

Greenhouse Gas Accounting Rules and Guidelines for the Forest Sector

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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

Accounting Rules and Guidelines for Forestry - List of Documents

- Contributions to DOE “General Reporting Guidelines”
- Greenhouse Gas Inventory Methods for Forestry
- Technical Appendices:
 - Measurement Protocols
 - Guidelines for Using Models
 - Default Tables
 - Estimation Methods for Wood Products
- Case Studies

Improvements to Existing Guidelines

- Guidance for entity-wide estimation and reporting
- Improved “default” coefficients and lookup tables
- Updated default estimates for RPA regions and forest types
- New guidelines for estimating and reporting wood products
- New measurement and monitoring protocols for those wishing to conduct their own sampling
- New guidelines for evaluating uncertainty and rating estimation methods
- Realistic examples and case studies for representative forestry activities

Estimation and Reporting Process Summary

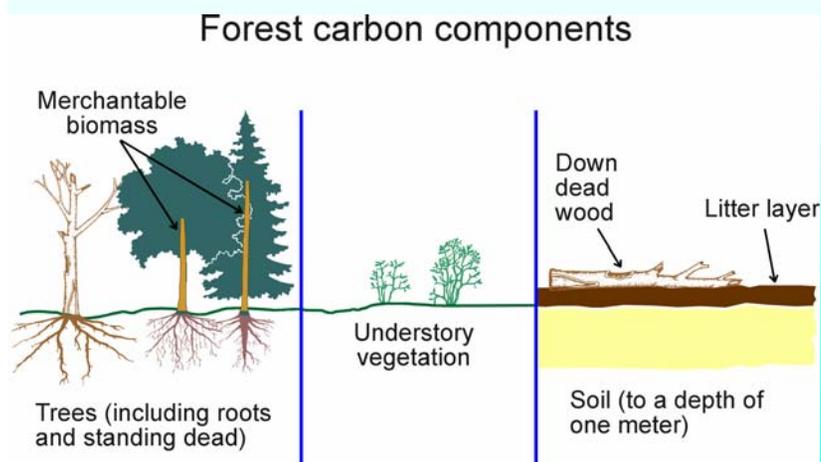
- Define entity boundaries
 - Legal and financial control are key guidelines
 - Determine if large or small entity
 - Identify greenhouse gas sources and sinks
 - Define sub-entities if needing more than one calculation method
- Choose a start year
- Choose one of 5 approved calculation methods
 - “Changes in carbon storage” most likely for forest land
- Select estimation method
 - Measure
 - Model
 - Lookup table
- Estimate and report start-year inventory of carbon stocks
 - Include both forest ecosystem and wood products
- Make annual estimates and enter into reporting system
- DOE reviews reports and determines whether to include in registry

Categories of Forestry Activities

- Afforestation
- Mine land reclamation
- Forest restoration
- Agroforestry
- Improved forest management
- Short-rotation biomass energy plantations
- Forest preservation
- Wood products management
- Urban forestry

Carbon pools in forest ecosystems

Not shown – carbon in harvested wood products



(graphic from Linda Heath and Jim Smith)

<i>Detailed measurement and estimation</i>	<i>Summarized estimates for default tables</i>	<i>Summarized estimates for reporting</i>
Live trees: above-ground	Live trees	Ecosystem carbon
Live trees: below-ground		
Tree seedlings	Understory vegetation	
Shrubs, herbs, forbs, grasses		
Standing dead trees: above-ground	Standing dead trees	
Standing dead trees: below-ground		
Down dead wood	Down dead wood	
Stumps and dead roots		
Fine woody debris	Forest floor	
Litter		
Humus		
Soil carbon	Soil carbon	

Estimation Methods for Forestry

- Low cost/high accuracy required
- Methods assigned ratings
- Technical guidelines provided for three basic methods:
 - Sampling and Measurement (rating = “A”)
 - Models (rating = “B”)
 - Look-up tables (rating = “C”)
- Must meet QA/QC standards to be registered (“B” avg.)
- Partitioning (stratifying) the land base
 - Powerful tool for efficiently making estimates by using more than one estimation method
 - Does not require defining a subentity

