



United States Department of Agriculture

US Forest Service Carbon Estimation Tools

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Forest Service

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Outline

- Foundation of the carbon tools
- Introduction of selected Forest Service carbon tools
 - Summary of benefits and limitations of each tool
- Choosing the right tool for the right job
- Where to find the tools and additional information



Carbon Tools Background

- Most tools are based on forest inventory data from the US Forest Inventory and Analysis Program (FIA)
- Many tools are periodically updated to reflect ongoing data collection, changes to methods, etc.
- None of these tools provide a lifecycle analysis, they simply report forest carbon pools or fluxes



Tools with output at various scales

- Forest Stand
- Landscape
- County
- State
- Region or ecoregion
- National



FVS-FFE
GTR-343

COLE
CCT

All tools except FVS-FFE based on FIA data

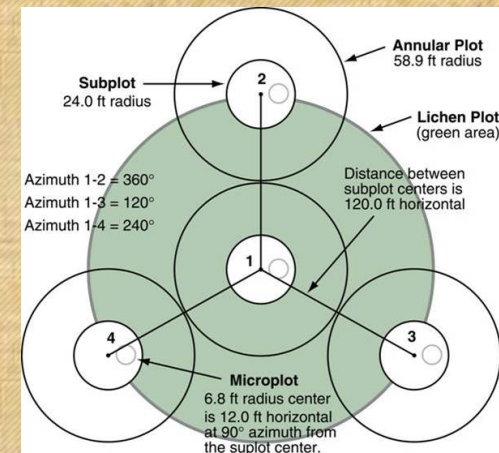


Forest Inventory and Analysis (FIA) Overview



FIA Sampling Design

- Phase 2 - forest inventory
 - 1 plot per 6,000 ac
 - visit plot every 5 years (10 in West)
- Phase 3 - forest health
 - each 16th Phase 2 plot
 - soils, forest floor, down dead wood
 - 1 plot per ~ 96,000 ac
 - soils sampled every 2nd visit
- Phase 1 - remote sensing
 - reduce variance through stratification



Where to find FIA data and tools

- **DATIM** - Design and Analysis Toolkit for Inventory and Monitoring
 - Four components, including basic tables (spatial component)
 - Suitable for a wide variety of users
- **Evalidator**
 - Estimates and *sampling errors* for selected areas
 - Can customize tables; easy to use
- **Data Mart** - download or query FIA database
- *Many other products available*

<https://www.fia.fs.fed.us/tools-data/>



Forest Inventory and Analysis National Program

(enter query)

Search

- U.S. Forest Service
- Forest Inventory & Analysis
- Regional Offices
- Program Features
- FIA Data and Tools**
- Other Tools
- Spatial Data Services
- Maps
- Customer Service
- FIA Library
- FIA Stakeholder Mtg Links
- Contact Us
- Site Map
- Regulations.gov
- Employee Search
- Information Center
- National Offices and Programs
- Phone Directory
- Evaluate Our Service
- We welcome your comments on our service and your suggestions for improvement.

FIA User Alerts.

