ORNL/CDIAC--48

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Environmental Sciences Division

# CARBON DIOXIDE INFORMATION ANALYSIS CENTER: FY 1991 ACTIVITIES

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# TABLE OF CONTENTS

# LIST OF FIGURES

# LIST OF TABLES

# ACKNOWLEDGMENTS

As with any collective effort, this report has been prepared with the help of many people. CDIAC's greatest debt is to the contributing investigators and researchers whose data compose the core of CDIAC's information analysis and data packaging. We also extend our thanks to the laboratories, data centers, agencies, institutions, and organizations that have supported the efforts of this research community. Were it not for the voluntary cooperation and dedication of this group of researchers, CDIAC, as well as its derived information products, comprehensive information services, and specialty publications, could not exist.

Our thanks are also extended to the thousands of people from around the world who have sought assistance from CDIAC over the past year. CDIAC was founded with the intent of providing broad information services to a multidisciplinary audience with divergent interests and needs. We continue to be delighted not only with the response received from the research community for these services but also by the increase in requests for CDIAC services by policy and social scientists, educators, and others interested in various aspects of global environmental issues, including climate change.

We would like to express our gratitude to the following personnel in CDIAC at Oak Ridge National Laboratory and Martin Marietta Energy Systems, Inc. Their collective efforts have brought this report into being. Our deepest thanks go to Sonja Jones and Debbie Shepherd, who handle information requests and respond to requests for CDIAC's publications, numeric data packages, and computer model packages. Their record keeping serves as the core for producing the statistics reported in this document. We also thank Marvel Burtis for her specialized desktop publishing, design, and production skills. We would also like to acknowledge the work of Rich Daniels, Dale Kaiser, Bob Sepanski, Russ Vose, and Tammy White, who, under the supervision of Tom Boden, are responsible for the detailed information analysis and packaging of numeric data. Our thanks also to Judy Aebischer, Publications Division, for editing the text.

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# ABSTRACT

CUSHMAN, R. M., AND F. W. STOSS. 1991. Carbon Dioxide Information Analysis Center: FY 1991 Activities, ORNL/CDIAC-48, Oak Ridge National Laboratory, Oak Ridge, Tennessee. 74 pp.

During the course of a fiscal year, Oak Ridge National Laboratory's Carbon Dioxide Information Analysis Center (CDIAC) distributes thousands of specialty publications—numeric data packages (NDPs), computer model packages (CMPs), technical reports, public communication publications, newsletters, article reprints, and reference books—in response to requests for information related to global environmental issues, primarily those pertaining to climate change. CDIAC's staff also provides technical responses to specific inquiries related to carbon dioxide ($CO_2$), other trace gases, and climate. Hundreds of referrals to other researchers, policy analysts, information specialists, or organizations are also facilitated by CDIAC's staff.

This report provides an account of the activities accomplished by CDIAC during the period October 1, 1990 to September 30, 1991. An organizational overview of CDIAC and its staff is supplemented by a detailed description of inquiries received and CDIAC's response to those inquiries. An analysis and description of the preparation and distribution of numeric data packages, computer model packages, technical reports, newsletters, factsheets, specialty publications, and reprints is provided. Comments and descriptions of CDIAC's information management systems, professional networking, and special bilateral agreements are also described.

**Keywords:** air pollution, ambient temperature, atmospheric chemistry, carbon cycle, carbon dioxide, climate, climate change, data analysis, data exchange, data management, earth atmosphere, emissions, fossil fuels, environmental effects, geophysical surveys, global aspects, global warming, greenhouse effect, information analysis, information management, meteorology, methane, monitoring, regional analysis, temperature monitoring, temperature surveys, trace gases

# 1. INTRODUCTION

The Carbon Dioxide Information Center (CDIAC) was established by the U.S. Department of Energy (DOE) in 1982 to support its Carbon Dioxide Research Program (CDRP). CDRP's role within DOE has been to study how atmospheric concentrations of carbon dioxide change in response to fossil-fuel emissions and other sources of $CO_2$ and what the response of the Earth's climate system might be. Initially, CDIAC's mission was to provide identification, collection, quality-assurance, documentation, and distribution for information on the biogeochemistry of carbon dioxide and the effects of $CO_2$ on the earth's climate. As this research area matured, so did the scope of CDIAC, to include related global-change topics (e.g., other greenhouse gases and the effects of climate change on the environment). The flow of information into and out of CDIAC—numeric data, journal articles, agency reports, bibliographic data—has paralleled the increasing interest in the "greenhouse" issue.

Such a broad research program, involving many scientists not only in the United States but around the world, could only succeed if there was an explicit recognition of the value of information, in all its forms, and if measures were taken to ensure that this information would be freely exchanged. CDIAC's mission goes beyond supporting the research community. The education community—teachers and professors from elementary schools to university graduate departments, as well as their students—also has to be involved in this information exchange, if tomorrow's scientists are to be prepared to work on this long-term issue.

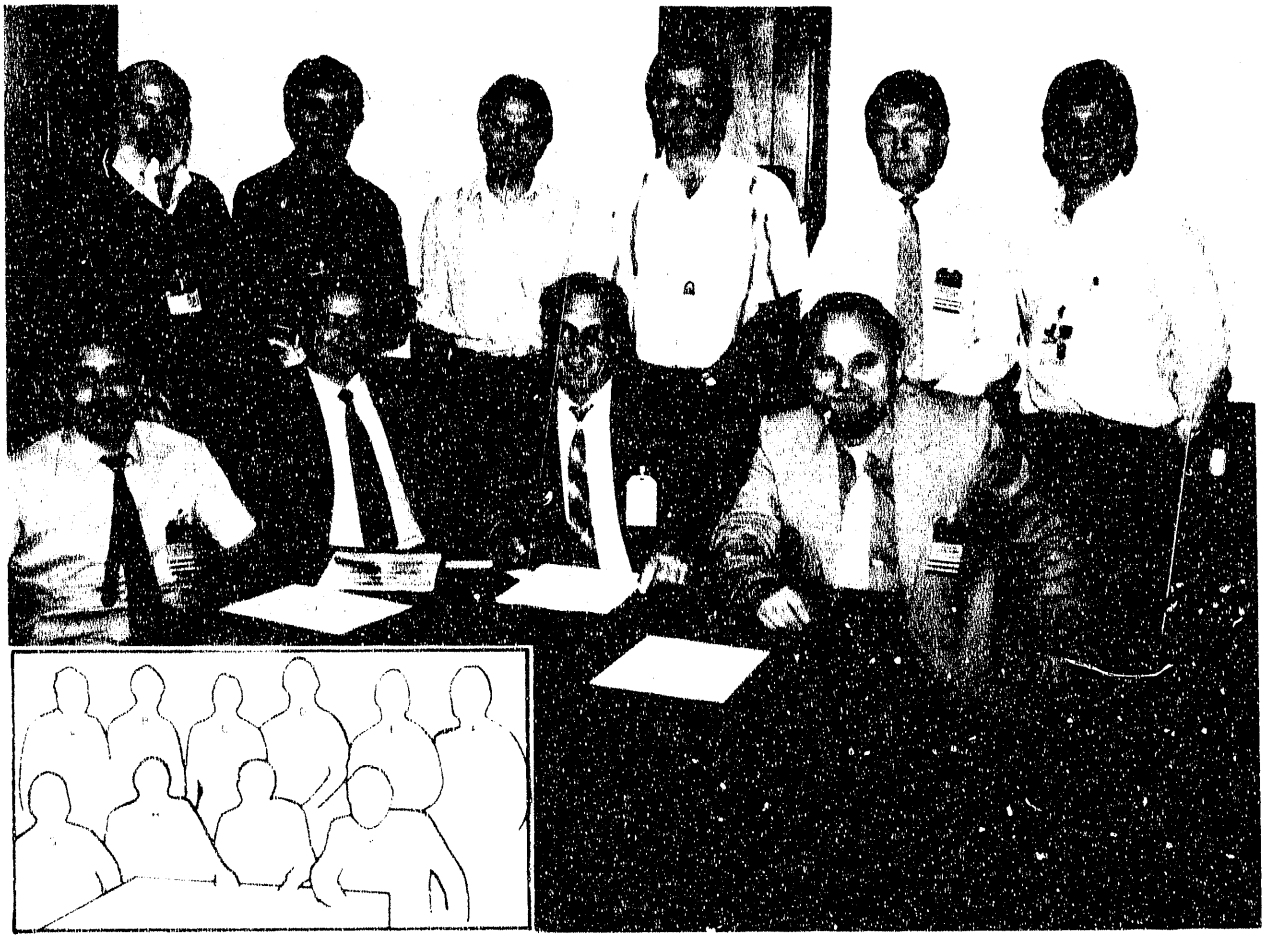
This report summarizes CDIAC's activities in collecting and distributing information during FY 1991, its tenth year of existence.

For more information about CDIAC or to request information products from CDIAC, contact the Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, TN 37831-6335 U.S.A.; telephone 615-574-0390, FAX 615-574-2232; TELEX 854478; electronic mail CDP@ORNLSTC (Bitnet), CDP@STC10.CTD.ORNL.GOV (Internet), or CDIAC (Omnet).

# 2. HIGHLIGHTS

## Soviet Scientists Visit CDIAC

During FY 1991, CDIAC expanded its interactions with scientists from the Soviet Union. Konstantin Vinnikov (State Hydrological Institute, Leningrad, U.S.S.R.) came to CDIAC to continue earlier discussions that originated when CDIAC visitors Mike Farrell and Paul Kanciruk were in Moscow in August of 1990. Of interest to CDIAC and Dr. Vinnikov were both groups' data-related activities and future collaboration. CDIAC will be working with Dr. Vinnikov's empirical analyses of climate data, which he has supplied to CDIAC for production of related numeric data packages. A five-member team of scientists—Drs. Gennadiy Menzhulin (Head, Laboratory on Study of Water Regime in Agroecological Systems, Agrophysical Institute, Leningrad); Yakov Popov (Head, Main Department of the Hydrometeorological Systems, U.S.S.R. State Committee for Hydrometeorology, Moscow), Vladimir Radyukhin (Chief, Synoptic Climatology Department), Vyacheslav Razuvayev (Chief, Climatology Department), and Rudolf Reitenbach (Director, All-Union Research Institute of Hydrometeorological Information, Obninsk)—spent two days visiting with CDIAC staff to discuss possible future collaboration and data exchange potentials. Such visits have opened exciting avenues for future CDIAC activities and for enhancing the program's goals for making important data sets available for large-scale use. They also demonstrate the effectiveness of CDIAC's international networking efforts. Pictured below are the five Soviet scientists and CDIAC staff at their November 6–7, 1990, meeting at Oak Ridge National Laboratory (ORNL).



(A) Michael P. Farrell, CDIAC; (B) Russell S. Vose, CDIAC; (C) Robert J. Sepanski, CDIAC; (D) Dale P. Kaiser, CDIAC; (E) Vyacheslav Razuvayev; (F) Thomas A. Boden, CDIAC; (G) Vladimir Radyukhin; (H) Rudolf Reitenbach; (I) Yakov Popov; and (J) Gennadiy Menzhulin

## CDIAC Continues Work on Chinese Climate Data

CDIAC staff initiated efforts to produce a DOE technical report on the basis of climate data, some originating in the late 600s, which were obtained from the People's Republic of China's Academy of Sciences. Additional climate and proxy data were received from Drs. Shi-Yan Tao and Wei-Yun Zhang, to be used in current CDIAC program activities. CDIAC outreach related to interactions among the Chinese scientific community included the exchange of data sets (Shi-Yan Tao's) with Wei-Chyung Wang, Tom Karl, Sultan Hameed and David Portman; a meeting in Albany, New York, to discuss the Chinese climate and proxy data; and correspondence with Qing-Yun Zhang requesting assistance in dealing with erroneous data values that have been identified by CDIAC. These interactions with Chinese scientists are providing a unique opportunity for all parties involved to exchange, discuss, and refine data and to exchange ideas related to the use and quality control of these unique data sets. An example of such data set shown in Fig. 1. The graph represents flood data that record the dates of the flowering of plum trees, which vary in response to weather conditions (in this case to patterns of rainfall prior to and during the blossoming of plum trees).

The graph also illustrates the enhanced graphics capability made possible by the new SPARC™ workstations. The output file for this graph, produced by the SAS™/GRAPH software, is 631,288 bytes in size, yet took only 3.88 minutes to generate. The simultaneous display of ten time-series plots and the accompanying annotated legends would have been impossible even on our fastest 386 PCs using the current PC SAS™ software. For somewhat simpler graphics that were previously generated on the PCs, the SPARC™ workstations can effect a very substantial decrease in processing time, often as much as 100-fold.

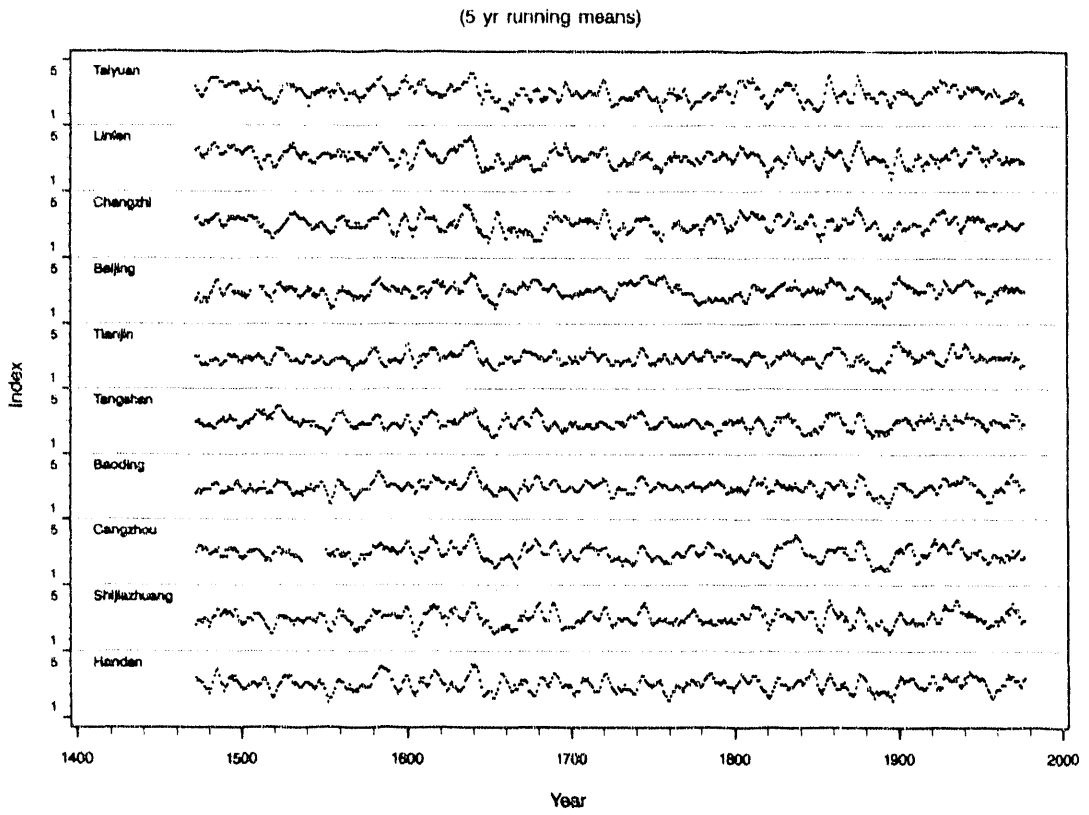



Fig. 1. Proxy precipitation records for 10 Chinese cities from the 1400s through the 1990s.

## CDIAC Hosts Data Centers Directors' Meeting

**World Data Center-A and U.S. national data center directors convene their 1991 meeting at ORNL.**

CDIAC hosted the 1991 meeting of the directors of the World Data Center-A (WDC-A) and the directors of the U.S. national data centers. Among the organizations represented were the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), DOE, the U.S. Geological Survey (USGS), and several universities. WDC-A is the U.S arm of the World Data Center System, which is sponsored by the International Council of Scientific Unions. Among the items discussed at their 2-day meeting was a proposal to include global-change data in the U.S. coverage of environmental and geoscience data.

## Update of $CO_2$ Emissions Data

A data base compiled by CDIAC showed that total global $CO_2$ emissions reached $5.954 \times 10^9$ metric tons of carbon in 1989, an increase of 1.09% over 1988. This estimate represents the largest annual emission ever from fossil-fuel consumption and cement production and continues an increasing trend that has prevailed since 1983. Decreases that followed the oil price shocks of the 1970s into the early 1980s have now been erased, and a new upward trend seems well established even though the 1989 growth rate is considerably less than the 4.05% growth from 1987 to 1988. U.S. emissions reached $1.329 \times 10^9$ metric tons of carbon in 1989 (5.37 metric tons of carbon per capita and 22% of the global total), exceeding the previous high set in 1988 and continuing an increasing trend that began in 1983. U.S. emissions grew by 1.14% in 1989, down from the 4.78% growth seen in 1988, and making 1989 the third consecutive year this growth rate was higher than the global average growth rate.

## *Trends '91* Available

*Trends '91: A Compendium of Data on Global Change*, a source of frequently used global-change data, was produced during FY 1991. This second issue of the *Trends* series expands the coverage of sites recording atmospheric concentrations of $CO_2$ and methane ($CH_4$), and it updates records reported in *Trends '90*. Historical records from ice cores and modern records from continuous monitoring and flask sample programs are provided, as well as new data for trace atmospheric gases. Historical data from ice cores are reported for nitrous oxide ($N_2O$), as are modern records of atmospheric concentrations of chlorofluorocarbons (CFC-11 and CFC-12) and $N_2O$. Global emissions of CFC-11 and CFC-12 are also presented. The estimates for global and national $CO_2$ emissions from burning of fossil fuels, production of cement, and gas flaring have been revised and updated. Regional $CO_2$ emission estimates have been added, and long-term temperature records have been updated and augmented.

The 700 page report is printed in an 8½- x 11-in. format with data records presented in four- or six-page sections, each dealing with a specific site, region, or emission species. Data records include tables; graphs; maps; discussions of methods for collecting, measuring, and reporting the data; trends in the data; and references that provide further information. All data appearing in the document are also available on digital media. A total of 74 individual investigators from 30 institutions in 10 countries contributed data for inclusion in *Trends '91*.

## CDIAC Produces First GIS NDP

CDIAC's repertoire for data packaging increased in FY 1991 with the production of its first numeric data package (NDP) for use with geographic information system (GIS) software. NDP-35, *A Global Geographic Information System Data Base of Storm Occurrences and Other Climatic Phenomena Affecting Coastal Zones*, has several applications in climatology and climate change research and policy development. For example, cyclonicity data may be used to calibrate or verify general circulation models, and the tropical/extratropical cyclone frequency data may be used to estimate the recurrence intervals of storm events, such as hurricanes. This NDP consists of documentation and magnetic media (i.e., tapes or diskettes). Each of the data groups is provided with its own ARC/INFO export file, a flat ASCII file, and dedicated I/O routines. The flat file for each data group has been designed to allow the entry of this data into both grid-based GISs and non-GIS data base management systems.

# 3. ORGANIZATION AND STAFF

Paul Kanciruk is the director of CDIAC, which is located in the Earth Sciences Section of the Environmental Sciences Division (ESD) at ORNL. Robert M. Cushman is Deputy Director, and Patricia J. Crabtree is CDIAC's secretary. CDIAC consists of three groups (Fig. 2): Data Systems, Information Systems, and Computer Systems, headed, respectively, by Thomas A. Boden, Frederick W. Stoss, and Tommy R. Nelson. The Data Systems group handles the quality assurance and documentation of data which is the cornerstone of CDIAC. Through its Information Systems group, CDIAC provides a forum for the exchange of data among researchers and is active in a network of information organizations and special libraries and in publicizing its products and services. CDIAC's Computer Systems group, in addition to maintaining CDIAC's own network of personal computers, work stations, and links with ORNL's mainframe computers, strives to ensure that CDIAC's system is compatible with that of its user community. Table 1 lists the CDIAC staff and their titles.

