Retrospective on CDIAC's Activities in United States–China Research on the Greenhouse Effect

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Abstract

This paper summarizes the accomplishments of the Carbon Dioxide Information Analysis Center under a joint research program on the greenhouse effect conducted by the United States and the People's Republic of China. The focus is on efforts in the areas of computing systems; data quality assurance, documentation, and publication; data analysis; data exchange and distribution; project summary and bibliography publication; and visitor exchange.

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Background

From the beginning of the joint research program on the greenhouse effect, a bilateral program of the U.S. Department of Energy (DOE) and the People's Republic of China's Academy of Sciences (CAS) (Koomanoff et al. 1988; Riches et al. 1992), the Carbon Dioxide Information Analysis Center (CDIAC) at the DOE's Oak Ridge National Laboratory has been an active participant, especially in support of the task on preparation and analysis of paleoclimatic, historical, and modern instrumental climate data. During the infancy of the joint program, Kanciruk and Farrell (1987) prepared protocols for hardware, software, and data management.

This paper focuses on the roles played by CDIAC in (1) setting up computing systems in China to facilitate the digitization and documentation of climate data, (2) quality-assuring and publishing Chinese climate data, (3) exchanging global-change data with Chinese investigators, (4) analyzing trends in Chinese climate, (5) hosting visitors from the CAS, and (6) publishing a project summary and Chinese-English bibliography of important Chinese-language climate-change literature. This paper updates the progress reported by Boden et al. (1993).

Computing Systems

In the earliest days of the U.S.–China agreement, CDIAC cooperated with the CAS to develop a computing system to support CAS investigators who were digitizing paleoclimate, historical, and recent climate data for analysis in China and for exchange with U.S. investigators. CDIAC determined the requirements for and assembled a personal computer system (processors, monitors, printers, and other peripheral devices) and developed the needed software (Mitchell 1985, Nelson 1985). CDIAC then delivered this system to China (the equipment was shipped to China in 1985 and 1990) and traveled to China to assist in the setup and to train the Chinese investigators in the use of this system.

Data Quality Assurance, Documentation, and Publication

It has been CDIAC's experience that data produced by investigators are, in general, rarely in perfect condition for archival and distribution, regardless of their source. Typically, additional work is needed in formatting, checking for errors (and making necessary corrections), and providing documentation, so that current and future users will understand how the data were derived and have confidence in the integrity of the data. In support of the U.S.–China joint research program on the greenhouse effect, two important data products were transmitted from the CAS to CDIAC, which then performed its value-added steps of quality-assurance and documentation.

The first data product, Two Long-Term Instrumental Climatic Data Bases of the People’s Republic of China (Tao et al. 1991, 1997), was published initially in 1991 and updated in 1997. This numeric data package (NDP) now includes data through 1993. The Institute of Atmospheric Physics (IAP) of the CAS provided records from 267 stations, partitioned into two networks of 65 and 205 stations. Data from the 65-station network contain monthly means, extremes, or totals of barometric pressure, air temperature, precipitation amount, relative humidity, sunshine
duration, cloud amount, dominant wind direction and frequency, wind speed, and number of days with snow cover. Station histories are available from 59 of the 65 stations. Data from the 205-station network contain monthly mean temperatures and monthly precipitation totals (but not station histories). Sixteen stations from these data sets (13 from the 65-station, 3 from the 205-station) have temperature and/or precipitation records beginning before 1900, whereas the remaining stations began recording in the early to mid-1900s.

For the second data product, *Climate Data Bases of the People's Republic of China 1841-1988* (Kaiser et al. 1993), the IAP provided records from 296 stations, organized into five data sets: (1) a 60-station data set containing monthly measurements of barometric pressure, surface air temperature, precipitation amount, relative humidity, sunshine duration, cloud amount, wind direction and speed, and number of days with snow cover; (2) a 205-station data set containing monthly mean temperatures and monthly precipitation totals; (3) a 40-station subset of the 205-station data set containing monthly mean maximum and minimum temperatures and monthly extreme maximum and minimum temperatures; (4) a 180-station data set containing daily precipitation totals; and (5) a 147-station data set containing 10-day precipitation totals. Sixteen stations from these data sets (13 from the 60-station set and 3 from the 205-station set) have temperature and/or precipitation records that begin prior to 1900, whereas the remaining stations began recording in the early to mid-1900s. Records from most stations extend through 1988.

Additional work was done to quality-assure and document twelve long-term proxy data sets (Boden et al. 1992), including winter temperature indices, dryness/wetness indices, plum rain indices, and harvest indices. Some of the data extend to 6000 years before present; the spatial resolution of the proxy data sets varies from single sites to large regional averages.

