed. This varies with wind and sea conditions, but on Revelle and most other ships, we have found that 2 knots usually works well. Whenever the bridge feels that conditions are changing, please contact the MMP data logging station at the aft end of the Main Lab. UW/APL requests that the ship operate at constant rpm when taking microstructure data. As long as the wind direction is suitable for the atmospheric and aerosol sensors, the exact course made during data sampling tracks is not important. Steering by adjusting the directions of the Z-Drives while they remain at constant rpm should produce an adequate track.

During daylight, the UCSB group will also be working from the stern, taking optical profiles (SPMR) to 100 m every hour. It is anticipated that the MMP will remain in the water at the stern during the relatively short (5-10 minutes) SPMR casts. Initially, however, the MMP will be will recovered before SPMR casts.

Continuous operation of the ADCP is the only other requirement for microstructure profiling. For us to assess the state of shear and mixing, we request access to the ADCP data stream so we can process it without a large delay. [Contact: Dr. Michael Gregg, UW/APL]

2.5.1.3 SPMR

The UCSB group will measure spectral irradiance at the surface, profiles of spectral irradiance, and will perform CTD/Rosette profiles from the RHB during EPIC. The Satlantic SeaWiFS

Profiling Multichannel Radiometer (SPMR) is a long (~120 cm), slender (~9 cm diameter) hand-deployed instrument that measures downwelling irradiance and upwelling radiance in 11 spectral bands (340 to 685 nm). The measured quantities are transmitted through a data cable and recorded on a computer set up in the ship's lab. An SPMR profile to 100 m will be made every hour during daylight while at each of the long-term stations. A similar single profile (100 m) will be performed at each CTD station made during daylight hours. A surface sensor mounted on the bow-mast (to which the ETL flux sensors are to be attached) will record similar quantities simultaneously.

An SPMR profile involves hand-lowering the instrument into the water with the ship moving slowly (~1 knot) forward so that ship-SPMR separation occurs. Once the instrument is ~30 m from the ship the SPMR is allowed to free-fall to 100 m. The instrument is kept away from the ship to avoid ship motion and shadowing effects. Once 100 m is reached the SPMR is pulled in by hand with the help of a small manual winch/spool.

UCSB plans on mounting the surface sensor on the ship's mast at the bow with ETL's (Chris Fairall) pyranometer. Computer space is requested in the hydrolab for data recording; some analysis will also be done in the Wetlab. ETL's incident solar (pyranometer) data rather than recording similar data of our own.

CTD/Rosette casts will be made to 200 m near noon on each day with water samples collected at 12 depths. We plan on using the ship's CTD/Rosette system for this. Water samples will be filtered to measure chlorophyll concentration aboard the RHB, and water samples will be frozen and stored for nutrient analysis in the lab back at UCSB. [Contact: Dr. Carter Ohlmann, UCSB]

2.5.1.4 Flux

The ETL flux system consists of five components. (1) A fast turbulence system with ship motion corrections mounted on the jackstaff. The sensors are: Sonic anemometer, IR-hygrometer, IR-CO_2/hygrometer, motion-pak, mean T/RH sensor in aspirator. (2) A Li-Cor 6262 fast CO_2/hygrometer is mounted on the bow tower with a sample tube run to the sonic anemometer. (3) Solar and IR radiometers (Eppley pyranometer/pyrgeometer) mounted on the top of the bow tower. (4) A near surface sea surface temperature measurement is made with a floating thermistor deployed off port side with outrigger. (5) A dual set of narrow-band IR thermal radiometers are used to measure the interfacial sea surface temperature. These systems are logged in the main lab; they will run continuously throughout the cruise. The best situation for obtaining flux data is with the ship going slow ahead and the wind within 45 degrees of the bow.

The ETL flux team will also operate a Vaisala cloud ceilometer (previously installed in the hydrolab) to record cloud base height at 30-s intervals. The ETL 915 MHz wind profiler (installed by ETL in 2000) will be operated continuously and the data logged and archived for later distribution. [Contact: Dr. Chris Fairall, ETL]

2.5.1.4 C-band Radar

The C-band radar on-board RHB will be operated continuously while the ship is on station at 10º N 95º W. CSU will be responsible for the radar operations and data processing on Leg 1; Michelle Ryan of ETL will advise as necessary. One of the goals of the first Intensive Operation Phase (IOP) is to use the radar to map rainfall over the eastern Pacific ITCZ (Inter Tropical Convergence Zone) region. In order to meet this requirement, it will be necessary for the ship to minimize the length of transects required for oceanographic work and maintain it's position within approximately 10 km of it's on station location during the IOP. UW will be responsible for radar operations and data processing on Leg 2; Duane Hazen of ETL will be available for engineering support. It is expected that the C-band radar will be setup to run a variety of tasks in order to meet the science goals of the experiment.

The initial specification of each radar task (range of elevation angles, azimuth range, number of samples, etc) will be determined while the ship is in port in Seattle prior to the start of the EPIC2001 cruise. It will be necessary to radiate the radar in port in Seattle and it may also be necessary in port in the Galapagos. The FOO will work with the science party to obtain permission to test the system in port. [Contact: Drs. Rob Cifelli, CSU and Sandra Yuter, UW]

2.5.1.5 Cloud radar and microwave radiometers

ETL has an integrated system in a seatainer that includes a Doppler Ka-band cloud radar (MMCR) and a microwave radiometer (MWR); the system has been used on three cruises on the RHB in 1999 and 2000. These systems are used for deriving microphysical quantities of ice clouds (cirrus) and to deduce profiles of cloud droplet size, number concentration, liquid water concentration etc. in stratus clouds. If drizzle (i.e., droplets of radius greater than about 50 μm) is present in significant amounts, then the microphysical properties of the drizzle can be obtained from the first three moments of the Doppler spectrum. The system has similar applications in deep convective clouds, but microphysical retrievals are complicated by mean vertical motion in the air column. The radar is extremely sensitive and can detect most tropical cirrus and fair weather cumulus clouds. The Doppler capability can also be used to measure in-cloud vertical velocity statistics. This seatainer will be deployed forward on the 02 deck and operated continuously throughout the cruise. [Contact: Taneil Uttal, ETL]

2.5.1.6 Lidar

The ETL mini-MOPA Doppler lidar will be deployed in a seatainer on the 02 deck forward. This mini-MOPA is medium resolution Doppler lidar integrated with a stabilized scanning system that can measure a variety of sub-cloud layer turbulence properties including stress and turbulent kinetic energy profiles. This Doppler lidar can obtain detailed information on the vertical and horizontal structure of the boundary layer wind fields. The system has full-hemispheric scanning capabilities with motion compensation for shipboard operation. The system can also be operated as a DIAL (differential absorption lidar) system so that it will be possible to obtain water vapor profiles (with lesser time resolution) for a variety of studies of boundary layer sub-cloud moisture variability and structure. In addition to water vapor profiles the lidar measurements can also provide cloud base heights throughout the troposphere as a subset of information since clouds provide such large signal returns. In this way, the lidar provides high-resolution water vapor structure and characteristics of the boundary layer air in concert with ceilometer-type cloud data. The lidar is completely eyesafe outside the container, but there are eye hazards inside so admission will be restricted. [Contact: Dr. Janet Intrieri, ETL]

2.5.1.7 Aerosols

The Aerosol Physics Group of the Universidad Nacional Autónoma de México (UNAM) is participating in the EPIC project to study the interaction of clouds and aerosols. Cloud formation and evolution is dependent upon the concentration, composition and size distribution of cloud condensation nuclei (CCN) that are a subset of the atmospheric aerosols. The properties of CCN can be modified after they have been processed by clouds, i.e. after the particles have been in cloud water droplets or ice crystals. Sea salt and sulfate particles coming directly or indirectly from the ocean are expected to be the primary sources of CCN for clouds in the EPIC research area. Thus, measurements are needed of aerosols and precursor gases near the ocean surface, aerosols near cloud boundaries, and particles within the clouds. The UNAM research group will be making aerosol and gas measurements on RHB and the NSF C-130 aircraft. In addition, the group will analyze complementary gas, aerosol, cloud and meteorological measurements being made on the ship and aircraft by other groups.

