



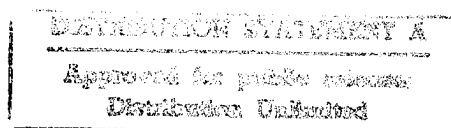
## United States Global Change Research Program

Global Change Data and Information System (GCDIS)  
Data Management Working Group  
Subcommittee on Global Change Research  
Committee on Environment and Natural Resources Research

# GCDIS IMPLEMENTATION 1995

VOLUME I—INTERAGENCY IMPLEMENTATION  
(drafted in mid-1995)

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# USGCRP

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Department of Commerce

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National Aeronautics and Space Administration

National Science Foundation

U.S. Department of Agriculture

## **EXECUTIVE SUMMARY**

Three characteristics of global change data and information challenge the Federal agencies participating in the United States Global Change Research Program (USGCRP) to make their relevant data and information available in a useful format to users. First, there are massive amounts of data and information generated by USGCRP related activities. Second, these data and information are highly diverse, covering disciplines ranging from the physical and natural sciences to the social and economic sciences. Third, the community of potential users of global change data and information is very broad, including researchers, policy makers, educators, private industry, and the general public.

To meet this challenge, the Federal agencies involved in the USGCRP have cooperated to establish the Global Change Data and Information System(GCDIS). Interagency development of GCDIS is coordinated through the Global Change Data Management Working Group (GCMDWG) and its Access, Content and Library Subgroups.

As a result, the interagency GCDIS implementation strategy is founded on strong coordination and cooperation among the participating Federal agencies, yet recognizes the differences in their individual level and type of support to the USGCRP. This has led to GCDIS being a virtual system that provides a corporate view of the diverse Federal global change related data and information holdings. While the initial phase of GCDIS implementation focuses on the Federal agency systems, it will be broadened to provide increased access to relevant international and state and local holdings.

Seamless access to the disparate agency systems is being achieved through technology sharing, data policy coordination, and the use of common standards and approaches. Using this approach, GCDIS can readily evolve to take advantage of changes in technology. The implementation effort also recognizes each agency's own requirements to provide access to the full suite of its holdings. To help facilitate this process, guidelines to the agencies are being developed in cooperation with organizations sponsoring Federal initiatives that complement the GCDIS implementation. These include the Government Information Locator Service(GILS), the National Environmental Data Index(NEDI), and the National Spatial Data Infrastructure(NSDI) of the Federal Geographic Data Committee(FGDC).

The data management issues, policies, and plans of GCDIS have been presented in a series of three documents published in 1991[2], 1992[3], and 1994[4]and in this 1995 report, *GCDIS Implementation- 1995*, which sets forth specific goals that will be accomplished within the three-year period from Fiscal Year 1995 through the end of Fiscal Year 1997. Each of these reports has benefited significantly from a continuing series of reports by the National Academy of Sciences Committee on Geophysical and Environmental Data(CGED)[7] and from close working relationships with its members.

This report contains the implementation plans of the three interagency subgroups (Access, Content and Library) and of the individual Federal agencies participating in the development of GCDIS: DOC, DOE, DOI, EPA, NASA, NSF, and USDA. Each agency plan outlines the implementation of its GCDIS nodes. These nodes are existing or planned agency mission-responsive data and information systems which provide GCDIS access and have been selected by the agencies to respond to the broad requirements of the USGCRP. The Agency Node Summary Section summarizes the agency nodes including the content of its data and information holdings and the method of its access. Currently, there are about 70 nodes in GCDIS.

Below are summaries of each of the subgroup's implementation plan. Following the Introduction is a section on System Wide Aspects of GCDIS which summarizes the crosscutting aspects of the continuity of system support, standards, pricing and access policies, international connections, and user satisfaction and system evaluation. It is the voluntary, continuing cooperation and sharing among all the participating agencies that gives the best possible assurance that the interagency goals of GCDIS will be met while also helping the participating agencies themselves with their individual missions.

## **Access Subgroup**

As a federated system, GCDIS provides just enough supporting infrastructure to ensure a relatively seamless look at the data and information across all of the agency systems. The current elements of the access infrastructure of GCDIS consists of telephone, mail, and fax services through the Global Change Research Information Office and GCDIS Gopher and World Wide Web (WWW) servers.

By the end of Fiscal Year 1997, the access infrastructure will include a distributed data directory and a search engine that is accessible via the WWW. The Access Subgroup is currently funding the Assisted Search for Knowledge Pilot Project, which is developing a prototype user search and retrieval tool for distributed databases.

GCDIS builds upon and leverages the sharing of software, tools, and standards already being developed and used by the agencies participating in GCDIS. The Access Subgroup actively promotes the sharing of these capabilities with the research community, the public, and among the agencies. GCDIS relies on the Internet and the WWW; public domain software such as WAIS and Web browsers; and existing standards, such as the ANSI Z39.50 standard and the NSDI Content Standard for Geospatial Metadata and Spatial Data Transfer Standard. The Access Subgroup provides the GCDIS coordination with other Federal initiatives (NSDI, NEDI, GILS).

The Access Subgroup has characterized the access levels of the GCDIS agency nodes' capabilities in connectivity, search, browse, order, and delivery for the present and for the next two years. At the present time, all agencies provide at least the minimum level of access to their data and information nodes. Beyond that, there is considerable variability among agencies and among the available data and information sets.

## **Content Subgroup**

In order for the GCDIS to meet the current and future needs of the USGCRP, it must provide access to data and information product holdings that are increasing in volume and intellectual diversity. This growth will challenge, for example, the data and information product quality assurance process by requiring researchers and data managers to apply more effort to both more products and products of higher complexity. The Content Subgroup implementation plan addresses such issues and its interagency program includes the following focused activities:

- The Identification and Prioritization Pilot Study (IPPS) has been established to help determine the appropriate process to prioritize the data and information products that will be used to address USGCRP discipline goals. This pilot addresses the improvements in existing data and data products necessary to understand the global sources and sinks of carbon dioxide and other trace gases.
- A report that identifies international global change data linkages for potential use as an international directory for the GCDIS Gopher and WWW servers.
- A series of special workshops on data center issues that will include as subjects:
  - User services
  - Quality assurance of data and data products
  - Numerical and graphical computational model output documentation and preservation
  - Integrated data products

## **Library Subgroup**

GCDIS includes libraries and information center resources and the skills, expertise, and advice of librarians and information specialists to deliver GCDIS services to the general public. A survey of 98 libraries and information centers of the agencies participating in GCDIS(Appendix - Interagency Access) has shown that:

- Many of the libraries and information centers are providing access and assistance to their collections through in-house on-line catalogs and bibliographic files as well as through bulletin boards, help desks, and WAIS, Gopher, and WWW servers. Access to global bibliographic resources is also available through major utilities.
- Most libraries and information centers share resources and bibliographic cataloging records through formal library networks. These networks are extensive and exist at multiple levels: nationally and internationally, at the federal level, within geographic regions, at the state and local level, in urban and rural areas, at the agency level, etc. These activities are linked through the use of the Anglo-American Cataloging Rules and interchange standards such as the MARC (ANSI Z39.2) and ANSI Z39.50.

- While many libraries and information centers are well-placed and adequately supported within technologically advanced settings, others are not. For GCDIS to effectively use these other libraries and information centers, they need to be linked to the Internet and trained in its use.

- Most of the libraries and information centers have valuable paper-based resources that are now handled manually. Many of these are aging and need to be evaluated for preservation, digitization, and metadata descriptions in cooperation with agency data centers.

The Library Subgroup is sponsoring a GCDIS evaluation project which is gathering feedback from actual users of the GCDIS Gopher. The project is in Virginia and the participants represent diverse educational institutions ( elementary school, middle school, high school, community college, college, university) as well as public library and citizen group participation. A continuing series of user surveys of both the GCDIS Gopher and WWW server will be initiated.

## **1.0 INTRODUCTION**

### **1.1 Background**

The United States Global Change Research Program (USGCRP) was established to observe, understand, and predict global change. These activities require that the results be made available for use in scientific assessments of climate change and ozone depletion, which have supported the national and international policy debate and decision making process. Such broad-ranging responsibilities depend on a foundation of high-quality, relevant data and information which transcend traditional scientific discipline boundaries and range from geophysical and biological sciences to economic and social sciences. Building on this foundation, is the capabilities for users to readily find, access and use the data and information they need.

The Committee on Environment and Natural Resources Research's(CENR's) Subcommittee on Global Change Research(SGCR) requested that the existing ad hoc Interagency Working Group on Data Management for Global Change(IWGDMGC) address the problems researchers were having in identifying, accessing, and using global change data and information. Responding to this request, the IWGDMGC became the Global Change Data Management Working Group(GCDMWG) of the SGCR and is implementing its coordination responsibilities through the design and implementation of the Global Change Data and Information System (GCDIS).

### **1.2 Purpose of GCDIS**

When the USGCRP was initiated, it was recognized that the existing Federal information systems and data centers were only strong starting points for developing the needed distributed and integrated global change data and information management system , since improvements were required to:

- Support both the expanded user community and data needs of the USGCRP.
- Cover all disciplines necessary to address the entire range of USGCRP issues.
- Strengthen the links and interoperability between various agency data and information activities into an effective national system.

These objectives were included in the 1991 report by the National Academy of Sciences Committee on Geophysical and Environmental Data(CGED), *Solving the Global Change Puzzle: A U.S. Strategy for Managing Data and Information*[1].

### **1.3 Approach**

The Federal agencies involved in the USGCRP are cooperating to define and implement the GCDIS by building on each agency's mission and available resources to link its global change relevant data and information to those of other agencies and to the user communities.

The GCDIS is intended to provide unified access to all significant Federal data and information relevant to the study of global change. While the initial need for development of the GCDIS came from the USGCRP research needs, the GCDIS strives to serve a diverse user community which, in addition to global change research scientists, includes policy makers, students and educators (including high school and grade school levels), academia, members of private industry, and private citizens. GCDIS aids users by identifying what global change data and information are available; by making the key holdings readily accessible in useful forms; and by helping ensure quality and continued availability of the data products.

By participating in the GCDIS, agencies themselves derive many benefits, including sharing of software and development costs and of application testing. The ability of the agency data systems to interoperate is enhanced through the use of technology sharing, data policy coordination, and common standards and approaches. GCDIS also provides agencies a convenient and common vehicle to meet their needs for making their agency data and information generally available and useful to all users, both within and outside the Federal government. By sharing information based on user feedback, improvements in the individual agency's data access programs and databases is expedited.

### **1.4 Expanded Federal Involvement**

The organizations initially taking a lead in the development of GCDIS were those with large USGCRP programs. These were primarily DOE , NASA, NOAA, NSF, and the U.S. Geological Survey of DOI. However, much of the data and information useful to global change researchers is useful to others as well, and much of the data that are generated by agencies for other purposes are crucial to global change research, assessments, and mitigation activities. This has resulted in an expansion of Federal agency involvement in GCDIS to include USDA, EPA, DOD, and into additional elements of the initial agencies, such as the Bureau of the Census of DOC and the National Biological Service of DOI.

### **1.5 Expanded User Community**

Access to data and information for interdisciplinary applications is a primary purpose of GCDIS. Therefore, GCDIS access is not targeted at the global change research community alone, but includes a wider range of research programs and users, with a broad range of capabilities and interests. This expanded user community will be served as GCDIS is expanded to link to the large volume of data and information that,

while important to the USGCRP, were produced for other purposes and add to the information that is specifically produced with USGCRP funding.