In addition to the data products based on Chinese climate data, CDIAC also quality-assured and published related data bases produced by other participants in the U.S.–China joint research program (and used for regional climate studies and comparisons between observational data and climate model output). For example, in cooperation with the National Climatic Data Center, CDIAC published *United States Historical Climatology Network (HCN) Serial Temperature and Precipitation Data* (Easterling et al. 1996), a data base containing monthly total precipitation and temperature data, extending through 1994, from 1221 stations in the contiguous U.S. This is probably the best monthly temperature and precipitation data set available for the contiguous U.S. because station moves, instrument changes, urbanization effects, and time-of-observation differences have been considered and, where necessary, the data have been corrected.

**Data Analysis**

No matter how much quality-assurance is performed on a data set, the final test occurs when the data are used in an analysis. Thus, data analysis, in addition to advancing scientific understanding, is a vital step in the quality-assurance process.

Kaiser (1993) published *Cloud Amount and Sunshine Duration in the People's Republic of China, 1954-88*, based on data in Tao et al. (1991). Kaiser found a significant 10.9% decrease in annual mean sunshine for the region as a whole, and a nonsignificant 2.6% decrease in mean
annual cloud amount, over the period 1954-1988. Sunshine decrease was driven by a large decrease in southern China, especially in autumn (21.4%). Decreasing sunshine not coupled with increasing cloud amount could be explained by changing cloud climatology.

This analysis demonstrated the validity and usefulness of the Chinese data sets, in addition to the merit of the analysis in advancing our understanding of climate change.

Data Exchange and Distribution

An important role of CDIAC in the U.S.–China joint research program is to supply global-change data sets (including, but not restricted to, data from the joint research program itself) to Chinese investigators and other researchers.


Over 200 printed copies of the numeric data package, Two Long-Term Instrumental Climatic Data Bases of the People’s Republic of China (Tao et al. 1991, 1997), have been distributed to users in 27 countries, including the accompanying digital data provided to users on a variety of media (e.g., floppy diskettes, 9-track magnetic tape, 8 mm tape, and CD ROM). Eighteen printed copies of this numeric data package were distributed to users in the People’s Republic of China. In addition to the copies distributed from the document center, CDIAC has received over 640 unique requests for this data product via CDIAC’S Web site and anonymous file transfer protocol (FTP) area.

Approximately 150 printed copies of the data product, Climate Data Bases of the People’s Republic of China 1841-1988 (Kaiser et al. 1993), have been distributed by CDIAC to users in 26 countries, nine of which were requested by users in the People’s Republic of China. In addition, CDIAC has received over 550 unique requests for this data product via CDIAC’S Web site and FTP area.

As evidence of the scientific impact of the data products resulting from the U.S.–China joint research program, the Chinese data distributed by CDIAC have been cited in the published literature. For example, Dai et al. (1997) cited Tao et al. (1991) in their study of the role of thick precipitating clouds and precipitation in observed decreases in diurnal temperature range. And Wai et al. (1995) cited both Tao et al. (1991) and Kaiser et al. (1993) in their analysis of the spatial and temporal distribution of rainfall over Hong Kong and South China.

Project Summary and Bibliography Publication

In 1990, CDIAC published the "Research Project of the Month" Urban Warming in China (Wang et al. 1990), which showed an average urban warming of 0.23°C across all regions and seasons during the period 1954-1983, with the strongest urban warming in winter; considerable variability exists among regions. There was a decreasing trend before 1966, then an increasing trend.
There is a wealth of significant climate-change literature that is not familiar to western researchers because it has been available only in the original Chinese language. As a result, in 1998 CDIAC, the CAS, and the Atmospheric Sciences Research Center (State University of New York, Albany) launched a collaborative project to identify and translate abstracts from key Chinese-language literature. The resulting bibliography, *Selected Translated Abstracts of Chinese-Language Climate Change Publications* (Ge et al. 1999), covers literature from the years 1995-1998 on the topics of adaptation, ancient climate change, climate variation, the East Asia monsoon, historical climate change, impacts, modeling, and radiation and trace-gas emissions.

**Visitor Exchange**

CDIAC staff visited China during the early years of the joint research program, especially to deliver and set up personal computing systems for the digitization and documentation of climate data. CDIAC staff also participated in annual meetings of the joint research program, both in the United States and in China.

In 1985, Peiyuan Zhang (CAS Institute of Geography) visited CDIAC to discuss data organization, quality assurance, and transfer protocols.

Xiao-Bai Wang (CAS Institute of Atmospheric Physics) visited CDIAC from July 1988 through February 1989, during which time she translated into Chinese the document "Publications and Documents," which contains abstracts of reports available from CDIAC, to inform Chinese colleagues of the DOE Carbon Dioxide Program (as the forerunner of DOE’s global change research was then known); and took a course in English Composition at a local community college.

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**Literature Cited**


