

Biological effects on the “brown” C cycle



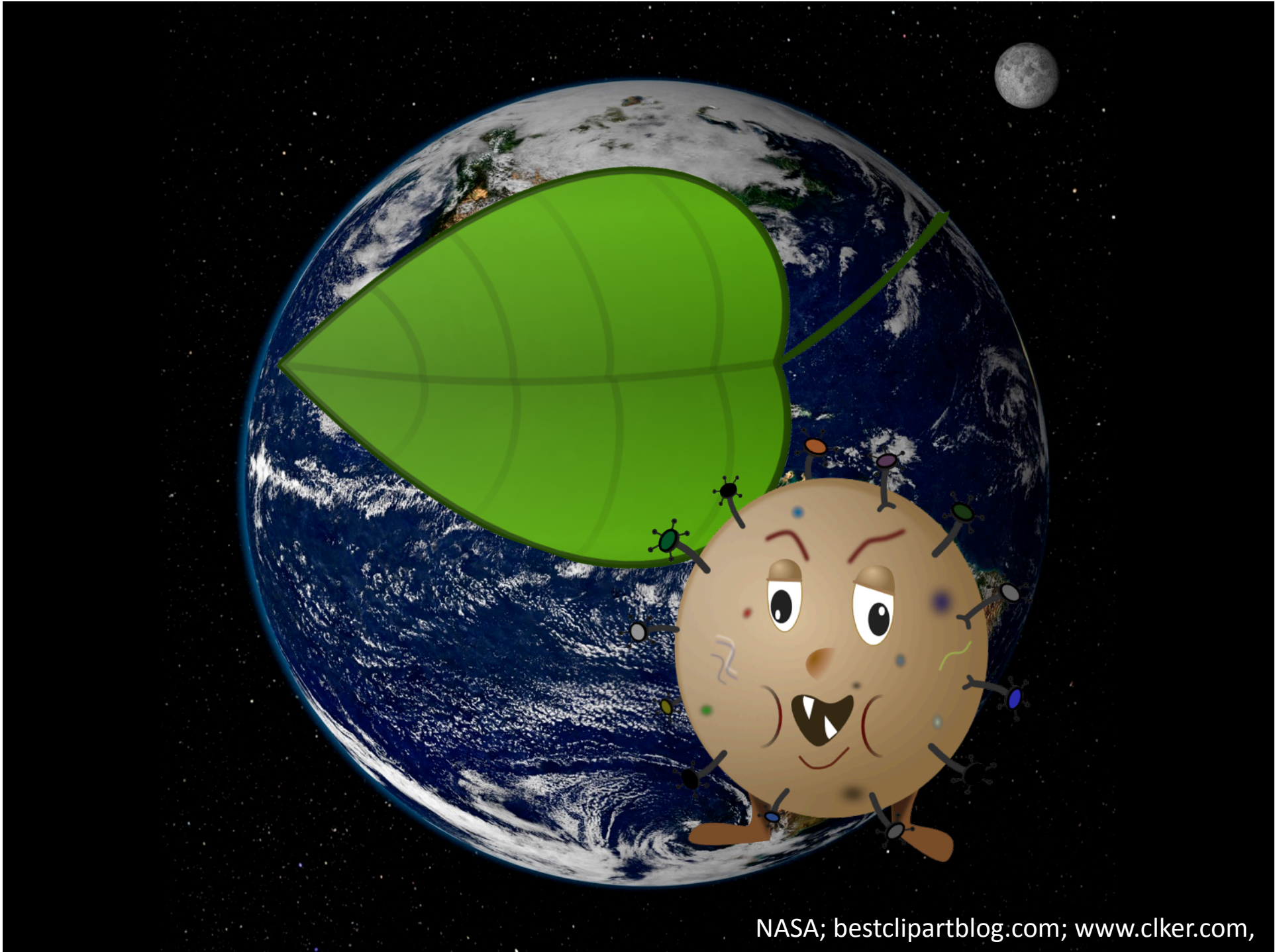
Will Wieder, Stuart Grandy,
Cynthia Kallenbach, Gordon Bonan

LWMG Meeting Feb. 2014

Do we need to rethink soil biogeochemical models?

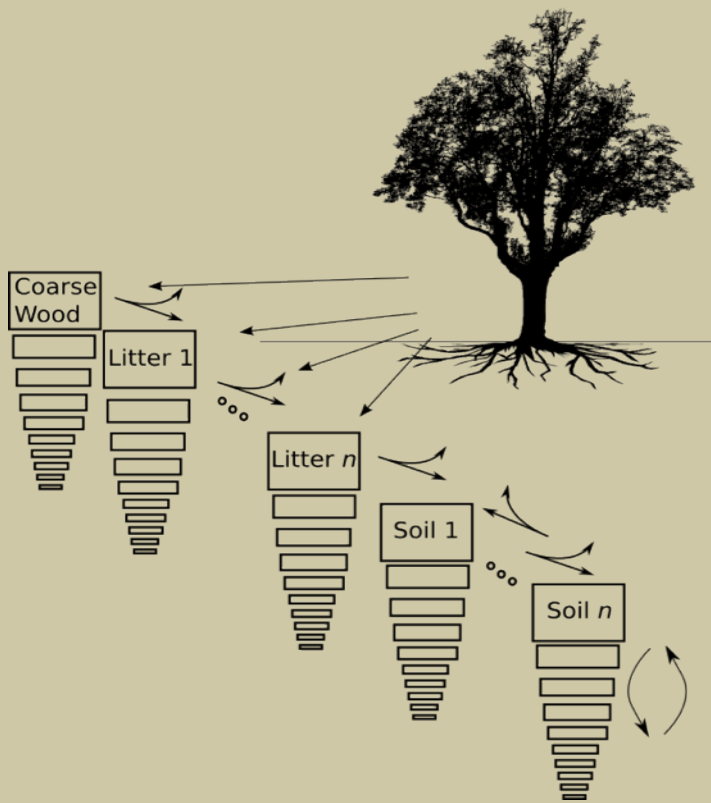


Todd-Brown et al. Biogeosciences 2013



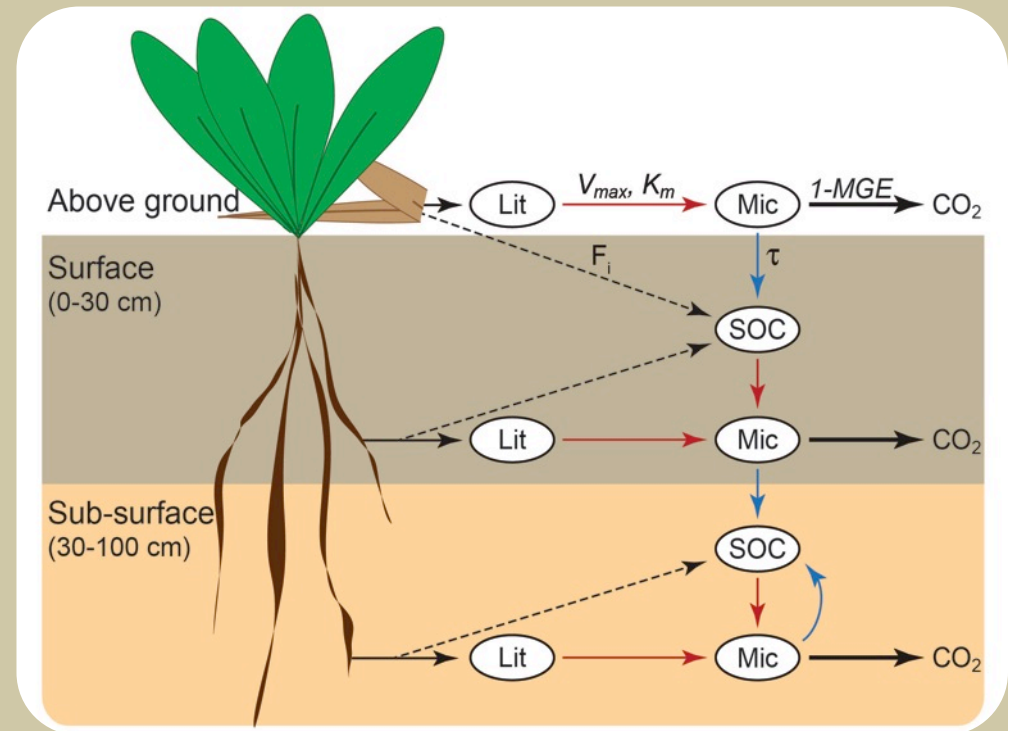
NASA; bestclipartblog.com; www.clker.com,

