Ocean Carbon Dioxide Related Substance Database for the Amount Elucidation of Anthropologic Carbon Dioxide Absorption of the Ocean (Abstract of the Final Report)

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1. Introduction

It is a very important subject to elucidate carbon exchange between the ocean and the atmosphere in order to estimate concentration change of carbon dioxide in the atmosphere and to predict the climate change in connection with the global warming.

Many research institutes in Japan have measured the quantity of carbon dioxide in the ocean and the atmosphere. Almost all data has been distributed by each research institutes. However its precision and accuracy are not uniformity because of difference between each observation techniques and advanced observation technique in recent years. A management of data quality has been required for the global massive data analysis, such as "High accurate analysis of total carbon dioxide data". However, it is difficult to make synthetic and systematical use of carbon dioxide related data distributed to each research institute, applying the conventional data management method.

For above reasons, it is urgently required to collect the high quality data related carbon dioxide substances to elucidate the oceanic absorption mechanism of carbon dioxide efficiently and to establish the data management system (database) for effective data use.

2. Research Objective

In order to support the research activities on the elucidation of the carbon dioxide absorption mechanism of the ocean, this research aims to establish the high accuracy carbon dioxide related data management system, which will be utilized by domestic and foreign researchers. The system will manage two kinds of information; one is inventory information of observation data, such as who observed, what kind of data, at where, the other is the observation data itself.

3. Research Method and Results

(1) Collection of the Inventory Information and Development of the Inventory Database

We have developed the database inventory in which contains necessary additional information of how to specify and acquire the data. The information is provided to the researchers. This database is named "Inventory for the Japanese Chemical Oceanographic Data (IJCD)" contains information of 367 cruises and also opened to the public now.

Furthermore, we have established database of inventory information, it is called "PICES Carbon Dioxide Related Data Integration for the North Pacific (PICNIC)", cooperation with the North Pacific Marine Science Organization (PICES) using IJCD system. PICNIC contains information of a part of IJCD and from U.S.A., Canada and the other countries. Information of 416 cruises is widely opened to the public now.

(2) Digitization of Carbon Dioxide Related Data

Digitization is necessary to operative distribution and utilization of the carbon dioxide related data in which has been distributed to research institutes. As a result, we have digitized the data of 41 cruises on R/V Hakuho-Maru (1968-1997) and 22 cruises on R/V Toyoshio-Maru (1981-1991) to CD-ROM. According to discussion on PICES Working Group 13 (PICES/WG13), those data were converted into spreadsheet format that is readable by commonly used oceanographic data processing software, "Ocean Data View (ODV)". We will provide this CD-ROM as dataset to researchers and the information will be also opened by on-line.

(3) Development of the Carbon Dioxide Related Database

According to the discussion on PICES/WG13, we evaluated the Live Access Server (LAS) as the real data service system of the ocean CO_2 related data. LAS is a configurable web server provides geo-referenced scientific data and flexible access.

As a result, 3-dimensional maps, such as the amount of carbon dioxide absorption in the ocean space concerned, can be easily obtained now.

We used the underway pCO_2 observation data conducted by National Institute for Environmental Studies from 1995 to 2003 as a test study for this evaluation. This evaluation of spatial distribution of delta-pCO_2 in winter and summer are shown in Fig.1 and Fig.2. It clearly depicts seasonal alteration of the balance of absorption and emission of carbon dioxide, opposite to trend between high latitude and medium latitude and considerably difference between east side and west side at same latitude.

(4) Development and Evaluation of the Quality Control Method of the Carbon Dioxide Related Data

