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# Proceedings

INMARTECH2002

JAMSTEC

## Acknowledgements


Hiroyasu Momma, Chair
INMARTECH2002 Local Organizing Committee

Shozo Tashiro, Secretary General
INMARTECH 2002 Secretariat




It is our great pleasure to report that we have finished the INMARTECH 2002 with great success. First of all, we would like to express our sincere acknowledgement to the three members of the international Steering Committee, Ms. Marieke Riedveld of Royal NIOZ, Mr. Edward Cooper of SOC, Mr. Barrie Walden of WHOI, for their great support and contribution in organizing this workshop.

The INMARTECH 2002, International Marine Technicians Workshop, was held from October 7th to 11th at JAMSTEC Yokosuka Headquarters for 5 days. It was the first time for INMARTECH to be held in the Asia and Western Pacific Region since it began in 1996 in Southampton, United Kingdom. In spite of the location, we received the largest numbers of participants ever, 169 guests to JAMSTEC, Yokosuka. Furthermore, it was significant topic for the future advancement of the INMARTECH that we had guests from 2 Asian countries, Taiwan and Korea for the first time.

Finally, we would like to express our sincere gratitude to all the participants from within and outside the countries for the excellent presentation and vigorous discussion, especially to the oversea guests for visiting Japan.

Also, we are so grateful to the staff members of three family companies, NME, MWJ, GODI, and of course, the members of JAMSTEC, for their great support and contribution in this workshop.

Thank you very much.

# PROGRAMME, 7-11 October, 2002

INMARTECH2002

**Japan Marine Science &Technology Center (JAMSTEC) Yokosuka Japan**

**Click the blue-title to jump straight to the data of the presentation you are interested in.**

**Monday 7 October:**

Arrival of participants, check-in at the front desk of Yokohama Bay Sheraton Hotel, by yourselves.

**17:00~18:30**

Registration for INMARTECH2002 with application for Lunch, Banquet, and excursion at the registration desk in front of the Room Nichirin. On 5th floor.

(We can only accept Japanese Yen, No foreign currency or credit card acceptable)

**18:30~20:00**

***************ICE BREAKER PARTY**************

**Yokohama Bay Sheraton Hotel at Room Nichirin**

**Tuesday 8 October**

**08:01** Yokohama Station (Limited Express, Keikyu Line) and **08:08**

**08:30** Oppama Station

*Shuttle service from Oppama Station to JAMSTEC is available at 8:30 and8: 40*

**09:00~09:10 WELCOME and OPENING ADDRESS**

Hiroyasu Momma, director of Research Support Department, JAMSTEC

**09:10~0930 History of INMARTECH**

Marieke J Rietveld, Netherlands Institute for Sea Research (NIOZ)

**09:30~10:30 Oral Session 1 (General Session)**

**(2-b) Long term monitoring**

*Chair*: Hans W. Gerber / TFH Berlin

: Koichi Takao / Marine Works Japan Ltd.

- **An approach for Mobile and real-time observation on the seafloor**

Katsuyoshi Kawaguchi / JAMSTEC

- **Abyssal Operation in the Inner Space for Geophysical Observatories and Biotechnology -MODUS (Mobile Docker for Underwater Sciences) for the European Research Projects GEOSTAR, BIODEEP and others**

Hans W. Gerber / TFH Berlin

**10:30~10:50** ***Coffee Break***

**10:50~12:50 Oral Session 2 (General Session)**

**(2-b) Long-term monitoring**

*Chair*: Hans W. Gerber / TFH Berlin

: Koichi Takao / Marine Works Japan Ltd.

- **Use of sediment profile imagery for the in situ observation of invertebrate infauna**

Martin Solan / Ocean Laboratory, University of Aberdeen

- **Deep-Sea current meter moorings : a review of hydrodynamic aspects and design criteria**

Anders Tengberg / Goteborg University

- **Operation of TRITON buoy array I. Problems due to human activities**

Toru Nakamura / JAMSTEC

- **Operation of TRITON buoy array II. Maintaining, deploying, recovering and repairing of TRITON buoys**

Masayuki Fujisaki / Marine Works Japan Ltd.

**12:50~13:50** ***Luncheon***

**13:50~14:50 Poster Session 1**

**14:50~15:30 Keynote Speech 1**

- **Around the Southern Hemisphere Hydrographic Navigation of R/V MIRAI**

Hiroshi Uchida / JAMSTEC

**15:30~17:00 Oral Session 3 (Parallel session)**

**(1-c) Geophysical Observation Technology**

*Chair*: Char-Shine Liu / National Taiwan University

: Takeshi Matsumoto / Nippon Marine Enterprises Ltd.

- **Multibeam Systems On An Ice Strengthened Vessel**

David Blake / British Antarctic Survey

- **Seafloor gravity measurement by use of manned submersibles**

Takeshi Matsumoto / Nippon Marine Enterprises Ltd.

- **Seismic data acquisition for gas hydrate investigation**

Char-Shine Liu / Oceanography, National Taiwan University

**(1-d) Sampling Technology**

*Chair*: Kazuhiro Kuroki / JAMSTEC

: Motoyuki Miyamoto / Marine Works Japan Ltd.

- **Evaluation of Quality of Sediment Cores : Comparison of Core Samples obtained by the Different Type Cores**

Ken Ikehara / Geological Survey of Japan, AIST

- **Conceptual Design Study for a New Long Coring System**

James E. Broda / Woods Hole Oceanographic Institution

- **Core Sampling Technology used on scientific drill ships**

Kazushi Kuroki / JAMSTEC

**17:00~17:20** ***Coffee Break***

**17:20~18:20 Oral Session 4 (Parallel Session)**

**(1-c) Geophysical Observation Technology**

*Chair*: Char-Shine Liu / National Taiwan University

: Takeshi Matsumoto / Nippon Marine Enterprises Ltd.

- **Developing new OBS**

Makoto Ito / Nippon Marine Enterprises Ltd.

- **Improvement of Air Gun Array's width for a quasi-3D Multi-Channel Seismic Survey by single streamer cable**

Shinichi Hosoya / Nippon Marine Enterprises Ltd.

**(1-d) Sampling Technology**

*Chair*: Kazushi Kuroki / JAMSTEC

: Motoyuki Miyamoto / Marine Works Japan Ltd.

- **A new way of oceanographic watersampling**

S. Ober / Royal Netherlands Institute for Sea Research (NIOZ)

- **Zooplankton Sampling Technology in Southern Africa**

Tembaletu Tanci / Marine and Coastal Management

**18:20** ***Adjourn***

Shuttle service from JAMSTEC back to Oppama station is available at 18:35, 19:05, 19:35, every 30 minutes until 21:05.

## Wednesday 9 October

**09:00~11:00 Oral Session 5 (General Session)**

**(2-a) Manned and Unmanned Vehicle**

*Chair*: Edward Cooper / Southampton Oceanography Centre

: Taro Aoki / JAMSTEC

- **United States Deep Submergence National Facility -Alvin, Jason II and ABE**

  Barrie Walden / Woods Hole Oceanographic Institution

- **Research on the improvement of propulsion maneuvering system of Shinkai 6500 with experimental thrusters and automatic motion control**

  Takuya Shimura / JAMSTEC

- **Compact, large capacity lithium iron battery for Shinkai 6500**

  Shinichi Suzuki / JAMSTEC

- **Borehole Re-Entry / Observatory Deploy ROV "Benkei"**

  Masanori Kyo / JAMSTEC

**11:00~11:20** ***Coffee Break***

**11:20~12:00 Keynote Speech 2**

**Unique Applications of ROV's in the Historic Salvage Effort of the F/V EHIME MARU**

Gregg W. Baumann / US. Navy

**12:00~13:00** ***Luncheon***

**13:00~14:00 Poster Session 2**

**14:00~16:00 Oral Session 6 (General Session)**

**(2-a) Manned and Unmanned Vehicle**

*Chair*: Barrie Walden / Woods Hole Oceanographic Institution

: Hiroyasu Momma / JAMSTEC

- **The Deep Sea Research ROVs of the JAMSTEC**

  Toshinobu Mikagawa / JAMSTEC

- **Preliminary Design and Operational Concept of a Deep-sea Unmanned Underwater Vehicle**

  Sea-Moon Kim / Korea Research Institute of Ships & Ocean Engineering

- **Autosub-Past and Future Activities from an Observers' Viewpoint**

  Edward Cooper / Southampton Oceanography Centre

・ **Experiments of an Autonomous Underwater Vehicle "Urashima"**

Satoshi Tsukioka / JAMSTEC

**16:00~16:50** ***Facility Tour (AUV&ROV)***

**16:50~18:20 Oral Session 7 (Parallel Session)**

**(1-b) Meteorological Observation Technology**

**(1-a) Oceanographic Observation Technology**

*Chair*: Shuichi Watanabe / JAMSTEC

: Kimiaki Kudo / Global Ocean Development Inc.

・ **On the calibration equation for the estimation of SSC in the coastal sea from remote sensing data**

Mohammad Rezwanul Islam / Nagoya Univ.

・ **The maintenance and management of Argo floats**

Asako Inoue / Marine Works Japan Ltd.

**(2-c) Ship Operation Technology**

*Chair:* Shinichi Takagawa / JAMSTEC

: Masataka Zaitsu / Nippon Marine Enterprises Ltd.

・ **Handling the 7m AUV Autosub Without the Need for Launching Small Boats**

Peter Stevenson / Southampton Oceanography Centre

・ **Winch Operations and the CLAM SYSTEM (Cable Logging And Monitoring)**

Peter Mason / Southampton Oceanography Centre

・ **Operational Results of Transponder Mooring System Recovery using The Rope Rescue System for "Shinkai 6500"**

Kikuo Hashimoto / JAMSTEC

**18:20** ***Adjourn***

## Thursday 10 October

**09:00~10:00 Oral Session 8 (Parallel Session)**

**(1-a) Oceanographic Observation Technology**

*Chair*: Kimiaki Kudo / Global Ocean Development Inc.

: Atsuo Ito / Marine Works Japan Ltd

- **A USB XBT Interface and Client/Server Approach to XBT Data Acquisition**

  Lindsay Pender / CSIRO Marine Research

- **Accuracy improvement of ADCP mounted on R/V MIRAI**

  Satoshi Okumura / Global Ocean Development Inc.

**(2-c) Ship Operation Technology**

*Chair*: Katsura Shibata / JAMSTEC

: Masataka Zaitsu / Nippon Marine Enterprises Ltd.

- **KYT (Training to predict danger)**

  Kouji Sameshima / Nippon Marine Enterprises Ltd.

- **Ice Navigation**

  Takaaki Hashimoto / Global Ocean Development Inc.

- **Operation of the Hybrid Anti-Rolling System on Board the R/V MIRAI**

  Satoshi Ueda / JAMSTEC

**10:00~10:20 *Coffee Break***

**10:20~12:20 Oral Session 9 (General Session)**

**(3) Data Management**

*Chair*: Kazuhiko Sono / JAMSTEC

: Toshio Tsuchiya / AESTO

- **Noises recorded by MCS system on R/V KAIREI and the trial of the noise suppression processing**

  Tetsuo No / Nippon Marine Enterprises Ltd.

- **Shipboard geological and geophysical observation systems on R/V MIRAI**

  Kazuhiro Sugiyama / Marine Works Japan Ltd.

- **Feasibility Study of Onboard support on the deep-sea research in JAMSTEC**

  Toru Kodera / Nippon Marine Enterprises Ltd.

- **Deep sea image processing of JAMSTEC**

  Jun Naoi / JAMSTEC

**12:20~13:20 *Buffet Luncheon***

**13:20~14:50 Oral sessions 10 (General session)**

**(3) Data Management**

*Chair*: Masao Nomoto / JAMSTEC

: Jun Naoi / JAMSTEC

- **Automated real-time eddy flux measurement system on a cruising ship.**

  Satoshi Takahashi / Okayama Univ.

- **Marine Information and Data Acquisition System**

  Francisco Hernandez / VLIZ (Vlaams Instituut voor de Zee)

- **Marine Technicians in NME -Supporting scientific activities in the JAMSTEC-**

  Misumi Aoki / Nippon Marine Enterprises Ltd.

**14:50~16:10 Facility tour & Tea ceremony at Kaikyu-an**

**16:10~16:20 Invitation to INMARTECH2004**

David Blake / British Antarctic Survey

**16:20~16:30 Closing address**

Masato Chijiya / Executive Director, JAMSTEC

**16:30~**

**Move to the JAMSTEC**

******* **Yokohama Institute for Earth Sciences(YES)** *******

**by a charter bus**

**17:00~18:00**

****************** **Facility tour of YES** ******************

**Earth Simulator & Earth Science Museum**

**18:00~20:00**

*****************

****************** ***Farewell party*** ******************

**at the guest house of YES**

**20:00** ***Adjourn***

Shuttle bus from YES to Yokohama Bay Sheraton Hotel leaves at 8:30.PM

**Friday 11 October**

# Excursion to MeSci
# (National museum of emerging science and innovation)

All transportation is by a JAMSTEC charter bus.

**8:30** **Yokohama Bay Sheraton Hotel**

Sightseeing around Yokohama bay area by bus

**9:00** **International Fleet Review**

Visit Japanese and Chilean Battle ship

**9:30** **Yokohama China Town**

**10:20** **Transport from MM21 area to Yamashita Park by Sea bass**

Walk to Yokohama China Town and visit Chinese Temple

**10:30** **Leave Yokohama China Town to Tokyo**

**11:40** **Arrive at MeSci in Odaiba area**

***Luncheon***

**14:00** **Leave MeSci to Asakusa area**

**14:40** **Asakusa Sensoji-temple**

**16:00** **Leave Asakusa area to the hotel via Akihabara**

**17:30** **Arrive at Yokohama Bay Sheraton Hotel**

**The end of INMARTECH2002**

*You can get off the bus and leave the tour if you have certain place to look around, such as Akihabara, Asakusa, etc, after visiting MeSci

# Poster Session

**All the posters will be available at seminar room during the whole period.**

| **Tuesday 8 October** | | **Wednesday 9 October** |
|---|---|---|
| **13:50~14:50** | **&** | **13:00~14:00** |

## (1-a) Oceanographic Observation Technology

- **Breakage and measure of vessel-mounted ADCP cover**

  Yasutaka Imai / Global Ocean Development Inc.

- **CTD Operation with Three Systems on R/V MIRAI**

  Fujio Kobayashi / Marine Works Japan Ltd.

## (1-c) Geophysical Observation Technology

- **Multibeam Systems on an Ice Strenghtened Vessel.**

  David Blake / British Antarctic Survey

- **Operation methods of MCS on R/V KAIREI**

  Takeshi Katayama / Nippon Marine Enterprises Ltd. Marine Science Dept.

## (1-d) Sampling Technology

- **Chemical analyses of seawater on R/V MIRAI**

  Katsunori Sagishima / Marine Works Japan Ltd.

- **Handling and operation of sediment sampling tools on R/V MIRAI and KAIREI**

  Yutaka Matsuura / Marine Works Japan Ltd.

## (2-a) Manned and Unmanned Vehicle

- **Autosub-Past and Future Activities from an Observers' Viewpoint**

  Edward Cooper / Southampton Oceanography Centre

- **JAMSTEC Deep Tow Systems**

  Naotaka Togashi / Marine Works Japan Ltd.

## (2-b) Long term monitoring

- **Autonomous Operation of Instruments with Flow-through System onboard VOS**

  Naohiko Nakajima / VOS Nippon

- **DOBO: Deep Ocean Benthic Observatory**

  Martin Solan / Ocean Laboratory, University of Aberdeen

- **ROBIO: Robust Biodiversity Lander**

  Martin Solan / Ocean Laboratory, University of Aberdeen

- **FRESP: In situ Fish Respirometer**

  Martin Solan / Ocean Laboratory, University of Aberdeen

- **ISIT Lander: Intensified Silicon Intensifying Target camera for observation of bioluminescence**

Martin Solan / Ocean Laboratory, University of Aberdeen

## (2-c) Ship Operation Technology

- **Oceanographic Ship's Winch Monitoring System**

Lindsay R. MacDonald / CSIRO Marine Research

- **Winch Operations and the CLAM SYSTEM (Cable Logging And Monitoring)**

Peter Mason / Southampton Oceanographic Centre

## (3) Data Management

- **Geophysical data management in JAMSTEC (Bathymetry data management and method of processing)**

Rie Ishii / Nippon Marine Enterprises Ltd. Marine Science Dept.

- **Gravity data management in JAMSTEC**

Masayuki Toizumi / Nippon Marine Enterprises Ltd. Marine Science Dept.

- **Development of database for sediment core samples in JAMSTEC**

Kazuhiro Sugiyama / Marine Works Japan Ltd.

- **Marine Information and Data Acquisition System**

Francisco Hernandez / VLIZ (Vlaams Instituut voor de Zee)

- **Centralized marine instruments data acquisition system onboard R/V OCEAN RESERCHER I**

Shye-Donq Chiu / Oceanography, National Taiwan University

- **Preparation of reference materials for measurement of total carbonate in seawater**

Hideki Yamamoto / Marine Works Japan Ltd.

- **Data management in JAMSTEC**

Yoshimasa Abe / Marine Works Japan Ltd.

- **Data management of ARGO float**

Hiroyuki Nakajima / Marine Works Japan Ltd.

- **CTD observed data- from data acquistion to publication-**

Kentaro Oyama / Marine Works Japan Ltd.

- **Underway data acquisition and distribution on the RS Africana**

Patrick Hayes-Foley / Marine and Coastal Management

INMARTECH2002

JAMSTEC

# INMARTECH 2002 Welcome and Opening Address

Hiroyasu Momma
Director, Research Support Deparment, JAMSTEC

“Good Morning, ladies and gentlemen. Welcome to Japan, and Welcome to JAMSTEC.
My name is Hiroyasu Momma. I am a director of Research Support Department in JAMSTEC. Also, I am serving a Chair of the Local Organizing committee in this Workshop and meeting.

It is my great honor to announce the opening of the INMARTECH 2002 hosted by JAMSTEC.
In this workshop, 41 oral and 25 poster presentations, including two keynote speeches are scheduled. More than 100 participants from 12 countries are registered.

First of all, I would like to express many thanks to the International Steering Committee members for their support and advice to this workshop. Please stand up, **Marieke Rietveld** from Royal Netherlands Institute for Sea Research in Netherlands, **Barrie Walden** from WHOI in USA, and **Edward Cooper** from Southampton Oceanography Centre in United Kingdom. Thank you.

Also, I would like to express my thanks to all of the Secretariat members in JAMSTEC. I will introduce **Shozo Tashiro**, Secretariat General.

Taking this opportunity, I would like to introduce JAMSTEC in a few minutes.
In Yokohama and Yokosuka area, there are many things to see, such as China Town, Sankeien Japanese Garden, great image of Buddha in Kamakura area, and famous battle ship, Mikasa in Yokosuka.
Also the Natsushima area, it has been the high-tech area since 10,000 years ago. Behind JAMSTEC, there is a small hill named Natsushima. On the top of the Natsushima, one of the oldest shell midden, clay jar and fishing gear were excavated. There is Nissan Company and Sumitomo Shipbuilding Company. Also, this area has been test field of world renown Zero fighters.
We celebrated 30th anniversary in 2001, meaning JAMSTEC was established in 1971, 30 years ago.
There are several JAMSTEC facilities all around the Japanese Islands, from Kushiro in Hokkaido, Aomori, and to Okinawa. Also, we have four branches in USA.
We will visit JAMSTEC Yokohama Institute on October $10^{th}$, Thursday.

We are operating five research vessels in JAMSTEC. Natsushima, Yokosuka, Kairei, Kaiyo, and Mirai. Also, we are operating two manned submersibles, Shinkai 2000, and Shinkai 6500. Unfortunately, Shinkai 2000 will stop its operation in the next year. We are operating three ROVs, Dolphin-3K, Kaiko, and Hyper Dolphin. Also, the Dolphin-3K will stop its operation in the next year.
We are operating deep cruising AUV, Urashima. This is a long range cruise AUV using PEFC (Polymer Electrolyte Fuel Cell).
This is the cruise track of R/V Natsushima between 1997 and 2001. This is for Kaiyo,

Yokosuka, Kairei and Mirai. This is a bar graph for operational base of the research vessels for three years. We are operating vessels almost 300 days in a year.
We are also building a drilling vessel for the IODP, Integrated Ocean Drilling Project. This is quite a huge drilling vessel, which uses a riser drill system.
Also, we are operating deep seafloor long-term observatories at three stations to monitor the deep seafloor in real time.
These deep sea systems are used for the purpose of geology, geophysics, seismology, deep sea biology, deep sea micro biology, and etc.

Further more, our research interests are extending from the polar region to the equatorial region for physical and chemical oceanography to study global climate change.

Training, education and public information are one of our important roles in JAMSTEC.

There are more than 1100 people in JAMSTEC, including three family companies. And, there are 96 marine technicians in the family companies.
The first one is Nippon Marine Enterprises, Ltd. They are operating four research vessels in JAMSTEC, three deep ROVs, multi-channel seismic survey system and OBSs. There are 20 marine technicians in Nippon Marine Enterprises.
The next one is Marine Works Japan, Ltd. There are 68 marine technicians. They are operating CTD water sampler, dredge, piston corer and scientific instruments on board the R/V Mirai.
The third company is Global Ocean Development, Ltd. There are 8 marine technicians. They are operating R/V Mirai and on board scientific instruments.

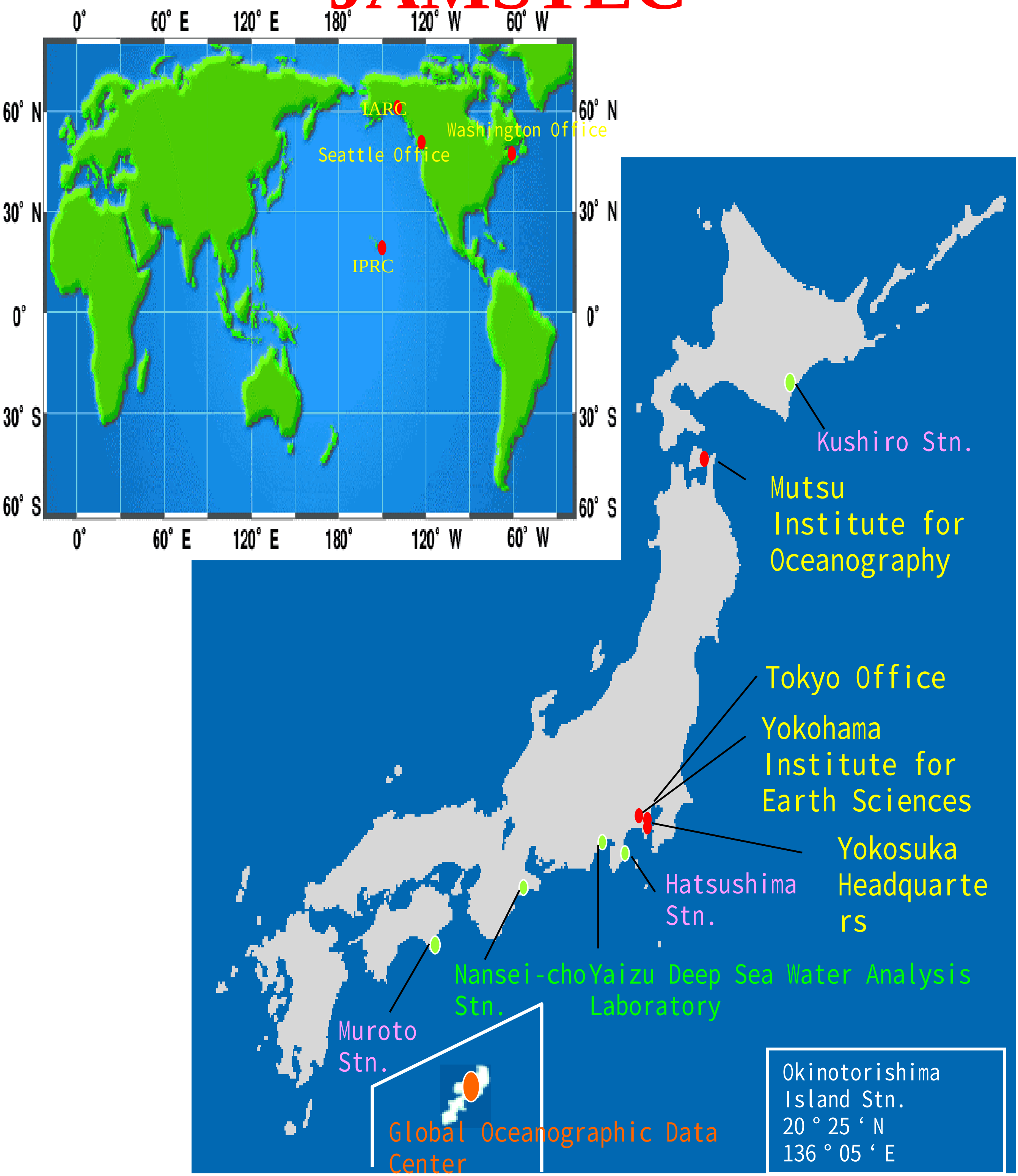
Ok, This is the end of my presentation.
I hope that you will enjoy INMARTECH 2002. Thank you.”

# Oral&Poster presentation

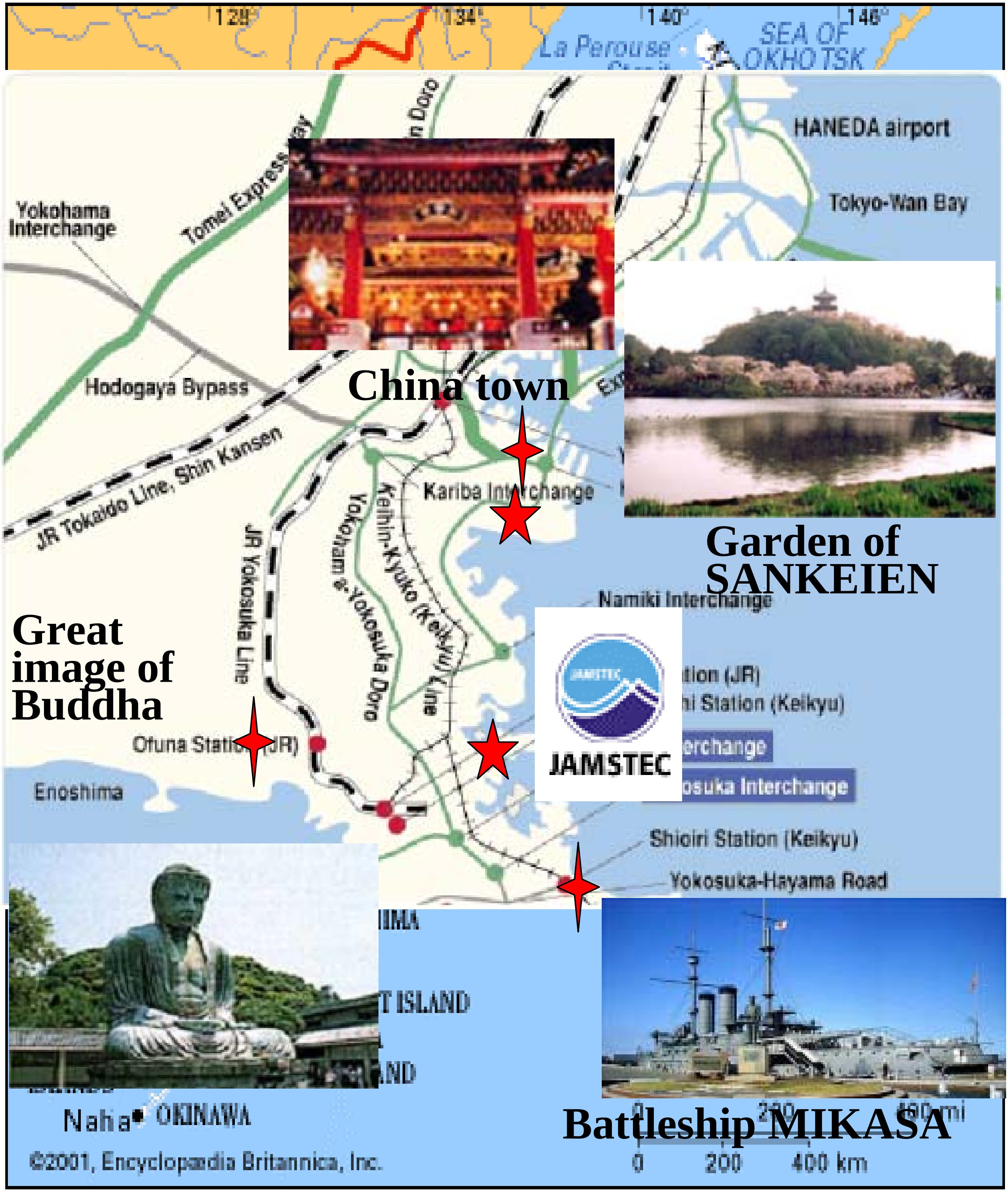
- Tentative list of titles for presentation (Oral)
  (1) Data acquisition technology   15
  (2) Handling and Operation of instruments   19
  (3) Data Management  7
  - **SubTotal  42**
- Tentative list of titles for presentation (Poster)
  (1) Data acquisition technology   6
  (2) Handling and Operation of instruments  9
  (3) Data Management  10
  - **SubTotal  25**

