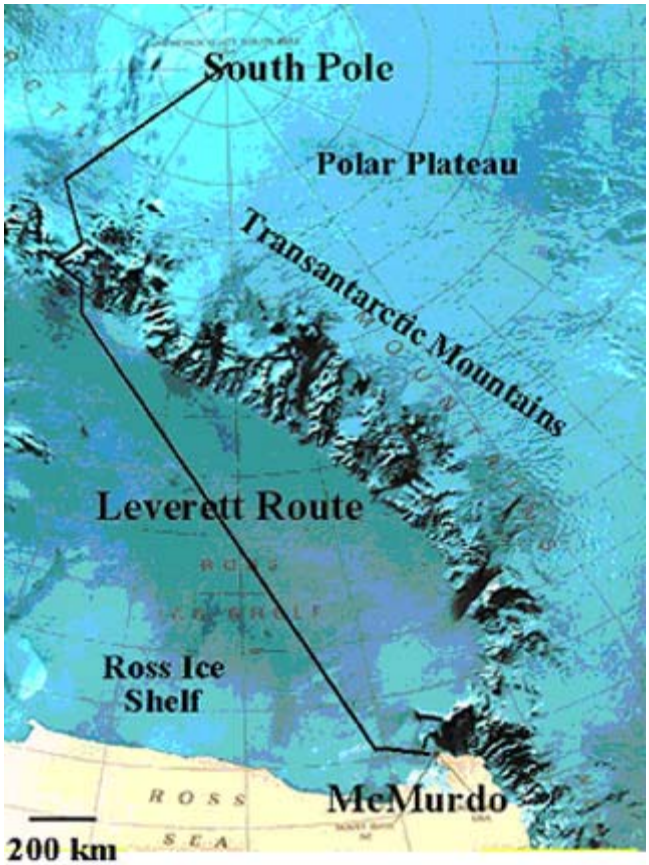
US Army Corps of Engineers®
Engineer Research and Development Center

Improving Cargo Train Mobility in Deep Snow in Antarctica

Description

ERDC's Cold Regions Research and Engineering Laboratory (CRREL) in Hanover, New Hampshire, conducted research for the United States Antarctic Program (USAP) to alleviate mobility challenges along the 1600-km over-snow route from McMurdo Station to South Pole Station in Antarctica. Despite relatively low sled ski pressures and encouraging pre-departure test results, cargo trains experienced poor mobility over undisturbed snow on the Ross Ice Shelf. A fleet of sleds encountered excessive towing resistances, immobility, and frequent breakdown. To define the problem and to recommend a solution, researchers conducted expedient mobility tests, snow-strength measurements, and snow-pit studies along 250 km of the route.



Traverse route from McMurdo Station across the McMurdo and Ross ice shelves, up the Leverett Glacier, and across the Polar Plateau to Amundsen-Scott South Pole Station.

Capabilities

After conducting numerous tests and analyzing the resulting data, the ERDC-CRREL researchers determined that the key phenomenon causing train immobility was traction–slip–resistance feedback resulting from sled skis riding in the ruts made by the towing tractors. Much lower towing resistance occurred when the same sleds were towed over undisturbed snow outside of the tractor ruts. Large pitch-and-roll motions, and consequently large resistance peaks, also occurred when several sleds were towed in series.

Supporting Technology

Researchers conducted expedient mobility tests and used instrumentation to measure fleet performance. Based upon their analyses, they made a number of recommendations to improve fleet mobility. These included towing fuel sleds in two-by-two, rather than four-in-line configurations; increasing sled gauge to place the skis outside of the tractor ruts; increasing ski area and altering nose shape for the fuel sleds; and installing instrumentation to monitor towing forces, sled sinkage, and snow strength along the entire route.

This tracked trailer (left) experienced large-amplitude roll motion. Sled motion caused numerous failures of attachment hardware, leading to "train wrecks" (right).

Researchers recommended towing fuel sleds in a two-by-two, rather than a four-in-line configuration, to decrease towing resistance and to improve mobility.

Benefits

The recommendations made as a result of this research have benefited the U.S. Antarctic Program by improving over-snow fleet mobility and decreasing the need for LC-130 aircraft to support operations, thereby significantly reducing operational costs and freeing these aircraft to support field work elsewhere in Antarctica.

Success Stories

All recommendations made by the ERDC-CRREL researchers were adopted by the U.S. Antarctic Program. These improvements realized a 55% reduction in required towing force.

ERDC POCs

Jason C. Weale
603-646-4321
E-mail: Jason.C.Weale@erdc.usace.army.mil