CDIAC

C A T A L O G

Numeric Data Packages &
Computer Model Packages

Carbon Dioxide Information Analysis Center
World Data Center-A For Atmospheric Trace Gases
Oak Ridge National Laboratory

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MAY 1993

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CDIAC Catalog of Numeric Data Packages and Computer Model Packages

**Thomas A. Boden
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May 1993

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CDIAC Catalog of Numeric Data Packages and Computer Model Packages. T. A. Boden¹; F. M. O'Hara, Jr.²; and F. W. Stoss.³ ORNL/CDIAC-62, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory,⁴ Oak Ridge, Tenn., 1993.

Abstract

The Carbon Dioxide Information Analysis Center acquires, quality-assures, and distributes to the scientific community numeric data packages (NDPs) and computer model packages (CMPs) dealing with topics related to atmospheric trace-gas concentrations and global climate change. These packages include data on historic and present atmospheric CO₂ and CH₄ concentrations, historic and present oceanic CO₂ concentrations, historic weather and climate around the world, sea-level rise, storm occurrences, volcanic dust in the atmosphere, sources of atmospheric CO₂, plants' response to elevated CO₂ levels, sunspot occurrences, and many other indicators of, contributors to, or components of climate change. This catalog describes the packages presently offered by CDIAC, reviews the processes used by CDIAC to assure the quality of the data contained in these packages, notes the media on which each package is available, describes the documentation that accompanies each package, and provides ordering information. Numeric data are available in the printed NDPs and CMPs, in CD-ROM format, and from an anonymous FTP area via Internet. All CDIAC information products are available at no cost.

Keywords: carbon cycle, carbon dioxide, climate, climate change, data analysis, data management, fossil fuels, geophysical surveys, global warming, greenhouse effect, information centers, methane, regional analysis, trace gases in the atmosphere, weather records.

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⁴Managed by Martin Marietta Energy Systems for the U.S. Department of Energy under Contract No. DE-AC05-84-OR21400.

Foreword

The issue of global change is international in scope. The Intergovernmental Panel on Climate Change was established in 1988 to develop a scientific strategy to investigate climate change. The U.S. portion of this multidisciplinary research effort has been overseen by the Office of Science and Technology Policy's Committee on Earth and Environmental Sciences (CEES). The U.S. Global Change Research Program (USGCRP) was developed by CEES to provide a better understanding of the integrated Earth system and will examine the possible implication of global change from scientific and social perspectives.

Providing comprehensive, reliable, and timely access to information is one means to reduce scientific uncertainties associated with global change. As part of its Global Change Research Program, the U.S. Department of Energy (DOE) is pursuing research designed to:

- Quantify the links between increased greenhouse gases and climate change;
- Create a better understanding of the resulting environmental, social, and economic costs and benefits related to global change;
- Develop technologies to reduce the threat of global change caused by an enhanced greenhouse effect;
- Develop any new technologies that are required by the threat of such changes; and
- Gather data and information and create tools to assess the social, economic, and environmental costs and benefits of human-induced climate change.

The CEES in its report *The U.S. Global Change Data and Information Management Program Plan* has underscored the need for reliable data and information for the purpose of supporting existing programs and archives and for directing new activities and initiatives related to the research and policies of global environmental change. Climatic and Earth-system data are used extensively for determining the state of global environmental change by investigating and evaluating scenarios of natural and man-made impacts on the environment. Observational data collected over periods of time form the scientific basis on which decision-makers assess those impacts and provide mitigative or remedial corrections.

CDIAC's role as a major information resource is clearly outlined:

The management philosophy of CDIAC supports the entire information needs of the global-change community, not just its data needs. In addition to fulfilling the standard function of a repository for research-produced data, CDIAC often creates derived data sets needed to address complex issues by integrating data from multiple disciplines. CDIAC responds to requests for policy-decision information as well as those for basic science data, and it provides stewardship of data on greenhouse gas emissions; concentrations of greenhouse gases in the atmosphere, oceans, and terrestrial ecosystems; and long-term climate data.

CDIAC has established strict guidelines for the quality assurance of data sets that are destined to become numeric data packages or computer model packages. CDIAC will continue to play an active role in developing and promoting standards for media and the processing and communicating of data and information.

This catalog of CDIAC's numeric data packages (NDPs) and computer model packages (CMPs) provides a complete inventory of specialized information products designed to assist in our understanding of global-change phenomena and to support the growing information needs of the global-change research, policy, and education communities. We hope you find this catalog useful.

Robert M. Cushman, Director
Carbon Dioxide Information Analysis Center
Oak Ridge National Laboratory
May 1993

Overview

CDIAC, An Introduction

The Carbon Dioxide Information Analysis Center (CDIAC), located within the Environmental Sciences Division of Oak Ridge National Laboratory (ORNL), has been in operation since 1982. CDIAC provides information support to the international research, policy, and education communities for evaluation of complex environmental issues associated with elevated atmospheric CO₂ and trace-gas concentrations, including potential climate change.

CDIAC activities include obtaining and evaluating data, articles and reports; producing digital numeric data and computer model packages (NDPs and CMPs); distributing greenhouse effect related reports; and producing the newsletter *CDIAC Communications*, with a world-wide distribution of more than 8000 subscribers in more than 152 countries. Presently, 42 NDPs and 2 CMPs are available. To date, 17 issues of *CDIAC Communications* have been distributed, and CDIAC has responded to more than 40,000 information requests.

CDIAC is funded by the U.S. Department of Energy (DOE) to support its Global Change Research Program (GCRP). The goal of the GCRP is to develop sound scientific information for policy formation and governmental action in response to changes of atmospheric levels of CO₂ and other greenhouse gases. The thrust of the GCRP during the past decade has been to (1) elucidate the processes that control the global carbon cycle and provide predictions of future atmospheric CO₂ change, (2) develop data and models of the processes by which changes in the Earth's radiative balance may change climate at global and regional scales and predict rates of potential climate change, and (3) develop the data and models required to define and predict the combined effect of climate and the direct effect of CO₂ on plants, crops, and ecosystems.

One of the fundamental services offered by the CDIAC is providing fully documented, machine-readable CO₂-related data sets and computer models to the international research and policy-making communities. CDIAC creates and distributes NDPs and CMPs. These packages are popular CDIAC offerings, with more than 8500 copies being distributed since 1985. From its inception, CDIAC has emphasized data quality and the completeness of supporting data documentation as being of paramount importance. We spend considerable time and effort checking and documenting the data sets and computer models we distribute. The following sections provide details on CDIAC's data-packaging activities. The packaging process is outlined in the accompanying figure.

The Data and Computer-Model Packaging Process

The data-packaging process.

Data Selection and Acquisition

Data-set selection is based on feedback obtained from surveys, users of CDIAC data products, and the research community in general and on programmatic considerations. Each year, we compile a list of potential data sets to be obtained, checked, and documented as NDPs. This list is sent to the Department of Energy's Global Change Research Program managers and CO₂ researchers collocated with CDIAC here at ORNL. In response to their comments and suggestions, we prepare a list of the data sets that we will attempt to package during the coming year.

After we compile this list of desired data sets, we attempt to obtain the data from the principal investigator or agency responsible for compiling or maintaining the data set. We have been encouraged by the willingness of researchers to make their data available to a broader scientific community. If not for this spirit of cooperation, our packaging process would not be possible.

If the data set is already fully quality-assured, documented, and readily available from another source, we usually obtain the data only for archival purposes and refer potential users to the original data source or data archive maintaining the data base. If the data are not quality-assured, documented, and made available elsewhere, CDIAC enters into an agreement of understanding with the original data source to obtain the data.

This agreement is a symbiotic relationship. CDIAC agrees to prepare the documentation for the data or model and also to distribute at no cost the researcher's data or model to anyone wishing to receive the package. In exchange, the researcher must agree to review our documentation prior to its distribution. The researcher, naturally, retains full authorship of the work and is no longer burdened with filling requests for the data. If the original source does not agree to work with us in the packaging process, CDIAC simply archives the data but does not document and distribute the data or model as an NDP or CMP. CDIAC will not distribute an NDP or CMP until the contributor has reviewed the documentation and granted written permission to do so.

Quality Assurance

A critical component of the NDP process at CDIAC is the quality assurance (QA) of data before distribution. Data received at CDIAC are rarely in perfect condition for immediate distribution, regardless of the source. To guarantee data of the highest possible quality, CDIAC conducts extensive QA reviews of every data set we receive. QA reviews involve examining the data for completeness, reasonableness, and accuracy. Although they have common objectives, these reviews are tailored to each data set, often through extensive programming efforts. We often make use of disciplinary experts to help design these reviews, either experts in our center, at ORNL, or in the research community at large. The effort involved in quality-assuring a data set is variable. Some simple data sets take only a few weeks to QA, others, such as our CO₂ emissions data base (NDP-030/R4) have taken a year of effort and the creation of thousands of lines of QA source code. This particular QA process checks that data are reported for the appropriate time span, that the country and other codes are correct, that erroneous or inappropriate units are corrected, that positive and negative signs are correct, that gaps in data are adequately explained, and that changes (in revisions) are verified and addressed. The cost to quality-assure, document, and distribute a data set can run into the hundreds of thousands of dollars. Although time-consuming, the QA process is an important component in the value-added concept that CDIAC adheres to for assuring accurate, usable CO₂ data for use by the research community.

Documentation

After a complete QA review, CDIAC fully documents each data set. Documentation includes written text, data listings, graphic illustrations, listings of computer codes that are provided to read and print data files, and reprints (not just references, but full reprints bound into the documentation) of pertinent literature.

We feel that it is important to include complete reprints in our documentation. This practice offers the user greater detail about the process by which the data were collected and about the author's published results and discussions. These reprints also ensure that "grey literature" publications, which are frequently used to document data-collection procedures, will still be accessible in the future just by obtaining the data-set documentation.

The documentation provides an abstract, background information, applications of the data, descriptions of data files (i.e., file formats, variables, units), and importantly, limitations of the data. All data have limitations in their application, but usually they are not written down. CDIAC attempts to work closely with the data source to determine what limitations the data have and to document these limitations in an attempt to prevent the

CDIAC NDPs are available in a variety of formats: floppy diskettes, magnetic tape, CD-ROM, and anonymous FTP; all come with hard-copy documentation.

misuse or misinterpretation of the data. This is especially important for data sets that will be in use for several decades.