- **Total   67**
- **Participants(include presenters)  102 from 12 Countries**

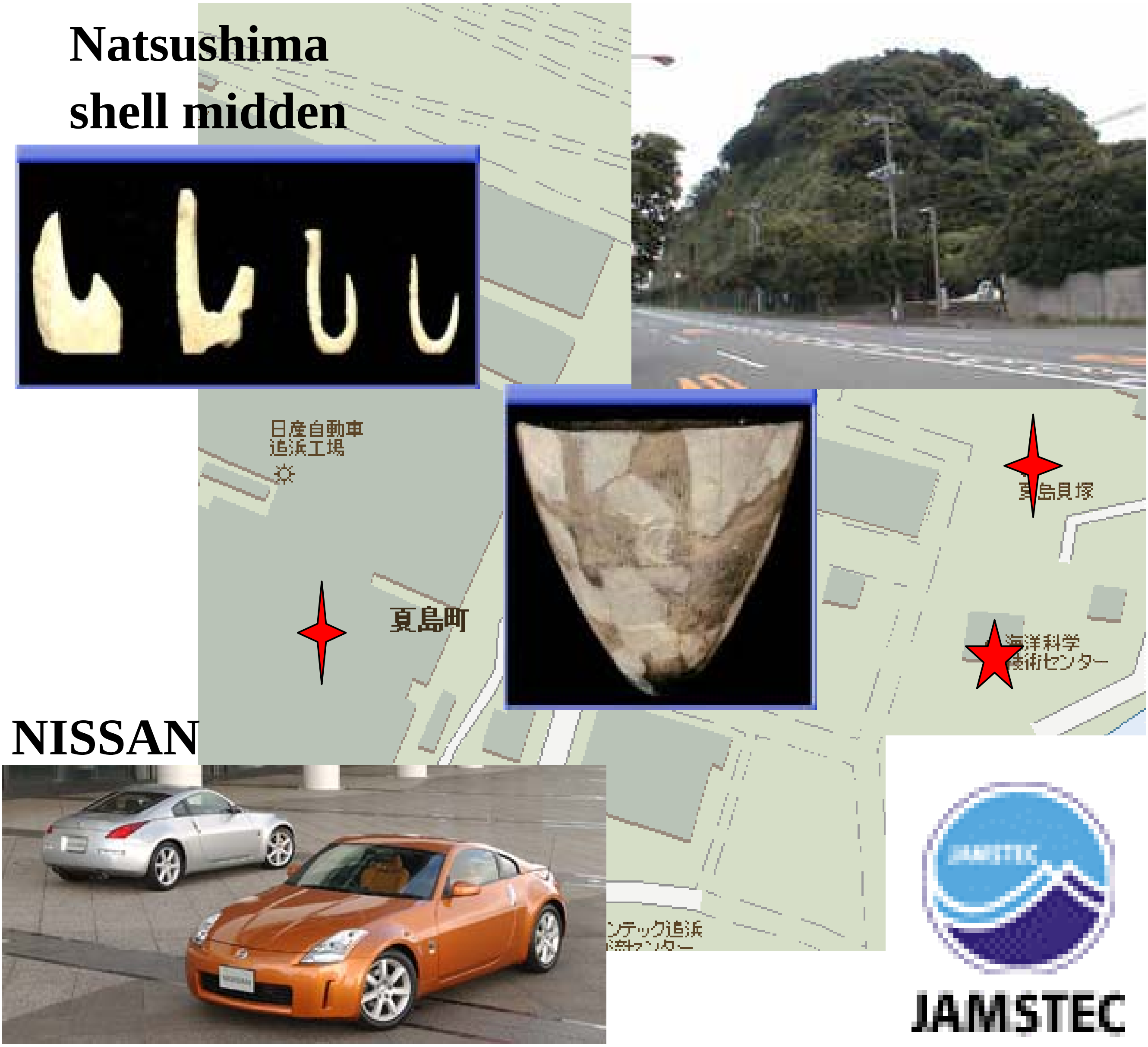
# Access Map of JAMSTEC



# Map of YOKOSUKA Area



# Map of Natsushima Area



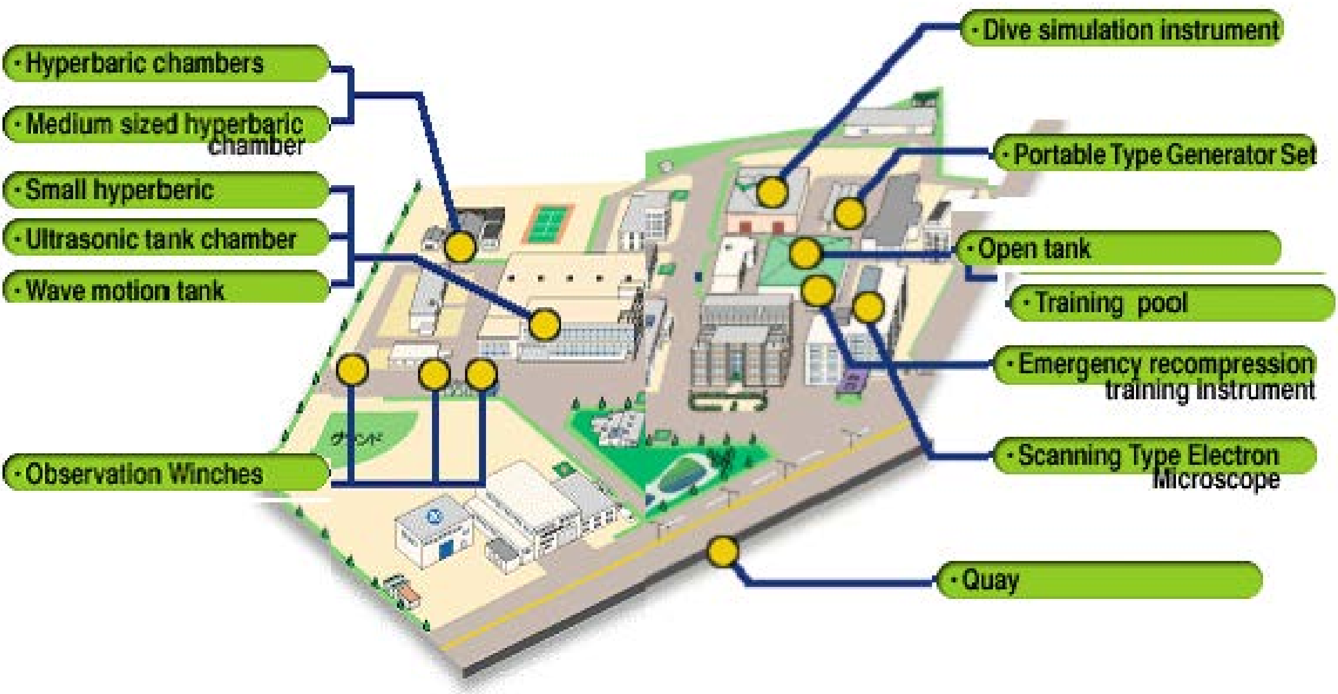

Natsushima shell midden

NISSAN

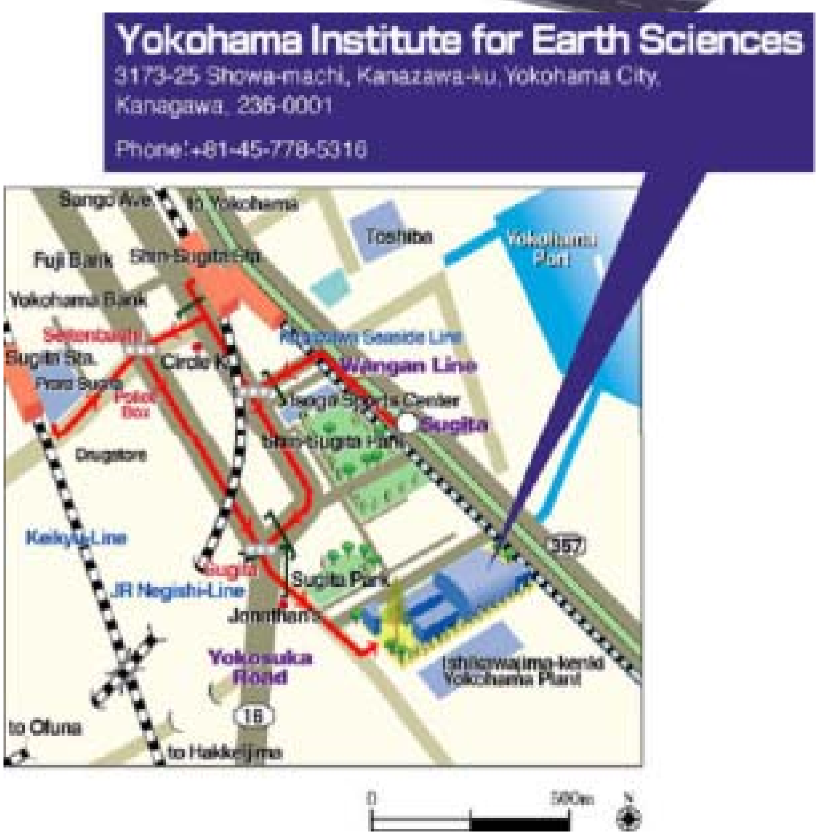
JAMSTEC

Zero fighter

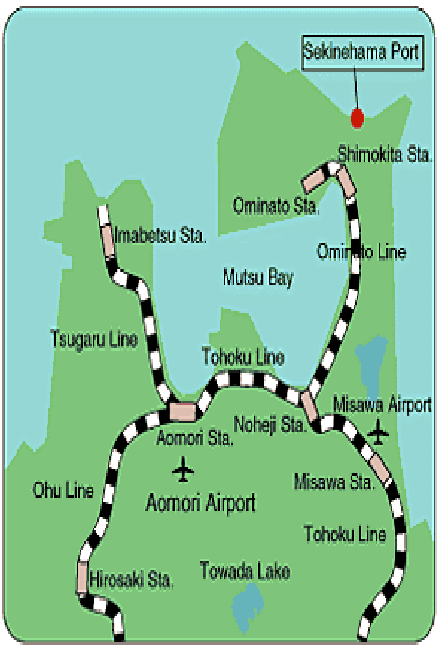
# JAMSTEC YOKOSUKA Headquarters:

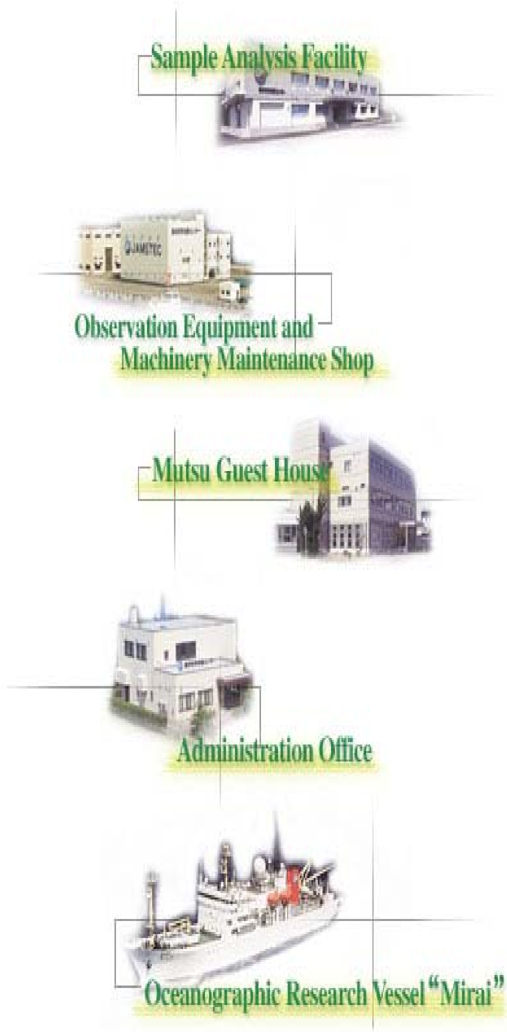


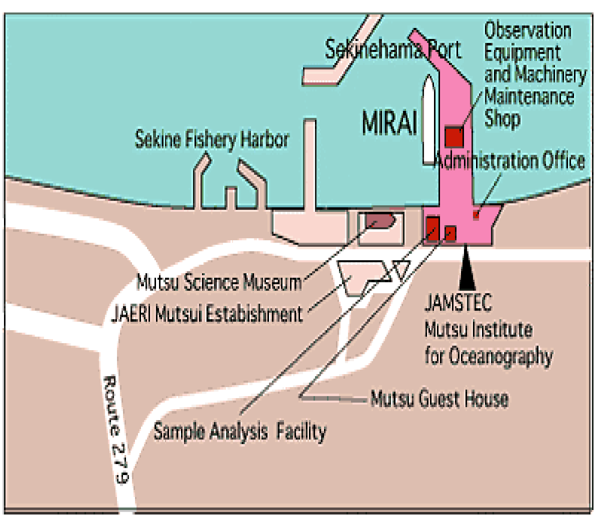

# JAMSTEC YOKOHAMA

# JAMSTEC Mutsu Institute for Oceanography




# Fleet of JAMSTEC

### *Natsushima*(1981)

- Length overall : 67.4m
- Beam overall : 13.0m
- Depth : 6.3m
- Gross tonnage : 1,553t

### *Yokosuka*(1990)

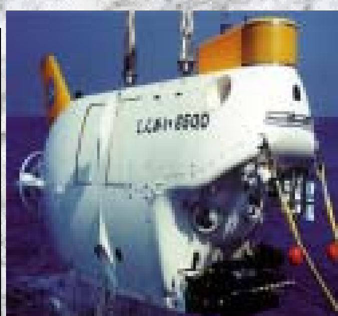
- Length overall : 105.2m
- Beam overall : 16.0m
- Depth : 7.3m
- Gross tonnage : 4,439t

### *Kairei*(1997)

- Length overall : 105.2m
- Beam overall : 16.0m
- Depth : 7.3m
- Gross tonnage : 4,600t

### *Mirai*(1997)

- Length overall : 130.0m
- Beam overall : 19.0m
- Depth : 10.5m
- Gross tonnage : 8,600t



### *Shinkai 2000*(1981)

- Length : 9.3m
- Width : 3.0m
- Height : 2.9m
- Maximum operation depth : 2,000m

### *Shinkai 6500*(1990)

- Length : 9.5m
- Width : 2.7m
- Height : 3.2m
- Maximum operation depth : 6,500m

### *Kaiko* (1995)

| | Launcher | Vehicle |
|---|---|---|
| Length : | 5.2m | 3.1m |
| Width : | 2.6m | 2.0m |
| Height : | 3.2m | 2.3m |
| Maximum operation depth : | 11,000m | |

### *Kaiyo* (1985)

- Length overall : 61.6m
- Beam overall : 28.0m
- Depth : 10.6m
- Gross tonnage : 2,849t

# Fleet of JAMSTEC



***Dolphin-3K(1988)***

- Length : **2.9m**
- Width : **1.9m**
- Height : **1.9m**
- Maximum operation depth : **3,300 m**

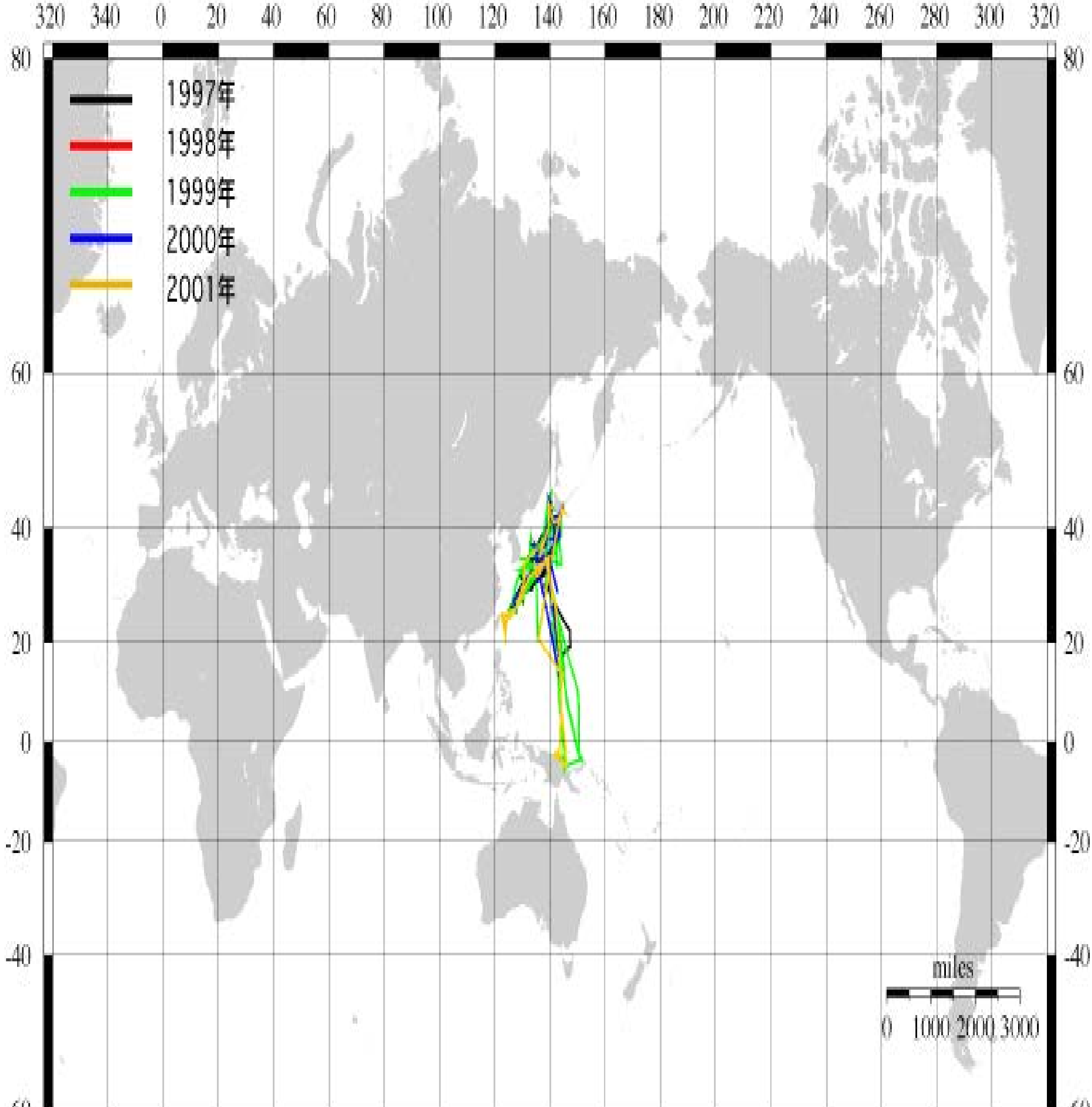
***Urashima***

- Length : **9.7m**
- Width : **1.3m**
- Height : **1.5m**
- Maximum operation depth : **3,500m**
- Cruising distance : **300km**

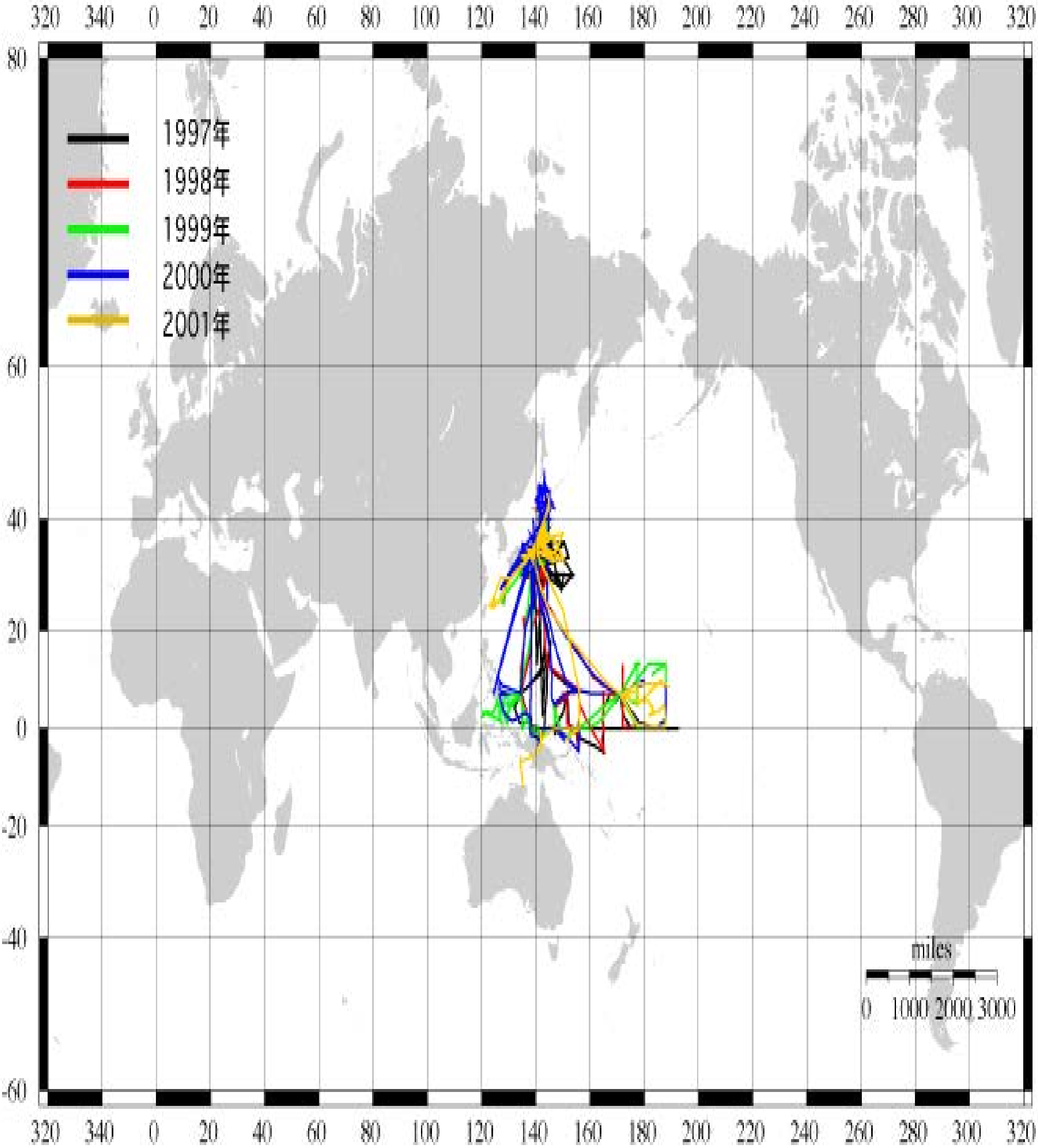
***Hyper-Dolphin***

- Length : **3.0m**
- Width : **2.0m**
- Height : **2.3m**
- Maximum operation depth : **3,000m**
- Weight in air : **3.8t**

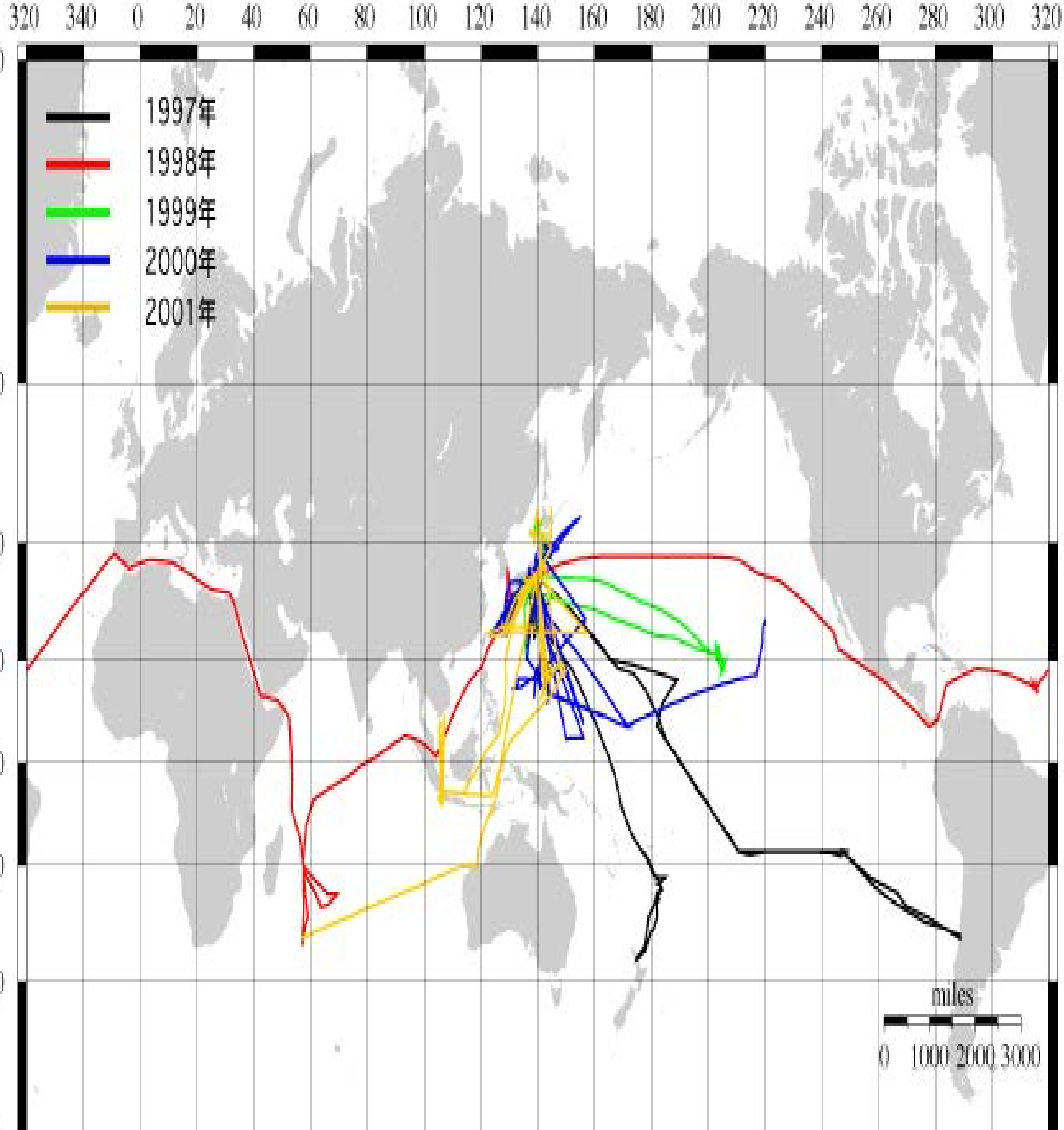
# M/V NATSUSHIMA Cruise Tracks, NT97-XX



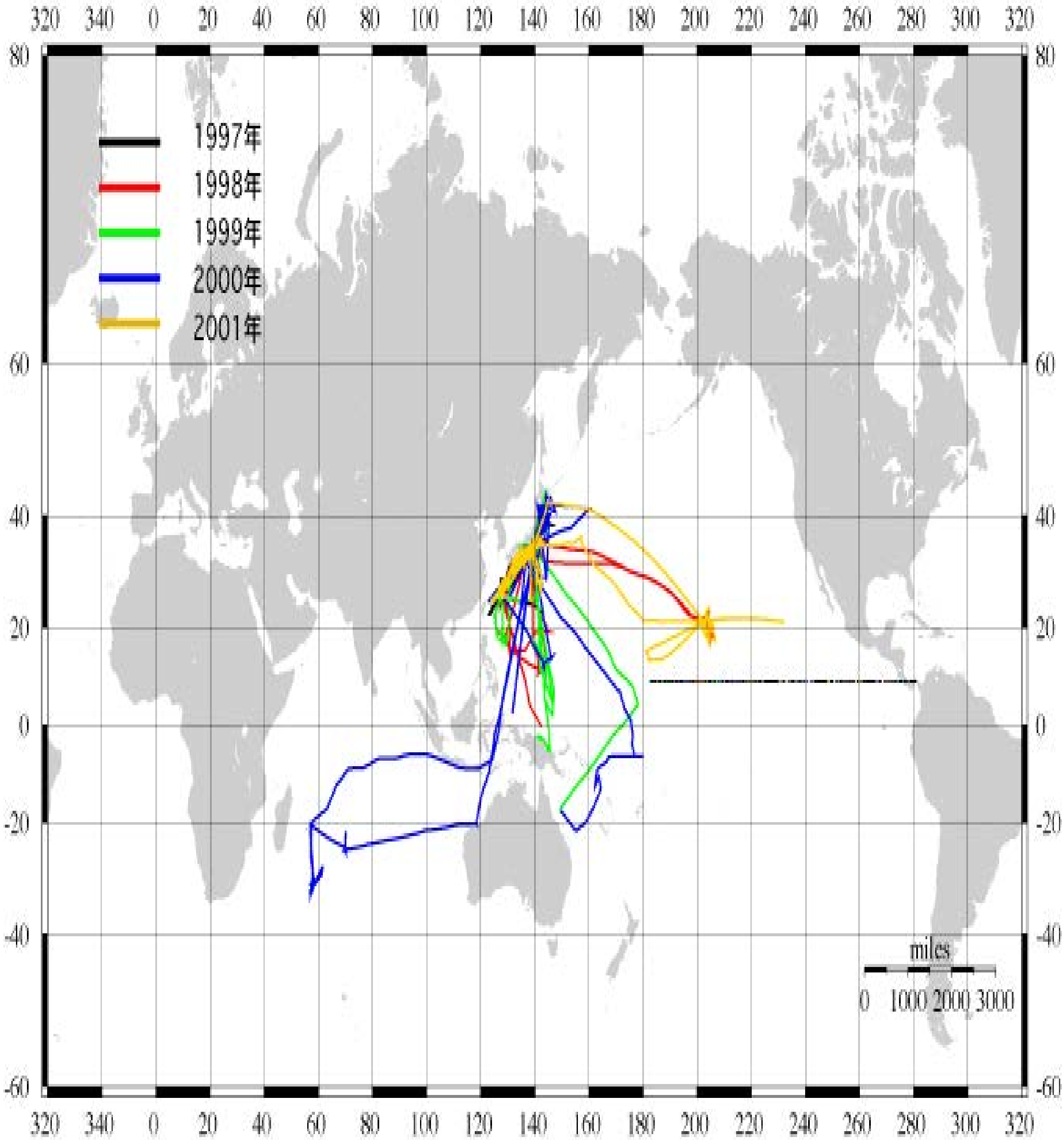
# R/V KAIYO Cruise Tracks, KY97-XX~KY01-XX



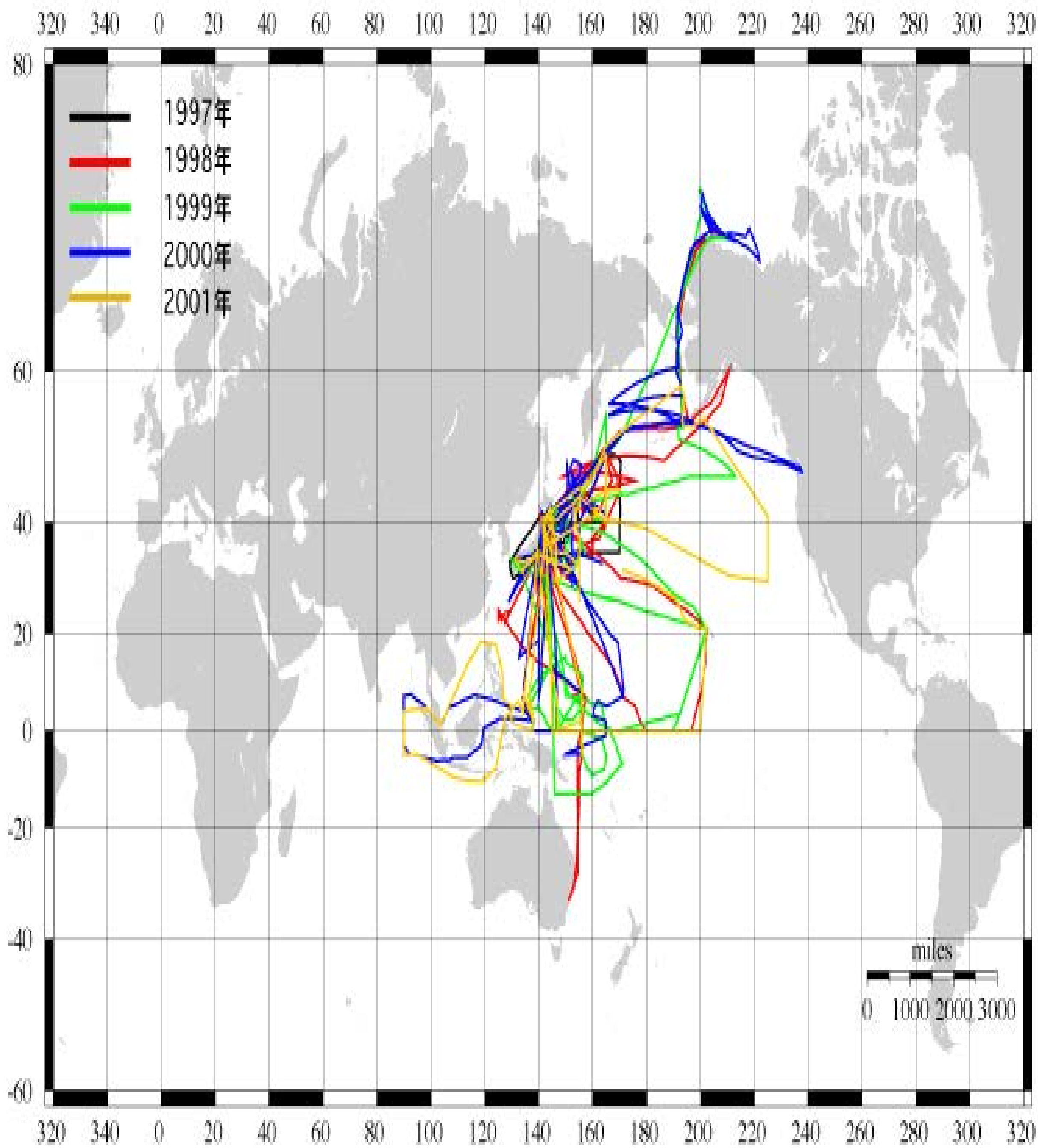
# M/V YOKOSUKA Cruise Tracks, YK97-XX~YK01-XX



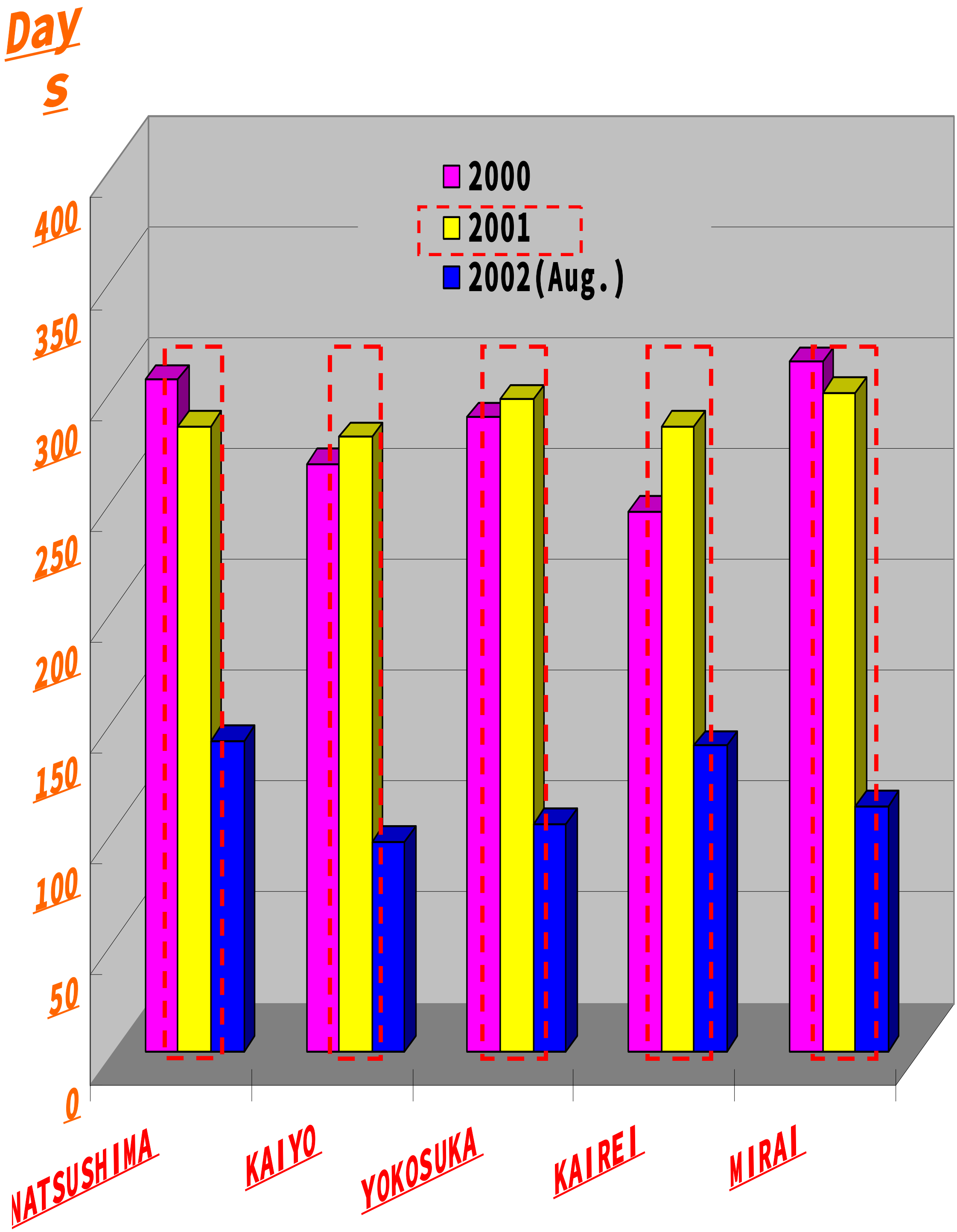
# R/V KAIREI Cruise Tracks, KR97-XX~KR01-XX



R/V MIRAI Cruise Tracks, MR97-XX~MR01-XX

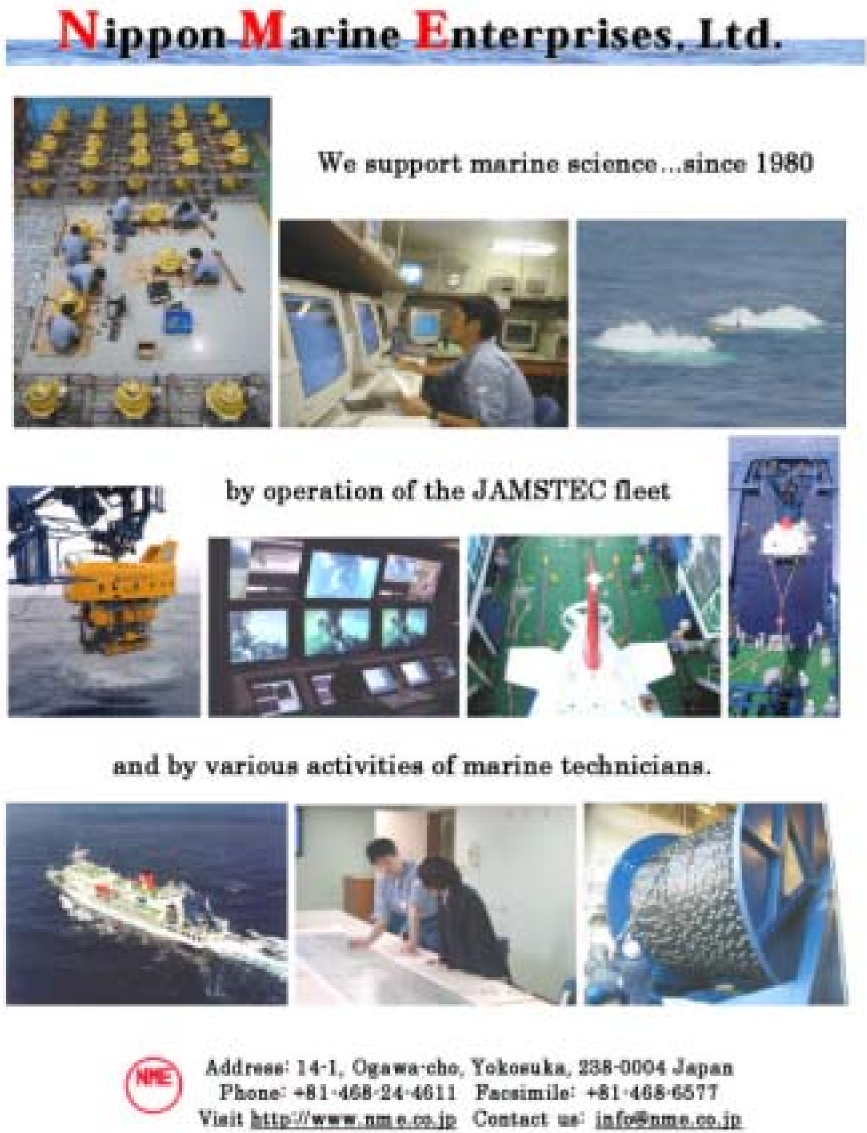


# Operation Days of the Research Vessels



# Nippon Marine Enterprises, Ltd. NME

Marine Technician : 20 staff
Main operation : Geophysics / MCS / OBS / Deep Sea Research



# MARINE WORKS JAPAN Ltd.

# MWJ

Marine Technician : 68 staff

Main operation : Water sampling / Mooring / Chemical analysis / Deep tow /  Sediment Sampling

# GLOBAL OCEAN DEVELOPMENT INC. GODI

Marine Technician : 8 staff

Main operation :Geophysics / Meteorological observation

About GODI

GODI is in charge of the operation and management of R/V MIRAI, one of the largest oceanographic research vessels in the world, under the supervision of the Japan Marine Science and Technology Center (JAMSTEC).

