Study suggests melting of Arctic permafrost may release massive amounts of nitrous oxide

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Permafrost peatbog border. Storflaket, Abisko, Sweden. Credit: Dentren/Wikipedia

(Phys.org)—A team of researchers from Sweden, Denmark and Finland

has conducted field experiments that offering evidence that suggests permafrost melting in the Arctic could release major amounts of nitrous oxide into the atmosphere. In their paper published in *Proceedings of the National Academy of Sciences,* the group describes their experiments and explain why they believe nitrous oxide emissions could have a bigger than thought impact on the speed at which the planet is heating up.

Scientists know that nitrous oxide is also a greenhouse gas, but because far less of it is emitted into the atmosphere, it has not generated the same degree of interest as carbon dioxide. But that might have to change, as the researchers suggest that the impact of melting permafrost might lead to the release of massive amounts of the gas. This could be a problem because nitrous oxide causes more blanketing in the atmosphere than carbon dioxide—prior research has shown it to be 300 times as heat retaining. It also has an atmospheric lifetime of 110 years and when it does finally break down it takes some atmospheric ozone with it. Currently, the largest natural source of nitrous oxide are rainforests, the researchers note, but that could change, they contend, as global warming causes permafrost to melt.

The researchers came to this conclusion by conducting tests on 16 peatland "mecocosms" in Finnish Lapland they designated. Each was a plot of land over permafrost, approximately 80 by 10 centimeters. Some were covered in plants, others lichen, while others were bare. Each plot was subjected to different conditions that caused the permafrost to melt over the course of 33 weeks while the researchers took core samples and used sensors to measure the amount of nitrous oxide released.

The group reports that the plots covered in plants or water did not release much of the gas, but the bare plots released as much of the gas as a similar plot in the rainforest, which was five times as much as normal. This, they contend, becomes more important in light of prior research finding that approximately one-fourth of the Arctic landmass area is

bare peat and that warming in the area is expected to cause relatively dry melting.

More information: Carolina Voigt et al. Increased nitrous oxide emissions from Arctic peatlands after permafrost thaw, *Proceedings of the National Academy of Sciences* (2017). DOI: 10.1073/pnas.1702902114

Abstract
Permafrost in the Arctic is thawing, exposing large carbon and nitrogen stocks for decomposition. Gaseous carbon release from Arctic soils due to permafrost thawing is known to be substantial, but growing evidence suggests that Arctic soils may also be relevant sources of nitrous oxide (N2O). Here we show that N2O emissions from subarctic peatlands increase as the permafrost thaws. In our study, the highest postthaw emissions occurred from bare peat surfaces, a typical landform in permafrost peatlands, where permafrost thaw caused a fivefold increase in emissions (0.56 ± 0.11 vs. 2.81 ± 0.6 mg N2O m−2 d−1). These emission rates match those from tropical forest soils, the world's largest natural terrestrial N2O source. The presence of vegetation, known to limit N2O emissions in tundra, did decrease (by ~90%) but did not prevent thaw-induced N2O release, whereas waterlogged conditions suppressed the emissions. We show that regions with high probability for N2O emissions cover one-fourth of the Arctic. Our results imply that the Arctic N2O budget will depend strongly on moisture changes, and that a gradual deepening of the active layer will create a strong noncarbon climate change feedback.

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