Traditional *Chemical recalcitrance*



Koven et al. *Biogeosciences* 2013

Emerging *Microbial activity*

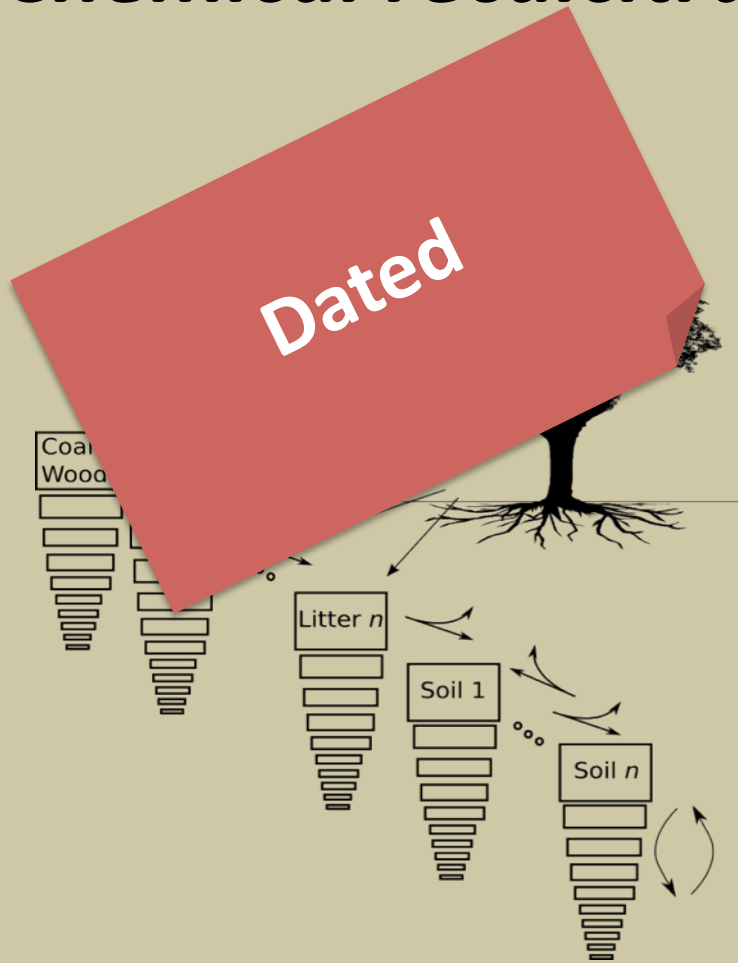


Wieder et al. *Nature Climate Change* 2013

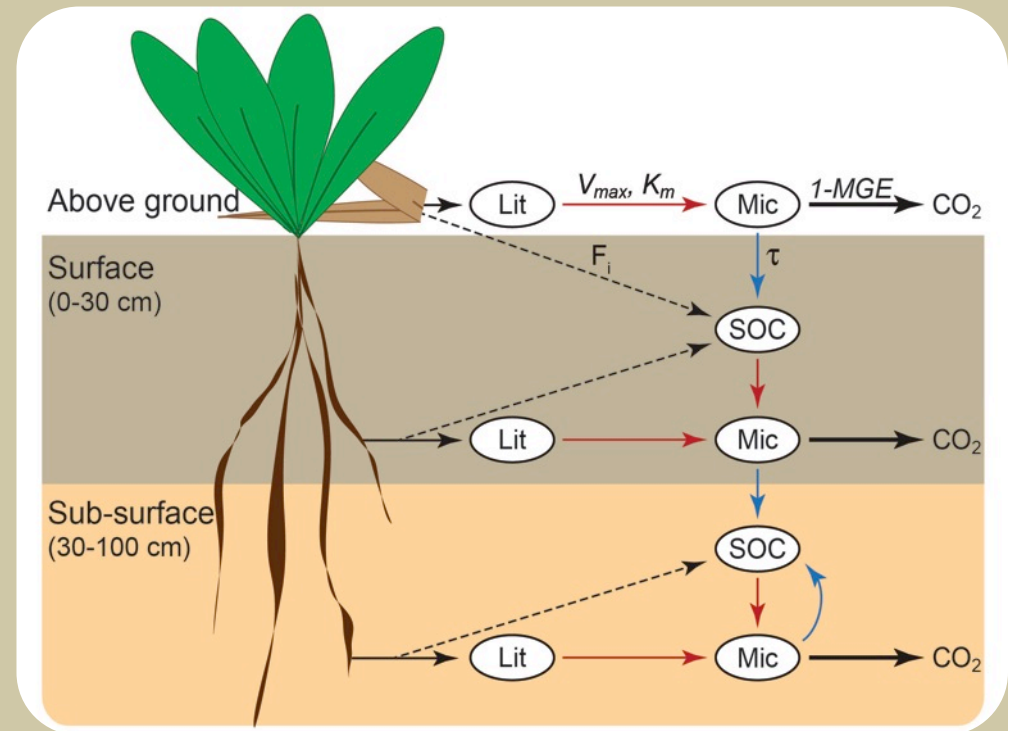
See also Xu et al. *Eco. Letters* 2014

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Koven et al. *Biogeosciences* 2013

