

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



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Acknowledgments: Peter Woodbury, Rich  
Birdsey, FIA, Ken Skog, Coeli Hoover, Jen Jenkins, etc

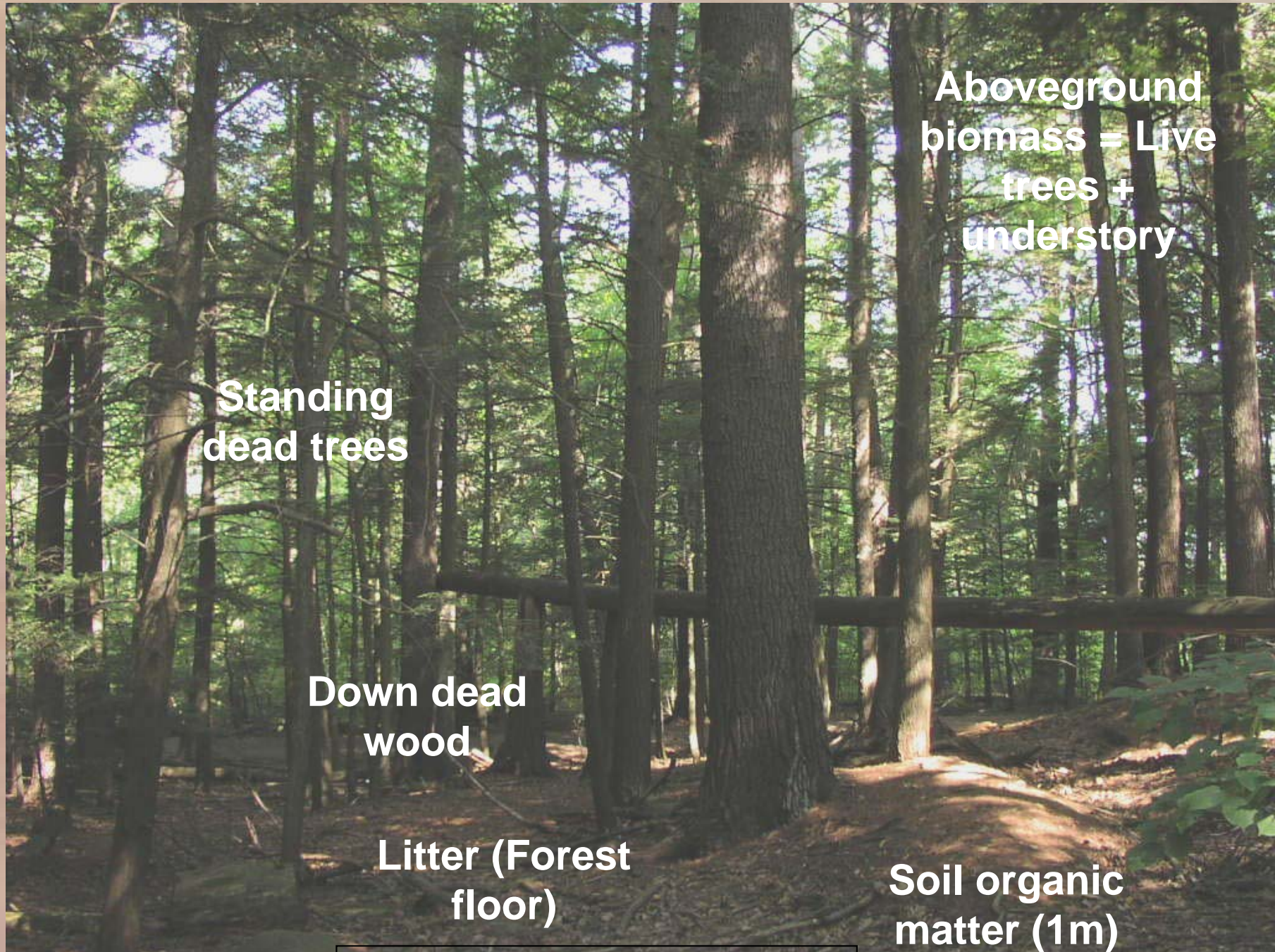
Third USDA Symposium on Greenhouse Gases and Carbon Sequestration in Agriculture  
and Forestry, 22-24 March 2005, Baltimore, MD



**Forest Carbon – Washington**



# Forest Carbon Components - Definitions



Aboveground  
biomass = Live  
trees +  
understory

Standing  
dead trees

Down dead  
wood

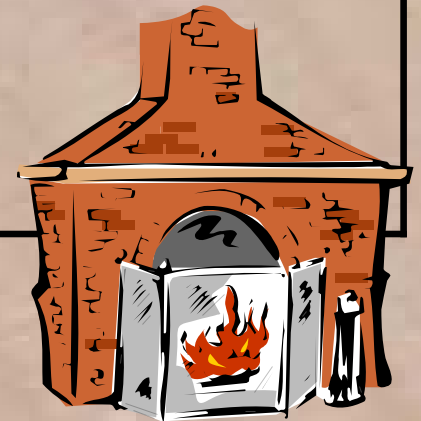
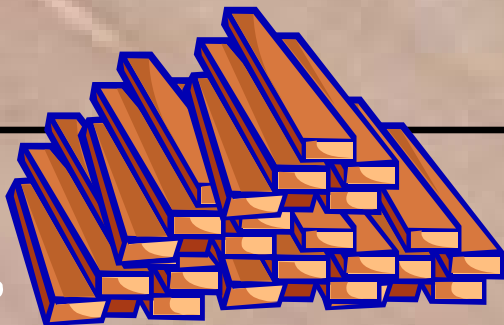
Litter (Forest  
floor)

Soil organic  
matter (1m)

Belowground biomass

# Categories of fates of harvested wood

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





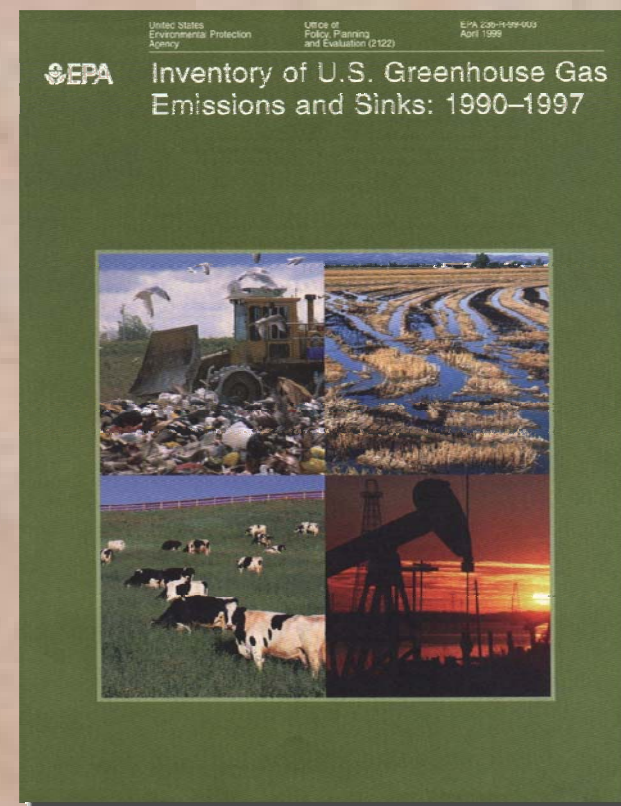
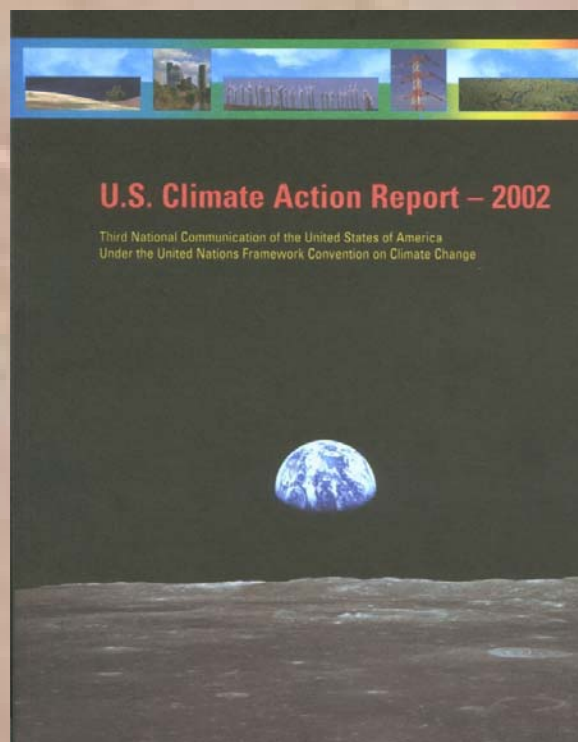
# National GHG reporting to UNFCCC

- 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.

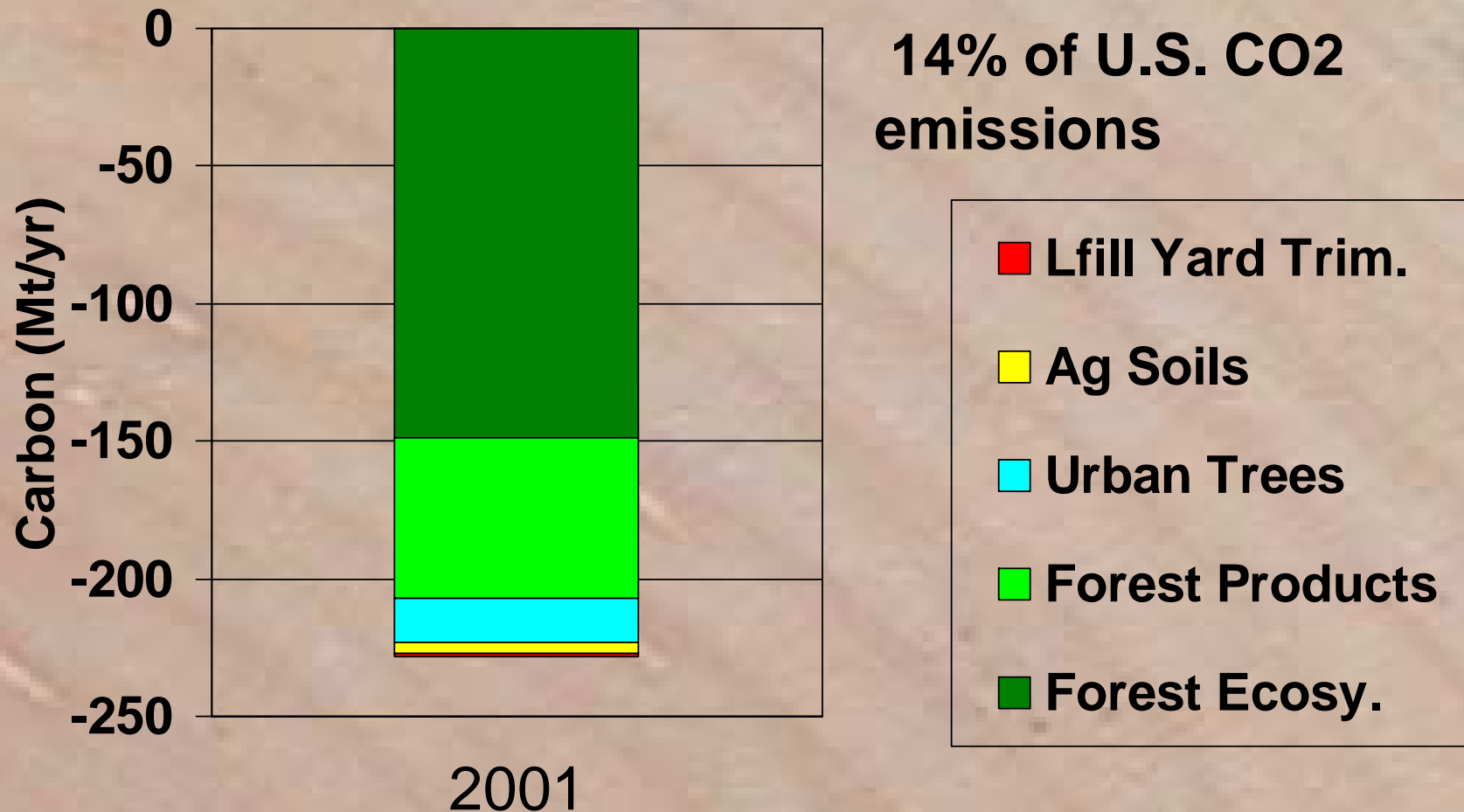
Public involvement



# Conform to Everimproving International Reporting Guidelines

- IPCC Guidelines for National Greenhouse Gas Emissions and Sinks (1994-1996)  
Reference, Workbook, Reporting
- IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry (2001-2003)
- IPCC Revision Guidelines (2004-2006) ?  
volumes. AFOLU: Agriculture, Forestry, and Other Land Use
- ➡ Nations need to be consistent with the methodology in the guidelines