## 1.6 Accomplishments

Key accomplishments of the GCDMWG include:

- Broader types of data accessible via GCDIS. Additional Federal sources of data and information of significant value to the USGCRP are now included in the design and implementation of GCDIS.
- Limiting the redundant activities of differing "locator" initiatives across the agencies, through coordination and cooperation with their responsible working groups. Included are the Federal Geographic Data Committee, the Government Information Locator Service specified by the Paperwork Reduction Act of 1995, and the National Environmental Data Index.
- Service provided to additional categories of users. The GCDIS approach supports a variety of users who don't know how to find desired global change data and information. GCDIS has established both Gopher and World Wide Web(WWW) servers for user access, in addition to telephone and mail service.
- Drafting and promulgation of data access policy. The thrust of the policy is to facilitate full and open access to high-quality global change data. The "full and open" data access policy concept established by the 1991 global change data policy statements[2] has been used in a number of international contexts[10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21]. Recently, it was included in the U.S. position on proposed modifications to the data access policies of the World Meteorological Organization.
- Approach to GCDIS implementation that accommodates agency differences. This implementation approach identifies standard access technologies with emphasis on a coordinated, jointly developed, interconnected system. This approach provides agencies with both knowledge of the plans of the other agencies and the flexibility to contribute within the priority and resource constraints each faces. Without this realistic approach, it would be difficult to obtain the level of participation required of all agencies.

## 1.7 Project Publications

This report is the fourth major GCDMWG (IWGDMGC) publication to address the data management program issues and the implementation of the GCDIS. Each of these publications discusses the GCDIS design and implementation with increasing levels of detail. The first was the *Policy Statements on Data Management for Global Change Research*[2] issued in 1991.

The second, *The U.S. Global Change Data and Information Management Program Plan*[3] addressed more specifically the roles of each of the participating Federal agencies and provided some broad milestones for the 30 years following the report release in 1992.

The third, *The U.S. Global Change Data and Information System Implementation Plan*[4] was completed in 1994 and provided a strategy for developing GCDIS, recognizing the differences among agencies in their current level of support to the USGCRP, and moving the development forward with strong coordination and cooperation among the participating agencies.

All three of these publications built upon and were enhanced by continuing guidance and reviews by the NAS CGED. In addition, all three reports were formally endorsed by the Science Advisor of the President.

This present report builds on the strategies presented in the previous publications and describes the agency and interagency actions to be taken over the three year period, Fiscal Years 1995-1997. The implementation approach recognizes and accommodates differences among agencies in the type of data and information they hold, the extent to which they receive funding directly from the USGCRP, and their level of current capability to make data available for outside access.

This report includes the detailed GCDIS implementation plans for each of the participating agencies based on their current understanding of the resources they will have available. In addition, the report includes the GCDIS interagency activities of the three subgroups of the GCDMWG. These subgroups are:

- Content Subgroup to help coordinate agency efforts to identify and prioritize global change data and information products needed by users;
- Access Subgroup to identify the standards (hardware, software, tools) needed to create seamless search, browse, order and delivery of global change data and information and to provide users with interagency data access systems while recognizing the range of sophistication and limitations of users and technology;
- Library Subgroup to provide the library/information center perspective and expertise for the evaluation and development of GCDIS.

With the completion of this implementation plan, the GCDMWG is more actively concentrating on system implementation, coordination, and oversight. While the initial implementation of GCDIS relies on currently available equipment and search and retrieval software, a major responsibility of the GCDMWG is to identify and incorporate, where possible, the rapidly evolving technologies that best meet user requirements.

## **2.0 SYSTEM-WIDE ASPECTS OF GCDIS**

There are several aspects of GCDIS which cut across the entire system. Among these are the level and continuity of resources provided for implementation of the system, standards, pricing and access policies, international connections and user satisfaction.

### **2.1 Continuity in System Support**

This plan is based on the resources which are anticipated to be available to the agencies through FY 1997. Each agency has conformed its implementation plan to the resources it believes will be available. These resource levels are consistent with the actual agency budget for FY 1995, the Administration's submission for FY 1996, and a projection of the FY 1996 budget to FY 1997. They do not assume any new commitments or programs, nor unexpected radical change.

In past reviews of the GCDIS plans, the National Academy of Sciences[1] has stated that without major budget increases for data and information management, the agencies will not be able to achieve the program's objectives. Agency USGCRP data management budgets are included in their *Our Changing Planet*[5] for each participating agency. There have been major data management funding increases at NASA associated with the development of EOSDIS of the type recommended by the National Academy of Sciences, but significant new resources have not been the case in the other agencies. However, improvements in technology, particularly the advent of the World Wide Web and its browsers, are enabling progress toward the original interoperability objectives of GCDIS to be made through the use of Gopher and WWW servers at modest cost.

For the agencies other than NASA, most of the funding support for management of data and information relevant to global change lies outside of the USGCRP. Because this funding overwhelmingly supports purposes other than global change in most of these other GCDIS agencies, a break-out of this data management funding would generally not be meaningful. DOC, however, did provide such a break-out in its agency plan.

The participating GCDMWG agencies provide resources for shared support of the GCDMWG and its various activities, including pilot studies selected by the GCDMWG and support for the group's executive secretariat. Such support for FY 1995 is equivalent to approximately \$1 million. This equivalent funding level includes funding for specific agency hosted and contracted activities and for in-kind contributions, but does not include the costs of agency participants. With level funding in the GCDMWG support level, the need to operate GCDIS servers and to continue their evolutionary development will require decreases in GCDMWG pilot activities.

## 2.2 Standards

Each subgroup -- Access, Content, Library -- deals with issues of standards pertaining to their areas. These are described in the Subgroup sections of this report. Several relevant standards have emerged and been mandated through executive orders and OMB circulars. GCDIS will use these standards and try to extend their application to take full advantage of the consistency they offer data providers, users, and system implementers. Of particular note are the applicable FIPS, the Government Information Locator Service, and two standards emanating from the Federal Geographic Data Committee in support of the National Spatial Data Infrastructure -- the Content Standard for Digital Geospatial Metadata and the Spatial Data Transfer Standard. Clearly, using standards will improve interagency interoperability and the ability to interface GCDIS effectively with other systems that hold data of relevance to global change research.

## 2.3 Pricing and Access Policies

GCDIS and its component agency systems will adhere to the data pricing and access policies of OMB Circular A-130 as well as the Data Management for Global Change Research Policy Statements from July 1991[2]. The 1991 Policy Statements state:

*Data should be provided at the lowest possible cost to global change researchers in the interest of full and open access to data. This cost should, as a first principle, be no more than the marginal cost of filling a specific user request.*

The U.S. has also supported the principle of full and open access of Federal environmental data in many international fora including ones with the United Nations, the World Meteorological Organization, the International Geosphere-Biosphere Program, the Committee on Earth Observation Satellites, and for the Framework Convention on Climate Change and the Second World Climate Conference[10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21]. In 1995, the policy was reviewed and endorsed by the National Academy of Sciences[7, 8, 9].

## 2.4 International Connections

The international connections of GCDIS have two purposes -- to facilitate international usage of GCDIS and to increase the availability of international data holdings through GCDIS. The agencies acting collectively within the GCDIS provide international users with access to the same data and information and to similar delivery services as those available to U.S. users. Agencies act individually and collectively to secure for U.S. users access to foreign sources of data and information. The GCDIS is and will continue to be accessible through the Internet, which knows no boundaries.

The international use of common access standards would provide a foundation for worldwide interoperability with GCDIS. The GCDMWG, acting for the CENR, is advocating that, at a minimum, international systems adopt the Z39.50 standard and the Internet as a means of access and interconnection.

GCDIS and its component systems aspire to offer connections and eventual interoperability with participating international data centers. Access to worldwide data and information resources can be accomplished by an international extension of the GCDIS access system approach, with the GCDIS becoming a U.S. node of a distributed, international, global change data and information network system. Many international linkages are already in place or under development in several agencies. NASA and NOAA, for example, are undertaking pilot efforts to make such connections through their participation in the Committee on Earth Observation Satellites (CEOS) whose membership includes virtually all countries and multinational entities that have satellites to observe the Earth. The NASA and NOAA agency plans provide more details.

The International Council of Scientific Unions (ICSU) World Data Center (WDC) System links data centers worldwide which conduct acquisition, exchange, dissemination, and archiving of solar, geophysical, and related environmental data and information. The WDC system already provides GCDIS with an initial set of international connections through several WDCs which exist within GCDIS agencies: (Several other component data centers of GCDIS are seeking designation as WDCs.)

| <u>Agency</u> | <u>World Data Center -A for</u>                                                                                                                       |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| DOC           | Glaciology<br>Meteorology<br>Marine Geology and Geophysics<br>Oceanography<br>Paleoclimatology<br>Solar-Terrestrial Physics<br>Solid Earth Geophysics |
| DOE           | Atmospheric Trace Gases                                                                                                                               |
| DOI           | Remotely Sensed Land Data                                                                                                                             |

As examples of the international cooperative activities in process at U.S. data centers:

- The USGS EROS Data Center serves as the North American node of the United Nations Environment Programme (UNEP) Global Resource Information Database (GRID), which is an international network for distributed environmental data and related research findings. This GRID node was established in 1991 by agreement between UNEP, USGS, and NASA. Similar facilities are located at GRID-Nairobi, GRID-Geneva, and GRID-Bangkok. This international network of facilities provides the world community with access to environmental data as well as data processing and telecommunication technology. It has long been hoped that GRID activities would result in reciprocal access to data and information from international sites.

- USGS, NASA, and NOAA are participating in pilot projects with the International Geosphere-Biosphere Program Working Group on Data and Information Systems (IGBP-DIS) to make data available on CD-ROMs. WDC-As have begun to participate in these pilot projects, which will provide space-based and in situ regional and global data sets on CD-ROMs or other media to facilitate international access to global change research data and information.
- The ISSC Human Dimensions Programme (HDP) Data and Information System is another international GCDIS link. This program is implementing metadata and data access mechanisms utilizing the Socioeconomic Data and Applications Center (SEDAC) facilities. SEDAC is one of the nine EOSDIS DAACs and is managed by CIESIN.
- Bilateral agreements commonly exist in GCDIS agencies. As an example, DOE-CDIAC staff participate in two bilateral agreements: Working Group VIII of a US-Russian agreement on environmental protection, and a U.S.-China agreement on research on the greenhouse effect. Both efforts include the sharing of data from the bilateral partner country.

## 2.5 User Satisfaction and Evaluation

The ultimate measure of data and information system success is the quality of service it provides to its users and the extent to which it enables them to accomplish their work more effectively. The system is not an end in itself. Recognizing that GCDIS is providing services to both the global change research community and the general public, assessing user satisfaction and obtaining specific user feedback is critical to guiding system operations and evolutionary development.

Accordingly, during 1995 a much expanded GCDIS user survey will be initiated. The Library Subgroup will develop this survey in consultation with the other subgroups of the GCDMWG and will provide analysis of the results. The survey will target all first time users to obtain information about their initial impressions of the system, identify learning curve issues (such as the degree to which the system appears accessible), and learn why some users do not become repeat users. It will also query continuing users to address issues relating to longer-term system use and to ensure on-going attention to user needs. The survey will also cover a variety of issues including whether the system ultimately met the users need and supplied the desired data. With this survey, information will be obtained for potential agency follow-up actions, such reducing the gaps and limitations of the data and information. The Access Subgroup will oversee the electronic implementation of identifying users and sending and receiving the user survey.

