Study ups plant CO2 intake estimates

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Plants may be able to limit the impact of our CO2 emissions even more than we previously thought, an innovative new experiment suggests.

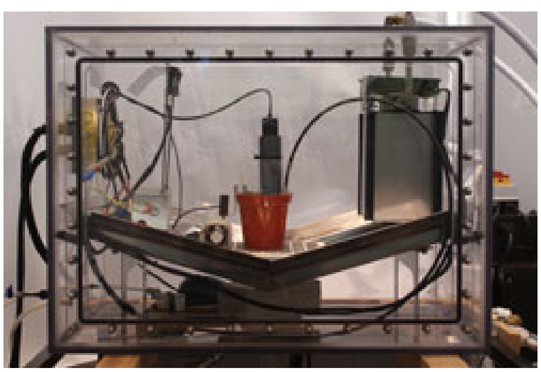
The study is the first to try to create a simplified self-contained replica of the Earth's land-based carbon cycle, using soil and plants in airtight containers. As researchers increased temperature and CO2 levels, the plants kept absorbing the extra gas for longer than computer models and earlier experiments had predicted.

In fact, they took in 62 per cent of the extra CO2 and prevented the temperature from increasing by more than 2.3°C. At that point the gas's concentration was still beneath 500 parts per million (ppm). Without the plants' increased activity, it would have been 760ppm, implying warming of around 4.4°C.

It's hardly a solution to climate change; plants couldn't keep this up for ever, and the experiments did not include the changes in the availability of water and nutrients that will be another consequence of climate change and that will almost certainly limit plant growth in many areas. But the study does suggest that plants may be more capable of adapting to changing conditions than we thought, and it will give us a more accurate idea of the consequences of climate change.

"The scenarios we used were very optimistic in terms of future CO2 anthropogenic emissions, so there are still very serious concerns about climate change," says Dr. Alex Milcu of Imperial College, London, the paper's lead author. "But it does look like plants may be able to take in more CO2 than previous experiments and models predicted."

At the moment, scientists estimate that terrestrial plants mop up around a quarter of the CO2 we emit. Increasing CO2 levels means they can grow faster and absorb even more of the gas. But the higher temperatures predicted from climate change will also make the microbes in the soil more active, increasing their respiration and hence their CO2 emissions.



Closed experiment to show how plants will respond to climate change

So we don't know what the overall effect will be - will more land ecosystems absorb more CO2 on balance, or less? Understanding this would let us make better predictions of the effect releasing different amounts of carbon into the air would have.

Previous studies have tried to answer the question either using computer models or by putting plants in an experimental setup and changing just one variable at a time - for instance, raising CO2 and seeing how they react.

But this approach doesn't do justice to the complexity of the carbon cycle, which is full of hidden tipping points and feedback loops. When the environment changes and affects how plants grow, their response changes the environment again, in turn affecting their growth, and so on. The researchers behind this study decided to try to model this complexity by building a closed, airtight system that worked as a simplified version of the whole terrestrial carbon cycle.

"Computer climate models have become increasingly complex and I wanted to go back to basics. We achieved this by somewhat radically building a 'physical' model of the terrestrial carbon cycle. This is equivalent to using a wind tunnel, as opposed to a computer simulation, to test the aerodynamics of a new structure," says co-author Professor Phil Ineson, from the University of York. "Our experimental findings made total sense but suggested that the capacity of the Earth to buffer against rising carbon dioxide may be greater than the computer models imply - we still have the same major concerns about climate change, but the Earth system may have some tricks up her sleeve!"

They put plants growing in microbe-rich soil into sealed plastic cabinets and varied the conditions they grew under, monitoring what happened under different scenarios for three months. Some were kept in unchanged conditions; others got more CO2 but unchanged temperatures. A third group got more CO_2 and temperatures that changed according to a climate model's predictions of the effects of its CO_2 levels - so the higher CO_2 levels climbed, the hotter it got.

They found that the plants in the final category didn't just absorb the extra carbon released by the soil microbes; they also took in much of the extra CO_2 that had been added to their cabinets' atmosphere, limiting temperature increase. But the plants didn't bring CO_2 levels or temperatures back down again; conditions never returned to how they'd started throughout the life of the experiment.

Milcu says the team would have liked to have carried on for longer, but that the experiment was so difficult to set up that by the time they sealed every leak and got a truly closed system working, they had just three months left.

They have done limited trials of a more sophisticated follow-up experiment whose cabinets also included an aquatic component, as the oceans are at least as important as plants on land in absorbing CO_2 from the atmosphere. But these weren't conclusive, and Milcu would like to carry out much more extensive and longer-lasting trials using this improved setup. He'd also like to use much more diverse plant communities, rather than just one kind of plant as here, to give a better idea of the overall response of whole ecosystems.

The NERC-funded study, published in *Nature Climate Change*, was authored by scientists at Imperial College London and the Universities of Newcastle, Reading, Stirling and York. It took place at NERC's Ecotron controlled-environment facility at Imperial.

More information: Biotic carbon feedbacks in a materially closed soil-vegetation-atmosphere system. Alexandru Milcu, et al. *Nature Climate Change* 2, 281-284 (2012) doi:10.1038/nclimate1448 www.nature.com/nclimate/journa … ll/nclimate1448.html

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