The Physical Oceanography and Climate Committee: The first decade

Paul H. LeBlond
S42, C7, RR#2, Galiano Island, B.C., Canada V0N 1P0. E-mail: leblond@gulfislands.com

The birth of POC

International scientific organizations have a long gestation period; they are eventually carried to a successful birth by repeated emphasis on the need for their existence. Discussions leading to the creation of PICES lasted over fifteen years (W. S. Wooster, PICES Press 1(1), 1992). Before the first formal PICES Annual Meeting, before the Convention for a North Pacific Marine Science Organization entered into force on March 24, 1992, a Scientific Workshop was convened in Seattle at the invitation of the United States (December 11-13, 1991). The purpose of the workshop was to review the state of knowledge, to identify gaps and priorities, and to consider where joint action under the new PICES convention would be most appropriate.

Four topics were selected for discussion at the workshop: climate change, the Bering Sea, environmental quality and fisheries oceanography. It is easy to recognize in these topics, with some modification, the origin of the four Scientific Committees of PICES. The issues debated by the Climate Change working group are clearly reflected in future concerns of the Physical Oceanography and Climate Committee (POC). The principal scientific question identified then was "to obtain a description of the climate change in such a way that the processes involved in climate change can be understood". Participants emphasized the need for easier and freer data exchange among North Pacific Rim countries, and also concluded that the "present exchange of ideas is not adequate". Participants also stressed the need for joint investigations and collaboration within existing international programs (*e.g.*, WOCE, JGOFS).

The existing Scientific Committees of PICES (BIO, FIS, MEQ, POC) emerged from the workshop discussion groups and were first provisionally established at the organizational meetings in March 1992, and confirmed as permanent committees at PICES II, in October 1993. In the words of our first Chairman: "These committees are more disciplinary-oriented than the discussion topics were, and reflected the experience of ICES which had found that committees centered on specific disciplines provided a home for specialists in those disciplines. The trick then was to get the committees to work together on interdisciplinary topics of common interest, leading to joint sessions and symposia. This is certainly the current practice in PICES. " (W. Wooster, priv. com. June 12, 2001).

It did not take long for POC to begin its work in earnest. At the First Annual Meeting (PICES I, Victoria, October 1992), Dr. Yutaka Nagata (Japan) was elected Chairman of the Committee. That meeting set the tone for POC's work in the years to come: an open and friendly forum, where ideas were welcome and seriously debated, and where exploration and understanding of the ocean was always the primary goal. Members agreed that one of POC's most important roles should be to facilitate collaboration in international scientific programs. They also identified four important topics to be addressed through the formation of Working Groups: ocean circulation and climate variability in the Subarctic Pacific; the Okhotsk Sea and the Oyashio Region; new technologies and observing strategies; and data collection and quality control. These topics have provided the main focus for POC's deliberations over the years.

Circulation of the North Pacific

Understanding the circulation of North Pacific waters as well as the nature of its variability is clearly a theme of common interest and great importance to all PICES members. At the very first PICES Annual Meeting, the Science Board created an interdisciplinary, inter-committee Working Group (WG 6) on the Subarctic Gyre, with the task of reviewing current description and understanding of ocean circulation and climate

variability in the subarctic North Pacific, identifying gaps, reviewing information on the biomass of major trophic levels - with special reference to carrying capacity for salmon - as well as reviewing the state of understanding of processes affecting primary and secondary production. Quite a task!

In addition, WG 6 was to identify key scientific questions and propose collaborative programs to advance knowledge and test major hypotheses. As much of the above was also the realm of interest of the international GLOBEC program, the Working Group was to advise which PICES and GLOBEC objectives could be linked.

