Engineering and Technology Solutions for Operational Challenges in Polar Environments, an Overview of CRREL's EPOLAR Program

Engineer Research and Development Center-
Cold Regions Research & Engineering Laboratory
(ERDC-CRREL)

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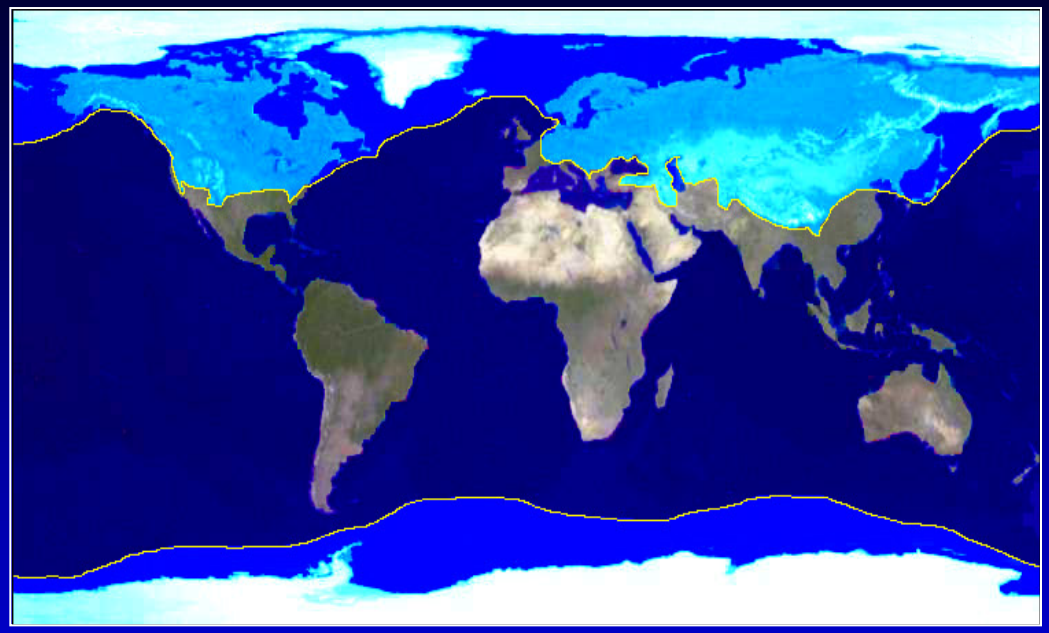
CRREL's EPOLAR Program



- Engineering for Polar Operations, Logistics And Research
- Use applied research and engineering to solve operational challenges in extreme and austere environments (Arctic and Antarctic).
- Primary client: NSF Funding: 100% Reimbursable TRL: 2-9

Utilizes CRREL's Specialized & Unique Expertise

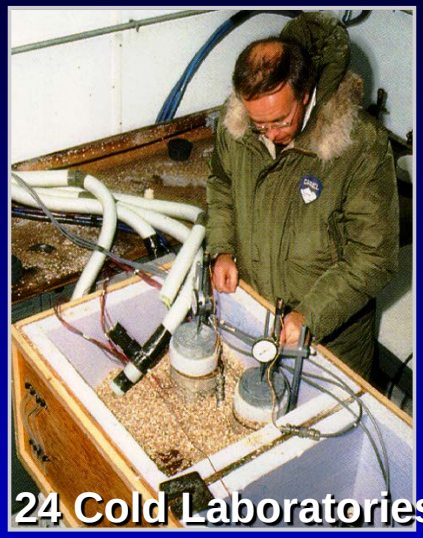
- Mechanical Engineers
- Civil Engineers
- Facilities Engineers
- Imagery Experts
- Snow Scientists
- Thermo-siphon experts
- Ground Penetrating Radar Experts
- Technicians

EPOLAR Collaborators

World-wide (world-class)
Experts from other ERDC labs, universities, government agencies and private sector

