



## U.S. Antarctic Program, 2006–2007

As part of the U.S. Antarctic Program, nearly 700 researchers and special participants will conduct 165 projects during the 2006–2007 austral summer, with some projects continuing through the austral winter. Supported by over 2,000 civilian contract employees and U.S. military personnel, these researchers and special participants (writers, artists, and teachers) will work at the three U.S. year-round stations (McMurdo, Amundsen-Scott South Pole, and Palmer), at remote field camps, with other national antarctic programs at locations around Antarctica, and in the waters of the Southern Ocean aboard the U.S. Antarctic Program's two icebreaking research ships—*Nathaniel B. Palmer* and *Laurence M. Gould*—and the Swedish icebreaker *Oden*.



A Zodiac boat near an iceberg. (NSF/USAP photo by Zee Evans)

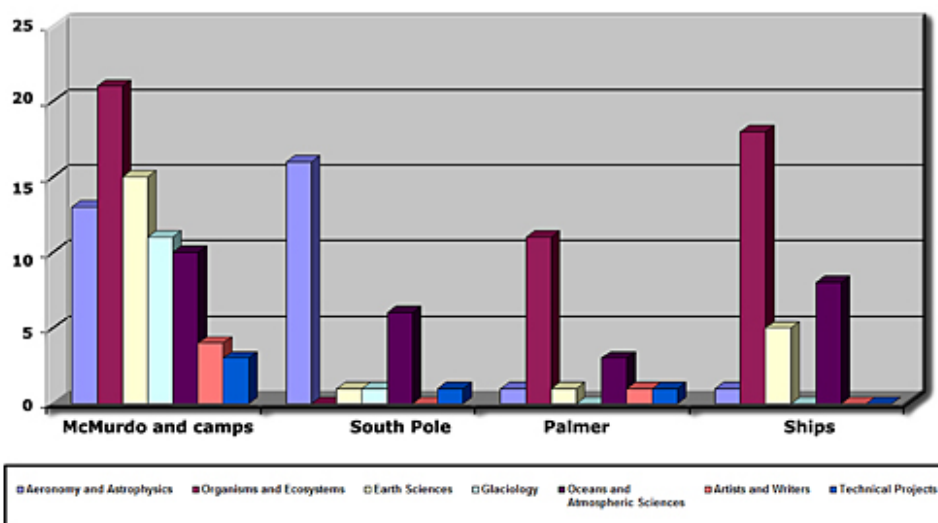
These projects, funded and managed by the National Science Foundation (NSF), are part of the international effort to understand the antarctic and its role in global processes. NSF supports research that can best be performed or can only be performed in Antarctica. Besides research projects, NSF's Office of Polar Programs (OPP) and the Directorate for Human Resources support PolarTREC (Teachers and Researchers Exploring and Collaborating; <http://www.polartrec.com/>), a teacher enhancement program administered by the Arctic Research Consortium of the U.S. PolarTREC strives to

advance polar science education by bringing K–12 educators and polar researchers together in hands-on field experiences in the Arctic and Antarctic. For its first antarctic activity, PolarTREC will support two teachers, Allan Miller and Ute Kaden, during an international oceanographic cruise of the Swedish icebreaker *Oden*. The scientific objectives of the cruise are monitoring wildlife, including seals, cetaceans, seabirds, and penguins; surveying sea ice and meteorological conditions; mapping the chemical, thermal and bathymetric properties of the ocean; and measuring the abundance of plankton and nutrients in the ocean. The research will be conducted while the *Oden* is in transit from Chile to McMurdo Station where the ship will assist in annual icebreaking activities.

Another OPP program—the [Antarctic Artists and Writers Program \(NSF 07-550\)](#)—provides opportunities for painters, photographers, writers, and others to use serious writing and the arts to increase people's understanding of the Antarctic and America's heritage there.

The scientists conducting the projects come primarily from U.S. universities and have won NSF support by responding to the [Antarctic Research Program Announcement and Proposal Guide \(NSF 07-549\)](#). Operational resources in Antarctica are also used to support scientists from other Federal agencies.

### U.S. Antarctic Program Science Projects by Discipline and Research Site



During the 2006–2007 austral summer, 77 projects will be based at McMurdo Station or at remote field sites, 32 will be supported on research ships, 25 will work at Amundsen-Scott South Pole Station, and 18 will work in and around Palmer Station.

### Science highlights

The following projects are among those supported during this austral summer and winter. Where appropriate, links for additional information have been added. NSF-funded science awards can also be found in the online NSF awards database. To access this information, search the database at [www.nsf.gov/awardsearch/index.jsp](http://www.nsf.gov/awardsearch/index.jsp). Each NSF award listed here, as well as in the other sections of this document, includes the award number, which can be used to do a keyword search.