Since her maiden voyage on October 1st,1997, GODI has supported various scientific and technical operations on board MIRAI, by widely experienced crew and marine technicians with extensive expertise.

GODI is nominated to operate and manage new deep sea riser drilling vessel "Chikyu" which will be in operation in 2005 by Japan Marine Science and Technology Center (JAMSTEC).

Besides, GODI is willing to contribute to any oceanographic operations in its area of interest.

Scope of BIZ

1. Operation and management of oceanographic fleet
2. Support of scientific and technical operations
3. Commission for oceanographic research and investigation
4. Development of hardware and software in the area of interest

Global Ocean Development Inc.
1-13-8, Kamiookanishi, Yokohama, 233-0002 JAPAN
TEL. +81-45-849-6630 FAX +81-45-849-6660

# INMARTECH 2002

# The History of INMARTECH

Marieke J. Rietveld

Royal Netherlands Institute for Sea Research, P.O.Box 59, Texel, 1790 AB, The Netherlands

"Ohayogozaimasu. Good Morning, everybody. I will tell you something about the history of INMARTECH. The history of INMARTECH is still really short. I will give you an overview of the INMARTECH workshops that were held in 1996, 1998, 2000 and are now followed by this INMARTECH held in 2002.

To start with an inventory of all the actors and sponsors:
In 1996 these were the Southampton Oceanography Centre (SOC) in the UK, that hosted the workshop, the University of Southampton and the Natural Environment Research Council (NERC) together with the European Union as its sponsor.
In 1998 the workshop was hosted in the USA by Scripps Institution of Oceanography (SIO), organized by the University National Oceanographic Laboratory Systems Research Vessel Technical Enhancement Committee (UNOLS-RVTEC), and sponsored by the National Science Foundation (NSF).
In 2000 the workshop was held in The Netherlands, hosted and organized by the Netherlands Institute for Sea Research (NIOZ), that also sponsored the workshop together with the European Union.
Now in 2002 the workshop is held in Japan, hosted, organized and sponsored by the Japanese Science and Technology Centre (JAMSTEC), Nippon Marine Enterprise (NME), Marine Works Japan (MWJ), and Global Ocean Development Inc. (GODI).

INMARTECH was born in 1995 at the International research Ship Operators Meeting (ISOM) that was held in Cape Town, South Africa, and named International Marine Technicians Workshop (INMARTECH).
The idea of a training course for marine technicians came up in 1994.
The representative of the European Union invited ISOM to submit a proposal, whereas a budget could be made available within the EU Marine Science and Technology Programme (MAST).
The driving force to write the proposal and implement the first workshop came from Mr. Ken G. Robertson, the scientific superintendent of SOC, Southampton. He was also closely involved in the workshops of 1998 and 2000 as member and chairman of the Organizing Committee. Though Mr. Robertson cannot be with us this time he hopes to be there again in 2004.

**Mr. Ken G. Robertson**

The INMARTECH goal was formulated as follows:

**INMARTECH will create and maintain a permanent international network of skilled technological support and key operators for sea-going marine research.**

Indeed the networking is a very important part of the INMARTECH goal: to get to know your fellow marine techs, and where to go and whom to contact for certain issues or problems in the marine technical field.

## 1996


Southampton Oceanography Centre
UNIVERSITY OF SOUTHAMPTON AND NATURAL ENVIRONMENT RESEARCH COUNCIL

*INMARTECH '96 - Southampton, UK*

The main topics were:

- **MOORING OPERATIONS**
- **FISHING GEAR TECHNOLOGY**
- **CALIBRATION and STANDARDS**

There were 60 marine technicians participation from 8 different countries (54 from Europe)

## 1998

**UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM**

**INMARTECH '98**

**Scripps Institution of Oceanography, La Jolla, California, USA**

The main Topics were:

- **UNDERWAY SAMPLING SYSTEMS**
- **GEOPHYSICAL TECHNOLOGIES**
- **ROV AND TOWED VEHICLES**
- **BOTTOM SAMPLING TECHNIQUES and DECK OPERATIONS & ONBOARD SAFETY**
- **ACOUSTIC DOPPLER CURRENT PROFILERS**
- **SHIPBOARD NETWORKING and SEANET**
- **CTD PACKAGES**

There were128 Participants, from 11 countries (92 from USA)

## 2000


**Royal Netherlands Institute for Sea Research (NIOZ) Texel, The Netherlands**

The main Topics were:

- **CABLE & WINCH TECHNOLOGY**
- **LANDER TECHNOLOGY**
- **ADCP AND CTD TECHNOLOGY**
- **HANDLING HEAVY AND LARGE EQUIPMENT**
- **CORING AND HIGH PRESSURE SAMPLING**
- **MOORING TECHNOLOGY**
- **INTRODUCTION ON LABORATORY CONTAINER/VAN TECHNOLOGY**

There were110 participants from 15 different countries (86 from Europe)

There were 23 invited speakers, 3 additional speakers and 1 evening speaker.
The presentations were given during 2 general sessions and 5 parallel sessions.
There were several **additional activities:**

**display of equipment**



**Continuous poster presentation with a poster walkway to ice-breaker party and coffee/tea corner**



**Informal get-together & ice-breaker party**

**....... and music**

**and for those who could stay another day: an excursion on board the small R/V NAVICULA built for the shallow waters of the tidal Wadden Sea.**

**With picnic in the sand**

INMARTECH

## PROCEEDINGS

The INMARTECH proceedings of 1996, 1998 and 2000 can be found on the NIOZ INMARTECH website at the URL address:

**http://www.nioz.nl/inmartech2000.html**

Those who participated in 2000 have received the CD-ROM with the proceedings, and I announced the Internet version to most of this year's participants. The proceedings are in pdf-format, with all different sessions and presentations bookmarked. This means that when you open the bookmark mode, you can jump straight to the part you are most interested in.

The experience learns that completion of the proceedings is a difficult task.
In 1996 the proceedings were ready within one year, in 1998 in two years, in 2000 again in two years, despite efforts to speed this up, and it would be a great achievement if in 2002 the process could be speeded up. For this the INMARTECH organizers of JAMSTEC need your contributions as quickly as possible. This is an urgent request to all presenters.

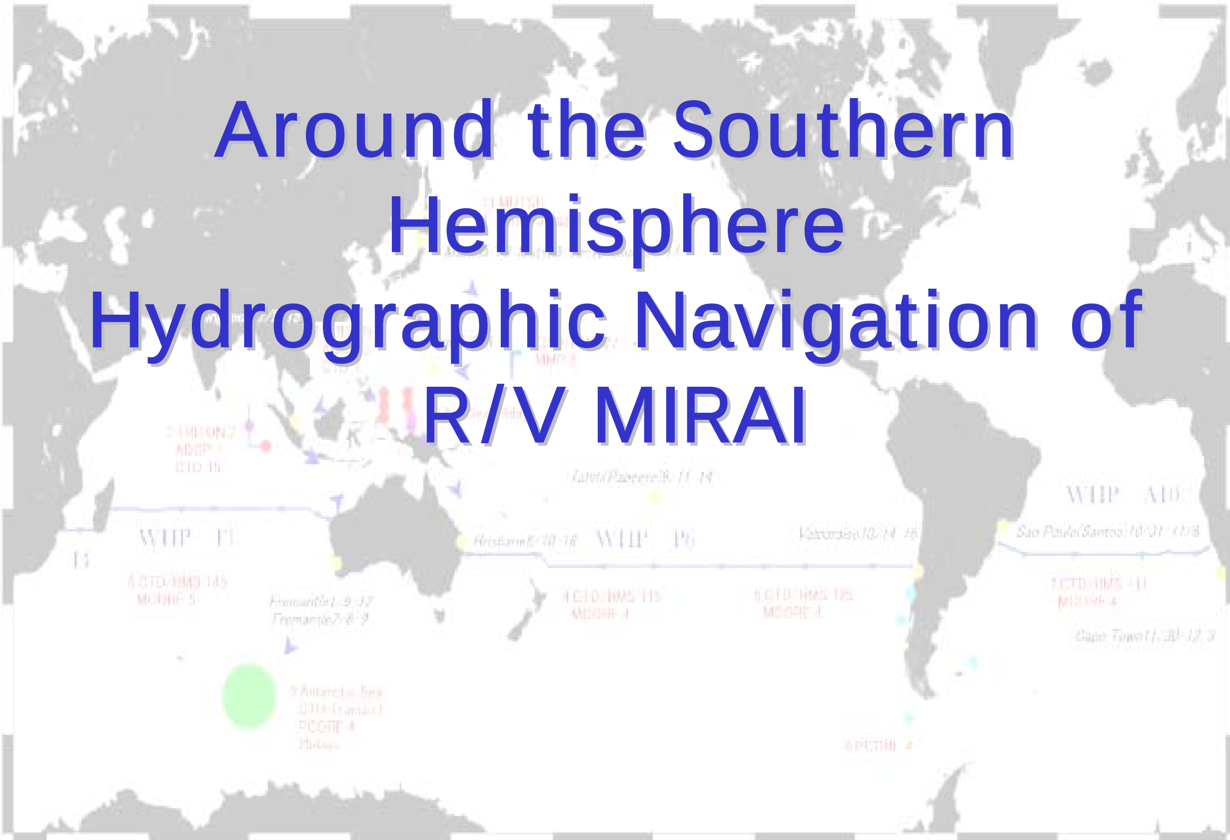
Now we are here to add some more history to INMARTECH: ....the programme for INMARTECH 2002 looks great: so let's get started!.

# Keynote speech 1

## Around the Southern Hemisphere Hydrographic Navigation of R/V MIRAI

Dr. Hiroshi Uchida

# Around the Southern Hemisphere Hydrographic Navigation of R/V MIRAI



## As a part of the 30th anniversary project of the founding

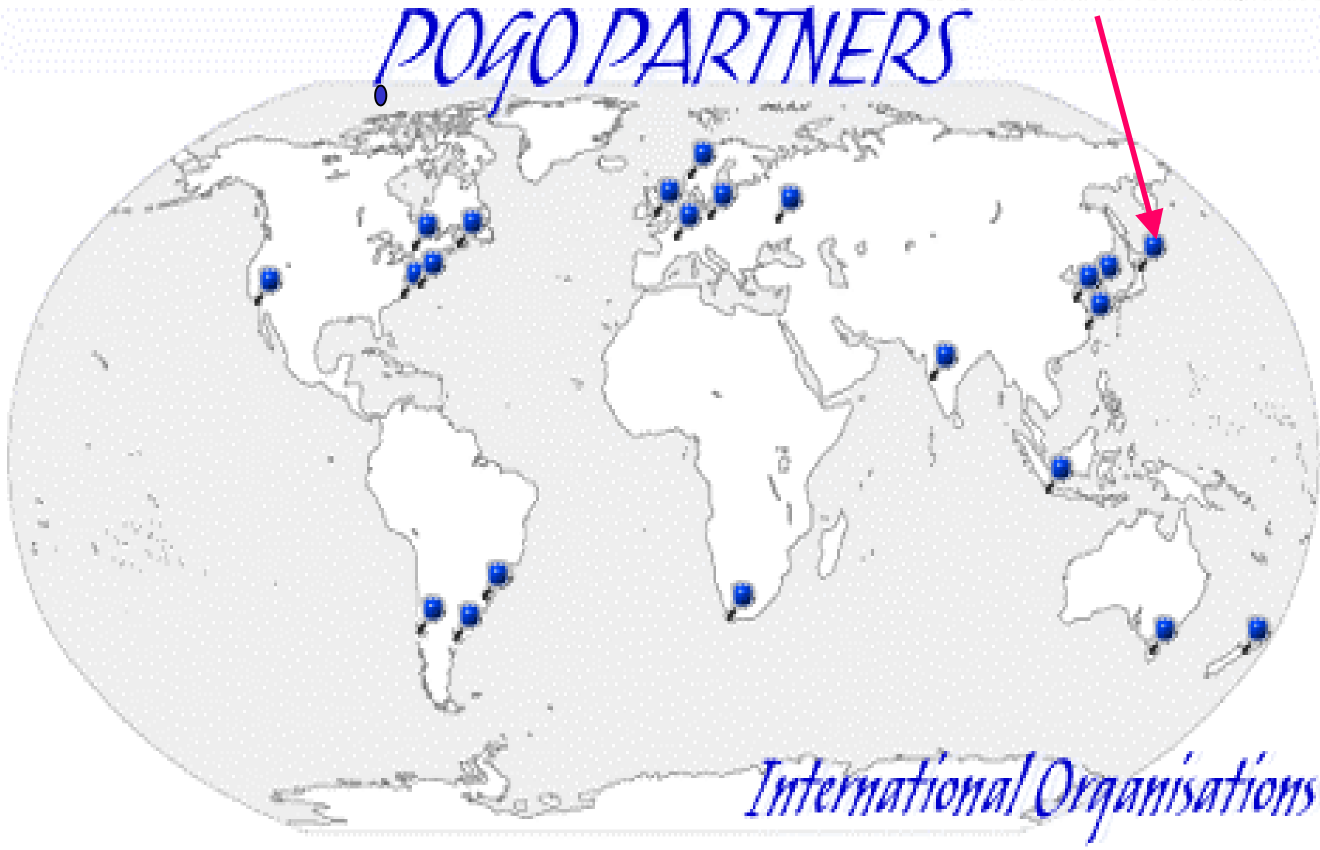
## Following up of the Sao Paulo Declaration of POGO


Hiroshi Uchida (e-mail: huchida@jamstec.go.jp)
Ocean Observation and Research Department
JAMSTEC


October 8, 2002
INMARTECH2002

# POGO
# (Partnership for Observation of the Global Oceans)

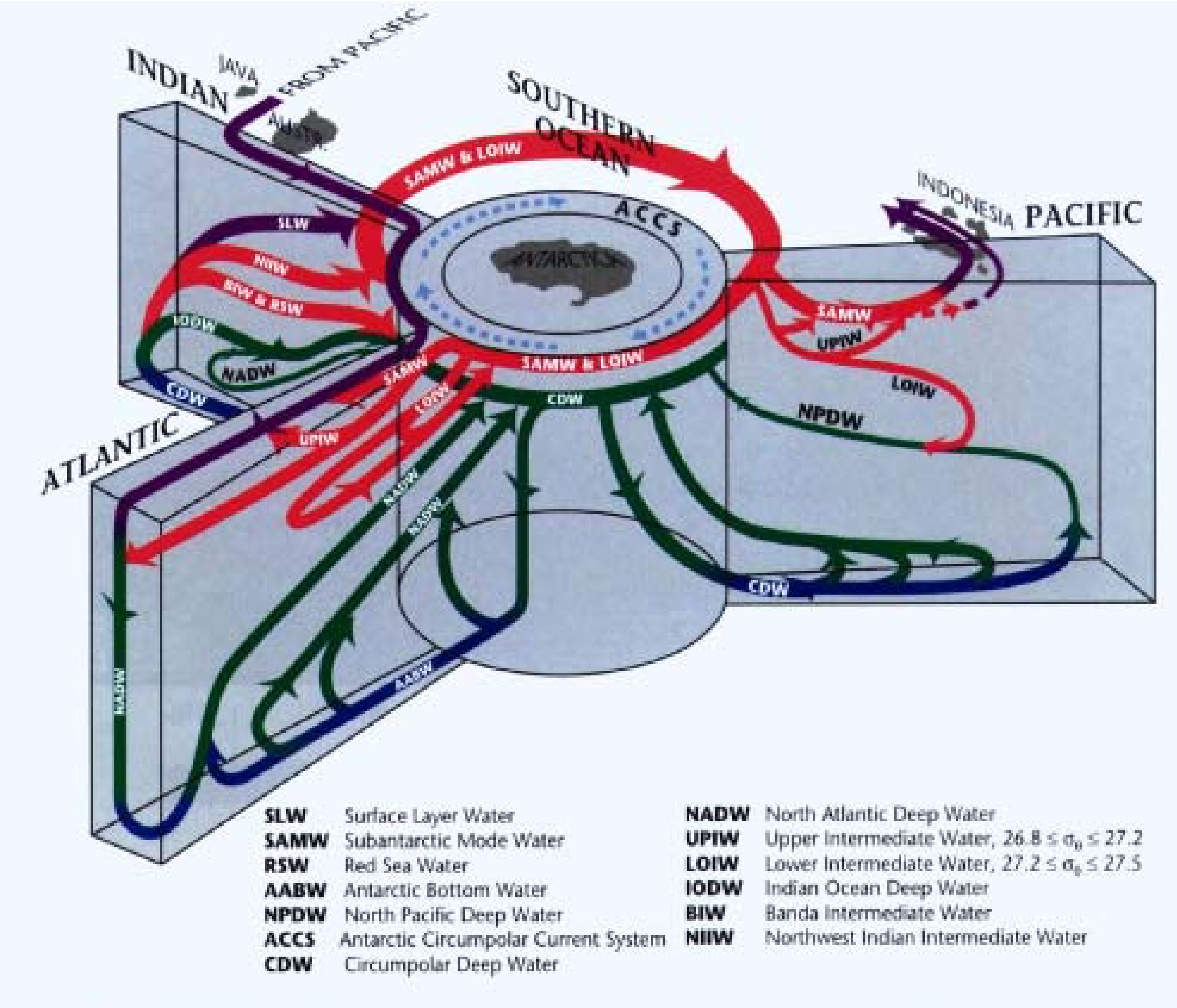
JAMSTEC
Japan Marine Science and Technology Center




Sao Paulo Declaration: 2001

**The enhancement of research capacity for the Southern Hemispheric Ocean was strongly recommended.**

# Key Role of the Southern Ocean

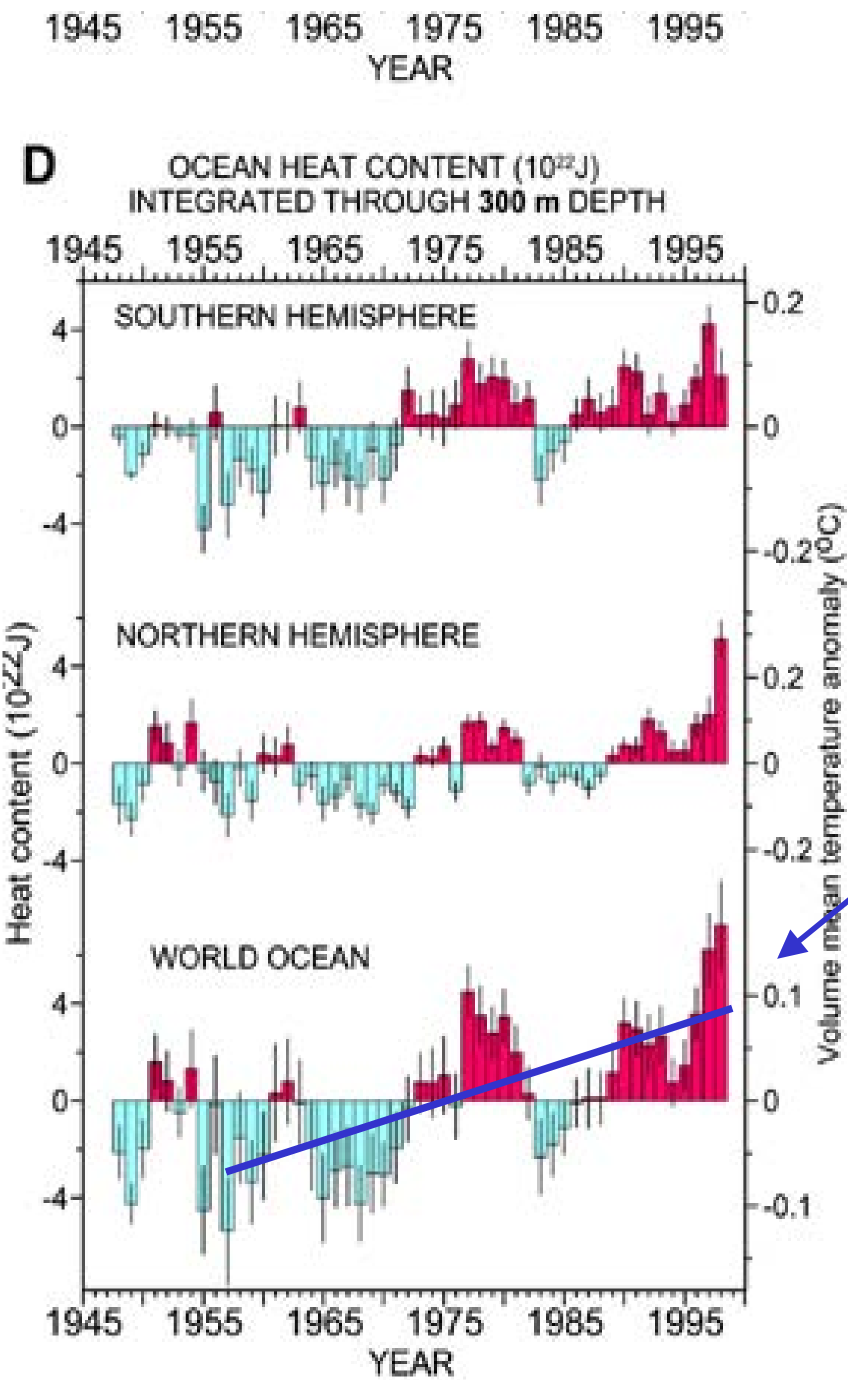



Global overturning diagram, from Schmitz (1996)

Water mass transformations in the Southern Ocean “close” the overturning circulations by converting deep water into lighter intermediate waters and denser bottom waters.

The Antarctic Circumpolar Current connects the  ocean basins and allowing anomalies to propagate between basins and influence the climate“downstream”.

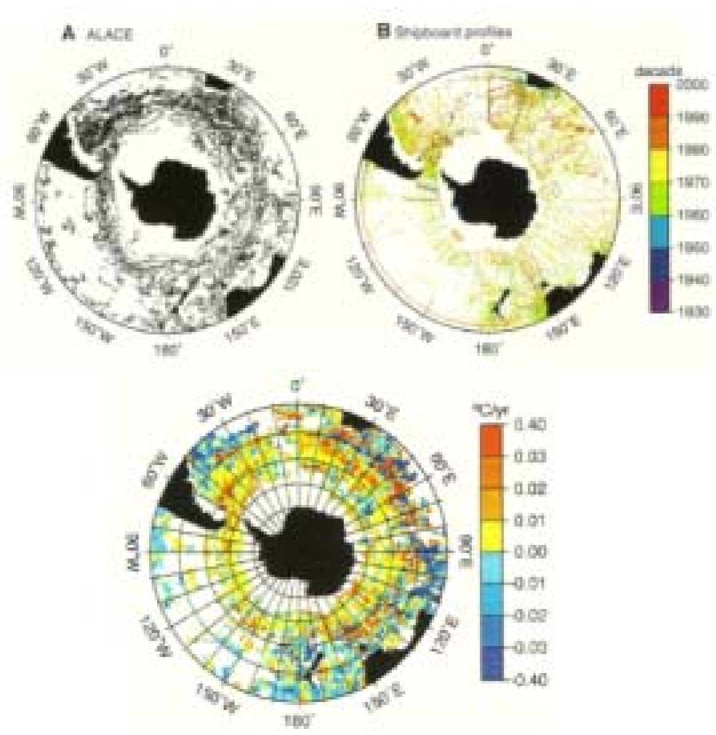
# Global Ocean Surface Warming

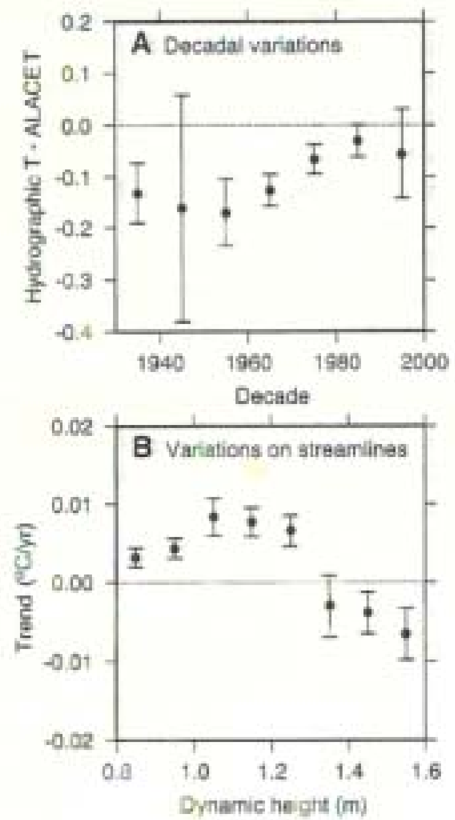



Levitus et al. (2000), Science 287

Ocean heat content of the world ocean integrated through 300m depth clearly increased between the mid-1950s and mid-1990s

# Southern Ocean Warming

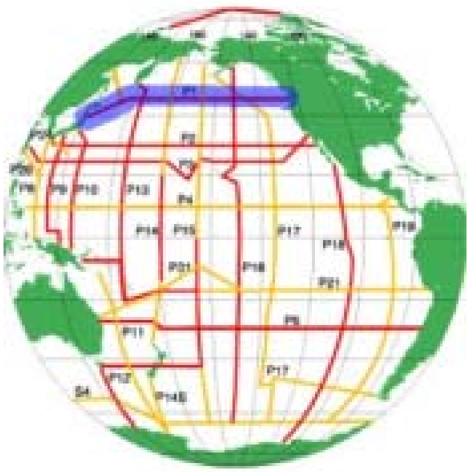



Srah T. Gille (2002) - Science 295

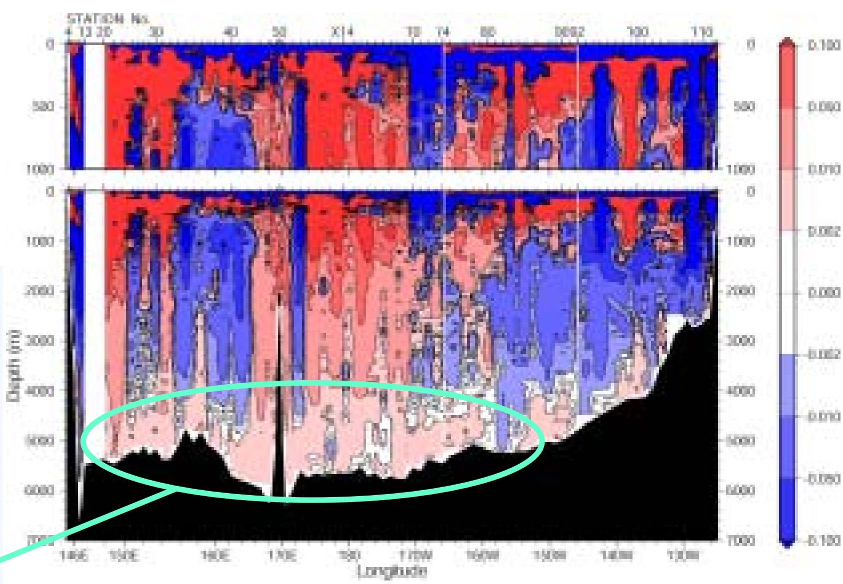
We can not identify which water mass is affected by the warming now.

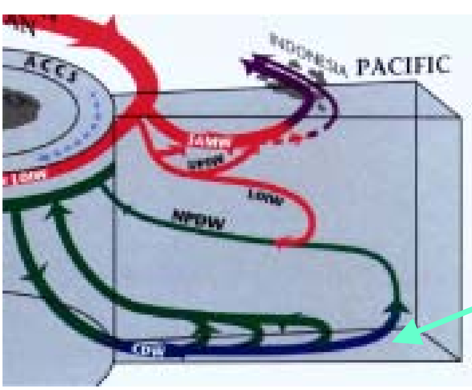
# Warming of Circumpolar Deep Water in recent decade



Revisit of land-to-land hydrographic section (WHP P1)

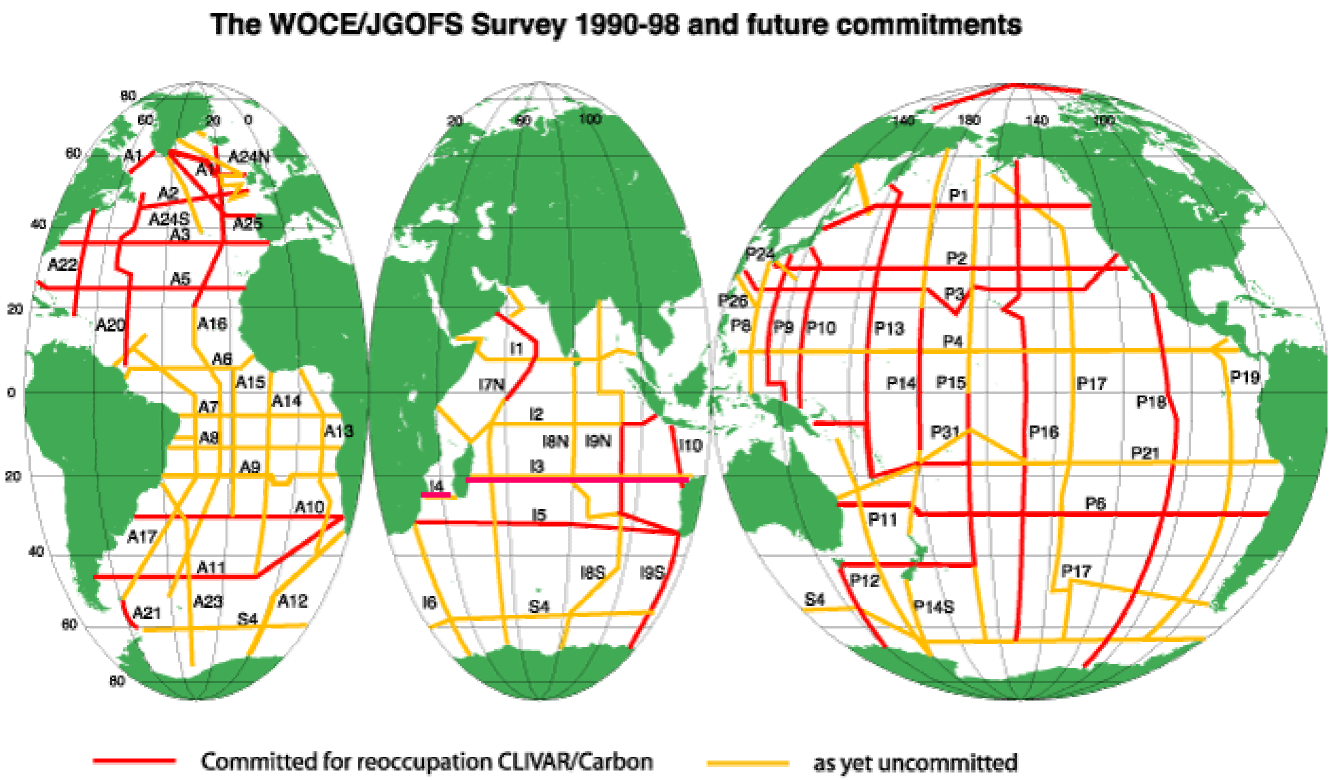
Temperature differences (1999-1985)




Fukasawa et al. (2002)     (in degrees C)

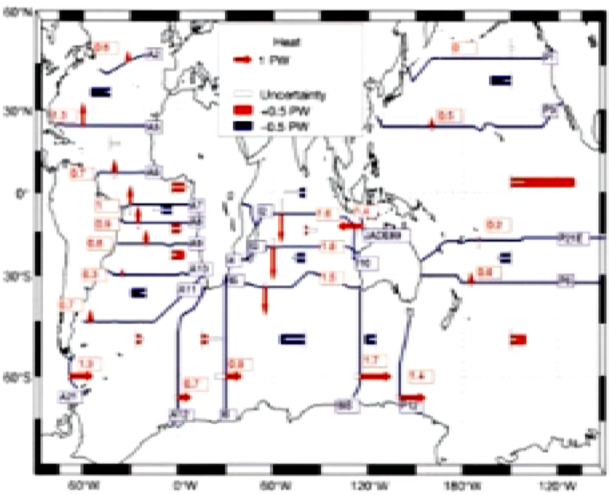
# World Ocean Circulation Experiment (WOCE)

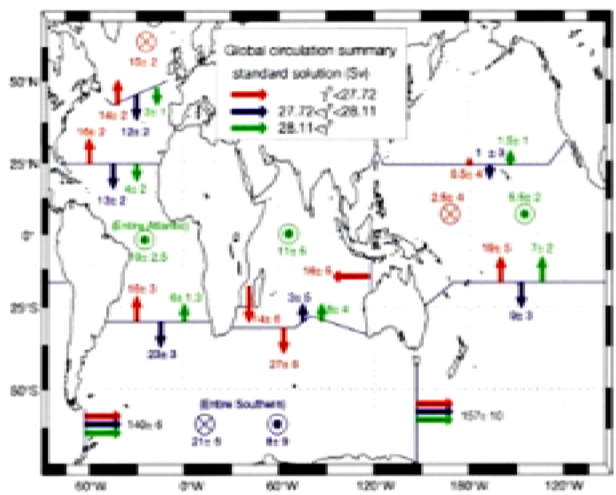



Recently, global high-quality hydrographic data had been gathered in 1990s in the World Ocean Circulation Experiment (WOCE) Hydrographic Programme (WHP) to obtain an accurate picture of the present circulation.

