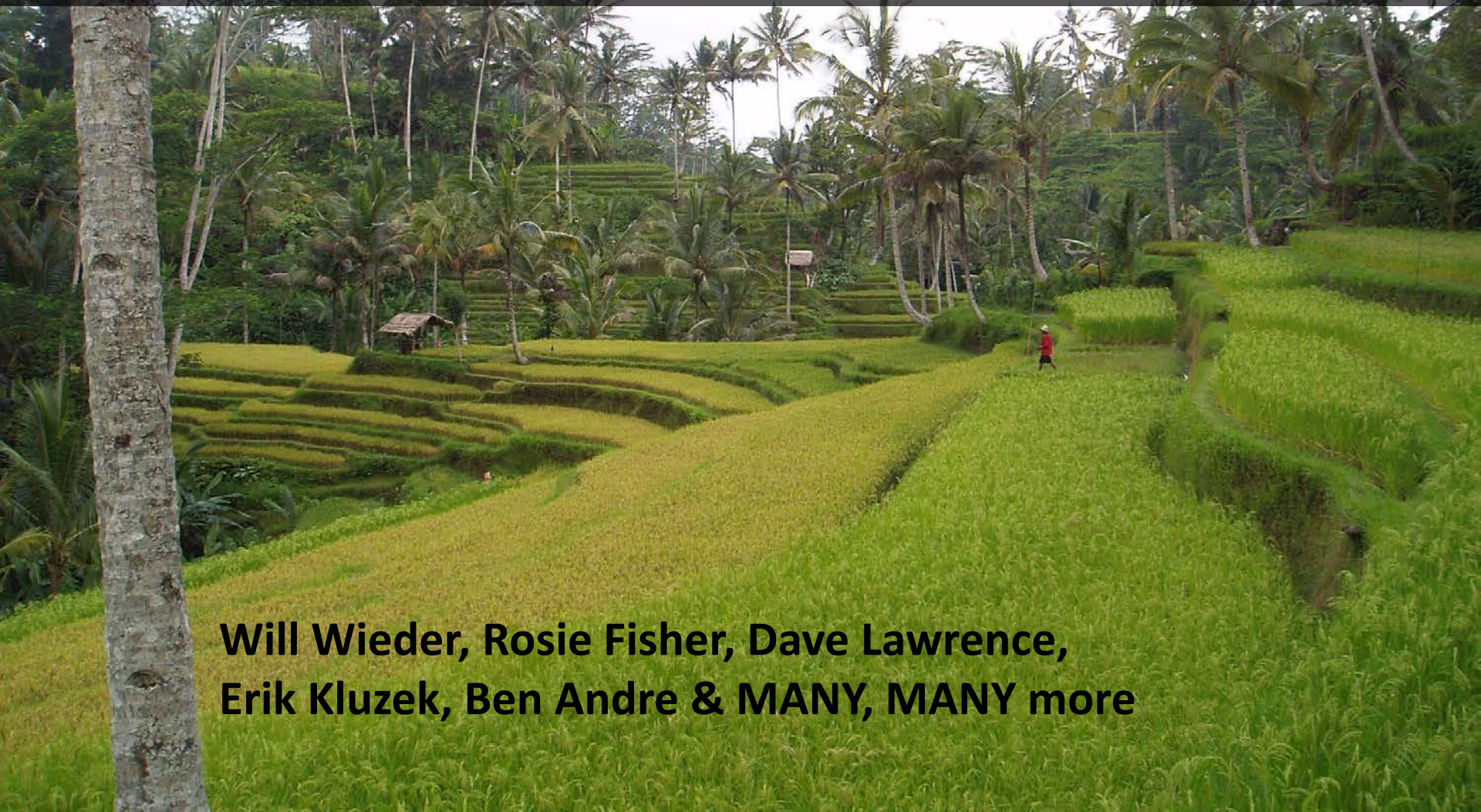
Nitrogen cycle in CLM5

"If your main thought of nitrogen is as a boring corner of the periodic table, then it is time to look again."

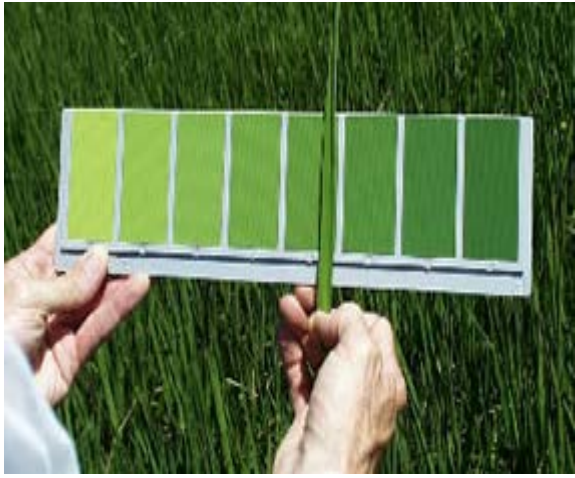
Nitrogen and Climate Change: An Explosive Story -Dave Reay



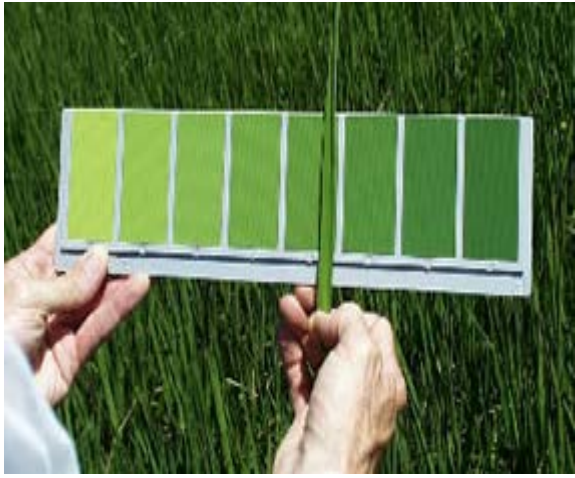
Will Wieder, Rosie Fisher, Dave Lawrence, Erik Kluzek, Ben Andre & MANY, MANY more

