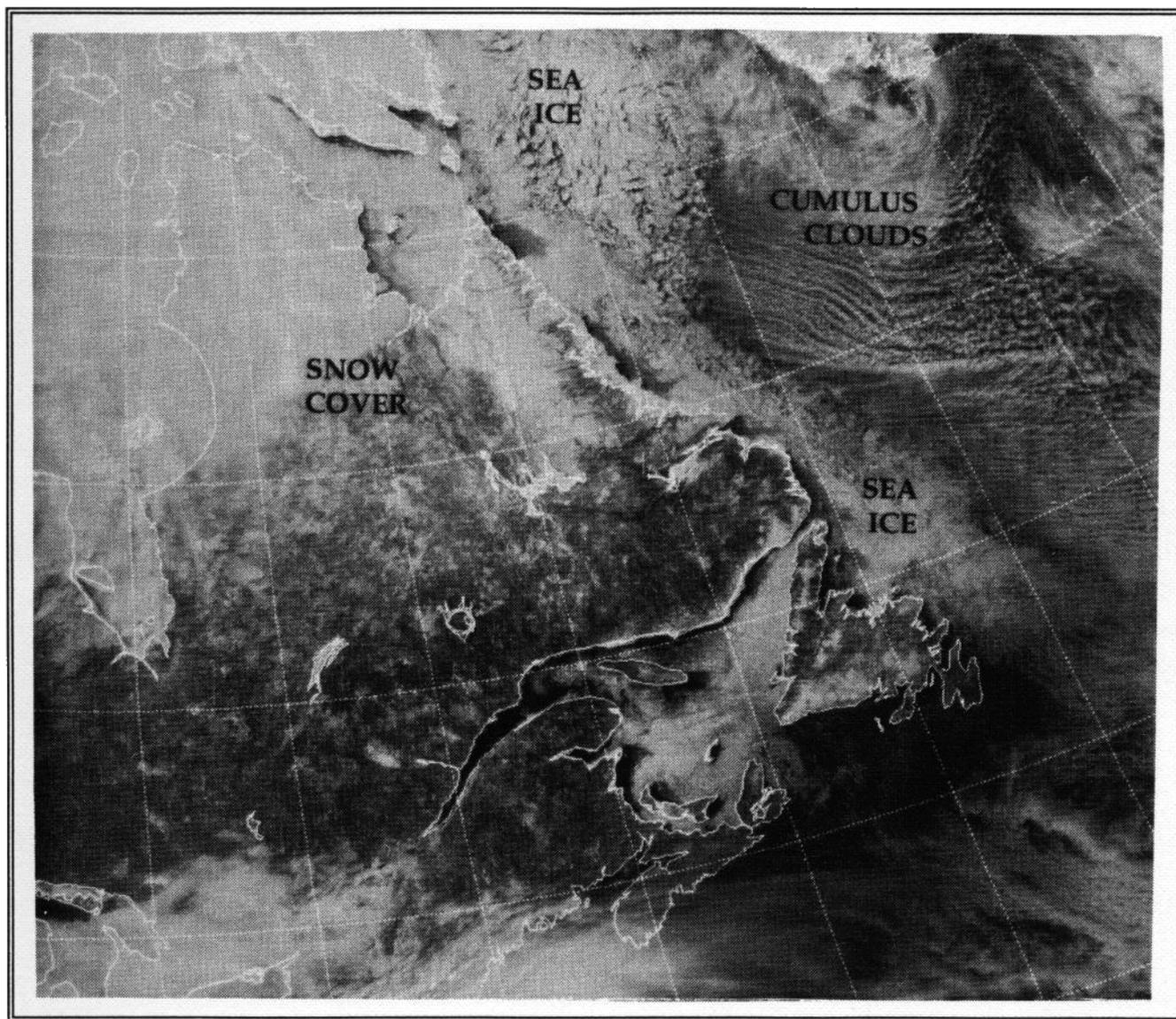


NATIONAL SNOW AND ICE DATA CENTER

WORLD DATA CENTER-A FOR GLACIOLOGY



***ANNUAL
REPORT*** ————— ***1993***

Cover: The cover shows an OLS visible-band image of eastern Canada at approximately 1430 GMT on March 24, 1993. This was an anomalous ice year in eastern Canada with sea ice extending as far south as Nova Scotia and obstructing the major shipping lanes in the Gulf of St. Lawrence and the Labrador Sea. The meteorological conditions leading to anomalous sea ice extent can be seen in this image. The lines of cumulus 'cloud streets' parallel with the direction of the wind in the Labrador Sea, are evidence of a cold air outbreak with off-ice advection.

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Annual Report

1993

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

NSIDC/WDC ANNUAL REPORT

FY 1993

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

ANNUAL REPORT FY1993

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 seventeenth year of service to the snow and ice research community from its Boulder location.

NSIDC/WDC is funded by various federal agencies, including the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), the Office of Naval Research (ONR), the U.S. Air Force (USAF) and the National Science Foundation (NSF). A portion of data management and administrative functions are supported by NOAA, with major project support from all the above mentioned agencies.

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. The latter mandate calls for information to assist policy formulation and decision-making regarding the oceans, atmosphere, and coasts, and to ensure related public health and safety and national resource development (Byrne, 1984). Examples of such activities directly relating to NSIDC/WDC 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 (NOAA, 1992, Appendix, C, D). These data sets serve as cryospheric components in inter-disciplinary global change research.

This report discusses NSIDC/WDC activities for the 1993 fiscal year (October 1, 1992 - September 30, 1993).

HIGHLIGHTS

NASA Contract for Distributed Active Archive Center (DAAC)

A five-year, \$7 million contract was awarded to the National Snow and Ice Data Center to archive and distribute passive microwave data and derived products. The DAAC facilities are part of NASA's Earth Observing System, a research effort to better understand the processes contributing to global change and the role of human activities.

Information provided by the NSIDC DAAC will support research on changes in the extent of polar sea ice and land snow cover that have been predicted, by global climate models, as a response to increasing greenhouse gases in the atmosphere. See p. 14 for details of ongoing work.

Arctic System Science (ARCSS) Program

The Arctic is a focal point in efforts to document and understand global change because it is a sensitive region where anticipated changes will be greatest and where changing processes will have global consequences. The goals of the Arctic System Science (ARCSS) Program are:

- (1) "to understand the physical, chemical, biological, and social processes of the arctic system that interact with the total Earth system and thus contribute to or are influenced by global change, in order
- (2) to advance the scientific basis for predicting environmental change on a decade to centuries time scale and for formulating policy options in response to the anticipated impacts of rapid climate change on humans and societal support systems.

The ARCSS initiative is an interdisciplinary, 'system-science' research program requiring the cooperative and collaborative involvement of scientists from many disciplines" (McCauley, 1991).

NSIDC has been funded by the National Science Foundation to provide data management services for three components of the ARCSS program: 1) Greenland Ice Sheet Project (GISP 2); 2) Ocean/Atmosphere/Ice Interactions (OAI); and 3) Land/Atmosphere/Ice Interactions (LAI). NSIDC will work with investigators by assessing requirements for commonly needed data sets, making results from ARCSS studies

available to Arctic researchers and coordinating ARCSS data with existing and emerging national and international data systems.

New CD-ROM Set from NSIDC

Beginning 1 October 1993, NSIDC will have available for distribution the Historical Arctic Rawinsonde Archive (HARA) on 3 CD-ROM volumes. Containing over 1.2 million vertical soundings of temperature, pressure, humidity and wind, this set represents all available rawinsonde ascents from Arctic land stations poleward of 65° North from the beginning of record through 1987. For most stations the record begins in 1958, a few begin in 1947 or 1948. The data are one file per year per station. Coverage is relatively uniform, except in the interior of Greenland. Typically 20-40 levels are available in each sounding. Documentation is provided on the CD-ROM volumes, and in hard copy (*NSIDC Special Report 2*, 1992). Software (Fortran and C) is provided on the CD-ROM volumes to retrieve a subset of the sounding data. Data for 1988-1990, and monthly averaged data, will be prepared for CD-ROM volume 4 during 1993. Sounding data were obtained from the National Center for Atmospheric Research (NCAR), Boulder, Colorado, and the National Climatic Data Center (NCDC) of NOAA in Asheville, North Carolina. When the CD-ROM stock is exhausted, we will determine whether to re-print the discs or to provide data via anonymous ftp, depending on feedback we receive from the science community. The HARA CD-ROM set is being distributed at no charge as an NSIDC DAAC product.

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

New and updated data sets received during FY93 include:

1. Glacier data. A diskette containing data for 1000 glaciers in the former Soviet Union was received from the World Glacier Monitoring Service. Additional glacier data are anticipated to

be delivered as hard copy printouts; we will determine whether key-entry is feasible.