# Results of WHP

Heat transport | Mass transport




Alex Ganachaud & Wunsch(2000) nature 408

Shallow
Middle
Deep

"The most reliable transport map that humankind could have through WHP" though data sets with 10 years span included together.

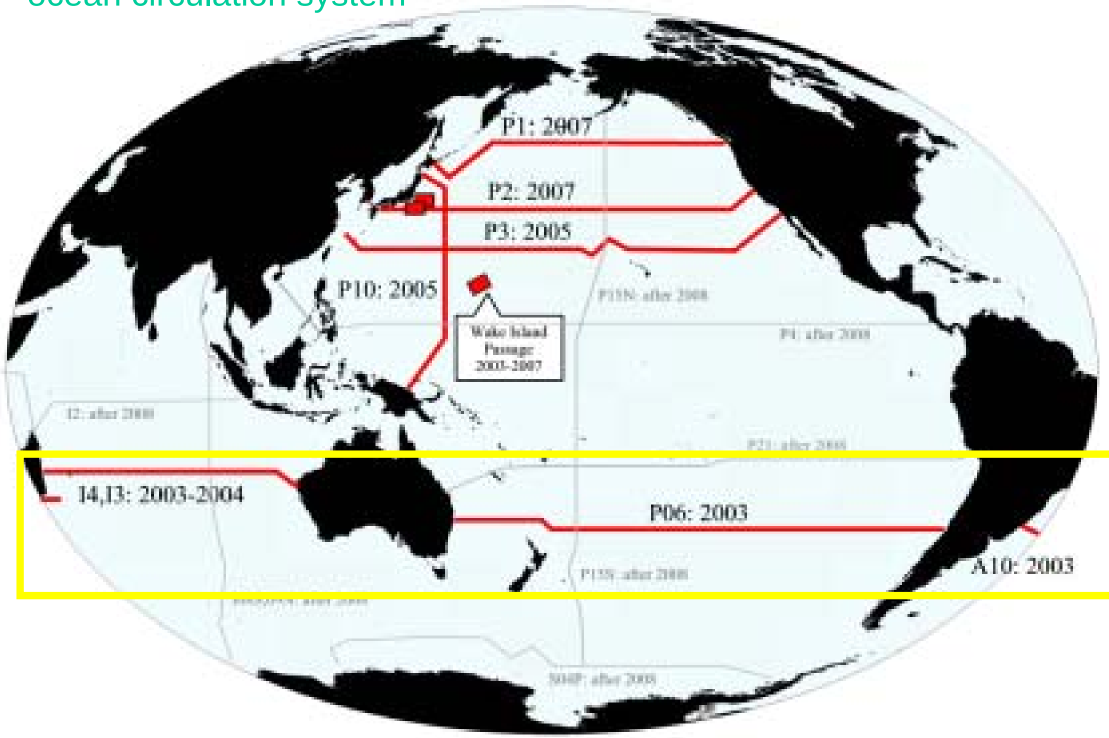
We hope to improve the map more at least for the Antarctic Overturn System through

1)Revisits of WHP lines just north of the Overturn System within a short period.
2)New chemical tracers as CFCs and Carbone.
3)Uniform data quality (accuracy and precision) along all WHP lines.

# Undergoing ocean research activities in JAMSTEC

## Action plan of **TaV-PI**

'Study on Transports and Variability of the Pacific / Indian General ocean circulation system'




Thinking highly of the Sao Paulo Declaration, TaV-PI set the Antarctic Overturn System as the first target.
And JAMSTEC decided to carry out
'Around the Southern Hemisphere Cruise'

## Scientific priorities

### 1. Heat and freshwater flux

- # Heat and freshwater transport
- # Heat and freshwater storage
- # Divergence/convergence of heat and freshwater
- # Changes in inventories of heat and freshwater

### 2. Basin/inter-basin overturn

- # Water mass formation area and rate
- # Pathway and mechanism of overturn
- # Changes in production rate, mass and pathway.

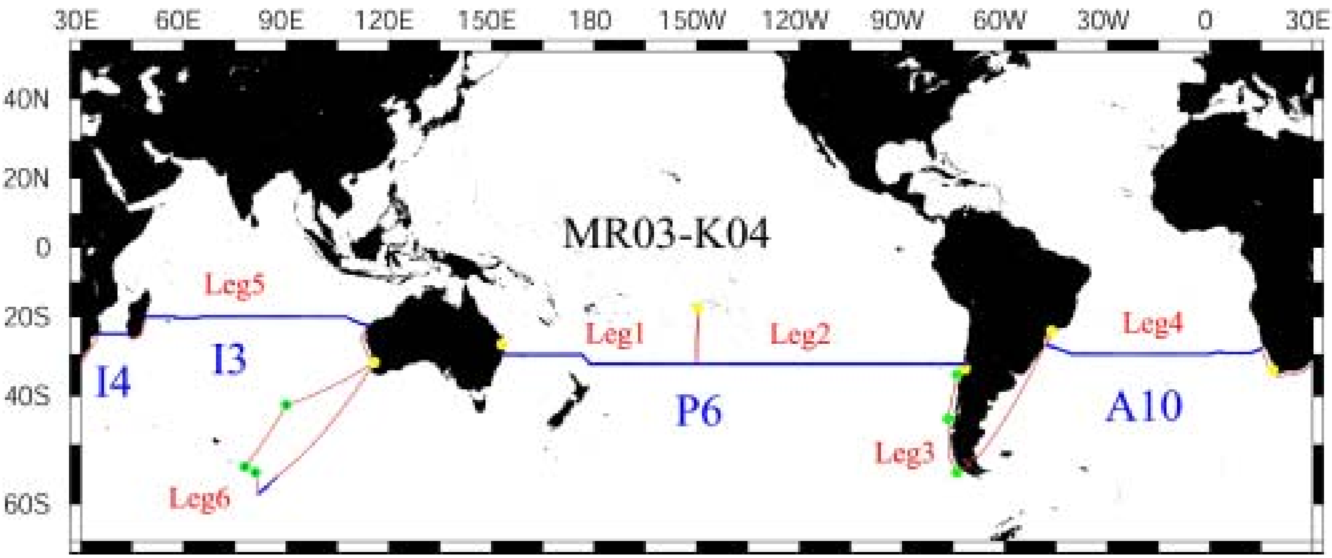
### 3. Ocean carbon cycle

- # Carbon and nutrients trasnport
- # Changes in the anthropogenic carbon inventory
- # Vertical flux of particulated carbon
- # Air-sea exchange of CO2

### 4. 4D interpolated data base (Earth simulator)

- # data for model validation
- # ARGO censor calibration

# ‘Around the Southern Hemisphere Hydrographic Navigation’ in FY2003

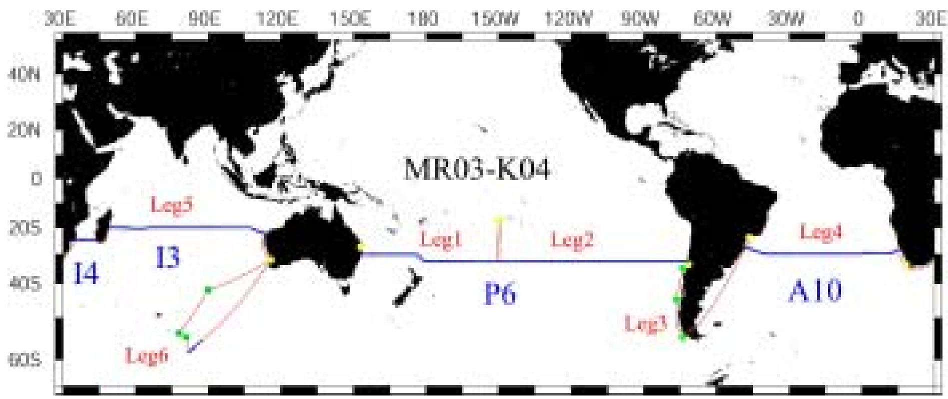



- From Brisbane (7 Aug 2003)
  to Fremantle (13 Feb 2004)
  191 days

- WHP revisits
  - Leg1 (WHP/P6)
  - Leg2 (WHP/P6)
  - Leg4 (WHP/A10)
  - Leg5 (WHP/I4 and I3)

- Piston coring
  - Leg3 (off Chile)
  - Leg6 (Kerguelen Plateau)

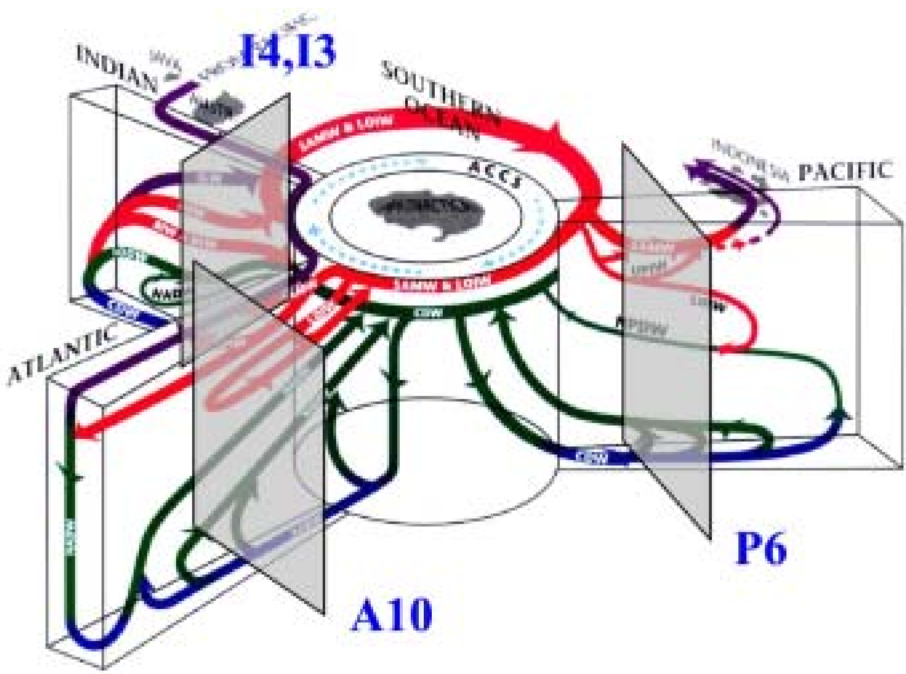
# ‘Around the Southern Hemisphere Hydrographic Navigation’ in FY2003




**WHP revisits**

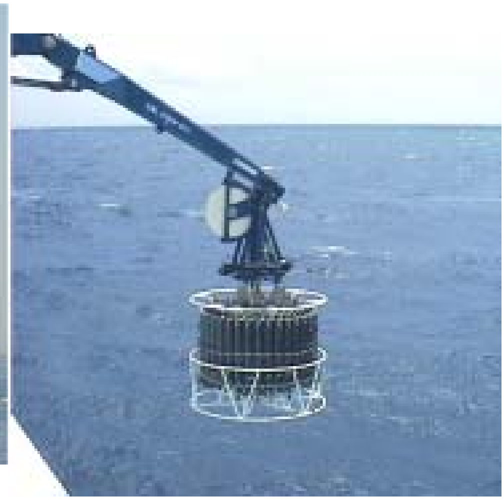
**P6:** 32 days + 34 days
**A10:** 31 days
**I4 and I3:** 44 days

Totally 496 CTD stations



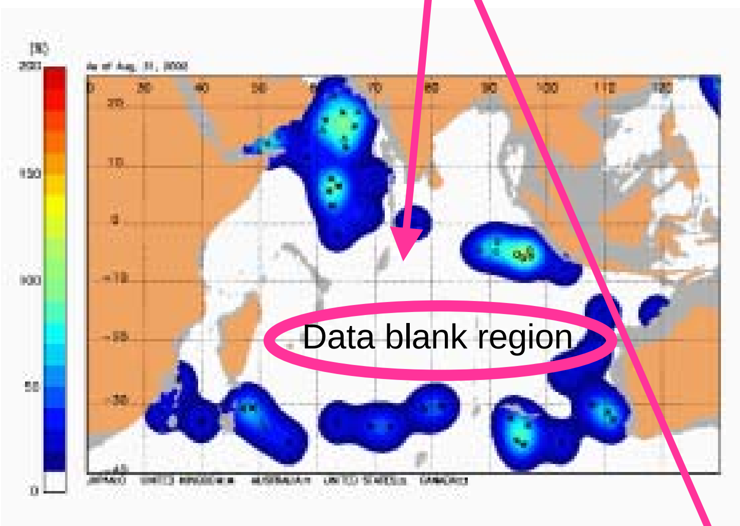
# Outline of the Cruise

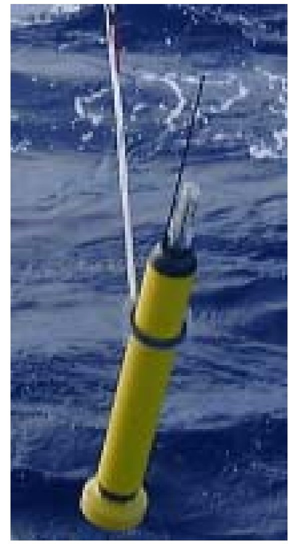
# 6 legs (4 legs for WHP) by R/V MIRAI
# All stations of WHP lines will be re-occupied including crossovers
# Every station includes a surface-to-bottom CTDO cast with 36 bottles (12L), LADCP, a fluorescence and a transmission meter
# Sampling parameters are salinity, DO, nuts, CFCs, TAlk, DIC, DOC, pH,14C, 13C, 3He/4He
# Underway measurements are pCO2, surface T, S, surface current (ADCP), bathymetry, geophysical and meteorological parameters
# All data should be opened through WHPO and JAMSTEC within two years after each leg



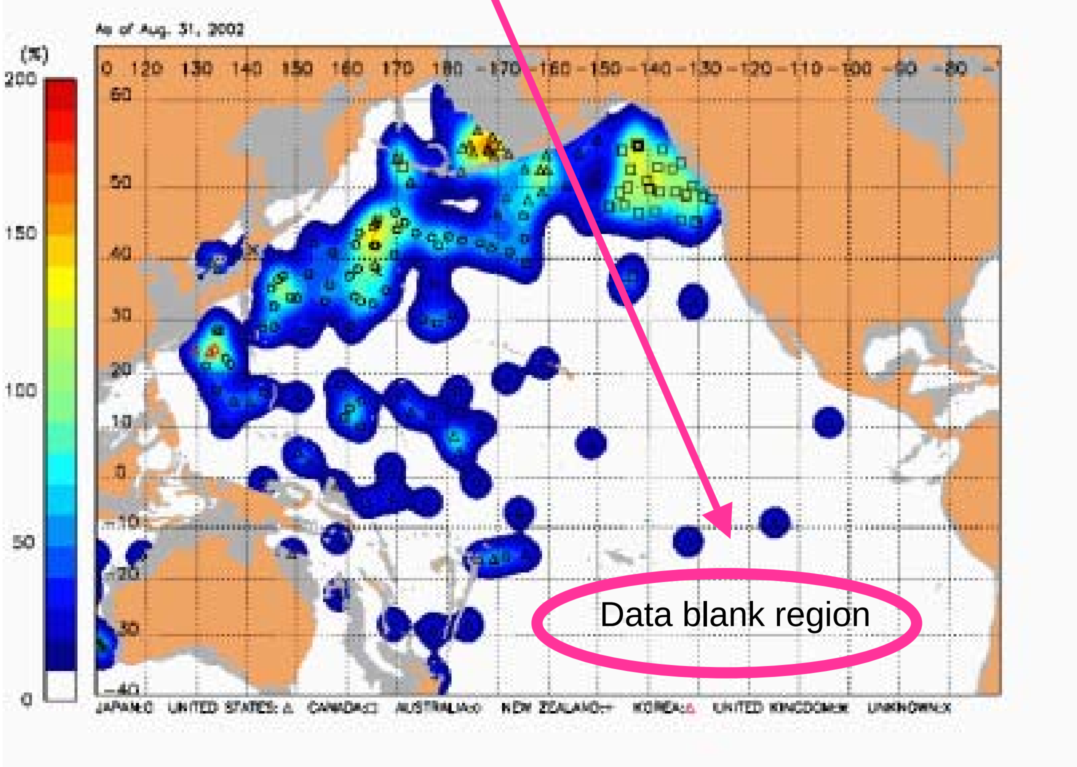
# Outline of the Cruise

# ARGO floats deployment (planed more than 80 floats)

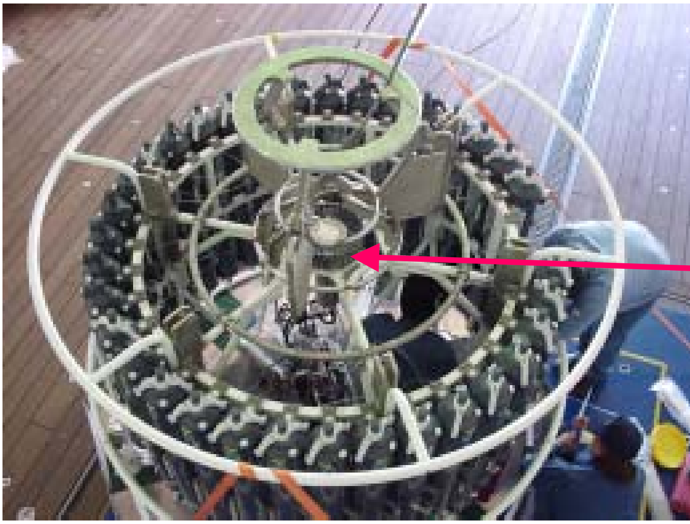


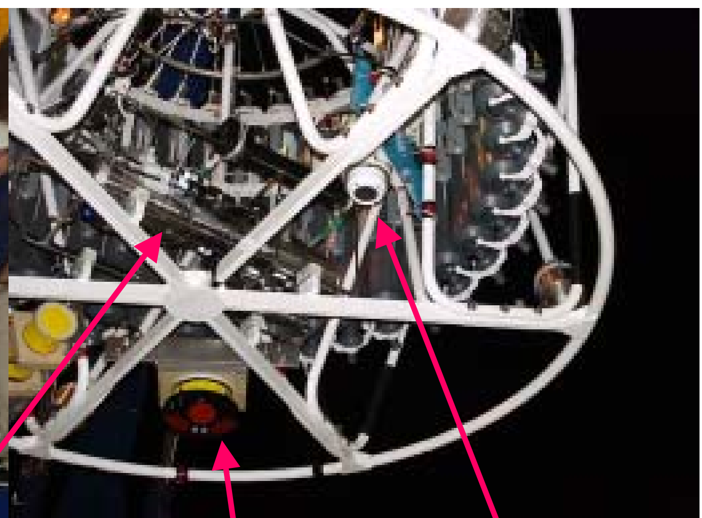
Distribution density of ARGO floats (Aug. 2002)



# CTD System on R/V MIRAI



SBE 32 Carousel Water Sampler



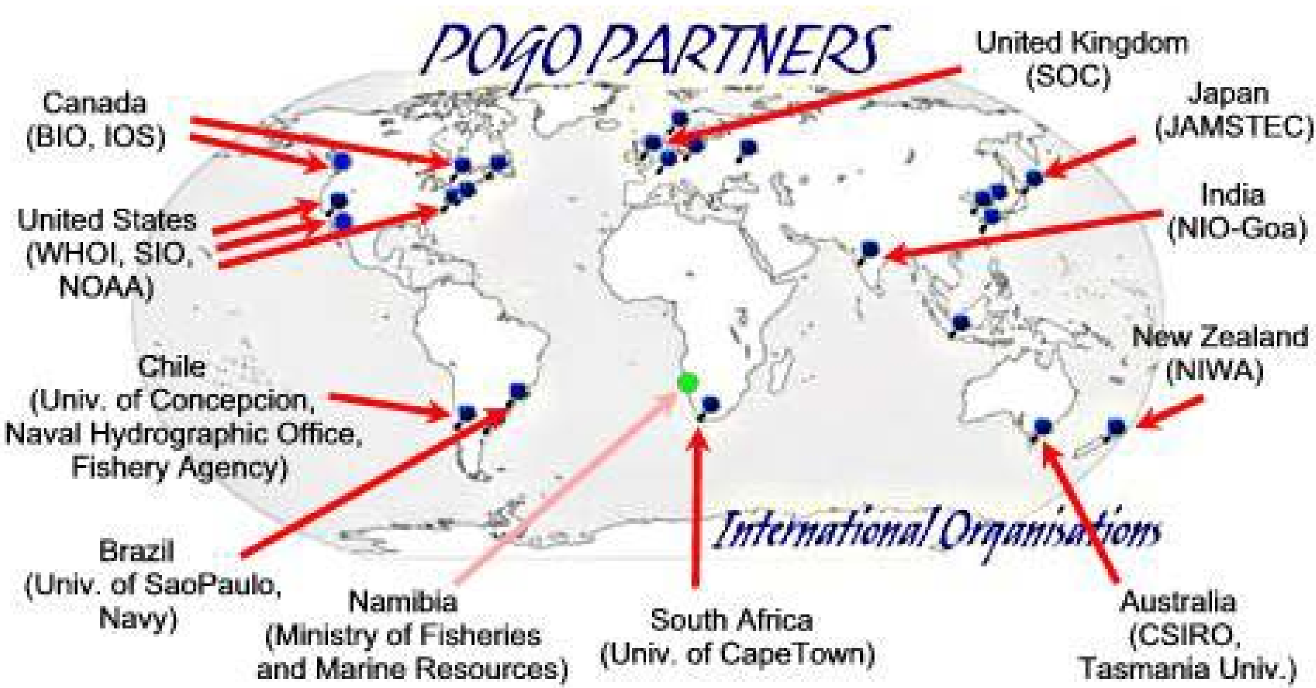
12L Niskin-X (36 bottles)

SBE9plus with 2 pumped TC, Oxygen (SBE43), and Transmissometer, Fluorometer

Altimeter

LADCP (300kHz)

# Participating International Organization

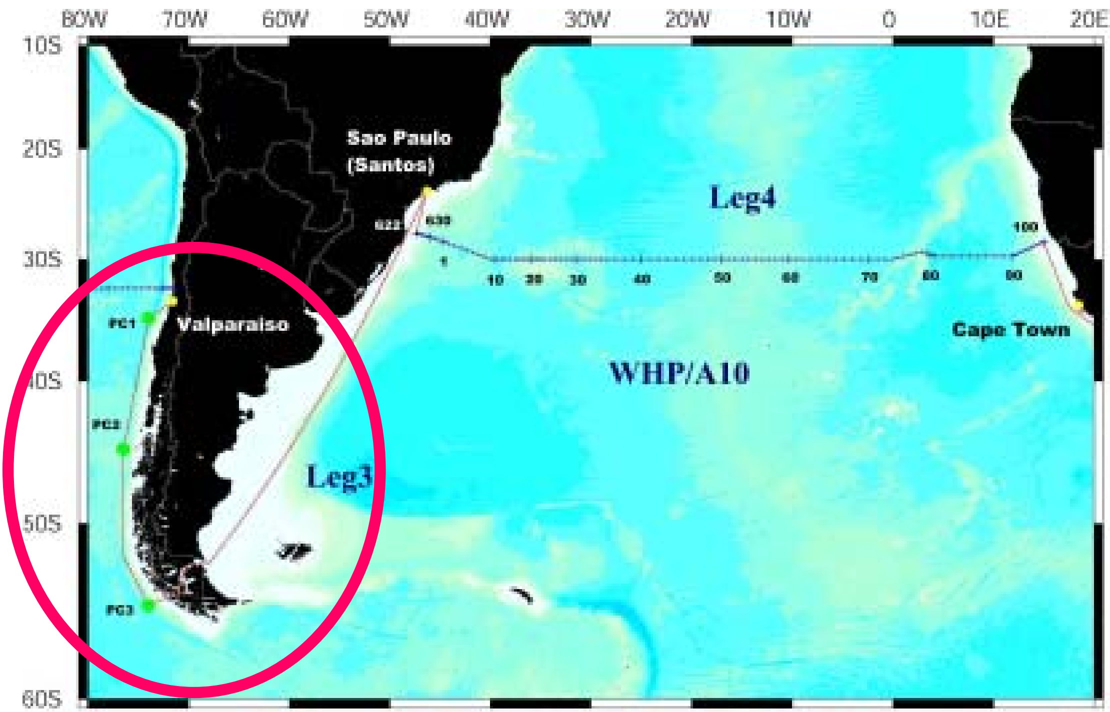



Looking for participants from ….

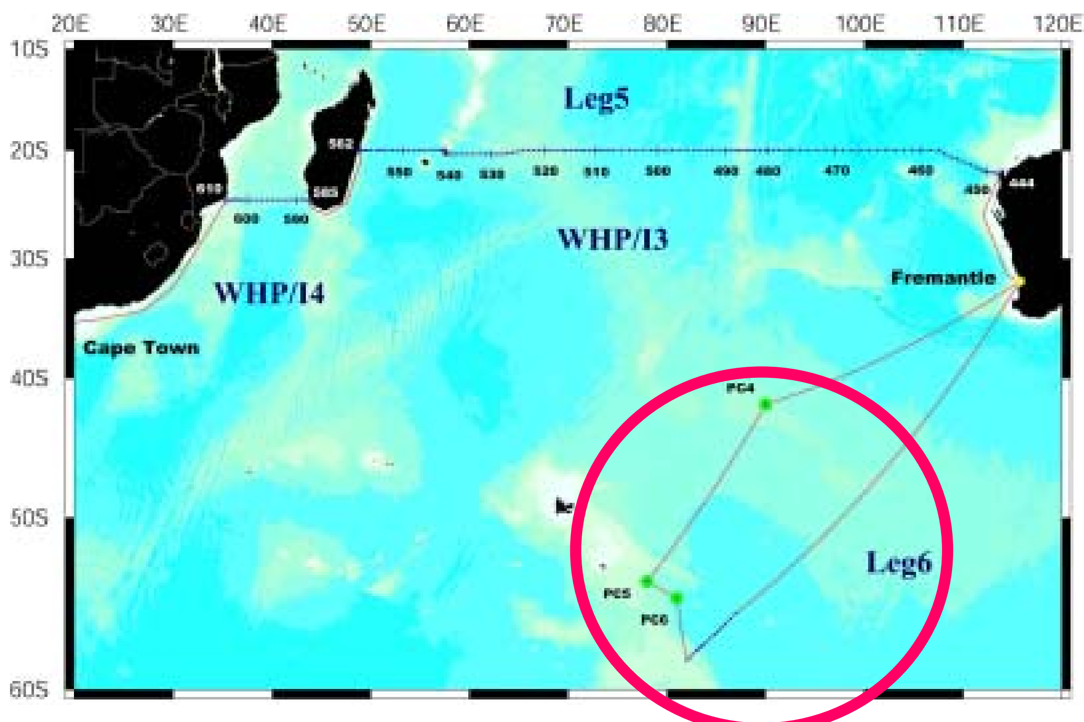
Mozambique, Madagascar, Mauritius,

France and so on

# Sediment collection with piston corer on R/V MIRAI



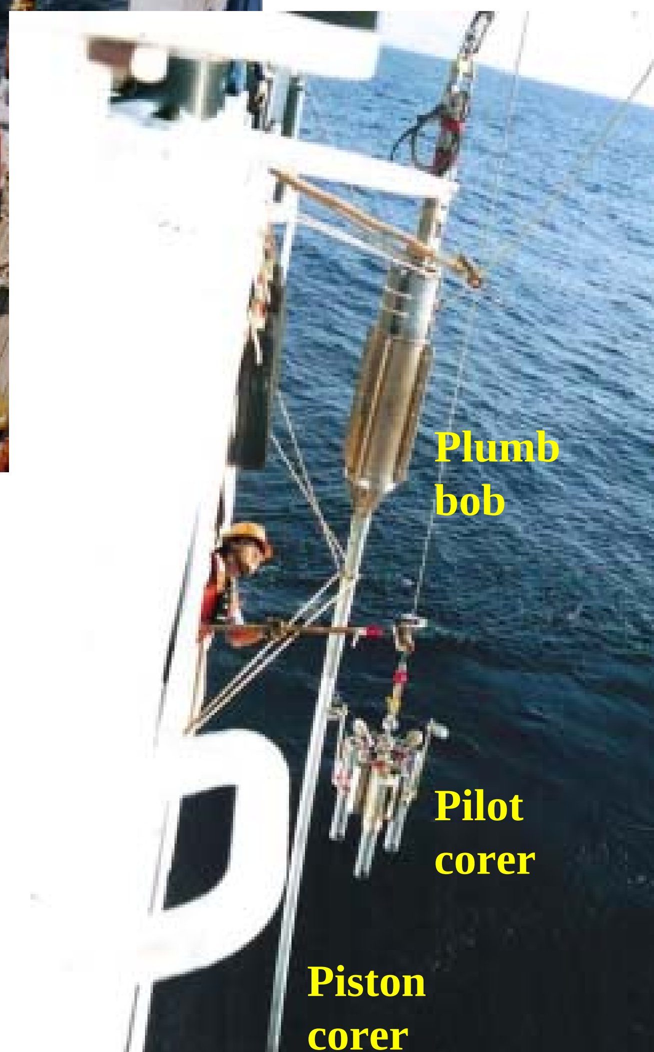

off Chile




Kerguelen Plateau

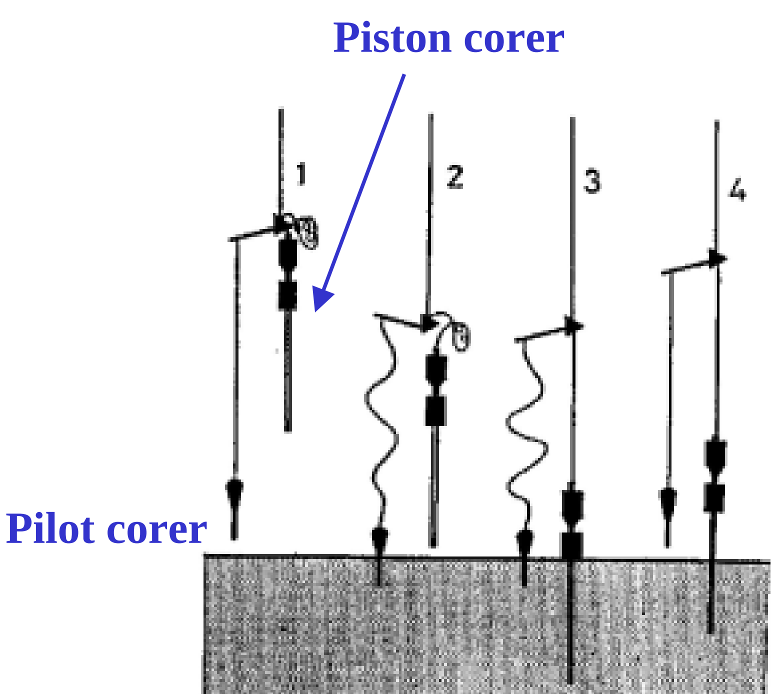
# Sediment collection with piston corer on R/V MIRAI

20m piston corer with 1.5ton plumb bob and pilot corer



# Sediment collection with piston corer on R/V MIRAI

- Precise investigation of seafloor by Subbottom Profiler (Seabeam).
- Aluminium pipe flexible for bending
- Clear inner tube (5m×4) without need to push out a sample
- Pilot corer (60cm) collecting surface sediment without damage



# Related presentation

**Poster 1-a:** CTD Operation with Three Systems on R/V MIRAI

F. Kobayashi (MWJ)

**Poster 3:** CTD observed data from data acquisition to publication

K. Oyama (MWJ)

**Poster 1-d:** Chemical analyses of seawater on R/V MIRAI

K. Sagishima (MWJ)

**Poster 1-d:** Handling and operation of sediment sampling tools on R/V MIRAI and KAIREI

Y. Matsuura (MWJ)

**Oral 7-1-a:** The maintenance and management of Argo floats

A. Inoue (MWJ)

# In Summary

**TAV-PI**

'Study on Transports and Variability of the Pacific/Indian General ocean circulation system'

WHP or Land-to-Land Hydrography

**Southern Ocean is the research area of the highest priority when we understand the role of the ocean to a climate change**

**TAV-PI set "the Antarctic Overturn System" to the first target**

↓

**'Around the Southern Hemisphere Hydrographic Navigation'**
along WHP lines in 2003-2004

# Keynote speech2

## Unique Applications of ROV's in the Historic Salvage Effort of the F/V Ehime Maru

LCDR Gregg Baumann

INMARTECH2002

JAMSTEC

# ***Unique Applications of ROV's in the Historic Salvage Effort of the F/V EHIME MARU***

On February 9th, 2001 USS Greenville (SSN 772) was conducting submarine exercises 13 miles off the coast of Oahu, Hawaii. While attempting an emergency ballast and surfacing procedure, the submarine struck and sank the Japanese fishing and high school training vessel Ehime Maru in 2000 feet of water. The collision, which took the lives of nine personnel aboard, created tension and at times strained relations between the Japanese and United States governments. In response, and as a sign of true sorrow and good will, the U.S. Navy promised to locate and recover the missing remains if it were deemed technically possible. What followed was one of the most ambitious and technically challenging salvage efforts of its kind to ever take place.

