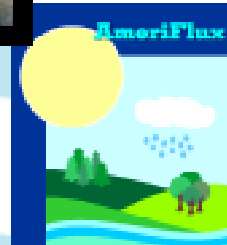
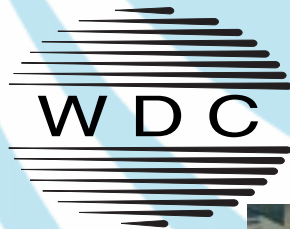




ORNL/CDIAC-116

Fiscal Year 1998 Annual Report



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

**Environmental Sciences Division
Oak Ridge National Laboratory**

March 1999

**Carbon Dioxide Information Analysis Center and
World Data Center–A for Atmospheric Trace Gases**

**Fiscal Year 1998
Annual Report**

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Introduction

Once again, the most recent fiscal year was a productive one for the Carbon Dioxide Information Analysis Center (CDIAC) at Oak Ridge National Laboratory (ORNL), as well as a year for change. The FY 1998 in Review section in this report summarizes quite a few new and updated data and information products, and the “What’s Coming in FY 1999” section describes our plans for this new fiscal year.

During FY 1998, CDIAC began a data-management system for AmeriFlux, a long-term study of carbon fluxes between the terrestrial biosphere of the Western Hemisphere and the atmosphere. The specific objectives of AmeriFlux are to establish an infrastructure for guiding, collecting, synthesizing, and disseminating long-term measurements of CO₂, water, and energy exchange from a variety of ecosystems; collect critical new information to help define the current global CO₂ budget; enable improved predictions of future concentrations of atmospheric CO₂; and enhance understanding of carbon fluxes, Net Ecosystem Production (NEP), and carbon sequestration in the terrestrial biosphere. The data-management system, available from CDIAC’s AmeriFlux home page (<http://cdiac.esd.ornl.gov/programs/ameriflux/>) is intended to provide consistent, quality-assured, and documented data across all AmeriFlux sites in the United States, Canada, Costa Rica, and Brazil. It is being developed by Antoinette Brenkert and Tom Boden, with assistance from Susan Holladay (who joined CDIAC specifically to support the AmeriFlux data-management effort).

Meanwhile, Tom Boden’s work in the NARSTO Quality Systems Science Center will be taken over by Sig Christensen (who has a long history in the ORNL Environmental Sciences Division, analyzing environmental data, but is new to CDIAC) and Linda Allison.

We welcome Susan Holladay and Sig Christensen to CDIAC!

During FY 1998, CDIAC also developed a “YOTO Drifters” web site (<http://drifters.doe.gov>) for U.S. Department of Energy’s (DOE’s) contribution to a multiagency project to deploy ocean drifters as part of the International Year of the Ocean (YOTO). The hope is to engage the education community in study of the oceans by making real-time data on ocean currents and temperatures readily available, along with related educational resource materials. Forrest Hoffman is the webmaster for this site.

I would like to acknowledge the guidance and support of Bobbi Parra, CDIAC’s Program Manager in the DOE’s Office of Biological and Environmental Research, and all the DOE global-change program managers (Pat Crowley, Roger Dahlman, Jerry Elwood, Wanda Ferrell, John Houghton, Peter Lunn, Anna Palmisano, Rick Petty, and Mike Riches).



Robert M. Cushman

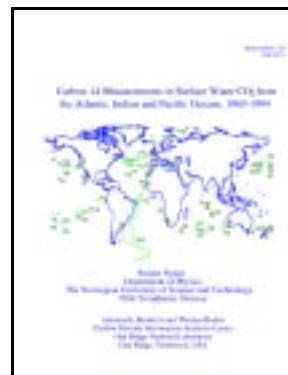
FY 1998 in Review

New Numeric Data Packages (NDPs)

During fiscal year (FY) 1998, the Carbon Dioxide Information Analysis Center (CDIAC) at Oak Ridge National Laboratory (ORNL) published six numeric data packages (NDPs) under the auspices of the U.S. Department of Energy (DOE). The data and descriptive files are available via the Internet from CDIAC's Web site (<http://cdiac.esd.ornl.gov>) and from CDIAC's anonymous file transfer protocol (FTP) area ([cdiac.esd.ornl.gov](ftp://cdiac.esd.ornl.gov)). Printed reports and data on digital media are available from CDIAC on request.

- ***A Coastal Hazards Data Base for the U.S. West Coast*** (ORNL/CDIAC-81, NDP-043C), by Vivien Gornitz [National Aeronautics Space Administration (NASA) Goddard Institute for Space Studies (GISS)] and prepared by Tammy Beaty and Richard Daniels (CDIAC). NDP-043C completes the three-part series (NDP-043A covers the U.S. East Coast and NDP-043B the U.S. Gulf Coast). It describes the contents of a digital database that can be used to identify coastlines along the U.S. West Coast that are at risk to sea-level rise. This database integrates point, line, and polygon data for the U.S. West Coast into 0.25-degree 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 databases. Each coastal grid cell and line segment contains data variables from the following seven data sets: elevation, geology, geomorphology, sea-level trends, shoreline displacement (erosion/accretion), tidal ranges, and wave heights. These variables may be used to calculate a Coastal Vulnerability Index (CVI); algorithms used to calculate several CVIs are listed within the text. (<http://cdiac.esd.ornl.gov/ndps/ndp043c.html>)

- ***Carbon-14 Measurements in Surface Water CO₂ from the Atlantic, Indian and Pacific Oceans, 1965–1994*** (ORNL/CDIAC-104, NDP-057A), by Reidar Nydal (Norwegian University of Science and Technology, Trondheim) and prepared by Antoinette Brenkert and Tom Boden (CDIAC). These data support the study of the dynamics of the global carbon cycle through quantification of the isotopic exchange between the atmosphere and oceans. NDP-057A accompanies the previously published NDP-057 which included atmospheric isotope data. (<http://cdiac.esd.ornl.gov/epubs/ndp/ndp057a/ndp057a.htm>)



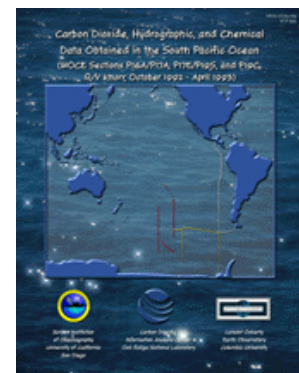
- ***Carbon Dioxide Emission Estimates from Fossil-Fuel Burning, Hydraulic Cement Production, and Gas Flaring for 1995 on a One Degree Grid Cell Basis*** (NDP-058A), produced by Antoinette Brenkert (CDIAC), complements NDP-058, which includes estimates for 1950, 1960, 1970, 1980, and 1990. The 1995 national emission estimates (taken from NDP-030, <http://cdiac.esd.ornl.gov/ndps/ndp030.html>) were distributed within each country according to the Li population database (DB1016, <http://cdiac.esd.ornl.gov/ndps/db1016.html>). (<http://cdiac.esd.ornl.gov/ndps/ndp058a.html>).

- ***Effects of CO₂ and Nitrogen Fertilization on Growth and Nutrient Content of Juvenile Ponderosa Pine*** (ORNL/CDIAC-107, NDP-061A), by Dale Johnson [Desert Research Institute (DRI) and the University of Nevada-Reno (UNR)], Timothy Ball (DRI), and Roger Walker (UNR) and prepared by Robert Cushman (CDIAC). NDP-061A presents measured values of plant diameter and height, biomass, and nutrient concentrations from a study of the effects of carbon dioxide and nitrogen fertilization conducted in open-top chambers. This database can help quantify the response of vegetation to rising atmospheric concentrations of carbon dioxide caused by fossil-fuel combustion and land use change. (<http://cdiac.esd.ornl.gov/epubs/ndp/ndp061a/ndp061a.htm>)



- ***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)*** (ORNL/CDIAC-103, NDP-064), by Christopher Sabine and Robert Key (Princeton University) and prepared by Alexander Kozyr and Linda Allison (CDIAC). NDP-064 includes data on mole fraction of carbon dioxide, sea surface salinity, and sea surface temperature measured during the nine 1994–1996 Indian Ocean cruises of the R/V *Knorr*. This database contributes to our understanding of the role of the oceans in the global carbon cycle. The data contributors are part of the Joint Global Ocean Flux Study supported by the U.S. Department of Energy to make carbon-related measurements on the World Ocean Circulation Experiment global survey cruises. (http://cdiac.esd.ornl.gov/oceans/ndp_064/ndp064.html)

