



ORNL/CDIAC-34  
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## Carbon Dioxide Information Analysis Center and World Data Center-A for Atmospheric Trace Gases

# Catalog of Databases and Reports



## How to Obtain CDIAC Data and Information Products

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Carbon Dioxide Information Analysis Center  
World Data Center—A for Atmospheric Trace Gases

**Catalog of Databases and Reports**

Compiled by Marvel D. Burtis  
Carbon Dioxide Information Analysis Center

Environmental Sciences Division  
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# Introduction

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Data products and reports made available by the U.S. Department of Energy's (DOE) Environmental Sciences Division, Office of Biological and Environmental Research (OBER), and the Carbon Dioxide Information Analysis Center (CDIAC) provide coverage in a number of areas relevant to the greenhouse effect and global climate change. Such areas include records of the concentration of carbon dioxide and other radiatively active gases in the atmosphere; the role of the terrestrial biosphere and the oceans in the biogeochemical cycles of greenhouse gases; emissions of carbon dioxide to the atmosphere; long-term climate trends; the effects of elevated carbon dioxide on vegetation; and the vulnerability of coastal areas to rising sea level. Currently in its eighth revision, this catalog provides information about the data products and reports available through CDIAC.



Many of the data products and reports listed in this catalog are available online in enhanced format as HTML documents or PDF documents. These products are denoted with CDIAC's Web site home page icon. Data files are available through online access, via CDIAC's Web site (<http://cdiac.esd.ornl.gov/>) or our anonymous file transfer protocol (FTP) area ([cdiac.esd.ornl.gov](http://cdiac.esd.ornl.gov)), or upon request, on a variety of media (e.g., CD ROM, 8 mm tape, floppy diskette).

CDIAC operates the World Data Center-A (WDC-A) for Atmospheric Trace Gases, a component of the World Data Center System coordinated by the International Council of Scientific Unions. Data products and reports produced by CDIAC and the WDC-A are denoted by the letters, **WDC-A**, printed beneath the publication number.

The catalog is divided into four sections, plus an author index and title index:

**Section A** – *U.S. Department of Energy Sponsored Research Reports* available through CDIAC listed in this section provide information on the scope, activities, and direction of OBER.

**Section B** – *CDIAC Reports* lists the publications produced and distributed by CDIAC.

**Section C** – *CDIAC Numeric Data and Computer Model Products* are thoroughly checked and documented before being released as numeric data packages (NDPs). This section includes information on the NDPs and the computer model package (CMP) available from CDIAC. The documentation provides complete descriptions of the data set, describes limitations and restrictions of the data, suggests data applications, provides tabular listings and graphical displays of the data, and includes reprints of pertinent literature.

**Section D** – *Databases Distributed by CDIAC* described in this section have not been subjected to normal CDIAC quality-control procedures. In order to make the data available more quickly the customary documentation is not available for these products. The data are available in electronic format only and include files describing the contents of each database.

CDIAC's newsletter, *CDIAC Communications*, available by subscription in hard copy or electronic format, provides information about current global change research, new and revised data products and reports, and upcoming events relating to global change.

Data products and reports listed in this catalog are distributed free of charge by CDIAC while supplies last. To request any of the materials listed in this catalog, please contact us by telephone, fax, email, or complete the order form in the back of the catalog and return to us. You may also order any of our products via the Internet order form (<http://cdiac.esd.ornl.gov/ndps/trreqst.html>).

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Please note that many CO<sub>2</sub> related proceedings, reports, and other publications listed in prior versions of the catalog are no longer available from CDIAC. DOE and DOE contractors should request copies from the Office of Scientific and Technical Information (OSTI), P.O. Box 62, Oak Ridge, TN 37831 (<http://www.osti.gov/>). Other individuals should purchase copies from the National Technical Information Service (NTIS) (703-487-4650 or <http://www.ntis.gov/>) in microfiche or hard copy; prices will vary with the number of pages.

CDIAC is supported by the Environmental Sciences Division (Michelle Broido, Director) of the Office of Biological and Environmental Research. CDIAC represents the USDOE in the multi-agency Global Change Data and Information System. Bobbi Parra is DOE's Program Manager with responsibility for CDIAC.

## Section A

U.S. Department of Energy  
Sponsored Research Reports

**Environmental Sciences Division: Summaries of Research  
in FY 1995**

(September 1996)

<http://www.doe.gov/waisgate/er.html>

DOE/ER-  
0693T

**Environmental Sciences Division, U.S. Department of Energy**

This document describes the Fiscal Year 1995 activities and products of the U.S. Department of Energy's Environmental Sciences Division. The report is organized into four main sections: Introduction, Research Areas and Project Descriptions, Appendixes, and Indexes.

**Environmental Sciences Division: Summaries of Research  
in FY 1996**

(June 1997)

<http://www.doe.gov/waisgate/er.html>

DOE/ER-  
0701T

**Environmental Sciences Division, U.S. Department of Energy**

This document describes the Fiscal Year 1996 activities and products of the Environmental Sciences Division, Office of Biological and Environmental Research, Office of Energy Research. The report is organized into four main sections: Introduction, Research Areas and Project Descriptions, Appendixes, and Indexes.

**Graduate Student Theses Supported by DOE's Environmental  
Sciences Division**

(July 1995)

<http://cdiac.esd.ornl.gov/epubs/doe/er0649t/er0649t.htm>

DOE/ER-  
0649T



**R. M. Cushman, Oak Ridge National Laboratory**

**B. M. Parra, Environmental Sciences Division, U.S. Department of Energy**

This report provides complete bibliographic citations, abstracts, and keywords for 212 doctoral and master's theses supported fully or partly by the U.S. Department of Energy's Environmental Sciences Division (and its predecessors) in the following areas: Atmospheric Sciences; Marine Transport; Terrestrial Transport; Ecosystems Function and Response; Carbon, Climate, and Vegetation; Information; Computer Hardware, Advanced Mathematics, and Model Physics (CHAMMP); Atmospheric Radiation Measurement (ARM); Oceans; National Institute for Global Environmental Change (NIGEC); Unmanned Aerial Vehicles (UAV); Integrated Assessment; Graduate Fellowships for Global Change; and Quantitative Links. Indexes are provided for major professor, university, principal investigator, program area, and keywords. This bibliography is also available in various machine-readable formats (ASCII text file, WordPerfect® files, and Papyrus™ files).



TR035

**An Annotated Inventory of Climatic Indices and Data Sets**

(DOE/NBB-0080, November 1986)

<http://cdiac.esd.ornl.gov/ndps/tr035.html>**H. A. Hattmer-Frey, Oak Ridge National Laboratory****T. R. Karl and F. T. Quinlan, National Climatic Data Center**

This publication describes 34 prominent climatic indices and provides an annotated listing and bibliography of additional indices to help meet the information needs of researchers who are evaluating the effects of increased atmospheric CO<sub>2</sub> levels. The goal was to discuss a wide range of indices that would be useful to scientists working directly in diverse areas of CO<sub>2</sub>-climate research and those individuals interested in climate research results for other applied studies.

This publication is a source to consider first to determine what information is available and how knowledge of climatic indices may help investigators meet their research goals.

To ensure that a broad spectrum of indices was considered, indices from the following ten subject areas are included: (1) Global/Hemispheres, (2) Marine Data Sets, (3) Long-Term Regional and Local Temperature and Precipitation Data Sets, (4) Atmospheric Constituents Data Sets, (5) Upper Air Data Sets, (6) Southern Oscillation/El Niño Data Sets, (7) Solar Data Sets, (8) Proxy Data Sets, (9) Lake Levels and River Flows Data Sets, and (10) Snow Cover and Sea Ice Extent Data Sets.

Each description provides a brief but detailed summary of the index's relevance, importance, and derivation. Seventeen descriptor fields were used to describe each index, including primary references, relevant background information, calculation of the index, temporal resolution, spatial coverage, unit of measurement, period of record, reliability, relationship to other indices, application, and citation information.

TR051

**A Comprehensive Precipitation Data Set for Global Land Areas**

(DOE/ER-69017T-H1, April 1991)

<http://cdiac.esd.ornl.gov/ndps/tr051.html>**J. K. Eischeid and H. F. Diaz, National Oceanic and Atmospheric Administration****R. S. Bradley, University of Massachusetts****P. D. Jones, University of East Anglia**

An expanded and updated compilation of long-term station precipitation data, together with a new set of gridded monthly mean fields for global land areas, are described. The present data set contains 5328 station records of monthly total precipitation, covering the period from the mid-1800s to the late 1980s. The station data were individually tested and visually inspected for the presence of spurious trends, jumps, and other measurement biases. The quality control procedure which was used to check the station records for nonclimatic discontinuities and other biases is detailed. We also discuss some of the problems which typically contribute to potential inhomogeneities in precipitation records.

The station data were interpolated onto a 4° latitude by 5° longitude uniform grid. Comparisons of these data with two other global-scale precipitation climatologies are

presented. We find good agreement among the three global-scale climatologies over the common areas in each set. Three different indices of long-term precipitation variations over the global land areas all indicate a general increase of annual precipitation since the 1940s, although a decline is evident over the last decade. There is some indication that the last few decades of the 19th century may have been as wet as the recent ones. An interesting feature of this study is the presence of relatively large differences in seasonal trends, with March–May and September–November becoming wetter in the last few decades. The December–February and June–August seasons exhibit smaller overall trends, although the northern winter season does exhibit large decadal-scale fluctuations.

**Climate Data Bases of the People’s Republic of China 1841–1988**  
(DOE/NBB-0091T, January 1993)  
<http://cdiac.esd.ornl.gov/ndps/tr055.html>

TR055

**D. Kaiser, University of Tennessee and Oak Ridge National Laboratory**

**S. Tao, C. Fu, Z. Zeng, and Q. Zhang, Chinese Academy of Sciences**

**W.-C. Wang, State University of New York, Albany**

**T. Karl, National Climatic Data Center**

A data base containing meteorological observations from the People’s Republic of China (PRC) is described. These data 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 August 19, 1987. CAS’s Institute of Atmospheric Physics (Beijing, PRC) has provided records from 296 stations, organized into five data sets: (1) a 60-station data set containing monthly measurements of barometric pressure, surface air temperature, precipitation amount, relative humidity, sunshine duration, cloud amount, wind direction and speed, and number of days with snow cover; (2) a 205-station data set containing monthly mean temperatures and monthly precipitation totals; (3) a 40-station subset of the 205-station data set containing monthly mean maximum and minimum temperatures and monthly extreme maximum and minimum temperatures; (4) a 180-station data set containing daily precipitation totals; and (5) a 470-station data set containing 10-day precipitation totals. Sixteen stations from these data sets (13 from the 60-station set and 3 from the 205-station set) have temperature and/or precipitation records that begin prior to 1900, whereas the remaining stations began observing in the early to mid-1900s. Records from most stations extend through 1988.

These data can be used in defining regional climate changes, establishing relationships between regional and large-scale climates, studying the climatic impacts of urbanization and increased concentrations of greenhouse gases, and assembling large-scale climate data bases. Additional uses could include examining impacts of periodic events such as volcanic eruptions or the El Niño/Southern Oscillation. These data sets represent the most comprehensive, long-term instrumental Chinese climate data currently available.

## Section B

### CDIAC Reports

**Bibliography on Tropical Rain Forests and the Global Carbon Cycle. Vol. 1. An Introduction to the Literature**

(May 1988)

<http://cdiac.esd.ornl.gov/epubs/cdiac/cdiac24v1/cdiac24v1.htm>ORNL/  
CDIAC-24/V1**C. A. S. Hall, State University of New York and University of Montana****S. Brown, University of Illinois****F. M. O'Hara Jr., Consultant, Oak Ridge National Laboratory****P. B. Bogdonoff, D. Barshaw, E. Kaufman, and S. Underhill, Cornell University**

This bibliography is Part I of a two-part volume; the second part will be an ecological and land-use bibliography on South Asia by J. F. Richards. World literature on tropical rain forests, tropical deforestation, land-use change in the tropics, tropical forest conversion, and swidden agriculture as related to the global carbon cycle is covered in this bibliography. Historic papers and books are included, but comprehensive coverage was only sought for 1980 through 1987. This compendium of nearly 2000 entries forms the point of departure for a series of bibliographies on this topic.

Other works in this series will be on the global carbon cycle and rain forests in specific geographic areas, whereas this volume includes references to literature about the global carbon cycle and rain forests anywhere in the world. The bibliography is ordered alphabetically by author and is indexed by subject and author.

This bibliography is the third in a series of up-to-date, specialized, and evaluated bibliographies that have been produced by the cooperative efforts of DOE's Carbon Dioxide Information Analysis Center and carbon dioxide researchers.

**Bibliography on Tropical Rain Forests and the Global Carbon Cycle. Vol. 2. South Asia**

(February 1989)

<http://cdiac.esd.ornl.gov/epubs/cdiac/cdiac24v2/cdiac24v2.htm>ORNL/  
CDIAC-24/V2**E. P. Flint and J. F. Richards, Duke University**

Considerable debate has centered on the role of biotic carbon release and uptake in the global carbon cycle. Carbon release caused by deforestation may contribute significantly to increased global atmospheric CO<sub>2</sub>. The first bibliography in this series addressed worldwide tropical rain forests and the carbon cycle, emphasizing the most recent literature. The focus of this bibliography is South Asia, primarily India, Pakistan, and Bangladesh and including some references to Nepal, Bhutan, Sri Lanka, Burma, and other nations.

This bibliography covers a range of ecological, botanical, forestry, agricultural, geological, and geographical sources for the period from 1889 to the present. References include land-use change as it affects all South Asia vegetation types, from tropical rain forests to high mountain systems to deserts. This broad scope was chosen because forests are believed to have covered most of South Asia within the past few millennia and because massive human impact is believed to be responsible for the prevalence of grassland, semidesert, and thorn forests in the regional landscape today.

Major emphases include biomass and productivity of all natural and agricultural South Asian vegetation types, forest area and volume, deforestation and environmental degradation, official

land-use statistics, descriptive and quantitative studies of vegetation and animals, forest history, and local and regional case studies of land-use. This bibliography is the fourth in a series of up-to-date, specialized, and evaluated bibliographies that have been produced by the cooperative effort of DOE's Carbon Dioxide Information Analysis Center and CO<sub>2</sub> researchers.

**ORNL/  
CDIAC-28**

**Environmental Consequences of CO<sub>2</sub>-Climate Interactions: The Need for Integrated Resource Analysis**

(January 1989)

<http://cdiac.esd.ornl.gov/epubs/cdiac28/cdiac28.htm>

**R. M. Cushman, J. C. Waterhouse, and M. P. Farrell, Oak Ridge National Laboratory**

The increasing concentration of atmospheric carbon dioxide is expected to alter the global climate and thereby affect agriculture, forestry, fisheries, and water resources. Resources such as these interact on a regional scale, and realistic projections of the effects on these resources must take into account the important interactions and feedbacks linking them. In addition, carbon dioxide directly affects the water use and growth of vegetation; therefore, the interactive effects of carbon dioxide and climate must also be considered. These interactions and feedbacks pose a significant challenge to any attempt to model the response of resources to changing carbon dioxide and climate. In particular, model linkage and the integration of processes that operate on different spatial and temporal scales are problems that must be addressed.

**ORNL/  
CDIAC-32**

**A Plan for Intermodel Comparison of Atmospheric CO<sub>2</sub> Projections with Uncertainty Analysis**

(June 1990)

<http://cdiac.esd.ornl.gov/epubs/cdiac32/cdiac32.htm>

**A. W. King and M. J. Sale, Oak Ridge National Laboratory**

Projecting future concentrations of atmospheric CO<sub>2</sub> is one of the principle objectives of the U.S. Department of Energy's Carbon Dioxide Research Program (CDRP). These projections are needed to assess the likelihood of significant global and regional change as a consequence of the continued use of fossil fuels and to determine whether alternative scenarios of future energy use can significantly alter this likelihood.

The projection of future atmospheric CO<sub>2</sub> concentration requires (1) estimates of the anthropogenic release of CO<sub>2</sub> to the atmosphere from the combustion of fossil fuels and changes in land use and (2) global carbon cycle models describing the atmospheric retention of that CO<sub>2</sub>. However, all model projections of future CO<sub>2</sub> concentrations involve some degree of uncertainty. Much of this uncertainty can be attributed to (1) uncertainties in future energy and land-use emissions, (2) uncertainties about the global carbon cycle reflected in the structural and conceptual differences between models, and (3) measurement error and uncertainty in the parameters and variables within a particular model. Fortunately, methods for quantifying model uncertainty exist so that projects can be made with confidence limits that reflect the associated uncertainties.

This document is a plan for an intermodel comparison of atmospheric CO<sub>2</sub> projections that includes uncertainty analysis of the global carbon cycle models used to make those

projections. The plan includes a procedure for the documentation, support, and archiving of global carbon cycle models within CDIAC at Oak Ridge National Laboratory. Uncertainty analysis is the examination of uncertainties in predictions from simulation models. The analysis identifies the dependence of model predictions on inputs, initial conditions, and parameters. Uncertainty analysis of global carbon cycle models can identify carbon cycle components and processes with the greatest sensitivities and uncertainties. This information can then be used to determine which uncertainties have the greatest influence on future atmospheric CO<sub>2</sub> concentrations and where further research and data collection could be most effectively applied to reduce uncertainties. An intermodel comparison of atmospheric CO<sub>2</sub> projections with uncertainty analysis can help define research that will improve model performance.

### **Environmental Atlas of the Iowa-Kansas-Missouri-Nebraska Climate-Change Study Region**

(March 1990)

<http://cdiac.esd.ornl.gov/epubs/cdiac33/cdiac33.htm>

ORNL/  
CDIAC-33

**L. J. Allison, C. T. Hunsaker, R. M. Cushman, T. W. White, and J. D. Draves**  
Oak Ridge National Laboratory

In 1988 DOE began an integrated research project to study the potential effect of changing climate on environmental resources. The area of study chosen was the four-state midwestern region of Iowa, Kansas, Missouri, and Nebraska. Baseline years are defined as 1984–1987 for agricultural crops and livestock and 1985 for water resources. Agriculture and water—resources that are sensitive to climate, interactive, and important to the study region and to the United States—were chosen for study. Essential to an integrated regional study is a comprehensive data base of environmental resources in the region, both to characterize the regional resources as they exist today and to serve as input for modeling the response of the resources to climate change. This atlas contains 45 maps and corresponding tabulated data showing the baseline agricultural and water resource data for the Iowa-Kansas-Missouri-Nebraska study region along with basic geographic reference data. This atlas may serve as input for modeling the response of resources to climate change and provides DOE project investigators with critical baseline agricultural and water resource data for the Iowa-Kansas-Missouri-Nebraska study region.

### **Catalog of Databases and Reports**

(May 1999)

<http://cdiac.esd.ornl.gov/epubs/catalog/index.htm>

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(WDC-A)

### **Carbon Dioxide Information Analysis Center and World Data Center–A for Atmospheric Trace Gases, Oak Ridge National Laboratory**

This document provides information about the many data products and reports available from CDIAC. It is divided into four sections plus author and title indices.



Section A provides miscellaneous DOE-sponsored reports describing the scope, activities, and direction of the DOE Environmental Sciences Division, Office of Biological and Environmental Research (OBER). Section B contains reports produced and distributed by CDIAC. Section C describes numeric data packages (NDPs) and a computer model package (CMP), and Section D describes databases offered by CDIAC. These databases are available in electronic format only and include files describing contents of each database.

