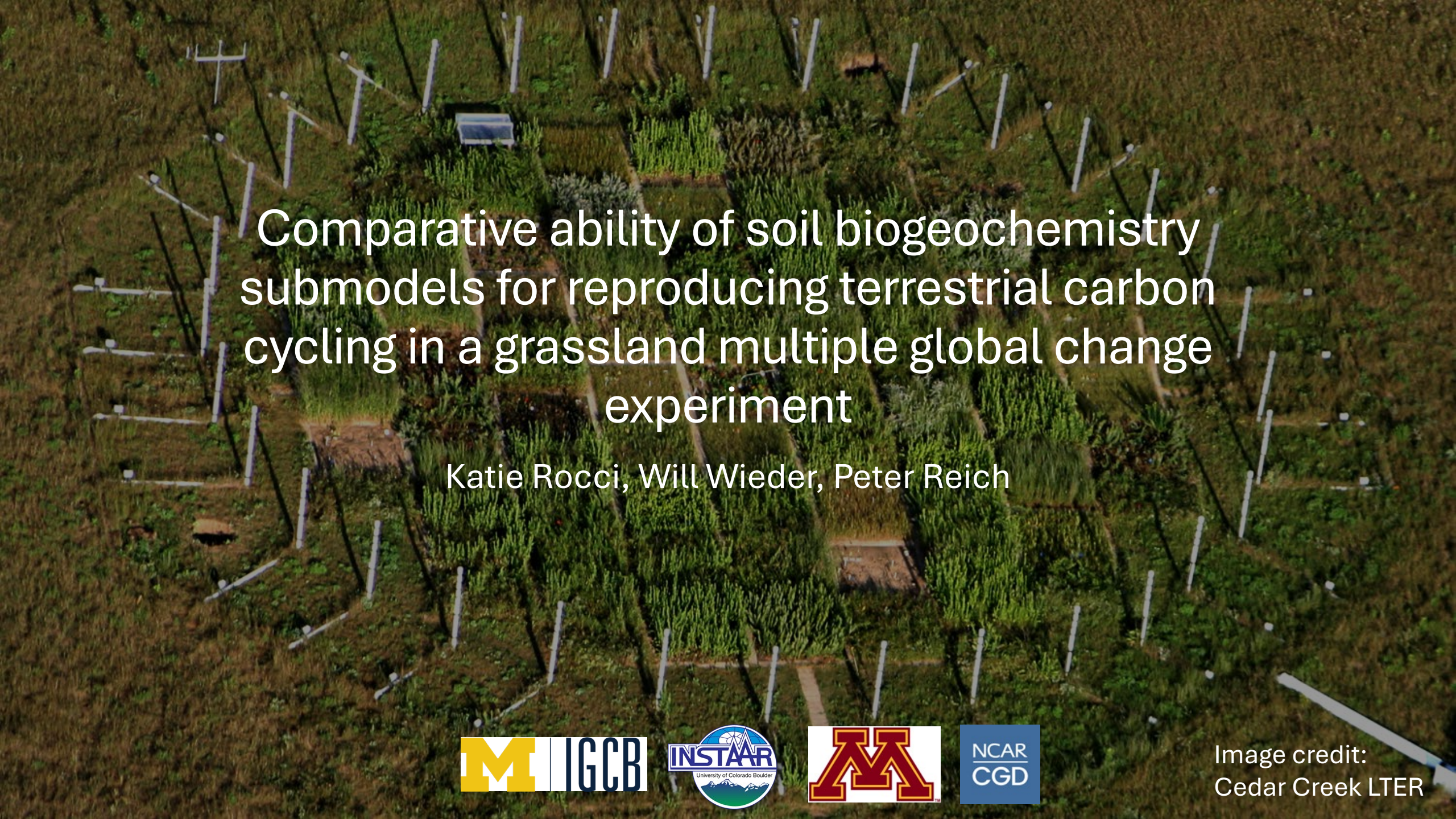


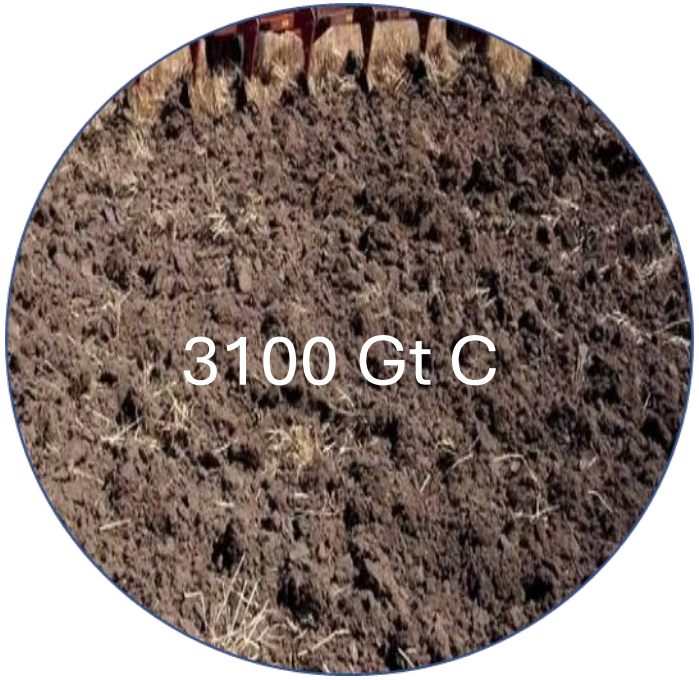
Comparative ability of soil biogeochemistry submodels for reproducing terrestrial carbon cycling in a grassland multiple global change experiment

Katie Rocci, Will Wieder, Peter Reich

Image credit:
Cedar Creek LTER

Why represent soil BGC mechanisms in ESMs?

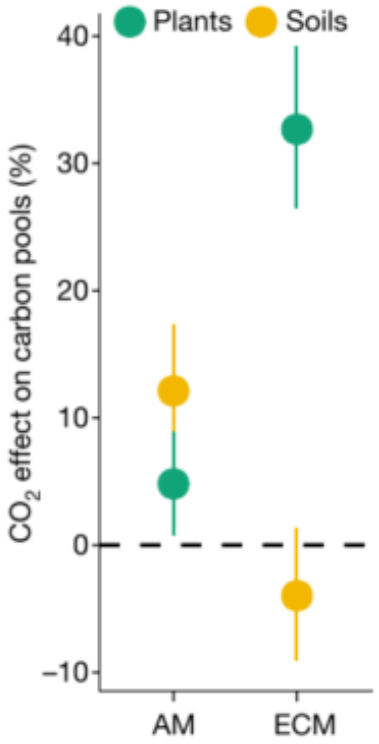
Soils are a quantitatively important contribution to the global C cycle



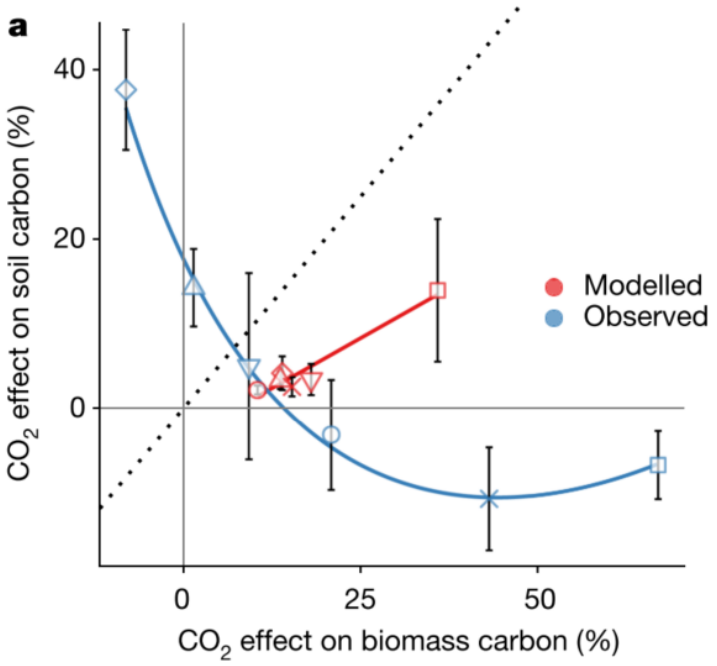
Friedlingstein et al., 2025

Why represent soil BGC mechanisms in ESMs?

