Towards a New World Data Center System: Meeting Global Needs

Report of the WDC Modernization Task Team to the Panel on World Data Centers

Task Team: Bob Chen (chair), CIESIN/Columbia University, USA; Gurbax Singh Lakhina, Indian Institute Of Geomagnetism, Mumbai, India; Liu Chuang, Global Change Information and Research Center, Beijing, China; Alex M. Sterin, All-Russian Research Institute of Hydrometeorological Information, Obninsk, Russia; Matthew Wild, Rutherford Appleton Lab, Chilton, United Kingdom; David Clark, Assistant Secretary, Panel on WDCs

1. THE VISION

The World Data Center System was established nearly 50 years ago to meet the needs of scientists in the International Geophysical Year. A system of "bricks-and-mortar" data centers was established, with each center tied to a particular scientific discipline in the solar, geophysical, and related environmental sciences. Since then, new centers and disciplines have been added, and new technologies have been adopted. Overall, however, the System has not yet reached its full potential to serve international science. We envision a stronger, more robust, and more comprehensive system, capable of supporting both basic and applied scientific research around the world, truly global in reach, and committed to its founding principles of free and open access to data, long-term preservation of data, and improvement in data quality.

A key element of this vision is the evolution of a "Global Science Data Network" from the existing collection of centers. Such a network will certainly include new technologies, new data, new participants, and new organizational principles. Even more important will be the strengthening of the human resources focused on science data management. It will be essential to improve links between ICSU science programs and the WDC system, and to provide the technology and training to facilitate state-of-the-art data management and research by scientists around the world, especially those in developing countries.

We anticipate that the network will continue under the non-governmental auspices of ICSU, building on the solid expertise and experience of the World Data Centers. As in the current WDC System, the network will draw on the scientific expertise of its centers and foster scientist-to-scientist links. It will support the exchange of results and expertise across scientific disciplines and world regions. It will ensure the preservation not only of the basic scientific data, but also the information and knowledge developed as a result of working with the data. It will continue to support common data policies, assuring full and open access to data and data products to scientists in all countries of the world. It will enhance the efforts of the scientific community around the world to support sustainable development, focusing in particular on building scientific capacity in developing countries.

12/12/03

2. GOALS FOR STRENGTHENING AND EXPANDING THE WDC SYSTEM

The WDC System was founded on the underlying principles of free and open access to data to the world scientific community, long-term preservation of important scientific data resources, and assurance of the quality of scientific data. These principles must remain the pillars of the WDC System as it evolves and expands.

To reach its long-term vision and to address current and future challenges facing the WDCs, the WDC system must also achieve two additional goals:

1) **Focus WDC data efforts on supporting the role of science in sustainable development**; and

2) **Build the capacity to manage and archive scientific data throughout the world.**

2.1 Science for Sustainable Development

The international scientific and policy communities are increasingly recognizing the key role that science can play in sustainable development, and the corresponding need for local- and regional-scale scientific research to address pressing science and policy questions regarding environmental variability and change and their human dimensions.

The WDC system, with its focus on long-term data on environmental processes and their interactions with human systems at local, regional, and global scales, is therefore a critically important resource for scientists around the world. Its early recognition that sharing of data across national borders and scientific disciplines is essential to scientific progress is a key lesson to be applied in the ongoing development of "sustainability science" and other approaches to focusing scientific efforts on the problems of sustainable development.

It is thus essential that the WDCs both individually and as a system address the goal of focusing WDC data efforts on supporting the role of science in sustainable development. This can take the form of making WDC data and information more accessible and usable by scientists around the world, developing new data resources or enhancing existing resources that address key scientific problems relevant to sustainable development, and working closely with scientists and other data users to apply data appropriately to address pressing environmental problems.

It is also important to recognize that not all types of data relevant to sustainable development are currently covered by the existing network of WDCs, nor by other comparable data centers. This gap means that some types of data needed for research—e.g., data on hydrological processes, biological and ecological resources, and land resources—may be at risk of loss and difficult to access. Efforts to broaden the types of data covered by the WDC system, including addition of new data to existing data centers and addition of new data centers to the system, will help close this gap and enable the development of more integrated, more accessible, and higher quality data resources for the scientific community.

