Predicting GHG emissions from horticultural peat soils using DNDC

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Project outline

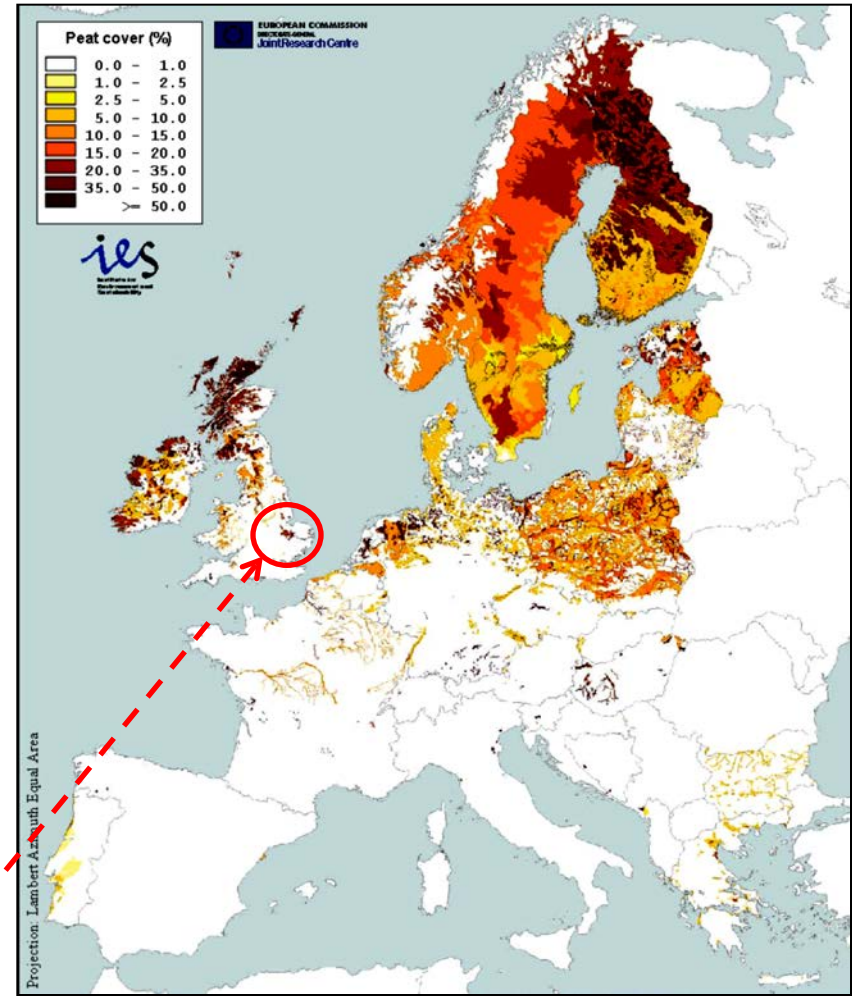
- Background
- Project aims
- Methods
  - Experimental monitoring of GHGs from horticultural peatlands
  - DNDC parameterisation
- Results
  - Measured vs. modelled emissions
- Summary

Background

- ~ 7% of Europe's land area is peat soil
- ~ 7% of Europe's peat land is cultivated

- BUT contains large C stock

- UK: 18% land area but 52% total soil C
- 39% lowland fen peat soils are cultivated



Montanarella *et al.* (2006). "The distribution of peatland in Europe". Mires and Peat **1**: 1-10.

High rates of soil loss in East Anglia

1848 AD

400 cm in 164 years
= Soil loss up to 2.4 cm y^{-1}

Recent estimate of
1.1 to 1.5 cm y^{-1} (1984-2004)

2012 AD

“The bread basket of England”

What's causing the soil loss?

