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The role of peat double porosity on groundwater-surface water interaction in a drained fen

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Groundwater discharge from an esker aquifer to a fen was studied to understand relevant hydrological processes for surface-groundwater interaction in an esker-peatland hillslope. Piezometric levels of the peat layer and esker sand layer were continuously monitored and compared to climate data. Groundwater exfiltration points were spatially mapped and related to peat depth. The study showed a clear interaction between fen surface water and sand esker groundwater although the hydraulic conductivity of peat was low and the peat depth thick. In the artesian aquifer beneath the fen, the piezometric head showed a clear response to precipitation and evapotranspiration. Wetting of the peat is rapidly seen as pressure increase in the confined aquifer. This provides new information on hydraulics of wetlands found in aquifer discharge areas. Groundwater exfiltrated through thick peat layers in vertical preferential point discharges demonstrating how double porosity provides flow through the peat layer with low hydraulic conductivity in the peat matrix. The "pipe flow" channels were found in the deep peat area in the transition zones from deep peat to shallow peat. Diffuse seepage through the ditch bottom was found where ditches cut into the sand layer. Increased discharge through the ditch bed reduced the flow resistance at the aquifer boundary which can lower the groundwater level in the esker. The results show new processes in the groundwater discharge zone that are useful for groundwater modeling and policy development for future groundwater protection.