

Press Release – July 21st, 2020

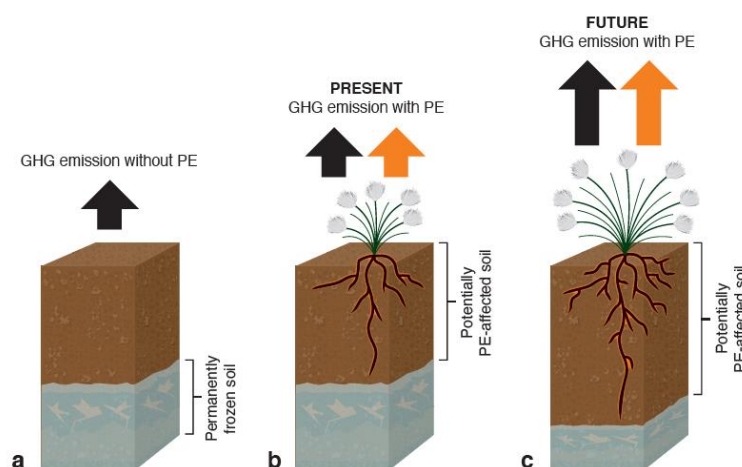
Plant roots increase carbon mission from permafrost soils

A key uncertainty in climate projections is the amount of carbon emitted by thawing permafrost in the Arctic. Plant roots in soil stimulate microbial decomposition, a mechanism called the priming effect. An international research team co-lead by Frida Keuper from INRAE and Umeå University and Birgit Wild from Stockholm University shows that the priming effect alone can cause emission of 40 billion tones carbon from permafrost by 2100. The study was published on July 21st in *Nature Geoscience*.

Permafrost is permanently frozen ground which stores as much carbon as there is in all plants on Earth and in the atmosphere together. The surface of the permafrost thaws in summer, allowing plant and soil life to thrive. When microorganisms breathe, they emit greenhouse gases. Scientists have previously anticipated that rapidly rising temperatures will drive the emission of 50-100 billion tones permafrost carbon by 2100. On top of that, plant roots feed sugar to the microorganisms in the soil, which the microbes can use to break down more soil organic matter – the priming effect – resulting in even higher greenhouse gas emissions.

“We have known about the priming effect since the 1950’s, but we did not know whether or not this small-scale ecological interaction had a significant impact on the global carbon cycle”, says Research Scientist Frida Keuper, affiliated with the French National Research Institute for Agriculture, Food and Environment, INRAE, and with Umeå University, Sweden.

The team of researchers combined maps of plant activity and data on soil carbon content from the Northern Circumpolar Soil Carbon Database with an extensive literature survey on priming and plant root properties, to estimate the priming effect in permafrost ecosystems and its influence on greenhouse gas emissions.



The priming effect (PE). (a) Greenhouse gas emissions (GHG) from permafrost soil without the priming effect; (b) GHG emissions from permafrost soil including the priming effect under present conditions; (c) Future scenario considering climate warming: faster growing plants; deeper thaw of the permafrost surface in summer; deeper rooting depth. Figure produced in collaboration with INproduktie, Amsterdam.

They show that the priming effect increases soil microbial respiration by 12 percent, which causes the additional loss of 40 billion tones carbon by 2100 compared to current predictions for permafrost. This equals almost a quarter of the remaining 'carbon budget' for human activities to limit global warming to max 1.5°C.

"These new findings demonstrate how important it is to consider small-scale ecological interactions, such as the priming effect, in global greenhouse gas emission modelling", says Birgit Wild, Assistant Professor at Stockholm University.

References

Frida Keuper, Birgit Wild, Matti Kummu, Christian Beer, Gesche Blume, Werry, Sébastien Fontaine, Konstantin Gavazov, Norman Gentsch, Georg Guggenberger, Gustaf Hugelius, Mika Jalava, Charles Koven, Eveline J. Krab, Peter Kuhry, Sylvain Monteux, Andreas Richter, Tanvir Shahzad, James T. Weedon, Ellen Dorrepaal, *Carbon loss from northern circumpolar permafrost soils amplified by rhizosphere priming*, Nature Geoscience (2020)

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