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Understanding the structure of Exmoor's peatland ecosystems using laser-scanning technologies

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Upland blanket peatlands in the UK are of high conservation value and in an intact state, provide important landscape services, such as carbon sequestration and flood attenuation. The drainage of many such wetlands for agricultural reclamation has resulted in changes to upland blanket mire topography, ecology, hydrological processes and carbon fluxes.

There is a need for spatially explicit monitoring approaches at peatland sites in the UK as although there has been a national effort to restore drained peat uplands, baseline and post restoration monitoring of changes to ecosystem structure and function is largely absent. Climate change policy and the emerging carbon markets also necessitate the need for enhanced system understanding to inform carbon targets and understand the impacts of restoration. Exmoor is the focus of this research because many areas of upland peat have, in the past, been extensively drained through government "moorland reclamation" programs. A large restoration project funded by South West Water is currently underway in association with Exmoor National Park, The Environment Agency and Natural England. Exmoor also provides an analogue for other westerly peatlands in the British Isles in terms of its climate, ecology and drainage characteristics.

Our approach employed airborne LiDAR data gathered by the Environment Agency Geomatics Group coupled with Terrestrial Laser Scanning (TLS) surveys. LiDAR data were processed to produce digital surface models (DSM) of the peatland surface at a 0.5m resolution. These data were further interrogated to separate vegetation structures and geomorphic features such as man-made drainage channels which have damaged the peatland. Over small extents the LiDAR derived DSM surface was then compared to a TLS derived DSM to examine the ability of these models to describe fine scale vegetation and geomorphic structure, which could then be extrapolated to larger spatial extents.

Exploration of the data has shown that ecosystem structure can be described at a fine resolution (>10 million measurements, resolution <25mm), and with greater precision than with airborne LiDAR data. Results also suggest that Terrestrial Laser Scanning (TLS) data capture the structure of vegetation in these peatlands effectively and at a resolution appropriate to capturing change, post-restoration (in this case ditch blocking). However, comparisons of structures captured in both LiDAR and TLS DSMs suggest that the elements of the structures measured differ considerably between these technologies. Evidence also suggests that certain vegetation structures can function to erode the signal of geomorphic features such as surface drainage in LiDAR DSMs. Consequently these data suggest that the ability of unmodified LiDAR DSMs to capture the morphology and extent of subtle artificial drainage features or other topographic detail (i.e. with a cross sectional area of $<50cm^2$) is highly limited.