SECTION NEWS

O C E A N S C I E N C E S

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Ocean Carbon Scientists Organize to Achieve Better Coordination, Cooperation

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Studies of the global carbon cycle and climate change necessarily involve investigations across regional and political boundaries. Recognizing the need to develop an international research framework, various working groups of programs such as the International Geosphere-Biosphere Programme (IGBP) have developed research strategies for global carbon cycle studies.

Based on recommendations from these programs, several nations are now moving ahead with plans for large-scale ocean carbon observations. Many of these national and regional studies are similar in focus, and have been designed to complement studies in other countries. However, there is an immediate need for global-scale coordination of these carbon observations and research efforts. There is also an urgent need to critically assess the overall network of planned observations to ensure that the results, when combined, will meet the requirements of the research community.

As part of a new pilot project, the Global Carbon Project (GCP) and the Ocean CO_2 Panel have joined forces to coordinate ongoing, large-scale ocean carbon observations over the next decade. This project coordination draws upon the long-term experience of the Ocean CO_2 Panel parent organizations; the Scientific Committee on Oceanic Research (SCOR) and the Intergovernmental Oceanographic Commission (IOC). It also draws on the carbon focus, and ties to the scientific community of the GCP parent organizations; the IGBP, the International Human Dimensions Programme (IHDP), and the World Climate Research Programme (WCRP). The International Ocean Carbon Coordination Project (IOCCP) has been organized to:

- gather information about ongoing and planned ocean carbon research and observation activities;
- identify gaps and duplications in ocean carbon observations;
- produce recommendations that optimize resources for international ocean carbon research and the potential scientific benefits of a coordinated observation strategy; and
- promote the integration of ocean carbon research with appropriate atmospheric and terrestrial carbon activities.

Only through a coordinated ocean sampling effort and improved basic scientific understanding of the ocean carbon cycle will the overall goal of skillful predictions of future atmospheric CO_2 be attained.

First International Coordination Workshop

As an initial activity of the IOCCP, a workshop was held in Paris on 13–15 January 2003. Fifty-six ocean carbon scientists and program managers from 17 countries gathered information on planned national and regional studies and discussed the needs of the ocean carbon community for international coordination. The emphasis of this first workshop was on carbon measurements made on the reoccupation of trans-basin hydrographic sections and time-series sites, as well as the rapidly growing network of near-surface CO_2 partial pressure (pCO_2) measurements made from ships of opportunity, drifters, and moorings.

The initial synthesis of trans-basin sections indicated that as many as 30 cruises may be completed by 9 countries in the next 5 years. Figure 1 shows the anticipated cruise tracks for these lines. The compilation of a map like this illustrates the impressive data set that can be compiled if the various nations are willing to cooperate and share data, but it also points out areas that are not being adequately covered under existing plans. The scarcity of cruises in regions such as the southeastern Pacific Ocean, and the absence of zonal cruises in the tropics can be clearly identified as missing elements in the existing observational plans.

Recognizing the potential benefits of coordinating and combining international data sets, the workshop participants have asked the IOCCP to work closely with the International Research Programme on Climate Variability and Predictability (CLIVAR) to promote an internationally coordinated approach for developing plans for hydrographic sections with carbon measurements, and a proactive policy of international data sharing. The need to develop and promote the use of an internationally accepted handbook for best practices regarding ocean carbon measurements was also highlighted. A move toward more standardized techniques and the use of certified reference materials (CRMs) and participation in inter-laboratory comparison exercises were seen as the most significant potential areas of improvement over previous global-scale surveys.

The near-surface CO_2 working group highlighted many of the same issues for the developing volunteer observing ship (VOS) network. Figure 2 shows the distribution of more than 25 existing or planned VOS lines operated by 15 countries. The importance of more standardized, robust, autonomous instruments and frequent inter-laboratory comparisons and free exchange of data were highlighted as critical elements of a global pCO_2 network.

