Peat soil thickness and carbon storage in the Belgian Hautes Fagnes: insights from multi-sensor UAV remote sensing

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Abstract

INTRODUCTION

- Peatlands are known to store a large amount of carbon stock.
- Peat depth and carbon stock are spatially variable across a peatland landscape even at small scales, and uncertainties remain about the controlling factors.
- There are now new methods (i.e., GPR, UAVs) based on digital soil mapping and/or remote-sensing tools for collecting high-resolution data, thereby providing new opportunities for achieving accurate peat depth and carbon storage estimates.

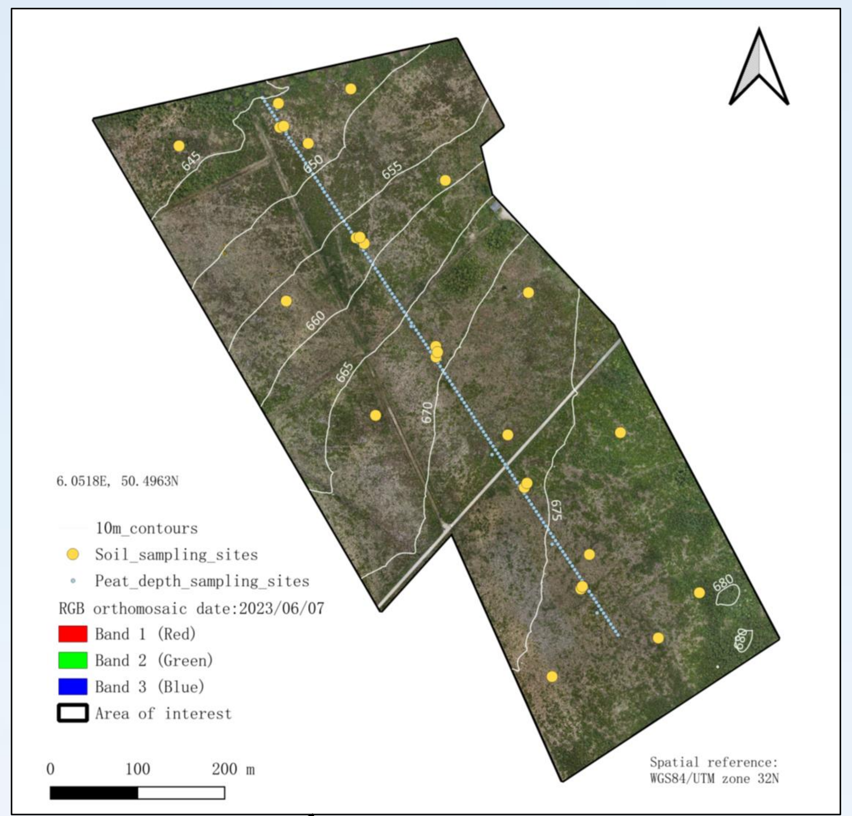
OBJECTIVES

- ➢ Characterizing the spatial and vertical distribution of peat soil thickness and carbon stock.
- ➢ Identifying factors that control carbon storage, with a specific focus on connections between surface and subsurface.
- ➢ Spatial mapping by UAV data.

STUDY SITE

- ■ Belgian Hautes Fagnes Plateau: situated in the east of Belgium and the southern part of peatlands in Europe.
- ■ The site is characterized by a steep topographic gradient and humid climate.
- ■ The site was drained for forestry in the early 20th century and it has been left to undergo natural evolution since 2017.

