Perspectives on International Oceanographic Research

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U.S. Department of State,
in cooperation with the Office of Oceans Affairs, U.S. Department of State,
and the Ocean Studies Board, National Academy of Sciences

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Report by

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Cover Image: The three dimensional morphology of the continents and oceans is depicted on this figure. The seafloor topography is the first synoptic map of the ocean floor derived from satellite gravity data coupled with available depth soundings from ships. The resolution of the data set, while impressive in this view, is approximately 15 km, orders of magnitude poorer than that available on the continents. The seafloor data were obtained from David Sandwell at the Cecil and Ida Green Institute of Geophysics and Planetary Physics at the Scripps Institution of Oceanography and Walter Smith at the National Oceanic and Atmospheric Administration. (Photo by Dr. John Orcutt.)

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Executive Summary

Description and Purpose

In November 2002 the Department of State and the Oceans Studies Board of the National Academy of Sciences hosted a roundtable entitled *Perspectives on International Oceanographic Research.* The roundtable was an informal gathering of experts with an interest in international policies and practices affecting marine science research. Two primary purposes of the roundtable were:

- To identify areas of concern among the marine science community and determine the most appropriate venue for addressing those concerns; and

- To increase awareness within the international policy development process of relevant ocean research efforts.

Selected Roundtable Topics

Speakers were invited to address three topics during the roundtable:

- International Priorities of the United States Ocean Science Community

- The Department of State: A Resource of the Oceanographic Research Community

- The Role of Research in the Integrated, Global Ocean Observation System: An Opportunity for International Collaboration

Within their presentations, speakers were also asked to address means by which the Department of State might enhance international collaboration with United States ocean scientists.

Conclusions

Speakers and participants identified the following priorities, needs, concerns and challenges:

Greater Funding and Interagency Efficiency. Increased funding for collaborative ocean research, closer interagency coordination in the United States, improved efficiency in planning and speedier implementation of international ocean science programs were identified as priority areas with which the Department of State might be able to assist.

- The Department of State will seek to improve interagency coordination through better and more regular use of the Subcommittee on Oceans Policy of the National Security Council's Global Environment Policy Coordinating Committee. Funding efficiency for ocean research and facilities will continue to be a priority for the National Oceanographic Partnership Program.

Capacity Building. Specific means were explored for promoting marine science capacity building through international ocean science organizations, through use of grants, fellowships and other forms of federal and private aid, and by facilitating wider participation of foreign scientists.

- The Department of State, through the embassy network, can assist the ocean science community in building partnerships abroad. The Department of State will also pursue posts for United States scientists in the secretariats of intergovernmental organizations, particularly those seeking to build capacity in the ocean sciences.

Access to Data. Full and open access to oceanographic data arising from international programs is urgently needed. Improvements are needed in domestic interagency coordination for data system architecture design, and delivery tools for multiple end users. The Intergovernmental Oceanographic Data Exchange program is inadequate in its current form.

- The Department of State, through its operational support of intergovernmental marine science organizations, can promote full and open access to ocean data and seek supporting funds for improving network infrastructure.

Clearance Process. Concerns were raised on intellectual property rights of coastal States and the corresponding impact on science collection permits. Also raised was a need for updated maritime boundary charts, efficient mechanisms for visa processing for foreign scientists, and changes in port security restrictions.

- Considering its role in the processing of visas and the clearance of marine research vessels, the Department of State can provide additional assistance to the ocean science community in these areas. The Department will also explore the options available to collaborating scientists, and will remain a reliable source for information regarding travel safety abroad.

Operational Oceanography. The major challenges to universal ocean observation and sampling through GOOS were: securing full and open access to real-time relay of data, large under-sampled areas, jurisdictional and boundary issues, and precarious funding.

- The Department of State will work closely with Ocean.US to better integrate ocean research priorities into ongoing science and technology meetings. The Department will continue its work to ensure that the principle of “full and open exchange” of operational data will be a major focus within international venues.

Proceedings

International Priorities of the United States Ocean Science Community

The United States marine science community is currently engaged in five major marine scientific research (MSR) studies with international scope, through the Scientific Committee on Oceanic Research (SCOR). These programs include JGOFS, GLOBEC, GEOHAB, SOLAS, and OCEANS. These programs are generally described as, and are intended to be international, by nature. However, some members of the marine science community question the accuracy of this description. The marine science community is eager and optimistic about engaging in international ocean science programs, but suggests the national governments must overcome the slow implementation of international or multi-national programs.

The United States marine science community participates in inter-governmental organizations (Intergovernmental Oceanographic Commission (IOC), International Council on the Exploration of the Seas (ICES), North Pacific Marine Science Organization (PICES), and various other marine organizations). Participants in the workshop identified the relatively limited level of funding provided to support these organizations, and suggested that the United States could offer additional support for large-scale international marine science programs by providing trained scientific personnel and travel grants for capacity-building efforts within these organizations. Participants recommended that re-entry into UNESCO should not affect continued and targeted funding for IOC programs of interest to the United States, particularly those relating to climate change, carbon dioxide disposal, coral reefs, and the effects of population growth on coastal ecosystems

The Roundtable identified the need to promote free and open access to oceanographic data arising from international science programs. Participants highlighted the critical importance of this issue at the domestic and international levels. Concerns were expressed about the urgent need for coordination among domestic agencies and legislative committees in Congress, specific attention to proprietary issues over data sets, and security issues affecting access to international data sets as a result of the September 11, 2001 attacks on the United States. Participants also highlighted major obstacles to full and open access posed by the technology revolution. The "floods of data" currently being acquired require uniform and concerted efforts at data system architecture to integrate the diversity of sources and effective delivery to multiple end users. These efforts present "formidable technical design difficulties" for many countries. In the United States, NOAA's Pacific Marine Environmental Laboratory, the National Oceanographic Partnership Program and NPOESS are successfully integrating oceanic and remote sensing data into periodic and holistic ecosystem assessments. International scientific organizations must account for a shift from an exclusive focus on data for research and operation, to data for management, and for the interrelationships between ecosystems and ocean environment data sets. Ocean data experts are concerned that these efforts are taking place outside the IOC's IODE system.

The Department of State: A Resource of the Oceanographic Research Community

The United States Secretary of State plays a coordinating role for international science and technology activities of the United States science community. This role is assumed by three areas within the Department of State: the Office of the Science Adviser to the Secretary, the Bureau of Oceans and International Environmental and Scientific Affairs, and the Bureau of Non-Proliferation.

At the domestic level, the Department coordinates United States ocean science and technology policy through chairing the Oceans Policy Subcommittee of the NSC Global Environment Policy Coordinating Committee (the "Oceans PCC") and through its participation in the National Oceanographic Partnership Program (NOPP).

The Department has been involved in the promotion of United States science agendas internationally through coordination of activities within specialized international organizations such as the Intergovernmental Oceanographic Commission. The Department is also a regular participant in the United Nations Informal Consultative Process on Oceans and the Law of the Sea, where discussions focus on implementation of the 1982 UN Convention on the Law of the Sea. The Department makes sustained annual contributions to the administration of international organizations engaged in ocean science of interest to the U.S, and promotes ocean operations and technology development programs such as Global Ocean Observing System, Census of Marine Life, Ocean Drilling Program, and the most recent White Water to Blue Water initiative.

The Department provides key services to the United States marine science community. It manages diplomatic correspondence relating to research vessel clearances and the corresponding ocean data transfers related to research cruises in foreign waters, incorporates oceanographic input into science and technology bilateral and multi-lateral agreements, and facilitates the exchange of personnel and equipment worldwide. Department of State travel warnings are available to the marine science community. These warnings have become a tool for cruise planning, particularly after the R/V MAURICE EWING incident of 2001.

The Roundtable identified the need to monitor developments in the Senate Foreign Relations Committee with regard to emerging marine science fields, such as biotechnology. Concerns were also raised about the growing use of special science collection permits by foreign countries and the need to address the interrelationship between vulnerable marine ecosystems and navigational safety, particularly through updated nautical charts. Another issue of concern was coordination between the Department and the Immigration and Naturalization Service regarding the issuance of visas for foreign scientific personnel on board research vessels. It was predicted that the

Port Security Act would have a significant impact on access to United States ports due to its very restrictive provisions.

The Role of Research in the Integrated, Global Ocean Observation System: An Opportunity for International Collaboration

There is an increase in global concert and willingness among nations to address predictive capabilities in areas such as weather observing systems, mitigation of hazards, and improvement of marine operations, for the purposes of both improved national security and reduction of health risks. These efforts consist of programs such as WOCE, TOGA, CLIVAR, ENSO, Argo, and Ocean.US.

International weather observing systems aim to deliver effective products for a range of scientific and management uses to all partners involved. Researchers seek continuity of partnerships through relationships and foreign contacts. The relevance of those partnerships grows as very large parts of the oceans remain under-sampled at the coastal, regional and global levels. Implementation of observational systems is best achieved through international organizations with regional representation. Currently, levels of United States and EU funding have resulted in greater focus on the Northern Pacific and Atlantic oceans. However, it is expected that in FY 2004, the focus will extend to the entire Pacific Ocean. Domestic funding will be provided by NSF and NOPP. The Ocean Drilling Program and MOUs with international organizations serve as models for multi-national cost sharing of global research and observational activities that occur in territorial waters and on the high seas.

Concerns were voiced regarding jurisdictional and boundary issues with certain countries (e.g. Chile) and how these issues affect the deployment of ENSO and Argo devices in foreign EEZs. The difficulties inherent in establishing optimal contacts in some key regions (e.g. Pacific Island nations, former Soviet Union) were also emphasized. Participants were also concerned about the difficulties experienced by United States scientists during the implementation of the Argo program.

Participants highlighted the need to ensure appropriate integration of effective capacity-building measures within United States funding agency mechanisms (such as the United States Agency for International Development or NOAA's Sea Grant Program), so as to foster developing country cooperation through grants aimed at encouraging greater use of Argo floats and gliders by those nations. Assistance in the form of travel subsidies, training courses, and technology transfer may ensure the effective participation by scientists of developing countries in international program planning and implementation events. DOS devotes considerable attention to these issues. The Census of Marine Life and the United States Geological Survey also devote attention and funds to capacity building on a country-by-country basis. It was also stressed that where capacity exists, internal dysfunction among agencies in foreign countries may also affect international program collaboration.

Participants hoped that new restrictions imposed on the basis of improved national security would not impede future developments in the ocean sciences, such as the need for full and open access to vast sources of remotely sensed and *in-situ* data. New restrictions could likewise impact technology transfer efforts for international capacity building in the ocean sciences. It was suggested that the expertise of agencies such as the former United States Information Agency could provide a means to integrate public diplomacy into the global dissemination of scientific data and related information products. Participants noted that the term "data" is often confusing for educational and public awareness purposes, particularly in the United States. Perhaps it should be replaced with the term "information," which may have a wider public appeal.

Roundtable Discussion: Possible Roles for the Department of State in advancing international collaboration with United States ocean scientists.

Speakers and participants proposed the following areas for action:

Capacity Building and Maintenance

- Facilitate interagency coordination of programs.
- Promote educational exchanges (technology transfer and training).
- Encourage placement of Fullbright Fellows interested in marine sciences, and the international growth of the Sea Grant Program.
- Assist with the strategic positioning of marine scientists at United States Embassies.
- Consider ways to integrate data sharing responsibilities for post-cruise obligations (to foreign countries) with other data sharing programs.

Public Diplomacy

- Encourage the regular use of port calls as an opportunity to better inform and educate foreign scientists and government officials about United States marine science research. United States Embassies may provide assistance in foreign port call reception planning.

Facilitating Partnerships

- Review Customs and Immigration and Naturalization Service (INS) procedures regarding visiting scientist/student programs.
- Identify key countries to improve current ocean science partnerships.

Program Development

- Assist with the correspondence necessary for placement of observation equipment for science.
- Improve the efficiency of vessel clearance processing through development of web-based forms and information exchanges.
- Request United States embassies and regional hubs to solicit information from countries regarding priorities in ocean sciences.

Additional Suggestions

- Reconsider means of improving ship security (boardings, piracy) through involvement with the International Maritime Organization (IMO) and UNOLS.
- Initiate discussions to consider intellectual property rights relevant to marine science research and observing systems.
- Formalize the non-governmental science advisory process to international policy issues and consider the better use of existing mechanisms in an effort to rejuvenate the role once played by PIPICO.
- Increase interaction with congressional foreign relations committees, for increased visibility for the marine science agenda.