- CH2MHill Polar Services (CPS)/Polar Field Services
- Lockheed Martin
- Raytheon Polar Services Corporation (RPSC)
- Dartmouth College
- Carnegie Mellon University
- MTU Keweenaw Research Center
- Natick Soldier Research Center
- Texas A&M
- ERDC-CERL, TEC, CHL, GSL

Utilizes CRREL's Specialized & Unique Facilities


24 Cold Laboratories


Ice Engineering Model Room


Permafrost Research Tunnel
Fox, AK


Frost Effects Research Facility


Ice Engineering Test Basin

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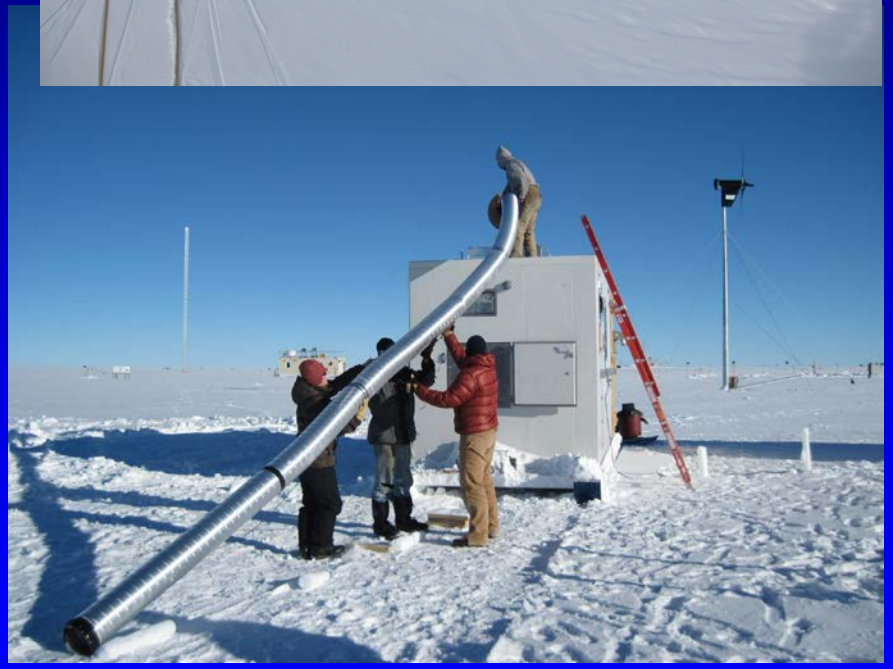
Engineer Research and Development Center