2. Freezeup and breakup data for a number of lakes in Finland, 1982-1992, have been added to the NSIDC archive. This data set now spans 1910-1992, with records for some lakes beginning as early as 1833. The data were provided by the National Board of Waters and the Environment, Helsinki.
3. AIDJEX data. A tape containing Arctic Ice Dynamics Joint Experiment (AIDJEX) meteorological data, received from Oregon State University/Department of Oceanography, has been archived at NSIDC. We are continuing some informal "data archaeology" towards the goal of rescuing any remaining data from AIDJEX, a large-scale research project in the Arctic Ocean north of Barrow during the 1970s. The data we have located so far have been in the hands of investigators who took part in AIDJEX, rather than in national or other organized data centers. NSIDC intends to incorporate the most important of the AIDJEX data sets into future CD-ROMs in the Eastern Arctic Ice, Ocean, and Atmosphere series, volume 1 of which was funded by the Office of Naval Research.

Oceanographic data from the AIDJEX, 1971-1978, were transferred from QIC tape (tar format) to 8-mm cassette for temporary storage pending ingest of the data for a future Eastern Arctic Ice, Ocean and Atmosphere CD-ROM. These data were received from Tom Manley, Marine Research Corp., Middlebury, VT, and Miles McPhee, McPhee Research Corp., Natchez, WA. Both scientists were AIDJEX investigators and participated in field camps on ice floes in the Arctic Ocean.

4. Iceberg data received from the International Ice Patrol (IIP) for 1960-1992 have been updated by the IIP and provided in a single format for the complete time series.
5. Sea ice concentration data, 1953-1990, from Dr. John Walsh, University of Illinois, have been reformatted to increase user access. In the process, additional quality-checking of the data grids was done, and documentation was improved by adding information about the grid projection and expanding explanations of the record format. This NOAA data set at NSIDC is important for hemispheric climate modelling.

6. Arctic sea ice concentration grids covering 1901-1956, extracted from published Danish sources by P.M. Kelly, University of East Anglia, were re-formatted to match the J. Walsh sea ice data (1953-present). These data sets use the same projection and grid size and now share software permitting the user to select and print out grids for any given month.
7. The latest version of the Arctic Ocean buoy data, 1979-1990, from the Polar Science Center, University of Washington, Arctic Ocean Buoy Program (AOBP) was transferred to NSIDC via ftp to replace the older version previously archived.
8. Snow cover data from the former Soviet Union were received from the National Climatic Data Center through the U.S.-USSR Bilateral and development of monthly and 10-day products from the data set "Soviet Snow Cover 1874-1985" is underway. The original station-order files of meteorological observations have been cleaned and converted to synoptic (date) order, and the station file is complete, with latitude, longitude, elevation, WMO number, station name, and comments. This data set should be ready for distribution by the end of 1993, and will later be incorporated with other snow data received from the former Soviet Union.
9. Sea Ice Data. North polar sea ice data received from the Arctic and Antarctic Research Institute (AARI), St. Petersburg, Russia, have been uncompressed and backed up to diskettes. This data now spans 1972-1989; additional years of data are being digitized at AARI and will be provided to NSIDC as part of the WMO-sponsored Global Sea Ice Data Bank.
10. NOAA/NESDIS/SDSD Northern Hemisphere snow and ice digitized data for 1991 were received and added to the data base covering 1966 to the present. The new files were transferred from 9-track tape to PC diskette. The diskette is available for future requests.

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 6200 monographs and technical reports and 13,500 reprints; 90 serial publications are regularly received. During 1993, approximately 1500 items were added to the collection.

All materials received are catalogued and assigned subject and geographic descriptors. Primary access to the collection is provided by CITATION, the in-house online 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 outputting reports, has been installed in the Information Center. SearchMAGIC allows CITATION to be available to each PC at NSIDC.

At the end of FY93, there were over 30,000 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, however, our focus in recent years has concentrated on snow cover and sea ice data and information and the effects of the cryosphere on climate. Online searches of the collection are performed on request.

Bibliographic access to the information holdings of NSIDC/WDC is available through two CD-ROMs. The entire data base is included on the *Arctic and Antarctic Regions* disc produced by the National Information Services Corporation (NISC) for the Library of Congress, Cold Regions Bibliography Project. Currently, the disc holds over 600,000 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 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.

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.

Two volumes in this series were published in 1993. *GD-25, Snow Watch '92; Workshop on Cryospheric Data Rescue and Access*, contains the proceedings and recommendations of two workshops: 1. *Snow Watch '92, Detection Strategies for Snow and Ice*, sponsored by the Canadian Climate Centre, the World Meteorological Organization and the Institute for Space and Terrestrial Science, University of Waterloo; 2. *Workshop on Cryospheric Data Rescue and Access*, supported by NOAA's program of Earth System Data and Information Management (ESDIM) and convened by Dr. Robert Crane, Pennsylvania State University.

GD-26, Permafrost Bibliography Update, 1988-1992, was prepared in conjunction with the Sixth International Conference on Permafrost held in Beijing in July 1993. The bibliography, which updates those published in *GD-14* and *GD-21*, contains over 3000 citations covering all aspects of permafrost research. Funding to support printing was provided by the U.S. Army Cold Regions Research and Engineering Laboratory.

Four issues of *NSIDC Notes*, were distributed to a mailing list of 650 names in FY93. *NSIDC Notes* provides information about activities at NSIDC including the NSIDC Snow and Ice DAAC, the Arctic System Science (ARCSS) data management, DMSP OLS digital and analog data distribution, passive microwave data distribution, DAAC activities, and research projects underway. This newsletter is part of NSIDC's commitment to foster communication within the cryospheric research community.

Data Related Meetings

U.S. Polar Information Working Group, 25-26 March 1993, Boulder, Colorado

Ann Brennan attended the annual meeting of the U.S. Polar Information Working Group held in Boulder, 25-26 March. The group has representatives from WDC/NSIDC, Institute of Arctic and Alpine Research, Library of Congress, U.S. Army Cold Regions Research and Engineering Laboratory, NSF, Byrd Polar Research Center, Dartmouth College and the University of Alaska. The aim of the Working Group is to ensure effective access to, and document delivery of, polar regions information to the user community. The focal point of this meeting was to discuss implementation of plans for cooperative acquisition and cataloging as well as continuation of the Polar Pac CD-ROM.

Workshop on Arctic Contamination, 2-7 May 1993, Anchorage, Alaska

Ann Brennan was an invited participant at the Workshop on Arctic Contamination sponsored by the Interagency Arctic Research Policy Committee. The Workshop was held in Anchorage, 2-7 May. Brennan prepared a draft bibliography on Arctic contamination which was distributed on diskette to the 250 participants and discussed information resources and management at a working session. The recommendations of the Workshop and the final bibliography will be published in the Fall issue of *Arctic Research of the United States*.

ESDIM/NSF Workshop on Prioritization of Snow and Ice Data, 10-12 May 1993, State College, Pennsylvania

A workshop to develop priorities for the rescue of snow and ice data was convened at Pennsylvania State University, State College, 10-12 May, by Dr. R. Crane (Center for Earth Systems Study). There were twelve invited participants.

A report on the meeting was prepared by Dr. Crane for submission to NSF and NOAA/ESDIM. The primary recommendations on cryospheric data rescue are for data for: (1) global change detection, (2) earth system model validation, (3) process model development and verification. Participants identified key data sets that should be made more accessible to earth scientists, and identified data at risk of being lost because of deteriorating storage media and other factors.

Changes in the United States and the former Soviet Union have made some valuable data sets available to research scientists for the first time, and the acquisition of these data sets was given top priority for rescue/acquisition within NOAA's ESDIM program.

Workshop on Arctic Reference Databases. 1-3 September 1993. Arendal, Norway

C. Hanson attended a Workshop on Arctic Reference Databases, hosted by United Nations Environment Program (UNEP) Global Resource Information Database (GRID), Arendal, Norway, and the U.S. Geological Survey Arctic Environmental Data Directory (AEDD). The workshop, held in Arendal on 1-3 September 1993, was attended by representatives from Canada, Denmark, England, Finland, Germany, Italy, New Zealand, Norway, Russia (Ministry of Environment Protection in Moscow, and Institute of North Industrial Ecology Problems in Apatity, Murmansk), and the U.S. (U.S. Geological Survey and University of Colorado). The purpose of the workshop was to recommend strategies for the development of a circumpolar Arctic Environmental Reference (i.e., metadata) Database, based on the cooperation of all Arctic countries, and countries active in the Arctic, in the framework of existing data directory efforts such as IGBP-DIS, the Global Change Master Directory, the Arctic Environmental Data Directory, and the UNEP/GRID system. The recommendations of the Workshop are being reviewed by the group. Following acceptance by the group of the draft, a steering committee or working group will be constituted to begin to implement the recommendations. Appropriate nations who did not attend the Workshop will be invited to participate in the steering committee/working group.

