Annual Report
Academic Year 1996-97

National Snow and Ice Data Center
World Data Center-A for Glaciology
1997
On the Cover:

Examples of monthly average snow cover and sea ice extent, derived from the Northern Hemisphere EASE-Grid Weekly Snow Cover and Sea Ice Extent product. Snow cover extent is based on the digital NOAA-NESDIS Weekly Northern Hemisphere Snow Charts, revised by D. Robinson (Rutgers University) and regridded to the EASE-Grid. The original NOAA-NESDIS weekly snow charts are derived from the manual interpretation of AVHRR, GOES, and other visible-band satellite data. Sea ice extent is based on the NSIDC polar stereographic sea ice concentration grids, derived from Scanning Multichannel Microwave Radiometer (SMMR) and Special Sensor Microwave Imager (SSMI) passive microwave brightness temperature data. The examples shown are (clockwise from top left): Northern Hemisphere monthly average snow cover and sea ice extent for February, April, June, August, October, and December, for 1978 through 1995.

Image credit: M. J. Brodzik, National Snow and Ice Data Center, Cooperative Institute for Research in Environmental Sciences, University of Colorado at Boulder.
NSIDC/WDC-A Annual Report
Academic Year 1996-97

Table of Contents

INTRODUCTION.................................................................1

HIGHLIGHTS.............................................................................2
The Polar Pathfinders: Coordinating Satellite-Based Polar Science........2
Distributed Active Archive Center (DAAC) Version 0 (V0) Data System.4
Installation of the DAAC EOSDIS Core System (ECS) Interface...........5
U.S.-Russian Environmental Working Group (EWG) Ocean CD-ROM.......6

NEW PRODUCTS.......................................................................8
Arctic Ocean Snow and Meteorological Observations from Drifting
  Stations CD-ROM..................................................................8
AARI 10-Day Arctic Ocean EASE-Grid Sea Ice Observations...............9
Digital SAR Mosaic and Elevation Map of the Greenland
  Ice Sheet...........................................................................10
Northern Hemisphere Weekly Snow Cover and Sea Ice Extent,
  1978-1995........................................................................10
DMSP-F13 SSM/I Daily Polar Gridded Brightness Temperatures........11
DMSP-F13 SSM/I Daily Polar Gridded Sea Ice Concentrations............11
DMSP-F13 SSM/I Monthly Polar Gridded Total Sea Ice
  Concentrations....................................................................12
Marshall Space Flight Center Data Acquisitions.........................12

CURRENT PROGRAMS............................................................15
Antarctic Data Coordination Center...........................................15
Global Geocryological Database (GGD)....................................16
ARCSS Data Coordination Center (ADCC).................................17
Greenland Ice Sheet Project II (GISP2)..................................18
Land-Atmosphere-Ice Interactions (LAI)...................................18
Ocean-Atmosphere-Ice Interactions (OAI).................................19
Human Dimensions of the Arctic System (HARC).......................19
Paleoclimates from Arctic Lakes and Estuaries (PALE)..............20
Web Page and Data Archive Development..........................20
K-12 Outreach..................................................................21
Environmental Services Data and Information Management
(ESDIM)..................................................................22
An Earth-Gridded Passive Microwave Data Set for Cryospheric
Studies and Global Change Monitoring (EASE-Grid).........23
NSIDC Distributed Active Archive Center (DAAC)..............24
ECS Test Activities..........................................................28
Data Sets....................................................................28
Advanced Spaceborne Thermal Emission and Reflection
Radiometer (ASTER)..................................................29
AVHRR Polar Pathfinder..............................................29
AVHRR Polar 1-km Data Set.........................................29
Moderate Resolution Imaging Spectroradiometer (MODIS)....30
Near-Real Time SSM/I EASE-Grid Daily Ice Concentration
and Snow Extent (NISE)............................................31
SSM/I Data................................................................31
Cross-DAAC (Distributed Active Archive Center) Activities..32
DAAC Yearbook (Distributed Active Archive Centers, Supporting Earth
Observing Science in 1996).........................................32
DAAC Impacts Assessment...........................................33
Electronic Publishing.....................................................34
Data Request Tracking System.....................................35
Data-Related Committees................................................35
AEDD Working Group..................................................35
ARCSS Committee......................................................36
ECS Operations Working Group....................................36
International Programme for Antarctic Buys (IPAB)............37
International Arctic Environmental Data Directory.............37
International Permafrost Association (IPA) Data and Information
Working Group........................................................38
U.S. Polar Bibliographic Working Group .................................................. 38
SCAR-COMNAP ad hoc Planning Group on Antarctic Data Management and SCAR-COMNAP Joint Committee on Antarctic Data Management .................................................. 39
USER SERVICES ................................................................................. 41
Data Request Statistics .................................................................. 43
Data Categories .............................................................................. 43
User Categories ............................................................................. 43
PUBLICATION PROGRAM ................................................................. 46
RESEARCH ....................................................................................... 48
RICHARD L. ARMSTRONG
Passive Microwave Satellite Remote Sensing of Ice and Snow ....... 49
Variability of Snow Cover and Glaciers in Central Asia: Applications to Hydrologic Modeling .................................................. 50
ROGER G. BARRY
Circumpolar Frozen Ground Conditions and Modeling Scenarios of Future Conditions .................................................. 52
Cryospheric Indices of Global Change .......................................... 52
FLORENCE FETTGER
Radarsat Multiyear Sea Ice Mapping ........................................... 53
A Sea Ice Melt Pond Study Using National Technical Means Data .................................................. 53
ANNE NOLIN
Hydrologic Impacts of Variations in the Albedo of Seasonal Snow .... 54
Assessment of Variations in the Snow Accumulation Rate in Northern Greenland .................................................. 54
Assessment of a Global Snow Mapping Algorithm Using Spectral Mixture Analysis .................................................. 55
TED A. SCAMBOS
Innovations in AVHRR Imagery Use for Polar Ice Sheet Study.................................. 55
Landsat Applications to Antarctica Project................................................................. 56
RadarSat Antarctic Mapping Project.............................................................................. 56
Site Characterization and Ice Stream History of Siple Dome, West Antarctica........... 57

GREG SCHARFEN
Global Lightning........................................................................................................... 57

MARK C. SERREZE
Arctic Sea Ice Anomalies............................................................................................ 58
Eastern U.S.A. Snowfall Variability Study................................................................. 59
Examination of Russian Arctic Watershed Atmospheric Hydrologic Budgets............. 59
Icelandic Low Storms and the North Atlantic Oscillation Teleconnection Pattern ..... 59
New Climatology of Arctic Downwelling Shortwave Radiation............................... 60
Studies Using the Comprehensive Ocean Atmosphere Data Set and NCEP/NCAR Reanalysis Model........................................................................................................ 60

KONRAD STRIFFEN
Greenland Ice Sheet Climatology and Surface Energy Balance Modeling: Greenland Climate Network (GC-Net)/Assessment of Variation in the Snow Accumulation Rate in Northern Greenland............................................................ 61
Sea Ice and Ocean Processes in Baffin Bay: A Study Using RADARSAT Data and Numerical Modeling................................................................. 62

JULIENNNE C. STROEVE
AVHRR-Derived Clear Sky Surface Temperature and Surface Albedo over the Greenland Ice Sheet.......................................................................................... 62
Intercomparison of DMSP F11- and F13-Derived Sea Ice Products.......................... 63

TINGJUN ZHANG
Atmosphere-Active Layer Permafrost Modeling.......................................................... 64
Thaw Lake Study on the North Slope of Alaska............................................................ 65
NATIONAL SNOW AND ICE DATA CENTER/
WORLD DATA CENTER-A FOR GLACIOLOGY

ANNUAL REPORT
Academic Year 1996-97

INTRODUCTION

The National Snow and Ice Data Center (NSIDC)/World Data Center-A for Glaciology (WDC-A) 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 the National Oceanic and Atmospheric Administration (NOAA). Within CIRES, NSIDC/WDC-A is a part of the Cryospheric and Polar Processes division. NSIDC/WDC-A is completing its twentieth year of service to the snow and ice research community from its Boulder location.

NSIDC/WDC-A is committed to making fundamental contributions to cryospheric science and to excelling in managing data and disseminating information to advance understanding of the Earth system. The role of the NSIDC/WDC-A is to acquire, archive, and disseminate data relating to all forms of snow and ice, within the context of the International Commission on Snow and Ice (ICSU) guidelines for international data exchange and NOAA's mission. 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-A is funded by various federal agencies, including NOAA, the National Aeronautics and Space Administration (NASA), and the National Science Foundation (NSF).
HIGHLIGHTS

The Polar Pathfinders: Coordinating Satellite-Based Polar Science

In October 1990, NOAA and NASA instituted a research program, called Pathfinder, for the study of earth systems. The NOAA/NASA Pathfinder project seeks to create data products that emulate the planned products of the upcoming 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 that will be continued by the new sensors flown on EOS platforms.

Three Pathfinder grant awards were issued for polar products derived from several passive-radiation-measuring sensors: Scanning Multichannel Microwave Radiometer (SMMR) and Special Sensor Microwave Imager (SSMI/I) (flown on the Nimbus-7 and Defense Meteorological Satellite Program, DMSP, satellite series) and Advanced Very High Resolution Radiometer (AVHRR) and TIROS Operational Vertical Sounder (TOVS) (both flown on the NOAA polar orbiter series). Each of these projects aims to establish a continuous, calibrated, and verified geophysical data product using published algorithms. As discussed below, these products are both related and complementary. For this reason, the investigators on the three grants are planning coordinated products to make data use easier.

The AVHRR Polar Pathfinder will produce a multiyear record of daily sea-ice motion, ice surface temperature for both sea-ice and the ice sheets, and polar broadband albedo. The time period planned is 1982 to 1997, although this range may be somewhat restricted by data availability. Spatial resolution of the time-series products will be 5 kilometers, based on a 4-km resolution GAC data, and 1.25-km resolution, available for the last five years of the period, based on 1.1-km
resolution local area coverage (LAC)/HRPT data. Ice velocity vectors will be on relatively coarser grids, since they are based on shifts in ice patterns measured on 10 10-pixel 'chips' from pairs of images. A cloud mask will also be produced as a secondary product.

The Passive Microwave Polar Pathfinder will process SMMR Level 1b data from a previous Pathfinder project and extend processing of SSM/I data to produce a 20-year record of passive microwave data in the Equal Area SSM/I Earth (EASE)-Grid format, at 25-km grid cell size and a supplemental 12.5-km grid for the 85 GHz channel. EASE-Grid brightness temperature data are available in three equal-area projections, azimuthal for Northern and Southern Hemisphere and cylindrical for full global. The data set will span 1978 to 1998. This data set is described in detail, and example images are provided by accessing the URL http://www-nsidc.colorado.edu/. Additionally, proposals are submitted to generate a snow cover and snow thickness product from this standardized 20-year record.

The TOVS Pathfinder will produce an 18-year (1979-1997) data set of daily atmospheric temperature and humidity profiles, cloud-cover and boundary layer parameters over sea ice for the north polar regions (>60 degrees). Spatial resolution of the product will be 100 kilometers. As with the other two Pathfinders above, extensive validation information and error estimates will be provided. A 20-month sample of this data set for the Pathfinder benchmark period, April 1987 to November 1988, is currently available from NSIDC.

NSIDC intends to generate these data products in compatible grids. For each project, the grids will match up precisely, differing only in pixel size. Thus, a single grid cell from the TOVS product will be exactly represented by four SSM/I brightness temperature grid cells, and 6400 (80x80) 1.25-km grid cells from the higher resolution AVHRR products. NSIDC also intends to provide utilities, documentation, and examples on how to combine and use variables from these products. Duplicate variables (e.g., cloud fraction and surface
temperature) will be further intercompared. Advantages and potential biases in the data sets will also be discussed.

The output grids for all of the products will be based on an equal-area azimuthal projection of the data that is already in use for the SSM/I data (Armstrong and Brodzik 1995). The advantages of this projection stem from the fact that each pixel represents an equal area; therefore the areal extent of a particular feature, i.e., sea ice, clouds, and a particular surface temperature range, may be determined by simply counting grid cells in the product image.


**Distributed Active Archive Center (DAAC) Version 0 (V0) Data System**

The NSIDC Distributed Active Archive (DAAC) provides data and information services to the research and educational communities through a V0 system. This is the initial operating system of the EOS Data and Information System (EOSDIS) at NSIDC. The components of the system include a Product Generation System (PGS), a Data Archive and Distribution System (DADS), and a DAAC-unique Information Management System (IMS) server that serves metadata to the EOSDIS V0 IMS clients across the country. Extensions to the core V0 architecture include a data request tracking system (TRAK) and a WWW server, which provides an alternative to the V0 IMS client for accessing NSIDC data and information services.
Internal interfaces are defined for ingest and archival of AVHRR imagery and SSM/I (Level 1) orbital data. Ingest occurs by either tape or electronic transfer, via ftp, and the data are archived on either 4-mm tape, DLT, or optical (WORM) media. Additional interfaces exist for archiving the SSM/I gridded products and generating "on-demand" calibrated Level 1B AVHRR using the Land Analysis System developed by the Earth Resources Observation Systems (EROS) data center (EDC).

External interfaces include TOVS Polar Pathfinder, AVHRR, and SSM/I Pathfinder projects. The DAAC serves SSM/I orbital data to the SSM/I Pathfinder production environment and AVHRR LAC/HRPT (High Resolution Picture Transmission) and GAC data for the AVHRR Polar Pathfinder project. Additionally, the DAAC provides ingest, archival, and distribution capabilities for the products generated by the Polar Pathfinder Consortium, which include the SSM/I, TOVS, and AVHRR Polar Pathfinder projects.

Installation of the DAAC EOSDIS Core System (ECS) Interface

The EOSDIS Core System (ECS), the infrastructure of EOSDIS, will provide a broad range of desktop services, such as data, product generation algorithms, and analysis tools, required to meet the needs of particular Earth science communities served by each DAAC. ECS was designed to allow for expansion of data providers to include any number of external sites.

The first EOS instruments, which will provide data to ECS, will be flown aboard the TRMM and EOS AM-1 satellites. EOS AM-1, which is scheduled for launch in July 1998, is the first of three spacecraft of the EOS AM series. Among the instruments carried aboard the EOS AM-1 platform are:
The Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER), which will provide high spatial resolution, multispectral images of the Earth's surface and clouds; Clouds and the Earth's Radiant Energy System (CERES) instrument, which will provide EOS with an accurate and self-consistent cloud and radiation database; Multiangle Imaging Spectroradiometer (MISR), which will routinely provide multiple angle, continuous sunlight coverage of the Earth at high resolution; and Moderate-Resolution Imaging Spectroradiometer (MODIS), which will employ 36 bands to measure biological and physical processes on a global basis every one to two days. (More information on ECS is available on the ECS INFO website: http://ecsinfo.hitc.com/)

Both ECS Pre-Release B Testbed and B.0 releases (the computer hardware and commercial off-the-shelf (COTS) software for IR-1 (Interim Release 1)) were delivered and installed at the NSIDC facility in 1997. The Testbed provides an environment for NSIDC to support Science Software Integration and Test (SSI&T) for MODIS product generation executives (PGEs) and will run until Release B.0 is fully operational. The Earth Science Data and Information System (ESDIS) Project has defined two additional phases of the B.0 software development: B.0' and Just In Time for launch. These phases provide additional capabilities to the B.0 in order to support AM-1, SAGE-III, and Landsat 7 at-launch functional requirements.

