

REPORT OF PHYSICAL OCEANOGRAPHY AND CLIMATE COMMITTEE

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The meeting of the Physical Oceanography and Climate Committee was held from 1330-1730 hours on October 22, 2000, and from 0900-1230 on October 25, 2000. The Chairman, Dr. Vyacheslav B. Lobanov, called the meeting to order and welcomed the participants (*POC Endnote 1*). Dr. Susan E. Allen served as rapporteur. The Committee reviewed the agenda and it was adopted as presented (*POC Endnote 2*).

Business arising from PICES VIII (Agenda Item 3)

Dr. Lobanov reported on the status of decisions taken at PICES VIII in 1999. An annotated Bibliography of the Oceanography of the Japan/East Sea has been published as the PICES Scientific Report No. 13. PICES co-sponsored the CREAMS-2000 Workshop on Oceanography of the East Asian Marginal Seas held May 15-17, in Vladivostok. Proceedings of the Workshop are currently under editorial preparation for publication. The North Pacific CO₂ Data Synthesis Symposium, co-sponsored by PICES and JST/CREST, and a joint WG 13/TCODE/JGOFS-NPTT meeting were organized in Tsukuba, Japan, just prior to the PICES Ninth Annual Meeting. The POC Topic Session on “Large-scale circulation in the North Pacific” and the joint with BIO Topic Session (co-sponsored by JGOFS) on “North Pacific carbon cycling and ecosystem dynamics” were convened at PICES IX. Communication with Argo and CLIVAR projects had begun and contacts with NEAR-GOOS continued. This resulted in an invitation for PICES experts to attend a joint NEAR-GOOS Ocean Dynamic and Climate Forecasting Workshop to be held in August 2001, in Seoul, Korea (in conjunction with the Fifth IOC/WESTPAC Scientific Symposium) and in recommendation to organize a joint PICES/CLIVAR Workshop immediately prior to PICES X, in October 2001.

Sessions and themes at future Annual Meetings (Agenda Item 10)

POC Topic Session at PICES X: POC recommended convening a ½-day session on “Coastal ocean physical processes responsible for biological productivity and biological resource distribution” (*POC Endnote 3*).

Joint sessions at PICES X: POC recommended convening a full day topic session jointly with BIO and FIS on “The physics and biology of eddies, meanders and rings in the PICES region” (*POC Endnote 4*). POC also accepted a joint session with MEQ and BIO on “Physical, chemical and biological interactions during harmful algae blooms” (see MEQ Report for description).

Science Board Symposium at PICES X: “Ecosystem Processes in Marginal Seas of the North Pacific” was proposed as a topic for the Science Board Symposium.

Annual Meeting Theme at PICES XI: “Technological advances in marine scientific research” was supported as a theme for the PICES Eleventh Annual Meeting, in 2002.

New Working Groups/Advisory Panels (Agenda Item 9)

The Working Group 13 on CO₂ in the North Pacific will complete its activity in 2001 and prepare a final report for publication in 2002. No new working groups were proposed for 2001, but the following suggestions were discussed for 2002:

- a. WG on North Pacific biogeochemical data integration and synthesis;
- b. WG on Coastal ocean physical processes responsible for biological productivity and biological resources distribution;

- c. WG on Mesoscale water dynamics and its implication to biological processes.

These proposals will be considered further by correspondence and at the PICES Tenth Annual Meeting.

Proposals with financial implications (Agenda Item 5)

Inter-sessional meetings: POC recommended that the following inter-sessional meetings be convened:

- a. A 3-day WG 13/TCODE CO₂ Data Integration Test Workshop, January 2001, Sidney, B.C., Canada;
- b. A 3-day WG 13/TCODE CO₂ Data Integration Implementation Workshop, May 2001, Tokyo, Japan;
- c. A joint (with CREAMS, ONR or other) Japan/East Sea Ecosystem Workshop, spring, 2002.

