

# Does modeling *reality* match ecological *theory*?



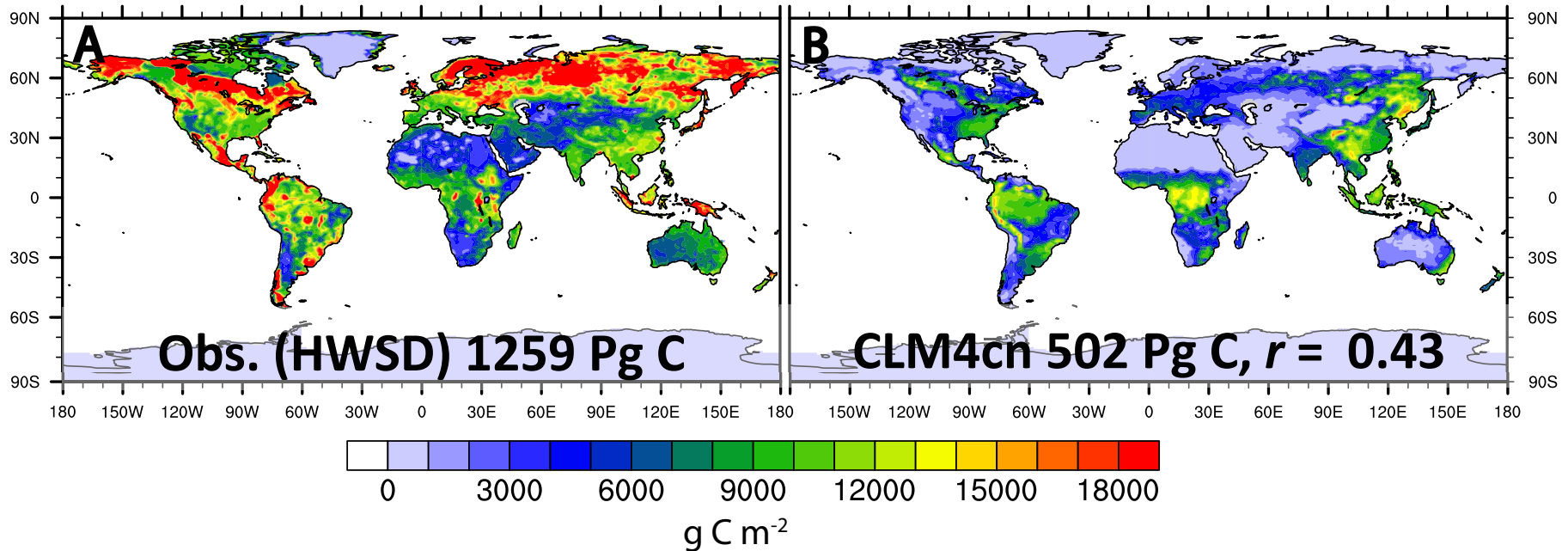
Will Wieder, Gordon Bonan, Steve Allison



LMWG Boulder Feb. 2013



# Motivation



CMIP5 models 500-3000 Pg C globally,  $r < 0.4$

Todd-Brown *et al.* Biogeosciences-Discussion (2012)

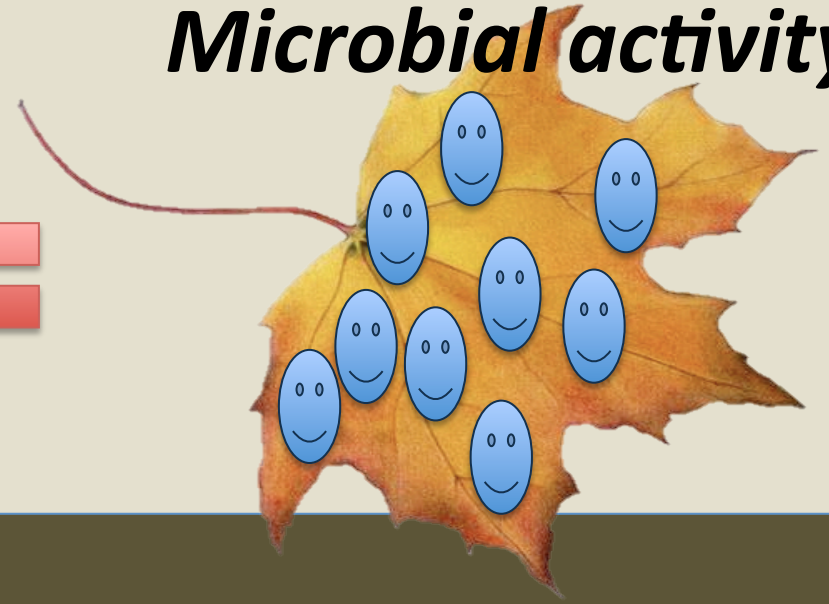
Traditional

***Chemical recalcitrance***



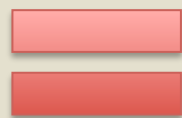
Emerging

***Microbial activity***



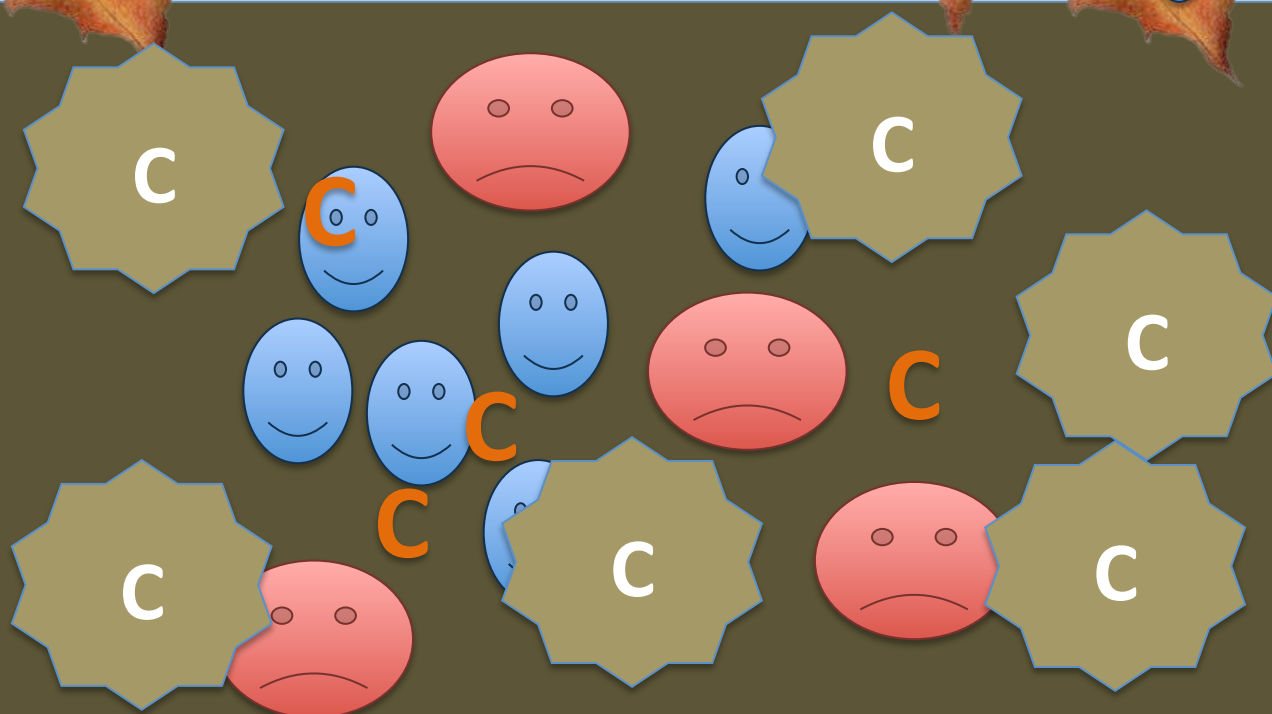
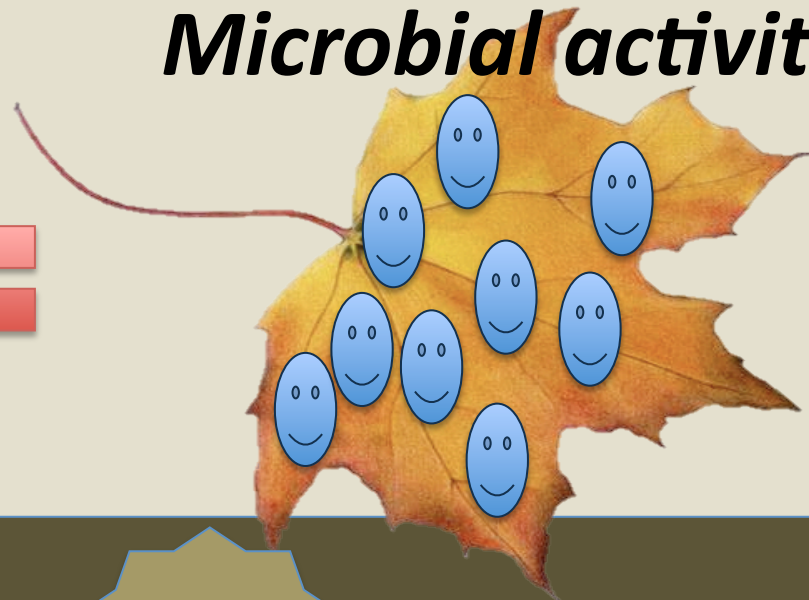
Traditional