U.S.-Russian Environmental Working Group (EWG) Ocean CD-ROM

1948 to 1993 by Russian and Western drifting stations, ice breakers, and airborne expeditions were used to develop the products contained in the atlas.

The goal of the EWG Ocean CD-ROM project is to provide the most comprehensive historical array of Russian and Western observations for the Arctic Ocean, including its marginal and shelf seas. This volume, which includes previously unavailable data from the Arctic and Antarctic Research Institute (AARI) in St. Petersburg, Russia, alone, more than doubles existing Arctic Ocean data holdings.

Future CD-ROMs are planned that will contain summer conditions in the Arctic Ocean, sea ice cover, and meteorology. It is expected that these atlases will aid scientists in conducting a more comprehensive investigation of the Arctic surface heat balance and will lead to improved understanding of Arctic climate system dynamics.

EWG, which was established by the U.S.-Russian Joint Commission on Economic and Technological Cooperation (or Gore-Chernomyrdin Commission), is charged with finding methods by which national security data assets could be used to study environmental issues. Dr. James Baker is the U.S. co-chair of EWG.

More information about the U.S.-Russian EWG is available on the Arctic Climatology Atlas Web Site, at http://ns.noaa.gov/adas/. The project is also highlighted in the February 1997 issue of National Geographic.
NEW PRODUCTS

Arctic Ocean Snow and Meteorological Observations from Drifting Stations CD-ROM

NSIDC, in collaboration with the Polar Science Center (PSC), University of Washington, released a CD-ROM containing snow, meteorological, and solar radiation data from the Soviet North Pole drifting stations. *Arctic Ocean Snow and Meteorological Observations from Drifting Stations, 1937, 1950 to 1991, Version 1.0* contains snow depth, snow surface temperature, snow density, snow water equivalent; meteorological data (air temperature, relative humidity, surface pressure, wind speed and direction, U-V components of wind, total and low cloud amounts, and precipitation type and amounts); and solar radiation data (diffuse, direct, global, reflected, and net radiation and albedo). North Pole (NP)-1 operated from May 22, 1937 through February 19, 1938. NP-2 began on April 22, 1950, and at least one station, at times two, operated from that date until the end of NP-31 on March 31, 1991.

Data on the CD-ROM are daily averages, or three-hourly measured values; spatial resolution is dependent on the movement of the ice floes on which the stations were located. Both original data, as digitized from station log books at AARI, St. Petersburg, Russia, and daily averaged data are included. Position data were linearly interpolated from the original irregular position observations. Meteorological instrument descriptions, including technical specifications regarding accuracy at low temperatures, are included in the documentation, which is provided on the CD-ROM. All the data are in ASCII files and are readable on any type of computer platform.

Rescue and organization of the meteorological data at AARI and PSC/University of Washington, and the CD-ROM development
portion of this project, were funded by NOAA as a part of its NESDIS ESDIM Program. Additional funding for snow data rescue and preparation was provided by NASA. Funding for the rescue, publication and access to the solar radiation data included on this CD-ROM was provided by the NSF Division of Atmospheric Sciences. This CD-ROM is a contribution to the Arctic Climate System (ACSYS) of the World Climate Research Programme.

AARI 10-Day Arctic Ocean EASE-Grid Sea Ice Observations

These gridded ice charts represent a reformatting by NSIDC of information contained in the Russian AARI digital sea ice charts. AARI digitized Arctic sea ice concentration and stage of development from original paper source charts as part of the Global Digital Sea Ice Data Bank project, sponsored by the World Meteorological Organization (WMO), Geneva, Switzerland. The AARI source charts were developed from aircraft and satellite observations for shipping purposes and provide extremely detailed information. Such data are particularly valued in process studies tracking the growth and recession of polynyas, or for looking at the preponderance of ice at certain stages of development in a particular area. AARI encoded these paper charts in digital Sea Ice Grid (SIGRID) format — a format that assigns numerical values to ice parameters and records them at specific lat/lon grid points. But due to the difficulties of visualizing, extracting, and working with data in SIGRID, NSIDC is now providing AARI data in NSIDC's EASE-Grid. The EASE-Grid format makes it easier to compare observed ice concentrations or ice types with the same parameters derived from satellite data.

AARI sea ice data in the EASE-Grid North azimuthal projection are gridded at a 12.5-km resolution, for both Western (24W to 110E) and Eastern (105E to 130W) sectors. Data extend from 1953 through 1990 and are available via ftp (file transfer protocol) in compressed tar format.
Funding for this product has been provided by the NOAA ESDIM program and the NSIDC DAAC.

Digital SAR Mosaic and Elevation Map of the Greenland Ice Sheet

The Digital SAR Mosaic and Elevation Map of the Greenland Ice Sheet CD-ROM combines the most detailed synthetic aperture radar (SAR) image mosaic available with the best current digital elevation model. The mosaic image shows both the location of the ice edge and the distribution of melt-related "scatterers" on the surface. These scatterers include ice lenses and complex layered structure in the percolation zone and faint features related to sun-glazing in the dry snow zone. Other visible melt-related features include lake and surface meltwater stream channels at lower elevations, as well as ice-marginal lakes. The mosaic provides a snapshot characterization of the ice sheet establishing a reference against which future change can be measured.

The image data are derived from SAR image swaths acquired by the ERS-1 satellite during August of 1992. The mosaic was assembled at the Jet Propulsion Laboratory (JPL) and Goddard Space Flight Center (GSFC). The Danish geodetic and cadastral agency Kort-og Matrikelstyrelsen (KMS) compiled the elevation data provided with the product from a number of sources, including field surveys, aerial photographs, and the ERS-1 radar altimeter.


NSIDC has developed a Northern Hemisphere cryospheric product that combines snow cover and sea ice extent in the same digital format and grid. The data are available at weekly intervals for the period 1978 to 1995. The data set also includes monthly climatologies describing snow and sea ice extent in terms of average conditions, probability of
occurrence, and variance. The data set is produced in an azimuthal equal area (25-km) projection (NSIDC EASE-Grid). The snow cover extent is based on the digital NOAA-NESDIS weekly Northern Hemisphere snow charts, revised by D. Robinson (Rutgers University) and regridded to the EASE-Grid. The original NOAA-NESDIS weekly snow charts are derived from the manual interpretation of AVHRR, GOES, and other visible-band satellite data. The sea ice extent is based on the existing NSIDC polar stereographic sea ice concentration grids, which are derived from the SMMR and SSM/I passive microwave brightness temperature data. Funding for this project has been provided by the NOAA Climate and Global Change Program and the NASA Pathfinder Program.

**DMSP-F13 SSM/I Daily Polar Gridded Brightness Temperatures**

Daily brightness temperatures for the North and South Pole regions, represented on polar stereographic grids taken from orbital (swath) data collected by the DMSP F13 satellite's SSM/I have been produced by NSIDC. The CD-ROM contains approximately three months of data, with coverage beginning in May 1995. Public domain software for accessing data in hierarchical data format (HDF) is available online; utilities to read and manipulate HDF data are available via ftp from the National Center for Supercomputing Applications (NCSA).

**DMSP-F13 SSM/I Daily Polar Gridded Sea Ice Concentrations**

NSIDC produces daily averaged sea ice concentrations on polar stereographic grids for North and South Pole regions from orbital (swath) data collected by the SSM/I, flown aboard the DMSP F8, F11, and F13 satellites. The instrument is a seven-channel, four-frequency, linearly polarized passive microwave radiometric system, with 85.5, 37.0, and 19.3 vertical and horizontal channels and a 22.2 GHz vertical channel.
F13 daily ice concentrations have been generated using the NASA Team algorithm and are available via ftp. Processing is continuous on the F13 data, beginning May 3, 1995.

Daily sea ice concentration grids are derived from the SSM/I daily brightness temperatures. With a resolution of 25x25 kilometers, sea ice concentrations are presented as raster images (HDF raster image sets, RIS) mapped to polar stereographic projections depicting North and South Pole regions. Data are stored in HDF and packaged in compressed tar format.

**DMSP-F13 SSM/I Monthly Polar Gridded Total Sea Ice Concentrations**

NSIDC produces monthly averaged sea ice concentrations on polar stereographic grids for North and South Pole regions from orbital (swath) data collected by the SSM/I, flown aboard the DMSP F8, F11, and F13 satellites.

Monthly averaged ice concentrations are produced using daily sea ice concentration grids generated using the NASA Team algorithm. The monthly sea ice grids can be used as masks to block ice-covered areas. To accommodate as many applications as possible, the monthly averaged ice extent is delineated by four minimum values (0%, 5%, 10% and 15% concentration). Monthly averaged ice concentrations are available via ftp.

**Marshall Space Flight Center (MSFC) Data Acquisitions**

Following the closing of the Marshall Space Flight Center DAAC, passive microwave data sets and derived products were transferred to NSIDC from October 1996 through January 1997. They include:
Nimbus-7 SMMR Pathfinder Brightness Temperatures

The Nimbus-7 SMMR Pathfinder Brightness Temperatures data set contains global brightness temperatures in swath format (level 1b) from October 25, 1978 to August 20, 1987. The instrument, SMMR, obtained near-global coverage at five frequencies (6.6, 10.7, 18, 21, and 37 GHz) in both horizontal and vertical polarizations, at a constant incidence angle of 50.3 degrees, every six days. Data are stored as daily orbit files in compressed HDF and are available on 4-mm and 8-mm tape.

Nimbus-7 SMMR Antenna Temperatures

The Nimbus-7 SMMR Antenna Temperatures data set contains global antenna temperatures in swath format (level 1b) from October 25, 1978 to August 20, 1987. The instrument obtained near-global coverage at five frequencies (6.6, 10.7, 18, 21, and 37 GHz) in both horizontal and vertical polarizations, at a constant incidence angle of 50.3 degrees, every six days. Data are stored as daily orbit files in compressed HDF and are available on 4-mm and 8-mm tape.

SSM/I Pathfinder Antenna Temperatures

The SSM/I Pathfinder Antenna Temperatures global data set is derived from the SSM/I on the DMSP F8 satellite. The data are currently available in HDF from NSIDC, for the period August 1, 1987 to December 31, 1988.

DMSP Special Sensor Microwave/Imager (SSM/I) F8 and F10 Wentz Antenna Temperatures

The SSM/I antenna temperature data set (T_A) is essentially a compacted, chronologically ordered version of the Temperature Data Records (TDRs) being produced by Fleet Numerical Oceanographic Center. These data were taken by the SSM/I aboard DMSP-F11. A similar data set is available for DMSP-F10 and DMSP-F8 satellites.
The compacted Ta data are available on a series of 6250 bpi magnetic tapes (eight tapes per month of data) from ESRIN, with each data file corresponding to a single SSM/I orbit. These tapes are produced by F. Wentz, Remote Sensing Systems (Santa Rosa, California, U.S.A.), and provided via NOAA/NESDIS to ESRIN for free distribution to European scientific users on CCT (6250 Bpi) and Exabyte.

NOAA/NASA SSM/I Pathfinder Program Level 2 and Level 3 Land Surface Products

The Pathfinder Program, sponsored by NOAA and NASA, is tasked to produce long-term data sets for global change research. The SSM/I Pathfinder Level 2 Land Products data set has been generated using the land classification algorithms developed by Neale and the land surface temperature algorithms developed by McFarland. This data set includes both the land classification and land surface temperature products. The Pathfinder Level 2 Land Products data set is in swath format. Coverage is global land surface, and covers August 1, 1987 through March 31, 1988. Data are available on 8-mm tape or via ftp, on request.

The SSM/I Pathfinder Level 3 Land Products data set has been generated using the Level 2 data described above. The Level 2 data were interpolated to a longitude-latitude grid with a resolution of one degree. For the Benchmark Period, the data were averaged over periods of five days (a pentad) or one month, although, for the land classification product, the most commonly occurring land class (the mode of the distribution within each bin) was chosen as the class for that bin and for the period. The data set, including both pentad and monthly grids, covers August 1, 1987 through December 31, 1988.
CURRENT PROGRAMS

Antarctic Data Coordination Center

On September 1, 1996, NSIDC was funded by the National Science Foundation's Office of Polar Programs to operate the U.S. Antarctic Data Coordination Center. The goal of this project is to enhance access to data resulting from U.S.-funded Antarctic research projects. NSIDC will locate U.S.-funded Antarctic data sets and their points-of-contact. NSIDC will prepare, or assist data holders in preparing data descriptions (Directory Interchange Formats or DIFs), and coordinate DIF submittal to the online Antarctic Master Directory (AMD), a cooperating node of the Committee on Earth Observing Satellites (CEOS) International Directory Network. The AMD was developed in response to recommendations from the Scientific Committee on Antarctic Research (SCAR), the Council of Managers of National Antarctic Programs (COMNAP), and the Antarctic Treaty, calling for a framework for Antarctic data management. (See the SCAR-COMNAP ad hoc Planning Group section, p. 39.)

In the U.S.A., central funding and coordination of the Antarctic Research Program at the NSF is available, but no central agency exists for research and data collection activities. The challenge is to ensure that all funded work is identified, and then to locate the resulting data in university departments, government offices, and data centers so that these data can be described. Coordinated funding of U.S.-funded Antarctic research by NSF presents an opportunity to incorporate the collection of metadata into the funding process.

Several important tasks have already been completed. An initial inventory of data centers with major holdings of U.S.-funded Antarctic data, data sets, and points-of-contact for each area has been completed and prioritized. DIFs have been written and submitted to
AMD for Antarctic data sets held at NSIDC. A list of data sets that have been described (in DIF form) as part of the NASA Global Change Master Directory (GCMD) effort has been compiled. These descriptions will be transferred in the coming months. NSIDC has evaluated DIF authoring tools that have been developed for AMD and GCMD.

Three briefings were given to raise awareness of Antarctic research in the community and to seek input from scientific groups, including the U.S. National Academy of Sciences/Polar Research Board (October 1996), Science On-Line Antarctica workshop (Tahoe City, California, September 1996), and Antarctic Weather Station workshop (Denver, Colorado, May 1997). Initial comments on the AMD effort have been favorable, but concerns were also expressed about preparation of data descriptions and its impact on time dedicated to scientific work.

NSIDC also participated in the first meeting of the SCAR-COMNAP Joint Committee on Antarctic Data Management. Representatives from 13 of the 26 Antarctic Treaty nations met in Christchurch, New Zealand, May 20 to 23, to initiate the AMD effort.

Global Geocryological Database (GGD)

NSIDC/WDC-A is funded by the NSF (Geosciences) to implement a pilot "Global Geocryological Database" (GGD). This effort provides start-up funding for the assembly of priority permafrost and frozen ground data sets in Russian archives, and for NSIDC/WDC-A to inventory, retrieve, and organize priority data sets identified by other members of the International Permafrost Association (IPA). The transfer of related data from Russia has been completed, including:

- Soil temperature data from late 1940s to 1965, for 120 stations in Russia.
- Ground temperature data from two boreholes in Siberia.
• Russian permafrost map inventory.
• List of institutions in Russia and the Commonwealth of Independent States involved in studies of permafrost and seasonally frozen ground.

Several members of the Data and Information Working Group (R. G. Barry, chair) and IPA Secretary General Jerry Brown met at NSIDC/WDC-A in July 1996 to review the results of preliminary inventories, and to plan future data activities. In preparation for the 1998 Seventh International Permafrost Conference in Yellowknife, Northwest Territories, Canada, the group reconfirmed two planned activities: (1) a data workshop organized by Dr. M. J. Clark (Geodata Centre, Southampton, UK) to be held during the conference; and (2) preparation of a CD-ROM containing permafrost data and information.