The work of WG 6 gave rise to a variety of questions about the functioning of the subarctic Pacific ecosystem. It stimulated further interest on the part of POC, which convened a scientific session on "Ocean circulation and climate variability" at PICES II and launched a Working Group (WG 7) on Modelling of the subarctic North Pacific circulation at the same meeting. WG 7 was to review the state of the art in physical modelling, identify gaps as well as the kind of information required to improve circulation models. This Working Group, co-chaired by Drs. Paul LeBlond (Canada) and Masahiro Endoh (Japan), brought together leading ocean modelers in meetings in Vancouver (June 1994) and at PICES III in Nemuro (October 1994). A final report was presented to POC at PICES IV in 1995, and published as PICES Scientific Report No. 5.

A number of conclusions and recommendations were made by WG 7 to improve the results of numerical modeling. The unavailability of high resolution bathymetric data, especially in strategically sensitive coastal areas, was found to be a limitation on the accuracy of coastal circulation models. More comprehensive ocean property atlases were felt to be needed and better quality and availability of meteorological information was deemed crucial to ocean modeling. The Working Group also expressed strong support for satellite-based ocean observing missions. Workshops on modeling, to familiarize the PICES community with model results and their limitations as well as the improvement of visualization techniques, were strongly advocated. This latter suggestion was eventually implemented by the PICES Technical Committee on Data Exchange (TCODE) through a Workshop on Data Visualization at PICES VIII in Vladivostok.

Modeling of the North Pacific circulation has remained a central concern of POC over the years. PICES scientists were invited to present their results in scientific sessions on "Physical processes and modeling of the subarctic North Pacific and its marginal seas" at PICES III (Nemuro, 1994) and on "Modeling and prediction of physical processes in the subarctic North Pacific: Progress since 1994" at PICES VIII (Vladivostok, 1999). Members of POC interested in ocean modeling have also played an important role in the MODEL Task Team of the Climate Change and Carrying Capacity (CCCC) Program. Given the ever growing importance of numerical models in exploring and describing ocean circulation as well as their emerging operational role in marine forecasting, POC is likely to continue to be keenly interested in ocean modeling.

Okhotsk Sea and Oyashio

At PICES I, the Science Board gave its blessing to a POC Working Group (WG 1) on the Okhotsk Sea and the Oyashio, an area of great oceanographic importance which would also hold POC's interest for a number years. WG 1 was to review the present level of knowledge of the oceanic circulation and water mass modification in the area of interest, identify gaps, review studies relating chemical, biological and geological regimes, and encourage planning of observations and interdisciplinary experiments. The group, under the chairmanship of Dr. Lynne D. Talley (U.S.A.), met in Nemuro, Japan, in September 1993, and prepared an extensive review (published as PICES Scientific Report No. 2: The Okhotsk Sea and Oyashio Region), identifying deficiencies in current understanding and recommending studies which would address these weaknesses. WG 1 also recommended that a follow-up meeting be held in Russia so as to fully engage Russian experts.

At its following meeting (PICES II, Seattle, 1993) POC devoted half its session to reviewing and

discussing WG 1's report, which it enthusiastically endorsed. POC supported the Working Group's recommendation that a follow-up meeting be held in Vladivostok, so that more extensive Russian contributions could be incorporated in the review of the Sea of Okhotsk and Kuril region.

Subsequently, an extensive workshop was held in Vladivostok (June 19-24, 1995), under the co-chairmanship of Vyacheslav B. Lobanov (Russia), Yutaka Nagata and Lynne D.Talley; 97 papers were presented on all aspects of ocean sciences in the area of interest. Workshop participants reviewed oceanographic and fisheries information and discussed data exchange (to be improved) and possible joint investigations (to be encouraged). Proceedings of the Vladivostok workshop on the Okhotsk Sea and adjacent areas were published as PICES Scientific Report No. 6. POC agreed that PICES should maintain a continuing interest in the region and suggested that another workshop be held a few years hence to assess progress.

A second Okhotsk Sea workshop was held in Nemuro, in the fall of 1998, under the direction of the same three convenors. Participants focused on recent advances in the physical oceanography of the Sea of Okhotsk, discussed research activities of mutual interest, and recommended that PICES endorse and support international cooperative projects in the Sea of Okhotsk, the Kuril Islands region and the Western Pacific Gyre. Proceedings of the Nemuro workshop are available as PICES Scientific Report No. 12.

