Crops in CLM5

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Dave Lawrence, Peter Lawrence, Yaqiong Lu, Sean Swenson, Keith Oleson, Rosie Fisher

CLM5: Active Crop Types

Corn*

Wheat

Sugarcane

Soy*

Cotton

Rice

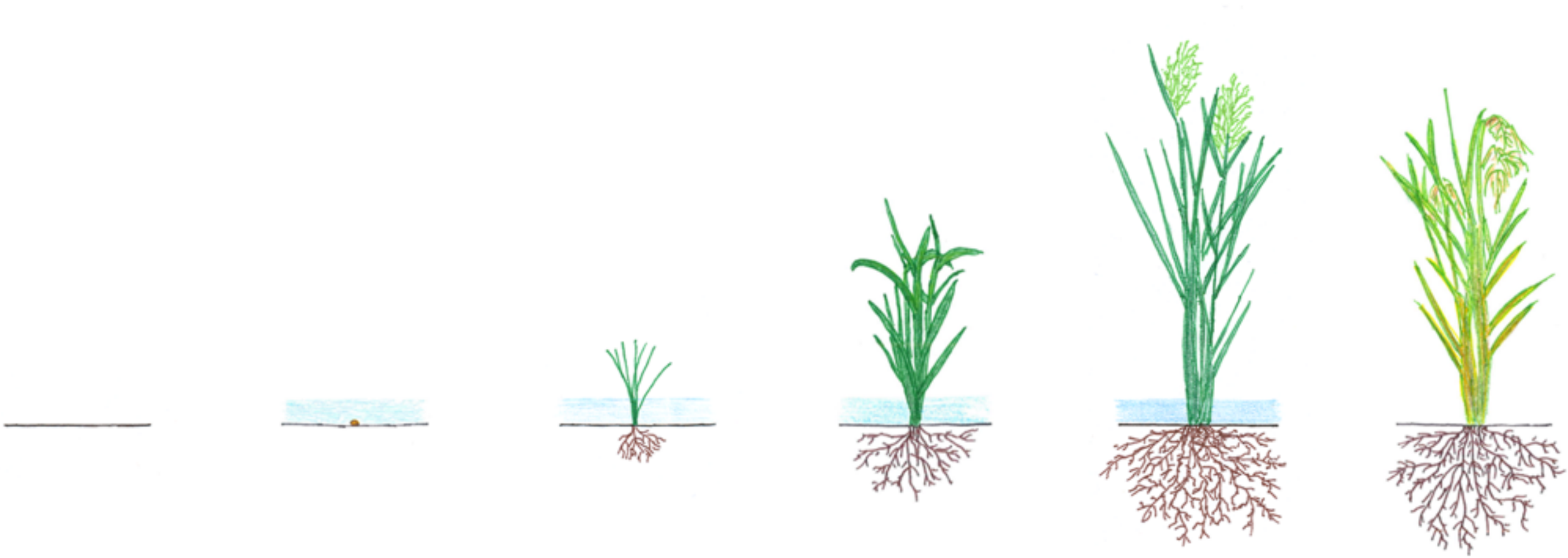
** Temperate and tropical varieties*

1) Phenology Updates

2) Management Updates

3) Considerations for Analysis

Phenology



1) Plant

1) Plant

2) Leaf Emergence

1) Plant

2) Leaf Emergence

3) Grain Fill

1) Plant

2) Leaf Emergence

3) Grain Fill

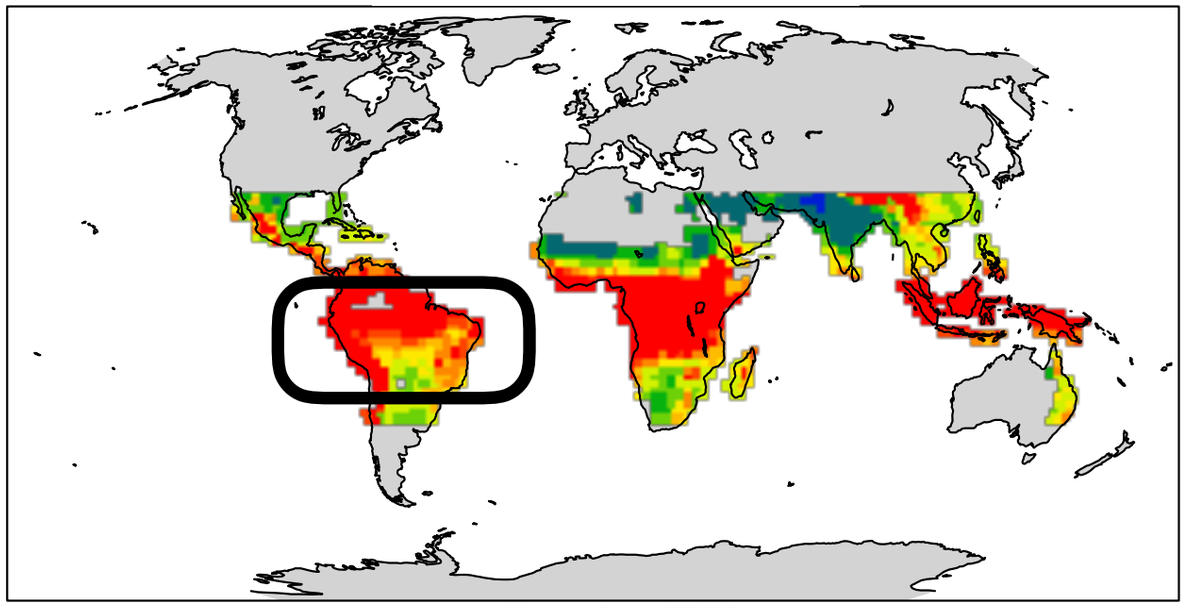
Two Changes:

1. Extend grain fill phase

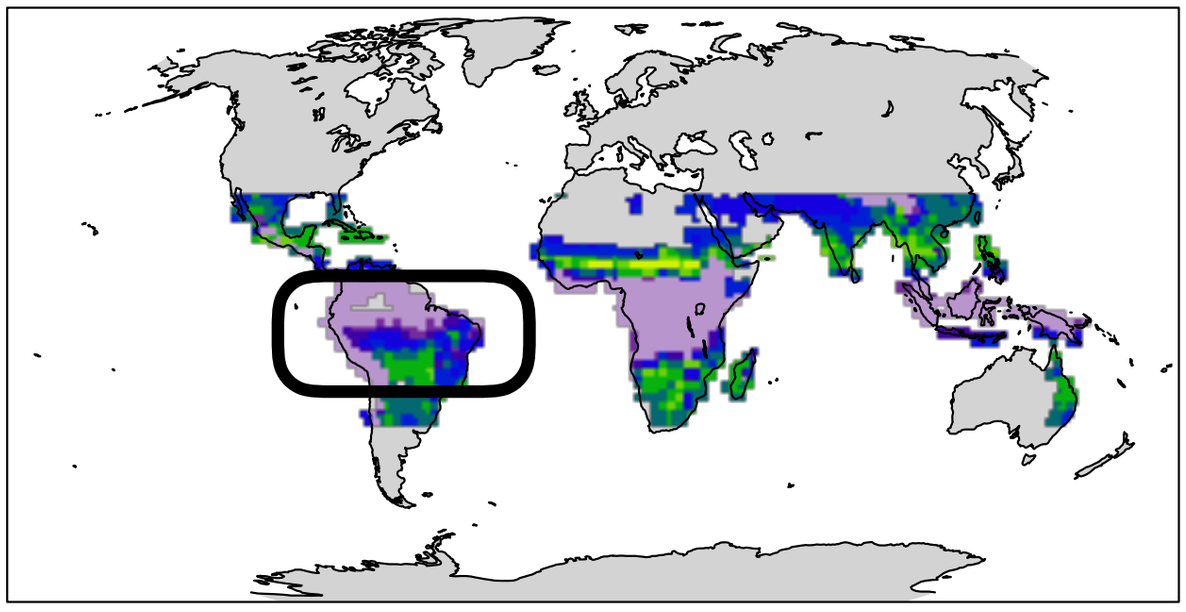
Changing Grain Fill Phase Length

Tropical Corn

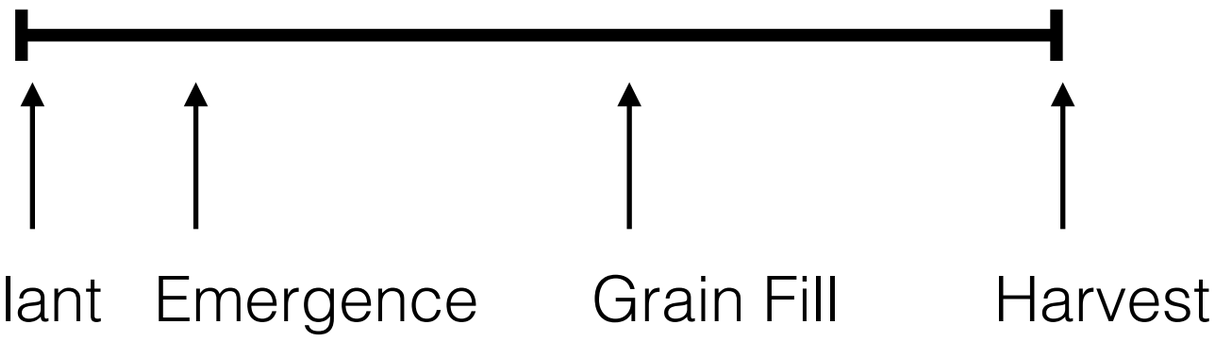
Before Leaf Emergence

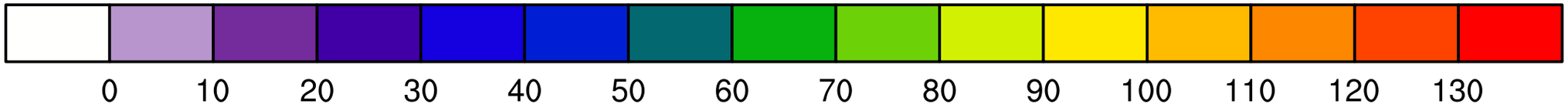


Grain Fill



After





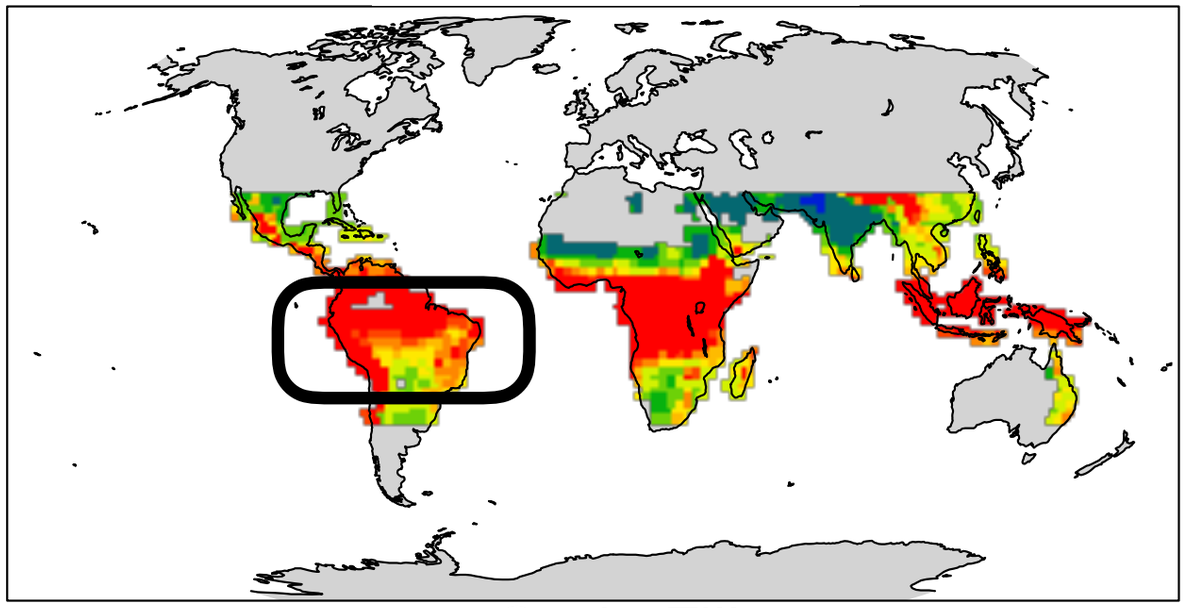
Number of Days

Changing Grain Fill Phase Length

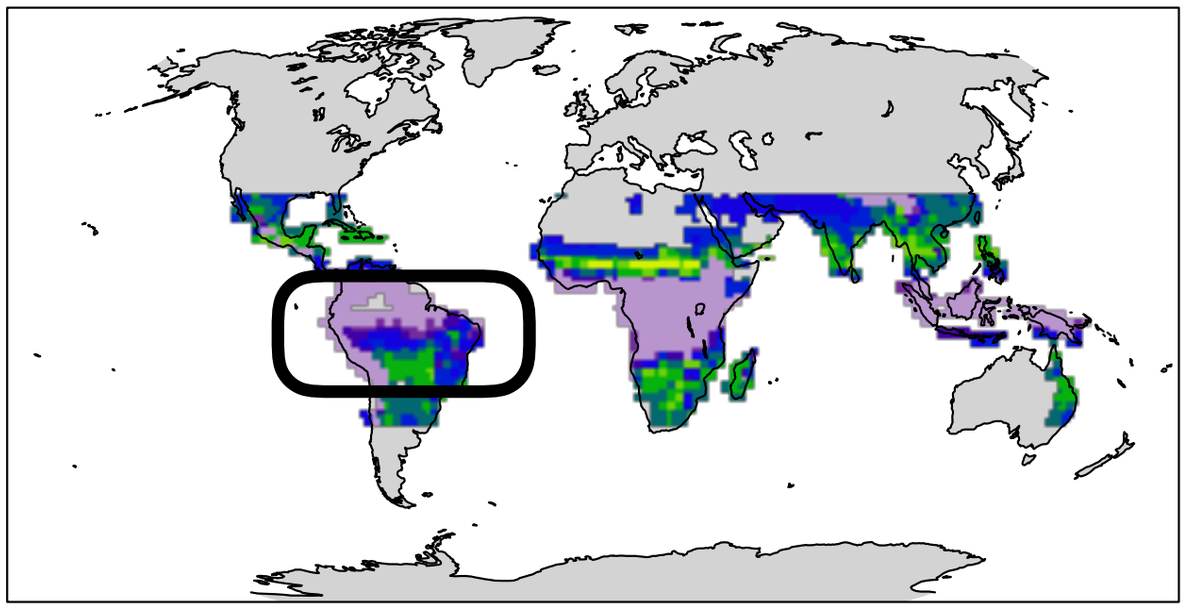
Tropical Corn

Before

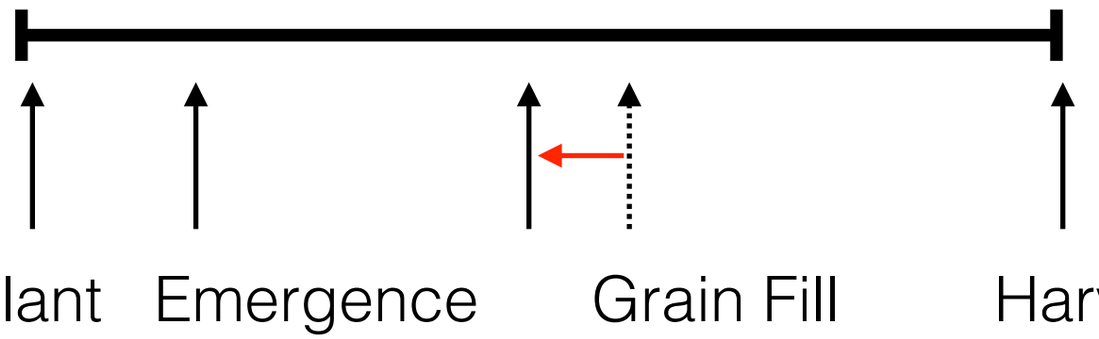
Leaf Emergence

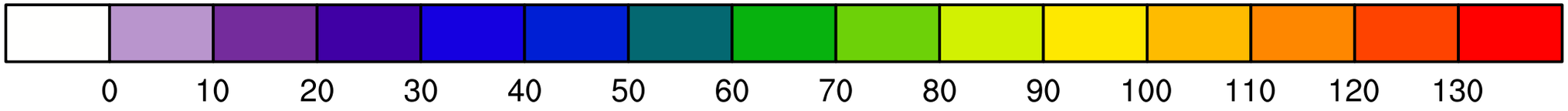


Grain Fill



After





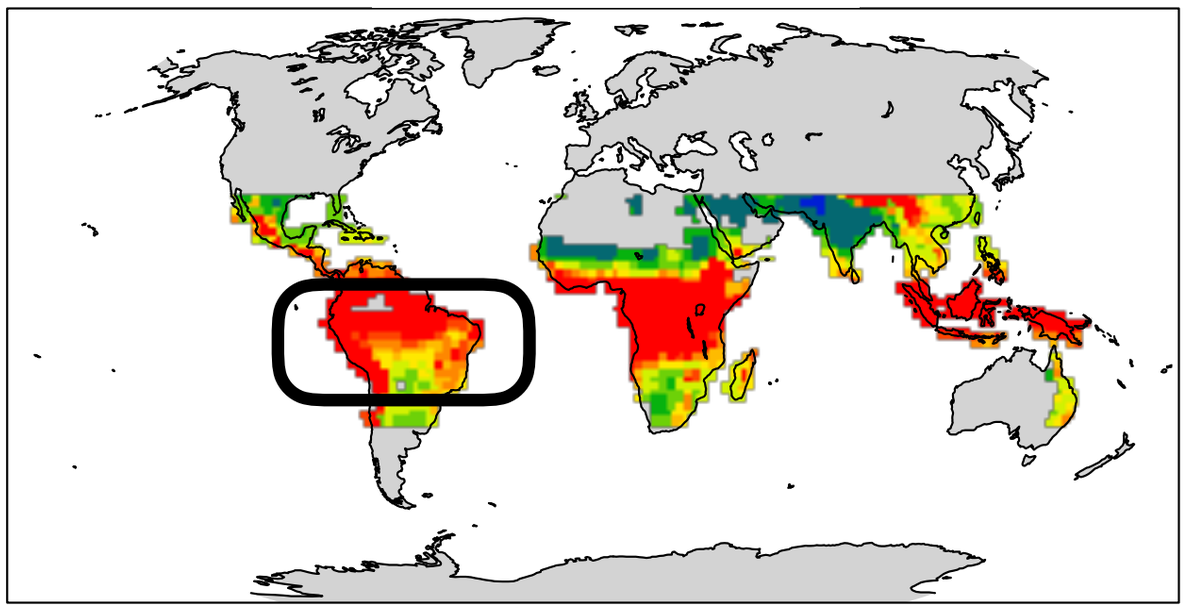
Number of Days