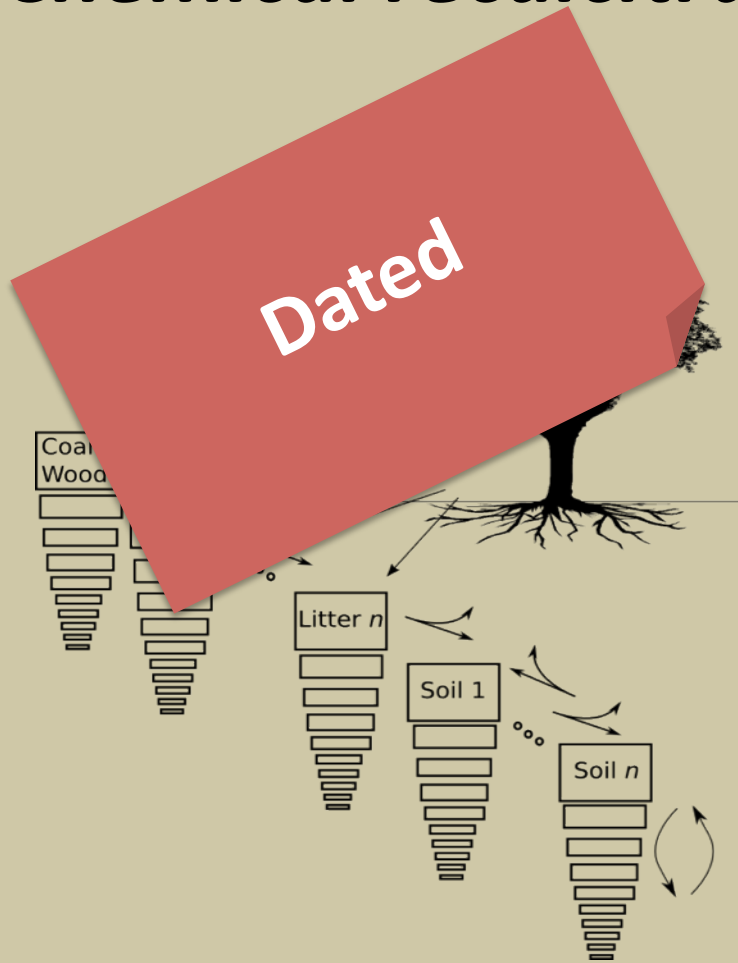


Wieder et al. *Nature Climate Change* 2013

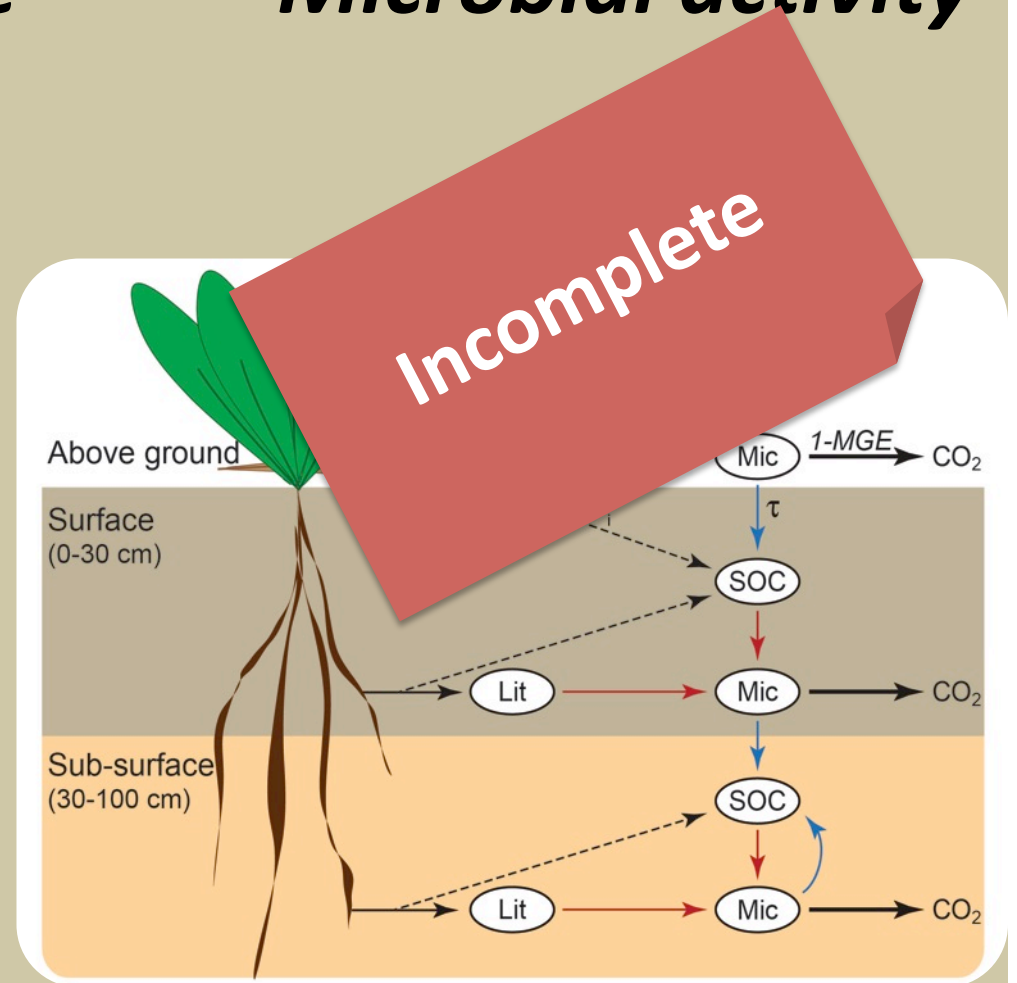
See also Xu et al. *Eco. Letters* 2014

Traditional *Chemical recalcitrance*

Emerging *Microbial activity*



Koven et al. *Biogeosciences* 2013



Wieder et al. *Nature Climate Change* 2013

See also Xu et al. *Eco. Letters* 2014

Biological drivers of the terrestrial C cycle:



Plant functional diversity



Agriculture



Soils...

Biological drivers of the terrestrial C cycle:



Plant functional diversity

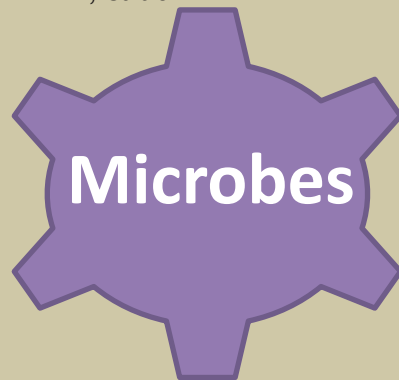
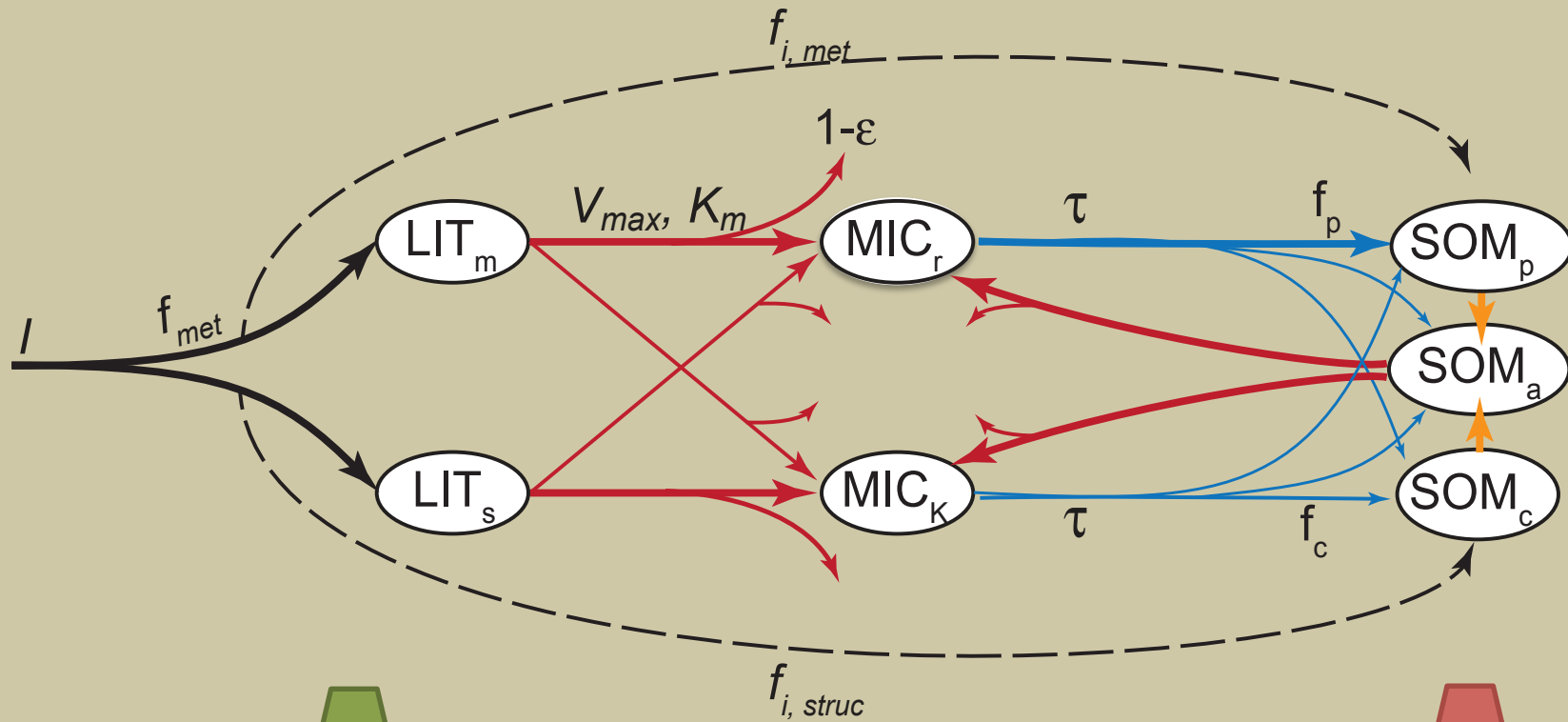


Agriculture



Soils...

Microbial-Mineral Carbon Stabilization MIMICS model



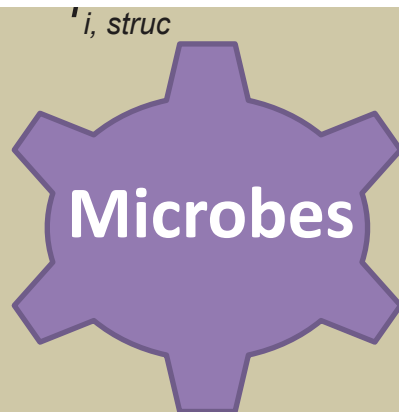
Microbial-Mineral Carbon Stabilization MIMICS model

