Analyzing and Influencing Carbon Sequestration in Harvested Wood Products

Alan Arnholt, Ben Jones, Hannah X Laws, Kelly Loucks, Eric Marland, Andrew Sullivan

Department of Mathematical Sciences

Appalachian State University

Abstract

WOODCARB3 expands the capabilities of the WOODCARB2 spreadsheet model by changing to an R package platform. The conversion brings increased capability for data manipulation, analysis, and reporting. It also increases the ease of integration with other datasets. This poster describes some of the results and demonstrates some of the potential for the WOODCARB3 model. Examples of the types of analysis possible include uncertainty analysis, sensitivity analysis, alternate model dynamics, alternate pathways.

Introduction

WOODCARB2 is used to document and calculate the total carbon stocks from harvested wood products (HWP). The statistics package R offers a wide variety of tools and interfaces with other software packages.

Sequestration of carbon in forests accounts for 87% of total CO_2 removals in 2014. Carbon mitigation efforts have thus focused much attention on reforestation, forest management,and forest based products. According to the most recent report to the **UNFCCC**, an estimated 18.7% of the total carbon in woody materials is contained in harvested wood **(HWP and SWDS).**

The amount of carbon in **HWP** and **SWDS** depend on how much wood is harvested, what types of products are produced, how the products are use, the lifetime of the wood products, and how the wood is processed at the end of its primary product lifetime.

Sources of Data and Equations

I. Input data from reports by Hair, Ulrich, Howard, Ince, etc.

II. The Production Approach is:

$$\frac{44}{12} * \left(-\Delta C_{HWP\ IU\ DH} - \Delta C_{HWP\ SWDS\ DH} \right) \quad (1)$$

III. $\frac{44}{12}$ converts Carbon to CO_2

IV. $\Delta C_{HWP\ IU\ DH}$ is change in stock of HWP in use from domestic harvest

V. $\Delta C_{HWP\ SWDS\ DH}$ is change in stock of HWP in SWDS from domestic harvest

Methodology

- Most analysis done with the Production approach.
- The Production approach focuses on carbon

Uncertainty Analysis

- Information is intended to aid in international discussions and any agreements about managing greenhouse gas emissions and sinks.
- Also provides national level methods and estimates of carbon sinks and emissions associated with HWP.
- The package provides quick accessibility, allowing data to be updated, modified, and manipulated with ease.

Projected Carbon Contribution

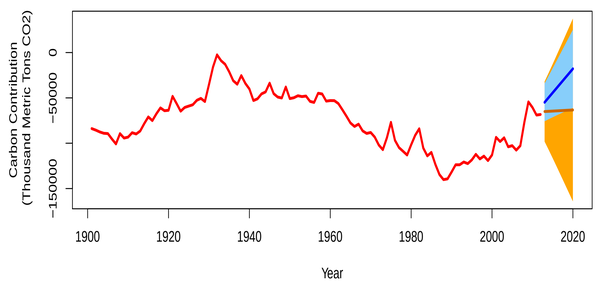

Figure: projections based on 5-year (orange) and 10-year (blue) simple linear regression

Total HWP Carbon Stocks with Uncertainty

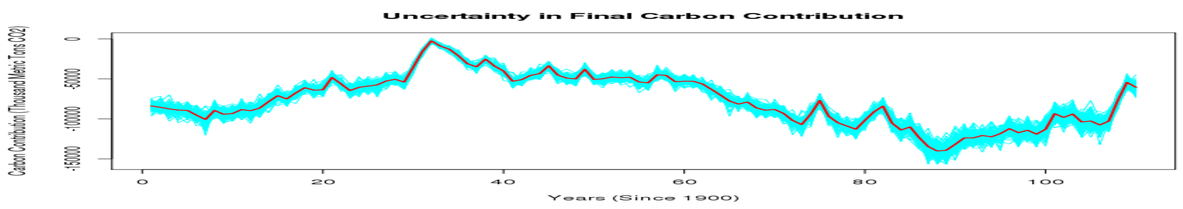

Figure: this is the caption that shows what is in the figure that explains the plot of HWP stocks and provides and envelope of uncertainty around it this is the caption that shows what is in the figure that explains the plot of HWP stocks and provides and envelope of uncertainty around it