ORNL/  
CDIAC-38

## Documentation and Analysis of a Global CO<sub>2</sub> Model Developed by Peng et al.

(July 1990)

<http://cdiac.esd.ornl.gov/epubs/cdiac38/cdiac38.htm>

H. I. Jager, T.-H. Peng, A. W. King, and M. J. Sale, Oak Ridge National Laboratory

In 1983, Peng et al. developed a modification of the Oeschger et al. 1975 ocean model. Both the original and the modification are one-dimensional representations of the ocean, including (1) CO<sub>2</sub> exchange between a well mixed atmosphere and a well mixed ocean surface layer and (2) diffusive mixing into the waters lying below the mixed layer. Peng et al. also added a representation of deep-water cycling from intermediate depths to the surface polar outcrop to the ocean bottom and then back to the surface. In addition, they incorporated oceanic primary productivity into the model and benchmarked the model against the penetration of bomb-produced tritium measured by the Geochemical Ocean Sections Study (GEOSECS) program.

This report documents that modified model and describes how the model was standardized to allow comparison with other models. Before being subjected to sensitivity analysis, the standardized version of the model was supplemented with a calibration routine to define reasonable combinations of initial conditions. This routine improved the model's ability to hold an initial equilibrium state. The subsequent sensitivity analysis showed that the model was sensitive to different parameters at different points in its run time. For short runs, the initial conditions selected were of greatest importance; the significance of the initial conditions declined in longer simulations. With the pCO<sub>2</sub> excluded from the sensitivity analysis, ocean surface area was always second in importance. Next, the CO<sub>2</sub> exchange rate was most important in short runs, but the alkalinity of the oceans was in all but the shortest runs.

ORNL/  
CDIAC-39  
(WDC-A)



## Glossary: Carbon Dioxide and Climate

(August 1990)

<http://cdiac.esd.ornl.gov/pns/glossary.html>

### Carbon Dioxide Information Analysis Center and World Data Center-A for Atmospheric Trace Gases, Oak Ridge National Laboratory

The impact of increased concentrations of CO<sub>2</sub> and other trace gases in the atmosphere is of concern in both scientific and nontechnical fields. This glossary contains definitions of selected CO<sub>2</sub>-related terms and has been compiled to help fill the gaps in information related to climate-change terminology.

Terms in the glossary are defined with an emphasis on their relationship to CO<sub>2</sub> and climate. Many of the definitions are then followed by a more comprehensive discussion of the terms and their use. References to the literature from which the definitions were taken are listed at the end of the glossary. In addition to terminology associated with the CO<sub>2</sub>-climate issue, a variety of other types of nomenclature is required to fully understand crucial relations between emissions, atmospheric conditions, and changing climate. The *Glossary* also contains seven tables of International System of Units Prefixes, common conversion factors, useful quantities found in CO<sub>2</sub> research, geological time scales, and abbreviations and acronyms commonly used in atmospheric research.

This is the third edition of *Glossary: Carbon Dioxide and Climate*. This new edition contains more than a hundred new terms, redefinitions of many of the original terms, and an expansion of a section of tables.

### **Climate Change and Water Supply, Management and Use: Literature Review**

(May 1992)

<http://cdiac.esd.ornl.gov/epubs/cdiac52/cdiac52.htm>

ORNL/  
CDIAC-52

**L. H. Chang, J. D. Draves, and C. T. Hunsaker, Oak Ridge National Laboratory**

There is evidence that concentrations of atmospheric CO<sub>2</sub>, tropospheric O<sub>3</sub>, and CH<sub>4</sub>, among other gases that contribute to the greenhouse effect, have increased in recent decades and that these changes may induce changes in global air temperatures and regional climate features in coming years. A literature review was conducted to sample the literature base on which our understanding of the water resource impacts of climate change rests. Water resource issues likely to be important include hydrologic response to climate change, the resilience of water supply systems to changing climatic and hydrologic conditions, and the effects of climate change on water quality and water uses (such as navigation and energy generation). A computer-assisted search of literature on the effects of climate change on these subjects was conducted. All studies were classified by type of paper (e.g., review, discussion, or case study), region, water resource variable studies, and source of climate scenario. The resulting bibliography containing more than 200 references was largely annotated. Case studies of potential hydrologic impacts have been more common than studies of impacts on water management or water use, but this apparent gap is closing. Case studies demonstrating methods of incorporating potential risks of climate change into water project planning and management have been performed. Considerable variability in regional coverage exists; the Great Lakes basin and California receive relatively more attention than such regions as New England and the Missouri River basin. General circulation mode-based and hypothetical climate scenarios have been the dominant sources of climate scenarios used in case studies, although a variety of other methods for developing climate scenarios have been developed.

### **Adapting to Sea-Level Rise in the U.S. Southeast: The Influence of Built Infrastructure and Biophysical Factors on the Inundation of Coastal Areas**

(November 1992)

<http://cdiac.esd.ornl.gov/epubs/cdiac54/cdiac54.htm>

ORNL/  
CDIAC-54

**R. C. Daniels, The University of Tennessee and Oak Ridge National Laboratory**

**V. M. Gornitz, Goddard Institute for Space Studies**

**A. J. Mehta, and S.-C. Lee, University of Florida**

**R. M. Cushman, Oak Ridge National Laboratory**

The Earth's mean surface air temperature has increased by 0.5° C over the past 100 years. This warming trend has occurred concurrently with increases in the concentration and number of greenhouse gases in the atmosphere (e.g., CO<sub>2</sub>, N<sub>2</sub>O, H<sub>2</sub>O, CH<sub>4</sub>, and CFCs). These gases may be partially responsible for this temperature increase and may cause this trend to accelerate in the future because of the increased amount of thermal radiation that will be trapped in the troposphere



by these gases. This trapping effect may result in a net increase in the earth's global mean surface air temperature of 1.5° to 4.5° C by the year 2100. An increase in the mean surface air temperature of this magnitude could cause significant increase. This increase in sea surface temperature will cause sea levels to rise—from thermal expansion of the sea and the addition of melt waters from alpine glaciers and continental ice sheets.

To allow for the cost-effective analysis of the impacts that sea-level rise may have on the U.S. Southeast, a method is needed that will allow sites potentially at risk to be identified for study. Previously, no objective method was available to identify such sites. This project addresses the problem of potential coastal damage by using a geographic data base that has information on both physical and climatological factors to identify areas of the U.S. Southeast at risk to inundation or accelerated erosion as a result of sea-level rise. The following six areas were selected for further study from the many identified as being at high risk: Galveston, Texas; Caminada Pass, Louisiana; Bradenton Beach, Florida; Daytona Beach, Florida; McClellanville, South Carolina; and Nags Head, North Carolina. These six areas are representative of three of the major stages of economic development on the East and Gulf coasts (i.e., urban/residential, undeveloped/rural, and resort/recreational), consequently any conclusion drawn from these case studies may be generalized to other high risk regions with similar geologic and economic histories.

For each study area the amount of land, by land-use type, in danger from inundation was calculated for three sea-level-rise scenarios. The calculated values were based on elevation alone. These studies were then extended by considering the effects that built infrastructure (e.g., seawalls) and biophysical factors (e.g., erosion/accretion rates) would have on the actual amount of land that would be inundated if the sea were allowed to advance unchecked. By considering these factors, a best-guess estimation of the amount of land that may be lost to the sea was derived for each study area and each scenario. These estimated values consider both natural (e.g., elevation and erosion/accretion) and anthropogenic (e.g., built infrastructure) effects when predicting the future location of the coastline in the years 2050 and 2100 for each study area, for each scenario.

ORNL/  
CDIAC-57



## **Selected Translated Abstracts of Russian-Language Climate-Change Publications. I. Surface Energy Budget**

(September 1992)

<http://cdiac.esd.ornl.gov/epubs/cdiac/cdiac57/1russ.htm>

**C. B. Ravina, All-Russian Research Institute of Hydrometeorological Information**

**M. D. Burtis, Oak Ridge National Laboratory**

This report presents abstracts (translated into English) of important Russian-language literature concerning the surface energy budget as it relates to climate change. In addition to the bibliographic citations and abstracts translated into English, this report presents the original citations and abstracts in Russian. Author and title indexes are included to assist the reader in locating abstracts of particular interest.

**Selected Translated Abstracts of Russian-Language Climate-Change Publications. II. Clouds**

(January 1994)

<http://cdiac.esd.ornl.gov/epubs/cdiac/cdiac64/2russ.htm>**C. B. Ravina, All-Russian Research Institute of Hydrometeorological Information****M. D. Burtis, Oak Ridge National Laboratory**

This report presents abstracts (translated into English) of important Russian-language literature concerning clouds as they relate to climate change. In addition to the bibliographic citations and abstracts translated into English, this report presents the original citations and abstracts in Russian. Author and title indexes are included to assist the reader in locating abstracts of particular interest.

ORNL/  
CDIAC-64**Trends '93: A Compendium of Data on Global Change**

(August 1994)

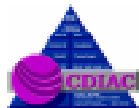
**T. A. Boden and D. P. Kaiser, Oak Ridge National Laboratory****R. J. Sepanski and F. W. Stoss, The University of Tennessee, Energy, Environment, and Resources Center**

This document provides synopses of frequently used global-change data. This third issue of the *Trends* series presents historical and modern records of atmospheric concentrations of carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), two chlorofluorocarbons (CFC-11 and CFC-12), a hydrochlorofluorocarbon (HCFC-22), and two halons (H-1301 and H-1211) from an expanded number of globally distributed sites. Virtually all of the modern records extend into the 1990s, some into 1994. Additional trace gas data presented in *Trends '93* include historical atmospheric CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O records derived from ice cores. *Trends '93* also includes revised and updated estimates through 1991 for global, regional, and national CO<sub>2</sub> emissions produced from the burning of fossil fuels, gas flaring, and the production of cement. Updated global emissions estimates through 1992 are presented for CFC-11 and CFC-12. *Trends '93* also updates and expands the presentation of long-term temperature records, whose spatial coverage ranges from an individual Antarctic ice core site to the entire globe and from the Earth's surface to the lower stratosphere. New subject matter appearing in *Trends '93* includes a chapter for long-term regional precipitation records, several time-series records for atmospheric aerosols, and isotopic <sup>14</sup>C measurements for atmospheric CO<sub>2</sub> from several globally distributed sites.

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Data records are presented in multipage formats, each dealing with a specific site, region, or emissions species. The data records include tables; graphs; discussions of methods for collecting, measuring, and reporting the data; trends in the data; and references to literature providing further information. Instructions for citing contributions by the principal investigator(s) are provided for each data summary.

(WDC-A)

**Trends Online: A Compendium of Data on Global Change**<http://cdiac.esd.ornl.gov/trends/trends.htm>**Carbon Dioxide Information Analysis Center and World Data Center–A for Atmospheric Trace Gases, Oak Ridge National Laboratory**

The *Trends* series continues to be produced as an online document accessible from CDIAC's Web site. It will no longer be produced in hard copy.

Current contents include sections on (1) historical and modern records (from ice cores and current monitoring stations) of atmospheric concentrations of CO<sub>2</sub>, (2) estimates of global, regional, and national CO<sub>2</sub> emissions from the combustion of fossil fuels, gas flaring, and the production of cement, (3) annual estimates of global anthropogenic methane emissions, and (4) long-term records of atmospheric temperature. The data summaries include tables; graphs; discussions of methods for collecting, measuring, and reporting the data; trends in the data; and references to literature providing further information.

In the future, *Trends Online* will include sections detailing information on global emissions estimates for CFC-11 and CFC-12, records of atmospheric methane concentrations, carbon content of the terrestrial biosphere, carbon fluxes to the atmosphere from land-use change, and long-term records of precipitation and cloudiness. In the meantime, links to such data are provided via the *Trends Online* Table of Contents.

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CDIAC-69**Report of the International Workshop on Quality Control of Monthly Climate Data**

(October 1993)

<http://cdiac.esd.ornl.gov/epubs/cdiac69/cdiac69.htm>**National Climatic Data Center**

Monthly climate data must rely on quality control techniques that are predominantly statistical. While the actual quality control may use numerical formulae or visual inspections of graphs, at the heart of most techniques are some basic statistical relationships. These relationships primarily fall into three categories: (1) relationships of data elements to themselves (e.g., outliers from long-term means), (2) relationships to nearby data (e.g., neighbor checks), and (3) relationships to some other data parameter (e.g., sea level pressure to station pressure). The purpose of this workshop was to discuss these data relationships and other quality control techniques, to relate experiences in applying quality control to data, and to organize cooperation in the production of quality control software.

**Direct Effects of Atmospheric CO<sub>2</sub> Enrichment on Plants and Ecosystems: An Updated Bibliographic Data Base**

(June 1994)

<http://cdiac.esd.ornl.gov/ndps/cdiac70.htm>**B. R. Strain and J. D. Cure, Duke University**

This publication provides bibliographic citations and abstracts on recent literature concerning the direct effects of elevated atmospheric concentrations of carbon dioxide (CO<sub>2</sub>) on plants and ecosystems. This report is an update to *Direct Effects of Atmospheric CO<sub>2</sub> Enrichment on Plants and Ecosystems: A Bibliography with Abstracts* (ORNL/CDIC-13), also by Strain and Cure, which was published in 1986.

The updated bibliography provides complete bibliographic citations, abstracts, keywords, and common and scientific plant names for approximately 800 references, published between 1980 and 1994 (half the cited references were published in 1990 or later). Many of the papers included in this volume, particularly papers from Europe, reflect a renewed interest in growth analysis as a way of studying allocation of mass and energy to the various organ systems. A large proportion of the recent research has focused at a level of organization beyond the individual organism.

**Handbook of Methods for the Analysis of the Various Parameters of the Carbon Dioxide System in Sea Water**

(Version 2–September 1994)

[http://www.mpl.ucsd.edu/people/adickson/CO2\\_QC/](http://www.mpl.ucsd.edu/people/adickson/CO2_QC/)**A. G. Dickson, Scripps Institution of Oceanography****C. Goyet, Woods Hole Oceanographic Institution**

The collection of extensive, reliable, oceanic carbon data is a key component of the U.S. Joint Global Ocean Flux Study (JGOFS). A portion of the JGOFS oceanic carbon dioxide measurements will be made during the World Ocean Circulation Experiment (WOCE) Hydrographic Program with funding from the U.S. Department of Energy Special Research Grant Program 89-7A: Global survey of carbon dioxide in the oceans. A science team has been formed from the investigators supported by DOE to plan and coordinate the various activities needed to produce high quality oceanic carbon dioxide measurements under this program.

This handbook was prepared at the request of, and with the active participation of, that science team. The procedures detailed in this handbook have been agreed on by the members of the science team and describe well-tested methods. The methods, together with an appropriate quality control plan, are intended to provide standard operating procedures (SOPs) for measurements made as part of this survey. These SOPs are not the only techniques in use for measuring the parameters of the oceanic carbon system; however, they do represent the current state-of-the-art methodology for shipboard measurements.

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### **Global Change Acronyms & Abbreviations**

(May 1995)

<http://cdiac.esd.ornl.gov/pns/acronyms.html>

**C. T. Woodard, Oak Ridge National Laboratory**

**F. W. Stoss, University of Tennessee and Oak Ridge National Laboratory**

This list of acronyms and abbreviations was compiled to provide the user with a ready reference for deciphering the linguistic initialisms and abridgements used in documentation about the study of global change. The terms included in the first edition were selected from a wide variety of sources: technical reports, policy documents, global change program announcements, newsletters, and other periodicals. The disciplinary interests covered by this document include agriculture, atmospheric science, ecology, environmental science, oceanography, policy science, and other fields. In addition to its availability in hard copy, the list of acronyms and abbreviations is available on DOS-formatted diskettes and through CDIAC's anonymous FTP area on the Internet.

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CDIAC-88



### **Selected Translated Abstracts of Russian-Language Climate-Change Publications. III. Aerosols**

(October 1995)

<http://cdiac.esd.ornl.gov/epubs/cdiac/cdiac88/3russ.htm>

**V. N. Razuvaev and S. G. Sivachok**

**All-Russian Research Institute of Hydrometeorological Information**

This report presents abstracts (translated into English) of important Russian-language literature concerning aerosols as they relate to climate change. In addition to the bibliographic citations and abstracts translated into English, this report presents the original citations and abstracts in Russian. Author and title indexes are included to assist the reader in locating abstracts of particular interest.

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CDIAC-94



### **Selected Translated Abstracts of Russian-Language Climate-Change Publications. IV. General Circulation Models**

(October 1996)

<http://cdiac.esd.ornl.gov/epubs/cdiac/cdiac94/4russ.htm>

**V. N. Razuvaev and S. G. Sivachok**

**All-Russian Research Institute of Hydrometeorological Information**

This report presents English-translated abstracts of important Russian-language literature concerning general circulation models as they relate to climate change. In addition to the bibliographic citations and abstracts translated into English, this report presents the original citations and abstracts in Russian. Author and title indexes are included to assist the reader in locating abstracts of particular interest.

**Publications, Presentations, and Awards of the Carbon Dioxide Information Analysis Center and World Data Center–A for Atmospheric Trace Gases**

(August 1997)

<http://cdiac.esd.ornl.gov/epubs/cdiac/cdiac101/publist.htm>ORNL/  
CDIAC-101**R. M. Cushman, Oak Ridge National Laboratory**

This online bibliography lists CDIAC's journal articles, book and proceedings chapters, numeric data packages and online databases, other ORNL and DOE reports published by CDIAC, presentations by CDIAC staff, and awards presented to CDIAC since its establishment in 1982. This is available online only.

**Program Developed for CO<sub>2</sub> System Calculations**

(February 1998)

<http://cdiac.esd.ornl.gov/oceans/co2rpert.html>ORNL/  
CDIAC-105**E. Lewis and D. Wallace  
Brookhaven National Laboratory**

Investigators interested in studying the ocean carbonate system are not in complete agreement on how to calculate inorganic carbon speciation in seawater. Over the years there have been many determinations and reviews of the constants used to describe the dissociation of carbon dioxide (CO<sub>2</sub>) in the ocean, but no universally accepted set of constants exists. Several subtly different pH scales remain in common use, as do variations in the definition of total alkalinity and arguments over the relative merits of reporting the partial pressure vs the fugacity of CO<sub>2</sub>. As ocean CO<sub>2</sub> measurements become steadily more accurate and investigators seek to evaluate very small changes in concentrations, these issues grow in importance.

It is hoped that the recently released a computer program will be of general use and perhaps help to clear up some of the confusion. Given any two of the four measurable carbonate system parameters, this program calculates the other two, together with the inorganic carbon speciation and the saturation of calcite and aragonite. The program also allows the user to select from four different pH scales and several sets of dissociation constants widely cited in the literature.

## Section C

### CDIAC Numeric Data and Computer Model Distribution

**Atmospheric CO<sub>2</sub> Concentrations—Mauna Loa Observatory, Hawaii, 1958–1997**

(revised August 1998)

<http://cdiac.esd.ornl.gov/ndps/ndp001.html> or<http://cdiac.esd.ornl.gov/trends/co2/sio-mlo.htm>**NDP-001**

(WDC-A)

**C. D. Keeling and T. P. Whorf (contributors)**

Since 1958, air samples have been continuously collected at Mauna Loa Observatory and analyzed by infrared spectroscopy for CO<sub>2</sub> concentrations. Data are averaged to give monthly and annual atmospheric CO<sub>2</sub> concentrations. These data represent the longest continuous record of atmospheric CO<sub>2</sub> 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 CO<sub>2</sub> in the middle layers of the troposphere and is critical to CO<sub>2</sub>-related research. The data are in one file taking 4.2 kB.