An important component of our documentation is the listing and graphic representation of as much of the data as possible. This practice is important for three reasons: (1) It provides the user with a feel for the information and a handy reference when pulling data off the transfer medium. (2) Often all a casual user wants is a few numbers or a graph of selected data; our documentation allows access to this information without having to read a magnetic tape or even having to use a computer. (3) The capturing of information on hardcopy is still a useful and reliable form of archiving. No matter what technology has in store for us, we will still be able to read data on printed paper a hundred years from now.

Review

Our draft documentation is reviewed both internally and externally before release, internally at ORNL by two technical reviewers and a technical editor and externally by at least the principal investigator (who maintains complete signoff authority; no data are released until the authors are satisfied with the package). Sometimes

it is necessary to go through several iterations of external review, and sometimes the review process is broadened to include testing by beta test sites.

Some NDPs and CMPs, because of their complexity and/or importance to the research community, undergo a "beta test" review. After the draft data set and documentation are reviewed internally and approved by the principal investigator, both are sent to beta test sites for testing before distribution to the general public. These sites are identified by CDIAC and are individuals or agencies having (1) a genuine, active interest in the data set and (2) the capabilities to rigorously exercise the data files and review the documentation. It is hoped that through actual application these beta test sites will uncover any possible errors in the data or suggest improvements to the documentation before the package is distributed to the general public. Our CO₂ emissions package (NDP-030/R4), for example, was tested by a dozen beta test sites in four countries before release.

CDIAC's primary means of announcing its products and services, including NDPs and CMPs, is our newsletter, *CDIAC Communications*. It is published three times a year and reaches more than 8500 users in more than 152 countries around the world. CDIAC products are also listed in other publications (e.g., *BioScience*, *Environment Abstracts*, and *GEOTIMES*) and referenced in various online data directories (e.g., the NASA Master Directory). CDIAC is expanding the publicizing of its services through electronic bulletin boards and producing CDIAC brochures and posters for dissemination and display at research conferences. CDIAC hopes to increase the accessibility of its data products by routinely sending copies of NDPs and CMPs to university and research libraries.

Presently, machine-readable files are distributed on 9-track magnetic tapes, CD-ROM, and, when feasible, on IBM-formatted floppy diskettes. Data may also be obtained over the Internet with the file transfer protocol (FTP) by accessing CDIAC's anonymous FTP area. Files may also be sent by electronic networks, such as Bitnet, Internet, and Omnet. Magnetic tapes are currently produced on an IBM 3090 mainframe system and in the near future may be produced on tape drives linked to our workstations in TAR formats. CDIAC is also considering distributing data on EXABYTE[®] tapes, so your input in evaluating the attractiveness of new transfer media would be appreciated.

CDIAC uses a FoxPro[®] system that maintains records of users requesting information from CDIAC, including data products. This system enables CDIAC to produce summary user statistics and also enables CDIAC to notify users of revisions to data products they have already received. As a courtesy to investigators who contribute data to CDIAC's NDP collection, periodically we supply them with a listing of the users receiving their data from CDIAC. This list serves as an indicator of the popularity of their data, identifies researchers with common interests, and illustrates the diverse group of individuals that are using the information they collected.

All data and computer codes distributed as NDPs or CMPs are archived in machine-readable form at CDIAC and in a separate building at the central computing facility at ORNL. Data files archived at CDIAC are stored

Beta Test Sites

Distribution

A sampling of the commands used to access CDIAC's anonymous FTP area is shown below. For a full description of user commands, contact CDIAC.

```
> ftp cdiaac.esd.ornl.gov
CDIAC> name? anonymous
CDIAC> Password? YOU@youraddress
CDIAC> Login OK
CDIAC> cd pub
CDIAC> dir
CDIAC> cd ndp035
CDIAC> dir
CDIAC> get ndp035.des
CDIAC> bye
CDIAC> Goodbye
```

Data Archiving

Numeric data most frequently requested.

A data package typically contains ...
An identification of the contributors
Background information on the data
The source and scope of the data
Applications of the data
CDIAC quality-assurance checks
Limitations and restrictions of the data
Keywords
References
Data media description
Statistics to verify data transport
A listing of data-retrieval programs
Graphic illustrations of model output
Source-code listings
Complete listings of model output
Copyright-cleared reprints
Data on magnetic media

on 5.25-in. Bernoulli[®] cartridges, 1.2-GB SCSI (small computer system interconnect) external drives, and 563-MB optical disks. Data files archived at the ORNL central computing facility are stored on 9-track magnetic tapes and 200-MB, 3480-type tape cartridges that reside in a StorageTek[®] automated data library with a 6000-cartridge storage capacity. The 9-track magnetic tapes are stored in a fire-proof, temperature- and humidity-controlled vault. Multiple copies of documentation text files (i.e., WordPerfect[®] files) are archived as well.

CDIAC has archived more than 200 data sets, computer models, and computer model outputs since 1985. Not all are available as NDPs and CMPs. Many were quality-assured, fully documented, and readily available before being archived at CDIAC, and it is not necessary for CDIAC to duplicate the services of other data centers. They are maintained here as an additional archival mechanism and for the convenience of local researchers. Other data sets or computer models that have not been announced as available simply are at the top of our list to package, or CDIAC does not have permission to distribute them to the public.

CDIAC uses a dBASE III[®] system to maintain an inventory of the data sets and computer models archived at CDIAC. This Data Inventory System (DIS) provides CDIAC staff with general and detailed information about all the data and computer models archived at CDIAC. Some of the general information maintained by

DIS includes data base name, principal investigator, sponsor, data description, literature references, and the full chronological history of the data base at CDIAC, including review and quality-assurance checks applied to the data. Detailed information contained in DIS includes file names (i.e., data files, FORTRAN retrieval codes, SAS® retrieval codes, graphics codes, and computer-model source codes), file sizes, file locations, variables, units, and missing-value codes.

NDPs are updated as new data become available. Previous versions are maintained for historical purposes. Revised documents go through the same complete QA and review processes that previously unpublished NDPs do. After NDPs are updated or revised, these new NDP versions are announced in *CDIAC Communications*, and notices are sent to previous recipients to notify them of the availability of the updated data.

Data Updates

CDIAC has released a CD-ROM containing 434 megabytes of global-change data from 38 NDPs and 1 CMP. This single disk replaces data from 39 reports, three 9-track magnetic tapes, 301 high-density diskettes, and 217,000 pages of computer printout. Future disks will contain more than 700 MB of data.

CDIAC a World Data Center

Because of the nature of CDIAC's role and mission, it was recently designated as part of the International Council of Scientific Unions' World Data Center System. As part of World Data Center-A (WDC-A), CDIAC will continue to serve an even broader portion of the international research community. In this *Catalog*, items that are a part of the World Data Center effort are identified with the letters WDC-A below the NDP number.

Acknowledgements

This report has been prepared with the help of many people. CDIAC's greatest debt is to the contributing investigators and institutions whose data constitute the core of CDIAC's information analysis and data packaging. Were it not for their voluntary cooperation and dedication, CDIAC, as well as its information products, information services, and specialty publications, could not exist.

We would like to express our gratitude to the following personnel in CDIAC and at Oak Ridge National Laboratory and Martin Marietta Energy Systems, Inc. Their collective efforts have brought this report and the NDPs and CMI-Ps described herein into being. Our deepest thanks go to Rich Daniels, Dale Kaiser, Bob Sepanski, Russ Vose, and Tammy White, who are responsible for the detailed information analysis and packaging of numeric data. We also thank Sonja Jones, Laura Morris, Debbie Shepherd, and Tim Stamm, who respond to and record requests for CDIAC's NDPs and CMPS, DOE and CDIAC publications, and other products and services provided by CDIAC. We also thank Laura and Debbie for their review of the manuscript.

We gratefully acknowledge CDIAC's support by the U.S. Department of Energy's Office of Health and Environmental Research (OHER), Environmental Sciences Division. And we express special thanks to Tom Gross, program manager with OHER's Global Change Research Program, for his continued support of CDIAC's information activities. Tom has long supported the international exchange of information, and his visionary promotion of information provision as a value-added process has insightfully guided the development of CDIAC's services and information products.

We thank Tom Cerniglio and Curtis Boles, ORNL Graphics Division, for the photographs accompanying this text. We extend our appreciation to Mitchell Williams, Graphics Division, for the design of the cover of this report. And we especially want to thank Michael O'Hara for the original design and layout of the whole publication.

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Numeric Data Packages

**Atmospheric CO₂ Concentrations—Mauna Loa Observatory, Hawaii,
1958-1991**

C. D. Keeling
Scripps Institution of Oceanography

NDP-001/R3 (Rev. 1992)
WDC-A

Since 1958, air samples have been continually collected at Mauna Loa Observatory from air intakes at the top of four 7-m towers and one 27-m tower. These samples have been analyzed by infrared spectroscopy for CO₂ concentrations. Hourly averages of atmospheric CO₂ concentration and the wind speed and direction are plotted as a basis for selecting data for further processing. Data are selected for periods of steady hourly concentration data to within approximately 0.5 parts per million by volume (ppmv), with at least six consecutive hours of steady data required to form a daily average. Daily averages are then used to estimate monthly and annual averages.

These data represent the longest continuous record of atmospheric CO₂ concentrations in the world. This precise data record covers a single site (Mauna Loa Observatory, Hawaii). It is a reliable indicator of the regional trend in the concentration of atmospheric CO₂ in the middle layers of the troposphere and is critical to CO₂-related research. The data provided by CDIAC are monthly and annual CO₂ mixing ratios that have been adjusted to the 15th of the month but have not had seasonal effects removed. The mixing ratios are offered as a single file consisting of 35 records and taking up 3.5 kB.