## Organisms and ecosystems

- **Long-term ecological research (LTER).** Two sites in Antarctica—one in the McMurdo Dry Valleys (NSF/OPP 04-23595) and the other along the west coast of the Antarctic Peninsula centered on Palmer Station (NSF/OPP 02-17282)—are among the world's 26 NSF-sponsored LTER sites, which are being investigated to increase our understanding of ecological phenomena over long temporal and large spatial scales. All of the other sites except one are in the United States. (<http://lternet.edu>; Palmer LTER, <http://pal.lternet.edu/>; McMurdo LTER, <http://www.mcmilter.org/>)
- **Weddell seal population dynamics.** Weddell seals have been studied in McMurdo Sound since 1968; this constitutes one of the longest intensive field investigations of long-lived mammals anywhere. More than 16,800 animals have been tagged, and almost 162,000 resightings have been recorded. The project is a resource for understanding the population dynamics not only of Weddell seals, but also of other species of terrestrial and marine mammals. New work this season includes assessing the role of food resources in limiting the population. (NSF/OPP 02-25110; [www.homepage.montana.edu/~rgarrott/index.htm](http://www.homepage.montana.edu/~rgarrott/index.htm))
- **Protein function in cold-adapted fish.** Antarctic fish live in an unusually cold environment where basic processes such as protein synthesis are thermodynamically challenging. Researchers are examining whether antarctic fish have unique adaptations for making proteins and are uncovering the genetic basis for these functions. Comparative studies with temperate fish will help to illuminate the evolutionary pathways of cold-adaptation and life in extreme environments. (B-134-M; NSF/OPP 04-40799)

## Ocean and atmospheric sciences

- **Monitoring for climate change.** A team of scientists from the National Oceanic and Atmospheric Administration (NOAA) are measuring carbon dioxide, methane, carbon monoxide, stable isotopic ratios of carbon dioxide and methane, aerosols, halocarbons, and other trace constituents. Flask samples are collected and returned for analysis, while concurrent in situ measurements of carbon dioxide, nitrous oxide, selected halocarbons, aerosols, solar and terrestrial radiation, water vapor, surface and stratospheric ozone, wind, pressure, air and snow temperatures, and atmospheric moisture are made. Air samples are also collected at Palmer Station. These measurements allow researchers to determine the rates at which concentrations of these atmospheric constituents change; they also point to likely sources, sinks, and budgets. NOAA scientists collaborate with climate modelers and diagnosticians to explore how the rates of change for these parameters affect climate. (NSF/NOAA agreement)
- **Primary and Secondary Production Measurements Along the Western Antarctic Coastline on the *Oden*.** The western antarctic coastline, notoriously understudied, is thought to play a large role in the Southern Ocean for global carbon cycling. The *Oden* transit cruise is an ideal opportunity to collect data in this undersampled region, from the western Antarctic Peninsula to Ross Island. The information will augment data obtained in adjacent regions during the conduct of two major ocean programs, Southern Ocean GLOBEC (Global Ocean Ecosystem Dynamics) and Southern Ocean JGOFS (Joint Global Ocean Flux Study). Underway measurements of primary and secondary production will establish a baseline for future cruises. Concurrently observations will be made of marine mammals, sea birds and ice conditions. The overall goal is to understand how the sea ice edge dynamics influence both primary and secondary production, particularly with respect to larval krill dynamics. (NSF/OPP 07-08292)

## Aeronomy and astrophysics

- **A 10-meter telescope for South Pole Station—South Pole observations to test cosmological models.** Much of the mass in the Universe is made up of dark matter, which emits little or no light or other electromagnetic radiation and makes its presence known only through the gravitational force it exerts on luminous matter. The University of Chicago continues to lead a consortium of six institutions to design and use a 10-meter off-axis telescope located at Amundsen-Scott South Pole Station to survey galaxy clusters. This survey will allow them to study integrated cluster abundance and its red shift evolution and will give precise cosmological constraints, completely independent of those from supernova distance and cosmic microwave background anisotropy measurements. The telescope will be constructed in the 2006–2007 austral summer and begin observations during the 2007 austral winter. (NSF/OPP 01-30612; <http://astro.uchicago.edu/scoara/may2004workshop/TALKS/spt-carlstrom>)
- **IceCube.** During the 2006–2007 austral summer, a consortium led by the University of Wisconsin-Madison will continue construction of the IceCube Observatory at the South Pole. IceCube is a neutrino telescope that will be buried 1.4 to 2.4 kilometers under the ice and will be used during the austral summers over 5 years. The detector will consist of 4,800 optical modules deployed on 80 vertical strings. AMANDA (antarctic muon and neutrino detector array) is the prototype for this international collaborative effort. Using neutrinos as cosmic messengers, IceCube will open unexplored wavelength bands and will answer such fundamental questions as what the physical conditions in gamma ray bursts are and whether the photons originating in the Crab supernova remnant and near the supermassive black holes of active galaxies are of hadronic (derived from subatomic particles composed of quarks) or electromagnetic origin. The telescope will also be used to examine the particle nature of dark matter, aid in the quest to observe supersymmetric particles, and search for compactified dimensions. (NSF/OPP 03-31873; <http://icecube.wisc.edu>)

## Glaciology

- **WAIS Divide.** This 5-year science program, involving a dozen research teams, will develop a detailed record of greenhouse gases for the last 100,000 years; determine if changes in the northern and southern hemispheres initiated climate changes over the last 100,000 years; investigate past and future changes in the West Antarctic Ice Sheet; and study the biology of deep ice. A 45-person camp to support the drilling program was established during the 2005–2006 austral summer at a site on the West Antarctic ice sheet divide. At this camp a 184-foot steel arch building will house the drilling and core processing facilities for the deep drilling project, which will collect a 3,400-meter ice core to bedrock. The project's objective is to develop climate records with an absolute, annual-layer-counted chronology for the most recent 40,000 years. Lower temporal resolution records will extend to about 100,000 years before present. These records will enable comparison of environmental conditions between the northern and southern hemispheres and study of greenhouse gas concentrations in the paleo-atmosphere with a greater level of detail than previously possible. (<http://www.dri.edu/People/kendrick/WDSprojmain.htm>; [http://www.ig.utexas.edu/research/projects/waiscores/wais00-poster/wais00\\_main.htm](http://www.ig.utexas.edu/research/projects/waiscores/wais00-poster/wais00_main.htm))
- **Earth's largest icebergs.** Icebergs released by the antarctic ice sheet represent the largest movements of fresh water within the natural environment. Several of these icebergs calved since 2000, represent over 6,000 cubic kilometers of fresh water—an amount roughly equivalent to 100 years of the flow of the Nile River. Researchers from the University of Chicago, Northwestern University, and the University of Wisconsin-Madison will study the drift and breakup of the Earth's largest icebergs in an attempt to understand the physics of iceberg motion within the dynamic context of ocean currents, winds, and sea ice, which determine the forces that drive iceberg motion, and the relationship between the iceberg and the geographically and topographically determined pinning points on which it can ground. In addition, we will study the processes by which icebergs influence the local

environment, as well as the processes by which icebergs generate globally far-reaching ocean acoustic signals that are detected by seismic-sensing networks. A better understanding of the impact of iceberg drift on the environment, and particularly the impact on ocean stratification and mixing, is essential to understanding the abrupt global climate changes witnessed by proxy during the Ice Age and future greenhouse warming. (NSF/OPP 02-29546, NSF/OPP 02-29492, and NSF/OPP 02-30028)