SCAR-COMNAP Ad Hoc Planning Group on Antarctic Data Management. 13-17 September 1993. Boulder, Colorado

C. Hanson, U.S. delegate, attended a meeting of the Scientific Committee on Antarctic Research (SCAR) - Council of Managers of National Antarctic Programmes (COMNAP) ad hoc Planning Group on Antarctic Data Management, hosted by NSIDC and held on the University of Colorado campus, 13-17 September 1993. This second meeting of the group focused on developing an implementation plan for an Antarctic Master Directory (AMD) as part of the International Directory Network (IDN). The AMD will be based on the DIF (Directory Interchange Format) to provide complete interoperability with the Global Change Master Directory and other parts of the IDN. The group will present a report to SCAR and COMNAP recommending a course of action to develop both a prototype AMD and a call for

proposals to develop and operate an operational directory. H. Meyers of NGDC, S. Worley of NCAR, T. Pfeffer of INSTAAR/University of Colorado, and U. Radok of CIRES/University of Colorado, attended an open afternoon session of the Planning Group for a briefing on the Planning Group draft report and to provide feedback and input to the AMD planning process. Members of the Planning Group, which is similar in structure to a SCAR "Group of Specialists", are from Argentina, Australia, Germany, Italy, New Zealand, the United Kingdom and the United States.

Project Activities

Defense Meteorological Satellite Program Data Management

Analog OLS Image Archive

NSIDC is in the eleventh year of service as the national archive for analog Operational Linescan System (OLS) data from the U.S. Air Force Defense Meteorological Satellite Program (DMSP). These images were the primary means of DMSP data distribution until the implementation of the present digital capability at Air Force Global Weather Central (AFGWC) about 3 years ago. Only about 500 images were added to the collection this year since hard-copy is only generated at selected receiving sites and for special cases. The collection now amounts to about 1.4 million pieces of imagery. Approximately 155 requests for data and information were processed in FY93 resulting in data sales of about \$6,800. The continuing usage of this data in light of the decrease in receipts of new images reflects the scientific value of this project.

NSIDC began the transfer of the DMSP collection to the Federal Records Center (FRC) this year. This transfer is in accordance with NOAA/NESDIS policy and will take several years to complete. NSIDC is attempting to minimize the impact to the user community by retaining the most widely used data sets for as long as feasible.

DMSP Digital Data Archive

NSIDC and the National Geophysical Data Center (NGDC) have made considerable progress in their joint effort to archive digital DMSP data. This effort will make the complete DMSP data stream available for the first time. Financial support has been provided by the DOD, NASA and NOAA, and is being coordinated by NOAA/NGDC. A memorandum of agreement is being negotiated between the Air Force and NOAA/NESDIS.

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. NSIDC is also contributing scientific expertise in data interpretation stemming from the DMSP/OLS analog archive and the DAAC project (see page 14), and considerable experience in the management of satellite data in support of cryospheric and climate system studies. While the archive of digital DMSP data will reside at NGDC, user services will be provided by both by NSIDC and NGDC, depending on the scientific discipline and type of request. NSIDC is gearing its operation to the provision of data and data products related to the cryosphere and climate system. Funding for the activity at NSIDC has come from NOAA/NGDC, NOAA Climate and Global Change Program and NASA.

Data from all DMSP satellites and sensors have been copied to 8 mm tape since March 1992. The archive will include digital data beginning then (although problems with the tape recorders at AFGWC have resulted in yet to be determined gaps in coverage between March and September 1992). The hardware and software computer processing systems at NGDC were installed in August 1993, and we expect to begin processing the backlog of data (and new data) in late 1993. Much of the hardware system at NSIDC is in place, and software development has been underway for more than one year. Some user services should be available this Fall.

Though the archive and user services components are not yet operational, NSIDC would like to encourage potential users to contact NSIDC/DMSP with their requirements for data at this time. Examples of DMSP/OLS visible band (Fig. 1) and thermal infrared (Fig. 2) are shown on the following page.

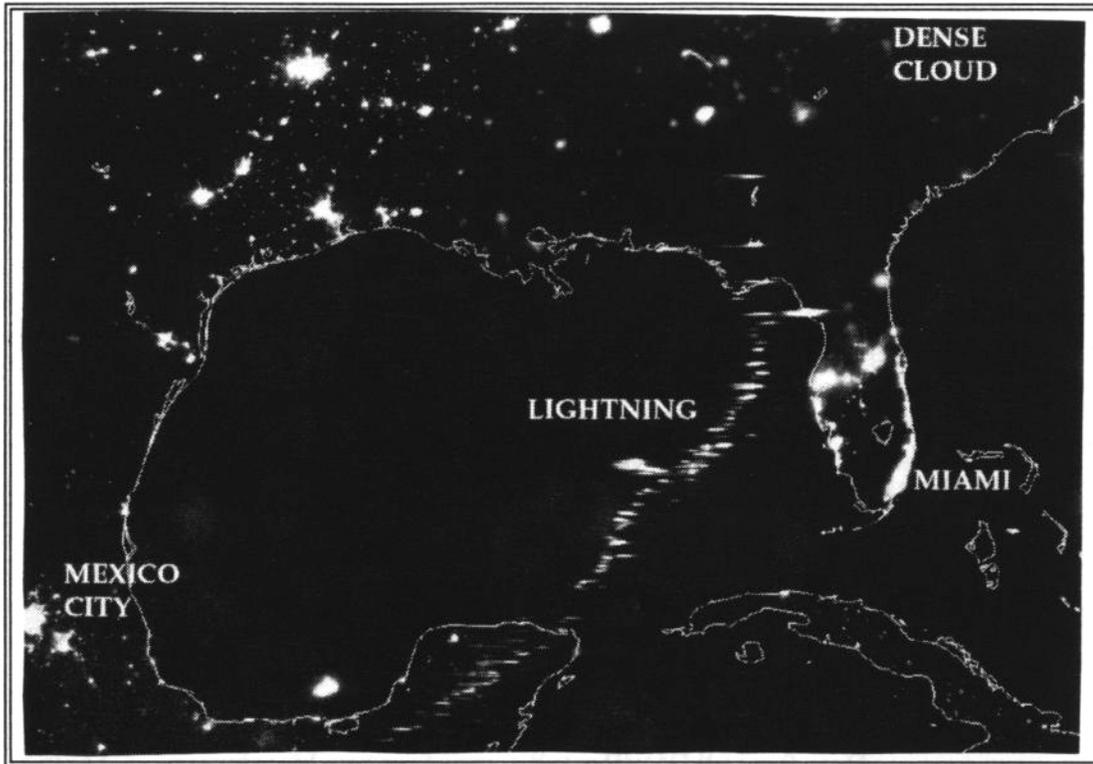


Figure 1. OLS visible-band image at 0400 GMT on 13 March 1993. The horizontal bright streaks are lightning signatures associated with the intense thunderstorm activity along the cold front. City lights of the central U.S. under clear skies and the eastern U.S. under cloudy skies are also visible.

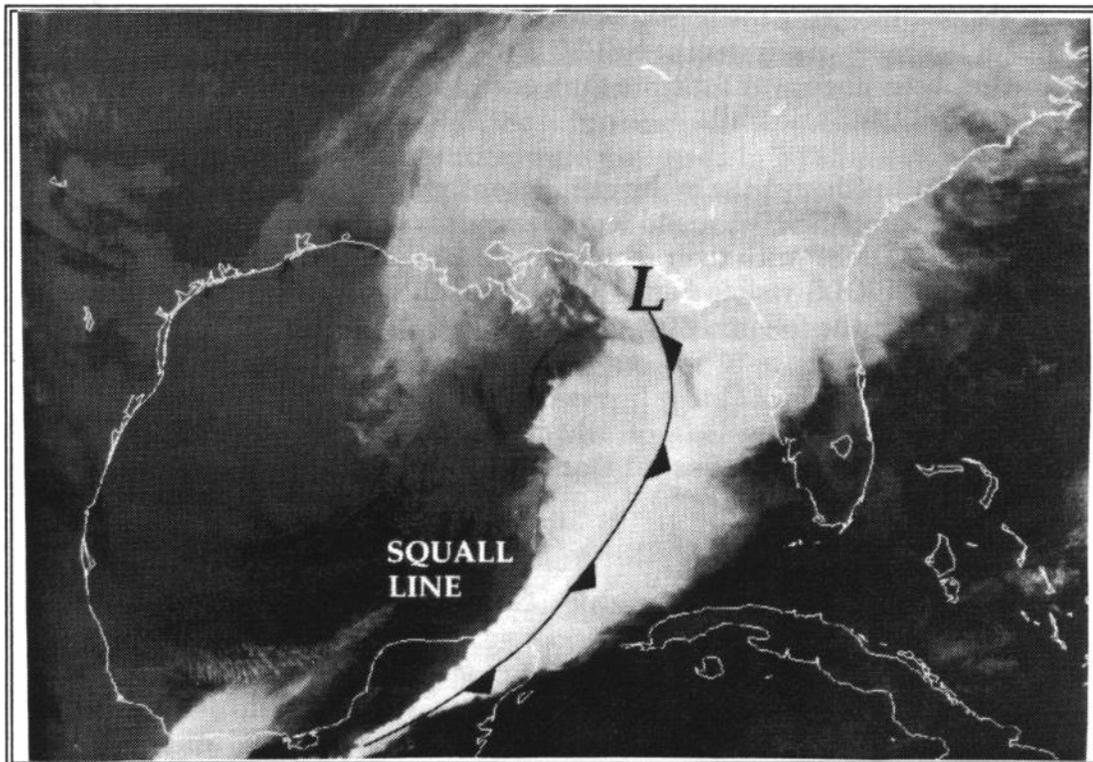


Figure 2. OLS thermal infrared image at 0400 GMT on 13 March 1993 showing the vigorous storm which later became known as the 'blizzard of 1993'. Superimposed on the image is the surface low pressure center and cold front taken from the 0300 GMT NMC surface analysis.