Changing Grain Fill Phase Length

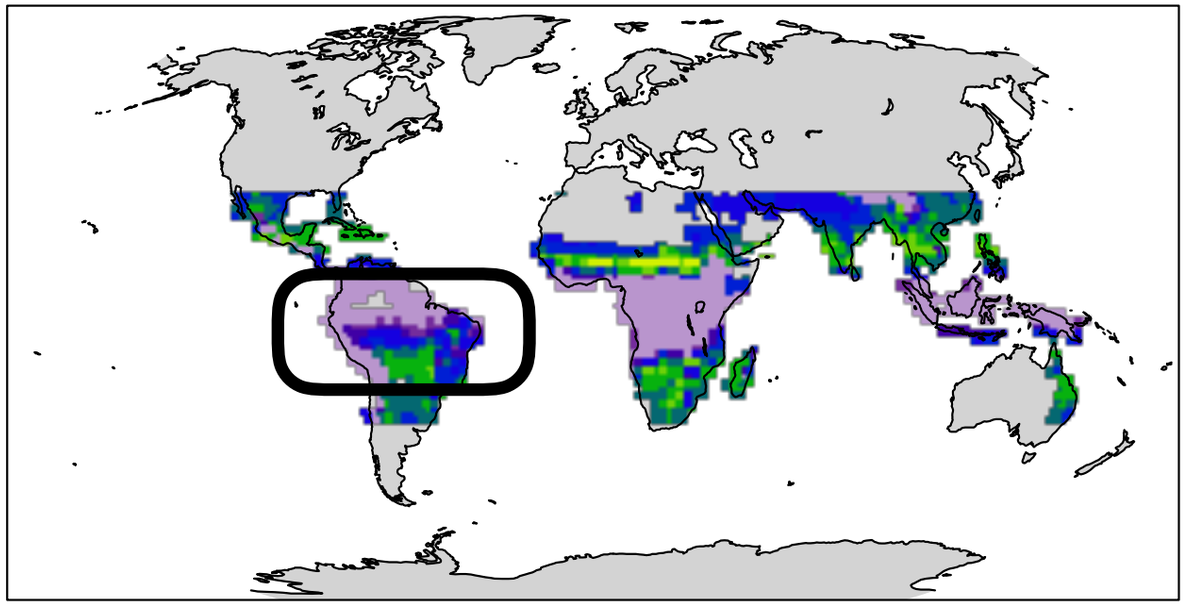
Tropical Corn

Before

Leaf Emergence

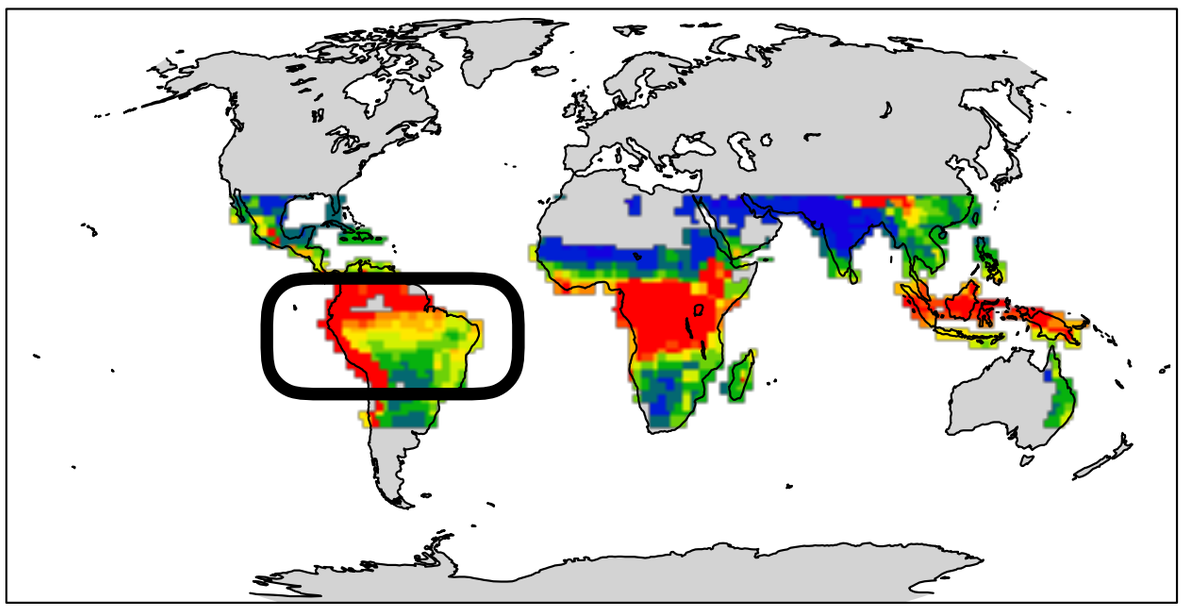


Grain Fill

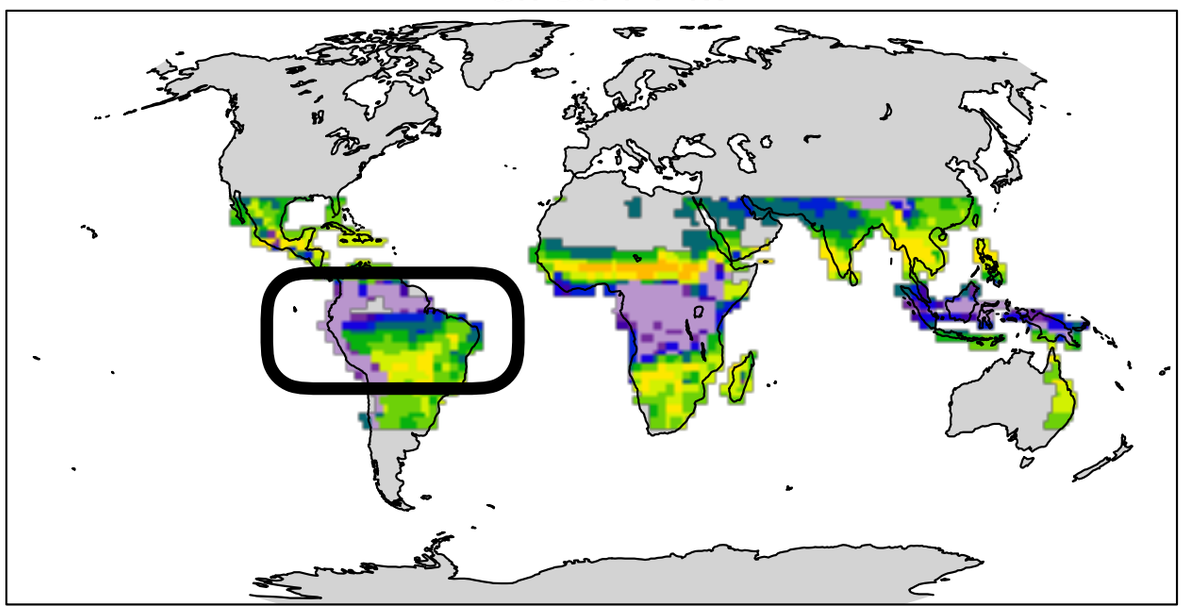


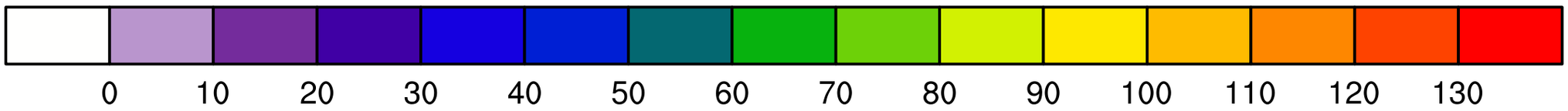
Leaf Emergence

After



Grain Fill





Number of Days

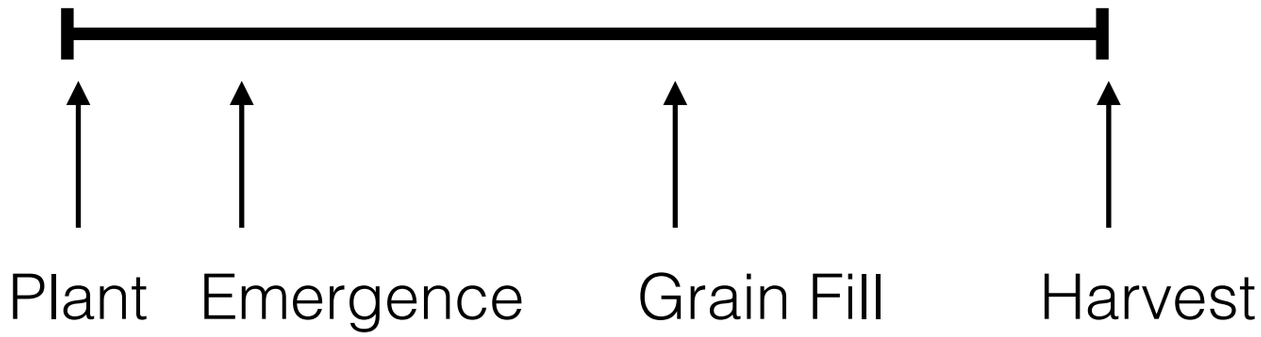
1) Plant

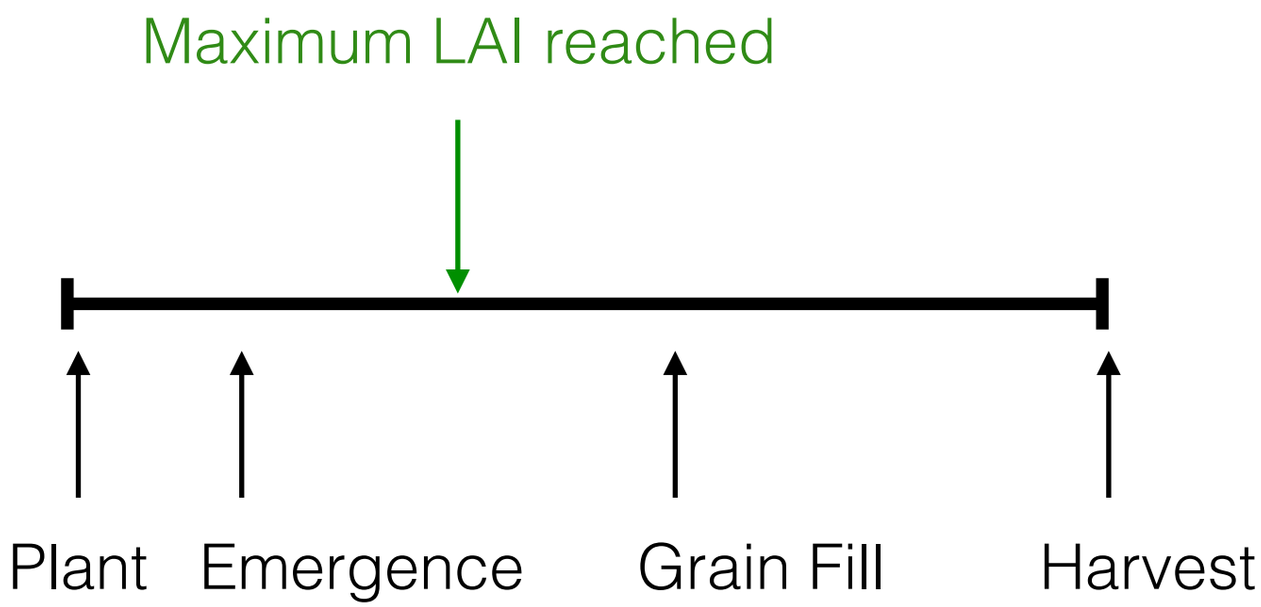
2) Leaf Emergence

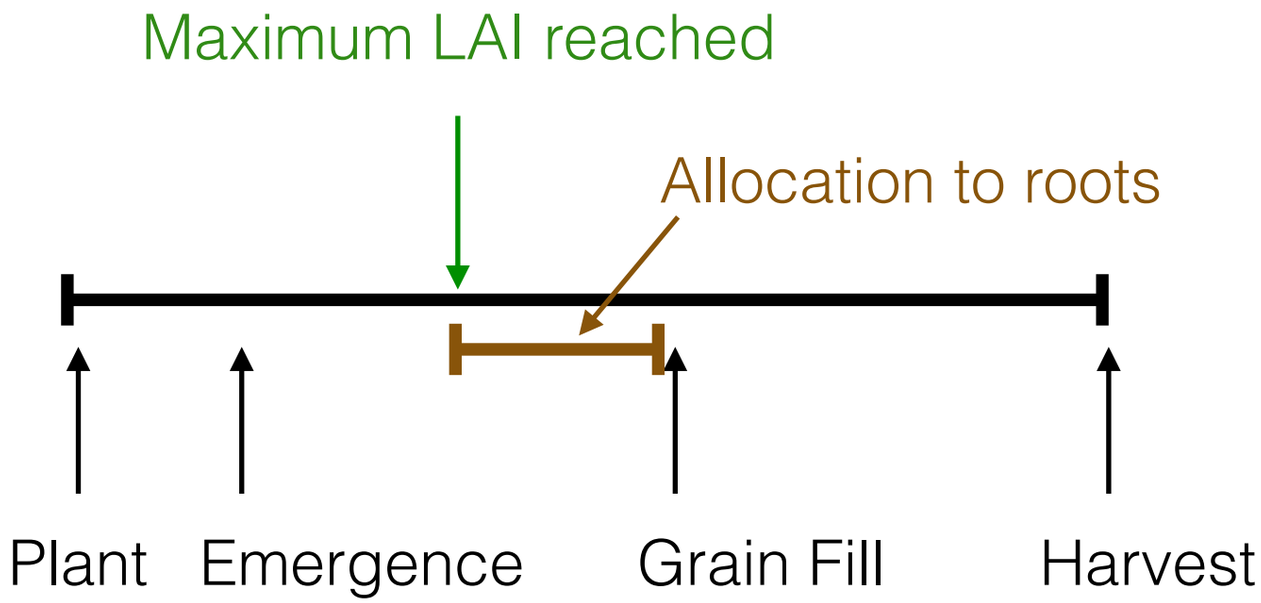
3) Grain Fill

Two Changes:

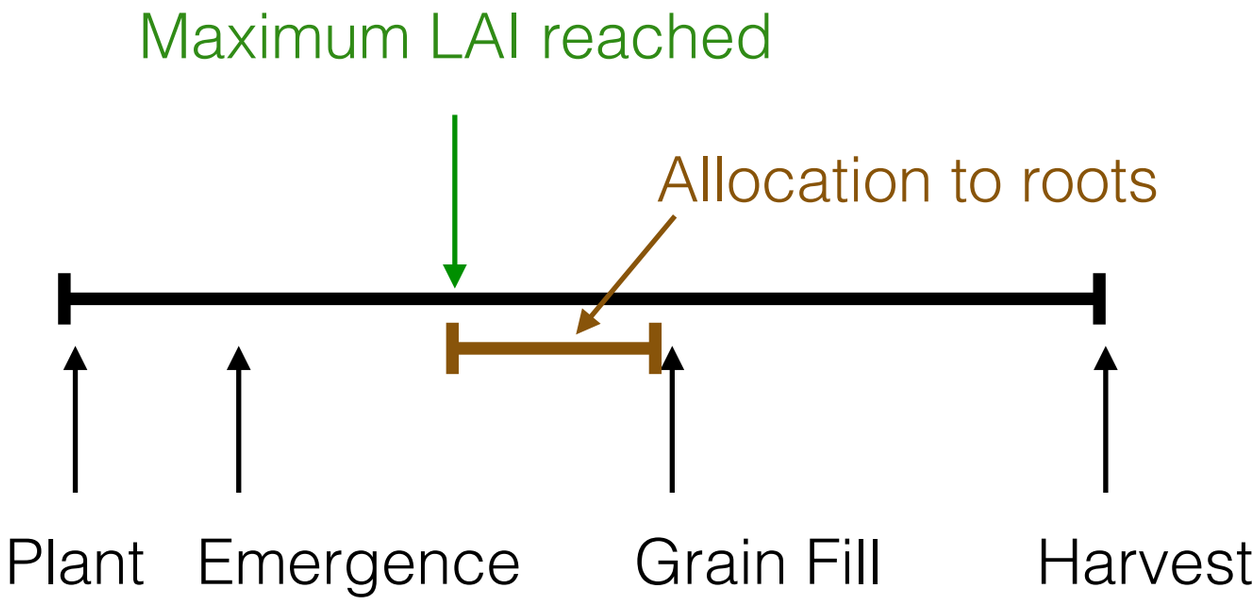
1. Extend grain fill phase
2. Reaching the maximum LAI triggers the grain fill phase


