Exploring carbon dynamics of restored blanket peatlands in 3D

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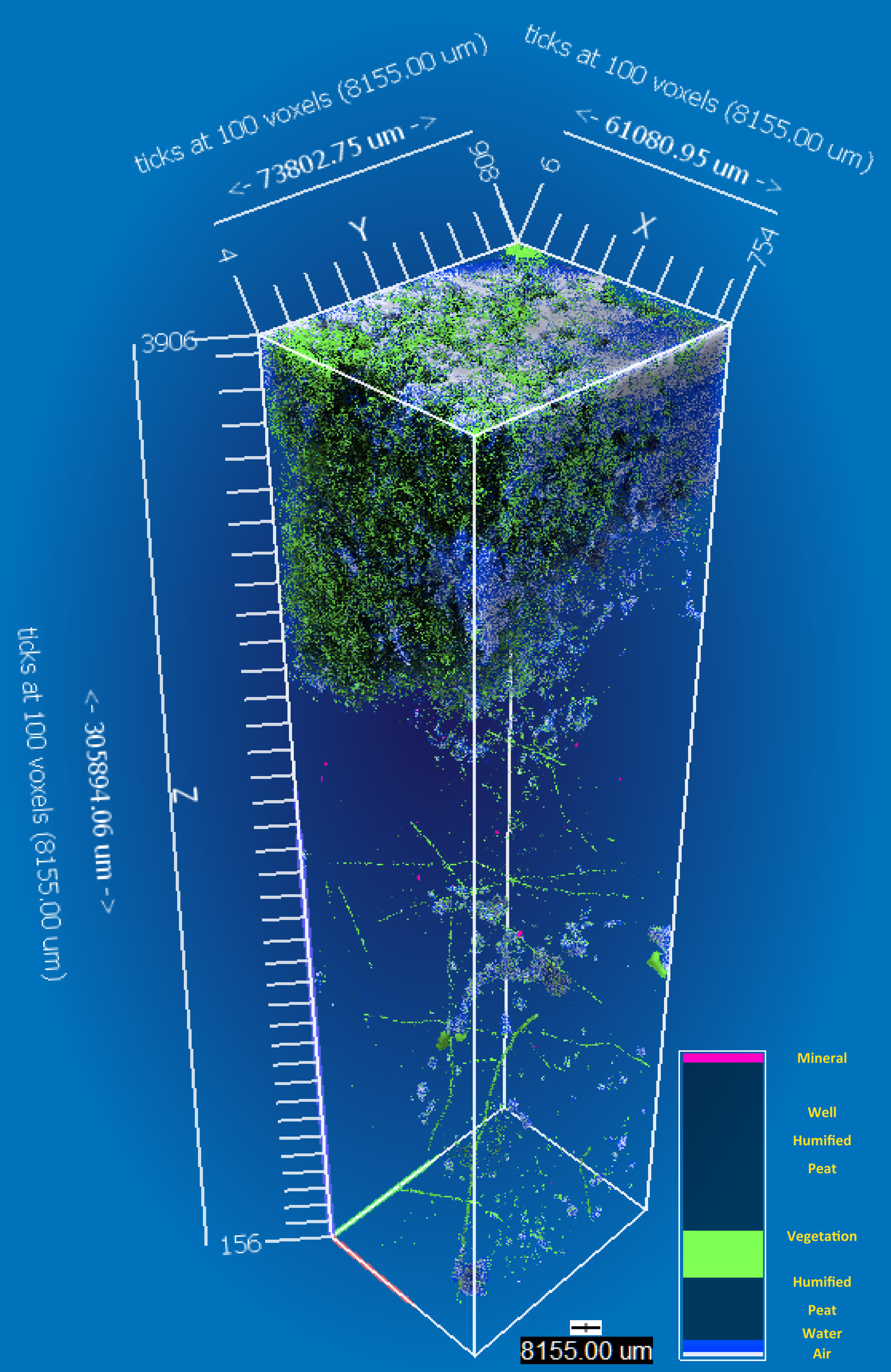
Introduction

A key function of healthy peatlands is their ability to sequester and store carbon. It is estimated that peat lands sequester ~500 million annually and store ~550-612 billion tonnes worldwide. However, anthropogenic disturbance has resulted in over half of the known extent to be emitting more carbon than what is being stored. Since 2013, the IPCC has included peatlands in guidelines for national GHG inventories. This has switched many countries' GHG inventories, including the UK, from overall net carbon sinks to net carbon sources. The restoration of carbon-emitting peatlands are thus at the forefront of national climate change mitigation strategies. Although, restored peatlands do not function the same as undisturbed, healthy peatlands, and in many cases they remain net carbon sources. We need to understand the fundamental processes that govern peat functionality if we aim to use peatland restoration as a tool to meet the climate crisis.



