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Mapping Spatiotemporal Changes in Peatland Coverage: A Case Study on Store Vildmose, Denmark

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Pristine peatlands are unique ecosystems for biodiversity conservation and climate regulation. They have the capacity to regulate local hydrology and balance carbon (C) fluxes between land and the atmosphere. Despite their importance, most peatlands can no longer be considered pristine mainly due to anthropogenic alterations. Although existing peatlands still support ecosystem services, they do so at a reduced capacity. Peatlands are the largest natural terrestrial C reserve with a global C stock estimated at about 20%. Naturally, peatlands act as C sinks. However, excessive drainage for agricultural use and rising global temperatures may tip them into C sources and risk an increase in the emission of greenhouse gases (GHGs). Therefore, it is important to assess the magnitude of the coupled impacts of climate and anthropogenic changes on peatland status and coverage. A major limitation in achieving this lies in the lack of coherent detailed records documenting the spatiotemporal changes in the peat properties such as its thickness and spatial extent. Increasingly, there is a global interest in sustainable, and restorative peatland research as both a mitigation and adaptation strategy to climate change. The challenge still holds where without sufficient understanding of the status, extent, and controls on the changes in peat, there could be a mismatch between targeted management strategies for conservation. This study will focus on characterizing a peatland area in Store Vildmose, Denmark. This is a the largest raised bog in Denmark and selected due to its age, various land uses over time and historical significance. There is compelling evidence for peat subsidence in this area due to anthropogenic influence. This can be jointly attributed to both the State and individual activities over the years. For example, the conversion of part of the bog to grazing lands by the State in 1920 (which required drainage by digging ditches and laying an extensive pipe network) and construction of cattle farms considerably degraded the peat. Additionally, the consumption of peat as an energy source favoured its extraction over conservation historically. In spite of the physical evidence, there is no accurate estimate of the changes in peat volume through time. This information is crucial to estimate the depletion and the current status of C stocks. Therefore, we propose to assess the changes in the peatland extent and volume by the use of historical cadastral maps (starting from 1880 onwards and yet to be digitized) and recent digital maps generated by the digital soil mapping approach. We will further perform scenario analysis and predictive modelling of the peat coverage with machine learning algorithms using additional covariates to more accurately quantify the C stocks and GHG emissions. The findings from the study will support stakeholder decision making for reducing the peatlands' CO_2 emissions.