Agenda

Sponsored by the Bureau of Intelligence and Research, U.S. Department of State

in cooperation with
the Bureau of Oceans and International Environmental and Scientific Affairs, U.S. Department of State
and
the Ocean Studies Board, National Academy of Sciences

Present

Perspectives on International Oceanographic Research

Carnegie Endowment for International Peace
1779 Massachusetts Avenue, NW – Washington DC
Tuesday, November 12, 2002

Annotated Agenda

8:00 **Coffee and Registration**

8:30 **Welcome**
10 min. *Charge to Speakers: Welcome; Address the goals and objectives of the meeting.*
(2) Lee Schwartz, Director, Office of Global Issues (DOS/INR)
(4) Nancy Rabalais, Chair, Ocean Studies Board (NAS/NRC)
(4) Margaret Hayes, Director, Office of Oceans Affairs (DOS/OES)

8:40 **International Priorities of the U.S Ocean Science Community**
1½ hrs. *Charge to Speakers: Discuss the priorities for MSR, the current scope of participation in international science organizations, needs of international organizations, and the current resources utilized for global collaboration.*
(20) Ed Urban, Executive Director, Scientific Committee on Oceanographic Research (SCOR)
(20) Peter Brewer, Senior Scientist MBARI, Joint Global Ocean Flux Study (JGOFS)
(20) Ed Miles, International Oceanographic Data Exchange (University of Washington)
(30) Discussion

10:10 **Break**

10:30 **The Department of State: A Resource for the Oceanographic Research Community**
45 min. *Charge to Speakers: Discuss the role of science within the State Department and the resources available to the ocean science community.*
(30) Mary Beth West, Deputy Assistant Secretary for Oceans (DOS/OES)
(15) Discussion

All comments are Off the Record and Not for Attribution

11:15 *1¼ hrs.*

The Role of Research in the Integrated, Global Ocean Observing System: An Opportunity for International Collaboration

Charge to Speakers: Discuss the current and developing observation technologies and international collaboration.

(15) Robert Weller (Woods Hole Oceanographic Institution) WOCE and CLIVAR: International Research on the Ocean and Climate

(15) Larry Atkinson (Old Dominion University) Ocean.US

(15) John Orcutt (Dean**,** Scripps Institution of Oceanography) Dynamics of Earth and Ocean Systems (DEOS) Global Working Group

(30) Discussion

12:30 *30 min.*

Catered Lunch

Keynote: Norman Neureiter, Science and Technology Adviser to the Secretary of State *Speaker will comment on his role in the Department of State and the application of oceanographic interests in bilateral science and technology agreements*.

2:00

Roundtable Discussion: Possible roles for the U.S. Department of State in advancing international collaboration with U.S. ocean scientists

Moderator: Ken Brink (Woods Hole Oceanographic Institution)

3:00

Break

3:15

Resume Roundtable Discussion

3:45

Closing Remarks

Margaret Hayes, Director, Office of Oceans Affairs (DOS/OES)

4:00 *2 hrs.*

Adjourn to reception hosted by the National Academy of Sciences

Location on site.

All comments are Off the Record and Not for Attribution

Transcript: Dr. Ed Urban

U.S. Participation in International Ocean Science

Ed Urban, Executive Director, Scientific Committee on Oceanic Research (SCOR)

The Scientific Committee on Oceanic Research (SCOR) is an international non-profit organization that promotes international cooperation in ocean sciences. SCOR was formed in 1957 as the first interdisciplinary committee of the International Council for Science (ICSU). SCOR's formation was partially in response to the positive experience of the International Geophysical Year, which demonstrated the value of international cooperation in planning and executing large ocean research projects. SCOR has played a major role in developing and coordinating many of the major international ocean research projects since 1960, including the International Indian Ocean Expedition, the World Ocean Circulation Experiment (WOCE), the Joint Global Ocean Flux Study (JGOFS), the Global Ocean Ecosystem Dynamics (GLOBEC) project, and more recently, the Surface Ocean – Lower Atmosphere Study (SOLAS) and the Ocean Biogeochemistry and Ecosystems Analysis (OCEANS) planning activity. My remarks are based on a relatively short experience working at international research coordination, but a longer acquaintance with U.S. ocean science activities.

Priorities for Marine Scientific Research

Many organizations in the United States and elsewhere are involved in setting priorities for marine scientific research. Priorities arise from both (1) societal needs for information about how ocean processes work and how such processes are affected by, and affect, human activities; and (2) areas of scientific inquiry that might not have immediate application, but which are valuable in terms of increasing our knowledge about fundamental processes of the ocean—its biology, chemistry, physics, and geology—and the ocean's relations to the atmosphere and land. In my opinion, there is no shortage of activity worldwide in relation to identifying priority areas of marine scientific research. The best U.S. example is *Ocean Sciences at the New Millennium* (NSF, 2001), an effort of the National Science Foundation that involved input from a significant portion of the U.S. ocean sciences community. A recent international example is *Oceans 2020: Science, Trends, and the Challenge of Sustainability* (Field et al., 2002), which resulted from a meeting organized by SCOR, UNESCO's Intergovernmental Oceanographic Commission (IOC), and the Scientific Committee on Problems of the Environment to link ocean science priorities with societal needs.

It is much harder, however, to prioritize among research areas to target the areas that are the most important. This difficulty in prioritization results from different perspectives of the most interesting science and the most vital societal needs, relative weighting of fundamental versus mission-driven science, and expectations about the desirable time horizon for results from the scientific activities. In the United States, the portfolio of research activities is well balanced between science focused on addressing shorter-term societal needs (such science tends to be selected from the top down based on mission agency mandates) and science with a longer-term focus, which tends to be determined by the "proposal pressure" from individual scientists who submit unsolicited proposals to the National Science Foundation and some parts of other agencies. The National Research Council, particularly the Ocean Studies Board, has been an active source of research priorities for individual agencies and their subagencies (e.g., many studies related to fisheries management; oil, nutrient, and sound pollution in the ocean; and other topics) and to the collection of federal agencies (e.g., *Priorities for Coastal Ecosystem Science*; NRC, 1994). The priorities for marine scientific research set in the United States are only adopted by other nations and international organizations insofar as they are accomplished through international organizations in which the United States (either the government or individual scientists) participates. Major priority-setting exercises, such as *Ocean Sciences at the New Millennium*, are often discounted by other nations, if their scientists did not participate in the development of the priorities.

Another means of setting marine scientific priorities, which has been extremely effective internationally, is the "open science conference." Such conferences usually aim to bring together the international ocean science community to discuss rather broad areas of ocean science, present ideas for specific science observations and experiments, and contribute to resulting documents that are designed to form coherent plans for large international ocean research projects. Such international plans are often implemented as national, multinational, and international research activities. U.S. scientists have been fully involved in planning and participating in most such projects in the past two decades, thanks to research support primarily from the National Science Foundation, but also from some other U.S. agencies. This mechanism has been used in recent years to plan and execute projects related to the ocean's role in global change and other topics.

Current Scope of Participation in International Science Organizations

The U.S. government and individual scientists participate fully in international marine science organizations, both intergovernmental and non-governmental. In the intergovernmental arena, the major organizations that relate to ocean sciences are IOC, the International Council for Exploration of the Seas (ICES), and the North Pacific Marine Science Organization (PICES). The United States participates in many other binational and multinational treaty organizations that have at least some ocean science mandates, particularly with relation to fisheries and marine pollution. Intergovernmental approaches should be used in cases for which it desirable to motivate national governments to agree on, fund, and carry out common actions. Examples include IOC's efforts to establish a global ocean observing system and ensure free and open access to data collected as part of IOC activities.

My organization, SCOR, is the primary international non-governmental organization that covers all areas of ocean science. SCOR provides a means for the U.S. community of academic ocean scientists to develop collaborative activities with scientists from other nations. The U.S. National SCOR Committee is the National Research Council's Ocean Studies Board, and it has taken an increased role in SCOR activities in recent years. For example, the 2000 SCOR General Meeting was held at the National Academy of Sciences; the current SCOR President, Dr. Robert Duce, is a well-known U.S. scientist and member of the Ocean Studies Board. U.S. scientists have played a major role in SCOR history, including Roger Revelle as SCOR's first president and a driving force in establishment of SCOR, and Warren Wooster as a later SCOR president. Many SCOR working groups and scientific steering committees are chaired or co-chaired by U.S. scientists, and most groups have one or more U.S. members. The National Science Foundation has been a major contributor to U.S. and international SCOR. NOAA, MMS, and NASA also contribute to SCOR activities currently.

Other international non-governmental organizations also contribute to specific areas of ocean science, including the International Association of Biological Oceanography, International Association of Meteorology and Atmospheric Sciences, International Association of the Physical Sciences of the Ocean, International Geosphere-Biosphere Programme, Scientific Committee on Antarctic Research, Scientific Committee on Problems of the Environment, and World Climate Research Programme. All of these organizations are part of ICSU and SCOR works with each one in relation to their interests in ocean research. A number of other non-governmental ocean science organizations exist outside the ICSU structure. Examples include the Census of Marine Life (focusing on marine biodiversity), Partnership for Observation of the Global Ocean (applying ocean institutions' resources to implementation of GOOS), and InterRidge (focusing on studies of the global mid-ocean ridge system).

I believe that no new structures need to be created for participation of U.S. scientists in international marine science organizations, although it may be helpful for the U.S. government and scientists to interact more intensely with the organizations to which they already belong. For any specific international activity, it is likely that an existing organization can be used as a vehicle, with the choice depending on the goals of the activity and whether an intergovernmental or non-governmental approach is likely to be more fruitful. (It should be noted that some activities are best addressed by cooperation of intergovernmental and non-governmental organizations; SCOR and IOC cooperate on many different issues and SCOR is a scientific advisor to IOC.) However, there is also latitude for creation of new international organizations that focus on specific areas of science and for which existing organizations are not well suited. The potential International Global Ocean Exploration activity being investigated by the Ocean Studies Board may fall into this category.

Needs of International Organizations

How can U.S. agencies and scientists help meet the needs of international marine science organizations? From my personal perspective, I can suggest some areas that deserve special attention. As mentioned previously, SCOR has received good support from U.S. federal agencies and scientists. Some important ways that I believe the U.S. government and scientists can continue to help SCOR and international marine scientific research activities more generally relate to several specific areas:

1. Free and open access to data. IOC is in the midst of an examination of its data access policy. After two meetings, IOC has proposed a policy that would ensure free and open access to data derived from IOC activities. The U.S. delegation to IOC has supported this position consistently, and SCOR and ICSU have provided support from the non-governmental scientific community. However, there is great pressure from some other governments to commercialize ocean data and restrict access to it. The IOC Executive Council will discuss this issue in 2003 and there is a danger that restrictions will be placed on access to ocean data. SCOR and ICSU believe that such restrictions would have serious consequences for the development of the global ocean observing system, as well as other operational and scientific use of such data.

2. Capacity building. Both SCOR and IOC emphasize the enhancement of scientific capacity in developing nations through targeted activities by international organizations and national governments. SCOR promotes capacity building by including developing country scientists in each of our activities. SCOR also provides travel support for scientists from developing countries to participate in ocean science meetings, through a grant from the National Science Foundation. I believe that U.S. federal agencies should devote much more attention and funding to capacity building. Some areas that should be explored include regional ocean education centers in developing regions of the world, enhanced exchanges of scientists between the United States and developing nations, and devotion of a greater proportion of international aid to scientific capacity building. Another idea would be graduate fellowships provided by the Department of State and other U.S. agencies for students from developing countries to study ocean science and/or policy in the United States.

3. Targeted Funding for IOC. The re-entry of the United States into UNESCO is likely to have a negative effect on IOC, because U.S. funds were previously provided directly to IOC, but will now be provided to UNESCO, which will decide what percentage of the funds will be devoted to IOC in relation to other parts of UNESCO. It will be important for the United States and other nations to ensure that important IOC activities, for example, those related to the global ocean observing system and ocean carbon, receive adequate continued support.

4. Funding for collaborative international research. The level of support for international scientific activities from U.S. federal agencies is relatively small, because there appears to be little interest in Congress and perhaps in agencies for such activities. I was surprised to learn some years ago that there is almost no collaborative research conducted by U.S. and Mexican ocean scientists, because Mexican research support is low and U.S. agencies have few special funds available for collaborative research with Mexican scientists. Compelling arguments can be made for special collaborative research efforts between scientists of the United States and those of Mexico and Canada because we share contiguous waters and the condition and fate of our marine areas are intimately related to activities in waters "upstream" from the United States.