- ***Carbon Dioxide, Hydrographic, and Chemical Data Obtained in the South Pacific Ocean (WOCE Sections P16A/P17A, P17E/P19S, and P19C, RV Knorr, October 1992–April 1993)*** (ORNL/CDIAC-109, NDP-065), by Stephany Rubin, John Goddard, David Chipman, Taro Takahashi, and Stewart Sutherland [Lamont-Doherty Earth Observatory (LDGO) of Columbia University] and Joseph Reid, James Swift, and Lynne Talley [Scripps Institution of Oceanography (SIO) of the University of California, San Diego] and prepared by Alexander Kozyr (CDIAC). NDP-065 includes data on total and partial pressure of carbon dioxide, the chlorofluorocarbons CFC-11 and CFC-12, and nutrient, chemical, and physical variables measured at 422 stations during three South Pacific Ocean cruises of the R/V *Knorr* (between Tahiti, Chile, and Panama). At 114 stations, complete vertical profiles were obtained from the surface to the ocean floor. This database contributes to our understanding of the role of the oceans in the global carbon cycle. The investigators were funded by the U.S. Department of Energy to make carbon-related measurements on the World Ocean Circulation Experiment global survey cruises. (http://cdiac.esd.ornl.gov/oceans/ndp_065/ndp065.html)



New Databases (DBs)

During FY 1998, CDIAC published one database. The data and descriptive files are available via CDIAC's Web site (<http://cdiac.esd.ornl.gov>) and from CDIAC's anonymous FTP area (cdiac.esd.ornl.gov), as well as on a variety of magnetic media.

- ***The Environmental Measurements Laboratory's Stratospheric Radionuclide (RANDAB) and Trace Gas (TRACDAB) Databases*** (DB-1019), contributed by Robert Leifer and Nita Chan [DOE Environmental Measurements Laboratory (EML)] and prepared by Tom Boden (CDIAC). RANDAB represents the world's largest collection of stratospheric and upper tropospheric tritium, radon, and $^{14}\text{CO}_2$ data, extending from 1957 to 1983. The tritium data were provided by Allen Mason of Los Alamos National Laboratory and H. G. Östlund of the University of Miami. TRACDAB contains more than 1000 stratospheric trace gas (CCl_3F , CCl_2F_2 , CCl_4 , CH_3CCl_3 , SF_6 , N_2O , CO_2 , CH_4 , and COS) measurements for the period 1974 to 1983, analyzed at EML, Washington State University, and the Oregon Graduate Institute for Science and Technology. They are useful for developing and verifying large-scale transport and climate models, understanding tropospheric and stratospheric transport processes, and modeling the future atmospheric impact of a projected new fleet of stratospheric flying aircraft.
(<http://cdiac.esd.ornl.gov/epubs/db/db1019/db1019.html>)

Updated NDPs and DBs

- ***Atmospheric CO₂ Concentrations—Mauna Loa Observatory, Hawaii, 1958–1997*** (revised August 1998) (NDP-001), by Charles Keeling and Timothy Whorf (SIO) and updated by Tom Boden (CDIAC). It contains the monthly and annual atmospheric CO₂ record, including data from 1958 through 1997. These data represent the longest continuous record of atmospheric CO₂ concentrations in the world. This precise data series is a reliable indicator of the regional trend in the concentration of atmospheric CO₂ in the middle layers of the troposphere and is critical to CO₂-related research.
(<http://cdiac.esd.ornl.gov/ndps/ndp001.html>)
- ***Global, Regional, and National CO₂ Emission Estimates from Fossil Fuel Burning, Cement Production, and Gas Flaring: 1751–1996*** (NDP-030), by Gregg Marland (CDIAC), Bob Andres (University of Alaska-Fairbanks), Tom Boden (CDIAC), Cathy Johnston (The University of Tennessee-Knoxville), and Antoinette Brenkert (CDIAC) and prepared by Gregg Marland and Tom Boden (CDIAC). These data quantify CO₂ emissions from fossil fuel burning, cement production, and gas flaring through 1996, some as far back as 1751. These estimates, derived primarily from energy statistics published by the United Nations (UN), were calculated using the methods of Marland and Rotty (1984). Cement production estimates from the U.S. Department of the Interior's Bureau of Mines were used to estimate CO₂ 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 a few national estimates provided by Gregg Marland.
(<http://cdiac.esd.ornl.gov/ndps/ndp030.html>)
- ***Two Long-Term Instrumental Climatic Data Bases of the People's Republic of China (1997)*** (NDP-039), by Tao Shiyan, Fu Congbin, Zeng Zhaomei, and Zhang Qingyun (Institute of Atmospheric Physics, Beijing) and prepared by Dale Kaiser (CDIAC). NDP-039 contains monthly mean temperature and precipitation data from 205 stations, plus additional meteorological variables from a second network of 65 stations. The data extend through 1993; sixteen stations from these data

sets have records beginning before 1900. These databases, from a large Northern Hemisphere land mass (i.e., the People's Republic of China), are useful in tracking climate trends, validating climate models, and analyzing the relationship between such climatic factors as cloudiness and temperature. (<http://cdiac.esd.ornl.gov/ndps/ndp039.html>)

- ***Six- and Three-hourly Meteorological Observations from 223 U.S.S.R. Stations*** (ORNL/CDIAC-108, NDP-048), by Vyacheslav N. Razuvaev, E. G. Apasova, and R. A. Martuganov [All-Russian Research Institute of Hydrometeorological Information–World Data Centre (RIHMI-WDC) Obninsk, Russia] and prepared by Dale Kaiser (CDIAC). The database now includes data through 1990 for 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 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. (<http://cdiac.esd.ornl.gov/epubs/ndp/ndp048/ndp048.html>)
- ***The ALE/GAGE/AGAGE Monitoring Network*** (DB1001), which provides continuous high-frequency measurements of eight important trace gases: methane (CH₄); nitrous oxide (N₂O); the chlorofluorocarbons CFCl₃, CF₂Cl₂, and CF₂CFCFCl₂; methyl chloroform (CH₃CCl₃); chloroform (CHCl₃); and carbon tetrachloride (CCl₄). This database has been one of CDIAC's "Top Ten" most-requested products, and it supports analyses and monitoring related to both the Kyoto Protocol (to control global warming caused by elevated atmospheric concentrations of greenhouse gases) and the Montreal Protocol (to protect the Earth's ozone layer). The data were contributed by R. Prinn, D. Cunnold, P. Fraser, R. Weiss, P. Simmonds, F. Alyea, L. P. Steele, and D. Hartley; they were prepared for online distribution by CDIAC's Tom Boden. The program began in 1978, and this update provided data through September 1997 for all five existing 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). (<http://cdiac.esd.ornl.gov/ndps/alegagage.html>)
- ***In situ Carbon 13 and Oxygen 18 Ratios of Atmospheric CO₂ from Cape Grim, Tasmania, Australia: 1982–1993*** (DB1014), contributed by Roger Francey and Colin Allison (Commonwealth Scientific and Industrial Research Organisation, Australia) and prepared for online distribution by CDIAC's Tom Boden. Since 1982, a continuous program of sampling atmospheric CO₂ to determine stable isotope ratios has been maintained at the Australian Baseline Air Pollution Station, Cape Grim, Tasmania (40° 40' 56" S, 144° 41' 18" E). The samples, a preponderance of which are 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 CO₂ reference gas with isotopic carbon close to atmospheric values provide a unique combination of factors with respect to obtaining a globally representative signal from a surface site. The carbon-isotope data help partition the uptake of fossil fuel emissions between ocean and terrestrial reservoirs, whereas the oxygen-isotope data predominantly reflect the terrestrial hydrological cycle. (<http://cdiac.esd.ornl.gov/ndps/db1014.html>)

Publications

- ***Catalog of Databases and Reports*** (ORNL/CDIAC-34), compiled by Marvel Burtis (CDIAC). A new streamlined version provides information about the many reports and materials made available by

CDIAC. The catalog indicates the databases and reports that are available in enhanced format (e.g., with hyperlinks and graphics) from CDIAC's Web site.

