Annualized Forest Carbon Estimates for U.S. National Greenhouse Gas Reporting

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Forest Carbon Components - Definitions

- **Aboveground biomass** = Live trees + understory
- **Standing dead trees**
- **Down dead wood**
- **Litter (Forest floor)**
- **Soil organic matter (1m)**
- **Belowground biomass**
## Categories of fates of harvested wood

<table>
<thead>
<tr>
<th>PRODUCTS IN USE</th>
<th>LANDFILLS</th>
<th>EMISSIONS</th>
<th>BURNED FOR ENERGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumber</td>
<td>Landfill wood</td>
<td>Waste wood, decayed or burned with no energy captured</td>
<td>Products sent to landfills, recycling, emissions</td>
</tr>
<tr>
<td>Plywood</td>
<td>Landfill paper</td>
<td>Decay of products &amp; landfills</td>
<td></td>
</tr>
<tr>
<td>Other panels</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solid wood</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Paper</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

- **BURNED FOR ENERGY**: Products sent to landfills, recycling, emissions
- **EMISSIONS**: Waste wood, decayed or burned with no energy captured
- **LANDFILLS**: Landfill wood, Landfill paper
National GHG reporting to UNFCCC

• Annual Greenhouse Gas (GHG) Emissions and Sinks Inventories (1990-present) (US Environmental Protection Agency)
  - All sectors, we do forest estimates
• Every 5 years, summary national communication
  - State Dept.

Public involvement
Conform to Everimproving International Reporting Guidelines

- IPCC Revision Guidelines (2004-2006) volumes. AFOLU: Agriculture, Forestry, and Other Land Use
- Nations need to be consistent with the methodology in the guidelines
Net C sequestration, Land Use Change and Forestry

14% of U.S. CO2 emissions

Source: EPA (2003), includes all effects. All are net sinks. No non-CO2
US forest C nonsoil stock change, 2003

12% of total U.S. CO₂ emissions

DRAFT: Smith and Heath for 2005 EPA GHG Inventory
Other Nat’l GHG inventory reports

• Energy Information Administration (annual)
• USDA (first report 2003)

INCLUDES DETAIL AT STATE-LEVEL
Basic estimation of stocks and stock changes of forest C if you have “field” inventory data

- Carbon stock = Carbon/Area x Area (t/ha)

- C change = C stock at time 2 minus C stock at time 1. Divide by length of period = carbon/year (t/ha/yr)

- Measured carbon stocks do not include harvests/disturbance in the sense the trees are no longer there when measured. This amount must be added back in to the C change estimate.
Current Approach for US Forest Carbon Budget – Part 1

- We use USDA Forest Inventory & Analysis (FIA) inventory data coupled with conversion factors/models.
- Data from many field plots, collected by FIA beginning in 1950s. Area data from remote sensing. First nationwide 1987.
- Other relevant databases available (soils).
Summary of calculating C stock estimates from inventory data

• Using forest characteristics, volumes or areas:
  • Calculate biomass and convert to carbon (carbon = 50% of dry weight biomass)
  • Estimate forest floor & dead wood carbon (where not available) using basic relationships
  • Estimate soil carbon based on USDA State Soil Geographic database (STATSGO), coupled with historical land use change knowledge and assumptions of soil dynamics following land use change and disturbance
• Sum carbon pools
Generalized biomass equations for six selected species groups – available for all US species

SOURCE: Jenkins and others, 2003
Fitted equation and data points for live trees biomass, Maple-Beech-Birch, NE region (plot level)

SOURCE: Smith and others, 2003
Example forest floor C, Southern pines.

Years

Carbon mass density (Mg/ha)

Mixed or unknown age

SOURCE: Smith and Heath, 2002
FIA Program Inventory Evolution

• In recent past, FIA periodically (5-14 years) measured all plots in a state in a 1-2 year timeframe.

• FIA recently adopted annualized inventory, with a subset of plots measured throughout the state each year. (5-7 years).

• Soil and litter layer carbon measured on subset of plots in new system.
Beginning year of annualized FIA data

Compiled from FIA region web sites
Specifics

• The “lower 48” States all have data available from at least 2 inventories
• For 1990 C inventories some States have only plot level available (RPA database)
• More recent data at tree-level
• Compilation uses inventories at year of data collection.
Current Approach for US Forest Carbon Budget – Part 2

• Where FIA data are limited, develop/adopt models such as equations to estimate non-tree carbon, to a complex modeling system to track projections of C

State-level estimates
Average annual nonsoil forest carbon change, 1990-2003

Negative values represent sequestration from atmosphere
Average annual nonsoil forest carbon change, 1990-2003

“Green” crosshatched States are emitting forest carbon.
Area change of forestland (thousand hectares) by State 2002-1992

Smith and others, 2004
Carbon calculation tool (in review)
Painted Hills, OR