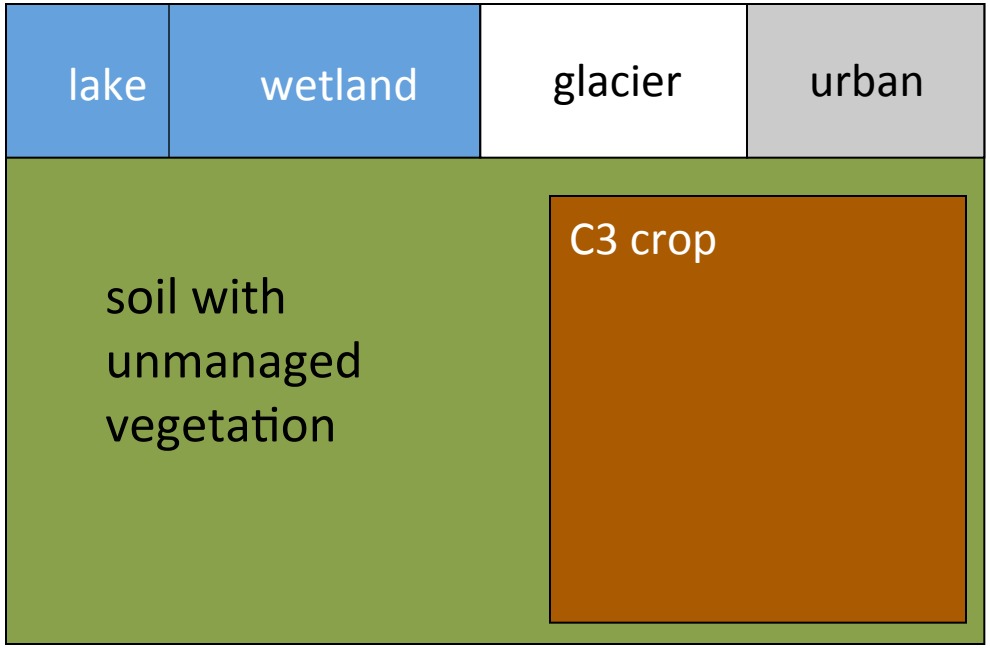
post4.5 CLM-CROP

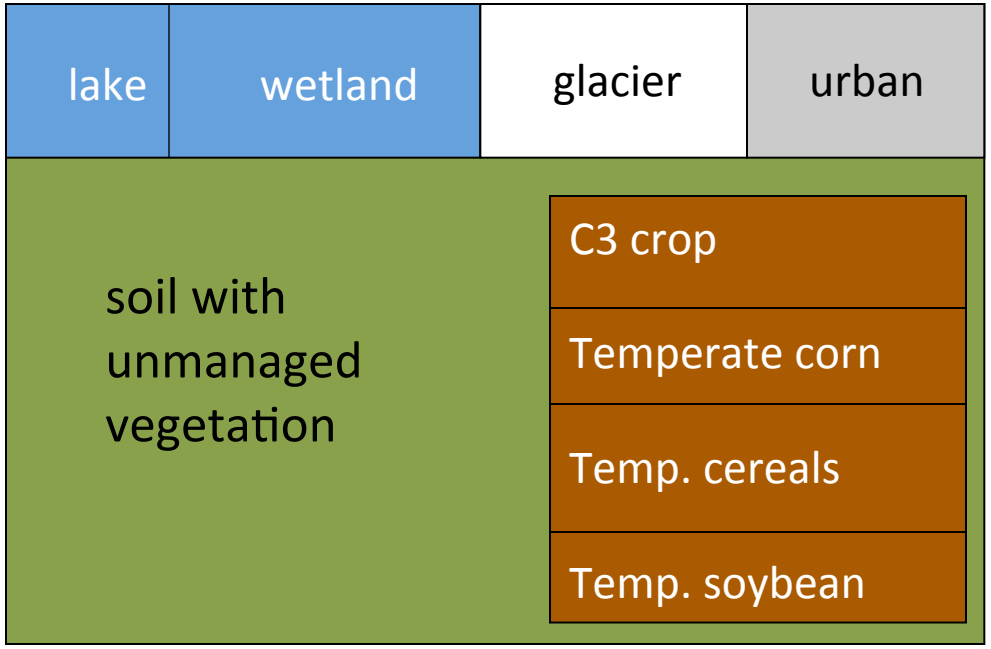
Sam Levis et al.