Requests for travel funding:

- a. 3 experts to attend the WG 13/TCODE CO₂ Data Integration Test Workshop, January 2001, Sidney, B.C., Canada;
- b. 2 experts to attend the WG 13/TCODE CO₂ Data Integration Implementation Workshop, May 2001, Tokyo, Japan;
- c. 1 scientist to attend the Fifth IOC/WESTPAC Scientific Symposium, August 2001, Seoul, Korea;
- d. 1 scientist to attend the 3rd International Argo Science Team meeting, March 2001, Sidney, B.C., Canada;
- e. 2 experts to attend the NEAR-GOOS/ ODC Forecasting Workshop, August 2001, Seoul, Korea, (proposal from MONITOR Task Team supported by POC).

Relations with other organizations and programs (Agenda Item 8)

POC revised the list of organizations and programs for collaboration and agreed to add PORSEC (Pacific Ocean Remote Sensing Conference) and SOLAS (Surface Ocean Lower Atmosphere Study). CLIVAR, Argo,

CREAMS, JGOFS, WESTPAC, GOOS, GCOS and NEAR-GOOS were identified as the highest priority program for cooperation. It was also suggested to support implementation of Argo program in the North Pacific (Dr. Kuh Kim) and to advise PICES community attending the Fifth IOC/WESTPAC Scientific Symposium to be held in Seoul, in August 2001 (Dr. Sang Kyung Byun). POC will pass these recommendations to the Science Board.

Best Presentation Award (Agenda Item 11)

The nominee received most votes for the POC Best Presentation Award is Dr. Anatoliy Salyuk (Russia) for his paper entitled "Exchange of deep and bottom water in the Kurile Basin, Sea of Okhotsk, with Pacific".

POC Strategic Plan (Agenda Item 4)

No modification was proposed.

Progress Report from WG 13 on CO₂ in the North Pacific (Agenda Item 6)

Dr. Yukihiko Nojiri, Co-Chairman of the WG 13 on CO₂ in the North Pacific, reported on the WG activity since last PICES Annual Meeting and future plans (*POC Endnote 5*). POC accepted the WG 13 progress report and approved the recommendations.

Science Board items (Agenda Item 7)

High priority scientific projects

POC reviewed the proposed PICES high priority scientific projects and discussed its role in their implementation.

POC supported in general the development of a North Pacific Ecosystem Status Report and requested clarification on what kind of center should be organized to implement the project and what resources are required. After a presentation by Dr. Sonia Batten, POC agreed to support an International Zooplankton Monitoring Program for the North Pacific and recommended to include more physical

parameters in the monitoring and to involve physical oceanographers in data analysis and interpretation process. POC requested more information on need for a workshop series on “Effect of human and climate interactions on fish production”. In addition to these three projects, POC suggests to the Science Board to

consider a pilot project on “The Japan/East Sea Ecosystem Study” as one of PICES high priority scientific projects.

PICES Wooster Award:

POC supported this proposal with modification that the Award need not be given every year.

POC Endnote 1

Participation List

Canada

Susan Allen (rappourter)

Japan

Yasuhiro Sugimori
Nobuo Suginoara
Takeshi Uji

People’s Republic of China

Republic of Korea

Kuh Kim
Sang Kyung Byun

Russian Federation

Sergey Gladyshev
Vyacheslav Lobanov (Chairman)

U.S.A.

Observers

Sonia Batten (UK)
Robin Brown (Canada)
William Crawford (Canada)
Albert Hermann (U.S.A.)
Gennady Kantakov (Russia)
Victor Kuzin (Russia)
Yutaka Nagata (Japan)
Nikolay Naumenko (Russia)
Yukihiro Nojiri (WG 13 Co-Chairman)
Vladimir Pischalnik (Russia)
Nikolay Rykov (Russia)
George Shevchenko (Russia)
Bruce Taft (U.S.A.)
Sergey Tarasyuk (Russia)
Max Taylor (Canada)
Takashi Yoshida (Japan)
Yuriy Zuenko (Russia)
Vldimir Zvalinskiy (Russia)

