Decomposing logs show local factors undervalued in climate change predictions

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Researchers distributed 160 blocks of pine tree wood across five sub-regions of temperate forest in the eastern United States to determine the affect of local factors on carbon cycling.

A new Yale-led study challenges the long-held assumption that climate is the primary driver of how quickly organic matter decomposes in different regions, a key piece of information used in formulating climate models.

In a long-term analysis conducted across several sites in the eastern United States, a team of researchers found that local factors—from

levels of fungal colonization to the specific physical locations of the wood—play a far greater role than climate in wood decomposition rates and the subsequent impacts on regional carbon cycling.

Because decomposition of organic matter strongly influences the storage of carbon, or its release into the atmosphere, it is a major factor in potential changes to the climate.

The findings underscore a key limitation of using aggregated data across wide geographic areas to predict future climate change, said Mark A. Bradford, an assistant professor of terrestrial ecosystem ecology at the Yale School of Forestry & Environmental Studies (F&ES) and lead author of the study published in the journal *Nature Climate Change*.

They also suggest that better identifying and measuring such hyper-local ecological factors could significantly improve the effectiveness of climate change projections, he adds.

"We're reaching the wrong conclusion about the major controls on decomposition because of the way we've traditionally collected and looked at our data," Bradford said. "That in turn will weaken the effectiveness of climate prediction."

It has long been thought that climate is the predominant factor controlling decomposition, mainly because warmer temperatures increase the activity levels of the "decomposer" organisms, such as microbes, that break down dead organic matter.

While scientific studies have revealed the critical importance of climate and temperature in determining decomposition rates across regional and global scales, the findings are often based on the mean response of decomposition across large areas.

According to Bradford, the use of mean responses can mask the local-scale information, such as the abundance of soil fungi and animals, which may be more important in governing the release of terrestrial carbon.

To better assess the importance of those local effects, the researchers distributed 160 blocks of pine tree wood across five sub-regions of temperate forest in the eastern United States—from Connecticut to northern Florida—and then monitored the decay that occurred over 13 months.

They selected similar forest types in order to focus on major differences in the effect of climate across the regional gradient. (The average annual temperature in southern New England is about 11 degrees Celsius cooler than Florida.) But within each of the five sub-regions they placed the wood blocks in different types of terrain to evaluate the effects of local versus regional factors on decomposition and capture the variability found in forest environments.

"Most people would try to make sure everything was as standard as possible," Bradford said. "We said, 'Well, let's generate as much variation as possible.' So we put some blocks on south-facing slopes, where they would be warmer in the summer, and others on north-facing slopes where it's colder. We put some on top of ridges and others next to streams where it was wetter."

After 13 months, they measured how much carbon had been lost, whether absorbed by the microbes growing on the wood or directly into the atmosphere as carbon dioxide.

According to their analysis, local-scale factors explained about three-quarters of the variation in wood decomposition, while climate explained only about one-quarter, contrary to the expectation that climate should

be the predominant control.

Since those local factors likely are the primary drivers of decomposition rates, Bradford said, they should be better documented and integrated into climate models.

"The [climate] modelers know that they can only produce models based on the data sets that we give them," he said.

"So the message for field ecologists like me is to go out and get much richer data sets with much more information. We shouldn't aggregate away information. We should make measurements at those local scales to capture all of the importance processes that affect ecosystem functioning.

"Then the modelers will have far richer data sets to test their models against and see if they work," he adds.

The study was a collaboration among researchers from Yale; State University of New York-Buffalo; the Institute of Microbiology, Academy of Sciences of the Czech Republic; the U.S. National Center for Atmospheric Research; Columbia University; and the University of Central Florida.

More information: "Climate fails to predict wood decomposition at regional scales," *Nature Climate Change*, 2014. www.nature.com/nclimate/journa … ll/nclimate2251.html

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