

***NATIONAL SNOW AND ICE  
DATA CENTER***

***WORLD DATA CENTER-A  
FOR GLACIOLOGY***



***ANNUAL*** \_\_\_\_\_ ***1995***  
***REPORT***

The cover photograph shows the Italian Dolomites and the village of Cortina in 1905. It is a print of a glass plate negative made by Henry Fielding Reid. It is a part of the Glacier Photograph Collection at the World Data Center-A for Glaciology. This collection comprises over 10,000 photographs, both aerial and terrestrial, taken between the 1880s and 1975, primarily in Alaska, northwest Canada, and the Alps.

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# ANNUAL REPORT

1995

*National Snow and Ice Data Center  
World Data Center-A for Glaciology*

# NSIDC/WDC ANNUAL REPORT - FY 1995

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# **NATIONAL SNOW AND ICE DATA CENTER/ WORLD DATA CENTER-A FOR GLACIOLOGY**

## **ANNUAL REPORT FY1995**

### **INTRODUCTION**

The National Snow and Ice Data Center (NSIDC)/World Data Center-A for Glaciology (WDC) is operated under a cooperative agreement between the University of Colorado, Cooperative Institute for Research in Environmental Sciences (CIRES), and the National Environmental Satellite, Data, and Information Service (NESDIS) of NOAA. Within CIRES, NSIDC/WDC is a part of the Cryospheric and Polar Processes division. NSIDC/WDC is completing its nineteenth year of service to the snow and ice research community from its Boulder location.

NSIDC/WDC is committed to make fundamental contributions to cryospheric science and to excel in managing data and disseminating information to advance understanding of the Earth system. The role of the NSIDC/WDC is to acquire, archive and disseminate data relating to all forms of snow and ice, within the context of the ICSU guidelines for international data exchange (ICSU, 1987) and NOAA's mission. Examples of such activities undertaken to achieve this include the acquisition and dissemination of global environmental satellite data, data on earth surface properties, including snow cover, on ocean variables, including sea ice extent and on paleoclimates, with ice core information. These data sets serve as cryospheric components in interdisciplinary global change research. Complementing these data management activities, NSIDC carries on an active research program. Scientists are involved in both data management and application of the data to research endeavors.

NSIDC/WDC is funded by various federal agencies, including the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), and the National Science Foundation (NSF). Some of the data management and administrative functions are supported by NOAA, with major project support from all the above mentioned agencies.

This report discusses NSIDC/WDC activities for the 1995 fiscal year (October 1, 1994 to September 30, 1995).

## HIGHLIGHTS

### EURASIAN GLACIER INVENTORY

The Eurasian glacier inventory, containing information for over 25,000 glaciers within the Former Soviet Union (FSU) and the People's Republic of China (PRC), is now available from NSIDC. (See Figure 1). Parameters within the inventory include: geographic location, area, length, orientation, elevation, and classification of morphological type and moraines. These data represent the digital version of thousands of handwritten records, digitized at the Institute of Geography/World Data Center-B for Glaciology, Moscow, and the World Data Center-D for Glaciology (WDC-D) in Lanzhou, China. Dr. Chen Xianzhang, a visiting scientist at NSIDC from WDC-D, completed digitizing data from the Qilian Shan, the Tien Shan, the Altai and the Pamirs during his visit here (May 1995 through February 1996), supported by the Chinese Academy of Sciences and CIRES.

The acquisition of these data and the development of the data product was funded through NOAA's Earth System Data and Information Management (ESDIM) data rescue initiative.

The Eurasian Glacier Inventory is available in ASCII files and is distributed both on diskette and electronically. The electronic data are available via ftp at <ftp.ngdc.noaa.gov> in the Snow\_Ice/Glaciers directory. The inventory is also available via the World Wide Web at [http://www-nsidc.colorado.edu/NSIDC/data\\_announcements](http://www-nsidc.colorado.edu/NSIDC/data_announcements).

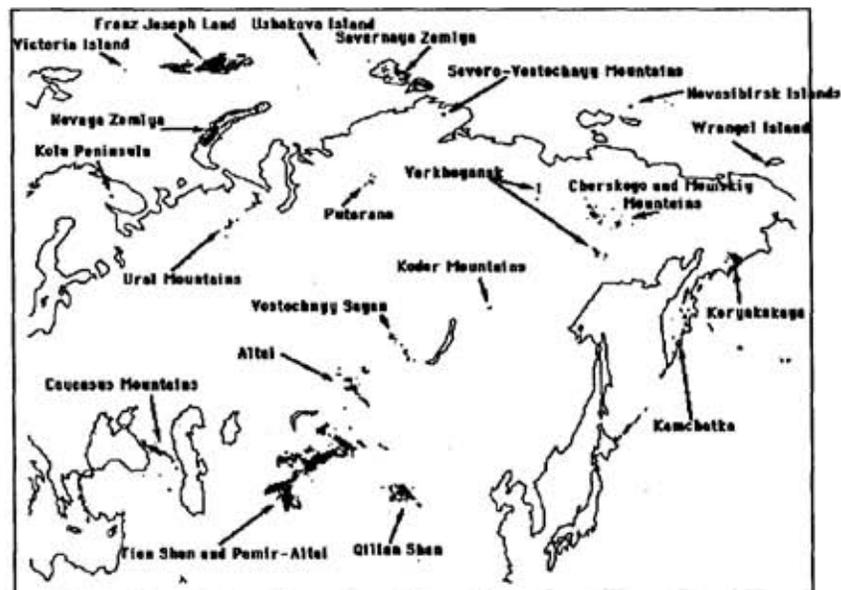


Figure 1. Current areas of coverage in the Eurasian Glacier Inventory.

## **WORLD WIDE WEB**

NSIDC began offering information through the World Wide Web in February 1994. In 1995, our presence on the Internet grew substantially, and we now maintain a host of services to facilitate user access and data use. Information includes data set user's guides and descriptive catalog listings, educational resources related to snow and ice, pages on projects currently supported by NSIDC, such as the Arctic System Science data coordination work, a gallery of satellite browse images, and the text of many of NSIDC's publications, including *NSIDC Notes* and *New Accessions List*. Our web pages also contain forms for contacting NSIDC User Services or to submit bibliographic information.

Interest in our Web site exploded in 1995. For instance, the total number of files transmitted during December 1994 was 5,175, with an average number of 168 files being transmitted daily. By December 1995, the total number of files transmitted over the month had grown to 41,760, with an average number of 1,347 files being transmitted daily. The site attracts an international audience, and shows concentrations of users in commercial, education, and government sectors.

## **SEA ICE DATA**

Gridded sea ice parameters, compiled by the Arctic and Antarctic Research Institute (AARI), St. Petersburg, Russia, are now available. The data were provided to NSIDC as part of a data exchange program sponsored by the World Meteorological Organization (WMO) for the purpose of developing a Global Digital Sea Ice Data Bank (GDSIDB) of the World Climate Program and the World Climate Research Program. Recently, support has also been received from the NOAA/ESDIM Project.

The AARI data were digitized from integrated sea ice charts generated by the operational division of AARI. The charts are produced through the assimilation and analysis of visual and instrumental aircraft observations and satellite data acquired by AARI during 10-day periods. Analysis of ice conditions in the Arctic is divided into two regions: the Western sector extends from 24°W to 110°E longitude with a minimum latitude of 68°N and the Eastern sector extends from 105°E to 230°E longitude with a minimum latitude of 60°N. Among the sea ice parameters obtained during the analysis of these sectors are total concentration, stage of development which includes new, first-year and multi-year stages, and form of ice.

The digitized data are converted into the SIGRID format, the WMO standard adopted by the WMO Commission for Marine Meteorology for the archival and exchange of digital sea-ice data. The minimum spatial resolution of the data stored in the SIGRID format is 15 minutes. NSIDC has received data for 1967 - 1990 from AARI for both sectors.

#### **SNOW DEPTH DATA**

The first ESDIM-funded CD-ROM of Historical Soviet Daily Snow Depth (HSDSD) was completed. These data were received through the US/USSR Bilateral Working Group 8 Data Exchange. HSDSD is based upon observations made by personnel at a series of 284 World Meteorological Organization stations throughout the Former Soviet Union. The earliest operational stations began recording snow depth in 1881 and the data continue until 1985. The geographic distribution of stations is primarily in the midlatitudes of Eurasia (35°-75°N and 20°-180°E) and corresponds to inhabited areas. They range in altitude from 15m below sea level (in Central Asia) to 2100 meters.

The daily data, as well as NSIDC-generated monthly means, are available on a single CD-ROM containing ASCII data files, extraction software, and data documentation.

## **CURRENT PROGRAMS**

The ongoing activities of NSIDC/WDC fall into three broad inter-related areas: 1) data - archiving, managing, disseminating; 2) projects - limited-scope or defined-period activities relating to specific data sets; 3) research/scientific study which expands our knowledge of the role of the cryosphere in the global climate system. Staff members are often involved in a variety of complementary activities.

### **DATA ACTIVITIES**

#### ***Data Set Administration***

The following data sets were added or updated in FY95.

1. Monthly Arctic and Southern Ocean Sea Ice Concentration data, 1901-1990, recently received from John Walsh, University of Illinois, now incorporate the Arctic data originally compiled by P.M. Kelly at University of East Anglia.
2. Updates for 1995 to the International Ice Patrol database of icebergs in the northwestern Atlantic were received and placed on-line. The total length of record is now 1961-1995.
3. The ASCII files extracted from the old System 2000 Univac CITATION database for the WDC-A/NSIDC permafrost bibliographies were re-formatted for INMAGIC. This will allow us to make available a complete, merged permafrost bibliography, 1978-1992, if there is sufficient interest.
4. Two diskettes containing Central Asian monthly snow cover data were received from Dr. B. Tsarev, Central Asian Hydrometeorological Research Institute (SANIGMI), Tashkent. These data are primarily from the 1960s to 1990, however there are a few stations with records back to the 1930s.
5. Raw ARGOS data for 1992 and January - August 1993, from the International Arctic Buoy Program, Polar Science Center (PSC), University of Washington, were archived on 3480 cartridges. Some missing data from 1988 for the ARGOS ice buoys for the Beaufort and Bering seas were received from Dr. C. Pease, NOAA/Pacific Marine Environmental Laboratory (PMEL). C. Haggerty, at NSIDC, is working on code to integrate these new data into the archive for 1988 and 1989. This provides the "deep archive" for this input data stream for the PSC gridded temperature, pressure, and ice velocity products.
6. Estonian snow depth data for 1891 - 1990 was received from J. Jaagus, Tallinn, in exchange for the Historical Soviet Snow Depth CD-ROM.

7. Chinese snow depth data, 1979 to 1990, were received from WDC-D. These data have both daily and end of month values from 71 stations, primarily in southwest China.

### ***Information Center and CITATION Data Base***

To support the research activities of the Center's scientific staff, to document the data holdings, and to meet the increasing demands for information on cryosphere climate studies on a global-scale, NSIDC/WDC maintains an active program to acquire published materials on snow, ice and permafrost research.

Currently, the Information Center contains 6,750 monographs and technical reports and 15,750 reprints; 90 serial publications are regularly received. During 1995, approximately 1,250 items were added to the collection.

All materials received are catalogued and assigned subject and geographic descriptors, including articles in journals and individual papers in conference proceedings. Primary access to the collection is provided by CITATION, the in-house on-line catalog. We are now using INMAGIC and SearchMAGIC software at NSIDC, which allows CITATION to be implemented in-house. SearchMAGIC, a user-friendly system for searching the data base and preparing reports, has been installed in the Information Center.

At the end of FY95, there were over 33,000 records in the data base. The file is updated regularly. The subject headings in CITATION are those used by the Cold Regions Research and Engineering Laboratory in their CRREL bibliography and COLD data base. Our collection holds materials on all aspects of snow and ice research, but particularly snow cover and sea ice data and information and the effects of the cryosphere on climate. On-line searches of the collection are performed on request.

Bibliographic access to the information holdings of NSIDC/WDC for the snow and ice community is also available through CD-ROM. The entire data base is included on the Arctic and Antarctic Regions disc produced by the National Information Services Corporation (NISC) and updated semi-annually. Currently, the disc holds over 750,000 references on various aspects of polar regions science and technology. Data have been contributed by the Cold Regions Bibliography Project and NSIDC/WDC (U.S.), the Arctic Science and Technology Information System, the Centre for Cold Ocean Resources Engineering, the Department of Indian and Northern Affairs, Northern Development, the Yukon Bibliography and two data bases from the Canadian Circumpolar Institute (Canada) and the Scott Polar Research Institute (U.K.). This disc provides access to the most

comprehensive bibliographic collections of polar regions science in the world.

### ***Publication Program***

Two series, *New Accessions List* and *Glaciological Data*, have been published by NSIDC/WDC since 1977. *New Accessions List* (NAL), a product of the CITATION data base, is a quarterly list of documents, categorized by subject, received and catalogued during a given period. This publication which fills much of the information exchange role stipulated by World Data Center System guidelines is mailed worldwide to about 350 scientists, research institutions, and libraries. One issue, comprising four quarterlies for 1994, was printed and distributed in FY95.

