Drone derived Multi-Modal AI Predictive Model to detect & identify peatland degradation, plan restoration activities & monitor peatland health

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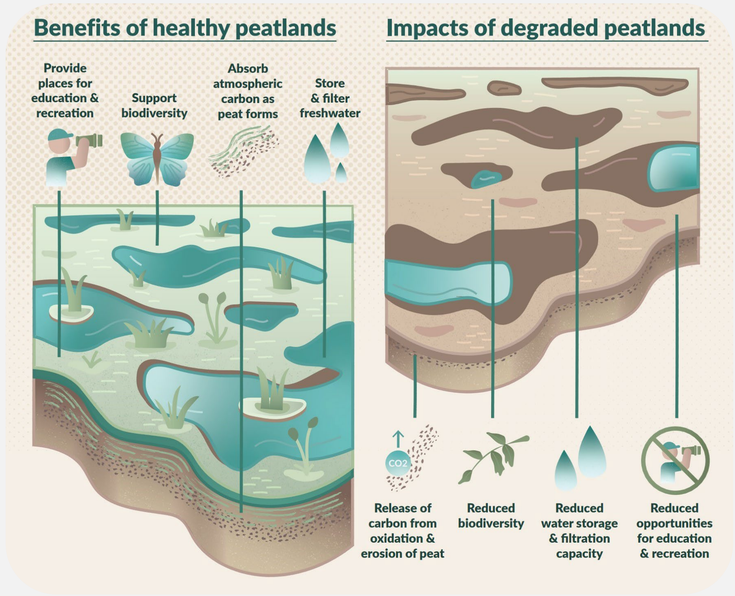
Background

Scenario

- UK has **3 million ha** of peatland which stores over **3 billion tonnes** of carbon [1]
- **80%** in poor condition & **releases 23 million tonnes** of CO_2 annually [1]
- Our AI based automated tool will enable **scalable planning of peatland restoration** activity cost effectively & **reduce carbon emissions faster**

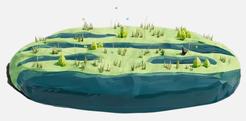
Healthy Peatland Vs Degraded Peatland



The Challenges with the Current Approach

Manual Approach

- Based on ground based assessments or low resolution satellite data



1. Ecologists walking the peatlands & collecting data (mapping erosion feature)

2. Unstructured/incomplete data is collected

3. Approximate land measurement & Plan Restoration

- Resource Intensive
- Time-consuming
- Subjective observation
- Lack precision & efficiency
- Hinder effective restoration planning & decision making

Expensive to deliver, lack of scalability, limited reduction of carbon emissions

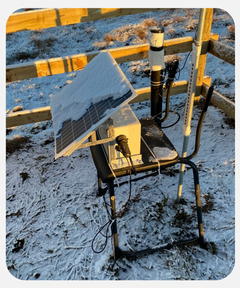
Our Approach: Multi-Modal AI Predictive Model

Drone & IoT Devices

High resolution RGB & LiDAR images are captured by drone

Water Table depth (WTD) & CO_2 Concentration are collected from remotely accessed IoT sensors

