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Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Department of Agriculture, Food and the Marine
An Roinn Talmhaíochta, Bia agus Mara

GHG emissions & climate mitigation potential of Irish grassland on peat soils

ISCRAES – Grassland System

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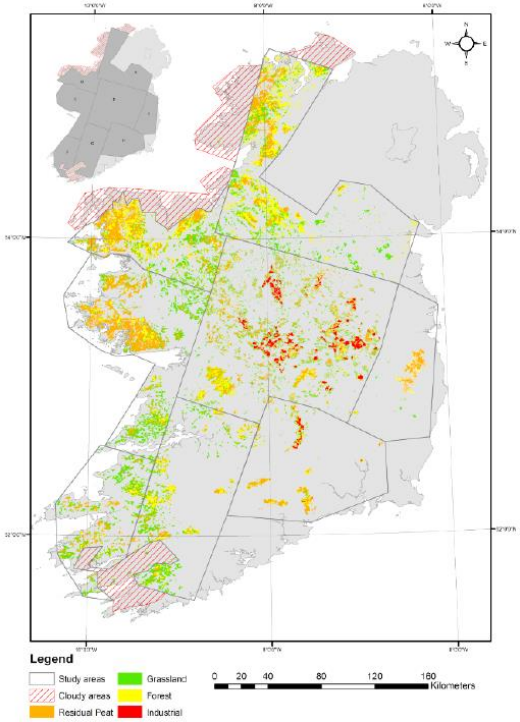
Peatland's relevance to Climate Change

- **Global Soil Organic Carbon (SOC) stock :**
  - *More C in 1st meter of soil than in all the vegetation + atmosphere*
    - 1/3 of SOC concentrates on 3% of the world's land area: in Peatlands!
      - ✓ Natural C sequestration capability

- **Irish Land Cover & Land Use**
  - 60% grassland, 10% forest, 10% crop
    20% peatlands
    - ➢ *up to 90% are degraded*
      - ✓ over 35% converted to **grassland**

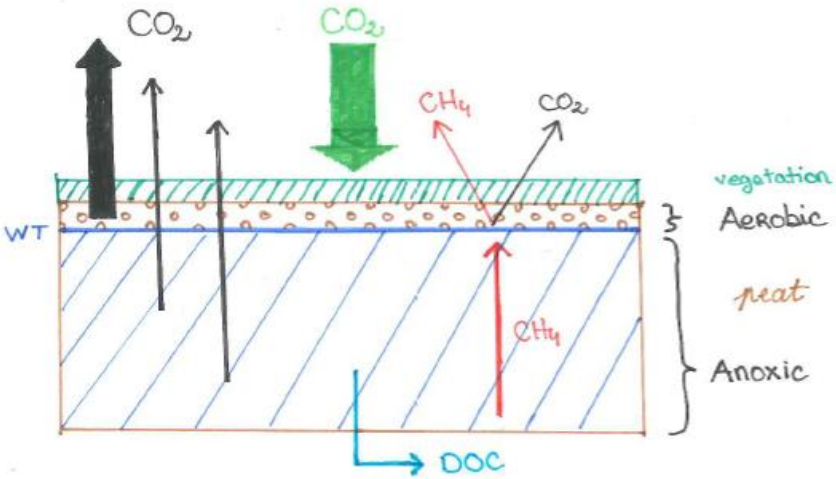


Extent and type of peatland land use in Ireland (Connolly, 2018)