POC Endnote 2

Agenda

1. Opening remarks and introduction.
2. Approval/modification of the agenda.
3. Business arising from PICES VIII (Vladivostok, 1999).
4. POC Strategic Plan: accomplishments and changes.
5. Proposals for 2001 with financial implications (inter-sessional meetings, travel support, publications).
6. WG 13 progress report.
7. PICES high priority scientific projects and role of POC in their implementation.
8. Relations with other international scientific organizations/programs.
9. Proposals for new working groups.
10. PICES X and PICES XI Annual Meetings: topic sessions and meeting themes.
11. Other items.
12. Draft of report and summary of POC recommendations to Science Board.

POC Endnote 3

PICES X POC Topic Session

Coastal ocean physical processes responsible for biological productivity and biological resource distribution. Convenors: Susan E. Allen (Canada) and Yuri I. Zuenko (Russia).

Of the many physical processes occurring in the coastal ocean some have disproportionately strong effects on biological processes. This session invites papers that present new results on coastal physical processes that determine: (1)

nutrient concentrations in the euphotic zone, (2) spatiotemporal variability in water stability and mixing layer depth, (3) retention, advection, aggregation or dispersal of plankton, fish and other marine organisms or (4) regulation of predator-prey interactions. Interdisciplinary papers are encouraged but purely physical papers with clear biological applications are also sought.

POC Endnote 4

PICES X POC/BIO/FIS Topic Session

The physics and biology of eddies, meanders and rings in the PICES region. Convenors: William R. Crawford (Canada), Jeffrey J. Polovina (U.S.A.) and Takashige Sugimoto (Japan).

Mesoscale processes in North Pacific, such as eddies, meanders and rings, have been examined in the past decade to determine the physical dynamics contributing to their formation, motion and decay, but the biological implications of these features are uncertain. In many cases, repeated oceanographic cruises, and satellite observations have enabled the tracking of individual eddies and meanders as well as the

passive and active association of some species with these features. This session explores the important physical and biological processes of eddies, meanders and rings in the PICES region, and considers how they may affect production of local biota and fisheries.

Selected papers from this session (oral and posters) will be published in a special issue of *Journal of Oceanography*. Authors desiring to be included in the publication should bring completed manuscripts to the Annual Meeting in Victoria. If review and final revision can be completed by March 1, 2002, publication might be scheduled before PICES XI, in October 2002.

POC Endnote 5

Progress report and recommendations of WG 13 on CO₂ in the North Pacific

The joint meeting of WG 13 on CO₂ in the North Pacific with TCODE and JGOFS NPTT (North Pacific Task Team) was held October 20-21, 2000, in the Epochal Tsukuba Congress Center, Tsukuba, Japan, immediately after the North Pacific CO₂ Data Synthesis Symposium. A brief summary of the symposium appears as *WG 13 Annex 1*.

The meeting was attended by representatives from Canada, Japan, Korea, Russia, and the

United States of America. After a welcome by the Co-Chairmen, Dr. Richard Feely (PMEL, U.S.A.) and Dr. Yukihiro Nojiri (NIES, Japan), the first day of the meeting was devoted to a series of scientific and technical presentations and discussions of future plans.

The North Pacific is an important sink for atmospheric carbon dioxide in the oceans and, consequently, plays a significant role in controlling long-term climate changes. There is

a considerable contrast in the ecosystems producing organic carbon and CaCO₃ particles, one of the factors determining the CO₂ sink strength in the ocean, between the eastern and western North Pacific. The contrast is likely due to the difference in the nutrient supply from the subsurface to the surface euphotic layer (i.e. resulting from the physical forcing which affects mixed layer depth) and in the atmospheric input of iron and other substances.

