

Building models that reflect our understanding of soil organic matter dynamics



SOAP

JERC

GRSM

WREF

KONA

DELA

OAES

OSBS



Building models that reflect our understanding

1. Background Perspectives
2. Biased Examples
3. Future Priorities

Soil BGC in CMIP models



Todd-Brown et al. 2013, 2014
Ito et al. 2020,
Varney et al 2022

‘Single-layer models of evaporation from plant canopies are incorrect but useful, whereas multilayer models are correct but useless’

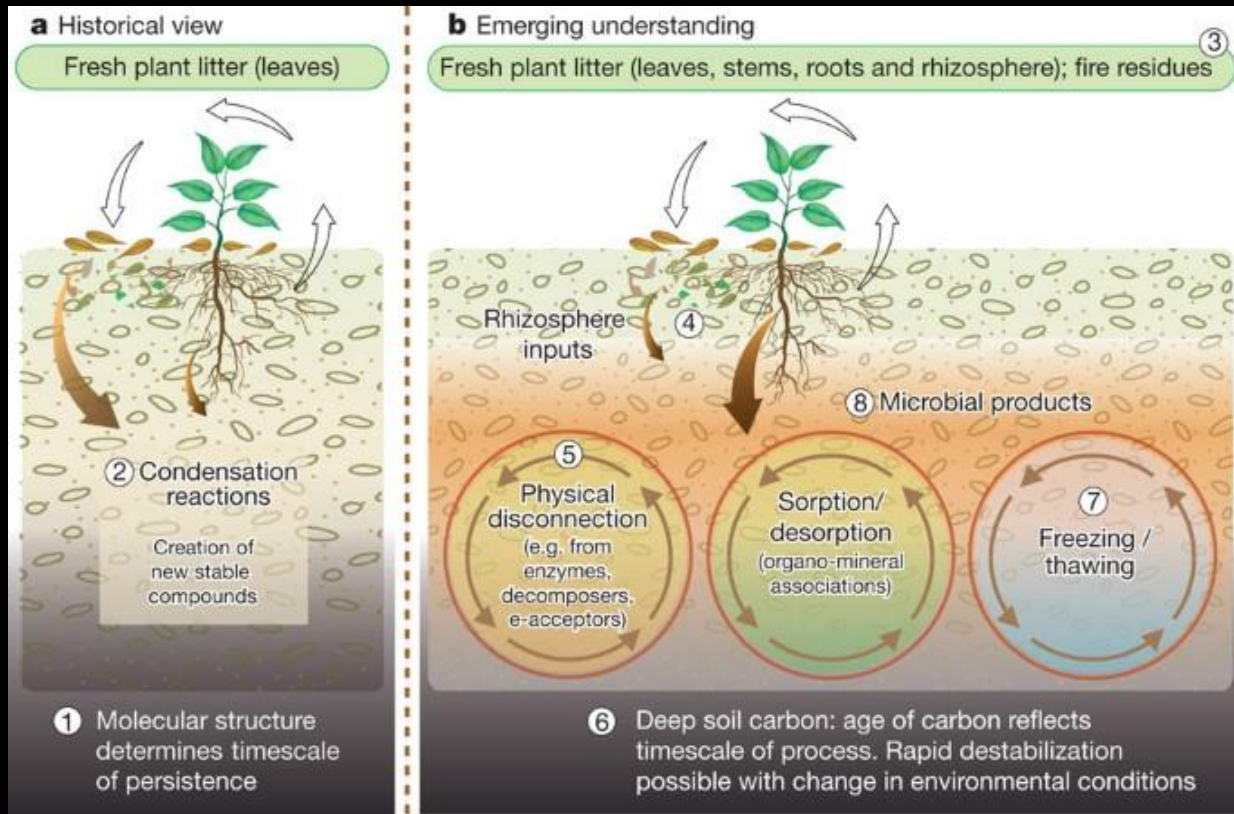
- Raupach & Finnigan 1988

“simplicity illuminates, and complication obscures”

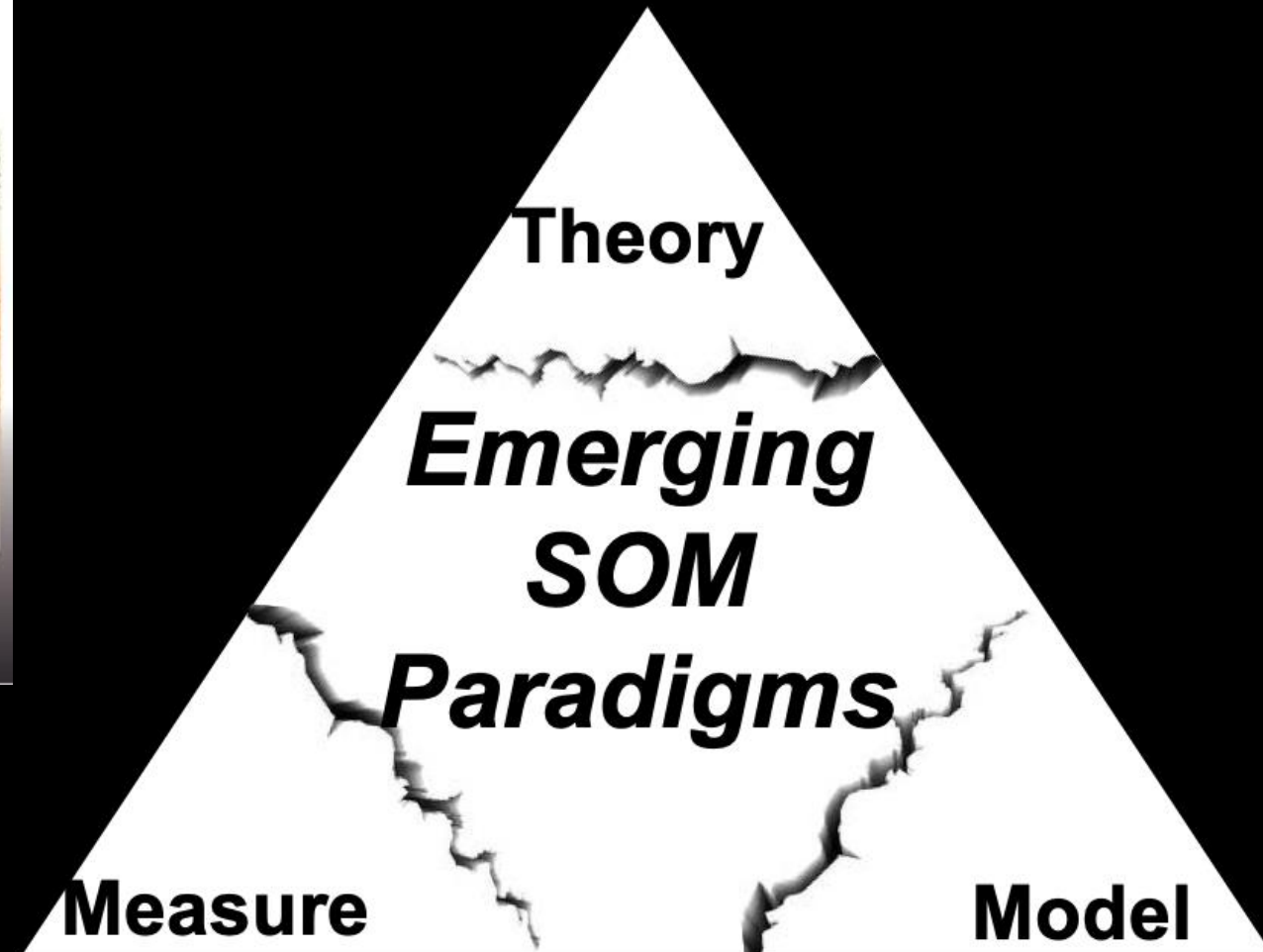
- Box 1979



Motivation:

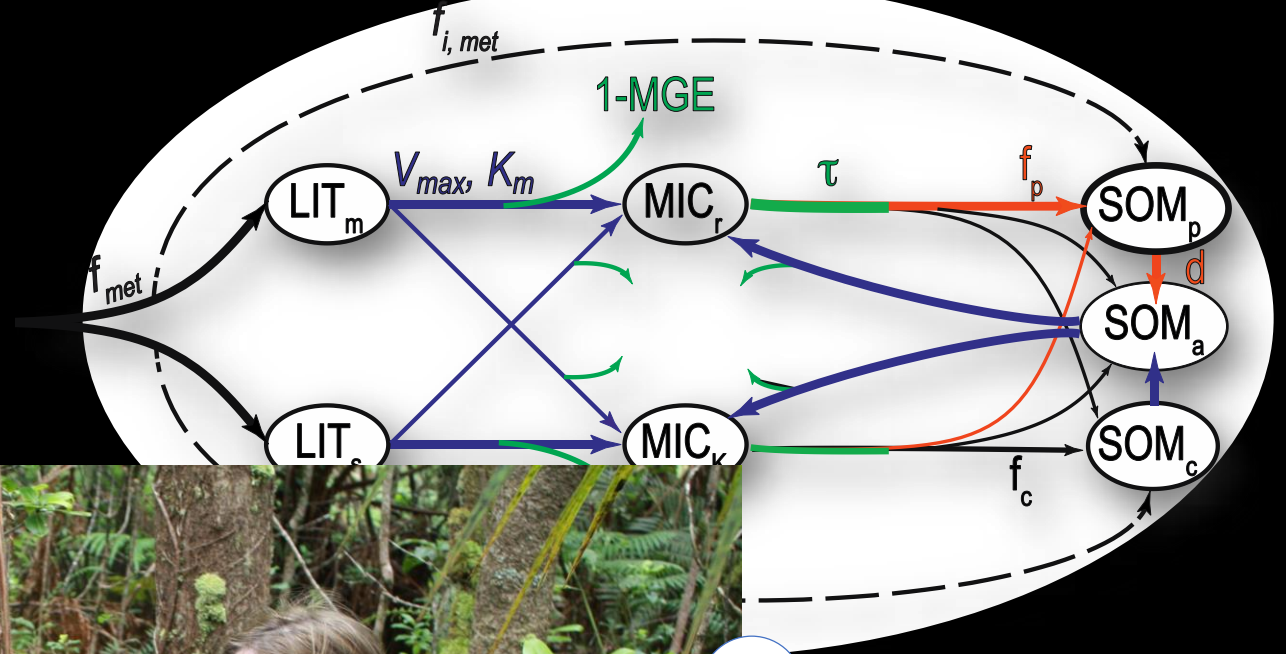


Schmidt et al. Nature 2011
Lehmann & Kleber Nature 2015
Lehmann et al. Nature Geo Sci 2020



Blankenship et al. Biogeochemistry 2018

Linking theory, models, & measurements





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Flavors of soil biogeochemical models



Time to **rethink** soil biogeochemical models?

Fast



CO₂



Slow



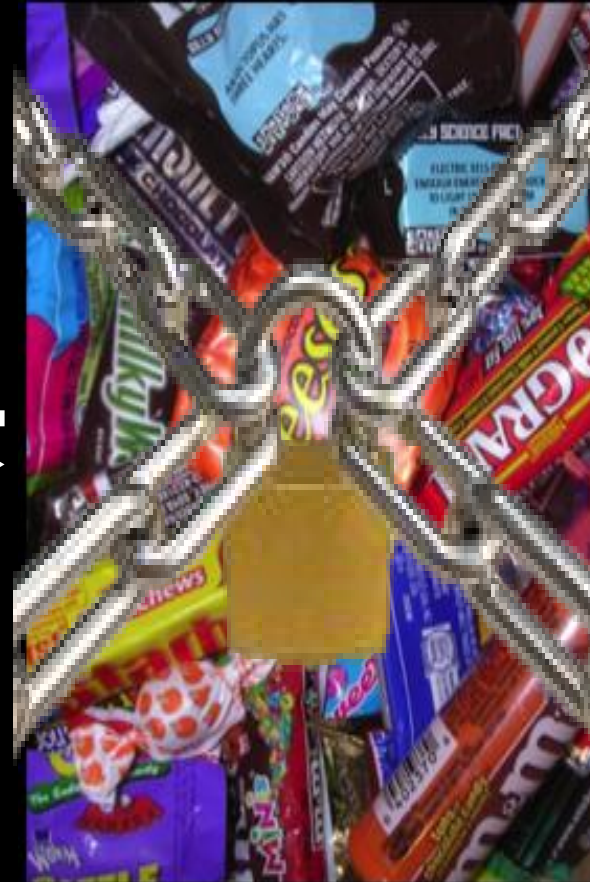
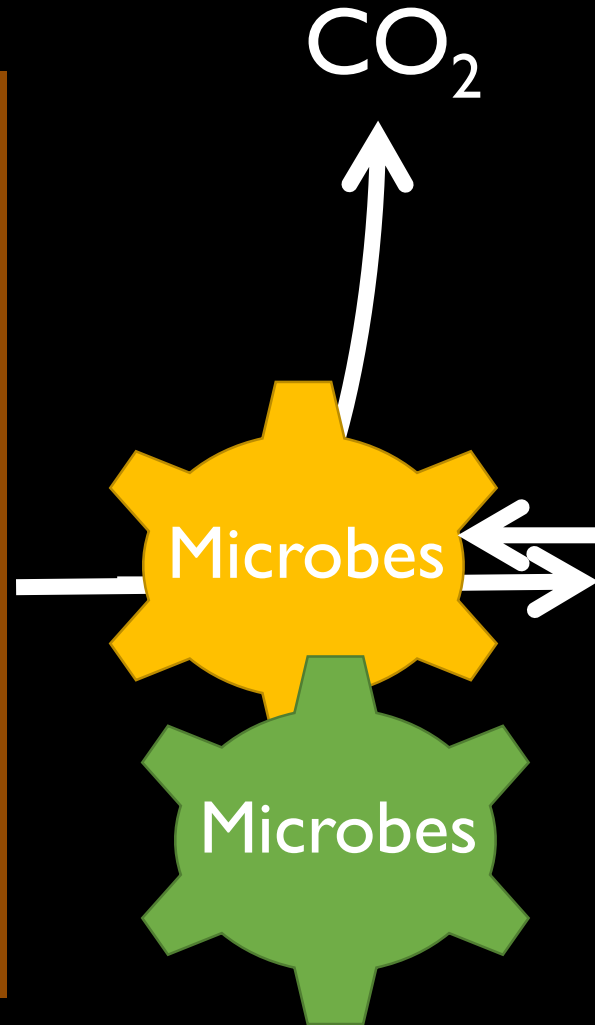
CO₂



