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The role of natural soil pipes in providing vertical and lateral connectivity of water, sediment and solute within peatland catchments

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Pipes are found in many peatlands, and particularly in blanket peats, but little is known about the geomorphology of these features. This paper presents data based on i) geophysical mapping of pipes; ii) geophysical tracing of pipe connectivity and iii) monitoring of sediment, solute and water fluxes from pipe networks in blanket peats. Pipes are found to be ubiquitous in blanket peat. It is shown to be possible to remotely detect the connectivity of subsurface soil pipes using ground penetrating radar without the need for disturbance or chemical sample collection. Pipe networks are complex branching systems with many over 1 km in length and they directly couple distant parts of hillslopes. Not all pipe networks connect with streams. Pipes were found at all depths throughout blanket peat profiles, including at the substrate which could be 8 m below the surface. The pipe networks undulate throughout the soil profile. The pipe hydrology is dynamic with relative contributions to the stream varying depending on antecedent conditions. The flowpaths for pipe source waters and evidence for pipe initiation processes in peatlands will be presented. Piping was found to be exacerbated by anthropogenic processes. Sediment and solutes derived from mineral soils several metres below the surface are often produced by pipes at their outlets. This is important in blanket peat catchments because they have been hitherto considered to have a disconnected substrate with nutrients supplied only by precipitation. However, piping transcends that notion and provides vertical hillslope connectivity of water, sediment and solute in addition to lateral hillslope connectivity. The extent of both the vertical and lateral pipe connectivity are shown to vary depending on storm event conditions. Suggestions on the applicability and extension of the work outside of peatlands will be made.