12/12/03

2.2 Capacity Building

The current WDC system is well represented in the developed world and continues to expand in many parts of the world such as China. The strong interest on the part of a number of institutions in becoming new WDCs is a sign of the continuing value of the system to the international scientific community. However, it is clear that expansion in some areas of the developing world such as Africa and Latin America is unlikely without active efforts on the part of the WDC system. In some cases, there may already be strong research institutions that have the capacity to become WDCs with only a small investment of time and resources. However, in many countries, the underlying scientific capacity remains weak and the resources available for data management and archiving are very limited.

The WDCs, individually and collectively, must work to build the capacity to manage and archive scientific data throughout the world. Local scientists have local knowledge and understanding that are vital to developing accurate understanding of local and regional environmental processes. Scientists in developing countries need to have access to, and control over, data and information resources relevant to their regions of interest not only to conduct their own research but also to work effectively with those concerned with sustainable development. By working directly with such scientists to build their capacity to manage and archive data, the WDC system can contribute both to overall global access to important new sources of environmental and associated data—in areas where such data have been most lacking—and to the long-term development of a truly distributed system of scientific data archiving and dissemination built on solid foundations in every country of the world.

3. STRATEGIES FOR IMPROVEMENT

Achieving these goals will require active collaboration and cooperation among the current WDCs and other interested parties. We propose specific initiatives in four major areas:

1) Extending the network;

2) Modernizing the system;

3) Ensuring data stewardship; and

4) Improving communication and collaboration.

3.1 Extending the Network

Historically, the WDC System grew out of the need to maintain scientific cooperation and exchange between the East and the West during the Cold War. This experience in bridging geopolitical divides is vitally important in a world still facing significant socioeconomic, political, and technological disparities.

During the past 20 years, the Earth sciences—and the ability to observe and monitor the Earth's environment—have developed rapidly and in tandem. However, most data have been developed, archived, and applied by scientists in developed countries. For example, data centers in the U.S.

currently archive on the order of terabytes of data every day, but most developing countries have archived a total of less than 1 terabyte. Measurements from satellites have helped to improve understanding of global environmental change, but the potential benefits of remote sensing to science and sustainable development at local and regional scales have yet to be realized in most of the developing world. In the meantime, environmental problems such as air pollution, water pollution, desertification, and deforestation are becoming more critical in many developing countries.

The WDCs have unique experience not only in managing a wide range of scientific data, but also in integrating such data across disciplinary lines, developing consistent time series of data vital for assessing environmental variability and change, and assembling data sets from geographically dispersed sources. They utilize state-of-the-art information technology to process and analyze data and to make data available online in forms appropriate for their users. From a disciplinary perspective, the WDCs have broadened their primary focus from the geosciences (geomagnetism, seismology, climatology) to a wider range of environmental issues such as land use/land cover, trace gases, and human interactions in the environment.

We propose a dual approach to extending the network: *1)* adding new centers and *2)* developing Partner sites.

Adding New Centers

Many research institutions in the developing world already have strong research and technical capabilities. Some like the international agricultural research centers supported by the Consultative Group on International Agricultural Research (CGIAR), the Asian Institute of Technology (AIT) in Thailand, and the University of Nairobi in Kenya have state-of-the-art environmental scientists, suitable facilities, and extensive experience in data development, analysis, and dissemination. However, for reasons often beyond their control, many of these centers do not have a historical tradition of data sharing or clear processes to ensure long-term preservation of data and associated documentation. Data archiving and management activities typically must compete internally for resources within these institutions and are often not considered as "glamorous" as research.

We believe that the WDCs can successfully work with selected institutions in a number of developing countries to develop strong proposals to establish new WDCs. A key challenge will be to convince the governments of host countries and other sponsoring organizations that, in the long run, sound data management and open exchange of data and information are vital to the success of the institution and to its mission. Careful planning will be needed with an institution's management and with scientific staff within the institution who are concerned about data issues. It will be essential to involve the appropriate ICSU adhering body within the host country in any planning efforts. We also believe that direct involvement of existing WDCs in developing countries (e.g., from India and China) in the planning process would be especially valuable in developing convincing arguments for the need for and potential benefits of establishing new WDCs.

