

Forest Carbon Management in the United States: 1600-2100

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Forest Carbon Management: 1600-2100

- **Extraction and Deforestation: 1600-1900**
- **Harvest, Regrowth, Management: 1900-2000**
- **Global Stewardship: The 21st Century**
 - Managing the atmosphere
 - Forest sector
 - Forestry activities
 - Forest practices
 - Technology

Themes:

- **Inventory systems**
- **Technologies and practices**
- **Decision support**

Extraction and Deforestation: 1600-1900



From Eric Sloan

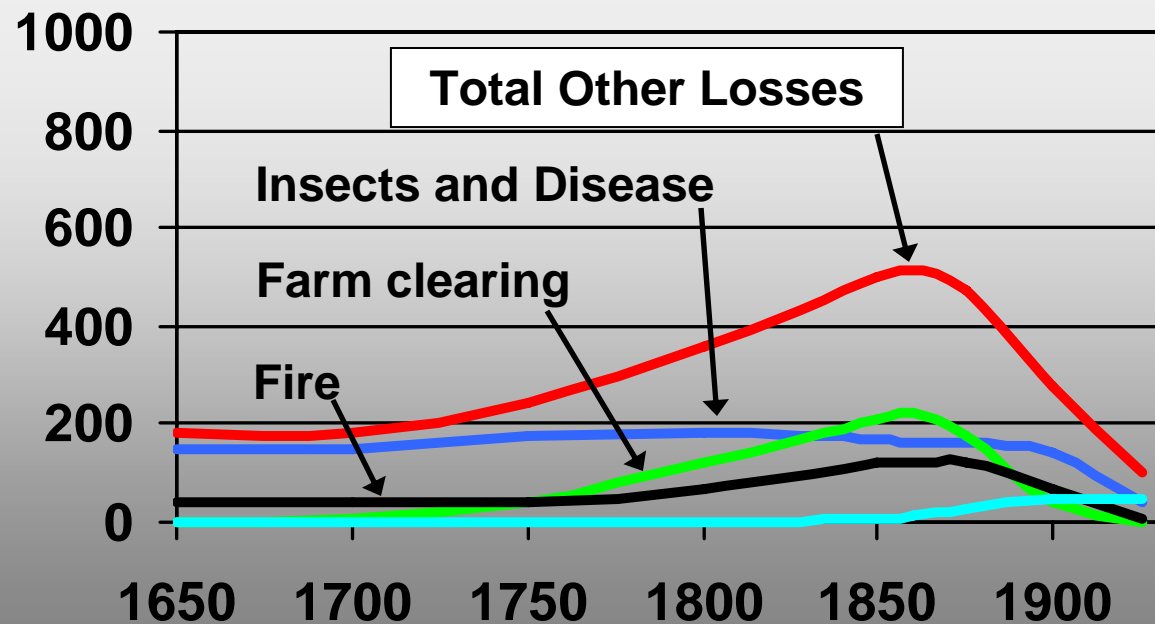
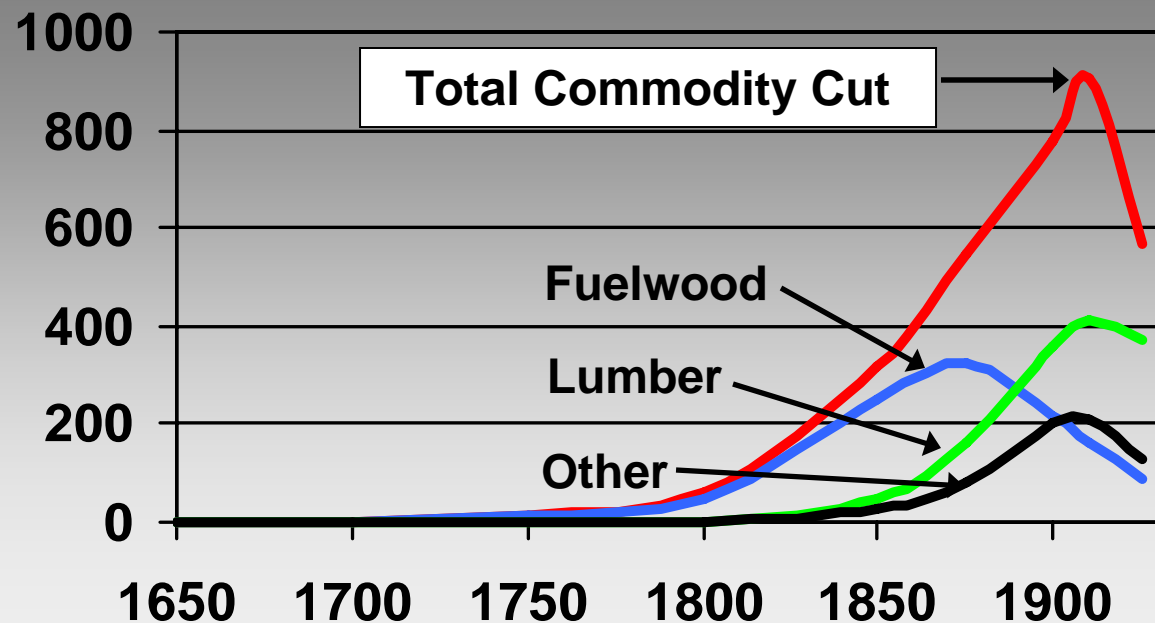
Drain on the Sawtimber Stand, 1650-1925

Billion Board Feet
per Decade

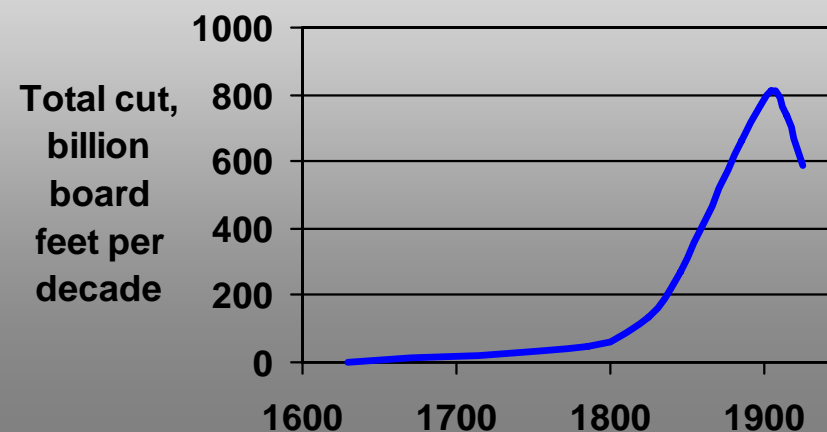
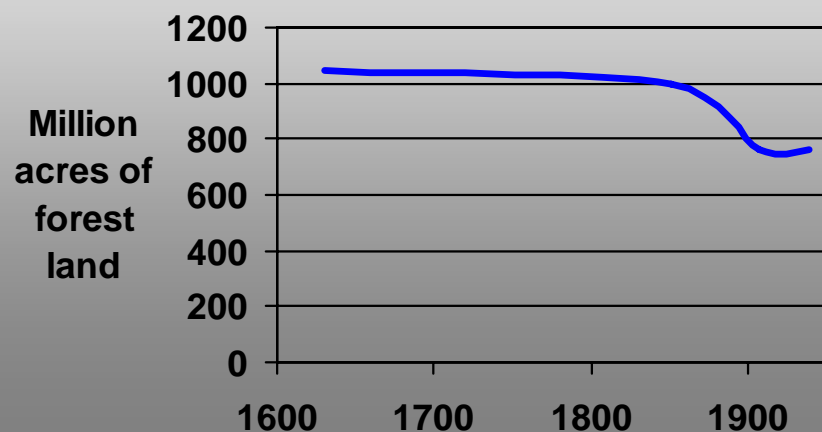
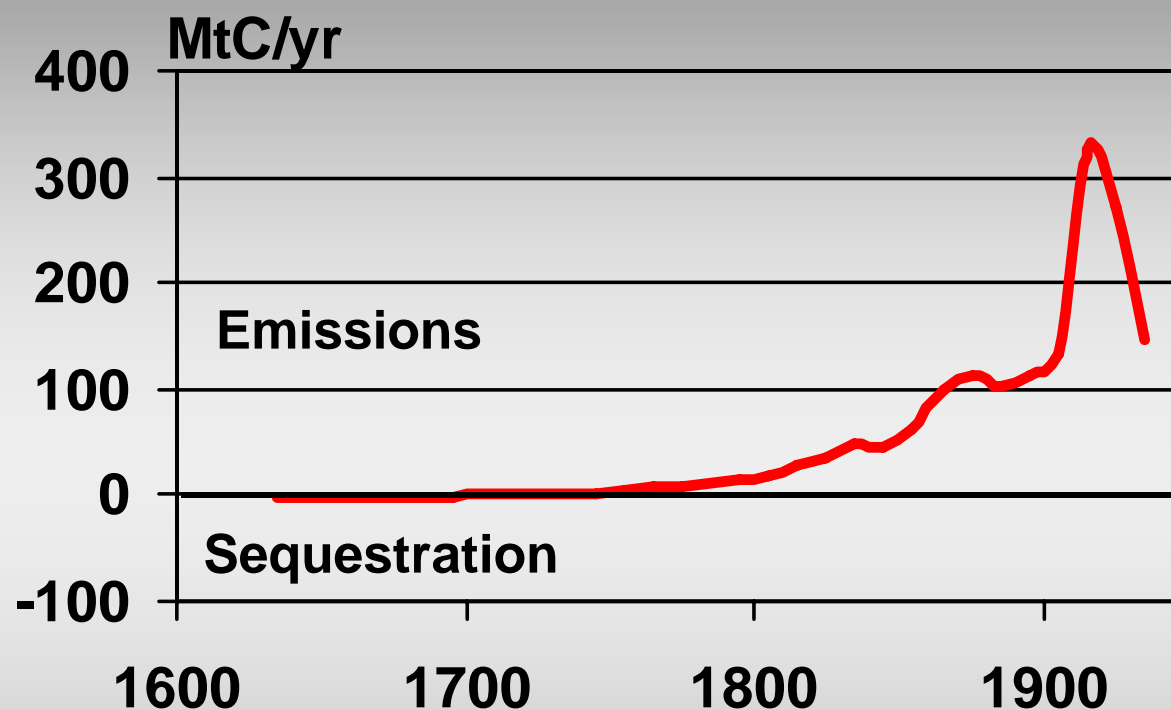
“A long struggle
against growth
was the experience
of hundreds of
thousands of
settlers in
timberland.”

