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

A Large Experiment Tests Impacts of Climate Change

Changes in regional climate across the southern United States, which are hypothesized to occur in response to increasing greenhouse gases in the atmosphere, have raised concerns that southeastern forests might be vulnerable to future drought conditions. To provide experimental information related to such concerns a catchment-scale (19,000 m^2) manipulation experiment was initiated on the Walker Branch Watershed (Oak Ridge, Tennessee) in July of 1993 to modify throughfall (precipitation passing through the forest canopy) to an upland oak forest over multiple growing seasons. The Throughfall Displacement Experiment (TDE) is being conducted by ORNL scientists with funding from the U.S. Department of Energy's (DOE's) Program for Ecosystem Research. The project seeks to identify the potential range of adjustments in physiological processes, water use, and aboveground and belowground growth by overstory and understory species and to evaluate changes in nutrient cycling and decomposition processes in the context of changing precipitation inputs.

Using a passive experimental design, the TDE treatments are implemented by a gravity-driven displacement of throughfall precipitation from one

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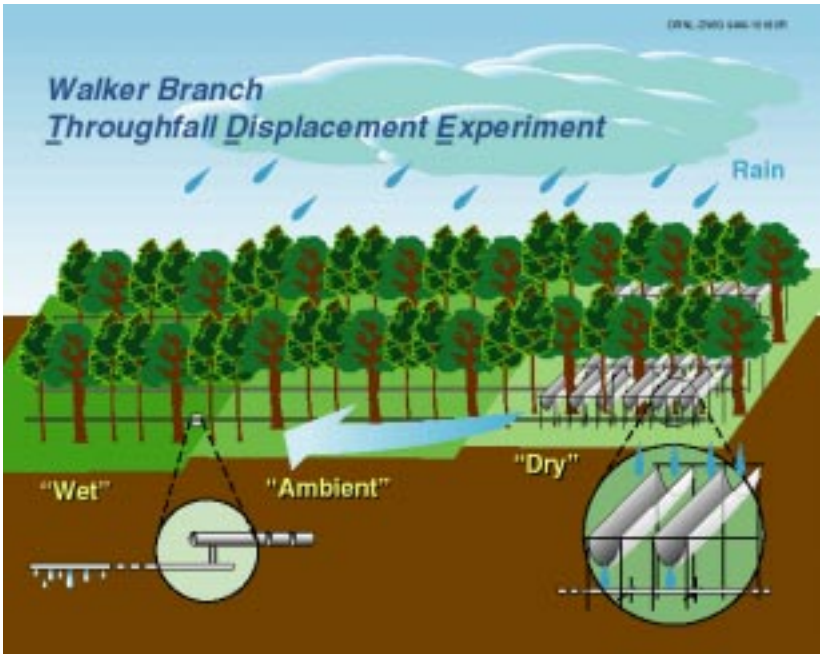

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Co-editors: Sonja Jones
Karen Gibson

What's Inside ...

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CDIAC's Program Manager:
Bobbi Parra

Trends Online

Carbon Dioxide Emissions from Fossil Fuel Consumption (http://cdiac.esd.ornl.gov/trends/emis/em_cont.htm)

Publications containing historical energy statistics have made it possible to estimate fossil fuel CO_2 emissions back to 1751. Since 1751 more than 265 billion tons of carbon have been released to the atmosphere from the consumption of fossil fuels and cement production. Half of these emissions have occurred since the mid 1970s. The 1996 estimate for global CO_2 emissions, 6518 million metric tons of carbon, is the highest fossil-fuel emission estimate ever. The 1996 estimate represents a 1.7% increase over 1995, continuing a trend of modest growth since a 1990-1993 decline in global CO_2 emissions.

Globally, liquid and solid fuels accounted for 77.5% of the emissions from fossil-fuel burning in 1996. Combustion of gas fuels (e.g., natural gas) accounted for 18.3% (1196 million metric tons) of the total emissions from fossil fuels in 1996 and reflects a gradually increasing global utilization of natural gas. Emissions from cement production rose to 202 million metric tons of carbon, a twenty-fold increase since the 1920s. Emissions from gas flaring for 1996 were estimated to be 67 million metric tons of carbon, well below the levels of the 1970s. Collectively, emissions from cement production and gas flaring contributed less than 5% to the total emissions for 1996.