NCAR

a CLM grid cell (CROP option **off**)

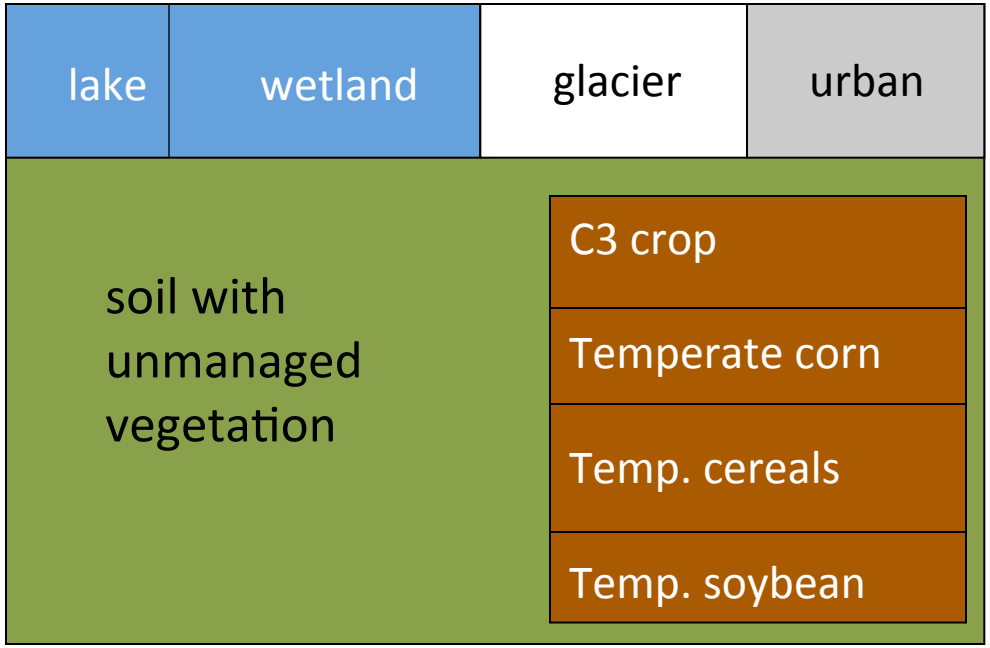


a CLM grid cell (CROP option **on**)



} crop-specific phenology* + C allocation
(Kucharik & Brye 2003)

a CLM grid cell (CROP option **on**)



} crop-specific phenology* + C allocation
(Kucharik & Brye 2003)

*phenology refers to appearance: here the processes of *leaf emergence, grain fill, and maturity*;
influenced by: weather and management (e.g., planting, harvesting, fertilizing, irrigating)

CLM4

Temp. corn

Temp. cereals

Temp. soybean

effects on atm.

Levis et al. (2012)

CLM4

Temp. corn

Temp. cereals

Temp. soybean

effects on atm.

Levis et al. (2012)

CLM4.5

w/ options to

fertilize (Drewniak, ANL)

irrigate (Sacks, NCAR)

Oleson et al. (2013)

enhanced soil C

decomposition

Levis et al. (2013)

CLM4

Temp. corn

Temp. cereals

Temp. soybean

effects on atm.

Levis et al. (2012)

CLM4.5

w/ options to

fertilize (Drewniak)

irrigate (Sacks)

Oleson et al. (2013)

enhanced soil C

decomposition

Levis et al. (2013)

post4.5

adding…

Trop. corn

Trop. soybean

Sugarcane

Rice

Cotton

A. Badger (GMU)

CLM4 & 4.5:

Ramankutty and Foley (1998)

