Quantification of Dissolved Organic Carbon Loss Through Soil in Watershed 1

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Overview

Recent interest in the carbon dynamics of Earth demands precise quantification of carbon fluxes, such as dissolved organic carbon (DOC), that may reveal characteristics and responses of significant carbon pools to environmental change. As a component of a larger carbon budget project within HJ Andrews Experimental Forest we are quantifying the flux of dissolved organic carbon (DOC) through the soil within Watershed 1, a small catchment of 1 km^2. The three mechanisms that lead to carbon loss in a forest system are: Respiration, DOC in stream flow, and DOC in soils.

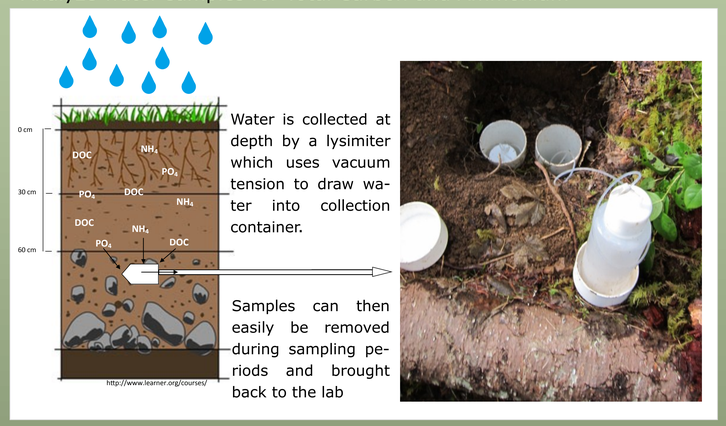
This study has been set up to answer three main questions:

1. What is the total loss of organic carbon through the soil each year?*
2. How do loss dynamics vary over the year?
3. What is the spatial variability of carbon loss within the watershed?

- We define DOC loss in soils as carbon reaching a depth of greater than 60cm, as the effects of micro-organism breakdown of carbon below this depth is negligible.

Study Design

- 17 permanent vegetation plots along 5 transects throughout watershed
- 2 DOC collection devices (lysimeters) per plot placed at 70—90cm depth
- Soil cores collected to determine root growth dynamics
- Collection frequency: once per month in early winter** and once per week late winter through spring
- Analyze water samples for Total Carbon and Ammonium



Water is collected at depth by a lysimiter which uses vacuum tension to draw water into collection container.

Samples can then easily be removed during sampling periods and brought back to the lab

We predict:

1. Relatively small carbon loss through soil since carbon leaving the system via stream flow is also small.
2. Early season carbon flux spike as water soluble carbon built up throughout the summer in the top soil layer is washed into soil.
3. Spatial variability of carbon concentrations to be dependent on plant community variability

** During early winter the watershed was inaccessible due to snow. As a result lower than desired sampling frequency occurred.

