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Quantifying groundwater contribution to the summer water-budget of a northern peatland complex, Schefferville, Québec, Canada

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Northern peatlands are one of the largest, naturally occurring terrestrial stores of soil carbon and are an important component of the global carbon cycle. These systems are predominately water-saturated with the average water table position situated close to the land surface. Fundamental questions remain as to the role of deeper groundwater systems in influencing the origin and development of peatlands and how groundwater and surface water interactions control the internal movement of water. The hydrology of a 0.095 km^2 peatland, located 20 km southeast of Schefferville Quebec, was studied to quantify and characterize the spatiotemporal contribution of groundwater from sub-peat deposits (>2m depth). The study site is of particular interest because it exhibits both ombrotrophic (rain-fed) and minerotrophic (rain and groundwater-fed) features drained by a single stream at the peatland outlet. A three-dimensional groundwater flow model, the finite-difference U.S. Geological Survey MODFLOW code, is used to simulate the peatland and characterize the groundwater flow system. The model is parameterized with data measured from June 17^{th} to September 4^{th}, 2009, including continuous meteorological measurements from an automatic weather station, 14 observation wells, and two 90° V-notch weirs. Over the study period there was an average precipitation of 65 mm $month^{-1}$, a calculated potential evapotranspiration of 46 mm $month^{-1}$, and the average surface discharge from the peatland was 1.64×10^{13} mm^3 $month^{-1}$, or a specific discharge of 174 mm $month^{-1}$. The hydraulic conductivity of the peat was calculated from head-recovery tests at 500 and 1000 mm depths and average values were 10^{-2} and 10^{-3} mm s^{-1} respectively. The estimated baseflow contribution was 9.60×10^{12} mm^3 $month^{-1}$, or a specific baseflow of 101 mm $month^{-1}$. The correspondence between stream stage and groundwater level fluctuations, in addition to the relatively large baseflow component of runoff, supports the hypothesis that groundwater plays a dominant role in this peatland flow system. We determined, based on field measurements, that upward groundwater flow from below the peat column is an important flow path through which water contributes to the peatland hydrologic budget, and implies that vertical flow is essential in certain peatlands.