ESTIMATING AND COMPARING THE CARBON SEQUESTRATION POTENTIAL OF WETLANDS AND THE OCMULGEE RIVER FLOODPLAIN

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Introduction

This study estimates and compares the carbon stock in the Ocmulgee River Floodplain and Fall Line Hills District of the Georgia Coastal Plain. Due to periodic inundation in wetland and river floodplain environments, these areas share many of the same environmental conditions. They have similar hydrologic and geologic conditions, as well as similar types of vegetation characteristics.

The carbon stock was estimated in trees and soil layers, as well as the carbon flux due to soil respiration. Tree diameter at breast height (DBH) was measured in 10 x 10 meter plots, and their carbon storage was determined using empirical equations. The total carbon within the first meter of soil was quantified from samples collected within the tree plots. These samples were sent and tested at an off-site CN Analyzer. Respiration rates were measured using homemade respiration chambers and a Vernier CO_2 probe attached to a Vernier LabQuest 2 meter. The sampling points within each site were located in areas sharing visually similar characteristics. After initial chamber pressurization, carbon dioxide concentrations were measured over a 15 minute interval. Linear regression of the CO_2 concentrations and the dimensions of the monitoring chambers were used to calculate the rate of CO_2 released per second per unit area (ppm sec^{-1} /$meter^2$). Within the wetlands, there were differences in plant cover, diversity, and abundance. Respiration rates within the wetlands varied widely with initial rates ranging from 35 ppm s^{-1} /m^2, to 420 ppm s^{-1} /m^2.

One of the primary objectives of this study was to quantify local carbon storage and observe the differences of carbon storage between some of the major local environments. We tried to incorporate all aspects of a local carbon budget, including geologic and biologic storage, as well as fluxes due to soil respiration.

Methods

Soil Carbon

- Soil samples were taken from within vegetation plots.
- 1 meter soil pits were dug, samples were taken every 20 cm.
- Samples were oven-dried at 75 °C for a minimum of 20 hours and then ground until they were able to pass through a 2 mm sieve (US Standard #10).

- Ground and dried samples were sent to Clemson University Agricultural Service Laboratory.
- C/N analysis was completed using Elementar Vario Micro, using combustion analysis.
- A distribution curve showing total carbon concentrations at different depths was made. (Figure 1 & 2).

Tree Storage

- 10 x 10 meter plots were marked and all trees within the plot were identified and had their diameters at breast height (DBH) measured.
- Trees less than 5 cm in diameter were not included in the study.
- The number of plots done at each site varied.
- Tree biomasses were calculated using the Jenkins Biomass Equation.

$$BM = e^{(\beta_0 + \beta_1 \ln dbh)}$$

- Carbon stock was then estimated using the standard carbon coefficient of biomass (0.55).
- Site wide averages for all the plots were calculated to determine dendrological Carbon storage.
- Graphs comparing soil total carbon storage versus dendrologic storage were also created. (Figure 3)

