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# Methane emissions are rising faster than ever

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The world has not hit the brakes on methane emissions, a powerful driver of climate change. More than 150 nations have pledged to slash by 30% this decade under a global methane pledge, but new research shows global methane emissions over the past five years have risen faster than ever.

The trend "cannot continue if we are to maintain a habitable climate," the researchers write in a Sept. 10 perspective article in *Environmental Research Letters* published alongside data in *Earth System Science Data*. Both papers are the work of the Global Carbon Project, an initiative chaired by Stanford University scientist Rob Jackson that tracks greenhouse gas emissions worldwide.

Atmospheric concentrations of methane are now more than 2.6 times higher than in pre-industrial times – the highest they've been in at least 800,000 years. Methane emission rates continue to rise along the most extreme trajectory used in emission scenarios by the world's leading climate scientists.

The current path leads to global warming above 3 degrees Celsius or 5 degrees Fahrenheit by the end of this century. "Right now, the goals of the Global Methane Pledge seem as distant as a desert oasis," said Jackson, who is the Michelle and Kevin Douglas Provostial Professor in the Stanford Doerr School of Sustainability and lead author of the *Environmental Research Letters* paper. "We all hope they aren't a mirage."

**More methane from fossil fuels, agriculture, and waste**

Methane is a short-lived but highly potent greenhouse gas that comes from natural sources like wetlands and human or "anthropogenic" sources such as agriculture, fossil fuels, and landfills. During the first 20 years after release, methane heats the atmosphere nearly 90 times faster than carbon dioxide, making it a key target for limiting global warming in the near term.

Despite growing policy focus on methane, however, total annual methane emissions have increased by 61 million tons or 20% over the past two decades, according to the new estimates. Increases are being driven primarily by growth of emissions from coal mining, oil and gas production and use, cattle and sheep ranching, and decomposing food and organic waste in landfills.

"Only the European Union and possibly Australia appear to have decreased methane emissions from human activities over the past two decades," said Marielle Saunois of the Université Paris-Saclay in France and lead author of the *Earth System Science Data* paper. "The largest regional increases have come from China and southeast Asia."

In 2020, the most recent year for which complete data are available, nearly 400 million tons or 65% of global methane emissions came directly from human activities, with agriculture and waste contributing about two tons of methane for every ton from the fossil fuel industry. According to the researchers, human-caused emissions continued to increase through at least 2023.

**Assessing pandemic impacts**

Our atmosphere accumulated nearly 42 million tons of methane in 2020 – twice the amount added on average each year during the 2010s, and more than six times the increase seen during the first decade of the 2000s.

Pandemic lockdowns in 2020 reduced transport-related emissions of nitrogen oxides (NOx), which typically worsen local air quality but prevent some methane from accumulating in the atmosphere. The temporary decline in NOx pollution accounts for about half of the increase in atmospheric methane concentrations that year – illustrating the complex entanglements of air quality and climate change.

“We’re still trying to understand the full effects of COVID lockdowns on the global methane budget,” said Jackson. “COVID changed nearly everything – from fossil fuel use to emissions of other gases that alter the lifetime of methane in the atmosphere.”

**Quantifying humans’ influence on methane from wetlands and waterways**

The Global Carbon Project scientists have made an important change in their latest accounting of global methane sources and “sinks,” which include forests and soils that remove and store methane from the atmosphere.

In previous assessments, they categorized all methane from wetlands, lakes, ponds, and rivers as natural. But the new methane budget makes a first attempt to estimate the growing amount of emissions from these types of sources that result from human influences and activities.

For instance, reservoirs built by people lead to an estimated 30 million tons of methane emitted per year, because newly submerged organic matter releases methane as it decomposes. “Emissions from reservoirs behind dams are as much a direct human source as methane emissions from a cow or an oil and gas field,” said Jackson, who published a new book about methane and climate solutions titled *Into the Clear Blue Sky: The Path to Restoring Our Atmosphere* (Scribner) in July.

The scientists estimate that about a third of wetland and freshwater methane emissions in recent years were influenced by human-caused factors including reservoirs and emissions increased by fertilizer runoff, wastewater, land use, and rising temperatures.

After a summer when severe weather and heat waves have given a glimpse of the extremes predicted in our changing climate, the authors write, “The world has reached the threshold of 1.5C increases in global average surface temperature, and is only beginning to experience the full consequences.”

*Jackson is also a senior fellow at the Stanford Woods Institute for the Environment and Precourt Institute for Energy. Other Stanford co-authors include Earth system science postdoctoral scholars Xueying Yu and Mengze Li, and Earth system science professor Steven J. Davis. Additional study authors are affiliated with Université Paris-Saclay, CSIRO*

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