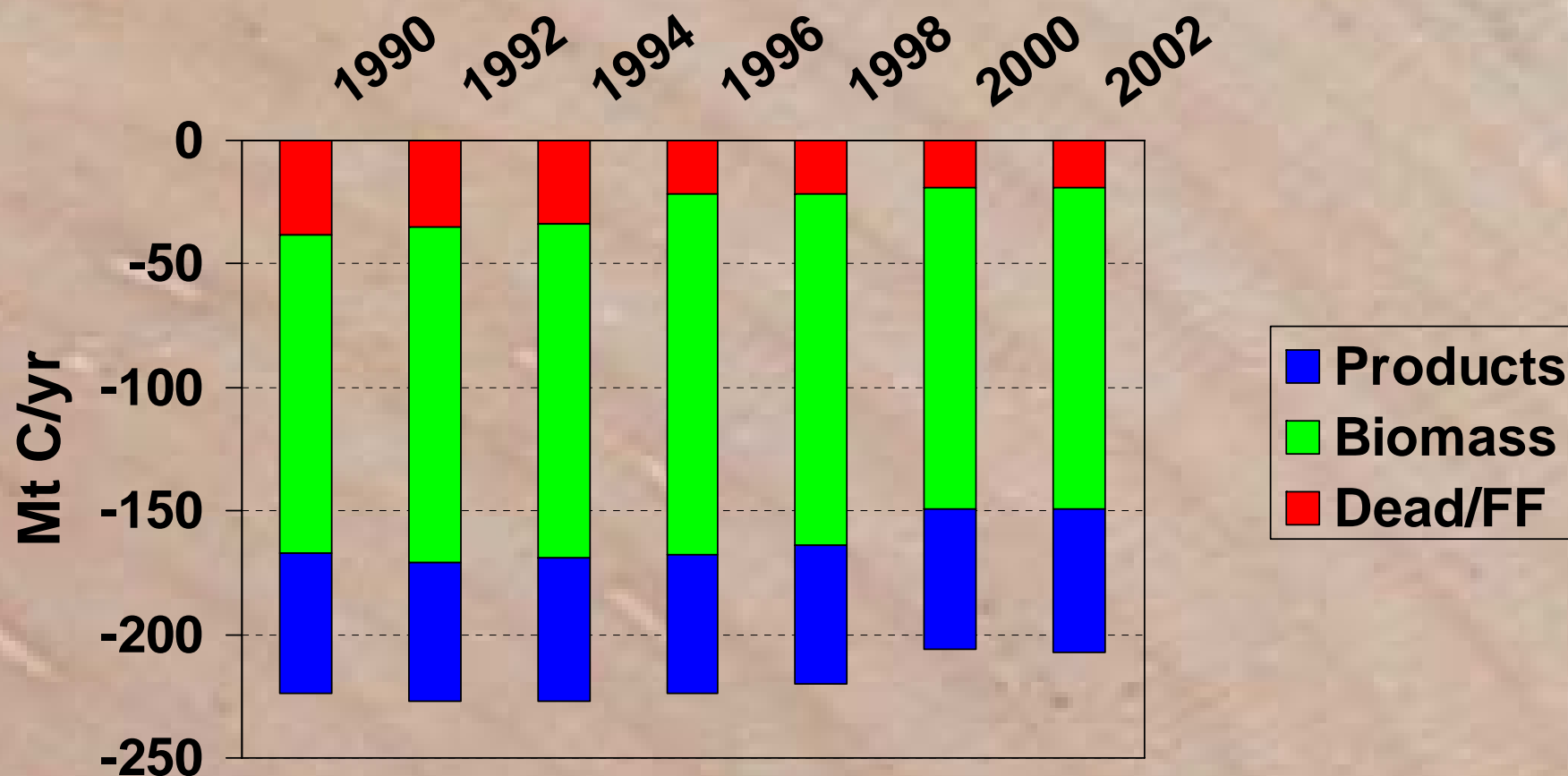
# Net C sequestration, Land Use Change and Forestry



Source: EPA (2003), includes all effects. All are net sinks. No non-CO<sub>2</sub>

# US forest C nonsoil stock change, 2003

12% of total U.S. CO<sub>2</sub> emissions



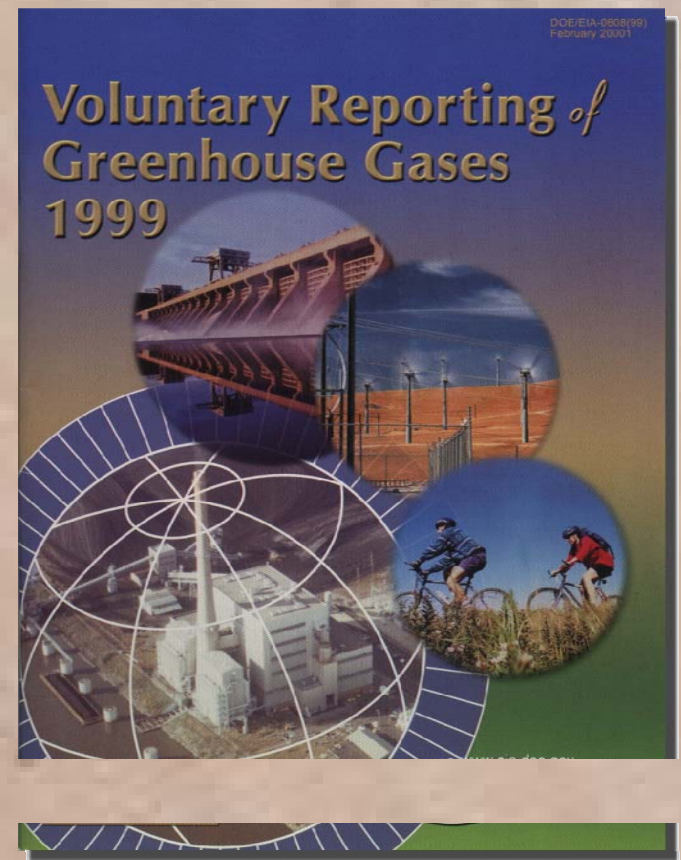
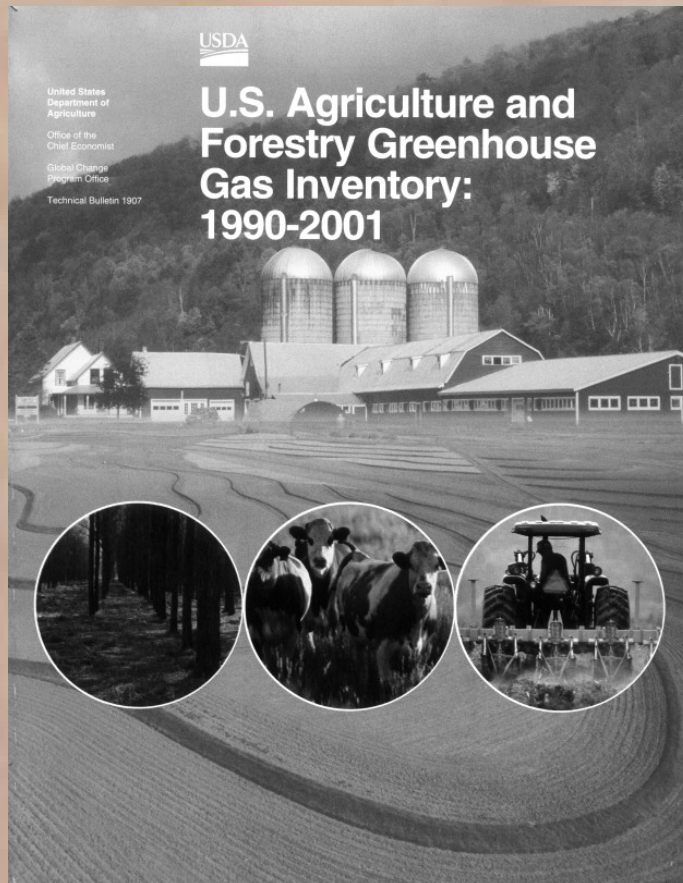
DRAFT: Smith and Heath for 2005 EPA GHG Inventory



