AGENDA FOR SCIENTIFIC AND TECHNICAL WORKSHOP
OF THE SHIP OBSERVATIONS TEAM

VENUE … Goa, India
DATE … 26 February 2002

Workshop chairman: Dr G. Narayana Swamy

Session 1 **New Programmes** (Chair: Dr G. Narayana Swamy)

1. PRACTICE OF OCEAN CO2 OBSERVATIONS USING TRANS-OCEAN CARGO SHIPS
Yukihiro Nojiri, Carbon Cycle Research Team, National Institute for Environmental Studies
Email: nojiri@nies.go.jp

ABSTRACT:

CGER-NIES (Center for Global Environmental Research belonging to National Institute for Environmental Studies) started monitoring of oceanic CO_2 and related parameters utilizing North Pacific cargo ships from 1995. The activity was combined with existed atmospheric sampling program using Japan-Australia line container ships. Summary of the history is shown in Table 1.

The daily operation of on board CO_2 instruments is one of most important and difficult issues for the long-term maintenance of VOS observation. Even by the advanced technologies, suction of seawater into the ship is indispensable for the accurate measurement of oceanic CO_2 parameters, such as partial pressure of CO_2 (pCO_2), total dissolved carbon (DIC), pH and alkalinity. The measurement of pCO_2 is most practical and popular CO_2 measurement as an underway mode. Because the measurement uses seawater in the ship, safe installation of the intake and exhaust system for surface seawater and care during the cruise are truly necessary. A complete automatic system may not be enough safe. Asking a regular seaman to watch the water system is usually very difficult under the recent trend of reducing number of crew on board.

In the history of CGER-NIES CO_2 monitoring program using Pacific VOS, the on board system operator was changed from laboratory technicians to a seaman, employed by the research budget. Seaman employment can save the operational cost of the monitoring work. Ship operator also can have benefit of addition of a seaman sharing his working hours. The on board seaman can be responsible about the safety of on board monitoring system, especially for safety of the seawater use.

We made effort for automation of on board CO_2 system, and data networking of equipments, such as air CO_2 system at ship bow, ocean pCO_2 system at ship bottom, and navigation/meteorological system at bridge. On board operator can remotely watch the measurement results at bridge through on board LAN by our update instrumentation. Less necessity of daily on board maintenance facilitates operation by seaman without scientific carrier. The similar type of pCO_2 system has recently been installed on board a North Atlantic VOS under cooperation with Institute für Meereskunde, Germany and NIES.

The oceanic pCO_2 measurement needs SST and SSS information. A thermosalinograph is usually operated simultaneously with the pCO_2 system. The CO_2 VOS program can cooperate with the continuous surface SST and SSS measurement network by VOS.

The integration of global data set of oceanic CO_2 parameters, assurance of analytical accuracy is also an important issue. About DIC and alkalinity, Scripps CRM (certified reference material) is playing a great part. Unfortunately CRM is not so useful for accuracy control of pCO_2. Inter-calibration of on board pCO_2 system and common use of certified CO_2 system are recommended. We are also making effort for the quality control work in this field.

Table 1. History of NIES VOS monitoring including air and ocean CO_2 measurement

North Pacific VOS monitoring (Japan-US/Canada west coast line)						
Ship	Flag	Started	Ended	Air CO_2	Ocean. CO_2	System operation
Skaugran	Norway	1995/03	1999/10	hourly	minutely	on board technician
Alligator Hope	Liberia	1999/11	2001/05	10 sec.	10 sec. dual system	employed seaman
Pyxis	Panama	2001/11	active	10 sec.	10 sec. (2002/06-)	employed seaman
Western Pacific VOS monitoring (Japan-Australia line)						
Ship	Flag	Started	Ended	Air CO_2	Ocean. CO_2	System operation
Hakuba	Japan	1992/06	1996/01	flask	none	unmanned
Southern Cross	Japan	1996/03	2001/05	flask	none	unmanned
MOL Golden Wattle	Liberia	2001/05	active	10 sec.	10 sec. (2002/10-)	employed seaman