*Glaciological Data* (GD) is the principal publication of NSIDC/WDC. Issues usually focus on a single topic and include specialized bibliographies, inventories and survey reports, and workshop proceedings relating to snow and ice data/research prepared by NSIDC/WDC staff, as well as invited or contributed articles on data sets, data collection and storage, methodology, and terminology in glaciology. Current circulation of GD is approximately 950 copies, 50 percent of which are mailed to addresses outside the United States, generally in exchange for publications submitted to the WDC. Whenever possible, GD publication costs are obtained through specific agency or project support.

One volume in this series was published in 1995. *Glaciological Data, Report GD-28, Workshop on Permafrost Data Rescue and Access* (Barry et al., 1995) was published in cooperation with the International Permafrost Association Working Group on Permafrost Data and Information. *GD-28* describes the activities and results of the workshop held in Oslo, Norway, 3-5 November 1994. It reports on the priorities established for permafrost data according to their use for detecting global change, modeling, engineering design, process understanding and impact evaluation. An implementation plan developed for a Global Geocryological Database (GGD) with national or regional nodes is also described. (See p. 17 for more information about GGD.) Russian data at risk are targeted as a first priority and the report identifies critical data sets and next steps. *GD-28* also includes an inventory of Russian maps of permafrost and a list of major Russian organizations that hold permafrost data. *GD-28* was distributed to a mailing list of about 1,000 individuals and organizations.

One volume in the *NSIDC Special Report* series was published in 1995, Fallot, J.M. "Variations of mean cold season temperature, precipitation and snow depths observed during the last 100 years in

the Former Soviet Union." This report was completed by Dr. Fallot, on a grant from the Swiss National Foundation for Scientific Research, during postdoctoral work at NSIDC using data recently obtained from the Former Soviet Union.

Four issues of *NSIDC Notes*, a quarterly newsletter, were distributed in FY95. The mailing list for this series continues to grow. This year, circulation has increased almost 40%; over 900 copies are distributed to a worldwide audience. *NSIDC Notes* provides information about activities at NSIDC including the NSIDC Distributed Active Archive Center (DAAC), the Arctic System Science (ARCSS) data management project, DMSP OLS digital and analog data distribution, passive microwave data distribution, and research projects underway. It also offers information from other centers which we think is useful to our audience. This newsletter is part of NSIDC's commitment to foster communication within the cryospheric research community.

#### ***Data-Related Committees***

WDC/NSIDC staff participates in numerous data-related national and international working groups, several of which are listed below. For a complete list of committee involvement and meetings attended, please see p. 47-53.

#### ***Arctic System Science (ARCSS) Ocean-Atmosphere-Ice Interactions (OAI) Steering Committee***

NSIDC provides data management services for three components Ocean-Atmosphere-Ice Interactions (OAI), Land-Atmosphere-Ice Interactions (LAI), and Greenland Ice Sheet Program (GISP2) of the ARCSS Program. Dr. Dave McGinnis is now the Project Manager. Claire Hanson handed over responsibility to Dave effective 8/95.

#### **Arctic Environmental Data Directory (AEDD) Working Group**

C. Hanson, A. Brennan and R.G. Barry are members of the AEDD Working Group, an activity sponsored by the Interagency Working Group on Data Management for Global Change to enhance the accessibility of Arctic data collected by U.S. agencies and organizations. The group meets annually, with periodic teleconferences to address issues of directory format, content, and population.

#### **International Arctic Environmental Data Directory**

R.G. Barry and C. Hanson are U.S. alternate delegates to the International Arctic Environmental Data Directory Steering Committee. This committee is the result of an initiative put forward by USGS and UNEP/GRID-Arendal to develop a "directory of

directories" based on existing DIF-based activities such as the Global Change Master Directory (GCMD). The group has members from Canada, Finland, Norway, Russia, the U.S., New Zealand (the SCAR liaison), and has met in Arendal, Norway, San Francisco, and Trømsø, Norway. The main focus of the activity is environmental data. Iceland, Sweden and Denmark will be invited to join the Steering Committee; the Ministry of Environment Protection of Russia is actively involved in the group.

#### U.S. Polar Bibliographic Working Group

This group, sponsored by the National Science Foundation, aims to ensure effective access to polar regions information for the user community. The group has prepared an update to *Arctic Information and Data: a Guide to Selected Resources* which will be published in FY96 with printing support from the Arctic Research Consortium of the U.S. Ann Brennan is a member of the Working Group.

#### SCAR-COMNAP ad hoc Planning Group on Antarctic Data Management

Claire Hanson is the U.S. representative to the SCAR-COMNAP ad hoc Planning Group on Antarctic Data Management. In November 1994, she briefed the Interagency Working Group on Global Environmental Affairs, Antarctic Subgroup, on recommendations for development of a U.S. Antarctic Data Coordination activity. Based on recommendations of the SCAR-COMNAP ad hoc Planning Group on Antarctic Data Management, SCAR and COMNAP issued a call for SCAR countries to designate a national coordinator and/or center to focus the activity of writing data descriptions for existing and new Antarctic data sets. These descriptions are to be made accessible through an Antarctic node of the International Directory Network. Representatives of the Interagency Working Group recommended that NSF/OPP/Polar Science Section convene a program-level meeting at which the Global Change Master Directory Coordinator (L. Olsen, NASA/GSFC) would present an overview of GCMD "discipline coordinator" capabilities that might be expanded to include a U.S. Antarctic focus. Meetings were held in November 1994, and March 1995. As a result of these meetings, NSF/OPP invited a proposal from NSIDC to provide U.S. Antarctic Data Coordination services, which was submitted in December 1995.

SCAR is the Scientific Committee on Antarctic Research;  
COMNAP is the Council of Managers of National Antarctic Programs.

## **PROJECT ACTIVITIES**

### ***ESDIM***

NSIDC has continuing programs to rescue critical data and address access needs for snow and ice data, funded by the NOAA Earth System Data and Information Management (ESDIM) Initiative via the National Geophysical Data Center (NGDC). The stated objectives of the ESDIM program are to:

- Provide an integrated Earth System view of NOAA's environmental data and information;
- Provide science-quality data and information that will lead to high-quality scientific results;
- Provide integrated, efficient environmental data and information services through NOAA-wide distributed capabilities.

There are numerous examples of data which are not already held by NSIDC, not available to NOAA scientists, and which also may be at considerable risk in their current location. These include the operational sea ice data generated by the Navy/NOAA Joint Ice Center, instrumental snow, ice and meteorological observations in the Antarctic, and non-U.S. data from both the Arctic and Antarctic, e.g., ground observations from Russia and other countries on snow cover and soil temperatures in permafrost regions.

### ***FY94 Accomplishments***

Three data sets held at NSIDC were recently approved for designation as NOAA-owned data: 1) Rand Corporation Global Monthly Mean Snow Cover, 2) Arctic Sea Ice 1901-1956, and 3) Central Asian Snow Cover. These data were obtained by NSIDC under NOAA-funded programs (items 1 and 2) or from foreign sources (item 3), and are thus subject to consideration for long-term archival by NOAA. NGDC has accepted responsibility for these three items, to be maintained by NSIDC for NOAA. Items 1 and 2 are now available to users on-line on the NGDC GOLD ftp site (<ftp.ngdc.noaa.gov>). The Central Asian Snow Cover data are newly received at NSIDC and are still in the ingest and evaluation process.

3480 archiving project. Four years of raw ARGOS Arctic Ocean buoy data on 9-track tape were archived and verified on a 3480 cartridge. Twenty-one 9-track tapes containing ARDS80 data were archived on 3480 cartridges. These are non-glaciological data collected by the Airborne Research Data System and archived at NSIDC by the NSF Antarctic Program. The Rand Corporation Global Monthly snow cover data and the National Ice Center weekly sea ice data were archived and verified on 3480 cartridges. Except for a few remaining

ARGOS buoy tapes, this brings the 3480 archiving project up to date for all the NOAA data sets held by NSIDC.

The following data sets are currently available on-line:

- Rand Corp's global snow depth
- Arctic and Southern Ocean Sea Ice Concentration, 1901-1990
- Great Lakes Degree Day Climatology
- Great Lakes Radiation Transfer through Ice
- Great Lakes Ice Thickness and Stratigraphy
- Great Lakes Ice Concentration
- International Ice Patrol Iceberg Reports
- International Ice Patrol Drifting Buoys
- NWS/NMC/CAC Arctic and Antarctic Sea Ice
- Great Lakes Ice Gage reports
- Eurasian Glacier Inventory

***Arctic System Science (ARCSS) Data Coordination Center at NSIDC***

NSIDC, through funding from the National Science Foundation/Office of Polar Programs, is the long-term archive and distribution center for all data associated with the ARCSS project. The ARCSS Data Coordination Center is the focal point for all of these activities at NSIDC. The role of the Center includes the following tasks: to coordinate ARCSS data management activities within the framework of U.S. and international data systems and centers, to ensure permanent archival of ARCSS-funded data at discipline-appropriate centers, to develop/coordinate data access and delivery strategies for long term ease of access by science community, and to develop and deliver Arctic data products to meet the needs of ARCSS-funded investigators.

In August of 1995, Dr. David L. McGinnis assumed management responsibilities for the ARCSS Data Coordination Center. His background in climatology and modeling will support the ARCSS program and provides the opportunity for a growing research emphasis. Dr. McGinnis currently serves on the ARCSS Advisory Committee, is a member of the Data Management Working Group and the Modeling Working Group and is involved in planning for education-related material connected with the Human Dimensions of Global Changes in the Arctic (HARC) program. Claire Hanson maintains her advisory role and provides a strong liaison to NSIDC User Services. Matthew Cross continues as the Data Manager and

Matthew Wolf has recently joined the ARCSS team as a scientific programmer.

### *Data Quality*

As the Data Coordination Center was being organized, much discussion on data revolved around issues of data quality control and data submittal procedures. We proposed an "evolutionary" approach to data set quality, based on the NSIDC passive microwave data product development and distribution project for NASA EOSDIS. In this model, the PI provides data sets or products that are correct and accurate to the best of his/her knowledge, based on careful checking and often following publication of science results. NSIDC archives and distributes an accurate copy of the data sets or products as provided by the PI, or works with the PI to arrive at such a product. Users of a data set or product may find errors or inaccuracies in the data, based on use of the data and through the peer-review process of the original and subsequent papers. NSIDC then interacts with the original PI to improve the quality of the data set or product. We are using this as a model for all ARCSS components.

The ARCSS Data Coordination Center is providing leadership to the ARCSS program and the ARCSS Advisory Committee regarding establishing an ARCSS Data Protocol and a set of Data Set Submission Guidelines. These documents are currently under review by the appropriate ARCSS communities.

### *ARCSS Highlights - FY95*

#### Listserver and WWW Access

An e-mail listserver for the ARCSS project was released during January 1995, to all ARCSS investigators. The listserver allows members to send and receive messages to each other using lists of subscribers for each ARCSS component. In addition, specific mailing lists are set up for each ARCSS component.

The ARCSS Home Page on the World Wide Web (WWW) (<http://www-nsidc.colorado.edu/ARCSS/>) is available and provides information on each ARCSS component. Lists of funded investigators with contact information, lists of Science Steering Committees, and bibliographies from each of the components (under construction) are among the types of information available through this service. All of the information files are also available using the ARCSS listserver for those without WWW access. Links to/from the NSIDC Home page provides the ARCSS researcher (and others) with access to other data sources available at NSIDC.

### Ocean-Atmosphere-Ice Interactions (OAI) NEW Study

Data from the Northeast Water Polynya (NEW) Project were acquired from the NEW Science Management Office at Brookhaven National Laboratory. The data, collected over the 1992 and 1993 field seasons, contain ocean properties (phytoplankton, temperature, salinity, etc.) within the Northeast Water Polynya. When all of the NEW data are in-house, they will be available to ARCSS/NEW investigators via CD-ROM, FTP and WWW access. Following quality checking by that community, the data will be released for general research use; the target date is summer 1996.

### Land-Atmosphere-Ice Interactions (LAI) Flux Study

The first ARCSS/LAI CD-ROM titled "ARCSS/LAI Data Series Volume 1: Alaska North Slope Data Sampler" was completed and distributed free of charge to ARCSS-funded investigators; the cost is \$50 per copy to non-ARCSS requesters. The data are also available via ftp at NSIDC. LAI data sets not on this CD-ROM continue to arrive at the data center and are available via ftp.

### Greenland Ice Sheet Program 2 (GISP2)

The latest version of the GISP2 archive was downloaded to NSIDC. This data set includes all of the data contributed by GISP2 investigators to the GISP2 Science Management Office as of April 1995. The data are available via ftp to all GISP2 investigators, but are not fully released for distribution to the general science community. We are currently contacting each GISP2 investigator individually to finalize plans for data migration to NSIDC. This will result in a GISP2/GRIP Ice Core CD-ROM to coincide with a special edition of the *Journal of Geophysical Research* (Atmospheres and Oceans) focusing on the ice core investigations. This project should culminate in the fall of 1996.

### Surface Heat Budget of the Arctic Ocean (SHEBA) Project

The SHEBA Project, a large-scale Arctic modeling and field experiment, is being supported by NSF/ARCSS as well as NASA, NOAA, Office of Naval Research (ONR) and possibly other agencies. As the ARCSS Data Coordination Center, NSIDC will provide data coordination and management services for data generated by the SHEBA investigations. Data will be permanently archived at NSIDC with copies of subsets at discipline-appropriate centers.