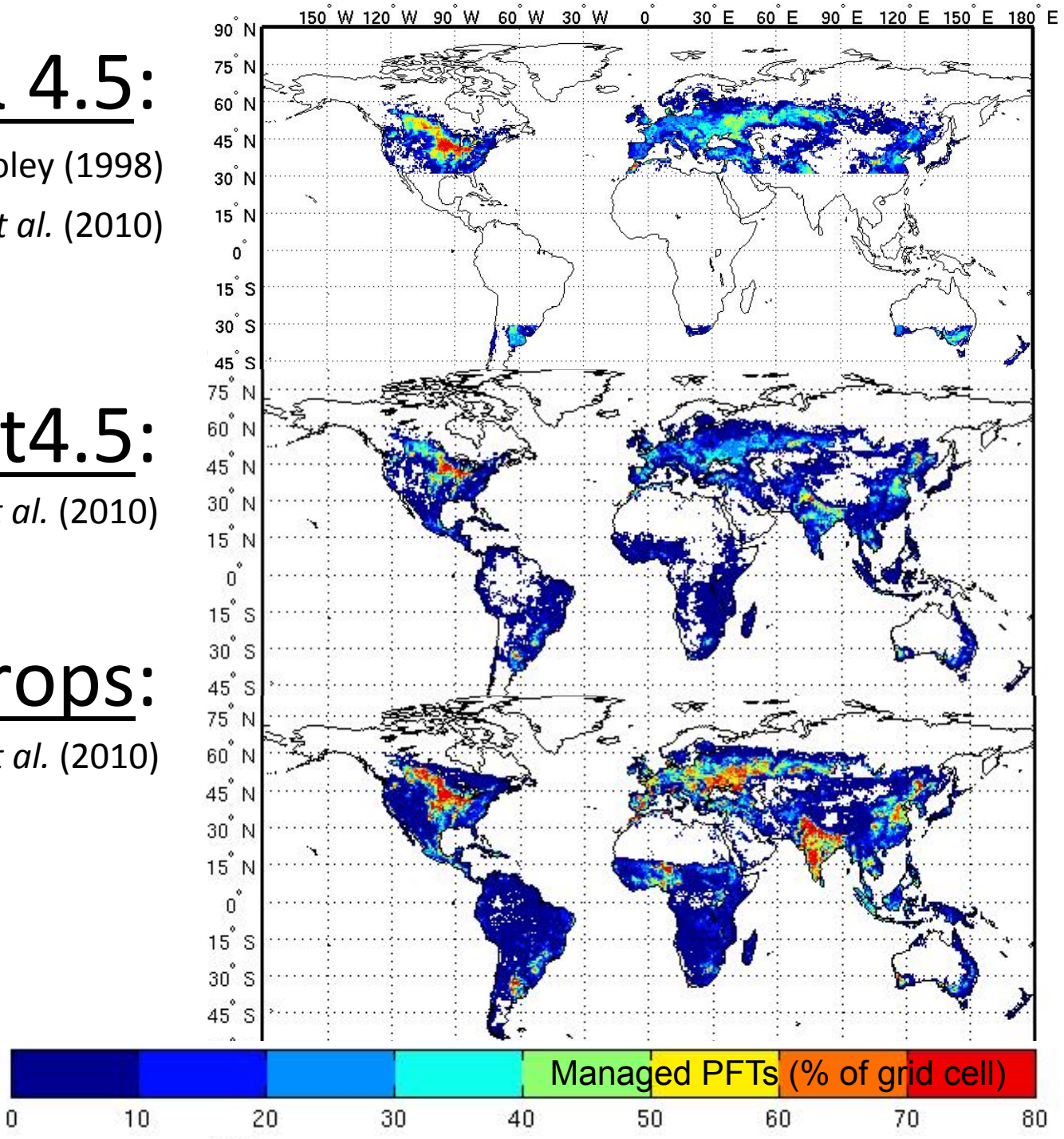
Portman *et al.* (2010)

post4.5:

Portman *et al.* (2010)

all crops:

Portman *et al.* (2010)



CLM4 & 4.5:

Ramankutty and Foley (1998)

Portman *et al.* (2010)

post4.5:

Portman *et al.* (2010)

all crops:

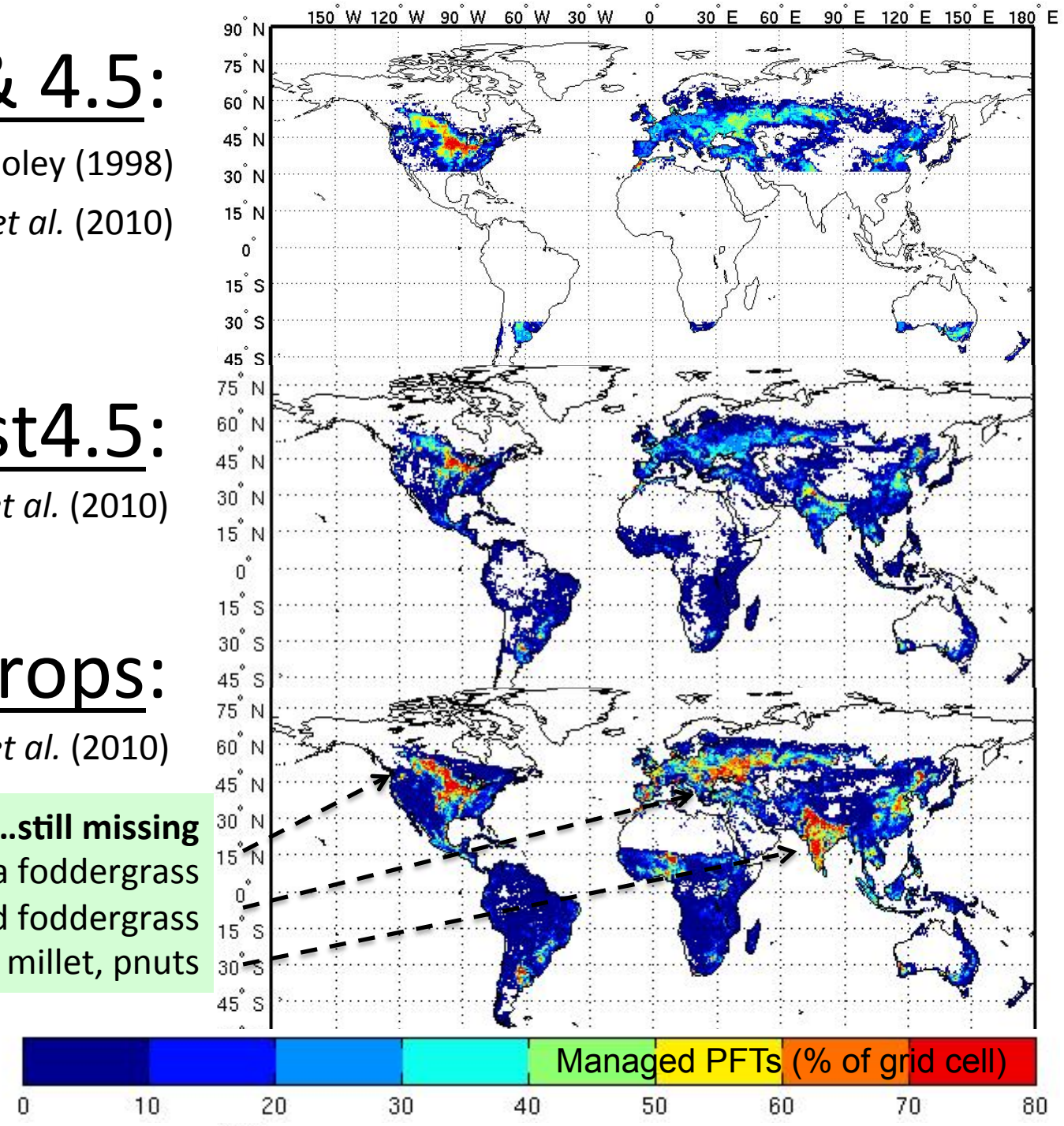
Portman *et al.* (2010)

…still missing

Canada foddergrass

Russia sunflower and foddergrass

India sorghum, pulses, millet, pnuts



Development steps: post4.5 crop data

1. **Downloaded** 5' rainfed & irrigated areas for **ALL CROPS** (Portmann et al. 2010)

2. **Made "raw dataset"** for clm's mksurfdata tool **with 78 instead of 24 pfts**

3. **Made 0.5° surfdata file** with the mksurfdata tool **with 78 instead of 24 pfts**