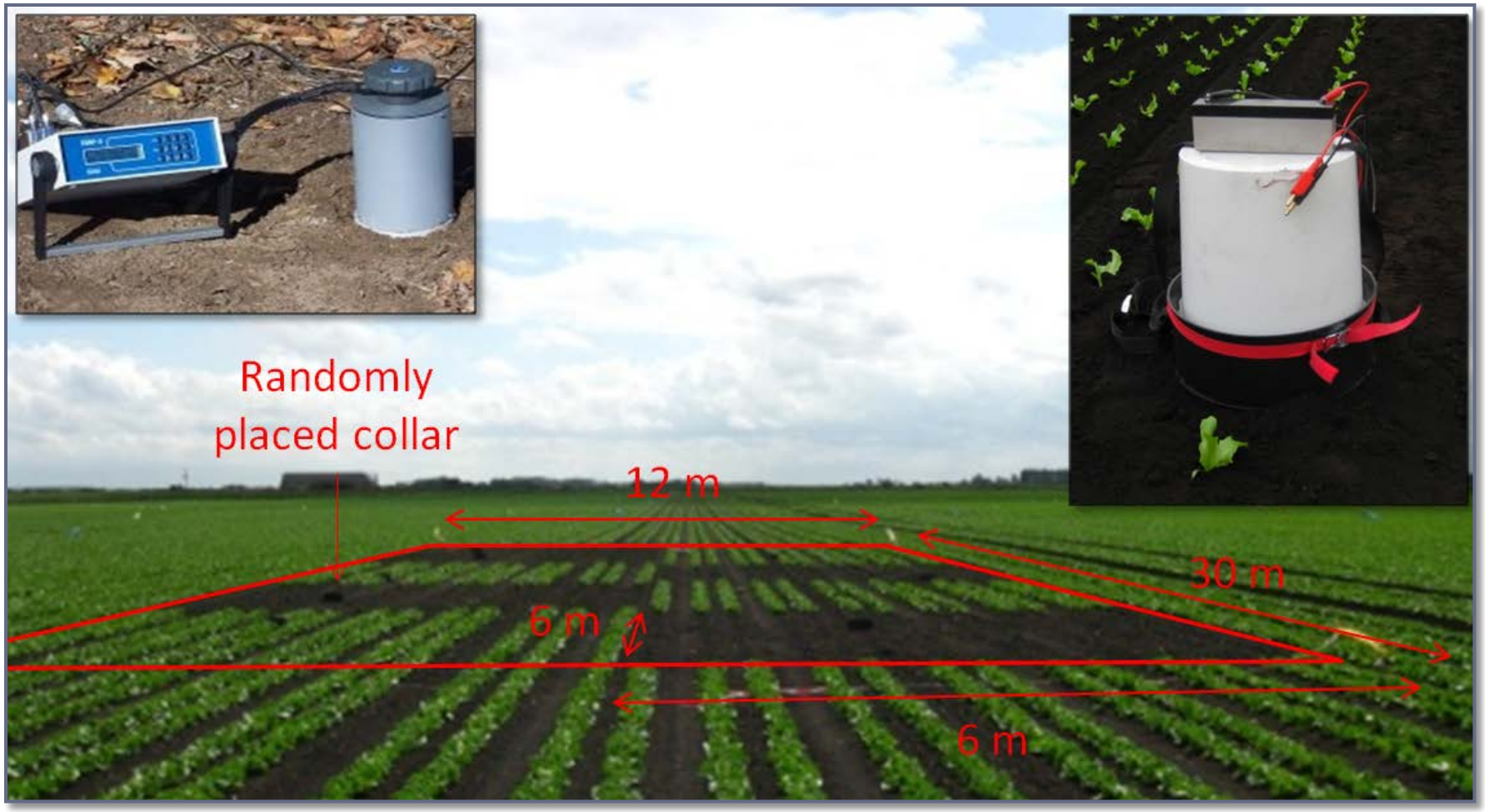
The literature suggests…

- High % lost as oxidation (CO_2 emission) (Dawson & Smith, 2007)
- Can be up to 100% (Leifeld *et al.,* 2011)
- So we need to focus on quantifying and reducing GHG emissions (CO_2, N_2O, CH_4)

Project aims

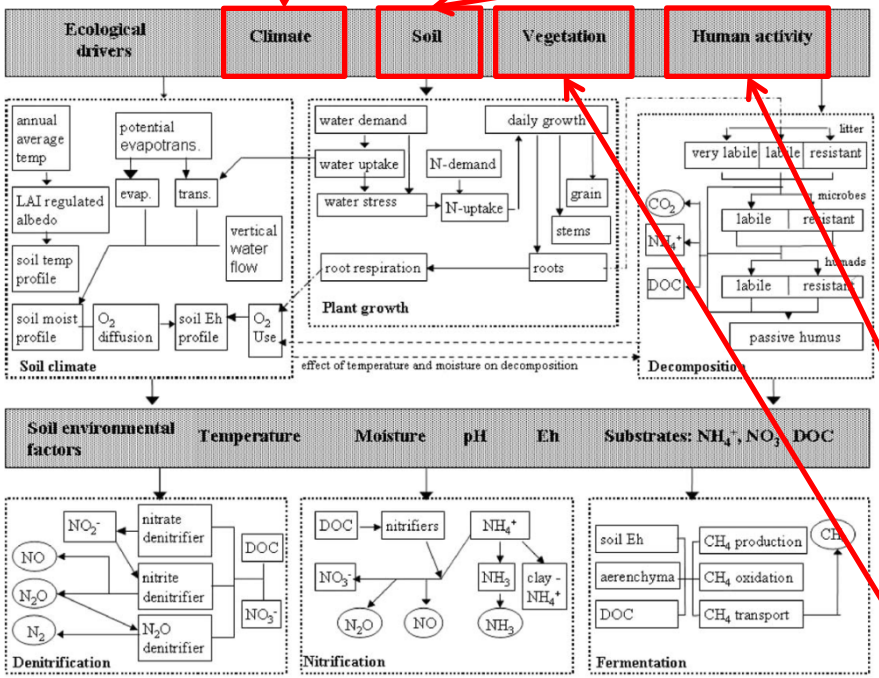
- Quantify GHGs from horticultural peats
- Validate DNDC for use on these soil types
  - Reduce future need for intensive, costly field monitoring
  - Test mitigation scenarios
- Reduce further soil loss
  - Encourage sustainable soil management practices

Methods: Measuring emissions



Methods: DNDC 95 parameterisation

UK Met Office data (rainfall, temperature)



Giltrap, D. L., *et al*. (2010). "DNDC: A process-based model of greenhouse gas fluxes from agricultural soils." Agriculture Ecosystems & Environment **136(3-4): 292-300.**

Additional soil texture category:
"Cultivated/drained peat soil"

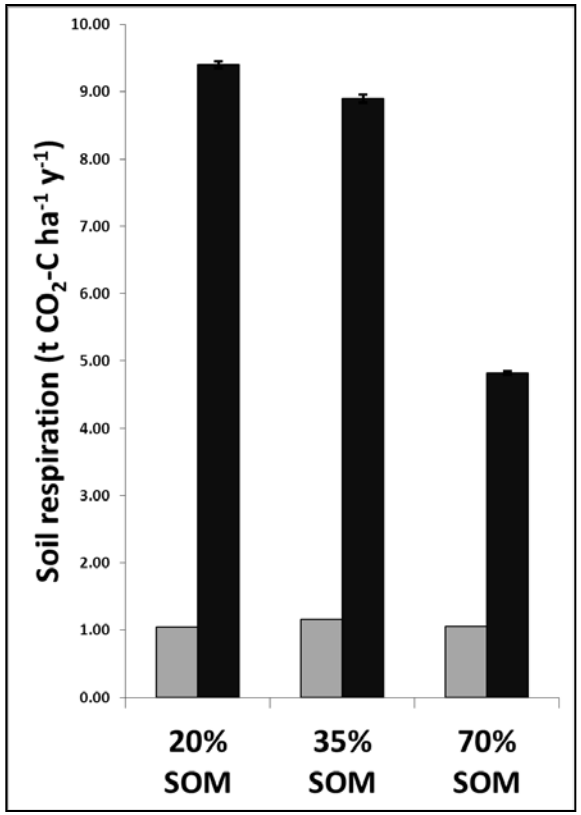
Experimentally measured values (Jan 2012):
pH
Bulk density
SOC
Initial soil nitrate
Initial soil ammonium

