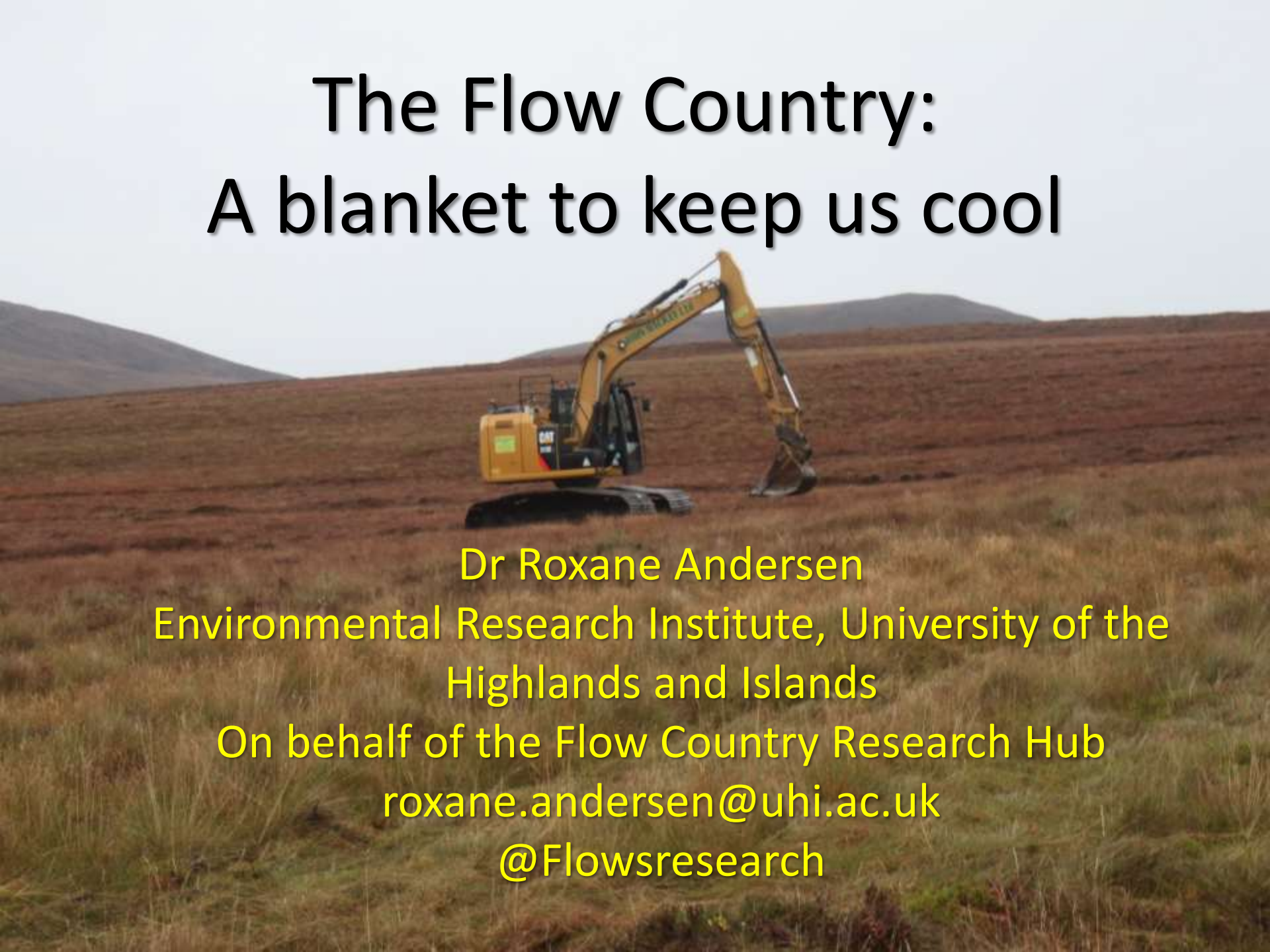
The Flow Country: A blanket to keep us cool