EPOLAR R&D Areas

- Transportation/Mobility
- Infrastructure
- Facilities
- Logistics

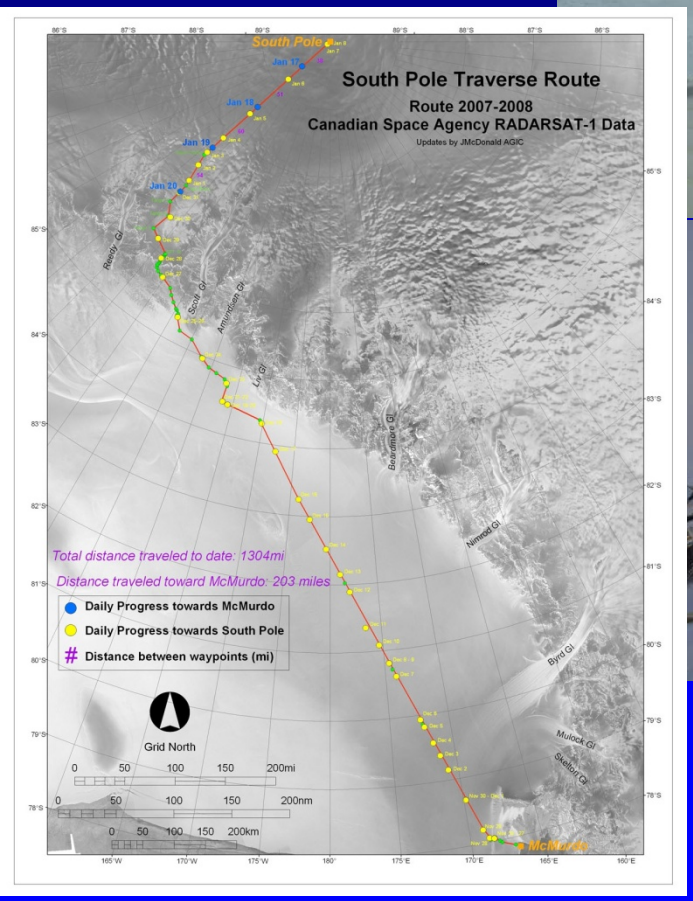


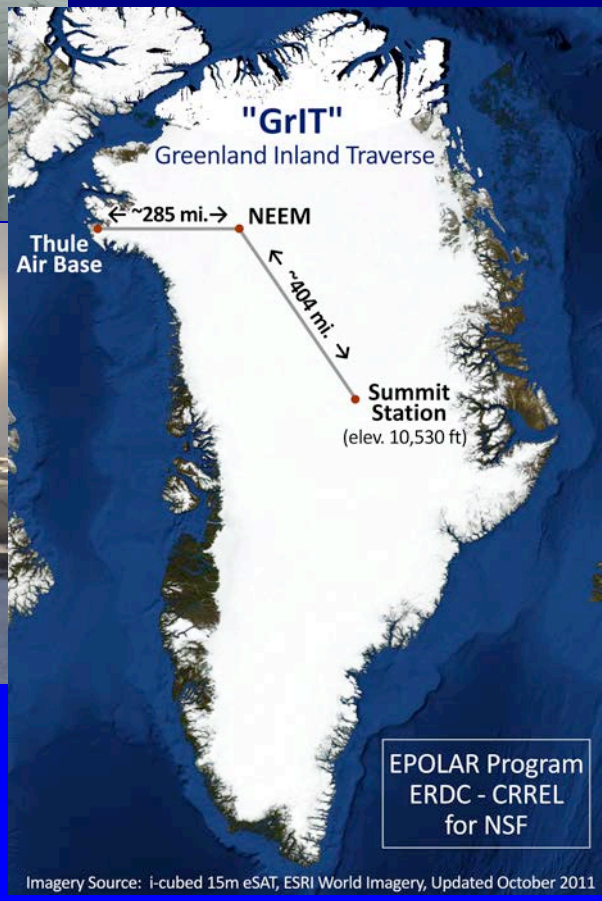
Transportation/Mobility-Polar Traversing