Plant
Emergence
Grain Fill
Harvest

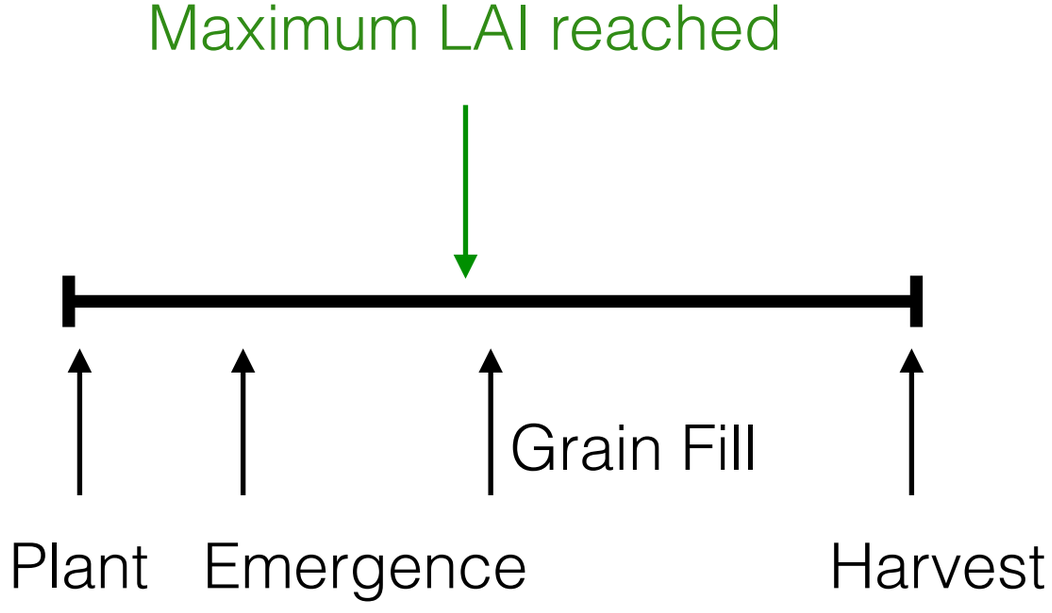

Maximum LAI reached
Plant
Emergence
Grain Fill
Harvest


Maximum LAI reached
Allocation to roots
Plant
Emergence
Grain Fill
Harvest

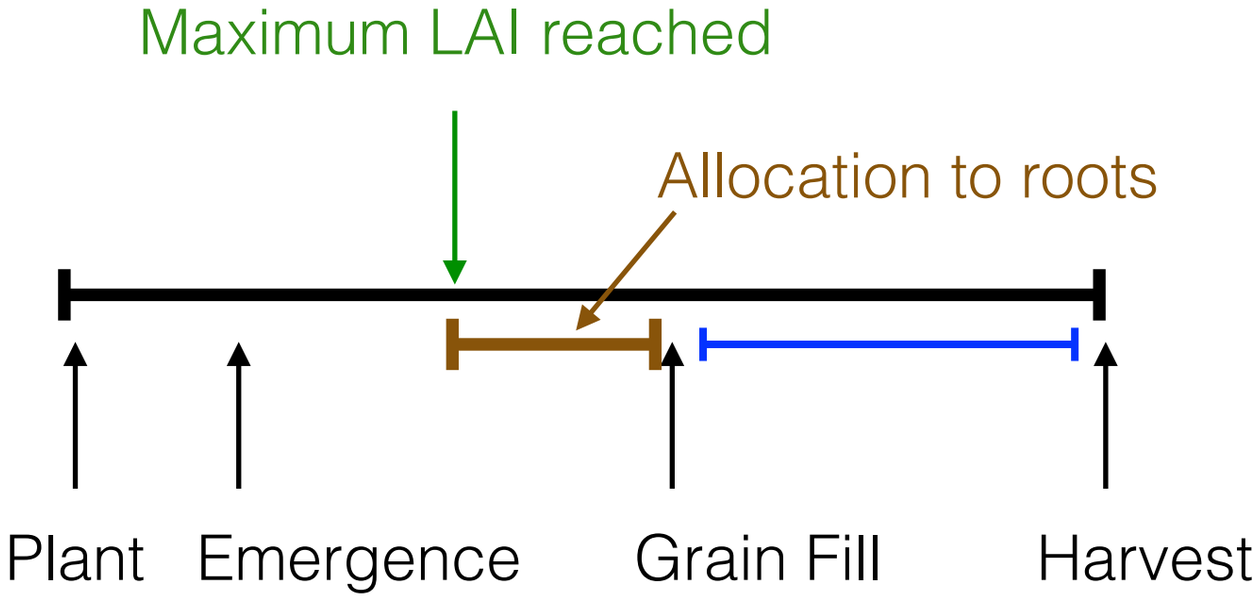
Old


Maximum LAI reached
Allocation to roots
Plant
Emergence
Grain Fill
Harvest

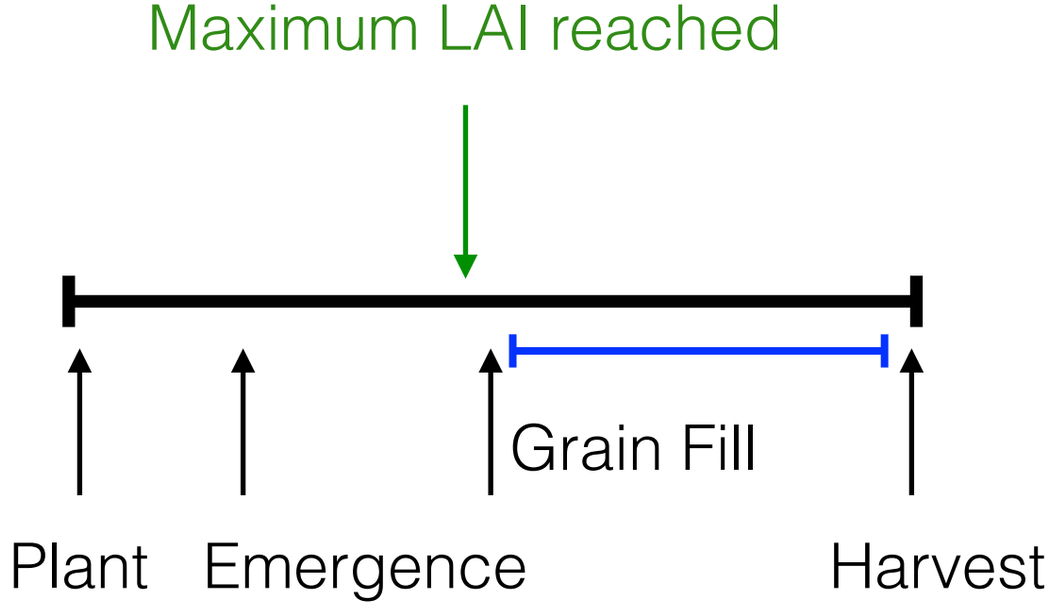
New


Maximum LAI reached
Grain Fill
Plant
Emergence
Harvest

Old


Maximum LAI reached
Allocation to roots
Plant
Emergence
Grain Fill
Harvest

New


Maximum LAI reached
Grain Fill
Plant
Emergence
Harvest

1) Plant

2) Leaf Emergence

3) Grain Fill

4) Harvest

1) Plant

3) Grain Fill

2) Leaf Emergence

4) Harvest

Also changing allocation parameters

Management

Fertilize

Irrigate

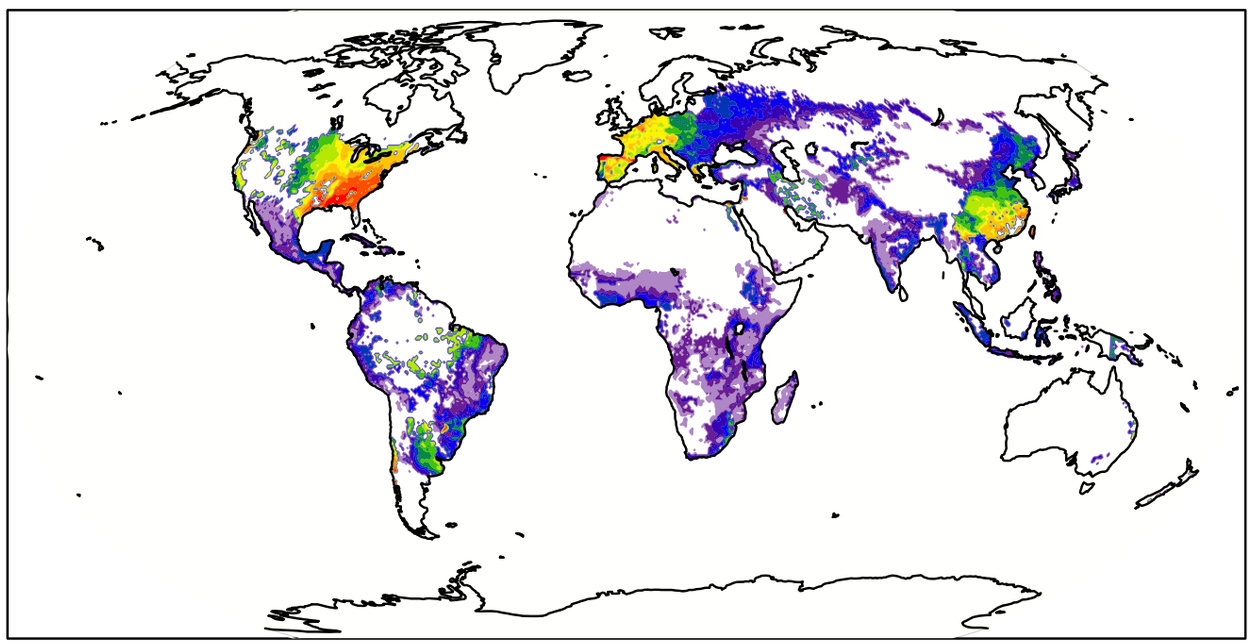
Transient fertilizer and irrigation are now on surface dataset

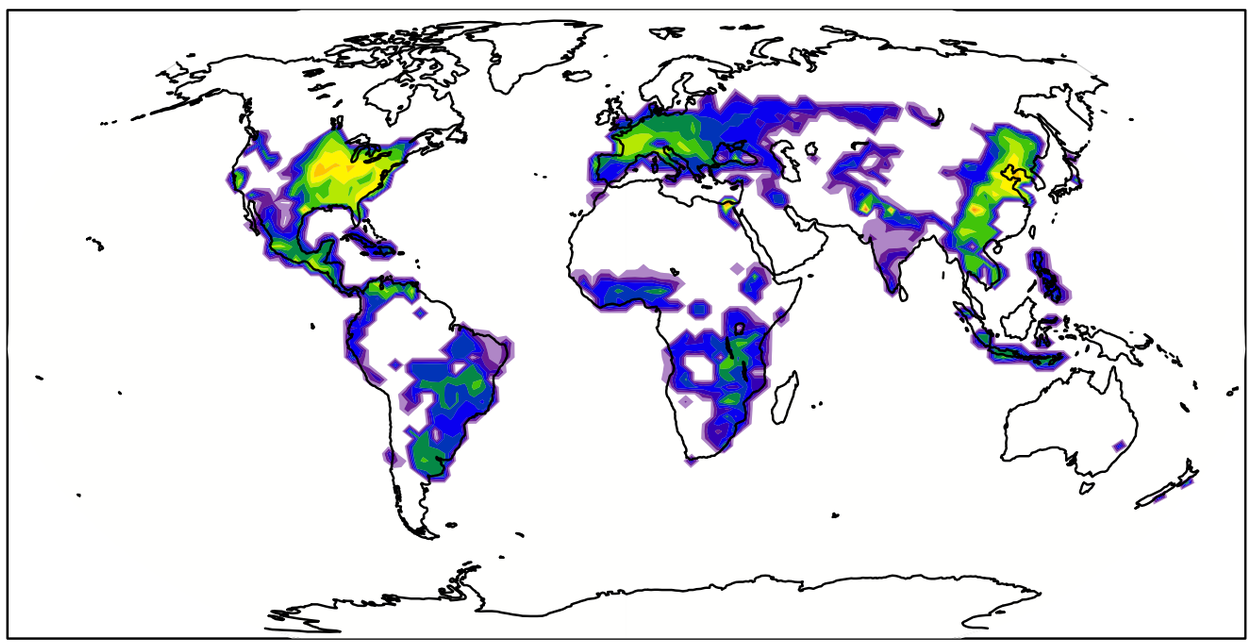
1850 fertilizer assumed to be from manure only

