



Analyzing and Influencing Carbon Sequestration in Harvested Wood Products

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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 CO₂ 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 used, 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, Inc., etc.
 - II. The Production Approach is:
- $$\frac{44}{12} * (-\Delta C_{HWP \text{ IUDH}} - \Delta C_{HWP \text{ SWDS DH}}) \quad (1)$$
- III. $\frac{44}{12}$ converts Carbon to CO₂
 - IV. $\Delta C_{HWP \text{ IUDH}}$ is change in stock of HWP in use from domestic harvest
 - V. $\Delta C_{HWP \text{ SWDS DH}}$ 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

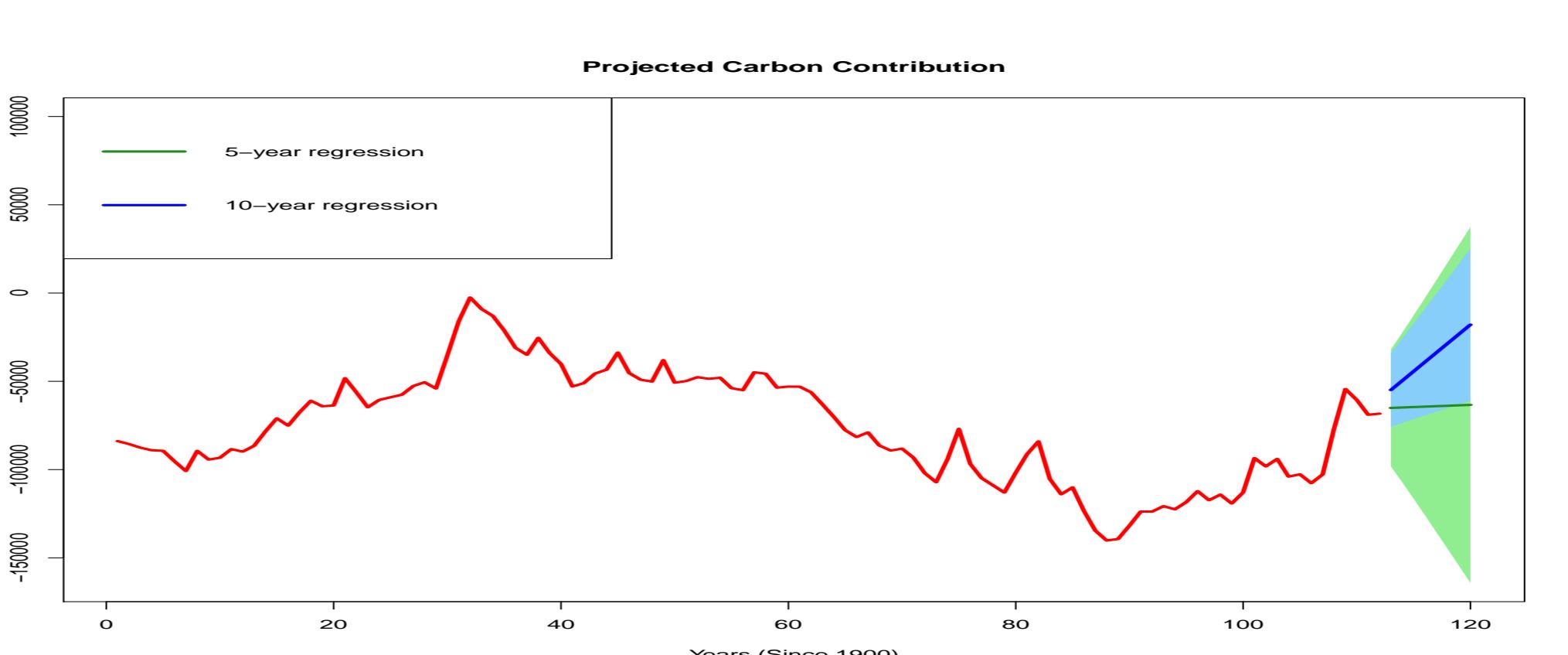


Figure 1: Projected carbon contribution based on five and ten year regressed projections.

