National inventories of forest ecosystem carbon stocks: documenting impacts of resource management on watershed carbon dynamics

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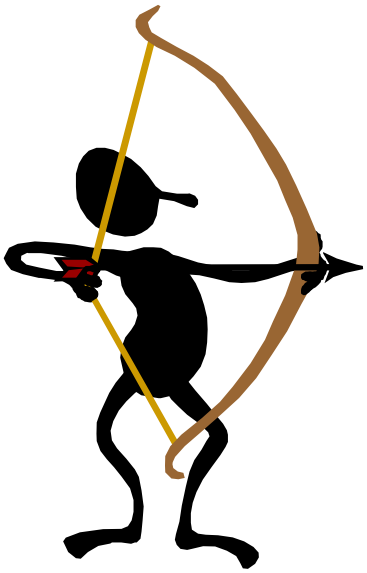
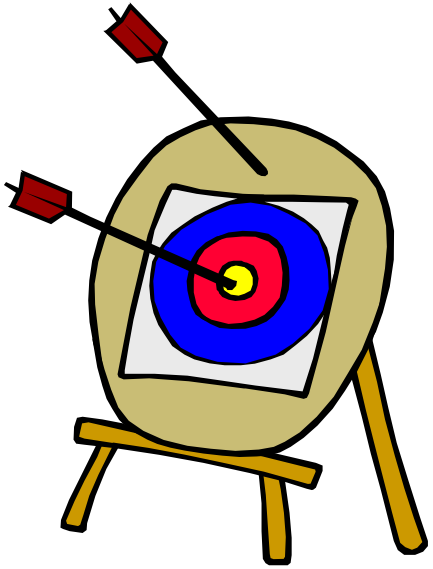
Outline

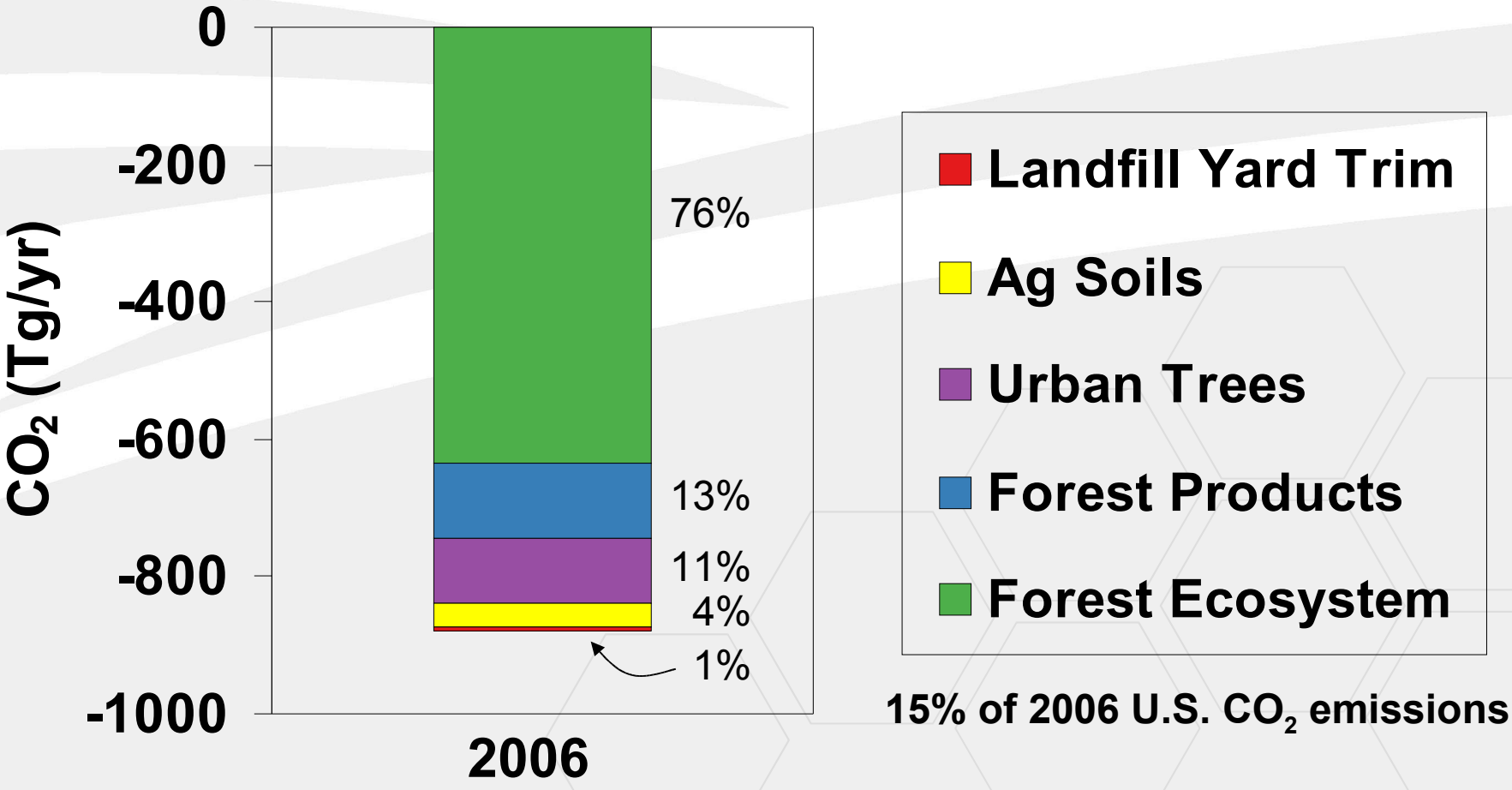
1. Background of FIA Program
2. Analysis & Reporting
3. Conclusions

1 Background





Net US C sequestration, LULUCF

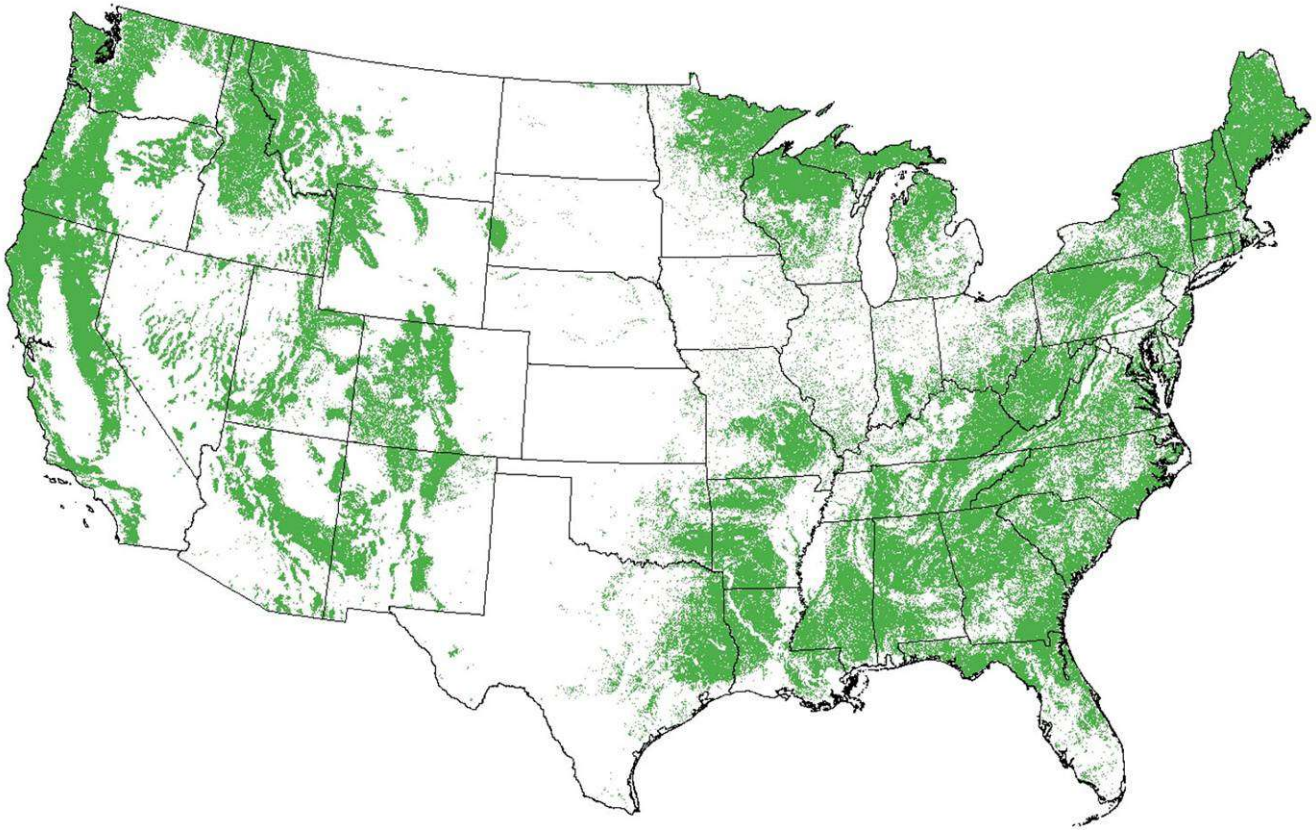


15% of 2006 U.S. CO_2 emissions

Source: EPA (2008), includes all effects (all are net sinks, no non-CO_2)

National program goals for FIA

To conduct strategic forest inventories of the United States to estimate:



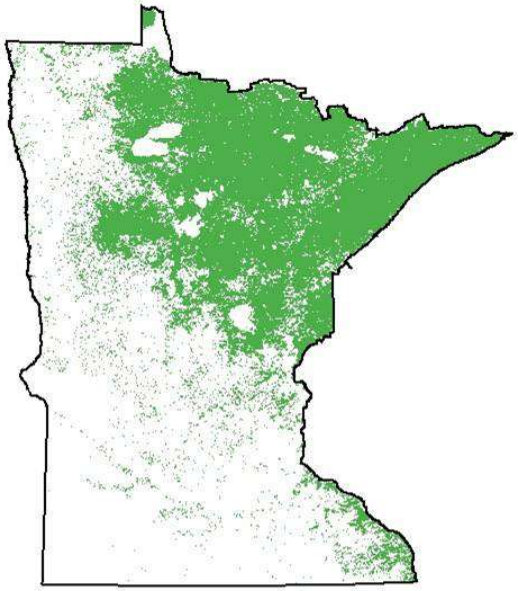
- ✓ the extent of forest land;
- ✓ the volume, growth, and removal of forest resources; and
- ✓ the health and condition of the forest.

