



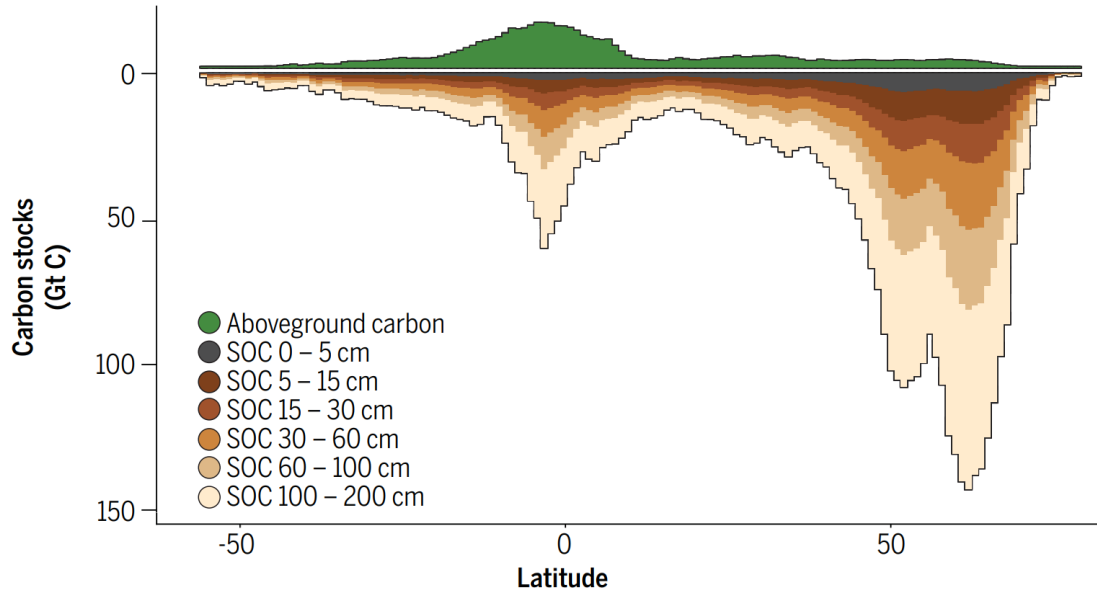
THE UNIVERSITY *of* EDINBURGH



Soil carbon, climate and land use.