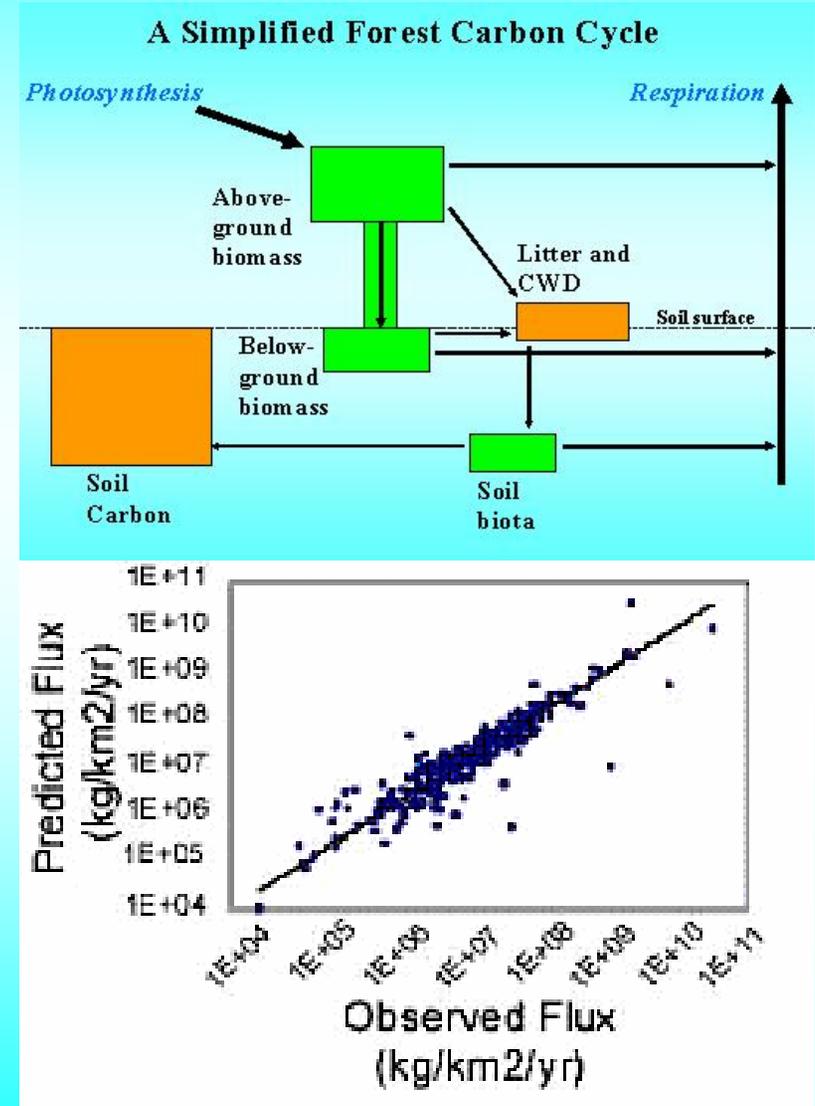
Alternative Inventory Methods (1) – Measurement and Monitoring

- Most accurate
- Most expensive
- Applicable for entities with large land-holdings and existing measurement and monitoring systems
- Technical appendix
 - Design efficient monitoring plans
 - Select and apply sampling procedures
 - Implement methods for data analysis
 - Estimate carbon storage and net changes in carbon stocks
 - Develop quality assurance and quality control plans



Alternative Inventory Methods (2) – Use of Models

- Accuracy more difficult to assess, but can be acceptable
- Often less costly than direct measurement
- Kinds of models – empirical and process
- Technical Appendix provides guidance on use of models:
 - Clearly define scope (domain) of model
 - Adequate documentation and peer review
 - Validate models with field data (periodically)



Alternative Inventory Methods (3) – Lookup Tables

- Simplest approach: pre-compiled estimates based on Forest Inventory and Analysis (FIA) data
- Quality of estimates will depend on the quality of input data and how well tables reflect conditions
- Some reports may not qualify for registration
- Technical appendix: 135 tables for reforestation and afforestation, by region and forest type