Strategic objectives

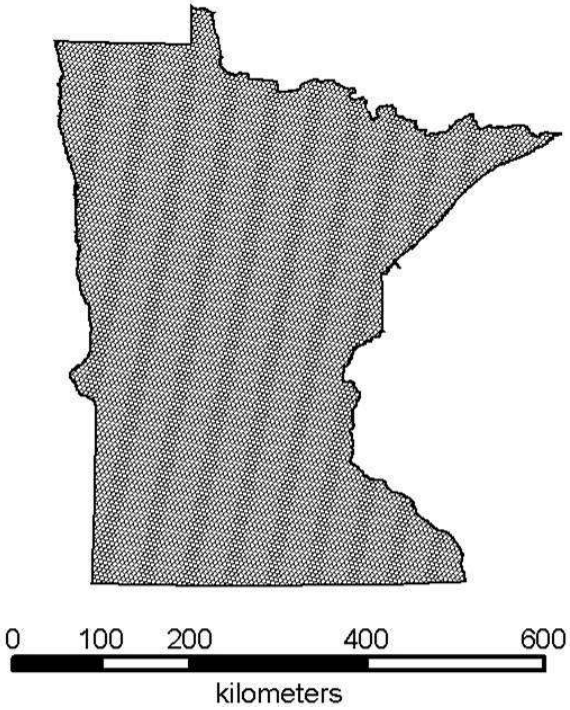
- National design standards
- Standardized estimation
- Data released at prescribed intervals
- A national database with user-friendly access
- Nationally consistent reports (5 years)
- Peer review/publication of outputs/procedures

FIA samples in 3 phases…

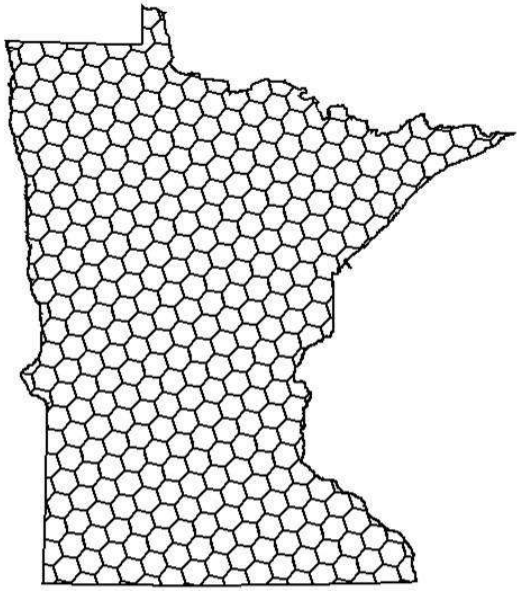
Phase 1
3,000,000 points



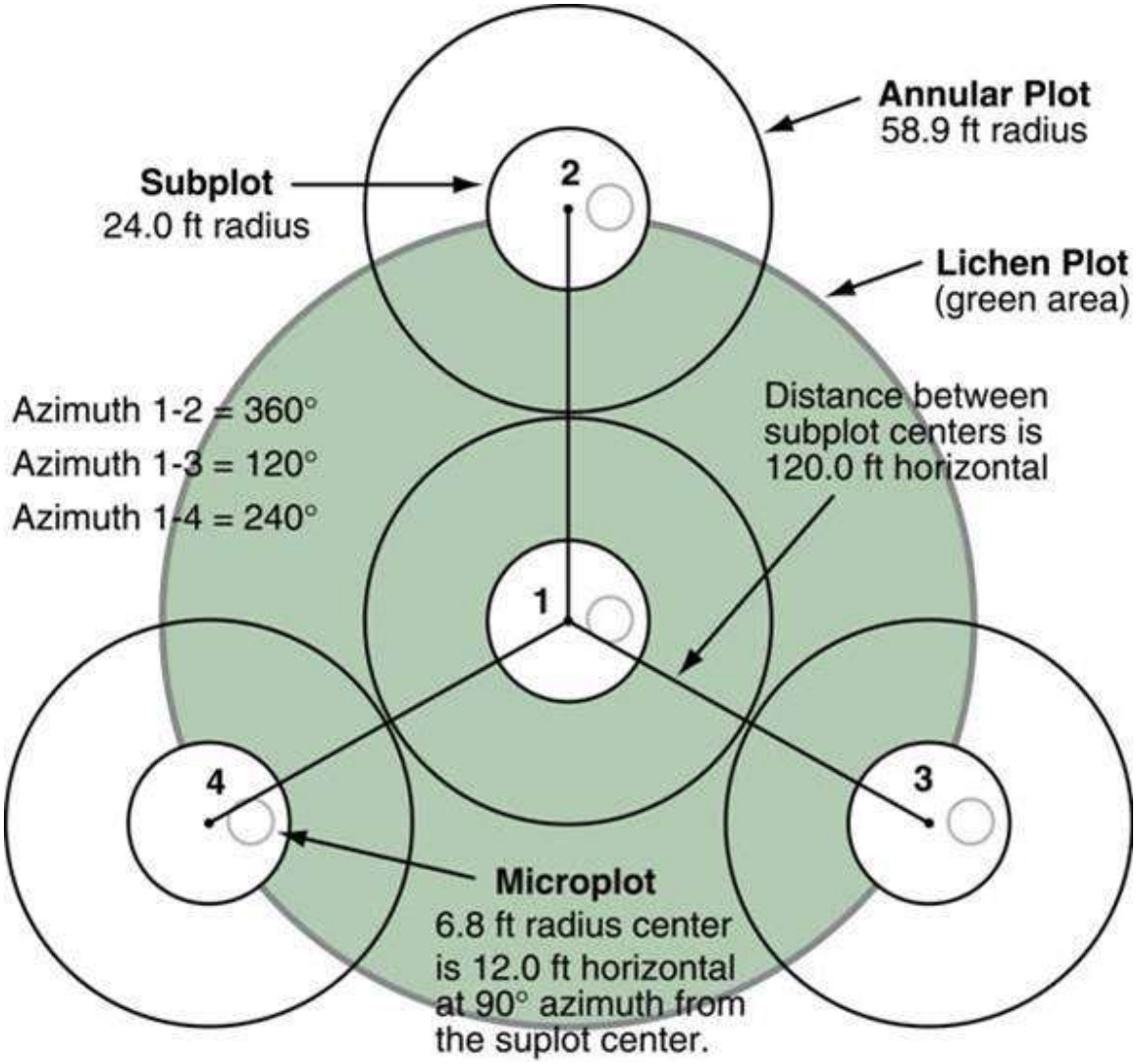
Phase 2
125,000 plots (1:6,000 acres)



Phase 3
7,800 plots (1:96,000 acres)



using a national plot design.

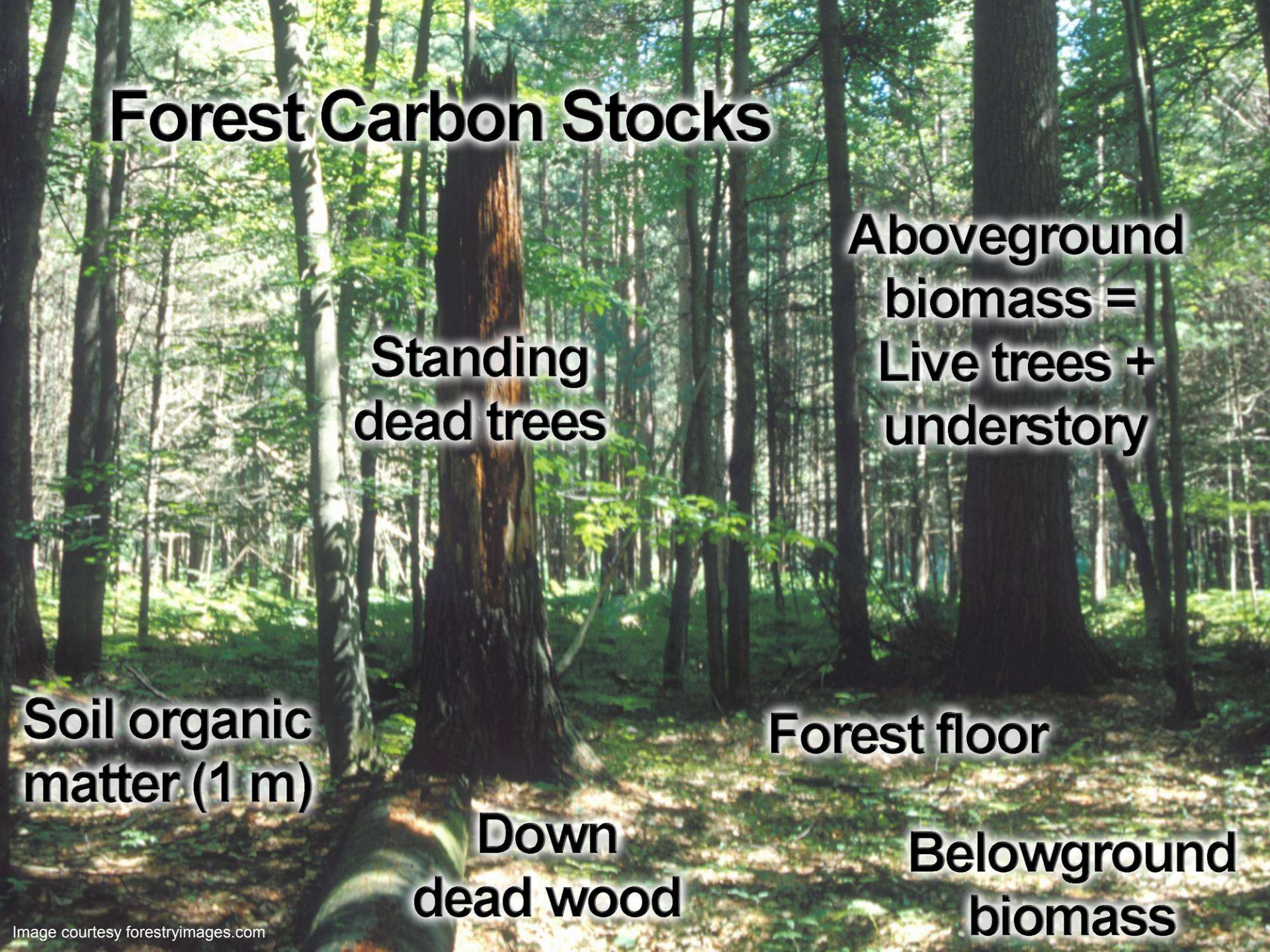


How do we calculate carbon stock estimates from forest inventory data?