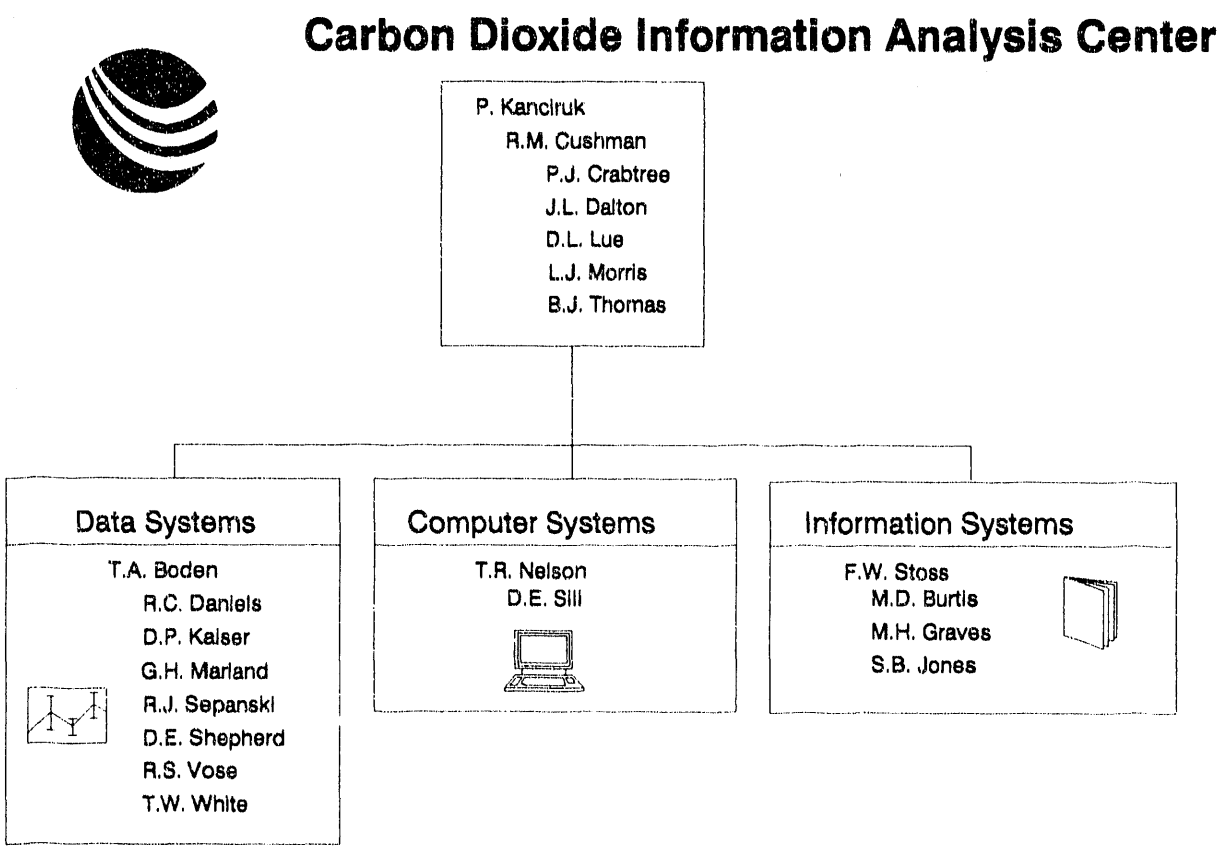



**Fig. 2. CDIAC organization** (September 30, 1991).

## Table 1. CDIAC staff, FY 1991

| Staff | Title |
|---|---|
| Thomas A. Boden | Task Leader, Data Systems |
| Marvel D. Burtis | Editorial Assistant |
| Linda S. Cooper* | Secretary |
| Patricia J. Crabtree | Secretary |
| Robert M. Cushman | Deputy Director, CDIAC |
| Richard C. Daniels** | Data Packaging Specialist |
| M. Helen Graves** | Request-Response Associate |
| Annetta M. Hendricks* | Secretary |
| Sonja B. Jones** | Request-Response Coordinator |
| Dale P. Kaiser** | Data Packaging Specialist |
| Paul Kanciruk | Director, CDIAC |
| Don L. Lue** | Associate Budget and Subcontracts Coordinator |
| Gregg Marland | $CO_2$ Emissions Specialist |
| Laura J. Morris | Budget and Subcontracts Coordinator |
| Tommy R. Nelson*** | Task Leader, Computer Systems |
| Robert J. Sepanski** | Data Packaging Specialist |
| Deborah E. Shepherd | Data Packaging Assistant |
| David E. Sill*** | Workstation Specialist |
| Kristi L. Stewart* | Office Assistant |
| Frederick W. Stoss** | Task Leader, Information Systems |
| B. Jeanne Thomas | Office Assistant |
| Russell S. Vose** | Data Packaging Specialist |
| Tammy W. White | Geographic Information Systems Specialist |

*Environmental Sciences Division, Earth Systems Section, September 30, 1991

**Energy, Environment, and Resources Center, The University of Tennessee, Knoxville

***Computing and Telecommunications Division, Oak Ridge National Laboratory

## Professional Development

CDIAC staff are encouraged to attend various workshops and training programs. These opportunities allow staff to gain new skills and improve their expertise in areas related to CDIAC's operations. The following is a list of CDIAC staff professional development activities for FY 1991.

- Fred Stoss attended a 1-day training workshop, Estimating the Total Costs of Publications, which was sponsored by the East Tennessee Chapter of the Society for Technical Communications.

- Russell Vose and Robert Sepanski attended a training course, SAS™ Macro Language. This should improve efficiency in running complex or redundant SAS™ jobs, such as those that will be required in the making of *Trends '91* and those that will be used in compiling the Global Historical Climatology Network (GHCN) data base.

- Dale Kaiser attended a SAS™ Programming training course in Toronto, March 5–8, 1991.

- Fred Stoss attended a 1-day ORNL class, Fundamentals of Document Design for Desktop Publishers.

- Dale Kaiser completed SAS™ Color Graphics I and II courses in Toronto, Canada, September 23–27, 1991.

- Tom Boden completed a SAS™ PC Graphics course in Irvine, California (October 22-26, 1991).

# 4. REQUEST-RESPONSE RECORDS ($R^3$) SYSTEM

When CDIAC began in 1982, the topic of greenhouse warming was still primarily a research topic, and CDIAC's role was, for the most part, one of distributing data *from* researchers *to* researchers. By 1990, however, when greenhouse warming was front-page news, the subject of newsmagazine lead stories, congressional attention, and international conferences, CDIAC's role—and its user community—had broadened considerably. CDIAC has been fielding information requests from congressional staffers drafting or evaluating legislation, from public school students working on science fair projects, and from science reporters compiling data for stories as well as from research scientists. The broadening of scope was accompanied by an enormous increase in the *volume* of requests, as well: the annual number of information requests handled by CDIAC has grown from 1360 in 1982 to 8650 in 1991 (Table 2).

**Table 2. Request/response activities**

| | Number of requests | | | | | |
|---|---|---|---|---|---|---|
| | Quarter FY 1991 | | | | | Total FY 1985 |
| Category | 1st | 2nd | 3rd | 4th | Total | To date |
| Discussions[a] | 875 | 934 | 972 | 747 | 3,528 | 13,451 |
| DOE reports | 170 | 260 | 222 | 168 | 820 | 4,728 |
| CDIAC reports | 471 | 624 | 506 | 451 | 2,052 | 4,314 |
| Other reports | 69 | 61 | 78 | 61 | 269 | 557 |
| Data processing | 8 | 3 | 5 | 5 | 21 | 267 |
| Articles | 15 | 9 | 80 | 12 | 116 | 399 |
| NDPs | 78 | 142 | 164 | 141 | 525 | 1,697 |
| CMPs | 14 | 14 | 14 | 18 | 60 | 355 |
| Directory searches | 410 | 340 | 283 | 226 | 1,259 | 3,132 |
| Total | 2,110 | 2,387 | 2,324 | 1,829 | 8,650 | 28,900 |

[a]Discussions include telephone conversations, letters, and interoffice correspondence that pertain to DOE deliverables or other $CO_2$-related matters. It does not include day-to-day operations at CDIAC.

- Responded to 8650 requests from 2781 individuals for CDIAC products and services from 73 countries: Algeria, Argentina, Australia, Austria, Bangladesh, Belgium, Botswana, Brazil, Bulgaria, Canada, Cape Verde, Central African Republic, Chile, Costa Rica, Cuba, Cyprus, Denmark, Ecuador, Egypt, Ethiopia, Finland, France, Germany, Ghana, Greece, Hong Kong, Hungary, India, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Japan, Kenya, Malaysia, Maldives, Malta, Mauritius, Mexico, Netherlands, New Zealand, Nigeria, North Korea, Norway, Pakistan, People's Republic of China, Philippines, Poland, Portugal, Romania, Saudi Arabia, Senegal, Singapore, South Africa, South Korea, Spain, Sri Lanka, Sweden, Switzerland, Syrian Arab Republic, Taiwan, Tanzania, Thailand, Turkey, United Kingdom, United States, U.S.S.R., Uruguay, Venezuela, Vietnam, and Zimbabwe (Fig. 3).

- Responded to 12 requests for the data presented in two technical reports: *Global Lake-Level Variations from 18,000 to 0 Years Ago: A Palaeoclimatic Analysis* (TR046, DOE/ER/60304-H1, September 1989, 213 pp.) and *A Comprehensive Precipitation Data Set for Global Land Areas* (TR051, DOE/ER-69017T-H1, April 1991, 82 pp.). In filling these requests, six floppy diskettes and seven magnetic tapes were generated.

  A total of 28,900 requests from 94 countries have been filled from FY 1985 to date (Fig. 4).

- Received a total of 2461 requests for reports, including:

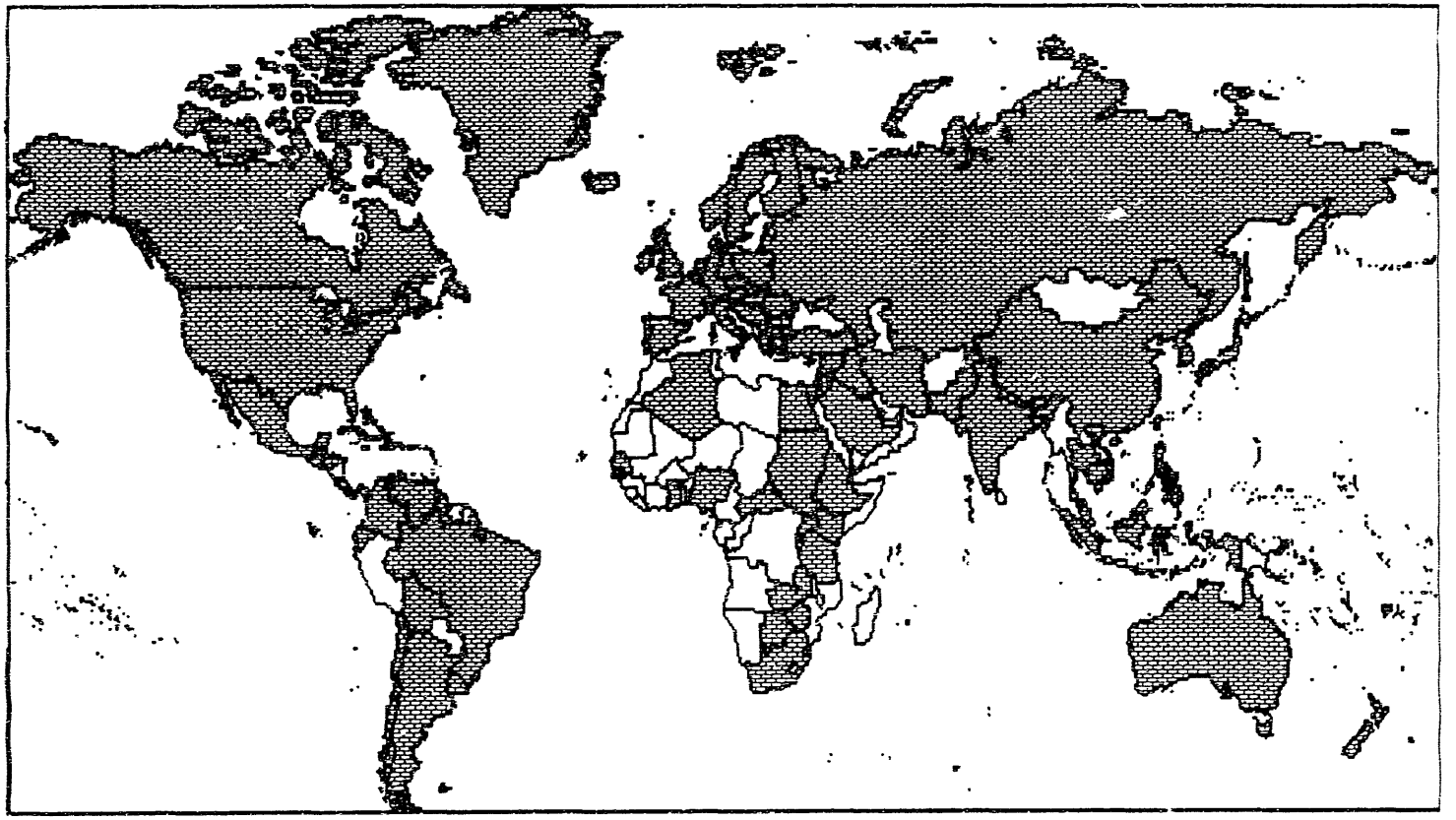
  DOE reports
  820 requests
  4,134 copies distributed

  CDIAC reports
  2,052 requests
  10,669 copies distributed

  Other reports
  269 requests

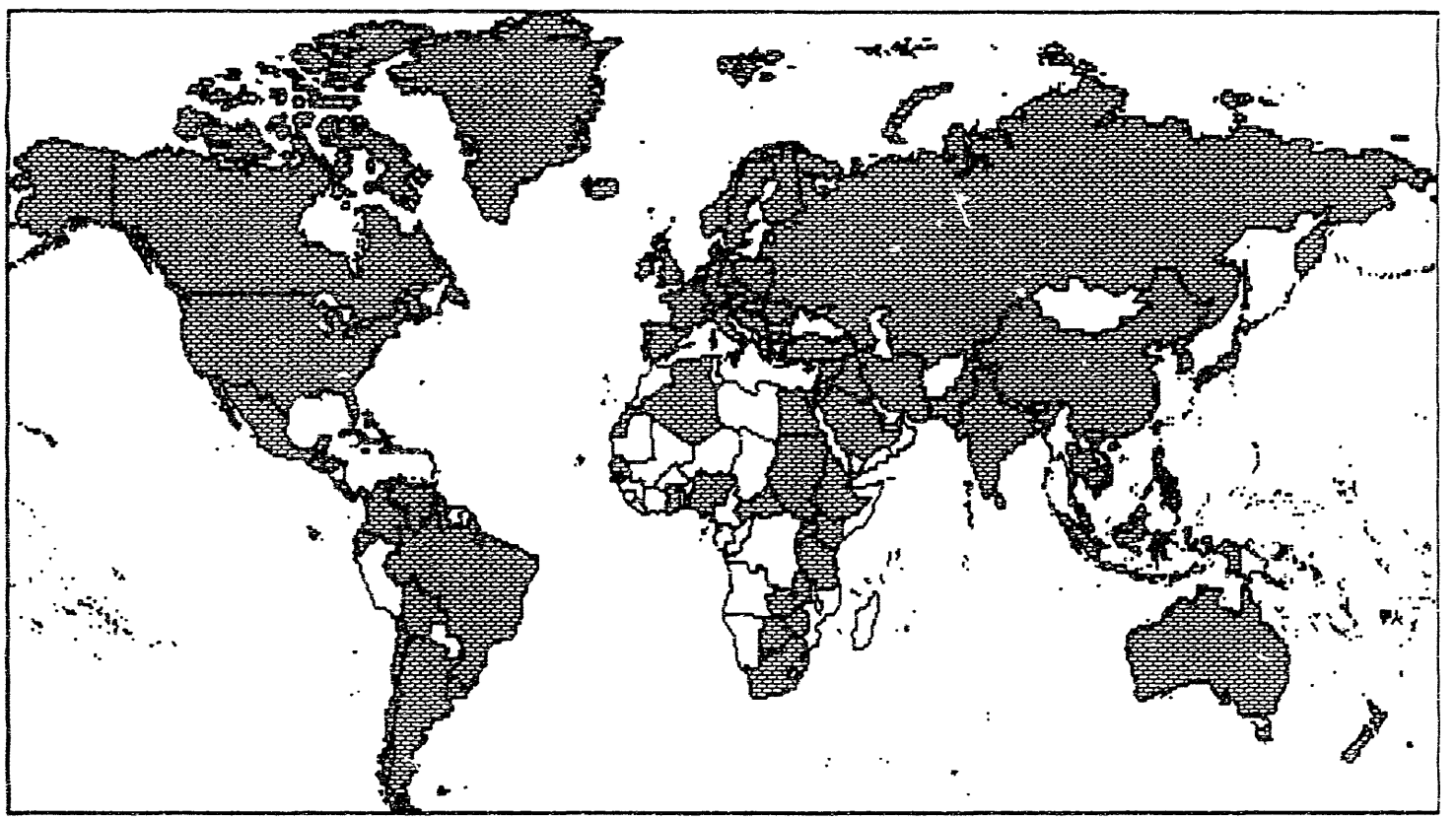
  Total reports distributed: 15,072

- Figure 5 shows the summary of request/response activities for FY 1991, while Figs. 6 and 7 summarize request/response activities from FY 1985–91 and FY 1990–91, respectively. The distribution by CDIAC of DOE Reports and CDIAC reports is summarized in Tables 3 and 4, respectively.



8,650 requests from 73 countries

**Fig. 3. FY 1991 request/response activities world map.**



28,900 requests from 94 countries

**Fig. 4. Request/response activities FY 1985 through FY 1991 world map.**

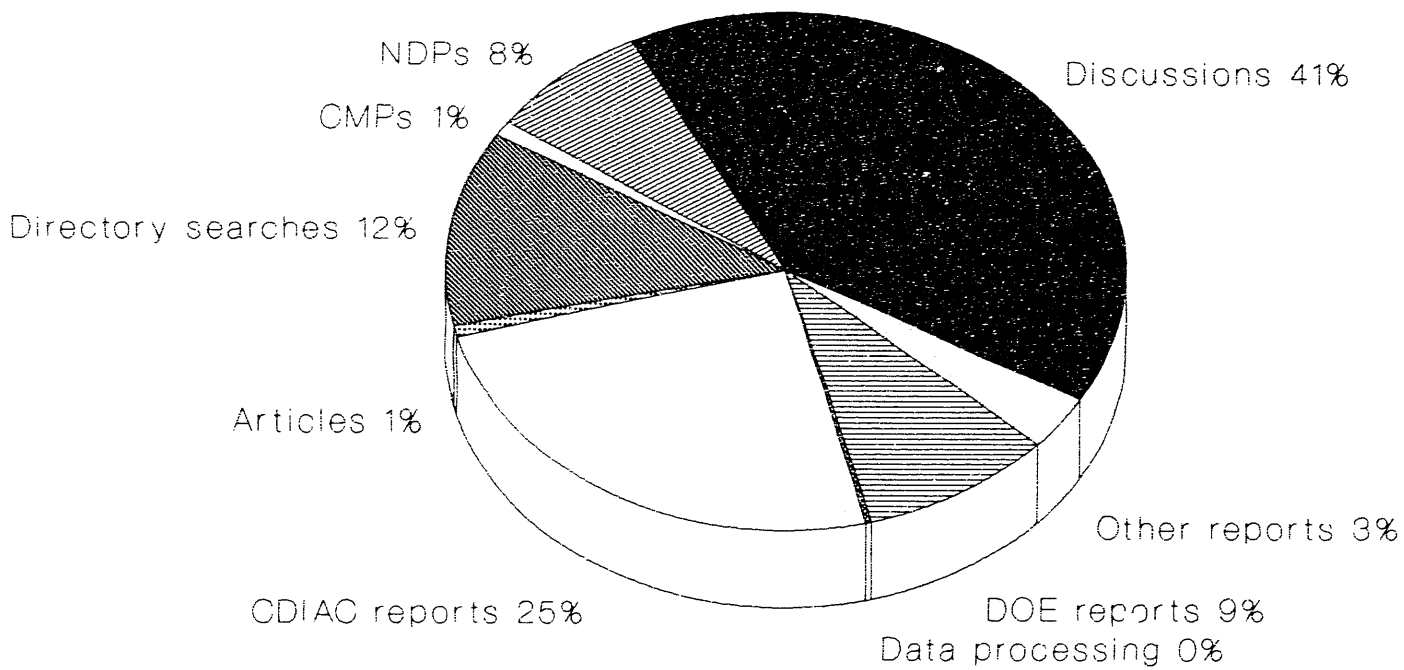



**Fig. 5. FY 1991 request/response activities graph.**

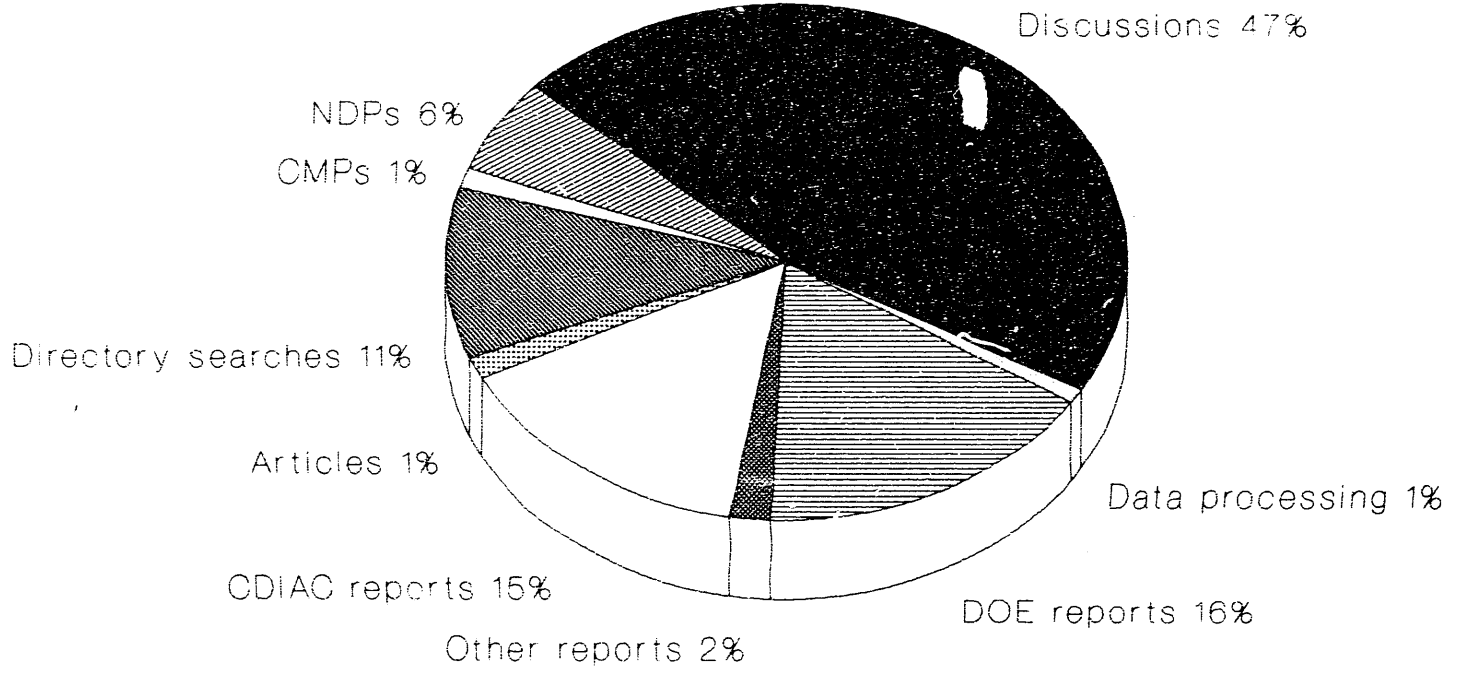



**Fig. 6. Request/response activities FY 1985 through FY 1991 graph.**

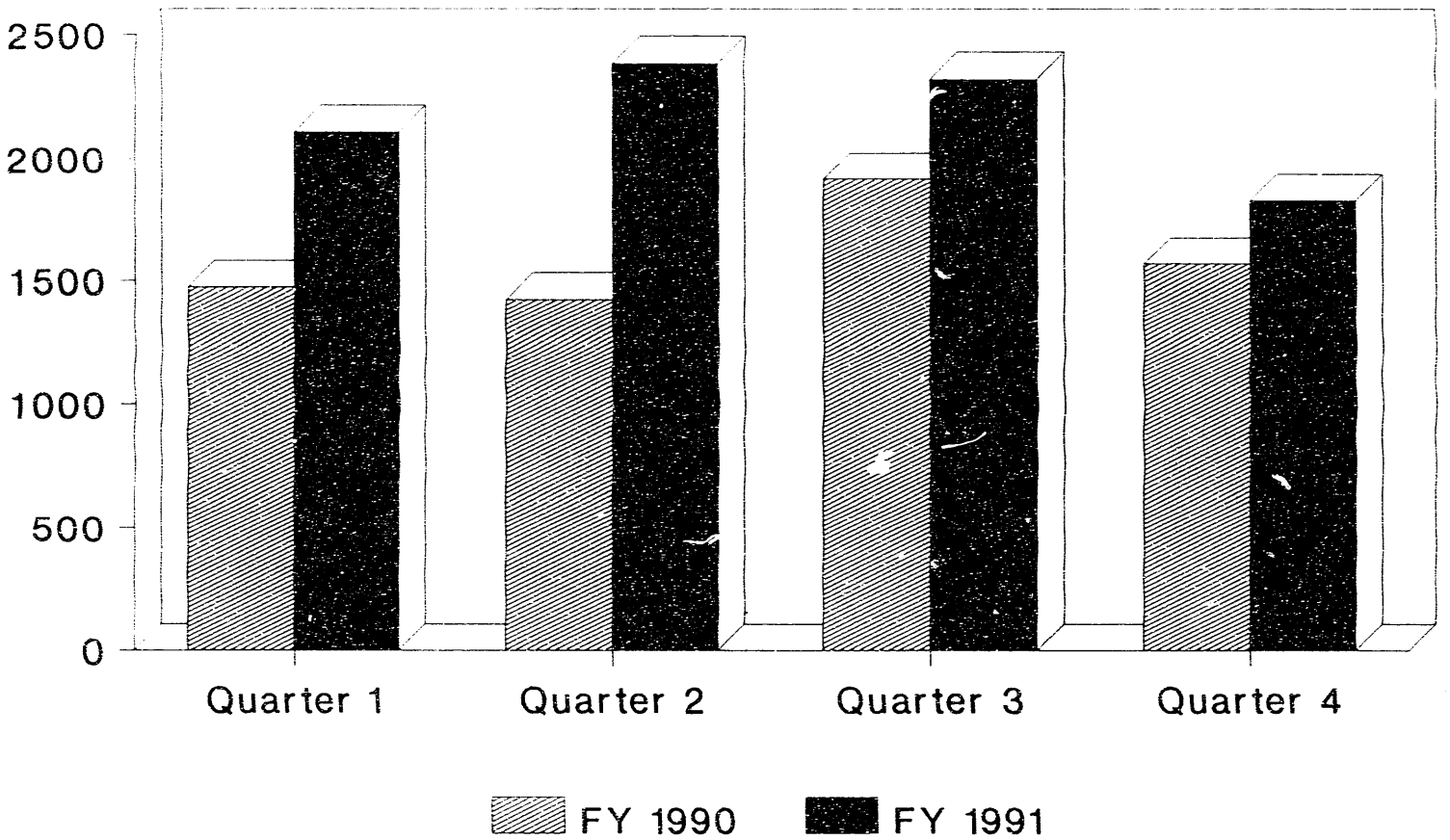



Fig. 7. Request/response activities per quarter FY 1990 vs FY 1991.