Application of Special Sensor Microwave Imager (SSM/I) Data for Snow Cover and Climate Research

NSIDC is currently funded by NASA's Interdisciplinary Research Program to develop a capability for the production of daily snow parameter products from the DMSP SSM/I satellite data. Snow cover is an important variable for climate and hydrologic models due to its effects on surface albedo, energy, and moisture budgets. Satellite passive microwave observations afford the best method to monitor temporal and spatial variations in snow cover on the hemispheric scale, avoiding the problems of cloud cover and polar night. A data system is being developed which will produce, archive, and distribute validated snow cover products for community use. Initial emphasis is on Northern Hemisphere snow extent. We are also exploring the potential of the SSM/I for mapping other snow cover properties such as snow water equivalent, snow depth, and dry/wet snow boundary. These tasks will contribute towards the production of a prototype snow cover climatology based on the first five years of SSM/I data.

Within this project, NSIDC coordinates the activities of the SSM/I Products Working Team (SPWT) which is a multi-agency and multi-disciplinary working group focusing on the problems associated with extracting land surface (primarily vegetation, soil, and snow cover) information from SSM/I. Currently, emphasis is on developing optimal binning, gridding, and global map projection methods, as well as the selection of one or more snow cover algorithms for use in the distribution of standardized data sets by NSIDC. A prototype version 0.0 of the Equal Area SSM/I Earth (EASE) Grid was distributed on CD-ROM for community evaluation in October 1992. Version 1.0, based on the user feedback provided, is currently under development. The basic purpose of the EASE-Grid is to provide a standard earth-located grid and an optimal technique to interpolate from the data in swath format to the appropriate earth-located grid cell. The EASE-Grid is intended to provide the general user with a data structure which is easier to use than swath format, while maximizing the radiometric, spatial, and temporal integrity of the original swath data.

Current and future activities involve snow cover algorithm comparison and validation undertaken in cooperation with several SPWT scientists. Regional test areas selected are the western United States, Prairie Provinces of Canada, and the former Soviet Union. Algorithms which derive geophysical products from SSM/I data are being evaluated in a systematic manner. Surface station measurements (e.g., snow depth) are interpolated to the EASE-Grid which allows direct quantitative comparison with algorithm output in the same grid.

Comparisons are made using histograms and digital image subtraction.

Distributed Active Archive Center (DAAC) at NSIDC

NSIDC has a five-year contract with NASA to participate as one of eight Distributed Active Archive Center (DAACs) in the Earth Observing System Data and Information System Project (EOSDIS). (See also Highlights, p.2.) 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.

Science Objectives

Polar regions have the following unique features that influence macro-scale climate processes. Support of research responding to the following attributes comprises the primary objective of the NSIDC DAAC:

The dramatic changes in energy fluxes associated with the annual cycle of snow cover on land and sea ice on the ocean.

The decoupling of the atmosphere from the ocean provided by the sea ice cover, especially in terms of turbulent fluxes of heat and moisture.

The effects of the melting and freezing of sea ice on ocean-density structure that controls the formation of the deep waters which cool and ventilate the deep oceans.

The vast ice sheets in Greenland and Antarctica, whose fluctuations in mass can significantly raise or lower sea level.

Data Products

Between 1991 and 1994 the EOSDIS Project Office is building a working prototype of the EOSDIS that will provide a smooth transition from the existing DAAC native data systems to the operational EOSDIS configuration. The DAAC staff at NSIDC are participating in the

Version 0 (V0) prototype efforts to create a unified, across-DAAC information management system. In addition we are working on browse generation issues specific to polar regions.

One of the NSIDC DAAC's on-going products includes the distribution on CD-ROM of the DMSP Special Sensor Microwave Imager (SSM/I) Brightness Temperature Grids for the Polar Regions (to date covering 9 July 1987 - 30 December 1991, 18 volumes), and associated sea ice concentration products. Volume 2, August 1990 - December 1991 of the Ice Concentration CD-ROM was published in FY93. A loose leaf *User's Guide* containing complete documentation is part of the package, along with display software for both PC and MacIntosh platforms.

We have also completed distribution of SMMR gridded brightness temperature data for the period October 25, 1978 to August 20, 1987. These data are in the same format as the SSM/I products.

During October, NSIDC expects to complete Version 1 of the *User's Guide for Nimbus-7 SMMR Polar Radiances CD-ROMs*. This document has been in an extended development and review process in order to provide the proper amount of information in a format that will be helpful to users. The *User's Guide* supplements the SMMR Atlas (Gloersen, P.; Campbell, W.J.; Cavalieri, D.J.; Comiso, J.C.; Parkinson, C.L.; and Zwally, H.J. *Arctic and Antarctic Sea Ice, 1978 - 1987: Satellite Passive Microwave Observations, NASA SP-522* (in press). NSIDC will automatically distribute the *User's Guide* to all recipients of the 12 SMMR CD-ROM volumes. Details on availability of the SMMR Atlas will be announced shortly.

Gridded sea ice concentration estimates from both the SMMR and SSM/I data have been issued on CD-ROM, covering 1978 to 1991. This combined data set is one of the longest satellite-era measurements of a cryospheric parameter.

Cryospheric Information Management System Development

The National Snow Ice Data Center and Laboratory for Atmospheric and Space Physics (LASP) are collaborating on the development of the Cryospheric Information Management System (CIMS) and in the V0 IMS interoperability development activities.

The following data sets have been populated into the CIMS:

- SSM/I Orbital Brightness Temperatures
- SSM/I Brightness Temperature Grids for the Polar Regions

SSM/I Sea Ice Concentration Grids
SMMR Brightness Temperature Grids for the Polar Regions
SMMR Sea Ice Concentration Grids
Historical Arctic Sounding Data
AOBP Buoy Position Data
AOBP Ice Velocity Grids
AOBP Pressure and Temperature Grids

The CIMS personnel at LASP have developed software to perform accurate spatial searches of the CIMS inventories. Modifications to the IMS search message have been proposed in order to integrate and test this software within the IMS operational environment. These modifications require: 1) that the IMS client provide the map projection (Mercator, polar stereographic, etc.) upon which the spatial query was performed, and 2) that the spatial search engine of the DAAC server know what type of map projection was used when the granule was generated.

Software to support requests for products through the IMS was integrated into the NSIDC DAAC server. Product request messages received from the IMS client are transcribed and then forwarded via E-mail to NSIDC DAAC User Services staff.

Personnel

Dr. Ted Scambos joined the NSIDC DAAC staff as a remote sensing scientist, 1 February 1993. His role is to interact with the polar community assuring that the NSIDC DAAC satisfies the research community's data requirements.

Spencer Shiotani was hired as scientific programmer to develop data ingest and quality assurance software for data sets received from external investigators. The first task was to develop access and manipulation software to be distributed with the Arctic Sounding Data Set.

Karen Robinson accepted the position of data base administrator (DBA) at NSIDC DAAC, 8 March 1993. Karen will be responsible for maintaining the CIMS databases.

ESDIM

NSIDC has been funded by NGDC to start work on critical data rescue and access needs for snow and ice data. This effort has been funded by the NOAA Earth Science System Data and Information

Management (ESDIM) Initiative. The stated objectives of the ESDIM program is 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 held by NSIDC, not available to NOAA scientists, and which also may be at considerable risk. 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., snow cover ground observations from Russia and data on the fluctuation of glaciers in the Caucasus.