N Assumptions in CLM4.0 & 4.5

1. Leaf nitrogen content is static & unrelated to stomatal conductance



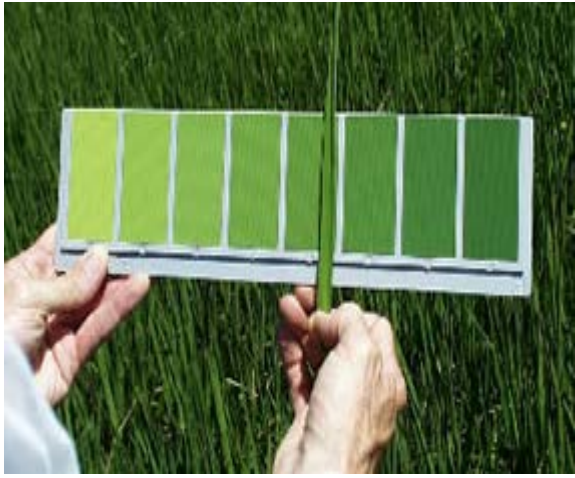
N Assumptions in CLM4.0 & 4.5



1. Leaf nitrogen content is static & unrelated to stomatal conductance

1. Photosynthetic capacity does not respond to the environment

N Assumptions in CLM4.0 & 4.5



1. Leaf nitrogen content is static & unrelated to stomatal conductance

1. Photosynthetic capacity does not respond to the environment

1. Plants get nitrogen for free

N Assumptions in *CLM5.0*

1. Leaf nitrogen content is ***dynamic*** & ***related*** to stomatal conductance

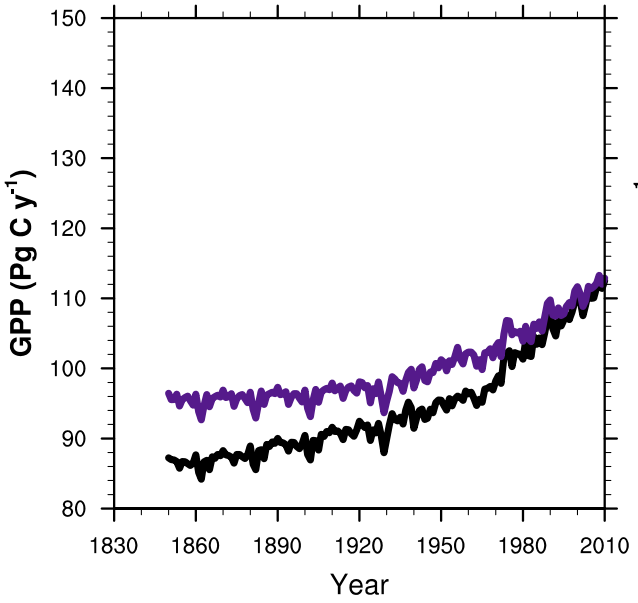
1. Photosynthetic capacity ***does*** respond to the environment

