UF Carbon Resources Science Center: Introduction and Opportunities

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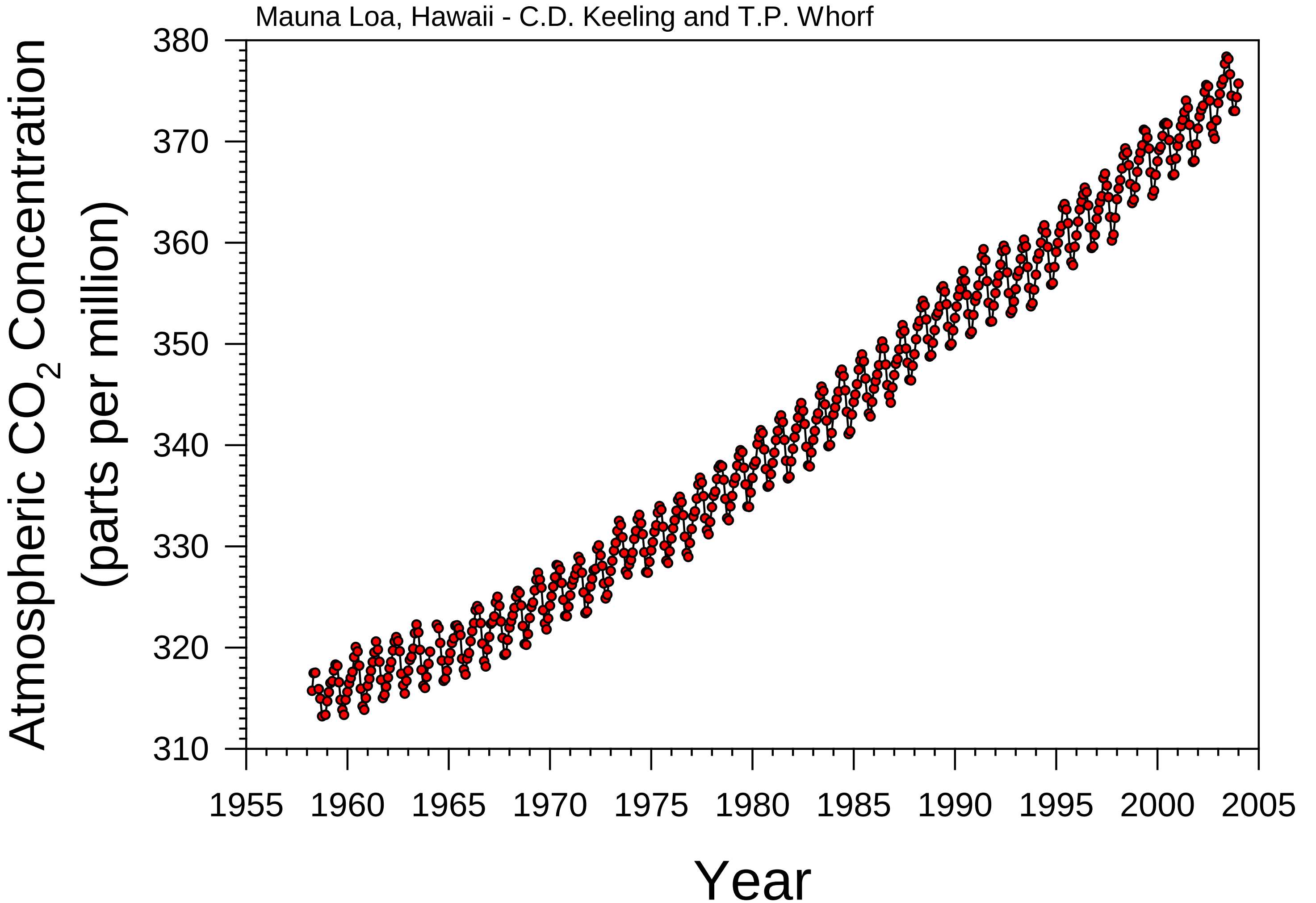
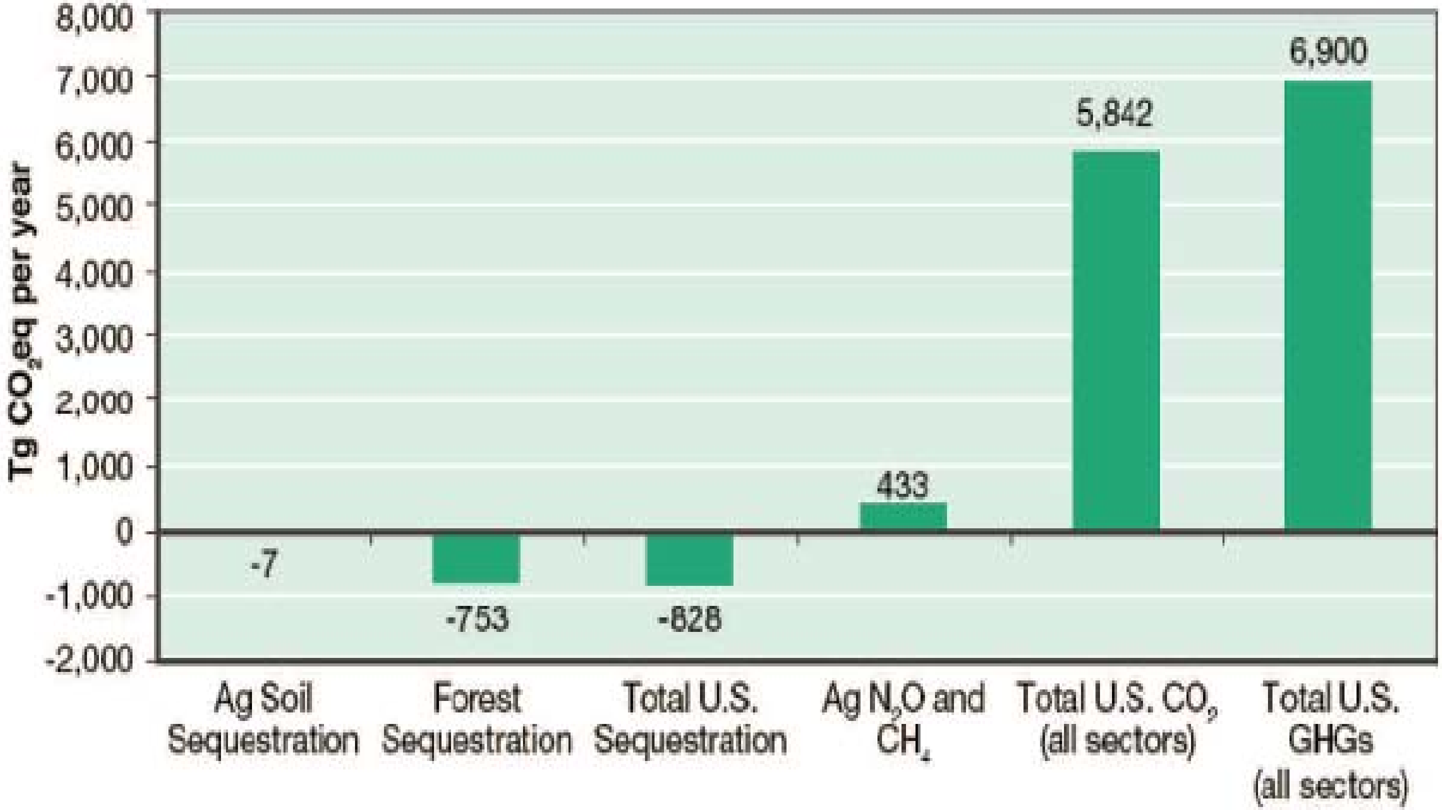
Timothy A. Martin, Director
Carbon Resources Science Center

Context



Mauna Loa, Hawaii - C.D. Keeling and T.P. Whorf
Atmospheric CO_2 Concentration (parts per million)
380
370
360
350
340
330
320
310
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year

