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A synthesis of growing-season and annual methane emissions among temperate, boreal, and arctic wetlands

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Wetlands are the largest natural source of methane to the atmosphere, but predicting methane emissions from wetlands using process-based modeling remains challenging due to the decoupling between production and emission. Furthermore, methane emissions are highly variable among sites, years, and temporal scales due to differences in production, oxidation, and transport pathways. Here, I synthesize growing season, non-growing season, and annual methane emissions from chamber and eddy-covariance measurements for >150 sites in undisturbed temperate, boreal, and arctic wetlands and adjacent uplands. I compare the magnitude of fluxes among regions, wetland classifications, vegetation classifications, environmental variables, and measurement methods. Growing season measurements were most abundant in bogs, fens, and tundra sites, while marshes, swamps, and permafrost thaw features were relatively undersampled. Methane emissions were largest from intermediate and rich fens (> 15 g CH4 m-2 y-1) and lowest from upland mineral soils and polygonal tundra ($\leq$ 3 g CH4 m-2 y-1). Non-growing season emissions accounted for $\sim$ 20% of annual methane emissions. Across all sites, there were no significant differences in growing season methane emissions between autochambers, manual chambers, and eddy covariance. These results provide constraints for methane emissions from temporal, boreal, and arctic wetlands utilizing the numerous flux measurements conducted over the past 25 years.