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Methane Dynamics of Kentucky Bottomland Hardwood Forested Systems

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Bottomland hardwood forests can hold large amounts of carbon in their tree biomass and their deep soil carbon pools. However, they can also produce a significant amount of methane (CH_4) in their anaerobic soils. While some of this CH_4 is oxidized in microsites and overlying waters, tree stems and exposed root systems can be significant conduits of CH_4 to the atmosphere, bypassing oxidation processes. We aim to identify differences in CH_4 source-sink dynamics among tree species, across heights on stems, and across stem hydrogeomorphic settings within bottomland hardwood wetlands. We predict that the greatest stem methane emissions will be found in hydrogeomorphic settings with the highest and most consistent of the following: inundation, organic matter content, and temperature. Additionally, we expect hydrogeomorphic setting to be a greater factor in explaining stem CH_4 emissions than species-level differences. CH_4 fluxes are being collected from stems of five tree species monthly in three protected areas in western Kentucky (i.e., Clarks River National Wildlife Refuge, Murphy's Pond Nature Preserve, Kentucky Lake's Hancock Biological Station). Monthly samplings include floodplain measurements at five heights (i.e., 20, 40, 60, 120, and 180 cm) on *Acer rubrum* and *Liquidambar styraciflua*, terrace measurements at five heights on *Quercus stellata* and *Quercus pagoda*, and measurements at two heights (i.e., 40 cm and 120 cm) at three hydrogeomorphic positions (i.e., slough, lake edge, and pond edge) on *Taxodium distichum*. Initial sampling was only completed for the floodplain and slough, during a moderate-to-severe drought (October 2022). During these dry conditions, floodplain soils acted as CH_4 sinks, while stems acted as CH_4 sources. We found no significant differences in CH_4 emissions among species, and contrary to existing literature, we did not observe significant differences in CH_4 emissions across stem heights. As we continue sampling, we expect stems to continue being CH_4 emitters, with greater emissions from stems during the hottest, wettest seasons. Under these conditions we also expect to see significant differences in emissions across stem heights as methanogenesis in soils increases. Stem measurements will be combined with estimates of the tree surface area to compare the contribution of stems to soils in sink-source dynamics of these systems. Our study will be essential to develop and validate tree stem CH_4 schemes to improve land surface models for CH_4 flux predictions.

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