***Chemical recalcitrance***



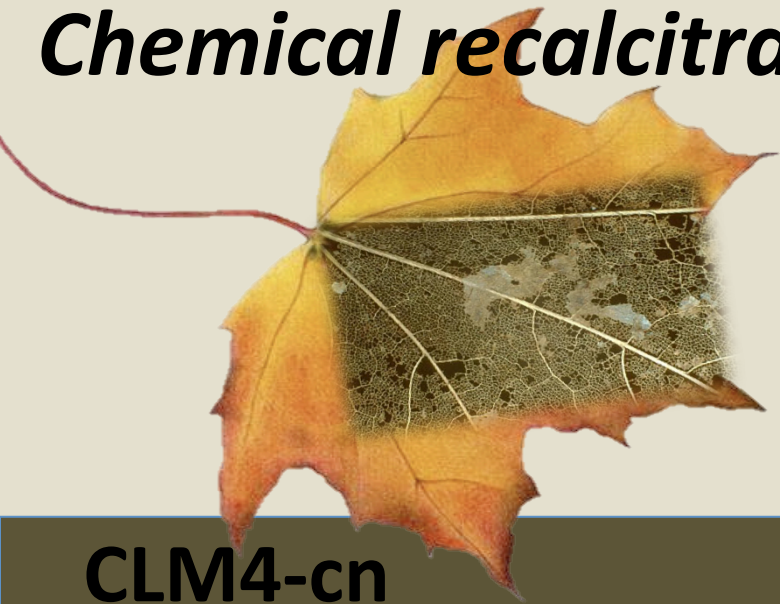
Emerging

***Microbial activity***



Traditional

*Chemical recalcitrance*



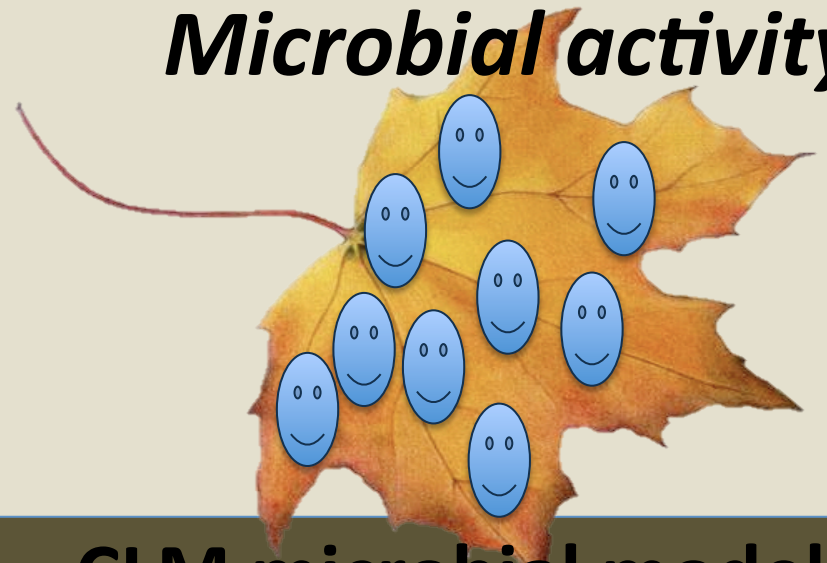
CLM4-cn

CLM4.5 (DAYCENT)

All other CMIP5 models

Emerging

*Microbial activity*



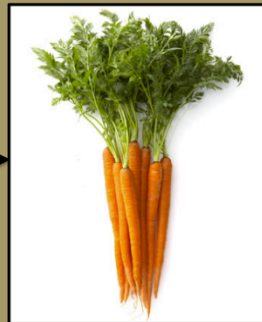
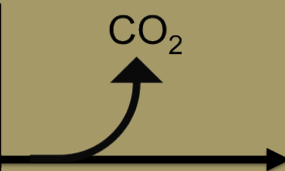
CLM microbial model

