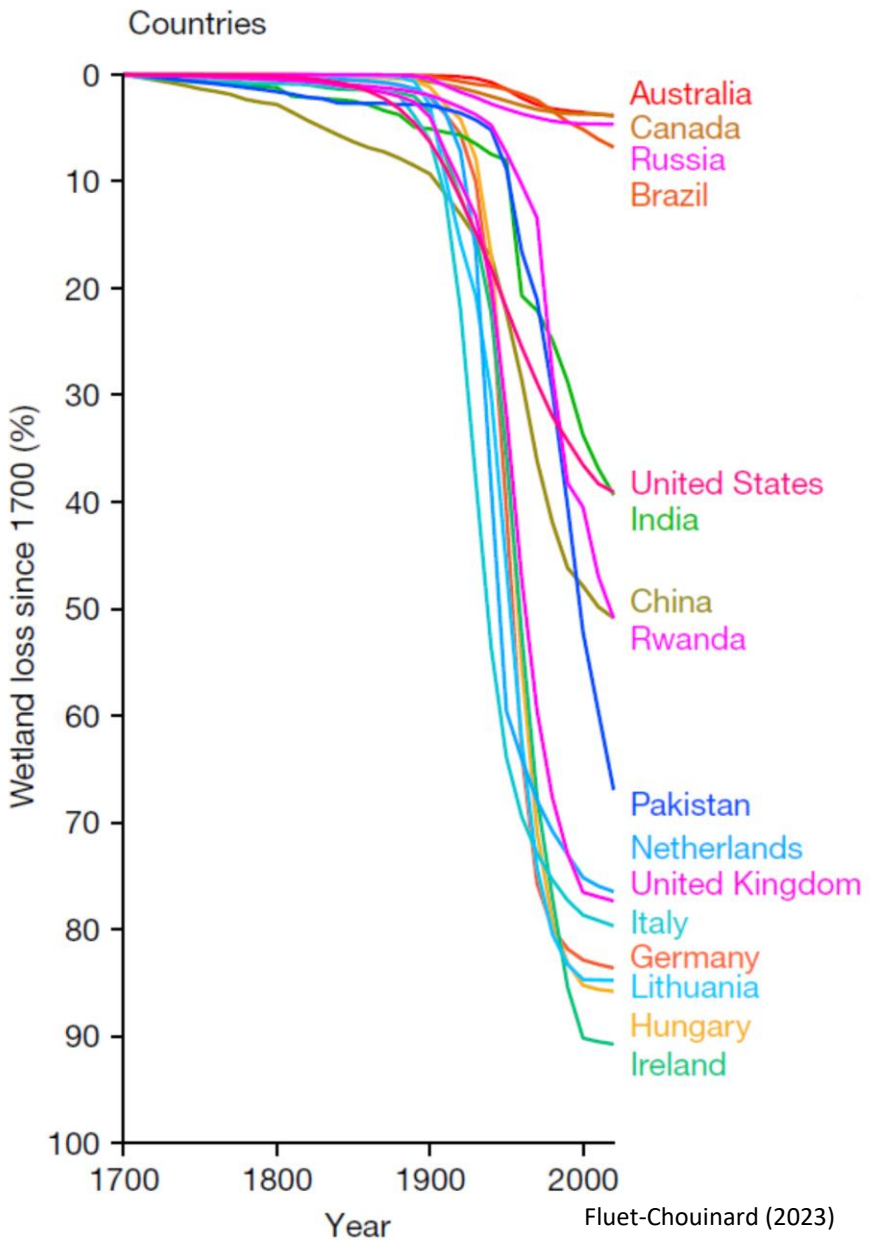
Counting carbon on agricultural peat soils

Matthew Saunders, Alina Premrov, Florence Renou-Wilson, Ian Clancy, Rachael Murphy, John Connolly, Louis Gilet, Wahaj Habib, Owen Fenton, Pat Tuohy and David Wilson

What are peatlands and why are they important?