We have developed the standard quality control method for the carbon dioxide related data. It was based on quality control method of National Oceanographic Data Center (NODC), U.S.A. We have made a manual of 146 pages. We divided the target area of surrounding Japanese sea into 6 sections and further more, each section was divided into coastal zone and oceanic zone. Totally, we defined 11 sea areas. By contrast, only 1 section exists for North Pacific Ocean in NODC method. It provides more precise and reliable threshold parameter. As the result of statistical calculations, we found the excessively narrow regulations in NODC method. These are inappropriate for data at some area, such as Silicate at oceanic zone of Okhotsk.
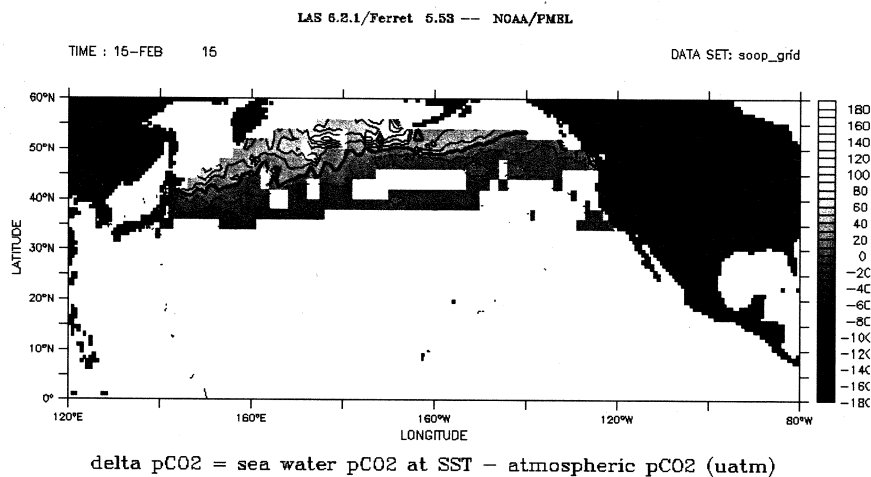
TIME : 15-FEB   15   DATA SET: soop_grid

delta pCO2 = sea water pCO2 at SST − atmospheric pCO2 (uatm)

Fig. 1 The Spatial Distribution of delta-pCO_2 in Winter

LAS 6.2.1/Ferret 5.53 — NOAA/PMEL

TIME : 16-AUG   06   DATA SET: soop_grid

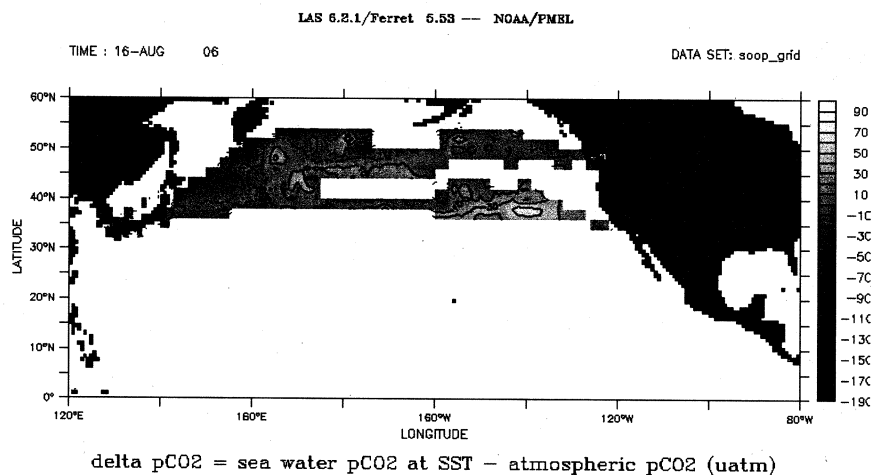delta pCO2 = sea water pCO2 at SST − atmospheric pCO2 (uatm)

Fig. 2 The Spatial Distribution of delta-pCO_2 in Summer

4. Conclusion

We have established IJCD and PICNIC which are the database of inventory information and metadata and opened to the public widely through the Internet.   Due to those operations, we have contributed to mutual use of the carbon dioxide related data between domestic and foreign researchers greatly and promoted the amount elucidation of carbon dioxide absorption of the ocean.

On the 3-dimensional map created using the carbon dioxide related database built by this research is very useful for standing the estimate of carbon dioxide absorption of the whole ocean.

By this research, the created quality control manual not only proposes a technique standard for operating data but greatly to training of researchers. This manual has received editorial supervision of the IJCD working group containing the main domestic researchers in a sea chemistry field, and is due to open towards the general researcher of the field concerned.

As mentioned above, the result of this research promotes powerfully mutual use of the sea carbon dioxide data between researchers in and outside the country, and is contributed to climate change prediction of global warming etc. Consequently, we think we could attain the original purpose.

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