Sample Lookup Table

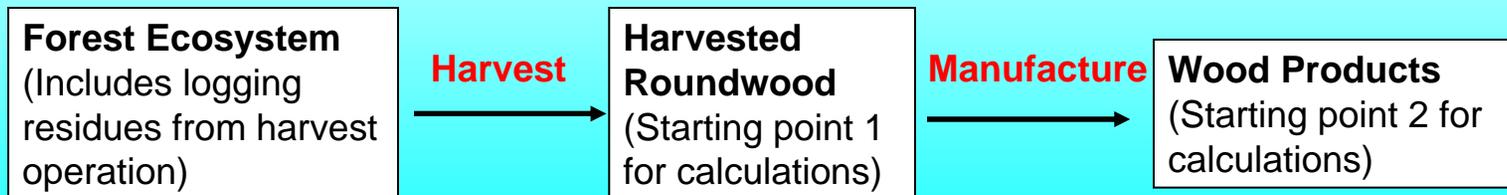
Aspen-birch, Northeast

Age	Mean Volume	Mean Carbon Density						
		Live tree	Dead tree	Under-story	Down dead wood	Forest floor	Soil organic	Total nonsoil
Years	m ³ /ha	Metric tons carbon per hectare						
0	0	0.0	0.0	1.0	10.5	10.2	237	22
5	0	16.0	0.5	2.2	7.4	7.5	237	33
15	13	22.5	1.5	2.1	4.4	6.0	237	37
25	34	32.9	2.2	2.1	3.7	6.5	237	47
35	58	45.0	2.9	2.1	4.0	7.5	237	61
45	85	57.7	3.5	2.1	4.7	8.5	237	76

(data continues through 120 years)

Methods for Wood Products

- Harvested wood product carbon pools:
 - Wood and paper in use (Forest sector)
 - Wood and paper in landfills (Forest sector)
 - Wood burned for energy (Energy sector)
 - Wood product emissions
- Two estimation approaches:
 - Track stocks over time
 - Estimate stocks at end of 100 years
- Technical appendix provides:
 - Look-up tables for roundwood harvested
 - Factors to convert various wood products to carbon



More on Wood Products

- Entity reporting changes in forest carbon stocks also reports changes in wood product C stocks
- Accounting for efficiency in manufacturing products is covered under “industrial processes” guidelines
- Accounting for biomass energy is covered under “stationary combustion” guidelines

Some Sector-specific Issues for Forestry

- Exclusions for:
 - Comparatively small emissions (e.g. trace gases)
 - Non-anthropogenic emissions (e.g., natural disturbances)
- Natural disturbance calculations
 - Estimate emissions and cause, and track separately
 - Cannot report additional C increases on affected land until C stocks return to pre-disturbance levels
 - May need to adjust start-year inventory
- Preservation of existing carbon stocks
 - Requires restrictions on future human-induced releases of carbon
 - Entities can report 1/100th of base-period C stocks plus C stock increases in each reporting year

More Sector-Specific Issues For Forestry

- Purchase or sale of land
 - Adjust C stock estimates for reporting year *and* base year
- Sustainably managed forest land
 - If land is certified to be sustainably managed, reporter may assume a default flux value of zero
- Incidental lands – lands that are a minor component of an entity's operations and are not actively managed for production of goods and services
 - Only specific categories of land may be labeled incidental, e.g., transmission line rights-of-way or areas around structures
 - Entities may use approved estimation methods or may assume a default flux value of zero

