Net bVOC emissions from a mixed hardwood forest floor: Importance of species composition and belowground processes in driving seasonal dynamics

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TES program poster abstract
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Our understanding of the sources of and controls over bVOC fluxes from terrestrial ecosystems remains incomplete. Namely, leaf litter and soils have recently been determined to be an important component of ecosystem bVOC source sink dynamics, yet emission models have yet to incorporate processes occurring at or below the soil surface, likely due to the complex nature of these interactions and general lack of data. The aim of our project is to quantify the mechanisms controlling soil bVOC uptake and emissions from a mixed hardwood forest – the Morgan Monroe State Forest Ameriflux research site in Indiana – within the context of plant-mycorrhizal interactions, tree species composition, and environmental and physical factors.

Data from our monthly field measurements of soil collars during the beginning and end of the 2014 growing season suggest that forest soils inhabited by tree species associated with arbuscular (AM) and ectomycorrhizal (ECM) fungi are a net bVOC source early in the growing season following leaf-out. As the season progressed into the fall, AM plots remained a small source yet ECM plots became a significant bVOC sink. As the leaves began to senesce and more litter accumulated on the forest floor, ECM plots once again became a bVOC source of the same magnitude observed in May with no change in emissions from AM-plots. Thus, in the fall when the major ecosystem bVOC source from the canopy is absent, the forest floor provides another source of VOCs whose magnitude and quality reflect differences in relative tree species composition, and thus, litter quality, decomposition, and the associated microbial communities.

We are currently analyzing these data to quantify relationships between the aforementioned variables observed in these plots over time. During 2015, we measured soil and litter bVOC flux at a higher temporal frequency during the dynamic senescence period. We coupled these soil measurements with bVOC concentration profiles within the canopy to investigate bVOC transport and the relative importance of soil fluxes at the ecosystem level. Initial data indicates that recently senesced leaf litter produces a large flux of bVOC, and that soils serve as a sink to a fraction of these emissions. Furthermore, this effect is differentiable between soils and litter associated with AM and ECM mycorrhizal fungi, providing a potentially useful framework in which to model bVOC emissions over time in deciduous hardwood forests.