In the days that immediately followed the accident, search and recovery crews scoured the ocean surface for survivors. However, as search efforts began showing few signs of locating any of the missing crewmembers, attention quickly turned to locating the sunken vessel on the sea floor and searching it for trapped crewmembers. Due to the extreme depth, divers would not be able to be used. Instead, the Commander in Chief, Pacific Fleet (CINCPACFLT) called upon Commander Naval Sea Systems Command (NAVSEA), Supervisor of Salvage and Diving (NAVSEA 00C also known as 'SUPSALV'), and Submarine Development Squadron 5 (SUBDEVERON 5) out of San Diego to mobilize their Remotely Operated Vehicles (ROV's) and accomplish the subsurface search. Both activities quickly mobilized and flew their equipment to Honolulu. SUPSALV, using the ROV "DEEP DRONE" and the "Shallow Water Intermediate Search System (SWISS) side scanning sonar system, and SUBDEVRON 5 using their ROV "SCORPIO", quickly located and visually searched the exterior and surrounding seafloor. After working around the clock for over two weeks and battling adverse weather, the subsurface search was called off. Unfortunately, none of the missing crewmembers were located. (See Figure 1)

With relations between the U.S. and Japanese governments strained because of the incident, the U.S. Navy decided to make the commitment to the surviving family members that if it were technically feasible to raise the Ehime Maru then the U.S. Navy would do so. Again, NAVSEA received a tasking to assist. Under direction from CINCPACFLT, NAVSEA assembled a feasibility study team that comprised of NAVSEA structural engineers and naval architects, a technical delegation from Japan, and contractor personnel. Using its pre-existing salvage contracts, NAVSEA SUPSALV included assistance from the salvage firms "SMIT International" from Singapore and "SMIT TAK" from Rotterdam. The team met immediately afterwards and quickly began the task at hand.

Due to the depth of the Ehime Maru, the team was extremely limited in the techniques they could employ for the recovery. Since saturation divers were out of the question and other means of gaining entry into the vessel at depth had very low probabilities for success, the team had to look at moving the vessel to an area in which personnel could safely search the interior of the vessel.  However, before being able to say this was feasible, a structural analysis of the damaged ship had to be performed.

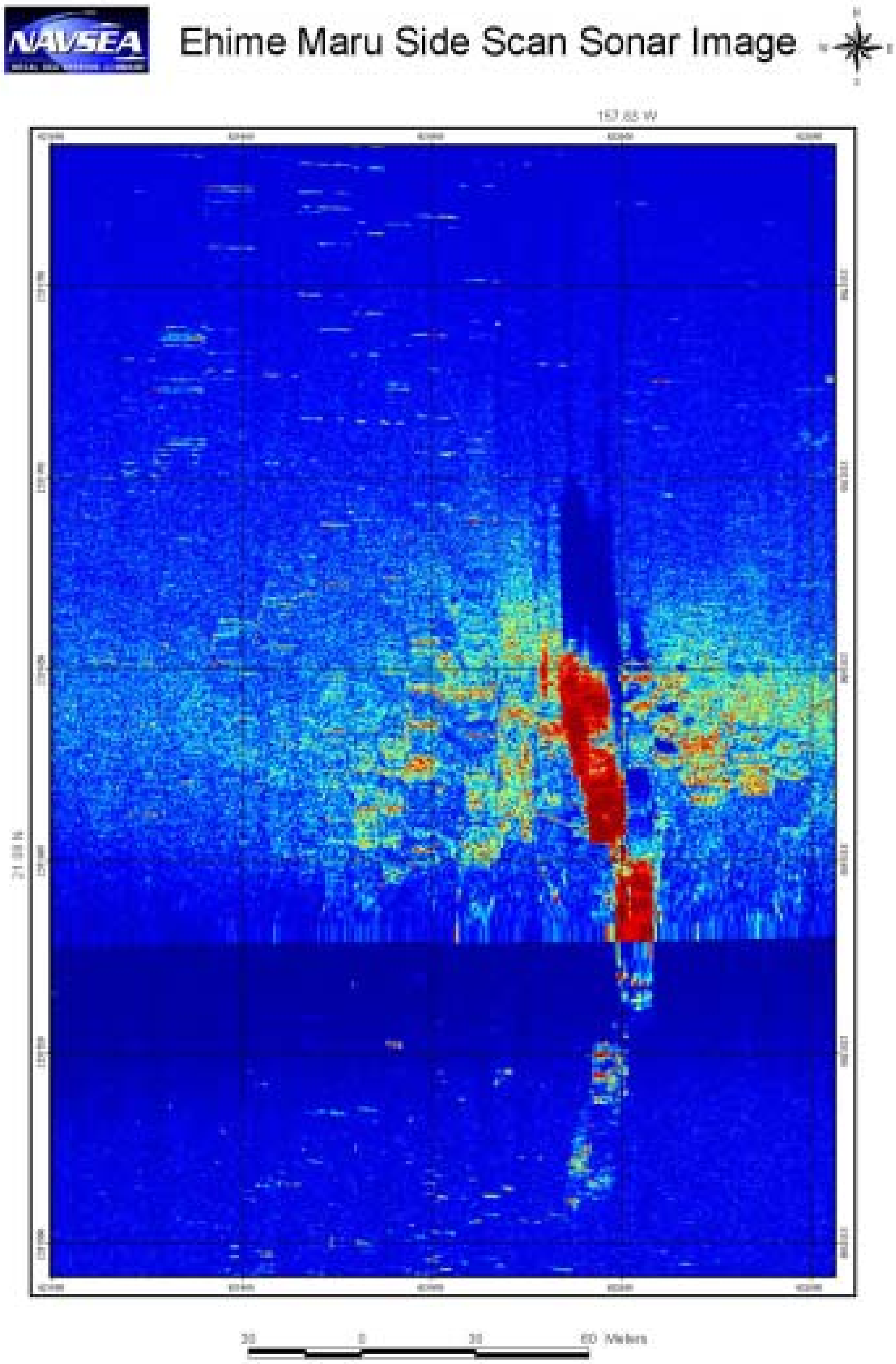



**FIGURE 1:** Side Scan SONAR image of Ehime Maru using NAVSEA 00C's

*'Shallow Water Intermediate Search System'*

With information gained from the initial ROV search, the NAVSEA team developed a structural model of the roughly 850 ton ship. Using a hull model based on a beam type finite element of over 200 nodes and the shipbuilder's lightship weight distribution, the team generated numerous bending moment curves for a number of different lifting arrangements. Incorporated into each analysis were reduced section moduli in way of the damaged areas which assumed a worst case damage scenario. The result of the analyses was that the Ehime Maru could withstand a static steady state lift but that the dynamic effect imparted by ocean swells could be problematic. Concurrent with this effort, SMIT engineers also conducted their own independent analysis, and came up with the same conclusion.

Now came the decision point on whether or not it was technically feasible to recover the Ehime Maru. Based on the detailed structural analyses and a concept of recovery operations from SMIT, NAVSEA concluded that that it was technically feasible to raise the Ehime Maru and estimated that there was an 80 percent chance of success. The results of the feasibility study and the odds of success were sufficient to convince CINCPACFLT to further pursue recovering the fishing vessel.

The concept of operations called for placing two large lifting straps beneath the ship and carrying it into shallow enough water whereby divers could safely enter and search the vessel. However, this required that a site be chosen where the ship could be relocated without causing damage to the environment. To prove this, CINCPACFLT had to accomplish an Environmental Assessment before the operation could begin. CINCPACFLT N45 (Environmental Division) was chosen to head this effort up. Drawing on assistance from "EDAW Inc." from Irvine, CA, numerous subcontractors, Code 00C oil pollution engineers, and SUPSALV "Emergency Ship Salvage Material" (ESSM) contractor personnel, CINCPACFLT conducted a nearly $2M study in less than 13 weeks. The Environmental Assessment culminated with ADM Fargo (CINCPACFLT) signing a "Finding of No Significant Impact" (FONSI) for moving the Ehime Maru from its current location to just a mile off the Honolulu airport.

With a FONSI signed by ADM Fargo, mobilization for the recovery operation could finally begin in earnest. To accomplish the rigging and lifting operations, specialized offshore equipment was mobilized from Singapore, Europe, Philippines, Texas, Louisiana, and California. Additionally, the Haliburton Corp. oil field drilling and diving support vessel 'Rockwater 2' was contracted with as the host work platform. (See Figure 2) Since the "Rockwater 2' was already operating in eastern Asia, it was outfitted for the operation in Batangas, Philippines and was then used to transport some of the lifting equipment to Hawaii. Additionally, three separate ROV systems, a coiled tube drilling unit, and rigging equipment were mobilized from the Gulf coast to Port Hueneme, CA and then barged to Honolulu on the Crowley Marine "250-6" barge.

Once the "Rockwater 2" and remaining support equipment arrived on-station, Pacific Shipyard was subcontracted with to complete vessel outfitting. This entailed welding down the ROV equipment, installation of portable generators for the deck equipment, and welding of additional rigging equipment for the deep ocean lift. While the 'Rockwater 2' was in the process of being mobilized and outfitted, a separate ROV support vessel was contracted with to conduct preliminary support operations on the


**FIGURE 2:** "Rockwater 2" oil field drilling and saturation diving support vessel towing Ehime Maru to shallow water.

Ehime Maru. The cable laying ship 'Ocean Hercules' was brought in to remove the center mast since it was determined an obstruction to the lifting hardware. For the mast removal, Jet Research Corp. from Texas was subcontracted with to cut the mast off using underwater explosives. M/V Ocean Hercules was also used to accomplish dredging of bottom sediment that was in way of the lift straps and also to place a constellation of underwater ROV navigational transponders around the sunken vessel.

After outfitting was complete, the 'Rockwater 2' immediately transited out to the Ehime Maru site to begin recovery operations. The first order of business was to calibrate the navigational transponder constellation. The purpose of this was so that the ROV pilots could maneuver the ROV's in limited to no visibility conditions. Once calibration was complete, the recovery team then went to work on putting two large lifting straps beneath the hull. The first attempt at doing so incorporated a technology called "coiled tube drilling." This technology is routinely used for drilling into oil wells, however, it had never before been adapted to deep ocean salvage work nor operated by ROV's. The general principle of coiled tube drilling is to pump high pressure water through 2 3/8" steel pipe outfitted with a drilling nozzle on the end and then to essentially "drill" with the high pressure water through the soil. (See Figure 3) While the modified technology proved to be successful in drilling at 2000 feet, it was unfortunately not successful in placing the lift strap messengers under the vessel given the time constraint.

**FIGURE 3:** Coiled Tube Drilling Unit

The next attempt at placing the lift straps beneath the Ehime Maru incorporated lifting the vessel via the stern and slipping the straps beneath it while it was suspended. The first try at lifting the stern resulted in the temporary lift strap breaking when it slipped onto and around the rudder post. On the second try, the team used a cable reinforced lifting strap. This time, the team was successful. With the stern lifted, the ROV pilots pulled a messenger wire underneath the after area of the hull. Unfortunately though, the team was unable to successfully install the forward lifting strap messenger. Hence, they had to develop another procedure to accomplish this.

After the stern of the vessel was set back down the ROV's were then used to rig one end of the aft messenger wire to the lifting strap and the other end to a heave compensated crane aboard the 'Rockwater 2'. With this setup, the crane could then be used to pull the lifting strap underneath the hull. The plan was a success as the crew was able to pull the aft strap through.

The forward strap, however, now posed a new challenge. With both the primary and secondary lift strap installation procedures having already been attempted and not been completely successful, the recovery team had to develop a third technique. With the aft strap installed, they developed a procedure whereby they would rig a temporary lift wire through the anchor chain hawsepipes and then lift the bow over and onto the forward lift strap. However, this too turned out to be a difficult procedure since the bow had buried deep into the sediment when the team lifted the stern. The proposed solution to the problem was to dredge the material from around the anchors. While the procedure was effective, the time in which it took to conduct the dredging was considerable.

Once the temporary lift wire was rigged through the hawespipes, the recovery team then placed the lower spreader bar assembly above the Ehime Maru. The spreader assembly (Figure 4) was designed to be buoyant so that when it was placed above the vessel and attached to the lifting straps, it would keep the lifting straps tensioned against the ship. However, since they had now deviated from the original plan, they had to reconfigure the rigging. Instead of attaching both the forward and aft straps to the spreader assembly, only the aft lift wire was attached. In order to balance the spreader assembly, one of the heave compensated cranes aboard 'Rockwater 2' was attached to the other end of the assembly. The temporary lift wire through the hawsepipes was then rigged directly to the linear winch. With this configuration, they could now lift the entire vessel and move it laterally and onto the originally designed forward lift strap. The interim procedure turned out to be a success as the team now had both the forward and aft lift straps attached to the lift assembly as originally designed.

**FIGURE 4:** Ehime Maru lower lift frame assembly being lowered into the water.

The next step was to lower the upper lift assembly down from the ‘Rockwater 2’ with the hydraulic linear winches. The two 500 ton linear winches (Figure 5) were installed such that their lift wire and associated sheave went over the side of the ‘Rockwater 2’ and down to the lower spreader assembly. Once the sheave was at depth, approximately 1900 feet, it was then stabbed and connected into the lower lift assembly. The entire connection process was accomplished using the ROV’s, the two heave compensated cranes on the ‘Rockwater 2’, and the two linear winches. Now that all of the rigging hardware was connected, the Ehime Maru was ready to be lifted as soon as favorable weather conditions appeared.


**FIGURE 5:** Aft working deck of 'Rockwater 2' outfitted with ROV launch and recovery systems (LARS's), portable power generators, coiled tube drilling equipment, sub-sea high pressure pump, and linear winches.

After closely monitoring the weather forecast, an acceptable window of opportunity finally presented itself. With seas less than 6 feet, the team commenced the relocation process by raising the Ehime Maru a distance of approximately 25 feet above the seafloor. (See Figure 6) With the vessel lifted, the ROV's maneuvered beneath the ship so that the area damaged by the submarine rudder could be inspected. The inspection confirmed that the structural damage was well within the estimates made in the feasibility study. All conditions were a "go" for relocating the Ehime Maru to shallow water.

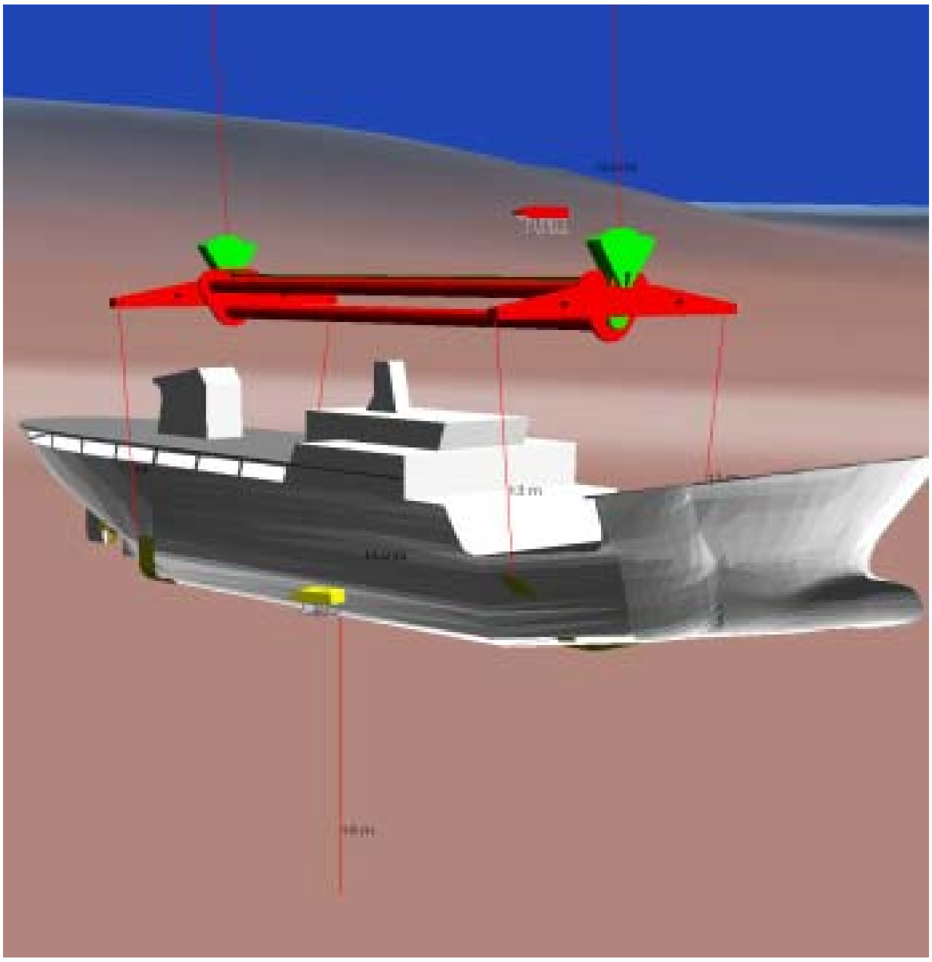


**FIGURE 6:** "XYZ Solutions Inc." Real-time animated graphic of the Ehime Maru being lifted at 2000 feet.

Transiting with an armada of other support vessels, the 'Rockwater 2' began its slow trek to the shallow water site. Ensuring there were no undiscovered problems with the lift, the initial transit speed was set at approximately 0.2-0.3 knots. Since the 'Rockwater 2' was outfitted with a dynamic positioning system for navigation and station keeping, this low speed was achievable. Once the team was comfortable with the lift arrangement, 'Rockwater 2's' speed was slowly increased to between 0.5-0.7 knots. Speeds were kept under one knot so that the dynamic loading on the lift system were kept to a minimum. Additionally, the speeds were kept low so that the Ehime Maru could be slowly raised with the winches as the 'Rockwater 2' approached shallower water. After completing the 13 mile journey, the Ehime Maru was successfully set down at the 110 foot shallow water site without incident.

The next phase of the operation called for the Mobile Diving and Salvage Unit ONE (MDSU ONE) divers to penetrate the sunken vessel and search for the missing crewmembers. After monitoring the ship for 48 hours to ensure it was stable, the navy divers began their difficult task. They did this by diving with surface supplied equipment that was staged aboard a 400-foot work and accommodations barge that SUPSALV hired from Crowley Marine Services. Using knuckle cranes with stages attached, the divers were lowered to the vessel. Once on the bottom, the MDSU ONE divers would then climb a ladder to gain entry into the ship. Working under low to no visibility conditions, they searched every compartment of the ship for the missing remains. After 29 days and 534 dives, MDSU ONE successfully recovered 8 of the 9 missing crewmembers as well as a significant number of personal effects. The project was now considered a success.

The last phase of the operation was to place the ship back out in deep water. Due to the cost of leasing the 'Rockwater 2' it was decided that the diving support barge provided by Crowley Marine would be used as the host platform. However, instead of using linear winches to lift the Ehime Maru from the shallow water sea floor, SUPSALV and Crowley opted to use ballast water to accomplish the lift. This was done by ballasting the barge down to a draft of 20 feet at the stern and then connecting the lower lift frame assembly to four chains that were suspended from the rear of the barge. Once connected, the barge was then deballasted to a draft of 13 feet. The lift went without incident and the Ehime Maru was successfully towed back out to sea and laid to rest in 8500 feet of water on 25 November 2001. (See Figure 7)

Despite all of the difficulties presented during this operation, the combined NAVSEA, CINCPACFLT, MDSU ONE and contractor team made history in carrying out this unprecedented recovery effort. The full impact of the success of the operation will probably never be truly known. However, what is already clearly apparent is that eight families of those nine unfortunate crewmembers have been able to bring home their loved one and that the ninth family has been greatly assisted in their grieving process. Furthermore, government to government relations between the two nations has dramatically improved. In the end, everyone who participated in the recovery has assisted in accomplishing a humanitarian act of kindness that will be remembered for a long time to come.

**FIGURE 7:** Crowley Marine Services "CMC 450-10" barge towing Ehime Maru out to sea.

**Author:** LCDR Gregg W. Baumann, NAVSEA Code 00C2O, Asst. for Salvage. LCDR Baumann served as a NAVSEA salvage engineer on the Ehime Maru project from February 2001 to December 2001.

# Contents

## Oral Session

# A USB XBT INTERFACE AND CLIENT/SERVER APPROACH TO XBT DATA ACQUISITION

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CSIRO Marine Research has recently developed a USB XBT interface and new software for XBT data acquisition. The small self-powered USB XBT interface offers a degree of portability not available with other XBT interfaces. An inter-comparison of XBT data collected using the USB interface, other XBT interfaces and a CTD are presented and the results discussed. As part of the upgrade of its XBT system, CSIRO has also developed a complete GUI based user interface for XBT deployment, quality control checking and bathymessage transmission. Communication between the XBT interface and user interface is via a socket based client/server system. The user interface (client) is written entirely in Java, making it system independent, whilst the USB interface (server) is Win 2000 based. The client/server approach offers the flexibility of the XBT acquisition system residing on a standalone computer, or on a networked system. In a networked environment (possibly via ship to shore link), remote real-time data displays and even remote XBT data acquisition become possible. The XBT data acquisition system also offers some novel approaches to the deployment process and quality control, such as audible prompts, immediate post-drop quality control utilizing climatology and animated/overlaid viewing of past and current drops. A brief overview of the data acquisition system is given.

# Accuracy improvement of ADCP mounted on R/V MIRAI

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## 1. Introduction

To estimate the performance of ADCP, the error caused by misalignment of transducer, ship's speed, accuracy of navigation has to be evaluated. The misalignment between transducer assembly and the ship's head cause a directional error of absolute currents. Navigation is also a major factor to determine accurate estimates the currents.

In adding, the acoustical circumference around a ship's hull is the most important issue. Since the performance of the equipment is greatly affected by the noise that the hull emits, the equipment cannot achieve the performance of catalog value. Especially, the sonar and ADCP, which acquire data under high speed cruising, is greatly influenced the noises hull emits.

The origin of the hull-making noise may be cavitations and/or wave making noise. The signal is attenuated by air bubble. To distinguish hull noise influence from the acquired data, the characteristic of the acoustical circumference around a ship's hull must be known. Some tests are examined to grasp the characteristic hull noise effect.

To improve the accuracy of ADCP, these errors were estimated by a various kind of tests. This paper describes error evaluation examined on R/V MIRAI.

## 2. Investigations

Following tests are examined to know acoustical characteristic of the instruments.

1. Bottom tracking test
   To Estimate misaligned angle between transducer and ship's head, the vessel's direction and current direction is compared.
2. Onboard quality check
   CODAS software is applied to check the quality of data on vessel.
3. High-quality GPS navigation
   To reduce the error of navigation, high-quality GPS navigation, GPS gyro is being investigated.
4. Calculation of hull stream
   Stream of hull is calculated to evaluate the way bubble flow. Pressure on the hull surface is also calculated to evaluate cavitations.

## 3. Conclusion

To improve the accuracy of ADCP, many tests are examined. Some of them are still being investigated.

# The maintenance and management of Argo floats

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The "Argo project," an international project launched in 2000, is a large-scale project to aim at making real-time measurements of variations in the ocean on a global scale. In this project, nearly 3,000 profiling floats (here after referred to as "floats") will be deployed in worldwide oceans to obtain vertical profiles of water temperature and salinity from the sea surface down to a depth of 2,000 m. Once deployed, these floats drift at a depth of 2,000 m, and surface every 10 days to transmit the temperature and salinity data collected during its ascent. After transmitting the data, the floats dive to a depth of 2,000 m.

Improvement of the precision of the onboard sensors is one of important issue for the Argo project. The present goal is to achieve a precision of 0.01 in practical salinity scale for salinity data and 0.005°C for temperature data; it is a great technical challenge to achieve this level of a precision. At the Japan Marine Science and Technology Center (JAMSTEC), we conduct maintenance and management of the float-borne sensors using a large calibration bath manufactured by SeaBird Electronics, Inc. before the floats are deployed at sea. Our calibration system for the float sensors and the results of the calibrations will be introduced.

The other important issue is "floats ballasting" work in a laboratory. Floats must reside at their parking depth set before the deployment and resurface without fail to transmit the collected data. To optimize the buoyancy of the floats, the density of seawater at the parking depth is estimated in advance, and "float ballasting" work is performed to provide the floats with neutral buoyancy at the parking depth when the bladder is at the designated volume. We will also introduce in this presentation practical methods of ballasting using high-pressure tank.

## Results from a one year deployment of an autonomous profiling system

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Category 1, subject 1a, subcategory c, oral

Future observational programs will aim at long deployment intervals and extended spatial coverage of the measurements taken. Accordingly new concepts have to be conceived and realised that will allow for cost efficient solutions to this goal. One concept that aims at high resolution measurements of parameters within the water column has been known for over 20 years and consists of an autonomous, profiling platform that carries a sensor suite through a pre-selected depth range along a mooring line. The advantages are apparent: Excellent coverage of the measuring parameters within this depth range and low bio- fouling on the sensors due to the fact that the system rests at the deep end of the mooring. The limiting factor of this approach is the amount of energy that can be supplied to the moving platform. Therefore different propulsion concepts have been realised and evaluated. Within the last ten years two competing concepts evolve: one where the platform has a direct connection to the mooring line as for instance the Woods Hole crawler and the other where the system has no direct contact and where the mooring line acts as a guiding line. The second approach employs a buoyancy change of the system to allow for locomotion along the mooring line. This latter concept, its mechanical and electronical realisation and first results of a one year mission will be described in more detail within this presentation.

**On the calibration equation for the estimation of SSC in the coastal sea from remote sensing data**

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There is no general agreement among the researchers about the best kinds model for the estimation of Suspended sediment Concentration (SSC) from remote sensing data. The majority of the proposed algorithms have been empirically derived from the regression analysis of SSC against remotely sensed reflectance. Values of SSC have usually been determined from filtration of surface water samples (within 1 m depth) obtained more or less simultaneously with the satellite over pass time. There are different forms of empirical algorithms (e.g., linear, logarithm and exponential). Though empirically derived algorithms provide predicted results with reasonable accuracy, it has number of limitations particularly for the coastal and estuarine water. Now a day, several researchers are using semi analytical model. Coefficients of these equations can be found directly through non-linear curve fitting or can be approximated adequately by exponential relationship (R vs. LogSSC) or power functions (LogR vs. LogSSC) or from the inverse relationship between reflectance and SSC. In this study, based on the relationship between remotely sensed reflectance and measured SSC collected within ± 30 minutes of satellite data acquisition time, an attempt has been taken to develop a physical based model for predicting SSC values in rivers and in the estuary and coastal sea, where average SSC is very high (e.g., Ganges and Brfahmaputra Rivers and in their estuary, where agerage SSC is <1g/lt). Reflectance values plotted against the measured SSC are extracted from ASTER band 2 data, which corresponds to red bands. Suspended Sediment Concentration (SSC) was estimated from the water samples collected from the Brahmaputra River around Jamuna Bridge and from Meghna River around Chadpur and Harina Ferry Ghat. These relationships could produce an error of about 15% between predicted and measured values. However, these calibrations equations produce higher correlation coefficient ($R^2$) values, ranging from 0.87-0.97. Different form of relationships between remotely sensed reflectance and other water clarity parameters (chlorophyll-q, salinity, secchi disk depth, temperature) were also examined for developing best kind of models to predict different water quality parameters.

## MULTIBEAM SYSTEMS ON AN ICE STRENGTHENED VESSEL

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The British Antarctic Survey (BAS) undertakes a balanced programme of scientific research in the Polar regions. BAS maintains 5 stations in Antarctica and two ice-strengthened vessels. One of the ships, the RRS James Clark Ross (JCR), has a dual role of supplying Antarctic stations and mounting scientific cruises in support of oceanographic, biological and geo-scientific programmes. In the year 2000 a multibeam echo system was fitted to the JCR. The installation of the equipment and the configuration necessary for an ice-strengthened vessel is presented. Data is now routinely acquired in polar regions up to sea state 10.

The JCR as commissioned in 1991 was not fitted with multibeam although a space for transducers was included. When a deep-water multibeam and sub-bottom profiler was fitted in 2000, transducer technology had progressed significantly. It became necessary to install additional 8 by 8 metre cavities to give a 1 by 1 degree array. To ensure the system could be used in ice, titanium windows were fitted. The installation required significant engineering and input and approvals from class society. High tolerance machining was necessary across the full length of the transducer housing to achieve accurate positioning of the arrays and hence high resolution bathymetric imaging.

The system was installed to enable the science community to undertake studies in polar regions of:

- Mid-ocean ridge structure, process and ecosystems
- Sedimentary processes and products on ocean margins
- Tectonic, volcanological and sedimentary processes around island areas.

The use of the equipment has now become routine and resulted in increased the demand for use of the vessel. Synchronisation of the pings over the full water column when using multibeam and sub-bottom profiler remains a challenge. Automation of the routine measurement of acoustic velocity of water has improved the accuracy of the depth measurements. Confidence in the equipment and operation of the system has enabled the equipment to be used for economic zone surveys as well as scientific studies.

## Developing new OBS

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In order to understand the deep structure of the earth's crust, JAMSTEC has carried out site surveys in the adjacent seas of Japan using multi-channel seismic survey system (MCS), and great success has been achieved. Nippon Marine Enterprises Ltd. (NME), which was established in 1980, operates four research vessels, deep submersible *Shinkai 2000*, and three deep ROVs owned by the JAMSTEC. Since 1997, the NME has been commissioned to operate the MCS from the JAMSTEC, and also commissioned to operate ocean bottom seismometers (OBSs) from 1999.

On board the JAMSTEC R/V *Kaiyo* and the R/V *Kairei*, the air-gun systems of "largest-in-the-world" capacity (capacity: 200 liter [24.6 liter×8 guns], pressure: 140 kgf/cm2) are installed. These vessels are used for the MCS reflection and refraction surveys, and correspond also to two-vessel reflection survey. The R/V *Kaiyo* conducts refraction survey using 100 OBSs at a time.

A total of 530 units of the OBSs were deployed between 1999 and 2002, and 514 units were recovered by sending acoustic command. Although the recovery rate of 97 % is not so bad, we are trying to increase it up to 99.5 %. In order to identify the reason of the failure, we are recovering those OBSs on the bottom as much as possible. As a result, three OBSs were recovered by ROV *Kaiko* in 1999, and one OBSs by ROV *Dolphin-3K* in 2000.

In some cases, the failure was caused by the malfunction of the transponder by leaking seawater into the pressure housing. The water came from the penetrator, or from O-ring seal of the pressure housing. In other case, there was a flooding into the glass sphere, which was thought both by human error and distortion of the glass sphere. Another reason for the failure was that one of the two electrolytic releases, which were connected in parallel, did not operate.

These problems should be coped with the first aid measure and improvement of equipment. Until now, the following problems remain. (1) A set of electrolytic release devices are connected in parallel. For this reason, it is unrecoverable unless both release devices operated. (2) Transponder battery life is too short (3 months), and transmission power is low (180 dB). (3) In recovering data, we have to open the glass housing. (4) While the recovery rate of the OBS is 97 %, data recovery rate is 93%.

As the present OBS system was developed in the University of Tokyo approximately ten years ago, we are planning to modernize the system in order to improve reliability and data quality. In 2000, advanced transponder, which is longer life and higher power than the present system was developed and is being evaluated. On the other hand, taking into account the above experiences, we designed advanced OBS, which is more reliable and easier to operate than the existing OBS.

## Improvement of Air Gun Array’s width for a quasi-3D Multi-Channel Seismic Survey by single streamer cable

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In order to understand the deep structure of the earth's crust, Japan Marine Science and Technology Center (JAMSTEC) has been conducting site surveys in the adjacent seas of Japan Islands using a multi-channel seismic survey system (MCS). Nippon Marine Enterprises, Ltd. (NME), which was established in 1980, operates four research vessels, a deep submersible Shinkai 2000 and three deep ROV’s owned by the JAMSTEC. JAMSTEC commissioned NME in 1997 to operate the MCS system and in 1999 one hundred ocean bottom seismometers (OBSs) were added for operation for seismic refraction survey program.

The R/V Kairei has installed on board an air-gun system of 200 liters in total capacity with 8 guns and pressure of 140 kgf/cm2, the largest in the world, and a 4000-meter long streamer cable to carry out the MCS reflection surveys. The air guns on both sides are shot by flip-flop mode to run two gun arrays at a time. The spacing of the air gun clusters towed on both sides in our system was only 65m in 1999. The towing width of the gun arrays should be more than 100m in order to do an effective quasi-3D MCS survey by a single streamer cable. Therefore, we started a program to increase the width of the air gun arrays up to 100m. Two paravanes, (height: 1.879 m, length: 4.755 m, width: 0.356 m, weight: 1045kg) made by FRAZER BOLT INC., are used to widen the air gun arrays towards the port and starboard sides.

The paravanes are connected to four chains and towed by a wire rope from the ship end. A water tank test was carried out at first, using a 1/10 scale model paravane to understand the basic characteristics. By varying the length of the four chains and towing speeds, we knew the best combination of the chains for the paravane. For the next step, we made a numerical simulation program of the towing system, which comprises the behavior of gun frames, umbilical cables and wire ropes, to estimate the best configuration of the towing system. The result of the water tank test and numerical simulation in July 2000 showed that we could expand the width of the air gun arrays from 65m to 72m. We conducted an experiment at sea in July and November 2000. In the November experiment at sea we succeeded in increasing the air-gun array width from 72m to 81m by changing the combination of chains and length of the umbilical cables. In the future we will look for some other ways to expand more the width of the air-gun arrays. Currently we are almost extending out the spacing of the umbilical cables up to 96m.

