Recent research insights in forest biomass and carbon estimation

Matthew Russell

30 Nov 2022

California Air Resources Board -
U.S. Forest Projects Compliance Offset Protocol Workshop

arbor-analytics.com

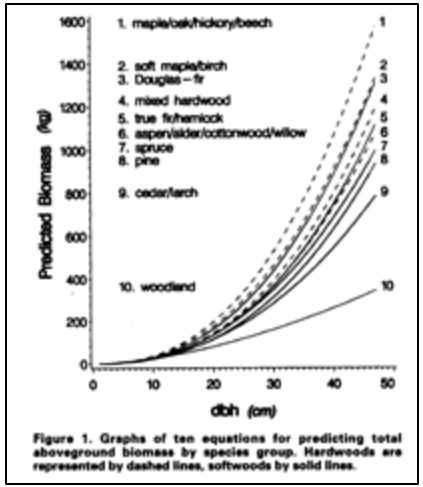
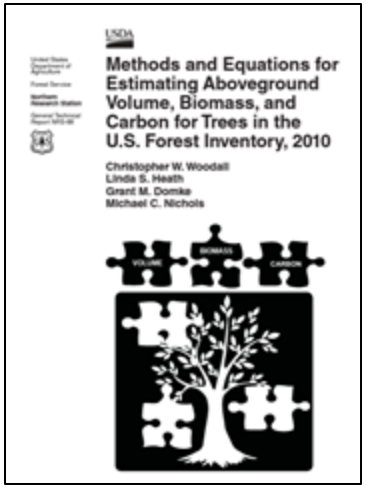


Figure 1. Graphs of ten equations for predicting total aboveground biomass by species group. Hardwoods are represented by dashed lines, softwoods by solid lines.



Jenkins biomass equations

"A call to improve methods for estimating tree biomass for regional and national assessments"

2003

2011

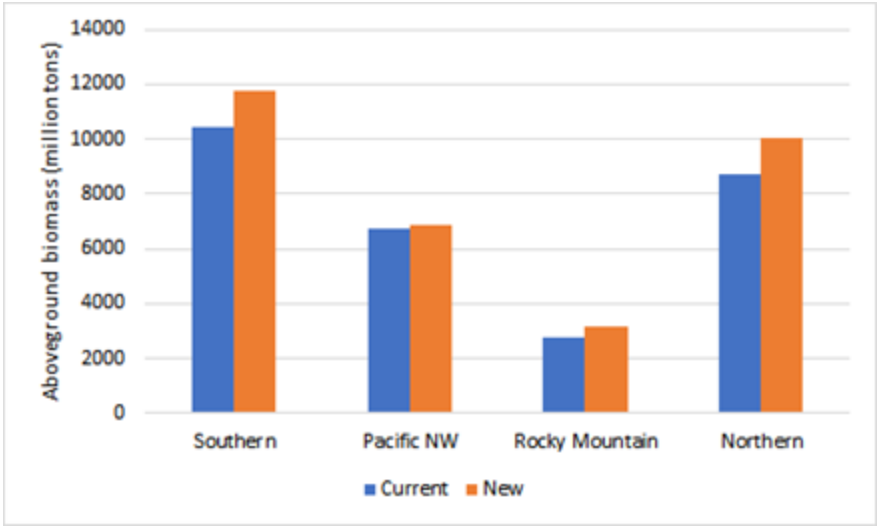
US Forest Service Component Ratio Method