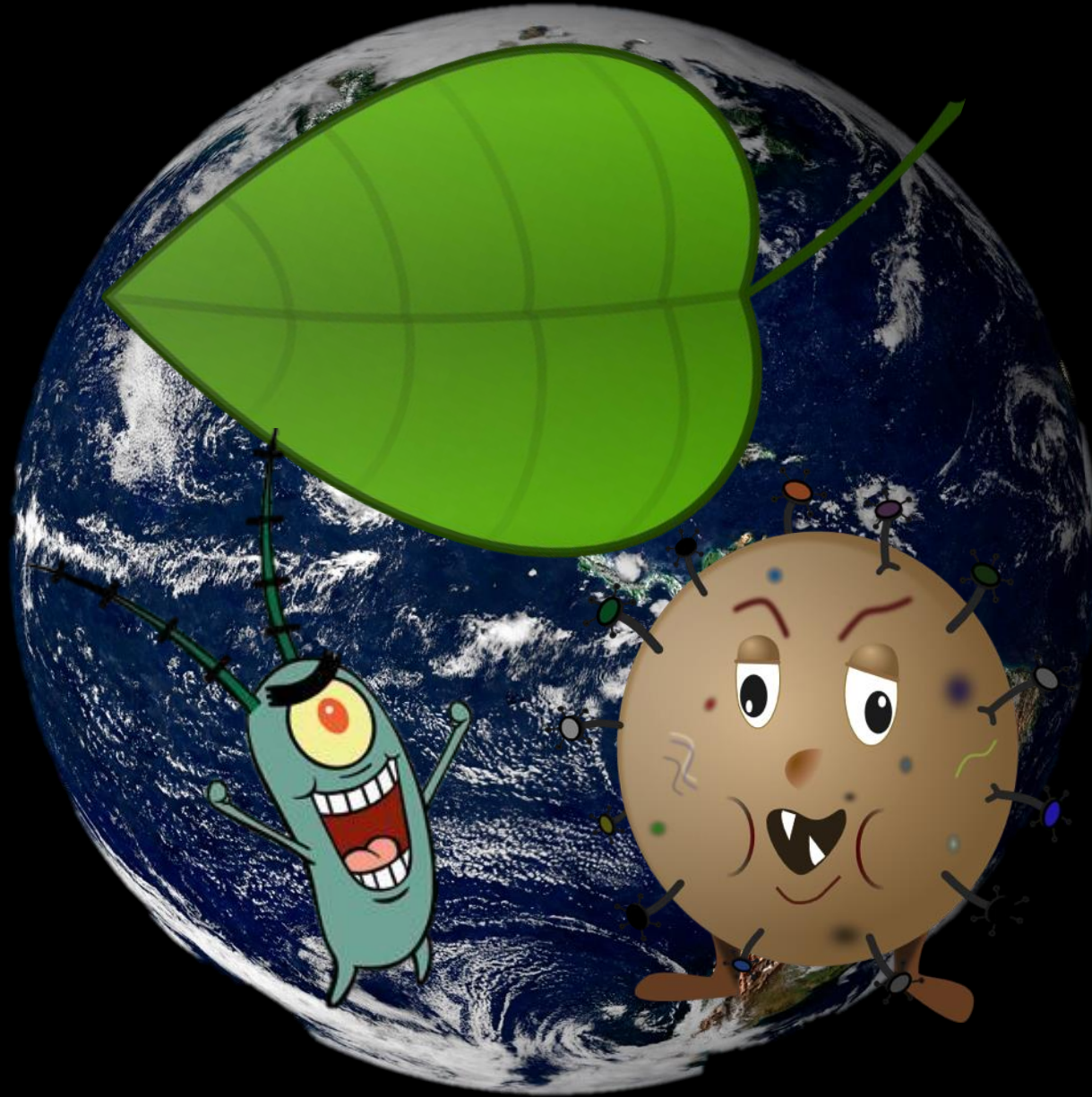
Chemistry

Catalyst

soil Conditions



Functional traits and the global C cycle

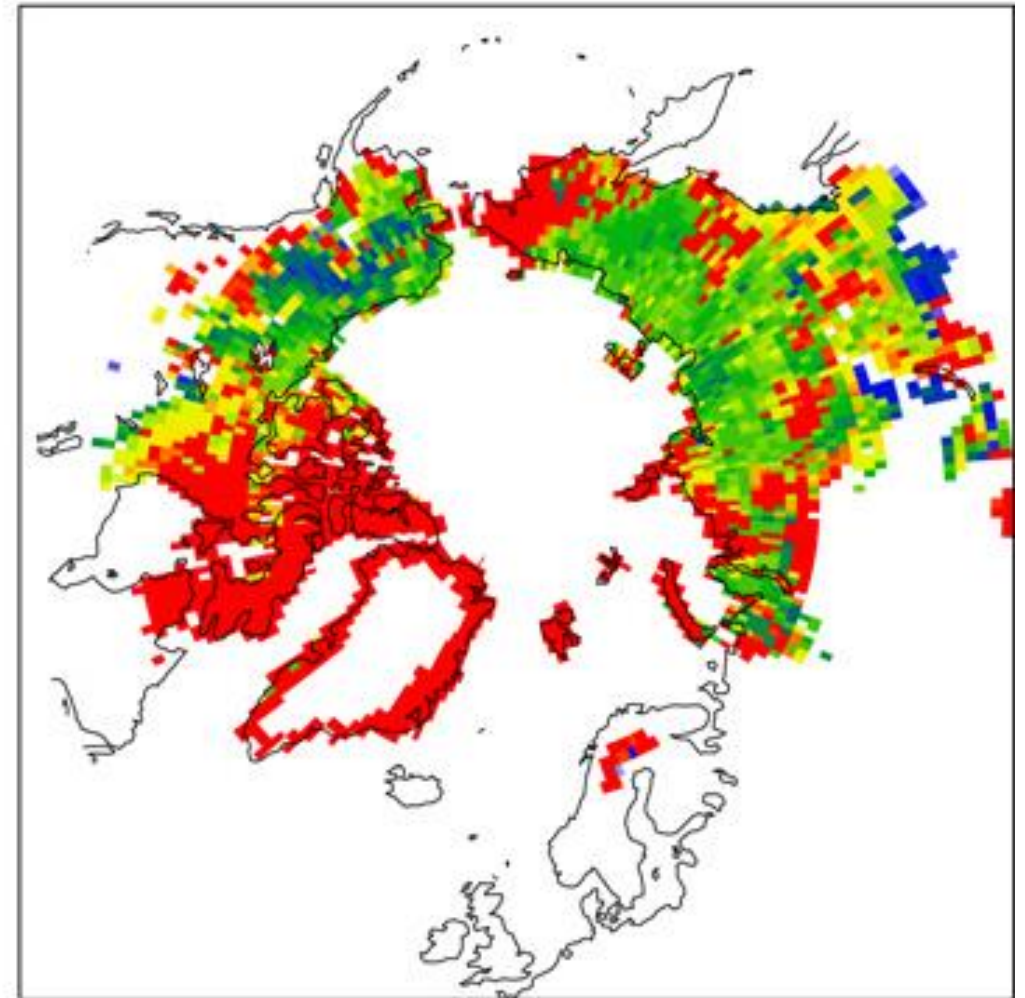




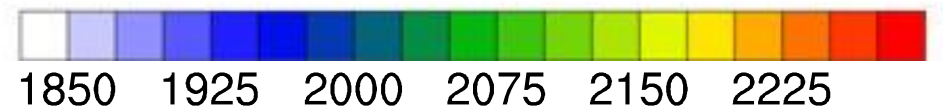
Building models that reflect our understanding

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2. Biased Examples
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Depth resolved