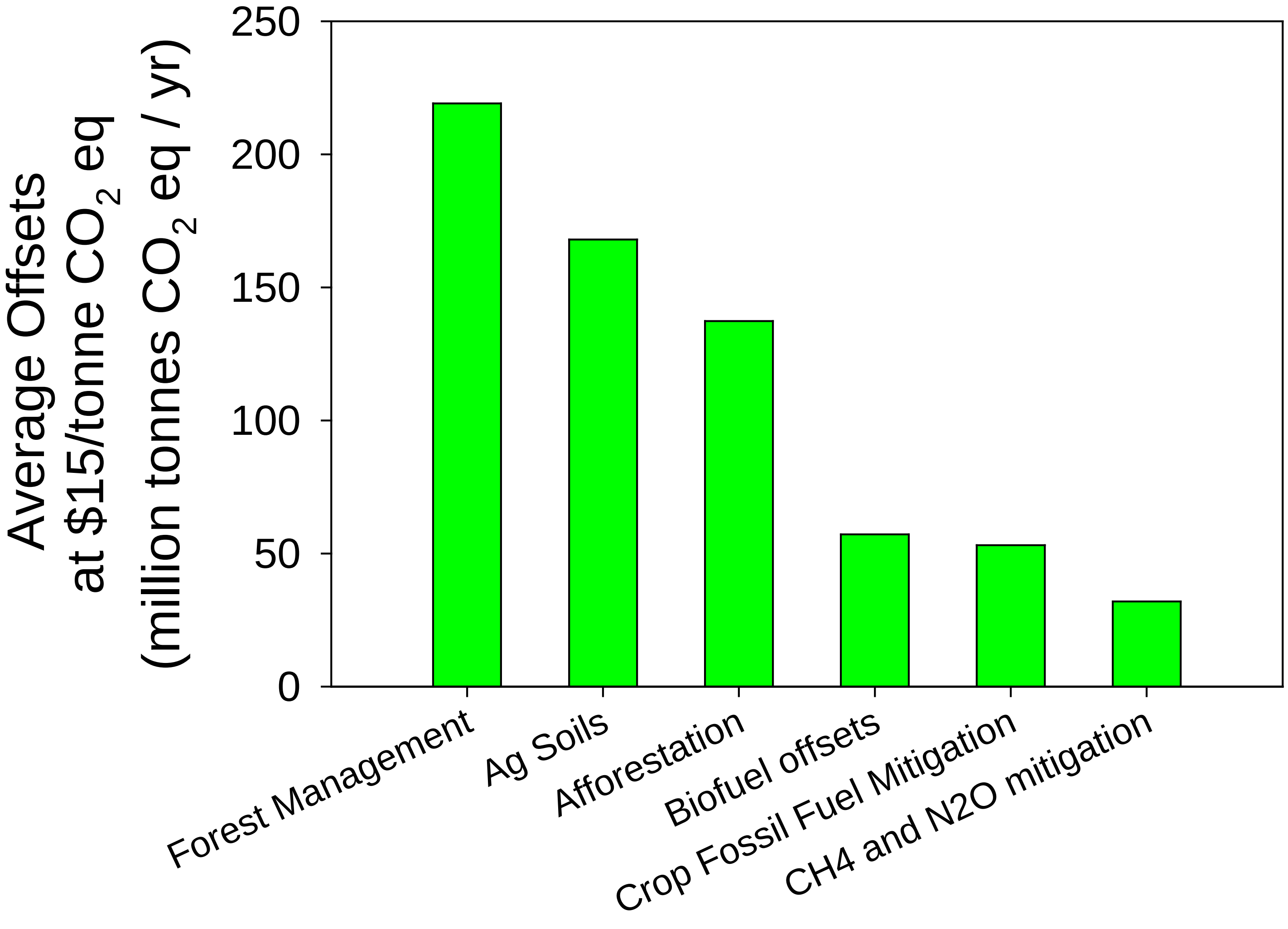
U.S. GHG Emissions and Agricultural / Forestry GHG Balance



Forests offset 11-16% of U.S. GHG emissions
Agriculture is a net GHG source

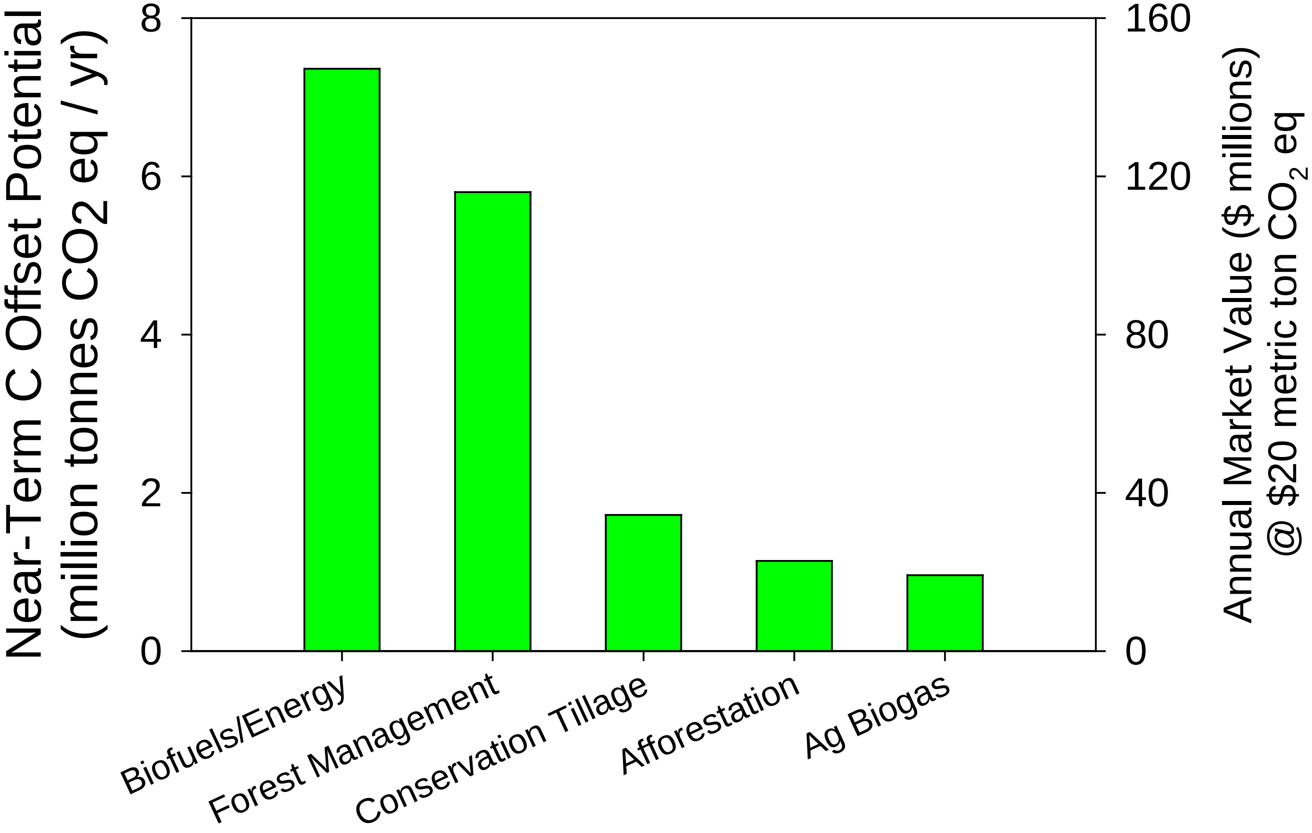
U.S. EPA 2005

Opportunities for Forestry and Agricultural Mitigation of Atmospheric CO_2 – U.S.



U.S. EPA 2005

Opportunities for Forestry and Agricultural Mitigation of Atmospheric CO_2 - Florida



Mulkey et al. 2008

UF Carbon Science Expertise

- Natural resource and agricultural management
- Plant sciences
- Ecology
- Biogeochemistry
- Remote sensing
- Engineering
- Economics
- Policy
- Social sciences

CRSC Mission

- Bring UF carbon science experts together to work synergistically on common problems
- Leverage new sources of research funding
- Serve as an objective, well-regarded source of rigorous information on carbon resources science for stakeholders

Focus Areas

- Develop optimum forest management regimes for sequestering carbon;
- Discover technologies for decreasing carbon emissions from agricultural production systems;
- Advance agricultural and forest management systems to produce carbon-neutral biofuels to substitute for fossil fuels;
- Create efficient methodologies for cost effective implementation of cap-and-trade systems;
- Conduct life-cycle analyses with full-cost accounting of alternative policies, incentives and management regimes; and
- Address critical shortage of US scientists through graduate education.

