

The International Polar Years, Permafrost, and the Barrow Environmental Observatory

First International Polar Year 1881-1883

125th Anniversary 2007-2009

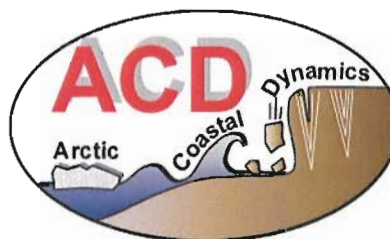


Ray Expedition
Barrow



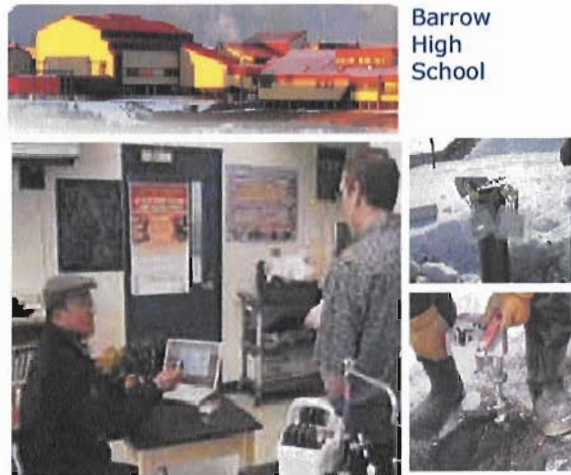
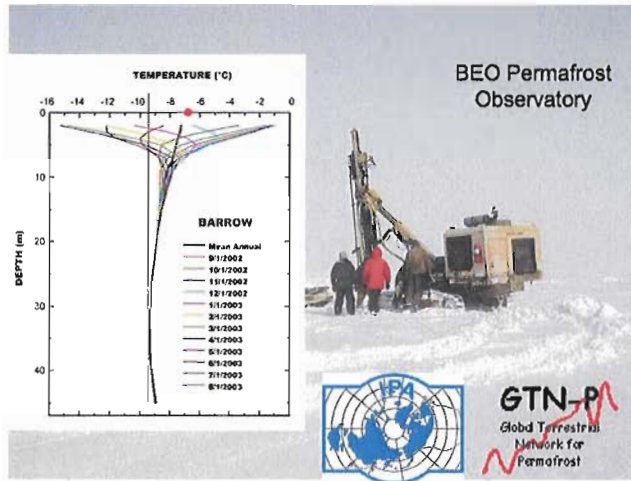
LEGACIES