FY93 Accomplishments:

1. Phase one of the ESDIM snow and ice data "rescue" was completed. This entailed placing in the NOAA digital archive at NGDC all of the NOAA data held by NSIDC. The tasks included: copying the original data on 9-track magnetic tapes to 3480 cartridges for the permanent NGDC archive; evaluating, modifying and backing up documentation and access software as necessary; acquiring a 3480 tape handling capability at NSIDC; and verifying and entering directory, catalog and inventory information into NGDC systems.
2. Much progress was also made in the ESDIM project to rescue Russian sea ice data. The project concerns (1) the acquisition, documentation and management of Arctic sea ice data from the Arctic and Antarctic Research Institute (AARI), St. Petersburg, and (2) related research on ice conditions in the Eurasian Arctic. The importance of these data sets was endorsed at a meeting on Data Rescue and Prioritization in May 1993 (Crane, 1993) (See *Data Related Meetings*, p.8). Digital data on Arctic sea ice were transferred from AARI to WDC-A for Glaciology as scheduled in late 1992 and June 1993. Digital sea ice data for the Eastern Arctic for 1972-90 have been received.

3. Arctic Drifting Station data from the University of Washington were digitized by NCDC and funded by ESDIM. It amounted to 9936 observations. This project is continuing (with FY92 funding) because only one out of eight data sets has been completed.
4. Snow cover data from the former Soviet Union (for 1987-89) were digitized by the Institute of Geography in Moscow and sent to WDC-A as part of the ESDIM data rescue project.
5. Updates to the World Glacier Inventory were provided to the World Glacier Monitoring Service in Zurich by the Russian Institute of Geography. 13.5 mb of data were provided to WDC-A.
6. Historical photographs of glaciers in Alaska and Europe, archived on glass plate negatives at NSIDC, were processed by a commercial photo lab to make contact prints so the collection is accessible to users. The glass plates have been unusable because of their extreme fragility.

Arctic System Science (ARCSS) Program

NSIDC is funded by NSF for data management activities for three components of the ARCSS Program. See Highlights, p. 2.

During FY93, NSIDC staff have been involved in ARCSS science and data management meetings to determine the scope of the ARCSS Program and the role NSIDC can play to support ARCSS-funded researchers.

NSIDC is represented on the ARCSS Ocean-Atmosphere-Ice Interactions (OAI) Science Steering Committee. This group continues to discuss the OAI Science Plan, linkages with the Land-Atmosphere-Ice Interactions (LAI) component of ARCSS, and the establishment of ARCSS-wide working groups for modelling and data management/access. NSIDC ARCSS staff attended a planning meeting of the LAI Flux Study investigators (Seattle, 1/93) and an interagency-sponsored Workshop on Surface Energy Budget, Radiation and Clouds Over the Arctic Ocean (Orlando, 2/93). The former led to the development of a list of data sets and products required by the Flux Study PIs that NSIDC is now working to acquire and deliver on CD-ROM; the latter to development of a list of existing data sets the present and future OAI-funded PIs must acquire and analyze before additional Arctic fieldwork can be funded. NSIDC is acquiring these data and will make them available to the Arctic community, beginning in late 1993. These examples illustrate an important part of the

ARCSS strategy for success: data management planning is an integral part of science planning for the project, and data management professionals are involved throughout the planning process. NSIDC is providing data support to all ARCSS-funded investigators, and is in communication with them as they design future experiments and field programs.

The Greenland Ice Sheet Project (GISP2) is now one of the components of the ARCSS Program. NSIDC is continuing its data management activities for this project. This includes the development of a data management plan specific to the needs of the GISP2 scientists undertaken in cooperation with the GISP2 Executive Committee and the GISP2 Science Management Office. This plan assures efficient and timely access to ice core data as they are released by the GISP2 Principal Investigators (PIs) and it provides the safe, long-term archival of key data.

Using this plan, derived data products from the Greenland Ice Sheet Project (GISP2) data base at the University of New Hampshire were downloaded to NSIDC using ftp. The data are organized by format (unix ascii, tabs for dos formats, spaces for macintosh formats). Online documentation describes the data coding scheme and the overall GISP2 project. The data will be distributed to GISP2 investigators by request and will eventually be copied to CD-ROM for general distribution.

Because of the widespread and growing interest in paleoclimate and global change, GISP2 data sets will receive ever-increasing attention from fields outside glaciology.

MIZEX/CEAREX

NSIDC continues to provide data management services for the Marginal Ice Zone Experiment (MIZEX) and the Coordinated Eastern Arctic Experiment (CEAREX). Data sets in the categories of physical oceanography, ice, acoustics, biology, remote sensing, and meteorology are available from the 1983, 1984, and 1987 field experiments in the East Greenland and Bering seas.

CEAREX field experiments were carried out in the East Greenland Sea in the area west of Svalbard between 70 and 85°N between August 1988 and May 1989 to provide a better understanding of the structure and function of the meso- to small-scale processes in the exchange of momentum, heat, and biomass within the ocean/atmosphere boundary layer.

AVHRR visible channels and comparison of two satellite-derived albedo data sets: and on flux modeling for leads.

The highlights can be summarized as follows:

- Satellite cloud amounts are generally 5-35% less than observed values over the entire Arctic.
- Shortwave and longwave fluxes at the surface were modeled from satellite data on a monthly basis for the entire Arctic. Net longwave flux was found to be negative throughout the year with a minimum value of -70 Wm^{-2} in the month of May.
- Seasonal variations of shortwave-, longwave- and net-radiation cloud forcing at the surface were computed; positive net forcing values of 65 Wm^{-2} were found for October through January, and the net cloud forcing was negative for the months May through August.
- Narrow leads in the sea ice have been found to be more effective in turbulent flux transfer than wide leads of the same aerial extent.

Assessment of Climate Variability of the Greenland Ice Sheet

K. Steffen

Funding: NASA, Swiss Science Foundation

The objectives of the program are to monitor surface properties of the Greenland ice sheet based on multispectral satellite data in combination with ground truth observations. Several key parameters of the surface energy balance are parameterized using satellite and ground measurements to derive a ten-year surface climatology of the entire ice sheet.

In the spring of 1993 we completed a successful field expedition (May and June). The turbulent and radiative energy flux measurements at the equilibrium line altitude (1150 m, 70°N, 49°W) showed that during daytime, the surplus of energy from the net radiation is mainly used to heat up the snow layer, and to a lesser extent for melting and evaporation. During the night, the sensible heat flux is a major energy source that makes up for approximately 50% of the radiative loss from the surface. In addition, the atmosphere was sampled on a daily basis with radiosonde and sun-photometers for atmospheric transfer modeling. The measurements are currently

analyzed for the calibrations of visible, thermal and passive microwave satellite data acquired over the same region of the ice sheet.

Parameterization and Scaling of Arctic Ice in the Context of Ice

K. Steffen

Funding: NASA

In the past year the major emphasis was on sea ice classification studies using ERS-1 SAR imagery. Co-registered SAR/Landsat Thematic Mapper (TM) were used to evaluate the utility of SAR data for ice classification and to develop a simple, effective SAR-based classification algorithm. The analysis showed that the backscatter coefficient of the C-band SAR can only be used to distinguish between multiyear and first-year ice; for young ice, thin ice and open water the backscatter coefficient varies depending on the surface wind speed and the growth history for the individual type.

Artificial Intelligence Applications for Sea Ice Classification and Processes

J.A. Maslanik and J. Key

Funding: NASA

Objectives are to automate knowledge and manual pattern recognition skills in ice classification and data processing tasks. Rule-based systems and neural networks have been applied to combine physical model output, meteorological data, and passive microwave imagery to minimize errors in sea ice classifications from SSM/I data. Current work focuses on automating quality control steps in geophysical processing of SSM/I data.

Modeled and Observed Sea Ice Conditions in the Arctic

J.A. Maslanik, H. Maybee, and M.C Serreze

Funding: NSF

Numerical models of the Arctic sea-ice cover are being used to test the sensitivity of the ice pack to thermodynamic and dynamic processes. A new sea ice model has been developed that includes a choice of a viscous-plastic or cavitating-fluid ice rheology, tracking of different ice types, coupling to radiation parameterizations, fetch and stability-dependent turbulent fluxes from leads, and a bulk similarity-theory model of the atmospheric boundary layer. Experiments with variations of this model have considered: 1) the influence of ice dynamics on ice transport during a 32-year model simulation; 2) effects of different cloud climatologies, radiative calculations, and temporal variability of cloud fraction; 3) comparisons of the two ice rheologies; 4) differences between

using monthly mean and daily-varying winds; 5) geostrophic versus gradient winds; and 6) effects of lead width with and without the atmospheric boundary layer coupling.

Estimation of Arctic Radiative Fluxes from Satellite Data

J.R. Key, A. Schweiger (University of Washington)

Funding: NASA

In order to quantify the Arctic radiation balance for large-scale process studies such as sea ice modeling we must rely on satellite remote sensing techniques to provide data with sufficient spatial and temporal coverage. The process of estimating radiative fluxes, cloud forcing, and surface albedo using satellite data is a complex combination of observations, models, and assumptions. The monthly cloud product of the International Cloud Climatology Project (ISCCP) has been used to estimate Arctic radiative fluxes and cloud forcing at the surface and top of the atmosphere for the years 1984-1990. Despite significant uncertainties in the ISCCP data, results such as these allow us to assess the potential accuracy of the retrieval and help identify areas in need of further research.