The planned CD-ROM will be called "Circumpolar Active-Layer Permafrost System (CAPS): A Contribution to Global Change Research." IPA Adhering Members are being asked to contribute at least one long-term data set for the CD-ROM, and individuals and IPA Working Groups are also invited to contribute important data to the project.

In order to maintain a reasonable rate of progress, the IPA proposed to hold a series of small regional meetings. The first, focused on North American data holdings, took place in Denver/Boulder, Colorado, December 12 to 13, 1996. Another meeting, the International Conference on the Problems of Earth Cryosphere (Basics & Applied Studies) took place in Pushchino, Moscow, Russia, from April 21 to 25, 1997; R. G. Barry and M. J. Clark met in Zurich, Switzerland in May 1997 for further discussion on CAPS and future activities of the IPA Data Working Group.

Further information on the GGD project is given in the December 1995 IPA newsletter Frozen Ground, no.18, p.12, and the IPA home page: http://www.geodata.soton.ac.uk/ima.
ARCSS Data Coordination Center (ADCC)

The ARCSS Data Coordination Center (ADCC) at NSIDC entered the second year of its current grant, through the NSF/OPP/Arctic Science Program, and strives to be a catalyst for ARCSS integration through data and information management. The work performed for each ARCSS program has been extensive. A description follows of ongoing work within each ARCSS component, as well as the peripheral support needed to achieve the proper level of data and information dissemination to the ARCSS community.

Greenland Ice Sheet Project II (GISP2)

The relationship developed with the Greenland Ice Sheet Project II (GISP2) Science Management Office (SMO) has been profitable and their guidance has enhanced many of the ARCSS accomplishments. Data migration plans established with each investigator ensured that all data were received by December 1996. A CD-ROM of data from both GISP2 and the European Greenland Ice Core Project (GRIP) in conjunction with the publication of a Journal of Geophysical Research special issue devoted to the GISP2/GRIP projects. ADCC worked with an interface tool (PaleoVu) and an interactive search engine (both developed by the National Geophysical Data Center) that assists in accessing data from the CD-ROM. The data are also available via ftp from the ARCSS home page (http://arcss.colorado.edu/). Due to the mutual interest in ice core data, the National Geophysical Data Center (NGDC) and NSIDC have established strong web page linkages. ADCC also worked closely with NGDC on a number of issues relating to data and information display and distribution.

Land-Atmosphere-Ice Interactions (LAI)

The Land-Atmosphere-Ice Interactions (LAI) Project continues to be a significant contributor to the ARCSS archive. Field summaries of each research project are posted on the ARCSS home page, and
ADCC continues to work with each LAII principal investigator in developing data migration plans. Also planned is a second edition to the popular ARCSS/LAII North Slope Data Sampler CD-ROM.

Ocean-Atmosphere-Ice Interactions (OAI1)

The Ocean-Atmosphere-Ice Interactions (OAI1) project is another major focus of current data management activity at NSIDC. ADCC continues to work with Northeast Water Polynya (NEW) investigators on data migration to NSIDC, guidelines have been established with staff at the University of Washington for acquiring Arctic Ocean Section (AOS) data, and the project is working closely with the Surface Heat Budget of the Arctic Ocean (SHEBA) SMO in establishing data migration plans for SHEBA Phase I Investigators. Planning for field support for Phase II will also continue through ADCC’s close relationship with the SHEBA SMO. Other important oceanographic data sets for Arctic research are being compiled. For example, the Western Oceanographic Data Set (WODS) will include CTD, bottle, phytoplankton, and current measurements from cruises and studies apart from ARCSS. NEW, AOS, and WODS CD-ROMs are scheduled for production this upcoming calendar year.

Human Dimensions of the Arctic System (HARC)

A recent addition to the ARCSS program is Human Dimensions of Global Change in the Arctic (HARC). An initial science planning meeting from this new program took place in Tucson, Arizona in the fall of 1995 and brought together researchers from a variety of disciplines, including biology, archeology, anthropology, and climatology. NSF strongly encourages this program to complement the ongoing physical science program in the Arctic. ADCC personnel have begun to work with HARC investigators on data management concerns. Social science data have many different characteristics from the usual ARCSS data collections, and certain types of social data that the HARC project will contribute to the ARCSS archive are inherently
sensitive. With this in mind, modifications were made to the ARCSS data protocol to address these concerns.

*Paleoclimates from Arctic Lakes and Estuaries (PALE)*

The strengthening relationship between the Paleoenvironments of Lakes and Estuaries (PALE) SMO and the ADCC fosters better integration between PALE and the rest of the ARCSS community. A Beringia Atlas is currently being developed through PALE; ADCC is working closely with PALE to see this project come to fruition. Plans to move the PALE data manager position into the ADCC are being developed.

Modeling studies have recently become a focus due to the special nature of model data output. Discussions with modelers have taken place to decide what model outputs will be in the archive and the modifications needed to make model data accessible and useful. ADCC is also continuing to work with modelers to develop and enhance data access for the general scientific community.

A new monthly gridded climatology of arctic downwelling short-wave radiation is currently being compiled at NSIDC. In conjunction with this effort, ADCC is amassing all of NSIDC's Arctic radiation data for inclusion on the CD-ROM. This Arctic Radiation CD-ROM will include short-wave, long-wave and net radiation values from stations above 50 N, as well as a new climatology. The data will also be available via ftp from the ARCSS home page at http://arcss.colorado.edu/.

*Web Page and Data Archive Development*

The ARCSS home page, available via http://arcss.colorado.edu/ has been completely revamped and includes many added features to assist in data and information acquisition from the ARCSS archive. The design was implemented to serve a broader community with a logical, user-friendly interface to retrieve data sets. All nonrestricted data are
now available directly via ftp; e-mail can be sent directly to an ARCSS investigator through the home page; more information about projects within ARCSS is now available; a calendar of events keeps users informed of ARCSS and ARCSS-relevant conferences and deadlines; overviews of the formal ARCSS projects are also presented to educate users about the goals of ARCSS and each of its components; and real time weather data are accessible through built-in hot keys directing the user to other home page locations. The ARCSS data holdings have been modified from a project orientation (LAI, OAII, etc.) to a subject orientation (Climate Data, Ice Core Data, etc.) This major modification is an integral step in providing Arctic data and information to ARCSS scientists and the expanding general scientific community.

In addition to the already established listserver for ARCSS, ADCC views the WWW home page development to be one of the most important improvements in global scientific community outreach. Since its implementation in May 1996, the number of web page contacts has greatly increased. Prior to May, the ARCSS WWW site averaged 525 hits and 2.72 megabytes of data downloaded per month; and since the new web page design, the hits and data downloaded have averaged 5,644 and 93.78 megabytes per month, respectively. ADCC strives to be on the cutting-edge of this technology. Plans include implementing an interactive point-and-click map of the Arctic to help a user determine data availability for a specific region of interest. The ARCSS data holdings at NSIDC will incorporate more detailed data descriptions and more subject groups, according to need. The hope is that the new web format will not only provide the ARCSS community with valuable services and an efficient database, but also be an inviting site for the interested public and educators wishing to learn more about ARCSS. A proactive role is anticipated in maintaining an evolving web page to best meet the needs of users.
K-12 Outreach

ADCC is also helping to bring students more in touch with current science. ADCC is collaborating with a teacher in Denver, Colorado, who spent a summer at the GISP2 camp to develop science curriculum using ARCSS data and information. The educational home page will include images, reading materials, lesson plans, and activities appropriate for K-12 curricula, with an emphasis on grades 9 through 12. A CD-ROM will serve schools without internet access. Data from GISP2 will support the initial curriculum, but the future focus will expand to other projects within ARCSS. The Data Center views this project as a critical element in long-range outreach to all communities interested in ARCSS data.

Environmental Services Data and Information Management (ESDIM)

NSIDC has continuing programs to rescue critical data and address access needs for snow and ice data, which are funded by the NOAA ESDIM program via the NGDC.

The objectives of the ESDIM program are to provide:

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

Numerous examples of data are available, which are not already held by NSIDC, not available to NOAA scientists, and which also may be at considerable risk in their current locations.
Accomplishments

Recently Archived Data

Eight data sets held at NSIDC were recently approved for designation as NOAA data: 1) Former Soviet Union Hydrological Snow Surveys; 2) Canadian Snow Depths 1943-1982; 3) Chinese Snow Depths 1979-1990; 4) Arctic Ocean Snow and Meteorological Observations from Drifting Stations; 5) Sea Ice Melt Pond Characteristics; 6) Estonian Snow Cover 1892-1990; 7) the Global Geocryological Database (a data set of permafrost and related observations); and 8) South Cascade Glacier Mass Balance Observations. These data were obtained by NSIDC under NOAA-funded programs (items 1 and 4) or through the activities of the WDC-A (items 2, 3, 5-8) and are thus subject to consideration for long-term archival by NOAA. NGDC has accepted responsibility for these eight items, to be maintained by NSIDC for NOAA.

Maintenance of the 3480 Tape Cartridge Archive at NGDC

The primary archive of NSIDC-held NOAA data is on 3480 cartridge at NGDC. This archive is continually undergoing changes as new data sets and updates to data sets are archived on 3480 tape cartridge. The transition of the full NGDC archive from 9-track tape to 3480 cartridge has been completed. Yearly updates for the International Arctic Buoy Program, the International Ice Patrol Iceberg reports, the Great Lakes Ice Gauge reports, the Arctic and Southern Ocean Sea Ice Concentration, the US Coast Guard Great Lakes Surface Ice Reports, and the US National Ice Center Great Lakes Ice Charts have all been archived onto 3480 cartridge.

Improved Access to NSIDC-held NOAA Data

Data received by NSIDC are prepared for distribution to the global scientific community. The two primary distribution methods are via CD-ROM and through the Internet. NSIDC produced the Arctic Ocean Snow and Meteorological Observations from Drifting Stations CD-ROM in cooperation with the Polar Science Center at the University of Washington. The Global Geocryological Database is planned for
release on CD-ROM and through the Internet in the summer of 1998, to coincide with the International Permafrost Association’s 7th International Conference on Permafrost. Several other new data sets, as well as updates to existing data sets, have been made available on-line in the past year. The following data sets are currently available online:

- Former Soviet Union Hydrological Snow Surveys
- Eurasian Glacier Inventory
- Canadian Snow Depths 1943-1982
- Sea Ice Melt Pond Characteristics
- Central Asian Snow Cover from Hydrometeorological Surveys
- Arctic and Southern Ocean Sea Ice Concentrations
- Great Lakes Daily Ice Reports
- International Ice Patrol Iceberg Reports
- International Ice Patrol Drifting Buoys
- National Ice Center Arctic and Antarctic Ice Charts
- National Ice Center - Great Lakes Ice Charts
- Rand Corporation Global Snow Depth Climatology
- Great Lakes Degree Day Climatology
- Great Lakes Radiation Transfer through Ice
- Great Lakes Ice Thickness and Stratigraphy
- Great Lakes Ice Concentration
- NWS/NMC/CAC Arctic and Antarctic Sea Ice

An Earth-Gridded Passive Microwave Data Set for Cryospheric Studies and Global Change Monitoring (EASE-Grid)

NSIDC continued to produce, archive, and distribute the DMSP SSM/I EASE-Grid Brightness Temperature product. This product was developed as a result of recommendations of the NASA SSM/I (Land) Products Working Team (SPWT), guidance from the Polar DAAC Advisory Group (PoDAG), and support from the NOAA/NASA Pathfinder Program.
The EASE-Grid data format that was developed for this product was designed to be flexible and extensible for other global data sets. Over the course of the last year, it has been adopted as the standard data format for the TOVS-P Pathfinder and AVHRR Polar Pathfinder data sets, as well as the AARI 10-Day Arctic Ocean EASE-Grid Sea Ice Observations data set (see p. 9) and the Northern Hemisphere (EASE-Grid) Weekly Snow Cover and Sea Ice Extent product (see p. 10) that NSIDC released in January 1997.

Current Pathfinder funding supports the development and production of a passive microwave data set in the EASE-Grid format that, at the completion of the current contract in 1998, will include 10 years (1978-1987) of Level 3 SMMR data, and 12 years (1987-1998) of Level 3 SSM/I data. The combined data will represent the first complete time series of global, satellite passive microwave data in a common data format.

The basic purpose of the EASE-Grid format is to provide the general user of remotely sensed passive microwave data with an optimal earth grid format that is between swath data (one file per orbit) and an averaged (over time and space) daily product with its inherent loss of information. The interpolation method that is used is based on the Backus-Gilbert interpolation, and was chosen to preserve the highest possible level of data precision and accuracy, combined with the utility of a gridded data format. The availability of a standard gridding scheme is a requirement for systematic time-series studies and supports the direct digital comparison of different geophysical algorithm outputs, as well as the validation of algorithms through quantitative comparison with EASE-Gridded surface station and other ancillary data.

The EASE-Grid SSM/I Brightness Temperature data provide full global coverage using equal-area projections and grid resolutions of 25 kilometers for all channels (19, 22, 37, and 85 GHz) and 12.5 kilometers for the 85 GHz channel. The data are available in three projections:
azimuthal equal-area projections for the Northern and Southern Hemispheres, respectively; and a cylindrical, equal-area projection for applications at lower latitudes and for those studies requiring complete global coverage on a single grid. During the past 12 months, NSIDC reached the following milestones:

- completed EASE-Grid Brightness Temperature data production for SSM/I data collected on the DMSP-F8 satellite (August 1987-December 1991);
- completed production and distribution of the Pathfinder Benchmark Period subset of the DMSP-F8 data (August 1987-November 1988) on a series of three CD-ROM multivolume sets (a total of 32 CD-ROM volumes issued);
- began production of SSM/I data collected on DMSP-F11 (starting in December 1991); and
- produced and released to the JPL DAAC the Pathfinder ocean products (ocean wind speed, cloud liquid water, and water vapor) for the Benchmark Period.

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 of monitoring temporal and spatial variations in snow cover on a global scale, avoiding the problems of cloud cover and darkness. NSIDC is developing the capability to produce daily snow products through the application of various algorithms to the EASE-Grid SSM/I Brightness Temperatures data.

Current algorithm validation studies apply digital image subtraction to directly compare snow extent derived from passive microwave data with snow extent from the NOAA weekly snow extent product, which has been regridded to the EASE-Grid format. This validation technique is being applied to surface station snow water equivalent data that are also regridded to the EASE-Grid. The digital image comparison techniques are being applied to longer time series to determine whether
the differences between the algorithm output and the validation data are systematic, and if so, whether the regions of the greatest consistent errors can be correlated with specific conditions identifiable using ancillary data (e.g., topography, vegetation, snow structure, and temperature).

NSIDC continues to supplement existing snow validation data sets with additional high spatial density data from the U.S.A. and the FSU (Former Soviet Union). Specific snow depth and water equivalent data sets from point measurements and along extensive transects from the FSU have been digitized and transferred to NSIDC through collaborative efforts with the Academy of Sciences (Moscow, Russia), WDC-B/Russian Hydrometeorological Institute, Obninsk, Russia, under the aegis of Working Group VIII, 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.

NSIDC Distributed Active Archive Center (DAAC)

NSIDC is in the fifth year of a five-year contract with NASA, participating as one of eight DAACs in EOSDIS. 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 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. Efforts
are under development that support improved access to data by the K-12 education community and the general public. This has generally entailed development of curriculum and interpretive products.