Gas Analyser

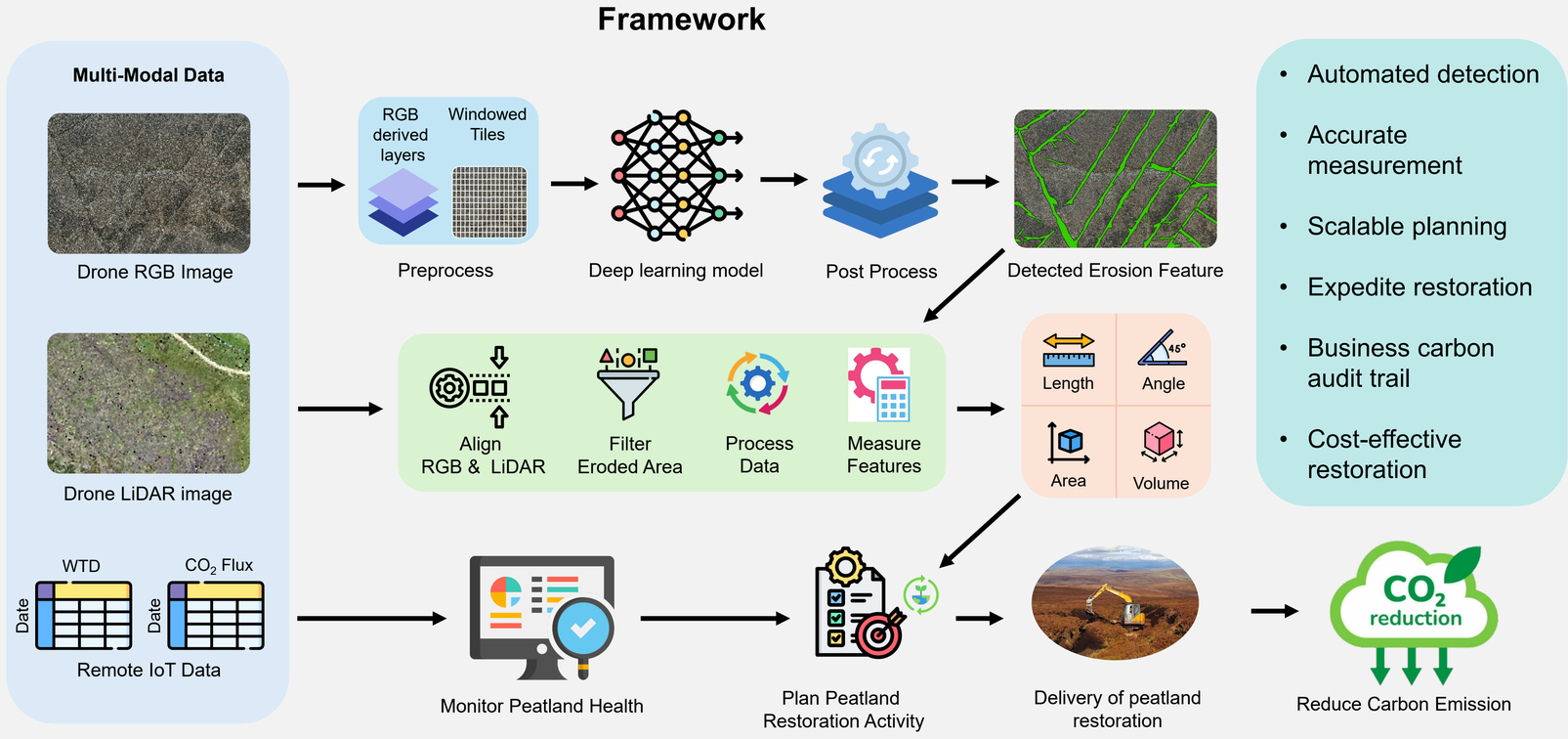


Peat Camera

Data Processing

Store

Framework



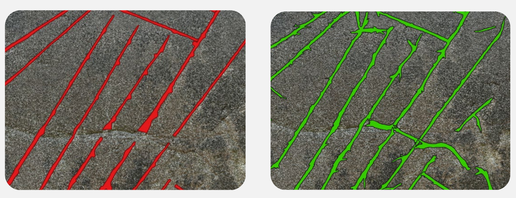
- Automated detection
- Accurate measurement
- Scalable planning
- Expedite restoration
- Business carbon audit trail
- Cost-effective restoration

Outcomes

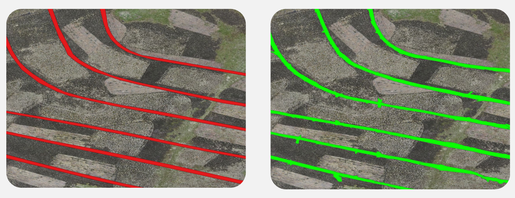
Map of Erosion Features

Identify areas undergoing **degradation**

Example 1:



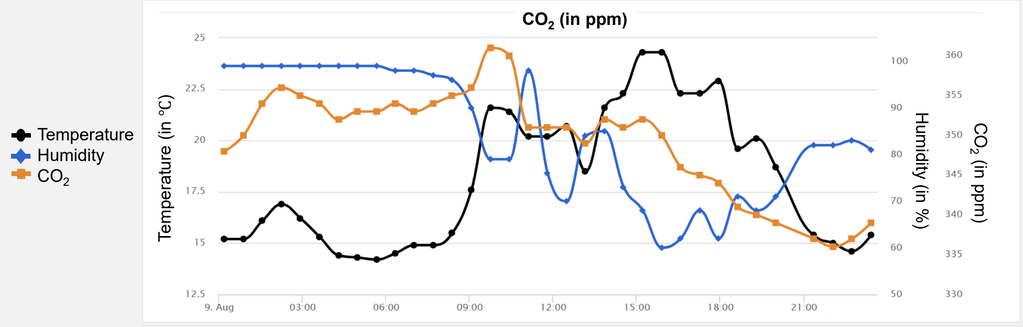
Example 2:

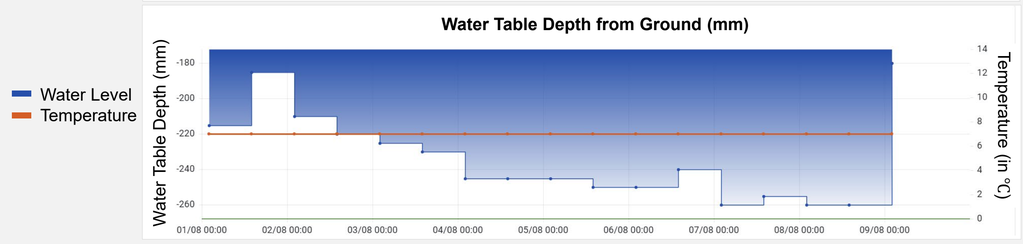


Manual Annotations (**Red**) vs Model Predictions (**Green**)

Peatland Health Assessment

Regularly observe remote data of **water table depth** & **CO_2 flux**





Restoration Plan

Plan restoration based on erosion features measurement & peatland health assessment

Example: Peatland restoration - Grip Blocking
Location: North Yorkshire
Restoration size: 50.5 ha
Carbon available: 2000 tC02e (over 20 years) [2]

Benefits

Carbon Sequestration

CO_2 Emission Reduction

Habitat Restoration

Biodiversity

Maintain Water level

Climate Change Mitigation

Extra Revenue Stream

References

1. UK natural capital-Office for National Statistics (ons.gov.uk), Accessed June 2024
2. https://csxcarbon.com/buy-carbon-buy-bng-offsets/ , Accessed August 2024
3. He, K., Gkioxari, G., Dollár, P. and Girshick, R., 2017. Mask r-cnn. In Proceedings of the IEEE international conference on computer vision (pp. 2961-2969).
4. Pawłowski, M., Wróblewska, A. and Sysko-Romańczuk, S., 2023. Effective techniques for multimodal data fusion: A comparative analysis. Sensors, 23(5), p.2381.
5. Robb, C., Pickard, A., Williamson, J.L., Fitch, A. and Evans, C., 2023. Peat Drainage Ditch Mapping from Aerial Imagery using a convolutional neural network. Remote Sensing, 15(2), p.499.

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