Innovative Water Table Modelling Supporting Water and Carbon Management

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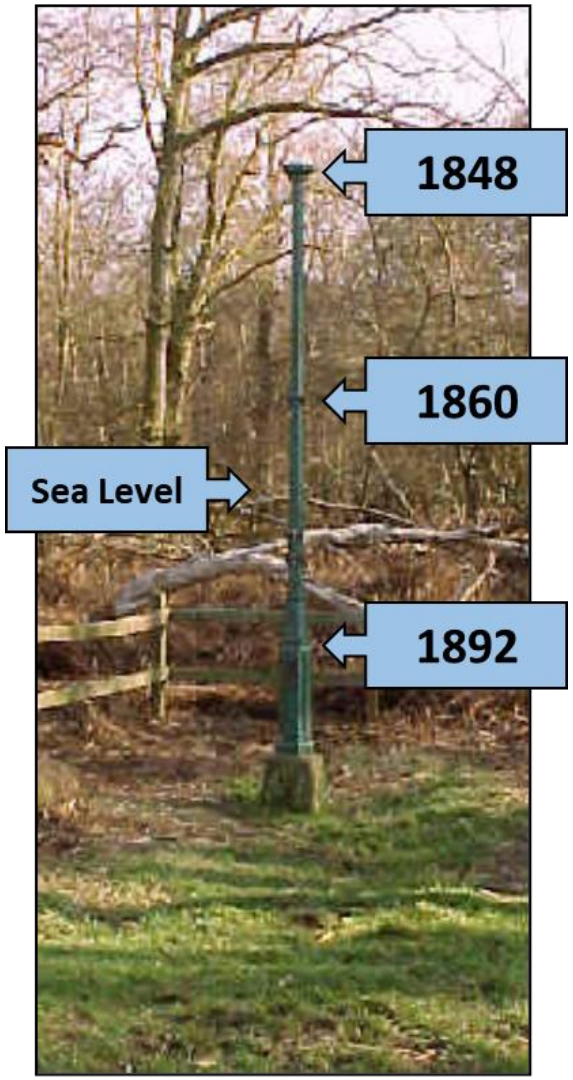
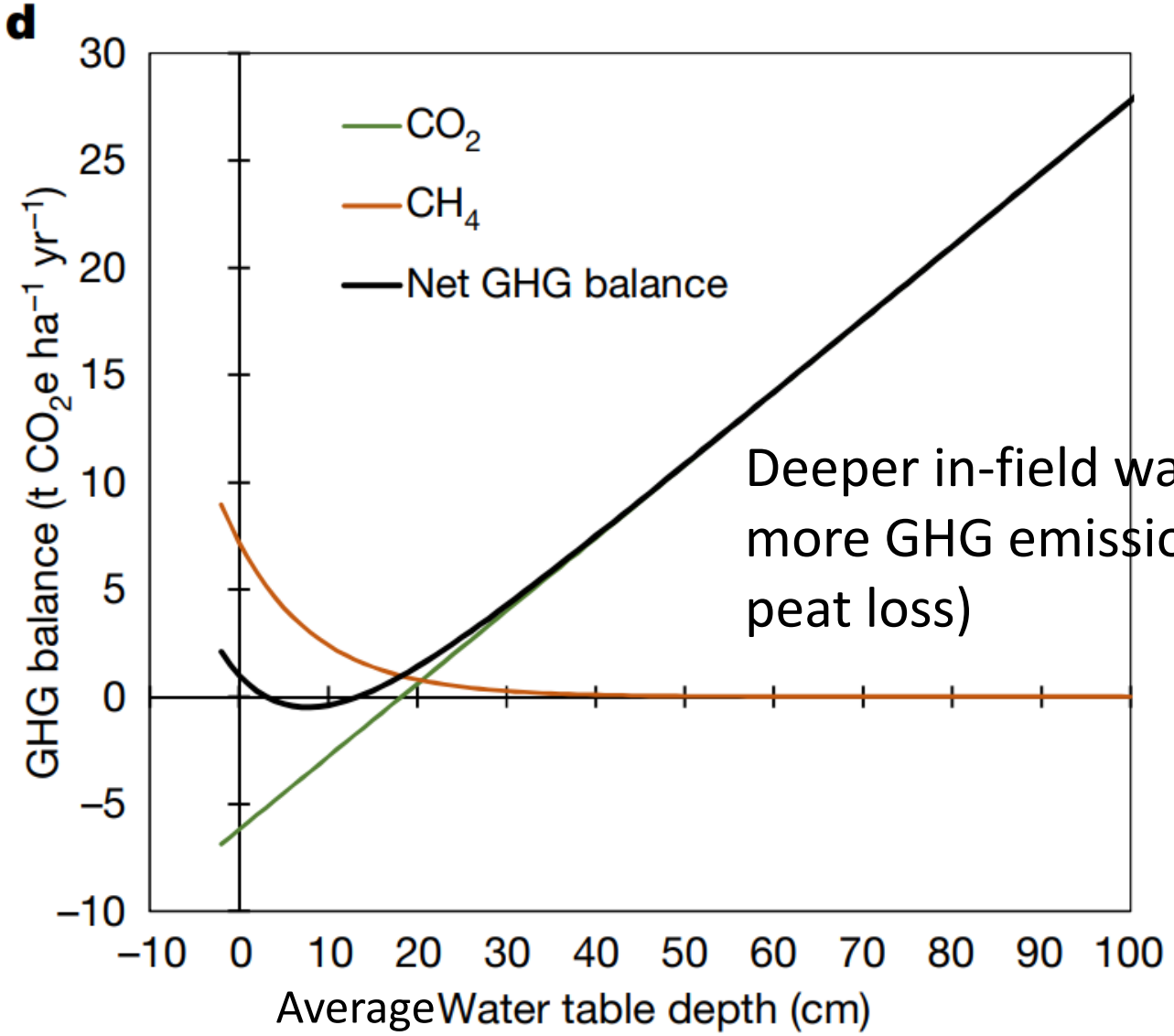
Overview

- Basics of land drainage for watertable control (freeboard and drain spacing)
- The challenge(s) of assessing in-field watertables
- Our approach and tool……
- Final remarks

Importance of watertable management



GHG emissions



Deeper in-field watertable = more GHG emissions (and peat loss)

