WATER INSTITUTE

Newly published article projects increase in peatland carbon emissions during non-growing season due to climate warming

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In an impactful article just released in Nature's Communications Earth & Environment journal, Water Institute members Fereidoun Rezanezhad and Philippe Van Cappellen provide insight into how global peatlands may respond to future climate warming.

Peatlands, which are a type of wetland, are some of the most valuable ecosystems globally. In addition to their role in preserving biodiversity and minimizing flood risk, they store approximately one third of the world's terrestrial organic carbon, despite only covering an estimated three per cent of the continents. As the climate warms, it is important to understand to what degree this will impact peatland ecosystems and their release of CO_2 emissions – especially in areas of greatest warming, which include peatlands in northern regions and during the non-growing season (NGS).


Mer Bleue Bog.

In order to improve our ability to predict NGS CO_2 emissions from northern peatlands under current and future climate change, a team of Water Institute researchers led by Ecohydrology Research Group Professors Fereidoun Rezanezhad and Philippe Van Cappellen worked with Professor William Quinton (Wilfrid Laurier University), Professor Elyn Humphreys (Carleton University), and Dr. Kara Webster (Canadian Forest Service Great Lakes Forestry Centre, Natural Resources Canada) to develop a machine learning model to determine that changes in soil temperature and photosynthesis are the primary drivers of changes in net carbon flux. To predict future NGS CO_2 emissions, the team developed the model using a continuous 13-year dataset of eddy covariance flux measurements from a peatland site located in Ottawa, Canada called the Mer Bleue Bog. As a result, they project a 103 per cent increase in peatland carbon loss by 2100 under a high radiative forcing scenario. Peatland carbon loss will therefore constitute a strong positive climate feedback loop.

> "Our research offers important insights into how Canada's northern peatlands will react to climate warming, especially during the non-growing season. We expect that in a warmer world, peatlands will increasingly become a major source of CO_2 emissions" said Rezanezhad.

While previous studies have improved our understanding of peatland carbon dynamics during the growing season, few have tried to predict CO_2 emissions during the NGS in remote cold regions. Those that have tend to show that these areas are contributing significantly to annual ecosystem carbon budgets. Despite this, these studies were still not able to predict how NGS CO_2 emissions from northern peatlands will change under an evolving and uncertain 21st century climate.

> As an undergraduate student at the University of Waterloo, I was grateful for the opportunity to work on such a unique project, and to be the lead author of an article that is published in such a highly impactful journal." said Arash Rafat.

The study has implications for future climate policy. Even under the lowest radiative forcing scenario, the Mer Bleue Bog will act as a source of CO_2 during the NGS throughout the remainder of the 21st century, reinforcing the hypothesis that climate warming has the potential to increase peatland CO_2 emissions during the NGS across various northern regions from around the world.

The study was part of the "Winter Carbon Losses in Wetland Ecosystems under Current and Future Climates" project within the "Advancing Climate Change Science in Canada" initiative funded jointly by Environment and Climate Change Canada, Natural Sciences and Engineering Research Council (NSERC), and Health Canada. Future work will look to investigate the influence of climate warming on different peatland types (fens, swamps, marshes) across various cold-region landscapes. Results of this work will be integrated into the Canadian Model for Peatlands (CaMP) to improve national estimates of net ecosystem exchanges and carbon emissions during the NGS.

This research was funded by the Canada Excellence Research Chair (CERC) in Ecohydrology, the Advancing climate Change Science in Canada program, the Winter Soil Processes in Transition project within Global Water Futures and a Natural Sciences and Engineering Research Council (NSERC) Discovery Grant.

Learn more about the research.