## **3.0 ACCESS SUBGROUP IMPLEMENTATION PLAN**

### **3.1 Executive Summary**

This Access Subgroup Implementation Plan for the Global Change Data and Information System describes the planned activities by the Access Subgroup for fiscal year 1995, 1996, and 1997 activities, but focuses on those activities that will be implemented during FY 1995. All these activities will be designed to fit within the existing agencies budgets. The ultimate goal of GCDIS Access is to create a seamless search, browse, order, and delivery of global change data and information on-line and off-line, at whatever speed users need, using readily available tools.

There are several principles of GCDIS that determine the Access Subgroup activities. The first principle is that GCDIS is a federated system, a coordinated set of separate agency systems which are themselves each controlled by a member agency. The interoperability of these separate systems is accomplished by the sharing and use of software and common standards with only just enough supporting infrastructure to ensure a relatively seamless look at the available data and information. Consequently, advances in GCDIS access will occur at different times in different agencies, as budgets and staffing allow. Users, however, will enjoy a relatively seamless look at the data and information available from many agency systems.

Another GCDIS principle is that the type of data produced by the activities of global change research is also useful to others beyond the global change researchers and that, additionally, much of the data that are generated for other purposes (non global change research) are crucial to global change research, assessments, and mitigation activities. Consequently, the GCDIS access is targeted not only at the global change research community, but includes a wide range of users, with a broad range of capabilities (hardware, software, and greyware) and interests.

Services available to users will be implemented at four different levels, depending on the capabilities of the users and the capabilities of the system and its distributed members. The focus of the development of GCDIS Access is to use on-line public domain Internet tools (e.g., WAIS, GOPHER, Mosaic), and standards (e.g., Z39.50, TCP/IP, HTML). GCDIS access will provide services ranging from dial up, character-based terminal emulation to fully equipped Unix work stations connected to the Internet.

### **3.2 Purpose and Scope**

The GCDIS Access Plan covers a broad spectrum of activities which will be continuously evolving and for which full implementation will require many years. These activities specifically involve the discovery, ordering and delivery of relevant global environmental data and information to the user's desktop or mailbox. This plan is for a three-year period, Fiscal Year 1995 through Fiscal Year 1997, with an emphasis on FY 1995 activities but with a summary of potential activities for later years.

GCDMWG Access Subgroup activities are based on the following assumptions:

- GCDIS is a federated system, whose interoperability is assured by the use of a small amount of shared resources and common standards.
- GCDIS Agencies have agreed to openly share software and access mechanisms developed for GCDIS access. They will comply with appropriate standards and executive orders pertaining to the public access of government information.
- GCDIS Agencies' global change data and information and metadata will be shared among the participating agencies, the scientific community, and the public at no more than the marginal cost of filling a user request.
- GCDIS access methods range from telephone, mail, and fax technologies to powerful, networked workstations. However, the initial emphasis for GCDIS development will be on making data and information available electronically through high speed computing and communications development.
- The Internet is the vehicle for high-speed communications and connectivity.
- Users will range from the scientists and engineers engaged in global change research and mitigation/adaptation development to the policy makers, legislators, various types of intermediaries, and the public. The GCDIS access design will provide different levels of service depending on user hardware and software capabilities, but will strive to accommodate all users at a minimum level of service.
- GCDIS Agencies have the primary responsibility for implementing GCDIS Access according to their own plans and funding. When necessary, the agencies have agreed to jointly fund crosscutting service, studies, and common development.

### **3.3 GCDIS Access Infrastructure Coordination**

#### **3.3.1 Coordination Structure and Methodology**

The Access Subgroup of the GCDMWG is responsible for the coordination among the participating agencies. This is necessary for the successful development of GCDIS access, and the optimal use of the agency systems while they are addressing multiple needs.

The Access Subgroup will coordinate the following issues :

- 1) Content of minimal agency metadata systems
- 2) Software and hardware requirements
- 3) Interagency data and metadata activities
- 4) Linkages to non-Federal entities, e.g., international, state, and local organizations
- 5) Topical search capabilities(with the Content and Library Subgroups)
- 6) Linking data sources to library resources, evaluation of access systems, and promotion of GCDIS to the public with the Library Subgroup
- 7) Meeting of special needs other SGCR working groups

The Access Subgroup will use the following methods to accomplish its coordination activities:

- 1) Establish a formal liaison with the leadership of FGDC, GILS, and NEDI to address issues of interoperability.
- 2) Establish links with international organizations, (e.g., CEOS) to facilitate the inclusion of international nodes in GCDIS.
- 3) Establish links with state and local organizations to facilitate the inclusion of their national nodes in GCDIS.
- 4) Utilize GCRIO to identify needed sources of data and information; submit recommendations based on user comments and queries; identify problems related to finding, accessing, or combining data from different sources.
- 5) Establish electronic mechanisms for the sharing of expertise and tools by technical experts at agency data centers.

### **3.3.2 Budget**

The GCDIS Access budget focuses on agency crosscutting activities and does not include agency-specific access programs, projects, or prototypes. The crosscutting activities are currently limited to three development projects: GCDIS Gopher; GCDIS WWW; and the Global Change Assisted Search for Knowledge (GC-ASK). Estimated budgets are listed below. Funding for the WWW and Gopher activities is limited to part-time contractor costs to operate, maintain, and upgrade these services. GC-ASK is being developed through a commercial contract, while the Gopher and WWW applications are being hosted by the Department of Commerce-NOAA and the Department of Energy-ORNL. Staff support is generally supplied by the NASA/Goddard Space Flight Center.

| <u>Activity</u> | <u>FY95(\$K)</u> |
|-----------------|------------------|
| Gopher          | 50               |
| WWW             | 50               |
| GC-ASK          | 240              |
| Support         | 50               |

### 3.3.3 Schedule

The Access Subgroup will meet on a regular basis and review progress toward the goals of establishing and maintaining common Internet access tools and user interfaces to the coordinated global change related resources of the participating agencies and non-Federal entities to meet user needs; overseeing the progress of its pilot projects; and coordinating interagency data and metadata activities. The schedules for each activity will be evolved to take advantage of opportunities and adjust to current circumstances following the procedures listed below.

- 1) Access Subgroup identifies items that need modification, capabilities that need to be added to the user interface, or additional tools that need development
- 2) Developers create prototypes of changes and place them on the appropriate test servers for general review and evaluation
- 3) Agency system administrators replace or add versions of GCDIS tools with new or added versions, after incorporating synthesized comments and suggestions

Each release will focus on major upgrades to GCDIS capabilities, as specified Table 1, but will also include many minor modifications.

Table 1. GCDIS Access Development Schedule

| Date     | Version | Upgrade                |
|----------|---------|------------------------|
| 4/1/94   | Alpha   | Initial Gopher         |
| 9/30/94  | Beta    | Database driven Gopher |
| 12/12/94 | n/a     | ASK Design Plan 1      |
| 1/1/95   | Beta.1  | ASK Prototype 1        |
| 2/10/95  | n/a     | ASK Design Plan 2      |
| 4/1/95   | 1.0     | Improved Gopher        |
| 4/10/95  | 1.1     | ASK Prototype 2        |
| 5/10/95  | n/a     | ASK Design Plan 3      |
| 7/10/95  | 1.2     | ASK Prototype 3        |
| 8/1/95   | 2.0     | WWW update             |
| 8/10/95  | n/a     | ASK Design Plan 4      |
| 10/10/95 | 2.1     | ASK Prototype 4        |
| 12/1/95  | 3.0     | Database driven WWW    |

## **3.4 GCDIS Description**

### **3.4.1 System Overview**

The GCDIS access infrastructure will be built on existing technologies that are freely available to users and that will allow the adoption of new technologies as they become available. Access to the distributed resources of the agencies and related global change resources will be provided through the Internet using technologies such as Gopher and the World Wide Web. Accepted protocols will be built into the system, including Z39.50 which will provide interoperability for searching across distributed, multi-formatted or non-formatted resources. The use of standard formats for metadata, documents, and data sets will be encouraged as well as the adoption of a common set of data and document viewers. GCDIS will take advantage of the technology developments of the participating agencies to enhance the capabilities of GCDIS access.

Currently, the user interfaces that exist (in addition to the individual agency systems) consist of a help line, a Gopher Server, and a World Wide Web Home Page. To keep the maintenance of GCDIS to a minimum, the GCDIS Gopher and Web pages point to existing agency resources. GCDIS provides access to these resources through agency/organizational links, through topic browsing categories, and through searching mechanisms. User feedback is used to improve the GCDIS interfaces and will be forwarded to the appropriate agency contact when the comment relates to a particular resource node.

The development of the GCDIS Gopher and Web pages is closely coordinated so that information and pointers are consistently updated and presented with a minimum of maintenance required.

Aliases for the Gopher and the Web sites are used so that the actual location of these servers can be changed with little disruption of service. Their addresses are:

|           |                                                                                 |
|-----------|---------------------------------------------------------------------------------|
| Gopher:   | <a href="gopher://gopher.gcdis.usgcrp.gov">gopher://gopher.gcdis.usgcrp.gov</a> |
| Home Page | <a href="http://www.gcdis.usgcrp.gov">http://www.gcdis.usgcrp.gov</a>           |

### **3.4.2 Gopher Server**

The GCDIS Gopher Server is located at and supported by NOAA/NESDIS. It contains basic information about GCDIS, and serves as a central pointer to other Gopher servers: those maintained by the participating GCDIS agencies, and those at appropriate government and international organizations. It interfaces with other Gopher servers via the Internet using standard TCP/IP and Gopher protocols. The Gopher Server allows user access via Internet or modem with any Gopher-compatible client software. A summary description is in the Appendix.

Agency representatives are responsible for identifying Gopher, ftp, and telnet sites for the GCDIS Gopher. The GCDMWG executive secretariat assists the GCDIS Gopher development by helping coordinate interagency material, agency resource pointers, and menu structure design. Comments from GCDIS Gopher users are

monitored and acted on, which may involve forwarding the comments to the appropriate agency representatives. Statistics of use are reported on and evaluated monthly.

The structure of the GCDIS Gopher supports access to resources by agency/organization and by topics. The topic structure and the scope of the pointers will be reviewed by the Access Subgroup and revised to meet user needs as necessary.

### **3.4.3 World Wide (WWW) Server**

The GCDIS WWW server is located at and supported by DOE's Oak Ridge National Laboratory (ORNL) in Tennessee. It contains basic information about GCDIS and serves as a central pointer to Gopher servers and WWW home pages maintained by the participating GCDIS agencies, as well as to other appropriate government and international organizations. The GCDIS Web home page provides pointers to all types of resources, including Gopher, telnet, and ftp sites. The Web pages are designed so that character-based clients can also access them. A summary description is in the Appendix.

The WWW Server allows user access via Internet or a modem with any WWW compatible client software. Users with less sophisticated computers view text only. The structure of the GCDIS Web server supports access to resources by topic, by search software, and by agency/organization.

Agency representatives are responsible for identifying resource Internet addresses and descriptions of the resources available. The GCDMWG executive secretariat assists the GCDIS home page development by helping coordinate interagency material, agency resource pointers, design of the pages and hypertext links, and GCDIS Gopher interfaces. GCDIS Web user comments are monitored, summaries reported, and acted on monthly.

### **3.4.4 Access Tools**

The ultimate goal is to provide an automated search and retrieval system for GCDIS that will search across distributed global change related resources and return required data and information to a user. The access and discovery tool set will be the direct means to browse, evaluate, or access these resources and eventually retrieve selected resources that meet the users needs. To accomplish this goal, the Access Subgroup will adopt available resource discovery technologies that work across the Internet and that are Z39.50 compatible. It is also supporting a pilot project to explore some of the alternatives of search system design that will assist the user in locating relevant resources. See Section 3.5.1 for a fuller description of the pilot project: the Assisted Search for Knowledge (ASK) project.

