Timber Products Output Carbon Accounting

Christopher Woodall

Group Leader

Staff

- Timber Products: Ron Piva (analyst), David Haugen (analyst), Brian Walters (analyst/programmer)
- National Carbon Accounting: James Smith (scientist), Michael Nichols (programmer), Grant Domke (scientist)
- State Responsibilities: North Dakota, South Dakota, Missouri

TPO: 2014 Accomplishments

- National mill canvas form approved by OMB
- National database now operational
- NRS 2012 and 2013 data is being processed and loaded
  National utilization program initiated
- TPO reports In Press or Published:
  - Michigan timber industry: an assessment of timber product output and use, 2008
  - Pulpwood production in the Northern Region, 2007
  - Pulpwood production in the Northern Region, 2008
  - National pulpwood production, 2010
  - National pulpwood production, 2012 (SRS Report)

Streamlined TPO Reports

USDA
United States Department of Agriculture

TIMBER PRODUCTS UPDATE FS-XXX

Michigan Timber Industry, 2010

This resource update provides an overview of timber products output and use in Michigan based on questionnaires designed to determine the size and composition of the State's primary wood-using industry, its use of roundwood, and its generation and disposition of wood residues. Conducted by the U.S. Forest Service, Forest Inventory and Analysis (FIA) program at the Northern Research Station in cooperation with the Michigan Department of Natural Resources (MI-DNR). Estimates are based on surveying all known primary wood-using mills collected by the MI-DNR and sent to NRS to be process and analyze. The estimates presented in this update are for the survey year 2010 with comparisons made to data reported in 2008. The data used in this publication were accessed from the FIA Database on September 2014.

Overview

In 2010, there were 306 primary wood-processing mills in North Dakota, 16 more mills than in 2008. These mills processed 326 million cubic feet of industrial roundwood, of which 300 million cubic feet was harvested from the State. Another 40 million cubic feet of the industrial roundwood harvested in Michigan was sent to primary wood-processing mills in Wisconsin, Minnesota, Indiana. Saw log harvesting accounted for 47 percent of the total wood material harvested in the state. The harvesting of industrial roundwood products resulted in 99 million cubic feet of logging residues. Primary wood-processing mills generated 2.8 million green tons of mill residues; forty-three percent of the mill residues were used for industrial fuel. One percent of the mill residues generated were not used for other products.

Table 1.—Michigan Timber Industry, change between 2008 and 2010

	2008 Estimates	2010 Estiamtes	Percent change
Quick Stats			
Number of primary wood using mills	290	306	5%
Industrial roundwood receipts--MCF[a]	349.7	325.7	-7%
Industrial roundwood production--MCF[a]	345.9	339.6	2%
Saw log receipts--MBF[b]	647.5	744.1	15%
Saw log production--MBF[b]	653.7	745.9	14%
Wood material harvested for industrial roundwood--MCF[a]	445.2	439.2	-1%
Growing-stock removals from timberland for industrial roundwood--MCF[a]	314.8	315.4	.1%
Sawtimber removals from timberland for industrial roundwood--MBF[b]	1,046.9	1,107.2	6%
Harvest residue generated by industrial roundwood harvesting--MCF[a]	98.8	99.5	.7%

[a]Thousand cubic feet
[b]Thousand board feet, International ¼-inch rule

Forest Service | November 2014

TIMBER PRODUCTS UPDATE FS-XXX

PRIMARY TIMBER INDUSTRY

Figure 1.—Primary wood-using mills, Michigan, 2010.

Industrial Roundwood

In 2010, Michigan primary wood-using industry totaled 306 mills, an increase of 16 mills since 2008 (Fig. 1). The primary wood-using mills in Michigan processed 326 million cubic feet of industrial roundwood.

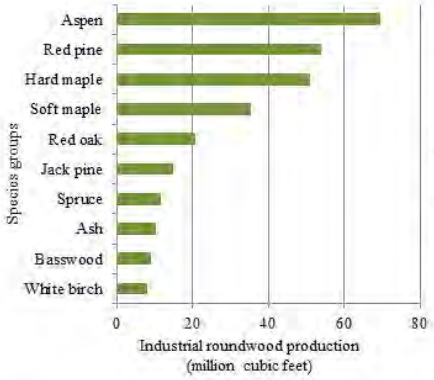


Figure 2.--Industrial roundwood production by top ten species group, Michigan 2010.

Ninty-two percent of the industrial roundwood processed by the State's primary wood-using mills was cut from Michigan forest lands. Wisconsin forests supplied the majority of out-of-State wood used by Michigan's forest products industry. Sixty-nine percent of the industrial roundwood processed by Michigan's primary wood-using mills were hardwood species. Aspen, hard and soft maple accounted for 46 percent of the total volume processed. Other species of importance to the forest products industry were red pine, jack pine, spruce, red oak, ash, and basswood (Fig. 2). Industrial roundwood production decreased by 2 percent, or 6.3 million cubic feet in 2010 (Fig. 3). Eighty-eight percent of the 339.6 million cubic feet of industrial roundwood harvested in Michigan was processed in the State. Primary wood processors in Wisconsin received 9 percent of the industrial roundwood exported out of state.

Saw logs

Michigan sawmill receipts totaled 744 million board feet in 2010, an increase of 15 percent from 2008. Softwood saw log receipts were estimated at 335.5 million board feet, while those of hardwoods equaled 408.6 million board feet. Saw log production increased by 14 percent between 2008 and 2010. In 2010, red pine and hard maple accounted for 45 percent of the total harvest of saw logs from Michigan forests. Other important species groups harvested were red oak, aspen, soft maple, jack pine, ash and spruce.

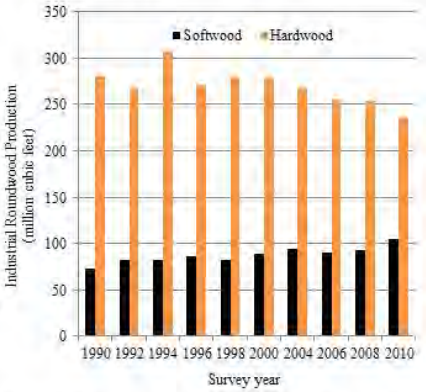


Figure 3.--Industrial roundwood production by softwoods and hardwoods, and survey year, Michigan

Streamlined TPO Reports cont'd

- More rapid publication
- Tables provided via pdf and online
- Efficiency
- Movement toward forest inventory reporting approaches (reduce publication $ and increase digital transfer)

National TPO Database

- Southern States
  - Uploaded historical data…
  - Now entering 2012 and 2013 data into the National Dbase
  - Processing with the National procedures

- Northern States
  - Historical data being moved into the National Dbase
  - Northern 2012 and 2013 data being entered into both the National Dbase and Northern TPO Dbase to verify processing procedures
  - Planned to be completed January 2015

Current State Status – Mill Surveys

State	Status
Connecticut	Southern New England Report in progress
Delaware	Working on collecting for 2014 or 2015
Illinois	Work on completing data collection for 2012
Indiana	Processing data for 2013
Iowa	Work on completing data collection for 2013
Kansas	Planning data collection for 2014 Discussing possible report with KS, MT, NE, ND, SD, WY (CO?)
Maine	Working on how to collect for 2014 or 2015
Maryland	Work on completing data collection for 2013
Massachusetts	Southern New England Report in progress
Michigan	Planning data collection for 2014 or 2015 Preparing OMB submission for Lake States annual TPO
Minnesota	2010 report in progress. Planning data collection for 2014 Preparing OMB submission for Lake States annual TPO
Missouri	2012 report in progress

(Continued)