## Table 3. DOE Reports Distribution

| Report number | Title and contents | Quarter (FY 1991) | | | | | Total FY 1985 to date | Remaining copies |
|---|---|---|---|---|---|---|---|---|
| | | 1st | 2nd | 3rd | 4th | Total | | |
| 001 | Workshop on the Global Effects of Carbon Dioxide From Fossil Fuels, May 1979 | | 1 | | | 1 | 25 | N/A |
| 002 | Summary of the Carbon Dioxide Effects and Assessment Program | | | | | | 12 | N/A |
| 003 | The Role of Temperate Zone Forests in the World Carbon Cycle, February 1980 | | | | | | 25 | N/A |
| 004 | The Role of Organic Soils in the World Carbon Cycle, February 1980 | | | | | | 25 | N/A |
| 005 | Carbon Dioxide Research Progress Report, April 1980 | 2 | 3 | 2 | | 7 | 43 | 119 |
| 006 | Environmental Control Technology for Atmospheric Carbon Dioxide, May 1980 | | 3 | | | 3 | 18 | 8 |
| 007 | The Role of Tropical Forests in the World Carbon Cycle, August 1980 | | 4 | | | 4 | 58 | 5 |
| 008 | A Comprehensive Plan for Effects Research and Assessment, Part 1: The Global Carbon Cycle and Climatic Effects of Increasing Carbon Dioxide | 2 | 2 | 3 | 1 | 8 | 41 | 74 |
| 009 | Workshop on Environmental and Societal Consequences of a Possible $CO_2$-Induced Climate Change, September 1980 | 2 | 4 | 4 | | 10 | 89 | 48 |
| 010 | Measurement of Changes in Terrestrial Carbon Using Remote Sensing | | 3 | | | 3 | 13 | 8 |
| 011 | Proceedings of the Carbon Dioxide and Climate Research Program Conference, December 1980 | 1 | 4 | 2 | | 7 | 48 | 28 |

## Table 3 (continued)

| Report number | Title and contents | Quarter (FY 1991) 1st | 2nd | 3rd | 4th | Total | Total FY 1985 to date | Remaining copies |
|---|---|---|---|---|---|---|---|---|
| 012 | Proceedings of the International Meeting on Stable Isotopes in Tree-Ring Research, December 1980 | 2 | 4 | 4 | 1 | 11 | 40 | 7 |
| 013 | Environmental and Societal Consequences of a Possible $CO_2$-Induced Climate Change - A Research Agenda, Volume I (December 1980). Volume II (Various Dates for 16 Parts, December 1980) | | 3 | | | 3 | 23 | N/A |
| | Part 1 | | | | | | 4 | N/A |
| | Part 2 | | | | | | 1 | N/A |
| | Part 3 | | | | | | 50 | N/A |
| | Part 4 | | | | | | 58 | 19 |
| | Part 5 | | | | | | 62 | N/A |
| | Part 6 | | | | | | 82 | 115 |
| | Part 7 | | | | | | 69 | 243 |
| | Part 8 | | | | | | 82 | 139 |
| | Part 9 | | | | | | 63 | 83 |
| | Part 10 | | | | | | 66 | 123 |
| | Part 11 | | | | | | 57 | 97 |
| | Part 12 | | | | | | 64 | 155 |
| | Part 13 | | | | | | 74 | 163 |
| | Part 14 | | | | | | 58 | 206 |
| | Part 16 | | | | | | 63 | 209 |
| | Part 17 | | | | | | 76 | 163 |
| 014 | Some Aspects of the Role of the Shallow Ocean in Global Carbon Dioxide Uptake, January 1981 | 4 | 4 | 3 | | 11 | 81 | N/A |

Table 3 (continued)

| Report number | Title and contents | Quarter (FY 1991) 1st | 2nd | 3rd | 4th | Total | Total FY 1985 to date | Remaining copies |
|---|---|---|---|---|---|---|---|---|
| 015 | Carbon Balance in Northern Ecosystems and the Potential Effect of Carbon Dioxide-Induced Climatic Change, January 1981 | | 1 | | | 1 | 21 | N/A |
| 016 | Flux of Organic Carbon by Rivers to the Oceans, April 1981 | 4 | 4 | 4 | 1 | 13 | 50 | 57 |
| 017 | Workshop on Oceanic $CO_2$ Standardization, February 1982 | 3 | 3 | 2 | | 8 | 59 | 200 |
| 018 | Proceedings of the Workshop on First Detection of Carbon Dioxide Effects, May 1982 | | 2 | | 2 | 4 | 53 | N/A |
| 019 | Global Dynamics of Biospheric Carbon, July 1982 | | | | | | 15 | N/A |
| 020 | Effect of $CO_2$ on Mammalian Organisms, December 1982 | | | | | | 19 | N/A |
| 021 | Proceedings: Carbon Dioxide Research Conference: Carbon Dioxide, Science and Consensus, February 1983 | 2 | | 2 | | 4 | 39 | N/A |
| 022 | Conf 8608144--Proceedings of the International Symposium of Ecological Aspects of Tree Ring Analysis | | 6 | 5 | 2 | 13 | 47 | 39 |
| 023 | Conf 8708252--Proceedings from the Second Annual Science Meeting of the USDOE and PRCAS Joint Research Program | 1 | 1 | 5 | | 7 | 38 | N/A |
| 024 | Workshop on Sea Level Rise and Coastal Processes, March 1989 | 5 | 5 | 7 | 3 | 20 | 161 | 75 |
| CONF-890525 | Proceedings of the International Conference on Global and Regional Environmental Atmospheric Chemistry, Beijing, China, May 3-10, 1989 | 11 | 21 | 11 | | 43 | 43 | N/A |

## Table 3 (continued)

| Report number | Title and contents | Quarter (FY 1991) 1st | 2nd | 3rd | 4th | Total | Total FY 1985 to date | Remaining copies |
|---|---|---|---|---|---|---|---|---|
| CONF-9006134 | Global Climate Feedbacks: Proceedings of the Brookhaven National Laboratory Workshop June 3–6, 1990 | | 33 | 7 | 30 | 70 | 70 | 19 |
| TR001 | On Possible Changes in Global Sea Level and Their Potential Causes, March 1983 | 4 | 9 | 5 | 1 | 19 | 138 | 13 |
| TR002 | Effects of Approximate Radiation Treatments Used in the Climate Models on the Clear Sky Thermal Radiation Flux: Its Perturbation Due to $CO_2$ Increase, January 1983 | 3 | 5 | 6 | 1 | 15 | 90 | 18 |
| TR003 | Carbon Dioxide Emissions from Fossil Fuels: A Procedure for Estimation and Results for 1950–1981, June 1983 | 3 | 10 | 6 | 2 | 21 | 175 | 6 |
| TR004 | Carbon in Live Vegetation of Major World Ecosystems, June 1983 | 6 | 11 | 6 | 5 | 28 | 174 | 23 |
| TR005 | Deforestation Measured by LANDSAT: Steps Toward a Method, June 1983 | 4 | 9 | 10 | 2 | 25 | 191 | 11 |
| TR006 | Response of the North American Corn Belt to Climate Warming, August 1983 | 2 | 7 | 5 | 3 | 17 | 124 | 28 |
| TR007 | An Analysis of Concepts for Controlling Atmospheric Carbon Dioxide | 7 | 11 | 7 | 2 | 27 | 268 | 12 |
| TR008 | Carbonate Chemistry of the Weddell Sea | 5 | 4 | 6 | | 15 | 106 | 25 |
| TR009 | Response of Unmanaged Forests to $CO_2$-Induced Climate Change: Available Information, Initial Tests, and Data Requirements | 4 | 7 | 9 | 4 | 24 | 143 | 6 |
| TR010 | Computer Implementation of a Globally Averaged Model of the World Carbon Cycle | 4 | 10 | 7 | 4 | 25 | 182 | 191 |

**Table 3 (continued)**

| Report number | Title and contents | Quarter (FY 1991) 1st | 2nd | 3rd | 4th | Total | Total FY 1985 to date | Remaining copies |
|---|---|---|---|---|---|---|---|---|
| TR011 | Historical Carbon Dioxide: Abundances Derived from the Smithsonian Spectrobolograms | 2 | 5 | 6 | | 13 | 103 | 28 |
| TR012 | Seasonal Climate Scenario for Europe and North America in the High-$CO_2$, Warmer World | 2 | 8 | 5 | 3 | 18 | 126 | 14 |
| TR013 | An Analysis of Possible Future Atmospheric Retention of Fossil Fuel $CO_2$ | 3 | 10 | 5 | 1 | 19 | 191 | 51 |
| TR014 | The Changing Pattern of Fossil Fuel $CO_2$ Emissions | 3 | 12 | 4 | 1 | 20 | 185 | 35 |
| TR015 | A Proposed Reference Set of Scenarios for Radiatively Active Atmospheric Constituents | 2 | 8 | 6 | | 16 | 138 | 33 |
| TR016 | A Systems Study for the Removal, Recovery and Disposal of Carbon Dioxide from Fossil Fuel Power Plants in the U.S. | 7 | 10 | 9 | 4 | 30 | 215 | 21 |
| TR017 | A Climatic Data Bank for Northern Hemisphere Land Areas, 1851-1980 | 3 | 10 | 7 | 2 | 22 | 203 | 113 |
| TR018 | A Global Paleoclimatic Data Base for 6000 Year B.P. | 2 | 4 | 5 | 4 | 15 | 147 | 12 |
| TR019 | Carbon Dynamics of Northern Hardwood Forests: Gas Exchange Characteristics | 3 | 10 | 5 | 4 | 22 | 103 | 44 |
| TR020 | Reconstruction of Past Atmospheric $CO_2$ Contents from the Chemistry of the Contemporary Ocean: An Evaluation | 6 | 4 | 4 | 1 | 15 | 117 | 18 |
| TR021 | A Two Dimensional $CO_2$-Ocean Model Including the Biological Processes | 4 | 6 | 4 | 3 | 17 | 105 | 58 |

## Table 3 (continued)

| Report number | Title and contents | Quarter (FY 1991) 1st | 2nd | 3rd | 4th | Total | Total FY 1985 to date | Remaining copies |
|---|---|---|---|---|---|---|---|---|
| TR022 | A Grid Point Surface Air Temperature Data Set for the Northern Hemisphere | 2 | 7 | 9 | 1 | 19 | 122 | 10 |
| TR023 | The Effect of Elevated Atmospheric $CO_2$ on Plant Communities | 26 | 8 | 8 | 4 | 46 | 178 | 12 |
| TR024 | Methods of Uncertainty Analysis for a Global Carbon Dioxide Model | 2 | 4 | 6 | 1 | 13 | 119 | 15 |
| TR025 | The Stability of Low-Altitude Sea Surface Temperatures: An Evaluation of the CLIMAP Reconstruction with Emphasis on the Positive SST Anomalies | 2 | 5 | 5 | 1 | 13 | 71 | 61 |
| TR026 | Carbonate Chemistry of the Bering Sea | 3 | 4 | 6 | | 13 | 56 | 17 |
| TR027 | A Grid Point Surface Air Temperature Data Set for the Southern Hemisphere | 3 | 8 | 8 | 1 | 20 | 128 | 55 |
| TR028 | Definition and Characterization of Data Needs to Describe the Potential Effects of Increased Atmospheric $CO_2$ on Marine Fisheries from the Northeast Pacific Ocean | 1 | 5 | 4 | 1 | 11 | 63 | 110 |
| TR029 | Preliminary Data Report for the INDIGO1/INDIVAT 3 Cruises in the Indian Ocean | 3 | 4 | 4 | | 11 | 45 | 99 |
| TR030 | Effects of Energy Technology on Global $CO_2$ Emissions | 7 | 17 | 14 | 4 | 42 | 331 | 26 |
| TR031 | Impact of Climate Change from Increased Atmospheric Carbon Dioxide on American Agriculture | 25 | 7 | 8 | 28 | 68 | 309 | 32 |
| TR032 | A Comparison of Tropical Forest Surveys | 2 | 7 | 7 | 2 | 18 | 133 | 17 |

**Table 3 (continued)**

| Report number | Title and contents | Quarter (FY 1991) 1st | 2nd | 3rd | 4th | Total | Total FY 1985 to date | Remaining copies |
|---|---|---|---|---|---|---|---|---|
| TR033 | High Accuracy Standards and Reference Methodology for Carbon Dioxide in Air | 3 | 5 | 5 | | 13 | 67 | 110 |
| TR034 | Carbonate Chemistry of the North Pacific Ocean | 4 | 5 | 9 | | 18 | 73 | 74 |
| TR035 | An Annotated Inventory of Climatic Indices and Data Sets | 2 | 5 | 9 | 4 | 20 | 191 | 40 |
| TR036 | Uncertainty in Future Global Energy Use and Fossil Fuel $CO_2$ Emissions 1975 to 2075 | 4 | 20 | 6 | 3 | 33 | 295 | 231 |
| | Appendices for TR036 | | 8 | 2 | 4 | 14 | 41 | 16 |
| TR037 | Monthly Mean Pressure Reconstructions for Europe (Back to 1780) and North America (to 1958) | 3 | 6 | 5 | 2 | 16 | 92 | 64 |
| TR038 | Data Bank of Antarctic Surface Temperature and Pressure Data | 2 | 6 | 4 | 1 | 13 | 49 | 126 |
| TR039 | The Prospect of Solving the $CO_2$ Problem Through Global Reforestation | 17 | 20 | 18 | 10 | 65 | 462 | 88 |
| TR040 | A Primer on Greenhouse Gases | 12 | 21 | 22 | 9 | 64 | 1035 | 38 |
| TR041 | Regional Intercomparisons of General Circulation Model Predictions and Historical Climate Data | 6 | 10 | 9 | 6 | 31 | 413 | 271 |
| TR042 | Surface Energy Balance of Three General Circulation Models: Current Climate and Response to Increasing $CO_2$ | 5 | 9 | 8 | 2 | 24 | 165 | 34 |
| TR043 | The Use of Statistical Climate Crop Models for Simulating Yield to Project the Impacts of $CO_2$ Induced Climate Change | 4 | 10 | 8 | 4 | 26 | 121 | 260 |

Table 3 (continued)

| Report number | Title and contents | Quarter (FY 1991) 1st | 2nd | 3rd | 4th | Total | Total FY 1985 to date | Remaining copies |
|---|---|---|---|---|---|---|---|---|
| TR044 | Documentation of IAP Two-Level Atmospheric General Circulation Model | 3 | 6 | 8 | 2 | 19 | 48 | 6 |
| TR045 | A Preliminary Analysis of U.S. $CO_2$ Emissions Reduction Potential from Energy Conservation and the Substitution of Natural Gas for Coal in the Period to 2010 | 19 | 20 | 15 | 4 | 58 | 547 | 512 |
| TR046 | Global Lake-Level Variations from 18,000 to 0 Years Ago: A Palaeoclimatic Analysis | 4 | 18 | 45 | 17 | 84 | 92 | 213 |
| TR047 | An Evaluation of the Relationship Between the Production and Use of Energy and Atmospheric Methane Emissions | 11 | 32 | 27 | 20 | 90 | 133 | 72 |
| TR048 | Effects of Air Temperature on Atmospheric $CO_2$ Plant Growth Relationships | 1 | 40 | 47 | 21 | 109 | 115 | 15 |
| TR049 | Simulating Climate with Two Different Numerical Schemes | 1 | 11 | 18 | 7 | 37 | 42 | 138 |
| TR050 | Modeling $pCO_2$ in the Upper Ocean: A Review of Relevant Physical, Chemical, and Biological Processes | 2 | 19 | 5 | 22 | 48 | 48 | 42 |
| TR051 | A Comprehensive Precipitation Data Set for Global Land Areas | | | 32 | 1 | 33 | 33 | 159 |
| TR052 | Processes for Identifying Regional Influences of and Responses to Increasing Atmospheric $CO_2$ and Climate Change—The MINK Project. This document is in eight volumes (TR052A-TR052H) | | | | | | | 132 Sets |
| DOE/ER-0178 | Carbon Dioxide Research Plan - A Summary | 1 | | 2 | 1 | 4 | 322 | 21 |
| DOE/ER-0186 | $CO_2$ Climate Research Plan | 1 | 1 | 2 | 1 | 5 | 153 | 20 |

## Table 3 (continued)

| Report number | Title and contents | Quarter (FY 1991) 1st | 2nd | 3rd | 4th | Total | Total FY 1985 to date | Remaining copies |
|---|---|---|---|---|---|---|---|---|
| DOE/ER-0187 | Vegetative Response to Carbon Dioxide | 1 | | 2 | 4 | 7 | 167 | 18 |
| DOE/ER-0188 | Carbon Cycle Research Plan | 1 | 2 | 2 | 2 | 7 | 102 | 18 |
| DOE/ER-0235 | Detecting the Climatic Effects of Increasing Carbon Dioxide (Hardbound = HB) | 5 | 7 | 3 | 1 | 16 | 481 | 47 |
| DOE/ER-0235 | Detecting the Climatic Effects of Increasing Carbon Dioxide (Softbound = SB) | 10 | 13 | 6 | 1 | 30 | 1,567 | 773 |
| DOE/ER-0236 | Characterization of Information Requirements for Studies of $CO_2$ Effects: Water Resources, Agriculture, Fisheries, Forests and Human Health (HB) | 5 | 7 | 4 | 1 | 17 | 483 | 132 |
| DOE/ER-0236 | Characterization of Information Requirements for Studies of $CO_2$ Effects: Water Resources, Agriculture, Fisheries, Forests and Human Health (SB) | 11 | 6 | | 1 | 18 | 1,673 | N/A |
| DOE/ER-0237 | Projecting the Climatic Effects of Increasing Carbon Dioxide (HB) | 5 | 7 | 3 | 1 | 16 | 481 | 50 |
| DOE/ER-0237 | Projecting the Climatic Effects of Increasing Carbon Dioxide (SB) | 11 | 17 | 7 | 5 | 40 | 1,598 | 172 |
| DOE/ER-0238 | Direct Effects of Increasing Carbon Dioxide on Vegetation (HB) | 5 | 7 | 3 | 1 | 16 | 481 | 56 |
| DOE/ER-0238 | Direct Effects of Increasing Carbon Dioxide on Vegetation (SB) | 14 | 16 | 7 | 14 | 51 | 1,630 | 181 |
| DOE/ER-0239 | Atmospheric Carbon Dioxide and the Global Carbon Cycle (HB) | 5 | 7 | 3 | 1 | 16 | 479 | 53 |

## Table 3 (continued)

| Report number | Title and contents | Quarter (FY 1991) | | | | | Total FY 1985 to date | Remaining copies |
|---|---|---|---|---|---|---|---|---|
| | | 1st | 2nd | 3rd | 4th | Total | | |
| DOE/ER-0239 | Atmospheric Carbon Dioxide and the Global Carbon Cycle (SB) | 15 | 17 | 7 | 7 | 46 | 1,648 | 91 |
| DOE/ER-0316 | Master Index of the Carbon Dioxide Research State-of-the-Art Report Series (HB) | 5 | 7 | 3 | 1 | 16 | 526 | 124 |
| DOE/ER-0316 | Master Index of the Carbon Dioxide Research State-of-the-Art Report Series (SB) | 9 | 10 | 3 | 2 | 24 | 740 | 296 |
| DOE/EV-0202 | Carbon Dioxide and Climate: Summaries of Research in FY 1983 and FY 1984 | 1 | | 2 | 1 | 4 | 147 | 21 |
| DOE/EV-0202/1 | Carbon Dioxide and Climate: Summaries of Research in FY 1985 | 1 | | 3 | | 4 | 109 | 21 |
| DOE/ER-0299 | Carbon Dioxide Summaries of Research in FY 1986 | 1 | | 2 | | 3 | 55 | 22 |
| DOE/EV-0129 | Research Issues and Supporting Research of the National Program on Carbon Dioxide, Environment and Society - FY 1980 | | | | | | 9 | 19 |
| DOE/ER-0347 | Carbon Dioxide & Climate: Summaries of Research in FY 1987 | 4 | | 4 | 1 | 9 | 186 | 16 |
| DOE/ER-0385 | Carbon Dioxide & Climate: Summaries of Research in FY 1988 | 4 | 3 | 7 | 2 | 16 | 143 | N/A |
| DOE/ER-0406 | Global Distribution of Total Cloud Cover and Cloud Type Amounts Over the Ocean | 3 | 23 | 17 | 9 | 52 | 66 | 184 |
| DOE/ER-0411 | Atmospheric Carbon Dioxide and the Greenhouse Effect | 558 | 262 | 15 | 3 | 838 | 7,200 | N/A |
| DOE/ER-0425 | Carbon Dioxide and Climate: Summaries of Research in FY 1989 | 14 | 17 | 10 | 2 | 43 | 210 | 22 |

