AMT Fertilizer

12/12/2025

Tom Butler, EPA

November Action items

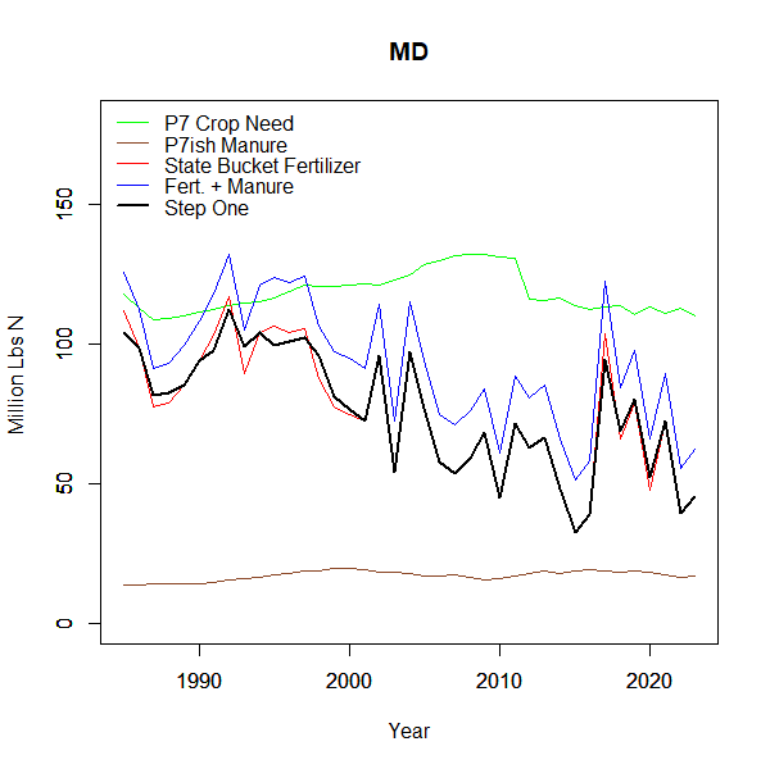
1) **Examine potential data collection changes in states**
2) **Add manure to smoother fertilizer and crop need figures**
    1) **Examine projection method for non reporting jurisdictions**
3) **Dig deeper into Delaware fertilizer data behavior**
4) **Supply County Level crop need data**
5) **Compare national and Chesapeake watershed scale fertilizer and crop data trends**
6) Compare Hillandale Populations vs CAFO permit numbers

Yellow Highlight = decisional item

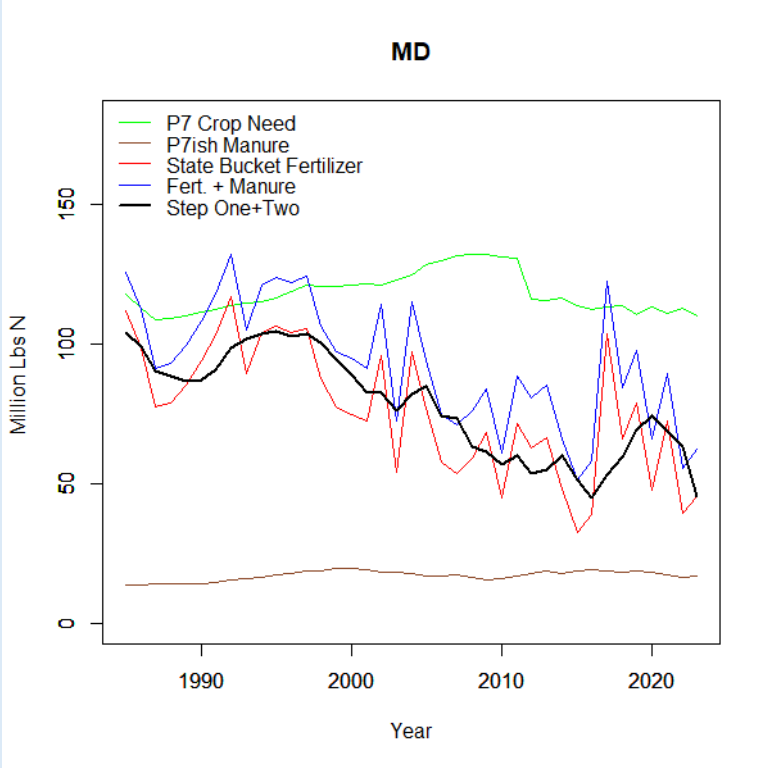
Item 1 Reach out to state chemists

- **<u>KEY TAKEAWAY:</u> CURRENT DATA ARE CORRECT**
- Pennsylvania Fertilizer Sales tonnage vs AAPFCO
  - Concerned that a change in data reporting caused an underreporting of NPK between 2007 - 2014.
- Discovered there are multiple reports of AAPFCO data
  - Book release (generalized)
  - Purchased reports (specific)
- Confirmed no collection concerns
  - DE, MD, VA
- No responses were taken to mean data were correct

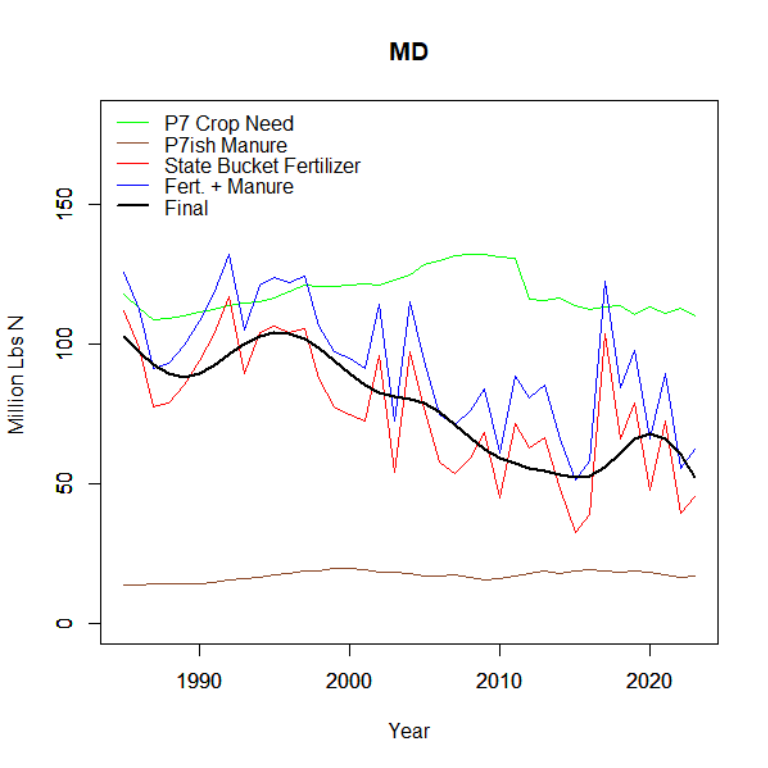
Item 2 Plot manure with crop need and smoothed fertilizer: How it works



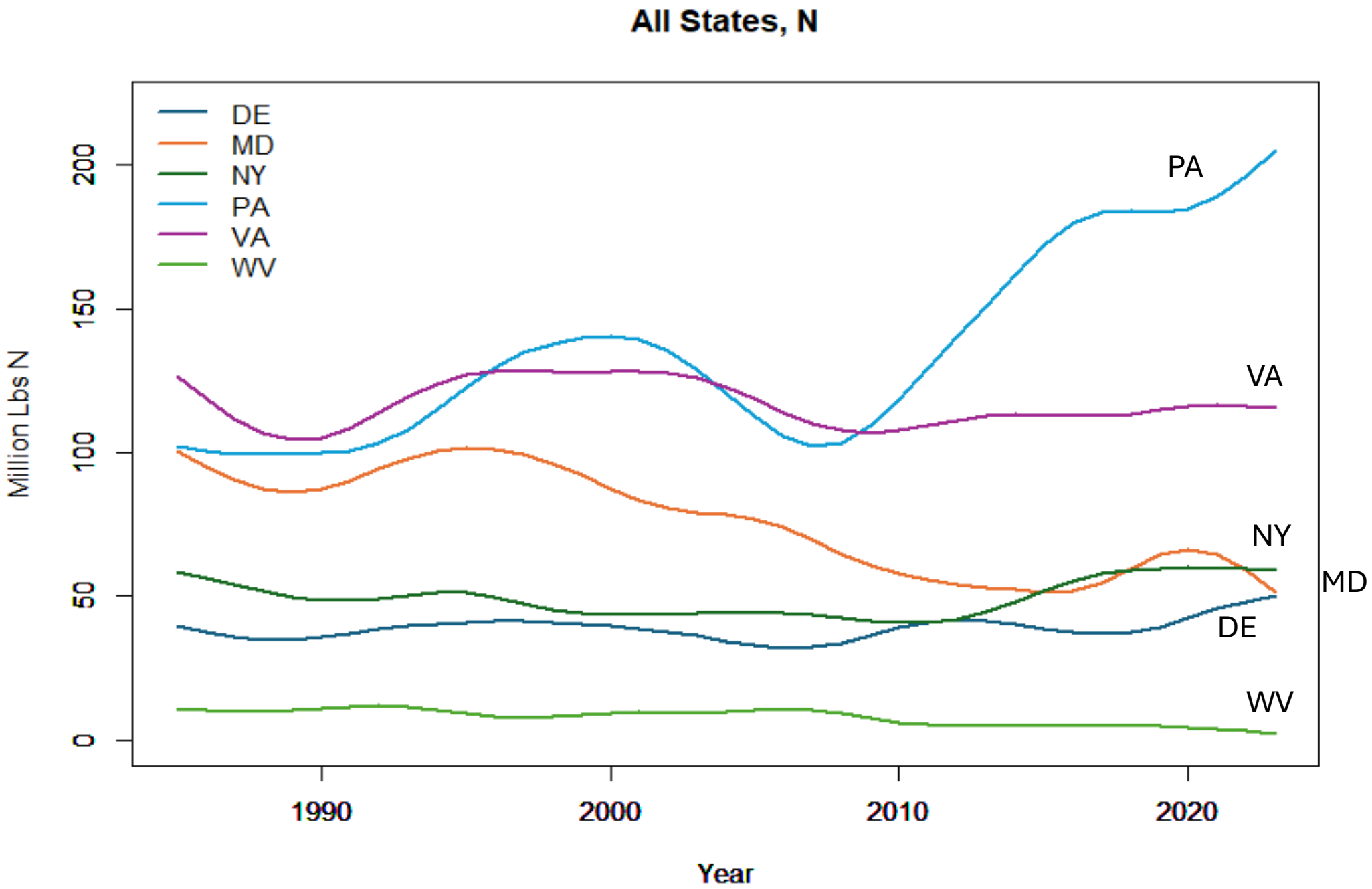
Step one: Redistributes fertilizer from years of surplus to years of deficit within a 4-year window. Surplus now defined including estimated manure PAN.