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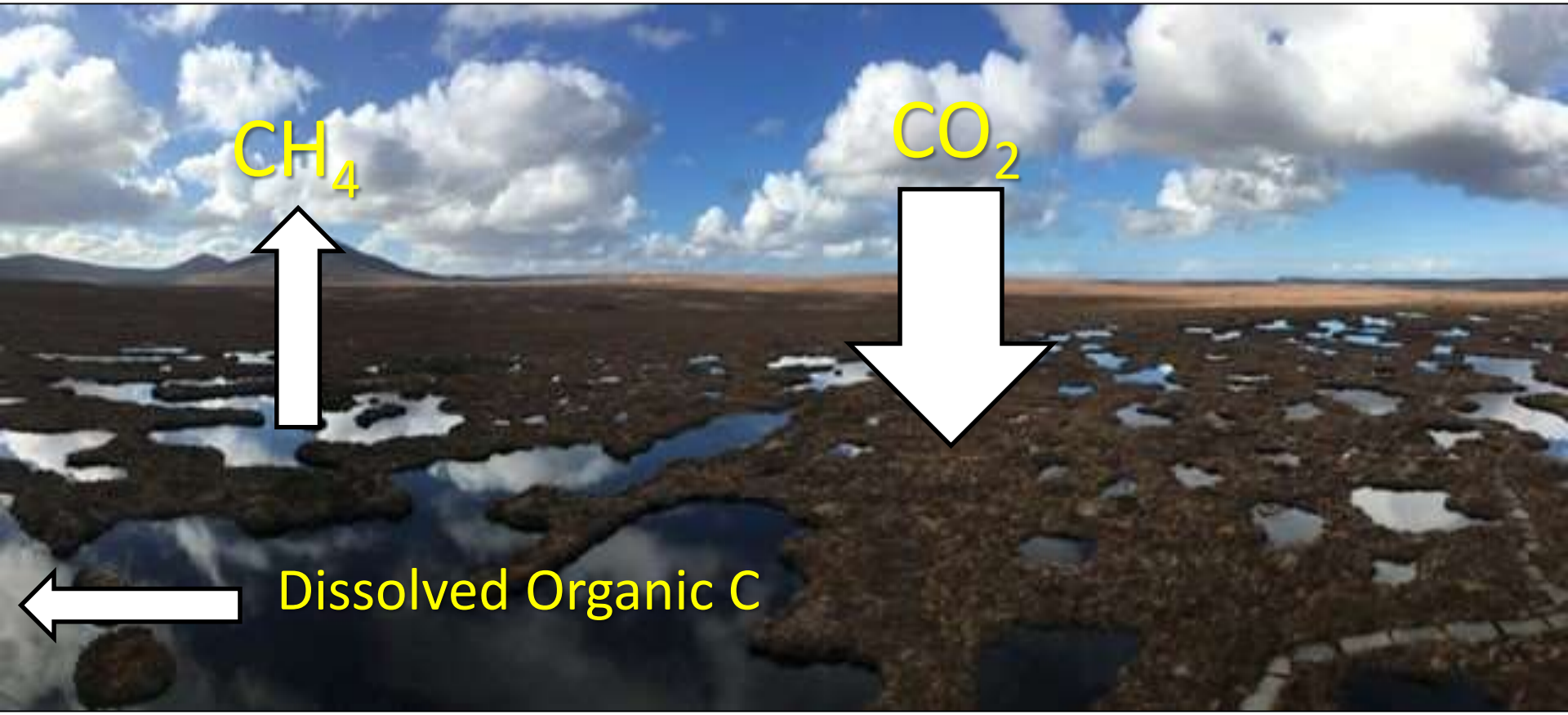
Outline

1) Background
2) Climate benefit of Forest to Bog restoration
3) Developing innovative monitoring tools
4) Legacies