**Tree Ring Chronology Indexes and Reconstructions of Precipitation in Central Iowa, USA**

(September 1984)

<http://cdiac.esd.ornl.gov/ndps/ndp002.html>**NDP-002****T. J. Blasing and D. N. Duvick (contributors)**

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. 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 (8 kB) and the annual reconstructed precipitation data for central Iowa (2 kB).

**Transient Tracers in the Oceans (TTO)—Hydrographic Data and Carbon Dioxide Systems with Revised Carbon Chemistry Data**

(revised September 1986)

<http://cdiac.esd.ornl.gov/oceans/ndp004.html>**NDP-004**

(WDC-A)

**P. G. Brewer, T. Takahashi, and R. T. Williams (contributors)**

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 CO<sub>2</sub> 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)].

**NDP-005**  
(WDC-A)



**Atmospheric Carbon Dioxide Mixing Ratios from the NOAA Climate Monitoring and Diagnostics Laboratory Cooperative Flask Sampling Network, 1967–1993**

(revised February 1996)

<http://cdiac.esd.ornl.gov/epubs/ndp/ndp005/ndp005.html>

**T. J. Conway and P. Tans (contributors)**

The National Oceanic and Atmospheric Administration's Climate Monitoring and Diagnostics Laboratory (NOAA/CMDL) has measured CO<sub>2</sub> in air samples collected weekly at a global network of sites since the late 1970s and from two stations since the late 1960s. Determinations of atmospheric CO<sub>2</sub> mixing ratios on the air samples collected in glass flasks are accomplished by nondispersive infrared gas analysis. All CMDL flask samples are measured relative to standards traceable to the World Meteorological Organization (WMO) Central CO<sub>2</sub> Laboratory operated by C. D. Keeling at the Scripps Institution of Oceanography. These measurements constitute the most geographically extensive, carefully calibrated, internally consistent atmospheric CO<sub>2</sub> data set available and are essential for studies aimed at better understanding the global carbon cycle budget.

This data report documents monthly atmospheric CO<sub>2</sub> mixing ratios and CO<sub>2</sub> measurements obtained by analyzing individual flask air samples from the NOAA/CMDL global cooperative flask sampling network. Records from 40 land-based sites and from shipboard measurements covering 14 latitude bands in the Pacific Ocean and South China Sea are provided. The earliest NOAA/CMDL flask CO<sub>2</sub> records date back to 1967. Records through 1993 are provided for all operating sites. Approximately 60,000 individual flask CO<sub>2</sub> measurements are provided including those not considered indicative of regional, background, tropospheric conditions. Each measurement is flagged according to the degree the CO<sub>2</sub> determination satisfies the NOAA/CMDL data selection criteria.

**NDP-006**  
(WDC-A)

**Production of CO<sub>2</sub> from Fossil Fuel Burning by Fuel Type, 1860–1982**

(September 1984)

<http://cdiac.esd.ornl.gov/ndps/ndp006.html>

**R. M. Rotty and G. Marland (contributors)**

Global carbon dioxide emissions for 1950 through 1982 were estimated by Marland and Rotty (1984) from fuel production data from the UN *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 CO<sub>2</sub> 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 CO<sub>2</sub> 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 taking 7.5 kB.

**Atmospheric CO<sub>2</sub> Concentrations—The CSIRO (Australia)  
Monitoring Program from Aircraft for 1972–1981**

(September 1984)

<http://cdiac.esd.ornl.gov/ndps/ndp007.html>**NDP-007**

(WDC-A)

**D. J. Beardsmore and G. I. Pearman (contributors)**

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 CO<sub>2</sub> 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 CO<sub>2</sub> concentration. These data represent the first published record of CO<sub>2</sub> concentrations in the Southern Hemisphere expressed in the WMO 1981 CO<sub>2</sub> Calibration Scale and provide a precise record of atmospheric CO<sub>2</sub> concentrations in the troposphere and lower stratosphere over Australia and New Zealand. The data are in one file taking 263 kB.

**Annual and Seasonal Global Temperature Anomalies in the  
Troposphere and Low Stratosphere, 1958–1996**

(revised March 1997)

<http://cdiac.esd.ornl.gov/ndps/ndp008.html>**NDP-008****J. K. Angell (contributor)**

Surface temperatures and thickness-derived temperatures from a global network of 63 radiosonde stations have been used to estimate annual and seasonal temperature anomalies over the globe and several zonal regions from 1958 through 1996. These estimates are calculated relative to a 1958-1977 reference period mean, and pertain to the surface and the following atmospheric layers: troposphere (850-300 mb), tropopause (300-100 mb), low stratosphere (100-50 and 100-30 mb), and from the surface up to 100 mb. Individual data sets containing the above measurements are provided for the globe, the Northern and Southern Hemispheres, and the following latitudinal zones: North (60-90° N) and South (60-90° S) Polar; North (30-60° N) and South (30-60° S) Temperate; North (10-30° N) and South (10-30° S) Subtropical; Tropical (30° N-30° S); and Equatorial (10° N-10° S). 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 11 files totaling 98 kB.

**NDP-009 Growth and Chemical Responses to CO<sub>2</sub> Enrichment—Virginia Pine (*Pinus Virginiana Mill.*)**

(March 1985)

<http://cdiac.esd.ornl.gov/ndps/ndp009.html>**R. J. Luxmoore, R. J. Norby, E. G. O'Neill, D. G. Weller, J. M. Ells, and H. H. Rogers (contributors)**

From June 28 to October 29 in 1982, Virginia pine seedlings were exposed to elevated CO<sub>2</sub> 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 CO<sub>2</sub>. The data are in seven files: initial dry weights before exposure (844 kB), dry weights after exposure (4 kB), major nutrient concentrations after final harvest (12 kB), minor nutrient concentrations after final harvest (17 kB), soil nutrient concentrations after final harvest (4 kB), soil leachate elements after final harvest (5 kB), and soil leachate solutes after final harvest (4 kB).

**NDP-011 Global Paleoclimatic Data for 6000 Yr B.P.**

(August 1985)

<http://cdiac.esd.ornl.gov/ndps/ndp011.html>**T. Webb, III (contributor)**

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 tephtras 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.

**NDP-013 Volcanic Loading: The Dust Veil Index**

(September 1985)

<http://cdiac.esd.ornl.gov/ndps/ndp013.html>**H. H. Lamb (contributor)**

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 (22.6 kB).

**Solar Records: The Wolf Sunspot Index and Umbral/Penumbral Ratio** **NDP-014**  
(August 1985)  
<http://cdiac.esd.ornl.gov/ndps/ndp014.html>

**D. V. Hoyt (contributor)**

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 umbral/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 umbral/penumbral ratio. The data are in one file (3.3 kB).

**Major World Ecosystem Complexes Ranked by Carbon in Live Vegetation: A Database** **NDP-017**  
(September 1985) **(WDC-A)**  
<http://cdiac.esd.ornl.gov/ndps/ndp017.html>

**J. S. Olson, J. A. Watts, and L. J. Allison (contributors)**

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<sub>2</sub> and other gases and a basis for improved estimates of vegetation and soil carbon, of natural exchanges of CO<sub>2</sub>, and of net historic shifts of carbon between the biosphere and the atmosphere. The data are in one file of 109 kB.

**Worldwide Organic Soil Carbon and Nitrogen Data** **NDP-018**  
(September 1986) **(WDC-A)**  
<http://cdiac.esd.ornl.gov/ndps/ndp018.html>

**P. J. Zinke, A. G. Stangenberger, W. M. Post, W. R. Emanuel, and J. S. Olson (contributors)**

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. The analyzed samples were collected at uniform soil-depth increments and included bulk-density determinations. 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 323 kB.

**NDP-019****United States Historical Climatology Network (U.S. HCN) Monthly Temperature and Precipitation Data**

(revised January 1996)

<http://cdiac.esd.ornl.gov/epubs/ndp019/ndp019.html>

**D. R. Easterling, T. R. Karl, E. H. Mason, P. Y. Hughes, and D. P. Bowman**  
(contributors)

Extending through 1994, 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 (1994), 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 database 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, the data have been 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 available on 9-track magnetic tape only.

**NDP-020****An Updated Global Grid Point Surface Air Temperature Anomaly Data Set: 1851–1990**

(revised October 1991)

<http://cdiac.esd.ornl.gov/ndps/ndp020.html>

**P. D. Jones, S. C. B. Raper, B. S. G. Cherry, C. M. Goodess, T. M. L. Wigley, B. Santer, P. M. Kelly, R. S. Bradley, and H. F. Diaz** (contributors)

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.

The present updated version of this data set is identical to the earlier version for all records from 1851–1978 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 where large discrepancies were evident. The present package also extends the record by adding monthly surface-air-temperature anomalies for the Northern (grid points from 85° N to 0°) and Southern (grid points from 5° S to 60° S) Hemispheres for 1985–1990. 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 data consist of 14 files, including five ASCII data files, eight FORTRAN 77 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.

### **Historical Sunshine and Cloud Data in the United States (revised 1991)**

<http://cdiac.esd.ornl.gov/ndps/ndp021.html>

**NDP-021**

**P. M. Steurer and T. R. Karl (contributors)**

This data base presents monthly sunshine data from 240 U.S. stations (including Puerto Rico and nine Pacific Islands) and monthly cloud amount data from 197 U.S. stations. The 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 only.

**NDP-022 Global and Hemispheric Annual Temperature Variations Between 1861 and 1991**

(revised August 1994)

<http://cdiac.esd.ornl.gov/ndps/ndp022.html>**P. D. Jones, T. M. L. Wigley, and P. B. Wright (contributors)**

This data set contains estimates of global and hemispheric annual temperature variations, relative to a 1950 through 1979 reference period, for 1861 through 1991. The estimates are based on corrected land and ocean data. Land data were derived from meteorological data and fixed-position weather-ship data that were corrected for nonclimatic errors, such as station shifts and/or instrument changes. The marine data used were those in the Comprehensive Ocean-Atmosphere Data Set (COADS) compilation, which with updates covers to 1986. Updates to 1991 were made with hemispheric sea-surface temperature estimates produced by the U.K. Meteorological Office. Each record includes year and six annual temperature variations: one estimate each for the globe, the Northern Hemisphere, and the Southern Hemisphere and another estimate each that reflects an adjustment to account for the influence of El Niño/Southern Oscillation events. The data are in one file of 13 kB.

**PLEASE NOTE.** Updates to these global and hemispheric temperature anomaly series produced by Jones et al. are now available through CDIAC's *Trends Online*. For the time being, NDP-022 contains data only through 1991, so users are encouraged to access the data through Trends Online, since the data extend through 1997. In the future, NDP-022 will be updated to catch up with the records as presented in Trends Online.

**NDP-023 Annual and Seasonal Global Variation in Total Ozone and Layer-Mean Ozone, 1958–1987**

(WDC-A)

(January 1991)

<http://cdiac.esd.ornl.gov/ndps/ndp023.html>**J. K. Angell, J. Korshover, and W. G. Planet (contributors)**

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 north and south 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)].

**Monthly Mean Pressure Reconstructions for Europe (1780–1980) and North America (1858–1980)**

NDP-025

(June 1987)

<http://cdiac.esd.ornl.gov/ndps/ndp025.html>**P. D. Jones, T. M. L. Wigley, and K. R. Briffa (contributors)**

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 for North America (0.72 MB).

**Climatological Data for Clouds Over the Globe from Surface Observations**

NDP-026

(February 1988)

<http://cdiac.esd.ornl.gov/ndps/ndp026.html>**C. J. Hahn, S. G. Warren, J. London, R. L. Jenne, and R. M. Chervin (contributors)**

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 two atlases (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 (FNO) 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 first cloud analyses for the first year of the GARP Global Experiment (FGGE); one containing cloud-type co-occurrences for land and oceans; and one containing a FORTRAN 77 program to read and produce maps). These files range in size from 12.5 kB to 5.67 MB and are available on 9-track magnetic tape only.

**Climatological Data for Clouds Over the Globe from Surface Observations, 1982–1991: The Total Cloud Edition**

NDP-026A

(October 1994)

<http://cdiac.esd.ornl.gov/ndps/ndp026a.html>**C. J. Hahn, S. G. Warren, and J. London (contributors)**

Routine, synoptic surface weather reports from ships and land stations over the entire globe, for the 10-year period December 1981 through November 1991, were processed for total cloud cover and the frequencies of occurrence of clear sky, sky-obscured due to precipitation, and sky-obscured due to fog. Archived data, consisting of various annual, seasonal and monthly averages, are provided in grid boxes that are typically  $2.5^\circ \times 2.5^\circ$  for land and  $5^\circ \times 5^\circ$  for ocean. Day and



nighttime averages are also given separately for each season. Several derived quantities, such as interannual variations and annual and diurnal harmonics, are provided as well. This data set incorporates an improved representation of nighttime cloudiness by utilizing only those nighttime observations for which the illuminance due to moonlight exceeds a specified threshold. This reduction in the night-detection bias increases the computed global average total cloud cover by about 2%. The impact on computed diurnal cycles is even greater, particularly over the oceans where it is found (in contrast to previous surface-based climatologies), that cloudiness is often greater at night than during the day.

**NDP-026B****Edited Synoptic Cloud Reports from Ships and Land Stations Over the Globe, 1982–1991****(February 1996)**<http://cdiac.esd.ornl.gov/epubs/ndp/ndp026b/ndp026b.htm>**C. J. Hahn, S. G. Warren, and J. London (contributors)**

Synoptic surface weather reports for the entire globe for the 10-year period from December 1981 through November 1991 have been processed, edited, and rewritten to provide a data set designed for use in cloud analyses. The information in these reports relating to clouds, including the present weather information, was extracted and put through a series of quality control checks. Reports not meeting certain quality control standards were rejected, as were reports from buoys and automatic weather stations. Correctable inconsistencies within reports were edited for consistency, so that the “edited” cloud report can be used for cloud analysis without further quality checking. Cases of “sky obscured” were interpreted by reference to the present weather code as to whether they indicated fog, rain or snow and were given appropriate cloud type designations. Nimbostratus clouds, which have not previously been assigned a standard synoptic code, were also given a special designation. Changes made to an original report are indicated in the edited report so that the original report can be reconstructed if desired. While low cloud amount is normally given directly in the synoptic report, the edited cloud report also includes the amounts, either directly reported or inferred, of middle and high clouds, both the non-overlapped amounts and the “actual” amounts (which may be overlapped). Since illumination from the moon is important for the adequate detection of clouds at night, both the relative lunar illuminance and the solar altitude are given, as well as a parameter that indicates whether our recommended illuminance criterion was satisfied.

This data set contains 124 million reports from land stations and 15 million reports from ships. Each report is 56 characters in length. The archive consists of 240 files, one file for each month of data for land and ocean separately. Due to the size of the database (~8 GB), the data are available on 8 mm tapes or via Internet only. With this data set, a user can develop a climatology for any particular cloud type or group of types, for any geographical region, and for any spatial and temporal resolution desired.

**GEOSECS Atlantic, Pacific, Indian, and Mediterranean Radiocarbon Data**

(January 1988)

<http://cdiac.esd.ornl.gov/oceans/ndp027.html>**NDP-027**

(WDC-A)

**H. G. Östlund and M. Stuiver (contributors)**

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  $^{14}\text{C}$  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  $^{14}\text{C}$ . 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.

**Carbonate Chemistry of the Weddell Sea**

(January 1988)

<http://cdiac.esd.ornl.gov/oceans/ndp028.html>**NDP-028**

(WDC-A)

**C.-T. A. Chen (contributor)**

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 (WEPOLLEX-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  $\text{CO}_2$  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)].

**Carbonate Chemistry of the North Pacific Ocean**

(January 1988)

<http://cdiac.esd.ornl.gov/oceans/ndp029.html>**NDP-029**

(WDC-A)

**C.-T. A. Chen, M. R. Rodman, C.-L. Wei, E. J. Olson, R. A. Feely, and J. F. Gendron (contributors)**

Carbonate chemistry data from 41 stations in the North Pacific Ocean were obtained during two NOAA  $\text{CO}_2$  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.

**NDP-030**  
(WDC-A)



**Global, Regional, and National CO<sub>2</sub> Emission Estimates from Fossil-Fuel Burning, Hydraulic Cement Production, and Gas Flaring: 1751–1996**

(revised March 1999)

<http://cdiac.esd.ornl.gov/ndps/ndp030.html>

**G. Marland, R. J. Andres, T. A. Boden, C. Johnston, and A. L. Brenkert**  
(contributors)

Global, regional, and national annual estimates of CO<sub>2</sub> emissions from fossil fuel burning, cement production, and gas flaring have been calculated through 1996, some as far back as 1751. These estimates, derived primarily from energy statistics published by the United Nations, were calculated using the methods of Marland and Rotty (1984). Cement production estimates from the U.S. Department of Interior's Bureau of Mines were used to estimate CO<sub>2</sub> emitted during cement production. Emissions from gas flaring were derived primarily from UN data but were supplemented with data from the U.S. Department of Energy's Energy Information Administration, Rotty (1974), and with a few national estimates provided by Marland. At present, this subdirectory provides three files containing the global (global96.ems), regional (region96.ems), and national (nation96.ems) CO<sub>2</sub> emissions estimates, along with a country code file (country.cod) and a region definition file (region.def).

**NDP-032**

**Antarctic Surface Temperature and Pressure Data**

(December 1991)

<http://cdiac.esd.ornl.gov/ndps/ndp032.html>

**P. D. Jones and D. W. S. Limbert** (contributors)

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.

**NDP-033**  
(WDC-A)

**Atmospheric CO<sub>2</sub> Concentrations Derived from Flask Samples Collected at U.S.S.R.-Operated Sampling Sites**

(May 1994)

<http://cdiac.esd.ornl.gov/ndps/ndp033.html>

**A. M. Brounshtein, E. V. Faber, and A. A. Shashkov** (contributors)

This NDP represents the first CDIAC data package to result from our involvement with Soviet scientists as part of Working Group (WG) VIII of the U.S.-U.S.S.R. Joint Committee on Cooperation in the Field of Environmental Protection. The U.S.-U.S.S.R. Agreement on Protection of the Environment, established in 1972, covers a wide variety of areas, including environmental pollution, the urban environment, nature preserves, arctic and subarctic ecological systems, earthquake prediction, and institutional measures for environmental protection. WG VIII is concerned with the influence of environmental changes on climate.

These atmospheric CO<sub>2</sub> concentrations are considered indicative of regional background air conditions and are directly traceable to the World Meteorological Organization's primary CO<sub>2</sub> standards. These measurements support the rising trend in atmospheric CO<sub>2</sub> 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.

Annual mean atmospheric CO<sub>2</sub> concentrations, calculated from available individual flask measurements for the four sites, have increased from 352.38 parts per million by volume (ppmv) in 1988 to 354.97 ppmv in 1990 for Teriberka Station, 343.52 ppmv in 1983 to 355.68 ppmv in 1990 for Ocean Station Charlie, 345.19 ppmv in 1986 to 354.93 ppmv in 1990 for Bering Island, and 351.96 ppmv in 1987 to 356.05 ppmv in 1990 for Kotelny Island. The atmospheric CO<sub>2</sub> measurements from each site show a pronounced annual seasonal oscillation caused by photosynthetic depletion during the northern growing season. The amplitudes of these seasonal oscillations are quite large (10 to 30 ppmv) and are consistent with measurement records from other northern-latitude locations.