## Earth sciences

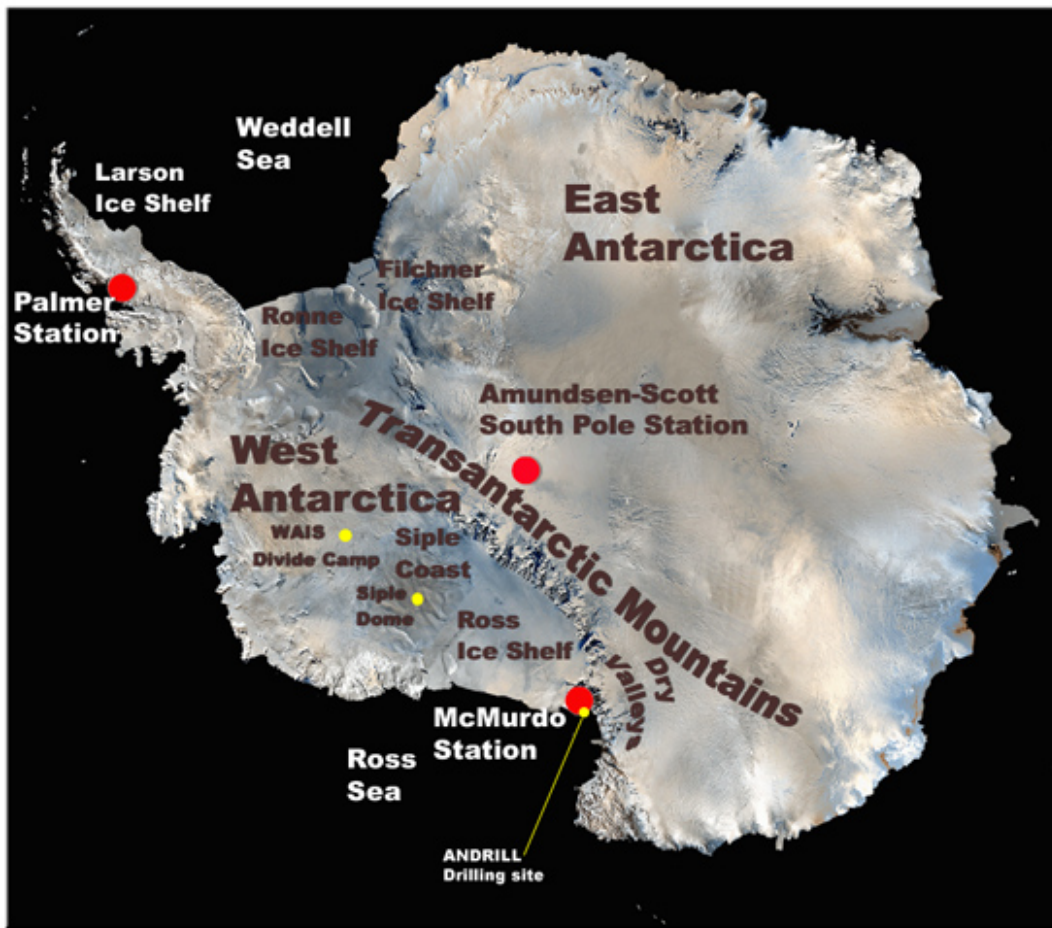
- **Antarctic Drilling (ANDRILL).** ANDRILL, an international program representing over 150 scientists from Germany, Italy, New Zealand, the United Kingdom, and the United States, is designed to investigate Antarctica's role in Cenozoic global environmental change. ANDRILL will obtain a record of important Eocene, Neogene, and Holocene stratigraphic intervals in high southern latitudes. This research will contribute to the development of strategies to cope with future climate change, provide insight into relationships between ice-sheet fluctuations and volcanic and seismic hazards, and improve models of glacially influenced sedimentary rift basins. It will also contribute to other international science goals, bring together international teams, and provide opportunities to share antarctic earth science with the global community. ANDRILL will foster strong partnerships with established educational programs to develop a broad array of activities designed to educate policymakers, K– teachers, students, and the community at large. (NSF 03-42484; <http://andrill.org>)
- **Age, origin, and climate significance of buried ice.** Buried ice deposits are potentially a far-reaching archive of atmosphere and climate on Earth, extending back for many millions of years. These deposits are also terrestrial analogs to widespread, young buried ice on the Martian surface as identified by recent data from Mars Odyssey. This project will evaluate the age, origin, and climatic significance of buried ice in the western Dry Valleys region. Microclimates of the Dry Valleys hold implications for landscape evolution and climate change on Mars. The Antarctic Dry Valleys are commonly viewed as a relatively fixed cold polar desert with little internal variation. Recent analyses have shown that there are three fundamentally different microclimate zones within this general 'stereotypical' cold polar desert, and that these may hold the keys to climate change on Mars. (NSF/OPP 03-38291; <http://people.bu.edu/marchant/>)

## Other programs

- **Antarctic Artists and Writers Program.** This program, which records the Nation's antarctic cultural heritage and extends understanding of the region and the U.S. Antarctic Program within the research community and beyond, will support the following five projects.

Artist/Writer	Project Title	Event Number
Anne Aghion	Work and Days: An Antarctic Chronicle	W-218-M
Lita Albuquerque	Stellar Axis: Antarctica	W-221-M
Xavier Cortada	Antarctic art message mural	W-217-M
Werner Herzog	The inner landscape (feature film)	W-219-M
David Ruth	Antarctic ice: Sculpture in cast glass	W-220-P

## U.S. Antarctic Program, 2006–2007: Sites of Major Activities



McMurdo, Amundsen-Scott South Pole, and Palmer Stations operate year-round. During the 2006–2007 austral summer, four major field camps will operate in West Antarctica (Byrd Surface, Siple Dome, Western Antarctic Ice Sheet (WAIS) Divide, and Taylor Dome). Smaller camps will operate in the McMurdo Dry Valleys and Transantarctic Mountains regions. Six automated geophysical observatories and more than 100 automated weather stations operate year-round. The weather stations involve international collaboration with the Italian, German, Australian, and British programs. The map shows U.S. Antarctic Program locations during the 2006–2007 season.



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