

## **The International Polar Year 2007-2009**

The years 2007-2008 will mark the 50<sup>th</sup> anniversary of the International Geophysical Year (IGY) and of the third International Polar Year. This period has been designated the fourth International Polar Year (IPY) by the National Academies of Sciences, the International Council of Scientific Unions, the Arctic Council and by many other international organizations.

Preparations are underway worldwide to make IPY a period of intense activity that promises, in the words of a NAS publication (“A Vision for the International Polar Year 2007-2008, see (<http://books.nap.edu/catalog/11013.html>), to “further our understanding of physical and social processes in the polar regions, examine their globally-connected role in the climate system, and establish research infrastructure for the future ... It will also serve as a mechanism to attract and develop a new generation of scientists and engineers with the versatility to tackle complex global issues.”

The 1957-58 IGY and IPY activities greatly increased our knowledge of the world around us and left behind profound legacies that continue to benefit research and researchers up to the present day. They also resulted in international arrangements such as the Antarctic Treaty under which an entire continent is governed with a primary goal of enabling scientific research. The U. S. played a leading role in shaping and implementing these 1957-58 activities and plans to do so again in 2007-2008 through research, education and public outreach efforts coordinated among the Federal agencies that support research in polar regions. Agencies are planning their IPY activities for this period consistent with their missions and the Report of an Implementation Workshop (Planning for the International Polar Year 2007-2008: Report of the Implementation Workshop, <http://books.nap.edu/catalog/11110.html> ).

The following is a preliminary discussion of Federal agency planning for the International Polar Year.

### **National Science Foundation**

The International Polar Year 2007-2009 is a unique opportunity to continue the legacy of international science years of the past including IPY 1882-1883, IPY 1932-1933, and the International Geophysical Year of 1957-1958. Each burst of internationally coordinated research and exploration of these years opened up the polar regions for exploration and science that led to significant discoveries about our planet and created important sets of observations for long-term comparison. In particular the IGY of 1957-58 brought a tremendous increase in our ability to predict weather worldwide, detail the thickness of the Antarctic Ice Sheet and our first real understanding of the Earth's magnetosphere. Enormous gaps in our understanding of the Arctic Ocean and ice sheet dynamics in Antarctica, as examples, demonstrate the need to undertake large-scale research and observations once again. Thus, NSF has particular interest in conducting activities in the

polar regions that will leave a similar legacy of data or observing capabilities for scientists and educators of the future.

NSF is poised to support the International Polar Year in a variety of important ways. The areas of emphasis described below derive from workshops and science programs that have evolved within the community as high priority topics, and that also align with the guidelines developed by ICSU and by the U. S. National Academies. Within NSF, the Office of Polar Programs (OPP) anticipates playing a significant role in implementing these ideas, but there is also interest throughout NSF in collaborating on a number of them. The Offices that may participate include Computer and Information Sciences and Engineering, Engineering, Education and Human Resources, Social, Behavioral and Economic Sciences, Mathematical and Physical Sciences, and Geosciences. In addition, we know that other Federal Agencies and agencies in other countries have closely related interests. Thus, a key overarching theme for us as we plan for IPY is to maximize the value from partnerships.

Partnerships for IPY will occur at many levels – within NSF, interagency, and international. The discussions today will, hopefully, result in agreement to move forward on developing some interagency partnerships. In that spirit, the following is a synopsis of NSF's current thinking about IPY activities:

**Some Potential Science areas for NSF emphasis in IPY:**

- Study of Environmental Arctic Change Program (SEARCH), with focus on establishing a multi-national circum-Arctic observation system.
- Integrated Ocean Observatory System
- Stability and dynamics of polar ice sheets
- Frontiers in Polar Biology: Life in the Cold and Dark
- Bering Sea Research
- Individual investigator and small group projects meeting IPY guidelines, with workshops to provide additional IPY focus
- Education and outreach activities linked to IPY research programs.
- Proposals to NSF Announcements of Opportunity, including the Study of North Alaska Coastal System (SNACS) and Sensor and Sensor Networks.