Fast

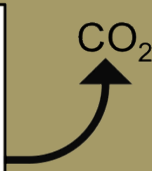
Slow



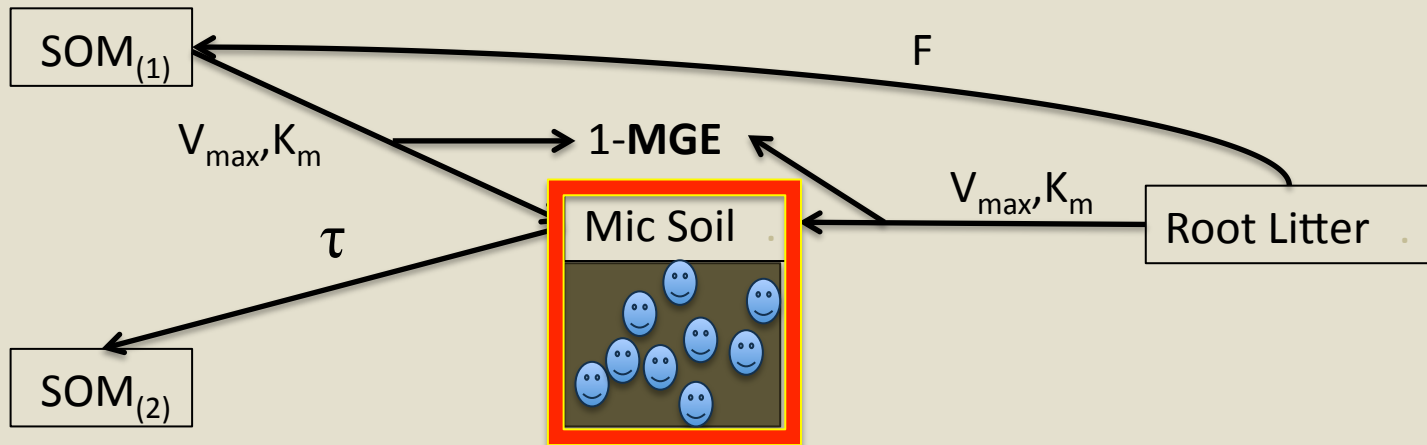
CO<sub>2</sub>



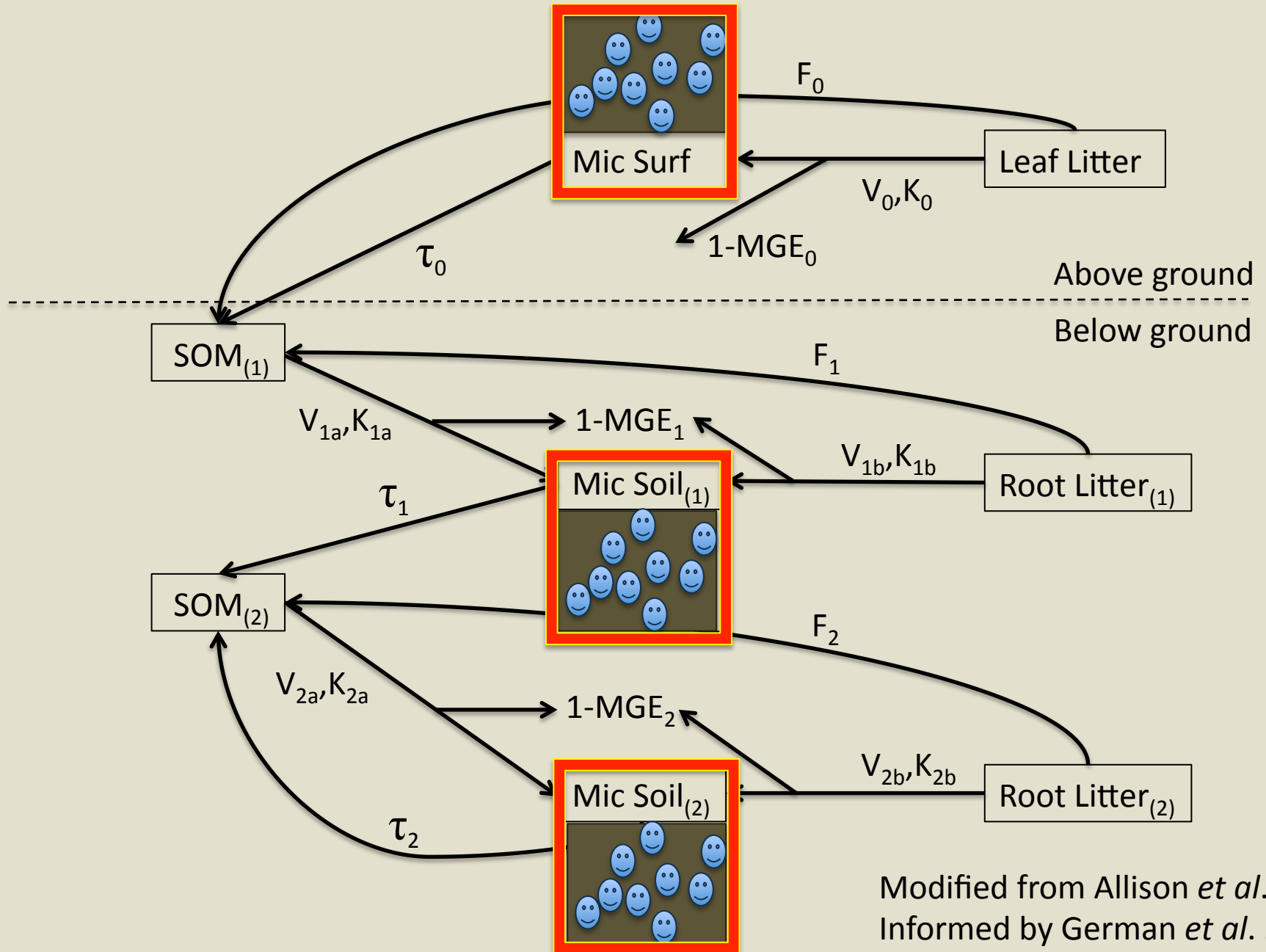
CO<sub>2</sub>



# CLM- Microbial Model

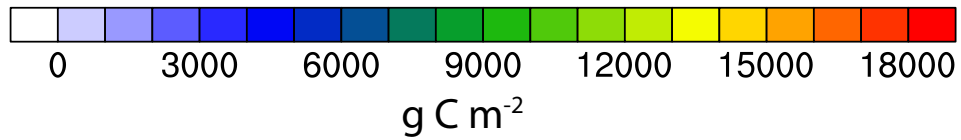
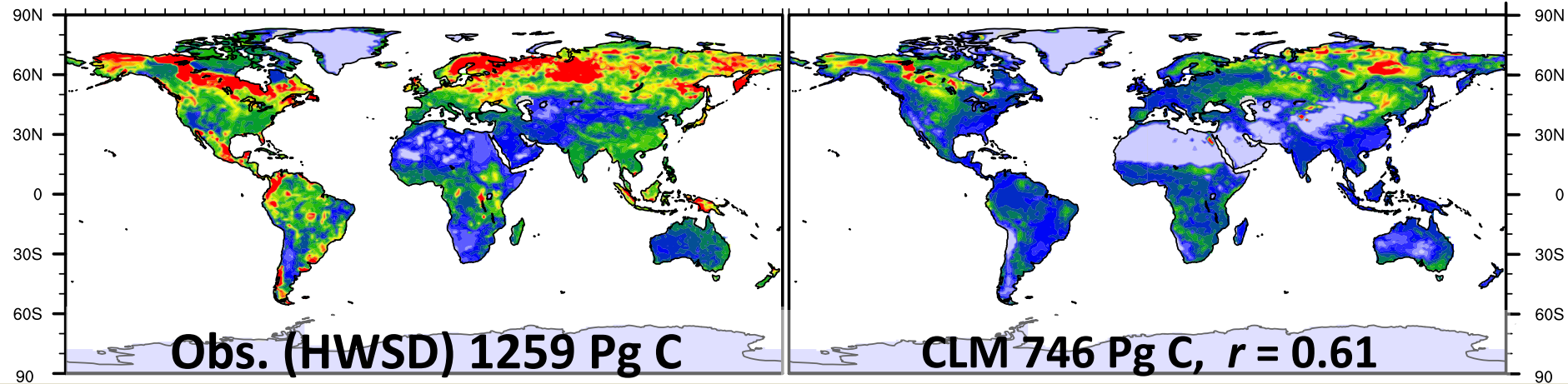