post4.5 list of pfts

1. "needleleaf_evergreen_temperate_tree
2. "needleleaf_evergreen_boreal_tree
3. "needleleaf_deciduous_boreal_tree
4. "broadleaf_evergreen_tropical_tree
5. "broadleaf_evergreen_temperate_tree
6. "broadleaf_deciduous_tropical_tree
7. "broadleaf_deciduous_temperate_tree
8. "broadleaf_deciduous_boreal_tree
9. "broadleaf_evergreen_shrub
10. "broadleaf_deciduous_temperate_shrub
11. "broadleaf_deciduous_boreal_shrub
12. "c3_arctic_grass
13. "c3_non-arctic_grass
14. "c4_grass
15. "c3_crop
16. "c3_irrigated
17. "temperate_corn
18. "irrigated_temperate_corn
19. "spring_wheat
20. "irrigated_spring_wheat
21. "winter_wheat
22. "irrigated_winter_wheat
23. "temperate_soybean,
24. "irrigated_temperate_soybean
25. "barley
26. "irrigated_barley
27. "winter_barley
28. "irrigated_winter_barley
29. "rye
30. "irrigated_rye
31. "winter_rye
32. "irrigated_winter_rye
33. "cassava
34. "irrigated_cassava
35. "citrus
36. "irrigated citrus
37. "cocoa
38. "irrigated_cocoa
39. "coffee
40. "irrigated_coffee
41. **"cotton**
42. **"irrigated_cotton**
43. "datepalm
44. "irrigated_datepalm
45. "foddergrass
46. "irrigated_foddergrass
47. "grapes
48. "irrigated_grapes
49. "groundnuts
50. "irrigated_groundnuts
51. "millet
52. "irrigated_millet
53. "oilpalm
54. "irrigated_oilpalm
55. "potatoes
56. "irrigated_potatoes
57. "pulses
58. "irrigated_pulses
59. "rapeseed
60. "irrigated_rapeseed
61. **"rice**
62. **"irrigated_rice**
63. "sorghum
64. "irrigated_sorghum
65. "sugarbeet
66. "irrigated_sugarbeet
67. **"sugarcane**
68. **"irrigated_sugarcane**
69. "sunflower
70. "irrigated_sunflower
71. "miscanthus
72. "irrigated_miscanthus
73. "switchgrass
74. "irrigated_switchgrass
75. **"tropical_corn**
76. **"irrigated_tropical_corn**
77. **"tropical_soybean**
78. **"irrigated_tropical_soybean**

Development steps: post4.5 crop data

4. clm_params file now includes 78 pfts with A. Badger's parameters for
   - Tropical corn
   - Tropical soybean
   - Sugarcane
   - Rice
   - Cotton

planting temperatures & dates

growing degree days & max maturity

fertilization

max LAI & height

albedo & transmissivity

ELSE mergetoclmpft

Development steps: post4.5 crop code

- CLM can now read 78 pfts from the input data
- **Tropical** corn & soybean use **temperate** corn & soybean code
- Sugarcane uses temperate corn code
- Rice and Cotton use spring wheat code

Simulations w/ post4.5 crop model

- **Global** 1973 CRUNCEP 2005 RCP 8.5 2100 
- irrigation: **OFF**
- CO_2 fertilization: **ON**