Global and Hemispheric Temperature Anomalies–Land and Marine Instrumental Records (P. D. Jones et al.) (http://cdiac.esd.ornl.gov/trends/temp/jonescru/jones.html)

These temperature anomaly time series are derived from a global database of corrected land and marine temperature data. The land portion of this updated database is comprised of surface air temperature data (land-surface meteorological data and fixed-position weather ship data) that have been corrected for nonclimatic errors, such as station shifts and/or instrument changes. A reanalysis of land surface data by the Climatic Research Unit (CRU) has resulted in (1) the inclusion of more than 1000 additional stations, (2) a new reference period common to all stations (1961–1990; previously 1950–1979), and (3) increased grid-box resolution of the temperature anomalies (5° × 5°). The marine data consist of sea surface temperatures (SSTs) that incorporate in situ measurements from ships and buoys. The resulting data set has been used extensively in various Intergovernmental Panel on Climate Change (IPCC) reports, and the global-mean temperature changes evident in the record have been interpreted in terms of anthropogenic forcing influences and natural variability.

Trends in annual mean temperature anomalies for the globe show relatively stable temperatures from the beginning of the record through about 1910, with relatively rapid and steady warming through the early 1940s, followed by another period of relatively stable temperatures through the mid-1970s. From this point onward, another rapid rise similar to that in the earlier part of the century is observed. Like 1997, 1998 has seen a new global mean temperature record set; 1998's anomaly was 0.57°C above the 1961–1990 reference period mean temperature. The six warmest years of the global record have all occurred since 1990 and are, in descending order, 1998, 1997, 1995, 1990, 1991, and 1994. The record shows that the average surface air temperature of the globe has warmed ~0.5°C since the middle of the nineteenth century.

A Large Experiment Tests Impacts of Climate Change

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treatment plot to another. The manipulation yields experimental plots that have normal rainfall inputs or one-third more or less rainfall than typical forests in eastern Tennessee. The TDE experiment is one of the largest terrestrial manipulation experiments ever conducted.

Multiyear growth and physiological observations through six years of manipulation show that the small-stature vegetation is the most sensitive to changing precipitation. Shallow-rooted dogwood saplings showed reduced growth, water use, and increased mortality in our dry-treatment scenario, while mature canopy trees did not. Unlike the imposed dry treatment, periodic natural drought events in 1993, 1995, and 1998 have resulted in mature-tree growth reductions of 30-50%, but the net impact on aboveground stand production over six years of manipulation is limited. Foliar litter production by the canopy has not been impacted by the TDE treatments, and is very stable from year to year at approximately 500 g m^{-2} y^{-1}. Belowground root production showed a significant increase in the dry treatment, suggesting a potential stand-level adjustment to the reduced precipitation scenario.

The sensitivity of overstory tree species to soil water deficits is ranked as follows: Yellow Poplar > Blackgum > Maple > White oak = Chestnut oak. This ranking is consistent among a variety of measured properties, including growth, canopy water use, foliar biochemistry, and CO_2 and water vapor exchange. In the understory, dogwood is more sensitive than red maple saplings, and dramatic increases in mortality of dogwood under the TDE's dry-treatment scenario suggest potential future changes in forest species diversity if such species die out.

Direct measurements of litter layer mass show a significant 20-30% increase following six years of sustained precipitation reductions. Litter mass accumulation indicates reduced decomposition and carbon accumulation for a dry future, but carbon accumulation in the forest litter layer might increase future fire hazards and long-term reductions in nutrient availability. The suite of TDE measurements has led us to conclude that differences in seasonal timing of rainfall will have a greater impact on plant productivity (or carbon sequestration) than changes in rainfall applied equally throughout a year.

A key implication of this conclusion is that accurate predictions of plant, forest-stand, and ecosystem responses to changing regional climates will require a concomitant understanding of future climate dynamics. The temporal resolution of current precipitation change scenarios (i.e., more or less rainfall annually) must be improved to include scenarios of rainfall periodicity. This requirement is essential because it is the balance between rainfall inputs and ecosystem water use that lead to quantification of soil water status.

The TDE is slated to operate for two additional growing seasons (1999 and 2000) to complete observations of long-term cumulative tree and soil responses, fill out mechanistic plant/ecosystem response relationships, and support ongoing and externally funded collaborative research efforts. Final results from TDE research will yield a hierarchical integration of physiological response mechanisms into ecosystem models required for long-term assessments of the influence of future precipitation change on forest productivity and carbon sequestration. Original data sets covering the experimental environment, plant growth, physiological characteristics, and soils will be archived by CDIAC for alternative analyses and modeling.

