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Relationships among the water table depth, water and surface elevations, and the composition of vegetation in a temperate hummocky, ombrogenic, oligotrophic raised shrub bog

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Microtopography, such as hummocks and hollows, pools, ridges and lawns are features that are believed to be a consequence of feedbacks among the local hydrology and the production and decomposition of organic material. To deductively test some of the postulates derived from several theoretical studies of the development of patterning on peatlands, over two consecutive years we examined the spatial and temporal relationships among the hummock – hollow microtopography, water table depths (WTD) and water elevations (WTE) in a raised, ombrotrophic bog (Mer Bleue, Canada) that has extensive and well developed microtopography. In each of two 20 x 20 m plots we measured the surface elevation at more than 1,000 points, the WTDs manually every two to three weeks at 100 wells located on a 2 x 2 m grid, and WTDs continuously at more than 20 sites at adjacent hummocks and hollows. In addition to the physical measurements we also measured the spatial pattern of the vegetation communities. The average difference in elevation between the hummocks and hollows was $\sim$ 0.5 m and as was expected the WTDs were shallower in the hollows than under the hummocks. The spatial variability in WTDs over time was very consistent. We tested the coherence between WTDs and surface elevation and found for a total of 46 spatial surveys over the two years and both plots the slopes from mixed modelled regressions were not significantly different for over 80% of the surveys. The difference in WTEs in adjacent microtopographic features (i.e. water levels referenced to a common datum), which determine the hydraulic gradients between hummocks and hollows, was quite small. The small gradients and the consistent coherence between WTDs and surface elevation suggests there is little lateral movement of water among the microtopographic features. The vegetation analysis showed the plot closer to the center, the apex, of the bog had stronger relationships among WTD-microtopography and vegetation than a plot closer to the margin. This indicates, while the physical structure of the bog microtopography is tightly coupled through ecohydrological feedbacks, the strength of the vegetation associations may vary with location in the bog. The physical observations seem contradictory to the hypothesized feedback in theoretical models of peatland microtopography. However, microtopography develops over hundreds and even thousands of years. From paleo-ecological studies it is believe that Mer Bleue has been a raised bog for > 3,000 years. We speculate that as a peatland develop they mature to a very stable state where the representation of the feedbacks subtle.