Current State Status – Mill Surveys

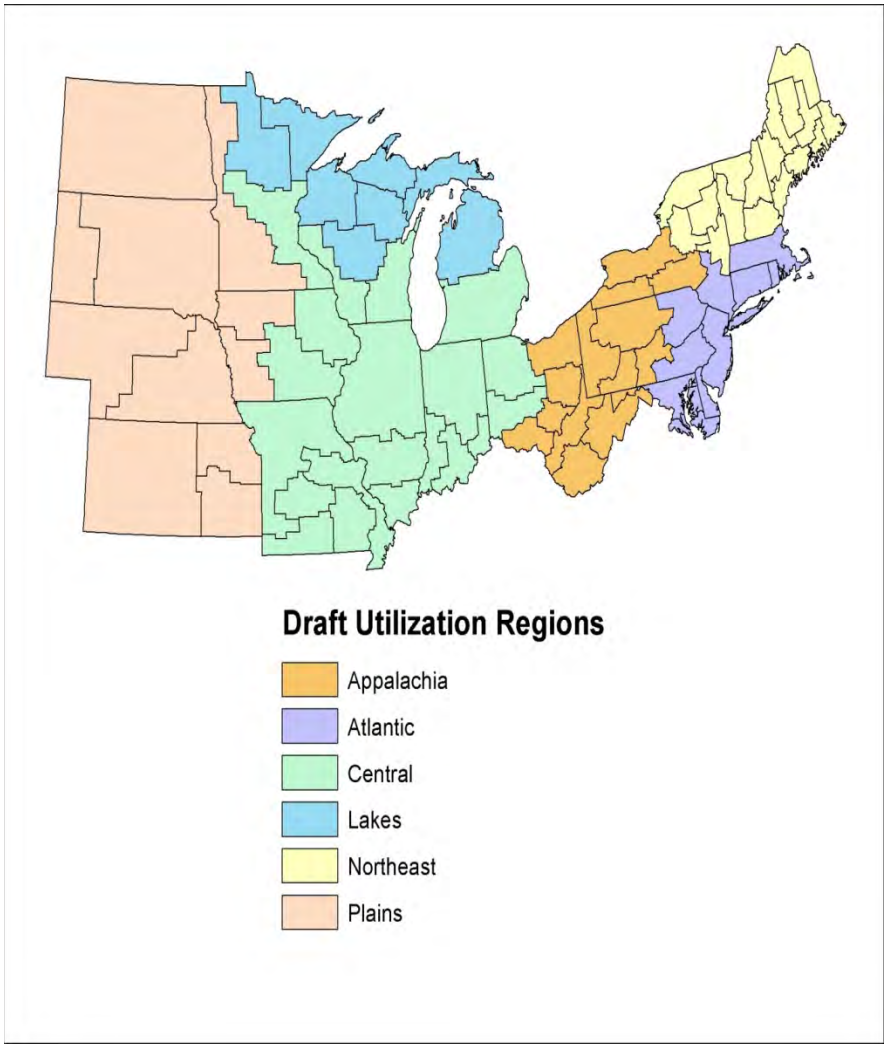
(continued)

State	Status
Nebraska	Planning data collection for 2014 Discussing possible report with KS, MT, NE, ND, SD, WY (CO?)
New Hampshire	Working on how to collect for 2014 or 2015
North Dakota	Planning data collection for 2014 Discussing possible report with KS, MT, NE, ND, SD, WY (CO?)
New Jersey	Working on collecting for 2014 or 2015
New York	Planning data collection for 2014
Ohio	Work on completing data collection for 2012
Pennsylvania	Processing data for 2012
Rhode Island	Southern New England Report in progress
South Dakota	Planning data collection for 2014. Joint report with WY Discussing possible report with KS, MT, NE, ND, SD, WY (CO?)
Vermont	Working on how to collect for 2014 or 2015
West Virginia	Working on how to collect for 2014
Wisconsin	Work on completing data collection for 2013 Preparing OMB submission for Lake States annual TPO

Harvest Utilization Studies

Northern Utilization Specifics

- Northern study based on utilization regions that have similar species and product mixes
- About 1,000 harvest utilizations sites will be sampled across the North over the next 7 years
- 7-year cycle across region in concert with Phase 2



Current National Utilization Effort

- National Methods
- Built Upon Existing Southern PDR Program
- MIDAS architecture
- Conducted by P2 crews in concert with forest inventory
- Sample additional national/volume biomass variables

Harvest Utilization Current Status

Number of trees sampled and number of harvest utilization sites by Utilization Region, State, product, and softwood and hardwood

Utilization Region and State	Number of trees				Number sites
	Saw logs	Pulpwood	Other products	Total no. or trees	
Appalachia					
West Virginia	13	--	11	24	2
Central					
Missouri	85	--	--	85	8
Lakes					
Michigan	--	17	29	46	2
Wisconsin	23	37	--	60	3
Plains					
South Dakota	55	--	--	55	3
Total	176	54	40	270	18

2015 TPO Goals

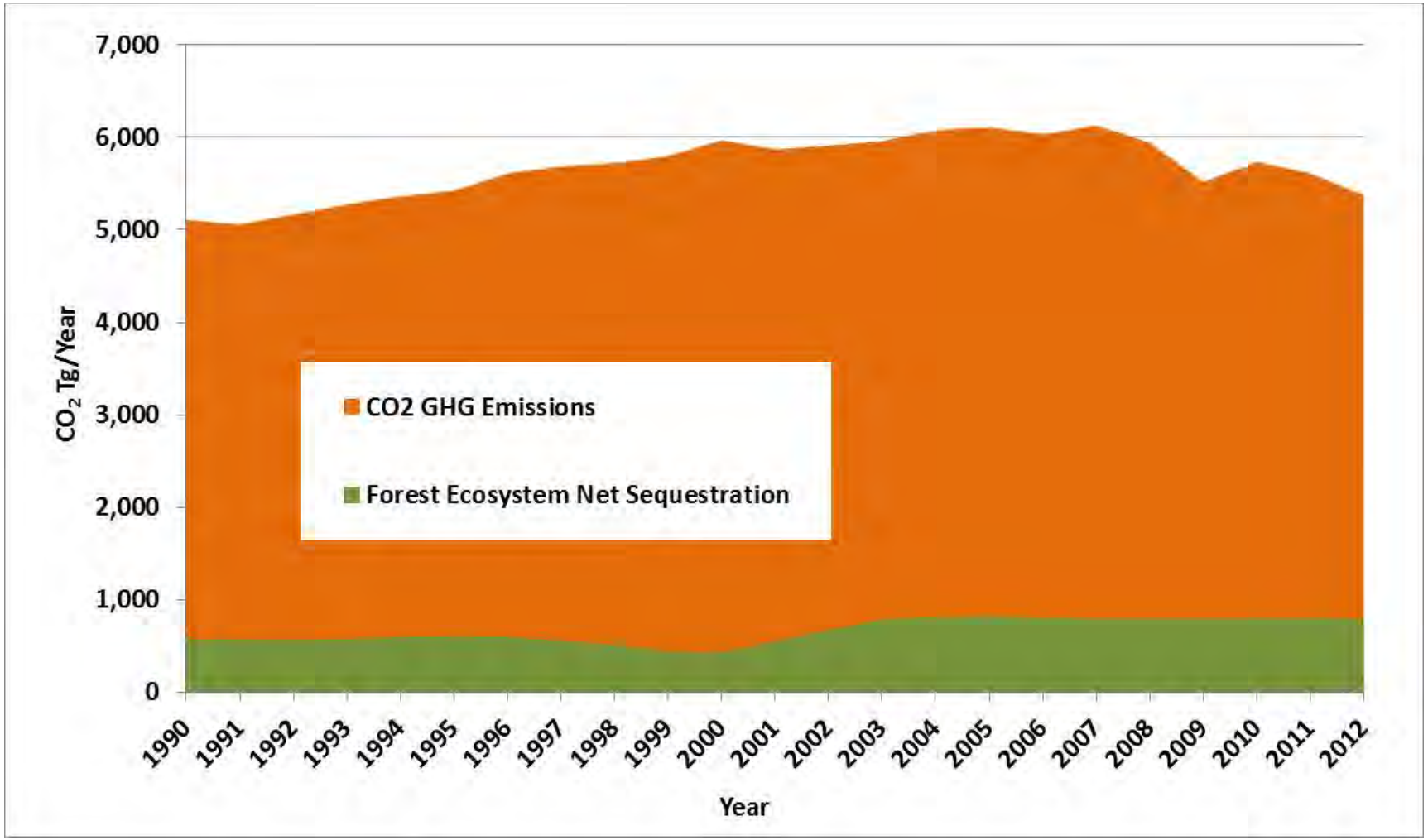
- Complete 125-150 utilization sites
- Lake States annual TPO
- Full adoption of national dbase for all TPO work
- SRS conducts annual national pulpwood survey
- Explore improved data distribution/analysis efforts