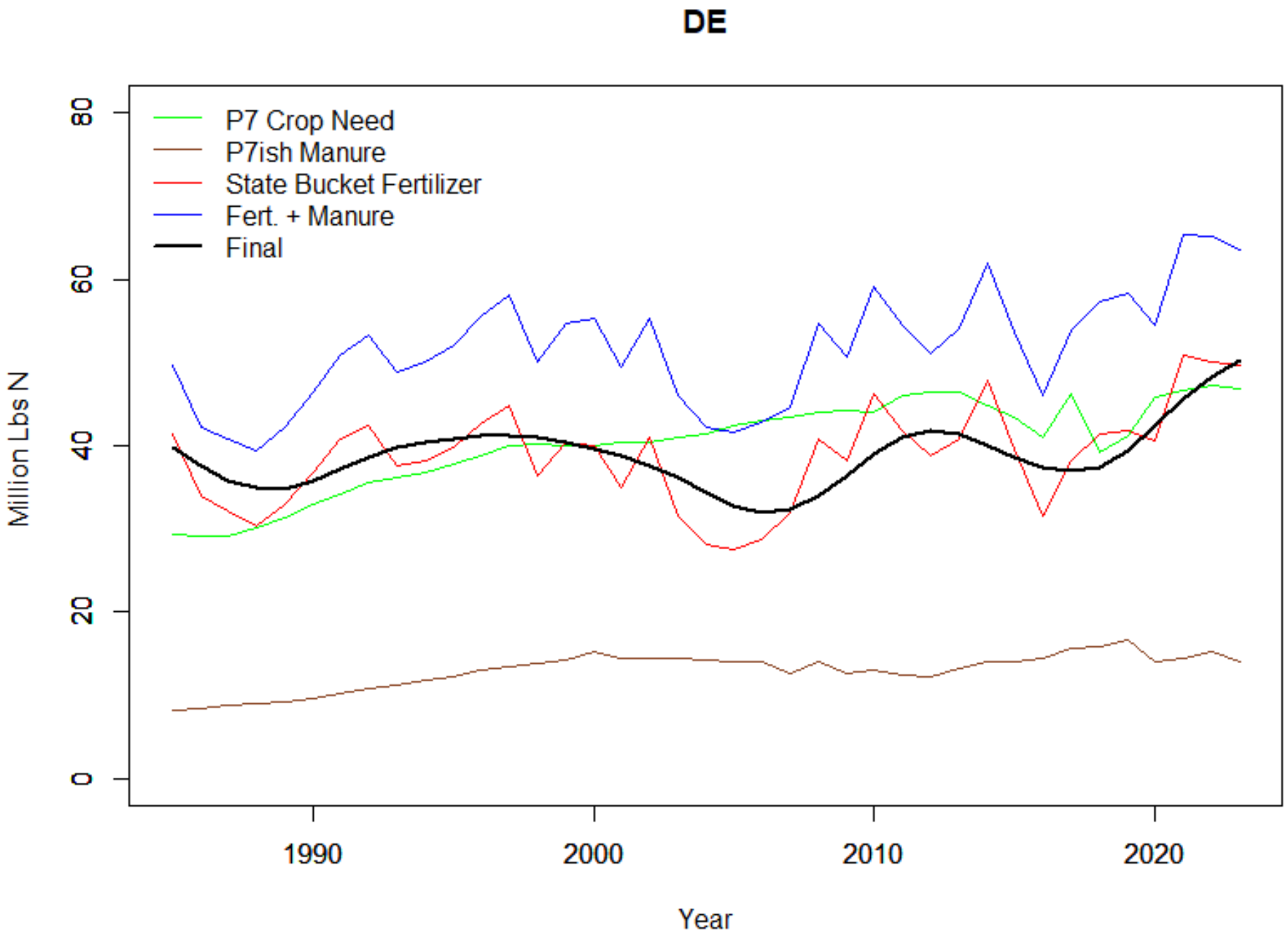


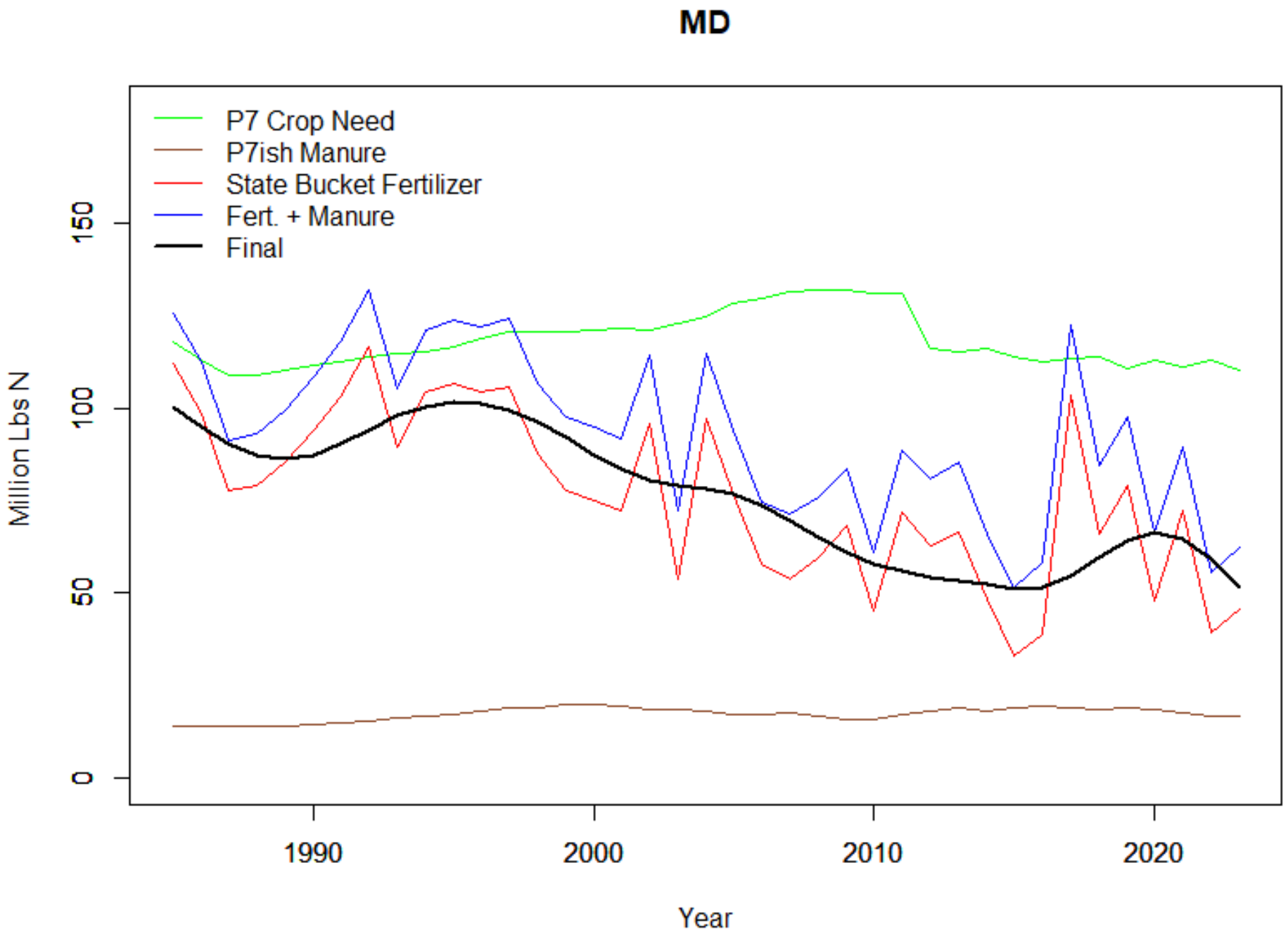
Step two: Redistributes fertilizer based on crop need within a forward looking 4-year window.

