Northern peatlands may contain twice as much carbon as previously thought

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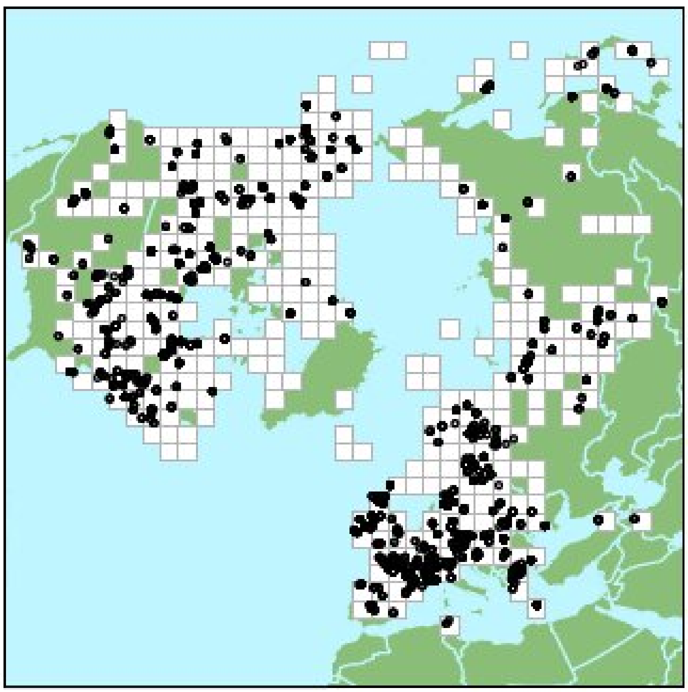

Map of sampled northern peatlands. Each white square indicates a grid where at least one sample with a basal age exists. Black dots indicate samples with additional information on depth. Because there are fewer samples from Asia and Eastern Europe, previous estimates of peatland carbon storage are believed to have been biased. Credit: Adapted from Nichols and Peteet, 2019.

Northern peatlands may hold twice as much carbon as scientists previously suspected, according to a study published today in *Nature*

Geoscience. The findings suggest that these boggy areas play a more important role in climate change and the carbon cycle than they're typically given credit for.

Peatlands are damp, mossy landscapes built on layers of partially decayed plants. Because the plant matter doesn't fully break down, peat can end up storing large amounts of carbon for thousands of years—much longer than a typical forest. Yet global climate models, which scientists use to predict climate change and its impacts, rarely account for the carbon that peat and other soils absorb, store and release.

"The carbon that's underground is the least well understood pool of carbon," said lead author Jonathan Nichols, an associate research professor at Columbia University's Lamont-Doherty Earth Observatory. "It's a huge question mark in a lot of global climate models." Refining those measurements could make climate models—and thus climate predictions—more accurate. That is what Nichols and his coauthor Dorothy Peteet, a paleoclimatologist at the NASA Goddard Institute for Space Studies and adjunct at Lamont-Doherty, set out to do.

Their new study incorporates 4,139 radiocarbon measurements from 645 peatland sites in northern Europe, Asia, and North America. But the main innovation is in how the researchers calculated the carbon storage in peatlands.

"Before, it was just assumed that all peatlands have accumulated carbon at the same rate at the same time throughout the last few thousand years, which is a terrible assumption," said Nichols. "The carbon accumulation rate can be wildly different from one place to another during the same point in time. Our own previous work has shown this, as well as the work of many others."

The problem was that there just wasn't a good statistical way to account for those differences. So Nichols and Peteet came up with a new algorithm to estimate the total amount of carbon stored in northern peatlands. "It allows us not to have to make this assumption that we all know is wrong," said Nichols.

Previously, scientists simply averaged the carbon accumulation rate measured in as many peat samples as they could find, and multiplied that average by the total area of peatland in the Northern Hemisphere. This strategy was biased, Nichols and Peteet point out, because there are many fewer samples from less-studied areas such as Asia or Eastern and Southern Europe; the data from these undersampled areas was effectively washed out by the sheer volume of measurements from North America and Europe.

By assuming peatlands in different parts of the world accumulate peat at different rates, and by weighing those rates by the size of the region, the new algorithm allowed the researchers to calculate that northern peatlands hold 1.1 trillion tons of carbon. That's a colossal amount of carbon—more than humans have so far dumped to the atmosphere by burning fossil fuels—and quite a jump from the previous estimate of roughly 545 billion tons.

Nichols and Peteet found that after the last glacial period, when the peatlands were absorbing this huge amount of carbon, the level of carbon in the atmosphere remained stable. How could that be, if the peatland plants were pulling carbon out of the air during photosynthesis and then never releasing it? The researchers suspect the ocean released more carbon during that time, which compensated for the carbon removed by the growing peatlands.

"An important next step is to add peat to simulations of global climate," said Nichols. "The more we understand the climate system, the better our models of that system are going to be."

The study's findings also have implications for predicting future carbon emissions from peatlands. "The parts of the world with peat are also the parts that are warming faster than the rest of the world. What happens when you warm them up? Do they grow faster and sequester more carbon, or do they decay faster and release more?" Nichols asks.

In general, he's finding that peatlands are decaying faster and releasing more carbon as the planet's thermostat climbs; climate change is disrupting natural rainfall patterns in peatlands, which can push out mosses in favor of plants such as sedges. Sedges grow and decay faster, and their roots bring oxygen deep into the layers of peat, allowing organic material to break down and release carbon that may have been stored there for millennia. In addition, humans often mine peatlands and burn the peat for fuel or use it in agriculture or horticulture. All these processes convert peatlands from absorbers of carbon to emitters, said Nichols. "And because of the work we've done for this paper, we now know that there's a lot more carbon that can be released to the atmosphere than we thought," he said.

More information: Rapid expansion of northern peatlands and doubled estimate of carbon storage, *Nature Geoscience* (2019). DOI: 10.1038/s41561-019-0454-z , nature.com/articles/s41561-019-0454-z

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