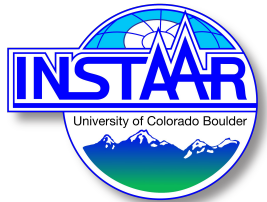


# Assessing the influence of soil biogeochemistry on reproducing land carbon stocks in response to an interactive global change experiment

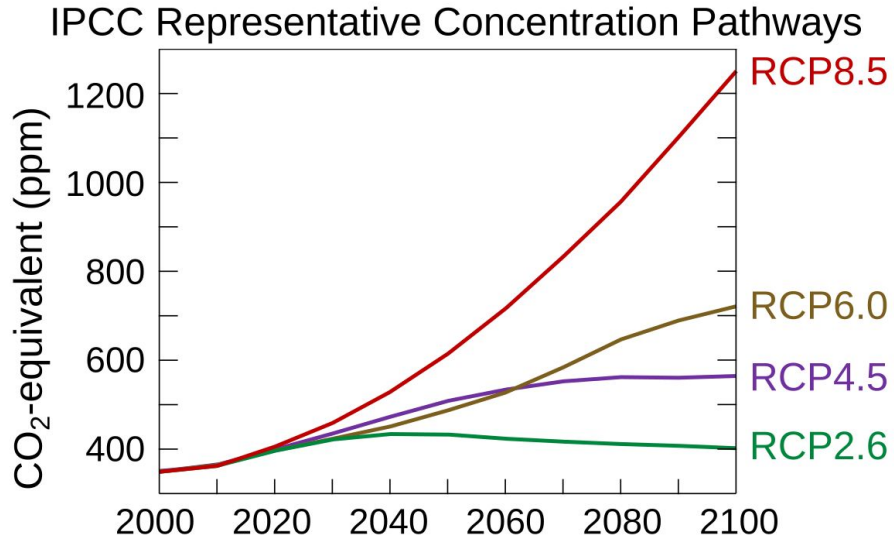
Katie Rocci, Will Wieder, Peter Reich



NCAR | CLIMATE &  
GLOBAL DYNAMICS



# Global changes aren't happening in isolation.



[https://en.wikipedia.org/wiki/Representative\\_Concentration\\_Pathway](https://en.wikipedia.org/wiki/Representative_Concentration_Pathway)




<https://www.ribaj.com/products/woodland-co-2-testing-station-extreme-spec-products>

“An... approach is to gain a thorough understanding of the modes of action of single factors, and rely on our understanding (as represented in models) to inform us of the probable interactions.

Multifactor (CO<sub>2</sub> × temperature) experiments remain important, however, for testing concepts, demonstrating the reality of multiple factor influences, and **reminding us that surprises can be expected.**”

Surprises may be more common than we think!



The image shows the header of a Nature Geoscience article. It features the 'nature geoscience' logo on the left, the word 'ARTICLES' in white on a dark green background on the right, and a DOI link: <https://doi.org/10.1038/s41561-020-00657-1>. Below the header are icons for a comment bubble and a 'Check for updates' button.

**Synergistic effects of four climate change drivers on terrestrial carbon cycling**

Peter B. Reich<sup>1,2</sup>, Sarah E. Hobbie<sup>3</sup>, Tali D. Lee<sup>4</sup>, Roy Rich<sup>1,5</sup>, Melissa A. Pastore<sup>3</sup> and Kally Worm<sup>1,3</sup>

“Multiple global change drivers had a profound combined influence on observed outcomes that would have been poorly predicted by knowledge of each driver alone.”

What mechanisms are needed to represent interactive effects in land models?

