

Assessing the Greenhouse Gas Balance of Forestry with COMET-Farm™

J. Ziegler¹, Easter M.¹, Swan A.¹, Paustian K.¹, Brown K.¹, Toureene C.¹, Stermer M.¹, Marx E.¹, Velayudhan S.¹, Huber A.¹, Chambers A.², Hoover, C.³, Van Dyke, M.³ & Baranski M.⁴
¹Natural Resource Ecology Laboratory—Colorado State University, ²USDA Natural Resources Conservation Service, ³USDA Forest Service, ⁴USDA Climate Change Program Office



Introduction to COMET-Farm

COMET-Farm is an integrated web-based decision support tool developed to aid farmers, agricultural producers, land managers and conservationists.

COMET-Farm provides total system greenhouse gas (GHG) accounting and carbon sequestration for these practices:

- Cropland, Pasture & Range
- Livestock
- Agroforestry
- Forestry
- Energy usage

By generating reports from users' current and potential future management scenarios, COMET-Farm allows users to evaluate how conservation practices may reduce GHG emissions and sequester carbon.

Forestry

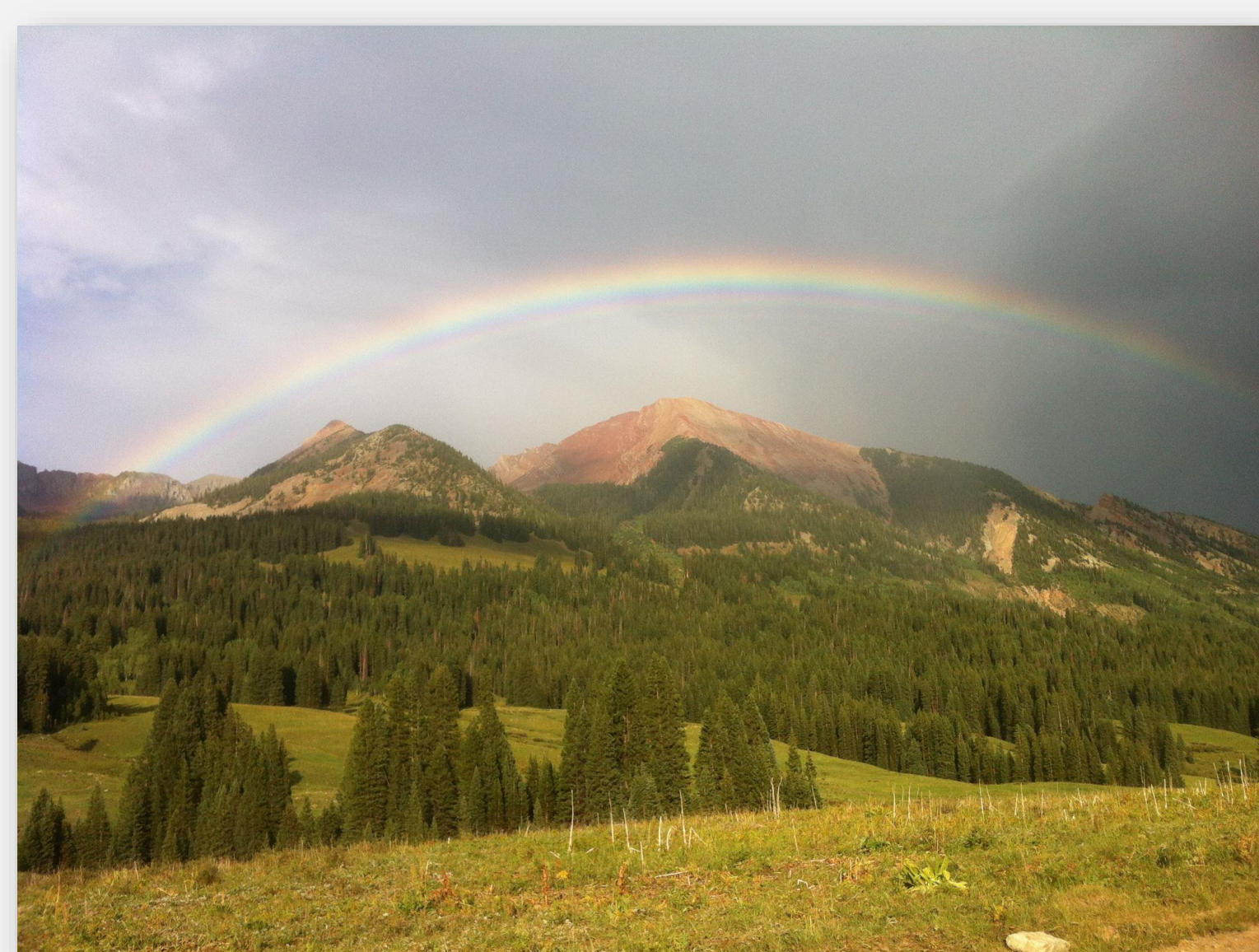
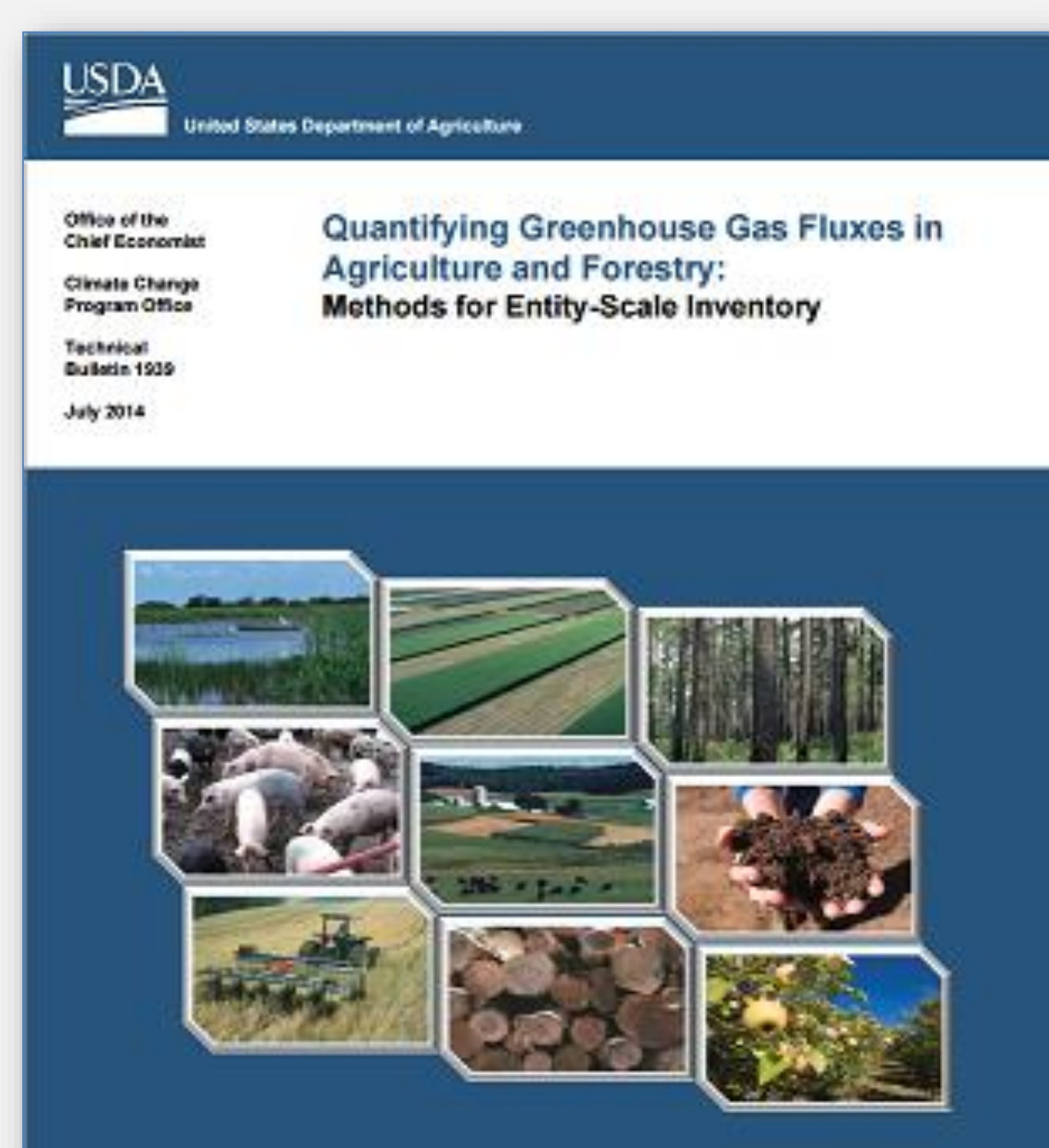


