



## Engineering for Polar Operations, Logistics, And Research (EPOLAR)

### Using applied research and engineering to solve operational challenges in extreme and austere environments

The EPOLAR program works to solve operational challenges in extreme and austere environments from pole to pole, with a focus on Greenland and Alaska in the north and Antarctica in the south. Many technologies and methods created at one pole are transferrable to challenges at the other pole, and the EPOLAR program leverages knowledge from ERDC-CRREL's basic research programs related to permafrost science, sea ice, cold regions hydrology, and glacier research, among other topics. EPOLAR includes experts from all branches at CRREL, including mechanical, civil, and facilities engineers; remote sensing, GIS, and GPR experts; snow and permafrost experts; and technicians.



### Research and Development Areas

The EPOLAR program has four main research and development areas:

- Transportation and mobility
  - Traverses to Summit Station in Greenland and South Pole Station in Antarctica, using GPR to avoid crevasses
  - Autonomous rovers developed to conduct remote science campaigns
- Infrastructure
  - Snow drift management
  - Runways and airfields
  - Rapidly deployable buildings
- Facilities
  - Energy and structural efficiency
  - Cooling systems for food and sample storage
- Logistics
  - Resupply operations
  - Support operations



A crevasse field in Greenland

### Customers and Clients

The primary client of the EPOLAR program is the National Science Foundation (NSF). EPOLAR provides support to both the Arctic Research Support and Logistics (RSL) Program and the Antarctic Infrastructure and Logistics (AIL) Division. EPOLAR works to allow both programs to do their jobs better, more efficiently, and as cost effectively as possible. The potential impact of improved efficiency and cost effectiveness in logistics is great, as the AIL Division



Both the Greenland and South Pole traverses carry fuel and cargo on sleds designed and developed at CRREL

currently spends 80% of the Antarctic budget on logistics and operations. Reductions in this cost leave a greater portion of the budget available for the NSF's scientific research.

Other customers and clients include the Canadian Air National Guard, ERDC market and business development, and the U.S. Coast Guard.

## Research & Engineering Capabilities

Cargo sleds developed at CRREL are used to resupply both Summit Station in Greenland and the South Pole via overland traverses. The sleds can be towed over rugged terrain more easily and efficiently than sleds equipped with skis. The traverses are navigated using a real-time GPR image analysis technique, which leads to the safest and most efficient route selection possible. Overland resupply to the South Pole alone saves the NSF four to five million dollars a year, as one delivery via traverse offsets 36 supply delivery flights.

Two autonomous over-snow rovers, developed jointly by CRREL and Dartmouth College, are used to conduct remote science campaigns on Polar ice sheets. The Yeti is battery powered and can operate in conditions as cold as  $-33^{\circ}\text{C}$ . The Yeti can be used with GPR to locate hazards buried under snow, and can also be fitted with other sensors to determine a variety of conditions including sea ice thickness and surface albedo. The "Cool Robot" is a solar powered rover that has unlimited endurance during Polar summers; it is a platform for scientific payloads with a 100kg towing capacity. Both rovers navigate using GPR waypoint-following and can execute pre-planned courses autonomously.

The EPOLAR program uses some novel concepts in the facilities research area to conserve energy and ensure living and working spaces in Polar regions are as efficient as possible. Infrared camera surveys are used to determine areas of energy inefficiency on buildings, and also to analyze the buildings' structural integrity. These surveys can also be used in foundation design and to detect building settlement. Additionally, the EPOLAR program developed an energy efficient cooling system that takes advantage of the cold air trapped in firn (snow that has survived a summer melt) to cool food and sample storage areas.

The EPOLAR program works to solve a variety of science and engineering needs for agencies and organizations operating in the polar regions. Emphasis is placed on developing scientifically sound solutions with recognition of the cost/benefit implication, whether it be selecting and building an ice runway in Greenland or evaluating water runoff issues in Antarctica.

## ERDC Point of Contact

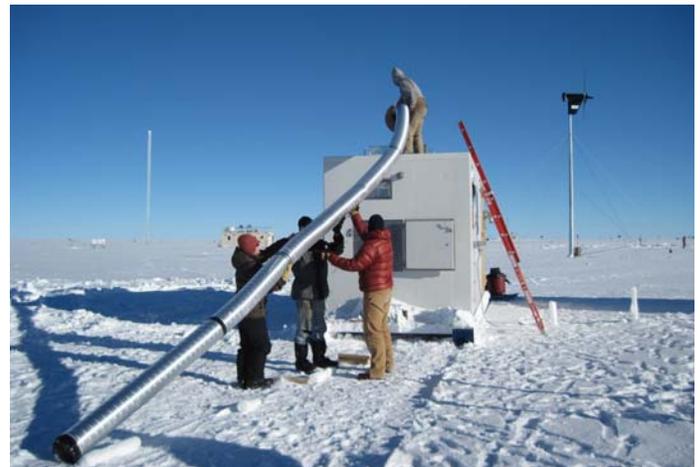
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The Yeti, an autonomous ground penetrating radar survey vehicle jointly developed by CRREL and Dartmouth College



A refrigeration unit that cools by recovering cold air trapped in firn enables controlled refrigeration in extreme cold environments with minimal energy consumption