

The State of the GCMD - CY 2005

I. Mission

The mission of the Global Change Master Directory (GCMD) is to assist the scientific community in the discovery of Earth science data and related services. Within this mission, the GCMD also provides holders of data and services the capability to make their products available to the Earth science community, along with citation information to properly credit their contributions, and to provide links directly to their data and services.

II. Organization

The directory is staffed by three software developers, a systems administrator, a database administrator, and four Earth science coordinators (one coordinator is supported by the USGS Biological Resources Division), the contract task lead, and the project manager, Lola Olsen. The science coordinators are responsible for the data sets related to the Biosphere and Land Surface; Oceans and the Hydrosphere; Solid Earth and the Cryosphere; Solar-Terrestrial Interactions; Spectral/Engineering data; Agriculture and Human Dimensions; the Atmosphere and Climate Indicators; and Paleoclimate. The software developers collectively hold skills in database management, Java, HTML, scripting languages (such as Javascript, Jython, and Struts), XML and XSLT, user interface design, software testing, and configuration management.

III. Science User Working Group

Representing the broad range of Earth science disciplines including life sciences, oceanography, geophysics, and atmospheric science is an active Science User Working Group. Members are chosen for their interest in NASA's directory effort and for their understanding of the importance of high quality data management. The composition of the group for the 2004 UWG meeting included Chairperson, Mr. Martin Ruzek (USRA); Dr. Walter R. Hoegy, NASA/Goddard representative from Code 910; Dr. Erick Chiang, National Science Foundation/Office of Polar Programs; Dr. Glenn Rutledge, NOAA/National Climatic Data Center (NCDC); Dr. Benno Blumenthal, Lamont-Doherty Earth Observatory at Columbia University; Dr. Wendell Brown, University of Massachusetts-Dartmouth; Dr. Hubert Staudigel, Scripps Institution of Oceanography; Ms. Andrea Buffam from the Canadian Centre for Remote Sensing (CCRS), representing the Committee on Earth Observation Satellites (CEOS) International Directory Network (IDN); and Dr. Doug Beard, USGS/Biological Resources Division (BRD). The GCMD Science User Working Group works under the UWG Terms of Reference. Recommendations from previous UWG meetings have helped to guide the progress of the directory.

IV. Highlights for 2005

1. Web site re-designed for compliance with One NASA standards.
2. New free text search term highlighting and brief excerpts from summary.
3. Dynamically-generated controlled vocabulary search interfaces for easier navigation.
4. New search refinement capabilities by keywords and/or free-text.
5. New data center buckets and location hierarchy for searching.
6. New spatial and temporal resolution buckets.
7. New fail-over system architecture that mirrors production and proxy machines in case of system failure.
8. Implementation of the OAI-PMH protocol for metadata harvesting.
9. Significant updates to docBUILDER and implementation of a stand-alone docBUILDER tool.
10. New portals implemented for JCADM partners: Uruguayan National Antarctic Data Center, Italian National Antarctic Data Center and the Spanish Antarctic Data Center.
11. Complete and successful metadata exchange with the GeoConnections Discovery portal (Canada) accomplished using XSLT and metadata harvesting technologies, resulting in a net gain of over 200 new Canadian metadata records.

V. Facility for Operations and Maintenance

The GCMD facility is located at the Goddard Space Flight Center. The primary operational computing resources consist of a proxy computer and a backup for the proxy - accessible through <http://globalchange.nasa.gov/>. These computers route user requests to an array of load balancing servers configured in a round-robin architecture. The load balancing architecture ensures minimal downtime, fault tolerance, maintainability and scalability. To ease the network burden for off-site contractors, a development platform is available at the contractor facility. New this year is an upgraded network architecture that provides a framework for GCMD production servers (web, database, email, mapping). Components include a private network for backups and network transfers, a proxy architecture for load balancing and failover, and a transparent bridge for firewalling and monitoring. See Figure 1.

GCMD Network Diagram:
Production Servers, All

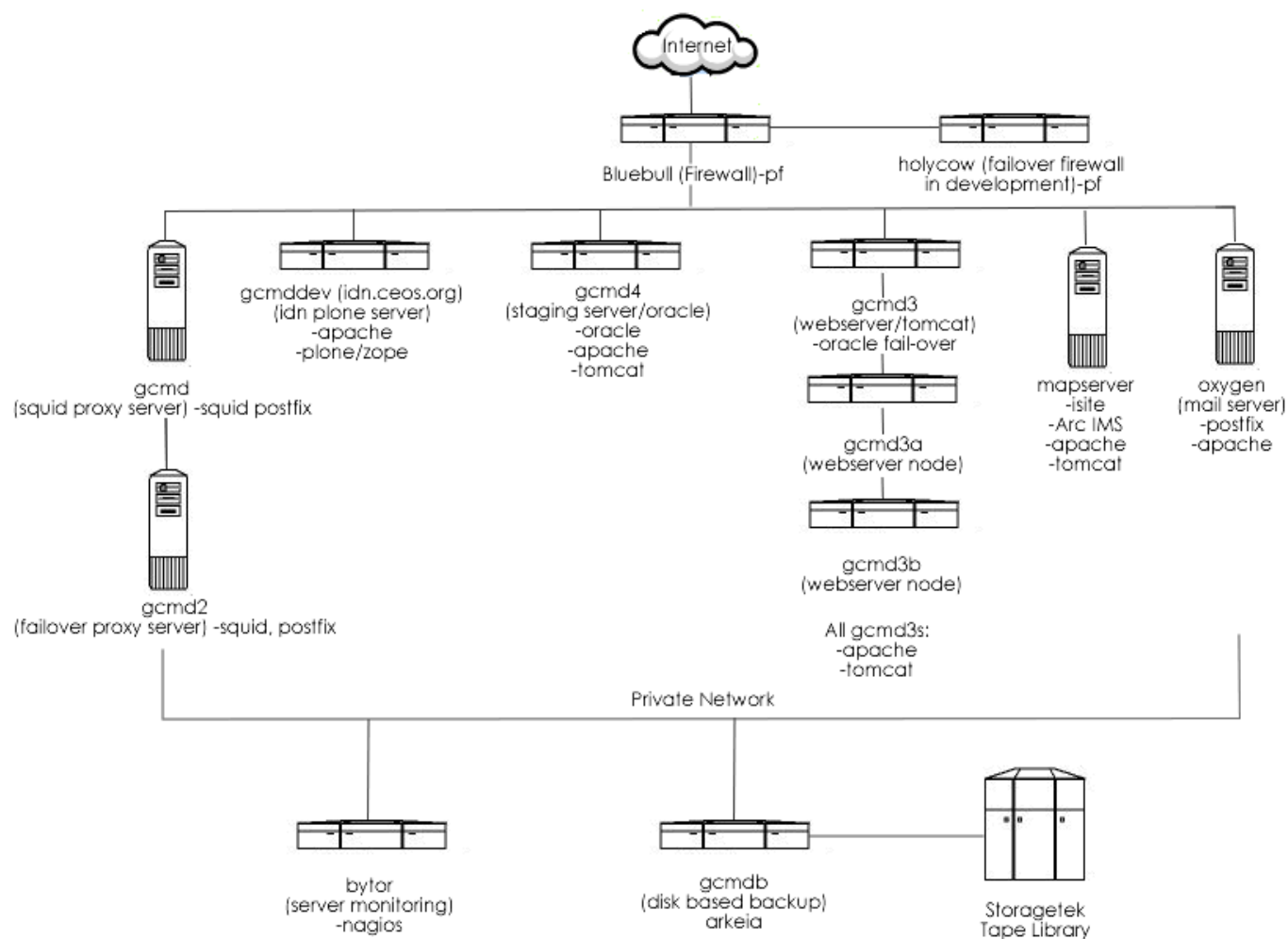


Figure 1. GCMD production server hardware architecture at NASA/GSFC.

VI. System Development

A. MD9.3

Version 3 of the MD9 software (MD9.3) was implemented and delivered in February 2005. This release provided a portal customization component, which provided more efficient portal creation and display, improvement to the query engine for more efficient caching, and more robust caching algorithms using Berkeley database libraries. Additional features included:

- New and improved free-text and advanced search capability powered by Lucene's search engine with geospatial and temporal search capabilities.
- Search term highlighting feature in record display, with credit to "InPerspective" (<http://www.inperspective.com/index.jsp>).
- Brief excerpt from record summary included within entry titles.
- New Earth Science and Services Keyword Topic-controlled search interface for easier navigation through hierarchical keyword lists.
- New graphical icons for Service keyword topics.
- New refinement box with capabilities for refinements by existing sets of "keywords" or "free-text".
- Improved features within Subscription Service: users can subscribe to new data services of interest.
- New customized portal interface with additional navigation features. Including left hand menu that points users to additional resources.
- Fully decoupled web applications (Conference Calendar, Project One Stop, OpenAPI, etc.).
- Squid proxy cache of dynamic pages.
- Upgraded version of Tomcat (4.1.30).
- Load balancing with Oracle on one computer and Apache and Tomcat split across computers.
- Web application based form for sending comments and feedback to GCMD staff (instead of mailto html email tags).
- GCMD Web site update:

The GCMD web site was redesigned to include the OneNASA standard. This standard was mandated by NASA and implemented with the release of MD9.3. These standards include common headers and footers, page layout, and color scheme. In an effort to increase accessibility, while meeting a core recommendation from the Science User Working Group, the GCMD site was reviewed through usability and software release testing. Some of the changes in MD9.3 influenced by user testing include:

- Google (and other search engine) robots were allowed to crawl and index cached GCMD metadata records for greater visibility.
- Titles for web site changed for greater visibility. Meta-tags added to home page so search engines could find site quickly. GCMD currently appears within the top 5 sites in Google and Yahoo when entering "global change" as the search term.
- Navigational menu names for Portals, Authoring, and Community updated.
- Centered home page so page appears scalable (removed a lot of the white space appearing on site since page was originally left aligned).
- Keyword search page navigation was updated for easier use.
- Images were added to Data Services page to be consistent with home page.
- GCMD header image and logo updated so that the black navigational menu tabs easier to find.

- Linked supplemental search topics on home page (Data Centers, Projects, Locations, Platforms, Instruments).
- Spatial coverage coordinates were added within the dataset record display next to the map to help users identify the map as static image instead of a dynamic map.
- A GCMD comment form was implemented so that users could anonymously provide comments to staff.

B. MD9.4

Version 4 of the MD9 software (MD9.4) was implemented and delivered in March 2005, which supports data resolution keywords and robust location and data center buckets for easier navigation

- New refinement boxes with capabilities for refinements by "keywords" or "free-text".
- New data center and location hierarchy for easier navigation.
- New help documentation (e.g., Basics of free-text search and Navigational Search Guide) for users.
- Increased number of characters available for specific DIF and SERF fields (e.g., Related_URL and Title fields).
- New spatial and temporal resolution range keywords within data resolution field. Users now have option to include resolution range keywords within records using docBUILDER tool.
- Improved features within docBUILDER authoring tool. Users can now create personalized templates within tool.

C. GCMD Prototype Mapserver

A prototype mapserver was implemented to showcase and visualize selected NASA data sets. The mapserver was developed using ESRI's ArcIMS software. Two interoperable features have been implemented:

1. The ArcMap server allows developers to use ArcGIS desktop to create maps and then publish them to ArcIMS.
2. The Open Geospatial Consortium (OGC) WMS connector allows for a standard communication between an OGC WMS client and the ArcIMS server to extract information. Data layers within the prototype mapserver can be accessed via the WMS GetCapabilities request documents. This is an XML encapsulated document that contains service-related metadata that calls up a WMS service.