Database Documentation

Data and Tools



DATIM



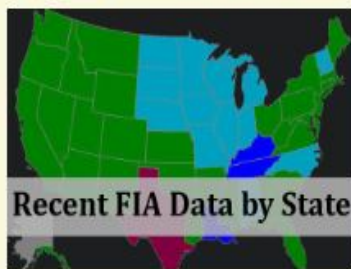
EVALIDator



FIA Data Mart



Urban Data Mart



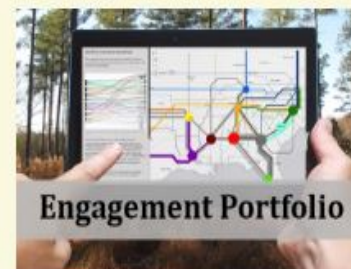
Recent FIA Data by State



Other Reporting Tools



Other Data



Engagement Portfolio



Training & Tutorials



Customer Service

FIA Data User?
 Click here to tell us how YOU are using FIA Data

Carbon Tools Overview

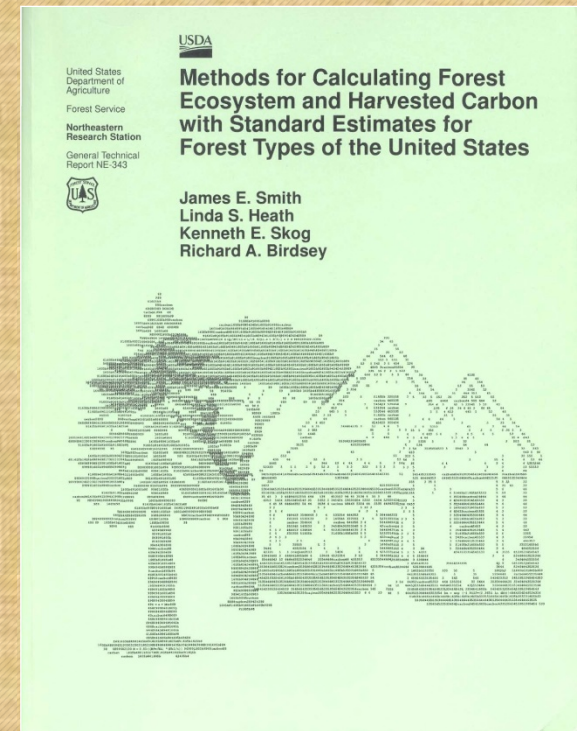


Tools Caveats

- “All models are wrong, but some are useful.”
 - George Box, 1979
- There is no one all purpose tool or model
- Whether a model is empirical or process based, there are tradeoffs
 - **Generality vs Accuracy** (don't forget \$, data required)
 - **No free lunches!** (i.e. remotely sensed data still need field data for equation development/validation, learning curve)
- Consider spatial scale, underlying data, key assumptions, data requirements

Standard Tables (GTR 343)

- Forest carbon and carbon in harvested wood from summary tables or simple calculations
- Intended for low cost or limited information applications
- Represent regional averages for common forest types
- Simple and transparent
- Consistent with international methods and Good Practice Guidance



GTR 343 - Standard Tables

CAN

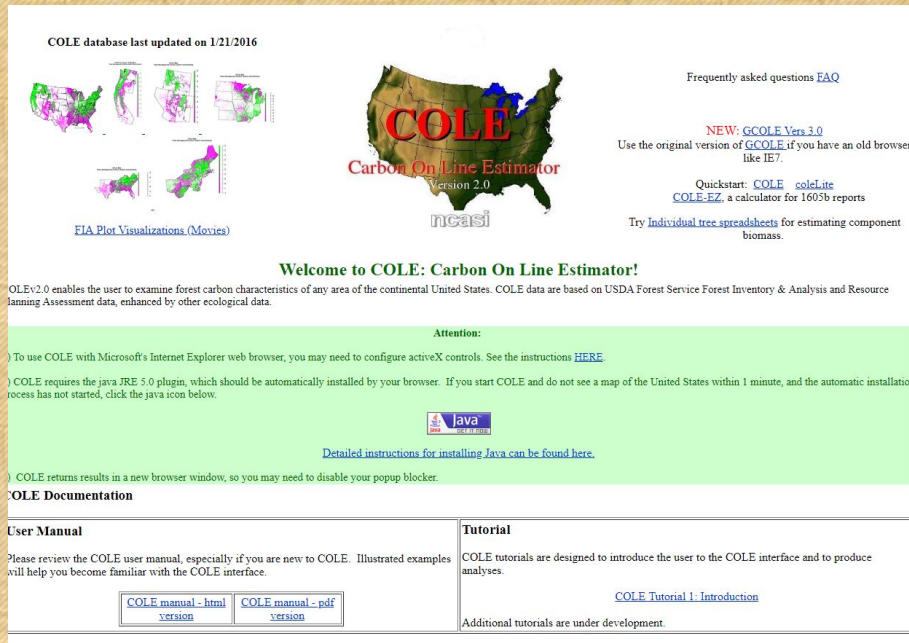
- Provide a quick estimate, based on regional data
- Serve as a “reality check” against which to compare your estimates
- Give a general estimate of what kind of carbon increases might occur over time

CAN'T

- Substitute for field inventory data for a specific project area
- Serve as a definitive projection of future conditions for a project area
- Reflect possible outcomes of management actions

