Modelling and evaluation of forest ecosystem responses to elevated CO_2 using land surface process models

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Ariennir yn Rhannol gan Lywodraeth Cymru
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Introduction

- Under current climate model predictions CO_2 levels are set to reach ~580 ppm by 2050

- Forest NPP could increase up to 23% with ↑ C sequestration in vegetation and soil pools (Norby *et al.* 2005)

- Data collected during the Bangor Free Air CO_2 Enrichment (BangorFACE) experiment used to evaluate model predictions of broadleaf tree C dynamics under ambient and elevated CO_2 enrichment

Introduction

- BangorFACE used 3 native tree species

Alder
(*Alnus glutinosa*)

Silver birch
(*Betula pendula*)

Beech
(*Fagus sylvatica*)

Introduction

- Saplings planted in monoculture and mixtures

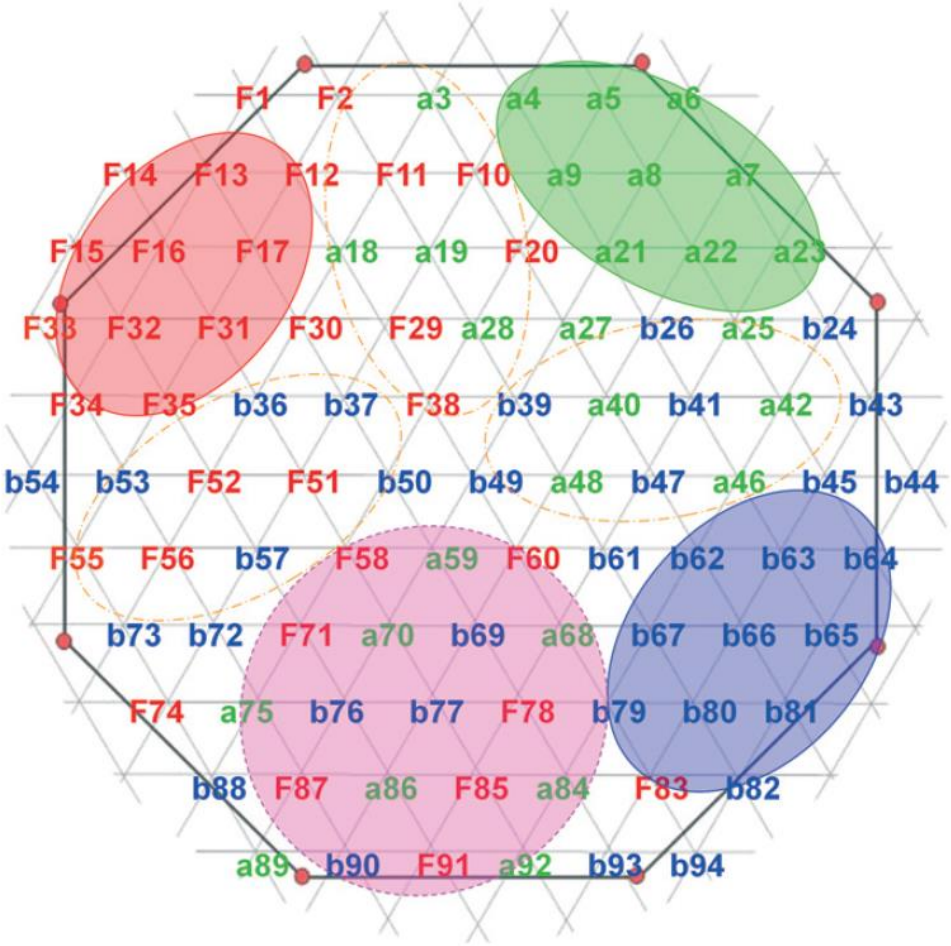
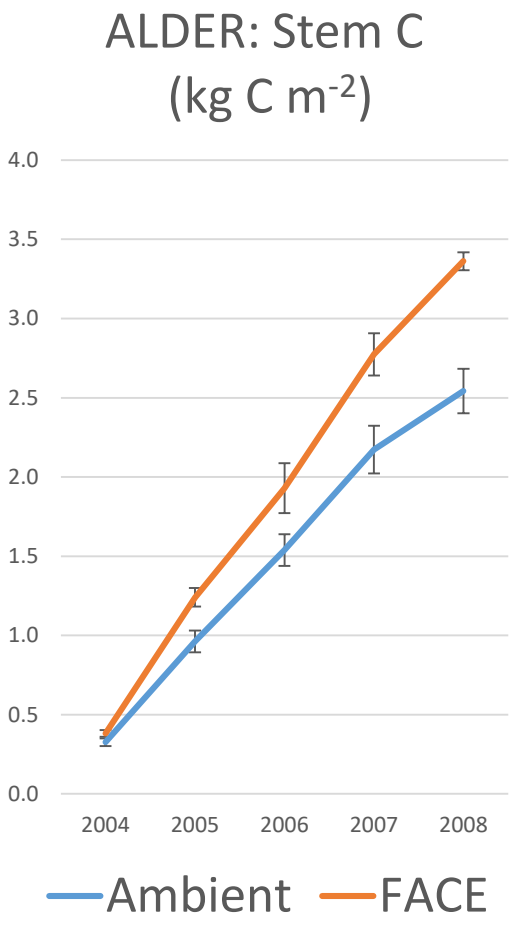
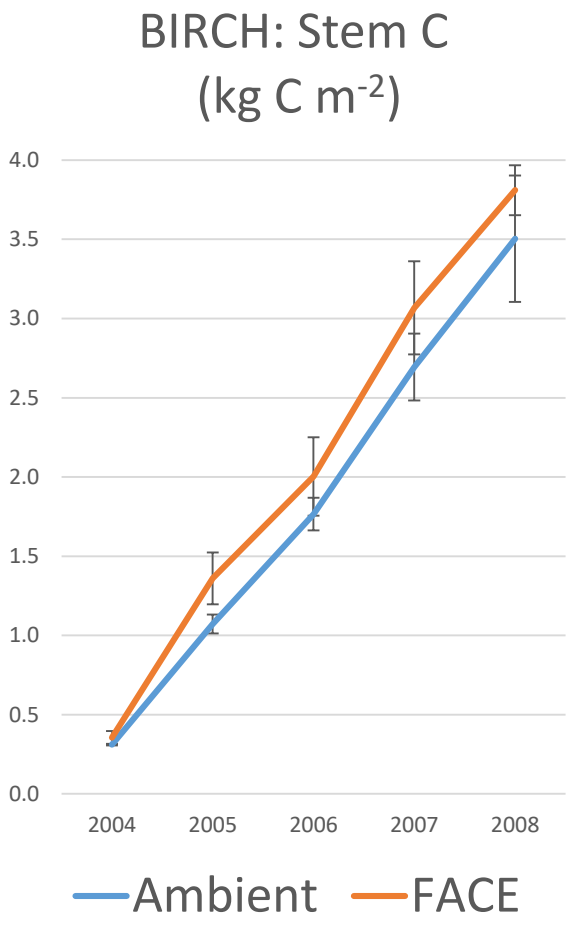


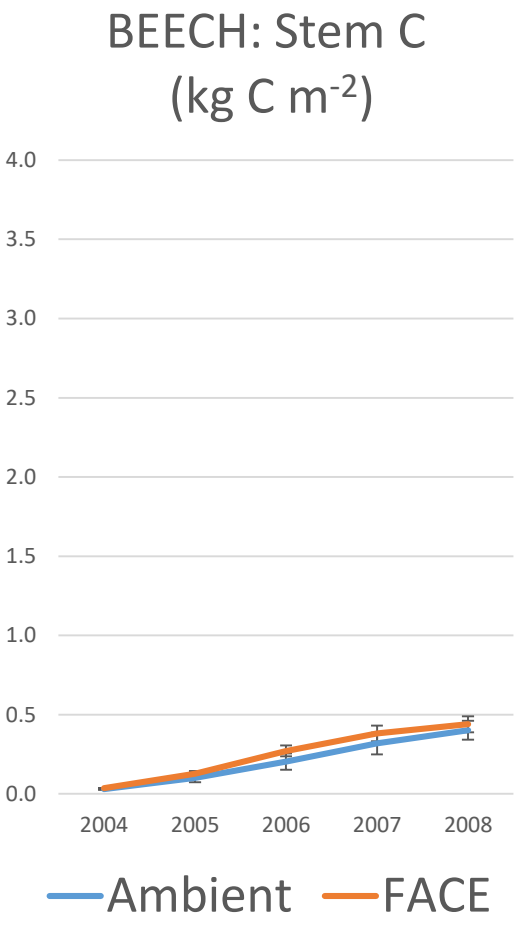
Fig. 1 Layout of ambient and elevated CO_2 plots; a, *Alnus glutinosa*; b, *Betula pendula*; F, *Fagus sylvatica*. Each plot contains 27 trees per species. The monoculture species area is indicated by a solid lined oval and the three-species polyculture plot is indicated by a dot-dashed line oval.