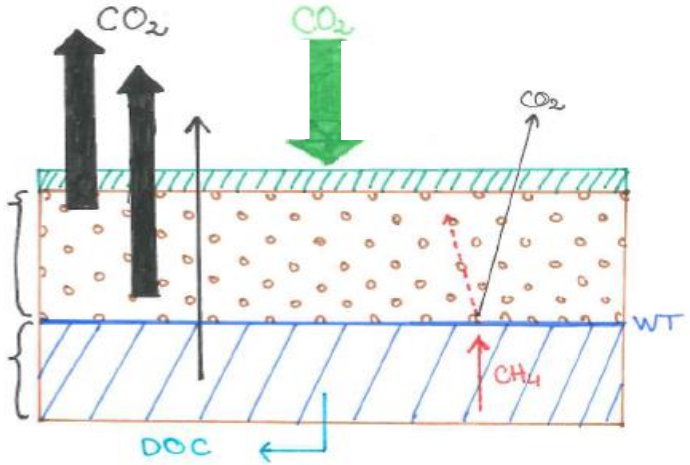
from Wetland to Grassland

Impact of hydrology (Water Table Level) on GHG emissions from peat soils

- **from Anoxic to Aerobic** conditions
  - ✓ *Decomposition of the high organic content of the peat*



- **from Sink to Source of GHG**
  - ✓ *from sink to source of CO_2 & N_2O*
  - ✓ *from source to sink of CH_4*



- **Substantial Climate Mitigation Potential upon Re-wetting**
  - *still challenging to predict & quantify* (site specific)

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Agri-SOC

Evaluating Land-Use and Land Management impacts on Soil Organic Carbon (SOC) in Irish Agricultural System

Teagasc
Agriculture and Food Development Authority

Lullymore Heritage and Discovery Park

❖ **Irish Context:**

- Grassland-based agriculture accounts for over 1/3 of national GHG emissions
- More than 1/3 of Irish peat soils are under grassland management
- 1st Eddy Covariance station on an Irish grassland on organic soil

Two years greenhouse gas (GHG) budget of an Irish grassland on drained peat soils managed for silage

- Mat&Met: Study Site, Eddy Covariance (CO_2) & Static Chamber (N_2O and CH_4)
- Results: Net Ecosystem Exchange, Harvested Biomass, Carbon Balance
- Discussion: Environmental Drivers & Management Impacts