- What are peatlands?
  - Form in areas of high precipitation and where drainage is impeded
  - Areas of carbon rich, dead/partially decomposed plant material
  - Peat soils - refer to soils with at least 20% organic carbon and a minimum thickness of 40cm
- These areas provide multiple ecosystem services
  - Carbon sequestration
    - **Global peatlands hold ~25% global soil C stocks on ~3% land area**
    - **In Ireland peatlands hold ~62-75% of the SOC stock on ~23% land area**
  - Water quality
  - Flood management
  - Biodiversity
  - Societal, cultural and recreational
- Significant areas of peatland in Ireland have been altered through drainage
  - Agriculture
  - Extraction for energy and horticulture
  - Conversion to forestry
- Vulnerable to management and climatic variability
  - Influence on key drivers of C/GHG exchange
- Growing appreciation of role of peatlands in regulating environmental processes
  - Opportunity to enhance multiple ecosystem services and develop nature positive systems through rehabilitation
  - Direct policy focus – targets for drained organic soils with reduced management intensity.

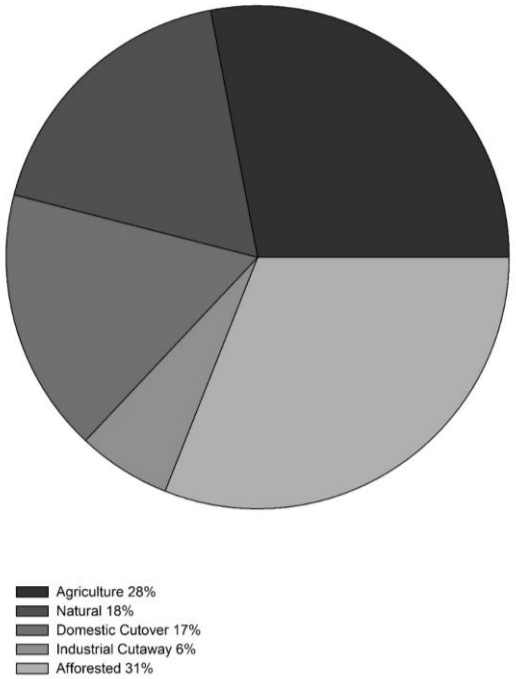


Fluet-Chouinard (2023)

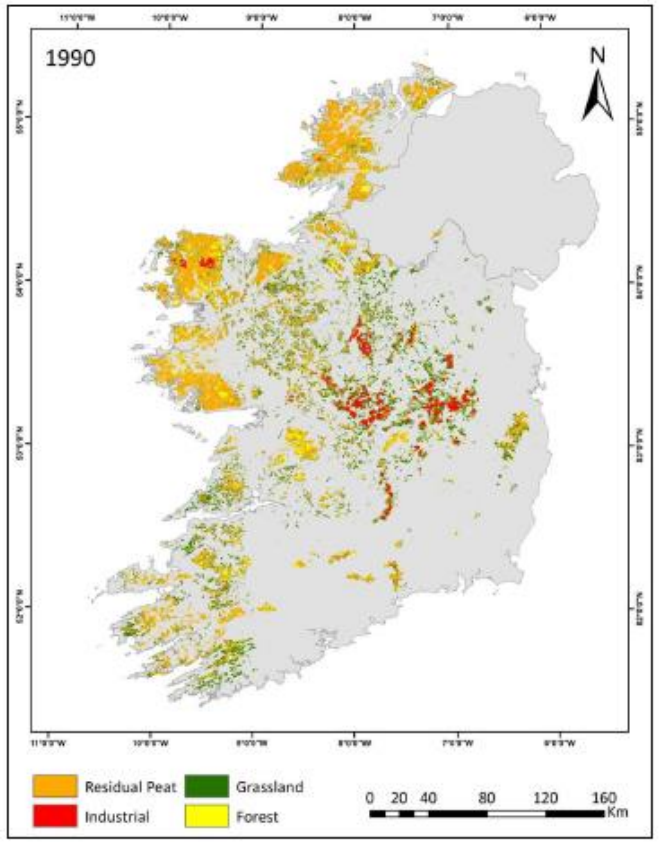
Where are they, what are they used for and what condition are they in?

- Peatlands cover 1.66 M ha which equates to ~23.3% of the total land area
- Agricultural peats ~ 339,000 hectares of drained grassland*

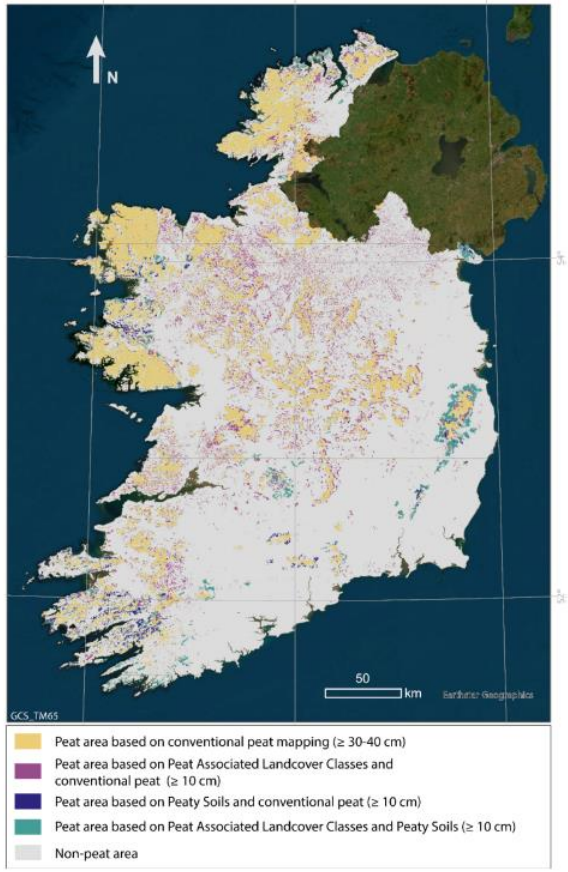
- Peatland area and land use (Wilson 2021)



- Peatland land use (Habib and Connolly, 2023)

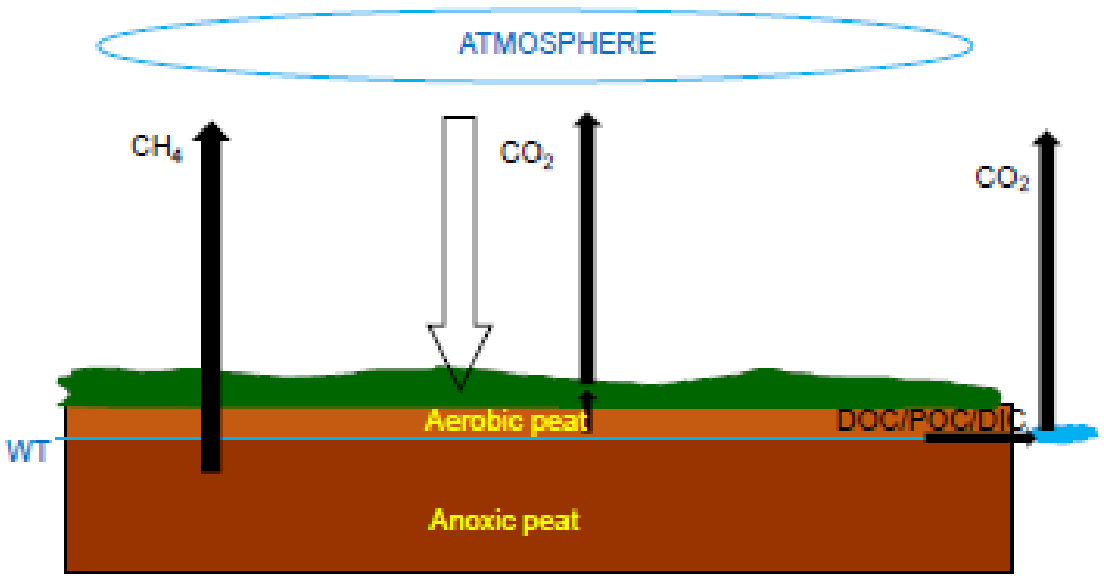


- New Irish peat soils map (Gilet et al., 2024)