METHODOLOGY



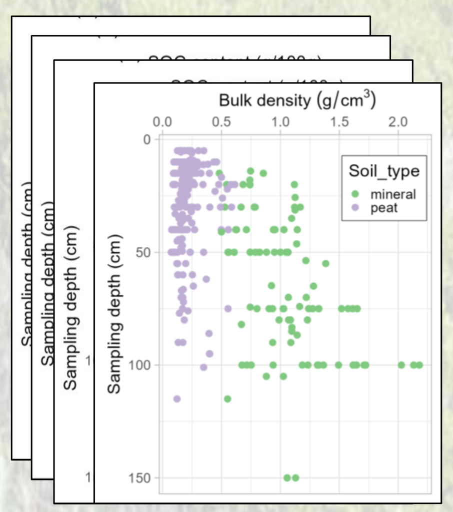
Soil sampling

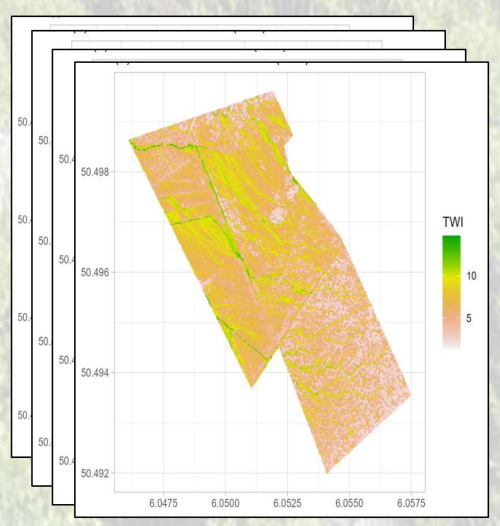
UAV surveys

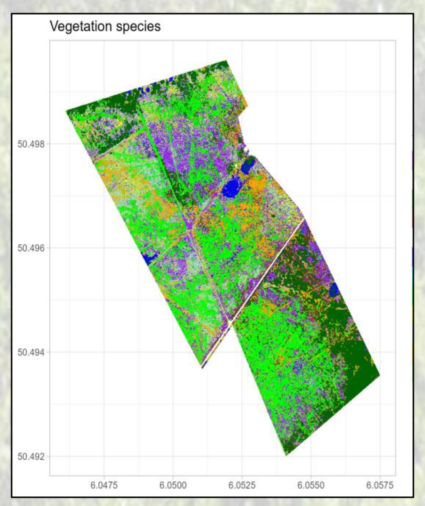
Soil property

topography

vegetation







SOC, TN, bulk density, soil texture…

DEM, slope, aspect, TWI, curvatures…

RESULTS 1: PEAT DEPTH & SOC STOCK

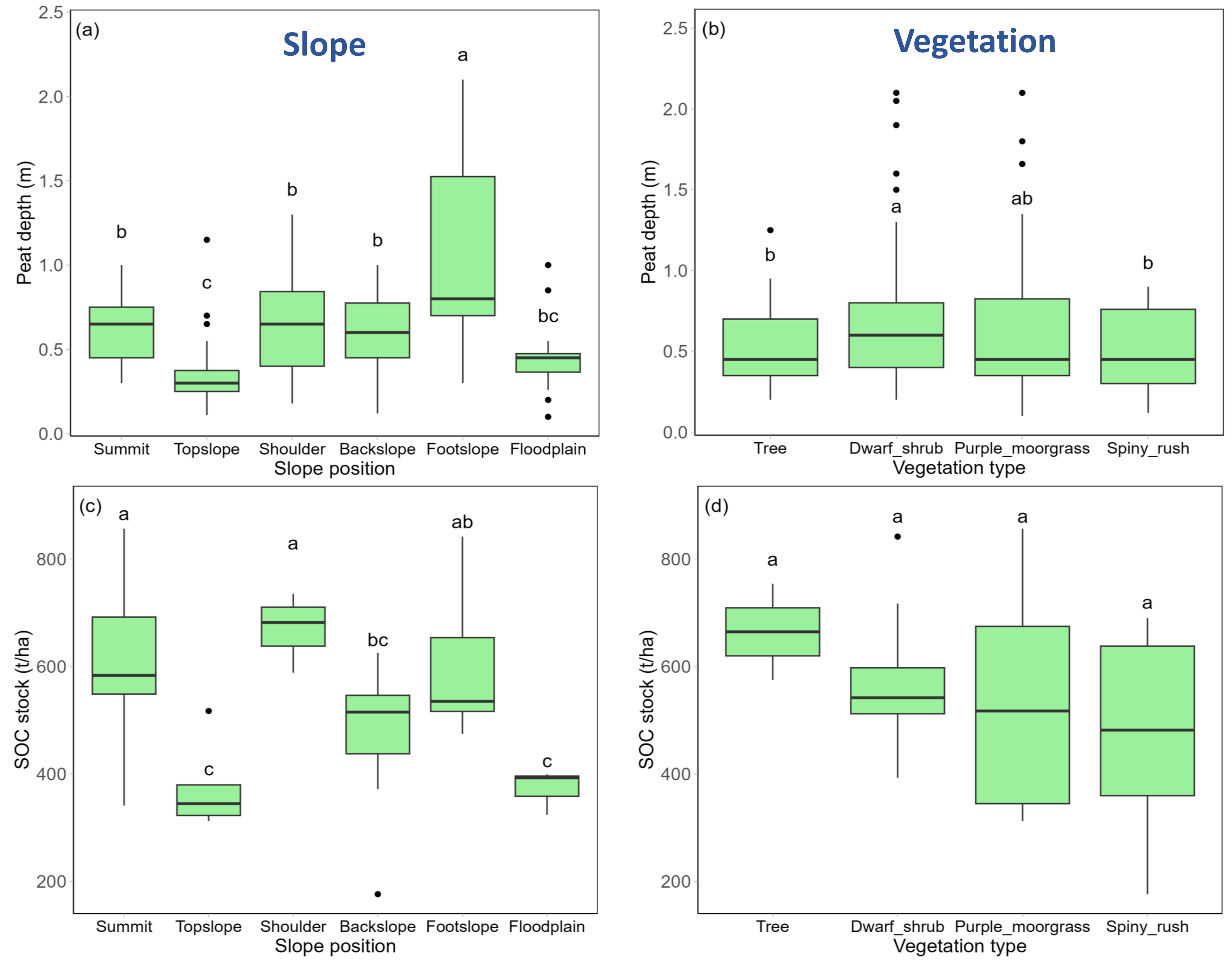