Objectives of IOCCP

The needs of the ocean carbon community as outlined at the workshop are not new; they have been discussed for 20 years or more. However, recent interest and pressure to develop an ocean carbon observing capability and research strategy for ocean carbon assessment

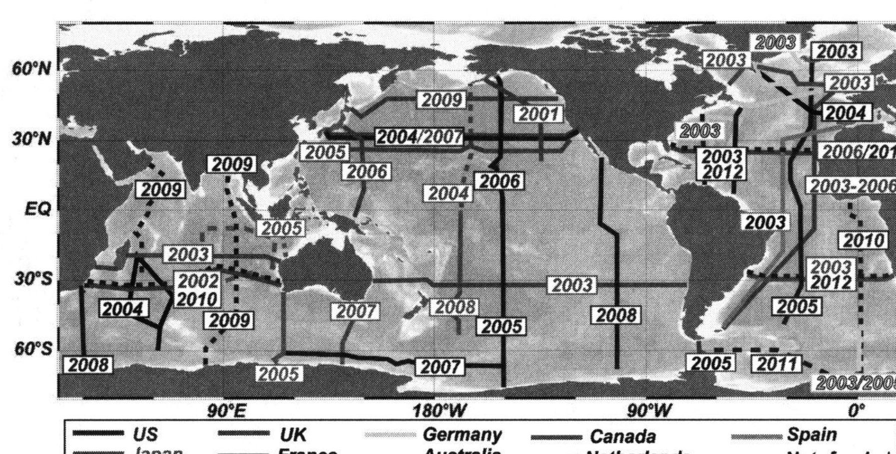

Fig. 1. In this global map of planned hydrographic sections with carbon system measurements, solid lines indicate funded lines. Dashed lines indicate planned lines that are not fully funded at this time. Original color image appears at back of volume.