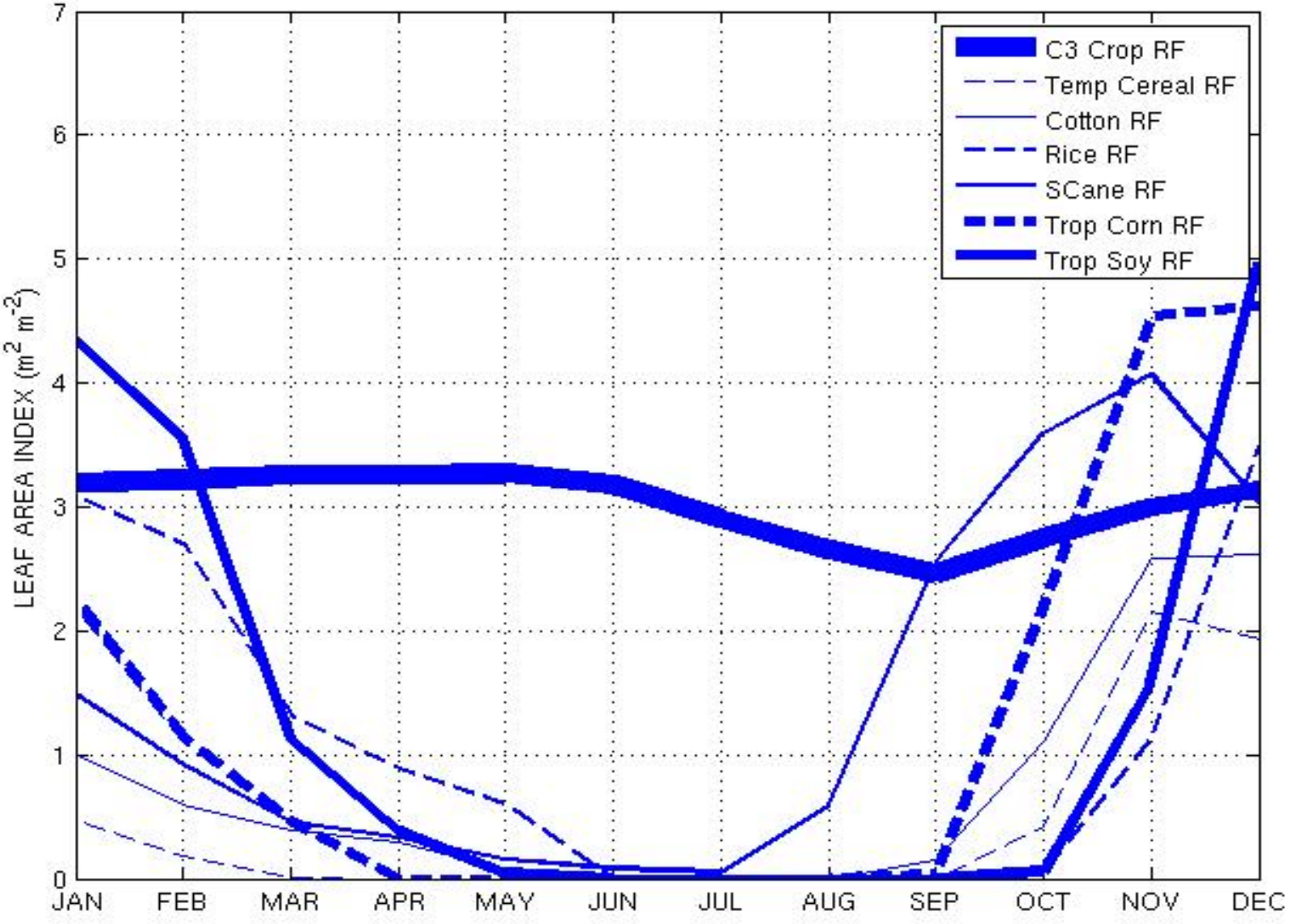
Simulations w/ post4.5 crop model

- **Global** 

- irrigation: **OFF**
- CO_2 fertilization: **ON**

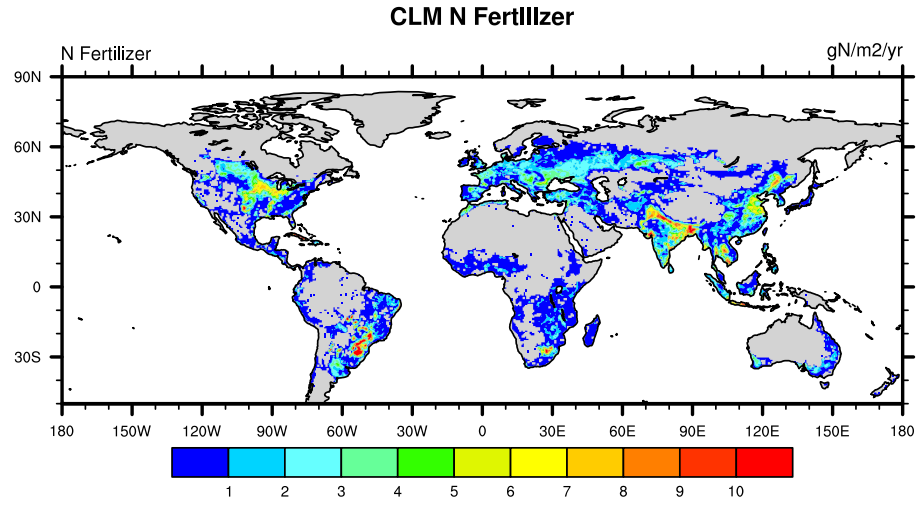
in the context of Brian O'Neill's EaSM2 on linking Human System Models and Earth System Models to assess regional impacts and adaptation

