Reproducing Field-Scale Active Layer Thaw in the Lab

In sub-Arctic regions, the thawing of permafrost holds deep repercussions for the global climate. Thawing of permafrost due to warming releases carbon into the atmosphere, which is not offset by the extended growing season. Understanding the freezing and thawing of permafrost is one of the important topics of climate change.

In the August issue of the Vadose Zone Journal, researchers replicate a one-dimensional permafrost environment in a laboratory setting. Their apparatus is capable of simulating the climate conditions of natural biomes between -40°C and +40°C, including light, precipitation, humidity, and carbon dioxide conditions. The setup created a lower, frozen layer and an upper layer that was exposed to a variety of climate conditions corresponding to the Scotty Creek catchment located in Canada. The setup was placed in a larger concentric container with the air space between the containers set to replicate the lateral conditions. The complicated setup was meant to ensure accurate simulation of external conditions in a closed laboratory chamber. The soil column was instrumented to measure the temperature at various levels in both the vertical and radial directions.

In the course of this experiment, temperature was measured at various depths and compared with the measurements in the field at Scotty Creek, Canada. The experiment results show a good comparison of temperatures at various depths for the freeze-thaw dynamics seen in the field.

The results show us that laboratory-scale models can be used to predict the changes in the thermal regime of the permafrost and active layer as a response to climate change. Use of instruments like this will help us to predict changes and release of stored soil carbon in sub-Arctic regions.

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