# 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**

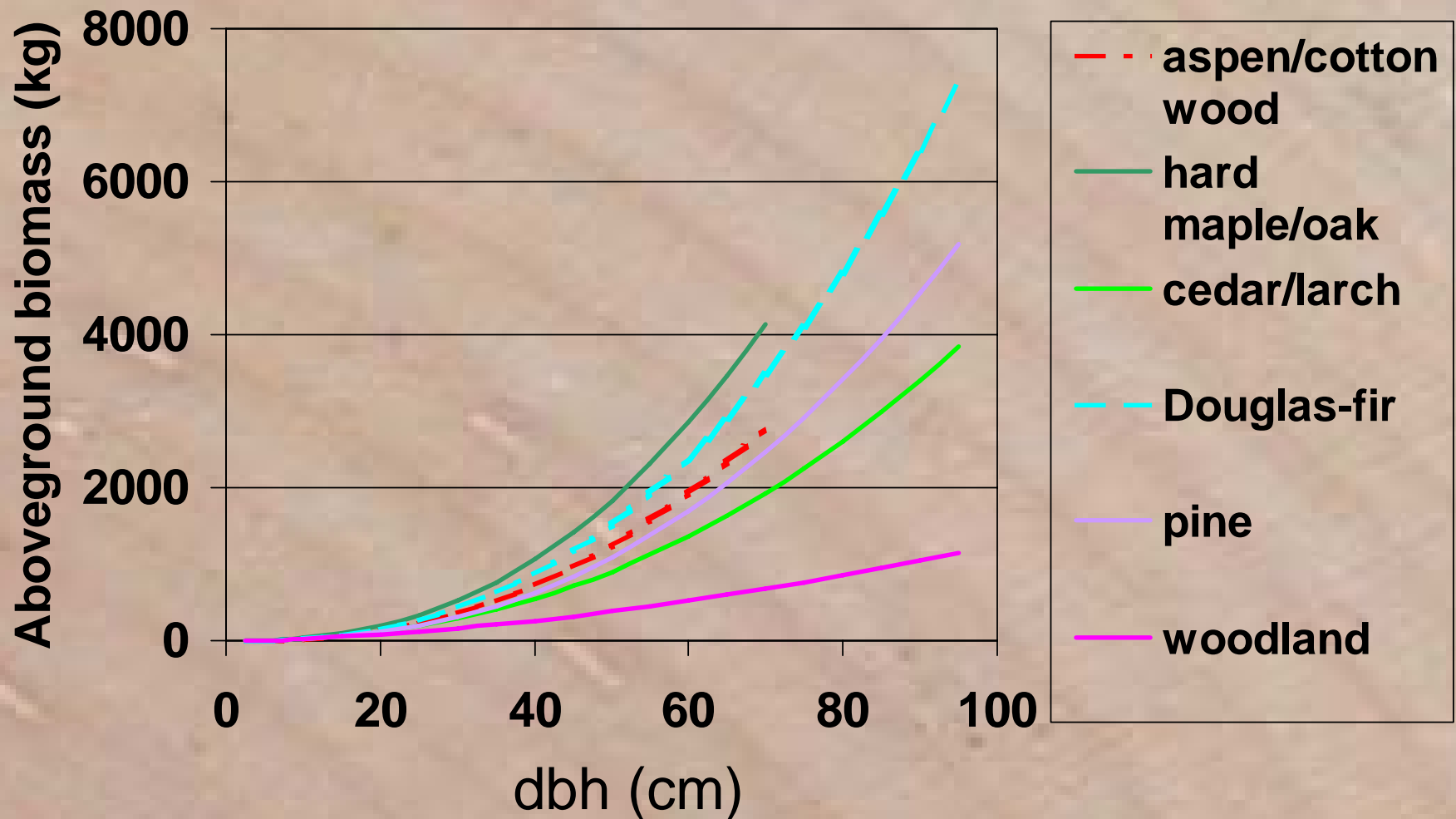
- We use USDA Forest Inventory & Analysis (FIA) inventory data coupled with conversion factors/models.
- Data from many field plots, collected by FIA beginning in 1950s. Area data from remote sensing. First nationwide 1987.
- Other relevant databases available (soils).



# Summary of calculating C stock estimates from inventory data

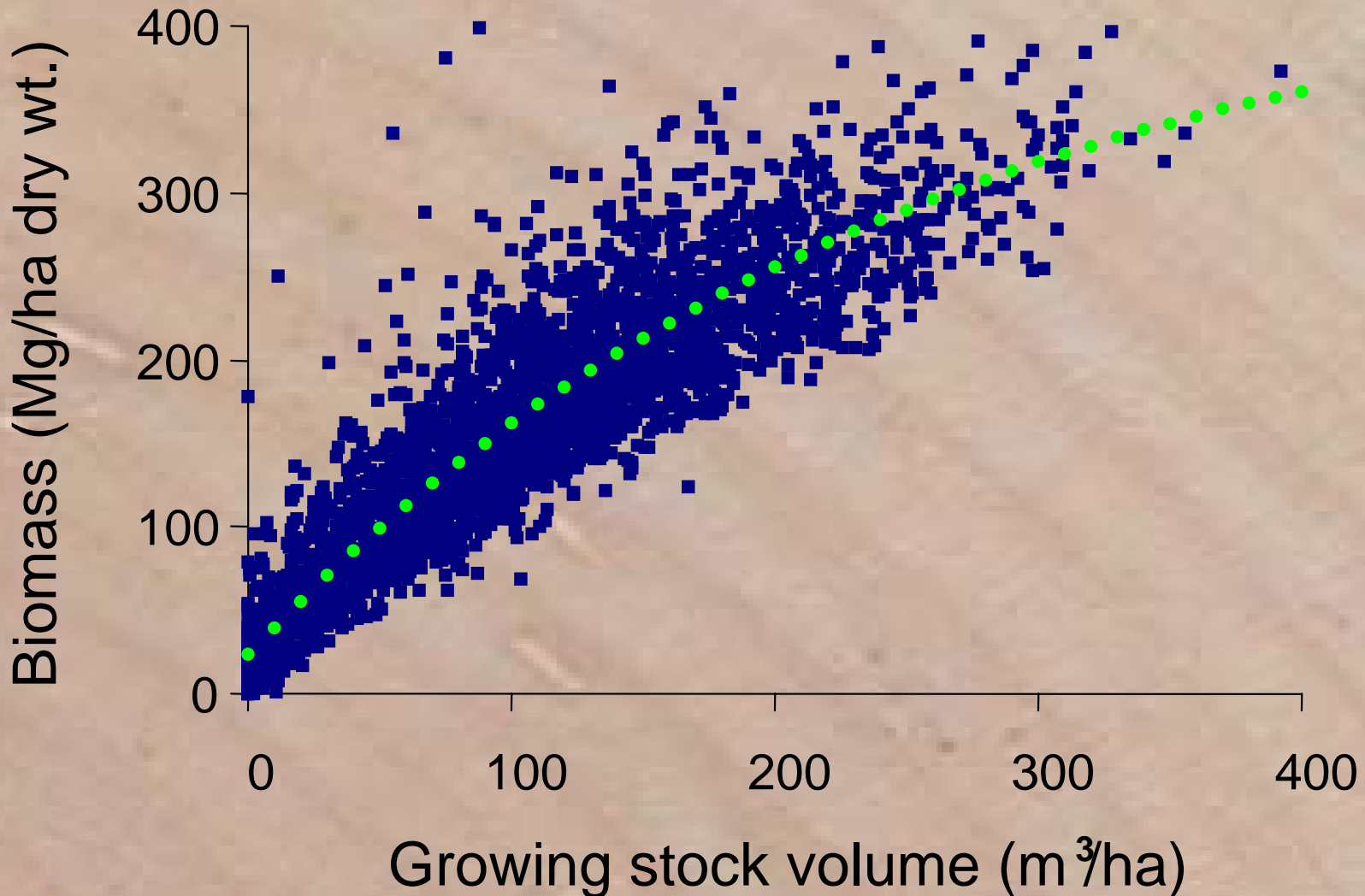
- **Using forest characteristics, volumes or areas:**
- Calculate biomass and convert to carbon (carbon = 50% of dry weight biomass)
- Estimate forest floor & dead wood carbon (where not available) using basic relationships
- Estimate soil carbon based on USDA State Soil Geographic database (STATSGO), 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