The primary data coordination activity for SHEBA will be the description, archiving and distribution of each SHEBA- (and ARCSS-) funded data set/product. NSIDC will work with other international

data centers (NOAA and others) to identify and agree upon suitable long-term archives for SHEBA data sets as appropriate.

#### HARC - the Human Dimensions of Global Change in the Arctic

The HARC program had organizational meetings in the fall of 1995 and currently a science plan is being developed. The ARCSS Data Coordination Center is discussing data management issues with members of the Steering Committee as they develop this plan. HARC data present new challenges for data management as restrictions on social science data often are very different from standard environmental data. We are working with HARC representatives to ensure proper data archival and distribution.

#### PALE - Paleoclimate, Arctic Lakes and Estuaries Project

The PALE archive continues to be managed by the PALE data coordinator, Matt Duvall at the Institute of Arctic and Alpine Research (INSTAAR), at the University of Colorado. The ARCSS Home page has direct links to the PALE Home page and PALE data are transparently available through the ARCSS Data Coordination Center.

#### ***Pathfinders***

In October 1990, NOAA and NASA instituted a research program for the study of earth systems, called Pathfinder. The NOAA/NASA Pathfinder project seeks to create data products that emulate the planned products of the upcoming Earth Observing System (EOS) mission using existing satellites. Its objectives are two-fold: to provide example data sets for algorithm development and testing of data distribution systems; and to initiate a time-series of important geophysical parameters which will be continued by the new sensors to be flown on the EOS platforms.

Recently, two Pathfinder grant awards were issued to NSIDC scientists for polar products derived from several passive-radiation-measuring sensors: SMMR and SSM/I (flown on the Nimbus and DMSP satellite series) and AVHRR (flown on the NOAA polar orbiter series).

#### Passive Microwave Polar Pathfinder

NSIDC has developed a data system to generate level-3, earth-gridded brightness temperatures and geophysical products from the DMSP Special Sensor Microwave Imager (SSM/I). Based on recommendations from the NASA SSM/I Products Working Team (SPWT), and guidance from the Polar DAAC User Working Group (PoDAG) and the NOAA/ NASA Pathfinder Program, NSIDC evaluated various data formats, resampling techniques, grids and

projections. The resultant format is NSIDC's Equal Area SSM/I Earth Grid (EASE-Grid) which the Pathfinder Program has adopted for the Level 3 geophysical products which include both SSM/I (1987 to present) and SMMR (Scanning Multi-channel Microwave Radiometer) data (1978-1987). See p. 22 for more information about EASE-Grid. Providing both data sets in the EASE-Grid will result in a 15-year time-series of satellite passive microwave data in a common format. The basic purpose of the EASE-Grid is to provide the general user of remote sensing data with an optimal earth-grid format which preserves the highest level of data precision while maintaining ease of application. All brightness temperature and geophysical products will be available on CD-ROM.

#### AVHRR Polar Pathfinder

A Pathfinder grant was awarded to Ted Scambos for generating a suite of polar geophysical products from the NSIDC Polar 1-km AVHRR Data Set and the Pathfinder 4-km AVHRR Data. The products to be generated are polar surface broadband albedo, ice surface temperature, sea-ice motion, and a cloud mask, on a daily basis, for both poles. Products will be produced at three different grid scales: 25 km for browse and global modelling; 5 km for basin-wide process studies and multi-year synopses; and 1.25 km for detailed regional process studies. The grids will be versions of the EASE Grid, and cells from each of the three grids will exactly correspond to cells of SSM/I data, greatly facilitating multi-sensor studies and derived products.

#### ***Defense Meteorological Satellite Program Data Management***

##### ***DMSP Digital Data Archive***

NSIDC provided user services in all disciplines, as an interim basis, for the NOAA/NGDC Defense Meteorological Satellite Program (DMSP) Digital Archive in FY 1995, the first year that the archive has been fully operational. Figures 2 and 3 are examples of data available through the archive.

NSIDC has been directly involved with development of many of the archive functions including system design, archive formats, geolocation, image display, and the search/browse/order graphic user interface. An example of this work is the design and implementation of DMSP OLS Geolocation, Image Display and Graphical Orbit Mapping Tool. This package of tools provides users with the ability to search and browse data and to scroll through orbits of DMSP visible and infrared imagery, overlay coastlines, political boundaries and graticules, and to adjust image brightness and contrast. Data can be geolocated approximately for time-critical applications or more accurately if time permits.

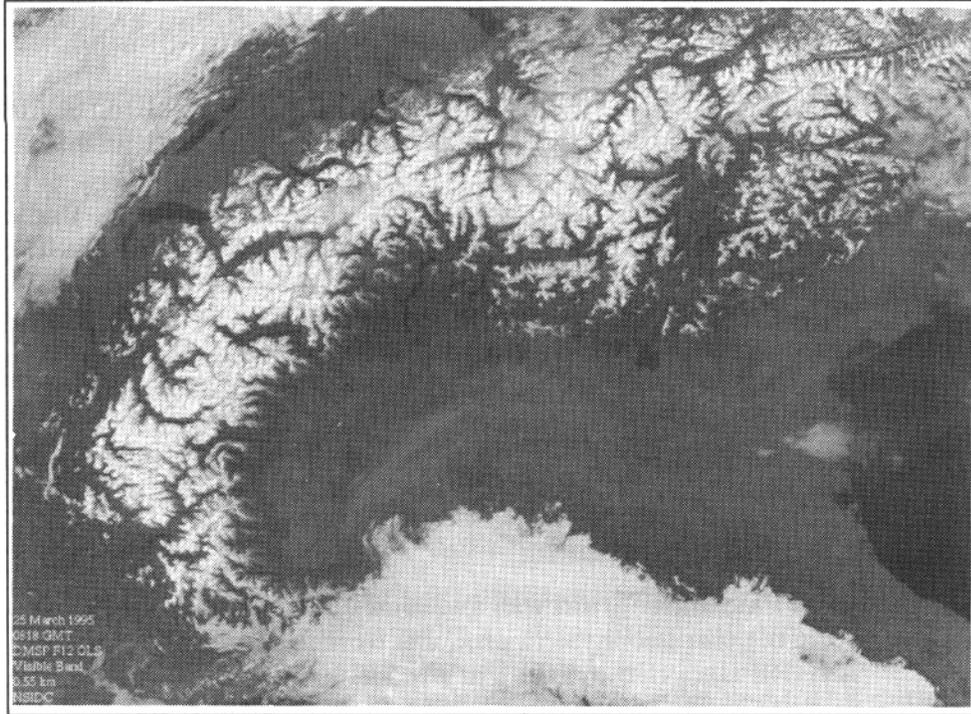


Figure 2. DMSP OLS Visible band, 0.55 km resolution image shows near-maximum snow extent in the Alps. (25 Mar. '95 0818 GMT)

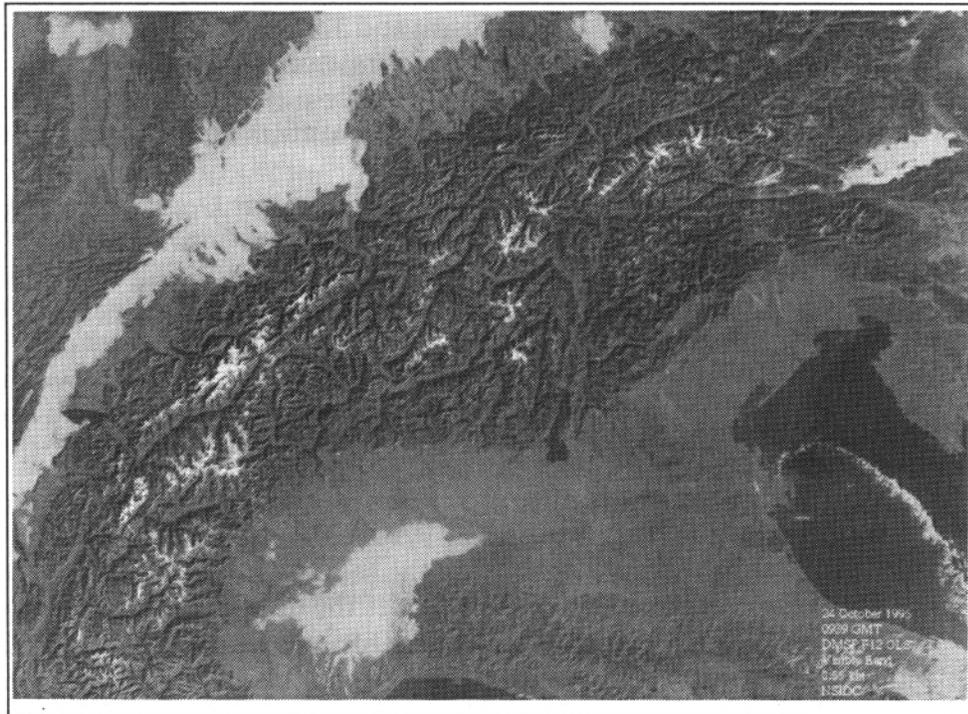


Figure 3. DMSP OLS Visible band, 0.55 km resolution image shows approximate minimum snowcover extent at the end of the summer melt. The area covered is the same as in Figure 2. (24 Oct. '95 0939 GMT)

### *DMSP Analog Film Archive*

The NSIDC DMSP Analog Film Archive, 1973-1993, is being transferred to the National Archives and Records Administration. Interim storage of these data is located at the Denver Federal Records Center. Transfer of the collection is proceeding at a stepped-up rate in order to meet space requirements for the NSIDC DAAC. However requests are still being serviced.

### *Global Geocryological Database*

The International Permafrost Association (IPA) is a 20-member non-governmental organization founded in 1983 to disseminate knowledge of permafrost, seasonal frost, artificial ground freezing, and periglacial phenomena. Permafrost underlies about 25% of the Earth's surface. Permafrost research is interdisciplinary in character, multinational in execution, and regional or global in significance. Data on permafrost collected over many decades have current vital scientific, engineering, economic and societal significance. However, many of these data sets remain widely dispersed and relatively unavailable, and some are in danger of being lost permanently.

One of the IPA's long-term goals is to retrieve, organize and disseminate frozen ground data at local, regional and global scales. To accomplish this, the IPA Working Group on Data and Information is developing a Global Geocryological Database (GGD), in cooperation with other IPA working groups and national and international organizations. (See Barry *et al.*, 1995.)

The GGD identifies existing data sets, current and historic; rescues those that are at risk of being lost; manages the acquired data; and makes data available to the scientific and engineering communities, either in raw form or processed into specific usable forms. Standard data descriptions are held in national and international directories and users access the data through a variety of modes and media. The IPA works with user communities to identify priorities for data rescue, acquisition and monitoring. Emphasis has been placed on retrieving data and time-series that are in danger of being lost.

Once identified and described, data sets are organized into standard file structures and accessed by an appropriate NGD (National Geocryological Database) or GGD regional node. Currently, the designated nodes are:

Federal Center for Geocological Systems, Moscow, Russia

GeoData Institute, Southampton, UK

World Data Center-A for Glaciology, Boulder, Colorado, USA

World Data Center-D for Glaciology and Geocryology, Lanzhou,  
China

To date, 37 data descriptions have been received at NSIDC for the GGD. NSIDC is logging these forms and holding them until funding is received to begin development of the GGD node at WDC/NSIDC. Also, two diskettes containing samples of permafrost-related data from sites in Russia were received from Professor N. Romanovsky, Moscow State University and soil temperature data from Dr. D. Gilichinsky, Institute for Soil Science, Puschino. During FY 95, workshops were held in Oslo, Norway and Potsdam, Germany. The first workshop, held in Oslo, 3-5 November 1994, was supported by the NOAA-ESDIM programs, the NSF-ARCSS program and the International Permafrost Association (IPA) and convened by Dr. Roger G. Barry, Director, WDC-A for Glaciology/NSIDC and Chair of the IPA's Working Group on Permafrost Data and Information. There were 19 attendees from eight member countries of the IPA representing permafrost science and data management.

A second workshop on permafrost data was convened and chaired by R.G. Barry at the Alfred-Wegener Institute in Potsdam, Germany, 1-3 August 1995. The meeting, sponsored by the International Permafrost Association (IPA) through its Working Group on Data and Information, involved 22 participants representing 11 countries. The group reviewed and modified the priorities for permafrost data rescue developed at the Oslo meeting of the Working Group, heard reports on national contributions to establishing the Global Geocryological Database, and developed related resolutions that were approved by the Council of the IPA meeting in Berlin, 4-5 August 1995.

#### ***NSIDC Distributed Active Archive Center (DAAC)***

NSIDC is in the fourth year of a five-year contract with NASA participating as one of eight Distributed Active Archive Centers (DAACs) in the Earth Observing System Data and Information System Project (EOSDIS). The Earth Observing System (EOS) is a long-term interdisciplinary and multidisciplinary research effort to study global-scale processes that shape and influence the Earth as a system. EOSDIS will manage the data resulting from NASA's research satellites and field measurement programs, and other data essential for the interpretation of these measurements. It will also provide access to data held in the archives of other government agencies, organizations, and countries.