Fig. 1. The peat depth and the SOC stock (top 1 m) of different slope positions (a) (c) and different vegetation types (b) (d).

RESULTS 2: MICRO VS MACRO SCALES

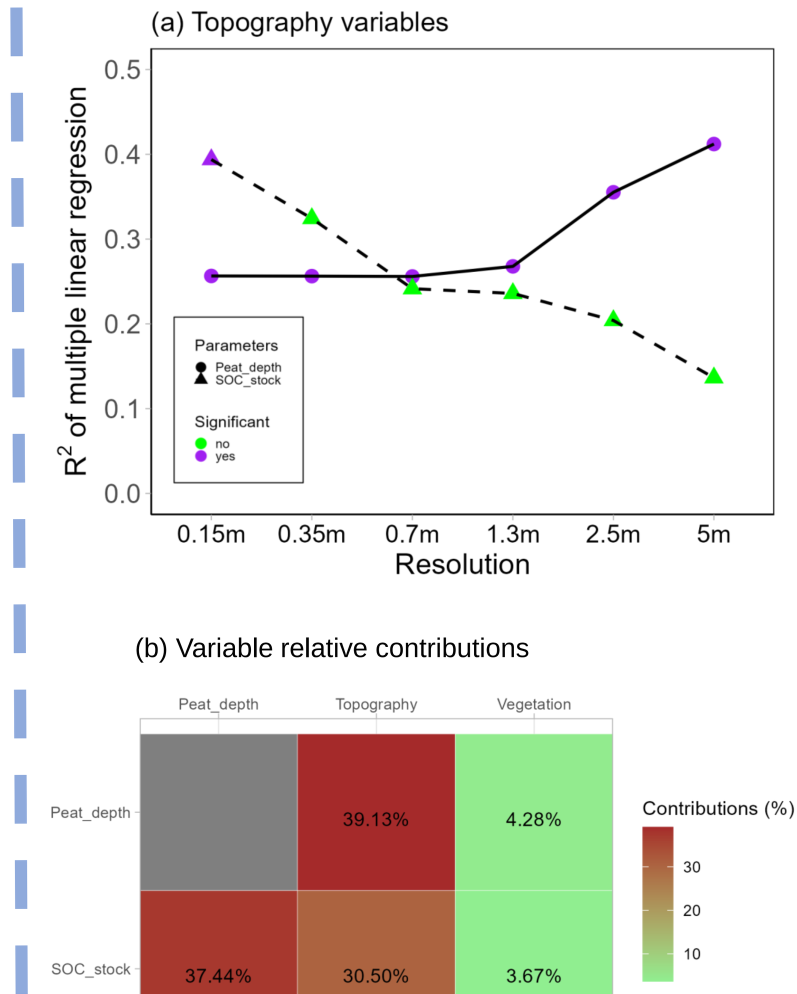


Fig.2. The results of multiple linear regressions for peat depth and SOC storage. Contributions from topography at different resolutions (a) and relative contributions from environmental factors at the optimal scales (b).