**Logistical Support Available to Polar Research:**

- Infrastructure At Barrow Research Facility
- US Antarctic Program infrastructure and support

**Study of Environmental Arctic Change: SEARCH**

SEARCH is a broad, interdisciplinary, multi-scale interagency program with a core goal of predictive understanding of a complex of recent and ongoing changes in the arctic environment. In addition to understanding how changes in the Arctic are interrelated, SEARCH will investigate the links between arctic change and global processes and will assess the impacts that arctic change may have throughout the Northern Hemisphere.

SEARCH will evaluate the possibility that changes in the Arctic can anticipate changes elsewhere on the globe.

For the period of IPY (2007-2009), NSF's principal interest related to SEARCH is to implement an arctic observing network.

## **INSTRUMENTATION FOR POLAR RESEARCH**

The National Ocean Partnership Program, through the Ocean-US office, is pursuing the establishment of an Integrated Ocean Observatory System (IOOS). The IOOS is planned to include three "Regional Associations" in Alaska, including Chukchi Sea and North Slope, Bering Sea, and NE Pacific. NSF is working with the National Oceanic and Atmospheric Administration and local groups to identify and to support these regional associations. Within NSF, Participants include OPP, Computer and Information Sciences and Engineering, and Engineering.

To enable the IOOS, and to provide for a new generation of polar research, NSF is committed to supporting work in developing and deploying novel instrumentation. New work is especially needed in chemical and biological sensors (for example, nutrients and plankton). In addition, there is a new set of platforms which must be developed for making and transmitting observations from under the ice pack, including both gliders and autonomous underwater vehicles. Finally, NSF will be deploying the first shore-based polar observatory off Palmer Station next January, and is confident that this experience will be invaluable in planning other polar coastal observatories.

## **BERING SEA RESEARCH**

The Bering Sea supports one of the most productive fisheries in the world, contributing about 40% of all finfish and shellfish landings in the United States, yet it is one of the least-studied areas of US waters. In recent years, it has become evident that this seasonally ice-covered sea is subject to decadal changes in climate that have resulted in abrupt and unexpected changes in the ecosystem. Careful risk management in the future will require a systems understanding of the relationships between climate, primary and secondary production, population dynamics, and the role of humans in sustaining the Bering Sea ecosystem. This information is essential for understanding the relative roles of climate variability and fishery harvests in structuring the Bering Sea ecosystem, and is an approach that represents a significant refinement of traditional academic or fisheries oceanography. Of particular concern is the possibility that the combined effects of climate change and fisheries removals may shift marine ecosystems into alternate stable states that may have a lower yield of species valuable to people. Identifying the mechanisms driving ecosystem change, including social and cultural factors, in the Bering Sea is seen as a key need for research in the area.

## **ICE SHEET STABILITY, DYNAMICS AND HISTORY**

The global ice sheets are dynamic features that contain unprecedented records of climate over the past several hundred thousand years. Future changes in the ice sheets of both polar regions will affect sea level and this is one of the major uncertainties in Intergovernmental Panel on Climate Change (IPCC) climate models. In Antarctica, we expect to emphasize studies of the stability and history of ice sheets, with a particular focus on West Antarctica. How do they work, how fast are they changing, and what will they be like in the decadal to century time frame in the future? This involves direct studies of the ice sheet but also includes work to understand processes important for interaction of the ice sheet with the lithosphere, oceans, and atmosphere. The combination of space-based and surface based studies is critical to success in this area. Comparison of dynamic behavior of the Antarctic and Greenland ice sheets is also a potential topic of IPY research.

One component of this work will include obtaining a high temporal resolution ice core in West Antarctica for comparison with the climate records obtained from the Greenland ice cores. There will likely be an opportunity to leverage logistics support to the ice core camp with support for other ground-based activity in West Antarctica, and to couple detailed ground- and space-based observations. The work in West Antarctica might include traverse-based studies, or other types of work that will be possible from our logistical hubs, that could be linked to related work in East Antarctica as well as study of change in the Ross Sea region. Because of the long lead time required for developing and implementing ice coring programs, NSF is also looking at IPY as an avenue to create an international collaborative framework to facilitate international ice coring projects beyond IPY.

