



National Snow and Ice Data Center World Data Center for Glaciology, Boulder



Annual Report 2007

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<http://nsidc.org/annualreport/>

Cover image captions (left to right)

Toku Oshima and Mamarut Kristiansen, hunters from Qaanaaq, Greenland, work with Andy Mahoney to install a sea ice-monitoring station near their community. (Courtesy Shari Gearheard)

Arctic sea ice extent reached a record low in September 2007. Regional observations and satellite data indicate that the Arctic sea ice melt season is lengthening. (Courtesy Shari Gearheard)

This is a still image from the film *Good Days on the Trail, 1938-1942: Film Footage of the Rocky Mountains, Colorado*. The film provides a glimpse into the mountaineering lifestyle of an earlier time in the Rocky Mountains, along with shots of Arapahoe Glacier and other Front Range glaciers. (Courtesy NSIDC)



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The National Snow and Ice Data Center (NSIDC) plays an active role in cryospheric research by archiving and distributing an extensive catalog of free, high-quality data products to researchers, education communities, and the commercial sector worldwide. Our scientists and staff provide information to educators and the general public and communicate research progress and data improvements in conference presentations around the world. In addition, we engage in a range of collaborative efforts to discuss research findings, develop new data products, and utilize new data visualization techniques.

During 2007, NSIDC scientists and staff accomplished the following:

- Monitored and reported on Arctic sea ice extent, including the record 2007 minimum
- Received funding to support data management for the International Polar Year and beyond
- Contributed to the Intergovernmental Panel on Climate Change reports, *Climate Change 2007: The Physical Science Basis* and *Climate Change 2007: Impacts, Adaptation and Vulnerability*
- Continued to expand the amount of data viewable using Google Earth
- Released new data sets and continued to update and reprocess existing products
- Hosted former Vice President Al Gore for a private science briefing.

NSIDC staff and scientists are known internationally for their expertise, and we are pleased to support the research and data management communities.

Richard Armstrong
Interim Director
NSIDC/World Data Center for Glaciology, Boulder

NSIDC/WDC will make fundamental contributions to cryospheric science and will excel in managing data and disseminating information in order to advance understanding of the Earth system.



Highlights

NSIDC scientists contribute to Nobel Peace Prize-winning effort

The 2007 Nobel Peace Prize was awarded to the Intergovernmental Panel on Climate Change (IPCC) and to former U.S. Vice President Al Gore for informing the world about the important issue of human-caused climate change. NSIDC scientists were among the many experts who contributed to the IPCC's efforts, including the report, *Climate Change 2007: The Physical Science Basis*, which was released in February 2007. For the Working Group I Report, *Climate Change 2007: The Physical Science Basis*, Roger Barry served as review editor. For Chapter 4, "Observations: Changes in snow, ice and frozen ground," Tingjun Zhang served as lead author, Oliver Frauenfeld as co-author, and Bruce Raup as contributing author. Drew Slater served as co-author for Chapter 8, "Climate models and their evaluation." Roger Barry was also review editor for Chapter 15, "The polar regions" in the Working Group II Report, *Climate Change 2007: Impacts, Adaptation and Vulnerability*.

U.S. former Vice President Al Gore visits NSIDC

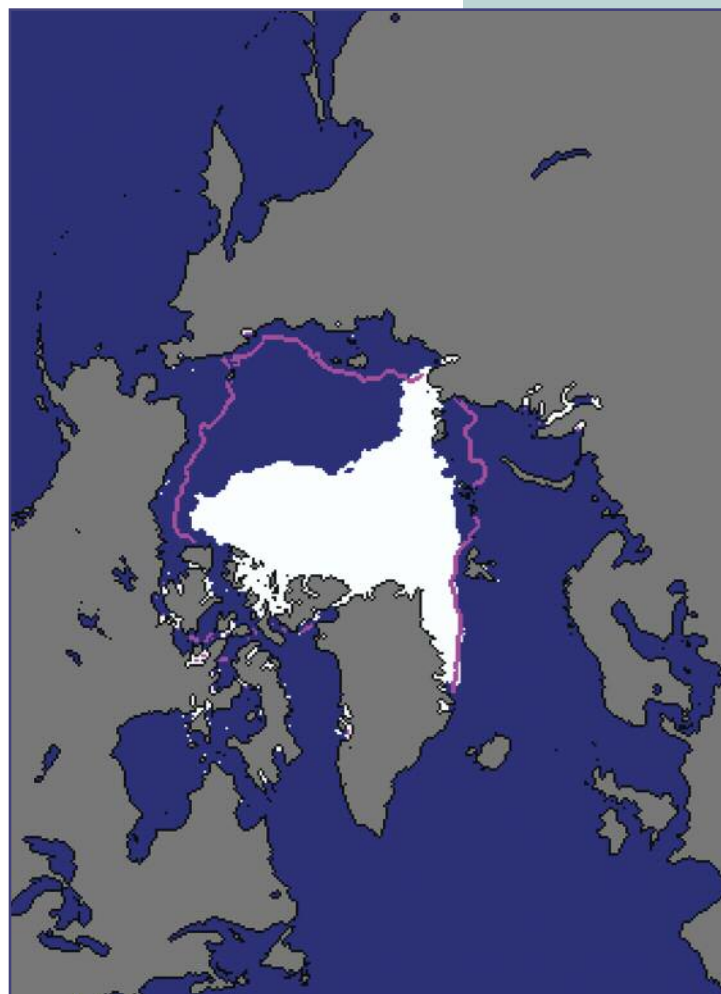
Former U.S. Vice President Al Gore requested a private science briefing from NSIDC scientists. In October 2007, CIRES director Konrad Steffen and NSIDC director Roger Barry hosted the briefing at NSIDC. Scientists Richard Armstrong, Mark Serreze, Ted Scambos, Julienne Stroeve, and Tingjun Zhang discussed the latest scientific research on snow and glaciers, Arctic climate change, ice sheets, sea ice, and permafrost. NSIDC was honored to present our research to former Vice President Gore.

Arctic sea ice shatters all previous record lows

Arctic sea ice extent during the 2007 melt season plummeted to the lowest levels since satellite measurements began in 1979. Not only did the ice season begin with less ice than normal, but the ice was thinner and more susceptible to melting. At the same time, weather patterns pumped warm air into the region, fostering further melt and pushing ice away from the Siberian shore. Arctic sea ice receded so much that the fabled Northwest Passage completely opened for the first time in human memory. NSIDC reported on the sea ice melt through the "Arctic Sea Ice News Fall 2007" Web site, which provided analysis and imagery throughout the season.

NSIDC receives funding to manage IPY data

NSIDC plays a leading role in International Polar Year (IPY) data management and has received several new awards supporting IPY data management nationally and internationally. Programs awarded funding in 2007 include the IPY Data and Information Service (IPYDIS), the Cooperative Arctic Data and Information Service (CADIS), and the Exchange for Local Observations and Knowledge of the Arctic (ELOKA). To learn more about these IPY programs, see the "Collaborative Data Systems: The Way Forward" section of this report.



Arctic sea ice during the 2007 melt season plummeted to the lowest levels since satellite measurements began in 1979. The minimum ice extent, 4.1 million square kilometers, occurred on 16 September 2007. White areas indicate sea ice; the magenta line indicates the median ice edge. (Courtesy NSIDC)

NSIDC introduced new look for Web site

We changed our online look as part of an ongoing project to make navigation options, and the contents of our site, easier to find and understand. We also added an “Education Center,” links to specific data collections, and included more detailed data search capabilities.

NSIDC releases Atlas of the Cryosphere

The NSIDC Atlas of the Cryosphere is a dynamic mapping Web site that allows users to explore the Earth’s frozen regions. Viewed from a polar perspective, the available scenes include snow cover, sea ice extent and concentration, glaciers, permafrost, and other critical components of the Earth’s cryosphere. Users can zoom in to a specific region on the Earth as well as overlay country borders, major cities, and other geographic information.

NSIDC releases archival film, “Good Days on the Trail”

This silent color film provides a unique glimpse into the mountaineering lifestyle and familiar landscapes of the past, and features recently-discovered historical footage of University of Colorado (CU) student alpine hikes in the Front Range mountains. The film was shown at the International Film Festival at CU, and the screening included live narration by university scientists, a brief history of the alpine program, a look at the science of local glaciers, and reminiscences of former students.

Canadian IPY stamp uses NSIDC data

The Canada Post released a commemorative stamp series to celebrate the International Polar Year (IPY). One of the products in the series features a graphic depiction of record low Arctic sea ice from September 2005, in comparison to Arctic sea ice from September 1979, the beginning of the satellite record. The graphic uses data from the NSIDC Sea Ice Index.

Local “Ice Fest” celebrates International Polar Year

NSIDC participated in Ice Fest, a free event held from 8 March through 11 March at the University of Colorado at Boulder. The community-wide event marked the beginning of the International Polar Year (IPY), and featured films, science talks, and polar research activities.

NSIDC director receives awards

Roger Barry is the first recipient of the new Francois Emile Matthes Award, given to recognize his accomplishments in the field of cryospheric science spanning fifty years. Barry also received the 2007 Royal Geographical Society Founders Medal in recognition of his international leadership in research on climate and climate change.

ARCUS invites NSIDC scientist to be Arctic Visiting Speaker

Senior research scientist Tingjun Zhang was invited to be the first Arctic Research Consortium of the United States (ARCUS) Arctic Visiting Speaker. Zhang gave a number of lectures over a period of several days in Fairbanks, Alaska, beginning on February 20, 2007.



This film still is from *Good Days on the Trail, 1938–1942: Film Footage of the Rocky Mountains, Colorado*. The film shows student hiking trips conducted in the Rocky Mountains, and provides a unique record of what those areas looked like at that time, and may provide visual information on the extent of the glaciers. (Courtesy NSIDC)

Data Management at NSIDC

NSIDC serves the scientific community by making cryospheric and other data accessible and useful to researchers around the world. We manage scientific data on behalf of our research communities, in turn supporting the quality, efficiency, and innovativeness of the research that depends on these data. Our collaborative approach to data management supports an increasingly complex scientific enterprise, which contributes to scientific understanding of Earth's frozen places and their relationship to Earth systems as a whole.

NSIDC involves teams of data managers and scientific programmers, plus researchers specializing in frozen ground, glaciers, ice sheets, sea ice, snow, and informatics. These experts work together to understand the evolving needs of our research communities, and to refine our data and information services. NSIDC User Services provides a feedback loop that helps improve our services, as well as access and timely responses for our user community.

NSIDC distributes hundreds of data sets, continuously adds new data sets, extends temporal coverage of existing data sets, and publishes new data algorithms and versions using refined processing methods that represent the most current scientific methodologies for retrieving parameters from remote sensing data. Much more than physically housing and distributing data, we strive to disseminate scientific data that is accessible, discoverable, understandable, reliable, and stable.

During 2007, NSIDC increasingly collaborated in the development of new data management models that address community needs for improved data access, for management of data across multiple locations, for ensuring that data remain accessible and usable for the long-term, and for new approaches to data services.

NSIDC is also active in research regarding data science and Earth science informatics, helping to advance the discipline of scientific data management, and to research and develop new methods for data stewardship and access.

Programs and Centers

NSIDC includes several distinct programs and data centers, each focusing on a particular objective defined by the sponsoring agency. Each program or center focuses on a specific research need, and allows NSIDC personnel to develop strong connections to data providers and to maintain expertise in their methods and topics, whether satellite or ground observations, Arctic or Antarctic, or specialized fields such as frozen ground research.

As data management practices and needs evolve, NSIDC engages in new programs and sunsets obsolete programs. During 2007, the Arctic System Science (ARCSS) Data Coordination Center (ADCC) data were transferred to the National Center for Atmospheric Research (NCAR), and the U.S. Antarctic Data Coordination Center was shifted to the Lamont-Daugherty Observatory.

During 2007, NSIDC hosted these programs and data centers, whose highlights are featured in the following section of this report.

Data Center	Focus
Antarctic Glaciological Data Center (AGDC)	Antarctic glaciological and cryospheric system data collected by the U.S. Antarctic Program
Cooperative Arctic Data and Information Service (CADIS)	A data management service for the Arctic Observing Network (AON)
Discovery, Access, and Delivery of Data for IPY (DADDI)	A collaborative, distributed data system that increases access, usability, and interoperability of existing polar data using XML-based Web services and related technologies
Exchange for Local Observations and Knowledge of the Arctic (ELOKA)	An NSF-funded IPY project providing data management and user support, and fostering collaboration between local and international researchers
Frozen Ground Data Center (FGDC)	Data related to permafrost and seasonally frozen ground
Global Land Ice Measurements from Space (GLIMS)	Inventory of critical information about the extent and rates of change of the world's estimated 160,000 glaciers
International Polar Year Data and Information Service (IPYDIS)	A global partnership of data centers, archives, and networks working to ensure proper stewardship of IPY and related data
NASA Distributed Active Archive Center (NSIDC DAAC)	Snow and ice data from NASA's past and current Earth science research satellites and field measurement programs
NOAA@NSIDC	Snow and ice in situ data, data rescue, and data sets from operational communities such as the U.S. Navy
World Data Center for Glaciology, Boulder (WDC)	Conducts international data exchanges regarding snow and ice, in accordance with the principles set forth by the International Council of Scientific Unions (ICSU)

Product teams

Cross-functional product teams at NSIDC focus on publishing new data sets and data set updates. Teams manage quality control, documentation, accessibility, and scientific and technical matters, such as adjustments to data processing. Data operations specialists, scientists, scientific programmers, user support experts, technical writers, and Web designers contribute to these efforts. Data operations staff provide feedback to scientists and developers about problems observed during processing, which leads to improvement in the quality of the product. Product teams provide suggestions on organization of the data, which improves accessibility and ease of use.

NSIDC scientists and scientific programmers

Scientists at NSIDC serve on product teams, collaborate on special research topics such as sea ice measurement or frozen ground studies, perform research with the data, and create new data sets in response to research questions. Because they understand the research questions in these fields, and how researchers want to use data, their contributions ensure that NSIDC data, documentation, discovery, and access meet the needs of the research community. NSIDC researchers specialize in numerous topics in snow, glaciers, sea ice, frozen ground, ice shelves, polar oceanography, and polar meteorology. Several researchers specialize in remote sensing methods for specific parameters.

Metadata and catalog

For each data set, NSIDC generates metadata records. Metadata, which are data about the data, provide documentary and descriptive information about each data set. These metadata, in turn,

enable data discovery, support understandability and stability of data, and support its long-term preservation and access. NSIDC staff research evolving metadata standards, including FGDC and ISO standards. Metadata is increasingly used on the World Wide Web to share information about data holdings and enable discovery through multiple search portals. NSIDC provides metadata to the NASA Global Change Master Directory (GCMD) on an ongoing basis to enable discovery of our data, and has engaged in discussions with other search portals to enhance the dissemination and value of our data.

Data access

NSIDC offers multiple data search, access, and distribution capabilities, based on the demands of particular data sets and projects. Satellite remote-sensing data, for example, require sophisticated search, subsetting, and ordering tools, while in situ data sets may be easily searched by science parameter and downloaded through FTP. Programming staff at NSIDC work continuously with NSIDC scientists and User Services to develop search mechanisms that more closely match the needs of data users. Data Operations specialists and User Services staff work one-on-one with users who have unique issues with access to data, to help them get data as efficiently as possible (for example, assisting users who need long time-series data and have no easy way to identify the thousands of granules they want).

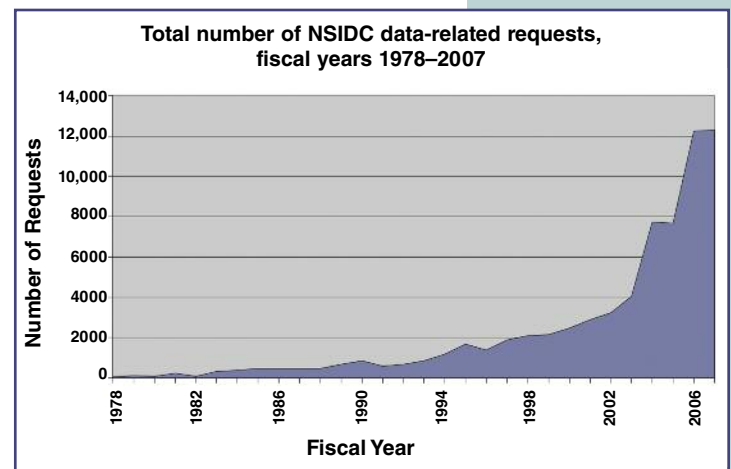
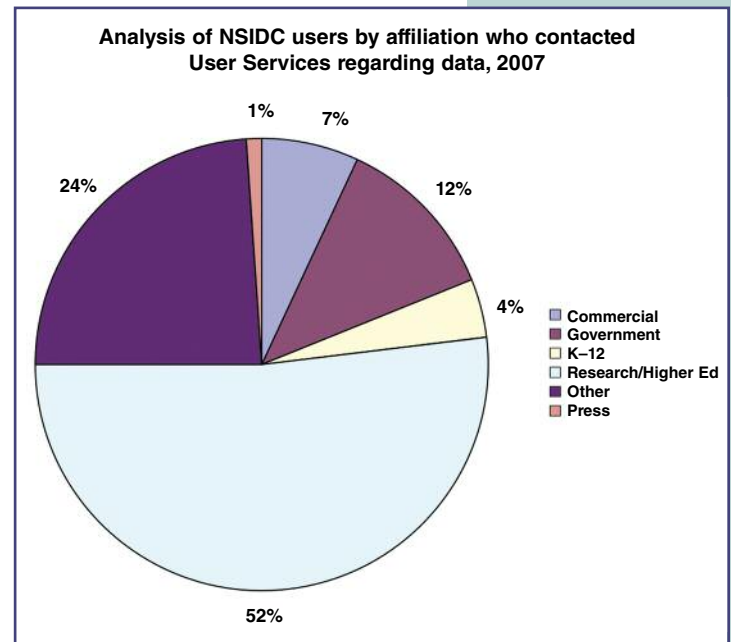
Data quality

NSIDC product teams strive to ensure that data are of the highest possible quality for scientific research. Data quality activities may range from statistical checks of data integrity and completeness, to researching and assimilating techniques for development of data sets, design, analysis, software development, production, user interface, scientific interpretation, and data delivery. Operations team members monitor data production to detect processing errors quickly. We maintain close ties with external and internal developers to expedite problem identification and resolution, and identify “beta testers” who get early access to the data to provide additional feedback on technical issues about the data.

User services

NSIDC’s User Services Office (USO) consists of specialists who maintain scientific and technical knowledge about the data we distribute. These specialists are also expert in user needs, and represent those needs on product teams, helping to ensure data and documentation usability. They are the first point of contact for all user inquiries; they provide prompt responses to requests, solve problems, and research user questions about data. USO also helps educate data users on our holdings through e-mail broadcasts, development of cryospheric parameter brochures, scientific conferences, and our quarterly data newsletter, *NSIDC Notes*.