# Seafloor gravity measurement by use of manned submersibles

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Seafloor gravity measurement is essential in order to investigate detailed sub-surface structure underneath the sea bottom and to estimate the density structure of sediment and bedrock. Measurement by use of on-land survey systems (nowadays LaCoste & Romberg and Scintrex CG-3M gravity meters are mainly used) on board the deep sea submersibles is carried out for this purpose. Only a couple of measurements during one dive are available because it takes much time for the submersible to fix its position on the sea bottom at each time of the measurement by filling the trim tank by sea water completely. The level is not stable enough to get data with as much accuracy as we get by onland measurements. However, the accuracy is much better compared with that by surface-ship gravity measurements. The precision of the measurement is also much better because the measurement is carried out when the submersible approaches towards an anomaly mass beneath the seafloor. Ordinarily, the observed gravity value is at first converted to the free air anomaly reduced to the sea surface for further analysis. For depth correction, it is necessary to add -0.2222mgal/m, sum of the gravity effect by the sea water layer and the free air reduction (-0.3086mgal/m) which is used in the case of land as a correction coefficient. Measurement on board SHINKAI2000 and SHINKAI6500 was so far carried out in the tectonically active sites: in the southernmost part of the Toyama Trough and the adjacent Toyama Deep Sea Channel, over the two small knolls located in the southermost part of the "Fukaura Small Hills" off Oga Peninsula, in the WMARK area, western Mid Atlantic Ridge - Kane Transform intersection, etc. In these areas high-precision gravity anomalies higher than those expected from the surface-ship survey were obtained. Active tectonics occurring in these sites was discussed through the analysis of the obtained gravity data.

The YOKOSUKA/SHINKAI6500 “MODE’94” Leg1 cruise was carried out in 1994 in the western Kane active transform area in the slow-spreading Mid-Atlantic Ridge system. During the cruise, seafloor gravity measurement was carried out at 20 stations in total during 11 dives of 15 in the whole cruise together with the visual observation and rock sampling on the sea bottom around the WMARK ridge–transform intersection area. Bedrock density and its regional variation in the study area were estimated by these measurements. The amount of the 3D terrain correction for Bouguer reduction on the sea bottom was calculated by the sloping wedge technique by use of the digital topographic data used as the basis of the topographical map produced by HS-10 multibeam bathymetric survey system with the correction density 2.67g/cc. The Bouguer anomaly VS. water depth plot was obtained to get the average gradient of the linear regression lines for these areas to estimate the average bedrock density. The results along the Transform valley transect-N (north of a transform fault), Transform valley transect-S (south of a transform fault), and Median tectonic ridge show almost equal gradient. The basement rock density estimated from the gradient is 3.0g/cc, showing extremely larger density compared with that of an ordinary oceanic crust. It probably corresponds to an exposure of ultramaphic and plutonic rocks, such as gabbros and peridotites. The average density at the nodal basin near the ridge-transform intersection was estimated as 2.7g/cc, which is consistent with the observed exposure of volcanic rocks. Two kinds of interpretations can be considered about the result. First, the difference between the northern and the southern side of the active transform is based on the difference in products between the MARK and WKARK ridge-transform intersections. WMARK products (northern side) may be more volcanic rather than MARK products (southern side). However, as for the northern side, remarkable change of magma supply with a time is also to be taken into account.  Another possibility is that the volcanic rock layer of the surface was eroded by shear motion along the active transform fault, and plutonic and ultramaphic rocks, most of them are serpentinised were exposed, as observed on the southern slope. Considering that the transform fault is characterised by extremely thin crust as compared with the surroundings from the result of seismic and gravimetric studies, it is interpreted that there is little amount of supply of magma along the fracture zone.

# Seismic Data Acquisition for Gas Hydrate Investigation

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Gas hydrate has attracted much attention in recent years because of its potential to become future energy resources, and because of environmental concerns. Though the most direct way in studying the nature and development of gas hydrate is to conduct *in situ* measurements through drilling, and to obtain natural gas hydrate samples from sea floor or boreholes, however, due to the high costs of drilling and the scarcity of sea floor hydrates, gas hydrate investigations still rely heavily on marine seismic studies. The bottom simulating reflector (BSR) identified on seismic reflection profiles has long been used as an indicator for the presence of gas hydrate beneath the sea floor. Other seismic characters and velocity information derived from the seismic data have also been used to define the thickness of the hydrate-bearing sediment and to estimate the amount of gas hydrate in place. Here we propose a sei mic data acquisition scheme to collect variety of seismic data in an efficient way for gas hydrate investigation.

The survey instruments used in this scheme include: a 38 kHz or 12 kHz echo sounder, a chirp or 3.5 kHz sub-bottom profiler, a high-resolution multi-channel seismic (MCS) reflection system, and several short-period 4-component ocean bottom seismometers (OBSs). The sound source preferred for the MCS system and the OBSs is a small array of double sleeve guns (GI guns) that can generate broadband seismic signals with minimum bubble effect. The streamer used in the MCS system is a 600-m-long 48-channel solid streamer with 12.5-m channel interval.

For reconnaissance survey, OBS needs not be deployed and conventional seismic survey is carried out to identify the possible existence of BSR. Once BSRs have been found, the following survey plan could be implemented for gas hydrate characterization. First, OBSs are dropped around the gas hydrate concentrated area, then the MCS data are collected over the survey area in closely spaced parallel lines while the OBSs record all the shots from the sleeve gun array. Several tie lines that pass the OBS locations are necessary to provide cross-line correlations and seismic arrivals from different azimuths. The data sets collected using this approach could provide a wealth of information. The 38 or 12 kHz echo sounder data are examined for possible gas bubble plume detection, the chirp or 38 kHz profile data are used for mapping the gas hydrate related features on the sea floor and its sub-bottom, such as pot holes, pinnacles, mud volcanoes, gas vents, faults, etc. MCS data can reveal the distribution of the BSR and many characteristics of the hydrate-bearing sediment. Velocity information from MCS data provide clue to the thickness of the hydrate-bearing sediment and the free gas zone beneath BSR, while large-offset seismic data recorded by the OBSs provide further constraints to the velocity structure. Further analyses of the MCS and OBS data will enable us to better understand the nature of the gas hydrate and its physical properties.

# Evaluation of Quality of Sediment Cores:
## Comparison of Core Samples obtained by the Different Type Corers

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There are so many kinds of sediment corers. For the scientific study, a long and non-disturbed sediment core is preferable. In general, the piston corer has been used for taking a long core of more than 8 or 10 m long. To obtain the long core with high quality by the piston corer, the piston must be located at just on the sea floor and be worked smoothly according to the penetration of core barrel. If the piston would penetrate to the bottom sediments, the sediment surface would be missed and/or disturbed. In some cases, the loss was estimated from the comparison of the cored material and high frequency seismic reflection profile. On the other hand, the cored material had vertically elongated when the piston would work too hard. The loss, disturbance and elongation might occur in the upper part of the cores. In the extremely long cores more than 20-30 m long, the pressure decreasing from the original position to the normal atmospheric condition on the ship is another process for core disturbance, especially in the gas-rich sediments. The sediments spouted out from core barrel during taking the corer to the pieces. The sediment spout was recognized as the deformation and void of sediments.

The gravity corer without the piston has been used for taking short core of the surface sediments. The core penetration is controlled by the speed of penetration (free-fall length), diameter of the corer, posture during the falling and the characteristics of the bottom sediments. In case of the best condition, almost full recovery would be expected by our system (5 or 7 m long and 120 mm inner diameter). The core shortening, however, occurred sometimes in the gravity core sampling. Because of the friction between the inner wall of the corer and the penetrated sediments, the length of corer penetration is larger than that of the sampled core. That means the core barrel is choked up with the sediments during the later stage of core penetration. According to the choke, the deeper sediments would be missed. Also in the gravity corer, the remarkable distortion of thick sand and tephra (volcanic ash) layer occurred occasionally. On the other hand, the gravity corer could obtain the uppermost loose sediments, although some deformation occurred during the recovery of the corer to mother ship. Therefore, the pilot and/or multiple corers must be used for taking a high quality surface sediment sample.

To obtain the complete and long stratigraphic section with less disturbance from the sediment-water interface, it is better to use three kinds of corer at a site. That is, the multiple corer for taking a high quality sample including the sediment-water interface, the gravity corer for taking a less disturbed and deformed surface sediment samples of several meters long, and the piston corer for taking more long core sample. If the complete set of the samplings could not be done, the degree of core disturbance must be checked by several methods including visual observation, non-destructive measurements and imaging using X-ray, gamma-ray or magnetics, physical properties, and comparison of high frequency seismic reflection records.

# Zooplankton Sampling Technology in Southern Africa

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Plankton research in southern Africa has been conducted for about a century, currently focusing on fisheries management. Weekly to annual surveys are conducted along the coast to monitor the food environment of pelagic fish, the distribution of fish eggs and larvae, and primary and secondary production. Sampling gear ranges from simple to multiple opening-closing nets and mechanically and electronically operated single and rosette bottle samplers. For many years, particularly South Africa had to engage in the development of its own sampling gear and sampling platforms including research vessels thereby meeting world standards. Electronics and software developed for some of the gear ranks amongst the top worldwide. For instance, the Rectangular Midwater Trawl (RMT) 1x6, with a mouth area of 1m$^2$ and six nets, and the Magnum Rosette, a multiple 18-litre bottle sampler, were designed and built in-house to address specific sampling needs. The dynamics of the Benguela Current upwelling system has over recent years drawn interest from foreign countries to conduct research in the region. Especially Norway and Germany have made available their research vessels, scientists and sampling gear in various collaborative research projects. This has allowed local scientists to acquire a taste of some state-of-the-art sampling gear used elsewhere. The Hydrobios Multinet, Longhurst Hardy Plankton Recorder-LHPR and BIOMOC are among the gear operated in our waters. Zooplankton sampling technology in southern Africa is of a high standard but needs an introduction of gear and technologies used worldwide, thus allowing intercomparison of data.

# A new way of oceanographic watersampling

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Watersampling is an important and common activity during oceanographic expeditions. This should be done in an efficiënt, reliable and ergonomic way. Meeting physical, chemical, biological and geological quality standards is essential. Commercially available systems showed several drawbacks. Therefore a team of technicians at the Royal Netherlands Institute for Sea Research developed partly in cooperation with Technicap (France), a complete new approach. This resulted in the "NOEX"- watersampler, hydraulically controlled by an instrument called “Multivalve". The "NOEX"-watersampler meets the above mentioned quality standards, even ultraclean sampling for e.g. trace metal research is possible. In combination with the "Multivalve" a high degree of automation and reliability is realized. Efficiënt and ergonomic operations are standard now. With a simple mechanical interface traditional samplers and instruments as NISKINS's, GoFlo's, reversing thermometers, etc. can still be used. The "Multivalve" is designed for use with the Seabird 9/11plus CTD-system and Seasoft. A small Windows program is written for the automated emptying of the samplers prior to each CTD-cast.

## Conceptual Design Study for a New Long Coring System

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A conceptual design study for 50 meter long coring systems for selected UNOLS research vessels is underway at the Woods Hole Oceanographic Institution . Principal topics of the study include: dynamic ship stability assessments, description of structural modifications required to support system components, high performance synthetic rope evaluation and selection processes, potential winch designs, coring hardware development, and adaptive handling systems for the prospective vessels. Modeling efforts to predict corer performance have established a range of requirements for winch and rope specification and overall system configuration. An update on the progress of the project will be presented.

# Core Sampling Technology used on scientific drill ships

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Abstract

The coring techniques used in drilling technology are very different compared to ordinary piston coring systems for oceanographic research. The coring technologies from a drill ship involve connecting drill pipes to the ocean floor, using a drill/core bit to start coring, and continuously coring to the target depth.

Based on oil/gas and mining industry technology, the Mohole project started in 1961 using the drill ship "CUSS1". The Mohole project tried to recover materials from the mantle by drilling through the Mohorovicic discontinuity, but it was only able to drill 170m below the sea floor at a water depth of 3560m at that time. Then the deep ocean drilling/coring project resumed with the Deep Sea Drilling Project (DSDP) in 1968 using the Glomar Challenger. From 1985 until 2003 the project has continued with the Ocean Drilling Program (ODP) using the JOIDES Resolution, and the total drilling depth extended to over 2000m below the sea floor. There are many excellent results and discoveries from these projects. The Ocean Drilling Program will hand over to the Integrated Ocean Drilling Program (IODP) in 2003 and expand to include multiple drilling platforms, using a riser system for the first time in scientific drilling and a riser-less system.

This report introduces the coring technologies and tools in ODP/IODP, such as soft sediment coring tools, hard rock coring tools, pressure core sampling tools and core sampling tools for microbiology and so on using riser and riser-less technologies.

# Autosub – Past and Future Activities from an Observers' Viewpoint

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Autonomous Underwater Vehicles (AUVs) are becoming accepted data-gathering tools within the marine science research community and commercially within the hydrocarbon and cable markets. Technology can now provide vehicles with useful range and depth envelopes accompanied by an elaborate suite of sensors and data gathering instrumentation.

Autosub is one such example developed to meet the scientific requirements of UK marine scientists via the Natural Environment Research Council. The NERC is the major funder for both development of the vehicles and the science programmes that they conduct.

Autosub a 0.9m diameter, 7m long vehicle has completed in excess of 271 missions comprising 3596 km of track and since science programmes commenced in July 1999, there have been 89 missions, 2502 km of track, 1812 km of which has been unescorted, 550 hours of mission time and 6 ships used for support.

Many of the applications to which Autosub has been assigned have enhanced the capability of scientists to monitor and understand aspects of the oceans that are not possible with conventional research ships.

This paper will illustrate the past development, initial scientific programmes, future missions and challenges for the Autosub vehicles operated by Southampton Oceanography Centre.

# Research on the improvement of propulsion maneuvering system of SHINKAI6500 with experimental thrusters and automatic motion control

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A manned-submersible, SHINKAI 6500 of JAMSTEC has made great contributions to scientific research programs for 10 years since it started operation. However, demands for more sophisticated maneuvering capabilities, such as hovering in irregular currents and moving along a wall or a similar underwater object, have arisen in recent years.

Since the thrusters currently mounted on the SHINKAI 6500 were designed with an emphasis on quiet operation and straight-line cruising performance, their start-up response is rather slow. Moreover, as these thrusters are manipulated individually, sophisticated maneuvering is difficult, and at present complex maneuvers are left to the operator's skills.

Then this study was carried out as a basic research to develop the propulsion maneuvering system that enables quick motion and advanced position attitude control using multiple rapid response thrusters and to reduce the burden of operators by using automatic control with those thrusters.

First with a view to improving thruster response, experimental thrusters were developed and real sea test at which they were equipped with SHINKAI6500 temporarily was executed. It was ensured that the thrust and response of the experimental thrusters are adequate and they would sufficiently improve the motion response of the vehicle.

Second, a Doppler sonar was used as a positioning sensor, and the experimental results demonstrated that it would be capable of more detailed positioning than a conventional acoustic positioning system.

At last, the test of station-keeping control on the forward-backward direction was conducted as a basic investigation into the motion control of the vehicle using automatic control. Although numerous research papers have been published on the position and attitude control of underwater vehicles, most only discuss simulation results, with a small number backed up with model experiments. At any rate, experiments involving a real vehicle are rare. In this test, "optimum control" of modern control algorithm was adopted as an algorithm generally used, and in addition, the "Ossman's adaptive control" algorithm was used to better position control accuracy. The results shows that it is possible to keep position at the high accuracy that $2\sigma$ is 4~5mm.

# Borehole Re-Entry / Observatory Deploy ROV "BENKEI"

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Borehole is not a mere relic after recovering the core sample from the sea floor, but is scientifically very important "window" for monitoring the earth's interior. The use of any standard research vessel for re-entry and deploy of borehole observatory will be better than use of drilling vessel because the re-entry operation is not a major task for the latter.

Thus, JAMSTEC (Japan Marine Science and Technology Center) developed a borehole re-entry / observatory deploy ROV "BENKEI" in 2000, which is launched from JAMSTEC's research vessel "KAIREI". "BENKEI", as shown in Figure 1, mainly consists of the Vehicle, the Observatory Station, the Borehole Sensor, and the on-board controller. Besides them, such major on-board equipments as the primary tether cable, the winch, and the heave compensator are already fitted on "KAIREI" for the operation of ROV "KAIKO". The maximum operational water depth of "BENKEI" is 6,000m, and the maximum borehole measurement depth is 1,000m beneath the sea floor.

Figure 1, Apparatus of "BENKEI".

The key features of "BENKEI" are 1) to transport the ultra heavy weight observatory, 2) to lead the instruments into the borehole while maintaining the pinpoint position at the sea floor, and 3) to softly launch and recover the instruments at the sea floor. The Borehole Sensor, at present, equips the mechanical caliper, the pressure sensor, the temperature sensor, the pH sensor, the TV camera with the lights, and the hydrophone, to investigate the borehole condition as the pre-survey before deploying the long term observatory.

One of the basic operation scenario is as follows; 1) to confirm the borehole location using the Vehicle itself, 2) to deploy the Station and the Sensor into the re-entry cone at the sea floor, 3) to measure the borehole condition on real time with the communication line, that is fiber optics, connected between the Station and the Vehicle, in case of the communication line cut-off, 4) to leave the Station and the Sensor at the borehole to start the automatic measurement for short term, and finally 5) to recover all the system from the borehole.

"BENKEI" is strongly expected to be applied for such borehole science as the seismology, the hydrogeology, the geochemistry, and the sub-surface microbiology, which all need the long-term observatory. Reflecting these recommendation and requirements, we are planning to develop sets of the Station and the Sensor suitable to each scientific purpose, and presently, we are developing the borehole seismic observatory that will be deployed into the borehole in the Indiana Ocean by "BENKEI" in 2005 as the collaboration program between Japan and French.

# Experiments of an Autonomous Underwater Vehicle "Urashima"

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Recently, an autonomous underwater vehicle has been developed that is expected to be used to conduct underwater surveying in unexplored areas such as frozen seas and areas around marine volcanos that are dangerous for a manned submersibe. Marine Science and Technology Center (JAMSTEC) completed an autonomous underwater vehicle "Urashima"(hereafter called AUV) in 2000. This AUV is an experimental one for investigating engineering issues such as precise navigation, electronics and energy source for a long-range cruising to develop more practical AUVs in the near future. The AUV equipped a multiple water sampler, a conductivity temperature dissolved oxygen (CTDO) sensor, a side scan sonar and a digital camera. Multiple seawater sampler collects up to 200 samples in 200ml bottles for scientific investigation.

The precise navigation in underwater is based on an inertial navigation system (INS). It measures motion of body in 6 degree of freedom and calculates position in every moment. Its motion sensors in the INS are composed of the high accuracy ring-laser gyros and acceleration sensors in triaxis strapped-down method. To improve position accuracy, the system is added another sensors. A doppler sonar in the body bottom directly measures its velocity to decrease errors in speed caused by INS and the depth of AUV is measured directly by depth sensors. As a result, a positional calculation with high accuracy can be expected more than the cases to use INS alone. However, it is an insurmountable difficulty to ignore the accumulated position error in long time operation by enviomental disturbances. Therefore, it is not enough to enhance underwater time of the AUV, because of its position uncertainty. To correct the position error, a homing sonar was developed and mounted on the AUV. It measures a slant range and a bearing angle to an acoustic transponder deployed at a known location and has a capability of 10km detection range, as same as a super short base line acoustic positioning system. A distance between two transponders is decided by position error rate of the AUV and the detection range of the homing sonar.

The AUV is programmed to refer an information file called "scenario", which works as a navigator including passthrough points, locations and reply frequencies of transponders and sampling missions. A scenario is made up in every time and download to computers based on VxWorks in the AUV before launching.

In sea tests, we equip an AUV console system in two 10ft-containers onboard the support vessel "Yokosuka" (4,439GT: hereafter, called "support vessel"). The console is composed computers based on Microsoft Windows, three kinds of communication system (acoustic, optical and radio) and power sources.

Every component such as propulsion and observation system in the vehicle is checked before diving, and engineering and scientific data collected in underwater is gathered after recovery by using this console. Arriving at test area, we deploy transponders and decide their position by the onboard acoustic positioning system (ANS) of the support vessel combined with a Differential GPS receiver. We measure conductivity and temperature profiles by a XCTD probe to calculate seawater density that is useful to adjust the buoyancy of the vehicle. The support vessel is also a carrier, the AUV is launched and recovered by the A-frame crane as same as the Deep Submersible "Sinkai-6500" operation.

Informations including speed, heading, INS, consumed electric energy and sensor data etc. of the AUV are up-linked to the support vessel through digital acoustic and/or optical communication system and they are watched on displays in the console during autonomous cruise. The AUV will cruise alone, but these real time data in test phases is precious not only to improve the system, but also to avoid some unexpected motion of the AUV. In some cases, the vehicle is also able to be controlled manually to give commands from the console. Sea tests began in June 2000 and two masterpiece results are followings.

1) The AUV was dived down to the maximum operation depth 3,500m in 2001.
2) The AUV was cruised autonomy over the range (100km) in design at 800m depth along 4 acoustic transponders (deployed every 30km), supplied electric power by lithium-ion batteries in 2002.

The AUV is positioned by itself described above, still more, the AUV position is measured by the ANS. We can obtain two AUV tracks measured by different method and the ANS track is effective in engineering to estimate the INS position drift during a test.

In addition, we designed a low noise reduction gear to improve the acoustic communication range. Results of the new helical reduction gears, its noise level was decreased 16dB compared with spur gear in an acoustic tank. In the sea test, acoustic communication was successfully over 3,000m depth when a thruster was operated.

# The Deep Sea Research ROVs of the JAMSTEC

**- Special feature and the main result at the operation -**

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JAMSTEC has three ROVs (Remotely Operated Vehicle) for deep-sea research, the DOLPHIN–3K, the KAIKO and the HYPER DOLPHIN. They have different features but have a one common point that Japan had challenged, not only to create a new underwater technology for deep-sea research but also to make the best ROV in each construction.

The DOLPHIN-3K, a 3000m class ROV, is the first largest work class ROV for deep-sea research in Japan and the state of the art technology was adopted in those days. It was developed in 1987 for scientific and rescue mission of the manned submersible SINKAI 2000 and has been working for various scientific missions ever since. It is theDOLPHIN-3K which established the ROV operational skill for the deep-sea research in Japan.

The KAIKO, constructed in 1995, is currently the only one ROV that can approach the deepest bottom at a depth of 11,000m. The KAIKO system consists of two under water robots called Launcher and Vehicle, two cables and cable handling systems. The superior ability of the KAIKO was proved by various conditions of the operations. By the success of the KAIKO completion, Japan showed one example of the form of full depth ROV to the world. At the scientific survey, the KAIKO discovered many new things in deep sea of over 6500m, in addition to the famous hydrothermal vent in the Indian Ocean. It was also used to search the artificial objects in the deep-sea. Further more, it established a long terms deep-sea observatory system named VENUS in off Okinawa Island in1999.

The HYPER DOLPHIN, a 3000m class ROV, was built in 2000. This is one of the market model ROVs but it is equipped with a special TV camera, called the Super HARP (High Gain Avalanche Rushing Photo-conductor) High Definition TV camera. The camera, developed by JAMSTEC and NHK (Japan Broadcasting Corporation), has the highest sensitivity and highest resolution in the world. This makes precise visual observation on ecological studies possible, which had been impossible before. And the camera makes the ROV operators and scientists feel at a live performance. From now on, the HYPER DOLPHIN is going to open a New World for the deep-sea research.

JAMSTEC's ROVs rustle in the ocean all over the world and keep challenging to make clear the unknown world in deep-sea frontier.

# PRELIMINARY DESIGN AND OPERATIONAL CONCEPT OF A DEEP-SEA UNMANNED UNDERWATER VEHICLE

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In May 2001 Korea Research Institute of Ships and Ocean Engineering (KRISO), an ocean engineering branch of the Korea Ocean Development and Research Institute (KORDI), has launched a project supported by the Ministry of Maritime Affairs and Fisheries (MOMAF) of Korea. The aim of the project is the development of an unmanned underwater vehicle (UUV) system, which will be operated up to 6,000m depth for various scientific researches, especially survey of the ocean around the Korean Peninsular. Because MOMAF wants an underwater vehicle which is capable of long-range survey, long-term observation, and precise works in harsh environments (strong tidal currents and high turbidity) around the Korean Peninsular, KRISO has decided to develop a specially designed UUV system which is composed of a launcher, an ROV, and an AUV. The brief design and operational concept of the system is as follows.

The launcher, which has a role of depressor of the whole system, will be connected to a support vessel via cable through which data communication and supply of energy will be performed. For the localization of the UUV, the LBL method will be used. After the UUV reaches a desired survey area, the ROV, which is attached under the launcher will be released and recovered after specified missions. For this purpose the launcher will be equipped with a drum being capable of managing the tether cable and a docking device for the ROV at the lower part. This operation concept is similar to KAIKO of JAMSTEC or JASON of WHOI. The ROV will be equipped with additional thrusters to improve the maneuvering performance of the vehicle in strong current. It will be also equipped with cameras and manipulators for various underwater works and an SSBL system will be used for its navigation and control. KRISO is also considering the possibility for the ROV autonomously doing light works without cable connection in future applications. While the vehicle system will be operated in this ROV mode in general, it will launch the AUV at particular situations, for example, when long-range survey is required. This will make it possible to survey wide area near a limited space where ROV works. For the launch and recovery of the AUV, the launcher will be equipped with additional homing and docking devices. At this stage KRISO is considering using both vision and acoustic sensors for autonomous reliable navigation, control, homing and docking. The acoustic sensors will be also used for the communication between the launcher and the AUV. The AUV will be able to be re-launched in deep-sea after recharging the power, saving the data and reloading control programs. The AUV will be designed as small as possible to minimize the size of the launching device. In the presentation the preliminary design results of the UUV and the operational concept will be described in detail.

## Deep-Sea current meter moorings: a review of hydrodynamic aspects and design criteria

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For more than thirty years oceanographers have used moored instrument to measure physical parameters in the sea. The “classical” way to measure current speed is to use rotor/propeller equipped instruments. The speed is acquired from the rotation of the rotor/propeller and the current direction is most commonly obtained by mounting of a vane assembly that directs the instrument into the current.

A more recent generation of current meters measures current speed and direction without moving parts using acoustic frequency-shift.

Recent comparative deep-sea (more than 2000 m) measurements with rotor and acoustic backscatter instruments on long moorings (several kilometres) have shown that differences in measured current speed and direction occurred occasionally. Common features when differences took place were that the current speeds were low (below 10 cm/s) and the instruments were mounted on long moorings.

Long moorings are used to study circulation at different layers in the deep ocean. Several instruments are attached on a mooring line, which often is several kilometres long. Different organisations have different techniques and preferences when they construct their moorings. The construction of a long mooring is a reflection of the particular aim of the study, the depth and conditions at the study site and the “traditions” of the organisation that is doing the study.

In this presentation the reason for why differences between mechanical and acoustic backscatter instruments occur will be discussed. Data from several comparative deep-sea measurements will be presented along with information on the modelled hydrodynamic performance of long moorings. A short summary of different design criteria and materials used by several organisations world wide will also be presented.

# Abyssal Operation in the Inner Space for Geophysical Observatories and Biotechnology - MODUS (Mobile Docker for Underwater Sciences) for the European Research Projects GEOSTAR, BIODEEP and others

Ing. Hans W. Gerber

Contents of the contribution includes a brief survey about the EU-funded projects GEOSTAR 1 and 2 (Geophysical and Oceanographic station for Abyssal research), which was dedicated to long-term monitoring on the sea floor with a bottom station as sensor carrier including underwater and surface communication systems for real time control and communication with the station. Moreover, with the development of the deployment and recovery tool MODUS, that is able to carry loads of max. 3 tons down to 4000 mwd. The operation of MODUS in the EU-funded project BIODEEP (Biotechnologies from the Deep) demonstrating its modular abilities for sampling in the HSAB (Hypersaline Anoxic Basin) in the Eastern Mediterranean Sea. In addition binational projects (Italian-German) as GNDT (Gruppo Nazionale per la Difesa dai Terremoti), MABEL (Multidisciplinary Antarctic BEnthic Laboratory) and future uses will be presented using the technologies and methods of GEOSTAR in the Mediterranean Sea and the Antarctic. Finally ORION (Ocean Research by Integrated Networks) the most recent EU-funded project will be presented. This is dedicated to set up a observatory net work including communication and new technologies for sensor burial in the deep sea soil.

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Key subjects

(1) Data acquisition technology, this category includes four sessions in which the technologies used to collect oceanographic data and samples will be introduced and discussed.

(1-a) Oceanographic Observation Technology

The following topics will be discussed in this session:

- (a) Maintenance / improvement / calibration / development of oceanographic instrumentation
- (b) Methodologies for analysis
- (c) New technologies for observation

(1-b) Meteorological Observation Technology

The following topics will be discussed in this session:

- (a) Maintenance and calibration of instruments
- (b) Platform harassment
- (d) Combination of satellite and in-situ measurements

(1-c) Geophysical Observation Technology

The following topics will be included in this session:

- (a) Shallow and deep water bathymetry with multi-beam echo sounders,
- (b) On board gravity and geomagnetic measurements,
- (c) Reflection and refraction seismic surveys,

(d) Narrow band and broad band ocean bottom seismometers,

(e) Ocean bottom electro-magnetic measurements etc.

**(1-d) Sampling Technology**

The following topics will be included in this session:

(a) Technologies used to **collect** oceanographic **samples for** chemical, geological, and **biological studies** will be discussed. The samples include sediment, rock, marine organisms, **seawater**, and suspended matter

(2) Handling and Operation of instruments, this category covers broad areas, including three sessions on manned and unmanned vehicles, long-term monitoring, and ship operation technology.

**(2-a) Manned and Unmanned Vehicle The following topics will be included in this session:**

(a) Manned submersible

**(b) Remotely operated vehicle (ROV)**

(c) Autonomous underwater vehicle (AUV)

**(2-b) Long-term monitoring**

The following topics will be included in this session:

(a) Autonomous **monitoring systems** moored in the ocean, or **on the ocean floor** will be discussed. The systems include surface moored buoys, sub-surface buoys and **seafloor observatories**. Systems that collect oceanographic samples such as sediment traps will be also presented.

**(2-c) Ship Operation Technology (ship, observation equipment, winch etc.)**

The following topics will be included in this session:

(a) Ship operation and manoeuvring under difficult condition such as rough weather, high latitude or icy environment. **Cranes** and oceanographic **winches** are also included in this session.

# Operation of TRITON buoy array:
# I. Problems due to human activities

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The large-scale air-sea interaction over the warmest sea surface temperature region in the western tropical Pacific Ocean called “warm pool” affects the global atmosphere and causes El Nino phenomena. In order to understand occurrence mechanism of El Nino phenomena, Japan Marine Science and Technology Center (JAMSTEC) is actively engaged in long-term oceanographic and meteorological observation with a moored surface-buoy array in the equatorial region since 1998. The array is named the TRIangle Trans-Ocean buoy Network (TRITON) and the buoys have been deployed in the western equatorial Pacific and in the eastern Indian Ocean.

The TRITON buoy is equipped with meteorological and oceanographic sensors. The sensors measure every 10 minutes. Those data are averaged for 1 hour and transmitted via the ARGOS system. When the data come into the Mutsu Institute of JAMSTEC, the quality is checked and the validated data are sent to PMEL. After receiving the TRITON data, PMEL integrates them with TAO data, and creates common format gridded data. Then, JAMSTEC and PMEL distribute the data from their web sites.

The TRITON buoys have encountered major problems. Most of the damage (broken tower, broken antenna, broken meteorological sensors and cut underwater cable) were caused by some vessel mooring to the buoy and possibly towing it. The engineering improvements have been made to make the moorings more robust as the countermeasure of these problems. As the result of these engineering improvements, the major problems of the TRITON buoys have decreased.

# Operation of TRITON buoy array:
# II. Maintaining, deploying, recovering and repairing of TRITON buoys

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The TRITON program aims to obtain the basic data for the better understanding of El Nino and variations of Asia-Australian Monsoon system. Japan Marine Science and Technology Center (JAMSTEC) entrusts Marine Works Japan, LTD (MWJ) with the tasks of sensor maintenance, deployment and recovery of TRITON buoys and the data management.

Meteorological and oceanographic sensors such as barometer, anemometer, CTD and so on are calibrated before and after deployment and daily quality check of the data from TRITON buoy are also carried out at Mutsu Institute for Oceanography of JAMSTEC. Recovery and deployments of the TRITON buoys are done using mostly by R/V Mirai and occasionally R/V Kaiyo. We have already deployed 18 TRITON buoys at 18 stations; those are six stations along 156E, three along 147E, four along 137E and 138E, three along 130E, one oat 5S, 95E and one at 1.5S, 90E.

The TRITON buoys had some damages by human activities. The worst example is that no data was transmitted from a moored Triton buoy because the installed meteorological sensors, antenna for data transmission, battery, and data transmission system were stolen. We carried out various restorations using chartered boats. In the presentation, we introduce the procedure in detail of maintenance, deployment and recovery of the TRITON buoys and also restorations of the damaged TRITON buoy.

# An approach for Mobile and real-time observation on the seafloor

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The submarine cable connected earthquake monitoring system is one tool for observation and had been deployed typical seismogenic zones around the Japan since 1970s. Although, high efficiency seismic observation requires a high-density seismic measurement network, there is considerable technological difficulty in deploying as many sensors on the seafloor as on land. The existing observation network is still small scale and insufficient for an ideal observation network covering Japan. To solve this problem, JAMSTEC developed an expandable and replaceable satellite measurement station called the Adaptable Observation System (AOS) and designed the newest cable system to extend the existing cable observation using this system. The AOS is a battery operated mobile observatory connected to the backbone cable system by the thin fiber cable to ensure real-time data recovery. The system consists of a branching system, a junction box, a fiber cable, and a battery system for 6-month operation. The branching system is a part of backbone cable system and the other equipment make up the observation site. Installation and construction of the AOS will be conducted by a towed vehicle and an ROV. Submarine thin fiber cable is too delicate to install to the seafloor from the sea surface as same manners as backbone submarine cable. It is necessary to use some device to lay the cable right above the seafloor. The thin fiber cable laying system was designed to store more than 10km of thin fiber cable in a cable bobbin and to maintain the tensile strength in the cable laying operation. Installation and construction of the AOS were conducted at the Off-Kushiro-Tokachi area by the underwater vehicles in JAMSTEC. The first trial of this system were successfully operated and confirmed the efficiency of mobile observatory in the 6 month observation. We believe this kind of system is a powerful too for future real-time seafloor observation and provides a chance to extend existing seafloor networks from in line to a wider area.