The NDP consists of a written document and a magnetic tape containing seven files: four data files (one for each station) that provide the atmospheric CO<sub>2</sub> concentrations from individual flask measurements, a descriptive file, and FORTRAN 77 and SAS<sup>®</sup> computer codes to access the data files. The written document presents the atmospheric CO<sub>2</sub> concentrations in graphic and tabular form, describes the sampling methods, defines limitations and restrictions of the data, and describes the information on the magnetic media. The data files range in size from 0.97 to 20.01 kB. These data are also available on CD-ROM or via FTP. For those wishing to receive these data on floppy diskette, the same files are available on IBM-formatted, high- or low-density, 5.25- or 3.5-inch floppy diskettes as DOS ASCII text files.

### **Atmospheric CO<sub>2</sub> Concentrations—The Canadian Background Air Pollution Monitoring Network**

(December 1995)

<http://cdiac.esd.ornl.gov/ndps/ndp034.html>

**NDP-034**  
(WDC-A)

**N. B. A. Trivett, V. C. Hudec, and C. S. Wong (contributors)**

Flask air samples collected at roughly weekly intervals at three Canadian sites [Alert, Northwest Territories (July 1975 through July 1992); Sable Island, Nova Scotia (March 1975 through July 1992); and Cape St. James, British Columbia (May 1979 through July 1992)] were analyzed for CO<sub>2</sub> concentration with the measurements directly traceable to the WMO primary CO<sub>2</sub> standards. Each record includes the date, atmospheric CO<sub>2</sub> concentration, and flask classification code.

They provide an accurate record of CO<sub>2</sub> concentration levels in Canada during the past two decades. Because these data are directly traceable to WMO standards, this record may be compared with records from other Background Air Pollution Monitoring Network (BAPMoN) stations. The data are in three files (one for each of the monitoring stations) ranging in size from 9.4 to 20.1 kB.

**NDP-035      A Global Geographic Information System Data Base of Storm Occurrences and Other Climatic Phenomena Affecting Coastal Zones**

(August 1996)

<http://cdiac.esd.ornl.gov/ndps/ndp035.html>**K. R. Birdwell and R. C. Daniels (contributors)**

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° · 1° or 5° · 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 77 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. The data are also available on CD-ROM or via FTP. 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.

**NDP-036      Indian Ocean Radiocarbon: Data from the INDIGO 1, 2, and 3 Cruises**

(WDC-A)

(June 1992)

<http://cdiac.esd.ornl.gov/oceans/ndp036.html>**H. G. Östlund and C. Grall (contributors)**

This data set presents <sup>14</sup>C activities from water samples taken at various locations and depths in the Indian and Southern oceans through the Indian 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<sub>2</sub> 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<sub>2</sub>, <sup>13</sup>C, and <sup>14</sup>C activity. The data are in one file of 25 kB.

**Carbon Dioxide Enrichment: Data on the Response of Cotton to Varying CO<sub>2</sub> Irrigation, and Nitrogen**

NDP-037

(May 1993)

<http://cdiac.esd.ornl.gov/ndps/ndp037.html>

**B. A. Kimball, J. R. Mauney, R. L. La Morte, G. Guinn, F. S. Nakayama, J. W. Radin, E. A. Lakatos, S. T. Michell, L. L. Parker, G. J. Peresta, P. E. Nixon III, B. Savoy, S. M. Harris, R. MacDonald, H. Pros, and J. Martinez (contributors)**

This NDP presents data on the effects of continuous CO<sub>2</sub> enrichment of cotton during five consecutive growing seasons, 1983 to 1987, under both optimal and limiting levels of water and nitrogen. Unlike many prior CO<sub>2</sub>-enrichment experiments in growth chambers or greenhouses, these studies were conducted on field-planted cotton at close to natural conditions with open-top chambers. Measurements were made on a variety of crop-response variables during the growing season and upon crop harvest. The initial experiment examined the effects of varying CO<sub>2</sub> concentration only. During the following two seasons, the interactive effects of CO<sub>2</sub> concentration and water availability were studied. During the final two seasons, the interactions among CO<sub>2</sub> concentration, water availability, and nitrogen fertility were investigated.

The data include identification variables (such as year, institution and site codes, and treatment regimens), intermediate growth measurements (such as 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 (such as lint yield, seed yield, and total aboveground dry biomass). These data will be useful in studying the possible future effects on crop production of a doubling of global atmospheric CO<sub>2</sub> concentrations and for validating crop-growth models designed to predict the effects of elevated CO<sub>2</sub> on cotton growth. The data show that, for all five growing seasons and all experimental treatments, cotton yields and plant dry weights were increased significantly by CO<sub>2</sub> enrichment.

The NDP includes a 48.4-kB ASCII data file, FORTRAN 77 and SAS<sup>®</sup> computer codes for accessing the data, a descriptive file, and written documentation. The documentation includes a supplemental text that describes and presents data for many other parameters, including daily weather, soil profile properties (e.g., initial soil moisture and nitrogen conditions), and irrigation and fertilizer treatments.

**Two Long-Term Instrumental Climatic Data Bases of the People's Republic of China**

NDP-039

(September 1997)

<http://cdiac.esd.ornl.gov/ndps/ndp039.html>

**S. Tao, C. Fu, Z. Zeng, and Q. Zhang (contributors)**

Two long-term instrumental data bases containing meteorological observations from the People's Republic of China (PRC) are presented in this NDP. The first version of this database extended through 1988 and was made available in 1991 as CDIAC NDP-039. This update of the database includes data through 1993. 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 270 stations, partitioned into two networks of 65 and 205 stations.

The 65-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. Station histories are available from 59 of the 65 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 65-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.

**NDP-040**      **Daily Temperature and Precipitation Data for 223 U.S.S.R. Stations**  
(November 1993)  
<http://cdiac.esd.ornl.gov/ndps/ndp040.html>

**V. N. Razuvaev, E. G. Apasova, and R. A. Martuganov (contributors)**

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 replacement 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.

**NDP-041**      **The Global Historical Climatology Network: Long-Term Monthly**  
**Temperature, Precipitation, Sea Level Pressure, and Station**  
**Pressure Data**  
(February 1992)  
<http://cdiac.esd.ornl.gov/epubs/ndp/ndp041/ndp041.html>



**R. S. Vose, R. L. Schmoyer, P. M. Steurer, T. C. Peterson, R. Heim, T. R. Karl, and J. K. Eischeid (contributors)**

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 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, 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., keypunch 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 were flagged, although no homogeneity corrections were applied.

The NDP consists of a written report, two magnetic tapes of data, and FORTRAN 77 and SAS<sup>®</sup> 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**

**NDP-042**

**(November 1995)**

<http://cdiac.esd.ornl.gov/ndps/ndp042.html>

**P. Y. Hughes, E. H. Mason, T. R. Karl, and W. A. Brower (contributors)**

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 United States 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.

## **A Coastal Hazards Data Base for the U.S. East Coast**

**NDP-043A**

**(June 1995)**

<http://cdiac.esd.ornl.gov/ndps/ndp043a.html>

**V. M. Gornitz and T. W. White (contributors)**

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. This 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<sup>™</sup> files.



**NDP-043B     A Coastal Hazards Data Base for the U.S. Gulf Coast**  
(June 1995)  
<http://cdiac.esd.ornl.gov/ndps/ndp043b.html>

**V. M. Gornitz and T. W. White (contributors)**

This document describes the contents of a digital data base that may be used to identify coastlines along the U.S. Gulf Coast at risk to sea-level rise. The data base integrates point, line, and polygon data for the U.S. Gulf Coast into 0.25° latitude by 0.25° longitude grid cells and into 1:2,000,000 digitized line segments that can be used by raster or vector geographic information systems (GIS) as well as by non-GIS data base systems. Each coastal grid cell and line segment contains data on elevations, geology, geomorphology, sea-level trends, shoreline displacement (erosion/accretion), tidal ranges, and wave heights.

To allow for the identification of coastlines at risk from sea level rise, 7 of the 22 original data variables in this data base were classified by vulnerability and used to create 7 relative risk variables. These relative risk variables range in value from 1 to 5 and may be used to calculate a coastal vulnerability index for each grid cell and/or line segment. The data for these 29 variables (i.e., the 22 original variables and 7 risk variables) have been placed into the following data formats:

1. Gridded polygon data for the 22 original data variables. Data include elevations, geology, geomorphology, sea-level trends, shoreline displacement (erosion/accretion), tidal ranges, and wave heights.
2. Gridded polygon data for the seven classified risk variables. The risk variables are classified versions of mean coastal elevation, geology, geomorphology, local subsidence trend, mean shoreline displacement, maximum tidal range, and maximum significant wave height.
3. 1:2,000,000 line segment data containing the 29 data variables (i.e., the 22 original data variables and the 7 classified risk variables).
4. Supplemental point data for the stations used in calculating the sea-level trend and tidal range data sets.
5. Supplemental line segment data containing a 1:2,000,000 digitized coastline of the U.S. Gulf Coast as defined by this numeric data package (NDP).

This document provides sample listings of the data and detailed descriptions of the file formats; offers FORTRAN 77 and SAS® retrieval program listings; describes the methods used in calculating each variable; discusses the sources, restrictions, and limitations of the data; provides five ARC/INFO™ export coverages and flat ASCII data files containing these data; and provides reprints of pertinent literature.

**A Coastal Hazards Data Base for the U.S. West Coast**

(December 1997)

<http://cdiac.esd.ornl.gov/epubs/ndp/ndp043c/43c.htm>**V. M. Gornitz and T. W. Beaty (contributors)**

This document describes the contents of a digital database that may be used to identify coastlines along the U.S. West Coast that are at risk to sea-level rise. The database integrates point, line, and polygon data for the U.S. West Coast into 0.25° latitude by 0.25° longitude grid cells and into 1:2,000,000 digitized line segments in a latitude/longitude coordinate system that can be used by raster or vector geographic information systems (GIS) as well as by non-GIS databases. Each coastal grid cell and line segment contains 29 data variables on elevation, geology, geomorphology, sea-level trends, shoreline displacement (erosion/accretion), tidal ranges, and wave heights. Seven of the 22 original data variables in this database were classified by susceptibility to sea level rise and/or erosion to form 7 relative risk variables. These risk variables range in value from 1 to 5 and may be used to calculate a Coastal Vulnerability Index (CVI). Algorithms used to calculate several CVIs are listed within this text.

NDP-043C

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

(February 1993)

<http://cdiac.esd.ornl.gov/oceans/ndp044.html>**R. F. Weiss, F. A. Van Woy, and P. K. Salameh (contributors)**

This NDP presents the results of surface water and atmospheric carbon dioxide (CO<sub>2</sub>) and nitrous oxide (N<sub>2</sub>O) 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, as well as the Mediterranean and Red seas.

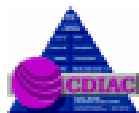
The measurements were made by an automated high-precision shipboard gas chromatographic system that measures CO<sub>2</sub> by flame ionization after quantitative reduction to methane in a stream of hydrogen. Nitrous oxide is measured by a separate electron-capture detector. The chromatographic system 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 CO<sub>2</sub> and, particularly, N<sub>2</sub>O 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 pCO<sub>2</sub>. 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 CO<sub>2</sub> and N<sub>2</sub>O. The data are in 82 files totaling 7.1 MB.

NDP-044

(WDC-A)

**NDP-045**  
(WDC-A)



**Carbon Dioxide, Hydrographic, and Chemical Data Obtained During the R/V *Meteor* Cruise 11/5 in the South Atlantic and Northern Weddell Sea Areas (WOCE sections A-12 and A-21) (December 1994)**

[http://cdiac.esd.ornl.gov/oceans/ndp\\_045/ndp045.html](http://cdiac.esd.ornl.gov/oceans/ndp_045/ndp045.html)

**D. W. Chipman, T. Takahashi, D. Berger, and S. C. Sutherland (contributors)**

This document presents the procedures and methods used to obtain CO<sub>2</sub>, hydrographic, and chemical data during the R/V *Meteor* Expedition 11/5 in the South Atlantic Ocean, including the Drake Passage (Section A-12); the Northern Weddell Sea; and the Eastern South Atlantic Ocean (Section A-21). This cruise was conducted as part of the World Ocean Circulation Experiment (WOCE).

The cruise started from Ushuaia, Argentina, on January 23, 1990, and ended at Capetown, South Africa on March 8, 1990. Samples were collected at 78 stations that covered the Drake Passage (56°–63° S); the Northern Weddell Sea (45°–35° W); a section along the 58° W parallel (25° W–prime meridian); and two segmented S–N sections between the Northern Weddell Sea and Capetown, South Africa. Measurements taken at WOCE sections A-12 and A-21 included pressure, temperature, salinity measured by the Conductivity, Temperature and Depth sensor (CTD); bottle salinity, oxygen; phosphate; nitrate, nitrite; silicate, total carbon concentration (TCO<sub>2</sub>); and partial pressure of CO<sub>2</sub> (pCO<sub>2</sub>) measured at 20°C. In addition, potential density at 0 decibar (dbar) and potential temperature were calculated from the measured variables.

The TCO<sub>2</sub> concentration in seawater samples was measured using a coulometer with an estimated precision of approximately ±1 μmol/kg. The coulometer was calibrated frequently at sea by using a high-precision gas pipette and CO<sub>2</sub> gas (99.998%). The pCO<sub>2</sub> value in seawater samples was measured at 20°C by means of a constant-volume (500 ml seawater) equilibrator and a gas chromatograph. CO<sub>2</sub> in equilibrated gas was first converted to methane, by using a ruthenium catalyst, and then measured by a flame-ionization detector. The precision of pCO<sub>2</sub> measurements has been estimated to be approximately ±0.1%.

**NDP-046**  
(WDC-A)

**Historic Land Use and Carbon Estimates for South and Southeast Asia: 1880–1980**

(June 1995)

<http://cdiac.esd.ornl.gov/ndps/ndp046.html>

**J. F. Richards and E. P. Flint (contributors)**

This digital data base contains estimates of land use change and the carbon content of vegetation for South and Southeast Asia for the years 1880, 1920, 1950, 1970, and 1980. These data were originally collected for climate modelers so they could reduce the uncertainty associated with the magnitude and time course of historical land use change and of carbon release. For this data base, South and Southeast Asia is defined as encompassing nearly 8 × 10<sup>6</sup> km<sup>2</sup> of the earth's land surface and includes the countries of India, Sri Lanka, Bangladesh, Myanmar (Burma), Thailand, Laos, Kampuchea (Cambodia), Vietnam, Malaysia, Brunei, Singapore, Indonesia, and the Philippines.

The most important change in land use over this 100-year period was the conversion of 107 × 10<sup>6</sup> ha of forest/woodland to categories with lower biomass. Land thus transformed

accounted for 13.5% of the total area of the study region. The estimated total carbon content of live vegetation in South and Southeast Asia has dropped progressively, from  $59 \times 10^9$  Mg in 1880 to  $27 \times 10^9$  Mg in 1980. Throughout the study period, the carbon stock in forests was greater than the carbon content in all other categories combined, although its share of the total declined progressively from 81% in 1880 to 73% in 1980.

The database was developed in Lotus 1-2-3™ by using a sequential bookkeeping model. The source data were obtained at the local and regional level for each country from official agricultural and economic statistics (e.g., the United Nations Food and Agriculture Organization); historical geographic and demographic texts, reports, and articles; and any other available source. Because of boundary changes through time and disparities between the validity, availability, and scale of the data for each country, the data were aggregated into 94 ecological zones. The resulting data base contains land use and carbon information for 94 ecological zones and national totals for 13 countries.

The database consists of 90 Lotus 1-2-3™ files, 3 ARC/INFO™ export files, and 5 ASCII data files. In addition to these, a descriptive file that explains the contents and format of each data file and 4 FORTRAN 77 and SAS® retrieval programs for use with the ASCII data files are included.

### **Carbon Dioxide Concentrations in Surface Water and the Atmosphere During 1986–1989 NOAA/PMEL Cruises in the Pacific and Indian Oceans**

(March 1995)

[http://cdiac.esd.ornl.gov/oceans/ndp\\_047/ndp047.html](http://cdiac.esd.ornl.gov/oceans/ndp_047/ndp047.html)

**P. P. Murphy, K. C. Kelly, R. A. Feely, and R. H. Gammon (contributors)**

This document presents data on carbon dioxide (CO<sub>2</sub>) concentrations in surface water and the atmosphere collected during Pacific Marine Environmental Laboratory (PMEL) expeditions during 1986–1989. CO<sub>2</sub> was measured quasi-continuously on 5 PMEL expeditions (12 legs) in the Pacific and Indian Oceans. These cruises were conducted under support from the National Oceanic and Atmospheric Administration (NOAA). CO<sub>2</sub> measurements in the atmosphere and in surface water were made by analyzing mixing ratios of CO<sub>2</sub> with an automated, temperature-controlled gas chromatograph system described by Murphy et al. (1991) and Bates et al. (1993). Instrument precision was determined by the average percent standard deviation of the standard response over a 6-h period. The precision varied between cruises but was always less than 1.2% and was more typically around 0.4%.

Air was pumped through 3/8-in. diam., plastic-coated, aluminum tubing from the jackstaff on the bow of the ship (10 m above the sea surface) to the oceanographic laboratory for analysis. Surface seawater entered the ship via a forward intake line located approximately 5 m below the water level.

Fifteen files are described in this report and distributed along with it, including one descriptive file (ndp047.doc) that provides an overview of the cruise network and describes details on the content and format of the thirteen data files; one FORTRAN 77 retrieval code (pmeldat.for) that may be used to read and print any of the data files; and thirteen data files, one (pmel8689.dat) that contains the data from all twelve legs, and separate files (12 total) for each leg. Each of the data files contains the same variables: cruise name; date (day, month, year); day of the year [Greenwich Mean Time (GMT)]; latitude and longitude (in decimal degrees); cumulative distance since the first sampling location on the leg; sea surface temperature (°C); warming temperature [indicates

**NDP-047**  
(WDC-A)



the warming ( $^{\circ}\text{C}$ ) of seawater as it transited from the intake line to the analysis site]; sea surface salinity; atmospheric pressure; reported atmospheric  $\text{CO}_2$  concentration  $[\text{X}(\text{CO}_2)_{\text{air}}]$ , which is the mole fraction of the dried air pumped from the bow line; reported surface seawater  $\text{CO}_2$  concentration  $[\text{X}(\text{CO}_2)_{\text{sw}}]$ , which is the mole fraction of the dried vapor drawn from the equilibrator headspace; the calculated fugacity values for the air  $[\text{f}(\text{CO}_2)_{\text{air}}]$  and seawater  $[\text{f}(\text{CO}_2)_{\text{sw}}]$  given in the data tables are the in situ fugacities, which have been corrected for the warming of the seawater; and data quality flags.

The NDP consists of printed documentation and machine-readable files. The data files are available on 9-track magnetic tape; IBM-formatted floppy diskettes; 8-mm tapes; and 150-mB, quarter-inch tape cartridge and from CDIAC's anonymous FTP area via Internet. This document also contains an appendix, that is a full reprint of the NOAA Technical Memorandum ERL PMEL-101 authored by Murphy et al. in 1994. The appendix contains cruise information, fully describes the sampling methods and instrumentation, and defines limitations and restrictions of the data.