Contact Paul Hanson (hansonpj@ornl.gov) for additional information and a list of published research papers.

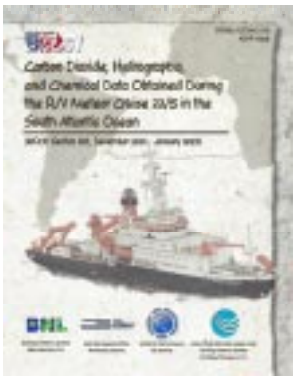
New Numeric Data Packages Available

CDIAC's data holdings 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 radioactively 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. Data that are thoroughly checked and documented are released by CDIAC as numeric data packages (NDPs). Recently released NDPs are described in this section. The data and documentation text or HTML version are available from CDIAC's Web site (http://cdiac.esd.ornl.gov/), from CDIAC's anonymous FTP area (cdiac.esd.ornl.gov), and on a variety of media upon request. Technical questions (e.g., methodology or accuracy) should be directed to the CDIAC staff member who is responsible for preparing the individual NDP.

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)

Johnson, Kenneth M., Brookhaven National Laboratory, Upton, New York; Bernd Schneider, Baltic Sea Research Institute, Warnemünde, Germany; Ludger Mintrop, Institute for Marine Sciences, Kiel, Germany; and Douglas W. R. Wallace, Brookhaven National Laboratory, Upton, New York
Prepared by Alexander Kozyr, CDIAC

NDP-066 (1998) (http://cdiac.esd.ornl.gov/oceans/ndp_066/ndp066.html)



Procedures and methods that were used to measure total carbon dioxide (TCO_2) and total alkalinity (TALK) at hydrographic stations, as well as the underway partial pressure of CO_2 (pCO_2) during the R/V *Meteor* Cruise 22/5 in the South Atlantic Ocean (Section A10) are presented in this data package. 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 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_2, TALK, and underway pCO_2. Knowledge of these parameters and their initial conditions will enable researchers to determine heat and water transport as well as carbon transport. An understanding of this transport will contribute to the understanding of processes that are relevant to climate change. This section in the South Atlantic subtropical gyre is especially relevant to understanding CO_2 transport because it crosses both the Brazil and the Benguela boundary currents.

The TCO_2 was measured by using two Single-Operator Multiparameter Metabolic Analyzers (SOMMAs) for extracting CO_2 from seawater samples that were coupled to a

coulometer for detection of the extracted CO_2. 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_2 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 and the Bundesministerium für Forschung und Technologie. *WDC-A database*

The International Intercomparison Exercise of Underway fCO_2 Systems During the R/V *Meteor* Cruise 36/1 in the North Atlantic Ocean

Körtzinger, Arne, Ludger Mintrop, and Jan C. Duinker, University of Kiel, Kiel, Germany; Kenneth M. Johnson, and Craig Neill, Brookhaven National Laboratory, Upton, New York; Douglas W. R. Wallace, University of Kiel, Kiel, Germany; Bronte Tilbrook, and Philip Towler, Commonwealth Scientific and Industrial Research Organisation, Holbart, Tasmania, Australia; Hisayuki Inoue, and Masao Ishii, Meteorological Research Institute, Tsukuba, Japan; Gary Shaffer, University of Copenhagen, Copenhagen, Denmark; Rodrigo Torres, Göteborg University and Chalmers University of Technology, Göteborg, Sweden; Eiji Ohtaki, and Eiji Yamashita, Okayama University, Okayama, Japan; Alain Poisson, Christian Brunet, and Bernard Schauer, Université Pieere et Marie Cure, Laboratoire de Physique et Chimie Marines, Paris, France; Catherine Goyet, and Greg Eischeid, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts
Prepared by Alexander Kozyr, CDIAC

NDP-067 (1999) (http://cdiac.esd.ornl.gov/oceans/ndp_067/ndp067.html)

Measurements of the fugacity of carbon dioxide (fCO_2) 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 fCO_2 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 fCO_2 and its influence on the oceanic uptake of anthropogenic CO_2. 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 fCO_2 Systems was proposed and carried out by the Institut für 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 fCO_2 systems, 1 discrete fCO_2 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 fCO_2.