New WDCs do not necessarily need to follow the traditional disciplinary model of existing WDCs. For example, it may make sense to establish regionally-oriented multidisciplinary WDCs

to meet the data needs of multiple scientific communities within particular regions. This would facilitate multidisciplinary and interdisciplinary research efforts as well as permit sharing of facilities and expertise.

We recommend establishment of a working group to assess potential candidates for new WDCs around the world. The objective of the group should be to gather relevant information about possible host institutions, solicit inputs from existing WDCs about any existing links and contacts, explore alternative WDC models (e.g., regional multidisciplinary centers), and develop a plan for approaching a small number of institutions to suggest development of proposals to join the WDC system. It would also be essential to work with relevant regional networks such as the Asia-Pacific Network (APN) and the Inter-American Institute for Global Change Research (IAI). The Working Group could work closely with ICSU on its preparations for the WSSD.

Developing Partner Sites

We recognize that the addition of new WDCs by approaching existing institutions is likely to be successful mainly in the higher income developing countries with reasonably strong scientific communities and scientific infrastructure. This process will also take time.

A Partnership program is therefore needed to foster the rapid development of effective partnerships between established WDCs and research groups in developing countries that are working in related scientific areas. Several promising partnerships have already been established during the past several years:

1) WDC Paleoclimatology in the U.S. has established partnership relationships with institutions in South Africa and France. The USA data collection is mirrored at these sites, and local data from these sites are also being made available. With support from the ICSU WDC Panel and WDC Paleoclimatology, similar partnership centers in Kenya and Argentina have been established. The Argentine site is has translated relevant WWW pages and associated documents into Spanish. These partner centers, established in areas where data access is often a problem, are starting to provide a mechanism for exchange of scientific data within the country on topics beyond the original focus of the partnership.

2) A Russian-USA WDC collaboration has established a system for interchange of data in the solar terrestrial arena, with partner centers now in many locations, including South Africa and India.

These partnership arrangements benefit the local research group in many ways, e.g., through technical assistance and training, by providing new research opportunities, and through contacts with the international scientific community. The established WDCs—and the WDC system as a whole—would benefit from the expansion of scientific contacts and from the increased flow into the WDC system of local and regional data sets that would be of interest to scientists in other parts of the world.

We recommend that the WDC Panel encourage the development of partnerships between established WDCs and appropriate organizations in developing countries by setting up a competitive program of seed funding. The established WDC would be expected to match (or more than match) the seed funding with either a direct financial contribution or "in kind"

assistance (e.g., equipment, time of scientific and/or technical personnel, and training and technical support).

Established WDCs would be invited to submit proposals to the WDC Panel for establishment of a Partner site. The WDC should, of course, explore with the candidate local group their interests, what facilities are in place and what would be needed, and an expression of commitment to become a Partner WDC. The established WDC should explain what resources it would provide and discuss the benefit to the WDC or a specific ICSU-sponsored program, in terms of anticipated data exchange. Access to an Internet connection by the Partner site would be advantageous to facilitate data exchange, but would not be a requirement, if other alternatives can be suggested (e.g., CD-ROMs or DVDs). A candidate list of criteria for partnerships is provided in Appendix A.

3.2 Modernizing the System

There are currently 52 WDCs around the world. Interactions among existing data centers are high due to the long history of WDC cooperation and the growing international use of the Internet. In today's world, advancing technology has one the one hand enabled the WDC to cope with large and varied amounts of data, but on the other hand has opened a technological gulf between many of the WDCs.

Modern technology can be used to bridge this gulf on several fronts. Rapid decreases in the costs of information technology and continuing expansion of networks and their bandwidth are making significant new capabilities available to WDCs of all sizes and in diverse locations. Often, the main barrier to adoption of new technology is not the upfront cost of hardware, but access to the software, expertise, and training needed to fully utilize the new technology to meet local needs.