From an unpublished Forest
Service Report by R.V.
Reynolds and A.H. Pierson

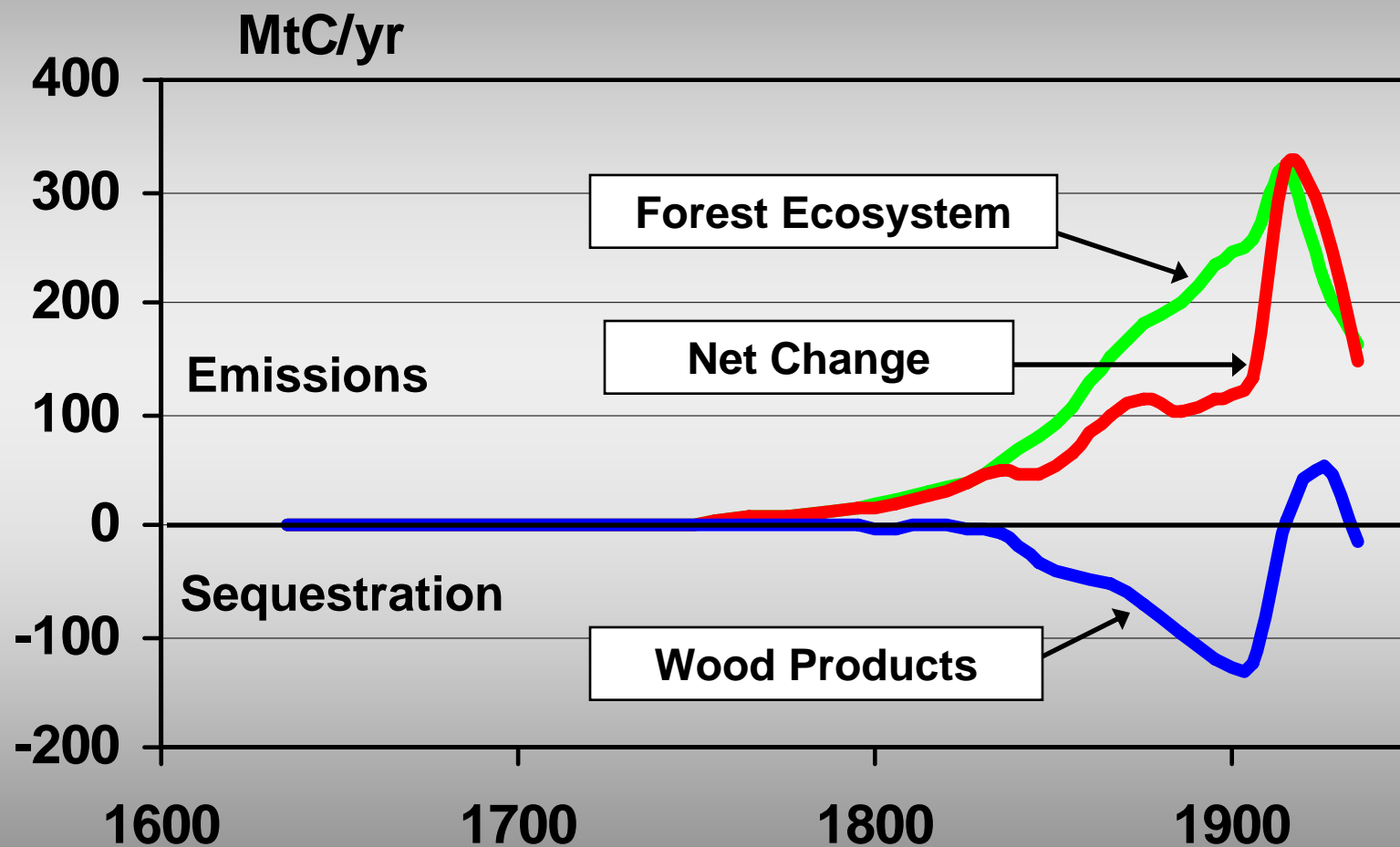
Washington, DC, 1941



Carbon Emissions from Drain on the Sawtimber Stand, 1630-1930



Carbon Emissions from Drain on the Sawtimber Stand, 1630-1930



Harvest, Regrowth, Management: 1900-2000



Old-growth stands provide the major part of the timber cut on the Pacific coast.

F-483766



Much of the recent gain in forest land area is attributable to reforestation of abandoned farmland.

F-504522

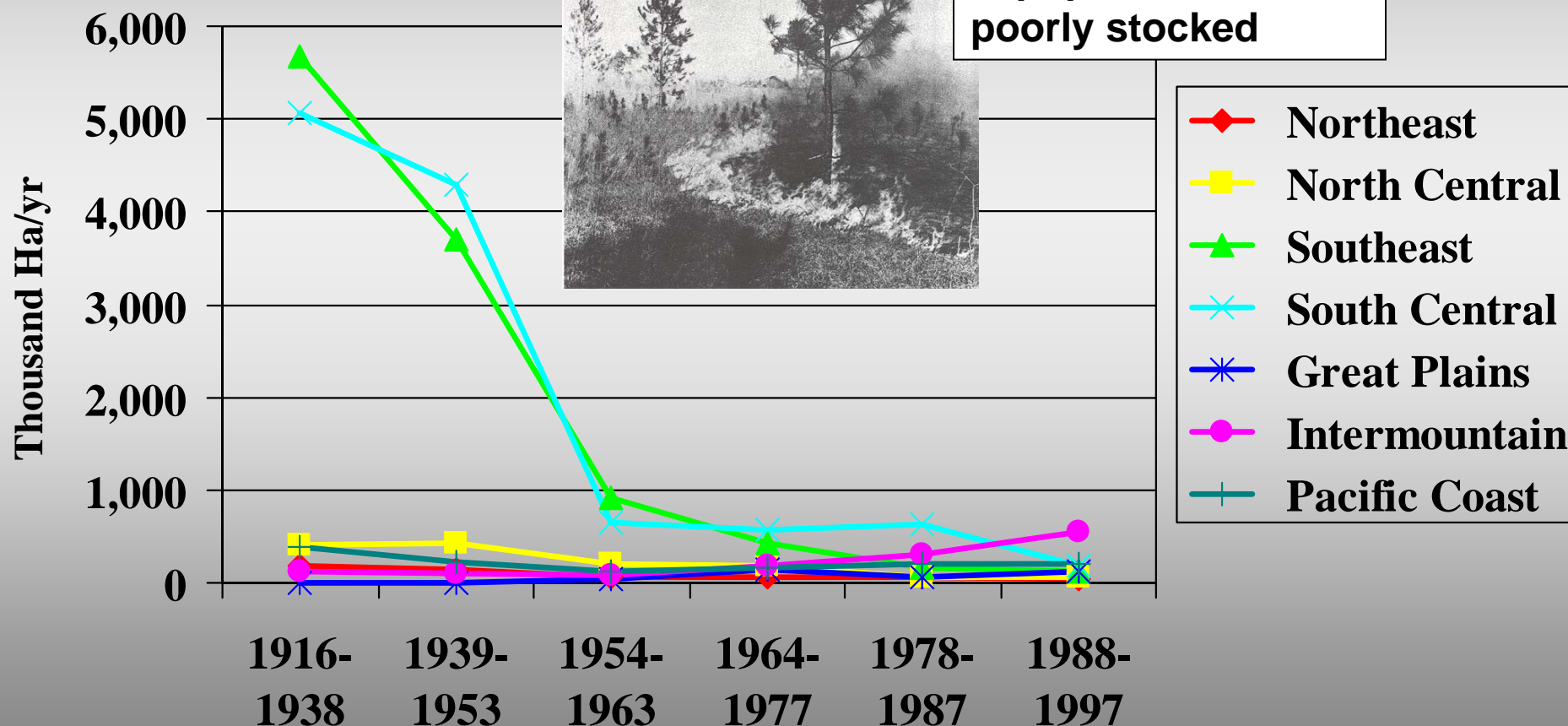


Over half of the forest land in the Southeast is grazed by domestic livestock.

