Agricultural Inorganic Fertilizer

5/09/2025

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Outline

- A look at several data sets
- Setting up a comparison
- Examining the results

Multiple fertilizer data sets exist:

CAST 23

- Annual 1985-present
- AAPFCO and state data
- Nitrogen and Phosphorus

TREND

- Annual 1930-2017
- Composite of multiple datasets
  - Several USGS, Cao et al 2018, USDA ERS
- Nitrogen

Running a comparison:

CalCAST

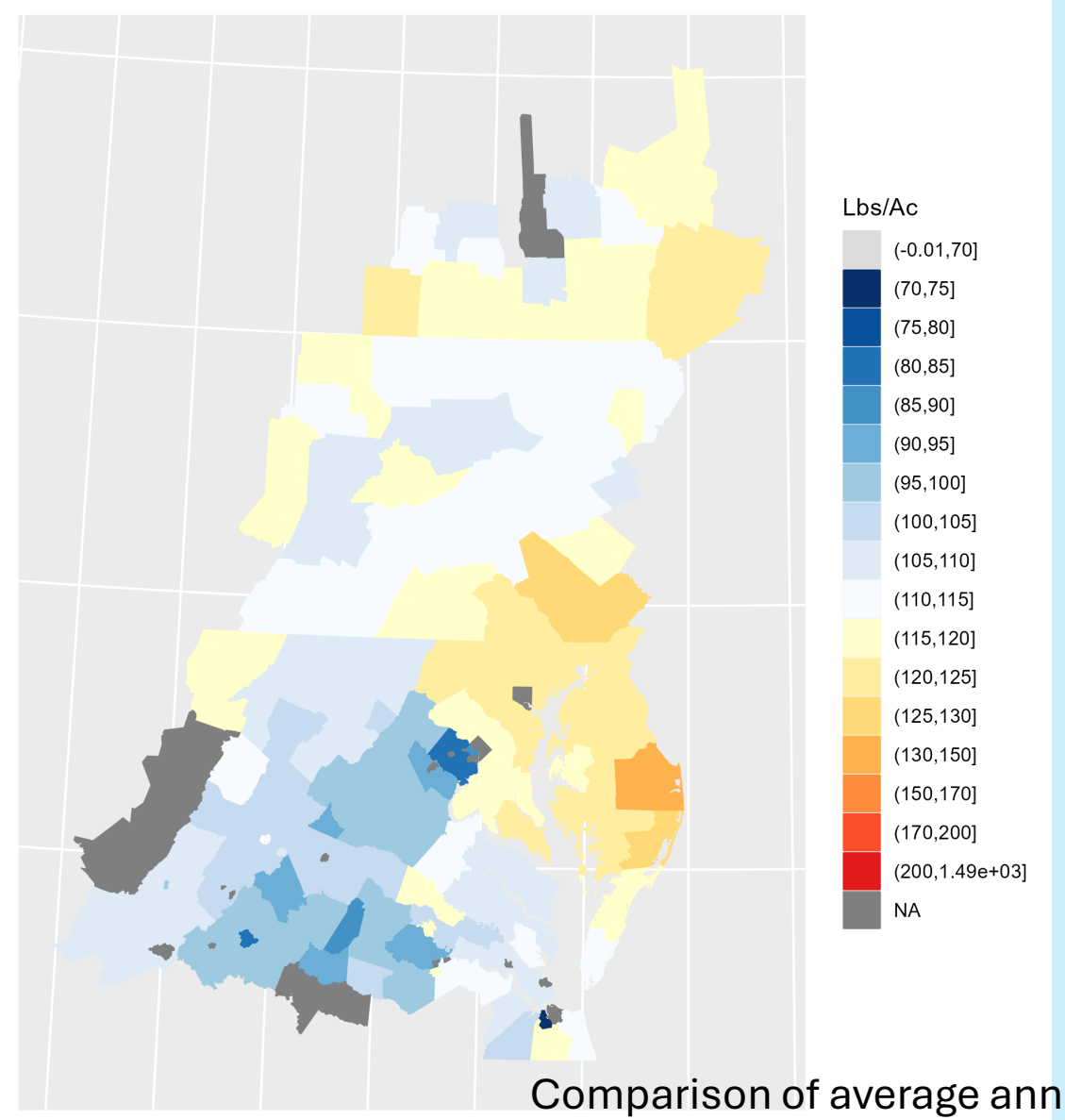
- Tool for finding parameters that best match observations
- Can be easily modified to determine how different data sets help predict water quality
- Same input data as CAST
- Results are NOT 100% the same as CAST
  - Some parameters are estimated statistically to fit with monitoring data

How do the inputs compare?

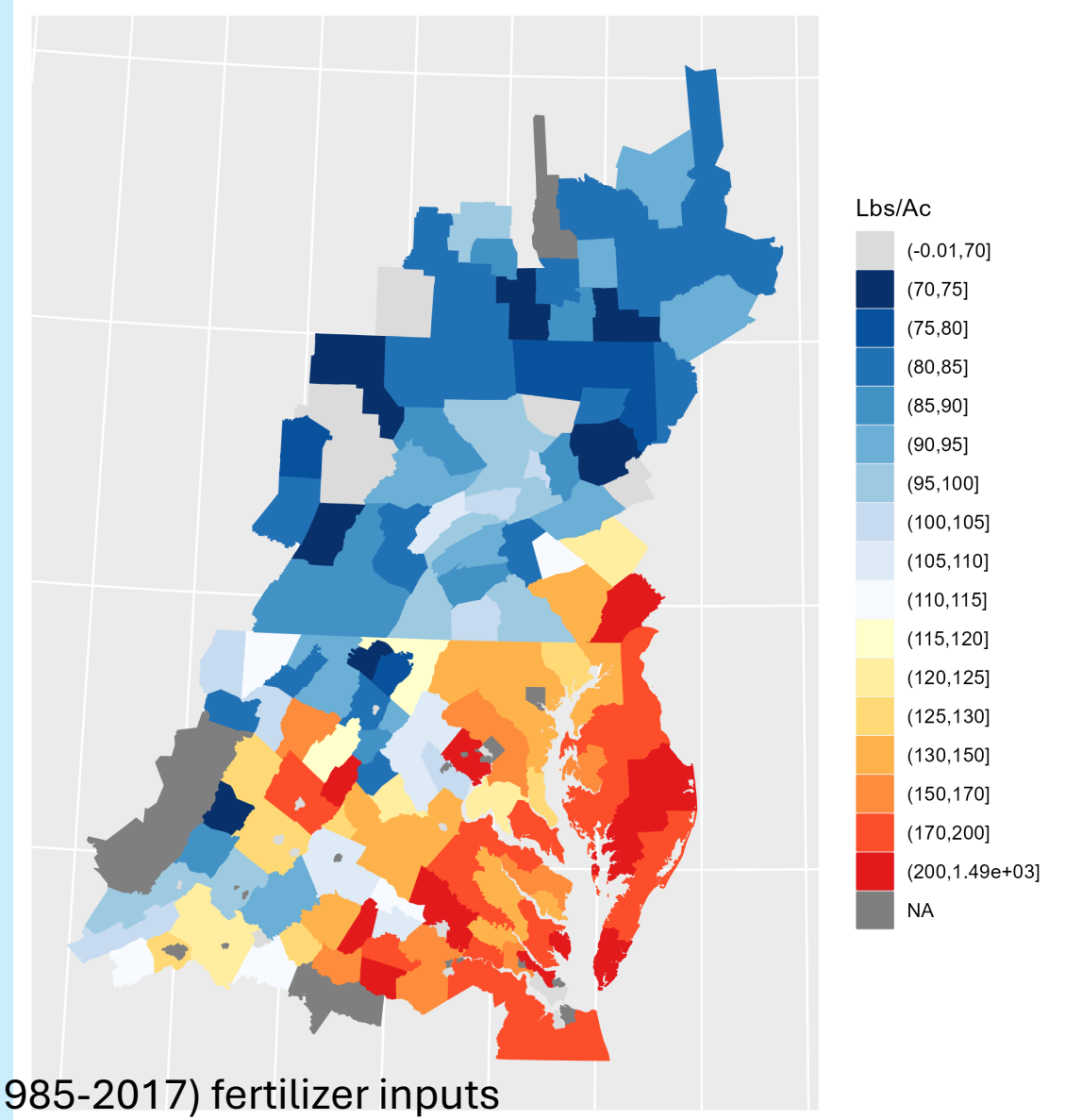
- Everything is the same
- EXCEPT the N fertilizer data set
  - TREND vs CAST 23
- Note* CalCAST does not have several of the changes we have implemented in CAST so far
  - Grain split using PAN
  - New Land Uses

