

# Soil Biogeochemistry in CLM4cn



Will Wieder, Gordon Bonan, Johan Feddema  
wwieder@ucar.edu

A satellite-style map of the Americas, showing North and South America in shades of green and brown, surrounded by the blue oceans. The map is centered on the Atlantic Ocean.

What color planet are we  
simulating?

Climate

Climate Change- C

Climate Change- CN

# Soil Biogeochemistry, Generalized

Litterfall

```
graph TD; Litterfall[Litterfall] --> Litter[Litter]; Litter --> SOM[Soil Organic Matter]; SOM --> Litter; Litter --> Litterfall; SOM --> Litterfall;
```

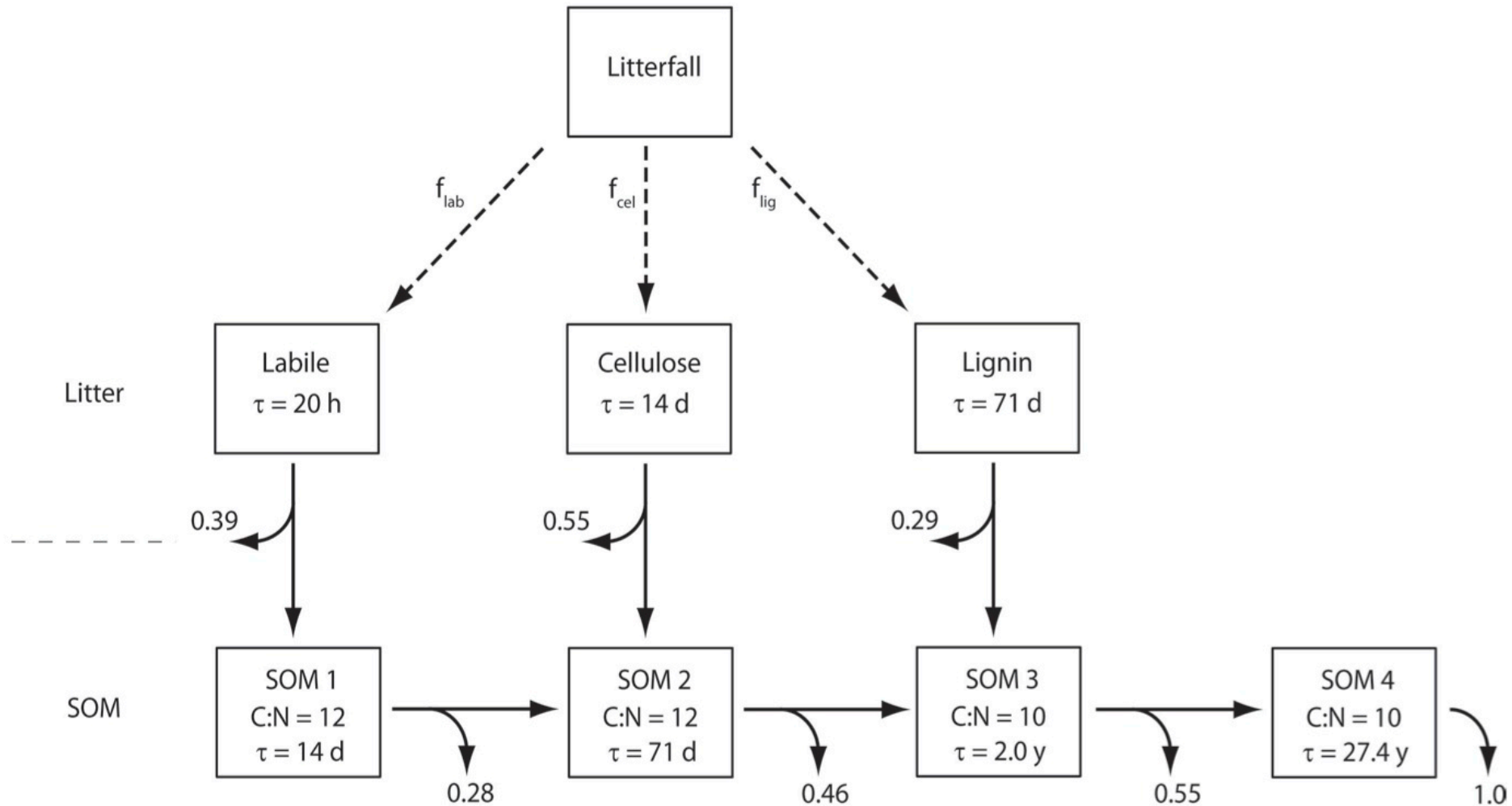
Litter

Soil Organic Matter

*Modified by:*

- Climate
- Substrate quality  
lignin, N
- Soil properties  
texture, pH, O<sub>2</sub>
- Land use

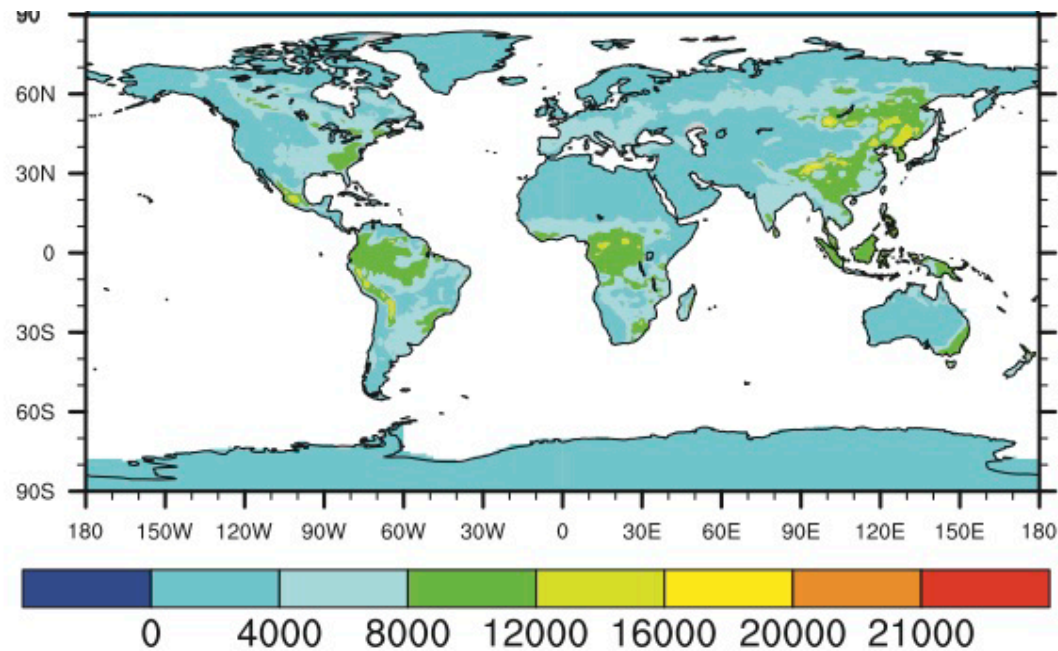
# Soil Biogeochemistry in CLM4 cn





# Soil C pools $\text{gC/m}^2$

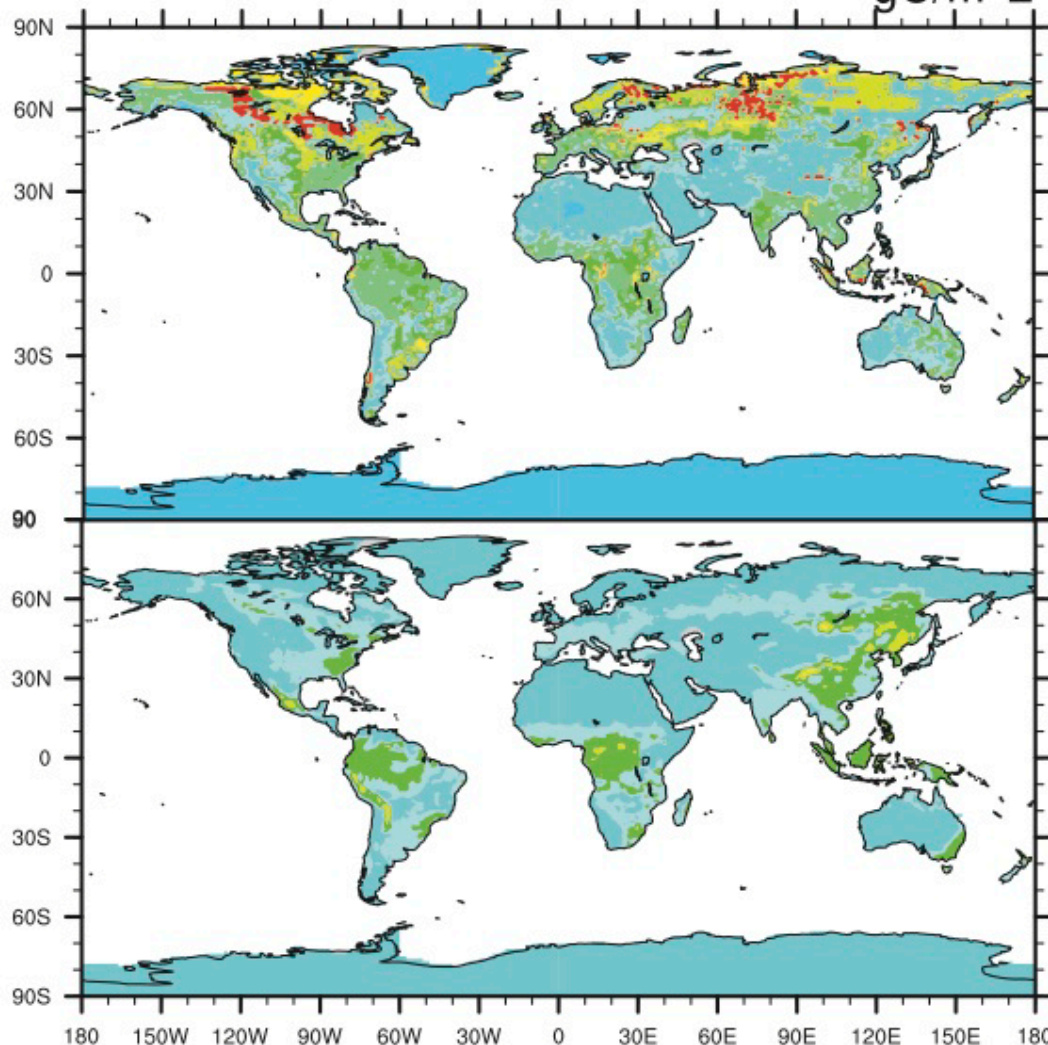
CLM4 cn



510 Pg C