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 through the NOAA-NASA Polar Pathfinder efforts. Satellite altimetry data are being archived and distributed to support ice sheet topography studies.

ECS Test Activities

NSIDC staff participated in ECS test-planning activities that will culminate with actual hands-on participation in the test activities through the Operations Readiness Review. Tests include exercises (Operations Readiness Exercises) that stress DAAC operations of ECS, including systems and network performance, staffing, facilities, logistics support, and collecting and reporting statistics.

Staff involved in the planning and participation of the acceptance testing, and ECS integration and test activities include representatives from DAAC operations, systems and networks administration, user services, SSI&T staff, as well as on-site investigators. NSIDC DAAC staff will generate reports of the operational test results, including nonconformance reports. (See ECS Operations Working Group, P. 36.)

Data Sets

In 1996, the NSIDC DAAC released or made updates to 23 data sets from various sources and made them available through the V0 IMS and the NSIDC DAAC website.
Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER)

NSIDC is working with the ASTER Science Team and glaciologists at the USGS in Flagstaff, Arizona to develop the Glacier Land-Ice Monitoring System (GLIMS). GLIMS is a cooperative effort with regional partners who are specialists in the study of selected glacierized regions and individual glaciers. The partners will use data from ASTER and other instruments to routinely map glacier surface area, length, width, ablation area, and ice motion vectors. ASTER will provide a global source of well-calibrated, high-resolution data for glaciological studies using visible, near-infrared and thermal infrared data. NSIDC will archive the derived products. (The actual images will be available as part of the ASTER holdings at EDC.) During the coming months, NSIDC and the USGS will finalize the GLIMS database design and begin design of the user interface.

AVHRR Polar Pathfinder

Ingest of a daily record of both poles from the AVHRR sensors on NOAA satellites 11, 12, and 14 continued this year. The total number of images in the archive now stands at 20,000, or an average of 12 images per day. The DOMSAT receiver on the University of Colorado (CU) campus currently serves to augment coverage of the Antarctic by capturing NOAA-12 LAC data, which provides two or three scenes of the continent daily. Use of the scenes by the community has consistently increased, and two new applications of the data to polar ice sheet study (photoclinometry and data cumulation) were recently demonstrated and submitted for publication by Dr. Ted Scambos of NSIDC (with Gair Kvaran of CU and Mark Fahnestock of the University of Maryland). The upcoming Pathfinder processing is expected to use nearly every scene in the archive for product generation.
AVHRR Polar 1-km Data Set

Progress on the Pathfinder processing of the AVHRR Polar 1-km data into products included development of the prototype processing system and testing of the system on selected time periods. The remaining work, prior to a general processing of the entire data set, centers on eliminating remaining navigation errors and improving the cloud identification algorithm. Several periods of test data have been processed to derive polar albedo, surface temperature, and sea-ice motion, on a daily basis, for both poles. Products will be produced at three different grid scales: 25 kilometers for browse and global modeling; 5 kilometers for basin-wide process studies and multiyear synopses; and 1.25 kilometers for detailed regional process studies. The output grids are versions of the EASE-Grid, and cells from each of the three grids will exactly correspond to cells of SSM/I data. This will greatly facilitate multisensor studies and derived products.

Moderate Resolution Imaging Spectroradiometer (MODIS)

The NSIDC DAAC is responsible for snow cover and sea ice products from MODIS on AM-1. Level 2 MODIS snow and ice products will be generated at GSFC and shipped to NSIDC for archival and distribution. NSIDC will produce the Level 3 gridded daily and composite products. The Level 3 production code requires that an intermediate Level 2g (gridded swath format) product is generated. The MODIS Science Team and NSIDC are determining the most logical place for the Level 2g production to occur. Demands on processing, network capacity, and user community format requirements are being considered as part of this decision.

The MODIS Science Team is developing the products, in part, based on scientific input from the user community. An ad hoc committee on the MODIS snow and ice products met during November 1996, and recommended that an ice surface temperature product be implemented as part of the sea ice product at the time of the AM-1 satellite launch. The IST algorithm is based on work by J. Key and others with
AVHRR data, and is being adapted to the MODIS data by the MODIS Science Team.

NSIDC has begun planning for Science Software Integration and Test (SSI+T) of the MODIS Science Data Processing Software (SDP S/W). SSI+T will take place on the ECS testbed system now at NSIDC. Spencer Shiotani was hired as SSI+T engineer to lead this activity. Agreements to guide the SSI+T process are being developed between NSIDC and the MODIS Science Data Support Team. SSI+T will ensure that the software developed by the MODIS Science Team runs as designed, with interfaces to the SDP Toolkit, on the ECS system. SSI+T at NSIDC will include Version 1 and 2 MODIS SDP S/W and begin in late 1997.

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

The Near-Real Time SSM/I EASE-Grid Daily Ice Concentration and Snow Extent (NISE) product is being developed to provide important ancillary data to at least two NASA EOS instrument teams: MISR and CERES. Currently under development, this product uses SSM/I 19GHz and 37 GHz brightness temperature data, acquired from Marshall Space Flight Center, to create daily, global maps of sea ice concentration and snow cover extent. The data are produced in the EASE-Grid format. Sea ice concentrations are calculated using the NASA Team algorithm and snow cover is mapped with a pair of algorithms for both dry and wet snow extent. NSIDC will continue to collaborate with Dr. Barry Goodison and Dr. Anne Walker of the Canadian Climate Centre to further refine and validate their wet and dry snow algorithms. This product will represent the first near-real time effort for mapping daily, global ice and snow extent.
SSM/I Data

The NSIDC DAAC processes 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. A polar stereographic projection covering the polar regions is currently employed. The SSM/I EASE-Grid is being produced parallel to the polar stereographic products to provide improved radiometric fidelity, temporal resolution, and coverage. (See the EASE-Grid section on p. 247.) A new Users' 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 NCSA or commercial packages, such as IDL.

NSIDC produces monthly and daily averaged sea ice concentrations on polar stereographic grids for North and South Pole regions from orbital (swath) data collected by the SSM/I, flown aboard the DMSP F8, F11, and F13 satellites.

Cross-DAAC (Distributed Active Archive Center) Activities

DAAC Yearbook (Distributed Active Archive Centers, Supporting Earth Observing Science in 1996)

In 1995, the NSIDC DAAC produced the first in an annual series of publications designed to describe the use of EOSDIS DAAC data set by the scientific and other communities. The Yearbook, Distributed Active Archive Centers, Supporting Earth Observing Science in 1996, consists of a collection of feature articles highlighting scientific applications of DAAC data, preferably interdisciplinary applications using data from multiple DAACs. Written to be understood by a lay person with some college education, each article addresses a broad ecological or earth science theme. The narrative approach is relaxed, avoiding detailed explanations of processes and bureaucracy, relying instead on examples, anecdotes and graphics to enliven the presentation.

The Yearbook is attaining a wide circulation. It is distributed at meetings and mailed to scientists with a focus on the EOS Investigators Working Group (IWG). Efforts are also underway to distribute the publication to Mission to Planet Earth (MtPE) Interdisciplinary Science teams (IDS), the Science Data Panel, Science Working Group for the AM Platform (SWAMP), Global Change Fellowship, NOAA data centers, and Congress through the MtPE and NASA outreach offices.

DAAC Impacts Assessment

In 1997, it was proposed that a limited assessment of DAAC impacts on the scientific community be undertaken. Although conceived as addressing a continuing need, the objective for the first year of the effort is to establish a replicable, routine method for partial assessment of the impacts of the EOSDIS DAACs.

Development of a metric for each of three measurements is planned: Data set uses in selected subsequent citations; data set uses in
selected conference proceedings; and data set uses in selected student publications. The initial investment for the first year is limited, and efforts are focused on a narrow list of material in each area from each DAAC.

NSIDC is collaborating with consultant librarians and each of the DAACs to define procedures for identifying selection criteria and searching for material in each of the three subject areas. After data collections, deliverables will be spreadsheets reporting raw counts of subsequent citations, scientific conference mentions of data sets, and theses or dissertations where the work has relied on use of DAAC data sets. Reports will be due approximately 12 months from the start of the project, funding permitting.

Electronic Publishing

In 1997, a proposal was made to develop a prototype web site with a scope similar to the DAAC Yearbook in that it will serve all the DAACs. The site would also complement the Yearbook by providing a more comprehensive and timely approach to delivery of information on scientific, educational, and societal impacts of the EOSDIS DAACs.

The goals of the site are:

- To educate a broad and general public about the unified DAAC efforts and resources, and at a high level, about the specific geophysical disciplines and holdings each DAAC represents.
- To facilitate direct contact with the DAACs, and therefore, data access.
- To help characterize the work of archival, processing and distribution carried out within the DAACs as indispensable.
- To describe the benefits of the DAACs as data institutions with the same integrity and utility as a public library system focused on providing users with geophysical and remote sensing data.
NSIDC is collaborating with the DAAC managers, an ad hoc DAAC outreach group, NASA headquarters public relations staff, and User Services Working Group (USWG) through the design and development of the prototype site. At this time, the schedule is still in development and delivery date for the prototype is to be determined.

Data Request Tracking System

The online Data Request Tracking System became operational in 1996, providing the capability to automatically record requests generated through the IMS and the NSIDC WWW server, as well as provide NSIDC User Services Office the capability to manually enter requests for data and information received via phone, e-mail, or personal contact. The most important functions of the system are to track the various stages of the request to ensure timely delivery and to generate periodic reports that will be used to summarize user profiles, requests for data and information, and the resources required to support the communities that rely on the DAAC services. (User profiles and data requests appear in the User Services Data Request Statistics section, p. 43.)

Data-Related Committees

NSIDC/WDC-A staff participates in numerous data-related national and international working groups; several of these are described below. A complete list of committee involvement and meetings attended, is given on pages 77-87.

AEDD Working Group

Members of the Arctic Environmental Data Directory (AEDD) Working Group include Claire Hanson, Ann Brennan, and Dr. Roger Barry. AEDD is 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. The focus of this year's meeting, held in December 1996, was enhancement of the AEDD website, http://www-ak.wr.usgs.gov/aedd/aedd.html.

**ARCSS Committee**

The ARCSS Committee (AC) provides guidance on the direction of science priorities within the ARCSS program and contributes to advancing the following themes stated in the draft ARCSS Science Plan:

- the arctic climate system and its variability;
- the role of the Arctic in global biogeochemical cycling;
- the structure and stability of arctic ecosystems; and
- the links between environmental change and human activity.

The AC also addresses infrastructure needs within ARCSS. Membership in the AC is comprised of representatives from each of the ARCSS components – OAI; LAII; and GISP2, PALE, and HARC. Data issues are also represented by the ADCC Data Manager, Matthew Cross.

**ECS Operations Working Group**

NSIDC staff are continuing to participate in the Operations Working Group. Participation in this group is crucial to the success of the NSIDC DAAC operation of the Release B ECS. The responsibilities of NSIDC staff assigned to the Operations Working Group are to ensure that the information and services ECS provides to the DAAC operations staff are intuitive to use and provide adequate functionality to perform the tasks associated with operating the ECS. Assigned staff will continue to participate in telecons, review ECS operations procedures and GUI utilities, as well as provide feedback and direction to the ECS contractor on the implementation approach being considered for ECS operations.
Planning for the Operations Readiness Review began in 1997 and will continue through the next review, scheduled for the spring of 1998. NSIDC staff will participate in the operations tests and exercises beginning shortly after the Release Readiness Review, which is currently scheduled for January 1998, and continuing through the Operations Readiness Review, scheduled May 1998.

International Programme for Antarctic Buoys (IPAB)

The International Programme for Antarctic Buoys (IPAB) held its first meeting at the Scott Polar Research Institute, Cambridge, UK, on August 1 to 3, 1996. This federation of scientists from about 15 countries is undertaking a focused program of sea ice motion studies using instrumented buoys deployed on ice floes (or, in some cases, in open water) in the Southern Ocean, as near to the coastline of Antarctica as is practicable. The study is ongoing, and is part of the World Climate Research Programme of the World Meteorological Organization. The aim is to provide observations around the entire Antarctic continent. The U.S. contribution will be in the form of technical advice to participants from the National Ice Center, Suitland, and data archiving and distribution services from the WDC-A for Glaciology/National Snow and Ice Data Center (WDC-A/NSIDC), Boulder, Colorado. WDC-A/NSIDC will collaborate with Programme Coordinator Dr. I. Allison of the Australian Climate Research Centre, Hobart, to help publicize the availability of data from the buoys and to ensure data access for users outside IPAB. C. Hanson of WDC-A/NSIDC attended the Cambridge meeting.

International Arctic Environmental Data Directory

The U.S. alternate delegates to the International Arctic Environmental Data Directory Steering Committee are Dr. Roger Barry and Claire Hanson. This committee is the result of an initiative put forward by USGS and the United Nations Environment Program (UNEP)/GRID-Arendal to develop a “directory of directories”
based on existing DIF-based activities, such as the GCMD. The group includes members from Canada, Finland, Norway, Russia, the U.S.A., New Zealand (SCAR liaison), and has met in Arendal and Tromso, Norway and San Francisco, U.S.A. The main focus of the activity is environmental data. Iceland, Sweden, and Denmark have been invited to join the Steering Committee; the Ministry of Environment Protection of Russia is actively involved in the group.

**International Permafrost Association (IPA) Data and Information Working Group**

The IPA Data and Information Working Group is developing a pilot GGD. (See the GGD section on p. 16-7.) Several members, including Chair R. G. Barry and IPA Secretary General Jerry Brown met at NSIDC/WDC-A in July 1996 to review preliminary inventory results. The IPA Working Group plans to produce a CD-ROM, "Circumpolar Active-Layer Permafrost System: A Contribution to Global Change Research", to which adhering members are asked to contribute at least one long-term data set. NSIDC/WDC-A is providing technical assistance in assembling data and information components of the CD-ROM and will produce the final version for mastering. Claire Hanson and Tingjin Zhang are coordinating the NSF-funded GGD pilot project at NSIDC/WDC-A.

**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. *Arctic Information and Data: A Guide to Selected Resources* was updated and published in 1996, with printing support from the Arctic Research Consortium of the U.S. (ARCUS). A web version of this publication was also prepared. It is accessible on the ARCUS site http://arcus.polarnet.com. Ann Brennan is a member of the Working Group.
SCAR-COMNAP ad hoc Planning Group on Antarctic Data Management
and SCAR-COMNAP Joint Committee on Antarctic Data Management

Claire Hanson is the U.S. representative to the Scientific Committee on Antarctic Research-Council of Managers of National Antarctic Programs (SCAR-COMNAP) ad hoc Planning Group on Antarctic Data Management.

Based on recommendations of the Planning Group, 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 CEOS International Directory Network. NSF/Office of Polar Programs (OPP)/Polar Science Section responded to the SCAR and COMNAP call by funding NSIDC beginning October 1996 as the U.S. Antarctic Data Coordination Center. The focus of the activity is to identify U.S.-funded Antarctic data (historical, current, and planned) in all disciplines, and to coordinate the preparation of data descriptions for submission to the AMD.

In June 1996, the Planning Group met for the last time and transitioned into the SCAR-COMNAP Joint Committee on Antarctic Data Management (JCADM), with membership consisting of the managers of National Antarctic Data Centers in each of the Antarctic Treaty Nations, plus a representative from SCAR, COMNAP, and International Centre for Antarctic Information and Research (ICAIR), the AMD host. The JCADM is the operating committee for AMD; annual meetings of the group are scheduled.