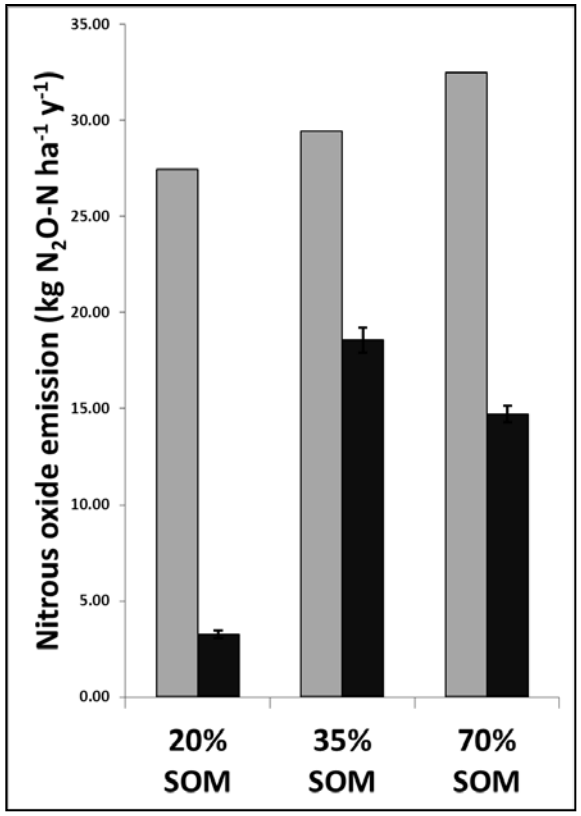
Farm operational data provided by FMs:
Tillage
Fertilisation
Irrigation
Plastic