Photo courtesy of Matthew Stermer Colorado State University

Forest management can offset GHG emissions by sequestering carbon within vegetative biomass. COMET-Farm reports sequestered CO₂ equivalents of aboveground and belowground carbon stocks of live overstory trees in forest stands up to 500 acres in size. COMET-Farm also reports carbon pools of products in use and in landfills.

Scientific Basis



COMET-Farm utilizes peer-reviewed greenhouse gas (GHG) inventory methods published by the USDA in *Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory* to assess the greenhouse gas balance of forest management at the forest stand level.



This poster showcases the capabilities of the Forestry module of COMET-Farm depicting a hypothetical scenario. The stand management focus on three stands located in the Big Meadow Unit of the University of Idaho Experimental Forest.



East Big Meadow

- Dominated by Douglas-fir (*Pseudotsuga menziesii*).
- 48 acres

West Big Meadow

- Dominated by Douglas-fir (*Pseudotsuga menziesii*).
- 40 acres

Joe's Cut

- Dominated by Ponderosa Pine (*Pinus ponderosa*),
- 77 acres

Using COMET-Farm

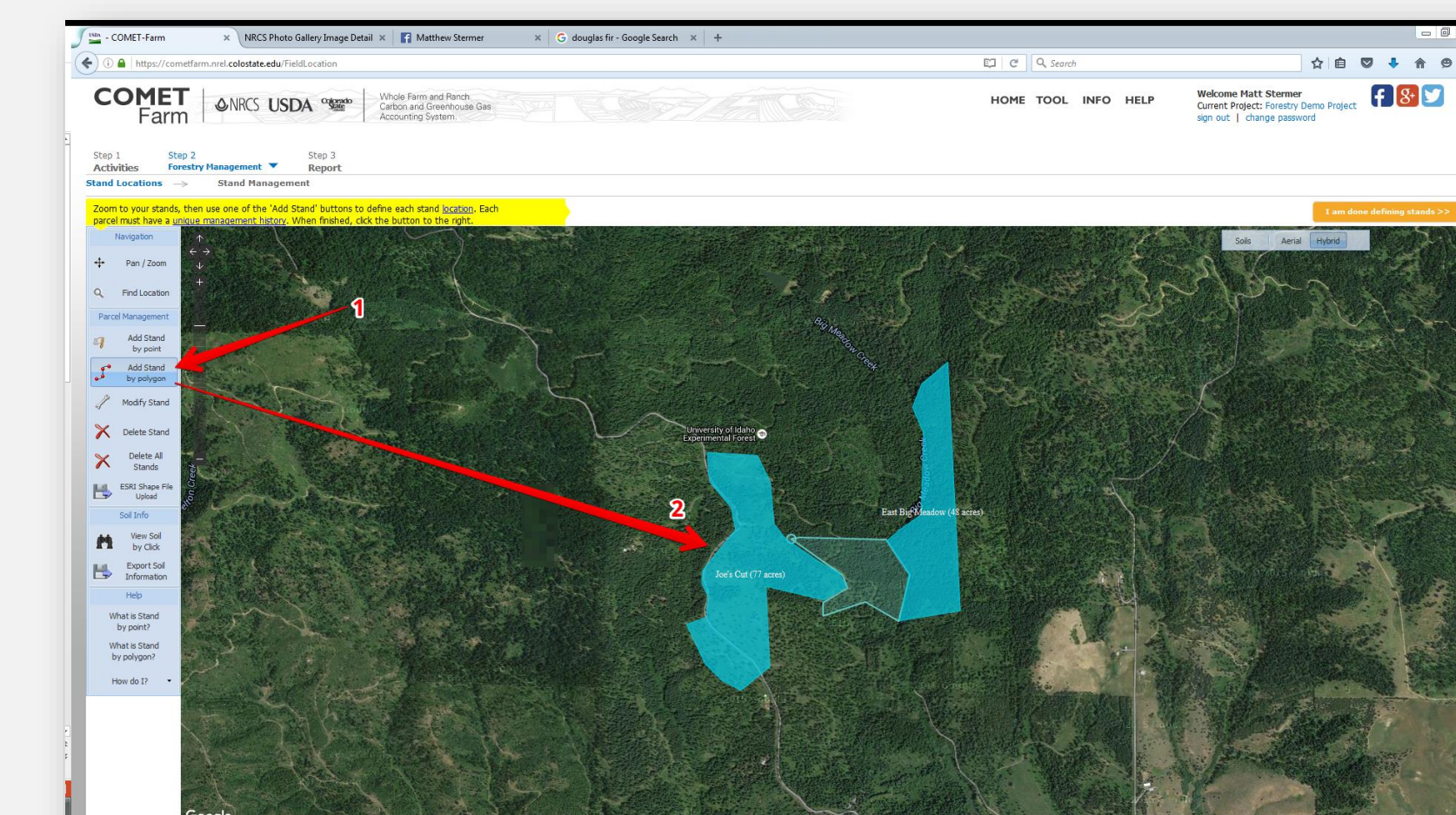
1. Start a Project

Creating a forestry project in COMET-Farm is easy. Simply create and name a customized project and begin to describe the stand management activities.



2. Select a Location

The next step is to define the location, which is crucial to determine regional tree growth rates.



3. Enter in Inventory Data

Once stands are defined, users enter the detailed stand inventory information regarding forest type, past land cover, age (yr.) or current volume (cu ft./ac), management prescription and time periods of management activities. In this example, "Joe's Cut" is denominated by Ponderosa Pine that is currently 15 years old. The prescription selected is a clear-cut harvesting event to occur in 2040.

Select a stand: [Dropdown]

For stand Joe's Cut (selected at left) what was its forestry management?

Forest type: [Ponderosa pine]

Past land cover: [Forest]

Age (yr.): [15]

Volume (cu ft./ac): [0]

Prescription: [Clear-cut harvesting]

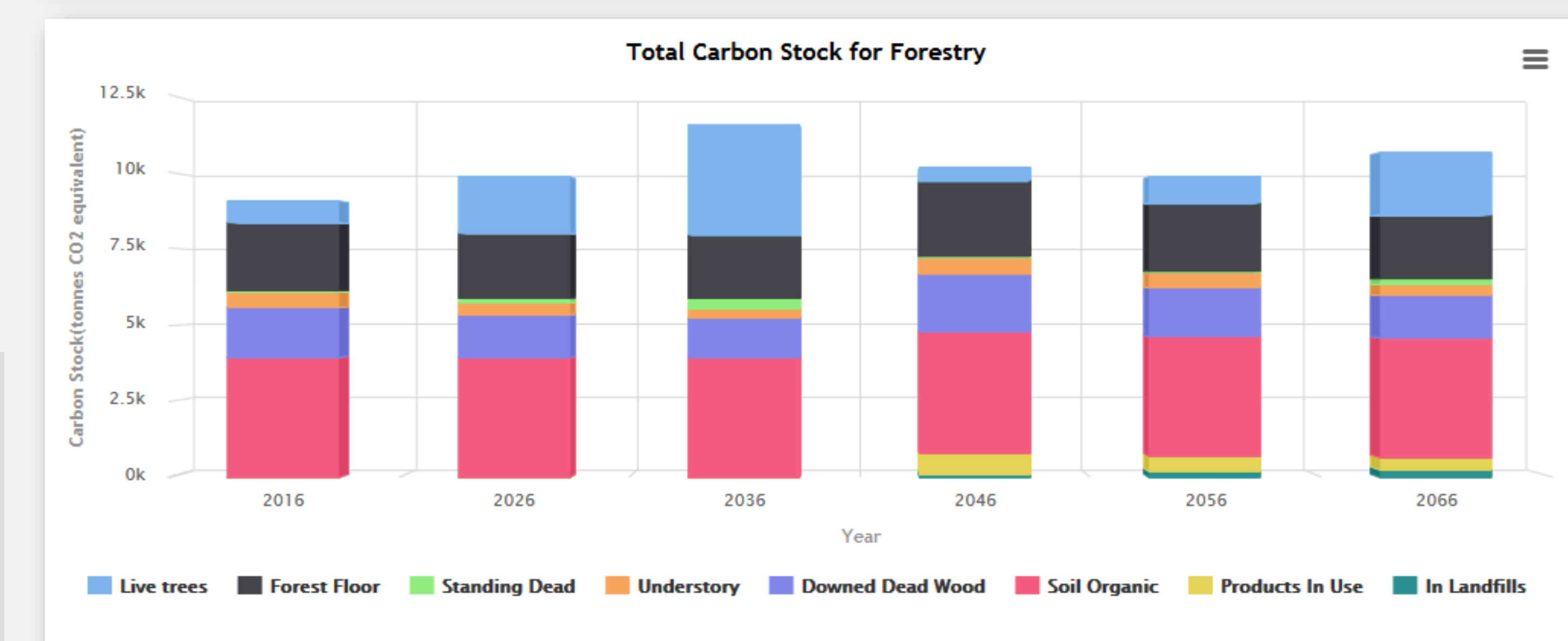
Select activity years: [2040]