The discipline focus of the NSIDC DAAC is on snow and ice processes, especially interactions between snow and ice and the atmosphere and ocean. The primary areas in which the DAAC

supports research are global change detection, Earth system model validation, and process model development and validation relating to the cryosphere (Barry *et al.*, 1995).

Currently, snow and ice products are generated from DMSP SSM/I data. Nonsatellite data, such as meteorological fields, station data, and buoy measurements, are archived for comparison to satellite information and for input into sea-ice and climate models. The NSIDC DAAC supports the development of products to monitor ice-surface temperature and motion by providing access to 1 km AVHRR and TOVS satellite data. Satellite altimetry data are being archived and distributed to support ice-sheet topography studies.

### *Development*

#### Data Request Tracking System

The release of the EOS Information Management System (IMS) V0 IMS has led to an increase in the number of orders. Requests for information, assistance, and product support have increased, requiring more staff time spent in assisting users to access the V0 IMS and to obtain HDF software tools.

The Data Request Tracking System will provide the capability to automatically ingest requests generated through the IMS and the NSIDC WWW server as well as provide NSIDC User Services Office the capability to enter requests for data and information received by phone, e-mail, or personal contact. The most important functions of the system will be the capability to track the various stages of the request to ensure timely delivery and to generate periodic reports which will be used to summarize user profiles, requests for data and information, and the resources required to support the communities which rely on the DAAC services.

#### World Wide Web (WWW) Information Server

During FY 95, we completed a reorganization of the information architecture for the WWW local information server. The DAAC Guide Server was integrated with the central NSIDC WEB server and relocated from a workstation to an SGI server. Please see Highlights, p. 3, for more information.

#### Special Sensor Microwave/Imager (SSM/I) Data

The NSIDC DAAC processes the SSM/I data into gridded, full global and polar data products. All Brightness Temperature products are available via ftp (128.138.135.20). Sea Ice Concentration data for DMSP-F8 are available via CD-ROM and DMSP-F11 data are available via ftp.

Products generated at the NSIDC DAAC from SSM/I data include gridded sea-ice concentration and brightness temperature. Currently, a polar stereographic projection covering the polar regions is employed. The Equal Area SSM/I Grid(EASE-Grid) is being produced in parallel with the polar stereographic products to provide improved radiometric fidelity, temporal resolution, and coverage. (See p. 23 for more information on EASE-Grid). A new User's Guide containing complete documentation is part of the package. Sea ice concentration data, and F11 brightness temperature data are distributed in HDF and can be displayed and manipulated using software from the National Center for Supercomputing Applications (NCSA) or commercial packages such as IDL.

To date, NSIDC has processed and distributed DMSP-F11 data from 3 December 1991 - 31 August 1995.

#### Arctic Water Vapor Characteristics (AWV)

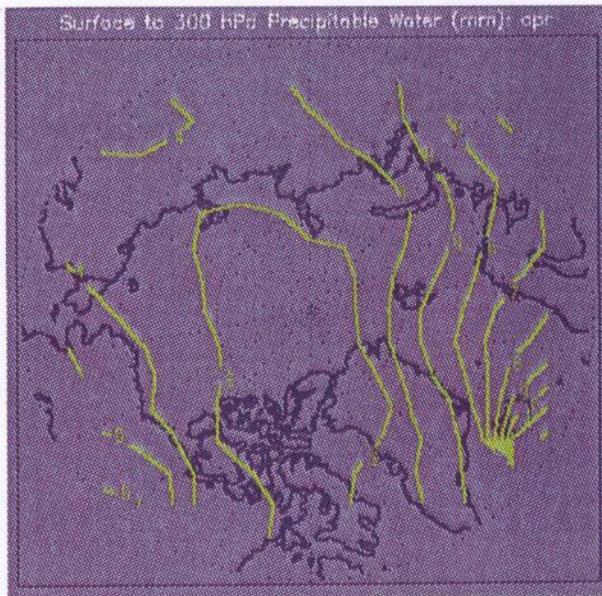
This data set contains climatological data suitable for validating Arctic climate simulations from general circulation models and improving retrieval of Arctic surface properties from satellite remote sensing. The data were compiled from existing rawinsonde data into a gridded monthly-mean data set of water vapor characteristics and related parameters (Serreze *et al.*, 1994).

The data set is based on records from approximately one-half million soundings in the Arctic region from 1954 through 1991 including:

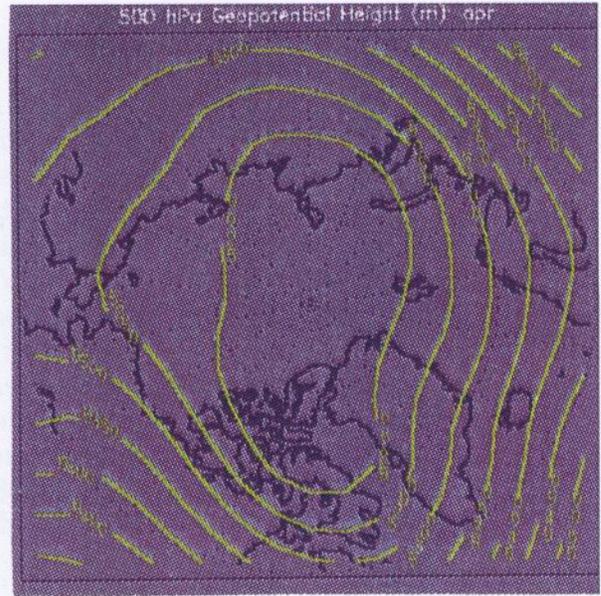
1. fixed station soundings from the Historical Arctic Rawinsonde Archive distributed by NSIDC
2. ship soundings obtained from National Center for Atmospheric Research (NCAR) data tapes
3. drifting ice station soundings obtained through the U.S.-Russian Joint Committee on Environmental Protection.

Users can download individual monthly-mean data files from an index of all files in the data set. These include precipitable water, geopotential height, meridional water vapor flux and zonal water vapor flux. Figure 4 is an example of the AWV data that are available from NSIDC.

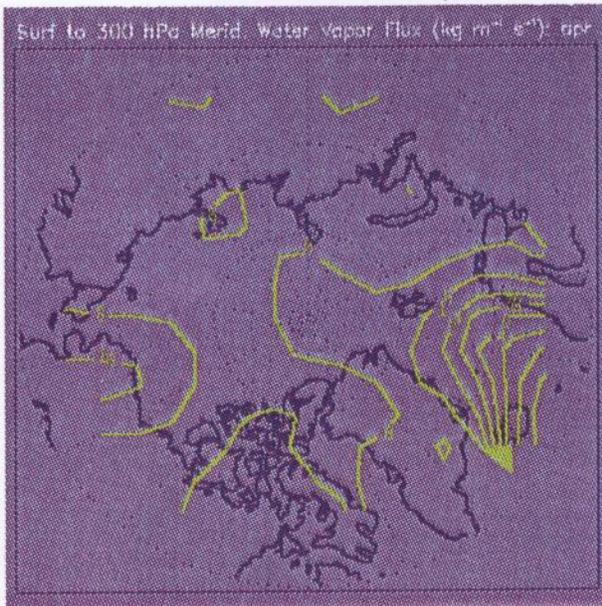
Compilation of this data set was supported by the NSF ARCSS program; distribution is supported through the EOSDIS program.



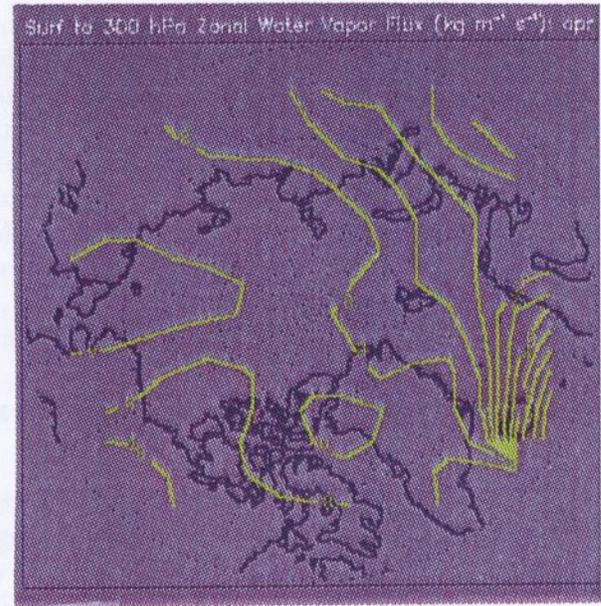
a.



b.



c.



d.

Figure 4. Example of Arctic water vapor characteristics data available from NSIDC.  
a) Precipitable water; b) Geopotential height; c) Meridional water vapor flux; d) Zonal water vapor flux.

### AVHRR Polar 1-km Data Set

Ingest of a daily record of both poles from the AVHRR sensors on NOAA satellites 11, 12, and 14 continued this year. Highlights were the incorporation of a large number of McMurdo scenes from the austral summer of 1992-1993, and from the U.S. Coast Guard icebreaker *Polar Sea* during a cruise to Greenland's Northeast Water Polynya in the summer of 1993. Total scenes in the archive now number approximately 10,000, and use of the scenes by the community has been consistently increasing. Equipment for the ingest of scenes from the DOMSAT receiver on the University of Colorado (CU) campus was purchased and installed, and software for the ingest and archiving of data from a second workstation located at CU's Laboratory for Atmospheric and Space Physics was written. Details of the ingest and archiving are still being worked out.

A Pathfinder proposal to generate polar geophysical products from 4-km GAC and 1-km LAC and HRPT data for a 15-year time period (1982-1997) has been submitted by a team of researchers at University of Colorado. Sea-ice motion, ice surface temperature, and polar albedo are the proposed products. These products will be developed and generated using (in part) DAAC hardware, although salaries, additional computing hardware, and consumable supplies are funded separately by the grant proposal. NSIDC DAAC is prepared to archive and distribute these products as they are generated using existing hardware (optical WORM jukebox, IMS file server workstation) and personnel. As user demand for these products increases (in late 1996 and 1997), it may be necessary to request additional funds to manage the data sets and their distribution.

### ***An Earth-Gridded SSM/I Data Set for Cryospheric Studies and Global Change Monitoring***

NSIDC has developed a data system to produce, archive, and distribute validated global-scale geophysical products derived from the DMSP Special Sensor Microwave Imager (SSM/I). Based on the recommendations of the NASA SSM/I (Land) Products Working Team (SPWT), guidance from the Polar DAAC Advisory Group (PoDAG) and the NOAA/NASA Pathfinder Program, NSIDC has been evaluating various data formats, resampling techniques, grids and projections. The resultant format is the Equal Area SSM/I Earth-Grid (EASE-Grid) which the Pathfinder Program has adopted for the Pathfinder Level 3 geophysical products which include both SSM/I and SMMR (Scanning Multichannel Microwave Radiometer) data (1978 to 1987). Providing both data sets in the EASE-Grid will result in a 15-year time-series of satellite passive microwave data in a common format. Results of the evaluation of two prototype versions of the EASE-Grid,

distributed to the user community during 1993 and 1994, form the basis for the current version. The basic purpose of the EASE-Grid is to provide the general user of remote sensing data with an optimal earth grid format representing a design which is between swath data (one file per orbit) and an averaged (time and space) daily or multi-day product with its inherent reduction in precision. The EASE-Grid methodology preserves the highest level of data precision and accuracy while still maintaining ease of application. The availability of a standard gridding scheme is a requirement for systematic time-series studies and also supports the direct digital comparison of different algorithm outputs as well as the validation of the algorithms through quantitative comparison with EASE-Gridded surface station and other ancillary data.

EASE-Grid provides full global coverage using equal-area projections with cell sizes of 25 km for all channels (19, 22, 37 and 85 GHz) as well as 12.5 km for the 85 GHz channel. The user can display the data using either of two earth projections: azimuthal equal area for north and south high latitude/polar regions and cylindrical equal area for applications at lower latitudes and for those studies requiring complete global coverage. The first product in the EASE-Grid to be produced and distributed by NSIDC will be for applications at lower latitudes and for those studies requiring complete global coverage. The first product in the EASE-Grid to be produced and distributed by NSIDC will be global brightness temperatures for the NOAA/ NASA Pathfinder Benchmark Period (August 1987 through November 1988). Cryospheric products will include snow cover extent and sea ice concentration. Beyond snow and ice parameters, NSIDC will create additional geophysical products using algorithms recommended by the Pathfinder SSM/I Science Working Group. Currently this product list includes: vegetation index; land surface classification and land surface temperature; ocean wind speed, cloud water, and water vapor.

### ***Global Snow Cover Mapping***

The extent and variability of seasonal snow cover is recognized to be an important parameter in climate and hydrologic systems and trends in snow cover serve as an indicator of global climatic changes. Passive microwave data from satellites afford the possibility to monitor temporal and spatial variations in snow cover on the global scale, avoiding the problems of cloud cover and darkness. NSIDC is developing the capability to produce daily snow products from the DMSP-SSM/I data with a spatial resolution of 25 km. Algorithm validation studies include the technique of digital image subtraction to directly compare surface station data, interpolated to the EASE-Grid, with satellite measurements. NSIDC has compiled a validation data

set of station measurements for the northern hemisphere with specific focus on data with high spatial density from the United States and the former Soviet Union. Specific snow depth and water equivalent data sets from point measurements and along extensive transects from the FSU are being digitized and transferred to NSIDC through collaborative efforts with the Academy of Sciences (Moscow, Russia) and the Central Asian Hydrometeorological Research Institute (Tashkent, Uzbekistan). This "data rescue" effort is being funded in large part by NOAA's National Geophysical Data Center and Climate and Global Change Program.