# Soil C pools

gC/m<sup>2</sup>



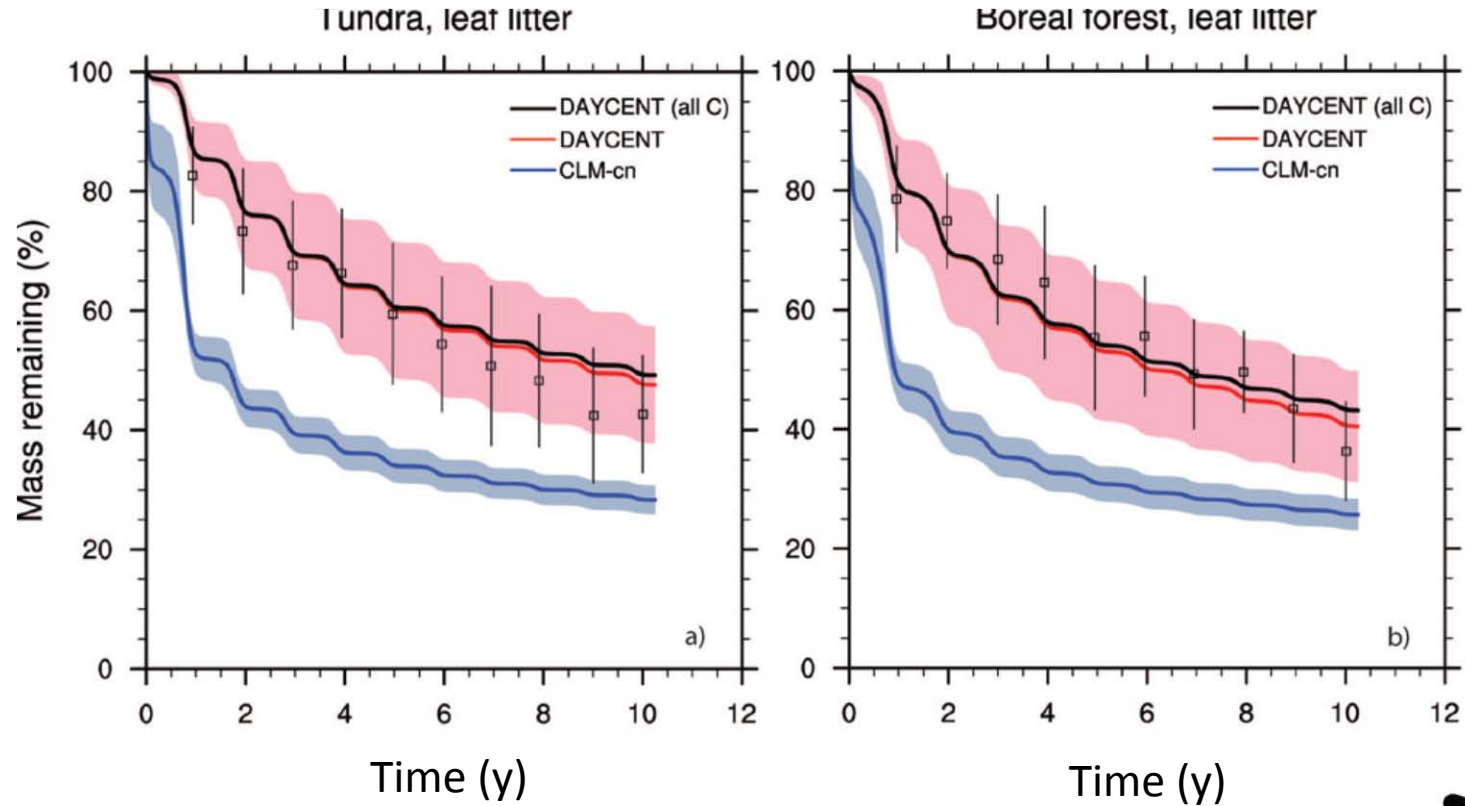
1100+ Pg C

CLM4 cn

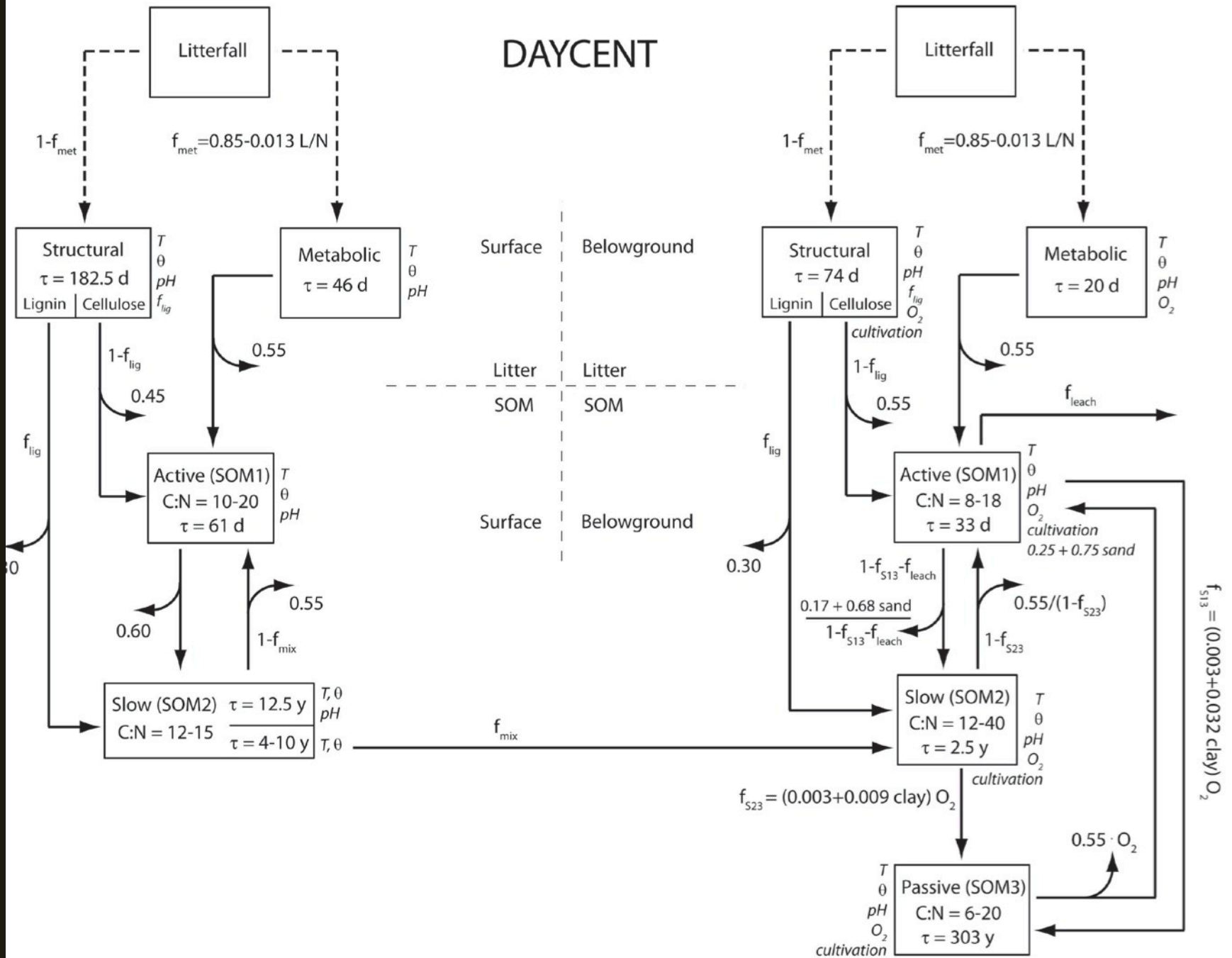
510 Pg C



# Soil Biogeochemistry in