It is convenient, although arbitrary, to divide the Catalog System into Directory, Guide, and Inventory components. This set of distinctions is most appropriate for observations and measurements, and less appropriate for bibliographic entries and general information sources. The primary feature of the Catalog System is that it contains metadata. Within the Catalog System, the Directory contains metadata about data sets and data systems, the Inventory describes individual data elements (granules),

and the guide contains a wide variety of narrative information used to interpret or provide context for the data. All three components may not be present, or necessary for a successful user search and retrieval. However, the GCDIS agencies have agreed to provide at least Directory level information for GCDIS searches. However, in many cases inventory level (description of individual data elements) and guide level (narrative information to help interpret the data) are also made available. The deeper a user can search the contents of the data systems, the higher the level of interoperability. The ultimate goal is for a user to be able to search across all types of information with one search action and to be allowed to search for specific data items within data sets.

A GCDIS search will ultimately access catalogs as well as data systems of the participating agencies, including their library resources. Included in the current GCDIS catalog system is the NASA Global Change Master Directory (GCMD) and the NOAA Data Set Catalog, both of which provide information about the data holdings of distributed data centers and are described in respective agency summaries contained in Volume II. The GCMD also includes mapping tools that will translate between metadata formats. Users can interface with the GCMD using a character based dialup or client software adhering to Telnet and WWW protocols. Users can search the GCMD for appropriate information through the use of tools that use the Z39.50, version 2, standard.

The Access Subgroup will work toward coordinated access to the metadata and inventory data by cooperating with the Government Locator Service (GILS), the Federal Geographic Data Committee (FGDC), National Environmental Data Inventory (NEDI), and similar initiatives to identify global change related data and information and to help coordinate the access systems and metadata policies and practices used. The Access subgroup will also support the distribution and use of common tools for search, browse, order, and delivery.

### **3.4.5 Interoperability Standards**

GCDIS will not require any standards in addition to those currently imposed on all Federal agencies. GCDIS standards will comply with FIPS and will facilitate the adoption of new technologies as they become available. GCDIS servers will use Gopher, Z39.50 version 2, Telnet, File Transfer Protocol, WAIS, and World Wide Web protocols. Data transfer formats will follow the applicable FIPS (such as SDTS) as appropriate. GCDIS will adhere to Hypertext Markup Language (HTML) standards, and GCDIS will allow multiple metadata formats, such as DIF, MARC, and GILS. The GCDIS also expects the participating agencies to use, when appropriate, a metadata format compliant with the FGDC Content Standard for Digital Geospatial Metadata.

The choice of protocols and standards will not restrict access to GCDIS from any UNIX, DOS, or Macintosh computer, nor will it restrict Internet or modem access to GCDIS. Further, the choice of protocols and standards will not restrict the portability of GCDIS components between hardware platforms. GCDIS will not require any unique client software and it will adapt to new client packages as they become available.

### **3.4.6 Hardware and Software Interfaces**

Both the Gopher and WWW servers will include simple pointers to the appropriate agency catalog systems. The Gopher Server will interface with all of the agency nodes using ftp, TCP/IP, and Gopher protocols. The WWW Server will interface with all of the agency nodes and agency home pages, using ftp, TCP/IP, Gopher, and WWW protocols as well as allowing fielded searches using the Wide Area Information Server (WAIS) software. The nature of WWW protocols will allow the WWW Server to include all of the contents of the Gopher Server, however, the Gopher server cannot include all of the contents of the WWW Server.

A WAIS search engine will interface with all other components, essentially operating on index files maintained locally at each data center using at least Z39.50 protocols. The ASK Pilot Project will examine some alternatives to the interface and any other protocols that might be added.

### **3.4.7 User Interfaces**

GCDIS will allow user access with any clients compatible with Telnet, Gopher, Z39.50, and WWW protocols. A user should have full access with a freely available client package (such as Mosaic, WAIS, Turbo Gopher, and Lynx), or with enhanced commercially available packages that adhere to the standards used by GCDIS. GCDIS will not require any unique client software. GCDIS will adapt to new client packages as they develop.

GCDIS will allow user access via Telnet, FTP, Internet, or modem. Access through Telnet or modem might limit the user to viewing text only. Images and text can be accessed with direct Internet connections. Data and information can be downloaded electronically via FTP, common modem software (e.g., XMODEM, Kermit, etc.), Gopher, WAIS, and World Wide Web clients. GCDIS will allow user access from any UNIX, DOS, or Macintosh computer.

### **3.4.8 Levels of Access**

GCDIS has established levels of access (See Table 2) based on the user-oriented functions of connectivity, search, browse, order, and delivery. With Level 1 being the highest level of access service, these levels are:

Level 1 is the full GCDIS access system. All nodes containing GCDIS relevant data are connected to the Internet at speeds exceeding 1 Mbps. A full catalog system is present, including metadata descriptions at the granule (inventory) level, where appropriate. Browse products can be generated on line (dynamically) according to user capabilities and needs. Ordering is integrated with the search and browse software, and data can be delivered on or off line using user-specified subsets and logical joins.

**Level 2** provides on line, via modem or over the Internet, access to data set or data system (directory) level information, and static browse products. Requests can be ordered on line, with manual confirmation and forwarding of requests. On line delivery can be requested.

**Level 3** adds to level 2 telephone communications and ordering (perhaps via FAX), a GCDIS oriented directory, off line digital browse products, and the ability to select from a list of standard products.

**Level 4** represents an entirely manual system. Users search and view hard copy reports and place orders via written requests to the appropriate data centers. At level 4, the user may only be able to subscribe to a stream or series of standard products (such as a series of publications, or a pre-determined CD-ROM).

**Table 2. GCDIS ACCESS LEVELS**

| LEVEL | CONNECTIVITY                                             | SEARCH                                                                                                         | BROWSE                                    | ORDER                          | DELIVERY                                                                                    |
|-------|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-------------------------------------------|--------------------------------|---------------------------------------------------------------------------------------------|
| 1     | Data transfers greater than 1 Mbps (i.e. T-1, T-3, etc.) | Full Catalog system on line with all agency's gcd/i described in accordance with GCDIS standards               | On line dynamic browse product generation | On line GCDIS integrated       | User choice, on/off line via standard formats (i.e. user Boolean or spatial subsets/ joins) |
| 2     | Data transfers to 1 Mbps                                 | Directory level info and agency gcd/i documentation on line to GCDIS standards                                 | On line static browse products            | On line with manual forwarding | User choice, on/off line standard products                                                  |
| 3     | Voice-grade telephone line                               | Priority gcd/i directory level info to GCDIS standards and gcd/i documentation by hard copy to GCDIS standards | Off line digital browse products          | Manual interface               | User choice of standard products                                                            |
| 4     | Regular mail                                             | Existing directory level gcd/i and hard copy documentation available to GCDIS                                  | Off line hard copy browse products        | Manual interface               | Standard products                                                                           |

\*gcd/i = Global Change Data and Information

### 3.4.9 Agency Summary

Currently, all GCDIS agencies have at least level 4 access to data and information produced by its focused USGCRP activities. Except for a limited number of data sets, no agencies have overall functionality at level 1. Some agencies have level 1 access to metadata, but limited access to the data itself. Many have available potentially significant contributing holdings.

- Connectivity: All of the agencies have capabilities to transfer data and information at T-1 speeds.
- Search: Several agencies have achieved level 1 search capability, while others will require considerable development to attain those goals.
- Browse: None of the agencies offers dynamic browse nor do they intend to do so by 1997, but all agencies plan to provide static browse for some data sets by 1997.
- Order: Several agencies offer on line ordering or direct download capability. Most agencies have primarily manual systems.
- Delivery: Most agencies plan to deliver data on line.

The goal of the GCDIS implementation is for all global change data and information residing in participating agencies to be available at levels 1 through 4 and moving toward level 1. This goal will not be reached immediately by any agency, and each agency will proceed implementing its access capabilities at a pace defined by internal funding and priorities.

### 3.4.10 Libraries

Libraries form a special category of GCDIS users, as well as a special access point for GCDIS, acting as intermediaries to users seeking global change data and information. The Library Subgroup of the GCDMWG has developed a separate Implementation Plan detailing its GCDIS crosscutting services, Section 5.0.

## 3.5 Special Activities

In addition to operating the Gopher and WWW servers, the GCDIS Access Subgroup is undertaking several projects to develop improvements to the common infrastructure. These are conducted by the agencies as pilot activities to determine the feasibility of an overall implementation or the improvement of a method or technique. Three interlinked special activities are underway which have the potential to significantly improve the usefulness of the GCDIS search engine and catalog system.

### 3.5.1 GCDIS - Assisted Search for Knowledge

GCDIS - Assisted Search for Knowledge (ASK) is one of the Access Subgroup's pilot projects. The fundamental ASK concept is of a prototype system that links databases that are diverse in format and content while enabling users with different skills, needs, and access methods to obtain relevant information from these databases by using natural language inquiry and a common user interface.

The GCDIS-ASK Project Plan includes the development of four prototypes to be delivered over a twelve month period.

| <u>PROTOTYPE</u> | <u>DELIVERY DATE</u> |
|------------------|----------------------|
| Prototype I      | January 1995         |
| Prototype II     | April 1995           |
| Prototype III    | July 1995            |
| Prototype IV     | September 1995       |

Prototype I, a software test bed, demonstrates key principles that serve as the technical foundation essential for continued successful development. It includes the ability to enter a single command line query via the client software, which searches multiple databases over the Internet, and provides a single merged response. In addition, a User Concept of Operation is developing and will be reviewed at each stage of development by the GCDIS-ASK User Working Group. This Group represents experts of the identified user categories, and provide a mechanism to assess user needs for enhanced system development.

Prototype #2 added a Graphical User Interface, Z39.50 compliance, additional knowledge bases (National Institute of Health's Unified Medical Language System (UMLS), Defense Technical Information Center (DTIC) and NASA Thesaurus, and additional databases. It was available for Earth Day on the Mall. The success of Prototype #1 is the baseline for providing increasing support to a broad cross section of users who are concerned with access and analysis of global change data and information.

Prototype #3 will add a GIS capability, additional graphical interfaces and a consistent data presentation model to demonstrate the capability for multiple user classes. It will also add non-native (non-ConQuest) search engines to demonstrate the capability to link to and effectively utilize the functionality of existing search engines of participating agencies.

Prototype #4 will demonstrate the capability for simultaneous information access across multiple databases and non-native search engines. It will include retrospective searching, real-time profiling, and on-disk (CD-ROM) product searching. It will manage metadata and enable source selection using a knowledge base.

### **3.5.2 Directory Level Interoperability**

Interoperability within GCDIS is defined as the ability of one data system to effectively communicate with another. With Directory Level Interoperability, users can search multiple data centers for specific data sets.

Over the years, individual GCDIS agencies have developed their own metadata formats and directories to serve their needs and to respond to available technology, to goals of the specific program developing the metadata, and to applicable Federal mandates in effect at the time of generation. Historically, the Global Change Master Directory (GCMD) has been the repository for metadata describing focused USGCRP holdings.

Currently, agencies are responding to requirements generated by the Government Information Locator System (GILS), and the Federal Geographic Data Committee (FGDC) for spatial metadata content.

The Access Subgroup, acting in conjunction with the Committee on Environment and Natural Resources (CENR) Task Force on Observations and Data Management (TFODM), is attempting to coordinate metadata formats and the development of a common directory among at least GILS, GCDIS, FGDC, and the National Environmental Data Index (NEDI). This effort is underway and does not require additional funding outside of the agency budgets.

By adopting a common standard and tools, and by sharing development costs, ease of access will likely increase, and considerable agency resources will likely be saved in the implementation of standards and the generation of software.

