Argonne NATIONAL LABORATORY

Biosciences

Argonne, UIC researchers get the dirt on prairie soil

Researchers from Argonne National Laboratory and the University of Illinois at Chicago have dug up some interesting dirt on prairie soil and certain crops and grasses common to the central Midwest.

"Beyond growing crops like corn and soybeans, prairie soil is better than soils found in other parts of the United States at retaining carbon dioxide," said Roser Matamala, a terrestrial ecologist in Argonne's Biosciences Division and the principal investigator of two projects that measure the intake from and release of carbon dioxide into the atmosphere. In addition, her research has found that certain types of vegetation are better than others at absorbing carbon dioxide.

The projects are located on an active farm site and a restored tallgrass prairie at the National Environmental Research Park on the grounds of the Fermi National Accelerator Laboratory in Batavia, Ill.

The absorption and retention of CO_2 by plants and soil, respectively, is beneficial because it means less of the greenhouse gas lingers in the atmosphere, absorbing the Sun's heat and contributing to the increase in Earth's average temperature, Matamala said.

Data collected at the two research sites show that tall prairie grasses absorb more CO_2 per square meter in one year than corn and soy, she said, adding that soybeans absorb the least amount of CO_2. Tall prairie grasses, which are common in Illinois and other parts of the central Midwest, absorb up to 480 grams per square meter compared to 250 grams for corn.

Most absorbed CO_2 is used by the plants as a fuel, Matamala said, but it also becomes part of the plant, including the seed and grain. Much of the absorbed CO_2 in food crops like corn is harvested.

A substantial portion of a plant's absorbed CO_2 is transported to the soil regardless of the type of plant. The CO_2 that is transported to the soil is eventually converted into organic matter; that conversion process continues for centuries before the soil becomes saturated, creating a sustained terrestrial carbon sink, an accumulation of absorbed carbon. Carbon that gets to the soil by this process does not accumulate in the atmosphere, thereby mitigating global warming.

An Eddy Flux tower, powered by solar energy, located at a soybean field at Fermilab is measuring the exchange of carbon dioxide between plants and soil and the atmosphere to study the carbon balance of agricultural fields typical of the U.S. Midwest.

Prairie land's ability to retain high levels of CO_2 is an important feature of the vegetation and soils in the Midwest, Matamala said. Virgin prairie land – land that has never been cultivated – is richer in organic matter compared to restored prairie land. Organic matter makes soil dark in color.

Virgin prairie land has greater amounts of carbon than cultivated fields and restored areas, such as found at the Fermilab site, because it is not disturbed by cultivation, Matamala said. Plowed soil respires, releasing CO_2.

The restoration of farmland leads to greater retention of CO_2, she said. "The soil in the prairie keeps more carbon dioxide in the winter compared to other regions," Matamala said. Because the Midwest has longer

Soils originated under prairie accumulated soil organic matter and became deep and fertile. Under cultivation 40 percent of the original organic matter is lost. Sustainable cultivation and restoration practices bring back the carbon to the soil.

periods of cooler to cold temperatures, less CO_2 is respired from the soil. And when the soil freezes, less CO_2 is respired. Conversely, warm to hot temperatures and humid conditions activate microorganisms in soil and the microorganisms use the organic matter to grow; that process respires CO_2 back into the atmosphere. Cultivated lands lose more soil carbon during spring and fall months compared to restored prairie land because the microorganisms in the soil are activated by warm temperatures and soil plowing.

The two projects are part of the AmeriFlux Network, a coordinated collection of long-term research sites in the Americas that are organized to quantify and understand the role the terrestrial biosphere has in global climate change. The goal of the AmeriFlux project is to collect data that computational scientists use to refine the resolution of climate change models.

"Refining the resolution of climate models can provide a better picture of what is happening in small geographical areas like cities, counties and states versus large geographical regions," said Robert Jacob, an Argonne climate modeler.

The project's research data is collected by two eddy covariance towers. One tower is located on a farmland that rotates corn and soybean corps under tillage. The other tower is located in a field that was restored with native grassland species in 1989 and represents long-term Conservation Reserve Program management.

AmeriFlux is sponsored by the U.S. Department of Energy's Office of Biological and Environmental Research, the Department of Commerce's National Oceanic and Atmospheric Administration, the Department of Agriculture and the National Aeronautic and Space Administration.

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