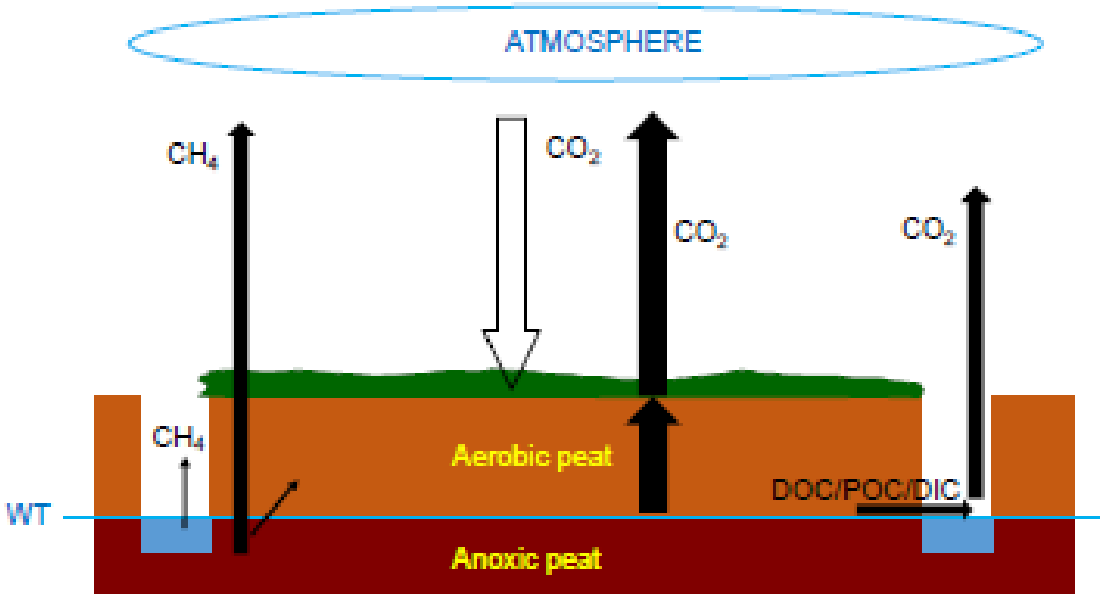


What happens when we drain peatlands?