The GCMD mapserver provides a highly scalable architecture. When a user accesses the mapserver, a request is sent to the ArcIMS spatial server through the web server. That request is then sent to the external ArcIMS or WMS servers to extract information. Next, the response from the external application is sent back to the ArcIMS spatial server, which forwards the information to the user. Finally, the client provides the tools for viewing and querying the data.

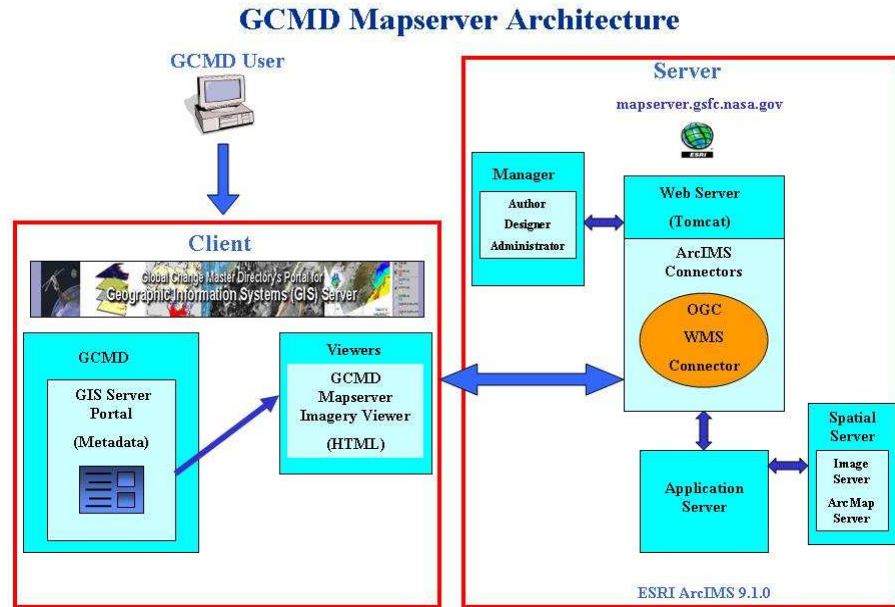


Figure 2. Schematic of the GCMD mapserver architecture.

VII. Metrics for Content Usage and User Feedback/Support

An additional statistics generation application, NetTracker, is being tested by the EOSDIS Metrics System group (EMS). GCMD web usage data has been added to the NetTracker system using page tags (javascript tags) that record GCMD usage information to the EMS servers. The NetTracker application is a rich and highly customizable application, which is capable of performing extensive analysis of usage data, which is stored in a RDBMS (Oracle). Data mining and other techniques can be applied to discover current trends or deficiencies in GCMD web site usage. NetTracker will be fully functional in 2006.

A. Content

The population of the directory's data set descriptions (in the Directory Interchange Format (DIF)) reached 16, 312 at the end of December 2005, up from 15,107 the previous year. The number of new data set descriptions was up from 1,943 in 2004 to 2,192 in 2005. In a continuing effort to improve the quality of the database, over 923 data set descriptions were deleted because the data were obsolete or no longer available. The number of revised data set descriptions was up from 5,881 in 2004 to 11,161 in 2005.

The population of Earth science services (in the Services Entry Resource Format (SERF)) reached 1,336 at the end of 2005. The number of new services descriptions was up from 282 in 2004 to 304 in 2005.

GCMD POPULATION	2004	2005	% CHANGE in 2005 input.
New DIFs	1943	2192	+12.8%
Revised DIFs	5881	11161	+89.8%
Deleted DIFs	911	923	+1.3%
New SERFs	282	304	+7.8%
Revised SERFs	349	603	+72.8%
New Data Centers	685	390	-43.0%
Revised Data Centers	45	30	-33.3%
New Platforms	30	13	-56.6%
Revised Platforms	11	21	+90.9%
New Instruments	75	96	+28.0%
Revised Instruments	9	27	+200.0%
New Projects	25	31	+24.0%
Revised Projects	8	17	+112.5%

Table 1. Population of GCMD database

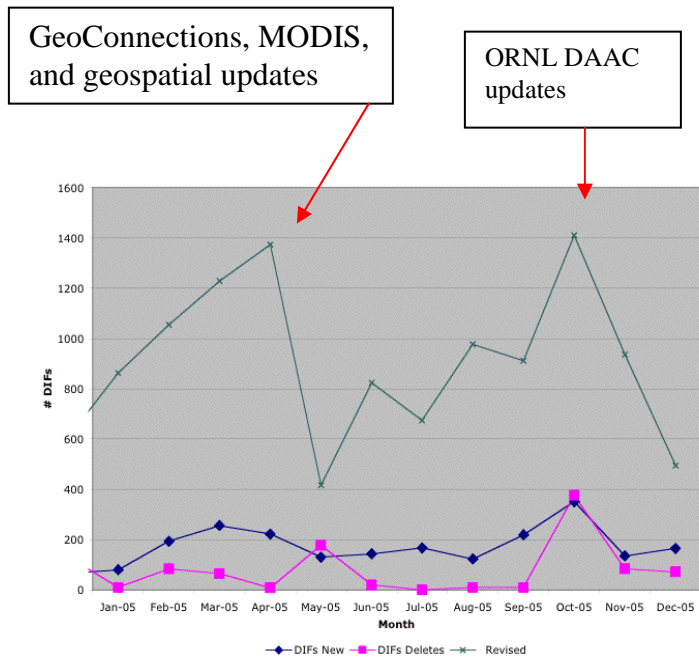


Figure 3. 2005 DIF population activities including new, deleted and revised DIFs.

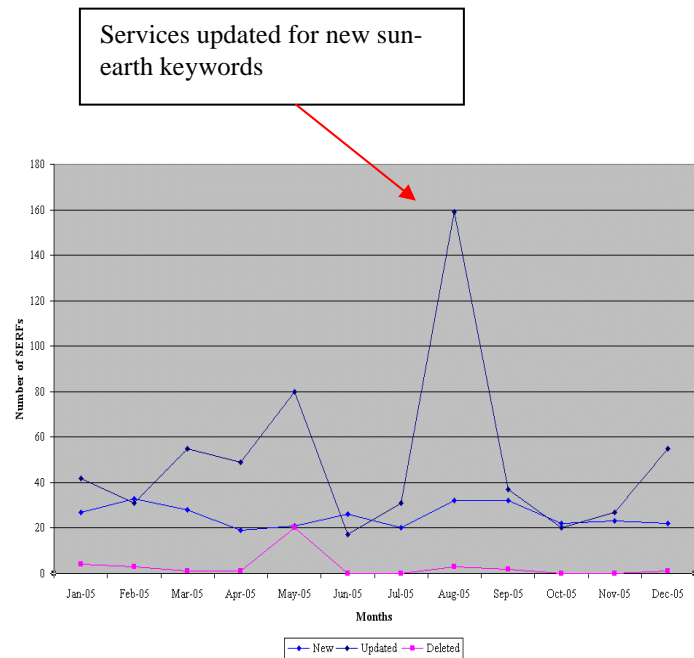


Figure 4. 2005 SERF population activities including new, deleted and revised SERFs.

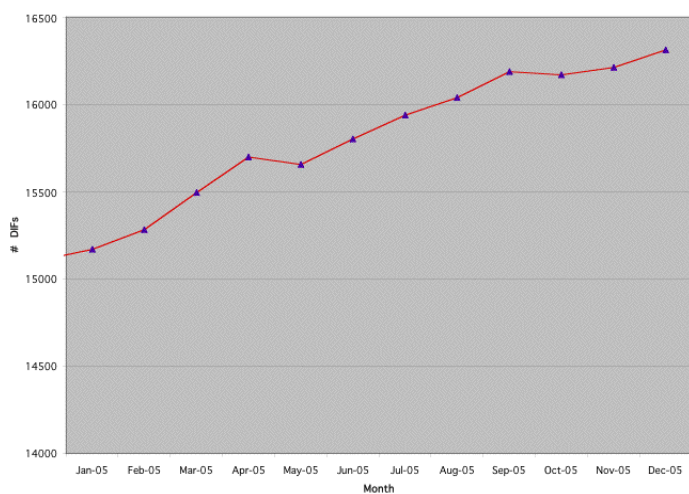


Figure 5. Cumulative population of new DIFs. 2,192 new DIFs were added in 2005.

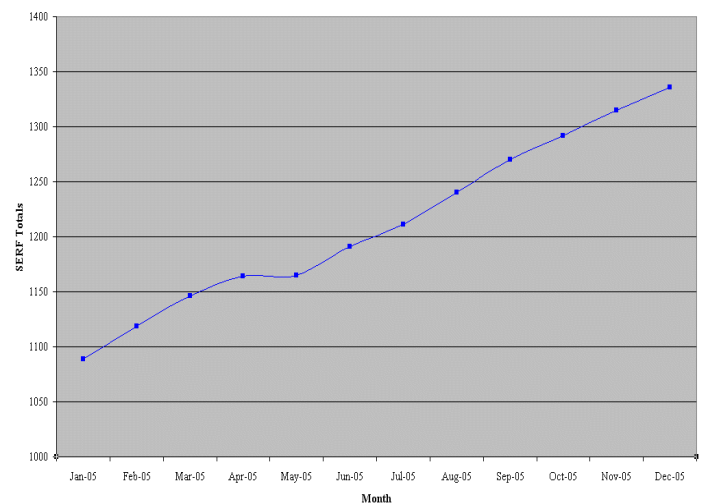


Figure 6. Cumulative population of new SERFs. 304 new SERFs were added in 2005

TOPIC	2004	2005	% CHANGE
AGRICULTURE	130	174	+33.85%
ATMOSPHERE	728	544	-25.3%
BIOSPHERE	545	613	+12.5%
CLIMATE INDICATORS	80	51	-36.2%
CRYOSPHERE	145	274	+88.9%
HUMAN DIMENSIONS	302	331	+9.6%
HYDROSPHERE	382	365	-4.4%
LAND SURFACE	452	670	+48.2%
OCEANS	468	746	+59.4%
PALEOCLIMATE	203	143	-29.5%
SPECTRAL/ENGINEERING	156	179	+14.7%
SUN-EARTH INTERACTIONS	53	48	-9.4%
SOLID EARTH	140	279	+99.3%

Table 2. Population of New DIFs by Earth Science Topic

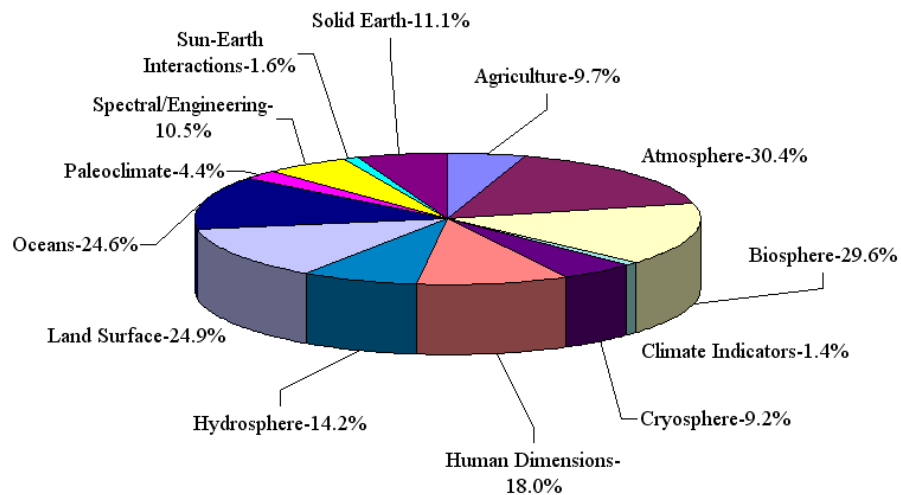


Figure 7. Population of DIFs by Earth science topic. The majority of data sets represent Atmosphere (30%), Biosphere (29%), and Oceans and Land Surface (24%).