The objective of this analysis is to characterize the aerosol and cloud properties and use them as input to a cloud model to study the microphysics of clouds in the EPIC research region. The primary interest is in evaluating the cloud droplet spectra with respect to the CCN characteristics and to look at the relationship between aerosol properties (size distributions and optical properties) and the proximity of these aerosols to cloud boundaries.

The measurements made by the UNAM group on the ship will consist of the following:

Parameter	Technique	Instrument
Sulfur Dioxide	UV Fluorescence	API Inc. Model 100A
Condensation Nuclei (CN)	Optical Particle Counter	TSI Model 3010
Aerosol Size Spectra (0.1 – 3 μm)	Optical Particle Counter	PMS Turbo 110
Aerosol Composition inorganic ions, organic carbon, black carbon	Ion and thermographic analysis of quartz filters	URG PM1.0 impactor
DMS	Flame Ionization	Shimatzu Gas chromatograph

DMSP	Flame Ionization	
Sea water CO2	FID + methanizer	
Sea Water fluorescence	Fluorescence profiler	Biospherical PNF300
Chlorophyll a	Extract with Acetone	Bench Fluorometer
Phytoplankton identification	Store with Acetate Lugol	

The atmospheric measurements of SO_2 and aerosols will be made continuously throughout both legs of the cruise, with the exception of downtime for filter changes and instrument maintenance. It is imperative that sampling of ship exhaust be minimized. During those periods that the ship is underway, the probability of taking contaminated samples should be minimal. During periods when the ship is stationary, if possible, we would like the ship pointed into the wind. Otherwise, the aerosol filter sample will have to be shut down during those periods. According to the operation's plan, the ship will be stationary for extended periods of time. If we are unable to operate in these periods, it will seriously impact the usefulness of the measurements. [Contact: Dr. Darrel Baumgardner, UNAM]

2.5.2 IMET Station Operations

2.5.2.1 IMET Mooring recovery/deployment

Woods Hole Oceanographic Institution has been funded to deploy an air-sea interaction surface mooring to monitor the evolution and coupling of the oceanic and atmospheric boundary layers under the persistent stratus cloud deck found west of Peru and Chile. This region is of critical importance to seasonal and interannual climate variability in the Americas. Observations will provide the first accurate and complete time-series of the air-sea fluxes of heat, freshwater, and momentum from this region and will resolve variability on time scales from diurnal to interannual.

The surface mooring was deployed at 20° 9.4' S, 085°9.0' W, during cruise Cook 2 of the R/V *Melville*. The mooring was deployed on October 7, 2000. The three-year deployment is timed to support the initial, and later more intensive, phases of the cooperative fieldwork on the eastern Pacific that has been planned under the Eastern Pacific Investigation of Climate (EPIC).

The three-meter discus buoy is equipped with meteorological instrumentation, including two Improved METeorological (IMET) recorders, and a stand-alone humidity and temperature recorder. The WHOI mooring also carries vector measuring current meters; temperature recorders; and conductivity and temperature recorders located in the upper 450 meters of the mooring line, as well as a Acoustic Doppler current profiler, a Falmouth Scientific Instruments (FSI) current meter, a chlorophyll absorption meter, 4 Onset Tidbit temperature loggers, and an acoustic rain gauge. Details are provided in the WHOI writeup.

A total of 41 recording instruments with 72 sensors were deployed on the Stratus 1 surface mooring. There are two meteorological systems, one stand-alone relative humidity/air temperature recorder (SAHTR), one floating sea surface temperature recorder, three current meters, sixteen temperature data loggers, ten conductivity/temperature-recording instruments, one chlorophyll absorption meter (CHLAM), one acoustic rain gauge, and one acoustic current meters.

During leg 2 of RHB's EPIC cruise, a turn around of the surface mooring is planned. The mooring deployed last October will be recovered, and another mooring with almost identical instrumentation will be deployed in its place. The recovery, clean up, preparation and deployment will require six days of intensive work at and around the mooring site.

The WHOI mooring is an inverse catenary design utilizing wire rope, chain, nylon and polypropylene line and a scope of 1.25 (Scope = slack length/water depth). The surface buoy is a three-meter diameter discus buoy with a two-part aluminum tower and rigid bridle.
In addition to the mooring work described, underway measurements will be conducted during the transit to the mooring site. Measurements include meteorological observations, CTDs, XBTs, thermosalinograph, and ADCP. [Contact: Dr. Robert Weller, WHOI]

2.5.2.2 C-band Radar

The main goal of the University of Washington observations is to assess the degree to which depletion of cloud water by precipitation processes such as drizzle regulates the SE Pacific subtropical stratocumulus cloud cover and liquid water path. Scanning C-band radar observations will yield information on the three-dimensional structure, distribution, and evolution of drizzle-bearing clouds. GPS upper-air soundings, launched every three hours, will document the vertical profile of temperature, moisture and wind both within and above the boundary layer. Cloud photography will provide a visual context for interpreting the radar and upper-air sounding data.

Proposed Measurements:

Measurement	Instrument	PI
C-band radar reflectivity, radial velocity and spectral width (continuous)	Ship's C-band scanning radar	Yuter
Thermodynamic profile (3 hourly)	Ship's GPS Upper air sounding system	Yuter
Cloud photography	Digital camera	Yuter
Drizzle drop size	Water-sensitive dye on filter paper	Yuter

Data Requirements
The following data are required for University of Washington science operations.

GPS sounding data in ascii format – shortly after each sounding is terminated.

SCS time series data of ship's position, ship's gyros and accelerometers, meteorological sensors including IMET, sea surface temperature and salinity. These data are needed as ascii files at **both** hourly and daily time intervals.

C-band radar data in Sigmet file format, remote copied from Ship's radar HP workstation to UW Sun workstation in Biolab shortly after the completion of each scan. UW scientists can set up the SIGMET software to do this if the necessary LAN connectivity is in place. [Contact: Drs. Rob Cifelli, CSU and Sandra Yuter, UW]

2.5.2.3 Other

Operations of the flux, cloud radar, and lidar will be done as per section 2.5.1.

2.5.3 CTD Station Operations

CTD profiles to a depth of 300 m will be taken at 30 nm or 60 nm increments. The ship will stop for about 3/4 hr for the 300-m CTDs. The CTD's will be done 1) once per day at local noon while the ship is at 10 N 95 W and at 20 S 85W, 2) during transects indicated with a speed of 9.0 kts (30 nm increments) or 10.5 kts (60 nm increments) on the waypoint tables. During CTDs the ship will, conditions permitting, hold heading with the wind from the starboard side with the bow slightly into the wind to permit continued uncontaminated atmospheric sampling (a similar procedure was used in JASMINE). When possible, sondes will be launched during these periods. Personnel from UCSB and WHOI will assist with CTD's as needed; a watch schedule will be worked out at the beginning of each leg. One transit on Leg2 has been computed assuming one CTD 60 nm to save time. All CTDs may be extended to 500 m if operational experience shows this can be done within the time limits.