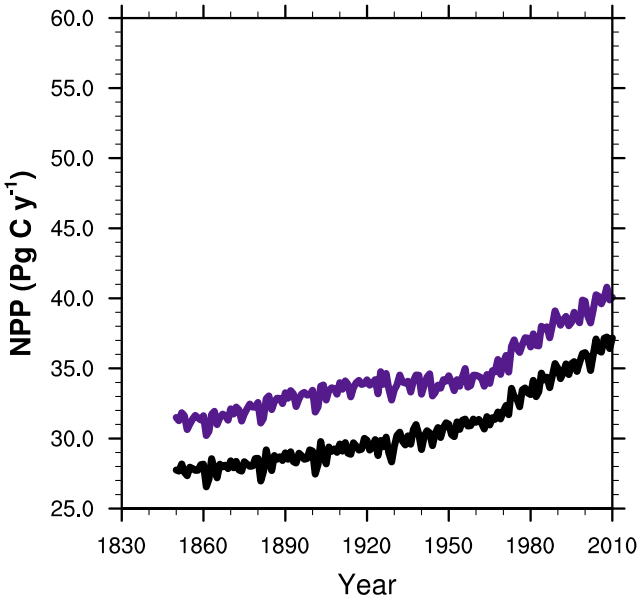
1. Plants ***pay*** C to get N

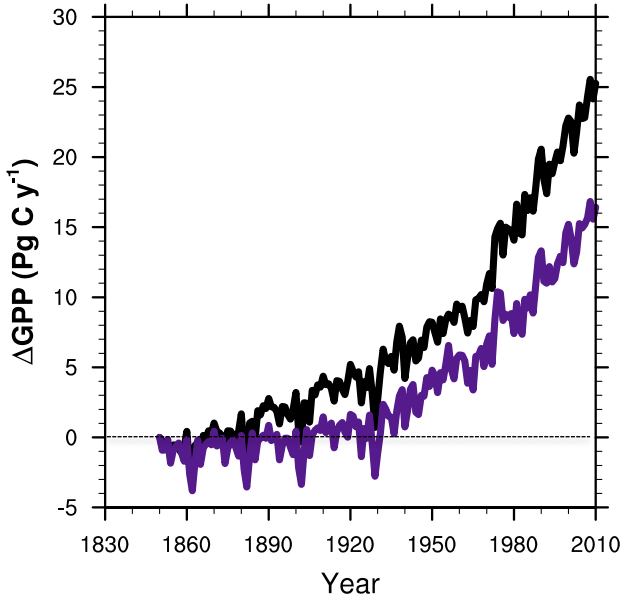
CLM5 Historical

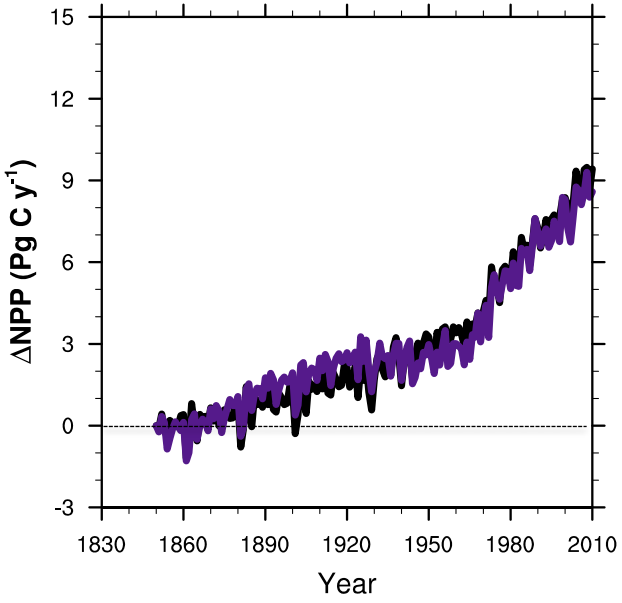
1850-2010, GSWP3

CLM4.5N **+ FlexCN & LUNA** **+ FUN**



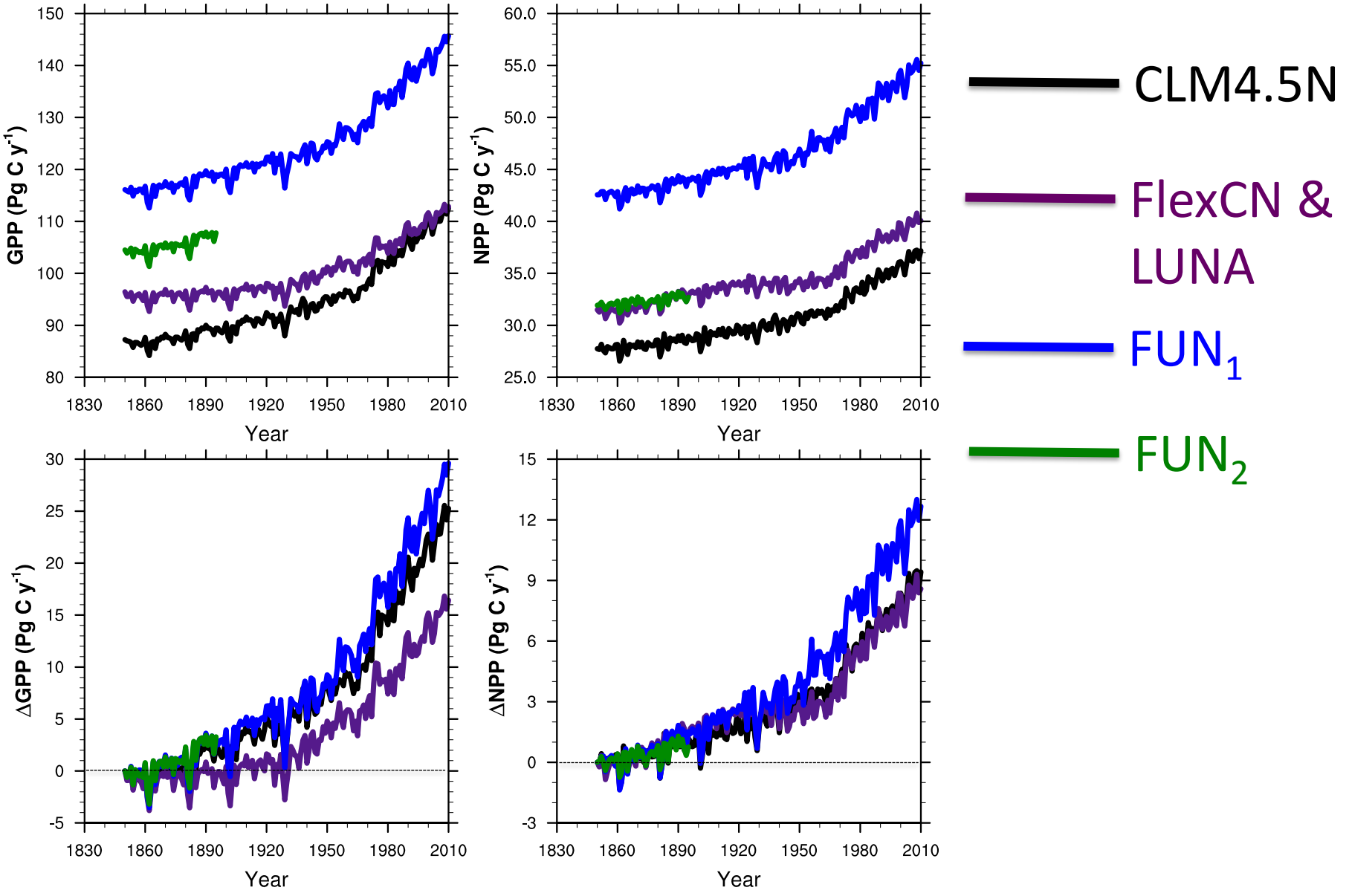




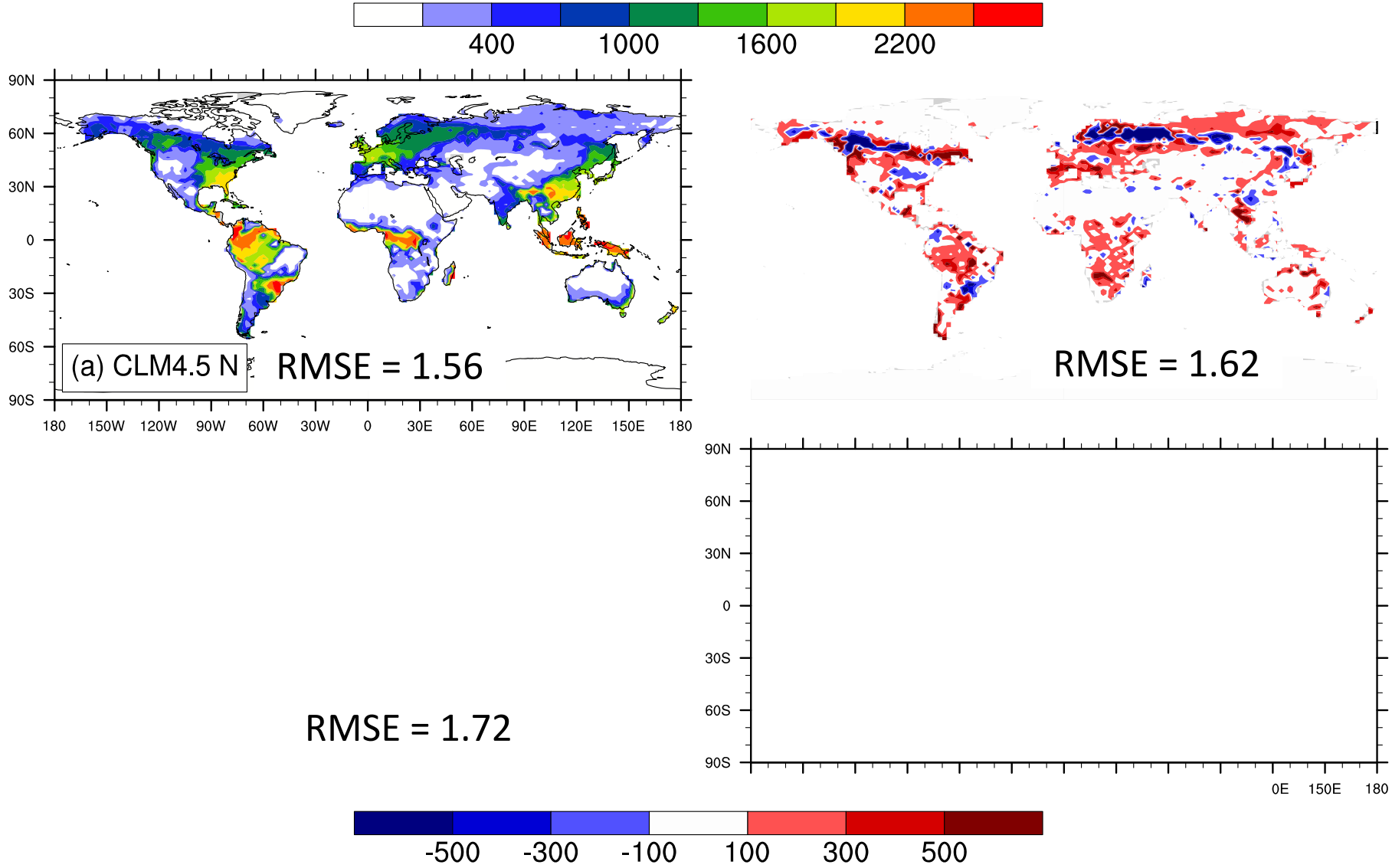


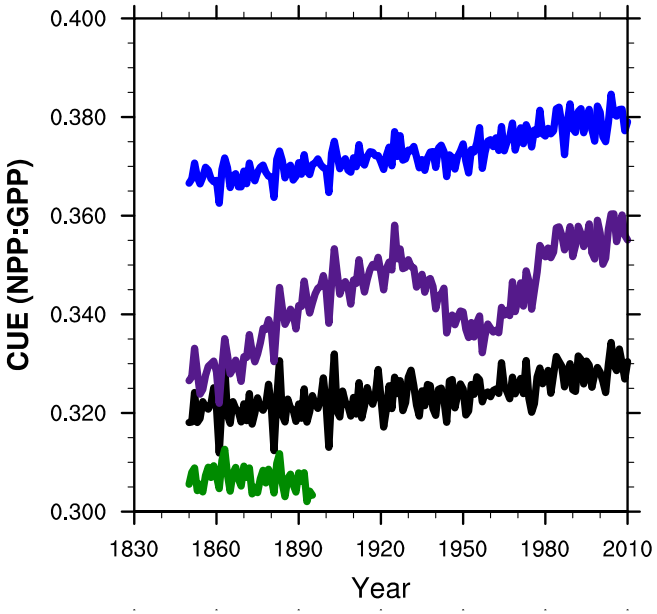
CLM4.5N

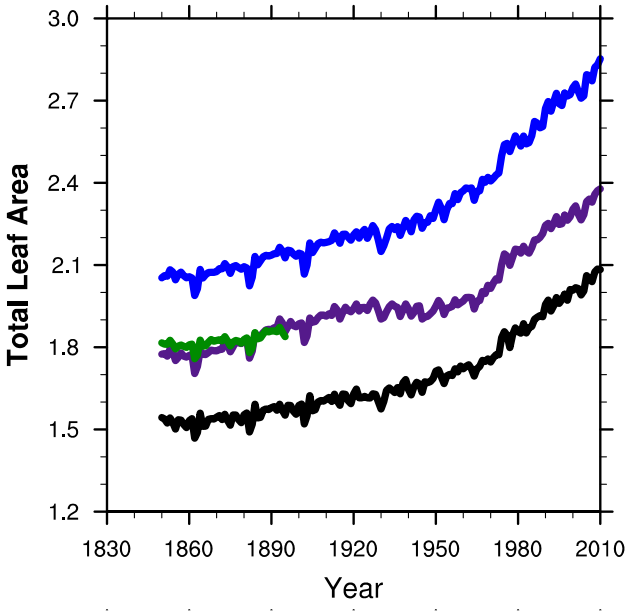