And More Sector-Specific Issues For Forestry

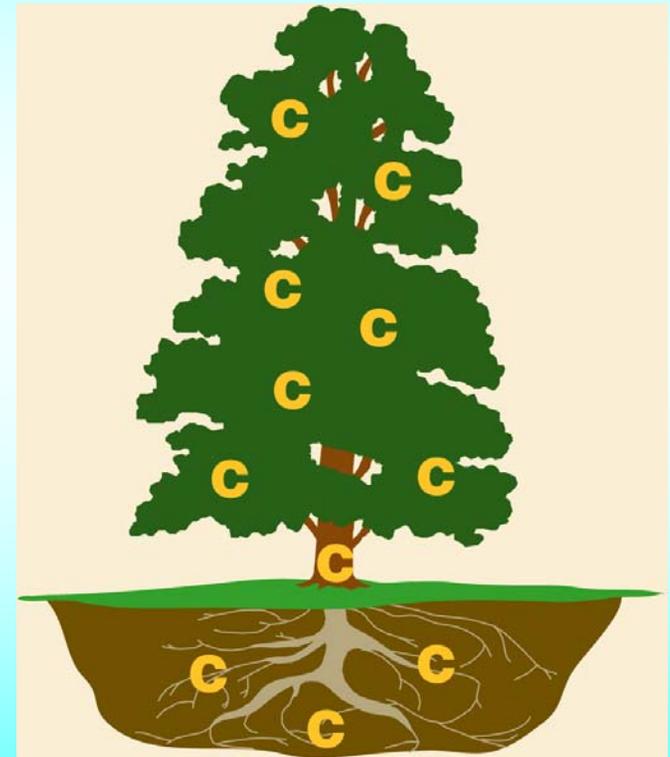
- Leakage or secondary effects –
 - entity-wide reporting required (large emitters)
 - “activity-level” report with certification that activities do not have impacts elsewhere on lands under control of the entity (small emitters)
 - No accounting for macro-economic effects
- Permanence – continued reporting required
- Additionality – not addressed since focus is on entity-level reporting

Who Cares About Revised Forestry Guidelines? Some examples...

- States, e.g. Maine, California, Texas, others
- AF&PA, some timber companies
- Electricity producers
- Conservation Organizations (e.g. TNC)
- Management and restoration of Lower Mississippi bottomland hardwoods (Cooperative)
- Southeast Pennsylvania tree planting initiative (Cooperative)
- City of Baltimore
- Chicago Climate Exchange

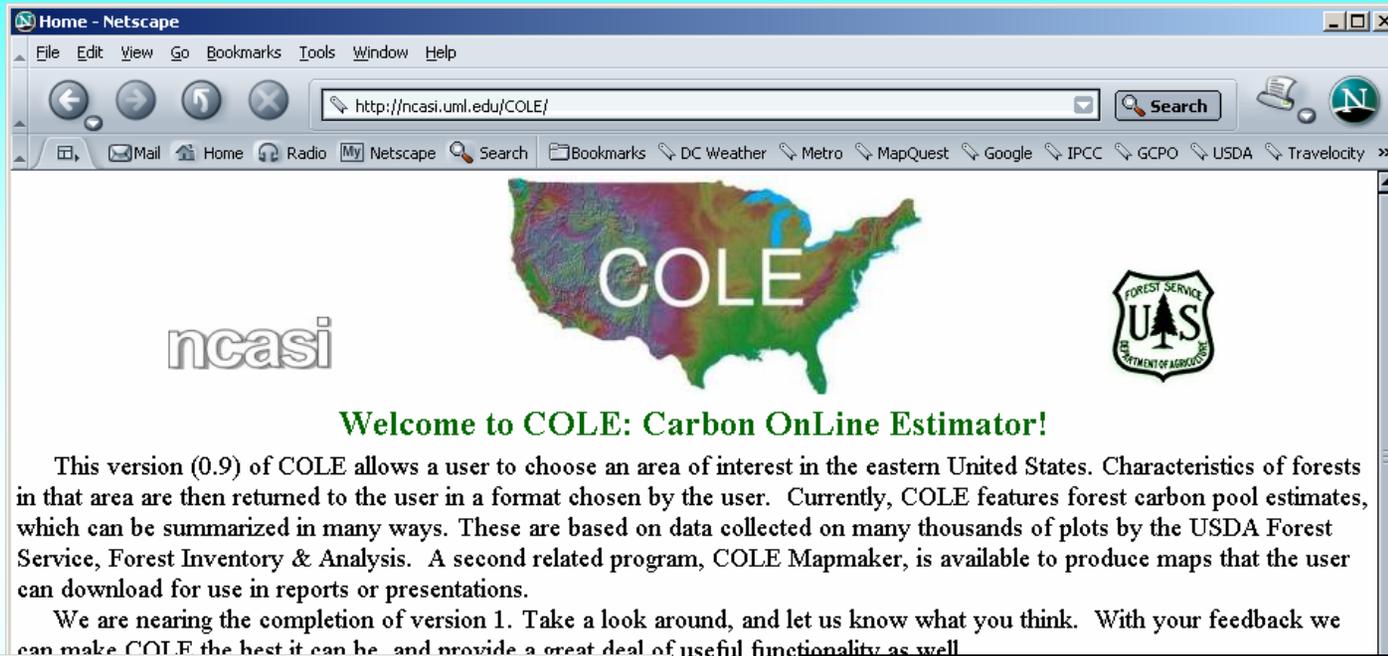
Forest Carbon Management: Program Delivery