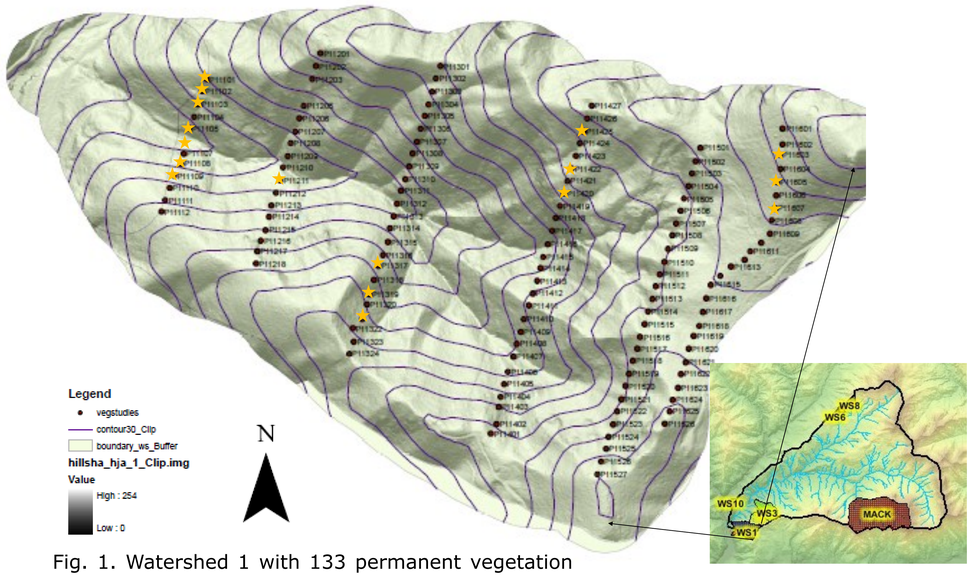


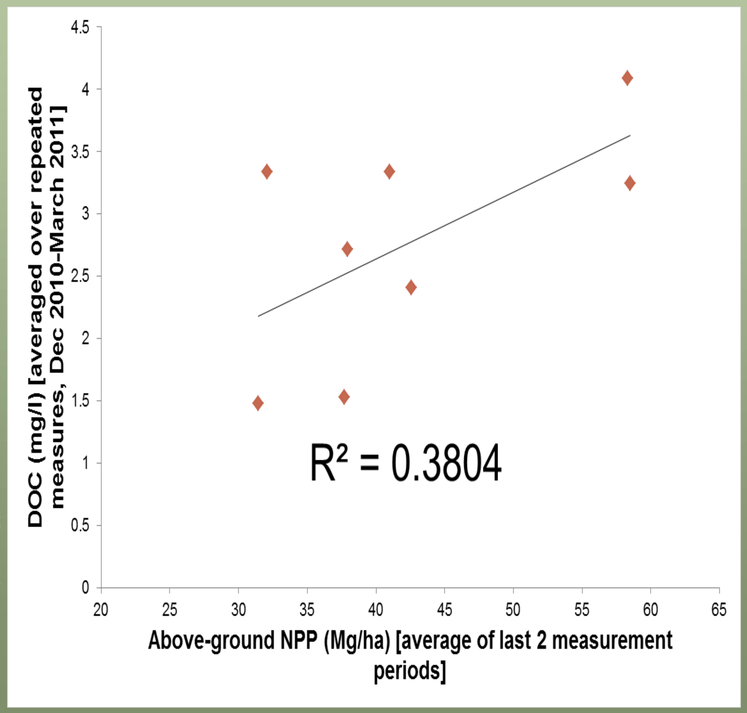
Fig. 1. Watershed 1 with 133 permanent vegetation plots broken into 6 transects. 17 plots (starred) are being used for the carbon budget modeling project.

HJ Andrews Experimental Forest in the Oregon Cascade Range, 6400 ha.

Preliminary Results

Fig. 3: Early analysis of relating DOC concentrations to LiDAR derived Above-ground Net Primary Productivity

Very preliminary results using the five initial collection periods suggests a significant correlation between DOC and above-ground primary productivity. We predict this correlation to strengthen as our sample size increases. This result is expected as primary productivity is the source of carbon to the forest floor via leaf, root and log litter. Areas with higher productivity input more material for micro-organisms to break down, inputting more dissolvable carbon into the area.



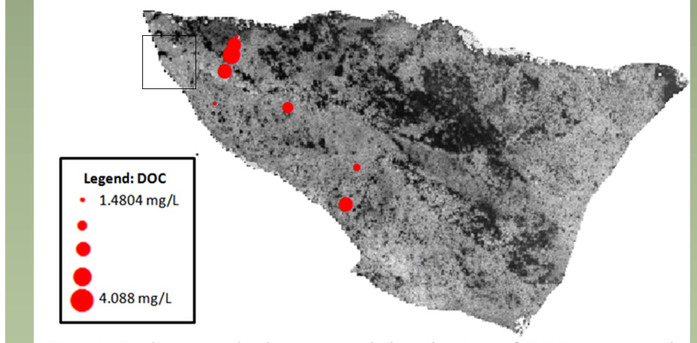


Fig. 2: Preliminary look at spatial distribution of DOC, Averaged over Dec. 2010-March 2011. DOC concentrations at each plot remained relatively stable, suggesting stable spatial variance through time.

Looking Forward

Sampling will continue through the spring with water and root mass samples collected on a weekly basis. As more data is accumulated we expect to see a stronger trend in DOC concentrations vs. Above-Ground Net Primary Production. We intend to related root growth with DOC concentrations to see if there is a correlation, as during root growth microorganisms breakdown of organic material increases as does root exudate.

Working towards answering our question?

Although there seems to be a strong relationship between DOC and productivity, we still need to acquire more samples to determine if observed trends will continue for the remainder of the season. We also intend on continuing this study next year and possibly in future years. We have yet to discover any trends in variance from plot to plot throughout the season, however at the conclusion to this years study we should have a rough estimate of the total carbon loss through the soil for the entire watershed.

In addition to analyzing samples for carbon, we plan to look for Phosphorus and Nitrate as well to fuel thought for future research projects using the existing setup. All results from this project will be tied in with results from the entire Carbon Budget Project taking place throughout Watershed 1.

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