Lorna Street & Naomi Housego

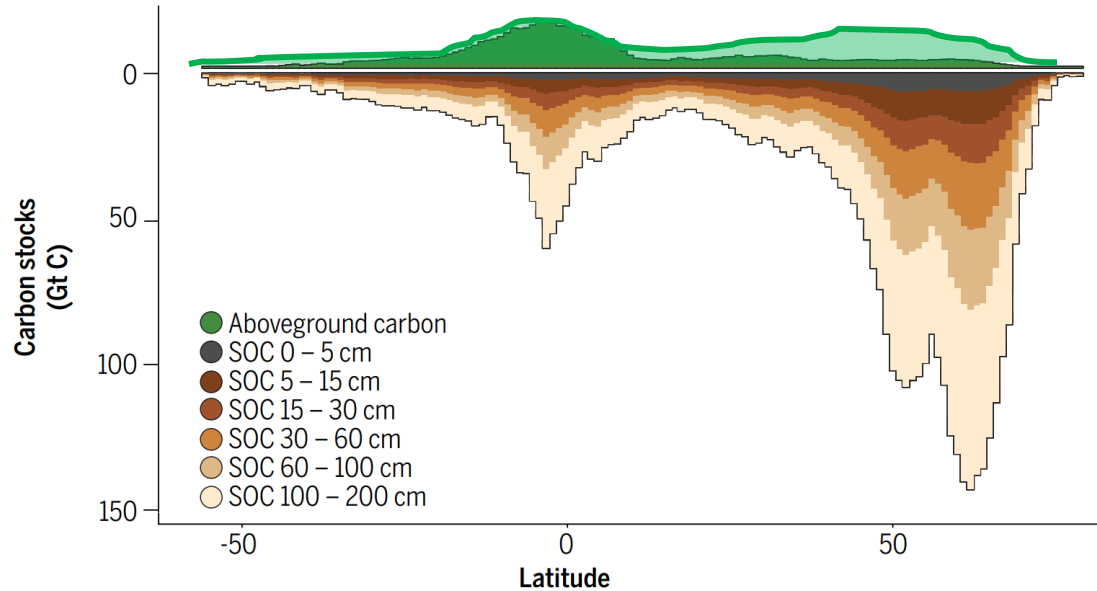
Global land carbon by latitude



Total carbon on land:
~3300 Gt

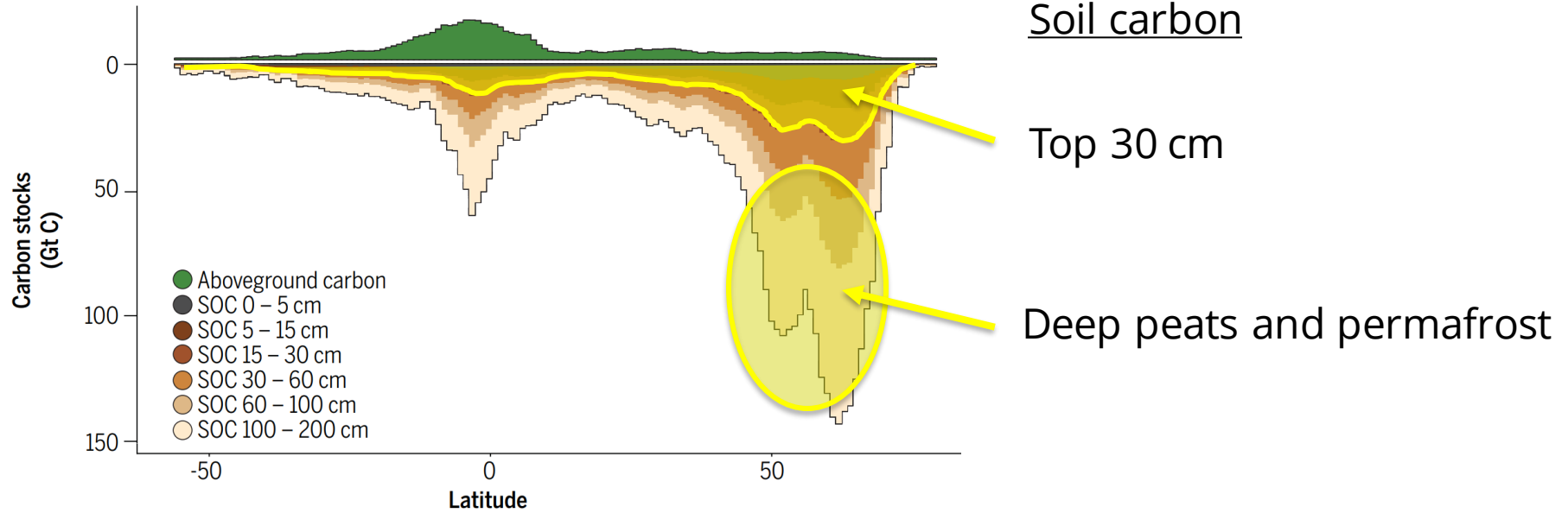
C budget for 1.5°C:
~100 Gt

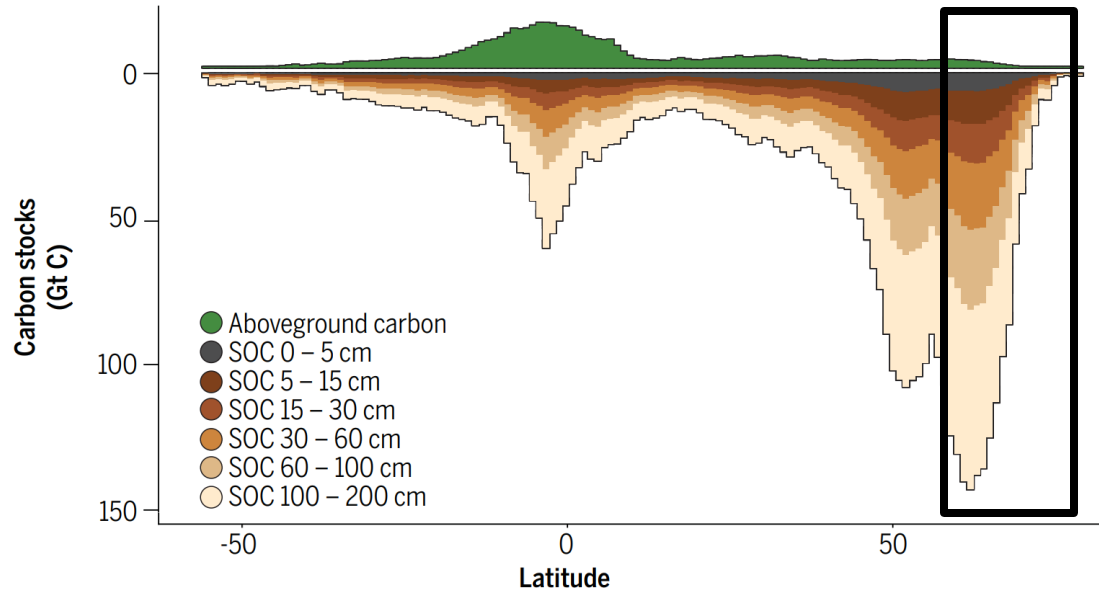
Crowther *et al.* 2019 *Science*



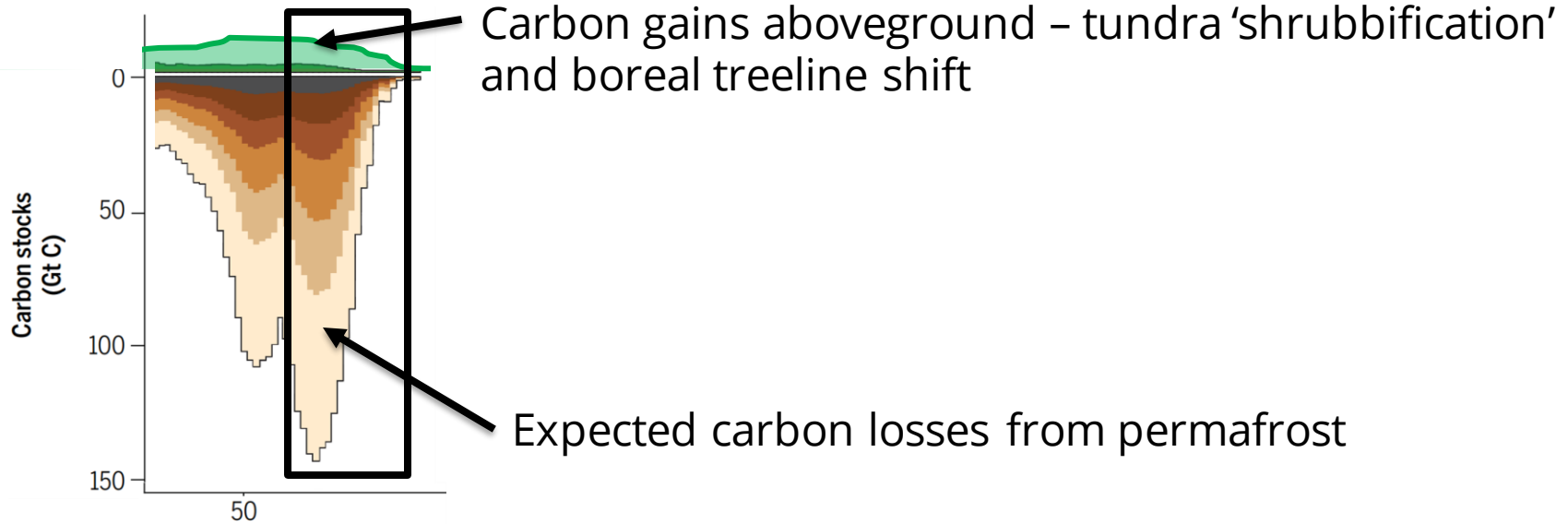
The northern hemisphere is greening...

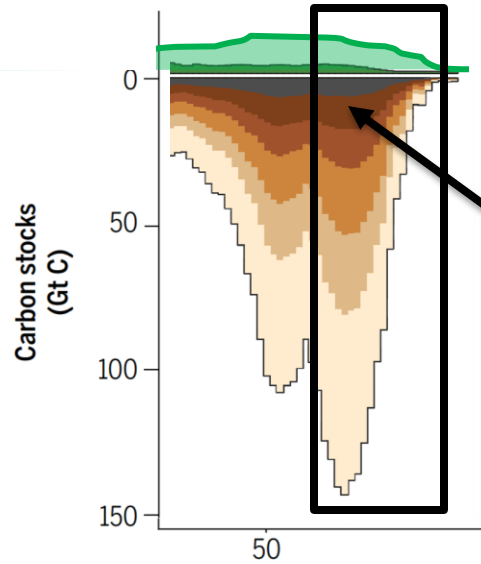
- temperature,
- CO₂ fertilisation
- land use change