1. How peatlands cool the Earth



Long-term C accumulation in the Flow Country : 16.3 g C m^{-2} y^{-1}

Mean value for northern peatlands: 18.6 g C m^{-2} yr^{-1}

1. The Flow Country: UK's biggest terrestrial C store

~7200-8500 years of peat accumulation

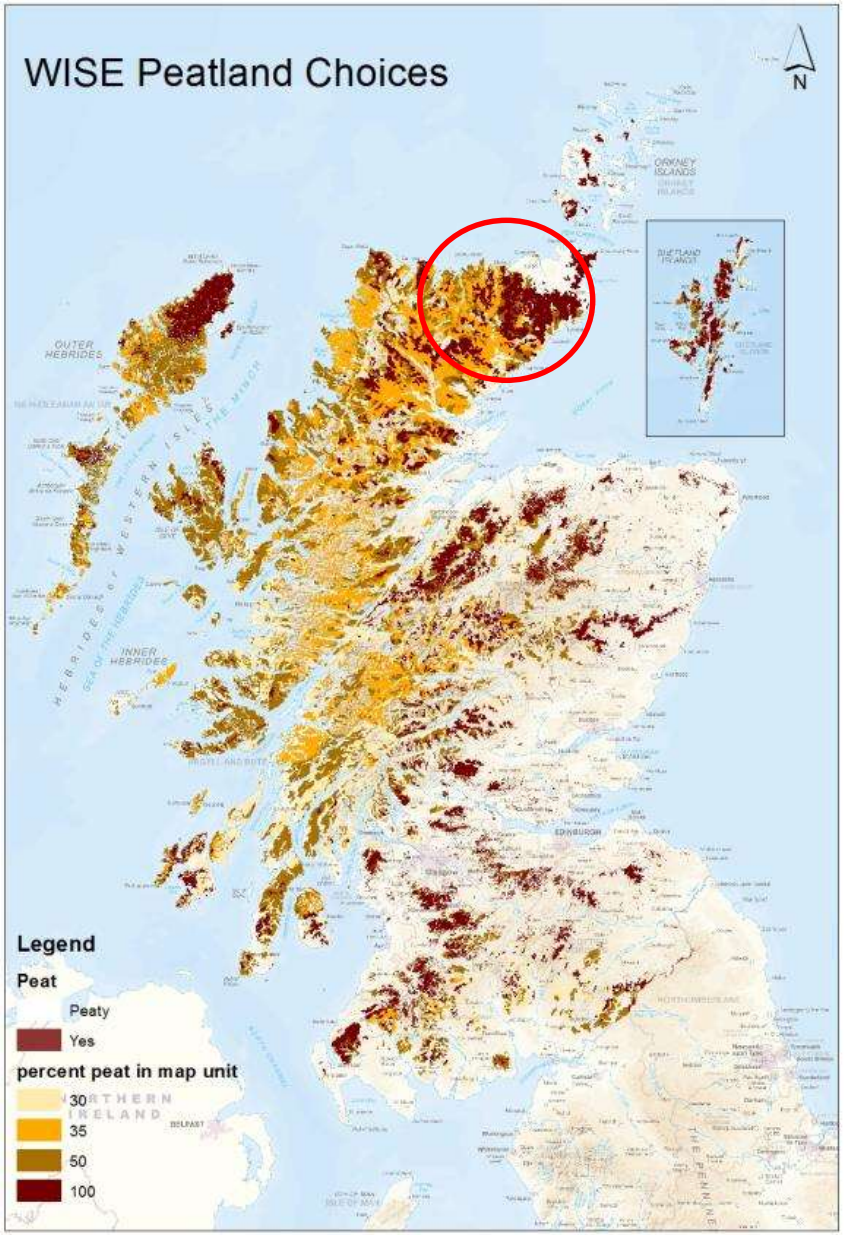
UK Peatlands: 1620 Mt of C

= 100 years' worth of Scotlands GHG emissions

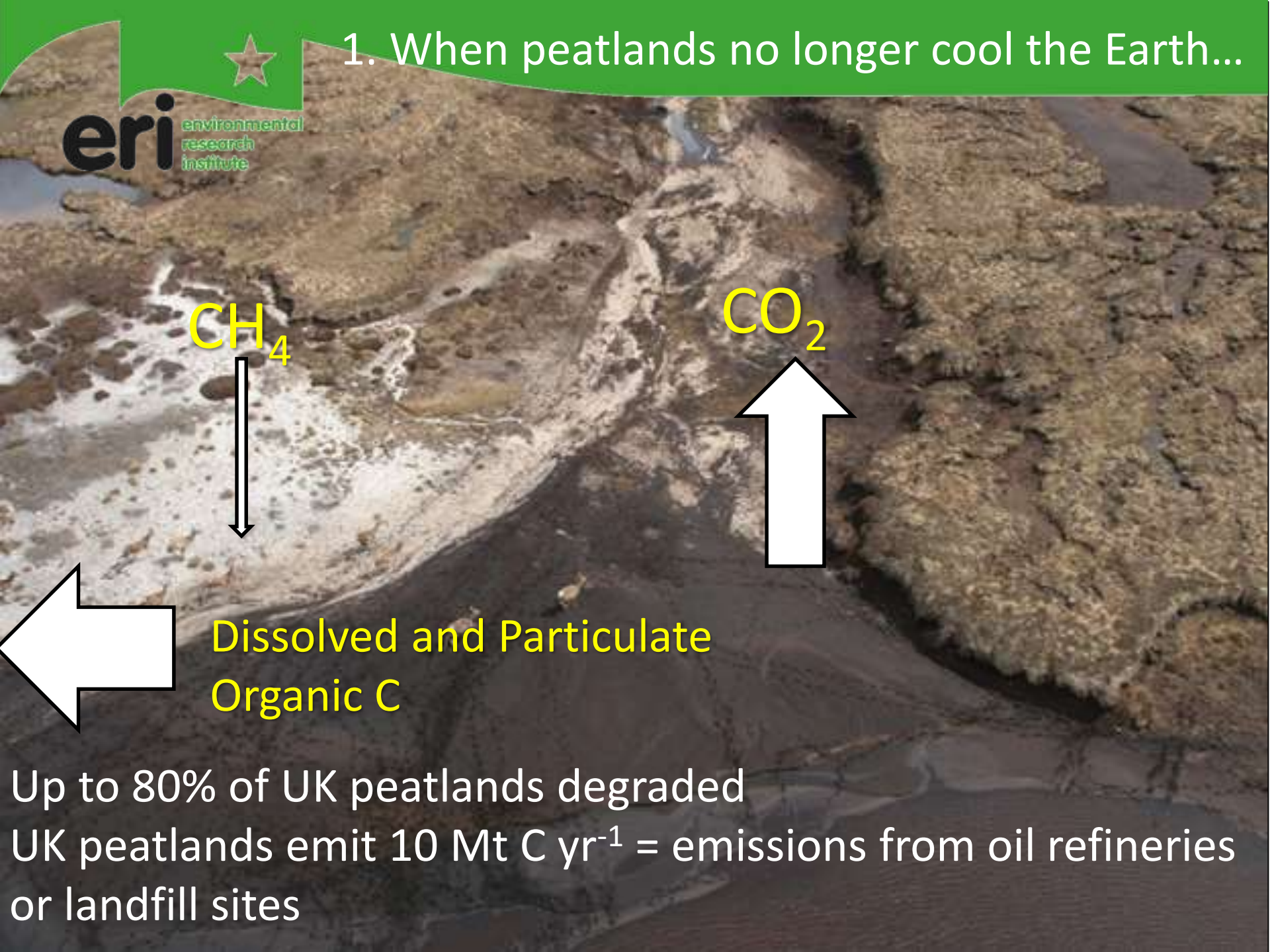
Flow Country: 400Mt of C

= 3 x UK biomass

Payne et al., 2016 & 2017 ; Ratcliffe et al., 2019, Chapman et al., 2009; Artz et al, 2014



1. When peatlands no longer cool the Earth…



Up to 80% of UK peatlands degraded

UK peatlands emit 10 Mt C yr^{-1} = emissions from oil refineries or landfill sites

1. Afforestation and Forest-to-Bog restoration

- 800,000 ha of UK peatlands were afforested with non-native conifers during the 1950s -1980s, including 67,000 ha (17%) in the Flow Country
- Large-scale “forest-to-bog” restoration started in late 1990s
- Flows to the Future project → nearly 2000 ha forest-to-bog restoration in RSPB Forsinard Flows NNR