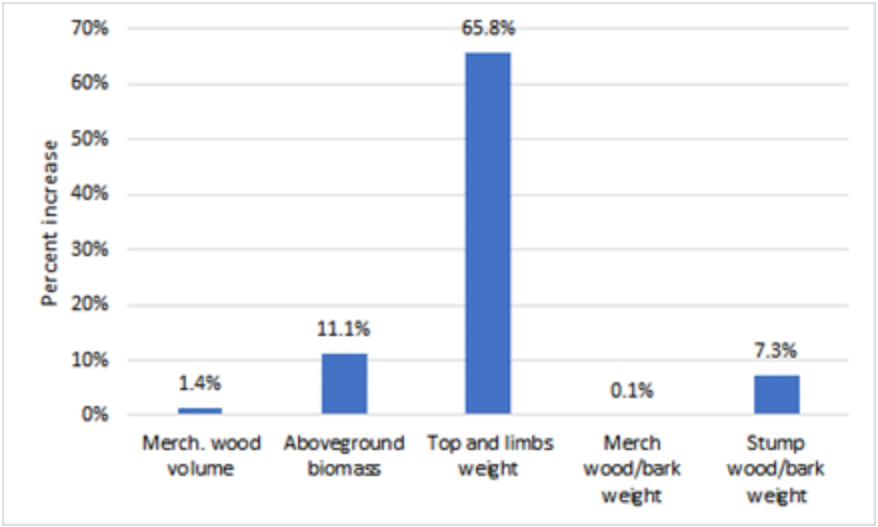
2015

2022

New volume-biomass equations for US tree species

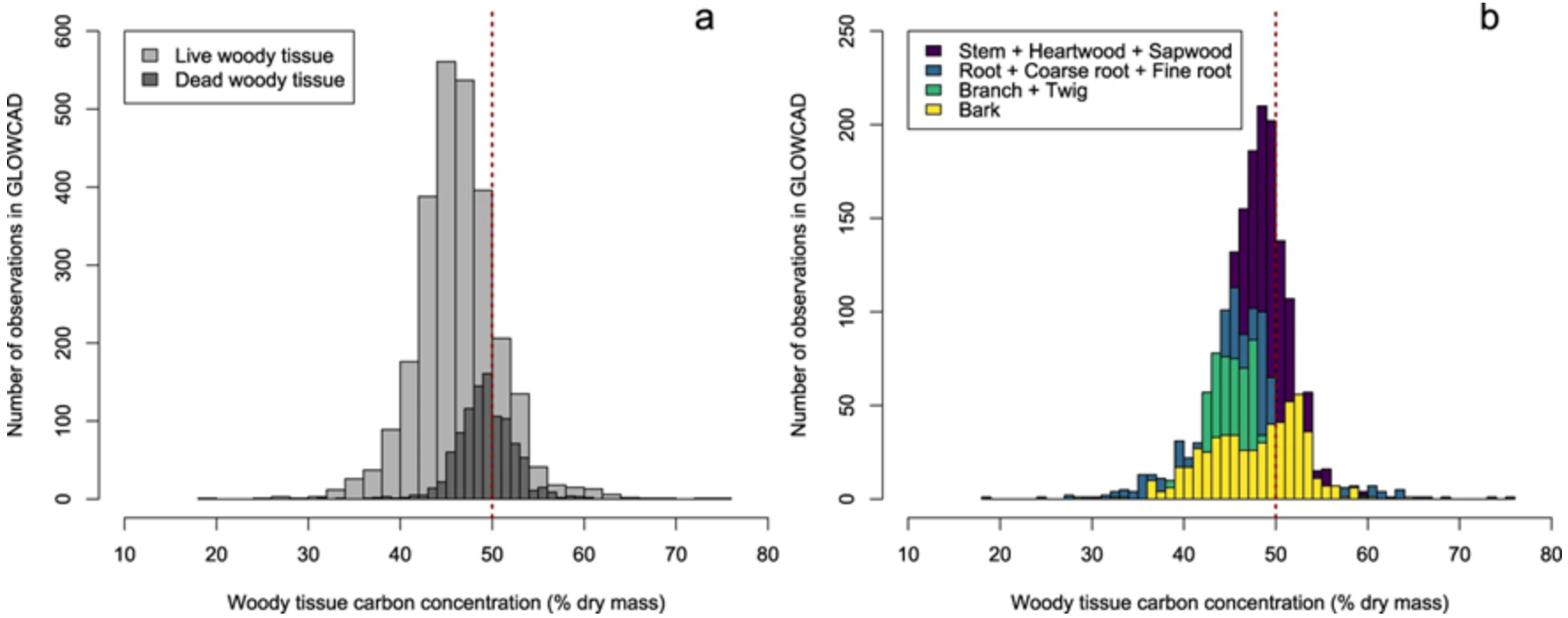
New national scale volume and biomass estimators show an 11% increase in aboveground biomass.