**NDP-048****Six- and Three-Hourly Meteorological Observations from 223 U.S.S.R. Stations****(March 1998)**<http://cdiac.esd.ornl.gov/epubs/ndp/ndp048/ndp048.html>**V. N. Razuvaev, E. G. Apasova, and R. A. Martuganov (contributors)**

This database contains 6- and 3-hourly meteorological observations from a 223-station network of the former Soviet Union. These data have been made available through cooperation between the two principal climate data centers of the United States and the former Soviet Union: the National Climatic Data Center (NCDC), in Asheville, North Carolina, and the All-Russian Research Institute of Hydrometeorological Information—World Data Centre (RIHMI-WDC) in Obninsk, Russia. The first version of this database extended through the mid-1980s (ending year dependent upon station) and was made available in 1995 by CDIAC as NDP-048. This update of the database includes data through 1990. Station records consist of 6- and 3-hourly observations of some 24 meteorological variables including temperature, past and present weather type, precipitation amount, cloud amount and type, sea level pressure, relative humidity, and wind direction and speed. The 6-hourly observations extend from 1936 through 1965; the 3-hourly observations extend from 1966 through 1990. These data have undergone extensive quality assurance checks by RIHMI-WDC, NCDC, and CDIAC. The database represents a wealth of meteorological information for a large and climatologically important portion of the earth's land area, and should prove extremely useful for a wide variety of regional climate change studies.

This NDP consists of a printed document detailing the initial version of the database (Razuvaev et al. 1995) that extended through the mid-1980s, 15 updated data retrieval and documentation files, and 223 data files updated through 1990 (one per station; ~2.9 gigabytes total, in uncompressed form) that are available via the Internet through CDIAC's Web site or anonymous FTP server, and upon request, on various magnetic media.

**Carbon-13 Isotopic Abundance and Concentration of Atmospheric Methane for Background Air in the Southern and Northern Hemispheres from 1978 to 1989**

(January 1996)

<http://cdiac.esd.ornl.gov/ndps/ndp049.html>**NDP-049**

(WDC-A)

**C. M. Stevens (contributor)**

This data package presents atmospheric CH<sub>4</sub> concentration and <sup>13</sup>C isotopic abundance data derived from air samples collected over the period 1978–1989 at globally distributed clean-air sites. The data set comprises 201 records, 166 from the Northern Hemisphere and 35 from the Southern Hemisphere. The air samples were collected mostly in rural or marine locations remote from large sources of CH<sub>4</sub> and are considered representative of tropospheric background conditions. The air samples were processed by isolation of CH<sub>4</sub> from air and conversion to CO<sub>2</sub> for isotopic analysis by isotope ratio mass spectrometry.

These data represent one of the earliest records of <sup>13</sup>C isotopic measurements for atmospheric methane and have been used to refine estimates of CH<sub>4</sub> emissions, calculate annual growth rates of emissions from changing sources, and provide evidence for changes in the rate of atmospheric removal of CH<sub>4</sub>. The data records consist of sample collection date; number of samples combined for analysis; sampling location; analysis date; CH<sub>4</sub> concentration; <sup>13</sup>C isotopic abundance; and flag codes to indicate outliers, repeated analyses, and other information. The data are contained in one 21.5 kB file.

**Continental Scale Estimates of the Biotic Carbon Flux from Land Cover Change: 1850 to 1980**

(September 1995)

<http://cdiac.esd.ornl.gov/ndps/ndp050.html>**NDP-050**

(WDC-A)

**R. A. Houghton and J. L. Hackler (contributors)**

This data package contains annual carbon flux estimates from land cover change for nine regions of the world (i.e., North America, Europe, the former Soviet Union, Pacific developed region, China, South and Central America, North Africa–Middle East, tropical Africa, and south and southeast Asia). Annual rates of land cover change and vegetation–soil response curves for each region and ecosystem are included in the database. The vegetation–soil response curves are used in bookkeeping the carbon model to estimate (1) the carbon flux in the atmosphere from clearing or degradation of vegetation, cultivation of soils, decay of dead vegetation, and (2) the recovery of abandoned lands. The model calculates the net flux of carbon in each region based on the land cover change rates and vegetation–soil response curves for the period 1850–1980 (a few regions have land cover records that begin in 1700 and carbon flux data ending in 1990). These data were collected and modeled in an attempt to reduce the uncertainty associated with the magnitude and time course of the flux of carbon from terrestrial vegetation to the atmosphere.

NDP-051  
(WDC-A)



**Carbon Dioxide, Hydrographic, and Chemical Data Obtained During the R/V *Meteor* Cruise 15/3 in the South Atlantic Ocean (WOCE Section A9, February–March 1991)**

(December 1995)

[http://cdiac.esd.ornl.gov/oceans/ndp\\_051/ndp051.html](http://cdiac.esd.ornl.gov/oceans/ndp_051/ndp051.html)

**K. M. Johnson, D. W. R. Wallace, R. J. Wilke, and C. Goyet (contributors)**

This data documentation discusses the procedures and methods used to obtain data on total carbon dioxide (TCO<sub>2</sub>), total alkalinity (TALK), and discrete partial pressure of CO<sub>2</sub> (pCO<sub>2</sub>) during the Research Vessel (R/V) *Meteor* Expedition 15/3 in the South Atlantic Ocean (Section A9). Conducted as part of the World Ocean Circulation Experiment (WOCE), the cruise began in Vitoria, Brazil, on February 10, 1991, and ended in Pointe-Noire, Congo, on March 23, 1991. WOCE zonal Section A9 began at ~38° W and continued along the 19° S parallel until ~8° E. Samples were collected for TCO<sub>2</sub> from 28 stations along the 19th parallel and at 3 diversions north and south of the 19th parallel. The latter stations were occupied to track bottom water movements. Measurements made along WOCE Section A9 included pressure, temperature, salinity, and oxygen measured by conductivity, temperature and depth sensor (CTD) as well as bottle salinity, oxygen, phosphate, nitrate, nitrite, silicate, CFC-113, CCl<sub>4</sub>, CFC-12, CFC-11, TCO<sub>2</sub>, TALK, and pCO<sub>2</sub> measured at 20°C. Replicate samples from ten Niskin bottles at four stations were also collected for later shore-based reference analyses of TCO<sub>2</sub> and TALK by vacuum extraction and manometry in the laboratory of Dr. Charles Keeling, Scripps Institution of Oceanography (SIO).

NDP-052  
(WDC-A)



**Total Carbon Dioxide, Hydrographic, and Nitrate Measurements in the Southwest Pacific During Austral Autumn, 1990: Results from NOAA/PMEL CGC-90 Cruise**

(August 1995)

[http://cdiac.esd.ornl.gov/oceans/ndp\\_052/ndp052.html](http://cdiac.esd.ornl.gov/oceans/ndp_052/ndp052.html)

**M. F. Lamb, R. A. Feely, L. Moore, and D. K. Atwood (contributors)**

This document presents the procedures and methods used to obtain total carbon dioxide (TCO<sub>2</sub>), hydrographic, and nitrate data during the NOAA/PMEL research vessel (R/V) *Malcolm Baldrige* CGC-90 Cruise. Data were collected along two legs; sampling for Leg 1 began along 170° W from 15° S to 60° S, then angled northwest toward New Zealand across the Western Boundary Current. Leg 2 included a reoccupation of some stations between 30° S and 15° S on 170° W and measurements from 15° S to 5° N along 170° W. Along the cruise track 68 CTD stations were occupied for collection of chemical and hydrographic data. The data report summarizes the TCO<sub>2</sub>, salinity, temperature, and nitrate measurements from 63 stations. In addition, potential density and potential temperature were calculated from the measured variables.

**Rattlesnake Mountain Observatory (46.4° N, 119.6° W)  
Multispectral Optical Depth Measurements: 1979–1994**

(April 1996)

<http://cdiac.esd.ornl.gov/ndps/ndp053.html>**NDP-053**

(WDC-A)

**N. R. Larson, J. J. Michalsky, and B. A. LeBaron (contributors)**

Surface measurements of solar irradiance of the atmosphere were made by a multipurpose computer-controlled scanning photometer at the Rattlesnake Mountain Observatory in eastern Washington. The observatory is located at 46.4° N, 119.6° W at an elevation of 1088 m above mean sea level. The photometer measures the attenuation of direct solar radiation for different wavelengths with 12 filters. Five of these filters (i.e., at 428 nm, 486 nm, 535 nm, 785 nm, and 1010 nm, with respective half-power widths of 2, 2, 3, 18, and 28 nm) are suitable for monitoring variations in the total optical depth of the atmosphere.

**Carbon Dioxide, Hydrographic, and Chemical Data Obtained in the  
Central South Pacific Ocean (WOCE Sections P17S and P16S)  
During the TUNES-2 Expedition of the R/V *Thomas Washington*  
July–August, 1991**

(April 1996)

[http://cdiac.esd.ornl.gov/oceans/ndp\\_054/ndp054.html](http://cdiac.esd.ornl.gov/oceans/ndp_054/ndp054.html)**NDP-054**

(WDC-A)

**T. Takahashi, G. Goddard, S. Rubin, D. W. Chipman, S. C. Sutherland, and C. Goyet  
(contributors)**

This data documentation discusses the procedures and methods used to obtain data on total carbon dioxide (TCO<sub>2</sub>), total alkalinity (TALK), and discrete partial pressure of CO<sub>2</sub>, (pCO<sub>2</sub>) during the Research Vessel (R/V) *Thomas Washington* TUNES Leg 2 Expedition in the central South Pacific Ocean. Conducted as part of the World Ocean Circulation Experiment (WOCE), the cruise began in Papeete, Tahiti, French Polynesia, on July 16, 1991, and returned to Papeete on August 25, 1991. WOCE zonal Sections P17S along 135° W and P16S along 150° W were completed during the 40-day expedition. A total of 97 hydrographic stations were occupied. Hydrographic and chemical measurements made along WOCE Sections P17S and P16S included pressure, temperature, salinity, and oxygen measured by conductivity, temperature and depth sensor as well as bottle salinity, oxygen, phosphate, nitrate, nitrite, silicate, CFC-12, CFC-11, TCO<sub>2</sub>, TALK, and pCO<sub>2</sub> measured at 20°C.

**Tropical Africa: Land Use, Biomass, and Carbon Estimates for  
1980–With a Method for Extending the Data to 1990 and Beyond**

(August 1996)

<http://cdiac.esd.ornl.gov/ndps/ndp055.html>**NDP-055**

(WDC-A)

**S. Brown and G. Gaston (contributors)**

This document describes the contents of a digital database containing maximum potential aboveground biomass, land use, and estimated biomass and carbon data for 1980. In addition it describes a methodology that may be used to extend this data set to 1990 and beyond on the basis of population and land cover data. The biomass data and carbon estimates pertain to woody



vegetation in Tropical Africa. These data were collected to reduce the uncertainty associated with the possible magnitude of historical releases of carbon from land-use change. Tropical Africa is defined here as encompassing  $22.7 \times 10^6$  km<sup>2</sup> of the earth's land surface and includes those countries that are located for the most part in Tropical Africa. The report also contains information about maximum potential biomass and land cover but not biomass or carbon estimates. This report also contains countries bordering the Mediterranean Sea and in southern Africa (i.e., Egypt, Libya, Tunisia, Algeria, Morocco, South Africa, Lesotho, Swaziland, and Western Sahara).

The database was developed through the use of the GRID module in the ARC/INFO<sup>TM</sup> geographic information system. Source data were obtained from the Food and Agriculture Organization (FAO), the U.S. National Geophysical Data Center, and a limited number of biomass-carbon density case studies. These data were used to derive the maximum potential and actual (ca. 1980) aboveground biomass values at regional and country levels. The land-use data provided were derived from a vegetation map originally produced for the FAO by the International Institute of Vegetation Mapping, Toulouse, France.

Analyses conducted with this database found that 18% of Tropical Africa was in closed forest and 36% was in open forest in 1980. These forested lands contained over  $138 \times 10^9$  Mg of aboveground live biomass, equivalent to  $69 \times 10^9$  Mg of carbon. Closed forests and open forests had mean aboveground biomass values of 209 Mg/ha and 67 Mg/ha, respectively, in 1980. These values are down from maximum potential aboveground live biomass values of 296 Mg/ha for closed forest and 108 Mg/ha for open forest.

The 26 files consist of seven ARC/INFO<sup>TM</sup> export files, eight flat ASCII data files, ten FORTRAN 77 and SAS<sup>®</sup> data retrieval files, and one descriptive file that explains the contents and format of each data file. The documentation contains information on the methods used in calculating each variable; detailed descriptions of file contents and formats; and a discussion of the sources, restrictions, and limitations of the data.

**NDP-056**  
(WDC-A)



**Carbon Dioxide, Hydrographic, and Chemical Data Obtained During the R/V *Meteor* Cruise 18/1 in the North Atlantic Ocean (WOCE Section A1E, September 1991)**

(October 1996)

[http://cdiac.esd.ornl.gov/oceans/ndp\\_056/ndp056.html](http://cdiac.esd.ornl.gov/oceans/ndp_056/ndp056.html)

**K. M. Johnson, B. Schneider, L. Mintrop, and D. W. R. Wallace (contributors)**

This data package discusses the procedures and methods used to measure total carbon dioxide (TCO<sub>2</sub>) and total alkalinity (TALK) at hydrographic stations, as well as underway partial pressure of CO<sub>2</sub> (pCO<sub>2</sub>) measured during the R/V *Meteor* Cruise 18/1 in the North Atlantic Ocean (Section A1E). Conducted as part of the World Ocean Circulation Experiment (WOCE) and the German North Atlantic Overturning Rate Determination expedition, the cruise began in Reykjavik, Iceland, on September 2, 1991, and ended in Hamburg, Germany, on September 25, 1991, after 24 days at sea.

WOCE Zonal Section A1E began at 60° N and 30°30' W (southeast of Greenland) and continued southeast with a closely spaced series of hydrocasts to 52°20' N and 14°15' W (Porcupine Shelves). Measurements made along WOCE Section A1E included pressure, temperature, salinity, and oxygen measured by a conductivity, temperature, and depth (CTD) sensor; bottle salinity; oxygen; phosphate; nitrate; nitrite; silicate; TCO<sub>2</sub>; TALK; and underway

pCO<sub>2</sub>. A total of 61 CTD casts were made, including 59 bottle casts and 2 calibration stations. Replicate samples from seven Niskin bottles at five stations were also collected for later shore-based reference analyses of TCO<sub>2</sub> (by vacuum extraction and manometry) and TALK in the laboratory of Dr. Charles D. Keeling, Scripps Institution of Oceanography; these results are also included in this report. TCO<sub>2</sub> was measured by using an automated sample processor to extract CO<sub>2</sub> from seawater samples and a coulometer to detect the extracted gas. The precision and accuracy of the system was  $\pm 1.60$   $\mu\text{mol/kg}$ . Samples collected for TALK were measured by means of standard potentiometric techniques; precision was  $\pm 2.0$   $\mu\text{mol/kg}$ . Underway pCO<sub>2</sub> was measured by infrared photometry; precision was  $\pm 2$   $\mu\text{atm}$ .

The NDP consists of three oceanographic data files, three FORTRAN 77 data retrieval routine files, and an ndp-056.doc file, which describes the contents and format of all files as well as the procedures and methods used to obtain the data.

### **Carbon-14 Measurements in Atmospheric CO<sub>2</sub> from Northern and Southern Hemisphere Sites, 1962–1993**

(November 1996)

<http://cdiac.esd.ornl.gov/epubs/ndp/ndp057/ndp057.htm>

**R. Nydal and K. Lövseth (contributors)**

In the 1960s, thermonuclear bomb tests released significant pulses of radioactive <sup>14</sup>C into the atmosphere. This major perturbation allowed scientists to study the dynamics of the global carbon cycle by measuring and observing rates of isotopic exchange. The Radiological Dating Laboratory at the Norwegian Institute of Technology performed <sup>14</sup>C measurements in atmospheric CO<sub>2</sub> from 1962 to 1993 at a network of ground stations in the Northern and Southern hemispheres. These measurements were supplemented during 1965 with high-altitude (9–12.6 km) air samples collected by aircraft from the Norwegian Air Force. The resulting database, coupled with other <sup>14</sup>C data sets, provides a greater understanding of the dynamic carbon reservoir and a crude picture of anomalous sources and sinks at various geographical latitudes. This database is outstanding for its inclusion of early <sup>14</sup>C measurements, broad spatial coverage of sampling, consistency of sampling method, and  $\Delta^{14}\text{C}$  calculation results corrected for isotopic fractionation and radioactive decay. This database replaces previous versions published by the authors and the Radiological Dating Laboratory.

Fourteen stations spanning latitudes from Spitsbergen (78° N) to Madagascar (21° S) were used for sampling during the lifetime of the Norwegian program. Some of the stations have data for only a brief period, while others have measurements through 1993. Sampling stations subject to local industrial CO<sub>2</sub> contamination were avoided. The sites have sufficient separation to describe the latitudinal distribution of <sup>14</sup>C in atmospheric models. The sampling procedure for all the surface (10–2400 m asl) <sup>14</sup>C measurements in this database consisted of quantitative absorption of atmospheric CO<sub>2</sub> in carbonate-free 0.5 N NaOH solution. The <sup>14</sup>C measurements were made in a CO<sub>2</sub> proportional counter and calculated ( $\delta^{14}\text{C}$ ) as per mille excess above the normal <sup>14</sup>C level defined by the U.S. National Institute of Standards and Technology (NIST). Atmospheric <sup>14</sup>C content is finally expressed as  $\Delta^{14}\text{C}$ , which is the relative deviation of the measured <sup>14</sup>C activity from the NIST oxalic acid standard activity after correction for isotopic fractionation and radioactive decay related to age. The data are organized by sampling station, and each record of the database contains the sampling dates; values for <sup>14</sup>C excess ( $\delta^{14}\text{C}$ ) relative to the NIST standard, fractionation <sup>13</sup>C ( $\delta^{13}\text{C}$ ) relative to the Pee Dee Belemnite (PDB) standard, and corrected <sup>14</sup>C ( $\Delta^{14}\text{C}$ ) excess; and the standard deviation for  $\Delta^{14}\text{C}$ . The  $\Delta^{14}\text{C}$  calculation results presented here are thus corrected for isotopic fractionation and radioactive decay, and they constitute the final product of a research effort that has spanned three decades.

**NDP-057**  
(WDC-A)



The  $\Delta^{14}\text{C}$  station data show a sharp increase in tropospheric radiocarbon levels in the early 1960s and then a decline after the majority of nuclear tests came to an end on August 5, 1963 (Test Ban Treaty). The sharp peaks in tropospheric radiocarbon in the early 1960s are more pronounced in the Northern Hemisphere, reflecting the location of most atomic weapons tests. The measurements show large seasonal variations in the  $\Delta^{14}\text{C}$  level during the early 1960s mainly as a result of springtime transport of bomb  $^{14}\text{C}$  from the stratosphere. During the 1970s, the seasonal variations are smaller and result partly from seasonal variations in  $\text{CO}_2$  from fossil-fuel emissions. The rate of decrease of atmospheric radiocarbon provides a check on the exchange constants of the atmosphere and ocean.

The Nydal and Lövseth atmospheric  $^{14}\text{C}$  database comprises 21 data files totaling 0.2 MB in size. The report describes the sampling methods and analysis. In addition, the report includes a complete discussion of CDIAC's data-processing efforts, the contents and format of the data files, and a reprint of a related Nydal and Lövseth journal article.