- Carbon on-line estimator (COLE)
- Forest Vegetation Simulator (FVS)
- Urban forest effects model (Growout)
- Wood products carbon (Woodcarb)
- Natural disturbance effects (CASA)
- Northern Institute of Applied Carbon Science (NIACS)
- Pilot studies and case studies
- Research and technology transfer

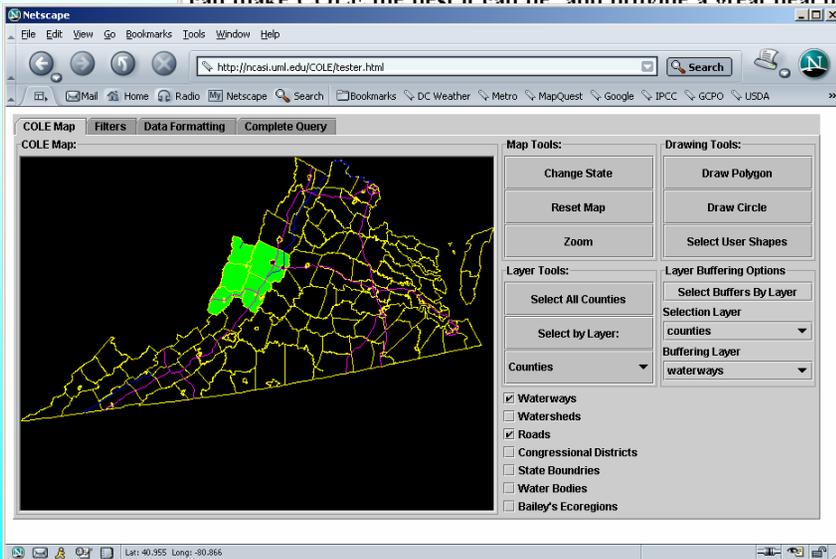


Regional Average and Benchmark Carbon Estimation

Beta Version is Up and Running: <http://ncasi.uml.edu/COLE/>



The screenshot shows the homepage of the Carbon OnLine Estimator (COLE) website. The browser window is titled "Home - Netscape" and the address bar shows "http://ncasi.uml.edu/COLE/". The page features the "ncasi" logo on the left, a map of the United States with "COLE" overlaid in the center, and the USDA Forest Service logo on the right. Below the map, the text reads: "Welcome to COLE: Carbon OnLine Estimator! This version (0.9) of COLE allows a user to choose an area of interest in the eastern United States. Characteristics of forests in that area are then returned to the user in a format chosen by the user. Currently, COLE features forest carbon pool estimates, which can be summarized in many ways. These are based on data collected on many thousands of plots by the USDA Forest Service, Forest Inventory & Analysis. A second related program, COLE Mapmaker, is available to produce maps that the user can download for use in reports or presentations. We are nearing the completion of version 1. Take a look around, and let us know what you think. With your feedback we can make COLE the best it can be, and provide a great deal of useful functionality as well."