Buttons: << Back, Next >>

4. Generate Reports & View Results

The last step is to run the scenario to generate tabular and graphic reports of sequestered CO₂ equivalents projected over 50 years for each stand.

Source	2016	2026	2036	2046	2056	2066	Average Yearly Emissions
Joe's Cut (Forest Type:Ponderosa pine)-(Prescription:Clear-cut harvesting)							
Live Trees (tonnes CO ₂ equiv.)	726.5	1833.4	3563.1	415.1	837.1	2006.4	-25.6
Standing Dead (tonnes CO ₂ equiv.)	69.2	184.5	345.9	27.7	80.7	200.6	-2.6
Forest Floor (tonnes CO ₂ equiv.)	2237.0	2110.2	2098.6	2506.8	2224.3	2109.0	+2.6
Understory (tonnes CO ₂ equiv.)	495.8	369.0	288.3	547.7	483.1	360.9	+2.7
Downed Dead Wood (tonnes CO ₂ equiv.)	1602.8	1383.7	1279.9	1924.5	1580.9	1373.3	+4.6
Soil Organic (tonnes CO ₂ equiv.)	3955.1	3955.1	3955.1	3955.1	3955.1	3955.1	0.0
Products In Use (tonnes CO ₂ equiv.)	0.0	0.0	0.0	687.0	483.7	388.0	-7.8
In Landfills (tonnes CO ₂ equiv.)	0.0	0.0	0.0	117.0	208.7	248.5	-5
Total	9086.4	9835.9	11531.0	10181.0	9853.7	10641.9	-31.1



In the "Joe's cut" example, clear cutting periodically removes live tree biomass resulting in dynamic changes in ecosystem, atmospheric, forest product and landfill carbon pools.

Conclusion

The example demonstrates how the Forestry module within COMET-Farm can be used to determine the impact of modifying or adapting forestry conservation practices. COMET-Farm's Forestry module has the capacity to model all common North American tree species anywhere within the continental US. Used in conjunction with cropland, agroforestry, livestock and energy modules, users can determine how forestry practices affect the ecosystem balance of whole-system operations.