# CLM- Microbial Model



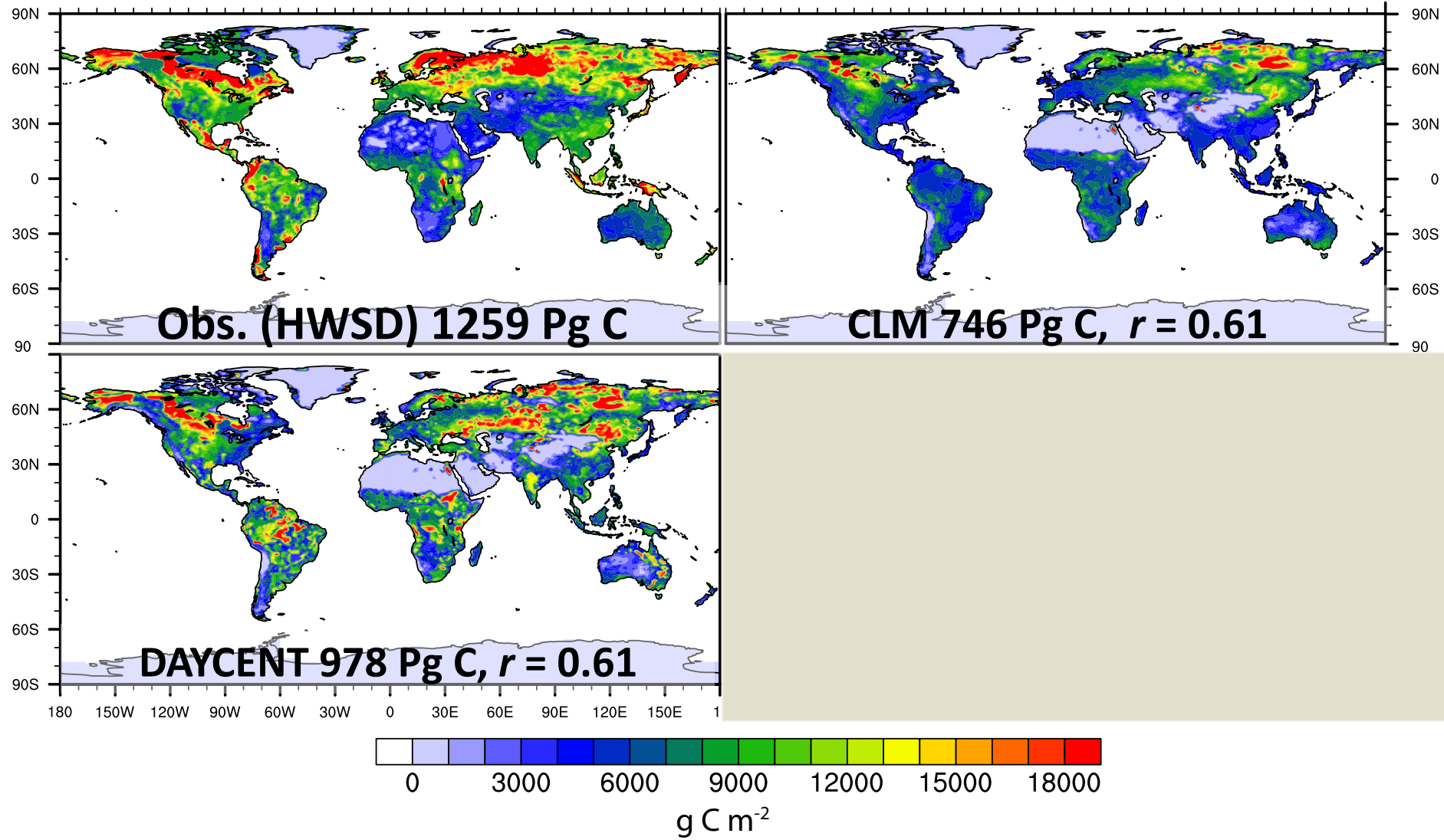
Modified from Allison *et al.* 2010  
Informed by German *et al.* 2012