The primary CTD will be the ship's system with 12 bottles and the RHB 911-plus CTD. WHOI will bring a internally-recording CTD as a backup for the RHB sensor. If the entire CTD system is lost, the PMEL system (aboard for RB-01-09) will be used as a backup.

2.6 Underway Operations

Instruments on the EPIC2001 mission typically will be acquiring data continuously, both while the ship is underway and when it is holding station.

GPS sondes (weather balloons) will be launched nominally every 4 hours during Leg 1 (00Z, 04Z, 08Z, 12Z, 16Z, 20Z) and every 3 hours during leg 2 (00Z, 03Z, 06Z, 09Z, 12Z,15Z,18Z,21Z) from the ship's main or 01 deck aft. Additional or fewer launches may be decided on location. A sounding procedure will be agreed upon by UW/CSU/ETL. All sounding launches should follow this procedure for consistency. The sounding procedure will include surface humidity and temperature measurements from a handheld sling psychrometer on deck in proximity to the launch area. Members of the scientific crew will be trained in launch procedures on the transit to the on station area. The 00Z and 12Z launches will be sent to the Global Transmission System (GTS), as usual. The data from the soundings will be made available to the work station in the Biolab via ftp from the ship's computer network and on writeable CD (to be supplied by UW). These data will be processed/backed up onto DLT tapes intermittently but no less than every three days by the work station in the Biolab in addition to the writeable CD storage. In addition digital cloud photos will be taken at designated areas around the ship at the time of launch.

3.0 FACILITIES

3.1 Provided by Ship

3.1.1 Communications, including INMARSAT link for data and written messages, and e-mail. In the vicinity of Galapagos Islands, ship-to-shore and ship-to-ship voice communications via HF and/or VHF radio will also be needed. There will be a need to communicate with the *R/V New Horizon* via marine radio and the two research aircraft via a small handheld VHF aircraft radio.

3.2.1 GPS Navigation: Navigation information will be recorded in the Marine Operations Abstract (MOA - OSC Worksheet 001). All events will be recorded as they occur and at least every 4 hours and at the time the ship changes course or speed while underway in open water. In the event of SCS failure, the bridge will record hourly GPS positions in the MOA. GPS position and time-base will be made available in real-time to the science work stations over the ship computer network. These data should be supplied on same frequency and time-base as other ship board data streams.

3.1.3 Thermosalinograph record for the entire cruise, calibrated to within 0.1° C and 0.01 ppt.

3.1.4 Laboratory/work space in the main lab, hydro lab, wet lab, bio lab, plot room, and computer room, primarily for instrument data systems whose sensors are positioned outside. One unit of computer space is defined as counter-top space 2 feet wide, 30 inches deep, and 3 feet high. Needed are:

Sensor	Sensor Location	Best Lab	Units Needed
Ceilometer	02 Deck Aft, Port	Hydro	1
Aerosol	Bow Tower	Hydro, Comp	2,1
C-band radar	Main mast	Bio	9
Rawinsonde	O2 aft rail	Hydro	1
Cloud-Radar	02, Port	None	-
Lidar	02, Stbd	None	-
CTD	Main Deck, Stbd	Computer	2

ADCP	Transducer void	Main/Comp.	2
Flux System	Jack Staff/Bow Tower	Main	5
$pC0_2$	Hydro Lab	(As setup during previous missions)	
BNL. Radiation	02 Deck	(As setup during previous missions)	
MMP	Fantail	Main	8
SMPR	Fantail	Wet, Hydro	2, 4
WHOI Buoy	Fantail	Main	8

ETL Main Lab. We will set up two workstations and two PC's in the forward section. Hydro Lab: One PC for ceilometer.

UW/CSU: Bio Lab - 3tables will need to be setup in the Bio Lab area for the Sun work stations.

UW/APL: Main Lab. UW/APL will setup up data processing computers in the main lab aft. 3 8-ft tables for computers and 5 8-ft bench spaces for MMP operations are needed.

UCSB Wet Lab. CTD and bottle operations; hood for chemical analysis; Hydro for computers.

WHOI Main Lab. Extensive space will be used in the main lab to store/stage mooring components prior to deployment. Computer space is required for downloading and processing recovered mooring data.

UNAM Computer Lab, one space for PC. Hydrolab, 2 m^2 for analysis.

3.1.5 Dry compressed air (100 psi, 2 CFM) to vans, as needed.

3.1.6 Power to vans, as indicated in APPENDIX B. Only the following power outputs are available from the ship, all at 60 Hz: 1) 450 VAC, 3 phase, 2) 220 VAC, 1 or 3 phase, and 3) 120 VAC, 1 or 3 phase. Three-phase power is configured as "delta" (no ground), not as "Y" (with central ground). Transformers or motor-generators for other power requirements will not be provided by the ship and must be provided by the participants. Only U.S. standard power plugs and jacks will be provided by the ship.

3.1.7 SCS data streams:

ETL will require an RS-232 data stream for the ship's SCS at a rate of 2s. This will consist of navigational information (ship's P-code gps, ship's gyro, ship's Doppler log) and some met/oce data (thermosalinograph water temperature, some IMET data). Details are given in APPENDIX E.

UW/APL requests a GPS navigational data feed via RS-232.

UW requests a data stream of all ship met/oce/nav data including ship's position, ship's gyros and accelerometers, meteorological sensors, IMET, sea surface temperature and salinity archived at a rate of 0.5 Hz. The exceptions are rain gauges which may record every 1 min on the minute. Instruments which do not sample new data every 2 s will provided repeated data points at 2 Hz sampling frequency. These data are needed as ascii files at hourly and daily time intervals. The data will be available to all scientific workstations via the ship's computer network and backed up onto writeable CD.

UCSB requests a NMEA format GPS feed in the Hydrolab.

At regular intervals, not to exceed 5 days, the ship's CST will archive data from disk to tape (or CD) for delivery to Chief Scientist at the end of the cruise.

3.1.8 Navigation adjustments prior to sounding launch

To minimize the possibility of the upper-air sounding becoming fouled on the ship's superstructure or other equipment on deck it is requested that the ship turn just prior to balloon launch such that the relative wind on deck will safely blow the balloon away from the ship. When the ship is underway, it may also be necessary to slow the ship just prior to launch. It is anticipated that these navigation maneuvers would take less than 5 minutes per launch.

3.1.9 Upper air sounding release after dark

The upper-air soundings are released from deck and handling of the balloon and instrument package can be ungainly for one person. For safety reasons, it is requested that for launches after dark that either a member of the scientific crew or the ship's crew accompany the balloon launcher on deck to assist in balloon release.

3.1.10 The ship's ADCP will be logged continuously and data will be provided (ethernet link preferred, or zip drive) to the UW/APL group for onboard processing.

3.1.11 Scanning 5 cm Doppler precipitation radar.

Data Flow Description for EPIC Radar Science in Biolab

The current configuration of the RHB ship's networks differs from the setup in TEPPS 1997, JASMINE 1999 and KWAJEX 1999. In the current configuration, the two HP radar workstations are physically isolated from the rest of the ship's computers. NOAA ETL (Michelle Ryan) has purchased a five port switch to facilitate radar data distribution.

The EPIC radar science workstations, PCs, and peripherals owned by Colorado State University (CSU) and University of Washington (UW) will be setup in the Biolab. Ethernet connections to both the Ship's LAN with SCS and upper-air sounding data and the Radar data network are required into the Biolab. The proposed network configuration is illustrated in the figure in APPENDIX G.