$f_{i,met}$

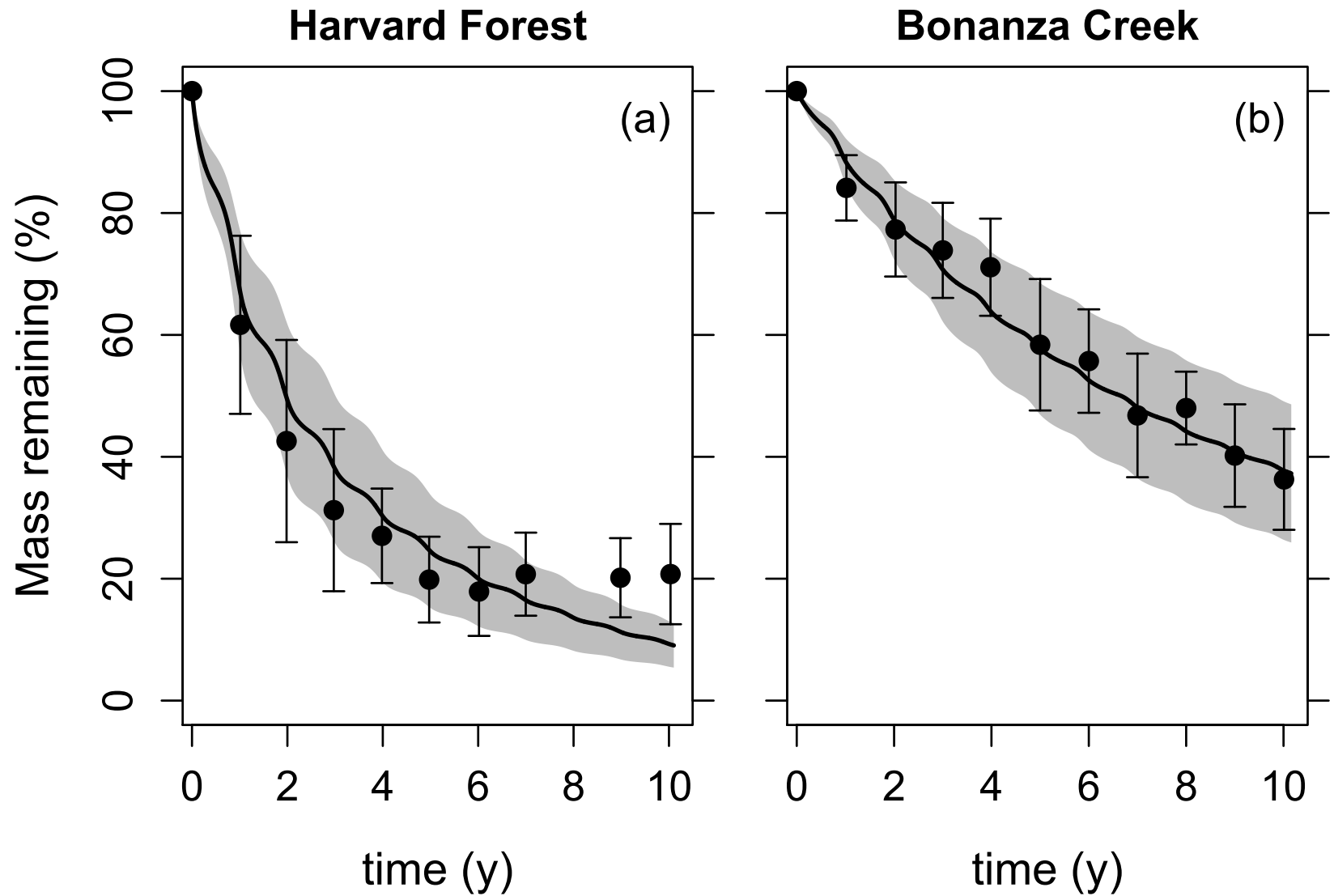
Decomposition =

$$MIC_r \times V_{max} \times SOM_p / (K_m + SOM_p)$$

$(mg\ cm^{-3})$

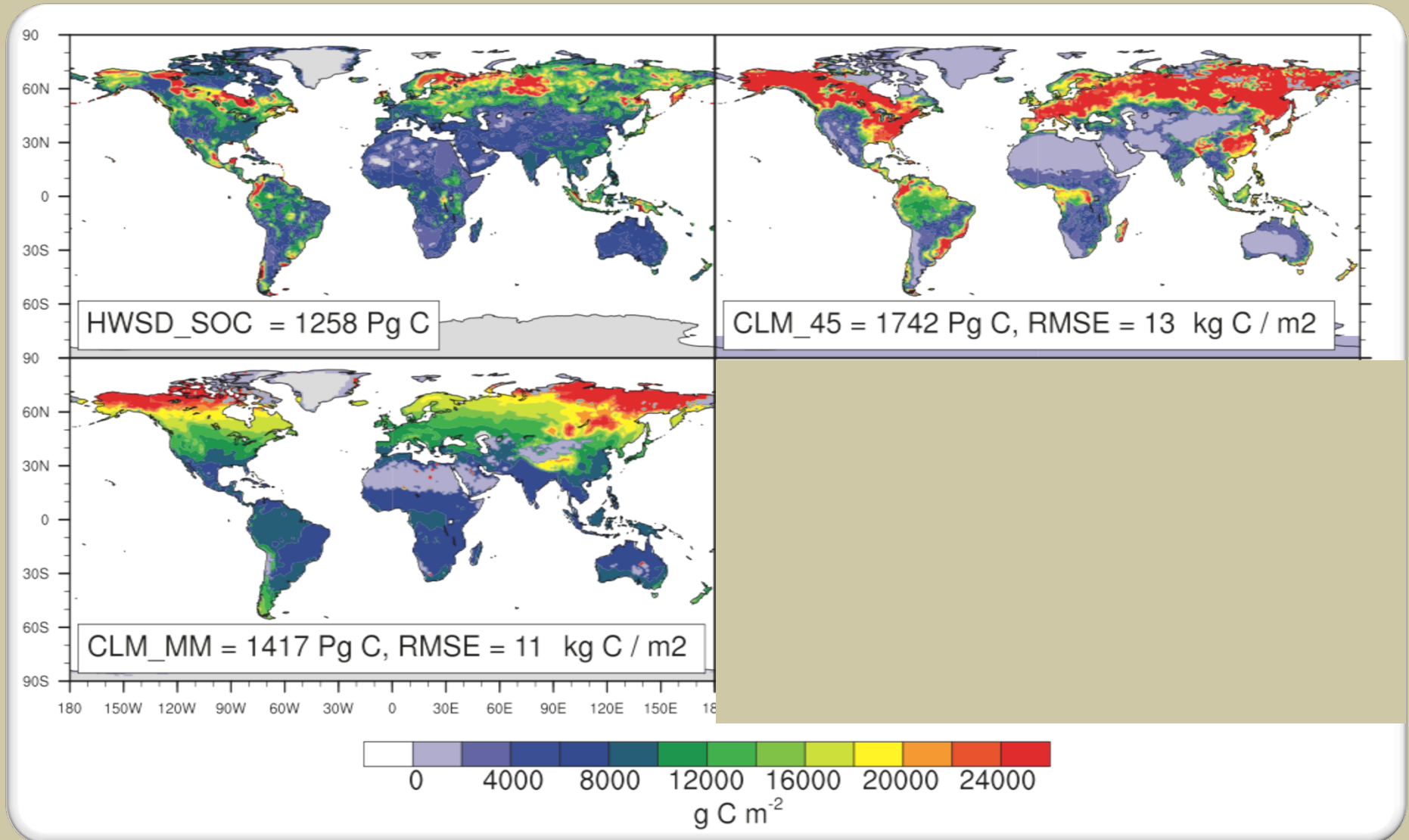


Validating MIMICS



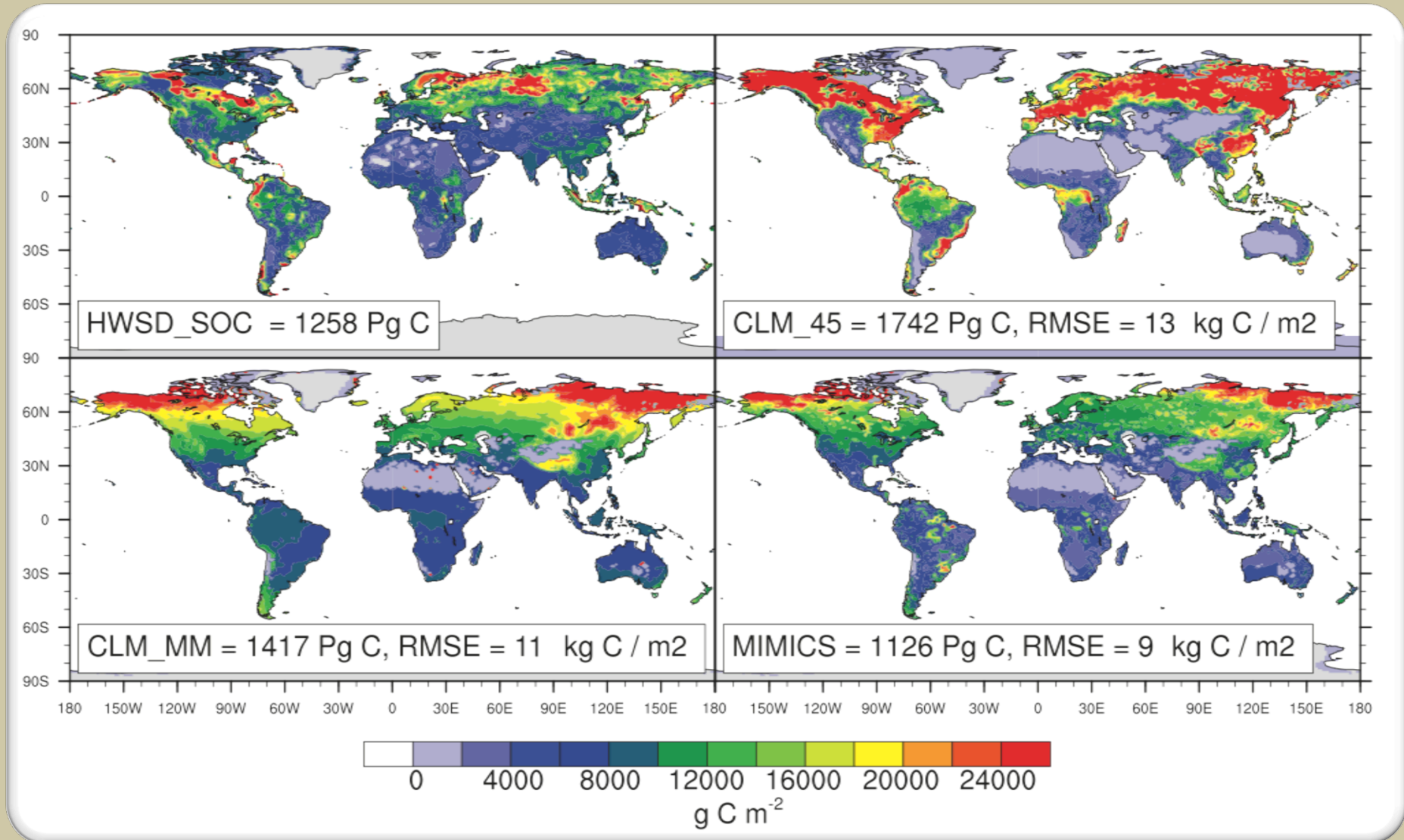
Wieder et al. BGD (2014); see also Bonan et al. GCB (2013)