### **3.5.3 Inventory Level Interoperability**

The ultimate goal of GCDIS is to provide users the ability to search for specific data items within data sets, as well as inventory level searches. The deeper a user can search the contents of the data systems, the higher the level of interoperability is required.

The effort to develop this higher inventory level of interoperability will begin in FY 1996 and develop more fully in FY 1997. The ASK prototype will assist in defining alternatives for supporting inventory level interoperability. Its evaluation will be the starting point for the development of alternatives.

## **3.6 User Services and Outreach**

Assistance to users is provided by the agency data nodes and common user help facilities. These are summarized in the Appendix.

### **3.6.1 Agency User Services and Outreach**

Each agency node provides user support for its own data holdings and services. Each agency node performs outreach targeted at its own specific user community. Most nodes offer on-line help services, ranging from simple "read me" files to hypertext help. Many nodes offer e-mail and phone services for more direct interaction with the user. Some offer mail services.

### **3.6.2 Interagency User Services and Outreach**

The Global Change Research Act of 1990 (PL 101-606) created the Global Change Research Information Office (GCRIO) to disseminate global change related information to governmental entities, businesses, institutions, and private citizens, both within and outside the United States. GCRIO will provide user services and outreach for GCDIS, complementing that which is provided by each agency node.

The Act provided a total of \$2 million to create GCRIO. In 1993, at the direction of USGCRP, NASA funded a four year grant to CIESIN to create GCRIO. The Access Subgroup provides oversight and direction to GCRIO on behalf of the SGCR.

#### **3.6.2.1 User Services**

The WWW Server, the Gopher Server, and the Directory will have an electronic suggestion box to collect comments, criticisms and questions from users. GCRIO will receive and organize these comments and will forward them to the Access, Content, and Library Subgroups, as appropriate.

GCRIO will staff a help desk equipped with an e-mail address, a phone line, and a fax line to answer user inquiries. GCRIO will set up Gopher and WWW servers specifically designed to answer common user questions, to summarize the available help services, and to explain how to GCDIS.

GCRIO will provide the Access Subgroup with a quarterly report summarizing the user inquiries, comments and suggestions.

#### **3.6.2.2 Outreach**

The FY 1995 *Our Changing Planet*[5] outlines the basic goals, objectives, and strategy for user outreach. The Subgroups will identify and implement specific outreach activities, and will supply the initial master copy of any outreach material to GCRIO.

GCRIO handles the logistics of outreach to the user community, which includes identifying target user groups, obtaining mailing lists, performing surveys, etc. GCRIO also handles reproduction and dissemination of USGCRP brochures, booklets, videos, etc. Its grant funding mechanism does not allow GCRIO to create any products for the primary benefit of the Federal government. However, GCRIO does collate feedback from its outreach effort and supplies it to the appropriate GCDIS subgroup.

In satisfying user requests about global change, GCRI may identify worldwide sources of data and information and, if so, will pass these sources to the Access Subgroup for inclusion in GCDIS.

### **3.7 International Access**

International users may have access to the same quality of data and information and similar delivery services that are available to U.S. users via the GCDIS agencies and the GCRI activities. Conversely, agencies act individually and collectively to secure for U.S. researchers access to internationally available data and information.

#### **3.7.1 International Access**

Access to worldwide resources is accomplished by extending the GCDIS access system internationally, with GCDIS becoming a U.S. node of a distributed, international, data and information network.

Many international linkages are already in place or under development in several agencies. Hypertext links to metadata and data are provided at many agency home pages. Additional international access mechanisms are in place in selected agencies. Brief descriptions of some international access mechanisms are included in Section 2.0 of this Plan. Additional details may be found in Volume II's agency implementation plans.

Internet access is currently offered via Gopher and World Wide Web (WWW) servers. Gopher servers provide a menu structure of choices allowing users to search and access resources distributed at linked sites. The WWW GCDIS home page serves as another entry point for the GCDIS. These access points are summarized in the Appendix and further information contained in the Volume II agency implementation plans.

#### **3.7.2 International Standards**

GCDIS agencies are participating in the arena of international standards, in addition to system implementations. For example, NOAA and NASA are participating in the Committee on Earth Observation Satellites (CEOS) whose Working Group on Data (WGD) addresses issues of standards associated with catalog interoperability and ground networking.

Additionally, the Access Subgroup has begun an effort to provide the CENR Task Force on Observations and Data Management with access interoperability recommendations to the international community. Current recommendations for information search and retrieval standards include the use of the Internet and Z39.50 (ISO 10162/10163).

### **3.8 Potential Activities for FY 1996 and 1997**

In FY 1996 and 1997, the Access Subgroup expects to continue to support the Gopher and WWW home page efforts. As the technology matures for character-based interface to the WWW, the emphasis is expected to shift to the WWW home page. The level of effort required for such support is anticipated to be comparable to the current effort.

After the delivery of the final ASK prototype in October 1995, the GCDIS development team will have a one year period to evaluate ASK, during which the licensing fees have been waived by ConQuest and its partner firms. During this period, it is planned that the GCDIS team will decide whether to use all or part of ASK to link GCDIS nodes, to fund any expansion of the prototype, or to abandon the effort. This decision will be determined by the cost of using ASK commercial software, the utility of ASK, and ease of integrating additional data systems with ASK.

Depending on the results of the ASK pilot, the Access Subgroup anticipates an ASK-follow-on pilot project will probably be needed during the evaluation period in FY 1996. We expect that approximately \$130K will be needed for ongoing technical support and some expansion and refinement of the prototype software.

The Access Subgroup will also engage in evaluations of additional tools for search, browse, order, and delivery that may be applicable to all agencies involved in the management of global change or environment and natural resources data and information. In most cases, funding for tool development will reside within specific participating agencies and will be coordinated by the GCDMWG.

## **4.0 Content Subgroup Implementation Plan**

### **4.1 Executive Summary**

The Content Subgroup is one of the three subgroups of the GCDMWG. It was established to coordinate the efforts to identify and prioritize data and information and related information products within GCDIS. The Content Subgroup deals with the challenging current characteristics of the data and information found in GCDIS - a wide array of types of data and information (including international), produced by a wide range of research activities and used by a wide range of national and international users.

In addition, the Content Subgroup foresees the future of data and information within GCDIS to be increasing in volume and intellectual diversity. Further, the future content of GCDIS will include data and information that are routinely subjected to various levels of quality assurance (QA) audits, which will require more effort on behalf of researchers and data managers and will need to be conducted on many more data products of higher complexity.

## **4.2 Purpose and Scope**

The purpose of this Content Subgroup Implementation Plan is to provide a three-year framework (FY 1995-1997) of activities with the central focus being the FY 1995 activities. The terms of reference for the Content Subgroup identify the following primary types of activities:

1. Identify available global change data and information that meets user needs
2. Categorize global change data and information
3. Identify actions needed to resolve data and information gaps
4. Identify existing standards for metadata and other areas related to GCDIS contents
5. Identify activities and special products needed to increase awareness of GCDIS content.
6. Develop policies and procedures to encourage researchers to participate in GCDIS
7. Provide a forum for sharing lessons learned
8. Coordinate the establishment of data and information quality assessment processes
9. Serve as the point of contact for users that need special products,
10. Identify education data and information products needed by schools (grades K-12)

Not all of these needed activities can be pursued simultaneously because of budget and human resources constraints. Therefore, the Content Subgroup has identified in Section 4.4 two interagency activities it would support in FY 1995. Their focus is on addressing the need for prioritizing the data and information product requirements of an expanding USGCRP.

## **4.3. GCDIS Content Subgroup Infrastructure Coordination**

### **4.3.1 Coordination Structure and Methodology**

The coordinating infrastructure of the Content Subgroup proposed activities, for FY 1995-96, will entail interagency steering committees and task groups involving the GCDIS agencies.

### **4.3.2 Budget**

The GCDIS Content Subgroup budget focuses on agency crosscutting activities and does not include agency-specific programs, project or prototypes. The crosscutting activities are currently limited to two projects: Identification and Prioritization Pilot Study (IPPS) and annual workshops. Estimated budgets are listed below. Workshop costs, including travel for invited lecturers, local expenses, and mailings, will be recovered by the workshop registration fees.

| <u>Activity</u> | <u>FY 1995(\$K)</u> |
|-----------------|---------------------|
| IPPS            | 95                  |
| Workshops       | 0                   |

#### **4.3.2 Schedule**

The two Content Subgroup interagency activities identified will be scheduled throughout the next two years, as indicated in the Table below. The specific activities of IPPS will occur in succession, beginning in 1995, and will be dependent on the completion of the previous activity. Any necessary follow-up activities relating to the IPPS project will be determined upon its completion in 1996.

| <u>DATE</u> | <u>ACTIVITY</u>                       |
|-------------|---------------------------------------|
| 9/95        | 1st Data Center Workshop              |
| 1995        | IPPS Histories and Status Report      |
|             | IPPS Delphi Survey                    |
| 1996        | 2nd Workshop                          |
|             | IPPS Final Report and Recommendations |

#### **4.4 Special Activities**

The two Content Subgroup interagency activities identified to meet their responsibilities entail a pilot project, IPPS, and a series of annual workshops.

##### **4.4.1 Identification And Prioritization Pilot Study(IPPS)**

The objective of the Identification and Prioritization Pilot Study (IPPS) is to develop a process for the identification and prioritization of existing data and information products which are not currently accessible by the national and international research and policy communities. The objective of IPPS was limited to identifying those data sets that are currently of limited usefulness due to factors such as poor data quality and documentation and the lack of access by users.

IPPS only addresses identifying the policy-relevant data and information needed to determine national sources and sinks for atmospheric CO<sub>2</sub> and other greenhouse gases. The results of determining these sources and sinks will be used as part of the monitoring system for a global greenhouse gas emissions reduction agreement.

The Contents Subgroup has identified six components relating to the IPPS project which it will undertake.

A. Establish a Joint Task Group to provide oversight and ensure coordination and communication among the agencies and organizations involved with the IPPS and the user community.

B. Develop a Histories and Status Report detailing the historical perspective and the current status of identified data and information products critical to improving the understanding of unresolved issues connected with IPPS. This will involve a study of workshop reports, proceedings, and conferences on global carbon cycle and other trace gases.

C. Conduct a two-stage Delphi Survey to build a broad, open consensus on the data and information needs associated with this crosscut. The Delphi Survey will be sent to 6000 users identified with the thematic crosscut. The Task Group chair will draft a report on the findings of the Delphi Survey, in consultation with the Contents Subgroup members.

D. The Task Group chair will draft several reports evaluating the IPPS process, the various participating working groups and their reports, and lessons learned.

E. Develop a prospectus of each data and information need to provide current, up-to-date information on the disposition of the data and/or information products developed by agencies, organizations or individuals. The prospectus will include information on the human resources and estimates on the financial support required to produce the necessary data and information products.

F. Report the identified data and information needs as determined by the IPPS project to a Prioritization Working Group, which will create a consensus ranking of these needs. The Prioritization Working Group will be an independent, ad hoc committee established by the National Academy of Sciences Board on Global Change.

G. The Task Group chair will draft a report describing recommended future activities to identify and prioritize data and information needs across the USGCRP agencies.

#### **4.4.2 Annual Workshops**

The objective of the annual workshops, sponsored by the Content Subgroup, is to foster information exchange on data center operational issues. These workshops will also serve to maximize efficiency and cultivate familiarity and cohesion among national data center operational staff.