The main idea of the exercise was to compare surface seawater fCO_2 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_2 and of all equilibrator temperature sensors. Furthermore a common procedure for the calculation of final fCO_2 was applied to all data sets. These measures were taken in order to reduce the largest possible amount of controllable sources of error.

The results demonstrated in this report show that three of the seven underway systems agreed to within 2 µatm throughout the cruise. This was not only the case for seawater fCO_2 measurements but also for measurements of the atmospheric mole fraction of CO_2 (χCO_2). It was found that significant offsets of up to 10 µatm occurred in underway fCO_2 measurements for three systems under typical and identical field work conditions. Finally, the discrete fCO_2 system measurements agreed within its nominal accuracy of 1% with the three most consistent underway fCO_2 systems data sets.

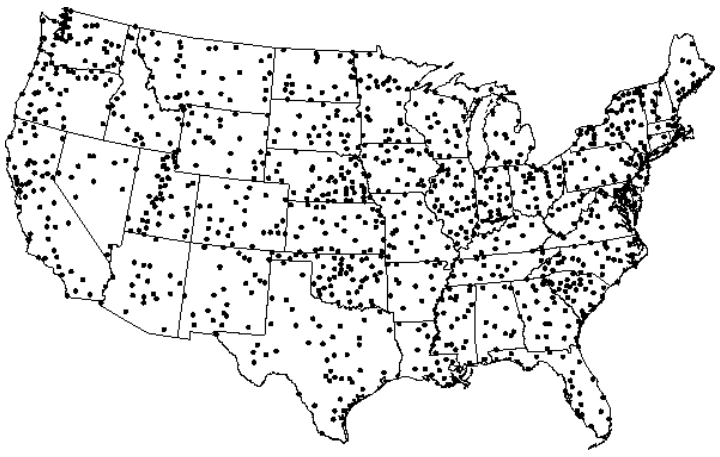
General conclusions and recommendations for underway fCO_2 work are based on a detailed comparison and evaluation of this large intercomparison data set and may serve as background information for a successful preparation of a coherent database of surface ocean fCO_2 values. The results of this exercise certainly underline the need to address carefully the important issue of the interlaboratory comparability of fCO_2 data. *WDC-A database*

United States Historical Climatology Network Daily Temperature, Precipitation, and Snow Data (1871–1997)

D. R. Easterling, T. R. Karl, J. H. Lawrimore, and S. A. Del Greco, National Oceanic and Atmospheric Administration (NOAA), National Climatic Data Center (NCDC), Asheville, North Carolina
Prepared by Dale P. Kaiser and Linda J. Allison, CDIAC

NDP-070 (1999) (http://cdiac.esd.ornl.gov/epubs/ndp/ndp070/ndp070.html)

Not only an update, but an expansion of the original 138-station database previously released by CDIAC as NDP-042 in 1992, this database contains daily observations of maximum and minimum temperature, precipitation amount, snowfall amount, and snow depth from 1062 observing stations across the contiguous United States. The 1062 stations in NDP-070 are a subset of the 1221-station U.S. Historical Climatology Network (HCN), the monthly database compiled at NCDC and distributed by CDIAC, that has been widely used in analyzing U.S. climate. Data from 1050 of the NDP-070 daily records extend into the 1990s, while 990 of these extend through 1997. Most station records are essentially complete for at least 40 years; the latest beginning year of record is 1948. Records from 158 stations begin prior to 1900, with that of Charleston, South Carolina beginning the earliest (1871).



Locations of Stations in the U.S. HCN/D

The daily resolution of these data makes them extremely valuable for studies attempting to detect and monitor long- term climatic changes on a regional scale. Studies using daily data may be able to detect changes in regional climate that would not be apparent from analysis of monthly temperature and precipitation data. Such studies may include analyses of trends in maximum and minimum temperatures, temperature extremes, daily temperature range, precipitation "event size" frequency, and the magnitude and duration of wet and dry periods. The data are also valuable in areas such as regional climate model validation and climate change impact assessment.