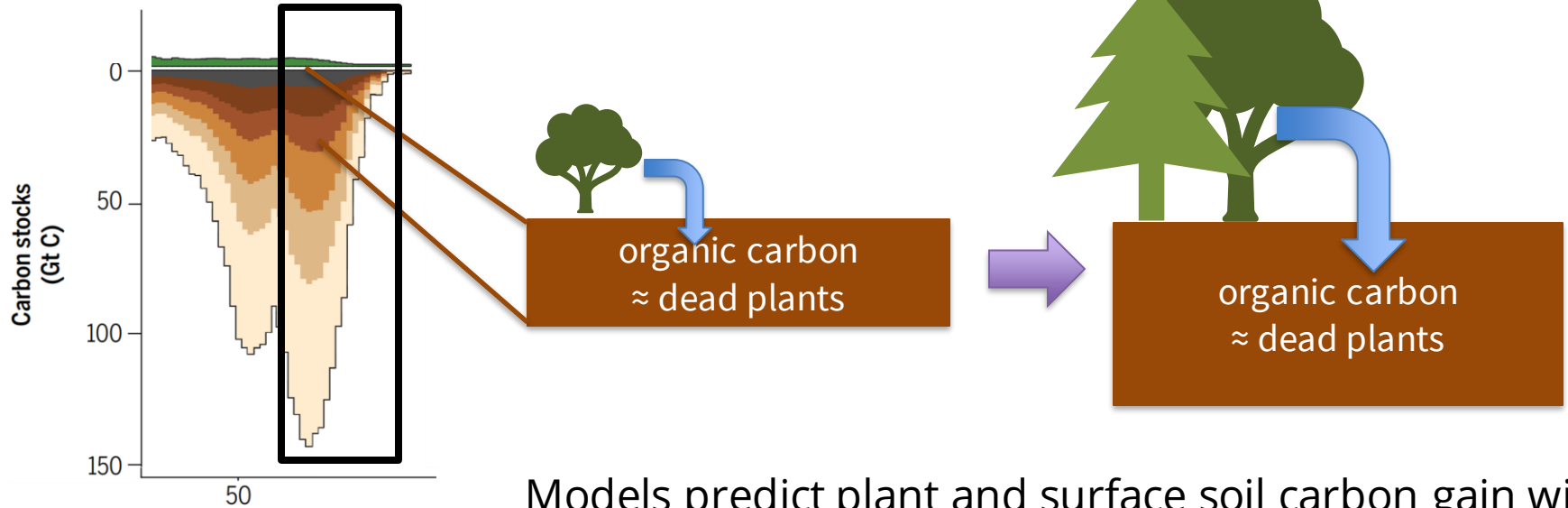


Soils in permafrost regions

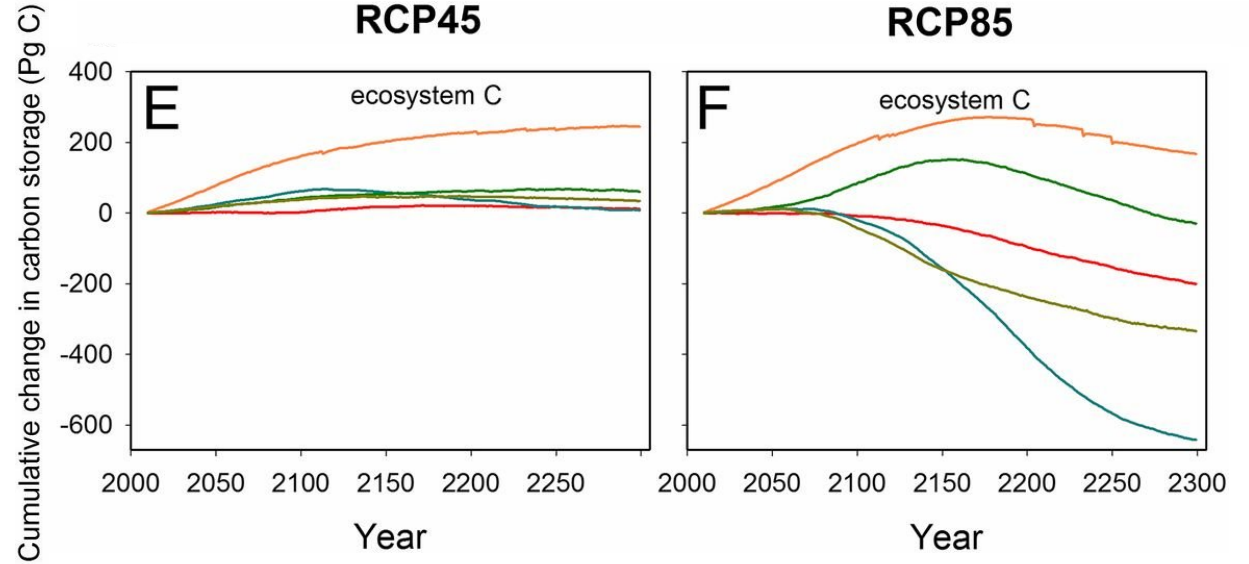
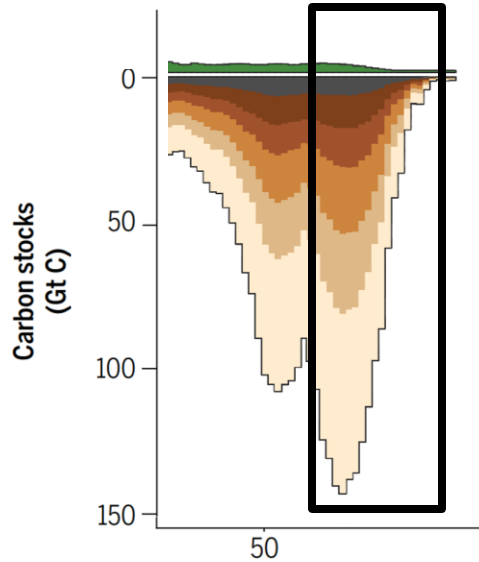




What about surface 'active-layer' soils?