*The atmospheric CO₂ record from Mauna
Loa, Hawaii, from 1958 to 1991; commonly
referred to as the pulse of the planet.*

NDP-002 (1984)

**Tree-Ring-Chronology Indices and Reconstructions of Precipitation
in Central Iowa, USA**
T. J. Blasing and D. N. Duvick
Oak Ridge National Laboratory

Tree core samples (4 mm in diameter) were extracted from the trunks of white oak (*Quercus alba*) at three sites in central Iowa (Duvick Back Woods, Ledges State Park, and Pammel). At least 60 trees were sampled at each site, and at least two cores were taken from each tree. The growth rings of each core were dated by calendar year and measured; the measurements were then transformed into dimensionless ring-width indices and correlated with annual precipitation. Cores were collected, and data were collected for the years 1680 through 1979. Each tree ring was characterized by the site, year, tree-ring-width index, number of core samples, decade year, and the annual reconstructed precipitation estimate. These data have more than 50% of their variance in common with the known annual statewide average precipitation for Iowa and serve as useful indicators of the precipitation and drought history of the region for the past 300 years. The data are in two files: tree-ring-chronology data (347 lines, 8 kB) and the annual reconstructed precipitation data for central Iowa (30 lines, 2 kB).

*Annual precipitation in Iowa
from 1900 to 1979 recon-
structed from tree-ring data.*

Global Surface-Air Temperature Variations: 1851–1984

P. D. Jones, S. C. B. Raper, P. M. Kelly, and

T. M. L. Wigley

University of East Anglia

H. F. Diaz

National Oceanic and Atmospheric Administration

R. S. Bradley

University of Massachusetts

Monthly and annual surface-air temperature anomalies relative to the 1951–1970 mean surface-air temperature were calculated for the periods of 1851–1970 for the Northern Hemisphere, 1858–1984 for the Southern Hemisphere exclusive of Antarctica, and 1958–1984 for the Southern Hemisphere inclusive of Antarctica. These estimates are derived from land-based meteorological station data and fixed-position weather-ship data interpolated onto a 5° latitude by 10° longitude grid. The data are in three files, one for the Northern Hemisphere temperature anomalies (134 lines, 10 kB) and two for the Southern Hemisphere temperature anomalies (127 lines, 9 kB; 27 lines, 2 kB).

NDP-003/R1 (Rev. 1986)

Annual temperature anomaly in the Northern Hemisphere from 1851 to 1984.

Transient Tracers in the Oceans (TTO) — Hydrographic Data and Carbon Dioxide Systems with Revised Carbon Chemistry Data
P. G. Brewer
Woods Hole Oceanographic Institution
T. Takahashi
Lamont-Doherty Geological Observatory
R. T. Williams
Scripps Institution of Oceanography

The 1981 TTO North Atlantic experiment cruise consisted of seven legs and visited 250 hydrographic stations across the North Atlantic Ocean in 200 days. About 9000 water samples were taken for analysis of salinity, oxygen, and nutrients. More than 3000 samples were collected for tritium analysis, and more than 1000 samples for radiocarbon analysis. Samples were characterized hydrographically (e.g., sample depth, ocean depth, and water temperature) and chemically (e.g., alkalinity, salinity, silicate concentrations, and nitrate concentrations). They may be used for ocean-mixing studies, for testing models of ocean CO₂ uptake, and for determining the exchange of carbon dioxide between the atmosphere and the ocean. The data are in two files [original TTO data (0.67 MB) and revised TTO data (0.86 MB)]. The revised TTO data include measured quantities of pCO₂ for seawater at 20°C and total CO₂ concentrations, which were computed from the measured alkalinity and pCO₂ values. These new CO₂ concentration values are smaller by about 20 µmol/kg, and the discrepancy is greatest for seawater samples collected at depths less than several hundred meters.

The correlation between total CO₂ normalized to a constant salinity of 35.00 and temperature in North Atlantic waters.

Atmospheric CO₂ Concentrations — The NOAA/GMCC Flask Sampling Network

T. J. Conway and P. Tans
National Oceanic and Atmospheric Administration

Flask air samples are collected approximately once per week at 29 stations scattered around the globe. The earliest samples were taken in 1968, but the period of record varies from station to station. The samples are analyzed for atmospheric CO₂ concentration on a nondispersive infrared gas analyzer apparatus at the NOAA/GMCC (now the CMDL or Climate Monitoring and Diagnostics Laboratory) laboratory in Boulder, Colorado. The measurements are directly traceable to the World Meteorological Organization primary CO₂ standards. Each sample is characterized by station, year, sampling date and time, flask identification number, CO₂ concentration, date and time of analysis, and quality indicators. The data are in 30 files [one file that contains data through 1981 (946 kB), and one file for each site with data from 1981 through 1986 (ranging from 3.6 to 55.8 kB)].

NDP-006 (1984)
WDC-A

Production of CO₂ from Fossil-Fuel Burning by Fuel Type, 1860-1982
R. M. Rotty and G. Marland
Oak Ridge Associated Universities

Global carbon dioxide emissions for 1950 through 1982 were estimated by Marland and Rotty (1984) from fuel production data from the U.N. Energy Statistics Yearbook (1983, 1984). Data before 1950 came from Keeling (1973). Fuel-production data were used in these calculations because they appeared to be more reliable on a global basis than fuel-consumption data. The data given are the year and annual global CO₂ emissions (annual global total; cumulative global total since 1860; and annual global emissions from solid fuels, liquid fuels, natural gas, gas flaring, and cement manufacturing). These data provide the only pre-1950 estimates of the amount of carbon emitted to the atmosphere from fossil-fuel burning. The CO₂ emission record since 1950 has been updated and revised several times with the most recent estimates being published by Marland et al. (1989). The data are in one file of 123 lines taking 7.5 kB.

Thousands of millions of metric tons of carbon released to the atmosphere in the form of CO₂ by the burning of fossil fuels each year from 1860 to 1986.

Atmospheric CO₂ Concentrations — The CSIRO (Australia) Monitoring Program from Aircraft for 1972–1981

D. J. Beardsmore and G. I. Pearman
Commonwealth Scientific and Industrial Research Organization

NDP-007 (1984)
WDC-A

From 1972 through 1981, air samples were collected in glass flasks from aircraft at a variety of latitudes and altitudes over Australia, New Zealand, and Antarctica. The samples were analyzed for CO₂ concentrations with nondispersive infrared gas analysis. The resulting data contain the sampling dates, type of aircraft, flight number, flask identification number, sampling time, geographic sector, distance in kilometers from the listed distance measuring equipment (DME) station, station number of the radio navigation distance measuring equipment, altitude of the aircraft above mean sea level, sample analysis date, flask pressure, tertiary standards used for the analysis, analyzer used, and CO₂ concentrations. These data represent the first published record of CO₂ concentrations in the Southern Hemisphere expressed in the WMO 1981 CO₂ Calibration Scale and provide a precise record of atmospheric CO₂ concentrations in the troposphere and lower stratosphere over Australia and New Zealand. The data are in one file of 3519 lines taking 26.3 kB.

CO₂ concentrations measured at various altitudes and many sampling sites in the Southern Hemisphere from 1972 to 1981.

Annual and Seasonal Global Temperature Anomalies in the Troposphere and Low Stratosphere, 1958-1992

J. K. Angell and J. Korshover
National Oceanic and Atmospheric Administration

For 1958 through 1992, the annual and seasonal temperature anomalies relative to a 1958-1977 mean (expressed in degrees Celsius) were calculated for the surface, troposphere (850-300 mb), tropopause (300-100 mb), and low stratosphere (100-50 mb and 100-30 mb) layers on regional, hemispheric, and global scales. Most of the values are column-mean temperatures obtained from the differences in height between constant-pressure surfaces at individual radiosonde stations. The pressure-height data before 1980 were obtained from published values in Monthly Climatic Data for the World. These temperature anomalies may be used to analyze long-term temperature trends for a layer of the atmosphere (i.e., surface, troposphere, tropopause, and low stratosphere), a region (i.e., polar, temperate, subtropical, and equatorial), a hemisphere, or the globe. The data are in one file of 64.5 KB.

Global annual temperature anomalies from 1958 to 1992.

Growth and Chemical Responses to CO₂ Enrichment – Virginia Pine (Pinus virginiana Mill.)

R. J. Luxmoore, R. J. Norby, E. G. O'Neill, and D. G. Weller
 Environmental Sciences Division
 Oak Ridge National Laboratory
 J. M. Ellis and H. H. Rogers
 North Carolina State University

NDP-009 (1985)

From June 28 to October 29 in 1982, Virginia pine seedlings were exposed to elevated CO₂ levels in open-top growth chambers at one of four concentrations (75, 150, 300, and 600 ppm above ambient).

Plant dry weight; height; stem diameter; and chemical contents of leaf, stem, and root tissues were measured before and after exposure. Soil variables were also characterized. These data illustrate the short-term physical and chemical response of Virginia pine seedlings to elevated levels of CO₂. The data are in seven files: initial dry weights before exposure (84 lines, 4 kB), dry weights after exposure (72 lines, 4 kB), major nutrient concentrations after final harvest (216 lines, 12 kB), minor nutrient concentrations after final harvest (216 lines, 17 kB), soil nutrient concentrations after final harvest (72 lines, 4 kB), soil leachate elements after final harvest (72 lines, 5 kB), and soil leachate solutes after final harvest (72 lines, 4 kB).

Changes in mean dry weight of Virginia pine seedlings following CO₂ enrichment.

**Atmospheric CO₂ Concentrations — The CSIRO Monitoring Program:
Surface Data for Cape Grim, Tasmania**
D. J. Beardsmore, G. I. Pearman, and R. C. O'Brien
Commonwealth Scientific and Industrial Research Organization

From 1976 through 1988, air samples collected from a high-volume general intake 10 m above the roof of the laboratory at Cape Grim, Tasmania, were dried and analyzed for CO₂ concentrations with a nondispersive infrared gas analyzer. This baseline CO₂ record from Cape Grim indicates the CO₂ concentrations in large, maritime air masses devoid of vegetative influences in this region of the Southern Hemisphere. The data available on each sample are sampling date; daily, monthly, and annual CO₂ concentrations; standard deviation associated with each concentration; number of hours of data used to calculate the CO₂ values; and the analyzer used. The data are in three files: daily (1090 lines, 17 kB), monthly (93 lines, 3kB), and annual (9 lines, 310 bytes).