## Table 3 (continued)

| Report number | Title and contents | Quarter (FY 1991) 1st | 2nd | 3rd | 4th | Total | Total FY 1985 to date | Remaining copies |
|---|---|---|---|---|---|---|---|---|
| DOE/ER-0441 | Atmospheric Radiation Measurement Program Plan | 83 | 130 | 18 | 2 | 233 | 736 | 427 |
| DOE/ER-0442 | Atmospheric Radiation Measurement Program Plan (Executive Summary) | 87 | 109 | 2 | | 198 | 746 | 880 |
| DOE/ER-0470T | Carbon Dioxide and Climate: Summaries of Research in FY 1990 | 43 | 58 | 90 | 19 | 210 | 210 | 472 |
| DOE/ER-0479T | Building an Advanced Climate Model Program Plan for the CHAMMP Climate Modeling Program | 34 | 97 | 11 | 2 | 144 | 144 | 201 |
| DOE/ER-0494T | Identification, Recommendation, and Justification of Potential Locales for ARM sites (Executive Summary) | | | 38 | 1 | 39 | 39 | 254 |
| DOE/ER-0495T | Identification, Recommendation, and Justification of Potential Locales for ARM sites | | | 38 | 1 | 39 | 39 | 254 |
| DOE/EV-60235-1 | Glaciers, Ice Sheets, and Sea Level: Effect of a $CO_2$-Induced Climatic Change (HB) | 5 | 7 | 3 | 1 | 16 | 481 | 145 |
| DOE/EV-60235-1 | Glaciers, Ice Sheets, and Sea Level: Effect of a $CO_2$-Induced Climatic Change (SB) | 8 | 7 | 5 | | 20 | 1,083 | 200 |
| DOE/ER-60085-H1 | Global Distribution of Total Cloud Cover and Cloud Type Amounts Over Land | 4 | 22 | 18 | 11 | 55 | 143 | 158 |
| DOE/ER-60197-H1 | On the Surging Potential of Polar Ice Streams FY 1987 Amounts Over Land | 4 | 3 | 3 | 1 | 11 | 33 | 192 |

## Table 3 (continued)

| Report number | Title and contents | Quarter (FY 1991) 1st | 2nd | 3rd | 4th | Total | Total FY 1985 to date | Remaining copies |
|---|---|---|---|---|---|---|---|---|
| DOE/PE-0094P | Global Climate Trends and Greenhouse Gas Data: Federal Activities in Data Collection, Archiving, and Dissemination | 12 | 27 | 22 | 10 | 71 | 76 | 74 |
| PNL-4384 | An Analysis of Methods and Models for Assessing the Direct and Indirect Economic Impacts of $CO_2$-Induced Environmental Changes in the Agricultural Sector of the U.S. Economy | | | | | | 38 | N/A |
| PNL-4709 | Identification and Preliminary Characterization of Global Water Resource Issues Which May Be Affected by $CO_2$-Induced Climate Change | | | | | | 51 | N/A |
| BERN | Bern $CO_2$ Symposium | 2 | 1 | 5 | | 8 | 84 | 19 |
| DOE/NBB-0039 | International Carbon Dioxide-Related Activities: The International Organizations Involved and U.S. Bilateral Arrangements | 1 | | | | 1 | 35 | N/A |
| DOE/NBB-0068 | Review of Carbon Dioxide Research Staffing and Academic Support | 1 | | 1 | | 2 | 39 | 68 |
| DA001 | Field Studies of Plant Responses to Elevated Carbon Dioxide Levels, 1980 | 1 | 1 | 3 | 2 | 7 | 39 | 4 |
| DA002 | The Soybean Crop Simulator, Glycim: Model Documentation, 1982 | | | | | | 13 | 13 |
| DA003 | Effects of Increased Carbon Dioxide on Photosynthesis and Agricultural Productivity of Soybeans, 1981 | | 1 | 3 | 2 | 6 | 34 | 4 |
| DA004 | Soybean Responses to Carbon Dioxide: Measurement and Simulation, 1981 | | | | | | 14 | 12 |

## Table 3 (continued)

| Report number | Title and contents | Quarter (FY 1991) 1st | 2nd | 3rd | 4th | Total | Total FY 1985 to date | Remaining copies |
|---|---|---|---|---|---|---|---|---|
| DA005 | Field Studies of Plant Responses to Elevated Carbon Dioxide Levels, 1981 | | | | | | 12 | 13 |
| DA006 | Effects of Carbon Dioxide Enrichment on Nitrogen Fixation in Soybeans, 1981 | | | | | | 9 | 7 |
| DA007 | Effects of Increased Carbon Dioxide on Photosynthesis, Transpiration, Water-Use Efficiency, and Productivity of Soybeans, 1982 | | 1 | | | 1 | 10 | N/A |
| DA008 | Soybean Responses to Carbon Dioxide: Measurement and Simulation, 1982 | | | | | | 14 | N/A |
| DA009 | Field Studies of Plant Responses to Elevated Carbon Dioxide Levels, 1982 | | | | | | 7 | N/A |
| DA010 | Effects of Carbon Dioxide Enrichment on Nitrogen Fixation in Soybeans, 1982 | | | | | | 7 | N/A |
| DA011 | The Simulation, with GLYCIM, of Soybean Crops Grown in the Field and at Various $CO_2$ Concentrations in Open-Top Chambers During 1982 | | | | | | 8 | 6 |
| DA012 | Field Studies of Plant Responses to Elevated Carbon Dioxide Levels, 1983 | | 1 | | | 1 | 12 | N/A |
| DA014 | Effects of Increased Carbon Dioxide and Water Stress Interactions on Photosynthesis, Transpiration, and Productivity of Soybeans, 1983 | | | | | | 4 | N/A |
| DA019 | The Response of Arctic Ecosystems to Elevated Carbon Dioxide Regimes, 1984 | | | | | | 15 | 6 |

## Table 3 (continued)

| Report number | Title and contents | Quarter (FY 1991) 1st | 2nd | 3rd | 4th | Total | Total FY 1985 to date | Remaining copies |
|---|---|---|---|---|---|---|---|---|
| DA020 | Radiation Densitometry in Tree-Ring Analysis: A Review and Procedure Manual, 1985 | | | | | | 44 | 10 |
| DA021 | Effects of Increasing Atmospheric $CO_2$ on the Yield and Water Use of Crops, 1983 | | | | | | 9 | N/A |
| DA022 | Field Studies of Sweet Potatoes and Cowpeas in Response to Elevated Carbon Dioxide, 1985 | 2 | 3 | 2 | 2 | 9 | 42 | 10 |
| DA023 | Effects of Increasing Atmospheric $CO_2$ on the Yield and Water Use of Crops, 1984 | | | | | | 13 | 16 |
| DA024 | Sorghum at Elevated Levels of $CO_2$ | | | | | | 12 | 7 |
| DA025 | Preliminary Ring-Width and Ring-Density Data for Deriving Wood Mass Chronologies of Coniferous Species from the Northwest U.S. and Canada | | | | | | 5 | 9 |
| DA026 | Western U.S. Tree-Ring Index Chronology Data for Detection of Arboreal Response to Increasing Carbon Dioxide | | | | | | 10 | N/A |
| DA027 | Western U.S. Tree-Ring Index Chronology Data for Detection of Arboreal Response to Increasing Carbon Dioxide | 1 | | | | 1 | 6 | N/A |
| DA028 | Assessing the Effects of Elevated Carbon Dioxide on Plants: Towards the Development of a Generic Plant Growth Model | | | | | | 17 | 31 |

**Table 3 (continued)**

| Report number | Title and contents | Quarter (FY 1991) 1st | 2nd | 3rd | 4th | Total | Total FY 1985 to date | Remaining copies |
|---|---|---|---|---|---|---|---|---|
| DA033 | Influence of Nutrition on Vegetation Response to Carbon Dioxide. I. Interactions of Nitrogen and Phosphorus Supply on Soybean Growth and Nutritional Parameters, 1986 | | | | | | 6 | N/A |
| DA034 | Effects of Elevated Carbon Dioxide on Chesapeake Bay Wetlands. I. Description of the Study Site | | | | | | 4 | N/A |
| DA040 | Effect of Elevated Levels of $CO_2$ on Winter Wheat Under Two Moisture Regimes | | | | | | 1 | N/A |
| DA041 | SERECO: A Model for the Simulation of Ecosystem Response to Elevated $CO_2$ Parts I - III | | | | | | 1 | N/A |
| DA042 | PRECO: A Model for the Simulation of Plant Response to Elevated $CO_2$ Parts I - III | | 1 | | | 1 | 7 | N/A |
| | Total | 1,275 | 1,526 | 948 | 385 | 4,134 | 35,934 | |

N/A - No longer available from CDIAC

## Table 4 CDIAC reports distribution

| Report number | Title and contents | Quarter (FY 1991) 1st | 2nd | 3rd | 4th | Total | Total FY 1985 to date | Remaining copies |
|---|---|---|---|---|---|---|---|---|
| CDIAC-13 | Direct Effects of Atmospheric $CO_2$ Enrichment on Plants and Ecosystems: A Bibliography with Abstacts, June 1986 | 3 | 5 | 1 | 2 | 11 | 16 | 39 |
| CDIAC-21 | Graduate Student Theses Supported by Carbon Dioxide Research Division Office of Basic Energy Sciences, U.S. Department of Energy, September 1987 | 4 | 4 | 1 | 1 | 10 | 19 | 2 |
| CDIAC-23 | Preliminary Development of a Seashore-Effects Analysis System, February 1989 | 2 | 4 | 2 | | 8 | 31 | N/A |
| CDIAC-24/V1 | Bibliography on Tropical Rain Forests and the Global Carbon Cycle. Vol. 1. An Introduction to the Literature, May 1988 | 5 | 10 | 8 | 5 | 28 | 66 | 79 |
| CDIAC-24/V2 | Bibliography on Tropical Rain Forests and the Global Carbon Cycle. Vol. 2. South Asia, February 1989 | 3 | 12 | 10 | 4 | 29 | 69 | 127 |
| CDIAC-28 | Environmental Consequences of $CO_2$-Climate Interactions: The Need for Integrated Resource Analysis, January 1989 | 7 | 5 | 10 | 2 | 24 | 65 | 29 |
| CDIAC-32 | A Plan for Intermodel Comparison of Atmospheric $CO_2$ Projections with Uncertainty Analysis, June 1990 | | 4 | | 10 | 14 | 14 | 85 |
| CDIAC-33 | Environmental Atlas of the Iowa-Kansas-Missouri-Nebraska Climate-Change Study Region, March 1990 | 1 | 3 | 1 | 1 | 6 | 9 | 11 |
| CDIAC-34 | Catalog of Data Bases and Reports | 236 | 257 | 389 | 232 | 1,114 | 3,815 | † |

## Table 4 (continued)

| Report number | Title and contents | Quarter (FY 1991) 1st | 2nd | 3rd | 4th | Total | Total FY 1985 to date | Remaining copies |
|---|---|---|---|---|---|---|---|---|
| CDIAC-36 | *Trends '90:* A Compendium of Data on Global Change, August 1990 | 6,800 | 399 | 175 | 258 | 7,632 | 7,632 | 618 |
| CDIAC-38 | Documentation and Analysis of a Global $CO_2$ Model. Developed by Peng et al. (1983), June 1990 | 1 | 13 | 16 | 7 | 37 | 37 | 25 |
| CDIAC-39 | Glossary: Carbon Dioxide and Climate, August 1990 | 348 | 328 | 416 | 361 | 1,453 | 2,097 | 1,903 |
| | *CDIAC Communications* | 1,079 | 300 | 616 | 312 | 2,307 | 4,343 | ‡ |
| | CDIAC Factsheets | 1,586 | 1,223 | 1,449 | 691 | 4,949 | 5,356 | † |
| | Total | 10,075 | 2,567 | 3,094 | 1,886 | 17,622 | 23,569 | |

†These documents are updated periodically and reprinted to satisfy requests.

‡New issues produced several times a year.

# 5. WORLD DIRECTORY OF $CO_2$ RESEARCHERS AND POLICYMAKERS

Developing and maintaining an active inventory of researchers, policy scientists, administrators, officials, educators, librarians, and communications specialists are essential activities for the successful dissemination of CDIAC's derived-information products, publications, and other services. Over the course of 6 years, CDIAC has compiled such an inventory in its *World Directory of $CO_2$ Researchers and Policymakers*. This inventory consists of 6415 individuals in 145 countries. Universities (35%) and government agencies (33%) comprise the two largest categories in the *World Directory*. In FY 1991, 1005 names were added to the directory from key national and international climate-change committees and working groups, lists of conference and seminar attendees (from the traditional scientific communities but also, as the topic is rapidly expanding, in the social sciences and humanities disciplines), and other directories of potential CDIAC users (e.g., state environmental agency staff, electric utility managers, special libraries, environmental media specialists and reporters, and special and public interest groups). This directory is used primarily as an in-house reference by program managers and sponsors. Special, limited arrangements have been made for sharing directory information with persons and organizations outside CDIAC or DOE.

Total participants from FY 1985 through FY 1991 = 6415

**Table 5. Net additions in total participants**

| | Quarter FY 1991 | | | | |
|---|---|---|---|---|---|
| Category | 1st | 2nd | 3rd | 4th | Total |
| U.S. members | 284 | 130 | 128 | 85 | 627 |
| Foreign embassies (in United States) | 1 | | 1 | | 2 |
| Foreign members (143 countries) | 82 | 63 | 135 | 39 | 319 |
| Net additions | 367 | 193 | 264 | 124 | 948 |
| Total additions | 429 | 279 | 297 | 186 | 1,005 |
| Total deletions | 62 | 86 | 33 | 62 | 181 |

- Table 5 provides a summary of the net additions to CDIAC's World Directory, while Table 6 gives a detailed summary of network entries by country. Fig. 8 represents the World Directory's entries by work affiliation. Fig. 9 shows the geographic distribution of the World Directory members.

## Table 6. Alphabetical listing of countries and their outlying territories[a] and the number of participants listed in the World Directory of Researchers and Policymakers

October 1991

| No. | Country | No. | Country | No. | Country |
|---|---|---|---|---|---|
| 1 | Afghanistan | 5 | Ghana | 1 | Panama |
| 1 | Albania | 5 | Greece | 2 | Papua New Guinea |
| 5 | Algeria | 2 | Guatemala | 2 | Paraguay |
| 2 | Angola | 1 | Guinea | 3 | Peru |
| 12 | Argentina | 1 | Guinea-Bissau | 13 | Philippines |
| 357 | Australia | 1 | Guyana | 12 | Poland |
| 27 | Austria | 1 | Haiti | 1 | Portugal |
| 1 | Bahamas | 2 | Honduras | 1 | Qatar |
| 1 | Bahrain | 4 | Hong Kong | 4 | Romania |
| 6 | Bangladesh | 7 | Hungary | 1 | Rwanda |
| 2 | Barbados | 2 | Iceland | 1 | St. Lucia |
| 36 | Belgium | 67 | India | 1 | Sao Tome & Principe |
| 1 | Belize | 6 | Indonesia | 4 | Saudi Arabia |
| 1 | Benin | 3 | Iran | 2 | Senegal |
| 3 | Bolivia | 13 | Ireland | 1 | Seychelles |
| 3 | Botswana | 19 | Israel | 1 | Sierra Leone |
| 23 | Brazil | 41 | Italy | 9 | Singapore |
| 3 | Brunei | 1 | Ivory Coast | 1 | Solomon Islands |
| 4 | Bulgaria | 1 | Jamaica | 2 | Somalia |
| 2 | Burkina Faso | 83 | Japan | 11 | South Africa |
| 2 | Burma | 2 | Jordan | 14 | Spain |
| 1 | Burundi | 24 | Kenya | 2 | Sri Lanka |
| 1 | Cameroon | 1 | Laos | 3 | Sudan |
| 166 | Canada | 1 | Lebanon | 1 | Suriname |
| 2 | Cape Verde | 1 | Lesotho | 1 | Swaziland |
| 2 | Central African Republic | 1 | Libya | 34 | Sweden |
| 1 | Chad | 2 | Luxembourg | 52 | Switzerland |
| 6 | Chile | 2 | Madagascar | 1 | Syria |
| 76 | China, People's Republic | 2 | Malawi | 9 | Taiwan |
| 2 | Colombia | 59 | Malaysia | 5 | Tanzania |
| 1 | Congo | 1 | Maldives | 17 | Thailand |
| 6 | Costa Rica | 1 | Mali | 1 | Togo |
| 5 | Cuba | 4 | Malta | 2 | Trinidad/Tobago |
| 2 | Cyprus | 1 | Mauritania | 1 | Tunisia |
| 3 | Czechoslovakia | 1 | Mauritius | 3 | Turkey |
| 12 | Denmark | 6 | Mexico | 3 | Uganda |
| 1 | Djibouti | 1 | Mongolia | 178 | United Kingdom |
| 1 | Dominican Republic | 1 | Morocco | 4386 | United States |
| 2 | Ecuador | 1 | Mozambique | 79 | U.S.S.R. |
| 12 | Egypt | 2 | Nepal | 3 | Uruguay |
| 2 | El Salvador | 60 | Netherlands | 6 | Venezuela |
| 4 | Ethiopia | 23 | New Zealand | 3 | Vietnam |
| 4 | Fiji | 1 | Nicaragua | 1 | Western Samoa |
| 9 | Finland | 4 | Niger | 2 | Yemen |
| 73 | France | 12 | Nigeria | 5 | Yugoslavia |
| 1 | Gabon | 4 | North Korea | 1 | Zaire |
| 1 | Gambia | 24 | Norway | 3 | Zambia |
| 120 | Germany | 7 | Pakistan | 3 | Zimbabwe |

[a]As defined in *The Statesmen's Year-Book*, John Paxton, ed., 1985.