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

- **CDIAC Communications**, Number 24, Winter 1998, co-edited by Sonja Jones and Karen Gibson (CDIAC). This issue features a lead story on CDIAC's CO₂ emissions estimates through 1995, a special story on the role played by CDIAC in support of the Kyoto meeting on international greenhouse-gas emissions reductions, a discussion of the NARSTO Quality Systems Science Center now operated by CDIAC, descriptions of new databases available from CDIAC, and summaries of new global-change publications that may be of interest.
(<http://cdiac.esd.ornl.gov/newsletr/winter98/ccw98.htm>)
- **Fiscal Year 1997 Annual Report** (ORNL/CDIAC-106), by Bob Cushman, Tom Boden, Sonja Jones, Dale Kaiser, and Tommy Nelson (with input from the other CDIAC staff) and compiled by Marvel Burtis (CDIAC). The report documents highlights from the fiscal year (new data products and other publications); provides statistics, such as the number of requests for global-change data and information from CDIAC, and citations in the published literature of data obtained from CDIAC; alerts users to new data products that CDIAC hoped to release in Fiscal Year 1998; lists awards received by CDIAC and publications and presentations of its staff; and lists the many organizations with which CDIAC has collaborated to produce the data and information products it released in FY 1997.
(<http://cdiac.esd.ornl.gov/epubs/cdiac/cdiac106/1997ANN.REV.htm>)
- **Program Developed for CO₂ System Calculations** (ORNL/CDIAC-105), by Ernie Lewis and Doug Wallace (Brookhaven National Laboratory) and prepared by Linda Allison (CDIAC). The program documented in this report calculates any two of the four carbonate system parameters in seawater, given measurements of the other two; the user may select from four different pH scales and several sets of dissociation constants. As increasingly accurate ocean carbon measurements are taken, in the attempt to quantify the role of the oceans in regulating atmospheric concentrations of the greenhouse gas carbon dioxide, these calculation issues grow in importance.
(<http://cdiac.esd.ornl.gov/oceans/co2rpert.html>)

Additions and Updates to Online Publications

- **New to Trends Online**



Global and Hemispheric Temperature Anomalies—Land and Marine Instrumental Records by Philip D. Jones, Tim J. Osborn, and Keith R. Briffa (University of East Anglia, Norwich, UK) and David E. Parker (Hadley Centre for Climate Prediction and Research, Bracknell, UK) and prepared for online publication by Dale Kaiser (CDIAC). The 1856–1997 time series updates the data last presented in CDIAC's printed *Trends* '93 report. The land portion of this new database is composed 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. The marine data consist of sea surface temperatures that incorporate in situ measurements from ships and buoys. These data have been used extensively by the Intergovernmental Panel on Climate Change (IPCC). The time series indicate that the five warmest years of the global record have all occurred since 1990 and that 1997 was the warmest. The average surface air temperature of the globe has warmed approximately 0.5 degrees Celsius since the middle of the nineteenth century.
(<http://cdiac.esd.ornl.gov/trends/temp/jonescru/jones.html>)

Historical CO₂ Records from the Law Dome DE08, DE08-2, and DSS Ice Cores (Antarctica), contributed by D. M. Etheridge, L. Paul Steele, R. L. Langenfelds, and Roger J. Francey (Division of Atmospheric Research, CSIRO, Aspendale, Victoria, Australia), J. -M. Barnola (Laboratoire de Glaciologie et Géophysique de l'Environnement, Saint Martin d'Hères-Cedex, France), and Vin I. Morgan (Antarctic CRC and Australian Antarctic Division, Hobart, Tasmania, Australia) and prepared by Mónica Martínez (summer student from the University of Puerto Rico, Rio Piedras) and Tom Boden (CDIAC). These data provide atmospheric CO₂ mixing ratios from 1006 to 1978 A.D. Because of the high rate of snow accumulation at Law Dome, the air enclosed in the three ice cores has unparalleled age resolution and extends into recent decades. Preindustrial CO₂ mixing ratios were in the range 275 to 284 ppm, with the lower levels during 1550–1800 A.D., probably as a result of a colder global climate. The Law Dome ice core CO₂ records show major growth in atmospheric CO₂ levels over the industrial period, except during 1935–1945 A.D. when levels stabilized or decreased slightly. Such data have a number of important applications, such as studying the relationship between greenhouse gases and climate change and calibrating models of the global carbon cycle. (<http://cdiac.esd.ornl.gov/trends/co2/lawdome.html>).

Annual Estimates of Global Anthropogenic Methane: 1860–1994, contributed by David Stern (Centre for Resource and Environmental Studies, Australian National University, Canberra) and Robert Kaufmann (Center for Energy and Environmental Studies, Boston University) and prepared for online publication by Bob Cushman (CDIAC). Methane is thought to rank second only to carbon dioxide in terms of importance as a greenhouse gas, and a knowledge of anthropogenic emissions is important for studies of the biogeochemical cycling of methane and for consideration of strategies for reducing emissions. (<http://cdiac.esd.ornl.gov/trends/meth/ch4.htm>)

- The fossil-fuel CO₂ emissions section of *Trends Online*, which included global, regional, and national CO₂ emission estimates for 1751–1995 (Marland et al.), was redesigned and made available online during FY 1997.
- **Updates to *Trends Online***

Data records of atmospheric carbon dioxide measurements from Mt. Cimone, Italy, (<http://cdiac.esd.ornl.gov/trends/co2/mtcim.htm>) and Lampedusa Island (<http://cdiac.esd.ornl.gov/trends/co2/lampis.htm>) were updated by Tom Boden (CDIAC). The Mt. Cimone data, contributed by Tiziano Colombo and Riccardo Santaguida (Italian Meteorological Service, Sestola, Italy), began in 1979 and now extend through 1996. The atmospheric CO₂ record from Mt. Cimone represents the longest continuous record available for the Mediterranean area. From 1980 to 1996, the annual mean atmospheric CO₂ concentration at Mt. Cimone rose from 337.31 parts per million by volume (ppmv) to 363 ppmv. The Lampedusa Station data, contributed by Luigi Ciattaglia and P. Chamard (CNR/IFA, Rome), now extend from 1992 through July 1997.

Data records of carbon 14 in atmospheric carbon dioxide from Schauinsland, Germany, (<http://cdiac.esd.ornl.gov/trends/co2/cent-scha.htm>) were updated by Tom Boden (CDIAC). The Schauinsland data, contributed by Ingeborg Levin, Bernd Kromer, and Rolf Graul (Institut für Umweltphysik, University of Heidelberg, Germany), begin in 1976 and extend now through 1996. On the basis of close agreement between the data from Schauinsland and Vermunt, the two records are considered indicative of the ¹⁴C level of tropospheric CO₂ above central Europe. The Schauinsland

record shows a seasonal pattern, with minimum values occurring during the winter half year, a consequence of bomb ^{14}C still equilibrating with the world oceans and the biosphere, as well as an ongoing input of ^{14}C -free fossil fuel CO_2 into the atmosphere.

- ***Selected Translated Abstracts of Russian-Language Climate-Change Publications***, produced in collaboration with the All-Russian Research Institute of Hydrometeorological Information-World Data Center (Obninsk, Russia) is now online as a four-volume series that includes hundreds of abstracts on the topics of the surface energy budget, clouds, aerosols, and general circulation models. The series, produced under the auspices of a 1972 U.S.–U.S.S.R. agreement on protection of the environment, opens up to western researchers a wealth of climate-change literature that was previously available only in Russian.
(<http://cdiac.esd.ornl.gov/epubs/cdiac/russengl.html>)
- The **Quality Systems Science Center**, operated by CDIAc on behalf of the North American Research Strategy for Tropospheric Ozone (NARSTO) has published online three important documents to assist ozone researchers in ensuring the quality of their research results. These publications are available online as PDF files, and may be read with the free Adobe Acrobat Reader.
(<http://cdiac.esd.ornl.gov/cdiac/programs/NARSTO/narsto.html#qsmp>)

NARSTO Quality Systems Management Plan (ORNL/CDIAC-110), by Ronald Patterson (U.S. Environmental Protection Agency) and Les Hook, Meng-Dawn Cheng, and Thomas Boden (CDIAC) identifies the NARSTO program quality assurance and data management requirements and guidelines for ensuring NARSTO product credibility, reliability, accessibility, and quality—the keys to NARSTO success.