The digital image comparison techniques are being applied to longer time-series to determine whether or not the differences between the algorithm output and the validation data are systematic, and if so, can the regions of the greatest consistent errors be correlated with specific conditions identifiable using ancillary data (e.g., topography, vegetation, snow structure, temperature). Using data from the SSM/I F11 satellite, we are evaluating algorithms employing the 85 GHz channels. It is expected that the increased scattering produced at this frequency will enhance the capability to identify areas of shallow snow cover. We will also analyze the feasibility of applying polarization difference algorithms in order to better discriminate between wet and dry snow. By coordinating with the Jet Propulsion Laboratory (JPL), NSIDC plans to produce a 16-year record of global passive microwave data by combining SMMR with SSM/I in the EASE-Grid format. This data set will represent an important tool for use in monitoring of high-latitude snow and ice parameters that are likely to respond to climate change. NSIDC will continue to develop the concept of a snow cover data set based on passive microwave but which is produced through continuous interaction with a dynamic data base of surface changes that includes both station snow depths and visible-band satellite measurements.

#### ***DMSP Beaufort Arctic Storms Experiment Data***

NSIDC is compiling a subset of all available DMSP data for the Beaufort Arctic Storms Experiment (BASE) which took place in September and October 1994. During BASE, U.S. and Canadian researchers examined the freeze-up of the Beaufort Sea in relation to the passage of synoptic weather disturbances. The DMSP subset will compliment other field and remote sensing during the experiment, while utilizing the multi-spectral aspect of the DMSP sensor suite.

## FUTURE PLANS

### NEW DATA SETS

Table 1 is a comprehensive list of our Version 0 DAAC data sets. Those with a status level of 1 are currently operational or ongoing and are available through the Version 0 IMS. Those with a status of 2 are in development and will be fully operational and IMS visible sometime in FY96. We plan to develop those with status level 3 when funding is allocated. Several of these products may be made available in FY96 depending on funding and priorities from our User working Group (PoDAG). In particular, if funded, we will be working with the Polar Exchange at the Sea Surface project (POLES) scientists to develop certain AVHRR products.

Table 1. NSIDC Version 0 Data Sets.

ID#	Experiment	Data Set Name	Data Producer	Available
DAAC V0				
SI-01	SSM/I	F8 Sea Ice Concentration, Type (25 km)	NSIDC	C
SI-02	SSM/I	F8 Gridded Daily Brightness Temp. for the Polar Regions	NSIDC	C
SI-04	SSM/I	F8 EASE Gridded Daily Brightness Temperatures Global	NSIDC Pathfinder	C
SI-05	SSM/I	Level 2 Sea Ice Concentration (Pathfinder) (MSFC)	MSFC	C
SI-06	SSM/I	Monthly Sea Ice Concentrations	NSIDC	C
SI-07	Altimeter	Ice Sheet Altimetry Data Set	J. Zwally	C
SI-08	ESMR	Brightness Temp.	Zwally, et al.	C
SI-09	SMMR	Gridded Sea Ice Conc., Type (25 km)	Gloersen	C
SI-10	SMMR	Gridded Brightness Temp. (25 km) (polar stereographic)	Gloersen	C
SI-11	SMMR	Nimbus-7 SMMR Derived Global Monthly Snow Cover and Snow Depth 1978-1987 (C	PLDS	C
SI-12	Multi	Navy-NOAA Weekly Sea Ice Concentration and Extent	U.S. Navy, NOAA	C
SI-13	Multi	Gridded Sea-ice Surface Energy Fluxes (POLES)	POLES	TBD
SI-14	Multi	Gridded Cloud Cover, Type, Height (POLES)	POLES	TBD
SI-15	Multi	Cloud Cover, Type, Height (by Orbit) (POLES)	POLES	TBD
SI-16	N/A	Rawinsonde Over Polar Regions (HARA)	Kahl, Serreze, NSIDC	C
SI-17	N/A	International Arctic Buoy Program Pressure and Temperature Data	R. Colony	C
SI-19	N/A	Arctic and Southern Ocean Sea Ice Concentrations (Walsh) (NOAA)	Walsh	C
SI-21	Multi	Russian Digitized Sea Ice Charts (NOAA) (AARI)	AARI	C
SI-22	SMMR, SSM/I	Pathfinder SMMR-SSM/I Global Snow Cover 1978-present	NSIDC	TBD
SI-23	AVHRR	Ice Motion Vectors 5 km	NSIDC & CCAR	TBD
SI-25	AVHRR	AVHRR 5 km Ice Surface Temperature	TBD	TBD
SI-26	AVHRR	AVHRR 5 km Albedo	POLES	TBD
SI-27	AVHRR	Ice Margin Ocean SSTs	POLES	TBD
SI-28	AVHRR	AVHRR Polar 1 km Subset	EDC, Scripps	C
SI-29	TOVS	TOVS Pathfinder Path-P Data; Polar Subset	NOAA	C
SI-30	Multi	Northern Hemisphere Weekly Snow Cover and Sea Ice Extent 1978-1994	NOAA NESDIS, NSIDC	C
SI-32	Multi	CEAREX Data Sets	PIs	C
SI-33	Radarsat	Radarsat Antarctic Mapping Project (RAMP)	TBD	TBD
SI-34	SAR	Greenland SAR Base Map	GSFC	1996
SI-40	Multi	Historical Soviet Daily Snow Depth 1881-1985	Russian Hydromet. Serv.	C

Table 1, continued.

ID#	Experiment	Data Set Name	Data Producer	Available
SI-41	Multi	Beaufort Arctic Storms Experiment	NOAA, NSIDC	TBD
SI-42	AVHRR	Sea-ice Motion Products for Modeling and Monitoring	NSIDC	1996
SI-43	N/A	Arctic Water Vapor Characteristics from Rawindsonde, Ice Station, and Other Data	NSIDC	C
SI-44	AVHRR	AVHRR Arctic Leads	ONR	C
SI-45	SMMR, SSM/I	Passive Microwave Derived Global Weekly Snow Extent, 1978-present	NSIDC	1996
SI-46	SSM/I	F11 Gridded Daily Brightness Temp. for the Polar Regions	NSIDC	C
SI-48	SSM/I	F11 Sea Ice Concentration, Type (25 km)	NSIDC	C
SI-49	SSM/I	F8 EASE Gridded Daily Brightness Temperatures Northern Hemisphere	NSIDC Pathfinder	C
SI-50	SSM/I	F8 EASE Gridded Daily Brightness Temperatures Southern Hemisphere	NSIDC Pathfinder	C
SI-51	ESMR	Sea Ice Conc.	NSIDC	C
SI-52	N/A	International Arctic Buoy Program Position Data	various	C
SI-53	N/A	International Arctic Buoy Program Ice Velocity Data	various	C
SI-54	AVHRR	Ice Motion Vectors 1.25 km	NSIDC & CCAR	TBD
SI-55	AVHRR	AVHRR 5 km EASE-Gridded Bands and Angles	NSIDC & CCAR	TBD
SI-56	AVHRR	AVHRR 1.25 km Ease-Gridded Band 2 and 4	NSIDC & CCAR	TBD
SI-57	AVHRR	AVHRR 5 km Cloud Mask	NSIDC & CCAR	TBD
SI-58	AVHRR	AVHRR 1.25 km Cloud Mask	NSIDC & CCAR	TBD
SI-59	AVHRR	AVHRR 1.25 km Ice Surface Temperature	NSIDC & CCAR	TBD
SI-60	AVHRR	AVHRR 1.25 km Albedo	NSIDC & CCAR	TBD
SI-60	SSM/I	Ice Melt Product	NSIDC	1996
SI-61	SSM/I	F11 EASE Gridded Daily Brightness Temperatures Global	NSIDC Pathfinder	TBD
SI-62	SSM/I	F11 EASE Gridded Daily Brightness Temperatures Northern Hemisphere	NSIDC Pathfinder	TBD
SI-63	SSM/I	F11 EASE Gridded Daily Brightness Temperatures Southern Hemisphere	NSIDC Pathfinder	TBD
SI-64	SMMR	SMMR EASE Gridded Daily Brightness Temperatures Global	NSIDC Pathfinder	TBD
SI-65	SMMR	SMMR EASE Gridded Daily Brightness Temperatures Northern Hemisphere	NSIDC Pathfinder	TBD
SI-66	SMMR	SMMR EASE Gridded Daily Brightness Temperatures Southern Hemisphere	NSIDC Pathfinder	TBD
SI-67	in-situ	US Snow Depth and Water Equivalent Climatology	SCS, NCDC	TBD

### MODERATE RESOLUTION IMAGING SPECTROMETER (MODIS)

NSIDC is responsible for snow cover and sea ice related products from MODIS on AM-1. MODIS Level 2 snow and ice products will be generated at GSFC and archived at NSIDC, while Level 3 products will be generated and archived at NSIDC. NSIDC has been working with ECS, the MODIS Instrument Team and the MODIS Science Data Support Team on a number of issues including algorithm development, grids for the polar regions, and integration and test of hardware and software at NSIDC.

### **ADVANCED SPACEBORNE THERMAL EMISSION AND REFLECTION RADIOMETER (ASTER)**

There is considerable interest in glacier-related products derived from ASTER. This activity is appropriate to NSIDC's heritage of providing data services and science support in glacier studies, and our co-location with the WDC-A for Glaciology. NSIDC has been working with the ASTER Science Team, and Dr. H. Kieffer of the USGS in Flagstaff, AZ, in particular, to participate in a plan to monitor glaciers with ASTER data. While glacier products from ASTER have not been designated standard products by EOS, the ASTER instrument has great utility for studying glaciers, and recently the USGS formed the Glacier Land Ice Monitoring with Satellites (GLIMS) program to pursue this activity from ASTER. GLIMS seeks to involve centers with regional specialization to participate in this program, bringing resources and expertise to the process. Additionally, NSIDC would serve as the point of distribution for the resulting products. NSIDC is also interested in the utility of ASTER data for other cryospheric problems, and will explore proposed polar cloud/snow and ice/albedo products that are under development.

### **TELEVISION INFRARED OBSERVING SATELLITE OPERATIONAL VERTICAL SOUNDER (TOVS)**

NSIDC will archive and distribute future TOVS Polar Pathfinder products generated by the POLES project.

### **SCANNING MULTICHANNEL MICROWAVE RADIOMETER (SMMR)**

The SMMR on Nimbus-7 operated from 1978 to 1987. The SMMR data extends the passive microwave observational record of sea ice and snow cover extent an additional 9 years. There will be two SMMR Pathfinder products of interest to the snow and ice community, each containing 10 channels (5 frequencies, 2 polarizations) of brightness temperature data. The first consists of recalibrated SMMR level-1B data in swath (orbital) format, with spatial resolution varying from 21 x 33 km for the 37 GHz channels to 105 x 160 km for the 6.6 GHz data. The second Level-2 product will contain SMMR data mapped to NSIDC's 25 km EASE-Grid format. Production of this data set has been proposed to the NOAA/NASA Pathfinder Program for FY96 funding.

## **USER SERVICES**

Michelle Holm served as co-chair of the EOSDIS User Services Working Group and will move into the chair position this year. Her USWG duties include providing liaison between the USWG and the ESDIS IMS Project, chairing monthly USWG Executive telecons, and representing the USWG at meetings.

## **ANTARCTIC DATA MANAGEMENT**

NSIDC's involvement in Antarctic data issues will continue in an effort to assist the National Science Foundation, Office of Polar Programs to identify a funding mechanism for the designation of a US Antarctic Data Coordinator. The recommended course, modeled on the US Arctic Environmental Data Directory (AEDD) startup, is to identify agencies that participate in U.S. Antarctic research and data collection, and convince them to contribute a share of the resources necessary to establish and maintain the U.S. Antarctic data description activity.

The U.S. data description activity (Antarctic Data Coordinator) is estimated to be one FTE if located in an established center. Both NSIDC and NASA/Global Change Master Directory (GCMD) have submitted informal proposals to NSF/OPP to become the U.S. Antarctic Data Coordinator. The activity would consist mainly of identifying existing Antarctic data sets in all disciplines, locating cognizant individuals, preparing data descriptions (DIFs) for these data, and coordinating their submittal to the Antarctic Master Directory (AMD) at the International Centre for Antarctic Information and Research (ICAIR) and to the GCMD. Data descriptions would also be obtained from PIs as they prepare for or return from field work in Antarctica. To date, support for NSIDC participation in these Antarctic issues (travel funds) have been provided by the Polar Research Board of the National Academy of Sciences, National Research Council.

## **RESEARCH ACTIVITIES**

The Cryospheric and Polar Processes Division of CIRES (NSIDC's home base at University of Colorado) focuses on the role of the cryosphere and the polar regions in the global climate system. Its activities involve basic and applied research and the related projects of the World Data Center-A for Glaciology and the National Snow and Ice Data Center. The work of the Division is carried out by three Fellows, six Senior/Research Associates, twenty-eight Senior/Professional Research Assistants, four staff, nine graduate students and ten undergraduates. Total funding for the Division increased to over \$3.3 million for FY95.

