



Effect of Drier Summers on Deep Soil Carbon

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Introduction

Southeastern U.S. forests contain 1/3 of the contiguous U.S. forest carbon and form the backbone of an industry that supplies 60% of the U.S. timber output and 16% of global industrial wood. (1)

In the southeast U.S. it is predicted to be warmer and drier in the summer in coming decades (2). The soil carbon pool, as the largest pool of carbon on land, could lose 0.7% of its content for every degree of global warming during this century, 5.8% of the global net primary production on land. (3)

This research is designed to reduce precipitation by 30% which is at the extreme end of predictions for precipitation and soil moisture variation associated with climate change for this region. There is specific interest in looking at the effects of the drying on soil carbon and particularly the role of increased summer drying on deep soil carbon.

Method

Loblolly pine (*Pinus taeda*) were planted in 2005 at a spacing of 2.1 x 3.5m. A2x2 factorial experiment with 4 replicate blocks (Fig. 1) has been installed with the following treatments: Control (C); Fertilizer (F); Throughfall exclusion (R; see Fig. 2); Fertilizer + throughfall exclusion (FR).

Method



Fig. 1 Blocking map



Fig. 2 Throughfall exclusion structure

Soils were sampled pre-treatment at 0-10, 10-20, 20-50, 50-100, 100-150, 150-200, 200-250 and 250-300 cm depths and will be sampled again in following years. These samples are also being incubated in sealed 1 L jars at field moisture capacity and 35°C to estimate CO₂ release. Gas samples for CO₂ were taken at 1, 2, 4, 7, 12 and 24 h. CO₂ concentration was analyzed with LI-COR 7000. Repeated wetting and drying cycles will be applied to these samples.

Soil samples were also analyzed for C, N and other mineral content. VWC (volumetric water content) data are being collected to match the depths of soil incubation samples. Soil textures are also being evaluated by the hydrometer method as a covariate for CO₂ efflux.

Preliminary Results

VWC (%) was around 20% through the whole profile in Dec. 2012. Paired with soil texture data, plant available water is higher in top soil than in deep soil, with increases below 100 cm. (Table1)

Soil respiration in incubations was much higher in 0-10 cm soil (24%) than deeper soils. At all depths, there are significant increases of CO₂ (%). (Fig. 3)

Table. 1 VWC of all depths , soil texture and C and N content

Depth (cm)	0-10	10-20	20-50	50-100	100-150	150-200	200-250	250-300
VWC(%)	21.6	17.8	18.1	21.5	20.9	20.0	21.2	22.1
Sand (%)	33.3	34.6	29.2	11.9	15.5	13.8	10.3	20.5
Silt (%)	56.1	42.0	36.4	47.5	44.1	51.2	59.4	53.9
Clay (%)	10.7	23.4	34.3	40.6	40.4	35.0	30.4	25.5
C (%)	1.77	0.80	0.58	0.25				
N (%)	0.09	0.05	0.05	0.03				

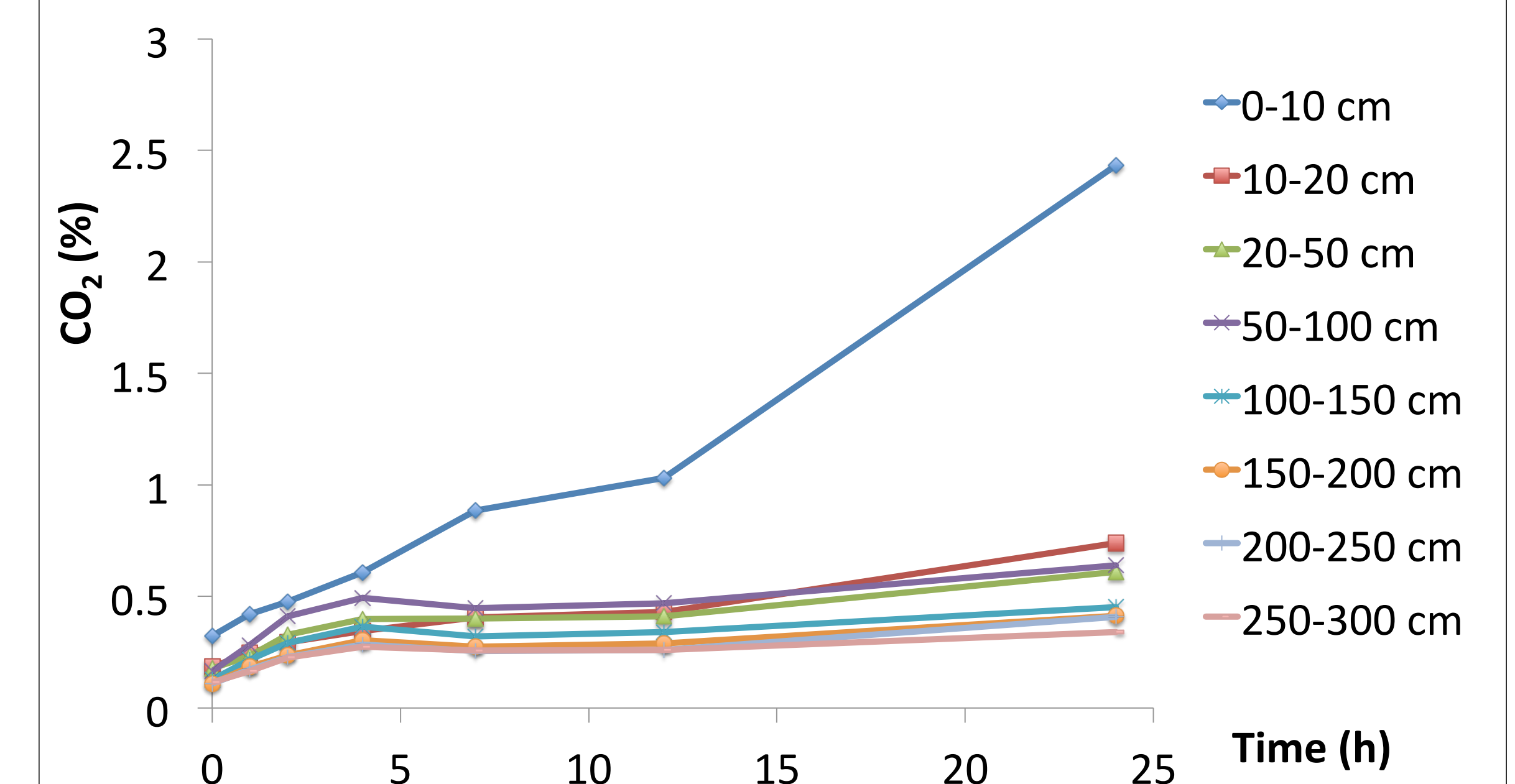


Fig. 3 CO₂ (%) of all depths over 24h

Future Plan

1. Resample soil for C changes under the drying treatments after year 1 and 4 of the treatments.
2. Apply wetting and drying cycles to incubations for soils through 300cm.

Literature Cited

1. <http://www.pinemap.org/>
2. Solomona, Susan et al. (2008) Irreversible climate change due to carbon dioxide emissions. PNAS 106:1704-1709
3. Schimel, David. et al. (1994) CO₂ and the carbon cycle, in climate change. Intergovernmental Panel on Climate Change:39-71