The NARSTO Quality Planning Handbook (ORNL/CDIAC-111), by Les Hook, Meng-Dawn Cheng, and Thomas Boden (CDIAC) offers guidance concerning the preparation of project quality system planning documentation and research, modeling, and assessment reports.

The NARSTO Data Management Handbook (ORNL/CDIAC-112), by Thomas Boden, Les Hook, and Meng-Dawn Cheng (CDIAC) offers guidance concerning the management of data, products, and records to help ensure the long-term utility of NARSTO products.

- Tom Boden and Sonja Jones (CDIAC) put online a concise table of important information about carbon dioxide and eleven other greenhouse gases, including data on pre-industrial (1860) concentration, present tropospheric concentration, global warming potential, and atmospheric lifetime. All data are referenced to their sources. This information should prove a convenient reference for global change studies and for analyses related to the Kyoto and Montreal protocols.
(http://cdiac.esd.ornl.gov/pns/current_ghg.html)

New Focus Areas

- CNN Interactive cited the Project YOTO Drifters Web site, hosted by CDIAc and developed by Forrest Hoffman, in its online article “Ocean drifters bring science to the classroom” (<http://www.cnn.com/TECH/science/9807/23/drifters.yoto/>) posted on 23 July 1998. This Web site (<http://drifters.doe.gov/>) was developed as DOE’s contribution to the multiagency National Oceanographic Partnership Program project to deploy ocean drifters as part of the International Year

of the Ocean (YOTO) and to engage the education community in study of the oceans by making real-time data on ocean currents and temperatures readily available, along with related educational resource materials.

- CDIAC is responsible for developing and maintaining a web-based data management system for AmeriFlux, a research program to quantify fluxes of carbon between the terrestrial biosphere and the lower atmosphere at selected sites in Brazil, Canada, Costa Rica, and the United States.

FY 1998 marked the first year AmeriFlux data were available and distributed from CDIAC.

AmeriFlux scientists are now routinely submitting CO₂ and radiation flux, meteorological, and ecological data to CDIAC. By the end of FY 1998, data were available from three sites considered part of the AmeriFlux network, which now includes roughly 40 sites in the Americas. The three sites for which data are available are Harvard Forest (Massachusetts), Howland Forest (Maine), and Walker Branch Watershed (Tennessee). Data from seven other AmeriFlux sites were submitted to CDIAC in FY 1998 and are currently being processed.

Work priorities for FY 1998 focused on interactions with AmeriFlux scientists, documentation issues aimed at improving future AmeriFlux site data integration and intercomparison efforts, computer program development to assist AmeriFlux data processing and QA/QC efforts, and development of the AmeriFlux Web site. Development and maintenance of the AmeriFlux Web site continued during FY 1998 and the site received over 58,000 “hits” from more than 1,500 users worldwide.

(<http://cdiac.esd.ornl.gov/programs/ameriflux/>)

- The U.S. Information Agency had a link to CDIAC’s web site in their online story *President Clinton on Climate Change: Radio address, July 25, 1998*. The USIA page also had a link to a World Wildlife Fund page with country-by-country CO₂ emissions, the data for which came from CDIAC.
- CDIAC developed a special web page in honor of Charles David Keeling’s historic 40-year record of atmospheric carbon dioxide measurements at Mauna Loa, Hawaii. Keeling’s work at Mauna Loa provided the first evidence of rising concentrations of this most important greenhouse gas. This web page, developed by Sonja Jones (CDIAC), provides links to Vice President Al Gore’s presentation of a special achievement award to Keeling and to the data.
(http://cdiac.esd.ornl.gov/new/keel_page.html)
- CDIAC has added a Global Climate Change Links Page to its Web site. This page, developed by Dale Kaiser (CDIAC), provides links to web pages that responsibly present information and discussion pertinent to the science behind the global climate change debate. CDIAC hopes it will be especially helpful for those who may be just beginning their research into these issues.
(<http://cdiac.esd.ornl.gov/pns/gcclinks.html>)
- Dale Kaiser contributed sections on Current Climate, Climate Trends, and Climate Scenarios to the North America chapter of the Intergovernmental Panel on Climate Change’s (IPCC’s) 1998 special report, *The Regional Impacts of Climate Change*. Because of a recent publication on cloud amount trends over China (see CDIAC publications list, p. 11), he has been invited to contribute his findings to the Intergovernmental Panel on Climate Change’s upcoming Third Assessment Report, *Climate Change 2000, The Science of Climate Change*. This type of work is facilitated by DOE’s bilateral research agreement and activities with the People’s Republic of China’s China Meteorological Administration, in which Dale is an active participant. FY 1999 will likely also see further research at CDIAC into cloudiness trends over the former Soviet Union, which, when published later in FY

1999 or in early FY 2000, may also be included in the aforementioned IPCC report. The former Soviet Union climate research stems from data-sharing activities under the U.S.–Russia Agreement on Cooperation in the Field of Protection of the Environment and Natural Resources, Working Group VII, The Influence of Environmental Changes on Climate.

CDIAC Presentations, Publications, and Awards

Presentations

- Cushman, R. M., and S. B. Jones. 1997. The Carbon Dioxide Information Analysis Center and World Data Center-A for Atmospheric Trace Gases. Kyoto and Beyond: International Climate Change Policy Moves to Center Stage. Washington, D.C., November.
- Cushman, R. M. 1998. CDIAC: Data and Information for Global-Change Studies, Special Libraries Association 89th Annual Conference. Indianapolis, Ind., June.
- Cushman, R. M. 1998. CDIAC's Recent Working Group VIII Activities. Working Group VIII Meeting, Boulder, Colo., September.
- Kaiser, D. P. 1998. Analysis of Monthly Mean Cloud Amount for China: 1951–1994. Ninth Symposium on Global Change Studies, Phoenix, Ariz., January.

Publications

- Cushman, R. M. 1997. Publications, Presentations, and Awards of the Carbon Dioxide Information Analysis Center and World Data Center-A for Atmospheric Trace Gases. ORNL/CDIAC-101. Oak Ridge National Laboratory, Oak Ridge, Tenn.
- Kaiser, D. P. 1998. Analysis of total cloud amount over China, 1951–1994. *Geophysical Research Letters* 25:(19)3599–3602. (<http://www.agu.org/GRL/articles/98GL52784/GL483W01A.html>)
- Shriner, D. S., R. B. Street, R. Ball, D. D'Amours, K. Duncan, D. Kaiser, A. Maarouf, L. Mortsch, P. Mulholland, R. Neilson, J. A. Patz, J. D. Scheraga, J. G. Titus, H. Vaughan, and M. Weltz. 1998. Chapter 8, *North America*, in *The Regional Impacts of Climate Change*, Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK.

Awards

- 1997 Technical Publications Competition sponsored by the East Tennessee Chapter of the Society for Technical Communication (STC).

Award of Merit in the technical reports category (conferred in February 1998).

Carbon-14 Measurements in Atmospheric CO₂ from Northern and Southern Hemisphere Sites, 1962–1993 (Thomas A. Boden and Virgene Zimbrunn)
(<http://cdiac.esd.ornl.gov/epubs/ndp/ndp057/ndp057.htm>)

- 1997 Online Competition, sponsored by the Atlanta Chapter of the Society for Technical Communications.

Award of Excellence in the technical publications category (conferred in April 1998).

Carbon Dioxide, Hydrographic, and Chemical Data Obtained During the R/V Meteor Cruise 18/1 in the North Atlantic Ocean (Alexander Kozyr)
(http://cdiac.esd.ornl.gov/oceans/ndp_056/ndp056.html)

Awards of Achievement in online newsletters

CDIAC Communications Spring Issue No. 23 (Karen N. Gibson and Frederick M. O'Hara)
(<http://cdiac.esd.ornl.gov/cdiac/newsletr/spring97/spr97.htm>)

DOE Research Summary. Historical Variations in Terrestrial Biospheric Carbon Storage (Wilfred M. Post, Anthony W. King, Stan D. Wullschleger, Forrest M. Hoffman, and Marvel D. Burtis)
(<http://cdiac.esd.ornl.gov/pns/doers/doer34/doer34.htm>)

- Additional Awards

Karen Gibson received a Lockheed Martin Energy Research Corporation Significant Event Award recognizing her role and efforts in producing the newsletter *CDIAC Communications* which received an award in the 1996 Atlanta Online Competition of the STC, October 1997

Sonja Jones received the Environmental Sciences Division award for Distinguished Technical Achievement, May 1998.