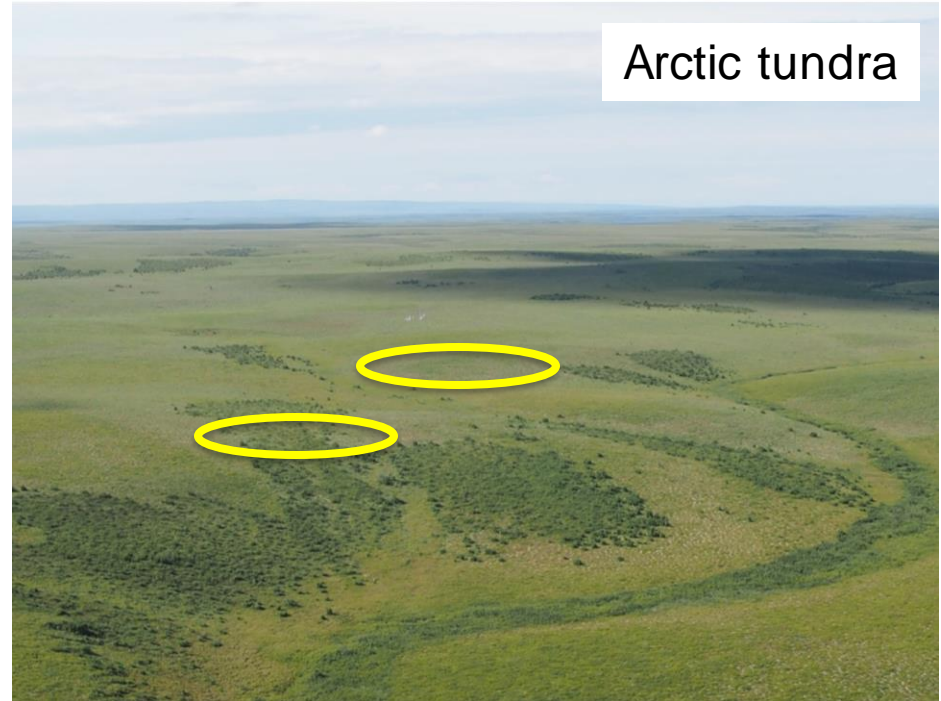
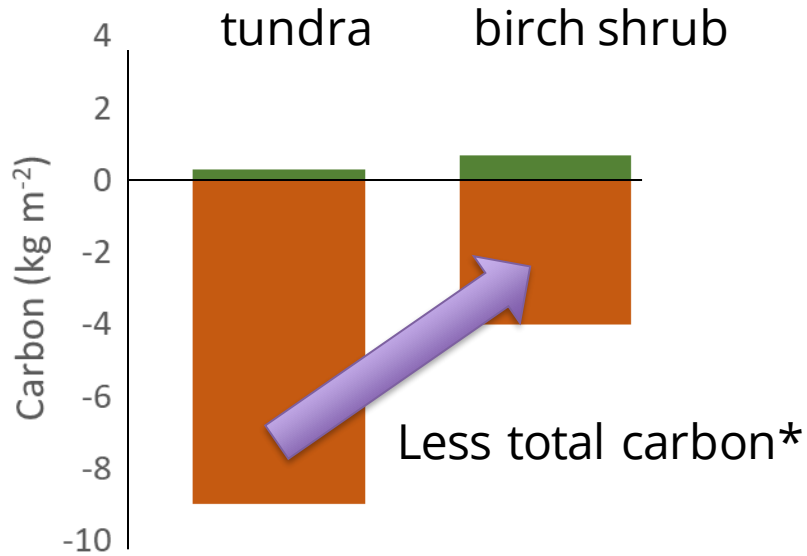


Models predict plant and surface soil carbon gain will offset permafrost carbon losses (for next ~80 years)

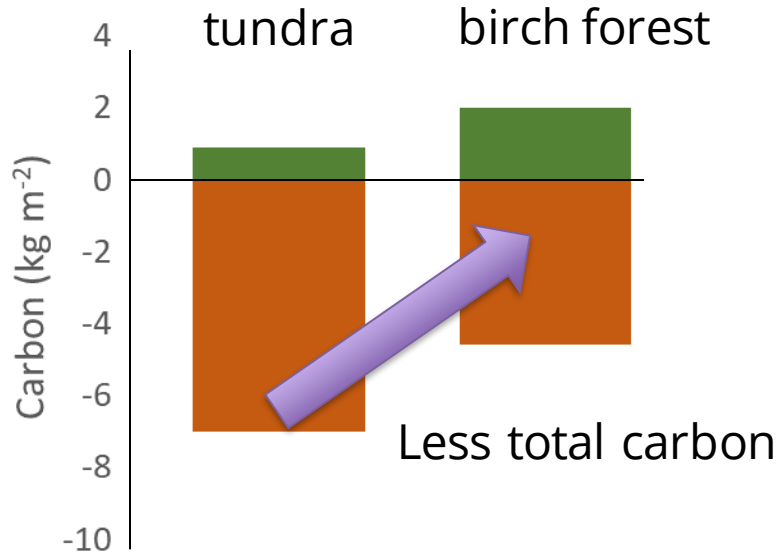


Phew!

