WORLD OCEAN COUNCIL

The International Business Alliance for Corporate Ocean Responsibility

Smart Ocean/Smart Industries Workshop

(UNESCO-IOC, Paris, 12-13 December 2011)

REPORT

INTRODUCTION

The World Ocean Council (WOC) Smart Ocean/Smart Industries Workshop, (12-13 December, Paris) brought together more than 70 representatives from a range of ocean industries, along with representatives from government agencies, intergovernmental organizations and academic institutions involved in ocean and climate observations.

The Intergovernmental Oceanographic Commission (IOC) of the United Nations Education, Scientific and Cultural Organization (UNESCO) hosted the workshop at the IOC in Paris and provided invaluable support with logistics and other arrangements. The Management Committee of the Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) provided assistance by working with WOC to develop the workshop program and identify speakers, and were critical, active participants in the workshop.

The WOC Smart Ocean / Smart Industries Working Group is co-chaired by A.P Moeller-Maersk and Transocean. A.P Moeller-Maersk provided additional financial support to make the workshop possible.

The WOC Working Group and partners developed a vision and goal for the Smart Ocean/Smart Industries concept, as well as objectives for the initial workshop and a workshop structure to deliver on its objectives:

Smart Ocean/Smart Industries - Vision

> Leadership companies from a range of ocean industries are collaborating with the scientific community in the systematic, regular, sustained and integrated collection and reporting of standardized ocean and atmospheric data for input to operational and scientific programs that improve the safety and sustainability of commercial activities at sea and contribute to maintaining and improving ocean health.

Smart Ocean/Smart Industries - Goal

> To establish a platform/portal that facilitates and coordinates efficient, cost effective scientific and ocean observing community collaboration with shipping and other ocean industries in the collecting of ocean and atmospheric information.

Smart Ocean/Smart Industries Workshop Objectives

- Develop a common understanding between and across business and the scientific community on the scope, scale and intent of existing voluntary observation programs.
- Understand the key barriers to scaling up these programs up to an integrated global scale, e.g. human capacity, resource needs, structure, legal issues, etc.
- Develop the principles, define the high level resource needs and structure for a global program* and outline the roadmap and workplan for moving forward.

  [*Global program to facilitate, coordinate and scale up the efficient, cost effective ocean and atmospheric information collection by a growing number and range of vessels and platforms for ocean and weather/climate observations]

Smart Ocean/Smart Industries Workshop Structure

1. Presentations: Overview of voluntary observation programs and technology

2. Presentations: Voluntary observation programs: Status, progress, and lessons learned for scaling up and cross-sectoral applications
3. Breakout Groups: Parameters and technologies for multi-sectoral voluntary observations
    - Group A: Ocean observation parameters and technology needs and opportunities for both vessels and platforms
    - Group B: Marine atmosphere/ocean surface observation parameters and technology needs and opportunities for both vessels and platforms
4. Discussion: Parameters and technologies for multi-sectoral voluntary observations
5. Breakout Groups: Data considerations and institutional arrangements
    - Group C: Data interoperability, communications, management and access
    - Group D: Institutional and operational needs and options for a global multi-sectoral program
6. Discussion: Data considerations and Institutional arrangements
7. Closing Discussion: Developing the principles, roadmap and workplan

This report presents a summary of the presentations, discussions and conclusions of the workshop. The complete presentations are available at http://www.oceancouncil.org/site/smart_ocean.php

The appendices to this report contain the following information:

Appendix 1 - Conference Program
Appendix 2 - List of Participants
Appendix 3 – Breakout Group Guidance and Questions
Appendix 4 – Acronyms

SUMMARIES OF PRESENTATIONS

The presentations provided valuable context for the workshop, and identified specific data gaps and concrete suggestions for the Program. The presentations were categorized into four sections:

I. Overview of Voluntary Observation Programs and Technology
II. Voluntary Observation Programs: Status, Progress, and Lessons Learned for Scaling Up and Cross-Sectoral Applications
III. Parameters and Technologies for Multi-Sectoral Voluntary Observations
IV. Data Considerations and Institutional Arrangements

To start the workshop, Wendy Watson-Wright, IOC Executive Secretary and Assistant Director General, UNESCO, provided a warm welcome to the group and supported the innovative collaboration between science and industry.

I. Overview of Voluntary Observation Programs and Technology

Eskild Sorensen, A.P. Moeller-Maersk

Eskild Sorensen provided a welcome and introduced the group to Maersk’s interest in ocean and climate observations. With 16% of the shipping container business, Maersk has a critical need for good metocean data. In particular, Maersk wants to see:

- More structured and beneficial use of sensors on ships, to enhance understanding of the ocean for business expansion, environmental protection, and safety improvements;
- Global data sharing, so that all can benefit; and
- Strong coordination between science and industry in this Program.

Paul Holthus, WOC

Paul Holthus introduced the Smart Ocean/Smart Industries concept, as well as the workshop objectives and process. He noted that this Program will build on existing programs, so that the whole is greater than the sum of the parts.

Albert Fischer, Global Ocean Observing System (GOOS) Project Office, IOC

Albert Fischer discussed the science and management needs for voluntary ocean and climate observations. He described the fact that the GOOS already has a strong partnership with industry, focused on ship-based in situ measurements for climate and weather. Many of these voluntary industry observation programs are coordinated through JCOMM and Fischer briefly described some of these. Fischer noted that human impacts are having significant effects on the planet and that we are now in the "anthropocene" era where humans are generating fundamental changes in the ocean. Fischer suggested that the path to sustainability includes:

- Observations for building knowledge and early warning systems;
- Encouraging science-based policy;
- Action at all levels; and
- Progression toward a blue-green economy.

Fischer stated that the current voluntary observations are incredibly important, but, in the future, additional observations are needed to provide better information for the ocean economy. These additional observations should include physical surface, subsurface, carbon, biogeochemical and ecosystem variables from growing number of platforms.

Candyce Clark, National Oceanic and Atmospheric Administration (NOAA) and JCOMM

Candyce Clark provided an overview of JCOMM and the existing voluntary observation programs. JCOMM has three program focus areas:

- Services and forecast systems;
- Data management; and
- A coordinated network of in situ observations, through six existing observing programs.

Some of the observing programs have a foundation that dates back to the Brussels Maritime Conference of 1853. The six programs are:

1. Voluntary Observing Ships (VOS) - More than 3000 ships have been recruited by meteorological services to voluntarily weather observations for meteorological forecasts and for climate research.
2. Ships of Opportunity Programme (SOOP) - A ship of opportunity network focused on expendable bathythermograph (XBT) measurements, with additional measurements, such as thermosalinograph (TSG), expendable conductivity,-temperature-depth (XCTD), conductivity-temperature-depth (CTD), acoustic Doppler current profiler (ADCP), partial pressure carbon dioxide (pCO_2), and phytoplankton concentration.
3. Data Buoy Cooperation Panel (DBCP) - 1250 surface drifting buoys and 400 moored buoys, providing measurements such as sea-surface temperature, surface current velocity, air temperature and wind speed and direction.

4. Global Sea Level Observing System (GLOSS) - The main component of GLOSS is the 'Global Core Network' (GCN) of 289 sea level stations around the world for long term climate change and oceanographic sea level monitoring.
5. Argo Profiling Float Array - a global array of 3,000 free-drifting profiling floats that measures the temperature and salinity of the upper 2000 m of the ocean.
6. OceanSITES - a worldwide system of long-term, deepwater reference stations measuring dozens of variables and monitoring the full depth of the ocean from air-sea interactions down to 5,000 meters.

Basic information on these programs can be found at http://www.jcomm.info. Additional information is available at http://www.jcommops.org (observations support center and data management).
Clark pointed out that there is a general decline in in situ marine observations, most notably in the number Voluntary Observing Ships and in visual observations. Most observations tend to include the essential climate variables (sea surface temperature, sea level pressure, air temperature, wind speed, total cloudiness, relative humidity, and evaporation parameter). Clark suggested that the Smart Ocean/Smart Industries Program address data gaps, facilitate a sustained system, improve current technologies, and help develop new technologies.