3.1.12 TeraScan satellite receiver system for environmental satellite data. Satellite images from polar orbiting and geostationary satellites, and archive of encrypted SeaWiFS passes from the system are requested. In addition, images downloaded from the GOES satellite for the operating region (GOES-10 west of 100 W, GOES-8 east of 100 W) will be saved as GIF images and archived. Carter Ohlmann, UCSB will coordinate his data requirements with the ship's TeraScan opearator, LT Robert Kamphaus.

3.1.13 The ship's IMET system data will be provided to the science work stations via the ship computer network and ftp'd to work station a UW/CU workstation. Recording rate of these data will be the same as for all other ship instruments and on same time base. These data will be redundantly backed up onto DLT tapes by the work station in the Biolab intermittently but no less than every three days.

3.1.14 The science party will require the following connections to the ship's computer network:

Network requirements by EPIC2001 science party.		
Group	Space	Usage
ETL	Main Lab	2 workstations, 2 PC
ETL	Cloud radar van	1 workstation
ETL	Mini-MOPA lidar van	1 workstation
UW/APL	Main Lab	2 workstations, 3 PC
UW/CSU	Bio Lab	1 SCS connect, radar connect
UCSB	Hydro Lab	2 PC
WHOI	Main Lab	2

3.1.15 Freezer storage for about 850 10 ml bottles of seawater, refrigerator storage for approximately 1000 vials and/or petri dishes, and cool dark storage for 450 250 ml bottles.

3.1.16 Research groups will require storage space for various shipping containers:

Storage requirements for EPIC science party.		
Group	Space	Usage
ETL/FLUX	Indoors	20 shipping cases.
UW/CSU	Indoors	25 shipping cases
UCSB	Indoors	25 shipping cases
ETL/LIDAR	No sea spray	5 crates, misc. loose pcs

UNAM	Indoors	10 shipping cases
WHOI	Indoors	10 shipping cases

3.2 Provided by Participants

*The instruments supplied by the participants are summarized in Appendices B, C, D.
*Meteorological balloons, sondes, and helium (in storage racks) for balloon launches
*Office supplies: pens, paper, storage disks, etc

4.0 DISPOSITION OF DATA AND REPORTS

4.1 Data Responsibilities

The Chief Scientist, working with the crew of the RONALD H. BROWN, is responsible for providing adequate opportunity for participants to acquire relevant datasets with their instruments. However, each participant is responsible for quality control, archiving, and data accessibility of data to other participants.

The Chief Scientist is responsible for dissemination of data to nations in whose EEZ data are acquired and requested. The Chief Scientist will furnish the ship a complete listing of all data gathered by the primary scientific party, detailing types and quantities of data.

The Chief Scientist will receive all original data gathered by the ship for the primary mission, and this data transfer will be documented on NOAA form 61-29. The ship will assist in copying data and reports insofar as facilities require. Individuals in charge of piggyback projects conducted during the cruise have the same responsibilities for their project's data as the Chief Scientist has for the primary project.

The Commanding Officer is responsible for all data collected for ancillary projects until those data have been transferred to the project's principal investigators or their designees. Data transfers will be documented on NOAA Form 61-29. Copies of ancillary project data will be provided to the Chief Scientist when requested. Reporting and sending copies of ancillary project data to NESDIS (ROSCOP) is the responsibility of the program office sponsoring those projects.

4.2 Data Requirements

The Chief Scientists will request that the following ship's data be provided to the to him:

Calibration information for ship's instruments

Marine Operations Abstract (MOA)
Deck weather log and SEAS log sheets
ADCP digital recordings
SCS on CD-ROM

4.3 Ship Operation Evaluation Report

The Chief Scientist will complete the Shipboard Operations Evaluation Form and forward it to Director, Office of Marine and Aviation Operations (OMAO) within 20 days of the completion of the cruise.

4.4 Pre- and Post-cruise meetings

A pre-cruise meeting between the Commanding Officer and the Chief Scientist will be conducted either on the day before or the day after departure, with the purpose of identifying day-to-day project requirements, in order to best use shipboard resources and identifying overtime requirements. A post-cruise meeting between the Chief Scientist and the CO will be held at the conclusion of operations.

4.5 Foreign Research Clearance Reports

Requests for research clearance in Foreign waters (Ecuador and Chile) have been submitted by NOAA Corps to the U.S. Department of State on behalf of the Chief Scientist for the EPIC2001 mission. Copies of clearances received will be provided to the CO before departure. The chief scientist is responsible for satisfying the post-cruise obligations associated with diplomatic clearances to conduct research operations in foreign waters. These obligations consist of (1) submitting a “Preliminary Cruise Report” immediately following the completion of the cruise involving research in foreign waters, due at OMAO within 30 days, (2) ultimately meeting the commitments to submit data copies of the primary project to the host foreign countries, and (3) satisfying any additional reporting requirements stipulated in the final research clearance.

5.0 ADDITIONAL PROJECTS

Any additional work will be subordinate to the primary project and will be accomplished only with the concurrence of the Commanding Officer and the Chief Scientist(s).

5.1 Supplementary ("Piggyback") projects:

5.1.1 Underway Measurements in support of Global Carbon Cycle Research (GCC)

5.1.1.1 Request: As part of the ongoing research to quantify the CO_2 uptake by the world's oceans we have installed underway systems on RHB. On many cruises we request bunk space for one scientist of our laboratories to maintain the many systems outlined below. If we cannot send a dedicated person we try to have a scientist of the specific scientific party look after the Underway pCO2 system (described in section A4 below). On some cruises we are unsuccessful in attracting a volunteer and would like to use the services of the survey technician for the Underway pCO2 system only. After initial start-up, which requires about one hour of monitoring, the system needs checking twice a day requiring a total of about 20-minutes. We would also request weekly data downloads and transmission such that we can perform on shore near-real-time quality control to assess if the instrument is operating satisfactorily. All costs of the email transmissions and survey technician overtime would be covered by AOML. The chief survey technician, J. Shannahoff, has operated the instrument before with good results. In the event of system malfunction that cannot be easily repaired, we will ask Mr. Shannahoff to shut the system down. The shoreside leader of the effort, Mr. Robert Castle has interacted closely with J. Shannahoff and feels that this arrangement would work well.

5.1.1.2 Introduction: The underway sensors on RHB will be used in support of the objectives of the Global Carbon Cycle Research (GCC) to quantify the uptake of carbon by the world's ocean and to understand the bio-geochemical mechanisms responsible for variations of partial pressure of CO2 in surface water (pCO2). This work is a collaborative effort between the CO2 groups at AOML and PMEL.

Principal investigators:

Dr Rik Wanninkhof	305-361-4379	wanninkhof@aoml.noaa.gov	AOML
Dr. Richard Feely	206-526-6214	feely@pmel.noaa.gov	PMEL

The semi-automated instruments are installed on a permanent basis in the hydrolab of RHB and are operated by personnel from AOML and PMEL. All work is performed on a not-to-interfere basis and does not introduce any added ship logistic requirements other than the continuous operation of the bow water pump and thermosalinograph. This effort requires one permanent berth for the operator of the systems. The instrumentation is comprised of an underway system to measure pCO2, a SOMMA (single operator multi-parameter metabolic analyzer)-coulometer system to measure total dissolved inorganic carbon, a Turner Designs fluorometer, and a YSI oxygen probe. An oxygen titrator and stand-alone fluorometer will be used to calibrate the underway oxygen and fluorometer, respectively. All the instruments are set up along the port bulkhead and aft bench in the hydrolab.