Natural peatlands

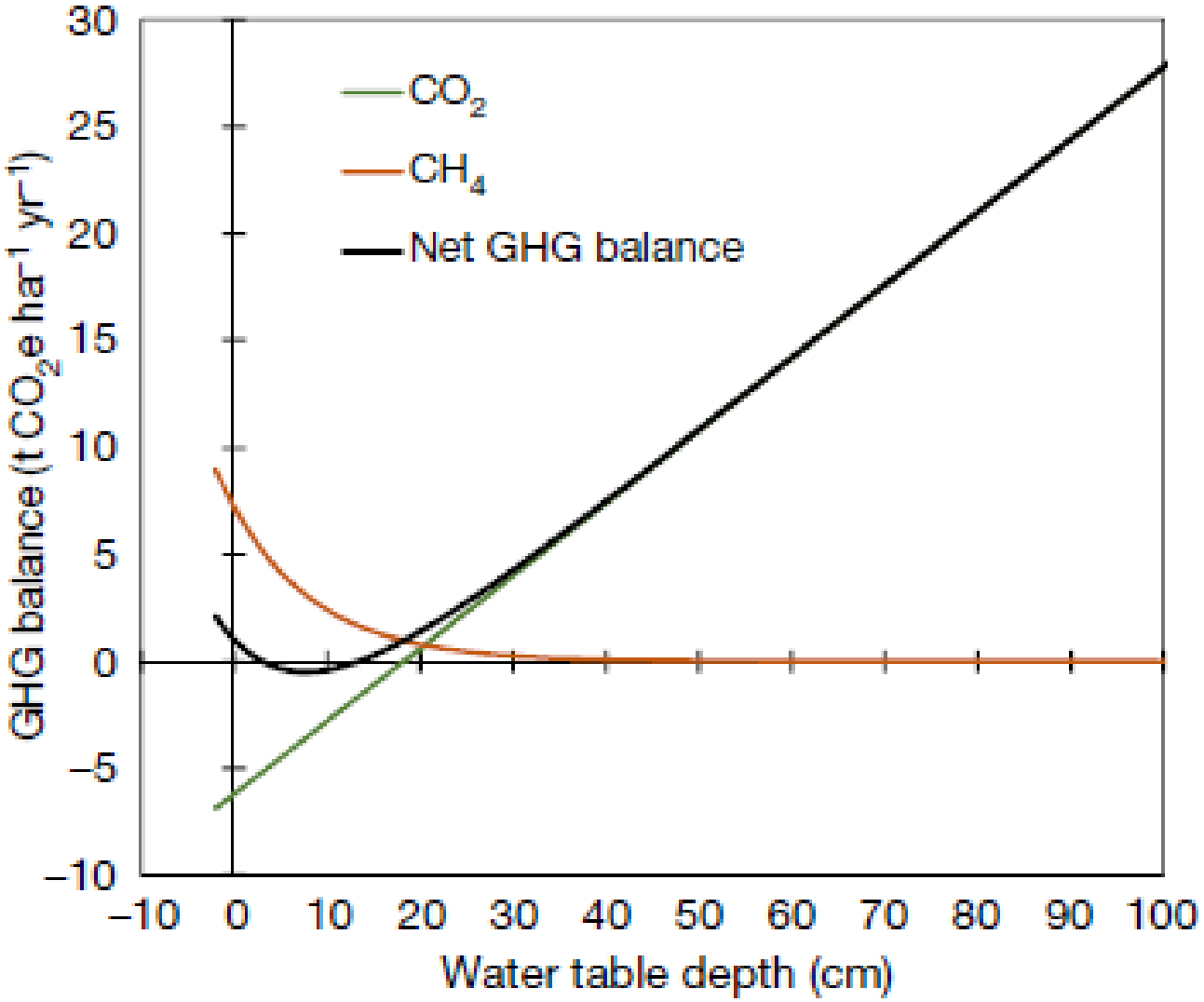


Drained peatland under grassland



Renou-Wilson et al. (2015).

Benefits of water table management



(Evans et al., 2021)

Importance of science informing policy

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Review

Drainage status of grassland peat soils in Ireland: Extent, efficacy and implications for GHG emissions and rewetting efforts

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A review of greenhouse gas emissions and removals from Irish peatlands

