

World Data Centers

Status and Priorities for the future

Mission Statement of the World Data Center System

Data constitute the raw material of scientific understanding. The World Data Center system works to guarantee access to solar, geophysical and related environmental data. It serves the whole scientific community by assembling, scrutinizing, organizing and disseminating data and information.

This mission implies *de facto* specific objectives, such as designing, building, and populating data archives, curating and preserving data sets, and discharging diligently all obligations attached to data stewardship, including the guarantee of *full and open* data access at the marginal cost of reproduction.

I. Background

The first large-scale international scientific enterprises were the International Polar Years of 1882-1883 and 1932-1933, that inspired the International Geophysical Year (IGY) of 1957-1958. Planning of the IGY was coordinated by CSAGI, the Special Committee for the IGY set up by the International Council of Scientific Unions (ICSU). CSAGI established the World Data Center (WDC) system to serve the IGY, and developed data management plans for each IGY scientific discipline. Because of its success, the WDC system was made permanent and used for post-IGY data exchange. New programs evolved, based on the IGY structure as a general framework, such as the International Quiet Sun Year of 1964-1965, the International Magnetospheric Study of 1976-1979, the Solar Maximum Year of 1979-1981 and the Middle Atmosphere Program of 1982-1985. Most of the sponsoring national bodies agreed to continue the WDCs to serve these programs, and the data collections have remained accessible to users.

Originally established in the United States, Europe, Russia, and Japan, the original WDC system of 27 centers has since expanded to other countries and to new scientific disciplines. The WDC system now encompasses 51 Centers in 12 countries. Its holdings include a wide range of solar, geophysical, environmental, and human dimensions data. (See Attachment 1; note the hyperlinks to summary pages and home web pages). These data cover timescales ranging from seconds to millennia, and spatial scales ranging from atomic to galactic dimensions; they provide baseline information for research in many ICSU disciplines. WDCs are funded and maintained by their host countries on behalf of the international science community. They accept data from national and international scientific and monitoring programs as resources permit. All data held in WDCs are available *on a full and open access basis for no more than the cost of copying and sending the requested information* (Attachment 2). In many cases, the data are available online at no cost.

The Panel on World Data Centers (Geophysical, Solar, and Environmental) was established in 1968 at the 12th General Assembly of ICSU, to advise the Officers of ICSU on the management of the World Data Centers, and to carry out related activities (Attachment 3). It succeeded the other ICSU bodies that created the WDC system for the International Geophysical Year of 1957-1958 and supervised subsequent WDC operations. Today the Panel oversees all 51 WDCs, Through its varied activities and initiatives, the Panel promotes the use of common standards and new technologies, enabling good science to be conducted from new and old data by the scientists of many nations. For further information see <http://www.ngdc.noaa.gov/wdc/reports.shtml> (NOTE some of the information on these web pages is out of date. Updating is in progress but will not be finished until late 2007)

II. Past and Current Activities

The World Data Center system of today is structured as a loose federation of data centers hosted mostly at governmental or academic institutions. Most of the WDCs do not have direct funding from their host, but rather are operated in conjunction with the normal activities of the hosting organization. This mode of operation has affected the way the WDCs have evolved. In instances where the hosting organization mission has diverged from the original premise on which the WDC was set up, the incidental support (and funding) for the WDC has decreased. This is listed as one of the weaknesses noted below. Many of the more recently established WDCs tend not to have this problem, as their activities are seen to be aligned with the host institution's mission.

The WDC Panel loosely coordinates the activities of the WDCs. Members of the panel serve as volunteers. The Chairman is approved by ICSU after nomination by the WDC Panel. The Chairman in turn appoints the Panel Executive. (Attachment 4) No direct, permanent or continuing funding is received by the Panel. Over the last 5 years, some of the revenue required for the Panel to function has been generated as a result of a few one-time projects funded by one US government agency. As a result of this one time funding, the WDC Panel has a bank balance \$44,000US as of July 2007. As in the past, there are no prospects of new continuing funding for the Panel in 2007 or for the out years beyond 2007. Also, there are no prospects for additional one-time funding from the current source beyond 2007

Looking back over the last fifty years, the WDC System can boast of a number of significant accomplishments. First and foremost is the preservation of the data from the IGY. This was the original founding mission of the WDCs and the system worked very well. The data are still preserved today in the WDC system. Also, from the outset, they produced a "Guide to International Data Exchange," the first of its kind and the model for the development of future guidelines of this type. The WDCs have always championed full and open data access, the provision of data on an exchange basis or for the minimal cost of reproducing the data. Because it is an ICSU body, the WDC system operates under the premise of non-discriminatory access to data and hence was successful in bridging the East – West divide during the Cold War, which was particularly important in the early years.

The WDCs, through the WDC Panel, has initiated numerous data rescue projects in the former Soviet Union, India and China. In more recent years, the System has expanded to China, Australia, India and most recently other parts of Europe. This expansion also carried over into a wide range of discipline areas by adding new diverse WDCs in Biodiversity, Ecology, Astronomy, Soils, Geology, Human Dimensions, Remote Sensing and Land Cover, to name a few.

One of the major focus areas of WDCs in recent years has been the transition from an analog to a digital mode of operation. This evolution to digital technology was carried out as a result of the WDCs being co-located with national or academic data centers. (It should be noted that many of the WDC still need to keep some of their analog capabilities since some users —mostly those using historical data sets— still require analog services.)