The presentations addressed a number of topics concerning the oceanic carbon dioxide system in the North Pacific. Dr. Nojiri summarized collaborative research conducted by scientists onboard the M/S *Skaugran* and *Alligator Hope* from 1995-2000 and at the KNOT time-series station in the western North Pacific. He described the major seasonal variations of the sources and sinks for carbon dioxide north of 35°N. This region of the North Pacific is a large net sink for CO₂ (~0.24 PgC yr⁻¹) with large wintertime sources in the convective overturn regions of the western North Pacific and the Aleutian Islands, and large spring and summertime sinks in the northwestern Pacific and Bering Sea regions due to high nutrient concentrations and new production. Dr. Nojiri discussed plans for future VOS ship and time-series observations in the North Pacific and recommended an expansion of efforts into the subtropical Pacific.

Dr. Akihiko Murata (JAMSTEC, Japan) reported on several JAMSTEC cruises conducted in the Bering Sea and Arctic Ocean. These summertime surveys of pCO₂, total dissolved inorganic carbon (DIC) and total alkalinity (TAlk) revealed significant sinks (pCO₂ < 250 µatm) in the northern Bering Sea due to new production; whereas, in the Arctic Ocean pCO₂ values decreased with decreasing temperatures.

Galina Pavlova (POI, Russia) informed on the Russian-German KOMEX expeditions in the Sea of Okhotsk. Sediment cores were analyzed for pore water chemistry and sediment mineralogy. Large sea plumes of methane gas

coming from the bottom sediments were observed at depths ranging from 380 to 600 m. Large bivalves were found in the region of the gas seepage.

Dr. Paul Quay (UW, U.S.A.) reported on isotopic measurements of seawater DIC in the Pacific Ocean. Approximately 825 stations in the Pacific have been analyzed for seawater DIC ¹³C/¹²C isotope ratios. High ratios were observed at about 45°S in South Pacific, with lower ratios towards the north and south of this latitude band. Surface concentration changes since the 1970s indicated an oceanic uptake of anthropogenic CO₂ of approximately 2.0 ± 0.5 PgC yr⁻¹. Laboratory inter-comparison studies were suggested at the international level. It was recommended that a collaborative method inter-comparison study has a high priority to enable future CO₂ measurements by PICES nations to be comparable and correct.

Dr. C.S. Wong (IOS, Canada) reviewed ongoing and future CO₂ research programs in Canada. The Line P time-series is occupied about 3 times per year with hydrocasts and moored sediment traps. Ship of opportunity between Japan and Canada, and between Canada and Australia using VOS run approximately 6 times per year. Canada will participate in an international CO₂ ocean sequestration experiment off Hawaii in fall 2001 and plans are underway for an Fe fertilization experiment at Ocean Station P.

Robin Brown (IOS, Canada), Alex Kozyr (CDIAC, U.S.A.), Paulette Murphy (NODC, U.S.A.), and Toru Suzuki (MIRC, Japan) reported on the status of ocean CO₂ data sets for the member countries. In the United States and Japan ongoing efforts are being made to provide inventories and, in some cases, final data on the World Wide Web. Other countries are making similar plans for data integration and distribution. A plan was developed to initiate an international North Pacific CO₂ data synthesis activity, which will be planned and carried out in collaboration with the PICES TCODE and JGOFS NPTT.

The second day was devoted to discussions of the methods inter-comparison and to the formulation of recommendations (see below). The Working Group felt that it was important to emphasize the objective of improving the overall quality oceanic CO₂ measurements in the North Pacific. Dr. Andrew Dickson (SIO, U.S.A.) reported on the results of the PICES-sponsored international method inter-comparison study for dissolved inorganic carbon and total alkalinity, which began in 1999 and continued through 2000. At the first CO₂ Technical Workshop in April 1999 (see PICES 1999 Annual Report and PICES Press, Vol. 8(1), for details), it was agreed that this year's study would focus on the measurement of total alkalinity (TAlk) in seawater. Four samples were distributed for analysis by the participating laboratories (1 from Canada, 7 from Japan, 1 from Korea, 1 from Russia, and 3 from the United States) and were analyzed using acid supplied by the Scripps Institution of Oceanography. The results were discussed at the second CO₂ Technical Workshop held in Tsukuba on October 20, 2000. This workshop was attended by 24 scientists including both members of the participating laboratories and some observers. The results were significantly better than they had been in 1999. With the exception of two laboratories, the TAlk values (when normalized to a common reference material) were in good agreement with each other (means within 2 µmol/kg of the assigned value; standard deviations of these laboratories ranged from 2-4 µmol/kg). This result is typical for laboratories with experience in this measurement, and indicates the increased skills of the various participating laboratories acquired over the past year. Nevertheless, it is essential to maintain an awareness of potential inter-laboratory calibration problems, and the sources of these were discussed at length during the Technical Workshop. A full report, detailing both the 1999 and 2000 exercises is in preparation and should be completed in early 2001. The various workshop participants expressed an interest in continuing further such exercises at about a 2-year interval. PICES plans to explore ways of doing this in the future.

