Linking peatland hydrology to changes in methane flux

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The primary goal of the proposed research is to gain understanding of the impacts of abrupt climate change on the terrestrial carbon cycle. It is especially important to understand how hydrologic changes will affect the Arctic and sub-arctic, as these areas represent extensive peatland areas. Two key problems will be addressed: **1)** Currently, there is no method to reconstruct past greenhouse gas (GHG) fluxes from peatlands. It is relatively straightforward to estimate the amount of carbon accumulated in a peatland system, however, there is no established method to quantitatively assess methane emissions. One purpose of the proposed research is to develop a novel method for the reconstruction of methane flux from peatlands. Our method will be based on the carbon isotopes of *Sphagnum* biomarkers. A methanotrophic bacterium lives symbiotically with *Sphagnum* in its hyaline (water-holding) cells. As more methane is released from the peatland, the methanotrophic symbiont provides more methane-derived (^{13}C-depleted) CO_2 to the *Sphagnum*. Therefore, higher methane fluxes under warm, wet conditions lead to more assimilation of CH_4-derived CO_2 and thus lower carbon isotopic ratios of *Sphagnum* lipids. Funds from the Climate Center will be used to analyze *Sphagnum* calibration samples collected from sites nearby methane flux monitoring stations (ie. Mer Bleue, Canada), and establish the relationships necessary to validate our proxy. **2)** Many records of continental moisture balance reveal that the Holocene is characterized by abrupt and significant changes in regional hydrology. The ways in which these large perturbations in the hydrologic cycle have changed the way northern peatlands store and emit carbon are poorly understood. Once we have developed our proxy for methane emission, we will use our proxy to determine changes in methane flux from peatlands across known perturbations in the hydrologic cycle from independent paleoclimate records. These include intervals such as the early Holocene, mid Holocene (6-5ka), the Medieval Warm Period, and the Little Ice Age. Our new records will clarify the changing role of peatlands in the global carbon cycle through time.