Sarah North, UK Metrological Service

Sarah North reported on the status of the VOS Scheme (http://www.bom.gov.au/jcomm/vos/), which currently numbers ~3300 recruited ships, although the number of actively reporting ships is ~2500. These ships provide vital data for use in weather and ocean forecast models. Depending on their suitability and areas of operation, they are recruited to different classes of participation and are increasingly being fitted with Automatic Weather Stations (AWS). On manually reporting ships, the coded observations are typically compiled and submitted by the officers at the main synoptic hours, whilst automated observations are usually submitted hourly. All VOS observations are shared over Global Telecommunications System (GTS) for use by all National Meteorological Services. In addition, the observational data are stored at Global Collecting Centers (in Edinburgh and Hamburg (see http://www.metoffice.gov.uk/weather/marine/observations/gathering_data/gcc.html and http://www.dwd.de/gcc). To support the VOS Scheme, participating meteorological services maintain a network of Port Meteorological Officers (PMOs) at key ports around the globe. PMOs collect delayed mode data, check the instrument calibrations and metadata, train officers in the correct observing practices and also collect delayed mode data that is stored in the electronic logbook software used by VOS. North stressed that it was important to continue to maintain and expand the traditional VOS network, whilst at the same time enhancing the use of automated system. Meteorological services have limited funding and resources to recruit new ships and to fit new, automated systems (which can cost a few thousand Euros) and to pay for transmission costs. Active shipowner support for the aims of the VOS Scheme is therefore essential to ensure its continued success. In addition to ships, many offshore installations (such as drilling offshore oil rigs , fixed oil and gas platforms, and floating production/storage units), also submit metocean data. In some cases, theses installations will be recruited in a similar fashion to the VOS. However, offshore installations are increasingly being fitted with sophisticated AWS providing high quality data. Meteorological services could therefore benefit from access to this high quality third-party data, which could provide vital input to forecast models, thereby helping to ensure safety at sea.

North identified several important areas for improvement and opportunities for collaboration with the Smart Ocean/Smart Industries Program, such as:

- The development of generic design standards, which would help greatly when installing meteorological and oceanographic instrumentation to new or existing ships;

- The supply and calibration of meteorological instruments, such as digital barometers and acoustic anemometers;
- Assistance with data transmission methods and costs e.g. the use of email and compressed data transmissions to reduce costs;
- Improving quality by providing regular monitoring feedback on the quality of observations;
- Helping to encourage increased participation in the VOS program by volunteering suitable ships and by hosting AWS installations; and
- Supplying additional data sources to the National Meteorological Services and to the GTS e.g., offshore installation data.

II. Voluntary Observation Programs: Status, Progress, and Lessons Learned for Scaling Up and Cross-Sectoral Applications

Joaquin Trinanes, NOAA

Joaquin Trinanes discussed the SOOP. The mission of SOOP is to facilitate the international collaboration and interaction between the scientific and operational communities with the shipping industry, and to establish the standards of data acquisition, transmission, quality control, distribution, and archiving of XBT, TSG, and other underway data. To accomplish this, SOOP:

- Collects XBT and TSG observations;
- Closely collaborates with other observational programs (e.g., VOS, pCO2, ADCP, drifters, XCTDs, Argo, Continuous Plankton Recorder (CPR)…);
- Sets data management standards (e.g., ensures the transmission of data in real time from participating ships;
- Maintains close collaboration with the scientific community and shipping industry; and
- Closely collaborates with private industry (Lockheed Martin/Sippican, Sea-Bird Electronics…)

The SOOP includes 50 global, science-based transects. Approximately 100 ships participate in the program with 19,000 deployments. SOOP also facilitates the creation of new observation technologies.

Trinanes suggested that WOC collaborate with SOOP by:

- Helping fill gaps in observations;
- Facilitating the identification and utilization of existing shipping routes and encourage active participation of new shipping agencies in the High Density XBT Network;
- Providing support to recruit ships on recommended transects that SOOP has difficulty to recruit ships;
- Helping improve current technology;
- Providing support to develop improved technology of current instrumentation (e.g. wireless launchers);
- Helping develop new technology; and
- Working with SOOP engineers, provide expertise, and provide a link to engineering companies to develop, test, and implement new technologies to measure ocean parameters, as required by scientific community.

Mathieu Belbeoch, JCOMM in situ Observing Platform Support Center (JCOMMOPS)

Mathieu Belbeoch presented the Argo profiling float program, which uses robotic floats globally. The program provides data, such as temperature, salinity, nutrients, bio-optics and dissolved oxygen for the upper ocean. It also includes some ocean bottom sensors. Belbeoch discussed the data management of the program. In conclusion, Belbeoch noted:

- In the context of global economic pressure, Argo is doing well, because float lifetime is improving (but, some floats are getting older and will need replacement);
- Ocean access will remain a continuous challenge;
- The deployment of 800 floats per year is a challenge;
- Caution: piracy and the Law of the Sea;
- Cooperation with the WOC is required for ship time, in particular, in the Southern Ocean;
- The JCOMMOPS centre will make the link with WOC community to set up cooperative arrangements;
- There is room for a dedicated "ship logistics coordinator" (2012); and
- Are there any resources available through WOC?

Pierre Blouch, Meteo-France

Pierre Blouch discussed the DBCP, which is a joint effort of the IOC and the WMO. The DBCP is an international program coordinating the use of autonomous data buoys to observe atmospheric and oceanographic conditions, over ocean areas where few other measurements are taken.
The 1250 data buoys, deployed by voluntary commercial ships and research vessels, measure:

- Air pressure,
- Sea surface temperature,
- Ocean current velocity,
- Wind velocity
- Air temperature and humidity,
- Wave characteristics, and
- Sea surface salinity.

The observations are relayed by satellite and are used immediately to improve forecasts and therefore increase marine safety. Delayed mode data are also used for the validation of satellite measurements and for climatology. Blouch noted that the drifting buoys have a 18-month lifetime, which could be improved. Blouch said that additional ships are needed for additional deployments to maintain the network. The buoys are pre-packaged for easy, underway deployment.

Mario Tamburri, Alliance for Coastal Technologies (ACT)

Mario Tamburri discussed the ACT and provided an overview of ocean observing technologies. ACT provides the following services:

- A third-party testbed for evaluating a wide-variety of technologies;
- A forum for capacity and consensus building (e.g., through workshops); and
- An information clearinghouse for environmental technologies.

One of ACT's 40 workshops focused on integrated sensor systems for vessels of opportunity. The goals of the 2006 workshop were to identify current state of technology and uses, limitations and ways to overcome them, and future directions. Participants included technology users, technology manufacturers and shipping representatives. In 2006, the current state of technology included:

- Several groups were using integrated sensor system packages on vessels of opportunity;

- The majority of the packages were developed by researchers for specific purposes;
- The advantages of these packages included: high spatial and temporal resolution, high availability of platforms , system is protected against harsh environment, biofouling can be more easily prevented, low running costs, no power restrictions, and easier maintenance
- The limitations were: data limited to the vessel route, no depth profiles, installation/retrofitting (e.g., hull penetrations), and bubbles.

The recommendations of the workshop were to work with operators with real-time data to improve efficiency and safety, provide outreach and education on the benefits of the observations, publish in peer-reviewed journals, encourage the acceptance of integrated sensor systems within the broader community, and standardizing technologies and interfaces.

Tamburri also described the Maritime Environmental Resource Center, which:

- Evaluates the mechanical and biological evaluations of ballast water treatment systems – laboratory, land-based, and shipboard;
- Assesses the economics of ballast water regulations and management approaches; and
- Facilitates the development and adoption of green ship technologies.

Ian Boyd, Saint Andrews University

Ian Boyd described the International Quiet Ocean Experiment, which has the objective to create a global program of research to understand the effects of sound on marine life. The problem is that there are many anthropogenic sources of sound that have frequencies within the hearing range of many species of marine life. Boyd noted it is important to understand the effects and consequences of marine sound on marine life. This understanding can help mitigate economic impacts, as well as marine life impacts. Boyd noted that the work program will include: ocean observations, data management and communications, soundscape modeling, understanding trends in anthropogenic sound, regional experiments, engagement with industry and the public, and understanding economic impacts.

Nazeeh Shaheen, L3 MariPro

Nazeeh Shaheen described L3 MariPro and cabled observatories and platforms. For over 50 years, L3 MariPro has undertaken 60+ projects related to cabled, undersea sensor systems. He described several existing, mature cabled observatories, including Monterey Accelerated Research System (MARS) and Neptune Canada, as well as the Ocean Observatories Initiative and its Regional Scale Nodes. Shaheen noted that the cable technology is well-suited to address the long-term, real-time, stable, secure, and expandable environmental monitoring requirements of oil and gas platforms.

Tom Rossby, University of Rhode Island

Tom Rossby described the OceanScope effort. The OceanScope Working Group is a joint effort of Scientific Committee on Oceanic Research (SCOR) and the International Association for the Physical Sciences of the Oceans (IAPSO) to establish a science-industry partnership to outfit commercial vessels with automatic sensor systems to provide an integrated approach to monitoring the global ocean water column. The approach will include:

- A coordinated partnership with industry;
- Standardized methods and technologies;
- Economies of scale essential to reduce costs; and
- Building upon, and providing a framework for, coordinating existing activities.

OceanScope will:

- Coordinate the installation and operation of instrumentation on a fleet of commercial vessels;
- Optimize present technologies for commercial vessel use (standardized, automated, reliable); and
- Facilitate the development of next-generation ocean water column measurement technologies.