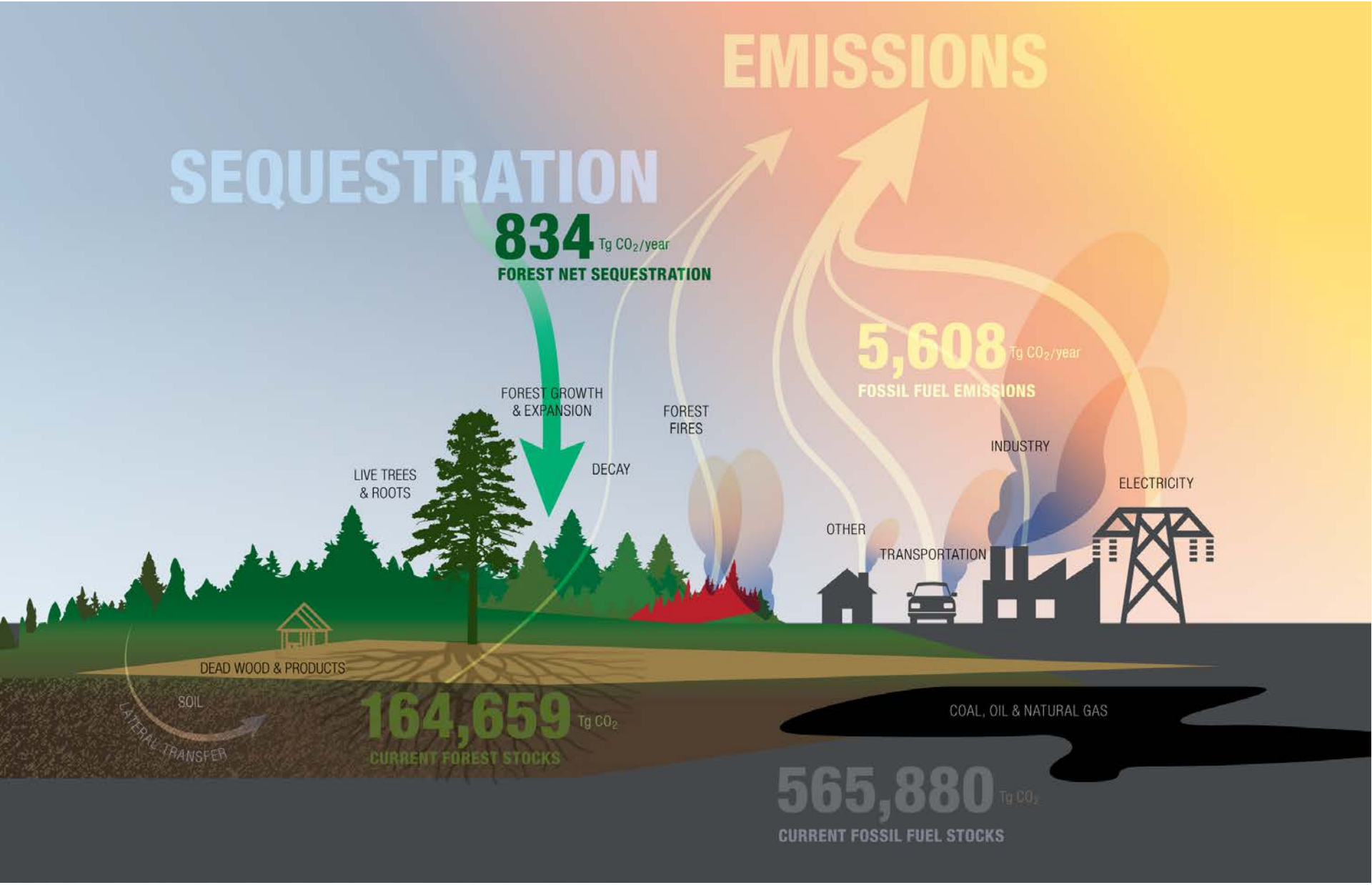
National TPO Leader

- Dr. John Coulston to be stationed at Virginia Tech
- Coordinate science and development of national TPO program
- Look for stakeholder workshop this Spring/Summer

TPO Questions??

Carbon Accounting





Forest Carbon Cycle in Context of US Emissions

Courtesy of Perry et al. In Prep Atlas of US Forests

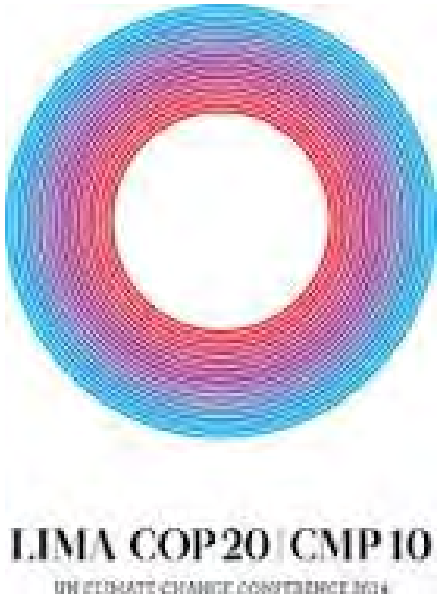
UN Expert Review

- Attribution
- Land Use Change
- Disaggregation
- A plan for improvements
- AK/HI
- Improving 1990-present baseline
- Refined uncertainty assessments

Recent CEQ Guidance -Inventory-

- Builds off UN recommendations with eye toward future policy issues
  - Annual information on land-area classification, and land-use changes/transitions
  - Annual tracking of C stock changes on all lands and pools, and significant fluxes of non-CO_2 gases (including sources of uncertainty)
  - Improve methods for attribution
  - Complete coverage of fluxes on all managed land (AK)

Forests Part of 2030 Agreement



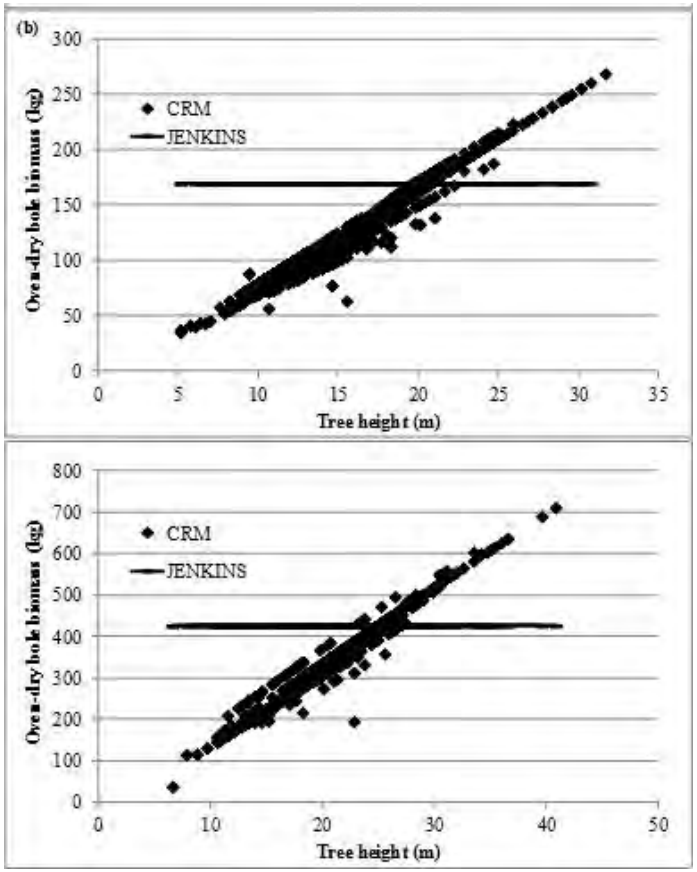
- Conference of Parties, Peru this week
- White House/State Department need reduced uncertainty for agreement
- Exploring investment opportunities with FIA
- Should align with 2014 Farm Bill

Recent Improvements by Inventory Submission

- Greater use of in situ plots
- Greater alignment of NGHGI with other Domestic/International reports
- Incorporation of emerging science
- Use full suite of FIA data to address attribution and land use change

2012: Live Tree Volume/Biomass

- Component Ratio Method: Function of species, dbh, and height (ratios of biomass components using Jenkins' equations)
- CRM Documentation: Woodall et al. 2011
- Comparison of Previous and Current Methods: Domke et al. 2012



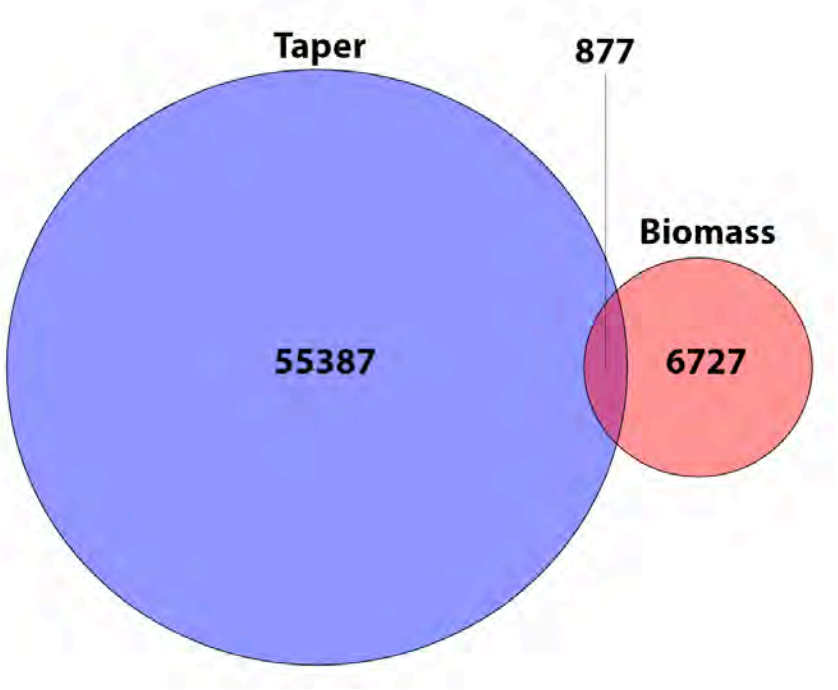
Douglas-fir (22.9 vs 33.0 cm DBH)

Woodall, C.W., Heath, L.S., Domke, G.M., Nichols, M.C. 2011. Methods and equations for estimating aboveground volume, biomass, and carbon for trees in the U.S. forest inventory, 2010. Gen. Tech. Rep. NRS-88.