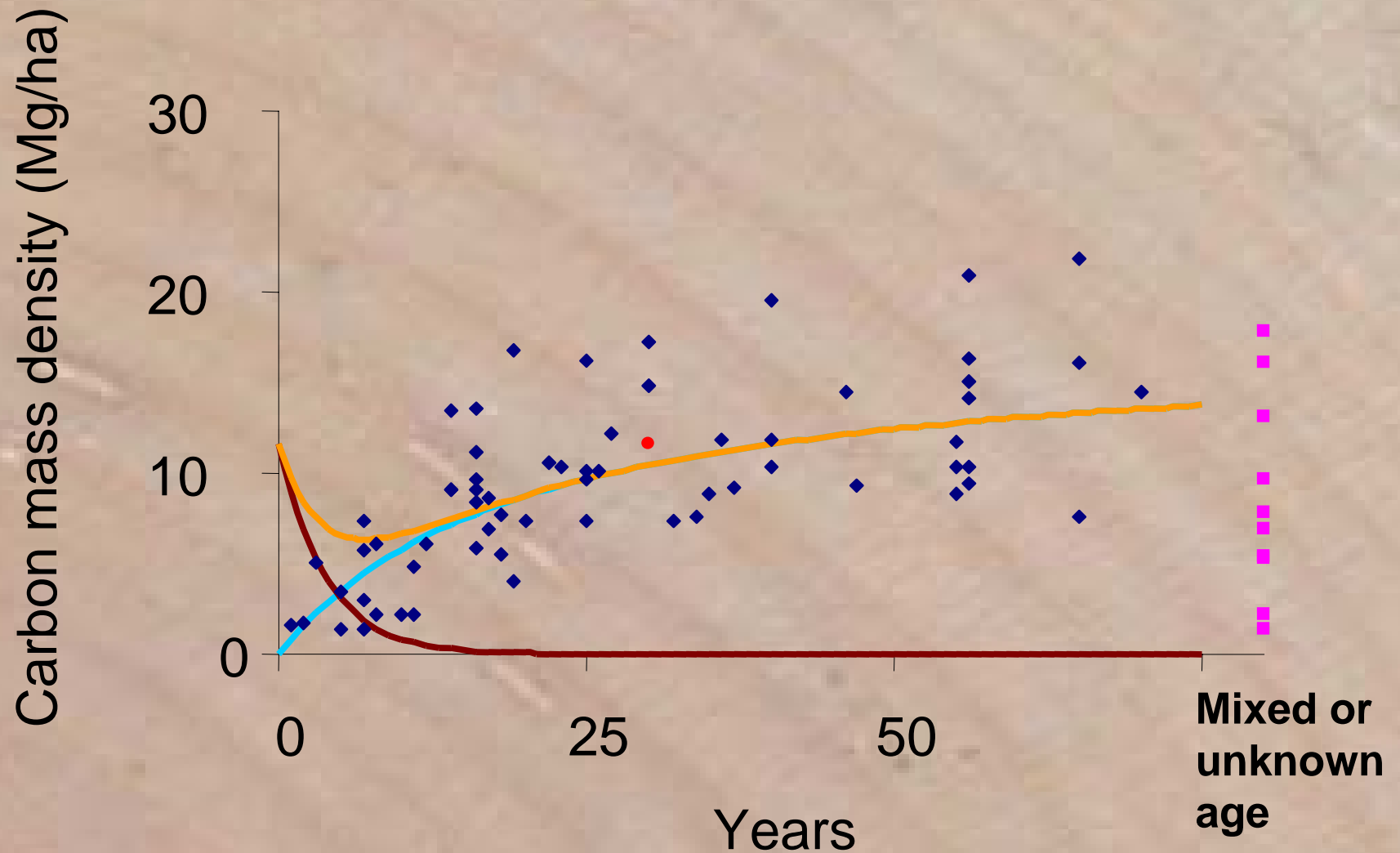
# Fitted equation and data points for live trees biomass, Maple-Beech-Birch, NE region (plot level)



