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Bad Sign for Global Warming: Thawing Permafrost Holds Vast Carbon Pool

GAINESVILLE, Fla., Sept. 3 (AScribe Newswire) -- Permafrost blanketing the northern hemisphere contains more than twice the amount of carbon in the atmosphere, making it a potentially mammoth contributor to global climate change depending on how quickly it thaws.

So concludes a group of nearly two dozen scientists in a paper appearing this week in the journal Bioscience. The lead author is Ted Schuur, an associate professor of ecology at the University of Florida.

Previous studies by Schuur and his colleagues elsewhere have estimated the carbon contained in permafrost in northeast Siberia. The new research expands that estimate to the rest of the permafrost-covered northern latitudes of Russia, Europe, Greenland and North America. The estimated 1,672 billion metric tons of carbon locked up in the permafrost is more than double the 780 billion tons in the atmosphere today.

"It's bigger than we thought," Schuur said.

Permafrost is frozen ground that contains roots and other soil organic matter that decompose extremely slowly. When it thaws, bacteria and fungi break down carbon contained in this organic matter much more quickly, releasing it to the atmosphere as carbon dioxide or methane, both greenhouse gases.

Scientists have become increasingly concerned about this natural process as temperatures in the world's most northern latitudes have warmed. Just last week, it was announced that the amount of sea ice covering the Arctic may reach a new low this summer. Meanwhile, there is widespread consensus that the highest latitudes will warm the fastest, a process already visible in the accelerated thawing of glaciers worldwide.

Two years ago, Schuur and two colleagues authored a paper in the journal Science estimating that 400,000 square miles of northeast Siberian permafrost contained 500 billion metric tons of carbon. For this new paper, scientists combined an extensive database of measurements of carbon content in different types of permafrost soils with the estimated spatial extent of those soils in Russia, Europe, Greenland and North America.

Schuur said the researchers estimated the carbon contained in permafrost to a depth of three meters, two meters deeper than many earlier estimates. Although permafrost depths vary greatly with location, basing the estimate on three-meter depth "better acknowledges the true size of the permafrost carbon pool," Schuur said.

The new estimate is important because it mirrors other climate change science suggesting that at a certain tipping point, natural processes could contribute significant amounts of greenhouse gases, supplementing human-influenced, industrial processes that release fossil fuel carbon, Schuur said.

"There are relatively few people living in the permafrost zone," Schuur said. "But we could have significant emissions of carbon from thawing permafrost in these remote regions."

How fast the permafrost would release its carbon is a hugely important question.

Schuur said the burning of fossil fuels contributes about 8.5 billion tons of carbon dioxide each year. Deforestation of the tropical forests and replacement of the forest with pasture or other agriculture is thought to add about 1.5 billion tons per year. How much permafrost will add will depend on how

fast it thaws, but Schuur said his research indicates the figure could approach .8-1.1 billion tons per year in the future if permafrost continues to thaw.

With the Arctic warming and permafrost thawing, shrubs and trees are likely to grow on ground formerly occupied by tundra - indeed, such a transformation has already been observed in parts of Alaska, where some arctic tundra is becoming shrub land.

Because plants take in carbon dioxide and release oxygen, it might appear they could compensate for whatever carbon is released by the thawed permafrost. But Schuur said the amount of carbon stored in the permafrost is far greater than what is found in shrubs or trees.

For example, he said, a mature boreal forest may contain five kilograms per meter squared of stored carbon. But the same area of permafrost soil can contain 44 kilograms, and 80 percent of that could be lost over long-term warming. "The bottom line," he said, "is that you can't grow a big enough forest to offset the carbon release from the permafrost."

The research was conducted as part of the International Polar Year 2008-2009 and sponsored by the National Science Foundation-funded National Center for Ecological Analysis and Synthesis, and the United Nations Educational, Scientific and Cultural Organization in a grant to the Global Carbon Project.

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