To ensure prompt response and resolution, USO tracks user requests. The accompanying charts depict historical growth in user requests, and the affiliations of users who contacted NSIDC.



Information Center and Analog Archives

The Information Center and Analog Archives at NSIDC data constitute a unique, specialized research collection focusing on the cryosphere. This collection is open to researchers who visit NSIDC, and includes published and unpublished analog materials on snow cover, land and sea ice, cold climates, and frozen ground, as well as digital data such as CD-ROMs and Web resources. It contains more than 44,000 monographs, serials, journal articles, reprints, videos, maps, atlases, and CD-ROMs. We currently receive more than 100 periodicals and newsletters relating to the cryosphere and to remote sensing of ice and snow. The Center's collection also includes many hard-to-locate international journals dating back well into the mid-twentieth century, as well as many foreign-language materials. Our Information Center catalog can be searched on site and is also available on the Web, as part of the Arctic and Antarctic Regions Database published by the National Information Services Corporation (NISC). Our analog data archives include rare field notebooks, photographs, ice charts, and other research materials.

NSIDC on the Web

NSIDC's primary interface to the world is through our Web site (<http://nsidc.org>). Users may obtain general information about data offerings, search the data catalog, use our search and order tools, obtain data, and obtain data set documentation. Our site also provides general information about the cryosphere and research developments to the public, press, educators, and students. Many of these visitors sought general information about the cryosphere, such as about glaciers, snow, or ice. See "Outreach" below for more information about the Web content we host for these visitors.

The screenshot shows the NSIDC Education Center website. The header includes the NSIDC logo, the text "National Snow and Ice Data Center", a Google Site Search box, and navigation links for "Education Center" and "Photo Gallery". Below the header is a navigation menu with links for "Data", "Centers & Programs", "Science", "Publications", "News & Events", and "About". The main content area is titled "All About the Cryosphere" and features several sections:

- What is the cryosphere?**: A section with sub-headers for "What is the cryosphere?", "Why does the cryosphere matter?", and "Where is the cryosphere?". It includes a list of links: "The Arctic", "Antarctica", "And in between", "Snow", "Ice", "Sea ice", "Glaciers", "Ice shelves and icebergs", and "Frozen ground".
- What is the cryosphere?**: A text block explaining that some places on Earth are so cold that water is a solid—ice or snow. Scientists call these frozen places of our planet the "cryosphere." The word "cryosphere" comes from the Greek word for cold, "kryos."
- Why does the cryosphere matter?**: A text block stating that the cold regions of our planet influence our entire world's climate. Plus, the cryosphere is central to the daily lives of the people, plants, and animals that have made it their home.
- Where is the cryosphere?**: A text block explaining that when scientists talk about the cryosphere, they mean the places where water is in its solid form, where low temperatures freeze water and turn it into ice. It notes that people most often think of the cryosphere as being at the top and bottom of our planet, in the polar regions. We call the area around the North Pole the Arctic and the area around the South Pole the Antarctic. But snow and ice are also found at many other locations on Earth.
- The Arctic**: A text block describing the Arctic Ocean, sea ice, and permafrost.
- Antarctica**: A text block describing the ice sheet on Antarctica and ice shelves.

There are two images: one of a person in a snowy landscape and another of sea ice. A sidebar on the right contains "Learn About NSIDC" with links for "Education Resources", "News", "Scientists", and "Related Resources". It also includes a "Tour of the Cryosphere Movie" and "Google Earth Outreach: Environment and Science". A "Contacts" section at the bottom right provides email and phone information for general public and data users, and for members of the press.

A page from the NSIDC Education Center: All About the Cryosphere. (Courtesy NSIDC)

Scientific data users can obtain information on all of our data holdings using our Web site, and can download many products directly from the Web using FTP. Users can also search for and create distribution requests for larger data sets, in particular remote sensing data and data subsets. NSIDC product teams include technology experts, user interface design specialists, and professional designers and writers who focus on making interactions with our Web site efficient, intuitive, and productive. During 2007, we completed a new Web page and navigation design to enhance site usability.

Outreach

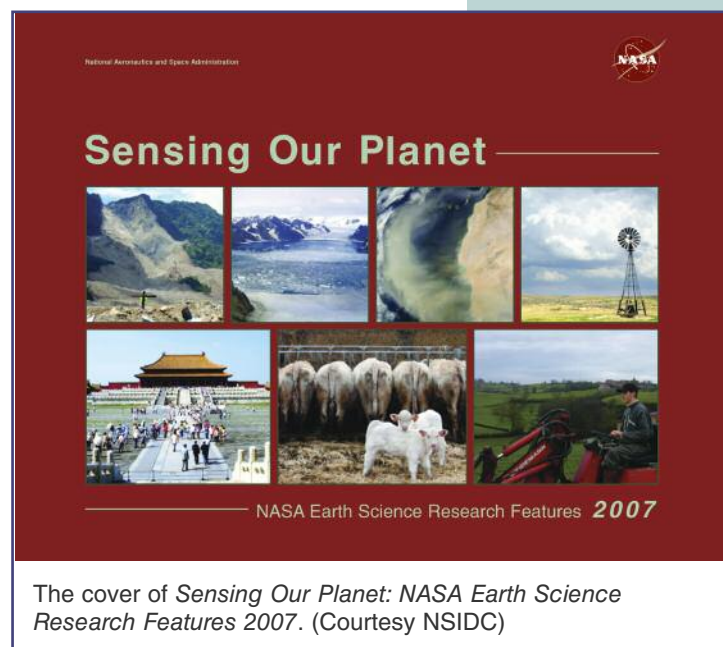
NSIDC scientists and writers research, create, and maintain the Education Center and Education Resources, containing educational materials about snow, ice, glaciers, sea ice, Arctic meteorology, and other cryospheric topics of interest to K–12 students and the public. This reference work is extremely popular, receiving several million visits during 2007.

During 2007, NSIDC scientists and outreach staff again offered “Arctic Sea Ice News and Analysis,” with running commentary on Arctic sea ice conditions during the melt season. This blog-like site, updated as changing conditions warranted, provided the public and press with timely, accessible, and quality scientific information about the unprecedented retreat of Arctic summer sea ice, resulting in the public being more accurately informed on the significance of this climate indicator. Accompanying data graphics helped tell the story; media outlets around the world obtained these data graphics from NSIDC to illustrate their news stories.

During September 2007, Arctic sea ice reached the lowest point ever recorded in thirty years of satellite record, prompting worldwide concern from scientists, the public, and policymakers regarding the state of climate warming. These concerns prompted a visit to NSIDC from former Vice President Al Gore, who requested a private science briefing from NSIDC scientists.

Publications

During 2007, we issued the thirteenth annual science feature publication on behalf of the NASA EOSDIS data centers, including the NSIDC DAAC. Titled *Sensing Our Planet: NASA Earth Science Research Features 2007*, this full-color, 50-page print publication offers feature stories on intriguing research uses of NASA remote sensing data. The complete publication is available online, and stories are republished on the EOSDIS data centers Web site, “NASA Earth System Science Data and Services.” NSIDC publications staff research and write ten to twelve articles each year, and design and produce the print publication and Web site, to help the centers promote interest their data products. This publication continues to be a popular educational piece for NASA audiences and also generates interest among potential data users.



The Distributed Active Archive Center (DAAC)

The NSIDC Distributed Active Archive Center (DAAC) serves scientists, educational communities, and the general public by providing cryospheric, land, and ocean data and information. The primary goal is to provide easy and reliable access to Earth Observing System (EOS) satellite data, ancillary in situ measurements, relevant baseline data, model results, and algorithms relating to cryospheric and polar processes. The NSIDC DAAC, in its fifteenth year of operation, is an integral part of the multiagency-funded efforts at NSIDC to provide snow and ice data and information management services.

The DAAC manages products from the following instruments:

- Moderate Resolution Imaging Spectroradiometer (MODIS)
- Advanced Microwave Scanning Radiometer - Earth Observing System (AMSR-E)
- Geoscience Laser Altimeter System (GLAS)
- Special Sensor Microwave/Imager (SSM/I) and the follow-on Special Sensor Microwave Imager/Sounder (SSMIS)
- National Oceanic and Atmospheric Administration (NOAA) Advanced Very High-Resolution Radiometer (AVHRR)

Ron Weaver is the DAAC manager, Marilyn Kaminski is the deputy DAAC manager and senior systems engineer, and Roger Barry is the senior DAAC scientist. However, Roger will be relinquishing his responsibilities as senior DAAC scientist in 2008, and Ted Scambos will be replacing Roger as senior DAAC scientist.

The Year in Summary

The NSIDC DAAC continues to operate in a stable environment with continuing evolutionary growth in functionality. All data products from MODIS on Terra and Aqua, AMSR-E on Aqua, and GLAS on ICESat continue to be ingested, archived, and distributed. By the end of 2007, the DAAC held 105 terabytes (TB) of data and 9.6 million science granules. Throughout 2007, NSIDC distributed 83.5 TB of data, an average of 6.7 TB per month, and a total of 6.8 million science granules. Despite increased utilization of subsetting tools and greater use of data compression, this still represents significant growth in distribution over the 53 TB total distribution in 2006, and shows a trend in wider use of our data products across the board.

The product suites of all three major instruments continue to expand and evolve. MODIS released Version 5 of the Aqua snow and sea ice products, including a new monthly climate modeling grid product, and incorporating fractional snow cover in the swath and daily snow products. AMSR-E continued production of the Version 2 validated algorithms, with complete reprocessing of brightness temperature data and the start of reprocessing of the land, rain, and ocean products. GLAS released several Version 28 campaigns, including the first releases of GLAS data with the satellite's attitude in airplane mode. A wide variety of data were made available for use with Google Earth, and our suite of tools and services continues to evolve enabling the wider utility of our data.

Science Data Operations

Geoscience Laser Altimeter System (GLAS)

<http://nsidc.org/data/icesat>

The Geoscience Laser Altimeter System (GLAS) is the sole instrument on the Ice, Cloud, and land Elevation Satellite (ICESat), which was launched in January 2003. The GLAS instrument provides high-resolution elevation data to improve the understanding of ice sheet mass balance in the Polar Regions. NSIDC archives and distributes 15 products, including Level-1A, -1B, and -2 laser altimetry and atmospheric LIDAR data.

In 2007, NSIDC released the following Version 28 ICESat campaigns:

Laser	Products	Operational Time Period	Release Date
3A	GLA01–GLA09 GLA12–GLA15	2004-10-03 to 2004-11-08	2007-01-02
2A	GLA01–GLA15	2003-09-25 to 2003-11-18	2007-03-07
3G	GLA01–GLA09 GLA12–GLA15	2006-10-25 to 2006-11-27	2007-04-10
1A	GLA01–GLA04	2003-02-20 to 2003-03-21	2007-04-26
3H	GLA01–GLA09 GLA12–GLA15	2007-03-12 to 2007-04-14	2007-08-20
3F	GLA01–GLA09 GLA12–GLA15	2006-05-24 to 2006-06-26	2007-09-10
3C	GLA01–GLA09 GLA12–GLA15	2005-05-20 to 2005-06-23	2007-09-28

Laser 3F and 3C were the first releases of GLAS data with the satellite's attitude in airplane mode. Depending on the time of year, the satellite's attitude is changed from airplane to sailboat to accommodate sun angle changes and for power and thermal stability. The Greenland 1km and Antarctic 500m Digital Elevation Models (DEMs) were also made publicly available from NSIDC's FTP site.

Other noteworthy accomplishments include transitioning the GLAS subsetting system from a Unix HP to a more powerful Linux system with a much larger disk array, and NSIDC team members presenting a GLAS DEM poster at the Fall 2007 American Geophysical Union in San Francisco.

Moderate Resolution Imaging Spectroradiometer (MODIS)

<http://nsidc.org/data/modis>

The Moderate Resolution Imaging Spectroradiometer (MODIS) is an optical instrument with 36 spectral bands, which flies aboard the NASA Earth Observing System (EOS) Terra and Aqua satellites, and it provides daily global coverage at spatial resolutions of 250, 500, and 1,000 meters. NSIDC archives and distributes MODIS snow and sea ice products, and helps guide the development of these products through close interaction with the NASA development team.

During 2007, NSIDC accomplished the following tasks for MODIS:

On 12 January 2007, NSIDC released Version 5 (V005) reprocessed MODIS/Aqua snow and sea ice products, which contain several improvements over the previous versions:

- Monthly snow products are available in a Climate Modeling Grid (CMG) format.
- Fractional snow cover was added to MYD10_L2 and MYD10A1 products.
- Browse images are available for all products.
- All products use HDF compression making the file size much smaller.
- Sea Ice by Ice Surface Temperature (IST) and combined sea ice fields were removed.
- The MODIS/Aqua Snow Cover Monthly L3 Global 0.05 Degree CMG data product (MYD10CM) was released.
- The MODIS/Aqua Sea Ice Extent Daily L3 Global 1 km EASE-Grid Night data product (MYD29P1N) was released.

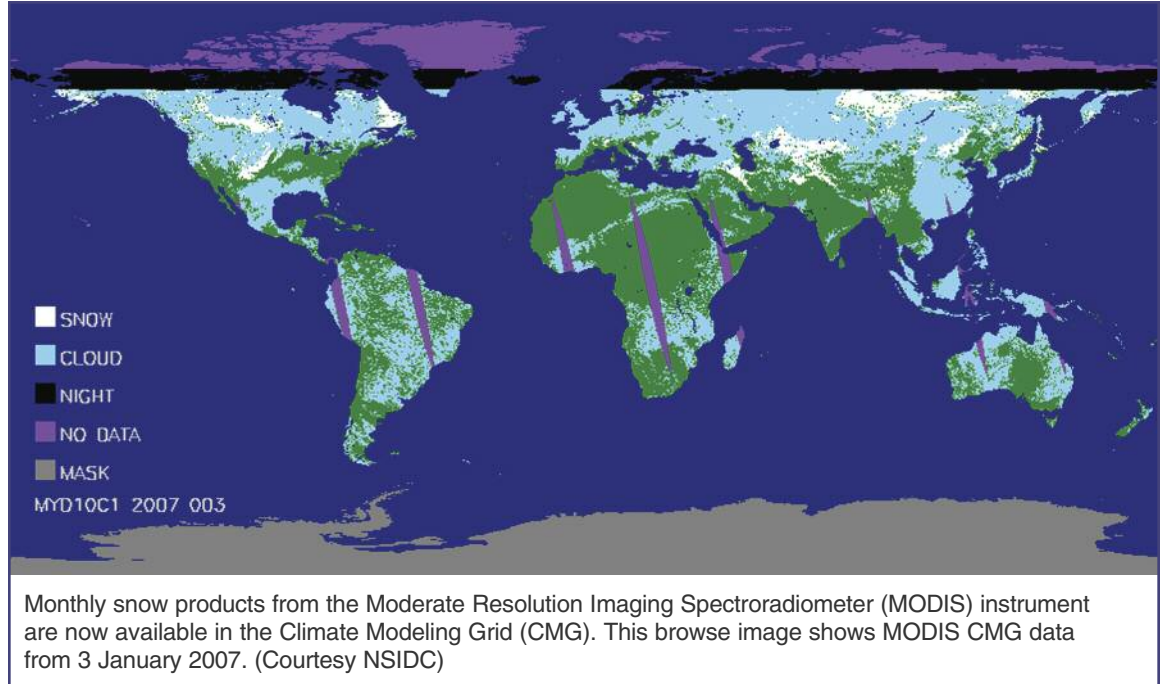
Forward data processing for the MODIS/Aqua sea ice products began in January 2007.

Reprocessing of existing MODIS/Aqua V005 data is expected to start in mid-2007, and should take two years.

Also, the complete times series of Version 4 (V004) data for the following data products are now available from the Data Pool:

- MODIS/Terra Snow Cover 8-day L3 Global 500m Grid (MOD10A2)
- MODIS/Terra Snow Cover 8-day L3 Global 0.05Deg CMG (MOD10C2)
- MODIS/Terra Snow Cover Daily L3 Global 0.05Deg CMG V004 (MOD10C1)

The time series extends from February 2000 through December 2006.



Advanced Microwave Scanning Radiometer (AMSR)

<http://nsidc.org/data/amsr>

The Advanced Microwave Scanning Radiometer (AMSR) instrument was launched on board the Advanced Earth Observation Satellite II (ADEOS-II), also known as Midori-II, on 14 December 2002. AMSR was an eight-frequency, passive-microwave radiometer system with the ability to observe from day to night, under any weather conditions with less cloud effects. It measured horizontally polarized radiances at 6.9, 10.65, 18.7, 23.8, 36.5, and 89.0 GHz, and vertically polarized radiances at 50.3 and 52.8 GHz. Spatial resolution of the individual measurements varies from 5 kilometers at 89 GHz to approximately 50 kilometers at 6.9 and 10.65 GHz.

The AMSR instrument measured geophysical variables such as atmospheric water vapor, precipitation, sea surface wind speed, sea surface temperature, soil moisture, sea ice extent, and snow water equivalent. NSIDC archives and distributes daily Level-1A data from AMSR.

During 2007, NSIDC released JAXA's ADEOS-II Level-1A AMSR data and supporting Web site and documentation.

Advanced Microwave Scanning Radiometer - Earth Observing System (AMSR-E)

<http://nsidc.org/daac/projects/passivemicro/amsre.html>

The Advanced Microwave Scanning Radiometer - Earth Observing System (AMSR-E) is a mission instrument that was launched on NASA's Aqua Satellite on 4 May 2002. The Aqua mission provides data for multidisciplinary studies of the Earth with a special emphasis on oceans. NSIDC has archived the Level-0 data since the Aqua launch, and will continue to do so for the life of the mission. In Addition, NSIDC archives and distributes all 16 standard data products, including Level-1A, -2A, -2B, and -3 data.

During 2007, NSIDC accomplished the following tasks for AMSR-E:

- Completed reprocessing of L2A brightness temperatures. Data from 18 June 2002 to the present are now at Version 2 (V09), a validated version of the algorithm
- Began production and reprocessing of L2B land, rain, and ocean products to Version 2, which changes the algorithms to Transitional (T) or Validated (V) states

Advanced Microwave Scanning Radiometer - Earth Observing System (AMSR-E) Validation

http://nsidc.org/data/amsr_validation

NSIDC continues to support AMSR-E product validation activities by hosting a Web site portal to all NASA AMSR-E validation experiments, including soil moisture, rainfall, and cryospheric validation campaigns. NSIDC provides documentation (user guides) as well as metadata (GCMD DIFs) for AMSR-E validation experiments and collaborates with the AMSR-E Science Investigator-Led Processing Systems (SIPS) to provide scientists in the field (Arctic and Antarctic ship and flight campaigns) with quick, easy access to subsetted and reformatted data for their experiments. Ten additional AMSR-E validation data sets were released in 2007.