## **FRONTIERS IN POLAR BIOLOGY: LIFE IN THE COLD AND DARK**

Ecologically important biogeochemical processes are known to begin before the traditional operational season in polar regions and continue beyond the end of the traditional field season. Living organisms now are known to continue functioning at temperatures well below freezing. New technologies (genomics, proteomics, etc.) offer the opportunity to gain a deep understanding at a microscopic level of how organizations have adapted to these extreme environments. The Long Term Ecological Research (LTER) sites at Toolik Lake in Alaska and in the Antarctic Dry Valleys, as well as research platforms operating the Arctic and Southern Oceans, offer the opportunity to bring these new technologies to bear in research on the polar regions. A recent NAS report, "Frontiers in Polar Biology in the Genomics Era" describes potential research benefits of these new tools. Within NSF, there is interest in OPP and in the Biology and Geology Directorates in this area of research. OPP has examined the technical feasibility of extending Antarctic operations into the austral Fall and early Winter and may be able to implement such capability by 2007. Supporting winter work elsewhere in the polar regions will require evaluation of options on a case-by-case basis.

## **Other Areas of IPY Research**

In addition to large scale projects like those mentioned above, NSF plans to support IPY activity addressing the ICSU and NAS guidelines in a broad spectrum of areas, particularly including research that addresses opportunities in the social sciences. One example is research on endangered languages in Arctic cultures, where we have the opportunity to create a legacy of knowledge that will inform future generations of scholars while at the same time strengthening local cultures. Another area where NSF can have a significant IPY impact is in research on distant education, both in terms of technology and in terms of the science of learning as it applies to different cultures.

## **IPY and Documenting Endangered Languages**

The Documenting Endangered Languages (DEL) program is a multi-year funding partnership between the National Science Foundation (NSF) and the National Endowment for the Humanities (NEH) to support projects to develop and advance knowledge concerning endangered human languages. This program is made urgent by the imminent death of an estimated half of the 6000-7000 currently used human languages. Working with the SBE Linguistics Program, the OPP Arctic Social Sciences Program has identified DEL as a natural IPY project. The unfortunate situation of the estimated 52 Arctic indigenous languages is no exception to the international prognosis. Following the first DEL Announcement of Opportunity, over 10% of the proposals were to research Arctic languages and the DEL Management Group anticipates over 10% of the recommended proposals to be for research in the Arctic region. NSF and NEH have agreed to funding for DEL for three years with an evaluation and possibility for renewal in 2008, during the International Polar Year. IPY provides an opportunity to bring publicity and resources to the pressing issue of endangered languages in the Arctic.

## **Data Management for IPY**

Archiving and distribution functions for data required in support of the Arctic and Antarctic research are distributed among all the U.S. national data centers. These 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). For example, 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 for Glaciology in Boulder, Colorado (<http://www.ngdc.noaa.gov/wdc/>). These also include satellite-derived measurements, in-situ observations, and ancillary information from the Antarctic and the Arctic 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.

For data management, a new focus on "Virtual Observatories" is being developed and promoted by the "Electronic Geophysical initiative Year" (<http://www.eGY.org>). As more researchers provide their data on Web or FTP sites, rather than submitting to data centers, the current "push data" approach (where the data must be submitted to the National and World Data Centers System) is now becoming more difficult to implement. Therefore, the worldwide data management is focusing on providing more effective access to globally distributed data sets via the "pull data" concept. The eGY group and the ICSU World Data Centers Panel are working toward a convergence of centers into "data clearinghouses", while the Virtual Observatories are developing a network of interconnected data holdings and retrieving/visualizing software that constitutes the worldwide "data fabric". NSF is supporting the concept of Virtual Observatories as a means of managing relevant data for IPY.

## **EDUCATION AND OUTREACH FOR IPY**

The Office of Polar Programs has maintained strong support for linking research in the polar regions with formal education and outreach to the public. OPP sponsored a workshop in June 2004 to bring together educators, researchers, media and museum outreach experts, agency representatives and others to discuss effective mechanisms to perform education and outreach in conjunction with IPY. The results of the workshop discussions and recommendations for IPY are available now in a draft report that will be published in spring 2005. The workshop highlighted many of the education and outreach efforts that have already been supported by OPP, including Teachers Experiencing Antarctica and the Arctic (TEA), which is co-funded with NSF's Elementary, Secondary and Informal Education Directorate, Teachers and Researchers Exploring and Collaborating (TREC), Antarctic Artists and Writers, various journalists in the field, museum exhibits and Research Experiences for Undergraduates.