More recently, the WDCs have been initiating new collaborations with other data-oriented organizations and programs. In the early 1990's the WDC Panel entered into a close association with the International Ocean Data and information Exchange (IODE) of the Intergovernmental Ocean Commission. (Some of the IODE national data centers are also WDCs.) To improve international data exchange, the WDC for Solar and Terrestrial Physics (STP), Boulder developed a mirroring/partnering effort (Space Physics Interactive Data Resource – SPIDR) with several of the STP discipline WDCs in China, Russia, Australia, Japan and India as well as other interested organizations world-wide. This is an application of state-of-the-art data network connectivity. Similarly, the WDC for Paleoclimatology initiated mirror/partner sites for capacity building in data management in China, India, Argentina, South Africa and Kenya. Such collaborative efforts represent indubitably one of the critical directions to be taken by a revitalized WDC system.

III. Planning: ICSU PAA, Certification

An independent in-depth assessment of ICSU was completed in 1996 and resulted in several key changes, including the establishment of a new Committee on Scientific Planning and Review ([CSPR](#)). This assessment encouraged ICSU to evolve from its original function of principally helping its Members (Unions and National Members) achieve their own individual objectives, to assuming a more proactive and strategic role in addressing key international interdisciplinary issues of importance for science and society.

In 2002, ICSU's CSPR convened several ad-hoc groups to carry out strategic Priority Area Assessments (PAAs) of key areas. The combined outcomes from all of these activities have been integrated into an overall 6-year strategic plan which was approved by the 28th ICSU General Assembly in October 2005. One of these PAAs was on Scientific Data and Information (PAA SDI). http://www.icsu.org/1_icsuinscience/DATA_Paa_1.html The PAA SDI comprises a review of ICSU's data and information activities and organizations, including the Federation of Astronomical and Geophysical Data Analysis Services (FAGS), Committee on Data for Science and Technology (CODATA), and the WDC system. A number of

recommendations with regard to the re-focusing of ICSU's existing data and information services were made, notably:

- The World Data Center (WDC) system and the Federation of Astronomical and Geophysical Data Analysis Services (FAGS) will be reformed, taking account of user needs, including those of existing and new ICSU programmes. This will form part of the development of a broader strategic framework for data and information.
- The Committee on Data for Science and Technology (CODATA) will be encouraged to develop a long-term strategy.

Specifically for the WDCs, the PAA SDI recommended that the WDCs 1) implement new data management technologies, 2) adapt new techniques to acquire scientific data, 3) maintain relevance to existing ICSU programs, and 4) ensure relevance to new observation programs including GEO/GEOSS, IPY and eGY.

The WDCs have begun to address these recommendations. In 2005, the WDC Panel initiated a *certification* process of the WDCs in response to the PAA SDI. This process starts with the establishment of administrative and technological criteria for the WDCs; the specification of minimum standards for WDC accreditation; a review of utilization of and compliance with modern data management techniques; and an overall assessment of adherence to national and international standards. Far from a punitive intent of "weeding out the system" of less performing resource-limited members in favor of high-performance resource-rich members, the certification process aims to identify, both on a center-by-center basis and on a system-wide basis, specific activities that would facilitate the adaptation and improvement of individual centers, as well as of the entire system, to the current rapid technological revolution.

We anticipate that this process, and the concomitant improvement of the WDCs in coming up to the accreditation standards, will lead to an overall enhancement of the international credibility of the WDC system and to the establishment of a "get well" plan for deficient Centers. WDCs that are no longer willing or able to implement the WDC updated criteria, principles and responsibilities will of course have the option of withdrawing from the system, temporarily or permanently.

The WDC certification criteria will identify three categories among the existing WDCs (all will be compliant with WDC Principles and Responsibilities): a *World Data Center* (fully operational modern IT standards), an *Associate WDC* (intends to adopt modern IT standards), and a *Center Under Development (WDC-UD)*. Specifically, a WDC will hold scientifically *significant/relevant* data holdings; furnish data on a nondiscriminatory basis, without restriction, for no more than the cost of reproduction; maintain a web-accessible directory of holdings compliant with national /international standards; and provide a means for users to find and download data online. An Associate WDC will furnish data on a nondiscriminatory basis, without restriction, for no more than the cost of reproduction; maintain a directory of holdings; and provide a means for users to obtain data. A Center Under Development will undertake to work towards achieving Associate

or World Data Center status. The criteria for the WDC-UD have not yet been formalized; this category is generally meant to apply to new Centers in developing countries.

The certification process is divided into three phases. Phase 1 is a self assessment for the criteria listed in the above paragraph. This phase was completed last year for 53 WDCs. The results of this phase were that 48 WDCs were self-certified, two WDCs chose to be decertified, and three dropped to Associate WDC status. It was decided by the WDC Panel that this self-certification should be verified. An informal Phase 1b certification was conducted (i.e., checking that WWW sites exist, the web site is accessible and points to actual, downloadable data). The WDC Panel proposed to ask the electronic Geophysical Year (eGY) participants to help with a more formal Phase 1b certification. This phase is currently underway. Phase 2, or the expert evaluation phase, is just starting. This will focus on the evaluation of the scientific “significance” of the data held by the WDC. This evaluation will be done by the WDC Panel and its agents, much as a peer-review process, and the results will be endorsed or challenged by relevant ICSU bodies, (e.g., IAGA, IGBP, IHDP, WCRP, IGCC.) It is hoped that when this evaluation is complete, the WDCs will have a baseline of expertise and interoperability better to serve ICSU’s data and information needs.