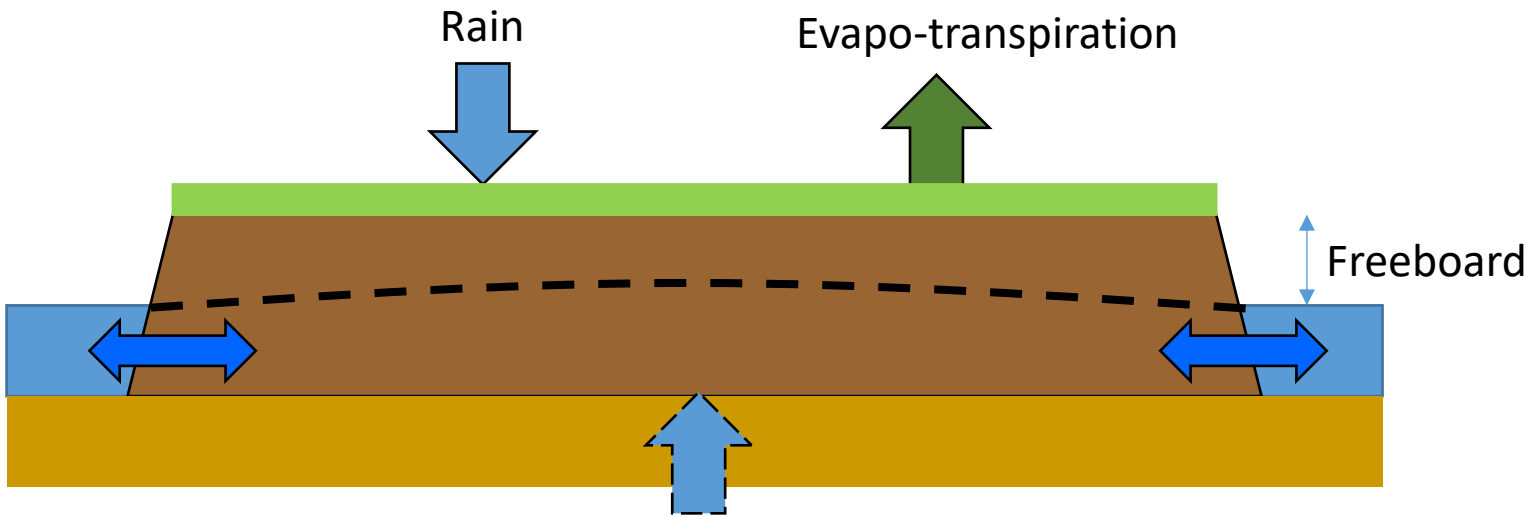
Evans et al. (2021). https://doi.org/10.1038/s41586-021-03523-1

Basics of drainage

Watertable depth in LAP is a function of drainage regime, water inflows and water outflows

Watertable shape is a parabola that changes with :

- distance from drain
- Peat properties (Ksat)

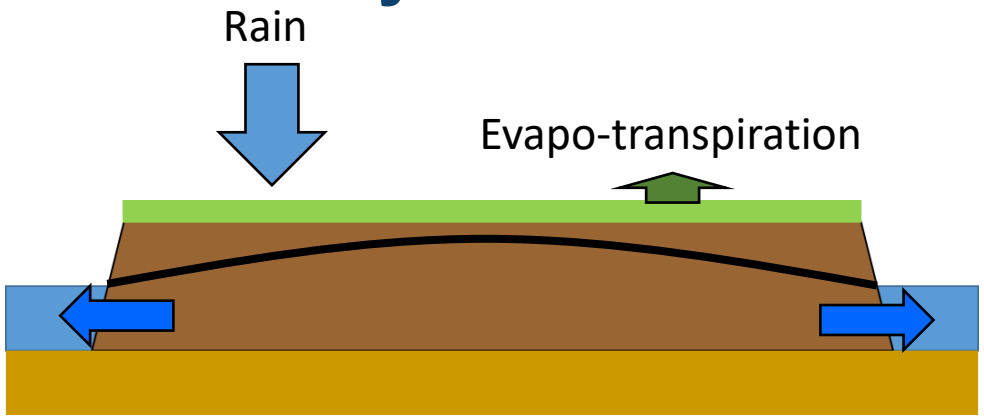


Key WT controls

- Drain spacing
- Freeboard (drain water level)
- Peat properties (Ksat and Sy)
- Weather
- Groundwater

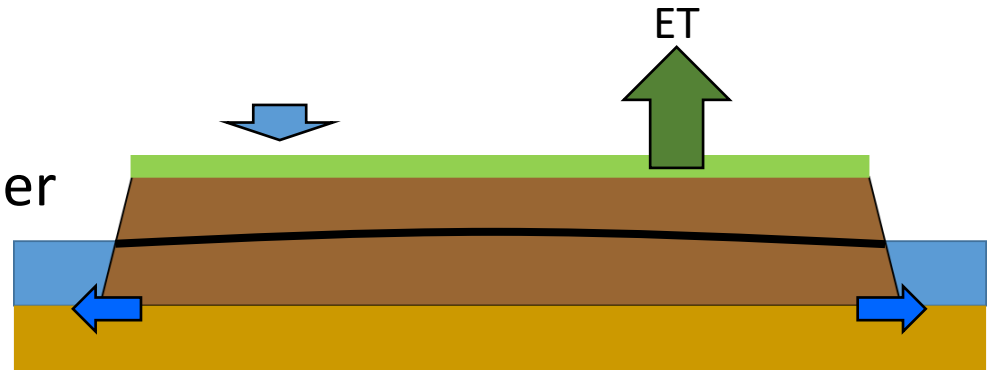
Seasonality

Winter



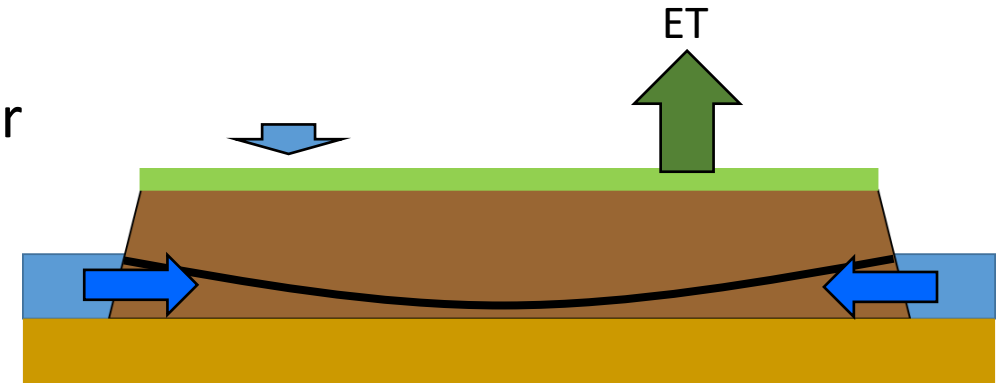
- Watertable level above drain water level
- Watertable highest **midway between** drains