- Fuel and Cargo resupply from deep water ports to inland stations

South Pole Traverse (SPoT)
~ 1030 miles

Greenland Inland Traverse (GrIT)
~ 720 miles





Transportation/Mobility-Robotics

‘Yeti’- a small, low ground pressure vehicle to tow instruments for surveys

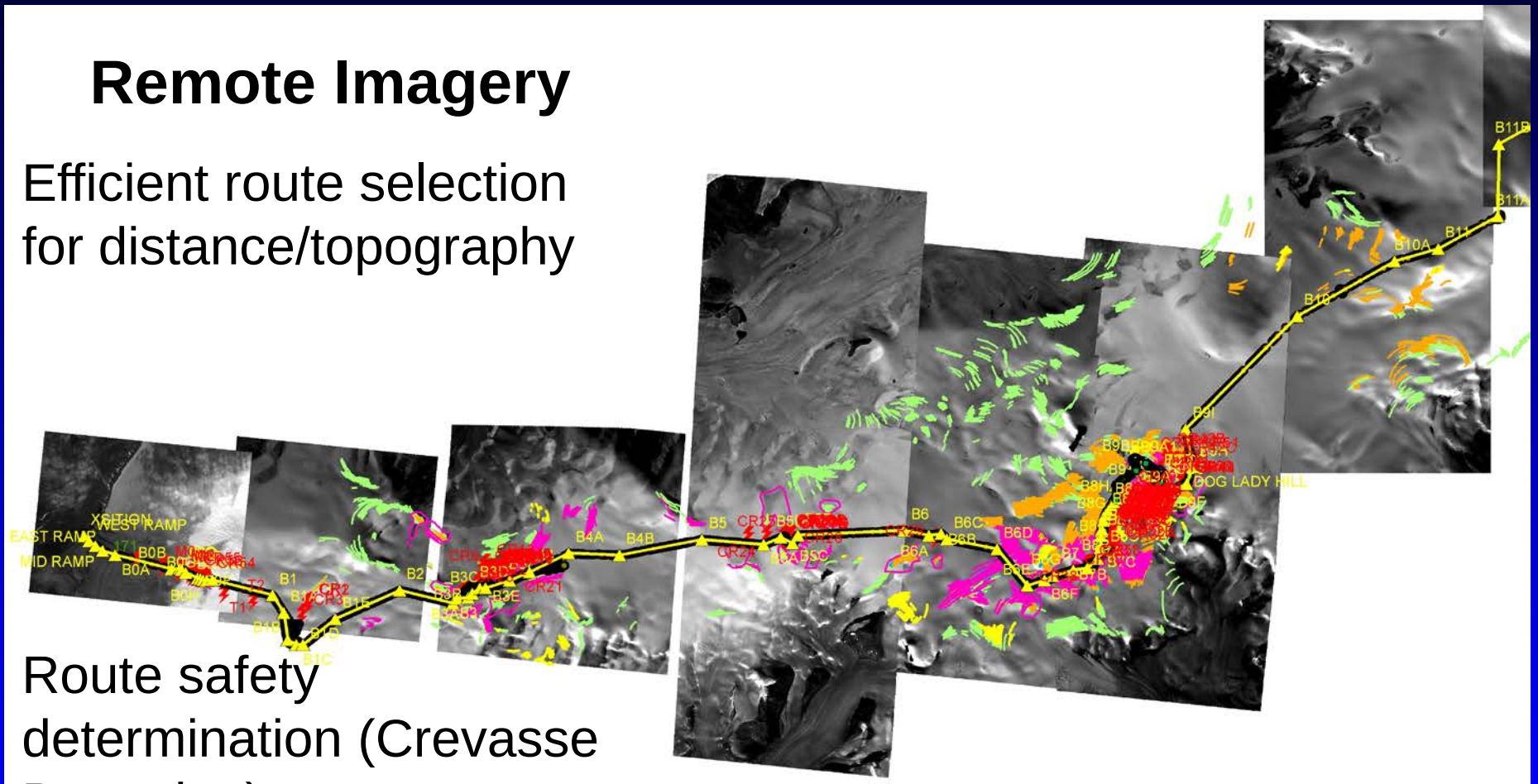
Roboticized heavy-haul tractors

- reduces manpower needs
- reduces total length of mission

Transportation/Mobility-Route Planning and Safety

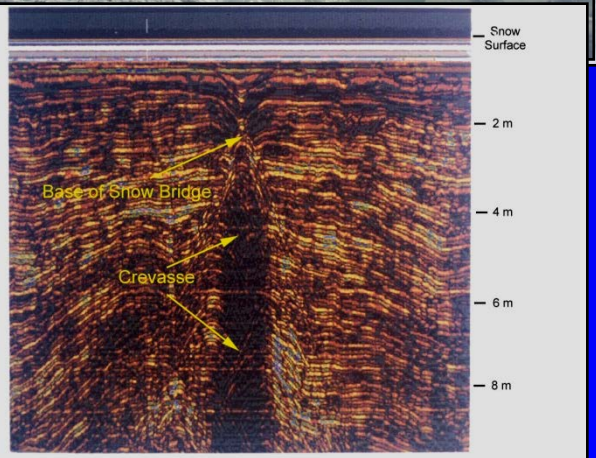
Remote Imagery

Efficient route selection for distance/topography



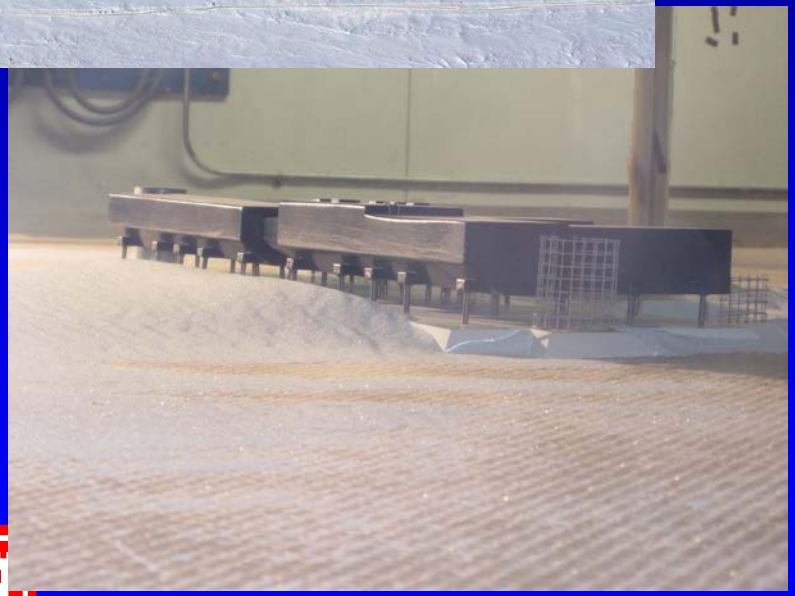
Route safety determination (Crevasse Detection)

Transportation/Mobility-Route Planning and Safety



- Combination of Imagery Analysis and Ground Penetrating Radar
- GPR relies on expert interpretation in real time (15 ft. stopping distance)
- Crevasse crossing criteria = 1/3 track length (based on sea ice travel criteria)

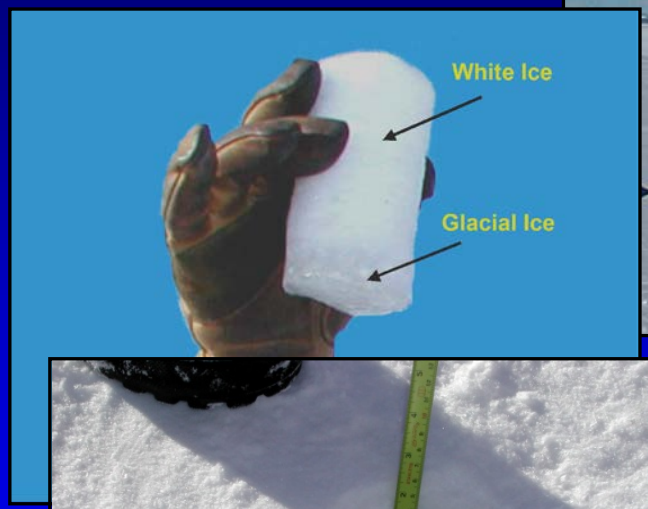
Infrastructure-Snow Drift Management



- Small-scale Physical Models of Buildings/Structures
- Wind Tunnel Snow Accumulation Studies
- Drift Management/Mitigation
- Building Design/Porosity Effects

Infrastructure-Airfields

- White-Ice Pavement
- Sea-Ice Runways
- Deep Snow Airfields



Infrastructure-Snow Roads/Transportation

- Snow Roads/Transport
- Construction/Maintenance practices
- Improve performance
- Improve Transportation Efficiency

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of Engineers

Infrastructure-Drainage/Erosion Management

- Flow/Sediment measurements
- Rerouting and Drainage Ditch Geometry
- Fines management
- Road/Surface Binding (Dust Reduction)

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Infrastructure-Rapid Deploy Buildings

- In Collaboration with Natick Soldier Research Center
- Airbeam Quonset Huts
  - Replace Korean War-era Jamesways
  - Light-weight
  - Fast Set up
  - Durable
- Field tested outside of Thule, Greenland in March 2011

