# Allocation and turnover of biomass C in CLM, CMIP5, and observations

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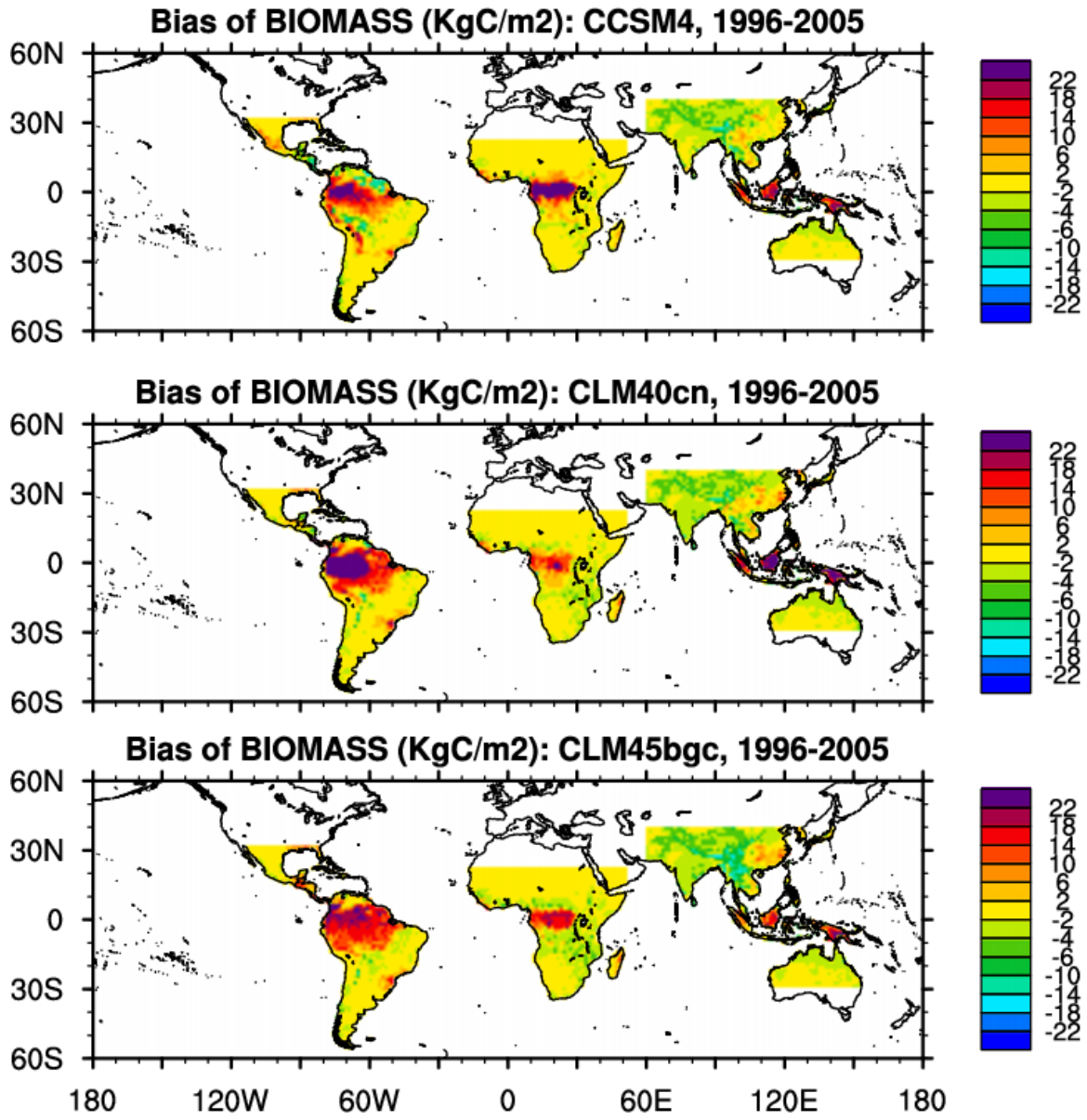
And thanks to
Mingquan Mu