Polar Stereographic

http://nsidc.org/data/grids/ps_grid.html

In 2007, regular processing continued for the Bootstrap and NASA Team sea ice concentration data sets and for the Defense Meteorological Satellite Program (DMSP) Special Sensor Microwave/Imager (SSM/I) polar gridded brightness temperatures.

Bootstrap Sea Ice Concentration and NASA Team Sea Ice Concentration

<http://nsidc.org/data/nsidc-0051.html>

In 2007, the NSIDC polar stereographic standard sea ice products were routinely updated, and the Goddard sea ice products were updated through the end of 2006 for Bootstrap and through mid-2006 for NASA Team. The Goddard Bootstrap sea ice time series update included algorithm changes to provide consistency with the AMSR-E Bootstrap product; the entire time series was updated and is now considered Version 2 of the data set. Monthly fields from the NASA Team time series were made available in Google Earth (.kml) format.

DMSP SSM/I Daily Polar Gridded Brightness Temperatures

<http://nsidc.org/data/nsidc-0001.html>

In 2007, NSIDC routinely updated the brightness temperatures as data became available from Remote Sensing Systems.

Near Real-Time DMSP SSM/I Daily Polar Gridded Sea Ice Concentration

<http://nsidc.org/data/nsidc-0081.html>

This product was updated daily throughout 2007. It was used to track the extreme record minimum Arctic sea ice extent during August and September 2007. Data were made available in Google Earth (.kml) format.

Equal-Area Scalable Earth Grid (EASE-Grid)

<http://nsidc.org/data/ease>

In 2007, regular processing continued for the Defense Meteorological Satellite Program (DMSP) Special Sensor Microwave/Imager (SSM/I) brightness temperatures in all three Equal-Area Scalable Earth Grid (EASE-Grid) projections. The processing maintained pace with ingest from Remote Sensing Systems.

SMMR and SSM/I EASE-Grid Brightness Temperature Products

<http://nsidc.org/data/nsidc-0071.html>

<http://nsidc.org/data/nsidc-0032.html>

NSIDC transitioned the distribution of Scanning Multichannel Microwave Radiometer (SMMR) EASE-Grid data from CD to FTP and disposed of excess CD stocks. Incoming SSM/I data were

processed through September 2007. To prepare for planned decommissioning of obsolete SGI hardware, NSIDC began the process of porting EASE-Grid processing system software from SGI to Linux systems.

Near Real-Time SSM/I EASE-Grid Daily Global Ice Concentration and Snow Extent (Near Real-Time Ice and Snow Extent, NISE)

<http://nsidc.org/data/nise1.html>

Daily updates to the NISE product continue to provide users with daily, global near-real-time maps of sea ice concentrations and snow extent. NSIDC creates the NISE product using passive microwave data from the DMSP F13 SSM/I instrument, and then projects these data onto the EASE-Grid projection. Sea ice concentration and snow extent maps are provided in two azimuthal, equal-area projections: the Southern Hemisphere 25 kilometer low resolution (SI) EASE-Grid and the Northern Hemisphere 25 kilometer low resolution (NI) EASE-Grid.

In 2007, the entire NISE archive—which spans from 4 May 1995 to the present—was made available through NSIDC’s Earth Observing System (EOS) Data Pool, a user interface that allows for more convenient and expedient data access. The percentage of unique users who downloaded NISE data in 2007 increased 11 percent from 2006. In addition, a NISE time series was added to NSIDC’s Virtual Globes Web page which features NSIDC data via Google Earth imagery. The “NISE Daily Sea Ice Concentration, July–September 2007” time series animation displays daily sea ice concentration for the two months leading up to the record Arctic sea ice minimum extent in September 2007.

AMSR-E EASE-Grid and Quarter-Degree Gridded Brightness Temperature Products

<http://nsidc.org/data/nsidc-0302.html>

In 2007, NSIDC researchers investigated a bias in the AMSR-E data at the swath edge that is summarized at http://nsidc.org/data/docs/daac/ae_l2a_tbs.gd.html#alongscanerror and in an internal white paper. Operational production was interrupted for the duration of the investigation. The investigation included collaboration with Dr. Eni Njoku and Mr. Stephen Chan (JPL). As a result of the investigation, internal processing software was modified to allow better control over these data in gridding algorithms. AMSR-E EASE-Grid and Quarter-Degree processing were restarted and are now designated product v03.

To take advantage of improved server capacity, NSIDC is porting this software processing system from 32-bit to 64-bit Linux servers.

To take advantage of improved server capacity, NSIDC is porting this software processing system from 32-bit to 64-bit Linux servers.

Northern Hemisphere EASE-Grid Weekly Snow Cover and Sea Ice Extent Version 3

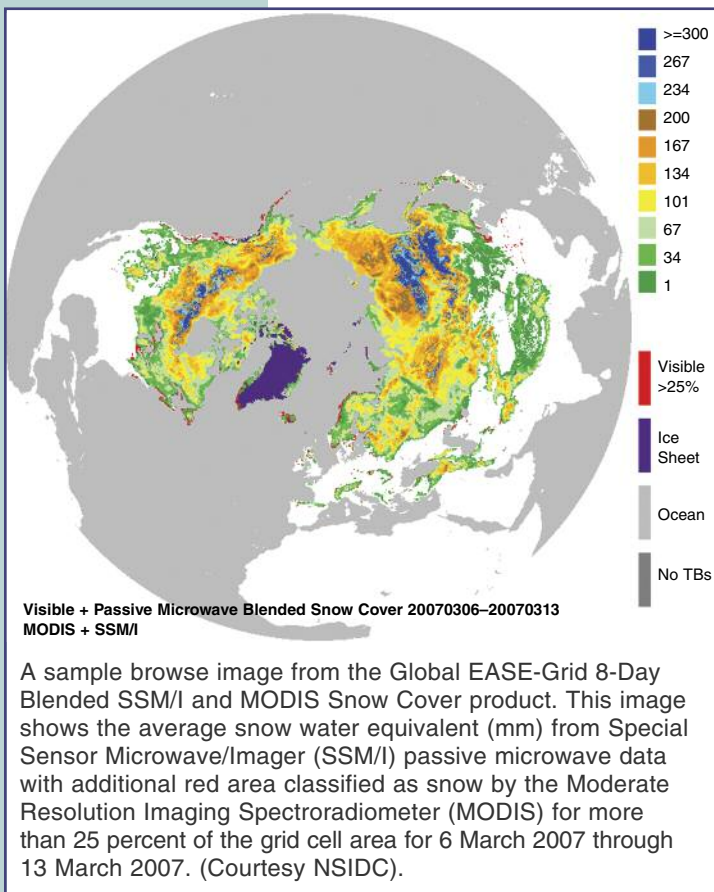
<http://nsidc.org/data/nsidc-0046.html>

In 2007, NSIDC updated this product with new data from 2005 through 2007. To view browse images of this product, see the online browse utility at http://nsidc.org/data/docs/daac/nsidc0046_nh_ease_snow_seaice/browse/viewer.html. This product was reformatted for NASA Earth Observatory (NEO) distribution.

Global Monthly EASE-Grid Snow Water Equivalent Climatology

<http://nsidc.org/data/nsidc-0271.html>

In 2007, NSIDC updated this product with data from 2005 through 2007. This product was also reformatted for NASA Earth Observatory (NEO) distribution.



Polar Pathfinder Daily 25 km EASE-Grid Sea Ice Motion Vectors

<http://nsidc.org/data/nsidc-0116.html>

Sea ice motion fields were updated through December 2006. Buoy data were updated through December 2005, and SSM/I data were updated through 2006.

Global EASE-Grid 8-Day Blended SSM/I and MODIS Snow Cover

<http://nsidc.org/data/nsidc-0321.html>

In 2007, NSIDC began developing a new, 8-day snow product that blends snow-covered area (SCA) data from Moderate Resolution Imaging Spectroradiometer (MODIS) with snow water equivalent (SWE) data from SSM/I. This is our first EASE-Grid data set released in Network Common Data Form (netCDF) format and was developed specifically for the climate modeling community.

Outreach and Collaboration

NSIDC collaborated with the Science Education Research Center (SERC) at Carlton College to develop an Earth Exploration Toolbook (EET) chapter on sea ice as a teaching resource. The chapter uses data from the NSIDC Sea Ice Index to provide lessons on using scientific data, understanding statistics, and learning about climate change and the cryosphere. The chapter is available at the SERC Web site (<http://serc.carleton.edu/eet/seaice>). Sea ice information for the State of the Cryosphere was also updated to include information through the Arctic 2007 sea ice minimum.

Arctic sea ice decline press coverage

NSIDC's outreach coordinator and NSIDC scientists expanded a Web page to provide information to scientists, media, and the public about the dramatic 2007 Arctic sea ice decline. Regular updates throughout the Arctic summer melt season provided data, images, and scientific analysis on current conditions. The site included information from sea ice experts from other U.S. and international research centers.

Sensing Our Planet: NASA Earth Science Research Features

<http://nasadaacs.eos.nasa.gov>

As a member of NASA's DAAC Alliance, the NSIDC DAAC published the thirteenth edition of *Sensing Our Planet: NASA Earth Science Research Features*, formerly the DAAC Alliance Annual, a multidisciplinary publication that highlights applications and research uses of data from NASA's Earth Observing System satellites. Articles from the 2007 issue are available electronically from the DAAC Alliance Web site.

Program for Arctic Regional Climate Assessment (PARCA)

<http://nsidc.org/data/parca>

In 2007, the NSIDC PARCA team released the Greenland Ice Sheet Melt Characteristics Derived from Passive Microwave Data. This data set is a binary indicator of the state of melt of each pixel (melting or not melting) on the Greenland ice sheet for each day of observation. The data set is derived from SSM/I and SMMR passive microwave satellite brightness temperature characteristics and is a daily estimate of the spatial extent of wet snow on the Greenland ice sheet since 1979. The data set is provided in a variety of formats including raw data in ASCII text format, data in binary format gridded on a Greenland subset of the Northern Hemisphere polar stereographic projection, and annual and complete time series climatologies in binary and GeoTIFF format. A Google Earth animation, "Greenland Annual Surface Melt, 1979–2007," was also created with the annual melt GeoTIFF files and is available from NSIDC's View NSIDC Data on Virtual Globes: Google Earth Web page at http://nsidc.org/data/google_earth/index.html. These data were also included in NSIDC's Atlas of the Cryosphere, a Web site that allows visitors to explore and dynamically map the Earth's frozen regions.

For more information, visit the DAAC Web site
 (<http://nsidc.org/daac>)

Arctic System Science (ARCSS) Data Coordination Center (ADCC)

During 2007, the Arctic System Science (ARCSS) Data Coordination Center (ADCC) received and processed 17 data sets. With the end of the National Science Foundation's (NSF) funding for the ADCC at NSIDC, operations were transferred to the National Center for Atmospheric Research/Earth Observing Laboratory (NCAR/EOL) in August of 2007. Thus, all data and metadata are now located at NCAR/EOL. While NSIDC will continue to maintain a listing of the current catalog of data, all further data acquisition and processing will be managed by NCAR/EOL.

Featured Data Products

ArcticRIMS: A Regional, Integrated Hydrological Monitoring System for the Pan-Arctic Landmass

<http://nsidc.org/data/arcss161.html>

The Arctic Rapid Integrated Monitoring System (ArcticRIMS) uses products from numerical weather prediction models, such as the National Centers for Environmental Prediction/National Center for Atmospheric Research (NCEP/NCAR) and the European Centre for Medium-Range Weather Forecasts (ECMWF) Re-Analysis-40 (ERA-40), station records, satellite remote sensing, and other data sets in conjunction with an atmosphere-land surface water budgeting scheme. In addition to historical time series, updates are compiled of various gridded fields. These include precipitation, evapotranspiration, soil moisture, soil freeze/thaw state, active layer thickness, snow extent and its water equivalent, soil water storage, runoff, and simulated discharge.

Oxygen and Deuterium Isotope Measurements from Siberia, 2002–2004

<http://nsidc.org/data/arcss157.html>

Investigators performed a stable isotope analysis of rain, snow, the Kolyma River, and a local stream near Cherskii, Siberia, from 30 June 2002 through 27 April 2004. As part of the Russian-American Initiative on Shelf-land Environments (RAISE) program, this research was designed to quantify the impacts of disturbance on the seasonal cycle of atmospheric carbon dioxide and the discharge of carbon and nitrogen into the Arctic Ocean in forest and shrubby tundra regions. Monitoring the stable isotopic composition of water runoff from Arctic rivers provides a means to investigate integrated basin-scale changes. Investigators measured changes in river water and precipitation of oxygen-18 and deuterium to partition the river flow into snow and rain components in the Kolyma River basin (Welp et al. 2005).

Mooring and Drifting Buoy Data: Beaufort Gyre Freshwater Experiment, 2003

<http://nsidc.org/data/arcss165.html>

In the summer of 2003, investigators established an observational program to measure the freshwater content (in sea ice and in the ocean) of freshwater fluxes in the Beaufort Gyre using moorings and drifting buoys. They collected temperature time series, salinity, current, sea ice draft, and bottom pressure measurements. Investigators used conventional mooring systems containing a McLane Moored Profiler (MMP) to sample currents and hydrographic data from 50 meters to 2,050 meters with 17-hour time intervals. They measured sea ice draft with an Upward-Looking Sonar (ULS). Using a high accuracy Bottom Pressure Recorder (BPR), they measured sea level height variability and near-bottom seawater temperatures. Each mooring consisted of a surface floatation package at 50-meter depth, which housed the ULS, a mooring cable containing the MMP, and dual acoustic releases and a BPR located immediately above the anchor. Investigators also deployed several ice-tethered beacons to provide concurrent temperature and salinity data at several discrete depths in the uppermost 40 meters.

Model Output Assessing Net Carbon Exchange Across the Arctic Tundra-Boreal Forest Transition in Alaska, 1981–2000

<http://nsidc.org/data/arcss162.html>

In this study, investigators simulated the temporal and spatial patterns of net carbon exchange in Alaskan ecosystems that span the transition from Arctic tundra to boreal forest. They modeled net carbon storage in terrestrial ecosystems by the balance between net primary production (NPP) and decomposition. They also modeled vegetation and soil carbon and nitrogen pools in tundra, shrub tundra, and tree line evergreen conifer forest ecosystems. Field data were used to develop parameterizations for the Terrestrial Ecosystem Model (TEM) 5.0. Investigators extrapolated the model spatially over the Alaskan Arctic to the boreal tree line to simulate changes in vegetation and soil carbon storage from 1981–2000 (Thompson et al. 2005).

High-Resolution Rectified Aerial Photography for Collaborative Research of Environmental Change at Barrow, Alaska, USA

<http://nsidc.org/data/arcss306.html>

This data set includes aerial photography of Barrow, Alaska, which were geocorrected to a 2002 QuickBird satellite image or Interferometric Synthetic Aperture Radar (IFSAR) imagery. Photography included in the set are from 4 August 1948, 29 July 1949, 12–14 August 1955, 12–24 August 1962, 14 July 1964, 15 July 1979, 31 August 1984, and 16 July 1997.

Paleoenvironment, Geomorphic Processes, and Carbon Stocks of Drained Thaw-lake Basins in the Arctic Coastal Plain, Alaska, USA, 2002–2005

<http://nsidc.org/data/arcss176.html>

These data are from a study of the origin and associated geomorphological, ecological, and pedological processes of thaw-lake basins of the Arctic Coastal Plain, Alaska. The research utilized high-resolution multispectral satellite data, ground-penetrating radar, and extensive coring to estimate the amount of carbon sequestered in the drained basins. Investigators used radiometric dating, microfossil analysis, and soil development to determine whether carbon accumulation rates respond to regional changes in climate, or if they are influenced by local rates of plant succession. Investigators reported depths, adjusted depths, radiocarbon dates, calibrated radiocarbon dates, pollen, microfossils, soil bulk density, total organic carbon (TOC), and other descriptive statistics from the spring and summer seasons of April 2002 through April 2005.

For more information, visit the ADCC Web site
 (<http://nsidc.org/arcss> or
<http://www.eol.ucar.edu/projects/arcss>)

Antarctic Glaciological Data Center (AGDC)

The National Science Foundation's Office of Polar Programs (OPP) funds the Antarctic Glaciological Data Center (AGDC) at NSIDC to provide Antarctic data management and to archive and distribute Antarctic glaciological and cryospheric system data obtained by the U.S. Antarctic Program.

AGDC has two guiding objectives: to accumulate the data record of NSF-funded Antarctic Glaciology grants, and to provide glaciology researchers with basic geophysical parameters useful for field planning, modeling, and research.

AGDC provides two types of data: Principal Investigator (PI) sets with data acquired by specific grants, and compiled products that offer collections of important glaciological parameters. Compiled data archived at AGDC include ice velocity, firn temperature, shallow ice core measurements, geochemical composition of ice cores, snow pit data, and satellite images of ice shelves. AGDC now holds data contributed by 120 PIs, whose research spans a broad variety of glaciological topics.

2007 Accomplishments

In 2007, AGDC compiled ice grounding line and ice coastline files (as shapefiles) from the MODIS Mosaic of Antarctica (MOA). These ancillary files are very useful to a variety of geoscience research projects. For more information about this product, see the MOA Image Map Web site (<http://nsidc.org/data/moa>).

Featured Data Products

Images of Antarctic Ice Shelves

http://www.nsidc.org/data/iceshelves_images
Changes in the extent and stability of Antarctic ice shelves prompted NSIDC in 1995 to begin a monitoring program of the major ice shelves and glacier outlets along the Antarctic coast. This archive contains satellite images that span back to the late 1980s for some shelf areas. Early images are from AVHRR Polar 1 kilometer data products. Beginning in 2001, the AGDC switched to MODIS Level-1B data. Currently, 19 areas are being monitored year round using both thermal and visible channels to document the changes of the Antarctic

coastline and adjacent coastal features. This archive is a selected subset of scenes, generally the clearest and most informative images available.

Radar Investigations of Antarctic Ice Stream Margins, Siple Dome, 1998

<http://nsidc.org/data/nsidc-0303.html>

This data set consists of surface-based radar measurements, including geometry of the bed, surface, and internal layers, and bed reflectivity measurements at two sites along ice stream margins at Siple Dome, Antarctica.