One of the recommendations of the first Vladivostok workshop was that PICES prepare a multilingual nomenclature of geographical and oceanographic features of the Sea of Okhotsk and its surroundings, so as to ensure clarity and eliminate ambiguity in reporting place names. The nomenclature, establishing correspondences between names of land and marine features in Russian, Japanese and English, was completed in 1998 and published jointly by PICES (PICES Scientific Report No. 8) and the Marine Information Research Center of Japan (MIRC).

Japan/East Sea

Another marginal sea of great interest**,** especially to western Pacific PICES members, is the Sea of Japan or East Sea (as it is called in Korea). A Working Group on the Circulation and ventilation of the Japan/East Sea (WG 10) was created at PICES IV (Qingdao, 1995), with Co-Chairmen Drs. Sang-Kyung Byun (Korea) and Christopher N. K. Mooers (U.S.A.). Terms of reference were very similar to those assigned to the Okhotsk Sea Working Group (WG 1), however with a different geographical focus and a stronger emphasis on physical oceanography. Members of the Working Group met in Fukuoka, Japan, in February 1997, and again just before the PICES VI in Pusan (October 1997), where POC devoted a special scientific session to papers on the Japan/East Sea.

Among its findings, WG 10 noted that the level of regional scientific communication and cooperation was excellent, but that scientific access by researchers to the EEZs of the surrounding countries remained "the greatest limitation to international cooperative studies". A strong recommendation to PICES was that it should foster and encourage international scientific programs in the area, helping smooth the path to data exchange and access to EEZs.

WG 10 also provided a valuable forum for joint studies of the Japan/East Sea through support of, and collaboration with, the CREAMS program (Circulation Research of East Asian Marginal Seas). A CREAMS workshop, held jointly with PICES at PICES VII (Fairbanks, 1998), extended the discussion beyond the traditional physical oceanography core of CREAMS to include ecosystem studies. Follow-up workshops, in Seoul, in April 1998, and in Vladivostok, in May 2000, have contributed to strenghtening the PICES-CREAMS collaboration. In the wake of these discussions, the October-November 2000 "PICES Cruise" of R/V *Professor Gagarinskiy*, so called because it took Russian scientists from Vladivostok to PICES IX in Hakodate, made multidisciplary observations towards a comprehensive study of the ecosystem structure of the northern Japan/East Sea.

An extensive annotated bibliography of the oceanography of the Japan/East Sea prepared by Dr. Mikhail A. Danchenkov (Russia) was published as PICES Scientific Report No. 13. POC has continued to emphasize its support for the CREAMS and Japan/East Sea Office of Naval Research (U.S.A.) program as a working example of effective international collaboration. Additional workshops jointly sponsored by PICES are planned.

The Bering Sea

At PICES I, the Science Board created an interdisciplinary Working Group (WG 5) on the Bering Sea, with the mandate to review knowledge of the circulation, ocean properties and their variability, and the ecosystem and its response to environmental variability. Although POC was not formally responsible for WG 5, it took a keen interest in its progress and supported its work. POC also supported the efforts of NOAA to bring together the Bering Sea Ecosystem Biophysical Metadatabase.

CO_2 in the North Pacific

The North Pacific is recognized as an important sink for atmospheric CO_2 in the ocean, and plays an important role in controlling long-term climate change. POC turned in earnest to the "Climate" part of its mandate and, jointly with the Biological Oceanography Committee (BIO), recommended at PICES VI (Pusan, 1997) the creation of a Working Group on CO_2 in the North Pacific. This Working Group (WG 13), under co-chairmanship of Drs. Yukihiro Nojiri (Japan) and Richard A. Feely (U.S.A.), first met at a two-day workshop at PICES VII (Fairbanks, 1998), where members reviewed the state of knowledge of air-sea CO_2 exchange and the mechanisms controlling it, and planned their future work.