2. COORDINATION OF VOS AND SOOP PROGRAMMES MEASURING OCEAN CARBON AND RELATED PARAMETERS

Maria Hood, Intergovernmental Oceanographic Commission of UNESCO, Technical Secretary, SCOR – IOC Advisory Panel on Ocean CO_2
Email: m.hood@unesco.org

ABSTRACT:

The SCOR-IOC Advisory Panel on Ocean CO_2 has recently created an email and web-based communications forum for scientists making measurements of ocean carbon and related parameters. (http://www.ioc.unesco.org/iocweb/co2panel) In October 2001, the Panel initiated the development of an inventory of programmes and principle investigators to determine the routes and measurements being made, and to share this information with the wider community. To date, the Panel has identified 21 programmes (8 Atlantic, 9 Pacific, 1 Atlantic-Pacific, and 4 Indian and Southern Ocean) measuring a wide range of ocean and atmospheric variables, including SST, SSS, pCO_2, fluorescence, pigments, optical properties, Total CO_2, Alkalinity, and atmospheric CO_2, ^{13}C, ^{14}C, ^{18}O, CH_4, N_2O, O_2/N_2, O_3, air temperature, humidity, solar radiation, and wind velocity and direction. The vessels used are approximately 50% research or resupply vessels, and 50% industry vessels. Countries sponsoring programmes include Norway, Germany, UK, Spain, US, Japan, Australia, Canada, and France. A number of these programmes work together to create combined data sets and products. There is a need, expressed by several of the principle investigators, for greater communication between these programmes to improve the coordination and data sharing, and for intercalibration exercises, standardization of techniques, and agreement on and use of certified reference materials and data formats. The Panel discussed the way forward at its 2^{nd} Session meeting, 9-10 February, 2002. The initial inventory and plans for continued coordination and communication with this group of investigators will be presented.

3. BIOGEOCHEMICAL MEASUREMENTS OF SHIPS OF OPPORTUNITY- ONGOING PROGRAMMES AND FEASIBILITY

Yves Dandonneau, Laboratoire d’Oceanographie Dynamique et de Climatologie, Universite Pierre et Marie Curie, Paris

ABSTRACT:

The marine ecosystems that control the biological carbon sink are complex, including primary producers, grazers, predators, and bacteria, and produce a large variety of dead particles and dissolved organic matter. Their study implies measurements of many kinds of biomass and fluxes, and is possible only during devoted cruises onboard of oceanographic research vessels. Hence, only a limited number of such studies can be made, and these are generally organized in provinces where carbon fluxes are important and over which the dominant processes are considered to be homogeneous and can be predicted.

On the other hand, sea color sensors on satellites deliver data that can be converted into chlorophyll concentration, making it possible to obtain weekly global maps of chlorophyll concentration at the sea surface, i.e., information that is very close to the carbon flux which corresponds to gross photosynthesis.

Between these two approaches, there is a large gap, as global chlorophyll fields derived from satellites cannot be used accurately for the determination of global biogeochemical fluxes unless we know how the ecosystems operate these fluxes in all provinces. Ships of opportunity can help to describe the variability of the ecosystems which is mostly at large scale (regional, seasonal). Programs already exist that are based on sampling by ships of opportunity and that address oceanic biogeochemistry. They can be divided into two categories according to their objectives. Some of them aim to improve the estimates of surface seawater chlorophyll content from reflectance measured at the top of the atmosphere. For this, atmospheric correction represents 90% of the signal, making it a major difficulty. In order to validate the algorithms that estimate the seawater reflectance from reflectance at the top of the atmosphere, measurements of the former must be repeated in many places, covering the wide variability of aerosols and atmospheric conditions. For these measurements, three difficulties must be solved: avoiding the sun glitter, avoiding the white caps, and avoiding surfaces where the irradiance field is affected by the ship. The two last ones are especially difficult to solve. Two radiometers have been developed: the SIMBADA (Laboratoire d'Optique Atmosphérique in Lille, France) is a portable easy to use radiometer, that has 11 wavelengths near or close to those of SeaWiFS or MERIS sea color sensors and can be operated by the officers of ships of opportunity, and the Shadow Band Radiometer, developed at Brookhaven (New York), that is fully automatic and additionally measures the radiation from the sky (without direct sun radiation) using a rotating screen (the 'shadow band'). Other ones aim to describe the variability of biogeochemical conditions at sea, and can include the measurement of a very large number of parameters. Among these, photosynthetic pigments are especially interesting : they offer a way to validate the products of sea color satellite sensors, and they make it possible to characterize the ecosystems, because many of these pigments are indicators of phytoplankton groups. Great care must be taken for the sampling of photosynthetic pigments, especially for storage that must be done at temperature less than minus 40°C. Depending on the measurements to be made, presence of a scientific observer onboard of the ship is often necessary. Examples of such programs are the Atlantic Meridional Transect (AMT) managed from Plymouth, England, and the Geochemistry, Phytoplankton and Color of the Ocean project (GeP&CO) operated from LODyC, France.

