Investigating the Dynamics of the Largest Terrestrial Carbon Pool on Earth

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Introduction to My Research

Currently, researchers across the globe are trying to understand the dynamics of carbon pools that may accelerate or help to mitigate climate change by releasing or storing carbon, respectively. Soil contains vast quantities of carbon, which could be released into the atmosphere as CO_2 if it is metabolized by microbes. I am working to understand how vulnerable these carbon stores are to disturbances such as land use change (clearing of forests), and climate change, which could increase soil temperatures. My work takes place both in the Northeastern US, where clearing forests is posed to increase as alternative energy sources are utilized, and in Greenland, where soil carbon is stored in rapidly-warming soils.

Why Soil Matters to Our Climate

- Soil is the largest terrestrial carbon pool on earth, storing up to five times the quantity of carbon found in plants.
- The size of this pool suggests that small changes to it could have a significant impact on atmospheric CO_2 levels.
- Soil plays a key role in forest health by maintaining the quality and quantity of soil organic matter (SOM).
- *Deep* SOM has been increasingly studied as a major pool in the global carbon cycle, and its sensitivity to environmental conditions suggests that tree harvest could affect SOM stability.

The potential for deep soil to act as a significant source of carbon under certain environmental conditions and ecosystem transitions is currently unmeasured for our region. Our research aims to quantify post-harvest carbon loss from mineral soil pools in the Northeast and determine mechanisms that may be causing carbon loss.

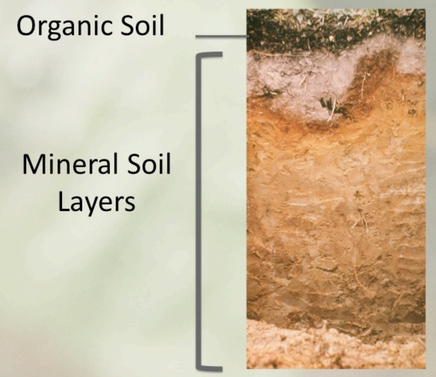

Photo: NSRC

Methodology

I extract soil to 60 cm depth in the mineral soil, sampling in 10-cm increments. I utilize the quantitative pit and deep-soil core methods. I look at several chemical and physical variables of the soil, such as texture, pH, and mineralogy to begin to understand variables influencing carbon storage. I also measure temperature and moisture deep within soils, in order to understand how land use change may affect environmental variables.

From Left: The first layer of a soil pit, solar panel used to collect environmental data, lysimeter, soil corer, mineral samples.

Results

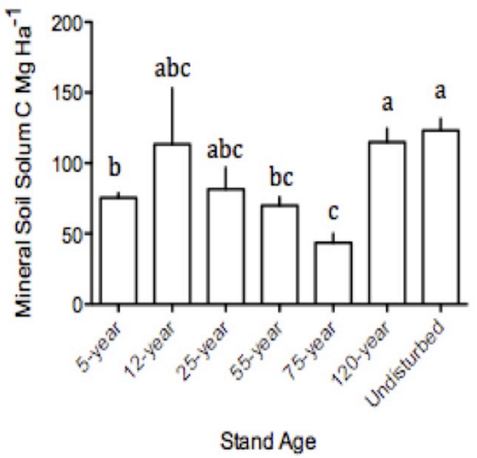

Figure 1. Soil carbon stocks vary across the landscape in aggrading forests that have been clear-cut in the past.

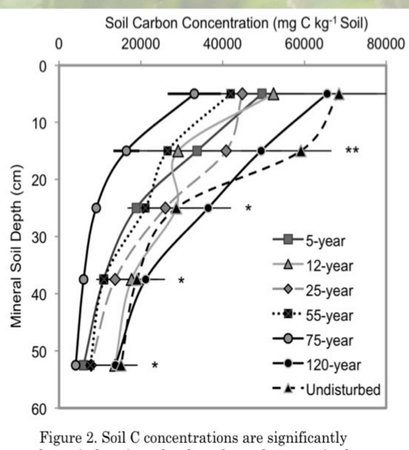

Figure 2. Soil C concentrations are significantly lower in locations that have been clear-cute in the past 100 years, as opposed to undisturbed or >100-yr. old forests. Mineral soil depth is presented on the vertical axis for ease of observing the trend with depth. Stars denote significant differences, where * and ** indicate significance at the 0.05 and 0.01 levels, respectively. Error bars show the standard error of the mean.

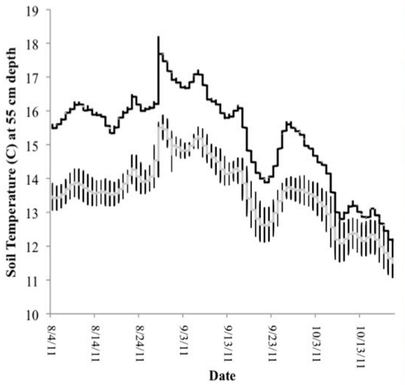

Figure 3. Soil temperature is higher in a clear cut forest at 55 cm depth, as compared to nearby forested areas. Biological processes' rates, such as microbial respiration, increase exponentially with temperature.

Conclusions

Disturbances, such as clearing forests, do affect both carbon concentrations and pools in Northeastern forests. Soil temperatures are also higher, even deep within the soil, which can affect biological and chemical processes. Results from our 202 Greenland soil sampling are forthcoming. We hope we can contribute new information about the protection of carbon in soils in a changing climate.