Rossby described some current ideas and challenges. In conclusion he noted:

- The need to sort out bubble constraints and optimization strategies;
- The obvious advantages of integrated sampling;
- The need to agree and prioritize new and existing technologies for merchant marine use; and
- The importance of the ocean observing community and industry collectively making the case for sustained ocean observation.

David Hydes, University of Southampton, National Oceanography Centre and Maciej Telszewski, International Ocean Carbon Coordination Project (IOCCP)

David Hydes discussed ocean carbon flux observations by the IOCCP and the Integrated Carbon Observation System (ICOS) projects. The IOCCP is a project of the IOC, that promotes the development of a global network of ocean carbon observations through technical coordination and communications services, international agreements on standards and methods, and advocacy and links to the global observing systems. Hydes described some of the pCO2 systems in use, as well as the Swire [Trust] NOCS Ocean Monitoring System (SNOMS) on a Chinese commercial vessel, the *MV Pacific Celebes*. Hydes offered some lessons learned through the project:

- Ship routes are limited and can change;
- Obtaining ship access can be challenging (many parties involved);
- Costs limit the expansion of the monitoring programs, particularly, since these programs are funded by national governments;
- IOCCP, with ICOS, will encourage closer collaboration with WOC and its partners.

Wilhelm Petersen, Helmholtz-Zentrum Geesthacht, Institute of Coastal Research/Operational Systems

Wilhelm Petersen presented on the status of FerryBox activities in Europe. The idea of FerryBox is to use ferries and other vessels with fixed routes to help provide data on water quality.

The advantages of the program include:

- Cost-effectiveness;
- Easier maintenance;
- No energy limitations;
- More effective antifouling measures;
- Long-term reliable data;
- “Friendly” environment for the system;
- Inline sensors;
- Possibility to operate new developed (less robust) sensors;
- Transboundary nature;
- Maturity;
- Expandability;
- Coordination with JCOMM Ships Observation Team (SOT); and
- High resolution of data in space and time.

The limitations of the program include:

- Data are limited to the transect;
- Depth profiles are not available;
- Ships are voluntary and their FerryBox activities might be driven by specific research needs; and
- Small market for designing additional instruments.

Petersen described the standard FerryBox system and provided an overview of the activities in Europe (www.ferrybox.org). He discussed as an example the integration of the system in the coastal observatory COSYNA (Coastal Observation System for Northern and Arctic Seas) in the German Bight in the North Sea. He also described the Joint European Research Infrastructure Network for Coastal Observatories (JERICO), which started in May, 2011, to coordinate existing, operational European coastal observatories. The future of the FerryBox program includes:

- coordination and harmonization through JERICO and MyOcean;
- expansion to include more biological and chemical parameters; and
- data management (free and open access, common vocabulary and quality control flags, and a common database).

Rich Pruitt, Royal Caribbean Cruise Lines (RCCL) and Peter Ortner, University of Miami

Rich Pruitt and Peter Ortner described the Royal Caribbean Cruise Lines' *Explorer of the Seas* project, the OceanScope testbed with the project, and industry and science perspectives. The *Explorer of the Seas* cruise ship has provided voluntary observations since 2000. In Phase One, the project included a continual shipboard technical presence, research ship instruments/control locations, a manual or operator-dependent system, lectures and tours for guests, and a shipboard lab. Over 200 scientific publications have used data (e.g., climate change and ocean current data) from this ship to date. Now in Phase Two, the project is serving as a prototype-testbed for OceanScope. The testbed will improve Phase One to include: visitations in port only as needed, automated or remotely-operated next-generation technology, automated passenger/bridge display systems, and optimized instrument and control locations. During Phase Two, two additional RCL cruise ships are to be equipped. Installation upon the Oasis Class, *Allure of the Seas* has already been initiated.

Pruitt provided the industry perspective on the project. He noted that:

- The project is an important component of RCL's commitment to sound science and informing the regulatory environment;
- RCL's business depends on a healthy ocean;
- Industry involvement in science is critical to understanding issues, such as climate change, ocean acidification, etc.;
- Access to sound science helps improve operational efficiencies; and
- Relationships between science, non-governmental organizations, and industry can facilitate synergies in other work.

Ortner provided the science perspective. He described the use of *Explorer of the Seas* data to help calibrate satellite data, to provide a better understanding of $CO2$ sequestration in the ocean and ocean acidification, and to better understand currents. Ortner also described the lessons learned from the project:

- There are operating implications to take into consideration, such as route changes (have modular systems) and very precise arrival and departure times;
- Personal relationships with the crew are necessary (in particular, the engineering personnel);
- Ship networks have advantages, such as communication for instrument testing;
- Automation is very cost-effective;
- Single points-of-contact are important on both sides; and
- The locations of instruments are specific to each vessel.

Martin Edwards, Sir Alistair Hardy Foundation for Ocean Science (SAHFOS) [Presented by Peter Ortner, University of Miami]

Peter Ortner also presented Martin Edwards' talk on the Continuous Plankton Recorder (CPR) survey. This is the longest running marine biological survey, initiated in 1931, in cooperation with the shipping industry. Five million nautical miles have been towed for 200,000 plankton samples. Ortner noted that, although the survey is aimed at plankton, valuable distribution information has also been collected on micro-plastics in the ocean environment, marine climate change impacts, marine biodiversity and invasive species, marine ecosystem and environmental health, ocean acidification, and fish stock recruitment. Ortner noted that there is a current effort to globally coordinate all CPR activities and that it provides a foundation for ships of opportunity programs. Lessons learned from this program include:

- The importance of consistent methodology and quality assurance;
- The importance of inclusion in the scientific literature; and
- The need to co-evolve with marine policy as management needs change.

Goulven Prud'Homme, nke Instrumentation

Goulven Prud'Homme presented on RECOPESCA Instrumentation, a tool for sustainable fishing and environmental surveys, which is being used voluntarily on fishing vessels. The tool is intended to complement log books, be used on different voluntary fishing vessels using different fishing vessels, be automated, and be low-stress to the fishermen. Prud'Homme described the different sensors installed as components of the system.

Magnus Jonsson, OceanSearch

Magnus Jonsson described OceanSearch, an initiative to demonstrate crowdsourcing of data from individual vessels. He described that many individuals have mobile devices and are downloading apps that allow them to provide accurate data in real-time. The apps also allow for important data visualization or translating the data to information, and then, to a story. Jonsoon provided an example of storytelling from data generated by tagged marine life. He also noted that this approach can create new interest groups and new dialogue. Jonsson described the OceanSearch Project, which currently involves one sailing vessel providing data, but which can be part of a larger community of data providers and storytellers. Oceansearch progress can be followed at http://www.oceansearch.org.

III. Parameters and Technologies for Multi-Sectoral Voluntary Observations

Mathieu Belbeoch, JCOMMOPS

Mathieu Belbeoch discussed the JCOMMOPS as a case study of network technical coordination and data management. He noted that global programs are funded nationally and identified Points-of-Contact for this WOC Program as IOC, WMO, GCOOS, and JCOMM. JCOMMOPS supports the DBCP, Argo, SOT, and OceanSites on a day-to-day basis. Data access is free and operational (real-time and monthly). JCOMMOPS aims to:

- Monitor and evaluate the performance of the networks;
- Assist in planning, implementing, and operating the observing systems;
- Act as a clearinghouse and focal point;
- Assist in data distribution; and
- Develop synergies between observing systems.

Belbeoch presented examples of different JCOMMOPS products and services. He concluded by noting that the programs are funding-limited and, although the programs are valued, additional marketing of their value could help achieve necessary funding. In this way, WOC could help.

IV. Data Considerations and Institutional Arrangements

David Vousden, Agulhas and Somali Currents Large Marine Ecosystem

David Vousden presented on the Agulhas and Somali Currents Large Marine Ecosystem (ASCLME) project in the Western Indian Ocean as an example of coordinating user needs and opportunities. The project includes nine countries and has a five-and-a-half-year timeline. The project includes geographic areas for which there are significant data gaps, particularly for baseline data. Additional support in these areas would be extremely helpful, and shipping lines often cross the areas. In addition, oil and gas activities are also becoming more prominent in this region and could help with data. The following data are essential from these gap areas:

- Any and all ocean-atmospheric data;
- Sea surface temperatures and temperature profiles at depth;
- CTD profiles;
- pH;
- Current speed and direction;
- Plankton types and abundance;
- Bathymetry and seabed mapping; and
- Fish stock data.

Vousden noted that an alliance with industry partners would afford industry multiple benefits:

- ‘Weight-of-Evidence” data and predictive modeling (valuable for long-term planning for tourism, reviewing shipping routes, fish stock migrations, etc.);
- reliable information on current speed and velocities, seasonal alterations in seawater density, weather data, and seasonal current/wind direction;
- direct engagement of industry into the monitoring and data collection process; and
- involvement of industry “on the team” for proposed regulatory procedures.