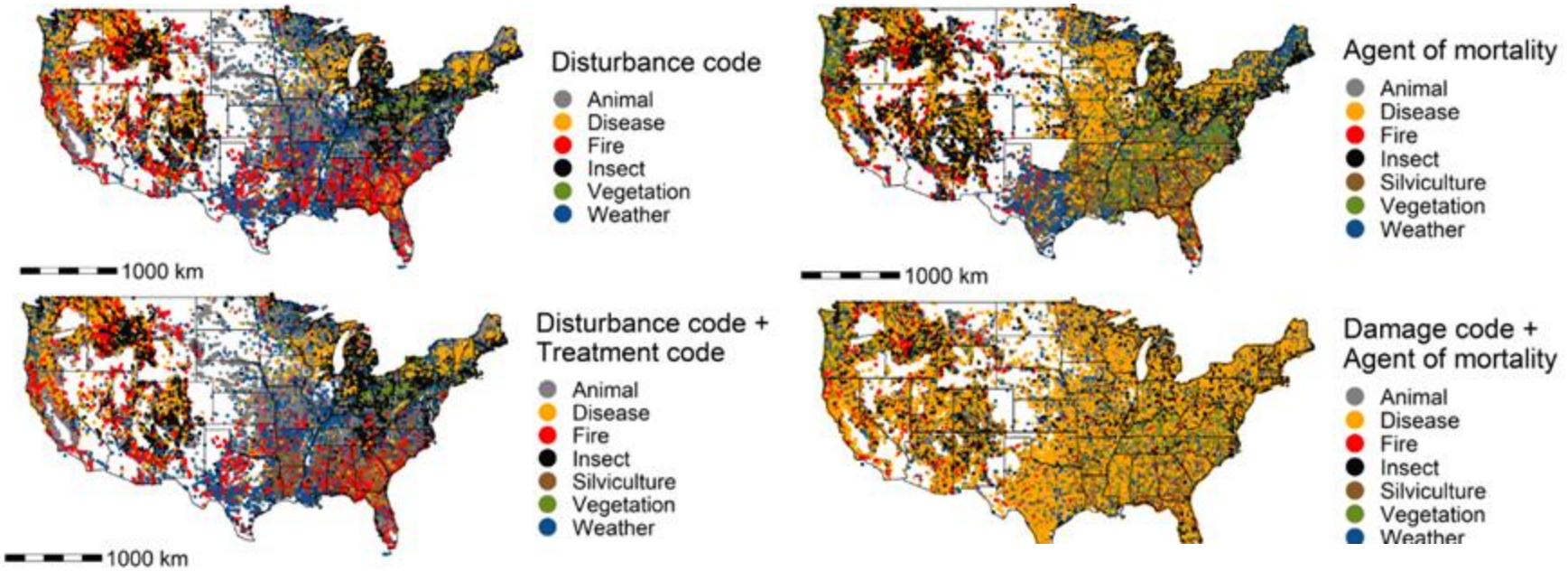
Source: USDA Forest Service, https://www.fs.usda.gov/research/research/inventory/FIA/VBC (July 2022)

Beyond the 50% assumption: carbon fractions in wood.



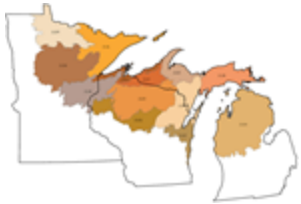
Source: Doraisami, M., R. Kish, N.J. Paroshy, G.M. Domke, S.C. Thomas, and A.R. Martin. 2022. A global database of woody tissue carbon concentrations. *Scientific Data* 9(1):284.

How we quantify forest disturbance matters.



Source: Fitts, L.A., G.M. Domke, and M.B. Russell. 2022. Comparing methods that quantify forest disturbances in the United States' national forest inventory. *Environ. Monit. Assess.* 194(4).

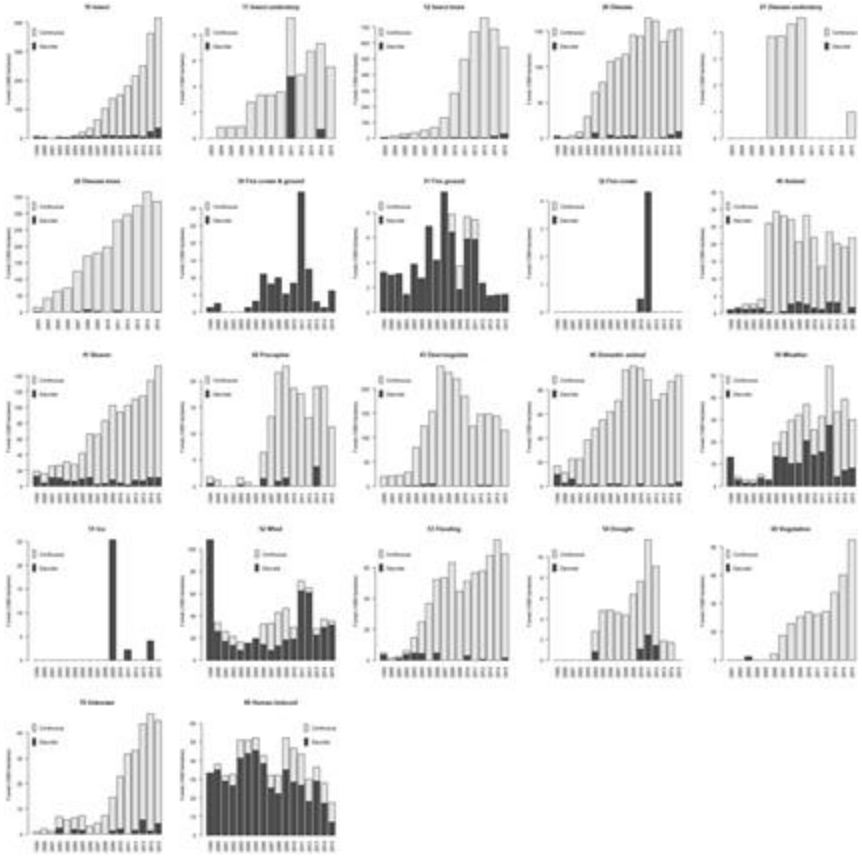
More disturbances to forests.
More detailed approaches to monitor disturbance.