Topic	2004	2005	% Change
Data Analysis & Visualization	499	619	24.0%
Data Management/Data Handling	262	336	28.2%
Education/Outreach	251	292	16.3%
Environmental Advisory	115	150	30.4%
Hazards Management	47	70	48.9%
Reference and Information Services	137	198	44.5%
Metadata Handling	41	51	24.4%
Models	192	259	34.9%

Table 3. Population of New SERFs by Earth Science Service Topic

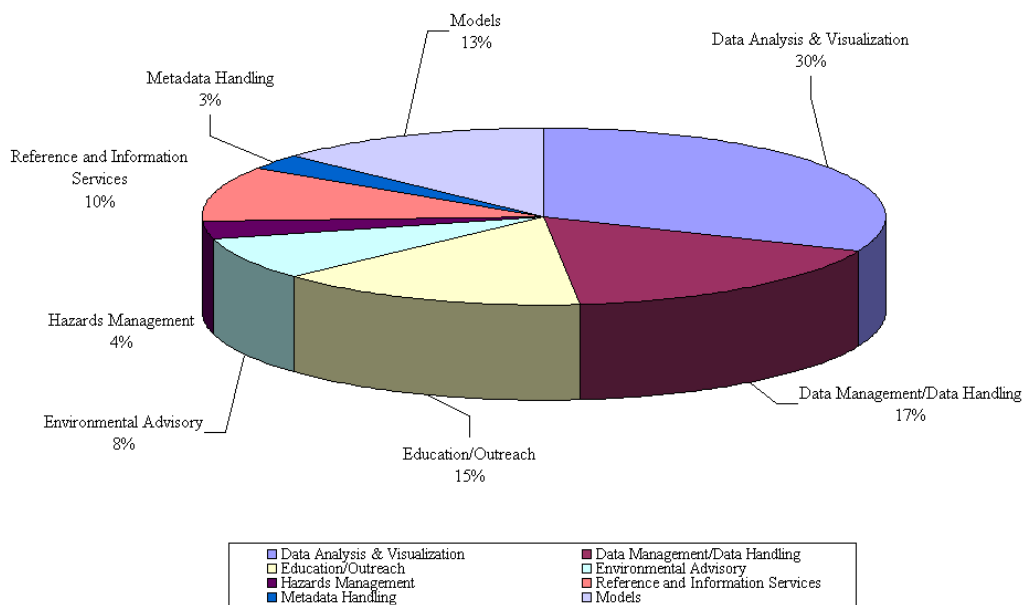


Figure 8. Population of SERFs by Services Topic. The most populated services are represented by Data Analysis & Visualization (30%), Data Management/Data Handling (17%) and Models (13%).

Metadata authoring tools (through docBUILDER) are offered for the creation and modification of DIFs, SERFs, and supplemental information (Data Centers, Projects, Instruments, Platforms). The DIF authoring tools are widely used among NASA's Distributed Active Archive Centers (DAACs). LaRC/ASDC, NSIDC, GES DAAC, MSFC/GHRC, SEDAC, and PODAAC regularly send all their new and modified DIFs using the tools. The DAACs have also contributed new and revised SERFs using the docBUILDER tools. In total, the DAACs contributed 83 new DIFs and 27 new SERFs to the GCMD in 2005.

Several of the Federation's Earth Science Information Partners (ESIPs) have provided DIFs and SERFs using the metadata authoring tools. The University of New Hampshire (EOSWEBSTER), and DODS/OPeNDAP were the most active contributors during the year. In total, the non-DAAC Type 1, Type 2, and 3 ESIPs contributed 147 new DIFs and 112 new SERFs.

The GCMD mission includes providing links to data sets. At the end of 2005, the GCMD provided 88,500 links to data sets and information within the DIF and SERF metadata - up from 70,866 in 2004, and an additional 6,114 links from within supplemental descriptions (instruments, platforms, projects, data centers) and over 1,000 links to web resources on the Earth Science pointers page.

The Global Change Conference Calendar currently contains 1,476 conference listings. During 2005, 224 new conferences were added, and 15 were updated.

B. GCMD Web Usage

Usage, as measured by the number of unique hosts for 2005 was up dramatically - by over 60% from 308,388 to 494,209 unique hosts, reflecting the increased usage related to metadata "harvesting" by internet search engines such as Google. The number of "hits" on the GCMD web site climbed from 31,018,492 in 2004 to 62,381,810 in 2005. User web sessions continue to show a remarkable "academic year"-like pattern of low activity during the summer and winter holidays. The following series of tables and charts compares 2004 to 2005 for:

- Distribution of unique hosts (US and international)
- Hits on the web site
- Search and retrieval from free-text and controlled keyword interfaces

U.S. UNIQUE HOSTS	2004	2005	%CHANGE
.gov	5,149	7,656	+48.7%
.edu	19,618	27,975	+42.6%
.org	2,459	4,254	+73.0%
.com	51,580	82,355	+59.7%
.net	74,108	133,227	+79.8%
.mil	1,971	3,477	+76.4%
.us	2,995	4,907	+63.8%
Numerical	77,866	118,578	+52.3%
HITS	31,018,492	62,381,810	+101.1%

Table 4. Usage by unique hosts from U.S. domains.

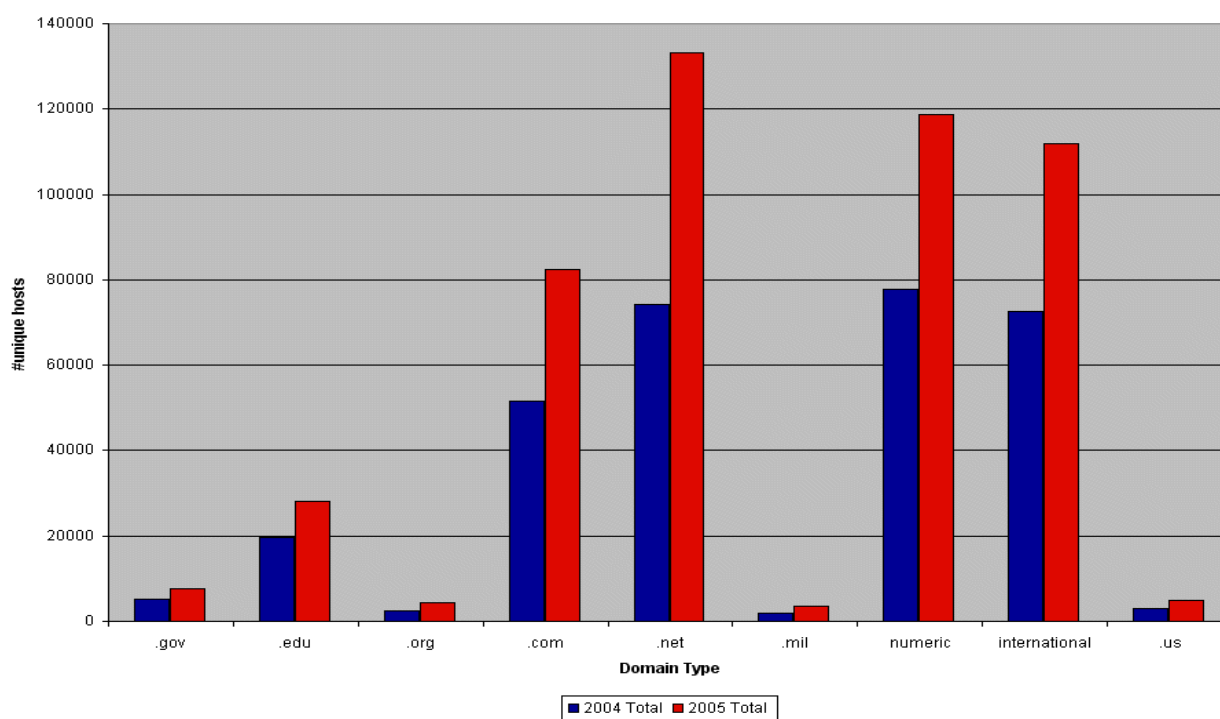


Figure 9. GCMD web usage in 2005 as measured by the number of unique hosts by domain type compared to 2004. Note the increase in usage across all domains in 2005.

INTERNATIONAL HOSTS	2004	2005	%CHANGE
All International hosts	72,641	111,780	+53.9%
.it (Italy)	4,684	7,394	+57.8%
.jp (Japan)	4,139	5,613	+35.6%
.fr (France)	3,959	5,702	+44.0%
.de (Germany)	4,316	6,777	+57.0%
.uk (United Kingdom)	6,115	10,160	+66.1%
.ar (Argentina)	928	1,568	+68.9%
.ca (Canada)	7,480	10,355	+38.4%
.br (Brazil)	1,830	3,534	+93.1%
.nz (New Zealand)	1,067	1,625	+52.3%
.ru (Russia)	687	1,228	+78.7%
.au (Australia)	6,393	8,474	+32.5%
Other International	31,043	49,340	+58.9%
All Unique HOSTS	308,388	494,209	+60.2%

Table 5. Usage by unique hosts from international domains.

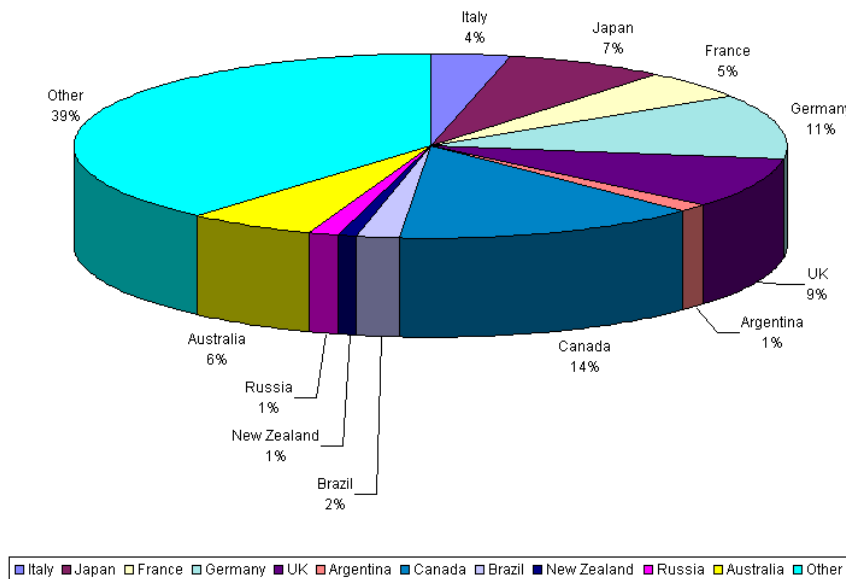


Figure 10. Percentage of international users accessing the GCMD web site.

