Eco-Link
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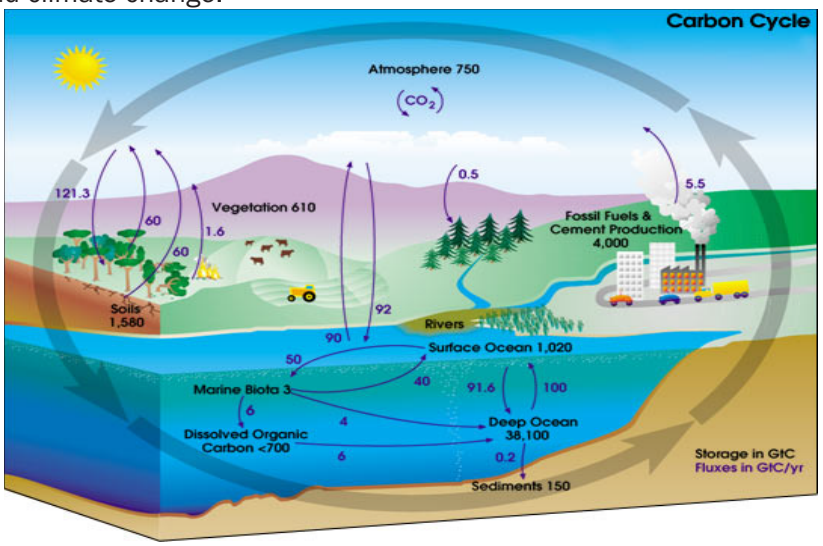
Climate Change:
Forests and Carbon Sequestration

Since the Industrial Age, the concentration of carbon dioxide in the atmosphere has risen from about 280 parts per million (ppm) to 377ppm, a 35 percent increase. Carbon dioxide makes up just 0.035 percent of the atmosphere, but is the most abundant of the greenhouse gases which include methane, nitrous oxide, ozone, and CFCs. All of the greenhouse gases play a role in protecting the earth from rapid loss of heat during the nighttime hours, but abnormally high concentrations of these gases are thought to cause overall warming of the global climate. Governments around the world are now pursuing strategies to halt the rise in concentrations of carbon dioxide and other greenhouse gases.

A vital role of forests is recycling of air in the lower atmosphere. Forests store and release carbon dioxide through natural processes. As a tree grows it takes in CO2 from the atmosphere and releases oxygen in the process of photosynthesis. The carbon that is taken from the air is incorporated into sugars (such as glucose), that become the building blocks for production of wood. About one-half the weight of dry wood is carbon and that carbon is stored or sequestered as long as the wood is in existence. When trees die, decay or burn they release carbon stored in the soils and biomass (organic matter such as stems, stumps and slash) as CO2 into the atmosphere. Carbon is also released as CO2 when trees are harvested, although considerable carbon is stored in wood put into long-term use such as in houses, furniture, and books. Forests contain nearly 75 percent of the earth's biomass (Cloughesy, 2006), so it is crucial to understand the role forests have with carbon and climate change.

Carbon Cycle

Carbon is naturally exchanged between the atmosphere, the ocean, and land ecosystems as part of the global carbon cycle. Hundreds of billions of tons of carbon in the form of CO2 are emitted to the atmosphere annually through natural and anthropogenic (human) emissions (sources). Carbon is also absorbed by ocean plankton and land-based (terrestrial) living biomass. In the U.S., forests (including vegetation, soils, and harvested wood) account for approximately 85 percent of the total terrestrial sequestration of CO2. When in equilibrium, carbon fluxes among these various reservoirs are roughly balanced. However, activity that results in an increase in greenhouse gas emissions (such as accelerating burning of fossil fuels), and/or a decrease in CO2 capture (such as through clearing of forests), can shift the balance, resulting in a net increase in the concentration of greenhouse gases in the atmosphere.



In any given year, tens of billions of tons of carbon move between the atmosphere, hydrosphere, and geosphere. Human activities add about 5.5 billion tons per year of carbon dioxide to the atmosphere. The illustration above shows total amounts of stored carbon in black, and annual carbon uxes in purple. (Illustration courtesy NASA Earth Science Enterprise) http://earthobservatory.nasa.gov/Library/CarbonCycle/carbon_cycle4.html

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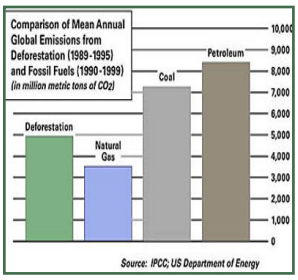
Terrestrial Carbon Sequestration