Greg Scharfen and Rob Bauer, the U.S. Antarctic Data Coordination Center project team at NSIDC, are the U.S. representatives to JCADM. Roger Barry, Claire Hanson, Richard Armstrong, Ann Brennan, Ted Scambos, and Florence Fetterer serve as the NSIDC internal advisory group for the U.S. Antarctic Data Center project at NSIDC.
SCAR is the Scientific Committee on Antarctic Research; COMNAP is the Council of Managers of National Antarctic Programs. There are 26 signatories to the Antarctic Treaty; 13 nations were represented at the JCADM meeting in June 1996: Australia, Chile, China, Ecuador, Finland, France, Germany, Italy, Netherlands, New Zealand, Spain, United Kingdom, and the USA.
USER SERVICES

In addition to providing integrated responses to user inquiries for NSIDC, WDC-A, NSIDC DAAC, and the ARCSS Data Coordination Center, User Services activities during the past year were focused on product design, product enhancement, and strategies for delivering information and data.

User Services staff contributed as members of Product Teams to major development and enhancement tasks for the SSM/I polar stereographic products (including documentation redesign and development of a list of "Frequently Asked Questions" for the NSIDC website); the Northern Hemisphere Weekly Snow Cover and Sea Ice Extent CD-ROMs; Historical Arctic Rawinsonde Archive update; the Arctic Ocean Snow and Meteorological Observations from Drifting Stations CD-ROM; the Greenland SAR Base Map and the Ihde and Ekholm Digital Elevation Models for Antarctica and Greenland, respectively; the Arctic and Antarctic Research Institute 10-Day Arctic Ocean EASE-Grid Sea Ice Observations; and the SSM/I products transferred to NSIDC DAAC from the former Marshall Space Flight Center DAAC.

Strategies for effective delivery of information and data were addressed by User Services staff, who participated in the redesign of the NSIDC website; the reorganization of the NSIDC anonymous ftp site; the update of the three multi-DAAC fliers describing CD-ROM products; educational products and the working of the DAACs, themselves; and the redesign of the EOSDIS USWG conference exhibit booth backdrop.

NSIDC User Services provided staffing support for the EOSDIS USWG exhibit booth at three conferences during the past year: Geological Society of America, October 28 to 30, 1996 in Denver, Colorado; GIS/LIS Conference, November 19 to 20,
1996 in Denver, Colorado; and AGU Fall Meeting, December 1996 in San Francisco, California.

Michelle Holm completed her term as Chair of the EOSDIS USWG on September 30, 1996. Her duties included chairing monthly USWG telecons; chairing the Ninth USWG Meeting at the Hughes Facility in Landover, Maryland, June 20 to 21, 1996; and focusing the agenda of the group on both conference support activities and planning activities for EOSDIS Version B.

During the past year, the new data request tracking system, "TRAK", was released for operational use by User Services. This Ingres-based custom application mirrors the day-to-day operations of the User Services team, and provides the detailed statistical reporting capability to characterize the types of users who order each of NSIDC's data and information products. The system also allows tracking of time spent in fulfilling requests, delivery media counts, sources of inquiries, and weight/number of packages by shipment type and destination country. Transfer of subscription records from the old (1983-1996) data request tracking system is underway; other records will be transferred as resources permit.

A pilot project with the CU Book Store, to test the feasibility of shipments of standard NSIDC products by an outside group, is ongoing. The test involves the new CD-ROM of Arctic Ocean Atlas data, compiled and produced by the U.S.-Russia Environmental Working Group. The Book Store is handling orders, payment, and shipping and providing weekly reports to NSIDC, listing shipping addresses and number of copies sent. For standard products, where a large volume of orders is anticipated, and for which there is a charge to users, future use of this mechanism may be considered.

As of June 1997, User Services is interviewing candidates for an additional User Services Representative to join the current team of four. It is anticipated that the new hire will begin working in late August 1997.
Data Request Statistics

Data Categories

Data and information requests have progressively increased since 1978 (Fig. 1) and have risen sharply after 1991, due to the release of new data sets. Analysis is underway to determine what percentage of these requests is DAAC-related.

The peak in 1989-90 is attributed to the distribution of the SMMR CD-ROMs and the release of the F8 SMM/I CD series. Both data sets are products of the NSIDC DAAC. The jump in requests between the years 1982 and 1983 is related to the start-up of the DMSP Analog Archive at NSIDC.

An individual may have more than one request during the year; all requests are reflected in this chart. A single request often results in multiple transactions, each of which may include both information and data transactions. This chart does not include numbers representing the transactions.

User Categories

As shown in Figure 2, for Fiscal Year 1996, out of 1,710 data and information requests from User Services, 1,372 (approximately 80%) are from distinct individuals. The largest user category is U.S. universities.
Data and Information Request Totals by Federal Fiscal Year (October 1 - September 30)

First 7 months of FY 97 = 1177
Linear projection to full year = 2017

NSIDC / DAAC / WDC-A
NSIDC / DAAC / WDC-A
Number of Distinct Users and Requests by Type
July 1, 1996 - June 30, 1997

User Type

US General Public
US Commercial
US University
US K-12
US State/Local Gov
NASA
NOAA
US Other Gov
US Other
Foreign Commercial
Foreign University
Foreign K-12
Foreign Gov
Foreign Other
WDC

Number of Requests by User Type
Number of Distinct Users by User Type

Quantity

Figure 2
PUBLICATION PROGRAM

Two series, New Accessions List (NAL) and Glaciological Data (GD), have been published by NSIDC/WDC since 1977. 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 WDC System guidelines, is mailed worldwide to about 400 scientists, research institutions, and libraries. One issue, comprising four quarterlies for 1995, was printed and distributed in Fiscal Year 1996. NAL is also available on the NSIDC WWW site: http://www-nsidc.colorado.edu/NSIDC/PUBS/, under “new library holdings.”

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 1,000 copies, 50 percent of which are mailed to addresses outside the U.S.A., generally in exchange for publications submitted to the WDC. Whenever possible, GD publication costs are obtained through specific agency or project support. GD is available online at http://www-nsidc.colorado.edu/NSIDC/PUBS/GD/index.html.

One volume in this series, GD-29, was published in 1996 in cooperation with the Cold Regions Research Centre, Wilfrid Laurier University, Waterloo, Ontario, Canada. GD-29 comprises an extensive bibliography on the hydrology of the Himalaya-Karakoram region, compiled by Gordon Young and Bhanu Neupane of the Cold Regions Research Centre.
Two volumes in the NSIDC *Special Report* series were published in 1996/97: *Special Report-4, Atmospheric and Sea Ice Characteristics of the Arctic Ocean and the SHEBA Field Region of the Beaufort Sea*, by Mark Serreze, Jim Maslanik, and Jeffrey Key (Boston University) and *Special Report-5, An Intercomparison of DMSP F11- and F13-Derived Sea Ice Products*, by Julienne Stroeve, Li Xiaoming, and Jim Maslanik.

Four issues of *NSIDC Notes*, a quarterly newsletter, were distributed in 1996. The mailing list for this series continues to grow. Over 1,000 copies are distributed to a worldwide audience. *NSIDC Notes* provides information about activities at NSIDC, including the NSIDC DAAC, the ARCSS Data Coordination Center, the Antarctic Data Coordination Center, passive microwave data distribution, and research projects underway. It also offers information from other centers thought to be useful to the *NSIDC Notes* audience. This newsletter is part of NSIDC’s commitment to foster communication within the cryospheric research community and is available online at http://www-nsidc.colorado.edu/NSIDC/NOTES/.
RESEARCH

The Cryospheric and Polar Processes Division of CIRES 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 WDC-A for Glaciology and the National Snow and Ice Data Center. The work of the Division is carried out by three fellows, nine senior/research associates, 33 senior/professional research assistants, four staff members, seven graduate students, and 10 undergraduate students. Total funding for the Division increased to approximately $5.88 million for Academic Year 1996-97.

Activities have been 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 NSIDC DAAC.
2. A four-year grant from NSF/OPP support for the data management of the ARCSS program.
3. Ongoing support provided by NOAA for WDC-A Glaciology.

Research grants are for the following:
- SSM/I data for snow cover mapping (NASA), and AVHRR data (NASA).
- Analysis of satellite imagery for global lightning (NASA).
- Data analysis and modeling studies on Arctic climate processes (NSF and NASA), ice-climate interactions (NSF and NASA), atmospheric variability (NSF), and modeling sea ice sensitivity to radiative forcing (NSF and NASA).

A summary of current projects, listed by principal investigator, follows.
Passive Microwave Satellite Remote Sensing of Ice and Snow

The primary focus has been on the production and quality control of an optimal technique to interpolate from satellite swaths to a fixed earth grid. The grid scheme (EASE-Grid) represents the first example of a standard interuse gridding method and has been adopted by several NASA EOS instrument and science teams. The EASE-Grid has been selected as the format for all Level 3 (earth-gridded) geophysical products to be distributed by the NASA Pathfinder Program, which include both SSM/I (1987-1998) and SMMR data (1978-1987), thus providing a 20-year time series of satellite passive microwave data in a common format.

The extent and variability of seasonal snow cover is recognized to be an important parameter in climate and hydrologic systems and is expected to serve as an indicator of global climatic changes. Up to now, analysis has primarily focused on trends in Northern Hemisphere snow extent, based mostly on monthly averages, using charts derived from visible-wavelength data, or station data for selected regions. 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 polar night. Currently, validation tests are running on various passive microwave algorithms in order to determine the best methodology to characterize snow water equivalent on a continental to global scale. Current analysis focuses on why certain regions typically provide reasonable results using existing algorithms in contrast to regions where large differences between algorithm output and validation data occur. Possible sources of differences are being studied, including the presence of wet snow, variable snow stratigraphy and forest cover density, as well as errors caused by the interpolation of station data to the scale of the SSM/I grid cells. This work is being undertaken in collaboration with Dr. Al Chang, NASA Goddard Space Flight Center, Greenbelt, Maryland,
and Dr. Christian Maetzler, Applied Physics Institute, University of Bern. Collaboration with Dr. Chang also supports algorithm development for the NASA EOS Advanced Microwave Scanning Radiometer (AMSR).

Variability of Snow Cover and Glaciers in Central Asia: Applications to Hydrologic Modeling

This study, which is partially funded by a North Atlantic Treaty Organization (NATO) Linkage Grant, is the result of collaborative research between NSIDC/WDC-A and the Central Asian Research Hydrometeorological Institute (SANIGMI). SANIGMI collects, archives and processes snow and ice data, and applies advanced computational methods to derive the heat and mass balance parameters for glaciers and snow cover in the alpine zones of Central Asia. Researchers at SANIGMI have conducted year-round observations, participated in numerous international and national research programs, and monitored pollution in water, ice, precipitation, and the biota of high-mountain areas since 1966.

The following tasks have recently been completed:

1. The successful transfer of key snow cover, glacier, and stream flow (runoff) data from SANIGMI to NSIDC, where the data have been archived and are stored on stable electronic media. In particular, the snow cover data have been thoroughly quality checked and are now available as an official NSIDC data set (Product Number FE01171).

2. The successful transfer of selected passive microwave remote sensing data sets from NSIDC to SANIGMI to support the mapping of snow cover in Central Asia.
3. Snow hydrology data from SANIGMI have formed the basis for the PhD dissertation of a CU student, Daniel Bedford. The first results of this study, "Snowmelt Runoff Modeling of the Upper Amu Darya Basin, Former Soviet Central Asia", were presented at the Fall Meeting of the American Geophysical Union, San Francisco, California, in December 1996.

4. Richard Armstrong traveled to Tashkent, Uzbekistan in September 1996 for the primary purpose of initiating collaboration with the Remote Sensing Group of SANIGMI and facilitating closer cooperation between the snow and ice hydrology research at SANIGMI and the remote sensing group. This was accomplished through formal meetings involving V. Konovalov and V. Martemianov, deputy director of the computer center that supports the remote sensing group.

Future work will include the completion of a time series that describes the changes in the basic characteristics of the snow and glacier cover within the mountain river basins of Central Asia. This summary report will also contain the analysis of trends in air temperature and precipitation in the same region and time period. The completion of this report was facilitated by a working visit by V. Konovalov to NSIDC, Boulder, Colorado, in early April 1997.

In a broader context of monitoring cryospheric variables throughout Central Asia, NSIDC is also collaborating with Dr. Vladimir Aizen at the University of California, Santa Barbara and Dr. Mark Dyurgerov at CU's Institute of Arctic and Alpine Research.
Circumpolar Frozen Ground Conditions and Modeling Scenarios of Future Conditions
R. G. Barry, F. E. Nelson, D. Anisimov, and D. Gilichinsky

A three-year collaborative project between CU, SUNY-Albany, and the Institute of Soil Sciences (ISS) of the Russian Academy of Science (RAS) has been funded by NSF (OPP) to investigate the response of active layer and permafrost conditions to climate changes and to model the potential effects of projected global warming on frozen ground environments. The SUNY team is responsible for modeling and mapping, and the CU-ISS (RAS) team for data collection, quality control, and archival. Dr. Barry visited ISS, Puschino in July 1997 to review the data being provided by Dr. Gilichinsky's group.

Cryospheric Indices of Global Change

A collaborative study on "Cryospheric Indices of Global Change" under agreements between Dr. Barry and V. M. Kotlyakov (Institute of Geography, Russian Academy of Sciences), as well as with SANIGMI, Tashkent, Uzbekistan, is continuing. The project is currently focused on snow cover observations from an extensive set of Russian surveys for 1966 to 1990 and passive microwave satellite remote sensing data. Professor Alexander N. Krenke of the Institute of Geography, who is visiting NSIDC under a Fulbright Fellowship (January-August 1997), is working on this project with R. G. Barry and Richard Armstrong. A NATO linkage grant is supporting travel between the groups, and Dr. Barry visited Moscow, Russia in July 1997 to continue the collaboration.
Florence Fetterer

Radarsat Multiyear Sea Ice Mapping

The objective of this work is to develop a sea ice classification algorithm that will reliably map multiyear ice in Radarsat SAR imagery. The Naval Research Laboratory is funding the algorithm’s development for operational use at the Navy/NOAA National Ice Center (NIC) in Suitland, Maryland. Multiyear ice poses a hazard to navigation, thus NIC’s interest in quickly mapping its location. Multiyear ice is generally brighter than other ice types in radar imagery. This makes a backscatter-based algorithm a logical choice. However, wide-swath (500-km) Radarsat imagery poses several challenges. These include backscatter falloff with range and lack of reliably calibrated data. For these reasons, a dynamic threshold method is being employed that uses local, rather than global backscatter characteristics to decide what is multiyear ice. The algorithm has been tested against the results of manually supervised classification of 17 ERS-1 SAR images, and optimized to 10 percent RMS error. Testing with Radarsat imagery has begun.

A Sea Ice Melt Pond Study Using National Technical Means Data

This study used a classified data source to observe the formation and development of melt ponds in the vicinity of a drifting buoy in the Beaufort Sea. Pond coverage (percent of floes covered by ponds) was measured in conjunction with air temperature and satellite passive microwave estimates of sea ice concentration. One important finding was that even when pond coverage is taken into account, passive microwave algorithms significantly underestimated the amount of ice present. Similar methods will be used to evaluate melt conditions around the SHEBA site in late 1997 and 1998.
Hydrologic Impacts of Variations in the Albedo of Seasonal Snow

Demonstrated in this NSF-funded project to collect preliminary data in understanding spatial and temporal variations in snow albedo, is the strong relationship between the surface climate, snowpack energy balance, and snow albedo. For the first time, the positive feedback between snowpack energy balance and albedo has been explicitly modeled on a physical basis. AVHRR remote sensing data have also been used to support the model results. Journal articles describing these results are currently in press in Annals of Glaciology and Remote Sensing of the Environment. A. Nolin is the principal investigator on this project.