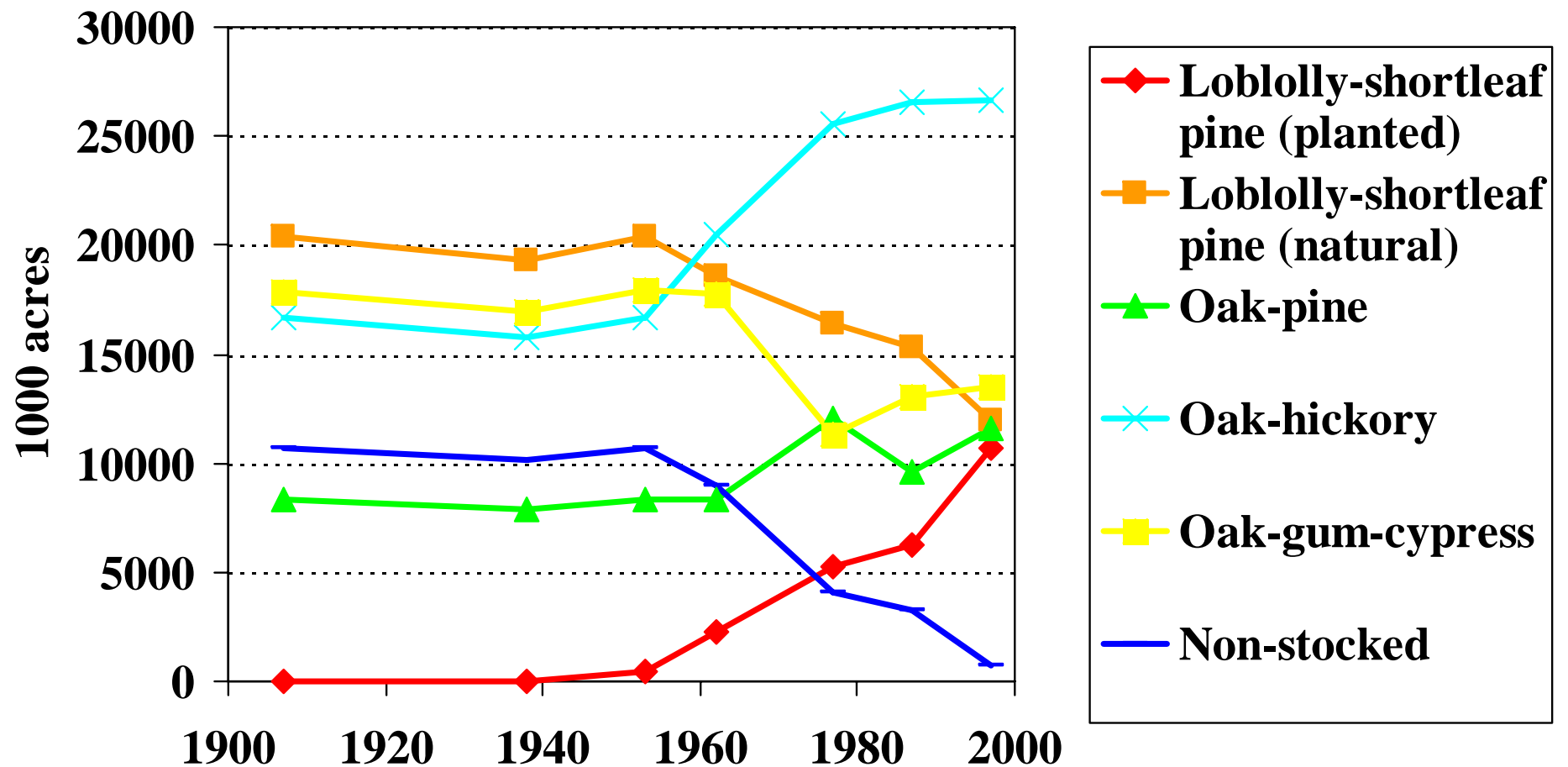
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Average Area of Land Affected by Wildfire, 1916-1997

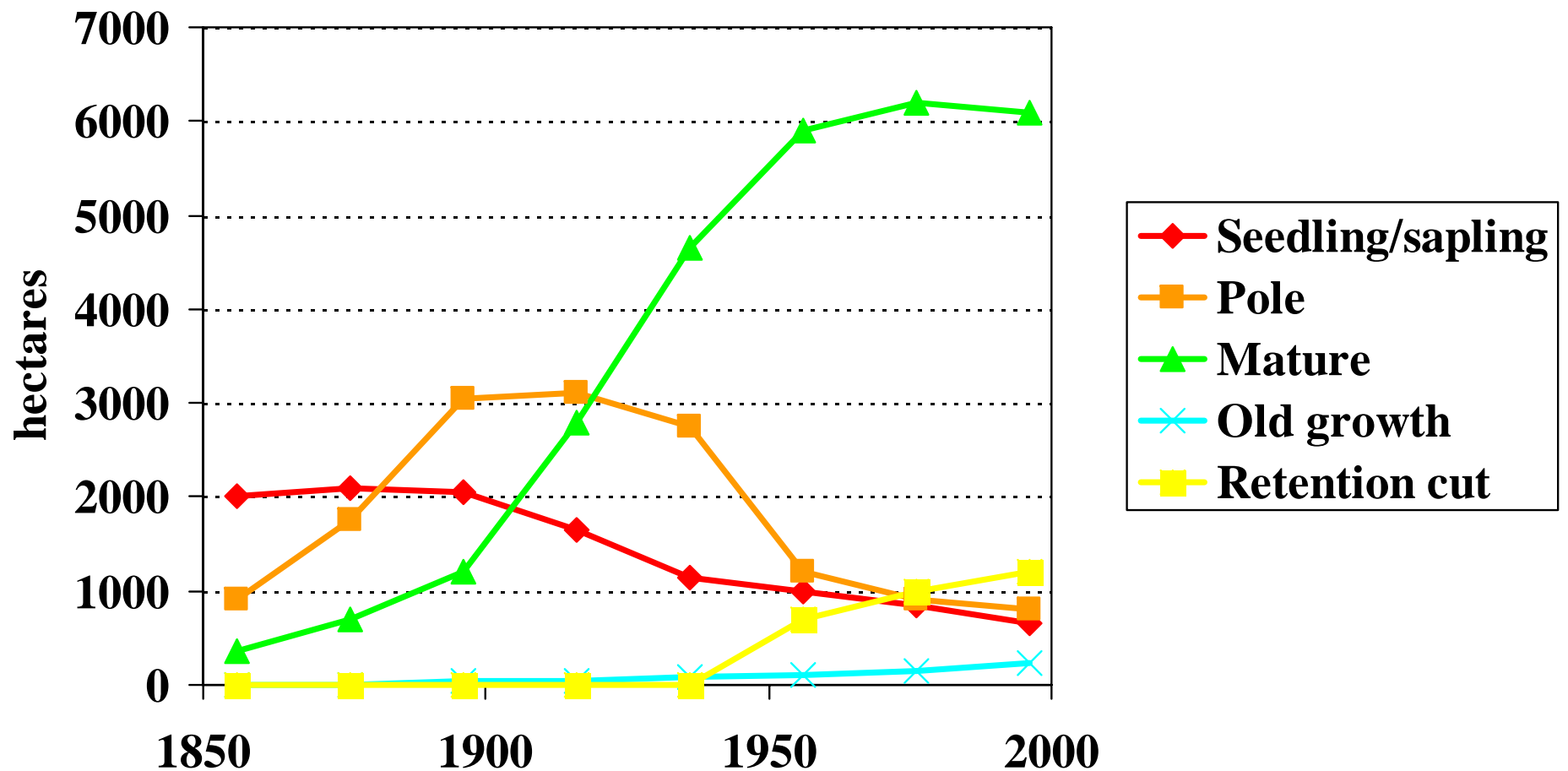
Uncontrolled fire in the 1930's and early 1940's in the South kept pine land poorly stocked



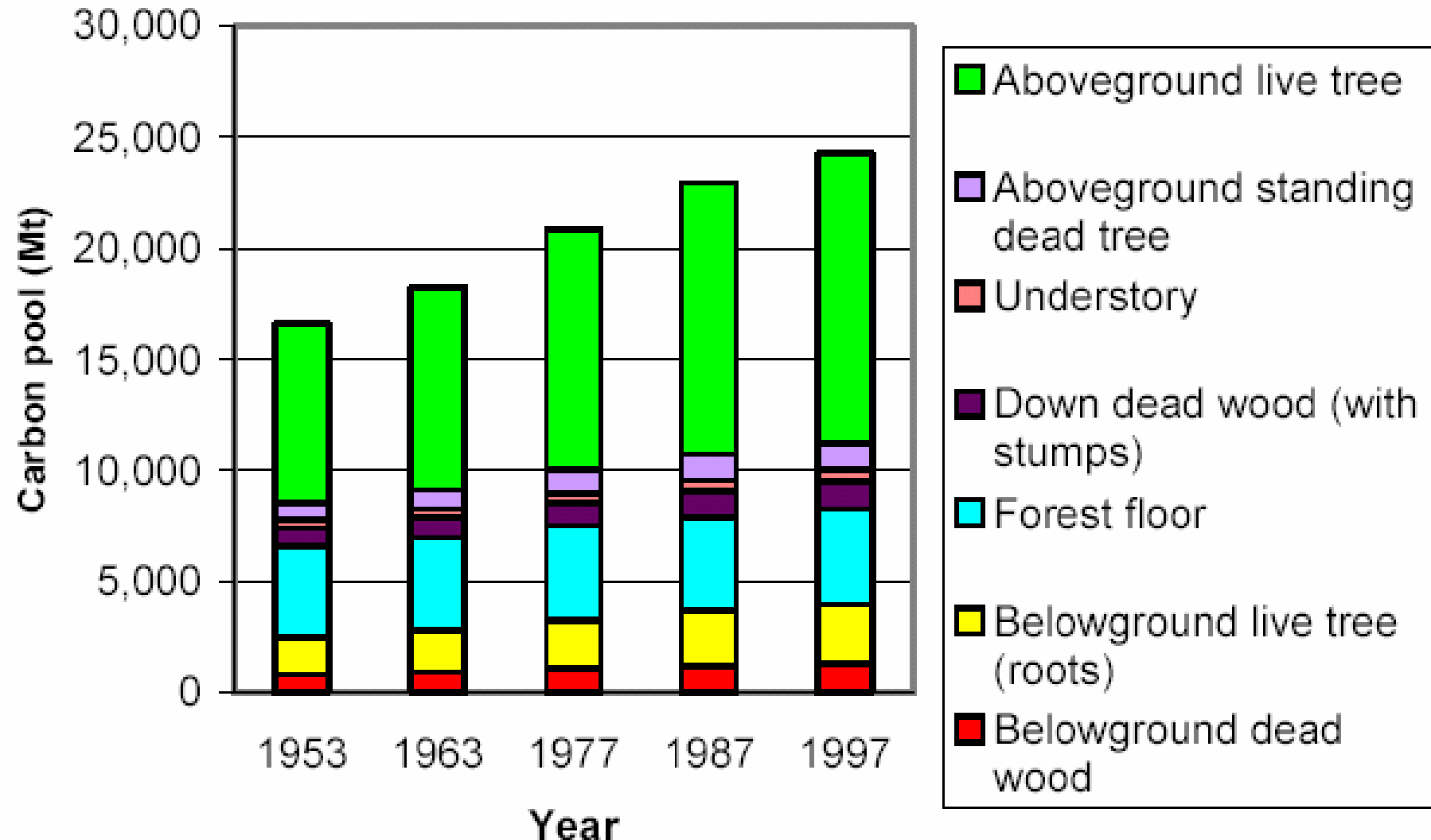
Example of Forest Type Changes: Southern U.S.