Analysis

FAO Corn

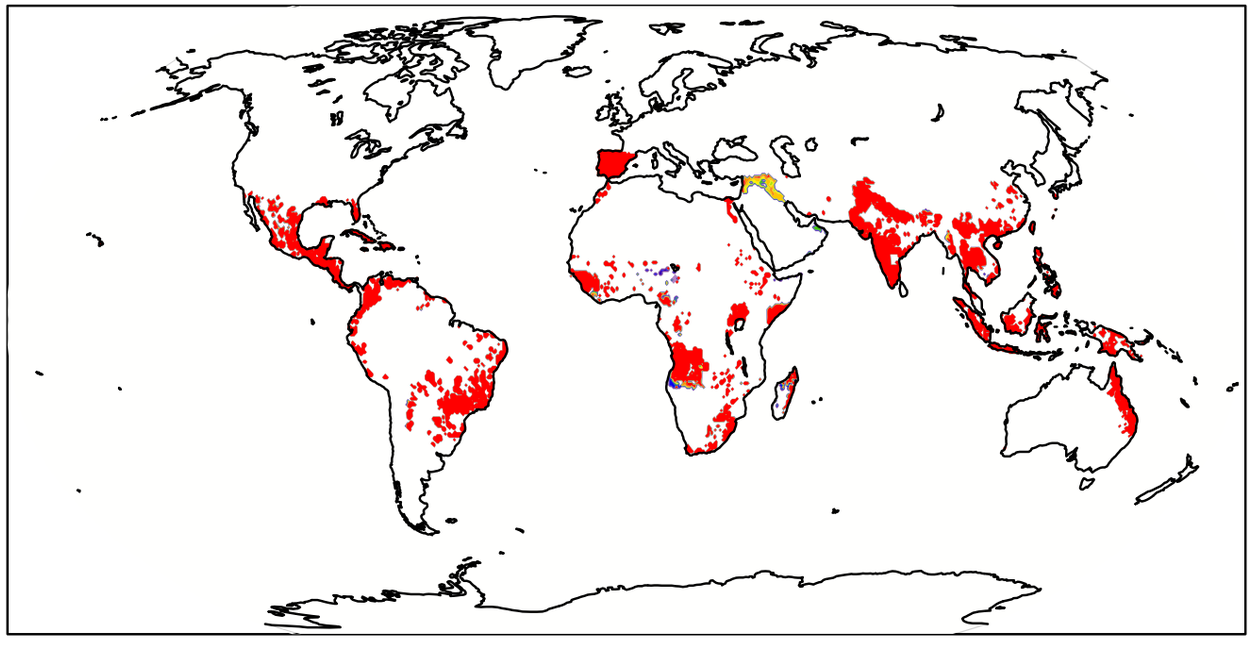
CLM5 Corn

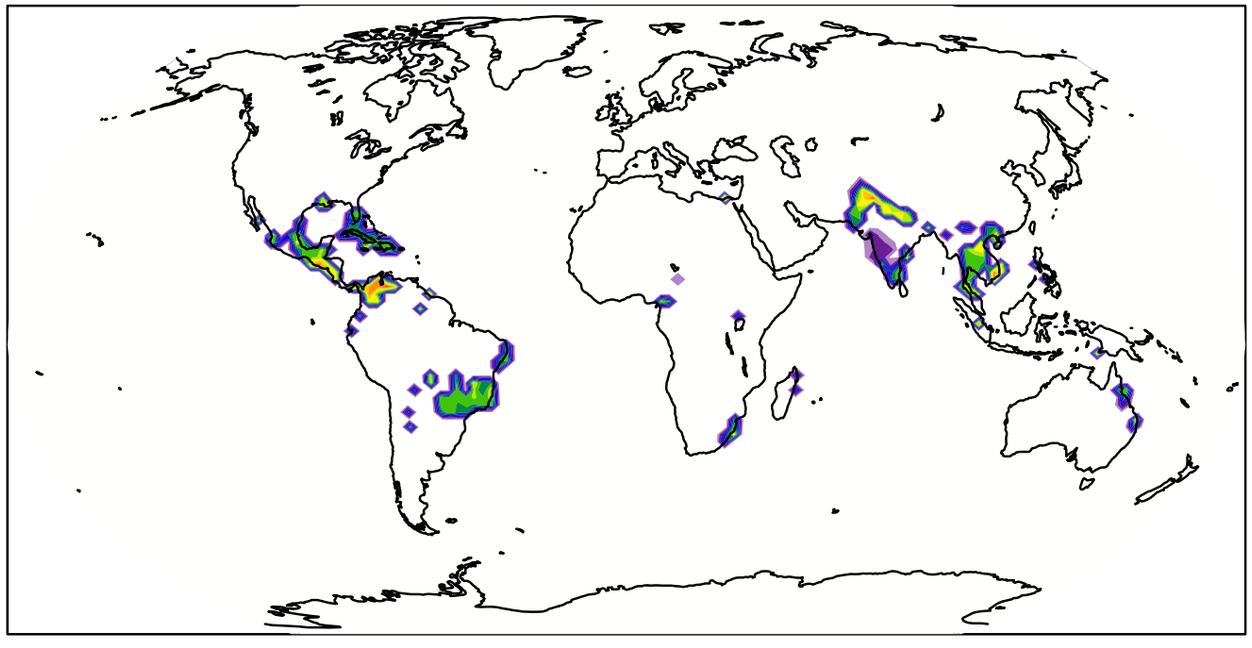




FAO Sugarcane

CLM5 Sugarcane

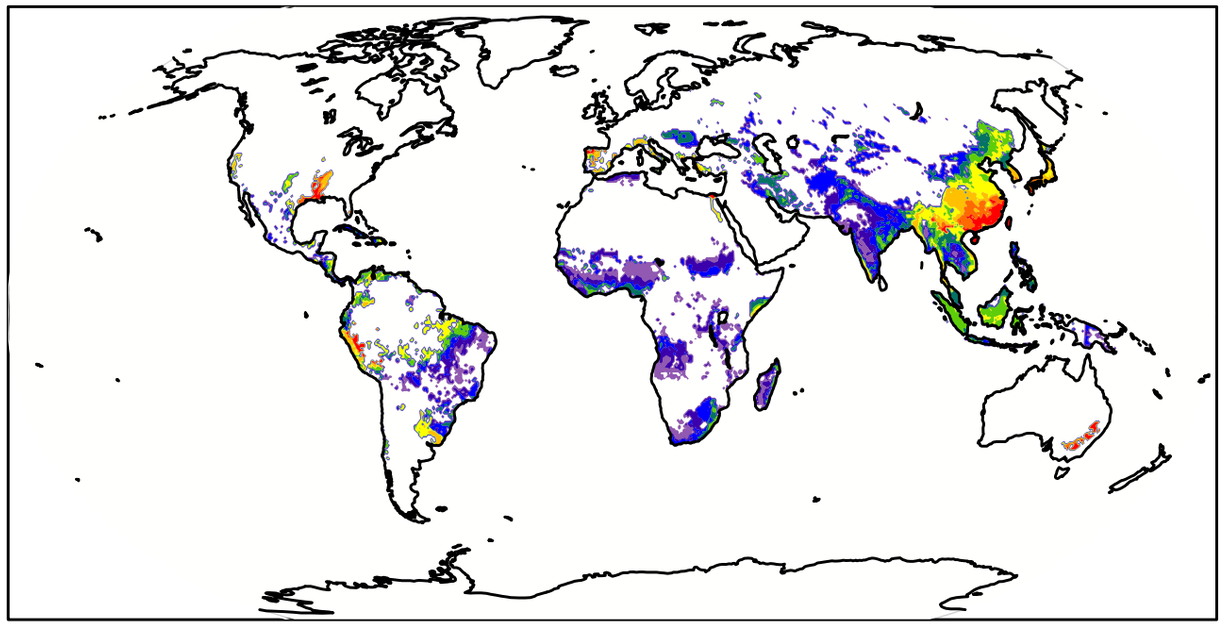


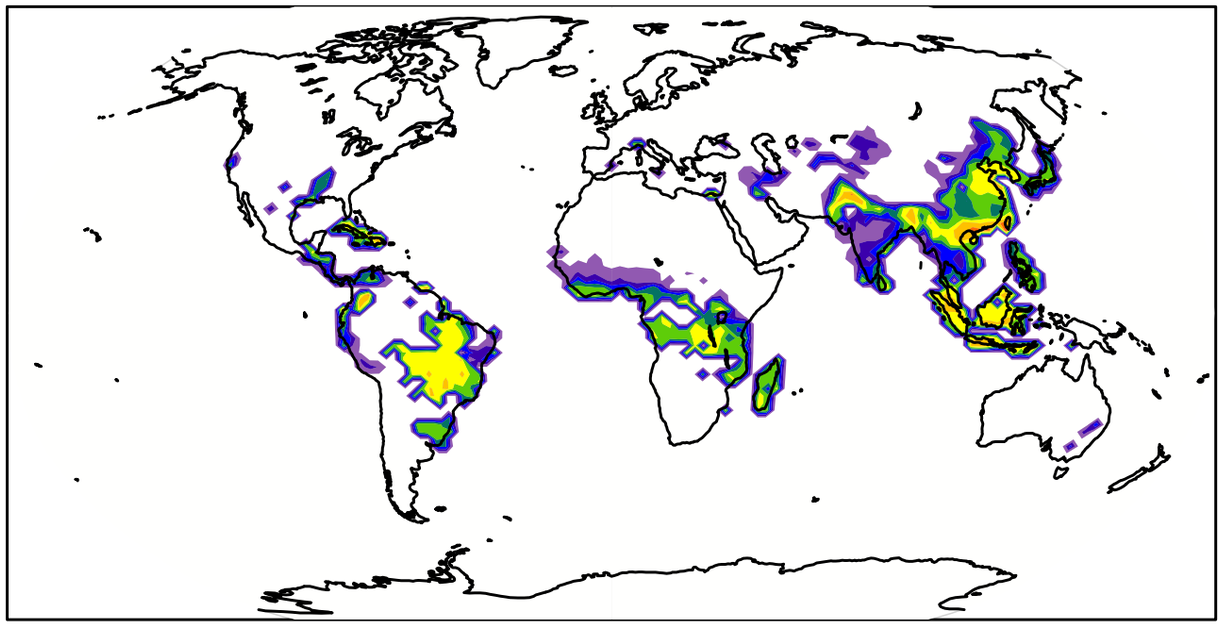


Annual Yield (tonnes ha^{-1})

