Peat Cameras: Land Subsidence and Watertable Assessment

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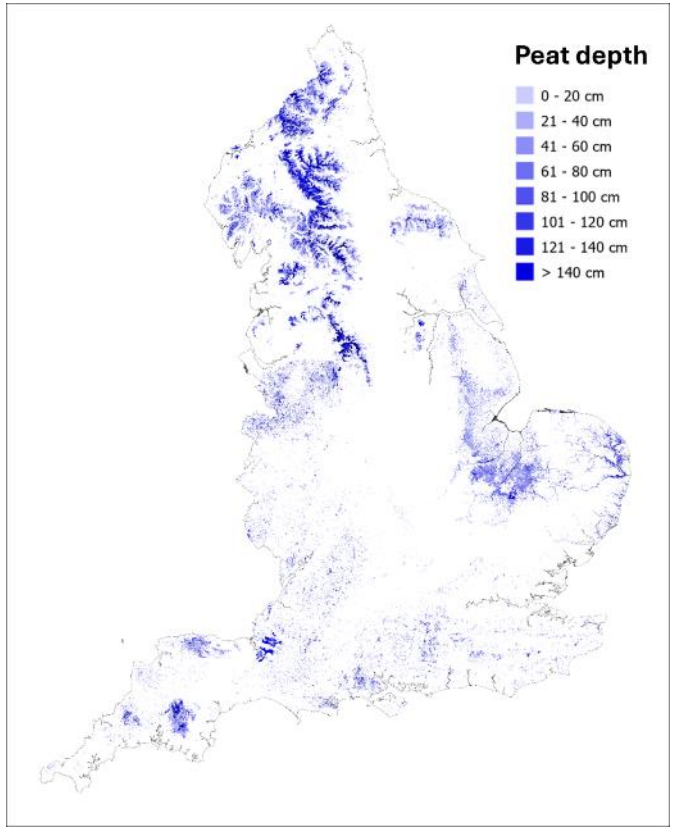
Introduction

- Peatlands are among the most intensive sources of land-use GHG emissions per unit area
  - Globally → peat drainage and degradation contribute around 2-4% of all anthropogenic GHG emissions
  - UK → around 3.5% of the UK's total GHG emissions.
- In the UK, peatlands cover around 10% of the land area
  - Around 80% of UK peatlands face some kind of degradation (e.g. drainage, peat extraction, land-use conversion, fire, etc)
- As a result, peatland restoration offer the largest and most space-efficient opportunities for climate change mitigation, with potential to make a major contribution to carbon offsetting
- However, the outcome of peatland restoration and mitigation measures is uncertain and difficult to verify
  - Ground monitoring: flux towers (very accurate but expensive), manual GHG measurements (labour intense and limited spatial and temporal information)
  - Satellite monitoring: monitoring of peatland GHG emissions is not possible – currently reliant on unproven proxies
- **Peat condition** assessment through **peat subsidence** and **WTD** monitoring



The England Peat Map. Source: https://naturalengland.blog.gov.uk/2025/05/12/a-new-peat-map-for-england/

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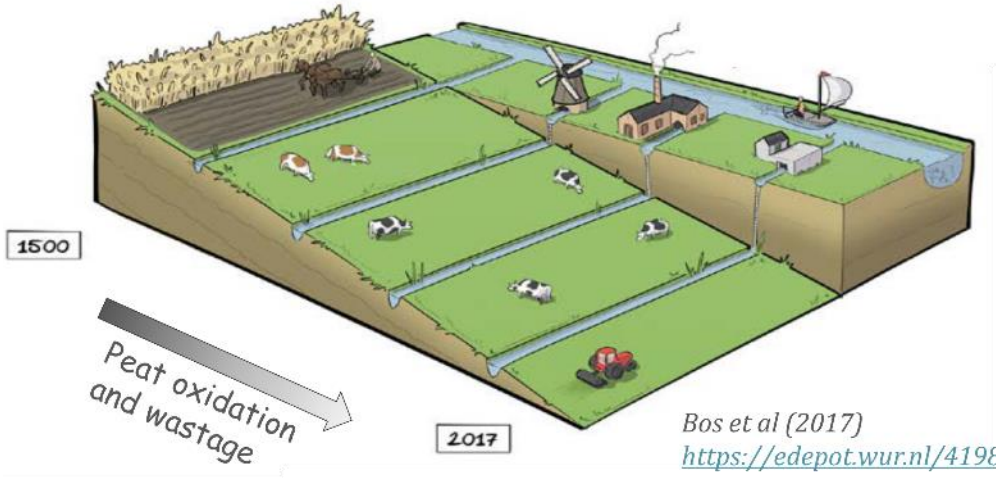
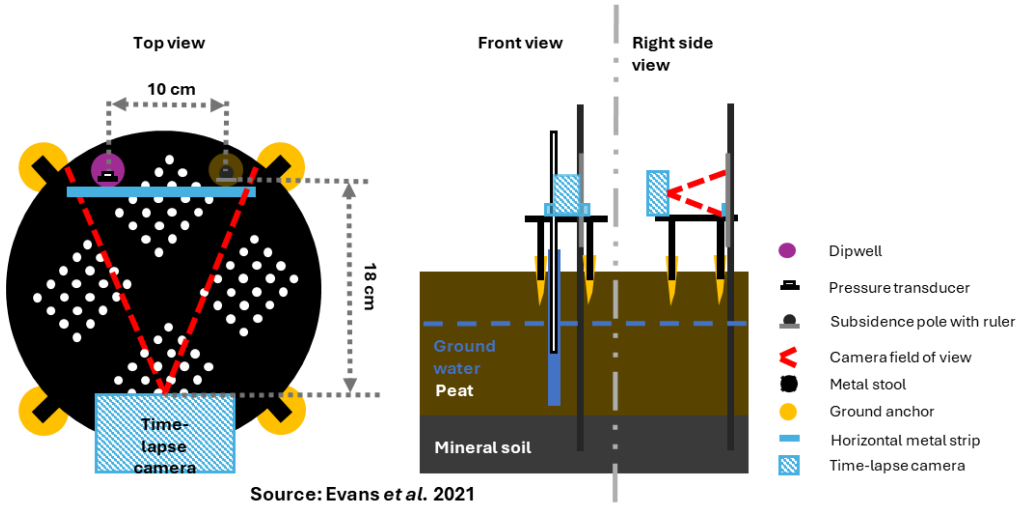
Peat subsidence