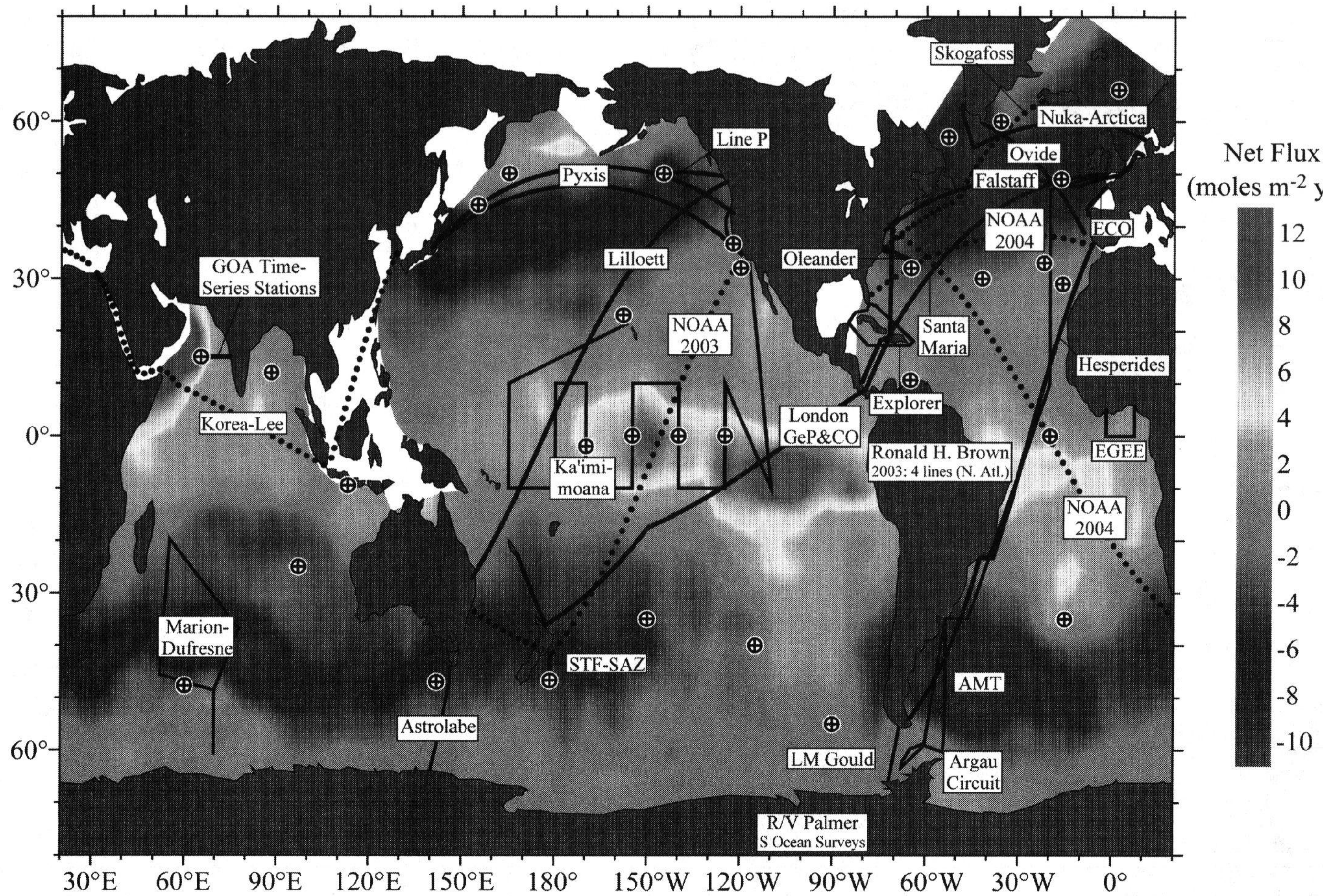

Fig. 2. In this global map of existing and planned near-surface pCO_2 measurements, solid lines indicate existing lines. Dashed lines indicate planned lines that are not operational at this time. Labels indicate ship name or project title. White circles with crosses indicate preliminary estimates of planned and existing time-series stations with surface CO_2 measurements. The background map shows net annual CO_2 flux adapted from Takahashi et al., *[2002]. Original color image appears at back of volume.*

and prediction requires a new level of international cooperation and collaboration that needs to be organized through an international body, rather than relying on individual scientists to establish collaborations on their own. Based on input from our sponsoring organizations and the workshop participants of the IOCCP has four primary objectives.

- To maintain an up-to-date compilation and synthesis of large-scale ocean carbon observation activities and plans.
- To promote the full integration of large-scale carbon studies into the planning activities of international research organizations.
- To identify and coordinate regional-scale science groups to critically examine the scientific balance, quality, and completeness of these observational networks with reference to global-scale research needs, and to promote the establishment of other regional groups as needed.
- To organize international groups to promote acceptance of standardized measurement techniques, (for example, through the publication of a best practices handbook); improved accessibility to international carbon data sets, (for example, to promote more uniform data handling/reporting, encourage submission of data to world data centers within 2 years or less of data collection, and investigate data citation issues); and internationally recognized quality assurance/quality control procedures; (for example, promoting the use of CRMs, and helping to organize training workshops and inter-laboratory comparison exercises).

In the short term, much of this will be initiated through a central Web site that will pull together information about ongoing and planned activities in the community. Active solicitation and cooperation of the ocean carbon community will be required to keep the information current. Over the next few years, workshops focused on specific aspects of the goals stated above will be organized. Several of these workshops are already in the planning stages now.

In the long term, we hope to move toward a truly integrated network in which national plans are developed with the "global picture" in mind, based on how these studies can fit into the international network of observations. This is a massive task, but through the support of our parent organizations and the scientific community, we hope to make significant advancements in international cooperation, and feel that the timing is right for this effort. We welcome interactions with other national and international groups, and encourage those interested in contributing to our collaborative effort to contact the authors of this article.

For more information about the IOCCP, go to: http://ioc.unesco.org/ioccp.

Acknowledgment

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BOOK REVIEWS

Sky and Ocean Joined: The U.S. Naval Observatory, 1830-2000

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STEVEN J. DICK
Cambridge University Press; New York; ISBN 0521815991; 609 pp.; 2002; $130.

Today, the U.S. Naval Observatory (USNO) is best known to most Americans as the location of the vice president's residence. Asked to search their memories, a few may recall that USNO maintains the nation's master clock, and is in some way responsible for introducing a "leap second" on New Year's Eve every few years. Even in the scientific community, the USNO is best known and most highly regarded for its service as the nation's timekeeper.