3D visualisation of a restored blanket peat sample (5-years post re-turve restoration). Figure demonstrates the capability of 3D µCT to detect the physical components of peat, such as air, water, and vegetation which determine hydrological and carbon dynamic function.

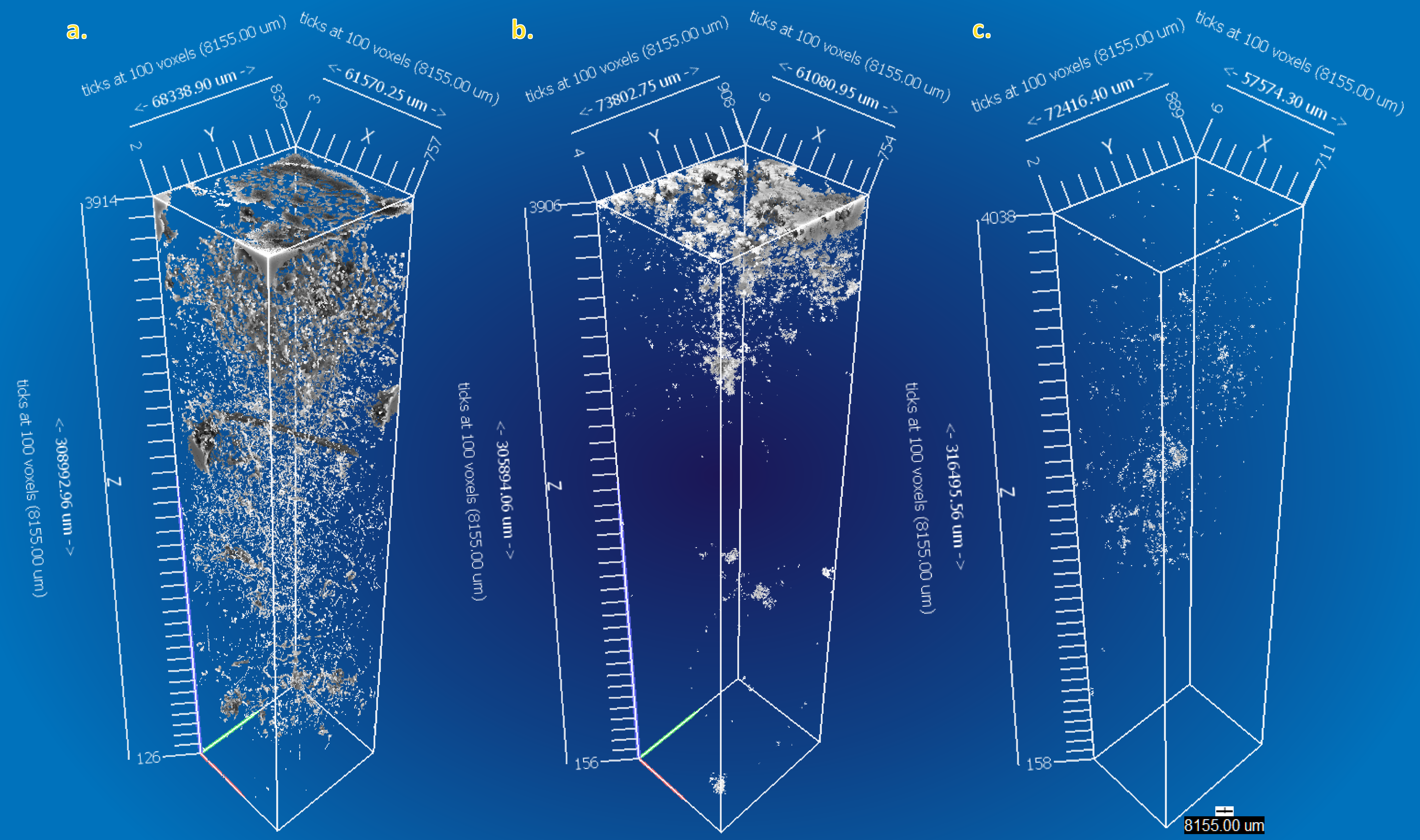
Methodology

15 sediment cores (30cm length x 11cm diameter) were recovered from multiple UK (Cumbria and North Yorkshire) restored, degraded, and near-natural upland blanket peatlands that experienced different conditional restoration treatments over variable timescales (~1 to 10 years post restoration). 3D µCT, a non-destructive imaging technique, was applied to evaluate the structure and composition of restored blanket peats including pore-space and root networks for the first time.