Representing soil BGC mechanisms can change answers

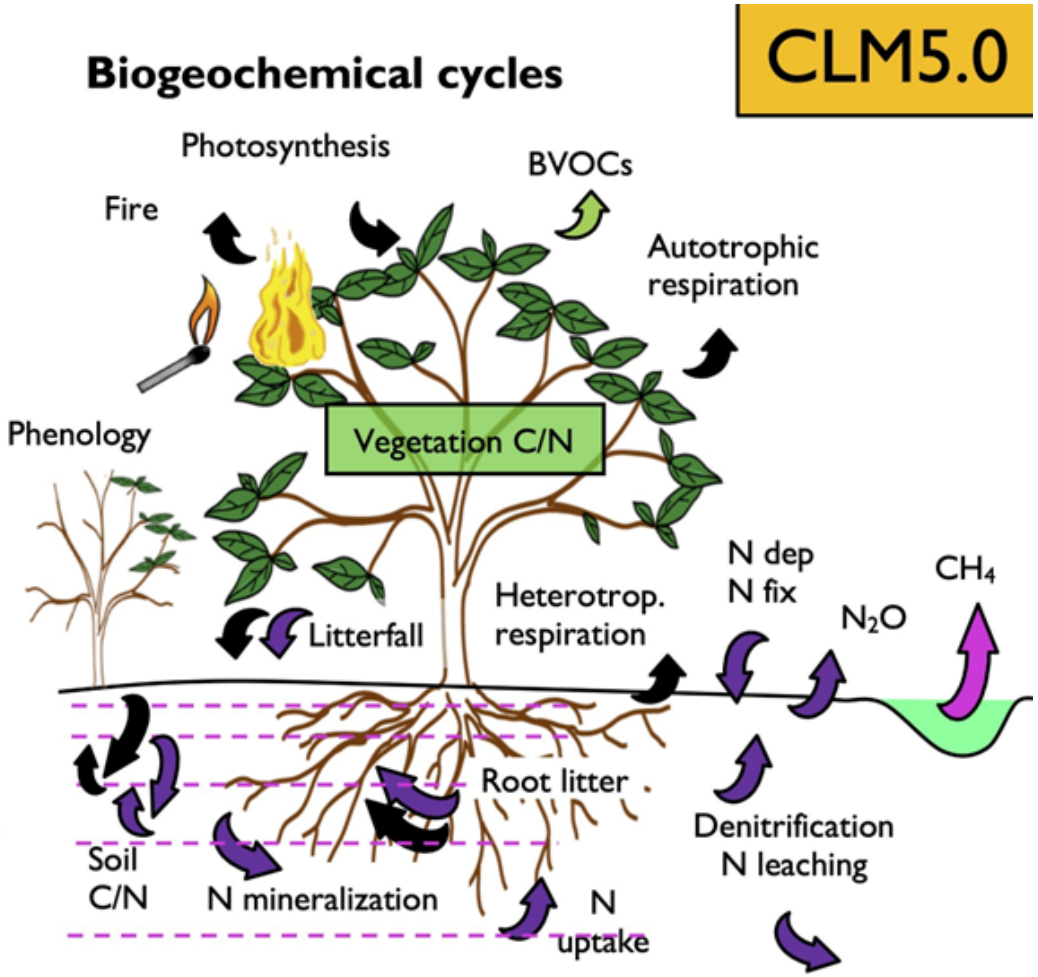


Some of these mechanisms are not currently well-represented in models

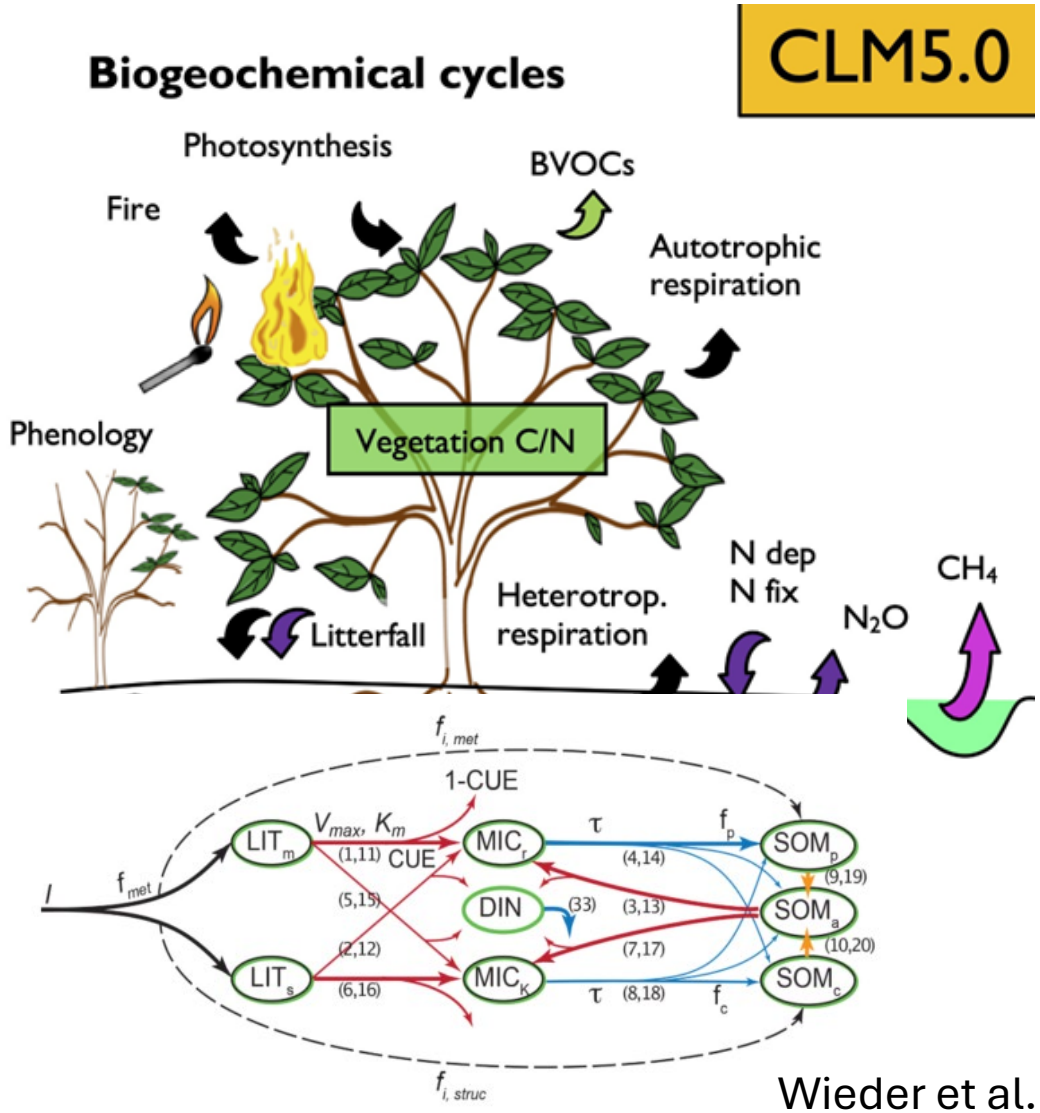


Terrer et al., 2021

We have the ability to assess soil BGC in CLM5



"CLM-Century"



"CLM-MIMICS"