RESULTS 3: SPATIAL MAPPING USING UAV DATA

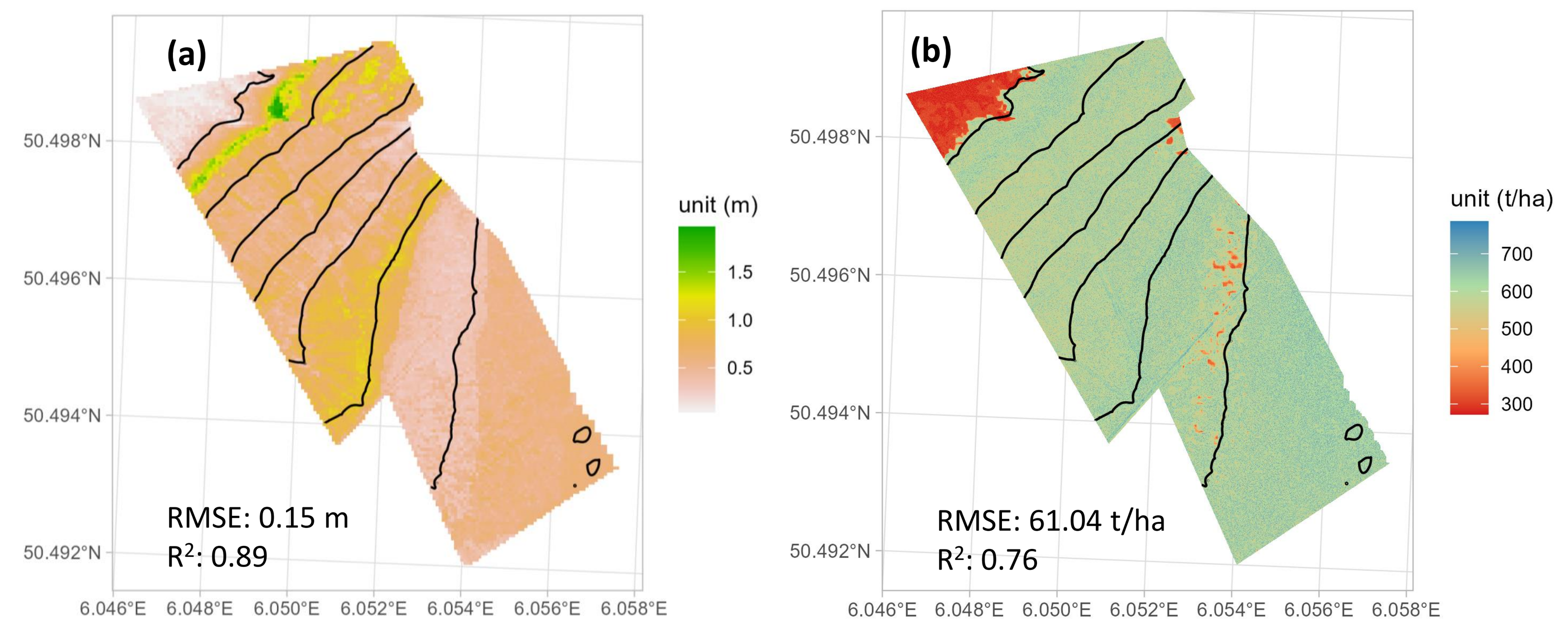


Fig.3. Spatial patterns of predicted peat depth (a) by the Cubist model and spatial patterns of predicted SOC stock (b) by the Random Forest model. The black line in the map indicates contours.

CONCLUSIONS

- ❖ Both peat depth and SOC stock showed great spatial variability across the landscape, and the influences from topography varied from micro- to macro-scales.
- ❖ Topography controlled the peat depth distribution while peat depth was the most influential factor for SOC stock.
- ❖ Vegetation has limited contributions in explaining the spatial variability.
- ❖ UAVs had great potential in achieving accurate peat depth and SOC stock estimates.