5. Staffing of international science activities. One of the most important ways that U.S. agencies have promoted international science has been in assigning U.S. scientists to posts abroad. This so-called "secondment" has been quite important for IOC and many U.S. scientists have served with great distinction in Paris for IOC. NOAA has been a major provider of seconded personnel, but other agencies, such as NSF and the Department of State, have contributed staff and/or salary support for such positions. Not only IOC, but also the sending agencies, have benefited from these arrangements, by providing opportunities for their personnel to learn about the international aspects of ocean science and build cooperative relationships between scientists from the United States and other nations.

   Less common has been the secondment of scientists to serve in the International Project Offices of the major international ocean science projects. SCOR, IGBP, and IOC are seeking to create three new International Project Offices for three developing projects, SOLAS, OCEANS, and the Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) project. It seems to be relatively easy to find other nations that will provide office space and salaries of support staff, but difficult to find funding for the executive officers for such projects. U.S. agencies could provide a major service to international ocean science by seconding some of their staff or to paying the salary of an academic or agency scientist to fill an executive officer position for two to three years for one of these projects.

6. Implement Recommendations of *The Pervasive Role of Science, Technology, and Health in Foreign Policy* (NRC, 1999). This National Research Council report made recommendations to the Department of State regarding how it could increase the use of "science for diplomacy" and "diplomacy for science." Although most of the recommendations are aimed at the department generally, their implementation could increase the role of U.S. agencies and scientists in international ocean sciences. Examples of relevant recommendations including establishing "scientific affairs" as the major focus of a departmental undersecretary and re-invigorating the department's corps of Science Counselors.

Current Resources Utilized for Global Cooperation

As described above, I believe that U.S. agencies and scientists do a good job of participating in international intergovernmental and non-governmental organizations. I believe that the Department of State's most important role in international organizations is in the area of helping U.S. agencies in their representation in intergovernmental organizations such as IOC, ICES, and PICES. Additionally, the Department of State can assist the academic community by helping U.S. scientists interact with scientists from other nations and in promoting capacity development in developing nations. Because several U.S. agencies are already active in international ocean science activities, it will be important for the Department of State to find a unfilled niche.

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Transcript: Dr. Peter Brewer

International Priorities of the U.S. Ocean Sciences Community

Peter G. Brewer, Monterey Bay Aquarium Research Institute

"Nass-Co, Nass-Cass, Pee-Sack-Poo
Eye-Co, Eye-Cass, A-Gee-You
Score, Scar, and the Eye-Aich-Bee,
We'll all live together in the Eye-Oh-Sea"
From "The Id of the Squid"

Introduction

Harris Stewart's 1970 "Nonsense Cheer for the Woods Hole Football Team" above happily illustrates the first impressions many have of international ocean science programs – a bewildering collection of acronyms. Most of the national committees above are now gone, but the principal international bodies of SCOR and IOC remain: testimony both to their impressive longevity, and to their usefulness to the ocean science community. Beyond the fundamental oceans ICSU representation through SCOR, and the UN-Intergovernmental representation through the IOC, there is now an enormous collection of acronyms – any serious international report has a couple of pages defining them. They include the climate/atmosphere/ocean programs linked through the WMO, and the biogeochemical programs linked through IGBP. But acronyms and committees are distinct from scientific priorities – at best they serve, and help to set, them.

Interestingly the largest and arguably most successful true international ocean science program, the (International) Ocean Drilling Program has evolved outside of this network, and pursued a wholly independent path.

When I asked my scientific colleagues for their suggestions in preparing this paper I at once got a long and enthusiastic list of science themes that "should" become new, significant international programs. This surely reflects the belief and expectation that, if the problems one is working on are large and of compelling interest, then the natural outcome is the tangible prestige of international acknowledgement through creation of a "real" international program, and possibly recognition through one of the established channels.

But when I asked a similar question of colleagues in government agencies I immediately heard an outcry over the difficulty of getting permits to work in international waters, and of getting the international committees we already have to act in a timely and effective manner. After all, if a decision to fund a program has been made then let's get on with it, and if they are supplying funds for committees to travel and meet, then they could at least help in these matters. More international programs may simply mean more problems to work around. And in many cases they believe they could simply hold a very effective meeting without the overhead the established organizations create. In any case the matter of clearances for work in foreign waters is not the province of international organizations – these are purely bilateral negotiations. And veterans know how cumbersome and time consuming our established international protocols can be. Possibly for these reasons the international organizations are chronically under-funded for the expectations placed upon them.

Beyond these basic attitudes and legitimate desires we should ask what our fundamental needs are, what are the challenges, and how they might be best accomplished and met in the real world of today. The trend towards multinational (as opposed to simply international) programs will likely increase, and we have little experience of this.

Brief History

SCOR was created in 1957 as the first interdisciplinary science body formed by ICSU. The timing was driven by the planning for the IGY, and for the International Indian Ocean Expedition of the early 1960's. SCOR is a purely scientific body. Its counterpart is the intergovernmental IOC, established within, but separate from, UNESCO. The first International Oceanographic Congress, held in 1959, pre-dates the formation of the IOC, and was held at the UN.

Thus the basic functions and operations of SCOR, and the IOC, were established in the post World War II years, and matured during the Cold War, the longest war the U.S. has ever fought. It was under the aegis of these bodies that East and West could meet, and it was possible, and indeed encouraged, for scientists from Western, Soviet bloc, and Third World nations to meet, present new findings, and plan new programs. International "working groups" (the first was on the thermodynamic properties of the ocean CO_2 system) provided the essential scientific output of SCOR, and still do today. Technical Panels on Standards were established, for example so that the Equation of State of sea water could be refined, or "Standard Seawater" be produced so that the basic salinity of sea water could be reliably measured. During those early years airplane travel was expensive, international tensions were high, and communication was slow and infrequent.

Today all that has changed. International travel has increased enormously, the collapse of the Soviet Union, and the emergence of China, have radically changed international tensions, and web based communication puts colleagues in touch near instantly and in astonishing detail. Any research campus today houses an amazing international mix of scientists of all ranks, and journals routinely carry large numbers of excellent multinational papers. It is now as easy to have a colleague in Tokyo or Stockholm as it is in Washington D.C. And all of this happily takes place without any formal international body to guide it.

Within the last two decades significant new international bodies have been created, some of which embrace or touch upon the ocean sciences. The establishment by the UN of the IPCC and the UNFCCC deals with the climate issue in many dimensions, and naturally ocean scientists are engaged in important ways in this activity. The creation of the IGBP by ICSU highlights the interlinked and changing fluxes between land, sea, and air, and ocean scientists are fully involved in this activity. Does this expand, or dilute, the talent pool available for meaningful international service?

We may well re-examine what is meant by an "international program". For example I vividly recall driving from Woods Hole to Lamont to plan an international program, with German, Japanese, Canadian, and U.S. colleagues. We all worked hard. But some time later when the cruises took place we had separate U.S., Japanese, German, and Canadian ships at sea. We all later met and compiled our separate observations. This is very strange behavior. Any lab. today has a busy mix of scientists of many nations working collaboratively on a daily basis, and going to sea together on routine cruises. Our so-called "international programs" are paradoxically far more national.

What then are our new science priorities, what is the future of our international ocean science organizations, and how have they adapted to change?

Expectations, Large Themes, and Complexity

- *Expectations*

A significant change in the conduct of international ocean science arose in the 1980s in response to the "Global Change" challenge. In my personal view the response, particularly of SCOR, was superb. In essence the international organizations provided a negotiating forum and clearinghouse for creation of very effective "big science" programs. Both WOCE and JGOFS used the talent, and good offices of SCOR and IOC to great effect in program creation. This was by no means easy. It is fundamentally difficult to persuade large numbers of independent minded scientists to commit to an organized enterprise that lasts for many years. In each case there was the promise of exciting new satellite launches (TOPEX-POSEIDON, SeaWIFS) that would enhance the field programs and provide new global sensing. And in each case the tedious (truly decadal) and labyrinthine ways of NASA caused such delays that the actual field programs were accomplished almost entirely before launch. Viewed another way we could also say that the rapidity and effectiveness of our international organizations in helping to create and execute major programs far exceeds the speed with which NASA can act.

Based upon these successes the expectation appears to be that a reprise is in order – the creation of very similar follow on programs that capitalize on past successes. I would urge caution here. And if JGOFS and WOCE were so successful then surely it is now the turn of other fields to follow the example, and similarly mobilize very large resources on a global scale. But which programs merit this and why?

There are differing national approaches to this: for an interesting philosophical example of varying interactions with “the international community” see the recent article by Francis Fukuyama (Washington Post, Sept. 11, p. A17 (2002). In essence the U.S. community sees international organizations as a tool to be used effectively to enhance national programs. The European view is one more of an actual dependence on international organizations to create programs that can be adopted nationally. What large themes are now being debated that will likely require serious U.S. engagement? (See http://www.ofps.ucar.edu/joss_psg/publications/decadal/ for a recent thorough review of US Ocean Science themes).

- *Large Themes and Complexity*

Global Change/Climate Change: These two themes are essential, paired, and distinct in their constituencies and science requirements. In essence the climate community requires sophisticated and long-term observations and modeling of the physical world of ocean/atmosphere interactions. Given the stochastic nature of climate, and the decadal oscillations that are observed, then a long-term commitment is essential; but this will likely take the form of many “programs” as specific needs are met. There has been no lack of discussion of this. Where change will likely be required is in responding to important new pressures from the policy community who must consider what constitutes “dangerous interference with climate”, and from a thriving paleoclimate community who provide compelling and imaginative case studies of past climates that increase the number of unknowns and level of uncertainty today.

For the Global Change theme there is now pressure for an important transition from study to action. This trend is likely to increase. The modern global change era has diffuse scientific origins, but in the U.S. these were crystallized as policy by the first publication of “Our Changing Planet” by the Bush administration. Thus this policy attention is now well more than a decade old, and the challenge will be to maintain the core science while also providing solutions. The options are increasingly narrowed. The Kyoto Protocol approach focusing on forestation as a carbon solution has now been largely discredited. For a very recent review of the energy/CO_2 future see Hoffert et al. (Science, v. 298, 981-987, 2002), which re-emphasizes the scale of the problem and the likelihood that “enormous sequestration rates” could be needed by mid-century, in which the ocean could be considered as a very large repository.

Coastal Ocean Science: High on every account of the importance of coasts is the record of the vast and growing human population that lives nearby. These citizens are affected to some degree by hurricanes, rising sea level, saline ground water invasion, pollution (the role of mankind as a geochemical agent competing in scale with nature is exemplified here) and so on. Yet the population grows because it is still very desirable to live there; either our list of concerns is overwrought, or we are facing delayed reality. The impact of a major hurricane is usually discussed as the crisis point, but chronic problems have to be faced too.

Ocean science programs have traditionally focused on observing change, and studying the fundamentals of coastal processes. The response of society has been to regulate. These two themes will clash. There is little predictive knowledge of the response of inherently non-equilibrium marine ecosystems to the establishment of protected areas. The desire to protect beach property (or rebuild after a natural disaster) has far reaching geophysical consequences. Toxic algal blooms are a subset of all algal blooms, and they keenly affect humans. Trans-national boundary issues that affect marine protected areas are not yet well known. But the trend will be to establish large scale “protected areas” in marine coastal zones world wide.

Observatories: The splendid success of the few ocean time series stations (Hawaii–HOTS, and Bermuda-BATS established within the JGOFS programare premier examples) is a sub-set of the need for capturing the time dependent behavior of ocean processes in new and sophisticated ways. In the U.S. this need has emerged as a call for “Observatories”, systems powered through sea floor cables with high two-way data rates. It is likely that this will become an international trend that may elegantly satisfy some of the difficult data requirements for climate change, global change, geophysics etc. However the negotiations for international access either for obtaining data from, or installing, an observatory that crosses the continental shelf/coastline of a sovereign state are unexplored. The sensitivities over data collection likely raise concerns beyond those experienced by long established international telephone traffic.

New Technologies: Our established international science bodies have been neglectful of innovative technologies beyond participating in ocean observing satellite discussions and drifter programs. Yet these are crucial in achieving new successes. The rise in sophisticated ROV usage will continue, and vigorous programs in the U.S., Canada, Japan, Germany, France, and the U.K. are now established. However there has been little planning for cross platform tools and data exchange. The opportunity for truly sophisticated experiments is clear, and the network for this is flourishing outside any established international organization.