Wieder et al., 2015
Lawrence et al., 2019

Taking advantage of a multifactor global change experiment: TeRaCON

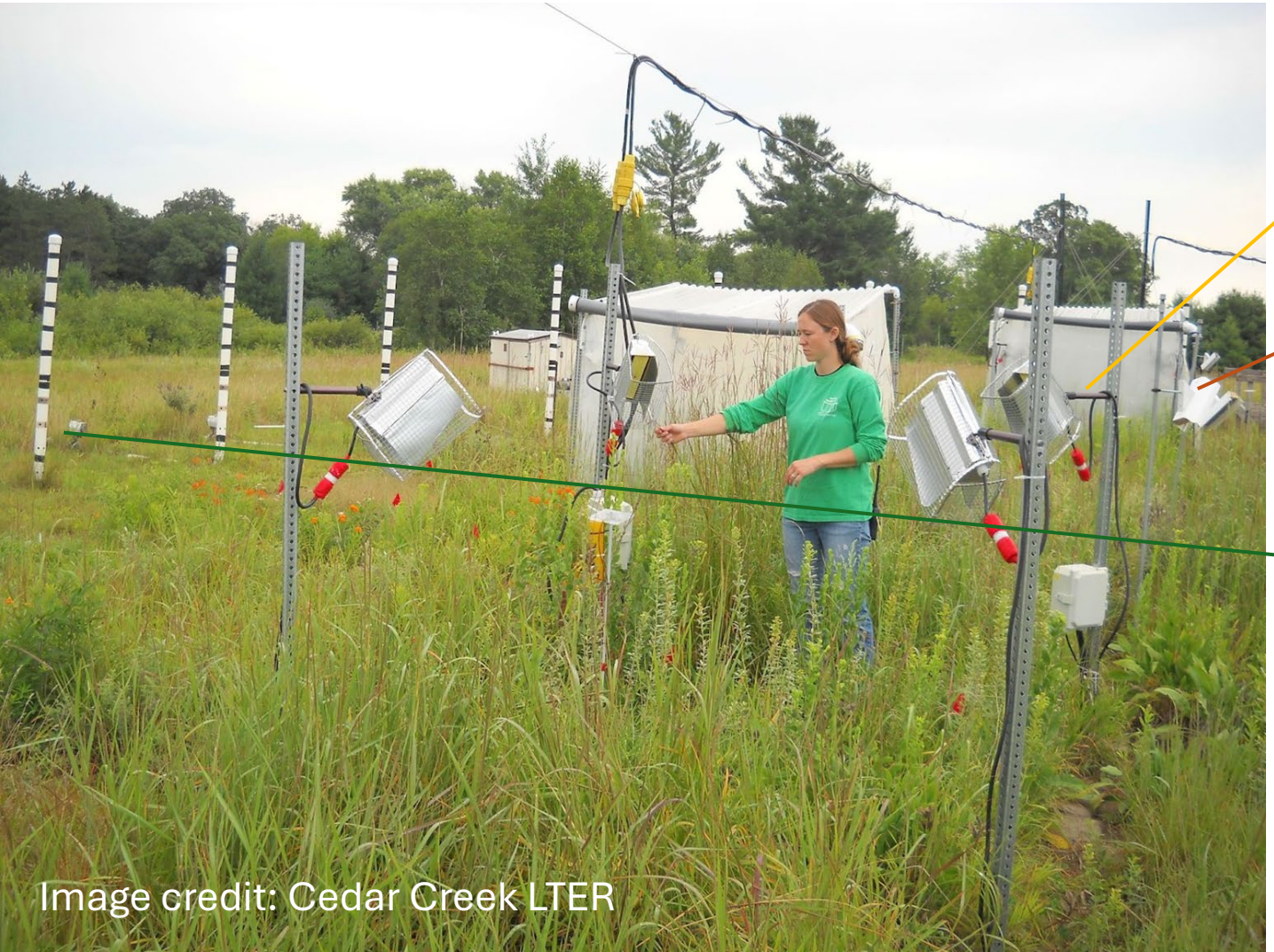


Image credit: Cedar Creek LTER

temperature

rainfall reduction

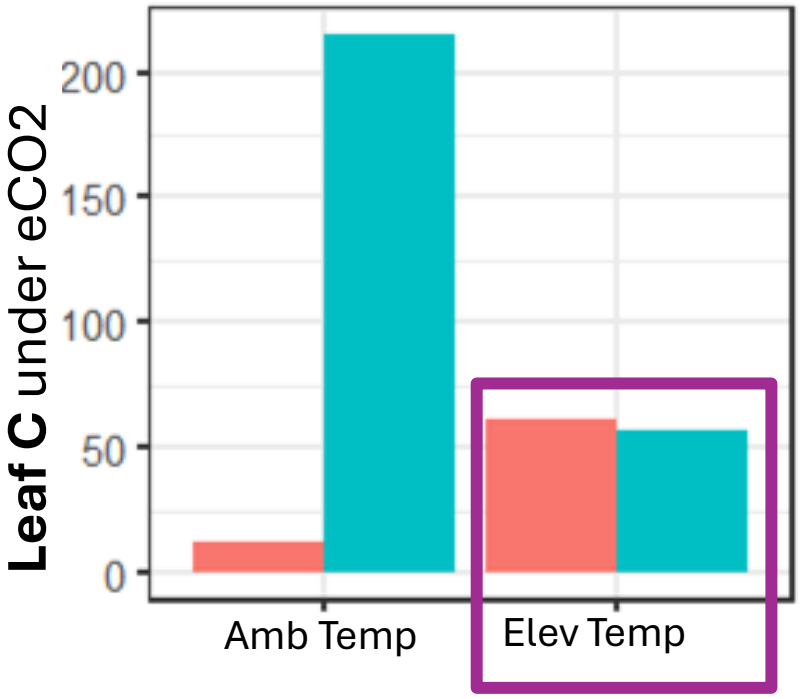
nitrogen addition

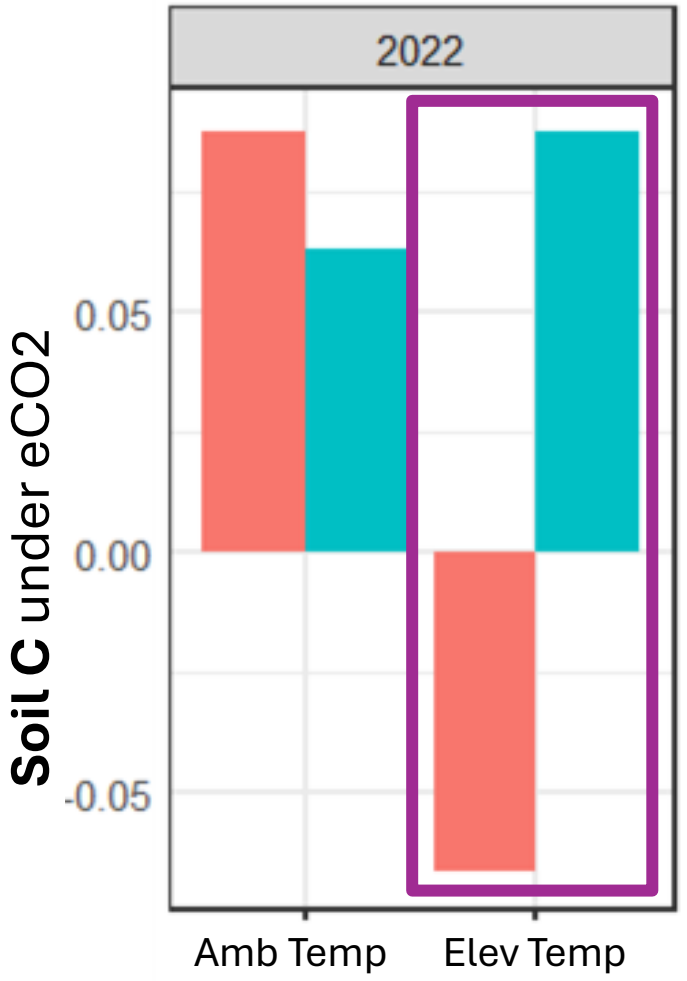
elevated CO2

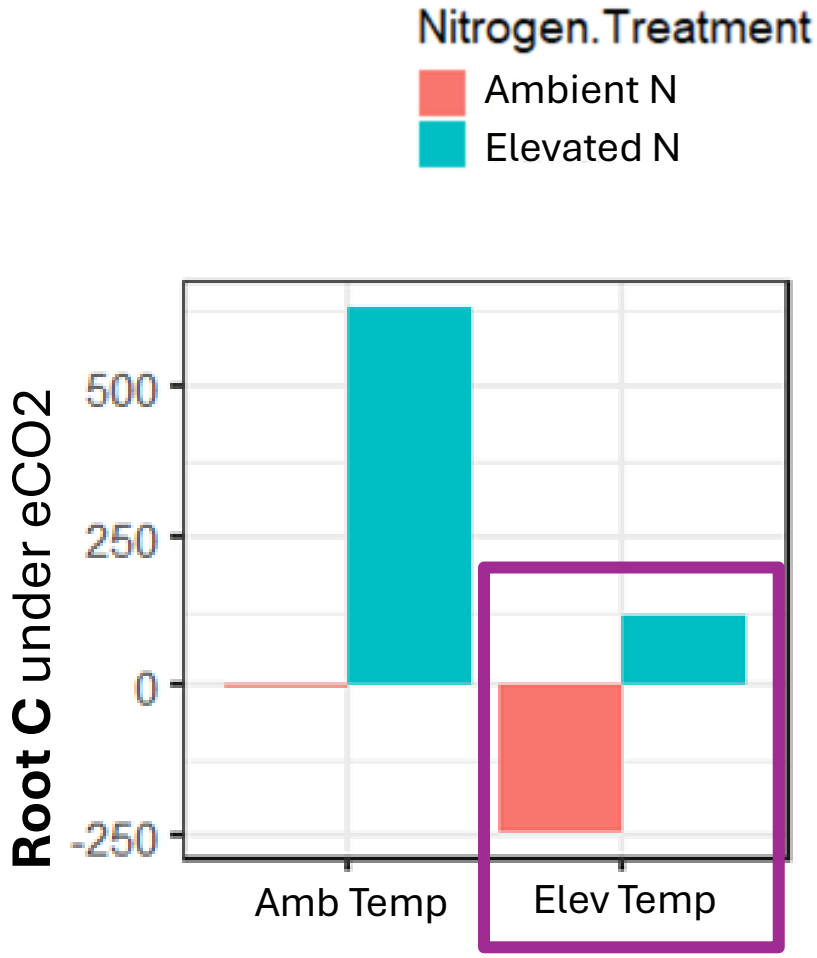
Initiated in tallgrass prairie in 2012

After 10 years, C cycle responses indicate potetnial soil biogeochemical mechanisms

Observational data



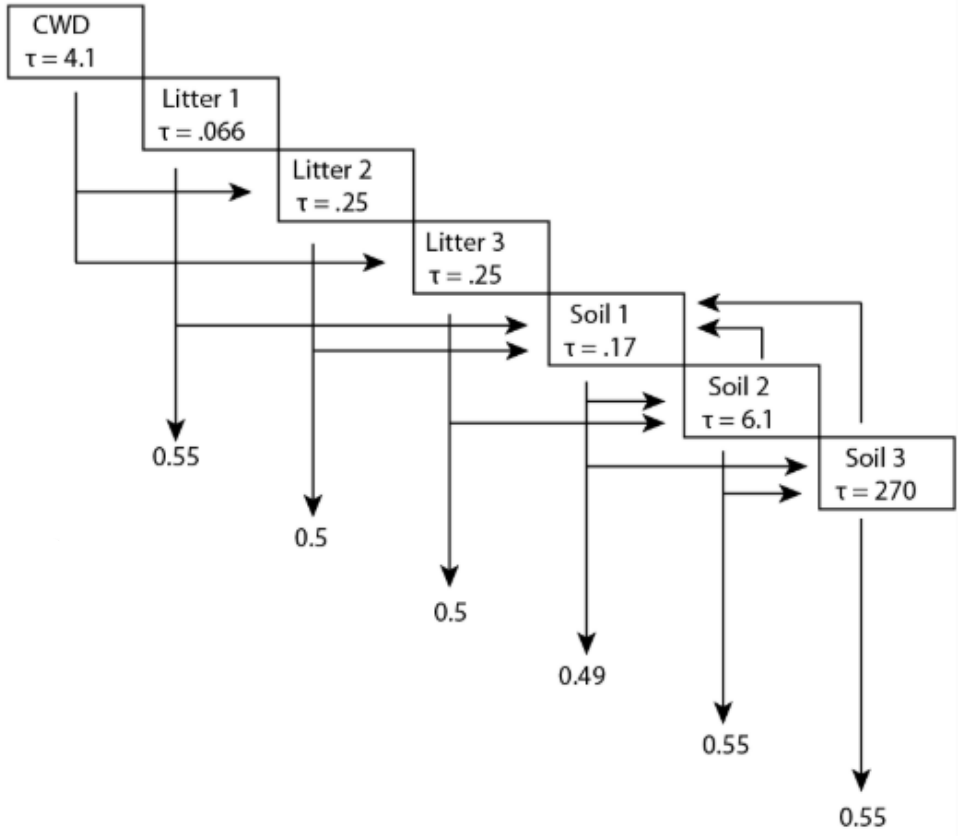




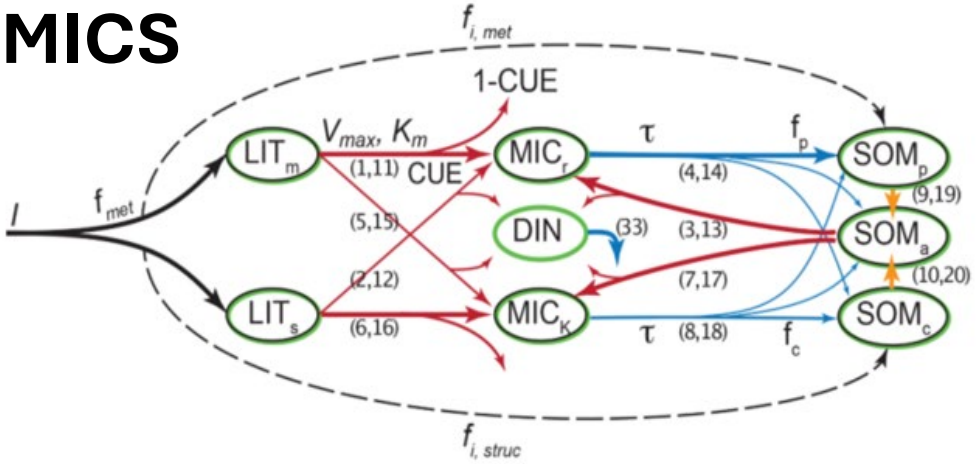
Does soil BGC alter global change responses?