COLE: Carbon OnLine Estimator

COLE database last updated on 1/21/2016



The screenshot shows the COLE website interface. At the top left, it states 'COLE database last updated on 1/21/2016'. Below this are several small maps of the United States showing different regions highlighted in green and purple. To the right of these maps is a larger map of the United States with the text 'COLE Carbon On Line Estimator Version 2.0' overlaid. Further right, there are links for 'Frequently asked questions FAQ', 'NEW: GCOLE Vers 3.0' (with a note to use the original version for old browsers), 'Quickstart: COLE cole-lite' and 'COLE-EZ, a calculator for 1603b reports', and 'Try individual tree spreadsheets for estimating component biomass'. A green banner with 'Attention:' contains instructions about Microsoft Internet Explorer and Java. Below the banner, there are links for 'Detailed instructions for installing Java can be found here.' and 'COLE returns results in a new browser window, so you may need to disable your popup blocker.' At the bottom, there are two columns: 'User Manual' with links for 'COLE manual - html version' and 'COLE manual - pdf version', and 'Tutorial' with a link for 'COLE Tutorial 1: Introduction'.

Frequently asked questions [FAQ](#)

NEW: GCOLE Vers 3.0
Use the original version of GCOLE if you have an old browser like IE7.

Quickstart: [COLE cole-lite](#)
[COLE-EZ](#), a calculator for 1603b reports

Try [individual tree spreadsheets](#) for estimating component biomass.

Welcome to COLE: Carbon On Line Estimator!

COLEv2.0 enables the user to examine forest carbon characteristics of any area of the continental United States. COLE data are based on USDA Forest Service Forest Inventory & Analysis and Resource Planning Assessment data, enhanced by other ecological data.

Attention:

To use COLE with Microsoft's Internet Explorer web browser, you may need to configure activeX controls. See the instructions [HERE](#).

COLE requires the java JRE 5.0 plugin, which should be automatically installed by your browser. If you start COLE and do not see a map of the United States within 1 minute, and the automatic installation process has not started, click the java icon below.



[Detailed instructions for installing Java can be found here.](#)

COLE returns results in a new browser window, so you may need to disable your popup blocker.

COLE Documentation

User Manual	Tutorial
Please review the COLE user manual, especially if you are new to COLE. Illustrated examples will help you become familiar with the COLE interface.	COLE tutorials are designed to introduce the user to the COLE interface and to produce analyses.
COLE manual - html version COLE manual - pdf version	COLE Tutorial 1: Introduction
	Additional tutorials are under development.

Can be reached through NRS tools page or FIA tools page (under Other Reporting Tools)

- Works with the FIA database (last update 2016)
- Produces a variety of maps and tables
- Reports many C pools
- County, state, and multi-state areas
- Can choose reports



COLE and gCOLE

CAN

- Provide a quick estimate, based on county/state level data
- Produce estimates of standard errors for selected variables
- Show differences between forest types, age classes, etc. (but watch # of plots!)

CAN'T

- Be used for smaller spatial scales (stands)
- Substitute for detailed forest inventory data for a project area
- Estimate fluxes
- Project outcomes from changes in management

Carbon Calculation Tool (CCT)

- Annual carbon pools and change from 1990 to present
- Comes with FIA data for mainland US
- Can download and use new data
- Produces annualized estimates
- State-level output
- Last update: 2017

The screenshot displays the Carbon Calculation Tool (CCT) interface, which is organized into several sections:

- LOCATE FILES:** This section prompts the user to "Enter or browse to the file locations." It includes two input fields: "Survey Summary File" (with the path C:\CCT\SurveySummaryFiles\survey_summary_022011_update.csv) and "Output Directory" (with the path C:\CCT\OutputFiles).
- CHOOSE CARBON POOLS:** This section asks the user to "Select the appropriate set of carbon pools." It features two radio buttons: "Reporting" and "Comprehensive" (which is selected). To the right, a list of carbon pools is provided: "Live Tree - Above Ground, Live Tree - Below Ground, Understory, Standing Dead Tree, Down Dead Wood, Forest Floor, Soil Organic Carbon".
- CHOOSE ESTIMATION METHOD:** This section prompts the user to "Consult user guide for details." It includes a dropdown menu currently set to "Single cycle-Hast if >50%new".
- GENERATE TABLES:** This section asks the user to "Select tables for output." It features a "By State" button and a list of tables. The list includes: "Stock -- Live Tree - Below Ground", "Stock -- Understory", "Stock -- Standing Dead Tree", "Stock -- Down Dead Wood", "Stock -- Litter", "Stock -- Soil Organic Carbon", "Stock -- Area, Total Forest", "Stock -- Area, Timberland", "Stock -- Growing Stock Volume on Timberland", "Flux -- ALL CATEGORIES (in single file)", "Flux -- Live Tree - Above Ground", "Flux -- Live Tree - Below Ground", "Flux -- Understory", "Flux -- Standing Dead Tree", "Flux -- Down Dead Wood", "Flux -- Litter", and "Flux -- Soil Organic Carbon".
- National:** This section includes a "National" button and a list of tables: "Stock Totals -- ALL CATEGORIES" and "Flux Totals -- ALL CATEGORIES".
- Buttons:** At the bottom, there are buttons for "Generate the Selected Tables", "Close", and "Exit".