FAO Rice

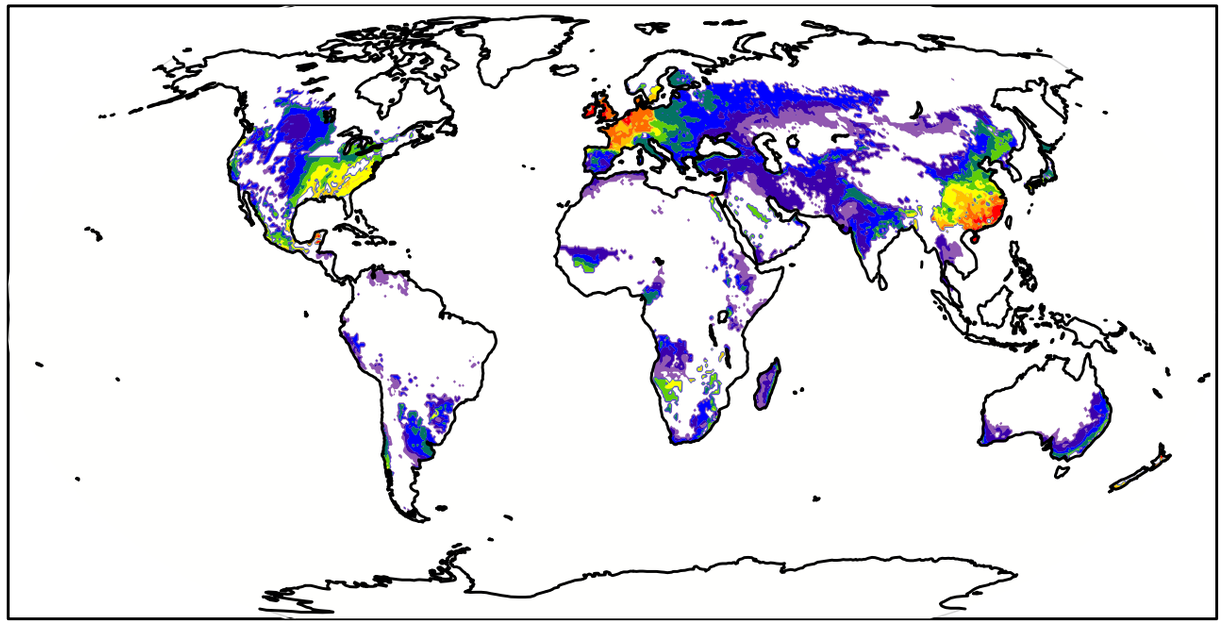
CLM5 Rice

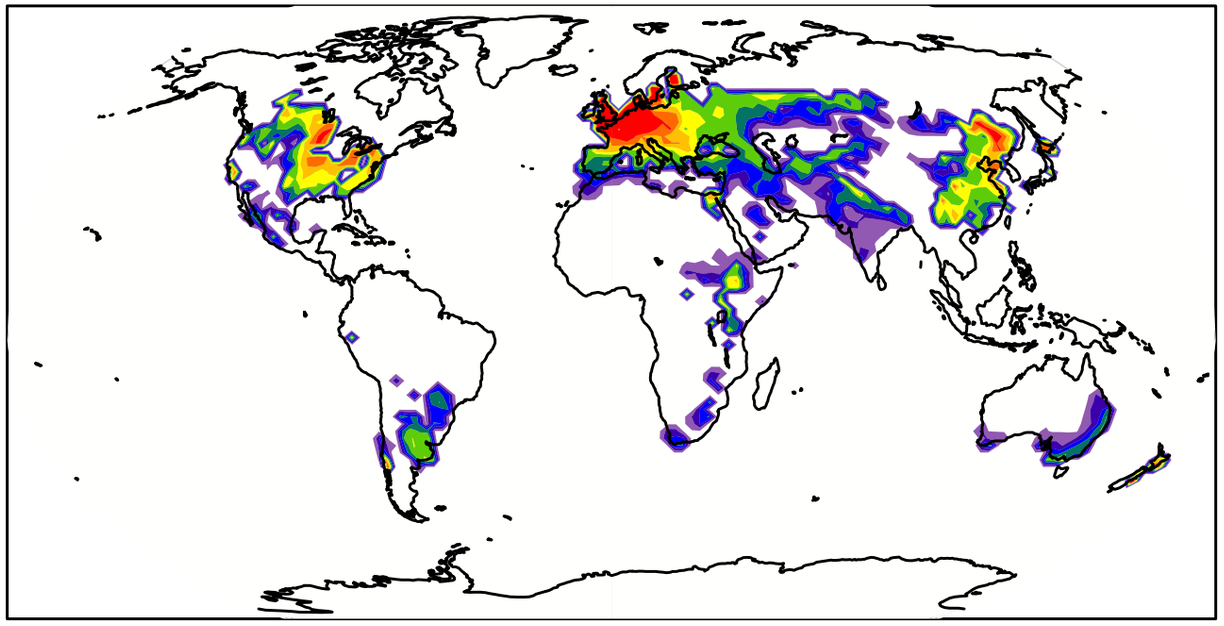


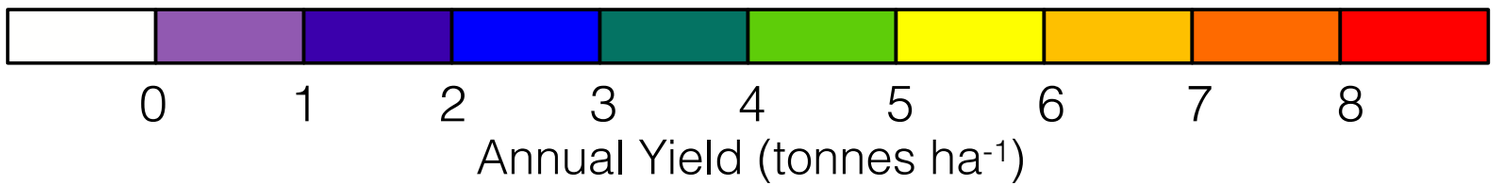


FAO Wheat

CLM5 Spring Wheat







FAO Soy

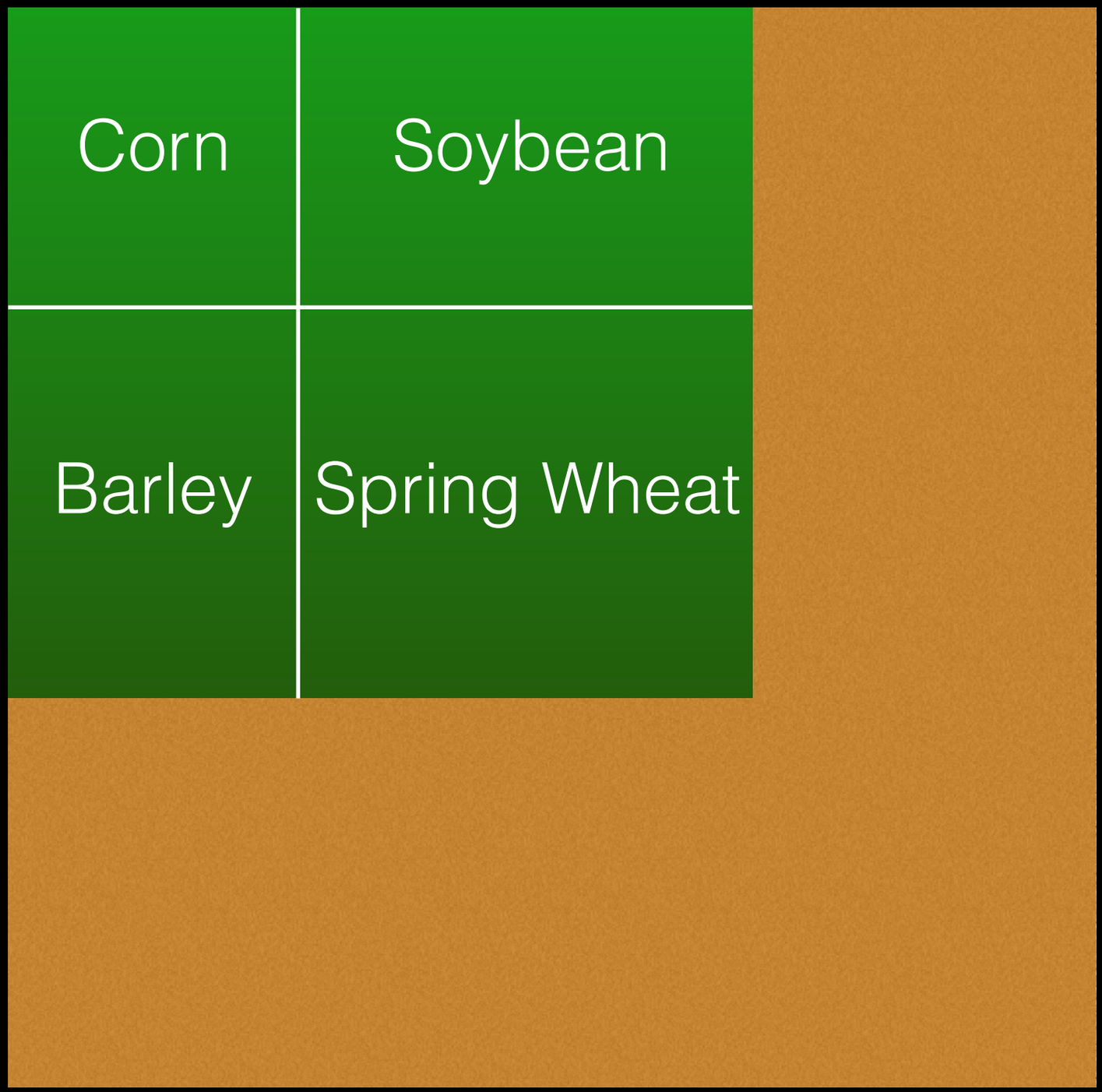
CLM5 Soy

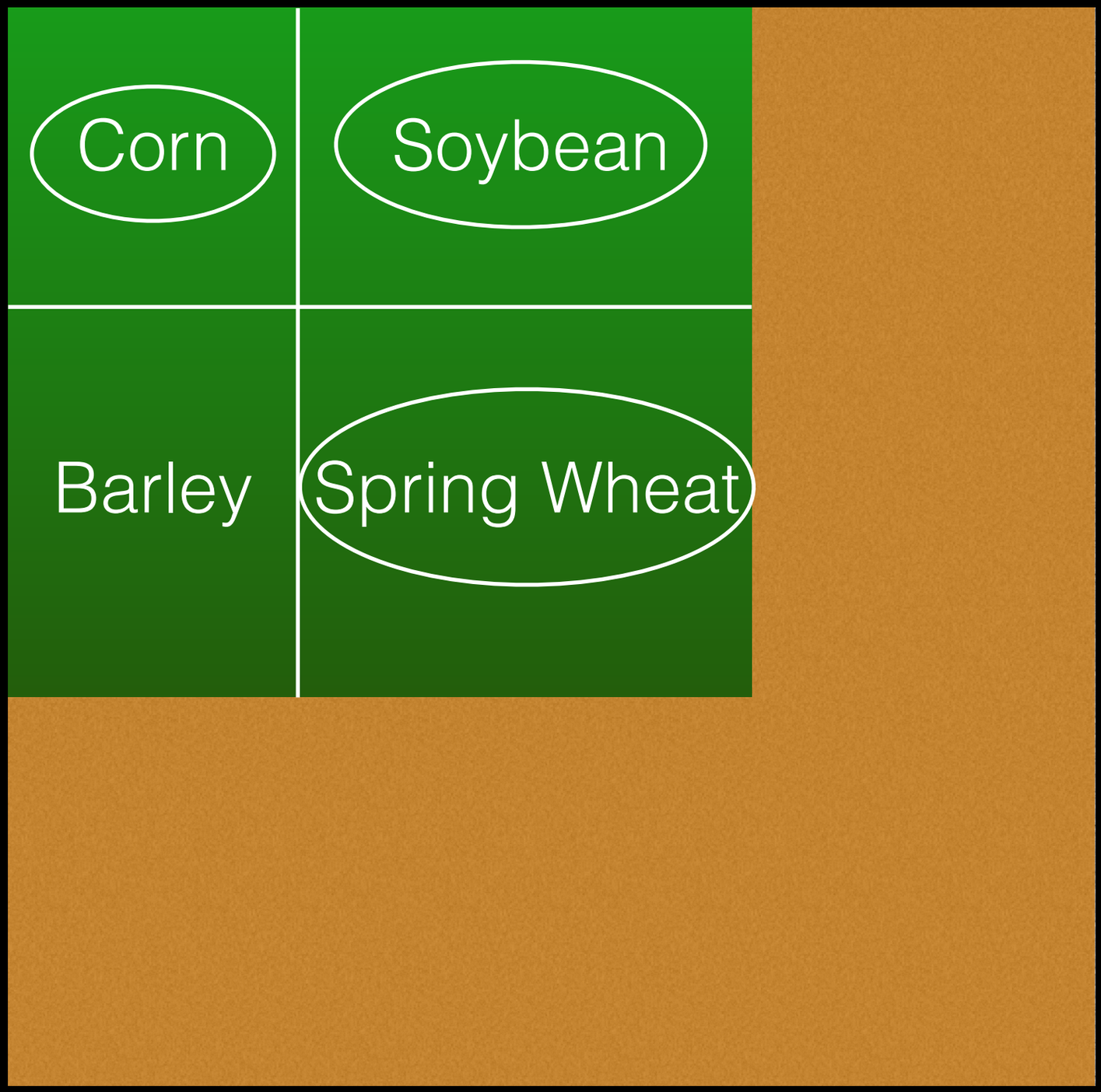
FAO Cotton

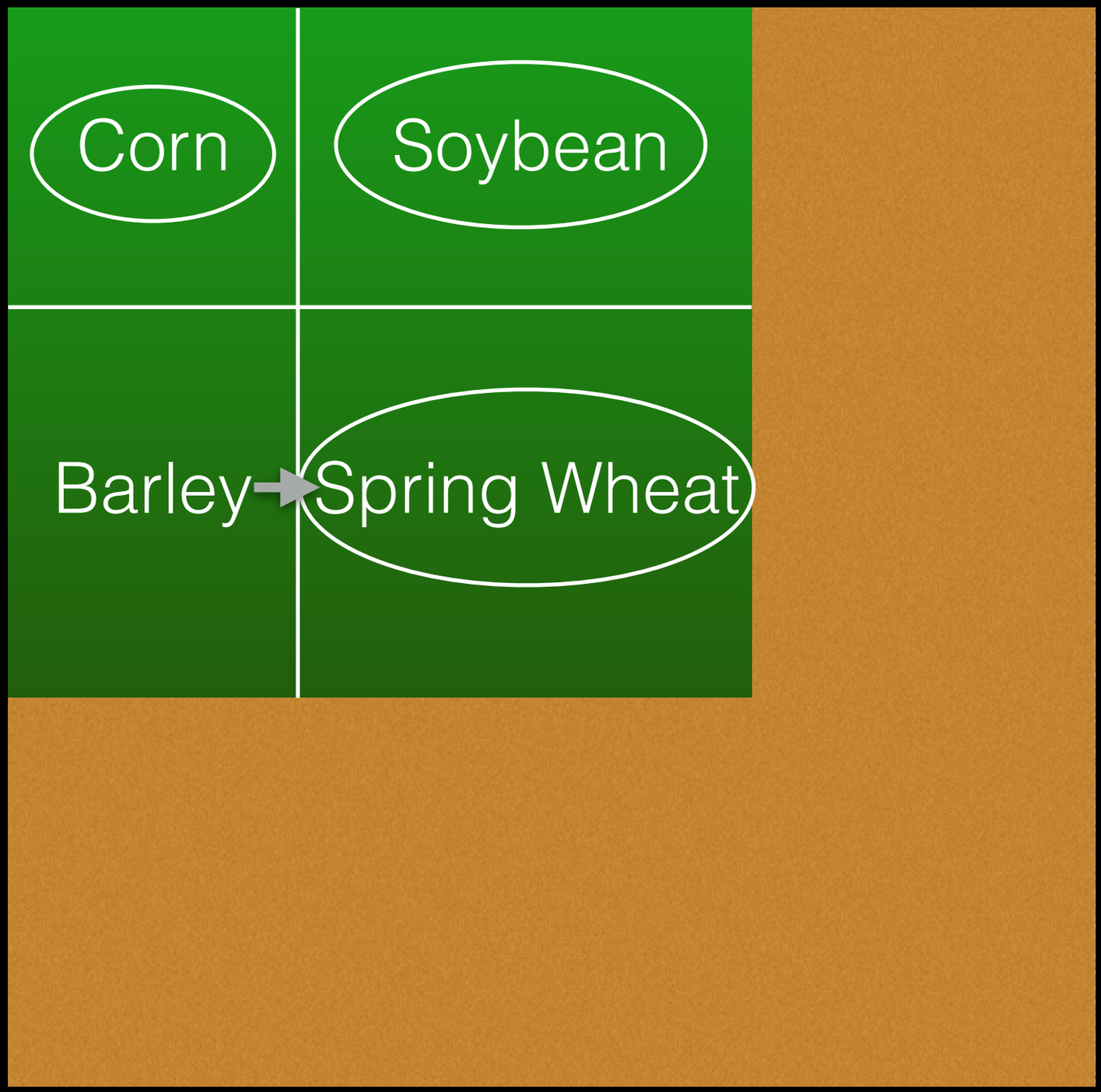
CLM5 Cotton

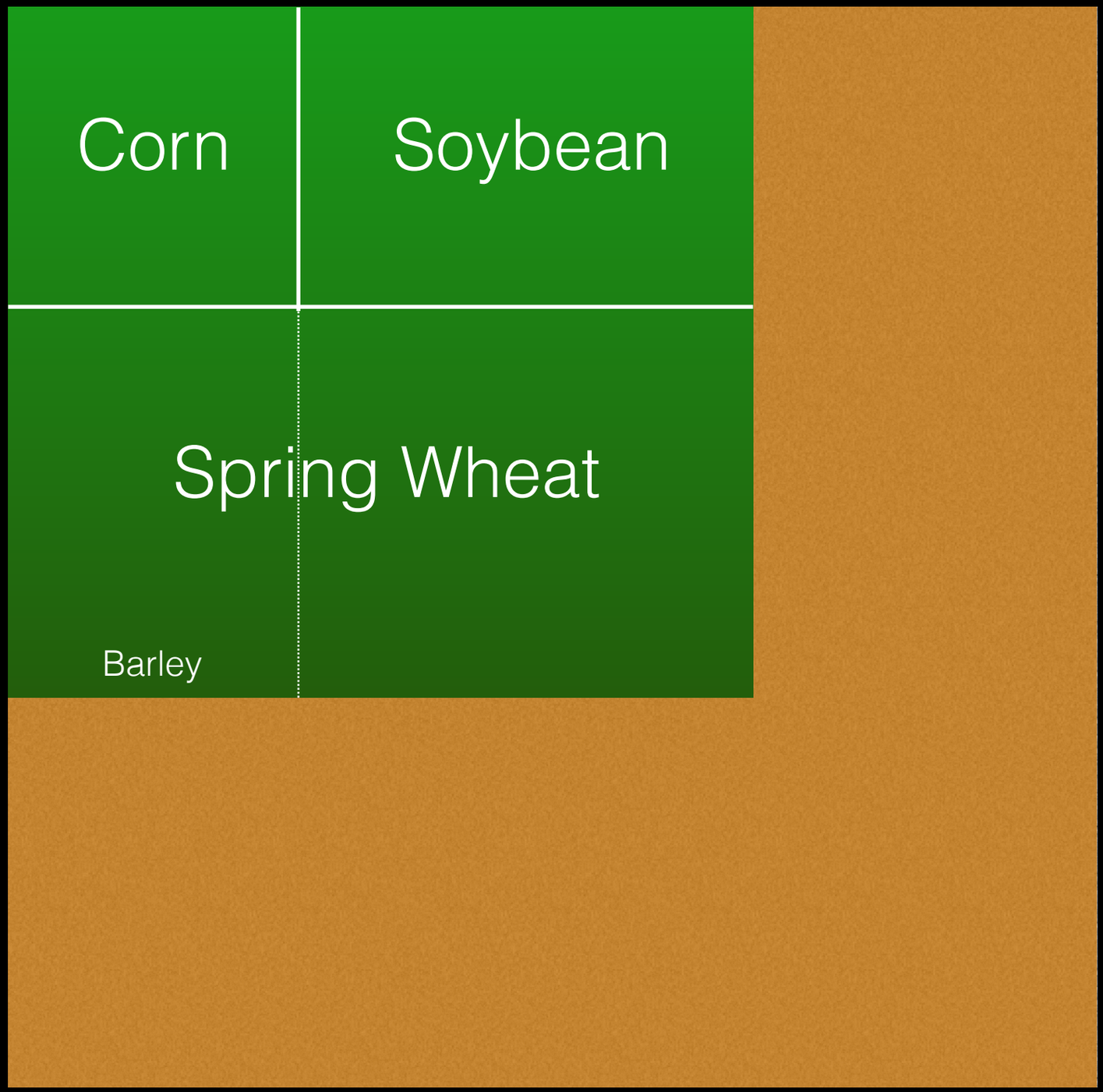
0 1 2 3 4 5 6 7 8

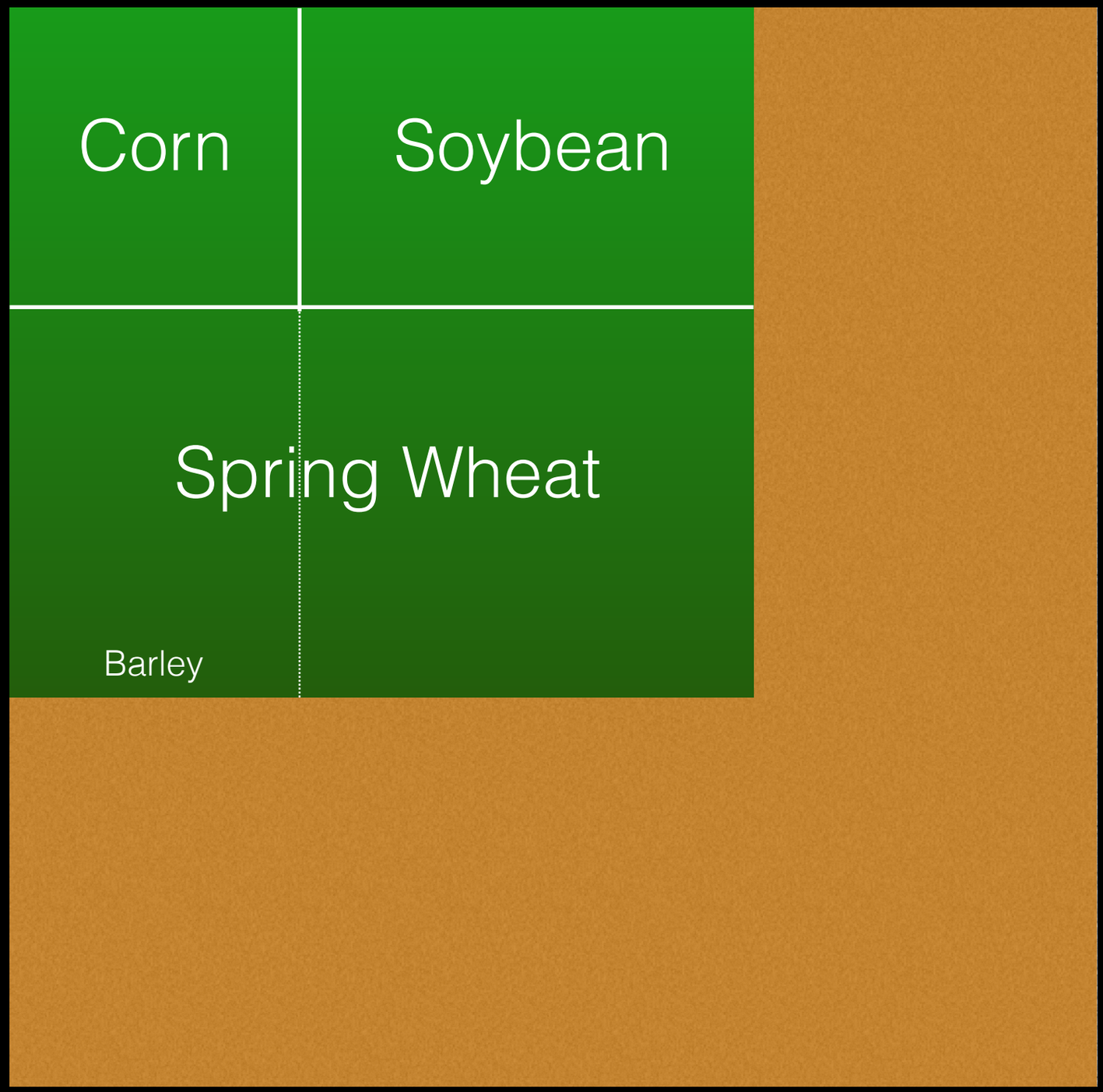
Annual Yield (tonnes ha^{-1})