- Subsidence is the process by which land or buildings sink to a lower level
  - In low-lying regions→ increased river flooding risk, challenges for water management, and possibly a reduction in the land area available for agriculture
- How to measure peat subsidence?
  - Repeated manual measurements on metal or plastic poles inserted into the peat and anchored into the mineral soil
- Peat cameras can automate peat subsidence and water table depth measurements
- Low-cost, custom-built time-lapse cameras
  - Based on Raspberry Pi computers, low-cost sensors, including a pressure transducer and telemetry capacities
- Solar-powered and autonomous system
- Automation of data analysis using computer vision



Bos et al (2017)
https://edepot.wur.nl/419822



Source: Evans *et al.* 2021
https://www.frontiersin.org/articles/10.3389/fenvs.2021.630752/full (open access)

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Peat cameras

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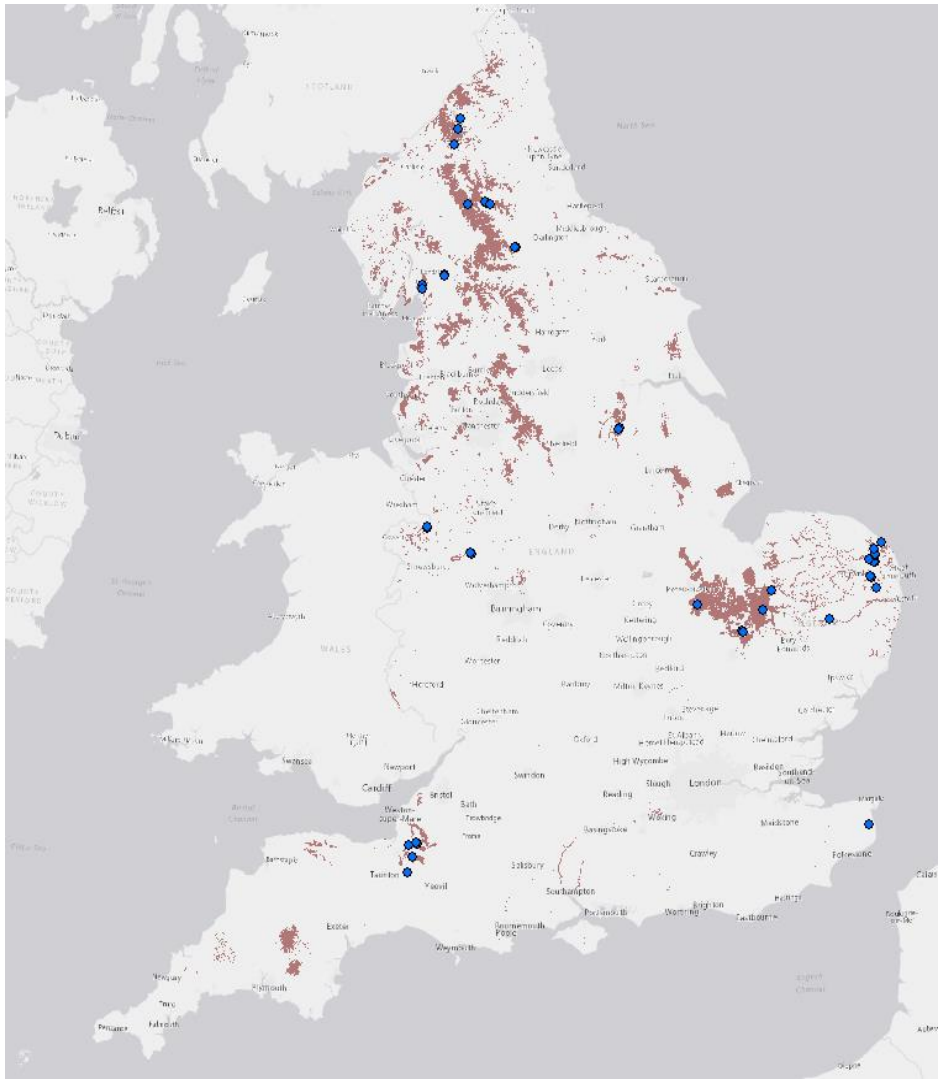
Worldwide network of peat cameras