In the summer of 2005, a team of experts visited and reviewed the Chinese WDCs. One reasoning for this site visit was to implement the process described above. Another reason was that the Chinese WDCs were never formally reviewed on-site prior to their admission to the WDC system. The team included representatives from the WDC Panel, WDC Directors, experts from Europe, US and China, and representatives from the Chinese Academy of Sciences. The results of the review are available from the WDC Panel Secretariat. The overall conclusion was that the Chinese WDCs are very healthy, highly capable, both in IT and in scientific expertise. They are well supported by their host institutions and should continue to be full WDCs. As a result of this successful on-site review process, the Panel is now considering a similar review of the Russian WDCs, as well as the Japanese WDCs. These should be scheduled for an on-site review in the next year or two.

IV. WDC Strengths and Weaknesses

Its strengths and weaknesses often tell much about an organization. By identifying these, the WDCs hope to develop a perspective of where they are and how they will evolve.

An obvious WDC strength, common to all centers, is its disciplinary support. The WDCs serve their disciplines well. Many are key partners in international research programs. For example, the SPIDR system serves a network of solar-terrestrial data nodes and is a mainstay in the solar-terrestrial physics community. Oceanographic centers are working as key partners of the International Oceanographic Data and Information Exchange (IODE) program of the Intergovernmental Oceanographic Commission. The WDC for Paleoclimatology led the establishment of mirror sites in developing countries and is now building partnerships with the host institutions. New WDCs have begun serving

new interdisciplinary areas, e.g., land use/land cover, biodiversity, and human dimensions.

Another WDC strength is universal data access. WDCs have supported *full and open data access*. The WDCs (working as ICSU entities) have been able to arrange data access for scientists in regions where governmental restrictions might otherwise have prevented exchange. WDC access principles have inspired other organizations to adopt similar principles. Individual WDCs have been at the forefront of developing new data access, visualization, and analysis tools. The WDC system has encouraged some countries to increase their support for open access data centers. WDC representatives are currently working with CODATA to assist the Group on Earth Observation (GEO) in developing implementation guidelines for agreed data sharing principles of the planned Global Earth Observing Systems of Systems (GEOSS)

Finally, in the near-unanimous opinion of the WDC Directors, the greatest WDC strength lies in data stewardship. The WDCs provide valuable expertise in science data management. World Data Center personnel are perhaps the greatest WDC asset. Most centers have a long history of close working relationships with scientists in their disciplines. The Center staff know their data and use this knowledge to assist users obtaining the data they need. WDCs have developed institutional commitments and partnerships to help ensure long-term preservation of their data holdings and have raised awareness of the need for data stewardship within many disciplines and countries.

Where there are strengths, there are also weaknesses. One very apparent weakness of the WDCs is that there is no real WDC “system.” Most centers have a directory of their data sets, but there is no overall interdisciplinary directory —although the IPY “union catalog” may provide a preliminary model for this. This has been a widely noted failing. There have been attempts to correct it, but these efforts have not been successful, typically for administrative rather than technological reasons. Further, the concept of interoperability has been minimally or superficially implemented. Some WDCs are “networked,” but the majority are not. Metadata and data formats vary greatly across disciplines. The outcome is that researchers tackling interdisciplinary problems can have a difficult time getting and using data from the WDCs. It seems to be a fair assessment that WDC system has not responded in a coordinated way to evolving user needs and increasing expectations for seamless, online access to data and supporting services.

Another WDC weakness is that there has not been a way to systematically manage the system. If the WDCs were actively managed, joint activities could be devised to strengthen the less well-resourced members. The WDC Panel has never found consistent resources to help centers develop, let alone to support Panel management activities. Issues such as directories, broadband communication, and interoperability are only being dealt with at the center level; there is no overall shared or coordinated development. There exist at present no certification criteria for WDCs to ensure data quality standards beyond bit-stream preservation. WDCs have not been very successful in raising awareness of data stewardship needs in key international scientific programs, organizations, and other initiatives (with the notable exception of the IPY, which places a

high premium on data stewardship). WDCs have not been active as a group in the development of international standards for data management and interoperability. In this vein, a further weakness is that the mission of the host institution has gradually diverged from the historical WDC mission in some cases. This divergence directly affects the resources available to the co-located WDC. All of these issues could be addressed by stronger system-level management.

A final critical weakness is that WDC system has not yet found a way to provide effective science support in developing countries. Most data sets are developed, archived, and applied by scientists in developed countries. The success in building East-West bridges during the Cold War has not yet been matched by North-South bridges today. There is no program in existence for training in science data management that might address this issue.

V. WDC Opportunities and Threats

What are the opportunities for the WDCs? This was the object of various animated discussions at the 2007 WDC Directors meeting in Bremen, Germany. There is a general consensus that the enormous growth in the IT arena offers extremely attractive opportunities in distributed data management. Moore's law for electronic components has a time constant (doubling time) of approximately 18 months; for mass storage, the doubling time is about 12 months; for bandwidth and data transfer capacity, the doubling time is 9 months.

These numbers are extremely favorable to distributed data systems. Even in the short term, investments in storage and communications look very attractive. The concomitant threat is that the supporting architectural concepts may not be able to take full advantage of this rapid evolution. To counter that threat, the Panel has recommended that limited, but realistic "pilot" projects be undertaken, in order to identify the potential successes to be pursued, and the pitfalls to be avoided.

It seems clear that fresh approaches can be devised and explored by working with our ICSU partners, e.g., FAGS, CODATA, IGBP, WCRP, eGY, etc. The WDCs must adapt as many have over the years. The system was created in response to a critical scientific need during the IGY. The system has expanded in recent years to address new scientific programs, but might profitably be much more proactive, instead of merely opportunistic. The scientific needs endure, but the focus is changing as evidenced by current government-supported international global initiatives (e.g., IPY, GEOSS, IPCC.) Just as the IGY provided a focus in the 1950s, these international initiatives provide new incentives for the WDC system to support global science in a significant way.