In *Sky and Ocean Joined: The U.S. Naval Observatory, 1830–2000*, Steven Dick points out that the history of the development of ever-more accurate clocks and the dissemination of time closely parallels the general advance of science and technology. In addition, he takes the reader inside USNO to meet some of the more fascinating individuals that drove the events and scientific achievements associated with the work of maintaining the nation's master clock.

Time-keeping evolved from pendulum clocks to quartz clocks, cesium standards, and hydrogen masers. In response, time dissemination evolved from visible signals, such as dropping a ball at the top of a prominent building, to local and trans-oceanic cable telegraphic signals, radio transmissions, portable clocks, and satellite signals, including the Global Positioning System. USNO personnel were intimately involved in virtually every step of that history.

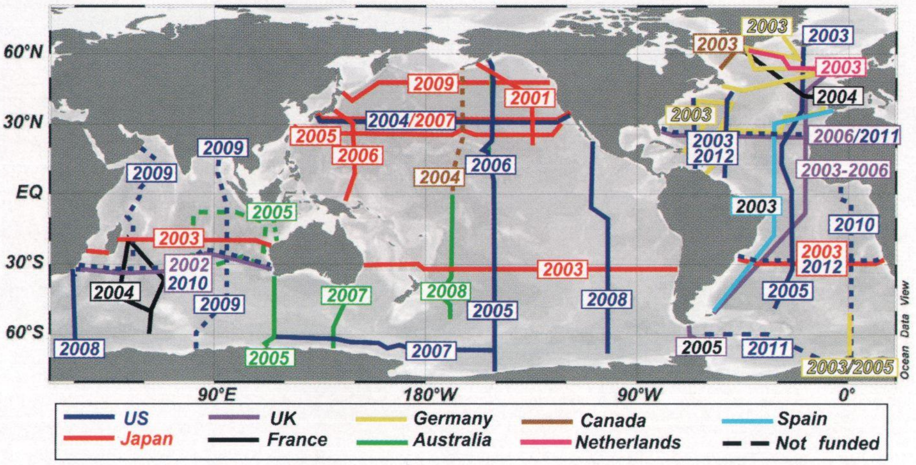
If we were to turn the calendar back 140 years, to a time when the rotation of Earth was considered the perfect clock, we would find the USNO about to enter what Dick calls its "golden era." The international recognition commanded by USNO during the latter decades of the 19th century derived predominantly from classical positional astronomy. For a few years, beginning in 1873, the USNO had the largest astronomical telescope in the world, a 66-cm-diameter aperture, 9.7-m-long, equatorially mounted refractor. Asaph Hall used this telescope in 1877 to discover the two moons of Mars. During this golden era, the leading astronomers at USNO were U.S. Naval staff officers assigned the title "Naval Professor of Mathematics" (NPM), a peculiar position first created by the Navy in 1834.

By far, the most renowned NPM was Simon Newcomb, who is widely acclaimed as the greatest American scientist of the 19th century. Though the USNO astronomers were assigned military rank, they had no military training and chafed under the direction of a succession of superintendents who were line officers and rotated assignments on time scales as short as 1 year. The astronomers made several attempts to have the USNO relocated to a civilian agency. The intrigue and political infighting between the succession of superintendents and the professors of mathematics provide human interest and give a glimpse of the battle to force a reluctant Congress to support scientific research at the national level.

Dick acknowledges that his book might be considered an "official history" because he wrote it while employed at USNO, but he states, "the terminology should not be considered pejorative" because he was free to "tell it as it was."

While I'm sure he did his best, and mostly succeeded, he falls short of the mark in a few areas. Foremost is his impassioned argument that the USNO should be considered the first U.S. national astronomical observatory. Dick provides ample examples of the Navy and USNO employees trying to portray the observatory as the equivalent of the Greenwich Observatory in England, but he provides no proof that Congress ever granted funding under that title. It is quite clear that few, if any, leading American astronomers of the time considered USNO a national observatory. Many worked hard to have it moved to a civilian agency with the intent of transforming it into a national observatory.