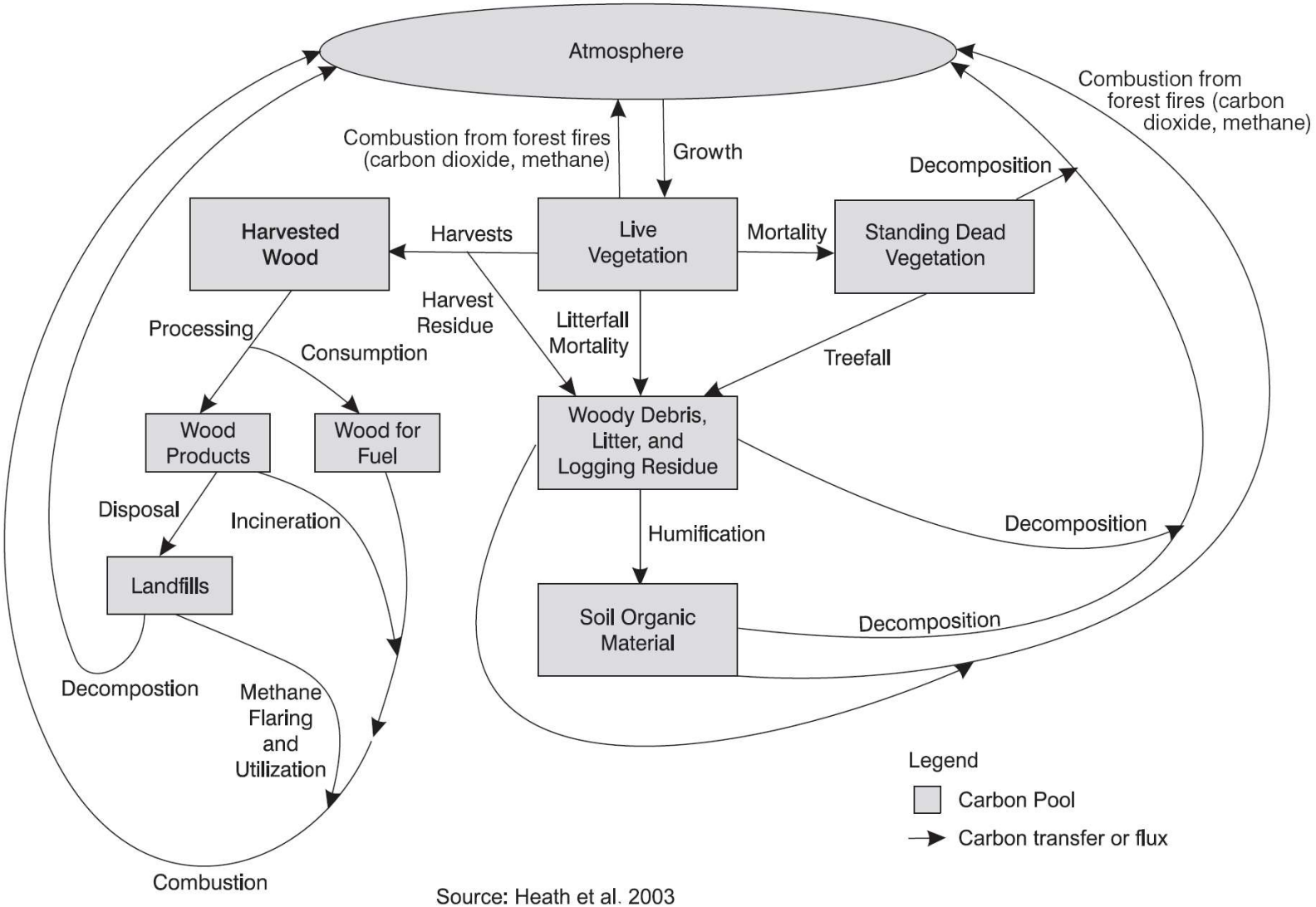
1. Calculate biomass and convert to carbon
   (carbon = 50% of dry weight biomass)
2. Estimate forest floor C with simple relationships
3. Estimate soil C based on STATSGO, coupled with historical land use change and assumptions of soil dynamics following land use change and disturbance

\+

Sum carbon pools

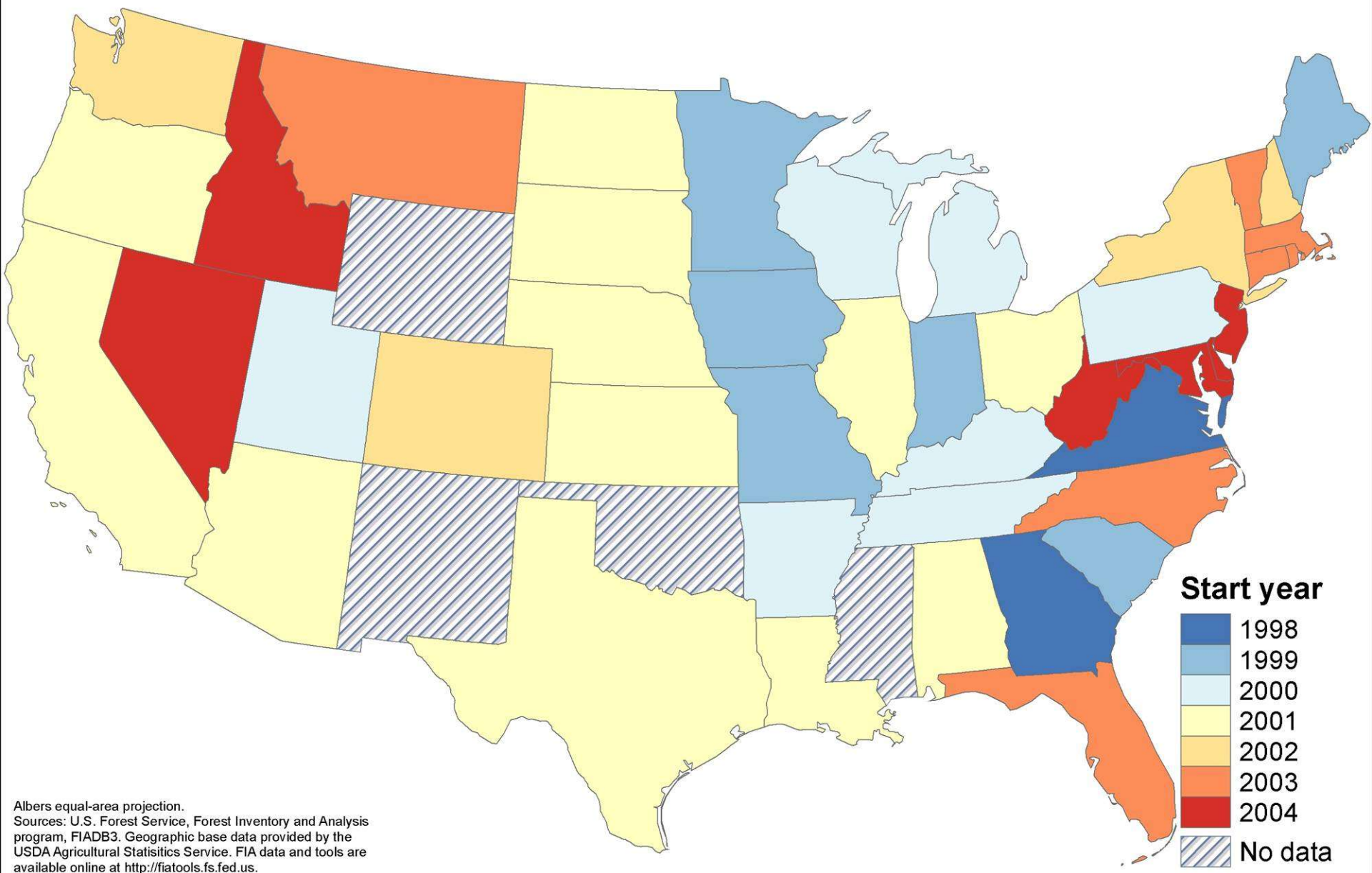

Forest Carbon Stocks
Aboveground biomass = Live trees + understory
Standing dead trees
Soil organic matter (1 m)
Forest floor
Down dead wood
Belowground biomass
Image courtesy forestryimages.com

Forest Sector Carbon Pools and Flows

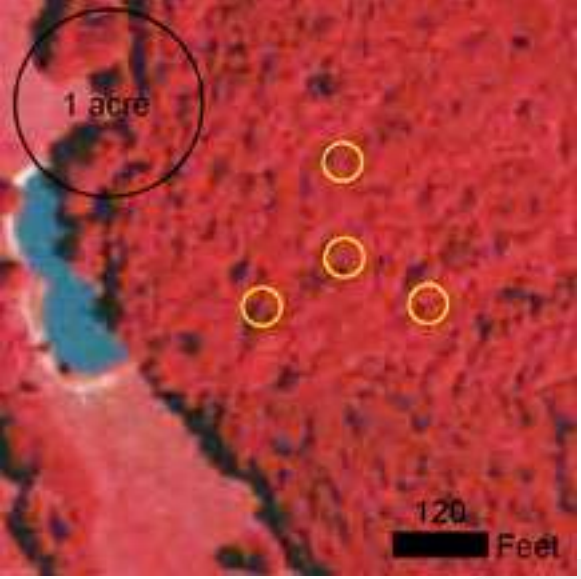


Source: Heath et al. 2003

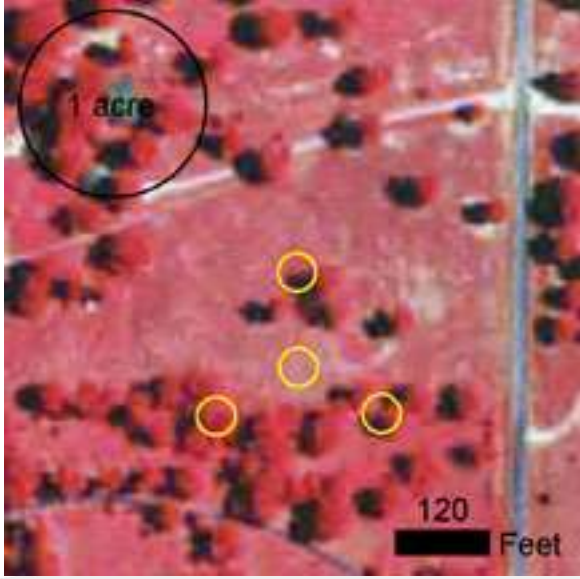
When did the annual inventory begin?

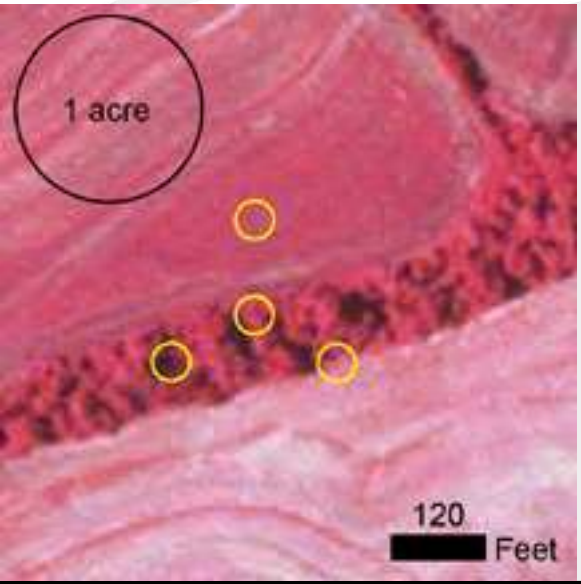


Albers equal-area projection.
Sources: U.S. Forest Service, Forest Inventory and Analysis program, FIADB3. Geographic base data provided by the USDA Agricultural Statisitics Service. FIA data and tools are available online at http://fiatools.fs.fed.us.
Cartography: C.H. Perry, U.S. Forest Service, St. Paul, MN
Date: 1 May 2008.