# Taking advantage of a multifactor experiment: TeRaCON

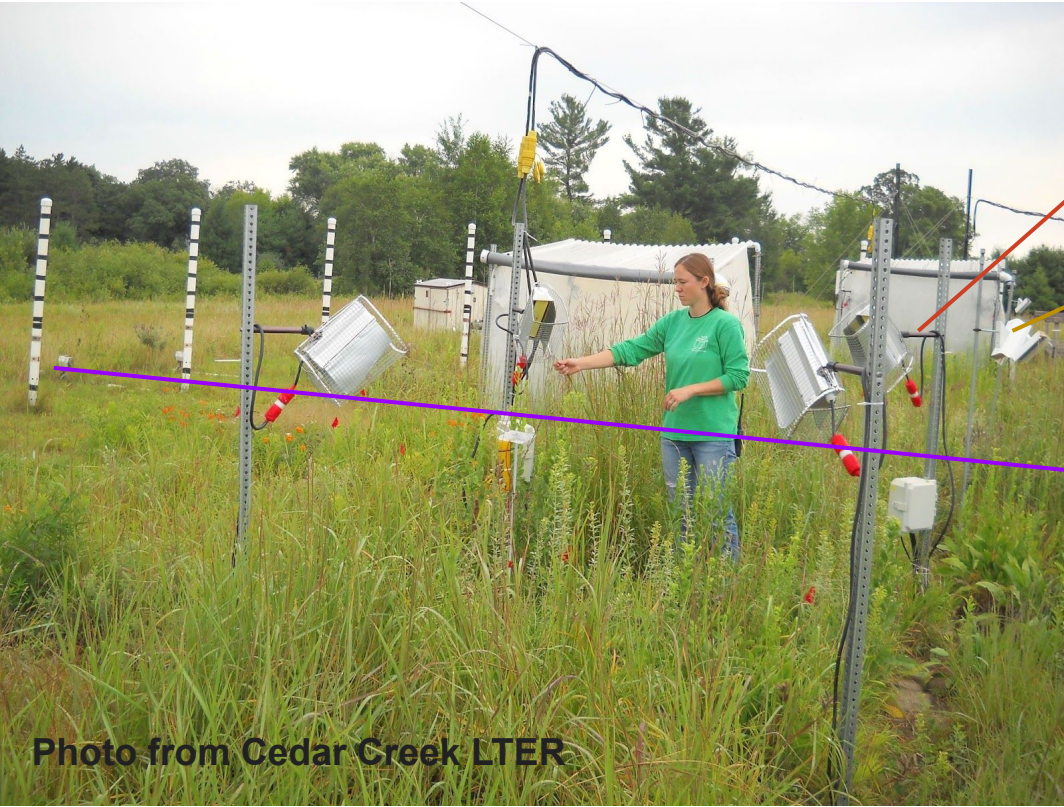
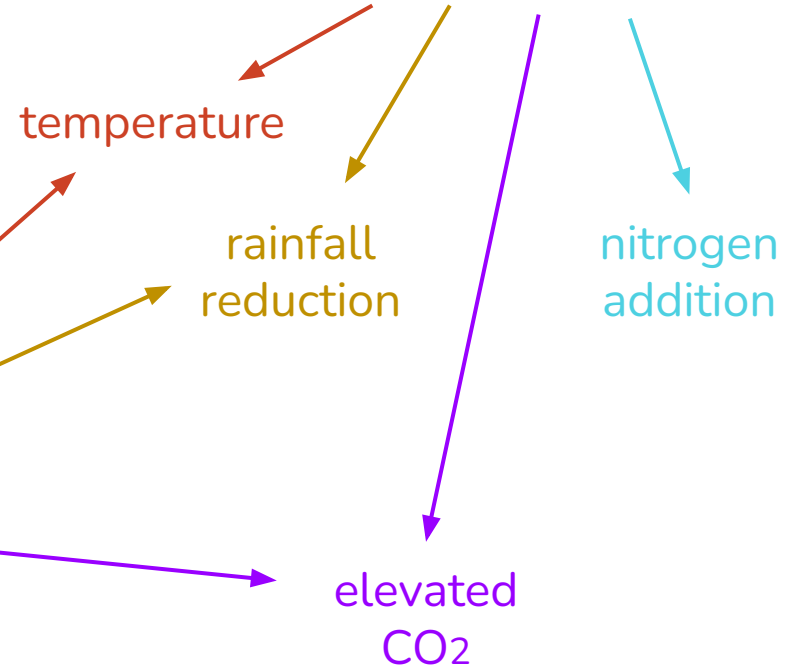
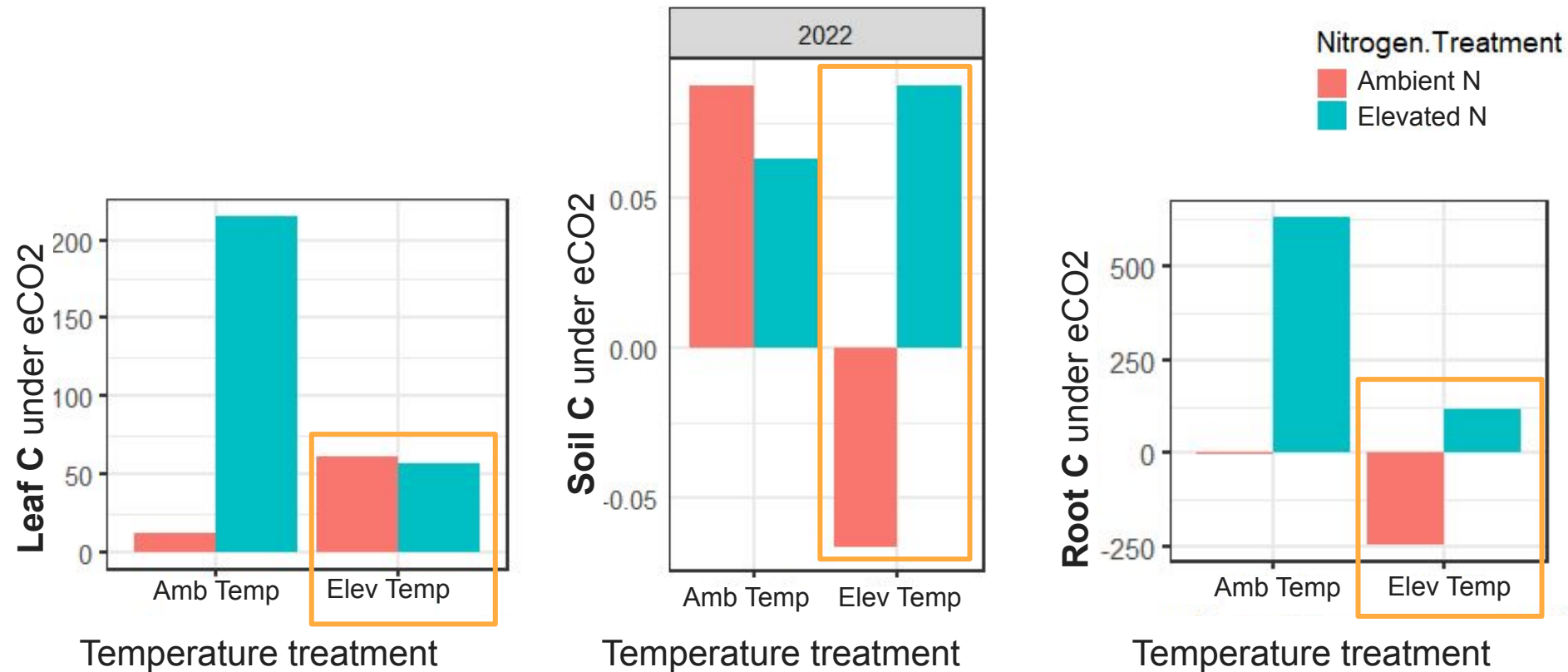


