

Do soil microbial communities matter for modeling temperate forest litter decomposition?

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Yale SCHOOL OF
THE ENVIRONMENT

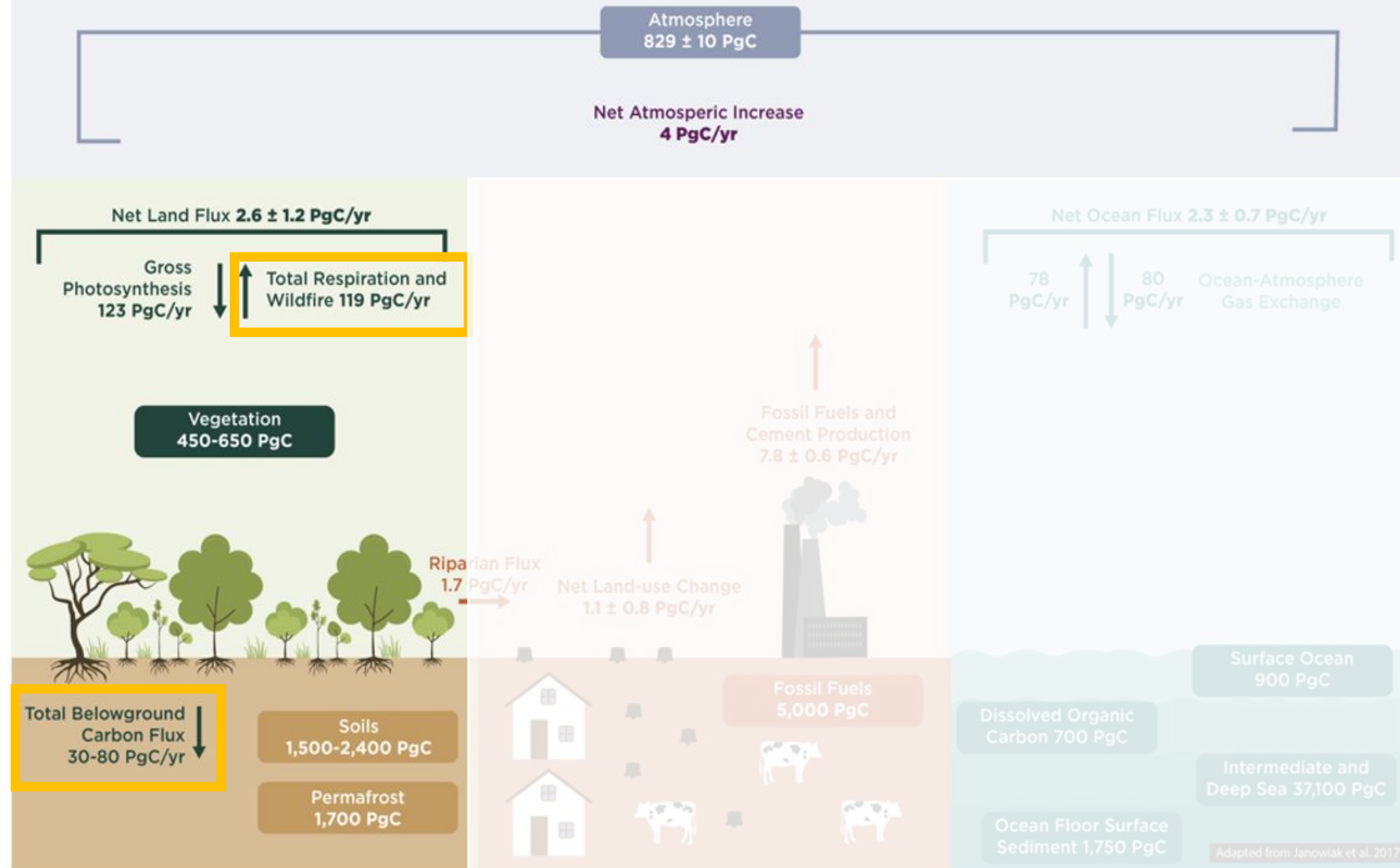


The Nature
Conservancy



NCAR
CGD

Atmospheric Carbon Pools and Fluxes

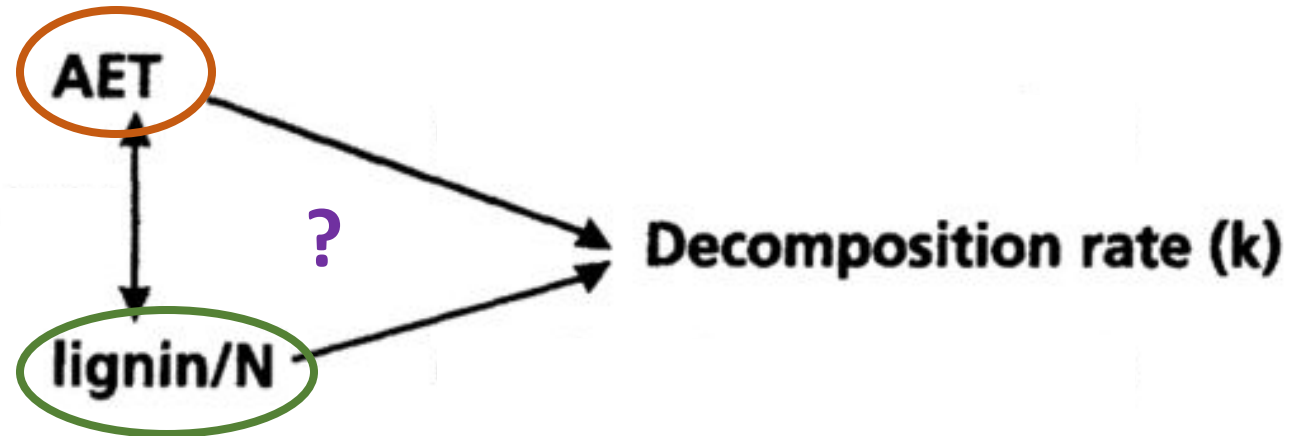


Adapted from Janowiak et al. 2017

Litter decomposition is a globally important C flux

What controls litter decomposition?