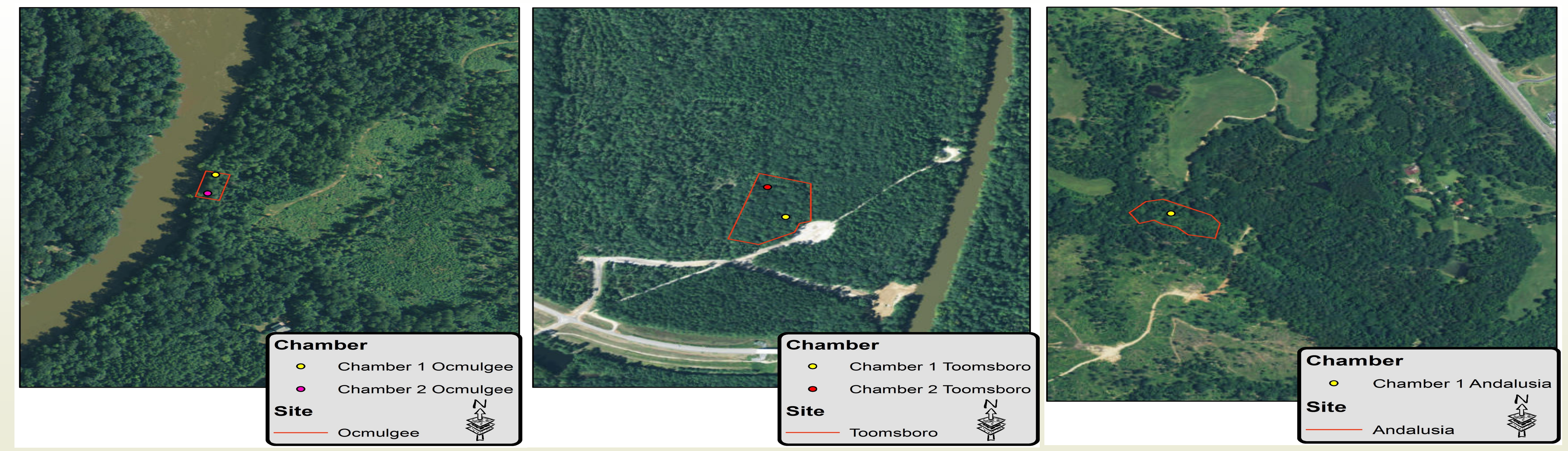
Soil Respiration

- Chambers to measure soil respiration were created by removing the bottom of contractor buckets. These buckets were placed in the ground to allow for maximum pressurization. (Figure 4)

Figure 4. Example of Soil Respiration chamber, as well as Vernier Lab Quest 2 data logger with CO_2 probe. The logger is showing typical CO_2 concentrations

- Andalusia had 1 chamber, while all other locations had 2.
- A Vernier Lab Quest CO_2 sensor was used to measure CO_2 concentrations over a 15 minute period.
- Regression analysis was done to determine the rate of CO_2 release.
- Using the rate of CO_2 build up in the chamber, as well as the area of the ground the chamber was covering, we were able to quantify a rate of CO_2 release per unit area, in this case we used ppm/s^{-1}/m^2.
- A graph comparing rates between sampling trips and locations was created. (Figure 5)