**NDP-057A**  
(WDC-A)



**Carbon-14 Measurements in Surface Water  $\text{CO}_2$  from the Atlantic, Indian, and Pacific Oceans, 1965–1994**  
(March 1998)

<http://cdiac.esd.ornl.gov/epubs/ndp/ndp057a/ndp57a.html>

**R. Nydal (contributor)**

In the 1960s, thermonuclear bomb tests released significant pulses of radioactive carbon-14 ( $^{14}\text{C}$ ) into the atmosphere. These major perturbations allowed scientists to study the dynamics of the global carbon cycle by calculating rates of isotopic exchange between the atmosphere and ocean waters. The Radiological Dating Laboratory at the Norwegian Institute of Technology performed  $^{14}\text{C}$  measurements of atmospheric  $\text{CO}_2$  from 1962 to 1993 at a network of ground stations in the northern and southern hemispheres; in addition it performed  $^{14}\text{C}$  measurements at high-altitude (between 9–12.6 km) during 1965 (Nydal and Lövseth, 1983, 1996). The Norwegian Radiological Dating Laboratory performed similar measurements on seawater samples collected at the ocean surface from 1965 through 1994.

The data from NDP-057A, coupled with other  $^{14}\text{C}$  data sets, can lead to a greater understanding of the dynamic carbon reservoir and lead to a crude picture of anomalous sources and sinks at different geographical latitudes. The database is outstanding for its inclusion of early  $^{14}\text{C}$  measurements, broad spatial coverage of sampling, relative consistency of sampling methods, and  $\Delta^{14}\text{C}$  calculation results corrected for isotopic fractionation and radioactive decay. This database replaces previous versions published by the author and the Radiological Dating Laboratory.

**NDP-058**  
(WDC-A)

**Geographic Patterns of Carbon Dioxide Emissions from Fossil-Fuel Burning, Hydraulic Cement Production, and Gas Flaring on a One Degree by One Degree Grid Cell Basis: 1950 to 1990**  
(February 1997)

<http://cdiac.esd.ornl.gov/epubs/ndp/ndp058/ndp058.html>

**R. J. Andres, G. Marland, I. Fung, and E. Matthews (contributors)**

This data package presents data sets recording  $1^\circ$  latitude by  $1^\circ$  longitude  $\text{CO}_2$  emissions in units of thousand metric tons of carbon per year from anthropogenic sources for 1950, 1960,

1970, 1980, and 1990. Detailed geographic information on CO<sub>2</sub> emissions can be critical in understanding the pattern of the atmospheric and biospheric response to these emissions. Global, regional, and national annual estimates for 1950 through 1992 were published previously.

Those national, annual CO<sub>2</sub> emission estimates were based on statistics about fossil-fuel burning, cement manufacturing and gas flaring in oil fields as well as energy production, consumption, and trade data, using the methods of Marland and Rotty (1984). The national annual estimates were combined with gridded 1° data on political units and 1984 human populations to create the new gridded CO<sub>2</sub> emission data sets. The same population distribution was used for each of the years as proxy for the emission distribution within each country. The implied assumption for that procedure was that per capita energy use and fuel mixes are uniform over a political unit. The consequence of this first-order procedure is that the spatial changes observed over time are solely due to changes in national energy consumption and nation-based fuel mix. Increases in emissions over time are apparent for most areas; for example, from 1980 and 1990, a 63% increase in CO<sub>2</sub> emissions (based on 1980 emissions) occurred in mainland China and a 95% increase in India. However, actual decreases from 1980 to 1990 occurred in Western Europe: 30% in Sweden, 27% in France, and 23% in Belgium. Latitudinal summations of emissions show a slow southerly shift (in the Northern Hemisphere) in the bulk of emissions over time. The large increases, from 1950 to 1990, in China's and India's contributions to anthropogenic CO<sub>2</sub> emissions compared to those by the United States are, for example, very apparent at the latitudinal band around 25.5° North.

## **Carbon Dioxide Emission Estimates from Fossil-Fuel Burning, Hydraulic Cement Production, and Gas Flaring for 1995 on a One Degree Grid Cell Basis**

(March 1998)

<http://cdiac.esd.ornl.gov/ndps/ndp058a.html>

NDP-058A



### **A. L. Brenkert**

This data package presents the gridded (one degree latitude by one degree longitude) summed emissions from fossil-fuel burning, hydraulic cement production and gas flaring for 1995. Analogous to the data presented in NDP-058 (which includes estimates for 1950, 1960, 1970, 1980, and 1990), national emission estimates from the 1995 United Nations Energy Statistics Database, hydraulic cement production estimates from the U.S. Department of Interior's Bureau of Mines, and supplemental data on gas flaring from the U.S. Department of Energy's Energy Information Administration were processed by Marland et al. following the methods of Marland and Rotty. The only change in the methodology used to calculate the national CO<sub>2</sub> emission estimates for 1995 was the implementation of separate carbon coefficients for soft and hard coal; the emissions estimates in NDP058 were calculated using a single carbon coefficient to characterize the carbon content of all coals. To distribute the national emission estimates from 1995 within each country, the population data base developed by Li and documented by CDIAC (DB1016) was used as proxy.

Previously, Andres had used a 1984 human population data set (Goddard Institute of Space Studies, Lerner et al., 1988) as proxy for gridding the 1950 through 1990 emission estimates within countries. The structure of the gridded 1995 emission data file differs, consequently, from the 1950-1990 gridded emission files in that individual grid cells may have been partitioned into more than one country analogous to Li's population data base. A country's representation in a grid cell is quantified by the percentage of that country's land area in a particular grid cell and identified by its United Nations identification code. The percentages and United Nations identification codes were used to allocate the national CO<sub>2</sub> emissions estimates to the grid cells.

Only those grid cells with a United Nations identification code, population estimate and carbon emission estimate are listed in the data file. Grid cells representing more than one country are repeated for each country represented. Note that to calculate national estimates from the data file, one has to sum by United Nations identification code. To calculate emissions for each grid cell or by latitude one has to sum by grid cell (latitude and longitude), or by latitude, respectively. A number of manipulations of Li's population database were necessary (and documented) to properly distribute the national 1995 CO<sub>2</sub> emission estimates over each country's grid cells.

### **NDP-059 Daily Snow Depth Measurements from 195 Stations in the United States**

(March 1997)

<http://cdiac.esd.ornl.gov/ndps/ndp059.html>

**D. R. Easterling, P. Jamason, D. Bowman, P. Y. Hughes, and E. H. Mason (contributors)**

This document describes a database containing daily measurements of snow depth at 195 National Weather Service (NWS) first-order climatological stations in the United States. The data have been assembled and made available by the National Climatic Data Center (NCDC) in Asheville, North Carolina. The 195 stations encompass 388 unique sampling locations in 48 of the 50 states; no observations from Delaware or Hawaii are included in the database. Station selection criteria emphasized the quality and length of station records while seeking to provide a network with good geographic coverage. Snow depth at the 388 locations was measured once per day on ground open to the sky. The daily snow depth is the total depth of the snow on the ground at measurement time. The time period covered by the database is 1893–1992; however, not all station records encompass the complete period. While a station record ideally should contain daily data for at least the seven *winter* months (January through April and October through December), not all stations have complete records. Each logical record in the snow depth database contains one station's daily data values for a period of one month, including data source, measurement, and quality flags. The snow depth data have undergone extensive manual and automated quality assurance checks by NCDC and CDIAC. These reviews involved examining the data for completeness, reasonableness, and accuracy and included comparison of some data records with records in NCDC's *Summary of the Day—First Order* on-line database. Since the snow depth measurements have been taken at NWS first-order stations that have long periods of record, they should prove useful in monitoring climate change.

### **NDP-060** (WDC-A)



### **Carbon Dioxide, Hydrographic, and Chemical Data Obtained During the R/V *Thomas Washington* Cruise TUNES-3 in the Equatorial Pacific Ocean (WOCE Section P16C)**

(December 1996)

[http://cdiac.esd.ornl.gov/oceans/ndp\\_060/ndp060.html](http://cdiac.esd.ornl.gov/oceans/ndp_060/ndp060.html)

**C. Goyet, P. R. Guenther, C. D. Keeling, and L. D. Talley (contributors)**

This data package discusses the procedures and methods used to obtain total carbon dioxide (TCO<sub>2</sub>), total alkalinity (TALK), hydrographic, and chemical data during the Research Vessel *Thomas Washington* Expedition TUNES-3 in the Equatorial Pacific Ocean (Section P16C).

Conducted as a part of the World Ocean Circulation Experiment (WOCE), the cruise began in Papeete, Tahiti, on August 31, 1991, and finished in Honolulu, Hawaii, on October 1, 1991.

WOCE Meridional Section P16C along 150° W and between 18° S and 19° N was completed during the 31-day expedition. All 105 hydrographic and 8 large-volume stations were completed to the full water column depth. Station spacing was 30 nautical miles (nm), except between 3° N and 3° S, where it was 10 nm. Twenty-five bio-optics stations were sampled for the Joint Global Ocean Flux Study, and at 21 stations CO<sub>2</sub> measurements were provided for DOE's Global Change Research Program. Hydrographic and chemical measurements made along WOCE Section P16C included pressure, temperature, salinity, and oxygen measured by conductivity, temperature, and depth sensor as well as bottle salinity, oxygen, phosphate, nitrate, nitrite, silicate, chlorofluorocarbon (CFC)-11, CFC-12, TCO<sub>2</sub>, and TALK. In addition, potential temperatures were calculated from the measured variables.

### **Effects of CO<sub>2</sub> and Nitrogen Fertilization on Growth and Nutrient Content of Juvenile Ponderosa Pine**

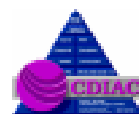
(March 1998)

<http://cdiac.esd.ornl.gov/epubs/ndp/ndp061a/ndp061a.htm>

**D. W. Johnson, J. T. Ball, and R. F. Walker (contributors)**

This data set presents measured values of plant diameter and height, biomass of plant components, and nutrient (carbon, nitrogen, phosphorus, sulfur, potassium, calcium, magnesium, boron, copper, iron, manganese, and zinc) concentrations from a study of the effects of CO<sub>2</sub> and nitrogen fertilization on ponderosa pine (*Pinus ponderosa* Dougl. ex Laws.) conducted in open-top chambers in Placerville, California, from 1991 through 1996. This data set contains values from 1991 through 1993.

**NDP-061A**



### **Carbon Dioxide, Hydrographic, and Chemical Data Obtained During the R/V *Thomas Washington* Cruise TUNES-1 in the Equatorial Pacific Ocean (WOCE Section P17C)**

(April 1997)

[http://cdiac.esd.ornl.gov/oceans/ndp\\_062/ndp062.html](http://cdiac.esd.ornl.gov/oceans/ndp_062/ndp062.html)

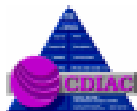
**C. Goyet, R. M. Key, K. F. Sullivan, and M. Tsuchiya (contributors)**

On May 31, 1991, R/V *Thomas Washington* departed San Diego for the first of its three consecutive TUNES series WOCE legs. Stations were numbered consecutively from the beginning of the R/V *Thomas Washington* work on Leg 1, TUNES-1 Expedition, starting off the coast of California and ending in Papeete, Tahiti, on July 11, 1991.

During the 42-day expedition, 123 hydrographic stations (including 9 large-volume stations) were completed. All stations were sampled to the bottom and consisted of a rosette/CTD cast. Basic station spacing was 30 nautical miles, closing to 10 nautical miles between 3° S and 3° N. Sampling was performed primarily with a 36-place double-ring rosette of 10-L bottles and mounted CTD and transmissometer. CTD data consisted of pressure, temperature, conductivity, oxygen, and transmissometry. Water samples were collected for analyses of salt, oxygen, silicate, phosphate, nitrate, and nitrite at all stations and for CFC-11, CFC-12, helium, tritium,  $\Delta^{14}\text{C}$ , TCO<sub>2</sub>, and TALK at selected stations. Underway measurements included ADCP, surface temperature, and surface water and atmospheric pCO<sub>2</sub> and N<sub>2</sub>O.

**NDP-062  
(WDC-A)**



**NDP-063**  
(WDC-A)**Carbon Dioxide, Hydrographic, and Chemical Data Obtained During the R/V *Akademik Ioffe* Cruise in the South Pacific Ocean (WOCE Section S4P, February–April 1992)**

(April 1997)

[http://cdiac.esd.ornl.gov/oceans/ndp\\_063/ndp063.html](http://cdiac.esd.ornl.gov/oceans/ndp_063/ndp063.html)**D. W. Chipman, T. Takahashi, S. Rubin, S. C. Sutherland, and M. H. Koshlyakov**  
(contributors)

The WOCE S4P Expedition aboard the Russian R/V *Akademik Ioffe* started in Montevideo, Uruguay, on February 14, 1992, and ended in Wellington, New Zealand, on April 6, 1992. WOCE Section S4P, located along ~67° S between 73° W and 172° E, was completed during the 51-day expedition. One hundred and thirteen hydrographic stations were occupied. Hydrographic and chemical measurements made along WOCE Section S4P included pressure, temperature, salinity, and oxygen measured by a conductivity, temperature, and depth sensor; bottle salinity; bottle oxygen; phosphate; nitrate; nitrite, silicate; TCO<sub>2</sub>; and pCO<sub>2</sub> measured at 4° C.

The TCO<sub>2</sub> concentration in ~1290 seawater samples was determined with a coulometric analysis system; the pCO<sub>2</sub> in ~1270 water samples was determined with an equilibrator-gas chromatograph system. In addition, 172 coulometric measurements for the Certified Reference Material (batch no. 7) were made at sea for 62 bottles and yielded a mean value of 1927.5 ± 1.8 μmol/kg. This mean value agrees within one standard deviation of the 1926.6 ± 1.7 μmol/kg (N = 6) value determined with the manometer of Keeling at Scripps Institution of Oceanography. The TCO<sub>2</sub> values listed in this report have not been corrected to this difference.

**NDP-064**  
(WDC-A)**Surface Water and Atmospheric Underway Carbon Data Obtained During the World Ocean Circulation Experiment Indian Ocean Survey Cruises (R/V *Knorr*, December 1994–January 1996)**

(November 1997)

[http://cdiac.esd.ornl.gov/oceans/ndp\\_064/ndp064.html](http://cdiac.esd.ornl.gov/oceans/ndp_064/ndp064.html)**C. L. Sabine and R. M. Key** (contributors)

January 1996 marked the completion of a 14-month, 92,000 km-long hydrographic survey of the Indian Ocean by the World Ocean Circulation Experiment (WOCE) Hydrographic Programme (WHP). In addition to the standard WOCE hydrographic parameters measured on these cruises, discrete and underway carbon measurements were made by members of the CO<sub>2</sub> survey team. The survey team is a part of the Joint Global Ocean Flux Study (JGOFS) supported by the U.S. Department of Energy to make carbon system measurements on the WOCE global survey cruises. As part of the survey team, the Princeton University Ocean Tracers Laboratory constructed an automated system for underway analysis of surface water and marine air CO<sub>2</sub> concentrations (hereafter referred to as the underway system). With the help of the other science team members, the underway system was run aboard the R/V *Knorr* during all nine legs of the Indian Ocean survey. This report provides a description of the data files, the underway system, as well as a brief explanation of when and where the data were collected, and any problems encountered with the system.

**Carbon Dioxide, Hydrographic, and Chemical Data Obtained in the South Pacific Ocean (WOCE Sections P16A/P17A, P17E/P19S, and P19C, R/V *Knorr*, October 1992–April 1993**

(June 1998)

[http://cdiac.esd.ornl.gov/oceans/ndp\\_065/ndp065.html](http://cdiac.esd.ornl.gov/oceans/ndp_065/ndp065.html)**T. Takahashi, J. G. Goddard, S. Rubin, D. W. Chipman, S. C. Sutherland, J. L. Reid, J. H. Swift, L. D. Talley (contributors)**

This data documentation discusses the procedures and methods used to measure total carbon dioxide ( $\text{TCO}_2$ ) and discrete partial pressure of  $\text{CO}_2$  ( $\text{pCO}_2$ ) during the three Research Vessel (R/V) *Knorr* Expeditions in the South Pacific Ocean. Conducted as part of the World Ocean Circulation Experiment (WOCE), the first cruise (WOCE Section P16A/P17A) began in Papeete, Tahiti, French Polynesia, on October 6, 1992, and returned to Papeete on November 25, 1992. The second cruise (WOCE Section P17E/P19S) began in Papeete on December 4, 1992, and finished in Punta Arenas, Chile, on January 22, 1993. The third expedition (WOCE Section P19C) started in Punta Arenas, on February 22 and finished in Panama City, Panama, on April 13, 1993. A total of 422 hydrographic stations were occupied during the three expeditions. Hydrographic and chemical measurements made along WOCE Sections P16A/P17A, P17E/P19S, and P19C included pressure, temperature, salinity, and oxygen [measured by conductivity, temperature, and depth (CTD) sensor], as well as bottle measurements of salinity, oxygen, phosphate, nitrate, nitrite, silicate, chlorofluorocarbon (CFC)-11, CFC-12,  $\text{TCO}_2$ , and  $\text{pCO}_2$  measured at 4° and 20° C. In addition, potential temperatures were calculated from the measured variables.

The  $\text{TCO}_2$  concentration in 4419 seawater samples was determined with a coulometric analysis system; the  $\text{pCO}_2$  in 4419 discrete water samples was determined with an equilibrator/gas chromatograph system. At 114 stations, complete vertical profiles from the surface to the ocean floor were obtained, whereas at the remainder of stations only surface mixed layer samples were taken. In addition, 758 coulometric measurements for the Certified Reference Material (batches 12 and 13) were made. The shipboard analyses agreed with the Scripps Institution of Oceanography (SIO) manometric values within 1.2  $\mu\text{mol/kg}$ . The overall precision of  $\text{TCO}_2$  measurements is estimated to be  $\sim\pm 2 \mu\text{mol/kg}$ . The shipboard  $\text{TCO}_2$  measurements listed in this data report have not been corrected for the differences with the SIO manometric values.

The NDP consists of six oceanographic data files, two FORTRAN 77 data retrieval routine files, a documentation file, and the printed report, which describes the contents and format of all files and the procedures and methods used to obtain the data.

**Carbon Dioxide, Hydrographic, and Chemical Data Obtained During the R/V *Meteor* Cruise 22/5 in the South Atlantic Ocean (WOCE Section A10, December 1992-January 1993)**

(December 1998)

[http://cdiac.esd.ornl.gov/oceans/ndp\\_066/ndp066.html](http://cdiac.esd.ornl.gov/oceans/ndp_066/ndp066.html)**Johnson, K. M., B. Schneider, L. Mintrop, D. W. R. Wallace, and A. Kozyr**

This data documentation discusses the procedures and methods used to measure total carbon dioxide ( $\text{TCO}_2$ ) and total alkalinity (TALK) at hydrographic stations, as well as the underway partial pressure of  $\text{CO}_2$  ( $\text{pCO}_2$ ) during the R/V *Meteor* Cruise 22/5 in the South Atlantic Ocean (Section A10). Conducted as part of the World Ocean Circulation Experiment (WOCE), the cruise began in Rio de Janeiro on December 27, 1992, and ended after 36

**NDP-065**  
(WDC-A)**NDP-066**  
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days at sea in Capetown, South Africa, on January 31, 1993. Measurements made along WOCE Section A10 included pressure, temperature, and salinity [measured by conductivity, temperature, and depth (CTD) sensor], bottle salinity, bottle oxygen, phosphate, nitrate, nitrite, silicate, chlorofluorocarbons (CFC-11, CFC-12), TCO<sub>2</sub>, TALK, and underway pCO<sub>2</sub>.