The author's characterization of the impact of Navy management on the scientific achievements of USNO seems to be downplayed. Newcomb was forced to retire in 1897, when he reached age 62, and the Navy's refusal to grant him access to his own work delayed his computations of the motion of the Moon almost to the day of his death, in 1909. Including the anticipated improvements in astrometric accuracies from the since cancelled Full-sky Astrometric Mapping Explorer (FAME) project, while omitting the historic involvement of USNO in the development of the International Earth Rotation Service and the operation



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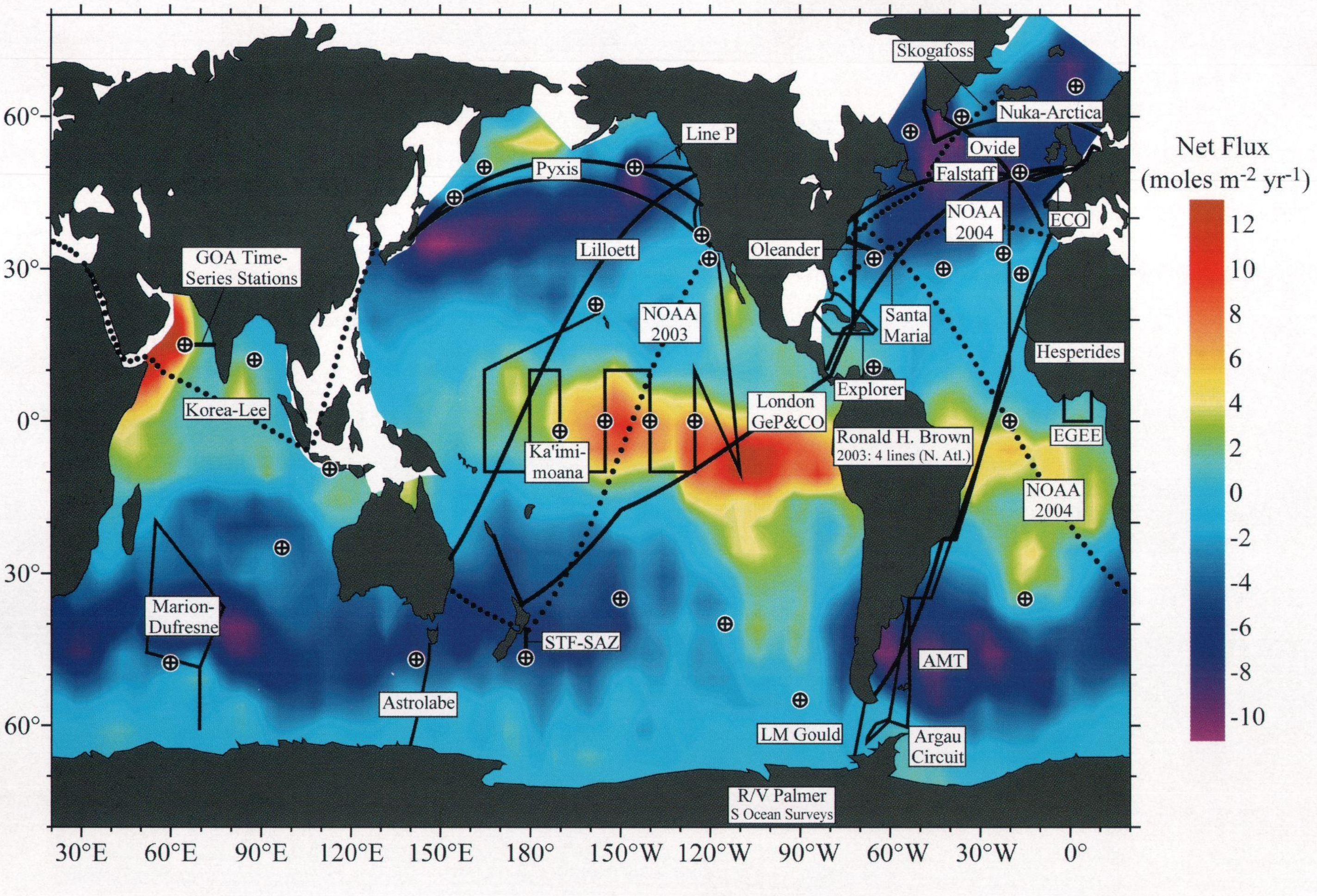

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