UC Irvine scientists devise method for cities to measure greenhouse gas emissions

Municipalities may employ the tool to evaluate initiatives to curb emissions.

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The sun sets over an expanse of greater Los Angeles that is occupied by one of the region's many oil refineries, a source of carbon dioxide pollution. Study co-author Claudia Czimczik says, "Our method successfully captures these patterns, but we need to test it in other cities … to understand if it works as well in places where emissions are subject to more consistent wind transport, rather than the mountain and basin situation we see in Los Angeles."

Picture Credit:
Steve Zylius / UC Irvine

- The method provides a cost-effective method for cities to measure their greenhouse gas emissions.
- It involves sampling turfgrass, which is shown to be a reliable recorder of fossil carbon dioxide concentrations.
- Cities without expensive gas monitoring equipment may find the tool useful.

Irvine, Calif., Nov. 3, 2025 — Cities around the world are working to limit emissions of climate-warming greenhouse gases, but there have been few ways of measuring whether those gases are actually decreasing in any given municipality. In new research, University of California, Irvine scientists created an effective method to measure greenhouse gas emissions around cities – something that can help local governments gauge the effectiveness of their emission-curbing programs.

"Emissions of fossilcarbon dioxide are the main driver of climate change," said Claudia Czimczik, UC Irvine Earth system science professor and senior author of the new *Journal of Geophysical Research: Atmospheres* study. "We found that measuring radiocarbon in turfgrasses is a practical and spatially sensitive tool for assessing urban fossil fuel carbon dioxide patterns."

The team, led by former UC Irvine doctoral student Cindy Yañez, measured radiocarbon in managed turfgrasses in urban and rural regions of Southern California. In the same locations, they used a greenhouse gas instrument provided by Manvendra Dubey of Los Alamos National Laboratory to quantify the total amount of carbon dioxide in the atmosphere.

"Our study demonstrates that radiocarbon analysis of turfgrasses can be used to map what we call urban carbon dioxide domes and to evaluate progress toward decarbonization goals, especially in areas that lack carbon dioxide monitoring infrastructure," said Czimczik.

Such plant data yields high-resolution pictures of greenhouse gas emissions around individual municipalities, which makes it possible for cities to gauge whether their emissions-curbing initiatives are effective.

The work builds on a study conducted during the COVID-19 pandemic where a joint UC Irvine-UC Riverside team asked volunteers to collect and send samples of invasive grasses from their neighborhoods to labs at UC Irvine. That analysis revealed a dramatic decrease in fossil fuel carbon dioxide emissions in the early days of the pandemic, followed by a rise in emissions as the pandemic eased and people resumed driving. In the current study, the team pivoted to sampling managed turfgrasses, which allowed for year-round observations, and they teamed with experts from the greenhouse gas monitoring community.

“One of the main challenges is understanding exactly how long the plants were recording the carbon dioxide signal,” said Czimczik. “We addressed this by focusing on managed lawns that are mowed regularly, typically every one to two weeks in Southern California.”

Sampling the tops of frequently mowed grass ensured samples represented approximately two weeks of recent growth, giving the team a more consistent timeframe for comparison with the atmospheric measurements of greenhouse gas concentrations.

“Los Angeles has unique atmospheric conditions, where surrounding mountains trap emissions in a basin,” Czimczik said. “Our method successfully captures these patterns, but we need to test it in other cities with different meteorological conditions to understand if it works as well in places where emissions are subject to more consistent wind transport rather than the mountain and basin situation we see in Los Angeles.”

Collaborators include Francesa Hopkins from UC Riverside, Manvendra Dubey of Los Alamos National Laboratory and Aaron Meyer of the University of Utah. The work was supported by the University of California’s Lab Fees Research Program In-Residence Graduate Fellowship to Yañez. Measurements were supported by the U.S. National Science Foundation (EAR-MRI #2117634) to Czimczik and Hopkins.

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