Results

- Elevated CO2 ↑ above-ground response in individual species

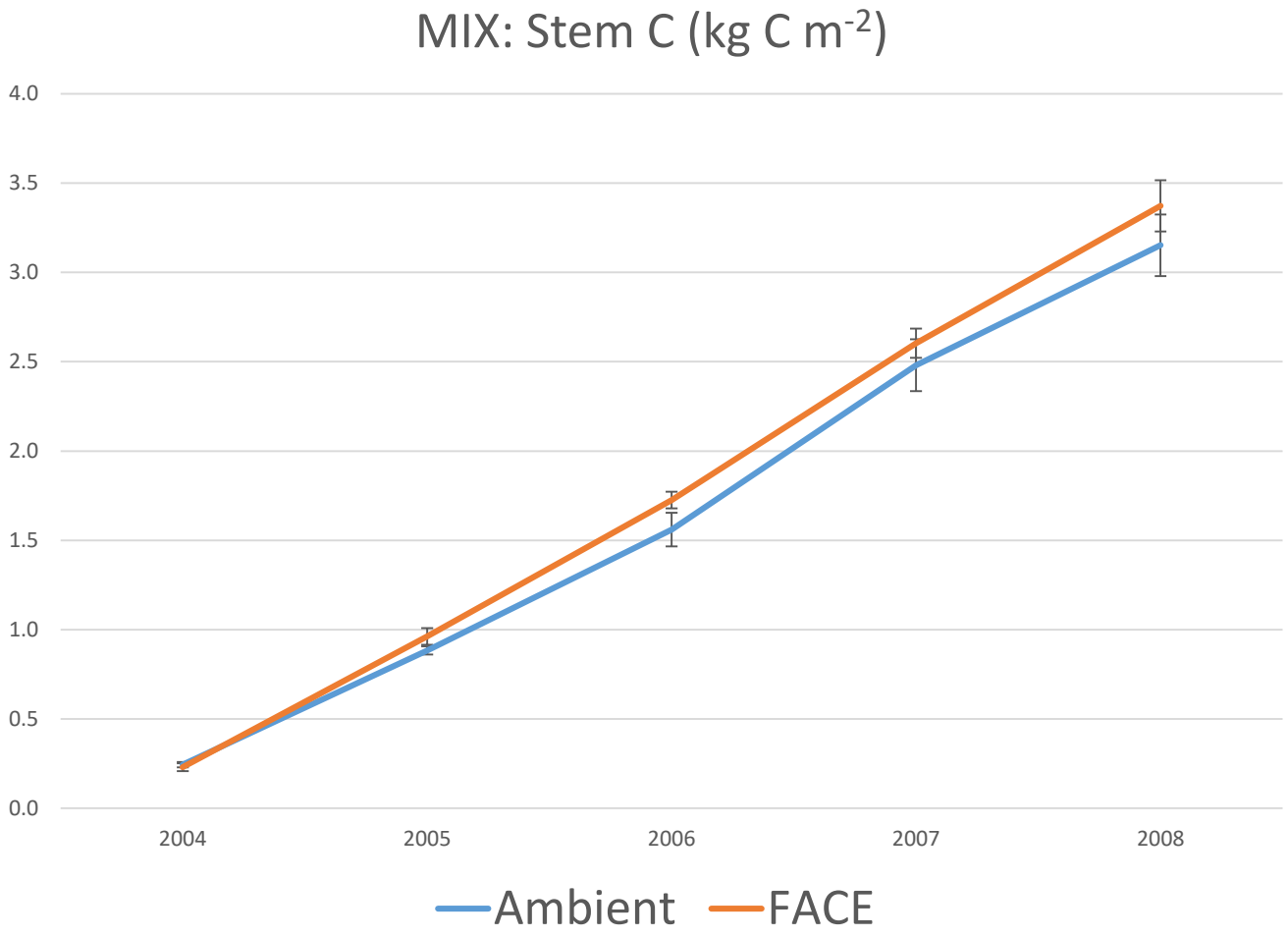