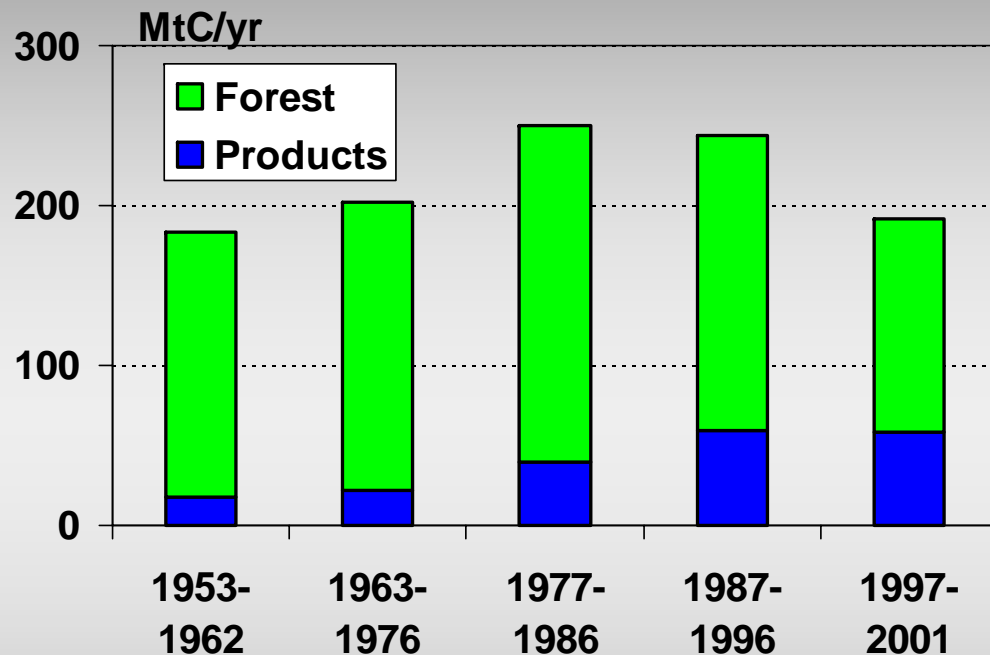
Example of Forest Structure Changes: Northern Rockies



Forest Ecosystem Carbon Pools for Forest Land of the Conterminous U.S. (soil C excluded)



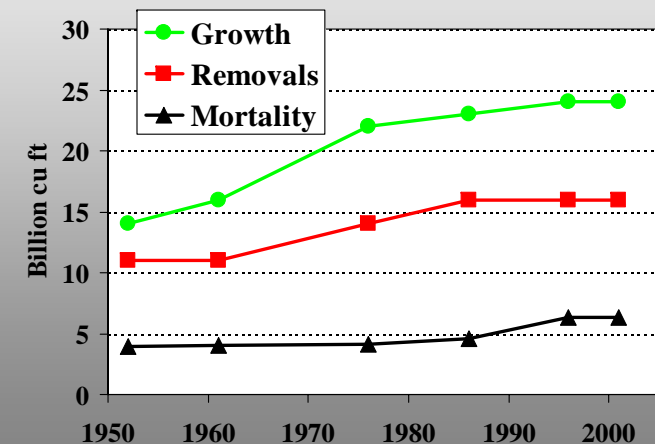
Carbon Sequestration on United States Timberland and in Wood Products, 1953-2001



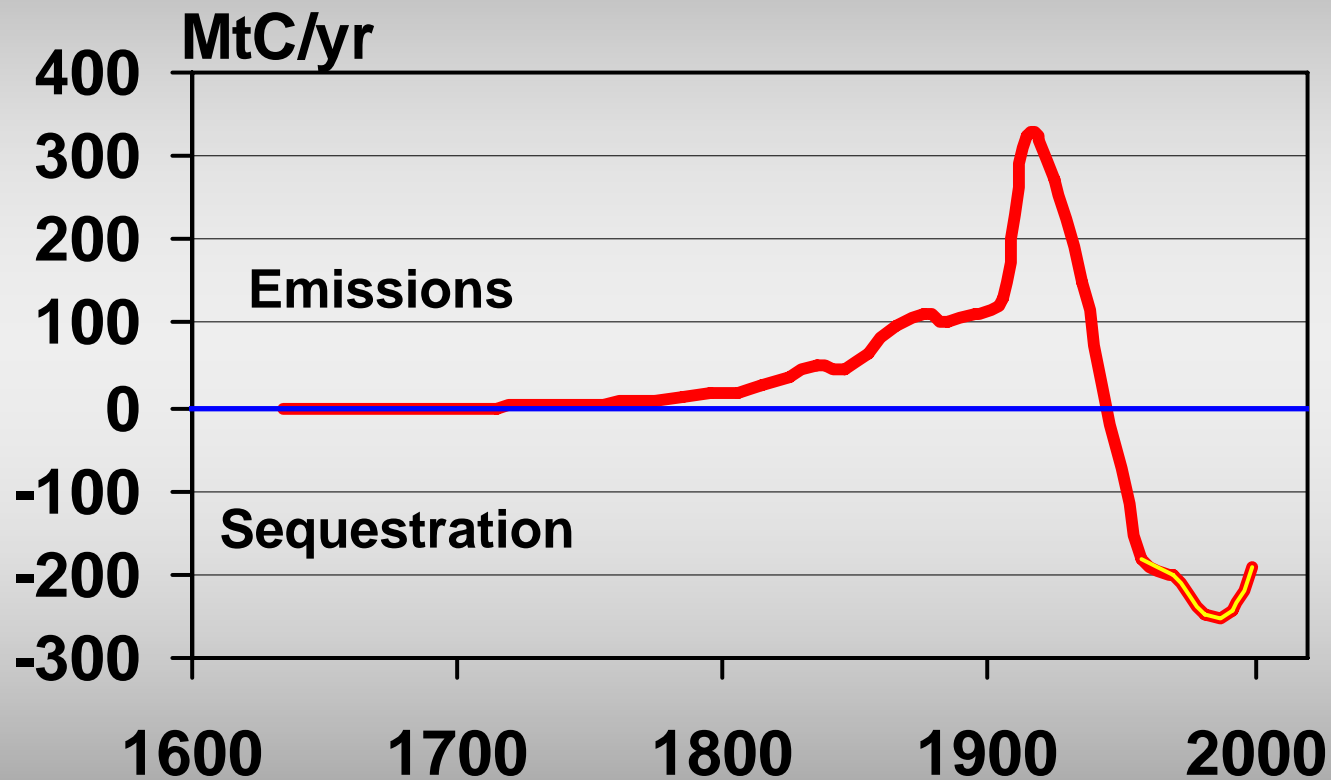
Excludes soil C, reserved forest land,
other forest land

From Heath and Smith 2003; Skog 2003

Annual Change in Timber Volume



Carbon Emissions from Drain on the Sawtimber Stand, and Sequestration from Regrowth, 1630-2000

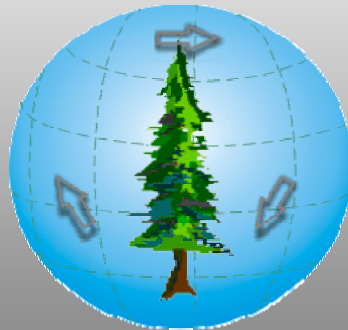


Global Stewardship: 2000-2100

- Managing the atmosphere
- Forest sector
- Forestry activities
- Forest practices
- Technology



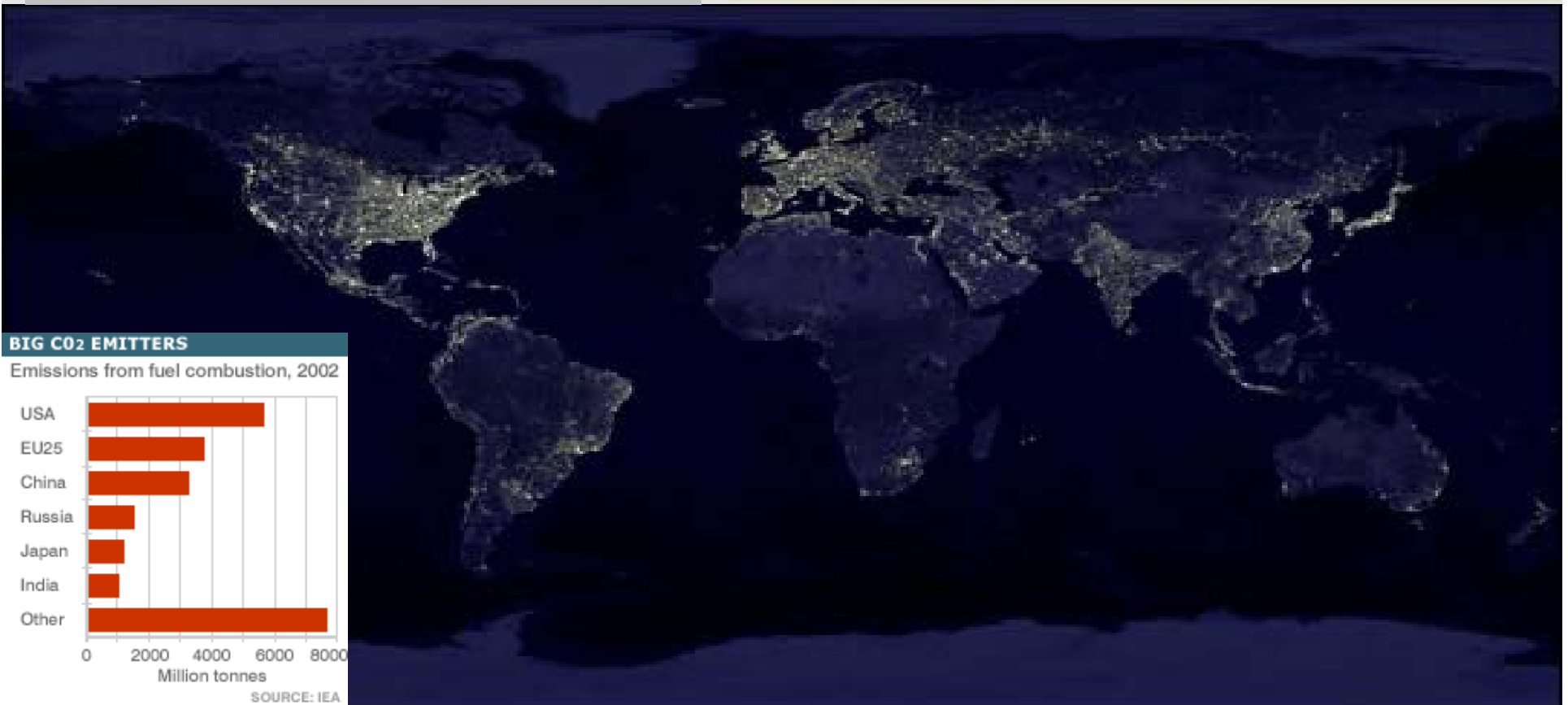
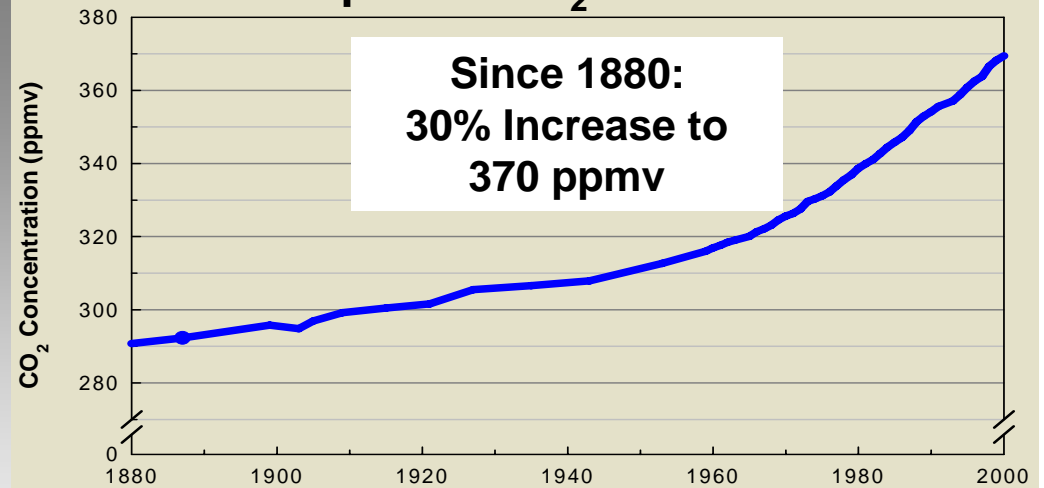
From Host



