Geophysical Research Abstracts
Vol. 14, EGU2012-1689, 2012
EGU General Assembly 2012

Effect of O horizon and Forest Harvest Residue Manipulations on Soil Organic Matter Content and Composition of a Loblolly Pine Plantation in the Southeastern United States

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Forest harvest residues and forest floor materials are significant sources of mineral soil organic matter and nutrients for regenerating and establishing forests. Harvest residues in particular are occasionally removed, piled, or burned following harvesting. While the forest floor is never purposely removed during operational harvesting and site preparation, they could become in high demand as bioenergy markets develop. Weyerhaeuser Company established an experimental study to evaluate the effect of forest-floor manipulation on site productivity and soil carbon. This study was installed in a loblolly pine plantation near Millport, Alabama, USA on the Upper Gulf Coastal Plain to test both extremes from complete removal of harvest residues and forest floor to doubling of these materials. This study has been continuously monitored since its establishment in 1994. We have examined the effects of varying forest floor levels on the biomass, soil carbon content, and soil carbon composition in the context of these management activities. Above- and below-ground productivity, soil moisture, soil temperature, and nutrient dynamics have been related to soil organic carbon in mineral soil size/density fractionation and lignin and cutin biomarkers from the cupric oxide (CuO) oxidation technique. We have found that while removing litter and harvest residues has little effect on biomass production and soil carbon, importing litter and harvest residues increases forest productivity and soil carbon content. Interestingly, increased carbon was observed in all depths assessed (O horizon, 0-20, 20-40, and 40-60cm) suggesting that this practice may sequester organic carbon in deep soil horizons. Our biomarker analysis indicated that importing litter and harvest residues increased relative contributions from above ground sources at the 20-40cm depth and increased relative contributions from belowground sources at the 40-60cm depth. These results suggest that organic matter manipulations in managed forests can have significant effects on deep soil carbon that may be resistant to mineralization or the effects of other perturbations such as climate change.