Domke, G.M., Woodall, C.W., Smith, J.E., Westfall, J.A., McRoberts, R.E. 2012. Consequences of alternative tree-level biomass estimation procedures on U.S. forest carbon stock estimates. Forest Ecology and Management. 270: 108-116.

Volume → Biomass → Carbon

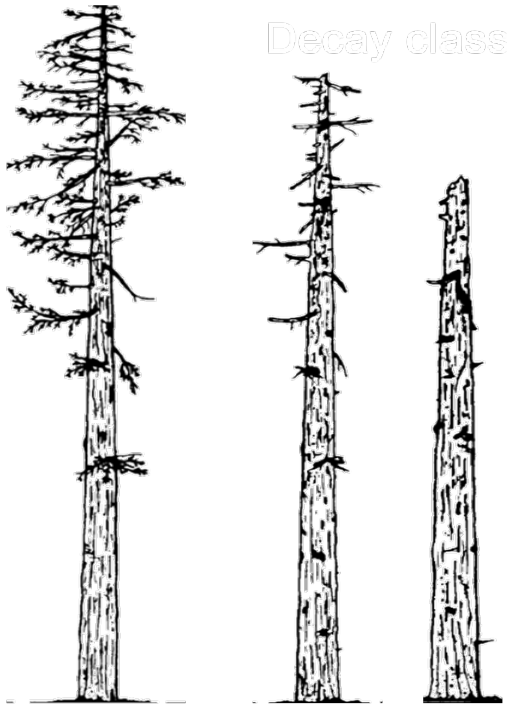
- National volume/biomass study
- NCASI, U of Maine, OSU, UMT, Va Tech, MSU, UGA



Felled Trees: Number of legacy data observations

Weiskittel, A.R., MacFarlane, D.W., Radtke, P.J., Temesgen, H., Affleck, D.L.R., Westfall, J.A., Woodall, C.W., Coulston, J.W. In Review. Importance and issues of field-based estimation of forest biomass and carbon. Journal of Forestry.

2012: Standing Dead Trees



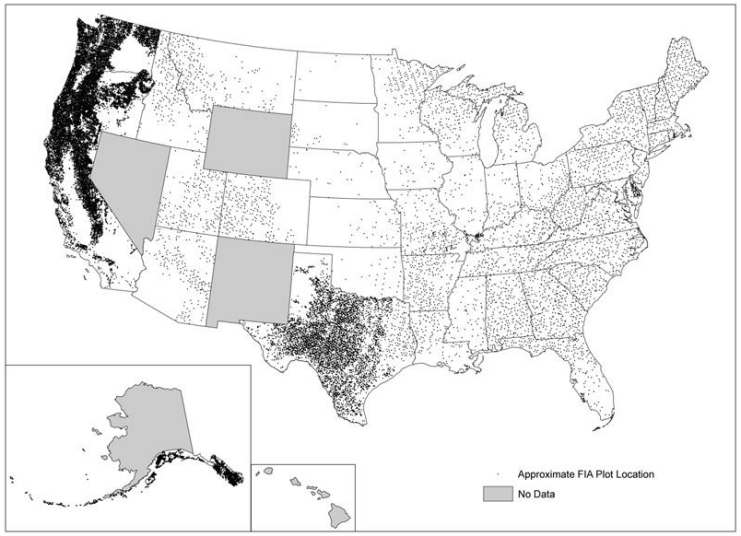
Method	Decay class 1	Decay class 2	Decay class 3	Decay class 4	Decay class 5
CRM:	91.2 kg C	74.8 kg C	29.4 kg C	2.4 kg C	0.4 kg C
CRM+DRF:	89.2 kg C	61.2 kg C	19.6 kg C	1.7 kg C	0.3 kg C
CRM+DRF+SLA:	87.9 kg C	49.1 kg C	12.1 kg C	1.0 kg C	0.2 kg C

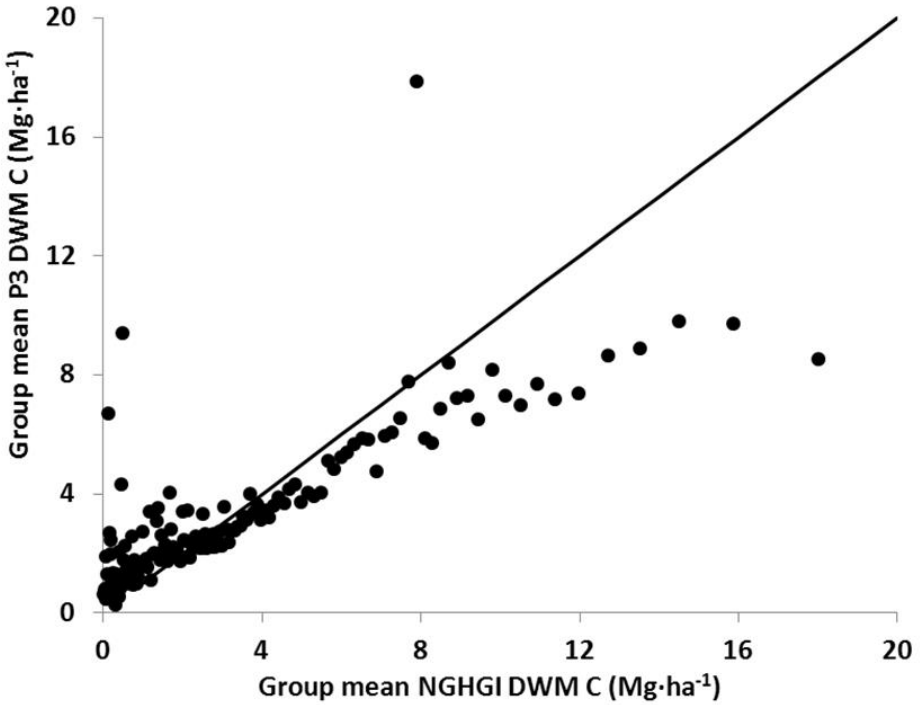
Domke, G.M., Woodall, C.W., Smith, J.E. 2011. Accounting for density reduction and structural loss in standing dead trees: Implications for forest biomass and carbon stock estimates in the United States. *Carbon Balance and Management* 6:14.

Woodall, C.W., Domke, G.M., MacFarlane, D.W., Oswalt, C.M. 2012. Comparing field- and model-based standing dead tree carbon stock estimates across forests of the United States. Forestry. 85: 125-133.

2013: Downed dead wood C

- Recently incorporated plot data (2002-2010; n = 22,641)



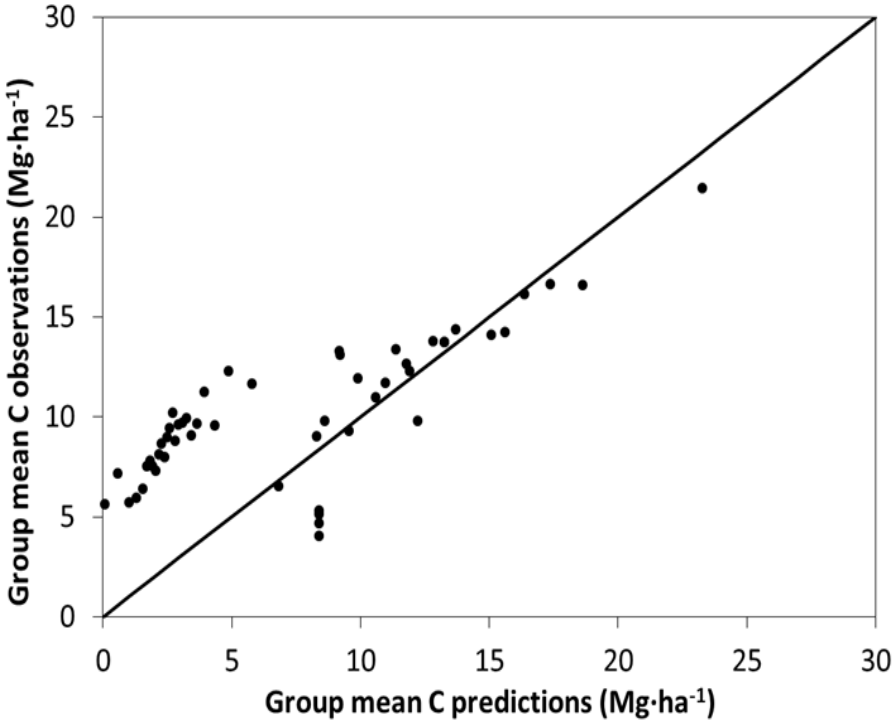


Domke, G.M., Woodall, C.W., Walters, B.F., and Smith, J.E. 2013. From Models to Measurements: Comparing Downed Dead Wood Carbon Stock Estimates in the US Forest Inventory. *PloS One*, *8*(3), e59949.