NSF has fostered US scientists' interests in sharing their research with broad audiences. Many polar researchers have been successful in seeking support from education programs for more directed efforts, such as through NSF's IGERT and GK-12 programs as well as Arctic Research and Education and Geosciences Education. Strong international partnerships in educational activities have developed in association with research programs in both polar regions. In the Arctic, such partnerships include US collaboration with groups from Russia, Greenland, Iceland, Canada, Denmark, Norway, Sweden, and Finland. In the Antarctic, partnerships include US collaboration with many SCAR nations.

There is significant interest within the Education and Human Resources directorate at NSF to leverage the inherently interesting features of the polar regions, including their remoteness and extreme conditions, to direct attention to scientific research and the importance of the polar regions to the global system. Other agencies such as NASA and NOAA have robust polar research and education programs interested in supporting IPY efforts. NSF is developing the foundation for international and interagency partnerships to bring together support and expertise from the community of researchers and educators with the aim of developing highly visible, long-lived education and outreach products for

IPY research and providing opportunities for educating the next generation of polar researchers.

## **LOGISTICS SUPPORT**

Arctic and Antarctic Research Support and Logistics are supported primarily through single-source research support and logistics contracts. These support contracts provide a flexible mechanism that is capable of supporting a wide range of potential science and educational activities. Other support is available in the Arctic through a cooperative agreement with the Barrow Arctic Science Consortium (BASC) in Barrow, Alaska, to provide research support and logistics for researchers working on the North Slope of Alaska and a cooperative agreement with the Institute of Arctic Biology at the University of Alaska Fairbanks to support operation of the Toolik Field Station, an NSF Long-Term Ecological Research site. NSF also works with the U.S. Coast Guard, NOAA, University-National Oceanographic Laboratory System (UNOLS), the Canadian Coast Guard and others to provide shipboard facilities for marine research in both polar regions. Cooperation with other national polar research programs offers an avenue for supporting international projects.

## **INFRASTRUCTURE AT BARROW RESEARCH FACILITY**

NSF is working with the Barrow community to develop a plan for a major observatory to be located in that community, with an emphasis on research that contributes to SEARCH and other high-priority Arctic programs. In anticipation of the development of such a site, basic cyberinfrastructure needs are apparent. In addition, better communication and ability to collaborate among research sites is necessary and could be developed with improved cyberinfrastructure.

## **YEAR-ROUND RESEARCH**

- Year-round research and research in remote areas is complicated and expensive to execute, yet is necessary to provide adequate spatial and temporal coverage to address research questions. Evolving technology can make it possible to collect many measurements remotely through instrumentation or through the use of remotely operated vehicles. These sensors could be networked, and could either record data or upload data via satellite. Other studies may require access to field sites later or earlier in the season than has been traditional in the research program. Upgrades and improvements of existing infrastructure include:
  - improvements in the information technology infrastructure at research hubs such as Barrow, Alaska
  - development of unmanned sensor networks in the Arctic and Antarctic
  - development of remote power for sensors, particularly using renewable resources
  - improvements in field research facilities such as laboratory space and equipment, living quarters, communications and safety.

## **DEPARTMENT OF ENERGY**

DOE is planning to support the International Polar Year in a variety of important ways through the following programs:

- Atmospheric Radiation Measurement Program
- Climate Change Prediction Program

### **ATMOSPHERIC RADIATION MEASUREMENT PROGRAM (ARM)**

The ARM Program will continue its year round operation at the North Slope of Alaska (NSA) site. This site is providing data about cloud and radiative processes at high latitudes. These data are being used to refine models and parameterizations as they relate to the Arctic. The NSA site is centered at Barrow and extends to the south (to the vicinity of Atqasuk), to the east Oliktok. DOE will also support IPY-related proposals to conduct experiments using either the NSA site and/or the ARM Mobile Facility.

### **CLIMATE CHANGE PREDICTION PROGRAM (CCPP)**

The CCPP will continue research to develop coupled climate models. The CCPP is developing ocean and sea ice models that are components of the Community Climate System Model (CCSM). In addition to coupled climate simulations, researchers apply the ocean and sea ice models to a variety of ocean and sea ice problems, including eddy-resolving ocean simulations, studies of the thermohaline circulation, and polar ice feedbacks. CCPP also supports analyses of the causes and consequences of biases in the mean climate and circulation of the Arctic.