- Over 100 cameras installed in the UK
- Over 20 cameras installed in Europe (Ireland, Poland, The Netherlands and Finland)
- Over 40 cameras installed in SE Asia (Indonesia and Brunei)
- 3 cameras installed in Tierra del Fuego, Chile



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Results of peat motion and water level assessment across different land-use classes and peat condition

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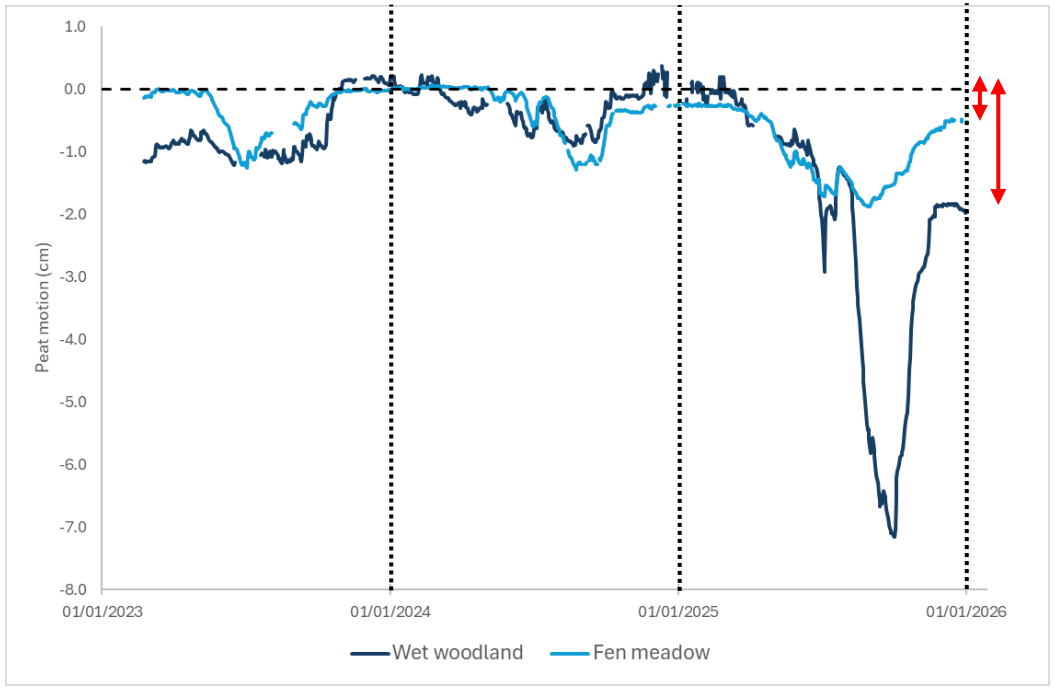
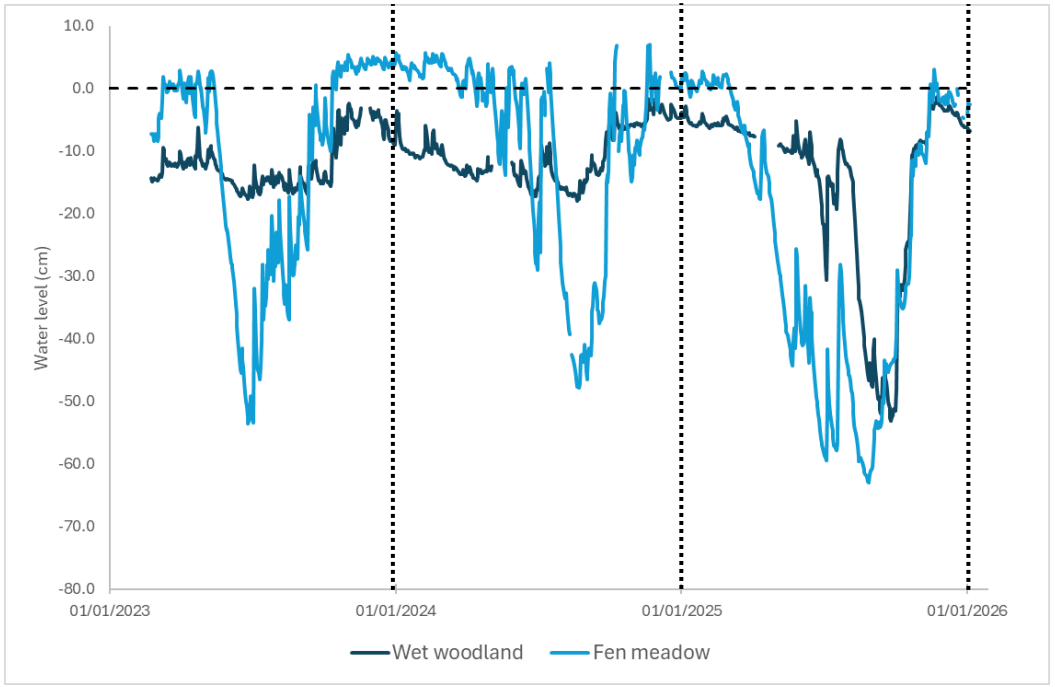
Semi-natural sites: How Hill

