EPA underestimates methane emissions from landfills and urban areas, researchers find

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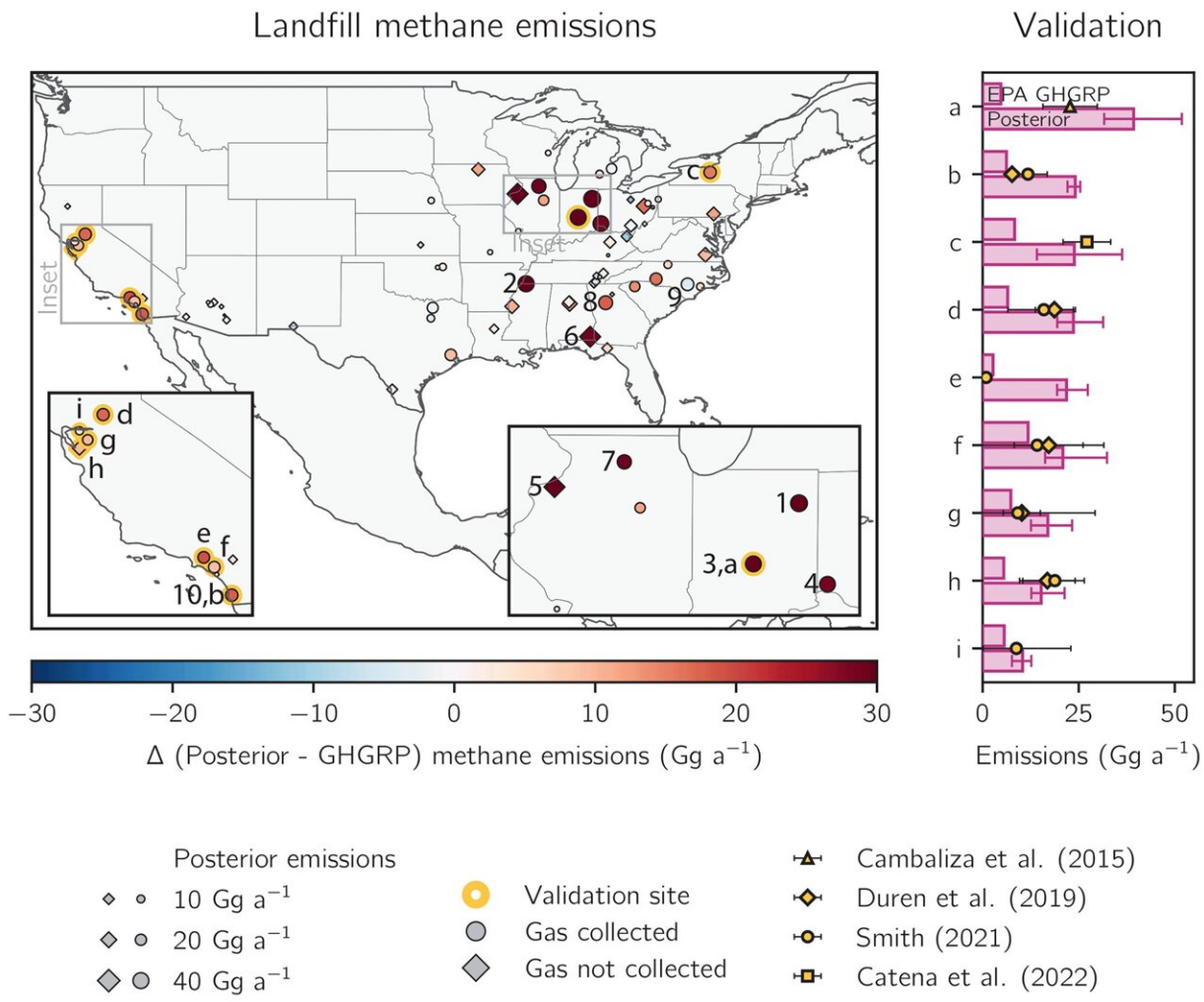

Methane emissions for 2019 from 70 individual landfills that report methane emissions of 2.5 Gg a^{-1} or more to the EPA's Greenhouse Gas Reporting Program (GHGRP) for 2019 and for which the TROPOMI inversion provides site-specific information. Credit: *Atmospheric Chemistry and Physics* (2024).

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The Environmental Protection Agency (EPA) is underestimating methane emissions from landfills, urban areas and U.S. states, according to a new study led by researchers at the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS).