FlexCN & LUNA


GPP (Pg C y-1)
NPP (Pg C y-1)
ΔGPP (Pg C y-1)
ΔNPP (Pg C y-1)
Year
1830
1860
1890
1920
1950
1980
2010
CLM4.5N
FlexCN & LUNA
FUN1
FUN2

Initial GPP (gC m^{-2} y^{-1})







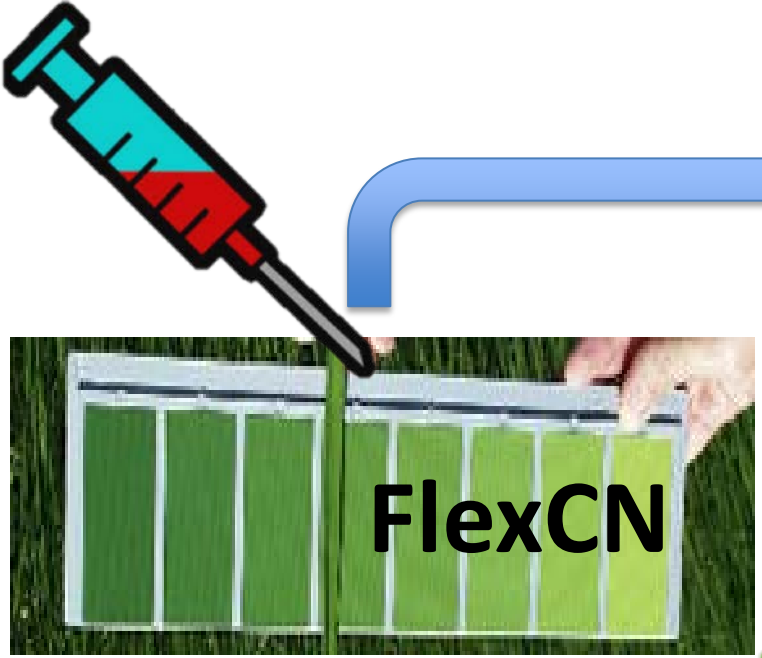
CLM4.5N

FlexCN & LUNA

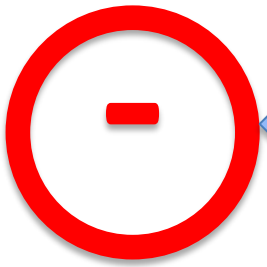
FUN_1

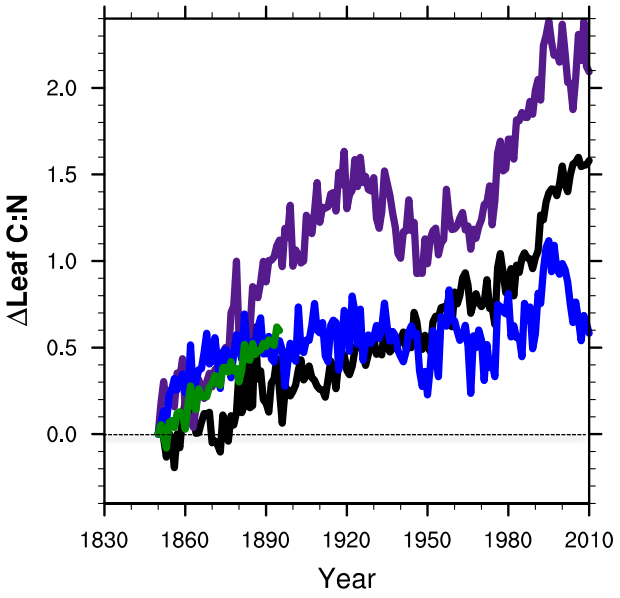
FUN_2

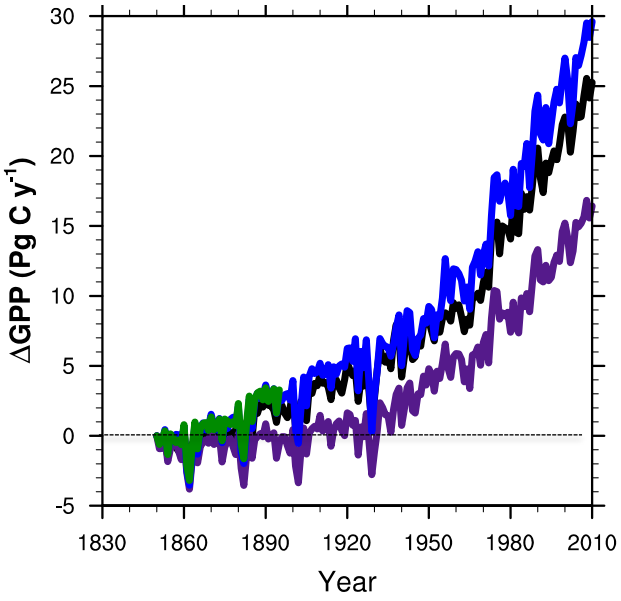
Excess C



↑C:N
↓GPP
↓CUE?