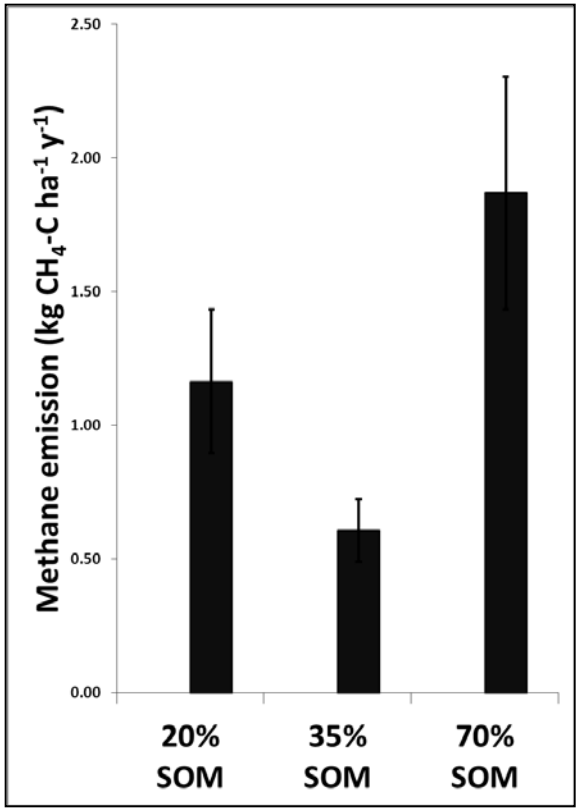
Crop data provided by Farm Managers

Results

Annual GHG budget

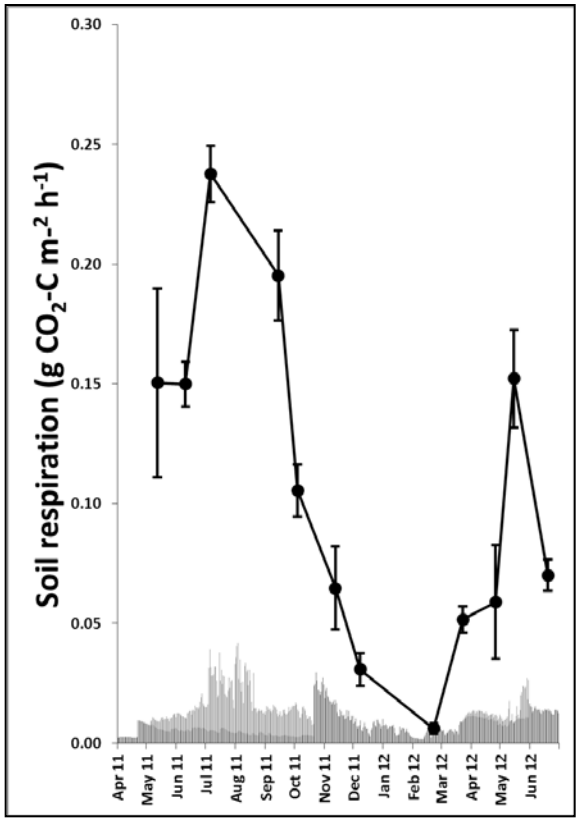




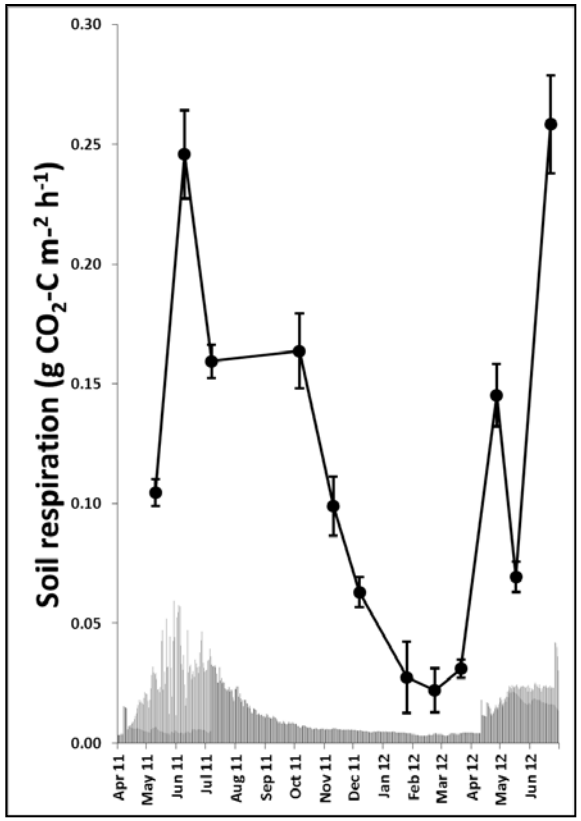


Modelled Measured

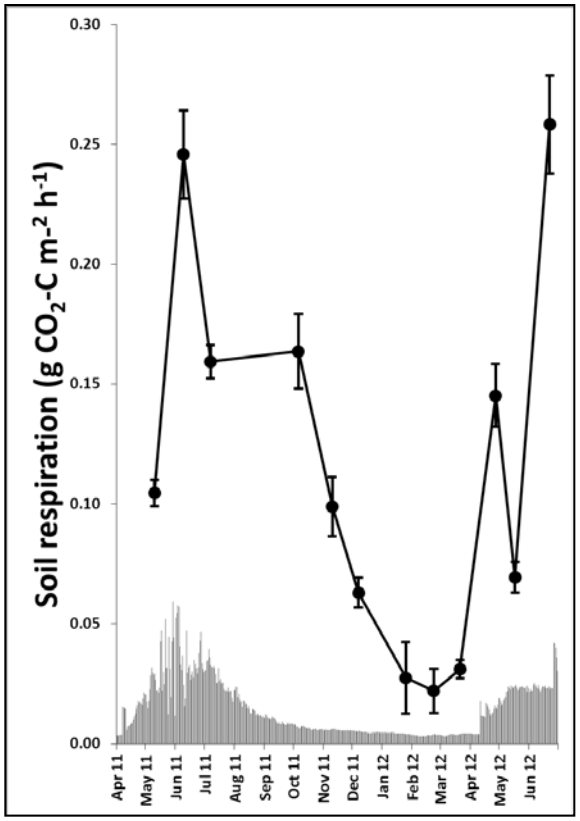
Seasonal soil respiration



20% SOM

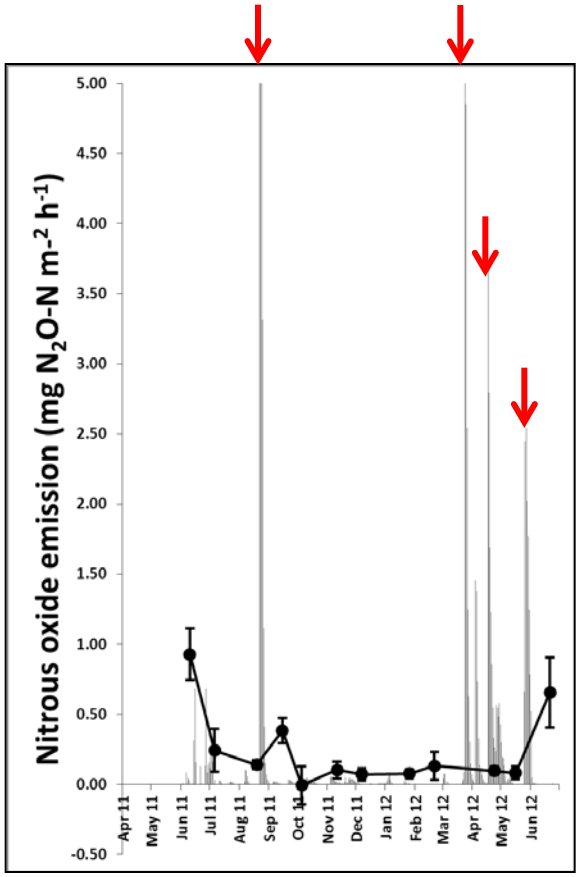


35% SOM



70% SOM

Seasonal nitrous oxide emission