Dale Kaiser received a Lockheed Martin Energy Research Corporation Significant Event Award recognizing his role as lead author on the North American Chapter of the Intergovernmental Panel on Climate Change's 1998 special report, *The Regional Impacts of Climate Change*, April 1998.

Proposal Awarded

- Tom Boden and Tony King received funding support for three years from DOE's Integrated Assessment of Global Climate Change Research Program for their proposal *National and Global Supply Curves for Land-Use CO₂ Emissions from an Ecological Land-Use Emissions Model and National Land-Use and Land-Cover Change Statistics*.

Selected CDIAC Citations

Data from CDIAC publications were cited in a number of journal articles, magazine articles, and newsletters. The following publications are representative of works that have been cited.

- NDP-026, NDP-026A, and NDP-026B, Cloud reports from ship and land stations series. (Hahn et al.)

Norris, J. R. 1998. Low cloud type over the ocean from surface observations. Part I: Relationship to surface meteorology and the vertical distribution of temperature and moisture. *Journal of Climate* 11:369–382.

Norris, J. R. 1998. Low cloud type over the ocean from surface observations. Part II: Geographical and seasonal variations. *Journal of Climate* 11:383–403.
- NDP-030, *Global, Regional, and National Annual CO₂ Emission Estimates for Fossil-Fuel Burning, Hydraulic Cement Production, and Gas Flaring: 1950–1995* (Boden et al.)

Meyerson, F. A. B. 1998. Population, carbon emissions, and global warming: The forgotten relationship at Kyoto. *Population and Development Review* 24:115–130.

World Wildlife Fund. 1998. Country by Country. (<http://www.panda.org/climate/country.shtml>).
- NDP-040, *Daily Temperature and Precipitation Data for 223 U.S.S.R. Stations* (Razuvaëv et al.)

Michaels, P. J., R. C. Balling, Jr., R. S. Vose, and P. C. Knappenberger. 1998. Analysis of trends in the variability of daily and monthly historical temperature measurements. *Climate Research* 10:27–33.
- NDP-041, *The Global Historical Climatology Network: Long-Term Monthly Temperature, Precipitation, Sea Level Pressure, and Station Pressure Data* (Vose et al.)

Peterson, T. C., R. Vose, R. Schmoyer, and V. Razuvaëv. 1998. GHCN quality control of monthly temperature data. *International Journal of Climatology* 18(11):1169–1180.
- NDP-042, *United States Historical Climatology Network Daily Temperature and Precipitation Data* (Hughes et al.)

Karl, T. R., and R. W Knight. 1998. Secular trends of precipitation amount, frequency, and intensity in the United States. *Bulletin of the American Meteorological Society* 79:231–241.

Michaels, P. J., R. C. Balling, Jr., R. S. Vose, and P. C. Knappenberger. 1998. Analysis of trends in the variability of daily and monthly historical temperature measurements. *Climate Research* 10:27–33.
- NDP-050, *Continental Scale Estimates of the Biotic Carbon Flux from Land Cover Change: 1850 to 1980* (Houghton and Hackler)

IGBP Terrestrial Carbon Working Group. 1998. The terrestrial carbon cycle: Implications for the Kyoto Protocol. *Science* 280:1393–1394.

- *Trends '93* (ORNL/CDIAC-65) and *Trends Online*

Anonymous 1998. Back from Wentz it came: Satellite temperature correction changes nothing. *World Climate Report* 3:24.

Dettinger, M. D., and M. Ghil. 1998. Seasonal and interannual variations of atmospheric CO₂ and climate. *Tellus* 50B:1–24.

Hoffert, M. I., K. Caldeira, A. K. Jain, E. F. Haites, L. D. D. Harvey, S. D. Potter, M. E. Schlesinger, S. H. Schneider, R. G. Watts, T. M. L. Wigley, and D. J. Wuebbles. 1998. Energy implications of future stabilization of atmospheric CO₂ content. *Nature* 395:881–884.

Meyerson, F. A. B. 1998. Population, carbon emissions, and global warming: The forgotten relationship at Kyoto. *Population and Development Review* 24:115–130.

Peng, T.-H., R. Wanninkhof, J. L. Bullister, R.A. Feely, and T. Takahashi. 1998. Quantification of decadal anthropogenic CO₂ uptake in the ocean based on dissolved inorganic carbon measurements. *Nature* 396:560–563.

Wamsley, P. R., J. W. Elkins, D. W. Fahey, G. S. Dutton, C. M. Volk, R. C. Myers, S. A. Montzka, J. H. Butler, A. D. Clarke, P. J. Fraser, L. P. Steele, M. P. Lucarelli, E. L. Atlas, S. M. Schauffler, D. R. Blake, F. S. Rowland, W. T. Sturges, L. J. Lee, S.A. Penkett, A. Engel, R. M. Simpffle, K. R. Chan, D. K. Weisenstein, M. K. W. Ko, and R. J. Salawitch. 1998. *Journal of Geophysical Research* 103(D1):1513–1526.

- *CDIAC's World-Wide-Web Site* (<http://cdiac.esd.ornl.gov>)

ABCNEWS.com, 1998. How Many Pounds Do You Produce Each Day? Calculate Your CO₂ (more.abcnews.go.com/sections/us/DailyNews/co2_calc1007.html).

United States Information Agency. 1998. Climate Change (<http://www.usia.gov/topical/global/environ/envcl.htm>).

- *AmeriFlux World-Wide-Web Site* (<http://www.esd.ornl.gov/programs/NIGEC/>)

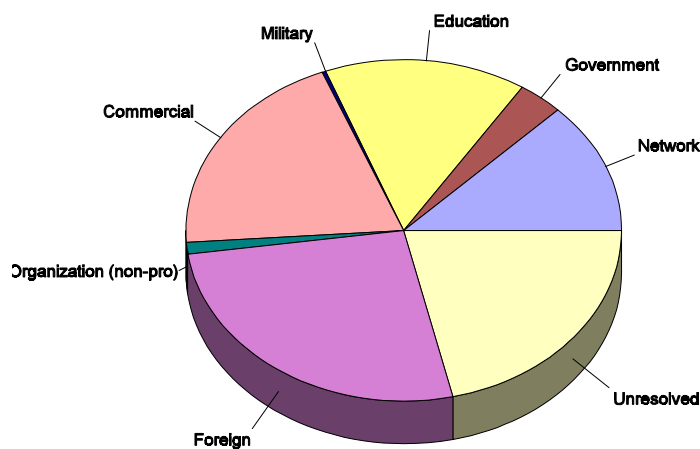
Kristi Coale. 1998. Sensors Keep Tabs on Emission Credits. *WIRED NEWS* (<http://www.wired.com/news/news/technology/story/11825.html>).