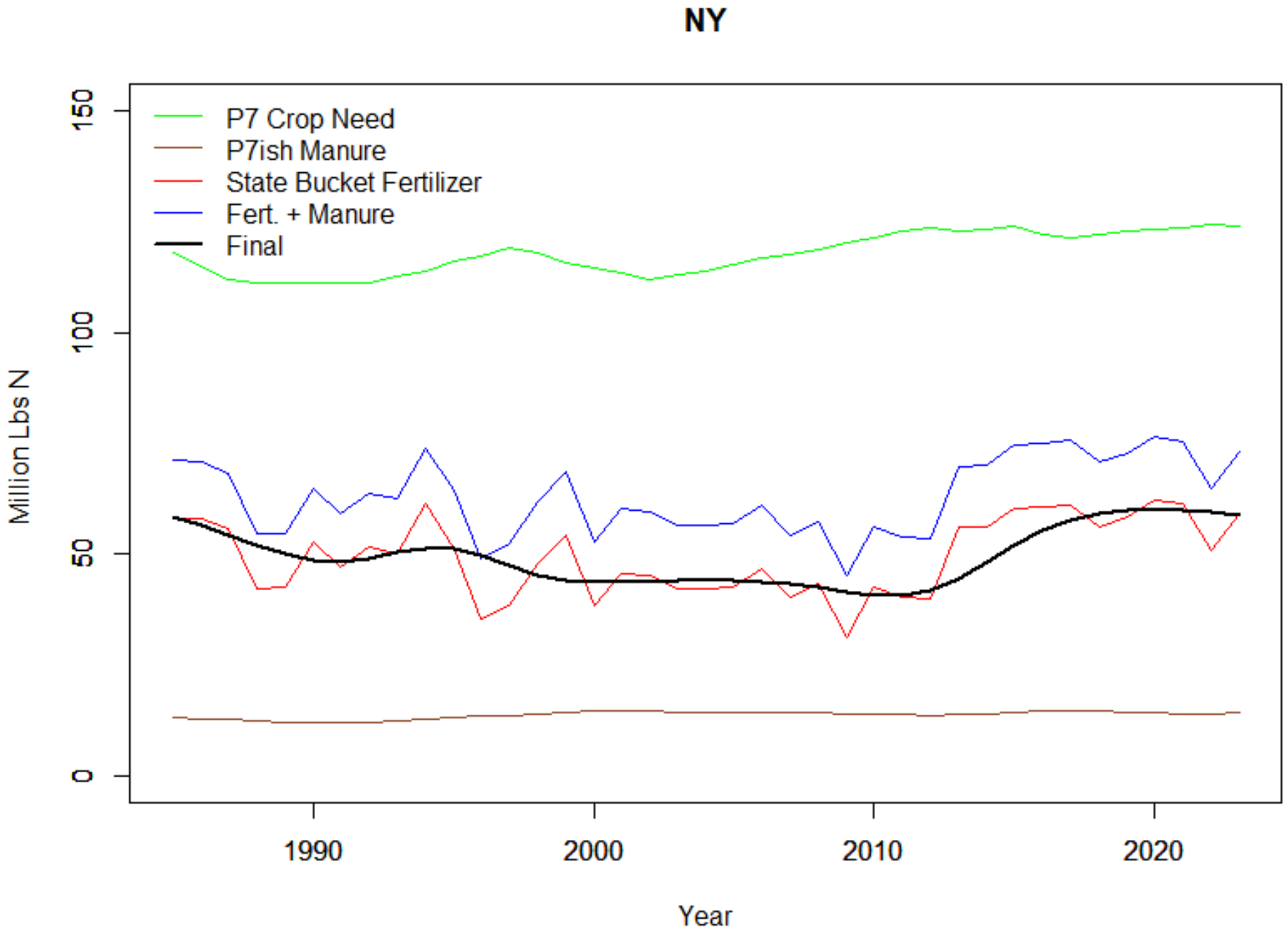


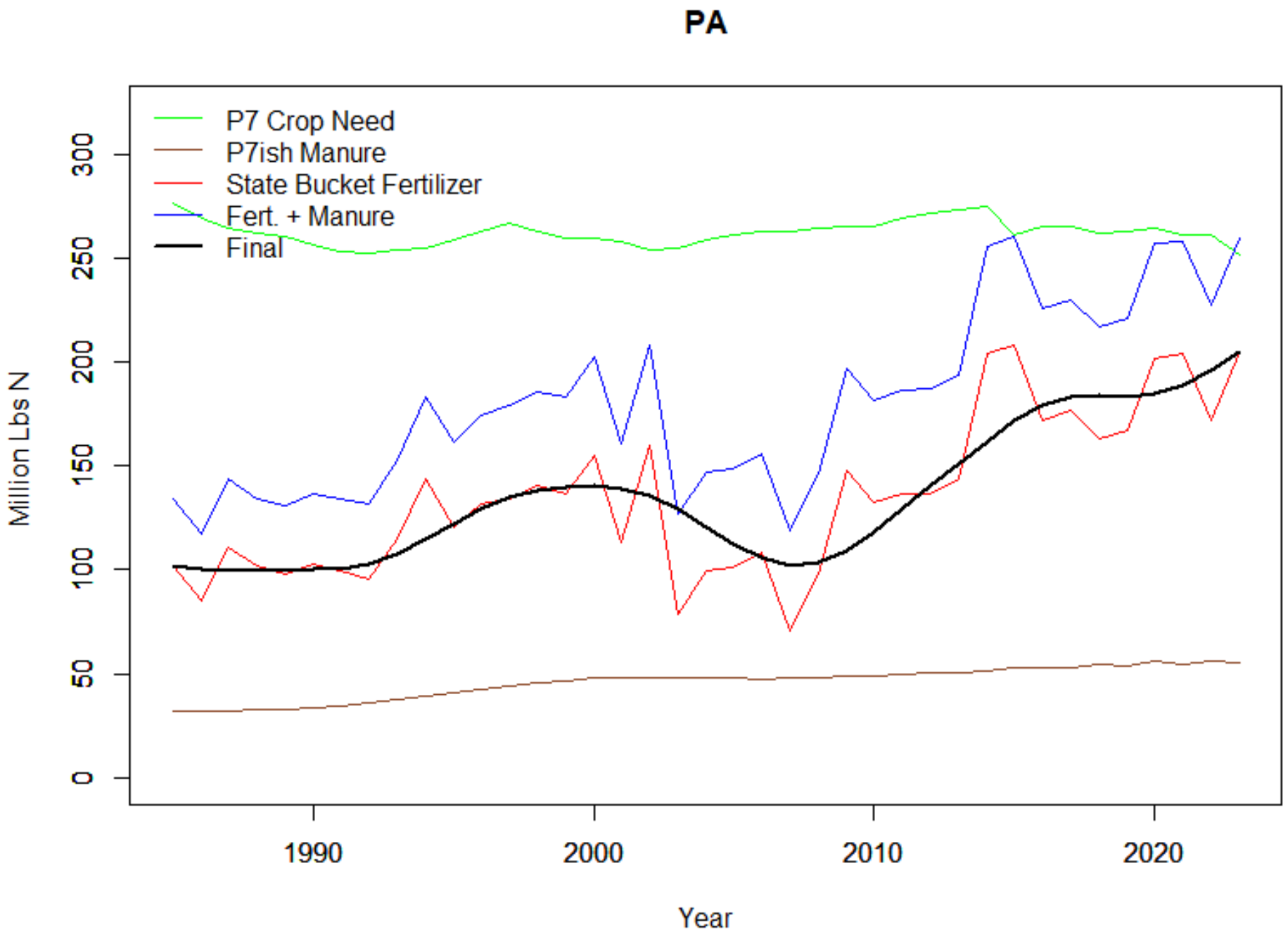
Step three: Uses a spline to provide additional arbitrary smoothing.

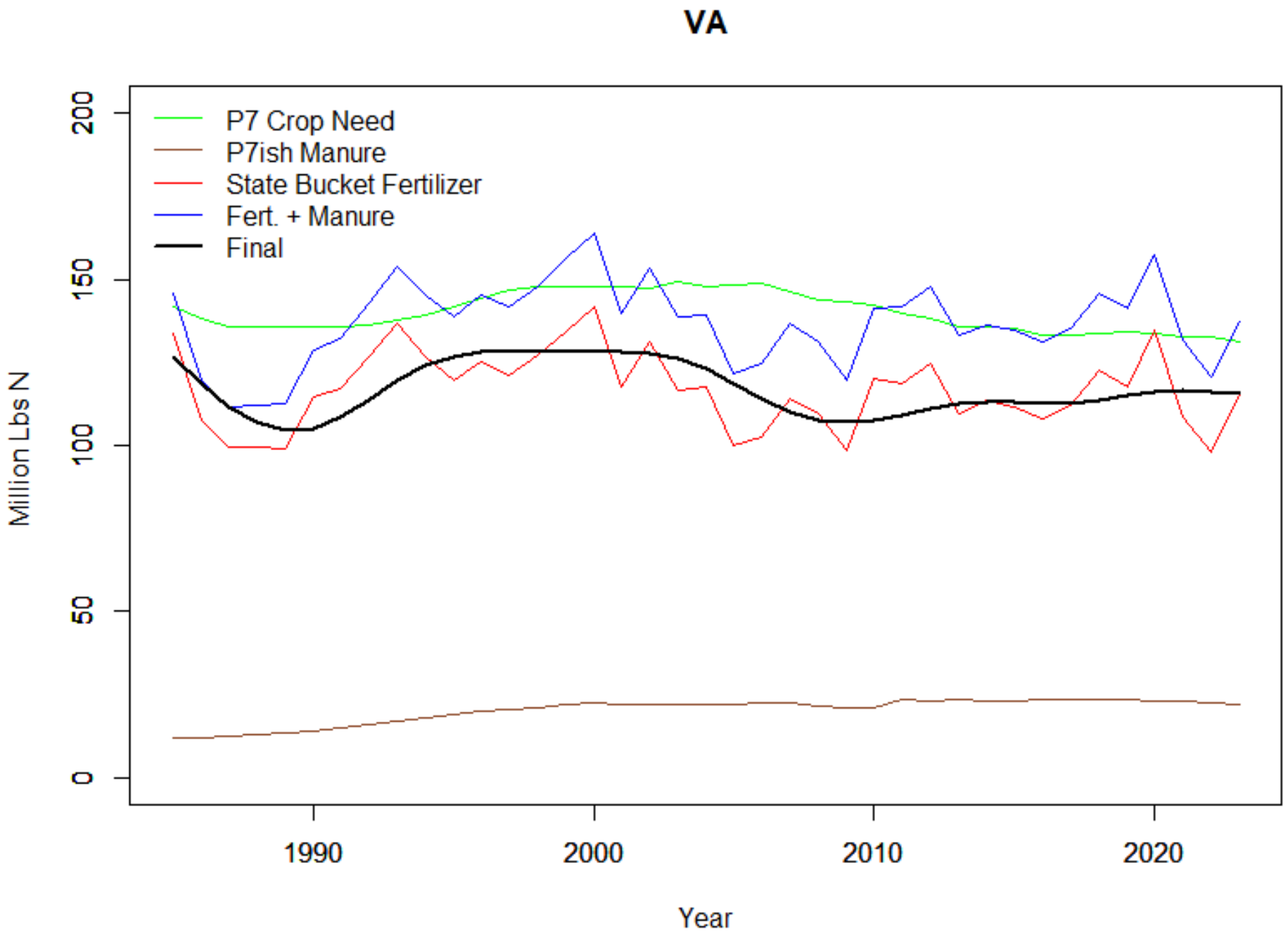

All States, N
DE
MD
NY
PA
VA
WV
Million Lbs N
0
50
100
150
200
1990
2000
2010
2020
Year
PA
VA
NY
MD
DE
WV

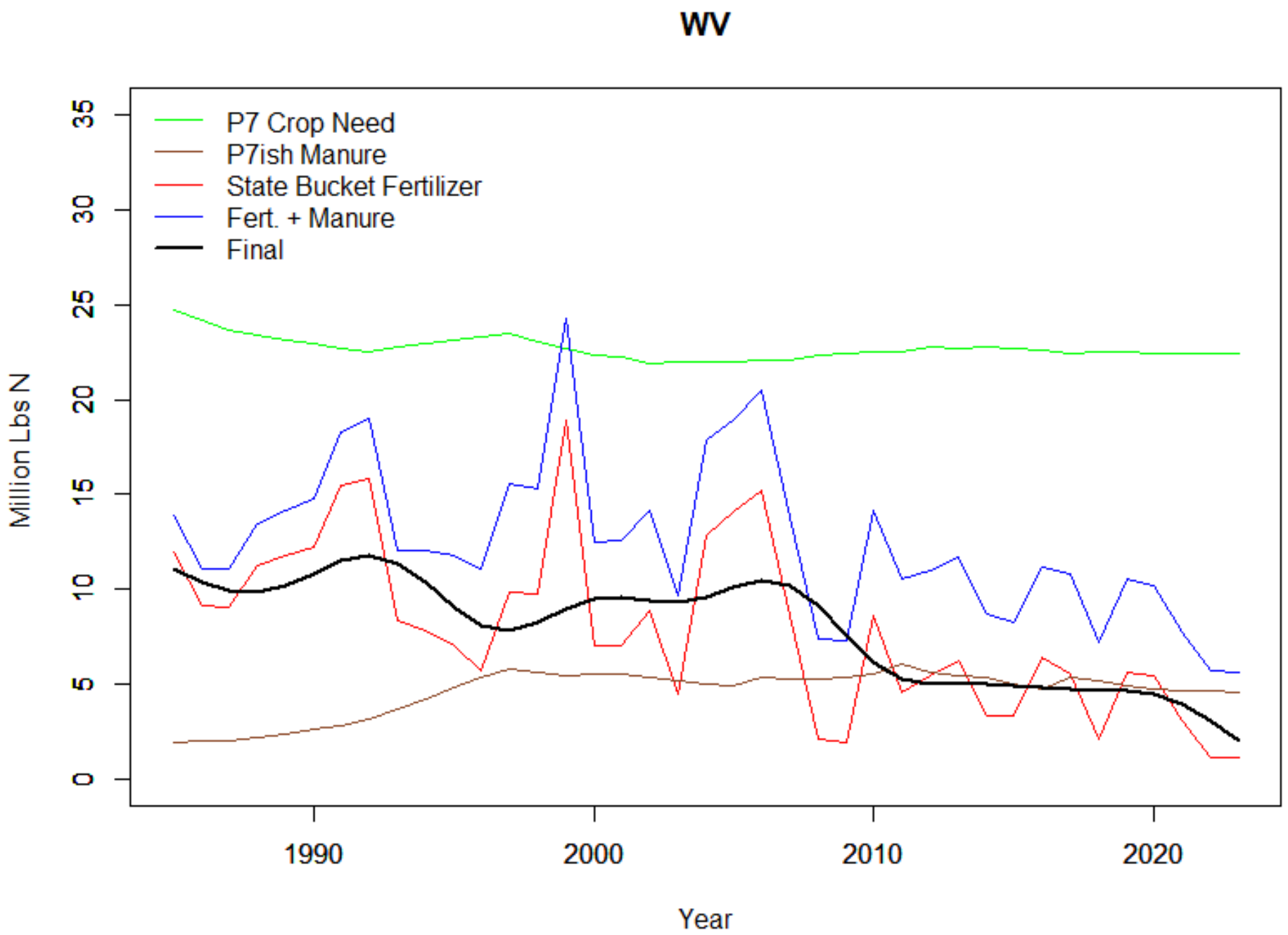

DE
P7 Crop Need
P7ish Manure
State Bucket Fertilizer
Fert. + Manure
Final
Million Lbs N
0
20
40
60
80
1990
2000
2010
2020
Year


MD
P7 Crop Need
P7ish Manure
State Bucket Fertilizer
Fert. + Manure
Final
Million Lbs N
0
50
100
150
1990
2000
2010
2020
Year


NY
P7 Crop Need
P7ish Manure
State Bucket Fertilizer
Fert. + Manure
Final
Million Lbs N
0
50
100
150
1990
2000
2010
2020
Year


PA
P7 Crop Need
P7ish Manure
State Bucket Fertilizer
Fert. + Manure
Final
Million Lbs N
0
50
100
150
200
250
300
1990
2000
2010
2020
Year