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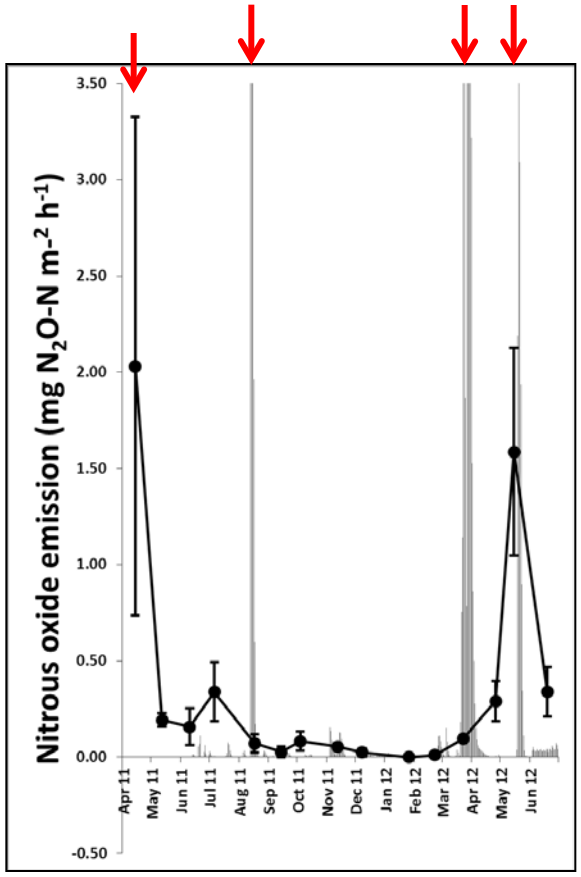

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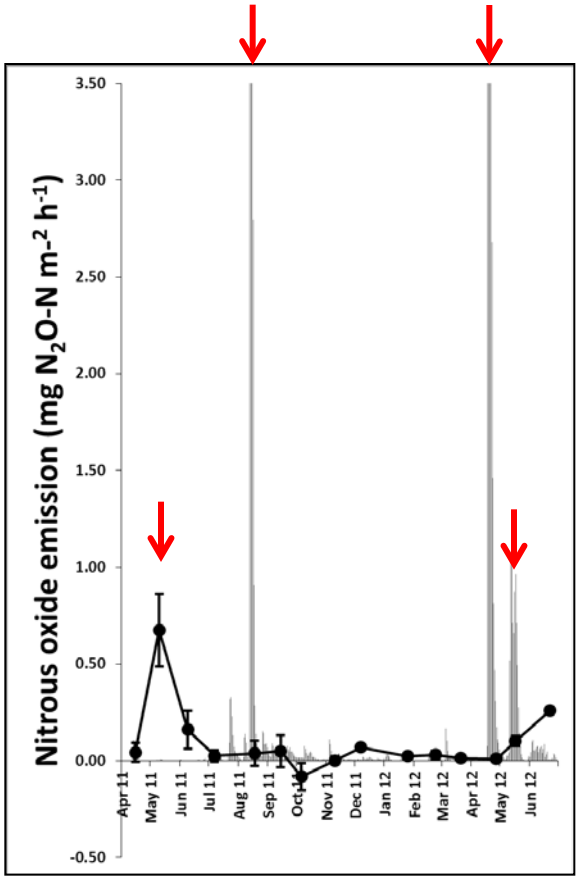
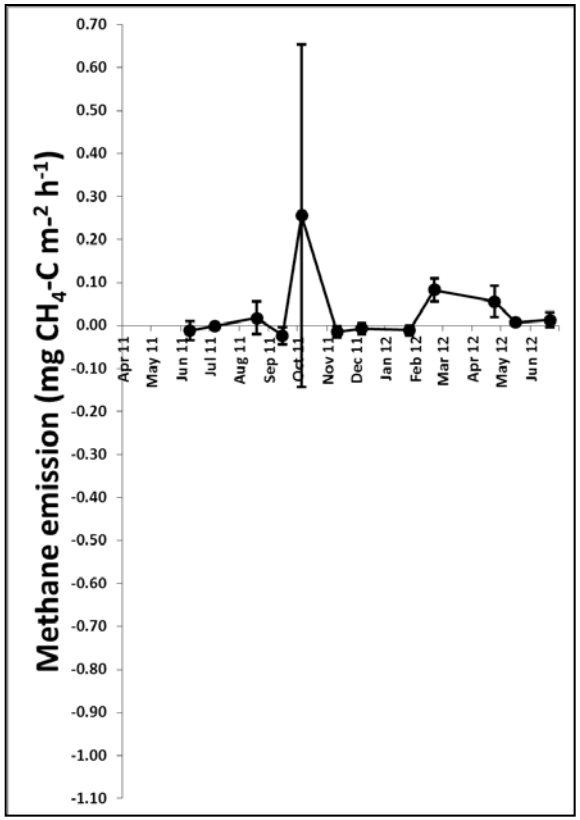


70% SOM

Seasonal methane emission



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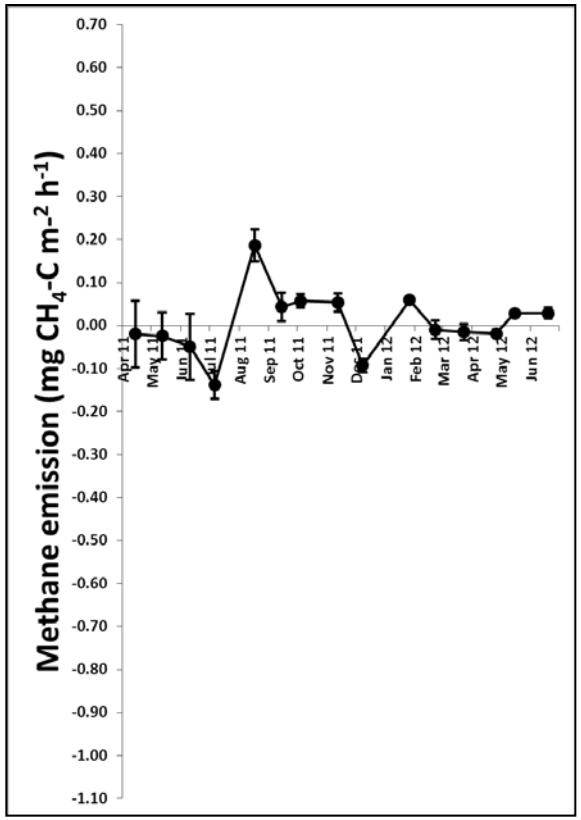