Global data sets are needed more than ever, and even meso-scale data sets now require modeling and interpretation in the embedding context of the global problems. WDCs are well positioned to support research efforts needed to address global issues such as climate change, tsunami preparedness, and population stresses. Clearly, global problems require global data access, and the data policies of full and open access promoted by the WDC

system are more appropriate than ever. Since the objects under study—Earth and Earth systems—are characterized by unmeasured complexity, multi-disciplinary data access strategies are called for. Once again, the WDC system offers the right characteristics of multi-disciplinarity. The threat that counterbalances this opportunity is that the WDCs might fail to adopt standards that facilitate multi-disciplinary research, so that scientists might “vote with their feet” and turn to other, more adaptable systems, at least in the short-term. Should that become the case, then there is a serious risk that a positive feedback loop might be triggered, so that the WDCs might quickly lose perceived relevance, and fail in their mission of supporting the scientific community.

It has long been obvious that data sets of relevance to modelers are now digital, and are accessed over the network. In fact, there is a demand to digitize data sets—in particular historical data sets—originally recorded in analog form. In order to support ever more powerful modeling platforms, a substantial and ongoing investment in infrastructure must be made at the WDCs. If WDC holdings prove to be not only useful, but critical to research, the opportunity of funding such infrastructure is more likely to materialize. Yet the “pump has to be primed.” Failure to initiate this investment in a visionary way is fraught with peril: the system runs the risk of falling further and further behind the “technological wave,” and of being unable to fulfill its mission.

Finally, WDCs should capitalize on the strengths mentioned earlier. Primary among these are data holdings: consistent, long-term time series data are needed more than ever. WDCs should pursue and nurture new institutional approaches, and seek the resources and partnerships needed to ensure long-term preservation and access to high quality — and properly vetted—data sets. WDCs must evolve from data archives to data libraries and data publishers in order to integrate data stewardship and inter-disciplinary data access into WDC tasks. It should be noted that in a number of disciplines—e.g. Oceanography and Climate—data sets should not be construed exclusively as instrumental data, but in many cases, model outputs need to be preserved for a long time, together with the appropriate metadata.

VI. The Future of the WDC System

A positive sign for the WDC system is the continuing interest by new scientific communities and countries in establishing new WDCs and WDC infrastructure. There is still a clear need for an international, nongovernmental organization to serve as a coordinating body and quality control mechanism. The WDC system needs to look at approaches taken by other groups that have been more successful in establishing active and sustainable networks of organizations with shared interests and activities.

In 2000, the WDC Panel organized a WDC Directors’ meeting at World Data Center for Meteorology in Asheville, North Carolina, USA. One of the major outcomes of this meeting was the formation of a WDC Modernization Task Team (see http://www.ngdc.noaa.gov/wdc/reports/Modernization_ReportFinal_121203.pdf). It recommended the evolution of a “Global Science Data Network” from the existing collection WDCs. The network would include new technologies, new data, new

participants, and new organizational principles. The report also recommended the strengthening of the human resources focused on science data management, with a special focus on developing countries. Specifically, it recommended extending the WDC network by establishing new centers and partner sites; modernizing the system by exploiting new technologies; ensuring data stewardship by providing long-term archive & data rescue; and improving communications by initiating liaisons with key international science programs.

In May 2007, the WDC Directors again met at the World Data Center for Marine Environmental Sciences in Bremen, Germany, to discuss the future of the WDC system (<http://bscw.pangaea.de/bscw/bscw.cgi/411061> User: WDC Password: wdc2007) More than 35 WDC Directors or their representatives attended the meeting as well as representatives from ICSU, IODE, CODATA, the Group on Earth Observations and FAGS.

Key topics of discussion at this meeting were the International Polar Year (IPY), which is a major international research program that has recognized the need for long-term data stewardship, and the Global Earth Observing System of Systems (GEOSS), which is looking to the WDC system for data management expertise in developing the next generation of international, interoperable Earth observing systems aimed at both scientific and practical applications. The WDCs individually and as a system need to demonstrate their willingness to work with the international scientific community and the Earth Observations community to make the IPY and GEOSS successful not only in terms of current needs, but long-term data accessibility and usability.

The major resolutions from the meeting affecting the future of the WDC system were:

1. The WDC system must respond robustly and effectively to ICSU's program data management needs. ICSU will not support the *status quo ante*. The WDCs will work with ICSU to meet this requirement.
2. The WDCs must strongly and actively support the data management needs of the IPY, a major new program of ICSU.
3. The WDCs must become an active partner in the planning of the GEOSS data activities.
4. The WDCs must implement network links between WDCs utilizing interoperable data systems to support current scientific programs. The WDCs must begin to promote the adoption and promotion of standards within the systems in order to achieve this interoperability.
5. The WDCs must establish a baseline of IT capabilities that will form the backbone of a Global Science Data Network of WDCs.
6. The WDCs and the WDC Panel must identify and secure funding for managing the System
7. Data publishing is an effective way of making historical data available and should be widely implemented in the WDC System.
8. The WDC system and FAGS should discuss common operations and a possible merger of their activities.