Validating MIMICS



* 0-100cm, all models w/ same forcing from CLM4.5 output

Validating MIMICS

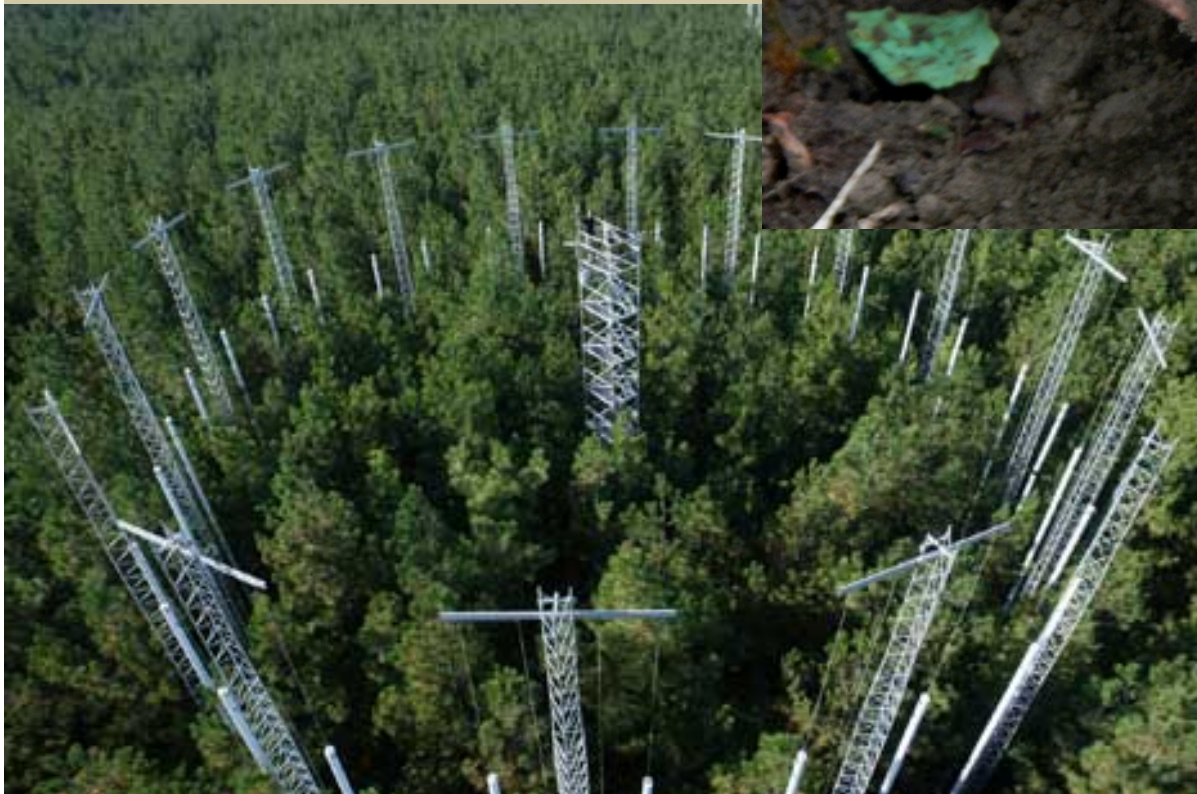


* 0-100cm, all models w/ same forcing from CLM4.5 output

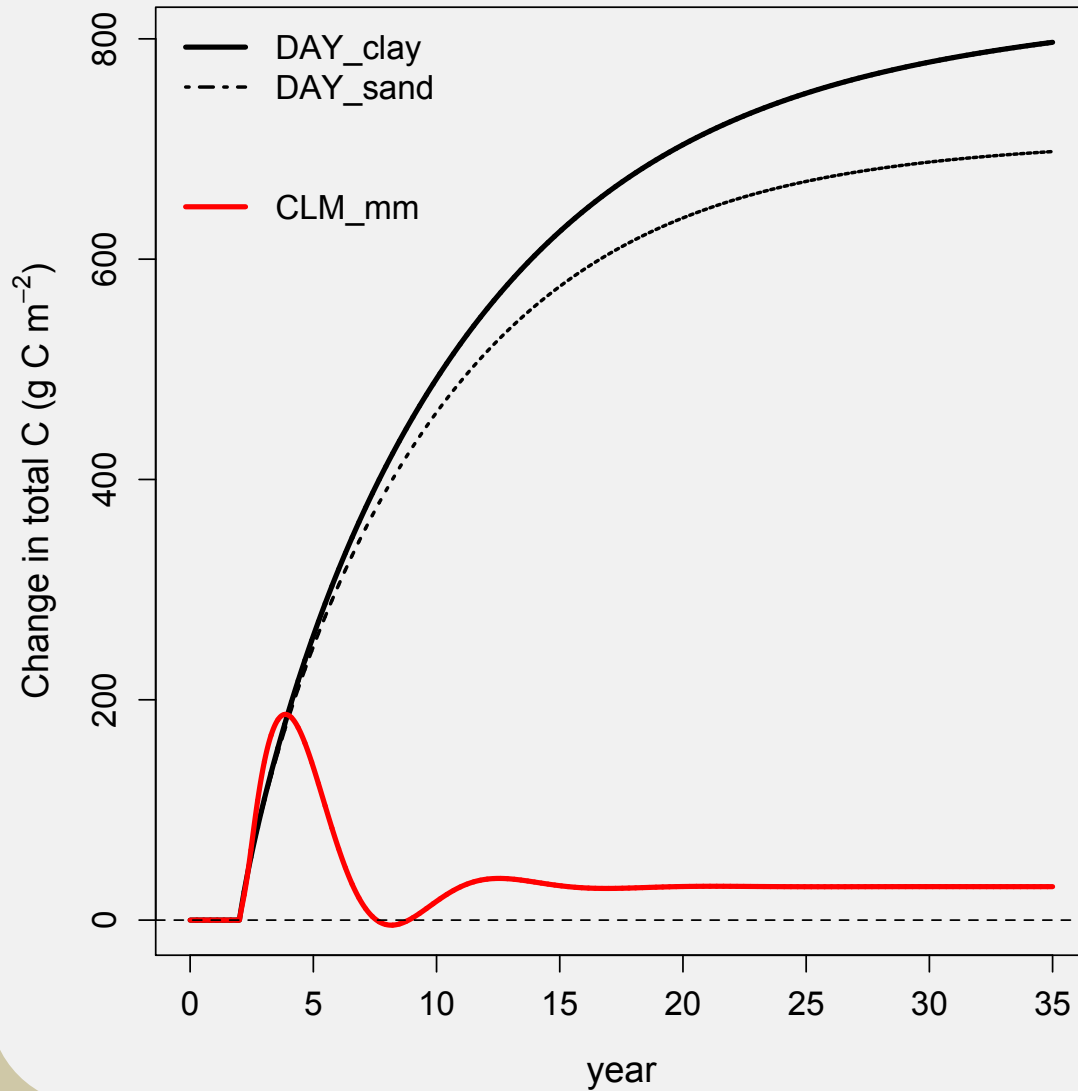
Future projections

↑ Quantity

↑ Quality

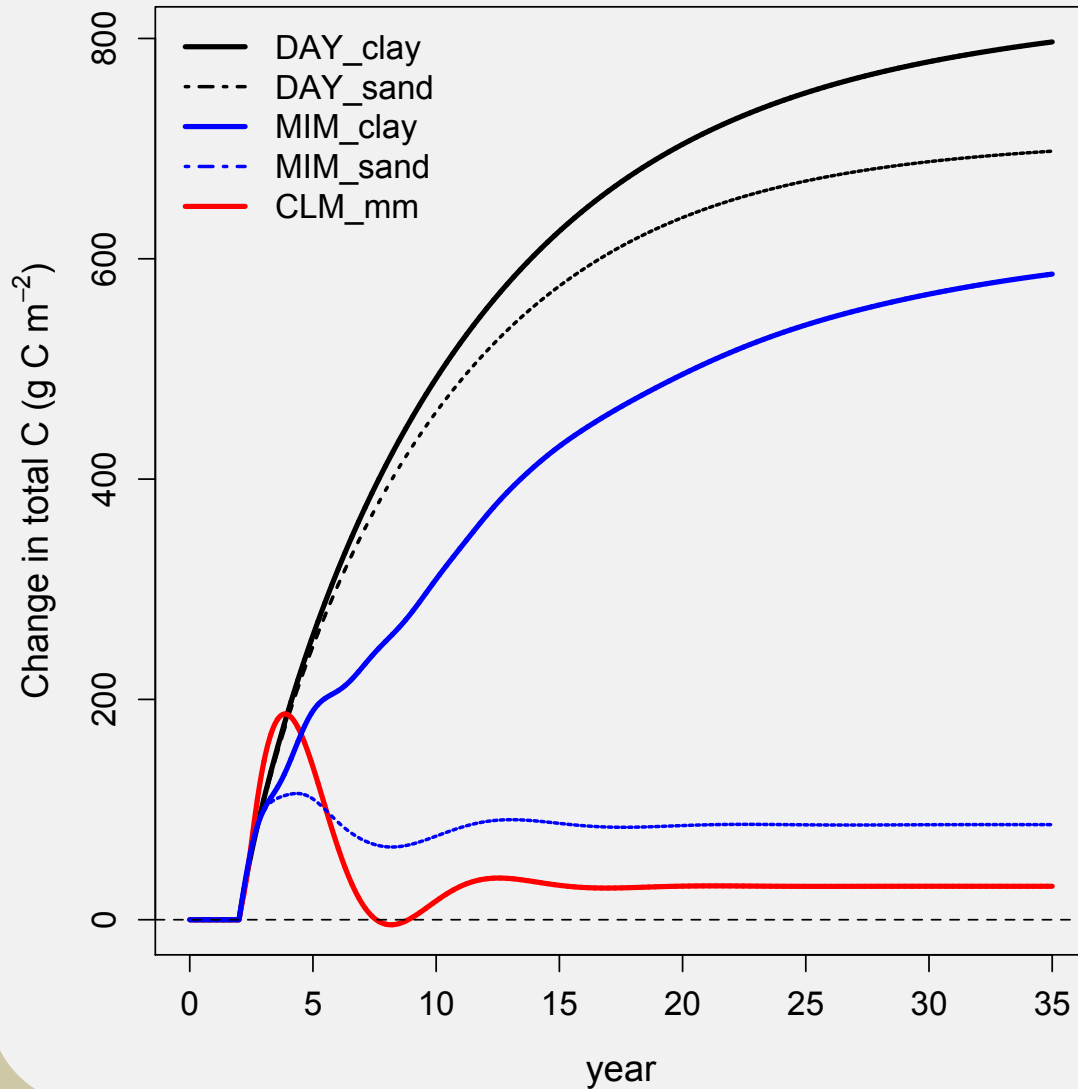


Increase litter quantity Stabilization vs. Priming



