Arctic permafrost is melting faster than predicted

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We may be closer to a major climate tipping point than we knew. Earth's permafrost – frozen soil that covers nearly a quarter of the northern hemisphere and traps vast amounts of carbon – may be melting faster than thought and releasing more potent greenhouse gasses.

The United Nations Environment Programme (UNEP) released a report yesterday reviewing the most up-to-date research on Arctic permafrost. It claims temperature projections due in 2014 from the International Panel on Climate Change are "likely to be biased on the low side" because the models that the IPCC bases its assessments on do not take into account the positive feedback cycle of permafrost melting and releasing greenhouse gases.

"Overall, these observations indicate that large-scale thawing of the permafrost may already have started", the UNEP report warns. It calls on governments to monitor permafrost in greater detail and urges communities in permafrost areas to develop plans for managing any damage to infrastructure caused by the frozen soil melting.

But even these calls might be downplaying both the extent of the melting and the severity of the warming it could cause, according to NASA researchers doing groundbreaking research. Using a plane flying just 150 metres above the ground, the team has been measuring levels of both carbon dioxide and methane above the Arctic.

Elevated values

The NASA team has not yet finished analysing the data, some of which will be presented at the American Geophysical Union meeting in San Francisco next week. But preliminary results are already suggesting that levels of greenhouse gases in some Arctic areas are much higher than climate models have predicted, says Charles Miller of NASA's Jet Propulsion Laboratory in

Pasadena, California, the principal investigator on the Carbon in Arctic Reservoirs Vulnerability Experiment (CARVE).

"I have been surprised by some of the elevated values that we've seen," he says. That indicates the permafrost is melting faster than expected.

The early findings also suggest that more methane – a greenhouse gas that is about 25 times more powerful than carbon dioxide over 100 years – is being released than models have predicted. The result agrees with other recent studies. Miller says climate models do not have a good grasp on how much methane will be emitted by the melting permafrost.

Pep Canadell, executive director of the Global Carbon Project in Canberra, Australia, says one exciting aspect of the NASA project is its attempt to locate where these greenhouse gases are coming from.

By flying at low altitude, the team is able to measure changes in the levels of gases over much smaller distances and time intervals than previous research flights, which have flown about 2 kilometres higher. "Those get measurements on a regional scale," says Miller. "There's a great deal of local information to be found flying this close to the surface."

Miller says the factors driving the release of gases are found on these small scales. "The vegetation, the relative heights of the land and the water table – these so called 'micro-topographic' variabilities really seem to be driving what's going on in terms of release of carbon dioxide and methane into the atmosphere."

Early warning

Another benefit of finer-grained measurements is their ability to give early warning of that major change – a large methane release for instance – is under way. Miller says they have no evidence for this as yet.

The team are also doing a lot more repeat measurements over a much longer period of time. Whereas previous studies have typically had four or five flight days over a six-week period, CARVE has flown for two weeks per month between April and October this year, its first year of experiments. It will carry out the same pattern of flights over the next four years.

One big question is how much of the 1700 billion tonnes of carbon locked in the permafrost as frozen organic matter will be released as methane and how much as CO_2 if there is a thaw.

Miller says that if the region gets warmer and drier, the microbes that thrive will be the type that produce CO_2. But if it gets warmer and wetter, they will tend to produce more of the potent methane.