Control, Warming, Elevated CO2, Warming x elevated CO2

CLM-**Century**



CLM-**MIMICS**

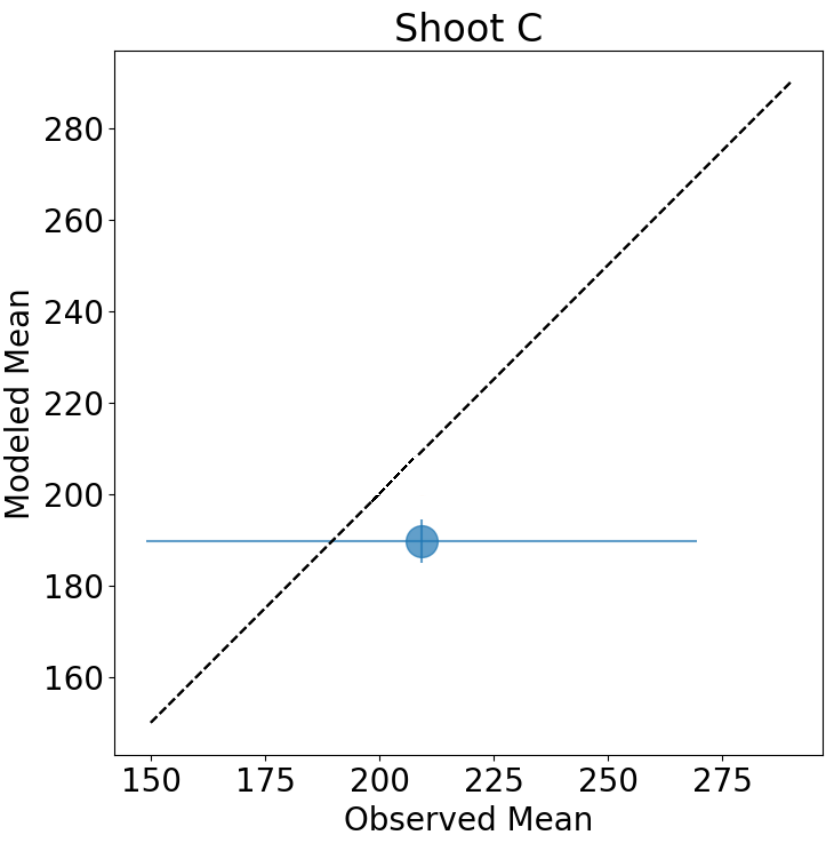


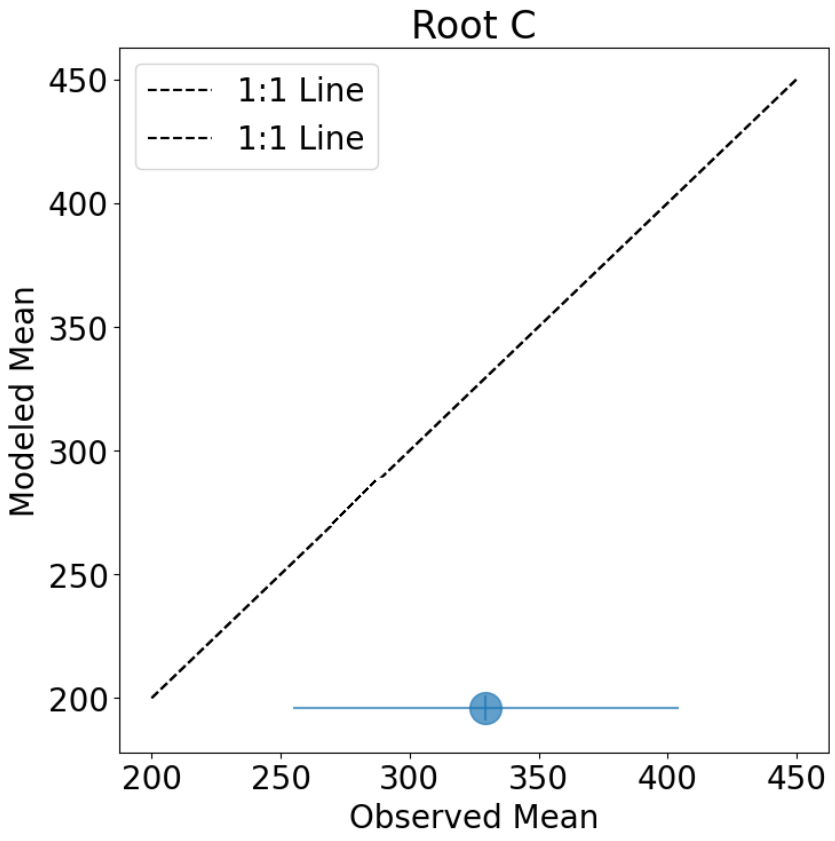
Different representations of soil biogeochemistry may allow for different global change responses