Session 2 Observational equipment and telecommunication facilities (Chair: Ms Sarah North)

4. AN AUTOMATED OCEAN AND WEATHER MONITORING SYSTEM FOR USE ON VOLUNTARY OBSERVING SHIP (VOS)

Tom Houston, Geoffrey K Morrison, Cynthia Moore, and Rod G. Zika, International SeaKeepers Society
Email: geoffmorrison@bigfoot.com

ABSTRACT:

The International SeaKeepers Society has developed an autonomous ocean and weather monitoring system. Systems are currently deployed on private superyachts, and commercial cruise ships, which participate in the Volunteer Observing Ship (VOS) program. Wind speed and direction, air temperature, barometric pressure, relative humidity, and sea surface temperature (SST), along with ship's position, are reported automatically to the United States National Weather Service via INMARSAT C email at regular intervals.

In addition to its "weather sensors", the SeaKeepers system is designed to accommodate a wide variety of oceanographic sensors as well. At present all participating vessels carry a suite of ocean sensors that measure, log and transmit data on SST and salinity. Other aqueous sensors such as dissolved oxygen, pH and Eh and optical sensors for chlorophyll and CDOM fluorescence and turbidity are being developed for inclusion in the system and are currently completing field tests. Sensors for pCO_2, total CO_2 and trace metals are also in development. A nutrient monitoring package is also planned.

This process represents a unique collaboration between:

The International SeaKeepers Society, a not for profit organization
The National Oceanographic and Atmospheric Administration, US government
The University of Miami, Rosenstiel School of Marine and Atmospheric Science
General Oceanics Inc. a US corporation
Idronaut Srl an Italian manufacturer

SeaPoint Corporation a US corporation
WS Envirotech a UK manufacturer

5. RELIABLE WIND DATA FROM SHIPBOARD AWS

R Caplikas, Manager, Vaisala Melbourne, Australia
R Hibbins, Instrument Engineering, Bureau of Meteorology, Australia
Email: robert.caplikas@vaisala.com

ABSTRACT:

Truly representative information about wind direction and speed at sea cannot be obtained by observing the weather on the coast. Australia's Bureau of Meteorology has installed a small number of Automatic Weather Station (AWS) on its Australian Volunteer Observing Fleet (AVOF) ships to assist in obtaining maritime weather observations. These ships report generally on a three hourly Synoptic schedule, and relay the conventional weather parameters such as wind speed and direction, pressure, temperature and humidity.

An INMARSAT-C satellite transmitter with an internal GPS receiver is used to transmit observations back to the Bureau's network. The GPS receiver provides information on the ship's position and speed and its course over the water. A laptop PC on the bridge displays real-time information on the AWS measurements. It also enables manual entry of observations such as visibility and sea state.

Data transmission costs from the AVOF ships is an important consideration. For this reason, the standard Synop message is converted to a short binary report prior to transmission and then decoded back to the standard Ship Synop code at the Bureau. This enables the use of very short data transmissions. The benefits are two-fold, observations can be made as frequently as once per hour, and costs are significantly lower compared with other communication options.

AWS data from these ships will significantly contribute to improve accuracy of marine forecasts. For example, the first Ship AWS was fitted to the Spirit of Tasmania to assist in the study of wind patterns across Bass Strait, as part of an effort to enhance the Bureau's computer derived forecasts and improve forecasting for Bass Strait.