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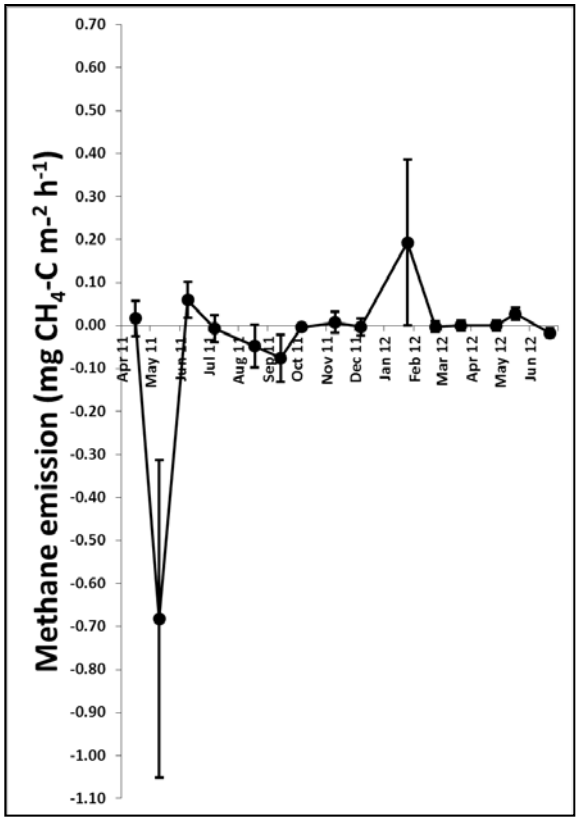
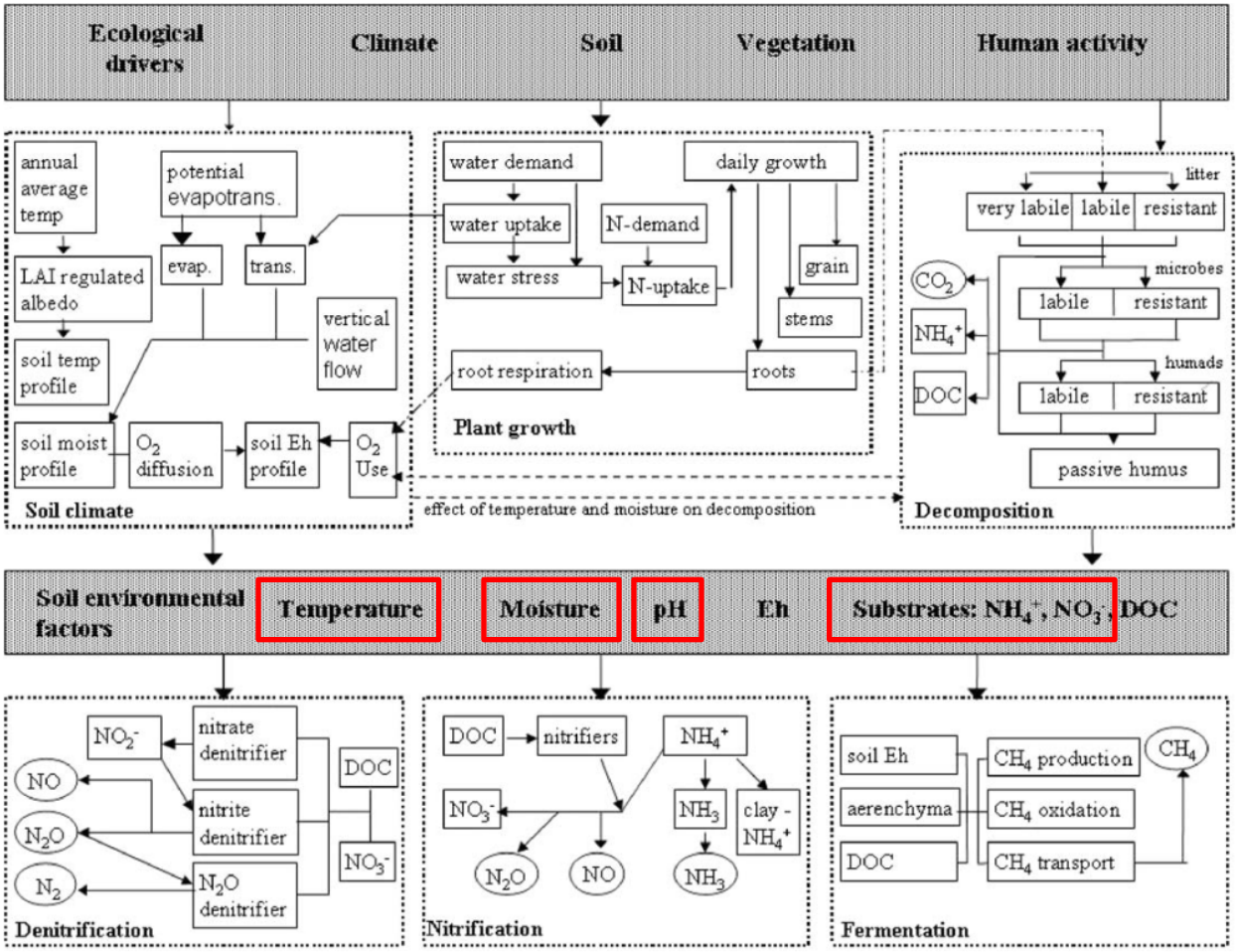