International Ocean Drilling: The largest international ocean science program has evolved its own very successful mode of planning and execution, distinct from any other effort. Is this a model for future large-scale programs? What is impressive is that the subject matter now involves energy resource and climate sensitive issues, such as hydrate drilling, within the exclusive economic zones of nations. Important lessons can be learned from this.

Threats: Many oceanographers consider themselves to be "environmental scientists" who chose their career out of an abiding wonder of nature. They spend much of their lives observing the ocean. So is astonishing to see the rise of fundamental environmentalist attacks on ocean science, and this presents a threat to progress unheard of a decade ago. Basically a new attitude has been disseminated that ocean scientists are, or can be, bad. The ocean science community has not taken this in any way seriously enough, and it has important international ramifications. The environmentalist attack on the ATOC experiment is one example. Objectively ship collisions may be the primary cause of premature whale deaths today; but the ability to raise public fears by attacking "science" provides a high profile opportunity for recognition of an environmental organization. If the regulatory process is based on emotion and not on objective data then ocean science will suffer.

Ocean CO_2 sequestration science provides another recent example: a long planned international (U.S./Japanese/Norwegian/Canadian) experiment to release a few tons of CO_2 at 800m depth off Hawaii was denied a permit by the EPA after environmentalists aroused fears among local fishermen. The project was then planned for Norwegian waters, and a permit issued. Greenpeace activists, emboldened by the events in Hawaii, successfully sued to have the permit withdrawn. The issue was explicitly not environmental harm, but the pressing of a system of beliefs that the knowledge gained could be dangerous since it might lead to further work. The subject matter here is controversial; but the desire to force ignorance as the basis for policy making is a threat to all science.

Ocean scientists have long had the fundamental freedom to explore the ocean world without permits. Those freedoms are increasingly being encroached upon. The system of requesting permits for work in national waters is complex. While it is an international issue, it is pursued solely on a bi-lateral basis. So far as I know no organization tracks this issue. For instance the details of Japanese requests to work in Indonesian waters, or German requests to work in Canadian or Indian waters, are simply not well known. Given the scale of international commercial shipping today, and the ease of monitoring ships positions, the posture over permitting collection of cores, water samples, plankton, etc. seems extraordinary, and it could be greatly simplified.

Suggestions and Recommendations

1. Take the environmentalist threat very seriously; it can affect significant U.S. national interests, and it poses a challenge to science policy. Creating a path for the conduct of important research will require the establishment of "sunshine" rules that will be beneficial, and base environmental laws on science.
2. Staff the major international organizations with wisdom and long-term attention to detail, and provide sufficient funding. At present these are afterthoughts.
3. Re-examine the international permit process and work to make it more timely and effective. Preserve the freedom of research at sea.
4. Choose major new international projects carefully. Amid the clamor for new projects only a few rise to the level of major programs, taking years and costing millions. Our procedures for establishing this are uncertain.
5. Take on the truly multinational joint experiment, as opposed to the traditional international program.
6. Accept that global change/climate change research will move (has moved) from the scholarly pursuit of knowledge to the requirement to provide, advise, and act on solutions.
7. Do not throw the baby out with the bath water. Maintain at all costs the scholarly pursuit of knowledge or the ability to act on item 6 will quickly erode.

8. Learn to create effective research programs appropriate for a highly regulated coastal environment. Ensure that research can be done in “Protected Areas”.
9. Be open to new things. For instance I am amazed that the emerging coral reef crisis has not spurred creation of a program of comparable scale to other initiatives. Oceania is a big piece of the ocean world.

Transcript: Dr. Ed Miles

International Priorities of the US Ocean Science Community: International Oceanographic Data Exchange

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Almost twenty years ago, I published a paper entitled "IOC Data and Information Exchange," (Miles 1983), in which I had assessed for the Intergovernmental Oceanographic commission (IOC) the implications of the 1982 United Nations Convention on the Law of the Sea for IOC's programs in international oceanographic data and information exchange.

My principal findings in that paper can be summarized as follows:

1. Changes in the law of the sea, and their accompanying requirements to international oceanographic data and information exchange, imply a significant expansion in the scope of IOC programs, especially in subject matter and emphasis.
2. Subject matter changes encompassed:
    a) Additions of data relating to marine ecosystem inter-relationships as well as relationships between the ocean environment and life forms;
    b) Data relating to the protection and preservation of the marine environment; and a wider array of types of data in relation to the conduct of marine scientific research. The principal change in emphasis related to the exchange of information on the potential utilization of research results for the benefit of developing countries, particularly in the subfields of marine geology and geophysics. *These changes implied a shift from an exclusive focus on data for research and operational purposes to a focus on information and data for management.*

In the early 1980's, I saw the implications of this shift described above as being highly significant for expanding the IOC's organizational role, and particularly that of the International Oceanographic Data Exchange Program (IODE), into one of a full-fledged broker for a much wider range of data and *information* for multiple purposes. But I acknowledge that the two major hurdles facing IOC as it tried to respond to the new demands would be cost and "…the formidable technical design difficulties which will face IODE as it begins to include information components in addition to data; as it tries to perfect mechanisms to ensure data quality and compatibility; and as it attempts to ensure that the distributional system works as intended."

These technical design difficulties arose from the then limited and costly capacity of computers to store large amounts of data. Since biological data lacked the compactness and high information density for storage to be cost effective, there was a definite bias in the system towards physical and chemical data. The other major technical problems affecting the performance of the IODE network which were evident at the time included:

- Member countries failing to submit data from cruises on declared national programmes.
- Member countries failing to submit data from cruises until several years have passed.
- Member countries failing to carry out declared national programmes.
- High error factors at national sources of input.
- High loss rate of national messages in the Global Telecommunications System (GTS).
- In certain regions of the world, the unwillingness of member countries to submit data perceived as sensitive.
- The inability of member countries in particular regions to produce data for exchange which meet system design requirements.
- Declining interest in specialized data sets, which are costly to maintain.

What has changed in the last twenty years? In my view, the all-encompassing change of the current era is the immensity of the information technology (IT) revolution, which reaches into every nook and cranny of human life.

Not only have the hardware and software changed in unbelievable ways, but we are now firmly in the grasp of Moore's Law*, drowning us in a veritable flood of data.

In this flood of data the major issues all relate to system architecture. In particular, multiplying diversity of sources vs. the increasing need for integration. Multiplicity of sources also raises issues of single users (the old mode) to multiple users (the new mode). But note that this change is overlaid on the old system, the major problems of which were never fully resolved, with the result that today the tensions between timeliness vs. data quality are greater than ever before, intensified by the need for multiple access.

In this context, the following needs are particularly acute: standard interface formats, data/interchange protocols, and explicit and detailed attention to metadata requirements. And where does the responsibility for global system oversight to ensure continuity in the face of change reside? Finally, as Moore's Law has powered us to new heights of performance, the digital divide has grown immensely, completely overpowering the solutions attempted in the 1982 UN Convention of the Law of the Sea. What then is to be done? I consider the following programs in search of some answers:

*IOC/IODE, NPOESS, GOOS, CLIVAR, PICES, and NOPP*IOC/IODE*

One must first admit that IODE has grown in concept and sophistication over the last 20 years. MEDI has been substantially upgraded and OceanPortal and OceanExpert are noteworthy additions. The former is a multidimensional directory of ocean data and information web sites, while the latter is a directory of ocean experts in a wide variety of flavors. GOOS will be discussed separately, but I do want to note that IODE has not responded in any direct fashion to the responsibilities referred to by the Law of the Sea Convention, almost all of which had *management of ocean use as their primary focus.*

While IODE has not responded in any concerted fashion, others are responding, including IOC. I am referring here to the multidimensional United Nations Atlas of the Oceans which is described as

> "… an information system designed for use by policy makers who need to become familiar with ocean issues and by scientists, students and resource managers who need access to underlying data bases and approaches to sustainability" (www.oceanatlas.org/html/).

The atlas design, currently in its initial stage, is seen as supporting Chapter 17 of Agenda 21 which defined a series of strategies for achieving sustainable development of the world ocean.

The same sustainability ethic is the driver behind ICLARM's ReefBase.2000, which is an attempt to build a comprehensive database on coral reefs to facilitate improving policies to achieve sustainable management of their use. The range of data and information which have been collected and stored on a single CD-ROM is astounding. It includes:

- Selected information on over 10,000 reefs;
- Over 3,800 records of ecological information on corals and fish communities;
- Over 2,500 records of coral reef stresses;
- Coral reef fisheries and mariculture production information;
- Dive sites, dive operators and tourist lodging information for over 1,600 reef destinations;
- Management practices and legislation information on over 500 marine protected areas;
- 196 maps covering known coral reefs in 107 countries and island states;
- 300 low-orbit earth photographs;

* Gordon Moore of Intel observed that, for the last 30 years, the doubling rate of the number of transistors on a chip has been 12-18 months. So performance has been rapidly increasing while the cost of chips has been stable. (NSB/NSF, 2002, 8-5).

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- Indexes of some 1,700 experts, 100 monitoring programs and 200 institutions involved in coral reef research, and a dictionary of common terms in the study of coral reefs;
- and over 9,000 references on coral reefs from published papers, conference proceedings, technical reports and news articles.

In another innovative departure CORE has sponsored an ambitious decadal international research program "… with the goal of assessing and explaining the diversity, distribution and abundance of marine organisms throughout the worlds oceans" called the Census of Marine Life (COML) (www.coreocean.org/Dev2so.web?anchor=comlhomepage). COML is an affiliated program of SCOR.

Another U.S. national effort, sponsored by the H. John Heinz III Center for Science, Economics, and the Environment, explicitly seeks to provide a database and evaluation system for achieving and maintaining sustainability and provides a template for other national and international efforts. *The State of the Nation's Ecosystems* provides data systematically on system dimensions, chemical and physical conditions, biological components, and human use with indicators of their current conditions.

Finally, the Living Marine Resources component of GOOS has been planning to include data on the status of marine ecosystems in the Global Ocean Observing System. Various regional entities in North America have complied such reports and PICES is now in the process of undertaking a similar effort for the North Pacific. The *raison d'être* of all of these efforts is clearly to support moves toward ecosystem-based management and the GOOS/PICES rationale for such an experiment is worth noting.

Participants in the Living Marine Resources Panel of GOOS thought about monitoring marine ecosystems, including their forcing by climate variations and human activities, and their responses throughout the food web from primary producers to top predators. Most data management systems have great difficulty in dealing with the wide variety of biological data, and especially in including data on fish abundances and distributions. Participants envisioned regional analysis centers where all the data would be brought together in periodic holistic analyses of ecosystem status. The attempt to develop a North Pacific Ecosystem Status Report, being considered at PICES XI in Qingdao, is a step in that direction.

While all of these efforts are responsive to the need to provide data for management purposes, they are all different and only the UW Oceans Atlas and the PICES experimental effort are linked, even if indirectly, to IODE. A question well worth considering is what is the most cost effective way in which the U.S. could support such a trend and provide for an architecture which facilitates making the separate components additive. We shall return to this question when we discuss the NOPP contribution. In this regard, we also have to ask what is the extent currently of community resistance to new modes of data exchange. This is really a cultural issue reinforcing the dominant bias towards physical and chemical data. The day is long past when that could be regarded as a satisfactory state of affairs and the time is more than ripe for a global effort on ocean data for management purposes.

It would seem that two other U.S. innovations have substantial promise for solving the kinds of problems referred to above. We refer here to the NOAA/PMEL Live Access Server (LAS) and the NOPP's Virtual Ocean Data Hub (VODHub). Each is powerful in its own right but linking them together promises to generate considerable synergy.

According to Hankin (2002):

> "LAS is a Web based visualization and subsetting system for scientific data (for an example see http://ferret.wrc.noaa.gov/las/). An individual LAS site can provide access both to locally held data – often data sets juxtaposed for purposes of comparison. Users can co-plot and difference (with regridding) the comparative data sets. LAS uses the NOPP VODHub framework for transparent access to distributed data."

LAS is now linked to the Distributed Ocean Data System (DODS) as the basis for the VODHub. The interesting thing about DODS is that it "… is a client/server architecture for the delivery of binary data and associated metadata" (Hankin, 2002). The points being that DODS is *not* limited to ocean data alone and "the ability of DODS to access both metadata and data (e.g. individual coordinates) directly from distributed data sources opens the door to radically improved methods of harvesting, maintaining, and searching metadata databases." (Hankin, 2002). The problem DODS itself was designed to solve was the characteristic problem of the fragmentation of scientific research results inhibiting their usability.