# CLM4-cn

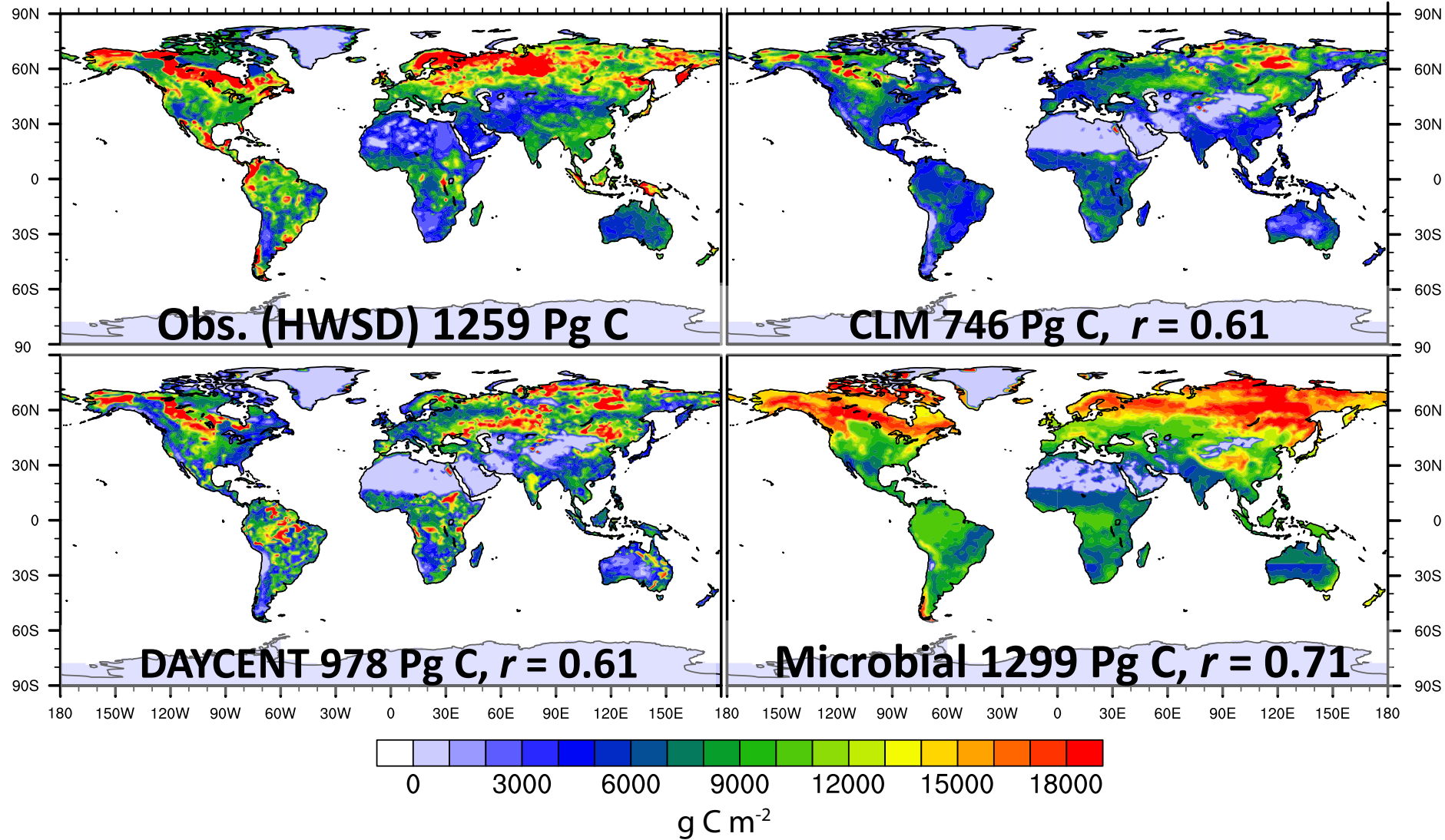




# CLM-DAYCENT



# CLM-Microbial Model



# Global predictions in a changing world



# Global predictions in a changing world



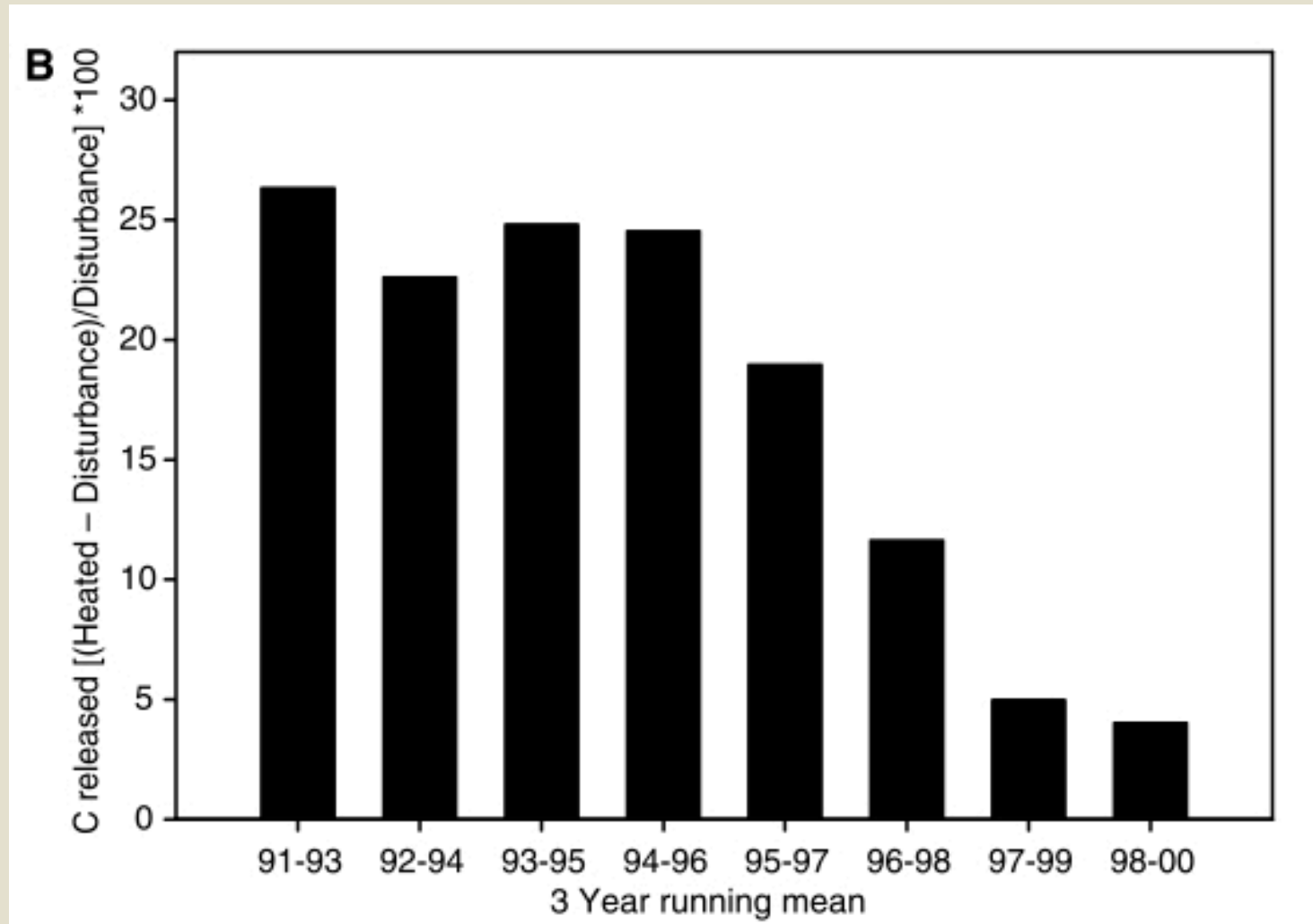
Past performance  $\neq$  future results

# Warming (acclimatization?)

Soil Respiration

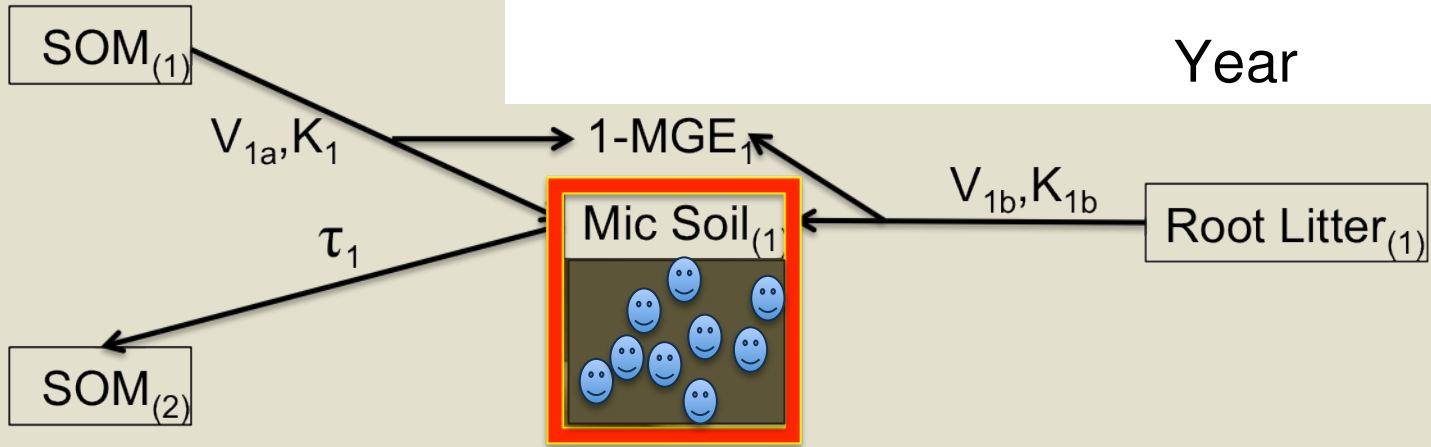
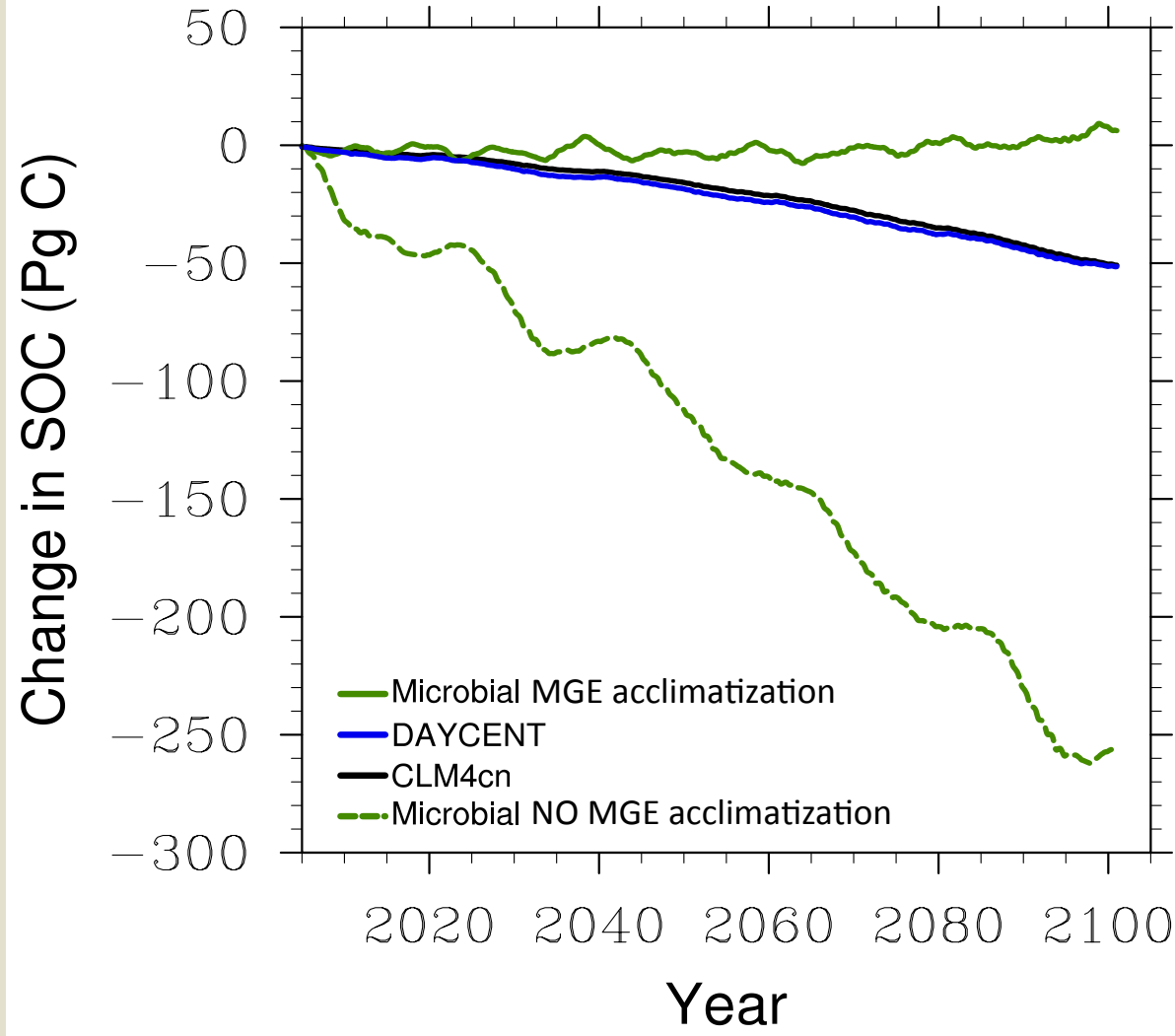
Warmed – Control