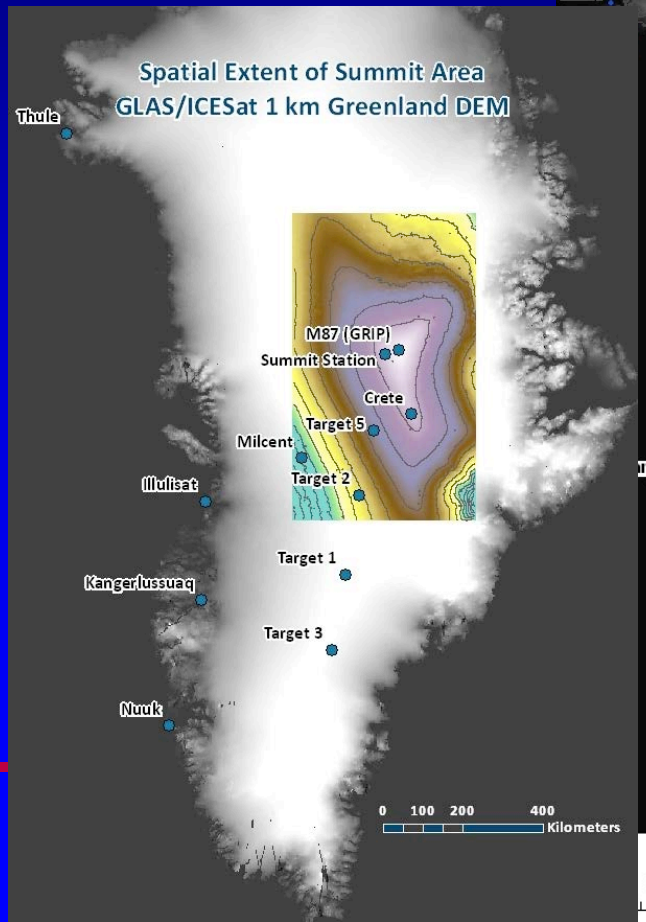
Rapid Deploy Buildings (cont.)

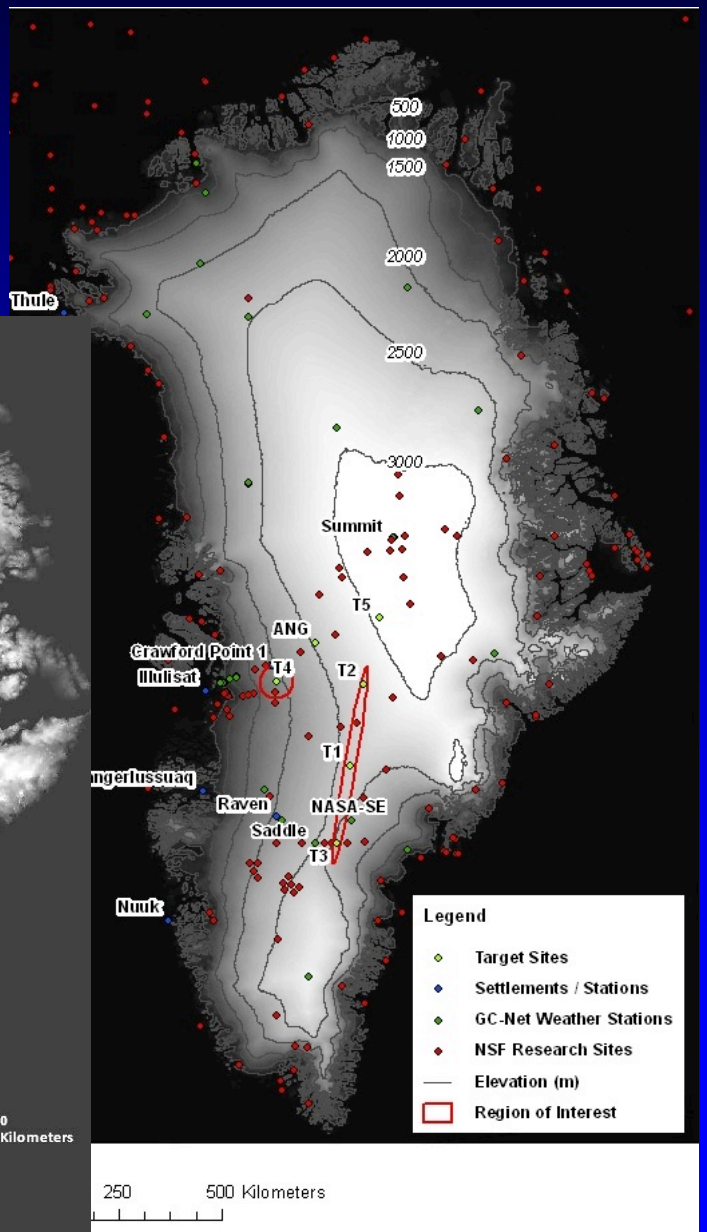
- **Combined cold temps and sustained high winds caused ‘cold cracking’ and fabric degradation**
- **Next generation-change of fabric**
- **SOP to limit use to summer**