Peat motion



Water level



- Water level and peat motion very stable during 2023 and 2024
  - WL at the Fen meadow showed larger variation through the year/s with just a few mm of peat subsidence
  - Wet woodland site didn't have any apparent subsidence (WL did not drop during the summer months)
- Drought in 2025 has resulted in a peat loss of 2 cm at the wet woodland site while the fen meadow showed a similar peat loss than that recorded in 2024.
  - In the long-term, continuous peat loss (through oxidation or compaction) will increase the flooding risk of these areas

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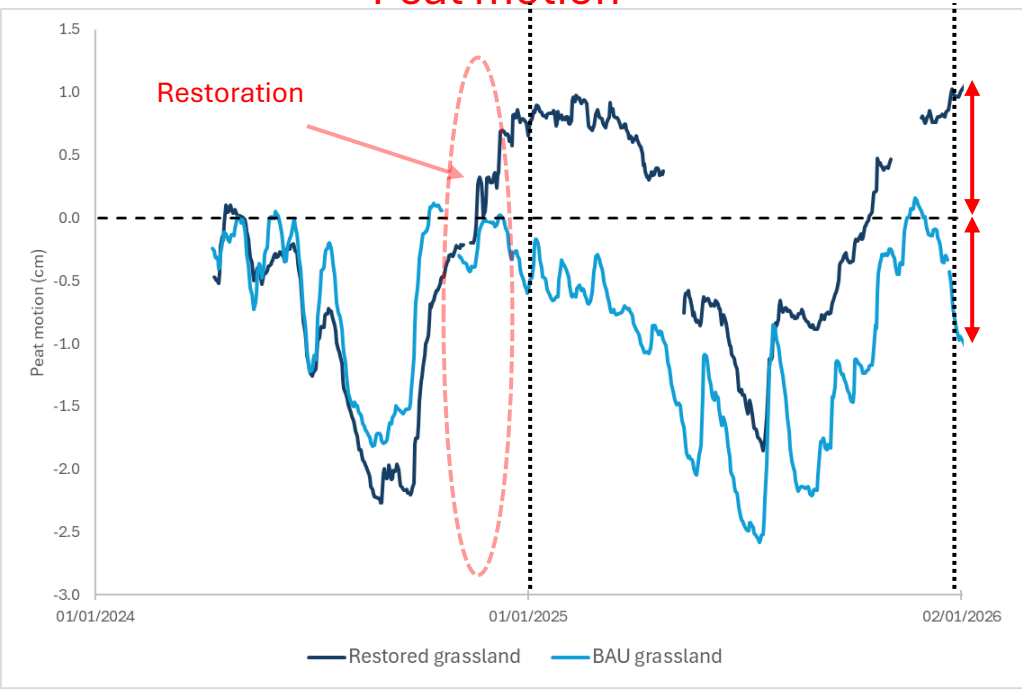
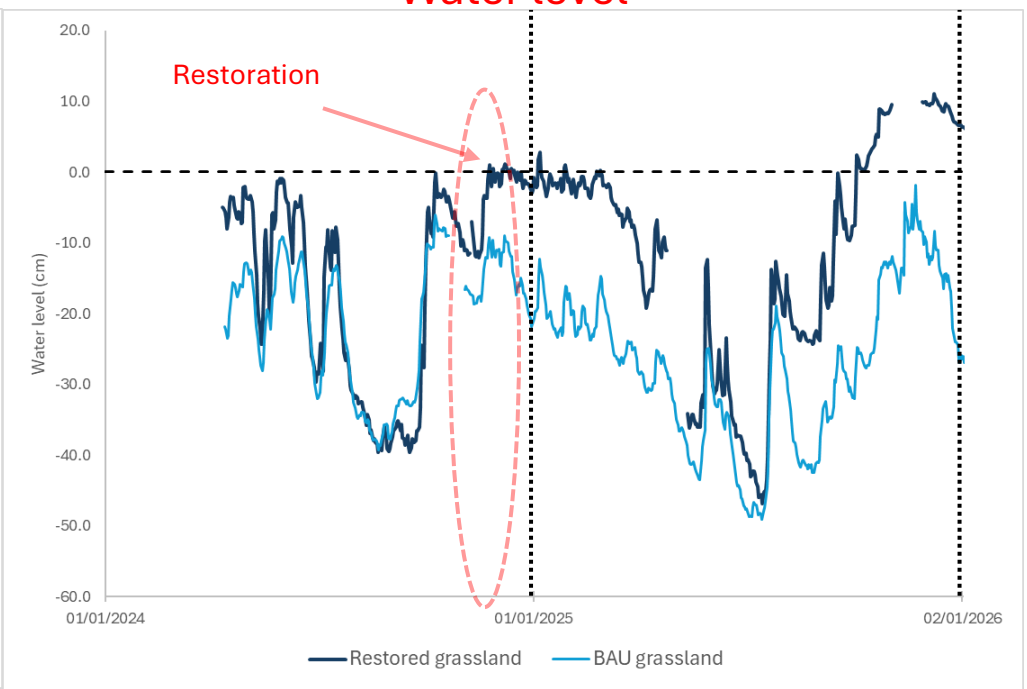
Grassland land use in the Broads