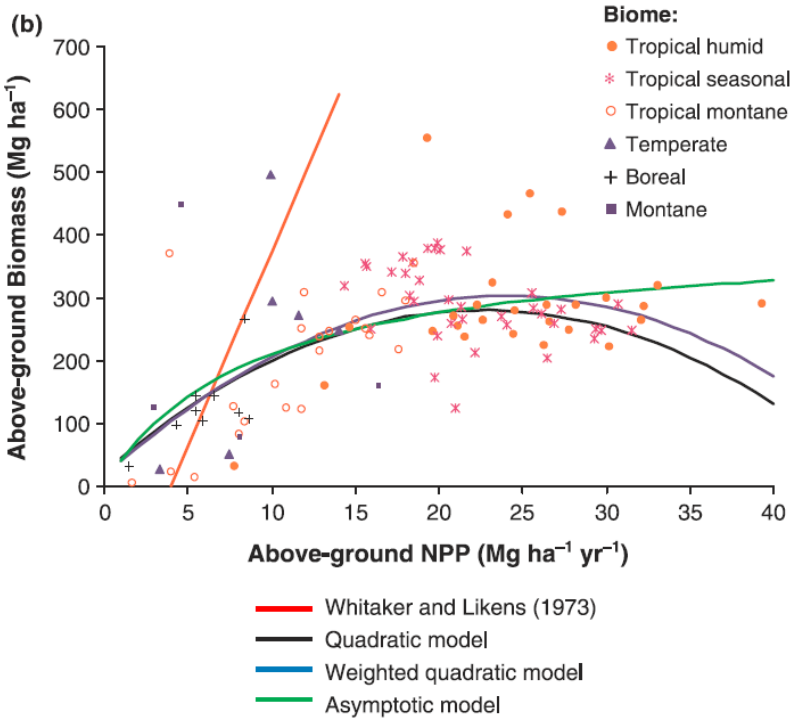

# Tropical forest biomass in CLM: persistent high bias



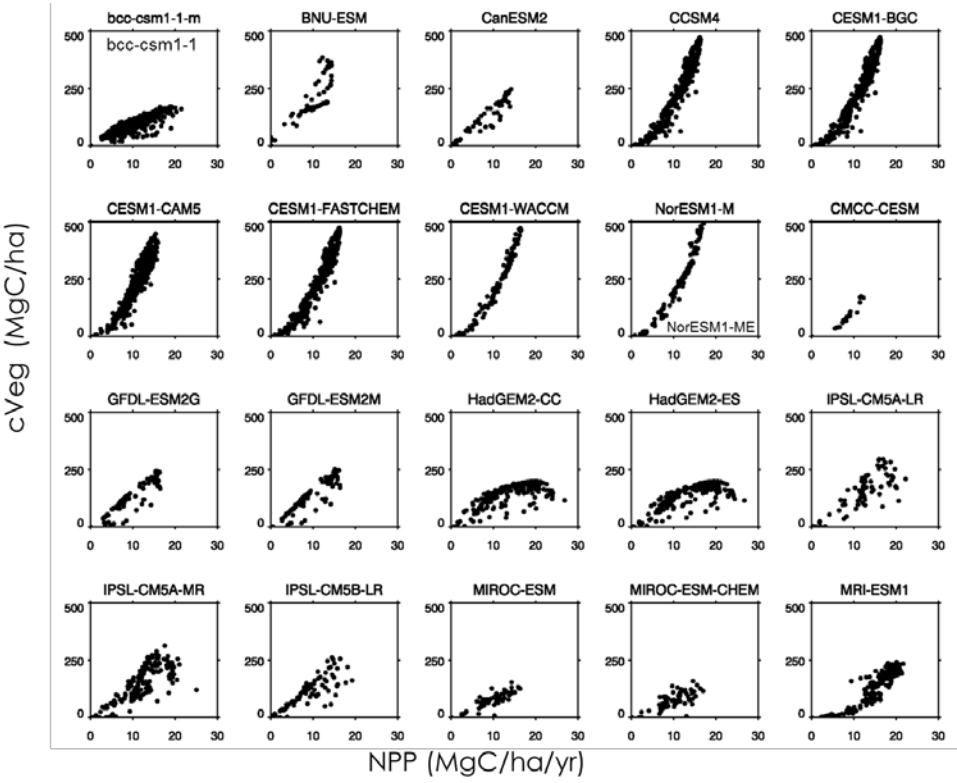

Figures: Mingquan Mu, ILAMB prototype: http://zea.ess.uci.edu/mmu/ILAMB/

Reference dataset is Saatchi et al. (2011)