CLM4 cn *is too rapid*

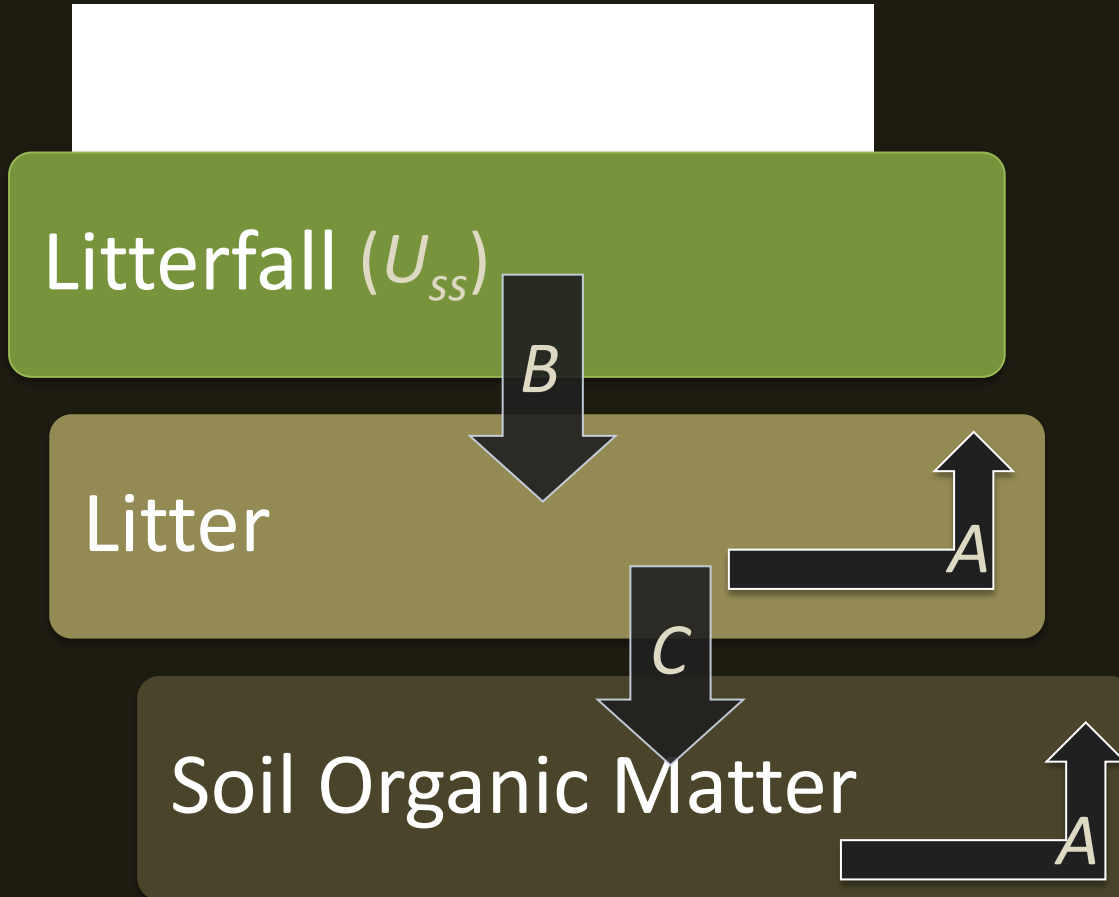


# DAYCENT

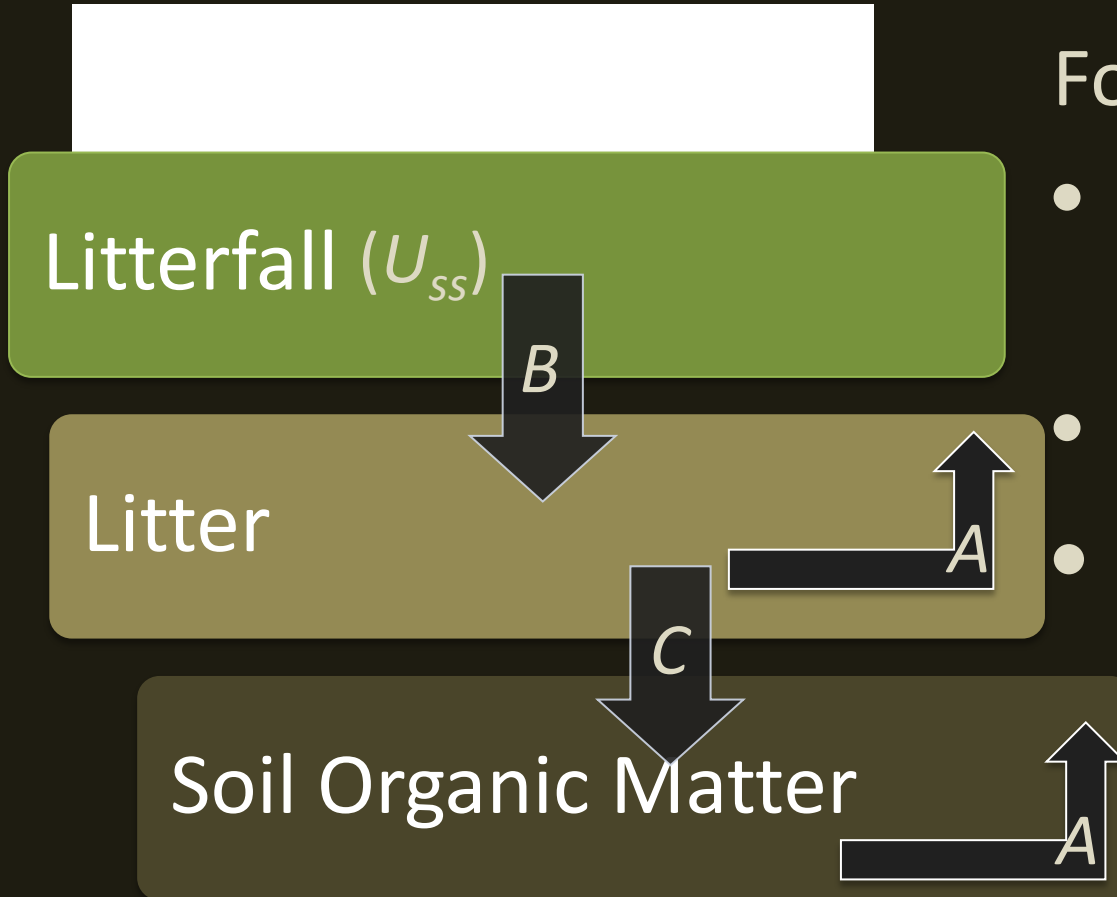




# Matrix solution



# Matrix solution



Forced with:

- CLM litterfall  
Leaf, froot, CWD
- CLM climate (CDI)
- CLM soil texture
- Make assumptions about CN, Lignin, pH

# Soil C pools

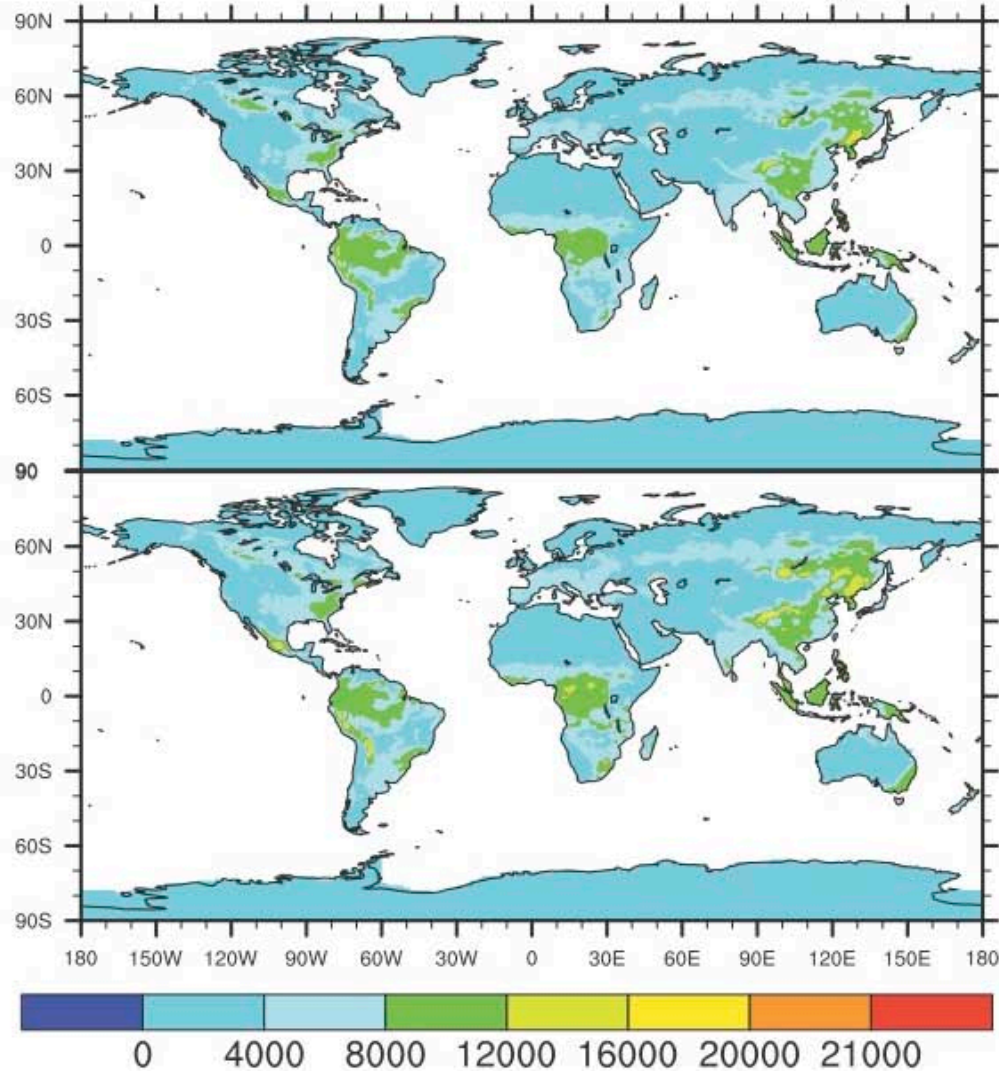
gC/m<sup>2</sup>

CLM4  
Spun up model

510 Pg C

CLM4  
Matrix solution  
(mean of monthly CDI)

588 Pg C  
 $r = 0.99$



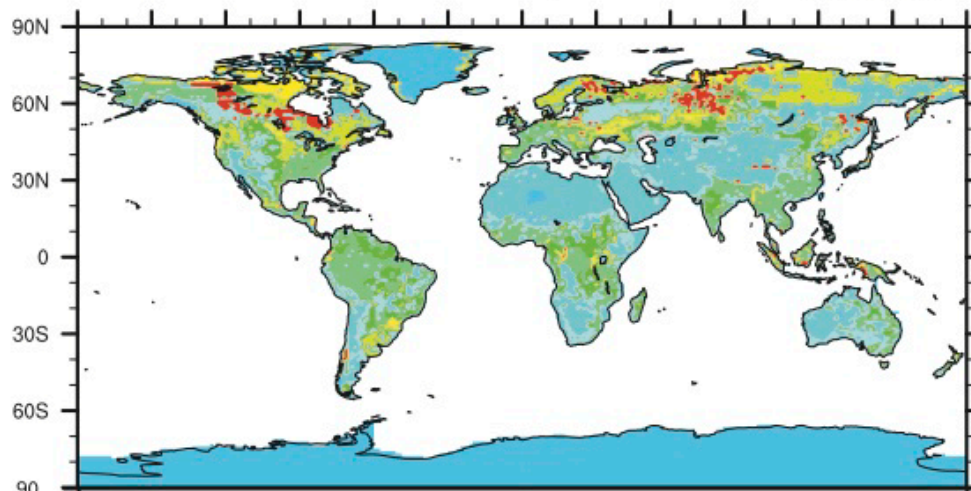
Matrix works for CLM4...  
What about DAYCENT?