McGuire *et al.* 2018 *PNAS*

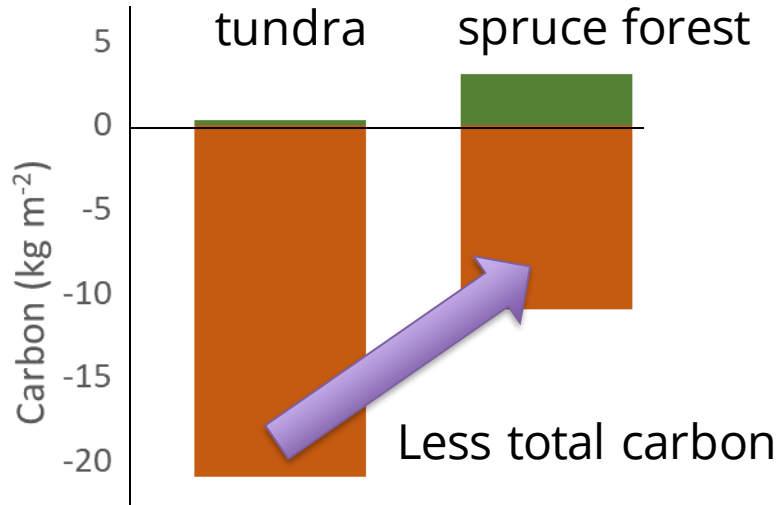


*Top 15 cm



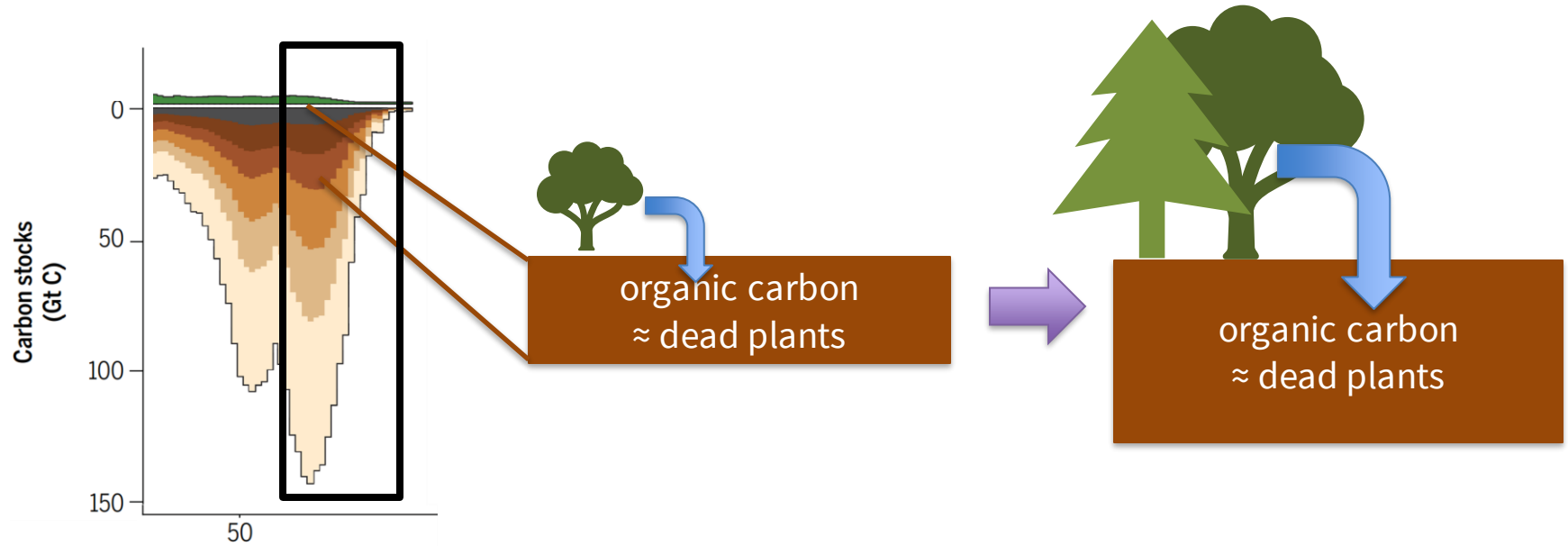
*full soil profile

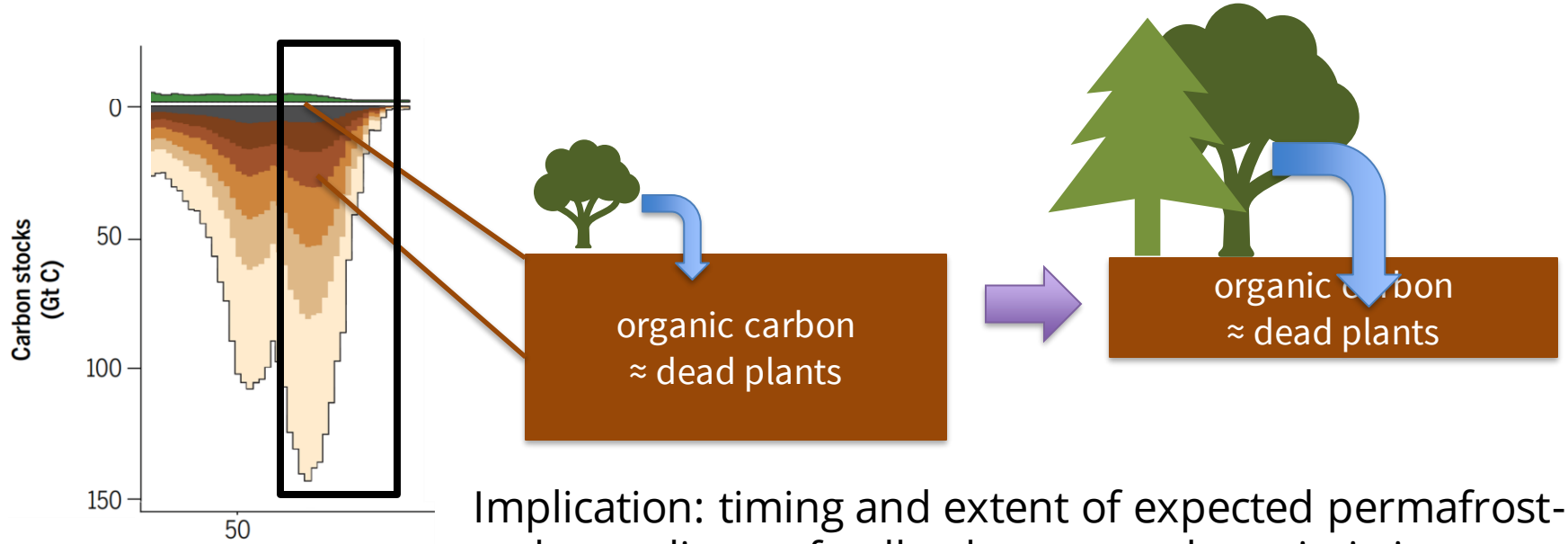
Hartley *et al.* 2012 Nature Climate Change



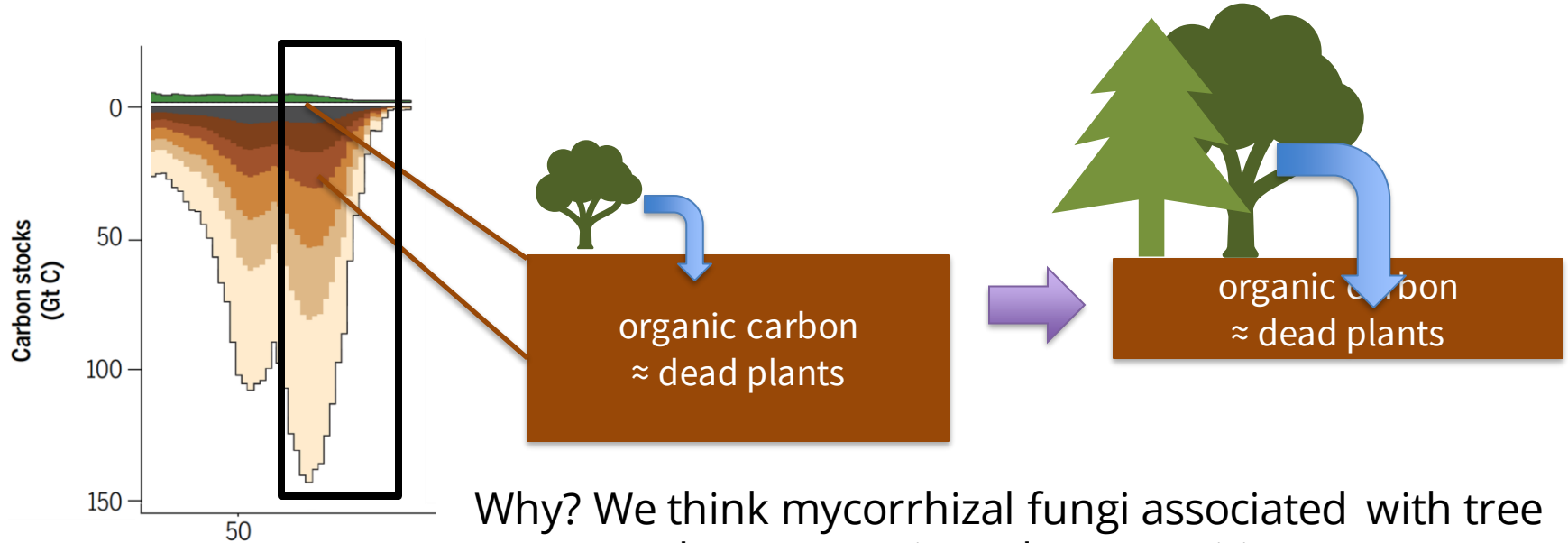
*partial soil profile

Wilmking *et al.* 2006 JGR Biogeosciences

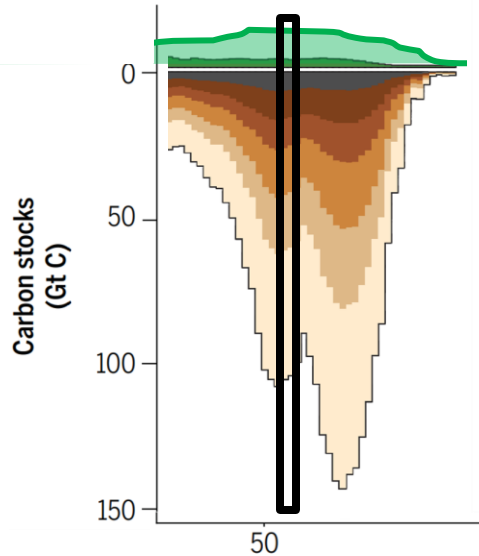




Implication: timing and extent of expected permafrost-carbon - climate feedbacks are overly optimistic