Year of change to C source

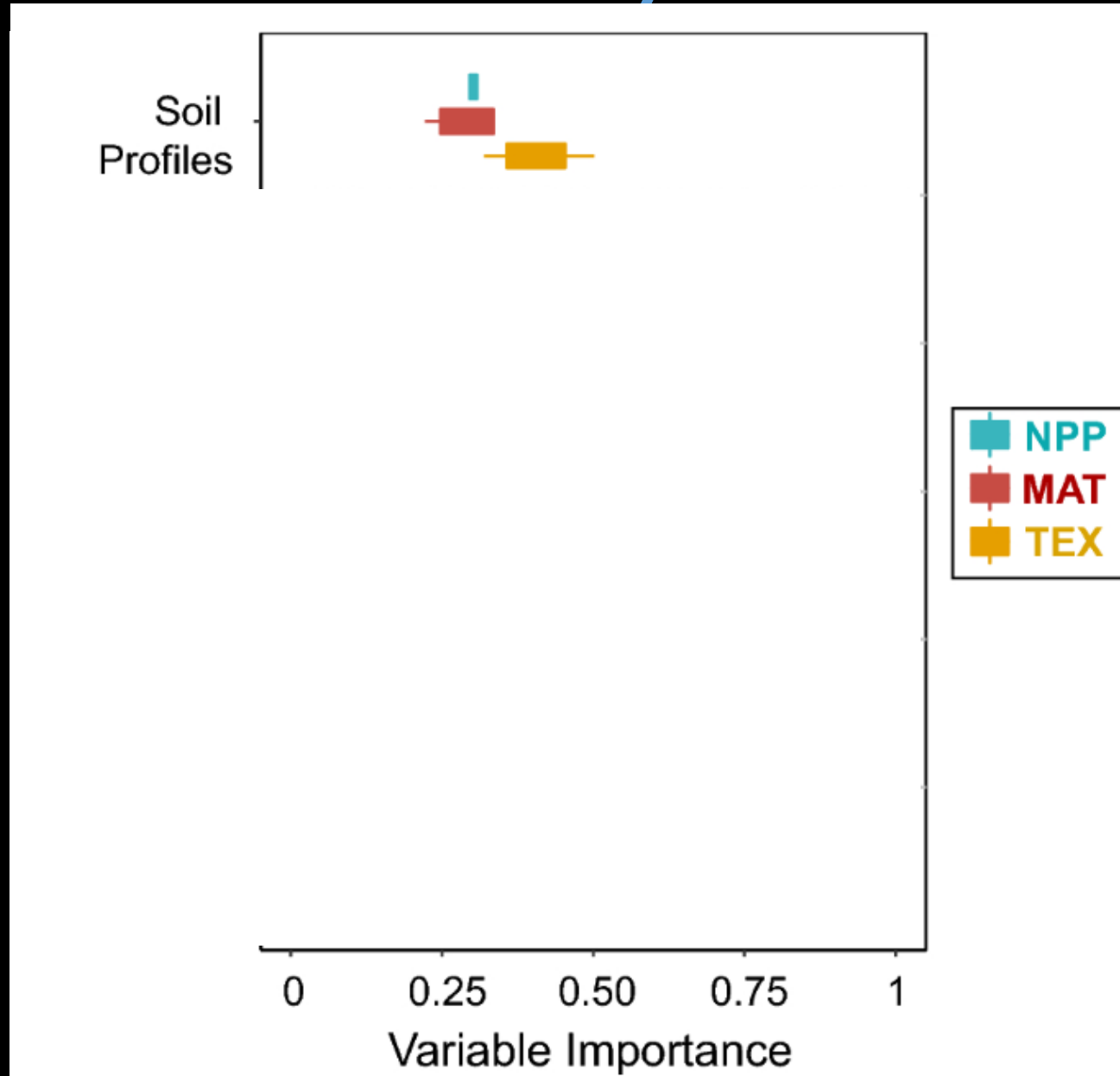


Koven et al. 2015

Nutrient enabled
with real **feedbacks** to vegetation