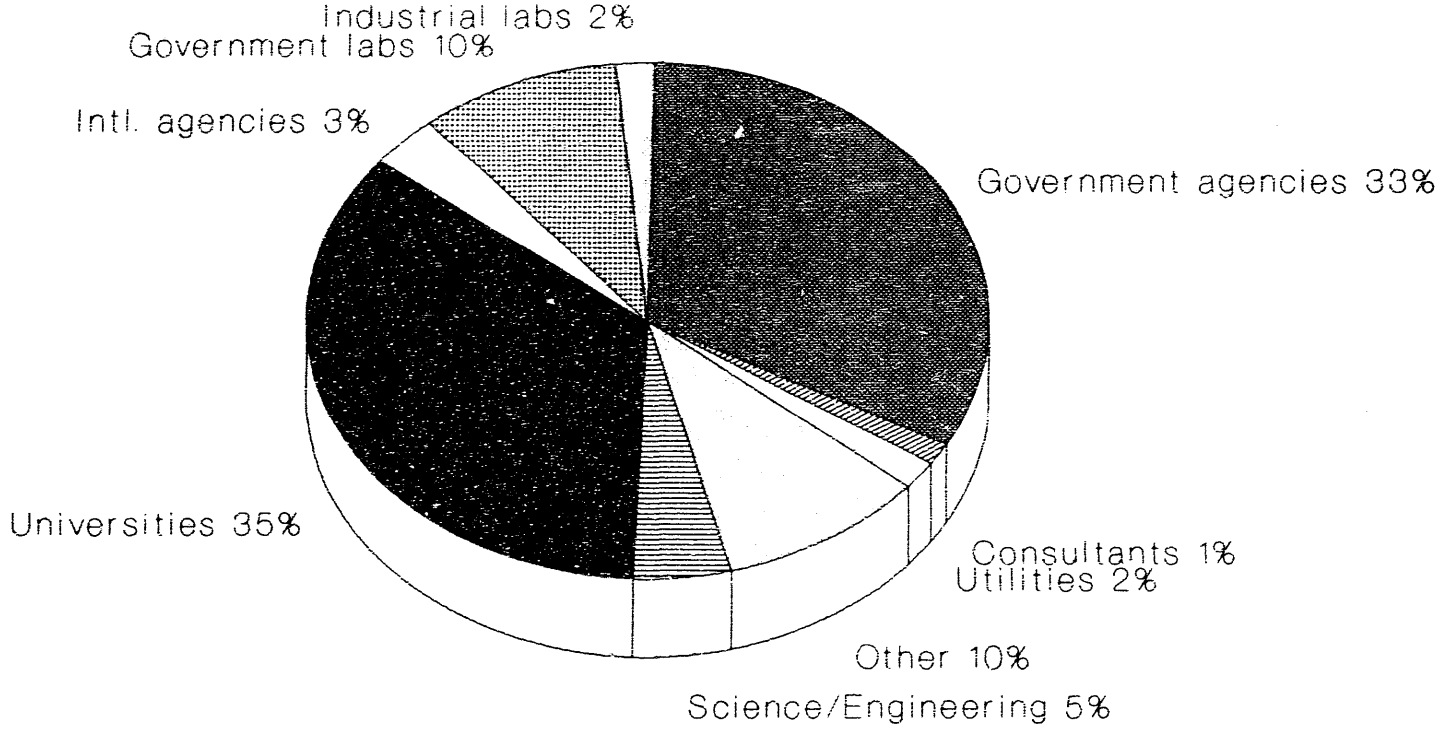



**Fig. 8. World Directory affiliations FY 1991.**

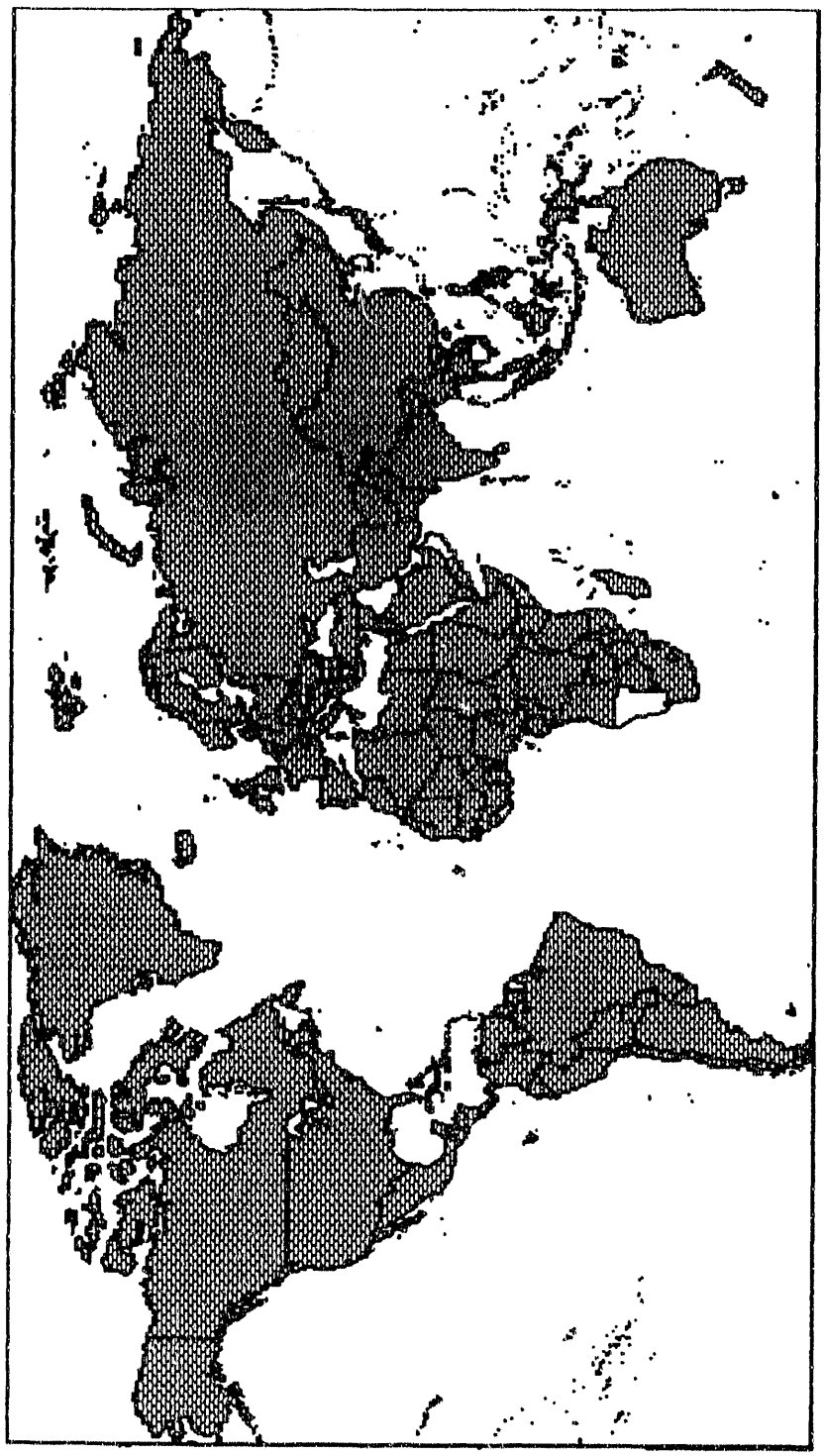


Fig. 9. Countries represented in the World Directory.

# 6. SYSTEMS

CDIAC's Computer Systems group, in addition to maintaining CDIAC's own network of personal computers, workstations, and links with ORNL's mainframe computers, strives to ensure that CDIAC's systems are compatible with those of its user community. CDIAC has, as a policy, attempted to focus on those technologies and media that will be most widely used by its user community, which exceeds 6000 individuals in 145 countries. Thus, while CDIAC explores state-of-the-art techniques in CD-ROMs, optical disks, and multimedia hypertext systems, it maintains the capability to distribute its data as paper hard copy, as microfiche, and on magnetic tapes and personal computer diskettes.

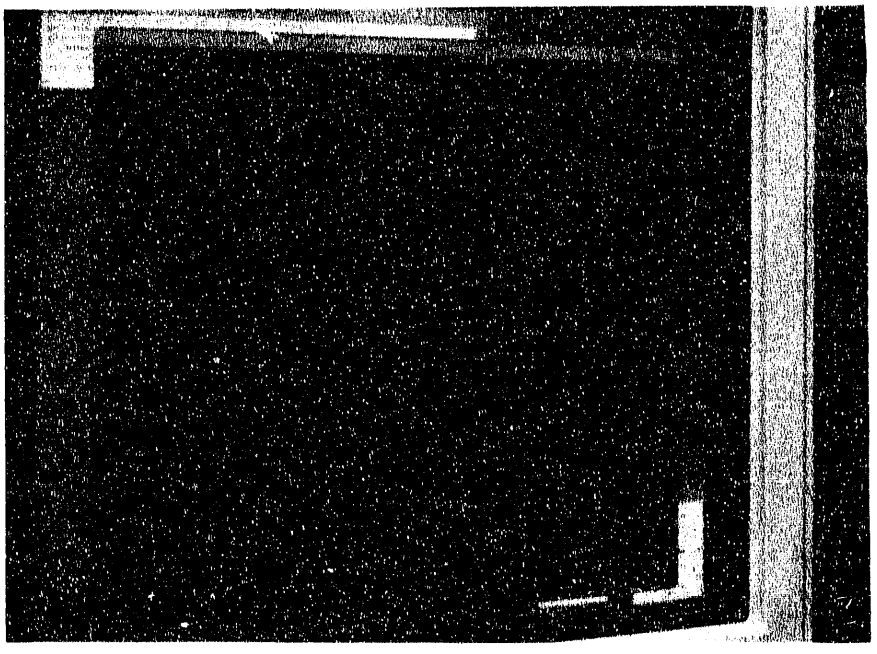


**Fig. 10.** CDIAC's new workstation system will not only facilitate the documentation and extensive quality assurance of data but will also allow CDIAC to fill requests for its data products even more quickly.

## CDIAC Computing Systems Network (CCSN)

Progress continued on setting up the CDIAC computing system network. We have now installed Fortran 77, Open Windows, DOS emulator and several DOS applications, a single user UNIX version of WordPerfect 5.0 for evaluation purposes, and a demo version of Slim TPS (desktop publisher).

- Renovation of the CDIAC computer room was completed. Modifications to accommodate the CCSN Server included electrical, cooling, networking, and ceiling upgrades.

- All hardware for the CDIAC Computing System Network was installed. The CCSN is in operational testing. Software installed for testing on the system includes: SAS™ 6.03 (Base, Graph, and AF), WordPerfect 5.0, DataViews graphical visualization software, FrameMaker desktop publisher, Interleaf TPS desktop publisher, and the Island Productivity series (Write, Paint, and Draw), and Flashback and Budtool backup utilities.

- A Hewlett-Packard 1/2" 1600/6250 BPI tape drive was installed on CCSN Server, and successful Input/Output (I/O) was made to the new device. Software has been ordered to allow I/O in various EBCDIC, ASCII, and BCD formats commonly used for NDP distribution.

- An Exabyte 8500 8-mm tape unit was installed. This unit gives users of the CCSN an additional 5 Gbytes (uncompressed) of on-line storage. The 8-mm tape format will be used primarily for archiving and backup. Automated routines back up all disk drives on the CCSN without requiring user intervention.

- Impressive performance by SAS™ 6.03 on the SPARC™ workstations was observed. One heavily utilized data/graphical output routine that had been executed in just over an hour on a 25MHz 80386/80387 has been executed in less than 1 minute on the workstation.

- A tape utility was located that will allow us to use our HP 1600/6250 BPI tape drive to write 1/2" tapes in the various distribution formats supported by CDIAC for NDP distribution. The software is part of AT&T's Toolchest Collection and requires the execution of a distribution agreement between ORNL and AT&T. The Martin Marietta Energy Systems, Inc., procurement office is working to place this agreement.

- R-Squared has a mature optical storage system on the market which we ordered. We intend to use a combination of one R-Squared unit and several 1.2 GByte disks. This solution offers us reliable storage immediately with an avenue for future expansion and time to work out any unexpected surprises that might arise from the optical unit.

- A test to determine the feasibility of utilizing existing HP printers as workstation postscript devices was successful. The performance of the converted HP laser printers is acceptable for all but the most demanding graphical applications. We anticipate additional conversions.

**Multimedia Presentation**

CDIAC is interested in multimedia presentations as a vehicle for distributing future NDPs. In addition to static data, these NDPs might include full video lectures by the principal scientist together with computer generated graphics. It is expected that such presentations would give rise to greater interest in global $CO_2$ issues. We began investigating PC and workstation platforms.

- We met with representatives of the Empruve Corporation and reviewed their Cornucopia product. The Cornucopia has been adopted by World Book Encyclopedia as the distribution platform for their "new generation" of encyclopedias. The Cornucopia provides impressive multimedia capabilities on a self-contained, but proprietary, platform.

- CDIAC staff attended the USENIX Technical Conference, June 10–14, in Nashville. The conference caters to a sophisticated audience of Unix, Hypermedia, and Multimedia users and developers. Technical sessions attended included Intro to Hypertext Systems and Hypermedia Applications; Emerging Hypermedia Standards; Spacio-Temporal Editing Using Multi-Layered Image Synthesis; Dynamic Multimedia Documents; Mass Media and Personal Computing; Integrating Real-Time Video with Sun Workstations; Automating System Administration; and Audio Conferencing Using the X Window System, UNIX, and TCP/IP.

- Orders were placed for a VCR and camcorder to capture multimedia input.

- We met with IBM representatives for a demonstration of their AVC (Audio Visual Connection), M-Motion, M-Audio, and Storyboard Live product offerings. Roland Productions, a local production company, had a representative at this meeting. The IBM offerings are very impressive and afford the presentation developer a great deal of flexibility. IBM PCs and IBM clones offer by far the largest installed hardware base on which to distribute multimedia presentations. Future meetings with IBM are planned.

**Multimedia Presentation (cont'd)**

- We also contacted Sun representatives; their offerings are very limited at this time, but the potential for product growth is very good.

- CDIAC staff met with representatives of the National Technical Information Service regarding CD-ROM production. For very reasonable fees, NTIS is able to provide pre-mastering, mastering, and production services to government entities. We initiated a purchase requisition for these services.

**Request Response Record System ($R^3$)/World Directory System**

- User and system documentation of the $R^3$ System was updated to include the latest revisions. Because we have decided to go to an outside contractor for a number of changes to the $R^3$ System, the documentation update was the first step in this process.

- Suggestions for improvement were solicited from all parties involved with the $R^3$ System. This information was compiled in a document that was later reviewed by those parties.

- One of the improvements under consideration is the inclusion of publication/document inventory capabilities. These functions would be integrated into the new $R^3$ System and would make possible a current and accurate inventory of the quantities of documents and publication available for distribution. The request-response coordinator would be reminded to reorder when the inventory dips below the assigned reorder quantity.

- Many meetings were held to discuss the redesign of the $R^3$ reference inquiry and document distribution software requirements and the initiation of new distribution mechanisms in conjunction with CDIAC staff now located at the Pellissippi Offices of The University of Tennessee's Energy, Environment, and Resources Center.

- System specifications were presented to Kevin Neuman and Matthew Blake of SAIC, who will provide programming support for development of CDIAC Information System (CIS). CIS will comprise the Request Response Record ($R^3$); World Directory; Publication and Document Inventory System (PDIS); and a tracking system. After careful study of the specifications, SAIC agreed to provide support for the development. Development of the system is expected to be modular with the most important features implemented first. This activity is on hold pending evaluation of existing software. All paperwork permitting SAIC to begin development of the new $R^3$ has been processed. SAIC has returned their proposal, and our procurement department is now reviewing.

# 7. COMMUNICATIONS

CDIAC actively publicizes its own products and services and the technical publications of the DOE Carbon Dioxide Research Program (CDRP) through its Information Systems group. CDIAC produces a newsletter, *CDIAC Communications*, and the series *DOE Research Summary*, which highlights current work sponsored by the CDRP. CDIAC also produces *Glossary: Carbon Dioxide and Climate* (now in its third edition), which provides concise definitions of terms found in the technical literature as well as important $CO_2$- and climate-related conversion factors and constants. Beginning in 1990, CDIAC began publication of a new series, *Trends*. The first issue, *Trends '90: A Compendium of Data on Global Change*, included graphs, data listings, and explanatory text characterizing time-dependent changes in atmospheric concentrations of carbon dioxide and methane; emissions of carbon dioxide from combustion of fossil fuels and production of cement; and global, hemispheric, and regional air temperature. The recently released *Trends '91* expanded the topical coverage to include atmospheric concentrations of nitrous oxide and chlorofluorocarbons, updated the time series wherever more recent data were available from the researchers, and included data from additional monitoring stations to provide a more thorough global coverage.

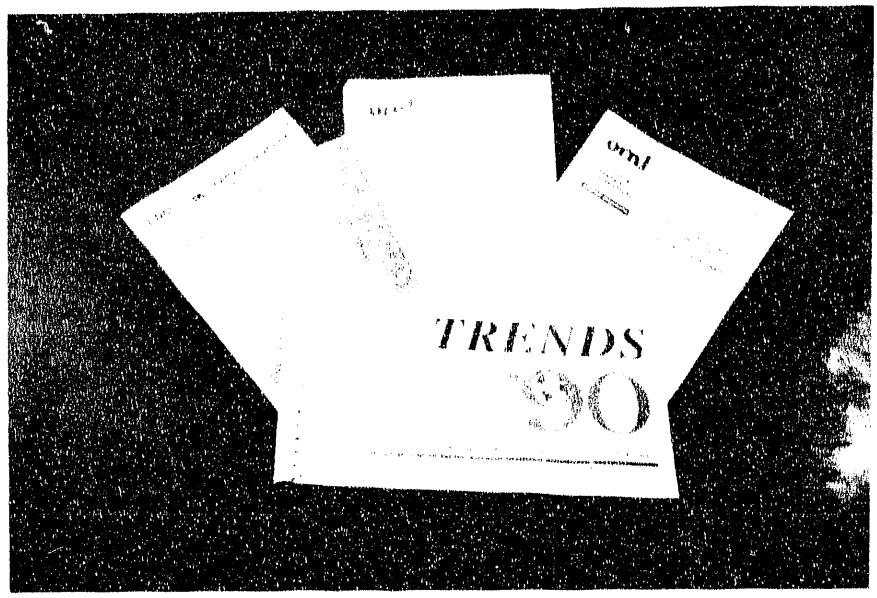



**Fig. 11.** CDIAC produces and distributes a wide variety of information to meet the needs of a diverse user community.

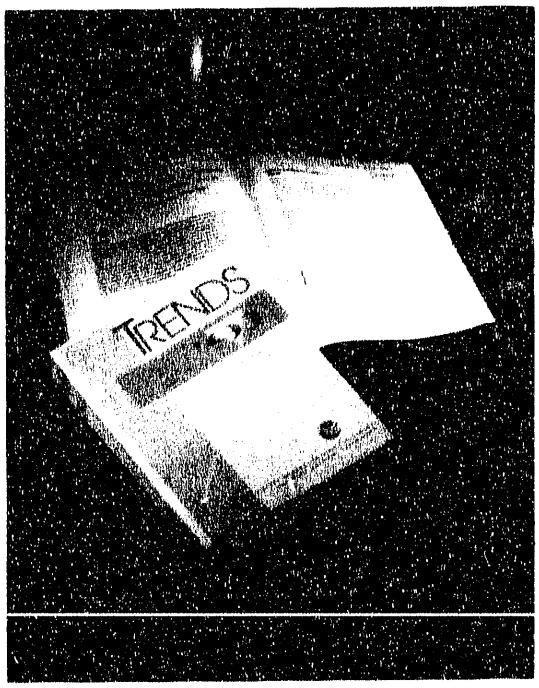



**Fig. 12.** *Trends '91* provides some of the most current and important data to researchers, educators, students, and policymakers interested in global change.

- CDIAC continued to receive numerous requests for general information about the program, its services, and its publications. One of the factors contributing to this growth is a more active effort in promoting the program to various audiences having a direct interest in $CO_2$ research, policy, education, or management-related interests.

- Directory listings for CDIAC were updated for Burwell Enterprises' *Directory of Fee-Based Information Services* and Gale Research Company's *Directory of Special Libraries and Information Centers.*

- CDIAC, *Trends '90*, the *Glossary*, and selected NDPs were the topics of Factsheet 5, issued by the Global Change Education Technology Project. This program is located in the School of Natural Resources and the Department of Educational Studies at Ohio State University. The project has been funded by the National Science Foundation and is directed to provide opportunities for the development of curricula related to the study of the impacts of technology on the earth.

- *Trends '90* has been on display at several conferences, including Chemistry of the Global Atmosphere (Chamrousse, France), the Second World Climate Conference (Geneva, Switzerland), the Annual Meeting of the American Society for Information Science (Toronto, Canada), and Global Climate Change: The Economic Costs of Mitigation and Adaptation (Washington, D.C.). Each conference produced a number of FAX requests from conference sites to send copies of the report to home offices; scores of requests followed!

    - *Trends '90* was used as a text for a new graduate education course, "Earth Systems Education," which was taught at Ohio State University.

    - A brief item describing *Trends '90* appeared in the November 1990 issue of the World Climate Change Report, published by the International Division of the Bureau of National Affairs (BNA). This monthly current awareness/news bulletin ceased publication with the December 1990 issue. The subject content of the *World Climate Change Report* has been incorporated into BNA's *International Environment Reporter*, which became a semi monthly newsletter in October.

    - Both *Trends '90* and CDIAC were described in the Winter 1990 issue of the *Environment and Resource Management Division Newsletter* and the in *East Tennessee Chapter* (SLA) newsletter (November 1990), both of which are publications of the Special Librarian Association.

    - Everyone who contributed data to *Trends '90* received a copy of the document along with a letter thanking them for their data contributions and asking them to provide updates for *Trends '91.* Individuals who either declined to make their data available for *Trends '90* or who failed to respond to earlier requests also received copies of the document as well as copies of a letter asking them to contribute data for *Trends '91.*

    - *Trends '90* was cited as "a particularly useful source" in the American Chemical Society's premiere issue of *Chemunity News.* This periodical will be produced five times per year during the school year as a current awareness publication for pre-high school and high school science teachers.

    - *Trends '90* was cited in the policy document, *America's Climate Change Strategy: An Action Agenda*, which was prepared for the International Negotiating Committee on a Framework Convention on Climate Change, held February 4–13 in Chantilly, Virginia. Data contributed to this report from DOE were derived from CDIAC's *Trends '90* report.

- *Trends '90* and *CDIAC Communications* were cited as examples of the particular types of information used by the Energy Technology Data Exchange of the International Energy Agency (IEA) for keeping abreast of current information on the topic of global climate change. These two CDIAC information products were among three documents pictured in the full-color IEA 1990 Annual Report.

- A second printing of *Trends '90: A Compendium of Data on Global Change* was completed.

- *Trends '90* was described in DOE's *Infotech Update* newsletter (91/2) and was featured in the new United Nations Environment Programme (UNEP) newsletter, *Tiempo: Global Warming and the Third World.*

- *Trends '91: A Compendium of Data on Global Change* was produced and published. A new chapter, "Other Trace Gases," presents data for three trace gases: $CFCl_3$ (CFC-11), a chlorofluorocarbon used mainly as a propellant in aerosol sprays and as a blowing agent in flexible and rigid foam products; $CF_2Cl_2$ (CFC-12), another chlorofluorocarbon used mainly as an aerosol propellant and as a the cooling agent in refrigerators; and $N_2O$ (nitrous oxide), a gas whose atmospheric concentration is thought to be influenced by a combination of human activities, including groundwater pollution, use of nitrogen fertilizers, combustion, and deforestation. The chapter provides $N_2O$ concentrations derived from ice cores; monthly average atmospheric concentrations for CFC-11, CFC-12, and $N_2O$ from five globally distributed monitoring sites; and estimates of annual atmospheric releases of CFC-11 and CFC-12.

- An abstract, *CDIAC: Responding to Changing Information Needs*, was accepted for presentation at the 1991 Annual Meeting and Exhibition of the Air and Waste Management Association, under a program entitled, "Information Resources: Knee-Deep and Rising." CDIAC staff member Fred Stoss served as Technical Session Chair for this event.

- An abstract, *The Carbon Dioxide Information Analysis Center: Providing Information about Global Change*, was accepted as a poster presentation at the Annual Meeting of the American Association for the Advancement of Science.

- Arrangements were made to have all NDPs and CMPs indexed in both *Environmental Abstracts* and *Energy Abstracts* (both are produced and published by A&I Bowker, a section of R. R. Bowker Publishers). Entries will be prepared from abstracts and text provided in the CDIAC *Catalog of Data Bases and Reports* and will appear in both the printed and on-line versions of these two data bases. Because of the potential importance of these entries, they may be featured as a monthly highlight for the printed abstracts when they are published.

- The possibility of developing a conference program on environmental information systems and services for the October 1991 Annual Meeting of the American Society for Information Science was explored.

- The Winter 1991 issue of *CDIAC Communications* featuring a lead article on the "Multilaboratory Group Reports on Climate Change" was distributed to more than 6000 individuals.

- A factsheet on newsletters that solely or frequently cover the topics related to global environmental studies or climate change was developed. This inventory provides the names, editors, addresses, phone numbers, and FAX numbers for more than 45 hard-copy newsletters and 4 online newsletter services.

- A format and style for *DOE Research Summary*, which replaces the *Research Project of the Month*, was developed.

- *The Global Temperature Record for 1990* (DOE Research Summary No. 10) by Philip D. Jones and Tom M. L. Wigley was printed and distributed.

- A new four-page, two-color brochure describing CDIAC, its services, and its information products was produced for limited distribution with a revised brochure planned for FY 1992.

- A third printing of CDIAC's *Glossary: Carbon Dioxide and Climate* was distributed.

- The Spring 1991 issue of *CDIAC Communications* was produced and distributed to nearly 7000 readers.

- *Mechanisms Controlling the Production and Transport of Methane, Carbon Dioxide, and Dissolved Solutes within a Large Boreal Peat Basin* (DOE Research Summary No. 11), by Donald I. Seigel and Paul H. Glaser, was produced and distributed.