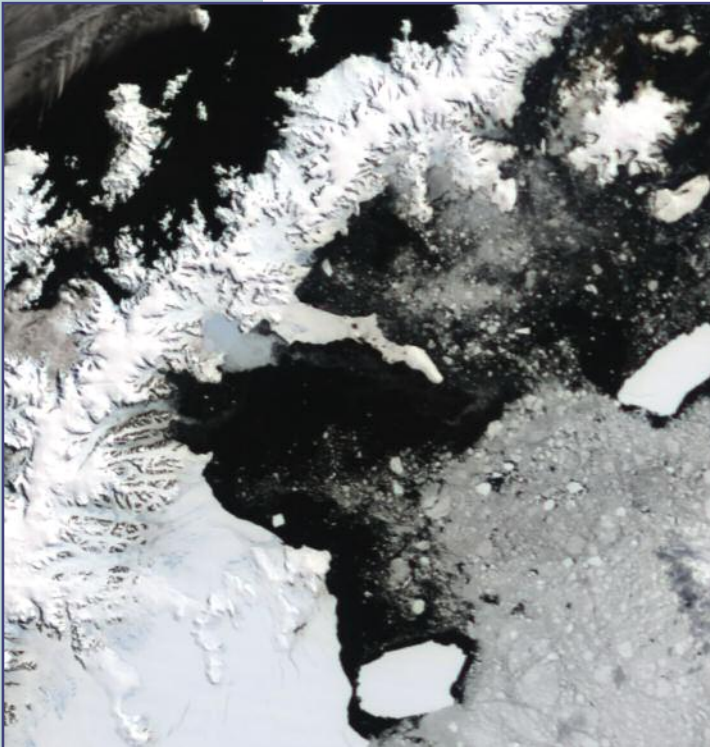


Image of the Antarctic Peninsula's Larsen B region on 24 January 2007 created from MODIS Level-1B data. The blue areas in the northwestern part of the embayment represent the continued retreat and breakup of the Hektor Glacier that formerly fed the ice shelf. Blue specks in the lower left section of the image indicate meltponds in the southern remnant of the Larsen B Ice Shelf and northernmost part of the Larsen C Ice Shelf. The gray, mottled area in the lower right section is sea ice, and the white masses are mobile icebergs. (Color enhanced image courtesy of Rob Bauer)

Cosmogenic Radionuclides in the Siple Dome A Ice Core

<http://nsidc.org/data/nsidc-0307.html>

This data set includes a record of cosmogenic radionuclide concentrations in the Siple Dome A ice core collected as part of the West Antarctic ice core program. The investigators measured profiles of both beryllium-10 (^{10}Be , half-life = 1.5×10^6 years) and chlorine-36 (^{36}Cl , half-life = 3.0×10^5 years) in the entire ice core, spanning the time period from the present to about 100,000 years before present.

Carbon-13 Isotopic Composition of Atmospheric Methane in Firn Air, Siple Dome, Antarctica

<http://nsidc.org/data/nsidc-0310.html>

This data set includes records of the delta carbon-13 ($\delta^{13}\text{C}$) of methane (CH_4) in firn air from the South Pole trapped in bubbles in a short ice core from Siple Dome, Antarctica.

Trapped Gas Composition and Chronology of the Vostok Ice Core

<http://nsidc.org/data/nsidc-0311.html>

This data set includes a time scale for the Vostok ice core, retrieved from Vostok Station on the East Antarctic Plateau.

Antarctic Ice Cores: Methyl Chloride and Methyl Bromide

<http://nsidc.org/data/nsidc-0313.html>

This data set is an analysis of methyl chloride (CH_3Cl) and methyl bromide (CH_3Br) in Antarctic ice core samples. Investigators reported mixing ratios of methyl chloride gas extracted from samples taken from the South Pole Remote Earth Science and Seismological Observatory (SPRESSO) core, drilled as part of the International Trans Antarctic Science Expedition (ITASE).

Atmospheric CO_2 and Climate: Byrd Ice Core, Antarctica

<http://nsidc.org/data/nsidc-0314.html>

Using new and existing ice core carbon dioxide (CO_2) data from 65,000 ~ 30,000 years before the present, a new chronology for CO_2 was established and synchronized with Greenland ice core records to study how high latitude climate change and the carbon cycle were linked during the last glacial period.

Atmospheric CO_2 and Climate: Taylor Dome Ice Core, Antarctica

<http://nsidc.org/data/nsidc-0315.html>

Using new and existing ice core carbon dioxide (CO_2) data from 65,000 ~ 30,000 years before the present, a new chronology for Taylor Dome ice core CO_2 was established and synchronized with Greenland ice core records to study how high latitude climate change and the carbon cycle were linked during the last glacial period. The new data and chronology should provide a better target for models attempting to explain CO_2 variability and abrupt climate change.

Stable Isotopes of Ice on the Surface of Taylor Glacier, Antarctica

<http://nsidc.org/data/nsidc-0323.html>

This data set contains oxygen and deuterium isotope ratios for approximately 980 sites on the surface of the ablation zone of Taylor Glacier, Antarctica.

For more information, visit the AGDC Web site (<http://nsidc.org/agdc>).

Frozen Ground Data Center (FGDC)

The World Data Center for Glaciology, Boulder, collaborated with the International Arctic Research Center to develop and distribute permafrost and frozen ground related data to help the International Permafrost Association (IPA) meet its strategy for data and information management. The Frozen Ground Data Center (FGDC) serves as a central node of IPA's Global Geocryological Data System and provides improved access to its data through an online search and order system. In July 2003, the FGDC published the Circumpolar Active-layer Permafrost System version 2.0 CD set, a compendium of data and metadata currently available in the FGDC and around the world.

The FGDC holds more than 100 data and information products for permafrost and seasonally frozen ground regions from in situ measurements and provides access to data and metadata for all the major IPA programs. The FGDC has also developed a collection of regional and hemispheric maps of permafrost, soil classifications, and related parameters. New types of frozen ground data, including data from models and satellite remote sensing, allow unprecedented spatial and temporal coverage of freeze/thaw parameters. More than 2,000 unique users download gigabytes of data from the FGDC each year. Unfortunately, funding for the FGDC ended in 2007. NSIDC continues to archive and distribute FGDC data products for the foreseeable future, but seeks continued support for the project and mechanisms for long-term stewardship of existing FGDC data.

For more information, visit the FGDC Web site
(<http://nsidc.org/fgdc>).

Global Land Ice Measurements from Space (GLIMS)

The Global Land Ice Measurements from Space (GLIMS) database project represents a fundamental baseline study that enables scientists to quantify the areal extent of existing glaciers in order to accurately assess the magnitude of glacier change that is occurring worldwide. The GLIMS team is continuing its work of creating an inventory of the majority of the world's estimated 160,000 glaciers and mapping their extent and rate of change. GLIMS is an international project with participation from more than 60 institutions in 28 nations worldwide. Each institution, called a Regional Center (RC), oversees the creation and analysis of data for a particular region appropriate to their expertise. These data are submitted to the GLIMS database at NSIDC and are accessible through the GLIMS Web site. This work continues in direct collaboration with the World Glacier Monitoring Service (WGMS) in Zurich, Switzerland, and is a logical extension of the WGMS World Glacier Inventory (WGI). The NSIDC GLIMS project is funded through research grants from NASA.

Featured Data Products

GLIMS Glacier Database

<http://glims.colorado.edu/glacierdata>

The NSIDC GLIMS project has created a geospatial and temporal database composed of glacier outlines and various scalar attributes. These data are derived from high-resolution optical satellite imagery, primarily from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) instrument aboard the NASA EOS Terra satellite and the Landsat Enhanced Thematic Mapper Plus (ETM+). Historic data, maps, and photographs are used to document changes from earlier periods. Each glacier snapshot is from a specific time, and the database is designed to store multiple snapshots representative of different times. The GLIMS glacier database inventory increased from 58,000 outlines of glaciers to about 83,000. In addition, the database now includes metadata for more than 200,000 ASTER images acquired over glacierized terrain, up from 160,000 ASTER images in 2006. The ASTER footprints can be spatially viewed, temporally constrained, and queried to help GLIMS collaborators quickly find suitable cloud-free ASTER imagery. Once found, a simple “one click” order feature is used to request scenes from the EROS/USGS/LP DAAC archive.

The Google Earth interface implemented in 2006 continues to be a powerful tool for users accessing the database of ASTER imagery. By loading a small file into Google Earth, users can view ASTER browse images (~150 meter pixels) and GLIMS glacier outlines overlaid on the terrain in Google Earth, and constrain which images appear by acquisition date. Clicking on the pushpin of an image displays metadata and a link that places the granule into a “shopping cart” for order, thus providing an additional feature for quick and easy access to both GLIMS glacier data and ASTER imagery. For more information, visit the GLIMS ASTER Browse Web page at <http://glims.colorado.edu/glacierdata/asterintro.php>.

For more information, visit the GLIMS Web site
(<http://nsidc.org/glims>).

NOAA@NSIDC and the World Data Center for Glaciology, Boulder

The National Oceanic and Atmospheric Administration (NOAA) program at NSIDC operates in cooperation with the NOAA National Geophysical Data Center (NGDC) to produce data sets relevant to polar and climate research. NOAA@NSIDC manages approximately 65 data sets with an emphasis on data rescue, data sets from operational communities, and development of products for tracking long-term climate change in the Arctic. We also help develop educational pages; contribute to larger projects; and support the WDC for Glaciology, Boulder, and the NSIDC Information Center.

In 2007, NOAA@NSIDC made numerous updates to both the Glacier Photograph Collection and the World Glacier Inventory. The team released three new data products, attended several conferences, and participated in a number of outreach activities.

NOAA@NSIDC activities are supported primarily by the NOAA National Environmental Satellite, Data, and Information Service's (NESDIS) NGDC. In 2007, the NOAA team included Florence Fetterer (NOAA liaison and program manager), Lisa Ballagh (project manager), Jonathan Kovarik (operations), Allaina Wallace (analog archivist and librarian), and Molly McAllister and Kara Gergely (user services).

2007 Accomplishments

Glacier Data Updates

Both the Glacier Photograph Collection and the World Glacier Inventory were updated in 2007. The Glacier Photograph Collection is a very popular data product with the general public. Since its inception, thousands of photographs have been added to the online collection. The project is in its fifth year with the NOAA Climate Database Modernization Program (CDMP). In 2007, more than 1,200 glacier photographs were added, including glaciers in such areas as Greenland and Colorado, and spanning in time from 1890 to 1996. Also added to the collection were glacier photograph pairs in which glacier photographs are taken from the same vantage point but years apart in time. To access these photographs and other glacier photographs, please visit the Glacier Photograph Collection Web site (http://nsidc.org/data/glacier_photo). The World Glacier Inventory is a repository that contains information for more than 100,000 glaciers throughout the world. In 2007, more than 34,000 glaciers in China and more than 1,600 glaciers in the former Soviet Union were added to the inventory. Also, errors with 368 glacier



These two photos are a glacier photograph pair of Qori Kalis Glacier in Peru from the NSIDC@NOAA Glacier Photograph Collection. The photograph on the left was taken in July 1978, and the one on the right taken from the same vantage point in July 2004. Glacier photograph pairs can reveal dramatic changes in a glacier over time. (Courtesy Lonnie G. Thompson, Byrd Polar Research Center, Ohio State University).

IDs were identified and corrected. To access the inventory, please visit the World Glacier Inventory Web site (http://nsidc.org/data/glacier_inventory).

Sea Ice Index in the Media

Another popular product with the general public is the NSIDC Sea Ice Index. Sea Ice Index graphics and numbers figured prominently in coverage of the 2007 record sea ice extent minimum. The Index Web site had more than 135,000 hits from more than 9,000 distinct users in the month of September alone. The data product currently averages more than 6,000 users each month.

Also in 2007, several magazines and news agencies used information from the Sea Ice Index Web site. The Sea Ice Index viewed using Google Earth illustrated “Perspectives on the Arctic’s Shrinking Sea-Ice Cover” that appeared in an article in Volume 315 of *Science*, and *Nature* used the Index for their article “The New Face of the Arctic,” in the 8 March 2007 issue.

Outreach, Awards, and Conferences

NOAA@NSIDC team members were also involved in a number of outreach activities, attended several conferences, and received awards in 2007.

Project Manager Lisa Ballagh gave a talk, “Communicating Scientific Buzz with GeoRSS,” at the Fifth International Symposium on Digital Earth in San Francisco in June 2007. NSIDC’s latest KML file (Sea Ice Edge from 1967–2002 in the Nordic Seas Monthly Means) is included in the Google Earth Outreach Environment and Science Showcase. It includes a Sea Ice Index animation, Repeat Photography of Glaciers, and an Antarctic ice shelf breakup animation.

The NSIDC@NOAA team produced a browse image tool for the National Ice Center Arctic Sea Ice Charts and Climatologies in Gridded Format data set. Using a Browse Image Spreadsheet Tool (BIST), one can quickly compare different time periods and products visually. Sea ice animations are now available in the data set catalog of NOAA’s Science on a Sphere. Animations of sea ice concentration show the annual cycle and give some idea of its variability, while a series of September monthly means from 1987 onward highlights the change in the annual Arctic minimum sea ice extent through time.

The Glacier Photograph Collection is an exceedingly popular part of NOAA@NSIDC’s data portfolio. Allaina Wallace’s role in developing this and other analog collections was recognized by NSIDC’s parent organization, the Cooperative Institute for Research in Environmental Sciences (CIRES). In March 2007, CIRES awarded Wallace the CIRES Outstanding Service Award. In June 2007, NSIDC’s Analog Archives were featured at the Special Libraries Association (SLA) conference. The conference, held in Denver, featured a session, “Resources for the International Polar Year,” at which Ruth Duerr spoke on the Discovery and Access of Historic Literature from the IPYs (DAHLI) project. Duerr and NSIDC archivist and librarian Allaina Wallace lead the project, which is partially supported by the NOAA Climate Database Modernization Program. Wallace presented a paper, “Tracking Climate Change in the 21st Century: Supporting Research with Historic Photographs and Google Earth.” Former Vice President Al Gore opened the conference, highlighting importance of special libraries.

In 2007, the National Endowment for the Humanities (NEH) awarded the Analog Archives collection a Preservation Assistance Grant for Smaller Institutions. This award will fund a contract with a preservation consultant to conduct a general preservation assessment of the collections. Below is the summary of the activities: The Preservation Assistance Grant for Smaller Institutions will provide funding for NSIDC/WDC to contract with a consultant (Randy Silverman, Preservation Librarian, University of Utah), who will conduct a general preservation assessment of the collections of NSIDC’s archives. These collections are located in several office

spaces, some shared, within the center. NSIDC is requesting assistance to determine the overall condition of the collection and establish a plan to create a more cohesive, accessible, and well-preserved collection. The assessment will include recommendations regarding proper housing for the materials, furniture requirements, security, and environmental controls within the archives, and archives policy creation. The consultant will provide the NSIDC archivist with a written report detailing his findings, which will include recommendations in order to form the basis of future preservation implementation efforts at NSIDC.

Web Site Updates

The Sea Ice Index pages were redesigned so that graphs and images are easier to find. Thumbnail images now take users to the Browse Image Spreadsheet Tool (BIST), where one can quickly compare images from different time periods. GIS compatible files (shapefiles) of monthly ice coverage are now available as well. The Glacier Photograph Collection pages were also revamped. Improvements include developing consistent navigation among the Web pages and rotating photographs on the overview page.

Featured Data Products

March through August Ice Edge Positions in the Nordic Seas, 1750–2002

<http://nsidc.org/data/g02169.html>

The ice edge data for this product were acquired from ship logbooks, diaries, and other sources, in addition to more recent satellite data products. Data are available as ASCII text, browse images, and as GIS shapefiles. This long record sheds light on ice edge variability through regional shifts in climate.

Sea Ice Charts of the Russian Arctic in Gridded Format, 1933–2006

<http://nsidc.org/data/g02176.html>

These newly published data, from the Arctic and Antarctic Research Institute in St. Petersburg, Russia, are an important new data source for those studying the role of sea ice in climate change.

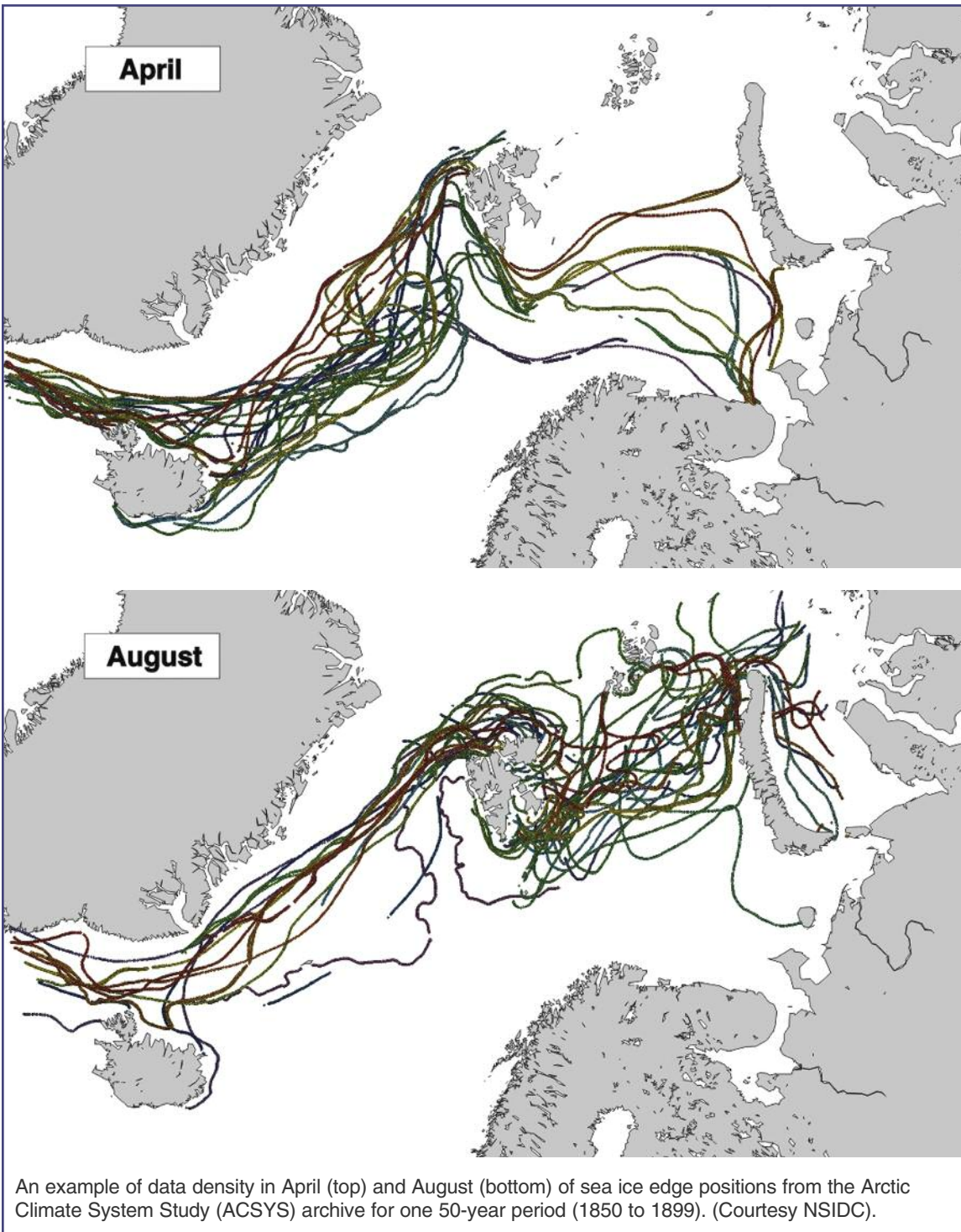
Good Days on the Trail, 1938–1942: Film Footage of the Rocky Mountains, Colorado

<http://nsidc.org/data/g02175.html>

This film was shown as part of the University of Colorado (CU) International Film Series. With color footage of CU students on alpine hikes, the film provides a glimpse into the mountaineering lifestyle of an earlier time, along with shots of Arapaho Glacier and other Front Range glaciers of the Rocky Mountains. Scientists from NSIDC and the CU Institute of Arctic and Alpine Research narrated. The film is being preserved and digitized with support from NOAA NGDC and the Climate Database Modernization Program.