J.R. Key, R. Silcox

Funding: NASA

Shortwave and longwave downwelling surface radiation fluxes as parameterized through simple schemes commonly used in sea ice models have been compared to fluxes calculated using a complex radiative transfer model and the ISCCP C2 cloud data set. The simple shortwave and longwave schemes require just a few input variables. Mean monthly fluxes for one parameterization scheme were accurate to within 5%, while another differed by 20%.

Satellite Retrieval of Surface Albedo and Temperature

J.R. Key, R. DeAbreu, U. Waterloo; R. Lindsay, U. Washington; M. Haefliger, Swiss Fed. Inst. Technology; M. Serreze; J. Maslanik

Funding: NASA

The albedo and temperature of the ice surface control the rate of sea ice growth and air-sea heat exchange and are therefore important parameters to monitor for climate change studies. Little effort has been directed to their retrieval in the Arctic. Recently, an algorithm for the retrieval of surface temperature from the thermal channels of the AVHRR was developed using Arctic temperature, humidity, and aerosol data. The method is straightforward and in theory is very accurate. In practice, however, significant uncertainties remain. Unfortunately, few

data are available for the validation of the temperature estimates provided by that algorithm. Surface albedo can also be estimated although the procedure is more complex, involving atmospheric correction, adjustments for the anisotropic nature of surface reflectance, and the conversion of narrow-band spectral measurements to a broadband value. Preliminary retrieval results are encouraging, although it appears that the atmospheric correction portion of the procedure is underestimating the effect of multiple scattering by aerosols.

Arctic Climate Variability

M. Serreze, J. Kahl, R.R. Barry, J.A. Maslanik, S.J. Khalsa
Funding: NOAA, EPRI, NSF, NASA

Research has been conducted on a variety of Arctic topics, including analysis of tropospheric temperature trends, low-level temperature inversions, synoptic activity, water vapor transports, and sea ice surface characteristics from satellite analyses and field studies in the Canadian Arctic.

Perhaps the most significant research highlight is the finding that over the past several decades, there have been no discernable tropospheric temperature increases over the Arctic Ocean that can be attributed to enhanced greenhouse warming, counter to what is predicted by most climate models. Similar conclusions have been reached from analyses of land stations. Both cyclonic and anticyclonic activity in the Arctic appears to have increased since 1952, indicative of a circulation change. While perhaps offering some insight into the reasons for observed increases in Arctic surface temperatures and thinning of the Arctic boundary layer, it is not clear at this point why these circulation changes are not expressed as temperature trends aloft. Studies are underway to address these issues.

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 60% of total funding. The NOAA contribution from various sources, DMSP, Climate and Global Change, ESDIM and NGDC, adds about 32% of overall funding. See Figure 3. Total funding for FY93 was just over \$2.6 million. The trend in funding 1977-1993 is shown in Figure 4.

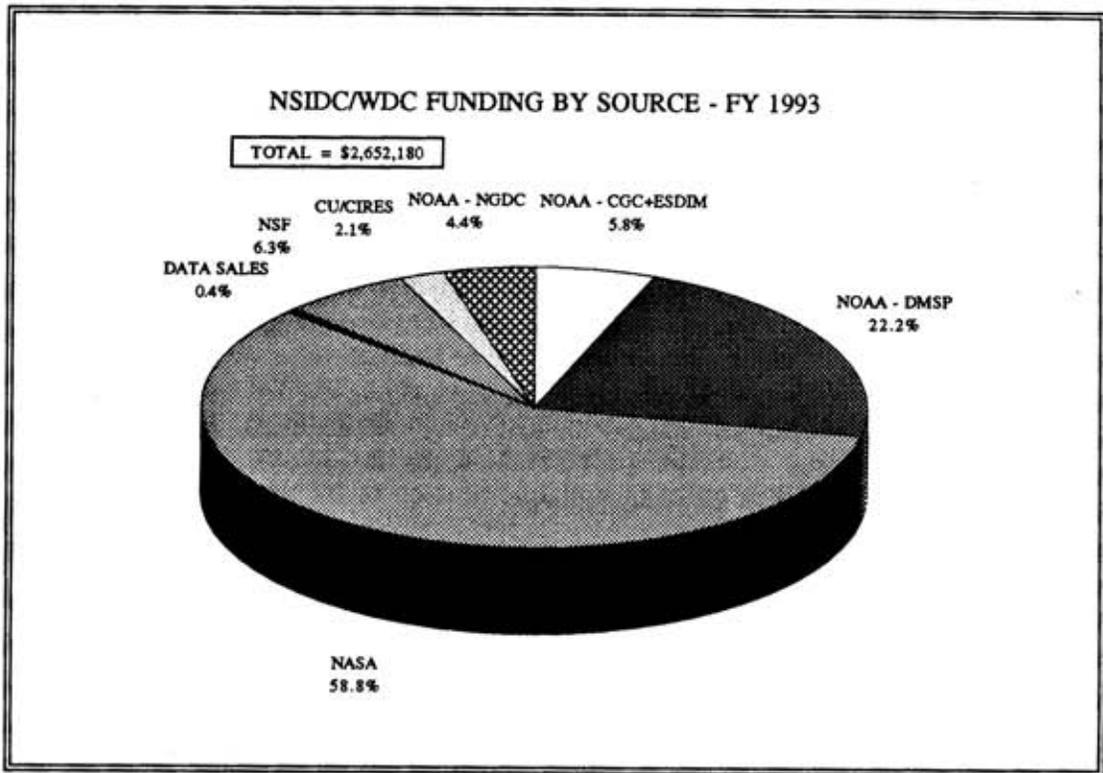


Figure 3. NSIDC/WDC funding by source - 1993.

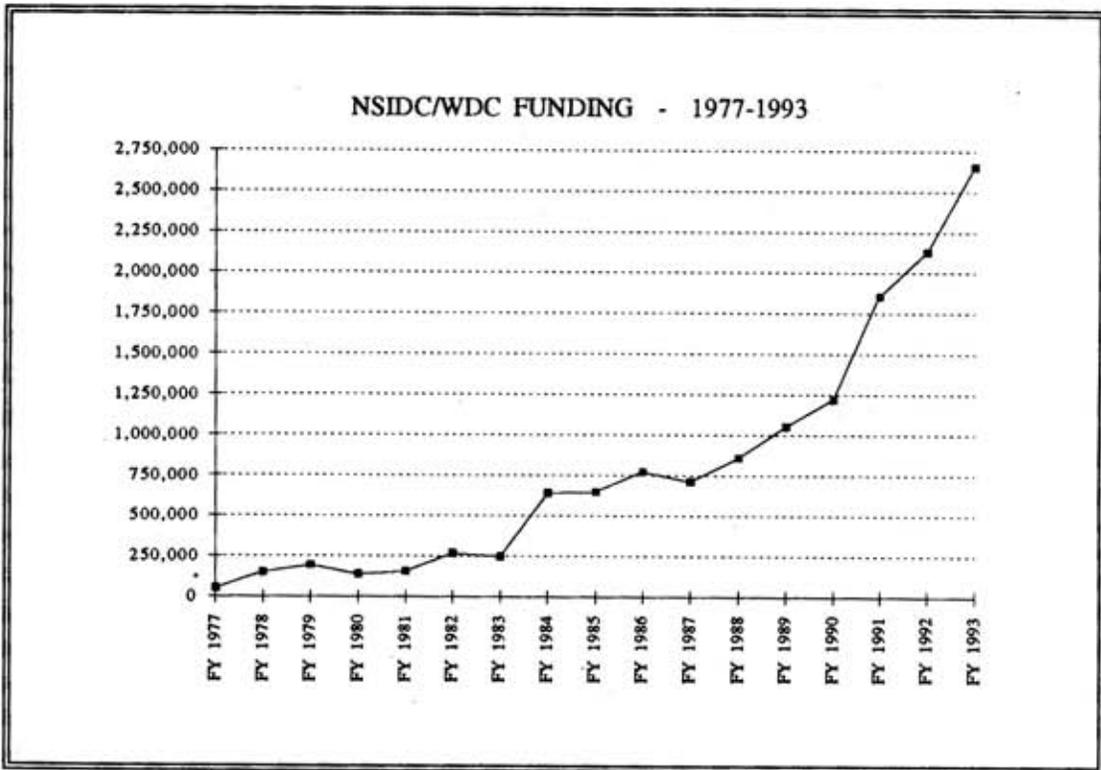


Figure 4. NSIDC/WDC total funding 1977 - 1993.