Among the first priorities identified was the need to carry out comparisons of measurement techniques between various laboratories, in order to establish quantitative standards in estimating dissolved inorganic carbon, total alkalinity and $^{13}C/^{12}C$ of inorganic carbon in sea water. A first PICES-sponsored intercomparison (technical workshop) brought together participants in Tsukuba (April 1999); a second exercise focused on improving the quality of alkalinity measurements and led to a second meeting, also in Tsukuba (October 2000). A joint BIO/POC scientific session at PICES IX (Hakodate, 2000) gathered physicists, chemists and biologists, on the topic of "North Pacific carbon cycling and ecosystem dynamics".

Having addressed measurement standards, WG 13 turned its attention to the task of data integration and synthesis, a topic first explored at a workshop held jointly with the PICES Technical Committee on Data Exchange (TCODE) in Sidney, B.C., Canada, in January 2001. Workshop participants recommended (among other things) that PICES work together with international data centers to compile an International North Pacific Data Inventory for CO_2 and CO_2-related data (Dickson 2001). A follow-up workshop, again co-sponsored by WG 13 and TCODE, was held in Tokyo on July 31-August 2, 2001, to discuss the implementation of the data integration proposals made at the Sidney workshop.

Oceanographic processes

Most scientific sessions sponsored by POC, as well as those held under joint sponsorship with the Science Board and other scientific committees, focused on themes already selected for the attention of Working Groups. For example, the "Ocean circulation and climate variability in the subarctic Pacific" theme of PICES II and the "Physical processes and modeling of the subarctic North Pacific and its marginal seas" theme of PICES III supported the activities of WG 6 and WG 7. The theme of circulation and its variability was addressed again at the PICES IX session on "Large-scale circulation in the North Pacific". The important modeling theme was also returned to at PICES VIII, where a session was devoted to "Modeling and prediction of physical processes in the subarctic North Pacific: Progress since 1994".

Connections between ocean variability and climate change was the focus of PICES IV scientific presentations on "Circulation in the subarctic North Pacific and its marginal seas and its impact on climate" and PICES VII, with papers addressing "Decadal variability of the North

Pacific climate". A joint session with BIO at PICES IX on "North Pacific carbon cycling and ecosystem dynamics" supported the work of WG 13. Closer inter-disciplinary presentations were planned for PICES X with topic sessions on "Coastal ocean physical processes responsible for biological productivity and biological resource distribution" and on "The physics and biology of eddies, meanders and rings in the PICES region" (jointly with BIO and FIS).

In some cases, scientific papers were solicited on more specific themes. For example, presentations on "Exchanges between continental shelf waters and the nearby ocean" of PICES V addressed coastal processes which were further explored in PICES VI in a session devoted to the "Circulation and ventilation of North Pacific marginal and semi-enclosed seas", which also supported the work of WG 10.

Input to inter-disciplinary programs

A number of Working Groups, special committees and Task Teams created by PICES have also attracted the interest and participation of the Physical Oceanography and Climate Committee. POC was a strong supporter of the creation of WG 9 on Monitoring of the Subarctic Pacific, and kept itself appraised of its progress. POC has supported and encouraged the work of TCODE. POC members have also been influential participants in the development of the CCCC Program and especially of its MODEL and MONITOR Task Teams.

Other concerns

While the work of POC is most clearly manifested through the activities of its Working Groups and the selection of topics for scientific sessions at PICES Annual Meetings, a number of other issues have repeatedly been raised at POC meetings, some of them with specific impacts on PICES business.

As in many inter-governmental organizations, there is a tendency for PICES meetings to be dominated by scientists working for government agencies. Early on, POC advocated increased participation by non-government researchers, particularly from universities, who have much to offer in ocean sciences. POC also strongly supported initiatives to increase participation by younger scientists in PICES meetings.

Research funding is often preferentially directed towards new ideas, sometimes at the detriment of long-term monitoring programs. POC emphasized the importance of maintaining a balance between routine monitoring and directed observational programs in support of specific scientific objectives.