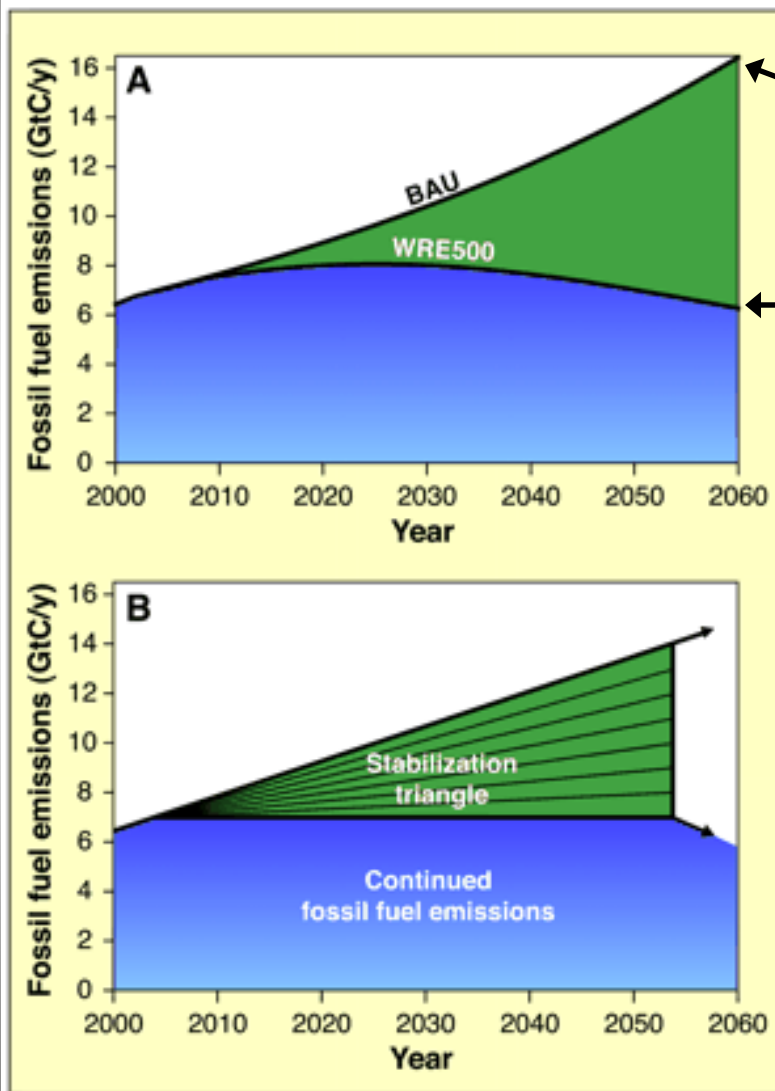
The U.S. Leads:

- Worldwide emissions of carbon dioxide
- Investment in climate change research (\$2 billion in 2004)

Atmospheric CO₂ Concentration



21st Century Challenge: Stabilize Atmospheric CO₂ Concentrations



Business-as-usual emissions scenario

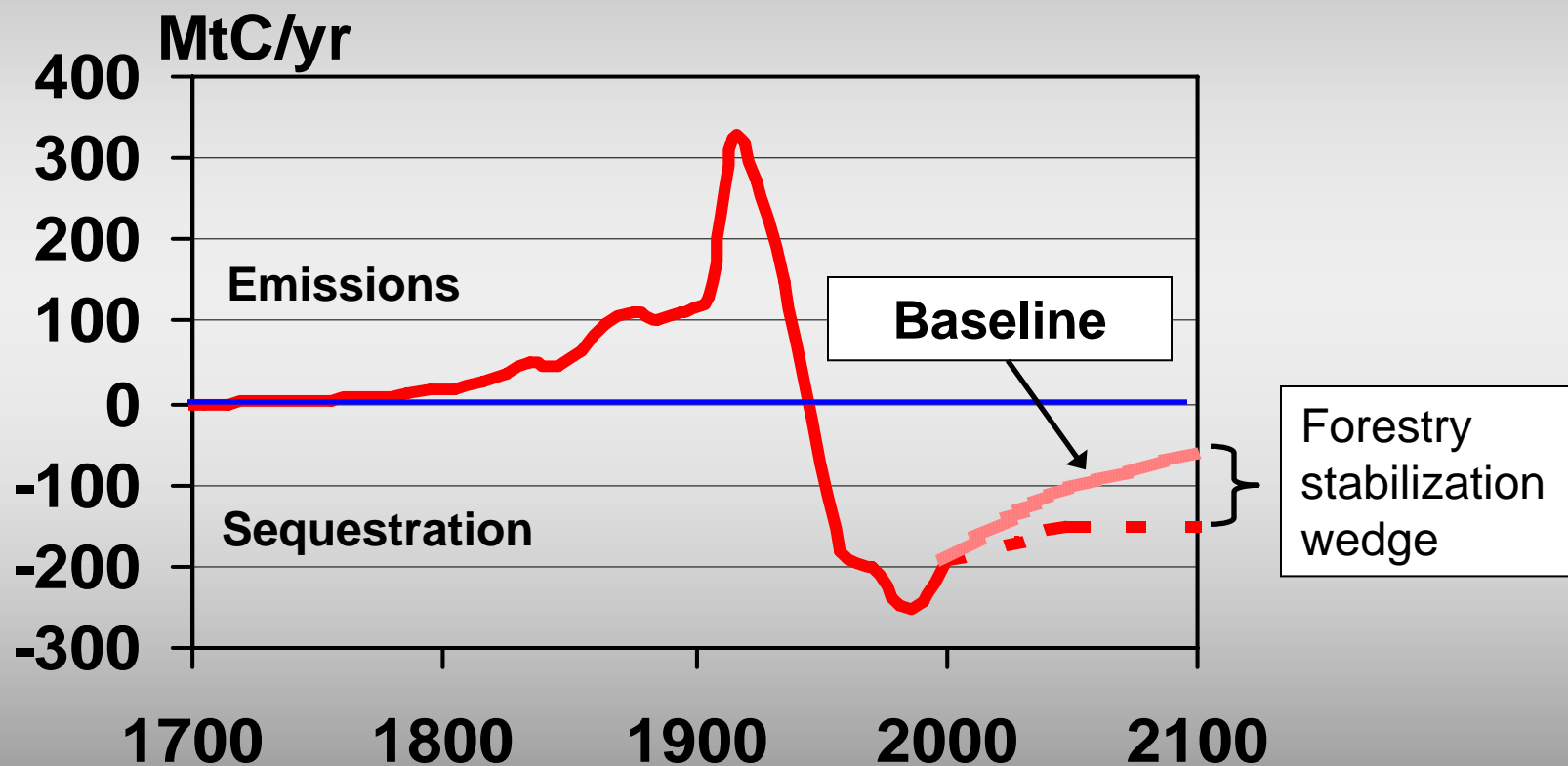
Emissions scenario to achieve stabilization at 500 ppm CO₂

Options to achieve stabilization

- Biomass energy
- Forestry
- Agriculture
- Other options

How Big is the Forest Sector Stabilization Wedge?