## **NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)**

### **EXPLORATION**

#### **1. Ocean Exploration in Polar Regions**

NOAA's Office of Ocean Exploration (OE) plans to support multiple projects in both the Arctic and Antarctic in conjunction with the International Polar Year (IPY). OE expects to solicit specific projects for IPY via Federal Register announcements in calendar years 2005, 2006, and 2007. Ocean Exploration together with the Arctic Research Office of NOAA and the Russian Academy of Sciences will facilitate an expedition to the Pacific Arctic in 2008, as part of the ongoing RUSALCA (Russian American Long-term Census of the Arctic) program.

### **OBSERVATIONS**

#### **2. Causes and Impacts of Recent Changes in the Pacific Arctic**

Unprecedented minima of sea ice area have occurred in the Pacific Arctic during the three most recent summers. Summer 2003 and 2004 brought record forest fires and drought to eastern Siberia and Alaska after a decade of warm springtime temperature



anomalies. In surrounding seas there has been a northward shift of ice-dependent marine animals, with pelagic species such as Pollock favored over bottom-feeding flatfish. Many Pacific Arctic changes are continuing, despite the observation that climate indices such as the Arctic Oscillation were negative or neutral for six of the last nine years. The Pacific Arctic may be having a larger role in shaping the persistence of Arctic change than has been previously recognized. We will work with our partners to carry out expeditions in this area to gather observations about ecosystem indicators of climate change and to set up systems to monitor these changes in the environment over space and time.

### **3. International Arctic System for Observing the Atmosphere**

A system of strategically located, long-term Atmospheric Observatories will be developed around the Arctic to carry out both routine measurements made at meteorological stations and intensive measurements at the surface and through the depth of the atmosphere. Measured quantities can include solar radiation, aerosols, air chemistry, trace gases, cloud properties, water vapour, ozone, temperatures, winds, precipitation, surface albedo and stratospheric properties.

The Atmospheric Observatory partnership includes the United States, Canada, Russia, Norway, Finland, and China.

### **4. Polar stratospheric Ozone Depletion Observations**

As a part the International Geophysical Year in 1957, column ozone measurements were initiated at South Pole, Antarctica using Dobson spectrometers. In 1985, the annual stratospheric ozone depletion over Antarctica - the "Antarctic Ozone Hole"- was identified. In less than 5 years it was proven that the ozone hole was caused by human emitted fluorochlorocarbons (CFCs) and the ozone hole has become a globally recognized "poster child" for showing how humans can cause global scale changes.

The Arctic stratospheric ozone changes, though lesser in magnitude than the Antarctic ozone hole, are by no means of lesser importance. Key studies will be undertaken in the Arctic to monitor these changes.

## **PREDICTION AND MODELING**

### **5. Short-term Arctic Predictability (STAP)**

This scientific study will explore the variability, and associated predictability of weather, sea ice, ocean wave, and land surface processes in the Arctic region in the 3-90 days time range, with special emphasis on improving forecast guidance for high impact events in the 3-14 day lead time range.

### **6. Advances in Satellite Products and Their Use in Numerical Weather Prediction**

Spatially comprehensive observations of the atmosphere in the data-sparse polar regions significantly and positively impact high latitude numerical weather predictions. In addition, errors in model forecasts for the high latitudes often

propagate to the mid-latitudes, implying that improvements to high latitude forecasts will result in better mid-latitude forecasts. These findings provide the motivation to improve our ability to measure the state of the polar regions with satellites and to expand the use of these data in Numerical Weather Prediction systems.

### **7. Arctic Climate Modeling –**

The general goal of this project is to improve predictions of the Arctic environment on timescales ranging from seasonal to climate change. Thus, our research will focus on analyzing and modeling the physical processes and teleconnections between the Arctic and the rest of the globe.