## Use of sediment profile imagery for the *in situ* observation of invertebrate infauna


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Advancement in our knowledge of marine benthic community structure has necessarily relied upon sampling devices that destroy the *in situ* relationships between organism and sediment. The use of Sediment Profile Imagery (SPI) avoids loss of such information and is increasingly being used in routine benthic monitoring and mapping exercises in shallow coastal waters. In recent years, a number of adaptations to the basic SPI system has led to a family of profiling cameras, each customised to suit the individual needs of the operator. Using data obtained in shallow water I show the utility of this technology for the *in situ* examination of organism-sediment relations and discuss the application of the same technology to examine ecological phenomena in deep water and on cabled network arrays.

# Handling the 7m AUV Autosub Without the Need for Launching Small Boats

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Autonomous underwater vehicles (AUVs) have now been under development for some 10 to 15 years and are beginning to prove themselves in real scientific and survey applications. Autosub is one such example, funded by the UK Natural Environment Research Council's (NERC) and hosted at the Southampton Oceanography Centre (SOC), it is 0.9m diameter, 7m long and has a flooded weight of 3.5T. Since AUV's present a new way of working at sea, the development of launch and recovery systems have also had to evolve in parallel with the vehicle. The recovery of any remote equipment at sea can be fraught but AUVs present added problems:-

- There is no initial line between ship and AUV.
- An AUV, of necessity, is lightweight in construction
- The recovery time may be several days after the start of the mission during which time weather conditions may have deteriorated considerably.

The SOC developed the idea of using a cradle fitted with winches to be part of a deck-mounted gantry with an extending boom. A cradle mounted on the boom comprises two hydraulically driven winches to lower or raise Autosub. The cradle is fitted to a rotating head for turning Autosub athwart ships and for untangling twisted lines. The combined cradle and boom traverse makes for a total vehicle movement of 4.2m outboard and 5.2m inboard giving a safe working area around the vehicle while on board and a healthy clearance between ship and Autosub for launch or recovery.

Prior to launch, the vehicle is winched up into the cradle and driven to its furthermost point from the ship and rotated athwartships. The vehicle is lowered into the water, as winch lines become slack, two release pins are snatched via the handling lines and Autosub is free from the ship. The mission is started by a radio command from the ship and the vehicle is free to start its surface run before diving  Once submerged, the vehicle depth, heading and altitude data is sent to the ship by an acoustic link to ensure the mission has started as intended, after which the ship often will move to another area for carrying out other science work in parallel with the Autosub work.

*For location at the end of a mission, Autosub is equipped with satellite ARGOS beacons, transmitting latitude and longitude with an accuracy of one km, these positions are transmitted to the SOC and forwarded to the ship's fax machine. For location at shorter ranges (within 5km), there is a radio Gonio directional finder to receive the ARGOS transmissions and flashing beacons for visual location. Having achieved location of the vehicle, a radio command is sent from the ship to release a float with a 50m light line from the vehicle. The line is grappled and pulled aboard and attached to two 30m recovery lines (for a two point lift) stowed in the vehicle. The recovery lines are connected to the winches, the cradle swivelled athwart ships and the slack line winched in. At this point, the ship makes way at about 0.1 to 0.3m/s, preferably on a bow thruster, to keep lines and vehicle strewn behind the ship. As the vehicle is winched closer to the ship it is possible to control it rather like a two string kite, i.e. winching in the port line will cause the vehicle to veer to port and vice versa. In this way* *the vehicle can be controlled to be in line with the gantry before the final lift.  Once clear of the water, it is gently winched into the cradle, the cradle swivelled 90 degrees to bring it line with the ship and the boom brought in.*

The Autosub gantry has operated off the side and stern of ships that were carrying out conventional trawl survey work and demonstrates the ability of AUVs to work in parallel with other scientific programmes.  The two year scientific programme encompassed working on six different ships and covering 2500km of missions, 1800km of which were unescorted.

# Winch Operations and the CLAM SYSTEM

**(Cable Logging And Monitoring)**

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Today, with the requirements of having to provide adequate training to staff and to ensure that all operations are conducted in a safe and reliable manner as well as recognising the implications of litigation should an accident occur, the use of deep oceanographic cables must be addressed as well as providing suitable training for the winch operators. This paper will explain the criteria that we operate our cables to and will look at a system that was designed specifically to meet these requirements and to assist the winch operators to perform their duties. I have also developed a detailed training course for winch operators that I will explain briefly at the end of this presentation.

Legislation says that cables used for lifting must be used with a factor of safety (FOS) of 5:1. This means that the maximum working load of a cable must not exceed one fifth of the cables breaking load. In reality, this criteria makes operating oceanographic cables to full ocean depth an impossibility. Chivers 1944 addressed this problem when Lloyds accepted his proposals as a recommendation. The main recommendations were that a peak cable load must not exceed a FOS of 2:1 and a mean working load must not exceed a FOS of 2.5:1. It was also recommended that the data be logged on a computer and that the 5:1 FOS should apply for any operations whilst the ship is tied up in port.

To assist in complying with these operating recommendations and to make it easier for the winch operator to work within these limits, a dedicated system was developed. The Cable Logging And Monitoring (CLAM) system was designed and has subsequently been installed on two of our ships. The CLAM system monitors the cable tension and the amount of cable payed out. This data is time stamped and written to a large cyclic file. Various instruments can be interfaced to the CLAM System; depth, CTD (pressure and altimeter), time and inclinometer. The display shows cable tension, cable out and cable speed as the main parameters. A graph of tension against time is also shown on the display, which proves very useful for most bottom operations. The pressure and altimeter data from a CTD instrument can be displayed, which simplifies stopping the winch to collect samples at the correct water depth. Other parameters displayed are, time, date, depth, inclinometer, various alarms and when necessary all the cable’s physical parameters can be shown.

The CLAM System is housed in a 19” rack mounted workstation with the software written in such a way that it becomes a turnkey operation. The unit is turned on and the system automatically comes up running. Similarly at the end of operations the F10 key on the front panel is pressed and the system shuts down; no mouse or keyboard is required.

The training that we provide for winch operators is formal with a course covering the theoretical aspects of winch operations followed by a written examination. This course covers many aspects of winch operations, some being; communications, the cable’s physical parameters, aspects associated with an instrument package moving through the water and the responsibilities that fall on the shoulders of the winch operator. Practical training is also given where the trainee has to complete at least three operations unaided before having that aspect signed off as being competent. The training record book travels with the owner, wherever they may be working.

This CLAM System has proved very popular for aiding the winch operator and to make the gathering of oceanographic data more successful.

# KYT
# (TRAINING TO PREDICT DANGER)

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Human was doing hunting freely long ago and at first walk erects by using the fire.
On the other hand, danger was entailed too. However, there was a shrewd thing in the sensitivity, which faced danger for that. I believe that human makes progress, and reaches the
Present because sensitivity to face dangerously is sharp.
However, that sensitivity to dangerous can't notice that dangerous to be dangerous because sensitivity to dangerously can't cope with rapid material civilization development. Therefore, a
Serious accident resulting in injury or death breaks out frequently. 4years front, based on the ISM code, our company made the SAFTY MANEGEMENT SYSTEM MANUAL for the purpose the safety of the life and vessel, and the ocean environment. Therefore, an accident doesn't happen until now. KYT is done to continue this no accident and now it carried out by each ship of our company management. KYT is doing in a short time, for exsampleon the rest time.
How to advance KYT.
1ROUND
We announced with seeing the illustration danger lurking, put ourselves in to that illustration, and discover the danger factor lurk in that, (he get hurt like this, because he does so.)
2ROUND
Select out the most important danger in the announced opinion.
3ROUND
We announced countermeasure plan "I do like this." About that most important danger.
4ROUND
We narrow down the high quality countermeasure from that, and decide it important item "We do like this."
When KYT was carried out, shamefulness disturbed it, and an opinion couldn't be said easily with real intention. I found in this KYT that how it is important mood-making inside the ship where an opinion can be contributed with real intention. I believe that consideration and look after to the subordinate is change their behavior, teamwork and vitality are produced. And I believe to grapple with real intention "if such a mood is full in the ship, though this is based on its boss personality and humanity as well.
A Company must do various safety countermeasures in the hard side and soft side because a company is responsible as a businessperson though KYT has just begun recently by dealing of the company. But we must always think of it because we are not carrying out KYT for the company but for myself, for my family and an injured person is not taken out from the company. But it is consequently good for the company. Therefore because it is absolutely forced, I think that I must have the mood-making which makes it set up a will.

## Recovery operation of Transponder Mooring System for the Ocean Acoustic Tomography using the Rescue Rope System for the "Shinkai 6500"

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In case the "Shinkai 6500" is trapped on the deep sea floor, the support vessel "Yokosuka" is ready to recover using the rescue rope system. The support vessel "Yokosuka" uses the rescue rope system to recover the "Shinkai 6500" in case of an emergency. The rescue rope system is composed of a 400 meter long trawling rope with 5 grapnel anchors, a 8,000 meter long towing rope,16 millimeter in diameter, and a winch system.

A rescue drill by the "Yokosuka" has been carried out every year since 1998 to maintain the skill of the crew. We usually set up the transponder mooring system on a 3,600 meter deep sea floor as a target for the drill. In 2002, we tried to recover the transponder mooring system for the ocean acoustic tomography, which did not ascend yet, at a depth of 5,100 meters near the Japan Trench.

We started the operation at 7.00 am to pay out the towing rope. After the trawling rope reached on the bottom, the "Yokosuka" steamed in a circle at a diameter of 2,600 meters, and turned around three times minesweeping, which took 5 hours and 30 minutes to complete. The operation was finished at 6.30 pm. We have achieved to recover the transponder mooring system successfully.

## Operation of the Hybrid Anti-Rolling System on Board the R/V Mirai

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The hybrid anti-rolling system has a computer controlled moving mass (100ton), and reduces the ship’s rolling under rough sea, by moving the mass in horizontal direction to the port/starboard side on board.

When the mass moves on an arc shaped rail, it acts as a “pendulum” due to gravity against the ship’s rolling. As sensors detect the ship’s rolling, the mass reacting against the wave forced moment is optimally driven by computer-controlled electric motors. By adopting the hybrid type, which combines the pendulum type passive mechanism with the motor used active control, an enormous effect of anti-rolling can be achieved with small energy use. [Photo 1: hybrid anti-rolling system.]

Its effectiveness has been verified in various navigation conditions from zero-speed to full speed; therefore, this system has proved to be the most suitable anti-rolling system for observation and research vessels that encounters various navigation conditions.

This new anti-rolling system was equipped on board the oceanographic research vessel Mirai (8,687GT) in 1997. Since then, we have been obtaining system operational data, together with rolling and wave height data at various Sea States. [Photo 2: R/V Mirai ]

The system is operational up to Sea State 6, which is about sixty percent of the ship time, and it can reduce rolling motion approximately by forty percent. We confirmed that the system functioned very well with high reliability.

We introduce this new system's performance, its ability by analyzing operational data and sea condition data, and its operational achievement.

# Ice Navigation

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1. Introduction of R/V “MIRAI”

Introduce the world largest class research vessel “MIRAI” and explain her ship’s particular and characteristics in terms navigation and ship operation. And the organization of ship’s personnel when in obseravation will be explained too.

2. Ice Navigation

“MIRAI” made arctic cruises 3 times in the past and she is in the arctic ocean at this time. “MIRAI” has an ice-strengthened body, but she is not an icebreaker and ices are still very dangerous for her hull and propulsion system.

1) Dangers in icy water

Collision with iceberg : The most dangerous ice is the one called “Growler”, which is 20 sq. meters big and height less than 1 meter. It surely makes a hole on ship’s hull when ship collides with high speed.

Loch up : Ice movement is sometimes unpredictable. Even when ship stays in open water, you should not feel relieved. If once weather changes, ice floes might be blown down around the ship and ship might be locked up.

There are other dangers in icy water such as pipe freezing, ice clogging in sea suction, damages to propellers and so on.

2) Prediction of ice

To predict ice appearance we have to collect the information published by NOAA, Naval ice center or other information center available. There also some sings like ice blink above the ice field or floating ice fragments before entering icy field.

3) Rules for ice navigation

There are some rules you must keep when navigate in ice water.

1. Keep moving
2. With the ice movement
3. Speed damage → Keep slow speed
4. Maneuvering → To be thoroughly familiar with the ship’s characteristics
5. Cruise on the windward

If you keep above rules, you will be safe back home !!

## Marine Information and Data Acquisition System

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This Marine Information and Data Acquisition System was developed by the Flanders Marine Institute for the planning and follow up of all activities onboard the RV Zeeleeuw and for the capturing of monitoring data.
The system captures underway data of different types (navigation, meteorological and oceanographic), and stores them in a relational database. It will also register all ship movements (leaving/arriving at ports and stations) as well as research activities (CTD casts, seabed and water sampling...).
The ships track, stations and sampling locations are displayed using a GIS interface with a direct query link to the UW data stored in the database. Drift from station calculations and distance-along-track-analysis for trawling activities are automated giving instant QC feedback to scientists and crew.
All data can be directly exported onboard or consulted some days later through the VLIZ website. The data is provided as is, meaning no further QC steps are implemented as to date.
*The database replication from shore to board and vice versa is based on XML files, but is still a manual process. (Optimisation planned and possible as soon as a direct telecom link is available.)*
*The ship programs have a two-tier client-server infrastructure with a database server, an acquisition server and two client applications (one for the bridge crew and one for the scientists). The shore components are a database server, a planning application and a CGI-BIN based web interface.*
*VLIZ being a non-profit organization and believing in the free exchange of software and data, has decided to make the system freely available to fellow institutes under the terms of the GNU license agreement.*
For more information please visit the site http://www.vliz.be/Vmdcdata/midas/.

## Automated real-time eddy flux measurement system on a cruising ship

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Sea surface eddy fluxes can be evaluated with bulk method or eddy correlation method. Bulk method can easily applied with simple measurement and it is possible to evaluate long-term continuous measurement. However this method include the inaccuracy for the empirical transfer coefficient.

While, eddy correlation method is based on direct turbulence measurements without empirical constants. However it needs very complex procedure, especially on a moving platform (e.g. ships or buoys). Present authors have developed a new eddy correlation measurement system, including simpler ship motion correction with sonic anemometer and motion sensors. The improved eddy flux system was introduced on R/V MIRAI of Japan Marine Science and Technology Center.

Since June 2000, the eddy flux system is running continuously throughout the whole cruises of R/V MIRAI. The observed turbulence data from sonic anemometer and others are displayed on PC monitor and raw time series are stored on the disk. However this system doesn't include ship motion correction or eddy flux calculation. They were calculated as off-line data processing after the cruise. This was a big disadvantage for the continuous sea surface flux monitoring.

A new real-time data processing system was planned as an automated observation system which involves ship motion correction and real-time flux calculation. This system can immediately converts to truth wind vector and evaluate sea surface flux on a cruising ship. This new system has started on November 2001 on R/V MIRAI and working every day over the Pacific. CO2 eddy flux system was added on May 2002.

The system can be applied to many cruising ships over ocean as a sea truth flux system over larger areas. These eddy fluxes are useful with bulk fluxes and radiation fluxes to understand sea surface heat balance over the global ocean.

## Noises recorded by MCS system on R/V KAIREI and the trial of the noise suppression processing

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Japan Marine Science and Technology Center (JAMSTEC) has conducted multi-channel seismic (MCS) reflection survey by R/V KAIREI since 1997 to study deep structure of the subducting plate around the Japan arc. The major problem of MCS data acquisition and data processing is noise suppression, which very important to get seismic reflection profiles of higher quality. These noises are classified into two types: coherent noise and random noise. Coherent noise, derived from the system configuration, includes multiple, bubble oscilation, ghost, diffraction wave, etc. Random noise, derived from factors outside the system, includes wind noise, ship noise, earthquake, wave noise etc. We are applying F-K filter, Radon filter, Predictive deconvolution filter, Front end mute, Surgical mute and Weighed stack for suppression of coherent noises during data processing. F-K filter, Radon filter, Surgical mute and Weighed mute are important to remove multiple reflections. We are using mainly Radon filter and Surgical mute for this purpose because these processing increase accuracy much more than other processing in our study area where the seafloor topography is very complected. We are applying Trace edit, Band pass filter and CMP stack against random noises. Though these processing techniques are very simple, they are essential to get seismic section of high quality after removal of the random noises. We report here the noise suppression processes that we use and some cases of their application to the MCS record.

## Marine Technicians in NME
## -Supporting scientific activities in the JAMSTEC-

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Nippon Marine Enterprises, Ltd. (NME) supports the scientific activities of the Japan Marine Science and Technology Center (JAMSTEC). NME contracts to operate many tools for observation which are owned by the JAMSTEC. They are four research vessels (R/V Natsushima, Kaiyo, Yokosuka, and Kairei), a manned submersible “Shinkai 2000”, and three remotely operated vehicles (ROVs Dolphin–3K, Kaiko, and Hyper-Dolphin).
About 20 marine technicians, 35 of shore based staffs, 16 operators of submersible and ROVs, and more than 150 of ship crew belong to NME.

Now I focus on to introduce the marine technicians in our company. We usually get onboard about 120 days and work in the office another 120 days in one year. The main purpose to being onboard is to support scientific party consistently. Although, we do preparation, maintenance equipment, post cruise processing of data, etc.
Our jobs are as follows. 1) Operation, quality control, and data processing of the seismic surveys by means of single and multi-channel seismic reflection survey system (SCS and MCS) which are equipped on R/V Kairei and R/V Kaiyo. We contract two cruises for each vessel in a year. This year, JAMSTEC started long offset reflection survey using those 2 ships. 2) Handling, maintenance and developing the ocean bottom seismograph (OBS). We usually deploy 200 OBSs in a year. The recovery ratio is about 97%. Our final destination is 100% recovery. 3) Data quality check and data base management. This means shore base work to support the JAMSTEC’s data management system. Now two of us work for this project. 4) Onboard support for the “deep sea research cruise” that means missions of submersibles and/or ROVs. Usually, only one technician attends to one cruise. In that case, he or she has to do anything for which helps the chief scientist. For example, handling the equipment, descriptions of samples, data processing, editing the cruise report, etc.

This marine technician in NME started since 1985 when the R/V Natsushima had been built. At first, only a few specialists such as professional divers and captains of support boat had contributed scientific cruise to lead scientists how to work on a ship. Recently, the roles of marine technician, not only the operator but also the technician for scientific support become more important. We must know widely about the background of the observation plan and understand what the scientists want to know.

## Shipboard geological and geophysical observation systems on *R/V MIRAI*

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JAMSTEC *R/V MIRAI* is one of the biggest research vessels for oceanographic research (128 m in length, 8687 t in gross tonnage). Members of Marine Works Japan Ltd. have been supporting various research activities such as CTD operation, and sampling of seawater and sediments, and acquisition of their primary phisical, chemical, and geological data. In this poster session, we briefly introduce onboard process of core treatments and facilities of geological and geophysical data acquisition on *R/V MIRAI*.

After the recovery of sediments, whole-round core sections are usually examined by GEOTEK multisensor core logger (MSCL) through which physical properties, i.e. Gamma-ray attenuation (GRA), P-wave velocity (PWV) and magnetic susceptibility (MS), can be obtained.

After the MSCL analysis, each section is cut using a custom-made core splitter to divide the section into archive and working halves. Description of lihtology and photography (still and digital cameras) are commonly made on the archive half cores. Sebsequently, case samples (200×30×7 mm) for onboard soft X-ray photograhy are continuously collected, and the archives are finally packed into plastic core case “D-tube” and kept in a large cold storage room until the end of the cruise.

The working half sections are first used for core color analysis using Minolta CM-2002 color refractometer, and various samples are collected using U-channel sampler for paleomagnetics, plastic bags for micropaleontological , mineralogical and geochemical reserarches. There is facilities to use X-Ray diffractometer (XRD) and X-ray fluorescence spectrometer (XRF) on *R/V MIRAI*, so that we also opperate XRD and XRF in response to requests of researchers during the cruise.

Above described process and the results are carefuly described using our original check sheets, which are utilized as the primary source of database.

## Feasibility Study of Onboard support on the deep-sea research in JAMSTEC

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The deep sea research cruise in Japan Marine Science and Technology Center ( JAMSTEC ) defined the dive research which used manned research submersibles, such as *Shinkai 6500* and *Shinkai 2000*, and romotely operated vehicles such as *Kaiko* and *dolphin-3K*. In this review, the present situation of the marine technician in the deep sea research which managed under new organization from the last japanese fiscal year is introduces and it's future view is considered.

In the deep-sea research cruise, reseachers obtain the data and many samples, and pulls out many informations which contributes not only to the research theme of dive researcher but to various research fields. Therefore, obtained samples are various such as the geological samples, the biological samples, etc. The marine technicians in our company, They perform from processing of the sample and data are obtained to the proposal about research cruise. And they support broadly and effectively to the whole voyage in order to obtain the maximum result from the cruise and dive research.

The marine technicians onboard's supports in deep-sea research cruise are following;

1. Editing the preliminary cruise report.
2. Processing and storage of various samples and data
3. Support onboard to the dive researcher (dive log )
4. Preparation and post-processing data and samples before and after the cruise

In the deep sea research cruise, many researchers are onboard and they have each scientifc theme and aim, such as geology, biology, and chemistry to one cruise. And the marine technicians have each research field speciality is corresponding to researcher's speciality. However, the marine technicians can onboard the cruise and are restricted on the problem of the number of room etc., therefore the talented marine technician were most suitable for the cruise. They are supporting whole research team under the chief researcher. By new organization from the last japanese fiscal year, some researchers without experience of research vessels, submarines, and oceanographic observations are onboard. The marine technicians advise an onboard life and safety to such researchers. Like onboard, also on land, The marine technicians are improve its skill to observation, and collect the newest research result, development of the observation technique and equipments positively.

As a problem which surround the marine technician, it is mentioned that it is not necessarily well-known to their existence. Since sufficient understanding cannot be obtained from researchers has onboarded from the other organizations but JAMSTEC, it may become the obstacle of operating execution. It not only calculates an understanding from researchers, but it has to send information positively also from marine technicians. In the near future, the samples and date which researchers will ask and deep sea research are diversified can expect. The system which maintained the independency which can respond flexibly to these changes is examined. I am pleased if you tell the present situation in another oceanographic institutions.

# Deep sea image processing of JAMSTEC

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Japan Marine Science and Technology Center (JAMSTEC) has collected large amount of deep seafloor and deep-sea fish images which were taken during the operations of JAMSTEC's underwater research vehicles. They include two manned research submersible, SHINKAI 2000, SHINKAI 6500, three remotely operated vehicles DOLPHIN 3K, KAIKO, HYPERDOLPHIN, and deep-sea towed vehicles. Several different methods are used for image recording. HYPERDOLPHIN, our newest deep ROV is equipped with a high definition TV camera. Photo films and image prints are stored in photograph albums. These images are converted to digital image data and registered to image databases. They can be viewed through JAMSTEC's internet web site since 1995.

Video movie pictures are originally recorded on magnetic tapes. Global Oceanographic Data Center (GODAC) in Nago, Okinawa, which was established in 2001, began to convert movie image to digital data and add indices for data retrieval. These image data are also viewed via the Internet. Digital movie files are stored in a mass storage archive system (400TB) in GODAC.

# Breakage and measure of vessel-mounted ADCP cover

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## 1. Introduction

This paper describes a tank experiment to modify vessel-mounted ADCP installation. A transducer of ADCP (RDI VM-75) is installed in a sounding room in a bottom of R/V MIRAI. The sounding room has LDPE (Low Density Poly-Ethylene) window, which ADCP's signal is transmitted through.
Since the operation started, this window has been suffered damage under heavy weather condition, and lost several times. To prevent suffering damage of the window, we investigate a relation between diameter of these holes and pressure acting on the window. We had a model test in a tank; pressure acting on the window is measured under a several diameter conditions. Finally, we found major cause for breakage for the cover of ADCP mounted at the bottom of R/V MIRAI.

## 2. Tank experiment

Tank experiment is held at the Yokohama National University. Specification of the tank is of 16m lengths, 1m widths and 1.5m water depths. 1/10 scale sound room, which dimension is 34mm*134mm*160mm, is swung in the tank. To discuss the load acting on a window, pressure acting inside and outside of the model is measured. We have 2 draft conditions. One is for usual draft condition, which is correspondent 6.5m of real ship. The other is slamming condition, where the window exposed on the water surface, and suffers impact pressure.
In the case1 experiment, equivalent to 0.65m (6.5m real ship) of the draft, the diameter of drain holes ware changed to 0mm (closing), 0.7mm (0.7cm), 1.5mm (1.5cm), 4mm (4cm), and 12mm (12cm). Also the air extraction hole was changed with 0mm (closed), 4mm (4cm), and 8mm (8cm).

## 3. Results

The FFT analysis of pressure shows that; if close the drain holes and open air-suction line, heavy load is experienced at 6rad/sec motion period, we evaluate this load 5 times of inertial force. The following conclusions were obtained from this experiment.

(1) To reduce the load acting the window, it is better to close an air suction line below draft during a voyage. However, it is necessary to open a valve suitably to suck air.
(2) The drain hole should not be closed. The highest pressure is experienced at closed drain hole and opened air suction line.
(3) If drain hole is smaller than 40mm, it approaches the state of (2), which resulting high pressure at the window.

# CTD Operation with Three Systems on R/V Mirai

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Japan Marine Science and Technology Center (JAMTEC) has five research vessels. The largest of them is R/V Mirai. We, Marine Works Japan Ltd. (MWJ), support scientists in JAMSTEC and other institutions on this research vessel for the CTD operation, water sampling, and so on.

There are three CTD systems (SBE911*plus*; Sea-Bird Electronics, Inc.) on R/V Mirai, and the configurations of them are as follows:

1. 12 liters Niskin or Niskin-X bottles - 12 positions Carousel Water Sampler
2. 30 liters Niskin bottles - 24 positions Carousel Water Sampler
3. 12 liters Niskin or Niskin-X bottles - 36 positions Carousel Water Sampler

Three CTD systems are used upon request from scientists onboard.

The 12 liters - 12 positions CTD system is used to observe physical properties with a minimum of chemical analysis. The 30 liters - 24 positions CTD system is used in the case that a lot of water is required in the same layer such as estimate of primary production, pigment analysis and so on. The 12 liters - 36 positions CTD system is used to analyze chemical properties in many layers, for example, in WOCE cruise. Depending on weather and sea condition, we decide which CTD systems are used.

# Operation methods of MCS on R/V KAIREI

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Nippon Marine Enterprises, Ltd. (NME) is employing research vessels, a manned submersible and remotely operated vehicles for various marine research programmes planned by Japan Marine Science and Technology Center (JAMSTEC). One of the major research programmes is 2D multi-channel seismic (MCS) reflection survey to investigate the structure of the subducting oceanic plate around the Japanese islands. R/V KAIREI owned by JAMSTEC carries MCS system. Since 1997, we have investigated on and around the Japan Trench and Nankai Trough where strong earthquakes occurred frequently due to the subducting oceanic plates.

Major onboard equipments of our MCS system are air guns for artificial seismic source, compressors to produce compressed air, hydrophone streamer cable to receive reflection waves from under the sea floor, data acquisition and processing systems, which are similar to those on board other seismic survey vessels. But KAIREI has the following feature for the purpose of subsurface structure study.

KAIREI is equipped with eight BOLT 1,500cu.in large volume air guns. The deck arrangement allows us to operate two individual seismic source strings to send out from the ship end. Total volumes is 12,000cu.in （197liter）.It is unique and highest possible in the world. In order to solve not only the both gunwales simultaneous oscillation that a seismic wave abounding in low frequency ingredients of normally survey but it can oscillate one side at a time by turns for the filed deep structure in false. For that purpose parvane is equipped so that the air gun arrays of both the gunwales can be developed to 80m or more.

The streamer cable used in this system is the 24-bit digital RDA streamer provided by Syntron Inc. Maximum number of channels is 156 with group interval 25m, then maximum offset is 4km. Recording and depth control is done by central acquisition system. SPECTRA navigation and positioning system using worldwide DGPS system is used for real-time positioning of the seismic source, streamer cable and KAIREI. Furthermore, the source and streamer tail buoy is positioned using Fuglo RGPS system.

In order to perform the seismic reflection data processing, we use the ProMAX-2D and iXL as data processing systems. Currently, poststack time migration and depth conversion processing are carried out on board after preprocessing including trace editing, geometry set, deconvolution, multiple suppression, NMO correction, stack, etc. for onboard data quality control.

We report the operation methods to the MCS record obtained on board R/V KAIREI.

## Chemical analyses of seawater on *R/V MIRAI*

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As part of our work, we have been supporting geochemical oceanographic observations carried out by Japan Marine Science and Technology Center (JAMSTEC). Since most of our works is performed on *R/V MIRAI*, improvements of our analytical techniques have been made through various observational activities on *R/V MIRAI*.

Chemical observations that we have supported over the last five years are on dissolved oxygen, nutrients, total dissolved inorganic carbon (TDIC), alkalinity, pH, pigments and primary & new productivities of sea water. Dissolved oxygen and nutrients were measured based on the method described in World Ocean Circulation Experiment (WOCE) manual. Other measurements are based mainly on the method used in the Joint Global Oceans Study (JGOFS). The observations have mostly been done in equatorial and north-western Pacific and Arctic Oceans so far. We also had opportunities to analyze the dissolved oxygen in the Indian Ocean during since tow years ago. We joined the cruise of WHP P1 and P17N lines in 1999 and 2001, respectively, and will join the cruise along P06, A10, I03, and I04 lines in 2003. In this poster session, we briefly introduce our chemical analyses on *R/V MIRAI*.

# Handling and operation of sediment sampling tools on *R/V MIRAI* and *KAIREI*

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We, Marine Works Japan Ltd. maintain and improve JAMSEC piston corers, multiple corers, dredgers, and other sediment sampling tools, and operate them on the oceanographic research vessel *MIRAI* and deep sea research vessel *KAIREI*.

One of the piston corer systems is composed of a weight (1.3 t), trigger, and a total 20 m-long duralumin outer pipe (80 mm in inner diameter) formed by four 5 m segments which are combined one another by stainless joint sleeves. After the recovery of the piston corer, each segment is cut using a portable band-saw to make 1 m-long sections, and sediments inside the duralumin pipe are pushed out by a custom-made pushing devise. The duralumin pipe is suitable for the sediment sampling since it is more ineffective for secondary magnetization of sediments than stainless. There are two types of pilot corer; one has a triple acryl barrel (60 cm long and 73 mm wide) and a similar sampling mechanism to the multiple corer, and the other is a simple gravity corer with a ca. 1 m-long thinner core barrel (30 mm wide) below a a lighter weight than the former. We can choose the type of the pilot corer, and also change the pipe length of the piston corer by means of decreasing the number of the 5-m segments, associated with the length control of wires, depending on the weather condition and thickness of sediments on the seafloor.

Recently, we are approaching so-called “inner tubes sampling” on the piston corer system. Each inner tubes is 5 m in length and set within the outer pipe. It is well-known that this type of sediment sampling has various advantage; e.g. easy construction and dismantling of the system and making it possible to examine sediments more accurately.  Inner tube cutter and longitudinal splitter are our custom-made.

The multiple corer has a frustum framework on which trigger, 620 kg weight and eight acryl barrel (60 cm long and 73 mm wide) are attached. This system can collect the surface sediments and “bottom water” without any turbidity. Since some chemists are interested in this “bottom water”, we are now developing a bottle sampling method of seawater using the multiple corer.

The dredgers have a cylindrical body (60 cm in length and 40 cm in diameter) below which is a long bag meshed by chains. This is commonly used for hard rock samplings instead of soft sediments.

In this poster session, we also illustrate and explain the details of other sampling tools available; i.e. 8 m-long piston corer, 6 m-long piston corer with heat-flow sensor, grab sampler, and box corer.

# JAMSTEC Deep Tow Systems

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JAMSTEC/Deep Tow systems have played an important role in establishing deep ocean technology at JAMSTEC, and has a 6000 m class deep tow camera that has been developed for site surveys associated with the manned research submersible *Shinkai 6500*. To make real-time transmission of several color video images, a double armored optoelectorical cable, 8000 m in length and 17.4 mm in diameter, was developed between 1988 and 1991. The optoelectorical cable has the same outer diameter as a double armored coaxial cables used in other equipment, in order to share the existing winch and sheave systems. The optoelectorical cable includes four electrical conductors and four single mode optical fibers that are separately encased in stainless steel tubes. The breaking strength of the cable is 17.2tf and the maximum electrical power that can be sent through the cable is approximately 6kVA at 1500V AC. An original towing gear is a gimbaled sheave which was designed to eliminate a damage of the armored cable at the sheave, and also to measure cable tension, length and directions with a certain quality.

Specifications of the 6KC are three color video cameras, eight 250-W halogen underwater lights, two black and white video cameras, two still cameras and flashes, CTD, altitude sonar and a transponder, which are installed on the camera sled. Original CCD cameras were replaced in 1992 by an ultra high sensitive color video camera (super-HARP video camera) that has a minimum luminous intensity of 0.1Lux. The super-HARP video camera is shared both with 4000-m and 6000-m camera systems. Among the four optical fibers, only one is used for transmitting signals at optical wave lengths of 1.3 and 1.55 μ m, respectively, for the camera system.

## Autonomous Operation of Instruments with Flow-through System onboard VOS

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Merchant vessels share longstanding tradition of reporting marine data for making use of other people. Present day shipping industries have inherited this tradition, however, marine transportation businesses have to encounter hard competition in global market that could induce them to avoid any risk in loss of their ship time. Hence, an instrumentation that should be safe to ship operation would be of prime importance in promoting voluntary observing ships (vos). Autonomous (unattended) operation, minimum instrumentation below water level, and outfitting inside ship's hull are the major conditions to encourage ship operators to participate as vos. On the other hand, these conditions limit the range of observation by a vos, and only selected sensing technologies that can be effective in closed, flow-through seawater system can readily be deployed onboard vos.

The instrumentation operated by us on vos comprises a C-T sensor, a fluorometer, a bottom thermometer and a dedicated GPS. C-T sensor and fluorometer, together with other electronics are installed above the water line of the vessel. For measurement, C-T sensor and fluorometer use seawater branched from ship's cooling seawater pipe to condenser unit of air conditioner, and return seawater directly to cooling seawater discharge pipe via closed circuit. A bottom thermometer is inserted in the same cooling seawater pipe but immediately after cooling seawater pump located at the lowest level of the engine room.

