Thawing permafrost has turned the Arctic into a carbon emitter

By Adam Vaughan, *New Scientist* (weekly magazine published in UK), Oct 21, 2019 (and read a related article further below)

The Arctic has begun releasing more carbon than it is absorbing. The change is a result of climate change thawing frozen ground, and the problem is expected to get much worse as the world warms further.

Previously, it appeared some sites in the Arctic had already flipped from being carbon sinks into sources of emissions, but research now shows the phenomenon has happened across the region as a whole.

Vegetation growth in the far north absorbs carbon dioxide across summer, and we had thought that negligible amounts of CO_2 were escaping from frozen soil in the long winter months, as the cold temperatures prevented thawing. Now it appears the region has warmed enough to change that. Observations for 2003 to 2017 show that between October and April, the Arctic emitted 1.66 gigatonnes of CO_2 a year, outweighing the 1.03 gigatonnes soaked up over the rest of the year.

"Given that the Arctic has been taking up carbon for tens of thousands of years, this shift to a carbon source is important because it highlights a new dynamic in the functioning of the Earth system," says Susan Natali at Woods Hole Research Center in Massachusetts. A recent report by the UN's Intergovernmental Panel on Climate Change didn't make it explicit that this threshold had been passed.

Natali and her colleagues compiled data from ground measurements of CO_2 flows collected over past decades across the Arctic, along with observations of other variables that can drive those flows, including soil temperature. They used the data to build a machine-learning model and project what the future holds as temperatures rise.

The model paints a worrying picture. Under the worst-case global scenario, by 2100 the CO_2 emissions from the Arctic's thawing permafrost will climb by 41 per cent. That would be the equivalent of adding the annual emissions of a country such as the UK.

However, if countries hold temperature rises below 2°C as the Paris climate deal demands, the increase will be limited to 17 per cent. Some level of soil warming and permafrost thaw in the Arctic is now unavoidable, but Natali says the work shows we can greatly reduce the impact by cutting global emissions.

Hanna Lee at Norwegian research centre NORCE says the study challenges assumptions that the region is still too cold to release CO_2 and shows the importance of monitoring winter emissions.

One aspect the research didn't examine was whether those emissions might be partially offset in coming decades by higher CO_2 levels driving increased plant growth. The study also didn't look

at methane emissions from permafrost, which researchers fear could abruptly skyrocket as temperatures rise.

In the future, another thing to watch for is whether fires, such as the unprecedented blazes across the Arctic this summer, will make the region an even bigger emitter of CO_2, as they strip off the trees and vegetation that insulate the permafrost.

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Related:

Huge Arctic fires have now emitted a record-breaking amount of CO2

By Adam Vaughan, *New Scientist*, July 25, 2019

Huge wildfires are continuing to burn across the Arctic, and have now released more carbon dioxide in 2019 than in any year since satellite records began nearly two decades ago.

Temperatures have been well above average in the region, and fires erupted in boreal peatlands across Siberia around 9 June. Normally the fires would last a few days, but this year some vegetation and peatland has been ablaze for a month and a half.

The result is the rapid release of more than 121 megatonnes of carbon dioxide – more than Belgium's annual emissions – eclipsing the previous record of 110mt of CO2 for the whole of 2004. "Based on our 17 years of data, this is unusual, particularly for northern Siberia," says Mark Parrington of the European Centre for Medium-Range Weather Forecasts.

The wildfire season in the Arctic usually runs from the start of July to the end of August, so Parrington notes the burning could continue for several more weeks yet, emitting even more carbon dioxide. Fires are not unknown in the region, but the duration of these ones are particularly unusual.

"The Arctic has historically experienced fire, and the area in Russia that is burning does have a history of fire," says Merritt Turetsky at University of Guelph. "But these Arctic fires are expected to occur more severely and more frequently in the future, and the CO2 measurements are a demonstration of how this will influence regional and potentially global emissions."

While the fires were initially clustered around the north of the Sakha Republic in Russia, more fires have appeared elsewhere in Russia, along with Alaska and even the south-west of Greenland. "Boreal Alaska is having a severe fire year and my guess is that fires will start affecting western Canada," says Turetsky.

Ruth Mottram at the Danish Meteorological Institute says the whole of Greenland has been experiencing “something exceptional” in high ground temperatures, which may be a contributing factor to fires, along with low rainfall.

There is no reason why more fires couldn’t occur in the next few weeks and next year, says Parrington. “If the permafrost is melting and there’s more peat and fuel available, it’s dry enough, and there’s lightning, sure you would expect to see something [again].”

Many of the Arctic fires are on peatland and could have been started by lightning strikes, judging from the type of clouds before the fires started and the colour of the smoke, an analysis by Thomas Smith of the London School of Economics found.

As well as bad news for efforts to tackle climate change, smoke from the fires has an immediate impact on human health. “The air quality in parts of Alaska are very poor and this is a direct result of the fires. People with respiration issues such as asthma are particularly vulnerable,” says Turetsky.