Data Request Statistics

User Categories

One of the variables by which NSIDC tracks users is by type of organization. Over the 16-year period of record, 1978-September 1993, the distribution of users by category has remained relatively stable. Of the over 800 requests this year, not including the 580 subscribers to SSM/I and SMMR CD-ROMs, 28% of requests came from the U.S. academic community. Twenty-two percent of requests came from outside the U.S.; 20% were from various Federal agencies; 12% represented industry. (See Figure 5).

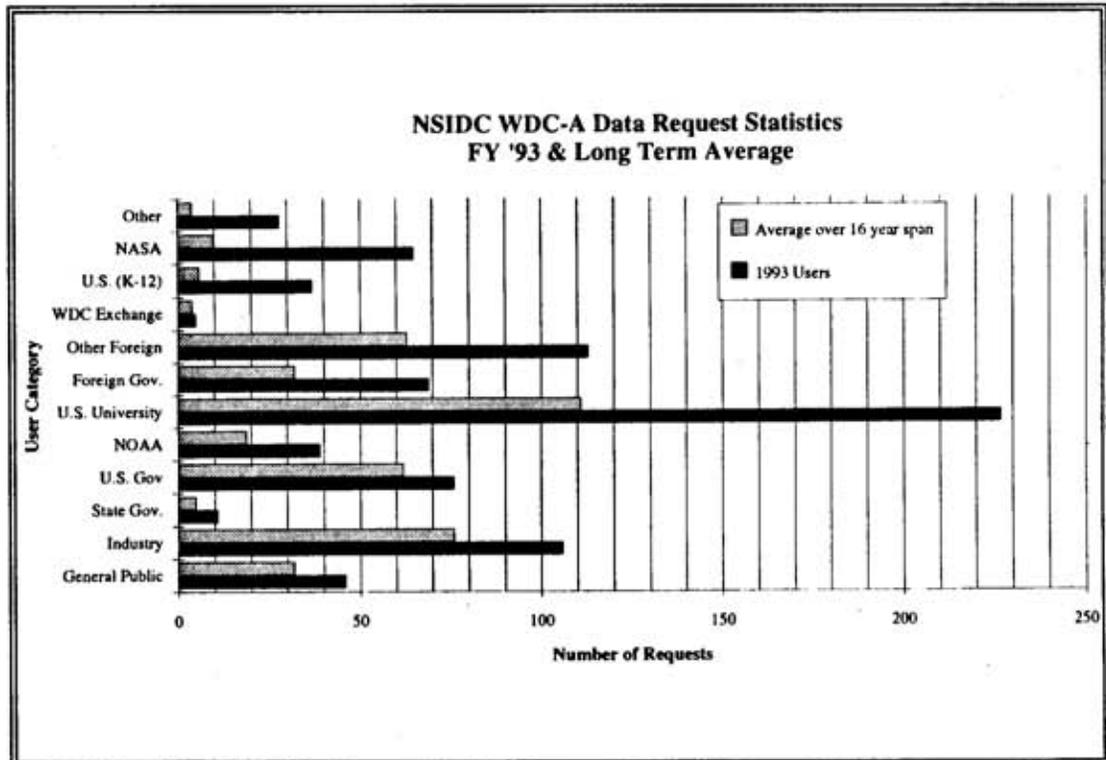


Figure 5.

Data Categories

Passive microwave data, both SSM/I and SMMR, had the highest number of users. These data, distributed on CD-ROM (19 volumes to date), are sent regularly to approximately 580 subscribers. DMSP data,

both analog and digital continues to lead data statistics in income generated. FY 93 saw 158 requests (19%) for DMSP data and information and over \$6K income.

Usage of the Information Center continues steady. Logged requests for bibliographic information account for 17% 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 think that the impact of the Information Center is not truly reflected in the statistics.

Figure 6 displays the number of requests and income earned since 1978.

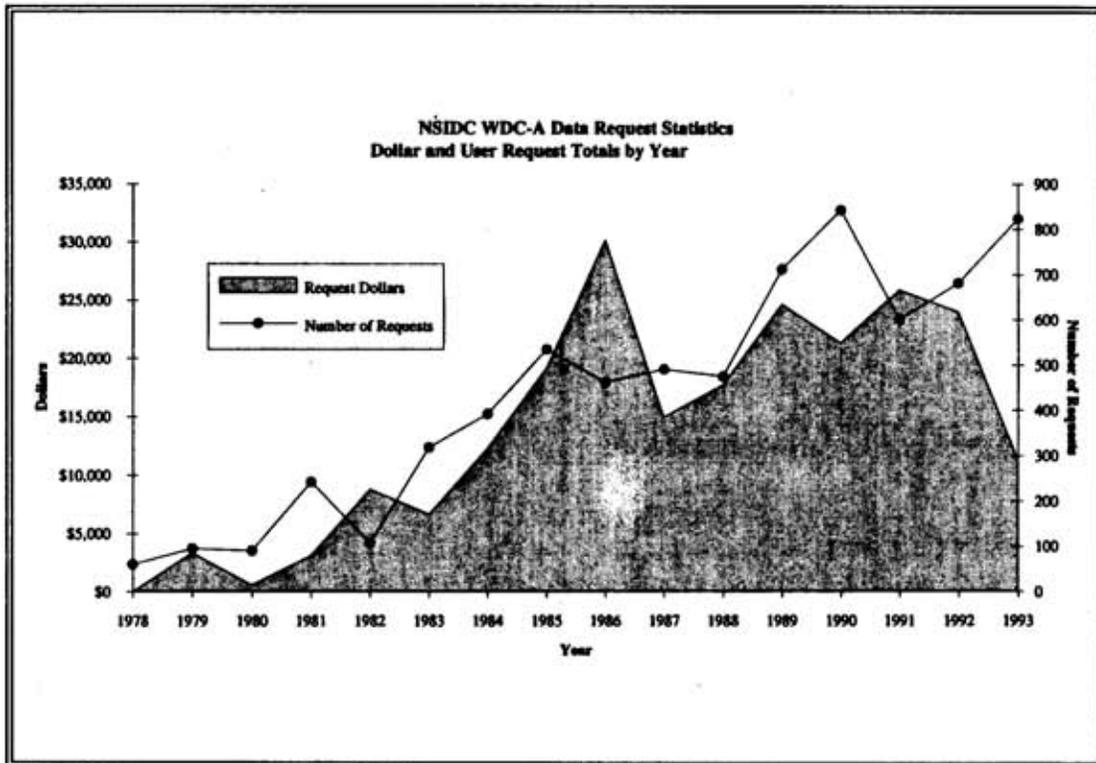


Figure 6.

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NATIONAL AND INTERNATIONAL COLLABORATION

CANADA

Arctic Institute of North America, Calgary, Alberta
Atmospheric Environment Service, Downsview, Ontario
Canadian Circumpolar Institute, Edmonton, Alberta
National Hydrology Research Institute, Saskatoon, Saskatchewan
University of Waterloo, Ontario

CHINA

Institute of Glaciology and Cryopedology, Lanzhou
(World Data Center-D for Glaciology)

RUSSIA

Arctic and Antarctic Research Institute, St. Petersburg.
Institute of Geography, Moscow.
Central Asian Hydrometeorological Center, Tashkent.
World Data Center-B (State Hydrometeorological Service), Obninsk.

SWITZERLAND

Institute of Geography, ETH, Zurich.
World Meteorological Organization, Geneva.
Swiss Federal Institute for Snow and Avalanche Research.

U.K.

Scott Polar Research Institute, Cambridge.
World Data Center-C for Glaciology, Cambridge.

U.S.A.

Cold Regions Research and Engineering Laboratory, Hanover, NH.
Library of Congress
NASA- Goddard; Jet Propulsion Laboratory, Marshall
NOAA- NESDIS- Joint Ice Center, Suitland, MD.
Ohio State University, Byrd Polar Research Center, Columbus, OH
U.S. Air Force, Offut, NB
University of Alaska, Geophysical Institute.
University of Washington, Seattle.
International Mountain Society (Univ. of California, Davis).

COMMITTEES

International Commission on Snow and Ice, Representative to International Association of Hydrological Sciences - R.L. Armstrong

Panel on Snow Avalanches, Committee on Ground Failure Hazards, National Research Council, National Academy of Sciences - R.L. Armstrong

SSM/I Products Working Team (SPWT), NASA - R.L. Armstrong

Western Snow Conference Executive Committee - R.L. Armstrong

International Snow Science Workshop Executive Committee - R.L. Armstrong

International Association of Hydrological Sciences, Snow Classification Working Group - R.L. Armstrong

Arctic Environmental Data Directory Working Group - C.S. Hanson, A.M. Brennan, R.R. Barry

SCAR representative to ICSU Panel on World Data Centers - R.R. Barry

U.S. Polar Bibliographic Information Working Group - A. Brennan

U.S. - Canadian Great Lakes - St. Lawrence Ice Information Working Group - C.S. Hanson

U.S. Canada Joint Ice Working Group - G.R. Scharfen

ARCUS Data and Information Resources Working Group - C.S. Hanson, Co-Chair

SCAR - COMNAP ad hoc Planning Group on Antarctic Data Management - C.S. Hanson

MEETINGS

International Snow Science Workshop - R.L. Armstrong, 4-8 October 1992 (Breckenridge, CO)

International Conference on Mountain Environments in a Changing Climate - R.G. Barry, 11-14 October 1992 (Davos, Switzerland)

SSM/I Pathfinder Science Working Group - R.L. Armstrong, 21-22 October 1992 (Annapolis, MD)

EOSDIS User Services Workshop - C. Hanson, R. Bauer, M. Holm, 4-6 November 1992 (Hampton, VA)

Polar DAAC Advisory Group - R.G. Barry, 17-18 November 1992 (Boulder, CO).