Materials & Methods — Lullymore Grassland

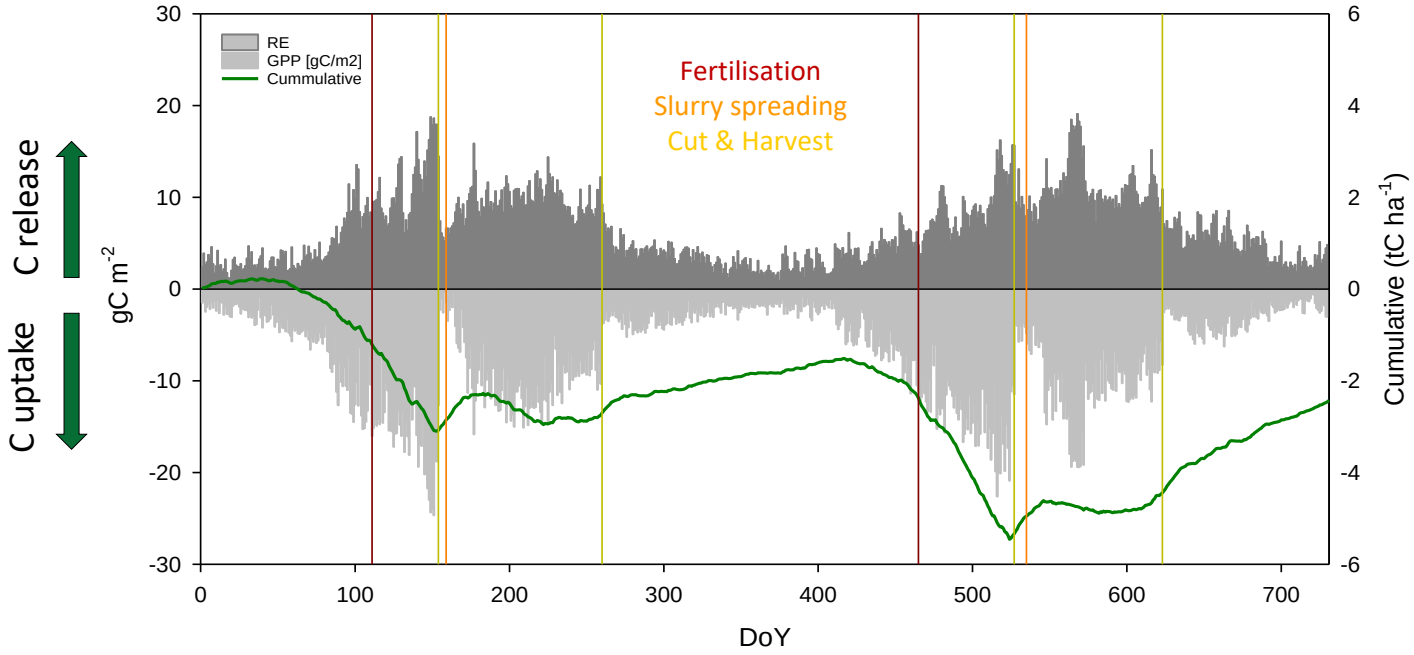
Study Site & GHG Monitoring

- Former peat extraction site: ~ 1m residual peat
  - Located in the Irish Midlands
  - Silage-based management
    - 2 cuts per year
    - 1 fertilisation + 1 slurry spreading event each year
- Monitoring of Biomass Growth and Export
- Eddy Covariance (EC) Station (CO_2)
  - LI-7500 DS open path gas analyser
  - Gill WindMaster 3D ultrasonic anemometer
  - Meteorological Station
- Weekly Static Chamber (CH) Measurements (NO_2 & CH_4)
  - 6 locations distributed across the site
  - 3 gas samples taken over 40min

Net Ecosystem Exchange (NEE)

EC measured Carbon uptake & release for 2020-21

- NEE = Ecosystem Respiration (ER) + Gross Primary Production (GPP)
  - *Carbon Release – Carbon Uptake*

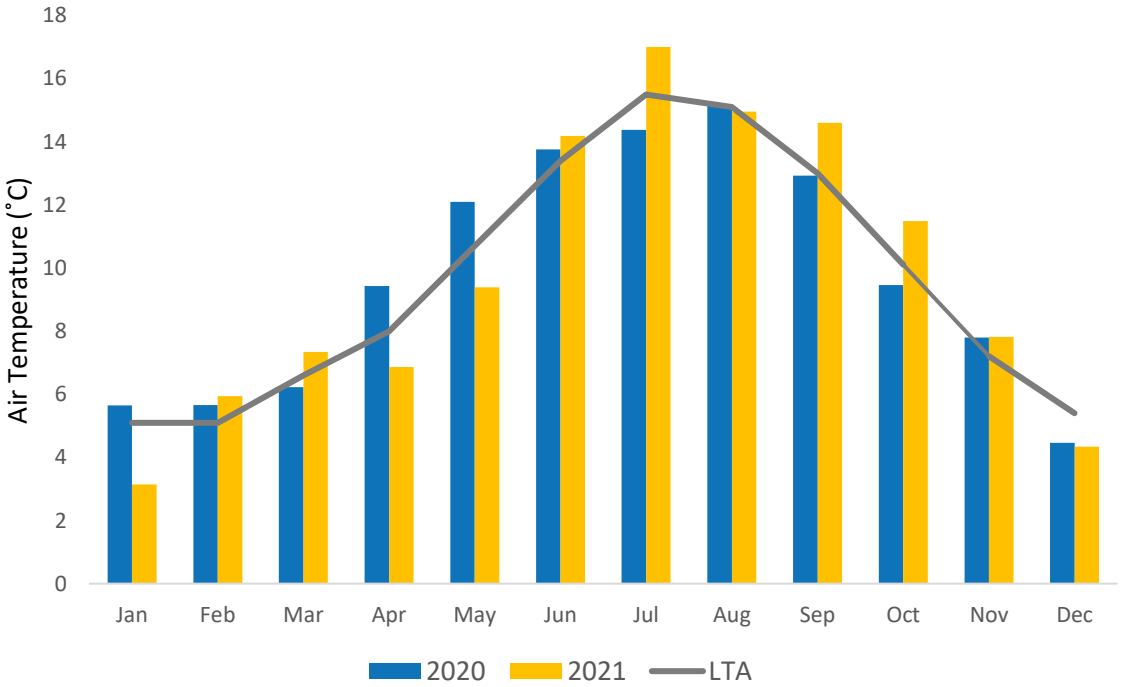


Annual Cumulative:

- 2020: **-1.82** tC h^{-1}
- 2021: **-0.60** tC ha^{-1}

Environmental Drivers of NEE

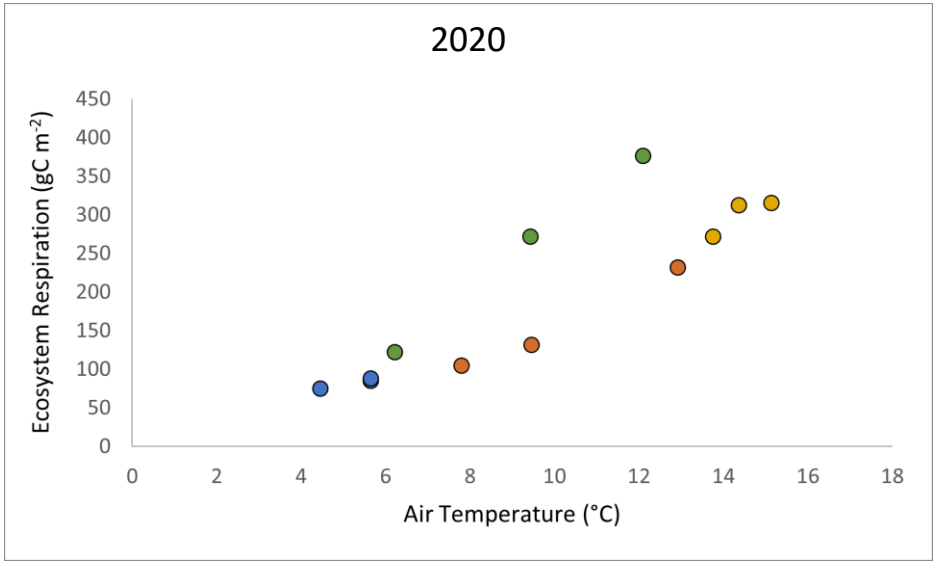
Air Temperature 2020-21

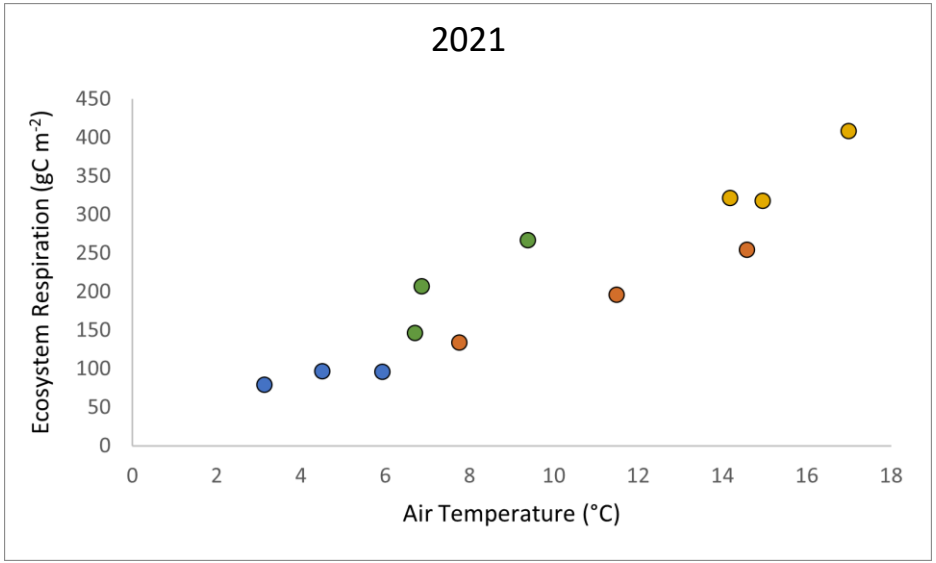


- July to October:
  - On average 2°C warmer in 2021

