QUANTIFYING CARBON SEQUESTRATION IN FOREST PLANTATIONS BY MODELING THE DYNAMICS OF ABOVE- AND BELOW-GROUND C POOLS

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Abstract--Intensive pine plantation management may provide opportunities to increase carbon (C) sequestration in the Southeast USA. Developing management options that increase fiber production and soil C sequestration require an understanding of the biological and edaphic processes that control soil C turnover. Belowground C resides primarily in three pools: roots, necromass (litter, roots), and soil. There is little evidence that intensive management affects mineral soil C.

INTRODUCTION
Forests are being considered as one option for stabilizing or reducing atmospheric CO_2. Forests can reduce atmospheric CO_2 by storing C in biomass, soil, and products and can be used as biofuel offsetting fossil fuel (Birdsey and Heath 2001). However, forests grown into perpetuity will provide no long-term CO_2 reduction because eventually C losses will equal or exceed C gain. Management of forest C sequestration should be viewed as a temporary mitigation effort spanning 50-100 years as new technologies to store C or reduce C emissions are developed.

Forests will likely never be managed solely for C sequestration (Johnsen and others 2004). However, the potential economic value of emission credits from C sequestration might provide a co-benefit that, depending on financial value, could affect management practices (Birdsey 2006). Intensive pine plantation management may provide opportunities to increase C sequestration in the Southeast USA.

MATERIALS AND METHODS
First-degree headings should be left justified using uppercased letters with a blank line preceding the heading. Text should begin on the line immediately below the heading. Suggested first order headers are: MATERIALS AND METHODS, RESULTS, DISCUSSION, CONCLUSIONS and LITERATURE CITED.

Second-Degree Headings
Second-degree headings should be left justified, using initial capitals for major words with a blank line between the second-degree heading and the preceding paragraph. Text should begin on the line immediately below the heading. Do not leave a blank line between first-degree heading and second-degree heading.

Third-degree headings--Third-degree headings should be left justified using lowercased letters, except for an initial capital on the first word. The last word should be followed by two dashes. Text begins immediately after the dashes with no spaces.

RESULTS
Place all tables and figure captions at the end of the manuscript. Typeset the tables in 9-point Helvetica. Typeset the text within graphics in Helvetica. On the manuscript's paper copy, mark the first reference to each table and figure with a highlighter.

DISCUSSION

CONCLUSIONS
The analyses shown in this study, while informative, are simple and not sufficient to quantify marketable C credits. However, we contend our approach is the most valid way to address the problem. Our results suggest that short-rotation; high productivity forests potentially can be managed for C sequestration, and

management practices that optimally increase productivity and retard necromass decomposition will provide the greatest C sequestration.

ACKNOWLEDGMENTS

This section, if needed, should be placed after the conclusions section under the first-degree heading

LITERATURE CITED

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Van Lear, D.H.; Kapeluck, P.R.; Parker, M.M. 1995. Distribution of carbon in a Piedmont soil as affected by loblloly pine management. In: Carbon form and functions in forest soils. Soil Science Society of America, Madison, WI: 83-91.

Table 1--Simulated mean integrated carbon storage over a 60-year project period. Carbon (C) storage in aboveground, belowground, and harvested biomass are compared for 20-year and 15-year rotations for stands under a range of treatments: no treatment (NT), weed control (WC), and fertilization plus weed control (FWC). Δ BG is the increase in belowground C storage compared to NT.

Treatment	**Rotation (years)**	**Total C Storage**	**Aboveground C Storage**	**Belowground C Storage**	**Δ BG**	**Harvested Biomass**
		----------------------------Mg C $ha^{-1}yr^{-1}$-------------------------				**Mg C ha^{-1}**
NT	**20**	28.0	14.8	13.2		197.1
WC	**20**	61.9	38.0	23.9	10.7	271.8
FWC	**20**	80.7	51.2	29.5	16.3	340.8
WC	**15**	54.4	28.0	26.4	13.2	344.0
FWC	**15**	72.9	39.8	33.1	20.0	438.4

FIGURE CAPTIONS

Figure 1--Conceptual changes in carbon storage in a pine plantation in aboveground and belowground pools over a 25-year rotation. Changes in soil matrix carbon reflect changes in the organic matter carbon pool above a baseline.

FIGURES

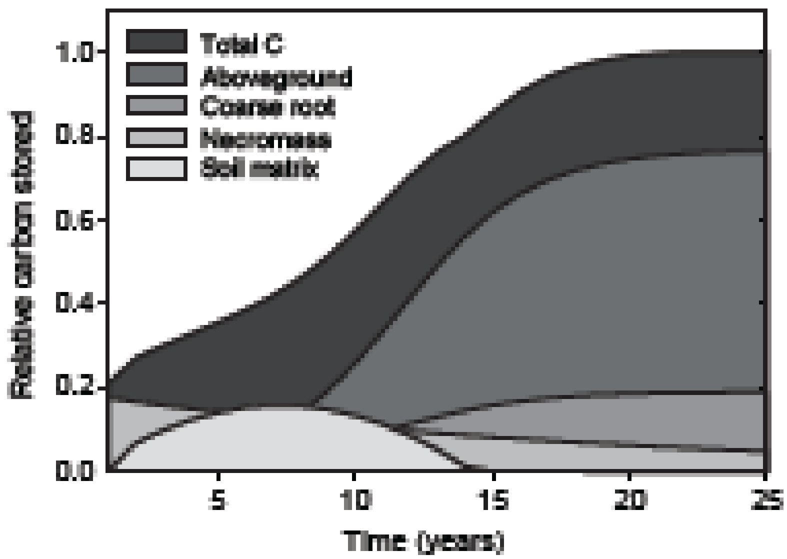
Total C
Aboveground
Coarse root
Necromass
Soil matrix
Relative carbon stored
1.0
0.8
0.6
0.4
0.2
0.0
5
10
15
20
25
Time (years)

Figure 1