The first vos is cruising mainly Japan - Gulf of Thailand route, and the second vos is servicing between Japan and Australia, both with about 30-day turn around time. SST, salinity, chlorophyll fluorescence intensity, UTC time and position data are updated and recorded every one minute during whole cruise, and recovered when vessels return to Japan. Also, regular sensor maintenance work is provided during port time. The collected data are segmented by one degree coordinate after the primary quality check and released over the Internet.

Advantage of vos in long-term monitoring of marine environment is clear and simple; longtime data documentation in frequent and recurring basis with cost-effective manner. In the meantime, there remain subjects to be further developed or clarified to expand vos. Some of them include;

- Development of advanced range of sensors customized for flow-through sensing system
- Refining of interpretation on sea chest depth variation depending on cargo conditions
- Quantification of influence of ambient environment inside the hull in the measurements

In promoting vos, it is essential to establish good communications with shippers, ship owners/operators, ship's officers and crew, and all other parties involved in vessel operation to ensure long-term data documentation. Carefully planned approach to ship operator is also important to have a vessel under long-term cargo contract participated as vos, which could provide the constant cruising tracks.

This poster presentation highlights briefly instrumentation, measurement system and navigation route of vos programmed and managed by us.

# Oceanographic Ship's Winch Monitoring System

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CSIRO Marine Research has many years of experience in the use and design of ship's winch monitoring systems. These are used with towing and oceanographic winches and are an integral part of CSIRO Research Vessel operations.

Winch monitoring has proved to be extremely important for ensuring safe operation during towing and deployment activities. Precise and accurate operation can only be carried out with precise and accurate information about cable tension, payout length and speed. Historical winch operating data is used to develop standard operating procedures to facilitate personnel safety and efficient control of deployed equipment. Of particular value has been the ability to make go/no go decisions based on sea state. This data also provides a log of cable wear and other service history.

CSIRO's latest generation of winch monitoring systems is presented. The hardware and software has been constructed and tested. The hardware design is relatively simple and employs a microprocessor.
Primary winch monitoring comes from a strain gauge providing wire tension and from magnetic detection of ship's block rotation giving wire payout information.
It also provides enhanced information for the user - maximum, minimum and average tension measurements. This design replaced a much more complex system CSIRO designed 15 years ago.

Category (2) Handling and operation of instruments.

Key subject (2c) Ship operation technology (winch).

Poster presentation.

# Centralized Marine Instruments Data Acquisition System Onboard R/V Ocean Researcher I

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The R/V Ocean Researcher I is a multipurpose research vessel operated by the National Taiwan University and equipped with various navigation, oceanographic and meteorologic equipments. Many of the data acquired by different instruments are relational, and often need to be displayed and/or distributed in real time onboard the ship, thus it is important to have an integrated data logging and distribution system. To fulfill this requirement, a centralized marine instruments data acquisition system (MIDAS) has been developed by the Electronics Lab of the Institution of Oceanography, National Taiwan University with supports provided by the Instrument Center for Ocean Research Vessels.

The MIDAS is a central processing system that performs both data acquisition (logging) and data dissemination functions. The data acquisition part of the system collects data acquired by various instruments through the MIDAS net interfaces. The central processing unit sends out synchronized signals to various instruments through network to control the data flow in an orderly fashion. Once the data from a certain instrument are sent to the MIDAS, they can be quickly processed by the central processing unit. Then the data are sent to the data logger for storage, and to the data distribution unit for data dissemination or displaying. Different software have been developed to display various scientific data in both digital and graphic forms for real time monitoring of the data acquisition process. Image data captured by the shipboard video cameras have also been put through this system, thus provide security monitoring for the ship as well as scientific operations. At the present stage, instruments which have been linked to the MIDAS include GPS navigation system, 12 kHz ELAC4700 depth sounder, 38 kHz EK500 fish finder/depth sounder, Chirp sonar sub-bottom profiler, Gyro-Compass and ship operation information, shipboard weather station, CTD data acquisition system, CTD winch system, deep sea winch system, magnetic data acquisition system, and the basic header information of the multi-channel seismic dat acquisition system. The MIDAS will continue to grow as other scientific equipments will be added to this system in the future.

# Geophysical data management in JAMSTEC

**(Bathymetry data management and method of processing)**

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Marine geophysical data of bathymetry, geomagnetics, and gravity have been acquired and integrated since the 1960’s internationally by major oceanographic institutions. Japan Marine Science and Technology Center (JAMSTEC), which was established in 1972, started to collect these data in 1980’s since the first multi-narrow beam echo sounder (MNBES) system was introduced on board R/V *Kaiyo*. At present, four research vessels (R/V's *Kaiyo*, *Yokosuka*, *Kairei* and *Mirai*) owned by JAMSTEC are equipped with the various marine geophysical instruments such as multi-narrow beam echo sounder system, proton magnetometer, three-component magnetometer, and gravity meter.

In JAMSTEC, the oceanographic database obtained by the R/V *Mirai* already exists. From 1999, Nippon Marine Enterprises, Ltd. (NME) has been commissioned to process and manage the geophysical data from JAMSTEC. The geophysical and oceanographic data sets obtained during the cruises are compiled at the Data Management Office (DMO) in JAMSTEC. Primary purpose of the database construction is to provide high quality data and easy access system for the user.

First of all, the geophysical data from the research vessels are edited and formatted with 'awk' program in UNIX command procedure. The edited data are then processed and visualized by post-processing software, generic mapping tools (GMT), under UNIX system. Processed bathymetric maps, gravity and geomagnetics anomaly maps are selected and constructed into the geophysical database. Some of the processed bathymetric data already appear on the JAMSTEC local web site.

The database is extended as soon as the additional data are collected, and will be used as the basis for further cruise planning to fill out sparse data areas.

We also tried to estimate the quality of the MNBES bathymetric data obtained by each JAMSTEC fleet as an example of data quality control procedures. At first, systematic depth-sounding bias among the SEABEAM2100 systems on board the four research vessels (*KAIREI*, *YOKOSUKA*, *MIRAI* and *KAIYO* ) was estimated. Next, the systematic depth-sounding bias between the two different types of MNBES (e.g. SEABEAM2100 [SEABEAM inc.] and HS-10system [FURUNO inc.]) was estimated. Then, the reproducibility of the data acquisition in the same area in the same system of the ship was verified.

## Gravity data management in JAMSTEC

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JAMSTEC (Japan Marine Science and Technology Center) is operating surface-ship gravity meters on board Research Vessels *YOKOSUKA*, *KAIREI*, and *MIRAI* for geophysical study to estimate the crustal and lithospheric structure, status of isostatic equilibrium in a certain region, etc. Since the gravity meters equipped on board are designed for relative measurement, the gravity values measured during the cruises are to be converted into absolute gravity values in order to get the gravity anomaly map after some gravity reduction procedures and its geophysical interpretation in the study area. In order to compute an absolute gravity value for each measurement, it is necessary to carry out a “gravity tie,” or relative gravity measurement between the station on the quay at which the research vessel is staying and a gravity reference station where absolute gravity value is known. Gravity tie is requested in each portcall during the cruises with onboard gravimetry, especially before and after the cruises. Until now, gravity tie has been carried out by the order of the scientists on board if they have definite information on the gravity reference station near the port of call. Gravity tie is not carried out if the gravity reference station is located far from the harbor of the portcall or no information on the gravity reference station is available in advance (especially in foreign countries).

The following procedures are of great importance to establish the systematic gravity tie by marine technicians at the time of portcalll in order to provide gravity data in good quality,

(1) We get in advance information on the gravity reference stations near the harbor of portcall during the cruise.

(2) If the gravity reference station is located far from the port of call, we define an appropriate observing point uniquely near the harbor as a tentative reference station, which enables us to perform gravity tie every time of portcall afterwards. This means that the reference station is established by ourselves. The absolute gravity value at this point is to be fixed after visiting for gravity measurement several times.

(3) We should check the result of gravity tie in the past to verify the quality of the reference station. There are a couple of gravity reference stations in a city near the port of call. However, the accuracy of measurement depends on the condition of the station (location, stiffness of the basement, with/without benchmarks etc.). Since we have only written document obtained from authorities or geological survey institutions in most cases, we do not know these conditions before we visit for the first time.

In the future, we will make a data base of gravity reference stations after compilation of all these information in order to make gravity tie in good quality. This database is also to be included in JAMSTEC geophysics database.

## Development of database for sediment core samples in JAMSTEC

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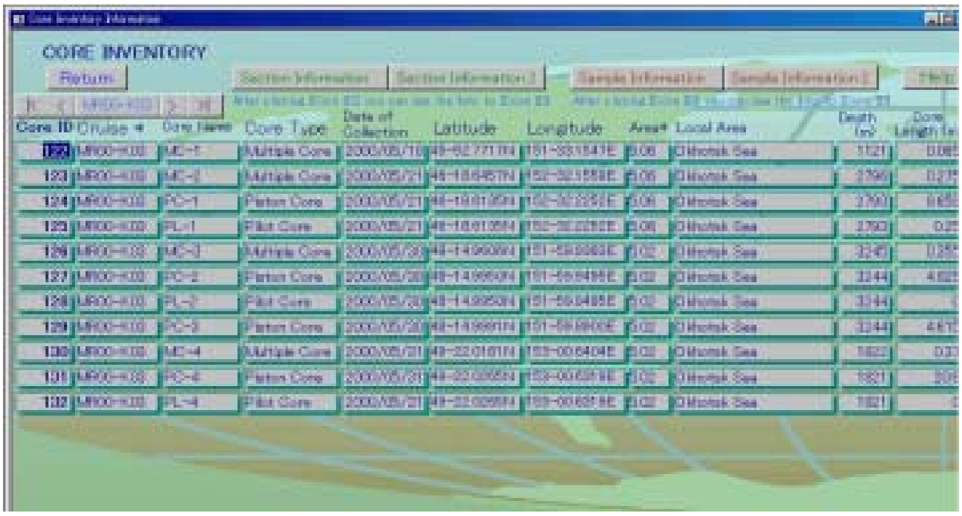
JAMSTEC has many databases that are provided through the web site. However, there is no offical database with respect to sediment cores from *R/V MIRAI, KAIREI*, etc.

Therefore, we are now constructing and improving a prototype of the core database using “Access 2000” (MICROSOFT) in order to open information of the cores obtained by the JAMSTEC facilities. It involves information of coring inventory, section data such as the length, storage place, ect., sample data such as position, volume, etc., and property data such as lithology and primary results of multisensor core logging and color reflectance analyses with illustration of nature and soft X-ray images. Users can easily search the data inputting key words. In near futur, the database will be converted to be web-based, and be open to the public.




Example 1  Inventry information of each coring.


Example 2  Search result.

# Preparation of reference materials for measurement of total carbonate in seawater

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1. Introduction

The increase of $CO_2$ concentration in the atmosphere is thought to play a role in major the Green house effect. In order to carry out a project to study about the global warming, it is important to evaluate the exchange of $CO_2$ between the atmosphere and the sea quantitatively. The measurement of Dissolved Inorganic Carbon (DIC) is a part of this project and has been carried out in many research institutions over the world. Since the studies related to DIC are often discussed world-widely, the data of DIC must be accurate enough to be exchangeable.

2. Necessity of the RM

Certified Reference Material (CRM) is used as a standard to determine the absolute concentration during the measurement of DIC. CRM has been recognized internationally and not only Japan Marine Science and Technology Center (JAMSTEC), but also many other institutions use it to certify the quality of their data. However, since the amount of produced CRM is limited, a secondary certified solution known as the Reference Material (RM) is used in the actual measurement at JAMSTEC. The RM is used as a standard material to calibrate the drifting of the measuring system and has become indispensable when the measurement is carried out. At JAMSTEC, the RM is prepared each and every time when the DIC is measured. When the RM is used, CRM is also used to certify the traceability of the measurement.

As a standard material, the concentration of RM must be the same for all the bottles produced and is required to be stable over a long time of period. To certify the uniformity and the stability of the concentration of the RM over the time, CRM acts as a standard.

3. Preparation of the RM

To keep the features described in section 2., the RM is produced by making a large amount of carbon-stable solution. Then the solution is poured repeatedly into separated bottles in a short while. A treatment is also made to restrict bacterial activities, which will effect the DIC concentration among the solution. The materials selected to produce the RM satisfies these conditions. To produce the RM, approximately one week is required including all the preparations.

In order to produce the RM, the method carried out following Dickson (2002).

4. Accuracy of the RM

The uniformity of the produced RM was measured. Out of 80 produced RM bottles, 15 were analyzed in a row. The CV of the concentrations from 15 bottles was 0.054%. Considering the measurement precision, the RM was considered to be stable enough.

5. Discussion

The change of the RM over a long timescale has not been fully studied yet. Therefore, a new experimental system will be established to store the data and to follow the change.

1) Dickson(2002), Sea water based reference material CO2 analysis : 1. Preparation, distribution and use, http://ioc.unesco.org/iocweb/co2panel/docs/1._Preparation_of_RMs.pdf

# Data management in JAMSTEC

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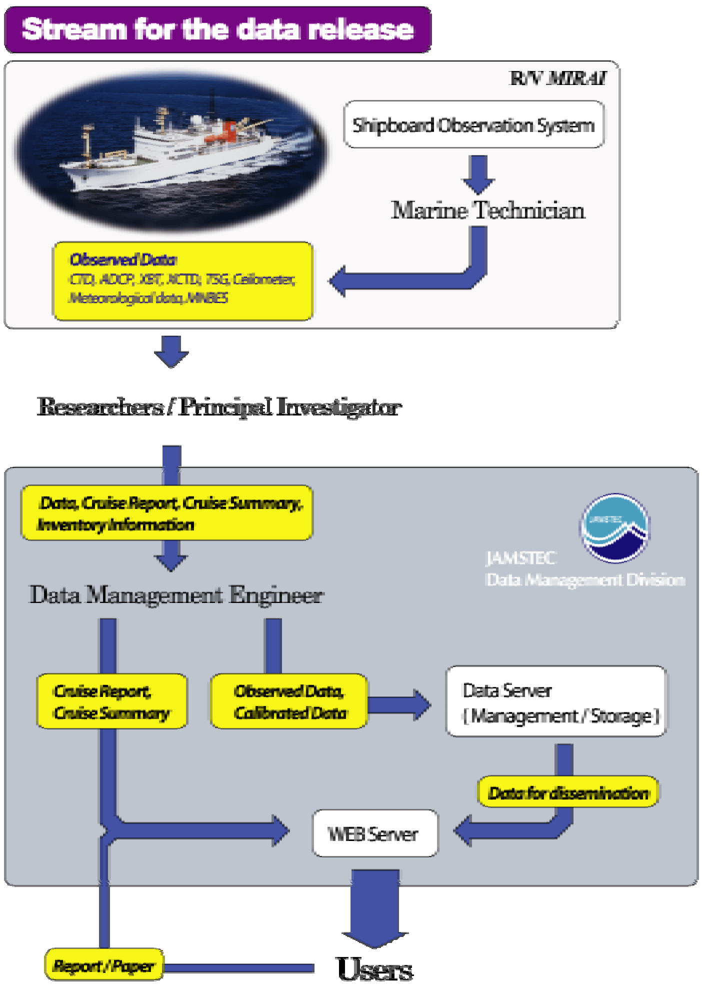
Japan Marine Science and Technology Center (JAMSTEC) is advancing to establish and improve on the data management system in order to manage or release the observed data which was obtained using JAMSTEC research vessels, ROVs and AUVs.

JAMSTEC research vessels are built to investigate the earth science such as global heat exchange, carbon cycle, marine ecosystem and the geophysical dynamics. JAMSTEC operates those vessels for the wide possible use of broad scientific communities. And we present the data processing stream of R/V MIRAI for example, here.

In JAMSTEC, Computer and Information Division (CID) performs data management for R/V MIRAI. The main performance of CID is the quality control, data release on web and development and management of database. These operations are performed based on JAMSTEC policy for handling data/samples and results obtained using the R/V MIRAI. According to this policy, JAMSTEC should release data/sample as quickly as possible to people.

The following figure presents the data processing stream for data release. Collaborating with the marine technicians and the JAMSTEC researchers, data management engineers prepare the optimum data sets for the broad utilization.



# Data management of ARGO float

Hiroyuki Nakajima*  Tsuyoshi Ohira*  Kensuke Takeuchi**  Keisuke Mizuno***
Nobuyuki Shikama**
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**Climate Variations Research Program, Frontier Observational Research System for Global Change (FORSGC)
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## 1. Introduction

Argo is a project that is being conducted under the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission of UNESCO (IOC) and other related institutions. The aim of the project is to build a real time, high resolution monitoring system for upper and middle layers of the world ocean. The Argo float drifts at a depth of 2000m and rises to the sea surface every ten days. It measures the temperature and salinity as it rises. During the period of the Argo project, approximately 3,000 Argo profiling floats will be deployed in the world ocean with average spacing of about 300km.

The data obtained will serve us better understanding of large scale, on-going oceanic variations. The monitoring system will greatly contribute to the study of interannual, decadal and interdecadal variations of the climate system.

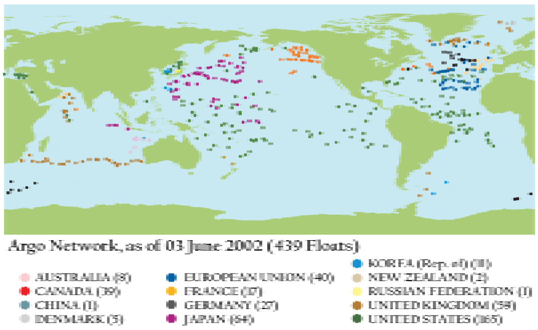


Fig.1 The position of Argo floats as of June 3, 2002.（http://argo.jcommops.org/）

JAMSTEC/FORSGC have deployed 57 ARGO floats as of May 2002. MWJ has conducted data management of these Argo floats.

## 2. The role of MWJ

The transmitted data from ARGO floats is sent to ARGOS ground station via ARGOS satellites that pass over the float. It is then delivered to users via e-mail, for example. The following work is automatically done by the server in JAMSTEC/ FORSGC; decoding ARGOS messages and converting into physical quantity, quality-controlling, registering into database and into our site on WWW (http://www.jamstec.go.jp/ARGO/J_ARGOj.html). MWJ is manually processing the data that is out side of the framework of automatically processing (fig.2).

3. Future view

JAMSTEC/FORSGC are due to perform delayed mode QC as a data center of ARGO project. MWJ is due to support the work of delayed mode QC and creation of the data set used as reference for QC of ARGO floats.

4. Acknowledgement

We used data of web of Argo Information Center (AIC). We would like to express our gratitude to AIC.

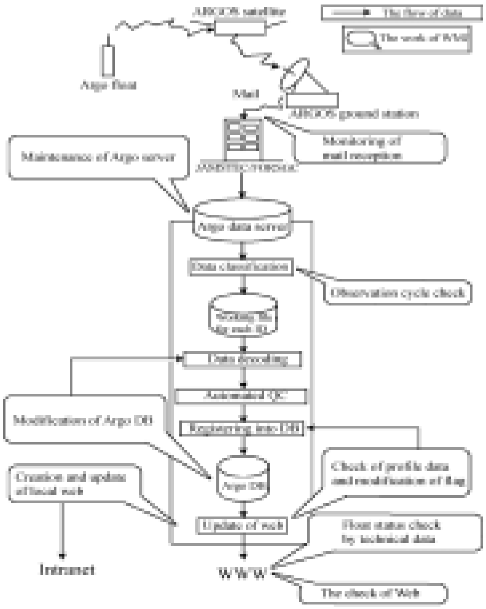


Fig.2 The flow of data processing of ARGO floats and the work of MWJ

# CTD observed data -from data acquisition to publication-


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(1) Introduction

JAMSTEC (Japan Marine Science and Technology Center) has been operated R/V MIRAI since 1998. JAMSTEC contracts with Marine Works Japan Ltd. (MWJ) for acquiring and managing observed data. CTD observation is generally performed on R/V MIRAI cruise.

(2) Data acquirement

Marine Technicians of MWJ perform the CTD operation on-board. They acquire CTD data and process the acquired data, drawing up the cruise reports. Processed data and cruise reports are submitted Principal Investigator.

(3) Data Management

Processed data is managed and archived in Computer and Information Division (CID) of JAMSTEC. These data is opened to the public through the Internet.

JAMSTEC makes calibration of temperature, conductivity and D.O. sensors twice a year for each one. Data Management Engineers of MWJ treat calibration information and history of usage for these sensors.

Meta data such as calibration information is presented on Web with processed data, which is used to evaluate the processed data. At the same time, users can see the sensor information and the operating information.

For each cruise, Marine Technicians and Data Management Engineers have a discussion on the observed data with the meta data and with the other detail information. As the result of this discussion, the observation procedure will be improved.

(4) Future prospects

JAMSTEC/MWJ plans to describe accuracy and precision for CTD data on Web after evaluation. For details, processed data should be corrected by the sensor drift or bottle data. And corrected data will be put error flags by considering observed area and water mass structure.

Finally JAMSTEC/MWJ is going to prepare the manual for a sequence of the data processing method.

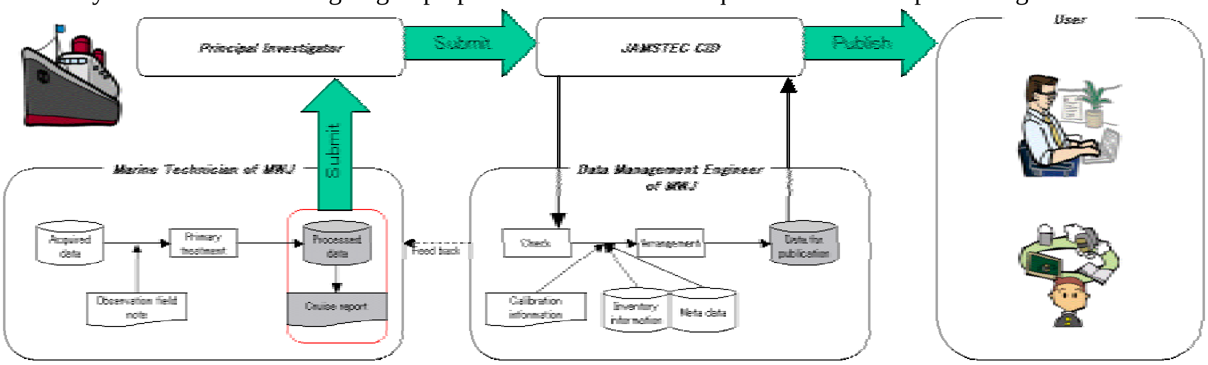


Figure   The flow of CTD data.

## UNDERWAY DATA ACQUISITION AND DISTRIBUTION ON THE RS AFRICANA

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FORETRUST HOUSE FORESHORE CAPE TOWN 8000,SOUTHAFRICA
PO BOX 8012 ROGGEBAAI 8012 CAPE TOWN,SOUTHAFRICA

The RS Africana is the flagship of the MCM fisheries research fleet. Since the early 1990's, she has had an underway data acquisition and distribution system. This system acquires, stores and distributes underway data from oceanographic, atmospheric and navigation sensors. In early 2001, the entire system was replaced with current pc technology and sensors.

The system can be divided into three sub-systems:
input, ie. sensors;
data acquisition and storage: one pc, equipped with specialised serial cards, logs and stores the data;
data distribution: the data is distributed from the data logging pc to pc's throughout the ship.

This poster gives an overview of the three sub-systems and how they are integrated to operate as one system.

# “ The compact, large capacity lithium ion battery for the "SHINKAI 6500" ”

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Japan Marine Science Technology Center (JAMSTEC)
2-15,Natsushimacho,Yokosuka,237-0061,Japan

**The main battery of "Shinkai 6500"**

The silver oxide - zinc alkali battery developed for the "Shinkai 2000" was loaded for operative results.

A large capacity silver oxide - zinc alkali battery was developed for the "Shinkai 6500", and it was carried on the ship.

**Development of the lithium ion battery**

Lithium can produce more energy compared with lead, zinc and cadmium.

Therfore, the development of the battery which used lithium was pushed forward, as the time practical use for metal lithium was not reached.

The lithium ion battery that discharged lithium in form of an ion was developed.

Afterwards, the lithium ion battery spread home electronic products which did not require a large amount of enegy capacity such as is needed for cellular phones or video cameras .

**A principle of the lithium ion battery**

A marketed representative lithium ion battery uses the life electrolyte which is dissolved in graphite carbon (C), an electrolyte with lithium salt (LiCl) for cobalt acid lithium (LiCoO2), and a cathode and an anode.

Lithium becomes an ion from an anode to a cathode in charge, and the inverse reaction happens in movement, as an electric discharge.

In all cases the material of an anode cathode relationship does not change because lithium is a form of an ion.

**Development of lithium ion battery for the "Shinkai 6500"**

More recently a submersible voyage of the "Shinkai 6500" must affect various demands from a researcher, such as a magnified submersible voyage range, and an increased capacity to carry observation machinery.

There was a limit by a silver oxide - zinc alkali battery to satisfy this demand, and an increased battery capacity became the much more necessary.

Therefore, the development of the lithium ion battery for the "Shinkai 6500" was demanded, and a basic evaluation examination towards practical use was started in 1999.

Currently, we are examining a management use method by doing cycle confirmation of the life limit, and are planning to establish a concrete practical use base.

# INDEX

# Closing Address

Masato Chijiya
The executive Director of JAMSTEC

Hello, my name is Chijiya. I am one of the three executive directors of JAMSTEC and also in charge of planning department, research support department, computer and information department, and Yokohama institute for Earth Sciences.
At first, I would like to thank you, all the participants for the very important INMARTECH2002 meeting. It was obvious that the participants had wonderful presentations, and fruitful discussions for three days.

Last month, JAMSTEC held the international symposium on ocean sciences in commemoration of the 30$^{th}$anniversary of JAMSTEC. We invited 13 guests of major oceanographic institution in the world.
The directors made panel discussion and came to a statement, which we call Yokosuka statement. And this is the copy of the Yokosuka Statement.
And now I would like to introduce the Yokosuka Statement.

Indeed, INMARTECH activity is most important and most significant along with this statement.
Next INMARTECH meeting is going to be held in England, kindly hosted by Mr. David Blake of BAS, British Antarctic Survey.
Thank you so much again and see you in INMARTECH2004!

**YOKOSUKA STATEMENT**
**-Ocean Science in the 21$^{st}$ Century-**

On the occasion of the 30th Anniversary of the Japan Marine Science and Technology Center, we, representatives of theworld's 14 major oceanographic institutions meeting at Yokosuka, hereby share the following recognition.

Our knowledge of the systems of Earth increased dramatically in the 20th century, a century in which the floating Earth was first viewed from space, and deep-sea ecosystems living without light were discovered. We learned how tectonic plates are dynamically produced, moved, and subducted. We also studied how the Earth's systems, including the atmosphere, hydrosphere, lithosphere and biosphere, interact with each other, and how human beings live together with these systems. Nevertheless, the vast majority of the oceans remains unknown and unexplored.

In addition, serious problems concerning global environmental changes such as global warming and depletion of ocean resources, in particular living resources, now threaten our planet. Appropriate measures must be taken to mitigate these and to achieve sustainable development. The oceans, occupying 71 percent of the Earth's surface, play a crucial role in maintaining the balance of the global environment.

We believe that the following approaches are important in order to develop a greater understanding of the unknown frontier, the Ocean, and to predict global environmental changes:

**-Exploring** the Earth and its ecosystem through research in ocean science as an essential contribution to understanding and predicting the Earth system, and as a prerequisite for wise decision making;

**-Improving** systems for observing little known areas, such as the deep ocean, Polar Regions and the Southern hemisphere;

**-Establishing** a global observation network with free exchange and access to data, and a global data and information network;

**-Developing** technologies and numerical models for more effective observations and better predictions;

**-Strengthening** recognition of the importance of the ocean and its resources by both the general public and policy makers by linking scientific issues with societal benefit through multidisciplinary research;

**-Educating** new generations of ocean researchers cognizant of the scientific, engineering and societal aspects of their work.

On behalf of major oceanographic institutions researching the huge potential of the oceans, we declare today that we will make every effort to obtain and contribute resources in a concerted manner and to enhance mutual cooperation to help solve global environmental issues.

# Invitation to INMARTECH2004

David Blake
British Antarctic Survey

Following a very successful INMARTECH 2002 at JAMSTEC in Japan, the next meeting will be held September 2004 in Cambridge, England. The British Antarctic Survey (BAS) and the Ocean Engineering Division (OED) of the Southampton Oceanography Centre, will organise the event.

A website will be developed detailing INMARTECH 2004 and information sent to all who attended INMARTECH 2002. Ideas and suggestions for conference themes and topics are most welcome.

On behalf of BAS and OED, I invite you to INMARTECH 2004 and hope that you are able to attend and take advantage of a visit to the historic University City of Cambridge.

Best regards,

David Blake

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CB3 0ET, England.

| | |
|---|---|
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British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

# INMARTECH 2004

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# INMARTECH 2004

Organised by

British Antarctic Survey

&

Ocean Engineering Division of Southampton Oceanographic Centre

British Antarctic Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

# INMARTECH 2004

- Venue — BAS Cambridge
- Date — September 2004
- Accommodation — Robinson College

British
Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

# INMARTECH 2004

# WELCOME

British
Antarctic Survey

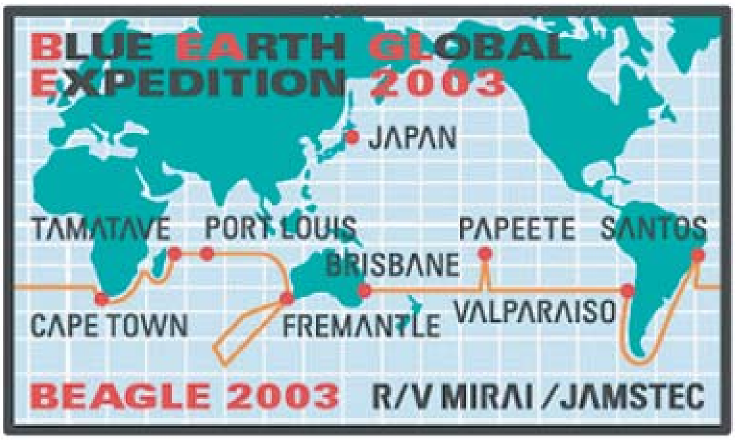
NATURAL ENVIRONMENT RESEARCH COUNCIL

# BEAGLE 2003

# (Blue EArth GLobal Expedition 2003)

### -The Southern Hemisphere Cruise of R/V MIRAI -

Oceanographic research vessel MIRAI, which is playing an important role from the Arctic Ocean to the North Pacific and the equatorial region, will depart for the cruise to go around the Southern Hemisphere in May, 2003. We named this cruise as BEAGLE 2003 after HMS Beagle, which was bound on a long scientific survey expedition to S. America and the South Seas (1831-36) boarding a British naturalist, Charles Darwin.


## BEAGLE2003 SYMBOL MARK

This cruise is going to have observation field around the South latitude 30 degrees to detect and quantify temporal changes in the Antarctic overturn system after WOCE (World Ocean Circulation Experiment). Also, this cruise is to clarify the climate changes, such as global warming.

Although the WHP of the 1990s, has been helping to obtain the feature of circulation of heat and chemical substances in the ocean briefly so far, for the sake of clarification for further detailed fluctuations, it is indispensable to perform high quality and spatially dense observation within a period of time. Moreover, the independent cruise of R/V MIRAI would have great deal with fixing the measurement conditions and making an observation error much smaller.

After R/V MIRAI departs from the Sekinehama port, Mutsu, Aomori prefecture, that is homeport of R/V MIRAI, in May 2003, and performs another observation cruise, the Southern Hemisphere cruise will start from Brisbane in Australia at the beginning of August. Then, along with the WHP (WOCE Hydrographic Program) lines, the water sampling and analysis would be conducted every day. And sediment sampling would be also carried out in this cruise. We will make port in every month, in Papeete (Tahiti), Valparaiso (Chile), Santos (Brazil), and Cape Town (South Africa) to accomplish the rotation of the crew, and re-supply of food and fuel, etc. The Southern Hemisphere cruise would be completed in Fremantle (Australia) in the middle of February 2004. The situation of observation will be available through the Web page of JAMSTEC periodically.

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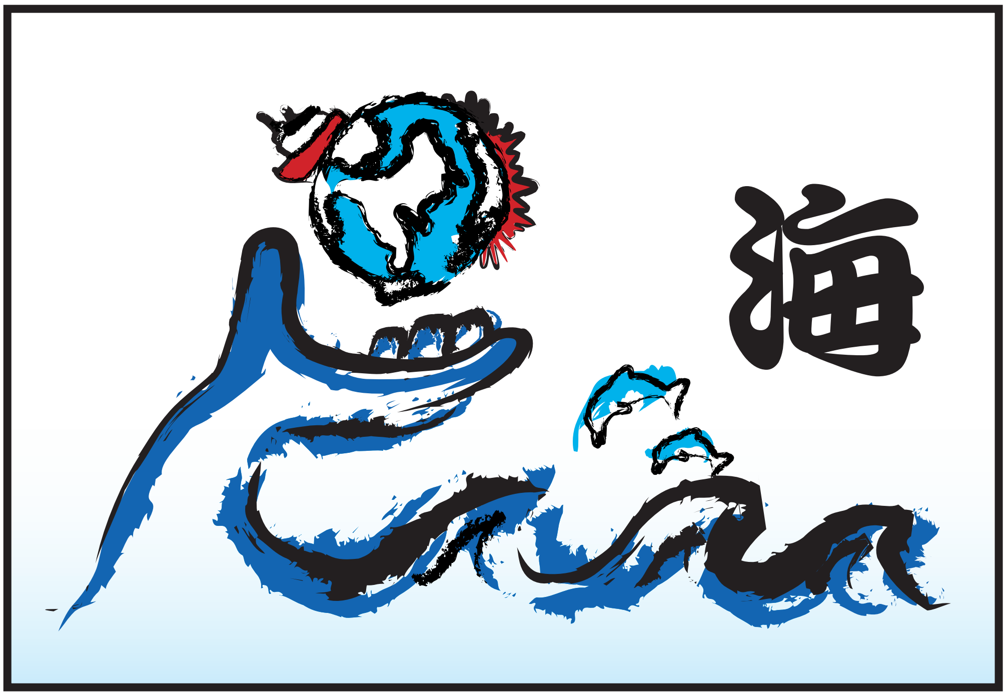


INMARTECH2002