Statistics

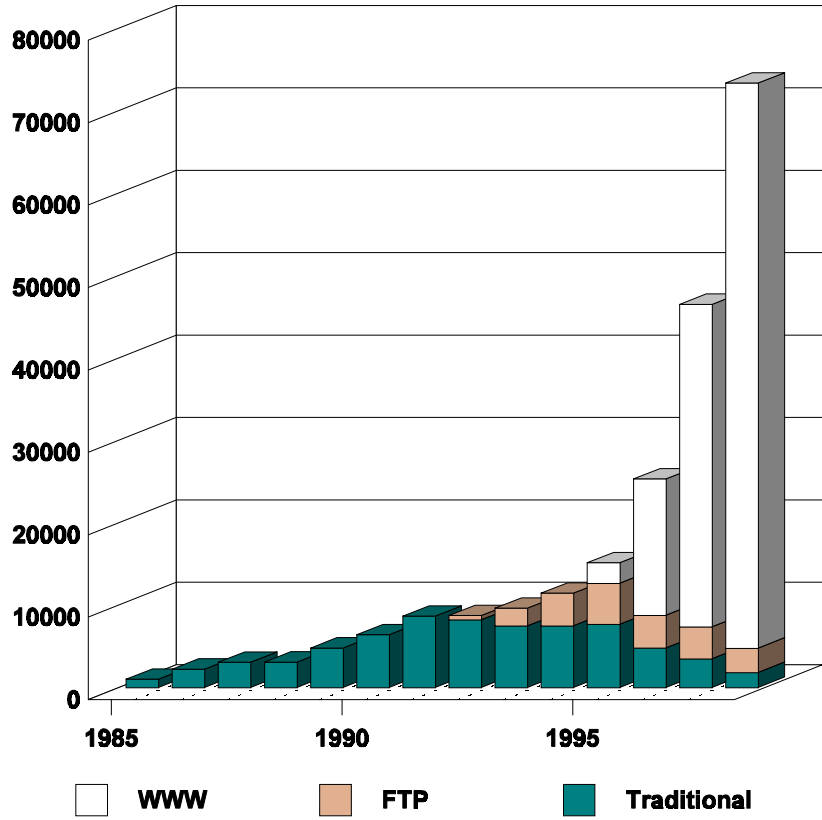
FY 1998

- CDIAAC's Web site experienced over 92,900 visits from 68,600 unique hosts (an average of 255 visits per day).
- Over 476,000 web pages were viewed by users to CDIAAC's web site (average number of pages viewed per visit was five, and the number of pages viewed per day was 1,307).
- More than 90% of the visits to CDIAAC's web site were from nongovernment domains. The Education and International sectors accounted for as much as 50% of the audience.
- The top keywords that people used to locate CDIAAC via online search engines (e.g., Yahoo, Alta Vista, etc.) were "carbon dioxide," "cdiac," "carbon dioxide emissions," and "average temperature."
- CDIAAC's anonymous file transfer protocol (FTP) area was accessed by over 2,940 unique systems retrieving over 4,300 datasets.

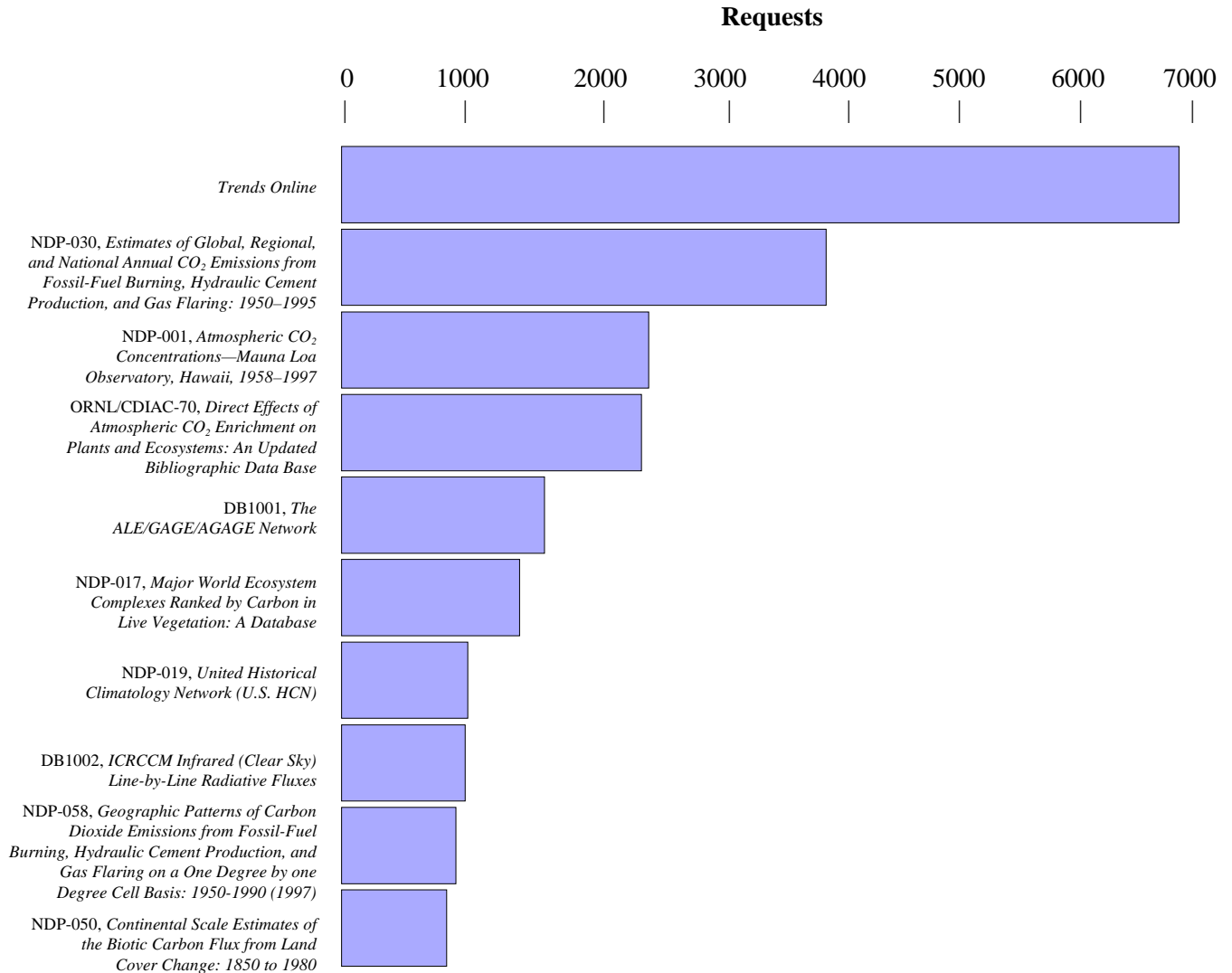
FY 1998 World Wide Web Visits by User Type



Requests to CDIAC exceed 70,000 in FY 1998




CDIAC's Most Requested World Wide Web Documents



What's Coming in FY 1999

CDIAC is working on the following new or updated NDPs and hopes to have them available (both in printed format and online) in FY 1998. Several have already been completed and are available as noted.

New NDPs

- NDP-026C ***Extended Edited Synoptic Cloud Reports from Ships and Land Stations over the Globe: 1952–1996*** (NDP-026C), by Carole Hahn (University of Arizona, Tucson). This comprehensive database will extend the NDP-026 series of surface-observed cloud databases to include observations over oceans from 1952–1995 and over land from 1971–1996.
- NDP-066 ***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)*** (ORNL/CDIAC-113, NDP-066), by Kenneth M. Johnson and Douglas W. R. Wallace (Brookhaven National Laboratory), Bernd Schneider (Baltic Sea Research Institute), Ludger Mintrop (Institute for Marine Sciences), and prepared by Alex Kozyr (CDIAC). This data documentation discusses the procedures and methods used to measure total carbon dioxide (TCO₂) and total alkalinity (TALK) at hydrographic stations, as well as the underway partial pressure of CO₂ (pCO₂) 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 17, 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), TCO₂, TALK, and underway pCO₂. Completed November 1998. (http://cdiac.esd.ornl.gov/oceans/ndp_066/ndp066.html)
- NDP-067 ***The International Intercomparison Exercise of Underway fCO₂ Systems during the R/V Meteor Cruise 36/1 in the North Atlantic Ocean*** (ORNL/CDIAC-114, NDP-067), by A. Koertzinger, L. Mintrop, J. C. Duinker (University of Kiel) and prepared by Alex Kozyr (CDIAC). Measurements of the fugacity of carbon dioxide (fCO₂) 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 fCO₂ 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 fCO₂ and its influence on the oceanic uptake of anthropogenic CO₂. Such an effort, however, is based on knowledge of the comparability of data sets from different laboratories. An International Intercomparison Exercise of Underway fCO₂ Systems was proposed and carried out by the Institute of Marine Research at the University of Kiel 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 seven underway $f\text{CO}_2$ systems, one discrete $f\text{CO}_2$ system and two 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 $f\text{CO}_2$.