CLM4.5N

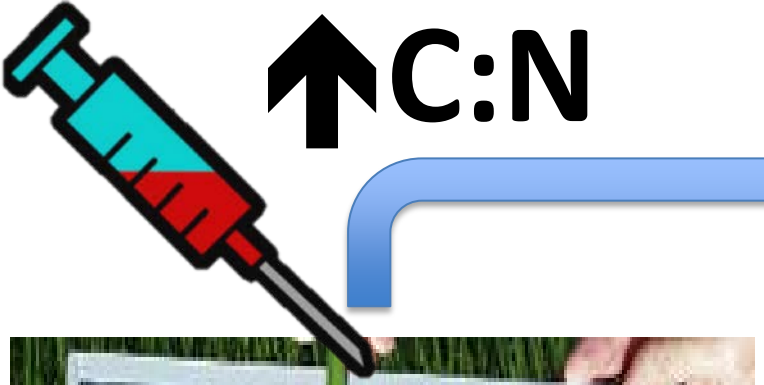
FlexCN & LUNA

FUN_1

FUN_2

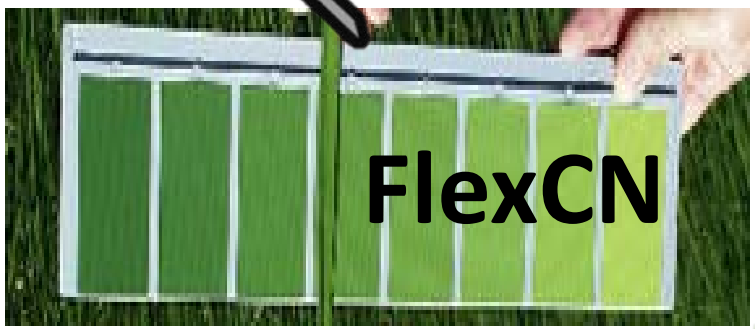
↑C:N

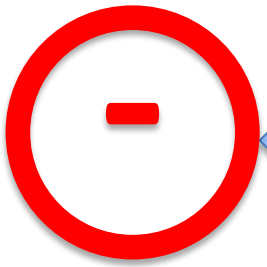
↓GPP



↑C:N

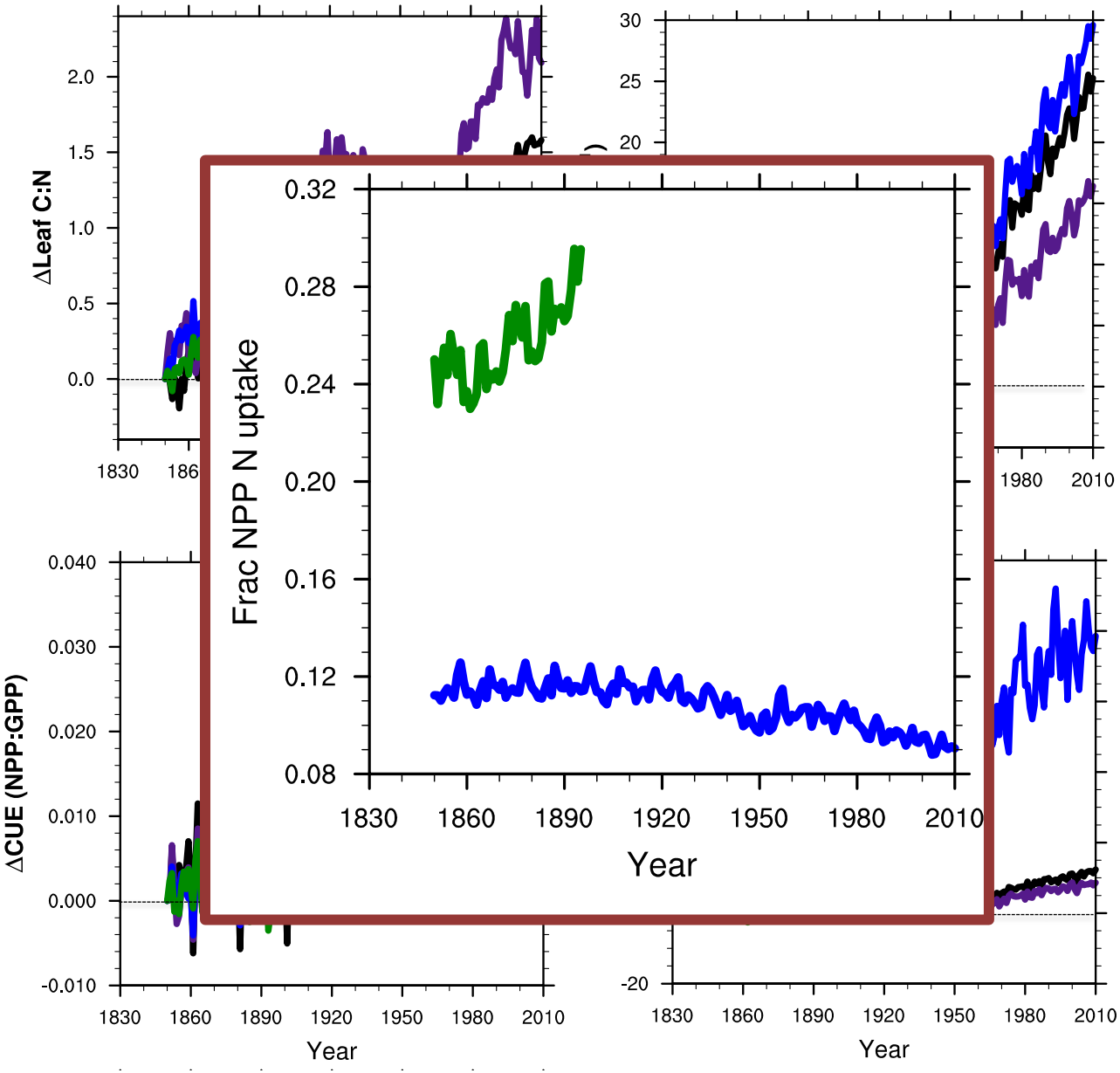
Excess C





N uptake

↓CUE?



