Project Could Provide Method To Track Changes In Ice Below Ground

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Rebekah Lee strides across a spongy landscape near Fairbanks, Alaska that calls to mind the strange landscapes in a Dr. Seuss children's book. Her rubber boots make a sloshing sound as they sometimes sink into the moss she walks on, carefully avoiding the treacherous clumps of grass that offer footing similar to stepping on a dodge ball. She walks alongside a measuring tape laid out on the ground, installing small geophones that will measure the vibrations in the ground that she along, with her mentors Rob Abbott and Hunter Knox of Sandia National Labs, will produce by striking a hammer against a metal plate.

This survey, along with measurements obtained by sticking a pole into the ground until it hits frozen ground, will serve as ground truth (or measurements known to be accurate) to test a new method (involving semi-permanently installed seismometers) for estimating the depth to permafrost. As the name suggests, permafrost is ground that is permanently frozen. The active layer is the layer above the permafrost that is able to freeze and thaw seasonally.

Thickness of the active layer has important implications for climate change. As more permafrost thaws, organic matter that was once trapped within the permafrost is able to decompose, releasing carbon dioxide and methane gas into the air. This creates a positive feedback loop as those gasses can warm the local environment, melting even more of the permafrost. The intensity of this feedback loop is unknown, but the potential release of large amounts of carbon contained in permafrost worldwide make tracking the changes to permafrost an important area of research.

There are already several methods for tracking the depth to permafrost but these methods are costly because they require site visits and realistically can only happen a few times per year. If successful, this new method would limit site visits and provide continuous estimates. Seismometers could be installed and left in the area of interest and then be used to track changes in the depth to permafrost over seasons or even years.

The setup for the method began in the fall of 2013 when Abbott traveled to the site near Fairbanks in order to install seven semi-permanent stations of seismometers to measure the natural, ambient noise of the area produced from sources like the wind moving through vegetation and even passing cars. These stations can take continuous measurements of waves traveling through the ground. As these waves travel, they interact with the ground they travel through and can tell something of the properties underneath the surface. In this case, the hope is to use a technique of processing the data called Horizontal to Vertical Spectral Ratio (HVSR) to track changes in the active layer through time.

Lee will use geophone data to obtain depth measurements and then compare results to those from the seismometers to test the new technique. If successful, this technique could be used with data previously collected from other seismometer stations, originally acquired for other purposes. This would provide a picture of the active layer reaching back several decades.