> "The data are collected for specific experiments and stored in proprietary home-grown formats on the scientist's computers. These data can be difficult to share even if the scientists want to share them and are, therefore, impossible for other scientists and decision makers to use." (Hoberman, 2002).

One last idea which should be mentioned before we conclude the discussion of developments outside the IODE framework which can powerfully assist the objectives the community has long sought is that the U.S. Government can provide a most useful service if it were to catalyse an international effort, with the assistance of IOC and SCOR, to systematize and make available in a common database the very large number of historical records of temperature, surface pressure, and precipitation which are available in the historical records. Access to such historical records is now limited but, were such an effort to be undertaken, it would transform our knowledge of the last 100 years of climate variability.

NPOESS

The National Polar-orbiting Operational Environmental Satellite System (NPOESS), having merged the DoD and Commerce systems of meteorological satellites into a single national asset, has developed the most tightly integrated data collection and exchange effort involving satellites that has so far been achieved. That this level of integration has been achieved to serve multiple uses and users across research, operations, and management domains is exceedingly impressive. In addition, it is an international program since it involves partnerships with space agencies in Europe and Japan (www.IPO.noaa.gov).

The objectives of NPOESS are to:

- Provide a single, national, polar-orbiting remote-sensing capability to acquire, receive and disseminate global and regional environmental data
- Achieve National Performance Review (NPR) cost savings through the convergence of DoD and NOAA environmental satellite programs
- Incorporate new technologies from the National Aeronautics and Space Administration's (NASA's) Office of Earth Science Enterprise (OESE) program
- Encourage international cooperation

Collecting a vast amount of data in order to provide a wide variety of products to multiple international users whose foci spread over the short- and long-term, the program succeeds on the basis of intense attention to integration requirements. These include a common spatial/temporal datum, defining the data rules from the outset and, more importantly, paying close attention to data collection, reduction, and customer product during the initial design/construction of the system (West; pers. commun., 2002). However, of equal importance, especially for data quality, is designing an approach to ensure accuracy via emphasis on calibration and validation.

GOOS

The Global Ocean Observing System has been a very long time coming. The original design for such a program was jointly produced by WMO-ICSU-SCOR-IOC in 1984 (WMO-ICSU-SCOR-IOC, 1984). This initial design was modest in its objectives relative to what would be needed but it was a deliberate attempt to be "…evolutionary in concept and implementation". Seven years later, an *ad hoc* group was convened by the Chairman of the Joint Scientific Committee for the World Climate Research Programme (WCRP) in the U.K. to produce a design for the Global Climate Observing System (GCOS). GCOS was more ambitious in its objectives and far more direct about what was wrong with the current state of the art.

Its design encompassed "…all components of the climate system: atmosphere, biosphere, cryosphere and oceans" (GCOS, 1991) and in concept extended far beyond the scope of existing operational atmospheric, land, surface, or ocean observing programs. The report declared bluntly that:

> "Currently available observing systems cannot meet the goals of GCOS. In general, climate research and prediction requires observations that have greater accuracy, denser sampling, and a greater range of variables than has been necessary to address existing environmental problems. In some cases, the climate specification can be met by improving and extending existing systems; but it will also be necessary to deploy new systems…In the case of the oceans, the existing permanent observing systems are very modest compared with what is needed to meet the GCOS goals. They are IGOSS (which adds bathythermograph and hydrothermograph and hydrographic profiles to the meteorological communication system) and GLOSS (which collects sea-level data from tide gauges), and two major research projects, WOCE and TOGA, are testing techniques which could be deployed in GOOS, the oceanic component of GCOS. The main issue is to achieve much higher density of sampling by deploying unmanned systems in space and on moored, drifting and powered systems in the ocean." (GCOS, 1991).

The planning for GCOS, though broader in scope and far more innovative ("thinking outside the box") than the initial planning for GOOS, was also evolutionary. For the first time, however, the physical planners recognized the inherent need to reach out to multiple users and to include the management dimension in their vision. The needs to be met by the new system included:

- Climate system monitoring, climate change detection and response monitoring, especially in terrestrial ecosystems;
- Data for application to national economic development;
- Data for research towards improved understanding, modeling and prediction of the climate system;
- Eventually, a comprehensive observing system for climate forecasting. (GCOS, 1991).

And, indeed, equal attention was given to the atmosphere, ocean, and land.

The next detailed look at the evolution of the GOOS design, and particularly the GOOS data and information management system (DIMS), occurred in June 2001. Recognizing that the system must perforce be a highly distributed and diverse one, in which components were pursuing different data and information management strategies, the document which was produced sought:

> "…to provide basic design information, guiding principles, typical responsibilities for data and information centres, and a strategy to be used by the scientific and technical panels and data managers in planning the development and implementation of the data and information systems for GOOS." (GOOS/DIMS, 2001)

Explicit in the design of GOOS/DIMS were two critical functions: 1. connecting the participants under *"…a unified and centralized information services system, where information about the programmes and observations may be obtained from a single source and where access to the data holdings or holder is provided,"* and 2. creating an automated, or semi-automated, tracking system to demonstrate whether or not the system is working and, if not, where the problems lie. A need to cooperate with the data management programs of others, particularly IOC and WMO, was recognized along with a much increased emphasis on capacity building.

The breadth of the potential applications recognized was quite a novelty in the track record of large international data-generating scientific programs, along with the recognition that, for data managers, information was far more important than data. The suite of applications was assumed to encompass:

- Intergovernmental conventions;
- Government agencies, regulators, public health, certifications agencies;
- Environmental management, wildlife protection, amenities, marine parks;
- Operating agencies, services, safety, navigation, ports, pilotage, search, rescue;
- Small companies; fish farming; trawler skippers, hotel owners, recreation managers;
- Large companies. Offshore oil and gas, survey companies, shipping lines, fisheries, dredging, construction;
- The single user, tourist, yachtsman, surfer, fisherman, scuba diver;
- Scientific researchers in public and private institutions.

In the context of this advanced design for GOOS, it is puzzling why the substantial amount of planning that has been done within NOAA on the U.S. contributions to GOOS has not yet seen the light of day. The draft NOAA Ten Year Plan does take into account both U.S. inter-agency and international concerns deriving from a matrix of CLIVAR, the Carbon Cycle Science Program, and the Global Water Cycle Program. Both the system design and the management requirements are consistent with the advanced GOOS designs and the projected coverage is comprehensive. It is to be hoped that the U.S. will find it possible to move these developments along with greater speed.

CLIVAR

Not much can be said about the CLIVAR approach to data management since the program is still in the early stages of developing its data management concept. But a series of principles for CLIVAR data have been enunciated. These are:

- Free and open exchange
- Timely exchange
- Quality control
- Metadata (full documentation)
- Preservation of data
- Plan for reuse in reanalyses
- Easy access
- Use of existing mechanisms and centers (CLIVAR, 2001. www.clivar.orf/publications/other_pubs/iplan/iip/data_set.htm)

Paleoclimate Data

The big change in paleoceanography since the mid-80s is that virtually all the data are now on the web. What is needed are better metadata, so that users can know more about the quality and peculiarities of the data, and better internationally accessible catalogs (again dependent on the inclusion of good metadata with data sets) so that users can easily search for particular data sets.

NOPP

The architecture of the National Oceanographic Partnership Program's design for a U.S. integrated, sustained ocean observing system, combined with the detailed planning for GOOS data management (2001), would appear to provide as close to an ideal system as could be conceived at this time. The two approaches are quite compatible in their focus on integration, multiple users, and research, operational, and management purposes. NOPP's design in fact explicitly meets seven critical national needs: (1) detecting and forecasting oceanic components of climate variability; (2) facilitating safe and efficient marine operations; (3) ensuring national security; (4) managing living resources for sustainable use; (5) preserving and restoring healthy marine ecosystems; (6) mitigating natural hazards; and (7) ensuring public health. Major cross-cutting objectives are strengthening education and improving knowledge. (NOPP, 2002)

Envisioned as a partnership between federal, state, and local agencies, the private sector and academia, the NOPP design is built upon the following characteristics:

1. Coordinated data collection efforts (efforts often in place for different purposes) among U.S. and international agencies to minimize duplication, reduce costs, and maximize data availability.
2. A balance of remote and in situ observing technologies. Mix and match the strengths and weaknesses of remote and in situ observing systems to design cost-effective and efficient approaches to data collection.
3. Development of an integrated information management plan to ensure continuous data-streams, timely delivery of data, and adequate quality control.
4. The ability to meet the requirements of multiple users by integrating observations collected for different purposes.
5. Adaptability to new and changing user requirements for ocean data and products.
6. Development of criteria for prioritization of existing and proposed observing systems.

Not only is the NOPP planning detailed, comprehensive, imaginative, and thorough but, in the Ocean.U.S. Workshop Report of May 23, 2002 participants link the recommended U.S. design with the global component and go on to spell out the governance considerations that should apply. (Ocean.U.S., 2002). The combined NOPP Plan and Ocean.U.S. Workshop recommendations are compelling. This is the direction in which the U.S. should proceed at both national and global levels.

Final Comments on U.S. participation in International Ocean Organizations

It is important that the U.S. speak with a consistent voice on policy questions in the different organizations, so that the same policy goals are pursued in dealing with bodies such as IOC, FAO, PICES, and NPAFC. For example, in the early 1990s in the formative years of PICES, the U.S. was pursuing a supporting role in PICES while appearing to work against it in NPAFC. In the past, PIPICO served to bring interested agencies, such as NOAA, ONR, and NSF, together to work out a uniform policy. The participation of the fisheries desk is essential given the nature of fishery interactions with other kinds of ocean uses and activities.

Among other things, PIPICO was involved in selecting U.S. delegates to organizations such as ICES and PICES. From the time of U.S. rejoining ICES, in 1973, there have been two delegates, one from government and the other from academia, a practice that was followed when PICES was established in 1992. In ICES, that practice broke down when John Steele (WHOI) was replaced by Mike Reeve (NSF) who was designated by the government delegate, Mike Sissenwine (NMFS). Reeve is now to be replaced. This selection should be made by PIPICO or its successor after consultation with the OSB. The same should be true with PICES where the academic delegate, Vera Alexander, must be replaced as she becomes PICES chairman.

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Transcript: Amb. Mary Beth West

Introduction

Good morning—

It is my honor and pleasure to speak to you this morning on behalf of the U.S. Department of State.

First, let me say that we are delighted to be having this exchange of ideas between the State Department and the oceanographic community.

We view our marine science functions as important. Today, we want you to know what we are now doing in this area, and to hear your thoughts on how we can work with the ocean community and other agencies to perform our functions even more effectively.

The three staff members most closely involved with marine science are here today to address any questions you might have. They are Conny Arvis, Roberta Barnes and Liz Tirpak. Of course, many of you already know Office Director Maggie Hayes and the Deputy, Ray Arnaudo. I hope you will get to know them all better today, and talk with them about their work.

Because we have only a few hands to handle our role in promoting international oceans research and providing for the needs of the U.S. oceanographic community abroad, it is critical that we work in the most effective manner with other agencies and with the science community. Our interagency colleagues – NOAA, Coast Guard, Navy, Interior, NASA to name a few off the top of my head – likewise have ambitious and extremely broad priorities, and it will be essential in view of budget stringency, for the agencies to work closely together to provide for the needs of the U.S. oceanographic community abroad.

As I noted, it is also important that we understand the priorities of and work effectively with the ocean science community. In fact, we hope that today's discussions might spawn new ideas for collaboration and interest in your community in utilizing the "tools" that the State Department has to offer in innovative ways to accomplish your research objectives. And, please know that even if ideas occur to you after the roundtable today, we are delighted to discuss them with you. In fact, my remarks say that we will be happy to discuss such ideas at all times, 365 days of the year, 24-7. That is a bit above and beyond the call of duty, but it shows the dedication of our marine science staff!!

International Science Functions at State

Let me begin by presenting some general information about science at the Department of State.

The Secretary of State has primary responsibility for the coordination and oversight of international science and technology activities of the U.S., which involves foreign countries, international organizations, and international commissions [22 USC 2656d(a)]. Indeed, the Department of State coordinates a wide variety of science and technology activities—activities that range from conducting programs to promote beneficial peacetime employment of former Soviet-bloc scientists (particularly nuclear scientists), to the processing of clearances for scientists traveling abroad, to the development and implementation of S&T agreements with other countries.