This is a still image from the film *Good Days on the Trail, 1938-1942: Film Footage of the Rocky Mountains, Colorado*. The film provides a glimpse into the mountaineering lifestyle of an earlier time in the Rocky Mountains, along with shots of Arapahoe Glacier and other Front Range glaciers. (Courtesy NSIDC).



For more information, visit the NOAA@NSIDC
Web site (<http://nsidc.org/noaa>).

Collaborative Data Systems: The Way Forward

The broad international and interdisciplinary data challenges presented by the International Polar Year (IPY) and the Arctic Observing Network (AON) require increasingly collaborative approaches to data management. NSIDC is leading several collaborative data management projects that address the needs of IPY and AON. We anticipate that these types of collaborative projects will become increasingly important in addressing the future challenges of cryospheric and polar data management.

International Polar Year Data and Information Service (IPYDIS)

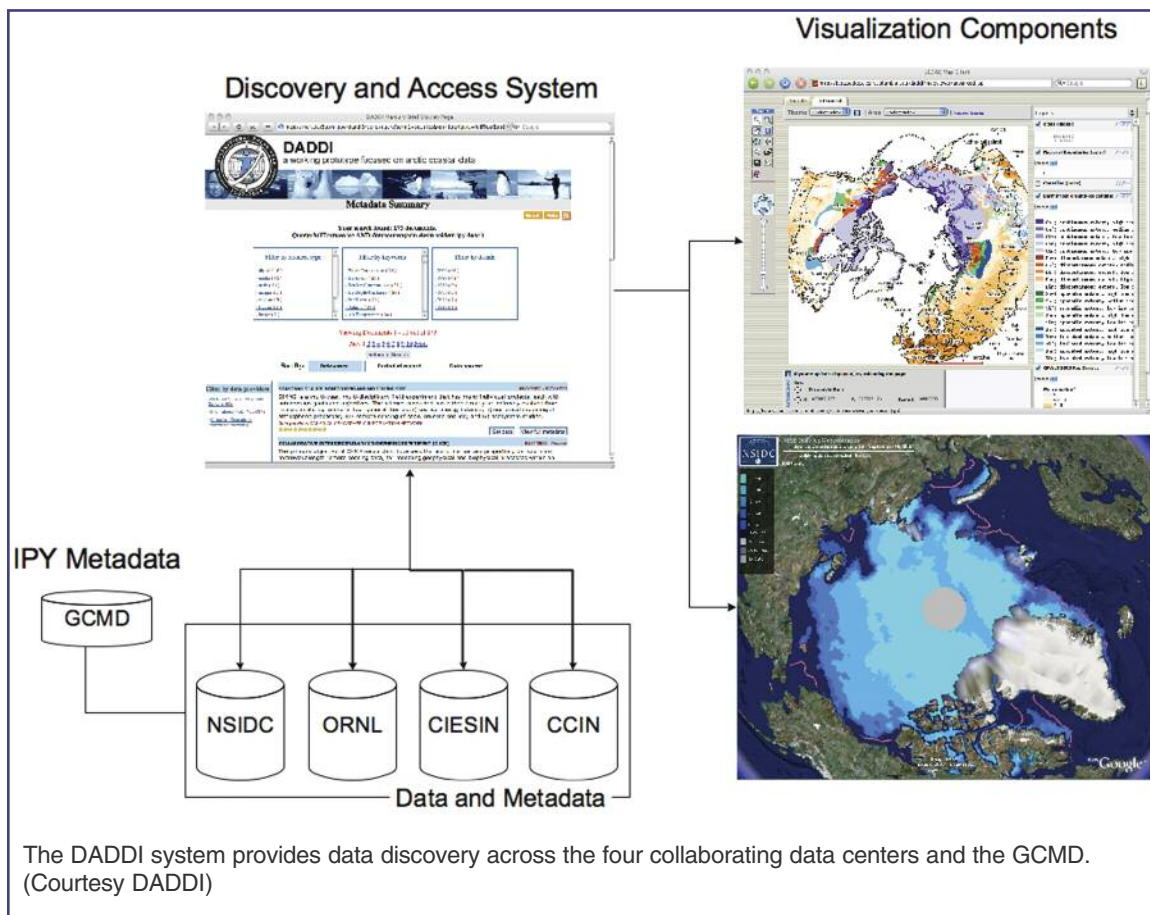
IPYDIS is a global partnership of data centers, archives, and networks working to ensure proper stewardship of IPY and related data. The IPY Joint Committee endorsed IPYDIS, led by NSIDC and the Secretariat of the Electronic Geophysical Year (eGY), as the primary data management project for IPY (Project 49). NSIDC is supported by NSF to act as a coordination office and help desk for IPYDIS to ensure not only long-term preservation of IPY data, but also broad, interdisciplinary, and non-expert access to IPY data. NSIDC has developed, maintained, and updated an IPYDIS Web site including a community discussion forum. This site helps researchers and data users identify data access mechanisms, archives, and services. It also provides information and assistance to data managers on compliance with standards, development of a union catalog of IPY metadata, and other data management requirements for IPY. We have also developed a set of data management guidelines to improve data sharing across IPY. Central among these is the IPY metadata profile and crosswalk, which is being used to describe IPY data around the world. NSIDC has been very active in the community presenting papers and organizing sessions and workshops devoted to IPY data management. We have also developed a database and directory of data archives and services supporting IPY. Finally, we seek to broaden use of IPY data by developing “Data Stories”—narrative descriptions of scientific research and inquiry processes that use a simple storytelling approach in conjunction with information technology and social networking.

IPYDIS is guided by the IPY Data Policy and Management Subcommittee, which develops the overall IPY data strategy and policies. In addition, IPYDIS is a supporter and participant in eGY.

For more information, visit the IPYDIS
Web site (<http://ipydis.org>).

Discovery, Access, and Delivery of Data for IPY (DADDI)

DADDI is a NASA-supported, collaborative project between NSIDC, the Oak Ridge National Laboratory Distributed Active Archive Center for Biogeochemical Dynamics (ORNL DAAC), the Socioeconomic Data and Applications Center (SEDAC) at Columbia University, the Canadian Cryospheric Information Network (CCIN), and the Global Change Master Directory (GCMD). In 2007, the team developed a distributed data system that increases access, usability, and interoperability of existing polar data using XML-based Web services and related technologies. Requirements for the system were developed from a set of use cases created at an interdisciplinary workshop focused on data needs for understanding Arctic coastal processes. As shown in the graphic below, the DADDI system provides data discovery across the four collaborating data centers and the GCMD and enables direct access to subsetted data held at the four centers. Visualization of select data sets is possible through Google Earth and Web Map Server. We now seek to expand the system to enable broader discovery and access of IPY data and welcome additional collaborators.



For more information, visit the DADDI Web site (<http://nsidc.org/daddi>).

The Cooperative Arctic Data and Information Service (CADIS)

Funded by NSF in March 2007, CADIS is a collaborative project to develop a data management service for the Arctic Observing Network (AON). The CADIS team includes more than twenty scientists and professionals from NSIDC, the National Center for Atmospheric Research (NCAR), and the University Corporation for Atmospheric Research (UCAR). CADIS will provide end-to-end data management services (from data collection through distribution to users) for the core set of approximately 20 AON projects. Over the longer term, CADIS is a step toward comprehensive Arctic scientific data management that builds on a foundation of federally supported data management research in Boulder, Colorado, and elsewhere.

Among the challenges facing the CADIS team are the wide variety of data types collected by AON, the diverse archiving and access needs across these supported projects, and the expectations of PIs who often have a preferred way of storing, accessing, and visualizing information that is appropriate for their data, but may not be appropriate for other AON data. An AON PI should be able to enter metadata quickly, efficiently, and without confusion; find his or her own data; display it over or with other data sets of interest; mathematically manipulate data; subset and export in a choice of formats; and enjoy easy-to-use graphical interfaces. A vision of how a PI might interact with an ideal polar data portal is given in *Toward an Integrated Arctic Observing Network* (National Academy of Sciences 2006, 62-70). The first step towards making this vision an eventual reality is to have solid metadata. To that end, the team developed a CADIS metadata profile that builds on the IPY profile and provides additional fields for improved data discovery. The CADIS team also developed and tested a metadata and data entry portal based on UCAR's Community Data Portal (CDP) framework.

Reference

Polar Research Board. 2006. "Data Management." In *Toward an Integrated Arctic Observing Network*, 62-70. Washington: National Academy of Sciences. (www.nap.edu/catalog/11607.html)

For more information, visit the CADIS Web site
(<http://www.eol.ucar.edu/projects/aon-cadis>).

Exchange for Local Observations and Knowledge of the Arctic (ELOKA)

ELOKA is an IPY project funded by the National Science Foundation that aims to facilitate the collection, preservation, and exchange of local observations and knowledge of the Arctic by providing data management and user support, as well as to foster collaboration between local and international researchers. While keeping control of data in the hands of community data providers, the ultimate goal of the project is to help make local and traditional knowledge (LTK) and community observations discoverable so more information is available for research and community planning.

Since ELOKA was approved for funding in March 2007, the team has been working to build connections among collaborators, communities, and data contributors in order to ultimately build a strong foundation for its continued development. ELOKA was launched through partnerships with four community-based projects that represent different regions, cultures, and data management needs. Data collection efforts through these partnerships are currently underway.

Some highlights for ELOKA in 2007 include the following:

- ELOKA principle investigator, Shari Gearheard, presented a poster on ELOKA at the Annual Scientific Meeting of ArcticNet in Collingwood, Ontario.
- ELOKA began collaborating with Dr. Martin Nweeia who is working with narwhal hunters from Greenland and Baffin Island to study narwhal migration and their salinity-sensitive tusks.
- ELOKA project manager Chris McNeave traveled to Sanikiluaq in Nunavut, Canada, in order to meet with community members and team representatives from the Hudson Bay Bioregion (HUBB) Community-Based Monitoring Network and System, discuss ELOKA needs, and build community relationships.
- ELOKA consultant Henry Huntington and project manager Chris McNeave met with partners and collaborators in Anchorage, Alaska. Representatives from the Alaska Native Science Commission (ANSC), Alaska Biological Research (ABR) Inc. Environmental Research & Services, and the Bering Sea Sub-Network (BSSN) participated in a review of projects and partner status regarding ELOKA.

With its emphasis on collecting, archiving, and distributing LTK data to scientists and indigenous peoples alike, ELOKA is charting new territory for supporting diverse Arctic research and heritage preservation efforts.

For more information, visit the ELOKA
Web site (<http://eloka-arctic.org>).

Research

NSIDC scientists are known internationally for their expertise in a range of fields related to the cryosphere. In-house scientists investigate the dynamics of Antarctic ice shelves, monitor the links between Arctic sea ice and climate, study new techniques for the remote sensing of snow and freeze/thaw cycles of soil, account for snow in hydrologic modeling, research large-scale shifts in polar climate, investigate seasonally and permanently frozen ground, and work to improve understanding of river and lake ice. Scientists pursue their work as part of the Cooperative Institute for Research in Environmental Sciences (CIRES) Cryospheric and Polar Processes Division at the University of Colorado at Boulder. National agencies fund research through the peer review proposal process.

Throughout 2007, NSIDC scientists published their findings in peer-reviewed journals. They also presented their research at conferences worldwide, convened special sessions, chaired meetings, and hosted workshops.

For more information about NSIDC scientists, visit <http://nsidc.org/research>. To view a listing of research projects at NSIDC, please visit <http://nsidc.org/research/projects.html>.

Arctic Peoples

There is an urgent need for scientists, decision makers, and others to better understand the human and social dynamics surrounding Arctic sea ice change, what is at stake for coastal communities, and what the responses might be. Scientists at NSIDC have been using remotely-sensed data to monitor sea ice conditions, and have regularly reported on the declining Arctic sea ice. NSIDC also continues to distribute the data product, *When the Weather is Uggianaqtuq: Inuit Observations of the Environment*, a compilation of knowledge from an indigenous community in Nunavut, Canada.

Shari Gearheard resides in Clyde River, Canada, and is working with several Inuit communities to gather climate change observations. In 2007, Gearheard collaborated with engineers from the University of Calgary and with Inuit hunters for the Igliniit project, which is developing snowmobile-mounted GPS/weather stations that will help Inuit hunters log their observations. The team is currently testing five units, and in 2008 they will begin downloading information to create maps. Combined with traditional knowledge, the system has promising application for Arctic communities, and may assist environmental change research, land use studies, and search and rescue efforts.

Gearheard and Andy Mahoney also conducted intense fieldwork in Qaanaaq, Greenland, and Barrow, Alaska, to study local sea ice conditions and learn from local sea ice experts. They worked with a research team of scientists, along with Inuit, Inughuit, and Iñupiat, to establish sea ice observing groups that would meet monthly, launching a second year of local sea ice monitoring and measuring efforts. The collaborative approach to recording local sea ice observations has been successful. For instance, local monitoring at Qaanaaq revealed an ocean heat source that likely



Toku Oshima and Mamarut Kristiansen, hunters from Qaanaaq, Greenland, work with Andy Mahoney to install a sea ice-monitoring station near their community. (Courtesy Shari Gearheard)

contributes to the dramatic spring melts recently observed in that area. Continued collaboration and monitoring throughout the Arctic is crucial: Sea ice and sea ice use in these communities is changing in various ways, and linking local and scientific knowledge provides the most complete picture for understanding Arctic sea ice changes.

In a collaboration with Clyde River elders and the University of Colorado Museum, Gearheard and Betsy Sheffield helped launch *Silavut: Inuit Voices in a Changing World*, an exhibit featuring Inuit knowledge regarding sea ice, glaciers, snow cover, and arctic animals. The exhibit opened 15 April 2007, and runs through 15 March 2009.

To see related research projects, visit NSIDC's Research Projects Web page (http://nsidc.org/research/projects.html#arctic_peoples)

Arctic Hydrology and Climate

Arctic change is a dominant theme, and scientists are trying to discern how much of this change is due to natural variability versus how much may be caused by greenhouse gases. Observed changes in the Arctic system, such as rising air temperatures, the shrinking sea ice cover, increasing river discharge, and permafrost warming already suggest that the terrestrial Arctic is experiencing the largest change of any world region. Modeling studies and current trends suggest that this change will continue. While natural variability has and will always be large in the Arctic, greenhouse gas loading is now becoming an important player.

Throughout 2007, Mark Serreze gave a number of invited lectures, including presentations at the University of Chicago, McGill University, and the annual meeting of The Wildlife Society in Tucson, Arizona. Serreze also gave the invited Nye Lecture at the American Geophysical Union Fall Meeting, "Arctic climate change: Where reality exceeds expectations."

To see related research projects, visit NSIDC's Research Projects Web page (http://nsidc.org/research/project.html#arctic_hydrology)

Antarctic Glaciology and Climate

Antarctica, at Earth's South Pole, is the world's coldest and windiest continent. A huge ice sheet covers most of Antarctica, forming numerous glaciers that, in some places, feed shelves of ice that float out over the ocean. The outer sections of these shelves can break off, or "calve," and form icebergs. The icebergs float in the oceans, melting and falling apart as they drift into warmer waters.

Scientists recognize that the final stages of iceberg breakup imitate the rapid disintegration of ice shelves caused by climate warming. Floating shelves of ice on the Antarctic Peninsula are experiencing temperatures and melt rates that they can no longer withstand. Ice shelves are important because they help control glacier flow; removal of ice shelves causes rapid glacier acceleration and calving. Ice shelf breakup is usually caused by surface pond melting and fracturing. Scientists believe that melting at the base of ice shelves also contributes to disintegration. However, they aren't sure how these processes interrelate. Waiting for a major ice shelf breakup could take decades—a long time to wait for important data.



Climate change is affecting communities across the Arctic, who must adapt to changes in weather, permafrost, and sea ice. This photograph shows cracks in the sea ice, which are normal, but Inuit hunters are noticing that cracks are now occurring in unpredictable places. (Courtesy Andy Mahoney)

Icebergs represent a kind of “test vehicle” for examining the stability and breakup mechanisms for ice shelves. By drifting northward, icebergs undergo a rapid change in climate, encountering higher surface air temperature and ocean temperature. In 2007, Ted Scambos, collaborated with Robert Bauer, Jennifer Bohlander, and others to analyze findings from research and fieldwork carried out on Antarctic icebergs. The team has identified three calving styles—rift calving, edge wasting, and rapid disintegration—that may correlate to ice shelf behavior. Edge wasting is a result of waterline ablation due to surface warming of sea-ice-free ocean; this mechanism may be important in summertime retreat of ice tongues, for example, in southeast Greenland. Rapid disintegration is associated with the presence of abundant surface melt.

Scientists are also trying to understand the dynamics behind the ice sheets that feed the continent’s ice shelves. Antarctica’s interior is remote and difficult to reach, but studying the East and West Antarctic Ice Sheets will help researchers monitor the ice’s stability. Scambos is investigating megadunes and “wind glaze” areas, which represent extreme air-snow interactions that are common only in the East Antarctic Plateau. These features can have regional affects on the mean annual snow accumulation rate. Wind glaze areas are regions where increased wind speed sweeps away all incoming blowing and falling snow, leaving a almost no accumulation on the surface, while megadunes represent an alternating pattern of accumulation and wind glaze (or near-wind glaze). After completing fieldwork several years ago, Scambos, along with Rob Bauer, Terry Haran, and other collaborators, analyzed the data and discovered that megadunes and wind glaze areas affect snowfall measurements. In fact, three recent regional assessments underestimate snowfall by about six percent on the East Antarctic Plateau.



In this aerial photograph, East Antarctica’s megadunes are visible as light and dark stripes in the snow. Megadune areas cover an area the size of Texas. By studying megadunes, NSIDC researchers have found that snowfall amounts on the East Antarctic Plateau have been underestimated by about six percent. (Courtesy Ted Scambos)

Atsuhiko Muto, a PhD candidate studying under Ted Scambos, participated in the Norwegian-U.S. Scientific Traverse of East Antarctica during the 2007–2008 austral summer. The team ventured 3,000 kilometers into previously unexplored areas of the continent, drilling ice cores, gathering meteorological data, mapping lakes under the ice sheets, measuring the thickness and movement of the ice, and collecting reference information for satellites. Muto visited areas that few humans have seen, such as Plateau Station and the Pole of Inaccessibility, both of which are more remote than the South Pole.

