

Urban soils release surprising amounts of carbon dioxide

February 23 2016, by Kira Jastive



Stephen Decina, Boston University PhD student, measures carbon dioxide being released from the soil using an automated soil carbon dioxide efflux system. The equipment, which is controlled with a smartphone, passes air through an infrared gas analyzer and measures the concentration of carbon dioxide accumulation over time. Credit: Stephen Decina

In the concrete jungle at the core of a city, carbon dioxide (CO₂) emissions are dominated by the fossil fuels burned by the dense

concentrations of cars and buildings. Boston University researchers now have shown, however, that in metropolitan areas surrounding the city core, plant roots and decomposing organic material in soil give off enough CO₂, in a process termed "soil respiration", to make an unexpectedly great contribution to total emissions.

In fact, analyzing CO₂ released from [soil respiration](#) at 15 sites across greater Boston, the BU scientists found that during the growing season, releases of the greenhouse gas from soil may approach those of [fossil fuels](#) in dense residential areas. The first study of urban soil CO₂ to reach this wide scale and to integrate a high-resolution model of both soil respiration and local fossil fuel [emissions](#), the research will help to improve assessments of climate action programs.

"Very close to this concrete jungle downtown, where you have a lot of fossil fuel emissions and no soil, you have residential areas that have lower fossil fuel emissions and a whole lot of soil," says Stephen Decina, a doctoral student and lead author on a paper published today in the journal [Environmental Pollution](#). "Over the growing season, CO₂ emissions from soil respiration are almost 75 percent of the fossil fuel emissions in those areas. In some places, they're actually higher than [fossil fuel emissions](#)."

"These biological fluxes are much larger than you'd expect," says Lucy Hutyra, Associate Professor of Earth & Environment and coauthor on the paper. "In our efforts to monitor, verify, and reduce greenhouse gas emissions in cities, we really need to pay attention to this."

Decina and his colleagues measured the emission of CO₂ from the same patches of soil around metropolitan Boston every two weeks during the growing season when releases of the gas are highest and measurements are not impeded by snow.

"We found that the average rate of CO₂ coming out of the soil is highest in landscaped areas such as gardens, followed by areas with a lawn, and it is lowest in the urban forests," he says.

These rates of CO₂ release generally reflect the level of human interventions at each location. "People often manage their flower beds more than they do their lawns, and in general they leave their forests alone," Decina points out.

"When people mulch their landscaped areas or fertilize their lawns, they're putting out yummy fresh highly decomposable carbon that soil microbes can use," says Pamela Templer, Associate Professor of Biology. "And that's stimulating microbial growth and loss of CO₂ out of these urban soils."

The scientists emphasize that they are not recommending that residents stop mulching or fertilizing their yards. Rather, this study highlights the high soil respiration rates associated with those activities.

Their findings will help in evaluation of climate action programs such as Boston's Greenovate, which aim to reduce greenhouse gas emissions from cities like Boston. "Studies that rely on satellite measurements of CO₂ don't distinguish between human-made and biological emissions. Our study shows that CO₂ fluxes from soils, which come from biology (microbes and roots), can make a significant contribution to total CO₂ emissions from a city like Boston," Templer says.

"If you assume all the CO₂ emissions in the city are coming from man-made sources like cars and buildings, and you don't account for what the soils are doing, then you don't have the correct information to assess whether your climate plan is actually reducing emissions," Decina says.

"For a long time we've had the perception that biology doesn't matter in

cities, because it seems that there's so little of it," Hutyra says. "But we show that biological sources are contributing a large amount of CO₂."

The BU team is going on to analyze urban flows of nitrogen, which are generated by cars, factories and farms and then deposited in high rates by precipitation or air particles. "Nitrogen is a limiting nutrient," Templer says. "A small amount of nitrogen from rain helps plants (whether they be in landscaped areas or forests) grow more. But too much nitrogen can be a bad thing for soils, waterways and human health."

At a broader level, the researchers are questioning whether urban ecosystems require scientists to re-think traditional models of nutrient flows.

"Does a tree in the city do more or less than a tree outside the city?" Hutyra asks. "That city tree is growing in a very different environment. It has extra CO₂, warmer temperatures, lots of nitrogen, lots of dogs, salt on the road, pipes that are leaking sewage and feeding it all sorts of nutrients, ozone, people cutting off its branches, and a whole suite of direct intentional and unintentional management."

"We're increasingly recognizing the importance of coupled human-natural ecosystems research—understanding not just how nature works, or how humans affect nature, but how that all feeds back to one another," Templer says.

Investigating these phenomena in cities is not always a picnic, the researchers note.

One challenge in urban ecology is that researchers can't expect their equipment to stay undisturbed, says Decina, which is one reason why almost all of the CO₂ study sites were in residential backyards.

"This fieldwork is different than the kind that we're used to, out in the forest worried about bears," he adds. "In the city you don't have to carry bear spray with you, but curious or angry humans can often be more disruptive to a research site than a curious or angry bear."

Provided by Boston University

Citation: Urban soils release surprising amounts of carbon dioxide (2016, February 23) retrieved 25 April 2024 from <https://phys.org/news/2016-02-urban-soils-amounts-carbon-dioxide.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.