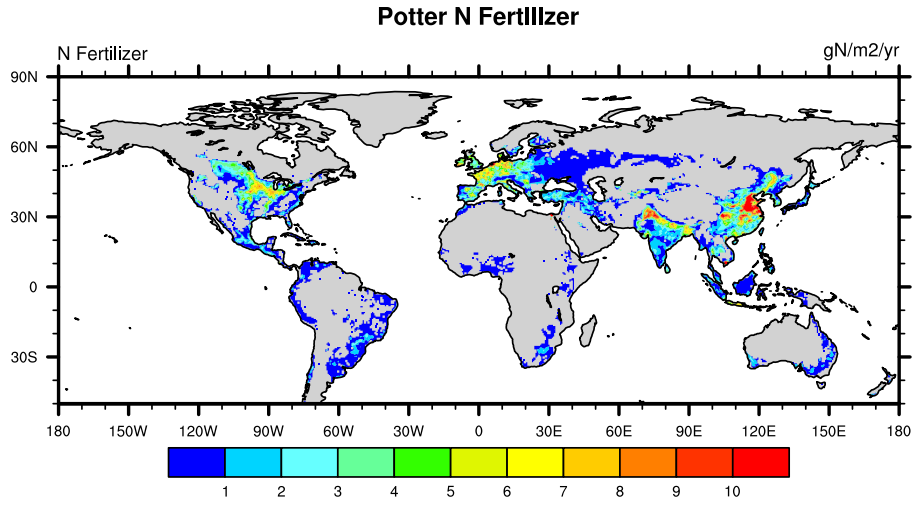
Tropical Latin America (SH)