5.1.1.3 Rationale: Current estimates of anthropogenic CO2 uptake by the oceans range from 1 to 2.8 Gigatons per year. The CO2 fluxes between air and water are poorly constrained because of lack of seasonal and geographic coverage of delta pCO2 (the air-water disequilibrium) values and incomplete understanding of factors controlling the air-sea exchange of carbon dioxide. Seasonal and temporal coverage can be increased dramatically by deploying pCO2 analyzers on ships.

The effort on RHB is expanded beyond the historical scope of the underway programs by incorporating additional sensors to improve our understanding of the factors controlling pCO2 levels.

5.1.1.4 Sensor Suite and Maintenance:
A. Underway pCO2 system
This system consists of a large (40-liter) air-water equilibrator requiring an unobstructed drain at floor level for the 15 L/min outflow, an infrared analyzer with valves and flow meters, and a computer controlling the operating sequence and which also logs the data. The underway pCO2 system is an integrated package for measurement of pCO2 in air and water and support sensors necessary to reduce the data (such as equilibrator temperature, location, salinity, sea surface temperature and barometric pressure). This system is an upgrade from the initial systems and requires routine checks at 6-12 hour intervals, including logging of mercury thermometers in the equilibrator.

B. Oxygen sensor
This is a compact pulsed electrode unit that also contains a temperature sensor. This is a new sensor built by Dr. Langdon at LDEO. Water requirement is 2-Liter/minute with a bench top drain. One foot of bench space is required. During this cruise the data will be validated against samples taken four time a day and analyzed by potentiometric winkler titrations

C. Turner Designs Fluorometer
This instrument, which was jointly purchased by AOML and MOC-A for BALDRIGE, requires a water throughput of about 5 L/min. Periodic cleaning of the flow through cell (2-14 days) is required. The signal of the fluorometer is logged on the shipboard SCS system or on the computer logging the underway pCO2 data. Aliquots of seawater are extracted twice per day and analyzed for chlorophyll and phaopigments on a separate fluorometer following routine procedures to calibrate the fluorometer signal. This information will be particularly useful to extrapolate the observations from the NASA SeaWiFS satellite to in situ pigment concentrations.

5.1.1.5 Summary - Ship infrastructure support:
1. Continuous seawater supply: 20 lpm minimum, 40 lpm maximum for instruments, and 75 lpm throughput to assure short residence time of water in line and minimal heating.

2. Access to TSG and SCS data: Temperature at intake, salinity from TSG, fluorometer signal, wind speed (true and relative), wind direction (true and relative), time, latitude, longitude, and ship speed.

3. Bench space, hydrolab space, access to bow water line and drains.

Specific questions should be directed to:
Robert Castle, phone 305-361-4418, castle@aoml.noaa.gov

5.2 NOAA Fleet ancillary projects:

Ancillary tasks will be accomplished in accordance with the NOAA Fleet Standing Ancillary Instructions.

6.0 HAZARDOUS MATERIALS

The RONALD H. BROWN will operate in full compliance with all environmental compliance requirements imposed by NOAA. All hazardous materials and substances needed to carry out the objectives of the embarked science mission, including ancillary tasks, are the direct responsibility of the embarked designated Chief Scientist, whether or not that Chief Scientist is using them directly. The ship's Environmental Compliance Officer (ECO) will work with the Chief Scientist to ensure that this management policy is properly executed, and that any problems are brought promptly to the attention of the Commanding Officer.

All hazardous materials require a Material Safety Data Sheet (MSDS). Copies of all MSDSs shall be forwarded to the ship at least two weeks prior to sailing. The Chief Scientist shall have copies of each MSDS available when the hazardous materials are loaded aboard. Hazardous material for which the MSDS is not provided will not be loaded aboard.

The Chief Scientist will provided the Commanding Officer with an inventory indicating the amount of each hazardous material brought onboard, and for which the Chief Scientist is responsible (see APPENDIX F). This inventory shall be updated at departure, accounting for the amount of material being removed, as well as the amount in science operations and the amount being removed in the form of waste.

The ship's dedicated HAZMAT Locker contains two 45-gallon capacity flam cabinets and one 22-gallon capacity flam cabinet, plus some available storage on deck. Unless there are dedicated storage lockers (meeting OSH/NFPA standards) in each van, all HAZMAT, except small amounts for ready use, must be stored in the HAZMAT Locker.

The scientific party, under supervision of the Chief Scientist, shall be prepared to respond fully to emergencies involving spills of any mission HAZMAT. This includes providing properly-trained personnel for response, as well as the necessary neutralizing chemicals and clean-up materials. Ship's personnel are not first responders and will act in a support role only in the event of a spill. The Chief Scientist will provide the Commanding Officer a list of science party members that are properly trained to respond in the event of a HAZMAT spill.

The Chief Scientist is directly responsible for the handling, both administrative and physical, of all scientific party hazardous wastes. No liquid wastes shall be introduced into the ship's drainage system. No solid waste material shall be placed in the ship's garbage.

7.0 RADIOACTIVE ISOTOPE POLICY

No radioactive isotopes will be used on this cruise.

8.0 MISCELLANEOUS

8.1 Scientific Berthing: The Chief Scientist is responsible for assigning berthing for the scientific party within the spaces approved as dedicated scientific berthing. The Ops Officer will send stateroom diagrams to the Chief Scientist showing authorized berthing spaces. The Chief Scientist is responsible for returning the scientific berthing spaces in the condition in which they were received; for stripping bedding and for linen return; and for the return of any room keys, which were issued. Only one set of linens/towels are provided to embarked personnel; the scientific complement is responsible for laundering their own linen and towels during the cruise.

8.1.1: The Chief Scientist is responsible for the cleanliness of the berthing and laboratory spaces and storage areas used by the science party, both during the cruise and at its conclusion prior to departing the ship.

8.1.2: In accordance with NC Instruction 5355.0, dated 16 August 1985, and other guidance regarding controlled substances aboard NOAA vessels, all persons boarding NOAA vessels give implied consent to conform with all safety and security policies and regulations which are administered by the Commanding Officer. All spaces and equipment on the vessel are subject to inspection or search at any time.

8.2 Medical Forms: The *NOAA Health Services Questionnaire* must be completed in advance by each participating scientist. The questionnaire will be sent out by the Chief Scientist and should be returned to the ship's medical officer in a separate, sealed envelope marked with the participant's name, cruise number and cruise dates. It should reach the ship no later than 4 weeks prior to the cruise to allow time to medically clear the individual, to request more information if needed, and to prepare for special circumstances. In order to ensure that all NHSQs are reviewed in a timely manner, medical forms which have not reached the ship prior to the 4 week deadline (e.g., scientist added late) should be faxed to the ship (via INMARSAT if underway) for review and clearance well before the cruise. All personnel are required to meet the NOAA Physical/Health Standard as specified in the NOAA Fleet Medical Policy Manual. If there are any questions about eligibility, individuals can directly contact *Ronald H. Brown*'s medical officer (e-mail: Medical.Ronald.Brown@noaa.gov) or MOC Health Services. All personnel must bring with them prescription and routine, over-the-counter medication (e.g. an aspirin a day). Supplies on board are limited, and chances to restock are few.

8.2.1 Emergency Contacts: Prior to departure, the Chief Scientist must provide a listing of emergency contacts to the Executive Officer for all members of the scientific party, with the following information: scientist's name, emergency contact's name, address, relationship to scientist, telephone number and e-mail address (if available).

8.2.2 Foreign Port Customs Information: The Chief Scientist will provide a list of Foreign Port Customs Information (Passport number, DOB, POB) for all members of the science party.