NSIDC scientists and staff also studied subglacial lakes in Antarctica. They combined data from the Ice, Cloud, and land Elevation Satellite (ICESat) and the Moderate Resolution Imaging Spectroradiometer (MODIS) and used image differencing to identify subtle surface topography changes in the Siple Coast ice streams, which permitted them to map the outlines of subglacial lakes and water movement. The team is also applying this technique to study subglacial water movement beneath the Whillans and Mercer ice stream system and the MacAyeal Ice Stream.

To see related research projects, visit NSIDC’s Research Projects Web page (<http://nsidc.org/research/project.html#antarctic>)

Sea Ice

Sea ice is frozen seawater that floats on the ocean surface. Blanketing millions of square kilometers, sea ice forms and melts with the polar seasons, affecting both human activity and biological habitat. In the Arctic, some sea ice persists year after year, whereas almost all Southern Ocean or Antarctic sea ice is “seasonal ice,” meaning it melts away and reforms annually. While both Arctic and Antarctic ice are of vital importance to the marine mammals and birds for which they are habitats, sea ice in the Arctic appears to play a more crucial role in regulating climate.

Arctic sea ice during the spring 2007 narrowly missed a record wintertime low, but during the summertime melt season, sea ice extent plummeted to a record low of 4.1 million square kilometers, the lowest level since satellite measurements began in 1979. Julienne Stroeve said, “The spring of 2007 started out with less ice than normal, as well as thinner ice. Thinner ice takes less energy to melt than thicker ice, so the stage was set for low levels of sea ice this summer.” Unusual atmospheric patterns accelerated the ice loss, pumping warm air into the Arctic region and pushing ice away from the Siberian shore. Arctic sea ice receded so much that the fabled Northwest Passage completely opened up for the first time in human memory.

In addition, NSIDC scientists have also noted that the date of the lowest sea ice extent has shifted and now occurs later in the year. Ted Scambos said, “What we’ve seen this year fits the profile of lengthening melt seasons, which is no surprise. As the system warms up, spring melt will tend to come earlier and autumn freezing will begin later.”

Scientists and staff at NSIDC also maintained the “Arctic Sea Ice News and Analysis” Web site, posting new images and scientific commentary throughout the 2007 melt season. NSIDC plans to continue to watch the sea ice and report on milestones in the coming years.

NSIDC’s efforts to monitor Arctic sea ice generated attention from the science community, public, and media, and led to a site visit by former Vice President Al Gore. Mr. Gore had requested a private science briefing, during which he discussed Arctic sea ice and other cryospheric factors with Richard Armstrong, Ted Scambos, Mark Serreze, Tingjun Zhang, and Julienne Stroeve. The record setting ice loss of 2007 was also featured in several television documentaries, including a film produced by the Discovery Science Channel, in which Mark Serreze and Julienne Stroeve appeared.

Serreze and Stroeve also reported that Arctic sea ice is melting at a significantly faster rate than projected by the most advanced computer models, underscoring how rapidly changes in the Arctic climate are occurring.

To see related research projects, visit NSIDC’s Research Projects Web page (http://nsidc.org/research/project.html#sea_ice)



Arctic sea ice extent reached a record low in September 2007. Regional observations and satellite data indicate that the Arctic sea ice melt season is lengthening. (Courtesy Shari Gearheard)

Glaciers and Ice Sheets

Because glaciers are sensitive to temperature fluctuations, they provide clues about the effects of global warming. With few exceptions, glaciers around the world have retreated at unprecedented rates over the last century. Some ice caps, glaciers, and even an ice shelf have disappeared altogether. Many more are retreating so rapidly that they may vanish within decades. Some scientists attribute this retreat to the Industrial Revolution; burning fossil fuels releases greenhouse gases into the atmosphere and affects our environment in ways we did not understand before.

While glacier stability can be an indicator of climate change, understanding the dynamics of glaciers and ice sheets can provide clues about future sea level rise. Ted Scambos collaborated with NSIDC/University of Washington researcher Ian Howat to show that partial recovery and slowdown can follow glacier acceleration in Greenland. This finding means forecasts of ice loss and Greenland's contribution to sea level require more detailed monitoring of ice flow than scientists previously assumed.

In addition, Oliver Frauenfeld completed a 224-year reconstruction of Greenland ice melt. He found that while the 2007 melt was indeed the greatest melt observed in more than two centuries, it still falls within the 95 percent confidence interval of previous melt periods. However, if the current melting trend continues, it will exceed anything previously observed in Greenland.

To see related research projects, visit NSIDC's Research Projects Web page (<http://nsidc.org/research/project.html#glaciers>)



Researchers are studying permafrost, sea ice, glaciers, and ice shelves to understand their dynamics and determine how they are responding to climate change. In Antarctica, for instance, meltponds on ice surfaces provide clues about how ice shelves and icebergs weaken and break up. (Courtesy Ted Scambos)

Climate Change and the Cryosphere

The cryospheric regions, or regions where water is found in solid form, provide scientists with direct visual evidence of temperature changes. Ice and snow exist relatively close to their melting point and may frequently change phase from solid to liquid and back again. Consequently, consistent and prolonged warming trends should result in observable changes to Earth's cryosphere.

To help document warming trends and the global effects of climate change, the Intergovernmental Panel on Climate Change (IPCC) has published several reports since 1990, drawing on global scientific expertise. Throughout 2006, NSIDC scientists contributed cryospheric expertise to the International Panel on Climate Change (IPCC) fourth assessment. For the Working Group I Report, *Climate Change 2007: The Physical Science Basis*, Roger Barry served as review editor. For Chapter 4, "Observations: Changes in snow, ice and frozen ground," Tingjun Zhang served as lead author, Oliver Frauenfeld as co-author, and Bruce Raup as contributing author. Drew Slater served as

co-author for Chapter 8, "Climate models and their evaluation." Roger Barry was also review editor for Chapter 15, "The polar regions" in the Working Group II Report, *Climate Change 2007: Impacts, Adaptation and Vulnerability*.

NSIDC scientists and staff were among the many experts who contributed to the IPCC's 2007 Nobel Peace Prize-winning efforts.

To see related research projects, visit NSIDC's Research Projects Web page (http://nsidc.org/research/project.html#climate_change)

Permafrost and Frozen Ground

Permafrost, or permanently frozen ground, is soil, sediment, or rock that remains at or below zero degrees Celsius for at least two years. Permafrost is not defined by soil moisture content, overlying snow cover, or location; it is defined solely by temperature. Seasonally frozen ground is near-surface soil that freezes for more than fifteen days per year. Intermittently frozen ground is near-surface soil that freezes from one to fifteen days per year. Permafrost underlies 12 to 18 percent of the exposed land surface in the Northern Hemisphere, and seasonally frozen ground regions may cover as much as 55 percent.

Understanding permafrost is critical to understanding environmental change, validating models, and building and maintaining structures in seasonal frost and permafrost regions. Frozen ground's widespread distribution makes it a substantial component of the cryosphere. Likewise, its role in the storage and release of carbon make it a major factor in future global change.

Tingjun Zhang discovered that permafrost degradation is widespread in Siberia, where permafrost surface temperature increased by up to three degrees Celsius between the late 1950s and 2000. This conclusion is consistent with results in Alaska reported by Zhang's colleagues. And similarly, soil temperatures in non-permafrost regions across Russia increased from 1930 to 2000. Changes in air temperature and snow cover may play a role. In addition, Zhang conducted fieldwork on the Tibetan Plateau, where he discovered that permafrost temperatures have increased over the past decade. Zhang also worked on permafrost modeling comparisons to help resolve the fact that several major climate models cannot model permafrost or soil temperature conditions properly.

Oliver Frauenfeld traveled across the Tibetan Plateau on the new Tibetan Railroad, surveying the effects of the railroad's construction on the underlying permafrost. He also visited meteorological stations on the plateau to assess the site characteristics and establish the suitability and quality of the station observations for climate research.

Andrew Slater collaborated with David Lawrence at the National Center for Atmospheric Research to investigate the relationship between Arctic sea ice decline and corresponding changes in the surrounding land areas. Their findings indicate that rapid sea ice loss produce large temperature changes on land, which can trigger permafrost degradation, or even precondition it for rapid demise.

To see related research projects, visit NSIDC's Research Projects Web page (<http://nsidc.org/research/project.html#permafrost>)

Snow Cover and Snow Hydrology

Snow is precipitation made up of ice crystals. When cold temperatures and high humidity levels combine in the atmosphere, snow crystals form. As long as air temperature remains below freezing, the crystals will fall to the Earth as snow. Snow can be found all over the world, even near the equator at high elevations. In terms of spatial extent, seasonal snow cover is the largest single component of the cryosphere and has a mean winter maximum areal extent of 47 million square kilometers, about 98 percent of which is located in the Northern Hemisphere. In many locations in recent decades, temperatures have risen while precipitation levels have remained largely the same. Satellite data have confirmed that average snow cover has decreased, especially in the spring and summer. Changes in snow cover may affect river flow and downstream water supplies.

Andrew Slater investigated the hydrologic forecasting applications of the Snow Data Assimilation System (SNODAS), and continued working with MODIS snow-covered-area data for potential assimilation in hydrologic forecasting.

To see related research projects, visit NSIDC's Research Projects Web page (<http://nsidc.org/research/project.html#snow>)

International Collaboration

International Polar Year (IPY): Data Management

The data and information that researchers generate during IPY will build on the foundation of previous IPYs, and add to the body of scientific knowledge about Earth. NSIDC is involved in several important data and information efforts for IPY:

The National Science Foundation (NSF) awarded funding to NSIDC to help manage scientific data taken during the International Polar Year (IPY). An internationally distributed network called the IPY Data and Information Service (IPYDIS), coordinated by NSIDC, will manage data from IPY and staff member Mark Parsons co-chairs the IPY Data Policy and Management Subcommittee.

NSIDC also manages data from several other IPY projects, including Exchange for Local Observations and Knowledge of the Arctic (ELOKA); Discovery and Access of Historic Literature from the IPYs (DAHLI); Discovery, Access, and Delivery of Data for IPY (DADDI); and the Cooperative Arctic Data and Information Service (CADIS).

NSIDC is also working to ensure the international development of a polar data legacy through active participation in the International Council for Science (ICSU) Committee on Data for Science and Technology (CODATA), the new World Data Services system, and the Sustained Arctic Observing Network (SAON).

The Dynamics of Human-Sea Ice Relationships: Comparing Changing Environments in Alaska, Nunavut, and Greenland

In 2007, Andy Mahoney and Shari Gearheard collaborated with Inuit hunters, whalers, and elders in Barrow, Alaska, Clyde River, Canada, and Qaanaaq, Greenland, to assess local sea ice conditions. The project, also referred to as the Siku-Inuit-Hila project, is an interdisciplinary, cross-cultural study of the dynamic relationship between humans and sea ice.

World Climate Research Programme: Climate and Cryosphere Asian Snow Cover Project

Tingjun Zhang leads this effort, working with 12 countries to collect and rescue in situ snow data. Zhang is also collaborating with colleagues to gather soil temperature across Russia, Mongolia, and China.

Permafrost Young Researchers Network (PYRN)

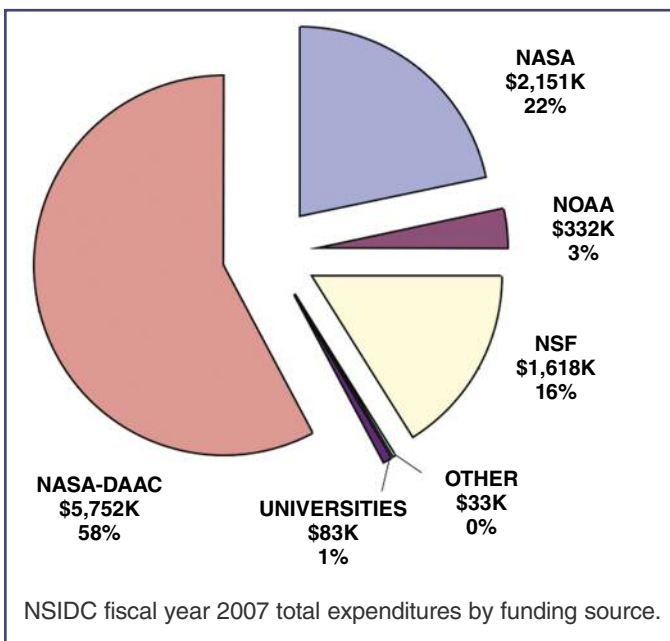
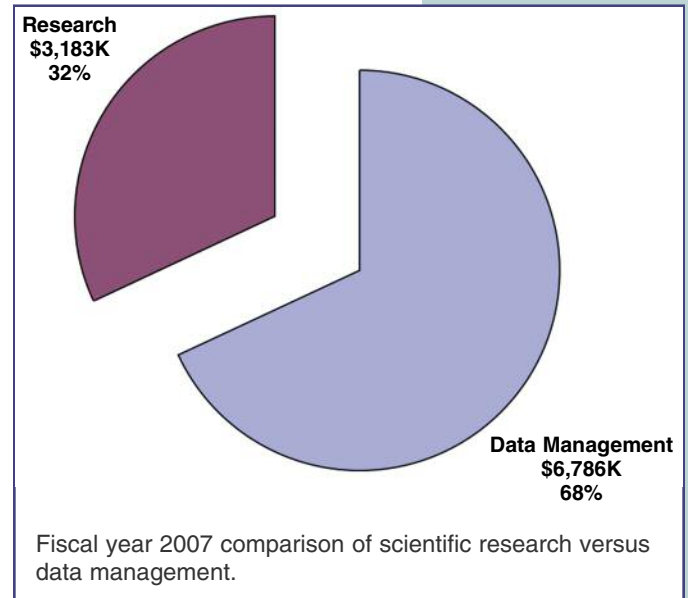
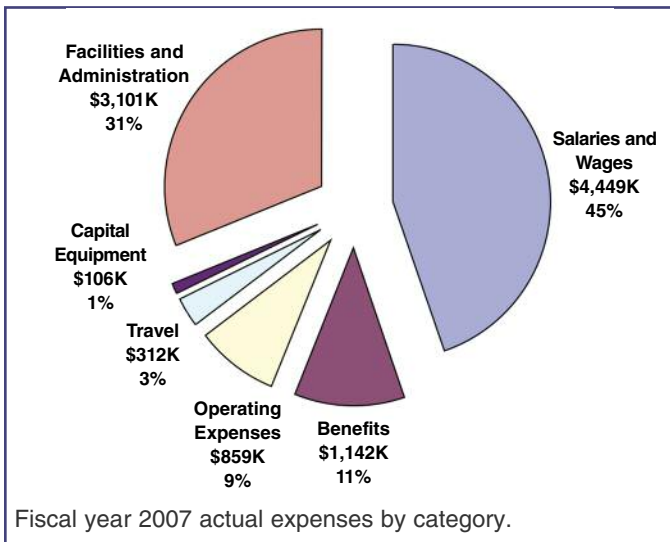
Oliver Frauenfeld continues to serve as coordinator for PYRN to help foster early career permafrost scientists and engineers. PYRN consists of 500 members from 44 countries, and Frauenfeld is also the U.S. chapter representative.

NSIDC scientists collaborate in Nobel Peace Prize-winning effort

The 2007 Nobel Peace Prize was awarded to the Intergovernmental Panel on Climate Change (IPCC) and to former U.S. Vice President Al Gore for informing the world about the important issue of human-caused climate change. NSIDC scientists were among the many experts who contributed to the IPCC's efforts, including the report, *Climate Change 2007: The Physical Science Basis*, which was released in February 2007. For the Working Group I Report, *Climate Change 2007: The Physical Science Basis*, Roger Barry served as review editor. For Chapter 4, "Observations: Changes in snow, ice and frozen ground," Tingjun Zhang served as lead author, Oliver Frauenfeld as co-author, and Bruce Raup as contributing author. Drew Slater served as co-author for Chapter 8, "Climate models and their evaluation." Roger Barry was also review editor for Chapter 15, "The polar regions" in the Working Group II Report, *Climate Change 2007: Impacts, Adaptation and Vulnerability*.

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NSIDC's annual budget for calendar year 2007 was 9.969 million dollars, with funding from national agencies such as NASA, NOAA, and NSF, as well as from various universities.



