4. Research Support, Logistics, Facilities, Data, and Information

4.1 Research Support and Logistics

IARPC and Federal agencies will use new resources targeted for Arctic logistics to enhance the U.S. leadership role in Arctic research. The focus on logistics entails:

- Establishment, development, and maintenance of national Environmental Observatories;
- Technology and instrument development;
- Expansion of marine platforms and aircraft support capabilities;
- Integration of research, education, and Arctic community interests; and
- Further international collaboration in the support of research.

The use of the new resources will be guided by the Arctic Research Commission's report *Logistics Recommendations for an Improved U.S. Arctic Research Capability* [available from the Arctic Research Consortium of the United States (ARCUS) at http://www.arcus.org]. The general recommendations of the report are:

- Ensure access to the Arctic over the entire year;
- Increase the availability and use of remote/autonomous instruments;
- Protect the health and safety of people conducting research in the Arctic;
- Improve communications and collaboration between Arctic people and the research community; and
- Seek interagency, international, and bilateral logistics arrangements.

Planning will be done in partnership with Native groups and other advisory bodies and will respond to merit-reviewed proposals.

The NOAA/CMDL Barrow Observatory, a manned atmospheric baseline facility located six miles northeast of Barrow, has been in continuous operation since 1973. The Barrow Observatory focuses on research relating to atmospheric constituents that are capable of forcing change in the climate of the earth through modification of the atmospheric radiative environment, as well as those that may cause depletion of the ozone layer. This facility conducts scores of continuous monitoring activities, including hosting 21 cooperative programs with universities and other government agencies. NOAA operates a three-station network of solar UV measurements with sites at Barrow, St. Paul Island, and Nome. The Barrow Observatory has expanded its research activities over its lifetime and expects to be monitoring climate change in the Arctic through the next century, as long as the requirement continues. Information on CMDL and the Barrow Observatory can be found at http://www.cmdl.noaa.gov.

Another major logistics issue in the Arctic is developing full access and capability to conduct research on all aspects of the Arctic Ocean. The U.S. plans to facilitate this by funding research use of the new USCGC *Healy* and improved sensors for the Arctic drifting buoy program, moorings, and autonomous underwater vehicles.

For both marine and terrestrial research the U.S. will improve basic health and safety by providing access to a pool of emergency beacons, satellite phones, and GPS receivers. There is also a need to better integrate traditional knowledge of Arctic residents with research to broaden our capability in the Arctic. The U.S. plans to increase the duration of measurements (especially during the winter) by providing remotely operated instruments linked with individual researchers in their labs, with other Environmental Observatories, and with distance learning centers.

4.1.1 Oceans

One of the largest single improvements made to U.S. logistical capability in the Arctic comes with the access to the USCGC *Healy*. For the first time, a U.S. research vessel capable of accessing the whole Arctic Ocean is available. In FY 01, NSF supported approximately 90 days of science cruises,

and the first full operational year began in FY 02, supporting four cruises north of Alaska. The maximum number of days of 200 were used in 2003, with 10 days allocated to NOAA, and a similar level of tasking is anticipated in FY 04 and FY 05.

While the *Healy* provides an enormous step forward in capability, it has catalyzed demand, and in 2002 two cruises that could not be accommodated on the *Healy* were supported by the *Polar Sea*. Better coordination between national research icebreakers has become a high priority, and the Forum of Arctic Operators is developing an approach to make scheduling information more widely accessible, with the goal of improved capacity of sharing research icebreaker scheduling information.

At the same time as the *Healy* becomes available, access to U.S. Navy submarines that are capable of operating in the Arctic has largely ended. The submarines provided a unique capability to access the whole Arctic Ocean under the icepack year-round. While the U.S. Arctic Research Commission pursues options to revive or replace this capability, NSF has begun to fund the development and testing of a long-range AUV to begin building a capability to range throughout the Arctic Ocean, perhaps in conjunction with the *Healy* or ice camps.