Carbon Budget of the U.S. Forest Sector, 1700-2100



The Forest Sector Stabilization Wedge

Activities:

- Afforestation
- Mine land reclamation
- Forest restoration
- Agroforestry
- **Forest management**
- Biomass energy
- Forest preservation
- Wood products
- Urban forestry

Example Practices:

- Thinning
- Rotation length
- Residue management
- Species/genotypes

Technology



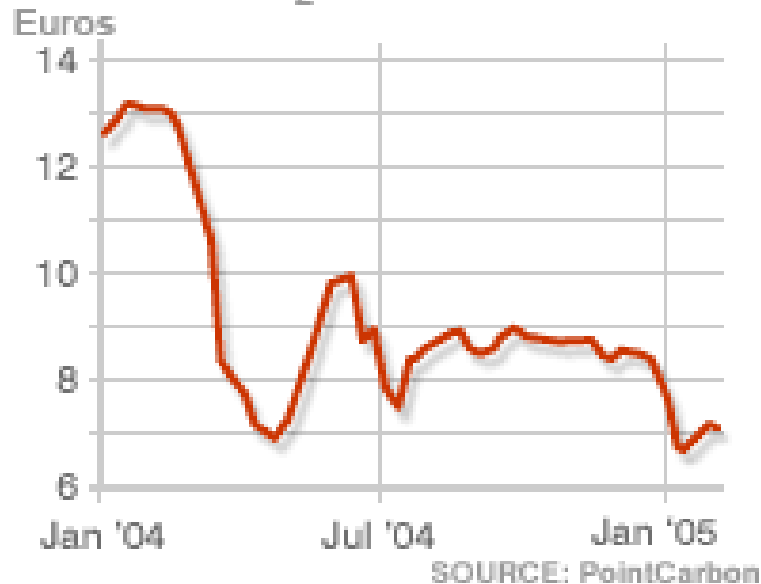
The National Plan for Reducing Greenhouse Gases

- In 2002, the President directed Secretaries of Energy and Agriculture to revise **guidelines** for reporting
 - Originally authorized in the 1992 Energy Policy Act section 1605(b)
- Program is **voluntary**
- Registered reductions may lead to **transferable credits**
- Take into account emerging **domestic and international** approaches
- Develop new **targeted incentives** for carbon sequestration and greenhouse gas reductions
- **Research** and development

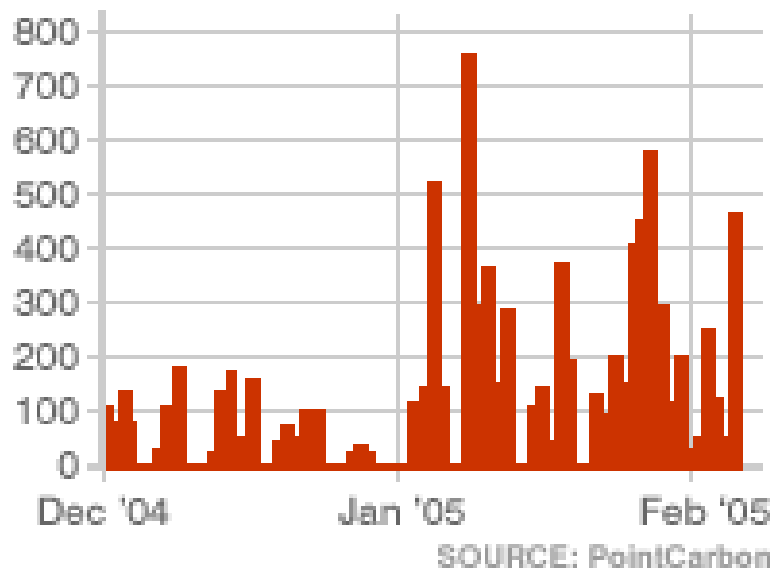
Continuing National and International Debate on Climate Policy Options

- **Market mechanisms**
 - Chicago climate exchange
 - European Union exchange
- **U.S., regional, and State**
 - Action plans
 - Greenhouse gas registries
- **DOE “Regional Partnerships” and “Climate Vision”**
- **EPA “Climate Leaders” program**
- **ISO greenhouse gas standards**
- **Kyoto treaty mechanisms**
 - National GHG reduction targets
 - Clean Development Mechanism
 - Joint Implementation projects
 - Emissions trading

What you pay for an allowance to emit one metric ton of CO₂



Metric tons (thousands)



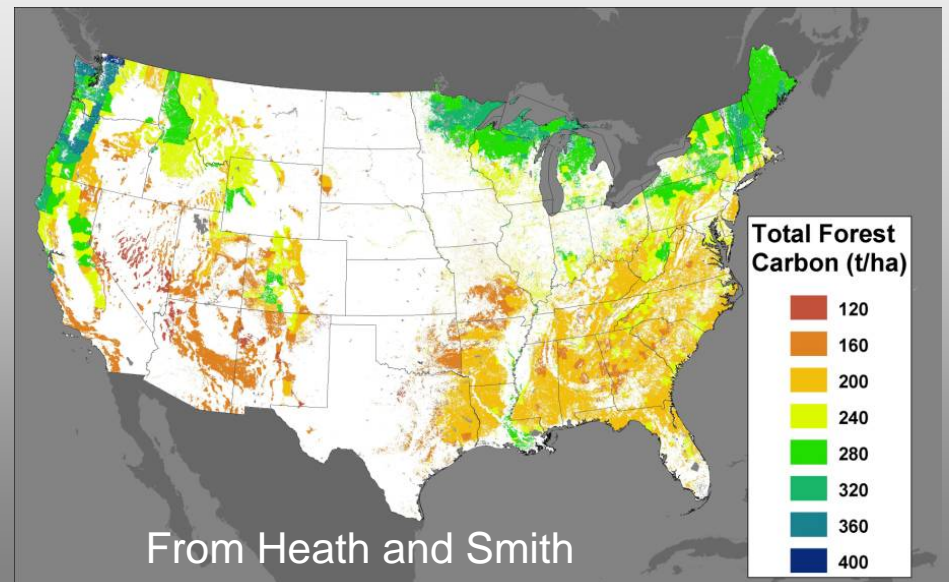
Will a market approach work for managing CO₂?

- European cap and trade system modeled after successful U.S. emissions trading scheme
- U.S. approach involves voluntary participation with incentives

From BBC News 2/16/05

Potential Role of Forests in Mitigating Greenhouse Gas Emissions

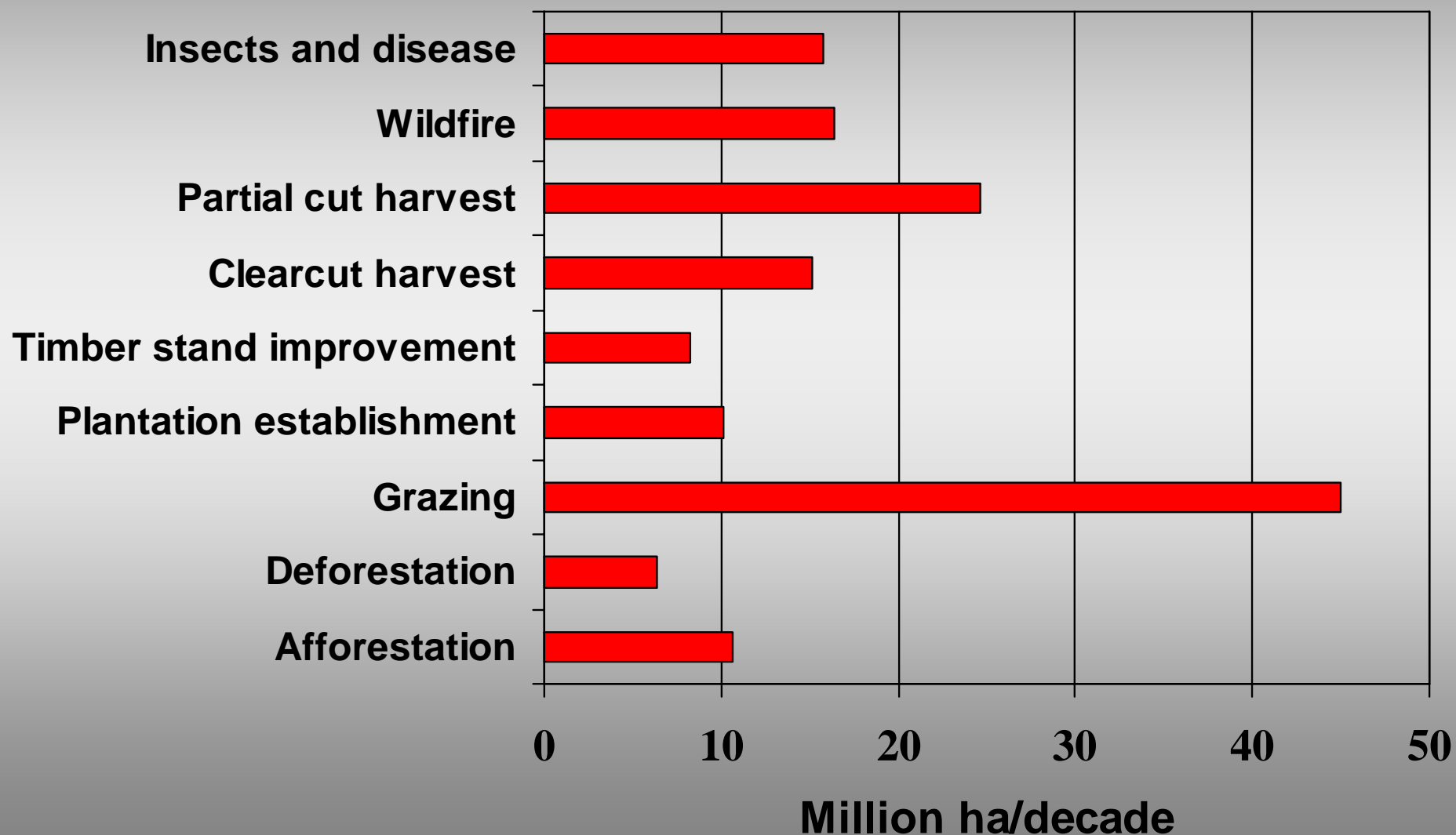
- **U.S. forests remove carbon dioxide from the atmosphere**
 - 200 million tons C per year (**10% of U.S. fossil fuel emissions**)
- **It is feasible to increase the rate of carbon sequestration in forests...**
 - Plant more trees
 - Maintain healthy forests
 - Manage productivity
 - Residue management
- **...and forest products**
 - Biomass energy
 - Use more wood