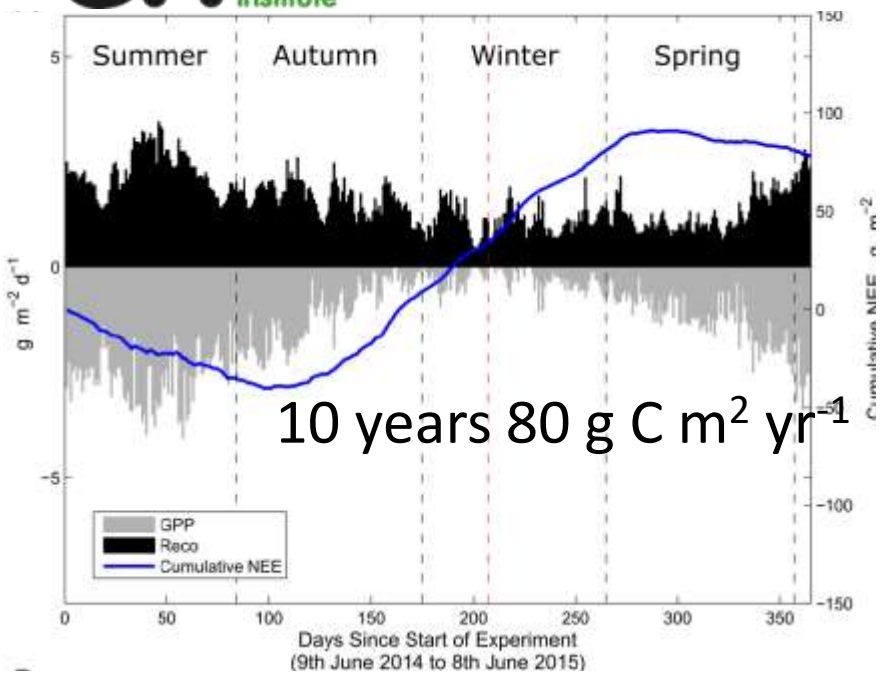
eri environmental research institute

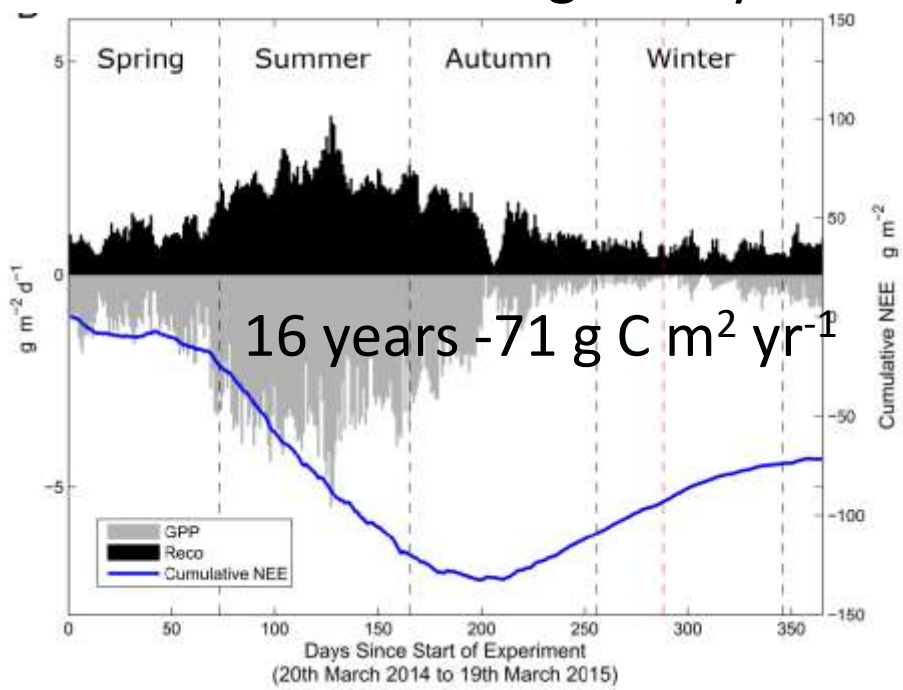
Can forest-to-bog restoration return C sink function and deliver climate benefits?

