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Carbon markets underestimate the risks U.S. forests face from climate change

The world's forests form a vast network of carbon reservoirs, keeping carbon sequestered from the atmosphere where its presence is disrupting Earth's climate systems. Many corporate, national and sub-national climate policies rely on forests' essential ability to store carbon, often tracked and funded through a system of "carbon credits" issued to polluting industries in exchange for protecting and restoring forests.

But if trees die — from wildfire, drought or insect infestation — large amounts of greenhouse gasses are released, exacerbating ongoing climate change. And the warming climate is accelerating this problem by making such disturbances more frequent and severe, but only in some places and not in others.

Scientists at the University of Utah and UC Santa Barbara, in collaboration with international experts, sought to determine which forests are most likely to release their stored carbon over the next 100 years, and whether current carbon-credit systems accurately account for those risks.

The results, published in Nature, show that there are places in the United States where carbon emissions from die-backs far exceed what is currently accounted for in carbon-credit systems. This is particularly true for the parched American West. Fortunately, the researchers point out ways it can be corrected.

“Getting to net zero emissions will take a portfolio of solutions,” said co-author Anna Trugman, a forest ecologist at UCSB. “But in many regions, escalating disturbance associated with climate change makes it riskier to count on forests to sequester carbon.”

“Forests are facing increasing durability risks due to climate change,” added senior author William Anderegg, a biology professor at the University of Utah. “Those risks have been underappreciated to date in multi-billion-dollar carbon markets.

“But with better science, we can set these policies up to potentially work better,” Anderegg continued. “We’re providing a potential solution as well.”

Carbon-credit programs aim to cover the risk of fire and other disturbances by using “buffer pools.” These are reserves of extra carbon credits set aside to compensate for forests that suddenly lose carbon if their trees burn or die. However, the study found these buffer pools are currently far too small for US forest projects within the California Air Resources Board (CARB), which manages one of the largest compliance carbon-credit programs in the nation. On average, they would need to be around six times larger to fully cover the expected losses over a century for the projects that have been set up so far.

The research team, which included scientists from seven other universities and organizations, used forest plot data, satellite observations and machine learning to predict where forest losses are most likely to occur. They mapped areas across the continental U.S., and calculated the risks of a carbon reversal — or carbon loss — occurring at least once in the next 100 years from wildfire, drought and insects. The maps show how risks vary across the landscape based on historical models and updated ones that account for climate change. The differences are stark.

While parts of the country remain relatively low risk, the portion of the country projected to experience a reversal expanded from 10% to 33% for wildfire; from 19% to 21% for drought; and from 23% to 25% for insects. Broad areas in Idaho, Southern California, Arizona and New Mexico show an 80% or more chance of experiencing such a carbon loss due to wildfire over the next century.

“Compared to other natural disturbances, we found that wildfire is the largest climate-sensitive risk to durability for forest nature-based climate solutions,” said co-

lead author Chao Wu, now at Tsinghua University in Beijing, China. “Our analysis shows for the first time what a robust, climate-informed buffer pool would look like to handle accelerating climate threats.”

Along with the maps, the Wilkes Center is releasing a set of interactive tools to help plan where and how to conduct forest management and conservation efforts with the highest chances of success.

Carbon credits are among a host of mechanisms to finance nature-based climate solutions. These strategies harness market incentives to encourage investments that keep greenhouse gases out of the atmosphere. Promoting tree growth is a great way to pull carbon and keep it locked up for decades — as long as the risk of trees dying prematurely is considered and appropriately managed.

“Nature-based climate solutions in forests aim to store carbon and keep it out of the atmosphere,” Anderegg said. “Sometimes that forest carbon is claimed as a ‘carbon offset’ for fossil fuel emissions elsewhere. Somebody’s buying that credit, assuming that a ton of carbon in the trees is the same as a ton of carbon in fossil fuels that you emit to the atmosphere.”

For this system to function as a climate solution, that carbon has to remain in the trees for a long time. Projects are typically planned on a 100-year horizon in the major California program that the researchers examined. Many offset protocols assume risks are stable over time and space. In reality, risks vary widely by location and are increasing due to climate change. And this new research makes it possible for the first time to account for how risks vary through space and time.

Trugman’s lab is currently investigating which species will continue to thrive under emerging climate conditions, why this is, and what managers can do to increase the resilience of high-value ecosystems under threat.

“There is some positive news here,” Anderegg said. “Once you have the best-available science and data directly incorporated into programs and policies, you can then inform and strategically guide where new projects get developed.

“This ability to choose and really focus on forest carbon in low-risk areas is very promising,” he continued. “This can incentivize these forest activities where they’re likely to last, and then maybe steer clear of areas where forests are likely to be gone

in 100 years.”

Tags
Climate Change

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