Sensitivity Analysis

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

Sensitivity Plot

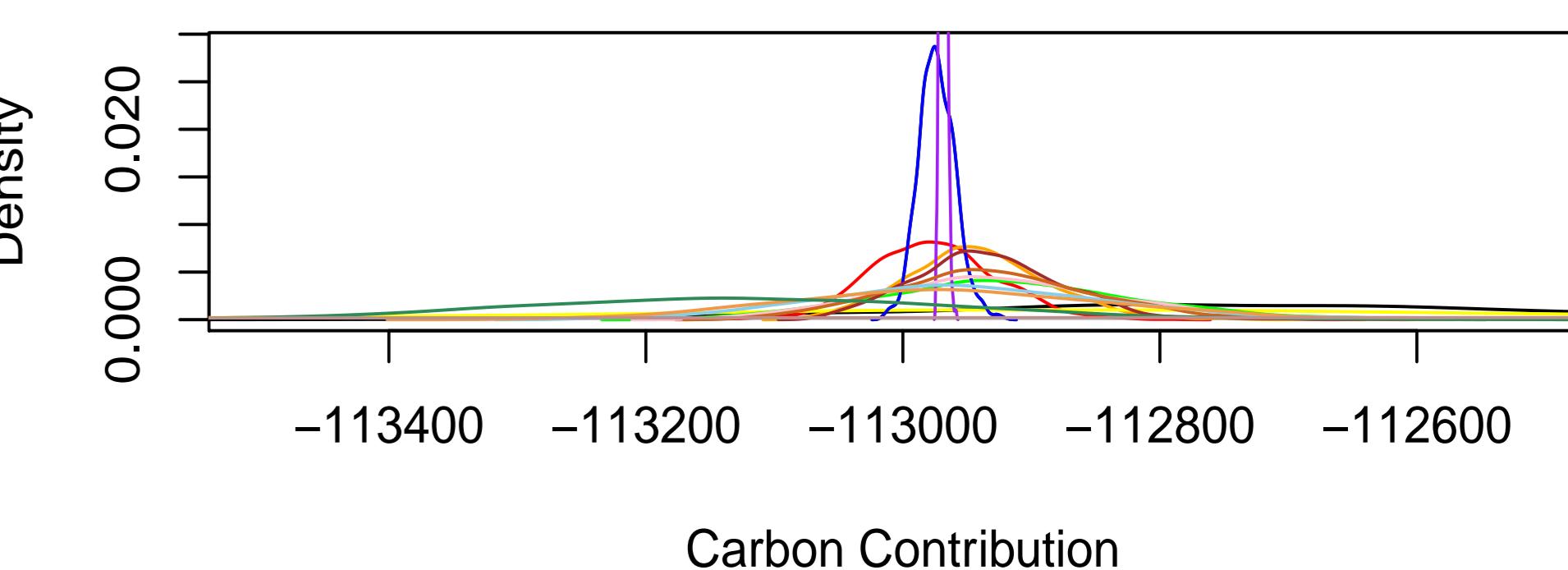


Figure: Figure New.Nonres.Rties and New.Nonres.Rcar.Repair have the least variance.

Total HWP Carbon Stocks with Uncertainty

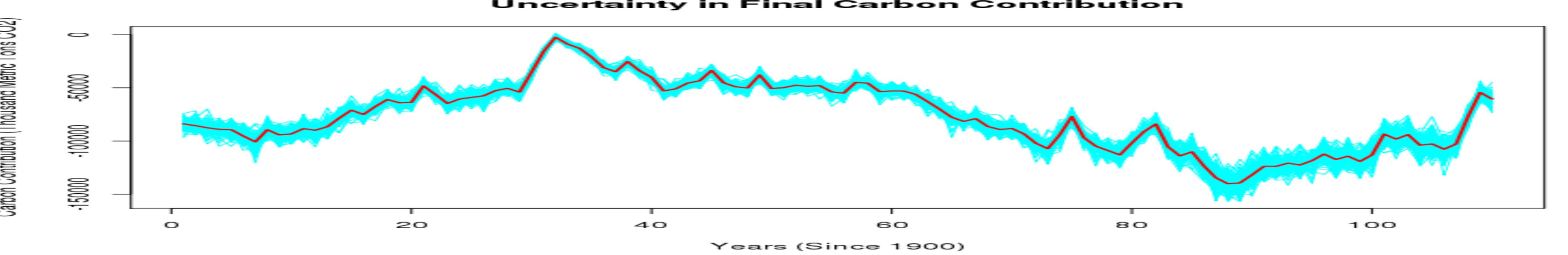


Figure: this is the caption that shows what is in the figure that explains the plot of HWP stocks and provides and envelope of uncertainty around it this is the caption that shows what is in the figure that explains the plot of HWP stocks and provides and envelope of uncertainty around it

Decay

- Decay functions are based on the gamma distribution:

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

- 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

Halflife Table

Half Life	1990	2000	2010
Single Fam Homes	78	49326.235419467	68293.9690705363
Multi Fam Homes	47.68835339937108	98724.8007179637	2380.01084123663
Shipping	38.0284145354606	10878.7494765968	13989.006528278
House Furniture	38.0284145354606	5175.20002571365	9369.04368951025
Comm. Furniture	38.0284145354606	1180.03262578815	3612.23906154734
Industrial	38.0284145354606	34036.325290149	31405.3383220674
Other	38.0284145354606	12834.9814511951	18264.2846333669
Res Upkeep	23.1334540304859	167096.425781801	172797.319502826
Paper	2.53087281800454	6391552.24965238	3603762.53086556
			139374.493167519