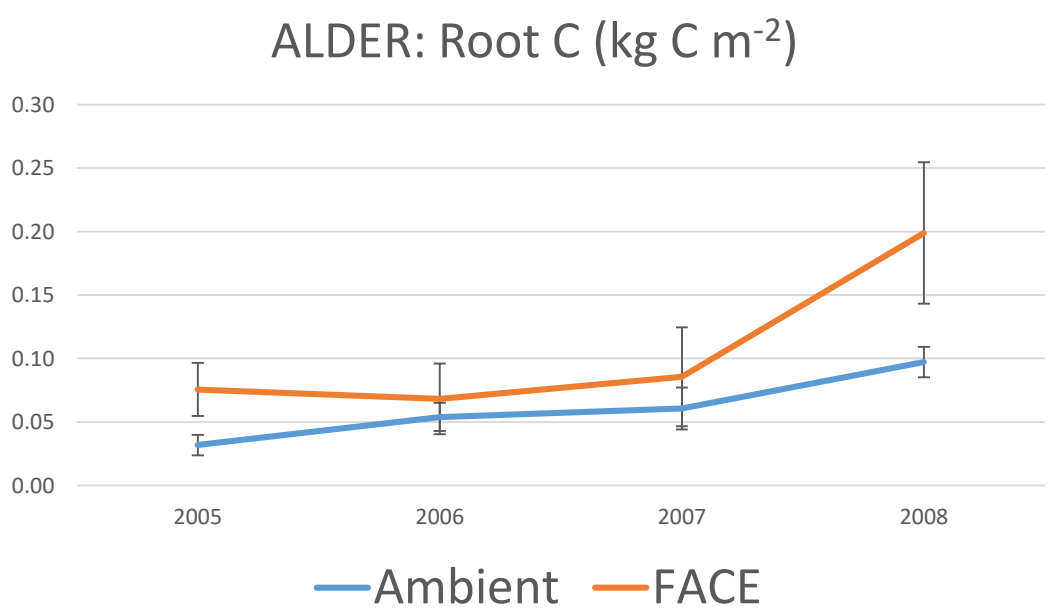
Results

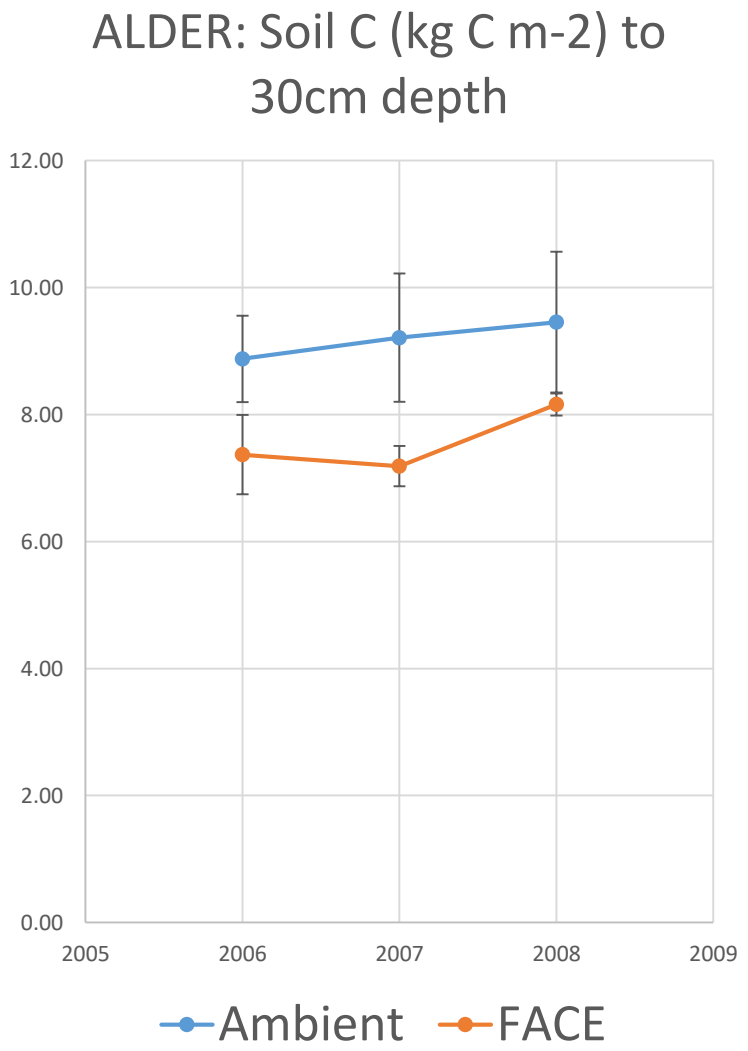
- Elevated CO2 ↑ above-ground response in mixed species