Each of the workshops will focus on a specific data center operational issue, designed for the staff of scientific and technical data centers. The workshop format will include a mixture of seminars on operational issues, panel-directed discussions, and hands-on demonstrations. The workshops are designed for the staff of scientific and technical data centers, including those involved in managing global change data and information.

Actions that the Content Subgroup plans to undertake in preparing for the workshop series will include surveying topics of interest, determining specific issues, forming a steering committee to develop an agenda for each annual workshop, identifying speakers and locations, and coordinating registration and related activities.

Following each workshop, planning for the next workshop will begin. The first workshop on "Data Centers User Services" is scheduled for September 1995 and will include sessions on World Wide Web servers and interfaces. The succeeding 1996 workshop will also be held in September.

## **4.5 International Contents Activities**

Global change research produces and utilizes international data and information products. The Content Subgroup will deal individually and collectively with disparate nature of international data exchanges, with an information-finding working task group that is composed of representatives of Federal and non Federal organizations and other stakeholders significantly involved in international data exchanges.

This task group will produce an integrating report that summarizes international agency linkages and exchanges, unresolved international issues, and recommends possible solutions to facilitate international data exchanges. After a review and comment period, the findings will be presented to the interagency GCDMWG and its Access Subgroup for appropriate actions.

## **4.6 Potential Activities for FY 1996 and 1997**

### **4.6.1 IPPS**

Based on the IPPS evaluations, the GCDMWG, in consultation with the USGCRP, will decide whether to conduct a full operational program to identify and prioritize data and information products across the full spectrum of USGCRP crosscutting themes. If an operational program is recommended, it will include establishing a selection process to be used to select specific data and information products identified in IPPS, processes and procedures for determining funding needs for each data or information product, and methods for presenting findings to agencies. If the operational program is undertaken, the following follow-up activities will be initiated.

#### **Follow-up Activities:**

1. Modify the IPPS process, as needed, to take into account the lessons-learned report and experiences/suggestions from the working groups.
2. Identify other crosscutting themes developed for USGCRP and from other sources.
3. Select and nominate task chairs who will be responsible for determining the schedule and budget for each thematic crosscut.
4. Conduct the operational studies.
5. Report findings to agencies for final disposition.

### **4.6.2 Computer Model Output Data**

The Content Subgroup will focus on the issues of maintenance of and access to the numerical and graphical outputs from computational models used to address global

change scientific and policy issues under study by USGCRP. This effort will include developing a draft strategy on how best to document and preserve model output data, building on current and past efforts to resolve associated issues across the agencies. A Content Subgroup steering committee of Federal agency representatives will be formed to develop an agenda for a national workshop to address computer model output issues.

### Objective

To build on past efforts to resolve issues associated with archiving model results and initiate a process to summarize and evaluate ongoing efforts across each of the USGCRP agencies as well as other institutions involved in modeling exercises. These efforts will form the basis for the development of a draft strategy and plan for archiving and accessing model outputs.

### Actions

1. Establish an interagency steering committee, coordinated with the NAS and other SGCR working groups, to plan a workshop directed at understanding the requirements associated with documenting, archiving, sorting, and transmitting model outputs. The workshop will emphasize both the production and documentation aspects of model execution outputs and have a strong focus on user needs.
2. Hold an interagency workshop, with research community participation, to determine the requirements associated with documenting, archiving, sorting, and transmitting model outputs.
3. Summarize the results of the workshop and make them available for review and comment.

### **4.6.3 Quality Assurance**

Increased demand for quality assurance(QA) of data and information products is anticipated as GCDIS evolves. While data centers involved in managing global change and other data each have their own QA procedures, there is no overarching QA standard for data products across data centers, and the USGCRP has not specified policies regarding QA procedures. At the same time, requirements for quick delivery of data products from researchers are needed to ensure the timely use of project results for analyses and/or assessments. The Content Subgroup will coordinate an interagency study to help agencies identify appropriate QA procedures and standards for global change data, consistent with available resources.

### Objective

To coordinate an interagency study directed at determining broad GCDIS QA standards that data centers can implement at minimal additional expense while continuing to provide all users with appropriate access to high-quality data products within reasonable time periods.

### Actions

1. Establish a working group to lead a study on QA.
2. Develop a summary of current agency policies on QA and the levels of QA applied to data and information products (through an interagency questionnaire and interviews).
3. Review and summarize the QA policies and procedures of other data management organizations.
4. Interview members of the scientific community (users of the data) for their QA needs.
5. Evaluate existing agency policies against user needs and make recommendations for GCDIS QA standards.
6. Present findings to GCDMWG.

#### **4.6.4 Integrated Data Products**

Global change questions need the integrated, interdisciplinary data sets that are both uncharacteristic products of traditional data centers and which are tedious for individual investigators to construct. Responding to this need for interdisciplinary data and information products to support USGCRP's integrated assessment activities, Content Subgroup will hold a series of workshops to identify critical data management issues associated with the creation of integrated data and information products.

### Objective

To conduct a study of the critical issues associated with the creation of integrated data and information products developed through the merging, collating, and analysis of multidisciplinary data.

### Actions

1. Appoint an interagency-user community steering committee to plan workshops to identify integrated data product issues.
2. Hold a series of workshops to identify the critical data management issues associated with the creation of integrated data and information products. The workshops will identify the need for integrated data and information products, evaluate obstacles, suggest possible solutions, and prioritize needed data products.
3. Summarize results from the workshops in a report.

## **5.0 LIBRARY SUBGROUP IMPLEMENTATION PLAN**

### **5.1 Introduction**

Within the GCDMWG , the Library Subgroup provides the library/information center perspective and professional expertise for the design, evaluation, and promotion of the GCDIS. Subgroup members bring many of these skills to the GCDIS and will also call upon other members of the profession via Internet and other means for their advice and suggestions. By such reaching out, the GCDIS will benefit from librarians' expertise in the areas of knowledge management, indexing and abstracting, on-line database production, successful sharing of information through bibliographic and telecommunication standards, and scientific and technical publishing. Additionally, the faculty and students of library and information science graduate departments at the university level will be consulted to provide expertise in user needs analysis, reference services, organization and categorization of information, archival preservation, search and retrieval systems, and evaluation of information products.

Library collections that are relevant to global change are valuable to the global change research effort and should be identified and made accessible through GCDIS. These collections include paper-based data, journal collections, technical reports, directories, indices, etc. More than any other means of information dissemination, libraries reach all ages, all professions, all institutions, and all geographic locations. Libraries and librarians serve users through school libraries, academic libraries, special libraries and government libraries using traditional methods as well as the Internet. For the delivery of GCDIS services, libraries have the proven infrastructure, customer base, experience and vision, to be the point-of-service contact for the GCDIS users throughout the world.

In this document, when the term "library" is used, it includes the broader category of information centers, virtual libraries, as well as traditional libraries. Similarly, "librarian" includes not only traditional librarians but also information professionals working in related fields.

### **5.2 Purpose and Scope**

In cooperation with the other GCDMWG subgroups, the Library Subgroup has responsibility to the GCDMWG for:

- 1) Linking the GCDIS implementation to the infrastructure of libraries and librarians

The Subgroup will build and/or point to significant global change related on-line distributed directories of libraries, data centers, and information services.

2) Evaluating the GCDIS from a library user's perspective and providing user needs analysis

The Subgroup will help provide the understanding of the information needs of the GCDIS user community and monitoring of user satisfaction through user feedback needed to guide the system operations and evolutionary development of GCDIS.

3) Promoting and delivery GCDIS to libraries and developing approaches to user education

The Subgroup will encourage the use of the GCDIS, by introducing librarians and users to the system and its contents, and will develop materials and methodologies for GCDIS user education. It will develop a promotional and educational program for the GCDIS, in cooperation with the Global Change Research Information Office (GCRIIO).

Advantage of the existing library and information center infrastructure will be taken to distribute information about the GCDIS, direct the GCDIS users to library and information centers that specialize in global change-type information, and engage the library profession in the development and use of the GCDIS.

4) Advising the GCDMWG on data and information processing standards and systems from the library perspective

The library community has extensive experience with shared cataloging systems, information description and classification, information processing and telecommunication standards, and with user-oriented system design. The Subgroup will continue to channel this expertise to the GCDIS effort.

## **5.3 GCDIS Library Infrastructure Coordination**

### **5.3.1 Coordination Infrastructure and Methodology**

The Library Subgroup has proposed activities to meet their responsibilities, and will coordinate them among the participating agencies by appointing a chair for each project, who will detail the project, estimate the level of effort required, establish deliverables and reporting dates, and recommend a budget, where appropriate, to accomplish the objectives.

### **5.3.2 Budget**

The GCDIS Library Subgroup budget focuses on four agency cross-cutting projects for 1995: Library Directory, LASR project and associated evaluation methodology projects, Strategic Plan for the access development, and promotional and educational activities. Estimated budgets for 1995 are listed below.

| <u>Activity</u>                     | <u>FY (\$K)</u> |
|-------------------------------------|-----------------|
| Linking( <i>library directory</i> ) | 0               |
| Evaluating( <i>LASR</i> )           | 75              |
| Promoting/delivery( <i>video</i> )  | 35              |
| Advising                            | 0               |

### 5.3.3 Schedule

The schedule for the four Library Subgroup projects for 1995 is as follows:

| <u>ACTIVITY</u>                   | <u>DATE</u> |
|-----------------------------------|-------------|
| Directory                         | 1995        |
| LASR                              | 1995        |
| Access Development Strategic Plan | 1995        |
| User Survey                       | 1996        |

## 5.4 Special Activities for FY 1995

### 5.4.1 Linking

On-line distributed directories of libraries, data centers, and information services that specialize in global change and related services will be built. The directory will be populated beginning with the Federal libraries identified through the Subgroup's survey of library resources of the agencies participating in the GCDIS. This listing is now available through the GCDIS home page and will be developed into a portable document that is full-text searchable. Methods will be developed for the continuing maintenance and expansion of the directory. The Subgroup will cooperate with other directory efforts that are collecting similar information without duplicating these efforts and point to existing directories as appropriate.

### 5.4.2 Evaluating

The Library Information Subgroup is sponsoring a GCDIS evaluation project known as the LASR (Library Access, Search and Retrieval) Pilot Project from September 1994 - August 1995. The goal of LASR is to gather feedback from actual users of the GCDIS gopher in libraries and classrooms. The project is under the direction of the Computer Sciences Department of the University of Virginia and the participants include elementary school, middle school, high school, community college, college, university, public library and citizen group participation. One outcome has been the development of an evaluation form that is currently available from the LASR home page at the University of Virginia <http://juliet.cs.virginia.edu/lasr/>.

The Library Subgroup will continue and expand the development of methodologies for obtaining user feedback from current and potential users of GCDIS and work with the other GCDIS subgroups to implement the methods chosen (e.g., user focus groups, on-line surveys, interviews, volunteer evaluators).

### **5.4.3 Promoting and delivery**

The Subgroup will complete development of a GCDIS logo, a brochure, exhibit materials (e.g., the GCDIS poster), and the GCDIS video that will promote the use of the GCDIS in classrooms. The Subgroup will work with the GCRIO in the development/revision of all promotional materials and in the planning and staffing of exhibits. Its members will continue to make presentations at library conferences, publish articles about GCDIS in the professional library print, in on-line sources, and other similar activities. A recent example is the *Global Change and the Role of Libraries* section in a special 1995 double issue of Library Hi Tech[6].

### **5.4.4 Advising**

The Subgroup will develop a strategic plan for the incremental development of the GCDIS access systems (e.g., the WWW and the Gopher) which will include agency participation in linking their library resources to the GCDIS. The draft plan will be submitted to the Access Subgroup for their review and implementation.