North Pole Environmental Observatory

The North Pole Environmental Observatory is a Long Term Observatory in the Arctic Ocean. Operations will be based out of Alert, Canada, involving an annual campaign of mooring deployments and servicing and hydrographic stations on a transect from Alert to the North Pole.

An international research team supported by the NSF established a temporary camp at the North Pole, laying the groundwork for a five-year project to take the pulse of the Arctic Ocean and learn how the world's northernmost sea helps regulate global climate. The team deployed a system of floating buoys and has anchored devices to the ocean floor to collect data on everything from the salinity of the water in the Arctic Ocean to the thickness and temperature layering of its ice cover. This is the first time such a congregation of drifting buoys has been placed at the North Pole.

4.1.2 National Ice Center

The National Ice Center (NIC) is a unique interagency organization with oversight from the Department of Defense (DOD), Department of Commerce (DOC), and Department of Homeland Security (DHS) and responds to both Defense and U.S. national interests as outlined in Annex II to the 1995 Navy–NOAA Umbrella Memorandum of Agreement (MOA). The Naval Ice Center (NAVICE) comprises the largest component of NIC and represents the Naval Meteorology and Oceanography Command through the Naval Oceanographic Office. The second leg of the triad, DOC, is represented under the National Oceanic and Atmospheric Administration's (NOAA) Office of Satellite Data Processing and Distribution. The U.S. Coast Guard's (USCG) Director of Operations Policy represents the third member of the triad, DHS.

NIC's mission is to provide the highest-quality operational global, regional, and tactical-scale sea ice analyses and forecasts, tailored to meet the requirements of U.S. national interests. It provides this support to U.S. armed forces, U.S. government and international agencies, academic and scientific institutions, and civil interests. Weekly global and regional-scale ice extent and coverage products are produced in support of mission planning, vessel operations, and scientific research. More frequently produced tactical-scale ice analyses and forecasts are tailored to customer-specified spatial and temporal requirements. Sea ice features of most frequent interest to operations include ice edge position, ice thickness, ice concentration, areas of compression or heavy deformation, and the location and orientation of open water or thin-ice-covered leads and polynyas. All NIC ice extent and coverage products are derived from a blend of remotely sensed and in-situ oceanographic and meteorological data.

NIC ice analyses are crucial to both the safety of navigation in ice-covered waters and as a U.S. contribution to international global climate and ocean observing systems. Real-time raster and digital ice products are distributed via the Internet using the NIC home page (http://www.natice.noaa.gov) and over military networks comprising the Defense Information Infrastructure.

The U.S. Interagency Arctic Buoy Program (USIABP), managed by NIC, collects and distributes surface meteorological and ice drift data. A historical quality-controlled archive of these data is available from the World Data Center–A or via the Internet (http://iabp.apl.washington.edu) from the Applied Physics Laboratory of the University of Washington.

The NIC science program, operating with fiscal support from ONR, NOAA, and NASA, is aimed

at expanding the use of NIC's products within the science community and providing a route for the migration of scientific techniques (such as algorithms) into the operational environment but was recently expanded to include five post-doctoral fellows. The NIC Science Plan (available at http://www.natice.noaa.gov) summarizes the activities, interests, and goals of this polar science program. Current areas of in-house research include improvements to the next generation of ice forecast models, study of Antarctic hydrography, evaluation of passive and active microwave remote sensing algorithms, refinement of data assimilation techniques, and improvements to long-term sea ice forecasting techniques.

4.1.3 Land-Based Facilities

Continuing and Expanding Long Term Observations

The response to NSF's first announcement of opportunity for Long Term Arctic Observations indicated that there is significant need in this area. NSF is now supporting unsolicited proposals to conduct service observations to be made available to broad communities particularly to facilitate long-term observations at sites where there is already a significant history of observations. It is envisioned that this area would increase substantially under SEARCH.

