

Forests and Carbon and Climate Change

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Forests and forest soils are important to climate change because they contain a lot of carbon. Globally, forests contain over 800 gigatons (Gt) of carbon and forest soils, another 1,500 Gt (a Gt is 2.2 trillion pounds). Forests have been headline news in the past few years, some good and some not so good. The not so good headlines are the large and severe forest fires that have burned across the American west, Australia, Brazil, Siberia, Southeast Asia, and other parts of the world. The Marshall fire in Boulder County Colorado, in the final days of 2021, is the latest example of increasingly severe fire behavior. Fortunately, in this case there were few fatalities, but thousands of people lost their homes.

In addition to destroying homes, such large fires emit tons of smoke and soot, which impact human health hundreds of miles downwind. You might remember choking on smoke from California fires this past summer. In recent years fires have released between 5 and 7 Gt of carbon dioxide (CO₂) into the atmosphere, much of it from forests where thick organic soils were burned. This might seem surprising, but our recent study of hundreds of fires across Alaska and Canada showed that almost 90% of CO₂ emissions came from the combustion of organic soils. Some of these fires smolder belowground through the winter months and reignite in the spring. These so-called “zombie fires” are becoming increasingly common, particularly in peatlands stretching across Alaska, Canada, and Russia.

As we would expect, more severe fires arise from an increasingly warmer and drier climate, and recent research indicates the current mega-drought in the western US is the most severe in the past 600 years. Hot and dry conditions cause more extreme “fire storm” behavior, in which fires create their own weather and inject plumes of CO₂ high into the atmosphere.

The better headlines have been about forest thinning and fire prevention. Communities in northern Arizona and California have invested millions of dollars in forest thinning operations. This has been mostly around populated areas, but its importance is increasingly recognized across the country and around the world. Recent innovations in the commercial use of small diameter trees and branches are making this more economical, and this strategy helps to avoid emissions from burning slash piles.

There have also been good headlines about forest conservation and regrowth. Because deforestation and forest degradation across the tropics and other parts of the world account for about 15% of global CO₂ emissions, many countries are focusing on protecting and regrowing their forests. In November 2021, 141 countries at the 26th United Nations Conference of the Parties (COP26) in Glasgow, Scotland pledged to “halt and reverse forest loss” by 2030. If these pledges are implemented, they will not only reduce carbon emissions, but will also ensure production of clean water. This can support sustainable livelihoods for the 25% of the world’s population who rely on forests. Meeting these pledges will also help to conserve biodiversity. This is critical, since forests are home to 80% of the world’s terrestrial biodiversity. Despite the many challenges, this would be a genuine win-win for people and the planet. Of

course, we need to ‘trust and verify’. Our team at NAU has been helping NASA develop satellite verification capabilities using data from GEDI (the Global Ecosystem Dynamics Investigation), which is currently operating on the International Space Station.

Forests also help reduce additional climate warming by taking 15 Gt of CO₂ from the atmosphere each year, while releasing oxygen and water vapor. This “ecosystem service” that forests provide humanity is very real. Not only do forests keep our atmosphere oxygen rich and sustain fresh water, both of which we all require to survive, they also effectively lock carbon away in woody biomass until it slowly decomposes or is rapidly released by fire. If we can keep forests intact, and not subject to intense wildfires, most of this carbon will stay out of the atmosphere. Not only that, healthy forests will continue to remove massive amounts of carbon from the atmosphere. For all of these reasons, forests are an important resource in our efforts to reduce climate change and maintain a viable planet that sustains us all.

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