Publications and Presentations

Journals

- Anisimov, O., V. Lobanov, S. Reneva, N. Shiklomanov, T. Zhang, and F. Nelson. 2007. Uncertainties in gridded air temperature fields and effects on predictive active layer modeling. *Journal of Geophysical Research* 112, F02S14, doi:10.1029/2006JF000593.
- Ballagh, L. M., M. A. Parsons, and R. Swick. 2007. Visualizing cryospheric images in a virtual environment: Present challenges and future implications. *Polar Record* 43(4): 305–310, doi:10.1017/S0032247407006523.
- Beedle, M. J., M. Dyurgerov, W. Tangborn, S. J. S. Khalsa, C. Helm, B. Raup, R. Armstrong, and R. G. Barry. 2007. Improving estimation of glacier volume change: a GLIMS case study of Bering Glacier System, Alaska. *The Cryosphere Discussion* 2(1): 33–51.
- Chu, D., L. Lu, and T. Zhang. 2007. Sensitivity of NDVI to seasonal and inter-annual climate conditions in Lhasa area, Tibetan Plateau. *Arctic, Antarctic, and Alpine Research* 39(4): 635–641.
- Fan, G., T. Zhang, J. Ji, K. Li, and J. Liu. 2007. Numerical simulation of the carbon cycle over the Tibetan Plateau, China. *Arctic, Antarctic, and Alpine Research* 39(4): 723–732.
- Finnis, J., M. M. Holland, M. C. Serreze, and J. J. Cassano. 2007. Response of Northern Hemisphere extratropical cyclone activity and associated precipitation to climate change, as represented by the Community Climate System Model. *Journal of Geophysical Research* 112, G04S42, doi:10.1029/2006JG000286.
- Frauenfeld, O. W., T. Zhang, and J. L. McCreight. 2007. Northern Hemisphere freezing/thawing index variations over the 20th century. *International Journal of Climatology* 27(1): 47–63, doi:10.1002/joc.1372.
- Fricker, H. A., T. Scambos, R. Bindshadler, and L. Padman. 2007. An active subglacial water system in West Antarctica mapped from space. *Science* 315 (5818): 1544–1548, doi:10.1126/science.1136897.
- Gearheard, S., and J. Shirley. 2007. Challenges in community-research relationships: Learning from natural science in Nunavut. *Arctic* 60(1): 62–74.
- Herzfeld, U. C., S. Drobot, W. L. Wu, C. Fowler, and J. Maslanik. 2007. Spatiotemporal climate model validation—Case studies for MM5 over northwestern Canada and Alaska. *Earth Interactions* 11, doi:10.1175/EI208.1.
- Holland, M. M., J. Finnis, A. P. Barrett, and M. C. Serreze. 2007. Projected changes in Arctic Ocean freshwater budgets. *Journal of Geophysical Research* 112, G04S55, doi:10.1029/2006JG000354.
- Howat, I. M., I. Joughin, and T. A. Scambos. 2007. Rapid changes in ice discharge from Greenland outlet glaciers. 2007. *Science* 315(5818): 1559–1561, doi:10.1126/science.1138478.
- Howat, I. M., S. Tulaczyk, P. Rhodes, K. Israel, and M. Snyder. 2007. A precipitation-dominated, mid-latitude glacier system: Mount Shasta, California. *Climate Dynamics* 28(1), doi:10.1007/s00382-006-0178-9.
- Ling, F., and T. Zhang. 2007. Modeled impacts of changes in tundra snow thickness on ground thermal regime and heat flow to the atmosphere in Northernmost Alaska. *Global and Planetary Change* 57(3–4): 235–246, doi:10.1016/j.gloplacha.2006.11.009.
- Mahoney, A., H. Eicken, A. G. Gaylord, and L. Shapiro. 2007. Alaska landfast sea ice: Links with bathymetry and atmospheric circulation. *Journal of Geophysical Research* 112, C02001, doi:10.1029/2006JC003559.
- Mahoney, A., H. Eicken, and L. S. Shapiro. 2007. How fast is landfast sea ice? A study of the attachment and detachment of sea ice near Barrow, Alaska. *Cold Regions Science and Technology* 47: 233–255.
- Malenovský, Z., H. M. Bartholomeus, F. W. Acerbi-Junior, J. T. Schopfer, T. H. Painter, G. F. Epema, and A. K. Bregt. 2007. Scaling dimensions in spectroscopy of soil and

- vegetation. *International Journal of Applied Earth Observation and Geoinformation* 9(2): 137–164, doi:10.1016/j.jag.2006.08.003.
- Maslanik, J., S. Drobot, C. Fowler, W. Emery, and R. Barry. 2007. On the Arctic climate paradox and the continuing role of atmospheric circulation in affecting sea ice conditions. *Geophysical Research Letters* 34, L03711, doi:10.1029/2006GL028269.
- Maslanik, J. A., C. Fowler, J. Stroeve, S. Drobot, J. Zwally, D. Yi, and W. Emery. 2007. A younger, thinner Arctic ice cover: Increased potential for rapid, extensive sea-ice loss. *Geophysical Research Letters* 34(24), doi:10.1029/2007GL032043.
- Meier, W. N., J. Stroeve, and F. Fettter. 2007. Whither Arctic sea ice? A clear signal of decline regionally, seasonally, and extending beyond the satellite record. *Annals of Glaciology* 46: 428–434.
- Oelke, C., and T. Zhang. 2007. Modeling the soil thermal regime of the Tibetan Plateau. *Arctic, Antarctic, and Alpine Research* 39(4): 714–722.
- Paimazumder, D., J. Miller, Z. Li, J. E. Walsh, A. Etringer, J. McCreight, T. Zhang, and N. Mölders. 2007. Evaluation of Community Climate System Model soil temperatures using observations from Russia. *Theoretical and Applied Climatology*, doi:10.1007/s00704-007-0350-0.
- Painter, T. H., A. P. Barrett, C. Landry, J. Neff, M. P. Cassidy, C. R. Lawrence, K. E. McBride, and G. L. Farmer. 2007. Dust deposition from disturbed deserts reduces mountain snow cover duration. *Geophysical Research Letters* 34(12), L12502, doi:10.1029/2007GL030284.
- Parsons, M. A., S. L. Smith, and H. H. Christiansen. 2007. Building the IPA-IPY data legacy: An editorial. *Frozen Ground* 31.
- Parsons, M. A., and B. E. Wilson. 2007. User-driven design of a data system for the International Polar Year. *Eos, Transactions, American Geophysical Union* 88(8): 98, doi:10.1029/2007EO080010.
- Raup, B., A. Kaab, J. S. Kargel, M. P. Bishop, G. Hamilton, E. Lee, F. Paul, F. Rau, D. Soltesz, S. J. S. Khalsa, M. Beedle, and C. Helm. 2007. Remote sensing and GIS technology in the Global Land Ice Measurements from Space (GLIMS) project. *Computers and Geosciences* 33(1): 104–125.
- Raup, B., A. Racoviteanu, S. J. S. Khalsa, C. Helm, R. Armstrong, and Y. Arnaud. 2007. The GLIMS geospatial glacier database: A new tool for studying glacier change. *Global and Planetary Change* 56(1–2): 101–110, doi:10.1016/j.gloplacha.2006.07.018.
- Saito, K., M. Kimoto, T. Zhang, K. Takata, and S. Emori. 2007. Evaluating a high-resolution climate model: Simulated hydrothermal regimes in frozen ground regions and their change under the global warming scenario. *Journal of Geophysical Research* 112, F02S11, doi:10.1029/2006JF000577.
- Scambos, T. A., T. M. Haran, M. A. Fahnestock, T. H. Painter, and J. Bohlander. 2007. MODIS-based Mosaic of Antarctica (MOA) data sets: Continent-wide surface morphology and snow grain size. *Remote Sensing of the Environment* 111(2-3): 242–257, doi:10.1016/j.rse.2006.12.020.
- Schaefer, K., T. Zhang, P. P. Tans, and R. Stöckli. 2007. Temperature anomaly reemergence in seasonally frozen soils. *Journal of Geophysical Research* 112, D20102, doi:10.1029/2007JD008630.
- Serreze, M. C., A. P. Barrett, A. G. Slater, M. Steele, J. Zhang, and K. E. Trenberth. 2007. The large-scale energy budget of the Arctic. *Journal of Geophysical Research* 112, D11122, doi:10.1029/2006JD008230.
- Serreze, M. C., M. M. Holland, and J. Stroeve. 2007. Perspectives on the Arctic's shrinking sea ice cover. *Science* 315(5818): 1533–1536, doi:10.1126/science.1139426.
- Shiklomanov, N. I., O. A. Anisimov, T. Zhang, S. Marchenko, F. Nelson, and C. Oelke. 2007. Comparison of model-produced permafrost active layer fields: Results for northern Alaska. *Journal of Geophysical Research* 112, F02S10, doi:10.1029/2006JF000571.
- Slater, A. G., T. J. Bohn, J. L. McCreight, M. C. Serreze, and D. P. Lettenmaier. 2007. A multi-model simulation of pan-Arctic hydrology. *Journal of Geophysical Research* 112, G04S45, doi:10.1029/2006JG000303.

- Stroeve, J., M. M. Holland, W. Meier, T. Scambos, and M. Serreze. 2007. Arctic sea ice decline: faster than forecast. *Geophysical Research Letters* 34(9), L09501, doi:10.1029/2007GL029703.
- Stroeve, J., M. Serreze, S. Drobot, S. Gearheard, M. Holland, J. Maslanik, W. Meier, T. Scambos. 2008. Arctic sea ice extent plummets in 2007. *Eos, Transactions, American Geophysical Union* 89: 13–14.
- Tsukernik, M., D. N. Kindig, and M. C. Serreze. 2007. Characteristics of winter cyclone activity in the northern North Atlantic: insights from observations and regional modeling. *Journal of Geophysical Research* 112, D03101, doi:10.1029/2006JD007184.
- White, D., L. Hinzman, L. Alessa, J. Cassano, M. Chambers, K. Falkner, J. Francis, W. J. Gutowski, M. Holland, R. M. Holmes, H. Huntington, D. Kane, A. Kliskey, C. Lee, J. McClelland, B. Peterson, T. S. Rupp, F. Straneo, M. Steele, R. Woodgate, D. Yang, K. Yoshikawa, and T. Zhang. 2007. The Arctic freshwater system: Changes and impacts. *Journal of Geophysical Research* 112, doi:10.1029/2006JG000353.
- Wu., W., A. Lynch, S. Drobot, J. Maslanik, A. D. McGuire, and U. C. Herzfeld. 2007. Comparative analysis of the western Arctic surface climate among observations and model simulations. *Earth Interactions* 11 (6): 1–24, doi:10.1175/EI202.1.
- Yang, D. Q., Y. Y. Zhao, R. Armstrong, D. Robinson, and M. J. Brodzik. 2007. Streamflow response to seasonal snow cover mass changes over large Siberian watersheds. *Journal of Geophysical Research* 112, F02S22, doi:10.1029/2006JF000518.
- Zhang, T. 2007. Perspectives on environmental study of response to climatic and land use and land cover change over the Qinghai-Tibetan Plateau: An introduction. *Arctic, Antarctic, and Alpine Research* 39(4): 631–634.
- Zhang, T., F. Nelson, and S. Gruber. 2007. Introduction to special section: Permafrost and seasonally frozen ground under a changing climate. *Journal of Geophysical Research* 112, F02S01, doi:10.1029/2007JF000821.

Book Chapters

- Barry, R. G., R. Armstrong, T. Callaghan, J. Cherry, S. Gearheard, A. Nolin, D. Russell, and C. Zaeckler. 2007. Chapter 4, Snow. In *Global outlook for ice and snow*, ed. United Nations Environment Programme, 39–62. Hertfordshire, England: Earthprint.
- Serreze, M. C., A. P. Barrett, and A. G. Slater. 2007. Chapter 13, Variability and change in the atmospheric branch of the Arctic hydrological cycle. In *Arctic-subarctic Ocean Fluxes: Defining the Role of the Northern Seas in Climate*, eds. R. R. Dickson, J. Meincke, and P. Rhines. The Netherlands: Springer.
- Stroeve, J., and W. Maslowski. 2007. Arctic sea ice variability during the last half century. In *Climate Variability and Extremes During the Past 100 Years*, eds. S. Brönnimann, et al., 143–154. New York: Springer.

Reports

- Barry, R. G. (contributing author). 2007. *Portals to the Universe: The NASA Astronomy Science Centers*. Washington, D.C.: National Academies Press.
- Barry, R. G. (review editor), et al. 2007. Chapter 4, Observations: Changes in snow, ice and frozen ground. In *Climate Change 2007: The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, eds. S. Solomon et al., 337–384. Cambridge: Cambridge University Press.
- Barry, R. G. (review editor), et al. 2007. Chapter 15, Polar regions (Arctic and Antarctic). In *Climate Change 2007: Impacts, Adaptation and Vulnerability, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, eds. M. L. Parry et al., 653–686. Cambridge: Cambridge University Press.
- Casey, K., L. N. Connor, J. Lillibridge, L. Miller, R. Stumpf, and F. Fetterer. 2007. Chapter 3, Satellite Contributions to the Ocean Observing System for Climate. In *NOAA Office of Climate Observations Annual Report for 2007*.

- Fetterer, F. (editor). 2007. The poles. In *State of the climate in 2006*, ed. A. Arguez. *Bulletin of the American Meteorological Society* 88: S35–S45.
- Frauenfeld, O. (contributing author), et al. 2007. Chapter 4, Observations: Changes in Snow, Ice, and Frozen Ground. In *Climate Change 2007: The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, eds. S. Solomon et al., 337–384. Cambridge: Cambridge University Press.
- Lemke, P., J. Ren, R. B. Alley, I. Allison, J. Carrasco, G. Flato, Y. Fujii, G. Kaser, P. Mote, R. H. Thomas, and T. Zhang. 2007. Chapter 4, Observations: Changes in Snow, Ice, and Frozen Ground. In *Climate Change 2007: The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, eds. S. Solomon et al., 337–384. Cambridge: Cambridge University Press.
- Meier, W. N., et al. 2007. Chapter 4, Sea ice. In *Integrated Global Observing Strategy Cryosphere Theme Report—For the Monitoring of our Environment from Space and from Earth*. WMO/TD-No. 1405. Geneva: World Meteorological Organization.
- Parsons, M., et al. 2007. *Environmental Data Management at NOAA: Archiving, Stewardship, and Access*. Washington, D. C.: National Academies Press.
- Raup, B. H. (contributing author), et al. 2007. Chapter 4, Observations: Changes in Snow, Ice, and Frozen Ground. In *Climate Change 2007: The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, eds. S. Solomon et al., 337–384. Cambridge: Cambridge University Press.
- Scambos, T., et al. 2007. Antarctic. In *State of the Climate*, ed. A. Arguez. *Bulletin of the American Meteorological Society*, 88: S71–S77.
- Slater, A. G. (contributing author), et al. 2007. Chapter 8, Climate models and their evaluation. In *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, eds. S. Solomon et al., 589–662. Cambridge: Cambridge University Press.

Other Publications

- Ballagh, L. M. 2007. A first look at comparing ice thickness from two sources, 1996–1998. Master's thesis, University of Colorado at Boulder.
- Beitler, J. A., 2007: Pinpointing an invasive plant's next move. *Sensing Our Planet: NASA Earth Science Research Features*. Boulder, Colorado: National Snow and Ice Data Center.
- Beitler, J. A., 2007: Saharan dust versus Atlantic hurricanes. *Sensing Our Planet: NASA Earth Science Research Features*. Boulder, Colorado: National Snow and Ice Data Center.
- Hicks, G. 2007. Getting at groundwater with gravity. *Sensing Our Planet: NASA Earth Science Research Features*. Boulder, Colorado: National Snow and Ice Data Center.
- Husted, L. 2007. Following the World Trade Center Plume. *Sensing Our Planet: NASA Earth Science Research Features*. Boulder, Colorado: National Snow and Ice Data Center.
- Naranjo, L. 2007. After the Larsen B. *Sensing Our Planet: NASA Earth Science Research Features*. Boulder, Colorado: National Snow and Ice Data Center.
- Naranjo, L. 2007. Cloud to cloud: Forecasting storm severity with lightning. *The Earth Observer* 19(1): 10–12.
- Naranjo, L. 2007. Connecting rainfall and landslides. *Sensing Our Planet: NASA Earth Science Research Features*. Boulder, Colorado: National Snow and Ice Data Center.
- Naranjo, L. 2007. Grasping the subtle needs of vegetation. *Sensing Our Planet: NASA Earth Science Research Features*. Boulder, Colorado: National Snow and Ice Data Center.
- Renfrow, S. 2007. Burgundy through space and time. *Sensing Our Planet: NASA Earth Science Research Features*. Boulder, Colorado: National Snow and Ice Data Center.
- Renfrow, S. 2007. Can Earth's plants keep up with us? *Sensing Our Planet: NASA Earth Science Research Features*. Boulder, Colorado: National Snow and Ice Data Center.
- Renfrow, S. 2007. Pollution trials for the Beijing Olympics. *Sensing Our Planet: NASA Earth Science Research Features*. Boulder, Colorado: National Snow and Ice Data Center.

Presentations

- Armstrong, R. L., M. J. Brodzik, and M. H. Savoie. 2007. Snow cover mapping at the continental to global scale using combined visible and passive microwave satellite data. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Ballagh, L. M. 2007. A first look at comparing ice thickness from ice charts and submarine data in a GIS. Presented at the European Geosciences Union General Assembly, Vienna, Austria.
- Ballagh, L. M., and F. Fetterer. 2007. Communicating scientific buzz with GeoRSS. Presented at the Fifth International Symposium on Digital Earth, Oakland, CA.
- Ballagh, L. M., W. N. Meier, R. G. Barry, and B. P. Battenfield. 2007. Evaluating derived sea ice thickness estimates from two remote sensing data sets. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Barrett, A. P., and M. C. Serreze. 2007. Disappearing sea ice and glacier mass balance in the Arctic. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Barry, R. G., R. L. Weaver, R. L. Armstrong, and F. Fetterer. 2007. Thirty years of data management for Earth observations at the National Snow and Ice Data Center (NSIDC). Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Beitler, J. A. 2007. Not as cool as they used to be. Presented at the International Polar Year/National Science Teachers Association: Web Seminar, The Role of Polar Regions in Earth's Changing Climate System, Denver, CO.
- Brodzik, M. J., R. L. Armstrong, and M. H. Savoie. 2007. Preliminary study of local regression methods to interpolate gridded passive microwave brightness temperatures. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Brodzik, M. J., R. L. Armstrong, and M. H. Savoie. 2007. Snow cover mapping at the continental to global scale using combined visible and passive microwave satellite data. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Brodzik, M. J., R. L. Armstrong, E. C. Weatherhead, M. H. Savoie, and D. A. Robinson. 2007. Regional trend analysis of satellite-derived snow extent and global temperature anomalies. Presented at the American Association of Geographers Annual Meeting, San Francisco, CA.
- Brodzik, M. J., M. H. Savoie, and R. L. Armstrong. 2007. Comparison of Kriging and LOCFIT methods for interpolating gridded passive microwave brightness temperatures. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Cassidy, M. P., and T. H. Painter. 2007. Development of a hyperspectral method for detecting the radiative impact of desert dust on alpine snow. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Chen, R. S., R. L. Weaver, J. Schumacher, and C. Lenhardt. 2007. Assessing the scientific benefits of Earth observations through citation analysis. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Dabney, P., D. Harding, J. Abshire, A. Seas, X. Sun, C. Shuman, and T. Scambos. 2007. The Swath Imaging Multi-polarization Photon-counting Lidar (SIMPL): A pathfinder for the LIDAR Surface Topography (LIST) mission. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Davis, R. E., P. C. Knappenberger, O. W. Frauenfeld, and P. J. Michaels. 2007. Observed changes in North Atlantic hurricane frequency and intensity using a multivariate model. Presented at the Association of American Geographers Annual Meeting, San Francisco, CA.
- Domack, E., T. A. Scambos, M. Vernet, and E. Rignot. 2007. Proposed and ongoing IPY activity in the Antarctic Peninsula. Presented at the European Geosciences Union General Assembly, Vienna, Austria.
- Duerr, R. 2007. Earth science data preservation. Presented at the University of Illinois at Urbana-Champaign, Urbana, IL.
- Duerr, R. 2007. Renegotiating the peer review process: Disseminating observational results in an age of instant access. Presented at the CIRES Symposium, Boulder, CO.
- Duerr, R., M. Folk, M. Yang, C. Lynnes, and P. Cao. 2007. Towards long-term archiving of NASA HDF-EOS and HDF data—data maps and use of mark-up language. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.