SOURCE: Smith and others, 2003



# Example forest floor C, Southern pines.

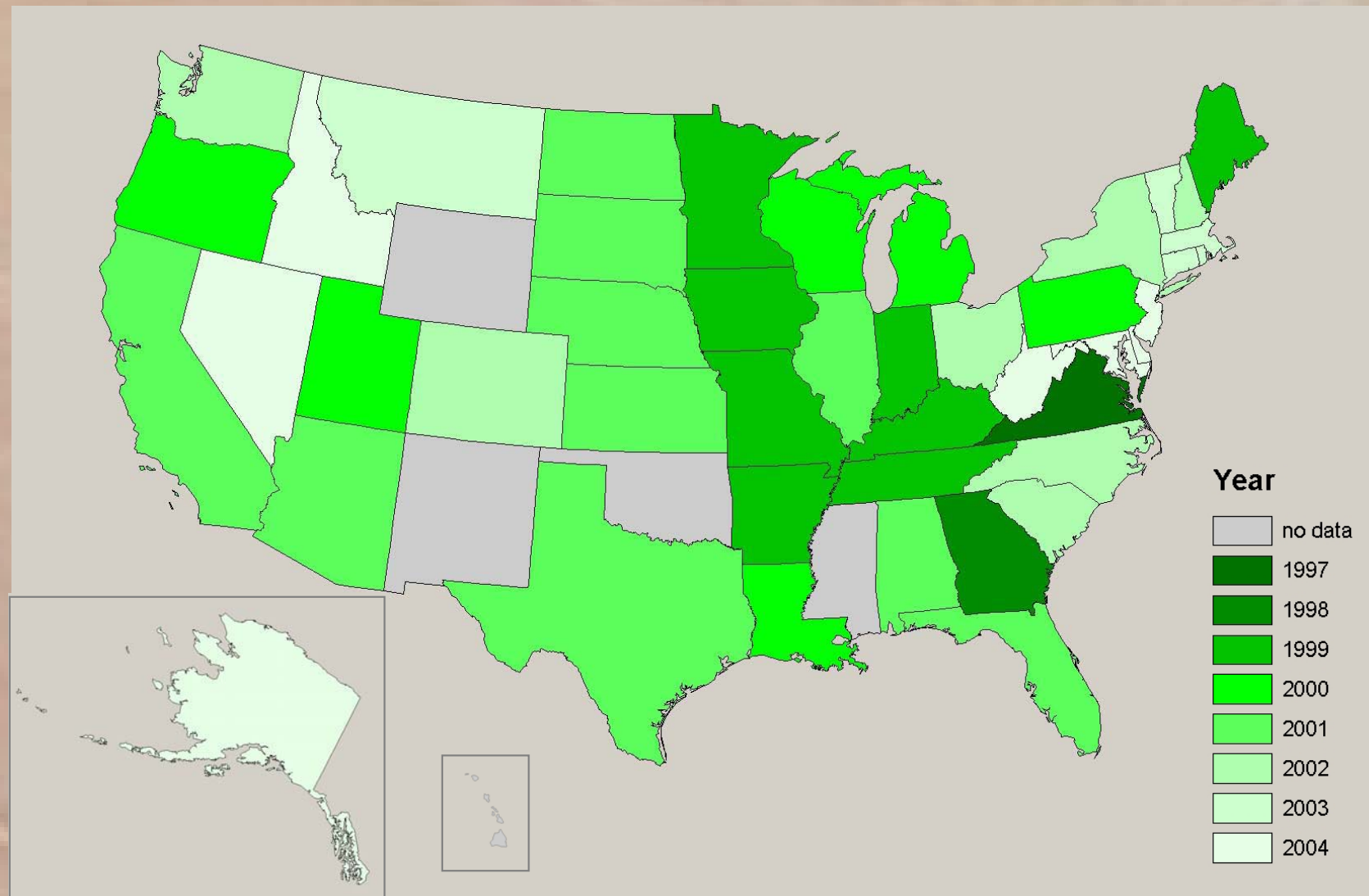


SOURCE: Smith and Heath, 2002

# 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

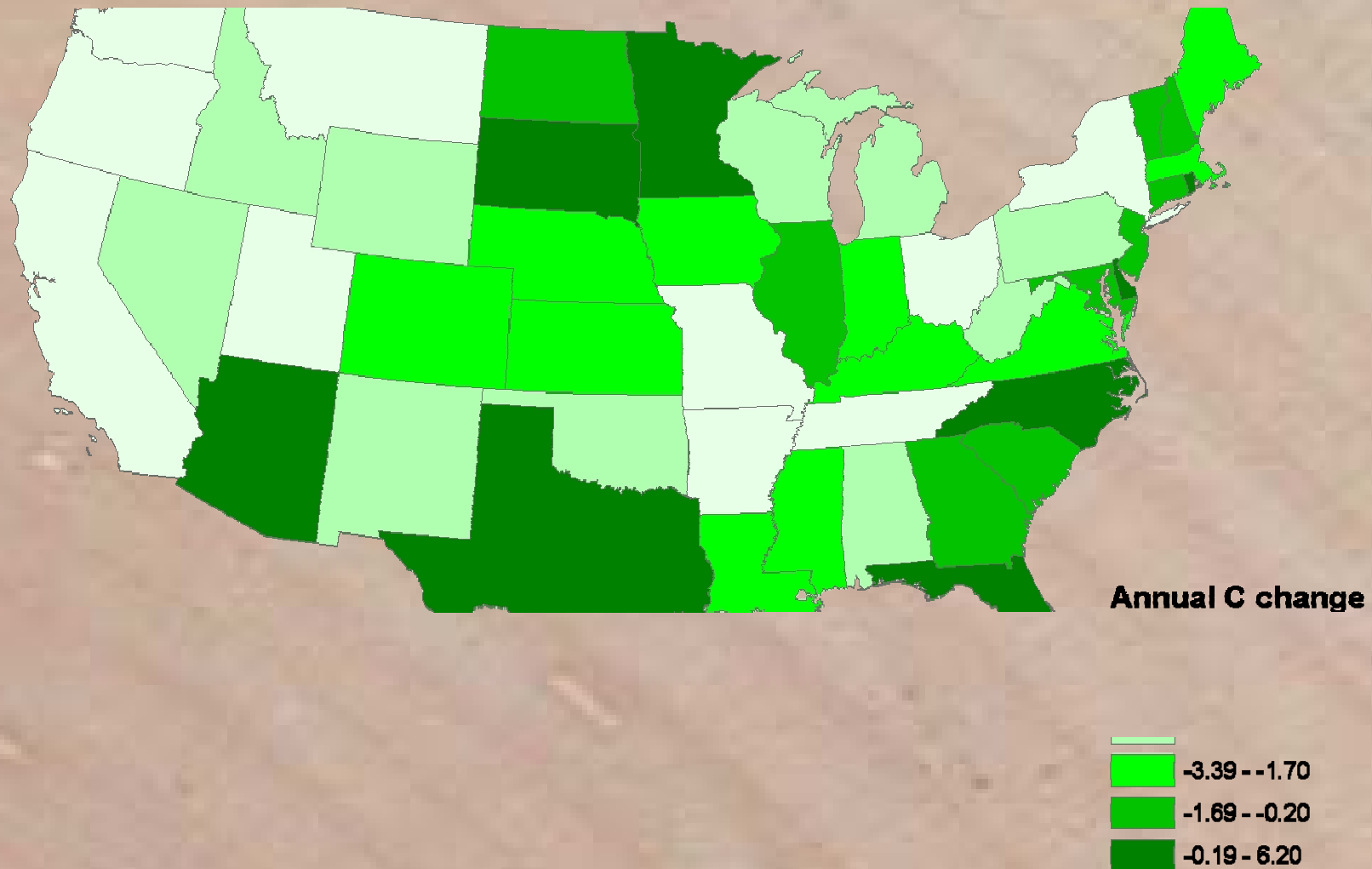
- The “lower 48” States all have data available from at least 2 inventories
- For 1990 C inventories some States have only plot level available (RPA database)
- More recent data at tree-level
- Compilation uses inventories at year of data collection.

# **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
- Model tracks carbon through harvested wood products (Skog and Nicholson 1998). Relies on data from US Dept of Commerce, other factors.

## State-level estimates

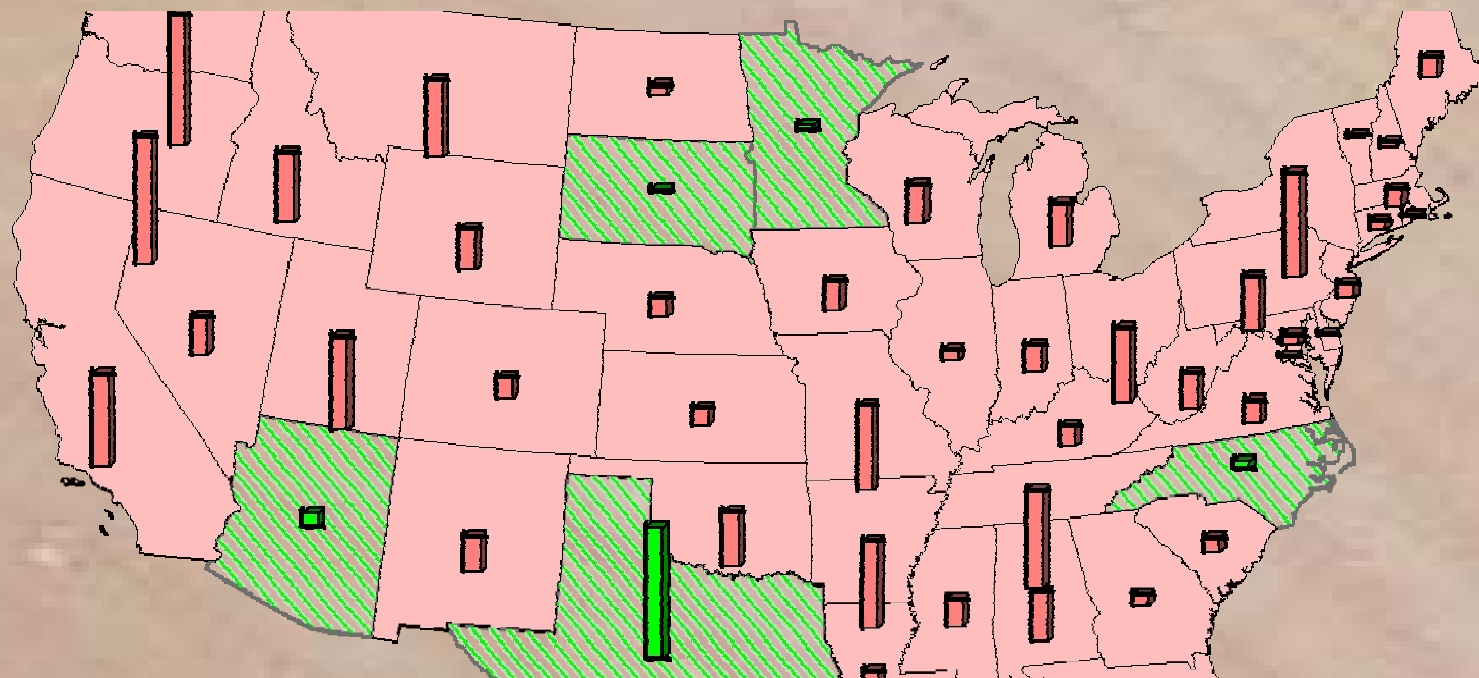
Average annual nonsoil forest carbon change, 1990-2003