Environmental Drivers of NEE

Ecosystem Respiration & Air Temperature Correlations

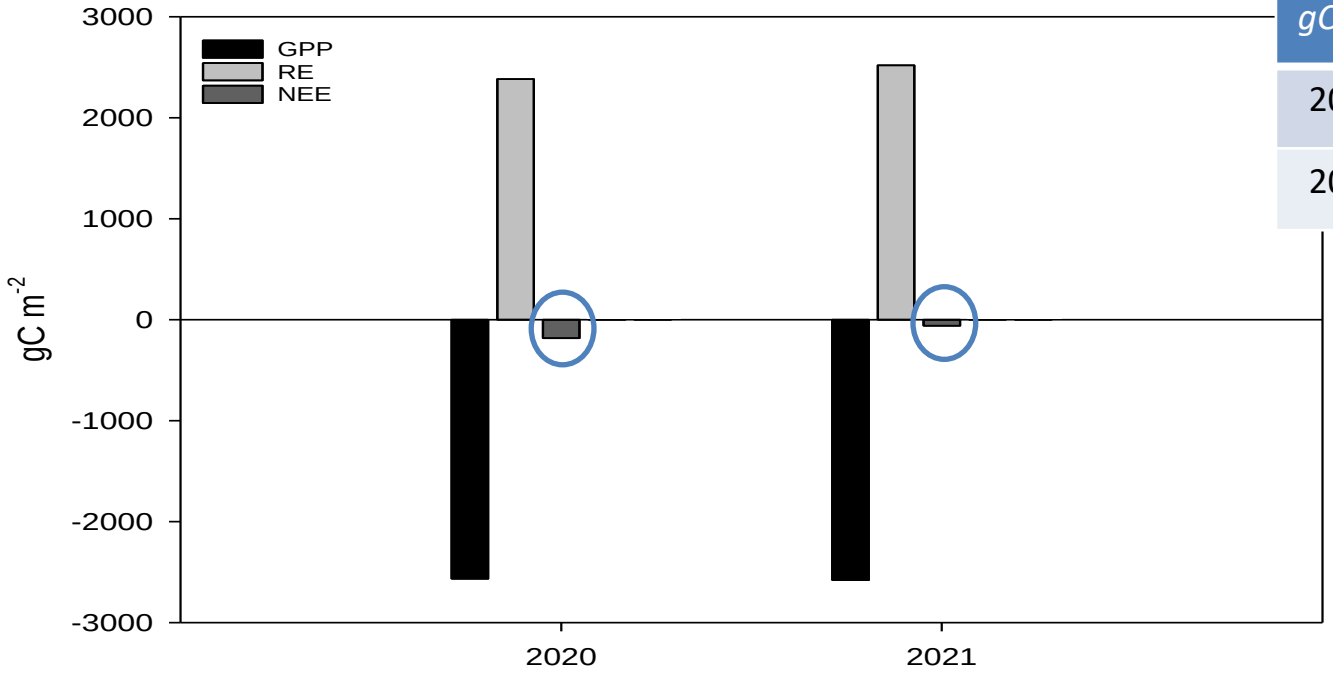




Winter (Dec-Feb) Spring (Mar-May) Summer (Jun-Aug) Autumn (Sep-Nov)

Net Ecosystem Carbon Balance (NECB)