To determine regional and global climatic variations during the past 6000 years, pollen, lake level, and marine plankton data from 797 stations were compiled to form a global data set. Radiocarbon dating and dated tephra were used to determine the ages of the specimens. The data available for the pollen data are site number, site name, latitude, longitude, elevation, and percentages of various taxa. For lake-level data, the data are site number, site name, latitude, longitude, and lake-level status. And for marine plankton, the data are site number, site name, latitude, longitude, water depth, date, dating control code, depth of sample, interpolated age of sample, estimated winter and summer sea-surface temperatures, and percentages of various taxa. The data are in 55 files: 5 files for each of 9 geographic regions and 10 supplemental files. The files for each region include (1) a FORMAT file describing the format and contents of the data for that region, (2) an INDEX file containing descriptive information about each site and its data, (3) a DATA file containing the data and available climatic estimates, (4) a PUBINDEX file indexing the bibliographic references associated with each site, and (5) a REFERENCE file containing the bibliographic references. The files range in size from 2 to 66 kB.

Pollen diagram for Lake Hope Simpson, Labrador, showing the percentages for the four major pollen types.

LAKE HOPE SIMPSON
LABRADOR: N52°27' W56°20'

NDP-012 (1985)

Climatic Data for Northern Hemisphere Land Areas: 1851-1980

R. S. Bradley

University of Massachusetts

P. M. Kelly, P. D. Jones, and C. M. Goodess

University of East Anglia

H. F. Diaz

National Oceanic and Atmospheric Administration

For the period 1851 through 1985, approximately 700 temperature records and 1200 precipitation records for Northern Hemisphere stations were added to the World Weather Records data base with the supplemental data obtained by surveying major libraries, archives, and meteorological data centers and by contacting scientists and meteorological agencies directly. The quality of these supplemental data were assessed when possible by using station-history information. For each addition, the WMO station identification number, station name, country, latitude, longitude, station elevation, beginning year of record, ending year of record, monthly mean temperature, and monthly total precipitation were entered. The data are in two files, one for monthly mean temperature (88,890 lines, 6.40 MB) and one for monthly total precipitation data (116,460 lines, 8.06 MB). Because of the size of this data set, it is available only on 9-track magnetic tape, on CD-ROM, or through CDIAC's anonymous FTP area.

*Mean annual temperature at
Bodo, Italy, from 1858 to 1980.*

Lamb's Dust Veil Index (DVI) is a numerical index that quantifies the impact of a particular volcanic eruption's release of dust and aerosols over the years following the event, especially the impact on the Earth's energy balance. DVIs have been calculated for eruptions occurring from 1500 through 1983. The methods used to calculate the DVI have been intercalibrated to give a DVI of 1000 for the eruption of Krakatoa in 1883. The DVI for any volcanic eruption is based on a review of the observational, empirical, and theoretical studies of the possible impact on climate of volcanic dust veils. The DVI allows one to compare volcanic eruptions by a single numerical index. The data base includes the name of the erupting volcano, year of eruption, volcano latitude and longitude, maximum extent of the dust veil, veil duration, DVI for the entire globe, DVI for the Northern Hemisphere, and DVI for the Southern Hemisphere. The data are in one file (455 lines, 22.6 kB).

Dust veil indices for the three largest volcanic eruptions ever recorded.

NDP-014 (1985)

Solar Records: The Wolf Sunspot Index and Umbra/Penumbral Ratio
D. V. Hoyt
National Center for Atmospheric Research

These data from observations of sunspot activity cover the period 1875 through 1981; reconstructions are possible back to 1832. Available sunspot models and the theory of mixing length indicate that the observed changes in the umbra/penumbral (U/P) ratio may be equivalent to changes in the solar constant. The U/P ratio is calculated from measurements of solar activity and has been shown to be in good agreement with the Northern Hemisphere temperature record. The data consist of year, number of sunspot groups, Wolf sunspot number, umbra area, whole area, penumbral area, and umbra/penumbral ratio. The data are in one file (107 lines, 3.3 kB).

**Wolf sunspot number from
1875 to 1981.**

**Surface-Air-Temperature Anomalies for the Northern Hemisphere:
The Russian Data Set**

A. Robock
University of Maryland
I. I. Borzenkova, G. V. Gruza, and K. Ya. Vinnikov
State Hydrological Institute, St. Petersburg, Russia

These Northern Hemisphere surface-temperature anomalies cover the period from 1891 through 1980 and were derived from maps compiled at the Main Geophysical Observatory (St. Petersburg) and maps appearing in the Synoptic Bulletin of the State Hydrometeorological Committee. The data include the year, month, and monthly surface-air-temperature anomaly (relative to a reference period mean in degrees Celsius). They may be compared with other Northern Hemisphere surface-air-temperature-anomaly data sets and used for studies attempting to detect carbon-induced climate change. The data are in seven files (three of monthly surface air temperature anomalies, three of monthly average temperature norms, and one of grid points' altitudes above sea level) that range from 5 kB to 1.46 MB and are only available on 9-track magnetic tape or through CDIAC's anonymous FTP area.

Annual change in the average surface-air temperature in the Northern Hemisphere from 1881 to 1978.

NDP-016 (1985)

Climatic Data for Selected U.S. and Canadian Stations 1941–1980
T. R. Karl and F. T. Quinlan
National Climatic Data Center
National Oceanic and Atmospheric Administration

For 1941 through 1980, monthly temperature and precipitation data were recorded for 130 nonurban stations in the U.S. and Canada. These stations were selected because they provide reasonably uniform spatial coverage of that area; consist of nonurban stations; have few missing daily and monthly data; have experienced few station relocations; and have undergone little change in observation times. These data were obtained from the archives of the National Climatic Data Center and the Canadian Climate Centre. Included in the data are the station identification number, station name, state abbreviation, province code, country code, station latitude and longitude, station population (1940, 1960, and 1980), name of observer, observing schedule code, time of observation bias codes, year, monthly precipitation, mean temperatures, mean daily maximum temperatures, mean daily minimum temperatures, and difference between the monthly mean daily maximum and minimum temperatures. The data are in eight files [five data files (530 KB each), one station history file (56 KB), one station inventory file (11.7 KB), and one file that lists the Canadian observers (7.9 KB)] and are available on all media.

**Annual maximum temperature
at Talkeetna, Alaska, from 1941
to 1980.**

Major World Ecosystem Complexes Ranked by Carbon in Live Vegetation: A Data Base

J. S. Olson, J. A. Watts, and L. J. Allison
Environmental Sciences Division
Oak Ridge National Laboratory

NDP-017 (1985)

In 1980, this data base and the corresponding map were completed after more than 20 years of field investigations, consultations, and analyses of published literature. They characterize the use and vegetative cover of the Earth's land surface with a $0.5^\circ \times 0.5^\circ$ grid. The data include latitude, longitude, and vegetation code. This world-ecosystem-complex data set and the accompanying map provide a current reference base for interpreting the role of vegetation in the global cycling of CO_2 and other gases and a basis for improved estimates of vegetation and soil carbon, of natural exchanges of CO_2 , and of net historic shifts of carbon between the biosphere and the atmosphere. The data are in one file of 125 kB.

Vegetative cover of Australia's land surface mapped with a $0.5^\circ \times 0.5^\circ$ grid.

Worldwide Organic Soil Carbon and Nitrogen Data

P. J. Zinke and A. G. Stangenberger
 University of California at Berkeley
 W. M. Post, W. R. Emanuel, and J. S. Olson
 Oak Ridge National Laboratory

This data base was begun with the collection and analysis of soil samples from California. Additional data came from soil surveys of Italy, Greece, Iran, Thailand, Vietnam, various tropical Amazonian areas, and U.S. forests and from the soil-survey literature. Collectively, soil carbon and nitrogen data are provided for approximately 3500 soil profiles. The analyzed samples were collected at uniform soil-depth increments and included bulk-density determinations, but samples reported in the literature did not always have this uniformity. For these cases, only profiles that were sampled to a meter depth or to actual depth were used. If bulk densities were not reported, estimates were made from regressions based on organic carbon content of the soil samples associated with the sample. The data on each sample are soil profile number, soil profile carbon content, soil profile nitrogen content, sampling site latitude and longitude, site elevation, profile literature reference source, and soil profile codes for Holdridge life zone, Olson ecosystem type, and parent material. These data may be used to estimate the size of the soil organic carbon and nitrogen pools at equilibrium with natural soil-forming factors. The data are in one file of 334 KB and are available on all media.

Cumulative carbon storage as a function of depth for four ecosystems.

United States Historical Climatology Network (HCN) Serial Temperature and Precipitation Data

T. R. Karl; C. N. Williams, Jr.; and F. T. Quinlan

National Climatic Data Center

National Oceanic and Atmospheric Administration

Extending through 1987, this data base contains monthly total precipitation and temperature data from 1219 stations in the contiguous U.S. To be included in the Historical Climatology Network (HCN), a station had to be currently active (1987), have at least 80 years of monthly temperature and precipitation data, and have experienced few station changes. These data were derived from a variety of sources including the National Climatic Data Center archives, state climatologists, and published literature. The data base contains several hundred variables, including state number; station number; monthly temperatures (minimum, maximum, and mean); total monthly precipitation; and time of observation. This is probably the best monthly temperature and precipitation data set available for the contiguous U.S. because station moves, instrument changes, urbanization effects, and time-of-observation differences have been considered and, where necessary, corrected. The data are in 13 files [one station inventory file, one station history file, six temperature files, one precipitation file, one time-of-observation correction file, and two quality-assessment files]. The file sizes range from 5 kB to approximately 50 MB and are only available on 9-track magnetic tape, on CD-ROM, or via CDIAC's anonymous FTP area.

NDP-019/R1 (Rev. 1990)

Mean annual temperature in Death Valley, California, from 1910 to 1987.

NDP-020/R1 (Rev. 1991)

An Updated Global Grid Point Surface-Air-Temperature Anomaly Data Set: 1851-1990

P. D. Jones, S. C. B. Raper, B. S. G. Cherry, C. M. Goodess, T. M. L. Wigley, B. Santer, and P. M. Kelly
Climatic Research Unit, University of East Anglia, Norwich, U.K.