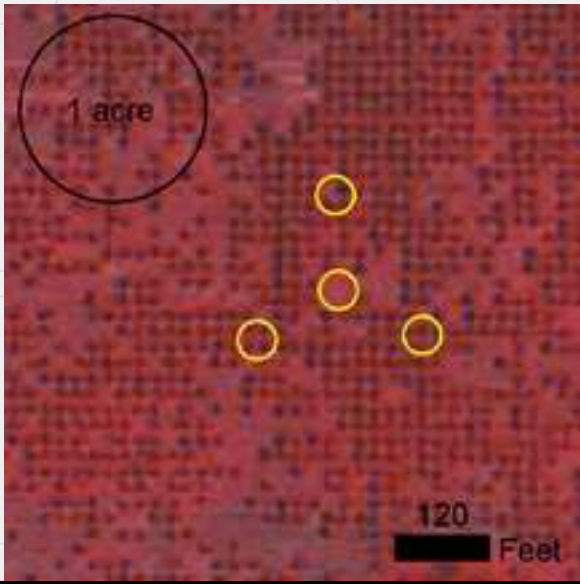


Which forest types and activities are considered?





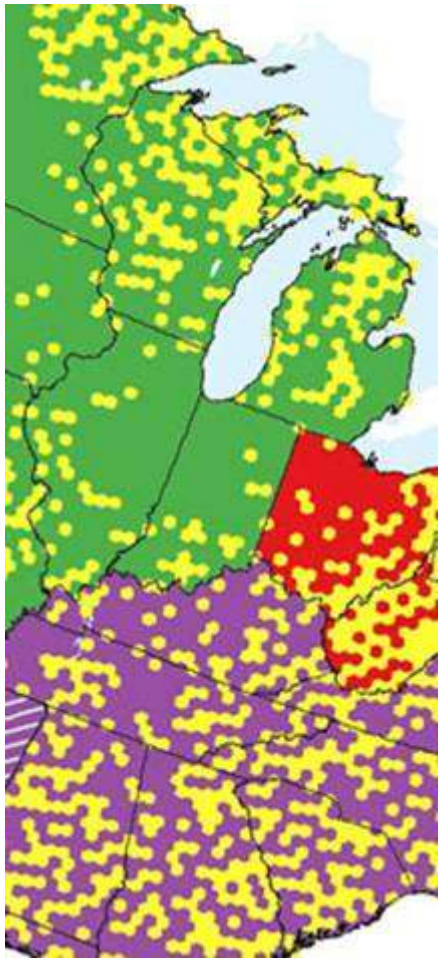
- All forest types meeting definition of forest
- All ownerships
- All ages



Major factors affecting forest C

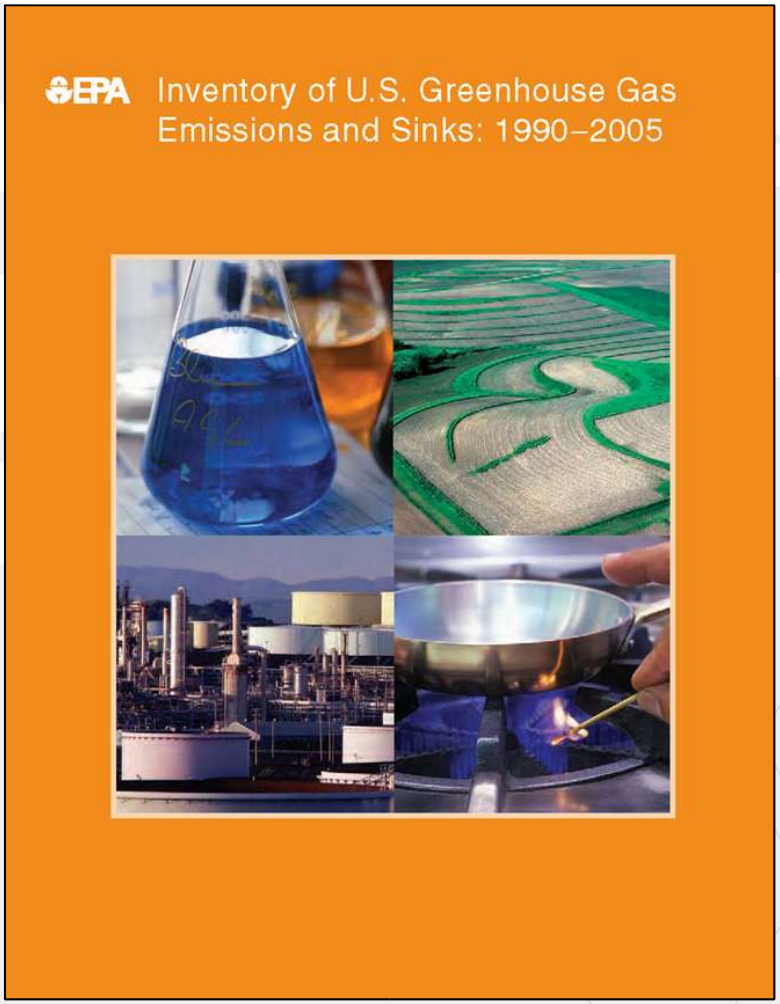
- Region
  - Northeast, Pacific Northwest
- Forest Type
  - Douglas-fir, Oak/Hickory
- Site Quality
  - High, Medium, Low
- Prior Land Use
  - Cropland, Pasture, Forest
- Age or Volume