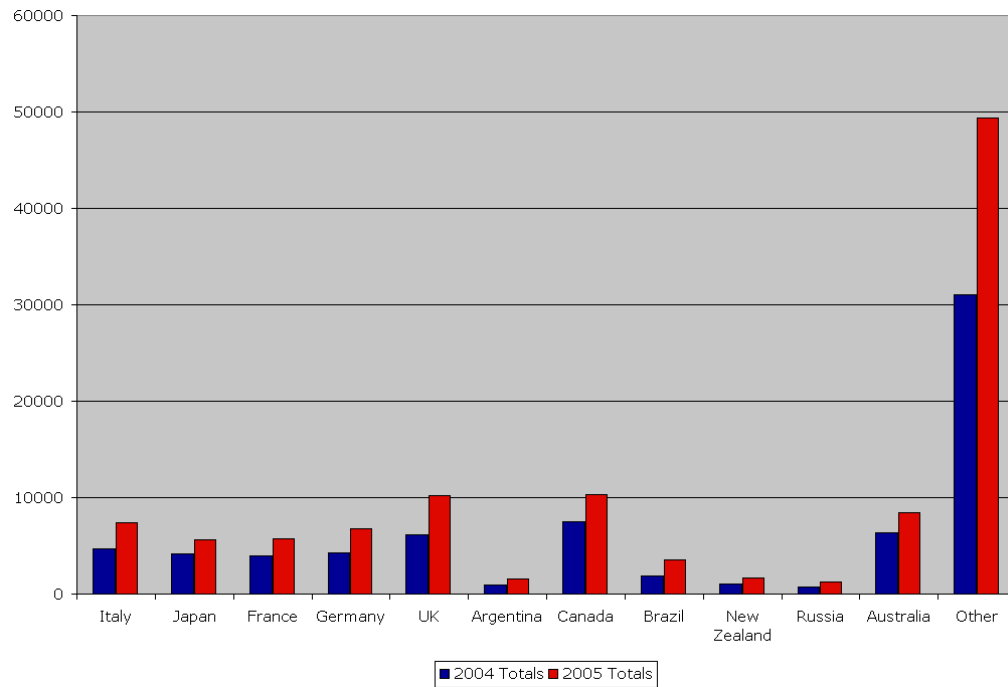


Figure 11. Comparison of international usage in 2004 (blue) with 2005 (red).

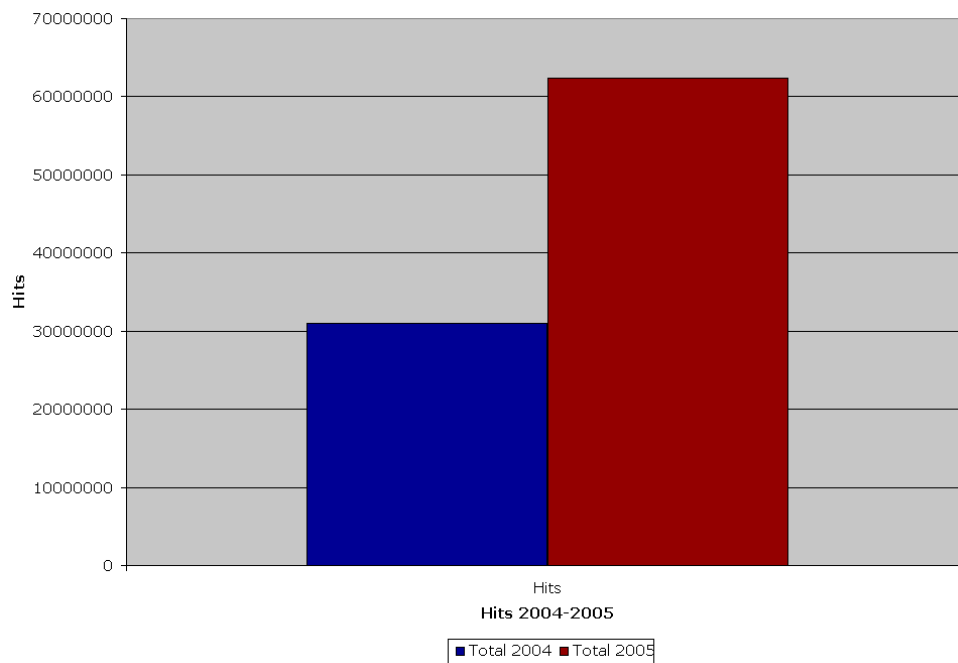


Figure 12. GCMD web hits in 2004 (blue) compared to 2005 (red). Usage increased significantly due to the exposure of GCMD to Internet search engine robots.

C. Search and Retrieval from free-text and keyword interfaces

The following tables and charts show the number of actual searches and retrieval of DIF and SERF content. Overall, there seem to be fewer searches in 2005 vs. 2004, however, there are many more retrievals of DIFs and SERFs, perhaps due to the increased access and indexing by Internet search robots. With the exception of the GSFC DAAC, retrievals from non-GCMD interfaces have declined (Table 9), most notably by retrievals from the EDG.

INTERFACE	2004	2005	%CHANGE
Search: Free-Text	47,964	32,834	-31.5
Retrieval: Free-Text	25,842	19,385	-25.0%
Retrieval: Supplemental	181,170	30,109	-83.4%

Table 6. Number of DIF free-text searches and retrievals using Lucene.

KEYWORD	2004	2005	%CHANGE
Search: Keyword	115,607	352,640	+205.0%
Retrieval: Keyword	171,947	1,126,914	+555.4%
Search: Portal Keywords	35,325	42,032	+18.9%
Retrieval: Portal Keywords	72,754	27,896	-61.6%

Table 7. Number of controlled keyword searches from the GCMD keyword interfaces.

TOTAL	2004	2005	%CHANGE
Search: SERF	35,017	32,699	-6.6%
Retrieval: SERF	28,041	54,274	+93.5%

Table 8. Number of SERF searches and retrievals from controlled keyword interfaces.

NON-GCMD RETRIEVALS	2004	2005	%CHANGE
EOSDIS Data Gateway (EDG)	163	27	-83.4%
USGS	151	146	-3.3%
GSFC DAAC	10,878	14,952	+37.4%
OTHER	76,461	24,136	-68.4%

Table 9. Number of retrievals from non-GCMD interfaces. For example, the GSFC DAAC has direct links to retrieve specific DAAC DIFs from the DAAC web site.

TOTAL RETRIEVALS	2004	2005	%CHANGE
Retrievals: ALL SOURCES	424,204	1,224,756	+188.7%

Table 10. Total DIF retrievals from all interfaces.

PARAMETER SEARCHES	SEARCHES CONDUCTED	%OF TOTAL SEARCHES
Agriculture	23,875	8.7%
Atmosphere	37,191	13.5%
Biosphere	17,241	6.3%
Climate Indicators	24,753	9.0%
Cryosphere	9,196	3.3%
Human Dimensions	18,754	6.8%
Hydrosphere	14,007	5.1%
Land Surface	40,512	14.7%
Oceans	42,623	15.5%
Paleoclimate	10,931	3.9%
Spectral/Engineering	7,531	2.7%
Sun-Earth Interactions	10,087	3.7%
Solid Earth	17,752	6.5%
Locations	22,899	8.3%
Platforms	7,515	2.7%
Instruments	12,383	4.5%
Projects	11,262	4.1%
Data Centers	24,148	8.8%

Table 11. Number of searches conducted by Earth Science Topic and the percent of the total keyword searches.

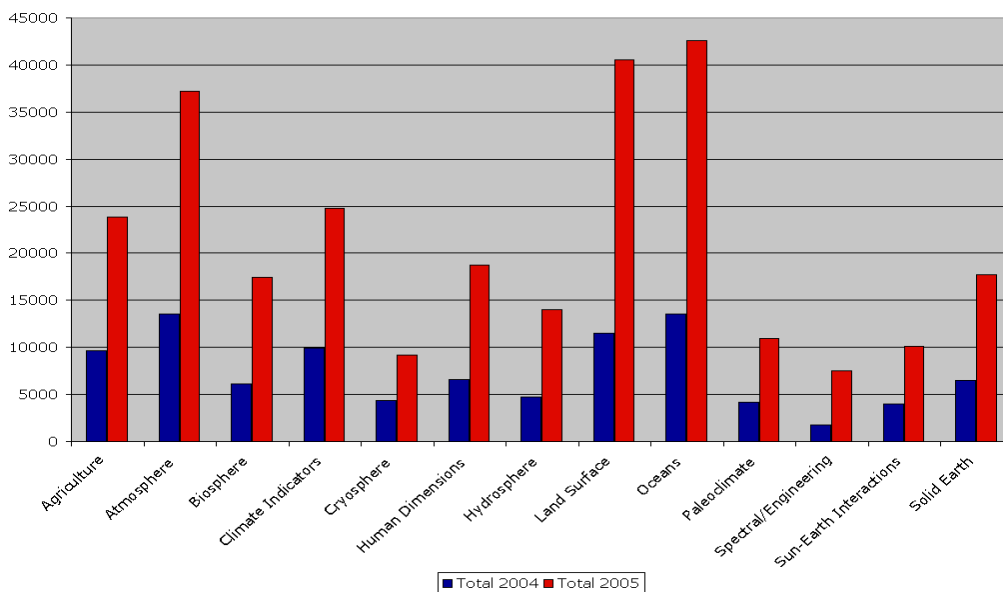


Figure 13. Comparison of Earth science topic searches from 2004 (blue) with 2005 (red).

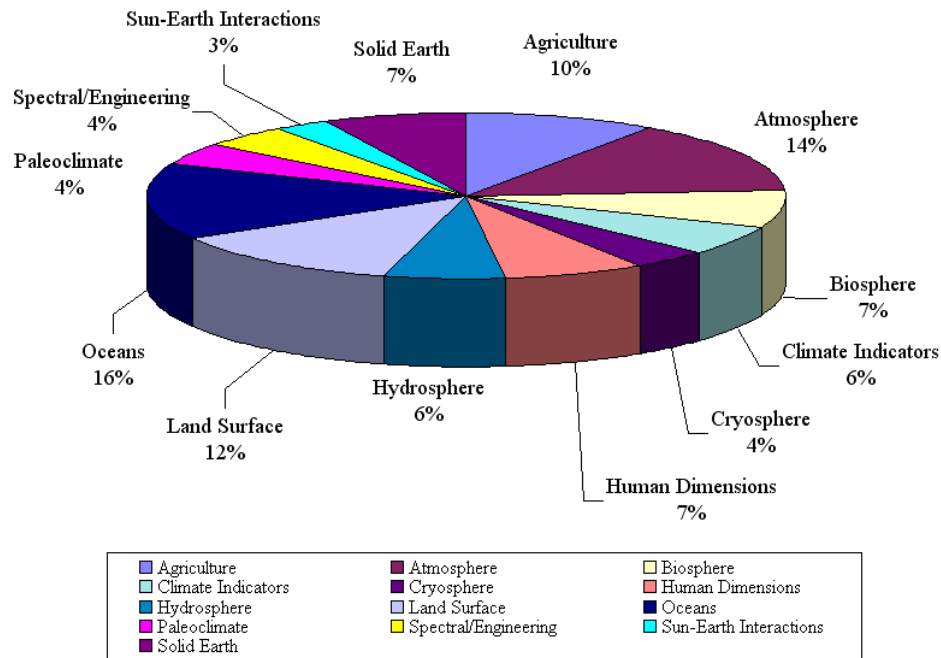


Figure 14. Percentage of Earth science keyword searches by Earth science topic. Atmosphere and Ocean topics record the most searches (14% and 16%, respectively).