R. S. Bradley

University of Massachusetts, Amherst, Mass.

H. F. Diaz

Environmental Research Laboratories, National Oceanic and Atmospheric Administration

This NDP 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 from 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 producing regional, hemispheric, and global time series for determining whether recent (i.e., post-1900) warming trends have taken place.

Monthly surface-air temperature anomalies for the Southern Hemisphere for 1857 through 1990.

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 the 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 Hemisphere (grid points from 85°N to 0°) and Southern Hemisphere (grid points from 5°S to 60°S). In addition, this updated package presents the monthly-mean-temperature records for the individual stations that were used to produce 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.

The NDP consists of a written report and a 9-track magnetic tape containing 14 files, including five ASCII data files, eight FORTRAN and SAS® retrieval routines, and a descriptive file. The data files range in size from 2 KB to 20 MB. Because of the size of the data files, it is not feasible to distribute these data on floppy diskettes, even as compressed files. The files are also available on CD-ROM or through CDIAC's anonymous FTP area.

Historical Sunshine and Cloud Data in the United States

P. M. Steurer and T. R. Karl

National Climatic Data Center

National Oceanic and Atmospheric Administration

NDP-021/R1 (Rev. 1991)

This data base presents monthly sunshine duration data from 240 U.S. stations (including Puerto Rico and nine Pacific Islands) and monthly cloud amount data from 197 U.S. stations. The longest periods of record are 1891 through 1987 for the sunshine data and 1871 through 1987 for the cloud data. The sunshine data were derived from measurements taken by a variety of sunshine-recording instruments. The cloud data were derived from land-based estimates of fractional cloud amount, which were made with observation practices that have varied during the period of record. Station number, station name, latitude, and longitude are given for all stations in each network. The sunshine data include monthly and annual total hours of recorded sunshine, monthly and annual maximum possible hours of sunshine, monthly and annual percentages of 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). The sunshine data are in four files: one station inventory (34.1 kB), one monthly and annual hours of measured sunshine (1.6 MB), one monthly and annual maximum possible hours of sunshine (21.5 kB), and one monthly and annual percentage of possible sunshine (2.1 MB). The cloud data are in two files: one station inventory (20.4 kB) and one monthly and annual cloud amount (2.4 MB). The data are available on 9-track magnetic tape, on CD-ROM, and via CDIAC's anonymous FTP area.

Global and Hemispheric Annual Temperature Variations Between 1854 and 1990

P. D. Jones, T. M. L. Wigley, and P. B. Wright
University of East Anglia

This data set contains estimates of global and hemispheric (northern and southern) annual temperature variations relative to a 1950 through 1979 reference period, for 1854 through 1990. For each year, two versions of the northern/southern/global data are included, one in which the influence of El Niño/Southern Oscillation (ENSO) related events is considered and another in which it is not. Both estimates are based on corrected land and marine data. These global and hemispheric annual variations show little trend during the nineteenth century, marked warming to 1940, relatively steady conditions to the mid-1970s, followed by a rapid warming during the 1980s. Over the period of record, globally averaged temperatures have risen approximately 0.5°C. The 1980s was a decade of unprecedented warmth, with 1990 the warmest year since comparable records began in the middle of the 19th century. Both the long-term and the recent warming trends have been common to the two hemispheres. The annual value for

Global annual temperature anomalies corrected for the effects of El Niño/Southern Oscillation from 1867 to 1988.

1990 is clearly the warmest for both the Northern Hemisphere and the global records. The six warmest years in the global record have now occurred since 1980. In descending order, they are 1990, 1988, 1987, 1983, 1989, and 1981. After correction for ENSO events, the four most recent years become the four warmest in the global record, and every year since 1985 shows an increase in temperature. The data are in one file of 5.8 kB.

Annual and Seasonal Global Variation in Total Ozone and Layer Mean Ozone, 1958–1987

J. K. Angell and J. Korshover
 Environmental Research Laboratories
 National Oceanic and Atmospheric Administration
 W. G. Planet
 National Environmental Satellite, Data, and Information Service
 National Oceanic and Atmospheric Administration

For 1958 through 1987, this data base presents total ozone variations and layer mean ozone variations expressed as percent deviations from the 1958 to 1977 mean. The total ozone variations were derived from mean monthly ozone values published in Ozone Data for the World by the Atmospheric Environment Service in cooperation with the World Meteorological Organization. The layer mean ozone variations are derived from ozonesonde and Umkehr observations. The data records include year, seasonal and annual total ozone variations, and seasonal and annual layer mean ozone variations. The total ozone data are for four regions (Soviet Union, Europe, North America, and Asia); five climatic zones (north and south polar, north and south temperate, and tropical); both hemispheres; and the world. Layer mean ozone data are for four climatic zones (north and south temperate and polar) and for the stratosphere, troposphere, and tropopause layers. The data are in two files [seasonal and year-average total ozone (13.4 kB) and layer mean ozone variations (24.2 kB)].

Total ozone variations for North America relative to the 1958–1977 reference period mean.

NDP-023/R1 (Rev. 1992)

NDP-025 (1987)

Monthly Mean Pressure Reconstructions for Europe (1780–1960) and North America (1858–1980)
P. D. Jones, T. M. L. Wigley, and K. R. Briffa
University of East Anglia

Real and reconstructed measurements of monthly mean pressure data have been constructed for Europe for 1780 through 1980 and North America for 1858 through 1980. The reconstructions use early pressure, temperature, and precipitation data from a variety of sources including World Weather Records, meteorological and national archives, circulation maps, and daily chart series. Each record contains the year, monthly mean pressure, quality code, and annual mean pressure. These reconstructed gridded monthly pressures provide a reliable historical record of mean sea-level pressures for Europe and North America. The data are in two files: pressure reconstructions for Europe (1.47 MB) and pressure reconstructions for North America (0.72 MB).

Annual mean atmospheric pressure at a 5° by 20° cell located at 70°N and 0°E.

Climatological Data for Clouds over the Globe from Surface Observations

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 University of Colorado
 S. G. Warren
 University of Washington, Seattle
 J. London
 University of Colorado
 R. L. Jenne and R. M. Chervin
 National Center for Atmospheric Research

With some data from as early as 1930, global long-term monthly and/or seasonal total cloud cover, cloud type amounts and frequencies of occurrence, low cloud base heights, harmonic analyses of annual and diurnal cycles, interannual variations and trends, and cloud type co-occurrences have been compiled and presented in four atlases (Hahn et al. 1982, 1984; Warren et al. 1988, 1990). These data were derived from land and ship synoptic weather reports from the "SPOT" archive of the Fleet Numerical Oceanography Center (FNOC) and from Release 1 of the Comprehensive Ocean-Atmosphere Data Set (COADS) for the years 1930-1979. The data are in 12 files (one containing latitude, longitude, land-fraction, and number of land stations for grid boxes; four containing total cloud, cloud types, harmonic analyses, and interannual variations and trends for land; four containing total cloud, cloud types, harmonic analyses, and interannual variations and trends for oceans; one containing cloud analyses for the time covered by the First Global GARP Experiment (FGGE); one containing cloud-type co-occurrences for land and oceans; and one containing a FORTRAN program to read and produce maps). These files range in size from 12.5 kB to 5.67 MB and are available on all media except floppy diskette.

Daily averaged diurnal cycle of percentage of cloud cover at 30-40°N, 20-40°W for the months of June, July, and August; the upper curve is for stratus and stratocumulus clouds, and the lower curve is for cumulus clouds.

NDP-026 (1988)
 WDC-A

NDP-027 (1988)

GEOSECS Atlantic, Pacific, Indian, and Mediterranean Radiocarbon Data

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M. Stuiver

University of Washington, Seattle

Radiocarbon data for the Atlantic, Pacific, and Indian oceans were obtained between 1972 and 1977 as part of the Geochemical Ocean Section Study (GEOSECS) cruises during which more than 2200 water samples were collected. Some Mediterranean Sea data were also collected. Samples for ^{14}C were collected at 124 stations, and approximately 18 samples were collected at each station from intervals throughout the water column. The data included in the data base are ship position (latitude and longitude), sample number, depth, potential temperature, salinity, and delta ^{14}C . The GEOSECS data sets allow a better understanding of large-scale oceanic transport and mixing and the establishment of the gross rate of deep-ocean circulation. The data are in three files (radiocarbon data for the Atlantic, Pacific, and Indian Oceans) ranging in size from 39.9 to 50.4 kB and are available on all media.

Per mille change in carbon-14 with ocean depth at a given station.

Carbonate Chemistry of the Weddell Sea

C.-T. A. Chen

Oregon State University

In the late austral winter of 1981, carbonate data were obtained from the Weddell Sea as part of the U.S.-U.S.S.R. Weddell Polynya Expedition (WEPOLEX-81). Both surface samples and vertical-station samples were taken. The data include ship position (latitude and longitude), date, station number, sample depth, salinity, water temperature, pH, normalized surface total alkalinity, and calcium. These data represent the first comprehensive carbonate data obtained in the Weddell Sea during late winter. Because of the importance of the Weddell Sea as a source of deep water for the world's oceans, these data have improved the understanding of the oceanic circulation of excess CO_2 in the carbon cycle. The data are in two files [one for data from surface stations (15.5 kB) and one for data from vertical stations (5.9 kB)].

*Composite excess CO_2 results
for all stations plotted vs depth.*

NDP-029 (1988)

Carbonate Chemistry of the North Pacific Ocean

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E. J. Olson

College of Oceanography

Oregon State University

R. A. Feely and J. F. Gendron

Pacific Marine Environmental Laboratory

National Oceanic and Atmospheric Administration

***Cross-section of the normal-
ized total CO₂ distribution
along 165°E.***

Carbonate chemistry data from 41 stations in the North Pacific Ocean were obtained during two NOAA CO₂ Dynamics Cruises (June–July 1981 and May–June 1982) and two legs of the NORPAX Hawaii–Tahiti Shuttle Experiment (April 1979 and March–April 1980). The data for each sample include ship position (latitude and longitude), date, station number, sample depth, salinity, water temperature, pH, normalized total alkalinity, and normalized calcium. The data from each of the three cruises are in separate files ranging in size from 7.1 kB to 10.1 kB.