CCT

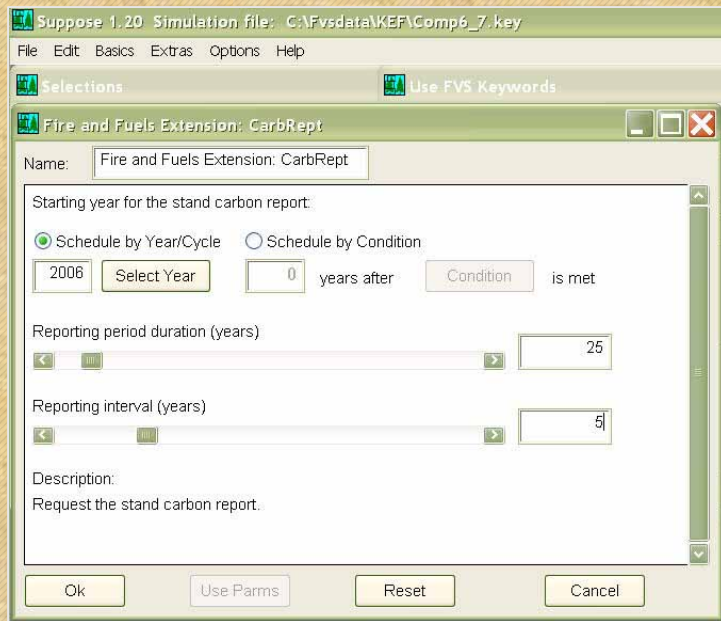
CAN

- Produce stock and flux estimates
- Produce annualized estimates
- Be updated with current FIA data by user
- Produce nationwide estimates

CAN'T

- Generate estimates at levels smaller than state
- Provide estimates prior to 1990
- Be initialized with site specific data by user
- Project scenarios

Forest Vegetation Simulator (FVS)



- Stand-level growth and yield model
- Uses field inventory data
- Simulates nearly any type of management
- Covers conterminous US
- Can generate reports on forest carbon stocks
 - Includes harvested wood products

***** CARBON REPORT VERSION 1.0 *****
STAND ID: 2849 STAND CARBON REPORT
RIGHT ID: NONE

YEAR	Aboveground Live		Belowground		Stand Dead	Forest			Total Stand Carbon	Total Removed Carbon	Carbon Released from Fire
	Total	Merch	Live	Dead		DDW	Floor	Shb/Hrb			
	T/HA	T/HA	T/HA	T/HA	T/HA	T/HA	T/HA	T/HA	T/HA	T/HA	T/HA
2006	114.4	75.2	21.4	12.5	0.0	18.1	14.9	0.7	182.1	48.5	0.0
2011	119.6	77.8	24.3	10.1	0.1	11.4	15.7	0.7	181.9	0.0	0.0
2016	123.2	80.4	23.5	9.1	1.2	10.2	16.2	0.7	184.1	0.0	0.0
2021	128.2	83.4	24.2	7.6	1.1	9.7	16.6	0.7	188.1	0.0	0.0
2026	132.7	85.8	25.0	6.5	1.6	10.2	17.1	0.7	193.7	0.0	0.0
2031	138.2	88.6	26.0	5.5	1.8	10.8	17.4	0.7	200.4	0.0	0.0



FVS Carbon Reports

CAN

- Assess carbon impacts of many management actions, including prescribed fire
- Estimate increases in carbon stocks over time
- Be used at the stand and landscape scales

CAN'T

- Be used without detailed inventory data from the site
- Be used in “plug and play” mode - extensive training is required
- Provide soil C estimates



Other tools

- Other FIA tools: DATIM, Evalidator, Data Mart
 - Provide estimates of forest carbon and many other forest attributes in a variety of formats
 - Range from easy to use to more complex
- i-TREE Products: Produces estimates of harvested carbon in wood products from harvest data
 - Similar to HWP C report from FVS
 - Two modes accommodate general and more specific data
- Variety of other tools
 - Many specific to a geographic region
 - Some specific to particular user groups, i.e. National Forests
 - Many “carbon footprint” calculators also available



Right tool for the right job...