Woodall, C.W., Walters, B.F., Oswalt, S.N., Domke, G.M., Toney, C., Gray, A.N. 2013. Biomass and carbon attributes of downed woody materials in forests of the United States. Forest Ecology and Management. 305: 48-59.

2015: Forest floor (litter) C

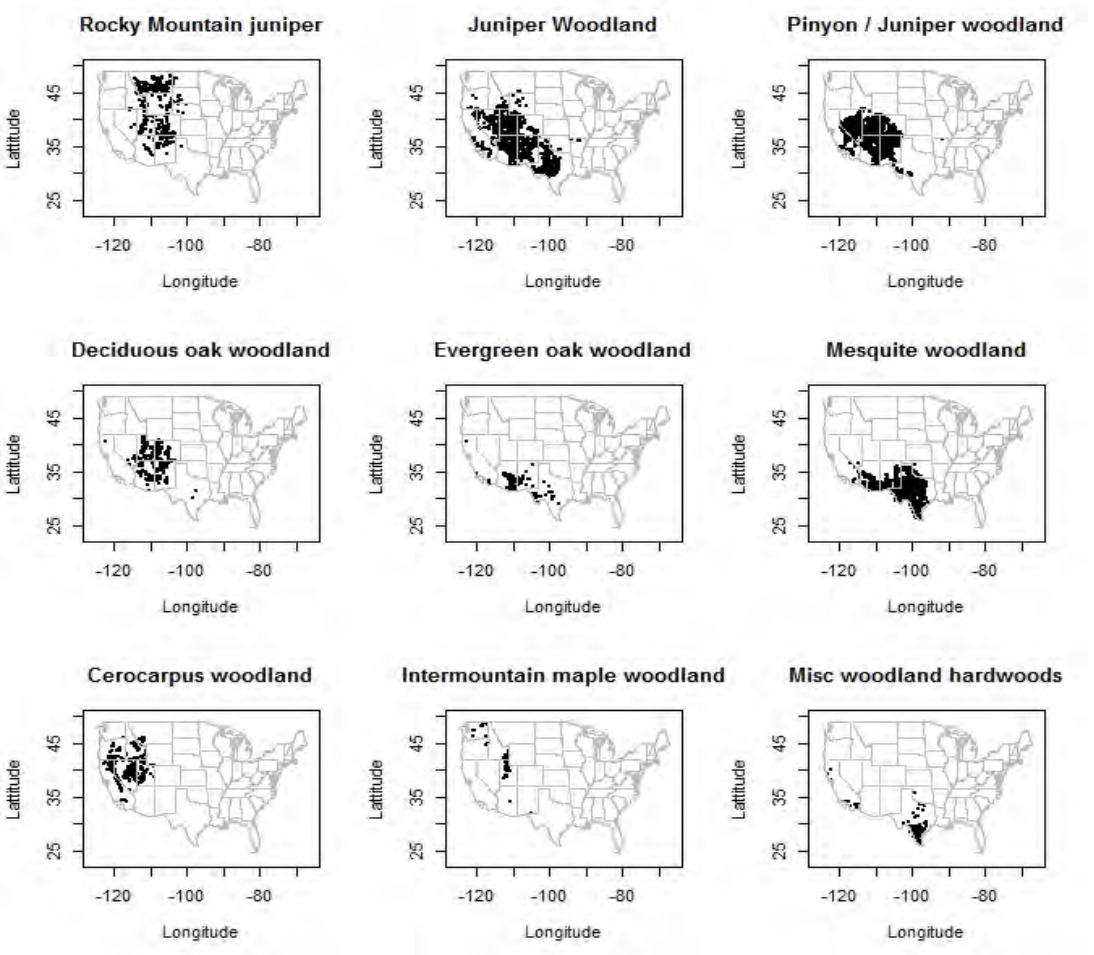
- Forest floor C measured on 4,500+ plots
- Machine learning (Random Forest) used to identify relevant variables
- A RF model was developed using variables such as lat, long, AG live tree C, mean annual precip, max annual temp
- Error term representing the uncertainty in the model prediction as well as the observed variability around the prediction was included in each forest floor C estimate



Domke, G.M., Perry, C.H., Walters, B.F., Woodall, C.W., Smith, J.E. In Preparation. Estimation of forest floor carbon using the national forest inventory of the United States. Intended outlet: Geoderma.

2015: Woodlands vs Forest land

- Align definition of forests used in FAO FRA with US' NGHGI
- Ability to reach minimum height threshold (5 m) in situ
- Transferred 29 million ha from Forest to Woodland land use (~4% reduction in C stocks)



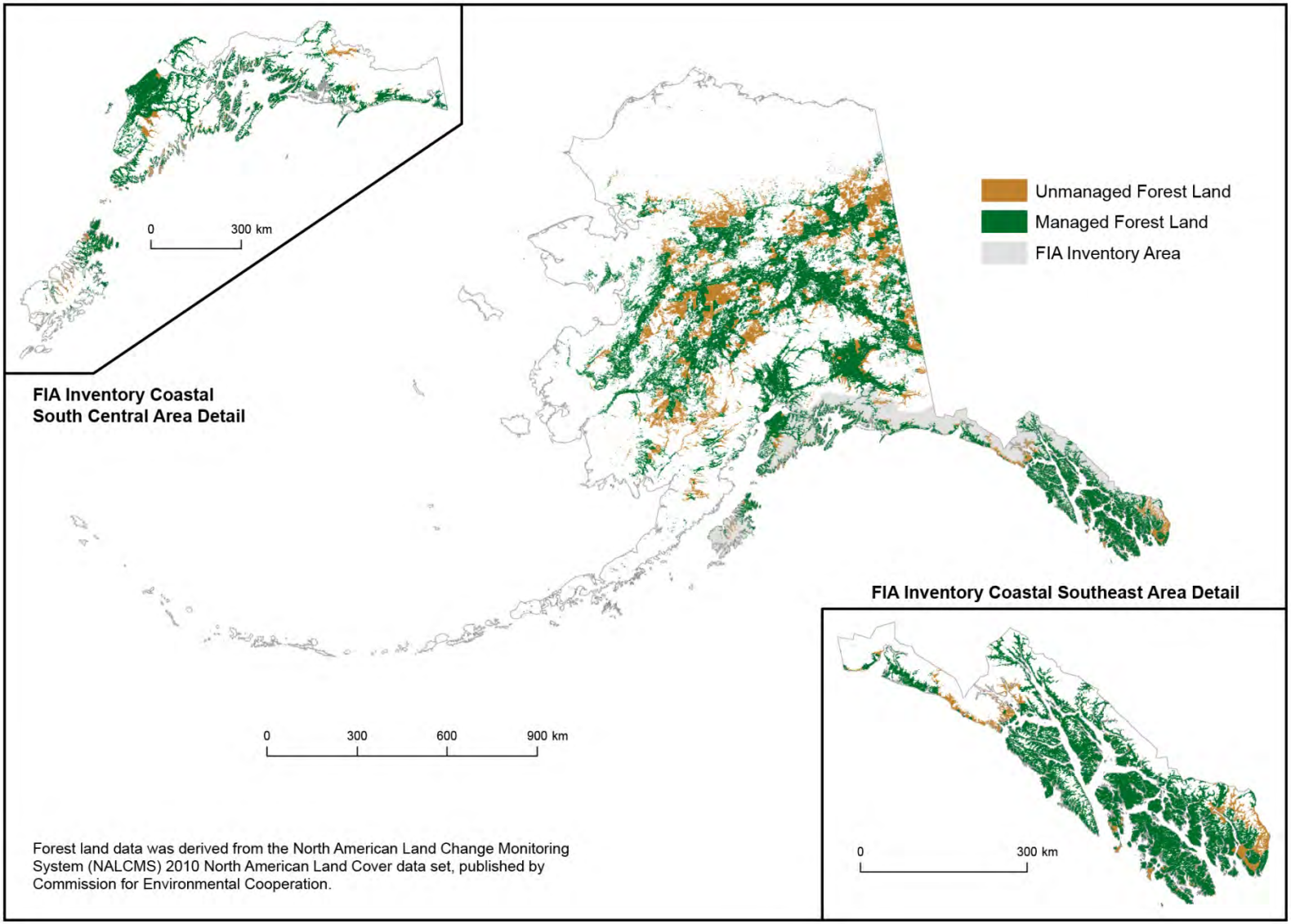
Coulston, JW, Woodall, CW, Domke, GM, Walters, BF. In Prep. Refined Delineation between Woodlands and Forests with Implications for US National Greenhouse Gas Inventory of Forests. Intended Outlet: Climatic Change.