Figure: Figure caption

Decay of Hardwood in Multifamily housing

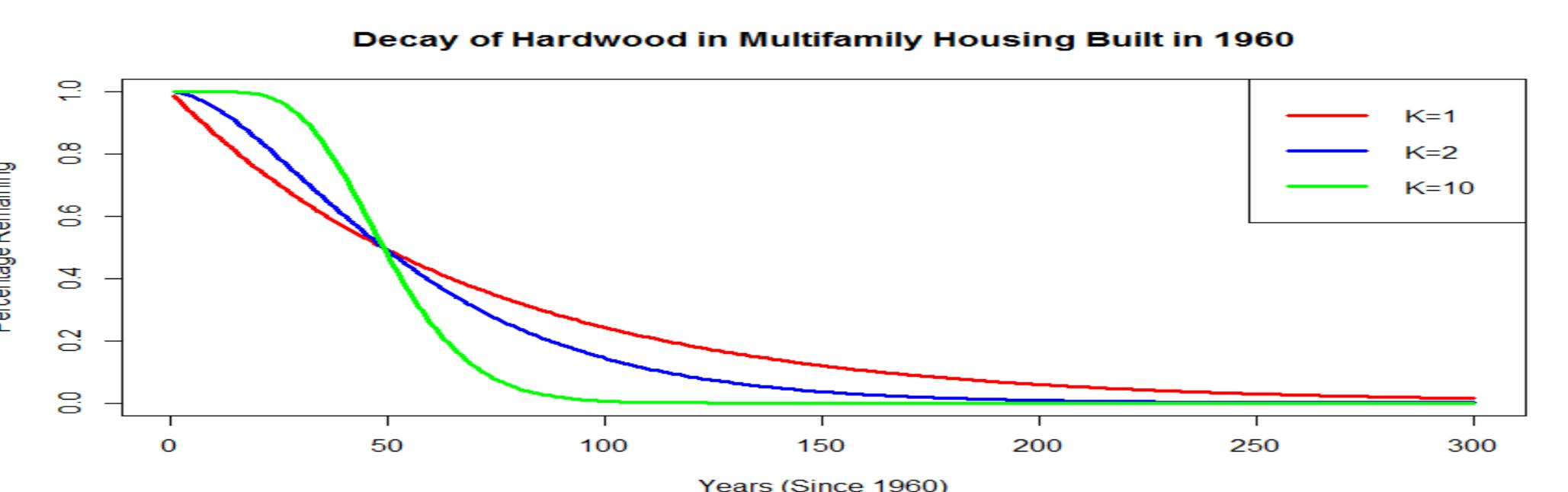


Figure: This figure shows the over effect of the decay function on multifamily housing built in 1960

Overall Decay

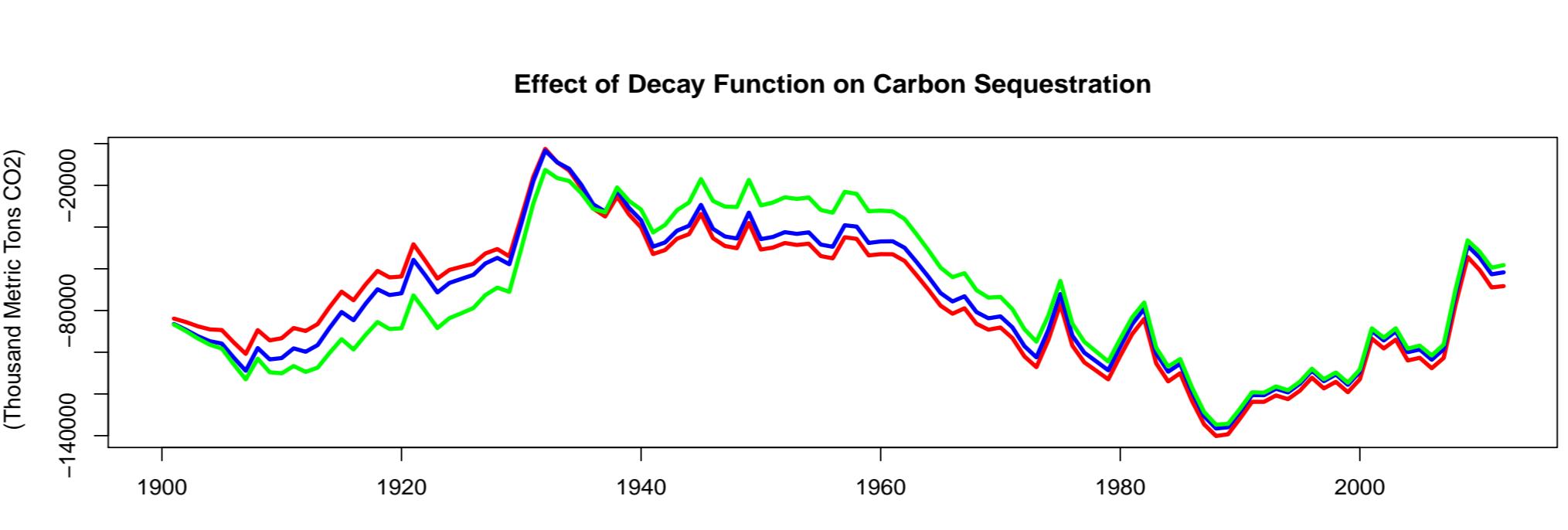


Figure: This figure shows the over effect of the decay function on Carbon Sequestration

Acknowledgements

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Contact Information and Package Access

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