AGU Fall Meeting - R.G. Barry, C. Hanson, M. Holm, 7-10 December 1992 (San Francisco, CA).

Arctic Environmental Data Directory Working Group - R. Barry, C. Hanson, 9 December 1992 (San Francisco, CA).

DMSP Mission Sensor Working Group - G. Scharfen, 15-16 December 1992 (El Segundo, CA).

ESA/NASA International Workshop on Passive Microwave Remote Sensing Research Related to Land-Atmosphere Interactions - R.L. Armstrong, 11-15 January 1993 (St. Lary, France).

ARCSS Land -Atmosphere Ice Interactions Flux Study Planning Meeting - C.S. Hanson, 16-17 January 1993 (Seattle, WA).

Paleoecology of Arctic Lakes and Estuaries Working Group - R.G. Barry, 29-30 January 1993 (Seattle, WA).

Arctic System Science Panel - C.S. Hanson 30 January - 1 February 1993 (Tuscon, AZ)

NGDC Retreat - G. Scharfen, 2-4 February 1993 (Estes Park, CO).

Interagency Workshop on Surface Energy Budget, Radiation and Clouds over the Arctic Ocean - C.S. Hanson, M. Cross, 9-11 February 1993 (Orlando, FL).

AAAS - R.G. Barry, 11-14 February 1993 (Boston, MA).

NOAA Earth Watch Service - R.G. Barry, 22-23 February 1993 (Silver Spring, MD).

EOSDIS Core System - R.G. Barry, T. Scambos, V. Troisi, 10-11 March 1993 (Greenbelt, MD).

Arctic Research Commission - R.G. Barry, A.M. Brennan, 24-25 March 1993 (Boulder, CO).

Polar Information Working Group - A.M. Brennan, 25-26 March 1993 (Boulder, CO).

ARCSS Science Steering Committee - C. S. Hanson, 1-2 April 1993 (Knoxville, TN).

The Oceanography Society - C.S. Hanson, M. Holm, 13-16 April 1993 (Seattle, WA).

Workshop on Arctic Contamination - A.M. Brennan, 2-7 May 1993 (Anchorage, AK).

EOSDIS V0 User Services Working Group - C. Hanson, M. Holm, 4-6 May 1993 (Boulder, CO).

ESDIM/NSF Workshop on Prioritization of Snow and Ice Data - R.G. Barry, R. Weaver, 10-12 May 1993 (State College, PA).

EOSDIS Quarterly Review - R.L. Weaver, May 1993 (Greenbelt, MD).

VI International Conference on Permafrost - R.G. Barry, July 1993 (Beijing, China)

WDC Directors - R.G. Barry, 22-23 July 1993 (Sioux Falls, SD).

Alaska SAR Facility Data Users - R.G. Barry, 25-29 July 1993 (Seattle, WA).

Workshop on Arctic Reference Databases - C.S. Hanson, 1-3 September 1993 (Arendal, Norway).

International Symposium on Seasonal and Long-Term Fluctuations of Nival and Glacial Processes in Mountains - R.G. Barry, R. L. Armstrong, 12-19 September 1993 (Tashkent, Uzbekistan).

SCAR-COMNAP ad hoc Planning Group on Antarctic Data Management - C.S. Hanson, 13-17 September 1993 (Boulder, CO).

EOSDIS Systems Requirements Review - R. Weaver, N. Sandoval, K. Robinson, M. Holm, G. Mountain, 14-15 September 1993 (Greenbelt, MD).

NOAA DAAC Meeting - R. Weaver, 16-17 September 1993 (Silver Springs, MD).

International Conference/Workshop on Integrating Geographic Information Systems and Environmental Modeling - M. Cross, M.J. Brodzik, 26 September - 1 October 1993 (Breckenridge, CO).

PAPERS and REPORTS PUBLISHED DURING FY1993

R.L. Armstrong

- 1993 An earth-gridded SSM/I data set for global change monitoring over land surfaces. In: *Pecora Symposium, 12th, August 1993, Sioux Falls, SD. Proceedings* (in press).

Application of SSM/I data for snow cover and climate research. In: *ESA/NASA International Workshop on Passive Microwave Remote Sensing, Research Related to Land-Atmosphere Interaction, January 1993, St. Lary, France* (in press).

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R.G. Barry

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A.M. Brennan

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ACRONYMS

AARI - Arctic and Antarctic Research Institute (Russia)
AEDD - Arctic Environmental Data Directory
AEDDWG - AEDD Working Group
AFGWC - Air Force Global Weather Central
AIDJEX - Arctic Ice Dynamics Joint Experiment
AMD - Antarctic Master Directory
AOBP - Arctic Ocean Buoy Program
ARCSS - Arctic System Science
ARCUS - Arctic Research Consortium of the U.S.
AVHRR - Advanced Very High Resolution Radiometer
CDMS - Cryospheric Data Management System
CEAREX - Coordinated Eastern Arctic Experiment
CGC - Climate and Global Change Program
CIMS - Cryospheric Information Management System
CIRES - Cooperative Institute for Research in Environmental Sciences
COMNAP - Council of Managers of National Antarctic Programs
CRREL - Cold Regions Research and Engineering Laboratory
CSES - Center for the Study of Earth from Space
DAAC - Distributed Active Archive Center
DIF - Directory Interchange Format
DMSP - Defense Meteorological Satellite Program
DOD - Department of Defense
DPP - Division of Polar Programs
EASE - Equal Area SSM/I Earth Grids
EOS - Earth Observing System
EOSDIS - EOS Data and Information System
ESDIM - Earth Science System Data and Information Management
ESMR - Electrically Scanning Microwave Radiometer

ETH - Eidgenössische Technische Hochschule (Switzerland)
EUBEX - Eurasian Basin Experiment
FRC - Federal Records Center
GD - Glaciological Data
GDSIDB - Global Digital Sea Ice Data Bank
GIS - Geographic Information System
GRID - Global Resource Information Database
GISP - Greenland Ice Sheet Program
HARA - Historical Arctic Rawinsonde Archive
ICSU - International Council of Scientific Unions
IDN - International Directory Network
IGBP - International Geosphere Biosphere Program
IGS - International Glaciological Society
IIP - International Ice Patrol
IMS - Information Management System
ISCCP - International Satellite Cloud Climatology Project
IST - Ice Surface Temperature
JIC - Joint Ice Center
LAII - Land/Atmosphere/Ice Interactions
LASP - Laboratory for Atmospheric and Space Physics
LAVC - Local Area Vax Cluster
LEADEX - Leads Experiment
MIZEX - Marginal Ice Zone Experiment
NAL - New Accessions List
NASA - National Aeronautics and Space Administration
NASDA - National Space Development Agency (Japan)
NCAR - National Center for Atmospheric Research
NCDC - National Climatic Data Center
NESDIS - National Environmental Satellite, Data and Information
Service

NGDC - National Geophysical Data Center
NISC - National Information Services Corporation
NMC - National Meteorological Center
NOAA - National Oceanic and Atmospheric Administration
NODS - NASA Ocean Data System
NORAL - Naval Oceanographic and Atmospheric Research Laboratory.
NOS - National Ocean Survey
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
PDS - Planetary Data System
SAFARI - South African Fire – Atmosphere Research Initiative
SCAR - Scientific Committee on Antarctic Research
SDSD - Satellite Data Services Division
SGI - Silicon Graphics Incorporated
SIGRID - Sea Ice Grid
SIMMS - Seasonal Ice Monitoring and Modeling Program (Canada)
SMMR - Scanning Multichannel Microwave Radiometer
SPWT - SSM/I Products Working Team
SSM/I - Special Sensor Microwave Imager
SSM/T - Special Sensor Microwave Temperature
SQL - Standard Query Language
THIR - Temperature Humidity Infrared Radiometer
TOGA - Tropical Oceans and Global Atmosphere Project (WMO)
UNEP - United Nations Environment Program
USAF - United States Air Force
USGS - United States Geological Survey
V0 - Version 0

WDC - World Data Center

WMO - World Meteorological Organization

WOCE - World Ocean Circulation Experiment