2015: Managed Lands (Alaska)

- Per IPCC guidance only managed forests included in submission
- Coterminous US forests all considered managed
- "Managed" AK forests: impacted by settlements, along transport corridors, mining/gas areas, protected areas managed for recreation or suppression of disturbance

Ogle, S.M., Woodall, C.W., Swan, A., Smith, J., Wirth. T. In Prep. Determining the Managed Land Base for Delineating Carbon Sources and Sinks in the United States. Intended Outlet: Environmental Science and Policy.

How About Managed Forest Land?



What Are We Missing in Interior AK?

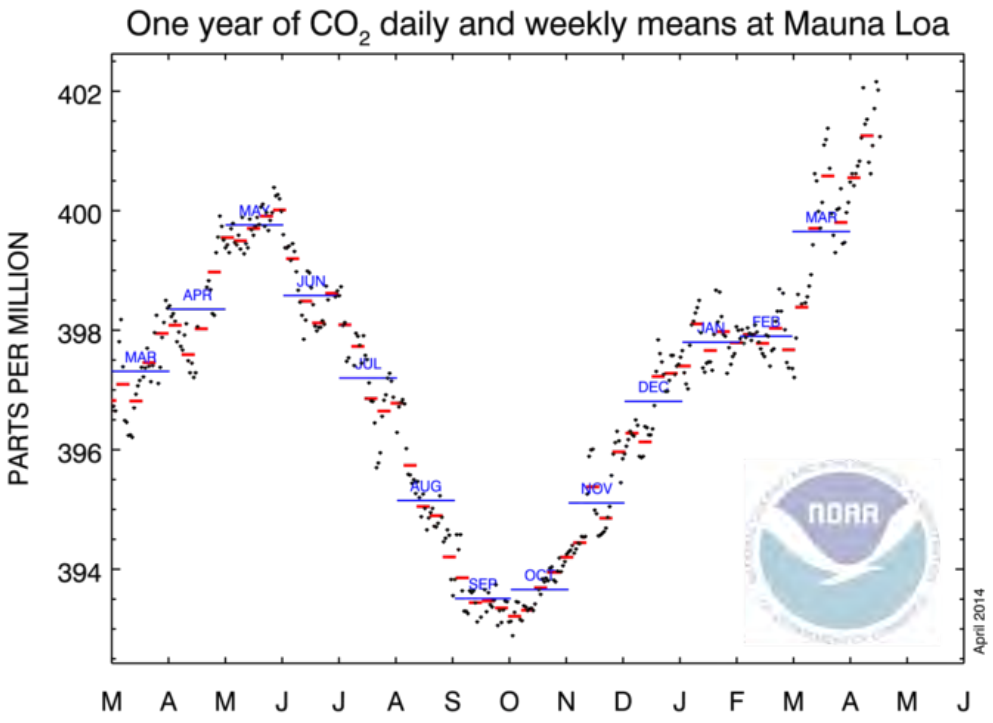
- How much managed forest?
  - 46-49 million ha of forestland (~68% of interior forest)
- How large of a carbon stock?
  - 7,700 to 15,100 Tg C
  - Equivalent to 37% of total forest C stocks in coterminous US

Genet et al. In Prep. Synthesis of the role of dynamic driving factors (climate, fire, permafrost dynamics, and forest management) on the historical and projected vegetation and soil organic carbon dynamics in upland ecosystems of Alaska. Intended outlet: Ecological Applications.

McGuire et al. In Prep. A synthesis of terrestrial carbon balance of Alaska and projected changes in the 21st Century: Implications for climate policy and carbon management at local, regional, national, and international scales. Intended outlet: Ecological Applications.

Saatchi et al. In Prep. Distribution of Carbon Stocks in Managed and Unmanaged Forests of Alaska. Intended outlet: Carbon Balance and Management.

Beyond 2015: The Future

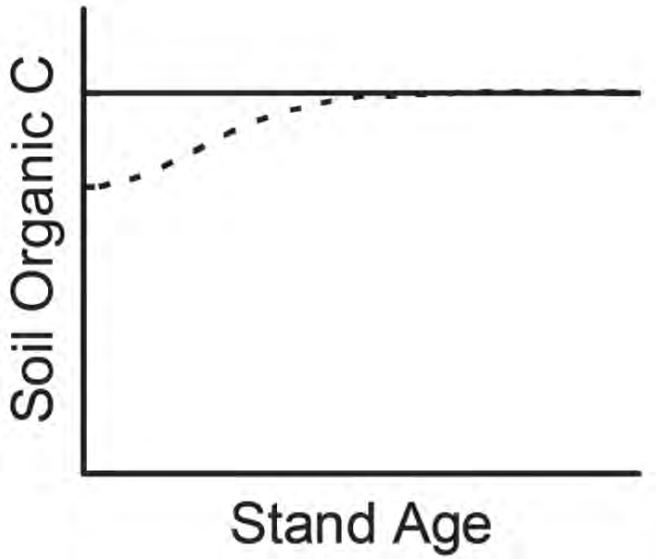


- Improving pool estimation
- Explore LiDAR and Landsat incorporation
- Continue alignment of NGHGI and other national summaries
- Refinement of non-live tree pool estimates
- New accounting system in 2016 NGHGI

Soil organic C

- Estimated from models based on average SOC by geographic area and forest type
- Includes fine organic material below soil surface modeled to a depth of 1 m (does not include roots)
- Refinements expected in 2016 Submission

Soil organic carbon

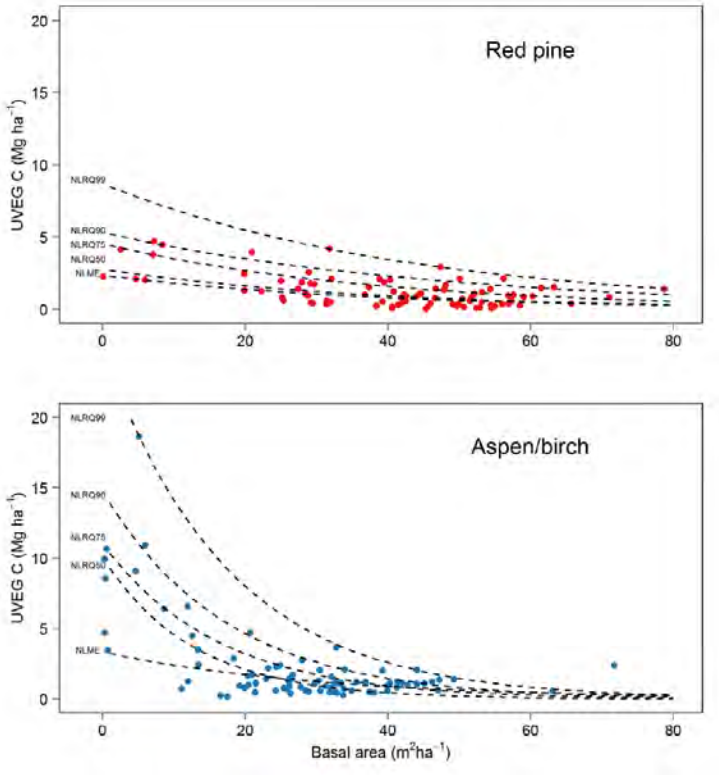


USDA, Soil Conservation Service. 1991. State soil geographic (STATSGO) data base data use information. Misc. Publ. 1492.

Amichev, B.Y. and Galbraith, J.M. 2004. A revised methodology for estimation of forest soil carbon from spatial soils and forest inventory data sets. Environmental Management. 33(Suppl. 1): S74-S86.

