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The long-term impacts and controls of peripheral drainage on the eco-hydrology and carbon balance of an intact raised bog

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Ombrotrophic peatland environments are characteristically dynamic systems, being distinguished by biota adapted to anoxic conditions that are maintained by hydrological processes that change as the ecosystem develops over millennia. The eco-hydrological dynamics of these systems control their carbon feedback functions and have helped influence global climate, as evident by the vast carbon stores present as peat soil on earth. Though this influence has decreased with the losses of vast areas of wetland, the capacity of degraded systems to sequester carbon with active management ensures they are prominent in the debate on the solutions needed to combat the effects of climate change. However, restoring a positive sequestration function following environmental damage is difficult, as the controls on the peatlands water table have modified and sometimes linked to regional catchment pressures. In damaged systems, morphological changes that have been incurred due to drainage may be expected to reach equilibrium soon after initiation. However, detailed eco-hydrological monitoring of a raised bog in Ireland over a 25 year period discovers that peat continues to subside long after initial drainage, complicating management, yet providing valuable information on their functionality and supporting conditions. This study demonstrates that there is continual movement of surface catchment boundaries and progressive degradation of the distribution of peat-forming communities. The effects of this dynamism is reflected in the peatlands carbon balance, with an intensive field monitoring programme indicating that carbon losses in aquatic pathways are as significant as losses incurred via surface gaseous emissions. Significantly, though this peatland is free of superficial drainage, its overall carbon balance is one of carbon loss due to the impact of peripheral drainage and associated hydrogeological pressures, an underrepresented carbon flux pathway in peatland monitoring and modelling studies.