- A draft factsheet for NDP-035, *A Global Geographic Information System Data Base of Storm Occurrences and Other Climatic Phenomena Affecting Coastal Zones* was completed. Such NDP factsheets will be distributed to newsletter, journal, and magazine editors for inclusion in their respective sections of new publications and resources. A list of candidates to receive these factsheets is growing.

- CDIAC staff participated in a live, on-air interview on WATE-TV to discuss CDIAC's hosting of the directors' meeting of the national geophysical data centers.

- Working with staff from DOE's Office of Scientific and Technical Communications, CDIAC prepared a comprehensive description of its history, services, and information products for inclusion in the U.S. Interagency Global Change Program Plan.

- An entry describing CDIAC's information services and products for *Energy Education Resources*, produced by DOE's Energy Information Administration (National Energy Information Center) was submitted for the 1992 issue. This booklet is used by DOE to respond to general requests for information for teachers and students in grades K-12. Selected CDIAC materials were described for use by middle and high school students.

- Sarah Clark (Environmental Defense Fund) was provided with a statement providing permission to use portions of *Trends '90* in a manuscript, "Fight Global Warming," to be published by *Consumer Reports*.

- The CDIAC brochure, *CDIAC Communications*, and Research Project of the Month/DOE Research Summary were submitted to the 1992 International Technical Publications Competition sponsored by the Society for Technical Communication.

- The United Nations Environment Programme's *INFOTERRA International Directory of Sources* was provided with an updated entry for CDIAC. This international directory of environmental information was last updated in 1987.

- The availability of the CDIAC brochure and DOE Research Summary No. 10, *The Global Temperature Record for 1990*, prepared by Philip Jones and Tom Wigley was cited in *ERMD Newsletter*, produced by the Environment and Resource Management Division of the Special Libraries Association.

# 8. COLLABORATIVE EFFORTS WITH CHINA

In August 1987, DOE and the People's Republic of China (PRC) Chinese Academy of Sciences signed an agreement to conduct a joint research program on climate changes that could result from increasing atmospheric carbon dioxide[1]. This program consists of four tasks: (1) analysis of climate models, (2) preparation and analysis of climate data, (3) study of the relationship between large-scale and regional climates, and (4) measurements of methane. CDIAC has contributed significantly to task (2) by participating in the archiving, quality assurance, documentation, and distribution of data sets compiled by the Institutes of Atmospheric Physics and Geography [IAP and IG (Beijing)] and the National Climatic Data Center [NCDC (Asheville)] and by participating in the preparation of DOE reports resulting from this research program.

## Data Sets Archived During FY 1991

**Institute of Geography** (Beijing, PRC)

- Twelve proxy climate data sets were received during FY 1991 from Professors Zhang and Gong, Wei-Chyung Wang, and Sultan Hameed. The proxy data sets received are as follows:

  (1) Proxy Precipitation Records for 120 Stations, 1470–1979
  (2) Beijing Monthly Rain Days and Hours, 1724–1903
  (3) Cold Severity Over China, 1470–1975
  (4) Winter Temperature Indices North and South of the Huai River and Qing Mountains, 1470–1982
  (5) Monthly Summer Temperature Reconstructions for Beijing, 1724–1986
  (6) Dryness/Wetness Indices for Beijing (1260–1980) and Luoyang (600–1979)
  (7) Beijing Harvest Index, 1736–1979
  (8) Number of Counties Affected by Drought and Flooding, 1501–1947
  (9) Typhoons: Reportings (1470–1981), Records (1470–1929), and Number of Regions Affected (1470–1929)
  (10) Plum Rain Intensities, 1470–1975
  (11) Reconstructions of Holocene (6000 yr B.P.) and Modern Temperatures (1950–1979)
  (12) Moisture Indices for Eastern China for the Last Two Thousand Years

**Institute of Atmospheric Physics** (Beijing, PRC)

- Climate data sets from Dr. Shiyan Tao for five Chinese station networks were received (September 7, 1990). The number of stations, period of record, and parameters for each data set are as follows:

  (1) 60-station network—13 variables (e.g., mean monthly temperature, total monthly precipitation, mean wind speed); 1984–1988. These data update the pre-1984 data already received from the PRC for the 60-station network.

  (2) 205-station network—2 variables (mean monthly temperature and total monthly precipitation); 1984-1988. These data update the pre-1984 data already received from the PRC for the 205-station network.

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[1]See F. A. Koomanoff, Ye Duzheng, Zhao Jianping, M. R. Riches, W.-C. Wang, and Tao Shiyan. 1988. The United States' Department of Energy and the People's Republic of China's Chinese Academy of Sciences Joint Research on the Greenhouse Effect. Bull. Am. Meteorol. Soc. 69(11):1301-1308.

(3) 40-station subset of the 205 station network—4 variables (minimum and maximum mean and extreme monthly temperatures); 1984–1988

(4) 180-station network—1 variable (daily precipitation); 1951–1982

(5) 147-station network—1 variable (10-day precipitation); 1951–1982

**National Climatic Data Center (Asheville, North Carolina)**

- NCDC provided updates to the 240-station U.S. sunshine data set through 1987 and also provided complementary cloud data for the same network and time period.

**Quality Assurance**

- All of the proxy and instrumental data sets received from IG, IAP, and NCDC were checked for accuracy and reasonableness. Specific details on the checks performed by CDIAC are provided in the documentation for these data bases (see Sect. 9). Where possible, proxy records were compared to original Chinese State Meteorological Administration publications with the assistance of Chinese and Taiwanese-American scientists at ORNL. When possible, erroneous values were corrected or flagged by CDIAC. In other instances, erroneous or suspect values were resolved and corrected with the assistance of Shiyan Tao, Congbin Fu, Zhaomei Zeng, and Qingyun Zhang (IAP—instrumental data); Tom Karl, David Easterling, Pete Steurer, and Pam Hughes (NCDC—instrumental data); and Wei-Chyung Wang (SUNY—Albany), Sultan Hameed (SUNY—Stony Brook), and Peiyuan Zhang and Gaofa Gong (IG—proxy data).

- Many of the proxy data sets are poorly understood and documented. Details concerning how these proxy records were derived have been difficult to obtain. During FY 1992, Wei-Chyung will send a graduate student to Beijing to attempt to obtain critical information for documenting and analyzing these proxy records.

**Documentation**

- CDIAC compiled two technical reports (*Long-Term Proxy Data Sets from the People's Republic of China* and *Climatic Data Bases of the People's Republic of China, 1841–1988*) that document the PRC proxy and instrumental data sets. Draft versions of these reports were sent to China and reviewed during Wei-Chyung's visit to China. Wei-Chyung was able to acquire some very useful information concerning the instrumental data. Professor Shiyan Tao resolved many of the questions we had concerning specific instrumental data values and provided sufficient metadata (e.g., station latitude and longitude coordinates, station elevations, etc.) to enable us to fully document these data. Unfortunately, Professor Peiyuan Zhang was unable to provide Wei-Chyung with the details necessary to fully document many of the proxy data sets. As stated in the previous section, efforts are under way to obtain additional information concerning the PRC proxy data sets.

- Dale Kaiser completed NDP-021/R1, *Historical Sunshine and Cloud Data in the United States* (final document expected in February 1991). This data base presents monthly sunshine data from 240 U.S. stations (including Puerto Rico and nine Pacific Islands) and monthly cloud amount data from 197 U.S. stations. The sunshine data include monthly and annual total hours of recorded sunshine, monthly and annual maximum possible sunshine (hours recorded/hours possible), and dates of use for specific types of sunshine recorders at each station. The cloud data contain monthly and annual cloud amount (in percent of sky cover).

**Distribution**

- During FY 1991, CDIAC responded to 83 requests for the U.S. Historical Climatology Network data and 46 requests for the U.S. Sunshine/Cloud Network data, for a total of 330 and 120 requests, respectively, since 1987. Both data bases were compiled by NCDC under the DOE/PRC agreement.

- Copies of all PRC proxy and instrumental data sets were sent to U.S. principal investigators (i.e., Wei-Chyung Wang, Tom Karl, Sultan Hameed, and David Portman).

# 9. NUMERIC DATA AND COMPUTER MODEL PACKAGING

The cornerstone of CDIAC is the quality assurance and documentation of data, which is handled by the Data Systems group. The culmination of this effort is an ever-increasing series of numeric data packages (NDPs). By late 1991 this list had grown to more than forty, covering such diverse topics as atmospheric concentrations of $CO_2$ and methane; emissions of $CO_2$ from fossil fuels and cement manufacturing; long-term records of temperature, precipitation, pressure, sunshine, cloudiness, and volcanic dust; ocean chemistry; soil carbon and nitrogen; global distribution of ecosystems and their carbon storage; tree-ring chronologies; and plant responses to elevated $CO_2$. NDPs [or computer model packages (CMPs), which are similar in content to an NDP but contain a fully documented model useful in global-change studies], contain not only the data themselves (which is available on magnetic tapes or diskettes, customized to meet the user's needs, as well as in hard-copy format), but also important information concerning the data and its applications (Fig. 13). The preparation of an NDP is a multistep process (Fig. 14) that begins with identifying an important data set—and a principal investigator willing to work with CDIAC in the NDP process—and ends with the announcement and distribution of a new NDP. But even then the job is not complete: many NDPs are updated as newer data are available, and CDIAC notifies recipients of earlier releases of the NDP to see if they desire the latest data. In addition, CDIAC periodically lets NDP contributors know who has requested their data.

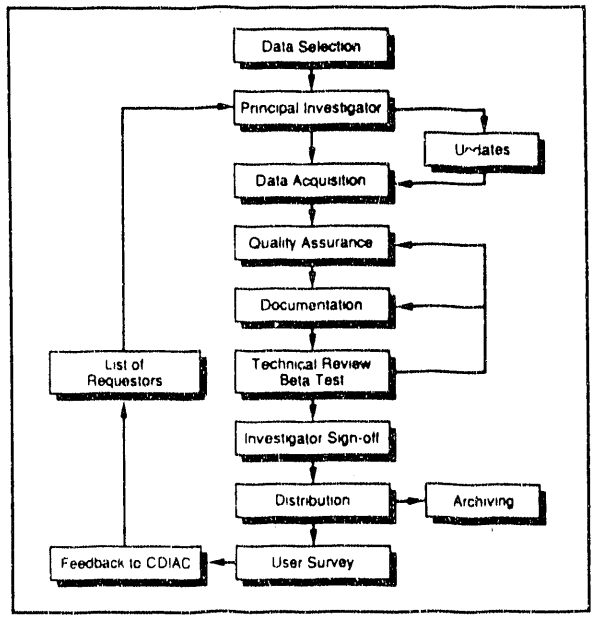



**Fig. 13.** The production of a CDIAC NDP or CMP is a process that involves close cooperation between CDIAC and the contributor of the data or model and includes important quality-control and review steps.

**Data Package Contents**

- Contributors
- Background information
- Source and scope of data
- Applications of the data
- CDIAC quality assurance checks
- Limitations and restrictions of data
- Keywords
- References
- Data media description
- Statistics to verify data transport
- Quality assurance outline
- Source code listings
- Graphical illustrations of model output
- Copyright-cleared reprints
- Ordering information
- Listing of data retrieval programs
- Data in electronic format

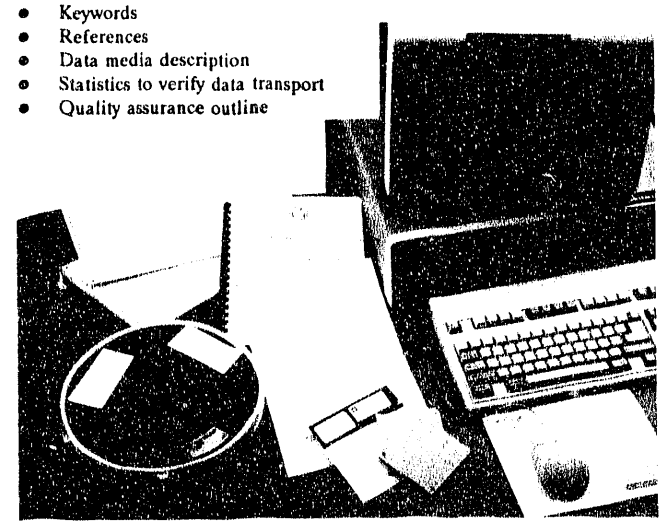


**Fig. 14.** A CDIAC NDP or CMP typically includes not just the data set or model but complete documentation to ensure that the user receives it in uncorrupted form and understands how the data set or model was produced, what its limitations are, and how it can be used.

**Requests for NDPs and CMPs**

- 606 requests from 45 countries for 1602 copies of numeric data packages (NDPs), 211 copies of the PC-version of the IEA/ORAU Long-Term Global Energy $CO_2$ Model, and 47 requests for all the data that were presented in *Trends '90* in electronic formats were filled. In response to these requests, 255 magnetic tapes and 1582 floppy diskettes were generated. Activities related to NDPs and CMPs are found in Fig. 15 and Fig. 16. Table 7 provides a list of countries to which NDPs and CMPs were sent, while Table 8 provides a distribution inventory of all NDPs and CMPs from 1985 through FY 1991.

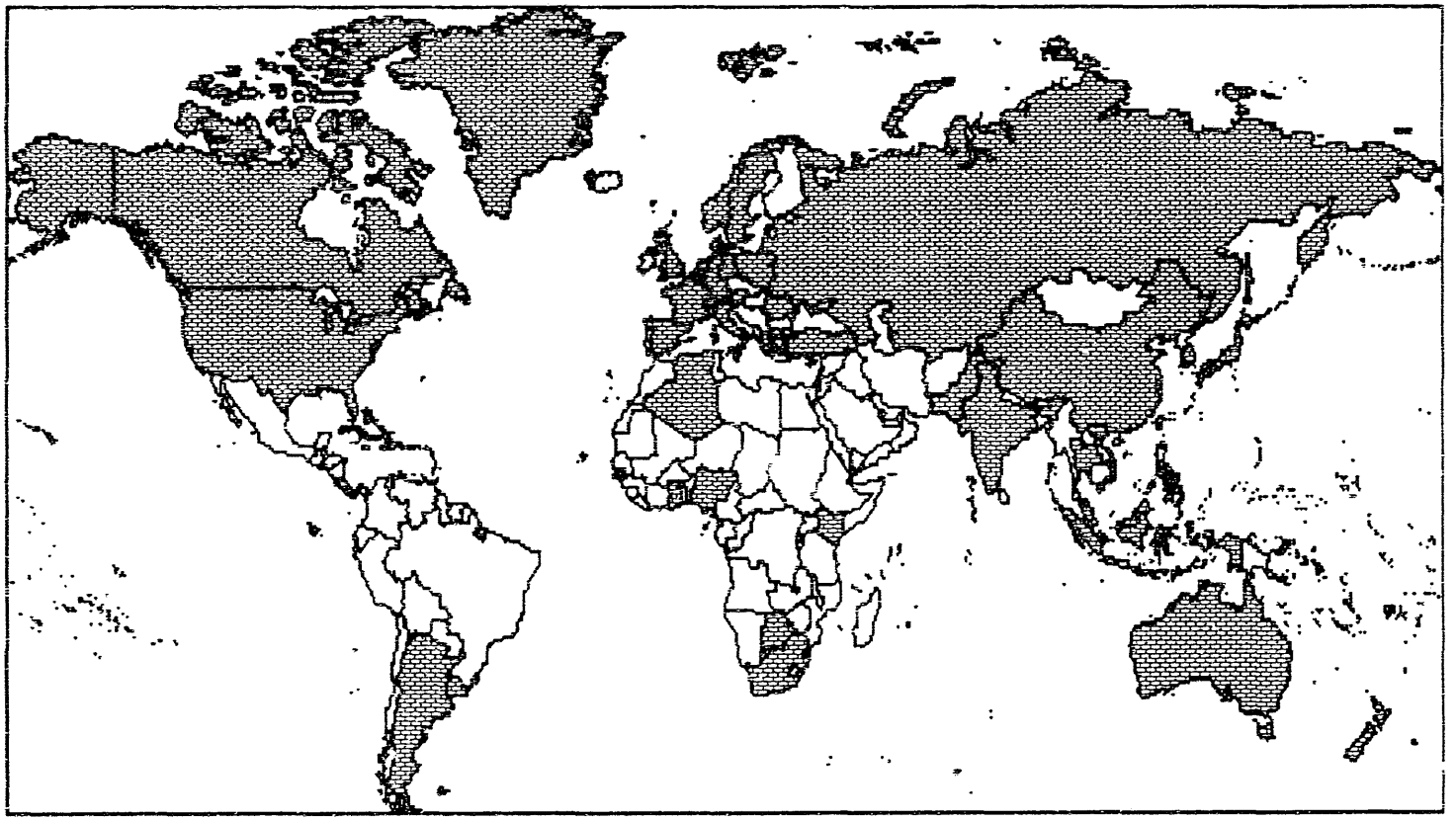
**New and Updated NDPs**

- **NDP-020/R1,** *An Updated Global Grid Point Surface Air Temperature Anomaly Data Set: 1851-1990* was completed. This package presents land-based monthly surface air temperature anomalies (departures from a 1951–1970 reference period mean) on a 5° latitude by 10° longitude global grid. Monthly surface air temperature anomalies (departures from a 1957–1975 reference period mean) for the Antarctic (grid points from 65°S to 85°S) are presented in a similar way as a separate data set. The data were derived primarily from the *World Weather Records* and the archives of the United Kingdom Meteorological Office. This long-term record of temperature anomalies may be used in studies addressing possible greenhouse-gas–induced climate changes. To date, the data have been employed in generating regional, hemispheric, and global time series for determining whether recent (i.e., post-1900) warming trends have taken place.

  The present updated version of this data set is identical to the earlier version for all records from 1851 through 1978, except for the addition of the Antarctic surface air temperature anomalies beginning in 1957. Beginning with 1979 data, this package differs from the earlier version in several ways. Erroneous data for some sites have been corrected after a review of the actual station temperature data, and inconsistencies in the representation of missing values have been removed. For some grid locations, data have been added from stations that had not contributed to the original set. Data from satellites have also been used to correct station records in cases in which large discrepancies were evident. The present package also extends the record by adding monthly surface air temperature anomalies for the Northern (grid points from 85°N to 0°) and Southern (grid points from 5°S to 60°S) Hemispheres for the period 1985–1990. In addition, this updated package presents the monthly mean temperature records for the individual stations that were used to generate the set of gridded anomalies. The periods of record vary by station. Northern Hemisphere data have been corrected for inhomogeneities, while Southern Hemisphere data are presented in uncorrected form.

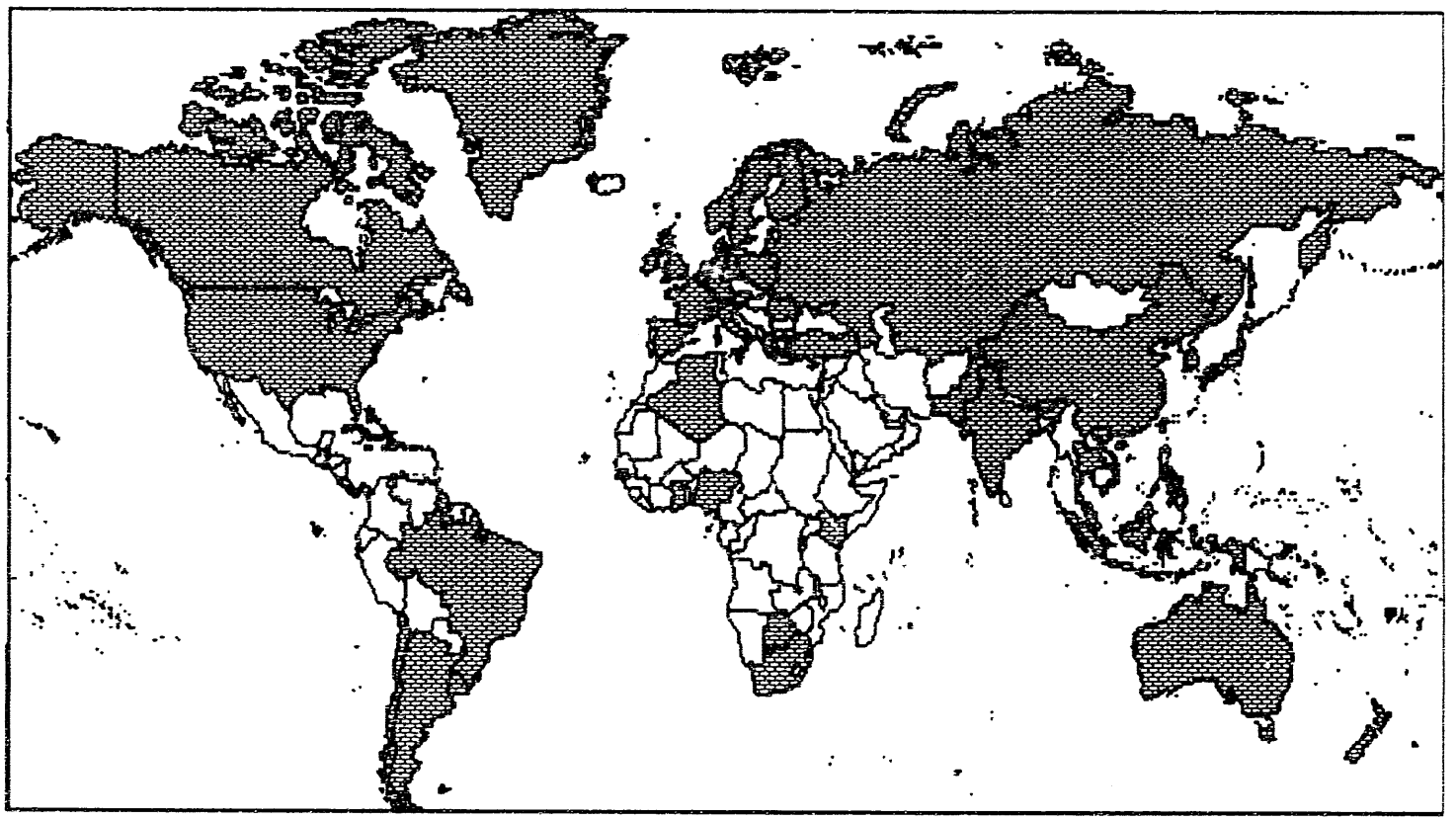
- Dale Kaiser completed NDP-021/R1, *Historical Sunshine and Cloud Data in the United States* (final document expected in February 1991). This data base presents monthly sunshine data from 240 U.S. stations (including Puerto Rico and nine Pacific Islands) and monthly cloud amount data from 197 U.S. stations. The sunshine data include monthly and annual total hours of recorded sunshine, monthly and annual maximum possible sunshine (hours recorded/hours possible), and dates of use for specific types of sunshine recorders at each station. The cloud data contain monthly and annual cloud amount (in percent of sky cover).