Dr. Dickson recommended that each laboratory develop an approach that independently calibrates the total alkalinity system so that the Certified Reference Materials (CRMs) can be used as an independent check on the calibration.

Plans for future WG 13 activities

- As a continuation of its method inter-comparison activity, the Working Group will plan and carry out an international inter-comparison of seawater DIC ¹³C/¹²C isotope ratio measurement techniques by exchanging test samples to be analyzed in the various participating laboratories before June 2001.
- The Working Group will initiate a North Pacific CO₂ data synthesis activity in collaboration with the JGOFS NPTT and PICES TCODE. Activities planned for 2001 include the compilation of an inventory of CO₂ data available for the North Pacific, planning and organization of a 3-day CO₂ Data Integration Test Workshop to be held in January 2001, in Sidney, B.C., Canada, and a 3-day CO₂ Data Integration Implementation Workshop to be held in May 2001, in Tokyo, Japan.
- The Working Group will collaborate with other PICES Committees to organize a new Working Group on North Pacific Biogeochemical Data Integration and Synthesis.
- The Working Group will continue, where possible, to plan and coordinate international efforts and research programs aimed at studying CO₂ in the North Pacific. This activity is assuming an increasing importance as PICES countries such as Japan, Canada, Russia, and the United States plan new research programs into aspects of the carbon cycle. As an example of this, scientific interactions within the PICES Working Group 13 and the international IGBP Global Carbon Cycle Study Plan is encouraged to improve collaborations between scientists who are working on CO₂ in the North Pacific. IOC/SCOR CO₂ Panel is preparing a proposal about the design of Ocean Carbon Observation System and

emphasizing the importance of regional international forum and PICES was supported as one of the excellent forum.

Recommendations to PICES

- Provide logistics support for seawater DIC $^{13}\text{C}/^{12}\text{C}$ isotope ratio inter-comparison study (PICES is a cosponsor with NIES and SIO).
- Convene a joint WG 13/TCODE CO₂ Data Integration Test Workshop in Sidney, B.C., Canada, in January 2001, and provide travel support for one Japanese and two North American scientists to attend the meeting;
- Convene a joint WG 13/TCODE CO₂ Data Integration Implementation Workshop in Tokyo, Japan, in May 2001, and provide travel support for two scientists to attend the meeting;
- Continue to provide the forum for the international coordination of ocean carbon cycle research in the North Pacific.

Plan for publication

- Review and results from the 1999 and 2000 PICES method inter-comparisons for carbonate parameters in a bilingual (Japanese/English) report published by the Center for Global Environmental Research (CGER) of the National Institute for Environmental Studies, Japan, and in the PICES Scientific Report Series, in spring 2001 (minor expenses for PICES);
- Proceedings of the North Pacific CO₂ Data Synthesis Symposium in a report published by the Center for Global Environmental Research (CGER) of the National Institute for Environmental Studies, Japan, and in the PICES Scientific Report Series, in spring 2001 (minor expenses for PICES);

WG 13 Annex 1

North Pacific CO₂ Data Synthesis Symposium Summary

The North Pacific CO₂ Data Synthesis Symposium, which preceded the PICES WG 13/TCODE/NPTT meeting, was held October 18-19, 2000, in the Epochal Tsukuba Congress Center, Tsukuba, Japan. The Symposium was

- WG 13 final report in the PICES Scientific Report Series, in spring 2002:
 - Present scientific status;
 - Summary of 1st and 2nd DIC/Talk inter-comparisons, and progress of ^{13}C inter-comparison;
 - Technical and scientific aspects of data integration, including desirable metadata for CO₂ and related species, guideline of CO₂ data quality assurance, data format for the integrated database;
 - Recommendation for the future observation.