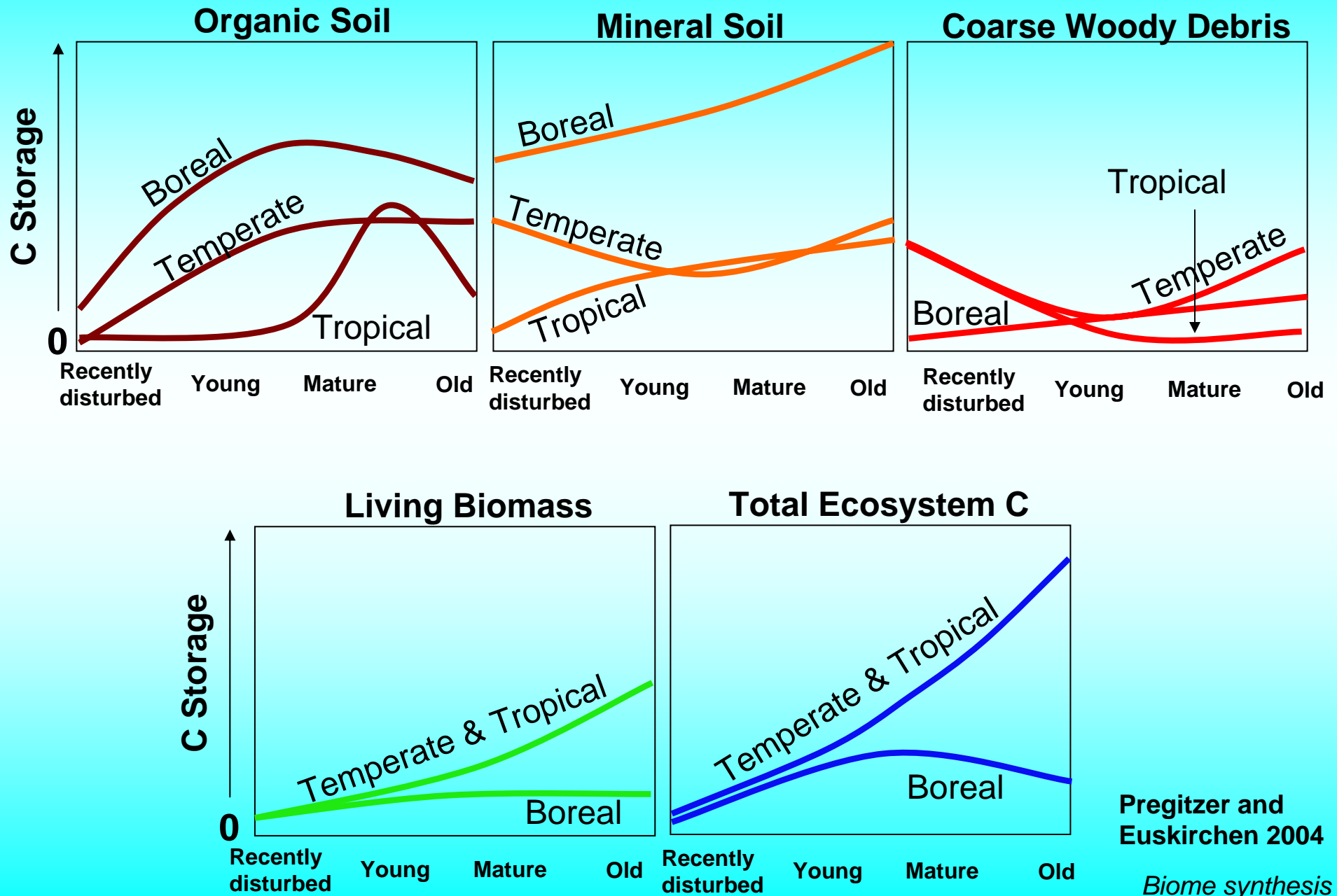
Forest Ecosystems, Practices and Technology

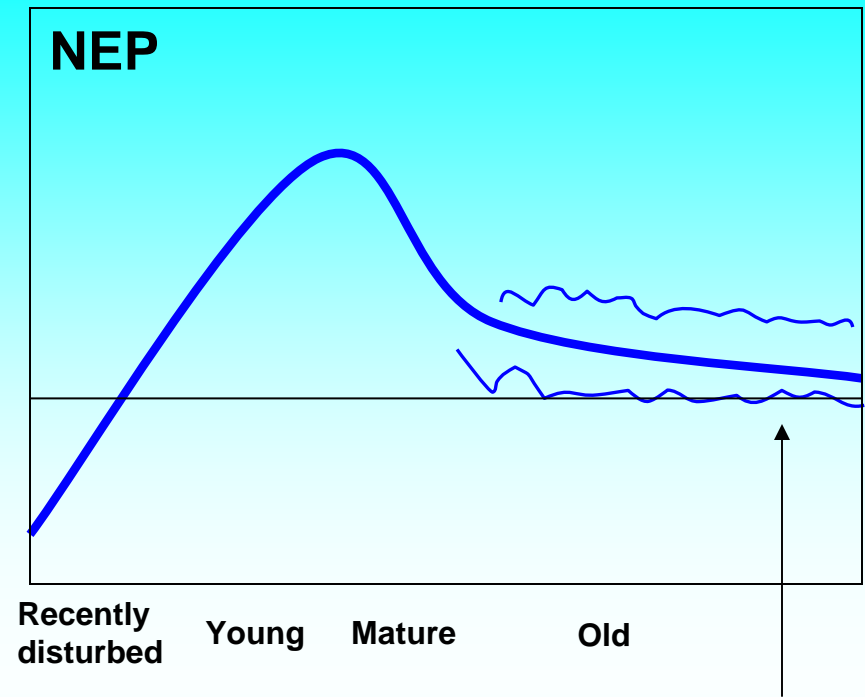
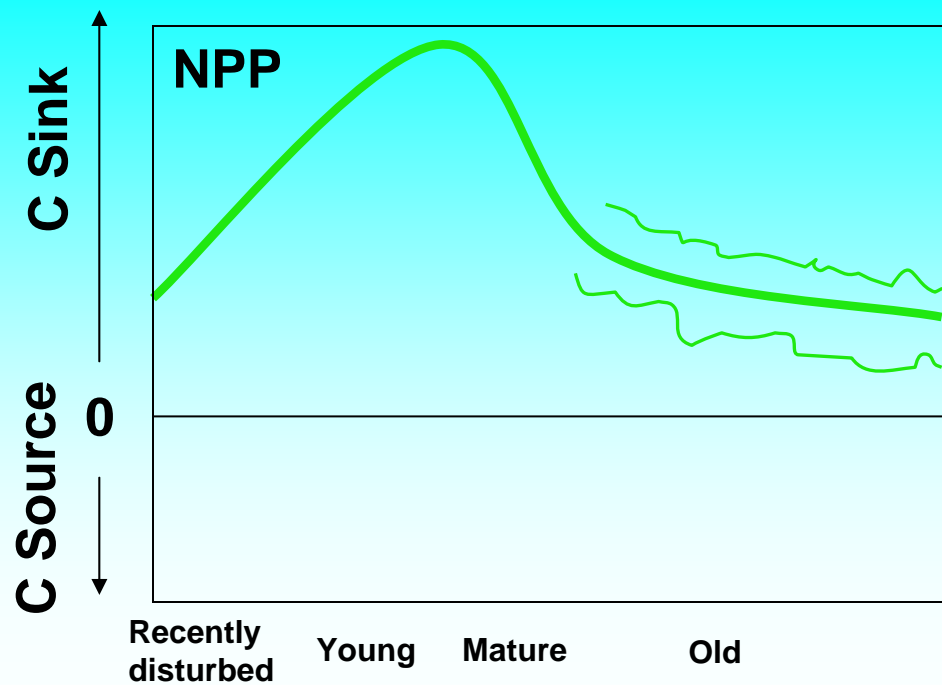


Disturbances Affecting U.S. Forests, 1990's

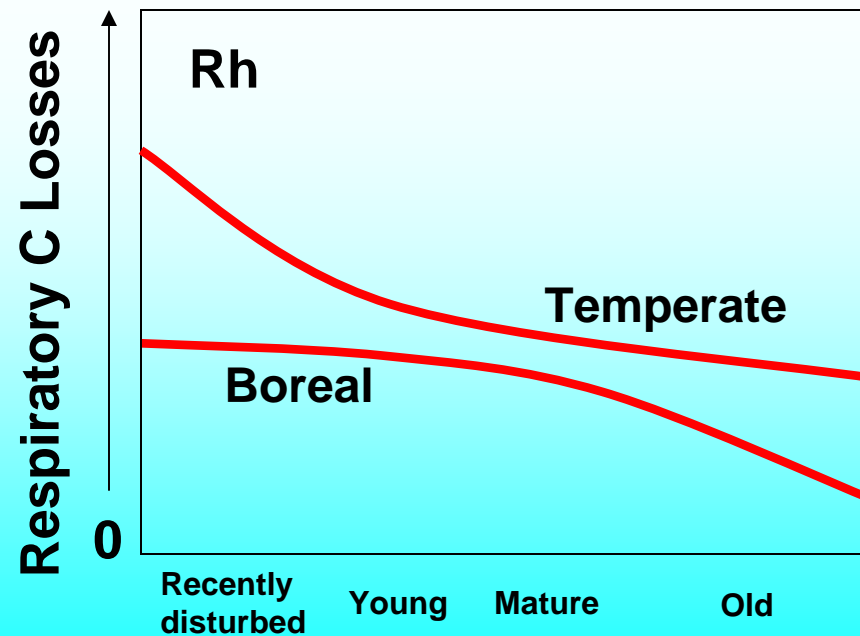


How Carbon Stocks Change After Disturbance is Critical





The Role of Ecosystem Respiration



General steady state, but with some interannual variability due to climate

Pregitzer and Euskirchen 2004

Biome synthesis

Generalizations Regarding Carbon Cycling and Storage in Forests

- Net C accumulation depends on time since disturbance
- NPP and NEP are strongly correlated except in younger forests
- Microbial respiration (R_h) declines with age
- Reducing the pulse of microbial respiration after disturbance will increase NEP
- Factors that regulate decomposition of CWD are the same as those that regulate R_h

Some Promising Forestry Technology for Increasing Carbon Sequestration

- Nutrient management
- Residue management and utilization
- Thinning and utilization of thinnings
- Low-impact harvesting
- Optimum rotation length
- Species/genotype selection
- Forest biotechnology

Critical Research Needs for Forest Carbon Management (1)