Corn
Soybean
Barley
Spring Wheat


Corn
Soybean
Barley
Spring Wheat


Corn
Soybean
Barley
Spring Wheat


Corn
Soybean
Spring Wheat
Barley



Yields can be calculated for 31 crop types

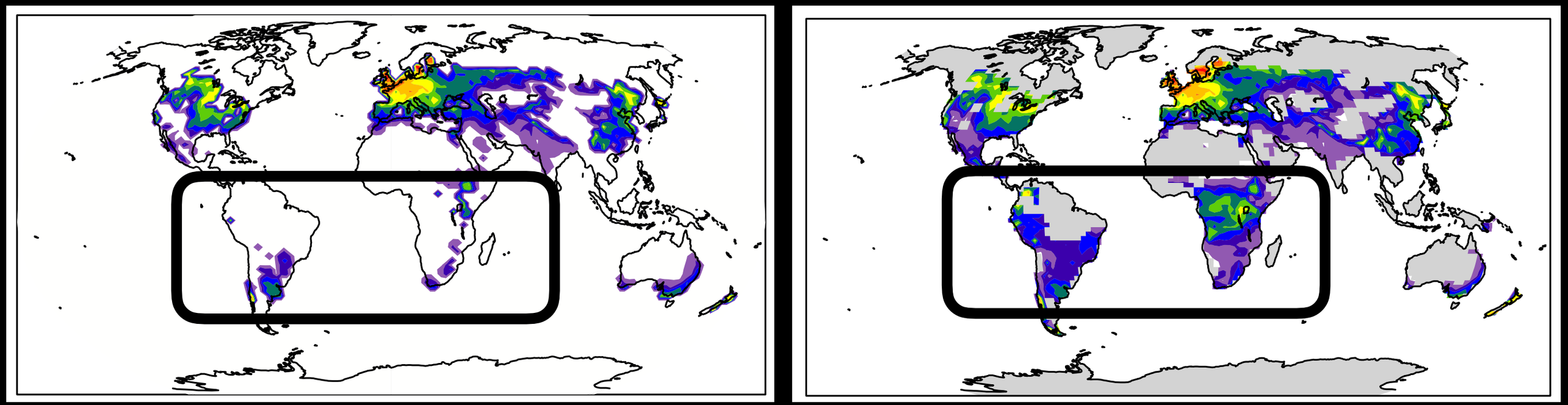
Assumption that inactive crops have same growing triggers & allocation as the active crop

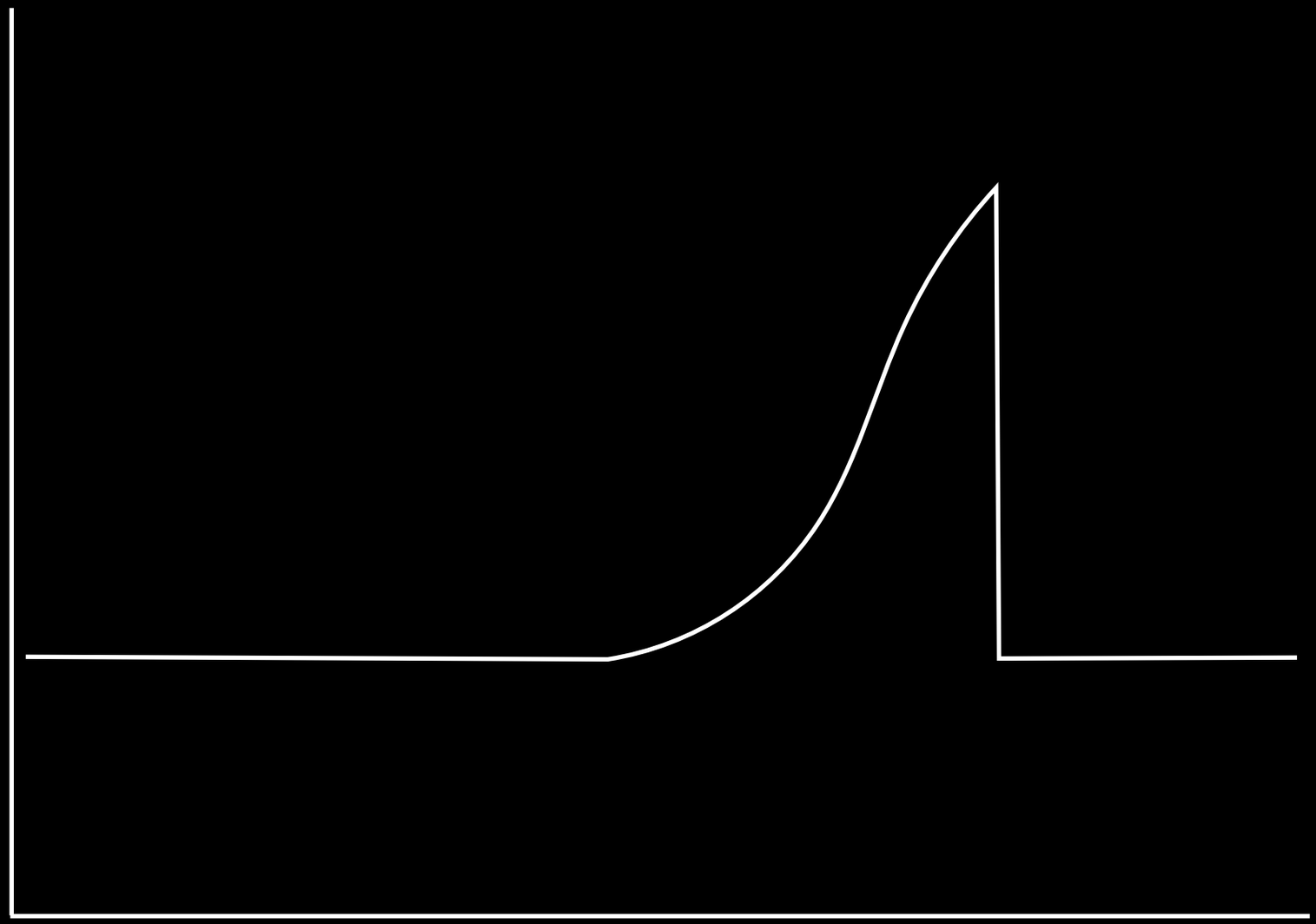
Need to use surface dataset for remapping during analysis