Proposed schedule for WG 13 activities in 2001

Method Inter-comparison

Prepare samples for a seawater DIC $^{13}\text{C}/^{12}\text{C}$ isotope ratio inter-comparison study:

January

Distribute samples to participants:

April/May

Return results to organizers and report results to WG 13 Co-Chairmen:

June

Report results at WG 13 meeting in Victoria;

October

Data Inventory

Prepare North Pacific CO₂ data inventory:

ongoing

CO₂ Database and Integration

Convene a CO₂ Data Integration Test Workshop in Sidney, B.C., Canada:

January

Convene a CO₂ Data Integration Implementation Workshop in Tokyo, Japan:

May

co-sponsored by PICES and JST/CREST and was hosted by NIES. More than 60 scientists and administrators attended this two-day scientific session.

The first day of the symposium was devoted to the synthesis of basin-scale observations and time-series measurements. Dr. Richard Feely (U.S.A.) opened the session with an update of the ongoing synthesis of the Pacific Ocean WOCE/JGOFS Global CO₂ survey. He reported on the progress of the international synthesis effort to provide the oceanographic community with a unified internally consistent carbon data set. He also showed how he and his colleagues were using the cruise-to-cruise certified reference material (CRM) results and the crossover stations to propose individual cruise adjustments for each the carbon parameters. The revised data set shows remarkable coherency between cruises even though many laboratories were involved in making the measurements.

Drs. Christopher Sabine (U.S.A.) and Nicolas Metzl (France) gave similar talks on the synthesis of the JGOFS data from the Indian and Southern Oceans. Dr. Sabine discussed his work on comparisons of observations versus model estimates of anthropogenic CO₂ inventories in the Indian Ocean, and Dr. Metzl reported on temporal and spatial variability of CO₂ fluxes in the Southern Ocean, south of the Indian Ocean.

Drs. John Dore (U.S.A.), Nickolas Bates (U.S.A.; this talk was given by Dr. Sabine), Yukihiro Nojiri (Japan) and Keiri Imai (Japan) reviewed the results of the measurements at the HOT, BATS and KNOT time-series stations in the North Pacific. Based on seasonal amplitudes

of nutrients and dissolved inorganic carbon the northwestern Pacific KNOT time-series data indicate significantly larger variations of primary production than other regions of the North Pacific.

On the second day of the symposium the focus was on data synthesis and integration. Dr. Kitack Lee (U.S.A.) gave a presentation on his analysis of the global interannual variability of air-sea fluxes of CO₂ based on regionally and seasonally varying pCO_{2sw}-temperature relationships and interannual anomalies in sea surface temperature and winds. The results indicate much smaller variability of CO₂ fluxes (0.4 PgC yr⁻¹) than is observed atmospheric inversion models or the ocean biogeochemical model results. Dr. Paulette Murphy (U.S.A.) presented her analysis of the M/S *Skaugran* data, which indicated that 9-10 samplings per year were required to provide an adequate representation of pCO₂ distributions in the Subarctic Pacific. Dr. Masao Ishii (Japan) presented his estimate of net community production (38 mmol m² d⁻¹) based on DIC and pH measurements in the central and western equatorial Pacific, and Dr. Ludger Mintrop (Germany) summarized the efforts to synthesize the WOCE/JGOFS data in the North and South Atlantic under the CARINA Project. Efforts of data management and data base technology were also described during this symposium. In addition to 17 oral presentations, 12 papers were presented as posters.