

Scientists 'fingerprint' methane to track a climate change culprit

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Methane is the second-most abundant greenhouse gas in Earth's atmosphere, and its emissions have been rapidly—and mysteriously—rising since 2007. Though pervasive, the origin of the

colorless compound is tricky to trace, complicating efforts to curb gases that trap heat in the atmosphere and warm the planet.

To overcome this challenge, a University of Maryland-led team of researchers developed a new method of "fingerprinting" methane. [Published](#) in the journal *Proceedings of the National Academy of Sciences*, the study analyzed the chemical composition of methane's rarest forms, known as isotopic variants. This new approach will help researchers distinguish fossil fuel sources of methane from microbial sources arising from swamps, landfills and farms—a feat that is difficult to achieve with existing methods, which measure methane's more common isotopes.

"Methane plays a significant role in [climate change](#), but there are many unknowns about the reasons behind the recent increase in [atmospheric methane](#)," said the study's lead author, Mojghan Haghnegahdar, a National Science Foundation postdoctoral fellow in UMD's Department of Geology.

"Our understanding of how to control and decrease methane emissions to the atmosphere is going to be critical for maintaining our standard of living, as well as avoiding huge costs to society in the not-too-distant future."

The research team analyzed air samples collected from several sites on or near the UMD campus. Using custom-built extraction equipment, the researchers also captured methane from a covered grill burning wood and charcoal, two wetlands and from samples of compressed air and [natural gas](#). After isolating and purifying the methane, they used a high-resolution mass spectrometer to take a closer look at the gas's chemical makeup.

Their analyses revealed that microbial sources of methane have a

signature distinct from fossil fuel sources. The isotopic fingerprint of a particular plume of methane could be used to identify the culprit, helping policymakers trace this greenhouse gas to its source and prioritize their efforts to mitigate it.

"Understanding what drives fluctuations of atmospheric methane carries important implications for how society approaches the mitigation of this greenhouse gas," Haghnegahdar said. "Do we focus mitigation efforts on fossil sources such as natural gas leakage or on microbial sources such as landfills, agriculture and wetlands?"

Russell Dickerson, an atmospheric and oceanic science professor at UMD and a co-author of this study, explained why methane is so difficult to trace back to its source.

"Methane has many sources—both natural and man-made—so if a landfill and a swamp are located near a natural gas distribution center or near a city with a leaky, old supply infrastructure, it is hard to distinguish which source dominates," Dickerson explained. "The isotopes can tell us where the methane came from."

In addition to monitoring current emissions, the researchers believe their methods could be applied retroactively, enabling them to study long-term changes in the global methane cycle.

As a next step, the team is working to obtain decades-old [air samples](#) to determine whether past models of methane emissions are accurate. Going forward, their method could also be used to determine whether any efforts to mitigate or remove methane from the atmosphere are successful.

Methane is more than 28 times as potent as carbon dioxide at trapping heat in the atmosphere. However, methane has a shorter

lifetime—roughly 10 years—than the hundreds of years that carbon dioxide can linger in the atmosphere. This makes it a meaningful target for [climate action](#), according to study co-author James Farquhar.

"Reducing [methane](#) is one of the few things we can do that will have some effect in our lifetime," said Farquhar, a Distinguished University Professor and chair of UMD's Department of Geology. "If we can buy just 50 years so that other people can figure out how to address climate change, we're going to be living in a much different world."

More information: Mojghan A. Haghnegahdar et al, Tracing sources of atmospheric methane using clumped isotopes, *Proceedings of the National Academy of Sciences* (2023). [DOI: 10.1073/pnas.2305574120](https://doi.org/10.1073/pnas.2305574120)

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