Approach

- Directed, high impact internal research projects
- Formal and informal meetings among Center-affiliated faculty
- Support for Center-affiliated faculty activities and grantsmanship
- Periodic newsletters
- Website
- Extension activities coordinated with an already-established Extension focus group

http://carboncenter.ifas.ufl.edu

Search GO

CRSC Seminar Schedule

All seminars will be held on Fridays 3 - 4 pm in room 112 Newins-Ziegler Hall. Refreshments begin at 2:45 pm. *The location for the keynote address on February 6 will be announced soon.*

Date	**Speaker**	**Affiliation**	**Title**
January 9th	Dr. Tim Martin	UF - SFRC	UF Carbon Resources Science Center: Introduction and Opportunities
January 23rd	Dr. Sabine Grunwald	UF - Soil and Water Science	Geospatial Tracking of Soil Carbon
February 6th - *location TBD*	Dr. Roger Sedjo	Resources for the Future, Washington, D.C.	Keynote: The Role of Forests in Climate Change and in Possible Mitigation
February 20th	Dr. Jim Jones	UF - Agricultural and Biological Engineering	From Climate Projects to an Interdisciplinary Florida Climate Institute
March 6th	Dr. Nick Comerford	UF/NFREC - Soil and Water Science	How is C Sequestered in Florida Soils and Is There a Role for Charcoal?
March 27th	Dr. Francisco Escobedo	UF - SFRC	Urban Forests and Carbon: Mitigation Tool or Public Relations Strategy?
April 10th	Dr. Leda Kobziar	UF - SFRC	Fire and Climate Change: Facts, Predictions, and Stumpers

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Seminar

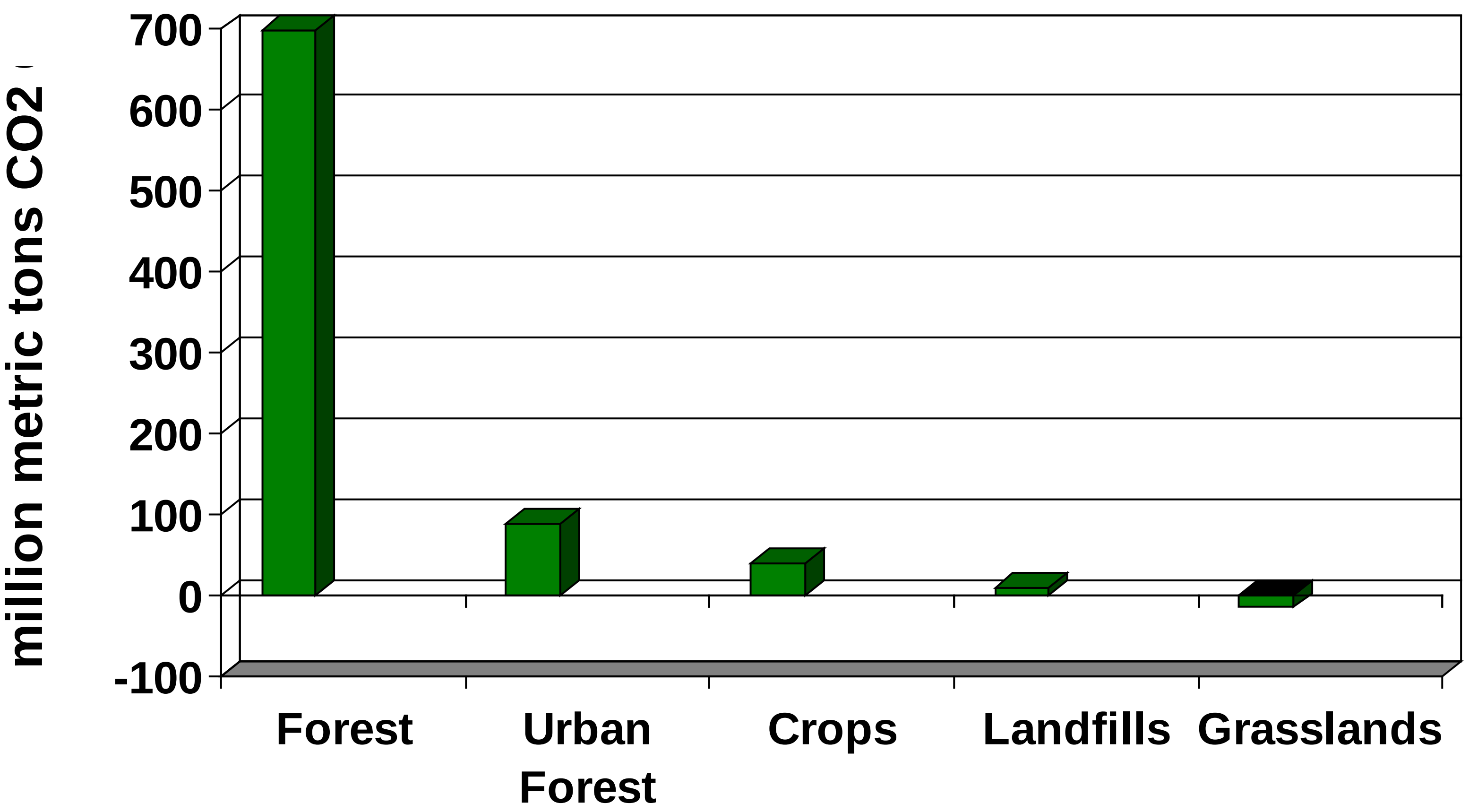
Faculty Roundtable

Facilitated Visioning Process

Simulation of Pine Plantation Carbon Dynamics Under Contrasting Silvicultural Scenarios

Timothy A. Martin
Wendell P. Cropper, Jr.
School of Forest Resources and Conservation
University of Florida

Forest Store LOTS of CO_2 just through growth (*in situ*)