Global, Regional, and National CO₂ Emission Estimates from Fossil-Fuel Burning, Cement Production, and Gas Flaring: 1950–1990

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Environmental Sciences Division
Oak Ridge National Laboratory

NDP-030/R4 (Rev. 1993)
WDC-A

Global, regional, and national CO₂ emissions from fossil-fuel consumption (including gas flaring in oil fields) and cement production are provided on an annual basis for the period 1950 to 1990. These estimates were derived with the methods of Marland and Rotty (1984) and energy- and cement-production statistics published by the United Nations, DOE's Energy Information Administration, and the Bureau of Mines. Unlike previous versions of this data package and documentation, this version details the data and methods used to determine emissions from gas flaring.

Global total CO₂ emissions reached 6.1 gigatons of carbon in 1990, an increase of 1.2% since 1989, and are continuing an increasing trend that has prevailed since 1983. The three largest emitters in 1990 (the United States, the USSR, and China) account for approximately half of the world's emissions from fossil-fuel consumption. In 1990, U.S. emissions reached 1.31 gigatons of carbon (5.26 metric tons of carbon per person), a decline of 0.01% from the 1989 emission level. This marked the first year since 1982–1983 that U.S. emissions dropped.

Global CO₂ emissions by source from 1950 to 1990.

Average Total Snowfall Data for Selected U.S. Stations
 National Climatic Data Center
 National Environmental Satellite, Data, and Information Service

From 1868 through 1986, the average monthly snowfalls for 286 U.S. stations were extracted from the Local Climatological Data Annual Summary. Only stations operating in 1986 and having a minimum of 3 years data and at least 1 month on record with snowfall greater than a trace (>0.05 in.) were included in the record. The data contain the station name, number of years of data used to estimate the average monthly snowfall, average monthly snowfall, and annual snowfall. The monthly average snowfall data for 286 U.S. stations are in one 46.4-KB file.

Annual and monthly average snowfall in inches for Knoxville, Tennessee.

Antarctic Surface Temperature and Pressure Data

P. D. Jones
University of East Anglia
D. W. S. Limbert
British Antarctic Survey

Monthly mean surface temperature and pressure data for 30 Antarctic stations (the earliest beginning in 1903 and all extending through 1988) were assembled primarily from World Weather Records and Monthly Climatic Data for the World. The data were assessed for quality and long-term homogeneity. The data presented are station name, station latitude and longitude, station elevation, first and final year of data record, year, mean monthly sea-level or station-level pressure, and mean monthly surface temperature. The data are in four files (two temperature and two pressure data files) ranging in size from 25 to 43 kB.

Annual mean surface air temperature at Islas Orcadas, Antarctica, from 1903 to 1987.

NDP-033 (1991)
WDC-A

Atmospheric CO₂ Concentrations Derived from Flask Samples Collected at U.S.S.R.-Operated Sampling Sites
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St. Petersburg, (formerly) USSR

*Locations of the four flask
sampling sites.*

This package presents daily atmospheric CO₂ concentrations from four sampling sites [Teriberka Station (69°12'-N, 35°06'-E), Ocean Station Charlie (52°45'-N, 35°30'-W), Bering Island (55°12'-N, 165°59'-E), and Koteln'y Island (76°06'-N, 137°54'-E)]. The period of record varies by station, with the earliest measurements dating back to 1983 and recent estimates from early 1991. These CO₂ concentrations are derived from air samples collected in 1.5-L stainless steel electropolished flasks and later analyzed at the Main Geophysical Observatory (St. Petersburg, Russia) with a nondispersive infrared gas analyzer. Measurements not meeting criteria were either discarded or flagged. All measurements have been corrected for drift biases introduced during flask storage.

These atmospheric CO₂ concentrations are considered indicative of regional background air conditions and are directly traceable to the World Meteorological Organization's primary CO₂ standards. These measurements support the rising trend in atmospheric CO₂ concentrations measured at other monitoring sites around the world and may be compared with similar measurements made by various monitoring programs at other northern-latitude sites.

The data files range in size from 0.97 KB to 20.01 KB.

Atmospheric CO₂ Concentrations – The Canadian Background Air Pollution Monitoring Network

N. B. A. Trivett
Environment Canada

NDP-034 (1989)
WDC-A

Flask air samples collected at roughly weekly intervals at three Canadian sites [Alert, Northwest Territories (July 1975 through August 1992); Sable Island, Nova Scotia (March 1975 through July 1992); and Cape St. James, British Columbia (May 1979 through July 1992)] were analyzed for CO₂ concentration with the measurements directly traceable to the WMO primary CO₂ standards. Each record includes the date, atmospheric CO₂ concentration, and flask classification code. They provide an accurate record of CO₂ concentration levels in Canada during the past decade. Because these data are directly traceable to WMO standards, this record may be compared with records from other Background Air Pollution Monitoring Network (BAP-MoN) stations. The data are in three files (one for each of the monitoring stations) ranging in size from 3.2 to 12.8 kB.

Long-term trend and seasonal cycle in CO₂ concentration determined from weekly flask samples taken at Sable Island, Nova Scotia, from 1975 to 1991.

NDP-035 (1991)

A Global Geographic Information System Data Base of Storm Occurrences and Other Climatic Phenomena Affecting Coastal Zones

K. R. Birdwell

Murray State University (Kentucky)

R. C. Daniels

Miami University (Ohio)

To convert storm-track data (left drawing) to grid-cell values (right drawing), the paths of tropical depressions (dotted lines), storms (dashed lines), and hurricanes (solid lines) are plotted for a given year. The grid cells are then coded as having only tropical-storm activity (upper-left shaded), hurricane activity (lower-right shaded), or both during the year.

This NDP quantifies the occurrence of synoptic storms and other climatological factors that affect coastlines (e.g., induce erosion or contribute to coastal inundation). This NDP is unique in that it represents CDIAC's first offering of ARC/INFO[®] export data files and equivalent flat ASCII data files that may be used by raster or vector geographic information systems (GISs). The data set contains 61 variables, including information on tropical storms, hurricanes, super typhoons, extratropical cyclogenesis, polar lows, cyclonicity, influence of winds in monsoon regions, and sea-ice concentrations. Increased availability of source data has made it possible to extend the area of these data variables to regional or global coverages. All data variables except five are referenced to 1° x 1° or 5° x 5° grid cells of latitude and longitude. These data help meet the demand for new and improved climatologies of storm events and may be used in climate research studies, including the verification of general circulation models and the calculation of storm-recurrence intervals.

The NDP consists of a written report and a 9-track magnetic tape containing 34 files, including eight ARC/INFO[®] files, flat ASCII files, and FORTRAN and SAS[®] retrieval routines; a vector coordinate file; and a descriptive file. The data files range in size from 0.1 KB to 5.31 MB. For those wishing to receive these data on floppy diskettes, CDIAC will provide all except the ARC/INFO[®] files on IBM-format, high-density 5.25- or 3.5-in. diskettes.

Indian Ocean Radiocarbon: Data from the INDIGO 1, 2, and 3 Cruises
H. Göte Östlund and Charlene Grall

Rosenstiel School of Marine and Atmospheric Science, University of Miami

NDP-036 (1991)

This data set presents ^{14}C activities from water samples taken at various locations and depths in the Indian and Southern oceans through the Indian Gaz Ocean (INDIGO) project. These data were collected as part of the INDIGO 1, INDIGO 2, and INDIGO 3 cruises, 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 records include the station, date, ocean bottom depth, latitude and longitude, sampling depth, potential temperature, salinity, density, total CO_2 , and ^{13}C and ^{14}C activity. 10 The data are in one file of 25 kB and are available on all media.

Sampling stations during the INDIGO I, II, and III expeditions in 1985, 1986, and 1987, respectively.

B. A. Kimball, R. L. La Morte, F. S. Nakayama, S. T. Mitchell, G. J. Peresta,
 P. E. Nixon III, S. M. Harris, and J. Martinez
 U.S. Water Conservation Laboratory, U.S. Department of Agriculture, Ag-
 ricultural Research Service, Phoenix, Arizona
 J. R. Mauney, G. Guinn, J. W. Radin, L. L. Parker, B. Savoy, R. MacDonald,
 and H. Pros
 Western Cotton Research Laboratory, U.S. Department of Agriculture,
 Agricultural Research Service, Phoenix, Arizona
 E. A. Lakatos
 Soil and Water Science Department, University of Arizona, Tucson, Arizona

The data include identification variables (e.g., year, site codes, and treatment regimens), intermediate growth measurements (e.g., plant height, leaf-area index, number of flowers, and dry weight of leaves) taken at various times during the growing season, and crop-harvest results (e.g., lint yield, seed yield, and total aboveground dry biomass). These data will be useful in studying the possible future effects on crop production of increased atmospheric CO₂ concentrations and for validating crop-growth models. For all five growing seasons and all experimental treatments, cotton yields and plant dry weights were increased significantly by CO₂ enrichment.

The NDP includes a 48.4-kB ASCII data file, FORTRAN and SAS® computer codes for accessing the data, and a descriptive file. The documentation for this package describes and presents data for many other parameters, including the daily weather, soil profile properties (e.g., initial moisture and nitrogen conditions), and identification of irrigation and fertilizer treatments. These additional data are available from CDIAC on magnetic media upon request.

Atmospheric Methane Concentrations - The NOAA/CMDL Global Cooperative Flask Sampling Network, 1983-1988

L. Paul Steele

Cooperative Institute for Research in Environmental Studies

Patricia M. Lang

University of Colorado/National Oceanic and Atmospheric Administration

This data set presents monthly averages and sampling statistics for atmospheric methane concentrations from measurements made by the global cooperative flask sampling network of the National Oceanographic and Atmospheric Administration/Climate Monitoring and Diagnostics Laboratory (NOAA/CMDL) from 1983 through 1988. The data are 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 CO₂. The samples were analyzed for atmospheric methane concentration on a gas chromatograph (fitted with a flame ionization detector) at the NOAA/CMDL laboratory in Boulder, Colorado. The data consist of station identification code; year; and mean monthly methane concentration, standard deviation, and number of samples contributing to the mean for each month. The data are in one file of 66.5 kB and are available on all media.