The screenshot shows the COLE Mapmaker interface. The browser window is titled "Netscape" and the address bar shows "http://ncasi.uml.edu/COLE/ester.html". The interface includes a map of the eastern United States with a green highlighted area. To the right of the map are several tool panels: "Map Tools" (Change State, Reset Map, Zoom), "Drawing Tools" (Draw Polygon, Draw Circle, Select User Shapes), "Layer Tools" (Select All Counties, Select by Layer), and "Layer Buffering Options" (Select Buffers By Layer, Selection Layer: counties, Buffering Layer: waterways). There are also checkboxes for "Waterways", "Watersheds", "Roads", "Congressional Districts", "State Boundaries", "Water Bodies", and "Bailey's Ecoregions". The status bar at the bottom shows "Lat: 40.955 Long: -80.866".

Carbon OnLine Estimator

Access to FIA data and standard carbon coefficients

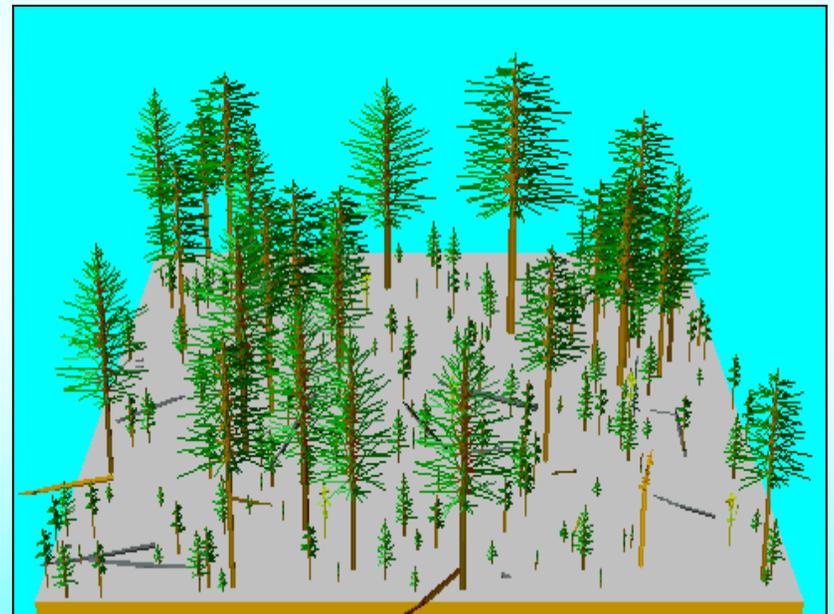
User-defined geographic area and data attributes

Spatial resolution as small as several counties

Forest Vegetation Simulator



- Simulates growth and yield for most major forest tree species, forest types, and stand conditions
- Can simulate a wide ranges of silvicultural treatments
- Most widely used forest stand simulator in the U.S.
- We are currently adding capability for carbon accounting



“Growout” for Urban Forests

- Based on “Urban Forest Effects” (UFORE) model
- Projects growth, mortality, and benefits of a population of urban trees
- Enhanced to include annual monitoring capability and calculation of energy benefits



Woodcarb

Proposal to provide online access to methods in technical appendices, plus additional features

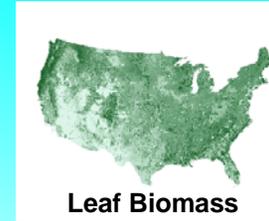
- If starting at removal of timber from forest:
 - Lookup tables by region and harvest type
- If starting at manufactured product:
 - Conversion factors and decay functions by product
- Two calculation methods
 - Track stocks over time
 - Estimate stocks at end of 100 years
- Product substitution calculations
 - Not currently in Woodcarb but available in “CORRIM”



NASA / NGA
SRTM
Elevation



NASA MODIS
Products



Leaf Biomass



Cropland NPP



VEMAP & Daymet (UMT)
Climate data

CASA CQUEST – A Decision Support System for Carbon Accounting

Inputs include continental-scale land cover, NDVI, FPAR, elevation, soils, and climate data ...