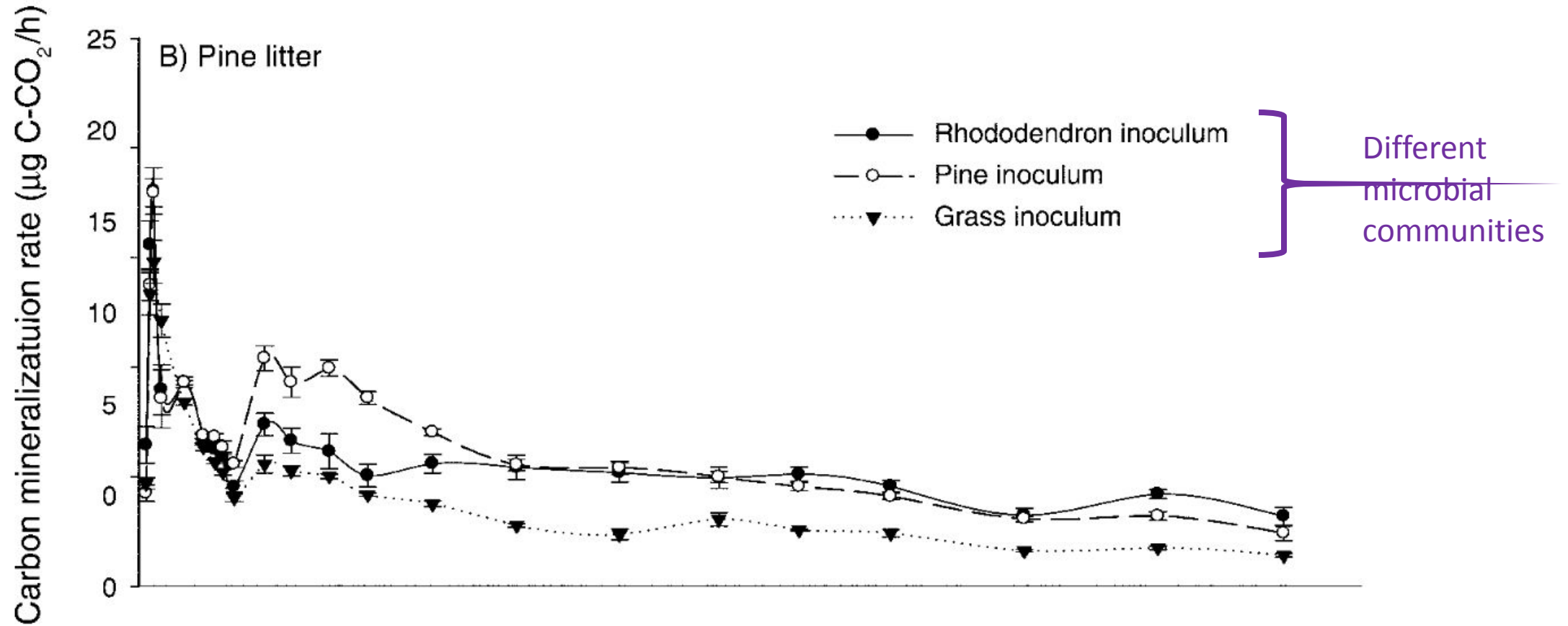
Climate



Litter
quality

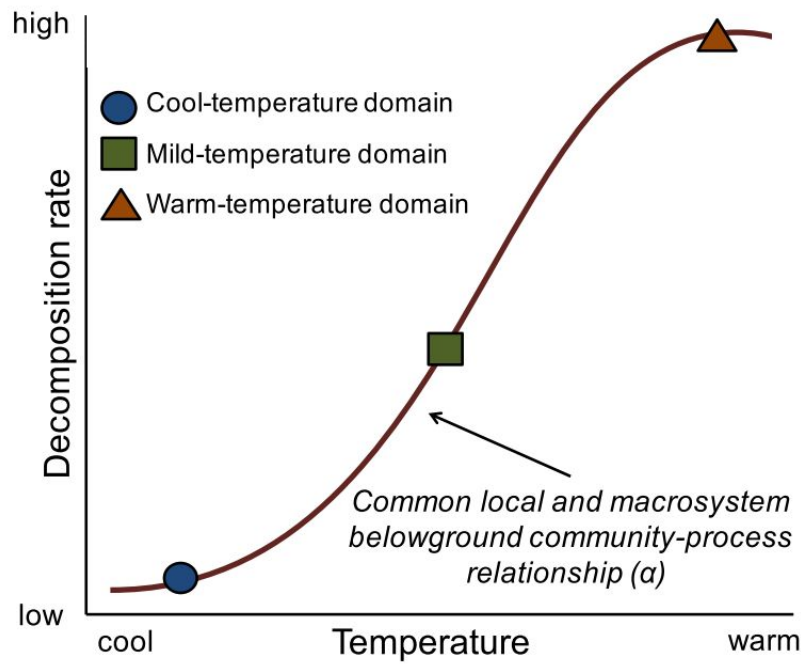
Soil microbial communities matter!

Proxy for decomposition rate

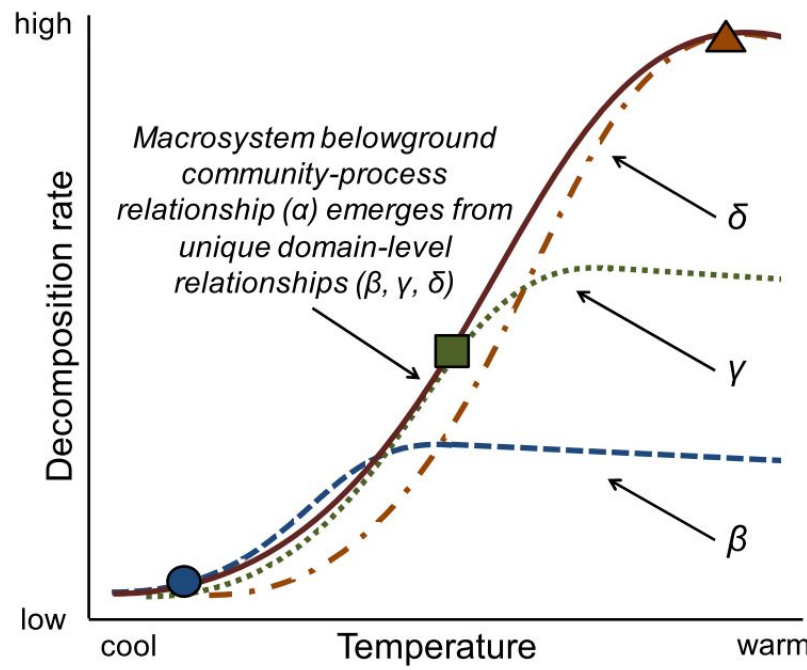


So, microbial community might matter!