9. Since the some of the National Oceanographic Data Centers of the IODE are WDCs, closer interactions and coordination between the two systems are logical and necessary. IODE relies on the WDCs for data archival and dissemination.
10. WDCs need to integrate their future IT activities with new state-of-the-art technologies like Virtual Observatories and the activities of electronic Geophysical Year.
11. The WDC system needs to expand its discipline structure and its geographic distribution to better serve ICSU programs—while perhaps at the same time consolidating in some areas. This includes a concerted push to expand to developing countries and the Southern Hemisphere. The WDC Panel and ICSU need to identify mechanisms for the establishment of new WDCs within national structures.
12. The WDCs should be open to look at a new paradigm in restructuring the WDC System (virtual WDCs?).
13. As the world transitions into a digital environment, the WDCs must address the fate of analog data and make it a priority to rescue the analog data by converting them into digital data.

The future is bright for the WDCs. While there are many challenges ahead, the concept of the WDC system developed 50 years ago is still viable. This assertion is widely recognized by the WDC community to be correct. An active and energetic implementation of this concept is needed now more than ever. However, the WDC system must evolve to meet today's needs of ICSU and the scientific community

END OF PAPER

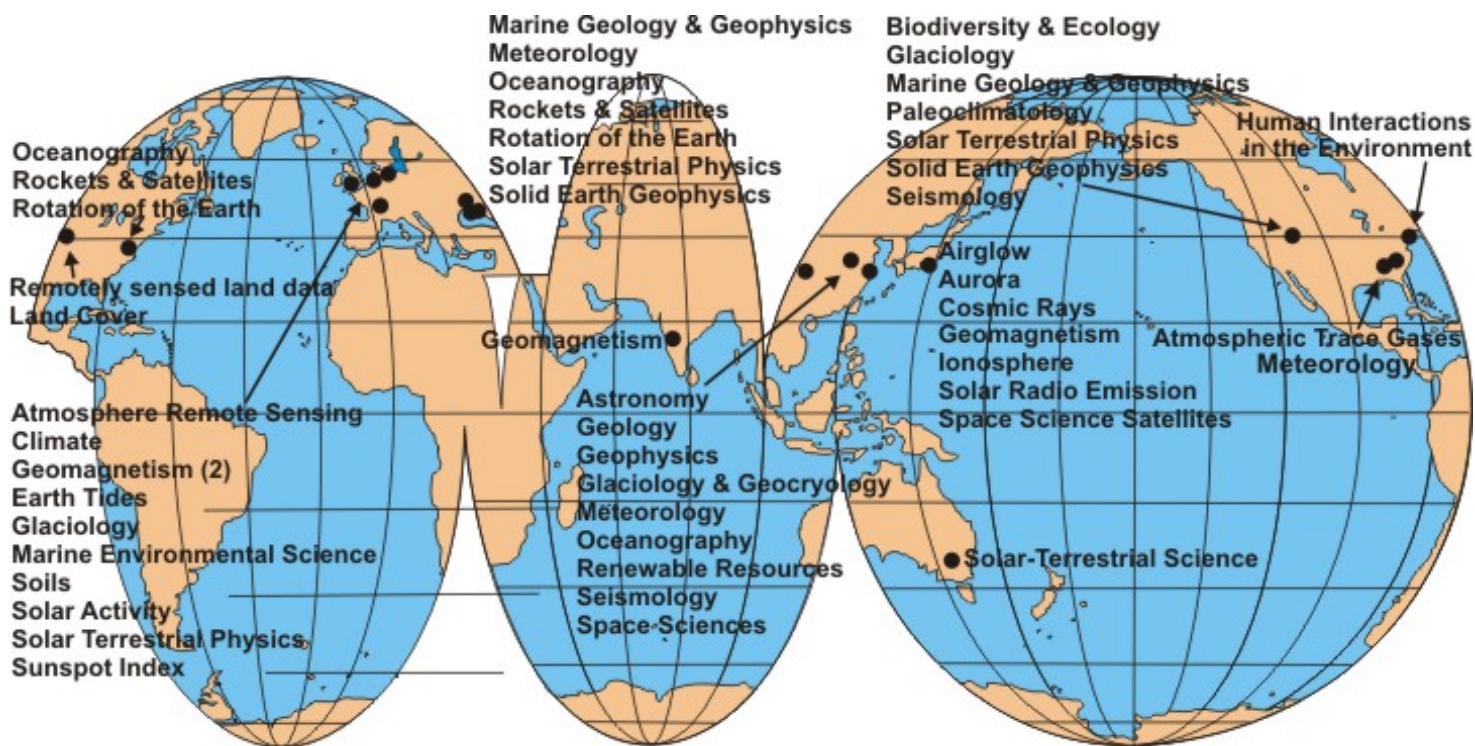
Attachment 1

List of World Data Centers with Hyperlinks to WDC Guide page and WDC home page				
	World Data Center (Hyperlink to WDC Guide page*)	Host Institution	World Data Centre Web site (Hyperlinked)	Date established at host institution
1	Airglow	National Astronomical Observatory, Tokyo, Japan	http://solarwww.mtk.nao.ac.jp/wdc.html	1957
2	Astronomy	Beijing Astronomical Observatory, CAS, Beijing, China	http://badc.lamost.org	1988
3	Atmospheric Trace Gases	Oak Ridge National Laboratory, USA	http://mercury.ornl.gov/cdiac/ No WDC Web page	
4	Aurora	National Institute of Polar Research, Tokyo, Japan	http://polaris.nipr.ac.jp/~aurora/	1981
5	Biodiversity and Ecology	USGS Center for Biological Informatics, Denver, CO, USA	http://wdc.nbii.gov	2002
6	Climate	Max-Planck-Institute for Meteorology and German Climate Computing Centre, Hamburg, Germany	http://wdc-climate.de/	2002
7	Cosmic Rays	Solar-Terrestrial Environment Laboratory, Nagoya University, Toyokawa, Japan	<a href="http://www.env.sci.ibaraki.ac.jp/databas
e/html/WDCOCR/index.html">http://www.env.sci.ibaraki.ac.jp/databas e/html/WDCOCR/index.html	1957
8	Earth Tides	Observatoire Royal de Belgique, Brussels, Belgium	http://www.astro.oma.be/ICET/	
9	Geology	Chinese Academy of Geological Sciences, Beijing, China	http://www.wdcgeo.net	1988
10	Geomagnetism, Copenhagen	Danish Meteorological Institute Copenhagen, Denmark	<a href="http://dmiweb.dmi.dk/fsweb/projects/wdc
c1/">http://dmiweb.dmi.dk/fsweb/projects/wdc c1/	1957
11	Geomagnetism, Edinburgh	British Geological Survey, Edinburgh, UK	http://www.wdc.bgs.ac.uk/	
12	Geomagnetism, Kyoto	Kyoto University, Kyoto, Japan	<a href="http://swdcwww.kugi.kyoto-
u.ac.jp/index.html">http://swdcwww.kugi.kyoto- u.ac.jp/index.html	1957
13	Geomagnetism, Mumbai	Indian Institute of Geomagnetism, Mumbai, India	http://www.wdciig.res.in/	1990s
14	Glaciology, Boulder	CIRES, University of Colorado, Boulder, USA	http://nsidc.org/data/wdc.html	1976
15	Glaciology, Cambridge	Scott Polar Research Institute, Cambridge, UK	http://wdcgc.spri.cam.ac.uk/	