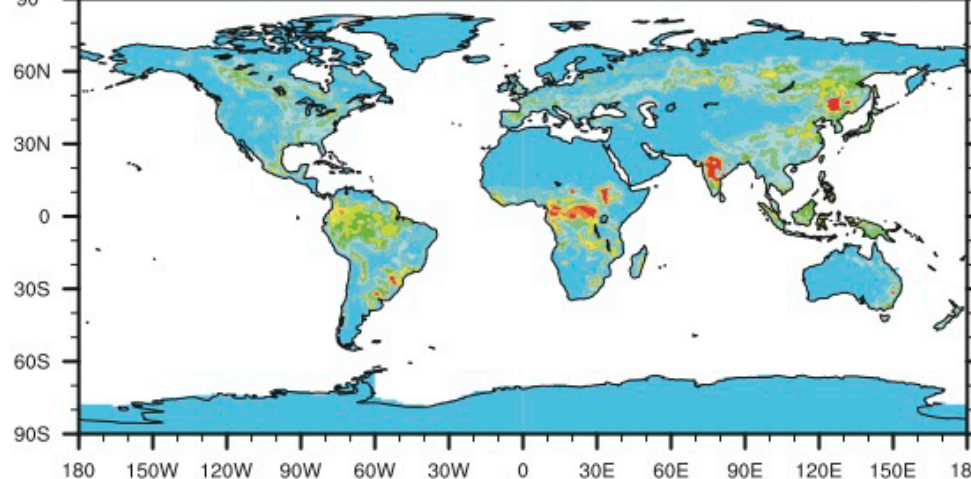
# Soil C pools $\text{gC/m}^2$

ISRIC-WISE  
OBS

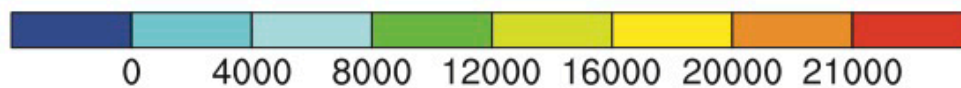


1100+ Pg C

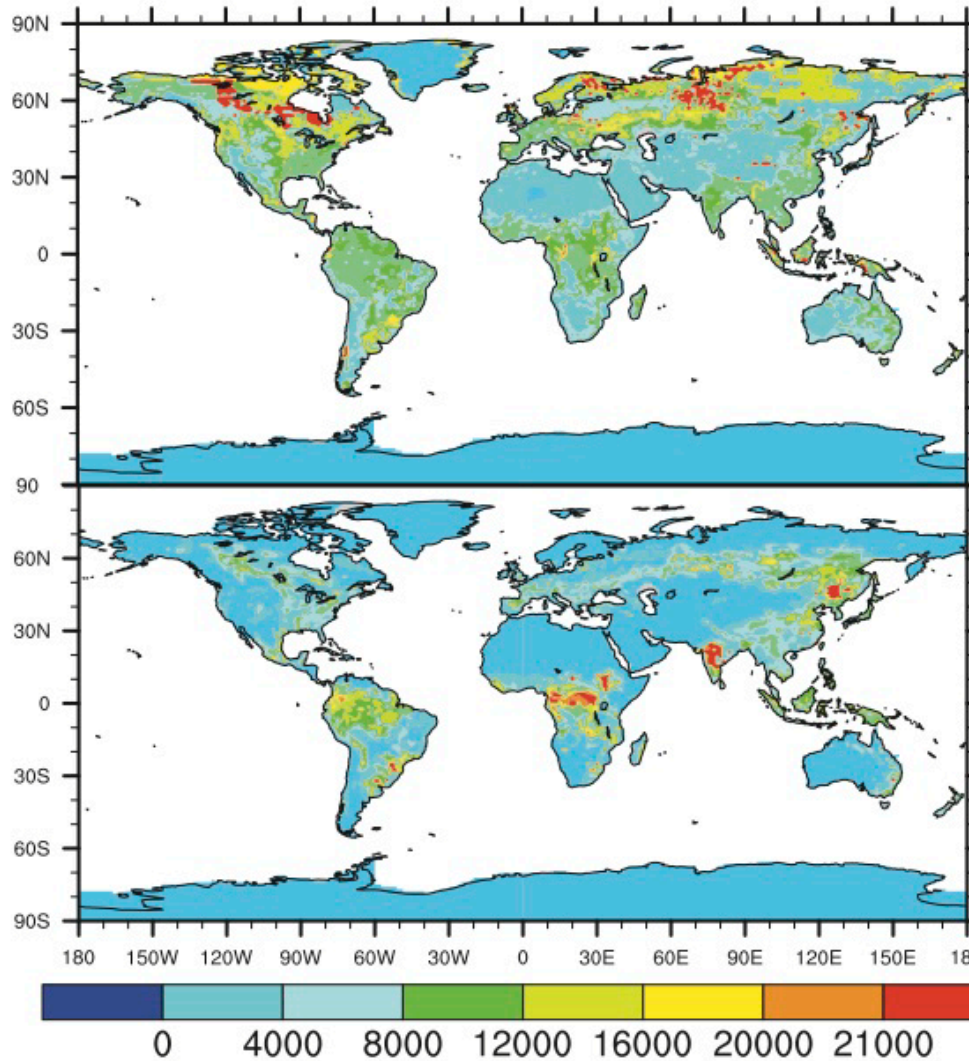
DAYCENT  
Matrix solution  
(pH = 7, C:N = 50)



484 Pg C



# Soil C pools $\text{gC/m}^2$



ISRIC-WISE  
OBS

1100+ Pg C

DAYCENT  
Matrix solution  
(pH = 7, C:N = 50)

484 Pg C

+ 0.1 Pg CN = 80

+ 26 Pg pH = 5

+ 110 Pg  $\uparrow$ Clay

+  $\uparrow$ CWOOD

+  $\uparrow$ Lignin

+  $\uparrow$ ....