Current Activity: SBIR (Knuth)- rapid-deploy light-weight structures to withstand extreme environments

Infrastructure-New Research Site for Greenland Telescope and non-Clean Air Studies

- Additional Research Site for Non-Clean Air Studies
- Planned Telescope Installation near Summit
  - Foundation test build this field season





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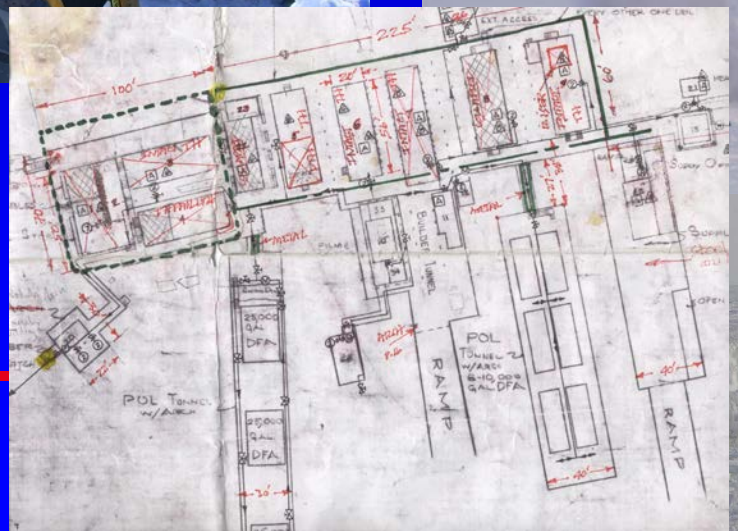
Old South Pole Station Remediation

- T5 buildings had double ‘top hats’ built over them as station drifted in
- All top hats now collapsed and drifting in
- Yeti re-surveyed area in 2011 to check for any remaining voids



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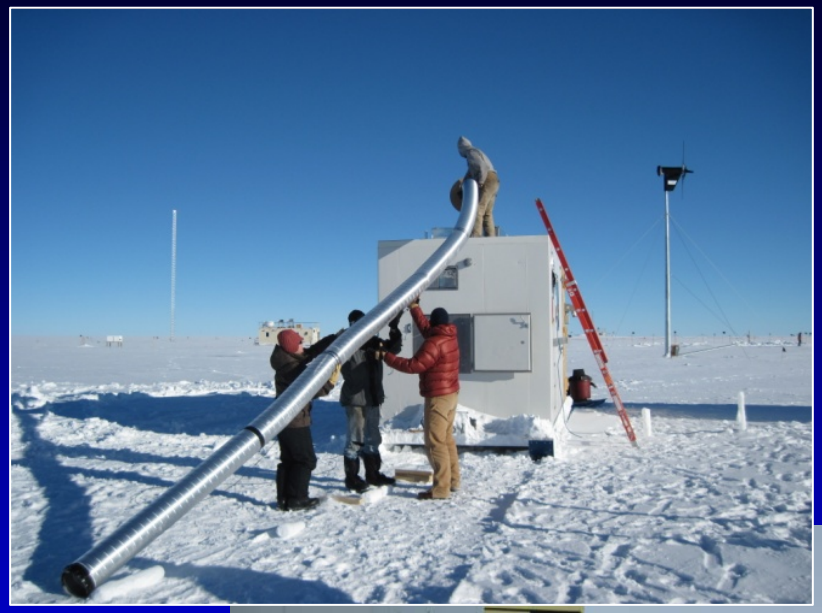
Facilities-Energy Efficiency and Structural Efficiency