Understory

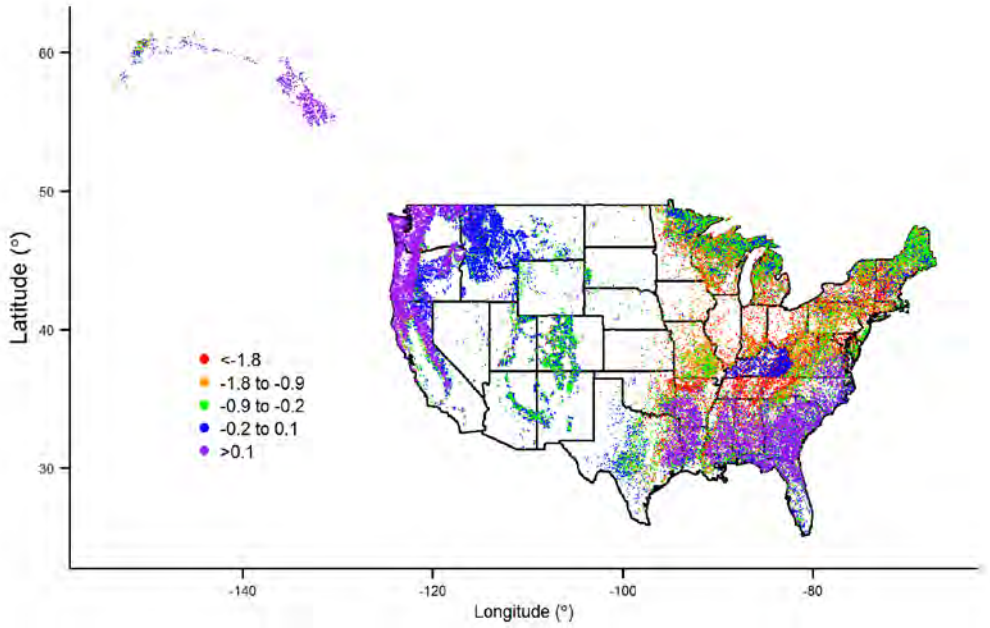
- Estimated from models based on live tree C density, forest type, and geographic area
- Includes above and belowground portions of seedlings, shrubs, and bushes
- Refinements currently underway…



Russell, M.B., D'Amato, A.W., Schulz, B.K., Woodall, C.W., Domke, G.M., and Bradford, J.B. 2014. Quantifying understory vegetation in the US Lake States: a proposed framework to inform regional forest carbon stocks. *Forestry*.

Birdsey, R.A. 1996. Carbon storage for major forest types and regions in the conterminous United States. In. Sampson, N., Hair, D. eds. Forests and global change. Volume 2: forest management opportunities for mitigating carbon emissions. Washington DC: American Forests: 1-25, Appendix 2-4.

Belowground



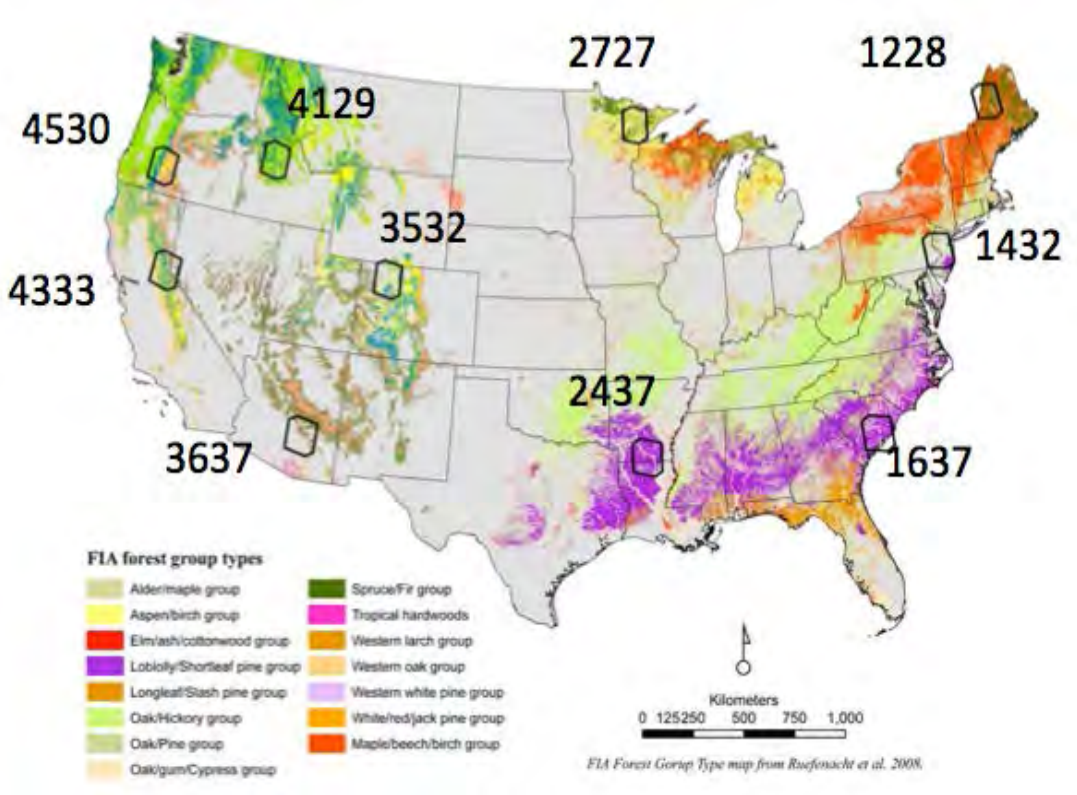
- Static allometric equations
- Ratio of total aboveground biomass and tree DBH
- Per emerging research (Reich et al. 2014) incorporate climate variables

Russell, M.B., Domke, G.M., Woodall, C.W., D'Amato, A.W. In Review. Comparisons of allometric and climate-derived estimates of tree coarse root carbon in forests of the United States: Implications for the National Greenhouse Gas Inventory. Intended outlet: Climatic Change

Reich, P.B., Luo, Y., Bradford, J.B., Poorter, H., Perry, C.H., Oleksyn, J. 2014. Temperature drives global patterns in forest biomass distribution in leaves, stems, and roots. Proc. Natl. Acad. Sci. U.S.A. 111:13721-13726.