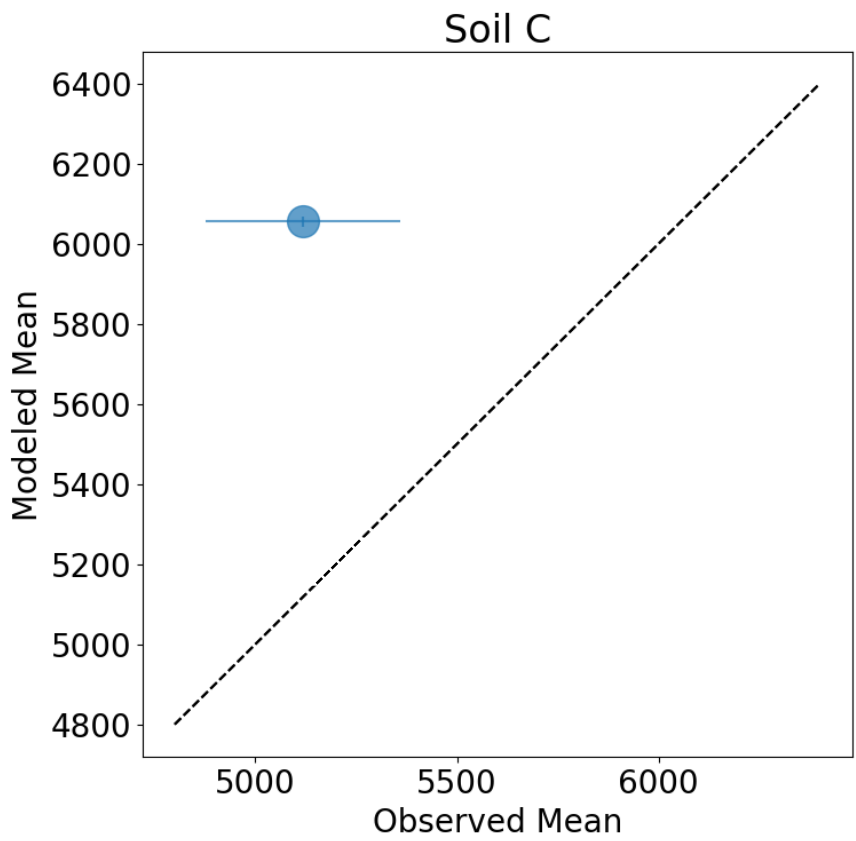
Calibrating CLM-Century

=default

=calibrated





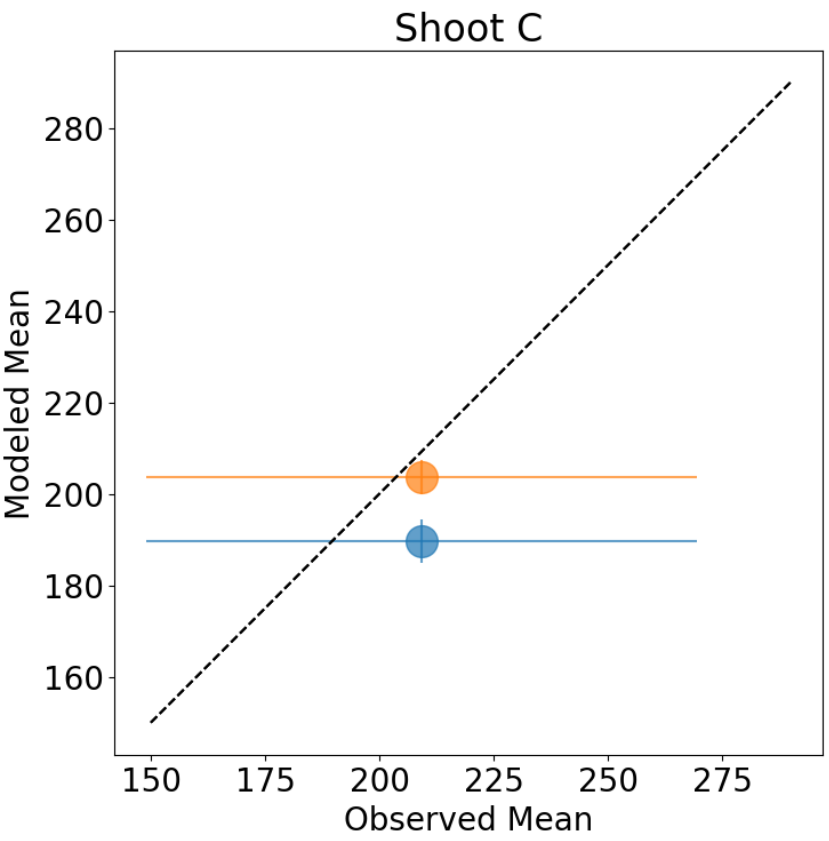


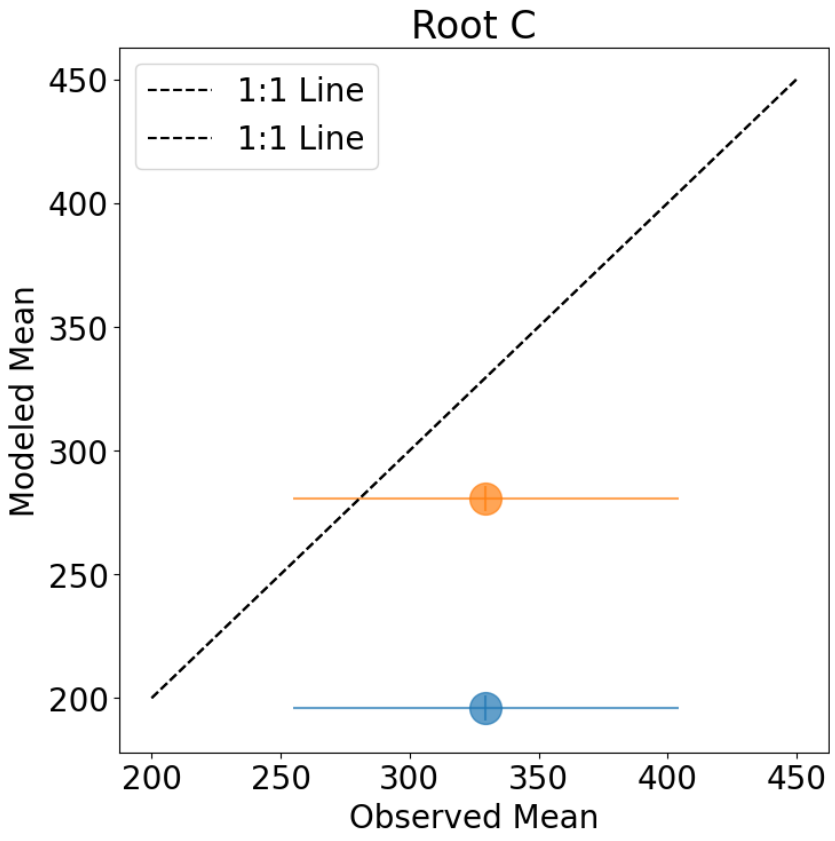
Calibrating CLM-Century

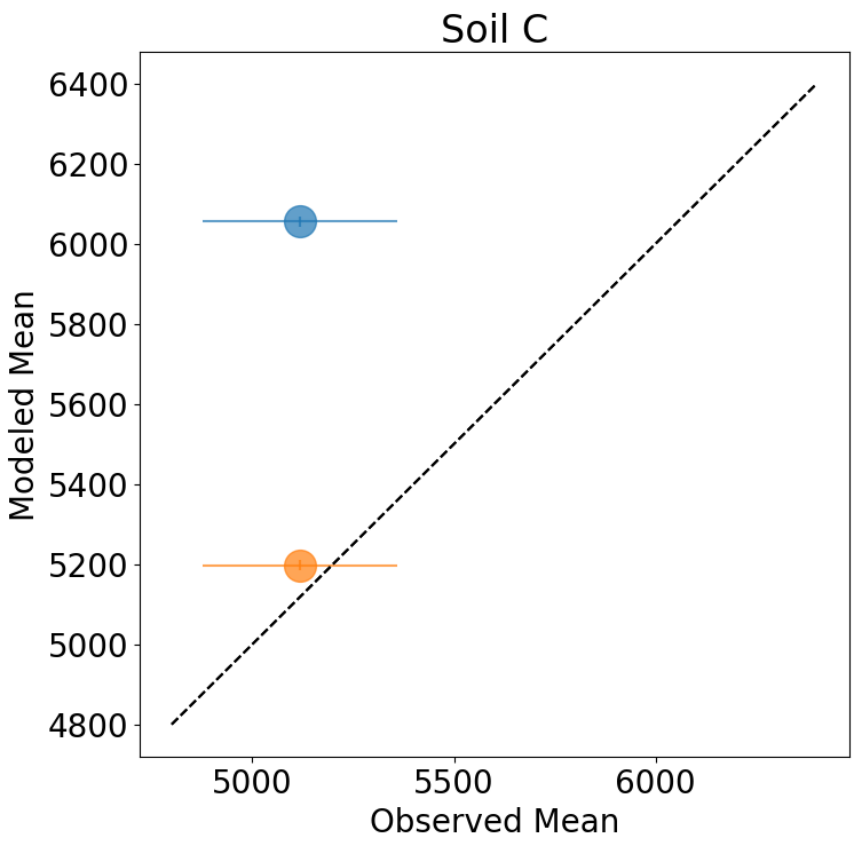
=default

=calibrated

Altered decomp rate, photosynthesis dependence on N, and root:shoot ratio



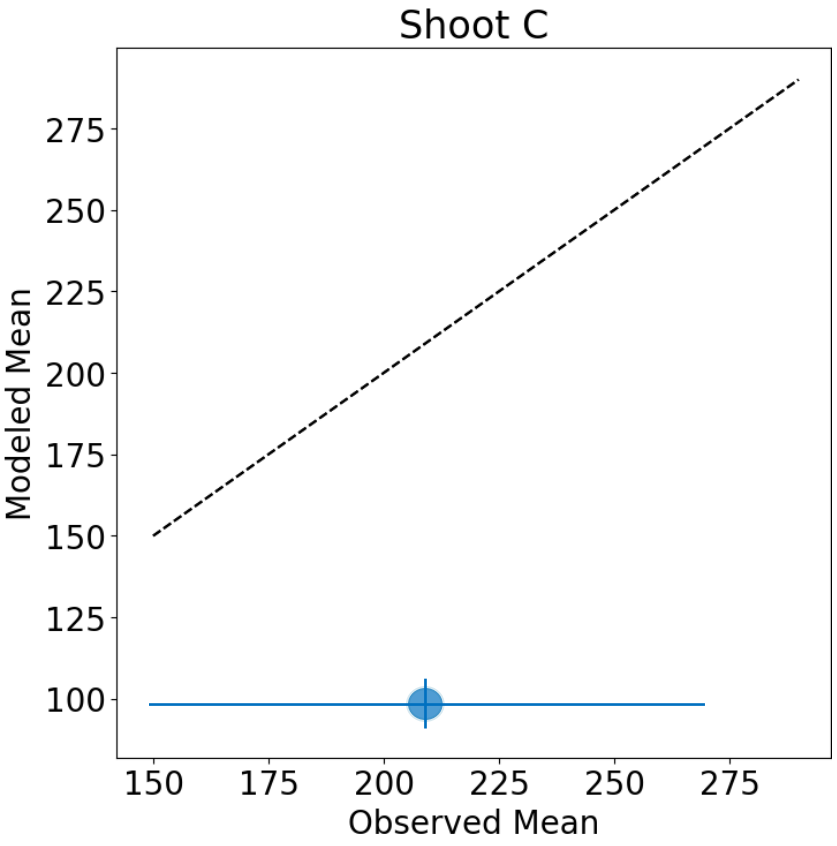


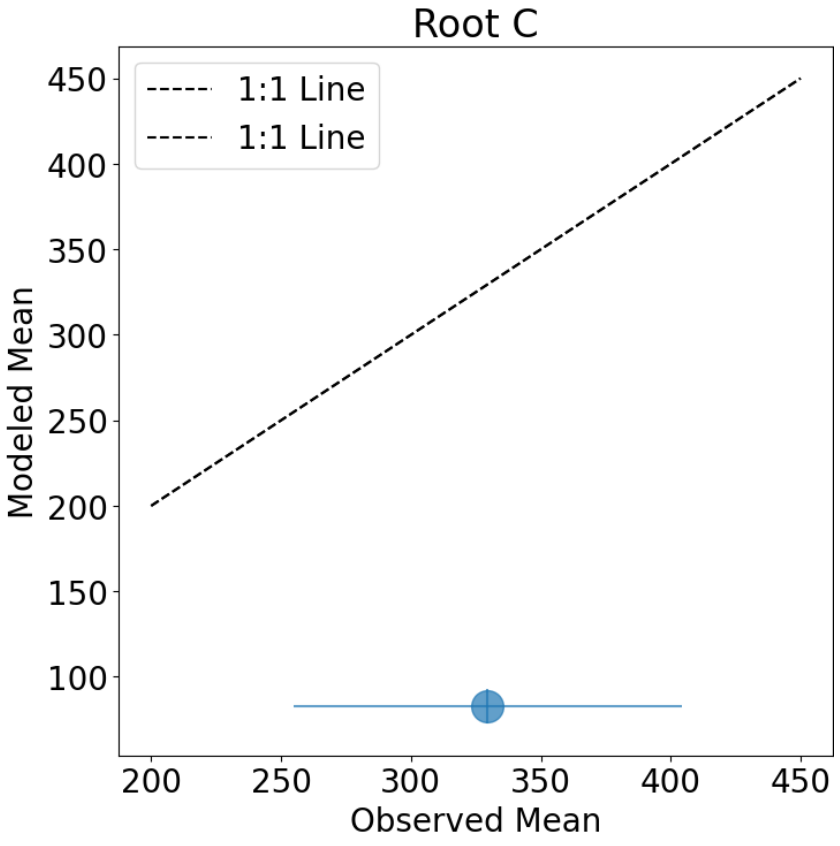


