Using current hydrological conditions to better understand Holocene ecohydrological dynamics in oligotrophic peatlands of north-central Quebec, Canada

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The biogeographic limit of the peatlands in the central-north Quebec region (53°80'-53°85'N) corresponds to the ecotone between the open boreal forest and the forest-tundra. At this latitude, peatlands are mainly represented by patterned fens that developed in topographic depressions of the Precambrian Shield. They are characterized by mildly minerotrophic conditions with surface patterning similar to that observed in western Labrador, central Sweden and the aapa mires of northern Finland. In eastern Canada, patterned peatlands have shown ecohydrologic disequilibrium during the last centuries expressed by a general water table rise with degradation of strings and expansion and coalescence of pools. It has been shown that peatlands in this region present a similar pattern of ecohydrological disequilibrium to those documented in the northeast section of the La Grande River watershed, subarctic Quebec (54°00'N-54°05'N) and this confirms the importance of investigating their ecohydrological vulnerability to natural and anthropogenic pressures in terms of hydrology and carbon balance. A multidisciplinary project was initiated to quantify the hydroclimatic changes that may have influenced the ecohydrologic disequilibrium phenomenon using two peatlands control sites. The results presented here focus on the current water budget of the peatlands and aim at identifying the parameters that influence most significantly peatland hydrology and its connection to the surrounding aquifer. The two peatlands were instrumented with 15 piezometers (in the peat and in the aquifer) where groundwater levels were measured during two growing seasons. Peatland characterization included peat depths, peat hydraulic conductivities (six cores, Modified Cube Method), hydraulic gradients and surface outflow rates. Preliminary results from time series analyses and water budgets show indications of groundwater inflows at each site. If confirmed, these results would comfort the hypothesis that the peatlands are sensitive to hydro-climatic variations with more precipitation inducing higher groundwater levels and thus increased groundwater inflow to the peatlands. Using quantitative paleoclimate reconstructions (pollen, macrofossils and testate amoeba), it has been shown that the two peatlands have registered hydroclimatic periods with potential groundwater input sufficient to induce a shift from bog to fen in these ecosystems.
Inversely, a recent shift from fen to bog during the 20th century suggest that enhanced plant productivity with the lengthening of the growing season duration might influence a decrease of groundwater input in the peatlands. The warmer climate shift under way is expected to induce even more of these changes, thus increasing further the large-scale phenomenon as observed in peatlands of northeastern Canada.