Greenhouse heating amplified by an arctic surprise?

Global change holds another nasty surprise. This one comes from an area where warming will be felt more strongly than elsewhere: the Arctic Region. When the arctic soil warms up vast amounts of the strong greenhouse gas methane will be released into the atmosphere. To increase this effect, decomposing organic matter in the thawing wetlands will release carbon dioxide, with the end result of a positive feedback amplifying the warming trend. New data from two Siberian research sites quantify the net greenhouse gas fluxes from permafrost wetlands.

Wetlands generally absorb greenhouse gases in the shape of carbon dioxide by storing it in the soil as peat. Besides uptake of carbon dioxide, wetlands emit another strong greenhouse gas, methane, produced by bacteria in waterlogged soils. In the past many wetlands were a sink of greenhouse gases as the emission of methane was smaller than the uptake of carbon dioxide. However, when the climate warms, wetlands may turn into a source of greenhouse gases instead, by increase of the emission of methane. This holds particular for Arctic regions, where the soil is permanently frozen (permafrost).

In the Arctic warming of the climate is expected to be considerably larger than the average global warming, also precipitation will increase. The arctic soil warms up and higher precipitation amounts increase the time that wetland soils are waterlogged. As a result, methane emission will increase.

Also the permafrost will thaw. Permafrost soils in wetlands are gigantic frozen storehouses of organic matter. Upon thawing it may be rapidly decomposed and released into the atmosphere as greenhouse gases: carbon dioxide and methane.

The increased methane release from the Arctic wetlands may further fuel global warming. However, the mechanisms behind this positive feedback in the climate system are by no means simple, and most of all, poorly quantified. In particular the data coverage in the vast wetlands of northern Eurasia is very poor, because of the demanding research conditions.

Our session brings together researchers from the Eurasian continent who study this subject. Conveners are Prof. Torben Christensen from Lund University in Sweden, and Dr. Ko van Huissteden from Vrije Universiteit, Amsterdam, both representing research groups that are active in arctic methane flux research in Europe and Siberia. Solicited speaker is Dr. Sergei A. Zimov, from the Northeast Science Centre in Cherskii, northeastern Siberia, who has first-hand experience with research on permafrost thaw and methane emission.

New data from two Siberian research sites quantify the net greenhouse gas fluxes. These data apply to permafrost wetlands. The methane flux at these sites may be low, but considering the effectiveness of methane as a greenhouse gas relative to carbon dioxide, one of the sites has a net contribution to the greenhouse effect. At the other site, spatial variation in fluxes is very high. True methane flux 'hotspots' occur, in particular on the river plain. These are in particular sensitive to climate change as they are affected not only temperature but also by precipitation changes. In wetlands in northern Canada, carbon dioxide storage did increase as permafrost melted, but at the same time also a 30-fold increase of methane emission occurred. From research in northern Siberia it is concluded that thawing of ice-rich permafrost may contribute strongly to methane fluxes. All contributions present significant new knowledge on methane emission processes. This includes mathematical models of methane emission.

Session: BG4.04 Impacts of climate, atmospheric chemistry, and humans on the terrestrial carbon cycle | >>programme

Dr Ko van Huissteden
Hydrology and Geo-Environmental Sciences
Vrije Universiteit Faculty of Earth and Life Sciences
Amsterdam, Netherlands
+31 20 5487354, +31 653 977687 (m)
ko.van.huissteden@geo.falw.vu.nl

Dr Torben Christensen
Dept. of Physical Geography and Ecosystem Analysis
Lund University
Sweden
+46 46 222 3743
torben.christensen@nateko.lu.se