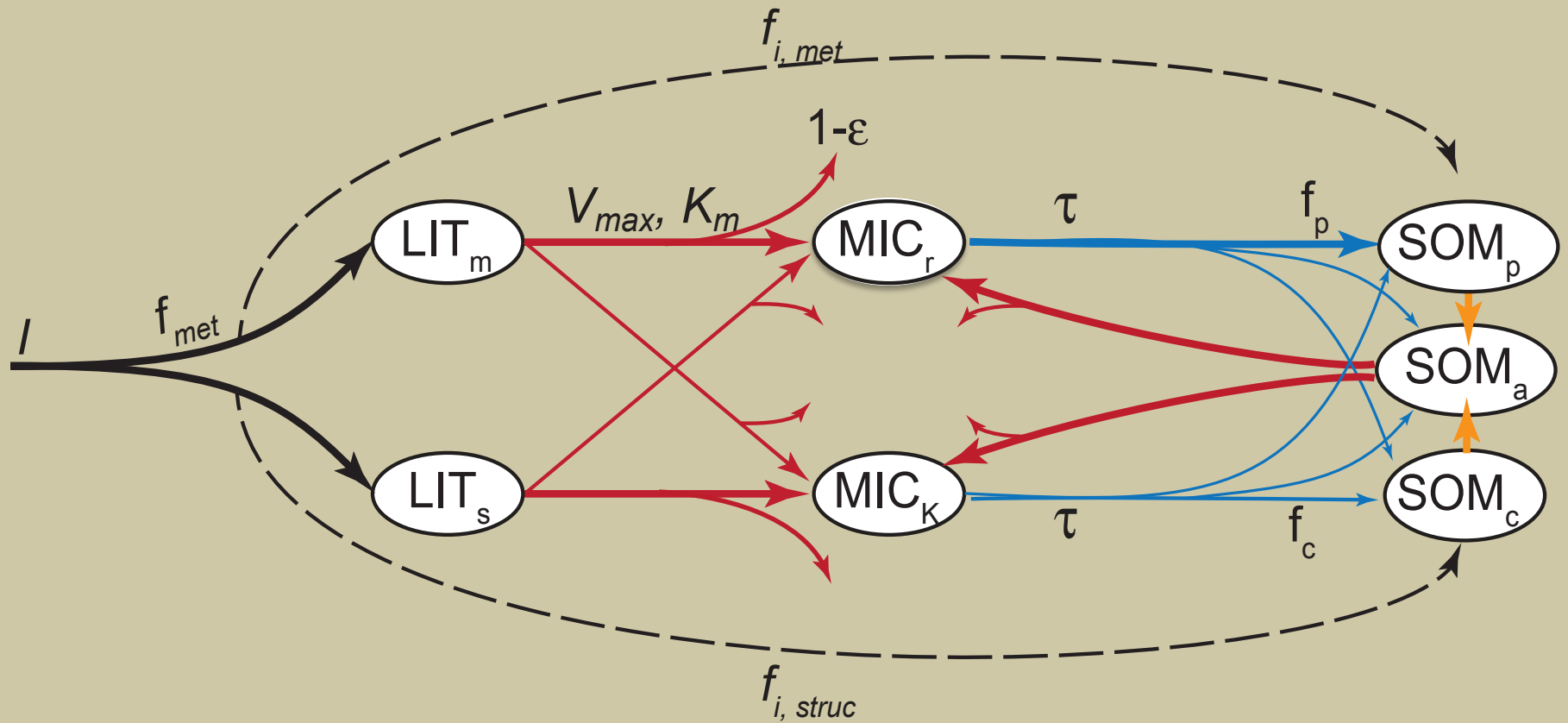
Wieder, unpublished

Increase litter quantity Stabilization vs. Priming



Wieder, unpublished

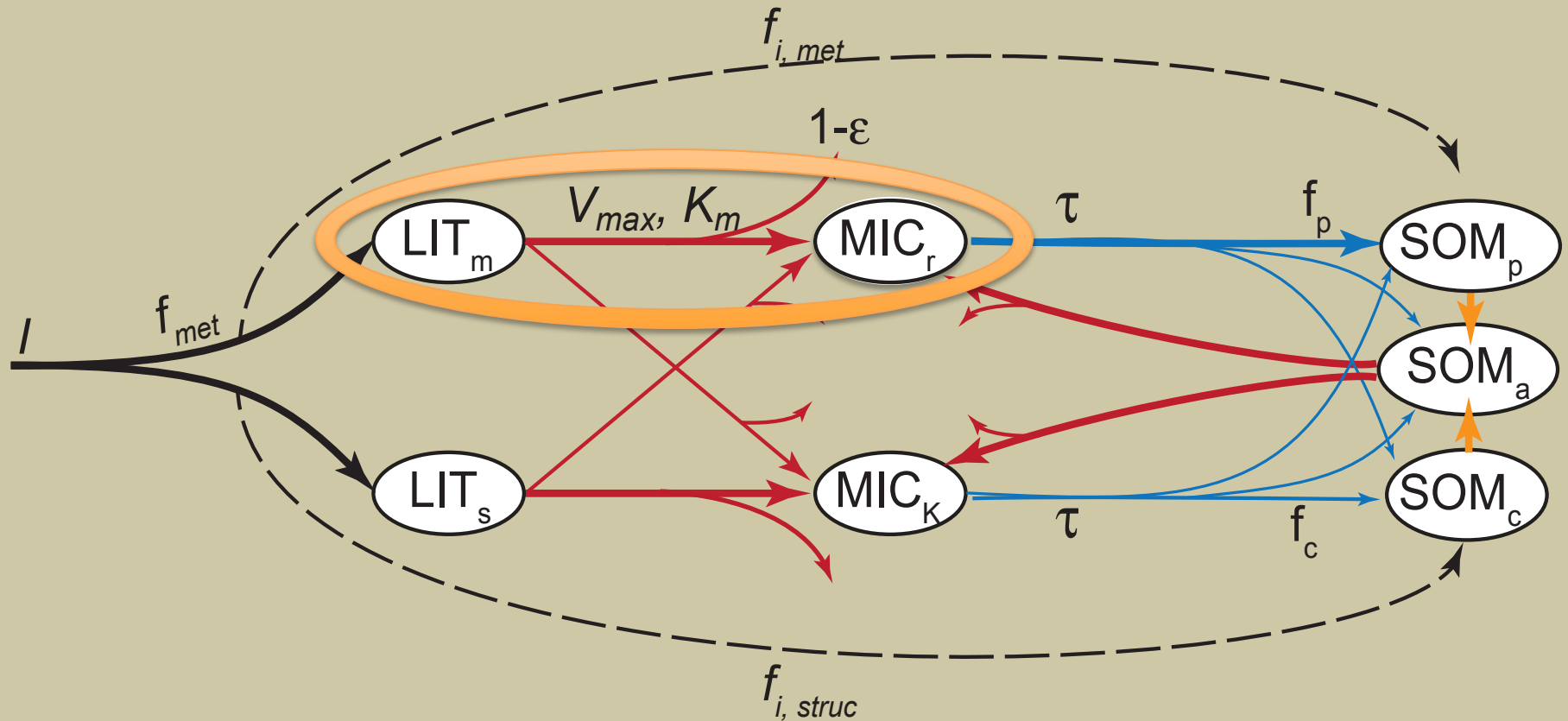
Increasing litter inputs in MIMICS



Stabilization vs. Priming

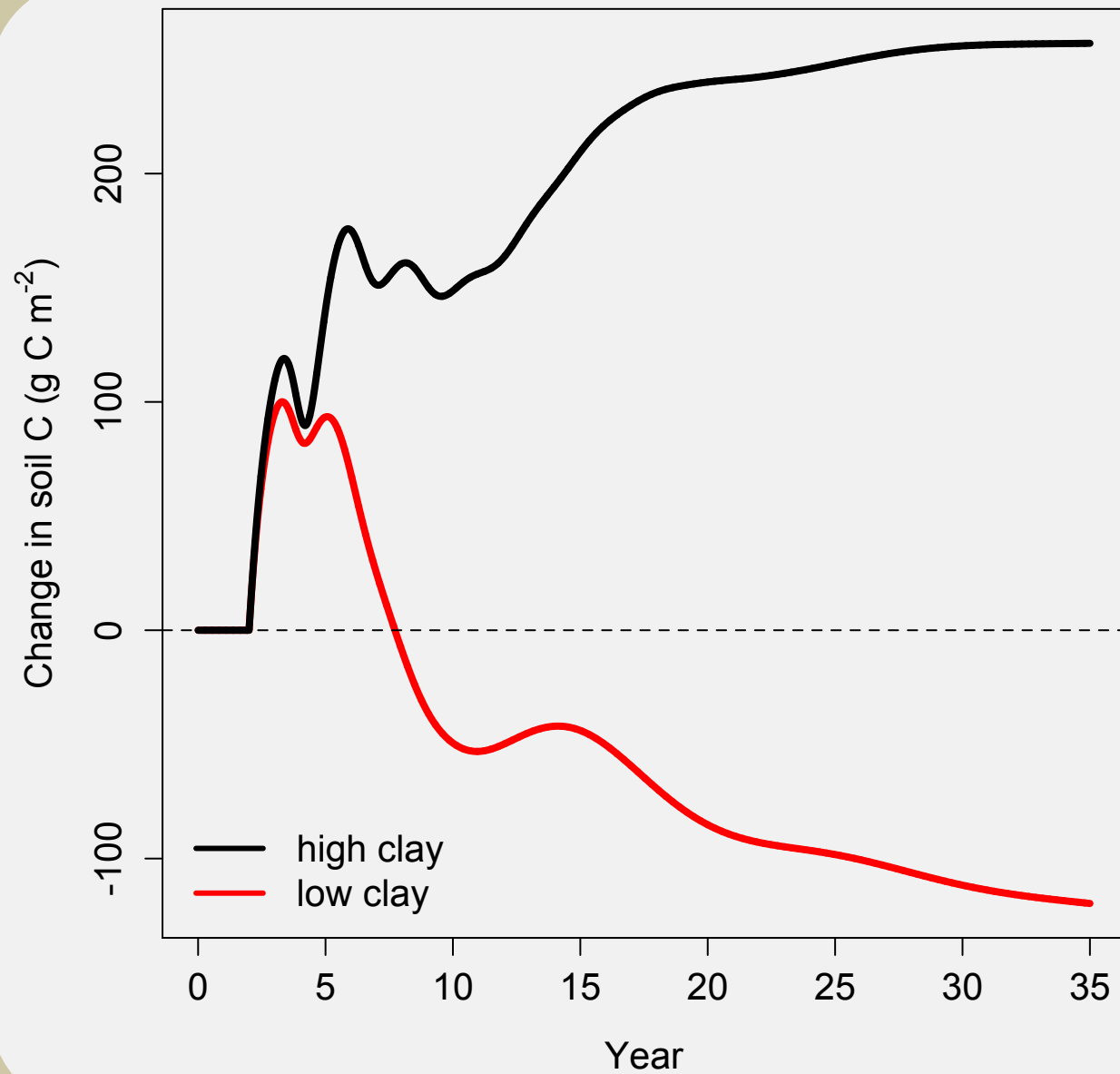
Increasing litter Quantity

Do labile plant inputs form stable soil organic matter?