## **5.5 Potential Activities for FY 1996 and 1997:**

### **5.5.1 Linking**

Coverage of the directory of global-change related libraries, and data centers and information centers will be expanded to include additional types of information sources such as on-line discussion groups, professional societies, related workshops and meetings, etc. Included will be the expansion of active participation in the GCDIS development and implementation and evaluation by the worldwide library community.

Since information resources are divided into types of data and information (e.g., data centers, libraries, on-line bibliographic files) that are managed and made available by different information management systems, users cannot easily link different types of information. To address this problem, user-oriented studies and projects to advance techniques to build links between text-based resources and data and other types of information will be initiated. Activities involved in this effort may include:

A. Developing/adapting search strategies and information filtering methodologies to identify data and information relating to global change topics of interest to targeted groups, both as "automatic" current awareness services and as 'canned' strategies that can be used at any time.

B. Identifying collections of historical data in libraries that are relevant to global change that require preservation and digitization for wider availability. This information will be provided to the agencies and other organizations for their action.

### **5.5.2 Evaluating**

The results of the LASR project vis-a-vis presentation, publications, etc. will be made available to all elements of GCDIS and a follow-on multi-state library network evaluation project will be developed.

### **5.5.3 Promoting and delivery**

Promotional materials will be revised and reissued in cooperation with GCRIIO. User training sessions tailored to the needs of representative user groups will be developed.

### **5.5.4 Advising**

The Subgroup will continue to advise on the development of the GCDIS and work toward its integration into libraries.

## **APPENDIX - - - GCDIS Access Nodes**

### **Interagency Access**

#### **1. GCDIS home page and Gopher**

**Organization:** Global Change Data Management Working Group  
Department of Agriculture  
Department of Commerce  
Department of Defense  
Department of Energy  
Department of the Interior  
Environmental Protection Agency  
National Aeronautics and Space Administration  
National Science Foundation

**Data System:** Global Change Data and Information System (GCDIS)

**Description:** GCDIS provides access to the global change related data and information sources and services of the participating Federal agencies through organized Internet-accessible interfaces.

**Content:** Agency resources are organized into broad topics: atmospheric sciences; ecological and biological systems; general environmental sources; general global change sources; human dimensions of global change; ocean systems; snow and ice; solid earth systems; solar influences; and terrestrial, inland aquatic, and near coastal systems. Special topic groupings are also provided: education resources, data/information centers, library/information centers, searchable data/information sets, images, and currently funded global change research projects. Background information about GCDIS and pointers to GCRIIO and other related sites are provided.

**Access:** WWW home page: <http://www.gcdis.usgcrp.gov>  
Gopher: <gopher.gcdis.usgcrp.gov>  
E-mail for comments/questions: [gcdis@usgcrp.gov](mailto:gcdis@usgcrp.gov) or  
use the comment forms available with home page and  
gopher.

**Interfaces:** Internet: telnet, gopher, and web browsers  
Phone, fax, e-mail, US postal service

**Standards:** Internet protocol

User Assistance: Global Change Research Information Office  
2250 Pierce Road  
University Center, MI 48710  
Phone: (517)797-2730. Fax: (517)797-2622.  
E-mail: help@gcrio.org

Schedule: Order and delivery of data and information sets is handled by the individual agencies. Search access to the distributed data and information sources of GCDIS is being planned.

## **2. GCRIO home page and Gopher**

Organization: United States Global Research Program (USGCRP)

Data System: Global Change Research Information Office (GCRIO)

Description: As required by Section 204 of the Act, the Global Change Research Information Office (GCRIO), was created in 1993 by the U.S. Global Change Research Program in the Consortium for International Earth Science Information Network (CIESIN). The purpose of the GCRIO is "to disseminate to foreign governments, businesses, and institutions, as well as citizens of foreign countries, scientific research information available in the United States which would be useful in preventing, mitigating, or adapting to the effects of global change."

Content: GCRIO responds to requests for information about a wide range of global change topics such as: more efficient energy consumption, recycling and source reduction of pollutants, remote sensing data and technology, results of scientific studies, conservation of forest resources, data from in situ measurements and observations, replacements for CFC's and other ozone depleting substance, solar energy and renewable energy resource, ecological pest management and proper use of agricultural and industrial chemicals, human interactions with the environment, and materials to support educational activities.

Access: WWW home page: <http://www.gcrio.org>  
Gopher: <gopher.gcrio.org> or [telnet gopher.gcrio.org](telnet:gopher.gcrio.org)  
(login as 'gopher')  
E-mail for comments/questions: [help@gcrio.org](mailto:help@gcrio.org)

Interfaces: Internet: telnet, gopher, and web browsers  
Phone, fax, e-mail, US postal service

Standards: Internet protocol

User Assistance: Global Change Information Office User Services  
2250 Pierce Road  
University Center, MI 48710 USA  
Phone: (517)797-2730; Fax: (517)797-2622  
E-mail: help@gcrio.org

### 3. USGCRP Home Page

Organization: United States Global Change Research Program

Data System: USGCRP home page

Description Organized in 1989, the U.S. Global Change Research Program (USGCRP) is comprised of 18 departments and agencies of the Federal Government, including the Agency for International Development, Dept. of Agriculture, Dept. of Commerce, Dept. of Defense, Dept. of Energy, Dept. of Health and Human Services, Dept. of the Housing and Urban Development, Dept. of the Interior, Dept. of State, Dept. of Transportation, Environmental Protection Agency, National Aeronautics and Space Administration, National Science Foundation, Smithsonian Institution, and the Tennessee Valley Authority. The Program works to better understand and to deal with natural and human-induced changes in the Earth's environment. Changes in the global environment, including ozone depletion, climate change, and land use change have the potential for inducing significant effects on human society and the Earth's natural ecosystems. The USGCRP is dedicated to sponsoring research on these and other global change issues, to use this information to project future climate conditions, and to improve understanding of possible consequences of global climate change.

Content: The roles of the 18 departments and agencies of the U.S. government in the USGCRP and the functional framework of eight coupled streams of research activity are described: Observing the Earth System, Data and Information Management, Understanding Earth Processes, Predicting Changes, Analyzing Consequences, Assessing Policies and Options, International Interactions, and Education and Public Awareness.

Access: WWW home page: <http://www.usgcrp.gov>

Interfaces: Internet: Web browsers  
Phone, fax, e-mail, US postal service

Standards: Internet protocol

User Assistance: Global Change Research Information Office  
2250 Pierce Road  
University Center, MI 48710  
Phone: (517)797-2730; Fax: (517)797-2622  
E-mail: help@gcrio.org

#### **4. GCDIS Agency Libraries**

Organization: GCDMWG Library Subgroup

Data System: GCDIS Directory of Federal Libraries

Description: The Library Subgroup provides the library and information center perspective to the GCDIS.

Content: A survey was conducted of the 98 participating GCDIS agency libraries and information centers to determine the methodology for access, services, content resources, and standards. The responses from the survey are available in a summary chart which consists of the capabilities and collections of the library and information centers. The contents also describe the subject strengths of the individual library and information centers. A more extensive survey would be needed to determine the unique materials and detailed subject strengths of each.

Access: At least 64% of the libraries had access to the Internet either by way of dial-up or direct access. There were eight gopher servers; seven on-line bulletin boards; eleven home pages; three WAIS servers. Three out of six agencies reported to have agency-wide on-line catalogs of library holdings; DOE, EPA, NASA, NSF, and USDA maintain on-line bibliographic files; and EPA and NASA have formal library networks. Most agency libraries provide limited service to the public through interlibrary loan, reference services, and on-site use of materials. Agency library holdings are, in general, included in the On-line Computer Library Center (OCLC) national union catalog; agency documents are distributed through GPO and NTIS. Some agency files are accessible through DIALOG's retrieval system.

Interfaces: Telephone, Internet, postal service

Standards: Anglo-American Cataloging Rules and Library of Congress Subject headings; specialized thesauri are used to index non-book materials. These thesauri are standards themselves for the subject area they cover. For bibliographic record exchange: the MARC format (Z39.2) is in general use. There is some use of COSATI bibliographic format and the DIF, FGDC, and GILS formats are being integrated into some of the library systems. The USDA and EPA have Z39.50 servers.

User Assistance: Agencies report that their libraries and information centers provide help desks, document delivery (e.g., photocopies of articles), interlibrary loans, and current awareness services. Indexing, abstracting, and database building activities take place in all agencies. The creation and distribution of printed guides to the literature are available from most agency libraries and information centers.

## 5. Global Change Master Directory (GCMD)

Organization           Goddard Space Flight Center(NASA)

Data System           Global Change Master Directory

Description           The Global Change Master Directory is a client-server software system, which incorporates a commercial database management package to provide directory level information on Earth science data sets to users (primarily researchers). The GCMD database holds more than 2800 high-level data set descriptions that give the user data set information. Data set information is stored in the database (Oracle) in Directory Interchange Format (DIF). For some data sets, the descriptions offer more detailed information - sometimes even the data are available through a LINK command to a remote site external to the system. If the LINK command appears highlighted when the entry is being viewed, an automatic telnet connection can be made, which links the user directly to an external data system.

A majority of U.S. federal agencies are represented by the data sets cited, as well as many foreign countries. The entire software system has been ported to countries around the world through the Committee on Earth Observation Satellites' International Directory Network (CEOS IDN). Database updates are exchanged through bimonthly database coordination procedures. Software upgrades are distributed periodically.

Content           The majority of data set descriptions in the GCMD are from the Earth sciences. At the present time, there are a total of 2831 entries; 2298 of these are from the Earth sciences - Atmosphere, Land, Ocean, and Interior/Crust; and 533 are from other disciplines including the Planetary Sciences, the Life Sciences, Astronomy, and Solar Physics. The GCMD contains data set descriptions from nearly all federal agencies including NASA, NOAA, DOI, EPA, DOE, and USDA, as well as from universities, private industry, and foreign agencies. The GCMD has descriptions of data being distributed through all of the EOSDIS DAACs, data from most of the NOAA agencies (NGDC, NCDC, NODC, etc.), unclassified DOD environmental data, and data from international programs such as IGBP, UNEP/GRID, and the CEOS IDN.

The GCMD has assumed responsibility for the Committee on Earth Observation Satellites' (CEOS) International Directory Network (IDN). Through the CEOS Working Group on Data, representatives from Canada, France, Germany, Italy, Japan, Argentina, Russia, and the United States have collaborated to provide information about their country's scientific data sets. This working group represents many agencies, universities, and other organizations within each country.

Access           Users can access the GCMD through the Internet using telenet or World Wide Web clients, such as Mosaic. The GCMD offers the user a variety of computer interfaces including an ASCII text interface (used primarily by the CEOS IDN nodes); a windows-like JAM interface (JAM is JYACC's Application Manager, a commercial package from JYACC) used in GCMD telnet sessions; an X-client interface; and a WWW interface using query forms and WAIS search capabilities.

WWW: <http://gcmd.gsfc.nasa.gov/>

Telnet: [gcmd.gsfc.nasa.gov](telnet://gcmd.gsfc.nasa.gov) (login as "gkdir")

Interfaces                The GCDIS interfaces with the GCDIS through Gopher and Mosaic links. The GCMD interfaces with some of the other GCDIS systems directly with telenet, gopher, or mosaic links.

Standards                Entries for the directory are submitted in the Directory Interchange Format (DIF), providing standardized information on parameters, geographic and temporal coverage's, data set providers, and other summary information that can be automatically loaded into the database. Work is in progress in cooperation with other federal agencies to assure that the DIF evolves to become compliant with the Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata in response to Executive Order 12906, "Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure" and the Government Information Locator Service (GILS).