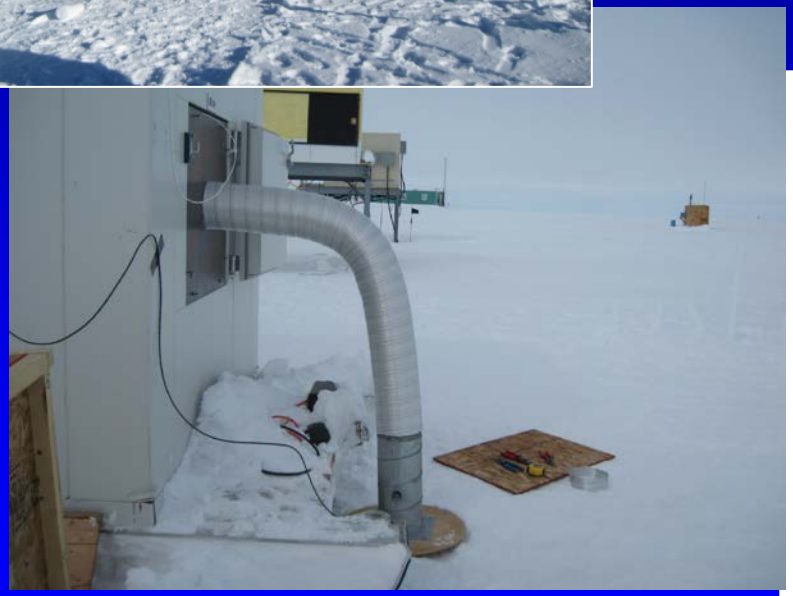
IR Camera surveys

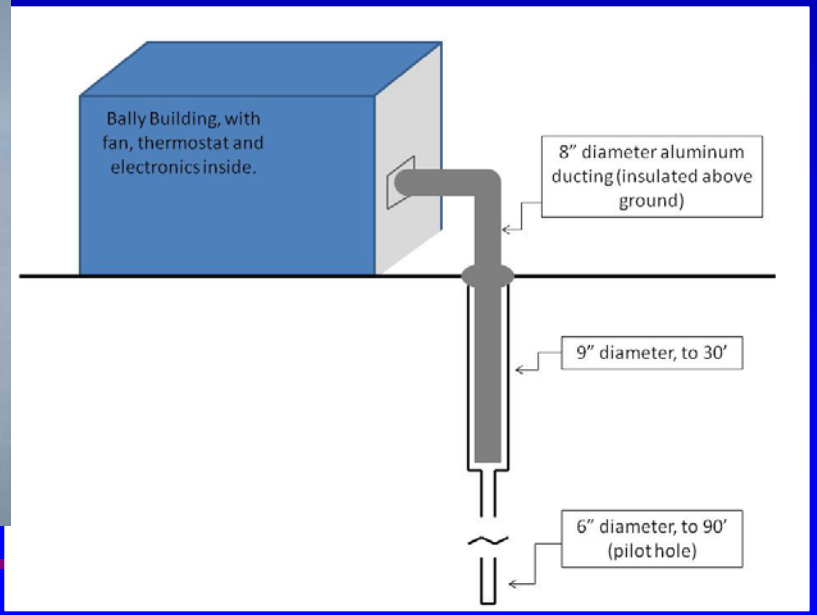
- Determine areas of energy inefficiency
- Analyze structural health/integrity
- Foundation Design
- Building Settlement

Facilities-Cooling Systems



- Using air trapped in snow firn to cool refrigeration units
- Food Storage (-18C FDA Regulation)
- Sample Storage (-20C max.)
- More energy efficient





Logistics-Resupply and Support Options

- Analysis of transport options to a small Antarctic coastal station (air, sea)
- Pier is small with only 30 feet depth

Questions/Comments?