Why? We think mycorrhizal fungi associated with tree roots accelerate or 'prime' decomposition...
new project: 'MYCONET'



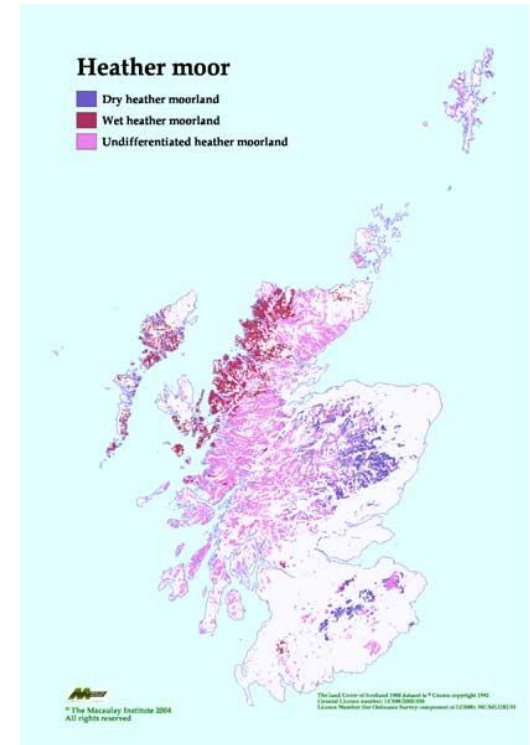
Scottish uplands also:

- cold and wet
- have highly organic carbon-rich soils
- lots of heathland vegetation
- tree cover also expected to increase...

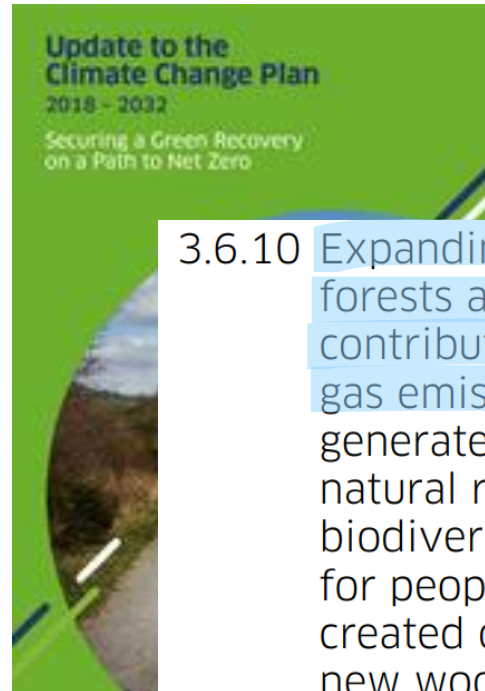
- I'm looking at native tree colonisation of Scotland's heather moorlands and its effects on soil carbon



- I'm looking at native tree colonisation of Scotland's heather moorlands and its effects on soil carbon
- With a particular focus on the contributions of these newly establishing woodlands to net zero targets



- Is woodland establishment in Scotland the silver bullet for climate change mitigation that we hope it is?



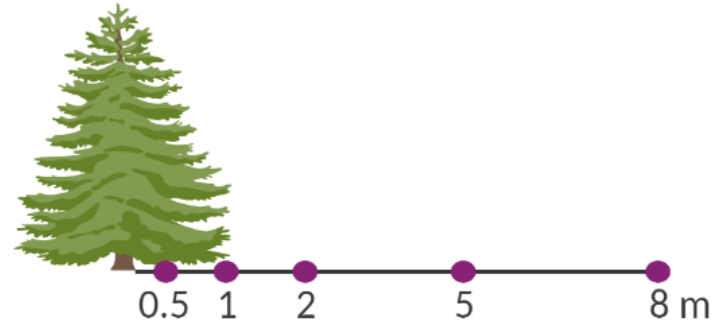
3.6.10 Expanding the area of Scotland's forests and woodlands will contribute to reduced greenhouse gas emissions, and will also generate an important commercial natural resource, improve biodiversity and provide spaces for people to enjoy. We have created over 22,000 hectares of new woodland in the last two years, and we will continue to invest to increase overall forest cover in Scotland. As part of the

What I've been up to...



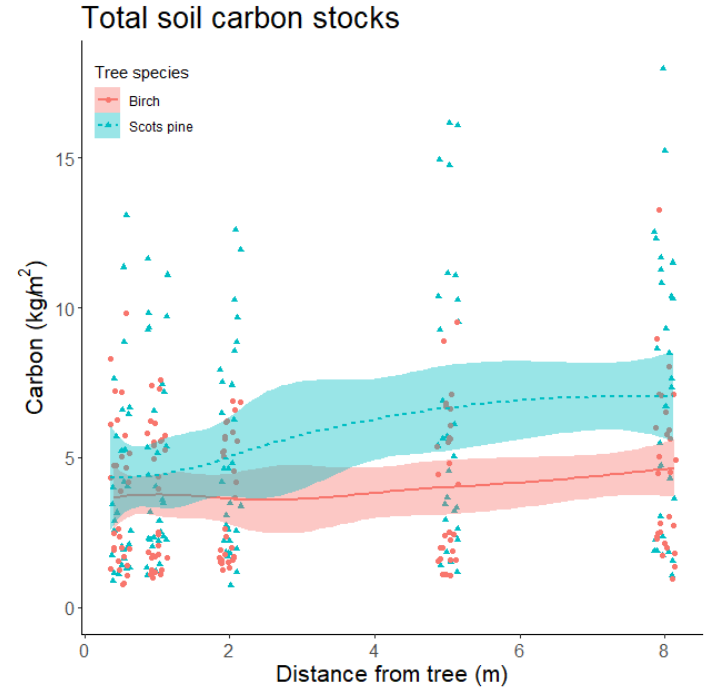
What I've been up to...

