

Rising emissions are turning arctic permafrost into a carbon source, research shows

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Arctic regions have captured and stored carbon for tens of thousands of years, but a new study shows winter carbon emissions from the Arctic may now be putting more carbon into the atmosphere than is taken up by plants each year.

The study, supported by NASA ABoVE and conducted in coordination with the Permafrost Carbon Network and more than 50 collaborating institutions, was published today in the prestigious *Nature Climate Change* journal. It warns that winter carbon dioxide loss from the world's permafrost regions could increase by 41 percent if human-caused [greenhouse gas emissions](#) continue on their current pace.

"High-latitude cold regions, including Arctic, are warming more than twice as fast as the rest of the planet, with the greatest warming occurring during the winter. Given that a major process responsible for CO₂ emissions; microbial respiration, increases with warming even at [sub-zero temperatures](#), winter is a critical period for carbon cycling," said study co-author Dr. Fereidoun Rezanezhad, University of Waterloo Water Institute & Ecohydrology Research Group member and professor in Earth and Environmental Sciences.

"We've known that [warmer temperatures](#) and thawing permafrost have been accelerating winter CO₂ emissions, but we haven't had a clear accounting of the winter carbon balance," said WHRC Arctic Program Director Dr. Sue Natali, lead author on the study.

Permafrost is the carbon-rich frozen soil that covers 24 percent of Northern Hemisphere land area. Across the globe, from Alaska to Siberia, permafrost holds more carbon than has ever been released by humans. Right now, permafrost keeps carbon safely locked away, but as [global temperatures](#) warm, permafrost thaws and releases greenhouse gases to the atmosphere. Carbon from thawing permafrost had been omitted from many models and reports that informed international climate policy.

Researchers synthesized on-the-ground observations of CO₂ emissions to assess current and future winter carbon losses from the northern permafrost regions. They estimate a contemporary loss of 1.7 million

metric tons of carbon from the permafrost region during the winter season (October through April). That loss is greater than the average growing season carbon uptake for this region estimated from process models (1.0 million metric tons of carbon taken up per year). Extending model predictions to warmer conditions in 2100 indicates that winter CO₂ emissions could increase 17 percent under a moderate mitigation scenario (RCP 4.5) but could rise 41 percent under a business-as-usual emissions scenario (RCP 8.5).

"Considering the vast amount of land within the world's permafrost regions, it is difficult to gauge how quickly ecosystems are changing. The research resulting from this project could inform government decision-making on climate action to see the impacts of winter warming on the export of [carbon](#) under different climatic scenarios" said Dr. Rezanezhad.

Dr. Rezanezhad is leading more research on [winter](#) processes in Canadian wetlands, peatland, permafrost and agroecosystem through [Winter Soil Processes in Transition](#), a Global Water Futures project and an NSERC Climate change funded initiative entitled Winter Carbon Losses in Wetland Ecosystems under Current and Future Climates.

More information: Susan M. Natali et al. Large loss of CO₂ in winter observed across the northern permafrost region, *Nature Climate Change* (2019). [DOI: 10.1038/s41558-019-0592-8](https://doi.org/10.1038/s41558-019-0592-8)

Provided by University of Waterloo

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