Negative values represent sequestration from atmosphere

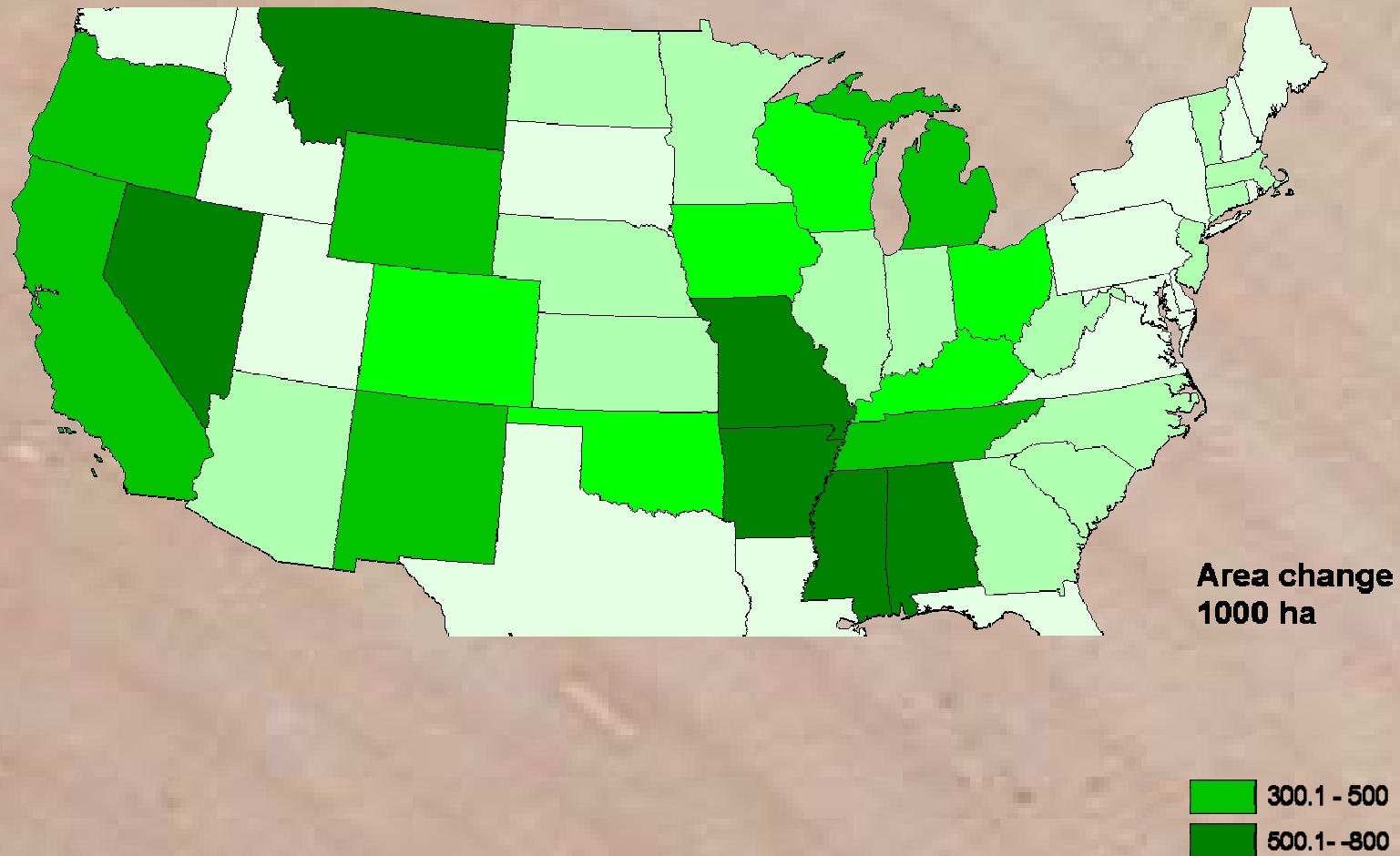


## Average annual nonsoil forest carbon change, 1990-2003



“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)

**Update Survey Summary File**

File Help

Location of Files and Directories

Edit these two selections, then click the "Start" button

Survey Summary File

New Inventory Directory

Inventories files in New Inventory Directory

- fiadb17\_AL\_04\_2003
- fiadb17\_AZ\_01\_1985
- fiadb17\_CO\_02\_2003
- fiadb17\_VA\_03\_2001