Activities are supported by a mix of research- and data management-related grants and contracts. The major components involve:

1. A five-year NASA contract for operation of the Snow and Ice Distributed Active Archive Center (DAAC);
2. A three-year grant from NSF/OPP support for the data management for the Arctic System Science (ARCSS) program;
3. A three-year ESDIM grant from NGDC for support of data rescue and access;
4. On-going support provided by NOAA for WDC-A Glaciology;

Research grants for remote sensing-based of Arctic sea ice using ERS-1 synthetic aperture radar data (NASA), SSM/I data for snow cover mapping (NASA) and AVHRR data for detection of leads in sea ice (NASA), analysis of satellite imagery for global lightning (NASA), archive of OLS products from DMSP, for field studies on physical climatology on the Greenland ice sheet (NASA), on the Ross Ice Shelf in the Antarctic (NSF) and on sea ice in the eastern Canadian Arctic (NSF), and for data analysis and modeling studies on Arctic climate processes (NOAA, NSF, NASA), ice - climate interactions (NSF, NOAA, NASA), atmospheric Arctic water vapor transport (NSF), atmospheric controls on Arctic cryospheric variability (NSF), evolution of sea ice in the Beaufort Sea, and modeling sea ice sensitivity to radiative forcing (NSF).

## **ROGER G. BARRY**

### **Cryospheric Indices of Global Change**

A collaborative study on "Cryospheric Indices of Global Change: under agreements between Roger G. Barry and V.M. Kotlyakov (Institute of Geography, Russian Academy of Sciences) as well as with the Central Asian Hydrometeorological Research Institute (SANIGMI), Tashkent, Uzbekistan, is continuing. The Project is

focused currently on snow cover observations from surface data and passive microwave satellite remote sensing and on glacier mass balance fluctuations in the Caucasus and Central Asia. During October 19-November 2, Professor A.N. Krenke, Dr. T. Kadomtseva, Dr. T. Khromova and Lev Kitayev visited NSIDC for discussions on snow cover mapping. In addition Professor Krenke gave a seminar to the Cryospheric and Polar Processes Division of CIRES. In September 1995, Dan Bedford visited Tashkent for discussions on run-off variability with personnel of SANIGMI. He also attended a conference on the Aral Sea under ESDIM funding support. The funding which supported the travel was provided through NATO Linkage Grants to Richard Armstrong and Roger Barry.

The prototype glacier inventory of the former Soviet Union (See p. 2) was acquired as part of this activity. A joint proposal for Digital Snow and Ice Data Sets from the Former Soviet Union is being submitted to the Civilian Research Defense Fund. Under the same project, snow survey data for ~800 stations has been digitized and transferred to NSIDC through a collaboration between Dr. Raznvayev, RIHMI, Professor A.N. Krenke (Institute of Geography) and NSIDC, under Working Group VIII of the Russia-U.S. Bilateral Agreement on the Environment. The records provide measurements of snow water equivalent and other snow pack characteristics along transects at about 10-day intervals.

## **KONRAD STEFFEN**

### **Assessment of Climate Variability of the Greenland Ice Sheet**

K. Steffen, W. Abdalati, J. Stroeve

This NASA-sponsored research involves the application of multispectral satellite data in combination with ground truth measurements to monitor surface properties of the Greenland Ice Sheet which are essential for describing the energy and mass of the ice sheet. Several key components of the energy balance are parameterized using satellite data and in situ measurements. The analysis will be done for a ten year time period in order to get statistics on the seasonal and interannual variations of the surface processes and the climatology.

In 1995 we completed a successful field season of two months at the ETH/CU camp on the Greenland ice sheet, and along the western slope of the ice sheet, installing three additional automatic weather stations (AWS) roughly 2000 m above sea level. At the ETH/CU we retrieved 315 days of climate and glaciological data recorded in our absence, including year-round net radiation balance and short-wave radiation balance recordings. Cloud classification based on longwave

sky radiation revealed that along the western slope of Greenland, overcast sky occurred for 25% of the time in winter, and for 15% in spring and summer respectively. Winter and summer both show the same occurrence of clear sky of approximately 26%. Further, the analysis of the winter data revealed that the katabatic wind shows a distinct diurnal cycle with a maximum in the morning (7-9 h solar time) and a minimum in the late afternoon (18 h solar time). Radiative transfer modeling of firn support our belief that the observed trends in 18 and 19 GHz passive microwave brightness temperatures are attributable to accumulation rate changes. Modeling also indicates the above relationship is detectable because of the presence of depth hoar. Analysis of the AVHRR data showed that top of the atmosphere (TOA) broadband albedos derived from visible and near infrared reflectances for the entire ice sheet from May 1990 - June 1991, had highest albedo values along the southeast coast of the ice sheet, which is consistent with the summer peak of precipitation due to onshore flow loaded with high water vapor content. TOA albedo values dropped to around 40% along the south-western coast during July and August due to bare ice surface.

This project is the field component of the Program for Arctic Regional Climate Assessment (PARCA). More information is available on the World Wide Web site <http://cires.colorado.edu/parca.html>.

### **Assessment of Variation in the Snow Accumulation Rate in Northern Greenland**

K. Steffen, A. Nolin, J. Estupinan

The NSF-funded project focuses on the analysis of ground-based and satellite-derived accumulation rates of the Greenland ice sheet. A field camp in northwest Greenland (Humboldt Glacierr area, 78° 35' N, 57° 13'W, 200 m) was occupied in May for a duration of 3 weeks. At the base camp, an automatic climate station was installed, which monitors 16 parameters with a sampling frequency of 10 seconds. Besides the meteorological parameters, the short-wave and net radiation, as well as the snow accumulation rate are monitored. The data are transmitted hourly via the polar orbiting ARGOS satellite to the NASA/Wallops receiving stations.

A total of six ice cores (1 x 150 m 5 x 20 m) was obtained to study the regional variation of the accumulation rate in a 400 km<sup>2</sup> area. Oxygen isotope, dust, and other chemical analysis are currently being made to determine the annual accumulation rate. Preliminary isotope versus depth analyses for the Humboldt Base Camp core revealed an average accumulation rate of 23.5 cm water equivalent for the time period 1967-95. Further, results from the different ice cores showed an accumulation variability of up to 17 % over 25 km.

## **JAMES MASLANIK**

### **Arctic Sea Ice Anomalies**

Using NSIDC-provided sea ice data, large reductions in the Arctic sea ice cover were identified in the summers of 1990, 1993, and 1995. These anomalies appear to be linked to unusual atmospheric circulation conditions in the central Arctic. Overall, the Arctic Ocean ice extent appears to be decreasing at a rate of about 0.5% per year, and conditions since 1990 have been quite unusual. A paper by Maslanik, Serreze and Barry has been submitted to *Geophysical Research Letters*.

### **Arctic Climate Modeling**

The National Center for Atmospheric Research's GENESIS earth system model was used to assess global model performance for the Arctic. GENESIS was found to provide substantial improvement over previous-generation GCMs, with realistic simulations of sea level pressure patterns, surface air temperature, downwelling radiation, ice extent and thickness.

Stand alone sea ice model runs using a two-dimensional dynamic-thermodynamic ice model were used to assess the sensitivity of the Arctic ice cover to choice of cloud climatology and radiation parameterization schemes as a function of the level of physical detail in the model. The various model formulations showed considerable sensitivity to cloud and radiation inputs. In particular, the combination of ISCCP cloud fractions and the standard Parkinson and Washington downwelling shortwave parameterization yielded large sensitivities due to the unsuitability of the parameterization for polar regions.

### **AVHRR Polar Pathfinder**

As part of NASA's Pathfinder effort, work is underway to derive surface temperature, albedo, cloud fraction, and sea ice motion from the historical record of Advanced Very High Resolution Radiometer (AVHRR) data. Plans are to prepare a twice-daily set of gridded products extending from 1983-1996. (See p. 14 for more information about NSIDC Pathfinder activities).

## **MARK C. SERREZE**

### **Variability in the Northern Hemisphere Cryosphere**

The Arctic sea ice cover exhibited a record minimum in areal extent during 1990, characterized by extensive ice-free conditions during August and September along the Siberian coast. Fields of sea

level pressure, temperature and surface radiation fluxes derived from the International Satellite Cloud Climatology Program data set were used to examine the evolution of this feature. These reductions were driven by warm, windy conditions in May, associated with unusually vigorous cyclone activity over the central Arctic Ocean and continued warmth in June, promoting early melt and reductions in ice concentration. This provided for a feedback on the surface net radiation flux fostering rapid melt through July, with a final rapid breakup in August forced by strong coastal winds. However the unusually warm Arctic conditions in 1990 were part of a larger-scale Northern Hemisphere temperature anomaly pattern, linking the sea ice reductions to accompanying record minima in Eurasian snow cover.

Further analyses reveal that ice extent has remained below normal in subsequent years. Large negative anomalies in late-summer ice extent, again in the Siberian sector, occurred in 1993 and 1995. As for 1990, these can be related to unusually vigorous cyclone activity over the central Arctic Ocean. Further analyses reveal that this circulation anomaly is part of a more general increase in northern high latitude cyclone activity during the past decade. Efforts are underway to examine variability of snow cover over the Northern Hemisphere and snowfall over the eastern United States. One interesting finding is an apparent link between snowfall in the Ohio Valley and the North Atlantic Oscillation (NAO). Snowfall tends to increase during the negative mode of the NAO. This is largely explained by attendant negative anomalies in temperature on precipitation days, rather than by changes in precipitation.

The characteristics of Arctic Ocean snowfall and precipitation are poorly known. As a start to addressing this issue, daily marine surface reports from ships and drifting ice stations contained in the Comprehensive Ocean Atmosphere Dataset (COADS) have been examined. Through evaluation of the 'present weather codes' available for each report, the seasonal cycles in precipitation frequency and the relative contributions of solid, liquid and mixed precipitation have been defined. A paper has been submitted to *Geophysical Research Letters* by M. Clark (Geography graduate student), M.C. Serreze and R.G. Barry. The COADS investigations have been carried out both as part of an analysis of Arctic Ocean climate for Phase 1 of the planned SHEBA field experiment in the Beaufort Sea and for validation of fields of snowfall and snow water equivalent provided by the National Meteorological Center (NMC) reanalysis project. The objective of the reanalysis project is to provide internally consistent fields of atmospheric circulation and modeled surface variables using a state-of-the-art numerical weather prediction and data assimilation model, with the assurance that all historical assimilation data are subjected

to strict quality control. NMC plans to have completed the reanalysis for a 40-year period by the end of 1996.

## **TED A. SCAMBOS**

### **Site Characterization and Ice Stream History of Siple Dome, West Antarctica**

Initial results of last years field season were written and submitted. The most important discovery of the first season was the confirmation that a former ice-stream margin and ice stream exists on the northeast flank of Siple Dome. The evidence indicates that this stream ceased rapid ice flow approximately 1500 years ago. The implications for the historical evolution of the West Antarctic Ice Sheet are that the current configuration of ice streams is not fixed in time, and that the current state of the West Antarctic should be viewed as containing an ice stream system, as opposed to containing five specific ice streams in fixed locations. Additionally, results from a radar and modelling study of the summit show that the dome has been relatively stable through the last 10,000 years, that the crest of the summit has migrated very slowly to the north during that time, and that there may have been a more drastic change in the location of the summit for the ice sheet in this area prior to 10,000 years ago. A second field season, focusing on the southwest side of the dome and repeat measurement of a strain grid at the summit, is planned for late in 1996.

### **Innovations in the Use of AVHRR Imagery for Polar Ice Sheet Study**

Two new techniques for applying AVHRR data to the polar ice sheets are being pursued at NSIDC: data accumulation and photoclinometry. Data accumulation combines the data from several AVHRR scenes taken of the same area to generate an image with enhanced spatial and radiometric resolution beyond what any single AVHRR scene can provide. This technique is being developed by a Geography student Geir Kvaran in conjunction with Dr. Scambos. Several areas have already been imaged by preliminary versions of this technique: Siple Dome (see above); Ice Stream C; and the northeast Greenland ice stream. Photoclinometry from AVHRR is being demonstrated in the Siple Dome area and Greenland. The greatest potential for AVHRR in this application is to improve coarse-resolution DEMs (digital elevation models) by using the image data as a guide to local (1-km) variations from a 5- or 10-km resolution DEM. Initial tests of the approach indicate that the method should be able to resolve slope variations as small as 0.0002.

## **Radarsat Antarctic Mapping Project**

A project, headed by Principal Investigator, Ken Jezek, Byrd Polar Research Center, the Ohio State University, is underway to map the entire Antarctic continent using SAR imagery from the Canadian satellite, Radarsat. This effort involves rotating the satellite 180 degrees to a southward-looking mode for a three-week period. NSIDC is contributing information and data for DEMs of the continent to assist in the reduction of the data.

## **GREG SCHARFEN**

### **Global Lightning**

NSIDC's DMSP lightning project, funded by NASA Marshall Space Flight Center, has little to do with the cryosphere, but is a spin-off of our involvement in the DMSP analog and digital archives. Lightning has a distinct signature in nighttime images collected by the DMSP Operational Linescan System (OLS) sensor. The OLS sensor records a horizontal streak about 100 km long that corresponds to the scanned portion of an illuminated thunderstorm cloud. Although only a sample of total lightning occurrence, the data base of these signatures provides a unique source of information about the spatial and temporal distribution of global lightning. This is used in studies of climate, the hydrological cycle and the global electric current. In the past NSIDC manually identified and digitized these signatures from the analog OLS images.