Grain Without Manure

C23

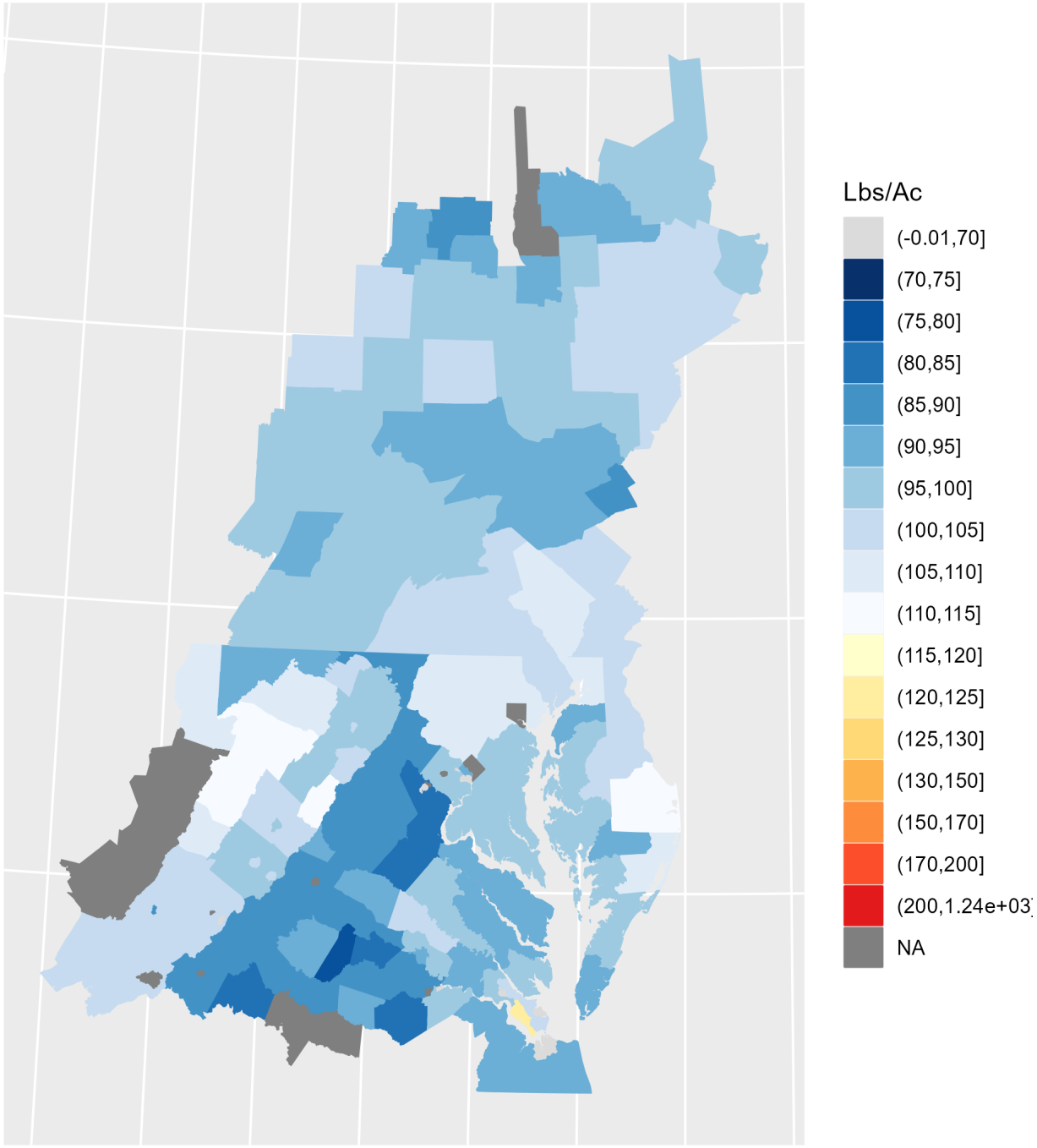


TrendN

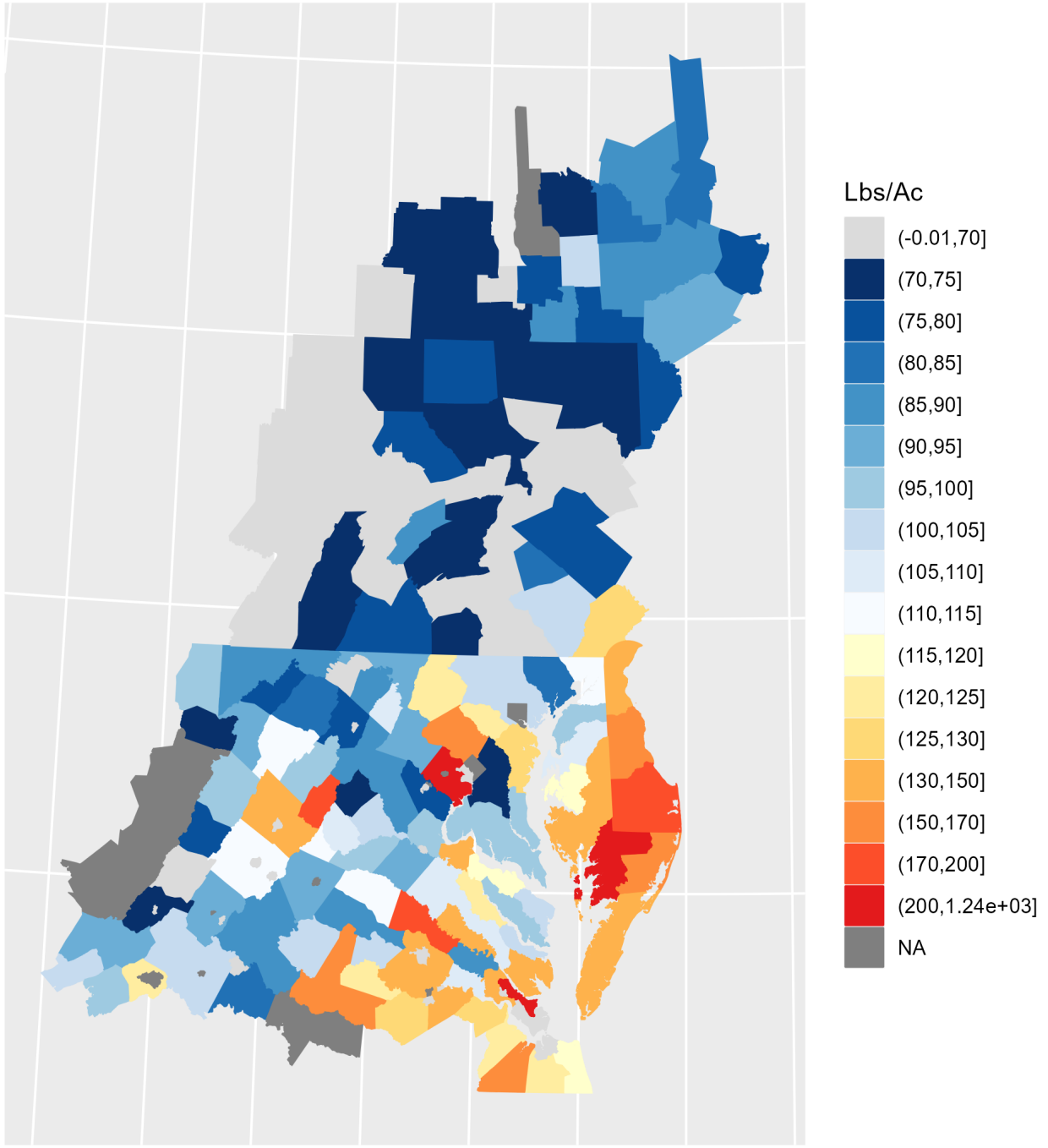


Comparison of average annual (1985-2017) fertilizer inputs

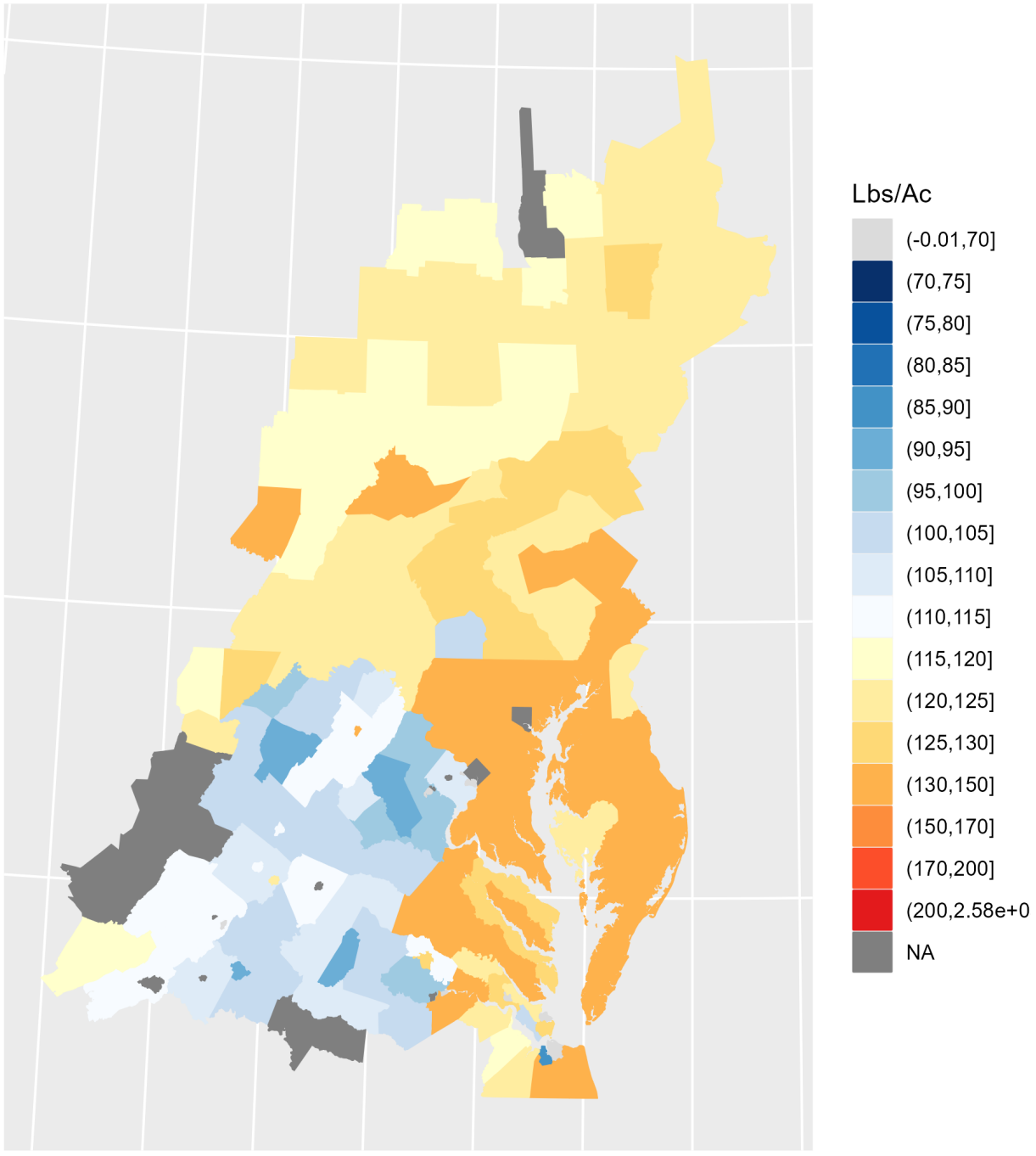
C23 Grain without Manure 1985



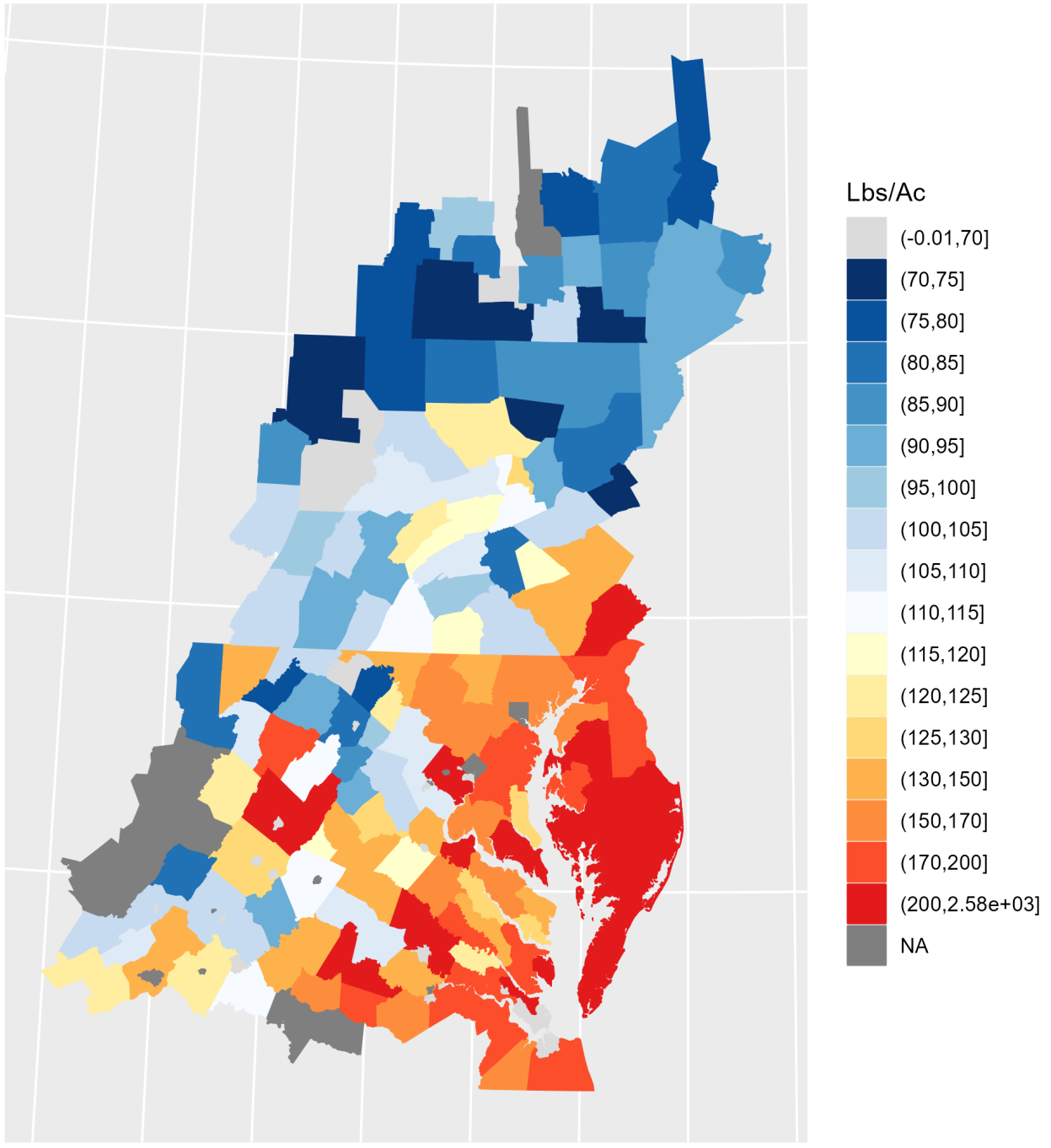
TrendN Grain without Manure 1985



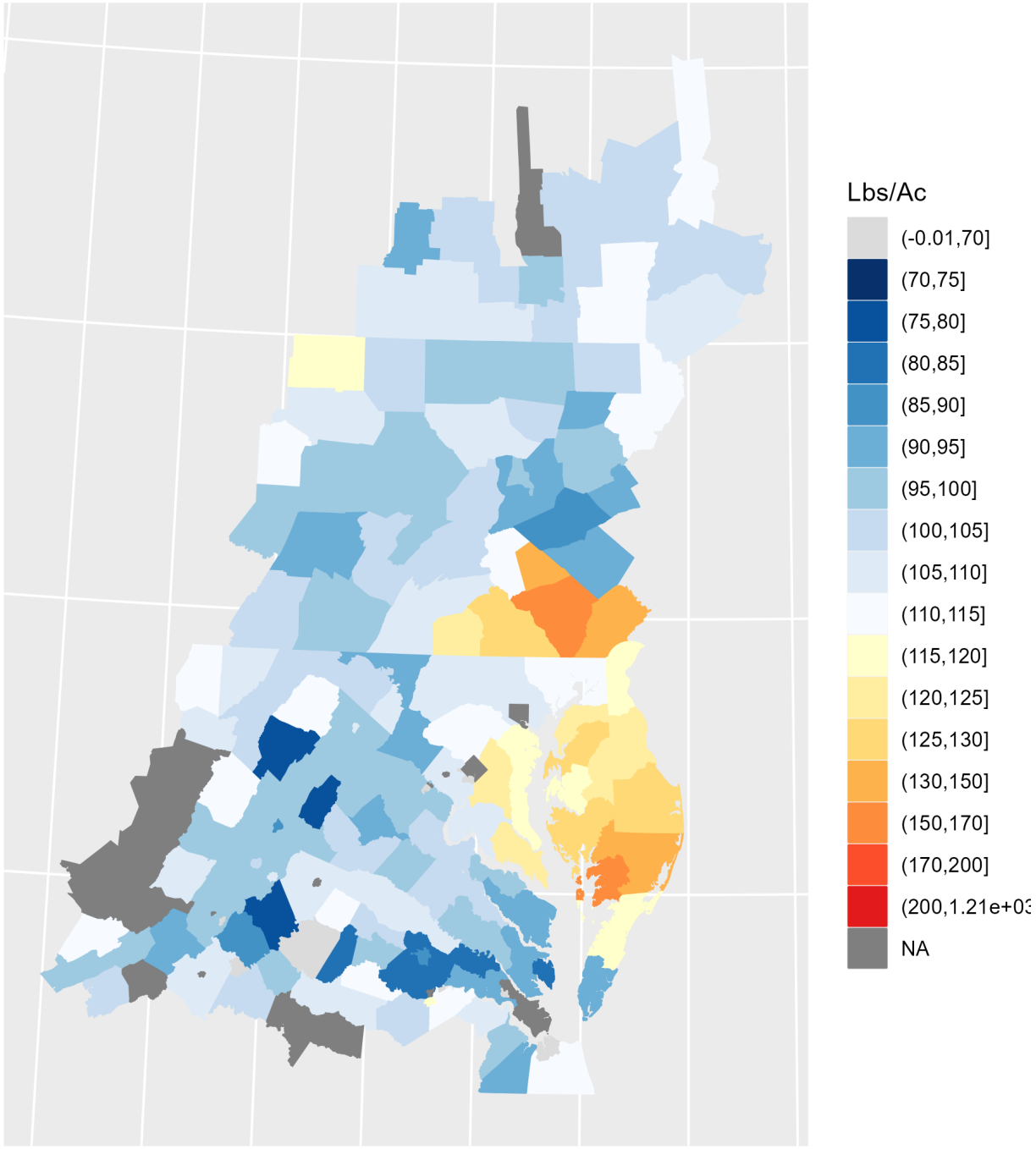
C23 Grain without Manure 2000



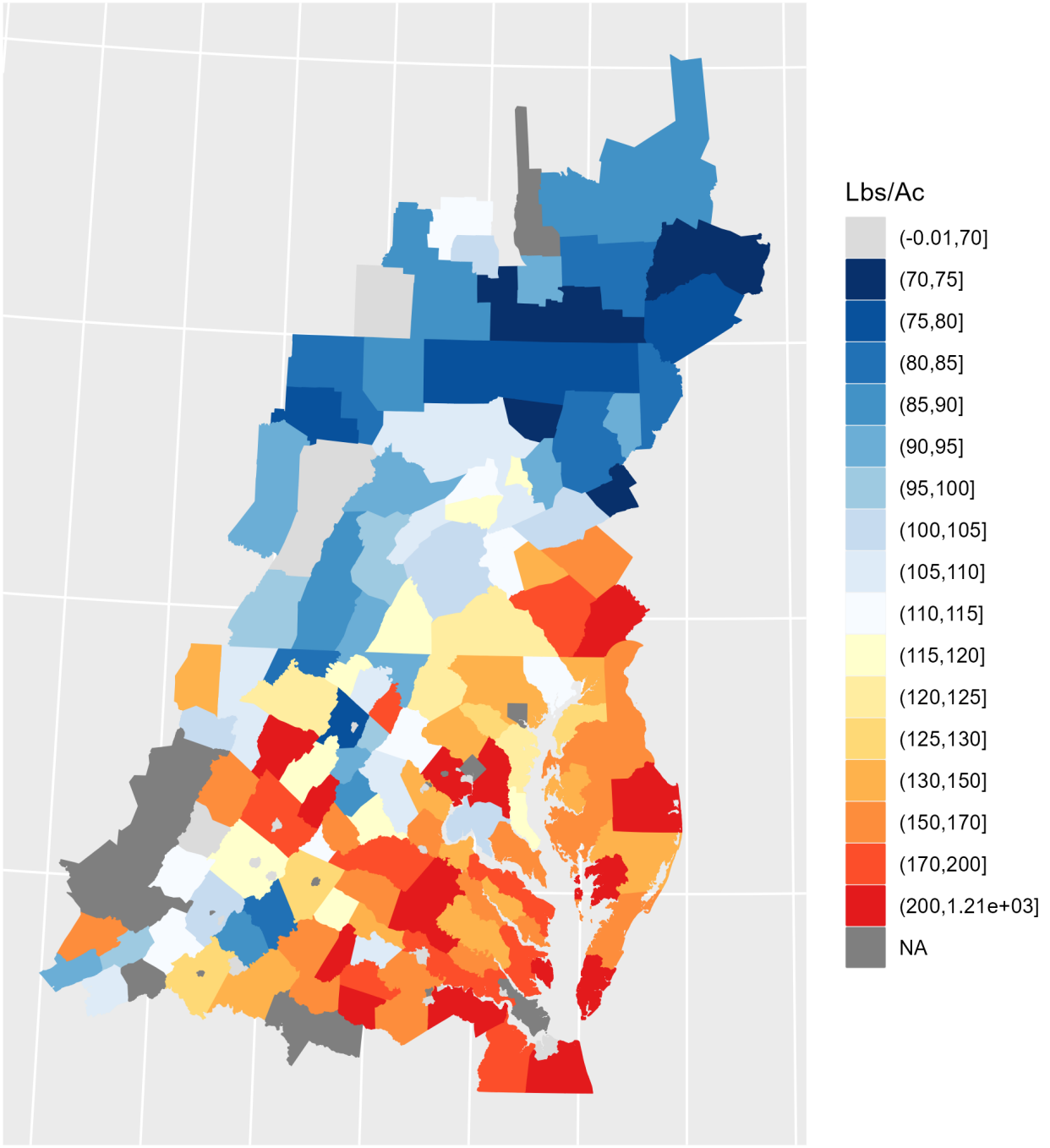