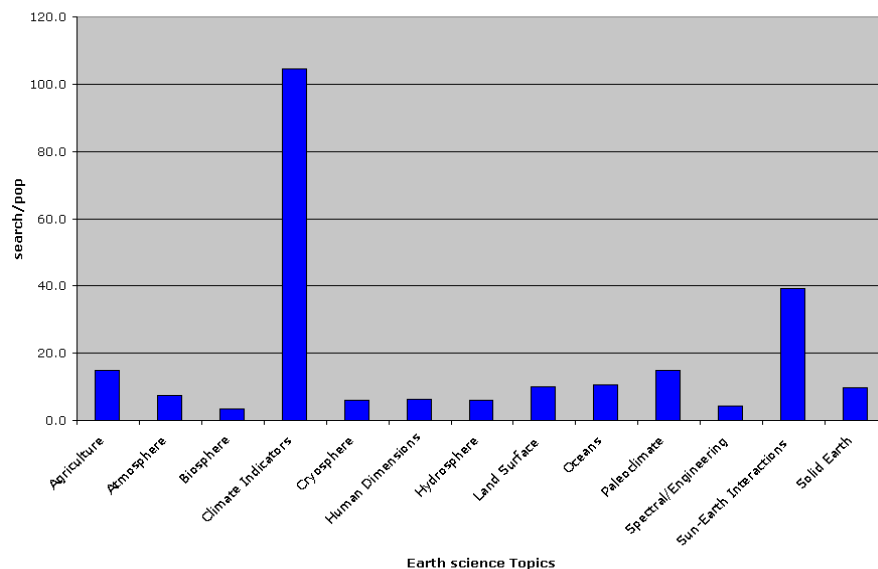


Figure 15. Searches as a function of science topic population in 2005. The search/population index shows that “Climate Indicators” had the highest number of searches relative to the number of DIFs in the database. In contrast, “Biosphere” had the lowest number of searches relative to the number of Biosphere DIFs.

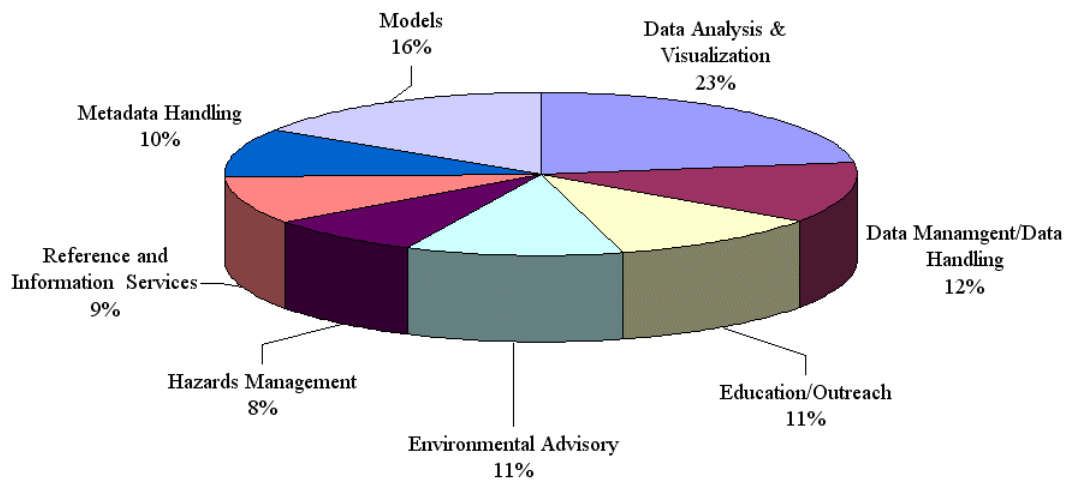


Figure 16. Percentage of keyword searches by Earth science service topic. Data Analysis and Visualization is the most searched topic at 25%.

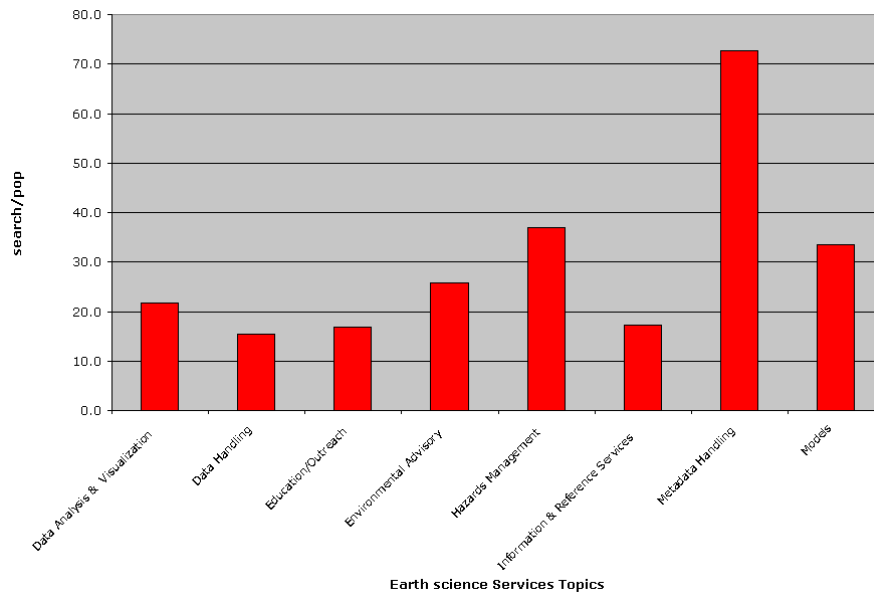


Figure 17. Searches as a function of Services Topic population. The search/population index shows that “Metadata Handling” had the highest number of searches relative to the number of SERFs in the database. In contrast, “Data Handling” had the lowest number of searches relative to the number of Data Handling SERFs.

D. User Feedback and User Support

Staff received and answered 353 user support questions during 2005 - more than double the number of questions received and answered in 2004 (151). Users ask a variety of questions pertaining to atmospheric or climate topics, remote sensing, global change, research topics, and questions about the GCMD's software and its capabilities.

User questions in 2005

212 Questions from Researchers and Scientists

104 Questions from Students and Educators

12 Questions from Commercial Organizations

25 Questions from the General Public

Sample questions received in 2005

Initial Date of Request: January 6, 2005

Mark Gonzales: "My son had heard the earthquake in Indonesia had cause the earth to shift on its axes is this true?"

Staff Response: We recently put an article related to this effect of the Earthquake on the Earth's Rotation on our site, located here "What's New" Earth Science and Climate Change News. It is now in the archived News. Here is the address:

http://gcmd.nasa.gov/Resources/pointers/weblights_archive/weblights_December2004.html

Article was written on Dec. 27th, 2004, <http://www.slate.com/Default.aspx?id=2111443>

Also, please see, Media contacts if you wish to investigate further:

http://www.jpl.nasa.gov/news/media_contacts.cfm

Please also see:

<http://www.cnn.com/2004/TECH/science/12/29/quake.wobble.reut/>

Initial Date of Request: March 8, 2005

Jeff Berg: "I am researching cloud data over Lake Kinneret, Israel, also known as the Sea of Galilee, for a marine sciences professor here at Texas A&M at Galveston and am having difficulties accumulating such data. Any help or redirection is greatly appreciated."

Staff Response: I can suggest 3 courses of action.

1) Use the MM5 forecasts, available from the ISA-MEIDA site

(<http://www.nasa.proj.ac.il/MM5-overview.html>) as proxies for observations

2) Contact the Israel Oceanographic and Limnological Research

(<http://www.ocean.org.il/>) or perhaps directly the Kinneret Limnological Laboratory

(<http://marine.ocean.org.il/goto.dbm?URL=KLL>), and ask them for cloud data.

3) Contact the Israel Meteorological Service

(<http://www.ims.gov.il/index.htm>) and ask for data from one of their stations close to the Kinneret.

Subsequent Response from User: Sorry this response took a while for I received a brief break from the research and am once again gathering data. Thank you very much for your help regarding the Israel cloud data.

Initial Date of Request: March 11, 2005

Valerie Grant: "I was just wondering if you had any insight as to some informative websites regarding specifics about the 2004 Hurricane Season in the Atlantic. I am writing an essay on this topic, so any guidance would be greatly appreciated."

Staff Response: Please check out these two links. These should help you get

started on your essay:

Charts plotting the 2004 Hurricanes

<http://weather.unisys.com/hurricane/index.html>

The Federal Emergency Management Agency 2004 Hurricane Review

<http://www.fema.gov/emanagers/2004/nat112804.shtm>

Initial Date of Request: March 14, 2005

Dr. Margaret Turnbull: User wanted information on ground reflectance as seen by satellite.

Staff Response: Have you investigated using the MODIS instrument Surface Reflectance data?

from the Land Processes Distributed Active Archive Center (LP DAAC)? The LP DAAC offers TERRA and AQUA Satellite MODIS instrument global surface reflectance data with 250m, 500m, and 1 Km resolutions. The data is in HDF-EOS format, but there are various tools available to translate HDF to ASCII.

You can view and order the datasets via this link:

<http://lpdaac.usgs.gov/modis/dataproducts.asp>

These are the datasets:

Surface Reflectance Daily L3 Global 0.05Deg CMG

Surface Reflectance 8-Day L3 Global 500m

Surface Reflectance Daily L2G Global 500m

Surface Reflectance Daily L2G Global 250m

Surface Reflectance Quality Daily L2G Global 1km

Surface Reflectance 8-Day L3 Global 250m

You might also find the Global Land Cover Characteristics database interesting.

<http://lpdaac.usgs.gov/glcc/glcc.asp>

Tools for translating HDF-EOS to ASCII:

<http://hdfeos.gsfc.nasa.gov/hdfeos/softwarelist.cfm>

Subsequent Response from User: Thank you very much for your help! I'll investigate all the leads you gave me, and will let you know either way, if I find what I'm looking for, or not. This is at least helping me get a handle on what is available!

Initial Date of Request: March 15, 2005

Cara Bissell: A researcher asked, "Magnetic Fields occurring naturally on and above the earth's surface. Are there tables of measurements for any geographical area? Are there measurements for various altitudes for a given area? What equipment specifically would permit measurements of the type eluded to above?"

Staff Response: Here's a nice overview of the Earth's magnetic field:

http://www.geomag.bgs.ac.uk/earthmag.html#_Toc2075548

You also asked if there were any measurements that were done geographically. I found this, but I'm not sure if this is what you are looking for:

<http://www.intermargins.org/maps/magnetic.html>

Here is some information on unusual events from the Australian Space Weather

Agency:<http://www.ips.gov.au/Main.php?CatID=8&SecID=3&SecName=Magnetic%20Field&SubSecID=1&SubSecName=Geomagnetic%20Activity>

Please also go here: <http://nssdc.gsfc.nasa.gov/space/model/models/igrf.html>. This is the International Geomagnetic Reference Field (IGRF) model and this page allows you to calculate the geomagnetic field based on geographic coordinates and height.

Subsequent Response from User: Thank you for your answers Stephanie. Your web site listings give me a healthy starting place. I'll be delighted to keep you up to date with whatever I can do with the data and its perceived relevance to my investigation.

VIII. Collaborations

A. Steering Committees

The GCMD project manager serves on the following scientific steering/planning committees:

- Metadata Marine Interoperability (MMI)
- Integrated Ocean Observing System/Data Management and Communications (IOOS/DMAC)
- Global Organization for Earth System Science Portal (GO-ESSP)
- Observation Working Group/Observation Working Group Data and Information System (OWG/OWGDIS) of the Climate Change Science Program (CCSP).
- International Polar Year (IPY)
- Integrated Ocean Drilling Program (IODP)
- EPA Global Earth Observation System of Systems (GEOSS) Coordinating Committee

B. Portals

Many organizations acknowledge the importance of metadata related to their areas of interest but do not have the resources required to manage their content. Portals allow organizations to maintain and document their data without duplicating the effort in creating another online directory. By hosting metadata through a GCMD portal, users can view the virtual subset of interest. Portals help provide science, or application-specific foci for other agencies, science focus groups, consortia, etc.