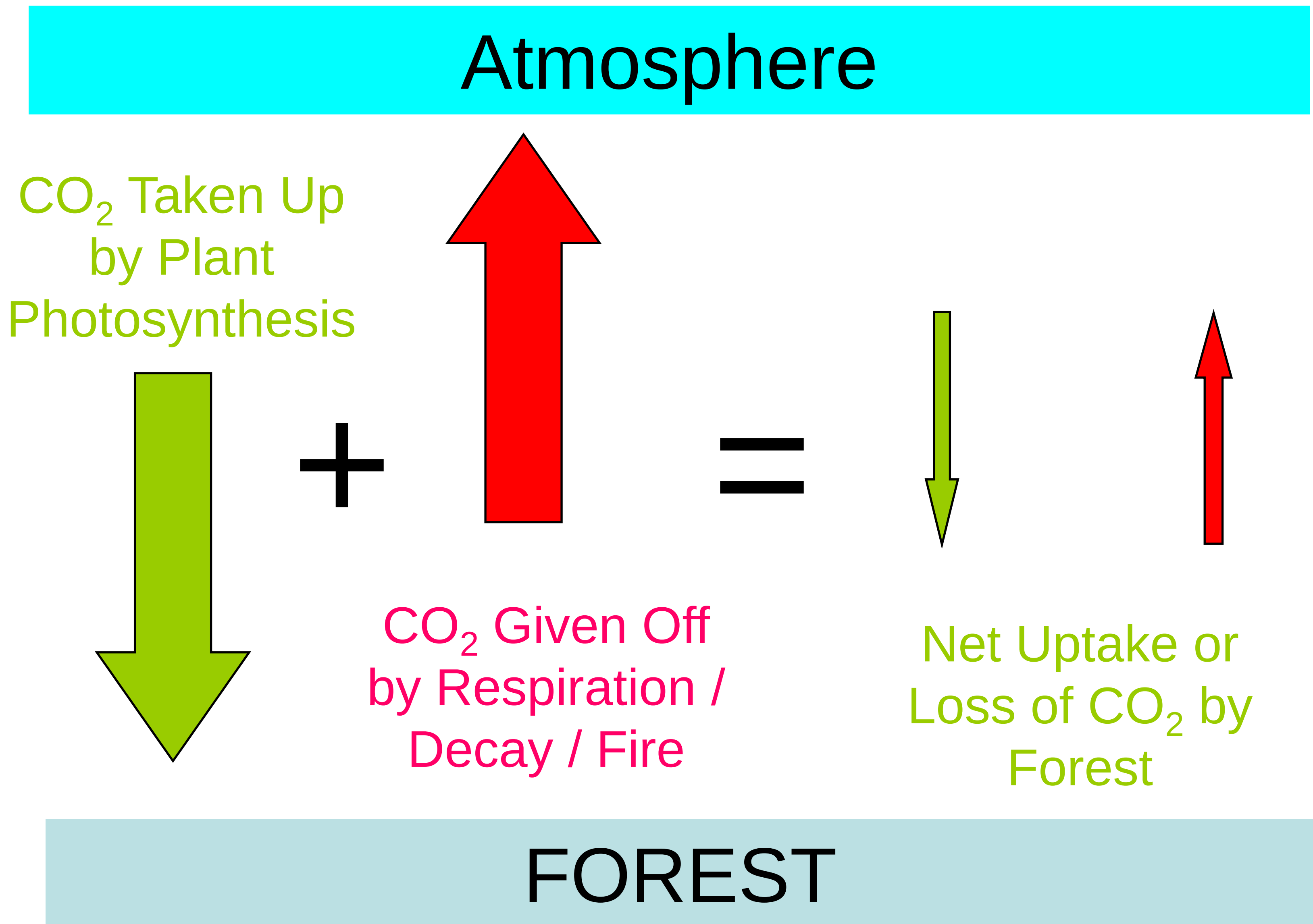


U.S. EPA 2007

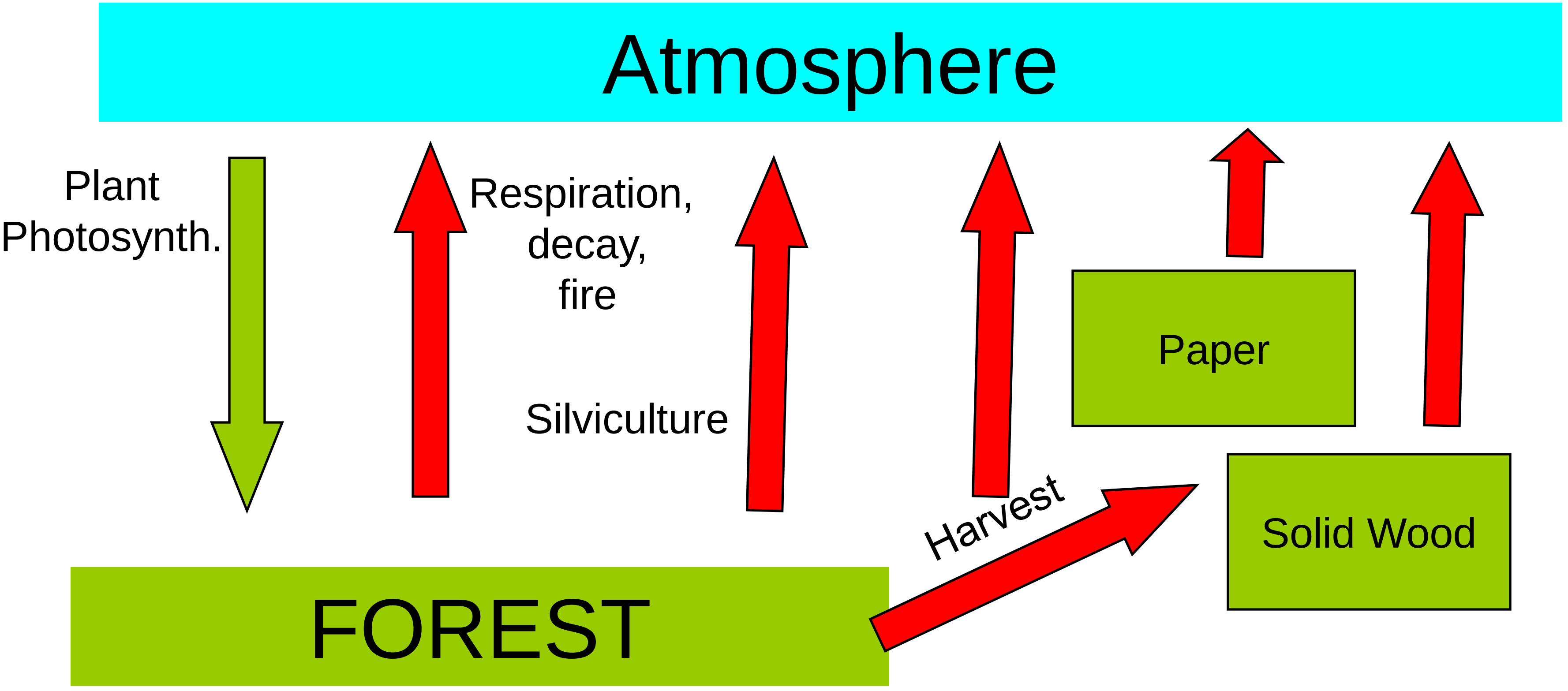
ex situ forest carbon sequestration

- Storage in wood products – paper, lumber, furniture
- Storage in landfills
- Substitution for other, carbon-emitting products like steel or concrete
- Substituting for fossil fuels

Biological Carbon Balance



In Situ + *Ex Situ*
Forest Carbon Balance



Forestry Carbon Emission Mitigation Strategies

- Increase forested land area through reforestation or afforestation
- Increase carbon density of existing forests at both stand and landscape scales
- Expand the use of forest products that sustainably replace fossil fuel CO_2 emissions
- Reduce emissions from deforestation and degradation

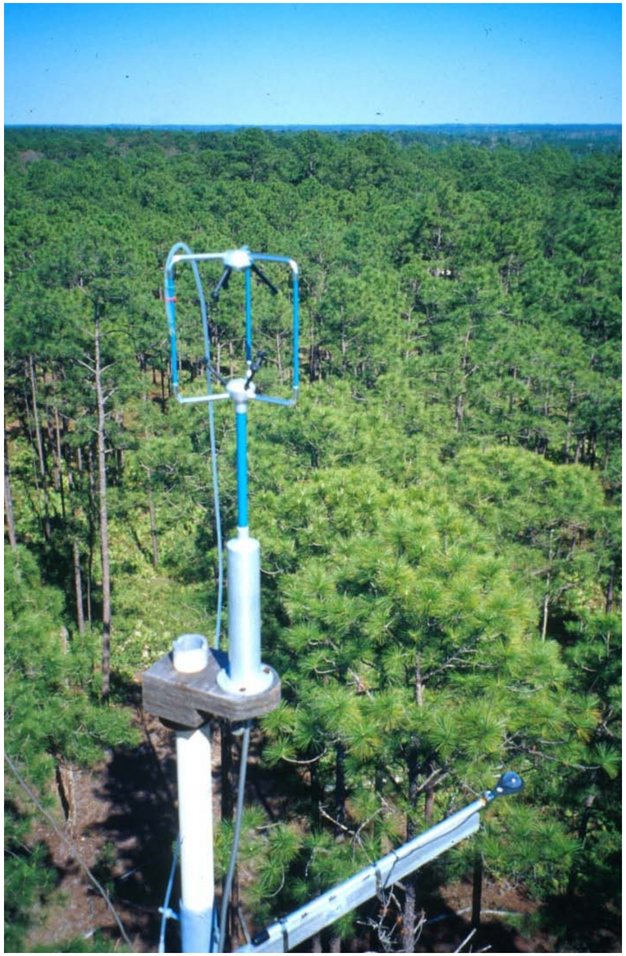
Canadell and Raupach. 2008. Science 32:1456-1457

