# Density changes of black carbon particles and effects on particle movement and storage

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Soil carbon makes up a substantial part of the global carbon cycle and black carbon (BC – produced from incomplete combustion of biomass) is a sizeable fraction of soil carbon. Soil BC cycling is still poorly understood – very old BC is observed in soils, suggesting recalcitrance, yet in modern short term studies BC seems to break down rapidly. Climate change is predicted to increase the frequency of fire outbreak which will increase global production of BC. As up to 80% of BC produced in wildfires can remain local, increased fire frequency will cause significant perturbations to soil BC accumulation. This leaves us with a need to understand what controls BC landscape movement, in order to estimate how the soil BC reservoir will change.

The accumulation of BC in soils is a function both of production rates and factors effecting storage and losses. One large issue is that the low effective density (approaching 0.3 $g/cm^3$) of BC particles may play a primary role in BC stability and landscape mobility. BC may be expected to erode in any rainstorm subsequent to a burn, inflating estimates of its degradability, yet some BC does make it into the soil, remaining for centuries. If BC pores were filled with minerals, making it more dense, or ingrown with root and hyphal anchors, then BC might be protected from erosion. Consequently, how quickly BC is mixed deeper into the soil column is likely a primary controller on BC accumulation. Additionally as the litter layer builds back up again, BC will be capped belowground, protected from erosional forces and re-combustion in subsequent fires as it is progressively mixed deeper into the soil column.

We have taken advantage of a fire chronosequence in the Pine Barrens of New Jersey to investigate how density of BC particles changes over time, and how an increase in fire frequency will affect soil BC storage and movement down the soil column. Different plots have variable fire return rates, but a similar plant history and soil quality. The area is typified by highly sandy, acidic soils, allowing us to measure the effect of fire frequency on BC storage and mixing without the complication of secondary soil minerals. We have collected a series of soil cores throughout the chronosequence, and are picking macro BC particles to define the density changes of BC that has been stored from previous fires. We hypothesize that increases in fire frequency will increase BC soil stocks up to a point, and then begin decreasing with increasing frequency, due to insufficient time allowed for particle mixing, and that particles deeper in the soil column will have greater bioaccumulation than shallower particles. These changes in particle density should relate directly to particle mixing and therefore storage.