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The complex relationships between methane emissions and water table at an ombrotrophic bog

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Broad spatial and temporal variations in methane emissions from peatlands have been related to many variables including water table position, temperature and vegetation characteristics and functioning. In general, wetter peatlands tend to have greater methane emissions. However, over shorter periods of time and space, the relationship between water table and methane emissions can reverse, show hysteresis or be absent entirely. These relationships are investigated at the Mer Bleue Bog, a temperate ombrotrophic bog near Ottawa, Canada. Six years of concurrent growing season eddy covariance and automated chamber fluxes reveal the expected broad patterns. During the wettest growing season, the water table remained within 40 cm of the bog's hummock surfaces. Methane emissions were upwards of 20 to 45 mg C m-2 d-1 and exceeded the emission rates from two drier growing seasons which saw periods where the water table dropped to nearly 80 cm below the hummock surface. In those periods, methane emission rates declined to about 5 mg C m-2 d-1 or less. Lawn plots with aerenchymatous Eriophorum vegetation and high water tables had greatest emissions (exceeding 200 mg C m-2 d-1) compared to hummock plots vegetated by ericaceous shrubs, which had emissions rates similar to those measured by eddy covariance. However, within a growing season, hysteresis and inverse relationships between water table and methane emissions were observed at both ecosystem and chamber plot scales. These included periods between rainfall events where methane emissions increased while the water table deepened. The potential roles of methane production, consumption, storage and transport processes on these patterns will be discussed.