An additional problem is that many different technologies have been implemented by different WDCs, which may not be compatible with each other. For example, one current problem is that there is no unified directory of WDC data sets, since WDCs maintain data catalogs in a variety of systems that are not interoperable.

The first step in modernizing the system is therefore to establish a WDC-wide mechanism for communication and collaboration on technical issues. **We therefore recommend the establishment of a WDC Technical Task Team to take the lead on modernization of data access and networking and to coordinate the development and implementation of appropriate solutions.**

We have identified three priority areas that we feel the Technical Task Team (T3) should address as quickly as possible:

1) establishment of a data directory and catalog of WDC data sets;

2) development of an interoperability framework for a WDC data system; and

3) assessment of technical solutions for data archiving and data rescue.

Data Directory and Catalogs

A pressing need is to develop a simple, easy-to-maintain directory of data sets available from all WDCs. Several alternative methods need to be investigated. One approach is to utilize a central catalog; for example, a prototype "portal" has been established by the NASA Global Change Master Directory (GCMD) focused on WDC data at:

http://gcmd.gsfc.nasa.gov/Data/portals/wdc/.

However, in the short term it is not likely that all WDC datasets could be documented in the data format required by the GCMD (the NASA Directory Interchange Format). Other approaches such as the use of commercial engines should be considered. The latter might have the benefit of making data more accessible not only to the scientific community, but also to a broader range of users, e.g., from the education community, commercial sector, and the general public. Clearly, the ease of regularly updating the WDC directory should be a major consideration in the design of the system and selection of particular tools. The T3 should quickly evaluate the alternatives and provide an implementation recommendation for WDC review.

Interoperability Framework

With the rapid evolution of new technologies for networking and increasing data and computational interoperability, it is vital that the WDCs to work together to investigate how best to use these technologies to meet both local and system-wide needs.

In the short term, there are specific needs such as ongoing efforts to establish "mirror sites" that contain a regularly updated subset of a "mirrored" data center's holdings. As mirror sites proliferate across many disciplines, data centers, and countries, it will be important to share resources, expertise, and experience and to coordinate efforts wherever possible to avoid the unintended development of an overly complex and unwieldy network of duplicate data sources. The T3 could play a strong role in sorting out the technical approaches likely to be the most flexible and maintainable in the long run and in ensuring their coordinated implementation across the WDC system.

In the long run, the T3 will need to investigate a wide range of needs with regard to distributed data processing and data interoperability. Current efforts to develop totally distributed computational and data handling systems (e.g., the European DataGRID) could provide WDCs and partners throughout the world with access to advanced computing capabilities. New standards for supporting data interoperability, being developed under the auspices of the International Standards Organization, the World Wide Web Consortium, the Open GIS Consortium, and other groups, could greatly enhance the ability of WDCs to develop and deliver scientific data more flexibly and more cheaply than ever before. As many of these standards will be implemented using commercial software, coordination in dealing with software vendors and in sharing maintenance costs and expertise could have many benefits for both individual WDCs and the system as a whole. Alternatively, it may be worthwhile investing in open system approaches that may help avoid problems of licensing costs for smaller WDCs and reduce reliance on particular vendors or proprietary solutions.

Specific areas of activity of the T3 related to interoperability are expected to include:

1) Open system approaches;
2) Commercial software;
3) Conversion tools (data and metadata);
4) International standards and protocols; and
5) Training and technical support needs.

Data Archiving and Data Rescue

New technologies are also changing capabilities in the arena of data archiving and data rescue. Large amounts of data can now be stored using relatively low cost computing systems and media. New digital imaging technologies could reduce the cost of retaining a digital image of hard-copy records, and improvements in Optical Character Recognition techniques are starting to reduce the cost of high-quality transcription of data.

At the same time, however, a vast quantity of historical scientific data is in danger of being lost. Hard-copy records and outdated digital media are deteriorating rapidly, and the scientists and data managers most familiar with them are in some cases retiring or dying. Often these data are critical in supporting the global and regional studies which are at the forefront of today's scientific research.