16	Glaciology and Geocryology, Lanzhou	Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, Lanzhou, China	http://wdcdgg.westgis.ac.cn/	1988
17	Human Interactions in the Environment	CIESIN, Columbia University, Palisades, NY, USA	http://sedac.ciesin.columbia.edu/wdc/	1995
18	Ionosphere	National Institute of Information and Communications Technology, Tokyo, Japan	http://wdc.nict.go.jp/index_eng.html	1957
19	Land Cover Data	USGS, EROS Data Center, Sioux Falls, USA	http://landcover.usgs.gov/ No WDC web page	2002

*(NOTE some of the information on these web pages is out of date. Updating is in progress but will not be finished until late 2007)

20	Marine Environmental Sciences	Centre for Marine Environmental Sciences and Alfred Wegener Institute for Polar and Marine Research, Bremen, Germany	http://www.wdc-mare.org/	2001
21	Marine Geology & Geophysics, Boulder	NOAA NGDC, Boulder, CO, USA	http://www.ngdc.noaa.gov/mgg/aboutmgg/aboutwdcmgg.html	1975
22	Marine Geology & Geophysics, Moscow	Glav NIVC MNR RF, Moscow, Russia	Bad URL	
23	Meteorology, Asheville	National Climatic Data Center, Asheville, NC, USA	http://www.ncdc.noaa.gov/oa/wdc/index.php	
24	Meteorology, Beijing	National Meteorological Information Center, Beijing, China	http://data.cma.gov.cn/index.jsp	1988
25	Meteorology, Obninsk	All-Russian Research Institute of Hydrometeorological Information, Obninsk, Russia	wdc@meteo.ru No WDC Web Page	
26	Oceanography, Obninsk	All-Russian Research Institute of Hydrometeorological Information, Obninsk, Russia	wdc@meteo.ru No WDC Web page	
27	Oceanography, Silver Spring	NOAA/NODC, Silver Spring, MD, USA	http://www.nodc.noaa.gov/General/NODC-dataexch/NODC-wdca.html	
28	Oceanography, Tianjin	National Marine Data & Information Service State Oceanic Administration, Tianjin, China	http://wdc-d.coi.gov.cn/english/eindex.html	1988
29	Paleoclimatology	NOAA/NGDC, Boulder, USA	http://www.ncdc.noaa.gov/paleo/datalist.html	1989
30	Remotely Sensed Land Data	USGS, EROS Data Center, Sioux Falls, SD, USA	http://edc.usgs.gov/ No WDC web page	1992
31	Remote Sensing of the Atmosphere	German Aerospace Centre, DLR, German Remote Sensing Data Centre (DFD), Oberpfaffenhofen, Germany	http://wdc.dlr.de/	2002
32	Renewable Resources and Environment	Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China	http://eng.wdc.cn:8080/Metadata/index.jsp	1988
33	Rockets and Satellites	All-Russian Research Institute of Hydrometeorological Information, Obninsk, Russia	http://meteo.ru/english/ No WDC web page	
34	Satellite Information	NASA Goddard Space Flight Center, Greenbelt, USA	http://nssdc.gsfc.nasa.gov/about/about_wdc-a.html	1966
35	Space Science Satellites	Inst. Space & Astronautical Science, Kanagawa, Japan	http://darts.isas.jaxa.jp/index.html.en No WDC web page	1969
36	Rotation of the Earth, Obninsk	All-Russian Research Institute of Hydrometeorological Information, Obninsk, Russia	http://meteo.ru/english/ No WDC Web page	
37	Rotation of the Earth, Washington	U.S. Naval Observatory, Washington, DC, USA	http://maia.usno.navy.mil/ No WDC Web page	
38	Seismology, Denver	USGS, Denver Federal Center, Denver, USA	http://neic.usgs.gov/ No WDC Web page	1986
39	Seismology, Beijing	China Earthquake Networks Center, Beijing	http://210.72.96.21:8080/wdc/home-1.html	2004
40	Soils	ISRIC - World Soil Information, Wageningen, The Netherlands	http://www.isric.org/UK/About+Soils/WD C+for+Soils/	1989
41	Solar Activity	Observatoire de Meudon, Meudon, France	http://bass2000.obspm.fr/home.php No WDC Web page	1978