At present the Bureau has installed this system on five AVOF ships and is currently planning to install a further five to ten over the next three years. In summary, the Ship AWS system provides automatically accurate, around the clock, information on the marine weather situation. The weather information collected is proving to be an extremely useful contribution for forecasts, and model input both in the Australian area, and also for input into the worldwide NWP models.

6. DEVELOPMENTS IN VAISALA'S ASAP EQUIPMENT

Erkki Jarvinen, Vaisala
Email:Erkki.Jarvinen@vaisala.com

ABSTRACT:

This presentation introduces the Vaisala ASAP Product. Product is based on DigiCORA III MW21 based radiosounding equipment. DigiCORA III sets new standards for upper-air sounding operations due to its open software architecture, flexibility, telecommunication and networking capabilities.

Several improvements have been made to GPS-derived upper air wind measurements. These improvements have been implemented in the Vaisala radiosonde design and its associated computation algorithms. The effect of these improvements has been analyzed for performance and reliability and compared with collected operational data from the field.

This presentation will also consider "Data as a product" -concept: Discussion about one possibility to accelerate the increase of the ASAP-observations over the oceans. Vaisala could consider furnishing ASAP-installations and providing data for GTS.

7. DEVELOPMENT OF BEOGEOCHEMICAL AND PHYSICAL DATA ACQUISITION SYSTEMS FOR USE ON MERCHANT VESSELS

Rick Bailey (CSIRO/BMRC JAFOOS Australia), Roger Francey, Bronte Tilbrook, John Parslow (CSIRO Australia)
Email:rick.bailey@marine.csiro.au

8. REPORT ON THE DEVELOPMENT OF CO2 MONITORING SYSTEMS TO BE INCLUDED IN AN AUTONOMOUS DATA GATHERING SYSTEM

Geoffrey K Morrison, Frank Millero, Flavio Graziottin, Walter Varda, Regis Cook, Richard Wood and Rod G. Zika, International SeaKeepers Society
Email: geoffmorrison@bigfoor.com

ABSTRACT:

The development of two specialized sensors for monitoring air-sea CO_2 flux is described: 1) A pCO_2 continuous-flow system utilizing a miniature shower head equilibrator and 2) a continuous-flow differential pH system for monitoring total inorganic carbonate (TCO_2). The initial development of these instruments was funded by an NSF STTR grant. The second phase of the development is now being funded by an NSF Phase II STTR grant. The two sensors are being designed so that they can be easily installed, together with other ocean and atmospheric sensors, in the SeaKeepers Ocean & Atmospheric Monitoring System currently being deployed on ships, buoys and piers around the world. After being fully field tested, the two CO_2 instruments will be deployed worldwide by the non-profit International SeaKeepers Society to analyze CO_2 absorption by the oceans as a contribution to the research on the role of CO_2 in global warming.

9. IMPROVING THE FREQUENCY AND RELIABILITY OF GLOBAL METEOROLOGICAL OBSERVATIONS AT SEA

Ron Fordyce, PMO Manager, Environment Canada, Hamilton, Canada
Tom Vandall, Director, AXYS Environmental Systems, Victoria, Canada
Email: tvandall@axys.com

ABSTRACT:

The Voluntary Observing Ships' (VOS) meteorological reports provide essential data to meteorologists and climatologists. Currently these observations are collected, corrected (true wind, magnetic variation, pressure etc.) and transmitted manually using the standard WMO format. Until recently, over 20% of the observed data in Canada's VOS program was being rejected by failing automated quality control (QC) tests, or being lost by complications in the data routing pathways to the GTS. Commonly, data was rejected due to errors in the observed wind speed and direction or errors with the observed position.

The manual nature of VOS data collection introduces an inherent risk for observation bias and/or input error. In addition, the frequency of data reporting is inconsistent and often not carried out in extreme weather conditions when the data is most important. Other limitations include the wide variety of uncalibrated instruments that are in use. In an effort to improve Canada's VOS program, Environment Canada contracted AXYS Environmental systems to develop the Automated Voluntary Observing Ships AVOS™ system to transmit fully automated VOS observation reports. This system was based on the successful Watchman™ based buoy payloads in use in the Canadian Weather Buoy Network. Today AVOS™ reports include GPS position, UTC time, vessel identification, 3 hourly ship speed made good, course speed made good, pressure tendency, true wind speed and direction, pressure, air temperature, wet bulb temperature and sea surface temperature. The system uses standardized, calibrated climate quality sensors, which are in use in the National Weather Buoy Network. Early data return rates for AVOS™ have been excellent with automated region detection algorithms supporting reporting modes for Synoptic (6 hr.), Intermediate Synoptic (3 hr.) and Data Sparse (1hr.) regions. As a result the frequency of measurements has risen dramatically with automatic region detection and automatic reporting of STORM and SPREP conditions also taking place.