Photo from Cedar Creek LTER

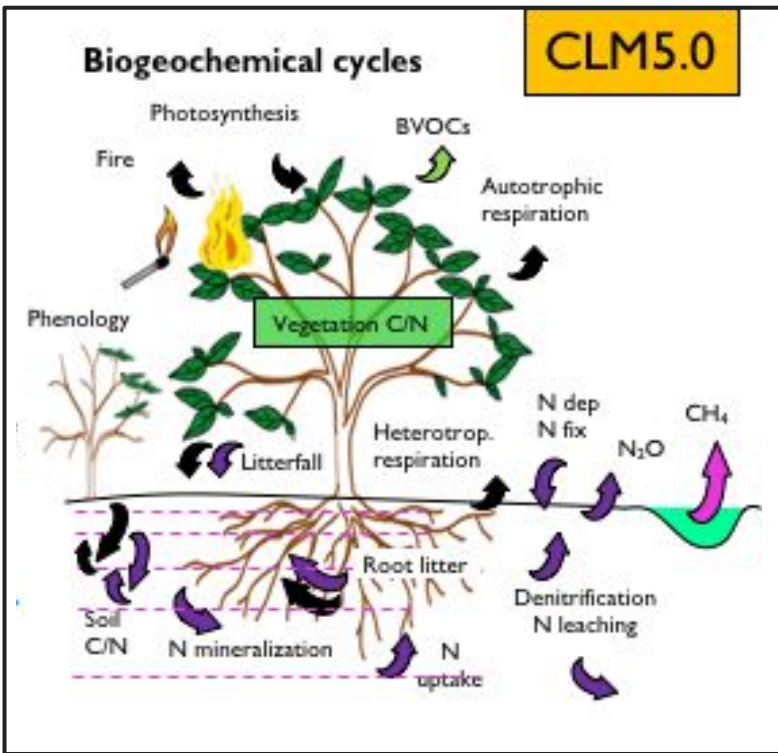


Initiated in tallgrass prairie in 2012

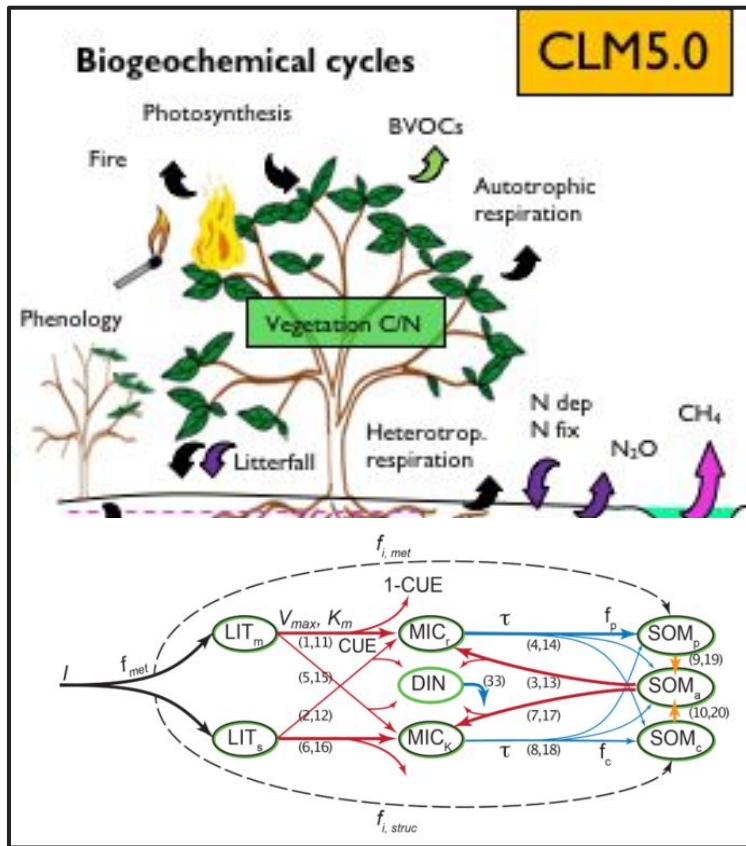
After 10 years, C cycle responses indicate interactions between elevated CO<sub>2</sub> and warming, influenced by N availability



# Assessing whether soil biogeochemistry alters responses



“CLM-default”



“CLM-MIMICS”