42	Solar Radio Emissions	Nobeyama Solar Radio Observatory, National Astronomical Observatory, Nagano, Japan	http://solar.nro.nao.ac.jp/norp/archive.html	1969
43	Solar Terrestrial Physics, Boulder	NOAA/NGDC, Boulder, USA	http://www.ngdc.noaa.gov/stp/WDC/wdcstp.html	1957
44	Solar Terrestrial Physics, Chilton	Rutherford Appleton Lab, UK	http://www.ukssdc.ac.uk/wdcc1/data_menu.html	
45	Solar-Terrestrial Physics, Moscow	Geophysical Center, RAS, Moscow, Russia	http://www.wdcb.ru/stp/index.en.html	1956
46	Solar-Terrestrial Science, Sydney	IPS Radio and Space Services, Sydney, Australia	http://www.ips.gov.au/World_Data_Centre	2000
47	Geophysics, Beijing	Institute of Geology and Geophysics, CAS, Beijing, China	http://gp.wdc.cn/wdc/english/indexnew.htm	1988
48	Solid Earth Geophysics, Boulder	NOAA/NGDC, Boulder, USA	http://www.ngdc.noaa.gov/seg/wdc/	1972
49	Solid Earth Physics, Moscow	Geophysical Center, RAS, Moscow, Russia	http://www.wdcb.ru/sep/	1971
50	Space Science	Center for Space Science and Applied Research, Chinese Academy of Sciences, Beijing, China	http://www.cssdc.ac.cn/	1988
51	Sunspot Index	Royal Observatory of Belgium, Brussels, Belgium	http://sidc.oma.be/	1981



World Data Centers

May, 2007

Attachment 2

PRINCIPLES and RESPONSIBILITIES of World Data Centers 1987 VERSION

GENERAL PRINCIPLES

- 1 World Data Centers (WDCs) operate under the auspices of the International Council for Science (ICSU) for the benefit of the international scientific community and provide a mechanism for international exchange of data in all disciplines related to the Earth, its environment, and the Sun.
- 2 World Data Centers in the United States are designated as WDCA. Those in the Soviet Union are designated WDCB. The WDC Centers, C1 and C2, are located in other countries. (*NOTE: A, B, C and D designations are no longer used*) An individual WDC may treat one or several of the disciplines or programs covered in the *Guide to the World Data Center System*.
- 3 World Data Centers, to the extent their resources allow, acquire and store data from national and international sources, in accordance with procedures and standards recommended by various international scientific bodies in the ICSU family, or other appropriate international organizations, and approved by the ICSU Panel on World Data Centers. These procedures are published periodically in the *Guide to the World Data Center System*.
- 4 World Data Centers exchange data among themselves on a mutually agreed, reciprocal basis.
- 5 Data held by a World Data Center must be completely accessible by scientists in all countries, upon written request or personal visit. Charges may be imposed to cover the costs of providing services to users.
- 6 The resources required for the activities of a World Data Center are the responsibility of the host country or institution. In order to provide continuity, the host country is expected to provide these resources on a long-term basis.
- 7 The coordination of WDC activities within a country is the responsibility of the appropriate national committee or scientific institution under which it is established.
- 8 The designation of institutions as WDCs is normally the responsibility of the host country acting with the approval of the ICSU Panel.
- 9 A WDC which for some reason may not be able to continue its activities and services is invited to make its holdings and records available to another WDC in the same discipline, and to notify the ICSU Panel through the A, B, C1 or C2 representative.

10 Each WDC is expected to report on its activities as requested by ICSU.

RESPONSIBILITIES OF A WORLD DATA CENTER

- 1 In accord with the General Principles, World Data Centers will fulfill data exchange requirements set out in the current version of the Guide to the World Data Center System. To the extent possible they will also respond to resolutions and recommendations from appropriate international organizations.
- 2 Duplication of data collections between WDCs may be specified in some disciplines.
- 3 Whenever possible the exchange of data between World Data Centers will take place without charge.
- 4 The provision of WDC data to an individual scientist or institution will normally require a charge to cover the costs of duplication and handling. This charge may be waived when the individual or institution is a contributor to the WDC concerned.
- 5 A WDC may also provide a mechanism for a scientist to request data not explicitly described in the Guide to the World Data Center System. In response to a bona fide request for such data, the WDC will attempt to obtain the data or forward the request to another WDC for action.
- 6 Where a WDC maintains a data collection, it must provide proper facilities for data storage and maintenance, and ensure that data copies are subject to adequate standards of accuracy, clarity and durability.
- 7 World Data Centers will explore the utilization of modern technology for data storage, data communications and user access.
- 8 Each World Data Center must be open to visitors and guest workers from any country and all data held under WDC auspices must be accessible to such visitors and workers.
- 9 Each World Data Center has a responsibility to make available to other WDCs and the scientific community a detailed description of the data available through the WDC.
- 10 Where more than one WDC holds or has access to data in a given discipline, joint data catalogs or inventories should be compiled.
- 11 World Data Centers endeavor to coordinate their activities, standardize data formats and cooperate in international projects and to this end visits by WDC staff to other WDCs and to international scientific meetings are encouraged.

- 12 World Data Centers receive data from many sources. While every attempt will be made to assure reasonable standards of data quality and related documentation, the ultimate responsibility for data reliability lies with the data contributor, not the WDC.