Objective

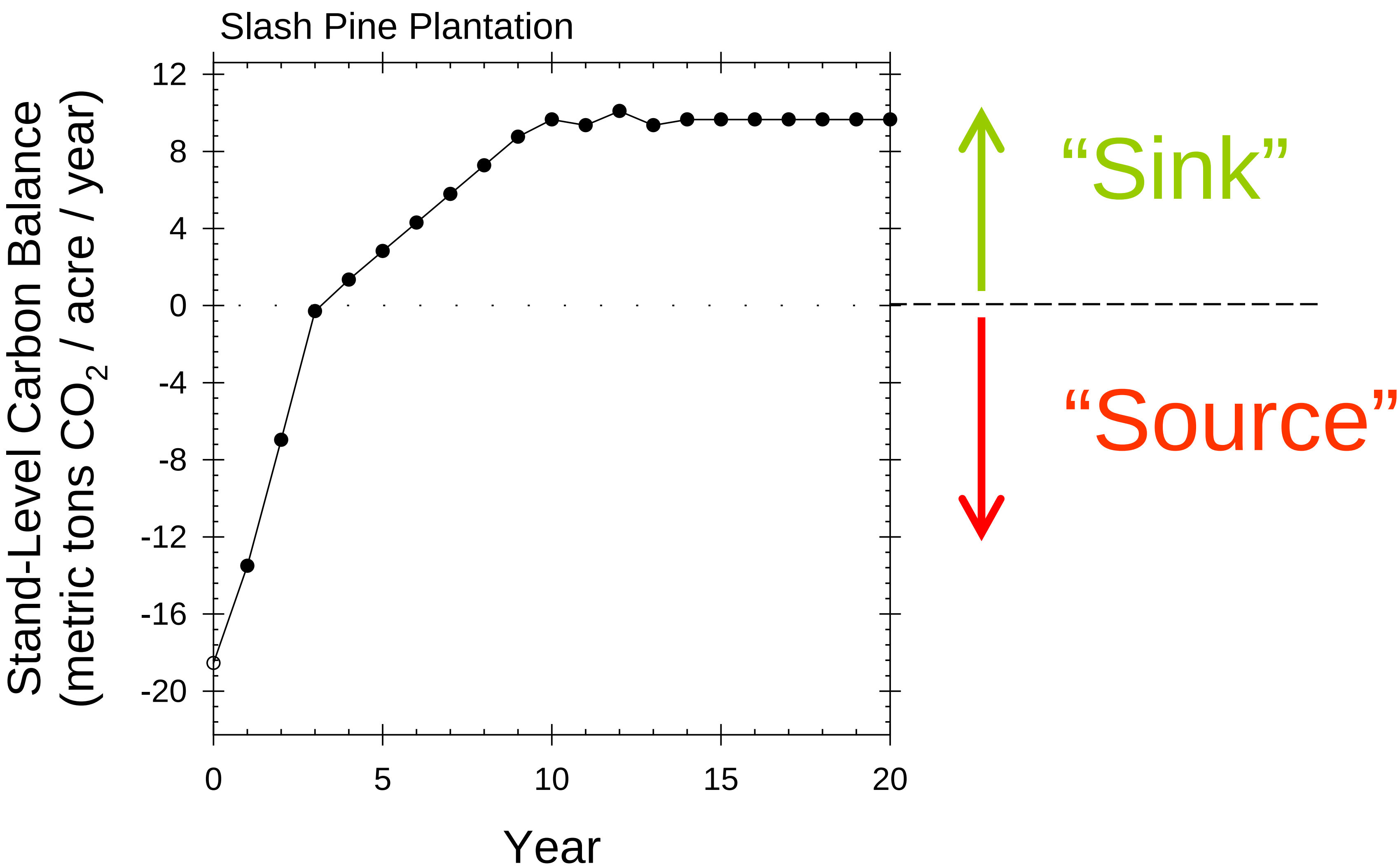
- To quantify how different silvicultural scenarios affect the C balance of plantation pine forests in northern FL, a region representative of much of the SE U.S. Coastal Plain

Methods

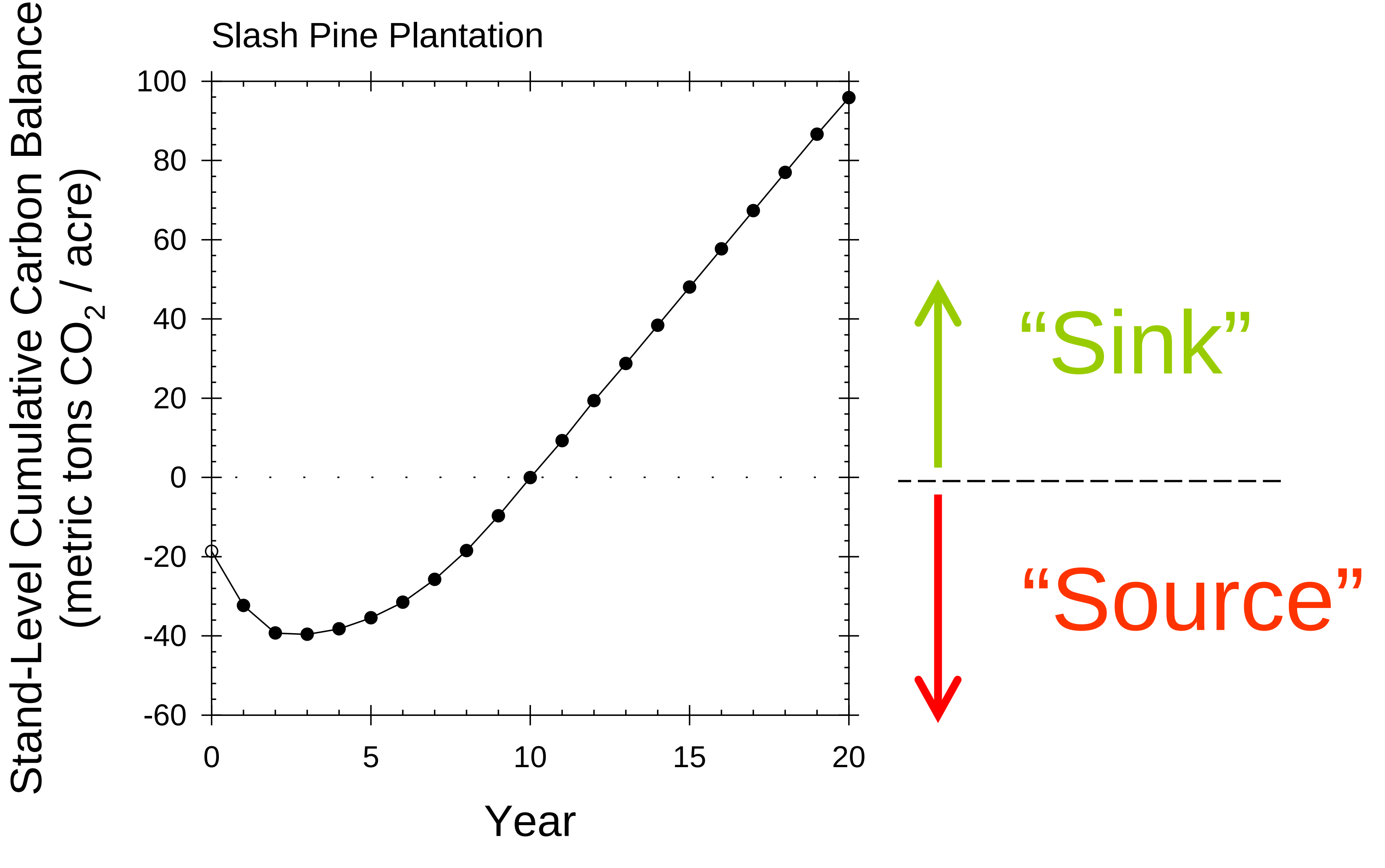
- Phenomenological model of pine plantation C balance based on eddy covariance data from ~ 15 site-years of data
- Estimates of C fluxes due to silvicultural activities, harvest, storage in wood products



Pattern of Southern Pine Plantation Carbon Sequestration - Yearly



Pattern of Southern Pine Plantation Carbon Sequestration - Cumulative



Silvicultural Regimes

- 20 Year Rotation
  - NP fertilizer at age 6 yrs.
  - 100% pulpwood
- 30 Year Rotation
  - NP fertilizer at age 6 and 20 yrs.
  - 50% pulpwood, 50% chip 'n saw / sawlog
- 45 Year Rotation
  - NP fertilizer at age 6, 20 and 30 yrs.
  - Stands thinned to 70 ft^2 / ac of basal area
  - Final harvest at 45 yrs.
  - 50% pulpwood, 50% sawtimber at thinning;
  - 80% chip 'n saw / sawlog, 20% pulpwood at final harvest