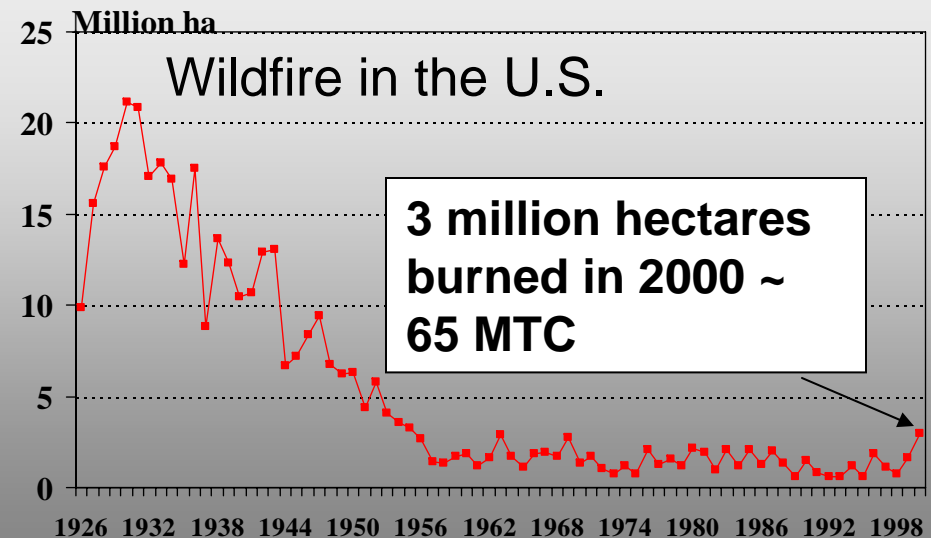
- Socioeconomic issues
 - Quantifying the forestry opportunity
 - Relative benefits of sequestration vs. emissions reduction
 - Integrating carbon management with other objectives
 - Land-use policies and drivers of land-use change
- Forest carbon accounting and measurement issues
 - Life cycle analysis including fossil fuel emissions associated with management and use
 - Additionality, leakage, and avoided emissions
 - Reducing cost of measurement and monitoring

Critical Research Needs for Forest Carbon Management (2)

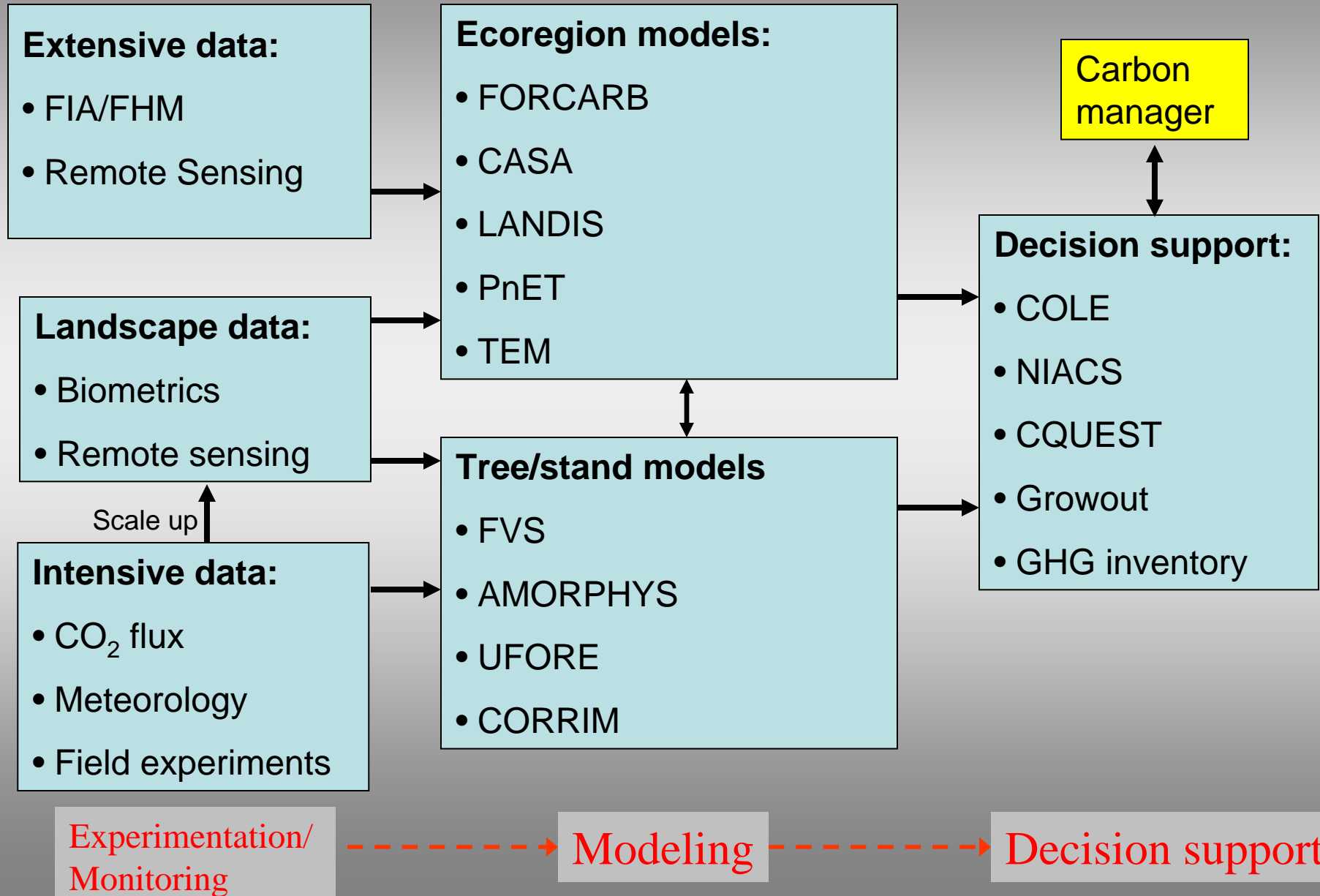
- Carbon management technology
 - Reduce respiration emissions from forests
 - Utilization of logging residues
 - Low-impact harvesting
 - Reduce fossil fuel emissions from operations and manufacturing
 - Efficiency in harvesting technology and biomass transportation
 - Efficiency in manufacturing operations
 - Mechanistic studies of C fluxes along chronosequences
 - Well-designed field experiments to develop practices for maximizing NEP following harvest
 - Improve efficiencies of carbon management technologies
- Technology transfer
 - Decision support tools
 - Demonstration projects

Carbon Management Questions and Concerns

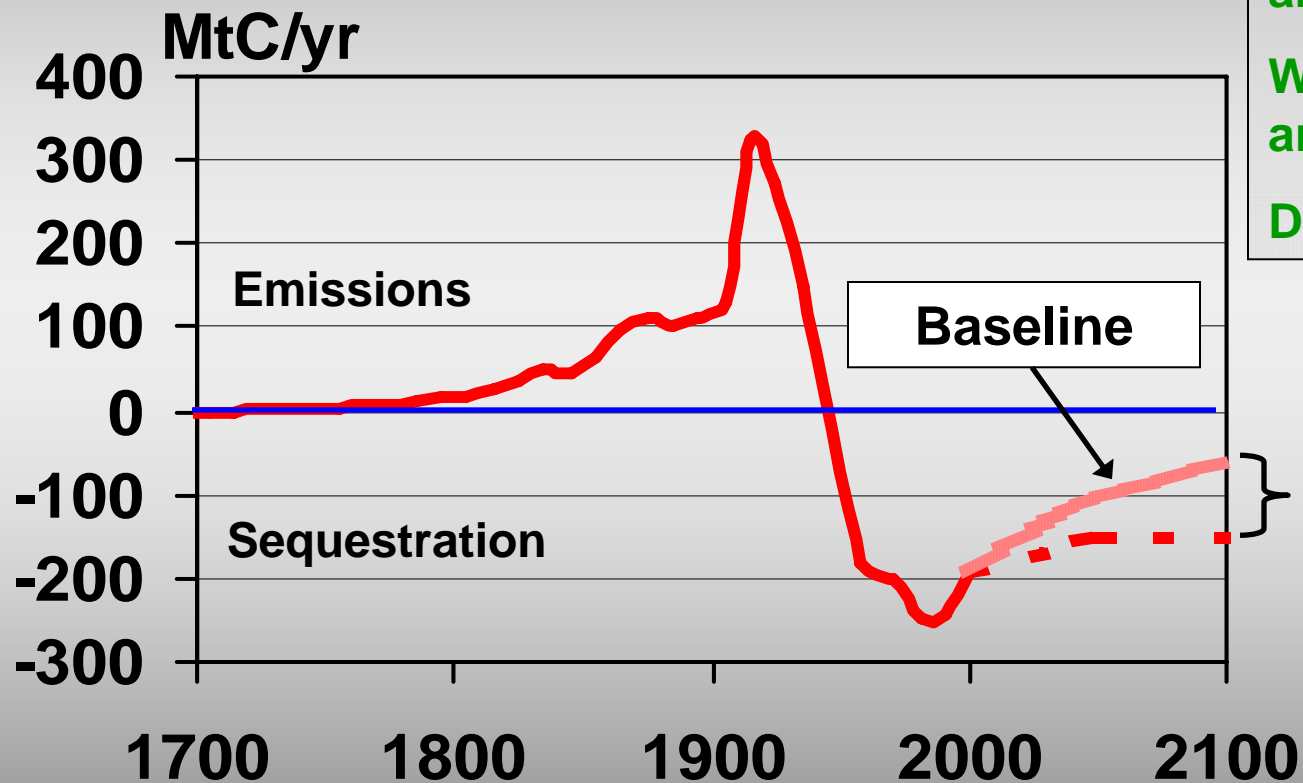
- Are forest carbon sinks permanent?
- How much CO₂ is emitted from wildfire?
- How to account for natural disturbance?
- Changes in forest soil carbon?
- Accounting for wood products
- Who will participate?
- Will the market accept forest carbon credits?
- Estimate “additionality”?



Simplified Decision Support “Roadmap” for Carbon Management



Outlook for Forest Carbon Management



Themes:

Inventory of baseline and wedge

What technologies and practices?

Decision support

Forestry stabilization wedge

Goal:
additional
100-200
MtC/yr

Final Thoughts

- **Sustainability** – are recommendations for forest carbon management complementary with resource sustainability?
- **Ecosystem Services** – how does forest carbon management enhance or detract from other ecosystem services such as water and biodiversity?