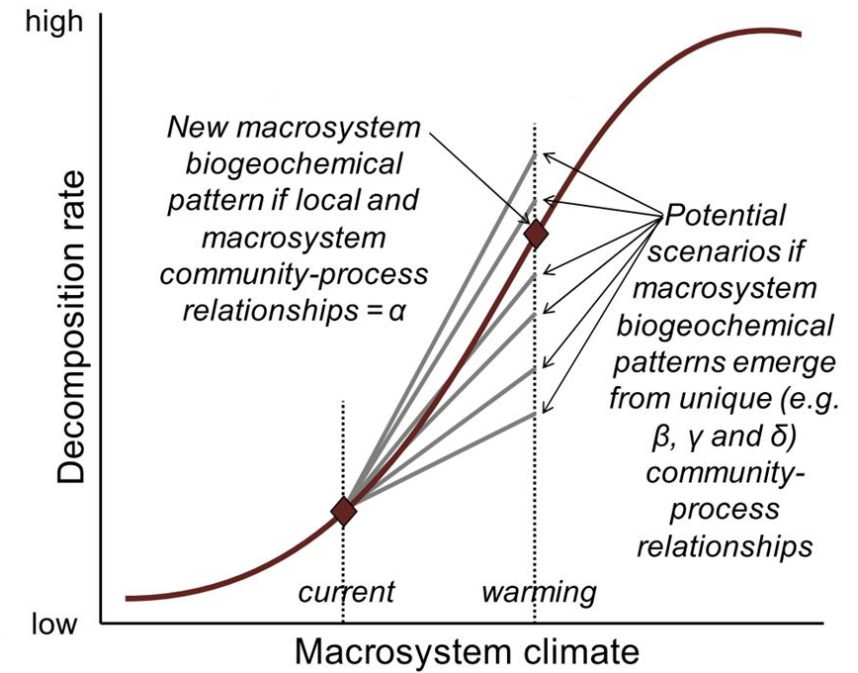
Aerts model, represented in most land models



If microbial community matters



Potential responses to climate change

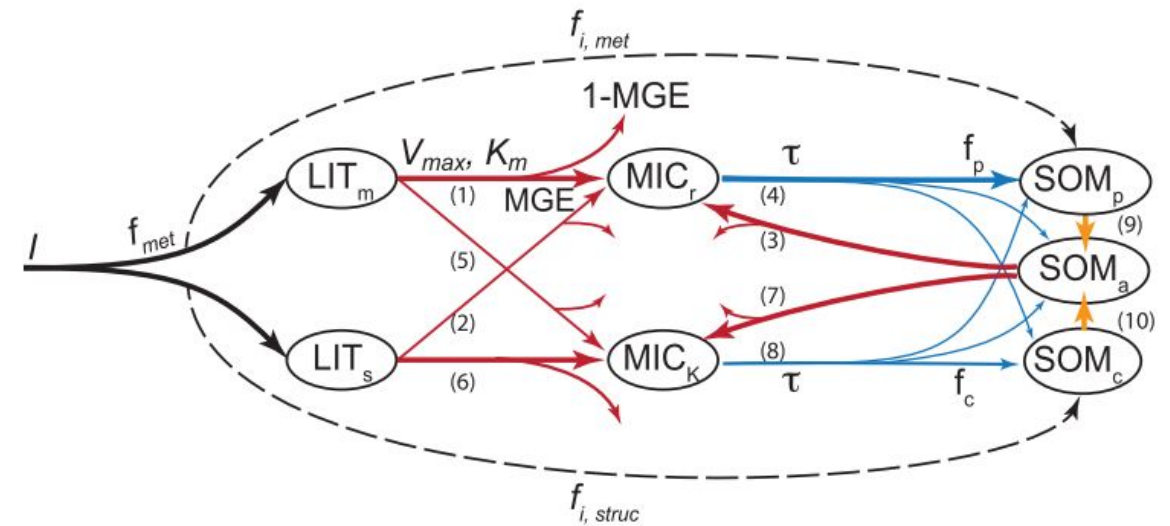
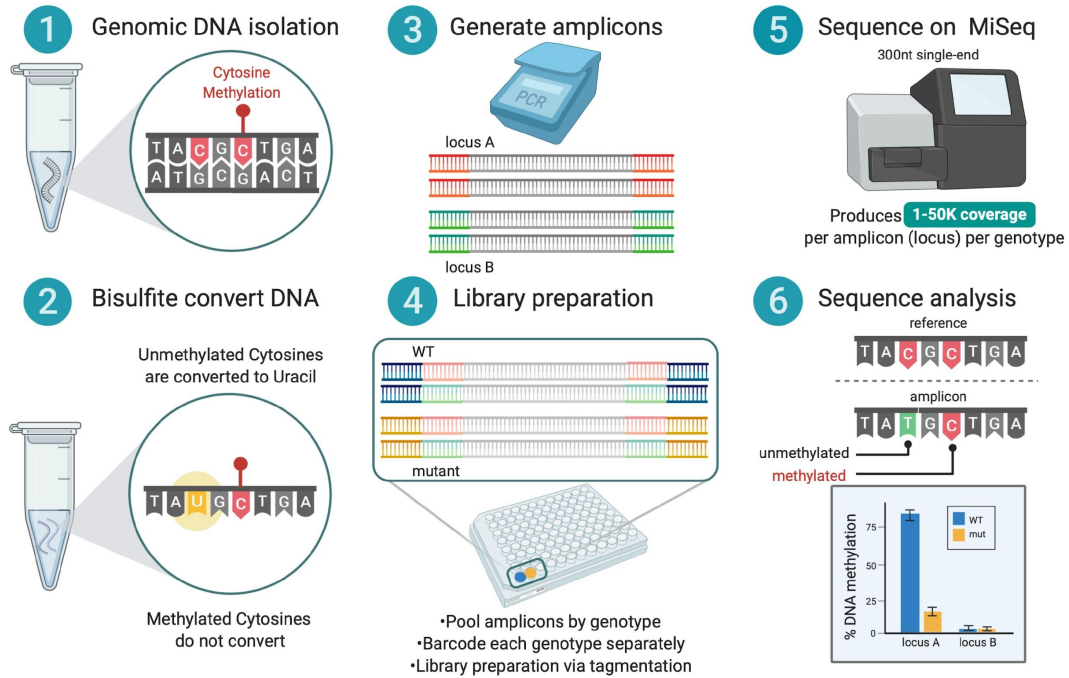


So, if microbes matter how do we study them?