It is therefore essential that the WDC system move quickly to address this issue on both technical and organizational levels. We feel that the T3 could play a strong technical role in identifying and disseminating technological solutions that could be implemented in support of WDC needs for archiving and data rescue.

3.3 Ensuring Data Stewardship

The fundamental role of the WDC system is to provide data stewardship to ensure preservation of scientific data that describe long-term changes and trends in the Earth system. There are at least three essential functions related to data stewardship:

1) managing data from new observing programs;

2) long-term archiving; and

3) data rescue.

We recommend the establishment of a Data Stewardship Working Group to address these three functions across the WDC system.

New Observing Programs

Ideally, the WDC's role in new observing systems should be identified at the earliest stages of planning for new programs. A strategy should be developed between the data managers and the data collectors, data processors, applications scientists, researchers, and users of the operational data. This fundamental strategy should map the end-to-end lifetime of the data stream from collection to the ultimate long-term archival of the data. It should facilitate the rapid and reliable

transformation of data into new information and new knowledge. In this way the preservation of the data will be assured well beyond the life cycle of the observing program.

Ensuring that sufficient attention is given to data needs and that resources are allocated to data management in scientific programs is not an easy task. It is incumbent upon the WDCs to use their influence, expertise, and long-term perspective to work with the relevant scientists and observing system programs to make sure that an appropriate data management plan is developed and implemented with a reasonable level of resources. Working collectively through the Data Stewardship Working Group (DSWG), the WDC System should be able to address key technical and institutional challenges and achieve important economies of scale. Moreover, by taking advantage of increased interoperability, the WDC System as a whole should be able to provide improved levels of service to a much wider international audience.

Long-Term Archiving

A basic objective of the WDC system is to provide a mechanism for the long-term preservation of scientific data that describe the Earth system. This is not to say that the individual WDCs or its partners centers will physically archive all relevant data, but the WDC system as a whole needs to actively address the issues and policies necessary to ensure preservation of data for the next generation of scientists in this century and beyond. At a minimum, the WDCs must ensure that the data they hold will pass the "20 year test"—i.e., whether data can be used as effectively as when it was collected, 20 years after it has been archived—or even a 100-year test.

There are several basic concepts and policies that will dictate the role of WDCs in the long-term archival of scientific data. The first is compatibility with national and international standards relating to the archival of data. The second is the adequacy of documentation of the data ("metadata"). The third is the adherence to national and international requirements and regulations regarding the preservation of data considered national assets or valuable international scientific records. The fourth is the preservation of concepts, software, and systems that were used to process and apply the data.

The WDCs need to be at the "state of the art" in knowledge and experience in data archiving technologies. Attention to preserving existing data should not weaken as new observational data come to the WDCs. WDCs need to upgrade their hardware and software facilities on a regular basis, meet basic standards for migration of data to new media, and maintain offsite data backups in accordance with national and international archiving standards.

In part because of the many difficulties of obtaining resources to support long-term archiving, we envision significant benefits from WDC collaboration. For example, use of automated, reliable mirroring technologies across multiple WDCs could reduce the need for every WDC to maintain its own offsite backup facility. Smaller WDCs might be able to piggyback on the long-term archiving facilities of larger WDCs. Sharing of experience and resources in data migration could significantly reduce these costs across the WDC system. We envision the DSWG taking a strong role in coordinating long-term archiving activities across the WDC system, making sure that no data fall "through the cracks" and encouraging collaboration and communication wherever appropriate. The DSWG will need to work closely with the T3 on both archiving and data rescue

issues to ensure that available technical and organizational solutions are applied appropriately to meet system-wide needs.

Data Rescue

Many physical processes occurring in nature require a long series of data to understand both short- and long-term variability. A substantial part of the data in several WDCs is in the form of analogue data on charts, photopaper, magnetic tapes, and other media that are at high risk of degradation. The data of the 19th and early part of the 20th century is either on paper charts or photopaper or print, and is in the danger of getting lost forever unless immediate steps are taken to rescue the data. The advancement in technology has produced high quality digital cameras and scanners. The analog data can be converted into high-quality images by a digital camera or a scanner and subsequently stored digitally on CD-ROM or other digital media. The rescued data could then be shared via the Internet or some other means by scientists all over the world to carry out their research.

