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Winter greenhouse gas emissions from fluvial wetland dominated streams in Ipswich River, Massachusetts, USA

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Aquatic ecosystems are major sources of greenhouse gases (GHG), in particular methane (CH4) and carbon dioxide (CO_2). Methane is produced anaerobically in stream sediment and then emitted into the atmosphere either through diffusion between the sediment-water and water-atmosphere interfaces or ebbulitive release of highly concentrated bubbles directly from sediment. Methane can also be transported horizontally to streams from riparian zones and wetlands, then emitted hydrodynamically from the stream surface. Carbon dioxide is often supersaturated in streams, even greater so when connected to fluvial wetlands, resulting in outgassing from surface waters to the atmosphere. Carbon dioxide in streams varies depending on physical factors, such as stream size and discharge, and biological processes, for example decomposed organic material, root respiration and consumption via photosynthesis. Though lakes and streams only cover 3.7% of the continental surface area, their contribution to global GHG budgets are substantial. Stream GHG budgets, however, are primarily based on growing season measurements, with little data during the winters due to logistical issues or severe weather conditions. As average global temperature continues to increase, winter measurements of GHG emissions, which are currently not well constrained, are vital for evaluating regional and global carbon budgets and for predicting future emissions. This research aims to determine winter stream GHG emissions in a temperate watershed. To do this, weekly sampling campaigns at six sites along the Ipswich River, Massachusetts were performed; flux measurements for CO_2 and CH4 were collected using a floating chamber method. Measurements of dissolved CO_2 and CH4, water table, water and air temperature, conductivity, pH and dissolved oxygen content were also collected in the streams. Preliminary analysis suggests that streams adjacent to fluvial wetlands have higher emissions with increased presence of organic matter and lower dissolved oxygen content. Additionally, sustained CO_2 fluxes are higher at forested sites with lower incoming solar radiation reaching the stream.