# More wrong relationship between NPP and biomass in CLM than other CMIP5 models



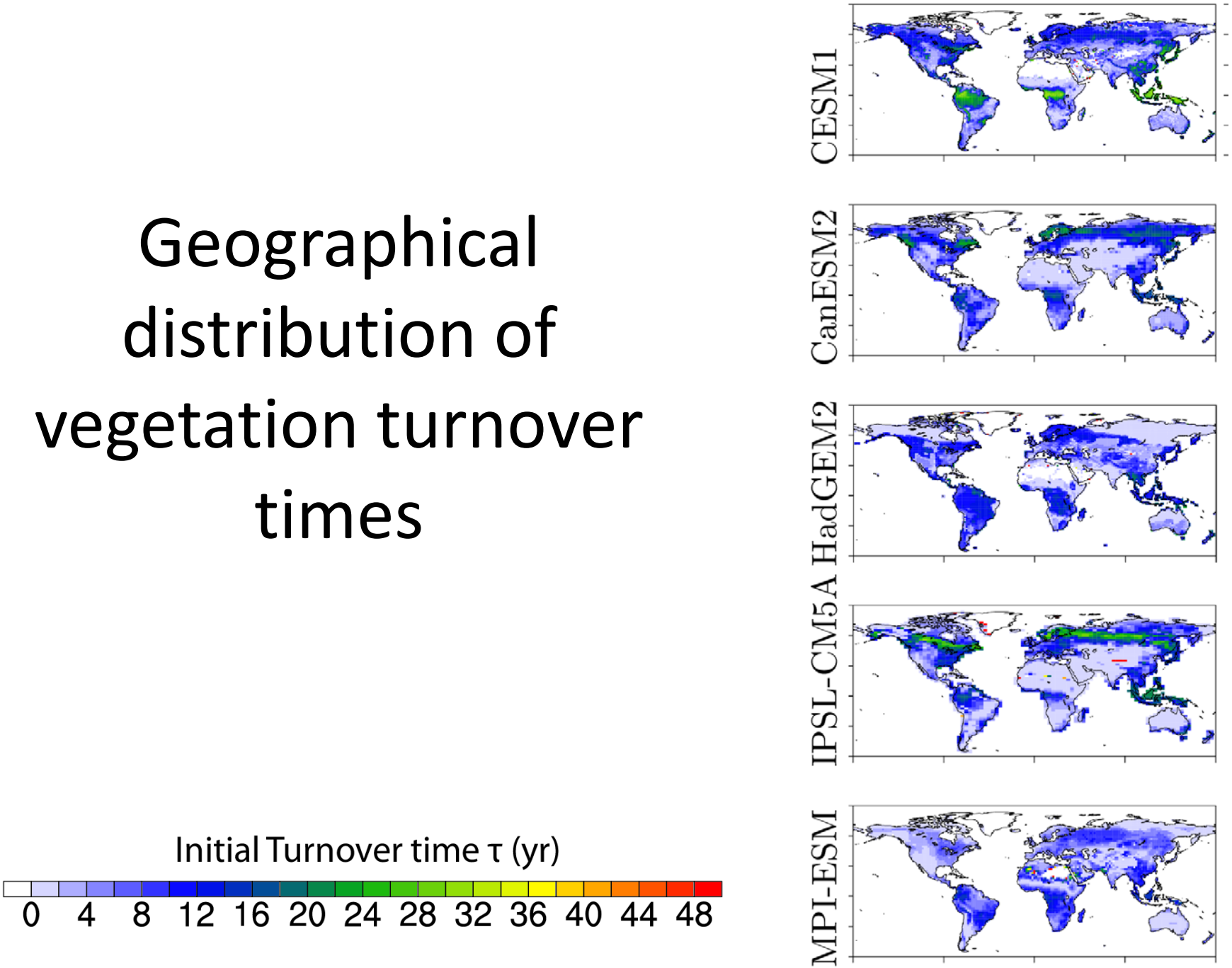

Keeling and Phillips, 2007




Negron-Juarez et al., *in prep*

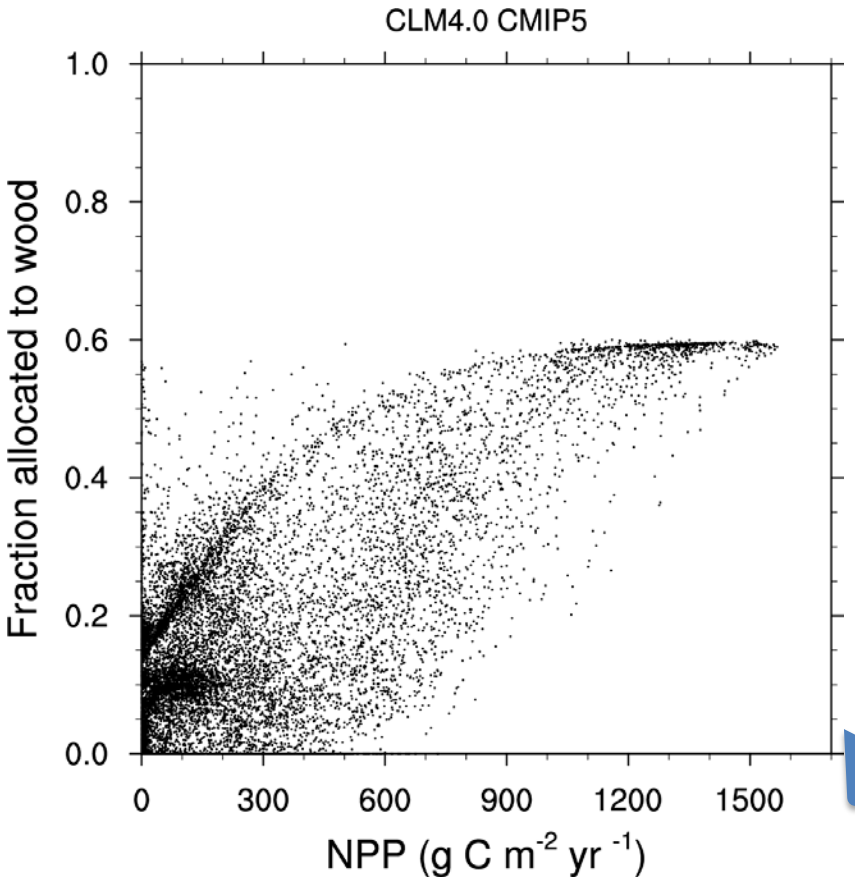
$$\tau_{veg} \approx F_{wood}\tau_{wood}$$

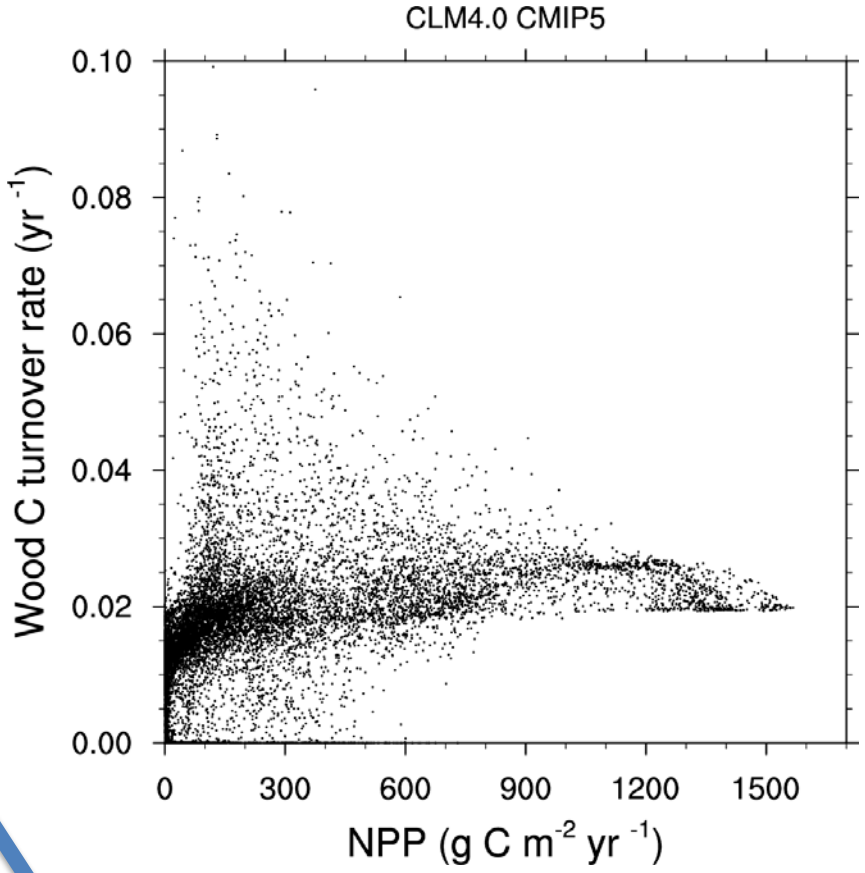
# Geographical distribution of vegetation turnover times