Control

Warming

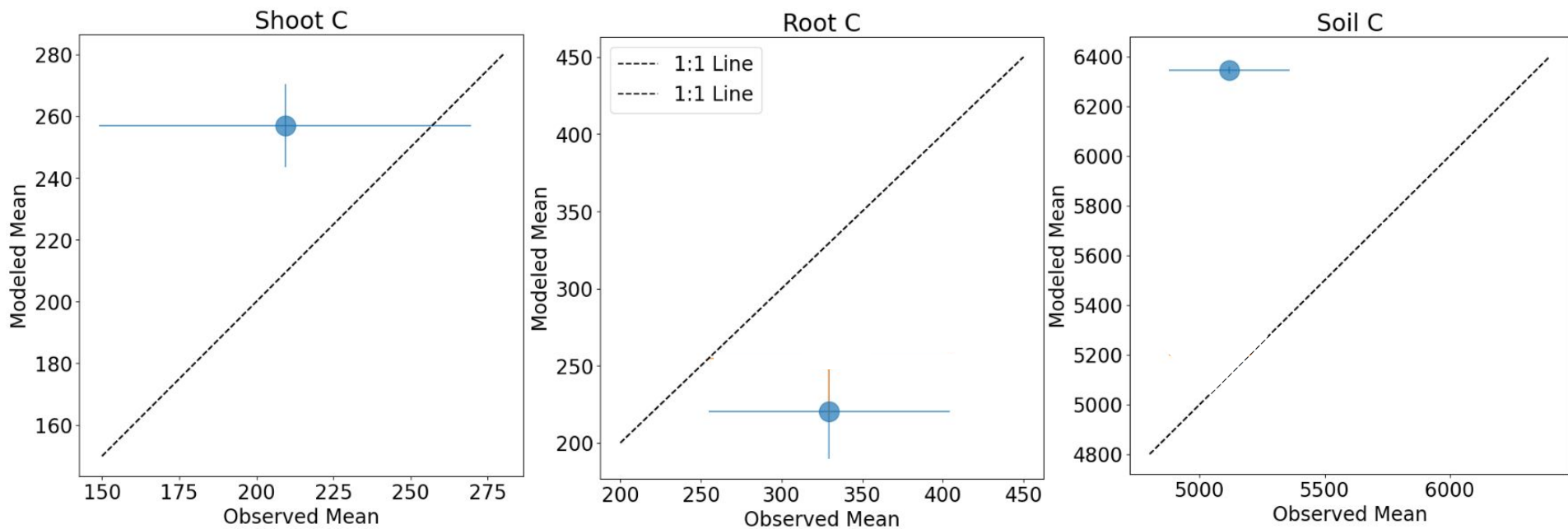
Elevated CO<sub>2</sub>

Warming x  
elevated CO<sub>2</sub>

# Parameterizing\* CLM-default

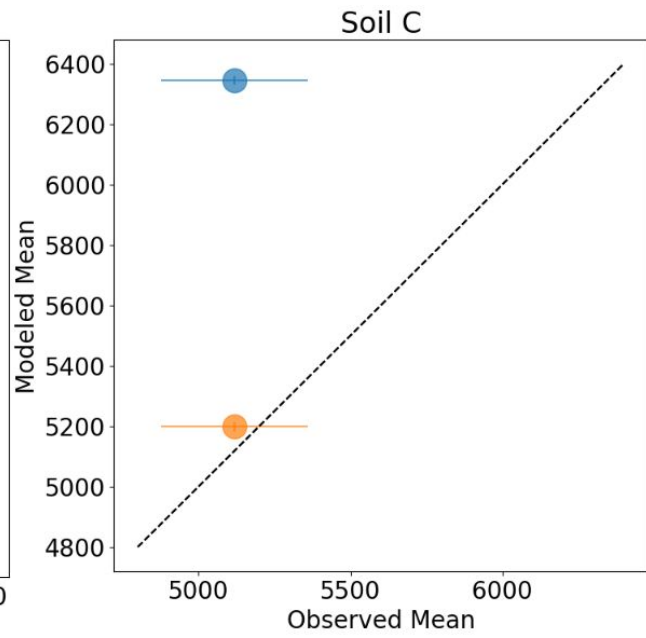
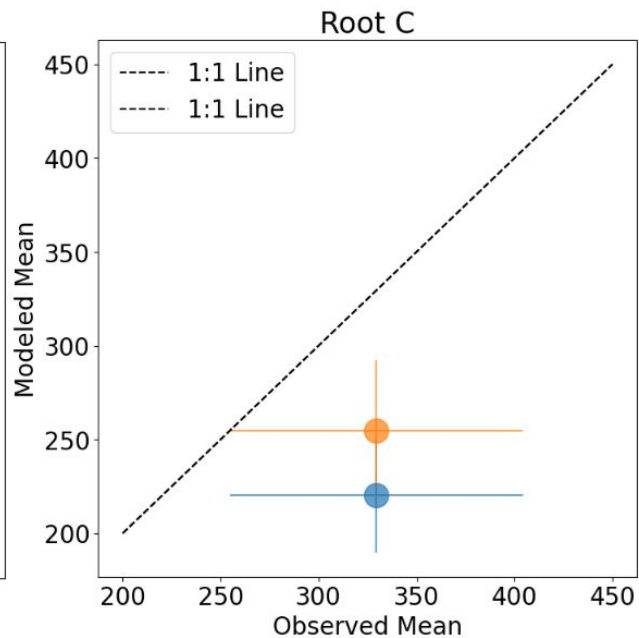
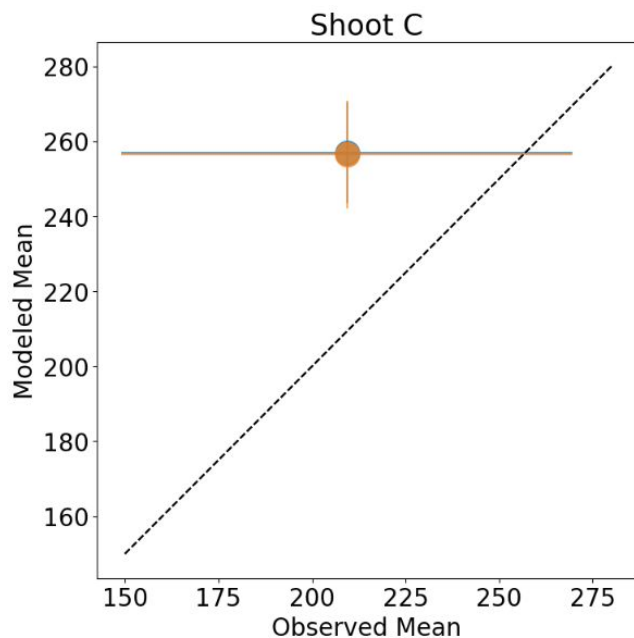
\*First updated with observed plant traits and soil properties

