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Greenhouse Trace Gases in Deadwood

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Deadwood, long recognized as playing an important role in carbon cycling in forest ecosystems, is more recently drawing attention for its potential role in the cycling of other greenhouse trace gases. We report data from four independent studies measuring internal gas concentrations in deadwood in in three Quercus dominated upland forest systems in the Northeastern and Central United States. Mean methane concentrations in deadwood were 23 times atmospheric levels, indicating a lower bound, mean radial wood surface area flux of ∼6 x 10-4 μmol CH4 m-2 s-1. Site, decay class, diameter, and species were all highly significant predictors of methane abundance in deadwood, and log diameter and decay stage interacted as important controls limiting methane concentrations in the smallest and most decayed logs. Nitrous oxide concentrations were negatively correlated with methane and on average ∼25% lower than ambient, indicating net consumption of nitrous oxide. These data suggest nonstructural carbohydrates fuel archaeal methanogens and confirm the potential for widespread in situ methanogenesis in both living and deadwood. Applying this understanding to estimate methane emissions from microbial activity in living trees implies a potential global flux of 65.6±12.0 Tg CH4 yr-1, more than 20 times greater than currently considered.