Decay

- Decay functions are based on the gamma distribution:

$$\int_0^n \frac{1}{\Gamma(k)\theta(k)} x^{k-1} e^{-x/k} dx$$

- WOODCARB2 used an exponential decay where $k = 1$ in the gamma distribution
- Two alternate decay functions, $k = 2$ and $k = 10$, were calculated by altering k in the gamma distribution and introduced in the WOODCARB3R package

Decay of Hardwood in Multifamily housing

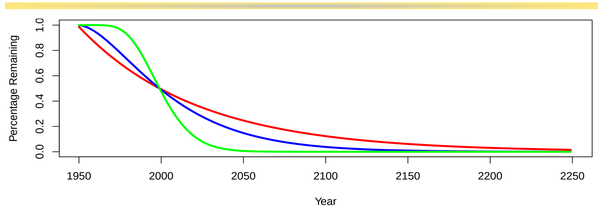

Figure: This figure shows the over effect of the decay function on multifamily housing built in 1960

Halflife Table

	Half Life	1990	2000	2010
Single Family	78	49326.24	68293.97	68979.34
Multi Family	47.69	98724.8	2380.01	1756.76
Shipping	38.03	10878.75	13989.01	11874.62
House Furn	38.03	5175.2	9369.04	8638.16
Comm. Furn	38.03	1180.03	3612.24	3657.69
Industrial	38.03	34036.33	31405.34	26583.78
Other	38.03	12834.98	18264.28	16991.37
Resid Upkeep	23.13	167096.43	172797.32	114967.8
Paper	2.53	6391552.25	3603762.53	139374.49

Figure: Figure caption

Overall Decay

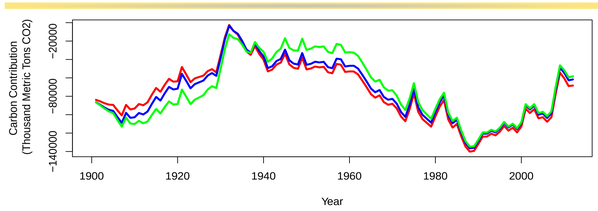

Figure: This figure shows the over effect of the decay function on Carbon Sequestration

Sensitivity Analysis

- Halflife role in final carbon contribution calculation.
- Error is assumed to be N(1,.2).
- Assume how well halflifes hold with applied error.
- Results can be used to improve half-lives.
- Results can also show which half-lives are concerete.

Sensitivity Plot

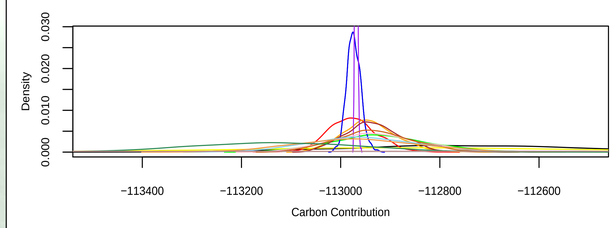

Figure: Figure New.Nonres.Rties and New.Nonres.Rcar.Repair have the least variance.

Sensitivity Affect

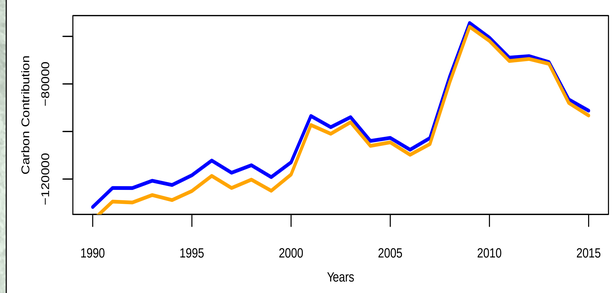

Figure: This is a comparison between Paper half-life and a 50 percent increase.

Discussion

- Targeted changes in average half life can increase total stocks.
- End of life dynamics make a big difference in stock size.
- Sensitivities help channel reductions in uncertainty.

Acknowledgements

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Contact Information and Package Access

- Email: marlandes@appstate.edu
- Online link: WOODCARB3R package