Early summer



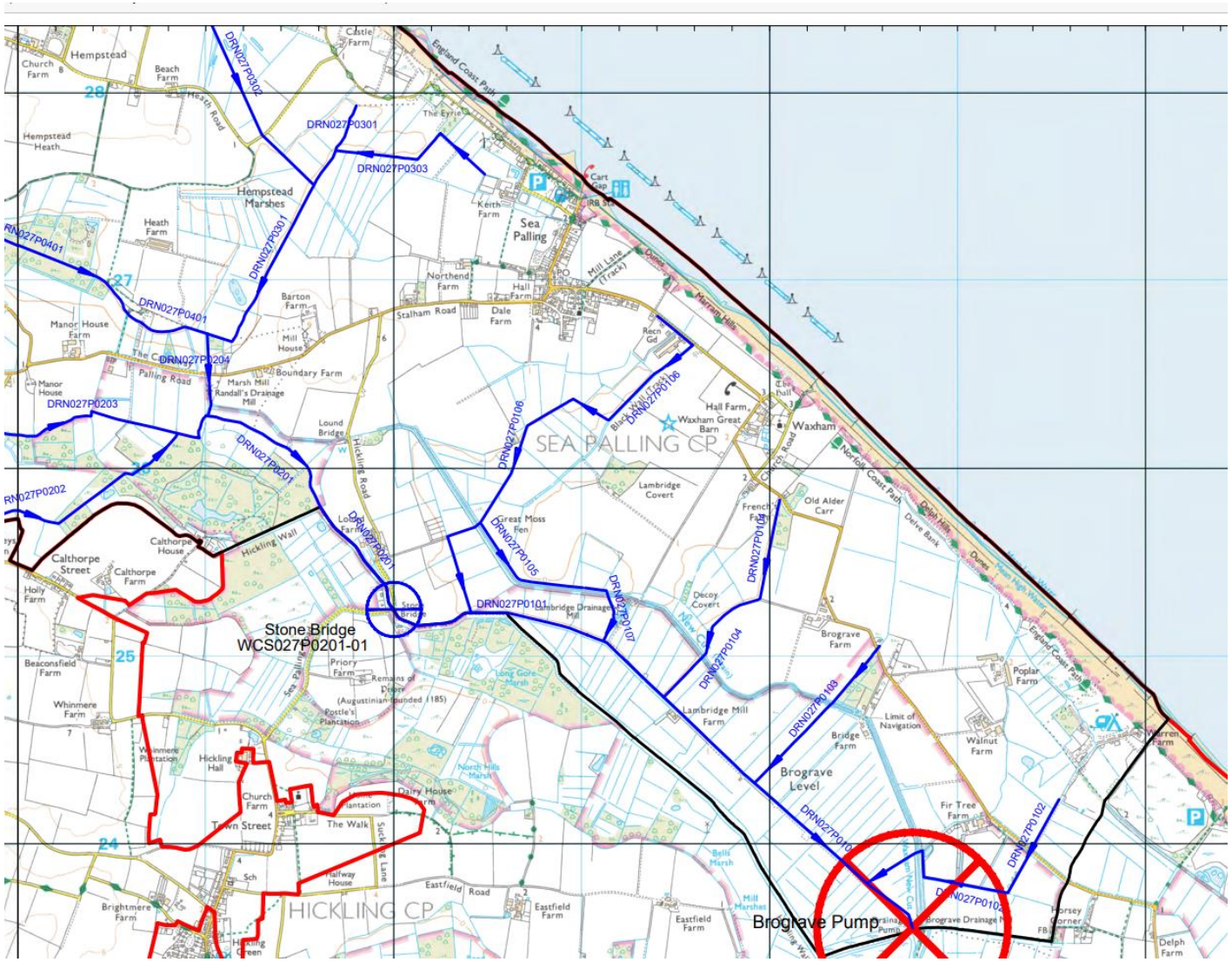
- Watertable level falls
- Watertable highest **midway between** drains

Late summer / dry years



- Watertable level continues to fall due to ET
  - AET > rate of 'sub-irrigation'
- Watertable highest **near** drains

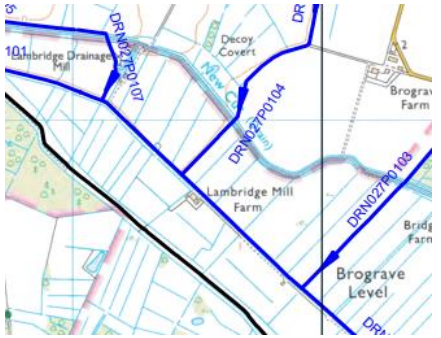
Challenges of assessing in-field watertables



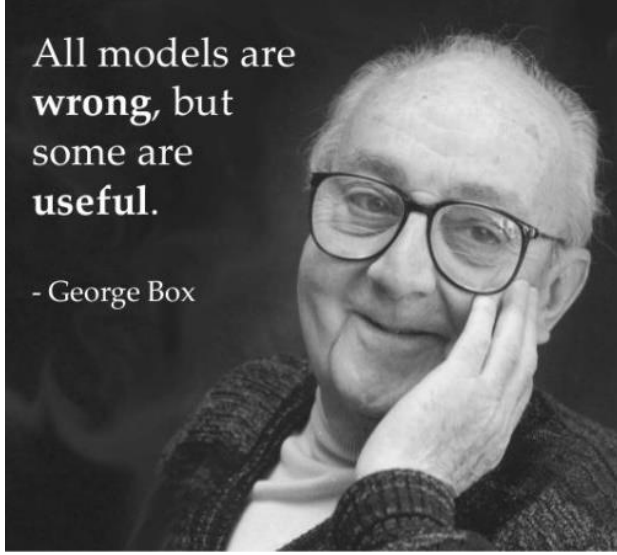
- Presence of ditches – **known**
- IDB Main drain water levels - **unknown**
- Non-IDB drain water levels – **unknown**
- Presence of under-drains **– unknown**
- Condition of under-drains **– unknown**
- Pump on-off levels – **known**
- Watertable depth – (**largely) unknown**