The ASCLME already has funding for administration and organizing equipment. Additionally, the ASCLME is finalizing an agreement with the Western Indian Ocean Alliance and is viewed by UN as a possible pilot project for this kind of collaborative initiative.

RESULTS OF BREAKOUT GROUP AND SUMMARY DISCUSSIONS

The bulk of the workshop discussions on the development of the Program took place during the four breakout groups and the plenary discussions at which the summary of the breakout group discussions were presented. Appendix 3 contains the guidance materials that were provided to the breakout groups.

Group A. Ocean observation parameters and technology needs and opportunities for both vessels and platforms

The group reviewed and reiterated the Core Variables that need to be considered by the program.
The Global Climate Observing System (GCOS) Essential Climate Variables for the subsurface ocean are:

- Temperature, salinity, current, nutrients, carbon dioxide partial pressure, ocean acidity, oxygen, tracers

The US Integrated Ocean Observing System (IOOS) provides a regional example of 26 Core Variables that have been adopted:

- Acidity, bathymetry, bottom character, colored dissolved organic matter, contaminants, dissolved nutrients, dissolved oxygen, fish abundance, fish species, heat flux, ice distribution, ocean color, optical properties, partial pressure of CO2, pathogens, phytoplankton species, salinity, sea level, stream flow, surface currents, surface waves, temperature, total suspended matter, wind speed and direction, zooplankton abundance, and zooplankton species

The group considered the opportunities and challenges posed by the similarities and differences of the range of vessels and platforms that could engage in the Program:

- Different types of merchant vessels, e.g. containers, tankers, cruise ships;
- Different types of vessels more broadly, e.g. ferries, fishing vessels, offshore oil/gas exploration vessels, offshore oil/gas service vessels, offshore wind energy service vessels, cable laying/repair vessels, etc.;
- The operational characteristics of different vessel types, i.e. regularity of routes, etc.;
- Vessels vs. platforms, e.g. power supply, space constraints, etc.; and
- Coastal waters vs. offshore, open ocean, e.g. legal obstacles monitoring within the EEZ.

Key points that emerged from the opportunities and challenges related to the range of vessels and platforms include:

- The need to develop simple menu of options for industry consideration;
- This menu could be a shortlist, e.g. a feasibility-based menu, of variables to measure and consider for multiple platform options;
- Among the components of the menu:
    - Physical variable measurements are feasible now
    - Biogeochemical variable measurements have a mix of feasibility issues
    - Biological/ecosystem variable measurements are less developed but are very important
- The shortlist must also include and ingrate consideration of the measurement technologies
    - Those available for immediate use
    - Those that are a priority for research and development
- A comprehensive system for coordinated voluntary observations will also need to address the needs for:
    - A standard ship and platform interface
    - A standard science payload interface
- The need for a protected central repository of ship and platform information to facilitate prioritizing their involvement in observations.

The group also noted that the structures for linking the science community and industry may appear too complex to the ocean business community. For example, JCOMM provides one of the key coordinating mechanisms for ocean observations, but is addresses primarily physical oceanography. There is no JCOMM equivalent for other variables, such as biodiversity, biology, and ecology. IOC/GOOS and the new GOOS Steering Committee may help address this need for a more comprehensive focal point for science and industry interaction regarding ocean observations.

To implement the actions needed, the group recommended:

- Developing a small joint industry/science group to develop the rationale and compelling case to industry for expanding their involvement in the observing system.
- This business case for observations should address:
    - The feasibility of scaling up the kinds and levels of industry observations
    - The impact of greater industry observations

- The end use of observation data
- The value to industry in saving lives, protecting property, improving environmental stewardship, etc.

- Establishing a technical group to define interface requirements for platforms and payloads, ensuring that the group builds on and takes advantage of existing programs and structures, such as OceanScope, JCOMM Components, FerryBox, etc.

Group B. Marine atmosphere/ocean surface observation parameters and technology needs and opportunities for both vessels and platforms

The group reviewed the types of vessels and platforms that might be involved in voluntary observations:

Type	**Remarks**
Bulk carriers	Good conventional ships; Worldwide trading: good for filing data sparse areas
Container carriers	Regular routes; Installation of more Automatic Weather Station (S-AWS) desirable; Good candidates for CO_2 observations
Cruise ships	Co-operation needs to be extended, particularly in sparsely-traveled areas (e.g., Arctic, Antarctic); Installation of S-AWS desirable; Make contact with cruise ship associations, e.g. International Association of Antarctic Tour Operators (IAATO), Cruise Line Industry Association (CLIA)
Fishing boats	Reluctance of fishing vessels to identify their location, but could be valuable for filling data sparse areas e.g., West of Ireland
Leisure vessels	Crowdsourcing projects possible
Navy ships	Problems with confidentiality of positions
Oil rigs	Good platforms often with high quality data. However, data often not available onto the GTS, especially from oil and gas platforms outside northern hemisphere, e.g., Gulf of Guinea. Raw Global Positioning System (GPS) data could potentially also be used for atmospheric water column content.
Racing yachts	OceanoScientific experience has shown the potential for equipping yachts sailing in data sparse areas with automatic weather stations
Research ships	Very useful for to testing new or non-conventional measurement systems, e.g., prototype new sensors, expensive sensors, etc.
Tankers, gas carriers, Chemical carriers	Good potential VOS but often operating without Port Met Officer coverage; security problems when operating in piracy areas; Intrinsic safety problems if fitted with AWS;
Training ships	Not very active in observations, due to long periods in port and high turnover in staff

The group also reviewed the types of weather and climate observation systems currently used on ships recruited to the VOS Scheme and rated them from the least complex (one asterisk) to the most complex (five asterisks), including:

- Conventional VOS (proposed new Ancillary VOS class) *
- Conventional VOS (Auxiliary/Supplementary class) **
- Conventional VOS (Selected class) ***
- Conventional VOS (VOSClim AWS class) ****
- Autonomous S-AWS (Supplementary AWS class) **
- Integrated S-AWS (Selected AWS class) ****
- Integrated S-AWS (VOSClim AWS class) *****

The group rated the different levels of complexity involved in each type of VOS recruitment, and the consequent level of shipowner support that might be needed (see asterisks above). For more complex systems -- a fully integrated AWS systems reporting VOS Climate quality data -- the sensors may need to be integrated with the ships systems (e.g., connections to the ship's gyro compass for wind direction and cabling to the engine room for sea temperature measurements) and a computer input would also be needed on the bridge to allow the observers to manually input the visually observed elements. By contrast, attention was also drawn to the newly proposed Ancillary class of VOS where the shipowner would assume responsibility for supplying and maintaining the calibration of the meteorological instruments and ensuring that the data quality is monitored on a regular basis.

The group identified the main standards and tools for voluntary weather and climate observations including the following:

- WMO Guide on Instruments and Observation Practices (available online as WMO Pub. No 8) http://www.wmo.int/pages/prog/www/IMOP/publications/CIMO-Guide/CIMO_Guide-7th_Edition-2008.html
- TurboWin Logbook Software (freely available on the Web at http://www.knmi.nl/turbowin/ and now used on the majority of the national VOS fleets)
- Generic Design Standards proposed by JCOMM/SOT/VOS (it was noted that WOC could help develop and promote these)
- EUMETNET Surface Marine Program (E-SURFMAR) S-AWS Technical Specifications (developed by E-SURFMAR to encourage a uniform AWS design for use by its members – tender to be issued soon)
- WMO Manual No 306 on the Global Telecommunication System http://www.wmo.int/pages/prog/www/ois/Operational_Information/Publications/WMO_386/WMO_386_Vol_I_2009_en.pdf (to faciliatate the flow of real time observation data to WMO members in a timely, reliable and cost effective way)
- WMO Publication No 47 - International List of Selected, Supplementary and Auxiliary Ships (http://www.wmo.int/pages/prog/www/ois/pub47/pub47-home.htm) and the associated E-SURFMAR Metadata database (available at http://esurfmar.meteo.fr/doc/vosmetadata/)
- The VOS and VOSClim Websites (http://www.bom.gov.au/jcomm/vos/ and http://lwf.ncdc.noaa.gov/oa/climate/vosclim/vosclim.html)
- The Quality Control Monitoring Tools available on the Web (e.g. from Meteo-France at http://www.meteo.shom.fr/qctools/ and from the Met Office at http://research.metoffice.gov.uk/research/nwp/observations/monitoring/index.html)

A number of key issues were identified for the WOC to consider in moving forward with the Program, including the need to:

- Focus on data sparse areas, e.g., polar regions, noting that cruise ships are increasingly visiting these regions; and

- Consider the use of AIS to transmit weather information in coastal regions, and the potential for an interface between AIS and S-AWS to collect and transmit report the observations, noting that suitable data formats already exist and have been circulated by IMO.