CLM4.5N

FlexCN & LUNA

FUN_1

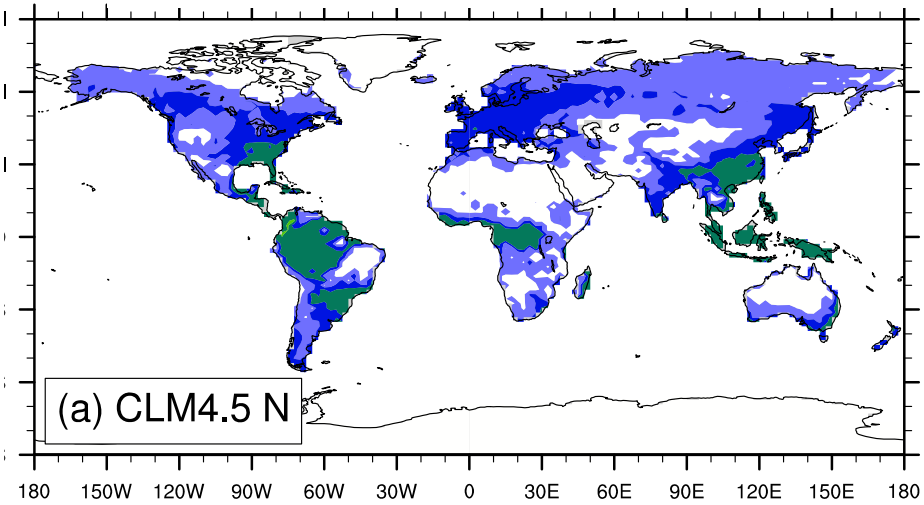
FUN_2

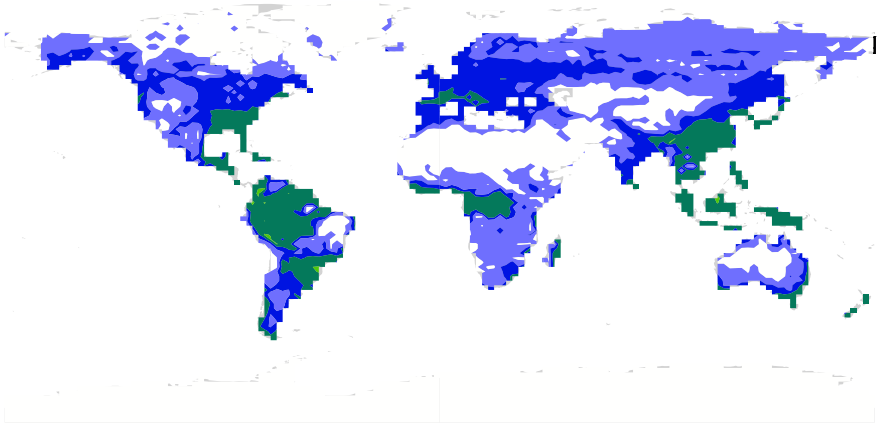
↑C:N

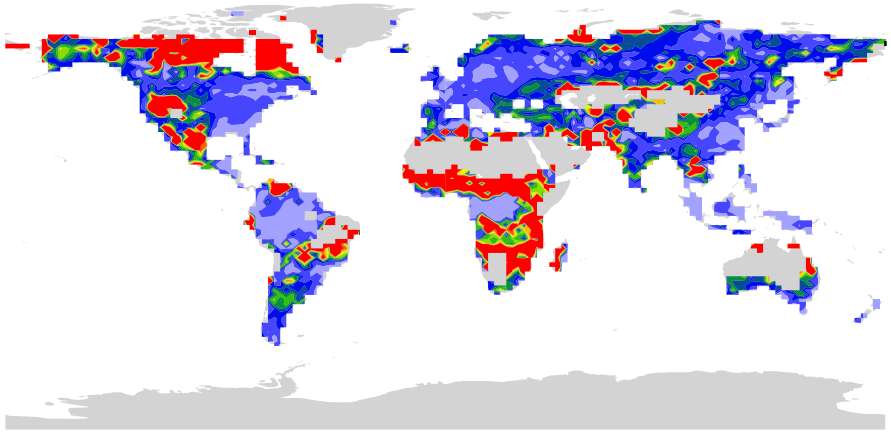
↑N_{uptake}

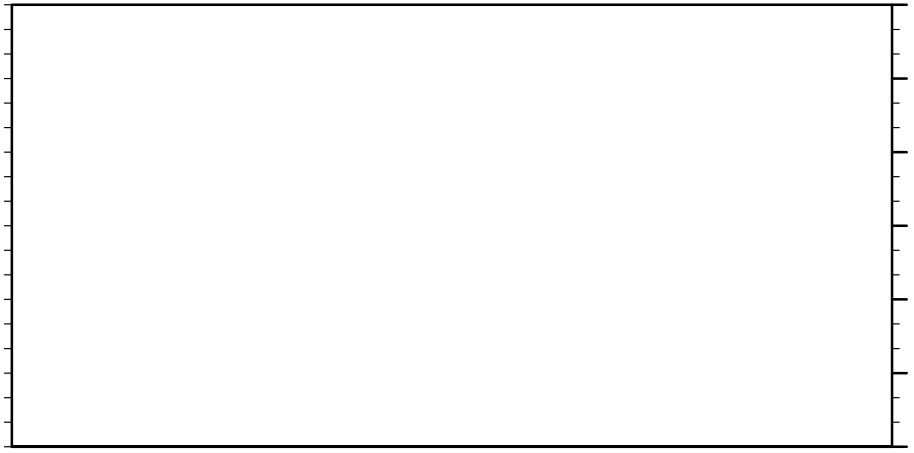
↓CUE

Initial N fixation (gN m^{-2} y^{-1})