Toolik Field Station

Significant improvements have been made to the laboratories, power system, communications system, and living conditions since FY 99. The University of Alaska has, with NSF's encouragement and with significant input from the user community, developed a long-range development plan that has been approved by the landowner, BLM. While work towards the goals in the plan have slowed, it is hoped that in the next five years it could be completed to provide a safe and efficient work environment for approximately 40 projects and up to 120 scientists annually.

Barrow

Approximately 25–30 NSF projects are active each year, and greater collaboration has developed between NSF projects and other agencies. Plans for the future include building the information technology infrastructure on the recently funded T1 link and providing alternative access to the Barrow Environmental Observatory.

Summit, Greenland

NSF is supporting a series of atmospheric and snow chemistry measurements at Summit, Greenland, in collaboration with NOAA. European-supported projects also continue at Summit, coordinating their activity with NSF through the station operator. However, efforts to develop a joint U.S.–European management of the station have not yet succeeded because of European administrative decisions, but progress is expected in 2004.

Circum-Arctic Environmental Observatory Network

The Circum-Arctic Environmental Observatory Network is an initiative to provide stronger collaborations among existing observatory operators so that they can leverage each other's strengths, particularly in the area of long-term observations and data standards. It is expected that U.S. observatories (Barrow, Toolik, Summit, North Pole) will learn from their international counterparts, mostly European, as they implement new capabilities.

Bering Strait Environmental Observatory

The Bering Strait Environmental Observatory is a Long Term Observatory, located on Little Diomede in the Bering Strait. This project is establishing an onshore environmental observatory at Diomede Village, Alaska, in the center of Bering Strait. The strategic location of this observatory on Little Diomede Island will permit rapid, flexible collection of chemical, biological, and physical data on the transport of nutrient- and organic-rich waters of north Pacific origin into the Arctic Ocean through this narrow strait. An interactive, web-based communication system will facilitate the use of the data by end users in education and research and in local communities in the Bering Strait region. Finally, because of the importance of benthic communities on the shallow Bering and Chukchi shelves to Arctic biogeochemical cycling, a 15-year record of benthic biological and chemical sampling will be continued at two highly productive sites directly north and south of Bering Strait. Ships of opportunity transiting Bering Strait will be used as sampling platforms. Additional information is available at http://eco53.bio.utk.edu.

Aircraft Support

DOC/NOAA has available hangar facilities for two H-1N helicopters at Fort Richardson, Anchorage, Alaska. These facilities have some additional space for field equipment, scientific instruments,

and Arctic gear. NOAA fleet ships have previously worked above latitude 60°N, ice and weather permitting. NOAA aircraft have flown Arctic research projects while based out of Elmendorf AFB, Eielson AFB, and Thule AFB. NSF, ONR, and the New York Air National Guard have taken over the SPAWAR Arctic Logistics infrastructure at Thule.

Cold Regions Research and Engineering Laboratory

A memorandum of understanding between the National Science Foundation and the U.S. Army Corps of Engineers has been implemented that allows NSF-supported engineering and scientific researchers to use USACE laboratory facilities. Many of these state-of-the-art facilities are dedicated to cold regions research and engineering thrusts and are described below. An aggregation of unique facilities that are nationally and internationally recognized exists at the Cold Regions Research and Engineering Laboratory (CRREL). The main complex is in Hanover, New Hampshire. In addition, a permafrost research tunnel and additional coldrooms are located near Fairbanks, Alaska. Industry and academia often use CRREL's unique experimental facilities.

At the Hanover campus the main laboratory houses 24 low-temperature research laboratories capable of achieving temperatures as low as –50°F, special-purpose ice test facilities, cleanrooms, a chemical laboratory, and two specialty low-temperature materials laboratories. The Material Evaluation Facility can simulate snow and icing conditions and static and cycling temperatures ranging from –50° to 120°F and has the capability to conduct full-scale tests on automotive vehicles. The High Performance Materials Laboratory is used for strength and thermal testing of many types of materials, including construction, road, bridge, and composite materials. Specialized testing machines, such as the Split Hopkinson Pressure Bar, enable low-temperature, high-strain materials evaluation to temperatures as low as –80°C. Other equipment includes thermal cycling chambers that allow for thermal cycling from –100° to 100°C and a specially fabricated UV–radiometry system for exposing testing materials to controlled doses of radiation.