Peat motion



Water level



- Two grazing farms (500-800m apart) adjacent to the river Yare. One site was restored in November 2024.
- Before restoration, WL and peat motion was similar at both sites
- After the restoration, both, WL and WT have raised considerably.
- While the 2025 drought has resulted in a peat loss of 1 cm at the BAU site, the restored site does not show any apparent peat subsidence. Restored site has increased resilience against drier conditions.

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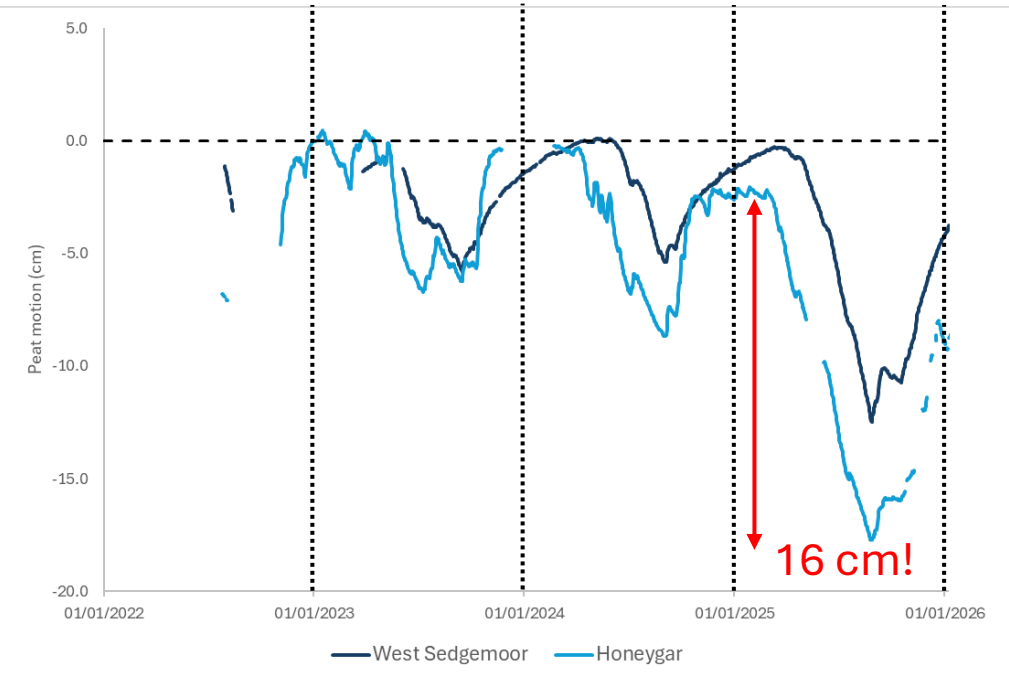
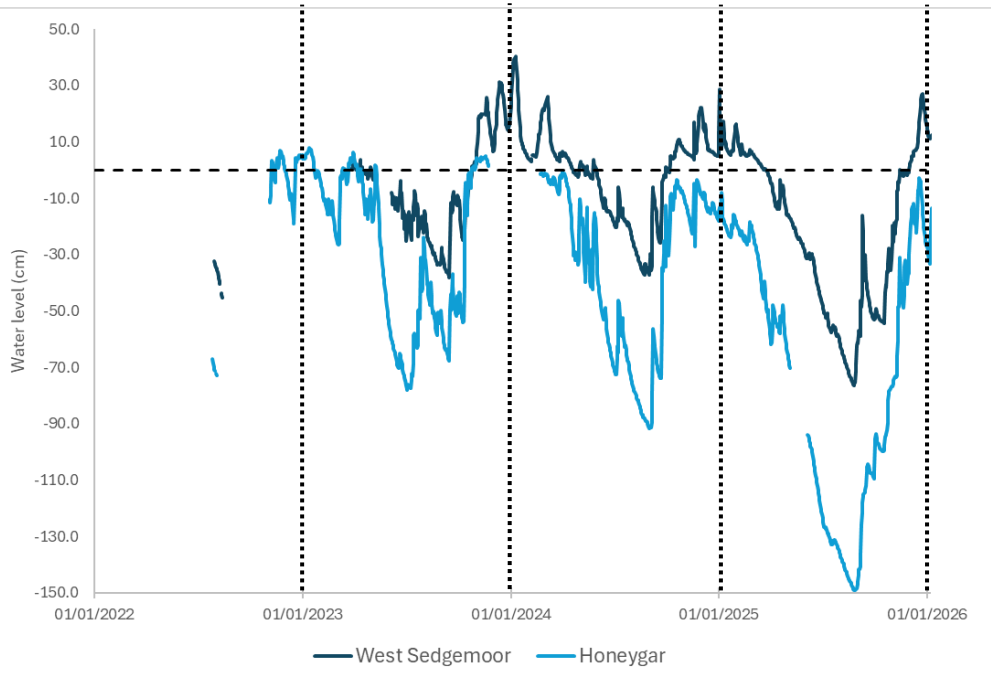
Grassland land use in the Somerset Levels

