

CO₂ data integration activity for the North Pacific

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Dr. Sachiko Oguma was a data manager at the Marine Information Research Center (MIRC), Japan Hydrographic Association (JHA). Since April 2004, when she received her Ph.D. from Tohoku University, Sachiko has been working for this school. Her major scientific background is physical oceanography, and her current research is on application of isotopes to water mass analysis.

Dr. Toru Suzuki is the general manager of the research division at MIRC. His current work includes integration of oceanographic data and information and development of a quality control procedure. His scientific background is physical oceanography in coastal regions. Toru is also a member of the PICES WG 17 on Biogeochemical data integration and synthesis.



As interest in greenhouse gases has increased, oceanic CO₂ observations have been actively done in many projects around the world, and lots of data have been accumulated to analyze air-sea CO₂ exchange in various temporal and spatial scales. There are some difficulties for data exchange, however, not only for CO₂ data, but also for other chemical oceanographic data. To be able to share and fully open the data, an effective data management method is crucial.

Some efforts for data exchange have been made among researchers; for example, the scientist group known as CARINA (Carbon Dioxide in the North Atlantic Ocean), has accomplished the data management for CO₂ data of the North Atlantic Ocean. For the North Pacific, a Japanese scientist group established the Inventory for Japanese Chemical oceanographic Data (IJCD) in 2000. Now IJCD data inventory is made public via the web (<http://ijcd.jp/>), and is partly linked with web sites with original data which can be fully opened.

PICES Working Group 13 on *CO₂ in the North Pacific* (co-chaired by Drs. Richard A. Feely and Yukihiro Nojiri) had planned to construct an international CO₂ data inventory for PICES countries as a part of data integration activity. Firstly, a PICES CO₂ Data Integration Planning Workshop was held at the Institute of Ocean Sciences (Canada) in January 2001 (see *PICES Press*, Vol. 9, No.2). At this meeting, it was recommended that PICES WG 13 and TCODE (Technical Committee on Data Exchange) work together with the data centers (JODC, NODC, CDIAC, etc.) and the JGOFS North Pacific Task Team to compile

an international North Pacific data inventory for CO₂ and CO₂-related data. A new data inventory, PICNIC (PICES CO₂ Related Data Integration for the North Pacific), was developed following this recommendation.

The PICNIC data inventory is constructed by cruise lists, including information about observation cruises which obtained data of CO₂ and CO₂-related variables in the North Pacific. The format of the PICNIC data inventory follows that of CDIAC and IJCD; which is composed of cruise name, ship name, observation period, principal investigator, observed variables, etc. These components are not defined as indispensable information, however they are very important information to search the cruise individually. The cruise information registered in PICNIC are originally collected by IJCD, CDIAC and IOS, and then compiled into a common format based on the IJCD format at the Marine Information Research Center, a management office of the IJCD data inventory.

To follow-up the fruit of the January workshop, a PICES CO₂ Data Integration Implementation Workshop was held from July 31-August 2, 2001, at the Hydrographic and Oceanographic Department, Japan Coast Guard, in Tokyo (Fig. 1). The workshop aimed at (i) developing strategies for exchange of CO₂ and related data at the international level; and (ii) examining the technical issues in integrating presently available data into a uniform data structure or database.

For efficient data exchange, common formats of data and metadata for CO₂ data were discussed. The WOCE format

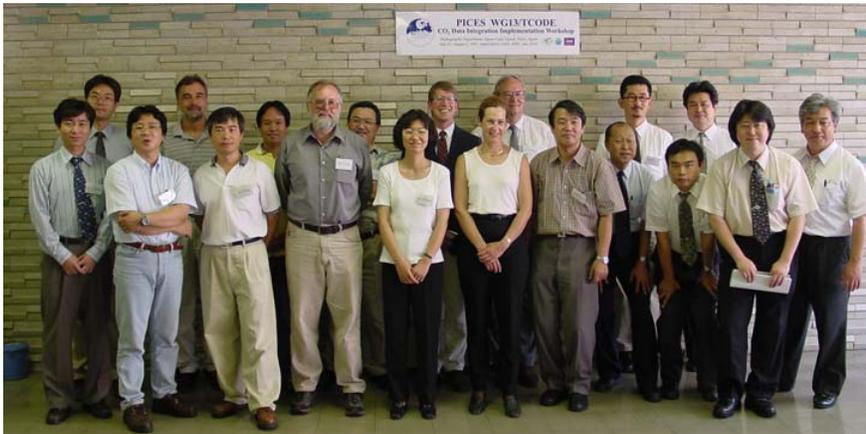


Fig. 1 Participants of the PICES CO₂ Data Integration Implementation Workshop held July 31 - August 2, 2001, at the Japan Hydrographic Department, Tsukiji, Tokyo, Japan.