Popular Updates

ALE/GAGE/AGAGE (May 1999)
(http://cdiac.esd.ornl.gov/ndps/alegage.html)

Prinn, R., D. Cunnold, P. Fraser, R. Weiss, P. Simmonds, F. Alyea, L. P. Steele, D. Hartley and R. H. J. Wang
Prepared by Tom Boden, CDIAC

CDIAC released an updated database from the global ALE/GAGE/AGAGE monitoring network (DB1001), which provides continuous high-frequency gas chromatographic measurements of eight important biogenic/ anthropogenic gases, including methane (CH_4); nitrous oxide (N_2O); the chlorofluorocarbons $CFCl_3$, CF_2Cl_2, and $CF_2ClCFCl_2$; methyl chloroform (CH_3CCl_3); chloroform ($CHCl_3$); and carbon tetrachloride (CCl_4). This database supports analyses and monitoring related to both greenhouse gases and the Earth's ozone layer and also captures the increased growth in CH_4 and N_2O seen in 1998. This database provides data from 1978 when the program began and includes data through September 1998. Data are available for the following sites: Cape Grim, Tasmania; Point Matatula, American Samoa; Ragged Point, Barbados; Mace Head, Ireland; and Trinidad Head, California (stations also previously existed at Cape Meares, Oregon, and Adrigole, Ireland). *WDC-A database*

Global, Regional, and National CO_2 Emission Estimates from Fossil Fuel Burning, Cement Production, and Gas Flaring: 1751–1996
(March 1999) (NDP-030)
(http://cdiac.esd.ornl.gov/ndps/ndp030.html)

Marland, G., T. Boden, and A. Brenkert, CDIAC; B. Andres, University of Alaska-Fairbanks; and C. Johnston, University of Tennessee-Knoxville

CDIAC's database of emissions on carbon dioxide from fossil-fuel combustion and cement production has recently been updated. This database provides quantitative estimates of annual CO_2 emissions from fossil-fuel combustion and cement production through 1996, with global total emissions for each year and some national estimates beginning in 1751. Since 1751 over 265 billion tons of carbon have been released to the atmosphere from the consumption of fossil fuels and cement production. The 1996 estimate for global CO_2 emissions, 6518 million metric tons of carbon, is the highest fossil-fuel emission estimate ever. The 1996 estimate represents a 1.7% increase over 1995, continuing a trend of modest growth since a 1990-1993 decline in global CO_2 emissions. *WDC-A database*

New Latest Release New

Atmospheric CO_2 concentration records from the SIO sites (Mauna Loa, Hawaii; Barrow, Alaska; Cape Matatula, Samoa; and the South Pole) updated through 1998. (http://cdiac.esd.ornl.gov/trends/co2/sio-keel.htm).

New Database Available

Typically, CDIAC checks all files that it receives and fully documents these files in the form of numeric data packages (NDPs) or computer model packages (CMPs) before making them available to the general public. CDIAC also offers databases (DBs) that have not been subjected to the normal CDIAC quality-control procedures in order to make them available more quickly. The abstract that follows describes the most recent database available from CDIAC. The database is available from CDIAC's Web site (http://cdiac.esd.ornl.gov/), from CDIAC's anonymous FTP area (cdiac.esd.ornl.gov), and in a variety of media upon request. Files describing the contents of the database are provided, but no additional documentation is available from CDIAC. Questions about accessing the database should be directed to CDIAC; technical questions (e.g., methodology or accuracy) should be directed to the CDIAC staff members responsible for preparing the database.

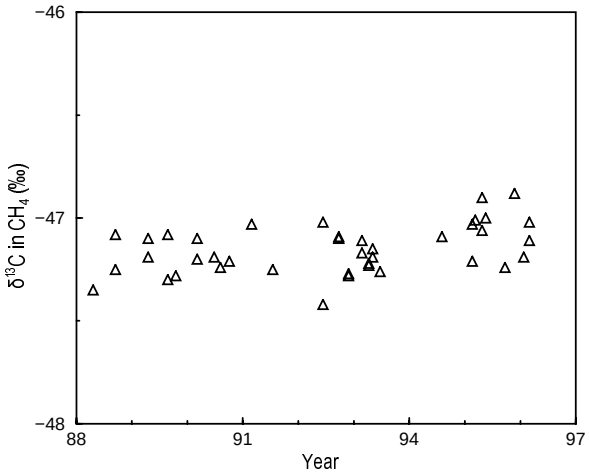
Measurements of Atmospheric Methane and $^{13}C/^{12}C$ of Atmospheric Methane from Flask Air Samples