Our approach

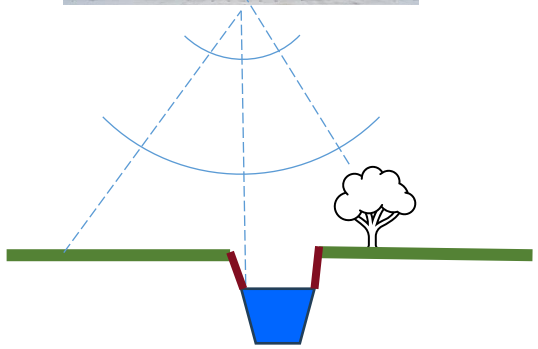
Ordnance Survey mapping



Drain spacing



Lidar (radar)

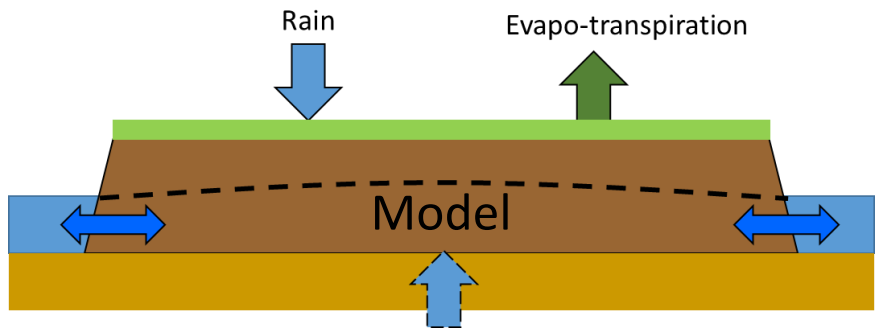


Evaluation against:

Source: ADA

Source: Defra

- Drain water levels
- Field (ground) elevation
  - Freeboard



Evaluation against:

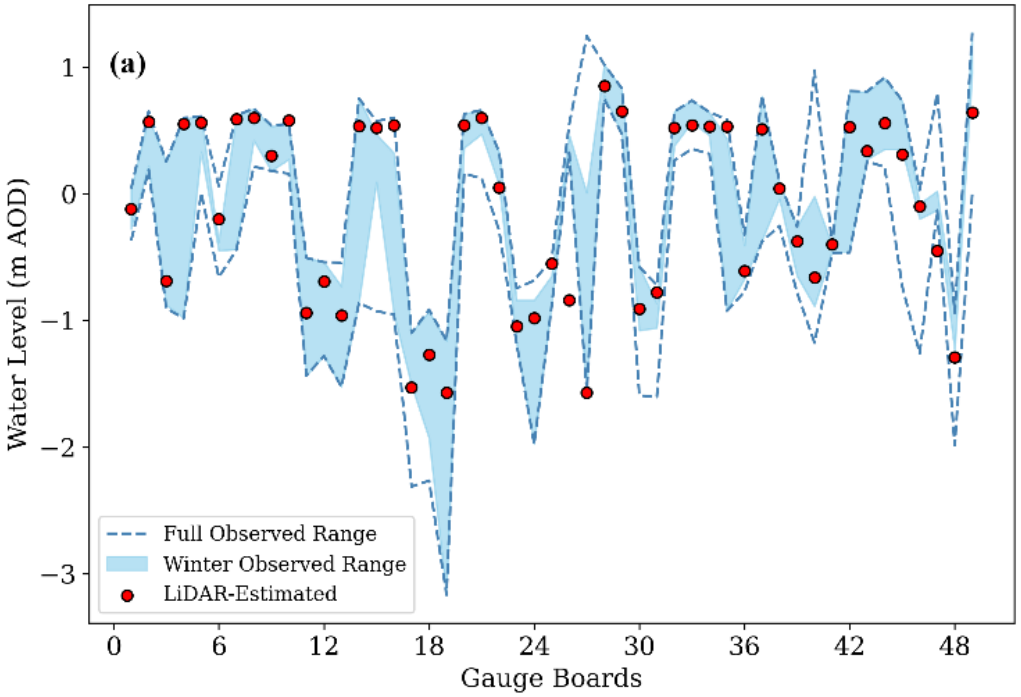
Source: BGS

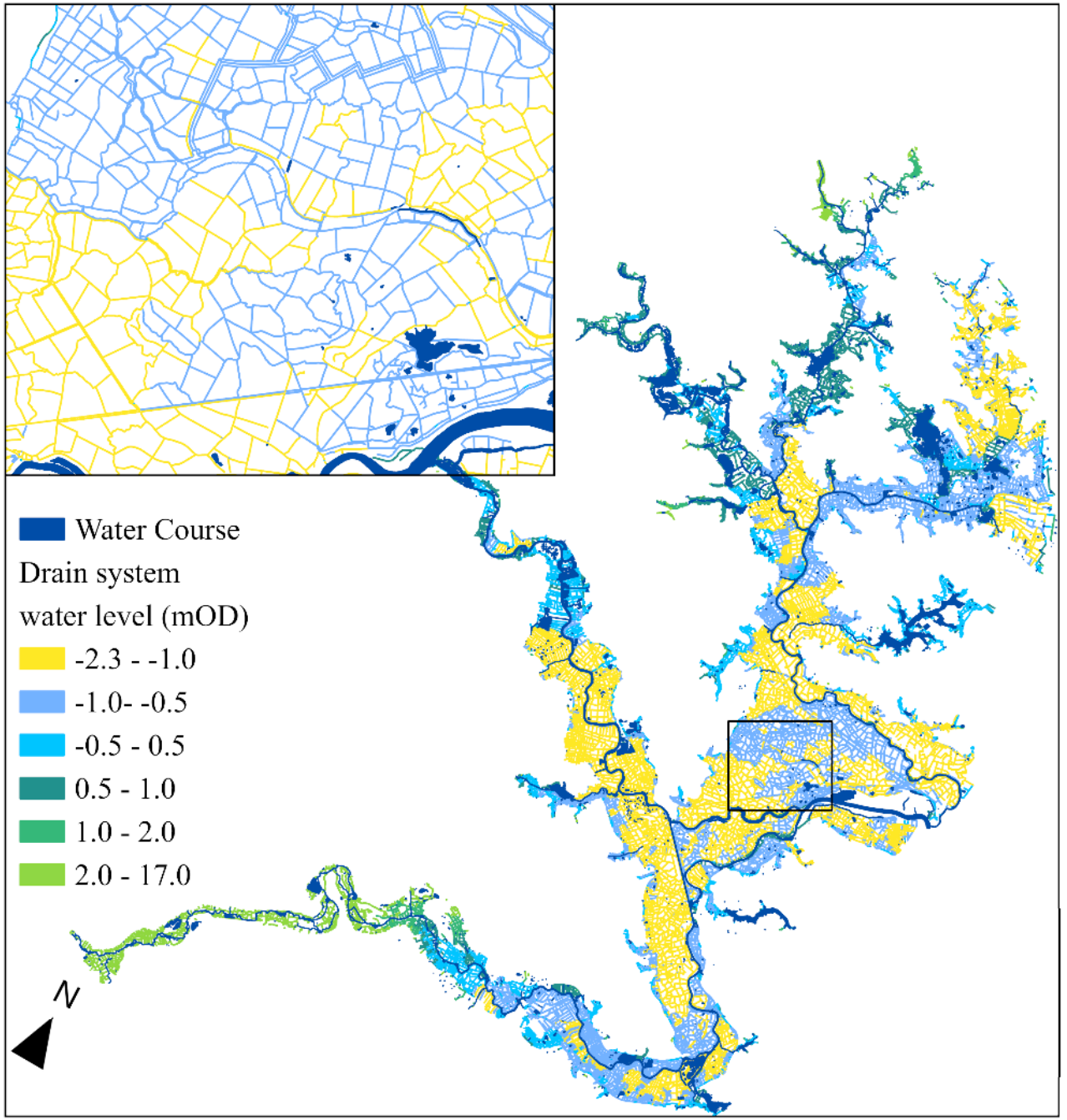
Other inputs

GHG emissions

Drain water level scenarios

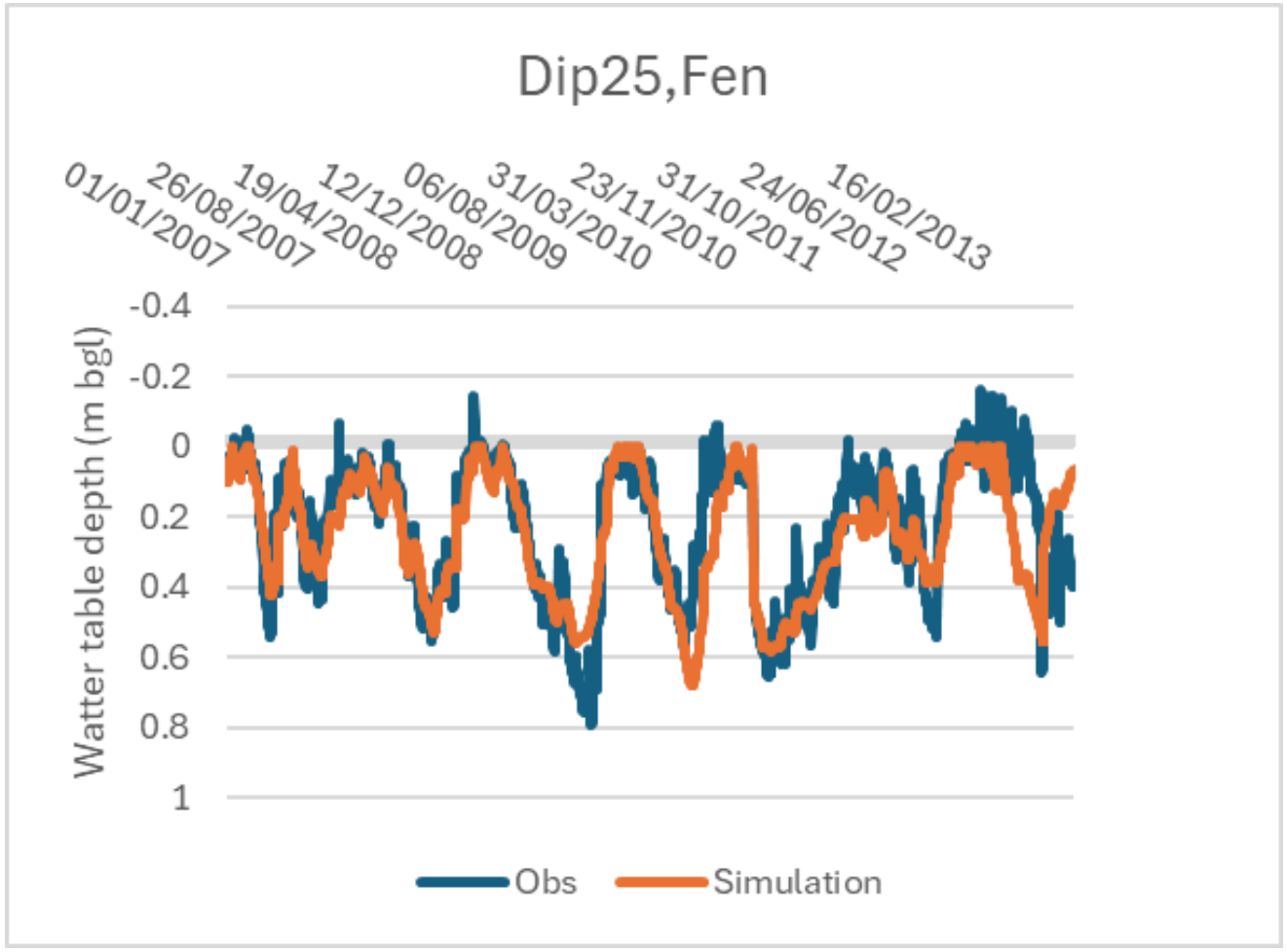
Drain water levels (mOD)