Peat motion



Water level



- Large seasonal peat motion at the grassland sites in the Somerset Levels
- West Sedgemoor, has great resilience and the large peat motion recorded annualy did not result in any apparent peat subsidence between 2023 and 2024. However, in 2025 → around 3 cm of peat.
- By contrast, peat at Honeygar seems more susceptible to changes in water level, with around 2 and 10 cm of peat loss measured in 2024 and 2025, respectively.
- Wet conditions at West Sedgemoor during the winter resulted in less peat loss during the summer.

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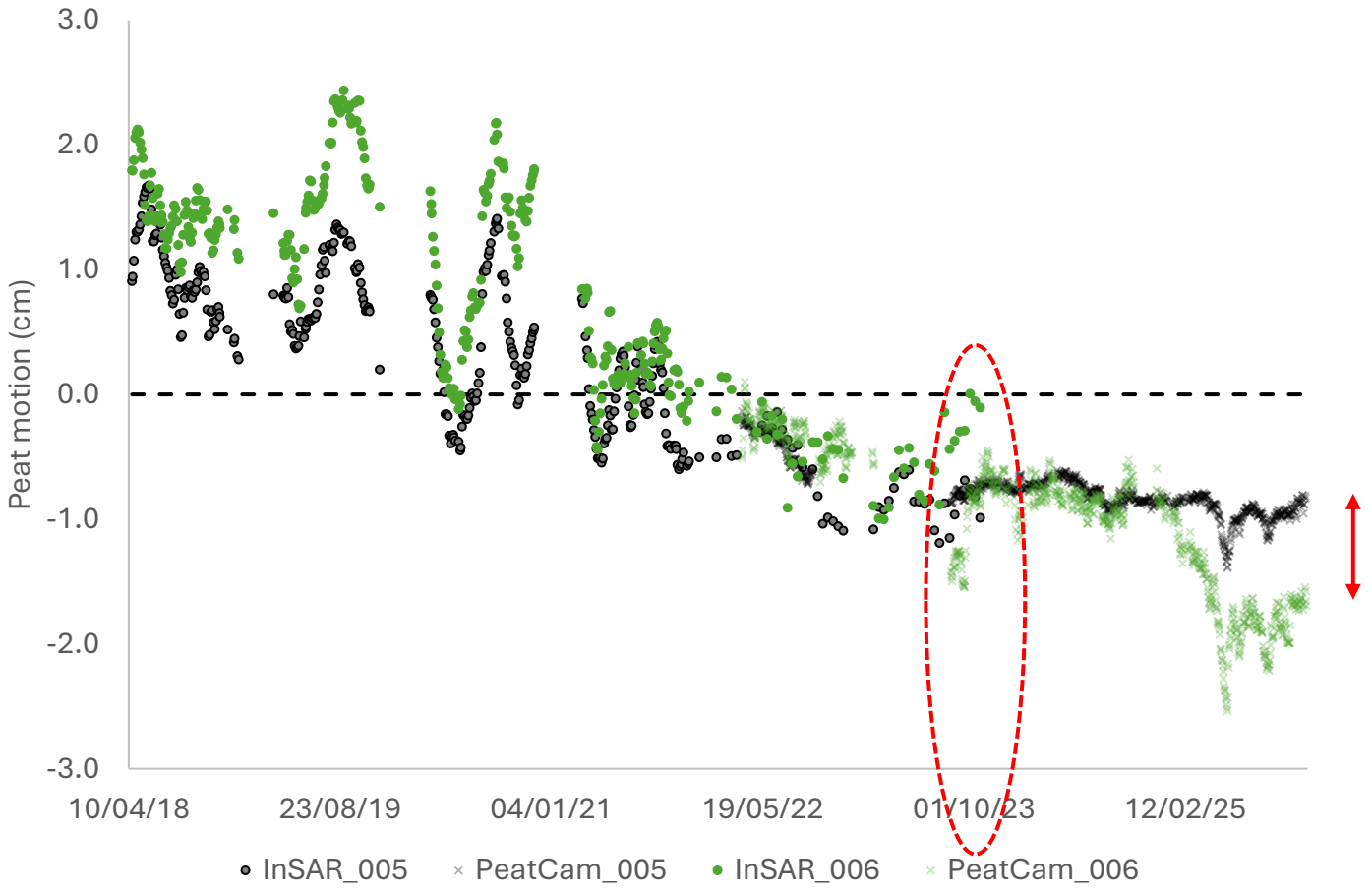
Blanket bogs (North Pennines)