Paul Quay and Johnny Stutsman, School of Oceanography, University of Washington, Seattle, Washington
Prepared by Tom Boden and Linda Allison, CDIAC

(1999) (http://cdiac.esd.ornl.gov/ndps/quay.html)

Precise measurements of atmospheric methane and $^{13}C/^{12}C$ in atmospheric methane from flask air samples collected at eight sites worldwide and aboard NOAA cruises in the Pacific Ocean are offered in this database. The eight sites include Olympic Peninsula, Washington; Cape Grim, Tasmania; Fraserdale, Ontario; Marshall Islands; Baring Head, New Zealand; Mauna Loa, Hawaii; Point Barrow, Alaska; and American Samoa. The measurements span the period 1988 to mid-1996. All isotopic measurements are reported in per mil (‰) and have been corrected for standard drift.

These data are useful for global methane budget analyses, for determining spatial and temporal trends in the atmospheric isotopic composition of methane, and for constraining the magnitude of the fossil and biogenic CH_4 source strengths.
WDC-A database



$^{13}C/^{12}C$ of Atmospheric CH_4 at Cape Grim

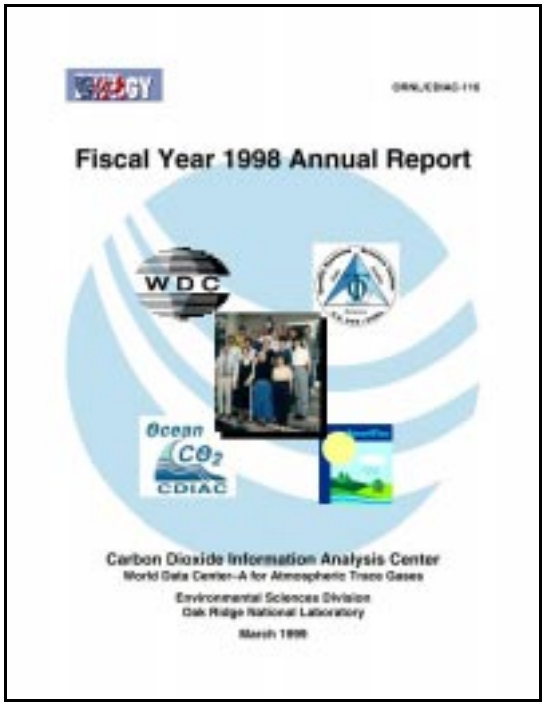
Recent and Relevant

Carbon dioxide-related publications are available from CDIAC while supplies last. Please note*: Several publications listed in prior versions of the catalog are no longer distributed by CDIAC. DOE personnel and DOE contractors should request those copies from the Office of Scientific and Technical Information (OSTI), P.O. Box 62, Oak Ridge, TN 37831 (http://www.osti.gov/). Other individuals may 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.*

Fiscal Year 1998 Annual Report

Robert M. Cushman, Thomas A. Boden, Les A. Hook, Sonja B. Jones, Dale P. Kaiser, and Tommy R. Nelson, CDIAC
Prepared by Marvel D. Burtis, CDIAC

ORNL/CDIAC-116 (1999) (http://cdiac.esd.ornl.gov/epubs/cdiac/annintro.htm)



Each fiscal year, CDIAC staff reflect upon the data center's progress by producing an annual report that documents highlights from the year and goals for the coming year. The *Fiscal Year 1998 Annual Report* provides information on new data products, publications, and additions to CDIAC's Web site and information on CDIAC's focus areas. The report provides statistics on the center's activities, such as the number of requests for global-change data and information, products requested, and citations in the published literature of data obtained from CDIAC. It also alerts users to new data products that CDIAC hopes to release in fiscal year 1999, lists awards received by CDIAC and publications and presentations of its staff, and names the many organizations with which CDIAC has collaborated to produce the data and information products it released in fiscal year 1998.

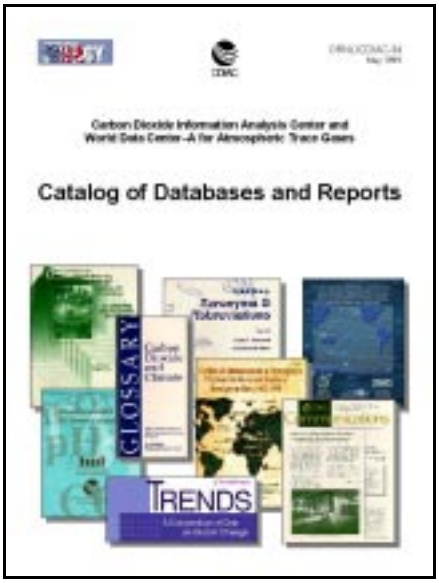
Please note: Only a limited number of printed copies are available upon request.

