Western Siberian rivers and lakes emit greenhouse gases into the atmosphere

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West Sibirian landscape. Credit: Egor Istigechev

Warmer climate and thawing of permafrost increase greenhouse gas emissions from West Siberian rivers and lakes. This is shown by Svetlana Serikova in her dissertation, which she defends on September 27 at Umeå University.

Carbon is everywhere, and it is constantly on the move between land,

water and atmosphere. While quantities of carbon exchanged between land and atmosphere are rather certain and easy to measure, the amount of carbon that travels between water and atmosphere is uncertain and is not so easy to quantify. This is especially true for regions that contain a lot of water and a lot of carbon in permafrost, as for example Western Siberia, that is home to one of the world's largest rivers, the Ob' River, and where permafrost covers more than 40 percent of the land area.

When permafrost thaws, carbon that was previously frozen for thousands of years, is released and can end up in rivers and lakes, where it is turned into greenhouse gases and emitted from the water surface into the atmosphere. If the planet continues to warm, more of this frozen carbon can end up in rivers and lakes causing even greater rivers and lakes greenhouse gas emissions, which in turn will further warm up the planet.

Yet, nobody has attempted to quantify combined rivers and lakes greenhouse gas emissions in regions where permafrost has undergone different degree of thawing, mainly because these regions are remote and inaccessible. Western Siberia is a good example of such region. Such knowledge gap limits scientists' abilities to understand the impacts of permafrost thaw on rivers and lakes greenhouse gas emissions, and makes it harder to predict how these emissions may change in the future.

Svetlana Serikova performed several field campaigns to Western Siberia in a transect over 1 500 km distance, travelling from the very south of the region with no permafrost, all the way to the Arctic Ocean where permafrost is stable. She measured rivers and lakes greenhouse gas emissions in different seasons and in different years.

The new findings provide increased knowledge about the effects of thawing permafrost on greenhouse gas emissions from inland waters.

"I found that Western Siberian rivers and lakes are sources of

greenhouse gas emissions into the atmosphere, the magnitude of which varies depending on the state of permafrost in this area. For example, river greenhouse gas emissions were greatest in areas where permafrost is thawing, whereas lake greenhouse gas emissions were greatest in areas where permafrost is still intact," says Svetlana Serikova.

She also shows that currently greenhouse gas emissions from all Western Siberian rivers and lakes exceed the amount of carbon that Western Siberian rivers transport to the Arctic Ocean. Such finding means that a major part of previously frozen carbon that ends up in rivers and lakes in this region is emitted as greenhouse gases from the water surface into the atmosphere, making Western Siberia a hotspot for river and lake greenhouse gas emissions following permafrost thaw.

"This finding is important because it highlights the necessity to account for rivers and lakes greenhouse gas emissions, especially in regions that are severely affected by climate warming, when attempting to quantify the amount of carbon exchanged between land, water and atmosphere. Failing to do so will increase the risk of underestimating the impact of climate warming on such areas and will result in false predictions of the Earth's changing climate," says Svetlana Serikova.

More information: The thesis is available online: urn.kb.se/resolve?urn=urn:nbn:se:umu:diva-162581

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