The 73,000-square-foot Ice Engineering Facility has three special-purpose research areas: a large low-temperature towing tank, a 100-foot-long refrigerated flume for modeling rivers, and a large hydraulic model room for studying ice effects on civil works facilities, primarily locks and dams. The Ice Engineering Facility also houses a snowdrift wind tunnel.

The Frost Effects Research Facility (FERF) allows full-scale research on the impact of freeze–thaw cycles on pavements, foundations, and utility systems. This 29,000-square-foot facility contains a 182- by 75-ft soil testing area that can be maintained at temperatures below 30°F and 12 large test cells where soil can be frozen and thawed at temperatures ranging from as low as –35°F to as high as 120°F. Six to eight natural freeze–thaw cycles can be simulated in a single year. The newest addition to the CRREL's experimental capability, the Heavy Vehicle Simulator (HVS), is housed in this facility. The HVS can simulate the effect of heavy vehicles on roads and pavements.

At the Alaska campus in Fairbanks, CRREL has a research permafrost tunnel and maintains a 133-acre permafrost research site. The CRREL facilities in Alaska include two coldrooms capable of –30°F temperatures, a heavy equipment maintenance shop, a woodworking shop, a soils laboratory, a shock laboratory, and several Small Unit Support Vehicles (SUSVs) used as research vehicles.

The Technical Information Analysis Center (TIAC) serves DOD and the Nation as the most comprehensive source of cold regions information in the world. The 24,000-square-foot TIAC provides a gateway to the world's information and research resources for cold regions science and engineering. The Cold Regions Science and Technology Information Analysis Center (CRSTIAC) serves as the Nation's corporate repository for cold regions science and engineering data. This center houses the CRREL library, which contains 30,000 books, 160,000 reports, 450 journals, 450 rolls of microfilm, 250,000 pieces of microfiche, 40 CD-ROM reference titles, and topographic maps of all 50 states. The Bibliography on Cold Regions Science and Technology, comprising 53 volumes dating from 1951, is prepared for CRREL by the Library of Congress and contains approximately 250,000 citations, including cumulative author and subject indexes.

4.1.4 Atmospheric Facilities and Platforms

Because of the strategic location of the Arctic for observing space-related phenomena, an extensive infrastructure has been established over the past four decades to observe the Arctic upper atmosphere and ionosphere. The Arctic is the site of many ground-based radio, radar magnetic, and

optical observing sites. These sites and many other smaller facilities have been an important aspect of the Arctic social structure, providing economic benefits in remote regions and educational opportunities for indigenous people.

Among the major upper-atmospheric research facilities in the Arctic are the Sondrestrom Radar in Greenland, the High Frequency Active Auroral Research Program (HAARP) radar in Alaska, the Poker Flat Rocket and Research facility near Fairbanks, the Resolute Bay Observatory in Canada, the Longyearbyen Optical Station in Norway, and the SuperDARN radar network with sites spanning the Western Hemisphere Arctic. These and other smaller sites are operated in collaboration with international partners, including academic and research institutions in Canada, Denmark, Norway, and Japan.

NASA is establishing a Network for Detection of Stratospheric Change (NDSC) program at Thule and Sondrestrom, Greenland, to provide long-term data on a variety of stratospheric constituents. NASA and NSF cooperated in a program called the Program for Arctic Regional Climate Assessment (PARCA). This involved satellite and airborne surveys of different regions of the ice sheet to establish patterns of ice sheet thickening and thinning, along with ground-based surveys to establish reference data for interpreting airborne and satellite observations. Ground observations included the deployment of automatic weather stations and the analysis of shallow snow pits and deep ice cores. The results have, for the first time, shown clear regional patterns in the mass balance of the ice sheet.