NDP-038 (1991)
WDC-A

Bimonthly average atmospheric methane concentrations at Mauna Loa, Hawaii.

NDP-039 (1991)

Two Long-Term Instrumental Climatic Data Bases of the People's Republic of China
 Tao Shiyan, Fu Congbin, Zeng Zhaomei, and Zhang Qingyun
 Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China

Two long-term instrumental data bases containing meteorological observations from the People's Republic of China (PRC) are presented in this NDP. These data sets were compiled in accordance with a joint research agreement signed by the U.S. Department of Energy and the PRC Chinese Academy of Sciences (CAS) on Aug. 19, 1987. CAS has provided records from 265 stations, partitioned into two networks of 60 and 205 stations, each providing good geographical coverage of the PRC.

The 60-station-network data contain monthly means, extremes, or totals of barometric pressure, air temperature, precipitation amount, relative humidity, sunshine duration, cloud amount, dominant wind direction and frequency, wind speed, and number of days with snow cover. Detailed station histories are presented for all 60 stations.

The 205-station-network data contain monthly mean temperatures and monthly precipitation totals; however, station histories are not currently available. Sixteen stations from these data sets (13 from the 60-station, 3 from the 205-station) have temperature and/or precipitation records beginning before 1900, whereas the remaining stations began observing in the early to mid-1900s. Records from 262 stations extend through 1988; the remaining three station records extend through the early 1980s.

The data are contained in five files: one station-inventory file for each of the networks (3.2 KB for the 60-station; 13.7 KB for the 205-station), one data file for the 60-station network (6.5 MB), one temperature data file for the 205-station network (1 MB), and one precipitation data file for the 205-station network (1 MB).

Variation in autumn mean cloud amount and sunshine for China and three subregions for the period 1954-1988, expressed as percentage deviations for the autumn mean for the whole period. Dashed lines are linear regressions. The correlation between each series pair is given between the series. Magnitudes of linear trends are given at the right (with an accompanying significance level if significant at the 5% level or better).

Daily Temperature and Precipitation Data for 223 USSR Stations

V. N. Razuvaev, E. G. Apasova, and R. A. Martuganov
Research Institute of Hydrometeorological Information
Obninsk, Russia

NDP-040 (1993)

Under an international agreement, the National Climatic Data Center (NCDC) in Asheville, N.C., is exchanging climatological information with the Research Institute of Hydrometeorological Information in Obninsk, Russia. To expedite the dissemination of these data, CDIAC, with funding provided by NCDC, is distributing one of the more useful archives acquired through this exchange: a 223-station daily data set covering from 1881 to 1989. The data set contains (1) minimum, mean, and maximum daily temperatures; (2) daily precipitation; (3) station inventory information (i.e., WMO number, name, coordinates, and elevation); (4) station history (i.e., station relocation and rain-gage re-placement information); and (5) quality-assurance information (i.e., flag codes that were assigned as a result of various data checks). The data are in 18 files.

Locations of the weather stations in the former Soviet Union from which daily climatologic data are available.

NDP-041 (1992)

The Global Historical Climatology Network: Long-Term Monthly Temperature, Precipitation, Sea Level Pressure, and Station Pressure Data

R. S. Vose

Carbon Dioxide Information Analysis Center

R. L. Schmoyer

Statistical Computing Office

Oak Ridge National Laboratory

P. M. Steurer, T. C. Peterson, R. Heim, and T. R. Karl

National Climatic Data Center

National Oceanic and Atmospheric Administration

J. K. Eischeid

Cooperative Institute for Research in Environmental Sciences

National Oceanic and Atmospheric Administration

Plot of monthly precipitation totals for a time series with an apparent discontinuity.

This NDP contains monthly temperature, precipitation, sea-level-pressure, and station-pressure data for thousands of meteorological stations worldwide. The database was compiled from pre-existing national, regional, and global collections of data as a part of the Global Historical Climatology Network (GHCN) project. It contains data from roughly 6000 temperature stations,

7500 precipitation stations, 1800 sea level pressure stations, and 1800 station pressure stations. Each station has at least 10 years of data, and about 40% have more than 50 years of data. Spatial coverage is good over most of the globe, particularly for the United States and Europe. Data gaps are evident over the Amazon rainforest, the Sahara desert, Greenland, and Antarctica.

A detailed analysis has revealed that most stations (95% for temperature and precipitation; 75% for pressure) contain high-quality data. However, gross data-processing errors (e.g., key-punch problems) and discontinuous inhomogeneities (e.g., station relocations and instrumentation changes) do characterize a small number of stations. All major data processing problems have been flagged (or corrected, when possible). Similarly, all major inhomogeneities have been flagged, although no homogeneity corrections were applied.

The NDP consists of a written report, two magnetic tapes of data, and FORTRAN and SAS® data retrieval codes. Because of the size of the data base, the NDP is not available on floppy diskette.

United States Historical Climatology Network Daily Temperature and Precipitation Data

P. Y. Hughes, E. H. Mason, T. R. Karl, and W. A. Brower
National Oceanic and Atmospheric Administration

This package consists of a data base containing daily observations of maximum and minimum temperature and precipitation amounts at 138 U.S. stations. These stations are a specially chosen subset of the 1219-station U.S. Historical Climatology Network (HCN), which was compiled by the National Climatic Data Center (Asheville, North Carolina) and is contained in NDP-019/R1. The daily data network (referred to as the HCN/D) consists of stations considered to be the best of those in the HCN, selected to provide effective coverage of the contiguous U.S. after considering the temporal

homogeneity of each station's observing times, instrument positioning, and surroundings. The data for each station extend through 1987, and most station records are complete for at least 80 years. The daily resolution of these data lends maximum flexibility for studies attempting to detect and monitor long-term climatic changes on a regional scale. The data are contained in seven files (one station-inventory file, one station-history file, and five temperature and precipitation data files). The files range in size from 10 kB to approximately 31 MB.

HISTORICAL CLIMATOLOGICAL STATIONS

The Historical Climatology Network stations (small circles) and the daily data network subset (large circles and squares) are dispersed across the continental United States.

Quality-assured data for the mean wave height, wave standard deviation, and mean 20-year maximum significant wave produced for 18.5-km reaches along the east coast of the United States. These reaches and their data (here, wave-height data along the North Carolina and South Carolina coasts) were laid out on a grid (left portion of the figure below), and values were calculated for each grid cell for each variable (right portion). The value for a grid cell that encompassed more than one reach was calculated by averaging the data for each reach that occurred within that cell.

A Coastal Hazards Data Base for the U.S. East Coast
V. M. Gornitz
Goddard Institute for Space Studies
National Aeronautics and Space Administration
T. W. White
Environmental Sciences Division
Oak Ridge National Laboratory

This NDP presents data on coastal geology, geomorphology, elevation, erosion, wave heights, tide ranges, and sea levels for the U.S. east coast. These data may be used either by nongeographic database management systems or by raster or vector geographic information systems (GISs). The database integrates several data sets (originally obtained as point, line, and polygon data) for the east coast into 0.25°-latitude by 0.25°-longitude grid cells. Each coastal grid cell contains 28 data variables.

This NDP may be used to predict the response of coastal zones on the U.S. east coast to changes in local or global sea levels. Information on the geologic, geomorphic, and erosional states of the coast provides the basic data needed to predict the behavior of the coastal zone into the far future. Thus, these data may be seen as providing a baseline for the calculation of the relative vulnerability of the east coast to projected sea-level rises. The data will also be useful to research, educational, governmental, and private organizations interested in the present and future vulnerability of coastal areas to erosion and inundation.

The data are in 13 files, the largest of which is 1.42 MB; the entire data base takes up 3.29 MB, excluding the ARC/INFO® files.

Surface-Water and Atmospheric Carbon Dioxide and Nitrous Oxide Observations by Shipboard Automated Gas Chromatography: Results from Expeditions Between 1977 and 1990

R. F. Weiss, F. A. Van Woy, and P. K. Salameh
Scripps Institution of Oceanography

NDP-044 (1992)
WDC-A

This NDP presents the results of surface-water and atmospheric CO₂ and N₂O measurements carried out on shipboard by gas chromatography from 1977 to 1990. These data include results from 41 legs of 11 ocean surveys conducted in the Atlantic, Pacific, Indian, and Southern oceans and in the Mediterranean and Red seas.

The measurements were made with an automated, high-precision, shipboard, gas-chromatographic system that measures CO₂ by flame ionization after quantitative reduction to methane in a stream of hydrogen. Nitrous oxide is measured by a separate electronic capture detector. The chromatographic system measures 196 dry-gas samples a day, divided equally among the atmosphere, gas equilibrated with surface water, a low-range gas standard, and a high-range gas standard.

These data constitute one of the most extensive records available of CO₂ and, particularly, N₂O in marine air and surface seawater. The data will be valuable in modeling the ocean's role in the global cycles of carbon and nitrogen, in studies of ocean-atmosphere dynamics, and in evaluations of other methods for determining pCO₂. The records include the names of the expedition and research vessel, sample date and time, latitude and longitude, sample type (i.e., marine air or surface seawater), barometric pressure, surface water temperature, and dry-gas mole fractions of CO₂ and N₂O. The data are in 82 files totaling 7.1 MB.

Cruise track locations in dashed lines denote expedition legs on which only N₂O was measured; on all other legs, both N₂O and CO₂ were measured.

Computer Model Packages

The IEA/ORAU Long-Term Global Energy-CO₂ Model
J. A. Edmonds and J. M. Reilly
Oak Ridge Associated Universities

CDIAC CMP-002 (August 1984)
WDC-A

This mathematical model, written in FORTRAN IV and adapted for use on an IBM 370/3033, makes projections concerning global energy and CO₂ emissions at 25-year intervals from 1975 through 2100 based on economic, demographic, and energy interactions. The model separates the world into nine regions, each having four components: demand, supply, energy balance, and CO₂ emissions. Energy demand is a function of the population, economic activity, technological change, energy prices, and energy taxes and tariffs existing in each region. Supply is dependent upon resource constraints, behavioral assumptions, and energy prices in a region. Energy balance reconciles the global energy supply and demand for fuels. Emissions are determined by applying appropriate carbon coefficients at the points in the energy flow where carbon is released. The model offers three energy/emission scenarios through 2100 and illustrates the complex relationships between global CO₂ emissions, rising populations, and energy parameters. The model is in nine files, three containing the source code and subroutines and one input-data and one output file each for low, mid, and high cases. These files range in size from 45.6 to 422 kB.