# Allocation and turnover in CESM1

$$\tau_{veg} \approx F_{wood}\tau_{wood}$$

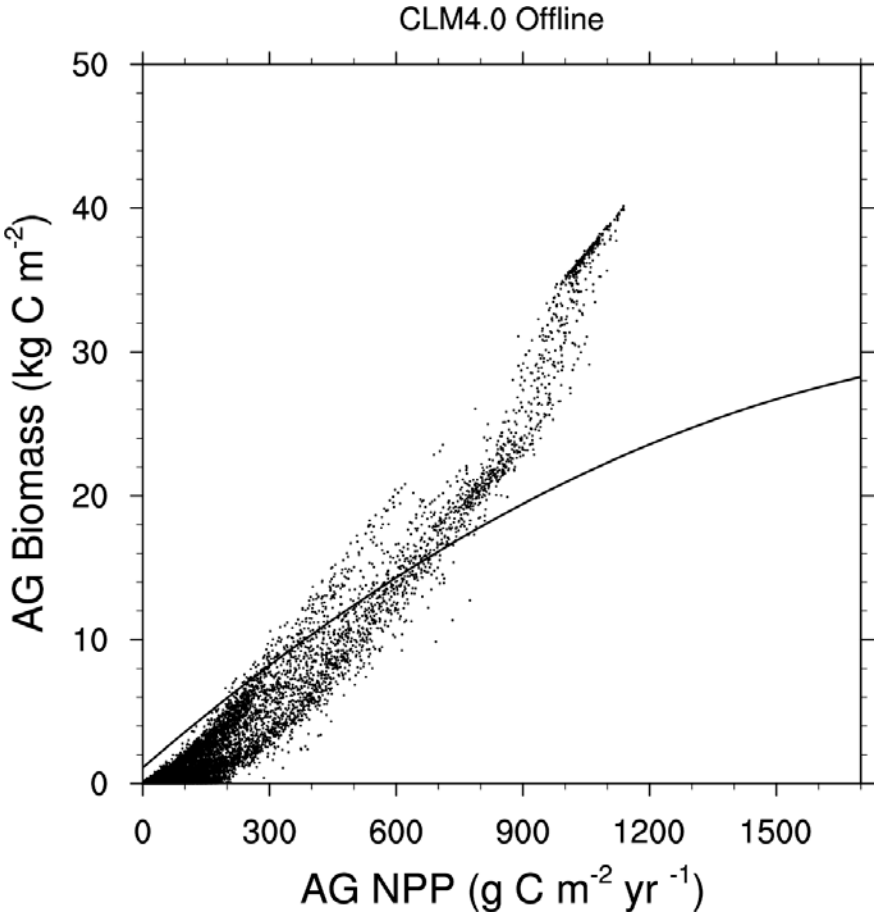


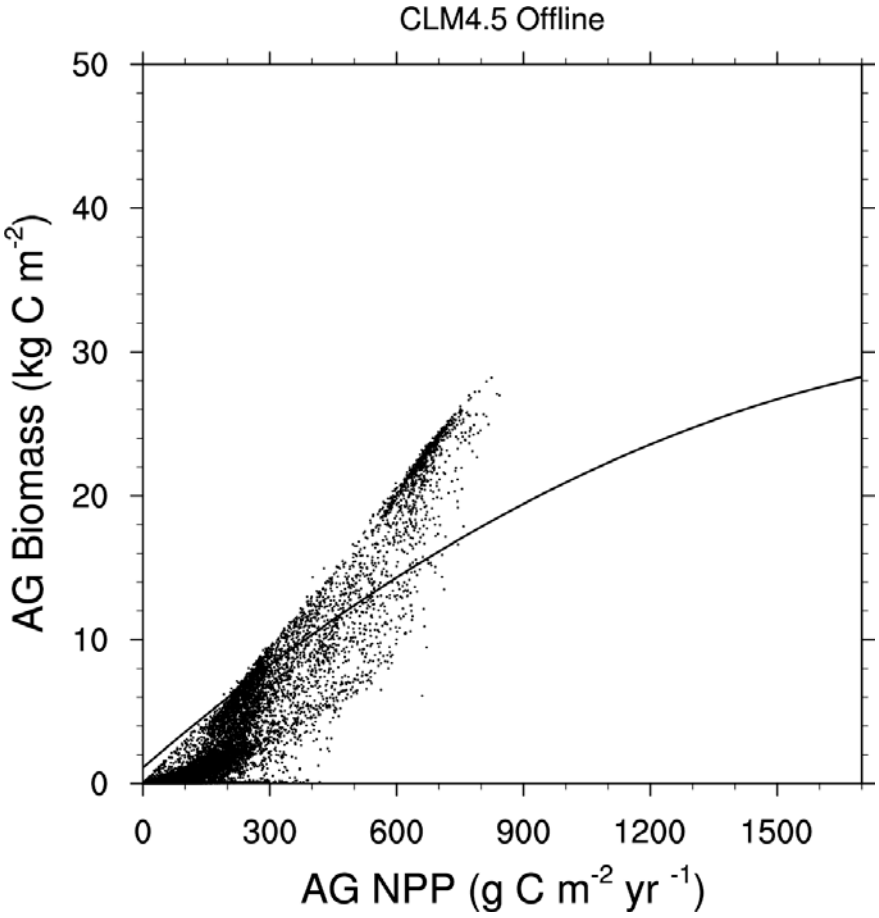




$$a_3 = \frac{2.7}{1+e^{-0.004 NPP_{ann} - 300}} - 0.4 \qquad (13.8)$$

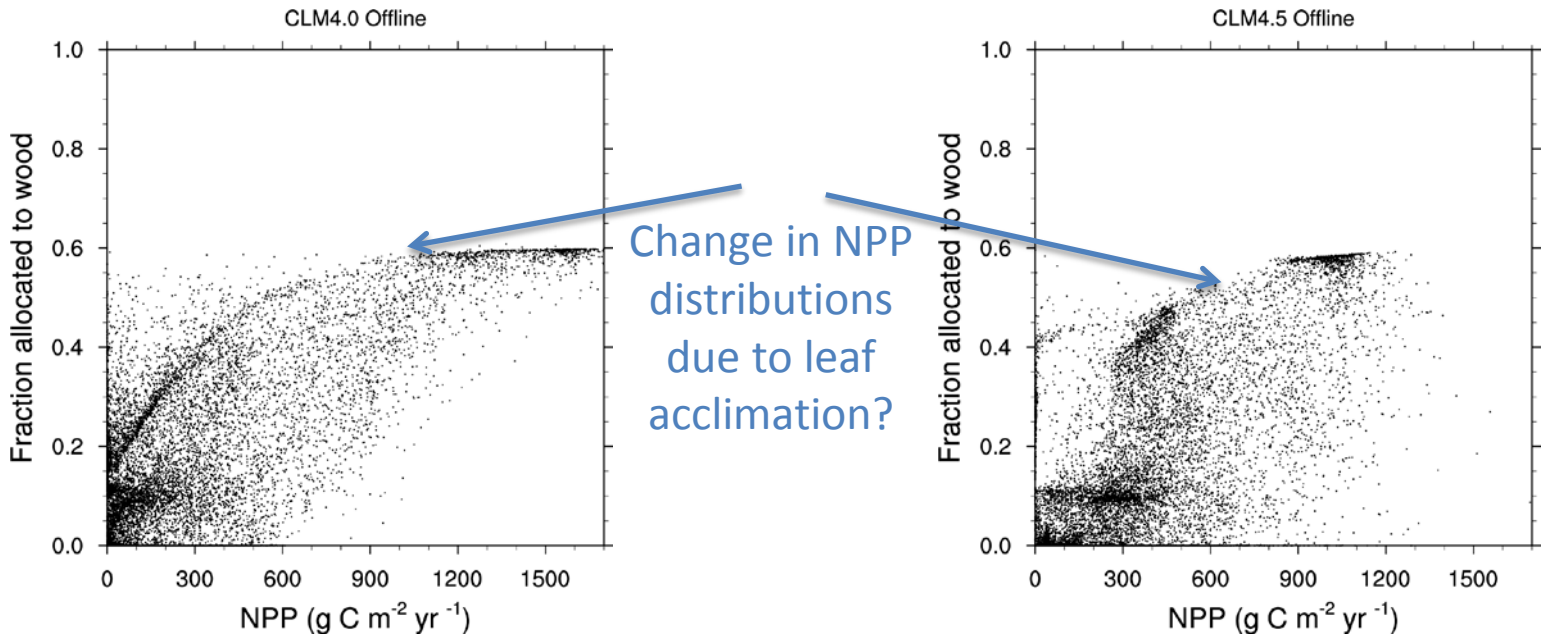
CLM4.5 Tech note (Oleson et al., 2013)