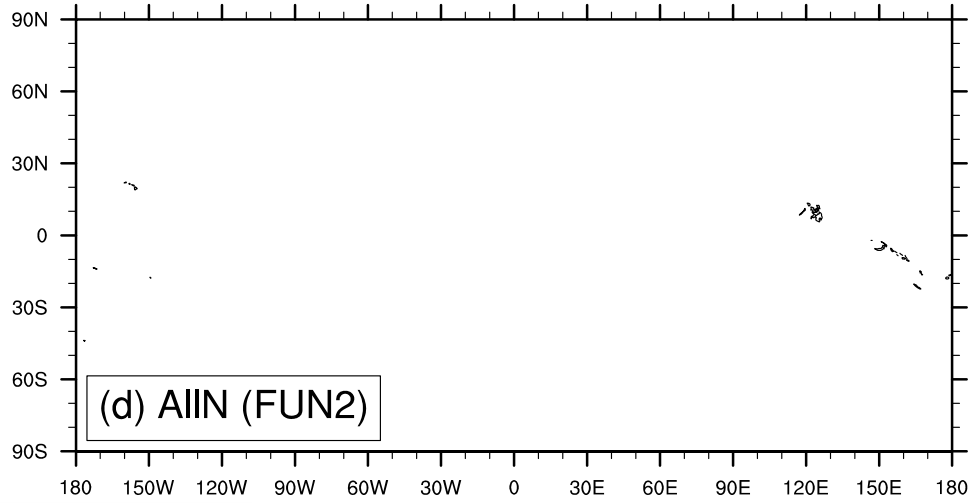




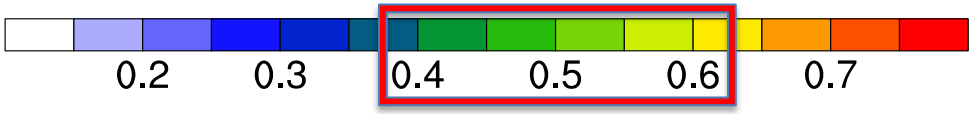


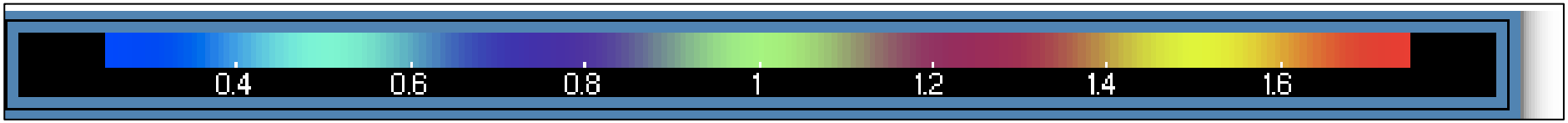
$fNPP\ N_{up}$


0
0.06
0.12
0.18
0.24
0.3

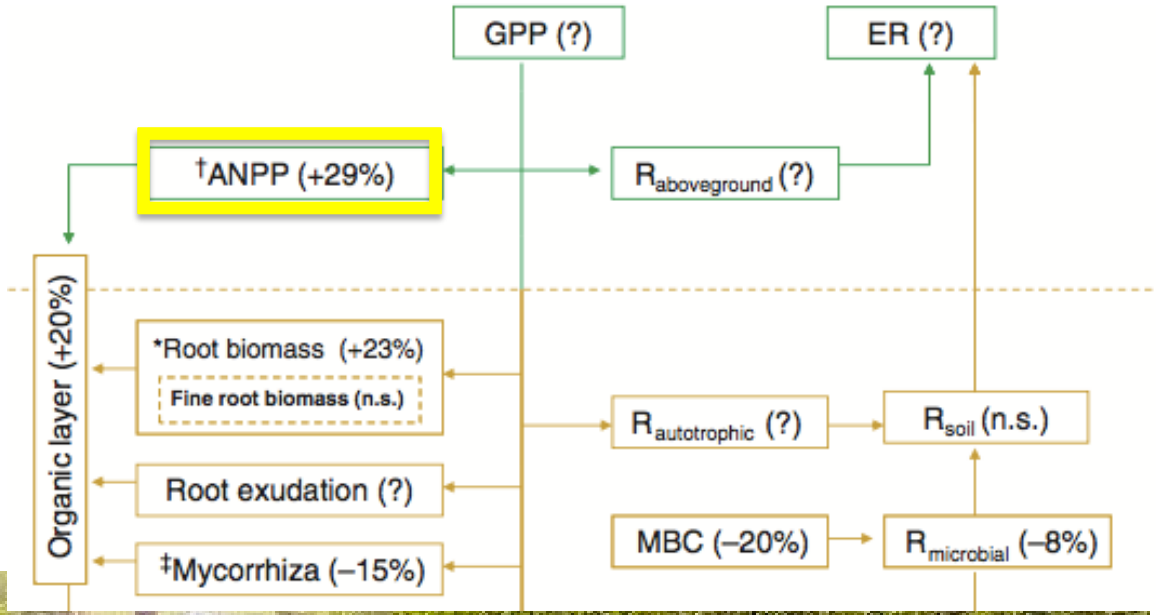

90N
60N
30N
0
30S
60S
90S
180
150W
120W
90W
60W
30W
0
30E
60E
90E
120E
150E
180
(d) AllN (FUN2)

CUE

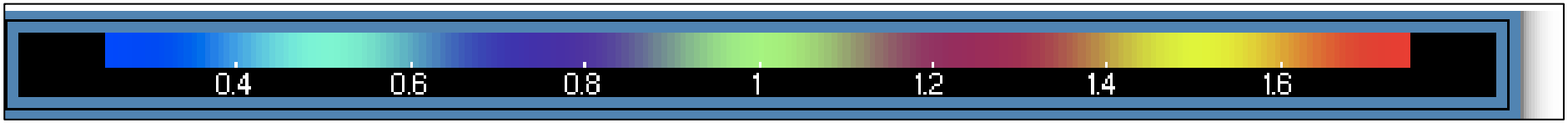

0.2
0.3
0.4
0.5
0.6
0.7



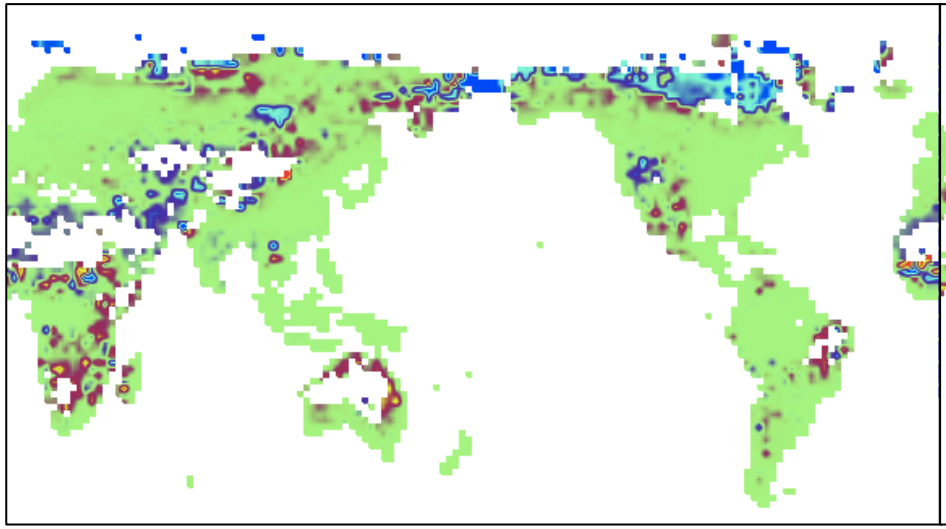
Fertilized / Control



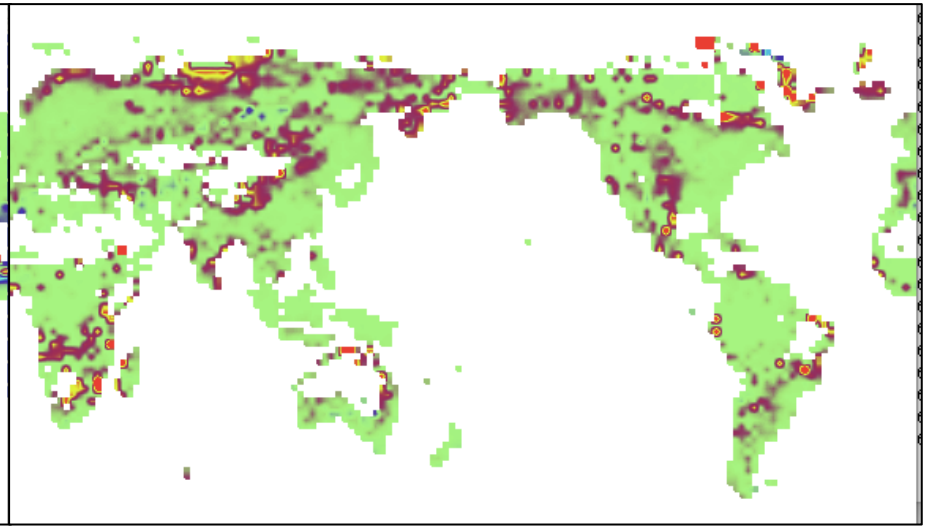
Liu & Greaver 2010 *Eco Let*
Janssens et al. 2010 *Nat Geo*
Yue et al. 2016 *Sci Rep*



