



## FOR IMMEDIATE RELEASE

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### **Warmer Soils Release More CO<sub>2</sub> to Atmosphere; Effect Stabilizes Over Longer Term**

As temperatures rise, forest soils release more carbon dioxide into the atmosphere, creating a feedback loop that could exacerbate climate change in the future. Luckily, this effect diminishes over time, according to a long-term study at the Harvard Forest, published today in the journal *Nature Climate Change*. The study—led by University of New Hampshire professor Serita Frey and co-authors from the Marine Biological Laboratory and the University of California-Davis—sheds new light on the impacts of climate warming on soil microorganisms: abundant and essential contributors to ecosystems around the globe.

On a yearly basis, the trillions of microorganisms in our soils release 10 times more carbon dioxide to the atmosphere than humans and carbon-emitting machines do. These soil microorganisms are drawing from a belowground carbon reserve that is greater than the carbon found in forest trees and the atmosphere combined.

Frey and her colleagues—Jerry Melillo from the Marine Biological Laboratory, and Johan Six and Juhwan Lee from the University of California-Davis—were curious how warming temperatures might affect soil microorganisms and this massive belowground storage facility of carbon. So they looked to the Harvard Forest in Petersham, Mass., where, with support from the Long-Term Ecological Research Program, they set up experiments to raise soil temperatures by 5 degrees using underground heating cables. One set of experiments has been running for two years, and another for more than 18 years. “It’s like having a heating blanket under the forest floor,” Frey says, “allowing us to examine how this particular environmental change—long-term soil warming—is altering how the soil functions.”

According to the *Nature Climate Change* study, a major key to understanding soil carbon dynamics lies in the efficiency of microorganisms. In other words, the scientists asked, in warmer temperatures, how well do tiny microbes metabolize carbon to maintain their own cellular machinery? “While they’re low on the charisma scale, soil microorganisms are critically important to the carbon balance of the atmosphere,” Frey says.

In soils heated for only two years, Frey and her colleagues found that the microorganisms’ level of efficiency was linked not just to temperature, but also to the type of carbon being decomposed.

Warming temperatures had little effect on microbes' ability to use glucose, a simple food source released from the roots of plants. But for phenol, a more complex carbon source common in decomposing wood or leaves, soils showed a 60 percent drop in efficiency at higher temperatures.

Frey explains, "You could infer that as the soil warms, more carbon dioxide will be released into the atmosphere, exacerbating the climate problem."

That effect diminishes, however, over the longer term. In soils that had been continuously heated for 18 years, Frey reports: "We saw a change in the microbial community to be more efficient." Less carbon dioxide was released from soil communities that had more time to adjust to the temperature change.

In light of their new results, the research team also examined a commonly used computer model that simulates carbon dynamics in various ecosystems. These models generally assume that microbial efficiency is fixed. "There is clearly a need for new models that incorporate an efficiency parameter that is allowed to fluctuate with temperature and other environmental conditions," Six says.

The new article, "The Temperature Response of Soil Microbial Efficiency and its Feedback to Climate," is available in the January 20, 2013 issue of *Nature Climate Change*.

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The Harvard Forest, founded in 1907 and located in Petersham, is Harvard University's outdoor laboratory and classroom for ecology and conservation, and a Long-Term Ecological Research (LTER) site funded by the National Science Foundation. Its 3,500 acre property is one of the oldest and most intensively studied research forests in the U.S. Open to the public year-round, the site includes educational and research facilities, a museum, and recreational trails. More information can be found at <http://harvardforest.fas.harvard.edu/>.