TrendN Grain without Manure 2000



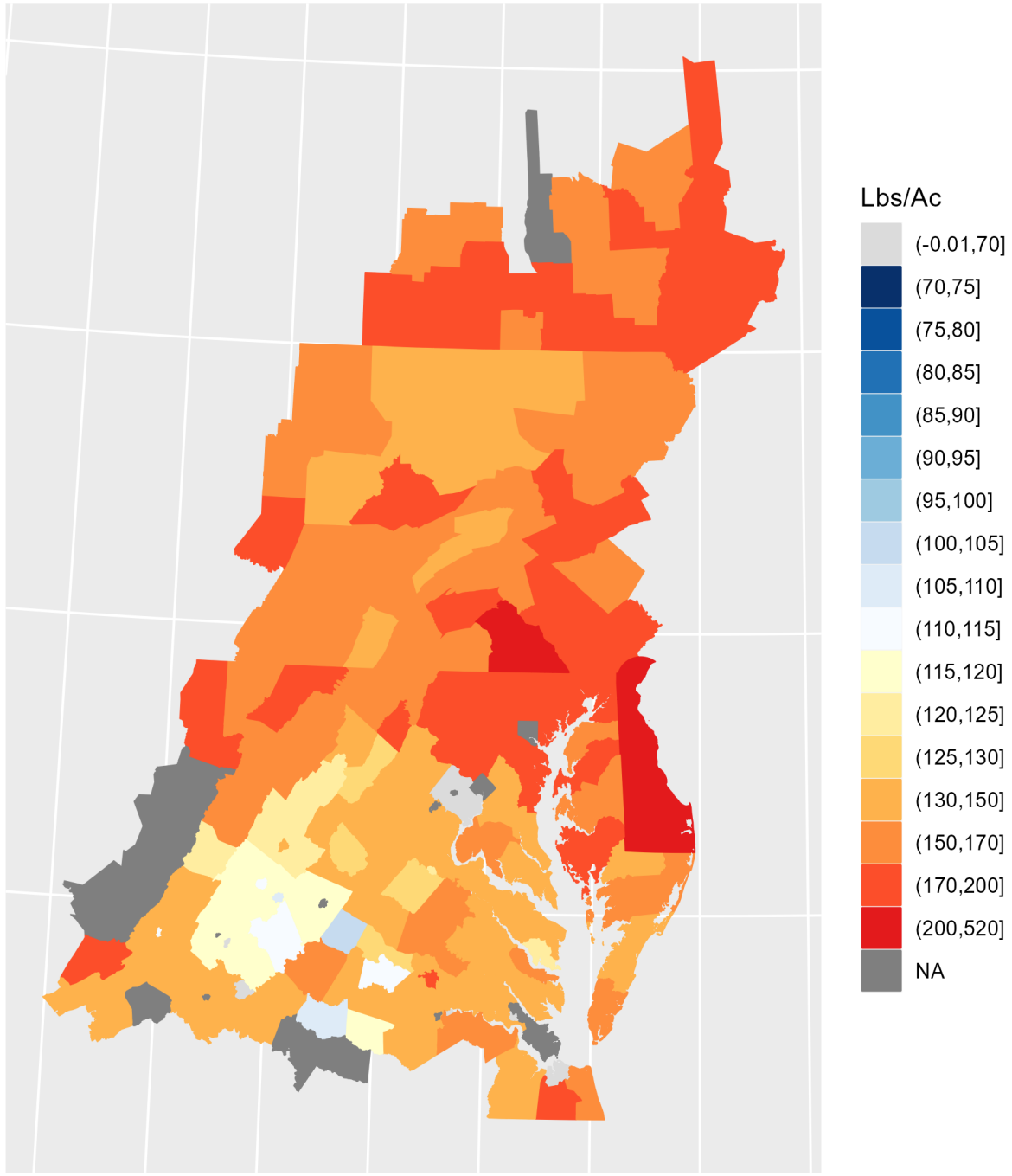
C23 Grain without Manure 2009



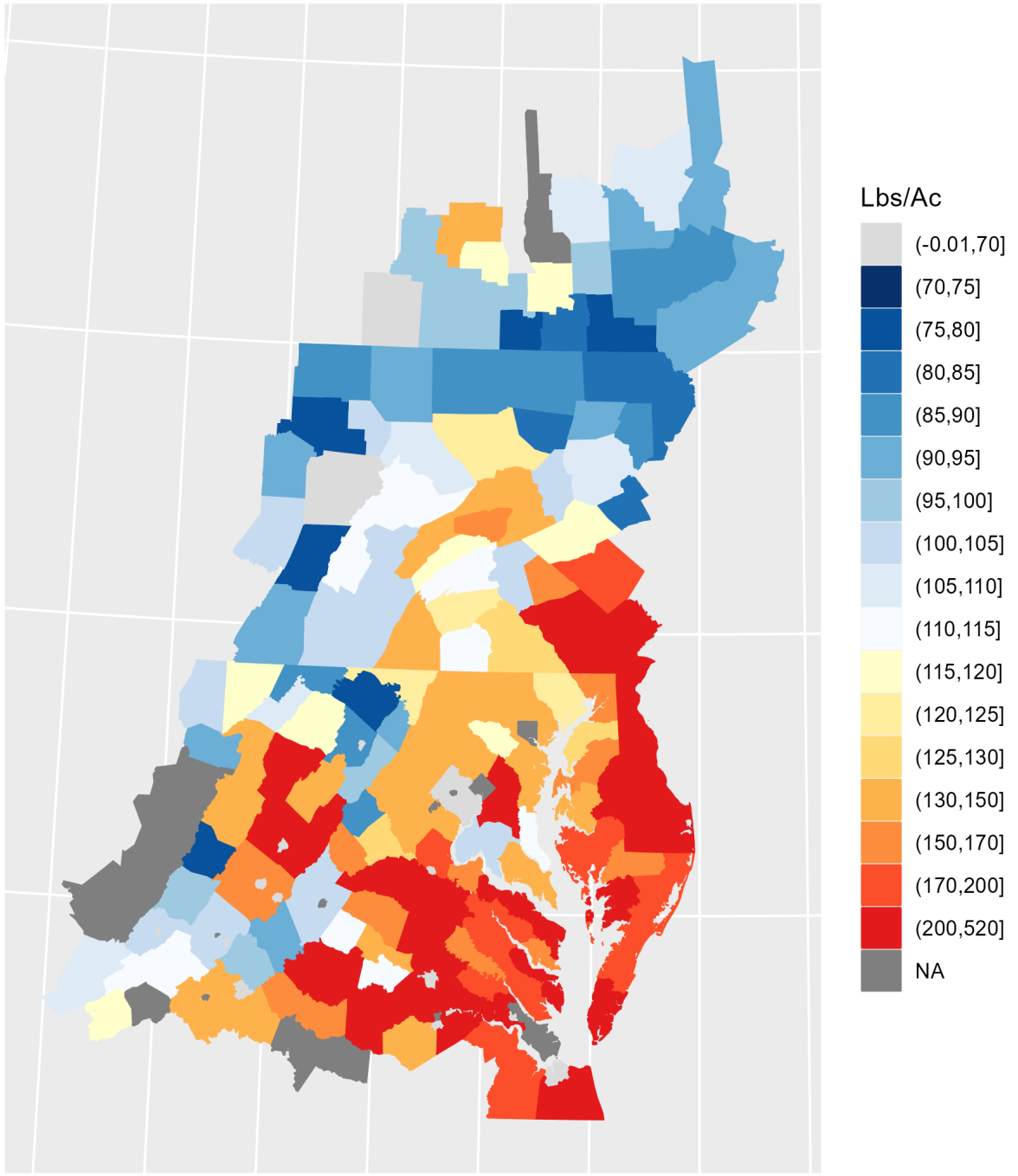
TrendN Grain without Manure 2009



C23 Grain without Manure 2017



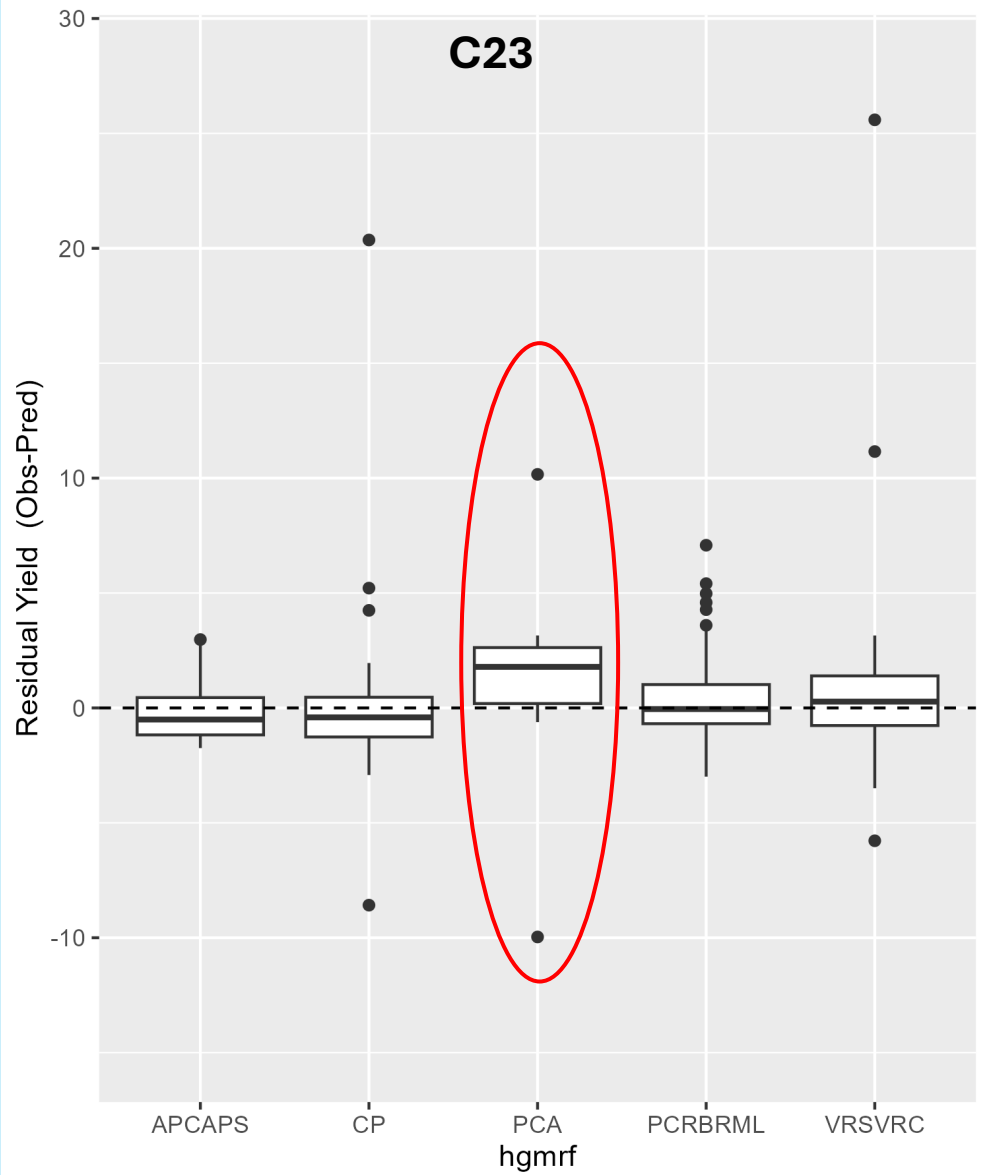
TrendN Grain without Manure 2017

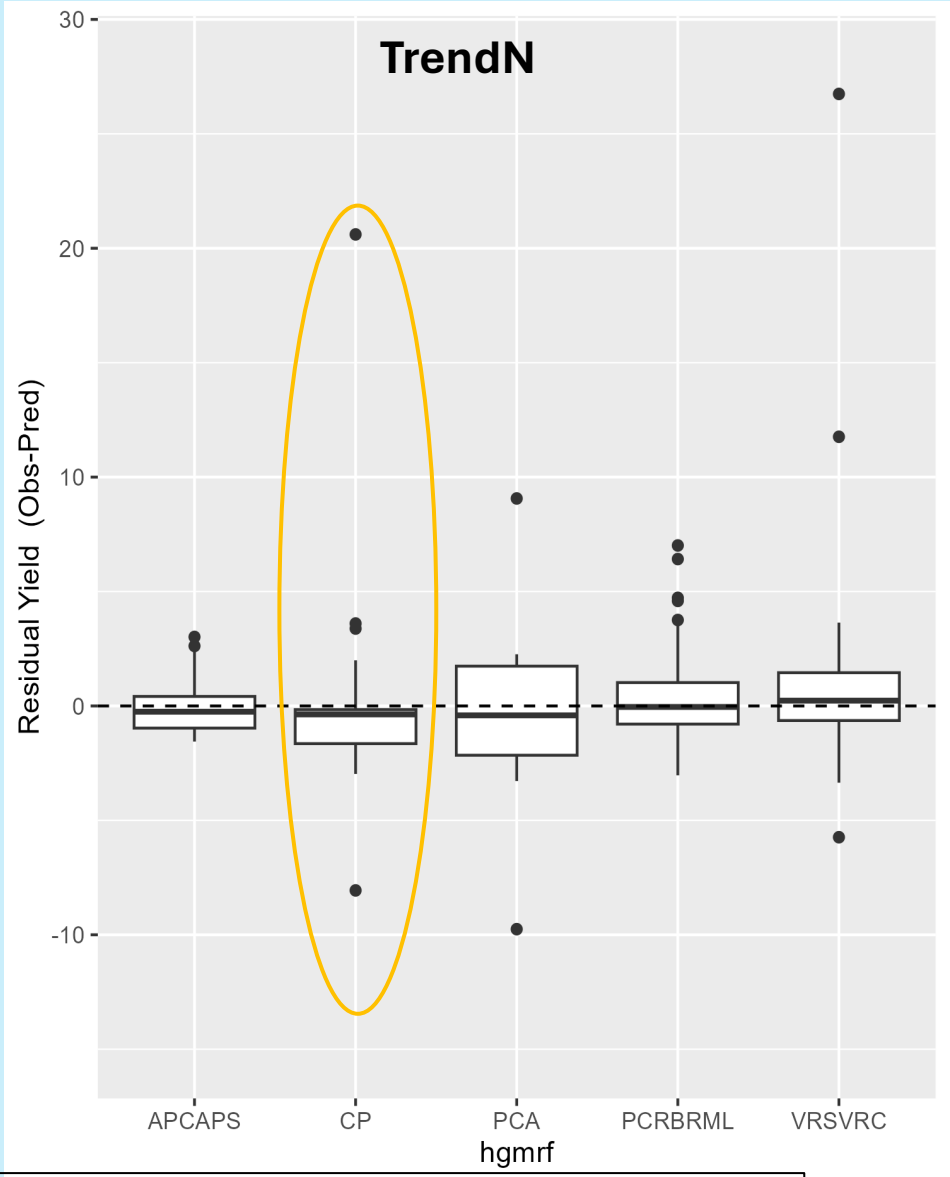


Results

APCAPS:	Appalachian Plateau Carbonate, Appalachian Plateau Siliciclastic	38 stations
CP:	Coastal Plain	21 stations