Using a portal to search a virtual subset is advantageous in that as metadata is added to the portal, it is also available from the GCMD's home page for scientists in other disciplines to search and access. Maintenance and creation of customized free-text and keyword search portals for the science community continued in 2005 – with new 24 portals added. Usage statistics are also regularly tracked and available.

See: http://gcmd.nasa.gov/Data/portal_index.html

- OBIS Europe regional node *created December 2005*
- OBIS Indian Ocean regional node *created December 2005*
- OBIS New Zealand regional node *created December 2005*
- OBIS South America regional node *created December 2005*
- OBIS Sub-Saharan Africa regional node *created December 2005*
- OBIS United States regional node *created December 2005*

Current portals also include:

- Sun-Earth Interactions Data *created December 2004.*
- Sun-Earth Interactions Data Services *created December 2004.*
- Coordinated Enhanced Observing Period (CEOP) *created December 2004.*
- Earth Science Models *created December 2004.*
- Earth Science Information Partners Services *created December 2004.*
- Estonian Antarctic Data Center *created July 2004.*
- NASA Earth Science Enterprise Distributed Active Archive Centers *created July 2004.*
- NASA Geographic Information Systems (GIS) Server Portal *created July 2004.*
- NOAA Operational Model Archive Distribution System (NOMADS) *created May 2004.*
- Socioeconomic Data and Applications Center (SEDAC) *created May 2004.*
- JAXA > Japan Aerospace eXploration Agency (JAXA) *created April 2004.*
- IAI-DIS > Inter-America Institute for Global Change Research - Data and Information System (IAI-DIS) *created April 2004.*
- Japan's National Institute for Polar Research *created February 2004.*
- US Data Centers/US Antarctic Data Coordination Center *created February 2004.*
- Swiss Committee on Polar Research *created November 2003.*
- Canadian Polar Commission/Canadian Committee for Antarctic Research *created October 2003.*
- NASA Geospatial Framework *created September 2003.*
- National Center for Atmospheric Research (NCAR) *created September 2003.*
- Argentina Antarctic Center *created August 2003.*
- NASA GSFC GES Distributed Active Archive Center *created June 2003.*
- Remote Sensing for Conservation *created May 2003.*
- United Nations (UN) Earth Science Data *created April 2003.*
- Finnish Antarctic Program *created January 2003.*
- Belgian Antarctic Program *created January 2003.*
- World Water Forum (WWF) *created January 2003.*
- National Oceanic and Atmospheric Administration (NOAA) *created July 2002.*
- Model Output Data portal *created September 2002.*
- Geographic Information for Sustainable Development (GISD) [a CEOS project] *created June 2002.*
- Climate Variability and Predictability (CLIVAR) [a WCRP project] *created January 2002.*
- Rosenstiel School of Marine and Atmospheric Science (RSMAS) [University of Miami] *created July 2001.*
- World Data Centers (WDC) *created June 2001.*
- Committee on Earth Observation Satellites (CEOS) *created June 2001.*
- Global Ocean Ecosystems Dynamics (GLOBEC) [an IGBP project] *created May 2001.*
- Earth Science Information Partnership (ESIP) *created December 2000.*
- Global Observation of Forest Cover (GOFC) [a CEOS project] *created September 2000.*
- Open-Source Project Network Data Access Protocol (OPeNDAP)/Distributed Oceanographic Data System (DODS) *created August 2000.*
- Joint Committee on Antarctic Data Management/Antarctic Master Directory (JCADM/AMD) *created August 2000.*

- Global Observation System Information Center (GOSIC) including Global Climate, Terrestrial, and Ocean Observing Systems (GCOS, GTOS and GOOS) *created March 2000.*
- U.S. Department of Agriculture (USDA) *created October 1999.*

C. Collaborations and Partnerships

The GCMD is engaged in the following partnerships and collaborations:

Distributed Active Archive Center and National Aeronautics and Space Administration Collaborations:

- EOS Clearinghouse
- Software Reuse Group
- User Services Working Group
- Goddard Distributed Active Archive Center
- Physical Oceanography and Distributed Active Archive Center
- National Aeronautics and Space Administration Stennis
- National Aeronautics and Space Administration Langley Research Center
- Land Processes and Distributed Active Archive Center
- Oak Ridge National Laboratory and Distributed Active Archive Center
- Socioeconomic Data and Applications Center
- Alaska SAR Facility and Distributed Active Archive Center
- National Aeronautics and Space Administration/MSFC GHRC
- National Snow and Ice Data Center and Distributed Active Archive Center
- EOS Data and Information System Outreach
- National Aeronautics and Space Administration Geospatial Interoperability Office
- Earth Science Information Partner Federation

Geospatial Collaborations:

- Geospatial One-Stop
- Federal Geographic Data Clearinghouse

National Oceanic and Atmospheric Administration Collaborations:

- National Oceanic and Atmospheric Administration/North Pacific Marine Science Organization
- National Oceanic and Atmospheric Administration /National Oceanographic Data Center
- National Oceanic and Atmospheric Administration /National Geophysical Data Center
- National Oceanic and Atmospheric Administration /Coastal Services Center National Oceanic and Atmospheric Administration /National Climatic Data Center
- National Oceanic and Atmospheric Administration /WDC Paleoclimatology

Ocean Collaborations:

- Integrated Ocean Observation System/Data Management and Communications
- Ocean Biogeographic Information System and Gulf of Maine Ocean Observing System
- Gulf of Maine Ocean Data Partnership
- Global Ocean Ecosystems Dynamics RSMAS
- Marine Metadata Interoperability
- Open-source Project for a Network Data Access Protocol
- Canada Department of Fisheries and Oceans
- European Directory of Marine Environmental Data/British Oceanographic Data Centre
- Fleet Numerical Meteorology and Oceanography Center/ Global Ocean Data Assimilation Experiment

Polar Collaborations:

- Joint Committee on Antarctic Data Management
- National Snow and Ice Data Center
- International Polar Year

International Directory Network Collaborations:

- Catalog Interoperability (CIP)
- Data Services Task Team (DSTT)

IDN Organizations	
European Space Agency (ESA)	Canada Centre for Remote Sensing (CCRS)
Global Change Information and Research Center/China	Institute of Radio-engineering and Electronics (RAS), Russia
Remote Sensing Satellite Ground Station/Chinese Academy of Sciences (RSGS)	British National Space Centre (BNSC)
NOAA/NESDIS National Geophysical Data Center (NGDC)	Geo-Informatics and Space Technology Development Agency (GISTDA), Thailand
U.S. Geological Survey/EROS (USGS)	ESYS
Research School of Earth Sciences, Australian National University	Keio University, Japan
Centre National d'Etudes spatiales (CNES)	Comision Nacional de Actividades Espaciales (CONAE)
Remote Sensing Technology Center/Japan (RESTEC)	Instituto Nacional de Pesquisas Espaciais (INPE)
Japan Aerospace Exploration Agency (JAXA)	United Nations Environment Program (UNEP)

Table 11. Organizations associated with the International Directory Network (IDN).

Other Collaborations:

- Global Observing Systems Information Center (GCOS, GTOS, GOOS)
- Global Organization for Earth System Science Portal (GEOSS)
- National Environment Research Council DataGrid
- InPerspective
- WEBSTER/ Earth Science Information Partners
- Digital Library for Earth Science Education (DLESE)
- Coordinated Enhanced Observing Period (CEOP)
- National Biological Information Infrastructure (NBII)
- The National Center for Atmospheric Research (NCAR)

New Collaborations in 2005**Geospatial One-Stop**

The GCMD provides NASA metadata to the Geospatial One-Stop (GOS) portal through the Z39.50 harvesting protocol (currently 2,440 metadata records related to NASA data). This provides the capability for users to search NASA metadata through the GOS portal at <http://www.geodata.gov>. The GCMD also provides metadata on NASA missions (currently 31 records), which reference existing and planned Earth observation satellite platforms. This work is being done as part of the U.S. Office of Management and Budget (OMB) E-government initiative that allows for improved access to geospatial information.

Gulf of Maine Ocean Data Partnership



The purpose of the Gulf of Maine Ocean Data Partnership (GoMODP, <http://www.gomodp.org/>) is “to promote and coordinate the sharing, linking, electronic dissemination, and use of data on the Gulf of Maine region”. The participants have decided that a “coordinated effort is needed to enable users throughout the Gulf of Maine region and beyond to discover and put to use the vast and growing quantities of data in their respective databases”. GoMODP members invited the GCMD staff to discuss further collaborations in view of this effort during the Metadata Training Workshop in October and the Partnership Meeting in December of 2005. The partnership requested a GoMODP portal (<http://gcmd.nasa.gov/portals/gomodp/>) in the Fall of 2005 to increase the visibility of their data holding throughout the Gulf of Maine region and beyond. As of December 2005, the GoMODP holds 114 records from 28 data centers and 24 projects. Metadata from the Gulf of Maine Ocean Observing System (GoMOOS) can be found in the GoMODP portal.

International Polar Year (IPY)



With the beginning of the International Polar Year (2007/2008) nearly a year away, the GCMD is participating in a worldwide effort in the data and information management of IPY. The directory submitted an Expression of Intent (EoI) for an IPY Metadata and Information Portal Network for the Data and Information Service (DIS). EoIs can be searched on the IPY website at <http://www.ipy.org/development/eoi/index.htm>. The GCMD EoI along with other related EoIs were brought together under the IPY DIS for Distributed Data Management full proposal. The GCMD anticipates contributing to the design of the data management system for IPY and to the ongoing efforts in the years to come. The JCADM/AMD contribution is expected to play a key role in IPY.

Marine Metadata Interoperability (MMI)



The GCMD is collaborating with the Marine Metadata Interoperability (MMI) project, a community effort aimed at making marine science data sets easier to find, access, and use. Scientists and data managers can find valuable information about data management and metadata policies on the MMI website. The GCMD contributes by sharing its extensive list of keywords and metadata expertise with the community. Staff attended a MMI workshop in Boulder, Colorado in August of 2005. The workshop focused on developing mappings between existing marine metadata vocabularies, and making those mapped vocabularies available to users via web services. The GCMD has been involved with MMI for many years and continues to support MMI activities by sharing experiences and knowledge related to metadata.

National Antarctic Data Centers (NADCs)



A listing of all NADC portals is located at http://gcmd.nasa.gov/Data/portals/amd/nadc_portals.html. Seven new NADC portals were added in 2005 for the following countries: Chile, France, Italy, Malaysia, New Zealand, Spain, and Uruguay. In 2005, the GCMD staff attended the JCADM-9 meeting in Buenos Aires, Argentina, where several presentations were made to highlight new features of the AMD.

Ocean Biogeographic Information System (OBIS)



The Ocean Biogeographic Information System (OBIS, <http://www.iobis.org/>) is the information component of the Census of Marine Life (CoML). It is a web-based provider of global geo-referenced information on marine species. Marine species data collections from all of the world's oceans can be discovered through the OBIS portal at <http://gcmd.nasa.gov/portals/obis/>. The portal is intended to follow the JCADM AMD model, with 10 OBIS regional portals as of February 29th, 2005. GCMD staff members are working with the OBIS community to help manage and enrich OBIS discovery metadata. The OBIS community continues to make extensive use of the GCMD metadata tools and has provided valuable user feedback. In the future, we hope to incorporate the OBIS taxonomy discovery vocabularies into the GCMD keyword hierarchy.

