River ice reveals new twist on Arctic melt

April 2 2014

Images show before (lower) and after (upper, one day later) onset of dynamic ice breakup in the central Mackenzie delta's middle channel.

A new study led by Lance Lesack, a Simon Fraser University geographer and Faculty of Environment professor, has discovered unexpected climate-driven changes in the mighty Mackenzie River's ice breakup. This discovery may help resolve the complex puzzle underlying why Arctic ice is disappearing more rapidly than expected.

Lesack is the lead author on Local spring warming drives earlier river-ice breakup in a large Arctic delta. Published recently in *Geophysical Research Letters*, the study has co-authors at Wilfrid Laurier University, the University of Alberta and Memorial University.

Its goal was to understand how warming global temperatures and the intensifying Arctic hydrological cycle associated with them may be driving increasing water discharges and more rapid ice breakup in the Arctic's great rivers.

But the researchers stumbled upon an unexpected phenomenon while trying to figure out why the Mackenzie River's annual ice breakup has been shortening even though its water discharge isn't increasing, as in Russian rivers.

Just slightly warmer springs with unexpected snowfall declines—rather than warmer winters or increasing river discharge, as previously suspected—can drive earlier-than-expected ice breakup in great Arctic rivers.

The Mackenzie exemplifies this unexpected phenomenon. The researchers discovered this by accessing records dating back to 1958 of the river's water levels, snow depths, air temperatures and times of ice breakup.

This finding is significant, as Arctic snow and ice systems are important climate-system components that affect the Earth's ability to reflect solar radiation.

"Our surprising finding was that spring temperatures, the period when river-ice melt occurs, had warmed by only 3.2 degrees Celsius. Yet this small change was responsible for more than 80 per cent of the variation in the earlier ice breakups, whereas winter temperatures had warmed by

5.3 degrees but explained little of this variation," says Lesack.

"This is a strong response in ice breakup for a relatively modest degree of warming, but further investigation showed that by winter's end snow depths had also declined by one third over this period. The lesser snow depths mean less solar energy is needed to drive ice breakup."

Lesack says this is the first field-based study to uncover an important effect of reduced winter snowfall and warmer springs in the Arctic—earlier-than-expected, climate-change-related ice breakup.

"The polar regions have a disproportionate effect on planetary reflectivity because so much of these regions consist of ice and snow," says Lesack. "Most of the planetary sea ice is in the Arctic and the Arctic landmass is also seasonally covered by extensive snow. If such ice and snow change significantly, this will affect the global climate system and would be something to worry about."

Lesack hopes this study's findings motivate Canadian government agencies to reconsider their moves towards reducing or eliminating ground-based monitoring programs that measure important environmental variables.

There are few long-term, ground-based snow depth records from the Arctic. This study's findings were based on such records at Inuvik dating back to 1958. They significantly pre-dated remote sensing records that extend back only to 1980. Without this longer view into the past, this study's co-authors would still be in the dark about the more rapid than expected Arctic melt and planetary heat-up happening.

Facts:

Canada's Mackenzie and several Russian rivers are among the Arctic's gigantic waterways. The hydrological cycle is the cycling of water from the oceans to the atmosphere and back down to the continents, which the rivers then drain back to the ocean. Planetary warming hastens this cycle, which should lead to higher river discharge, more rapid river ice breakup, and ultimately more extreme weather patterns.

About a third of the size of Switzerland and reaching 200 kilometres inland, the Mackenzie River delta sits at the end of Canada's longest river and sustains 45,000 lakes.

The Mackenzie River delta and other Arctic deltas are considered biological hotspots because their sites have much higher biological productivity and biodiversity than their surrounding Arctic environment. Their peak river levels enhance marine ecosystems by flushing nutrients and organic matter from vast deltas that sit at freshwater-ocean water interfaces into the ocean.

Provided by Simon Fraser University

Citation: River ice reveals new twist on Arctic melt (2014, April 2) retrieved 26 April 2024 from https://phys.org/news/2014-04-river-ice-reveals-arctic.html