The group discussed what incentives and actions might best enhance and expand the VOS fleet involved in weather and climate observations. Industry interests in promoting the company brand may play an important role in this. It would be useful to determine if incentives measures exist or could be developed, e.g.in relation to insurance or tax deductions for companies that participate in observation or environmental efforts.

It was recognized that the WOC could play a helpful role in extending the dialogue between shipping/Oil & Gas companies and the meteorological services. In developing the Program, it may, for instance, be valuable for the WOC to contact IACS, ICS or trade associations, and other industry bodies to help promote the observation initiatives being developed by JCOMM.

In developing suggestions for the way forward, the group recommended that:

- That JCOMM/SOT is a key partner for WOC in working to scale up industry weather and climate observation efforts;
- The majority of the technologies needed for vessel or platform involvement in marine atmosphere / ocean surface observations are currently available;
- The differences between vessels and offshore platforms are less than between some types of vessels, e.g., a fishing boat and a container ship would be used differently for voluntary observations;
- The minimum level of vessel or platform involvement in observations should be conventional manually reporting VOS (Ancillary or Selected class) and/or Autonomous S-AWS (Supplementary AWS class) installed onboard;
- The option that lends itself best to retrofitting vessels or platforms is the Autonomous S-AWS;
- The option that should be considered for new builds is the Integrated S-AWS, because it will be easier to agree and approve the design plans and necessary cabling before the ship is built;
- One of the operational and financial challenges that will need to be overcome by vessels and platforms in order to scale up observations will be the cost of the data transmissions. The use of email and compressed data formats will help to reduce transmission costs; and
- Research and development opportunities for scaling up industry observations includes the potential use of AIS for weather messages and for interfacing to S-AWS systems, (and the associated data collection mechanisms ashore to allow the AIS derived data to be distributed on the Global Telecommunication System).

Group C. Data interoperability, communications, management and access

Data Interoperability

Data Interoperability includes many topics, such as command and control, format, access to data, etc. In considering these data issues, the group noted that various observations programs collect different data, maintain different databases and establish different data flows and standards, e.g. Argos, SOOP, JCOMM, IOC, Maritime Environmental Resource Center (MERC), Listening to the Deep Ocean Environment (LIDO), IOCCP, JERICO, Ocean Observatories Initiative (OOI)/Regional Scale Node (RSN), FerryBox, etc.

It will be essential for the WOC program to ensure it is not reinventing the wheel. Industry participants emphasized the need to keep things as simple as possible, e.g. having a single point of contact for a company to interact with on data issues. Overall the group stressed that it is important for participants in voluntary programs to think about what the system is to do first and then look to existing systems to see if they will provide the result.

In the overall review of addressing the data situation, the fundamental aspects included the need to:

- Fill data gaps;
- Share data freely and openly;
- Identify a common vocabulary and standard quality control;
- Adopt or establish minimal data requirements;
- Identify and assess current data efforts;
- Analyze and identify user requirements and then provide the observations that respond to those needs;
- Provide users with access to data products, and not just data;

The group discussed how the WOC Program can work with ship and platform owners to be part of the solution so that the data will help interested companies address data issues, such as by:

- Using ship and platform centric data standards;
- Companies considering what their existing instrument and operational ship data can provide the scientist, e.g. is such data is reliable, can it pass peer-review, what is needed to make it useful to science?; and
- Being aware of important operational constraints, such as the need control of transmission of data in some circumstances, e.g. due to radio silence in high-risk areas.

A substantial portion of the discussion focused on the need for science to be able to trust the data resulting from voluntary observations. There is a critical need for metadata to understand the source of the data, calibration details, etc. This includes the following considerations:

- Instruments must be registered;
- Metadata should include the basic elements identified through existing collaborations, like Quality Assurance of Real-Time Oceanographic Data (QARTOD), QARTOD to Open Geospatial Consortium (OGC) Standards (Q2O), OOI, IOOS principles, OGC standards, System of Industry Metocean data for the Offshore and Research Communities (SIMORC), Marine Metadata Interoperability (MMI), International Council for Science (ICSU), etc.;
- Metadata must include data provenance information;
- The focus should be on high-reliability and automatic systems to help ensure data quality and reduce data variability;
- It is important to participate in existing programs and use existing structures and processes
- There are metadata standards for physical and metrological data, as well as for biological data (e.g., Ocean Biogeographic Information System (OBIS), Census for Marine Life);
- GTS provides a source of information for data and metadata for weather related information; and
- It will be important to reconcile the differences in requirements and criteria for data collection that may exist between metadata standards and company standards.

The group identified different options for dealing with databases and voluntary observations more broadly, including considerations of:

- A standard interface to variety of existing databases;
- A common database;
- The importance of leveraging existing international standards;
- Operational oceanographic readiness is in place for simpler physical data sets, but is not ready for more complex data; and

- Marine and oceanographic data is less consolidated and there is program-by-program access through the internet.

Data Communications

The group also discussed data communications, noting the following important aspects of transmitting data:

- The needs for standards for data communication;
- Data communication differs depending on the type of vessel or platform;
- There are different methods of communicating data within the vessel or platform, e.g. email, File Transfer Protocol (FTP), Secure FTP, satellite, cable, etc.; and
- Data communications even vary per vessel, depending on the ship location, e.g. at dock or at sea.

Data transmission reflects that different user groups require different timelines. Operational users need data as close to real time as possible. Scientists may not be as concerned about having data in real time. Ship or platform operator needs depend on the kind of data and its use.

The logistics and costs of data transmission are a significant concern:

- The additional power on different kinds of vessels and platforms needs to be taken into consideration;
- The needs to transmit large amounts of data, noting that small amounts of real-time data can be transmitted as bursts to keep costs low;
- Determining who pays for communications costs and the level of use of existing ship or platform systems is important;
- Identifying the priority of variables can influence the logistics and costs, e.g. does data need to be sent in real time or not, what is the sampling period and frequency of measurements?;
- Need to communicate back to the instruments, as there are many remote options available now.

A number of related technology and technical needs were identified, including:

- Increasing the relatively short life cycle of some technology, e.g., 18 month drifting buoys;
- Improving current technology and facilitating the development of new, needed technologies;
- Addressing space limitations for technology installation, e.g. possible micro- and nano-technology development options;
- Identifying optimization strategies for data communication;
- Facilitating integrated sampling schemes;
- Facilitating technical training; and
- Facilitating the automation of observations and data communication.

Data Management and Access

In discussing data management and access in relation to ocean and weather/climate observations, the group highlighted that a 5-year vision would be to have one or two sites as a common portal for data access. This could include consideration of a data archiving center for all relevant programs, noting that Open Access data services are currently available via OGC.
The group considered the need for a common Data Management System, which engenders important questions concerning:

- Who owns the data;
- Who the responsibility for managing the data; and
- How are the requirements of stakeholders met

Group D. Institutional and operational needs and options for a global multi-sectoral program

In the short term the group felt there was the need for:

- A "declaration", i.e. a strong concise statement of need for scaling up industry involvement in ocean and atmosphere observation and monitoring;
- A directory of the key programs and contact persons related to voluntary ocean observations, e.g. a " yellow-pages" of the programs and coordinators, such as JCOMM-SOT, GOOS, IOCCP, LIDO; and
- A joint science/industry steering committee be formed, e.g. with six from the science community and six from industry (from different sectors).

In the medium term, the steering committee should:

- Work with WOC to further develop and raise awareness of the Program; and
- Develop the value proposition to communicate to industry and encourage their participation.

For the medium term, the group emphasized that:

- WOC continue to serve as a key communication pathway to industry and encourage leadership companies to set the example and encourage more industry involvement in voluntary observations; and
- Scientists and companies develop closer relationships and work to ensure that companies can see the value in the ocean and weather/climate observations.

In the medium term, the steering committee should:

- Develop "plug-and-play" systems based on clear articulation of the scientific requirements and performance standards;
- Integrate biodiversity, biological parameters and larger organisms into the observing systems
- Explore Law of the Sea issues and the advocacy needed to move towards an expanded set of measurements that are open access, including from Exclusive Economic Zones (EEZs); and
- Continue to undertake communications to sell the concept and promote its achievements.

Over the longer term, the WOC, the Program and its steering committee should:

- Work to convince governments of need for "space agency equivalents" for ocean observations; and
- Engage and coordinate the role of industry as a key player in making this happen

Additional areas of consideration in the Program development and implementation came up during the plenary discussion after the breakout groups.

The Program should address the following needs and opportunities:

- Organization and Coordination
    - Help science and industry engage together in advancing voluntary observations;
    - Provide a single point of contact for both science and industry;
    - Help provide more structure to the observations being made; and
    - Help find an approach to address route changes in ships to maintain observation schemes.
- Outreach and Communications
    - Make the benefits of voluntary observations very clear and articulate these benefits; and
    - Work with science and industry to improve the "story telling" to better communicate the value and benefits of voluntary observations.