The researchers combined 2019 satellite observations with an atmospheric transport model to generate a high-resolution map of methane emissions, which was then compared to EPA estimates from the same year. The researchers found:

- Methane emissions from landfills are 51% higher compared to EPA estimates
- Methane emissions from 95 urban areas are 39% higher than EPA estimates
- Methane emissions from the 10 states with the highest methane emissions are 27% higher than EPA estimates

"Methane is the second largest contributor to climate change behind carbon dioxide so it's really important that we quantify methane emissions at the highest possible resolution to pinpoint what sources it is coming from," said Hannah Nesser, a former Ph.D. student at SEAS and first author of the paper. Nesser is currently a NASA Postdoctoral Program (NPP) Fellow in the Carbon Cycle & Ecosystems Group at the Jet Propulsion Laboratory.

The research, published in *Atmospheric Chemistry and Physics*, was a collaboration between scientists at Harvard and an interdisciplinary team of researchers from across the U.S. and around the world, including universities in China and the Netherlands.

The EPA estimates that landfills are the third-largest source of human-caused methane emissions in the U.S., but the EPA uses a bottom-up accounting method that often doesn't match observations of atmospheric methane.

The EPA methane estimate for landfills uses the Greenhouse Gas Reporting Program, which requires high-emitting facilities to self-report their emissions annually. For landfills without methane capture, the emissions are simply calculated by looking at the amount of trash that comes in and estimating how much methane trash produces over time. That figure is then scaled up to include landfill operations that don't report to the Greenhouse Gas Reporting Program.

Nesser and her colleagues' top-down approach uses observations of atmospheric methane from the Tropospheric Monitoring Instrument (TROPOMI) aboard the Sentinel-5 Precursor satellite together with an atmospheric transport model to trace the path of emissions from the atmosphere back to the ground.

Using this method, the team zoomed in on 70 individual landfills across the U.S. In these facilities, the researchers found emissions that were on median 77% higher than the estimates from the Greenhouse Gas Reporting Program.

The disparity is wider for landfills that collect methane as part of their operations.

Landfills don't measure the exact amounts of methane they are losing, but rather estimate how efficient their collection systems are. The EPA assumes the default efficacy rate for methane collection is 75%.

But Nesser and her colleagues found that in fact, landfills are much less effective at collecting methane than previously thought.

Of the 70 landfills the team studied, 38 recover gas. Among those facilities, the researchers found that methane levels were on median more than 200% higher than the estimates from the Greenhouse Gas Reporting Program.

"Our research shows that these facilities are losing more methane than they think," said Nesser. "The EPA uses 75% efficacy as the default for methane collection, but we find that it's actually much closer to 50%."

The EPA estimates also do not capture one-off events, such as construction projects or temporary leaks, which could lead to a massive increase in methane emissions and contribute to the discrepancy between EPA estimates and observed atmospheric methane.

The research team also compared their analysis to the EPA's new state-level greenhouse gas inventories.

The researchers found 27% higher methane emissions from the 10 top methane-producing states, with the largest increases in Texas, Louisiana, Florida, and Oklahoma. The team found that those 10 states are responsible for 55% of U.S. human-caused methane emissions. Perhaps unsurprisingly, Texas is responsible for 21% of anthropogenic methane emissions in the U.S., 69% of which is from the oil and gas industry.

At the city level, the researchers found that on average, the 10 cities with the highest urban methane emissions actually have 58% higher emissions than previously estimated. Those cities include New York, Detroit, Atlanta, Dallas, Houston, Chicago, Los Angeles, Cincinnati, Miami and Philadelphia.

"All of these places have a different profile of emission sources, so there's no one thing driving the methane underestimate across the board," said Nesser.

The researchers hope that future work will provide more clarity on exactly where these emissions are coming from and how they are changing.

"This research highlights the importance of understanding these emissions," said Daniel Jacob, the Vasco McCoy Family Professor of Atmospheric Chemistry and Environmental Engineering at SEAS and senior author of the paper. "We plan to continue to monitor U.S. emissions of methane using new high-resolution satellite observations, and to work with the EPA to improve emission inventories."

The research was co-authored by Joannes D. Maasakkers, Alba Lorente, Zichong Chen, Xiao Lu, Lu Shen, Zhen Qu, Melissa P. Sulprizio, Margaux Winter, Shuang Ma, A. Anthony Bloom, John R. Worden, Robert N. Stavins and Cynthia A. Randles.

More information: Hannah Nesser et al, High-resolution US methane emissions inferred from an inversion of 2019 TROPOMI satellite data: contributions from individual states, urban areas, and landfills, *Atmospheric Chemistry and Physics* (2024). DOI: 10.5194/acp-24-5069-2024

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