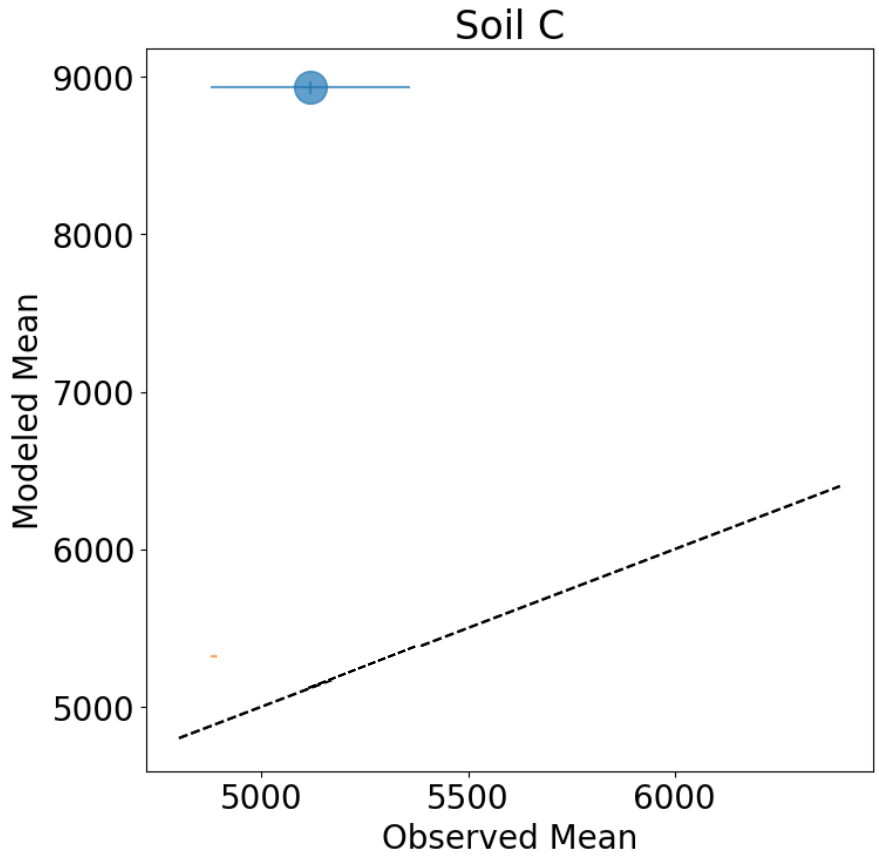
Calibrating CLM-MIMICS*

=default

=calibrated





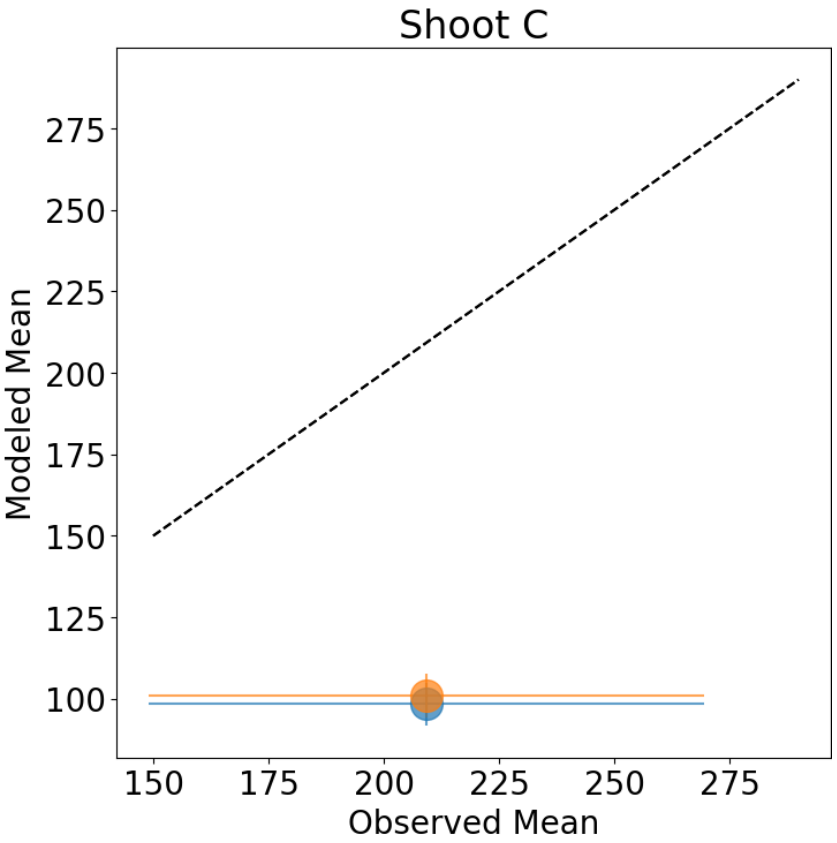


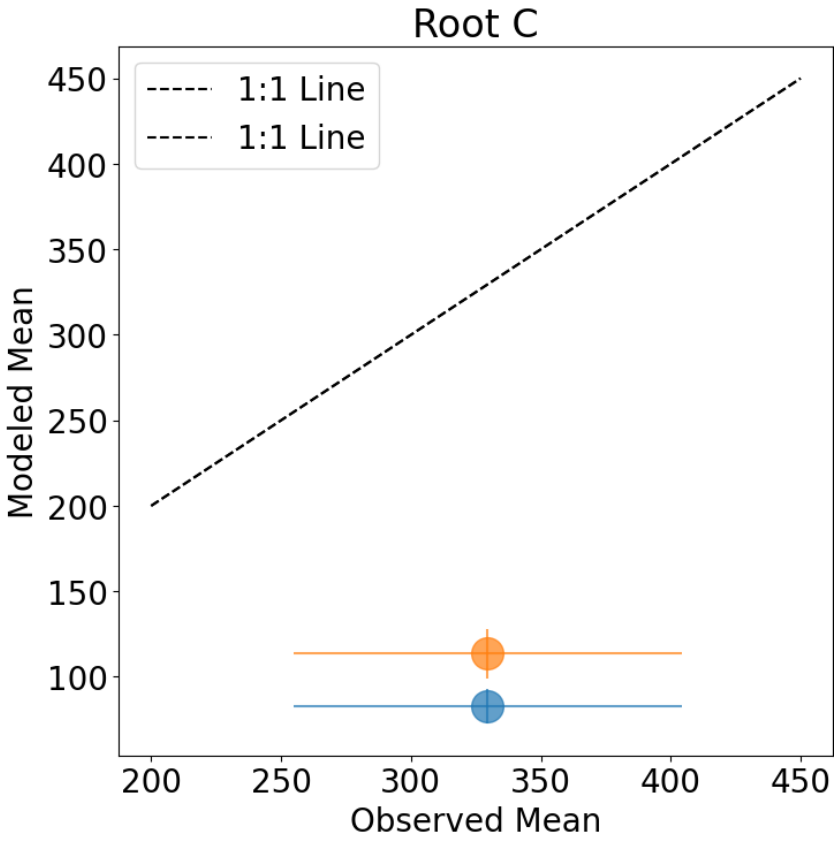
Calibrating CLM-MIMICS*

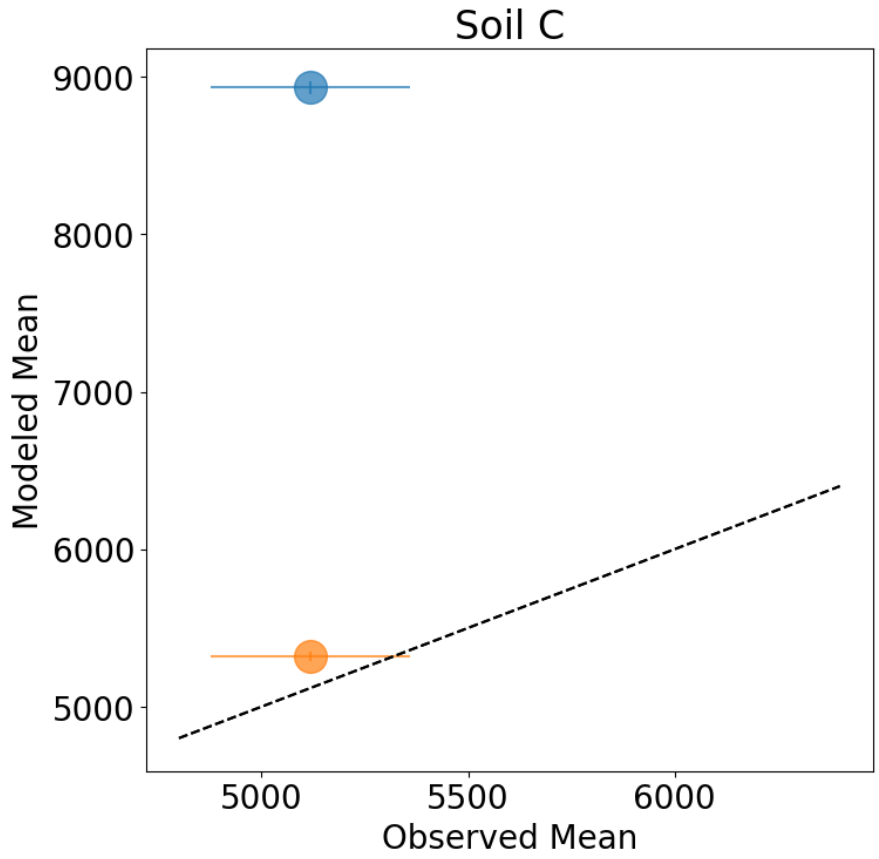
=default

=calibrated

Used same plant parameters as in CLM-Century plus changes in decomposition, desorption, and microbial turnover





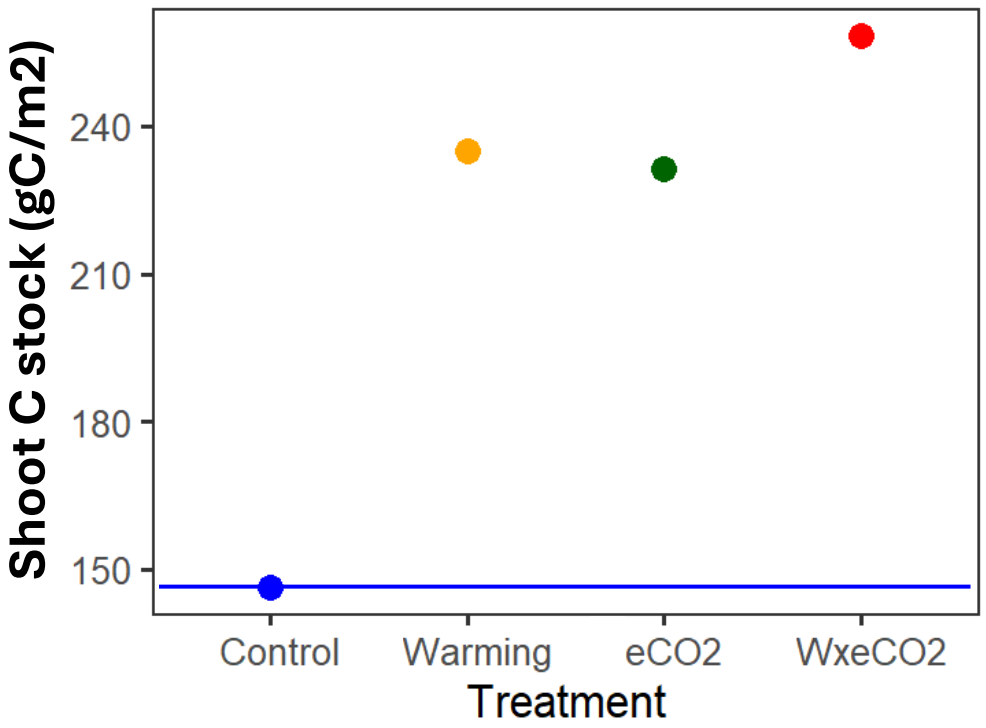


*could be improved!