For efficient data exchange, common formats of data and metadata for CO₂ data were discussed. The WOCE format was recommended for bottle sampling data, but there were too many model formats for underway pCO₂ data. Even in one data center, the underway pCO₂ data format is different among data sets, which were obtained by different methods and provided by different scientists. Corresponding to the difference in the data sets, classified data items were suggested: primary necessary data (date, position, seawater temperature, seawater CO₂ data), desired data (atmospheric pressure, salinity, atmospheric CO₂ data), supplemental meteorological data (atmospheric temperature, humidity, wind, wave, solar radiation), supplemental biological data (Chl-a, DO, pH, DIC, TAlk), and necessary data for global data integration ($\Delta \text{pCO}_2 / \Delta \text{fCO}_2 / \Delta \text{pCO}_2$).

As a tool to explore data in the common format, the Live Access Server (LAS) developed at the Pacific Marine Environmental Laboratory (PMEL) was introduced. LAS is a useful tool to search gridded data, such as NetCDF format data. It was agreed to use LAS as a data viewer of PICNIC. CO₂ and CO₂-related data registered in PICNIC will be converted firstly into the PICES common format, and then into the NetCDF format and mounted on LAS.

As of October 2003, 426 cruises (284 bottle sampling cruises and 214 underway pCO₂ cruises) are registered in PICNIC, and the cruise tracks of Japanese research in IJCD are shown in Figure 2. And the results of the test study of LAS using the underway pCO₂ observation data collected by the National Institute for Environmental Studies from 1995 to 2003 are shown in Figure 3.

Activities for CO₂ data integration are now continued by PICES Working Group 17 on *Biogeochemical data integration and synthesis* (co-chaired by Drs. Andrew G. Dickson and Yukihiro Nojiri). Based on the activities of WG 13 and WG 17, the PICNIC data inventory is assessable on the web (<http://picnic.pices.jp/>). The development of PICNIC was partly conducted by the study "Ocean Carbon Dioxide Related Substance Database for the Amount Elucidation of Anthropogenic Carbon Dioxide Absorption of the Ocean" by JODC using the Global

Environment Research Coordination System, Ministry of the Environment, Japan, from FY 2001-2003. To maintain the PICNIC database under international coordination will be one of our future challenges.

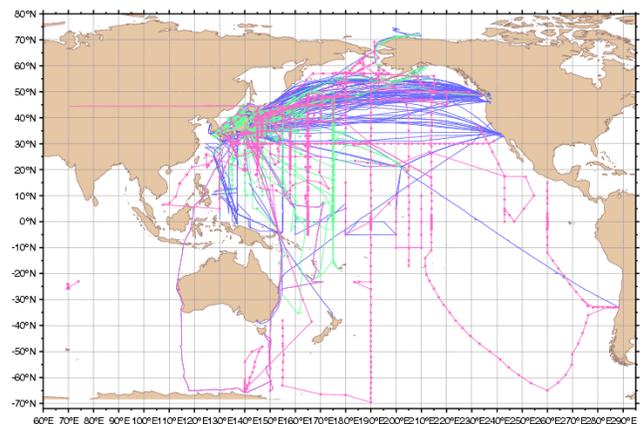


Fig. 2 Cruise tracks of Japanese Research in IJCD.

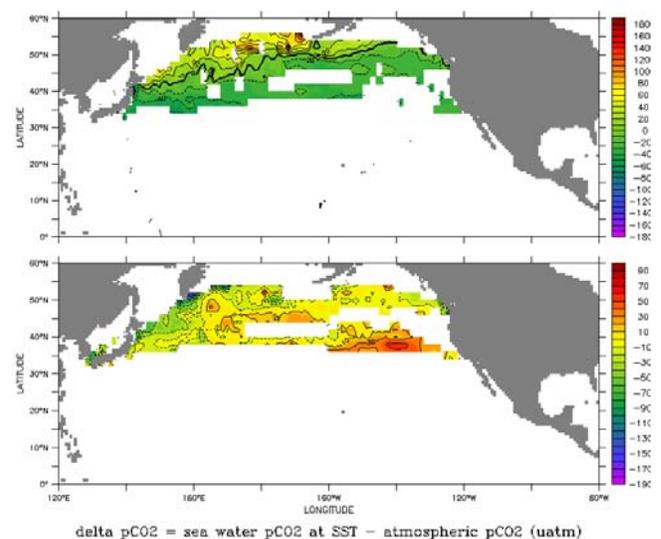


Fig. 3 Spatial distribution of ΔpCO_2 in winter (top panel) and summer (bottom panel).