Our coordination work is conducted both internally (within the Department) and externally (between and among USG agencies). The Department also has a large number of officers serving at our missions and embassies abroad who are responsible for science and environmental issues.

Within the Department, the Science Advisor and the OES and Nonproliferation bureaus work closely with "regional" bureaus to make sure that science issues are carefully coordinated and integrated with our foreign policy initiatives.

In the interagency community, the Department of State also runs many interagency processes to coordinate the development of U.S. positions on various science topics for international negotiations and international meetings.

Interagency Coordination

First, in the broader international oceans policy arena, the Department plays an interagency coordinating role as Chair of the Subcommittee on Oceans Policy. This group, a subset of the Global Environment Policy Committee of the National Security Council, addresses oceans policy issues with international implications. A number of smaller groups, chaired by State or other agencies (depending on the issue) also meet to develop U.S. positions on particular issues, such as ballast water, whales, or the delimitation of the U.S. continental shelf where it extends beyond 200 miles from the shore (Bob Smith is present).

In addition, to stay abreast of pending issues and developments in the ocean sciences, the Department regularly participates in meetings of groups such as the National Oceanographic Partnership Program (NOPP), which plays a vital role in coordinating national oceanographic research and education programs. Maintaining close contact with other research groups such as the Ocean Studies Board and the Federal Oceanographic Facilities Committee is also a high priority. We hope to develop our contacts within other ocean science organizations like the Scientific Committee on Oceanographic Research (SCOR) and Ocean.US (ocean-dot-U.S.) in the coming year. Other suggestions of organizations with which we should develop contacts are also welcome—we look forward to broadening our understanding of the wide scope of oceanographic research.

Pushing Science Cooperation Bilaterally

First, working with other agencies, the Department leads diplomatic efforts to establish new science and technology agreements with other countries – under which science activities are conducted. (Dr. Neureiter may talk about this in further detail during his lunchtime presentation.)

Pushing the Science Policy Agenda in International Organizations

Second, we work to push forward the science policy agenda in various international science fora. For example:

- IOC/UNEP regular assessment of oceans – working with Iceland
- Establishment of a science structure in the WCPFC
- UNICPOLOS – The Department leads US involvement in the UN Open-ended Informal Consultative Process on Oceans and Law of the Sea – the body that advises the UNGA on activities under the law of the sea treaty. Under this process, the Department has carefully encouraged the promotion of U.S. science priorities – such as free and open data exchange and international adherence to the letter and spirit of Part XIII of the Law of the Sea Convention.
- The Department also recognizes that privately supported research can play a very essential role, and we encourage the international endorsement of projects such as the Census of Marine Life and the International Ocean Drilling Program in various international fora.

Management of Support for International Science-Related Organizations

The Department of State also actively manages U.S. participation and dues payments to a number of international ocean science organizations (IOC, ICES, PICES, fish commissions). This slide illustrates our annual payments to these organizations over the last few years.

While these numbers may seem small, let me say that they represent only our contribution to the administrative side of the organizations. The U.S. government writ large gives far more to many science organizations through contributions by technical agencies to specific science programs. As long as the U.S. scientific community recognizes value in these organizations, the Department will work to ensure continued support for them. For example, with regard to the Intergovernmental Oceanographic Commission, the Department is working closely with NOAA and NSF on ways to provide continued financial support to the IOC, as we re-enter UNESCO.

Department Services Provided Specifically to the Ocean Science Community

- *Vessel Clearances/Data Exchange*

As deemed necessary by international practice based on Part XIII of the Law of the Sea Convention, the Department of State manages the diplomatic correspondence that enables U.S.-flagged research vessels to gain access to foreign waters. (The U.S. recognizes their jurisdiction over scientific research within 200 nautical miles off the coast.) We process over 300 individual clearances for 130 cruises to over 200 coastal States annually. We hope to expedite this process in the upcoming year by upgrading our infrastructure and integrating our tables with the NSF *Oceanic* database. If you have further questions today about the vessels clearance process, see Roberta Barnes or Liz Tirpak.

In addition, the Department of State manages the transfer of data resulting from each research cruise in foreign EEZs. This obligatory data exchange is currently an independent process from other data submission recommendations of other scientific bodies. We would like to know whether you would be interested in integrating reporting requirements—understanding that this might be most effective upon development of metadata protocols, as are under development in ICES and PICES. We welcome comments to this point after my presentation or in the afternoon session.

- *The Embassy Network*

The Department has approximately 240 embassies and consulates worldwide that assist in the transmittal of clearance documentation and post-cruise data reports that must be sent to each clearance-granting coastal country. This embassy network is a tremendous resource for your international work. If you plan to conduct any work outside the U.S., contact our office, which in turn can put you in touch with the vast contacts maintained by our embassy staff.

I do need to point out that the Department recommends that all persons traveling abroad take note of the Travel Warnings and Consular Information Sheets available on the Department of State website.

- *Promoting Oceans Operations*

As oceanographic sampling technologies develop, the Department of State can assist in clearing the way for the efficient operation and deployment of these new instruments. For example, we worked quite hard in cooperation with Dr. Stan Wilson (he may be in the audience) of NOAA to ensure that the proposed 3000+ autonomous buoys of the Argo project and other similar operational oceanographic sampling tools were considered operational equipment rather than marine scientific and therefore were not subject to the marine science permitting regime of the Law of the Sea. Unfortunately all countries participating in the IOC do not yet agree with us.

To facilitate research efforts, it is necessary that the Department learn about issues and potential hurdles for the science community before it is too late. We look to your constant attention to these matters and hope you will alert us to issues as early as possible.

- *Stimulus for Collaboration*

The Department can also serve as a stimulus for additional collaborative research.
The White Water to Blue Water Initiative illustrates this role. In response to the growing need for integrated watershed and marine ecosystem management, the Department is organizing a meeting of governments, international organizations, financial institutions, non-governmental organizations (NGOs), universities, and corporations in the Wider-Caribbean area. The aim of the conference, to be held in the fall of 2003, is to improve national and regional cooperation and promote partnerships among and between these stakeholders to increase national capacity to manage watershed and coastal resources in an integrated manner. The initiative will address land-based sources of marine pollution (such as sewage and industrial discharges, agricultural run-off and pesticide use, heavy metals, oil and other persistent organic pollutants), sustainable tourism and fisheries, degradation of coastal zone habitat, and sustainable forestry practices. Though the focus will begin in the Wider Caribbean Region, we hope its methodologies and results will serve as a blueprint for Africa and the South Pacific to follow in future years. (The initiative was announced on September 2 in Johannesburg, South Africa, during the World Summit on Sustainable Development (WSSD).) For more information on this initiative, a summary including contact information is available at the documents table.

Another exciting Department initiative is the Global Information for Sustainable Development. The objective is to apply a new generation of earth observation data, state of the art GIS-linked technologies, and field-tested geographic knowledge to ongoing sustainable development problems in diverse target areas within Africa. This alliance is being done in collaboration with activities and funding by many partners both within and outside of the continent of Africa. The aim is to assist local, national, and international agency users working in Africa to better address long-term challenges such as disaster mitigation, natural resource management, trade, and poverty alleviation. The results and lessons-learned will demonstrate the value of international collaboration in using geographic information for a broad range of sustainable development challenges over the next decade. An information sheet on the GISD is also available at the documents table.

Future Roles of the Department of State on behalf of U.S. Oceans Initiatives

We believe that the Department of State can play a larger role for the ocean science community in the following ways:

- Addressing key geographic areas of concern for oceanographic initiatives (stimulating talks to initiate partnerships)
- Facilitating capacity building efforts
- Incorporating oceanographic initiatives in S&T meetings (Dr. Neureiter will address this in full in his presentation)
- Facilitating the exchange of personnel, equipment, etc.

The Diplomatic Role of Scientists

Finally, let me point out that the scientific community plays an important diplomatic role. The growing number of international programs in the oceanographic sciences has increased the world's exposure to U.S. expertise and leadership in the oceanographic sciences, and your maintenance of essential human networks abroad can mean the difference of having access to a region of interest, or not. The Department recognizes this trend and is interested in responding appropriately to your needs.

You have a unique role and in some ways, as scientists engaged in global/regional research, you are as much the U.S.'s front line as our Foreign Service Officers! You can be ambassadors for the U.S. by developing productive relationships with private and governmental scientists and scientific communities abroad. This role is particularly important as science-based issues increasingly become central to our foreign policy agenda.

Conclusion

I noted earlier in my talk that the Department of State has statutorily-created responsibilities for coordination and oversight of international science and technology activities. There is one, very important addition to that responsibility. Indeed it drives the purpose of our meeting here today:

Congress has found that "in the formulation, implementation, and evaluation of the technological aspects of United States foreign policy, the United States Government should seek out and consult with both public and private industrial, academic, and research institutions concerned with modern technology."

It is our desire to have today's meeting be the beginning of many future dialogs between our communities. The Department of State, home to diplomats and what some might affectionately call "policy wonks", recognizes the vital role that science plays in building trust and partnerships abroad. For this reason I have great desire that the Department keep its ears sharp and eyes open to the priorities of your community that are presented here today, and that we strive to assist you in your efforts in every way possible.

Thank you very much for your time and attention. At this time, I welcome any questions.

Transcript: Dr. Robert Weller

WOCE and CLIVAR: International Research on the Ocean and ClimateRobert Weller, Woods Hole Oceanographic Institution

(Outline presented on powerpoint slides. Illustrated slides appear at the end of the outline.)

Ocean research before the 1990's

- Largely expeditionary, short-term, regional
- Limited long-term capabilities; for example, a lack of the ability to sustain time series stations
- Naval applications driving much of the ongoing observing systems, such as XBTs (expendable bathythermographs)

1990 and beyond - global research

- World Ocean Circulation Experiment (WOCE) an international oceanographic experiment 1990-1998
- Tropical Ocean Global Atmosphere (TOGA) - an international ocean and atmosphere experiment in the ocean tropics, 1985-1995
- CLIVAR - an international experiment on global climate focused on the ocean and atmosphere, 1995 to 2010, extension to 2025

WOCE initiated consideration of the ocean as a global system

- *WOCE - global ocean research*
    - WOCE sought to quantify the global ocean circulation, the ocean's role in storing and transporting heat and freshwater, and the variability of the ocean.
    - WOCE fielded surface drifters and moored instrumentation, but its major effort was a global, one-time survey of the world oceans by ship.
- *WOCE global survey*
    - *CLIVAR*
        - A focus on identifying and understanding the major patterns of climate variability.
        - Explicit consideration of atmosphere and ocean, attention to the impacts on land, partnership with other WCRP programs to work on land.
        - Seeks to expand predictive capability, to evaluate and enhance models of climate change that include anthropogenic impacts

CLIVAR is organized around regional principal research areas with strong local participation
Because of its concern for increased predictability on land, CLIVAR has great relevancy for many nations

ENSO variability has global reach
ENSO variability is linked to drought, disease

CLIVAR plans for global, sustained observations, relatively sparse but brought together with remote sensing using models. All national contributions are important.