Attachment 3

WDC Panel – May 2007

Jean-Bernard Minster, Scripps Institution - Chair

Hartmut Grassl, Max Planck Institute – Vice Chair

David Clark, NOAA/NGDC –Secretary

Michael Chinnery, Treasurer

Takashi Watanabe, Ibaraki University – Japan Representative

Gennady Sobolev, Russian Academy of Sciences – Russia Representative

Sun Honglie, Chinese Academy of Sciences – China Representative

Ferris Webster, University of Delaware – US Representative

Constitution and Bylaws
ICSU Panel on World Data Centers
(Geophysical, Solar, and Environmental)
(revised February 2005)

Constitution

The Panel on World Data Centers (Geophysical, Solar, and Environmental) was established in 1968 at the 12th General Assembly of ICSU, to advise the Officers of ICSU on the management of the World Data Centers (WDCs), and to carry out related activities. It succeeded the other ICSU bodies that created the WDC system for the International Geophysical Year of 1957-1958 and supervised its operation during and after the IGY. Today the Panel oversees dozens of WDCs, which are maintained by their host countries and are responsible for collecting, archiving, and distributing a wide range of data. These data cover timescales ranging from seconds to millennia and provide baseline information for research in many ICSU disciplines, especially for monitoring changes in the geosphere and biosphere—gradual or sudden, foreseen or unexpected, natural or man-made. Through its varied activities and initiatives, the Panel promotes the use of common standards and new technology, enabling good science to be done with both new and old data by the scientists of many nations.

1. The Panel shall work with data centers, providers, and users to further the following objectives:
 - a. To ensure permanent archiving and availability of geophysical, solar, and environment data for the benefit of the world research and education community.
 - b. To coordinate and further develop the WDC System, to establish the criteria to be met by the WDCs, to review the operation of WDCs, to approve the formation and closure of WDCs, and to agree and enforce the rules for availability and access of data.
 - c. To work with ICSU bodies to ensure the retention and access of data collected as a part of ICSU programs, and to identify and meet their data requirements.
 - d. To advise ICSU as appropriate on matters relating to scientific data within the purview of the WDC System.
2. The Panel should report to ICSU annually or otherwise as required.
3. Panel membership represents scientists and data managers concerned with the international exchange and dissemination of geophysical, solar, and environmental data.
4. The chair of the Panel is appointed by ICSU, with advice from the Panel. The chair appoints the vice-chair, treasurer, and secretary, with concurrence of the Panel. These officers form the executive.

5. The Panel shall comprise the executive and scientific representatives with regional oversight over WDCs and coordination offices. Other members of the Panel may include scientific representatives of relevant ICSU programs and bodies.
6. The Panel shall normally conduct affairs by consensus, but when an election or other matters requires a vote, each member of the Panel shall have one vote. The matter will be decided by a simple majority of those voting. The chair shall have a casting vote.
7. The Panel shall maintain its own bank accounts under the operational control of the Treasurer or other officer acting as Treasurer.
8. Accounts shall be rendered for approval to ICSU annually or otherwise as required.
9. Amendments to this Constitution are subject to the approval of ICSU.
10. The Panel shall maintain a set of bylaws to support this constitution.

Bylaws

1. The Panel shall compile and publish guides to the WDC system. Such publishing may be supplemented by electronic means.
2. The Panel shall promote awareness of the WDC and its capabilities through means such as publications, workshops, and exhibitions.
3. The Panel may undertake or sponsor special operations to acquire data from remote or unusual sources, to convert data into digital form, or to develop special analysis or applications services.
4. The chair of the panel may appoint assistant secretaries on an ad hoc basis to perform duties as requested. These assistant secretaries will not be voting members of the panel.
5. The Panel may designate officers and working groups for specific tasks, such as publishing reports, reviewing WDC activities and infrastructure, executing projects, or liaising with other bodies.
6. Panel members shall be appointed for a term of four years, and are eligible for reappointment for one further term of office. Efforts should be made to stagger the terms of appointment.
7. Relevant ICSU bodies shall be invited to submit nominations for Panel membership. Decisions on these nominations will be made by the Panel.
8. The size of the Panel shall not exceed 12 members. Two-thirds of members of the Panel members shall be considered a quorum for voting.
9. Panel members who miss two consecutive Panel meetings will normally be replaced.

10. The Panel may have correspondents, including all WDC directors and named representatives of appropriate ICSU and international bodies. These correspondents will receive the major mailings of the Panel.
11. Meetings of the Panel or the executive shall normally be called by the chair. Extraordinary meetings of the executive may be called at the request of a majority of the executive. Intercessional decisions may be carried out by correspondence.
12. Meetings of the Panel or the Executive shall take place at least annually. A summary of actions or recommendations arising from these meetings shall be distributed to Panel members and correspondents.
13. WDC directors and other correspondents are encouraged to participate in Panel meetings, although the Panel has no financial obligation to support their expenses.
14. The agenda and documents of Panel meetings shall, whenever possible, be circulated beforehand.
15. The Panel may call and organize meetings of all WDC directors as needed, and may contribute funding for such meetings.
16. The normal work of individual WDCs in receiving, archiving, and distributing data is financed by their host countries or organizations.
17. The Panel may receive funds from ICSU, national and international bodies, and individual WDCs. Such funds may be contracted to specific WDCs for work on special projects.
18. A yearly WDC membership fee shall be established by the Panel. The amount of this fee shall be reviewed annually.
19. Panel funds may be used to support the attendance of Panel members or representatives at meetings of the WDC Panel, ICSU, or other bodies at which the Panel should be represented.
20. Travel and other expenses necessary to carry out the Panel's objectives or projects must be authorized by the chair.
21. Proposed changes to the bylaws shall be circulated to the Panel at least one month before a vote. Amendments to these bylaws may be made by majority vote of the Panel.