# B34B-05 Advancing forested wetland methane flux modeling: optimizing flux predictions with a process-based approach

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## Abstract

Mechanistic understanding of methane (CH4) flux from vegetated freshwater wetlands is advancing. However, current modeling strategies often rely on overly complex structures or fail to incorporate tree dynamics that influence biogeochemical processes in forested wetlands. Here, we propose a process-based model that addresses these limitations by coupling and expanding existing modeling frameworks to simulate CH4 flux dynamics in forested wetlands. The model incorporates trees and tree-based carbon pool dynamics as integral components of the wetland system, while also accounting for the characteristics of seasonal change and its effects on the soil microbiome kinetics. This updated model framework captures wetland biogeochemistry using the PEPRMT model approach (Oikawa et al., 2017) and tracks ecosystem carbon allocation into different pools using the DALEC model strategy (William et al., 2005). This updated modeling strategy has been developed and validated using eddy covariance data from the US-NC4 (Alligator River, NC) and US-PFa (Park Falls, WI) sites. This updated CH4 model framework accurately represents net ecosystem exchange of both CO2 and CH4 fluxes at these sites. For CH4 flux simulations, the coefficient of determination exceeds 60%, and the Normalized Nash-Sutcliffe Efficiency exceeds 0.70 for both study sites. This enhanced, dynamic, and modular modeling framework is transferable to forested wetlands across different biomes, enabling better estimation of CH4 flux dynamics.

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