User Defined Profile
Region of Interest
Time Frame
Biophysical Management
Climate Scenario

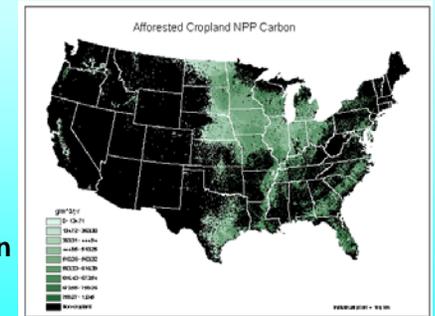
Output: landscape-to continental scale predictive maps of above and below ground distributions of sequestered carbon for different climate scenarios



USFS Forest Inventory and Analysis Data

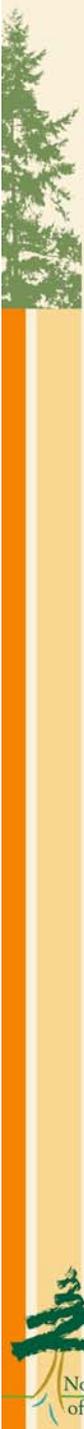


Carbon Sequestration Prediction



Cropland Afforestation Prediction

Multi-scale Validation Information



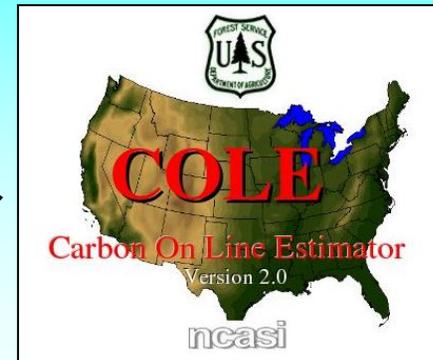
Northern Institute of Applied Carbon Science (NIACS)

- Synthesize and distribute information on the role of forests in carbon sequestration
- Conduct research to discover opportunities to improve forest carbon management
- Help forest managers apply carbon management technology
- Help forest managers participate in carbon credit reporting and trading

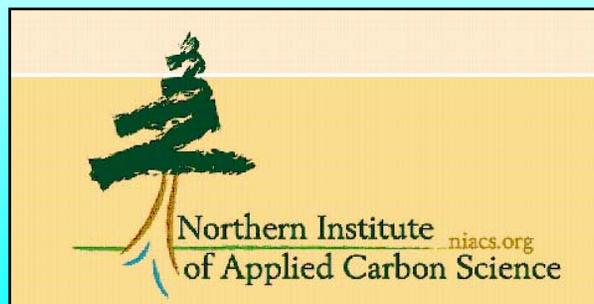
Proposed “Portal” to Decision-support for the 1605(b) Forest Sector

Start Page (select domain)

- Regional estimates
- Forest Management
- Urban Forestry
- Wood Products
- Natural disturbance
- Need more help?



WOODCARB



Case Studies

- Afforestation
- Mine land reclamation
- Forest restoration
- Agroforestry
- Improved forest management
 - Thinning techniques for Allegheny hardwoods – Northeast
 - Northern hardwood improvement project – North Central
 - Intensively managed loblolly pine plantation – Southeast
 - Uneven-aged ponderosa pine – Southwest
 - Fuel reduction treatments in the northern Rocky Mountains
 - Extended rotation of Douglas-fir, 40 to 60 years, Pacific Northwest.
 - Extended rotation of Douglas-fir, 40 to 80 years, Pacific Northwest
- Short-rotation biomass energy plantations
 - Conversion of farmland to woody biomass plantation
 - Conversion of forest land to woody biomass plantation
- Forest preservation
- Wood products management
 - Wood energy conversion project
 - Entity-level harvested wood products
- Urban forestry

Next Steps – Review and Implementation

- Public review period
- Develop reporting forms and software (with DOE)
- Technology transfer activities:
 - Complete case studies
 - Demonstration projects
 - Web interface (portal to COLE, FVS, etc.)
- Research to improve measurement, monitoring, and verification
- Research to quantify and predict forest management effects on carbon pools