Completed January 1999. (http://cdiac.esd.ornl.gov/oceans/ndp_067/ndp067.html)

- NDP-068 ***Tropical Southeast Asia: Land Cover and Biomass-Carbon Estimates for 1980***, by Sandra Brown (Oregon State University) and Anantha Prasad and Louis Iverson (U.S. Forest Service). This is the fourth database to be published by CDIAC concerning carbon fluxes to the atmosphere from tropical land-use changes. The database consists of estimates of geographically referenced carbon densities of forest soils and vegetation in tropical Asia. The vegetation carbon densities are based on potential carbon estimates, which are derived from climatic, edaphic, and geomorphic indices and vegetation and are subsequently modified on the basis of population densities, climate, and vegetation data. The soil organic carbon estimates are calculated from pedon data for tropical forests and mapped to a texture/climate map for all of tropical Asia.
- NDP-069 ***Carbon-13 and Oxygen-18 Data from the NOAA Climate Monitoring and Diagnostics Laboratory Cooperative Flask Sampling Network, 1990–1993***, by Michael Troler and James W. C. White (Institute of Arctic and Alpine Research, University of Colorado), and Kenneth Masarie and Pieter Tans (Climate Monitoring and Diagnostics Laboratory, NOAA), and prepared by Antoinette Brenkert (CDIAC). Stable isotope $^{13}\text{C}/^{12}\text{C}$ and $^{18}\text{O}/^{16}\text{O}$ ratios in the atmosphere expressed as deviations ($\delta^{13}\text{C}$ and $\delta^{18}\text{O}$) from the standard $^{13}\text{C}/^{12}\text{C}$ and $^{18}\text{O}/^{16}\text{O}$ ratios (Pee Dee River, South Carolina, Craig 1961, Craig 1957) were measured, starting in 1990, as part of a joint program between the Institute of Arctic and Alpine Research (INSTAAR) at the University of Colorado and the NOAA Climate Monitoring and Diagnostics Laboratory (CMDL) at six land sites and aboard two container ships in the Pacific Ocean. It was extended in January 1991 with a site in South Korea and in January 1992 with 19 additional land sites. Measurements from the Commonwealth Scientific and Industrial Organisation (CSIRO), Australia were merged with the NOAA/CMDL data after comparison for effects of difference in methodology.
- NDP-070 ***Measurements of Atmospheric Methane and $^{13}\text{C}/^{12}\text{C}$ of Atmospheric Methane from Flask Air Samples***, by Paul Quay and Johnny Stutsman (School of Oceanography, University of Washington) and prepared by Linda Allison (CDIAC). This database will offer precise measurements of atmospheric methane and $^{13}\text{C}/^{12}\text{C}$ in atmospheric methane from flask air samples collected at eight sites worldwide and aboard NOAA cruises in the Pacific Ocean. 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. These data are useful for global methane budget analyses and for determining the atmospheric isotopic composition of methane. All isotopic measurements have been corrected for standard drift.

- NDP-0XX *The Carbonate System in the Atlantic Ocean along 24 ° North*, by Frank Millero (University of Miami). These carbon-related data were obtained during the Spanish R/V *Hesperides* cruise along WOCE Section A5 in the Atlantic Ocean along approximately 24° N.

New Database

CDIAC has published the following database in the DB series online during FY 1998.

- DB1020 *Measurement of Air Pollution from Satellites (MAPS) 1994 Correlative Atmospheric Carbon Monoxide Mixing Ratios*, by Paul Novelli and Ken Masari [NOAA Climate Monitoring and Diagnostics Laboratory (CMDL)] and prepared by Linda Allison and Tom Boden (CDIAC). The database offers select carbon monoxide (CO) mixing ratios from eleven field and aircraft measurement programs around the world. 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.
Completed December 1998.
(<http://cdiac.esd.ornl.gov/epubs/db/db1020/db1020.html>)

Updated NDPs and DBs

- NDP-030 *Global, Regional, and National CO₂ Emission Estimates from Fossil Fuel Burning, Cement Production, and Gas Flaring: 1751–1996*, (NDP-030), by Gregg Marland (CDIAC), Robert J. Andres (University of Alaska, Fairbanks), Tom Boden (CDIAC), Cathy Johnston (The University of Tennessee, Knoxville), and Antoinette Brenkert (CDIAC). These data extend the period of record through 1996. Since 1992, global total emissions have climbed from 6095 million metric tons of carbon to 6518 million metric tons, the highest global total yet recorded. (The United States continues to be the single greatest carbon-emitting nation, responsible for 22% of the global total.) Updated CO₂ emission estimates extending from 1751 through 1996 are now available.
Completed January 1999. (<http://cdiac.esd.ornl.gov/ndps/ndp030.html>)
- NDP-042 *U.S. Historical Climatology Network (HCN) Daily Temperature and Precipitation Data (1871–1997)*, by David Easterling, Thomas Karl, Jay Lawrimore, and Stephen Del Greco (National Climatic Data Center). The data have been updated through 1994 and expanded to include not only the 138 stations in the original version of NDP-042 but also most of the remaining stations in the HCN, for a total of 1062 stations. This database is sure to be one of the most valuable climate resources available for the United States.
- DB1001 *The ALE/GAGE/AGAGE Monitoring Network*, which provides continuous high-frequency measurements of methane, nitrous oxide, three chlorofluorocarbons, methyl chloroform, chloroform, and carbon tetrachloride. This database supports

analyses and monitoring related to both greenhouse gases and the Earth's ozone layer. The data were contributed by R. Prinn, D. Cunnold, P. Fraser, R. Weiss, P. Simmonds, F. Alyea, L. P. Steele, and D. Hartley; they were prepared for online distribution by CDIAC's Tom Boden. Data from 1978 through March 1998 are now available for 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). 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; and the AGAGE database has been completely re-computed to introduce a new and improved pollution analysis scheme.
Completed January 1999. (<http://cdiac.esd.ornl.gov/ndps/alegage.html>)

Additional Publications

ORNL/CDIAC-115 *Comparison of the Carbon System Parameters at the Global CO₂ Survey Crossover Locations in the North and South Pacific Ocean between 1990–1996*, by Richard A. Feely, Marilyn F. Lamb, and Dana J. Greeley [NOAA Pacific Marine Environmental Laboratory (PMEL)], and Rik Wanninkoff [(NOAA/Atlantic Oceanographic and Meteorological Laboratory (AOML))] and prepared by Linda J. Allison (CDIAC).

We also plan to have two new issues of our newsletter, *CDIAC Communications*, available during FY 1999. Look for these online (<http://cdiac.esd.ornl.gov/newsletr/ccindex.html>); if you let us know, we will be glad to notify you via e-mail when a new issue is online. Printed copies of *CDIAC Communications* are available on request. Remember to check the “new” page on our Web site (<http://cdiac.esd.ornl.gov/new/new.html>) for announcements of the latest CDIAC products.

CDIAC Communications Issue No. 25, Fall 1998 was put online in December 1998.

Trends Online Update

Although CDIAC will not print a hard-copy version of *Trends* during FY 1999, we do plan to update and expand the *Trends Online* Atmospheric CO₂ and Fossil-Fuel CO₂ Emissions sections and add to the *Trends Online* Climate section. The following summarizes the FY 1999 activities planned for each of these sections:

- **Atmospheric CO₂ levels.** During FY 1999 we hope to add (A) or update (U) the following records:
 - U Vostok ice core record (Barnola et al.)
 - U Mauna Loa, Barrow, American Samoa, and South Pole records from SIO (Keeling and Whorf)
 - U Baring Head in situ record (Manning et al.)
 - U Mt. Cimone in situ record (Colombo and Santaguida)
 - U Amsterdam Island in situ record (Gaudry et al.)
 - U K-pusztta in situ record (Haszpra)
 - U Lampedusa Island flask record (Ciattoglia and Chamard)
 - U Wellington $\Delta^{14}\text{CO}_2$ record (Manning and Melhuish)
 - A Cape Grim $\delta^{13}\text{C}$ record (Francey and Allison)

- **Fossil-fuel CO₂ emissions.** This section was modified during FY 1998 to include historical fossil-fuel CO₂ emissions back to 1751. During FY 1999 we will update:
 - U Global, regional, and national fossil fuel CO₂ emission estimates for 1751–1996 (Marland et al.)
- **Climate.** During FY 1999 we will add to the *Trends Online* Temperature section and mark up selected *Trends* data for the precipitation section. In addition we will establish a new section detailing regional trends in cloud amount. We will offer the following records:
 - U Vostok ice core temperature record (Jouzel et al.)
 - U Global and hemispheric satellite temperature records (Spencer and Christy)
 - U Global, hemispheric, and zonal radiosonde temperature records (Angell)
 - U National and regional temperature and precipitation records for the contiguous United States (Karl et al.)
 - U National and regional temperature and precipitation records for Canada (Hogg et al.)
 - A China cloud amount trends (Kaiser)
 - A Former Soviet Union cloud amount trends (Kaiser)

CDIAC Collaborations

CDIAC realizes that it would not be possible to produce global-change data and information products without the generosity and cooperation of researchers at institutions throughout the United States and around the world. In this annual report, we have noted the collaborating individuals and institutions for each product. Below are listed the many institutions that have collaborated with CDIAC in the publication of the databases and other information products described in this report.