Increase soil C decomposition rate (lower `bgc_tau_s1-3`) & change root distribution (lower `rootprof_beta`)



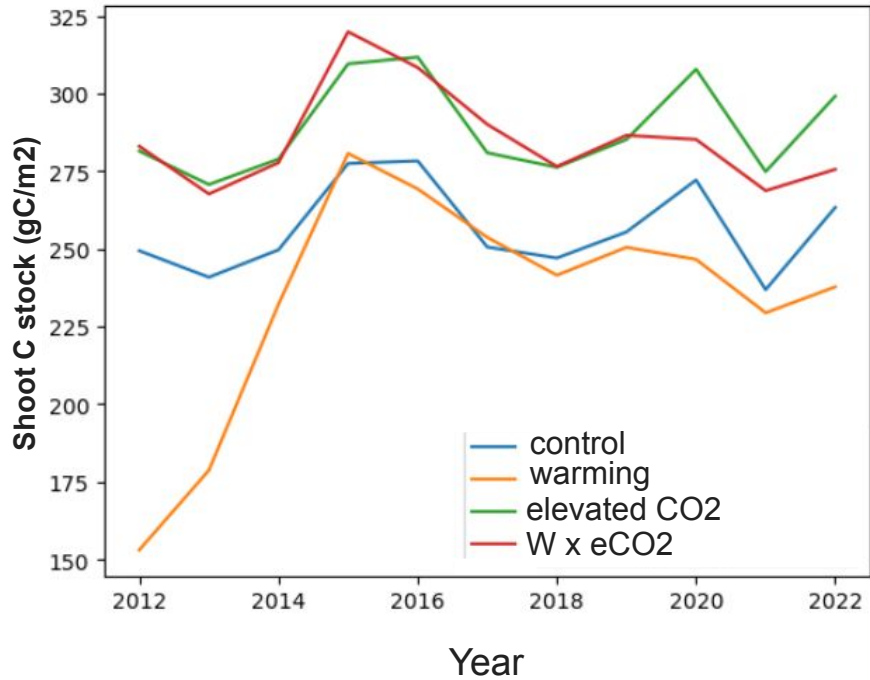


# Parameterizing CLM-default

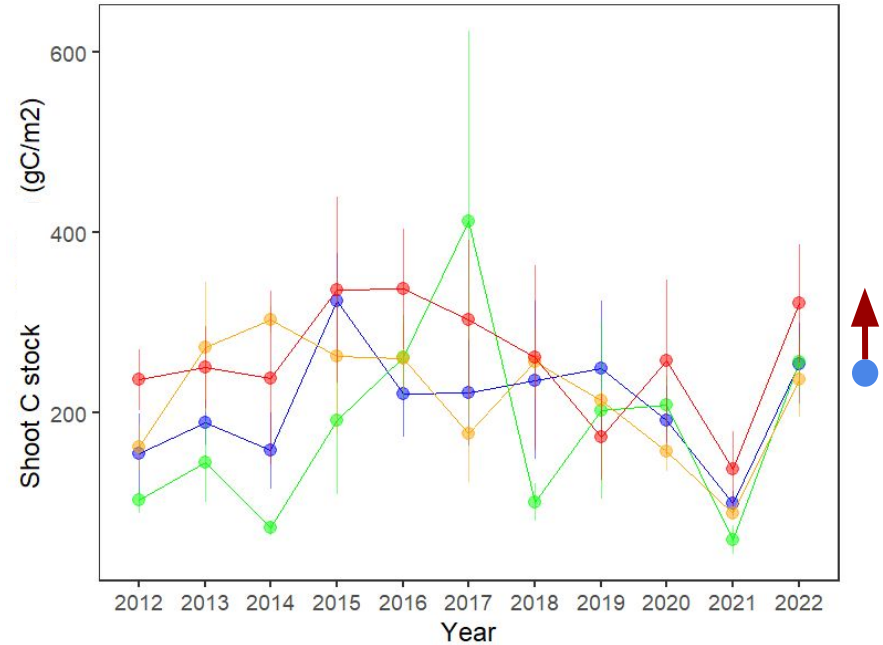