Recap

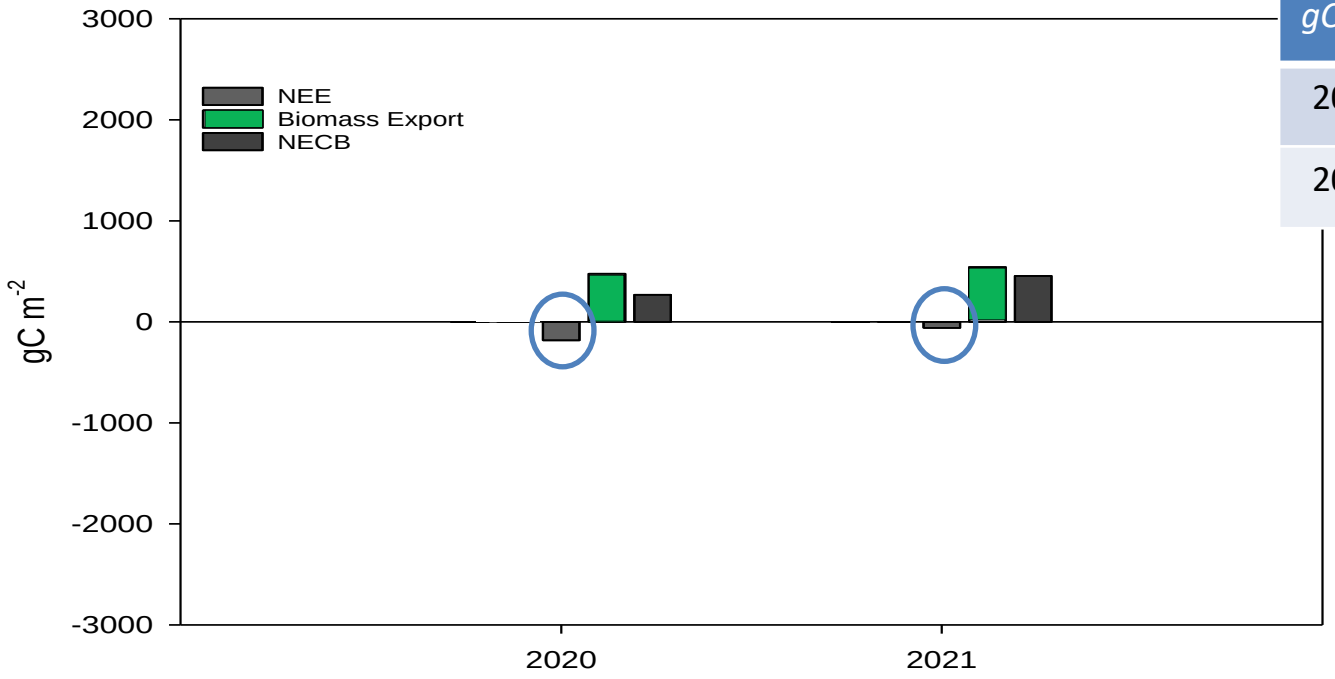


gC m^{-2}	GPP	ER	NEE
2020	-2565	**2383**	**-182**
2021	-2579	**2519**	**-60**

- **Interannual variability** is driven by the **temperature effect** on the **E**cosystem **R**espiration
  - *Vulnerability in the context of Climate Change*

Net Ecosystem Carbon Balance (NECB)