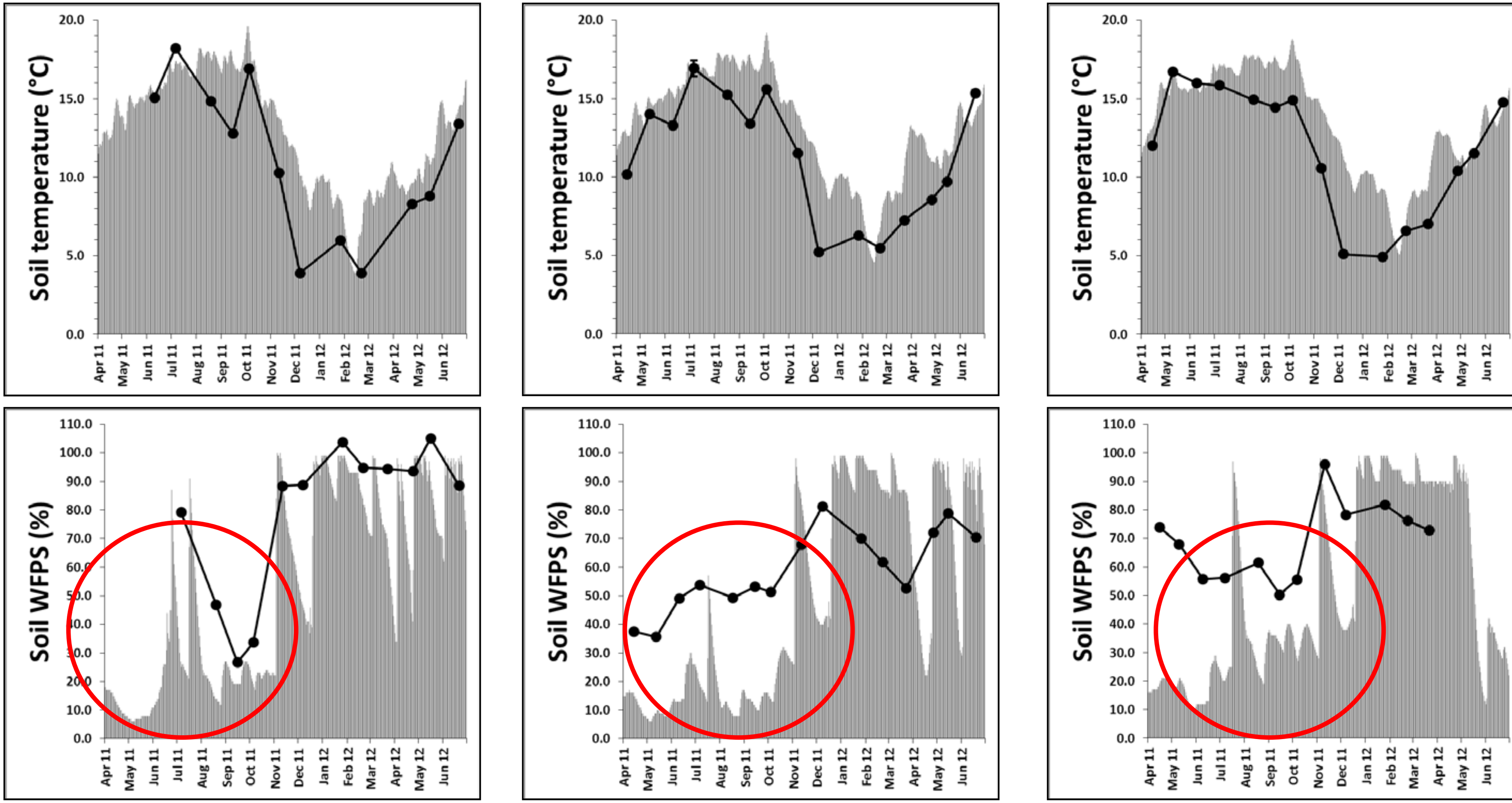
70% SOM

DNDC 95 sub-models



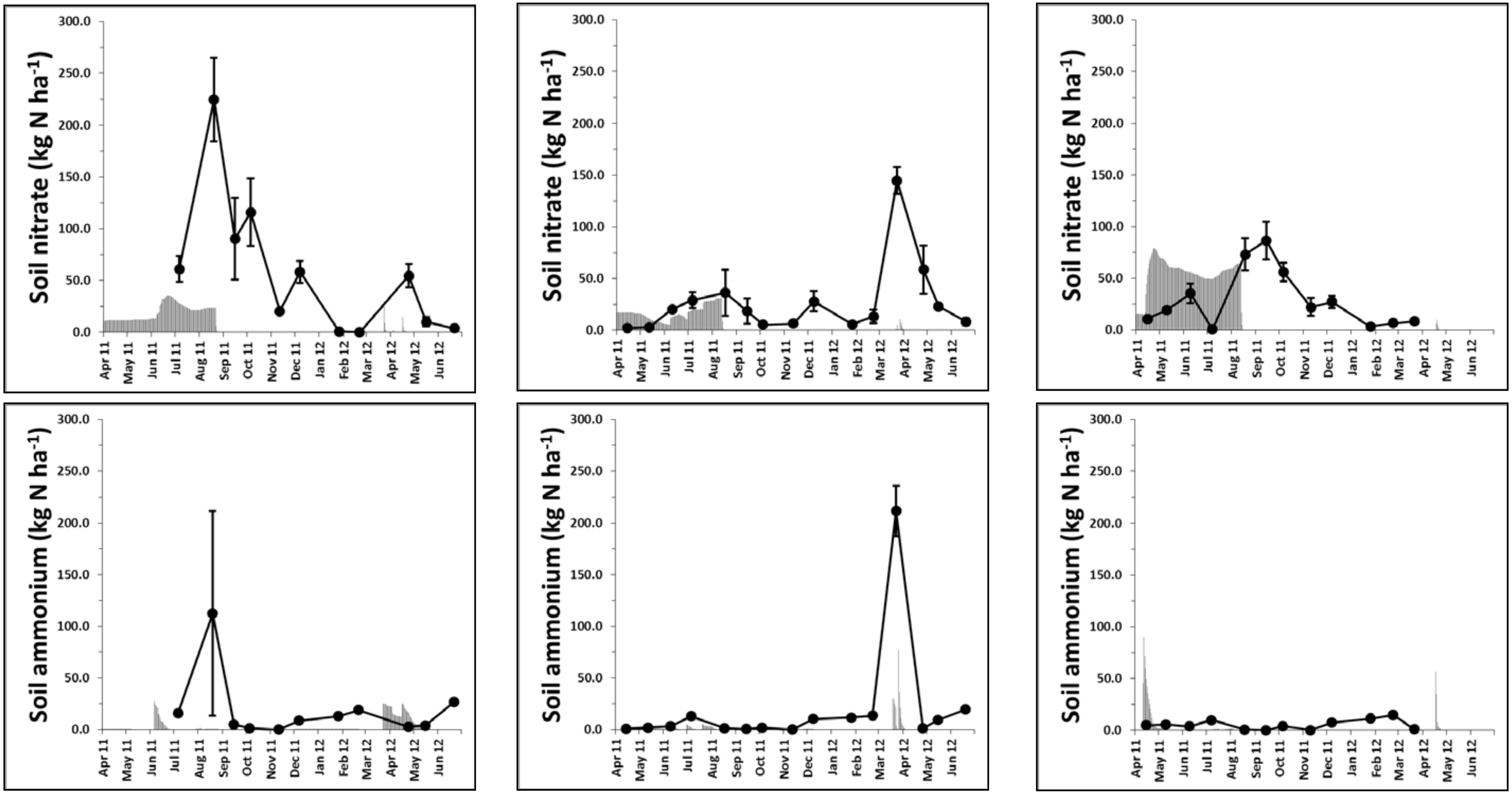
Giltrap, D. L. *et al*. (2010). "DNDC: A process-based model of greenhouse gas fluxes from agricultural soils." Agriculture Ecosystems & Environment **136(3-4): 292-300.**

Sub-models: Temperature, moisture



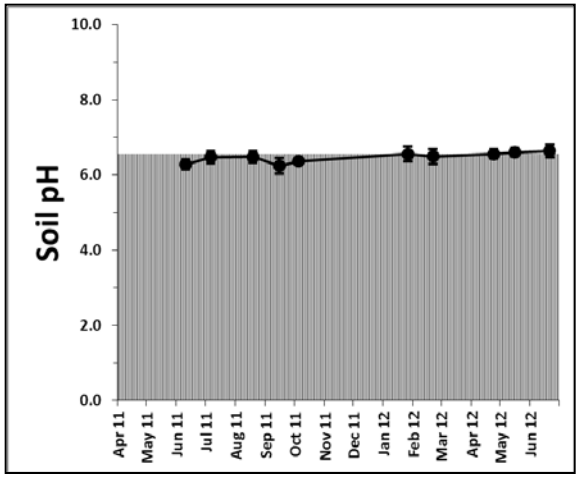
20% SOM **35% SOM** **70% SOM**

Sub-models: Nitrate, ammonium



20% SOM **35% SOM** **70% SOM**

Sub-models: pH



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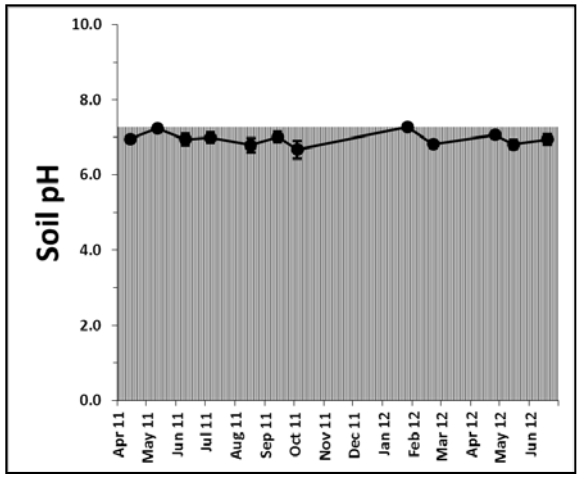