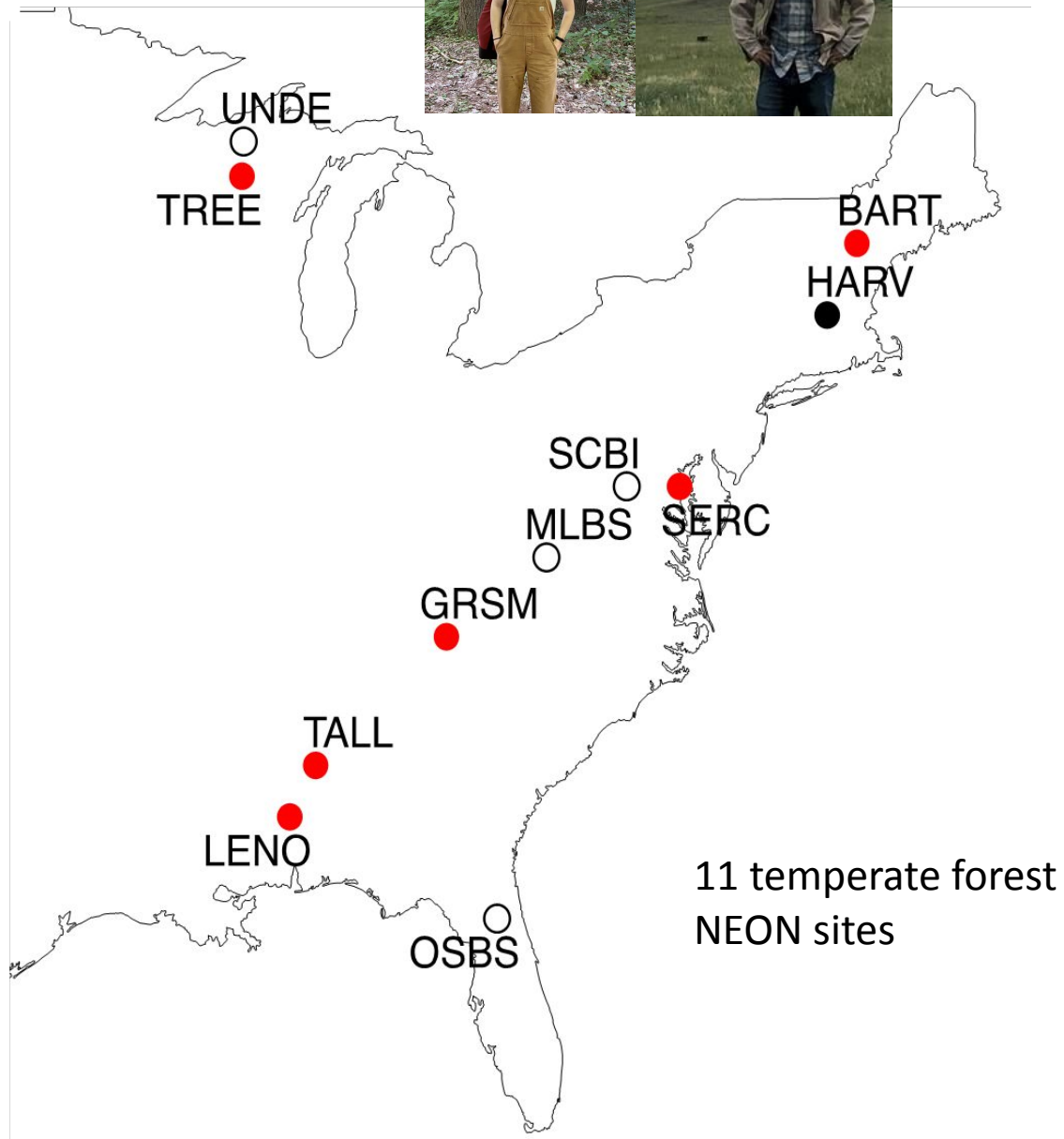
Microbial community data

+

Microbially explicit models



The data toolset to study litter decomposition



1. Incubation – isolates microbial effect
2. Field – highly replicated 2-year litterbag study
3. Modeling – what we'll talk about!