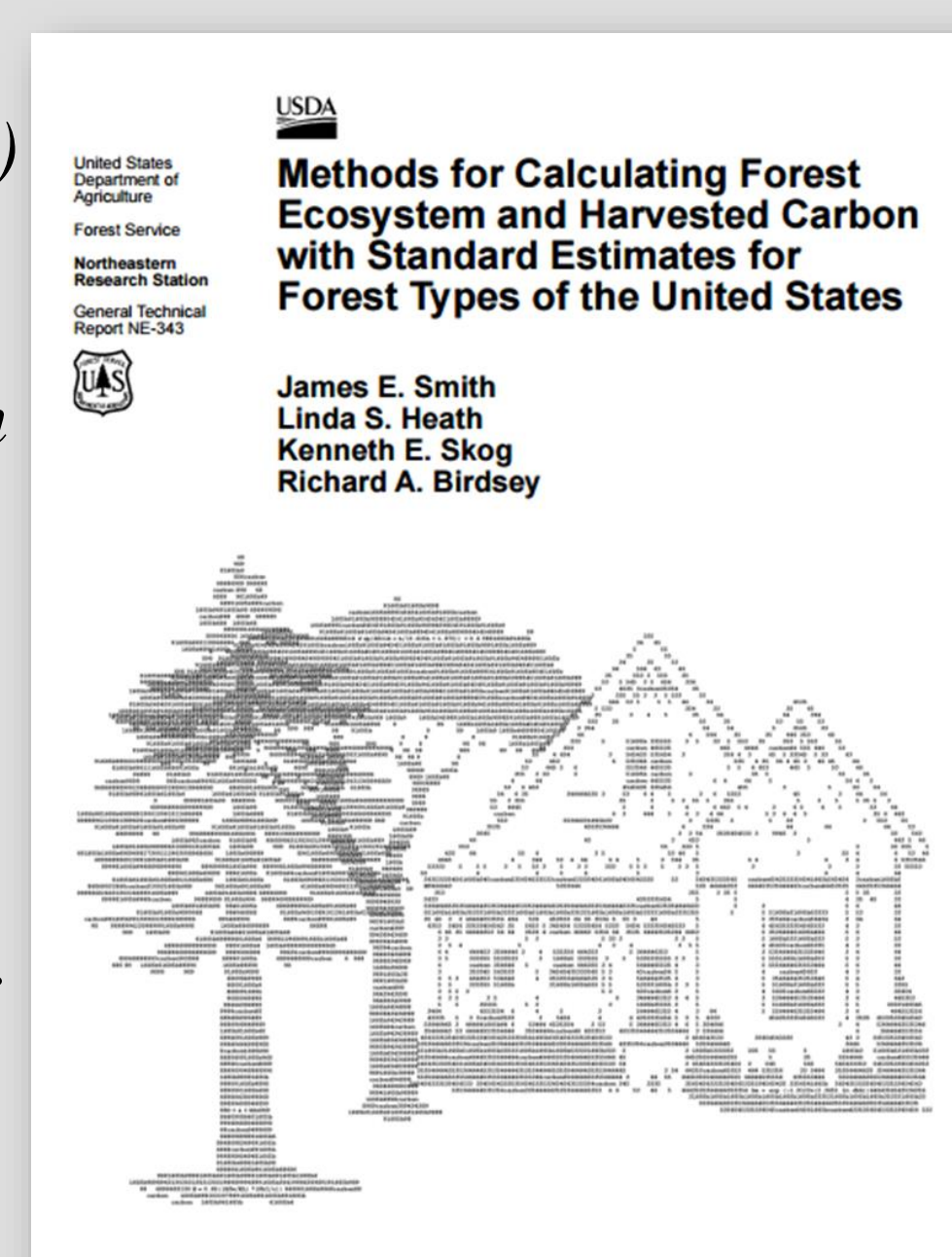
Acknowledgements

This work was supported by the USDA NRCS and USDA Climate Change Program Office.

Defined Scenarios in Detail

- Designed to provide reliable substitutions to costly inventories.
- Represent most common practices for each region of the US.
- Derived from the U.S. Forest Service:

Smith et al (2006)
Methods for Calculating Forest Ecosystem and Harvested Carbon with Standard Estimates for Forest Types of the United States.



Building on the Forestry Module

The live overstory tree component of forests contain the greatest amount of biomass. Forest carbon is contained, however, in additional carbon pools other than live trees. The COMET-Farm™ Forestry module accounts for carbon in:

- Overstory live trees
- Standing dead trees
- Understory
- Downed woody debris
- Forest floor
- Soil Organic Carbon
- Products in Use
- Landfills

Model projections extend from 10 to 50 years, reflecting the long-term investments of planting trees.

The system allows entry of management and natural disturbances to reflect the immediate and lasting effects.