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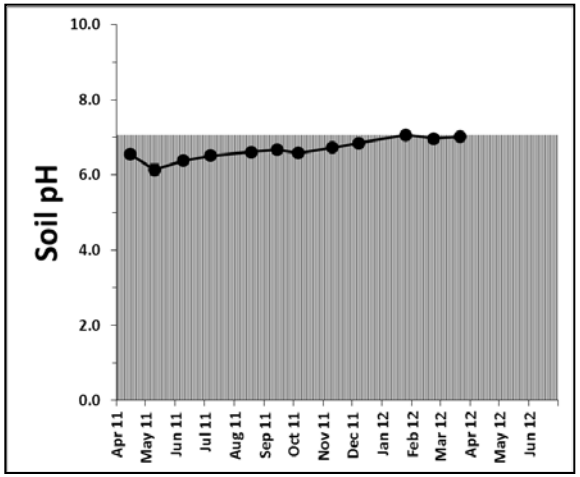

70% SOM

Summary

- Preliminary analysis suggests the modelled emissions do not correlate well with measured emissions
- Inputs sensitivity analysis is required
- Crop physiology may need adjusting for UK conditions
- Important for accurate GHG estimates
  - Sustainable soil management
  - National GHG inventorying

Thanks to…

- The late Prof. Gareth Edwards-Jones (Bangor University, Footprints 4 Food)
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Thanks for listening! 谢谢