Assessment of Variations in the Snow Accumulation Rate in Northern Greenland

The second and final field season on the northern portion of the Greenland ice sheet was completed in 1996, on this three-year, NSF-funded project. In that field season, an Automated Weather Station (AWS) was installed, nine ice cores were drilled, and snowpack physical properties were sampled. The ice cores are currently being analyzed for their deuterium and oxygen isotope contents. A portion of the ice core data was analyzed using Wavelet analysis, a statistical technique that permits time-localization of features of interest in the climate time series. From this analysis, Dr. Nolin has identified a possible connection to a signal similar in frequency to the North Atlantic Oscillation (NAO). An oscillation appears in the ice core time series, with its strength varying over time. The NAO signal is an important climate signal that is represented on a number of other climate data sets.
Assessment of a Global Snow Mapping Algorithm Using Spectral Mixture Analysis

Global mapping of snow cover extent with satellite remote sensing imagery is critical for hydrologic and climatologic applications. However, traditional approaches using binary classification procedures have not provided sufficiently accurate estimates. SNOMAP, the planned snow cover mapping product from the spaceborne MODIS will instead use an index-based binary classification. To assess the effectiveness of the SNOMAP algorithm, a second method, spectral mixture analysis, was used to calculate the fraction of snow cover in each pixel. Results of this case study show that in areas of optically thin clouds, SNOMAP has some difficulty in distinguishing snow from clouds. Partially snow-covered pixels can also be difficult to classify using the SNOMAP algorithm. Results of this NASA-funded work indicate that the SNOMAP results are particularly sensitive to empirically derived threshold values.

TED A. SCAMBOS

Innovations in AVHRR Imagery Use for Polar Ice Sheet Study

Two new techniques for applying AVHRR data to the polar ice sheets have been developed and demonstrated at NSIDC: data cumulation and photodinometry. Data cumulation combines the data from several AVHRR scenes 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 below); Ice Stream C; and the northeast Greenland ice stream. Photodinometry 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 digital
elevation models (DEM) by using the image data at a guide to local
(1-km) variations from a 5- or 10-km resolution DEM.

Landsat Applications to Antarctica Project

A new project was begun as part of the Science Team research
program for Landsat 7. The objective is to use existing Landsat 1, 2,
3, 4, and 5 data to map the ice velocity of glaciers in the West
Antarctic, and to search for changes in glacier outflow over the 25-year
record provided by the archive of Landsat images stored at EDC (with
Dr. Robert Bindschadler as principal investigator, Dr. Mark Fahnestock
and Dr. Ted Scambos as co-principal investigators). Ice velocity mapping
will be conducted using a semi-automated technique that relies on gray-
value correlation in image chips in sequential images. Initial work under
this grant has centered on the selection of suitable cloud-free images
from the thousands of images at EDC, and mapping Ice Stream D
and F outflow. Jennifer Bohlander, a research assistant at NSIDC, has
been hired to pursue the Landsat mapping effort.

Radasat Antarctic Mapping Project

A project is underway to map the entire Antarctic continent using
SAR imagery from the Canadian satellite Radasat. This effort
involves rotating the satellite 180 degrees to a southward-looking
mode for a three-week period. NSIDC’s contribution consists of
identifying, gathering, and delivering ancillary data, such as DEMs, ice
motion data, etc. to support the initial processing of the data. Several
DEM of the entire continent and selected areas of interest were
contributed to the project to facilitate creating the most comprehensive
DEM yet of the continent for use in geolocation and terrain correction.
Acquisition of the south-looking mode data is scheduled for
September/October 1997.
Site Characterization and Ice Stream History of Siple Dome, West Antarctica

The second and last field season at the Siple Dome site was conducted in November and December 1996. The main focus of this season was remeasurement of the survey markers to derive ice motions across the dome and radar profiling of its southern margin. Ice motions were determined to accuracies of centimeters per year using the differential Global Positioning System (GPS) method, and showed that the summit point is indeed the exact center of ice flow. The mass balance of the summit area (snowfall minus volume of outflow) is currently being determined. Radar work along the southern margin showed that large glaciers in the area have swelled and shrunk over the centuries, suggesting that the ice sheet in West Antarctica undergoes wide swings in its mass outflow through time.

Greg Scharfen

Global Lightning
Greg Scharfen, Rob Bauer, and Ross Swick

NSIDC has been analyzing U.S. Air Force DMSP analog and digital images for the presence of lightning for several years. The goal of this project, funded by NASA’s Marshall Space Flight Center, is to produce a global climatology of nighttime lightning. This information is a precursor to the more complete lightning climatology that will be available from the EOS Lightning Imaging Sensor (LIS), which will be flown in late 1997. The data used in the project at NSIDC are collected by the Operational Linescan System (OLS) sensor. Lightning has a distinct signature in the nighttime visible-band OLS images. 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 database of these signatures provides a unique source of information about the
spatial and temporal distribution of global lightning. This information
is being used in studies of climate, the hydrological cycle and the global
electric circuit.

An automated lightning detection system, developed by NSIDC, has
been successfully implemented. This system uses pattern recognition
algorithms that emulate the human process of lightning signature
identification, and greatly improves the efficiency of the analyses. The
algorithms use 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,
scanning noise and dropout, etc.). Approximately 17 months of digital
OLS data from 1994, 1995, and 1996 have been analyzed using the
automated system. A comparison of a subset of these analyses with
approximately coincident data collected by another lightning sensor, the
Optical Transient Detector (OTD), indicate good agreement.

MARK C. SERREZE

Arctic Sea Ice Anomalies
Mark C. Serreze, Roger G. Barry, and Jim Maslanik

Building upon earlier efforts, studies were undertaken to place the
observed record minimum in sea ice extent for 1990 into the context
of recent changes in Arctic circulation. Based on analysis of passive
microwave data and atmospheric fields, the 1990 anomaly appears to
be part of a general trend of decreasing sea ice extent dominated by
large late-summer anomalies along the Siberian Coast. These
anomalies are related to circulation changes characterized by increased
cyclone activity over the central Arctic Ocean. This work, undertaken
in collaboration with Jim Maslanik and Roger Barry, resulted in a
paper in Geophysical Research Letters and was presented as an invited talk
at the American Meteorological Society Workshop on Polar Processes
in Global Climate in Cancun, Mexico, in November 1996.
Eastern U.S.A. Snowfall Variability Study
Mark C. Serreze, Martyn Clark, Dave McGinnis, and D. Robinson

As part of new efforts to expand research efforts beyond the Arctic, a study was conducted of variability in snowfall over the eastern half of the U.S.A. This study, undertaken in collaboration with Martyn Clark, Dave McGinnis, and D. Robinson, finds a strong relationship between snowfall and the Pacific North American teleconnection pattern. A paper discussing these findings has been accepted for publication in *Journal of Climate*. Studies have also been initiated to examine variability and change in western U.S. snowpack water resources, supported by another new NSF grant ($290,000), on which Dave McGinnis, R. Pulwarty, Richard Armstrong, and Roger Barry are co-principal investigators. Efforts during the first year of this grant have focused on data set assembly. A first-cut climatology of western U.S. snow-water equivalent has been compiled and a research paper is in preparation.

Examination of Russian Arctic Watershed Atmospheric Hydrologic Budgets

Atmospheric hydrologic budgets were examined for the major Russian Arctic watersheds (the Lena, Ob, and Yenisei). Daily and monthly estimates of precipitation minus evaporation have been compiled for the period 1974 through 1991 by applying the aerological approach to an extensive rawinsonde archive extending down to 50 degrees North. Research is proceeding in collaboration with investigators at the University of Delaware and University of New Hampshire.

Icelandic Low Storms and the North Atlantic Oscillation Teleconnection Pattern

A paper addressing cyclone activity associated with the Icelandic Low recently appeared in *Journal of Climate*. This paper addresses the
general climatic characteristics of Icelandic Low storms, frequencies of
cyclogenesis, cyclone deepening rates and linkages between storm activity
and the phase of the North Atlantic Oscillation teleconnection pattern.

New Climatology of Arctic Downwelling Shortwave Radiation
Mark C. Serreze, Jim Maslanik, and K. Steffen

A new climatology of downwelling shortwave (global) radiation for
the Arctic, based on measurements from fixed land stations, the
Russian North Pole series of drifting ice stations, and clear-sky fluxes
derived from a radiative transfer model has been developed. This is
reported in a paper accepted for publication in *Journal of Climate* and
coauthored by J. Box, Jim Maslanik, J. Key, and K. Steffen. Comparisons are made with satellite-derived climatologies and radiation
fields from the National Center for Environmental Prediction (NCEP)/National Center for Atmospheric Research (NCAR) reanalysis
effort. The NCEP/NCAR model seriously overestimates radiation
fluxes due to large underestimates in cloud cover. This study was, in
part, supported by a new NSF award to assess the utility of modeled
surface fields from the reanalysis effort for Arctic climate studies.

Studies Using the Comprehensive Ocean Atmosphere Data Set
and NCEP/NCAR Reanalysis Model

Studies were conducted addressing characteristics of precipitation,
snowfall, and cloud cover over the Arctic Ocean utilizing marine reports
from the Comprehensive Ocean Atmosphere Data Set (COADS) (Clark
et al 1996). A related study examined the performance of the
NCEP/NCAR reanalysis model in predicting Arctic precipitation.
Results will appear in *Annals of Glaciology* (Serreze and Maslanik).
KONRAD STEFFEN

Greenland Ice Sheet Climatology and Surface Energy Balance Modeling: Greenland Climate Network (GC-Net)
Konrad Steffen, W. Abdalati, J. Stroeve, and J. Box

and

Assessment of Variation in the Snow Accumulation Rate in Northern Greenland
Konrad Steffen, A. Nolin, and J. White

Another successful field season has been completed on the Greenland ice sheet (April-June). This year, the main focus was on the drilling of eight shallow ice cores in the low accumulation area in northeast Greenland. This area is known as the "Greenland desert" with an annual precipitation of less than 20 cm snow. The surface topography was measured to an absolute accuracy of several centimeters for an area of 50 x 50 kilometers with GPS equipment. This local topography is needed for the interpretation of climate and accumulation records from the ice cores. Four new AWSs for the Greenland climate network were installed; two along the western slope around 2,000 meters, one at Summit, and one in the ablation area of the Jakobshavn drainage basin. A total of nine stations are transmitting 290 meteorological and glaciological parameters hourly. This data set will be used for surface energy balance parameterization and modeling. The surface melt assessment for the entire ice sheet, based on passive microwave satellite analysis for 1978 through 1994, has been completed (PhD thesis, Waleed Abdalati), as well as the radiative flux study based on NOAA's Advanced Very High Resolution Radiometer for the years 1989 through 1993 (PhD thesis, Julianne Stroeve). More information on the Arctic Regional Climate Assessment (PARCA program, which is funded by NASA, is available on the PARCA home page: http://cires.colorado.edu/parca.html.)
Sea Ice and Ocean Processes in Baffin Bay: A Study Using RADARSAT Data and Numerical Modeling
Konrad Steffen and John Heinrichs

A sea ice process study in northern Baffin Bay, between Greenland and the Canadian islands of Ellesmere and Baffin, revealed that the winter ice anomaly, known as the North Water, is caused by ice advection and upwelling of east Greenland warm water along the eastern coast of the Bay. These results were obtained from a three-dimensional ocean model with large-scale atmospheric forcing. The model runs were able to verify in situ field measurements in the North Water (PhD thesis, John Heinrichs). This project was funded by NASA’s Mission to Planet Earth.

Julienne C. Stroeve

AVHRR-Derived Clear Sky Surface Temperature and Surface Albedo over the Greenland Ice Sheet

AVHRR was used to derive clear-sky surface temperatures and albedos for one satellite pass over the Greenland ice sheet from 1989 through 1993. Results indicate that the surface temperature of the Greenland ice sheet is strongly dominated by topography, with minimum surface temperatures associated with the high elevation regions. Maximum surface temperatures occur during July along the western coast and southern tip of the ice sheet. Minimum temperatures are found at the summit during summer, and are displaced northward during the polar night. Large interannual variability in surface temperatures occurs during winter, associated with katabatic storm events. Summer temperatures show little variation, although 1992 stands out as being colder than the other years. The reason for the lower temperatures during 1992 is believed to be a result of the 1991 eruption of Mount Pinatubo. The surface albedo has been computed for the Greenland ice sheet during the months of May through September and documents
the progression of summer melt. During July, large drops in surface albedo are observed, with reductions of as much as 65 percent in coastal regions. Even in areas that experience little or no melt, albedo decreases of 10 percent are common. The albedo remains low in August, indicating that extensive melt occurs in late July and continues through early August. These large drops in surface albedo significantly alter the energy balance of the snowpack by doubling the amount of absorbed solar radiation.

Three papers are currently in press discussing the temperature and albedo variations over the Greenland ice sheet, in: (1) *Journal of Applied Meteorology* (surface temperature); (2) *Remote Sensing of the Environment* (surface albedo); and (3) *Annals of Glaciology* (surface albedo).

**Intercomparison of DMSP F11- and F13-Derived Sea Ice Products**

The effects of changing from the SSM/I F11 to the F13 satellite has been examined for a five-month overlap period. In terms of hemispheric averages of mean ice concentration, the biases introduced by the switch from F11 to F13 are slight and are not statistically significant in most areas, although relatively large and significant differences are seen in some regions. Furthermore, differences in sea ice extent and total ice covered area between the two platforms were found to be statistically significant. Previous efforts to reduce such differences in geophysical parameters between earlier SSM/I satellites have focused on establishing relationships between the brightness temperatures. However, the relations between the F11 and F13 brightness temperatures are found to be highly sensitive to the region chosen for the analysis. Consequently, the choice of sample has a substantial effect on the sensor-to-sensor adjustment and on the resulting sea ice concentrations. Furthermore, analysis of ice concentrations between F8 and F11 and between F11 and F13 shows that current attempts at a relative calibration of the two instruments do not offer a significant improvement in
corresponding ice fractions. A paper by J. Stroeve, X. Li, and J. Maslanik has been submitted to Remote Sensing of the Environment.

TINGJUN ZHANG

Atmosphere-Active Layer Permafrost Modeling

A collaborative study, "Investigation of the Impact of Climatic Change on the Ecosystem at High Latitudes", with Prof. K. Stamnes at the Geophysical Institute, University of Alaska, Fairbanks, is continuing. The Project is supported by the DOE NIGEC Western Regional Center (WESTGBC) for the period July 1, 1994 through June 30, 1998. During Academic Year 1996-97, the following research has been accomplished:

(i) Climate in Northern Alaska

The currently available data suggest differentiation of the North Slope of Alaska into three major climatic zones (from south to north): Arctic Foothills, Arctic Inland, and Arctic Coastal. The climate in Northern Alaska was strongly influenced by the ocean, not only during the summer months as reported in early literature but also during the winter months. The NWS records of precipitation measured by the standard 8-inch pan have underestimated the "true" quantity by 75 percent at Barrow, Alaska. The amount of snowfall measured by the 8-inch pan can be in error, on average, by a factor of 2.6, and up to a factor of 6.