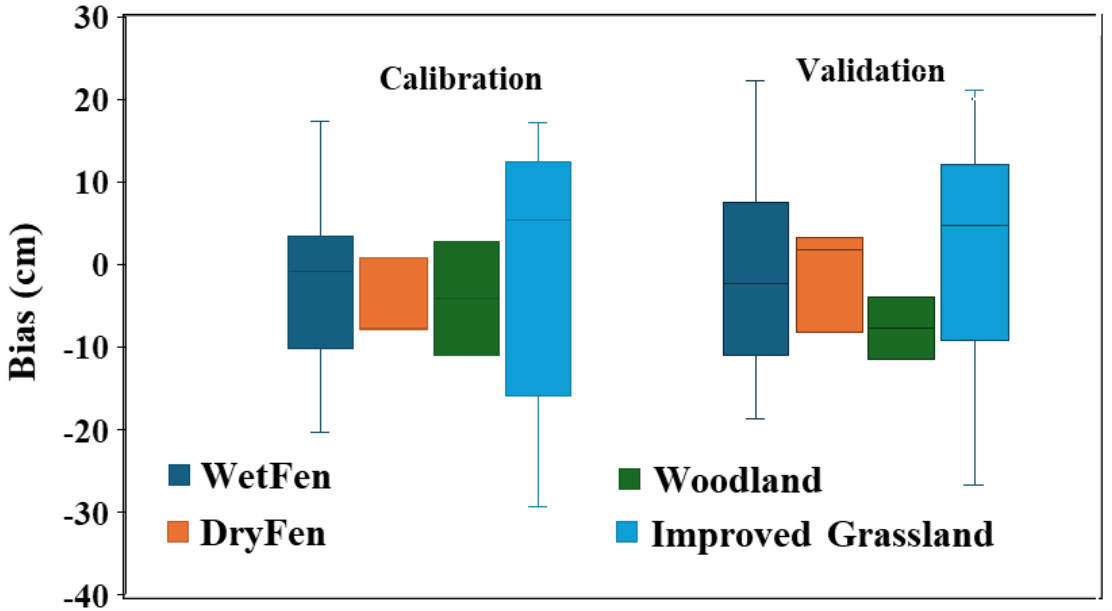




Water table (dipwells)

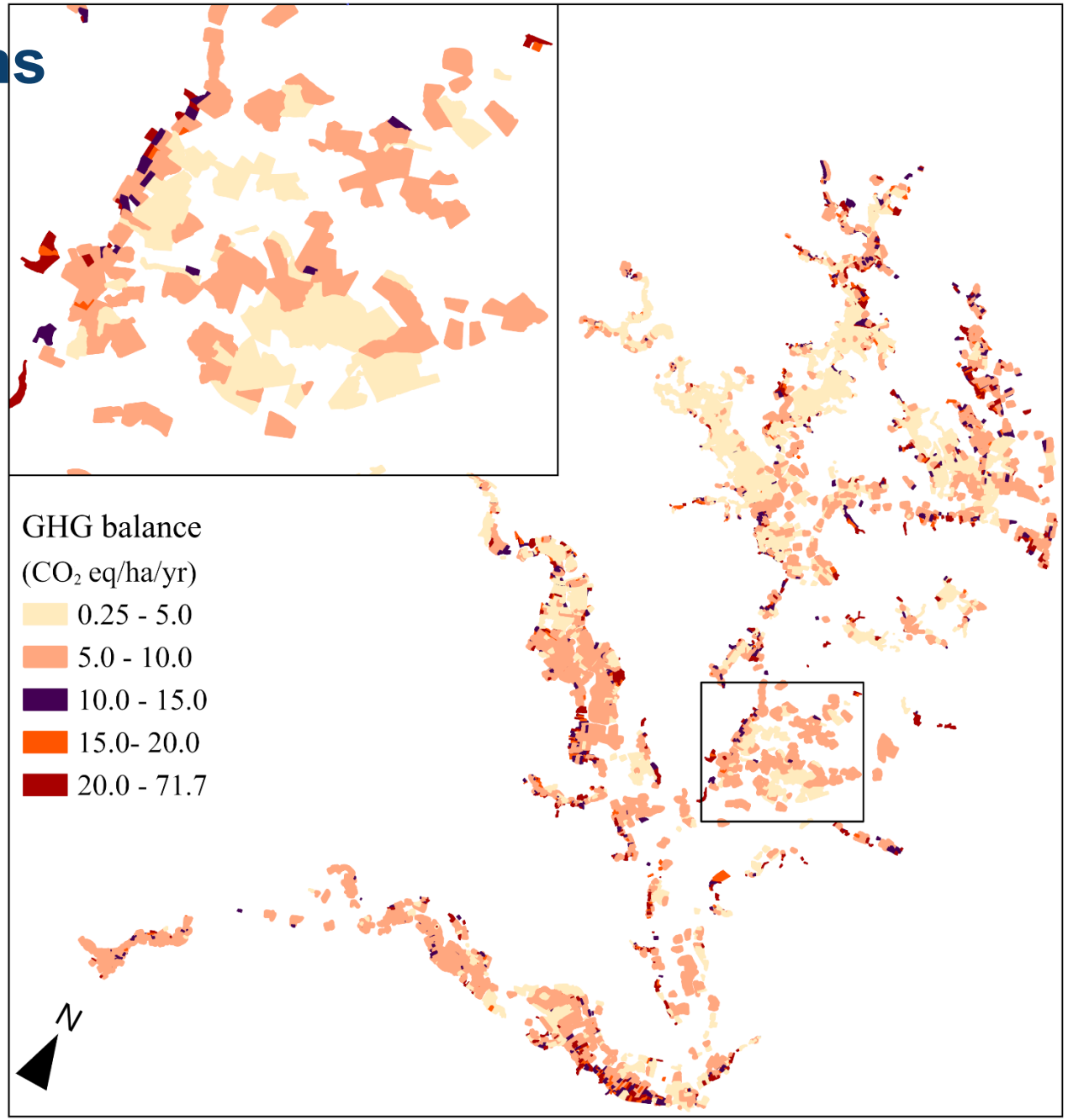
Example (a good one!)