Litterbag studies



- 36 (3 litter types x 12 replicates) litterbags deployed at each site

Litter quality

- Soil moisture measured at each plot

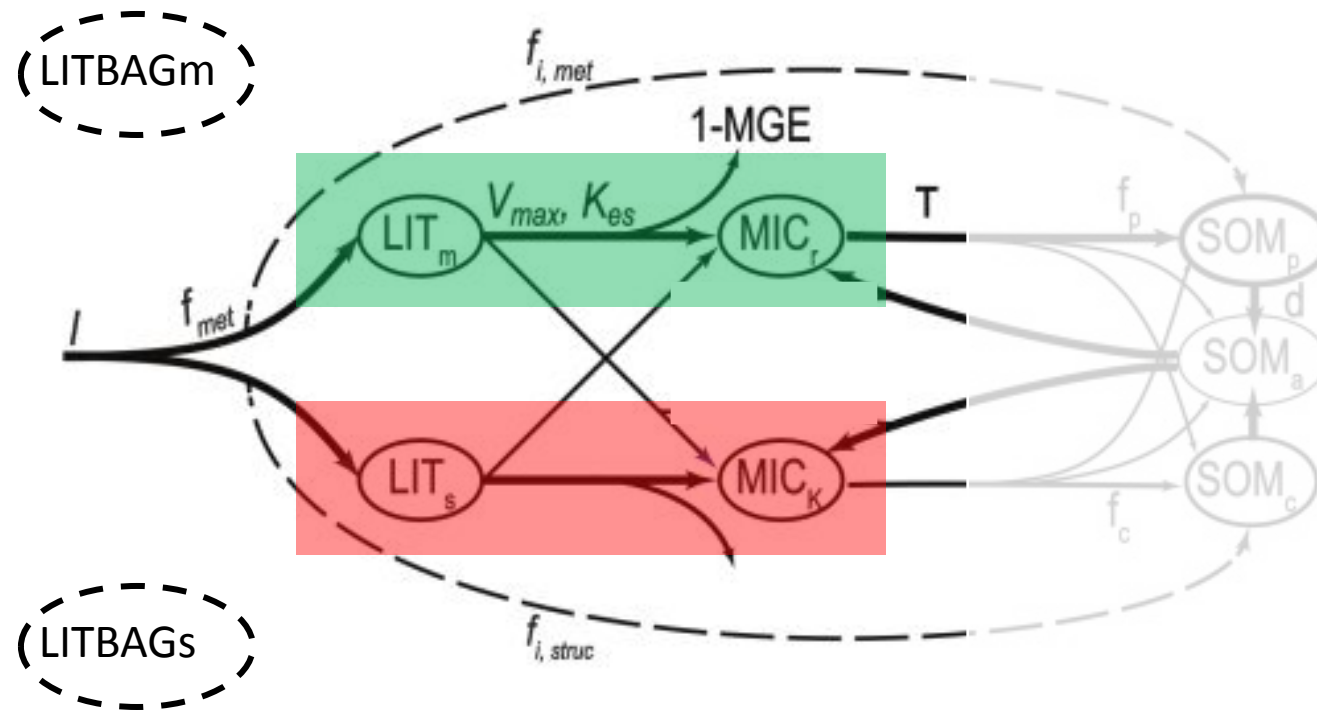
Climate

- Sites vary in climate

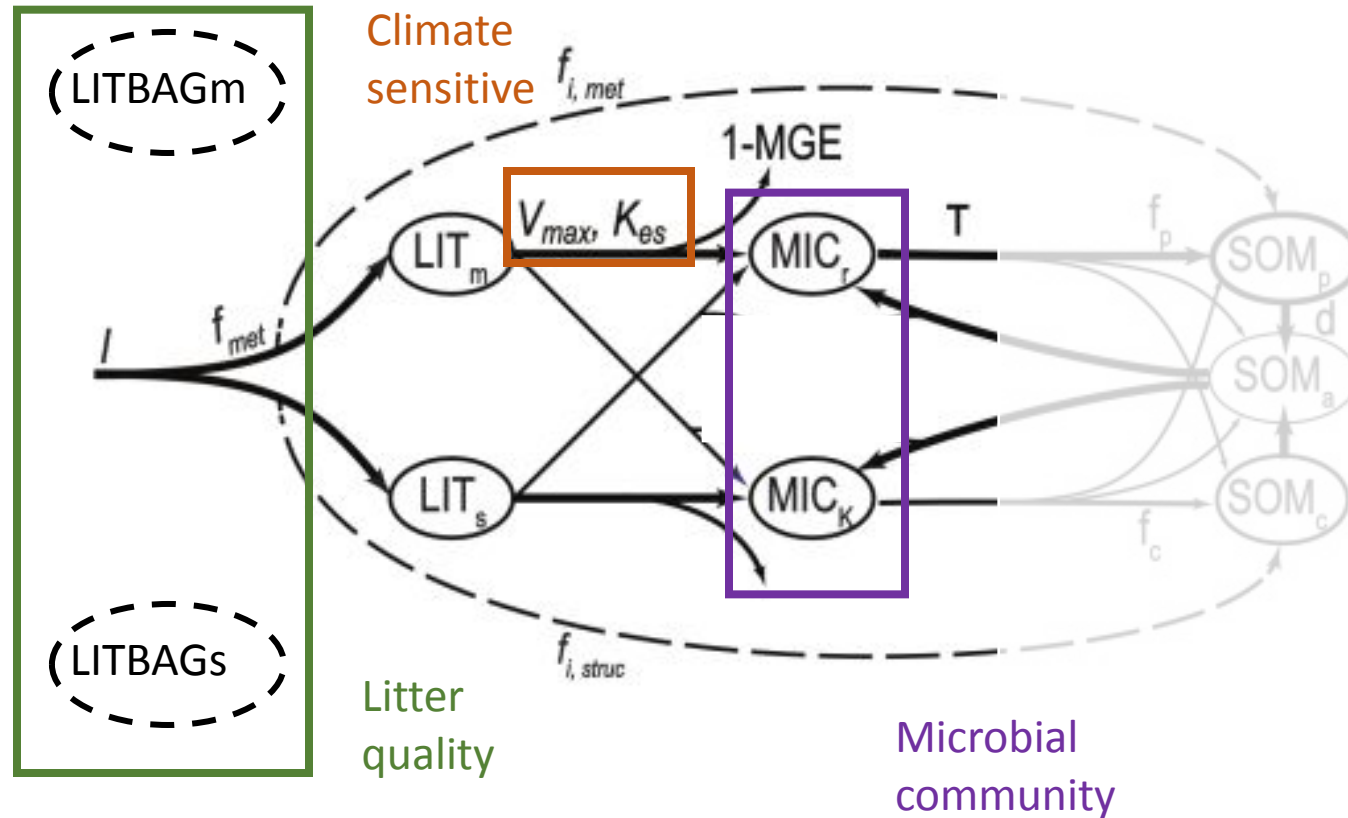
- Measured microbial diversity in soils under litterbags