(ii) Effect of Climate on Permafrost

Thermal regimes of the active layer and permafrost on the North Slope of Alaska were investigated by analyzing the data collected for over six years and by numerical modeling. Overall, no single factor explains the permafrost temperature increase from the coast inland. Lower permafrost temperatures along the Arctic Coast may be due to relatively short and
cool summers, hard wind-packed snow with lower depth hoar fraction caused by strong winds, and poorly developed vegetation and flat ground surface. Relatively higher permafrost temperature inland may be due to longer and warmer summers, less hard wind-packed snow (lower density) with greater depth hoar fraction caused by relatively weak wind, well-developed vegetation, and rough ground surface. Permafrost temperature at the Toolik Lake area probably is the highest in the region. Besides the factors discussed for interior Alaska, warmer winter (due to relatively weak atmospheric temperature inversion) is another important factor that results in a higher mean annual air temperature and permafrost temperature. Moving toward the Brooks Range (Galbraith Lake), permafrost temperature decreases due to its higher elevation.

Thaw Lake Study on the North Slope of Alaska

A three-year, collaborative research study, “Climate Sensitivity of Thaw Lake Systems on the Alaskan North Slope”, with Dr. M. Jeffries at the University of Alaska, Fairbanks and Dr. G. Liston at Colorado State University, is continuing. The project is supported by NASA. The objective of the project is to understand the present-day ice/lake/soil interactions and thermal regime of shallow tundra lakes on the North Slope of Alaska and to investigate their sensitivity to climate change, in order to determine the role of the thaw lakes in permafrost development and the distribution and potential changes in greenhouse gas fluxes from the tundra. The proposed research will combine remote sensing of lake ice processes with two-dimensional numerical modeling of ice/lake/soil interactions and thermal regime. The purpose of the project at CU is to develop the two-dimensional numerical model and conduct the related sensitivity analysis. The numerical model is still under development. Some primary modeling results show that snow over lake ice was thinner than over land at Barrow, Alaska. This result was confirmed by the field investigation during the spring of 1997 at Barrow. Modeling results also show that permafrost is still thawing after 40,000 years of the thaw lake presence over permafrost.
PUBLISHED WORK


Hanson, C. S., D. L. McGinnis, M. D. Cross, and M. J. Brodzik. 1996. The ARCSS data coordination center at the National Snow and Ice Data Center. Arctic Research of the United States. 9(Fall/Winter): 53-5.


COMMITTEES

Alaska SAR Facility Users Working Group - J. Maslanik

ARCSS Advisory Committee - D. L. McGinnis

ARCSS Data Management Working Group - D. L. McGinnis


GLAS Science Team - T. Scambos, A. Nolin

GEWEX International Satellite Land Surface Climatology Project Science Panel - G. R. Scharfen

Global 1-Km AVHRR Data Set Working Group - T. Scambos

IAHS/ICSI Panel to review the World Glacier Monitoring Service - R. L. Armstrong

International Arctic Environmental Data Directory - R. G. Barry, C. S. Hanson

International Commission on Snow and Ice, Chairman, Snow and Climate Working Group - R. L. Armstrong

International Commission on Snow and Ice, Representative to International Association of Hydrological Sciences - R. L. Armstrong
International Permafrost Association, Chair, Working Group on Permafrost Data and Information - R. G. Barry

NASA EOSDIS Data User Services Working Group - M. Holm
(Chair, through September 30, 1996), C. Hanson, C. McNeave, D. Starr

NASA EOSDIS System Engineers Working Group - V. Troisi

NASA EOSDIS Version 0 IMS Development Team - K. Robinson, R. Swick


NASA EOSDIS Operations Working Group - R. Ericson


NASA EOSDIS Version 0 Valids Cleanup Working Group - K. Robinson

RadarSat/National Ice Center Working Group - F. Fetterer (Chair)

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

SCAR-COMNAP Joint Committee on Antarctic Data Management - G. Scharfen, R. Bauer

RAMP Science Team - T. Scambos

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

SSM/I Products Working Team, NASA - R. L. Armstrong
UNAVCO Field Techniques Working Group - T. Scambos

U.S.-Canada Joint Ice Working Group - F. Fetterer

U.S.-Canadian Great Lakes-St. Lawrence Ice Information Working Group - F. Fetterer

U.S. National Committee on Permafrost and Frozen Ground - R. G. Barry

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


Western Snow Conference Executive Committee - R. L. Armstrong

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, Terrestrial Observations Panel - R. G. Barry

WMO/WCRP ACSYS Programme, Scientific Steering Group - R. G. Barry
MEETINGS


"NASA EOSDIS Version 0 IMS Development Team Meeting," Landover, Maryland, U.S.A., April 3-4, 1996 - K. Robinson


"EOS ASTER Science Team Meeting," Pasadena, California, U.S.A., June 10-14 1996 - G. Scharfen

"Ninth NASA EOSDIS User Services Working Group," Landover, Maryland, U.S.A., June 18-21, 1996 - C. Hanson, M. Holm, and C. McNeave


"ACSYS/WCRP Working Group on Arctic Precipitation Data,"
Global Precipitation Climatology Center (GPCC), Deutsche
Wetterdienst, Offenbach-am - Main, Germany, July 10-12, 1996 -
R. G. Barry, meeting chairman

"MODIS Land Team-Science Data Support Team Meeting,"
Goddard Space Flight Center, Greenbelt, Maryland, U.S.A., July
11-12, 1996 - G. Scharfen

"Payload Panel Meeting," Annapolis, Maryland, July 28-29, 1996 -
R. Weaver

"NASA EOSDIS Version 0 IMS Development Team Meeting,"
Landover, Maryland, U.S.A., July 29-31, 1996 - K. Robinson

"Guide Authors' Meeting," Landover, Maryland, U.S.A., July 31-
August 4, 1996 - M. Meshek and A. Varani

"Data Exchange Coordinators Meeting of the Working Group VIII
under the U.S.-Russian Bilateral Agreement in the Field
of Protection of the Environment and Natural Resources,"

"International Programme for Antarctic Buoyas," Cambridge,
England, U.K., August 1-3, 1996 - C. Hanson

"Fourth SCAR-COMNAP ad hoc Planning Group on Antarctic
C. Hanson

"Optical Science, Engineering, and Instrumentation Annual

"NSF/NCSA Federal Webmasters' Workshop '96," Bethesda,
Maryland, U.S.A., August 7-9, 1996- M. Meshek


“Annual Bureau Meeting of the International Commission on Snow and Ice,” Victoria, British Columbia, Canada, August 16, 1996 - R. Armstrong

“EOSDIS Conference and Outreach Planning Meeting,” Landover, Maryland, U.S.A., September 3-5, 1996 - M. Holm


“Science On-Line Antarctica Planning Meeting,” Tahoe City, California, U.S.A., September 24-26, 1996 - G. Scharfen


"Workshop on Recent Developments in Snowmelt Runoff Modeling and the Effects of Climate Change," Bern, Switzerland, October 7-11, 1996 - R. Armstrong

"EOS MODIS Science Team Meeting," Greenbelt, Maryland, U.S.A., October 10-11, 1996 - G. Scharfen


"25th Annual Canada-U.S. Great Lakes Ice Information Working Group Meeting," Canadian Ice Service, Ottawa, Ontario, Canada, October 22, 1996 - P. Fetterer


"EOSDIS Project Replan Meeting," Greenbelt, Maryland, U.S.A., November 5-6, 1996 - G. Scharfen and V. Troisi


"Fifth Radarsat/National Ice Center Working Group Meeting," Stennis Space Center, Mississippi, U.S.A., January 9, 1997 - F. Fetterer


"European Geophysical Society Annual Meeting," Vienna, Austria, March 1997 - R. G. Barry

"The 1997 Annual Canadian CRYSYS Meeting," University of Laval, Quebec, Canada, March 10-12, 1997 - T. Zhang

"Naval Research Laboratory Program Review," Stennis Space Center, Mississippi, U.S.A., March 11, 1997 - F. Fetterer


"National Ice Center Annual Meeting," Suitland, Maryland, U.S.A.,
March 26, 1997 - F. Fetterer

"The Association of American Geographers 93rd Annual Meeting."
Fort Worth, Texas, U.S.A., April 1-5, 1997 - T. Zhang

"EOS Science Working Group for the AM-1 Platform," Greenbelt,
Maryland, U.S.A., April 3-4, 1997 - G. Scharfen

"National Science Teachers Association Conference," New Orleans,
Louisiana, U.S.A., April 3-5, 1997 - R. Hauser

"Workshop on Sea Ice Thickness Measurements and Data Analysis."
Monterey, California, U.S.A., April 7-11, 1997 - F. Fetterer

"International Conference on the Problems of the Earth
Cryosphere (Basic and Applied Studies)," Pushchino, Moscow,
Russia, April 21-25, 1997 - T. Zhang

"Canadian Geophysical Union and Eastern/Western Snow
Conference," Banff, Alberta, Canada, May 5-8, 1997 - R. Armstrong

"BOS MODIS Science Team Meeting," Greenbelt, Maryland,
U.S.A., May 13-16, 1997 - G. Scharfen

"Antarctic Meteorological Working Group Meeting," Englewood,

"SCAR-COMNAP Joint Committee on Antarctic Data Management."
Christchurch, New Zealand, May 20-23, 1997 - G. Scharfen and
C. Hanson

"11th Meeting of the Canada/U.S. Joint Ice Working Group."
Downsville, Ontario, Canada, May 22-23, 1997 - F. Fetterer
“Lightning and Mountains,” Chamonix, Mont-Blanc, France, June 1-5, 1997 - R. Barry


“Workshop on the Impacts of Global Change in the Western Arctic/Bering Sea Region,” University of Alaska, Fairbanks, Alaska, U.S.A., June 3-6, 1997 - F. Fetterer

“MISR Science Team Meeting,” June 4-6, 1997 - A. Nolin


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
Sir Wilfrid Laurier University, Ontario

China
Institute of Glaciology and Cryopedology, Lanzhou
WDC-D for Glaciology, Lanzhou/Beijing

Germany
Alfred Wegener Institute for Oceanic Polar Research, Bremerhaven

Russia and the Former Soviet Union
Arctic and Antarctic Research Institute, St. Petersburg
Institute of Geography, Moscow
Central Asian Hydrometeorological Center (SANIGMI), Tashkent, Uzbekistan
WDC-B Russian Hydrometeorological Institute (RHMI) (State Hydrometeorological Service), Odninsk

Switzerland
Institute of Geography, ETH, Zurich
Swiss Federal Institute for Snow and Avalanche Research (EISLF), Davos

United Kingdom
Scott Polar Research Institute, Cambridge
WDC-C for Glaciology, Cambridge
U.S.A.
Cold Regions Research and Engineering Laboratory (CRREL),
Hanover, New Hampshire
Library of Congress
NASA- Goddard; Jet Propulsion Laboratory; Marshall; Langley
Research Center
NOAA- NESDIS- National Ice Center, Suitland, Maryland
Ohio State University, Byrd Polar Research Center, Columbus, Ohio
U.S. Air Force, Offutt, Nebraska
University of Alaska, Geophysical Institute, Fairbanks, Alaska
University of Washington, Seattle, Washington