CALM
Circumpolar Active
Layer Monitoring

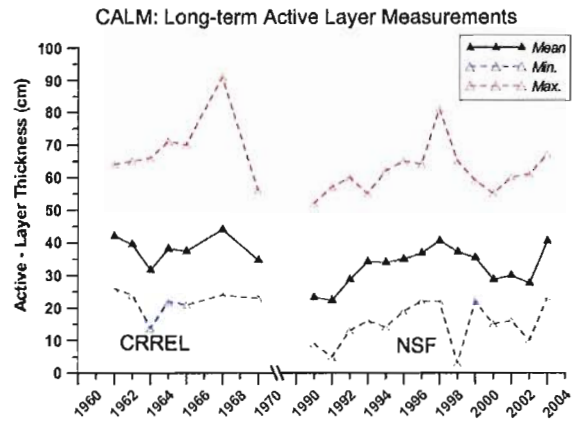


GTN-P
Global Terrestrial
Network for
Permafrost





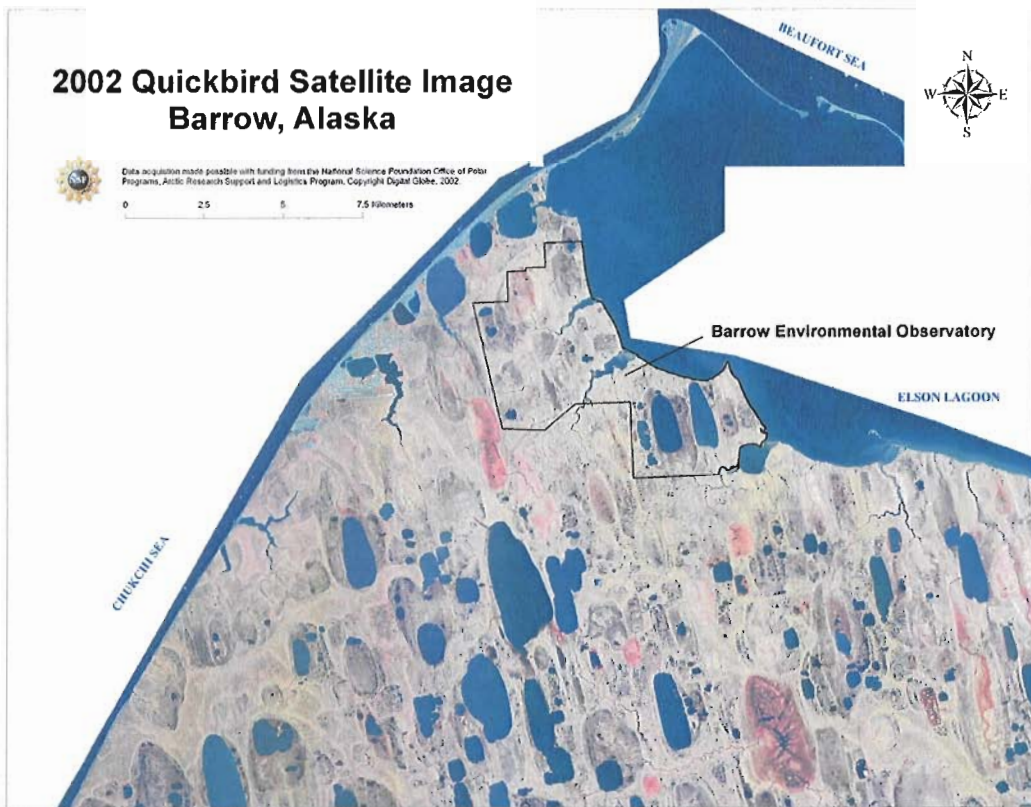
Approximate location of the Ray Expedition next to Brower's Cafe



ITEX Chamber and Gas Flux Measurements



Coastal Erosion Along Elson Lagoon



The International Polar Years, Permafrost and the Barrow Environmental Observatory

Jerry Brown, Chair, BASC BEO Subcommittee

Introduction

Barrow, Alaska, has been the location of permafrost observations and research since the First International Polar Year in 1882-1883. At that time, members of the Ray Expedition excavated a 37-foot deep meat cellar and measured daily permafrost temperatures (12⁰F, -11.1⁰C). During the late 1940s and throughout the 1950s the U. S. Geological Survey conducted a series of permafrost investigations including numerous year-round temperature measurements under different terrain types and buildings. During this period the Navy (ONR), and later the Army (CRREL) in the 1960s, sponsored a wide range of permafrost and geological investigations, with the CRREL program including drilling and coring of permafrost and the establishment of an active layer network. In the early 1970s, Barrow was the site of intensive research under the National Science Foundation (NSF) sponsored Tundra Biome project of the International Biological Programme. Starting in the 1990s, NSF began supporting a series of long-term research observational projects located in the Barrow Environmental Observatory (BEO). The BEO, 7,466 acres of relatively undisturbed tundra located between Elson Lagoon and the Cake Eater Road, was permanently set aside for research in 1992 by the Ukpeagvik Iñupiat Corporation (UIC). The North Slope Borough Assembly has designated the area as a Scientific Research District.

The following brief report describes current, long-term, permafrost observations and related research that contribute to the local celebration of the International Polar Year and to the designation of Barrow by the Alaskan Legislature as Alaska's Arctic Science City and focal site for the 125th Anniversary of the First International Polar Year. The history of these permafrost endeavors was presented by the author in a BASC-BLM lecture at the Inupiat Heritage Center, October 11, 2005, and entitled "History and Results of Permafrost Research at Barrow: A Contribution to the International Polar Year". The illustrated presentation is available on a CD from BASC.

Four, long-term permafrost-active layer observational projects are located in the BEO: (1) permafrost temperatures, (2) active layer thickness, (3) coastal erosion, and (4) ITEX. Several other projects are directly related to past and present landscape dynamics and climate change both within and adjacent to the BEO. Details of these projects are reported in the BEO Annual Reports that are found on the BASC web site (www.arcticscience.org). Project titles are attached to this report.

At the international level, the permafrost projects are part of the IPY Joint Committee approved coordinated permafrost projects under the leadership of the International Permafrost Association (IPA):

- Project 50: Permafrost Observatory Project: A Contribution to the Thermal State of Permafrost (TSP)
- Project 90: Arctic Circumpolar Coastal Observatory Network (ACCO-Net)
- Project 373: Carbon Pools in Permafrost Regions (CAPP)

The IPA legacy for the IPY is three fold:

- To facilitate development of a network of permanent permafrost observatories
- To establish a sustainable data system
- The next generation of permafrost researchers.

The BEO is one of only a few international sites that has a long history of observations and is protected from future human disturbances. As such, it is the premier site for the International Network of Permafrost Observatories (INPO).