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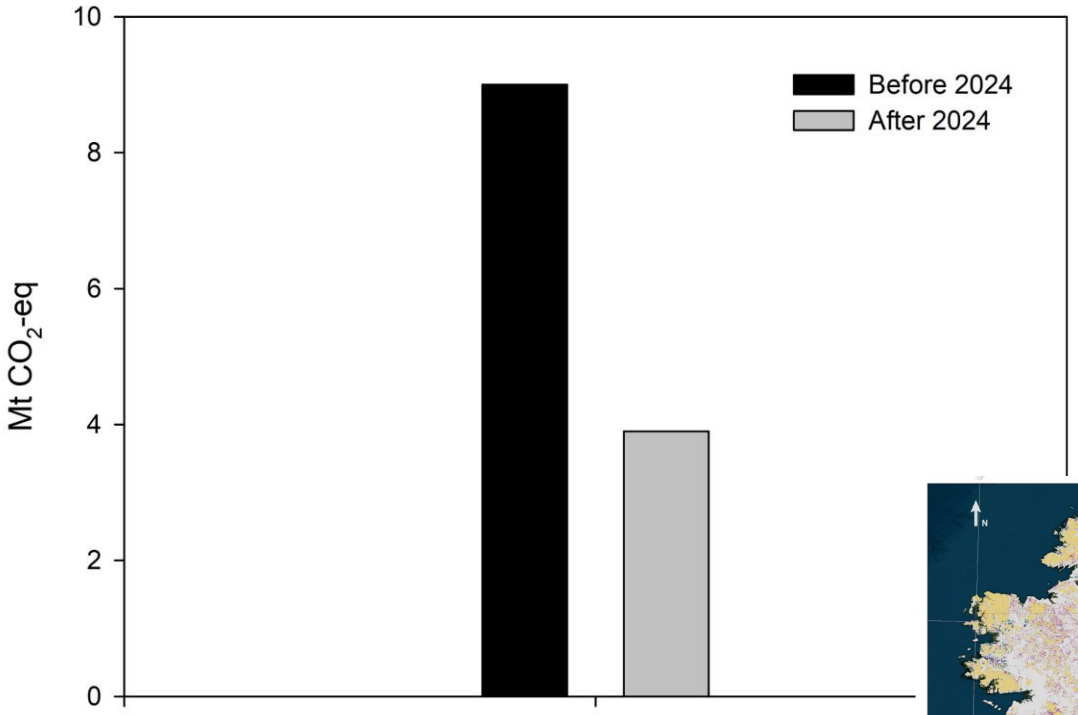
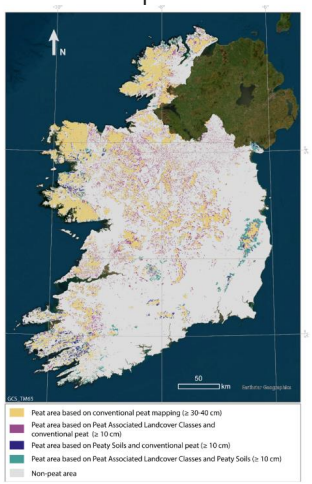
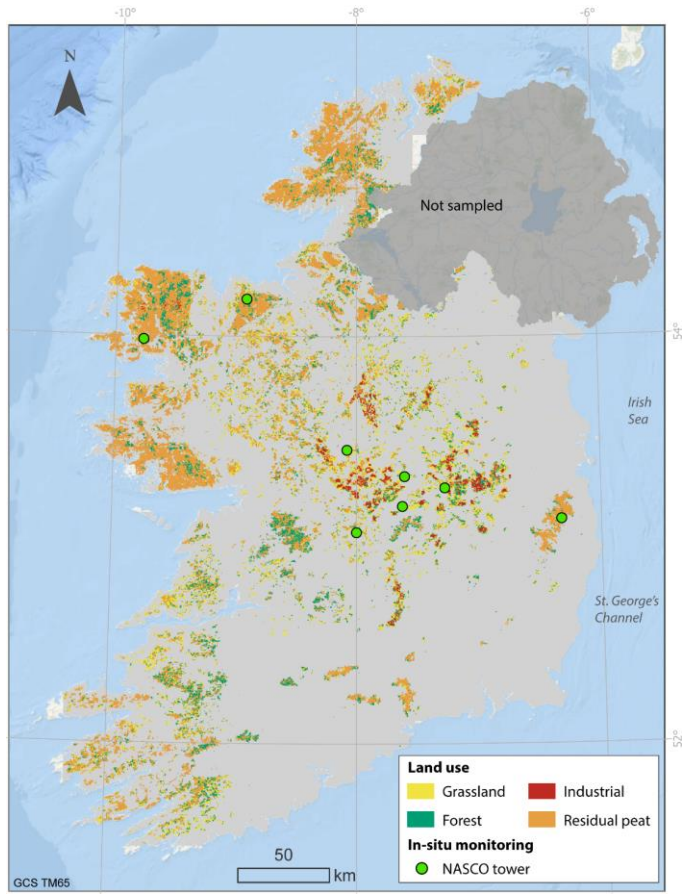
Peatland land use type	Nutrient status	CO_2 EF (t C ha^{-1} y^{-1})		CH_4 EF (kg C ha^{-1} y^{-1})		N_2O EF (kg N ha^{-1} y^{-1})	
		Tier 1	Irish	Tier 1	Irish	Tier 1	Irish
Industrial cutaway	Nutrient-poor	2.8 (1.1 – 4.2)	1.21 (0.4 – 2)	4.6 (1.2 – 8.3)	0	0.3 (0 – 0.6)	0
Industrial cutaway	Nutrient-rich		2.18 (0.86 – 3.5)		-0.3 (-0.8 – 0.3)		0
Domestic cutover	Nutrient-poor		1.59 (1.2 – 2.0)		4.6 (-0.4– 9.6)		0