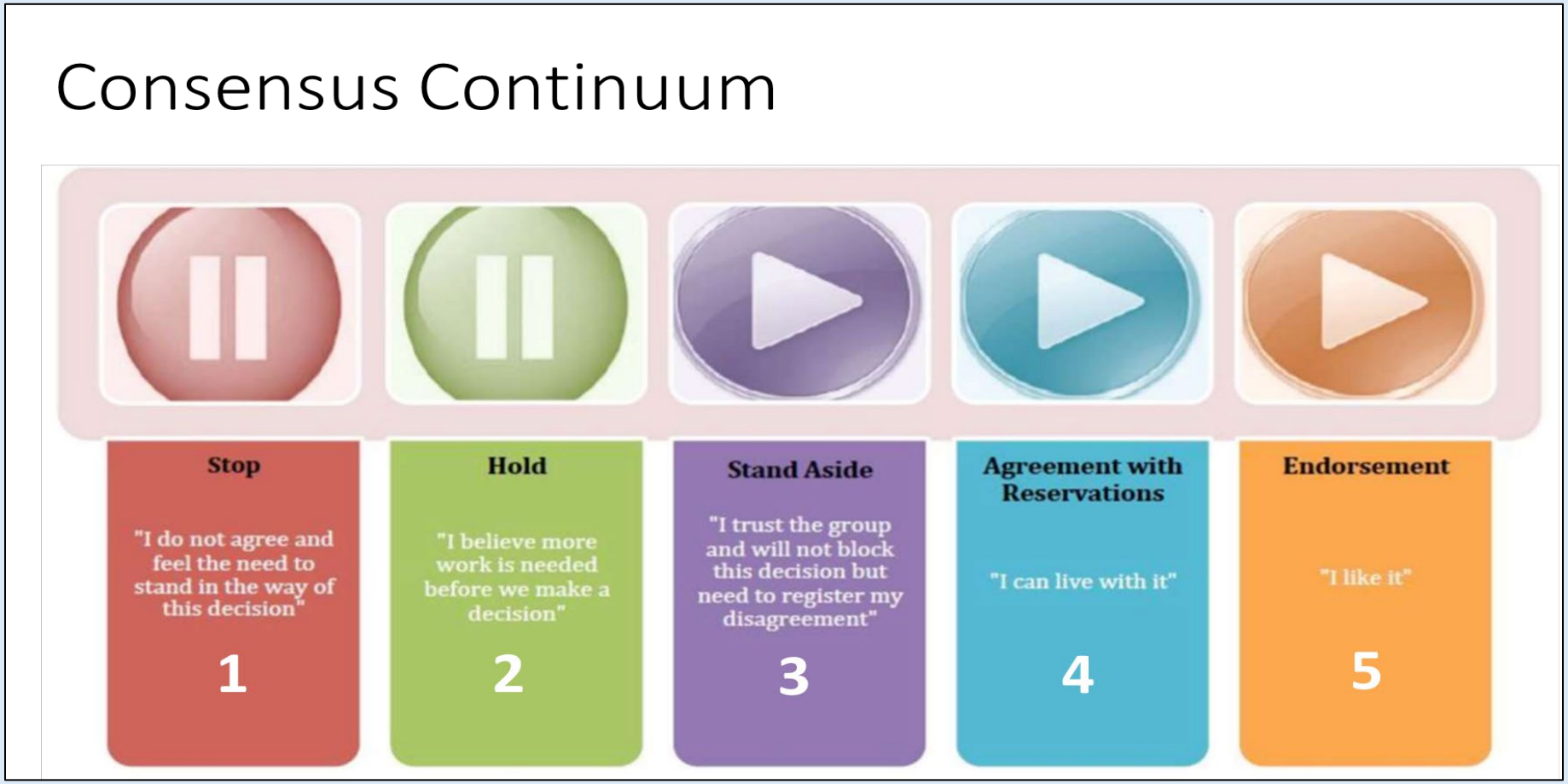

VA
P7 Crop Need
P7ish Manure
State Bucket Fertilizer
Fert. + Manure
Final
Million Lbs N
0
50
100
150
200
1990
2000
2010
2020
Year


WV
P7 Crop Need
P7ish Manure
State Bucket Fertilizer
Fert. + Manure
Final
Million Lbs N
0
5
10
15
20
25
30
35
1990
2000
2010
2020
Year

Questions?

Decision Proposal

- We should utilize the provided fertilizer data smoothing methodology for Phase 7.
  - State specific based on crop need, a four-year stockpiling window tied to crop need with a spline added.



Item 2.b Project fertilizer for states not reporting data

Option 1

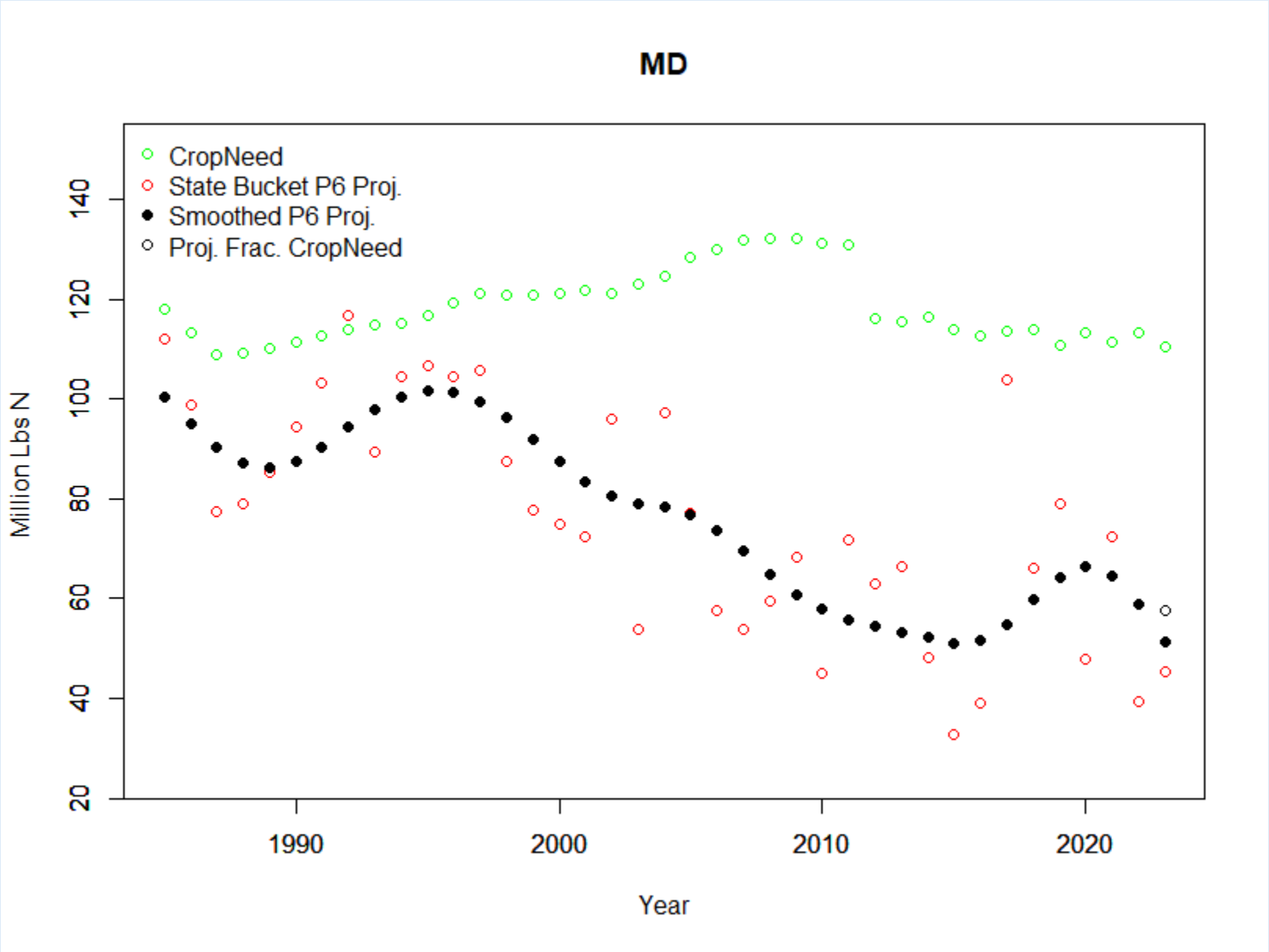
- Tied to the **last year** of known data