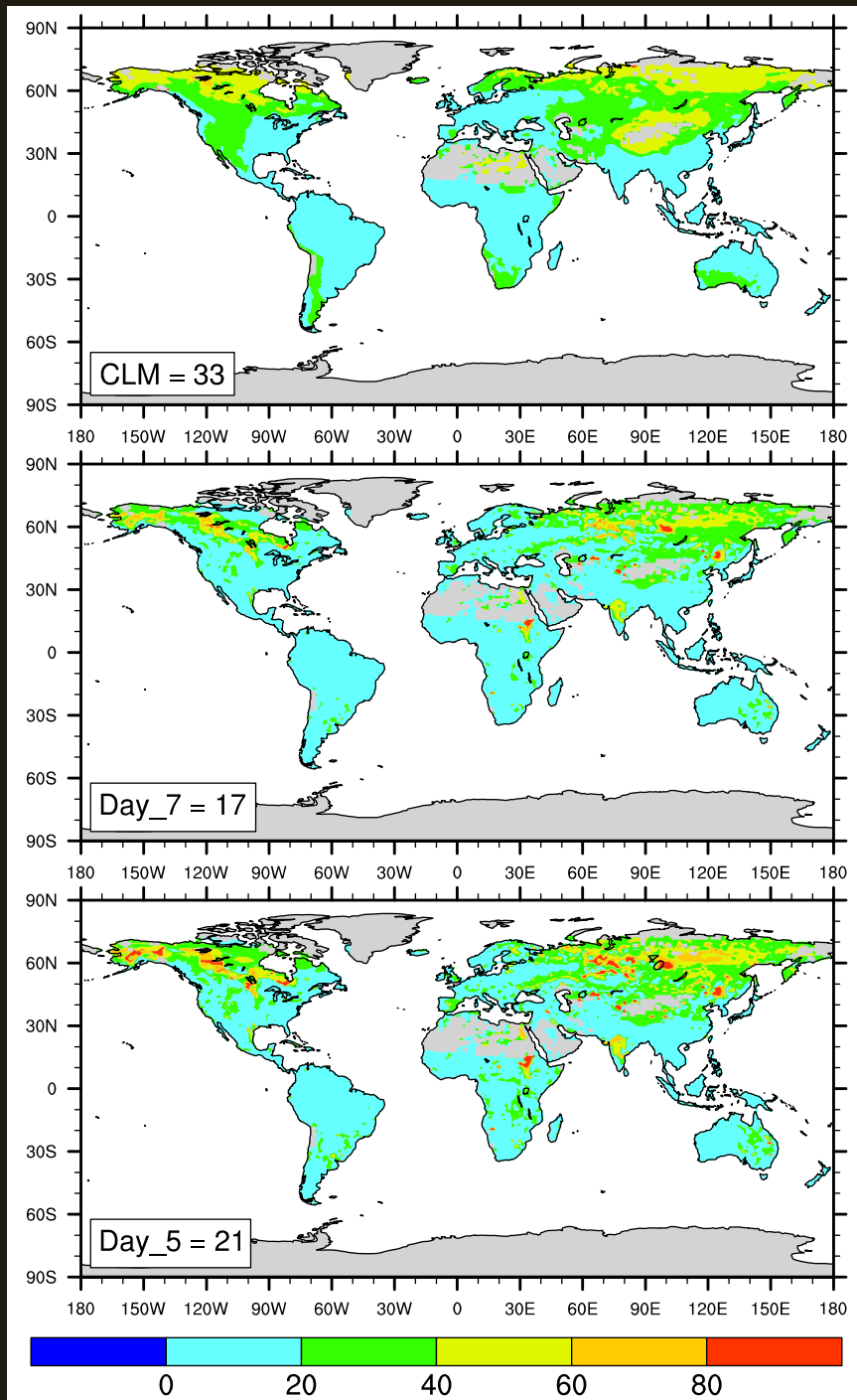


# Where are we going wrong?

- **Inputs CLM 43 Pg C y<sup>-1</sup>**  
    “Obs” 50 Pg C y<sup>-1</sup> (Matthews 1997 *JGR*)
- **Soil parameters**
- **Depth**
- **Processes SOM turnover time**
  - 20 y in DAYCENT
  - 33 y in CLM4 cn
  - 50+ y from Obs. (Schmidt et al. 2011)