Catalog of Databases and Reports

Prepared by Karen Gibson, CDIAC

ORNL/CDIAC-34 (1999) (http://cdiac.esd.ornl.gov/epubs/catalog/index.htm)

CDIAC's *Catalog of Databases and Reports* provides information on the data products and reports available through CDIAC, including the DOE-sponsored research reports, CDIAC reports, CDIAC Numeric Data Packages (NDPs) and Computer Model Package (CMP), and other databases (DBs). The catalog, as well as many of the data products and reports listed in the catalog, are available online in enhanced format as HTML and/or PDF documents.



A 1999 revision of the catalog is available in PDF format and may be accessed and printed from our Web site. The HTML version of the catalog is revised as new products and updates become available.

Awards

CDIAC recently received two awards for Informational Materials and Technical Reports in the East Tennessee Society for Technical Communications (STC) Chapter's 1998 Technical Publications and Art Competition.

Excellence
Catalog of Databases and Reports (http://cdiac.esd.ornl.gov/epubs/catalog/index.htm), submitted by Marvel D. Burtis, Karen N. Gibson, and Robert M. Cushman.

Merit
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)* (http://cdiac.esd.ornl.gov/oceans/ndp_064/ndp064.html), submitted by Linda J. Allison, Alexander Kozyr, Christopher L. Sabine, and Gay Marie Logsdon.

New Data Management Tool Being Developed at ORNL

Most of the readers of *CDIAC Communications* are familiar with how CDIAC operates. Scientists, usually at the end of a study, submit their data to CDIAC. CDIAC quality-assures and documents the data, in many cases adding value to the data by further analyzing or combining the data with related data, and then makes the data available for distribution. There is another data-management support function, which until recently was not supported by ORNL. That is support for field data that were not mature but nevertheless had value to active scientists working on the same project. Supporting the (limited) distribution of these constantly changing, dynamic data sets, among researchers on three continents, was a task that the National Aeronautics and Space Administration (NASA) was facing for its Large Scale Biosphere-Atmosphere Experiment in Amazonia (http://lba-ecology.gsfc.nasa.gov/lbaeco/). NASA wanted a system able to make field data quickly available that did not put too many demands on scientific investigators producing these data and that could be built and maintained quickly and inexpensively.

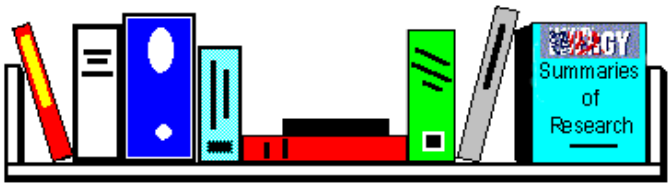
At the ORNL Distributed Active Archive Center (DAAC), a NASA-sponsored data center (http://www-eosdis.ornl.gov/), we developed a web-based, distributed data system we call Mercury. Mercury provides quick information delivery by supplying a template for creating detailed catalog entries, furnishing an engine that gathers data from linked web sites, and allowing users to search linked web sites for data. Researchers just need to make their metadata (information about their data sets) available on the Internet and, at night, an automated 'harvester' travels between the linked web sites retrieving the information and finally depositing it in an organized fashion at ORNL.

If a scientist put a data set out at night, it would be part of the system by the next morning. Each night, after the system has harvested the data, the database is rebuilt from scratch. Mercury takes advantage of the powerful XML (Extensive Markup Language) standard so it can support focused, fielded searches unlike many search engines. If the principal science investigator chooses to make a data set invisible to other users, it can be taken out of the database by the next day. This is important because it allows people to pull data from programmatic view if they later realize that there is some problem with them.

An initial test of Mercury began in late spring 1998. The International Geosphere-Biosphere Programme (IGBP) tested it until September of 1998, when they adopted it as their system (http://mercury.ornl.gov/servlet/igbp/). Currently, NASA's Earth Observing System Land Validation team has also adopted Mercury. ORNL is looking to work with NASA to expand the system to NASA's Earth Science Information Partners program. The Mercury home page is http://mercury.ornl.gov/. For a tutorial on Mercury see http://mercury.ornl.gov/PK/Mercury/tutorial.ppt. Open it as a presentation in PowerPoint.