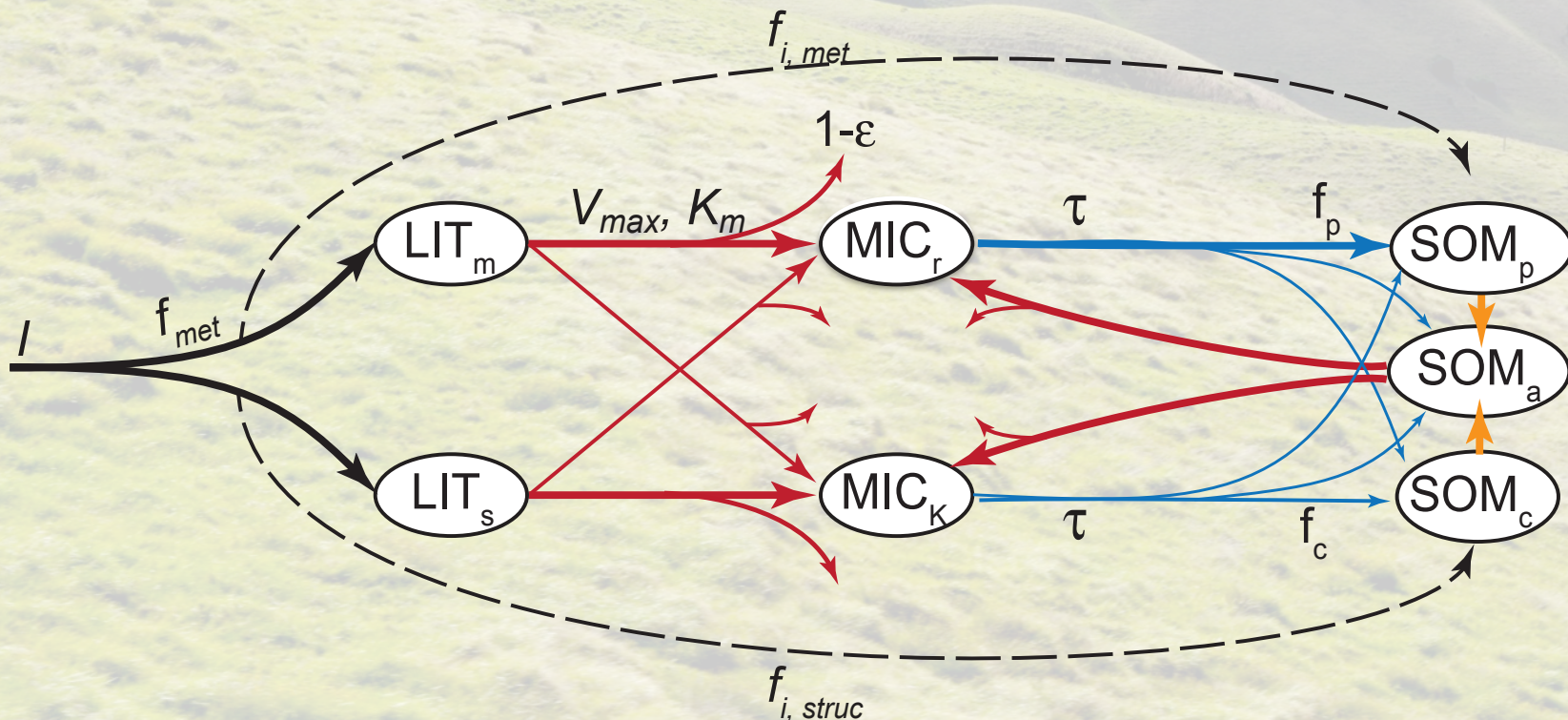
Stabilization vs. Priming

Increase Litter Quality



New Directions

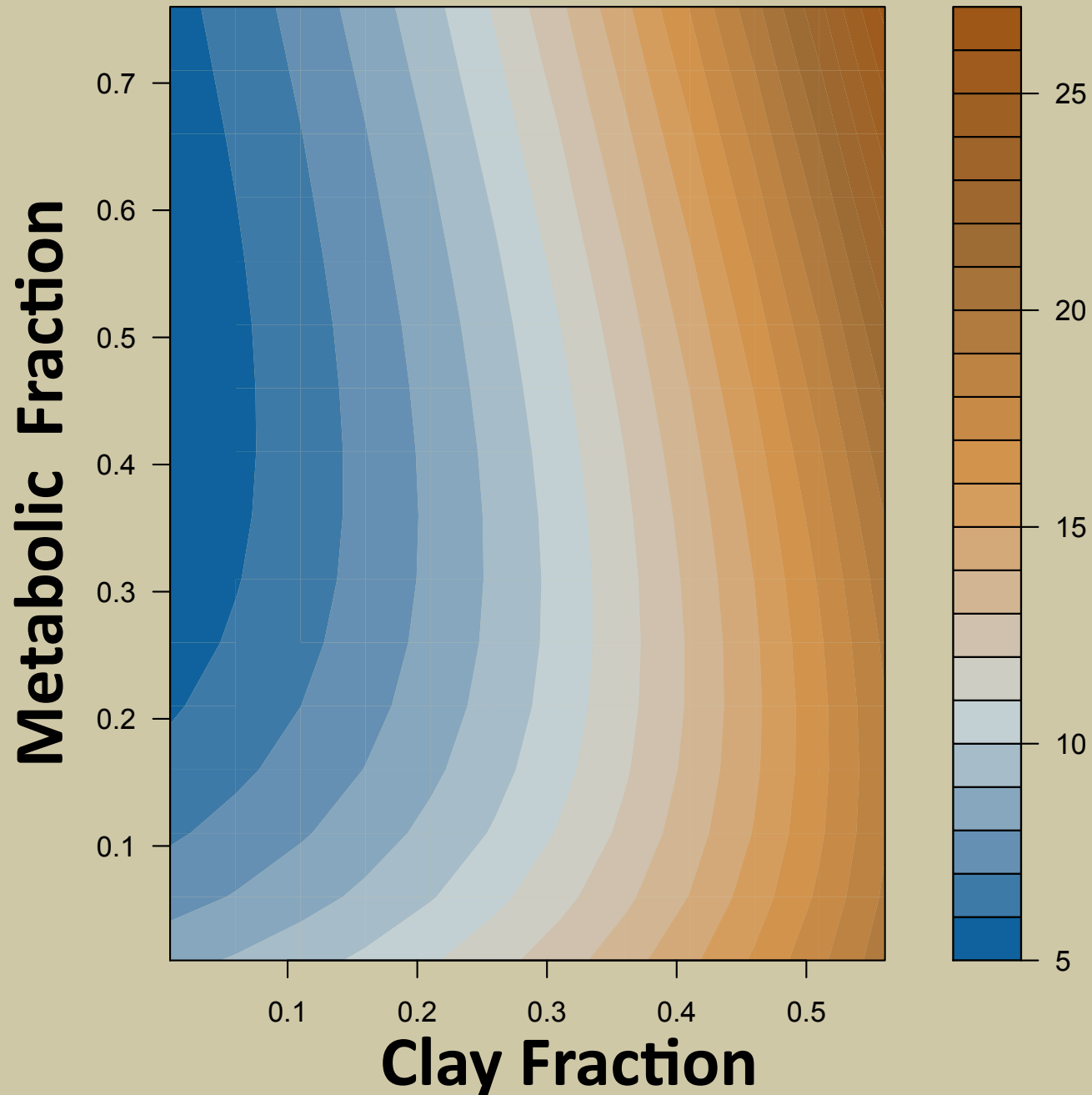
- Test ecological theory
- Evaluation & Validation
 - Functional traits (MGE, turnover)
 - Transient response
- Parameterization
 - scaling relationships (Climate, N, etc.)



Thank you