CLIVAR observations will be made in many country's EEZ's

International contributions as well as permissions

The ARGO floats are but one component

State Department will play a vital role for CLIVAR

- Clearances for expeditions
- Clearances for sustained observations in many nations' waters, including drifting floats, moored buoys
- Identifying national contacts - in government and science
- Capacity building - success will come from the participation of many nations
- Partnerships in sharing data
- Partnerships in using predictions and products
- Sustaining CLIVAR over 15 or more years requires sustaining national contacts and interests

1

WOCE and CLIVAR: International Research on the Ocean and Climate

Bob Weller
Woods Hole Oceanographic Institution
Woods Hole, MA
rweller@whoi.edu

2

Ocean research before the 1990's

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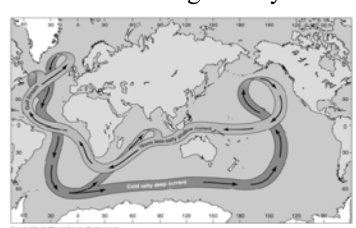
WOCE initiated consideration of the ocean as a global system



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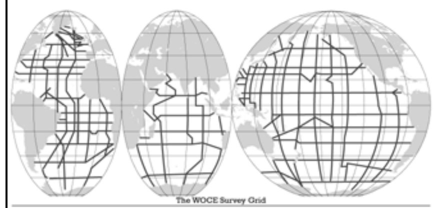
WOCE global survey



Hydrographic (temperature, salinity) and ocean chemistry sampled by lowering instruments and water samplers from ships

7

CLIVAR

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- Explicit consideration of atmosphere and ocean, attention to the impacts on land, partnership with other WCRP programs to work on land.
- Seeks to expand predictive capability, to evaluate and enhance models of climate change that include anthropogenic impacts

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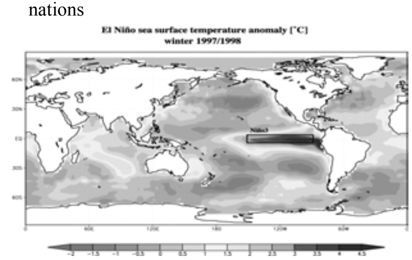

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ENSO variability has global reach

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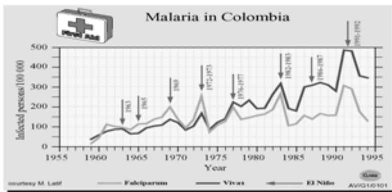

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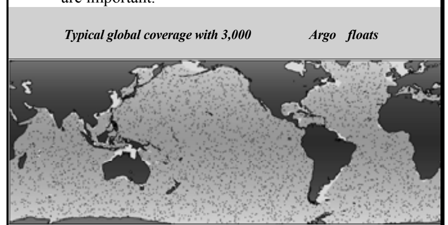

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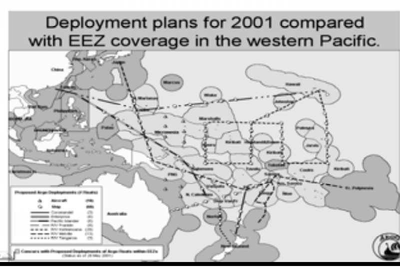

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- International contributions as well as permissions

International Commitments for Argo Floats.

Number of Floats by Country	Argo Funded FY99	Float Equiv's FY99	Argo Funded FY00	Float Equiv's FY00	Argo Funded FY01	Float Equiv's FY01	Proposed over next 3 years	Prop Float Equiv's over 3 yrs
Australia			10		10		90	
Canada			10		42		90	
China					10		80	
Denmark						5		30
European Commission					80			
France		8	70		65		200	
Germany				18		22	100	35
India					6		150	
Japan			20		90		300	
New Zealand					2		10	
Republic of Korea					20		90	
Spain							24	
United Kingdom			13		50	5	150	40
U.S.A.	55		132	51	150	40	825	60
TOTALS	55	8	255	69	525	72	2109	165
TOTALS BY YEAR	FY99 =	63	FY00 =	324	FY01 =	597	Ave/Yr =	758

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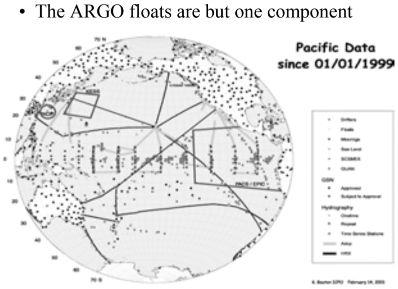
- The ARGO floats are but one component



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State Department will play a vital role for CLIVAR

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Transcript: Dr. Larry Atkinson

The U.S. National Integrated Ocean Observing System: A brief report to the Department of State roundtable on Perspectives on International Oceanographic Research

Larry P. Atkinson, Samuel and Fay Slover Professor of Oceanography, Old Dominion University

The creation of an Integrated Ocean Observing System for the United States is now underway. The goal is to create an operational ocean observing system to detect change in the ocean, both global and local. The system will meet seven general needs:

- Predict climate change
- Mitigate natural hazards
- Improve marine operations
- Improve national security
- Reduce public health risks
- Protect ecosystems
- Sustain marine resources

Simultaneously to providing information relevant to the above goals, research and education will provide needed new technology and techniques and the educated people to run the system and use the products from it.

Creating an IOOS is challenging because the ocean falls under the purview of many federal agencies. To meet this challenge the National Oceanographic Partnership Program (NOPP) was created. The National Ocean Research Leadership Council (NORLC) leads NOPP. The National Office for Sustained and Integrated Ocean Observations (Ocean.US) reports to the NORLC via a group of nine participating agency leaders. The important critical aspect of this organization is that plans developed by regional and global users can result in recommendations to the NORLC and subsequently may affect agency budgets.

What are the chances that a successful IOOS will be created? I think they are quite good. This is because there is a convergence of interest and capability including:

- Commission on Ocean Policy
- Ocean Caucus
- Consortium for Ocean Research and Education
- NOPP and Ocean.US
- NSF Ocean Observatories Initiative
- Recognized Needs
- Global Ocean Observing System
- Industrial Capability

The IOOS is consists of a data, information and communication component and two observing components. The global component primarily leads to climate change predictions. The coastal component consists of two sub-units: a national backbone and a federation of regional observing systems. The national backbone will provide information needed throughout the national coastal ocean. The regional observing systems will provide information specific to a region. For example, around port areas marine safety may be a priority while in other regions maintaining fisheries stocks may be high priority.

The international aspects of the IOOS can be divided into two areas: those related to the global system and those related to the national coastal system. The international conventions such as UNCLOS and organizations such as international GOOS and IOC are critical to provide international standards, ocean access and capacity building. The national coastal system will require close collaboration with Canada and Mexico primarily but also the Caribbean nations, Russia and the nations in the region of the Pacific Trust Territories.

The success of IOOS depends on close collaboration with all nations and these in particular. Additionally, success of IOOS depends on the following:

- Success of operational IOOS will require close international collaboration.
    - Enabling research
    - Operational coordination
- Anything but physical measurements are difficult (and most physical measurements are not that easy)
    - Research in all bio/geo/chemical areas are critical, are difficult and require international effort.
- We know little about the ocean. New measurements will reveal new process, questions, and issues.
    - The coastal and global connections cross political boundaries.
- Critical Issues
    - Security
    - Clearances
    - International Collaborations

The active participation of the Department of State bodes will for successful creation of the IOOS.

Transcript: Dr. John Orcutt

Ocean Observations Initiative, NSF MREFC
Chair, NSF/CORE Dynamics of Earth and Oceans Ecosystems (DEOS) Comm.
John A. Orcutt, Dean, Scripps Institution of Oceanography

(Outline presented on powerpoint slides. Illustrated slides appear at the end of the outline.)

What Will Ocean Observatories Look Like?

Three Components
Regional Scale
- Fiber optic cabled
- Substantial seafloor power/bandwidth

Coastal Observatories
- Fiber optic and mooring
- Significant bandwidth/power

Global Network - Moorings
- Long time series
- High bandwidth telemetry/seafloor power

Coastal Observatories
- Provide critical measurements
    - to observe episodic events and
    - secular change
- Improve the accuracy of regional coastal models and forecasts
- Assess the impact of anthropogenic inputs
  and geological/geophysical hazards in coastal environments
- Provide real-time, open data to, scientists, users and decision-makers on shore

Global Seismic Station Coverage
Global Network - Moorings
- Will collect long term, multi-disciplinary observations in remote areas
- Will include water column sensors for physical, biological and chemical studies.
- Will enhance understanding of oceans and underlying planet by increasing suite of observations from sea surface to ocean floor

Improve Climate Change Science and Technology
- Reduce climate change uncertainties by expanding understanding of heat transfer between ocean and atmosphere
- Increased data collection will allow for development of better models of carbon and hydrologic cycle
- Provide insights into turbulent mixing throughout the water column
- Only sustained point measurement can characterize the statistical variability of observables essential to global circulation models
- Measure secular change in ocean basin temperatures and depths using acoustic methods - Thermometry

Expeditionary Science - Long tradition in oceanography
- HMS Beagle, 1831-1836
- HMS Challenger, 1872-1876
- Formation of Office of Naval Research, 1946
- Formation of NSF in 1950 - Major investments in ships (28 US research vessels in UNOLS)

Observatory Strengths

- Only way to observe transients or changes
- Frequently low signal-to-noise ratios require long-term observations

Deep Ocean DEOS Buoy

- Global Thermometry Network
- Ocean Acoustic Thermometry
- Consistent with OMB/OSTP R&D Priorities
- Sustain and nurture America's science and technology enterprise
- Will dramatically expand the opportunities to investigate previously underexplored regions of the planet, including the polar regions
- Increase our understanding of the physical, biological, chemical and geophysical processes affecting the state of our ocean
- Provide observations on time-scales currently unavailable given traditional approaches to observing the
- oceans

Priorities

- Strengthen science, mathematics, and engineering education
    - Components include K-12 educational programs.
    - Graduate and undergraduate student focus in OOI components
    - OOI integrates input from teachers and students to ensure that education and outreach is an integral part of the system
- Long-term, potentially high-payoff activities requiring a federal presence
- Potential for profound payoffs in the areas of human health through the observation and discovery of new organisms living in extreme environments (bioprospecting)
- Coastal component will provide a greater understanding of water quality and its impact on human and ecological health
- Investigations into the water-column will increase our understanding of how Earth's climate behaves from the bottom of the oceans to the edge of the atmosphere
- Will be a permanent, scalable, national observatory system opening up new areas of oceanographic research for many years.
- Long-term measurements of deformation and seismicity will serve to mitigate potential coastal hazards including earthquakes, volcanoes, and tsunami
- Maximize efficiency and effectiveness through competitive, peer-reviewed processes
    - Developed from National Academies "Illuminating the Hidden Planet" Report
    - Approved by the National Science Board
    - Continually reviewed and overseen by independent DEOS Scientific Steering Committee
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    - Canadian Government has made funds available for NEPTUNE Canada project
    - OOI developed and lead by consortium of leading academic oceanographic research institutions
    - Coordinating with existing assets at NOAA, ONR and NASA

1

John A. Orcutt
Dean, Scripps Institution
of Oceanography

Ocean Observations Initiative
NSF MREFC
Chair, NSF/CORE DEOS Comm.

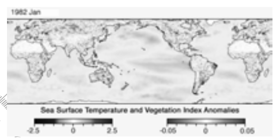
2

DEOS

Dynamics of Earth and Ocean Systems

3

82-83, 86-87, 91-94, 97-98



4

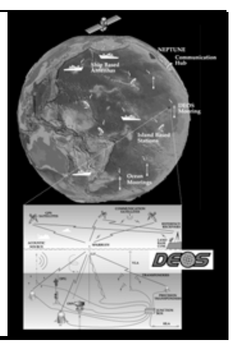
Significant Wave Height

QuickTime™ and a Photo decompressor are needed to see this picture.

5

Ocean
Observatory
Initiative

FY2004
Funding



6

How Will Ocean Observatories Serve Research Needs?

- Provide the research community with continuous observations of the oceans on seconds to decades time scales
- Enable measurements from millimeter to megameter spatial scales
- Provide real-time, open data to all potential users via the Internet.
- Utilize "plug-and-play", IP-based, modular sensors with duplex communications to allow flexible configuration of networks in response to transients
- Allow for sustained operations during adverse environmental conditions

7

What Will Ocean Observatories Look Like?

- Three Components
  - Regional Scale
    - Fiber optic cabled
    - Substantial seafloor power/bandwidth
  - Coastal Observatories
    - Fiber optic and mooring
    - Significant bandwidth/power
  - Global Network - Moorings
    - Long time series
    - High bandwidth telemetry/seafloor power

8

Coastal Observatories

- Provide critical measurements to observe episodic events and secular change
- Improve the accuracy of regional coastal models and forecasts
- Assess the impact of anthropogenic inputs and geological/geophysical hazards in coastal environments
- Provide real-time, open data to, scientists, users and decision-makers on shore

9

Tectonic plate scale

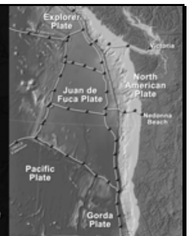
2000 miles of Fiber Optic Cable

Network of submarine laboratories

The Internet on the seafloor, 100kw of power and high bandwidth

Real-time data return and control, fleets of ROVs and AUVs

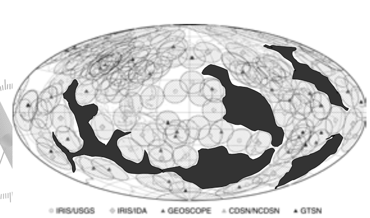
>30 year lifetime, adapable and expandable



NEPTUNE

10

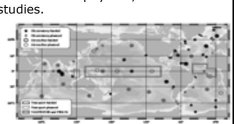
Global Seismic Station Coverage



11

Global Network - Moorings

- Will collect long term, multi-disciplinary observations in remote areas
- Will include water column sensors for physical, biological and chemical studies.
- Will enhance understanding of oceans and underlying planet by increas-ing suite of observations from sea surface to ocean floor



12

Opportunities and Challenges For Observatories and Systems

- **New approaches -> new discoveries**
- **Education, "Ocean Outreach"**
- **Monitoring episodic events at mid-ocean ridge**
- **Origin of life and limits to life-earth & beyond**
- **Biotechnological use of extremophiles**
- **Ocean circulation - in depth model testing**
- **Ocean productivity studies-primary,secondary**
- **Marine mammal & fish stock assessment**
- **Greenhouse gas cycling in ocean**
- **Resource formation and distribution**
- **Mantle circulation, structure, and change**
- **Hazard recognition and mitigation**

13

Improve Climate Change Science and Technology

- **Reduce climate change uncertainties by expanding understanding of heat transfer between ocean and atmosphere**
- **Increased data collection will allow for development of better models of carbon and hydrologic cycle**
- **Provide insights into turbulent mixing throughout the water column**
- **Only sustained point measurement can characterize the statistical variability of observables essential to global circulation models**
- **Measure secular change in ocean basin temperatures and depths using acoustic methods - Thermometry**

14

QuickTime™ and a Photo decompressor are needed to see this picture.

