A better way to predict Arctic riverbank erosion

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A permafrost riverbank near Huslia, Alaska, exhibits signs of erosion. Credit: Madison Douglas, thanking the Huslia Tribal Council for land access

Arctic riverbanks are typically resilient, thanks to the power of permafrost. This permanently frozen soil locks in sediment, leading to low erosion rates. But as Arctic river water warms due to climate change, some researchers worry that riverbanks in the region will thaw and crumble. This, in turn, could cause problems, including the release of

stored soil carbon and damage to infrastructure near rivers.

But there's a caveat to this concern: Existing models have predicted a more dramatic rate of Arctic riverbank erosion than has actually been observed. In a new study published in the *Journal of Geophysical Research: Earth Surface*, Madison Douglas and Michael Lamb set out to determine why.

To do this, the team created a model that couples the movement of sediment, such as sand and mud, with permafrost thaw to determine riverbank erosion. The model better reproduces erosion observations on parts of the Yukon River in Alaska. This is because in real-world scenarios, the rate of erosion is slowed by an insulating layer of thawed sediment. Rather than the warmer river water immediately washing away newly thawed sediment, this layer insulates deeper permafrost and limits the pace of bank erosion.

Although the thawed layer does eventually erode, factors such as water temperature, flow speed, and soil consistency can affect the buffer layer's longevity and effectiveness. The new model, which takes these variables into account, could be applied to rivers throughout the Arctic to determine how climate change might alter their rates of bank erosion. This, in turn, could help Arctic communities prepare for the impacts of eroding rivers.

More information: Madison M. Douglas and Michael P. Lamb, A Model for Thaw and Erosion of Permafrost Riverbanks, *Journal of Geophysical Research: Earth Surface* (2024). DOI: 10.1029/2023JF007452

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