8.3 Shipboard Safety: Wearing open-toed footwear or shoes that do not completely enclose the foot (such as sandals or clogs) outside of private berthing areas is not permitted. Steel-toed shoes are required to participate in any work dealing with suspended loads, including CTD deployments and recovery. The ship does not provide steel-toed boots. Hard hats are also required when working with suspended loads and will be provided by the ship when required. Work on top of vans while the ship is underway or station-keeping will require personnel to wear safety harnesses and be properly tethered. A limited amount of safety harnesses will be provide by the ship. Personnel doing work on top of vans should notify the bridge to obtain permission and to indicate when work has been safely completed. The Chief Scientist is responsible for the scientific party’s compliance with these regulations.

8.4 Communications: The Chief Scientist or designated representative will have access to ship's telecommunications systems. Direct payment (e.g. by credit card) to the communications provider (e.g. the telephone company) shall be used as opposed to after-the-fact reimbursement. Specific information on how to contact *Ronald H. Brown* and all other fleet vessels can be found at http://www.moc.noaa.gov/phone.htm.

R/V Ronald H. Brown communication information:

Home Port (Charleston, SC):(When in port, numbers will be provided)
Inmarsat A: 1
011-872-154-2643 (Voice)
011-872-154-2644 (Fax)
Inmarsat B: 1
011-OAC-336-899-620 VOICE (yes a 9-digit number)
-336-899-621 FAX
Ocean area code (OAC) is 874 Atlantic and 872 Pacific; normally switches to Atlantic East of 95 W.
Inmarsat Mini-M: 1
011-872-761 831 360 (Voice)
Cellular:
757-635-0678 (Ship)
206-910-3584 (OOD)
206-910-8152 (CO)
206-910-0184 (CME)
E-mail Address: Noaa.Ship.Ronald.Brown@noaa.gov

8.4.1 E-mail Policy: Standing Order 9.21-1: In recent years the proliferation of electronic mail (e-mail) and the reduction of INMARSAT costs have permitted the sending of nominal amounts of personal e-mail when transmitted with official ship's business. A complimentary amount of personal use will be permitted for all personnel aboard. Shipboard e-mail accounts will be provided. Downloads and uploads are made twice daily.

8.4.1.1: Each person will be allowed $45 per month for e-mail transmission costs. There is no provision for payment to a person who does not utilize the complimentary amount.

8.4.1.2: It should be understood that the cost of personal e-mail being transmitted from shore to an individual aboard ship will be charged against that individual's complimentary amount. A detailed billing statement will be issued periodically to any individual or Chief Scientist whose costs have exceeded his or his group's monthly entitlement. All costs in excess of an individual's or group's complimentary amount must be reimbursed. When personal use cannot be easily distinguished from official business, the amount of reimbursement will equal the total cost minus the complimentary amount. Each embarked person will have an e-mail account/address established in his/her name by the Lead Electronic Technician (LET) at the time of arrival.

8.4.2 Satellite Communications: Standing Order 9.21-2: INMARSAT-B (voice and fax) and INMARSAT-M (voice) communications are available aboard ship and may be used for personal or business-related calls so long as the caller makes arrangements to pay for the calls via credit card. INMARSAT calls can be extremely expensive and the exact cost may not be known until you receive your bill. Brevity is encouraged. See the Lead Electronic Technician (LET) for any questions regarding the use of these phones.

8.4.2.1 Ship Phone Services: Standing Order 9.21-3: Routine incoming non-emergency phone calls are discouraged. Use e-mail communications for this purpose. In an emergency, embarked personnel can be contacted by phone. Phone numbers for the Ronald H. Brown can be found at http://www.moc.noaa.gov/phone.htm#RB.

8.4.2.2 INMARSAT-B: For high-speed data transmission, including FTP, and high quality voice telephone communications. Costs range from $5-$11 per minute for use of the service, and may be charged to credit card or called collect.

8.4.2.3 INMARSAT MINI-M: For voice telephone communications and 2400 baud data transfer. Cost is about $3 per minute to the US and may be charged to credit card, collect or otherwise reimbursed. Mini-M coverage is by spot beam and may not be available in all the areas the ship may be working in.

8.4.2.3.1 Messages: can also be left with the Marine Operations Center-Atlantic, Norfolk, Virginia, at (757) 441-6206 or the Marine Operations Center-Pacific, Seattle, Washington at (206) 553-4548. After hours and on weekends and holidays, an answering service will relay a message to the appropriate duty officer.

8.4.3 Ship's Mail: Standing Order 9.22: Incoming letters and packages can be sent to embarked members of the ship's operating crew and scientific complement by addressing them to:

Name
NOAA Ship RONALD H. BROWN
Marine Operations Center - Pacific
1801 Fairview Ave. E.
Seattle, WA 98102

Mail received at the Marine Operations Center will be periodically forwarded to the ship's next port of call. When the ship is on a foreign deployment, senders are encouraged to mail letters and packages earlier to ensure delivery. Be advised that some foreign customs authorities routinely open and inspect incoming mail. Arrangements for ship's outgoing mail will be made on the morning of departure. In foreign ports, mail must have US postage affixed as it will be boxed and overnight-expressed to the Marine Operations Center-Atlantic where it will enter the US postal system. US postage stamps are not routinely available aboard ship.

8.5 Port Agent Services/Billing: Contractual agreements exist between the port agents and the commanding officer for services provided to NOAA Ship *Ronald H. Brown*. The costs or required reimbursements for any services arranged through the ship's agents by the scientific program, which are considered to be outside the scope of the agent/ship support agreement, will be the responsibility of that program. Direct payment shall be arranged between the science party and port agent.

AGENTS:

In U.S.:
None

In Galapagos
Not arranged

In Arica, Chile:
Inchcape Shipping Services S.A.
Jaime Otero
Arturo Prat 834 0f 201
Valparaiso
Chile
Phone: 56-32-217-681
Fax: 56-32-239-632
Telex: 230326 ISS ISS CL
E-mail: issvap@isschile.co.cl
or jotero@isschile.co.cl

*Shipping details should be CC'ed to the ship's CO and FOO
The ship's commanding officer, Captain Donald Dreves:

Donald_A_ Dreves%BROWN@ccmail.rdc.noaa.gov

The ship's Field Operations Officer, LT Robert Kamphaus:

FOO%Brown@ccmail.rdc.noaa.gov

8.6 Wage Marine Working Hours and Rest Periods

The Chief Scientist shall be cognizant of the reduced capability of the RONALD H. BROWN's operating crew to support 24-hour mission activities. Wage marine employees are subject to negotiated work rules contained in the applicable collective bargaining agreement. Dayworkers' hours of duty are a continuous eight-hour day, beginning no earlier than 0600 and ending no later than 1800. It is not permissible to separate such an employee's workday into several short work periods with interspersed non-work periods. Dayworkers called out to work between the hours of 0000 and 0600 are entitled to a rest period of one hour for each such hour worked. Such rest periods begin at 0800 and will result in such a dayworker being unavailable to support science operations until the rest period has ended. All wage marine employees are supervised and assigned work only by the Commanding Officer or his/her designee. The Chief Scientist and the Commanding Officer shall consult regularly to ensure the shipboard resources available to support the science mission are utilized safely, efficiently, and in accordance with the above policies.

8.6 Laser Safety

Two laser systems will be operated during this cruise.

8.6.1 Laser Radiation Internal to the Mini-MOPA System:

10.6 micron laser
632 nm (HeNe) alignment laser (not transmitted outside of seatainer)
Transmitted Radiation (10.6 microns):
Transmitted laser is invisible and completely eye-safe at exit of scanner and out to all ranges for the unaided eye and with any telescopes, binoculars etc. There are no health risks associated with the transmitted radiation.