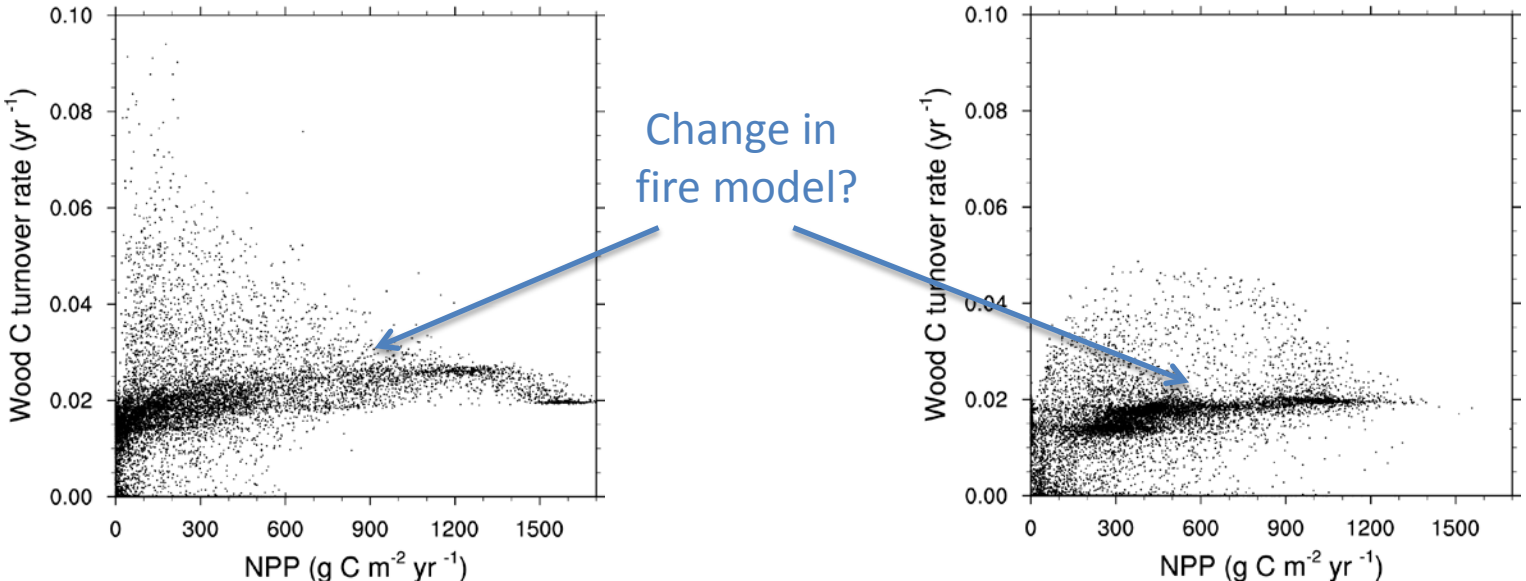
# Comparison of CLM4.0 and CLM4.5 to Keeling and Phillips relationship