# Does CLM-default capture interactive global change effects?

## Aboveground biomass C storage



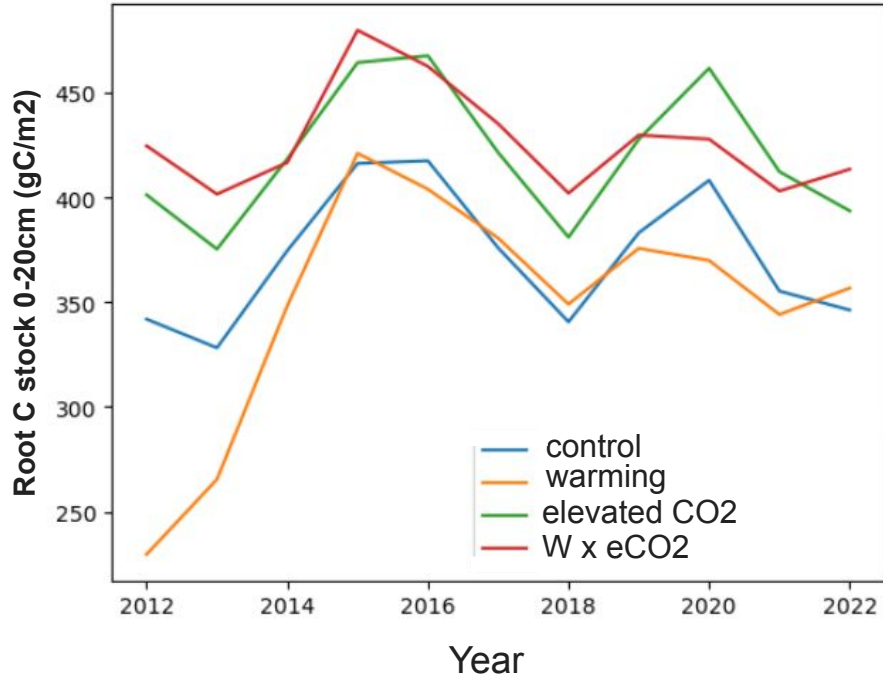
additive!



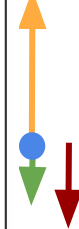
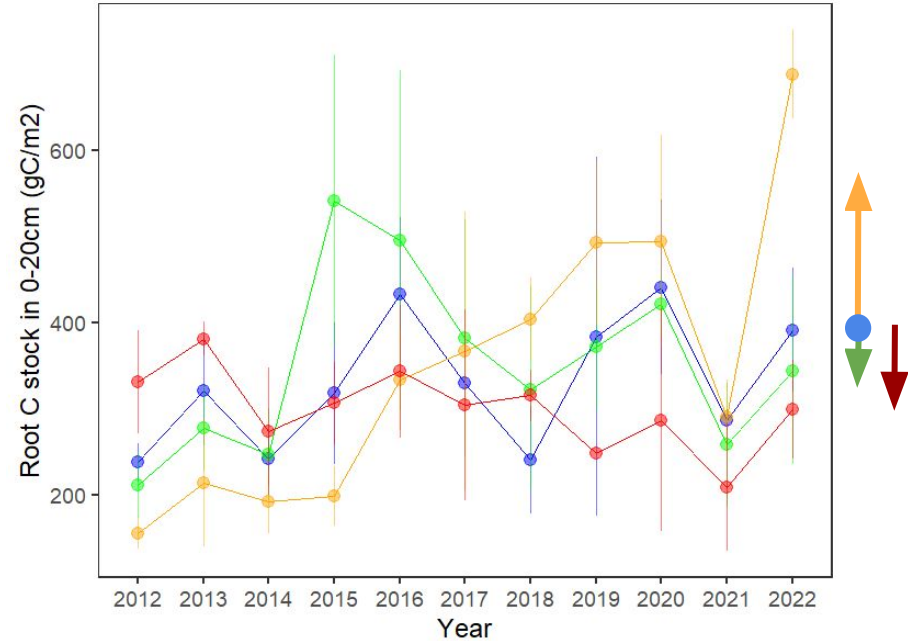
synergistic!