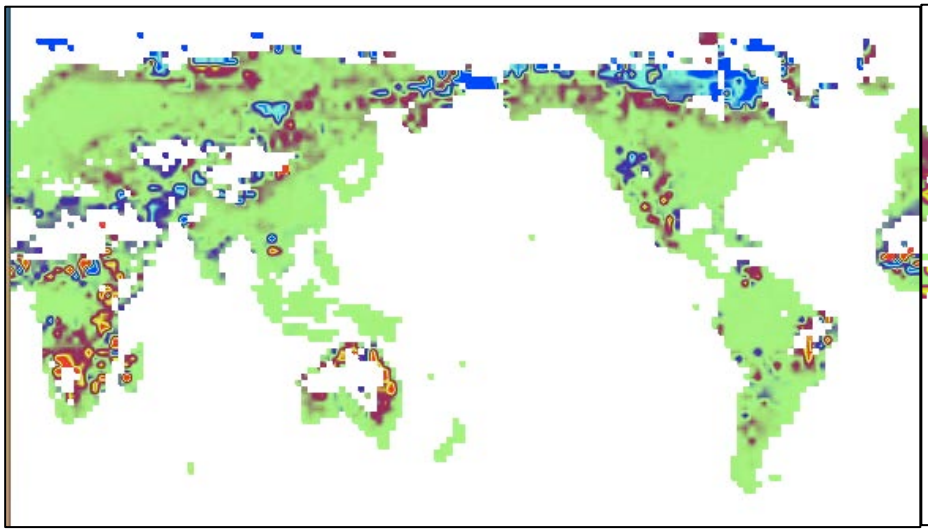
FUN_1 GPP



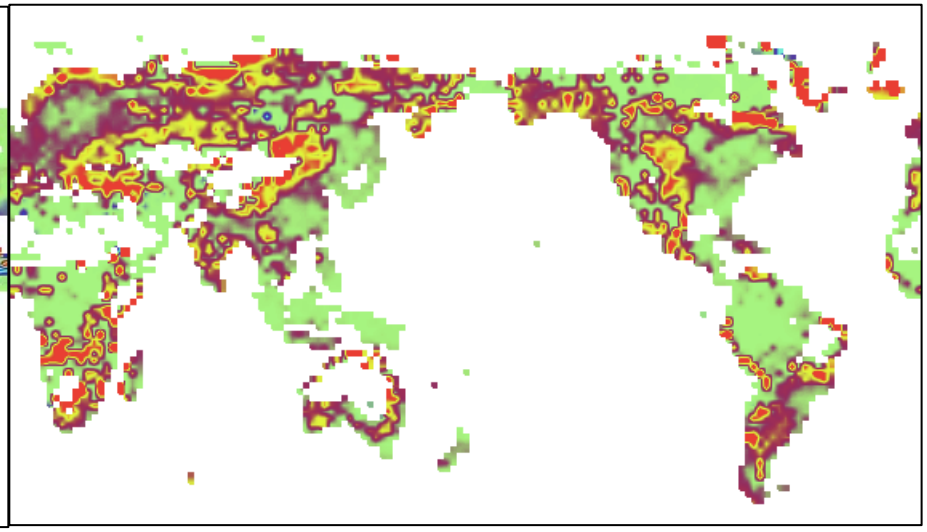
FUN_2 GPP



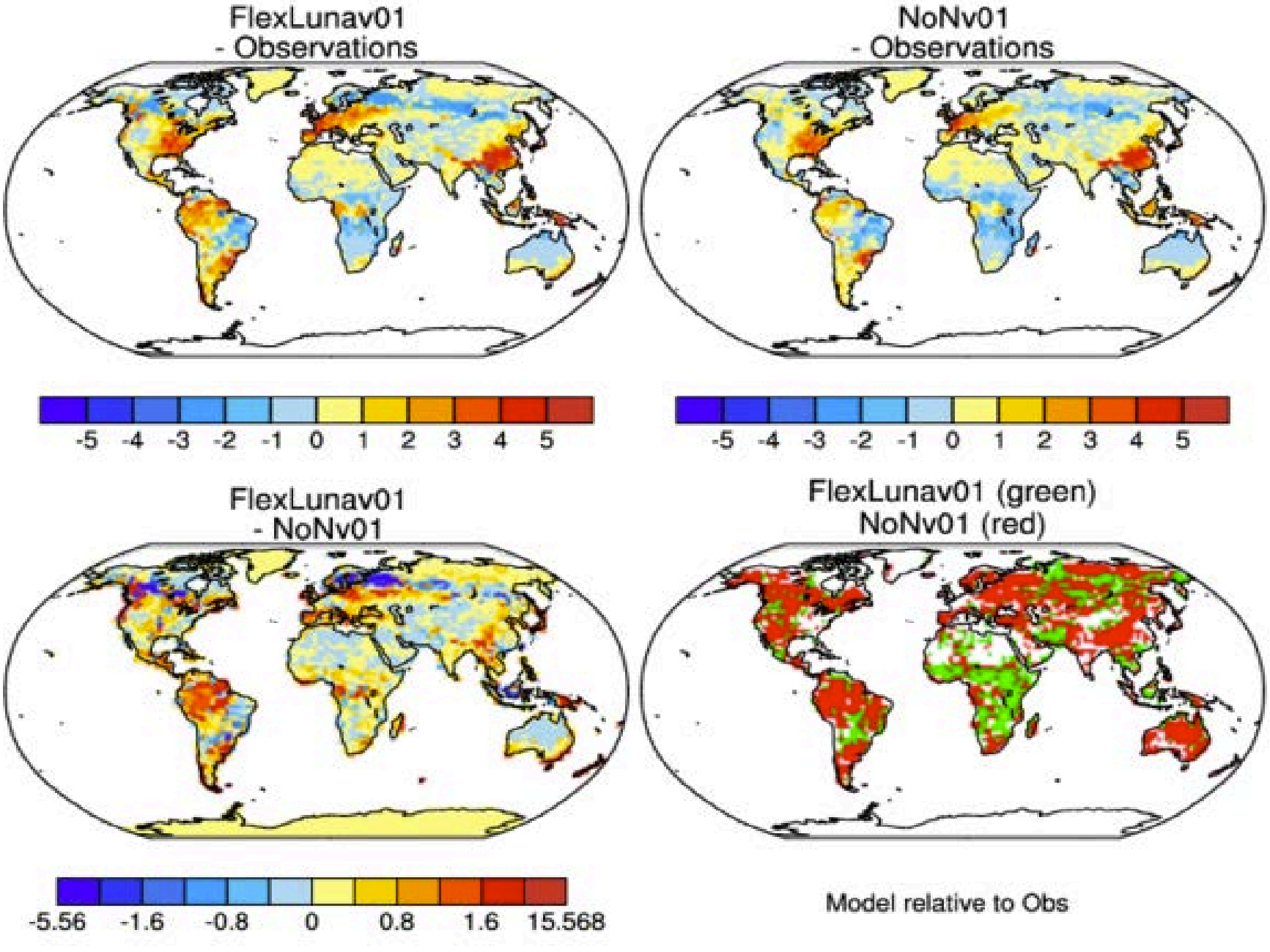
FUN_1 NPP



FUN_2 NPP



TLAI, FlexLuna vs. CLM45 N (2010)



Next Steps

Tuning
- FUN (Rosie)
- AR & allocation?

Evaluation
- Historical
- N Fertilization
- FACE

Sensitivity
- Target C:N
- FUN cost functions

Soil N
- Transformations
- Competition
- Loss

C for N uptake (fate in soils)

TLAI, AllN vs. FlexLuna (2010)