Through the use of image rich touch screen technology and an intuitive software interface, manually observed data such as cloud height and type, present and past weather, wave conditions and ice and icing can be added to the VOS report. Automated quality control protocols ensure that manual observations are correctly entered. Corrections for elevation and magnetic variation are made automatically using region detection algorithms. PMO's have been very enthusiastic about the simple installation and ease of use with AVOS™ which is helping them to promote the VOS program.

To date Environment Canada has purchased 13 AVOS™ systems and plans to outfit 75 vessels in the Canadian AVOS fleet over the next few years. Ships outfitted with AVOS™ have generated a ten fold increased in the average number of VOS reports. It is apparent that this system will significantly help Canada improve the frequency and accuracy of VOS observations.

10. THE NEW OBSJMA

Tadashi Ando, Japan Meteorological Agency
Email: t_ando@met.kishou.go.jp
(see extended abstract)

11. ARGOS SYSTEM APPLICATIONS AND ENHANCEMENTS

Christian Ortega , CLS/Service Argos
Email: ortega@cls.fr
(see extended abstract)

12. NEW INMARSAT MARINE SAFETY AND COMMERCIAL SERVICES IN 2002

Vladimir Maksimov, Inmarsat Ltd.
Email: vladimir_maksimov@inmarsat.com
(see extended abstract)

13. AUTOMATIC VOLUNTARY OBSERVING SHIPS' SYSTEM BRIDGE TOUCHSCREEN INTERFACE

Tom Vandall, AXYS Environmental Systems, Victoria, Canada
Email: tvandall@axys.com

ABSTRACT:

AVOS™ automatically samples, processes, displays, logs and transmits weather data from VOS ships in the universal FM 13-XI code to VOSCLIM (VOS Climate Project) standards.

Automated parameters include GPS position & UTC time, 3 hourly ship speed made good, course made good & pressure tendency, true wind speed & direction, air temperature & wet bulb temperature, barometric pressure, sea surface temperature, and vessel identification. Through the use of touch screen technology and an intuitive software interface, manually observed data such as cloud height and type, present and past weather, wave conditions and ice and icing can be added to the FM13-XI ship report. Automated quality control protocols ensure that manual observations are correctly entered.

Corrections for elevation and magnetic variation are made automatically using region detection algorithms. Region detection also supports automated reporting modes for Synoptic (6 hr.), Intermediate Synoptic (3 hr.) and Data Sparse (1hr.) reporting regions when required. STORM and SPREP conditions are also automatically detected and transmitted. AVOS Bridge Touchscreen Interface will be demonstrated.

Session 3 Evaluation (Chair: Mr Steve Cook)

14. RESULTS OF FIELD TESTS OF THE NEW XCTD-2

Tomowo Watanabe[1] and Michio Sekimoto[2]
[1] Tohoku National Fisheries Research Institute
[2] Tsurumi Seiki Co., LTD
Email: trade@tsk-jp.com

ABSTRACT:

The eXpendable Conductivity, Temperature, and Depth profiler for temperature and salinity observations to a depth of 1,850 m (XCTD-2) was tested during the MR01-K04 cruise of the research vessel R/V MIRAI in the summer of 2001. The new, deep–water probe was recently developed by the Tsurumi-Seiki Co., LTD. Field tests of the XCTD 2K are indespensible for determining the depth-time equation for practical use. On the cruise, 12 probes were launched during CTD up-casts at 11 CTD stations. Successful observations were collected to a depth of 1800 m by 9 of the 12 tests. By using the 9 pairs of XCTD and

CTD profiles, the depth-time equation was estimated as $D = 3.4005t - 3.2x10^{-4}t^2$, where D is the depth in meters and t is the elapsed time after the probe hits the sea surface. The temperature and salinity differences from CTD observations in the deep layer of 1000m to 1500m were -0.001^{0}C and -0.008psu respectively. Standard deviations were 0.018^{0}C and 0.013psu. These values indicate improvement of the XCTD system.