Paul Kanciruk, Manager
Environmental Information Analysis Program
ORNL Environmental Sciences Division

CDIAC's Bookshelf



In the course of our work at CDIAC, books and announcements that are highly specialized and may not get a broad announcement to the worldwide scientific community cross our desks, so we'd like to mention them here. CDIAC does ***not*** *stock or distribute these publications.*

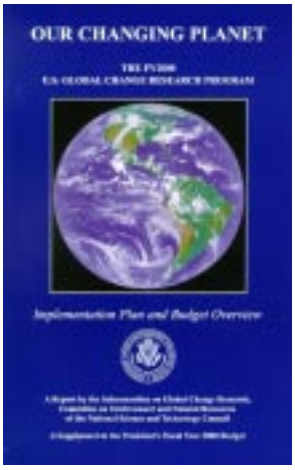
Our Changing Planet: The Fiscal Year 2000 U.S. Global Change Research Program (Committee on Environment and Natural Resources, National Science and Technology Council, Washington, D.C., 1999, 100 pp.).

The 2000 version of this annual report explains the major transition about to take place for the U.S. Global Change Research Program (USGCRP). The program will continue its research into improving our understanding of the changing Earth environment. A new focus is intended to advance our knowledge of how such change will affect society. And a global environmental change information service will facilitate the application of research results to national needs.

The USGCRP is guided by five broad objectives: determine the origins, rates, and likely future course of natural and anthropogenic changes; increase understanding of the combined effects of multiple stresses on ecosystems; understand and model global environmental change and its processes on finer spatial scales and across a wide range of time scales; address the potential for surprises and abrupt changes in the global environment; and understand and assess the impacts of global environmental change and their consequences for the United States.

To meet these objectives, the USGCRP includes five Program Elements: Understanding the Earth's Climate System; Biology and Biogeochemistry of Ecosystems; Composition and Chemistry of the Atmosphere; Paleoenvironment and Paleoclimate; Human Dimensions of Global Change; and the Global Water Cycle. The USGCRP is establishing a Carbon Cycle Science Initiative to give increased emphasis to that area.

The report summarizes key USGCRP accomplishments in 1998, such as continued progress in the National Assessment of the Potential Consequences of Climate Variability and Change; El Niño-Southern Oscillation forecasting; assessment of ozone depletion; and fire monitoring. Of special interest to readers of *CDIAC Communications*, the report lists global-change research data products newly available in 1998. Finally, the report describes the global-change 1998–2000 budget and program plans for each of the ten USGCRP agencies.



Copies of *Our Changing Planet* are available online at http://gcrio.ciesin.org/ocp00/ or from the U.S. Global Change Research Information Office, P.O. Box 1000, 61 Rt. 9W, Palisades, NY 10964 (914-365-8930, fax 914-365-8922)

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Quality Systems Science Center (QSSC)

Sponsored by the U.S. Department of Energy's Environmental Sciences Division and located within CDIAC, three important documents have been published *online* by NARSTO's QSSC to assist ozone researchers in ensuring the quality of their research results. These publications are available *online* only, as PDF files, and may be read using Adobe Acrobat Reader (http://cdiac.esd.ornl.gov/programs/NARSTO/narsto.html#qsmp).

Quality Systems Management Plan (QSMP)

ORNL/CDIAC-110

Ronald Patterson, U.S. Environmental Protection Agency; Les Hook, Meng-Dawn Cheng, and Thomas Boden, CDIAC

The QSMP identifies the NARSTO program quality assurance and data management requirements and guidelines for ensuring NARSTO product credibility, reliability, accessability, and quality—the keys to NARSTO success.

Quality Planning Handbook

ORNL/CDIAC-111

Les Hook, Meng-Dawn Cheng, and Thomas Boden, CDIAC

The planning handbook offers guidance concerning the preparation of project quality system planning documentation and research, modeling, and assessment reports.

Data Management Handbook

ORNL/CDIAC-112

Thomas Boden, Les Hook, and Meng-Dawn Cheng, CDIAC

The data management handbook offers guidance concerning the management of data, products, and records to help ensure the long-term utility of NARSTO products.

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