Initial looks at global change effects

Average response of **shoot C** over 10 years

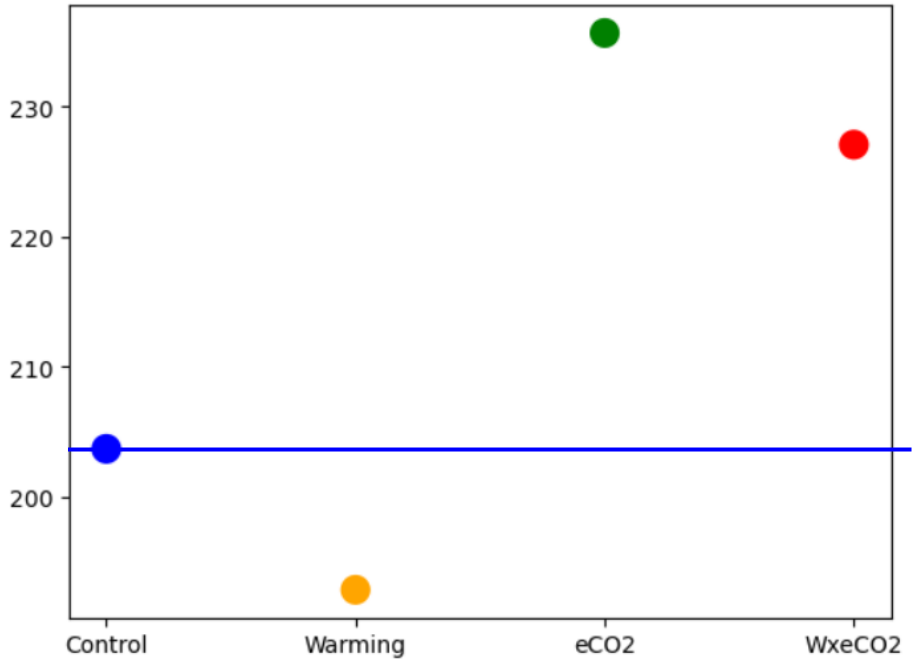
Observations

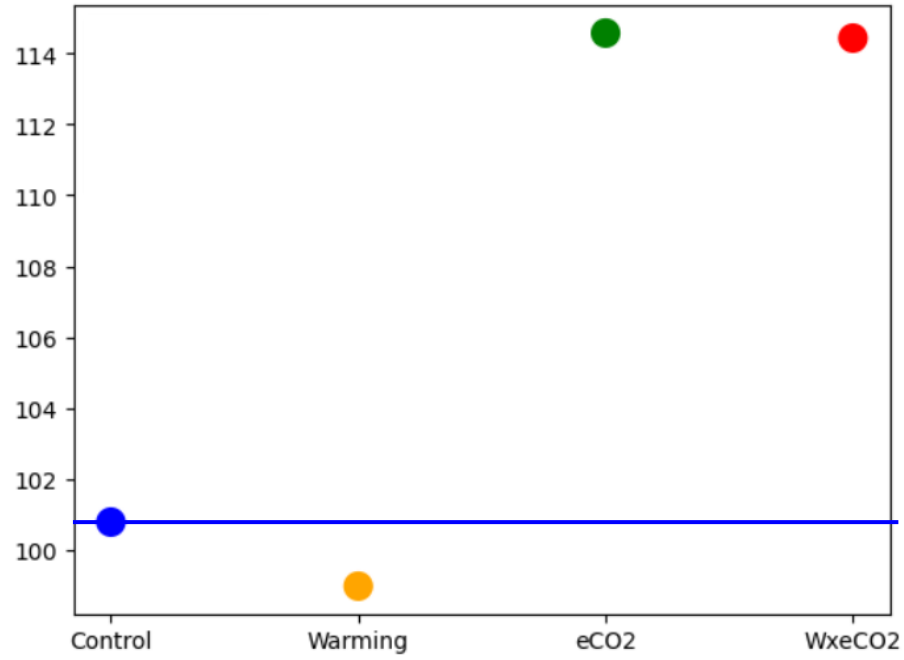


Century

MIMICS

Treatment2
Control
Warming
eCO2
WxeCO2

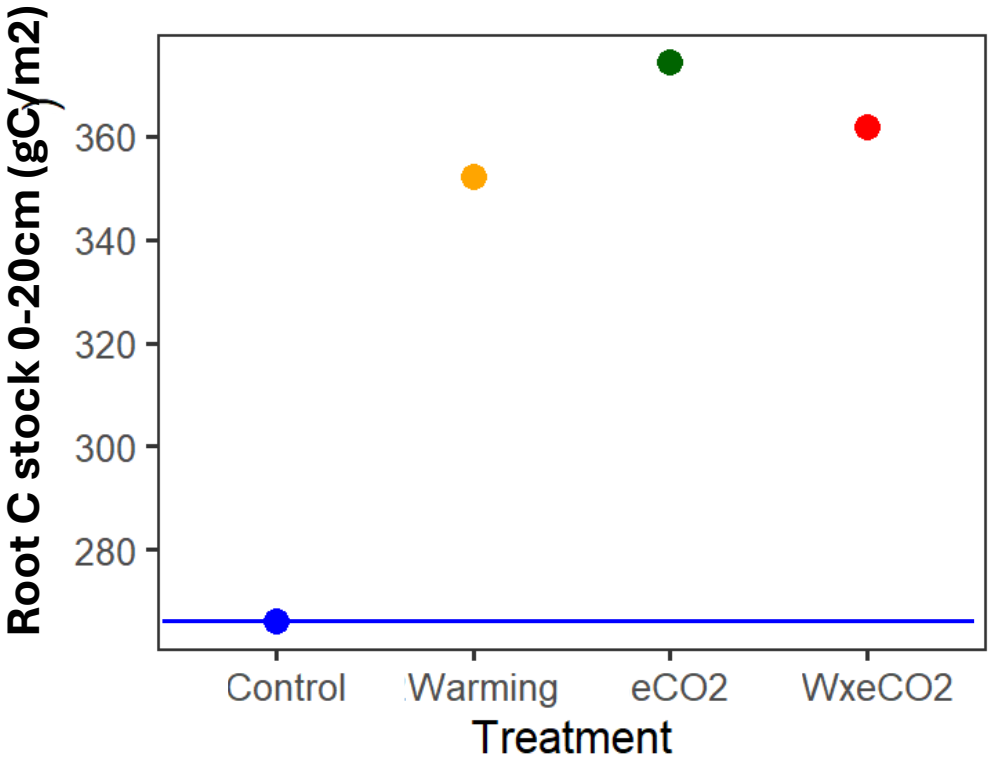




Initial looks at global change effects

Average response of **root C** over 10 years

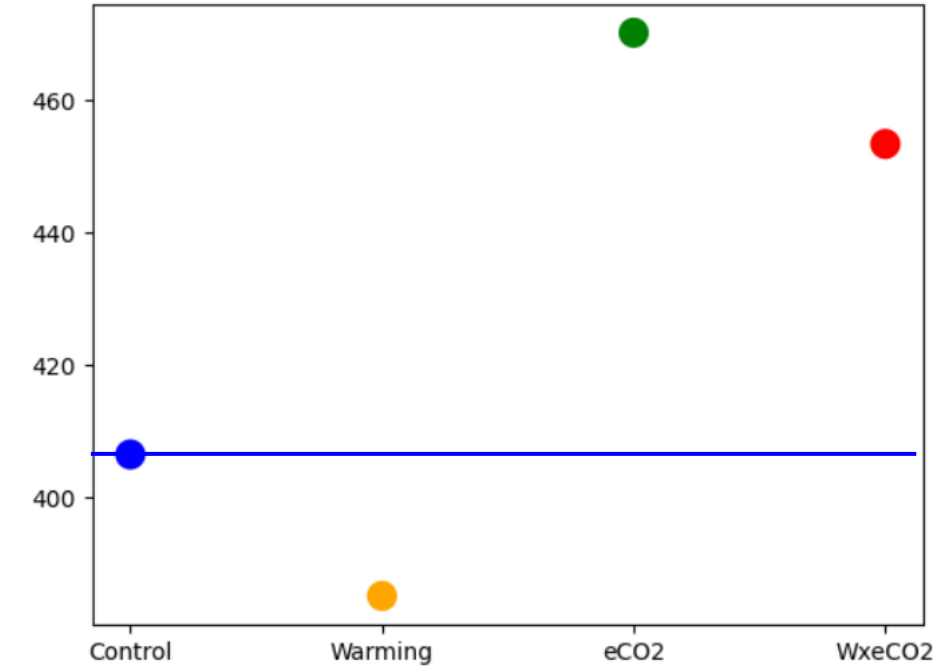
Observations

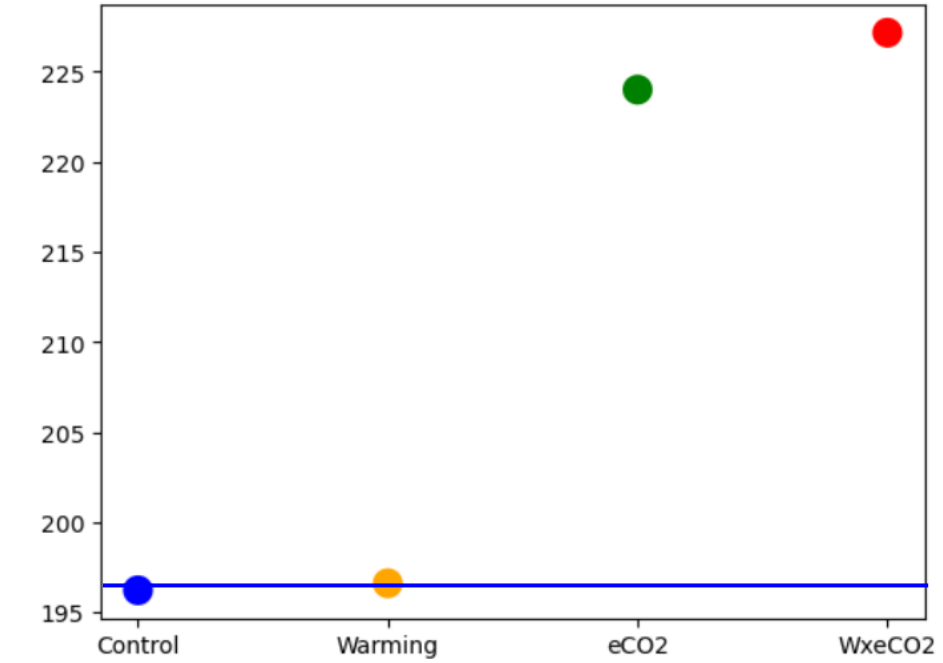


Century

MIMICS

Treatment2
Control
Warming
eCO2
WxeCO2

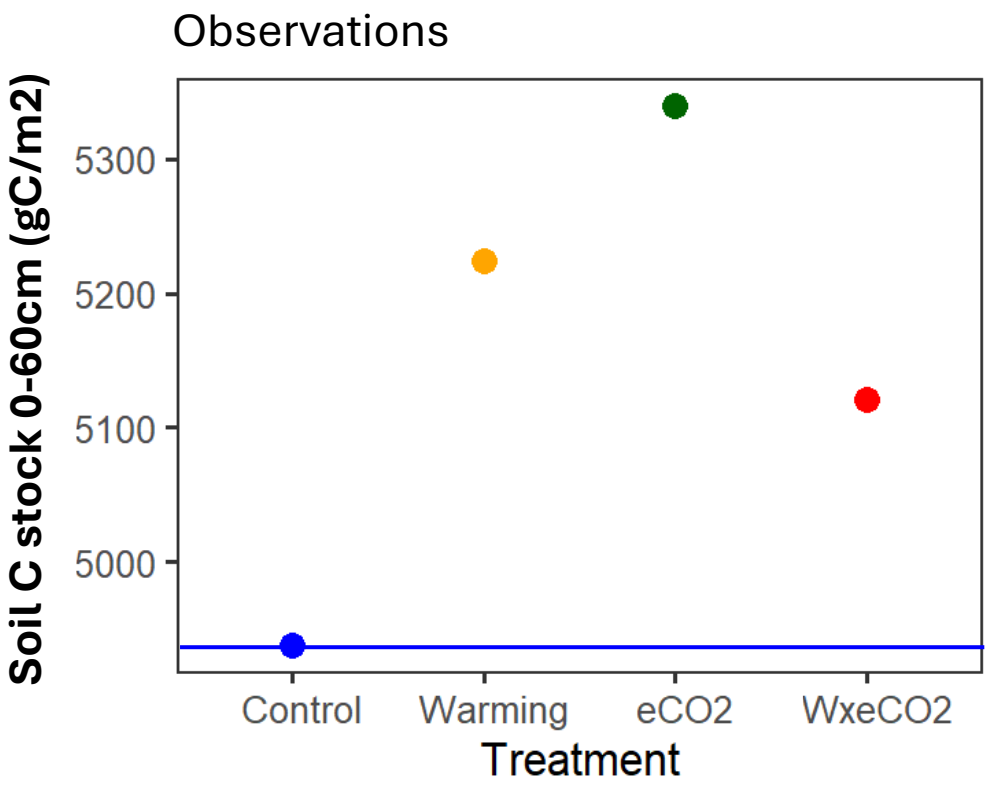




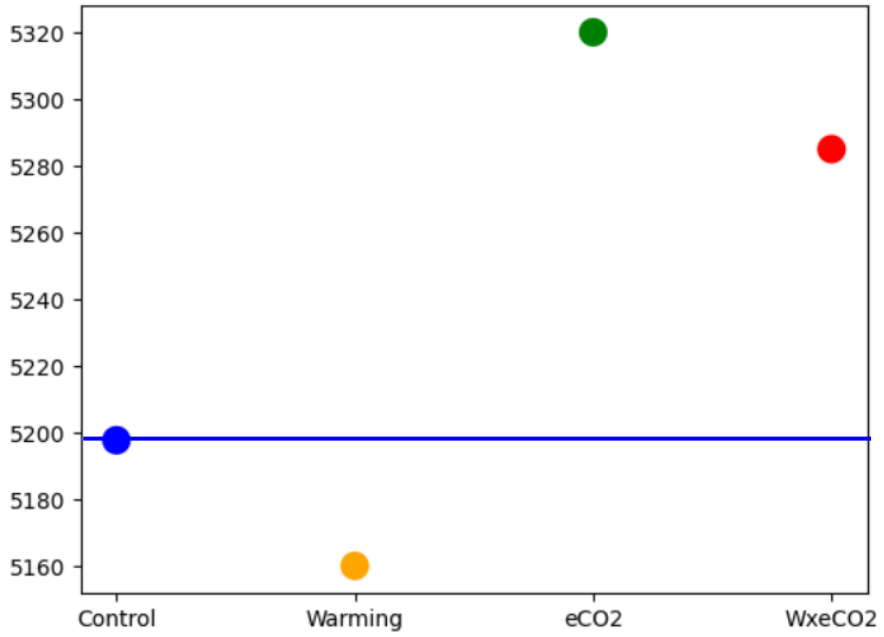
Initial looks at global change effects

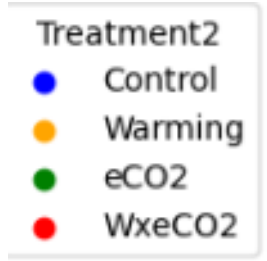
Average response of **soil C** over 10 years

Observations

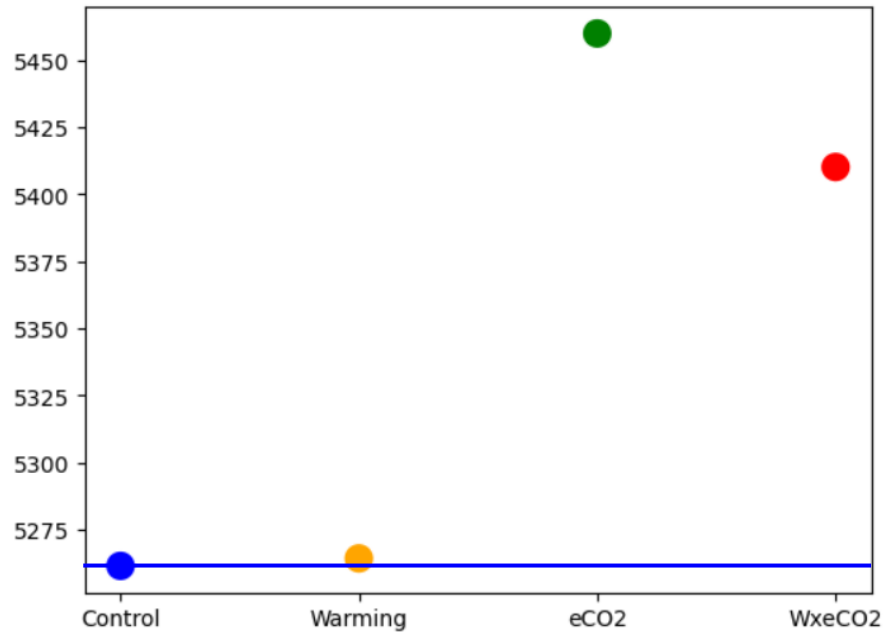


Century



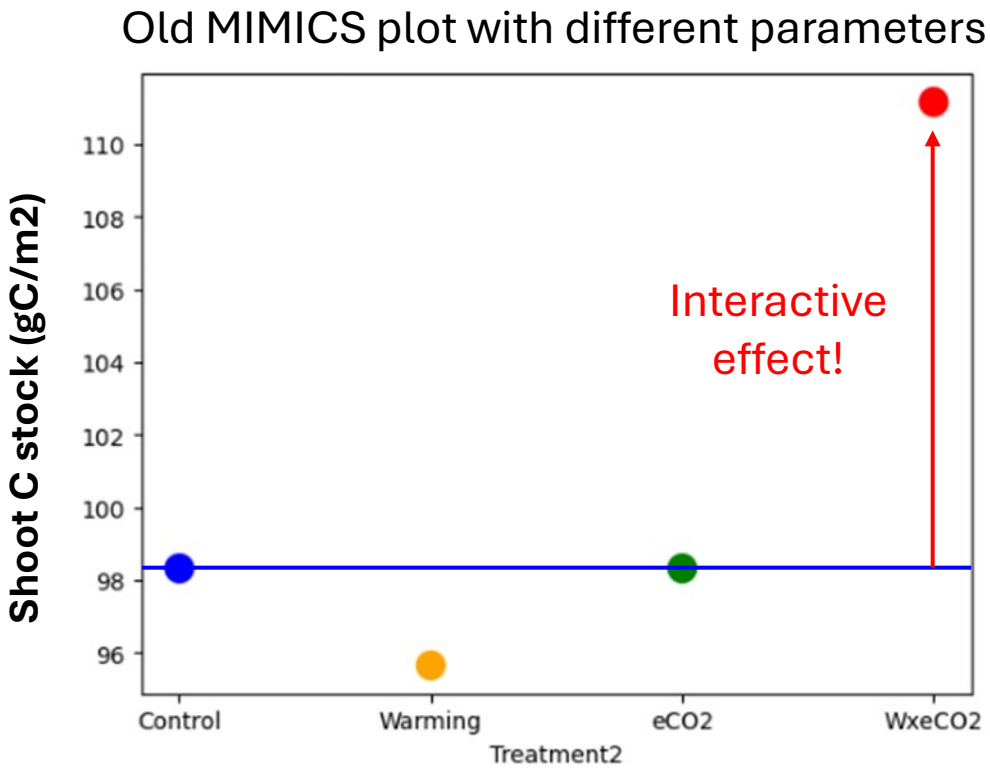