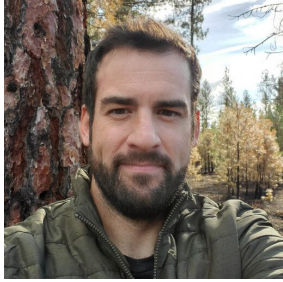
Microbial diversity

We created a litterbag version of the MIMICS model



We created a litterbag version of the MIMICS model



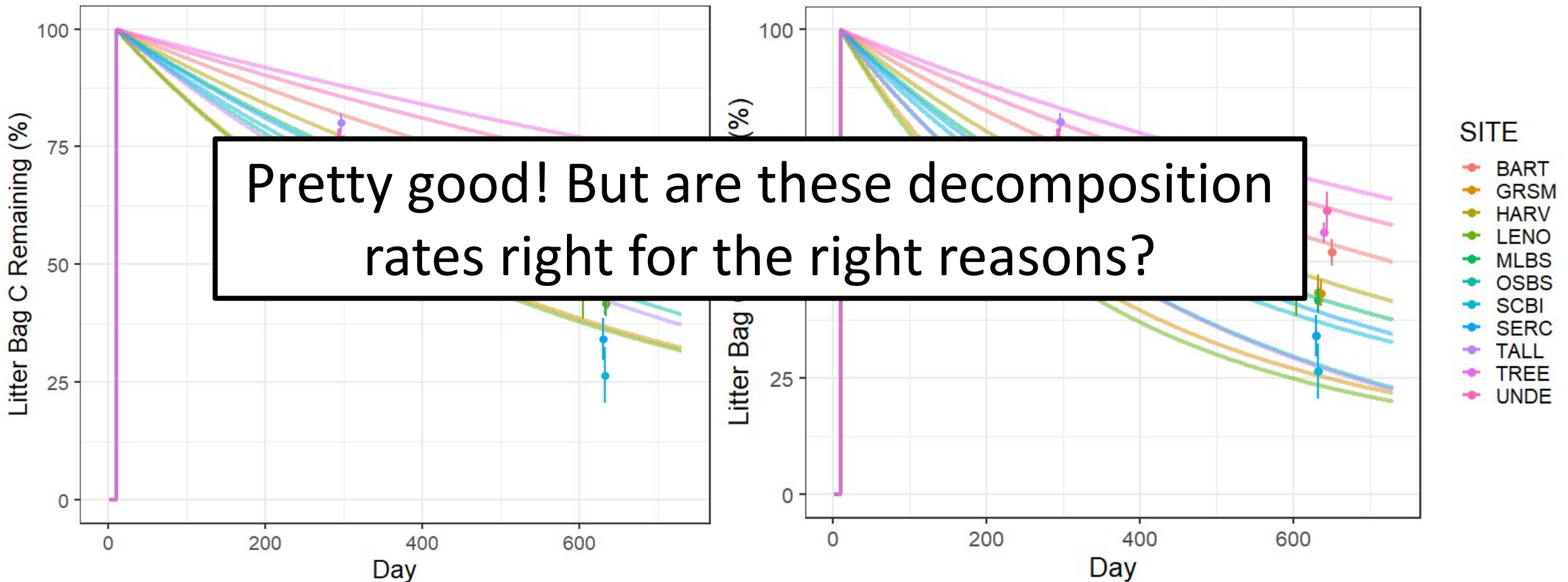


Our starting point

Out of the box MIMICS



Adjusted decomposition scalar and historically temperature sensitive parameters



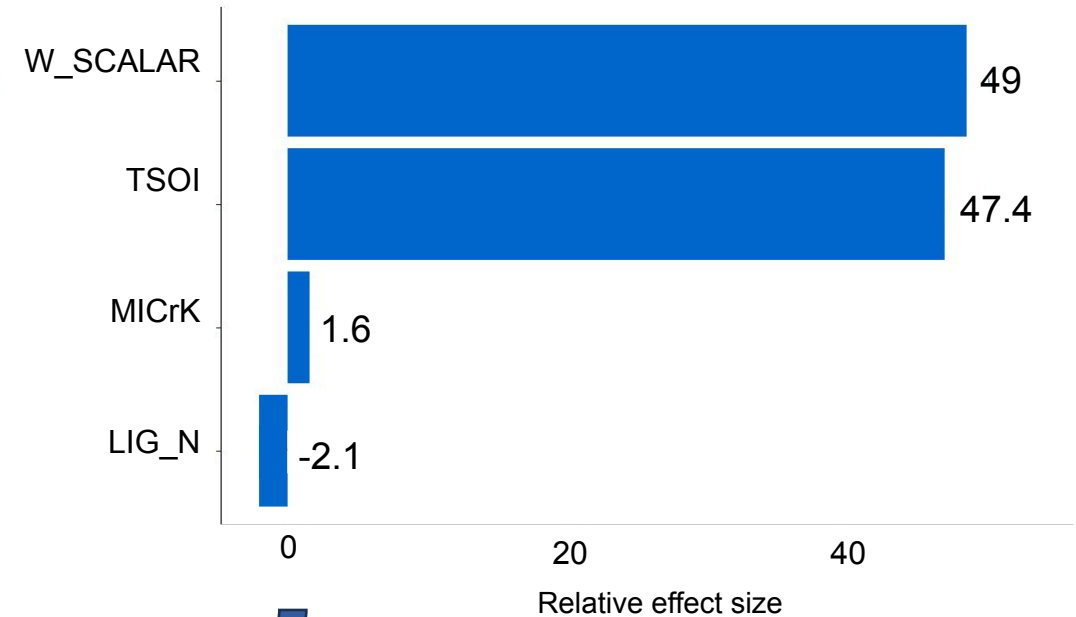
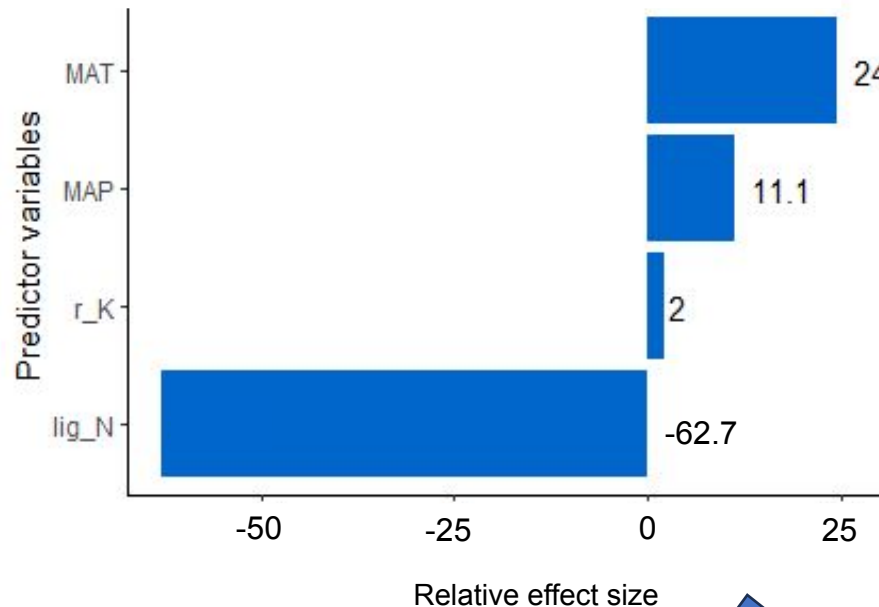
Our goal is to align the drivers in the model with drivers in the observations

An example:

Observations

Model output

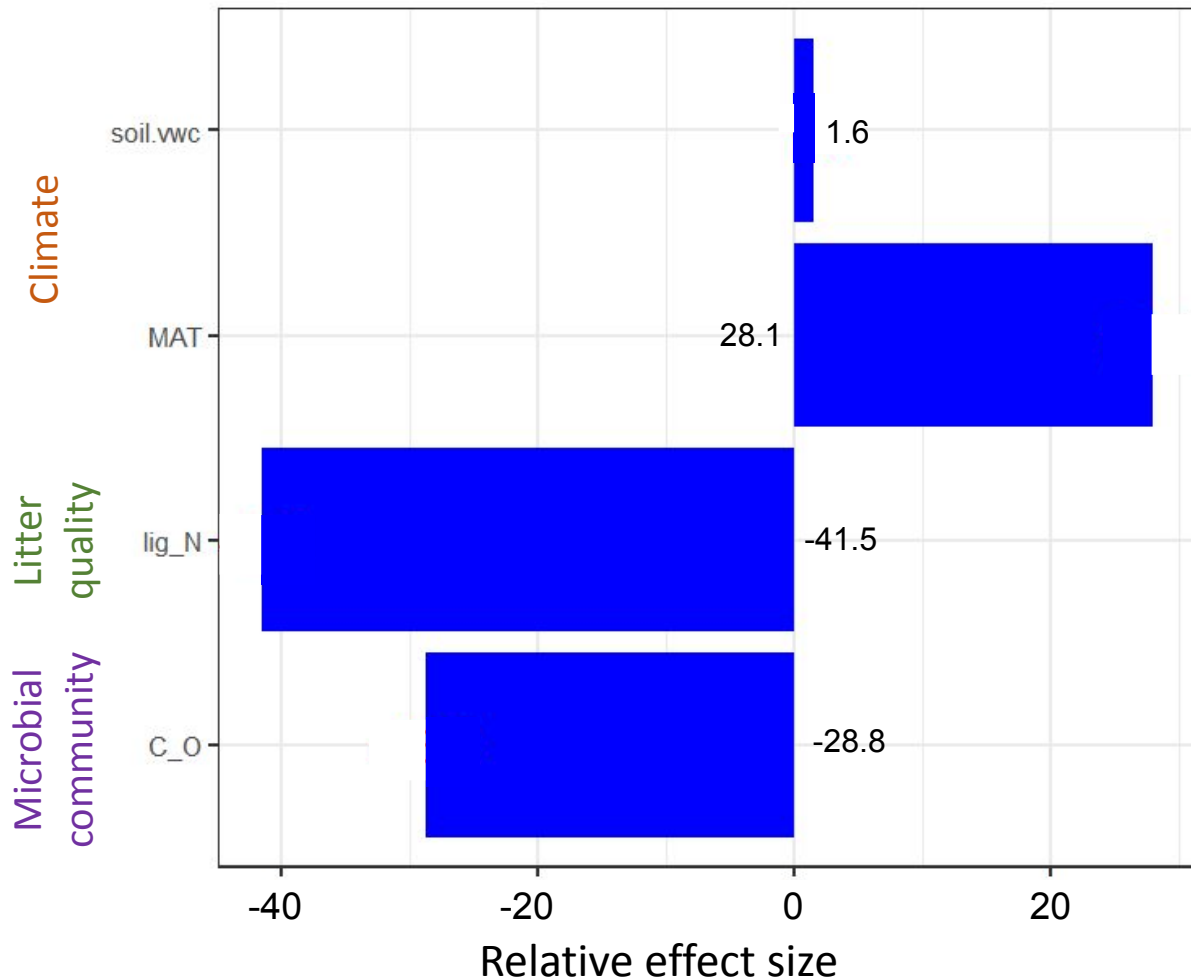
Climate
Microbial community
Litter quality