*See cover illustration for snapshot.

15

Expeditionary Science

16

Expeditionary Science

- Long tradition in oceanography
  - HMS Beagle, 1831-1836
  - HMS Challenger, 1872-1876
  - Formation of Office of Naval Research, 1946
    - Formation of NSF in 1950
- Major investments in ships
  - 28 US research vessels in UNOLS

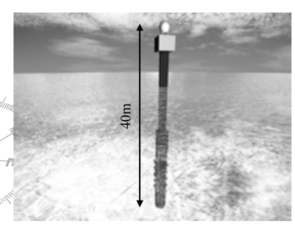
17

Observatory Strengths

- Only way to observe transients or changes
- Frequently low signal-to-noise ratios require long-term observations

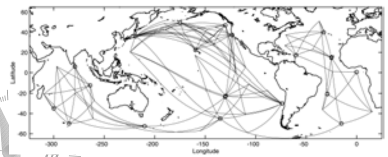
18

Deep Ocean DEOS Buoy



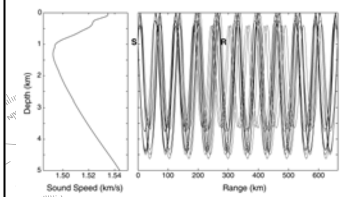
19

Global Thermometry Network



20

Ocean Acoustic Thermometry



21

Consistent with OMB/OSTP R&D Priorities

- *Sustain and nurture America's science and technology enterprise*
  - Will dramatically expand the opportunities to investigate previously underexplored regions of the planet, including the polar regions
  - Increase our understanding of the physical, biological, chemical and geophysical processes affecting the state of our ocean
  - Provide observations on time-scales currently unavailable given traditional approaches to observing the oceans

22

Priorities (cont.)

- *Strengthen science, mathematics, and engineering education*
  - Components include K-12 educational programs.
  - Graduate and undergraduate student focus in OOI components
  - OOI integrates input from teachers and students to ensure that education and outreach is an integral part of the system

23

Priorities (cont.)

- *Long-term, potentially high-payoff activities requiring a federal presence*
  - Potential for profound payoffs in the areas of human health through the observation and discovery of new organisms living in extreme environments (bioprospecting)
  - Coastal component will provide a greater understanding of water quality and its impact on human and ecological health
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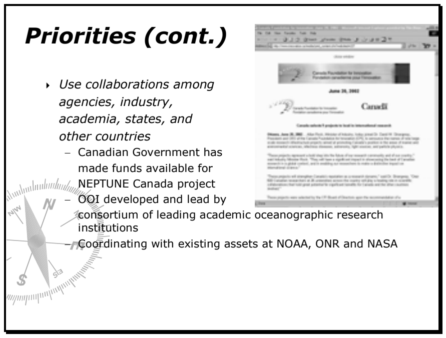
24

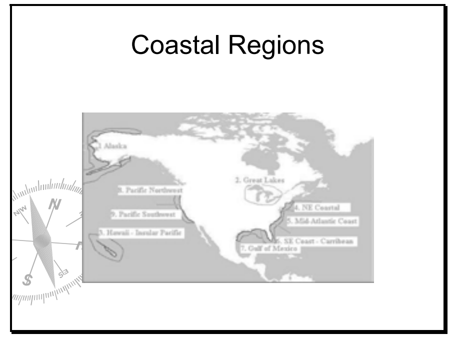
Priorities (cont.)

- *Maximize efficiency and effectiveness through competitive, peer-reviewed processes*
  - Developed from National Academies "Illuminating the Hidden Planet" Report
  - Approved by the National Science Board
  - Continually reviewed and overseen by independent DEOS Scientific Steering Committee

25


Priorities (cont.)
Use collaborations among agencies, industry, academia, states, and other countries
– Canadian Government has made funds available for NEPTUNE Canada project
– OOI developed and lead by consortium of leading academic oceanographic research institutions
– Coordinating with existing assets at NOAA, ONR and NASA
Canada

26


Coastal Regions
Alaska
2. Great Lakes
8. Pacific Northwest
9. Pacific Southwest
3. Hawaii - Insular Pacific
4. NE Coastal
5. Mid-Atlantic Coast
SE Coast - Carribean
7. Gulf of Mexico

List of Attendees

(asterisk denotes speaker)

First	Last	Affiliation	Phone
Larry	*Atkinson	Ocean.US - Old Dominion University	703-588-0846
Peter	*Brewer	Monterey Bay Aquarium Research Institute	831-775-1706
Ken	*Brink	Woods Hole Oceanographic Institution	508-289-2535
Montserrat	*Gorina-Ysern	American University/School of International Service	301-652-0506
Maggie	*Hayes	DOS/OES	202-647-3013
Jennifer	*Merrill	Ocean Studies Board	202-334-2985
Edward	*Miles	University of Washington	202-685-1837
Norman	*Neureiter	DOS/STAS	202-647-8725
John	*Orcutt	Scripps Institute of Oceanography	858-534-2887
Nancy	*Rabalais	Ocean Studies Board	504-851-2800
Lee	*Schwartz	DOS/INR	202-647-1988
Liz	*Tirpak	DOS/OES	202-647-0238
Ed	*Urban	ICSU/Scientific Committee on Oceanographic Research	410-516-4239
Mary Beth	*West	DOS/OES	202-647-2396
Mark	Abbott	Oregon State University	541-737-5195
Ray	Arnaudo	DOS/OES	202-647-3925
Conny	Arvis	DOS/OES	202-647-0234
Mary	Batteen	Naval Postgraduate School	831-656-2673
Johnathan	Berkson	U.S. Coast Guard	202-267-1457
Jerry	Boatman	Navy	228-688-5004
Steve	Bohlen	Joint Oceanographic Institutions	202-232-3900
Barry	Burgan	EPA	202-566-1242
Roberta	Chew	DOS/OES	202-647-3947
Andrew	Clark	Harris Corp./Marine Technology Society	321-674-4758
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Cynthia	Decker	Office of the Oceanographer of the Navy	202-762-0272
Jim	DeCorpo	DOS & Office of Naval Research	703-598-4096
Earl	Doyle	Ocean Studies Board	281-494-1037
Michael	Egan	DOS/INR	202-736-4720
Renee	Eppi	NOAA	301-713-2409
Melissa	Flagg	DOS/STAS	202-663-3241
Rocky	Geyer	Woods Hole Oceanographic Institution	508-289-2868
Morgan	Gopnik	Ocean Studies Board	202-334-2714
Paul	Gravel	Louisiana State University	202-434-8050
Sherri	Holiday	DOS/EAP/ANP	202-736-4683
Leonard	Johnson	University of Alaska	301-464-6724
Miriam	Kastner	Scripps Institute of Oceanography	858-534-2065
Theo	Kooij	Defense Advanced Research Project Agency	571-218-4323
Kathleen	Krane	NOAA	301-713-2158

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Cindy	Lee	Ocean Studies Board	631-632-8741
Ray	Lester	DOS/INR	202-647-3345
Bruce	Molnia	U.S. Geological Survey	703-648-4120
Ron	O'Dor	CORE/Census of Marine Life	202-448-1233
Paul	Pan	EPA	202-566-1229
Gina	Perovich	EPA	202-564-2248
Michael	Purdy	Lamont Doherty Earth Observatory	845-365-8348
Steve	Ramberg	Office of Naval Research	703-696-4358
Scott	Rayder	NOAA	202-482-3436
Jack	Rich	DOS/OES	202-736-4482
Ash	Roach	DOS/L-OES	202-647-1646
Robert	Senseney	DOS/STAS	202-663-3246
Noriko	Shoji	Senator Inouye's Office	202-224-1077
Stephen	Sielbeck	DOS/INR	202-776-8554
Robert	Smith	DOS/OES	202-647-5123
Richard	Spinrad	Office of the Oceanographer of the Navy	202-762-1697
Chuck	Trees	NASA	202-358-0310
Ken	Turgeon	U.S. Commission on Ocean Policy	202-418-3442
James	Watkins	U.S. Commission on Ocean Policy	202-418-3442
Robert	Weller	Woods Hole Oceanographic Institution	508-289-2508
Dick	West	Consortium for Oceanographic Research and Education	202-663-0013
Don	Wright	Virginia Institute of Marine Science	804-684-7103
James	Yoder	NSF	703-292-8580

List of Acronyms

Acronym	Full Name	Website (as of February 2003)
Argo	N/A	http://www-argo.ucsd.edu/
CLIVAR	Climate Variability and Predictability	http://www.clivar.org/
CoML	Census of Marine Life	http://www.coreocean.org/
DOS	Department of State	http://www.state.gov/
ENSO	El Nino/Southern Oscillation	http://www.ogp.noaa.gov/enso/
EU	European Union	http://europa.eu.int/index.htm
GEOHAB	Global Ecology and Oceanography of Harmful Algal Blooms	http://ioc.unesco.org/hab/GEOHAB.htm
GLOBEC	Global Ocean Ecosystem Dynamics	http://www.pml.ac.uk/globec/main.htm
GOOS	Global Ocean Observation System	http://ioc.unesco.org/goos/
ICES	International Council for the Exploration of the Sea	http://www.ices.dk/
INS	DOS-Bureau of Intelligence and Research	http://www.state.gov/s/inr/
IOC	Intergovernmental Oceanographic Commission	http://ioc.unesco.org/iocweb/default.htm
IODE	International Oceanographic Data and Information Exchange	http://ioc.unesco.org/iode/
JGOFS	Joint Global Ocean Flux Study	http://www.uib.no/jgofs/jgofs.html
MSR	Marine Science Research	N/A
NESDIS	National Environmental Satellite, Data and Information Service	http://www.nesdis.noaa.gov/
NOAA/PMEL	NOAA - Pacific Marine Environmental Laboratory	http://www.pmel.noaa.gov/
NOPP	National Oceanographic Partnership Program	http://www.coreocean.org/
NPOES	NOAA Polar-orbiting Operational Environmental Satellites	http://www.oso.noaa.gov/poes/
NSC	National Security Council	http://www.whitehouse.gov/nsc/index.html
Ocean.US	N/A	http://www.ocean.us.net
OCEANS	Ocean Biogeochemistry and Ecosystems Project	http://www.jhu.edu/~scor/obe.htm
ODP	Ocean Drilling Program	http://www.oceandrilling.org/
OSB	Ocean Studies Board	http://www.nationalacademies.org/osb
PICES	North Pacific Marine Science Organization	http://www.pices.int/
PIPICO	Panel for International Programs and Intergovernmental Cooperation in Ocean Affairs	Expired committee comprised of both academic and federal agency representatives, established by DOS as a mechanism to exchange marine science developments.
SCOR	Scientific Committee on Oceanographic Research	http://www.jhu.edu/~scor/index.htm
SOLAS	Surface Ocean - Lower Atmosphere Study	http://www.uea.ac.uk/env/solas/
TOGA	Tropical Ocean and Global Atmosphere	http://daac.gsfc.nasa.gov/CAMPAIGN_DOCS/TOGA/nasa_coare.html
UNESCO	United Nations Educational, Scientific and Cultural Organization	http://www.unesco.org/
USAID	U.S. Agency for International Development	http://www.usaid.gov/
WOCE	World Ocean Circulation Experiment	http://www.soc.soton.ac.uk/OTHERS/woceipo/ipo.html

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