The TCO<sub>2</sub> was measured by using two Single-Operator Multiparameter Metabolic Analyzers (SOMMAs) for extracting CO<sub>2</sub> from seawater samples that were coupled to a coulometer for detection of the extracted CO<sub>2</sub>. The overall precision and accuracy of the analyses was ±1.9 μmol/kg. Samples collected for TALK were measured by potentiometric titration; precision was ±2.0 μmol/kg. Underway pCO<sub>2</sub> was measured by infrared photometry with a precision of ±2.0 μatm. The work aboard the R/V *Meteor* was supported by the U.S. Department of Energy under contract DE-ACO<sub>2</sub>-76CH00016, and the Bundesministerium für Forschung und Technologie through grants 03F0545A and MFG-099/1.

The R/V *Meteor* Cruise 22/5 data set is available free of charge as a numeric data package (NDP) from the Carbon Dioxide Information Analysis Center. The NDP consists of three oceanographic data files, three FORTRAN 77 data-retrieval routines, a documentation file, and this printed documentation, which describes the contents and format of all files as well as the procedures and methods used to obtain the data. Instructions on how to access the data are provided.

**NDP-067**  
(WDC-A)



**The International Intercomparison Exercise of Underway *f*CO<sub>2</sub> Systems During the R/V *Meteor* Cruise 36/1 in the North Atlantic Ocean**

(March 1999)

[http://cdiac.esd.ornl.gov/oceans/ndp\\_067/ndp067.html](http://cdiac.esd.ornl.gov/oceans/ndp_067/ndp067.html)

**Koertzinger, A., L. Mintrop, J. C. Duinker, K. Johnson, C. Neill, D. W. R. Wallace, B. Tilbrook, P. Towler, H. Inoue, M. Ishii, G. Shaffer, R. Torres, E. Ohtaki, E. Yamashita, A. Poisson, C. Brunet, B. Schauer, C. Goyet, G. Eiseid, and A. Kozyr**

Measurements of the fugacity of carbon dioxide (*f*CO<sub>2</sub>) in surface seawater are an important part of studies of the global carbon cycle and its anthropogenic perturbation. An important step toward the thorough interpretation of the vast amount of available *f*CO<sub>2</sub> data is the establishment of a database system that would make such measurements more widely available for use in understanding the basin- and global-scale distribution of *f*CO<sub>2</sub> and its influence on the oceanic uptake of anthropogenic CO<sub>2</sub>. Such an effort, however, is based on knowledge of the comparability of data sets from different laboratories. Currently, however, there is not much known about this subject. In the light of the aforementioned situation, an International Intercomparison Exercise of Underway *f*CO<sub>2</sub> Systems was proposed and carried out by the Institut fuer Meereskunde Kiel (IfMK) (Institute of Marine Research at the University of Kiel), Kiel, Germany, during the R/V *Meteor* Cruise 36/1 from Hamilton, Bermuda, to Las Palmas, Gran Canaria, Spain. Nine groups from six countries (Australia, Denmark, Germany, France, Japan, and the United States) participated in this ambitious exercise, bringing together 15 participants with 7 underway *f*CO<sub>2</sub> systems, 1 discrete *f*CO<sub>2</sub> system, and 2 underway pH systems, as well as discrete systems for alkalinity and total dissolved inorganic carbon. This report presents only the results of the underway measurements of *f*CO<sub>2</sub>.

The main idea of the exercise was to compare surface seawater *f*CO<sub>2</sub> synchronously measured by all participating instruments under identical conditions. This synchronicity was accomplished by providing the infrastructure during the exercise, such as a common seawater

and calibration gas supply. Another important issue was checks of the performance of the calibration procedures for CO<sub>2</sub> and of all equilibrator temperature sensors. Furthermore a common procedure for the calculation of final *f*CO<sub>2</sub> was applied to all data sets. All these measures were taken in order to reduce the largest possible amount of controllable sources of error.

In this report we will demonstrate that the results of three of the seven underway systems agreed to within 2 μatm throughout the cruise. This was not only the case for seawater *f*CO<sub>2</sub> measurements but also for measurements of the μatmospheric mole fraction of CO<sub>2</sub> (*x*CO<sub>2</sub>). One system was in good agreement (+/-2 μatm) for most of the time but showed a considerable positive offset of up to 9 μatm for about 40 h. However, it was found that significant offsets of up to 10 μatm occurred in underway *f*CO<sub>2</sub> measurements for three systems under typical and identical field work conditions. Although at least in one case this may be a consequence of a technical failure, it is an indication of significant systematic differences in other cases. Finally, the discrete *f*CO<sub>2</sub> system measurements agreed within its nominal accuracy of 1% with the three most consistent underway *f*CO<sub>2</sub> systems data sets.

On the basis of a detailed comparison and evaluation of this large intercomparison data set we try to come up with general conclusions and recommendations for underway *f*CO<sub>2</sub> work. These may serve as background information for a successful preparation of a coherent database of surface ocean *f*CO<sub>2</sub> values. The results of this exercise certainly underline the need to address carefully the important issue of the inter-laboratory comparability of *f*CO<sub>2</sub> data.

**The IEA/ORAU Long-Term Global Energy-CO<sub>2</sub> Model: Personal  
Computer Version A84PC  
(1995)**

<http://cdiac.esd.ornl.gov/ndps/cmp002pc.html>

**CMP-002/PC  
(WDC-A)**

**J. A. Edmonds, and J. M. Reilly (contributors)**

The IBM® PC version of the Edmonds-Reilly model. It has the capability to calculate both CO<sub>2</sub> and CH<sub>4</sub> emission estimates by source and region. 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, synfuel costs, and the number of forecast periods may be interactively inspected and altered producing a variety of global and regional CO<sub>2</sub> and CH<sub>4</sub> emission scenarios for 1975 through 2100.

## Section D

### Databases Distributed by CDIAC

**The ALE/GAGE/AGAGE Network**

(revised and updated January 1999)

<http://cdiac.esd.ornl.gov/ndps/alegagage.html>**DB1001**

(WDC-A)

**R. Prinn, D. Cunnold, P. Fraser, R. Weiss, P. Simmonds, B. Miller,  
F. Alyea, and A. Crawford (contributors)**

In the ALE/GAGE/AGAGE global network program, continuous high frequency gas chromatographic measurements of two biogenic/anthropogenic gases (methane, CH<sub>4</sub>; nitrous oxide, N<sub>2</sub>O; and five anthropogenic gases (chlorofluorocarbons CFCl<sub>3</sub>, CF<sub>2</sub>Cl<sub>2</sub>, and CF<sub>2</sub>CICFCl<sub>2</sub>; methyl chloroform, CH<sub>3</sub>CCl<sub>3</sub>; carbon tetrachloride, CCl<sub>4</sub>) are carried out at globally distributed sites. The program, which began in 1978, is conveniently divided into three parts associated with three changes in instrumentation: the Atmospheric Lifetime Experiment (ALE), which utilized Hewlett Packard HP5840 gas chromatographs; the Global Atmospheric Gases Experiment (GAGE), which utilized HP5880 gas chromatographs; and the recently initiated Advanced GAGE (AGAGE). AGAGE uses a new fully automated system from the Scripps Institution of Oceanography containing a custom-designed sample module and HP5890 and Carle Instruments gas chromatographic components.

The current station locations are Cape Grim, Tasmania (41° S, 145° E), Point Matatula, American Samoa (14° S, 171° E), Ragged Point, Barbados (13° N, 59° W), and Mace Head, Ireland (53° N, 10° W). Stations also previously existed at Cape Meares, Oregon (45° N, 124° W), and Adrigole, Ireland (52° N, 10° W). The current Mace Head station replaced the Adrigole station and a station is planned at Trinidad Head, California (41° N, 124° W) to replace Cape Meares.

Presently, data from all three experiments are available. Data through March 1998 are now available for all five existing sites. All ALE and GAGE data have been recalculated according to the current AGAGE calibration standards, thus creating a unified ALE/GAGE/AGAGE data set based upon the same standards. Data have been calibrated to the standards as of September, 1998. *Please note that the AGAGE database has been completely re-computed (April 1998) to introduce a new and improved pollution analysis scheme and thus pollution designations may differ from previous versions of the data.* Individual measurements (generally made 4 times daily at each site for ALE, 12 times daily at each site for GAGE, and more than 30 times daily at each site for AGAGE) and monthly summary averages are provided for each site.

**ICRCCM Infrared (Clear-Sky) Line-by-Line Radiative Fluxes**

(January 1994)

<http://cdiac.esd.ornl.gov/ndps/db1002.html>**DB1002****A. Arking, B. Ridgway, T. Clough, M. Iacono, B. Fomin, A. Trotsenko, S. Freidenreich,  
and D. Schwarzkopf (contributors)**

The Intercomparison of Radiation Codes in Climate Models (ICRCCM) study was launched under the auspices of the World Meteorological Organization and with the support of the U.S. Department of Energy to document differences in results obtained with various radiation codes and radiation parameterizations in general circulation models (GCMs). ICRCCM produced benchmark, longwave, line-by-line (LBL) fluxes that may be compared against each other and against models of lower spectral resolution.

During ICRCCM, infrared fluxes and cooling rates for several standard model atmospheres with varying concentrations of water vapor, carbon dioxide, and ozone were calculated with LBL

methods at resolutions of  $0.01 \text{ cm}^{-1}$  or higher. For comparison with other models, values were summed for the IR spectrum and given at intervals of 5 or  $10 \text{ cm}^{-1}$ .

This archive contains fluxes for ICRCM-prescribed clear-sky cases. Radiative flux and cooling-rate profiles are given for specified atmospheric profiles for temperature, water vapor, and ozone—contains 328 files, including spectral summaries, formatted data files, and a variety of programs (i.e., C-shell scripts, FORTRAN codes, and IDL programs) to read, reformat, and display data. Collectively, these files require approximately 59 MB of disk space.

**DB1003      A Computer-Based Atlas of Global Instrumental Climate Data**  
(January 1994)  
<http://cdiac.esd.ornl.gov/ndps/db1003.html>

**R. S. Bradley, L. G. Ahern, and F. T. Keimig (contributors)**

Color-shaded and contoured images of global, gridded instrumental data have been produced as a computer-based atlas. Each image simultaneously depicts anomaly maps of surface temperature, sea-level pressure, 500-mbar geopotential heights, and percentages of reference-period precipitation. Monthly, seasonal, and annual composites are available in either cylindrical equidistant or northern and southern hemisphere polar projections. Temperature maps are available from 1854 to 1991, precipitation from 1851 to 1989, sea-level pressure from 1899 to 1991, and 500-mbar heights from 1946 to 1991. The source of data for the temperature images is Jones et al.'s global gridded temperature anomalies. The precipitation images were derived from Eischeid et al.'s global gridded precipitation percentages. Grids from the Data Support Section, National Center for Atmospheric Research (NCAR) were the sources for the sea-level-pressure and 500-mbar geopotential-height images. All images are in GIF files ( $1024 \times 822$  pixels, 256 colors) and can be displayed on many different computer platforms. Each annual subdirectory contains 141 images, each seasonal subdirectory contains 563 images, and each monthly subdirectory contains 1656 images. The entire atlas requires approximately 340 MB of disk space, but users may retrieve any number of images at one time.

Users should have monitors with the capability of displaying 256 colors (SVGA, 8-bit RGB color) and software for viewing GIF files. The monitor is necessary to take advantage of the high-resolution color images and to display them correctly. For users needing a GIF viewer, three shareware viewers are provided—one for an IBM-compatible PC, one for a Macintosh, and one for a workstation.

A CD-ROM version of the atlas is available for \$30.00. For a copy of the CD-ROM, send your name and address to Frank Keimig, Department of Geology and Geography, University of Massachusetts, Amherst, MA 01003-5820 or email address: [frank@climate1.geo.umass.edu](mailto:frank@climate1.geo.umass.edu).

**Alaskan Historical Climatology Network (HCN) Serial Temperature and Precipitation Data**

DB1004

(July 1994)

<http://cdiac.esd.ornl.gov/ndps/db1004.html>**T. R. Karl, R. G. Baldwin, M. G. Burgin, D. R. Easterling, R. W. Knight, and P. Y. Hughes (contributors)**

This database is a companion to the Historical Climatology Network (HCN) database for the contiguous United States (see NDP-019/R3 on page 28). The database contains monthly temperature (minimum, maximum, and mean) and total monthly precipitation data for 47 Alaskan stations. These data were derived from a variety of sources including the National Climatic Data Center archives, the state climatologist for Alaska, and published literature. The period of record varies by station. The longest record is for the Sitka Magnetic Observatory (1828) and most records extend through 1990. Unlike the HCN database for the contiguous U.S., adjustments have **not** been made to these climate records for time-of-observation differences, instrument changes, or station moves. The data are in three files [one data file that contains all four climate variables, one station inventory file, and one station history file]. The file sizes range from 3.5 kB to 1.7 MB.

**FORAST Database**

DB1005

(January 1995)

<http://cdiac.esd.ornl.gov/ndps/db1005.html>**S. B. McLaughlin, D. J. Downing, T. J. Blasing, B. L. Jackson, D. J. Pack, D. N. Duvick, L. K. Mann, and T. W. Doyle (contributors)**

The Forest Responses to Anthropogenic Stress (FORAST) project was designed (1) to determine whether evidence of alterations of long-term growth patterns of several species of eastern forest trees was apparent in tree-ring chronologies from within the region and (2) to identify environmental variables that were temporally or spatially correlated with any observed changes. The project was supported principally by the U.S. Environmental Protection Agency (EPA) with additional support from the National Park Service.

The FORAST project was initiated in 1982 as exploratory research to document patterns of radial growth of forest trees during the previous 50 or more years within 15 states in the northeastern United States. Radial growth measurements from more than 7000 trees are provided along with data on a variety of measured and calculated indices of stand characteristics (basal area, density, and competitive indices); climate (temperature, precipitation, and drought); and anthropogenic pollutants (state and regional emissions of SO<sub>2</sub> and NO<sub>x</sub>, ozone monitoring data, and frequency of atmospheric-stagnation episodes and atmospheric haze). These data were compiled into a single database to facilitate exploratory analysis of tree growth patterns and responses to local and regional environmental conditions.

The database files are divided into three groups. Two of the groups (FORASTR and FORAST) contain the same tree-ring chronology information (ring-width and basal area increments); one is sorted by region, and the other by tree species. The third group (FORASTEC) is a collection of miscellaneous background data including climate, air quality, and tree and site characteristics.

The database consists of 99 data files. The original 48 SAS® data files are provided and require approximately 111 MB of disk space. In addition, CDIAC has created 48 ASCII files of the same data, an ASCII db1005.doc file, region file, and species file. The region and species files merge all

the files in the respective subdirectory. Hard copy documentation describing the experimental protocols used and the format of the database files is available from CDIAC.

Portions of the FORAST database have been incorporated into the International Tree-Ring Data Base (ITRDB), a large collection of tree-ring data archived by and available from the National Geophysical Data Center (NGDC). For further information about the ITRDB, contact Bruce Bauer at NGDC (303-497-6280 or bab@luna.ngdc.noaa.gov).

**DB1006**      **Goddard Institute for Space Studies (GISS) 3-Dimensional (3-D)**  
**(WDC-A)**      **Global Tracer Transport Model**  
(January 1993)  
<http://cdiac.esd.ornl.gov/ndps/db1006.html>

**I. Fung (contributor)**

This directory contains the input files used in simulations of atmospheric CO<sub>2</sub> using the GISS 3-D global tracer transport model. The directory contains 16 files including a help file (CO2FUNG.HLP), 12 files containing monthly exchanges with vegetation and soils (CO2VEG.JAN . . . DEC), 1 file containing releases of CO<sub>2</sub> from fossil fuel burning (CO2FOS.MRL), 1 file containing releases of CO<sub>2</sub> from land transformations (CO2DEF.HOU), and 1 file containing the patterns of CO<sub>2</sub> exchange with the oceans (CO2OCN.TAK).

**DB1007**      **Atmospheric Methane at Cape Meares, Oregon, U.S.A.:**  
**(WDC-A)**      **A High-Resolution Data Base for the Period 1979–1992**  
(December 1994)  
<http://cdiac.esd.ornl.gov/ndps/db1007.html>

**M. A. K. Khalil and R. A. Rasmussen (contributors)**

This database presents continuous automated atmospheric methane (CH<sub>4</sub>) measurements taken at the atmospheric monitoring facility in Cape Meares, Oregon, by the Oregon Graduate Institute of Science and Technology. The Cape Meares data represent some 119,000 individual atmospheric methane measurements carried out during 1979–1992. Analysis of ambient air (collected 12 to 72 times daily) was carried out by means of an automated sampling and measurement system, using the method of gas chromatography and flame ionization detection. Despite the long course of the record and the large number of individual measurements, these data may all be linked to a single absolute calibration standard.

The data are contained in three files. The largest file (2.14 MB) contains all individual atmospheric methane measurements, collected at Cape Meares over the period January 1979–January 1992. A second file (189 kB) contains daily average concentrations of methane, sampling statistics, and interpolations for days when data were not taken. The last file (10 kB) contains monthly averages (derived from the individual and daily data) and statistics of dispersion, calculated by three different methods: the arithmetic mean (along with 90% confidence limits), the median (along with 5th and 95th percentile values), and a middle value (also with accompanying 90% confidence limits) based on a non-parametric statistical method.

**Atmospheric Methane Mixing Ratios—The NOAA/CMDL Global Cooperative Air Sampling Network, 1983–1993**

(November 1994)

<http://cdiac.esd.ornl.gov/ndps/db1008.html>**DB1008**

(WDC-A)

**E. J. Dlugokencky, P. M. Lang, K. A. Masarie, and L. P. Steele**  
(contributors)

This database presents atmospheric methane (CH<sub>4</sub>) mixing ratios from flask air samples collected over the period 1983–1993 by the National Oceanic and Atmospheric Administration, Climate Monitoring and Diagnostics Laboratory's (NOAA/CMDL's) global cooperative air sampling network. Air samples were collected approximately once per week at 44 fixed sites (37 of which were still active at the end of 1993). Samples were also collected at 5 degree latitude intervals along shipboard cruise tracks in the Pacific Ocean between North America and New Zealand (or Australia) and at 3° latitude intervals along cruise tracks in the South China Sea between Singapore and Hong Kong. The shipboard measurements were made approximately every 3 weeks per latitude zone by each of two ships in the Pacific Ocean and approximately once every week per latitude zone in the South China Sea. All samples were analyzed for CH<sub>4</sub> at the NOAA/CMDL laboratory in Boulder, Colorado, by gas chromatography with flame ionization detection, and each aliquot was referenced to the NOAA/CMDL methane standard scale.

In addition to providing the complete set of atmospheric CH<sub>4</sub> measurements from flask air samples collected at the NOAA/CMDL network sites, this database also includes files which list monthly mean mixing ratios derived from the individual flask air measurements. These monthly summary data are available for 35 of the fixed sites and 21 of the shipboard sampling sites.