Results

- BUT C priming effects seen below-ground



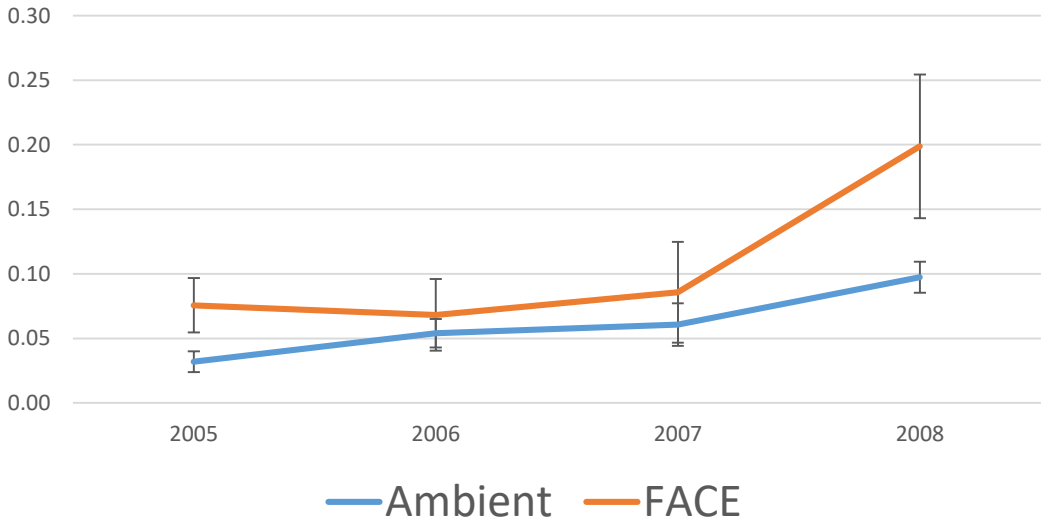


Results

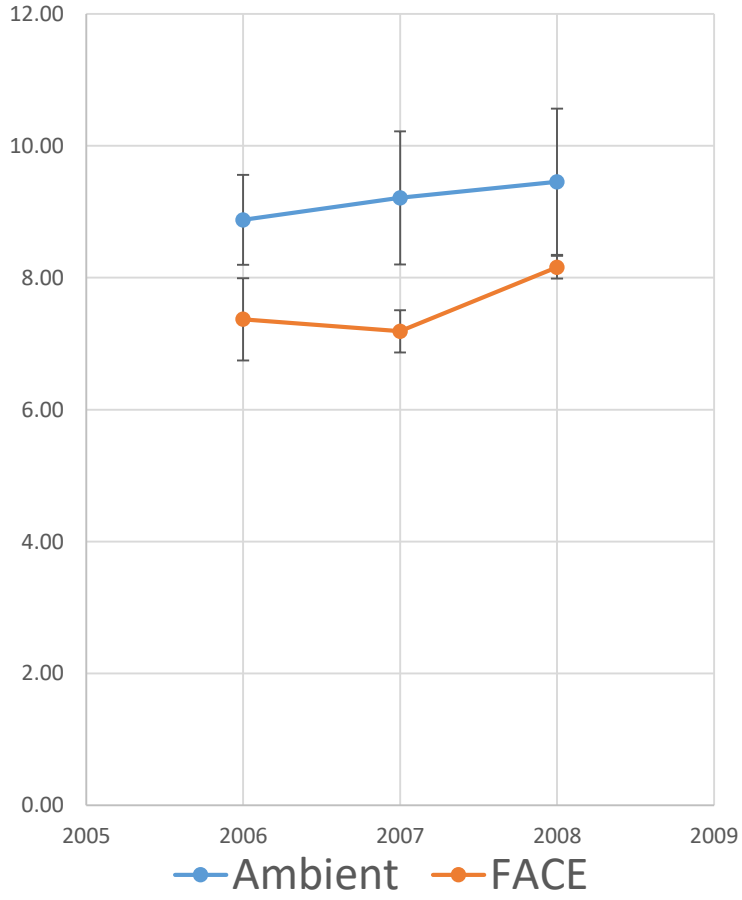
ELEVATED CO2

- ↑ root biomass
- ↑ rhizodeposition?
- ↑ in microbial biomass?
- ↑ SOM decomposition?
- ↓ in soil C

ALDER: Root C (kg C m^{-2})