Greenhouse gas emissions

- Greenhouse gas emissions differ between fields due to differences in water table depth and peat thickness

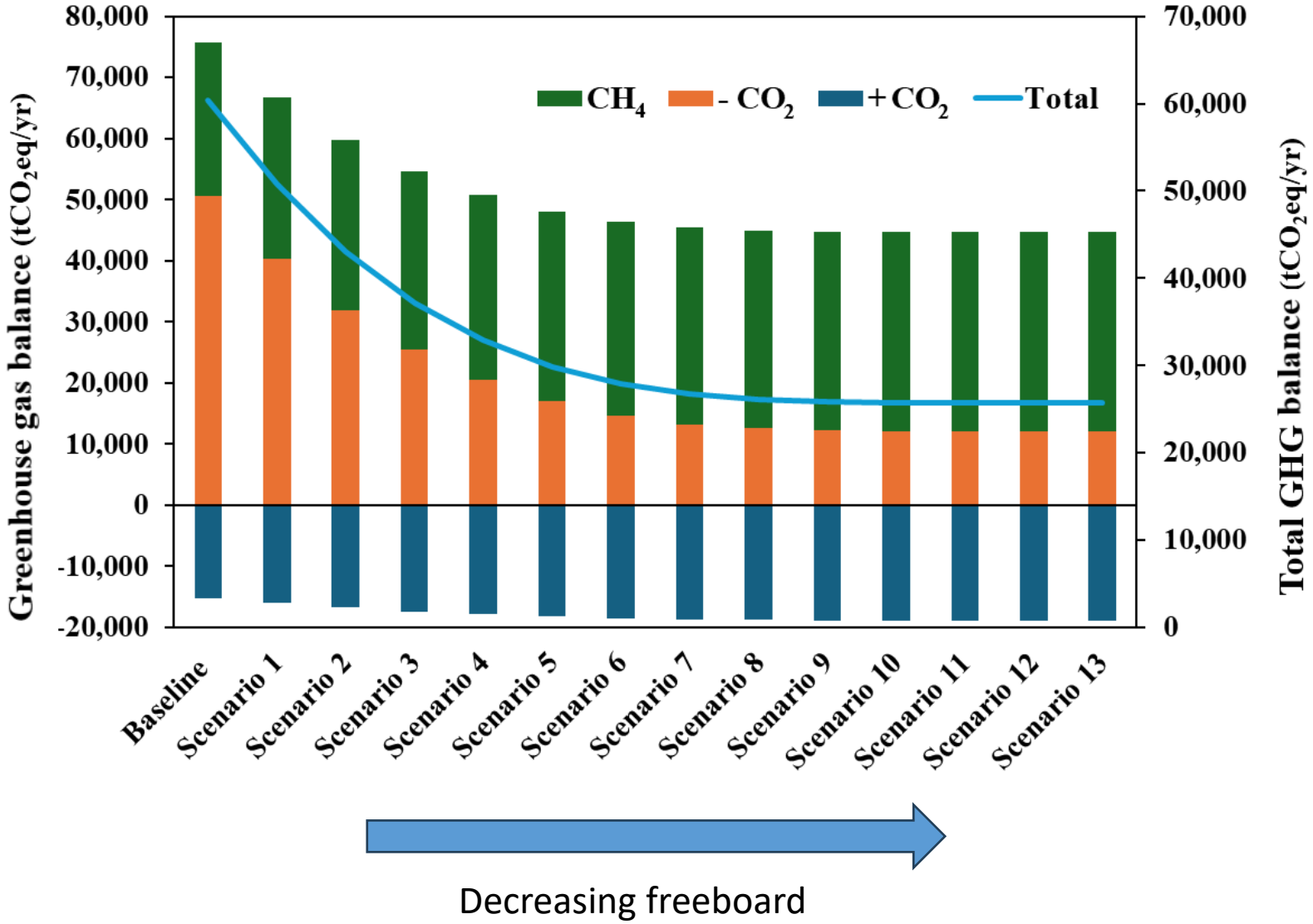


Broads National Park greenhouse gas emissions

As drain water levels are raised, emissions progressively reduce

Emissions made up of:

- CO2 uptake in functioning high watertable peatlands
- Methane (CH4) emissions in high watertable peatlands
- CO2 emissions in fields that fail to achieve high average watertable

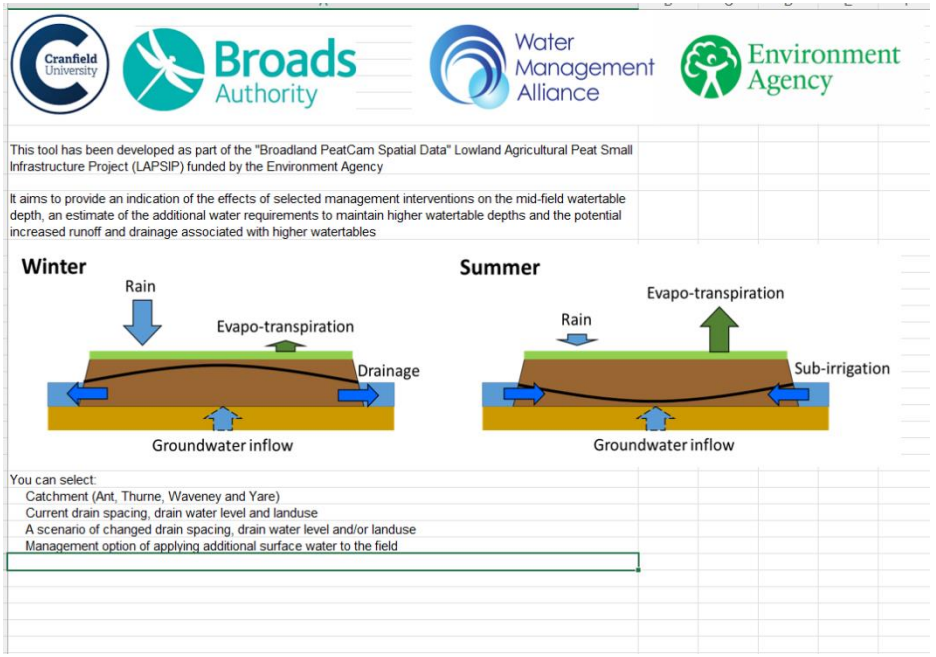


Watertable tool

- Regional modelling is a static representation of spatial variability in watertable depth
- It doesn't support land owners (and others) in developing options and planning for raising watertables