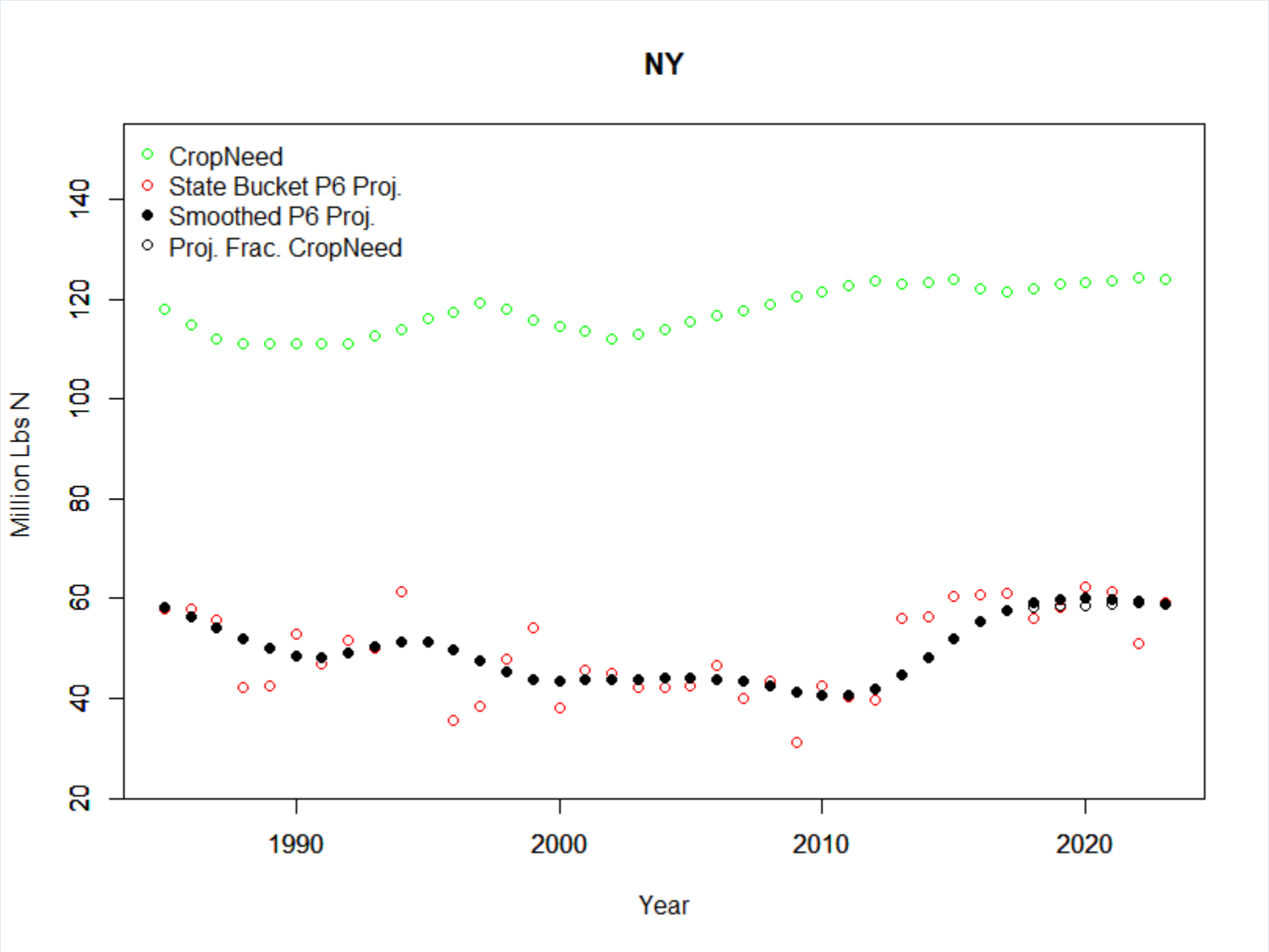
Option 2

- Tied to an **average of the last three years** of crop need

Option 1

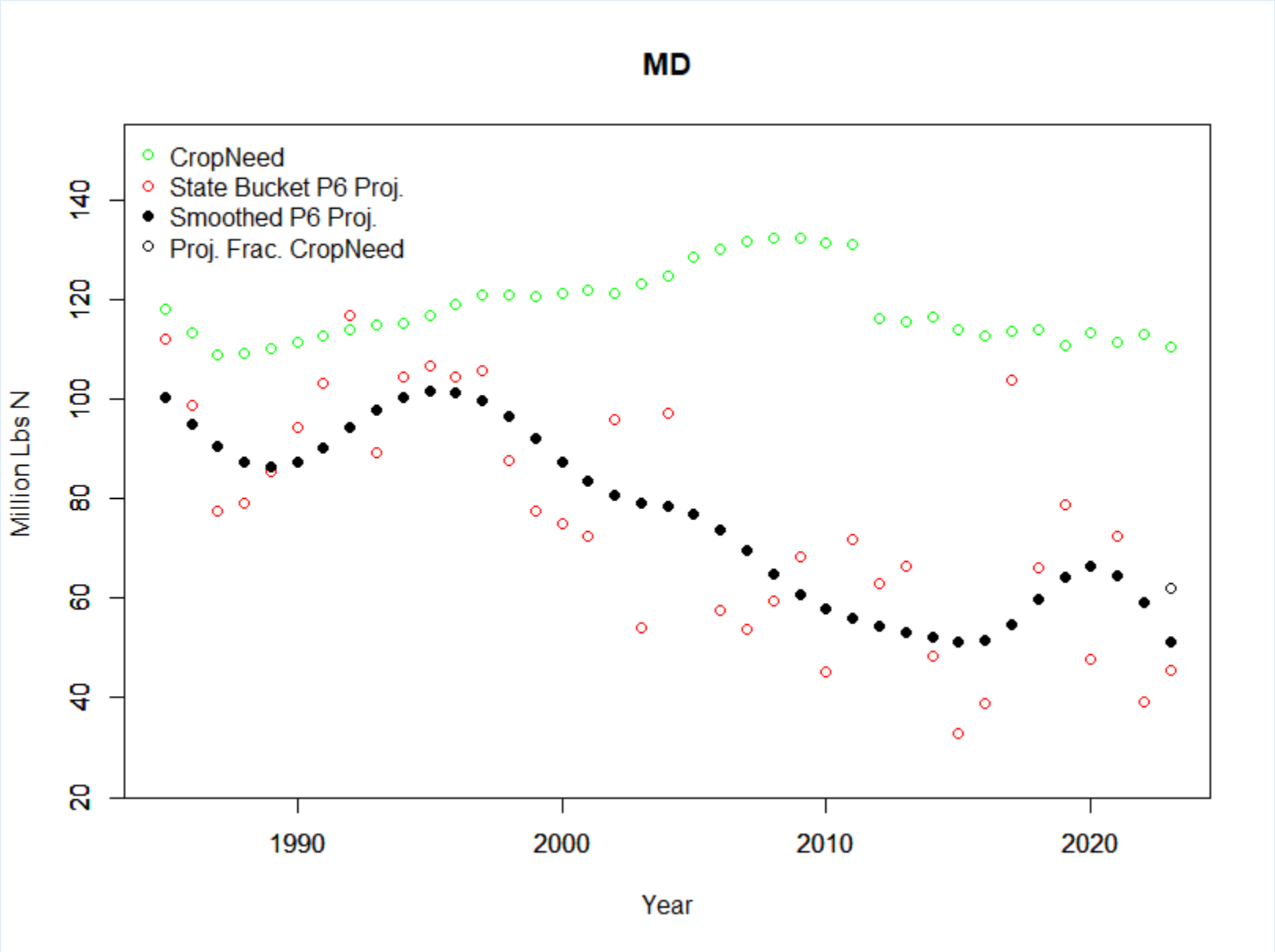
- Ties states fertilizer usage to crop need
  - Based on the last known year with BOTH fertilizer AND yields
    - Calculate the amount of crop need (application goal) that is satisfied with known fertilizer
      - Extrapolate into years with no known fertilizer but a known yield.
- Retains the ability of the states to keep fertilizer independent and tied to their own behavior