- **NDP-033** documentation was completed for the atmospheric $CO_2$ concentrations from the U.S.S.R. flask sampling programs at Kotelny Island, Teriberka Station, Ocean Station Charlie, and Bering Island that were contributed to CDIAC by Dr. Alexander Shashkov [Main Geophysical Observatory (MGO) - Leningrad]. The draft was sent to Shashkov and his colleagues at MGO for review in November 1990. Shashkov indicated, during a telephone conversation, that he had reviewed the documentation and returned his comments along with updates. A special cover design and Russian language cover, title



606 Requests for 1,860 packages from 45 countries.

**Fig. 15. FY 1991 requests for numeric data and computer model packages.**



1,999 Requests for 4,907 Packages from 51 Countries

**Fig. 16. FY 1985 through FY 1991 requests for numeric data and computer model packages.**

page, table of contents, abstract, and biographical sketches of contributors and their respective organizations was planned.

- **NDP-035**, *A Global Geographic Information System Data Base of Storm Occurrences and Other Climatic Phenomena Affecting Coastal Zones*, by Kevin R. Birdwell and Richard C. Daniels, was completed for release. NDP-035 contains storm (e.g., hurricanes, cyclones, monsoons, and tropical storms) frequencies and probabilities and other climate variables (e.g., sea ice concentrations). This marks the first NDP in which the data files are available as both flat ASCII files and ARC/INFO export files suitable for inclusion in GIS. Typically, only flat ASCII files have been offered. This data package was announced in the Spring 1991 issue of *CDIAC Communications*.

- **NDP-036** documentation was completed for Dr. H. Göte Östlund's radiocarbon data from the INDIGO cruises. This document presents $^{14}C$ activities (expressed in the internationally adopted $\Delta^{14}C$ scale) from water samples taken at various locations and depths in the Indian and Southern oceans through the Indien Gaz Ocean (INDIGO) project. These data were collected as part of the INDIGO 1, INDIGO 2, and INDIGO 3 cruises aboard the *Marion Dufresne*, which took place during the years 1985, 1986, and 1987, respectively. These data have been used to estimate the penetration of anthropogenic $CO_2$ in the Indian and Southern oceans. The document also presents supporting data for potential temperature, salinity, density (sigma-theta), $\delta^{13}C$, and total $CO_2$. All radiocarbon measurements have been examined statistically for quality of sample counts and stability of counting efficiency and background. In addition, all data have been reviewed by CDIAC and assessed for gross accuracy and consistency (absence of obvious outliers and other anomalous values). This new package (NDP-036) will be announced in the January issue of *CDIAC Communications*.

- **NDP-038**, *Atmospheric Methane Concentrations—the NOAA/CMDL Global Cooperative Flask Sampling Network, 1983–1988*, was completed and published in June 1991. The document presents monthly averages and sampling statistics for atmospheric methane mixing ratios obtained from the National Oceanic and Atmospheric Administration Climate Monitoring and Diagnostics Laboratory (NOAA/CMDL) global cooperative flask sampling network from 1983 to 1988. The data were derived from a network of 30 stations (26 of which were still active at the end of 1988), which collected flask air samples approximately once per week for measurement of both methane and carbon dioxide. These data represent the most spatially comprehensive atmospheric methane record available in the world.

- **NDP-039**, *Two Long-Term Instrumental Climatic Data Bases of the People's Republic of China*. This package contains data from the 60- and 205-station climate networks described in the draft version of the DOE Technical Report, Climate Data Bases of the People's Republic of China, 1841–1988. Variables contained in the 60-station data set include station pressure, temperature (monthly mean, monthly mean maximum and minimum), monthly total precipitation, monthly mean relative humidity, monthly mean cloud amount, monthly sunshine duration, monthly days with snow cover, and monthly dominant wind direction and frequency, and monthly wind speed. The 205-station data set contains monthly mean temperature and total monthly precipitation. The package also includes details of station networks (data sources, data collection methods, lists of stations/variables, and coverage maps) and information regarding the quality and availability of the data.

- **NDP-040**, *Daily Temperature and Precipitation Data for 223 Stations in the U.S.S.R.* This high-quality data set was obtained as a part of the U.S.A.-U.S.S.R. bilateral data exchange meeting held in Obninsk, U.S.S.R., in September 1989. The data set contains daily temperature and precipitation observations collected at 223 locations throughout the U.S.S.R., and the maximum period of record for any given station is 1874–1986. To date, the data set has been received by CDIAC and preliminary quality assurance checks have been conducted.

- **NDP-042,** *United States Historical Climatology Network (HCN) Temperature and Precipitation Data.* This package contains daily maximum/minimum temperatures and daily precipitation amounts from 138 U.S. stations. These stations are a specially chosen subset of the 1219-station U.S. Historical Climatology Network (HCN), described in ORNL/CDIAC-30, NDP-019/R1. The daily data network (referred to as the HCN/D) consists of stations considered to be the best of those from the HCN, selected to provide reasonably homogeneous spatial coverage of the contiguous U.S. after considering the temporal homogeneity of each station's observing times, instrument positioning, and surroundings. All stations have data through 1987, with the earliest providing data since 1871. The package also includes station histories and inventories and details of quality assurance procedures.

- A draft of **NDP-043,** *A Coastal Hazards Data Base for the U.S. East Coast* has been prepared. CDIAC is currently providing quality assurance for the data sets and organizing the coverages in a consistent manner.

- Dennis Lettenmaier (University of Washington, Department of Civil Engineering), Jim Wallis (IBM Research Division), and Eric Wood (Princeton University, Department of Civil Engineering) compiled a data set containing daily temperature and precipitation data from 1036 of the HCN stations and daily streamflow data from 1009 USGS streamflow stations for 1948–88. They mastered these data onto two CD ROMs, complete with retrieval codes and documentation, and produced 200 sets of copies for distribution. After several preliminary contacts with Tom Boden, Dennis Lettenmaier visited CDIAC on June 25 to request that we package and distribute these data as an NDP. The authors wanted CDIAC to serve as their data repository since we provide such thorough documentation (which all the contributors have used before), already distribute the monthly HCN data, and offer data to anyone without charge. The data base is attractive to CDIAC because it is not available elsewhere, offers good hydrological (which is lacking from CDIAC's data archive) and daily climate data, and enables CDIAC to quickly embark into CD-ROM media at no expense. After discussing documentation and updating considerations, we agreed to package this data base during FY92.

### Technical Reports

- A draft copy of a DOE technical report describing 16 long-term proxy data sets obtained through a collaborative research agreement between the People's Republic of China's Chinese Academy of Sciences and DOE was produced. Review of the report by DOE and by Chinese coauthors was completed. The data sets described in the report are unique in that they encompass a minimum of 179 years of data and one data set provides temperature reconstructions for the Holocene epoch beginning 6000 years before present. Other proxy data sets described in the report include winter temperature indices, dryness/wetness indices, precipitation indices, moisture indices, and harvest indices, as well as tabulated information concerning typhoons, droughts, floods, and rain days. The spatial resolution of these data sets varies greatly. Some records present information for single sites, while others present real averages that encompass most or all of China. The report contains background information (descriptions of the DOE/PRC agreement and data exchange protocol and a discussion of the significance of these data to long-term climate studies), details of station networks (data sources, data collection methods, lists of stations/variables, and coverage maps), and information regarding the quality and availability of the data.

### Fossil Fuel Data Base

- The fossil-fuel data base continues to be one of the cornerstones of CDIAC's data archive and is critical to carbon cycle modeling exercises. Over the past three years, CDIAC has provided $CO_2$ emission estimates to 307 requesters. These data have been used in countless carbon cycle model runs both at ORNL and elsewhere.

- CDIAC maintains and distributes a data base of $CO_2$ emissions from fossil-fuel use and cement manufacture. These emission estimates are fully documented and available from CDIAC. Since 1988, CDIAC has distributed this data base to over 300 individuals in 26 countries. This data set is organized by country and fuel and is continuous from 1950. With recent receipt of the annual global-energy-production data update from the United Nations Statistical Office, we have updated and revised the $CO_2$ emissions time series through 1989 and will begin updating the documentation (NDP030/R1) for these data.

- CDIAC estimates show that global total $CO_2$ emissions reached $5.954 \times 10^9$ metric tons of carbon in 1989, an increase of 1.09% over 1988. This estimate represents the largest annual emission ever from fossil-fuel consumption and cement production and continues an increasing trend that has prevailed since 1983. Decreases that followed the oil price shocks of the 1970s into the early 1980s have now been erased, and a new upward trend seems well established even though the 1989 growth rate is considerably less than the 4.05% growth from 1987 to 1988. Growth is most prominent in some developed countries, and emissions from the centrally planned economies of Asia, for example, are now 54% higher than in 1979. By contrast, emissions from Western Europe are still 12% below the 1979 maximum and are virtually unchanged since 1982. African $CO_2$ emissions are up 33% from 1979, and those from Latin America are up 16% over the same time interval.

- The three largest emitting nations in 1989—the United States, the Soviet Union, and China—accounted for over half (50.5%) the global $CO_2$ emissions from fossil fuel burning, cement production, and gas flaring. U.S. emissions reached $1.329 \times 10^9$ metric tons of carbon in 1989 (5.37 metric tons of carbon per capita and 22% of the global total), exceeding the previous high set in 1988 and continuing an increasing trend that began in 1983. U.S. emissions grew by 1.14% in 1989, down from the 4.78% growth seen in 1988, making 1989 the third consecutive year this growth rate was higher than the global average growth rate.

- The world hydraulic cement production data through 1989 was received from Wilt Johnson (U.S. Bureau of Mines). The 1989 estimates were keyed into a machine-readable file; the 1985–88 estimates that had changed since last year were revised. All estimates in the machine-readable data file were verified against the original Bureau of Mines publications, then used to generate national, regional, and global $CO_2$ emission estimates for cement production for the period 1950–89. In 1989, 152 million metric tons of carbon were emitted globally as the result of cement production, up 1.3% from the 150 million metric tons emitted in 1988. This accounts for roughly 2.5% of the total carbon emitted to the atmosphere from industrial sources, including fossil-fuel burning and gas flaring.

  The 1989 cement data show that China, the Soviet Union, Japan, and the United States are the four largest cement producing countries in the world and collectively account for 44.5% of the world's $CO_2$ emissions from cement production. Emissions from 1989 cement production for these countries were 28.1, 19.0, 11.1, and 9.5 million metric tons of carbon, respectively.

## Table 7. Numeric data package/computer model package requests

| | Quarter FY 1991 | | | | FY 1991 Total | Total FY 1985 to date |
|---|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | 4th | | |
| Country | | | | | | |
| Algeria | 0 | 0 | 1 | 0 | 1 | 1 |
| Argentina | 0 | 4 | 0 | 0 | 4 | 9 |
| Australia | 5 | 7 | 7 | 4 | 23 | 57 |
| Austria | 0 | 1 | 2 | 0 | 3 | 18 |
| Belgium | 0 | 0 | 2 | 1 | 3 | 9 |
| Botswana | 0 | 1 | 0 | 1 | 2 | 2 |
| Brazil | 0 | 0 | 0 | 0 | 0 | 6 |
| Canada | 5 | 6 | 7 | 7 | 25 | 89 |
| Cape Verde | 0 | 0 | 1 | 0 | 1 | 1 |
| Chile | 0 | 0 | 0 | 0 | 0 | 1 |
| China, People's Republic of | 1 | 1 | 1 | 3 | 6 | 26 |
| Costa Rica | 0 | 0 | 1 | 1 | 2 | 2 |
| Cuba | 0 | 1 | 1 | 1 | 3 | 4 |
| Denmark | 0 | 1 | 0 | 0 | 1 | 1 |
| Finland | 0 | 0 | 0 | 0 | 0 | 3 |
| France | 2 | 2 | 7 | 0 | 11 | 25 |
| Germany* | 2 | 6 | 7 | 2 | 17 | 75 |
| Ghana | 0 | 0 | 1 | 0 | 1 | 1 |
| Greece | 0 | 1 | 1 | 0 | 2 | 5 |
| Guyana | 0 | 0 | 0 | 0 | 0 | 1 |
| India | 0 | 4 | 6 | 4 | 14 | 21 |
| Indonesia | 0 | 0 | 2 | 2 | 4 | 5 |
| Ireland | 0 | 0 | 0 | 0 | 0 | 1 |
| Israel | 1 | 0 | 1 | 0 | 2 | 11 |
| Italy | 0 | 1 | 3 | 3 | 7 | 8 |
| Japan | 4 | 3 | 3 | 1 | 11 | 25 |
| Kenya | 0 | 0 | 1 | 0 | 1 | 3 |
| Luxembourg | 0 | 0 | 0 | 0 | 0 | 2 |
| Malaysia | 1 | 0 | 0 | 0 | 1 | 3 |
| Malta | 1 | 0 | 0 | 0 | 1 | 1 |
| Netherlands | 0 | 3 | 3 | 4 | 10 | 25 |
| New Zealand | 0 | 0 | 3 | 1 | 4 | 10 |
| Nigeria | 0 | 1 | 2 | 0 | 3 | 6 |
| Norway | 0 | 1 | 0 | 1 | 2 | 8 |
| Pakistan | 0 | 0 | 1 | 0 | 1 | 1 |
| Poland | 0 | 0 | 1 | 0 | 1 | 2 |
| Romania | 1 | 1 | 0 | 0 | 2 | 3 |
| Singapore | 0 | 1 | 0 | 1 | 2 | 2 |
| South Africa | 0 | 2 | 1 | 0 | 3 | 5 |
| South Korea | 0 | 0 | 0 | 2 | 2 | 2 |
| Spain | 0 | 1 | 0 | 1 | 2 | 6 |
| Sweden | 1 | 0 | 1 | 0 | 2 | 7 |
| Switzerland | 1 | 2 | 3 | 1 | 7 | 21 |
| Taiwan | 0 | 0 | 0 | 1 | 1 | 1 |
| Thailand | 0 | 0 | 1 | 1 | 2 | 2 |
| Turkey | 0 | 0 | 0 | 1 | 1 | 3 |
| United Kingdom | 9 | 9 | 8 | 6 | 32 | 82 |
| United States | 57 | 99 | 104 | 111 | 371 | 1,373 |
| U.S.S.R. | 1 | 6 | 1 | 2 | 10 | 21 |
| Uruguay | 0 | 0 | 1 | 0 | 1 | 1 |
| Vietnam | 0 | 0 | 0 | 1 | 1 | 2 |
| Total | 92 | 165 | 185 | 164 | 606 | 1,999 |

*Includes both German Democratic Republic and Federal Republic of Germany before FY 1991.

## Table 8. Requests for documents + tape/diskette and documents only FY 1991

| | | Documents + tape/diskette | Documents Only | Total | Total FY85 to date |
|---|---|---|---|---|---|
| NDP-001 | Atmospheric $CO_2$ Concentrations—Mauna Loa Observatory, Hawaii, 1958–1983 | *No longer distributed* | | | 68 |
| NDP-001/R1 | Atmospheric $CO_2$ Concentrations—Mauna Loa Observatory, Hawaii, 1958–1986 | 95 | 16 | 111 | 265 |
| NDP-002 | Tree Ring Chronology Indexes and Reconstructions of Precipitation in Central Iowa, U.S.A. | 24 | 6 | 30 | 66 |
| NDP-003 | Surface Air Temperature Anomalies for the Northern Hemisphere, 1881–present | *No longer distributed* | | | 84 |
| NDP-003/R1 | Global Surface Air Temperature Variations 1851–1984 | 67 | 8 | 75 | 180 |
| NDP-004 | Transient Tracers in the Oceans (TTO)—Hydrographic Data and Carbon Dioxide Systems | *No longer distributed* | | | 28 |
| NDP-004/R1 | Transient Tracers in the Oceans (TTO)—Hydrographic Data and Carbon Dioxide Systems with Revised Carbon Chemistry Data | 23 | 2 | 25 | 63 |
| NDP-005 | Atmospheric $CO_2$ Concentrations—The NOAA/GMCC Flask and Continuous Sampling Network | 42 | 4 | 46 | 118 |
| NDP-005/R1 | Atmospheric $CO_2$ Concentrations—The NOAA/GMCC Flask and Continuous Sampling Network | | | | 0 |
| NDP-006 | Production of $CO_2$ from Fossil Fuel Burning by Fuel Type, 1860–1982 | 61 | 16 | 77 | 203 |
| NDP-007 | Atmospheric $CO_2$ Concentrations—The CSIRO (Australia) Monitoring Program from Aircraft for 1972–1981 | 20 | 6 | 26 | 81 |
| NDP-008 | Seasonal Tropospheric and Stratospheric Temperature Anomalies for 1958–1984 | *No longer distributed* | | | 52 |

## Table 8 (continued)

| | | Documents + tape/diskette | Documents Only | Total | Total FY85 to date |
|---|---|---|---|---|---|
| NDP-008/R1 | Annual and Seasonal Global Temperature Anomalies in the Troposphere and Low Stratosphere, 1958–Summer 1986 | 33 | 7 | 40 | 81 |
| NDP-009 | Growth and Chemical Responses to $CO_2$ Enrichment—Virginia Pine (*Pinus virginiana Mill.*) | 17 | 5 | 22 | 62 |
| NDP-010 | Atmospheric $CO_2$ Concentrations—The CSIRO Program: Surface Data for Cape Grim, Tasmania | 20 | 7 | 27 | 70 |
| NDP-011 | Global Paleoclimatic Data for 6000 Yr B.P. | 43 | 5 | 48 | 132 |
| NDP-012 | Climatic Data for Northern Hemisphere Land Areas, 1851–1980 | 33 | 10 | 43 | 170 |
| NDP-013 | Volcanic Loading: The Dust Veil Index | 34 | 7 | 41 | 110 |
| NDP-014 | Solar Records: The Wolf Sunspot Index and Umbral/Penumbral Ratio | 35 | 2 | 37 | 97 |
| NDP-015 | Surface Air Temperature Anomalies for the Northern Hemisphere: The Russian Data Set | 6 | 3 | 9 | 70 |
| NDP-016 | Climatic Data for Selected U.S. and Canadian Stations, 1941–1980 | 13 | 5 | 18 | 95 |
| NDP-017 | Major World Ecosystem Complexes Ranked by Carbon in Live Vegetation: A Database | 92 | 13 | 105 | 215 |
| NDP-018 | Worldwide Organic Soil Carbon and Nitrogen Data | 69 | 15 | 84 | 158 |
| NDP-019 | United States Historical Climatology Network (HCN) Serial Temperature and Precipitation Data | *No Longer Distributed* | | | 170 |

## Table 8 (continued)

| | | Documents + tape/diskette | Documents Only | Total | Total FY85 to date |
|---|---|---|---|---|---|
| NDP-019/R1 | United States Historical Climatology Network (HCN) Serial Temperature and Precipitation Data | 36 | 47 | 83 | 160 |
| NDP-020 | A Global Grid Point Surface Air Temperature Data Set: 1851–1984 | 30 | 13 | 43 | 162 |
| NDP-020\R1 | An Updated Global Grid Point Surface Air Temperature Anomaly Data Set: 1851-1990 | 3 | 1 | 4 | 1 |
| NDP-021 | Historical Sunshine Data in the United States | 11 | 7 | 18 | 92 |
| NDP-021/R1 | Historical Sunshine and Cloud Data in the United States | 26 | 2 | 28 | 28 |
| NDP-022 | Global and Hemispheric Annual Temperature Variations Between 1861 and 1984 | *No Longer Distributed* | | | 56 |
| NDP-022/R1 | Global and Hemispheric Annual Temperature Variations Between 1861 and 1984 | 98 | 24 | 122 | 158 |
| NDP-023 | Seasonal and Annual Radiosonde Ozone Deviations, 1958–1985 | 31 | 6 | 37 | 84 |
| NDP-024 | A Global Planktonic Foraminifera Base for Evaluation of the Stability of Low-Latitude Sea Surface Temperatures | | 1 | 1 | 8 |
| NDP-025 | Monthly Mean Pressure Reconstructions For Europe (1780–1980) and North America (1858–1980) | 18 | 9 | 27 | 54 |
| NDP-026 | Climatological Data for Clouds Over the Globe from Surface Observations | 31 | 11 | 42 | 113 |
| NDP-027 | GEOSECS Atlantic, Pacific, Indian and Mediterranean Radiocarbon Data | 20 | 5 | 25 | 44 |

## Table 8 (continued)

| | | Documents + tape/diskette | Documents Only | Total | Total FY85 to date |
|---|---|---|---|---|---|
| NDP-028 | Carbonate Chemistry of the Weddell Sea | 11 | 5 | 16 | 26 |
| NDP-029 | Carbonate Chemistry of the North Pacific Ocean | 15 | 4 | 19 | 33 |
| NDP-030 | Estimates of $CO_2$ Emissions from Fossil Fuel Burning and Cement Manufacturing Using the United Nations Energy Statistics and the U.S. Bureau of Mines Cement Manufacturing Data | 4 | 41 | 45 | 302 |
| NDP-030/R1 | Estimates of $CO_2$ Emissions from Fossil Fuel Burning and Cement Production: 1950-1958 | 77 | 3 | 80 | 77 |
| NDP-030/R2 | Carbon Dioxide Emissions from Fossil Fuel Burning and Cement Manufacturing, 1950-1989 | 10 | 0 | 10 | 10 |
| NDP-031 | Average Total Snowfall Data for Selected U.S. Stations | 20 | 1 | 21 | 26 |
| NDP-032 | Antarctic Surface Temperature and Pressure Data | 19 | 4 | 23 | 54 |
| NDP-034 | Atmospheric $CO_2$ Concentrations—The Canadian Background Air Pollution Monitoring Network | 23 | 1 | 24 | 24 |
| NDP-035 | A Global Geographic Information System Data Base of Storm Occurrences and Other Climatic Phenomena Affecting Coastal Zones | 9 | 4 | 13 | 13 |
| NDP-036 | Indian Ocean Radiocarbon: Data from the Indigo 1, 2, and 3 Cruises | 19 | 2 | 21 | 21 |
| NDP-038 | Atmospheric Methane Concentrations—The NOAA/CMDL Global Cooperative Flask Sampling Network, 1983-1988 | 35 | 1 | 36 | 36 |
| CMP-002 | The IEA/ORAU Long-Term Global Energy $CO_2$ Model | 3 | 2 | 5 | 66 |

## Table 8 (continued)

| | | Documents + tape/diskette | Documents Only | Total | Total FY85 to date |
|---|---|---|---|---|---|
| CMP-002/ PC | The IEA/ORAU Long-Term Global Energy $CO_2$ Model: Personal Computer Version A84PC | *No longer distributed* | | | 267 |
| CMP-002/ PC/R1 | The IEA/ORAU Long-Term Global Energy $CO_2$ Model: Personal Computer Version A84PC | 167 | 2 | 169 | 307 |
| CDIAC-36 | Trends '90: A Compendium of Data on Global Change on diskette | 47 | 0 | 47 | 47 |
| | Total | 1,490 | 333 | 1,823 | 4,907 |

# 10. NETWORKING

To maintain its proactive position in information management activities, CDIAC strives to keep informed of current research, policy, and information developments and needs at the international, national, and local levels. In addition to the exchange of data among researchers, CDIAC has taken an active role in the networking of information among government agencies, industries, businesses, special libraries and information/data centers, institutions, organizations, and special and public interest groups. Maintaining close professional contacts with individuals and organizations, CDIAC's networking capabilities have included the dissemination of research results, policy initiatives, and education developments; objective technical interpretations and discussions of the technical and information management related to carbon dioxide and climate change; referrals to other individuals or organizations; and access to resources relevant to individuals' information needs. CDIAC's networking capabilities have been further enhanced by active participation in the programs and organizational administration of professional societies and associations. It has been through these networking activities that CDIAC has been able to monitor the information needs of the broad climate-change community and develop specific information products and services to help meet those needs.