2. Climate benefits of forest-to-bog

2. Climate benefits of forest-to-bog

Near Natural reference: -114 g C m^2 yr^{-1}

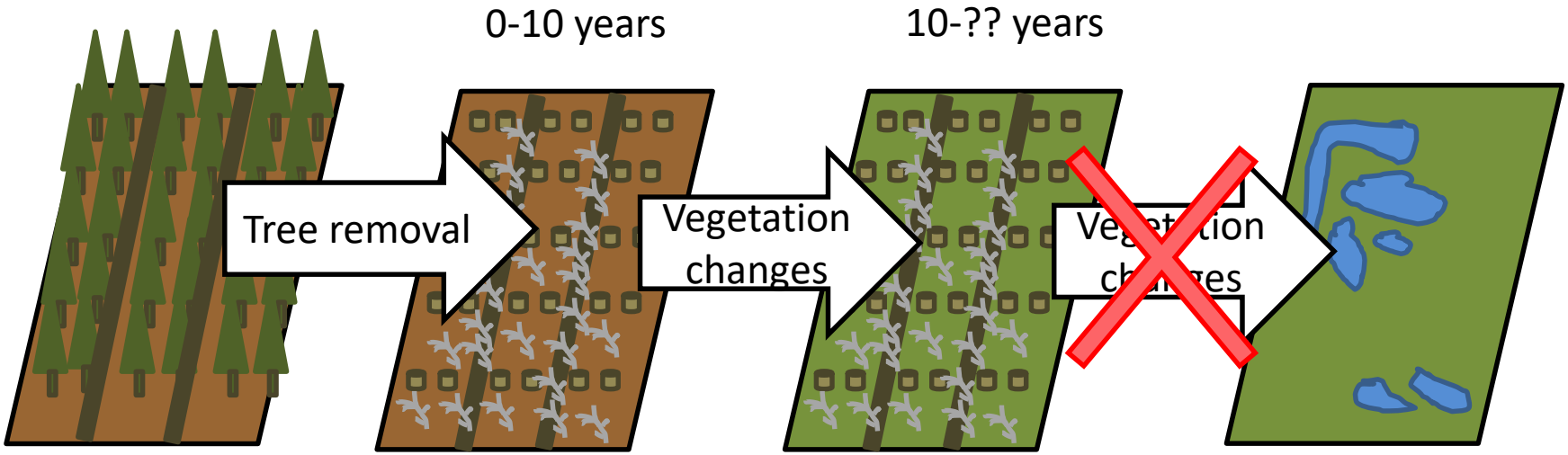




- Net climate benefits within 10-15 years
- CO_2 uptake (photosynthesis) similar within 5-7 years
- Higher CO_2 emissions during summer drought = vulnerable to climate change
- Woody debris + change in water quality ↑ CO_2 emissions

(Hambley et al., 2019, Hermans et al., 2019, Gaffney, 2016, Subke et al, 2019, Lees et al 2019)

2. Beyond climate benefits



"Restoration effects"

- CO_2 emissions → C source
- Rapid changes in water chemistry and hydrology
- Generalists species replace forest specialists
- No significant changes in DOC export when small proportion of catchment under restoration

"Legacy effects"

- CO_2 uptake = C sink
- Further changes in water chemistry and hydrology
- Generalists species persist, trophic structured altered, functional differences remain
- High respiration rates, vulnerability to droughts

