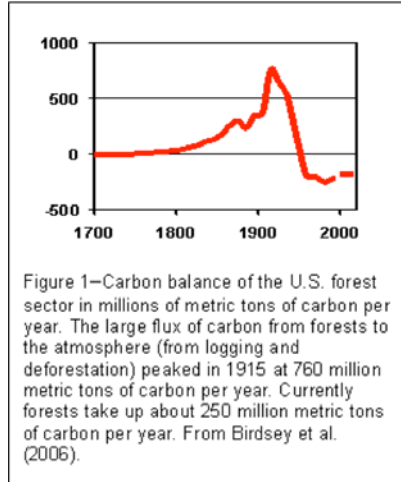


Forests and Carbon Storage

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Issue



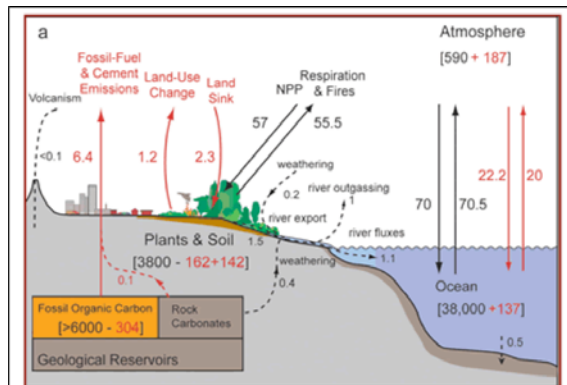
Forests store much carbon and their growth can be a carbon sink if disturbance or harvesting has killed or removed trees or if trees that can now regrow are planted where they did not historically occur. Forests and long-lived wood products currently offset 310 million metric tons of U.S. fossil fuel emissions of carbon—20 percent of the total (Pacala et al. 2007). This is an enormous ecosystem service; Jackson and Schlesinger (2004) estimated that offsetting another 10 percent of emissions would require the conversion of one-third of our current U.S. cropland to forest plantations. Large forested landscapes over long periods of time should have a carbon balance of near zero (Kashian et al. 2006). Our large carbon sink today results from past harvesting, which released much carbon dioxide (CO₂) into the atmosphere, and the regrowing forest is recovering that CO₂ (Birdsey et al. 2006).

(fig. 1). Nitrogen deposition and atmospheric CO₂ can make forests grow and are higher than in the past, perhaps contributing to today's forest carbon sink (Canadell et al. 2007). The persistence of this forest carbon sink is a concern, because the processes promoting the sink should taper off, while projected increases in the rates of such disturbances as fire may mobilize current carbon stocks (Canadell et al. 2007). We understand the carbon value of keeping forests as forests, of planting forests where none existed historically (afforestation), of replanting forests where they were located historically (reforestation), of using forest biomass as fuel in place of fossil fuel, and of storing carbon in long-lived products. However, several issues remain to be solved: (1) biophysical limits on storage and a complete accounting of the global warming budget of forests, which would include their albedo or reflectance (forests are dark and absorb solar energy) and the release of other greenhouse gases such as nitrogen oxides; (2) the lifespan of storage (including disturbances of all kinds, and market forces that will influence whether harvesting for wood products is more economical than other uses); and (3) accounting of storage in all forest carbon pools and the displacement of carbon loss to other areas.

Expected Changes

Over the next 50 years, the United States as a whole is projected to be warmer and wetter, which will increase forest growth. However, the Southwest and portions of the Southeast will experience warming and drying conditions that will reduce forest growth. Wildfires and insect outbreaks in the Western United States are projected to increase over the next 50 years. The short-term effect of these disturbances on forest carbon storage will depend on the amount of area affected each year, on the type and intensity of the disturbance, and on the pace of regeneration. Intense fires and insect outbreaks over large areas will increase carbon losses. Over the long term, fire effects on carbon stored in forests are minor, if the forest regenerates, because regrowth recovers the carbon lost in the fire and in decomposition of the trees killed by the fire. If fires convert forests to meadow or shrublands, losses of carbon can be considerable.

In the last 10 years, forest fires annually burned 0.9 percent of forested land in the United States, with the largest fire year (2006), burning 1.3 percent of forested land. This corresponds to an overall average return interval of 100 years for U.S. forest fires. If fires become more severe, especially where ecosystems are not adapted to severe fire, the likelihood that fire will change forest to shrublands or meadows will increase. Current fire emissions of carbon are estimated at 40 million metric tons/year, compared to net forest growth of 257 million metric tons/year (US EPA 2007). Given that the increase in fires over the past few decades has not decreased forest sequestration of carbon, it would probably take a doubling or tripling of the fire frequency (30- to 50-year fire return interval) coupled with some conversion of forests to meadow or brushland, for fire to affect the carbon stored in U.S. forests as a whole.



Options for Management

The most defensible options for managing forests for their carbon storage are keeping forests as forests, reforesting areas where forests historically occurred, using forest biomass to offset fossil-fuel use (burning forest biomass generally means that fossil fuel will not be burned), and promoting long-lived forest products such as wood-framed buildings. Forests (particularly older forests) generally store carbon better than forest products, so harvesting old-growth forests for their forest products is not an effective carbon conservation strategy (Harmon et al. 1990). However, harvest and regeneration of young to middle-aged forests for long-lived forest products can help with carbon storage. In forests with an ecological history of surface and mixed-severity fires, managing for maximum carbon storage will lead to an increase in stand density and the probability of more severe fires. In contrast, managing to reduce fuels and crown fire probability will reduce the carbon stored in the forest and likely be a carbon source unless the thinings are used for biomass fuel.

Selling carbon credits may be a mechanism to reduce costs of forest management in the future, especially if carbon reductions become more valuable in the United States. Two types of markets exist for trading carbon credits from forestry projects, the Chicago Climate Exchange and many voluntary carbon markets. Accounting rules and guidelines differ, and these markets, rules, and guidelines are unregulated; therefore, caveat emptor (buyer beware).

Recommended Reading

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Useful Links**SOCCR Report** (State of the Carbon Cycle Report)

The effects of climate change on agriculture, land resources, water resources, and biodiversity—Climate Change Science Program Synthesis and Assessment 4.3, Public Review Draft (See Land Resources Chapter for Forests)

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<http://www.fs.fed.us/ccrc/topics/carbon.shtml>