- Legal
  - Help clarify who has liability for equipment and data.
- Resources
  - Help identify the funding needed for nearly all ocean and weather/climate observation programs.

Principles, Roadmap and Workplan

The closing session of the workshop addressed the overall principles for the WOC Smart Ocean / Smart Industries Program (the "Program"), the general direction, structures and process to advance the Program development and the specific next steps to be taken in the first half of 2012.

Principles for the WOC Smart Ocean / Smart Industries Program

The workshop participants considered a set of draft principles that had been developed by the WOC Working Group and also emerged during the workshop. The principles could be used to guide the development and implementation of the Program. The draft Principles for the Program are presented here as a working version that will be further reviewed and refined by the Smart Ocean / Smart Industries Steering Committee.

These principles are designed to establish a framework for the WOC to develop and implement a global program to facilitate, coordinate and scale up the efficient, cost effective ocean and atmospheric information collection by a growing number and range of vessels, platforms, pipelines and cables for ocean and weather/climate observations, and to foster and guide WOC efforts to engage with scientific, government, operational and other partners.

1. ***Clear Value Proposition / Accessible***
   The Program's value should be clearly articulated to companies that may wish to become involved, including the "win-win" results that can be achieved for industry and for science.
   The Program should ensure data is accessible and leveraged for decision-making in participating companies, and should make it easy for companies to get involved and for expanding industry participation, indicating the points of engagement for industry
   The data needs to be operational and available, as much as possible in real-time, with a clear path to the data and the operational information that data feed into.
   Over the longer term, information needs to be accessible for supporting environmental stewardship and sage and responsible company operations and be mutually beneficial to all participants.

2. ***Inclusive, Integrated and building on existing efforts***
   The Program should seek and ensure effective participation of key stakeholders.
   Within the private sector, in addition to those with the vessels and platforms, this includes operators, sensor manufacturers, and value-added information generators.
   Outside of the private sector, this includes key inter-governmental organizations, government agencies, academic institutions and NGOs active in ocean and weather/climate observations.
   The Program should include operational observations and science/research observations.
   The Program should recognize, engage, learn from and build on existing voluntary observation organizations, programs and efforts in science, government and industry, taking advantage of energetic communities and leaders and working with them to promote best practices.

3. ***Global in Scope / Simple in design***
   The Program needs to be scalable to ensure global coverage.

Regional/pilot level efforts will be important, but these need to consider how they can bring benefit to the global scale by defining how to scale up regional/pilot efforts and widen the scope in the future projects.
The Program needs to be focused and simple to ensure efficient, successful delivery of results that contribute to achieving clear near-term and longer-term goals and actions.
The Program should be designed so that companies can begin participating in data collection and transmission of the kind, level and cost of observations they are able to most readily support, with the opportunity to "scale up" to a more extensive involvement as they have interest and ability.
It is important to understand the kind of data that is needed, the gaps between different kinds of studies, and that several layers of data could be accepted.

4. ***Quality Focused* / Standardized**
The Program should aspire to, and converge on, a common set of requirements for ensuring high quality and real time data collection.
Standards for data and metadata need to be established and implemented to ensure quality, promotion of best practices with documented quality levels, building on existing standards and methods for ocean data collection and industry standards for operations.
It is important to have quality standards that make the data gathering flexible and useful, but quality standards need to be balanced with considerations of what becomes too expensive to collect or too heavy to transmit.
Companies, scientists, non-governmental organizations (NGOs) and governments should be using the same data to make decisions, to create convergence and collaboration, thereby supporting making decisions on best possible grounds.

5. ***Research and Development***
The Program should foster and facilitate research and development of more efficient and effective methods, instruments, and practices for voluntary observations, e.g. in relation to the cost, size, installation, maintenance of equipment.
The Program should foster the expansion of observations into areas not adequately addressed, e.g. biological parameters, sound, acidification.

6. ***Effective Governance / Transparency***
The Program needs to operate according to clear and established governance protocols and procedures.
The Program design, planning and implementation need to be clear and undertaken in a transparent manner.

7. ***Compliance***
The Program should be designed, planned and implemented to comply with all relevant national and international law, including the relevant international conventions, e.g. the UN Convention on the Law of the Sea (CBD) and other international agreements.

Roadmap

The workshop participants discussed the structures and process for advancing the Program development.

Working Group

Participant discussion focused on the development of a small joint industry/science working group that could build on the interest and momentum generated by the workshop.

Terms of Reference

The initially proposed terms of reference for joint industry/science Working Group are as to:

1. Define the value proposition for expanding the role and scale of ocean industry participation in ocean and weather/climate observations, including the feasibility and the impact of increased industry efforts.
2. Develop the scientific and operational rationale for expanding the role and scale of industry participation in observations.
3. Define the "menu of options" and interface requirements for platforms (both mobile and fixed) and payloads (attended or not), such as power, mass, footprint, expendables, maintenance, flow, placement, telemetry, etc.
4. Explore and explain the principles and practice of open data access and the telemetry issues.

Membership

The discussion also resulted in suggestions for the size and composition of the Working Group.

Size
The Working Group should consist of about twelve representatives.

Composition
The Working Group should consist of both industry and science representatives.

Industry representation in the Working Group:

- Six representatives of WOC, with consideration of:
    - Giving priority to the companies that have provided leadership and support to the Smart Ocean/Smart Industries initiative to date
    - Including a mix of company and association representatives
    - Including a mix of sectors, i.e. both vessels and platforms
    - To be identified by WOC in consultation with the WOC Board, the WOC Smart Ocean/Smart Industries Working Group and the overall WOC membership

Science representation in the Working Group:

- Six representatives of the key groups and programs:
    - With balance of scientific disciplines
    - Dealing with both operational / sustained and research observations
    - Drawing from existing efforts by GOOS, JCOMM (SOT and DBCP), SCOR (OceanScope), IOCCP (CarbonVOS)
    - To be identified by IOC in consultation with the agencies and programs mentioned above

Secretariat:
The workshop agreed that the WOC and IOC are well positioned to serve as an informal "secretariat" to the joint industry/science Working Group.

Advisory Group

The workshop also agreed that an Advisory Group should be established to create the opportunity for input from a broader range of interested parties:

- Within the private sector, the Advisory Group should include those with vessels and platforms, as well as vessel and platform operators, sensor manufacturers, value-added information generators, and other relevant sectors.
- Outside of the private sector, the Advisory Group should include key inter-governmental organizations, government agencies, academic institutions and NGOs active in ocean and weather/climate observations.

The Working Group will develop more detailed recommendations for the size, composition, structure and processes of the Advisory Group.

Workplan

Working Group:

- Membership to be determined within three months, i.e., by 10 March 2012
- First meeting to be held within six months, i.e., by 10 June 2012

There are a number of opportunities for the Working Group to meet in the near future and to present and promote the Smart Ocean / Smart Industries Program.

Appendix 1: Program

	MONDAY 12 DEC
Session 1 ***0900-1030***	**Introductory Plenary** **Overview of Voluntary Observation Programs and Technology**
Chair	Paul Holthus, World Ocean Council
0830-0900	Registration
0900-0910	Welcome - Wendy Watson-Wright, IOC Executive Secretary and Assistant Director General, UNESCO
0910-0920	Welcome and introduction to Maersk interest in ocean and climate observations - Eskild Sorensen, A.P. Moeller-Maersk
0920-0930	Overview of Smart Ocean/Smart Industries concept and workshop objectives and process - Paul Holthus, World Ocean Council
0930-0950	The scientific need for voluntary ocean and climate observations, including results from key contributions of ships and platforms, gaps, future plans - Albert Fischer, IOC
0950-1010	Overview of voluntary observation programs and coordinating structures - oceans - Albert Fischer, IOC and Candyce Clark, JCOMM
1010-1030	The Voluntary Observing Ship Scheme (VOS), including shipborne Automated Weather Stations (AWS) and coordinating structures - Sarah North, UK Met Service
1030-1050	~ BREAK ~
Session 2 ***1050-1230***	**Voluntary Observation Programs:** **Status, progress, and lessons learned for scaling up and cross-sectoral applications**
Chair	Craig McLean, NOAA
1050-1110	Ship of Opportunity Program (SOOP) - oceanographic measurements - Joaquin Trinanes, NOAA
1110-1125	Argo profiling float program - Mathieu Belbeoch, JCOMMOPS
1125-1140	Data Buoy Cooperation Panel (DCBP) - Pierre Blouch, Meteo-France
1140-1200	Overview of ocean observation technology and sensors - Mario Tamburri, Alliance for Coastal Technologies
1200-1215	Ocean observations and sound in the marine environment - Ian Boyd, Saint Andrews University
1215-1230	Cabled observatories and platforms - Nazeeh Shaheen, L3 MariPro
1230-1350	~ LUNCH ~
Session 3 ***1350-1550***	**Voluntary Observation Programs (continued)** **Status, progress, and lessons learned for scaling up and cross-sectoral applications**
Chair	Francois Leroy, Liquid Robotics
1350-1410	OceanScope - Tom Rossby, University of Rhode Island
1410-1430	Ocean Carbon Flux Observations - IOCCP and ICOS - David Hydes, University of Southampton, National Oceanography Centre and Maciej Telszewski, International Ocean Carbon Coordination Project (IOCCP)
1430-1450	FerryBox - Willi Petersen, Institute of Coastal Research/Operational Systems