Grassland	Nutrient-poor	5.3 (3.7 – 6.9)	1.30 (0.04 – 2.55)	1.4 (0.5 – 2.1)	8.82 (2.63 – 15.02)	4.3 (1.9 – 6.8)	0
Grassland, deep-drained	Nutrient-rich	6.1 (5.0 – 7.3)	5.08 (3.6 – 6.57)	12 (1.8 – 21.8)	-0.75 (-2.2 – 0.72)	8.2 (4.9 – 11)	1.6
Forestry	Nutrient-poor	2.6 (2.0 – 3.3)	1.68	1.9 (-0.5 – 4.2)	NM	2.5 (-0.6 – 6.1)	NM
Near-natural	Nutrient-poor	-0.23 (-0.6 – 0.2)	-0.33 (-0.8 – 0.1)	92 (3 – 445)	54.7 (22.4 – 86.9)	0	NM
Rewetted, peat extraction	Nutrient-poor		-0.23 (-0.8 – 0.4)		79.8 (50.4 – 109)		0
Rewetted, grassland	Nutrient-poor		0.85 (-1.6 – 3.3)		68.1 (20.9 – 115.2)		0
Rewetted, peat extraction	Nutrient-rich	0.5 (-0.7 – 1.7)	3.22 (1.1 – 5.4)	216 (0 – 856)	117.9 (31.9 – 203.8)		0