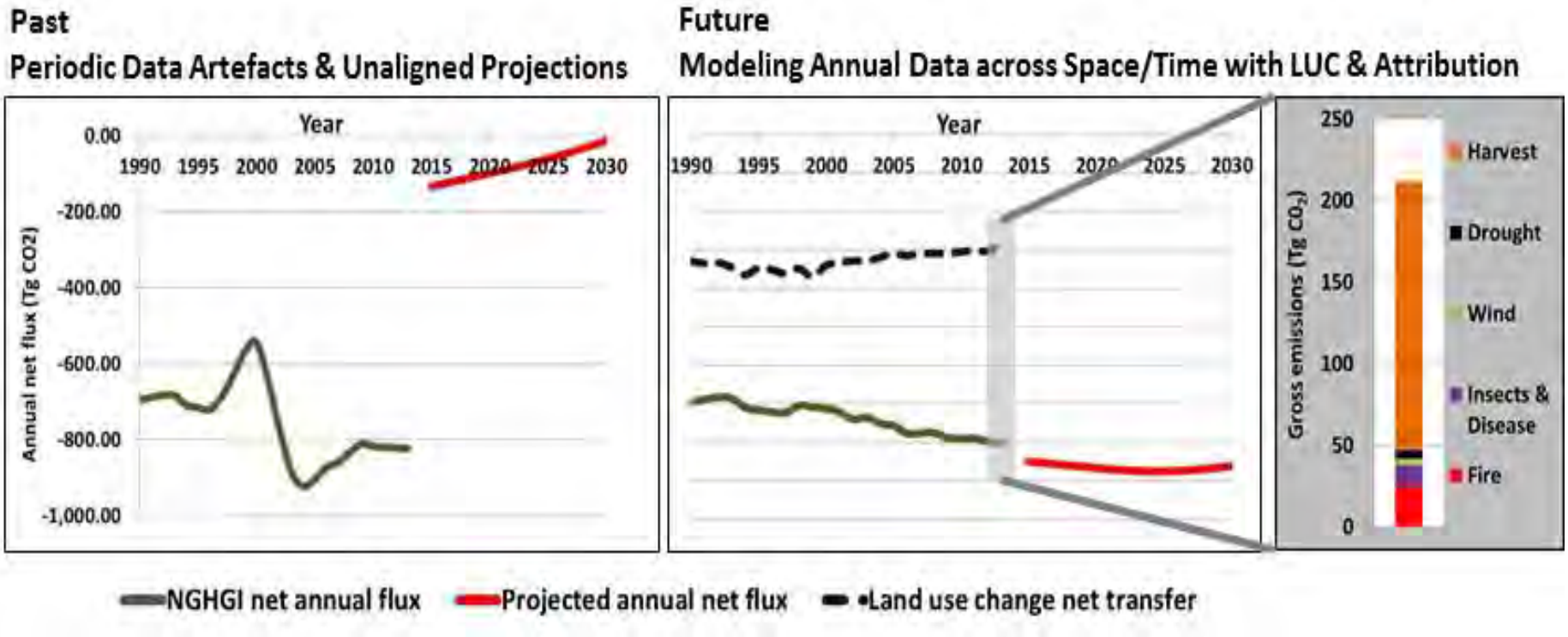
LiDAR and LANDSAT

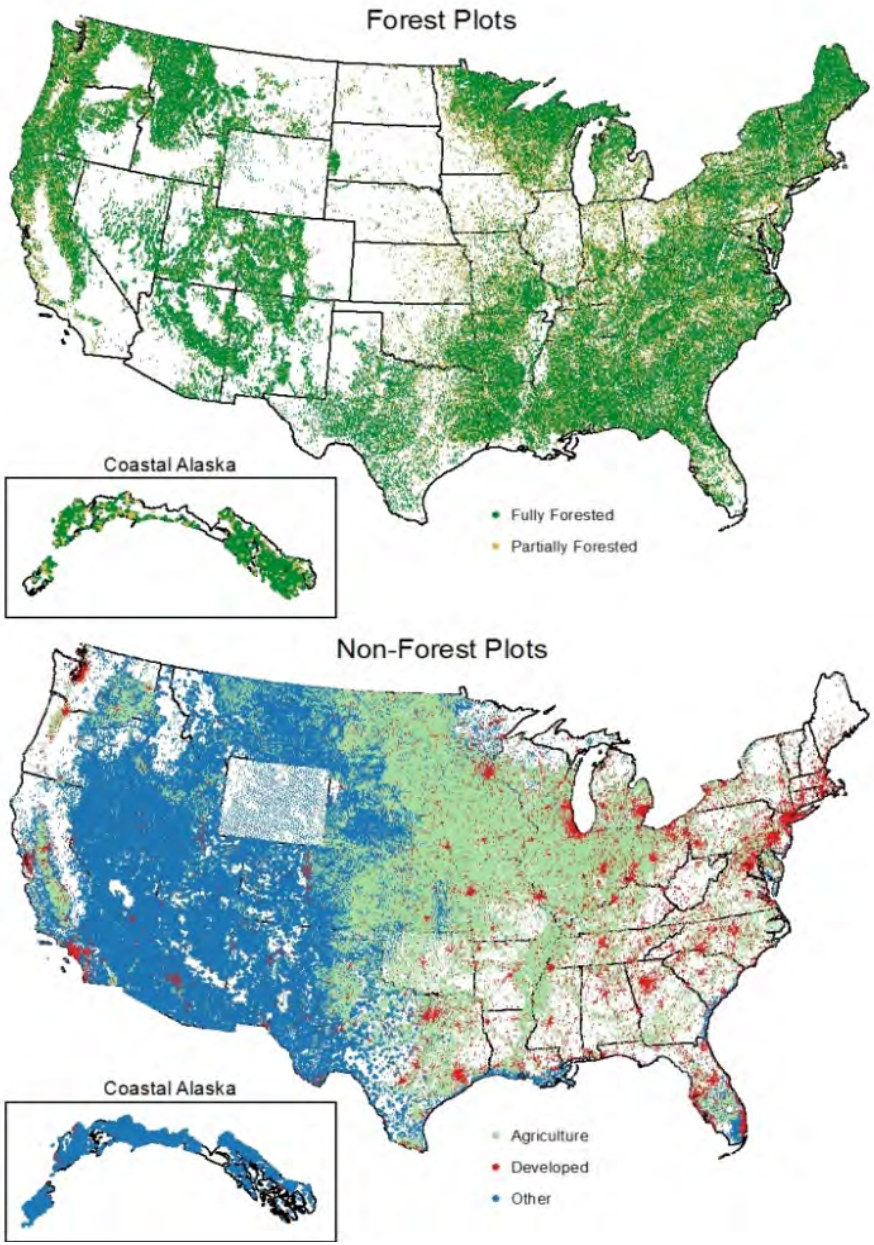
- Landsat offers opportunities to refine C baselines back to 1990
- LiDAR offers efficient manner to estimation AG biomass for areas such as interior Alaska
- NASA engagement recruits $$$ for FIA research



Cohen et al., and Nelson et al., NASA, Carbon Monitoring Systems Projects

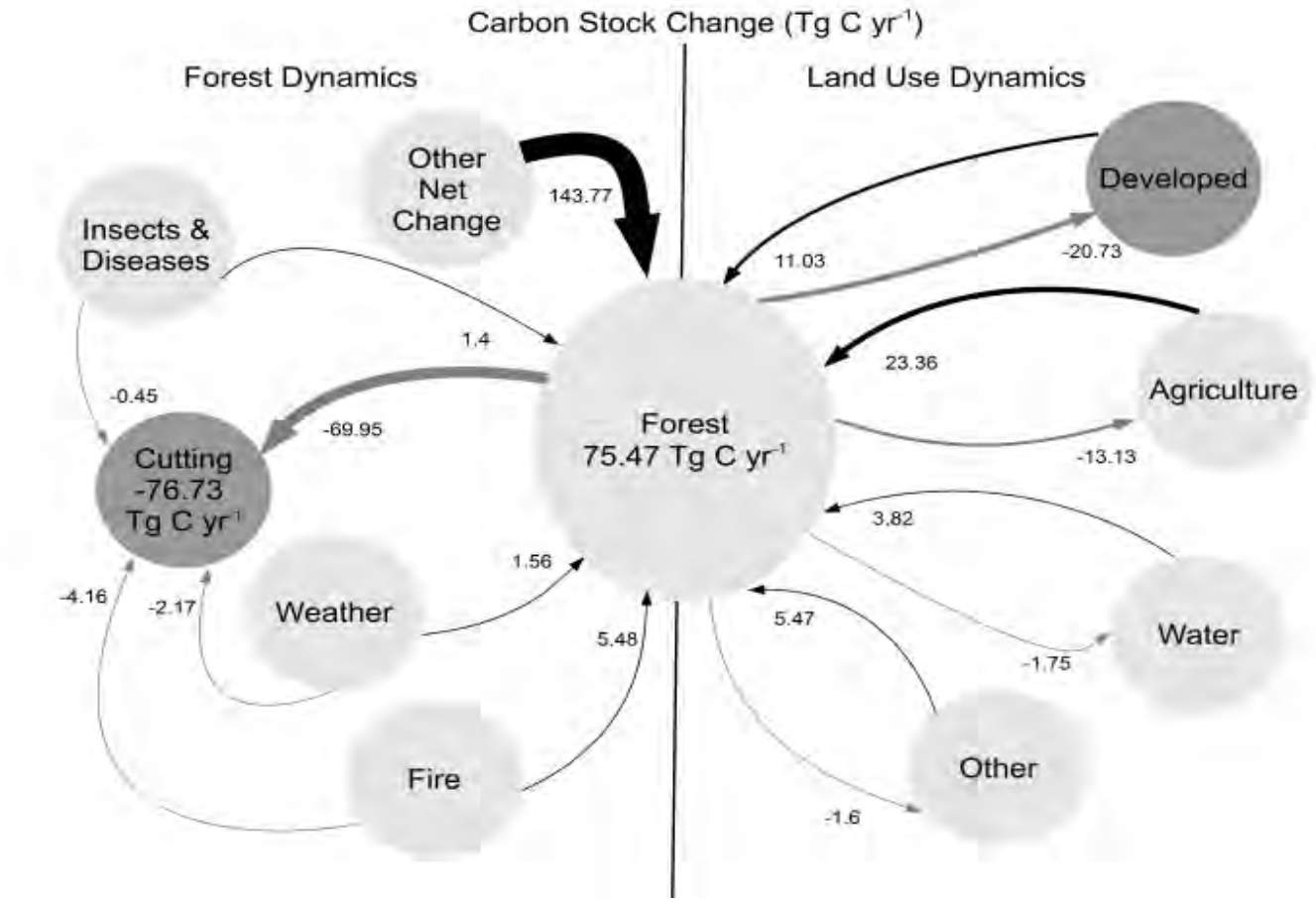
New Accounting System 2016





Leverage FIA'S Plot Network: Forest and Nonforest (ICE)

Disentangle Carbon Changes from Growing Forest, Land Use Change, and Disturbance



New System: "Doubling Down" on Modern FIA

- Older, periodic inventories will be removed from the accounting system,
- A modeling approach will be used to move the annual inventory system back (to 1990) and forward (to 2030),
- Allometric models will be refined (e.g., foliage) based on emerging research,
- In situ measurements of non-tree carbon pools (e.g., forest floor) will be used wherever possible,
- Repeated measures of the 360,000+ permanent locations will be used to inform land use change and disturbance effects on carbon stocks,
- Elements of this same approach, coupled with emerging research (e.g., airborne laser scanning), can be applied in interior Alaska.

Final Thoughts

- Annual progress to improve NGHGI
  - Refine stock estimation by pool
  - Improve LUC and baselines
- Benefits current and future commitments but also biomass and climate change monitoring
- For US…long history of resource monitoring across land uses…how do we bring together for future carbon monitoring (e.g., NRI)?
- Become final authority on "State of US Terrestrial Carbon"

Questions????

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