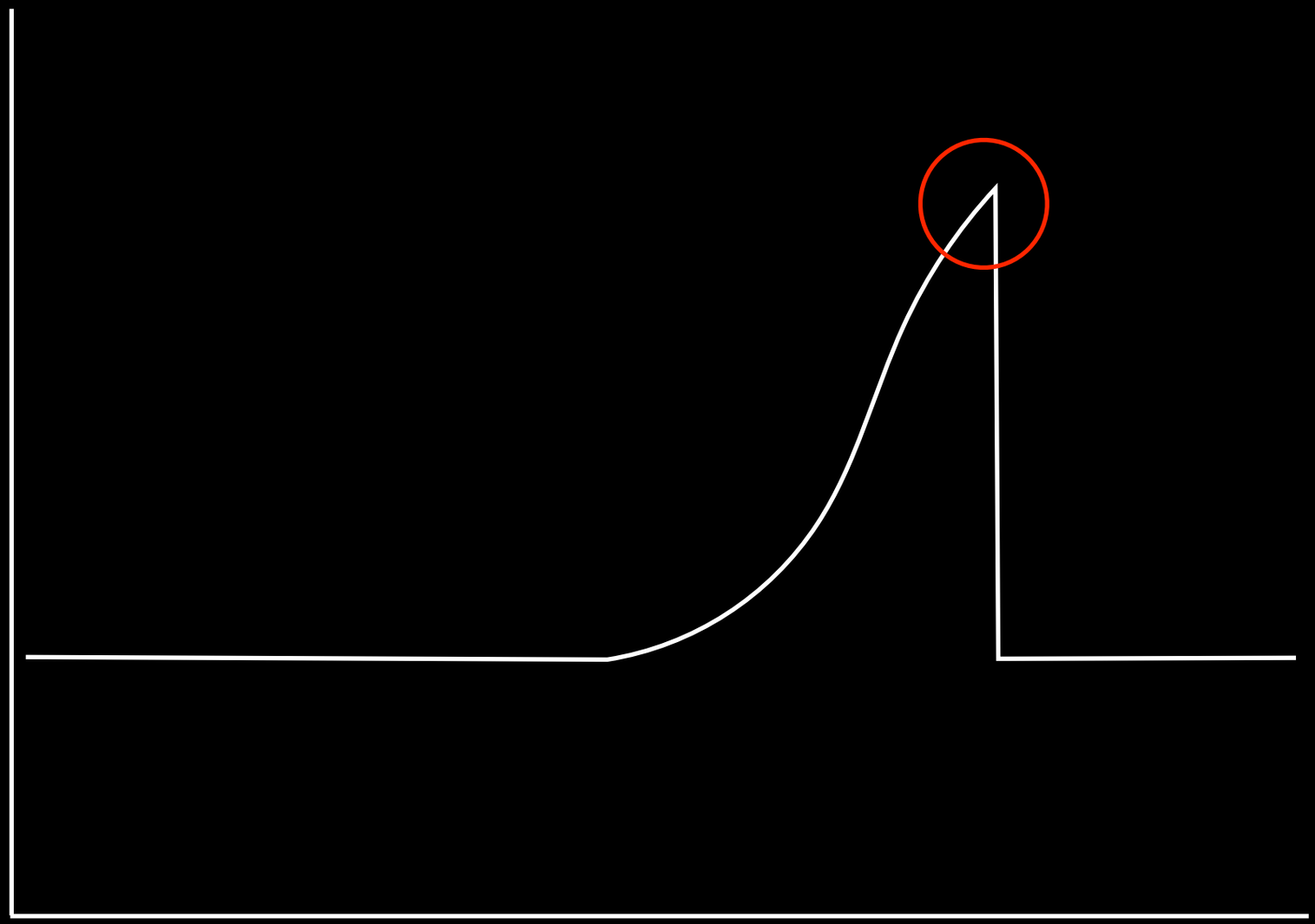
Spring Wheat

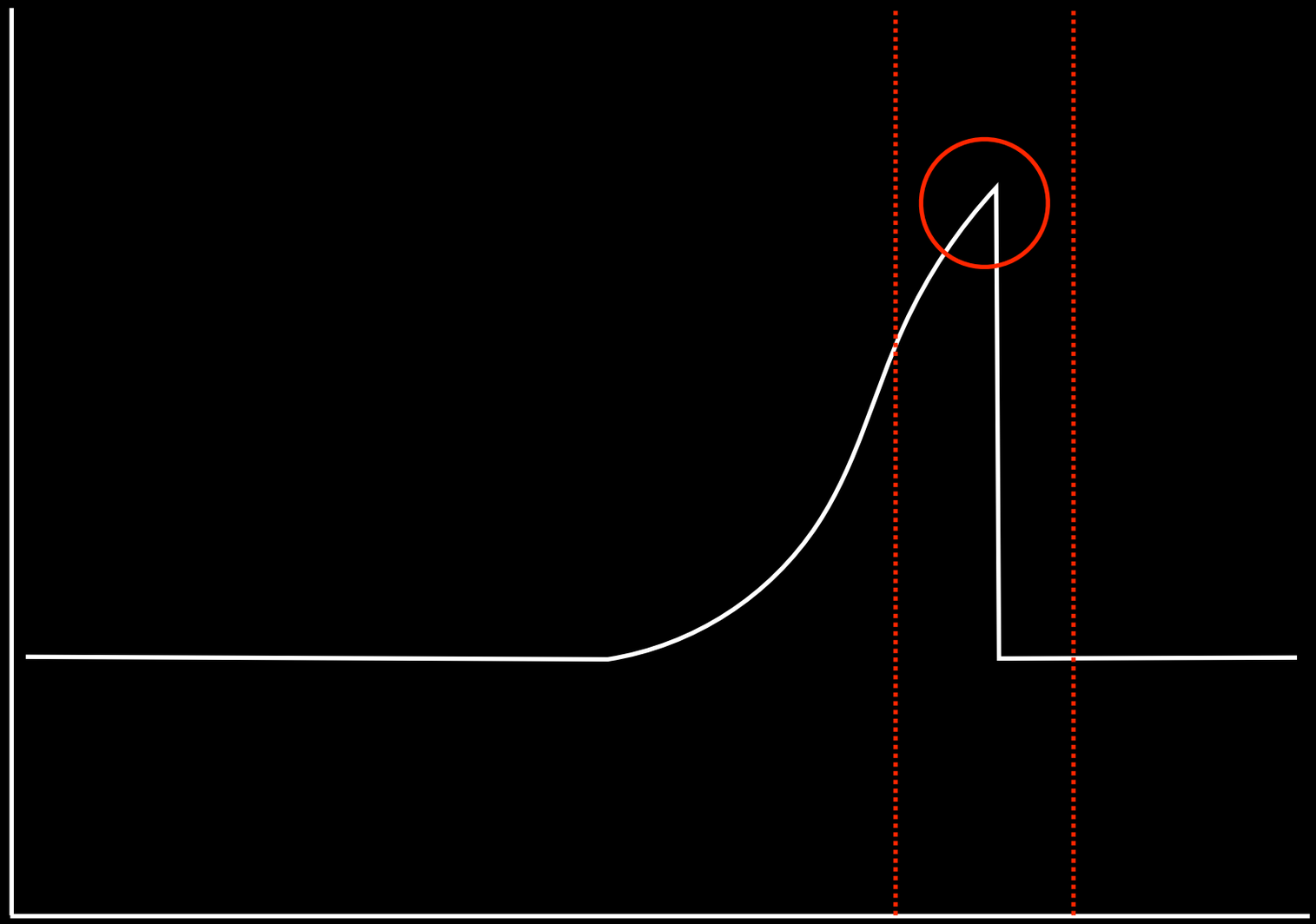
With Surface Dataset Mask

Without Surface Dataset Mask



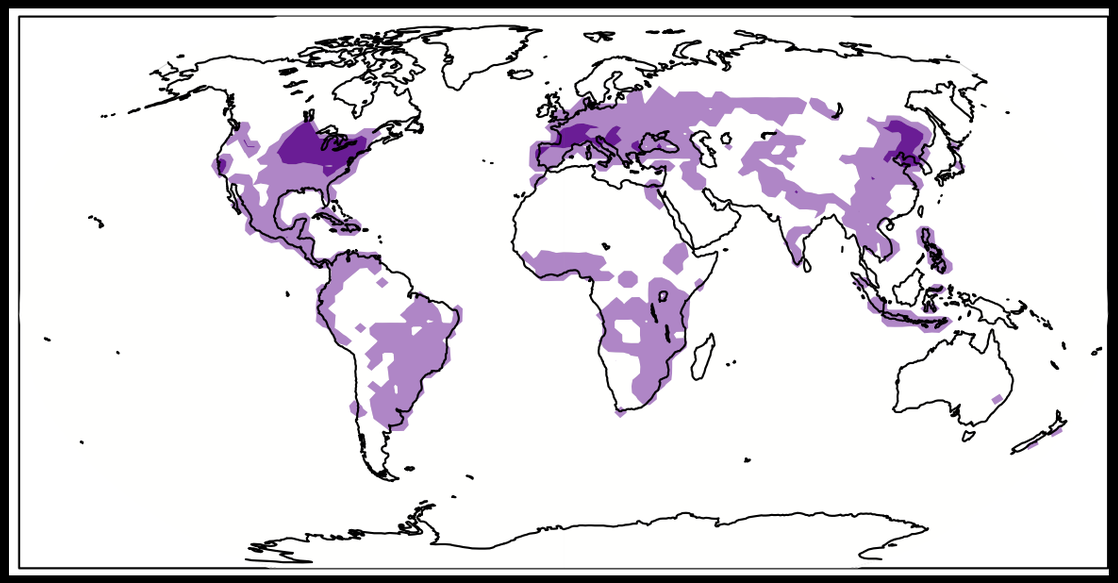

Grain C
Month

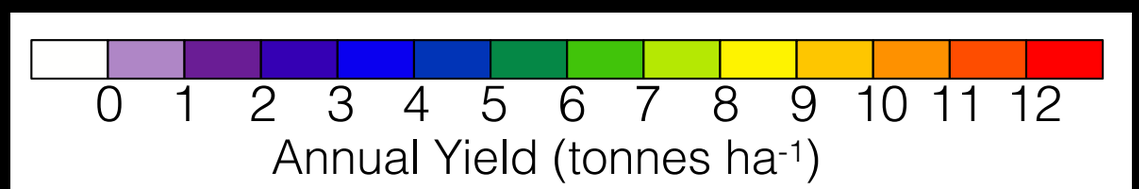

Grain C
Month


Grain C
Month

Corn

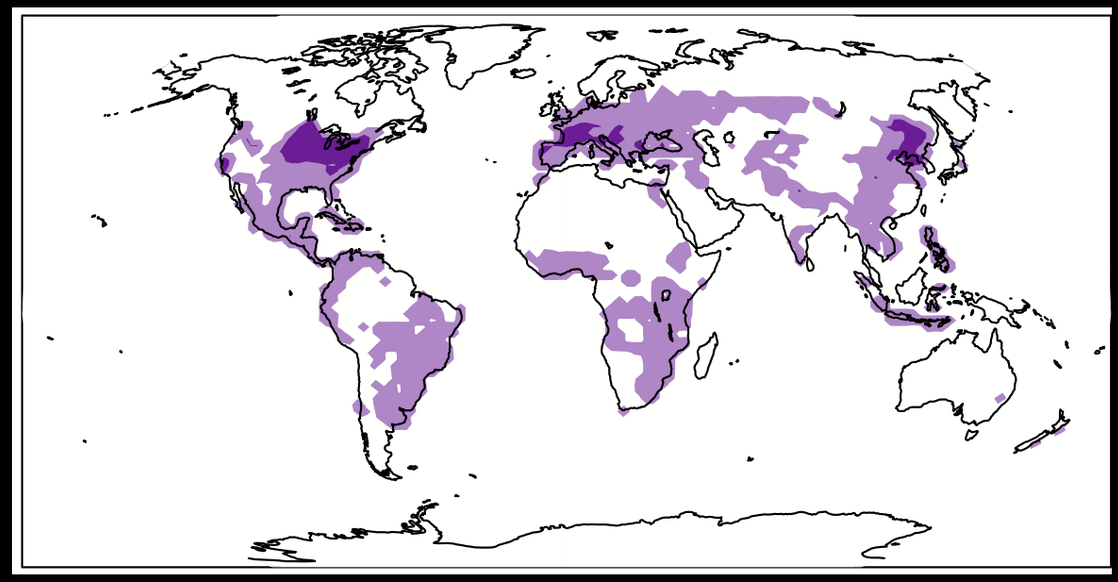
Grain C
Annual Average



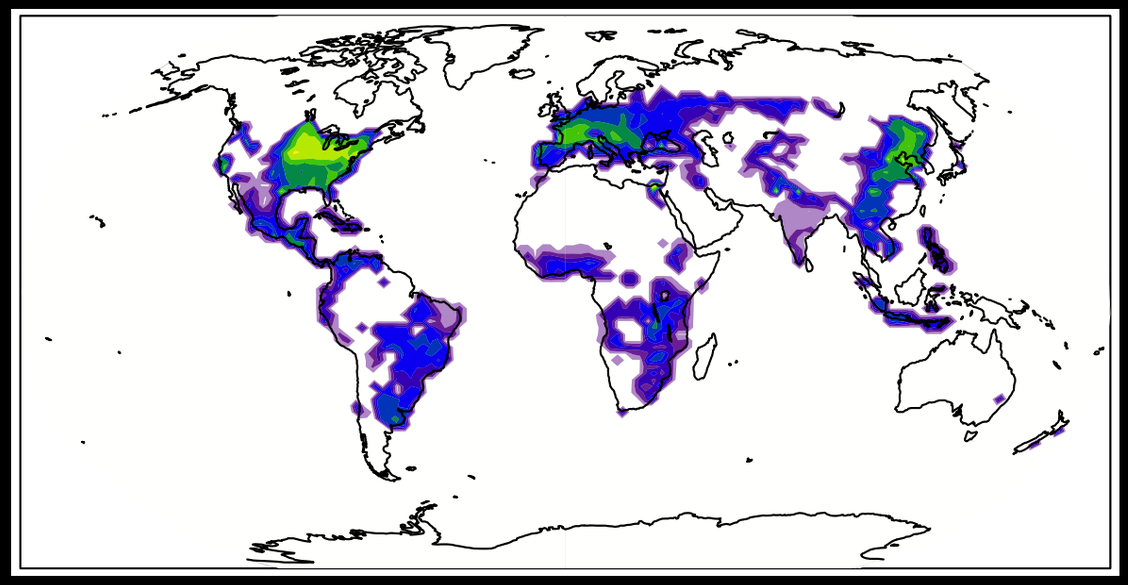


Corn

Grain C
Annual Average

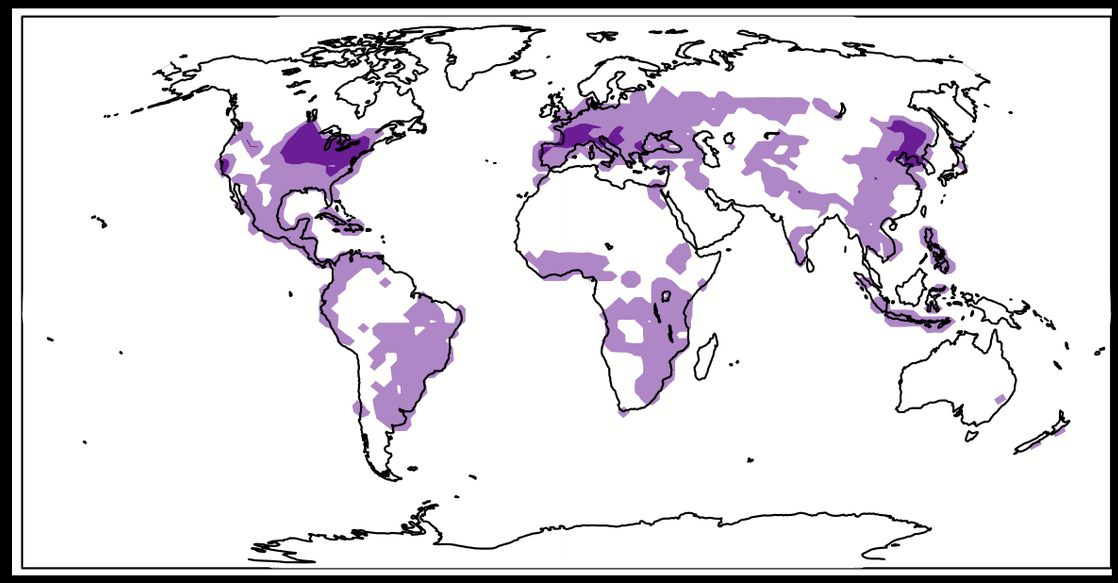


Grain C
Max Monthly Average

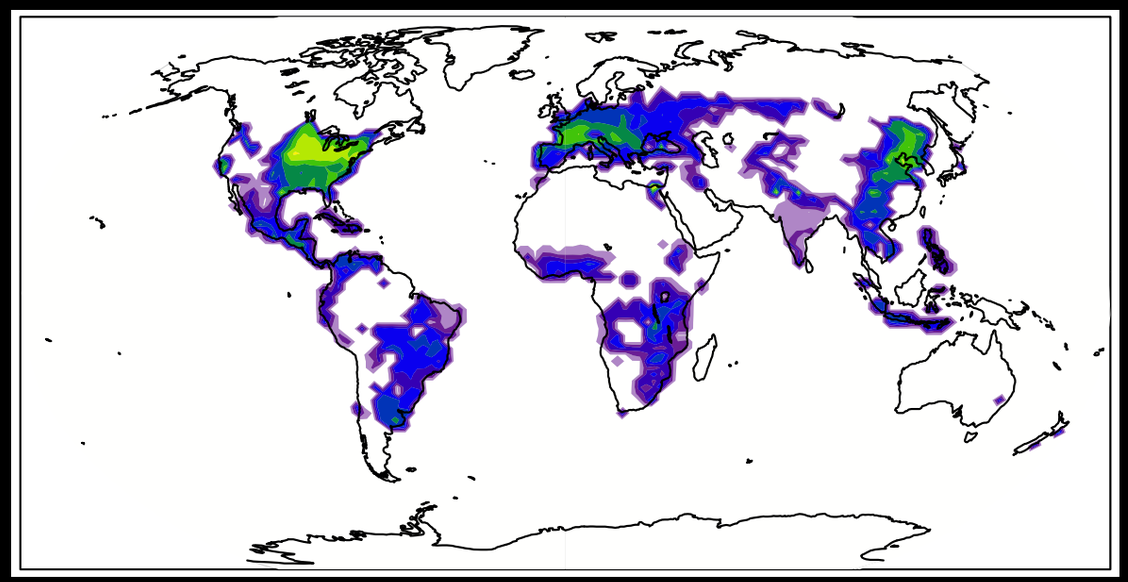


Corn

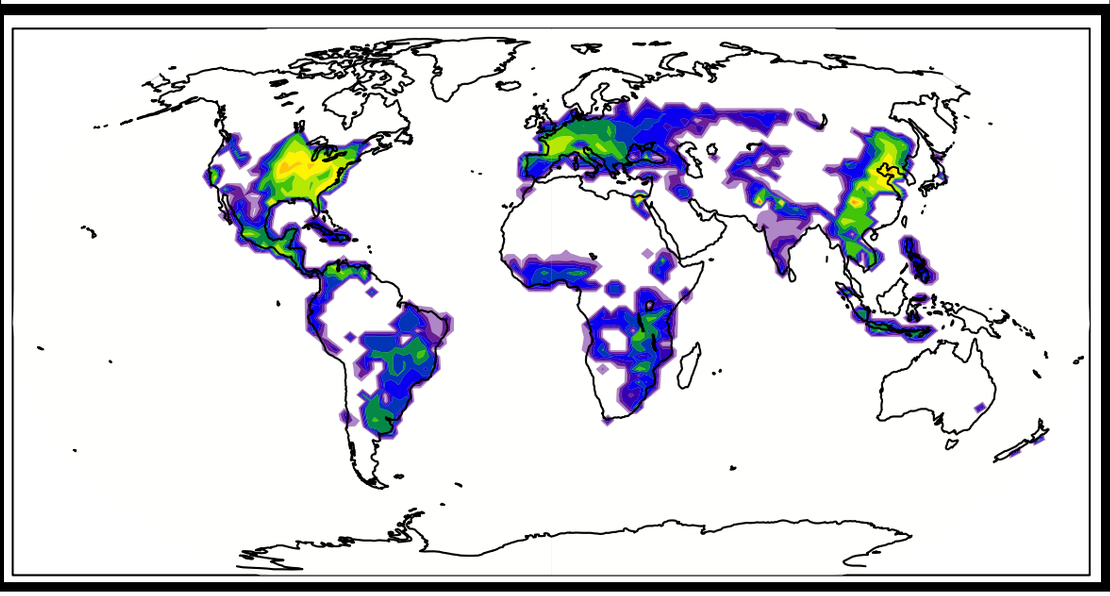
Grain C
Annual Average

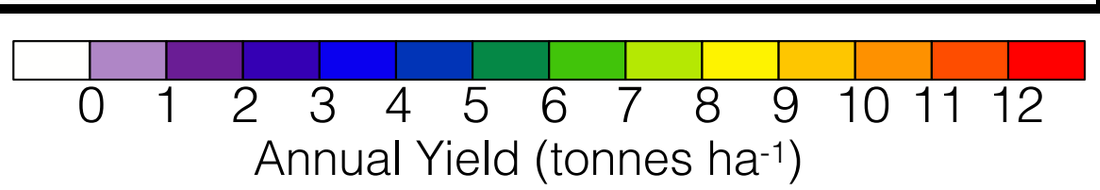


Grain C
Max Monthly Average



Grain C to Food
Annual Sum





CLM5-Crop

Things to keep in mind

- Yields available for 31 different crop types
  - (rain-fed & irrigated)
- Ability to run transient
  - (land area, irrigation, fertilizer)
- Several considerations for analysis
  - (conversion of 1-D output; variable used; remapping)
- Crop model is ~50% more computationally expensive
  - Active for CMIP6 simulations
- Still working on minor adjustments