- Measured tree, heather, and soil carbon stocks
- Along transect from single tree into open heather moorland



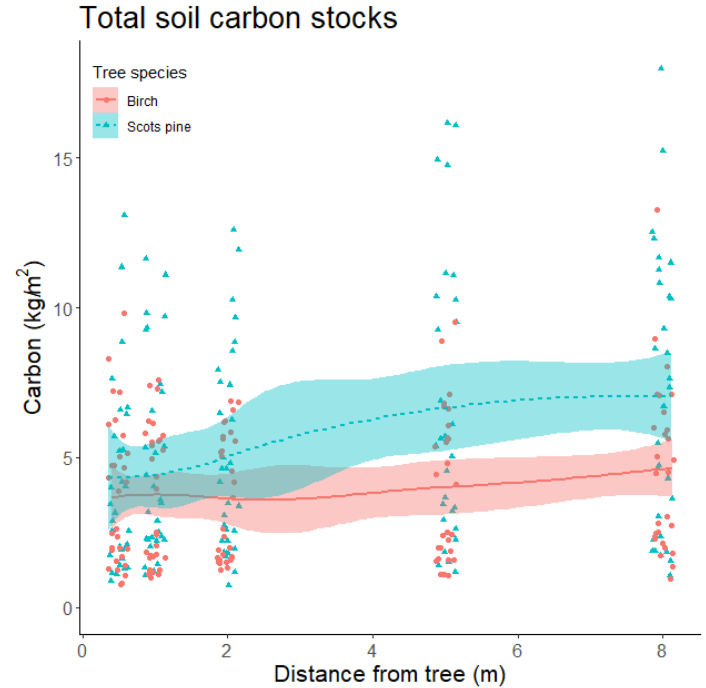
... What we've found

- Less soil carbon in the major rooting zone of trees



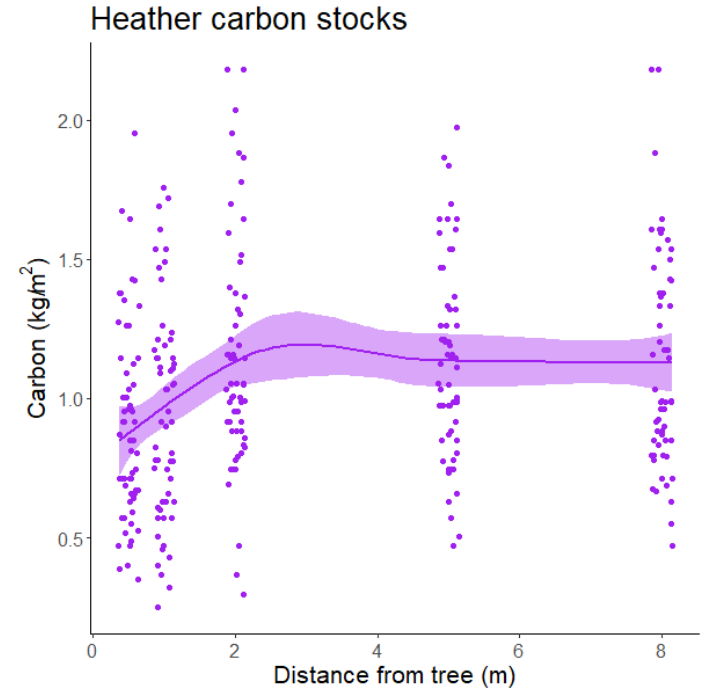
... What we've found

- Less soil carbon in the major rooting zone of trees
- Trees drive soil carbon losses



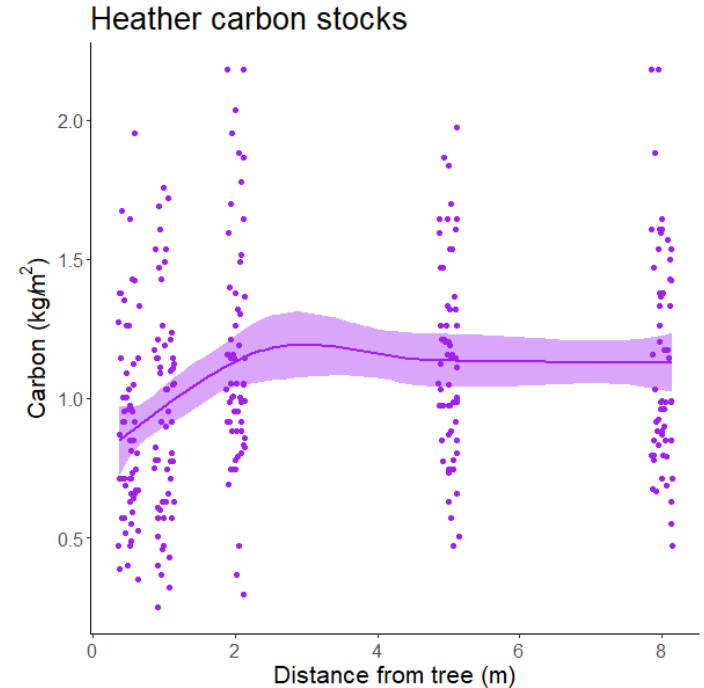
... What we've found

- Less heather (carbon) under the canopy of trees



... What we've found

- Less heather (carbon) under the canopy of trees
- Trees restrict heather growth via shading effects



What does this mean for the ecosystem?

- Looked at the difference between tree + heather + soil carbon stocks (i.e. ecosystem stocks) between colonised and uncolonised ecosystems



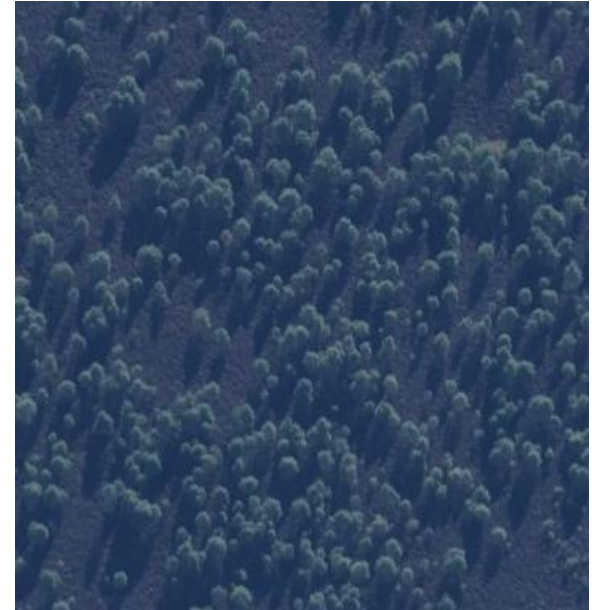
What does this mean for the ecosystem?

- Soil carbon losses were similar to tree carbon gains



What does this mean for the ecosystem?

- Soil carbon losses were similar to tree carbon gains
- After 25 years, colonised ecosystems gained no carbon compared to uncolonised ecosystems



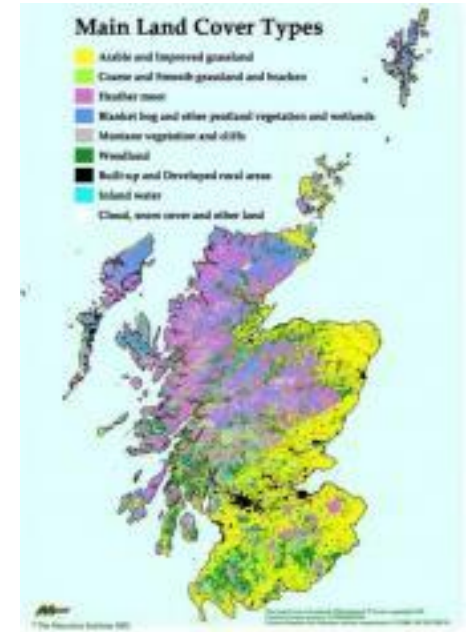
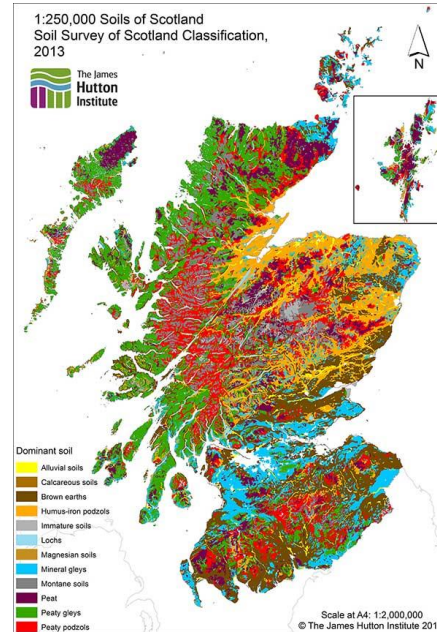
What does this mean for the ecosystem?