The data for the complete set of individual measurements are contained in 85 files, ranging in size from 2.7 kB to 187 kB and totaling 2.7 MB. Two additional files contain the monthly summary data.

One of these files (30.2 kB) contains all monthly mean methane values for NOAA/CMDL fixed monitoring sites. The second file (14.3 kB) contains all monthly mean methane values for NOAA/CMDL shipboard sites. An additional file (151.0 kB) contains a PostScript image showing the locations of all fixed sampling sites in the NOAA/CMDL cooperative air sampling network; also shown are the approximate sampling locations from ocean vessels participating in the shipboard sampling program. The data and accompanying descriptive material are available in electronic form only; hard copy documentation is not available.

**Intergovernmental Panel on Climate Change (IPCC), Working Group 1, 1994: Modelling Results Relating Future Atmospheric CO<sub>2</sub> Concentrations to Industrial Emissions**

(January 1995)

<http://cdiac.esd.ornl.gov/ndps/db1009.html>**DB1009**

(WDC-A)

**I. G. Enting, T. M. L. Wigley, and M. Heimann (eds.)**

This database contains the results of various projections of the relation between future CO<sub>2</sub> concentrations and future industrial emissions. These projections were contributed by groups from a number of countries as part of the scientific assessment for the report, "Radiative Forcing of Climate Change" (1994), issued by Working Group 1 of the Intergovernmental Panel on Climate Change. There were three types of calculations: (1) forward projections, calculating the



atmospheric CO<sub>2</sub> concentrations resulting from specified emissions scenarios; (2) inverse calculations, determining the emission rates that would be required to achieve stabilization of CO<sub>2</sub> concentrations via specified pathways; (3) impulse response function calculations, required for determining Global Warming Potentials. The projections were extrapolations of global carbon cycle models from pre-industrial times (starting at 1765) to 2100 or 2200 A.D. There were two aspects to the exercise: (1) an assessment of the uncertainty due to uncertainties regarding the current carbon budget, and (2) an assessment of the uncertainties arising from differences between models. To separate these effects, a set of standard conditions was used to explore inter-model differences and then a series of sensitivity studies was used to explore the consequences of current uncertainties in the carbon cycle.

The contents of this database are found in three subdirectories: “inputs”, “results”, and “report”. The “inputs” subdirectory (11 files totaling 130 kB) contains the empirical time series data that were used as the basis of the modeling projections. These data include historical and modern measurements of atmospheric CO<sub>2</sub> concentrations, CO<sub>2</sub> emissions from industry and land-use changes, and <sup>14</sup>C activities for atmospheric CO<sub>2</sub>. The “results” subdirectory (46 files totaling 1.02 MB) contains the projections (as time series) contributed by 10 groups of carbon cycle modelers. The categories of data in this subdirectory include (1) projected CO<sub>2</sub> concentrations for specified emissions scenarios, (2) ocean CO<sub>2</sub> fluxes for specified regimes of emissions or atmospheric concentrations, and (3) industrial emissions (from inverse calculations) for specified concentration time series (i.e., stabilization pathways). The “report” subdirectory (8 files totaling 4.45 MB) contains a set of PostScript files that constitute the report “Future Emissions and Concentrations of Carbon Dioxide: Key Ocean/Atmosphere/Land Analyses” (CSIRO Division of Atmospheric Research, Technical Paper No. 31). This report details the specifications for the modeling projections, the models that were used, and the results that were obtained.

**DB1010**  
**(WDC-A)**

**Globally Averaged Atmospheric CFC-11 Concentrations: Monthly and Annual Data for the Period 1975–1992**

**(January 1996)**

**<http://cdiac.esd.ornl.gov/ndps/db1010.html>**

**M. A. K. Khalil and R. A. Rasmussen (contributors)**

This data set presents globally averaged atmospheric concentrations of chlorofluorocarbon 11, known also as CFC-11 or F-11 (chemical name: trichlorofluoromethane; formula: CCl<sub>3</sub>F). The monthly global average data are derived from flask air samples collected at eight sites in six locations over the period August 1980–July 1992. The sites are Barrow (Alaska), Cape Meares (Oregon), Cape Kumukahi and Mauna Loa (Hawaii), Cape Matatula (American Samoa), Cape Grim (Tasmania), Palmer Station, and the South Pole (Antarctica). At each collection site, monthly averages were obtained from three flask samples collected every week.

In addition to the monthly global averages available for 1980–1992, this data set also contains annual global average data for 1975–1985. These annual global averages were derived from January measurements at the South Pole and in the Pacific Northwest of the United States (specifically, Washington state and the Oregon coast).

The data are contained in a single 1.8 kB file and are located in the subdirectory /pub/db1010.

**Atmospheric Carbon Monoxide Mixing Ratios NOAA Climate Monitoring and Diagnostics Laboratory Cooperative Air Sampling Network, 1988–1993**

(October 1994)

<http://cdiac.esd.ornl.gov/ndps/db1011.html>**DB1011**

(WDC-A)

**P. C. Novelli and K. A. Masarie (contributors)**

Individual site files provide CO mixing ratios in parts per billion (ppb) (ppb = parts in  $10^9$  by mole fraction) on the basis of measurements from the NOAA/CMDL Cooperative Air Sampling Network. Data are provided through June 1993 for stations at which the first sample was collected before July 1991. The report includes a list of locations from which samples of air were collected and analyzed for CO and a listing of all sites in the air sampling network used for CO measurements (as of 9/94). The latter listing, which is in the form of a table, includes the three letter code used to identify each site, the location of the site, latitude and longitude (in degrees and minutes), the altitude of the sampling location (in meters above mean sea level), the start and end dates for sampling CO, the country, and the cooperating agency. Sampling frequencies are approximately weekly for the fixed sites and average one sample every 3 weeks per latitude zone for PAW and OPC and about one sample every week per latitude for SCS. The air samples are collected by two general methods: (1) flushing and then pressurizing glass flasks with a pump or (2) opening a stopcock on an evacuated glass flask. During each sampling event a pair of flasks is filled in series.

All samples were analyzed for CO at the NOAA/CMDL laboratory in Boulder by gas chromatography with mercuric oxide reduction detection, and all measurements are referenced to the CMDL CO scale.

**A Global 1 Degree by 1 Degree Distribution of Atmospheric/ Soil CO<sub>2</sub> Consumption by Continental Weathering and of Riverine HCO<sub>3</sub> Yield**

(September 1995)

<http://cdiac.esd.ornl.gov/ndps/db1012.html>**DB1012**

(WDC-A)

**P. A. Suchet and J.-L. Probst (contributors)**

The mission of the Centre National de la Recherche Scientifique (CNRS) of Strasbourg Cedex, France, is to study “The Global Carbon Cycle and its Perturbation by Man and Climate, the Terrestrial Biosphere.” With the support of the Environment Programme of the European Communities, modeling of the spatial distribution of atmospheric-soil CO<sub>2</sub> consumption by chemical weathering of continental rocks has been and is being conducted. One of the major results of these studies is a set of global maps which show the distribution of CO<sub>2</sub> consumption (FCO<sub>2</sub>) and the transport of bicarbonate (FHCO<sub>3</sub><sup>-</sup>) from rivers to the ocean, each in moles per kilometer squared per year (mol km<sup>2</sup>/year).

This database contains estimates of the net flux of atmospheric-soil CO<sub>2</sub> (FCO<sub>2</sub>) produced by a model by Suchet and Probst and the associated bicarbonate river flux (FHCO<sub>3</sub><sup>-</sup>). These variables are referenced to a 1° latitude by 1° longitude world grid. The grid contains 64,800 records (i.e., grid cells) originating at -180° W by -90° N and extending to 180° W by 90° N.

**DB1013**      **Global and Latitudinal Estimates of  $\delta^{13}\text{C}$  from Fossil-Fuel Consumption and Cement Manufacture**  
(WDC-A)      (March 1996)  
<http://cdiac.esd.ornl.gov/ndps/db1013.html>

**R. J. Andres, G. Marland, and S. Bischof (contributors)**

This database contains estimates of the annual mean value of  $\delta^{13}\text{C}$  of  $\text{CO}_2$  emissions from fossil-fuel consumption and cement manufacture for 1860–1992. It also contains estimates of the value of  $\delta^{13}\text{C}$  for  $1^\circ$  latitude bands for the years 1950, 1960, 1970, 1980, 1990, 1991, and 1992. These estimates of the carbon isotopic signature account for the changing mix of coal, petroleum, and natural gas being consumed and for the changing mix of petroleum from various producing areas with characteristic isotopic signatures. This time series of fossil-fuel  $\delta^{13}\text{C}$  signature provides an additional constraint for balancing the sources and sinks of the global carbon cycle and complements the atmospheric  $\delta^{13}\text{C}$  measurements that are used to partition the uptake of fossil carbon emissions among the ocean, atmosphere, and terrestrial biosphere reservoirs. The data are in two files ranging in size from 2.8 to 12.9 kB.

**DB1014**      **In situ Carbon 13 and Oxygen 18 Ratios of Atmospheric  $\text{CO}_2$  from Cape Grim, Tasmania, Australia: 1982–1993**  
(WDC-A)      (December 1995)  
<http://cdiac.esd.ornl.gov/ndps/db1014.html>

**R. J. Francey, and C. E. Allison (contributors)**

Since 1982, a continuous program of sampling atmospheric  $\text{CO}_2$  to determine stable isotope ratios has been maintained at the Australian Baseline Air Pollution Station, Cape Grim, Tasmania ( $40^\circ 40'56''$  S,  $144^\circ 41'18''$  E). This program uses a unique combination of factors with respect to obtaining a globally representative signal from a surface site: the process of in situ extraction of  $\text{CO}_2$  from air, the preponderance of samples collected in conditions of strong wind from the marine boundary layer of the Southern Ocean, and the determination of all isotope ratios relative to a common high-purity  $\text{CO}_2$  reference gas with isotopic  $\delta^{13}\text{C}$  close to atmospheric values. Air samples are collected during baseline condition episodes at a frequency of around one sample per week. Baseline conditions are characterized by wind direction in the sector  $190^\circ$ – $280^\circ$ , condensation nucleus concentration below  $600/\text{cm}^3$ , and steady continuous  $\text{CO}_2$  concentrations (variation  $\pm 0.2$  ppmv/hour). Mass spectrometer analyses for  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  are carried out by CSIRO's Division of Atmospheric Research in Aspendale, usually one to three weeks following collection.

This record is possibly the most accurate representation of global atmospheric  $^{13}\text{C}$  behavior over the last decade and may be used to partition the uptake of fossil-fuel carbon emissions between ocean and terrestrial plant reservoirs. The database consists of two files, a descriptive db1014.doc file (153 lines) and a data file ("isotope.cgo," 440 lines) that contains the in situ  $^{13}\text{C}$  and  $^{18}\text{O}$  ratios of atmospheric  $\text{CO}_2$  from Cape Grim for 1982 through 1993.

**Global Patterns of Carbon Dioxide Emissions from Soils on a 0.5 Degree Grid Cell Basis**

(March 1996)

<http://cdiac.esd.ornl.gov/ndps/db1015.html>**DB1015**

(WDC-A)

**J. W. Raich and C. S. Potter (contributors)**

Semi-mechanistic, empirically-based statistical models were used to predict the spatial (0.5 degree grid cells) and temporal (monthly and annual) patterns of global carbon emissions from terrestrial soils. Emissions include the respiration of both soil organisms and plant roots. Geographically referenced data of mean monthly air temperature and precipitation, soil organic carbon and nitrogen content, soil type and natural vegetation type were used in the model development. It was found that at the global scale the rates of soil CO<sub>2</sub> efflux correlate significantly with temperature and precipitation, have a pronounced seasonal pattern in most locations, and contribute to observed wintertime increases in atmospheric CO<sub>2</sub>.

The DB1015 data are the predicted CO<sub>2</sub> emissions of the model based on untransformed precipitation data and the exponential relationship between soil biological activity and temperature. The data at the 0.5° latitude by longitude spatial and monthly temporal resolution represents the best resolved estimate to date of global CO<sub>2</sub> fluxes from soils and should facilitate investigations of net exchanges between the atmosphere and terrestrial biosphere.

The data files (~10 MB total) consist of 12 monthly and one annual model output files, one geographic information file and a db1015.doc file with simple FORTRAN 77 data access information.

**Global Population Distribution (1990), Terrestrial Area and Country Name Information on a One by One Degree Grid Cell Basis**

(February 1998)

<http://cdiac.esd.ornl.gov/ndps/db1016.html>**DB1016****Y.-F. Li (contributor)**

This database contains gridded (one degree by one degree) information on the world-wide distribution of the population for 1990 and country-specific information on the percentage of the country's population present in each grid cell. The database contains the percentage of a country's total area in a grid cell and the country's percentage of the grid cell that is terrestrial. An indicator was developed to signify how many countries are represented in a grid cell and if a grid cell is part of the sea; this indicator is only relevant for the land, countries, and sea-partitioning information of the grid cell. The database includes the latitude and longitude coordinates of each grid cell; a grid code number, which is a translation of the latitude/longitude value and is used in the Global Emission Inventory Activity (GEIA) databases; the country or region's name, and the United Nations three-digit country code that represents that name.

**DB1017**      **Northern Hemisphere Biome- and Process-Specific Changes in Forest Area and Gross Merchantable Volume: 1890–1990**  
(WDC-A)      (January 1997)  
<http://cdiac.esd.ornl.gov/epubs/db/db1017/db1017.html>

**A. N. D. Auclair, J. A. Bedford, and C. Revenga (contributors)**

This database lists annual changes in areal extent (Ha) and gross merchantable wood volume (m<sup>3</sup>) produced by depletion and accrual processes in boreal and temperate forests in Alaska, Canada, Europe, Former Soviet Union, Non-Soviet temperate Asia, and the contiguous United States for the years 1890 through 1990. Forest depletions (source terms for atmospheric CO<sub>2</sub>) are identified as forest pests, forest dieback, forest fires, forest harvest, and land-use changes (predominantly the conversion of forest, temperate woodland, and shrubland to cropland). Forest accruals (sink terms for atmospheric CO<sub>2</sub>) are identified as fires exclusion, fire suppression, and afforestation or crop abandonment. The changes in areal extent and gross merchantable wood volume are calculated separately for each of the following biomes: forest tundra, boreal softwoods, mixed hardwoods, temperate softwoods, temperate hardwoods, and temperate wood- and shrublands.

**DB1018**      **A Comprehensive Database of Woody Vegetation Responses to Elevated Atmospheric CO<sub>2</sub>**  
(April 1997)  
<http://cdiac.esd.ornl.gov/epubs/db/db1018/db1018.html>

**P. S. Curtis (contributor)**

A multi-parameter database was generated to aid in a statistically rigorous synthesis of research results on the response by woody plants to increased atmospheric CO<sub>2</sub> levels. Eighty-four independent CO<sub>2</sub>-enrichment studies, covering 65 species and 35 response parameters, met the necessary criteria for inclusion in the database, reporting mean response, sample size and variance of the response (either as standard deviation or standard error). The data were retrieved from published literature and, in a few instances, from unpublished reports. The effects of environmental factors (e.g., drought, heat, ozone, ultraviolet-B radiation), and the effects of experimental conditions (e.g., duration of CO<sub>2</sub> exposure, pot size, type of CO<sub>2</sub> exposure facility) on plant responses to elevated CO<sub>2</sub> levels can be explored with this database. The database consists of a 26-field data file of CO<sub>2</sub>-exposure experiment responses by woody plants, a paper-reference file, a paper-comment file and SAS<sup>®</sup> and FORTRAN-77 codes to read the data file.

**DB1019**      **The Environmental Measurements Laboratory's Stratospheric Radionuclide (RANDAB) and Trace Gas (TRACDAB) Databases**  
(October 1997)  
<http://cdiac.esd.ornl.gov/epubs/db/db1019/db1019.html>

**R. Leifer and N. Chan (contributors)**

This subdirectory contains two databases contributed by Robert Leifer and Nita Chan (Environmental Measurements Laboratory [EML]). The databases contain stratospheric radionuclide (RANDAB) and trace gas (TRACDAB) measurements.

RANDAB represents the worlds largest collection of stratospheric and upper tropospheric radionuclide data. The database contains results of measurements made from 1957 to 1983 during the ASHCAN, STARDUST, AIRSTREAM, and High Altitude Sampling Program (HASP) projects. More than 20,000 filters were collected during this period and analyzed for approximately 40 different radionuclides. All of the available data characterizing each filter are included in RANDAB. RANDAB offers gas samples characterizing the tritium, radon and  $^{14}\text{CO}_2$  concentration in stratospheric air. Only a limited amount of data is available for radon because of analytical and sampling problems. The tritium data were provided graciously by Dr. Allen Mason of the Los Alamos Laboratory and Dr. H. G. Östlund of the Tritium Laboratory, University of Miami.

The second database, TRACDAB, contains more than 1000 stratospheric trace gas measurements for the period 1974 to 1983. These samples were collected during Project AIRSTREAM. During the years 1974 to 1976, the samples were analyzed at EML. Subsequently, Washington State University (1976–1979) and the Oregon Graduate Institute for Science & Technology (formerly the Oregon Graduate Center 1980–1983) were under contract to EML to analyze AIRSTREAM gas samples. During the period 1974–1983, 980 gas samples were analyzed for one or more of the following gases  $\text{CCl}_3\text{F}$ ,  $\text{CCl}_2\text{F}_2$ ,  $\text{CCl}_4$ ,  $\text{CH}_3\text{CCl}_3$ ,  $\text{SF}_6$ ,  $\text{N}_2\text{O}$ ,  $\text{CO}_2$ ,  $\text{CH}_4$ , and  $\text{COS}$ .

**Measurement of Air Pollution from Satellites (MAPS) 1994  
Correlative Atmospheric Carbon Monoxide Mixing Ratios  
(December 1998)**

**DB1020  
(WDC-A)**

<http://cdiac.esd.ornl.gov/epubs/db/db1020/db1020.html>

**Paul Novelli and Ken Masarie (contributors)**

This subdirectory contains a database contributed by Paul Novelli [NOAA Climate Monitoring and Diagnostics Laboratory (CMDL), Boulder, Colorado] and Ken Masarie [Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, Colorado]. The database offers select carbon monoxide (CO) mixing ratios from eleven field and aircraft measurement programs around the world.

Carbon monoxide mixing ratios in the middle troposphere have been examined for short periods of time by using the Measurement of Air Pollution from Satellites (MAPS) instrument. MAPS measures CO from a space platform, using gas filter correlation radiometry. During the 1981 and 1984 MAPS flights, measurement validation was attempted by comparing space-based measurements of CO to those made in the middle troposphere from aircraft. Before the 1994 MAPS flights aboard the space shuttle *Endeavour*, a correlative measurement team was assembled to provide the National Aeronautics and Space Administration (NASA) with results of their CO field measurement programs during the April and October shuttle missions. To maximize the usefulness of these correlative data, team members agreed to participate in an intercomparison of CO measurements.

The correlative data presented in this database provide an internally consistent, ground-based picture of CO in the lower atmosphere during Spring and Fall 1994. The data show the regional importance of two CO sources: fossil-fuel burning in urbanized areas and biomass burning in regions in the Southern Hemisphere.

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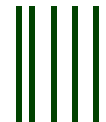
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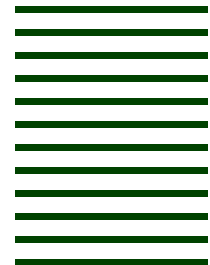
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