Carbon Costs of Silvicultural Operations

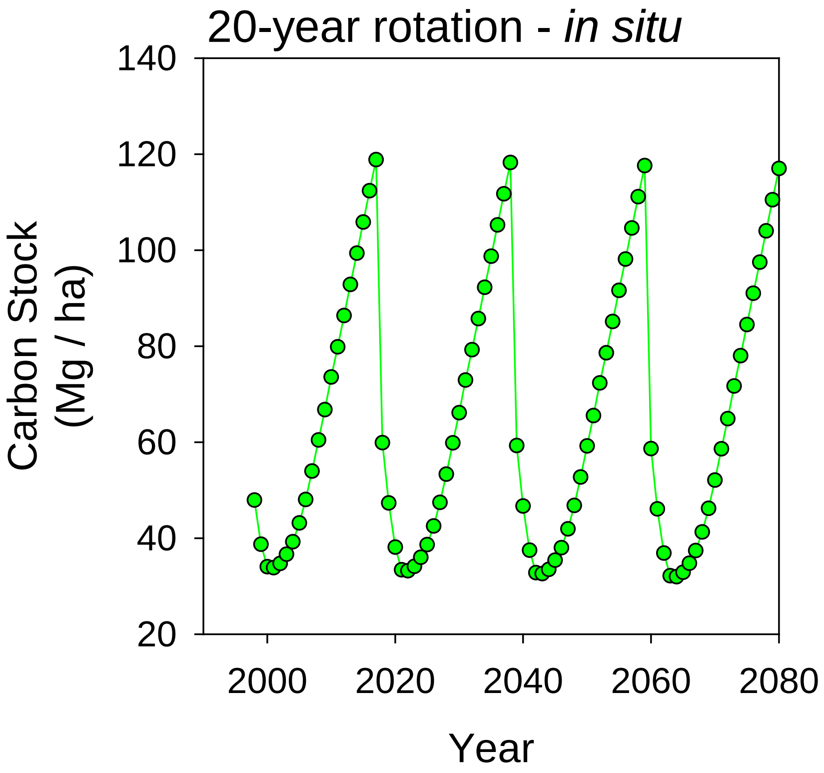
Plantation Age (years)	**Silvicultural Activity**	**Carbon cost (metric tons / ha)**
0	Site preparation; raking or spot piling, aerial application of herbicide, Savannah bedding	0.095
1	Machine planting	0.101
6 for pulpwood scenarios 6, 20, 30 for 45 yr rotation scenarios	Helicopter fertilization, 125 lb/acre DAP, 385 lb/acre urea	0.268
Rotation age for pulpwood scenarios Thinning age and rotation age for 45 yr rotation scenarios	Harvest	0.456

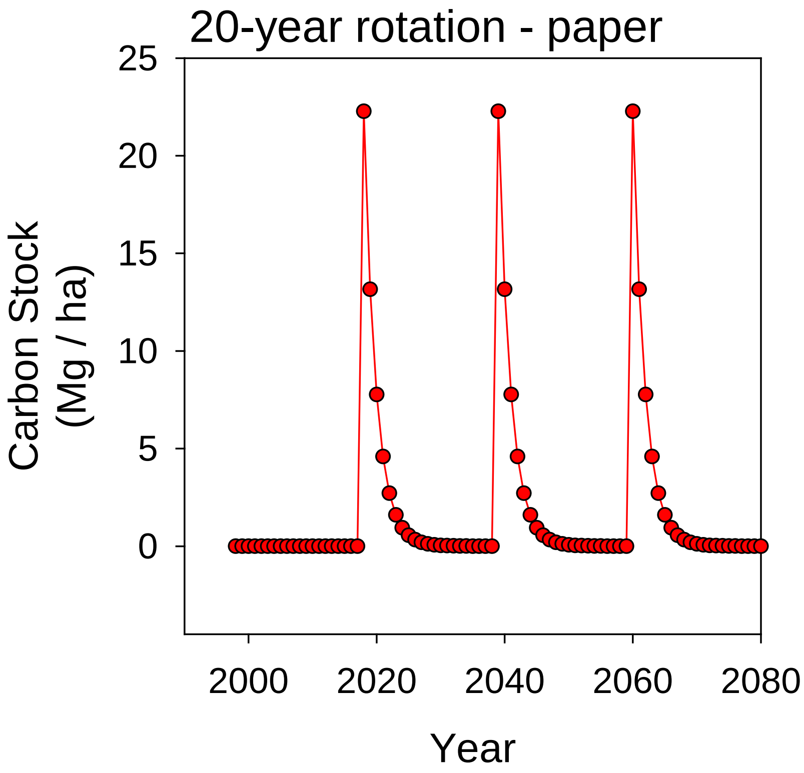
Modified from Markewitz 2006

Product Conversion Efficiency and Decay Rates

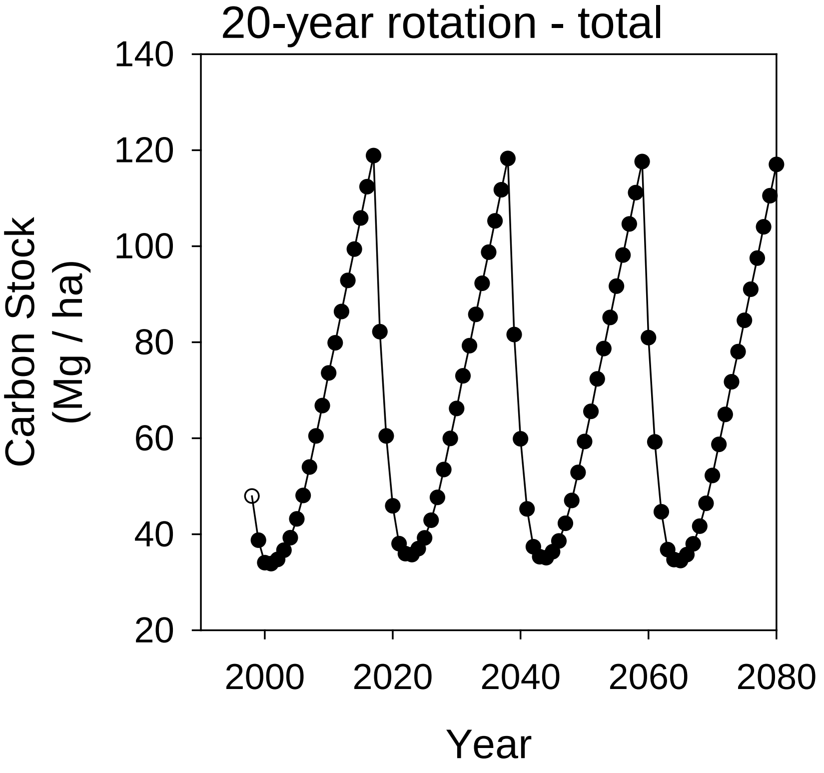
Product	Conversion efficiency (mass of product per mass of log input)	Half-life (yrs; Markewitz 2006)	Annual Decay Rate (1/yrs)
Pulpwood	58% (White et al. 2007)	1	0.6931
Chip 'n Saw and Sawlog	64.5% (Spelter and Alderman 2005)	50	0.0139

