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More Warming Worries: Methane from the Arctic

By Michael D. Lemonick

A string of 'gates over the past few months — Climategate, Himalayagate, among others — have landed some hard punches on the politics of climate change science. They haven't laid a glove on the science itself, however. Humans are pumping out planet-warming greenhouse gases at a prodigious rate, and the planet is warming. That's no coincidence.

But climate scientists don't have all the answers, as they will freely and frequently admit, and even when researchers uncover a new piece of data, it isn't always clear what it means. That's very much the case with a new paper about methane emissions, published Thursday in *Science*. Based on a series of expeditions to the margins of the Arctic Ocean by ship and helicopter, University of Alaska researcher Natalia Shakhova and her colleagues report that methane, a greenhouse gas that is 30 times more effective in trapping heat in the atmosphere than carbon dioxide, is bubbling up from the continental shelf and leaking into the atmosphere. The estimated total: 8 teragrams — that's 8 trillion grams — per year. (See pictures of the effects of global warming.)

Exactly what this means for climate change, however, isn't at all certain. Eight teragrams of anything, let alone a heat-trapping greenhouse gas, sounds dangerous, but as Martin Heimann of the Max Planck Institute for Biogeochemistry in Jena, Germany, points out, the newly discovered methane leak represents a small piece of the overall global total of methane emissions — about 500 teragrams annually — from wetlands, termites and agriculture (including belching cows, rotting manure and rice paddies).

The number itself isn't what worries people, though: it's whether this newly identified methane source is part of an ominous trend. Climate scientists have long worried about the enormous amount of methane locked in Arctic permafrost, the thick layer of soil just beneath the surface that remains frozen all year. The methane was originally deposited there through decomposition of organic matter in ancient wetlands, and as long as it stays put, it can't contribute to climate change. (See the top 10 scientific discoveries of 2009.)

But as the planet warms and the permafrost thaws, methane could begin to escape into the atmosphere, where it would trap more heat and melt more permafrost — one of the many positive feedback mechanisms

that could accelerate the climate change that is already under way.

Not all permafrost is on dry land either. The East Siberian Arctic Shelf, a vast expanse of shallow seafloor off Russia's northeast coast, was once wetland as well. It was submerged as melting glaciers drove sea level up at the end of the last ice age, but it still contains methane-rich permafrost, which Shakhova believes may now be becoming unstable. The numbers are not alarmingly large, she agrees, but what is worrisome is that *no* leakage was expected here. (See TIME's special report on the environment.)

What's changed, she thinks, may be that warmer water pouring into the sea from Siberia's north-flowing rivers have raised the sea-bottom temperature to the point where the methane, much of it stored under pressure in the form of methane hydrates, can begin to break free. Unlike the permafrost on land, says Shakhova, soil under the sea floor is always hovering at close to the melting point because of its proximity to unfrozen seawater. Anthropogenic (that is, human-caused) warming may be the last straw.

If the undersea permafrost really is destabilizing rapidly, it could in principle lead to a catastrophic burp that would release a massive amount of methane in a short time. That's a big if. The problem is that nobody has ever taken such careful measurements in this part of the world before, says Heimann. We have satellites that do a remarkable job of observing methane emissions from land, he says, but they're not very accurate over water. So while he considers Shakhova's data absolutely convincing, he's less convinced that these emissions are necessarily new. "In the context of the global methane cycle, has this been accelerating recently, or has it been going on for some time?" Heimann says. "It may be related to recent Arctic warming, but I don't know." (See the top 10 green ideas of 2009.)

The real value of this new report, he believes, is that it finally gives scientists a solid baseline against which they can measure changes in methane over the coming years to see if it really is increasing. It's also a perfect example of how climate science actually works, as opposed to the cartoon version bandied about by activists and politicians: you take data, acknowledge any uncertainties about exactly what it means, then go out and take more data to narrow those uncertainties. That's exactly why human-triggered global warming was widely acknowledged to be mostly theoretical a few decades ago — and why it's considered a scientific fact today.

Lemonick is the senior science writer at Climate Central.

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