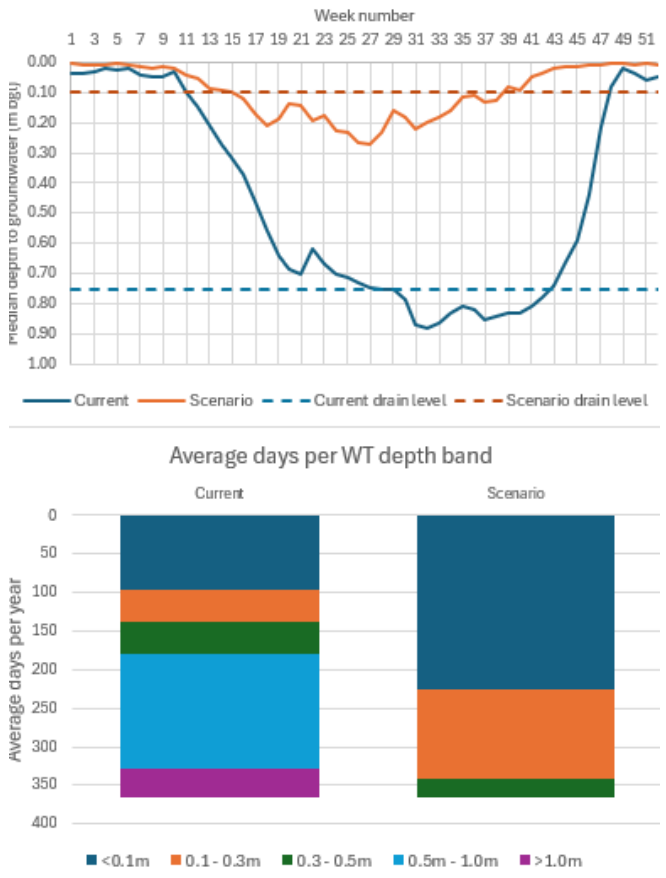
- Developed an Excel-based tool for the Broads to quickly show how changing
  - Drain spacing
  - Drain water level
  - Surface irrigation
  - Vegetation

  - Affects:
    - Watertable depth (within a year, and between years)
    - Water needs (within a year, and between years)
  - Within different catchments in the Broads

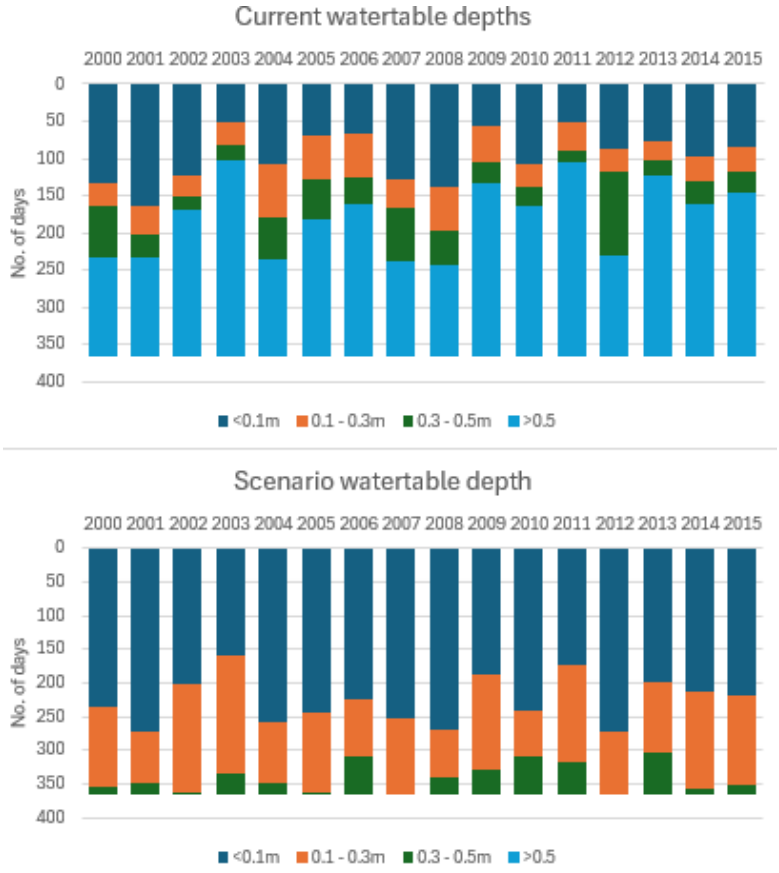


Watertable tool (example outputs)

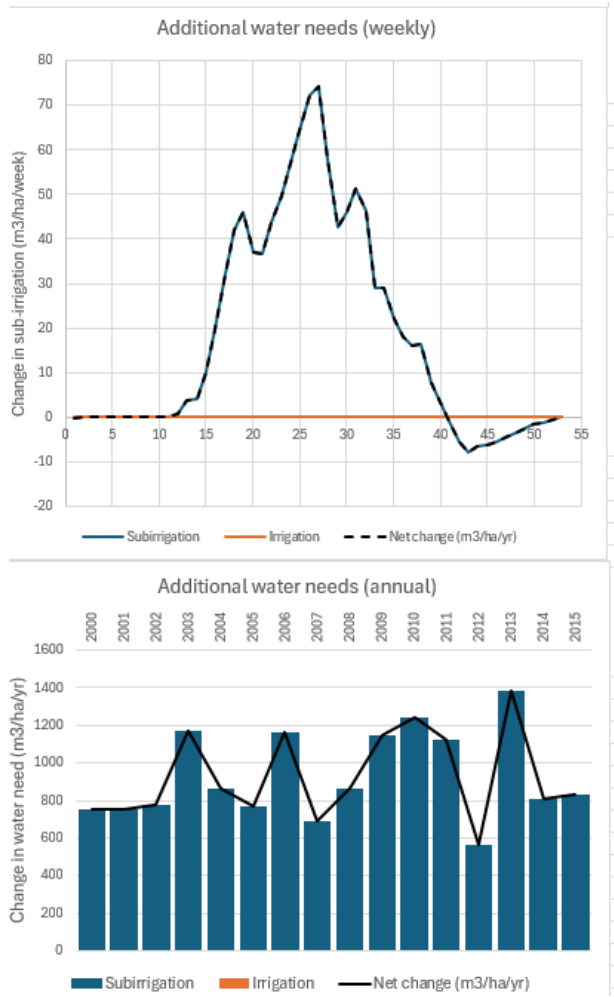
Intra-annual variability in WT depth



Inter-annual variability in WT depth



Intra- and inter-annual variability in additional water needs



Concluding comments

- We have developed an innovative approach for estimating current and future water table depth and GG emissions

- Raising and maintaining high watertables isn’t straightforward.
  - Higher drain water levels lead to higher watertables and reduced emissions, but do not guarantee sufficiently high water tables.
  - Maintaining higher water table requires increased water

- We have developed a prototype tool to support and empower landowners in feasibility discussions

Acknowledgements

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Excel tool funded as part of the Environment Agency Lowland Agricultural Peat Small Infrastructure Project

Thanks to:

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