MIMICS



The remaining questions

1. Do these results persist with better calibrations?



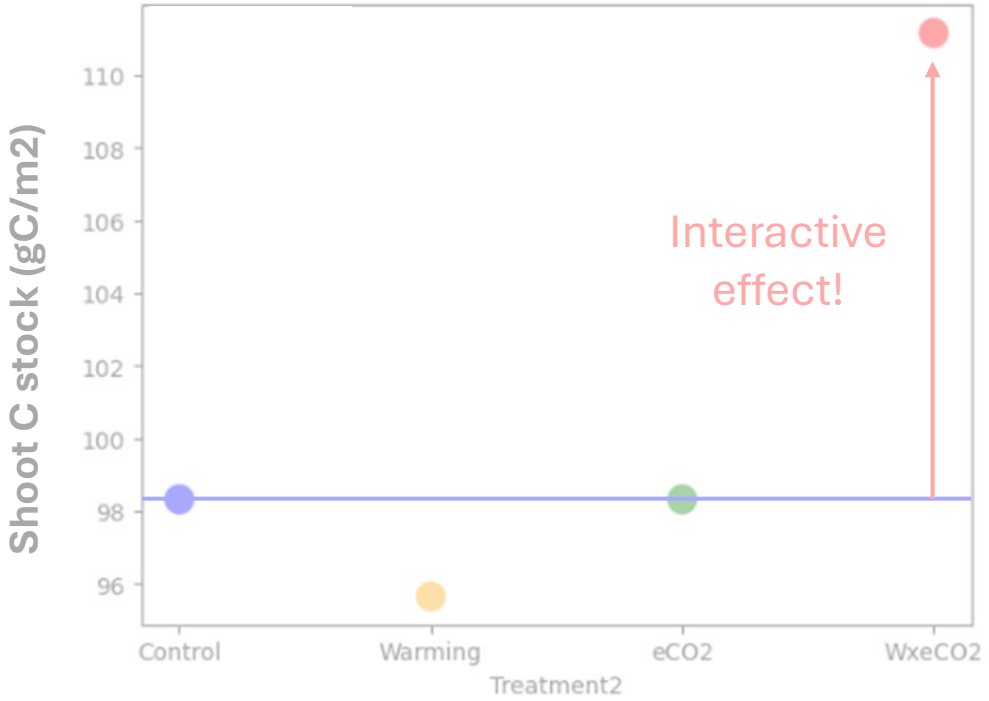
2. Can we reproduce global change effects with parameter or stuructural changes?

The remaining questions

Takeaway: currently, soil biogeochemistry minorly alters global change responses, but this might be altered with different parametrizations to better match observations!

1. Do these results persist with better calibrations?

Old MIMICS plot with different parameters



2. Can we reproduce global chagne effects with parameter or stuructural changes?

Thank you!

TeRaCON collaborators

Kally Worm

Xinli Chen

Sarah Raubenheimer

Liting Zheng

Funding

NSF Macrosystems

UofM Biosciences Initiative

NSF Biological Integration Institute

NSF Long-term Ecological Research

Image credit: University of Minnesota