- Soil carbon losses were similar to tree carbon gains
- After 25 years, colonised ecosystems gained no carbon compared to uncolonised ecosystems
- But this did not account for differing tree densities or spatial distribution



What does this mean for net zero policy?

- Newly established forests can't always be assumed to capture carbon
- Need to consider potential for soil and vegetation carbon losses



However...

- Also need to consider how these tree and soil carbon changes are different in productive forestry context...



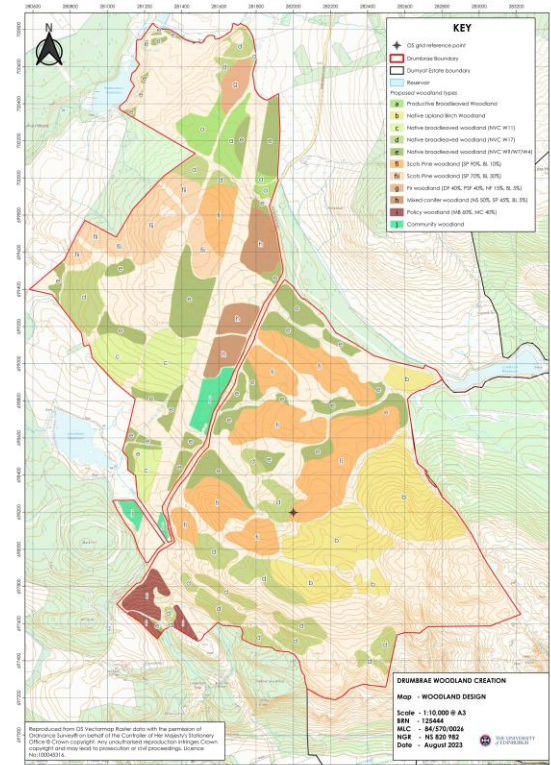
FPP

- FPP's Drumbrae project provides a unique opportunity to do so



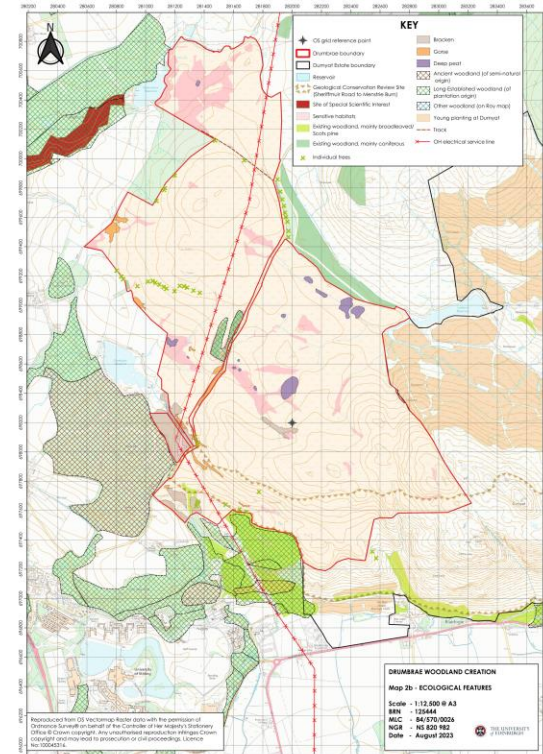
FPP

- Range of different tree species
- Representing current forestry practices and policy



FPP

- Three month placement with Lorna and the FPP team
- Baseline soil carbon at the Drumrae site and establishing locations for future re-sampling of soil carbon following tree planting and growth
- To understand impact of commercial forestry practices on soil carbon stocks

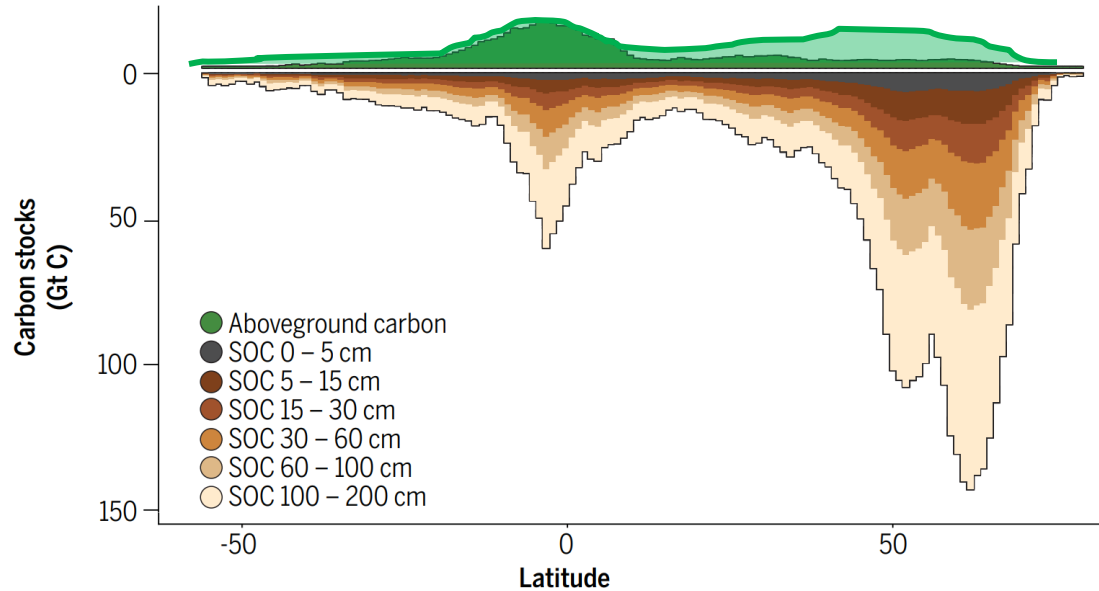




Thank you for listening!

Receive a copy of our paper once
it is published





Vegetation carbon:

Tropical rainforest:
 $\sim 20 \text{ kg m}^{-2}$ ($\sim 200 \text{ t ha}^{-1}$)

UK broadleaf:
 $\sim 6 \text{ kg m}^{-2}$ ($\sim 60 \text{ t ha}^{-1}$)