(Mellilo *et al.* 2002)



See also Frey *et al.* 2013

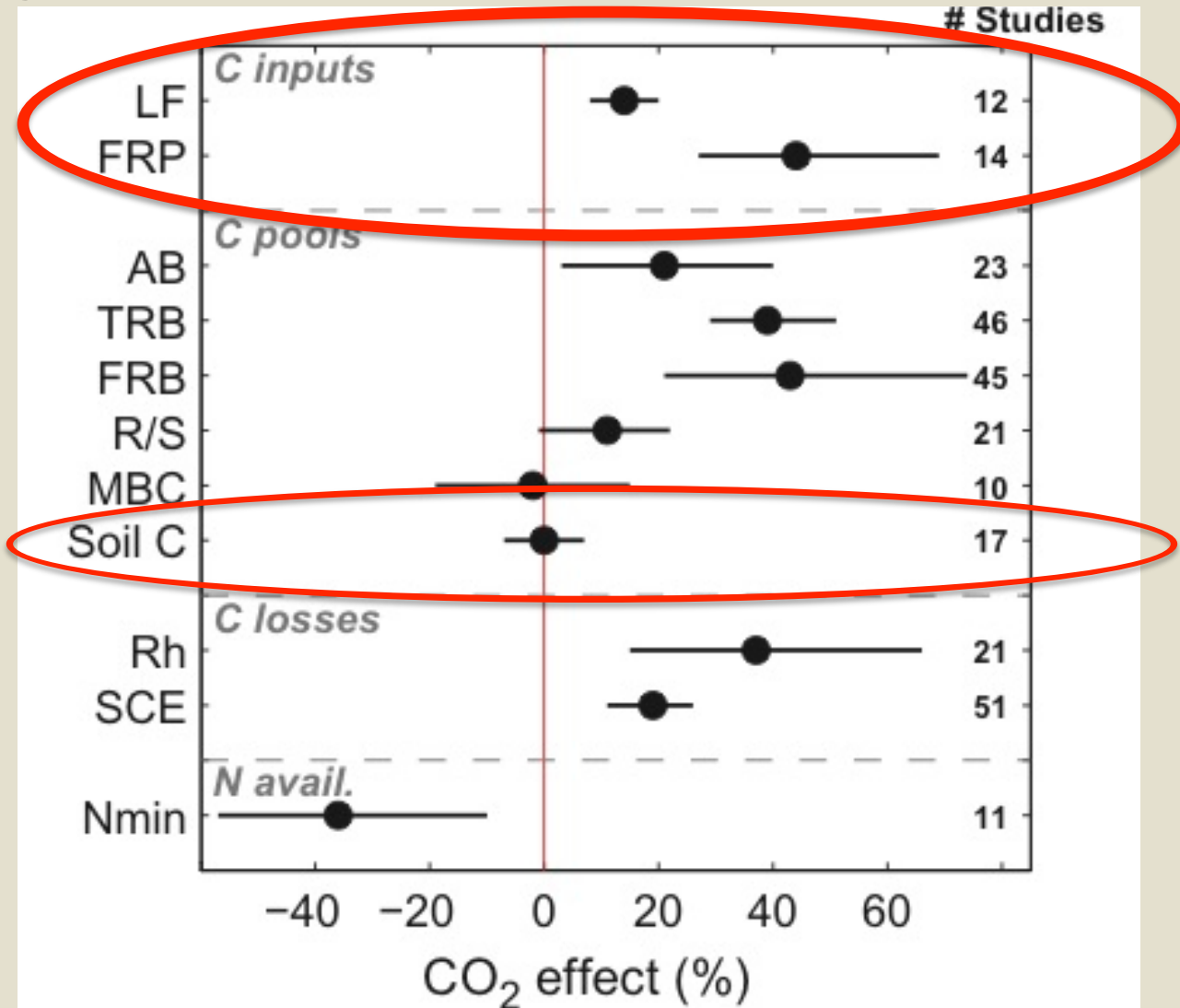
Warming  
(4.8 °C by 2100)



