Fact Sheet

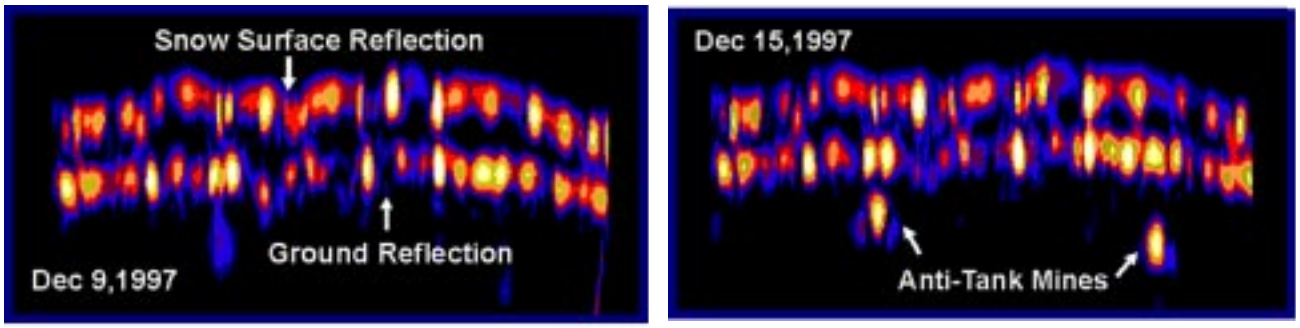
EFFECT OF FROZEN GROUND ON RADAR DETECTION OF BURIED LAND MINES

BACKGROUND

A key component of a multisensor package for detecting buried land mines is the surface-penetrating radar. The effect of environment on radar detection performance needs to be investigated to document the optimal operating conditions for radar sensors. Winter conditions such as snow cover can degrade the performance of a radar system. However, under appropriate conditions, the winter environment can enhance the performance of a radar system. The ability of radar signals to penetrate frozen ground can dramatically improve the performance of a radar mine detection system in a winter environment.

EXPERIMENTAL VERIFICATION

An FMCW radar operating at 2- to 6-GHz bandwidth was used to detect buried land mines in frozen and unfrozen soil. Buried thermistor array and a time domain reflectometer probe were used to monitor the movement of the freezing front into the soil. The following figure compares radar images, obtained approximately one week apart, of anti-tank mines at a snow-covered test site.



The enhanced detection capability observed on December 15, 1997, is attributed to the effect of frozen ground. The soil temperatures at the burial depth of the mines on December 9 and 15 were 0.2°C and –1.5°C, respectively. The permittivities of the soil on the respective dates were approximately 8 and 4. The effect of frozen soil is to enhance radar penetration, which greatly improves the probability of detection. The figure also illustrates the spatial variability of snow surface and ground reflections at radar frequencies.

SUMMARY

In a winter environment, the performance of radar sensors for detecting buried land mines will be enhanced when the ground is frozen.

POINT OF CONTACT

Gary Koh
(603) 646-4282
Fax: 603-646-4397
E-mail: gkoh@crrel.usace.army.mil

April 1998

US Army Corps of Engineers®
Cold Regions Research & Engineering Laboratory

CRREL, 72 Lyme Road, Hanover, NH 03755-1290