Image courtesy forestryimages.org



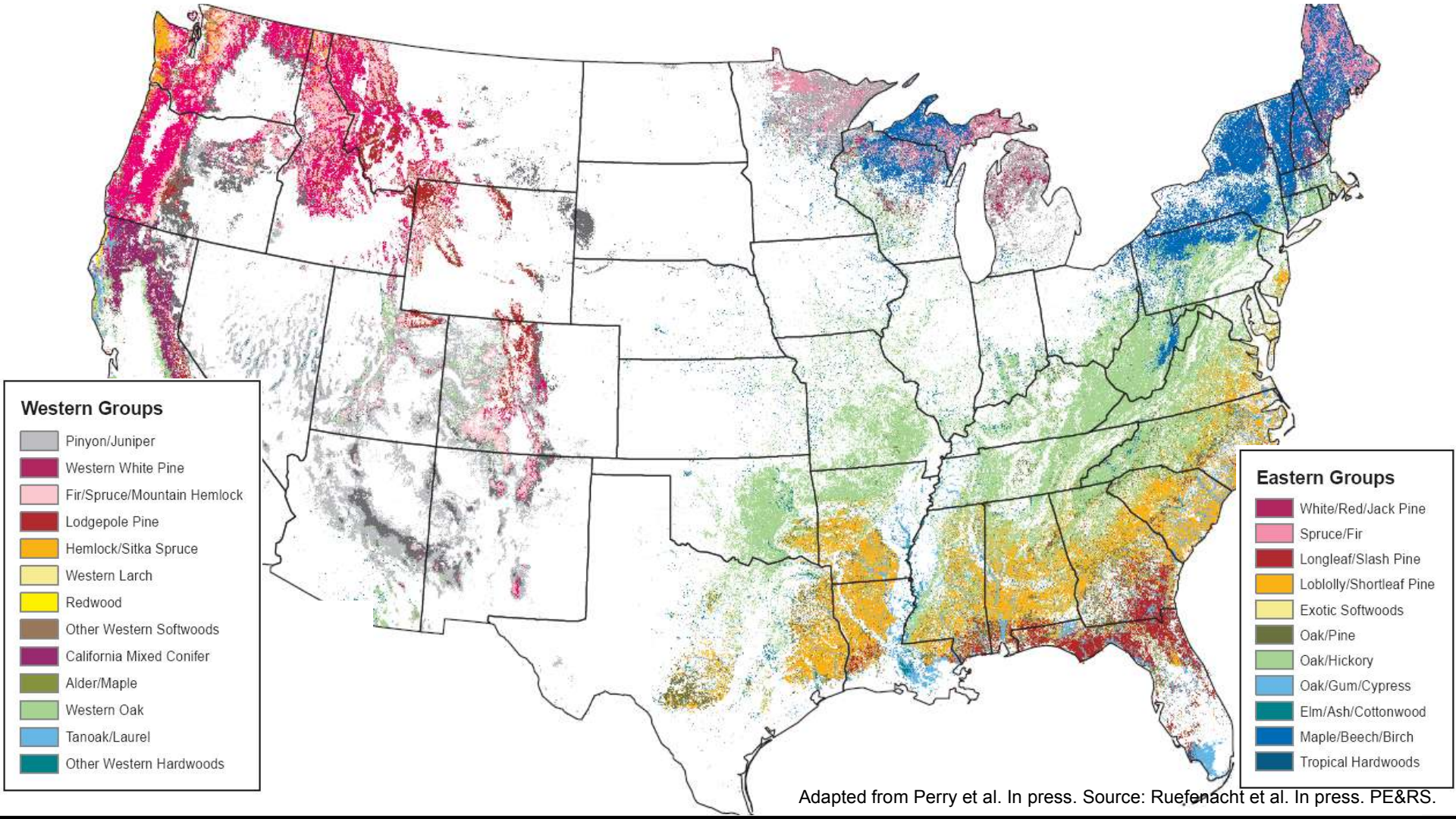
2 Analysis and reporting

National GHG reporting to UNFCCC



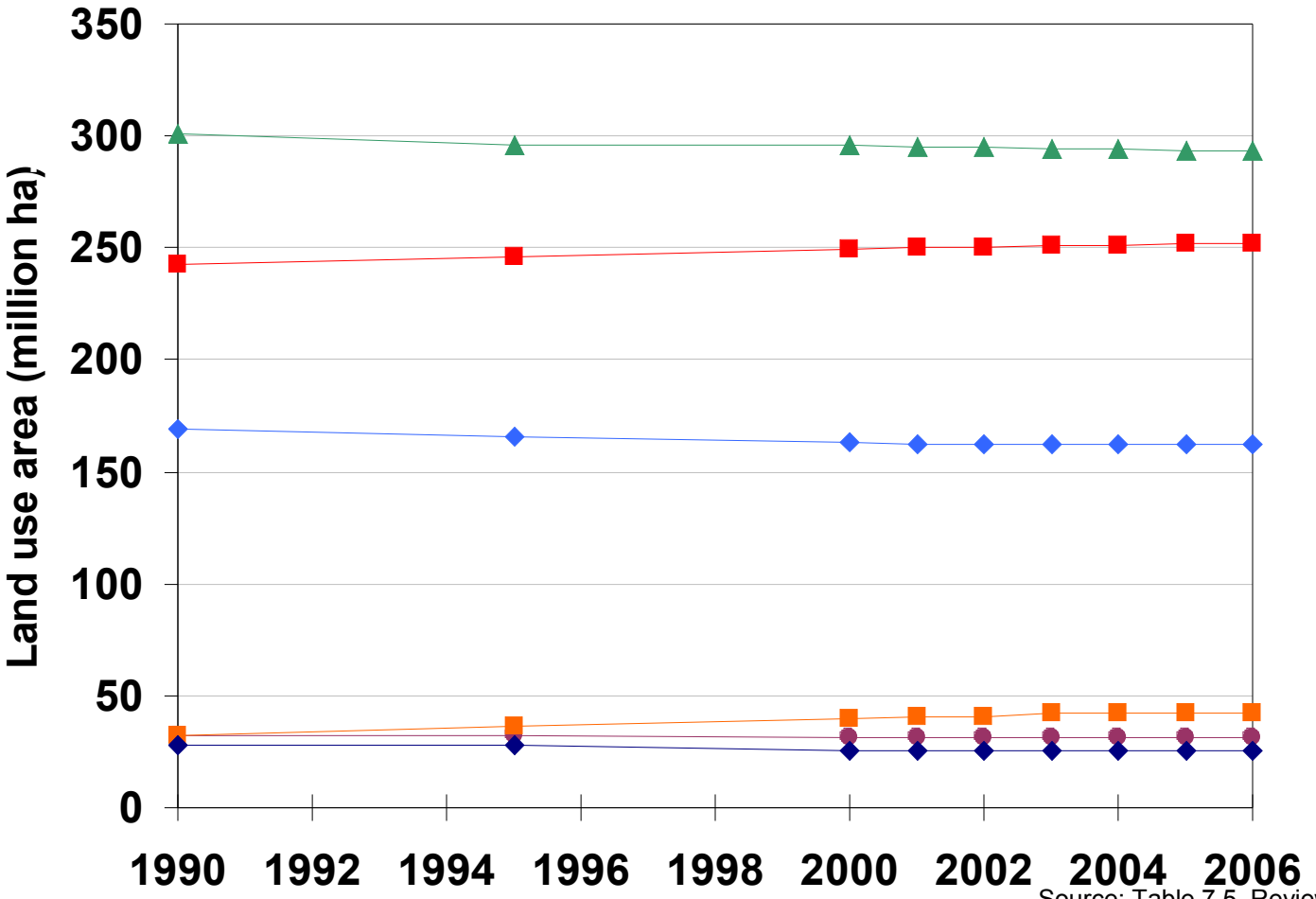
- US EPA Annual Greenhouse Gas Emissions and Sinks inventories
  - All sectors

Forest-types of the USA



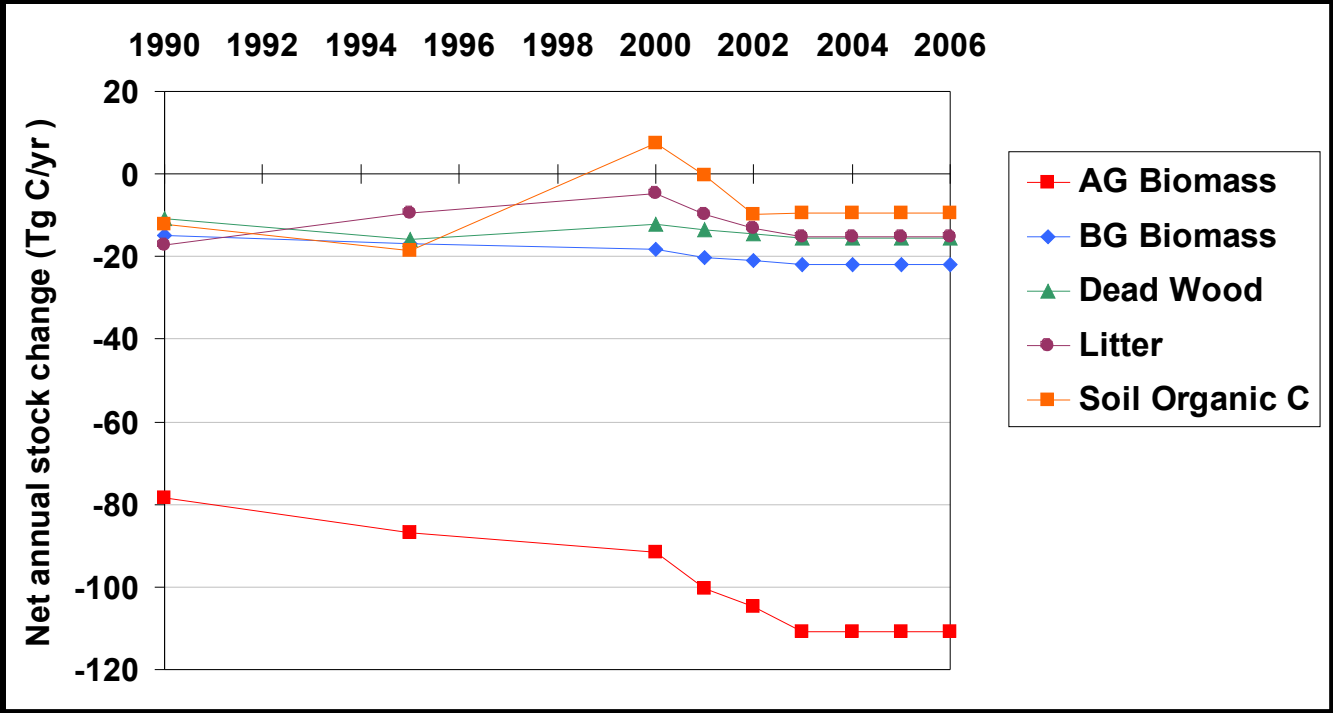
Adapted from Perry et al. In press. Source: Ruefenacht et al. In press. PE&RS.

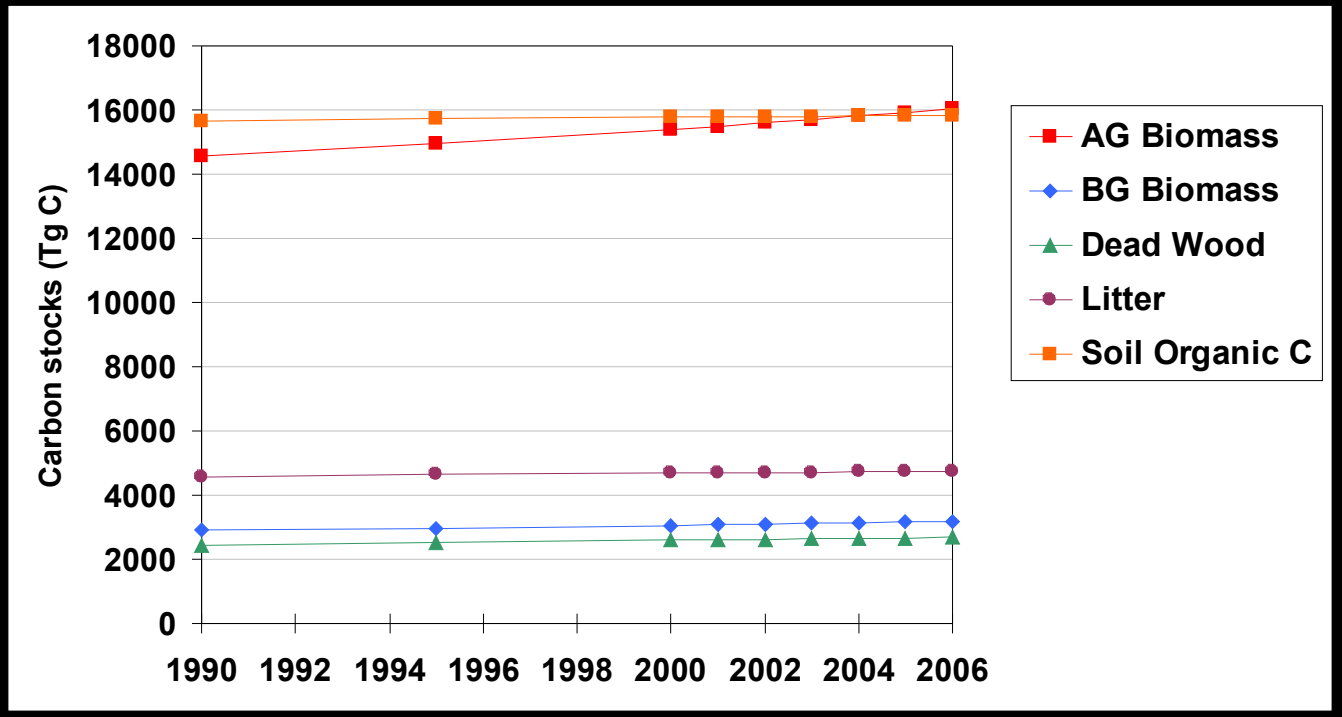
Results from international reporting (area changes)