8.6.2 Vaisala CT-25K laser ceilometer.

0.94 micron laser
Transmitted laser is invisible and consider eyesafe because of low power level. It is safe to look into the optics, but should not be viewed with any magnification (optics, binoculars., etc).

8.7 Other

The ship's mess will accommodate as possible the following meal requirements among the scientific crew: 1 x lactose intolerance.

The University of Washington and Colorado State University equipment will be loaded in Seattle, WA prior to the start of the EPIC cruise. The UW/CSU equipment will be offloaded in Charleston, SC after the TAO cruise following the EPIC cruise.

9.0 APPENDICES

APPENDIX A
Functions of Investigator and Ship Measurement Sytems

Instrument	Comments	Org./Person
Surface Meteorology	T, P, q, V, 0.01 to 10 min average, Multiple Locations	ETL Ship/ Tech
Ceilometer	Vaisala, 7.6 km max altitude, Not Stabilized, Stares Up	ETL
Radiosondes	2-8 daily, 20 mbar max altitude	CSU, UW Ship/Tech
Radar Wind Profiler	0-3, 0-16 km modes, Stabilized	ETL
Surface Flux Sensors	Heat, Momentum, Moisture, CO_2	ETL CSIRO
Sea Surface Temperature	Skin (IR), 10 cm, 5 m	CSIRO Ship/Tech
K_a-Band Cloud Radar	35 GHz (8.6 mm), 20 km max alt., Doppler, Not Stabilized, Stares Up	ETL
C-Band Precipitation Radar	6 GHz (5 cm), Scanning, Doppler, Stabilized	CSU, UW Ship/ET
Water vapor Lidar	DIAL, 3-5 km max alt., Stabilized, scanning	ETL
Wind Profiling Lidar	Doppler, 3-5 km max alt., Stabilized, Scanning	ETL
2-Ch Microwave Radiometer	Column water, liquid and vapor, Not Stabilized, Stares Up, Tip Cals	ETL
Infrared Radiometer PRT-5	11 mic, Sky Brightness & Cloud Base Temperatures	ETL
Aerosol Samplers	CN, size spectra, composition, SO2, DMS, DMSP	UNAM/NCAR

Satellite Receiver	GOES, NPOES, GMS, SeaWiFs, METEOSAT, WEFAX	ETL Ship/Tech.
Radiative Fluxes	Visible, IR, Direct, Diffuse IMET, BNL PRP	ETL Ship/Tech
Rain Gauges	Bucket and STI optical	ETL, CSIRO Ship/Tech
CO_2 Sensors	AOML/Wanninkhof dPCO_2 WHOI and ETL Fast CO_2	PMEL ETL
Microstructure Profiler	Temperature, Salinity, velocity profiles, 0.2-1.0 km max. depth	UW/APL
Optical/Biological Profiler	Radiation/ scattering profiles, 0.5 km max depth.	UCSB
Navigation, Ocean Sensors	Ship's Instruments, SCS	Ship/Tech
Ship's ADCP	Ocean current vector	UW/APL, UCSB
CTD, Bottles	Ocean T and Salinity profiles	UW/APL, UCSB
Ship's Thermosalinograph	Ocean surface T and S	Ship/Tech.

APPENDIX B
Equipment/Van List

1) **Portable Radiation Pack.** (DOE/BNL)
   - WT: 50 lbs
   - SIZE:1'L x 2'W x 1'H
   - PWR: 12 VDC
   - SITE: 02 Deck

2) **Cloud-Rad-FTIR Van** (NOAA/ETL)
   - WT: 15,000 lbs
   - SIZE: 20'L x 8' W x 8'H
   - PWR: 480 VAC, 3 phase 30 amps
   - SITE: 02 Forward, Port Outboard

3) **Ceilometer** (NOAA/ETL)
   - WT: 100 lbs
   - SIZE: 18"L x 18"W x 4' H
   - PWR: 120 VAC single phase 6 amps
   - SITE: 02 Aft, Port

4) **Flux System** (NOAA/ETL)
   - WT: 200 lbs
   - SIZE: 2'L x 1'W x 2'H
   - PWR: 120 VAC single phase 8 amps
   - SITE: Various, incl. Jackmast & Bow Tow.

5) **MiniMOPA Lidar Van** (NOAA/ETL)
   - WT: 15,000 lbs
   - SIZE: 20'L x 8'W x 8'H
   - PWR: 480 VAC 3-phase 30 amps
   - SITE: 02 Forward, TBD TBD

6) **Aerosol Sensor** (UNAM/NCAR)
   - WT: 200 lbs
   - SIZE: 3'L x 2'W x 3'H
   - PWR: 120 VAC 15 amps
   - SITE: Bow Tower

7) **Storage Van** (WHOI)
   - WT: 20,000 lbs
   - SIZE: 20'L x 9'W x 8'H
   - PWR: None
   - SITE: Fantail, Port

8) **Storage Van** (WHOI)
   - WT: 20,000 lbs
   - SIZE: 20'L x 8'W x 8'H
   - PWR: (not in use)
   - SITE: fantail, port

9) **Storage Van** (UW/APL)
   - WT: 10,000 lbs
   - SIZE: 20'L x 8'W x 8'H
   - PWR: (not in use)
   - SITE: Fantail, TBD

10) **Storage TAO Mooring Stuff** (NOAA/PMEL)
   - WT: 12,000 lbs
   - SIZE: 20'L x 8'W x 8'H (approx)
   - PWR: NA
   - SITE: 01 Aft, Port, Inboard

11) **MMP Winch** (UW/APL)
   - WT: 1,000 lbs
   - SIZE: 3'L x 8'W x 1'H
   - PWR: 120 VAC
   - SITE: Fantail, aft

12) **SPMR Winch** (UCSB)
   - WT: 100 lbs
   - SIZE: 2'L x 2'W x 1'H
   - PWR: 120 VAC
   - SITE: Fantail, aft

Below is a summary of responses from different groups on their plans for deploying seatainers on the EPIC2001 cruise:

Cloud radar/microwave radiometers	02 Forward	15,000 lbs	ETL	D. Hazen
M-MOPA lidar	02 Forward	15,000 lbs	ETL	R. Newsom
Microstructure staging/storage	main, aft	13,500 lbs	UW	J. Miller
Mooring gear	main, port	20,000 lbs	WHOI	J. Lord
Mooring gear	main, port	20,000*lbs	WHOI	J. Lord

*if deployed 02 forward, will be 10,000 lbs

These plans call for only 2 containers on 02 forward. There will be 3 containers on the main deck; 2 in the regular port location and one (the UW) near the crane aft. This list does *not* include Chris Beaverson's stuff for the regular TAO maintenance out of Chile or the stuff for the repairs at 8,10,12 N.

APPENDIX C
Van and Instrument Positioning Issues

The Cloud-Rad-FTIR van (#2) needs a clear vertical plane through which it can scan from horizon to horizon through the zenith. No cables (signal or power) should interrupt the side-to-side vertical scanning -- they should be run along the deck. Its scanning disc system extends from about 6" to 6' from the aft end of the 20' van. The 02 deck port was used successfully on the fall 2000 TAO tender cruise. It also needs 3' clearance on its port side, to open a door and to mount the FTIR.

The Lidar van (#5) has air conditioning units that stick out from the side. It probably will not be possible to place another van close enough to use the regular mounts on the 02 deck. One solution is to use the deck mount offsets built for the RHB for the Nauru99 cruise.

The BNL Radiation Package was deployed on the 02 deck forward and is supplied with 12 VDC power by the ship.