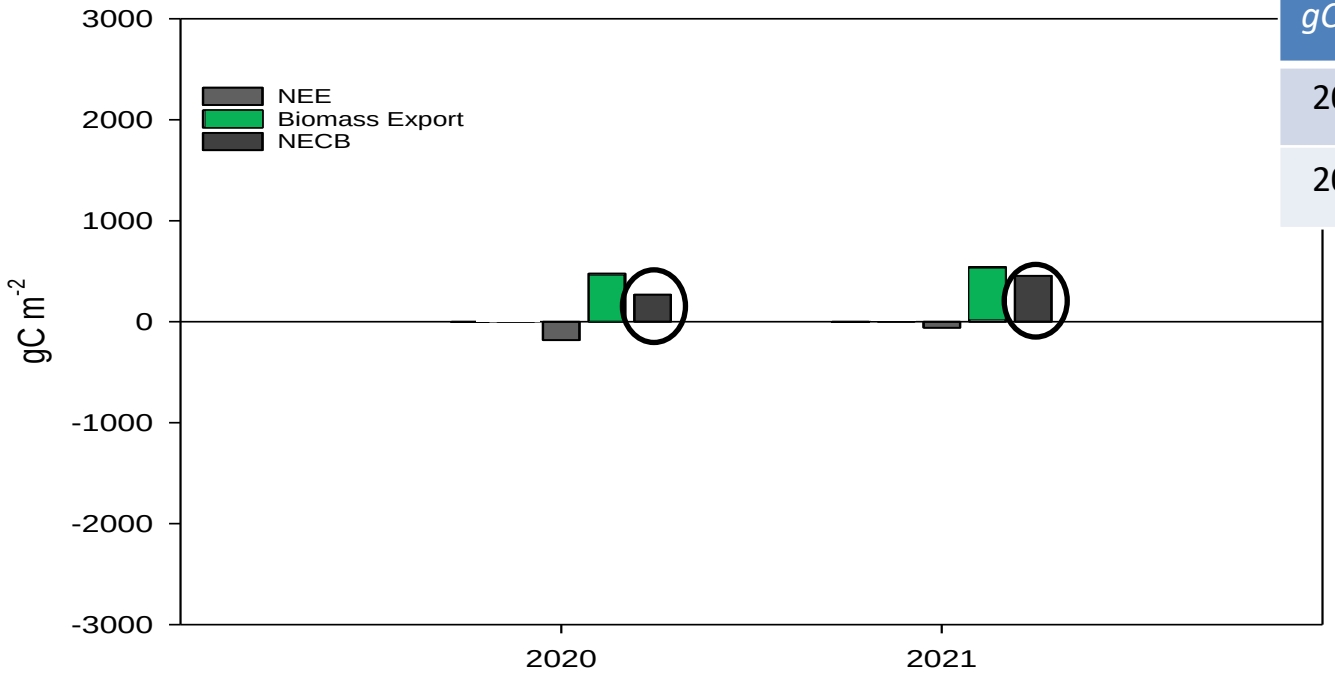
Impact of Biomass Export on the C dynamic



gC m^{-2}	NEE	Bexp	NECB*
2020	-182	498	316
2021	-60	544	484

Net Ecosystem Carbon Balance (NECB)

Impact of Biomass Export on the C dynamic

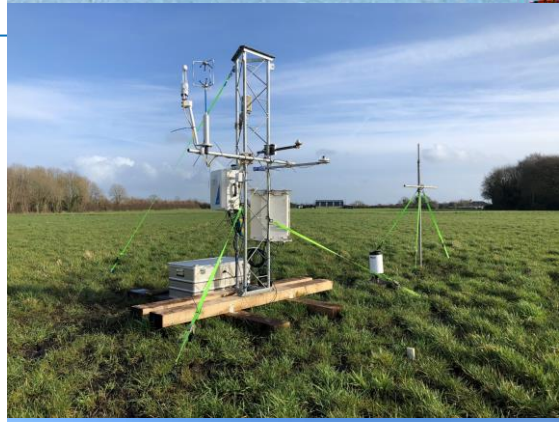


gC m^{-2}	NEE	Bexp	NECB*
2020	-182	498	316
2021	-60	544	484

- **Silage-based management** on grassland on peat soils has a **net warming effect**
  - *Opportunity for Emission Savings*

Next Step & Expected Outcomes

- Quantification of the Full Greenhouse Gas Budget
  - *N_2O and CH_4 fluxes, Slurry input, DOC*
- Assessing the Climate Mitigation Potential
  - *Best management practices, Rewetting*
- Upscaling & Projection (Modelling)
  - *Improved National Inventory Report & Climate Action Plan*



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Thank you!
Any Questions?

Lullymore
Heritage and Discovery Park

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