We believe that the DSWG should undertake a number of critical tasks:

1) Identify and document the status of WDC data at potential risk of loss;

2) Establish a process to prioritize the rescue of data;

3) Identify key resource and technical options for—and constraints on—data rescue efforts; and

4) Develop a plan to implement rescue efforts based on priorities and available resources and options.

3.4 Improving Communication and Collaboration

In support of the previous strategies, it is essential that the WDC System strengthen both its internal and external communication processes. We believe that initiatives are needed in both arenas: *1)* development of an electronic newsletter to promote communication and collaboration across the WDC System; and *2)* establishment of formal liaisons with key international scientific programs.

Electronic Newsletter

We recommend the establishment of a WDC-wide electronic newsletter to promote communication and collaboration across the WDC System. The purpose of the newsletter would be to:

1) Strengthen sense of community among WDC staff and extended family;

2) Provide a mechanism for encouraging and facilitating collaborative activities and sharing of resources between WDCs and WDC staff; and

3) Serve as an ongoing record and information resource on WDC accomplishments and progress as well as problems and challenges.

We believe that a useful newsletter could be developed with only a small investment of time and resources. For example, we suggest the following approaches to keep the newsletter focused on its objectives and at the same time simple and maintainable:

1) Simple text-only newsletter distributed quarterly (other formats optional);

2) Mailing list based on WDC staff lists, others if interested;

3) Primary audience to be the WDC community, followed by external users and sponsors;

4) International editorial committee (i.e., representatives across the WDCs);

5) Simple structure, e.g., regular features with both solicited and unsolicited items, e.g.:
   a) Descriptions of new WDCs
   b) Updates on existing WDCs, activities
   c) Important scientific developments, programmatic news
   d) New data products and services released
   e) New tools, software available from WDCs or others of interest
   f) User examples, citations in literature, awards, etc.
   g) Help wanted or available, e.g., notices of relevant RFPs, requests for technical/financial/training assistance, calls for partners on projects
   h) Staff news and notes
   i) Calendar of events

6) Small team of editors with specific assignments, e.g.:
   j) Feature editor (items a-c);
   k) Data/tools editor (d-e);
   l) Resource editor (f-g);
   m) News editor (h-i).

Clearly, these ideas should be reviewed and modified as appropriate by a small editorial committee.

Liaisons with Key International Scientific Programs and Institutions

As noted previously, it is essential for both individual WDCs and the WDC System as a whole to work closely with the international scientific community, managers of international observing programs, key user groups, and other key organizations. However, most interactions currently occur informally at the level of individual WDCs or groups of WDCs in similar disciplines. Only in a few cases has the WDC System been formally represented in international research and observational programs, and even in these cases, there has not always been an open flow of information with the broader set of WDCs that might be interested.

We therefore recommend that the WDC Panel establish formal liaisons between the WDC System and key international programs and institutions. These programs and institutions fall into at least six categories:

1) Existing and planned international observing programs such as the Global Terrestrial Observing System (GTOS), the Global Ocean Observing System (GOOS), and the Global Climate Observing System (GCOS);

2) International research and assessment programs such as the Intergovernmental Panel on Climate Change (IPCC), the International Geosphere Biosphere Program (IGBP), the International Human Dimensions of Global Environmental Change Program (IHDP), the World Climate Research Program (WCRP);

3) International data-oriented programs such as ICSU's Committee on Data for Science and Technology (CODATA);

4) International scientific unions with relevant research interests, such as the International Geographical Union (IGU) and the International Union of Geodesy and Geophysics (IUGG);

5) International agencies and organizations with strong research/data programs, such as the Committee on Earth Observing Satellites (CEOS), the Consultative Group on International Agricultural Research (CGIAR), the Food and Agriculture Organization of the United Nations (FAO), the Intergovernmental Oceanographic Commission (IOC), the United Nations Development Program (UNDP), the United Nations Environment Program (UNEP), and the World Meteorological Organization (WMO); and

6) Regional networks and organizations such as the SysTem for Analysis, Research and Training (START), the Asia-Pacific Network for Global Change Research (APN), and the Inter-American Institute for Global Change Research (IAI).