# Does CLM-default capture interactive global change effects?

## Belowground biomass C storage



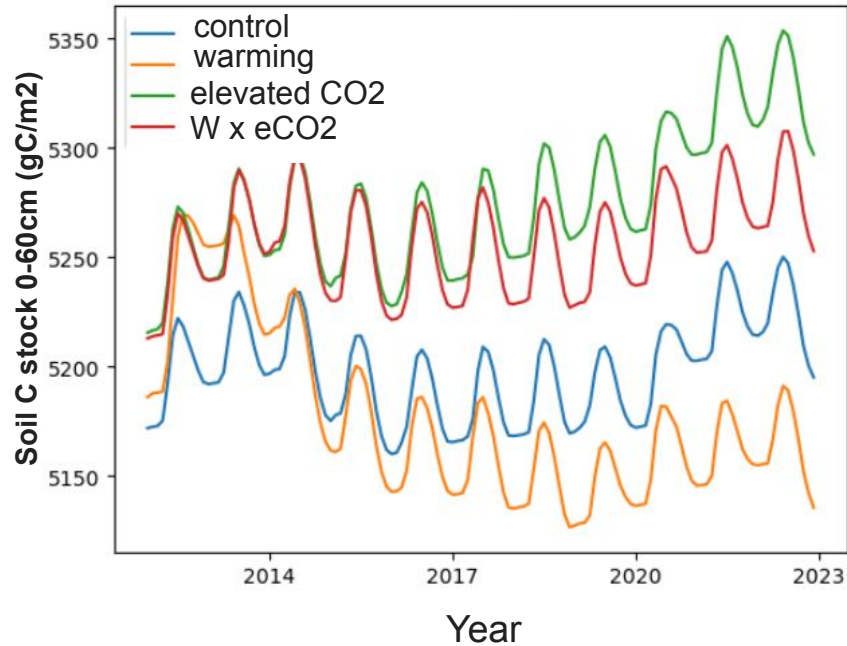
additive!



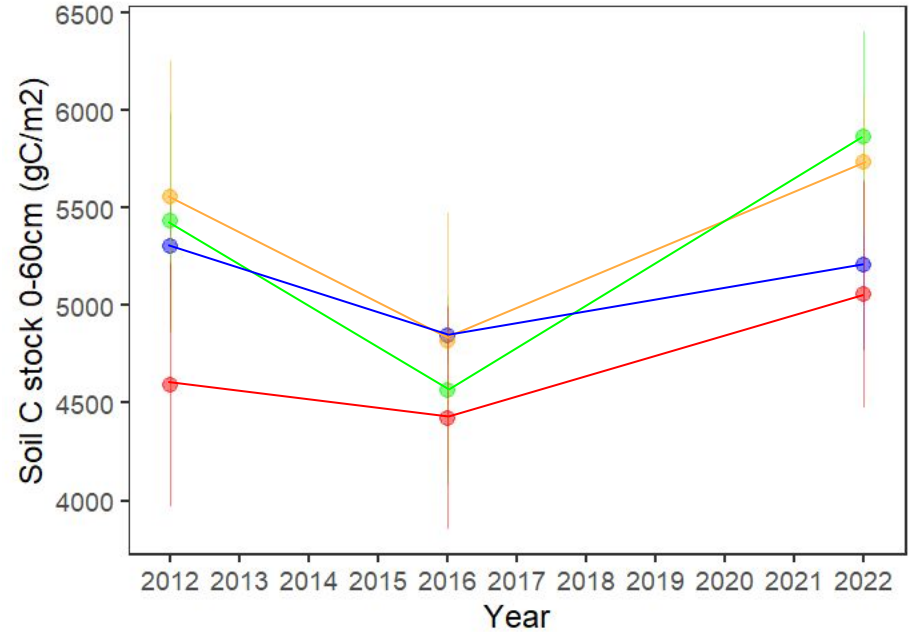
synergistic!

# Does CLM-default capture interactive global change effects?

## Soil C storage



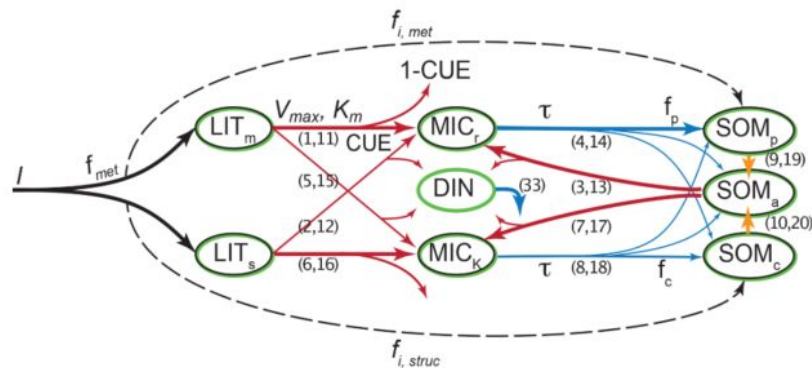
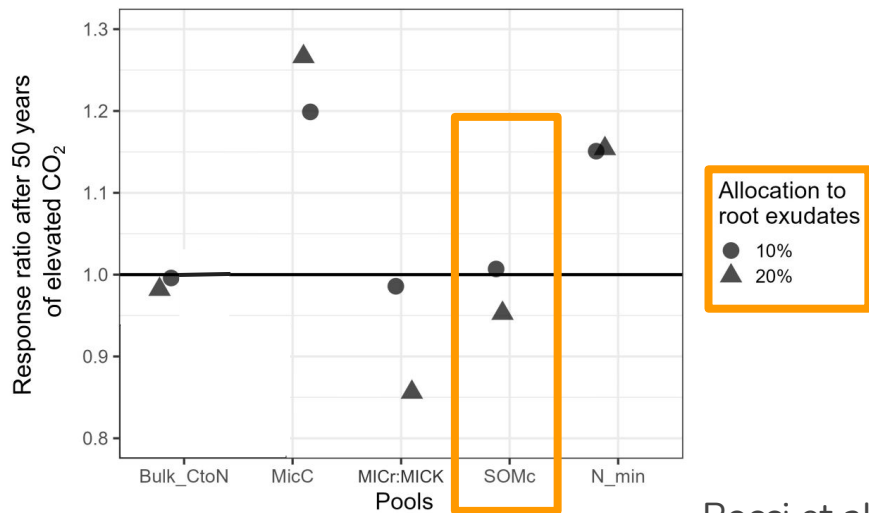
additive!



synergistic!