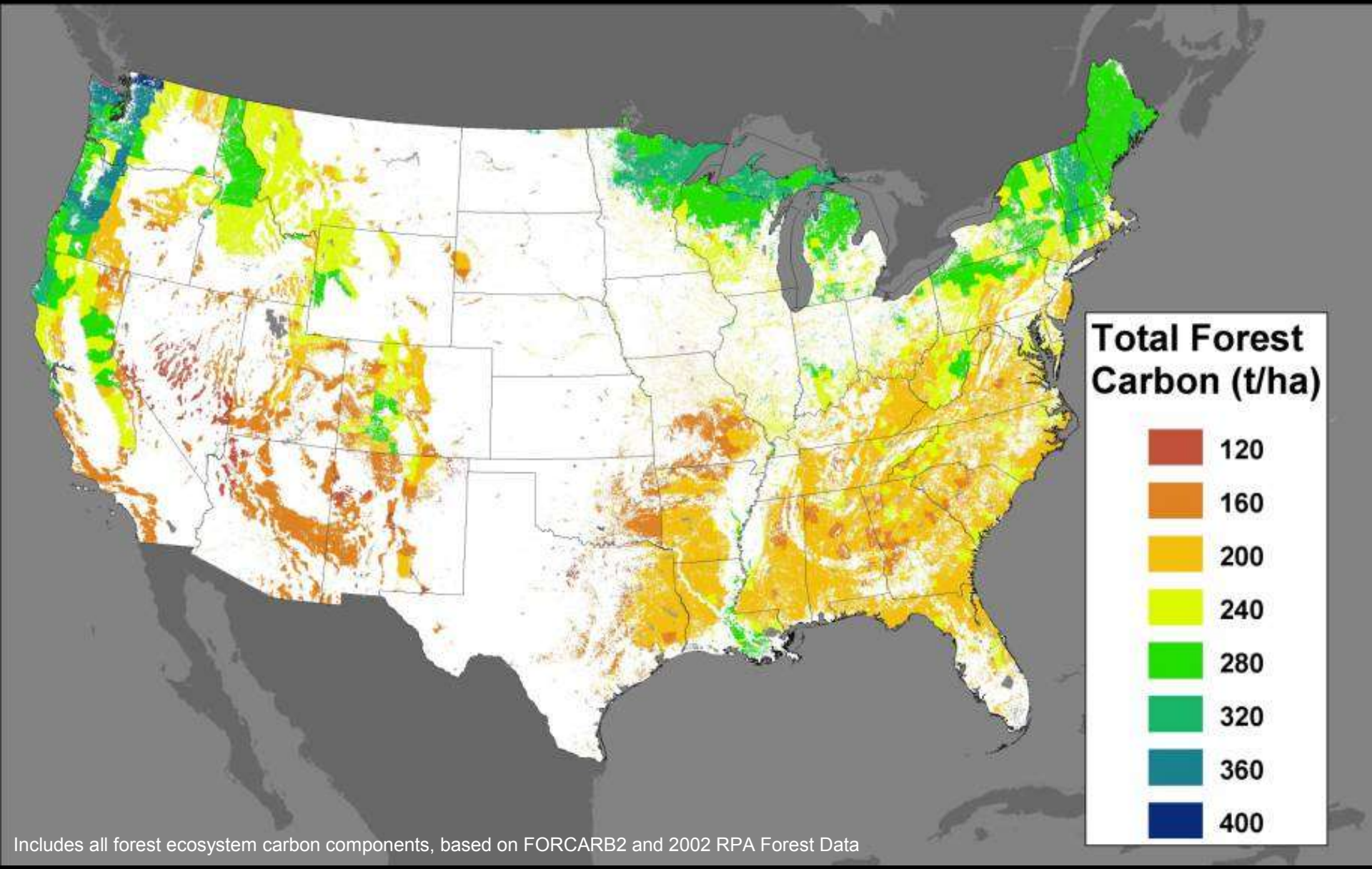
Source: Table 7.5, Review draft 1990–2006 EPA GHG Inventory.

Results from international reporting (stock changes)



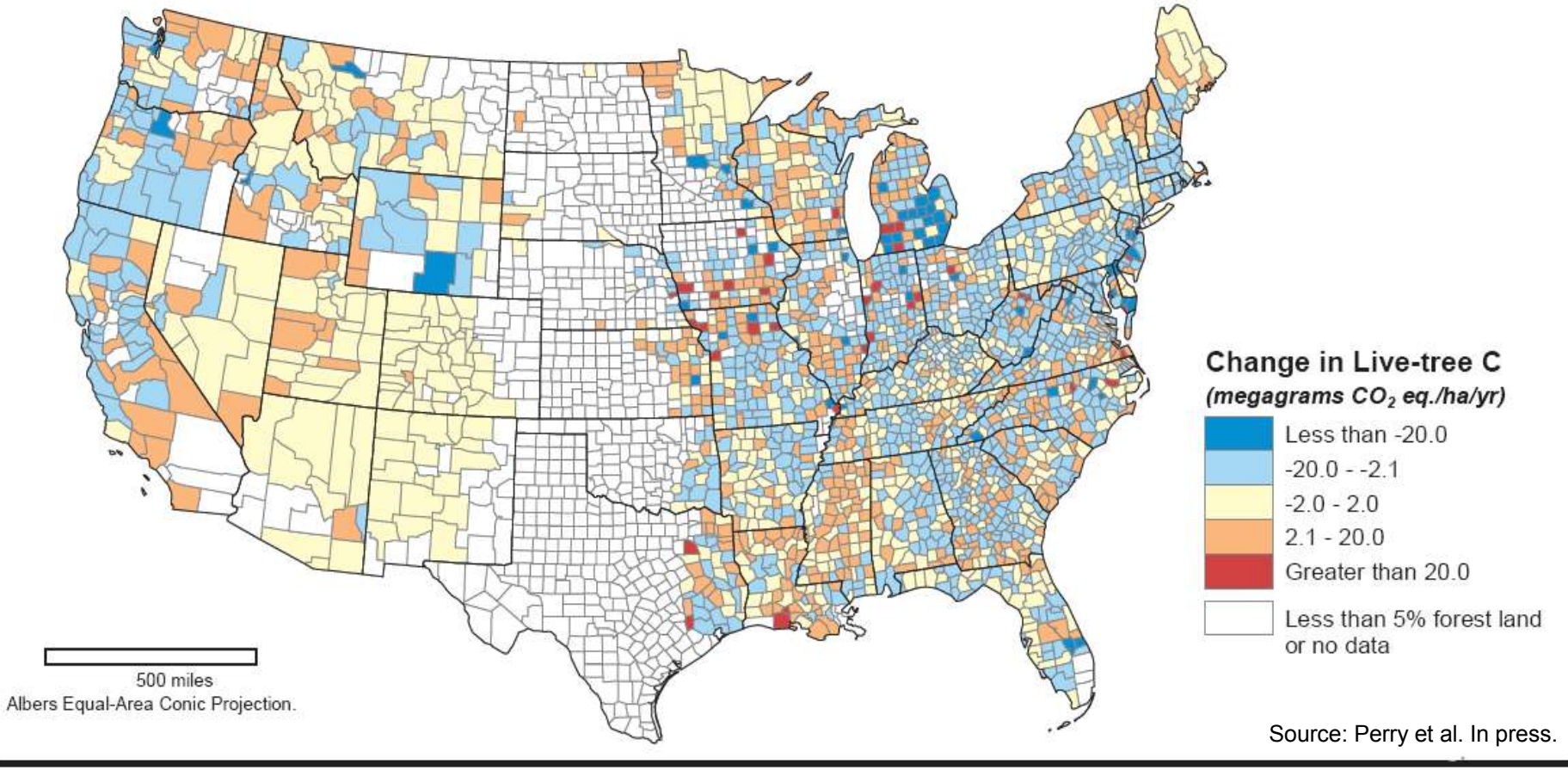


Source: Table 7.7 and 7-9, Review draft 1990–2006 EPA GHG Inventory.



Includes all forest ecosystem carbon components, based on FORCARB2 and 2002 RPA Forest Data

Map Plate 15. Net annual change in live-tree forest carbon stocks of the conterminous United States



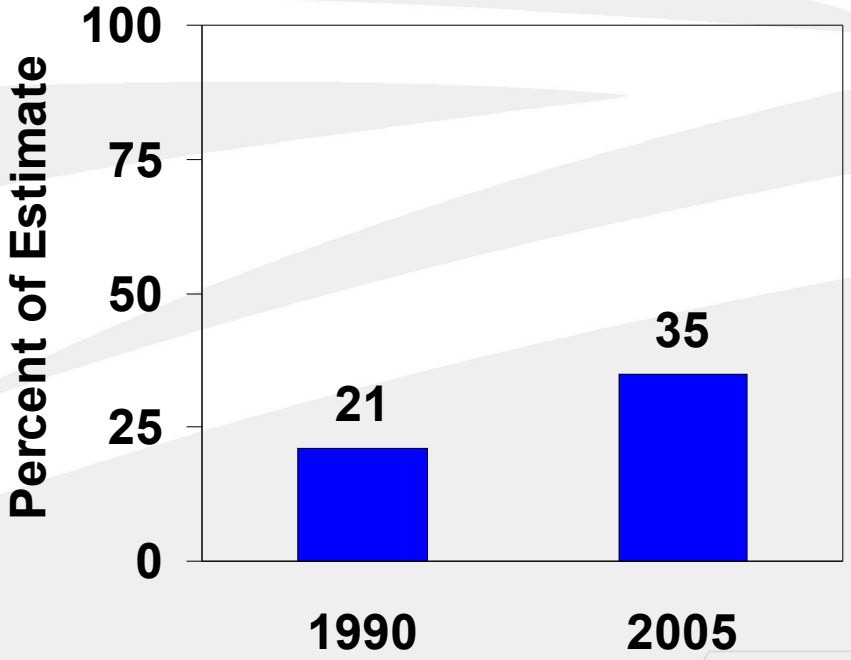
Source: Perry et al. In press.

Change in live-tree forest carbon stocks includes estimated changes in coarse roots, stems, branches, and foliage. FIA plot data are converted into county-level estimates using the FORCARB2 model (EPA 2007, Smith and others 2007). These estimates are net changes, and include the effects of harvest and land use change.

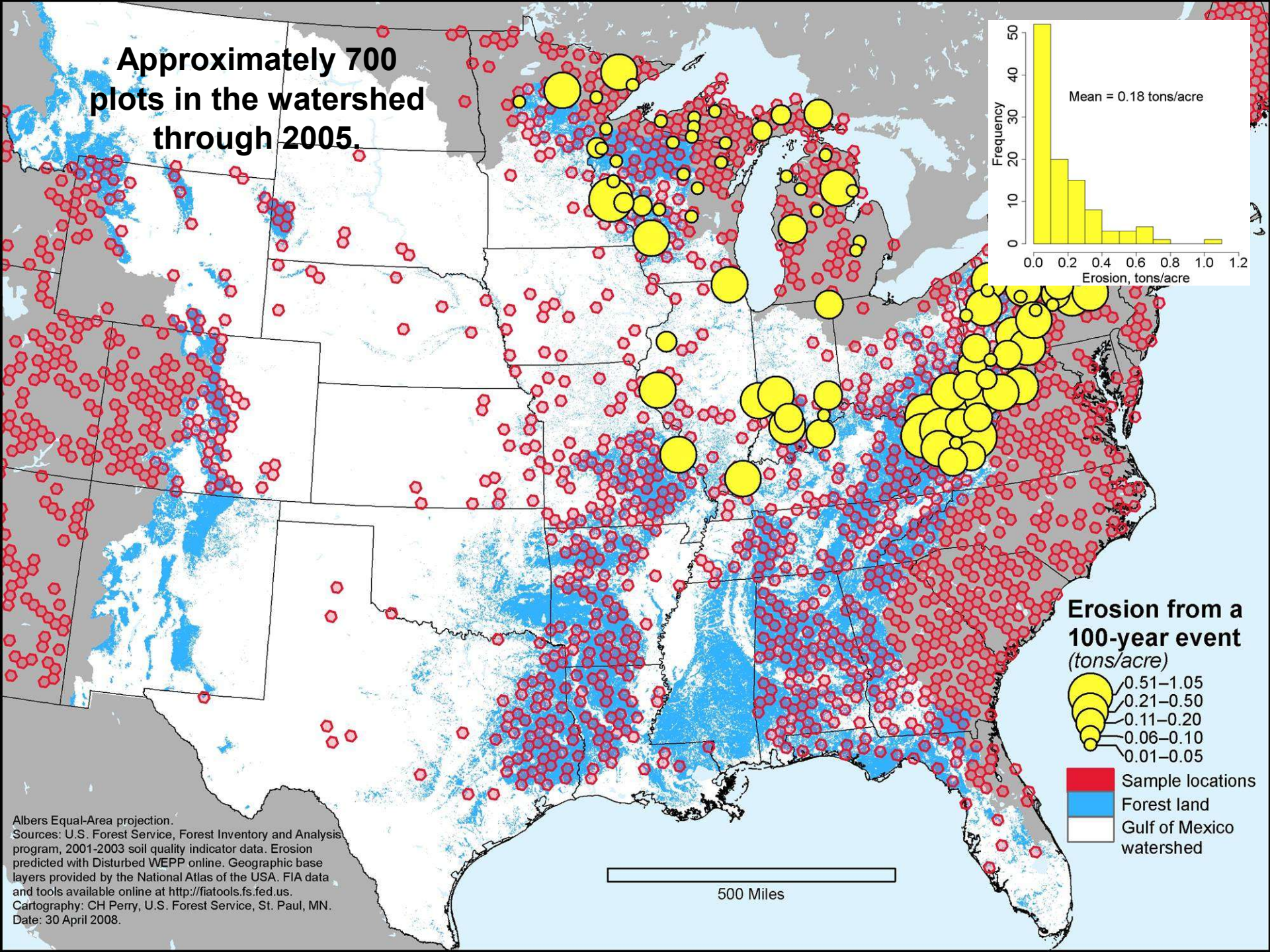
The atmosphere is the common frame of reference in carbon accounting. Losses from the atmosphere—forest carbon sequestration—are denoted by negative numbers (blue); emissions to the atmosphere—losses of forest carbon—are represented by positive numbers (red).