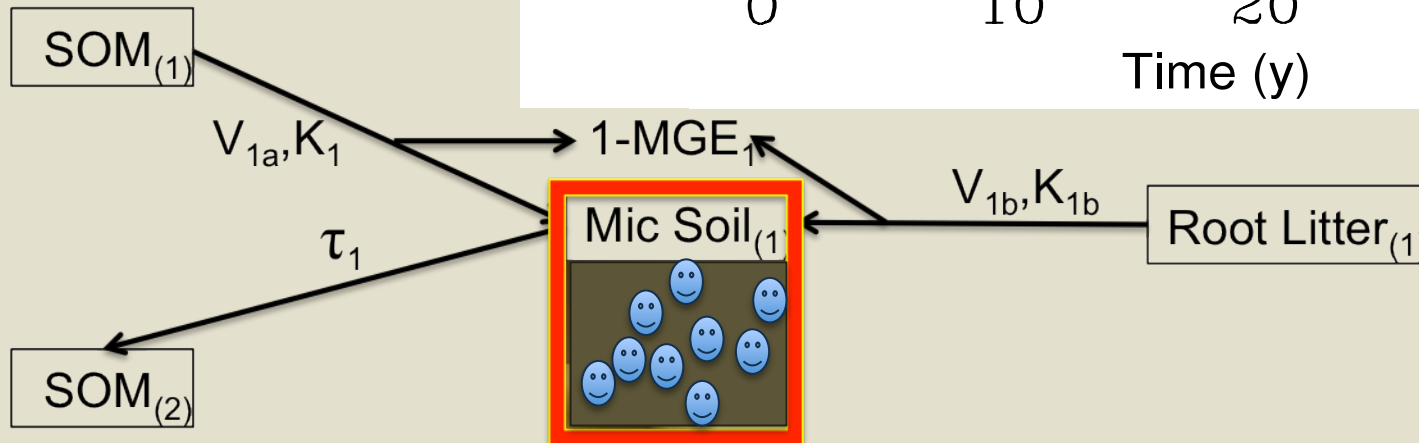
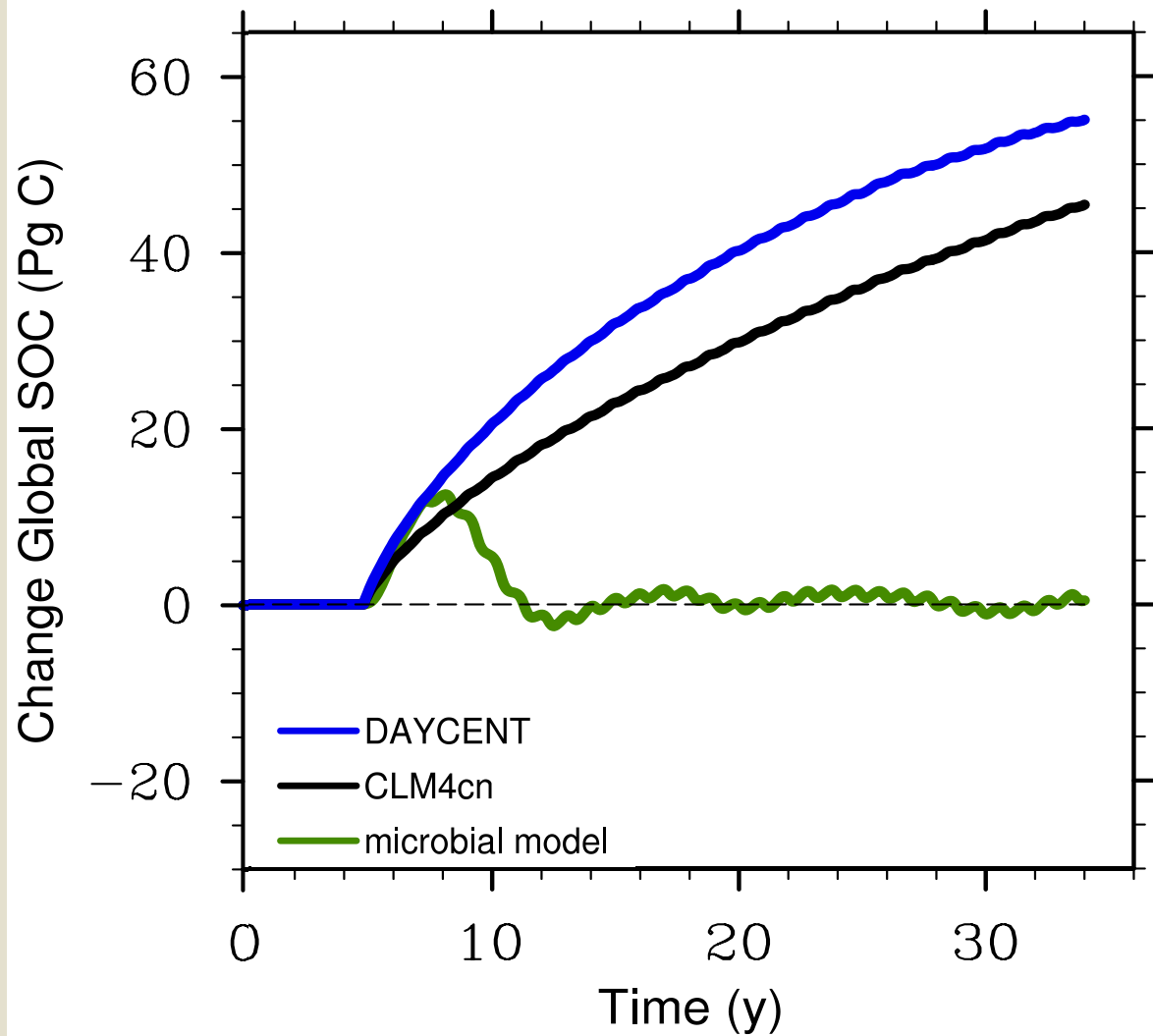
# $\Delta$ Litter Inputs (eCO<sub>2</sub> Obs.\*)

Dieleman *et al.* 2010

see also Hungate *et al.* 2009



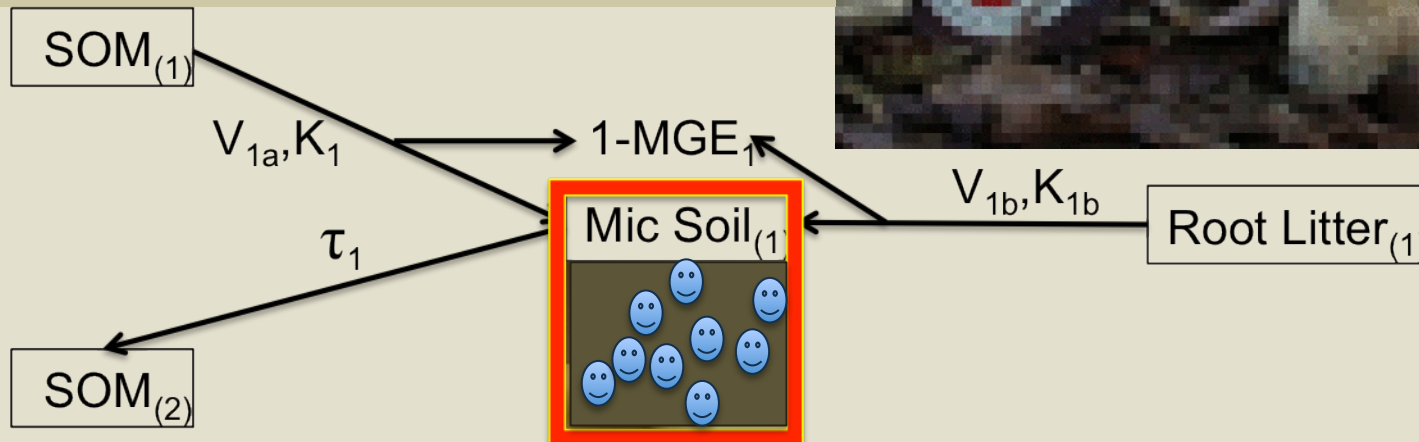
# $\Delta$ Litter Inputs (+ 20%)