### **8. Arctic System Reanalysis**

- a) A concerted effort during the IPY (2007-2008) to construct pan-Arctic atmosphere-ocean-ice-land data sets, and to assimilate and enhance these with a high-resolution (coupled) reanalysis system optimized for the Arctic region, will provide researchers with an unprecedented description of the Arctic environment over the past several decades. The operational analysis system (post 2008) expected to be a legacy of this activity would provide constantly updated depictions of the Arctic environment, and foster improved short- and medium-range weather forecasts as well as seasonal climate outlooks. Improved understanding of Arctic climate processes resulting from development of the ASR will lead to better global climate models, in turn reducing uncertainty in projected future climate states of the Arctic. The ASR will also serve as a vehicle for diagnostic evaluation of ongoing changes in the Arctic system.

## **DATA, OUTREACH AND DECISION SUPPORT**

### **9. NOAA's Data, Information, and Change Detection Strategy for the IPY**

NOAA's fundamental data management responsibilities will be to securely archive IPY datasets and ensure that these and relevant polar data are easily accessible for current and future users. NOAA will utilize the existing World Data Center (WDC) System and NOAA National Data Centers (NNDC) in order to serve as a clearinghouse and facilitator for data-management issues and will work with IPY participants to ensure that ICSU/WMO IPY Data Committee guidelines are followed. NOAA will also ensure that international standards such as the Open Archival Information System Reference Model and the ISO19115 metadata standards are met.

NOAA intends to build and maintain a pan-Arctic view of climate variability and change that will serve decision makers with information products. These range from baseline atlases against which future assessments can be carried out, to the Near Realtime Arctic Change Indicator Website, where information on the present state of Arctic ecosystems and climate is given in historical context.

### **10. Decision support for increasing adaptive capacity to climate change and variability in Alaska and the Arctic.**

The cornerstone of the National Oceanic & Atmospheric Administration's (NOAA)

Regional Climate Decision Support program for Alaska and the Arctic is to establish an integrated program spanning stakeholder-influenced research and development of decision-support tools for the sustained delivery of customer services.

This includes establishing in Alaska a Regional Integrated Sciences & Assessments (RISA) and a Regional Climate Center (RCC) with formal liaisons to NOAA's National Weather Service and the State Climatologist Office to foster growth of climate services.

## **DEPARTMENT OF STATE / NIH**

### **Arctic Human Health Initiative (AHHI)**

The Arctic Human Health Initiative (AHHI) will advance the joint research agenda of the Arctic Council, an eight-nation intergovernmental forum for sustainable development and environmental protection, in the areas of infectious disease, the effects of anthropogenic pollution, UV radiation, and climate variability on human health, and telehealth innovations. Specifically, the leaders of these research programs will build on their years of circumpolar collaboration to extend the International Circumpolar Surveillance network of hospitals and public health facilities into Russia and include additional infectious diseases of concern, to continue monitoring contaminants in human blood and tissues to reveal temporal and spatial trends and to combine experiences from the rapidly expanding disciplines of biomarker research and molecular epidemiology with these monitoring programs, and to extend circumpolar cooperation on telehealth, particularly to Arctic regions in the Russian Federation. In addition, the AHHI will draw on the outstanding leadership of the Arctic Council member states' national and international research programs in the areas of human genomics, biomarkers, hypothermia, hibernation, mental health, and climate sensitive infectious diseases.

### **U.S. Geological Survey**

The US Geological Survey serves the United States by providing reliable scientific information to

- Describe and understand the Earth
- Minimize loss of life and property from natural disasters
- Manage water, biological, energy, and mineral resources; and
- Enhance and protect our quality of life.

The USGS intends to participate in the IPY through extension and enhancement of programmatic activities in research, assessment, and monitoring in the polar regions that support the scientific mission of the organization and address the themes and goals of the IPY. These activities span the biologic, geologic, hydrologic, geographic, and information sciences and will include:

**Theme 1 Status:** Research and monitoring of status and distribution of fish, wildlife and vegetation; determination of species at risk; permafrost evaluation to include assessment of thermal regime, organic carbon characteristics, and distribution; evaluation of

hydrologic inputs including the influence of large river deltas, snow and water-borne contaminants and freshwater inputs; and the evaluation of surficial and geochemical processes in understanding the changing polar environment.