# The remaining questions

1. Does a different representation of soil biogeochemistry show more aligned global change effects?

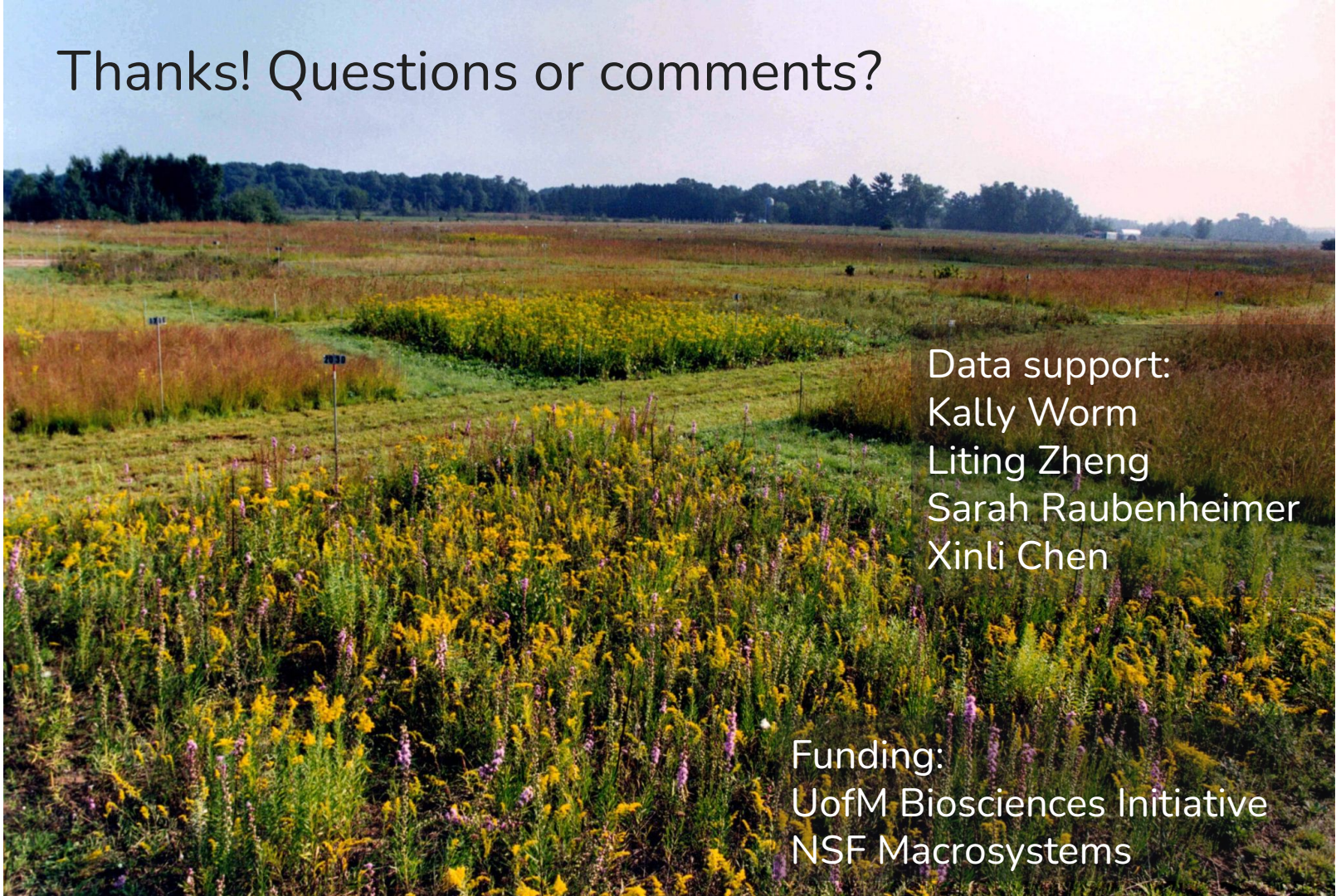


2. Do other processes need to be represented in CLM that are not currently?

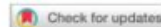
Thanks! Questions or comments?

Data support:  
Kally Worm  
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Xinli Chen

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UofM Biosciences Initiative  
NSF Macrosystems

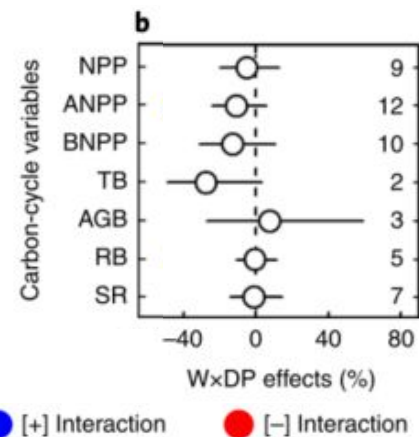






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What mechanisms are needed to represent interactive effects in land models?