PCA:	Piedmont Carbonate	7 stations
PCRBRML:	Piedmont Crystalline, Blue Ridge, Mesozoic Lowland	74 stations
VRSVRC:	Valley and Ridge Carbonate, Valley and Ridge Siliciclastic	66 stations

Distribution of residual yield (lbs/ac) by hydrogeomorphic region





- C23 tends to underpredict fertilizer N load in the Piedmont
- TrendN tends to slightly overpredict fertilizer N load in the Coast Plain

Another bonus of CalCAST: seeing the math

- CalCAST looks to change coefficients to statistically find the optimal parameters
- If two data sets are similar these coefficients will not substantially change
  - What did the results of CalCAST show us?

Coefficent	Cast 23 estimated mean (95% confidence Interval)	Trend N estimated mean (95% Confidence Interval)
watershed-wide average crop loading rate (lbs/ac)	40.07 (38.14-42.01)	39.43 (37.49-41.29)
land-to-water coefficient for groundwater recharge	0.61 (0.54-0.67)	0.66 (0.60-0.72)
land-to-water coefficient for % carbonate lithology	0.23 (0.07-0.39)	0.31 (0.13-0.54)
land-to-water coefficient for soil K-factor	0.8 (0.70-0.88)	0.83 (0.73-0.94)
land-to-water coefficient for density of small streams	-0.36 [(-0.55)-(-0.14)]	-0.58 [(-0.76)-(-0.39)]

General Takeaways:

- Applications:
  - On average the Trend dataset has higher applications in the southern jurisdictions
  - Increased variation between counties
