‘Nobody ever saw anything like this before’: how methane emissions are pushing the Amazon towards environmental catastrophe

As the world heats up, methane released from thawing permafrost and warming tropical wetlands is intensifying climate breakdown. But curbing it is achievable

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An aerial view of a fire in the Amazon rainforest in northern Brazil, which experienced a severe drought last year. Photograph: Michael Dantas/AFP/Getty Images

Controlling methane provides our best, and perhaps only, lever for shaving peak global temperatures over the next few decades. This is because it's cleansed from the air naturally only a decade or so after release. Therefore if we could eliminate all methane emissions from human activities, methane's concentration would quickly return to pre-industrial levels. Essentially, humans have released in excess of 3bn tonnes of methane into the atmosphere in the past 20 years. Quashing those emissions within a decade or two would save us 0.5C of warming. No other greenhouse gas gives us this much power to slow the climate crisis.

If the Earth keeps warming, though, reducing emissions from human activities may not be enough. We may also need to counter higher methane emissions in nature, including from warming tropical wetlands and thawing Arctic permafrost. The highest natural methane emissions come from wetlands and seasonally flooded forests in the tropics – such as the Brazilian Amazon forest I recently visited at the Mamirauá sustainable development reserve – and they are expected to rise with warming. Tropical wetlands yield so much methane because they are warm, wet (by definition) and low-oxygen environments perfect for growing methane-emitting microbes.

Last year ocean temperatures off Florida approached hot-tub levels of 40C – close to those suggested for cooking salmon

On my most recent trip there a year ago in July, El Niño [warming of sea surface temperatures] was strengthening and the tropical Atlantic was baking. Ocean temperatures off the coast of Florida approached hot-tub levels of 40C (104F) – close to temperatures suggested for cooking salmon and the highest surface ocean temperatures measured.

Warm ocean waters in the tropical Atlantic often bring drought to the Amazon. I sat in a boat in the Mamirauá reserve with my Brazilian host, hydrologist Ayan Fleischmann, who directs climate research there. "Drought may be coming," he said and added: "Water levels several hundred kilometres upriver at a monitoring station in Tabatinga, Brazil, are already as low as they've ever been." It was hard to envision drought as we floated past trees during the seasonal floods.

“The worst Amazon droughts happen in El Niño years with warm Atlantic waters,” Fleischmann said. The key ocean region is roughly the belt from the equator to Cuba and southern Florida. The extreme drought triggered by the 2015–16 El Niño featured record high temperatures, killed billions of trees and turned the Amazon from a global carbon sponge to a vast carbon source. Amazon fires raged in 2015 and 2016.

Global methane emissions rising at fastest rate in decades, scientists warn

Fleischmann’s warning was prescient. In late September, just two months after I left, the region baked in unprecedented drought. Water levels in the Amazon system were lower than at any time since record-keeping began more than a century ago. Brazil’s minister for the environment, Marina Silva, said: “We are seeing a collision of two phenomena; one natural, which is El Niño, and the other a phenomenon produced by humans, which is the change in the Earth’s temperature.”

Air temperatures around Mamirauá topped 40C for days and the absence of rain and clouds cooked Amazon waters in the sun. In Lake Tefé, a tributary of, and gateway to, the western Amazon, where I first met Fleischmann, he measured water temperatures above 40C between 3ft and 6ft underwater.

When we spoke over Zoom a few days later, Fleischmann was distraught. “Nobody ever saw anything like this before. I saw 70 river dolphin carcasses along the lake and one animal still agonising. It was about 4pm and

very hot. I watched a dolphin swimming in circles, struggling to survive. It was horrible. We didn't know what to do or how to help it." Not only was it hot and dry, but more than 7,000 fires raged across Amazonas state.

People were suffering, too. Many *ribeirinhos* – traditional peoples who live in communities along the river – couldn't reach hospitals or find food or water because water levels were too low for boat travel. News photos displayed desperate people hand-digging wells for drinking water in dry riverbeds.

I feel Fleischmann's despair – plus anger I didn't feel a decade ago. I never thought I would live to see the world's weather unravel and people suffer so much for it.

Biodiversity expert Tero Mustonen in Finland's Linnunsuo reserve, a former peat farm that his cooperative has taken over and regenerated. Photograph: Alessandro Rampazzo/AFP/Getty Images

But tropical basins such as the Amazon and Congo aren't the only natural systems we need to worry about for methane emissions. Arctic tundra and peatlands are also at risk. Organic-rich peat forms in low-oxygen, waterlogged environments where microbial decomposition can't keep up new plant growth.

Work led by Swedish scientist Gustaf Hugelius estimates that northern peatlands have accumulated at least 400bn tonnes of carbon since the last ice age – equivalent to nearly half of all the carbon our atmosphere currently holds.

The carbon in peat could reach the atmosphere as carbon dioxide through peat fires or through microbial decomposition if the permafrost thaws and soils in Arctic and boreal systems warm. Alternatively, if the thawed peatland turns swampy, microbes may release much of the carbon as methane. Either scenario would be terrible for the world's climate, but the methane scenario would be disastrous. We'll likely get some of both; it will start slowly – might already be starting – and grow to a climax.

I visited Finland recently for a peatland restoration project. My host was Tero Mustonen, co-founder and president of the Snowchange Cooperative, a global network of Indigenous cultures that documents observations of the climate crisis across northern Canada, Scandinavia, Russia and the US.