Field guide	INVYR[1]	Total number of disturbance agents listed	Disturbance agents added	Disturbance years estimated
1.3	2000	16		1999–2015
1.4	2001	17	43	2000–2015
1.5	2002	18	60	2001–2015
2.0	2004	23	11,12,21,22,95	2003–2015
4.0	2008	28	90,91,92,93,94	2007–2015

[1] Inventory year that the field guide was first generally applied across the study area.

Source: Edgar, C.B., and J.A. Westfall. 2022. Timing and extent of forest disturbance in the Laurentian Mixed Forest. *Frontiers in Forests and Global Change* 5.

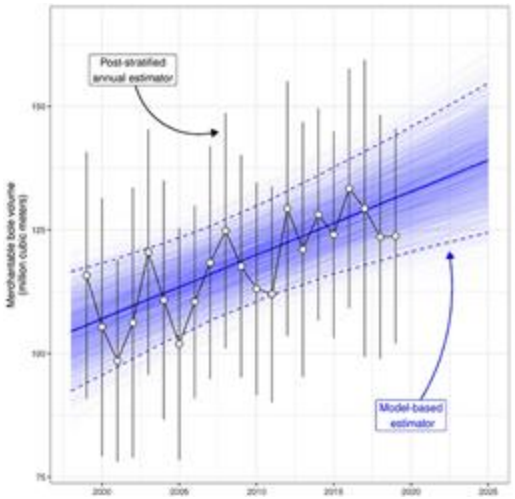


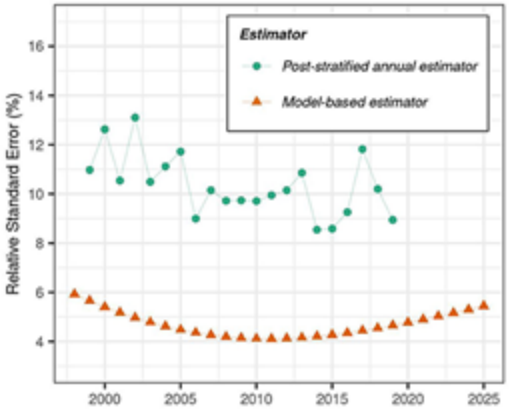
Small area estimation: forest inventory + other data

SAE: statistical approaches that improve the precision of forest inventory estimates for small geographic areas.

Incorporates additional data beyond the plot measurements (e.g., remote sensing data).

Results in more precise estimates.