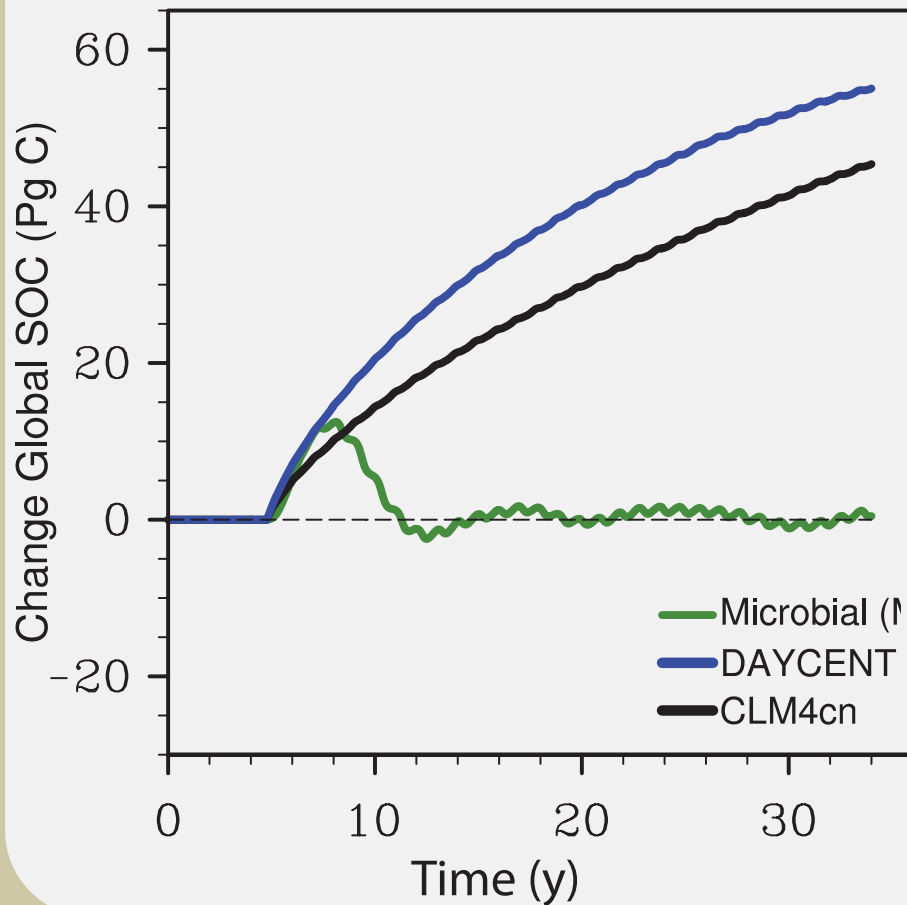


MIMICS SOC (mg C cm⁻³)

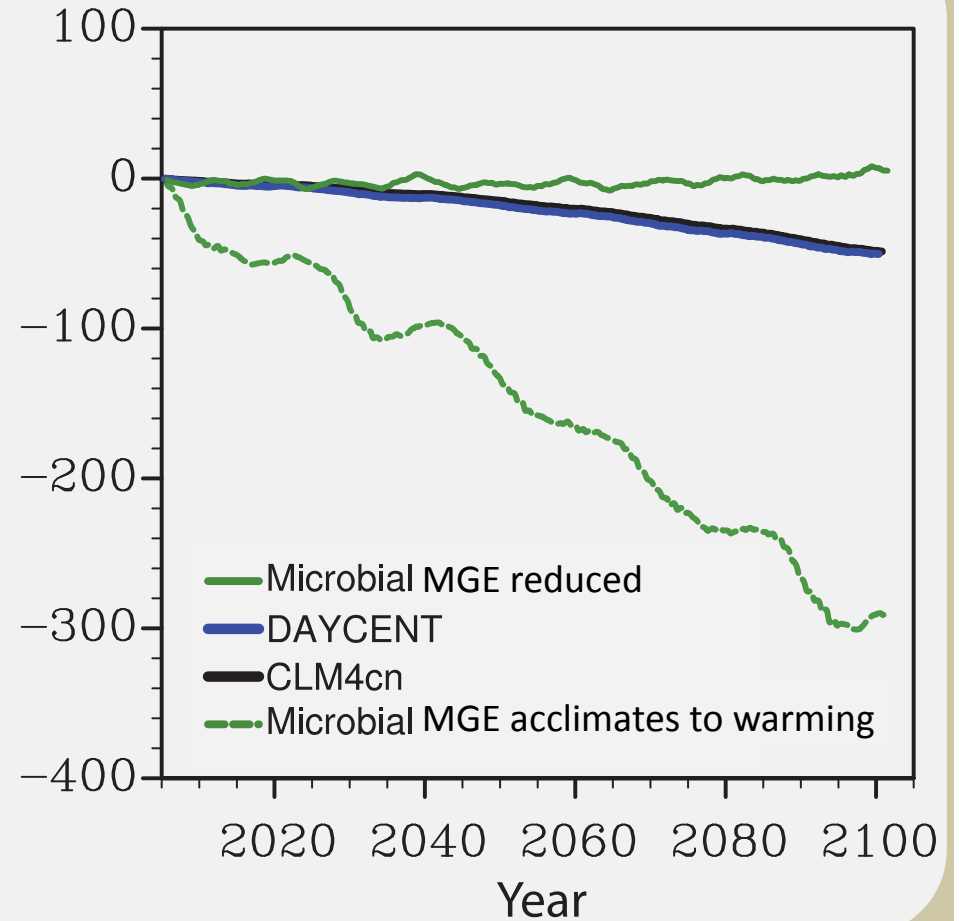


Model structure matters (in global change settings)

a) Increasing Litterfall



b) Increasing temperature



What affects relative abundance in MIMICS?

- Litter chemistry (rhizosphere inputs, eCO₂)
- Precipitation
- N enrichment
- Disturbance & Management