1450-1505	Royal Caribbean Cruise Lines: Next Generation Ships of Opportunity Program - Rich Pruitt, Royal Caribbean Cruises and Peter Ortner, University of Miami
1505-1520	Continuous Plankton Recorder - Martin Edwards, Sir Alistair Hardy Foundation for Ocean Science (SAHFOS) [Presented by Peter Ortner, University of Miami]
1520-1535	Collecting data from fishing vessels and operations - Goulven Prud'Homme, nke Instrumentation
1535-1550	Crowdsourcing data from individual vessels - Magnus Jonsson, OceanSearch
1550-1610	~ BREAK ~
Session 4 1610-1800	**Breakout Groups: Parameters and technologies for multi-sectoral voluntary observations**
	Group A Ocean observation parameters and technology needs and opportunities for both vessels and platforms - Chair: Eric Lindstrom, NASA - Rapporteur: Albert Fischer, IOC Group B Marine atmosphere/ocean surface observation parameters and technology needs and opportunities for both vessels and platforms - Chair: Sarah North, UK Met Service - Rapporteur: Pierre Blouch, Meteo-France
1830-2030	RECEPTION - At UNESCO (details to be provided at the workshop)

	TUESDAY 13 DEC
SESSION 5 0900-1030	**Discussion: Parameters and technologies for multi-sectoral voluntary observations**
Chair	Candyce Clark, NOAA
0900-0930	Report back from breakout groups A and B
0930-1010	Discussion on parameters and technologies for scaling up and coordinating multi-sectoral voluntary observation efforts
1010-1030	Network technical coordination and data management: JCOMMOPS case study and lessons learned for developing the Smart Ocean/Smart Industries program - Mathieu Belbeoch, JCOMMOPS
1030-1100	~ BREAK ~
SESSION 6 1100-1230	**Breakout Groups: Data considerations and Institutional arrangements**
	Group C Data interoperability, communications, management and access - Chair: Claire de Grasse, Oceans Network Canada - Rapporteur: Mathieu Belbeoch, JCOMMOPS

	Group D Institutional and operational needs and options for a global multi-sectoral program - Chair: Anne Walls, BP - Rapporteur: Doug Wallace, Halifax Marine Research Institute
1230-1400	~ *LUNCH* ~
Session 7* *1400-1530	**Discussion: Data considerations and Institutional arrangements**
Chair	Ru Morrison, Northeastern Regional Association of Coastal Ocean Observing Systems
1400-1430	Report back from breakout groups C and D
1430-1510	Discussion on data considerations and institutional arrangements for scaling up and coordinating multi-sectoral industry observation efforts
1510-1530	Coordinating with user needs and opportunities: Large Marine Ecosystem case study - David Vousden, Agulhas and Somali Currents LME
1530-1600	~ BREAK ~
Session 8* *1600-1730	**Closing Plenary: Developing the Principles, Roadmap and Workplan**
Chair *Rapporteur*	Gary Dinn, PanGeo Subsea Stephanie Watson, World Ocean Council
1600-1620	Principles for the global Smart Ocean/Smart Industries program Moderator: Albert Fischer, IOC
1620-1700	Roadmap for developing the global Smart Ocean/Smart Industries program Moderator: Eric Lindstrom, NASA
1700-1730	Workplan for developing the global Smart Ocean/Smart Industries program Moderator: Paul Holthus, World Ocean Council
	CLOSE OF WORKSHOP

Appendix 2: List of Participants

Mohamed	Adjou	University of Copenhagen	Postdoc in Oceanography
Constantine	Alexander	Global Oceans	Director Business Operations – Europe
Dan	Angelescu	ESIEE Paris	Professor
Mathieu	Belbeoch	JCOMMOPS (IOC/WMO)	Coordinator
Ulrike	Bernitt	IFM-GEOMAR	Coordinator
Pierre	Blouch	EUMETNET	E-SURFMAR Programme Manager
Tobias	Boehme	-4H- JENA Engineering GmbH	Scientific Project Manager Marine Technology
Michael	Boer	-4H- JENA Engineering GmbH	Divisional Director Marine Technology
Ian	Boyd	St Andrews	Professor
Marie-marguerite	Bourbigot	Pôle Mer Bretagne	Project Manager
Richard	Burt	Chelsea Technologies Group Ltd	Director
Patrick	Callahan	Maersk Line, Limited	Director, HSSEQ
Candyce	Clark	WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology	Observations Programme Area Coordinator
Jim	Costopulos	Global Oceans	CEO
Claire	de Grasse	Ocean Networks Canada	ICT Business Development Officer
Yves	Dégrés	nke instrumentation	Instrumentation director
Gary	Dinn	PanGeo Subsea	Vice President
Denis	Diverrès	IRD – Institute for Research and Development	Technical coordinator for Salinity and pCO_2 measurements on VOS
Okuku	Ediang	Nigerian Meteorological Agency, Marine Division	Assistant Chief Marine Meterologist
Remi	Estival	TOTAL S.A.	Metocean data engineer
Albert	Fischer	UNESCO IOC	Programme Specialist, Technical Secretary of OOPC
James	Fishwick	Plymouth Marine Laboratory	Bio-optical oceanographer, Western English Channel Observatory Dr.
Yves	Gouriou	IRD – Institut de Recherche pour le Développement	Director of IRD technical unit IMAGO
Patrick	Halpin	Duke University	Professor
Hans-Jørgen	Hansen	MacArtney Underwater Technology Group	Sales Manager – Ocean Science
Aatos	Heikkinen	Eniram Ltd	Research manager
Paul	Holthus	World Ocean Council	Executive Director

David	Hydes	National Oceanography Centre Southampton UK	Doctor
Magnus	Jonsson	Interactive Institute	Senior Production Manager
Chris	Karman	IMARES	Manager Business Development
Martin	Kramp	OceanoScientific	Programme Manager
Isabelle	Lambert	CGGVeritas	Vice President, Environment, Sustainable Development and Social Responsibility
Oliver	Legge	University of East Anglia, UK	Marine Carbon Observations Coordinator
Jean-François	Leprince-Ringuet	ROSS (Association RESEARCH-OCEANOSCIENTIFIC-SPORT)	President
Francois	Leroy	Liquid Robotics	Senior Vice President
Eric	Lindstrom	NASA Headquarters	Physical Oceanography Program Scientist
Olivier	Louf	CGGVeritas	Vice President, Sustainable Development and Social Responsibility
Bev	MacKenzie	Institute of Marine Engineering, Science and Technology (IMarEST)	Senior Technical Manager
Said	Mazaheri	Iranian National Institute for Oceanography	Assistant Professor, Head of Ocean Engineering and Technology Research Center
Craig	McLean	NOAA	Acting Administrator, OAR
Maurice	Meehan	Maersk Tankers	Sustainability and Performance Manager
Stephanie	Moffatt	Zodiac Maritime Agencies Ltd	Environmental Executive
Dave	Monahan	Guiding Committee of the General Bathymetric Chart of the Oceans (GEBCO)	Past Chairman
Ru	Morrison	NERACOOS, US National Federation of Regional Associations of Coastal and Ocean Observing	Executive Director, Vice-Chair
Sarah	North	UK Met Office	Marine Networks Manager
Lauren	Ordway	Royal Caribbean Cruises Ltd	Sustainability Analyst
Peter	Ortner	University of Miami /RSMAS/CIMAS	Director
Jeanne	Pagnan	Twin Dolphins	Vice President
Wilhelm	Petersen	Helmholtz-Zentrum Geestacht, Institute of Coastal Research/Operational Systems	Dep. Head / Dr.
Glen	Pezzoli	Scripps Institution of Oceanography	Manager, Ship of Opportunity Program