DOE Laboratories

- Brookhaven National Laboratory
- Energy Information Administration
- Environmental Measurements Laboratory
- Los Alamos National Laboratory

Other Federal Agencies

- NASA Goddard Institute for Space Studies
- NOAA Atlantic Oceanographic and Meteorological Laboratory
- NOAA Climate Monitoring and Diagnostics Laboratory
- NOAA National Climatic Data Center
- NOAA Pacific Marine Environmental Laboratory
- U.S. Department of the Interior's Bureau of Mines
- U.S. Environmental Protection Agency
- U.S. Forest Service

Universities/Research Institutions

- Boston University
- Desert Research Institute
- Georgia Institute of Technology
- Institute of Arctic and Alpine Research, University of Columbia
- Lamont-Doherty Earth Observatory of Columbia University
- Massachusetts Institute of Technology
- Oregon Graduate Institute for Science and Technology
- Oregon State University
- Princeton University
- Scripps Institution of Oceanography of the University of California, San Diego
- University of Alaska - Fairbanks
- University of Arizona - Tucson
- University of Maine
- University of Nevada - Reno
- University of Puerto Rico, Rio Piedras
- University of Tennessee - Knoxville
- University of Washington
- Washington State University

Foreign

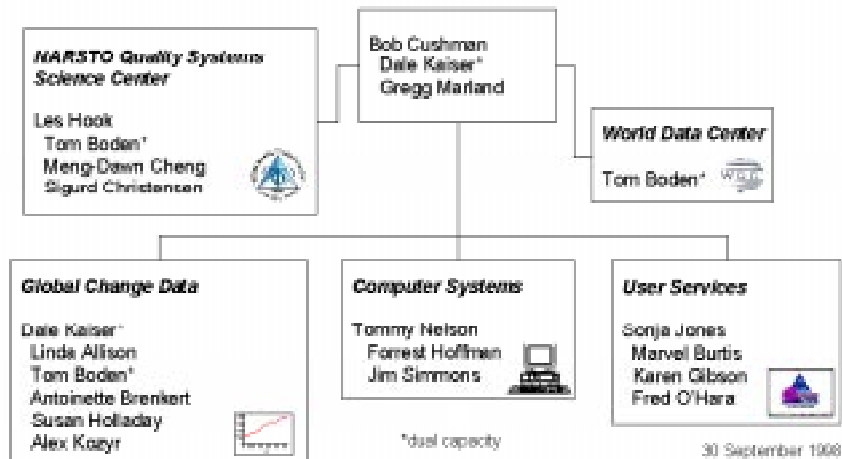
- All-Russian Research Institute of Hydrometeorological Information–World Data Center, Obninsk, Russia
- Australian National University, Canberra
- China Meteorological Administration, Beijing

- Division of Atmospheric Research, CSIRO, Australia
- Institute of Atmospheric Physics, Beijing
- Italian Meteorological Service, Sestola, Italy CNR Institute di Fisica dell' Atmosfera, Rome
- Institut für Umweltphysik, University of Heidelberg
- Institut für Meereskunde, University of Kiel, Germany
- University of East Anglia, Norwich, U.K.
- Hadley Centre for Climate Prediction and Research, Bracknell, U.K.
- Norwegian University of Science and Technology, Trondheim
- Commonwealth Scientific and Industrial Research Organisation, Australia
- Laboratoire de Glaciologie et Géophysique de l'Environnement, Saint Martin d'Hères, France
- Antarctic CRC and Australian Antarctic Division, Hobart, Tasmania
- University of Galway, Ireland

Organization and Staff



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



CDIAC staff in FY 1998

Staff	Phone no. (area code 423)	Internet address (@ornl.gov, unless stated otherwise)	Job title
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Thomas A. Boden	241-4842	tab	Director, WDC-A for Atmospheric Trace Gases; Ecologist
Antoinette Brenkert	574-7322	azt	Ecologist
Marvel D. Burtis	241-4843	um6	Editorial assistant
Meng-Dawn Cheng	241-5918	ucn	NARSTO QSSC chief scientist
Sigurd Christensen	574-7394	swc	NARSTO data analyst
Robert M. Cushman	574-4791	rma	Director, CDIAC
Karen N. Gibson	241-4854	gnk	User Services assistant
Dana C. Griffith	574-0390	xrq	Secretary
Forrest M. Hoffman	576-7680	hof	World Wide Web specialist
Susan Holladay	576-8356	skh	AmeriFlux data analyst
Les A. Hook	241-4846	lah	NARSTO QSSC Director
Sonja B. Jones	574-3645	cdp	Task leader, User Services
Dale P. Kaiser	241-4849	d9k	Meteorologist; task leader, Global Change Data
Alexander V. Kozyr ^d	241-4844	akozyr@utk.edu	Oceanographer
Gregg Marland	241-4850	gum	Senior scientist
Tommy R. Nelson ^b	574-0769	trn	Task leader, Computer Systems
Frederick M. O'Hara ^c	482-1447	ffo	Technical Editor
James W. Simmons ^d	574-1060	s4i	Workstation specialist

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^bComputational Physics and Engineering Division, ORNL

^cJAYCOR, Oak Ridge, Tenn.

^dComputing and Telecommunications Services, ORNL

Acronyms and Other Abbreviations

AGAGE	Advanced Global Atmospheric Gases Experiment
ALE	Atmospheric Lifetime Experiment
AmeriFlux	American CO ₂ Flux Network
AOML	Atlantic Oceanographic and Meteorological Laboratory
CDIAC	Carbon Dioxide Information Analysis Center
CCl ₄	carbon tetrachloride
CFCl ₃	chlorofluorocarbon
CF ₂ Cl ₂	chlorofluorocarbon
CF ₂ ClCFCl ₂	chlorofluorocarbon
CH ₄	methane
CH ₃ CCl ₃	methyl chloroform
CHCl ₃	chloroform
CMDL	Climate Monitoring and Diagnostics Laboratory
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTD	conductivity, temperature, and depth sensor
CVI	Coastal Vulnerability Index
DB	database
DOE	U.S. Department of Energy
DRI	Desert Research Institute
EML	Environmental Measurements Laboratory
FACE	Free-Air CO ₂ Exposure
FTP	File Transfer Protocol
<i>f</i> CO ₂	fugacity of carbon dioxide
FY	fiscal year
GAGE	Global Atmospheric Gases Experiment
GIS	geographic information system
GISS	NASA Goddard Institute for Space Studies
HCN	Historical Climatology Network
INSTAAR	Institute of Arctic and Alpine Research
IPCC	Intergovernmental Panel on Climate Change
LDGO	Lamont-Doherty Earth Observatory of Columbia University
MAPS	Measurement of Air Pollution from Satellites
NARSTO	North American Research Strategy for Tropospheric Ozone
NASA	National Aeronautics and Space Administration
NCDC	National Climatic Data Center
NDP	numeric data package
NEP	Net Ecosystem Production
N ₂ O	nitrous oxide
OBER	Office of Biological and Environmental Research (DOE)
ORNL	Oak Ridge National Laboratory
pCO ₂	partial pressure carbon dioxide
PDF	portable document format
PMEI	Pacific Marine Environmental Laboratory
QA/QC	quality assurance/quality control
QSSC	Quality Systems Science Center
QSMP	Quality Systems Management Plan
RANDAB	Radionuclide Database

RIHMI	All-Russian Research Institute of Hydrometeorological Information
SIO	Scripps Institution of Oceanography
STC	Society for Technical Communications
TALK	total alkalinity
TCO ₂	total carbon dioxide
TRACDAB	Trace Gas Database
UN	United Nations
UNR	University of Nevada-Reno
USIA	U.S. Information Agency
WDC-A	World Data Center-A
WHOI	Woods Hole Oceanographic Institution
WOCE	World Ocean Circulation Experiment
YOTO	Year of the Ocean

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