Quantifying impacts of forest fire on erosion and soil carbon

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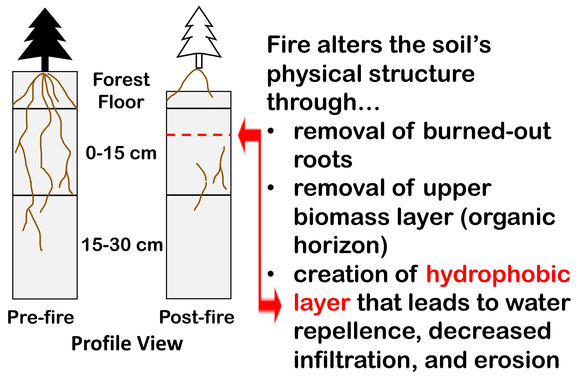
BACKGROUND

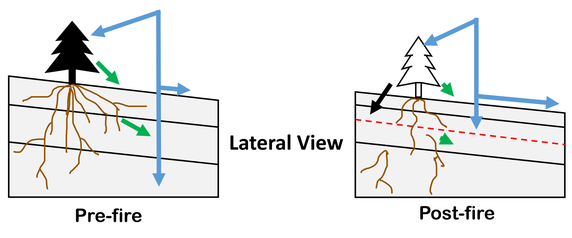
Forest fire influences the immediate post-fire soil carbon pool by…

- Increasing PyC inputs
- Decreasing carbon inputs
- Consuming aboveground and belowground biomass



Fire alters the soil's physical structure through…

- removal of burned-out roots
- removal of upper biomass layer (organic horizon)
- creation of hydrophobic layer that leads to water repellence, decreased infiltration, and erosion



Pyrogenic carbon (PyC) is important in soils because it is resistant to decomposition. PyC concentration after a fire is altered due to…

- higher erosion rates
- hydrophobicity in soil
- changes in ground cover

PURPOSE

Sequestration of forest soil carbon is essential for maintaining the global carbon balance

How are carbon stocks of soil carbon affected by forest fire?

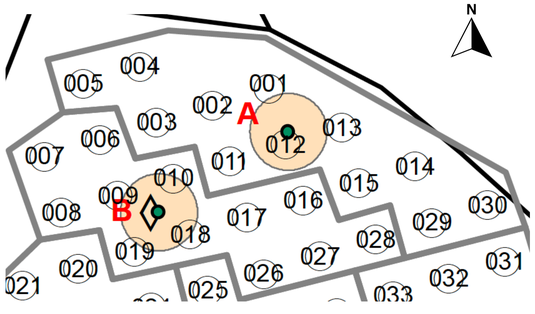
RESEARCH QUESTIONS

1. How do soil stocks of carbon, nitrogen, and pyrogenic carbon (PyC) change throughout the soil profile after a fire?

2. How does post-fire soil erosion influence soil stocks of carbon, nitrogen, and PyC across a site?

METHODS

Blocks and points were established pre-harvest in 2012 by Weyerhaeuser Company. Points and block centers were relocated after the Holiday Farm fire in winter 2021. There are a total of 25 blocks and 300 points on the site, with 12 points per block. Points are roughly 12 meters apart from one another and set in a grid pattern.



Plot map of blocks A and B (red). White circles represent numbered points, and green circles represent block centers, with an 8.02 meter radius circle shaded light orange.

Measures of % carbon, % nitrogen, and carbon:nitrogen ratio were completed in a previous study analyzing the influence of harvesting on soil carbon stocks[1]. All analyses were done at the block level, with the 12 block samples composited. C, N, and C:N at blocks K and U were also interpreted for each sample.

Samples were collected one meter south of each established point. Blocks A-E, K, and U were sampled at all 12 points; the remaining 18 blocks were sampled at 4 points per block to prioritize collection time post-fire over number of samples.

[1]Holub, S.M. & Hatten, J.A. (2019). Soil carbon storage in Douglas-Fir forests of western Oregon and Washington before and after modern timber harvesting practices. *Soil Sci. Soc. Am. J.* 83, S175-186. doi: 10.2136/sssaj2018.09.0354.

Soil collected from a 15-30 cm sample.

The site (A) pre-fire in March 2018 and (B) immediately post-fire in September 2020. Photo location is the southern boundary; site is bordered to the north by Douglas-Fir line, west by planting road, and east by major forest road. Photos from Scott Holub.

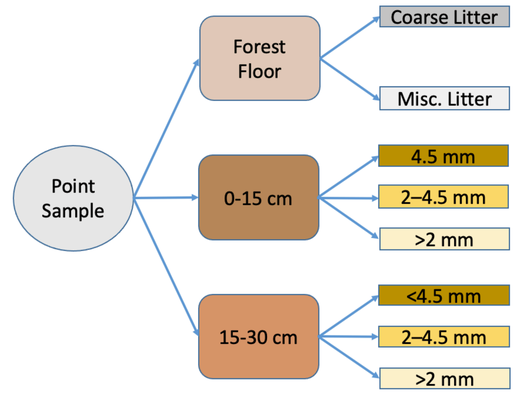


Diagram of sample separation process. There are three components of each sample: forest floor, 0-15 cm, and 15-30 cm. Forest floor biomass is split into coarse and miscellaneous litter, and soil samples are fractioned into three separate grain sizes. Analyzing separate sizes allows for use of grain size as a conservative tracer for erosion.

FUTURE WORK

In this project, C, N, and C:N will be completed at block level, with point-level analyzed at a subset of blocks for direct comparison. Other future tests include loss on ignition to estimate percent organic matter per sample and pyrogenic carbon measurement with the benzene polycarboxylic method (BPCA). These tests will be conducted on both the pre-fire (collected Jul-Sep 2015) and post-fire (Dec 2020 – Mar 2021) samples.