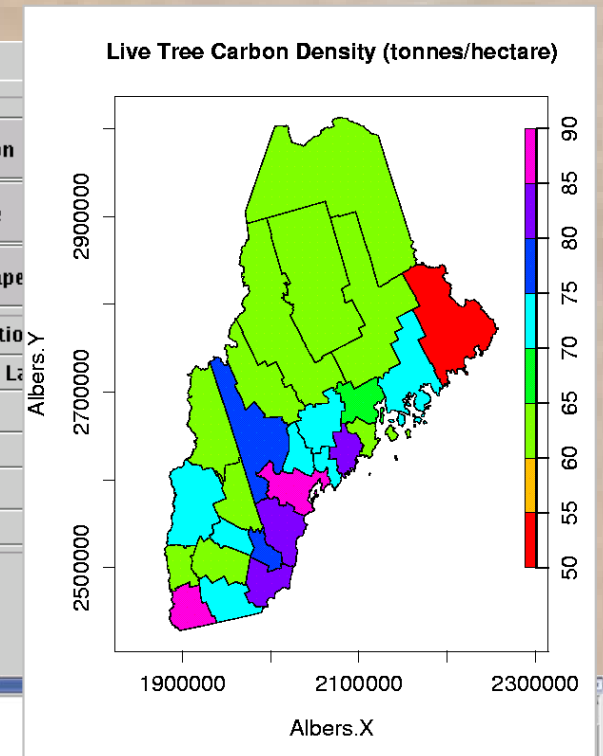
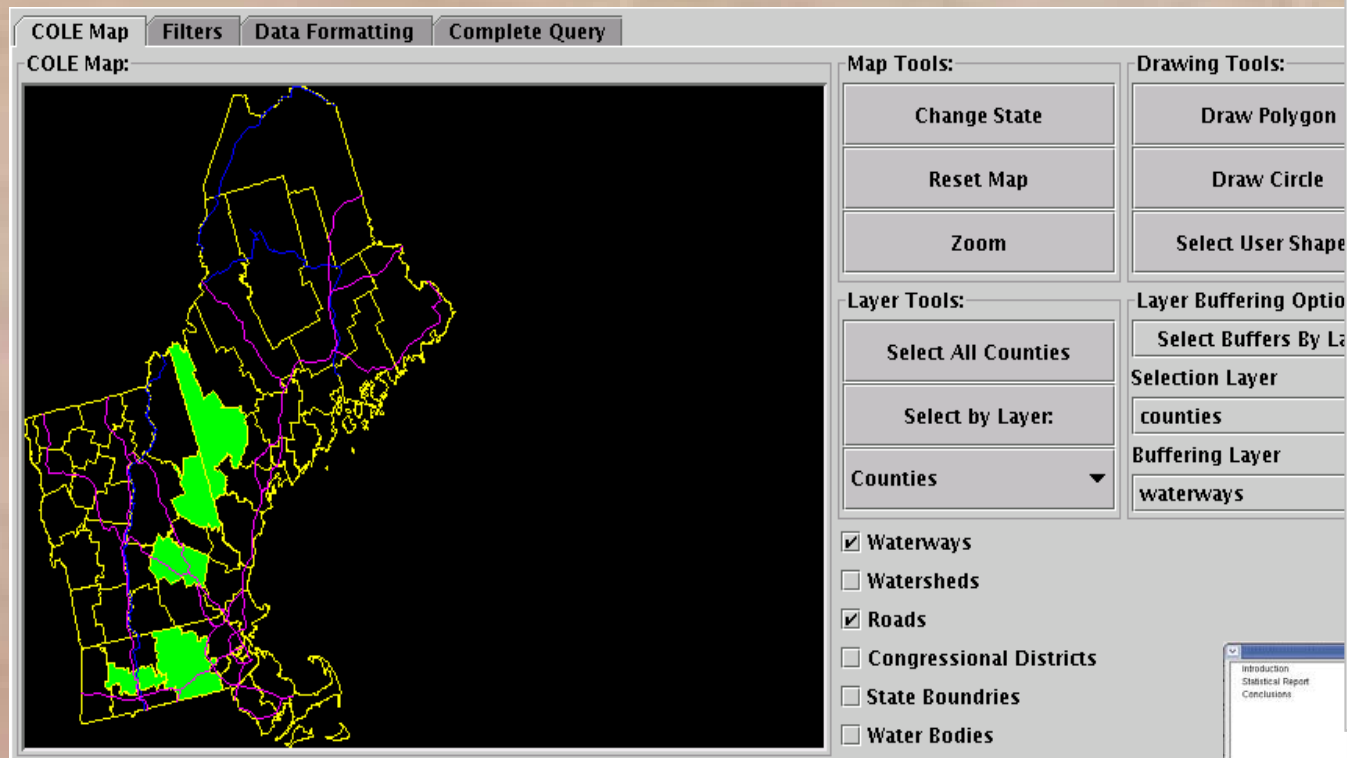
Choices

- Start
- Update if Needed
- Update Forced
- Remove Inventory
- Save + Clear
- Close

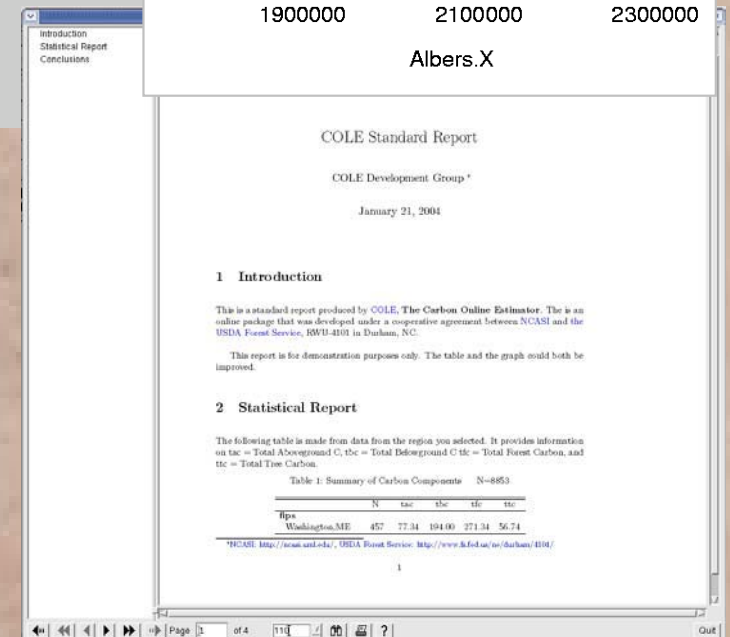
List of inventories in Survey Summary File

inventory	division	forest	updated	average year
RPADATA_UT_1987	all	all forest	0	1976.2888
FIADB17_UT_01_1993	all	all forest	20040824	1993.4217
FIADB17_UT_02_2003	all	all forest	20040824	2002.0454
FIADB17_VA_01_1984	all	all forest	20031007	1985.4067
FIADB17_VA_02_1992	all	all forest	20031007	1991.3888
FIADB17_VA_03_2001	all	all forest	20031007	1999.6902
FIADB17_VT_04_1983	all	all forest	20030926	1982.8996
FIADB17_VT_05_1997	all	all forest	20040317	1997.2613
RPADATA_WA_1987	East	all others	0	1980.5000
FIADB17_WA_03_1991	East	all others	20040401	1991.5805
RPADATA_WA_1987	West	all others	0	1978.9529
FIADB17_WA_03_1991	West	all others	20040401	1989.8263
RPADATA_WA_1987	East	nat forest	0	1987.5000
RPADATA_WA_2002	East	nat forest	0	1995.2125
RPADATA_WA_1987	West	nat forest	0	1987.5000
RPADATA_WA_2002	West	nat forest	0	1995.4702
FIADB17_WI_04_1983	all	all forest	20031007	1982.3696
FIADB17_WI_05_1996	all	all forest	20031007	1995.1076
FIADB17_WI_06_2003	all	all forest	20041006	2001.9639
FIADB17_WV_04_1989	all	all forest	20030925	1988.1982
FIADB17_WV_05_2000	all	all forest	20040311	2000.8652
RPADATA_WY_2002	all	all others	0	1983.5028
FIADB17_WY_02_2000	all	all others	20040824	2001.7615
RPADATA_WY_1997	all	nat forest	0	1984.6294
RPADATA_WY_2002	all	nat forest	0	1993.6743
FIADB17_WY_02_2000	all	nat forest	20040824	2000.0210

# Carbon OnLine Estimation web tool, (beta)



<http://ncasi.uml.edu/COLE>





# Painted Hills, OR