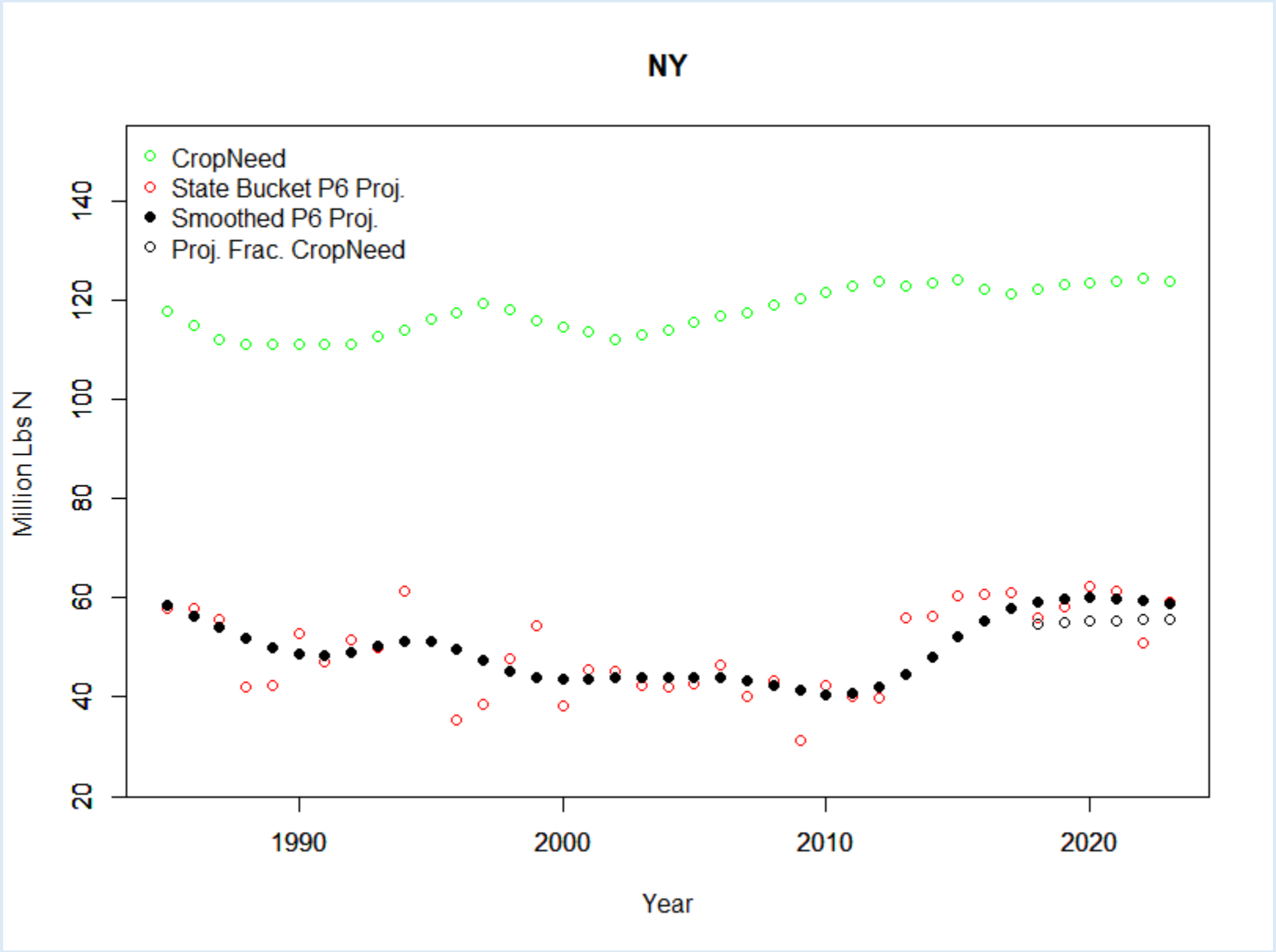

MD
CropNeed
State Bucket P6 Proj.
Smoothed P6 Proj.
Proj. Frac. CropNeed
Million Lbs N
20
40
60
80
100
120
140
1990
2000
2010
2020
Year


NY
CropNeed
State Bucket P6 Proj.
Smoothed P6 Proj.
Proj. Frac. CropNeed
Million Lbs N
20
40
60
80
100
120
140
1990
2000
2010
2020
Year

Option 2

- Average the fraction of crop need (application goal) met over the last three years
- Ties states fertilizer usage to crop need
  - Based on the last known year with BOTH fertilizer AND yields
    - Calculate the amount of crop need (application goal) that is satisfied with known fertilizer
      - Extrapolate into years with no known fertilizer but a known yield.
- Retains the ability of the states to keep fertilizer independent and tied to their own behavior

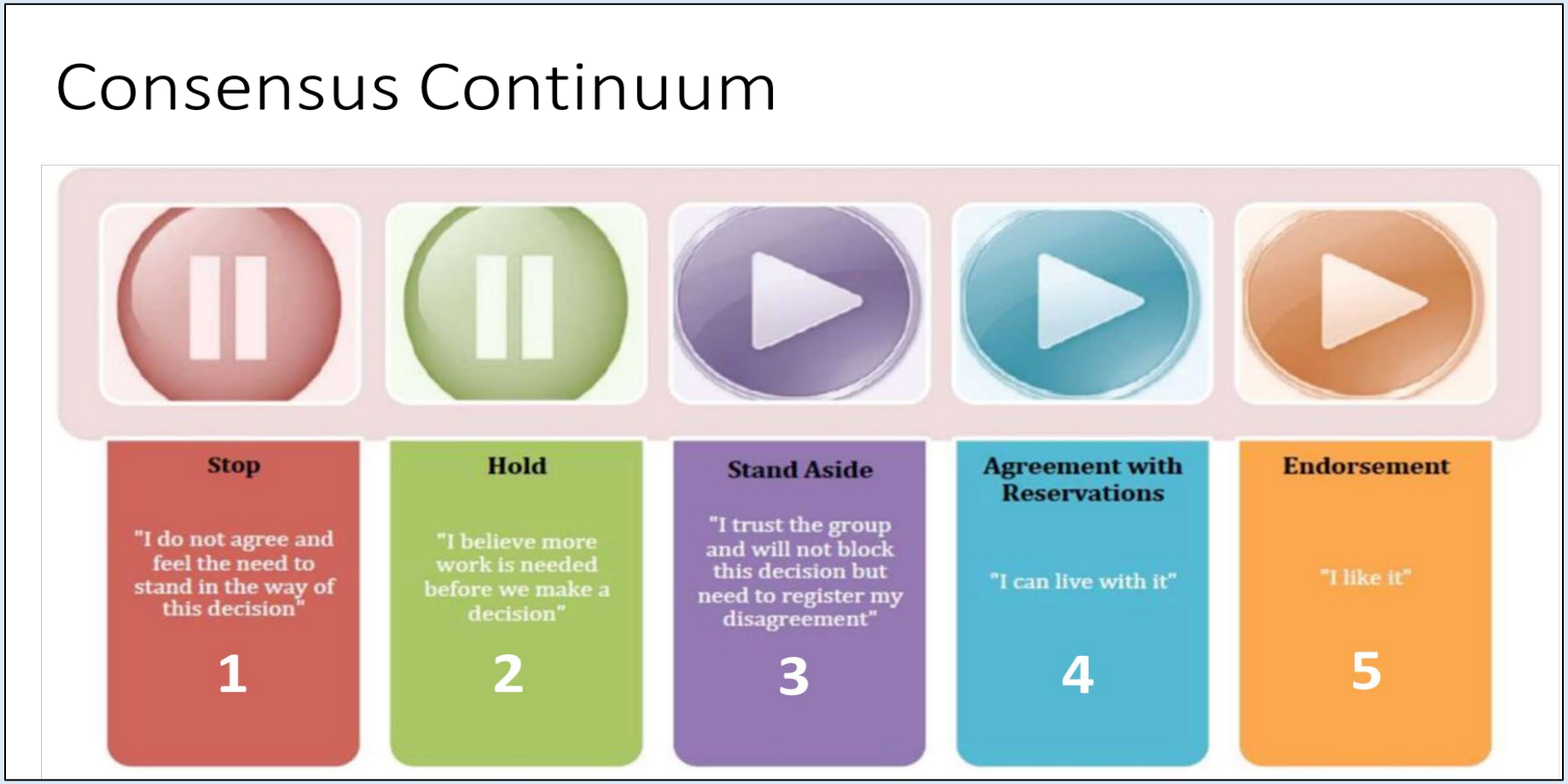

MD
CropNeed
State Bucket P6 Proj.
Smoothed P6 Proj.
Proj. Frac. CropNeed
Million Lbs N
20
40
60
80
100
120
140
1990
2000
2010
2020
Year


NY
CropNeed
State Bucket P6 Proj.
Smoothed P6 Proj.
Proj. Frac. CropNeed
Million Lbs N
20
40
60
80
100
120
140
1990
2000
2010
2020
Year

Questions?

Decision Proposal

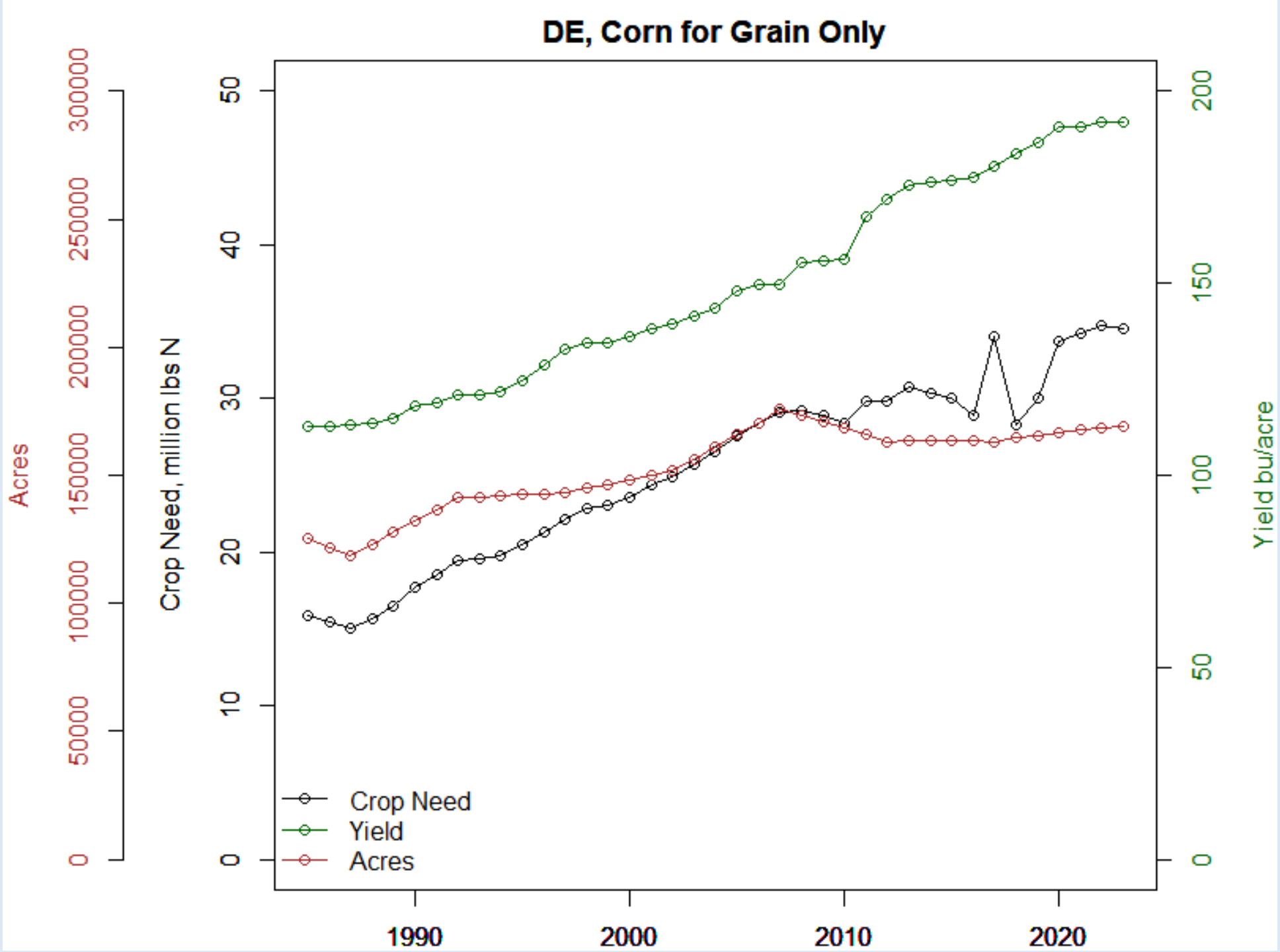
1) We should adopt the provided method for projecting fertilizer for Phase 7.
    1) Projection based on state specific crop need with an average of the last three years. This is only applicable during periods where no data is reported.

