Climate change and the soil: Climate warming may not drive net losses of soil carbon from tropical forests

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The planet's soil releases about 60 billion tons of carbon into the atmosphere each year, which is far more than that released by burning fossil fuels. This happens through a process called soil respiration. This enormous release of carbon is balanced by carbon coming into the soil system from falling leaves and other plant matter, as well as by the underground activities of plant roots.

Short-term warming studies have documented that rising temperatures increase the rate of soil respiration. As a result, scientists have worried that global warming would accelerate the decomposition of carbon in the soil, and decrease the amount of carbon stored there. If true, this would release even more carbon dioxide into the atmosphere, where it would accelerate global warming.

New work by a team of scientists including Carnegie's Greg Asner and Christian Giardina of the U.S. Forest Service used an expansive whole-ecosystem study, the first of its kind, on tropical montane wet forests in Hawaii to sort through the many processes that control soil carbon stocks with changing temperature. Their work is published in *Nature Climate Change*.

The team revealed that higher temperatures increased the amount of leaf litter falling onto the soil, as well as other underground sources of carbon such as roots. Surprisingly, long-term warming had little effect on the

overall storage of carbon in the tropical forest soil or the rate at which that carbon is processed into carbon dioxide.

"If these findings hold true in other tropical regions, then warmer temperatures may not necessarily cause tropical soils to release their carbon to the atmosphere at a faster rate," remarked Asner. "On the other hand, we cannot expect that the soil will soak up more carbon in places where vegetation is stimulated by warmer temperatures. Unlike tropical trees, the soil seems to be on the sidelines in the climate adaptation game."

This means the observed increase in the rate of soil respiration accompanying rising temperatures is due to carbon dioxide released by the an uptick in the amount of litter falling on the forest floor and an increase in carbon from underground sources. It is not from a decrease in the overall amount of carbon stored in the soil.

Giardina noted "While we found that carbon stored in the mineral soil was insensitive to long-term warming, the loss of unprotected carbon responded strongly to temperature. This tells us that the sensitivity of each source of soil respiration needs to be quantified, and the aggregate response examined, before an understanding of ecosystem carbon balance in a warmer world can be achieved."

Provided by Carnegie Institution for Science

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