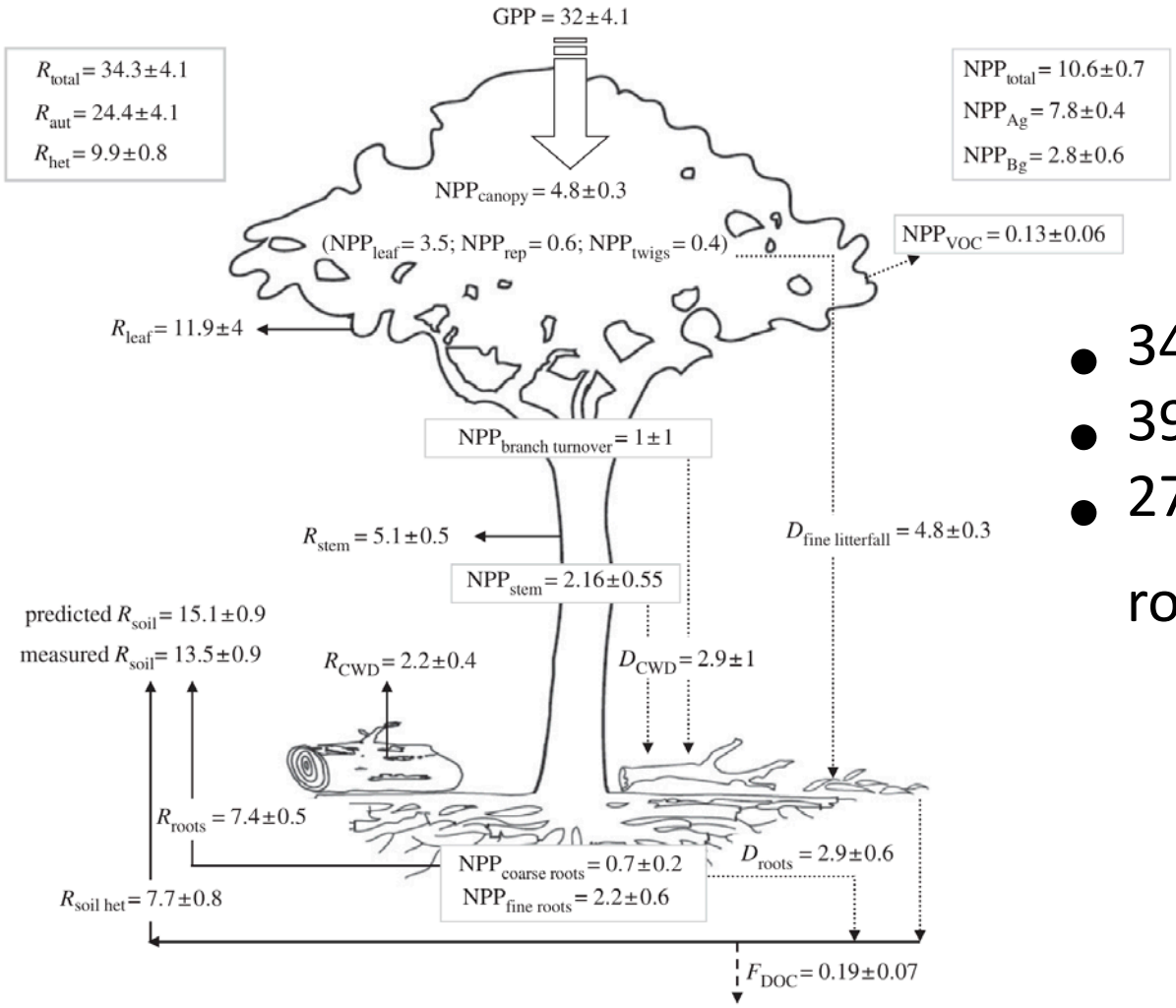



# Why the change from CLM4 to CLM4.5?



# Simple fix: Fixed Allocation?




- 34 ±6% canopy
- 39 ±10% wood
- 27 ±11% fine roots