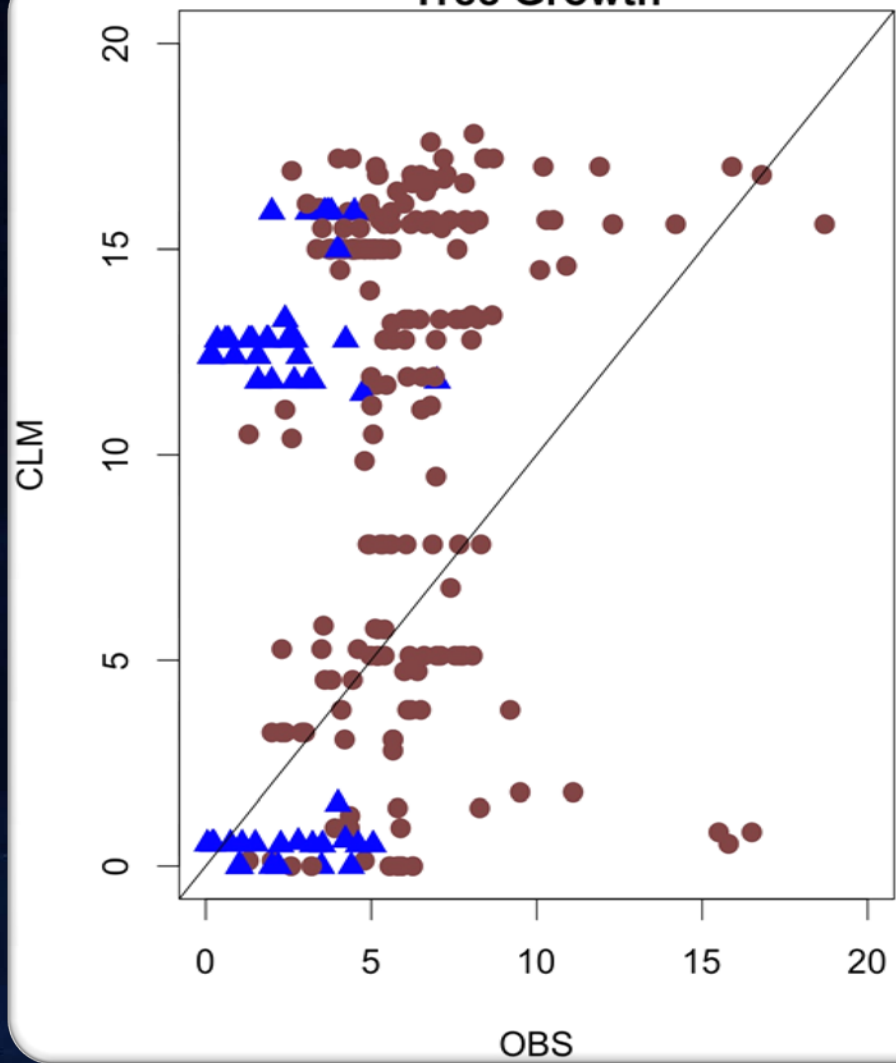


# SOC MRT (y)

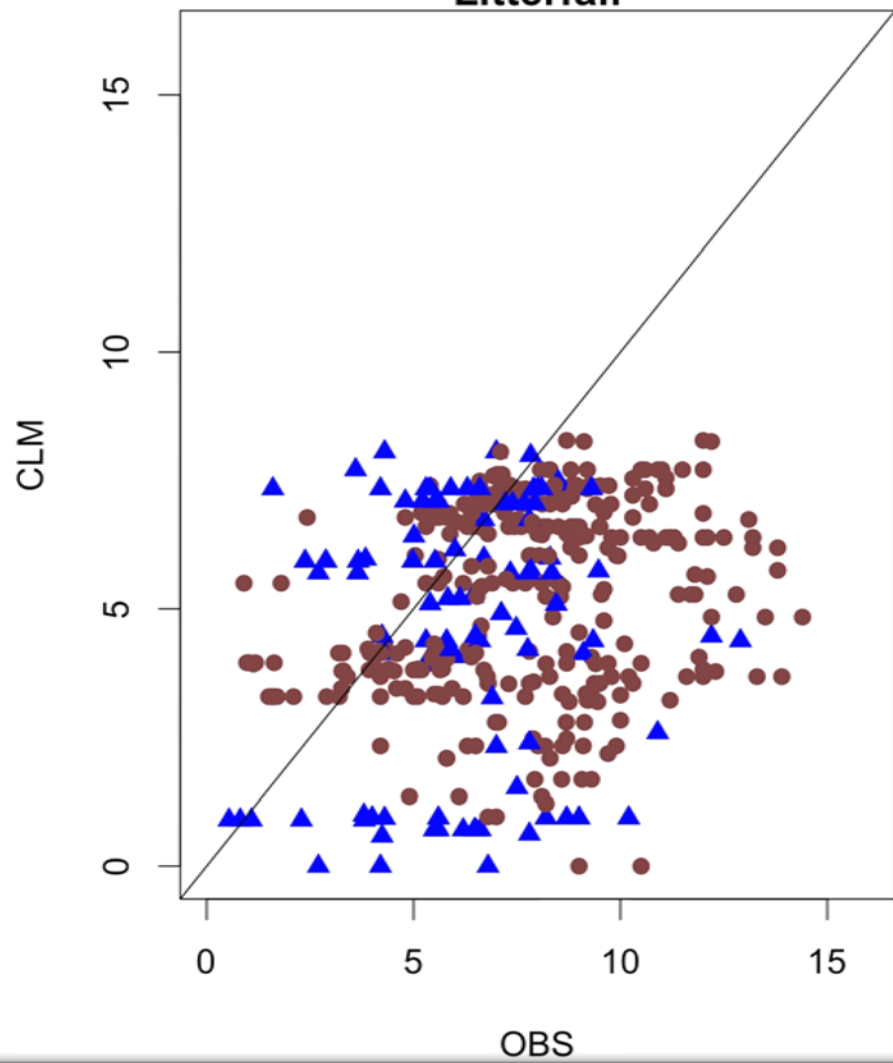




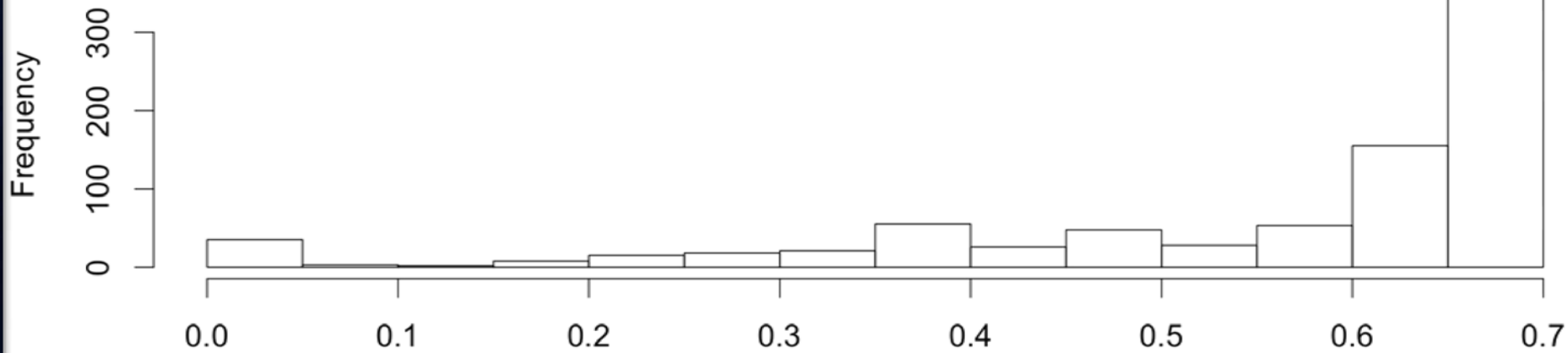
### Tree Growth



### Litterfall



## Relative Wood Allocation



## CLM