Highlights of Ongoing Collaborations for 2005

Antarctic Master Directory/Joint Committee on Antarctic Data Management (AMD/JCADM)

The Antarctic Master Directory (AMD) is an effort coordinated with the Joint Committee Antarctic Data Management (JCADM) to offer Antarctic data collected by researchers from 30 of the Antarctic Treaty countries. Data may be searched through the AMD portal, which was first created in 2001 and is located at: <http://gcmd.nasa.gov/Data/portals/amd/>. The AMD receives broad exposure, with over 10,000 search hits for the year 2005. As of February 1st 2006, the portal holds over 3,800 records, a 25% growth from last year. The growth can be attributed to the continued involvement by existing National Antarctic Data Centers (NADCs) and the implementation of new NADCs. A listing of all NADC portals is located at http://gcmd.nasa.gov/Data/portals/amd/nadc_portals.html. Seven new NADC portals were added in 2005 for the following countries: Chile, France, Italy, Malaysia, New Zealand, Spain, and Uruguay. A small set of the European Directory of Marine Environmental Datasets (EDMED) ISO metadata was provided to the GCMD by the French Polar Institut (IPEV) and included into the AMD in the summer of 2005. A customized EDMED ISO to DIF XSLT stylesheet was created by the GCMD staff. Additional EDMED southern ocean entries (90+) in the AMD are expected in 2006. The GCMD staff has also worked closely with the Australian Antarctic Data Center (AADC) in updating software and metadata. In 2005, the GCMD staff attended the

JCADM-9 meeting in Buenos Aires, Argentina, where several presentations were made to highlight new features of the AMD.

Earth Science Information Partners (ESIP)

The Federation of Earth Science Information Partners (ESIP) added 147 new DIFs and 112 new SERFs in 2005 for a total of 4388 DIFs and 330 SERFs in the GCMD, nearly 25% of the total GCMD database. The GCMD was elected as a formal member of the ESIP Federation in 2005 and is represented on the ESIP Information and Technology subcommittee, the Products and Services subcommittee, and the Education/Outreach cluster.

Global Data Assimilation Experiment (GODAE)

In response to the increasing demand for an efficient, comprehensive, integrated observing system for monitoring the global ocean, the GCMD is collaborating with the Global Data Assimilation Experiment (GODAE) to ensure the long-term discovery, access, and exchange of global ocean products, state-of-the art ocean models and assimilation products. With the end of the operational demonstration phase (2003-2005) approaching, an increasing new generation of ocean products (in-situ and remote sensing data) and forecasts, ranging from regional and global short-range forecasts to high-resolution estimates of ocean climate are now available to the public. These ocean data sets can be accessed through the US GODAE Monterey Server (<http://www.usgodae.org/>), and through the European GODAE MERSEA web site (<http://strand1.mersea.eu.org/html/strand1/welcome.html>). The GCMD is working with these organizations to host the metadata from all GODAE participants. Currently, over 40 GODAE related dataset records are available through the GCMD.

Global Organization for Earth System Science Portal (GO-ESSP)

Staff attended the Global Organization for Earth System Science Portal (GO-ESSP, <http://go-essp.gfdl.noaa.gov/>) meeting in England on June 6-8 at the British Atmospheric Data Center and delivered a presentation on the interoperability of the GCMD. GO-ESSP members have drafted a numerical model metadata schema extension to the DIF.

Global Observing System Information Center/Global Terrestrial Observing System (GOSIC/GTOS)

GOSIC and GCMD staff met on August 8, 2005 to discuss GCMD-GOSIC coordination. Topics covered at the meeting were the GTOS matrix links to the GOSIC portal (using Lucene), notification of GCMD keyword change updates, and adding additional Terrestrial Ecosystem Monitoring Sites (TEMS) topics to the GTOS matrix. Following the meeting the GTOS matrix links to the GCMD were restructured to produce more accurate results of GOSIC metadata in the GCMD.

International Oceanographic Data and Information Exchange (IODE)

As part of the major, long-term commitment of the International Oceanographic Data and Information Exchange (IODE) Program to preserve the long-term accessibility of present and future oceanographic data, metadata and information, the GCMD is currently featured within the Ocean Portal (<http://www.oceanportal.org/>), a high-level directory of ocean data and information related web sites. The objective of the ocean portal is to assist scientists and other ocean experts in locating data and information. As part of the IOC/IODE network, the GCMD also hosts the Global Ocean Observing System (GOOS) dataset records. A representative from the GCMD attended the IODE XVIII meeting in Ostend, Belgium in the Spring of 2005, where the official inauguration of the Intergovernmental Oceanographic Commission (IOC) Project Office for IODE took place. Meeting notes and proceedings are available online at <http://iode.org/>. The GCMD also attended the International Data and Information Systems Conference (IMDIS, <http://www.ifremer.fr/imdis/>) in 2005, which was organized by IFREMER (France) with the support of IOC.

Integrated Ocean Observing System/Data Management and Communications (IOOS/DMAC)

The [Data Management and Communications](#) (DMAC) subsystem will combine all of the global and coastal components of the sustained Integrated Ocean Observing System (IOOS), and link every part of the observing system from the instruments to the users. Project Manager has been serving on the IOOS DMAC Steering Committee, which meets by telecon on alternate Wednesdays. Communications are accomplished through a wiki site. Currently, the group is assessing the value and usability of metadata formats and standard keyword lists.

National Center for Atmospheric Research (NCAR)

The total NCAR metadata collection in the GCMD dropped to 422 DIFs in 2005 (a loss of about 20). This was a result of DIFs being deleted due to data sets expiring and several consolidations of DIFs (redundant or duplicate). During the summer of 2005, the harvesting of metadata from NCAR's OAI-PMH server to the GCMD and vice versa was tested. The results of the testing indicate that the metadata transfer mechanism was sound. The major hurdle is incompatible keywords between systems. Other issues discovered include foreign characters in the metadata and XML schema validation errors.

National Oceanographic and Atmospheric Administration (NOAA)

In August 2005 a complete import of the NOAA/NCDC metadata from the NOAA Metadata Managers Repository to the GCMD was performed. This resulted in a count of 455 NCDC metadata documents in the GCMD. This import brought 20 new and 192 updates. In the future, we hope to convince NOAA to use the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH). This will increase the efficiency of harvests and result in monthly imports rather than twice a year.

In the summer of 2005, members of the GCMD staff met with NOAA/NODC representatives to discuss the sharing of AVHRR Pathfinder and GODAE High Resolution SST (GHRSSST) metadata. NODC maintains the long-term archive and works with the NASA JPL/Caltech Physical Oceanography Distributed Active Archive Center (PO.DAAC) Global Data Assembly Center (GDAC, <http://ghrsst.jpl.nasa.gov/>) to provide stewardship of the GHRSSST data sets. The GCMD obtained high quality AVHRR Pathfinder SST FGDC metadata from NOAA/NODC. A customized XSLT stylesheet was created for XML translation. This small set of metadata (102 documents) will serve as a testbed for further GCMD-NODC collaborations.

USGS/Biological Resources Division (BRD)

The following metadata (records) were provided to the USGS/BRD National Biological Information Infrastructure (NBII) in 2005:

Southern Fire Portal - 95
Roost Survey and Habitat Requirements - 1
Northern Prairie Wildlife Research Center (NPWRC) - 8
Patuxent Wildlife Research Center (PWRC) - 1
Southwest Information Node - 1
Millenium - 39
California Information Node - 3
University of Alaska - 25
Gulf Coast States - 4
Montana State University - Whirling Disease Project - 3
Imperiled Species Project - 1
Rocky Mountain Science Center - 2

Climate and Cryosphere Project (CLIC)

The Climate and Cryosphere Project (CLiC) was established by the World Climate Research Programme (WCRP) in March 2000. In 2004, the Scientific Committee on Antarctic Research (SCAR) became a co-sponsor of the project. CLiC launched its Data and Information Service (DISC) in the fall of 2004. Datasets related to the cryosphere can be searched through their online metadata catalog at http://clic.npolar.no/disc/disc_datasets.php?datasetsa=1, which are harvested automatically from the GCMD on a weekly basis. As of December 2005, there are 1936 unique cryosphere related datasets.

Global Ocean Ecosystems Dynamic Program (GLOBEC)

Collaborations with the Global Ocean Ecosystems Dynamic Program (GLOBEC) community have continued. The main contribution has been from the U.S. GLOBEC program. The U.S. GLOBEC Program currently has major research efforts underway in the Georges Bank/Northwest Atlantic Region, the Northeast Pacific (with components in the California Current and in the Coastal Gulf of Alaska) and the Southern Ocean. Metadata from the Southern Ocean contributes to the AMD, while records from the Georges Bank can be found in both the GLOBEC and GoMODP portals. Partners involved in the U.S. GLOBEC program have been

very active at providing new and updated metadata to the directory. The project has continued to promote their portal by featuring the GCMD within their website (GLOBEC Metadata Inventory: <http://www.pml.ac.uk/globec/data/metadata.htm>).

IX. Standards

A. GCMD Controlled Science Keywords.

Although it is unclear how many groups use the GCMD science keywords, the following list illustrates the diversity of Earth science organizations that are currently reporting their usage.

Organizations known to use the GCMD controlled science keywords:

NASA organizations

EOSDIS Data Gateway (EDG)

EOSDIS Core System (ECS)

Eos ClearingHouse (ECHO)

NASA's Visible Earth

NASA Taxonomy (JPL)

Semantic Web for Earth Science Technologies (SWEET)

NASA Stennis

Open-source Project for a Network Data Access Protocol (OPeNDAP) (formally known as the Distributed Oceanographic Data System (DODS))

Program for Climate Model Diagnosis and Intercomparison, Lawrence Livermore National Laboratory (PCMDI)

NOAA Organizations

NOAA (used in NOAA FGDC records as the thesauri keywords)

Mermaid (NOAA/NODC)

CORIS (NOAA Coastal Reef Information System)

CEOS

Catalogue Interoperability Protocol (CIP/CEOS)

CCRS/GeoConnections

INformation on Earth Observations (INFEO)

Other Federal Agency/Funded Organizations

Federal Geographic Data Clearinghouse (FGDC)

Mercury/Beja Flor (ORNL)

Digital Library for Earth Science Education (DLESE) (acknowledges GCMD as a resource when constructing high-level DLESE controlled vocabulary)

Marine Metadata Interoperability (MMI)

Universities

U. California Natural Reserve System

Drexel University (hydrology ontologies)

International/national organizations

AGU Cryosphere keywords (Larry Hinzman)

GOSIC (Global Observing System Information System)

MEDI (Marine Environmental Data Inventory)

BENguela Environment Fisheries Interaction and Training; South Africa (BENEFIT)

Neptune (Australia National Oceans Office)
National Environment Research Council, UK (NERC)
European Directory of the Initial Ocean-observing System (EDIOS)
Marine Environmental Data Services Branch, Canadian Fisheries and Oceans
Australian Antarctic Data Center (AADC)
British Antarctic Survey (BAS) Discovery Metadata System
Climate and Cryosphere (CliC)
Intergovernmental Oceanographic Commission/International Oceanographic Data and Information Exchange (IOC/IODE) Ocean Portal
IOC/IODE Ocean Teacher
Meta-Door (Caro-COOPS)

Commercial Organizations
Geomatics@geoarctic.com

During 2005, the following keyword additions and modifications were made:

New/Modified Science Keywords:

- Added 2 new TERMS
- Added 45 new Variables and updated 5 Variables
- Currently (2005): 13 Earth science Topics, 119 Terms and 969 Variables

New/Modified Services Keywords:

- Added 2 new Variables.
- Currently (2005): 8 Topics, 44 Terms and 60 Services Variables

B. Metadata Formats at GCMD

The Directory Interchange Format (DIF):

<http://gcmd.nasa.gov/User/difguide/difman.html>

The Services Entry Resources Format (SERF):

<http://gcmd.nasa.gov/User/serfguide/index.html>

C. ISO 9001 for configuration control

http://gcmd.nasa.gov/Aboutus/software_docs/config.html

D. CMMI for Software Improvement

In 2005, the GCMD staff began the process of Capability Maturity Model® Integration (CMMI) certification with its contractor organization. CMMI is a process improvement approach that provides organizations with the essential elements of effective processes. The GCMD project was evaluated for two Standard CMMI Appraisal Method for Process Improvement (SCAMPI) benchmarks and will seek to obtain CMMI Level 2 certification in 2006. CMMI is managed by the Carnegie Mellon Software Engineering Institute (SEI).