4.1.5 Central Coordination and Logistics Information Clearinghouse

Arctic Logistics Information System (ALIAS)

The advent of the World Wide Web has changed our expectations for access to information. In planning and conducting Arctic research, investigators have to cope not only with the extreme polar climate that makes the region difficult and inhospitable to the unprepared, but also with sparse, independently minded populations, poor communications, and many languages. NSF has initiated a project to create a website to provide scientists with key information to assist in planning and executing research programs. An electronic bulletin board, ALIAS, on the Internet (http://www.arcus.org/ALIAS/index.html) is designed to provide information on logistics resources throughout the Arctic.

This key development has a potentially large payoff in terms of logistical cost, researcher time, and safety, with more than 150 NSF-funded projects in the field each year. The benefit will be felt not only by the NSF research community, but also by other Federal agencies and practically all researchers in the Arctic, with the potential of commercial applications and investment.

The Department of the Interior supports an Alaska Office of Aircraft Services (OAS), which coordinates aircraft services on a reimbursable basis.

4.1.6 Data Facilities

Archiving and distribution functions for data required in support of Arctic research are distributed among all the U.S. national data centers. Arctic data are held in global archives at the National Climatic Data Center (climatology and meteorology), at the National Oceanographic Data Center (oceanography), at the National Geophysical Data Center (seismology, geomagnetism, marine geology and geophysics, solar and ionospheric studies, ecosystems, topography, and paleoclimatology), and at the National Center for Atmospheric Research (upper atmosphere and ionospheric studies). Data sets for a vast array of cryosphere-specific variables in the Arctic (sea ice, snow cover, permafrost, etc.) are archived and distributed through the National Snow and Ice Data Center (NSIDC) and the World Data Center–A (WDC–A) for Glaciology in Boulder, Colorado. These include satellite-derived measurements, in-situ observations, and ancillary information that have been supported by NASA, NOAA, and NSF. Global satellite data archives for polar-orbiting satellites are held by NOAA/NESDIS/National Climatic Data Center (NCDC) in Asheville, NC. Included in these archives are:

- Global infrared and visible digital imagery from the advanced very-high-resolution radiometer (AVHRR) instruments;
- Atmospheric temperature and moisture data and derived soundings from the high-resolution infrared radiation sounder (HIRS) instruments; and
- Global passive microwave data from the special sensor microwave/imager (SSM/I).

Electronic access to recent AVHRR and HIRS data is available through the NESDIS Satellite Active Archive (http://www.saa.noaa.gov). Global satellite data archives for the Defense Meteorological Satellite Program (DMSP) Operational Linescan System (OLS) data are held by the National Geophysical Data Center.

The National Oceanographic Data Center (NODC)/WDC–A is the lead agency in the United Nations Intergovernmental Oceanographic Commission (IOC) Global Oceanographic Data Archaeology and Rescue Project (GODAR). Its goal is to locate and rescue historical oceanographic data that are in jeopardy of being lost, including Arctic oceanographic data.

The Alaska SAR Facility (ASF) also operates a NASA/EOSDIS, which receives and processes polar imagery from SARs onboard Canadian (Radarsat) and European (ERS-2) satellites. The ASF also carries out a range of tasks in support of the data, including calibration and the development of data analysis tools. A major data analysis project underway at the ASF involves implementation of the Radarsat geophysical processor system (RGPS), designed to generate high-level products, including ice drift, ice deformation, and ice thickness.

NOAA's Environmental Services Data Directory (NESDD) is a vital window into the U.S. national data archives, providing a means for scientists to locate the data they require.

4.1.7 Safety Support to Individual Projects

Several of the key recommendations in the *Logistics Recommendations for an Improved U.S. Arctic Research Capability* [available from the Arctic Research Consortium of the United States (ARCUS) at http://www.arcus.org] concerned improving the safety of researchers in the Arctic, under the general recommendation that a U.S. Federal program should "protect the health and safety of people conducting research in the Arctic." Specific recommendations were to:

- Sponsor Arctic travel skills and survival courses. NSF, through its contractors, offers three to four field training courses to 60 Arctic researchers annually.
- Supply portable satellite communications. IRIDIUM has become the standard for polar field communications. NSF has reached the goal of providing each field program that requires satellite voice communications with that capability. The next goal is to provide data communications with reasonable bandwidth.
- Support researchers in Russia. Approximately half of the Arctic falls within Russia or its economic zone. Access to the Russian Arctic for fieldwork has always been difficult, but after the initial opening up in the early 1990s, work in Russia is now difficult again and subject to increased risk compared to western standards. NSF has taken a leadership role in examining options that might open Russia to U.S. scientists.