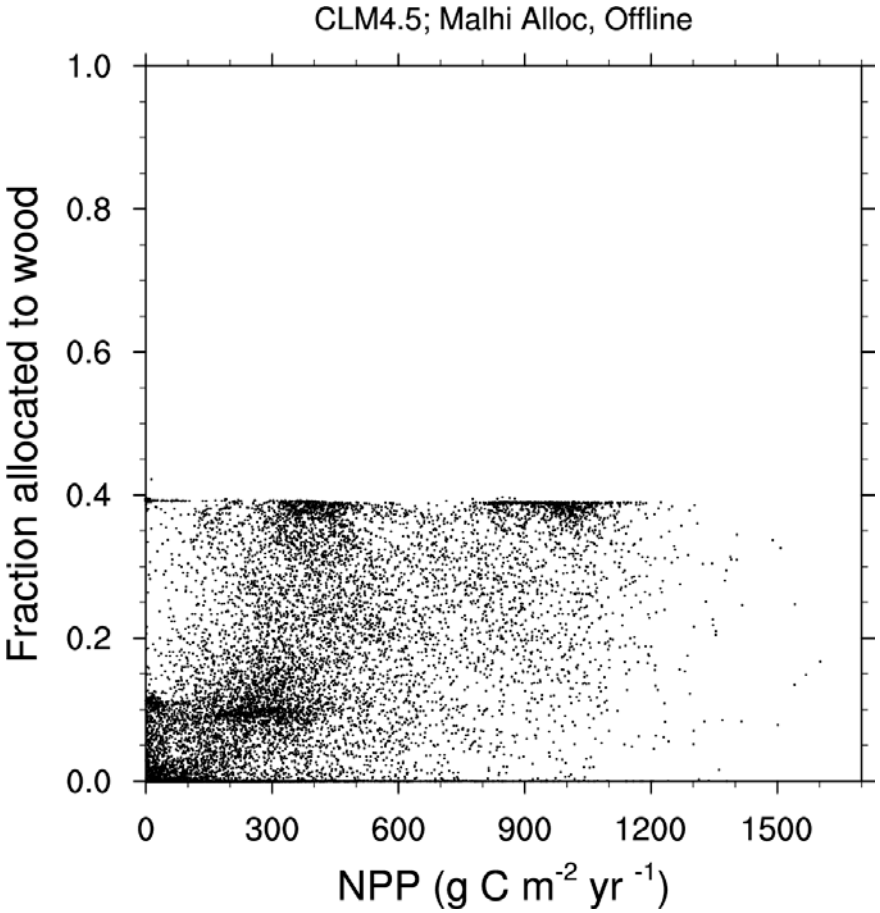
Malhi et al., 2011

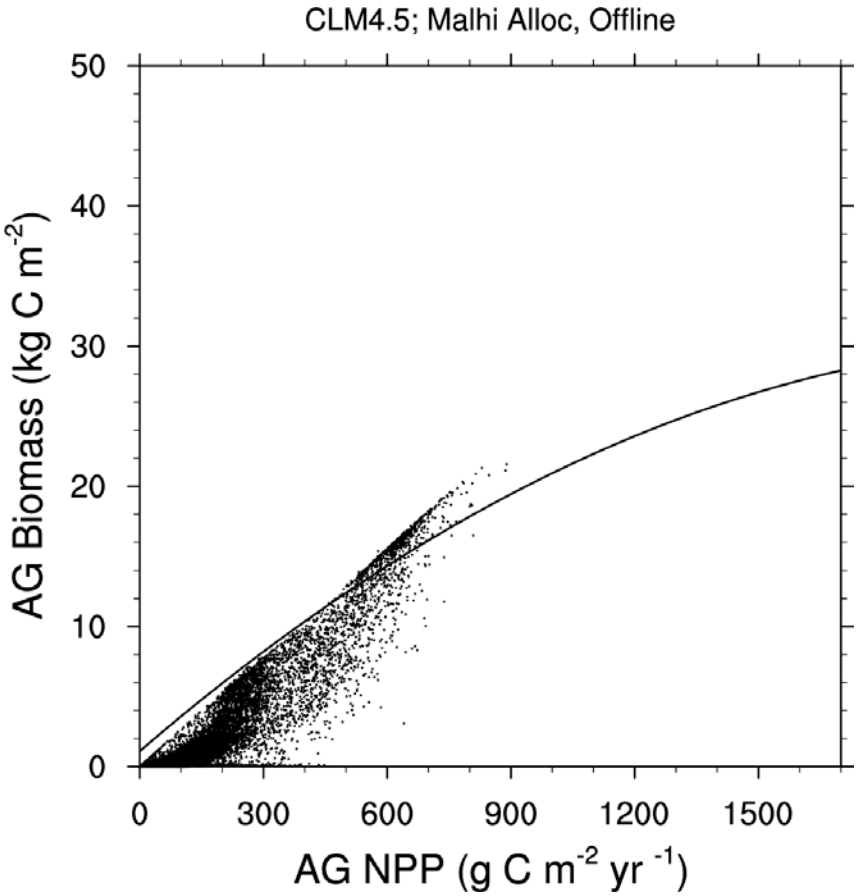
# Changes required to Malhi allocation values in CLM PFT parameters file:

1. Change stem_leaf from -1 (dynamic allocation flag) to 0.8824
2. Change froot_leaf from 1 to 0.794

- For first experiment here, changed for all woody PFTs
  - Next step: use PFT-specific parameters based on observations from different biomes

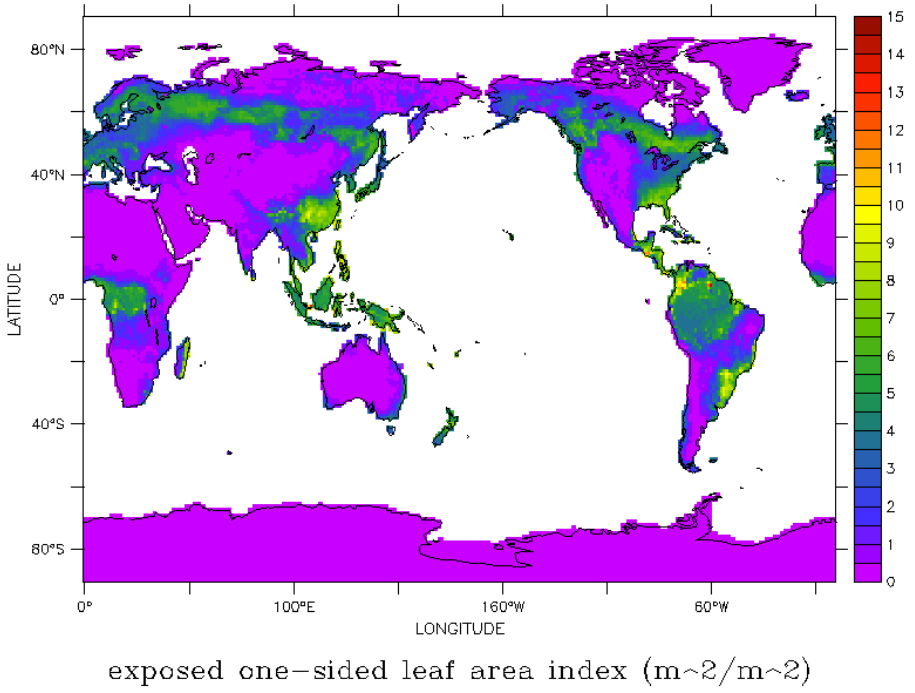
# Results of fixed allocation



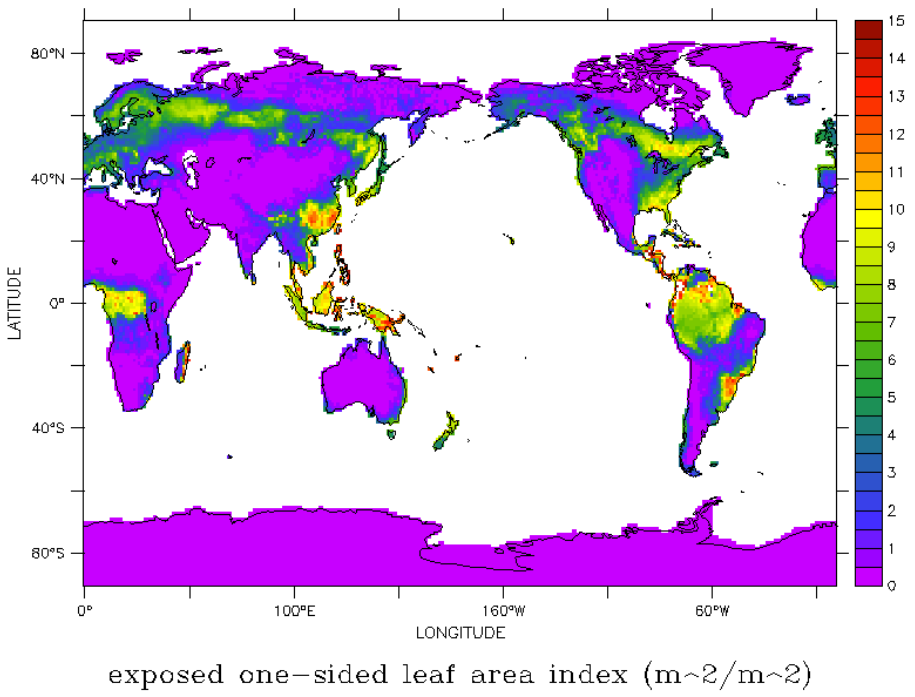



# But, more allocation to leaves means that LAI increases…

## Control




## Fixed Allocation




So we need a solution that allows both biomass and LAI to be reasonable: e.g. modify leaf tau, SLA?

# Why do we need dynamic allocation?

- Current scheme acts as stabilizing feedback for productivity, but at the cost of over-sensitive biomass
- Current CLM structure does not allow for allocation differences along successional trajectories
- Only plant organ that functions are leaves – no possibility for tradeoffs due to allocation
- Heretical proposition: make the model simpler
  - In the absence of mechanistic allocation effects, best to just set to mean observed ratios for each PFT?
- All this will change with CLM(ED), where more complex hypotheses can be explored

# Conclusions and Next Steps

- CLM Dynamic allocation leads to opposite relationship as compared to observations of vegetation turnover vs. NPP
- Replacing this with fixed allocation and values consistent with field data corrects the biomass overestimate and defines linear relationship
- But at the cost of increasing LAI
- But fixed allocation doesn't capture the saturating response: do we need to replace mortality from fixed (2%/yr) to increasing mortality under high NPP forests?

This research was supported by the Director, Office of Science, Office of Biological and Environmental Research of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231 as part of their Regional and Global Climate Modeling Program