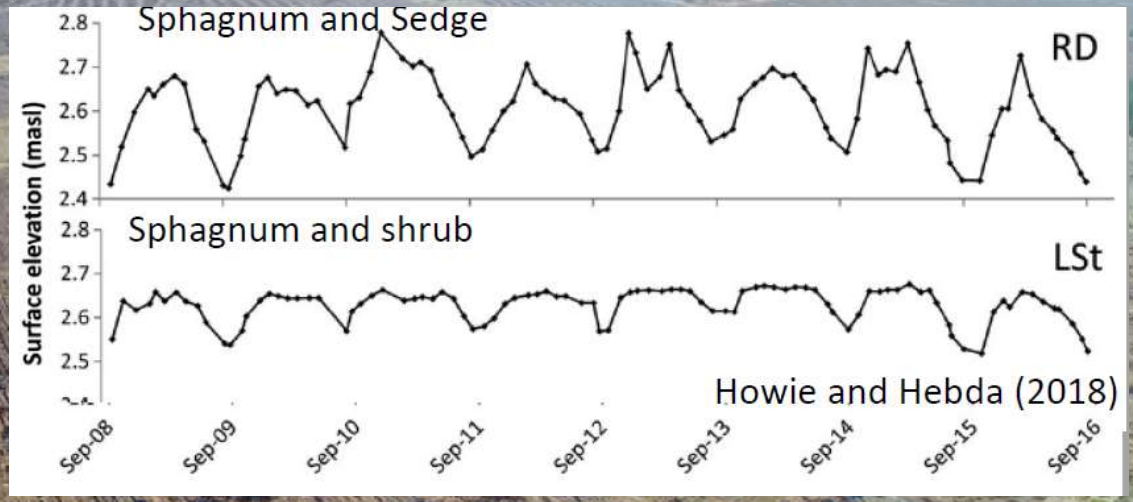
2. A new era of forest-to-bog restoration

- Rapid changes in water chemistry and hydrology?
- C sequestration?
- Space for specialist species?
- Persistence of “legacy effects?”
- Most cost-effective approach?

3. Developing innovative monitoring tools

How can we measure restoration success over such large scales?