*Definition of regions by the
 IEA/ORAU Long-Term Global
 Energy-CO₂ Model.*

**The IEA/ORAU Long-Term Global Energy-Economic Model with CO₂
and CH₄ Emissions**

J. A. Edmonds and J. M. Reilly
Pacific Northwest Laboratory

The PC version of the Edmonds-Reilly model reflects considerable refinements and improvements over the mainframe version (see CMP-002). It has the capability to calculate both CO₂ and CH₄ emission estimates by source and region. The basic methodology and features of the PC version are the same as those for the mainframe version. Population, labor productivity, end-use energy efficiency, income effects, price effects, resource base, technological change in energy production, environmental costs of energy production, market-penetration rate of energy-supply technology, solar and biomass energy costs, syrnfuel costs, and the number of forecast periods may be interactively inspected and altered producing a variety of global and regional CO₂ and CH₄ emission scenarios for 1975 through 2100. The executable versions of the model and the source code are contained in 74 files ranging in size from 10 bytes to 292 KB.

Annual carbon dioxide emissions by region of the world as calculated by the IEA/ORAU Long-Term Global Energy-Economic Model with CO₂ and CH₄ Emissions.

REGION	CO ₂ EMISSIONS BY REGION AND YEAR 10**6 TONNES OF CARBON PER YEAR					
	1975	2000	2025	2050	2075	2100
USA	1083.1	1015.4	1235.3	2374.5	4294.4	7062.7
CANADA & EUR	444.8	607.2	990.3	1179.0	1655.1	2377.7
OECD PACIFIC	85.0	140.1	343.3	653.1	1297.3	2139.9
USSR/E. EUR.	1190.1	2141.8	3702.6	5597.5	9626.5	15511.3
CHINA/ET AL.	419.8	556.6	745.0	1820.3	4336.5	9601.2
MIDDLE EAST	831.4	886.8	1370.6	2685.8	1929.4	28.6
AFRICA	267.2	573.1	729.8	1058.3	1284.0	1966.1
LATIN AMER	222.9	552.5	621.2	669.7	180.0	406.4
S. & E. ASIA	146.8	90.6	220.8	123.7	185.7	340.4

Appendix A:

Media Availability and File Sizes

NDP/CMP NUMBER	MEDIA AVAILABILITY								NUMBER OF FILES	TOTAL SIZE OF DATA BASE (MB)	SIZE OF LARGEST FILE (MB)
	CD-ROM	FTP	FLOPPY DISKETTES				NINE- TRACK MAGNETIC TAPE				
			3.5" 1.44M	3.5" 720K	5.25" 1.2M	5.25" 360K					
CMP-002	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9	3.95	1.05
CMP-002/PC/R1	No	No	Yes	Yes	Yes	Yes	Yes	No	58 ^a	0.99	0.35
NDP-001/R3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	6	0.03	0.01
NDP-002	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	6	0.03	0.01
NDP-003/R1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	6	0.02	0.01
NDP-004/R1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	4	1.62	0.92
NDP-005/R1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	30	1.76	0.93
NDP-006	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	3	0.01	0.01
NDP-007	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	4	0.28	0.26
NDP-008/R3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	4	0.09	0.08
NDP-009	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	22	0.10	0.03
NDP-010	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	5	0.05	0.04
NDP-011	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	54	1.03	0.11
NDP-012	Yes	Yes	Yes	No	No	No	No	Yes	4	16.27	9.07
NDP-013	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	4	0.04	0.03
NDP-014	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	4	0.01	0.01
NDP-015	No	No	No ^b	No ^b	No ^b	No ^b	No ^b	Yes	19	7.05	2.35
NDP-016	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	10	2.75	0.53

NDP/CMP NUMBER	MEDIA AVAILABILITY								NUMBER OF FILES	TOTAL SIZE OF DATA BASE (MB)	SIZE OF LARGEST FILE (MB)
	CD-ROM	FTP	FLOPPY DISKETTES				NINE- TRACK MAGNETIC TAPE				
			3.5" 1.44M	3.5" 720K	5.25" 1.2M	5.25" 360K					
NDP-017	Yes	Yes	Yes	Yes	Yes	Yes	Yes	3	0.14	0.12	
NDP-018	Yes	Yes	Yes	Yes	Yes	Yes	Yes	4	0.35	0.34	
NDP-019/R1	Yes	Yes	No ^b	No ^b	No ^b	No ^b	Yes	26	240.22	47.48	
NDP-020/R1	Yes	Yes	No ^b	No ^b	No ^b	No ^b	Yes	14	47.54	20.33	
NDP-021/R1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	14	6.37	2.44	
NDP-022/R2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	4	0.01	0.01	
NDP-023/R1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	5	0.06	0.03	
NDP-025	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7	2.23	1.47	
NDP-026	Yes	Yes	No ^b	No ^b	No ^b	No ^b	Yes	13	72.62	24.95	
NDP-027	Yes	Yes	Yes	Yes	Yes	Yes	Yes	6	0.26	0.09	
NDP-028	Yes	Yes	Yes	Yes	Yes	Yes	Yes	4	0.03	0.02	
NDP-029	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8	0.07	0.02	
NDP-030/R4	Yes	Yes	Yes ^c	Yes ^c	Yes ^c	Yes ^c	Yes	3	0.50	0.47	
NDP-031	Yes	Yes	Yes	Yes	Yes	Yes	Yes	4	0.05	0.05	
NDP-032	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8	0.26	0.08	
NDP-033	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7	0.05	0.02	
NDP-034	Yes	Yes	Yes	Yes	Yes	Yes	Yes	6	0.03	0.01	
NDP-035	Yes	Yes	Yes ^d	Yes ^d	Yes ^d	Yes ^d	Yes	26	17.85	5.31	

Appendix B:
NDP/CMP Order Form

Numeric Data Package and Computer Model Package Order Form

Please send me the following NDPs or CMPs:

NDP/CMP number	NDP/CMP number	NDP/CMP number	NDP/CMP number
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

☐ Documentation only ☐ Documentation & floppy diskette ☐ Documentation & 9-track tape

The following **MUST** be specified if a floppy diskette or magnetic tape is requested:

DOS floppy diskette 9-Track magnetic tape

Size	Density	Density	Label	Character set
☐ 5 1/4"	High ☐	☐ 1600 BPI	☐ Nonlabeled	☐ EBCDIC
☐ 3 1/2"	Low ☐	☐ 6250 BPI	☐ Standard	☐ ASCII

Please send me additional information about CDIAC's publications:

☐ <i>CDIAC Communications</i> , newsletter	☐ <i>Glossary: Carbon Dioxide and Climate</i>
☐ <i>ARM Outreach</i> , newsletter	☐ <i>Trends '91: A Compendium of Data on Global Change</i>
☐ <i>DOE Research Summary Series</i> (single issue)	☐ <i>Catalog of Data Bases and Reports</i>
	☐ CDIAC's Numeric Data Package Collection on CD-ROM

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Organization: _____

Mailing Address: _____

City: _____ State: _____ ZIP/Postal Code: _____ Country: _____

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Carbon Dioxide Information Analysis Center

The Carbon Dioxide Information Analysis Center (CDIAC), located within the Environmental Sciences Division of Oak Ridge National Laboratory, has been in operation since 1982. CDIAC provides information to support the international research, policy-making, and education communities in the evaluation of complex environmental issues associated with elevated atmospheric carbon dioxide (CO₂), including potential climate change.

CDIAC activities include obtaining and evaluating data, articles, and reports; producing digital numeric data packages (NDPs) and computer model packages (CMPs); distributing CO₂-related reports; and producing the newsletter *CDIAC Communications*, which has a distribution to subscribers in approximately 150 countries. CDIAC also has published *Trends '91: A Compendium of Data on Global Change*, *Catalog of Data Bases and Reports*, *Glossary: Carbon Dioxide and Climate*, and *DOE Research Summary* (a 4-page newsletter that highlights a specific DOE-sponsored research project). CDIAC also produces *ARM Outreach*, a newsletter for the Atmospheric Radiation Measurement (ARM) Program.

Since 1985, CDIAC staff have responded to more than 40,000 requests for information. CDIAC staff are available to discuss both general and technical aspects of issues related to the carbon-cycle; carbon dioxide, methane, and other trace gas emissions; and other climate change topics.

CDIAC is funded by the U.S. Department of Energy's (DOE) Environmental Sciences Division to support its Global Change Research Program (GCRP). The goal of GCRP is to develop sound scientific information for policy formation and government action in response to changes in atmospheric CO₂. GCRP's thrust during the past decade has been to (1) elucidate processes that control the global carbon cycle and provide predictions of future atmospheric CO₂ change; (2) develop data and models of the processes by which changes in the earth's radiative balance may affect climate at global and regional scales and predict rates of potential climate change; and (3) develop data and models required to define and predict the combined effect of climate and CO₂ on plants, crops, and ecosystems.

During 1989 the GCRP was moved from the DOE Office of Basic Energy Sciences into the Office of Health and Environmental Research. At the same time, GCRP efforts were coordinated with other atmospheric research activities being conducted by the Environmental Sciences Division, for which Dr. Ari Patrino is Director.

CDIAC houses the World Data Center-A for Atmospheric Trace Gases. The International Council of Scientific Unions established the World Data Centers (WDCs) in 1956 to provide an archive for the observational data resulting from the 1957 International Geophysical Year. WDC-A, located in the U.S. is a collection of data centers covering a broad range of biogeophysical disciplines. CDIAC's WDC-A broadens our holdings, and enhances our ability to support the worldwide global change community.

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Carbon Dioxide Information Analysis Center, Building 1000
P.O. Box 2008, MS 6335
Oak Ridge, Tennessee 37831-9984

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