15. EVALUATION OF DATA FROM A PILOT FIELD EXPERIMENTT UTILIZING SEAKEEPERS AUTOMOATED DATA COLLECTION AND TELEMETRY SYSTEMS ON A GROUP OF VESSELS

Geoffrey K. Morrison, Edward J. Kearns, Christine Caruso-Magee and Rod G. Zika,
InternationalSeaKeepers Society
Email:geoffmorrison@bigfoot.com

16. THE ACCURACY OF VOLUNTARY OBSERVING SHIPS' MARINE METEOROLOGICAL OBSERVATIONS

Elizabeth C. Kent and Peter K. Taylor, Southampton Oceanography Centre, U.K.
Email: elizabeth.c.kent@soc.soton.ac.uk

ABSTRACT:

Typically the merchant ships of the Voluntary Observing Ships scheme are recruited by a Port Meteorological Officer at a port which the ship frequently visits. The observing practises and meteorological instruments provided depend on the recruiting country and are often very basic. Indeed, the VOS system was primarily designed to aid weather forecasting, while climate change studies require higher quality data. A better understanding of the error characteristics of the VOS data is now needed for both data assimilation and climate studies.

Using sea and air temperatures as an example, this talk will show how the large random errors present in the data can be quantified. Determining the smaller, systematic biases is more difficult because correlations exist between the different variables and their respective errors. For example, the error in SST data measured using buckets is likely to depend on the air - sea temperature difference, and hence on both sea and air temperatures. Surprisingly the scatter in the air temperature data seems to vary with how the SST is measured, probably because the observing practises strongly depend on recruiting country. By transforming the data to form new variables which are uncorrelated, the systematic errors can be properly estimated and then transformed back in terms of the observed quantities. The results suggest that, while SST data from engine room intake (ERI) thermometers are very scattered, any mean bias is small. In contrast, while bucket SST data is less scattered, it is biased cold in regions of high heat flux. Previously it had been assumed that ERI data were biased warm.

Improving the quality of future VOS data requires fuller information on instrumentation and observing techniques, and the implementation of good observing practises. These are goals of the WMO sponsored VOS subset for climate (VOS-Clim). Eventually it is hoped to introduce better instrumentation. For example, hull contact SST sensors installed with acoustic data transmission rather than cables. The IMET project at Woods Hole Oceanographic Institute and the AutoFlux system (developed by SOC with European partners) are prototypes for future VOS instrumentation systems.

17. EVALUATION OF XBTs AND XCDTS IN SEA TRIALS

Rick Bailey, Lisa Cowen, CSIRO/BMRC JAFOOS
Ken Ridgway (CSIRO)
Email: rick.bailey@marine.csiro.au

Session 4 Scientific and operational applications (Chair: Mr Jean-Paul Rebert)

18. APPLICATIONS OF UPPER OCEAN THERMAL DATA

Rick Bailey , CSIRO/BMRC JAFOOS
Email: rick.bailey@marine.csiro.au

19. EUCOS, AN OCEAN OBSERVATION STRATEGY OVER THE NORTH ATLANTIC

François Gérard, Météo-France
Email: francois.gerard@meteo.fr

ABSTRACT:

The European meteorological services member of EUMETNET have established a strategy for the definition, implementation and operations of the surface based observation systems of interest for weather forecast over Europe. From 1999 to 2001, the EUMETNET Composite observing system (EUCOS) implementation programme has worked on network evolution scenarios to implement the strategy. The presentation will present the oceanic part of the scenario adopted at the end of the EUCOS programme. It will be shown that the use of sensitivity tools enable to issue clear requirements for the operation deployment of marine platforms like ASAP ships, VOS and buoys, in order to target the observation over the main sensitive areas. The fesibility of such targeting will be shown through the results of an experiment performed in September 2001with the European ASAP ships.