In FY 1991 CDIAC's networking activities included: 19 visits to CDIAC by more than 25 individuals for detailed personal discussions and exchanges of resources; 7 presentations at meetings of professional associations and societies, including the participation in development and planning of three international meetings; and CDIAC staff serving as members of nine committees of professional organizations and two editorial advisory boards.

## CDIAC Staff Activities

Discussions

- met with Harry F. Lins (Water Resources Division, U.S. Geological Survey), head of the USGS program in global-change hydrology, and Michael C. Yurewicz, Assistant District Chief for Hydrologic Investigations, Tennessee District, U.S. Geological Survey, to discuss the role of data centers in global-change research programs.

- discussed with staff from Congressman Markey's office the concept of cost to produce $CO_2$ by electric utilities. We discussed the variability of $CO_2$ emissions according to fuel type and the importance of accounting for both operating and capital costs. We referred Markey's staff to ORNL economist Jim Van Dyke for further discussions of utility accounting procedures.

- met with Drs. Sherry Rowland, Don Blake, and Ralph Cicerone (University of California - Irvine) to discuss their trace gas monitoring program, archiving of their data at CDIAC, and possible inclusion of some of their data in *Trends '91*.

- met with Drs. Gennadiy Menzhulin (Agrophysical Institute—Leningrad), Yakov Popov (U.S.S.R. State Committee for Hydrometeorology—Moscow), and Vladimir Radyukhin, Vyacheslav Razuvayev, and Rudolf Reitenbach (All-Union Research Institute of Hydrometeorological Information— Obninsk) who visited CDIAC on November 6–7 to learn more about CDIAC and the carbon cycle program, to discuss CDIAC's data-related activities, and to discuss future data exchanges.

- met with Frank Oldfield (University of Liverpool) on November 22 to discuss his research efforts, particularly his paleoclimate data, and to give him an overview of CDIAC.

- discussed mutual information needs and activities with the NOAA Library and Information Services Division at the NOAA Central Library in Rockville, Maryland, and with NOAA's Ocean Pollution Data and Information Network and exchanged various materials including reports, newsletters, brochures.

- held extensive discussions with two research team members of the Commission of the European Communities who are working on the project "External Costs of Fuel Cycles" — Jacqueline Boucher (Project Manager, Coherence) from Belgium and Nick Eyre (Chief Scientist's Group, Energy Technology Support Unit, UK Department of Energy) from the United Kingdom. Discussions included the mission of and services provided by CDIAC, greenhouse-gas and climate data, global $CO_2$ emissions inventories, and networking with the international global-change community. Boucher and Eyre are both working on a regional externalities (i.e., external costs of fuel cycles) project with ORNL's Energy Division.

- met with Brian Wynne (Director of the Centre for Science Studies and Science Policy, Lancaster University, UK) to discuss the challenges of communicating technical information to policy and nontechnical audiences.

- met with six members of a visiting Japanese delegation from the Research Institute of Innovative Technology for the Earth (RITE, National Research Laboratory), Kyoto, to discuss and make presentations concerning (1) the linkage between climate change and energy use, (2) information needs in projecting the impacts of climate change and rising sea level, and (3) the services available from CDIAC. The six members of the delegation were Yasuo Asada (Ministry of International Trade and Industry), Haruhiko Fukaya (Government Industrial Research Institute of Nagoya), Yoshiharu Miura (Osaka University), Hiroyasu Takenaka (Government Industrial Research Institute of Osaka), Kiyotaka Wasa (RITE), and Shin-Ya Yokoyama (National Research Institute for Pollution and Resources).

- discussed information management strategies with Dr. David Blockstein, Director of the Committee for the National Institutes of the Environment, who has been charged by the National Academy of Science to conduct a feasibility program for the creation of a National Institutes of the Environment.

- discussed environment and energy education issues with Paula Altman, in DOE's National Energy Information Center at the Energy Information Administration. Ms. Altman compiles the annual *Energy Education Resources*, an information booklet that highlights free or low-cost energy-related educational materials for primary and secondary students and educators. CDIAC's glossary, newsletter, and factsheets will be cited for general use and *Trends* will be listed as a resource geared for educators. These items will be listed in the section of materials available from DOE and will appear in the 1991 issue of Energy Education Resources.

- discussed climate change issues and resources with the reference staff of the Science and Technology Division of the Library of Congress and presented them with copies of *Trends '90, CDIAC Communications,* and *Glossary: Carbon Dioxide and Climate.* We provided sample copies of these CDIAC materials and 250 copies of CDIAC's factsheets for the Division's open house celebrating National Science Day, which was attended by more than 200 science and technology librarians and information professionals in the Washington, D.C., area.

- met with Mike DeLello, from DOE's Congressional Affairs Office, and described CDIAC and its various services, information products, and publications. Dr. DeLello visited all of the national laboratories in an attempt to better understand the scope of DOE's global-change programs that will help in addressing anticipated questions concerning the President's new budget, and to determine how we can assist him in spreading the good words about ORNL and CDIAC in particular. Bulk quantities of CDIAC's newsletters, glossary, factsheets, and other materials were directed to his office for distribution to appropriate Congressional staff.

- met with Tony Brazel and Sandra Brazel at the Arizona State University Laboratory of Climatology regarding independent research on the temporal synoptic variability of the Arizona monsoon. These discussions were in preparation for a presentation to be addressed at the annual Association of American Geographers meeting in Miami, Florida, in mid-April.

- met with Dr. Agus Pratama Sari (Ministry of the Environment, Jakarta, Indonesia) on May 7 to give him an overview of CDIAC, discuss CDIAC's $CO_2$ emission calculations, and to show him how to run the Edmonds/Reilly computer model. Dr. Sari was visiting several agencies throughout the United States to become better informed concerning what climate change–related data are available and to learn how to generate emission estimates for Indonesia.

- met with Nic Korte (Grand Junction, Colorado) on June 27 to discuss possible interest and opportunities for establishing a monitoring site/program in Guatemala. Nic is doing some long-term work with AID in Guatemala; has a budget and staff to support such a monitoring exercise; and wants to contribute, if possible, to climate change research by assisting in remote measurement activities. Gregg and Tom suggested he contact NOAA/CMDL or NOAA/NCDC, and Tom Boden contacted Ed Dlugokencky (NOAA/CMDL, Boulder, Colorado), who coordinates the CMDL methane flask sampling activities, and asked him to contact Nic about a possible collaborative effort.

- met with Dr. Steve Carpenter (University of Wisconsin, Center for Limnology) on June 28 to give him an overview of CDIAC and to discuss his whole–lake experiments.

- discussed mutual global change interests with Norman Coleman, Assistant Attorney General for the State of Minnesota and exchanged materials with the Global Institute of the Environment, which is a project developed by the Attorney General (Hubert H. Humphrey III) and the conservation biology program at the University of Minnesota.

- discussed with Carol A. Mouché, editor of *Environmental Protection*, a special issue featuring the topic of climate change. CDIAC materials have been directed to her and to the author working on the project.

- discussed mutual global-change interests with the staff at the center for World Environment and Sustainable Development at North Carolina State University and initiated an exchange of materials about our respective programs.

- discussed with John F. Ahearn, Executive Director of Sigma Xi (Scientific Research Society) to discuss the November 16–18, 1991 Washington, DC conference, "Global Change and the Human Prospect: Issues in Population, Science, Technology, and Equity." Materials about the conference and exhibitor information was circulated among staff.

- met with Dr. K. D. Singh to discuss the possibility of CDIAC serving as an archive and data manager for data sets produced by the United Nations Food and Agriculture Organization Forest Resources Assessment Project. All parties appeared to be satisfied with the high level of potential to initiate agreements for the transfer, storage, and possible repackaging of these data sets.

- discussed materials related to *Trends '91* material were made with Dr. R. F. Weiss of the Scripps Institute of Oceanography and with Dr. Donald A. Fisher of Du Pont. An attempt was made to obtain atmospheric $N_2O$ data from Dr. Weiss for inclusion in *Trends '91*. These data, collected from a number of land and ocean vessel sites, would represent a substantial expansion of our presentation of atmospheric $N_2O$ in *Trends*. Consultations with Dr. Fisher concerned the CFC production and release data obtained from the Chemical Manufacturers Association (CMA). Dr. Fisher has worked closely with these data and was able to provide information concerning the completeness of the CMA data and the availability of additional data, such as CFC release by country or region.

- discussed with Lelani Arris, program coordinator for ECONET, the ECONET Climate and Energy Information Exchange (ECIX), which is a computer bulletin board (e-mail, conference board, resource directory, and electronic newsletter) funded by the Joyce Mertz-Gilmore Foundation. ECIX will host the Climate Change Digest, an on-line communications tool linking ECONET's 2000 subscribers. Arrangements have been made to have the content of several of CDIAC's factsheets transferred to ECONET for distribution throughout the network.

- met with Leigh Carol Yuster, Associate Publisher for Bowker A&I Publishing (R. R. Bowker) at the Annual Meeting of the American Libraries Association in Atlanta, Georgia to discuss issues concerning the inclusion of descriptive sections of NDPs in *Environment Abstracts* and in the *ENVIROFICHE*. Leigh is also looking for authors for the 1991 *Environment Abstracts Annual* (the hardbound cumulative issue of 1991 issues of *Environment Abstracts*). Each annual contains two or three scholarly articles on some aspect of the environment. These are solicited from the abstract's board of technical advisors and are prepared to give special insights on some current environmental issue or topic.

- met with Cory Berish, Global Change Program coordinator for U.S. Environmental Protection Agency Region 4 to discuss potential joint work with CDIAC and The University of Tennessee's Graduate School of Library and Information Science. The work would include the identification of college and university programs in EPA Region 4 that are addressing the topic of Global Change in their classroom, laboratory, or field study instruction. A project could also be expanded to identify appropriate curricula, audio-visuals, and other teaching aids that would be useful for enhancing the formal lecture, field, or laboratory offering.

- contacted Kim Knox, Education Coordinator at the American Water Works Association (Boulder, CO (At the suggestion of Sue Terry, Librarian at the World Resources Institute), which is expanding its efforts in the area of environmental education. An exchange of materials was initiated.

- met with officials of the Nicolet National Forest and Chequamegon National Forest (Wisconsin). These national forests are under considerable pressure concerning their long-term management plans, including factors such as biodiversity and global change. The state of knowledge concerning climate change and its impacts, as well as data and other information products from CDIAC, were discussed.

- met with staff of the DOE Office of Foreign Intelligence, to discuss data concerning energy, environment, and economics, including CDIAC's country-specific $CO_2$ emissions data and participation in cooperative studies with Russian scientists.

- met with Kent Thornton, a water resources specialist with FTN Associates, Ltd. (Little Rock, Arkansas), concerning the incorporation of climate-change issues into a comprehensive water resources research initiative.

- met with several researchers from the Atmospheric Environment Service (AES) of Environment Canada while in Toronto, Canada, the week of September 23–27, 1991. AES continues to be a key partner of CDIAC by archiving their atmospheric trace gas measurements with us. CDIAC staff were briefed on the progress of AES's ongoing atmospheric trace gas measurements at Alert, Cape St. James, Sable Island, and Fraserdale. We discussed recent CDIAC products and activities and our data-related plans for the near future.

- discussed with Dennis C. Kois, Manager of MECCA (Model Evaluation Consortium for Climate Assessment, an international consortium formed by industry, academic, and government groups) for the services of CDIAC and MECCA. An initial exchange of publications and other materials related to climate change was set up.

**Hosted Visits**

- hosted the visit of Konstantin Vinnikov (State Hydrological Institute, Leningrad, U.S.S.R.), to discuss the progress at CDIAC in producing NDPs from data sets he has supplied and to set up discussions between Vinnikov and other research groups at ORNL involved in climate-change research.

- hosted the visit of Stanley Grotch (Lawrence Livermore National Laboratory) to discuss his approaches to climate data analysis.

- hosted the visit of Moriyoshi Aoyama (Environmental Protection Bureau, Kawasaki, Japan), to discuss climate change. Aoyama was traveling around the United States under a unique program funded by the City of Kawasaki, that allows selected employees, who are selected on the basis of submitted proposals, to travel abroad for discussions on environmental topics related to their work.

- hosted a visit with Ms. Piedad Dector, from the University of Mexico Science and Information Center, who was investigating various alternatives for data base management and information handling techniques. Her visit included a tour of ORNL library facilities and CDIAC. Her interests with CDIAC dealt with our unique approach for document distribution and data management techniques.

- Charles Hartgraves (Associate Deputy Chief, Administration) and Don Jameson (Computer Sciences and Telecommunications Staff) of the U.S. Forest Service visited CDIAC on November 26, 1990, to learn more about CDIAC and CDIAC's data-related activities. Hartgraves and Jameson were on a fact-finding mission to determine what resources (i.e., data, GIS expertise, staff) are available at ORNL that may be useful to the U.S. Forest Service in their own global warming programs.

- hosted a visit by Dr. Jyoti Parikh (Indira Gandhi Institute of Developmental Research, Bombay, India) on March 15 to discuss CDIAC's data archives and to talk with Gregg Marland. Dr. Parikh heads a large group of Indian scientists who are researching global warming issues and has compiled emission estimates for India, including emission estimates for over 500 individual power plants in India. Fred Stoss discussed CDIAC, publications, and access to bibliographic information with Dr. Parikh.

**Technical Assistance**

- sent various materials to Dr. Harriett S. Stubbs, Research Associate in the College of Education and Psychology at North Carolina State University, to assist in her efforts to establish the SCI-LINK program. SCI-LINK is an initiative that will bring environmental themes into elementary and secondary science curricula. Dr. Stubbs has applied for continuing support from the National Science Foundation and will use CDIAC materials (newsletters, glossary, and *Trends '90*) in her summer workshops for teachers.

- provided assistance to Kathy Deck, Technical Information Officer for the Center for Environmental Health and Injury Control (CEHIC). CDIAC and DOE reports were used to assist the Division of Environmental Hazards and Health Effects to provide technical expertise on an increasing number of issues related to air pollution. CEHIC is one of the components of the Centers for Disease Control in Atlanta.

- arranged for CDIAC materials to be included in the U.S. Geological Survey's (USGS) *Earth Science Data Directory*. This on-line interactive directory is being developed by the USGS as a system for determining the availability of specific earth science and natural resource data. This directory offers online access to a USGS mainframe computer repository of information about earth science and natural resource data bases. The types of data bases (automated and nonautomated) that are included in the *Earth Science Data Directory* are related to geologic, hydrologic, cartographic, and biologic sciences. The producers of this data base are particularly interested in improving their coverage of climate change-related data.

- provided samples of materials from CDIAC that can be made available to directors and designees to the Annual Directors Meeting of the International Energy Agency's Energy Technology Data Exchange, which will be hosted by DOE's Office of Scientific and Technical Information (Oak Ridge), and held in late April in Gatlinburg, Tennessee.

- assisted the Adirondack Park Agency and the Adirondack Visitors and Interpretive Center, have developed an extensive traveling museum exhibit on climate change. *Trends '90* and other CDIAC materials provided useful information for this exhibit. (Scheduled stops included the New York Museum of Natural History, the Bronx Zoo, and the New York State Museum, and will include numerous science museums in and around New York State and a stop at the Smithsonian in 1992). Press materials concerning the opening of the exhibit in Paul Smiths, New York were sent to CDIAC.

- provided assistance to the Finnish Meteorological Institute (FMI) in the preparation of a Finnish-Swedish-English meteorology/climatology glossary dictionary by providing the FMI with a copy (and the corresponding files on diskette) of CDIAC's *Glossary: Carbon Dioxide and Climate*. The entries from CDIAC's *Glossary* will be used to verify and add to entries that FMI is obtaining from other sources. The FMI glossary/dictionary will be distributed (at no cost) to Scandinavian climate researchers.

- provided assistance to Oak Ridge Associated Universities (ORAU) by preparing a set of mailing labels from our Directory for use in mailing announcements of the new DOE-funded Graduate Fellowships for Global Change. In a letter of thanks to CDIAC, ORAU noted that within a month they had received over 100 applications.

- assisted the Environmental Data Research Institute in its effort to identify funding sources of research in global change by providing information about the U.S. Global Change Research Program, CDRP, the ORAU-administered Graduate Fellowships for Global Change, as well as fellowships available from NASA, the American Foundation for Biological Sciences, and American Association for the Advancement of Science.

- provided assistance to Andrew Bull, Education Coordinator for Greenhouse Action Australia, with materials from *Glossary: Carbon Dioxide and Climate* and *Trends '91* for use in a multimedia CD-ROM information package they are preparing on the topic of global warming.

- provided assistance Jane Thomsen, Information Specialist in the Energy and Resources Division of the New Zealand Ministry of Commerce, by preparing names and address of government agency, industry, academic researchers, and others whose professional interests lie in the study of climate change. This information will be used to assist the Ministry's efforts for the "The Crystal Ball Conference—An Insight to Your Energy Futures," which is an industry/government agency-focused conference held in New Zealand March 31 through April 3, 1992.

**Individual Activities**

- Fred Stoss served as an invited speaker for the East Tennessee Chapter of the American Institute for Information Science (Knoxville, Tenn.)

- Tom Boden attended the Sixth NASA Master Directory Interoperability Workshop in Silver Spring, Maryland (September 30–October 3) to provide input on data documentation and data quality issues pertinent to NASA's Master Directory. CDIAC's NDPs and CMPs are cataloged in the Directory.

- Tom Boden attended the 1991 NOAA/CMDL annual meeting in Boulder, Colorado (March 6 & 7).

- Fred Stoss received a copy of the Solar Energy Research Institute's (SERI) Directory of Biofuels Industry on a floppy diskette. The files provide a listing of more than 2700 entries that are involved in the use or production of various biofuels. The Biofuels Database was provided by Kevin O'Connor at SERI.

- Fred Stoss received a preprint version of the U.S. Forest Service's *Directory of Forestry and Forest Products Libraries*, provided by Peter Evans, Head Librarian (retired) of the Forestry Library at the University of California at Berkeley. There are more than 450 entries in this updated version of the directory, which is scheduled for release in May or June. The directory was reformatted into WordPerfect format. This inventory has extensive foreign listings and should serve as an excellent vehicle for sharing information about CDIAC and its services and information products.

- Tom Boden and Dale Kaiser attended the 1991 Atmospheric Environment Service's *Canadian Baseline Program Review* meeting in Toronto, Ontario (May 29–30). Tom Boden chaired the methane session at the meeting. CDIAC archives and distributes all the trace gas measurements made by Neil Trivett's monitoring programs at Alert, Sable Island, and Cape St. James.

- Fred Stoss served as a representative of the Special Libraries Association's Environment and Resource Management Division at the American Libraries Association (ALA) Annual Meeting of the Environmental Task Force. This was the first year of operation of the Task Force, which was created under the auspices of the ALA Social Responsibilities Round Table. One of the topics at the 1992 ALA Annual Meeting may be the identification of scientific and technical data sets and information services related to specific environmental topics, including climate change and global warming.

- Fred Stoss has been asked to serve as the liaison for the Special Libraries Association to the Committee for the National Institutes for the Environment. He serves as co-chair for the Environment and Resource Management Division (SLA) Committee on NIE, and will prepare a report on NIE's proposed National Library of the Environment.

- Fred Stoss was selected to serve for a second term as Chair of the Networking Committee of the Science and Technology Division of the Special Libraries Association. As current chair, he prepared a comprehensive analysis of the division's membership, which was presented at the SLA Annual Meeting.

- Fred Stoss was added to the Interagency Working Group on Data Management for Global Change, Library/Information Subgroup (Chaired by Carol Watts, NOAA).

- Fred Stoss and Bob Sepanski attended the ORNL-sponsored/hosted conference, *Technologies for a Greenhouse Constrained Society*. The communications group prepared a poster exhibit about the operation of CDIAC and provided complimentary copies of back issues of *CDIAC Communications* and the DOE Research Summary (Jones and Wigley 1991). Requests for copies of materials on display or items appearing in the CDIAC Catalog of *Numeric Data Packages and Reports* were accepted and processed to be sent to the requestor's office, unless otherwise requested.

- Fred Stoss completed tasks as Technical Session Chair for the Air and Waste Management Association technical program in the Environmental Management Section. The specific title of the session was "Information Resources: Knee-Deep and Rising" and featured speakers from EPA, the Public Health Service, public utilities, contracting firms, and environmental consultants. This was the first time the topic of information and data management was presented as an independent program theme.

- Fred Stoss completed tasks as Program Chair for the Environment and Resource Management Division for the Special Libraries Association Annual Meeting. Among the six technical programs, training workshops, and round tables developed were: "Global Climate Change: The Information Community's Response," and "Technology Transfer to Developing Regions: The Special Librarian's Role." The session on climate change featured speakers from the Bureau of National Affairs, the Cutter Information Group, Elsevier Science Publishing Company, the World Resources Institute, and the Sierra Club.

- Dale Kaiser attended NASA's GEDEX (Greenhouse Effect Detection Experiment) Atmospheric Temperature Workshop held in Columbia, Maryland, July 9–11, 1991. He touched base with many researchers on a variety of subjects including CDIAC's function, possible new NDPs, NDP updates, *Trends '91*, and cooperation between those at CDIAC and NASA's Climate Data System in areas of global-change data acquisition and dissemination.

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