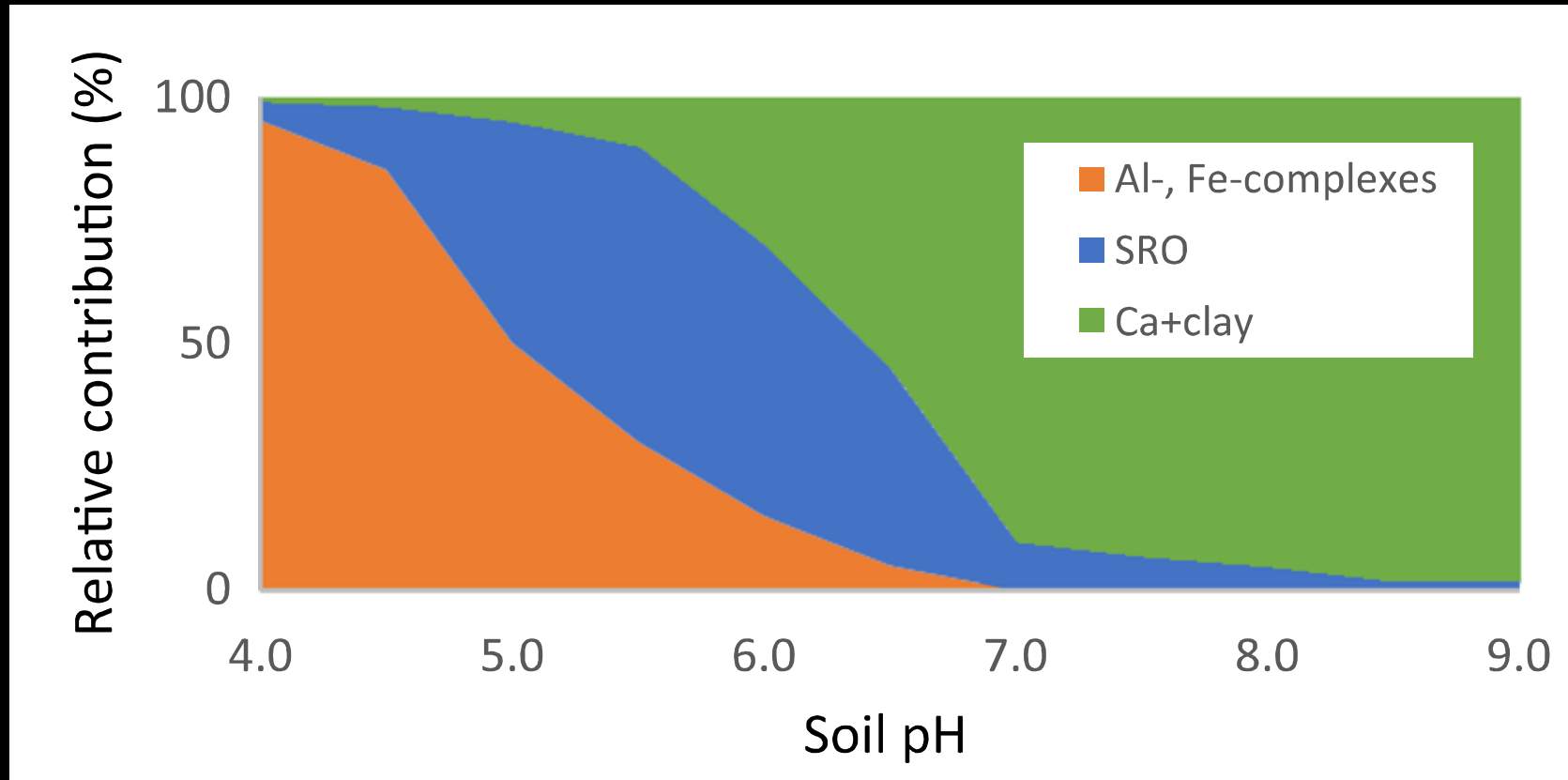
Improved Geochemistry



Georgiou et al
Biogeochemistry (2021)

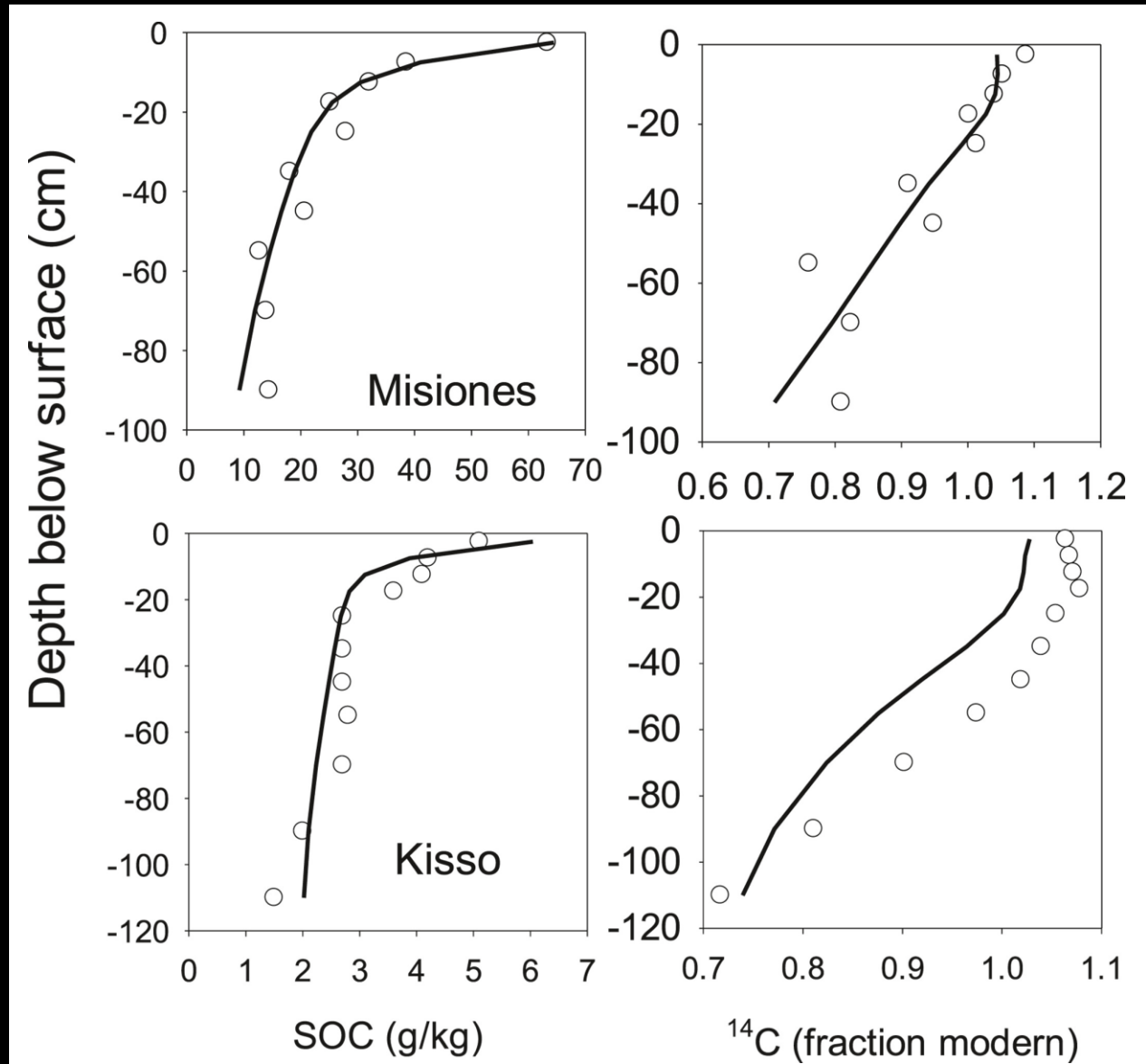
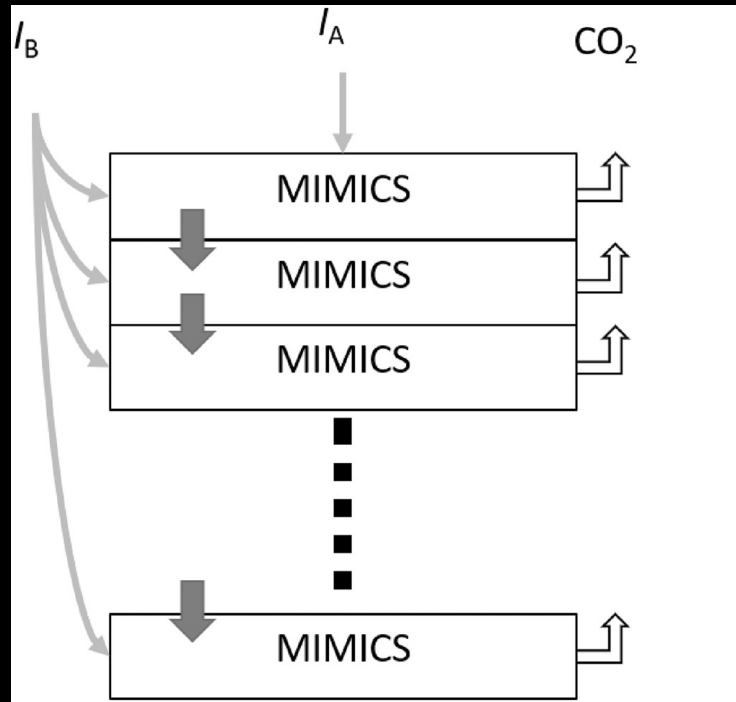