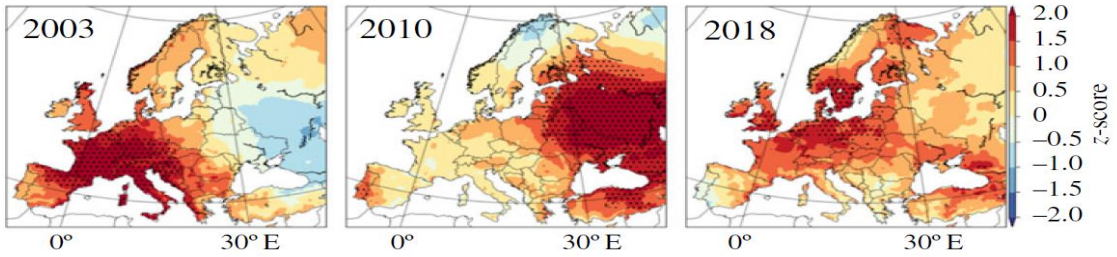


Current research

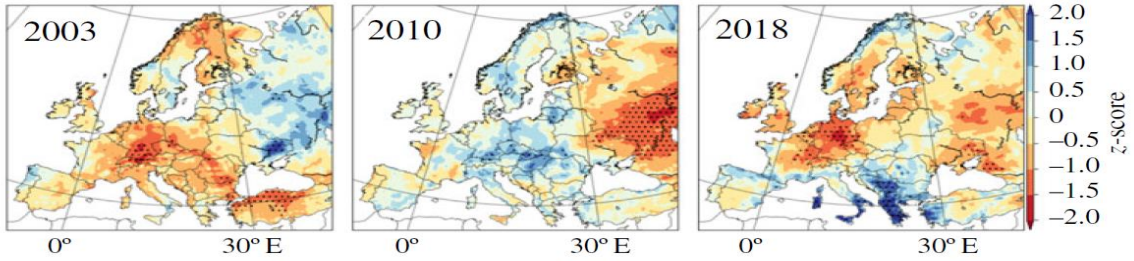


Need for climate resilient solutions

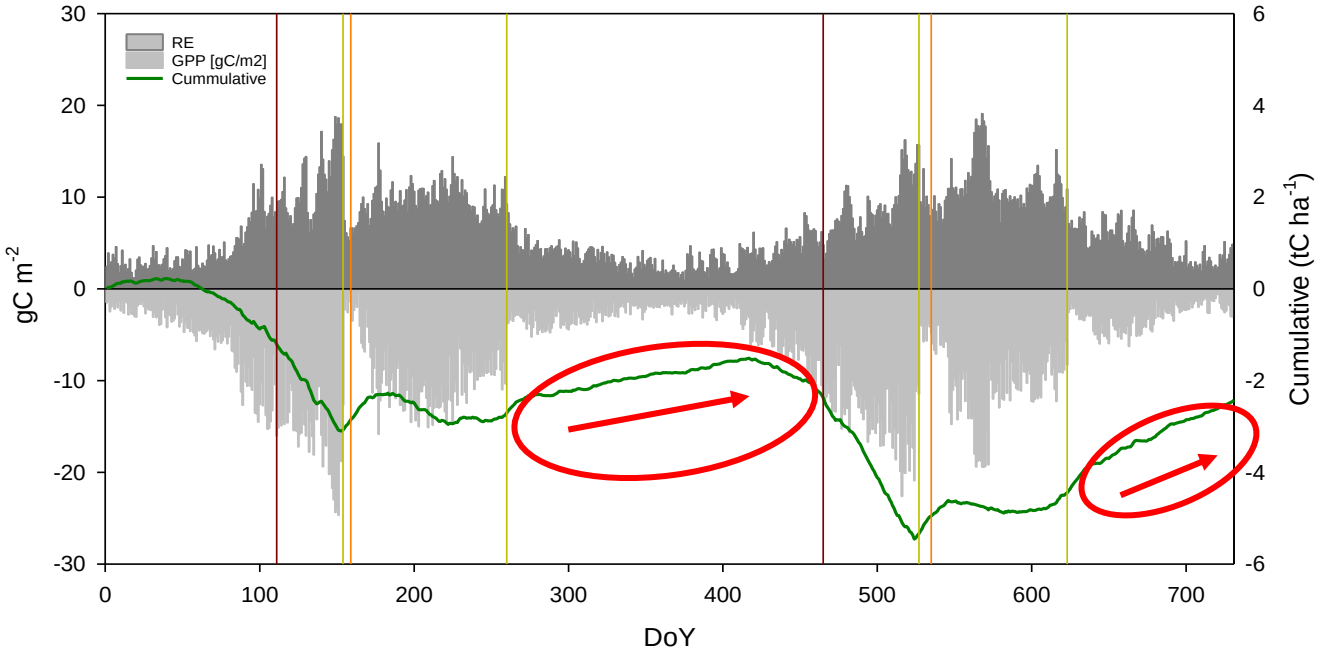
Temperature



Precipitation



Peters et al. (2020)



Annual Cumulative NEE

2020: **-1.82** t C h^{-1}

2021: **-0.60** t C ha^{-1}

Take home messages

- Grasslands on drained organic soils are a source of carbon
- Carbon in these ecosystems is vulnerable to management and climate
- Emissions can be reduced through changes in management intensity and water table management
- Ongoing research will further inform policy as impacts of hydrology on biogeochemistry and agricultural productivity are explored
- Opportunities for alternative production systems and the development of a community peatland code