- Duerr, R., M. Folk, M. Yang, C. Lynnes, and P. Cao. 2007. Towards long-term archiving of NASA HDF-EOS and HDF data—data maps and the use of mark-up language. Presented at the HDF Workshop XI, Landover, MD.
- Duerr, R., M. Parsons, and R. Weaver. 2007. VOiGs in the context of data stewardship. Presented at the Virtual Observatories in Geosciences Conference, Denver, CO.
- Duerr, R., and A. Wallace. 2007. The International Polar Years—creating access to 125 years of polar research. Presented at the Special Libraries Association Annual Conference, Denver, CO.
- Duerr, R., and A. Wallace. 2007. The reason for DAHLI: Making the holdings of historic IPY information accessible to all. Presented at the Geological Society of America Annual Meeting, Denver, CO.
- Fetterer, F., W. Meier, and J. Stroeve. 2007. Summer 2007: Sea ice on the threshold of a new climate state. Presented at the International Ice Charting Working Group Science Workshop, Frascati, Italy
- Fetterer, F., J. Moore, M. Parsons, D. Middleton, M. Ramamurthy, and R. Barry. 2007. A cooperative Arctic data and information service for one Arctic observing network. Presented at the 1st IPY Workshop on Sustaining Arctic Observing Networks, Stockholm, Sweden.
- Frauenfeld, O. W., T. Zhang, A. J. Etringer, and H. Teng. 2007. 21st century projections of the Northern Hemisphere freezing/thawing index. Presented Association of American Geographers Annual Meeting, San Francisco, CA.
- Frauenfeld, O. W., T. Zhang, A. J. Etringer, and H. Teng. 2007. How well do the IPCC AR4 models represent permafrost regions? A comparison between the observed and modeled freezing/thawing index for the 20th century. Presented at the International Union of Geodesy and Geophysics XXIV General Assembly, Perugia, Italy.
- Frauenfeld, O. W., T. Zhang, A. J. Etringer, and H. Teng. 2007. Reliability of the IPCC AR4 models: A 20th century intercomparison of the freezing/thawing index. Presented at the CIRES Symposium, Boulder, CO.
- Fricker, H. A., T. Scambos, R. Bell, R. Bindshadler, and B. Smith. 2007. Subglacial water distribution and transfer in Antarctica mapped with ICESat and image differencing. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Gallaher, D. 2007. NSIDC sea ice. Presented at the NREL Energy Forum, Golden, CO.
- Gearheard, S., A. R. Mahoney, H. Huntington, T. Oshima, T. Qillaq, and R. G. Barry. 2007. Community-based sea ice thickness observatories in the Arctic. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Geiger, C., F. Fetterer, and W. Meier. 2007. Sea ice thickness measurements—data management considerations. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Ghatak, D., A. Frei, J. Stroeve, and J. McCreight. 2007. Detecting and attributing a climate change signal to the Arctic sea ice extent. Presented at the Association of American Geographers Annual Meeting, San Francisco, CA.
- Glasser, N. F., and T. A. Scambos. 2007. A structural glaciological analysis of the 2002 Larsen B Ice Shelf collapse. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Haran, T. M., and T. A. Scambos. 2007. Enhancing a RADARSAT/ICESat digital elevation model of West Antarctica using MODIS imagery. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Hendrikx, J., M. P. Clark, A. G. Slater, and A. B. Tait. 2007. Observations, process studies, and modeling of seasonal snow in New Zealand. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Herzfeld, U. C., S. Williams, and J. Maslanik. 2007. Sea-ice roughness, morphogenesis and kinematics—Approaches to learn from the complexity of sea ice. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Howard, A. M., L. M. Ballagh, G. J. Hicks, and D. J. Scott. 2007. Tracking climate change in the 21st century: Supporting research with historic photographs and Google Earth. Presented at the Special Libraries Association, Denver, CO.

- Howat, I. M., B. Smith, I. Joughin, and T. Scambos. 2007. The rate of ice sheet mass-loss from southeast Greenland from combined GLAS and ASTER observations. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Ibbitt, R. P., M. P. Clark, R. A. Woods, X. Zheng, A. G. Slater, D. E. Rupp, J. Schmidt, and M. Uddstrom. 2007. Hydrological data assimilation with the ensemble Kalman filter: Use of streamflow observations to update states in a distributed hydrological model. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Johansson, M., H. Lantuit, and O. W. Frauenfeld. 2007. The Permafrost Young Researchers Network (PYRN): Contribution to IPY's "Thermal state of permafrost." Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Kaminski, M., C. Judy, F. Fetterer, and D. Scott. 2007. Scientific data management: Options for research projects. Presented at the European Geosciences Union General Assembly, Vienna, Austria.
- Khalsa, S. S., V. B. Aizen, A. B. Surazakov, and E. M. Aizen. 2007. Changes in seasonal snow cover in Tien Shan during the MODIS period of record. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Korn, D., T. Scambos, T. Haran, D. Fowler, J. Zwally, and J. DiMarzio. 2007. Ice, Cloud, and Land Satellite (ICESat) digital elevation models (DEMs) of Greenland and Antarctica at NSIDC. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Landry, C. C., T. H. Painter, A. P. Barrett, and M. Cassidy. 2007. Toward standardization in methods and techniques for measuring and monitoring snowcover albedo. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Lawrence, D., and A. Slater. 2007. Modeling permafrost and permafrost-related climate-change feedbacks in a GCM: Sensitivity to soil column depth and representation of soil organic matter. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Lokupitiya, E. Y., S. Denning, K. Paustian, I. Baker, and K. Schaefer. 2007. Using crop specific phenology models coupled with the Simple Biosphere Model (SiB) for improved prediction of land-atmosphere exchanges across the midcontinental region of North America. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Mahoney, A. R., R. G. Barry, and F. Fetterer. 2007. 20th century Russian ice variability: results from a new digital data set. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Marshall, H., A. Gleason, C. Landry, and J. McCreight. 2007. Snow depth and snow water equivalent distribution in a high alpine basin: quantifying the length scales and magnitudes of variation in Senator Beck Basin, Colorado. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Marshall, H.-P., N. Rutter, G. Koh, S. O'Neel, and J. McCreight. 2007. Ground-based FMCW radar measurements of dry snowpacks during the 2006–07 NASA CLPX field experiment. Presented at the Eastern Snow Conference, St. Johns, Newfoundland, Canada.
- Marshall, J. J., S. W. Berrick, A. Bertolli, H. Burrows, V. E. Delnore, R. R. Downs, Y. Enloe, S. Falke, M. Folk, N. Gerard, R. Gerard, M. Hunter, T. Jasmin, D. McComas, S. Samadi, M. Sherman, R. Swick, C. Tilmes, and R. E. Wolfe. 2007. A community-developed measurement of the reusability of software through reuse readiness levels. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Maslanik, J. A., C. Fowler, J. Stroeve, S. Drobot, H. J. Zwally, and D. Yi. 2007. A younger and thinner multiyear ice pack: Significance for extreme, accelerated and sustained losses of Arctic sea ice cover. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Maurer, J. 2007. Atlas of the Cryosphere: Mapping the Earth's frozen regions on the Internet. Presented at the IPY GeoNorth First International Circumpolar Conference on Geospatial Sciences and Applications, Yellowknife, Northwest Territories, Canada.
- Maurer, J. 2007. Atlas of the Cryosphere: A Web map service for the Earth's frozen regions. Presented at the Geoinformatics 2007 Conference, San Diego, CA.

- Maurer, J., and K. Steffen. 2007. Local-scale snow accumulation variability on the Greenland ice sheet from ground-penetrating radar (GPR). Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- McCaffrey, M. S., and M. A. Parsons. 2007. International Polar Year Data Information Service. Presented at the ARCUS Annual Meeting and Arctic Forum, Washington, DC.
- McNeave, C. K. 2007. ELOKA briefing for the Hamlet of Sanikiluaq. Presented at the Hamlet of Sanikiluaq and the Nunavut Hudson Bay Inter-Agency Working Group (NTK), Sanikiluaq, Canada.
- McNeave, C. K. 2007. ELOKA partner meeting. Presented at the Aleut International Association, Anchorage, AK.
- Meier, W. N. 2007. Climate change on the fast track: An Arctic in transformation. Presented at the Foundation for American Communications Seminar for Journalists, Nashville, TN.
- Meier, W. N. 2007. Climate change on the fast-track: An Arctic in transformation. Presented at the National Science Teachers Association Denver Area Conference, Denver, CO.
- Meier, W. N. 2007. Current sea ice activities and recent developments at NSIDC. Presented at the European Ocean and Sea Ice Satellite Application Facility Workshop, Boulder, CO.
- Meier, W. N., H. Stern, and F. Fetterer. 2007. Operational sea ice charts: A new tool to evaluate passive microwave estimates of Arctic sea ice and interannual variability. Presented at the International Union of Geodesy and Geophysics XXIV General Assembly, Perugia, Italy.
- Meier, W.N., and J. Stroeve. 2007. Analysis of passive microwave and enhanced-resolution scatterometer sea ice estimates. Presented at the International Union of Geodesy and Geophysics XXIV General Assembly, Perugia, Italy.
- Meier, W. N., and J. Stroeve. 2007. Combined enhanced resolution passive microwave and scatterometer sea ice fields. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Meier, W.N., J. Stroeve, and F. Fetterer. 2007. Whither Arctic sea ice? Presented at the AccessData Workshop, Marlborough, MA.
- Meier, W. N., E. Youngman, L. Dahlman, and T. Ledley. 2007. Whither Arctic sea ice? – An Earth Exploration Toolbook chapter on the climate’s canary in a coal mine. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Menard, C. B., H. Lantuit, and O. W. Frauenfeld. 2007. The Permafrost Young Researchers Network (PYRN): Education and outreach for the International Polar Year (2007–2008) and beyond. Presented at the International Union of Geodesy and Geophysics XXIV General Assembly, Perugia, Italy.
- Moore, J., F. Fetterer, D. Middleton, M. Ramamurthy, and R. Barry. 2007. The Arctic Observing Network (AON) Cooperative Arctic Data and Information Service (CADIS). Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Parsons, M. A. 2007. The challenge of and approach to IPY data management—building the legacy. Presented at the IPY GeoNorth First International Circumpolar Conference on Geospatial Sciences and Applications, Yellowknife, Northwest Territories, Canada.
- Parsons, M. A. 2007. Data and scientists in a sustained Arctic observing network. Presented at the International Polar Year (IPY) workshop on Sustaining Arctic Observing Networks, Stockholm, Sweden.
- Parsons, M. A. 2007. Data sharing, access, and archiving in IPY. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Parsons, M. A. 2007. Data sharing in IPY: Policy, practice, and services. Presented at the Government of Canada Program for IPY Researchers Workshop, Gatineau, Quebec, Canada.
- Parsons, M. A. 2007. Exploring the new world of the Arctic: Change, trust, and data. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Parsons, M. A. 2007. Information technology vision for data synthesis. Presented at the Arctic System Synthesis Workshop: New Perspectives through Data Discovery and Modeling, Seattle, WA.
- Parsons, M. A. 2007. The International Polar Year Data and Information Service—building a network of sharing, trust, and meaning. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.

- Parsons, M. A. 2007. A polar perspective on IGY+50 and eGY. Presented at the International Union of Geophysics and Geodesy XXIV General Assembly, Perugia, Italy.
- Parsons, M. A., R. Duerr, R. Weaver, and V. Papitashvili. 2007. Data for the ages: Data's role in science over the 125-year history of IPY. Presented at the International Union of Geophysics and Geodesy XXIV General Assembly, Perugia, Italy.
- Racoviteanu, A., Y. Arnaud, M. W. Williams, and S. S. Khalsa. 2007. Glacier changes in the Cordillera Blanca, Peru, derived from SPOT5 imagery, GIS, and field-based measurements. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Raup, B. H., S. S. Khalsa, and R. Armstrong. 2007. The GLIMS glacier database. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Savoie, M. H., J. Wang, M. J. Brodzik, and R. L. Armstrong. 2007. Atmospheric corrections for improved passive microwave snow cover retrievals over the Tibet Plateau. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Scambos, T. A. 2007. Coupling at the boundaries: Ice streams, ice shelves, icebergs, and oceans. Presented at the Gordon Research Conferences: Polar Marine Science, Ventura, CA.
- Scambos, T. A. 2007. IPY and the Antarctic Peninsula: Past changes and future goals. Presented at the Boulder Public Library, Boulder, CO.
- Scambos, T. A., and R. Bauer. 2007. Using drifting icebergs to study climate change. Presented at the International Polar Year Ice Fest, Boulder, CO.
- Scambos, T. A., J. Bohlander, T. Haran, R. Ross, and R. Bauer. 2007. Antarctic tabular iceberg evolution during northward drift: a proxy system for studying ice shelf breakup. Presented at the 10th International Symposium on Antarctic Earth Science, Santa Barbara, CA.
- Scambos, T., T. Haran, M. Frezzoti, K. Jezek, D. Long, and K. Farness. 2007. Mapping East Antarctic snow accumulation at high resolution from space. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Scambos, T. A., J. Stroeve, J. Bohlander, and M. Serreze. 2007. Changes in Arctic sea ice since 2000. Presented at the IPY GeoNorth First International Circumpolar Conference on Geospatial Sciences and Applications, Yellowknife, Northwest Territories, Canada.
- Scambos, T., J. Stroeve, W. Meier, J. Bohlander, and M. Serreze. 2007. Changes in Arctic sea ice extent since 2000: The record, and the forecast. Presented at the International Society for Photogrammetry and Remote Sensing (ISPRS) 1st International Circumpolar Conference on Geospatial Sciences and Applications, Yellowknife, Canada.
- Scambos, T. A., J. Stroeve, M. Serreze, and W. Meier. 2007. Notes on an ongoing catastrophe: sea ice in 2007. Presented at the Boulder Public Library, Boulder, CO.
- Schaefer, K., T. Zhang, I. Baker, and L. Lu. 2007. Interactions between snow cover, frozen soils, and the carbon cycle. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Schaefer, K., T. Zhang, P. Tans, and R. Stöckli. 2007. Temperature anomaly reemergence in seasonally frozen soils. Presented at the Community Climate System Model Workshop, CO.
- Serreze, M. C. 2007. Arctic climate change: Where reality exceeds expectations. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Serreze, M.C. 2007. The basis of recent climate change. Presented at the Wildlife Society, Tucson, AZ.
- Serreze, M. C. 2007. Moving toward a seasonally ice-free Arctic Ocean. Presented at the University of Chicago, IL.
- Serreze, M.C. 2007. Moving toward a seasonally ice-free Arctic Ocean. Presented at McGill University, Montreal, Canada.
- Slater, A. G., M. P. Clark, and J. L. McCreight. 2007. An assessment of SNODAS data for hydrologic forecasting. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Slater A. G., M. P. Clark, and J. L. McCreight. 2007. Uncertainty and complexity in snow hydrology models. Presented at the International Union of Geodesy and Geophysics XXIV General Assembly, Perugia, Italy.

- Stroeve, J. 2007. Future of Arctic sea ice. Presented at the science briefing to the U. S. former Vice President Al Gore, NSIDC, Boulder, CO.
- Stroeve, J. 2007. Stories from the edge of the world. Presented as the Macky Preconcert Talk: First Person: Stories from the Edge of the World, Boulder, CO.
- Stroeve, J., C. Fowler, and J. Maslanik. 2007. Relationships between sea ice age and GLAS-derived ice thickness. Presented at the ICESat-II Meeting, Baltimore, MD.
- Stroeve, J., A. Frei, J. McCreight, D. Ghatak. 2007. Arctic sea ice variability revisited. Presented at the International Union of Geodesy and Geophysics XXIV General Assembly, Perugia, Italy.
- Stroeve, J., M. M. Holland, W. Meier, T. Scambos, and M. Serreze. 2007. Arctic sea ice decline, faster than forecast. Presented at the CIRES Symposium, Boulder, CO.
- Stroeve, J., M. M. Holland, W. Meier, T. Scambos, and M. Serreze. 2007. Arctic sea ice decline, faster than forecast. Presented at the European Geosciences Union General Assembly, Vienna, Austria.
- Swick, R., and L. M. Ballagh. 2007. Climate change in Google Earth. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Thomas, D., S. S. Khalsa, S. Nativi, T. Ahern, and R. Shibasaki. 2007. Processes for achieving interoperability in GEOSS. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Weaver, R. L. S., J. Collins, and C. Judy. 2007. The World Data Center for Glaciology Boulder and National Snow and Ice Data Center Data at age 30: A vision for the future. Presented at the International Union of Geodesy and Geophysics XXIV General Assembly, Perugia, Italy.
- Weaver, R. L. S., D. Fowler, R. Duerr, and A. Leon. 2007. NSIDC DAAC data sets and proposed services to the IPY community. Presented at the Canadian Meteorological Oceanographic Society (CMOS) - Canadian Geophysical Union - American Meteorological Society Congress 2007, St. Johns, Newfoundland, Canada.
- Weaver, R. L. S., M. Kaminski, and L. Ballagh. 2007. NSIDC DAAC data sets and services for the IPY. Presented at the European Geosciences Union General Assembly, Vienna, Austria.
- Wood, K., J. Overland, and F. Fetterer. 2007. Enduring science: The heritage of the first International Polar Year, 1882–1883. Presented at the Geological Society of America Annual Meeting, Denver, CO.
- Yang, M., and R. Duerr. 2007. Storing EOS data using HDF5 Archival Information Package (AIP). Presented at the HDF Workshop XI, Landover, MD.
- Yang, D., Y. Zhao, R. Armstrong, D. Robinson, and M. Brodzik. 2007. Streamflow response to seasonal snow cover changes over large Siberian watersheds. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Zhang, T. 2007. Interactions and feedbacks between the cryosphere and climate system. Presented at the Annual Symposium of the National Key Laboratory of Cryosphere, Chinese Academy of Sciences, Lanzhou, China.
- Zhang, T. 2007. Permafrost degradation in the Northern Hemisphere. Presented at the science briefing to the U. S. former Vice President Al Gore, NSIDC, Boulder, CO.
- Zhang, T. 2007. Riding the Tibet Express—railroad construction and permafrost across the Tibetan Plateau. Presented at the 25th Annual Conference of the Rocky Mountain Chinese Society of Science and Engineering, Denver, CO.
- Zhang, T., and O. Frauenfeld. 2007. Impact of land use/land cover change on climate over the Tibetan Plateau. Presented at the Workshop on Qionghai-Tibetan Plateau Studies, Lanzhou, China.
- Zhang, T., and K. Schaefer. 2007. Soil temperature reemergence in permafrost. Presented at the American Geophysical Union Fall Meeting, San Francisco, CA.
- Zhang, T., and D. Yang. 2007. Hydrological response to changes in active layer and permafrost conditions in the Russian Arctic. Presented at the Asia-CliC Workshop, Yokohama, Japan.
- Zhang, T., D. Yang, O. W. Frauenfeld, L. Hinzman, A. Etringer, J. McCreight, D. Gilichinsky, and R. G. Barry. 2007. Hydrological response to changes in active layer and permafrost conditions in the Russian Arctic. Presented at the 7th International Conference on Global Change: Connection to the Arctic (GCCA-7), Fairbanks, AK.

Zhang, T., D. Yang, O. W. Frauenfeld, L. Hinzman, A. J. Etringer, J. McCreight, D. Gilichinsky, and R. G. Barry. 2007. Hydrological response to changes in active layer and permafrost. Presented at the International Union of Geodesy and Geophysics XXIV General Assembly, Perugia, Italy.

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