Improved Geochemistry

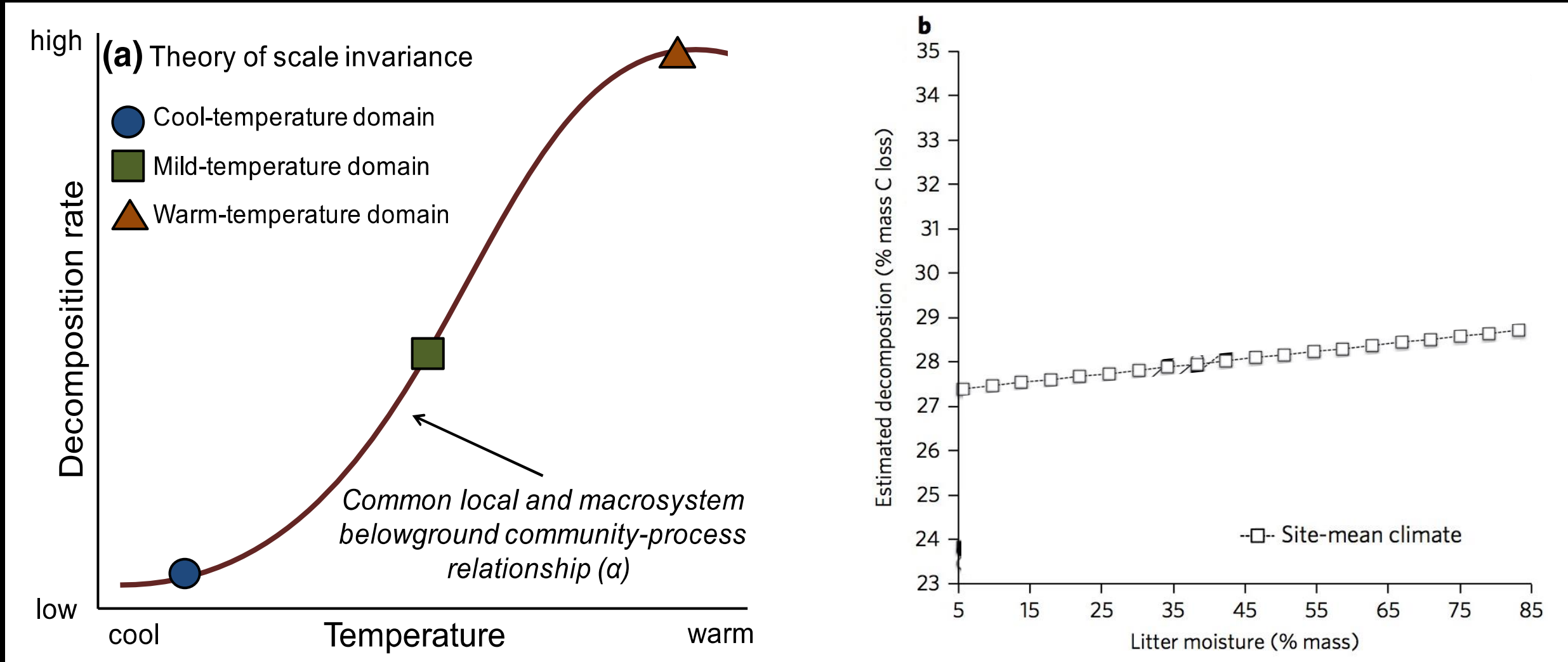


mechanisms of Persistence

Improved Parameterization



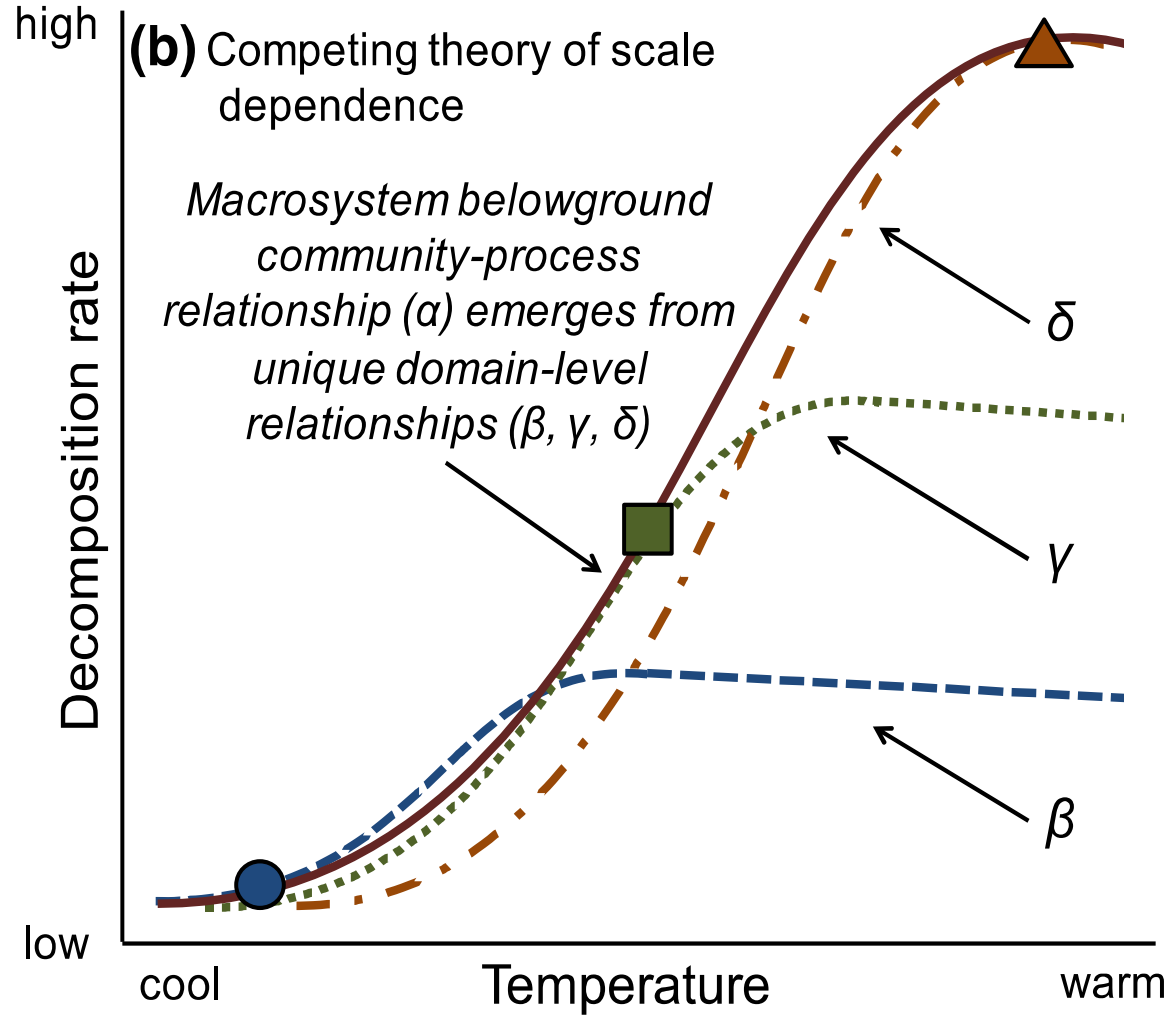
Scale independent



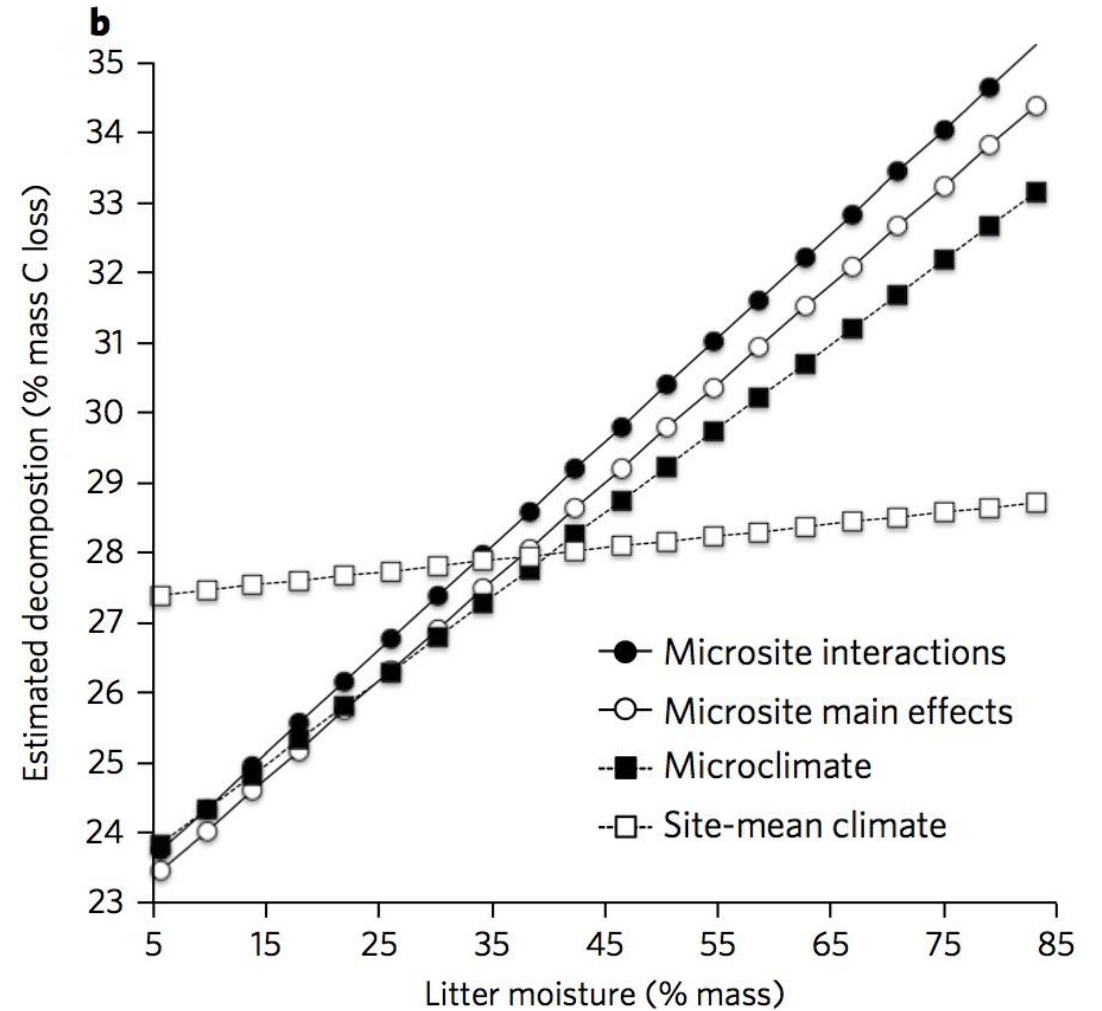
Bradford et al. *Biogeochemistry* (2021)

Bradford et al. *Nature Eco Evo* (2017)

Scale Dependence



Bradford et al. *Biogeochemistry* (2021)



Bradford et al. *Nature Eco Evo* (2017)



Building models that reflect our understanding

- **Depth** resolved
- **Nutrient** enabled with real vegetation feedbacks
- Better represent **geochemistry** & mechanisms of persistence
- Improved **parameterization** – considering scale dependence