E. ISO Geospatial Metadata Standard - 19115/TC 211

GCMD representatives continue to monitor the ISO standards. The DIF is compatible with ISO 19115. Metadata information fields were added, the personnel address fields were brought into compliance, and the new ISO Topic Category field was added. A metadata “crosswalk” between

the GCMD DIF and ISO 19115 was created. This crosswalk shows how DIF fields can be mapped to ISO fields to provide greater interoperability between metadata standards.

F. Federal Geographic Data Committee (FGDC) and the Geospatial One Stop

The explicit decision to retain the DIF format for use within the GCMD community, while making all DIF metadata available as FGDC-compliant records, has proven to be an excellent one. This decision has provided the distinct advantage of preserving the validation of metadata through the database – a property not available through the Clearinghouse. It has also allowed NASA to maintain fields critical for the GCMD and Earth science data sets that are not available in FGDC. These fields are considered to be absolutely essential to the NASA mission. They help prevent duplicative entries and assist in the discovery of data sets and include: (1) Entry ID (unique identifier for every data set); (2) Entry Title; (3) Parameters (science keywords essential for "normalization" of the database); (4) Sensor (Instrument); (5) Source (Platform - e.g., a satellite); (6) Minimum/Maximum Altitude and Depth; (7) Temporal Resolution; (8) Project; (9) Data Set Language; (10) Originating Center; (11) Data Center Name (variant); (12) Data Center URL; (13) Multimedia Sample URL; (14) Multimedia Caption; (15) Related URL; (16) IDN Node.

Because FGDC has no formal keyword vocabulary, the GCMD controlled keywords may be used as thematic keywords in Section 1.6.1.1 of the FGDC Content Standard for Digital Geospatial Metadata (CSDGM), where the Theme Keyword Thesaurus allows participants to specify a keyword framework. Organization such as NOAA that make available FGDC-formatted metadata records, use the GCMD Earth science keywords as specified in the Theme Keyword Thesaurus field.

NASA has met the requirements for the Geospatial One-Stop Initiative by providing information on geospatial acquisitions (Earth satellite platforms). See:

<http://gcmd.gsfc.nasa.gov/md/lucene/luceneSearch.html>

The GCMD provided all NASA DIFs and geospatial acquisitions for harvesting by the Geospatial One-Stop portal (<http://geodata.gov>). Because Geospatial One-Stop requires metadata to be in the GOS extension of FGDC, the GCMD has mapped the DIF to the GOS FGDC standard, which is available at http://gcmd.nasa.gov/Aboutus/standards/esri_to_dif.html.

G. National Biological Information Infrastructure (NBII)

The National Biological Information Infrastructure (NBII) (<http://www.nbii.gov>) is a broad, collaborative program to provide increased access to data and information on the nation's biological resources. The NBII uses the Biological Data Profile (BDP) of the Federal Geographic Data Clearinghouse (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM). The collaboration between GCMD and the USGS/BRD (see Collaborations in Section VIII) provides metadata to the NBII in the FGDC/BDP format using the Spatial Metadata Management System (SMMS) tool (an FGDC-compliant metadata editor produced by Intergraph), which contains the NBII Biological Data Profile. Metadata created using the SMMS tool is also converted to DIF for the GCMD.

H. Mapping/Transformation with other metadata standards

The eXtensible Stylesheet Language Transformations (XSLT) is the W3C standard for translating XML documents between one metadata format and another. The DIF conforms to the standards below through the use of XSLT:

- Dublin Core
- Federal Geographic Data Clearinghouse (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM)
- National Biological Information Infrastructure/Biological Data Profile (NBII/BDP)
- ISO 19115/TC 211 Geographic/Geomatics Metadata Standard
- Australia-New Zealand Land Information Council (ANZLIC)
- ESRI Profile (Modified for Geospatial One-Stop) of the Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM)

I. XML Standards

Throughout 2005 extensive revisions and improvements were performed on the eXtensible Stylesheet Language Transformations (XSLT) used to translate Content Standard for Digital Geospatial Metadata (CSDGM) metadata to DIF and vice versa. Additionally these scripts were modified to accommodate variations in the CSDGM standard implemented by data centers. These customizations were developed for GeoConnections Canada, NOAA/NCDC, and NOAA/NODC. XSLT to translate DIF to the ISO-19115 standard and the ECHO Collection Metadata format (and DIF to ECHO) was also completed.

J. Concurrent Versioning System (CVS)

The Concurrent Versioning System is used within the project for software configuration control. CVS will be replaced with the open source system Subversion in 2006.

K. The Zen of Object Publishing Enterprise (ZOPE) Standard

ZOPE, written in Python, is used for internal document management and for the Committee on Earth Observation's (CEOS) International Directory Network (IDN) interactions. Plone is used as a content management system for the Committee on Earth Observations (CEOS) International Directory Network (IDN) website. Plone runs on top of the ZOPE Content Management Framework (CMF).

Plone facilitates easy maintenance of the IDN site. The site's look and feel can be changed in one file and the changes are propagated throughout the site. Content access is easily managed using Plone. Web pages can be published or hidden from the public as needed.

L. OAI/PMH

The GCMD has developed an Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) compliant server for interoperating with its partners. The server permits partners to harvest metadata from the GCMD in any major metadata format using standardized queries. Tests of the server with an NCAR partner during the summer of 2005 were successful.

M. NASA/GSFC Webmaster Standards and Section 508 Compliance

In Fall 2004, NASA presented a new "One NASA" plan, which promoted creating consistent, identifiable NASA websites. The NASA GSFC webmaster site provided tools, information, and templates for converting websites to the "One NASA" design. Other NASA standards and guidelines were addressed by the GSFC Webmaster group. As of October 2005, a new Section 508 of the Rehabilitation Act of 1973 (as amended in 1998); the accessibility plan for reviewing NASA sites, was adopted by GSFC. The Section 508 web accessibility compliance standard (*GPR 2800.1, GSFC Section 508 Web Compliance*) addresses the importance of providing both employees and members of the public with disabilities access to websites. Additional information about 508 compliance guidelines is available online: <http://web508.gsfc.nasa.gov/>.

GCMD adheres to NASA policies and best practices and makes changes to the site as required. GCMD has incorporated the "One NASA" design in March 2005 (release of MD9.4 software). GCMD is making an effort to continually update content on the site to meet 508 compliance guidelines.

N. Conferences, Publications, Invited Lectures in 2005

Meaux, Melanie. "The challenges of interoperable data discovery." Gulf of Maine Data Partnership (GoMODP) Full Partnership Meeting, Portsmouth, New Hampshire, 13 December 2005.

Ritz, Scott, G. Major and L. Olsen. "Streamlining the exchange of metadata through the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH)." American Geophysical Union (AGU) Winter Meeting, San Francisco, CA, 7 December 2005.

Weir, Heather, J. Pollack, G. Major and L. Olsen. "docBUILDER - Building your useful metadata for Earth Science data and Services." American Geophysical Union (AGU) Winter Meeting, San Francisco, CA, 6 December 2005.

Meaux, Melanie. "Increasing the visibility of global ocean data sets through the GLOBEC Metadata Portal: NASA's Global Change Master Directory." Global Ocean Ecosystem Dynamics (GLOBEC) International Newsletter, Volume 11, No. 2. October 2005. <http://www.pml.ac.uk/globec/products/newsletter/newsletter.htm>

Meaux, Melanie. "Online metadata directories: A way of preserving, sharing and discovering scientific information." Gulf of Maine Ocean Data Partnership (GoMODP) Metadata Training Workshop, Gulf of Maine Research Institute, Portland, ME, 19-20 October 2005.

Ritz, Scott. "Learning about the data sets of the DAACs". User Services Working Group (USWG), Washington, D.C., 19 October 2005.

Weir, Heather, G. Major and L. Olsen. "Natural hazard information through NASA's Global Change Master Directory." Geological Society of America (GSA) Annual Meeting, Salt Lake City, UT, 16 October 2005.

Olsen, Lola. "Data discovery worldwide using the Global Change Master Directory." Invited. Computing in Atmospheric Sciences Conference (CAS2K5), Annecy, France, 11-15 September 2005.

Meaux, Melanie. "The Antarctic Master Directory (AMD)." Joint Committee on Antarctic Data Management, JCADM-9, Buenos Aires, Argentina, 12-16 September 2005.

Olsen, Lola. "Committee on Earth Observation Satellites (CEOS) International Directory Network (IDN) Newsletter", Issue 19, August 2005.

Lief, Christina, G. Major and L. Olsen. "Global Observing Systems datasets in the Global Change Master Directory." 2005 ESRI International User Conference, San Diego, CA, 27 July 2005.

Meaux, Melanie. "Edging toward interoperability". 4th Global Organization for Earth System Science Portal (GO-ESSP) Community Workshop, British Atmospheric Data Center (BADC), Rutherford Appleton Laboratory (CCLRC), Chilton, Didcot, England, 6-8 June 2005.

Meaux, Melanie and L. Olsen. "Locating marine data, services and tools through the NASA Global Change Master Directory." International Marine Data and Information Systems (IMDIS) Conference, Brest, France, 31 May - 3 June 2005.

Lief, Christina, L. Olsen, and G. Major. "Global Observing Systems Information Center (GOSIC) dataset information available through NASA's Global Change Master Directory (GCMD)." International Marine Data and Information Systems Conference, Brest, France, 31 May - 3 June 2005.

Meaux, Melanie and L. Olsen. "Pathways to Earth science data and services through NASA's Global Change Master Directory." International Oceanographic Data Exchange (IODE) XVIII, Oostende, Belgium, 25-30 April 2005.

Meaux, Melanie and L. Olsen. "The life cycle of NASA's Global Change Master Directory metadata format - Directory Interchange Format." International Oceanographic Data Exchange (IODE) XVIII, Oostende, Belgium, 25-30 April 2005.

Meaux, Melanie and L. Olsen. "Simplifying the search for ocean data sets and services through NASA's Global Change Master Directory." ASLO 2005 Aquatic Sciences Meeting, Salt Lake City, Utah, 20-25 February 2005.

Olsen, Lola. "Committee on Earth Observation Satellites (CEOS) International Directory Network (IDN) Newsletter", Issue 18, February 2005.

Stevens, Tyler. "Serving NASA's data to the GIS community: An ArcIMS Mapserver example." ESRI Federal User Conference, Washington, D.C., 1-3 February 2005. <http://gis.esri.com/library/userconf/feduc05/docs/pap120.pdf>

Major, Gene, C. Lief, L. Olsen, S. Ritz, G. Servin, and D. White. "Global Observing System Information Center (GOSIC) data set information available through NASA's Global Change Master Directory (GCMD)." American Meteorological Society Annual Meeting, San Diego, CA, January 2005. [Note: paper presented by C. Lief for G. Major].

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