We want the model output to look like the observational output

Parameter estimation to match empirical drivers

Effect size estimates for observations

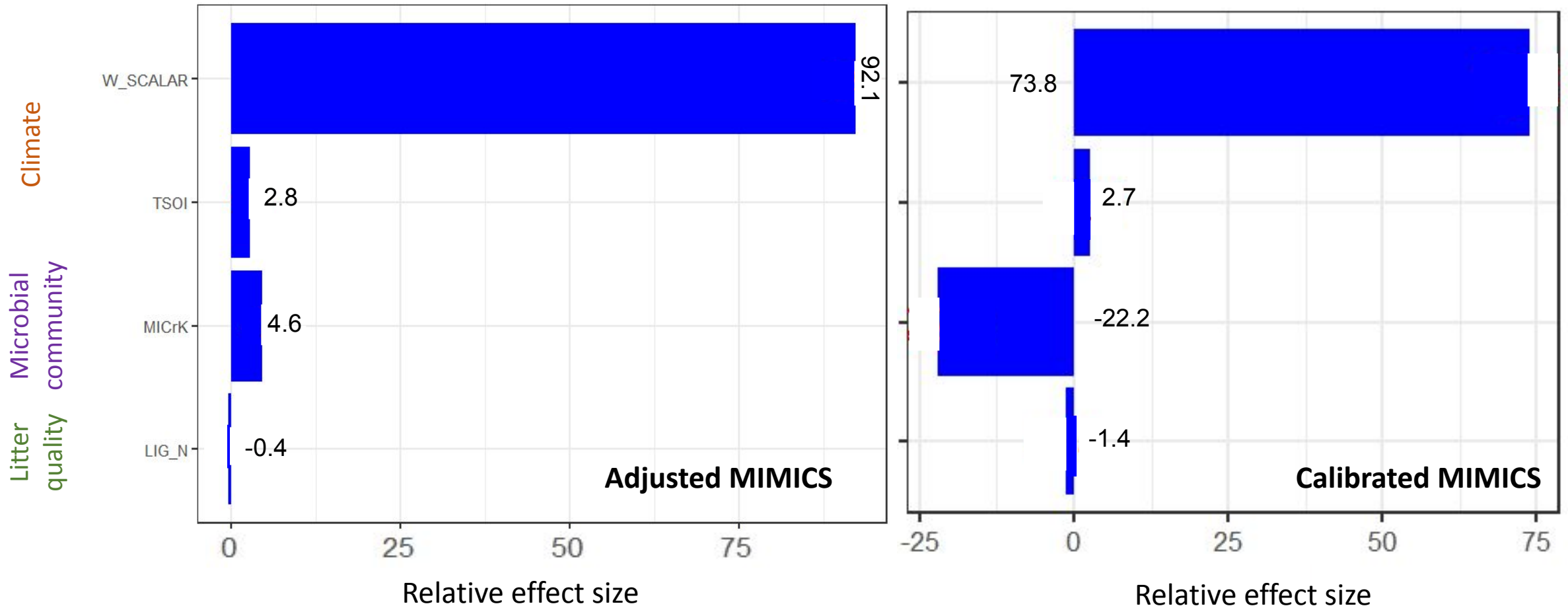


1. Monte Carlo parameter estimation – 8000 random parameter multipliers on vMOD & kMOD (microbial kinetics) and CUE & Tau (microbial physiology)
2. Filter out illogical parameter sets
3. Choose 50 lowest cost parameters: cost function minimizes differences in litter mass loss and empirical relative effect sizes

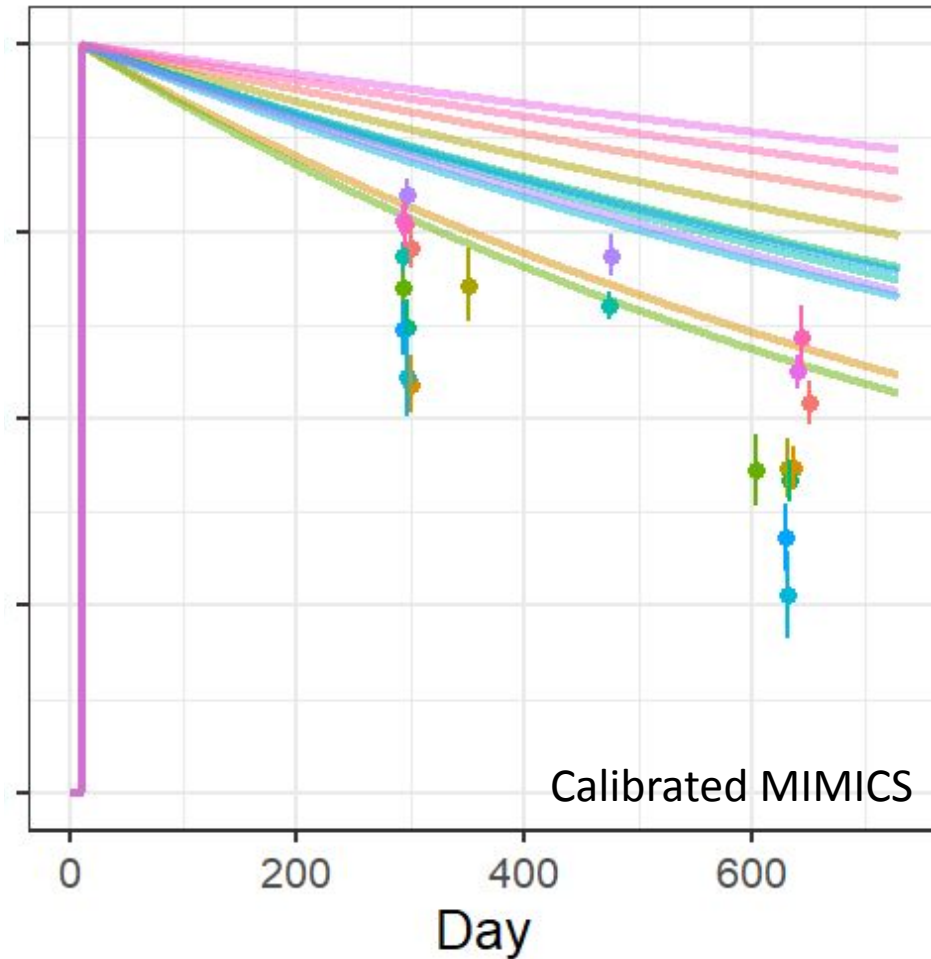
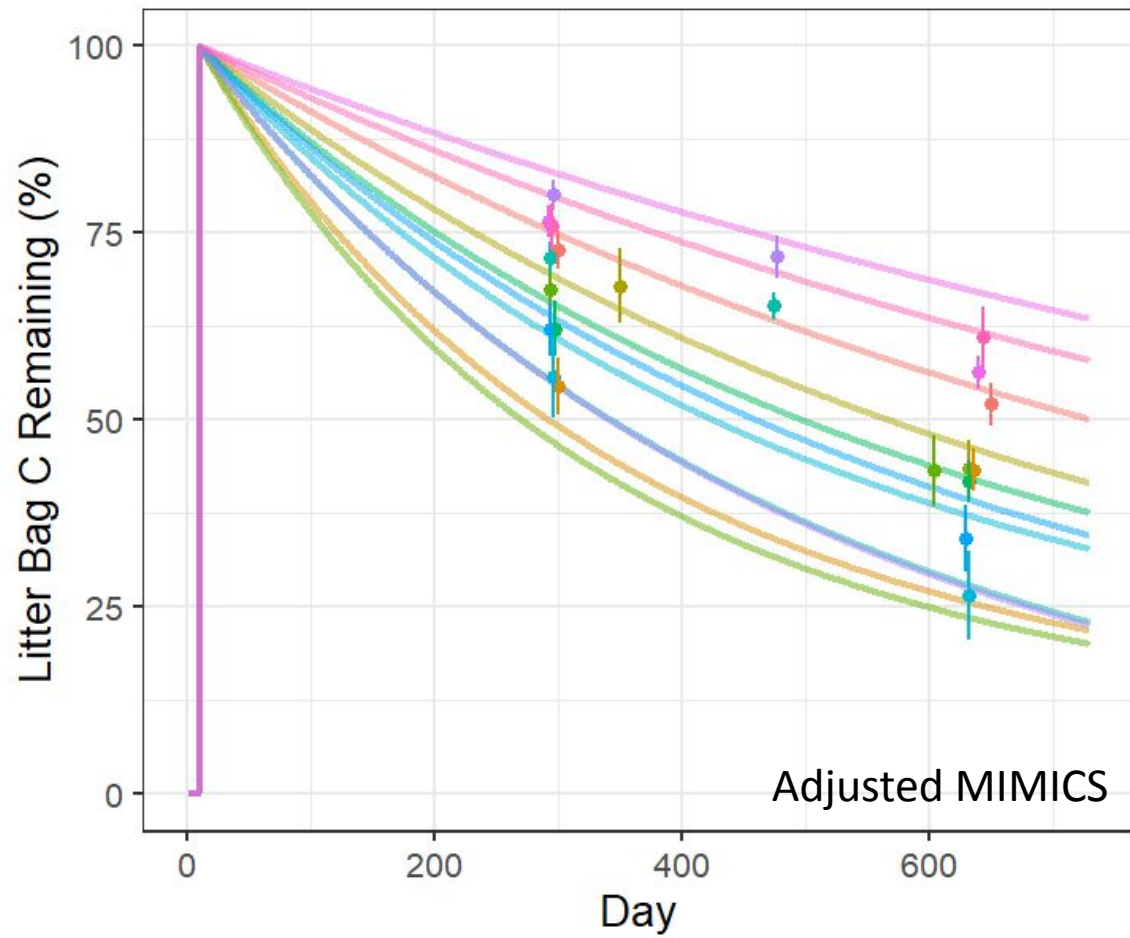