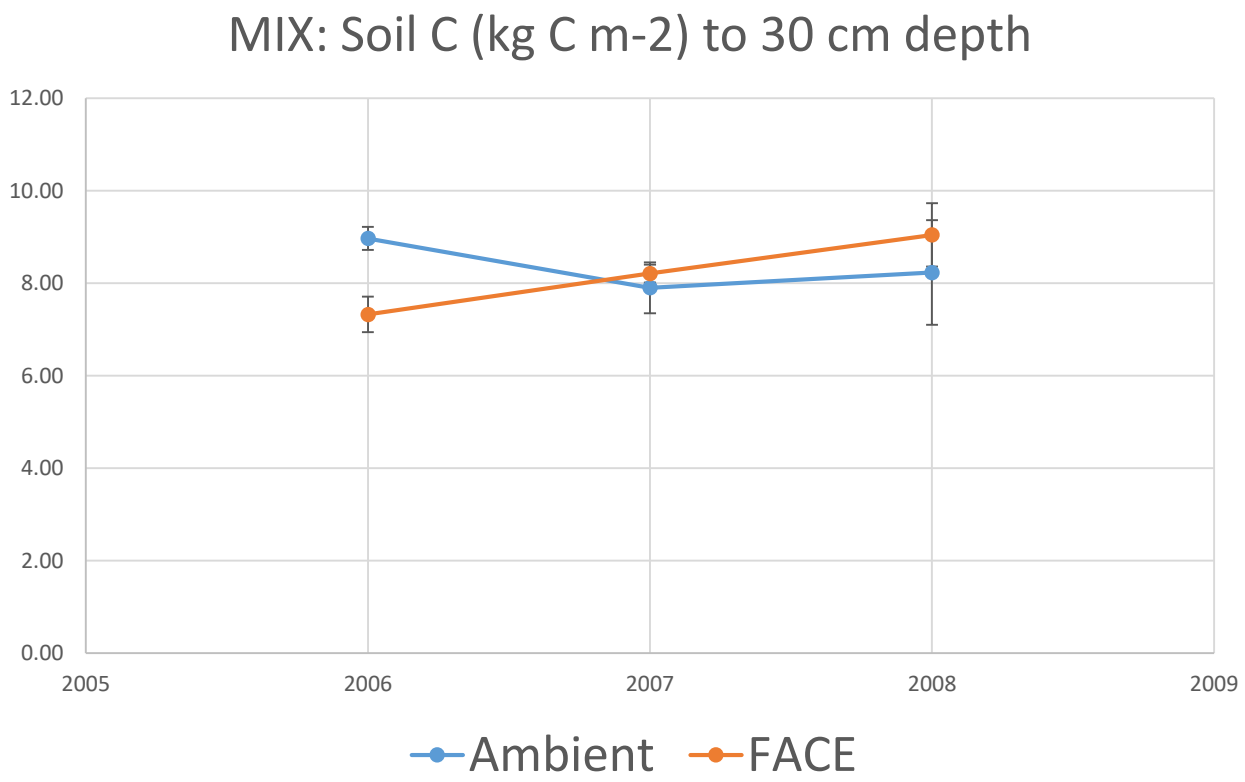


ALDER: Soil C (kg C m-2) to 30cm depth



Results

3 years after planting mixed saplings no longer showed priming effects



The challenge

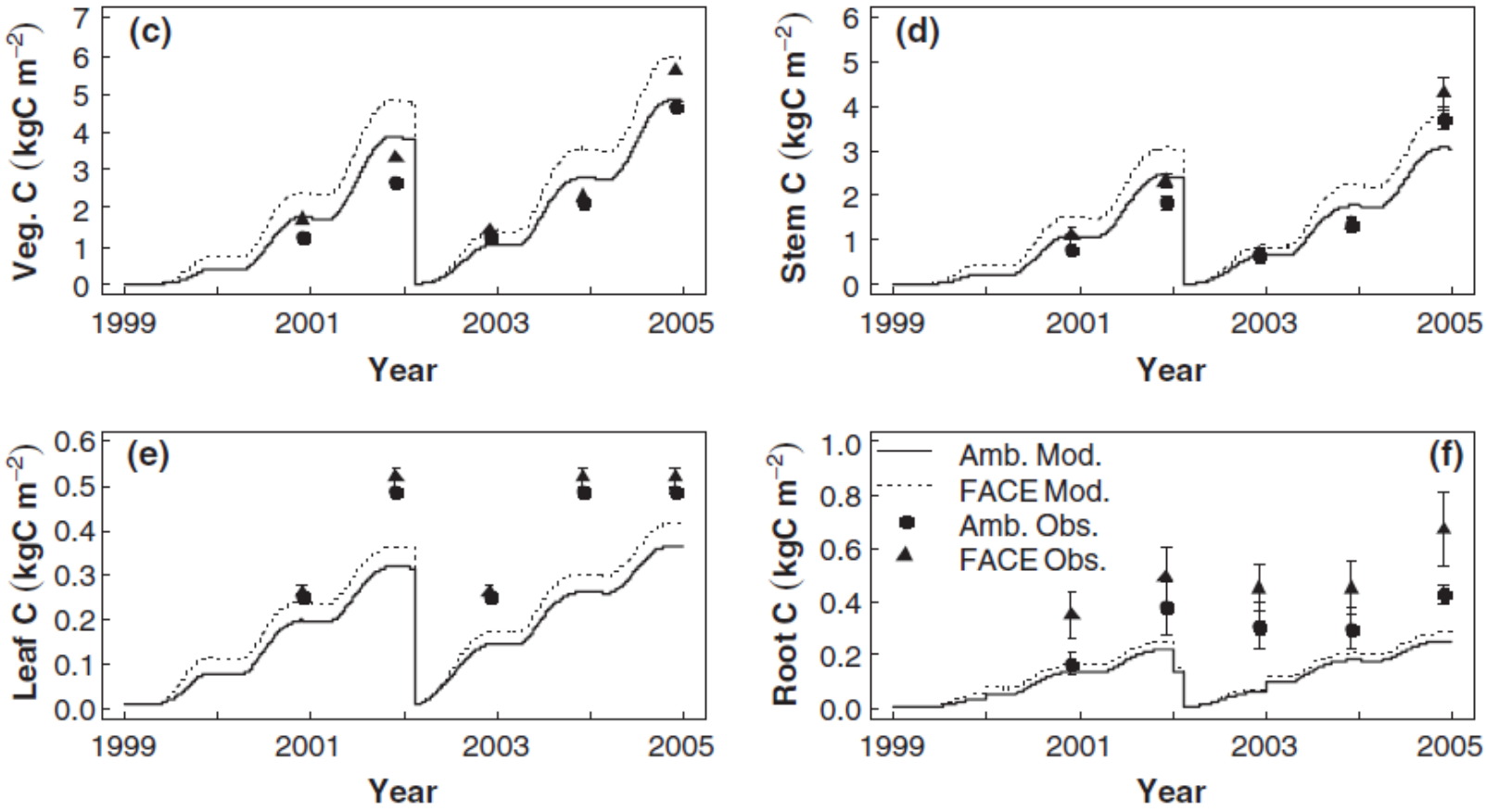
- Existing process based models do not accurately predict C allocation under elevated CO_2 conditions, particularly below-ground

- Parameterise JULES with BangorFACE data to predict changes in ecosystem C pools under ambient and elevated CO_2

- Compare model predictions with empirical data to test how well JULES does

The challenge

- Aim to produce paper similar to Oliver *et al.* 2015



Progress so far

- JULES set up on VM
- Adapting BiFoR (Birmingham institute of forest research) runs provided by Debbie Hemming
- Daily meteorological and LAI data used to drive model
- Output available soon – fingers crossed!

Multi-Land

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Any questions

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