User Assistance        The GCMD operates a User Support office and hotline. The GCMD also provides tools and assistance in registering new data sets, interpreting DIF information, and maintaining existing DIF records. Each discipline has a dedicated GCMD representative. The User support Office provides various publications about the GCMD and related activities. These publications include: Global Change Master Directory Bookmark, International Directory Network World Guide, Meteorological Information from the GCMD, User's Guide, Quick Reference Guide, DIF Manual, and DIF Writer's Guide. The GCMD also maintains anonymous ftp account containing the following documents: Directory Interchange Format (DIF) Manual, DIF Writer's Guide, System Documentation, Programmer's API, Operations Guide, Quick Reference Guide, GCMD Directory Valid Keywords List, User's Guide, and Context Passing Manual.

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Schedule                March 1995: Deliver Version 3 of the GCMD with the following: (1) autotransfer of DIFs to the CEOS IDN nodes, (2) UNIX-based DIF authoring tool for writing and editing DIFs, (3) operational version of WAIS, (4) the enhanced X client including (a) geographic map query capability (b) function to use minimum bounding rectangles to delineate regions of interest (c) expanded "go to" menu, which allows user to return to prior screens, (d) Mosaic text widgets (e) calls to Mosaic for help.

September 1995: Deliver Version 4 of the GCMD with the following functionality: (1) prototype distributed GCMD (Phase I - in coordination with the Distributed Oceanographic Data System) database server, (2) extended WAIS functionality, (3) enhanced functionality of geographic query capability, using FGDC Content Standards for Digital Geospatial Metadata, and (4) multiple protocol support.

Version 5 of the GCMD add the following functionality: (1) prototype thesaurus interface to keywords, (2) operational distributed GCMD database server, (3) integrated WAIS functionality, and (4) integrated functionality of enhanced geographic query capability.

## **Agency Access**

Each agency participating in the GCDIS Gopher and WWW has made available as on-line nodes of the GCDIS network the data systems of their following agency elements:

### **1. DOC Nodes**

- 1.1 Bureau of The Census/Center for International Research
- 1.2 Bureau of The Census/Regional Offices
- 1.3 Bureau of The Census/Census Data User Services Division
- 1.4 Bureau of The Census/Public Information Office
- 1.5 Bureau of The Census/Data-Information Centers
- 1.6 NOAA/NESDIS/National Climatic Data Center
- 1.7 NOAA/NESDIS/National Geophysical Data Center
- 1.8 NOAA/NESDIS/National Oceanographic Data Center
- 1.9 NOAA/NESDIS/World Data Center-A for Glaciology
- 1.10 NOAA/NESDIS/World Data Center-A for Meteorology
- 1.11 NOAA/NESDIS/World Data Center-A for Marine Geology and Geophysics
- 1.12 NOAA/NESDIS/World Data Center-A for Oceanography
- 1.13 NOAA/NESDIS/World Data Center-A for Paleoclimate
- 1.14 NOAA/NESDIS/World Data Center-A for Solar-Terrestrial Physics
- 1.15 NOAA/NESDIS/World Data Center-A for Solid Earth Geophysics
- 1.16 NOAA/NMFS/Fisheries Science Centers -Northeast
- 1.17 NOAA/NMFS/Fisheries Science Centers -Northwest
- 1.18 NOAA/OAR/Pacific Marine Environmental Laboratory
- 1.19 NOAA/OAR/Climate Monitoring and Diagnostics Laboratory
- 1.20 NOAA/OAR/Climate Diagnostic Center
- 1.21 NOAA/NWS/Climate Analysis Center, Diagnostics Branch
- 1.22 NOAA/NWS/Office of Hydrology
- 1.23 NOAA/NESDIS/Environmental Information Services
- 1.24 NOAA/NESDIS/Satellite Active Archive Center
- 1.25 NOAA Central Library and Information Services Division
- 1.26 NTIS/FedWorld
- 1.27 UCAR NOAA Office of Field Project-Support Data Management Center

### **2. DOE Nodes**

- 2.1 OER/Atmospheric Radiation Measurement(ARM) Archive
- 2.2 OER/Carbon Dioxide Information Analysis Center
- 2.3 OER/Oak Ridge National Laboratory Distributed Active Archive Center
- 2.4 Office of Energy Efficiency and Renewable Energy
- 2.5 Office of Scientific and Technical Information(OSTI)
- 2.6 Energy Information Administration
- 2.7 Environmental Measurements Laboratory

### **3. DOI Nodes**

- 3.1 US Geological Survey Global Change Research Program
- 3.2 US Geological Survey EROS Data Center
- 3.3 National Biological Service GCRP Data Management Program

### **4. EPA Nodes**

- 4.1 USEPA National Computer Center, Research Triangle Park, NC
- 4.2 USEPA National Supercomputing Center, Bay City, MI
- 4.3 USEPA Public Access Servers, Research Triangle Park, NC
- 4.4 USEPA/Office of Information Resources Management/EPA Library System

### **5. NASA Nodes**

- 5.1 Earth Observation System Data Information System (EOSDIS)
- 5.2 Alaska Synthetic Aperture Radar (SAR) Facility (ASF) DAAC
- 5.3 EROS Data Center (EDC) DAAC
- 5.4 Goddard Space Flight Center (GSFC) DAAC
- 5.5 Jet Propulsion Lab (JPL) DAAC
- 5.6 Langley Research Center (LaRC) DAAC
- 5.7 Marshall Space Flight Center (MSFC) DAAC
- 5.8 National Snow and Ice Data Center (NSIDC) DAAC
- 5.9 Oak Ridge National Lab (ORNL) DAAC
- 5.10 Socioeconomic Data Archive Center (SEDAC) DAAC
- 5.11 NASA Science and Technical Information (STI) Program
- 5.12 Crustal Dynamics Data Information System (CDDIS)
- 5.13 Pathfinder Data Server
- 5.14 Ames Research Center Life Sciences Library
- 5.15 Goddard Space Flight Center Homer E. Newell Memorial Library
- 5.16 Jet Propulsion Laboratory Library
- 5.17 Langley Research Center Technical Library
- 5.18 Global Change Master Directory (GCMD)
- 5.19 Miscellaneous Data Systems

### **6. NSF Nodes**

- 6.1 National Center for Atmospheric Research(NCAR)
- 6.2 National Center for Atmospheric Research Library
- 6.3 National Science Foundation Library

### **7. USDA Nodes**

- 7.1 USDA Cooperative Research Information System (CRIS)
- 7.2 Agricultural Research Service (ARS)
- 7.3 Cooperative State Research, Education, and Extension Service (CSREES)
- 7.4 Economic Research Service (ERS)
- 7.5 Forest Service (FS)
- 7.6 National Resources Conservation Service (NRCS)
- 7.7 National Agricultural Library (NAL)
- 7.8 Other USDA Global Change Libraries and Information Centers

## ACRONYMS and ABBREVIATIONS

|          |                                                                                       |
|----------|---------------------------------------------------------------------------------------|
| ANSI     | American National Standards Institute                                                 |
| CDROM    | Compact Disk Read Only Memory                                                         |
| CDIAC    | Carbon Dioxide Information Analysis Center                                            |
| CENR     | Committee on Environment and Natural Resources Research                               |
| CEOS     | Committee on Earth Observation Satellites                                             |
| CEOS-WGD | CEOS Working Group on Data                                                            |
| CGED     | Committee on Geophysical and Environmental Data                                       |
| CIESIN   | Consortium for International Earth Science Information Network                        |
| DAAC     | Distributed Active Archive Center                                                     |
| DIF      | Directory Interchange Format                                                          |
| DOC      | Department of Commerce                                                                |
| DOD      | Department of Defense                                                                 |
| DOE      | Department of Energy                                                                  |
| DOI      | Department of the Interior                                                            |
| DOS      | Disk Operating System                                                                 |
| DTIC     | Defense Technical Information Center                                                  |
| E-mail   | Electronic - mail                                                                     |
| EOS      | Earth Observing System                                                                |
| EOSDIS   | Earth Observing System Data and Information System                                    |
| EPA      | Environmental Protection Agency                                                       |
| EROS     | Earth Resources Observation Systems                                                   |
| FGDC     | Federal Geographic Data Committee                                                     |
| FIPS     | Federal Information Processing Standards                                              |
| FTP      | File Transfer Protocol                                                                |
| FY       | Fiscal Year                                                                           |
| GC-ASK   | Global Change - Assisted Search for Knowledge                                         |
| GCDMWG   | Global Change Data Management Working Group                                           |
| GCDIS    | Global Change Data and Information System                                             |
| GCMD     | Global Change Master Directory                                                        |
| GCRIO    | Global Change Research Information Office                                             |
| GILS     | Government Information Locator Service                                                |
| GIS      | Geographic Information System                                                         |
| GPO      | Government Printing Office                                                            |
| GRID     | Global Resource Information Database (UNEP)                                           |
| GSFC     | Goddard Space Flight Center                                                           |
| GUI      | Graphical User Interface                                                              |
| HDP      | Human Dimensions of Global Environmental Change Programme                             |
| HDPDIS   | Human Dimensions of Global Environmental Change Programme Data and Information System |
| HTML     | Hypertext Markup Language                                                             |

|           |                                                                         |
|-----------|-------------------------------------------------------------------------|
| ICSU      | International Council of Scientific Unions                              |
| IGBP      | International Geosphere-Biosphere Programme                             |
| IGBPDDIS  | International Geosphere-Biosphere Programme Data and Information System |
| IPPS      | Identification and Prioritization Pilot Study                           |
| ISSC      | International Social Science Council                                    |
| IWGDMGC   | Interagency Working Group on Data Management for Global Change          |
| K-12      | Kindergarten through 12th grade                                         |
| LASR      | Library Access, Search and Retrieval                                    |
| MARC (US) | Machine Readable Cataloging                                             |
| Mbps      | Megabits per second                                                     |
| NAS       | National Academy of Sciences                                            |
| NASBGC    | National Academy of Sciences Board on Global Change                     |
| NASA      | National Aeronautics and Space Administration                           |
| NEDI      | National Environmental Data Index                                       |
| NESDIS    | National Environmental Satellite, Data, and Information Service         |
| NOAA      | National Oceanic and Atmospheric Administration                         |
| NRC       | National Research Council                                               |
| NSDI      | National Spatial Data Infrastructure                                    |
| NSF       | National Science Foundation                                             |
| NTIS      | National Technical Information Service                                  |
| OCLC      | On-line Computer Library Center                                         |
| OMB       | Office of Management and Budget                                         |
| ORNL      | Oak Ridge National Laboratory                                           |
| OSTI      | Office of Scientific and Technical Information                          |
| OSTP      | Office of Science and Technology Policy                                 |
| QA        | Quality Assurance                                                       |
| SDTS      | Spatial Data Transfer Standard                                          |
| SEDAC     | Socioeconomic Data and Applications Center                              |
| SGCR      | Subcommittee on Global Change Research                                  |
| TCP/IP    | Transmission Control Protocol/Internet Protocol                         |
| TFODM     | Task Force on Observations and Data Management                          |
| UCAR      | University Corporation for Atmospheric Research                         |
| UMLS      | Unified Medical Language System                                         |
| UNEP      | United Nations Environment Programme                                    |
| USDA      | U.S. Department of Agriculture                                          |
| USGCRP    | U.S. Global Change Research Program                                     |
| USGS      | U.S. Geological Survey                                                  |
| WAIS      | Wide-Area Information Server                                            |
| WDC       | World Data Center                                                       |
| WGD       | Working Group on Data                                                   |
| WWW       | World Wide Web                                                          |
| Z39.50    | Z section of ANSI: Library Science                                      |

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