IPY Permafrost Projects

Thermal State of Permafrost: A U.S. Contribution to the International Network of Permafrost Observatories (INPO)

(NSF OPP-0520578) - Vladimir E. Romanovsky with Kenji Yoshikawa and Jerry Brown)

The observatory was established in 2002 when two, 50 m deep holes were drilled and instrumented with year-round temperature recorders and climate station. These two boreholes and several adjacent recording sites are being used to compare temperatures obtained in the 1950's with the present thermal state of permafrost. Comparison of temperatures with 1950s data indicates a small warming (about 1⁰C). Two other permafrost monitoring projects are underway in Barrow itself. A shallow borehole has been instrumented behind the High School by Kenji Yoshikawa so that students can download and analyze the data. This is part of the EPSCOR project with schools throughout the North (<http://www.uaf.edu/permafrost/>). Elsewhere in Barrow and Browerville, CALM project personnel are assisting in recording permafrost temperature in local meat cellars.

The Circumpolar Active Layer Monitoring Network-CALM II (2004-2008): Long-Term Observations on the Climate-Active-Layer-Permafrost System

(NSF OPP-0352958) - Frederick E. Nelson and Nikolay Shiklomanov, University of Delaware

Active layer plots were established in the early 1960s by CRREL and reactivated in 1992 (Kaye Everett and Jerry Brown) with the establishment of the BEO and new NSF Arctic projects. NSF funding of CALM started in 1998 (Ken Hinkel and F.E. Nelson). Minimum thaw depths were observed in the early 1990s with recent maximum depths similar to those observed in the 1960s. The Barrow site is one of approximately 150 sites located throughout the permafrost region of the Planet (<http://www.udel.edu/Geography/calm/>).

Arctic Coastal Dynamics (ACD): Elson Lagoon Key Site

(NSF OPP-0447422) - Jerry Brown Barrow Arctic Science Consortium, and

Collaborative Research on Flux and Transformation of Organic Carbon Across the Eroding Coastline of Northern Alaska

(NSF OPP-0436165 and 0436179) - Torre Jorgenson, ABR, Inc. and Chien Lu Ping, University of Alaska Fairbanks

Coastal erosion measurements have been reported from the early 1900s (Leffingwell) and more recently at Barrow starting in the 1940s (MacCarthy). Starting in 2002 annual erosion rates at 14 permanent transects along a 11-km section of Elson Lagoon are measured as part of the international project Arctic Coastal Dynamics (ACD). Students from several university projects

assist in these annual measurements. A total of 20.4 acres of BEO land were lost to erosion between 2003 and 2006. Other research on erosion is part of the NSF SNACS project to assess the quantity and quality of eroded organic matter into the near-shelf environment along the entire Beaufort Sea coast.

IPY: Collaborative Research: Study of arctic ecosystem changes in the IPY using the International Tundra Experiment

(NSF OPP-0632263) - Robert Hollister, Grand Valley State University and Steven F. Oberbauer, Florida International University

The ITEX experiment was established at Barrow in the early 1990s by Pat Webber and his colleagues to observe tundra vegetation responses to climate warming using open top chambers (OTC) to simulate warming. Active layer and soil temperature measurements are also measured. The project is now formally funded as an IPY project.

2007-2008 Plans

Many results of these Barrow-based projects will be presented at the Ninth International Conference on Permafrost (NICOP) at the University of Alaska Fairbanks, June 29-July 3, 2008. The NICOP represents an international commemoration of the IPY anniversaries. Two, Barrow-based IPY-NICOP events are planned in summer 2008. An international workshop on the CALM projects prior to the Conference and the culmination of a NICOP coastal field excursion from Prudhoe Bay to Nuiqsut to Barrow. We plan to present several community-based lectures at the Inupiat Heritage Center during these visits. Other visitors are expected to come to Barrow as part of the NICOP summer activities.

Several pending IPY proposals may include: participation of 15 Russian-U.S. undergraduate-graduate students in the CALM workshop, and the initiation of a project to investigate changes over the past 50 years to assess future changes (Back to the Future – BTF).

Other Related Projects

As indicated above, other recent and on-going projects associated with the BEO are related to these permafrost projects and include the following:

Spatial and Temporal Variability of Ground Temperature and Thaw Northern Alaska - Kenneth M. Hinkel and F.E. Nelson

Collaborative Research on Biocomplexity Associated with the Response of Tundra Carbon Balance to Warming and Drying Across Multiple Spatial and Temporal Scales - Walter C. Oechel, John Kimball, and Craig Tweedie

Eddy Covariance Carbon Flux - Walter Oechel

Infrastructure Development and Experimental Design - Craig Tweedie

Methane Fluxes - Yoshinobu Harazono

Plot Level CO₂ Fluxes – Steven Oberbauer

Tramline and Instrumentation Development – John Gamon

Remote Sensing and Hydroecological Process Models - John Kimball

Barrow Area Information Database and Internet Map Server (BAID-IMS) - Craig Tweedie and Allison Graves Gaylord