International
Global Climate Observing System (GCOS), World Climate Research
Programme (Geneva, Switzerland)
International Center for Antarctic Information and Research
(Christchurch, New Zealand)
International Glaciological Society
International Mountain Society (University of California, Davis)
International Permafrost Association
United Nations Environment Programme (UNEP) - Global
Resource Information Database (GRID) (Arendal, Norway)
World Climate Research Programme, Arctic Climate System (ACSYS)
World Glacier Monitoring Service (WGMS), ETH
(Zurich, Switzerland)
World Meteorological Organization, Sea Ice Working Group,
Commission on Maritime Meteorology (Geneva, Switzerland)
# Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AARI</td>
<td>Arctic and Antarctic Research Institute, St. Petersburg, Russia</td>
</tr>
<tr>
<td>ACSYS</td>
<td>Arctic Climate System Program (WCRP)</td>
</tr>
<tr>
<td>ADCC</td>
<td>ARCSS Data Coordination Center</td>
</tr>
<tr>
<td>ADD</td>
<td>International Arctic Environmental Data Directory</td>
</tr>
<tr>
<td>AEDD</td>
<td>Arctic Environmental Data Directory</td>
</tr>
<tr>
<td>AMD</td>
<td>Antarctic Master Directory</td>
</tr>
<tr>
<td>AMSR</td>
<td>Advanced Microwave Scanning Radiometer</td>
</tr>
<tr>
<td>AOS</td>
<td>Arctic Ocean Section</td>
</tr>
<tr>
<td>ARCSS</td>
<td>Arctic System Science</td>
</tr>
<tr>
<td>ARCUS</td>
<td>Arctic Research Consortium of the U.S.A.</td>
</tr>
<tr>
<td>ASTER</td>
<td>Advanced Spaceborne Thermal Emission and Reflection Radiometer</td>
</tr>
<tr>
<td>AVHRR</td>
<td>Advanced Very High Resolution Radiometer</td>
</tr>
<tr>
<td>AWS</td>
<td>Automatic Weather Station</td>
</tr>
<tr>
<td>CEOS</td>
<td>Committee on Earth Observing Satellites</td>
</tr>
<tr>
<td>CERES</td>
<td>Clouds and the Earth’s Radiant Energy System</td>
</tr>
<tr>
<td>CIRES</td>
<td>Cooperative Institute for Research in Environmental Sciences</td>
</tr>
<tr>
<td>COADS</td>
<td>Comprehensive Ocean-Atmosphere Data Set</td>
</tr>
<tr>
<td>COMNAP</td>
<td>Council of Managers of National Antarctic Programs</td>
</tr>
<tr>
<td>CRYSYS</td>
<td>Cryospheric System Program (Canada)</td>
</tr>
<tr>
<td>CU</td>
<td>University of Colorado</td>
</tr>
<tr>
<td>DAAC</td>
<td>Distributed Active Archive Center</td>
</tr>
<tr>
<td>DEM</td>
<td>Digital Elevation Model</td>
</tr>
<tr>
<td>DIF</td>
<td>Directory Interchange Format</td>
</tr>
<tr>
<td>DMSP</td>
<td>Defense Meteorological Satellite Program</td>
</tr>
<tr>
<td>EASE-Grid</td>
<td>Equal Area SSM/I Earth Grid</td>
</tr>
<tr>
<td>ECS</td>
<td>EOSDIS Core System</td>
</tr>
<tr>
<td>EDC</td>
<td>EROS Data Center</td>
</tr>
<tr>
<td>EOS</td>
<td>Earth Observing System</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------------------------------------------</td>
</tr>
<tr>
<td>EOSDIS</td>
<td>EOS Data and Information System</td>
</tr>
<tr>
<td>RSDIM</td>
<td>Environmental Services Data and Information Management</td>
</tr>
<tr>
<td>ETH</td>
<td>Eidgenossische Technische Hochschule</td>
</tr>
<tr>
<td>FSU</td>
<td>Former Soviet Union</td>
</tr>
<tr>
<td>ftp</td>
<td>File Transfer Protocol</td>
</tr>
<tr>
<td>GCMD</td>
<td>Global Change Master Directory</td>
</tr>
<tr>
<td>GC-Net</td>
<td>Greenland Climate Network</td>
</tr>
<tr>
<td>GCOS</td>
<td>Global Climate Observing System (WMO)</td>
</tr>
<tr>
<td>GD</td>
<td>Glaciological Data</td>
</tr>
<tr>
<td>GEWEX</td>
<td>Global Energy and Water Cycle Experiment</td>
</tr>
<tr>
<td>GGD</td>
<td>Global Geocryological Database</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information System</td>
</tr>
<tr>
<td>GISP</td>
<td>Greenland Ice Sheet Program</td>
</tr>
<tr>
<td>GLAS</td>
<td>Geoscience Laser Altimeter System</td>
</tr>
<tr>
<td>GLIMS</td>
<td>Glacier Land-Ice Monitoring System</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>GRID</td>
<td>Global Resource Information Database</td>
</tr>
<tr>
<td>GRIP</td>
<td>Greenland Ice Sheet Program</td>
</tr>
<tr>
<td>GSFC</td>
<td>Goddard Space Flight Center</td>
</tr>
<tr>
<td>HARC</td>
<td>Human Dimensions of Global Change in the Arctic</td>
</tr>
<tr>
<td>HDF</td>
<td>Hierarchical Data Format</td>
</tr>
<tr>
<td>HRPT</td>
<td>High Resolution Picture Transmission</td>
</tr>
<tr>
<td>ICAIR</td>
<td>International Centre for Antarctic Information and Research</td>
</tr>
<tr>
<td>ICSI</td>
<td>International Commission on Snow and Ice</td>
</tr>
<tr>
<td>ICSU</td>
<td>International Council of Scientific Unions</td>
</tr>
<tr>
<td>IMS</td>
<td>Information Management System</td>
</tr>
<tr>
<td>IPA</td>
<td>International Permafrost Association</td>
</tr>
<tr>
<td>IPAB</td>
<td>International Programme for Antarctic Buoys</td>
</tr>
<tr>
<td>ISCCP</td>
<td>International Satellite Cloud Climatology Program</td>
</tr>
<tr>
<td>ISLSCP</td>
<td>International Land Surface Climatology Project</td>
</tr>
<tr>
<td>JCADM</td>
<td>Joint Committee on Antarctic Data Management</td>
</tr>
<tr>
<td>JPL</td>
<td>Jet Propulsion Laboratory</td>
</tr>
<tr>
<td>KMS</td>
<td>Kort-og Matrikelstyrelsen</td>
</tr>
<tr>
<td>Acronym</td>
<td>Definition</td>
</tr>
<tr>
<td>---------</td>
<td>------------</td>
</tr>
<tr>
<td>LAC</td>
<td>Local Area Coverage</td>
</tr>
<tr>
<td>LAI</td>
<td>Land/Atmosphere/Ice Interactions (ARCSS)</td>
</tr>
<tr>
<td>LIS</td>
<td>Lightning Imaging Sensor</td>
</tr>
<tr>
<td>MISR</td>
<td>Multiangle Imaging SpectroRadiometer</td>
</tr>
<tr>
<td>MODIS</td>
<td>Moderate Resolution Imaging Spectrometer</td>
</tr>
<tr>
<td>NAL</td>
<td>New Accessions List</td>
</tr>
<tr>
<td>NAO</td>
<td>North Atlantic Oscillation</td>
</tr>
<tr>
<td>NASA</td>
<td>National Aeronautics and Space Administration</td>
</tr>
<tr>
<td>NATO</td>
<td>North Atlantic Treaty Organization</td>
</tr>
<tr>
<td>NCAR</td>
<td>National Center for Atmospheric Research</td>
</tr>
<tr>
<td>NCEP</td>
<td>National Center for Environmental Prediction (NOAA)</td>
</tr>
<tr>
<td>NCSA</td>
<td>National Center for Supercomputing Applications</td>
</tr>
<tr>
<td>NESDIS</td>
<td>National Environmental Satellite, Data, and Information Service</td>
</tr>
<tr>
<td>NEW</td>
<td>Northeast Water Polynya</td>
</tr>
<tr>
<td>NGDC</td>
<td>National Geophysical Data Center</td>
</tr>
<tr>
<td>NIC</td>
<td>National Ice Center</td>
</tr>
<tr>
<td>NISE</td>
<td>Near-Real Time SSM/I EASE-Grid Daily Ice Concentration and Snow Extent</td>
</tr>
<tr>
<td>NOAA</td>
<td>National Oceanic and Atmospheric Administration</td>
</tr>
<tr>
<td>NP</td>
<td>North Pole</td>
</tr>
<tr>
<td>NSF</td>
<td>National Science Foundation</td>
</tr>
<tr>
<td>NSIDC</td>
<td>National Snow and Ice Data Center</td>
</tr>
<tr>
<td>OAI</td>
<td>Ocean/Atmosphere/Ice Interactions</td>
</tr>
<tr>
<td>OLS</td>
<td>Operational Linescan System</td>
</tr>
<tr>
<td>OPP</td>
<td>Office of Polar Programs</td>
</tr>
<tr>
<td>OTD</td>
<td>Optical Transient Detector</td>
</tr>
<tr>
<td>PALE</td>
<td>Paleoenvironments from Arctic Lakes and Estuaries</td>
</tr>
<tr>
<td>PARCA</td>
<td>Program for Arctic Regional Climate Assessment</td>
</tr>
<tr>
<td>PARM-LO</td>
<td>Land/Ocean Parameters</td>
</tr>
<tr>
<td>PoDAG</td>
<td>Polar DAAC Advisory Group</td>
</tr>
<tr>
<td>POES</td>
<td>Polar Orbiting Environmental Satellite</td>
</tr>
<tr>
<td>PSC</td>
<td>Polar Science Center</td>
</tr>
<tr>
<td>RAMP</td>
<td>Radarsat Antarctic Mapping Project</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>SANIGMI</td>
<td>Central Asian Hydrometeorological Research Institute</td>
</tr>
<tr>
<td>SAR</td>
<td>Synthetic Aperture Radar</td>
</tr>
<tr>
<td>SCAR</td>
<td>Scientific Committee on Antarctic Research</td>
</tr>
<tr>
<td>SDP</td>
<td>Science Data Processing Software</td>
</tr>
<tr>
<td>SHEBA</td>
<td>Surface Heat Budget of the Arctic Ocean</td>
</tr>
<tr>
<td>SIGRID</td>
<td>Sea Ice Grid</td>
</tr>
<tr>
<td>SMMR</td>
<td>Scanning Multichannel Microwave Radiometer</td>
</tr>
<tr>
<td>SMO</td>
<td>Science Management Office</td>
</tr>
<tr>
<td>SPWT</td>
<td>SSM/I Products Working Team</td>
</tr>
<tr>
<td>SSI+T</td>
<td>Science Software Integration and Test</td>
</tr>
<tr>
<td>SSM/I</td>
<td>Special Sensor Microwave Imager</td>
</tr>
<tr>
<td>TOVS</td>
<td>TIROS Operational Vertical Sounder</td>
</tr>
<tr>
<td>UNEP</td>
<td>United Nations Environment Program</td>
</tr>
<tr>
<td>USGS</td>
<td>United States Geological Survey</td>
</tr>
<tr>
<td>USWG</td>
<td>User Services Working Group</td>
</tr>
<tr>
<td>V0</td>
<td>Version 0</td>
</tr>
<tr>
<td>WAIS</td>
<td>West Antarctic Ice Sheet</td>
</tr>
<tr>
<td>WDC</td>
<td>World Data Center</td>
</tr>
<tr>
<td>WMO</td>
<td>World Meteorological Organization</td>
</tr>
<tr>
<td>WODS</td>
<td>Western Oceanographic Data Set</td>
</tr>
<tr>
<td>WWW</td>
<td>World Wide Web</td>
</tr>
</tbody>
</table>
AN EXPERIENCE OF CREATION OF THE RUSSIAN VIRTUAL NETWORK ON GEOSCIENCES AND A NEW CONCEPTION OF WORLD DATA CENTER SYSTEM

Terminology
The Virtual World Data System (VWDCS) is the distributed automated system on the INTERNET basis, which provides:
- a simple system of presentation of new informational resources to the network;
- systematization, expertise, and periodic checking of information of the WDC data status;
- an easy and friendly organized access for the remote user to the VWDCS information resources;
- automatic notification of the recorded VWDCs users about the new (new datasets, new software, new network facilities etc.).

The VWDCS resource is built up by various systematized and reliable information on geosciences that can be reached through Internet and has the main WWW page with the <META> fields filled according to the VWDCS standard. The VWDCS is oriented at WWW (HTTP) interfaces to each resource, but can also contain Gopher, FTP, Telnet, and other variants of access.

THE PURPOSES OF THE PROJECT:
1. To set up an informational medium with maximal comfort (accessibility) for the authors (holders) of data sets and data bases.
2. Creation of a convenient tools to provide remote access to the VWDCS distributed information resources for the purposes of science and education.

In order to reach this aim it is necessary:
- to set up one or several equivalent startpoint(s) for convenient and quick search of the available resources in VWDCS;
- to organize the expert estimation of new information resources;
- to automatically maintain the actuality of the lists of distributed information resources and the software available through the VWDCS, current automatically, to create documentation;
- to create a system of automatic distribution of informational reports about new data to recorded VWDCS users.

The Russian Virtual GeoNet (RVGN) can be considered as a prototype of VWDCS.
At the start of RVGN creation, we tried to build up the system as a "black box" for the remote user, inside which the main bulk of work of processing, systematization, checking and renovation of resources takes place. In the course of this work, the technical procedure of new data sets and bases presentation in RVGN takes a minimal period of time for the author and has no essential technical requirements to him for further editing and renovation of the information presented by him. The remote user, with minimum efforts, acquires access to the list of available information resources at the moment of request to RVGN, and to the resources themselves. As a result, RVGN resembles an iceberg, only a small part of the top of which is seen by the user and available to him only through the Internet in the form of a search interface or dynamic lists of resources.

Brief description of the VWDCS major functions on the basis of experience acquired in setting up RVGN.

1. The procedure of presentation of a new information resource by the author data supplier:
The authors can place new information on either the VWDCS server or his own WWW-server. In both cases, in order to enter the VWDCS system, it is necessary to fill in the form composed, at least, of one field - the location of the given information source. An automatic system is then activated that finds out, in the first place, the preliminary information about the given resource (the character of access, lists of key words, the presence of resource description, etc.). The key words are used to automatically determine the list of possible experts for this information resource, who are notified that a new information is presented
to VWDCS for expertise. After collection of expert evaluations, they are used to automatically determine the attributes of the resource. If the resource complies with all formal rules of the VWDCS and have passed the "thematic" expertise, then it is entered into the VWDCS bank as the inner resource of the network. If it does not meet certain requirements, then it is entered into the VWDCS buffer layer, and all the notes of the experts and the automated processor are sent to the author of the resource. After that, the automatic VWDCS system checks the changes introduced by the author and compares them with the remarks of the experts (if it is possible). Thus, the author can improve his page and prepare it for the VWDCS users. If by the end of a certain period (e.g., two weeks) the author leaves the page uncorrected, then, depending on the value of information, this resource is either left in the VWDCS buffer layer, but its reworking is passed by the system to "hand" control, or deleted. In such a way the described system allows, on the one hand, to obtain the quality expertise and help the author to make a convenient interface to his data and, on the other hand, to economize the time of the experts by automating the entire preliminary work of resource checking. Table 1 shows a list of the most important VWDCS communications at this stage of work.

<table>
<thead>
<tr>
<th>Event</th>
<th>Address of communication</th>
<th>Periodicity</th>
<th>Confirmation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction of new user (author) to the system</td>
<td>Administration of the system</td>
<td>Once, at introduction of user</td>
<td>Not required, informational communication</td>
</tr>
<tr>
<td>Introduction of new item (object) describing data</td>
<td>Group of experts and administrators of the system</td>
<td>Once, at introduction of item</td>
<td>Verification of the item by one of the experts</td>
</tr>
<tr>
<td>Removal of item from buffer</td>
<td>Confirmation of removal to the remover and administrators of the system</td>
<td>Once, at removal of item</td>
<td>Not required, informational communication</td>
</tr>
<tr>
<td>Checking of items and their attributes</td>
<td>Checking report is sent to administrators of the system</td>
<td>Daily</td>
<td>Not required, informational communication</td>
</tr>
<tr>
<td>Alteration of attributes of the item</td>
<td>To the group of experts</td>
<td>At change of attributes</td>
<td>Requires a second expertise</td>
</tr>
<tr>
<td>Unavailability of the item</td>
<td>To owner of the item and administrators of the system</td>
<td>Every day from the moment of the loss of access, during 7 days</td>
<td>If access to resource is not re-established, the item is removed</td>
</tr>
<tr>
<td>Overflowing of buffer with communications for expertise</td>
<td>To administrators of the system</td>
<td>At overflowing</td>
<td>Requires reaction from administrators</td>
</tr>
</tbody>
</table>

The level of access for the user to the information resource is determined by the author: free, by a given list or feature, by individual password.

2. The access to Internet informational resources, not included in VWDCS (to external information resources).

Apart from the informational resources included in VWDCS, the Internet shall have functioning the servers maintaining the data bases (of interest to geosciences). Within the RVGN network, a special group of experts is set up to analyze geological-geophysical information accessible through Internet, to compile preliminary indexes of external resources, and to send this information to the reference system of the network. The reference system reduces the obtained information to the corresponding standard and forms a virtual list of links to external information resources. If a user decides to use one of the links from
this list and receives notification that URL indication is not correct, then a special program records this communication and, if it is repeated several times, forms and sends this communication to the corresponding expert, asking him to check this URL and to decide, whether it is necessary to remove it from the list of outer resources.

3. **Checking up the existing informational resources of the network.**
   A special robot regularly analyses the contents of metafields of all informational resources of the network, and if any changes introduced by the owner of the resource are discovered, or if new informational resource appears, the robot renewes the corresponding information in the central VWDCS data base. (If there are bilingual startpoints (see below) at this stage, then only the English version of data base is renewed). The system automatically forms a communication about detected changes; by using key words, it draws up a list of addresses for distribution of information to interested users of the network, and sends communications by E-mail. If a new informational resource is found and needs an expert estimation, then the system automatically forms a corresponding request; by using key words, it draws up a list of addresses for this request and sends it by E-mail.

4. **Allowances are made for the specific features of work in countries with limited access to Internet.**
   In a number of countries, including Russia and China, many scientists, though with valuable informational resources, have limited access to Internet and, more so, cannot build up their own WWW-servers and continually maintain them. In order to make these resources available to the world community, the so-called Automatic Web Server (AWS) was developed within the frame of RVGN and included into VWDCS; this server, with the help of a simple interface, automatically maintains an unlimited number of remote virtual users and allows them to edit and amplify their WWW-directories on the central server directly through Netscape with the help of FTP, HTTP, or File Unload technology.

5. **The problem of bilingual communication.**
   In many countries the problem of the language, in which the description of VWDCS resources is represented to the user, may be acute. The bilingual system (e.g., English-Russian, or English-Chinese) requires the maintenance of two parallel WWW-servers. The experience of RVGN can be applied, when a special function on WWW-server is realized, which automatically traces all discrepancies between the file systems of the Russian and English parts of RVGN. Naturally, to organize every bilingual system in VWDCS, it is necessary to have a special startpoint in the network and to provide its identity with other startpoints. In this process the automated checking of identity is carried out only by the English versions of different startpoints.

**THE ROLE OF THE EXISTING WORLD DATA CENTERS IN VWDCS.**
In the frame of the Virtual World Data Centers System, the now existing World Data Centers should carry out at least three functions:
1. Long-term storage of information.
2. Provision of means for maintaining control over the quality of information available in VWDCS.
3. Maintenance and coordination of connections with new informational resources on national (WDC A, WDC B, WDC D, WDC C2) and regional (WDC C1) levels.