4.2 Arctic Data and Information

4.2.1 Arctic Data

The Alaska SAR Facility has continued to serve the polar research community as the facility for archiving and distributing SAR data. Some of the major projects served this year include the Radarsat Geophysical Processing System project; operational support with near-real-time data (averaging less than three hours turnaround) for the National Ice Center; and the NOAA Coast Watch and Alaska Demonstration projects. In addition to these projects, ASF supports other projects, which together represent an estimated user community of 1400 individual PIs and co-PIs.

ASF has facilitated research and applications development through involvement with the science community, participating in workshops, attending conferences, and producing and distributing new products.

ASF continues to serve as the interface with the Canadian Space Agency, ensuring that data restrictions are appropriately enforced and that data are available to the users of Radarsat-1, whose mission life has exceeded its design life by more than two years. ASF also plans to continue reception of ESA's ERS-2 SAR data and to negotiate with ESA and NASA to participate in the reception, archive, and distribution segments of their future missions (Envisat, CryoSat, ALOS).

The National Snow and Ice Data Center (NSIDC) Distributed Active Archive Center (DAAC) provides access to cryospheric data for both northern and southern hemispheres, with the present emphasis on the Arctic. NSIDC is chartered and partially funded by NOAA, through the Cooperative Institute for Research in Environmental Sciences (CIRES), to provide snow and ice data services. The center is under contract to NASA's Earth

Observation System Data and Information System (EOSDIS) project as a DAAC, providing snow and ice data and information services. The DAAC processes, archives, and distributes sea ice and snow cover data from visible, infrared, and passive microwave sensors, in particular from the special sensor microwave imager (SSM/I), the moderate-resolution imaging spectrometer (MODIS), and advanced very-high-resolution radiometer (AVHRR) sensors, and related in-situ data. The DAAC's passive microwave data sets include a 20-plus-year time series of sea ice extent and concentration for both polar regions. The record will be augmented by the advanced microwave scanning radiometer (AMSR) on board the Aqua platform, which was launched in April 2002. Altimetry and aerosol data sets from the Geoscience Laser Altimeter System (GLAS) instrument on ICESat will also be distributed by the NSIDC DAAC. ICESat was launched in January 2003.

Non-EOS satellite data include the Near Real Time Ice and Snow in EASE grid (NISE) daily product, gridded passive microwave brightness temperatures and sea ice data on CD-ROM, AVHRR polar subsets at 1.25- and 5-km grids, and other in-situ data. Information on all NSIDC DAAC data sets may be found at http://www.nsidc.org/.

NSIDC was chartered by NOAA's National Environmental Satellite, Data, and Information Service (NESDIS) in 1982 to provide a focus for cryospheric data management activities. NSIDC operates under a cooperative agreement between NOAA and the University of Colorado's Cooperative Institute for Research in Environmental Sciences. Within NOAA, NSIDC is affiliated with the NESDIS National Geophysical Data Center. NSIDC is also the home of the World Data Center for Glaciology, Boulder. The majority of funding for NSIDC data management activities comes from NASA for operating a Distributed Active Archive Center (DAAC) for cryospheric data collected by the Earth Observing System (EOS) program.

