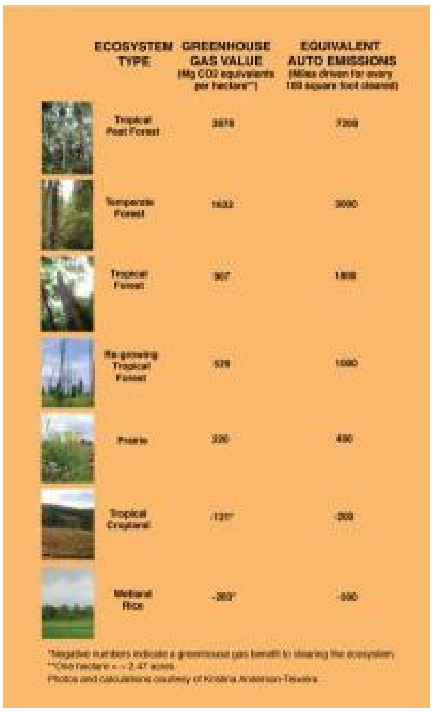
PHYS.ORG

Researchers calculate the greenhouse gas value of ecosystems

May 26 2010



Different ecosystem types vary in their absorption or emission of greenhouse gases. Credit: Kristina Anderson-Teixera and Diana Yates

Researchers at the University of Illinois have developed a new, more accurate method of calculating the change in greenhouse gas emissions that results from changes in land use.

The new approach, described in the journal [Global Change Biology](), takes into account many factors not included in previous methods, the researchers report.

There is an urgent need to accurately assess whether particular land-use projects will increase or decrease greenhouse gas emissions, said Kristina Anderson-Teixeira, a postdoctoral researcher in the Energy Biosciences Institute at Illinois and lead author of the new study. The greenhouse gas value (GHGV) of a particular site depends on qualities such as the number and size of plants; the ecosystem's ability to take up or release greenhouse gases over time; and its vulnerability to natural disturbances, such as fire or hurricane damage, she said.

Greenhouse gases trap heat in the atmosphere and contribute to climate change. The most problematic greenhouse gases include carbon dioxide (CO_2); methane (CH4), which is about 25 times more effective than CO_2 at trapping heat but persists in the atmosphere for much less time; and nitrous oxide (N_2O), an undesirable byproduct of crop fertilization.

The new approach accounts for emissions of each of these gases, expressing their net climatic effect in "carbon-dioxide equivalents," a common currency in the carbon-trading market. This allows scientists to compare the long-term effects of clearing a forest, for example, to the costs of other greenhouse gas emissions, such as those that result from burning fossil fuels for transportation, electricity, heat or the production of biofuels.

At first glance, biofuels appear carbon-neutral because the plants absorb carbon dioxide from the atmosphere and store the carbon in their tissues as they grow, said plant biology and Energy Biosciences Institute professor Evan DeLucia, who co-wrote the paper. That carbon is released when the plants are used as fuels. These emissions are balanced by the uptake of CO_2, so - in theory, at least - no new carbon is added to the atmosphere, he said.

But the full impact of a new biofuel crop should account for all of the greenhouse gases absorbed and released in the process of introducing new crops, he said.

Researchers and policymakers are already in the habit of conducting "life-cycle" analyses of biofuel crops, taking into account many of the greenhouse gas effects of growing the crops and producing the fuel, such as the combustion of fuel in farm equipment, emissions from the processing plant, and emissions from associated land-use changes.

But current methods of estimating the greenhouse gas value of ecosystems - whether for biofuels life-cycle analyses or other purposes - often get it wrong, Anderson-Teixeira said. When considering the cost of replacing a tropical forest with cropland, for example, some may look only at the amount of carbon stored in the trees as a measure of a forest's GHGV.

"What some analyses miss is the potential for that forest to take up more carbon in the future," she said. "And they're missing the greenhouse gas costs - the added emissions that result from intensively managing the land - that are associated with that new cropland."

Current approaches also routinely fail to consider the timing of greenhouse gas releases, DeLucia said.

"If you cut down a forest, all that carbon doesn't go up into the atmosphere instantly," he said. "Some of it is released immediately, but the organic matter in roots and soils decays more slowly. How we deal with the timing of those emissions influences how we perceive an ecosystem's value."

Using the new method, the researchers calculated the GHGV of a variety of ecosystem types, including mature and "re-growing" tropical, temperate and boreal forests; tropical and temperate pastures and cropland; wetlands; tropical savannas; temperate shrublands and grasslands; tundra; and deserts.

"In general, unmanaged ecosystems - those that we are leaving alone, such as a virgin forest or an abandoned farm where trees are re-growing - are going to have positive greenhouse gas values," Anderson-Teixeira said. Managed ecosystems such as croplands or pastures generally have low or negative greenhouse gas values, she said. (See chart.)

The calculations would of course vary as a result of local conditions, the researchers said, and the GHGV does not account for the other services a particular ecosystem might provide, such as flood control, improved air and water quality, food production or protection of biodiversity.

"To understand the place of nature these days, we've got to put a value on it," DeLucia said. "It's got to compete with all the other values that we put out there. This is by far the most comprehensive way to value an ecosystem in the context of greenhouse gases."

Provided by University of Illinois at Urbana-Champaign

Citation: Researchers calculate the greenhouse gas value of ecosystems (2010, May 26) retrieved 22 September 2024 from https://phys.org/news/2010-05-greenhouse-gas-ecosystems.html