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Testing a new version of the DigiBog model to explore the differential response of peatland microforms to shifts in surface wetness

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Over the last decades, many hypotheses have been put forward to explain pool formation in northern peatlands including topographic, biotic or climatic factors. Several studies suggest that pool formation is primarily controlled by autogenic, edaphic and topographic factors rather than external climatic influences (allogenic factors). However, there is still no consensus to explain pool formation and to confirm whether their initiation is primarily associated with autogenic or allogenic processes. Subarctic fens in northeastern Canada are characterized by a patterned surface of pools, flarks and narrow strings. Due to their geographic location at the northern ombrotrophic peatland distribution, these poor fens have been highly sensitive to hydroclimatic variations that influenced pool development and expansion. Our data indicate that wet hollows or shallow pools developed at minimal ages between ca 4200 cal BP and ca 2500 cal BP. We hypothesize that pool developed as secondary features under wetter and cooler conditions that (i) caused shorter growing seasons which negatively impacted on peat accumulation and (ii) led to lower rates of evaporation, and that (i) and (ii) in combination led to increased surface wetness.

The differential response of microforms to shifts in surface wetness show the complexity of processes involved in pool initiation. A recent version of the DigiBog model (Morris et al, 2015), that allows for sub-seasonal variations in precipitation and evaporation, is used to explore the interactions between climate, growing season, peat productivity, peat hydraulic properties and water-table behaviour. Model results suggest that decreases in growing season length, combined with decreases in evapotranspiration, can explain long-lived shifts to wetter conditions in peatlands. If evapotranspiration is reduced but growing season does not vary, long-lived shifts in peatland wetness are less likely and the peatland instead tends to show a homeostatic response to a wetter climate as reported by Swindles et al. (2012).