This year NSIDC completed development of an automated lightning detection system that will improve the efficiency the analysis. This system uses pattern recognition algorithms, that emulate the human process of lightning signature identification. The algorithm uses a series of tests and neural networks (generated by NASA's "NETS" software package) to distinguish lightning signatures from other similar looking features (moonlit clouds, cities, fires, scanline noise and dropout, etc.). Routine extraction of lightning information from digital DMSP/OLS data using this system will begin in 1996.

## FUNDING

### FUNDING SOURCES

The trend of the past several years continues in that NASA remains the largest funder of NSIDC/WDC programs, accounting for almost 76% of total funding. The NOAA contribution from various sources, DMSP, ESDIM and NGDC, adds about 14% of overall funding. NSF funding accounts for about 8%. See Figure 5. Total funding for FY95 was just over \$3 million. The trend in funding 1977-1995 is shown in Figure 6.

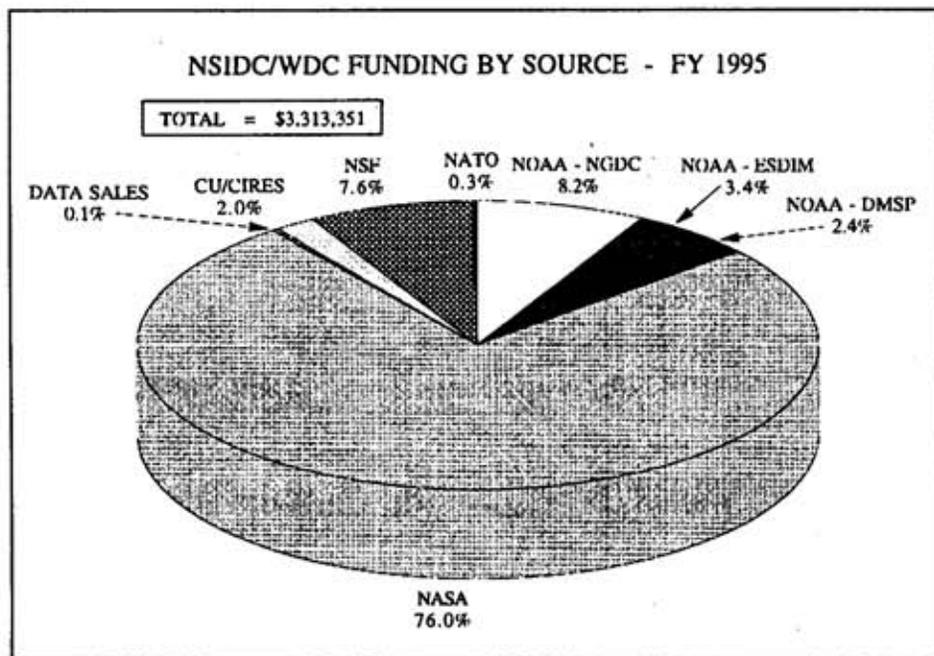


Figure 5.

### DATA REQUEST STATISTICS

#### DATA CATEGORIES

SSM/I passive microwave data continues as the NSIDC product category with the largest number of users. There are 575 distinct users of the SSM/I polar stereographic gridded products, and 120 distinct users of the SSM/I EASE-Grid products. Some users receive both of these products.

There were a total of 1501 requests for data and information during the past year, representing 999 distinct users, of whom 667 had not previously contacted NSIDC. In addition, there were approximately 200 requests for information regarding the DMSP OLS

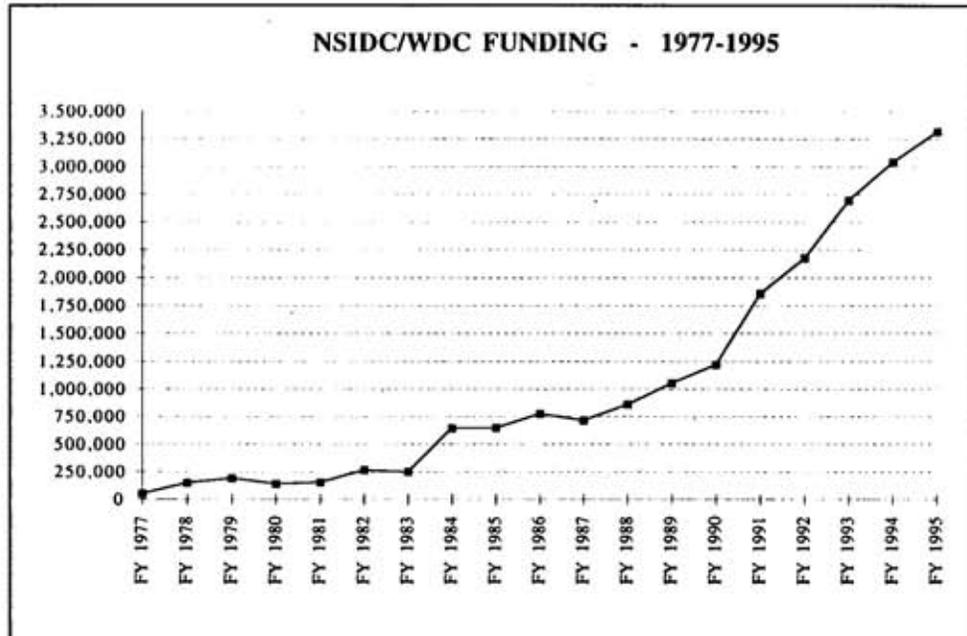


Figure 6.

Digital Archive. Due to a technical difficulty these information requests were not entered properly in the data request tracking system; this is being corrected so that complete FY95 statistics will be included in the FY96 reports. During FY95 we distributed approximately 3150 CD-ROMs.

Usage of the Information Center continues steady. Logged requests for bibliographic information account for about 10% of the total. However, in-house researchers at CIRES associates at INSTAAR and University students frequently use the collection without assistance and are consequently not logged into the system. We know that the impact of the Information Center is not truly reflected in the statistics.

#### ***USER CATEGORIES***

One of the variables by which NSIDC tracks users is by type of organization. Over the 18-year period of record, 1978 - September 1995, the distribution of users by category has remained relatively stable. Of the over 1500 requests this year, not including the subscribers to SSM/I and SMMR CD-ROMs, almost 30 percent of requests came from the U.S. academic community. Another 25 percent of requests came from outside the U.S.; 16 percent were from various Federal agencies; approximately 18 percent represented industry. (See Figure 7). Figure 8 displays the number of requests since 1978.

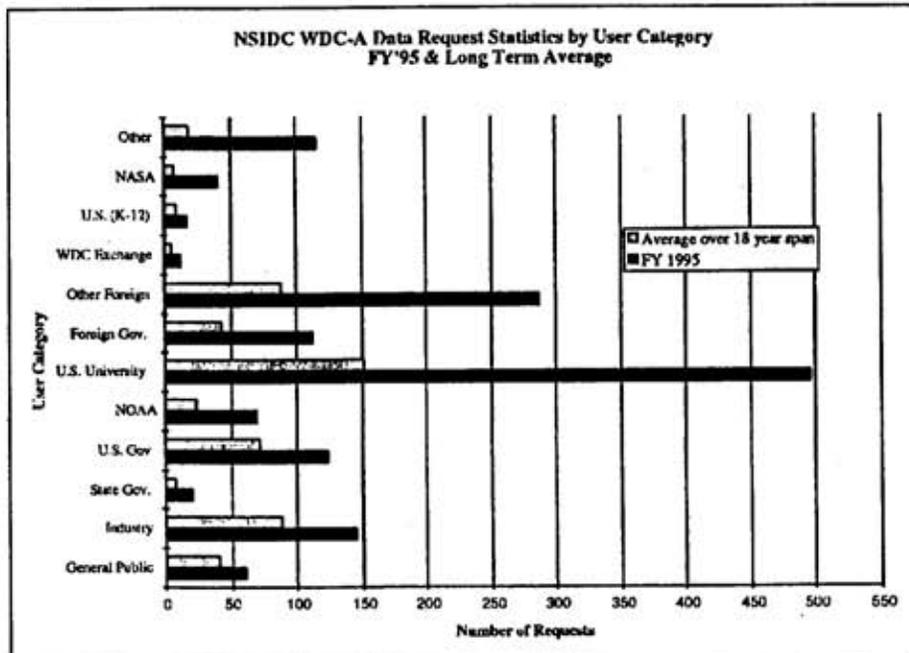


Figure 7. Data requests by user category.

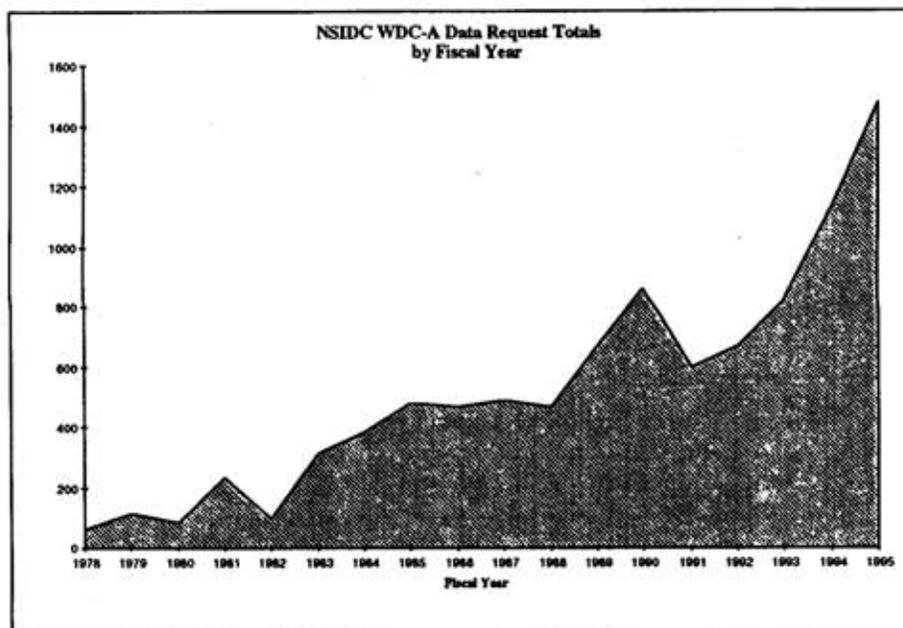


Figure 8. Data request totals, 1978 - 1995.

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Canadian Circumpolar Institute, Edmonton, Alberta  
National Hydrology Research Institute, Saskatoon, Saskatchewan  
University of Waterloo, Ontario

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Central Asian Hydrometeorological Center, Tashkent

### **New Zealand**

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### **Switzerland**

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World Glacier Monitoring Service  
World Meteorological Organization, Geneva.  
Swiss Federal Institute for Snow and Avalanche Research

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Scott Polar Research Institute, Cambridge  
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Ohio State University, Byrd Polar Research Center, Columbus, OH  
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U.S. Polar Bibliographic Information Working Group - A. Brennan

Western Snow Conference Executive Committee - R.L. Armstrong

World Meteorological Organization (WMO), Commission for Maritime Meteorology, Steering Group for the Global Digital Sea-Ice Data Bank - R.G. Barry, V. Troisi

WMO, World Climate Research Programme, GCOS, Terrestrial Observations Panel - R. G. Barry

WMO/ WCRP Arctic Climate System (ACSYS) Programme, Scientific Steering Group - R. G. Barry

## MEETINGS

Arctic System Science (ARCSS) Working Group, Arlington, VA, 12 October 1994 - C. Hanson

Royal Society, London, Discussion Meeting on The Arctic and Environmental Change, 12-13 October 1994 - R.G. Barry

Geoscience Laser Altimeter System (GLAS) Science Team Meeting, Goddard Space Flight Center, 13-14 October 1994 - V. Troisi

EOS IWG, Baltimore, MD, 19-21 October 1994 - R. Weaver

Strategic Environmental Data Active Archive Resource (SEDAAR) Advisory Group, NSIDC, 13-14 October 1994 - C. Hanson

Polar DAAC Advisory Group, Boulder, CO, 25-27 October 1994 - R.G. Barry, R. Weaver, V. Troisi, G. Scharfen, K. Knowles, M. Holm

Conference on Arctic Climate System Dynamics, WMO/WCRP, Göteborg, Sweden, 7-10 November 1994 - R.G. Barry

WMO/WCRP ACSYS Scientific Steering Group, Göteborg, Sweden, 7-10 November 1994 - R.G. Barry

7th NASA EOSDIS Version 0 User Services Working Group, Marshall Space Flight Center DAAC, Huntsville, Alabama, 14-17 November 1994 - C. Hanson, M. Holm, and C. McNeave

American Geophysical Union Fall Meeting, San Francisco, 5-9 December 1994 - R. Armstrong, R. Bauer, M. Cross, M. Holm, R. Kokaly, C. McNeave, G. Scharfen

Arctic Environmental Data Directory Working Group (AEDDWG), San Francisco, 8 December 1994 - C. Hanson

