Forest harvest often results in losses of soil C and N. Climate change may exacerbate post-harvest C and N losses from the soil. We designed an experiment to test this. We have previously reported that climate manipulation affected soil C and N fluxes, but found unexpected results (see Table).

Right: Previous results from post-harvest climate change experiment. Arrows indicate increase or decrease relative to control treatments. NS is non-significant.

Research Questions
Do shifts in C- and N-acquiring enzymes help explain previously reported unexpected soil C and N results?

What soil C and N metrics are best predicted by soil extracellular enzyme activity?

Results

Below: EEA over three years of the experiment. In a repeated measures ANOVA there was a significant warmed+wetted effect (p = 0.029) on BG and warmed effect (p=0.007) on NAG. In 2009 LA activity showed the inverse trend to the 5 EEA.

Below: principal components analysis of soil EEA from spring (O2), summer (C), and fall (N2). The vectors represent soil C and N metrics that best explained (p < 0.05) the variation in the EEA: Water-extractable organic C (WEOC), total nitrogen (ToTN), and carbon-to-nitrogen ratio (CN).

Soil Enzyme and Biogeochemical Measurements

Soil samples were collected every season and assayed for six extracellular enzyme activity (EEA) using para-nitrophenyl (hydrolyases) and L-DOPA (oxidoreductases) substrates. The following enzymes activities were quantified: β-1,4-glucosidase (BG), cellobiohydrolase (CBH), leucine aminopeptidase (LAP), β-1,4-β-glucosidase (β-P), aminopeptidase (AP), and β-glucosidase (BG). The methods used were based on Sinsabaugh et al (1999). Soil enzyme ratios were used to interpret shifts in substrate supply and demand (Sinsabaugh 2008, 2011). EEA over three years of the experiment. In a repeated measures ANOVA there was a significant warmed+wetted effect (p = 0.029) on BG and warmed effect (p=0.007) on NAG. In 2009 LA activity showed the inverse trend to the 5 EEA.

Methods & Materials

Forest Regeneration and Climate Experiment
Located at Penn State University’s Stone Valley Forest, in Centre County Pennsylvania. A 2 ha mixed-deciduous forest was whole-tree harvested in August 2007.

Soil Enzyme and Biogeochemical Measurements

Soil samples were collected every season and assayed for six extracellular enzyme activity (EEA) using para-nitrophenyl (hydrolyases) and L-DOPA (oxidoreductases) substrates. The following enzymes activities were quantified: β-1,4-glucosidase (BG), cellobiohydrolase (CBH), leucine aminopeptidase (LAP), β-1,4-β-glucosidase (β-P), aminopeptidase (AP), and β-glucosidase (BG). The methods used were based on Sinsabaugh et al (1999).

Soil enzyme ratios were used to interpret shifts in substrate supply and demand (Sinsabaugh 2008, 2011). EEA over three years of the experiment. In a repeated measures ANOVA there was a significant warmed+wetted effect (p = 0.029) on BG and warmed effect (p=0.007) on NAG. In 2009 LA activity showed the inverse trend to the 5 EEA.

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References: