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Water movement through blanket peat is dominated by a complicated pattern of near-surface flows

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Blanket peatland formation and functioning depend strongly on hydrology. Omitting the potential for pipe flow, the acrotelm-catotelm model is still widely held to apply to blanket peatlands. In the model, water flow through the peat profile is dominated by near-surface flow in the acrotelm, whereas water movement below the level of (near) permanent saturation (the catotelm) is characterised by very low hydraulic conductivity (K). Whilst some work has been done on characterising Kat different depths in blanket peatlands, very little is known about near-surface K, particularly with respect to how it varies between microforms and over fine spatial scales.

We undertook a detailed investigation of near-surface (0 – 12 cm) and deeper (30 and 50 cm) K at a blanket peatland site in the Flow Country in Scotland (UK). Near-surface $K$of peat samples taken across a range of microforms was measured vertically (K_v) and horizontally (K_h) in the laboratory using a new 'split cylinder' method (n = 48 excluding repeat tests). K_{30} (n = 20) andK_{50} (n = 20) were estimated *in situ* using the piezometer or seepage-tube method. To help our interpretation of the near-surface K measurements we recorded the vegetation cover from where the peat samples were taken and characterised each peat sample in terms of its plant macrofossil assemblage and dry bulk density.

We found that $K_v$and $K_h$were highly variable between microforms in the near-surface samples, ranging over two orders of magnitude (0.489 – 0.003 cm s^{-1}). Kernel density plots show that $K_v$was most commonly in the region of $\sim$0.03 cm s^{-1} at 0 – 6 cm, and $\sim$0.015 cm s^{-1} at 6 – 12 cm, whereas K_h was $\sim$0.05 and $\sim$0.001 cm s^{-1} respectively. These data reveal a high degree of absolute variability and anisotropy in K over small scales. The deeper $K_{30}$and K_{50} values were typically an order of magnitude or more lower than the near-surface K, and were less variable between test locations with the exception of poorly humified *Sphagnum*-dominated peat. These results are a step forward for improving models of blanket peatland hydrology, and understanding pore-water residence times and wider catchment behaviour.