3. The concept of Bog Breathing

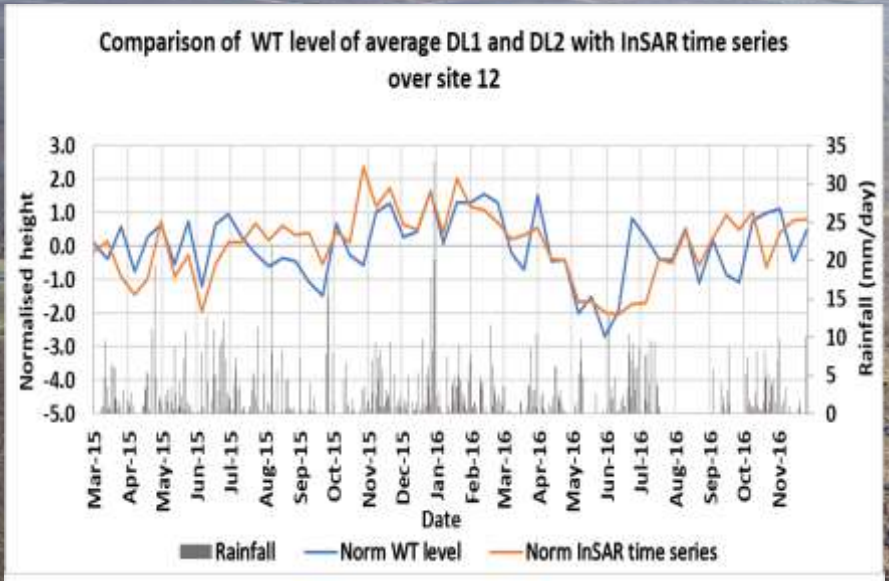


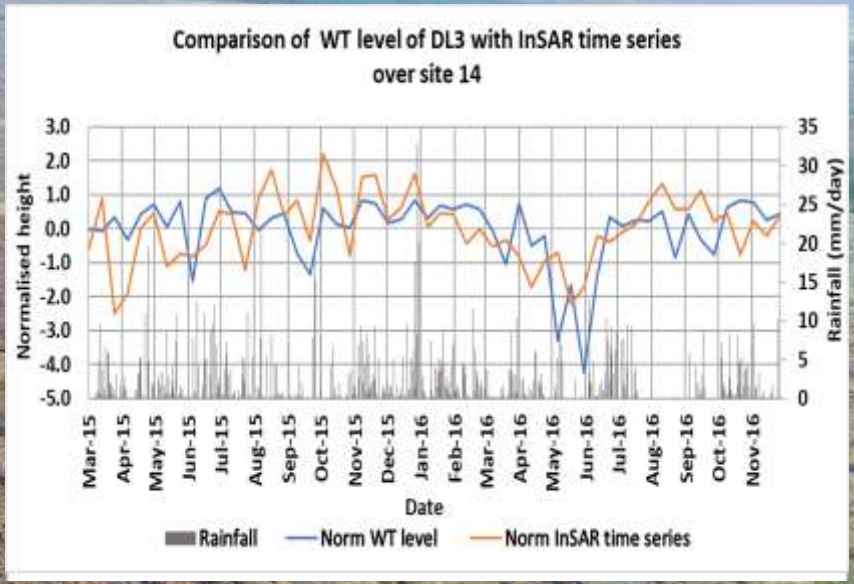
Mecanics

Hydrology

Ecology

3. InSAR as a proxy for hydrology

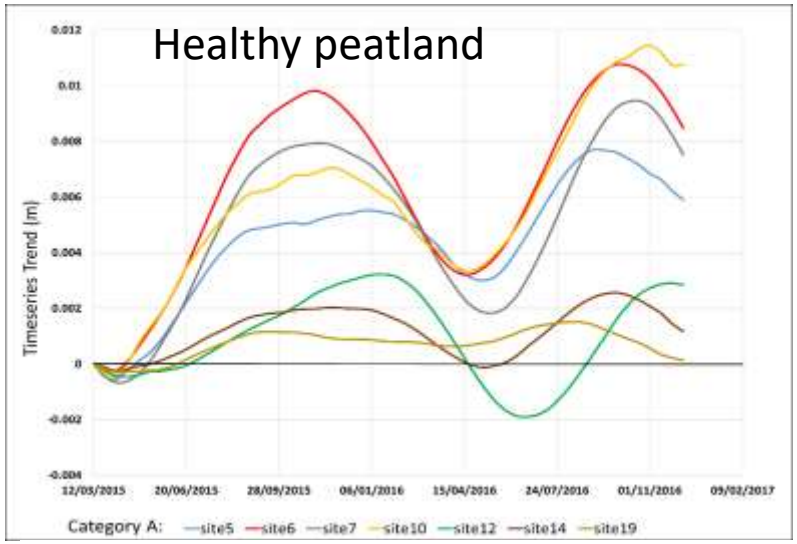


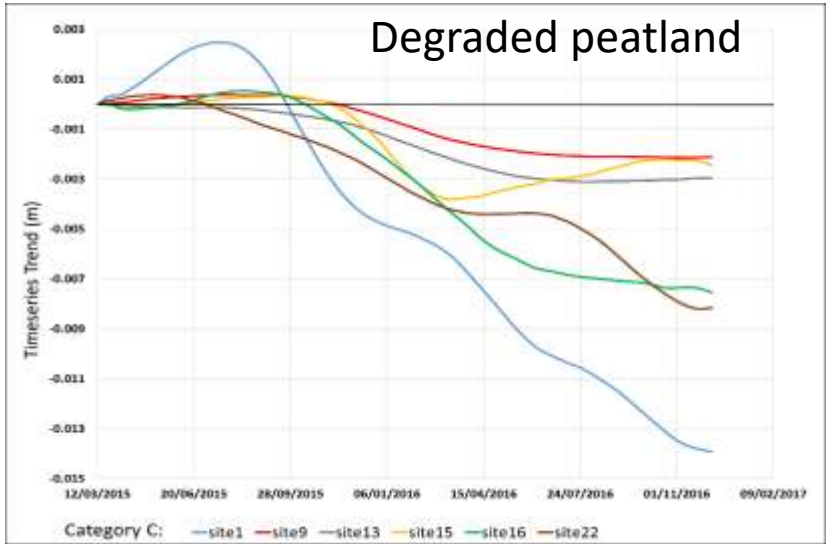


Satellite-derived ground motion is tightly coupled with hydrology

Large et al., *under review*

3. InSAR as a tool for monitoring peatland condition





Satellite-derived ground motion time-series are diagnostic of peatland condition, could be used to monitor recovery post-restoration

Large et al., *under review*

3. Bog breathing as a source of inspiration?

4. Legacy of the Flows to the Future project

Range of research opportunities to study peatland restoration across disciplines

Building evidence to improve decision making and cost-effectiveness

Space to host researchers and continue collaboration

4. Legacy of the Flows to the Future project