**Theme 2 Change:** Integrated monitoring for assessing regional changes in carbon cycle of Arctic watersheds; extension of current ground and satellite-based monitoring of glaciers and icecaps for volumetric changes and monitoring of thermal changes in permafrost; reconstruction of past climate and evaluation of current changes from sediment and ice cores; monitoring and assessment of changes in rates of coastal erosion and surficial process; evaluation of changes in status and distribution of circum-polar vegetation, fish, and wildlife (including invasive species) and freshwater discharges in the Arctic.

**Theme 3 Global Linkages:** Evaluation of the nature of arctic/boreal hydrologic interactions and the relationships between climate and plant growth, productivity, permafrost depth, and resulting effects on nutrient availability and heat source/sinks; evaluation of potential for methane hydrate decomposition in a regime of arctic warming.

**Theme 4 New Frontiers:** Development of a micro-seismicity array in the Antarctic South Pole quiet sector for high-resolution studies of the Earth's interior; establishment of an absolute geomagnetic observatory at South Pole for long-term time series observations of variations in the Earth's magnetic field; extremophile interactions in polar geochemical and nutrient cycles.

**Theme 5 Unique Vantage Point:** Establishment or extension of permanent monitoring infrastructure for permafrost, global seismicity, and geomagnetic activity. Assessment of energy resources in the circum-arctic area including, oil, gas, coalbed methane and methane hydrates.

An additional element will include the production of geospatial data to include high-resolution mapping and digital aerial photography and the structuring of all data in a geospatially-referenced knowledge management system as an element of the USGS' Natural Science Network.

## **NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

NASA's contributions to IPY likely will involve ongoing activities (operating satellites, continuing ground networks, and scientific research), some episodic activities (satellite snapshots and field campaigns), new efforts related to the development and deployment of sub-orbital capabilities (aircraft and unmanned aerial vehicles), and coordination of remote sensing observations with in situ measurements supported both by NASA and other agencies – primarily the National Science Foundation.

Currently, NASA operates nearly 20 satellites that collect information about the polar regions. The Ice Cloud and Land Elevation Satellite (ICESat) was specifically designed

to measure changes in the elevation of the Earth's great ice sheets and the ice sheet processes that are manifest in the surface topography in unprecedented detail. In addition, the mission has revealed new information about recent thickness characteristics of sea ice in the entire Arctic and Antarctic regions. Upcoming missions such as Cloudsat and Calipso will provide 3-dimensional information on the structure of the Earth's atmosphere, and as with all near-polar orbiting satellites, coverage will be maximum in the polar regions.

NASA has demonstrated success in the past in developing comprehensive polar observations through international collaborations with the Canadian Space Agency (CSA) to carry out the Antarctic Mapping Mission and the Arctic Snapshot of Arctic sea ice characteristics at very high spatial resolution. We expect to continue to develop these international efforts through a coordination of activities with our colleagues at space agencies in other countries.

NASA also has polar missions that reach beyond Earth, including the PHOENIX Mission that will land near Mars North Pole in 2008, the Lunar Recon Orbiter that will map Lunar polar regions for the first time in 2008, and the Mars Recon Orbiter (MRO) that will explore Martian polar regions from orbit. Polar analogues in Mars exploration are vital; for instance, scientists have used Earth's polar regions to simulate Mars for over 30 years. For instance, the Dry Valleys of Antarctica are the best "Mars analogue" known on Earth. The ASTEP Program (astrobiology) uses polar activities in Antarctic, Axel Heiberg, Svalbard, Siberia, and in the future potentially Iceland.

Efforts for the IPY are envisioned to focus on:

- understanding polar feedbacks in the Earth system
- developing a "snapshot" of the polar regions to serve as a baseline for future generations of observations. This will require coordination with international and industry partners
- ongoing satellite missions.
- new airborne surveys targeted at measuring land-ice elevation changes and thickness characteristics
- comprehensive observations of polar atmospheric composition, dynamics and thermodynamics
- utilization of polar regions as a stepping stone to exploring planetary environments
- understanding poles of other planets and similarities and differences to those on Earth.

NASA continues to study the Earth as a system through the unique sampling capability afforded by remote sensing. During the IPY and beyond, we will continue to develop this capability to understand polar processes, the role of the polar regions in the Earth's environment, and the nature of poles on other planets in our solar system.

## **U.S. DEPARTMENT OF AGRICULTURE**

The U.S. Department of Agriculture plans to continue its mission related activities in the Alaska region.