At one of its early meetings, POC advocated the idea of "State-of-the-Ocean" reports, describing conditions in various parts of the subarctic North Pacific. Thanks to official encouragement and the enthusiasm of a few volunteers, the idea germinated into the regional overviews now regularly appearing in PICES Press.

As a means of handling the many requests for special publications or translations put to them by scientists from member countries, POC and other committees suggested the creation of a Publications Committee, which has since developed procedures to consider such issues.

Every year, POC has re-affirmed the need for international collaboration in ocean studies, and the role which PICES, as a treaty organization, can play in facilitating exchanges and access to national EEZs for scientific investigations. The support of CREAMS, mentioned earlier, and recommendations for continuation of the La Perouse/Soya Project implemented by Russian and Japanese laboratories, are examples of the positive role which PICES can play.

New technologies

Technological improvements play an important role in ocean exploration. From its very beginning, POC has recognized the importance of new technologies and observing strategies, as well as data collection and management, for the progress of oceanographic studies. POC recommended to PICES a closer collaboration with CLIVAR and GOOS programs.

At its meetings in 1998, 1999 and 2000, POC emphasized and endorsed a closer collaboration of PICES member countries to develop and implement the Argo program and co-sponsored an Argo meeting in Sidney, B.C., Canada, in March 2001.

POC also initiated contacts with NEAR-GOOS (the North East Asian Regional component of the Global Ocean Observing System) project, under development by the Intergovernmental Oceanographic Commission (IOC/WESTPAC) for the Japan, East China Sea and Yellow Sea area. As a result, a closer cooperation has developed between PICES and NEAR-GOOS in the form of an exchange of expertise in developing international observing systems and a multidisciplinary ecosystem approach to ocean studies. PICES experts and representatives attended the NEAR-GOOS meetings in September 1999 and August 2001. Conversely, NEAR-GOOS representatives attended the PICES Annual Meetings in Vladivostok (1999) and Hakodate (2000).

A continuing role for POC

In the formative decade of PICES, the Physical Oceanography and Climate Committee has acted as a focus for scientific discussions of the oceanography of the subarctic North Pacific and its marginal seas; it has brought together in friendly and mutually beneficial collaboration scientists from member countries; and it has actively enhanced participation of physical oceanographers and climatologists in interdisciplinary programs.

As PICES refines its purpose of advancing "scientific knowledge about the ocean environment, global weather and climate change, living resources and their ecosystems, and the impact of human activities", the Physical Oceanography and Climate Committee will continue to be a preferred forum for exchange of ideas and information on issues of common interest to signatories.

Marine issues facing PICES members are both local and basin-scale. Local issues, while affected by local circumstances, have a great degree of commonality: coastal management, pollution, aquaculture, marine tourism, near-shore fisheries. Within the next decade, one should expect significant advances in operational modeling of the coastal environment. Ocean scientists and engineers from PICES member countries will strongly benefit from the exchange of ideas and technology on this issue. POC could play a useful role in creating a Working Group which would review the state of the art and the practical prospects of marine operational modeling.

Basin-scale issues such as climate change and regime shifts affect all parties. Characterization, recognition and eventually prediction of oceanic regime shifts is the central problem in understanding the long-term variability of the North Pacific. POC can continue to provide leadership by focusing the efforts of PICES scientists on this issue.

An understanding of the physics of the ocean and of its interaction with the atmosphere is an essential and basic component of all these issues. This is where POC comes in. POC members will continue to explore and suggest means of collaboration to enhance and accelerate understanding of ocean circulation properties and interactions with the atmosphere. Combining focused topic sessions, Working Groups with well-defined mandates, and interdisciplinary tasks (within the Climate Change and Carrying Capacity Program, for example) has provided an attractive and fruitful formula to engage physical oceanographers, modelers and climate scientists.

Acknowledgements

Information for this review was gathered from the Annual Reports of PICES as well as from issues of PICES Press. I wish to thank the Secretariat for providing additional documentation. Thanks also to Drs. Yutaka Nagata and Vyacheslav B. Lobanov, respectively first and third Chairmen of POC, for their input and comments.