DAAC Managers, Bethesda, MD, 13-14 December 1994 - R. Weaver, V. Troisi, M. Holm

Navy/NOAA National Ice Center (NIC) Annual Meeting, Suitland, MD, 14 December 1994 - V. Troisi

ECS Science Data Processing System (SDPS) Level 4 Requirements Review, 14-15 December 1994 - M. Holm, V. Troisi

Global Climate Observing System (GCOS) Program (WMO), Asheville, NC, 9-11 January 1995 - R.G. Barry

American Meteorological Society, Dallas, TX, 16-20 January 1995 - R.G. Barry, G. Scharfen, R. Armstrong, R. Weaver

Fourth Polar Meteorology Conference , Dallas, TX, 17 January 1995 -  
R. Weaver, R. Armstrong, R.G. Barry, R. Bauer, G. Scharfen

CSMS PDR, Landover, MD, 17-20 January 1995 - G. Mountain

SHEBA Science Working Group, Dallas, 20 January 1995 - C.  
Hanson, M. Cross

Radarsat Antarctic Mapping Program (RAMP), Montreal, Canada 30  
January 1995 - T. Scambos

ARCSS/PALE Principal Investigators, Pac Forest Research Station,  
WA, 4-6 February 1995 - M. Cross

V0 IMS Developers Meeting, Greenbelt, MD, 6-10 February 1995 - A.  
Varani, K. Robinson, C. Whittaker, M. Holm

SDPS PDR, Landover, MD, 13-16 February 1995 - V. Troisi

PDR Wrap-up Session, Landover, MD, 28 February 1995 - V. Troisi

DAAC Systems Engineering Group, University of Maryland, 1 March  
1995 - V. Troisi

Arctic System Science (ARCSS) Land-Atmosphere-Ice Interactions  
(LAI) Science Meeting, Orcas Island, 1-5 March 1995 - C. Hanson, M.  
Cross

Geoscience Laser Altimeter System (GLAS) Science Team, Columbus,  
Ohio, 2-3 March 1995 - T. Scambos, V. Troisi

Use of the Cryospheric System (CRYSYS) to Monitor Global Change in  
Canada, Toronto, 27-29 March 1995 - R. Armstrong

DAAC Managers Meeting, Oak Ridge, TN, 28-29 March 1995 - R.  
Weaver, V. Troisi

Gateways to Information Library Conference, Denver, 3-5 April 1995 -  
A. Brennan

Moderate Resolution Imaging Spectroradiometer (MODIS) Land  
Team Workshop, Greenbelt MD, 4-7 April 1995 - G. Scharfen

Global Climate Observing System (GCOS),WMO/GCOS Terrestrial  
Observation Panel, London, England, April 1995 - R.G. Barry

Science Software Integration and Test (SSI&T) Workshop, Landover,  
MD, 18-19 April 1995 - N. Sandoval, C. Whittaker

U.S. Polar Bibliographic Working Group, Washington, D.C., 23-25  
April 1995 - A. Brennan

ECS Data Modelling Working Group, Landover, MD, 3-5 May 1995 - M. Holm and K. Robinson

MODIS Science Team Meeting, Greenbelt, MD, 3-5 May 1995 - G. Scharfen

U.S./Canada Joint Ice Working Group, St. Hubert, Quebec, Canada, 8-10 May 1995 - G. Scharfen

Global Energy and Water Cycle Experiment (GEWEX) Workshop, Banff, Alberta, 22-26 May 1995 - R. Armstrong

Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Science Team Meeting, Flagstaff, AZ, 22-26 May - G. Scharfen

American Geophysical Union Spring 1995 Meeting, Baltimore, MD, 30 May - 2 June - R. Armstrong

SHEBA Science Working Group, Baltimore, MD, 31 May - M. Cross

ECS Prototyping Workshop, Landover, MD, 31 May 1995 - C. McNeave

Metadata Working Group, Greenbelt, MD, 11-14 June 1995 - K. Robinson, A. Varani

NASA - Global Hydrology, Washington, DC, 14-16 June 1995 - R. Armstrong

8th EOSDIS User Services Working Group Meeting, Alaska SAR Facility, 20-22 June - C. Hanson, M. Holm and C. McNeave

DAAC Managers Meeting, Santa Fe, NM, 26 June 1995 - R. Weaver

IWG Meeting, Santa Fe, NM, 27-29 June 1995 - R. Weaver, G. Scharfen, M. Parsons, A. Varani, R. Armstrong

ECS System Design Review, GSFC, Greenbelt, MD, 27-29 June 1995 - R. Weaver, V. Troisi, K. Robinson, N. Sandoval

ECS Cost Briefing, University of Maryland, 30 June 1995 - R. Weaver, V. Troisi

SOFT, University of Maryland, 30 June-1 July 1995 - R. Weaver

ECS Prototype Workshop #1, Landover, MD, 30 June-1 July 1995 - C. McNeave

Data Organization and Access Focus Team, University of Maryland, 30 June-1 July 1995 - K. Robinson

Data Processing Focus Team, University of Maryland, 30 June - 1 July 1995 - N. Sandoval

International Commission on Snow and Ice, Working Group on Snow and Climate, Boulder, CO, 7 July 1995 - R.G. Barry

IUGG, Boulder, CO, 2-14 July 1995 - R.G. Barry and numerous others

IMS Developers Meeting, Landover, MD 17-19 July 1995 - K. Robinson, R. Swick

American Meteorological Society's Seventh Conference on Mountain Meteorology, Breckenridge, Colorado, 17-21 July 1995 - R.G. Barry, M. Savoie

V0 WWW Workshop, Landover, MD, 20 July 1995 - K. Robinson, R. Swick

Progress in Electromagnetic Research Symposium (PIERS), Seattle, WA, 23-27 July 1995 - R. Armstrong

ECS Release B Level 4 Requirements Review, Landover, MD, 25-27 July 1995 - M. Holm, V. Troisi

Workshop on Permafrost Data, Alfred-Wegener Institute, Potsdam, Germany, 1-3 August 1995 - R.G. Barry

International Permafrost Association Council, Berlin, 4-5 August 1995 - R.G. Barry

Arctic System Science (ARCSS) meetings held at INSTAAR, University of Colorado, 6-8 August 1995 - C. Hanson, M. Cross and D. McGinnis

International Geoscience and Remote Sensing Symposium (IGARSS), Pasadena, CA, 8-12 August 1995 - C. McNeave

DOAFT Data Modelling Working Group, 30-31 August 1995 - V. Troisi, Michelle Holm

West Antarctic Ice Sheet Initiative Science Meeting, NSF Headquarters, 6-7 September 1995 - T. Scambos

World Glacier Monitoring Service Workshop, Zurich, Switzerland, 11-12 September 1995 - R. Armstrong, R. Weaver

Global Change Data and Information System Workshop on User Services, Oak Ridge National Labs, 12-14 September 1995 - M. Holm

EOS MODIS Snow and Ice Workshop, Goddard Space Flight Center, 13-15 September 1995 - R. Armstrong, G. Scharfen

ARCSS GISP2/GRIP Science Workshop, Wolfeboro, NH, 16-21  
September 1995 - D. McGinnis, M. Cross

DAAC Managers meeting, GSFC DAAC, 20-21 September 1995 - M.  
Holm

EOSDIS Data Panel meeting, Woods Hole, MA, 27-29 September  
1995 - M. Holm

Geographical Information System for Antarctica, Reston, VA, 27-29  
September 1995 - T. Scambos

Radarsat Geophysical Processor System (RGPS) Working Group,  
Boulder, CO, 27-29 September 1995 - R. Weaver

International Working Conference on Scientific and Statistical  
Database Management, Charlottesville, VA, 28-30 September 1995 -  
K. Robinson

## ACRONYMS

AARI	- Arctic and Antarctic Research Institute (Russia)
ACSYS	- Arctic Climate System Program (WMO)
ADD	- International Arctic Environmental Data Directory
AEDD	- Arctic Environmental Data Directory
AMD	- Antarctic Master Directory
ARCSS	- Arctic System Science
ARCUS	- Arctic Research Consortium of the U.S.
ASTER	- Advanced Spaceborne Thermal Emission and Reflection Radiometer
AVHRR	- Advanced Very High Resolution Radiometer
AWS	- Automatic Weather Station
AWV	- Arctic Water Vapor
BASE	- Beaufort and Arctic Storms Experiment
CIRES	- Cooperative Institute for Research in Environmental Sciences
COADS	- Comprehensive Ocean-Atmosphere Datasets
COMNAP	- Council of Managers of National Antarctic Programs
CRREL	- Cold Regions Research and Engineering Laboratory
CRYSYS	- Cryospheric System Program (Canada)
CU	- University of Colorado
DAAC	- Distributed Active Archive Center
DEM	- Digital Elevation Model
DIF	- Directory Interchange Format
DMSP	- Defense Meteorological Satellite Program
DOAFT	- Data Organization and Access Focus Team (EOSDIS)
DPFT	- Data Processing Focus Team
EASE	- Equal Area SSM/I Earth Grids
ECS	- EOSDIS Core System
EOS	- Earth Observing System
EOSDIS	- EOS Data and Information System
ESDIM	- Earth System Data and Information Management

ETH	- Eidgenössische Technische Hochschule (Switzerland)
FRC	- Federal Records Center
FSU	- Former Soviet Union
FTP	- File Transfer Protocol
GCM	- General Circulation Model
GCMD	- Global Change Master Directory
GCOS	- Global Climate Observing System (WMO)
GD	- Glaciological Data
GDSIDB	- Global Digital Sea Ice Data Bank
GEWEX	- Global Energy and Water Cycle Experiment
GGD	- Global Geocryological Database
GIS	- Geographic Information System
GISP	- Greenland Ice Sheet Program
GLAS	- Geoscience Laser Altimeter System
GLIMS	- Glacier Land-Ice Monitoring with Satellites
GMT	- Greenwich Mean Time
GPS	- Geophysical Processor System
GRID	- Global Resource Information Database
GRIP	- Greenland Icesheet Program
GSFC	- Goddard Space Flight Center
HARA	- Historical Arctic Rawinsonde Archive
HARC	- Human Dimensions of Global Change in the Arctic
HDF	- Hierarchical Data Format
HRPT	- High Resolution Picture Transmission
HSDSD	- Historical Soviet Daily Snow Depth
ICAIR	- International Centre for Antarctic Information and Research
ICSI	- International Commission on Snow and Ice
ICSU	- International Council of Scientific Unions
IIP	- International Ice Patrol
IMS	- Information Management System
INSTAAR	- Institute of Arctic and Alpine Research

IPA	- International Permafrost Association
ISCCP	- International Satellite Cloud Climatology Program
IVGG	- International Union of Geodesy and Geophysics
JPL	- Jet Propulsion Laboratory
LAC	- Local Area Coverage
LAI	- Land/Atmosphere/Ice Interactions
MIMR	- Multifrequency Imaging Microwave Radiometer
MODIS	- Moderate Resolution Imaging Spectrometer
MSFC	- Marshall Space Flight Center
NAL	- New Accessions List
NAO	- North Atlantic Oscillation
NASA	- National Aeronautics and Space Administration
NCAR	- National Center for Atmospheric Research
NCSA	- National Center for Supercomputing Applications
NESDIS	- National Environmental Satellite, Data and Information Service
NEW	- Northeast Water Polynya
NGD	- National Geocryological Database
NGDC	- National Geophysical Data Center
NIC	- National Ice Center
NISC	- National Information Services Corporation
NOAA	- National Oceanic and Atmospheric Administration
NSF	- National Science Foundation
NSIDC	- National Snow and Ice Data Center
OAI	- Ocean/Atmosphere/Ice Interactions
OLS	- Operational Linescan System
ONR	- Office of Naval Research
OPP	- Office of Polar Programs
PALE	- Paleoenvironments from Arctic Lakes and Estuaries
PARCA	- Program for Arctic Regional Climate Assessment
PDR	- Product Design Review
PI	- Principal Investigator

PIERS	- Program in Electromagnetic Research Symposium
PMEL	- Pacific Marine Environmental Laboratory (NOAA)
PoDAG	- Polar DAAC Advisory Group
POLES	- Polar Exchange at the Sea Surface
PRC	- People's Republic of China
PSC	- Polar Science Center
RAMP	- Radarsat Antarctic Mapping Project
RGPS	- Radarsat Geophysical Processor System
SANIGMI	- Central Asian Hydrometeorological Research Institute
SCAR	- Scientific Committee on Antarctic Research
SEDAAR	- Strategic Environmental Data Active Archive Resource
SGI	- Silicon Graphics Incorporated
SHEBA	- Surface Heat Budget of the Arctic Ocean
SIGRID	- Sea Ice Grid
SIMMS	- Seasonal Ice Monitoring and Modeling Program (Canada)
SMMR	- Scanning Multichannel Microwave Radiometer
SOFT	- EOSDIS Systems Operations Focus Team
SPWT	- SSM/I Products Working Team
SSM/I	- Special Sensor Microwave Imager
SSM/T	- Special Sensor Microwave Temperature
TOVS	- TIROS Operational Vertical Sounder
UNEP	- United Nations Environment Program
USGS	- United States Geological Survey
V0	- Version 0
WDC	- World Data Center
WMO	- World Meteorological Organization
WWW	- World Wide Web