The AOML dPCO2 system will be operated throughout the cruise. X cylinders of zero-air compressed gas will be loaded in Seattle for calibration of the LICOR CO2 sensors.

100 cylinders of helium will be loaded in pallets in Seattle.

The Ceilometer is a small instrument that stares vertically; it can be mounted easily within a 2' deck bolt pattern or bolted to a wooden pallet. On recent cruises it has been mounted on 02 deck, aft.

UNAM will be placing an aerosol sampling system on the bow tower. It will consist of a rack about 3 by 2 by 3 ft. If there is not room on the top section (port side), then it may need to go on a lower section. This will be decided in Seattle.

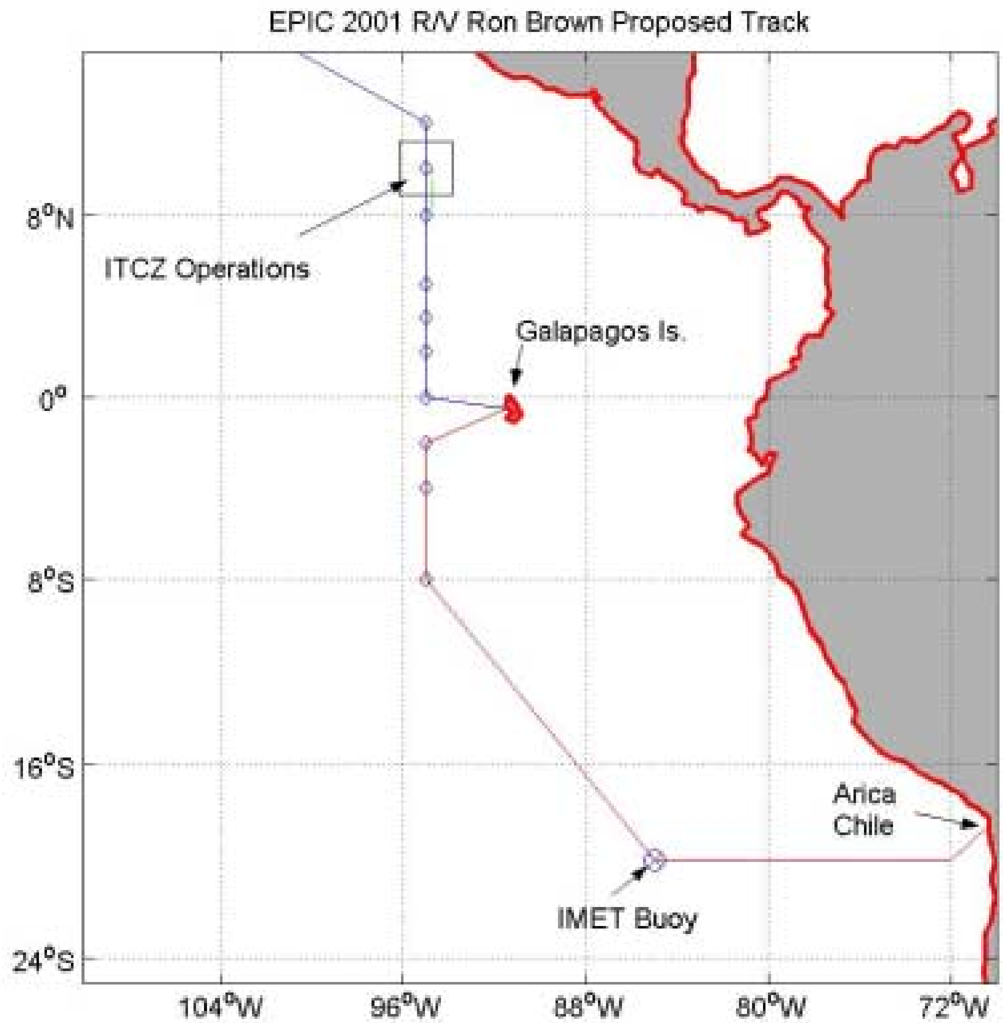
CSU will mount an electric field sensing instruments. The list is as follows:

1. (1) slow antenna with dimensions of ~ 1 ft^3;
2. (1 or 2) optical detectors, each with dimensions of ~ 1 ft^3
3. (1) field mill with dimensions of ~ 10 ft^3.

In terms of installation on the ship, the ideal situation would be to put these instruments in an area with the least amount of superstructure obstruction as possible so they get a good view of the sky in all directions. Our thinking was that the 05 deck or the bow tower might be good candidate positions. The equipment listed above will require the installation of a gain switching box (~ 2 ft^3) for (1) and (2) and PC (~6 ft^3) for data recording of (3). We would like to install the gain switching box and data recording PC in the Bio lab with our other radar and sounding equipment. We anticipate checking the detectors, antenna and field mill once per day to make sure everything is working OK - other than that, they should run more or less on auto pilot.

The ETL flux system was installed in San Diego in October 2000. It consists of five components. (1) A fast turbulence system with ship motion corrections will be mounted on the jackstaff using the same method as the GASEX-01 cruise. The sensors are: Sonic anemometer, IR-hygrometer, IR-CO_2/hygrometer, motion-pak, mean T/RH sensor in aspirator. At least six cables of various thicknesses have been run for logging the data in the Elect. Lab. (2) A Li-Cor 6262 fast CO_2/hygrometer may be mounted on the bow tower with a sample tube run to the sonic anemometer. (3) Solar and IR radiometers (Eppley pyranometer/pyrgeometer) will be mounted on the top of the bow tower. (4) A near surface sea surface temperature measurement will be made with a floating thermistor deployed off port side with outrigger. (5) A narrow-band IR thermal radiometers (mounted on the bow tower) will be used to measure the interfacial sea surface temperature.

APPENDIX D
Ship Track



[Chartlet #1: EPIC2001 Leg I and LegII cruise track]

APPENDIX E
Fast SCS Data Stream Requested by ETL

Ship SCS data message for RS-232 output (2s) for ETL.

002 - PCODE_TIME (HHMMSS)
003 - PCODE_LAT (DEGMIN)
004 - PCODE_LON (DEGMIN)
009 - PCODE_COG (Degrees)
010 - PCODE_SOG (Knots)
050 - TSG_Unit_Temp (Degrees_C)
052 - TSG_Salinity (PPT)
066 - Barometer (MB)
075 - Precip5-port03 (mm/hr)
080 - Imet-Rain (mm)
082 - Imet-Rel_Hum (Percent)
083 - Imet-Temp (Degrees_C)
089 - Imet-ShortWave (Watts-M2)
118 - LRing-Gyro (Degrees)
119 - Odec-Speed-msec (M/SEC)
121 - Imet-TWind1-Speed-MSEC (M/SEC)
122 - Imet-Twind1-Dir (Degrees)

APPENDIX F
Hazardous Materials List

UCSB, contact Carter Ohlmann
Acetone: 10 liters
HCl: 2 liters

UW, contact Sandra Yuter
Methylene blue dye: 20 g

CSU, contact Rob Cifelli
Mercury in thermometers

UNAM, contact Darrel Baumgardner
Butanol (4 liters)
Acetone (2 liters)
mercuric chloride (1 liter)
lugol acetate (1 liter)
KOH

Liquified gases:

ETL, contact Janet Intrieri, ETL
LN2 container: 640 liters

Compressed gases:

Hydrogen for UNAM: 1 10-liter bottle
Helium for sondes: 100 bottles
Zero-air: 4 cylinders from WHOI/ETL

APPENDIX G

Figures

EPIC 2001 Cruise: Radar Meteorology Science Network Components
Revised Draft 20 July 2001, S. E. Yuter, University of Washington