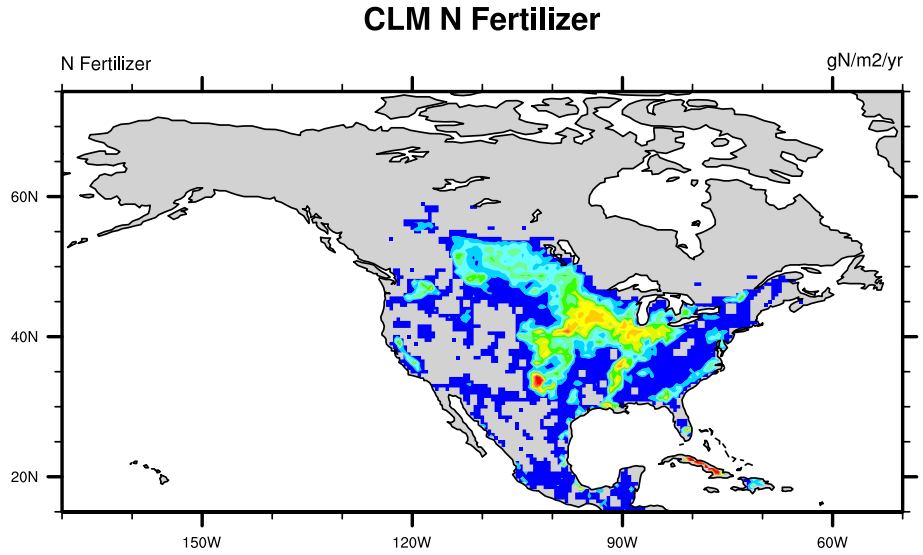


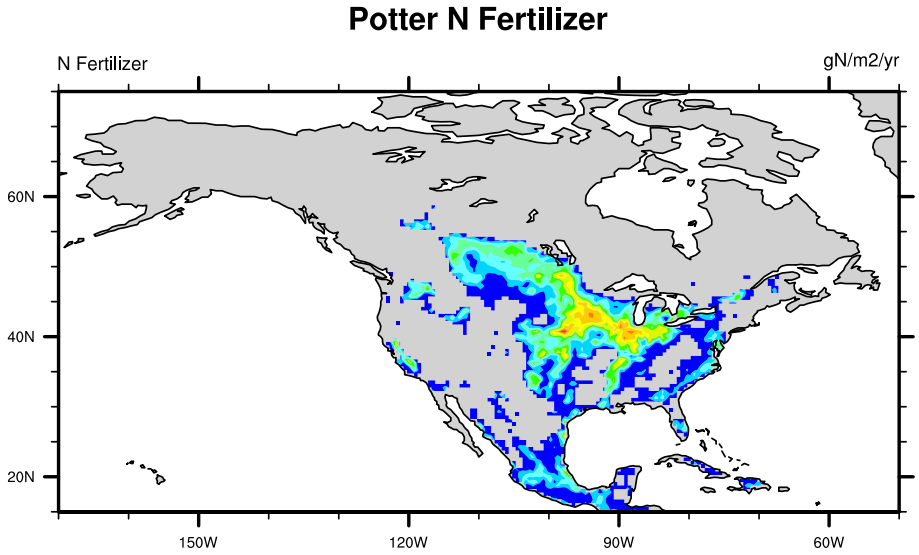
N fertilizer

Figure courtesy of Cindy Nevison

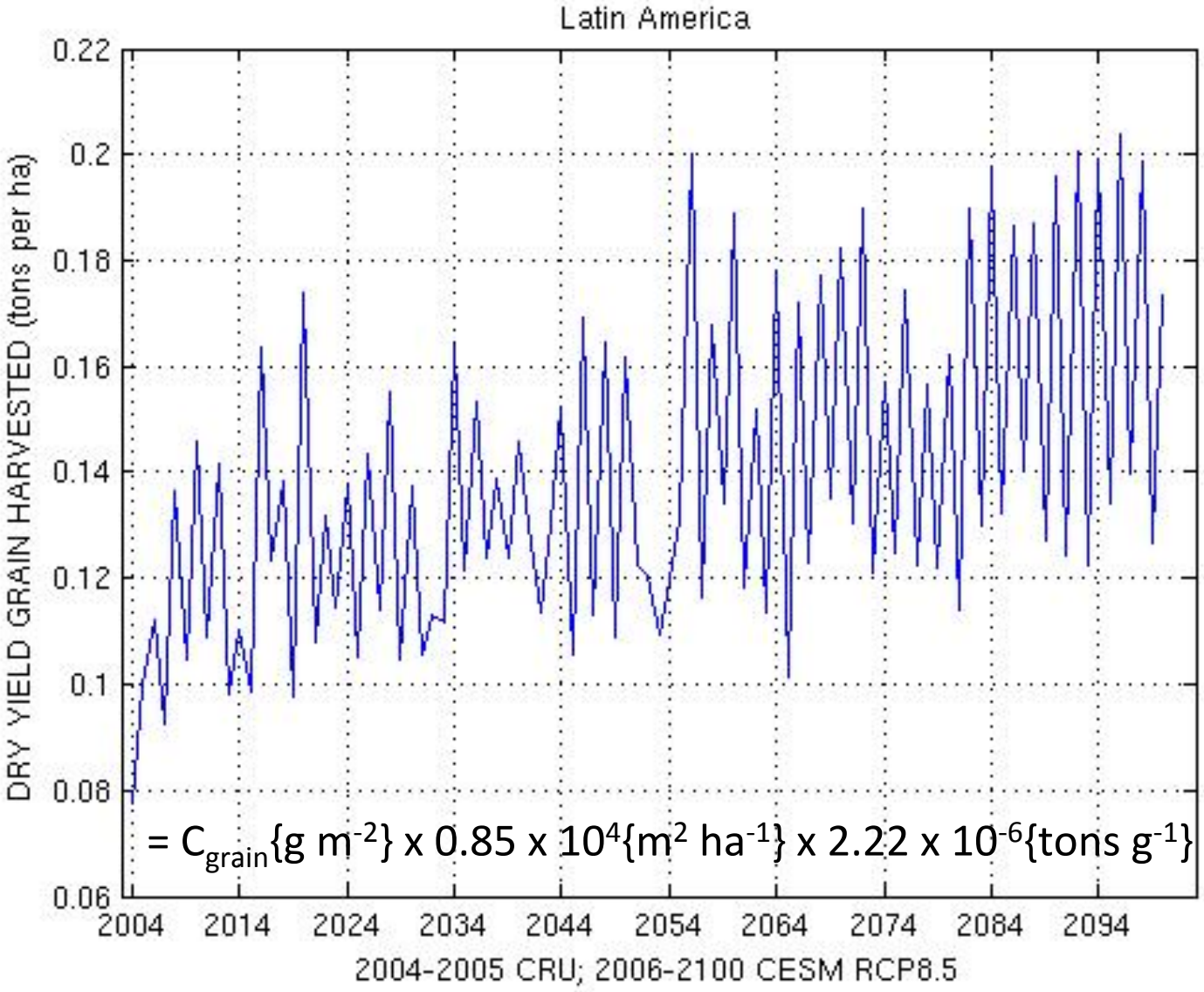








Yield: all CLM crops



2004 obs (tons ha^{-1})

Botswana	0.3
…	
USA	6.9
…	
Belgium	9.2

http://data.worldbank.org

Next steps

Working with

- Xiaolin Ren (NCAR) Integrated Assessment Modeling

Will work with

- Peter Hess (Cornell) manure fertilizer data and code

Interested in working with

- Crop-model developers on sharing parameterizations