Study Sites



Results

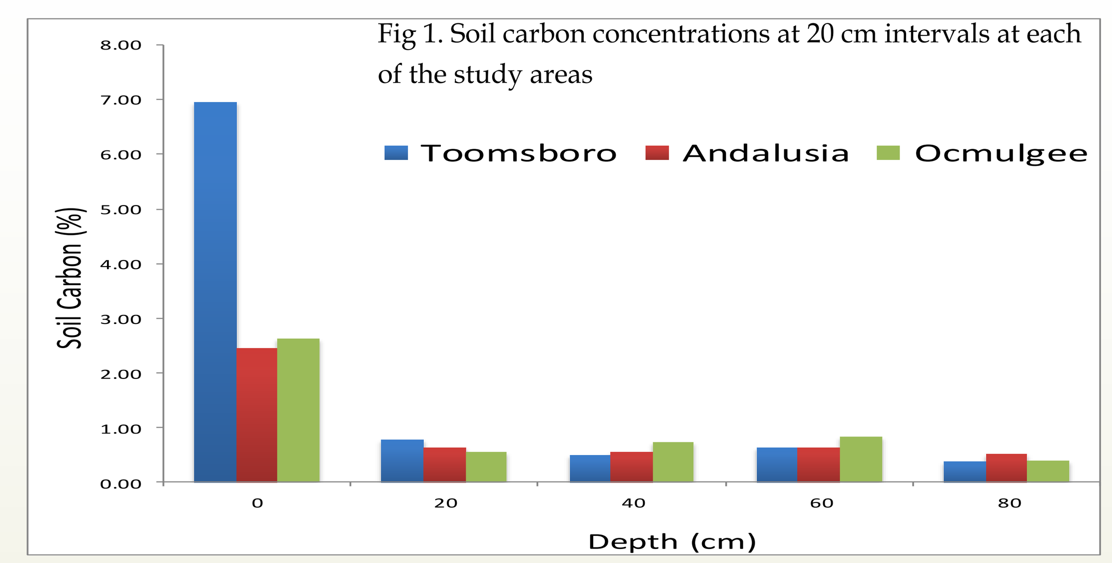


Fig 1. Soil carbon concentrations at 20 cm intervals at each of the study areas

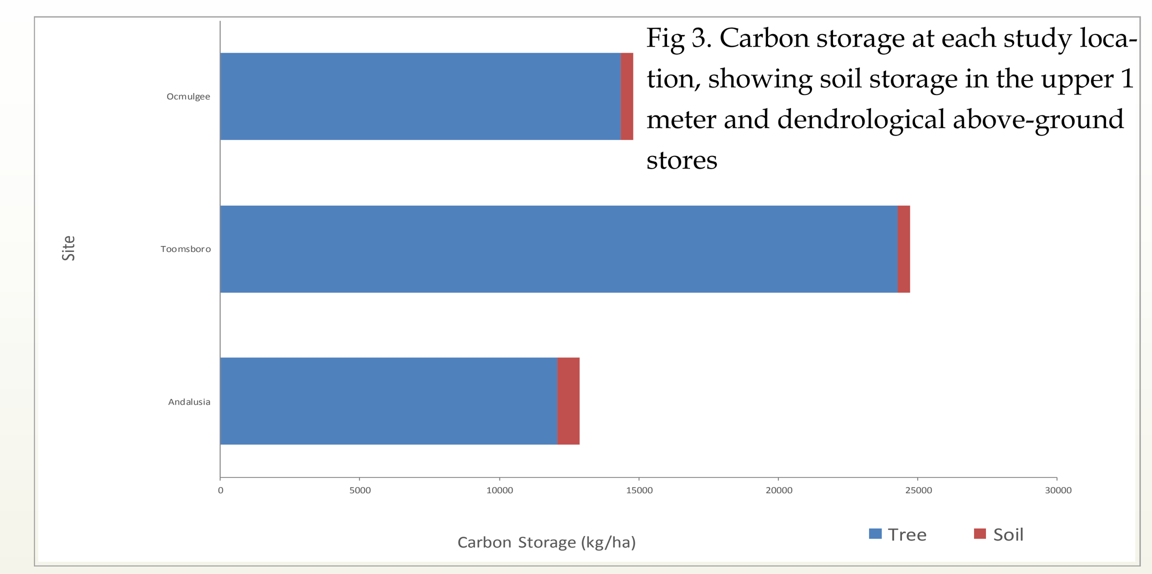


Fig 3. Carbon storage at each study location, showing soil storage in the upper 1 meter and dendrological above-ground stores