20-year rotation

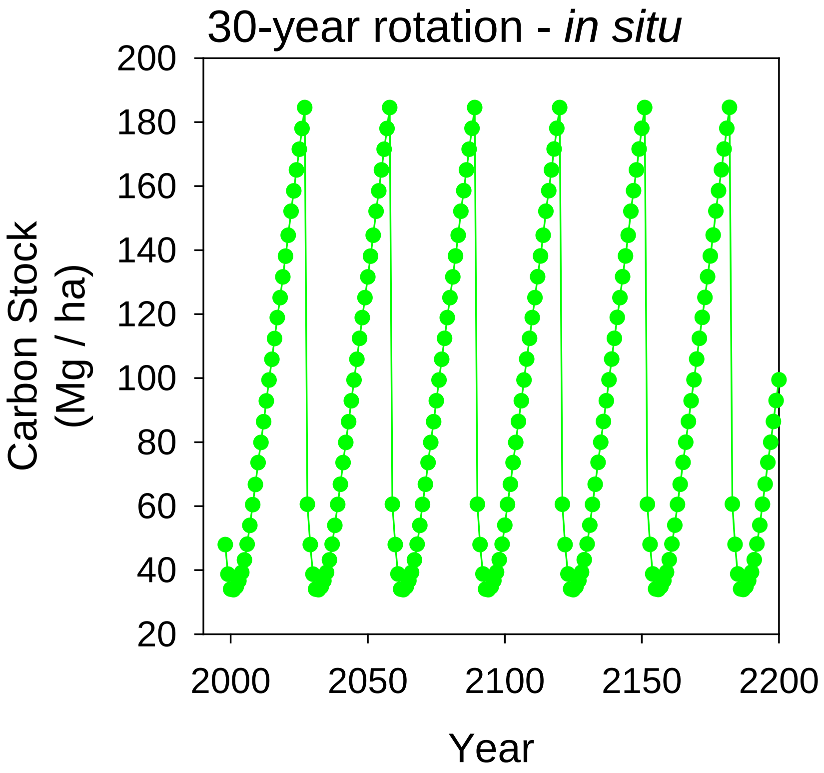


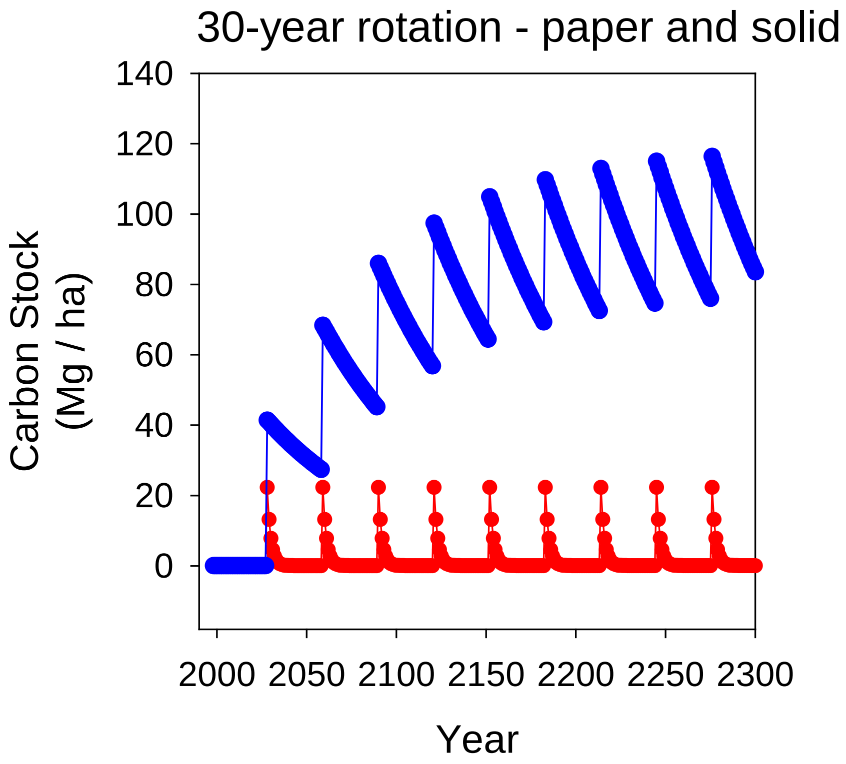


20-year rotation

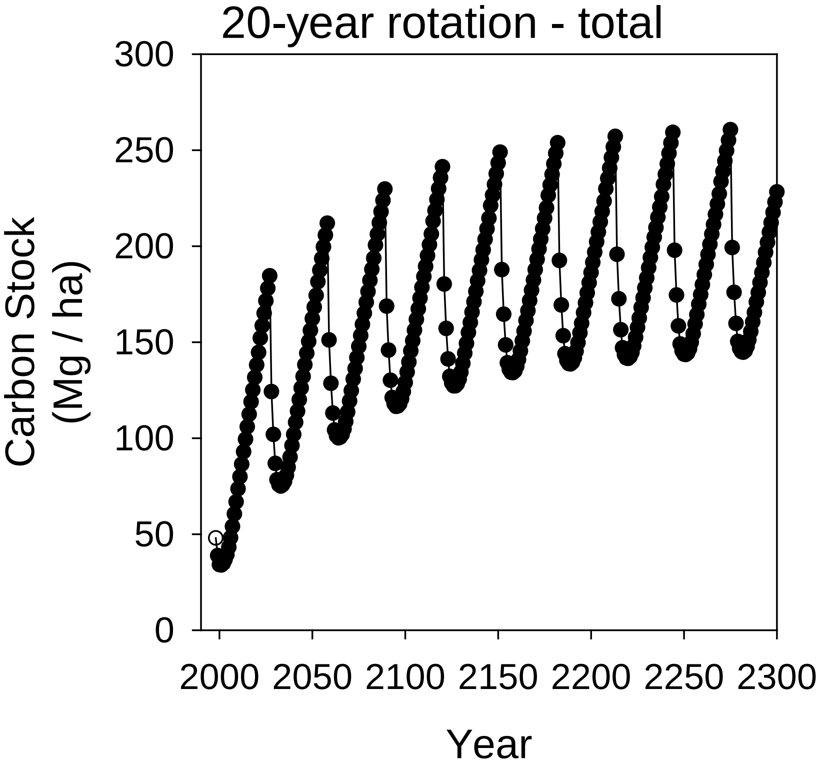


30-year rotation

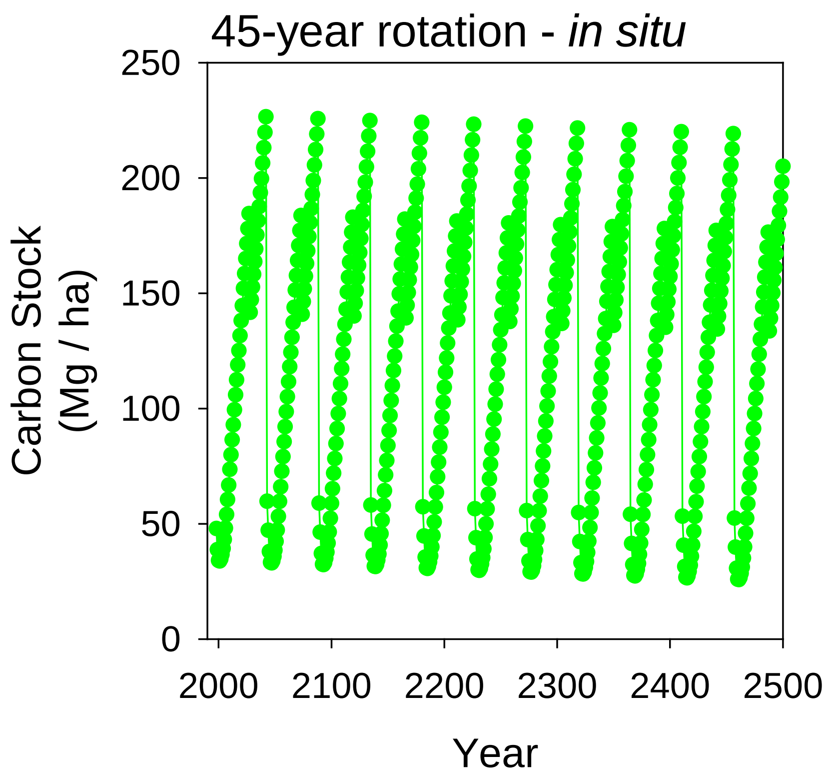


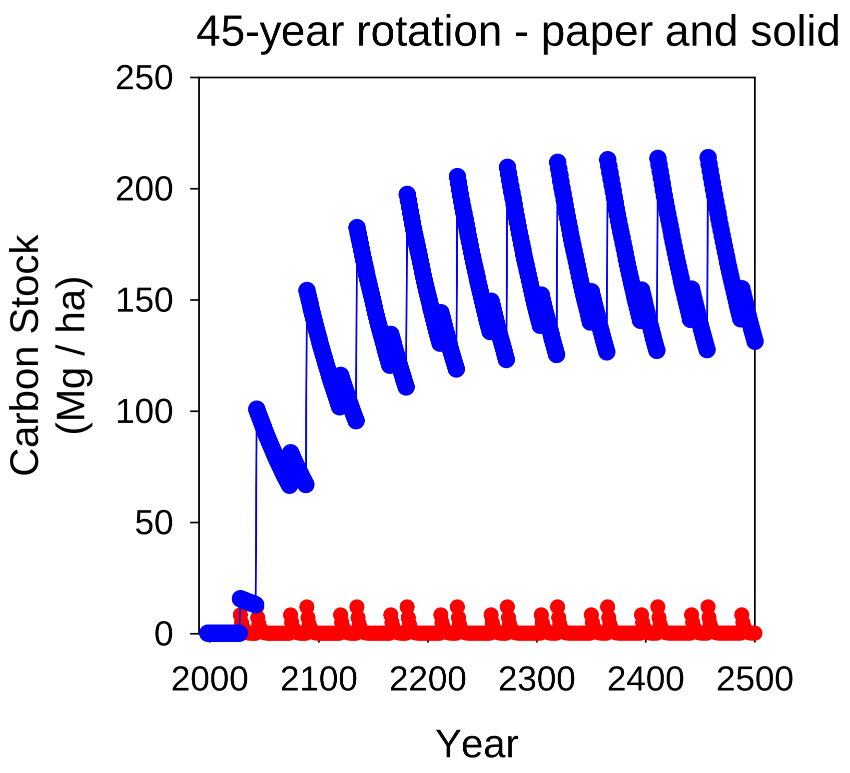


30-year rotation



45-year rotation with thinning





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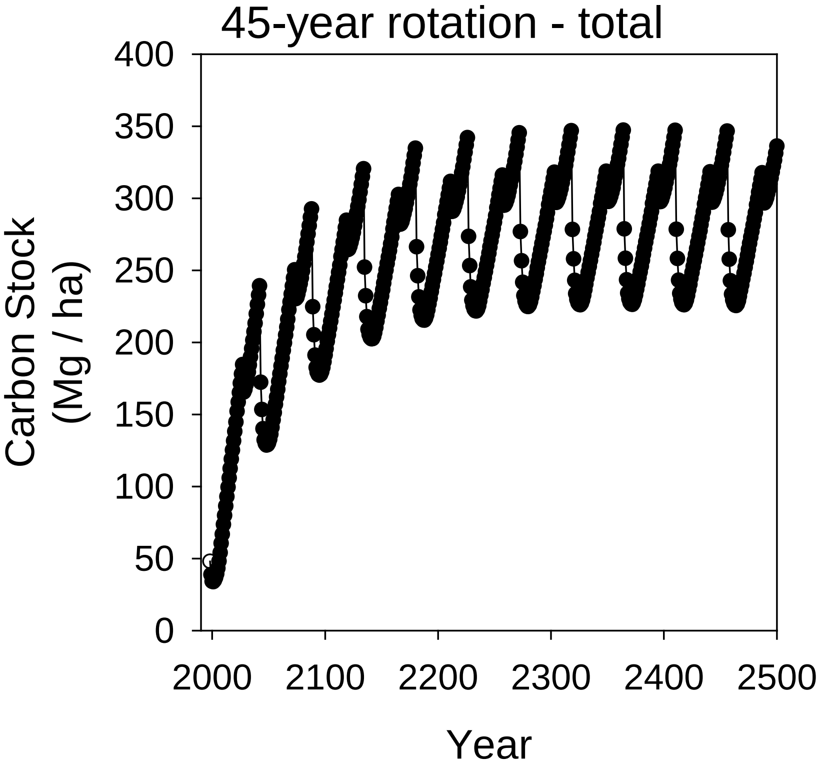

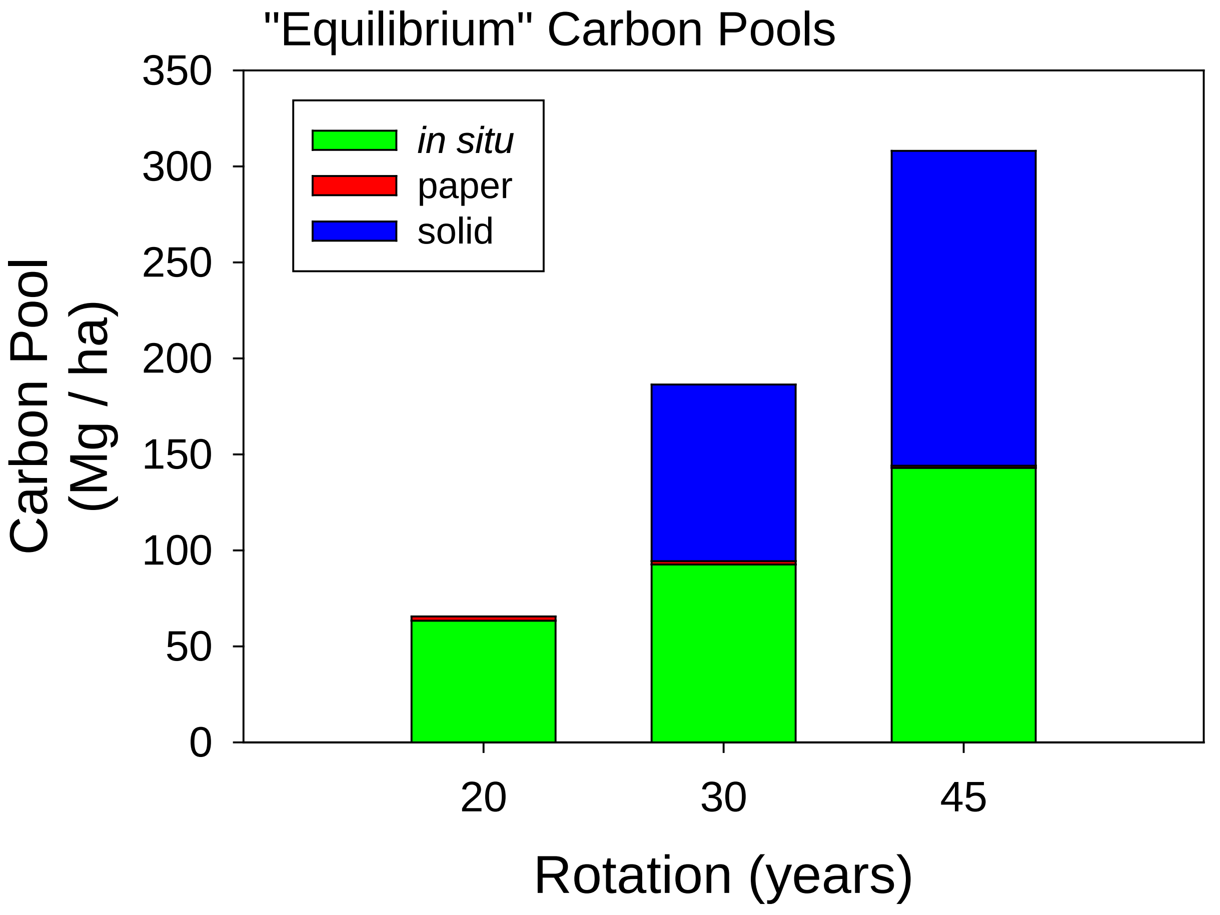
"Equilibrium" Carbon Pools
350
300
250
200
150
100
50
0
in situ
paper
solid
Carbon Pool
(Mg / ha)
20
30
45
Rotation (years)

Summary

- Lengthened rotations increased carbon density of slash pine plantation forest
  - Increased *in situ* sequestration
  - Increased *ex situ* sequestration in solid wood
- C cost of silvicultural activities was negligible
  - 2.2 Mg/ha over entire 45-year regime, compared to average *in situ* carbon density of 125 Mg/ha
- Sequestration in paper was negligible

Future Plans

- Incorporating uncertainty into estimates
- Economics
- Role of non-plantation stands and prescribed fire at stand and landscape levels
- Role of landfills
  - Possibly greatly increased half-life for paper products
  - Methane emissions = 30 times more warming potential than CO_2

Acknowledgements

- Florida Forestry Association
- NIGEC
- NICCR
- Forest Biology Research Cooperative
- IFAS Dean for Research
- SFRC