Source: J.E. Smith, L.S. Heath, and E. LaPoint, USDA Forest Service, Forest Inventory and Analysis Program, 2005 data. Geographic base data are provided by the USDA National Agricultural Statistics Service. FIA data and mapping tools are available on-line at http://fiatools.fs.fed.us. Date: March, 2008.

Percent of estimate from "measured" FIA data



- P3 data is being integrated now, so percentage will increase substantially
- Change estimation for area estimates remains difficult


Approximately 700 plots in the watershed through 2005.
Mean = 0.18 tons/acre
Frequency
0
10
20
30
40
50
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Erosion, tons/acre
Erosion from a 100-year event
(tons/acre)
0.51–1.05
0.21–0.50
0.11–0.20
0.06–0.10
0.01–0.05
Sample locations
Forest land
Gulf of Mexico watershed
500 Miles
Albers Equal-Area projection.
Sources: U.S. Forest Service, Forest Inventory and Analysis program, 2001-2003 soil quality indicator data. Erosion predicted with Disturbed WEPP online. Geographic base layers provided by the National Atlas of the USA. FIA data and tools available online at http://fiatools.fs.fed.us.
Cartography: CH Perry, U.S. Forest Service, St. Paul, MN.
Date: 30 April 2008.

Search

National NRCS

Enter Keywords GO

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National Resources Inventory

A statistical survey of land use and natural resource conditions and trends on U.S. non-Federal lands.

NRI Results

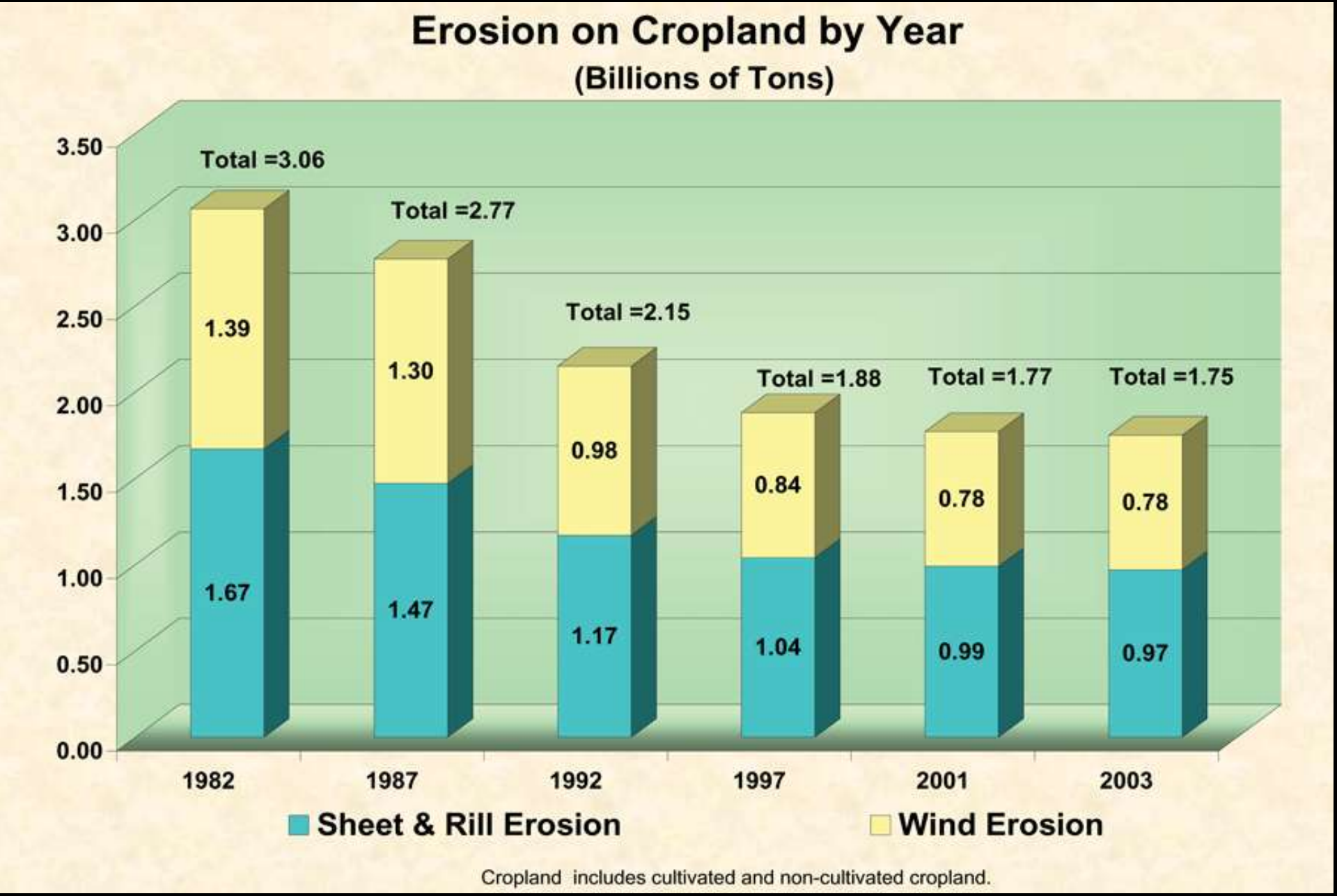
- 2003 Annual NRI - Land Use
  (National, Major River Basin, and State level estimates)
- 2003 Annual NRI - Soil Erosion
  (National, Major River Basin, and State level estimates)
- 2003 Annual NRI - Wetlands
  (Farm Production Region estimates)
- Archived Annual NRI
- 1997 Five-Year NRI
- Map Room
- Publications
- Data Availability

More About the NRI Process

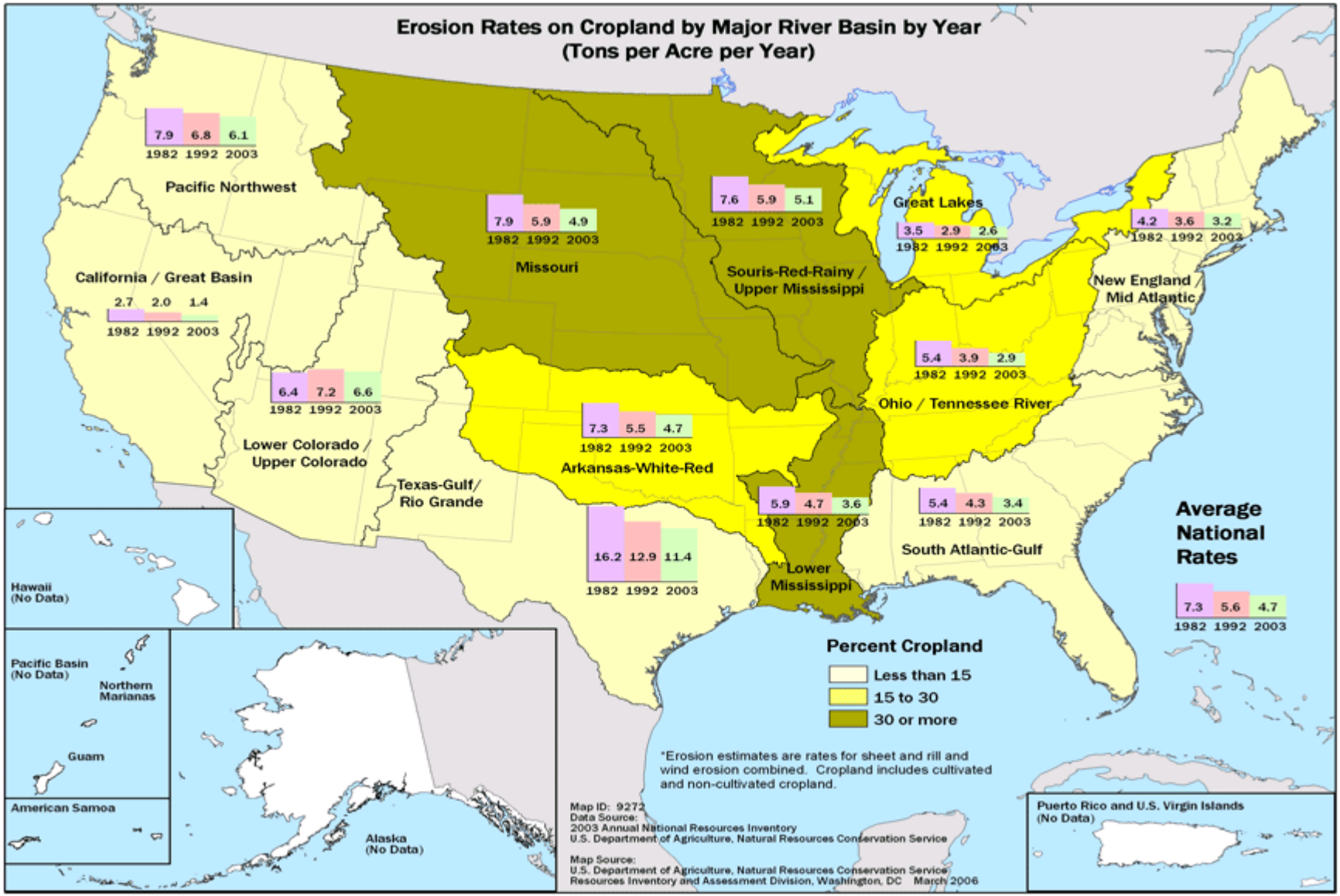
- Statistical Design
- Data Gathering
  --Remote Sensing Laboratories
- Statistical Estimation
- Glossaries