Niall	Phelan	UNEP World Conservation Monitoring Center (WCMC)	Senior Programme Officer
Benoît	Pirenne	Ocean Networks Canada	Associate Director, IT
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Liz	Selig	Conservation International	Conservation Scientist
Nazeeh	Shaheen	L3 MariPro	Director, Business Development, Ocean Observing Systems
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Darryl	Symonds	Teledyne RD Instruments	Director of Marine Measurements Product Lines
Mario	Tamburri	University of Maryland, Center for Environmental Science, Chesapeake Biological Lab/Maritime Environmental Resource Center	Director
Kathy	Tedesco	UNESCO IOC	Director, International Ocean Carbon Coordination Project (IOCCP)
Gunnar	Tietze	International Maritime Pavilion	Director
Joaquin	Trinanes	U. Santiago/U. Miami/NOAA	Assistant Professor
Jon	Upton	Shell Global Solutions BV	Senior Metocean Engineer
Fabienne	Vallee	Science Park Brest Iroise	Head of International Cooperation
David	Vousden	UNDP GEF ASCLME Project	Regional Director
Doug	Wallace	Halifax Marine Research Institute	Science Director
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Wendy	Watson-Wright	UNESCO IOC	IOC Executive Secretary and Assistant Director General
Christoph	Werner	Reederei Blue Star GmbH	Director, Nautical Fleet Management

Sandra	Werner	ExxonMobil Upstream Research Company	Research Engineer
Werenfrid	Wimmer	National Oceanography Centre, Southampton	ISAR project scientist

Appendix 3: Breakout Group Guidance and Questions

Breakout Group Guidance

The Breakout Group sessions are to enable a more focused discussion on 4 major aspects of developing a global program to facilitate, coordinate and scale up the efficient, cost effective ocean and atmospheric information collection by a growing number and range of vessels and platforms for ocean and weather/climate observations:

A. Ocean Observation Parameters and Technology Needs and Opportunities for Both Vessels and Platforms
B. Marine Atmosphere/Ocean Surface Observation Parameters and Technology Needs and Opportunities for Both Vessels and Platforms
C. Data Interoperability, Communications, Management and Access
D. Institutional And Operational Needs and Options for a Global Multi-Sectoral Program

Overall, the Breakout Group participants are asked to:

- Focus on practical outputs and guidance to assist the WOC in the development of the Smart Ocean/Smart Industries program.
- Provide constructive input to developing the common ground and agenda for moving forward with the program.
- Consider the phased development of the program over both the short-term (1-2 years) and long-term (5-10+ years).
- Consider the spatial scope and geographic phasing of the program.
- Avoid overly detailed discussion or promotion of specific instruments, technologies, projects or companies.

The vision of a comprehensive, multi-industry observations program presents opportunities and challenges due to the range of vessels and platforms that could engage in the program. The Breakout Group participants are asked to consider the opportunities and challenges posed by the similarities and differences of:

- Different types of merchant vessels, e.g. containers, tankers, cruise ships.
- Different types of vessels more broadly, e.g. ferries, fishing vessels, offshore oil/gas exploration vessels, offshore oil/gas service vessels, offshore wind energy service vessels, cable laying/repair vessels, etc.
- The operational characteristics of different vessel types, i.e. regularity of routes, etc.
- Vessels vs. platforms, e.g. power supply, space constraints, etc.
- Coastal waters vs. offshore, open ocean

Each Breakout Group session will be guided by a Chair. The major areas of discussion and outputs will be synthesized by a Rapporteur. The Chair will present the results of the discussions in plenary for discussion by the overall workshop.

Group A

OCEAN OBSERVATION PARAMETERS AND TECHNOLOGY NEEDS AND OPPORTUNITIES FOR BOTH VESSELS AND PLATFORMS

Chair: Eric Lindstrom, NASA
Rapporteur: Albert Fischer, IOC

Suggested questions for discussion:

- What are the core, baseline parameters for a minimum level of vessel or platform involvement in ocean observations?
- What is the "menu" of options for scaling up participation in observations?
- What are the options that lend themselves best to retrofitting vessels or platforms?
- What are the options that should be considered for design and newbuilds?
- What are the technologies needed for each of the above and are they currently available?
- What are the key similarities (and differences) between vessels and platforms that create opportunities (and challenges) for synergies?
- What are the R&D priorities for advancing a program to scale up observations, e.g. instrumentation development?
- What are the main operational impacts and challenges that will need to be overcome by different vessel types and platforms in order to scale up observations?

Group B

MARINE ATMOSPHERE/OCEAN SURFACE OBSERVATION PARAMETERS AND TECHNOLOGY

NEEDS AND OPPORTUNITIES FOR BOTH VESSELS AND PLATFORMS

Chair: Sarah North, UK Met Service

Rapporteur: Pierre Blouch, Meteo-France

Suggested questions for discussion:

- What are the core, baseline parameters for a minimum level of vessel or platform involvement in marine atmosphere/ocean surface observations?
- What is the "menu" of options for scaling up participation in observations?
- What are the options that lend themselves best to retrofitting vessels or platforms?
- What are the options that should be considered for design and newbuilds?
- What are the technologies needed for each of the above and are they currently available?
- What are the key similarities (and differences) between vessels and platforms that create opportunities (and challenges) for synergies?
- What are the R&D priorities for advancing a program to scale up observations, e.g. instrumentation development?
- What are the main operational impacts and challenges that will need to be overcome by different vessel types and platforms in order to scale up observations?

Group C

DATA INTEROPERABILITY, COMMUNICATIONS, MANAGEMENT AND ACCESS

Chair: Claire de Grasse, Oceans Network Canada

Rapporteur: Mathieu Belbeoch, JCOMMOPS

- What are the key aspects of data interoperability that need to be addressed in scaling up the number and kinds of vessels and platforms involved in observations?
- What are the communications needs for transmission of data from a wider range of vessels and platforms?
- Are the current systems, protocols and capacity for data management and access appropriate and sufficient?
- If not, what are the priorities for improving the situation?
- How should the Law of the Sea/legal issues re data from observations be addressed?

Group D

INSTITUTIONAL AND OPERATIONAL NEEDS AND OPTIONS FOR A GLOBAL MULTI-SECTORAL PROGRAM

Chair: Gary Dinn, PanGeo Subsea

Rapporteur: Doug Wallace, Halifax Marine Research Institute

- What kinds of institutional arrangements are needed for a global multi-sectoral program of voluntary observations?
- How can the WOC best develop these arrangements?
- What kind of interaction should the WOC develop with the key existing governmental, inter-governmental and scientific institutions?
- What are the operational needs to implement a global multi-sectoral program?
- How can the WOC best meet these needs?
- What are the resources required to develop the required institutional and operational needs for a global multi-sectoral program?

Appendix 4: Acronyms

ADCP – Acoustic Doppler Current Profiler
AIS – Automatic Identification System
ASCLME - Agulhas and Somali Currents Large Marine Ecosystem
AWS – Automated Weather Station
CLIA - Cruise Lines International Association
CTD - Conductivity-Temperature-Depth
CPR – Continuous Plankton Recorder
DBCP – Data Buoy Cooperation Panel
E-SURFMAR - EUMETNET Surface Marine Observation Program
EEZ - Exclusive Economic Zone
GCOS – Global Climate Observing System
GCN – Global Core Network
GLOSS - Global Sea Level Observing System
GOOS - Global Ocean Observng System
GTS – Global Telecommunications System
IAATO - International Association of Antarctic Tour Operators
IAPSO - International Association for the Physical Sciences of the Oceans
ICOS - Integrated Carbon Observation System
ICSU - International Council for Science
IOC - Intergovernmental Oceanographic Commission
IOCCP - International Ocean Carbon Coordination Project
IOOS – U.S. Integrated Ocean Observing System
JCOMM - Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology
JCOMMOPS - JCOMM in situ Observing Platform Support Center
JERICO - Joint European Research Infrastructure Network for Coastal Observatories
LIDO - Listening to the Deep Ocean Environment
MARS - Monterey Accelerated Research System
MMI – Marine Metadata Interoperability
MERC – Maritime Environmental Resource Center
NASA - US National Aeronautics and Space Agency
NERACOOS - Northeastern Regional Association of Coastal Ocean Observing Systems
NOAA - US National Oceanic and Atmospheric Administration
OBIS - Ocean Biogeographic Information System
OGC – Open Geospatial Consortium
OOI/RSN – Ocean Observatories Initiative/Regional Scale Nodes
pCO2 – Partial Pressure Carbon Dioxide
QARTOD – Quality Assurance for Real-Time Oceanographic Data
Q2O – QARTOD to Open Geospatial Consortium Standards
RCCL – Royal Caribbean Cruise Lines
SAHFOS - Sir Alistair Hardy Foundation for Ocean Science
SCOR – Scientific Committee on Oceanic Research
SIMORC - System of Industry Metocean data for the Offshore and Research Communities
SNOMS - Swire [Trust] NOCS Ocean Monitoring System
SOOP – Ships of Opportunity Program
SOT – Ships Observation Team
S-AWS – Supplemental Automated Weather Station
TSG - Thermosalinograph
UNESCO - United Nations Education, Scientific and Cultural Organization

VOS – Vessels of Opportunity
VOSClim – Vessels of Opportunity Climate
WMO - World Metrological Organization
WOC - World Ocean Council
XBT – Expendable Bathythermograph
XCTD - Expendable Conductivity-Temperature-Depth