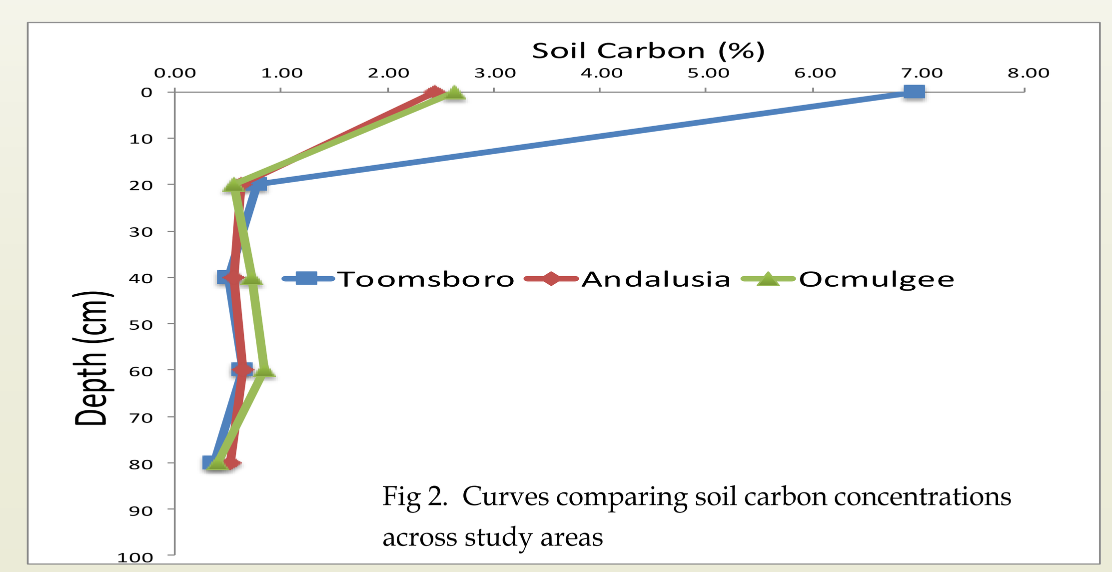


Fig 2. Curves comparing soil carbon concentrations across study areas

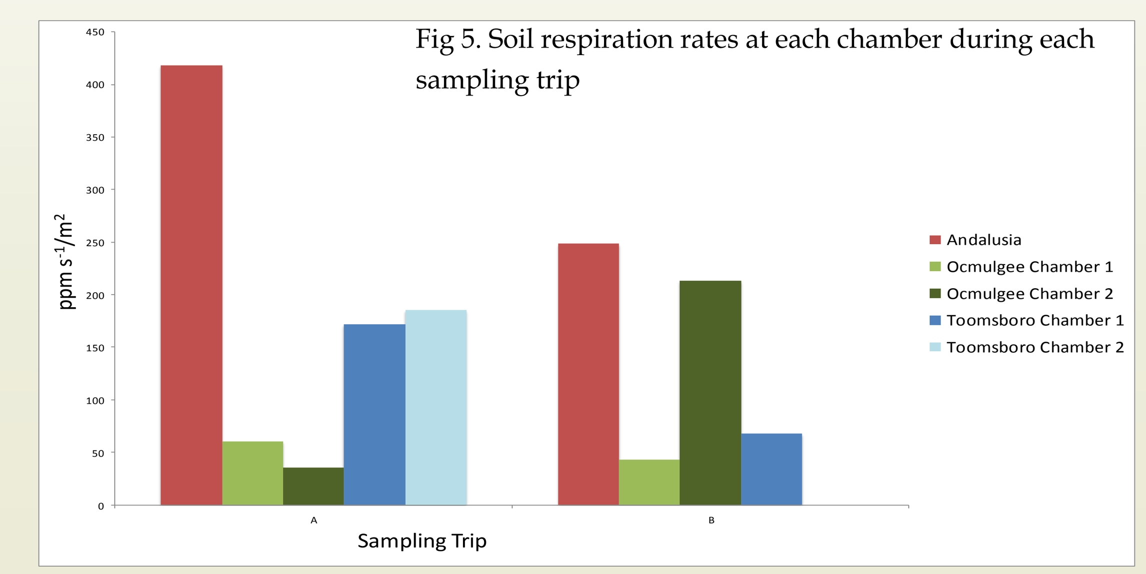


Fig 5. Soil respiration rates at each chamber during each sampling trip

Conclusions

- The largest concentrations of carbon was limited to the upper 20 cm. After that depth, concentrations level off to comparable amounts at all sites.
- There were not significant differences in total soil carbon between sites, the largest concentration in the upper 20 cm of Toomsboro may be at attributed to its periodic flooding, causing the area to turn into a marsh/swamp.
- Respiration rates were highest at Andalusia, which could be due to it having the heaviest vegetation cover. More sampling of respiration rates is needed to come to any sort of supportable conclusion. Protocol needs to be improved to check rates at more even intervals and more often.
- Comparing carbon sequestration of soils and trees showed a large difference. The concentration of carbon per hectare was much higher in trees than it was in the soils. The concentration of carbon within trees was almost two orders of magnitude greater than that of the carbon storage in soils. This might change with depth but further studies are needed to analysis the correlation of carbon concentration as it pertains to depth.

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