3D µCT and Carbon Dynamics

- Pore and root networks govern gas and solute transfer in peat (namely CO_2 and CH_4) through their influence on hydrology. This effects peats ability to sequester and store carbon.
- As evidenced in the figure above, degraded peat presents large, interconnected macropores in contact with the surface. These act as direct release pathways for greenhouse gases to the atmosphere and encourage a net loss of carbon.
- Restored peat demonstrates smaller, less interconnected macropore networks than that of degraded, but has many of its macropores in contact with the surface. This is un-like near-natural peat which has most of its macropores enclosed.

Total Air-Filled Porosity

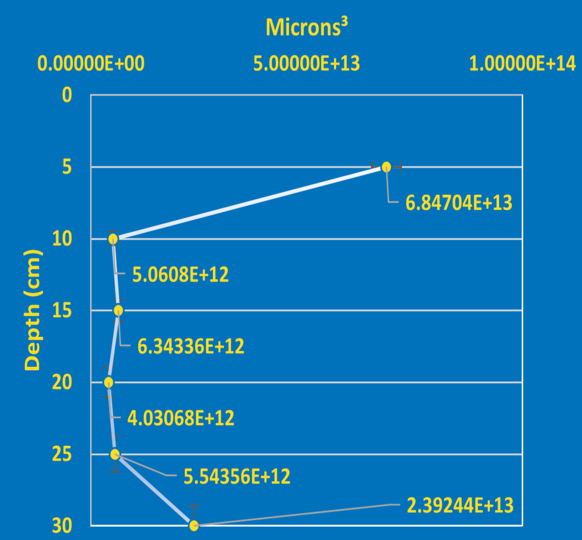


a. Degraded Blanket Peat (Bare Peat Surface):
- 264463 identified pores >1000 microns³

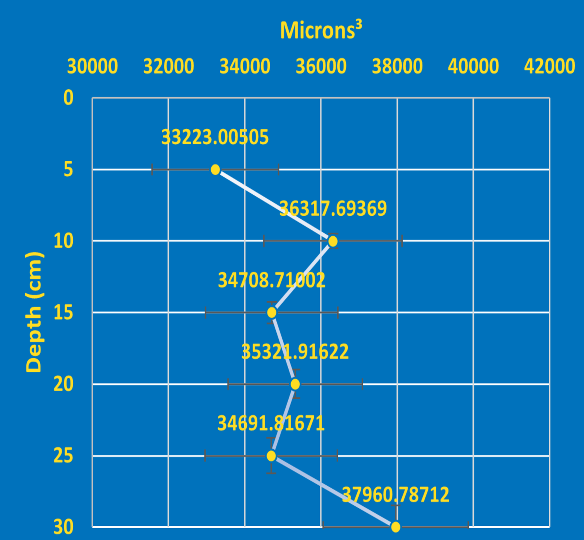
b. Restored Blanket Peat (5-years Post Local Re-turve):
- 168390 identified pores >1000 microns³

c. Near-natural Blanket Peat (*Sphagnum* Moss Surface):
- 56898 identified pores >1000 microns³

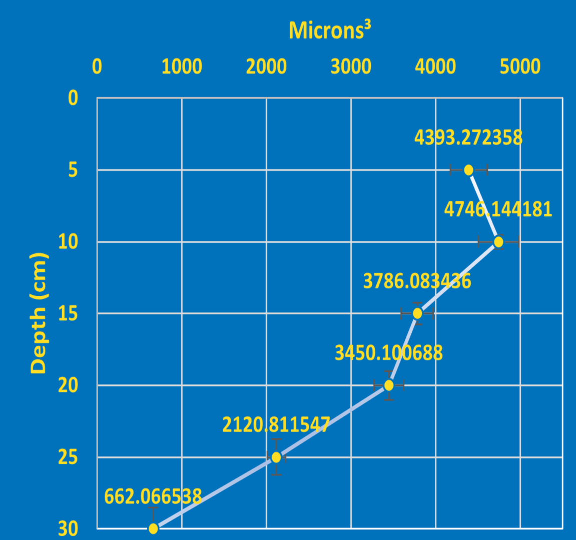
Total Volume microns³



Mean Feret Diameter microns³



Mean minor radius microns³



3D µCT enables the detailed examination of pore networks to understand their influence on carbon dynamic function.

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Session SSS5.5 – Carbon sequestration: organic and inorganic mechanisms of building soil carbon stocks as a pathway to net zero

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Project Website

Abstract

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