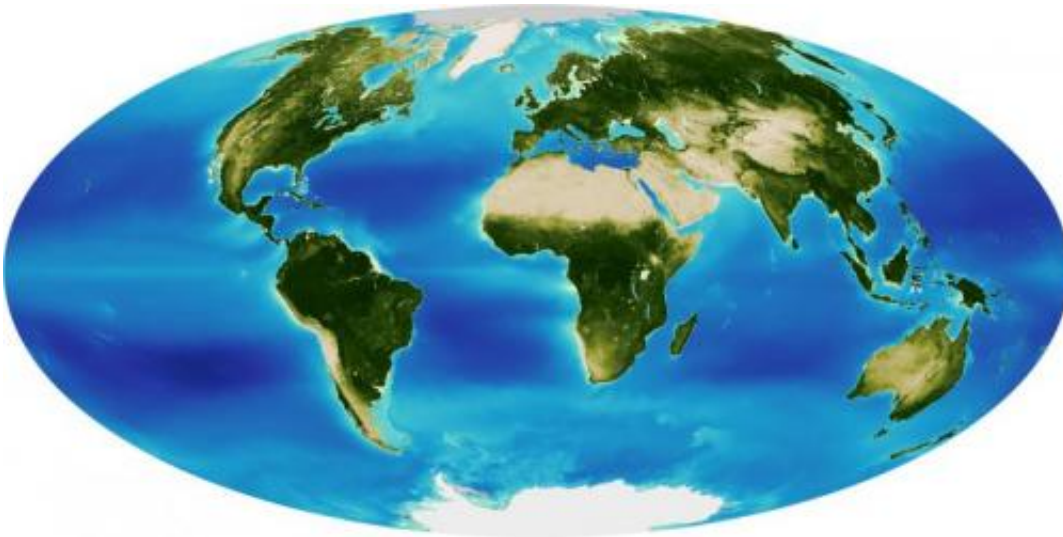


Study says Earth can sustain more terrestrial plant growth than previously thought

August 26 2014



Scientists have historically underestimated the potential productivity of the earth's land plants, researchers report in a new study. Credit: NASA Earth Observatory image by Jesse Allen

A new analysis suggests the planet can produce much more land-plant biomass – the total material in leaves, stems, roots, fruits, grains and other terrestrial plant parts – than previously thought.

The study, reported in *Environmental Science and Technology*, recalculates the [theoretical limit](#) of terrestrial [plant productivity](#), and finds that it is much higher than many current estimates allow.

"When you try to estimate something over the whole planet, you have to make some simplifying assumptions," said University of Illinois plant biology professor Evan DeLucia, who led the new analysis. "And most previous research assumes that the maximum productivity you could get out of a landscape is what the natural ecosystem would have produced. But it turns out that in nature very few plants have evolved to maximize their growth rates."

DeLucia directs the Institute for Sustainability, Energy, and Environment at the U. of I. He also is an affiliate of the Energy Biosciences Institute, which funded the research through the Institute for Genomic Biology at Illinois.

Estimates derived from satellite images of vegetation and modeling suggest that about 54 gigatons of carbon is converted into terrestrial plant [biomass](#) each year, the researchers report.

"This value has remained stable for the past several decades, leading to the conclusion that it represents a planetary boundary – an upper limit on global biomass production," the researchers wrote.

But these assumptions don't take into consideration human efforts to boost plant productivity through genetic manipulation, plant breeding and land management, DeLucia said. Such efforts have already yielded some extremely productive plants.

For example, in Illinois a hybrid grass, *Miscanthus x giganteus*, without fertilizer or irrigation produced 10 to 16 tons of above-ground biomass per acre, more than double the productivity of native prairie vegetation or corn. And genetically modified no-till corn is more than five times as productive – in terms of total biomass generated per acre – as restored prairie in Wisconsin.

Some non-native species also outcompete native species; this is what makes many of them invasive, DeLucia said. In Iceland, for example, an introduced species, the nootka lupine, produces four times as much biomass as the native boreal dwarf birch species it displaces. And in India bamboo plantations produce about 40 percent more biomass than dry, deciduous tropical forests.

Some of these plants would not be desirable additions to native or managed ecosystems, DeLucia said, but they represent the untapped potential productivity of plants in general.

"We're saying this is what's possible," he said.

The team used a model of light-use efficiency and the theoretical maximum efficiency with which plant canopies convert solar radiation to biomass to estimate the theoretical limit of net primary production (NPP) on a global scale. This newly calculated limit was "roughly two orders of magnitude higher than the productivity of most current managed or natural ecosystems," the authors wrote.

"We're not saying that this is even approachable, but the theory tells us that what is possible on the planet is much, much higher than what current estimates are," DeLucia said.

Taking into account global water limitations reduced this theoretical limit by more than 20 percent in all parts of the terrestrial landscape except the tropics, DeLucia said. "But even that water-limited NPP is many times higher than we see in our current agricultural systems."

DeLucia cautions that scientists and agronomists have a long way to go to boost plant productivity beyond current limits, and the new analysis does not suggest that shortages of food or other plant-based resources will cease to be a problem.

"I don't want to be the guy that says science is going to save the planet and we shouldn't worry about the environmental consequences of agriculture, we shouldn't worry about runaway population growth," he said. "All I'm saying is that we're underestimating the productive capacity of plants in managed ecosystems."

More information: The paper, "The theoretical limit to plant productivity," is available online:

pubs.acs.org/doi/abs/10.1021/es502348e

Provided by University of Illinois at Urbana-Champaign

Citation: Study says Earth can sustain more terrestrial plant growth than previously thought (2014, August 26) retrieved 12 May 2024 from <https://phys.org/news/2014-08-earth-sustain-terrestrial-growth-previously.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.