- Can we detect the success of peatland restoration using remote sensing techniques and peat cameras?
- Before the restoration, no clear differences in peat subsidence between both sites
- Site #005 was restored in the autumn of 2023
- Restored site was able to retain more water and minimise peat subsidence during the 2025 drought
- Good agreement between InSAR and in-situ measurements



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Real-time data

UK Centre for Ecology & Hydrology

PeatCam locations

PeatCam sites

Select PeatCam sites (or click on map to add):

NF-Wildflower meadow (How Hill) NF-Pigeon wood (How Hill)

Select x-axis Variable:

Hourly

Select climatic Variable:

Peat motion (cm)

Select secondary climatic Variable:

Peat motion (cm)

Select date interval

2025-01-01 to 2026-01-16

Reset date

About

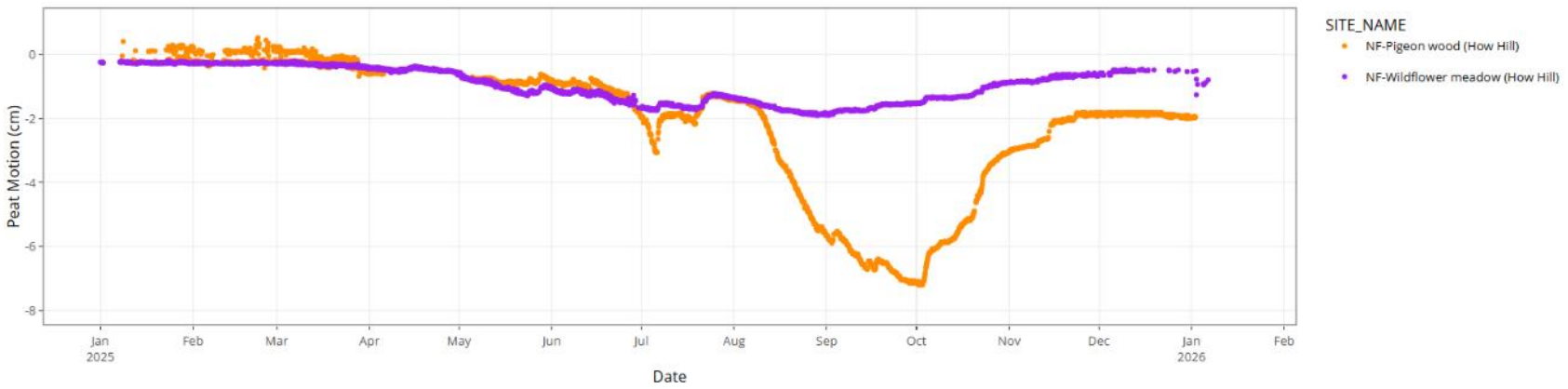
Select scale Y-axis:

-10 -8 1 2

-10 -8.8 -7.6 -6.4 -5.2 -4 -2.8 -1.6 -0.4 0.8 2

Reset scale

Time series plot:



Towards an affordable and scalable MRV solution

- Peat cameras are providing vital ground data at the site-level and nationally.
  - Over 100 peat cameras installed in England
  - 24 cameras installed in the Broads
- Peat motion, in combination with water table depth, can be used to confirm the success of peatland restoration projects
  - However, monitoring at natural and semi-natural sites is also needed to help understanding the success of peatland restoration (e.g. semi-natural sites recorded water level values below -30cm during the studied period; water level threshold determined by schemes like SW18)
- The combination of remote sensing techniques (e.g. InSAR) with ground-truth monitoring, through peat cameras, has the potential of becoming a **reliable and accurate Monitoring, Reporting and Verification method** in peatland restoration projects
- The **next step** is to link peat subsidence estimates with CO_2 emissions from Eddy Covariance flux towers (ongoing work)

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Acknowledgements

Natural England
Broads Authority
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Colleagues and collaborators of the peat camera network
Farmers and site owners & managers

Thank you

For more information please contact:

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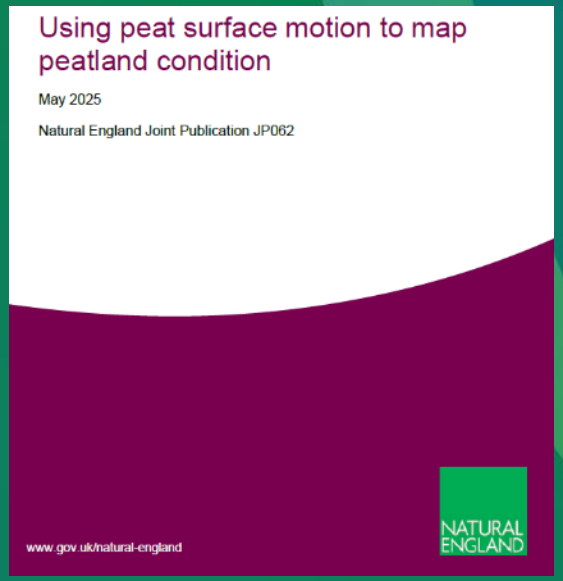
or check the Natural England Joint Publication **JP062** from the England Peat Map project
(https://publications.naturalengland.org.uk/file/5760677820760064)



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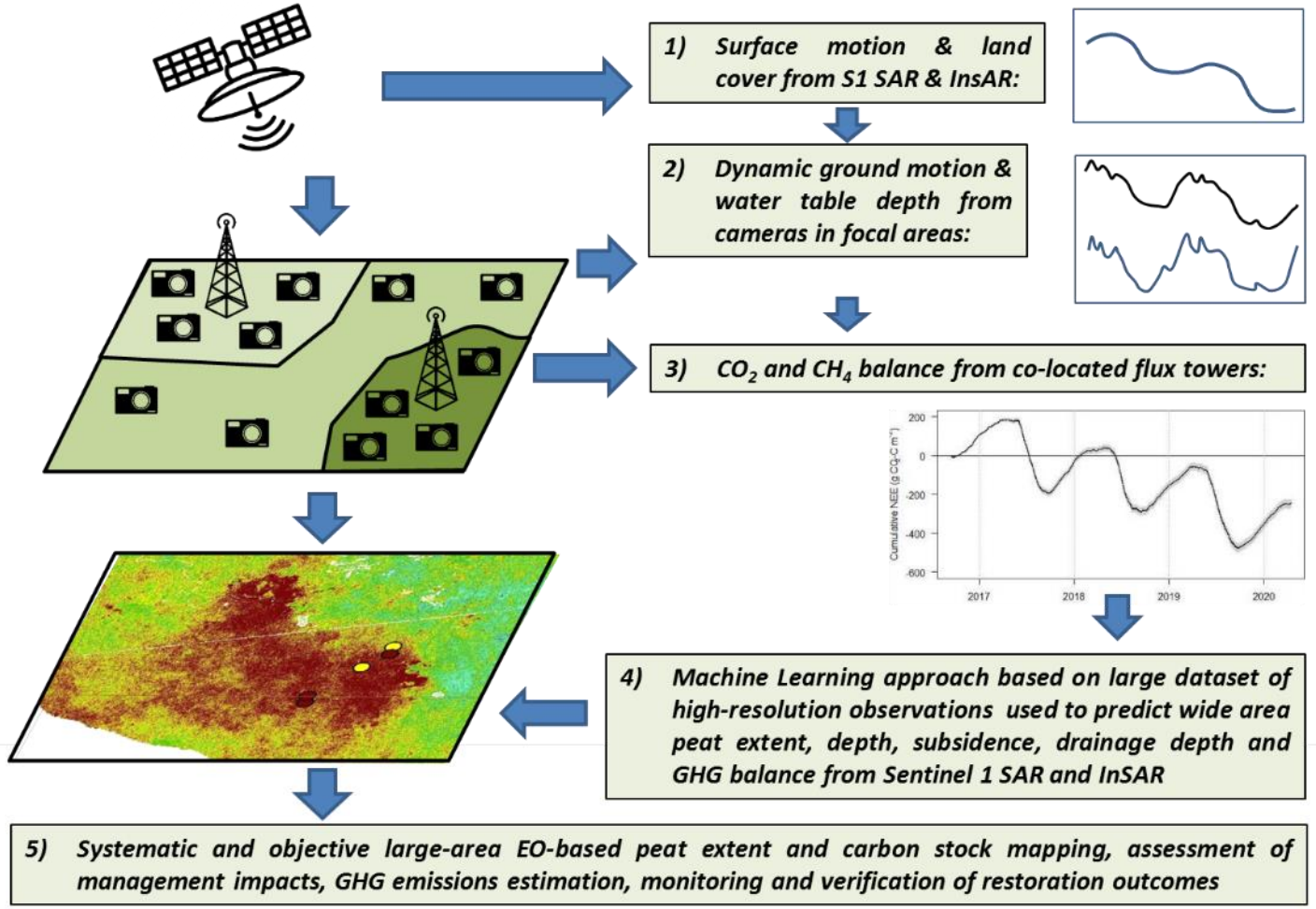
New peatland monitoring, reporting and verification (MRV) concept

- A new standard for global peatland monitoring and reporting
- Combination of in-situ peat subsidence and InSAR estimates
- Linking peat motion to GHG emissions
  - Development of empirical "transfer functions" between satellite data and ground observations of peat motion, water table depth, CO_2 and CH_4 emissions
- Scaling up to regional and national level using machine learning and other Earth Observation techniques



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