NRI Applications

- **Conservation Effects Assessment (CEAP) with the NRI**

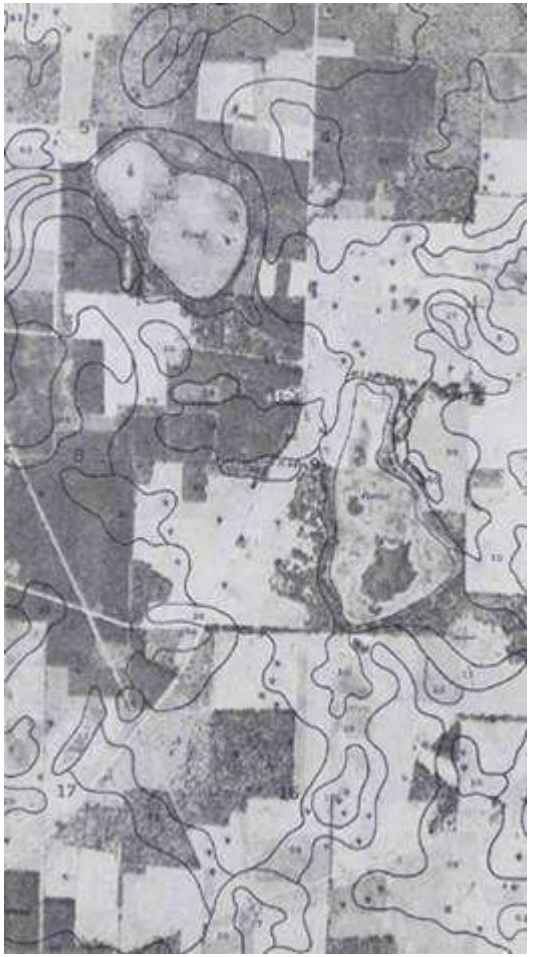


Source: National Resources Inventory



Source: 2003 NRI; http://www.nrcs.usda.gov/Technical/nri/2003/nri03eros-mrb.html

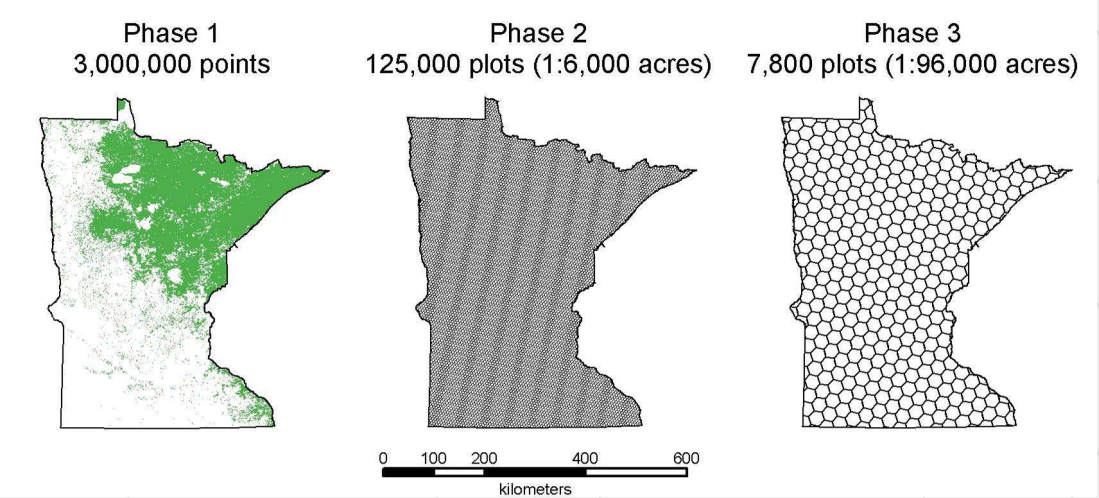
3 Conclusions



How does FIA data inform the carbon discussion?

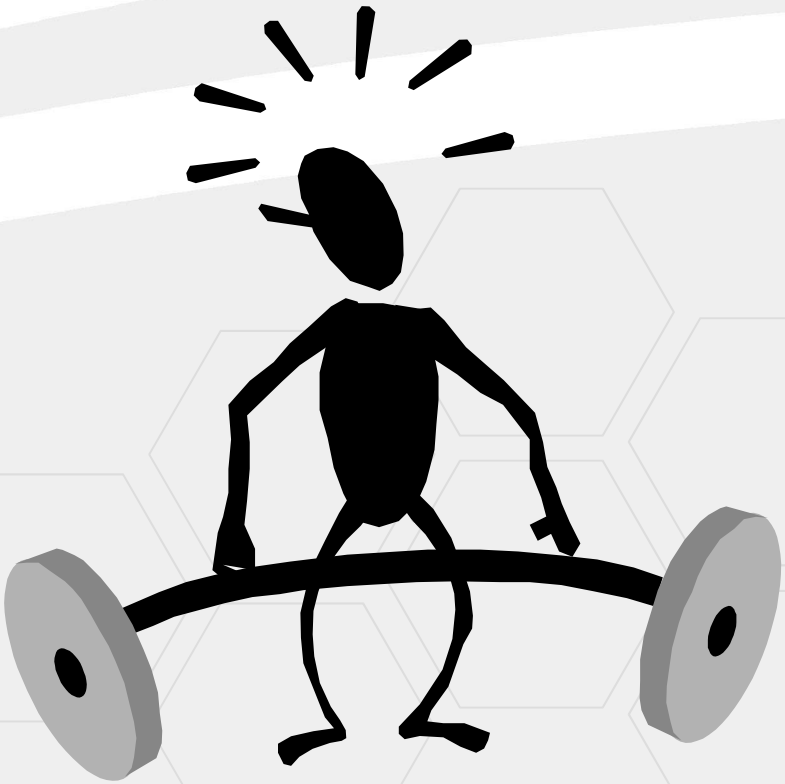
- Area and area change
- Field campaign
- New measures
  - Soils
  - Forest floor
  - Down wood

- Harvested wood & products (utilization, TPO, fuelwood, imports/exports) …



FIA's weaknesses are well-known,

- Coarse scale
  - Grid can be intensified to address specific forest health problems
- Landscape-scale status and trend
  - Small-scale variability not captured
- Not everything measured
  - Only upper 20 cm mineral soil
- Difficult to evaluate management



…but its strengths are considerable.

- Unbiased sampling across ALL ownerships
- Nationally consistent protocols
- Rolling annual inventory —status and trend
- Detection monitoring
- Integrated forest health indicators
- Data published on regular intervals

Contact Information

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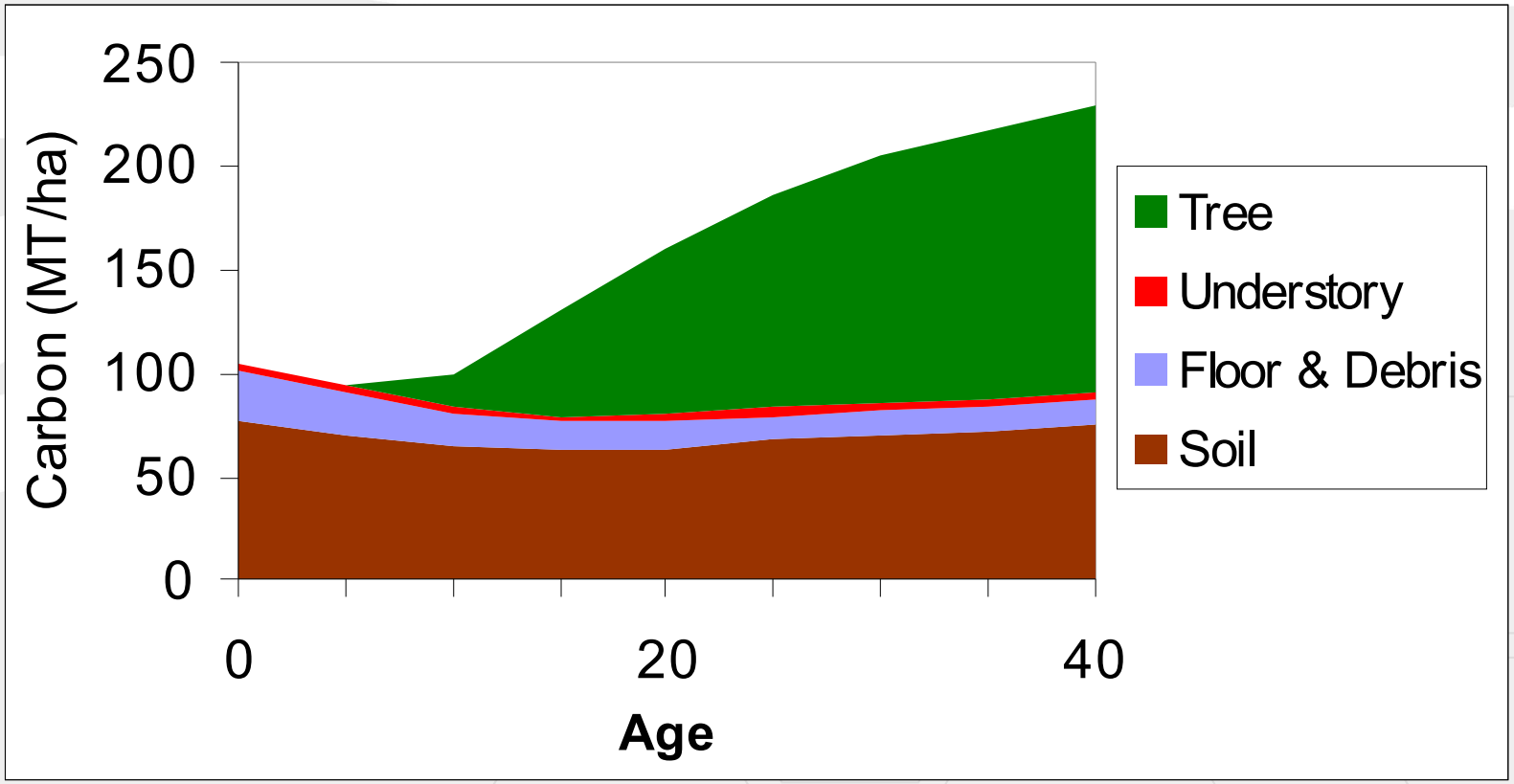
Example of land management—C budget for planted SE pine



Site quality assumed to be high.