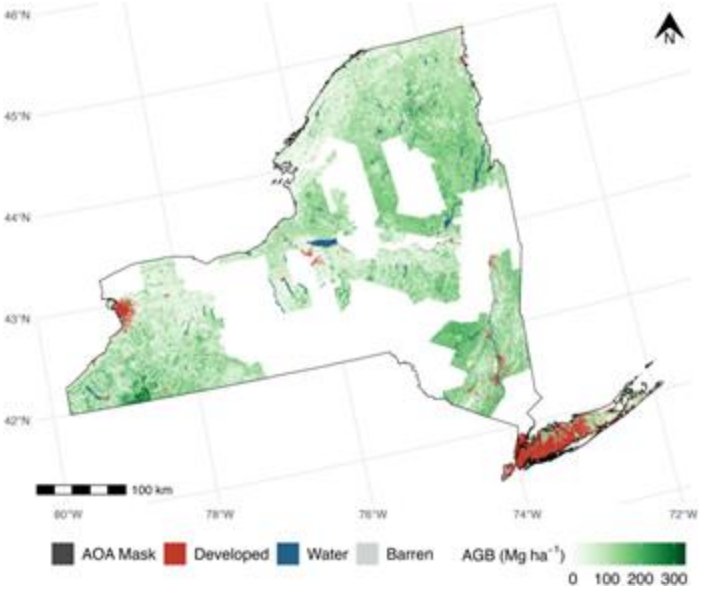


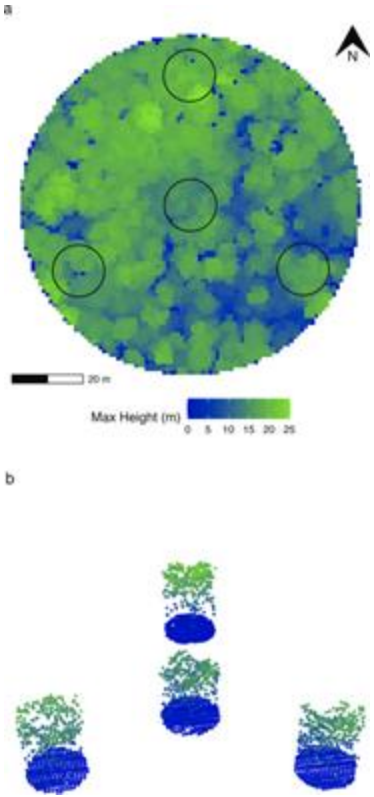
Washington County, Maine

Source: Stanke, H., A.O. Finley, and G.M. Domke. 2022. Simplifying small area estimation with rFIA: a demonstration of tools and techniques. *Frontiers in Forests and Global Change* 5.

Integrating inventory data with remote sensing.

- Trained models with FIA data, LiDAR, topographic, and climate variables.
- Explained up to 80% of variation of field observations.
- Produced 30 m AGB prediction surfaces.



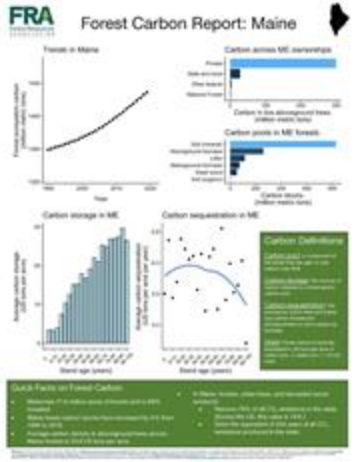


Source: Johnson, L.K., M.J. Mahoney, E. Bevilacqua, S.V. Stehman, G.M. Domke, and C.M. Beier. 2022. Fine-resolution landscape-scale biomass mapping using a spatiotemporal patchwork of LiDAR coverages. *Int. J. Appl. Earth. Obs. Geoinf.* 114:103059.

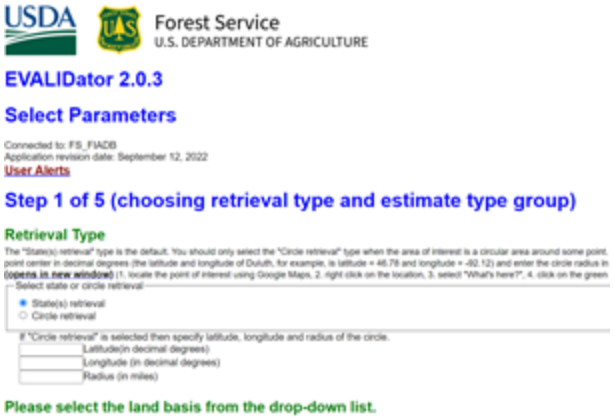
Improved tools to access forest carbon information

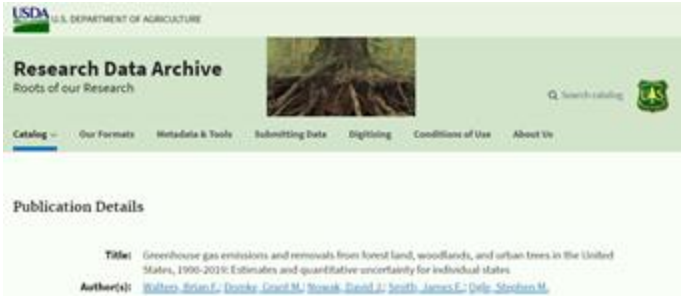
FIA DataMart

rFIA



FIA EVALIDator





Forecasting forest carbon

- Approved growth and yield tools for carbon accounting.
- Developed have recently improved access
  - Improved user interface
  - Source code availability
- Research need: continue to develop/integrate new equations and validate/benchmark.

FVS software: https://www.fs.usda.gov/fvs/software/index.shtml

Thank you!

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