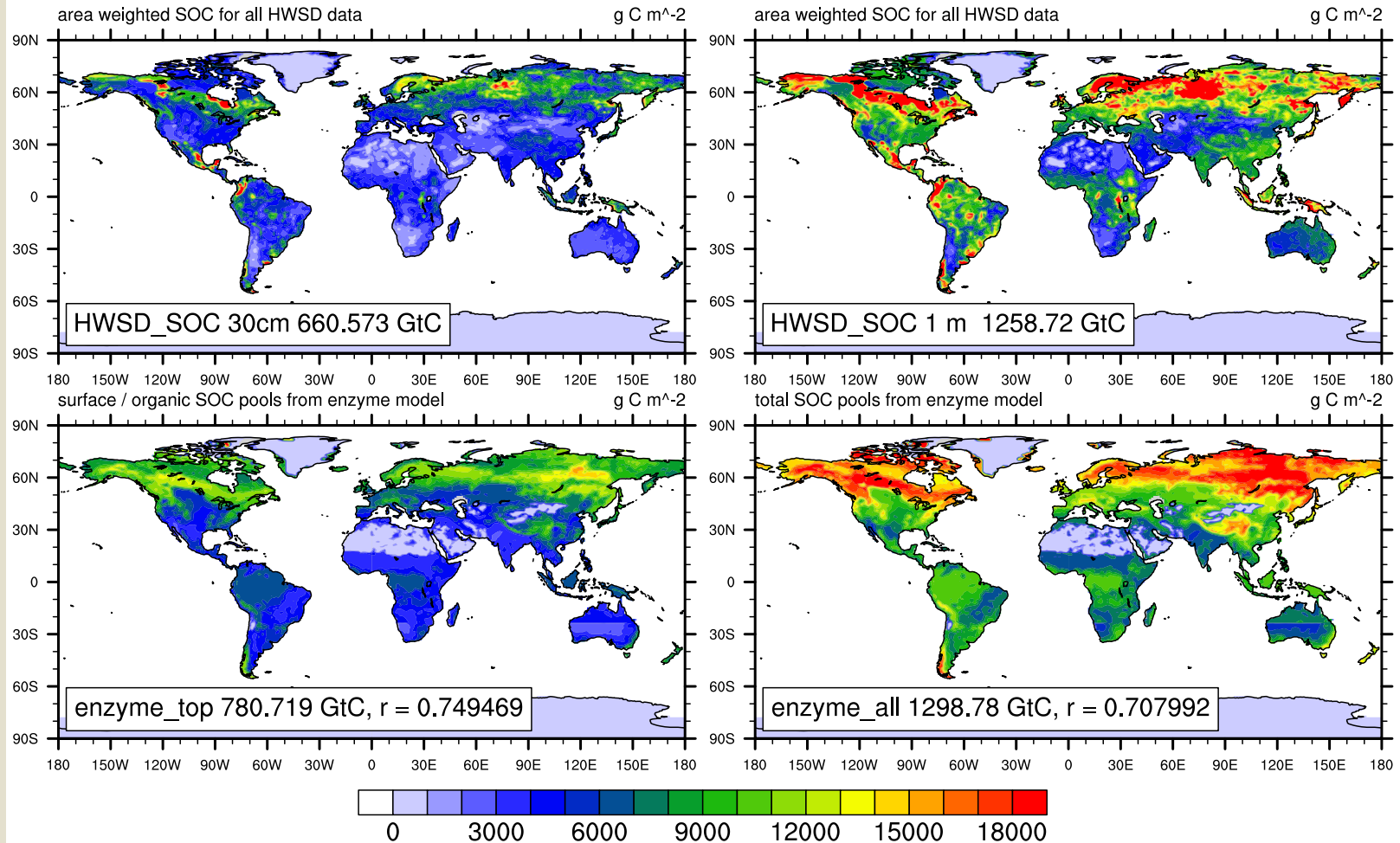


# New class of soil BGC model

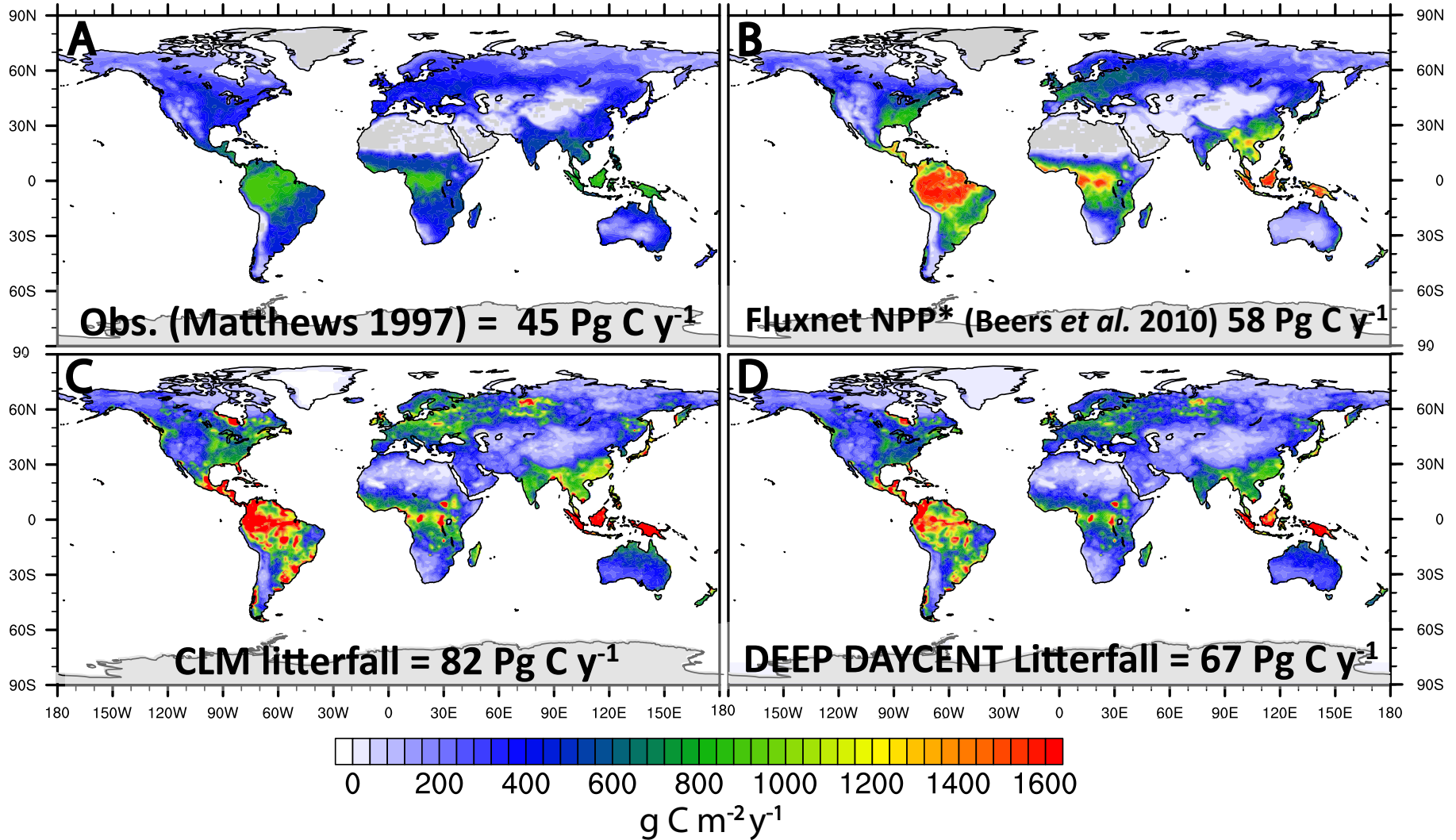
- Microbial physiology  
@ global scales!
- Alternative projections
- New opportunities
- Next steps
  - Nitrogen
  - Physical protection
  - Water, redox, CH<sub>4</sub>?
  - Vertical resolution
  - Evaluation



# Microbial Model at depth



# Litter inputs



# CLM4cn