- Load prediction
  - CAST 23 underpredicts N load in the piedmont carbonate
  - TREND overpredicts N load in the coastal plain
- In the end there is no clear “winner”

What does this mean for us?

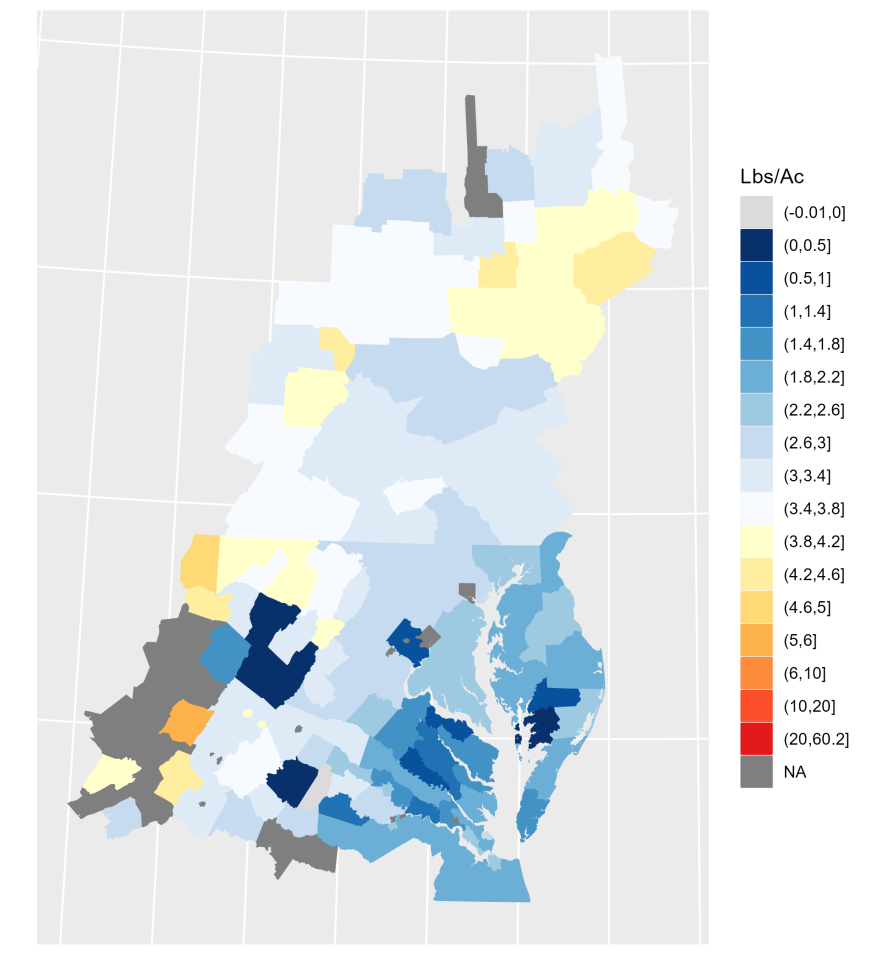
- The overall dataset can have a large impact on the distribution of fertilizer
  - Compounded by potential changes in scale
- We should keep looking at different fertilizer datasets

Questions?