The NSIDC DAAC provides access to EOS satellite data, as well as ancillary in-situ measurements, baseline data, model results, and algorithms relating to cryospheric and polar processes. NSIDC archives and distributes snow and ice products from the moderate-resolution imaging spectroradiometer (MODIS) instrument aboard the NASA TERRA and Aqua satellites. MODIS snow cover extent, sea ice extent, and sea ice surface temperature products are available in orbital and gridded formats. These products extend the existing 30-year record of passive-microwave-derived snow and sea ice products at greatly improved spatial and spectral resolution. Other DAAC products are the Near Real Time SSM/I EASE-Grid Daily Global Ice Concentration and Snow Extent, and global brightness temperatures from the Defense Meteorological Satellite Program's special sensor microwave imager. In addition to work with data sets, NSIDC compiles the *DAAC Yearbook*, a collection of articles on applications of DAAC data, written for the general public. (The *DAAC Yearbook* is available from NSIDC User Services, University of Colorado, Boulder, Colorado 80309-0449; nsidc@nsidc.org.)

As part of a larger joint NOAA/NASA program, NSIDC works closely with NOAA's NESDIS Long Term Archive team to develop a prototype long-term archive of snow and ice data, metadata, and products from EOS satellites. This effort will determine the resource requirements for a level of service to the user community that is comparable to the current level of service provided by NSIDC for EOS cryospheric data and by the National Geophysical Data Center for Defense Meteorological Satellite Program data and products.

The Arctic System Science (ARCSS) Data Coordination Center (ADCC) at NSIDC will provide ARCSS data and information to the scientific community well into the twenty-first century, consistent with mission objectives and appropriate peer reviews. The ADCC is the permanent archive and access point for data collected by investigators in the NSF's ARCSS program and serves as a catalyst for ARCSS integration through data and information management. Of note is ADCC's work to develop an automated system for climate model output data requests. ADCC averages well over 600 megabytes of data and information downloaded per month. These data sets are mostly in-situ and small data groupings rather than NSIDC's more typical large, multisensor collections.

NSIDC's participation in the joint U.S.–Russian Environmental Working Group's Arctic Climatology Subgroup to produce Arctic Atlases on CD-ROMs has strengthened connection to data repositories in Russia.

Investigators associated with NSIDC bring a polar scientist's perspective to data management. Work is being conducted under approximately 30 grants at any time, and topics range from studying variation in the timing and extent of snowmelt on the Greenland and Antarctic ice sheets with passive microwave data to documenting Inuit

knowledge of climate change. NSIDC also seeks to synthesize and interpret research for the general public. For example, "State of the Cryosphere" web pages (http://nsidc.org/sotc) present aspects of snow cover, sea ice, glaciers, and sea level changes as they relate to climate change.

NSIDC served as co-chair of a World Climate Research Programme (WCRP) Task Group to develop a Climate and Cryosphere (CliC) Science and Coordination Plan. The plan, which lays a path for the coordination of the cryospheric elements of existing projects of the WCRP, was adopted in March 2000, and a joint Arctic Climate System (ACSYS) –CliC Science Steering Group was established. The CliC project addresses interactions among all land and oceanic components of the cryosphere (snow cover, glaciers, ice sheets, permafrost and seasonally frozen ground, freshwater ice, and sea ice) and the climate system, as well as the role of the cryosphere as a climatic indicator for monitoring. Significant questions concern the contribution of glacier melt to sea level rise, the effects of changes in snow and ice cover on water resources, and the impacts of climate change on polar sea ice and on frozen ground. The text of the CliC plan is available at http://www.npolar.no/acsys/CLIC/clic_may.pdf.

4.2.2 Arctic Information

Arctic and Antarctic Regions is available for Windows, DOS, and Internet use from NISC. Comprehensive polar coverage on this CD offers over 800,000 records compiled by the major polar regions research organizations in the U.S., Canada, and the U.K.

A Polar web site, a collaborative project of the Polar Libraries Colloquy and others, provides a guide to Internet resources. The address is http://arktinen.urova.fi/polarweb/.

NOAA has created the Arctic Theme Page (www.arctic.noaa.gov), which contains overview material on Arctic science issues aimed at the non-technical reader. Links are provided to sources of technical information, pictures, and organizations active in Arctic science.