A carbon sink absorbs CO2 from the atmosphere, and stores it as carbon; in the case of a growing forest, carbon storage is in the form of wood and other vegetation and soil carbon. Young fast-growing forests absorb carbon dioxide more rapidly than older forests. An old forest is characterized by slow-growing trees and carbon losses due to death and decay that may translate to a net loss of carbon over time. As explained by Sedjo (2001) a carbon sink such as an old forest "may not be capturing any new carbon but can continue to hold large volumes of carbon as biomass over long periods of time." It is estimated that without the removal of CO2 from the atmosphere via carbon sinks, the present concentration of CO2 (377 parts per million) would be considerably higher (450 ppm) (Gillon, 2001). Carbon sinks can help offset environmental damage of energy intensive activities. The Kyoto Protocol recognizes carbon sinks as a form of a carbon offset.

As a result of photosynthesis carbon dioxide is removed from the atmosphere and stored in biomass. This is a part of the carbon cycle known as carbon sequestration. Trees and wood are carbon sinks, accumulating carbon as they grow and acting as stable carbon stores upon maturity. As noted earlier, this carbon storage applies even when trees are converted to lumber. When trees die or succumb to fire, their stored carbon is released back into the cycle through decay and combustion.

Within voluntary greenhouse gas reduction programs, such as those of the Chicago Carbon Exchange, carbon sequestration by forests is recognized as one way of mitigating industrial emissions of CO2. Because forests are sequestering carbon, forest managers are sometimes paid by corporations for maintaining carbon sinks, creating a "credit" on emissions for that corporation.

Forest Management and Carbon Sequestration



The foremost human-caused contributor to atmospheric carbon dioxide globally is the use of fossil fuels. Tropical deforestation (primarily for land conversion to agriculture), accounts for twenty percent of global CO2 emissions (IPCC; U.S. Department of Energy). However, in the United States, because of an increase in the extent of forests, as well as the volume of wood contained within them, forests are sequestering more carbon than they are emitting (www.ucsusa.org) and acting as carbon sinks. Managing forests to reduce carbon dioxide emissions and to increase carbon sequestration is possible through the following approaches (Salwasser, 2006 and U.S.EPA, 2007):

- Afforestation: converting non-forest lands to forests (i.e. tree planting on lands previously used for marginal crops)
- Reforestation: planting trees on lands previously used in forestry (i.e. re-planting quickly after a fire)
- Forest preservation: keeping forests as forests
- Forest Management: implementing strategies such as thinning or increasing the length of rotations (the period of time between harvests) to minimize risk of catastrophic fire.

Build with Wood

Utilizing wood has positive impacts on the environment. It is produced using solar energy and can be converted to useful products with little further expenditure of energy. In addition, much of the energy used in wood products manufacture is generated from wood scraps and bark. As a result, the use of wood reduces fossil fuel use and results in far lower emissions to air and water than use of alternative materials.

Carbon Offsets

Carbon offset "is the act of paying someone else for reducing (offsetting) their greenhouse gas emissions, when one is unable or unwilling to reduce one's own emissions" (http://en.wikipedia.org/wiki/Carbon_offset). An example is planting trees to offset one's gas emissions from driving a car to work every day. According to von Haggen and Burnett (2006), "a carbon offset project is one implemented specifically to reduce the level of greenhouse gases in the atmosphere." These projects have three elements:

1. Cancel out emissions
2. Reductions are documented in a greenhouse gas registry
3. The end offset is as though the cancelled emissions had not occurred

Foresters can implement forestry offset projects as listed above. Society can also reduce CO2 emissions, or offset the impacts of emissions resulting from other activities by using wood in building construction instead of more energy consuming concrete or steel and by using biomass for generation of energy instead of fossil fuels (von Haggen and Burnett, 2006). It is worth noting, however, that planting of trees, proper management of forests, and use of more wood cannot be expected to solve the CO2 emissions problem. As explained by Salwasser (2006), "...even if all global forests were managed for maximum carbon sequestration, they alone cannot completely offset carbon dioxide emissions from current rates of burning fossil fuels."

Deschutes River Riparian Reforestation Carbon Offset Project

The Deschutes Resources Conservancy (DRC) in Oregon has been involved in a carbon sequestration offset project with The Climate Trust since 2003. The Climate Trust buys carbon offsets from the DRC program which gives landowners incentives to reforest denuded riparian areas with native trees. Carbon dioxide is absorbed by the young growing trees and sequestered in its biomass. The sequestration is quantified and then The Climate Trust pays the DRC to "recruit and provide incentives to landowners to participate in the program." To ensure the program is carried out, landowners are legally bound to preserve the trees for at least fifty years. Benefits of the project include:

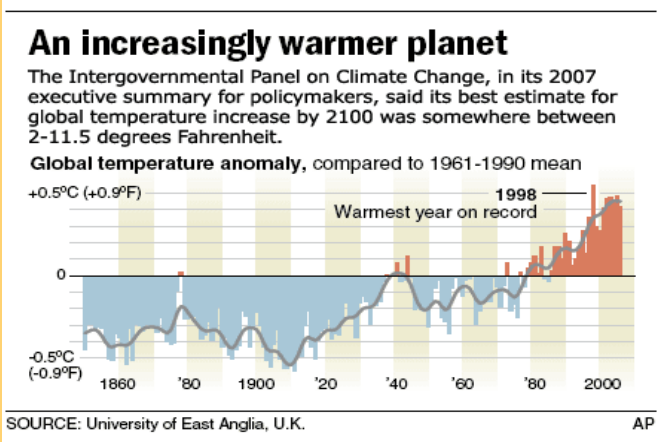
- The project offsets an estimated 234,000 metric tons of carbon dioxide a year (equivalent to average annual emissions of 46,614 automobiles).
- By 2008, 1500 to 1800 acres of riparian habitat will have been restored and actively sequestering carbon.

According to the Climate Trust, "Through the planting and maintenance of native trees along riparian areas of the Deschutes River Basin, this project demonstrates how organizations can work together to restore riparian areas for water quality and fish and wildlife habitat while sequestering carbon to reduce the impact of global climate change."

Fast Facts:

- One person emits ~20 tons of CO2 per year
- Average US car emits 4.5 tons of CO2 per year
- As a general rule one-half the dry weight of wood is carbon

Forests play a major role in the global carbon cycle and can be expected to play an even larger role as humans begin to focus on ways to reduce carbon and greenhouse gas concentration in the atmosphere.



Sources

Achterman, G., D. Bachelet, M. Burnett, J. Cathcart, M. Delaney, R.J. Drapek, M.Harmom, J.D. Kline, O.N. Krankina, J.M. Lenihan, C.Millar, R.P. Neilson, H. Salwasser, G. Taylor, B.v.Hagen, J. Wilson, and M. Cloughesy. 2006. Forests, Carbon and Climate Change: A Synthesis of Findings. The Oregon Forest Resources Institute, Oregon State University College of Forestry, and Oregon Department of Forestry. Oregon Forest Resources Institute, Portland, Oregon.

Farmer J.D. Methodology for forest guardians' carbon offset program. From http://fguardians.org. Retrieved on 5/21/2007.

Gillon, J. 2001. The lowdown on carbon sinks. SciDev Net. From http://www.scidev.net. Retrieved on 5/24/2007.

The Climate Trust. Deschutes riparian reforestation. From http://www.climatetrust.org/offset_deschutes.php. Retrieved on 5/21/2007.

Sedjo, R.A. 2001. Forest carbon sequestration: some issues for forest investments. Resources for the Future: Washington, D.C.

Union of Concerned Scientists. Recognizing forests' role in climate change. From http://www.ucsusa.org. Retrieved on 1/15/2007.

U.S. Environmental Protection Agency. Carbon sequestration in agriculture and forestry. From http://www.epa.gov/cgi-bin/epaprintonly.cgi. Retrieved on 4/4/2007.

Wikipedia. From http://en.wikipedia.org/wiki/Carbon_offset. Retrieved on 5/22/2007.

Planting a tree is a great way we can personally offset carbon, yet there are many other ways for example, switching to renewable energy such as wind power, solar power or biofuels and conserving energy to reduce the amount of fossil fuels we emit. The following websites have carbon calculators to calculate your carbon footprint to learn how much carbon dioxide you are emitting into the atmosphere and to discover how you can adopt a "carbon neutral" lifestyle:

www.carbonfootprint.com
www.climatecare.org
www.carbonneutral.com

Glossary of Terms

Atmosphere - The thin layer of gases that envelope the earth. Composed of gas molecules held close to the earth's surface by a balance between gravitation and thermal movement of air molecules.

Biomass - Organic matter such as wood, plants, residue from agriculture or forestry, and the organic component of municipal and industrial waste.

Carbon Credits - The idea of putting carbon sequestration in the form of a commodity so we have a measurable uniform unit of that commodity to sell. Carbon is measured in metric tons (2,205 pounds). Selling carbon credits can create partnerships between forest landowners and industry, while slowing down the accumulation of carbon in the atmosphere. Carbon sequestration credits are sold to industry as an offset for carbon emissions.

Greenhouse Gases - Gases that let in light and trap in heat. Include carbon dioxide, chlorofluorocarbons (CFC's), methane, nitrous oxide, and ozone.

Temperature - Refers to the relative hotness or coldness of materials such as air, water, soil, and living organisms.

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