For example, we believe that coordination with the emerging set of global observational programs is vital to ensure appropriate attention to data management and archiving needs. Active coordination with CODATA could be beneficial in areas such as data policy, issues surrounding intellectual property rights, and technology transfer across scientific disciplines and between developed and developing countries. Links with key scientific programs focusing on sustainable development issues will permit synergies with current and planned scientific exchanges, training activities, and field experiments.

At this point, we do not envision a complex committee structure, but simply designation of liaisons (by accepting volunteers or election) who would have basic responsibility to report to the entire WDC system on key developments, issues, or decisions and to accept and transmit inputs as appropriate.

Other Possible Activities

In the future, we envision other possible activities in support of communication and collaboration, e.g., a formal training program, a visiting scholar or scientific exchange program, and a more regular international WDC conference of some type. However, we realize that it may take some time and effort to generate sufficient interest and funding to support additional activities of this type. Such activities need to evolve at the "grassroots" level among the WDCs if they are to become sustainable in the long run.

4. NEXT STEPS

A number of the recommendations outlined in this document can and should be implemented quickly, with relatively modest investment of time and resources. Some will take more consideration and review.

As an initial step, however, **we strongly recommend immediate formation of key working groups and teams on partnership, technical issues, data stewardship, and the electronic newsletter**. The core membership for the Technical Task Team has already been identified. These groups can then begin refining their missions and initial activities, drawing on inputs from the entire community. The Panel also has sufficient funds in hand to initiate the Partnership program, which because of its importance and lead time, we feel should be the top priority for these resources.

We also recommend preparation of a formal proposal to the ICSU Grants Programme. We believe that the focus of this strategic plan on concrete efforts to support capacity building and sustainable development very much fits the stated priority themes for the Programme. The level of resources available through this programme would greatly facilitate a number of the initiatives identified here.

The next two years will clearly be critical in the evolution of the WDC System. The world continues to change rapidly in a myriad of ways. It is vital that the WDC System move aggressively to shape its future, lest the future leave it behind.

Summary of Major Actions/Recommendations

- Establish a working group to assess potential candidates for new WDCs around the world.

- Establish the development of partnerships between established WDCs and appropriate organizations in developing countries by setting up a competitive program of seed funding.

- Establish a WDC Technical Task Team to take the lead on modernization of data access and networking and to coordinate the development and implementation of appropriate solutions.

- Establish a Data Stewardship Working Group to address end-to-end data management, long term archival, and data rescue functions across the WDC system.

- Establish a WDC-wide electronic newsletter to promote communication and collaboration across the WDC System.

- Establish formal liaisons between the WDC System and key international programs and institutions.

- Prepare a formal proposal to the ICSU Grants Programme.

12/12/03

Appendix A: Suggested Partnership Criteria

1) General Criteria

   a) The Partner site should usually be in a developing country in Africa, Asia, or South America;

   b) The research interests and capability of the Partner site should be in a scientific area of relevance to larger regional or global research studies.

2) Partner site

   a) existence of a local scientific research group working in geo- or environmental sciences;

   b) existence of some data collections useful to ICSU programs (e.g., WCRP, IGBP, IHDP) or to the ICSU WDCs, and the potential to expand data collections;

   c) desire of the local research group to network with other scientists in their research area or with other WDCs;

   d) local resources adequate to sustain affiliation with a WDC beyond the initial period;

   e) availability of an Internet connection would be useful but not mandatory.

3) Host WDC

   a) interest in the research work of the local group and their data collections;

   b) resources to contribute to the establishment of the Partner site, e.g., financial, loan or provision of new hardware, staff to visit the Partner site to assist in establishing the partnership arrangement;

   c) willingness to assist the Partner site to archive data;

   d) willingness to assume archival responsibility for long-term archival in the event that the Partner site may not be able to continue.

12/12/03