Researcher seeks 'missing piece' in climate change models

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To most people, soil is just dirt. But to microbiologists, it is a veritable zoo of bacteria, fungi and nematodes. It's also a vast carbon dioxide factory. As these microorganisms consume carbon-based materials found in soil, they release carbon dioxide gas into the atmosphere as a normal part of their metabolism.

As the world gets warmer, they'll likely be cranking it out faster than ever.

"As the climate warms, it is predicted that soil carbon is going to be decomposed faster by soil microbes, which means more carbon dioxide is going to be released into the atmosphere," says Teri Balser, assistant professor of soil science at the University of Wisconsin-Madison College of Agricultural and Life Sciences. "So, there is a very real possibility that you might get this vicious cycle - a positive feedback loop - where increased warming causes more carbon dioxide (to be released from the soil), which causes even more warming."

Current climate models mostly ignore the specific role that soil microbes play in the release of carbon dioxide into the atmosphere. The information they do include is often based on assumptions that have never been tested in the field, and may be wrong or overly simplistic.

Balser hopes to change that. She recently received a career award from the National Science Foundation to help generate the data needed to correctly account for the role of soil microbes in climate change models.

"Even a tiny change in the amount of carbon in the soil (due to soil microbe activity) could really influence atmospheric carbon dioxide levels," explains Balser

With her new NSF grant award, Balser plans to test the effects of climate change on various microbial communities.

In one experiment, Balser will collect soil samples from northern Wisconsin, and then move half of each sample to southern Wisconsin, where the temperature is slightly warmer. Then, she will compare carbon dioxide released by the same microbial communities at the two different latitudes.

In a second experiment, Balser plans to remove soil cores from the earth, and then replace them upside-down in the same place. In this case, the soil microbes that were previously deeper underground where the temperature is relatively steady will be exposed to the fluctuating temperatures found near the surface. Again, she will look for changes in volumes of carbon dioxide released by the microbes.

Balser will also explore the types of carbon consumed by the microbes. More than 90 percent of soil carbon is stored in a "stable" form that is relatively difficult for microbes to utilize.

"We want to keep carbon in the soil, and not have it released into the atmosphere. The more complex the carbon molecule, the more likely it is to stay in the soil," says Balser. "(So) we don't want soil microbes using complex carbon."

Current climate models that do include soil microbe factors assume that as temperatures rise, microbes will utilize more of the stable carbon stored in the ground. These predictions are based on common laws of chemistry.

However, Balser's preliminary data suggest that this assumption is faulty.

"When you look at the physiology of soil microbes in the ground, you get the opposite result of what climate modelers are assuming," says Balser. "We saw that when the temperature went up, the utilization of simple carbon increased and the utilization of complex, difficult-to-use carbon decreased."

This result doesn't surprise Balser. Microbes are more than a collection of chemical reactions, she points out. They are biological creatures that behave according to their biological imperatives.

Source: University of Wisconsin-Madison

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