Empirical data emphasizes litter quality as most important

We can change relative importance! But not to match observations yet...



And we also ruin decomposition....

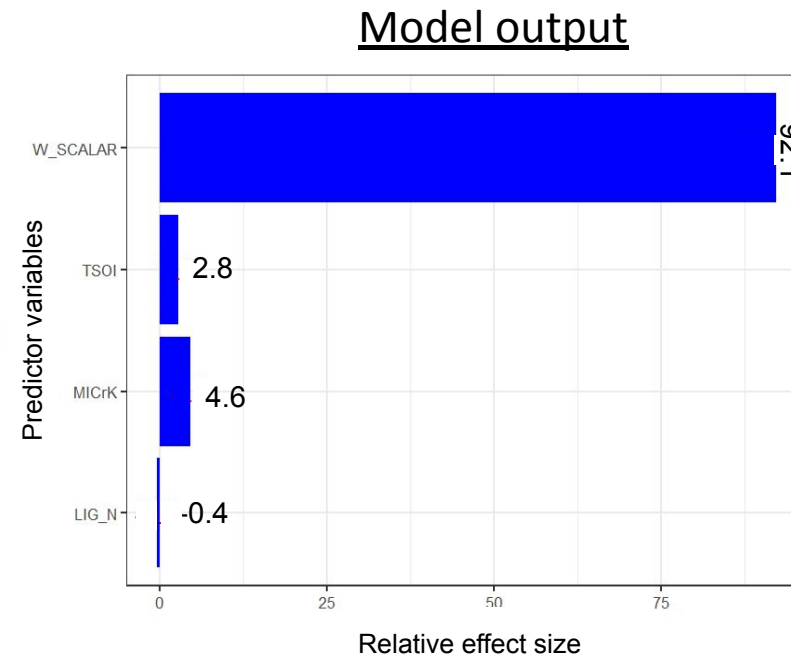
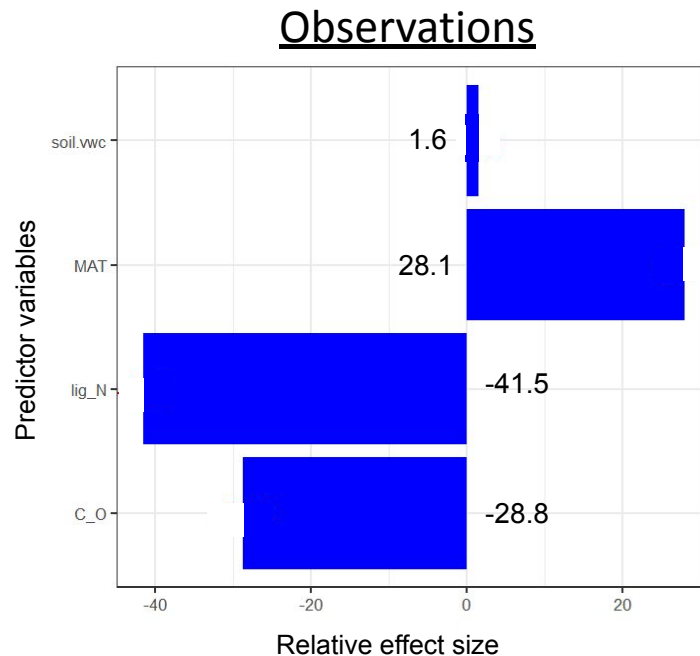


- SITE
- BART
 - GRSM
 - HARV
 - LENO
 - MLBS
 - OSBS
 - SCBI
 - SERC
 - TALL
 - TREE
 - UNDE

Looking forward

- Looking to try new cost functions and vary the parameters were calibrating
- If this works: test each parameter set under future climate projections using CLM

Observations emphasize litter quality, microbial community and temperature



MIMICS emphasizes soil moisture

Thanks for listening!



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... and these microbial communities might be shaped by historic climate