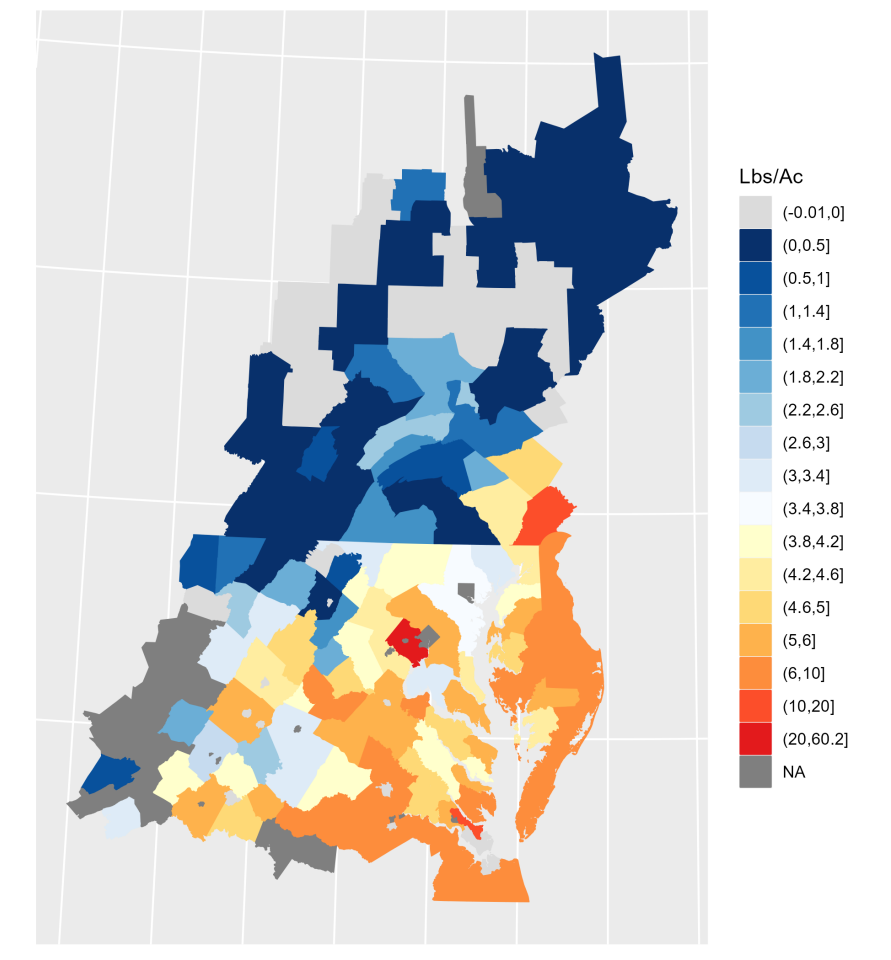
Additional visualizations

Full Season Soybeans

C23

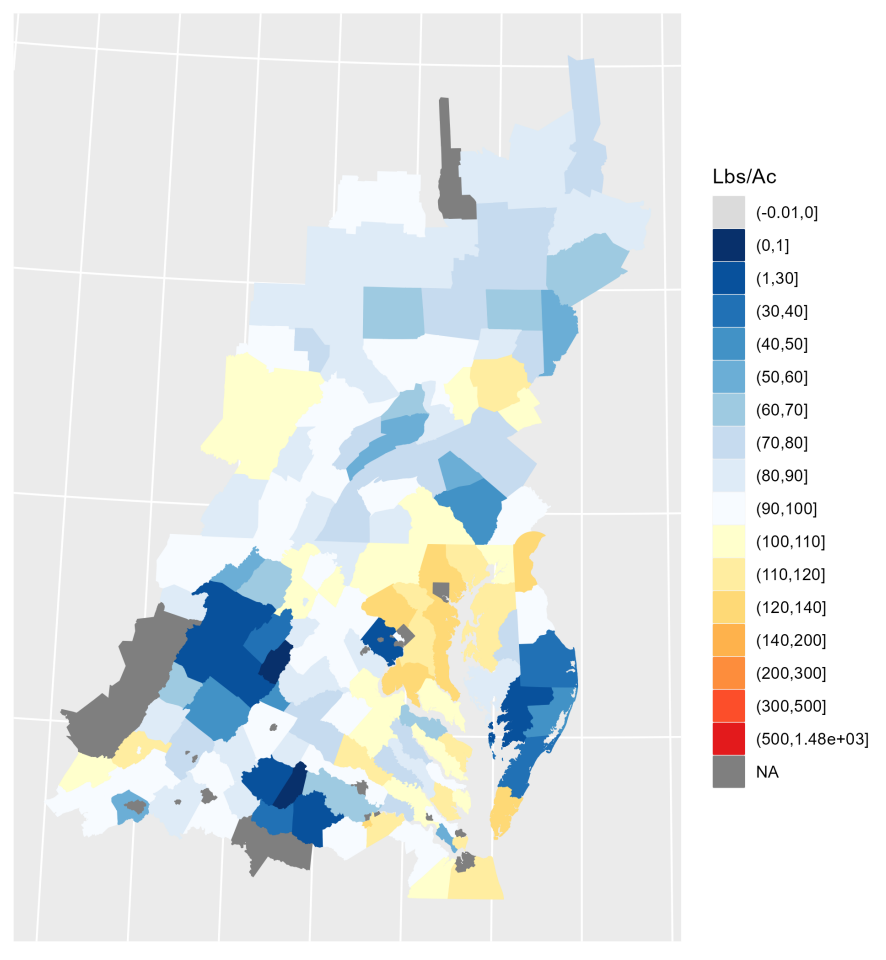


TrendN

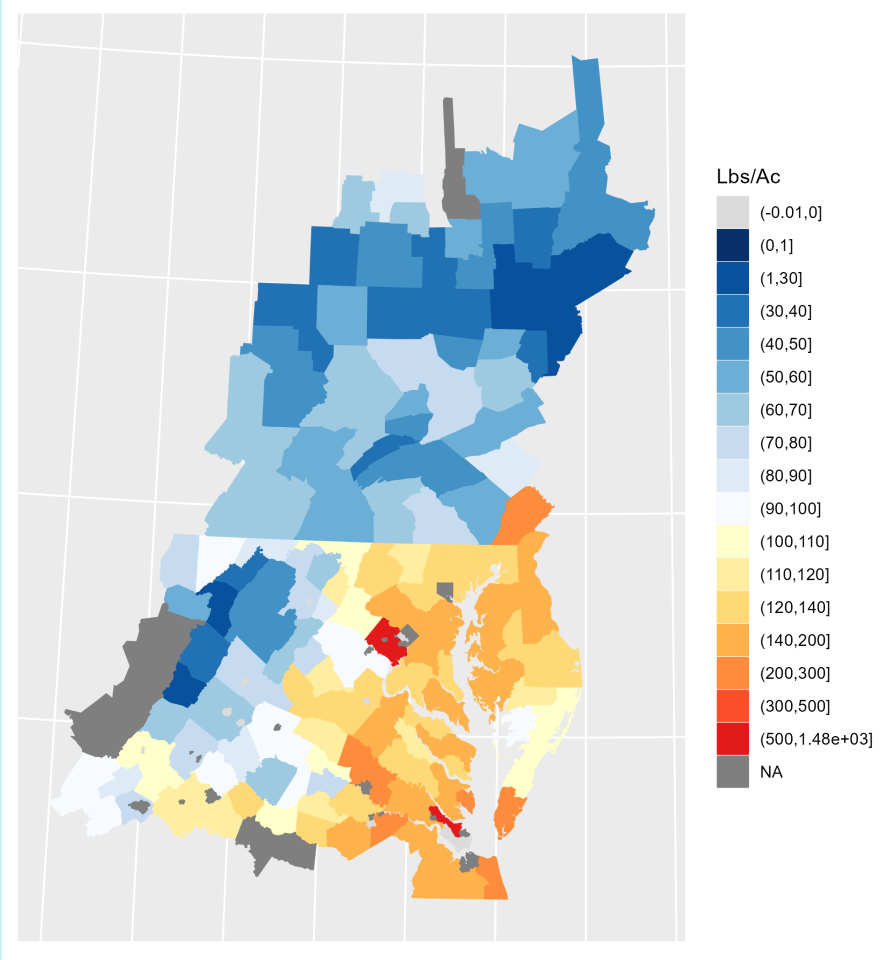


Grain With Manure

C23



TrendN




Grain with Manure
Grain without Manure
1.6e+08
1.2e+08
8.0e+07
Fertilizer Applied (lbs)
1990
2000
2010
Year
Dataset
C23
TrendN