- What is the relevant spatial scale?
- Do you need estimates of stocks, fluxes, or both?
- What level of accuracy do you need?
- Is the tool appropriate for your forest type/region?
- Do you want to use your own data?
 - What kind of data do you have?
- Do you want to compare management scenarios?
- Which carbon pools are of interest?
- How important is ease of use?



More caveats on tools...

- A tool is often developed in response to a specific need (i.e. 1605b, UNFCCC) and may not be updated once that mandate expires
- Tools developed and supported by a researcher may not be updated or continued when the researcher retires or changes jobs
- Support for a tool may be discontinued if funding is no longer available
- A tool developed for a specific geographic region may require considerable modification in order to be used in another region/forest type



Where do I find the carbon tools?

<https://nrs.fs.fed.us/carbon/tools>

Your gateway on the web for forest carbon inventory tools and information

- Each tool has a downloadable fact sheet

These tools and more can also be found at: <https://www.fs.usda.gov/ccrc/tools>





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- ▶ Scientists & Staff
- ▶ About NRS
- ▶ Partnerships
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Contact Information

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11 Campus Blvd., Suite 200
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(610) 557-4017
(610) 557-4132 TTY/TDD

You are here: NRS Home / Carbon / Tools

Carbon

Tools for carbon inventory, management, and reporting

Accurate estimates of carbon in forests are crucial for forest carbon management, carbon credit trading, national reporting of greenhouse gas inventories to the United Nations Framework Convention for Climate Change, calculating estimates for the Montreal Process criteria and indicators for sustainable forest management, and registering forest-related activities for state and regional greenhouse gas registries and programs.

Our scientists have contributed to developing a toolbox full of basic calculation tools to help quantify forest carbon for planning or reporting. The following tools are currently available:

- PRESTO: an online tool to estimate carbon in harvested wood products
- Measurement guidelines for the sequestration of forest carbon
- Field Measurements for Forest Carbon Monitoring: A Landscape-scale Approach
- Standard tables of forest ecosystem and harvested wood carbon
- Carbon OnLine Estimator (COLE)
- FORCARB2: An updated version of the U.S. Forest Carbon Budget Model
- U.S. Forest Carbon Calculation Tool (CCT)
- Forest Vegetation Simulator (FVS)
- CVal
- i-Tree
- CarbonPlus Calculator: A locally customizable emissions calculator for individuals and businesses

PRESTO: An online tool to estimate carbon in harvested wood products

UPDATE

PRESTO has a new home! PRESTO, an online tool for

Carbon

- Carbon Home
- Literature resources for carbon inventories
- Tools for carbon inventory, management, and reporting
- Tools Workshop
- Summaries
- Webcasts
- Carbon Factoids



Carbon Tools

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- Standard tables of forest ecosystem and harvested wood carbon
- Carbon OnLine Estimator (COLE)
- FORCARB2: An updated version of the U.S. Forest Carbon Budget Model
- U.S. Forest Carbon Calculation Tool (CCT)

Remember.....




- All tools have strengths and limitations
 - Know the “design specs”....errors increase when a tool is used outside its intended limits. Modifications may be needed.
- Spatial scale is very important when choosing the right tool for the job
- There are always tradeoffs!

Acknowledgements

- Jim Smith, Linda Heath, Ken Skog, Rich Birdsey
 - GTR 343, Standard Tables
- Paul VanDeusen, NCASI, Linda Heath
 - COLE
- Jim Smith, Linda Heath, Mike Nichols
 - CCT
- Stephanie Rebain and ESSA Technologies
 - FVS Carbon Reports
- And of course, many more....



Questions?
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END OF TRAIL
PROCEED NO FARTHER