"The north needs snow and ice for life," he said. "Climate change is hitting us harder here in the north than anywhere else, except perhaps in the Pacific. If you take away the most important part – the cold – it cascades across ecosystems and cultures.

In the Arctic tundra, I saw collapsing permafrost walls. There was a weird smell, too, as if you had a gas lamp running without a spark
Tero Mustonen, biodiversity expert

"What I and others have most observed in the high Arctic tundra," he said, "is the massive permafrost melt. I travelled, for example, 1,200 kilometres [745 miles] in a small, open boat on the East Siberian Sea coast. Kilometre after kilometre, I saw collapsing permafrost walls. I heard the sloosh of the coast slumping into the sea. There was a weird smell, too, as if you had a gas lamp running without a spark."

"I had no words," he said about seeing ecosystems collapse before him for hundreds of miles. "I decided: 'I must press every button in my power to convey how bad this is.'"

Mustonen and others at Snowchange are doing more than sounding alarms; they are turning climate despair into climate repair. A decade ago, the wetland I visited at Linnunsuo was a Mordor-like slag heap, the legacy of industrial peat mined for energy. Only two bird species used the site. Today, the restored wetland has become a prime hotspot for more than 200 bird species during spring and autumn migrations. Snowchange's efforts have reduced soil-based

emissions at Linnunsuo by an amount equivalent to taking a 100,000 cars off our roads a year.

An area of regenerated forest a short distance from the Linnunsuo reserve, where soil-based emissions have been hugely reduced by the Snowchange Cooperative. Photograph: Alessandro Rampazzo/AFP/Getty Images

To do so, they flooded some of the exposed peatland soils and added limestone to lower acidity and reduce acid drainage. “We had 2.8pH acidic waters leaving here that killed all life in the Jukajoki River downstream,” Mustonen said. “The event was not detected by the company but by our fishermen. We issued a dire warning to the company and authorities that there had been a big pollution event and that the whole river was dead.”

After a recurrence the following year, the company asked Snowchange if it would be interested in owning and maintaining the site. “After discussing the risks and benefits, we decided to adopt the wetland and try to fix the whole system,” Mustonen said.

What fascinated me was that Snowchange wasn’t trying to restore the site to a perfect peatland postcard. It was making do – and trying to make better – with something else: a novel wetland ecosystem that is now prime stopover habitat for migrating birds. The local landscape and people are adapting to the climate crisis. “These recovering ecosystems will never be exactly the way they were in

the 1800s," Mustonen said. "They will be living in a warming planet no matter how successful we are."

"In conservation biology, every little weed is nipped away along with every single species not wanted by humans," he added. "They want to create an artificial replica of something from the past. But we are never going back – in our lifetimes, at least – to something that was here in the 1950s or earlier."

I watched as Mustonen bent over and stroked the tiny feathery mosses emerging in the damp at our feet and said: "The sphagnum is starting to come back."

What you can do

Our homes are a great place to begin cutting methane emissions – replacing fossil gas with cleaner electric appliances and reducing our personal beef and dairy consumption.

Heat pumps tend to be two or three times more efficient than gas furnaces or boilers, so even with relatively expensive UK electricity prices, a heat pump makes sense for most homeowners. I recently replaced both my gas furnace and hot water heater for more efficient electric heat-pump models. The results in my home have been outstanding: cheaper to operate and, coupled to my fossil-free electricity, no greenhouse gas emissions or indoor pollutants.

One US study found the steady bleed of methane from switched-off gas stoves equalled the yearly emissions of half a million cars

Gas stoves are another substantial source of carbon dioxide and methane pollution in our homes. In our first US gas stove study, we found that three-quarters of all methane emissions occurred while the stoves were off, primarily through leaky pipes and fittings. Their steady bleed of climate-busting methane equalled the yearly emissions of half a million cars. We've measured similar leakage rates in homes in St Neots, Cambridgeshire, and London.

Methane pollution isn't the only reason to replace your gas or propane stove with a cleaner induction model, though. We also assess pollutants generated from burning gas indoors: carbon monoxide, carcinogenic benzene and asthma-triggering nitrogen oxides such as nitrogen dioxide (NO_2). We've measured these pollutants forming in the air of hundreds of homes, sometimes lingering at dangerous levels in kitchens and bedrooms hours after the stove is off (with extractors on and off).

Scientists with the nonprofit energy efficiency group Clasp and the European Public Health Alliance found similar dangers for residents burning gas and propane. They also found that gas cooking regularly increased indoor

NO_2 levels above World Health Organization air quality guidelines. They estimated that more than 700,000 children in the EU have suffered asthma symptoms in the past year attributable to gas stove combustion.

Beyond what fuel you cook with, changing what you eat is another way to reduce methane emissions. A typical cow burps a bathtub's worth of methane a day, around 100kg a year. More than a billion cows worldwide and their manure therefore emits more methane than the global oil and gas industry. Eating less beef and dairy is another smart (and healthy) way for people to cut their methane footprint.

- *Into the Clear Blue Sky: A Path to Restoring Our Atmosphere* by Rob Jackson is published by Allen Lane (£25). To support the Guardian and Observer order your copy at guardianbookshop.com. Delivery charges may apply