Arctic river flood plains are home to hidden carbon

Research reveals an overlooked role for rivers in northern ecosystems.

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The Colville River runs across northern Alaska.

In the race to account for how carbon moves through Arctic ecosystems, especially as they warm, scientists may be overlooking one major component: river flood plains.

A preliminary study of ten Arctic rivers suggests that they cycle roughly three to seven times more carbon through their flood plains than eventually exits the river into the ocean, says Joel Rowland, a geomorphologist at the Los Alamos National Laboratory in New Mexico.

The fate of that flood-plain carbon isn't known. It may be respired into the atmosphere, or be redeposited on riverbanks farther downstream. Either way, it represents an important chunk of the Arctic carbon budget that researchers do not yet understand, Rowland says. "There's a lot of action going on that's been ignored."

He reported the findings on 25 September at a meeting of the Geological Society of America in Denver, Colorado.

Arctic rivers are responsible for some 10% of the world's freshwater discharge, and their enormous size and meandering paths mean that many of them have large flood plains. Yet few studies have tackled what river flood plains mean for global carbon cycling, says Katherine Lininger, a geomorphologist at Colorado State University in Fort Collins.

Instead, researchers typically view rivers as pipes, funnelling the carbon that enters them upstream all the way to the ocean, practically untouched. Recent estimates suggest that Arctic rivers carry nearly 6 million metric tonnes of carbon into the ocean each year[1]. Offshore, that can form an important carbon sink[2].

Shifting soils

To see what the carbon might be doing along the way, Rowland and his colleagues analysed aerial images of rivers, including the

Lena in Siberia and the Yukon in Alaska. They used software to map changes in the river channels over time, and calculated how that corresponded to erosion on the flood plain — including how much carbon was released as the river shifted course. It is one of the first attempts to measure how much carbon moves around on river flood plains, Rowland says.

Shifting carbon from one point to another can affect its ultimate fate. Imagine that part of the riverbank crumbles away, and the carbon in that soil is washed downstream and then builds up on a fresh bank. Microbes will interact with the newly remobilized carbon differently than if it had remained upstream in the older soil.

Lininger has been measuring carbon directly in the flood plain of the Yukon River, floating downstream and taking samples of soil along the way. At the meeting, she reported preliminary estimates that the flood plain contains more carbon than Arctic-soil databases estimate. The work reinforces how much needs to be done to understand carbon in river flood plains, she says.

Rowland wants to expand his work to look at rivers globally. Those in warmer latitudes, such as the Amazon, may have entirely different patterns of carbon distribution in their flood plains, he says.

“If you’re not just worried about the carbon coming out the end, but also where it came from,” he says, “then you need to understand its life history.”

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References

1. McClelland, J. W. *et al*. *Glob. Biogeochem. Cycles* **30**, 629–643 (2016).
2. Hilton, R. G. *et al*. *Nature* **524**, 84–87 (2015).