Thanks! wwieder@ucar.edu

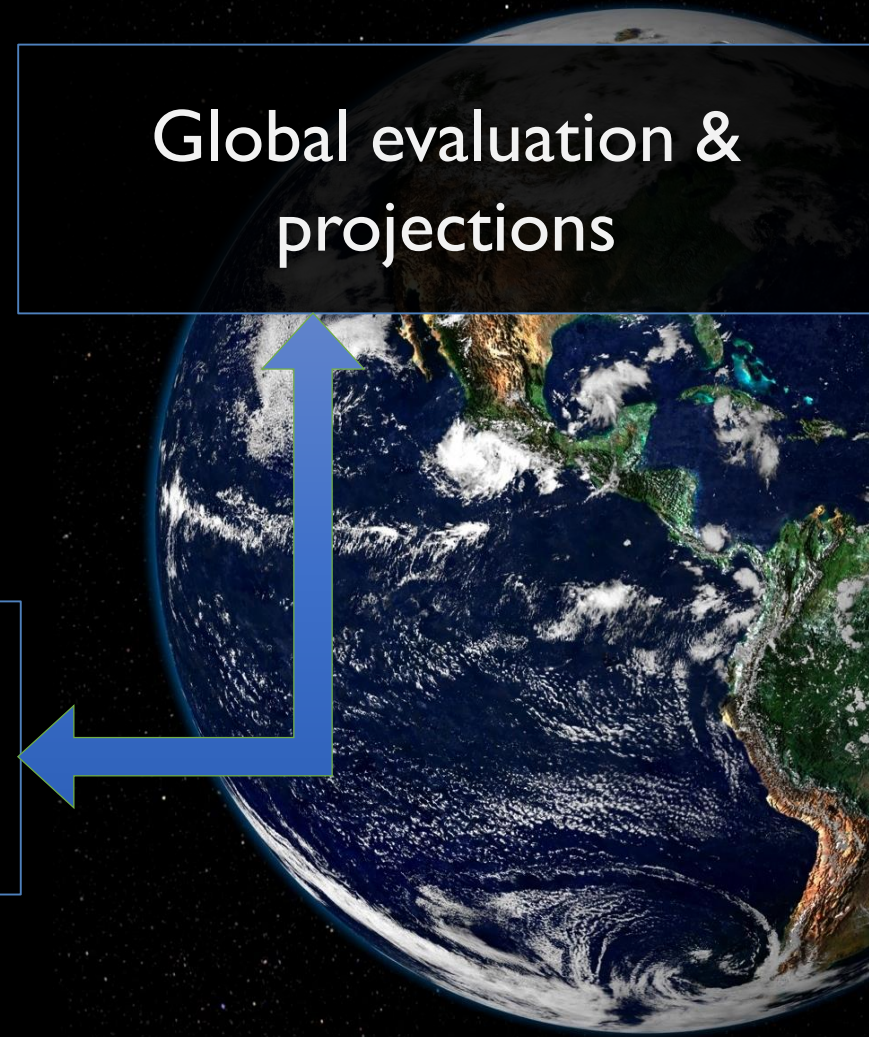
Moving **forward**?



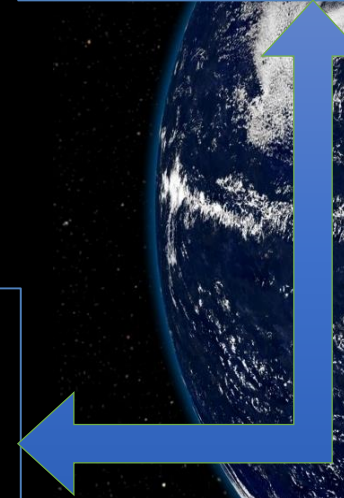
Physiological traits &
geochemical insights

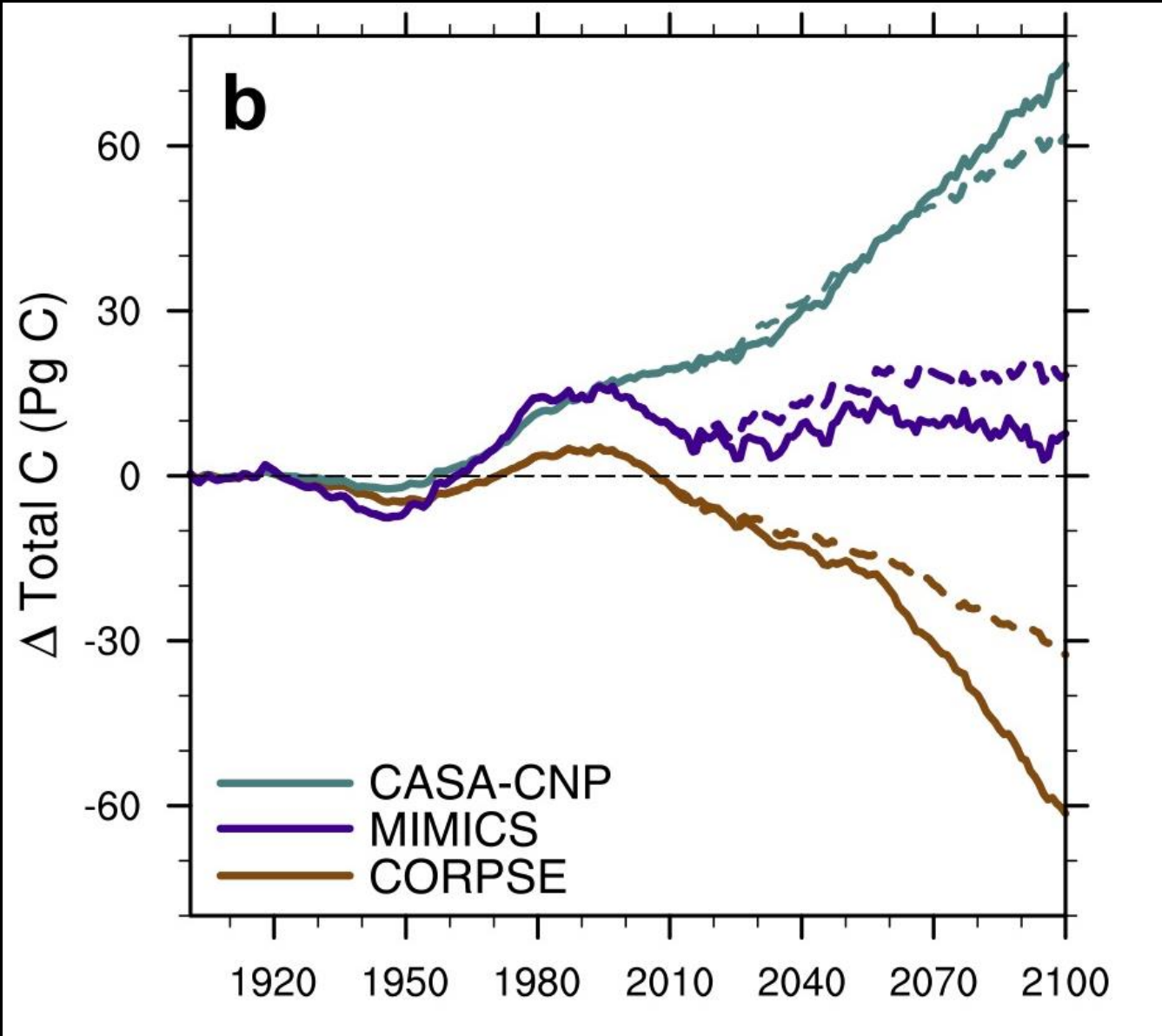


Landscape variation &
response to perturbations



Global evaluation &
projections





Chemistry



Catalysts



Conditions