The Agricultural Research Service (ARS) will continue its work towards preserving Alaskan plant diversity through its preservation and archiving of high latitude plant germplasm through traditional seed collocation and modern molecular methods. The US Forest Service through the Pacific Northwest Research Station is responsible for the management of the Alaskan boreal forest and will continue its commitment in support of the Bonanza Creek LTER, which takes place at the Bonanza Creek Experimental Forest. The Natural Resources Conservation Service (NRCS) will continue to provide assistance to state, Native Alaskan, and private landowners through the USDA Farm Bill. The forest Service and NRCS will continue their joint activities in permafrost and wetland soil research. The Cooperative State Research, Education and Extension Service will continue its educational support for the University of Alaska, which is the Alaska land-grant institution. CSREES will also continue its extension activities through the Alaska extension services and experimental research stations. CSREES is currently contributing to the interagency Study of Environmental Arctic Change (SEARCH) by providing resources to a joint solicitation with NASA for proposals on land use and land cover change. SEARCH is one of the primary activities of NSF for the IPY and the USDA will continue to work with the interagency working group of SEARCH to promote joint interests in Alaska.

## **SMITHSONIAN INSTITUTION**

- *Establish co-operative observation programs involving interested indigenous experts, subsistence users, and other polar residents to document the status of polar environment, using local ecological knowledge and indigenous terminologies.*

Through generations of life in the polar environment, polar residents have developed long-standing knowledge and observation techniques in recording and interpreting a broad range of signals and phenomena critical to many linked processes in the polar regions. Special efforts to integrate interested local experts into international observing networks would provide polar researchers with an opportunity to learn of both present and past conditions from the vast store of indigenous knowledge and to calibrate instrument and satellite data through local observations. Collaboration built on mutual partnership and consent could allow access to invaluable datasets spanning several generations and covering all seasons of the year. It will increase support and public awareness of the environmental expertise used by polar residents in their daily life, weather forecasting, subsistence activities, and resource planning.

- *Preserve the historical legacy of the International Polar Year 2007-2008 for the general public and for the inspiration of future generations through museum collections, public and outreach programs, exhibits featuring IPY science and scientists, and media venues.*

The International Polar Years are outstanding scientific ventures that have sparked human imagination and helped build public interest in polar research for over 125 years. The legacy of the International Polar Year 2007-2008, when preserved in science and personal memorabilia, diaries, instruments, photographs, and museum collections, will excite new generations of researchers and public in 25, 50 or even 100 years from now – as much as the collections of the earlier Polar Year ventures helped generate enthusiasm for the IPY 2007-2008. Special efforts are to be made to launch various public initiatives—such as museum exhibits, public forums, media events, lectures and open symposia—so that the legacy of the IPY 2007-2008 becomes ingrained in public knowledge and that the next generations of scholars and students remember the years of the IPY 2007-2008 as the formative experience of their life, much like the senior scholars of today remember the energy of the IGY 1957-1958.

## **ENVIRONMENTAL PROTECTION AGENCY**

EPA plans to support other agencies' IPY efforts through its Environmental Monitoring and Assessment Program (EMAP), and its involvement in the Global Earth Observation System of Systems (GEOSS). For 15 years, EMAP has developed cost-effective and policy relevant probabilistic sampling approaches for freshwater and marine resources.

EPA has supported monitoring of coastal resources in South Central and Southeastern Alaska, as well as freshwater monitoring in Central Alaska. The state of Alaska has submitted an IPY “Expression of Intent” for Arctic and Bering Sea Coastal Assessments.

EPA will give non-budetary support to this proposal. Other agencies also may wish to support this effort, and perhaps support a larger potential effort of developing a circumarctic or even circumpolar coastal monitoring program using EMAP approaches, to obtain baseline conditions. This larger effort could be done in the context of IPY 2007-2008.

EPA is involved in GEOSS as a data collector, integrator, and user. Also, EPA is co-chair of the GEO Secretariat’s User Requirements and Outreach Subgroup. EPA is interested in how the oceans observing network is expected to be included under GEOSS, and how all the other earth observations overlap with IPY. EPA looks forward to collaborating with other agencies in GEOSS activities related to the IPY.