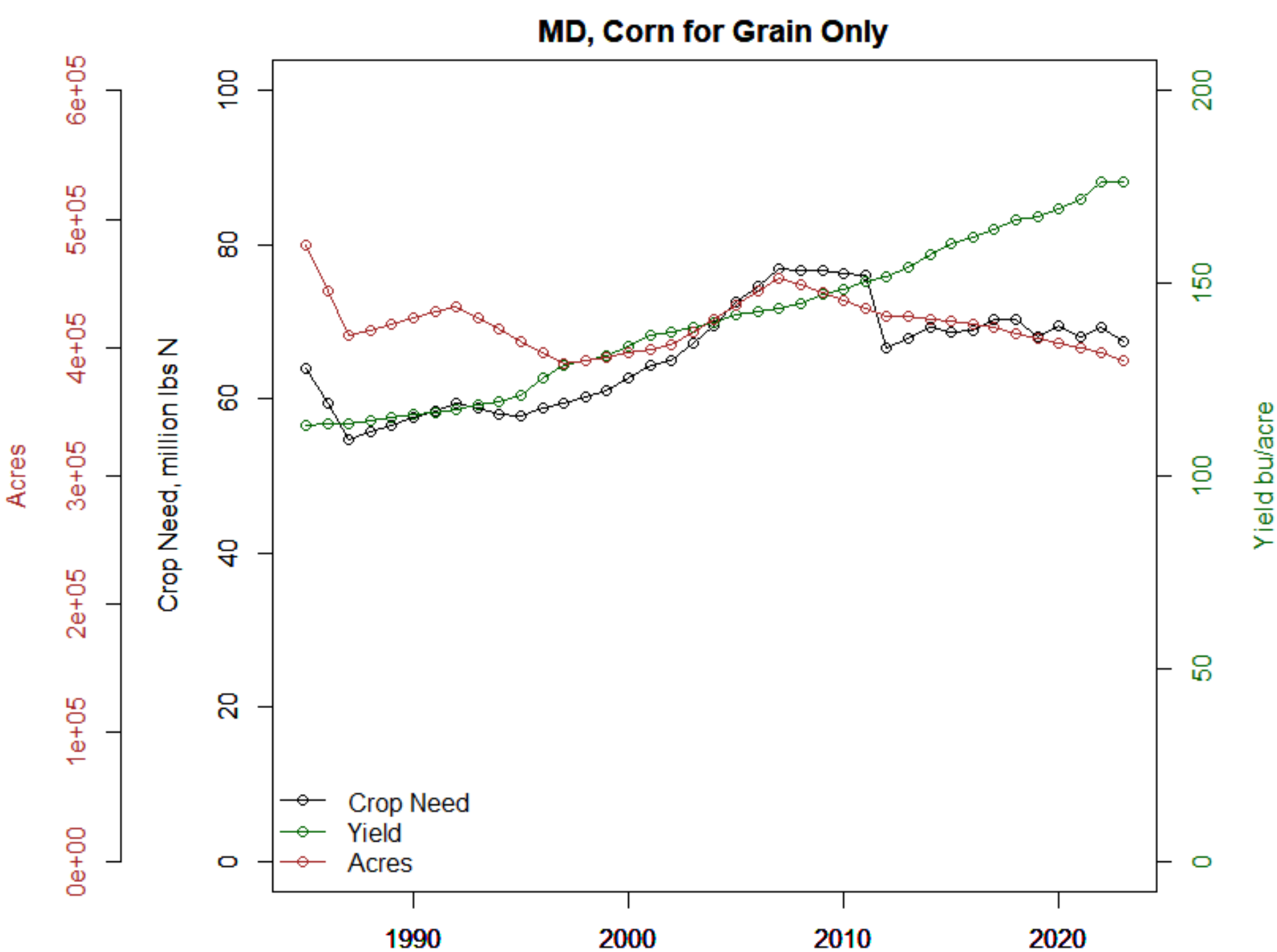


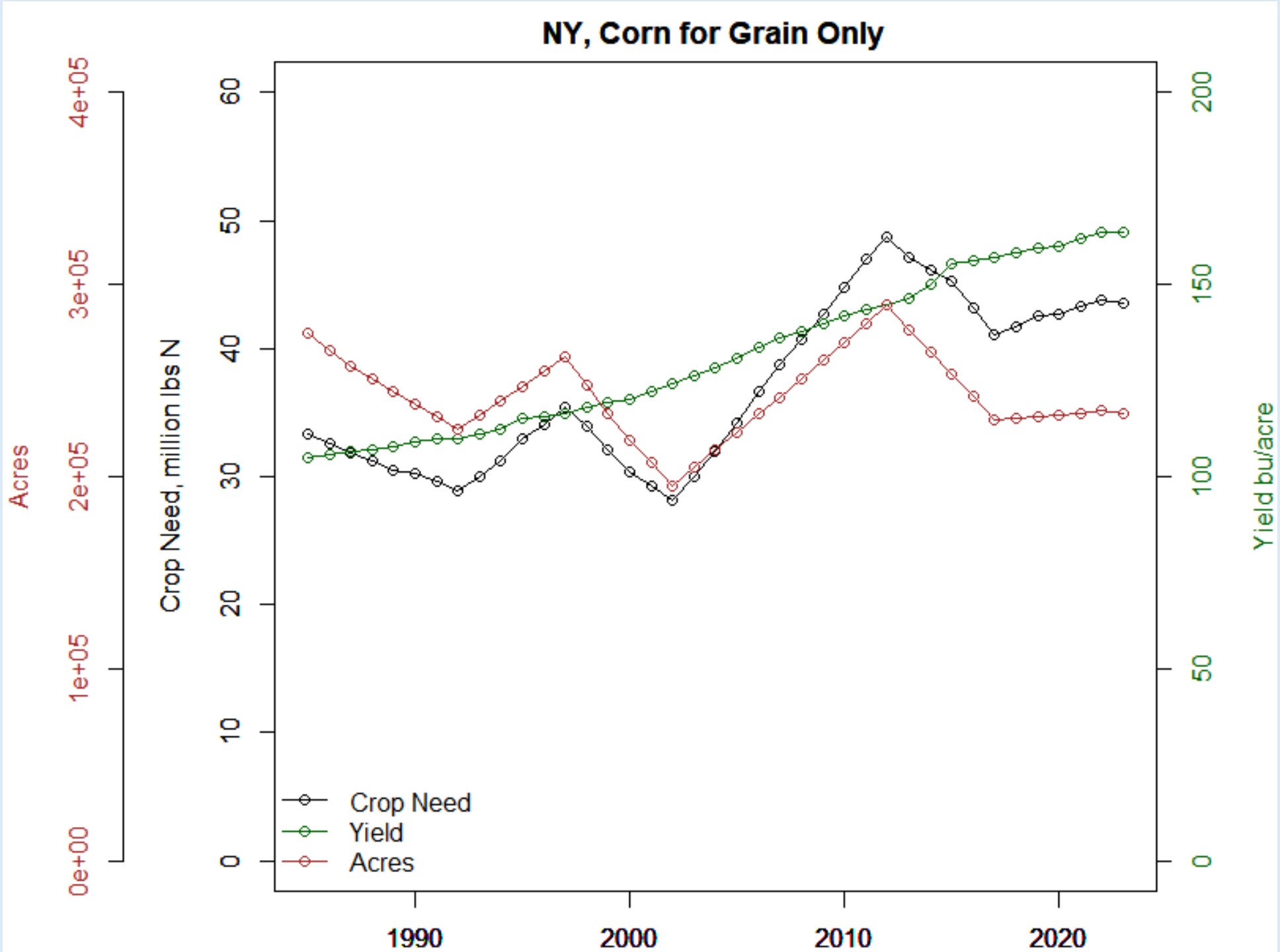
Item 3 Examine Delaware fertilizer data behavior

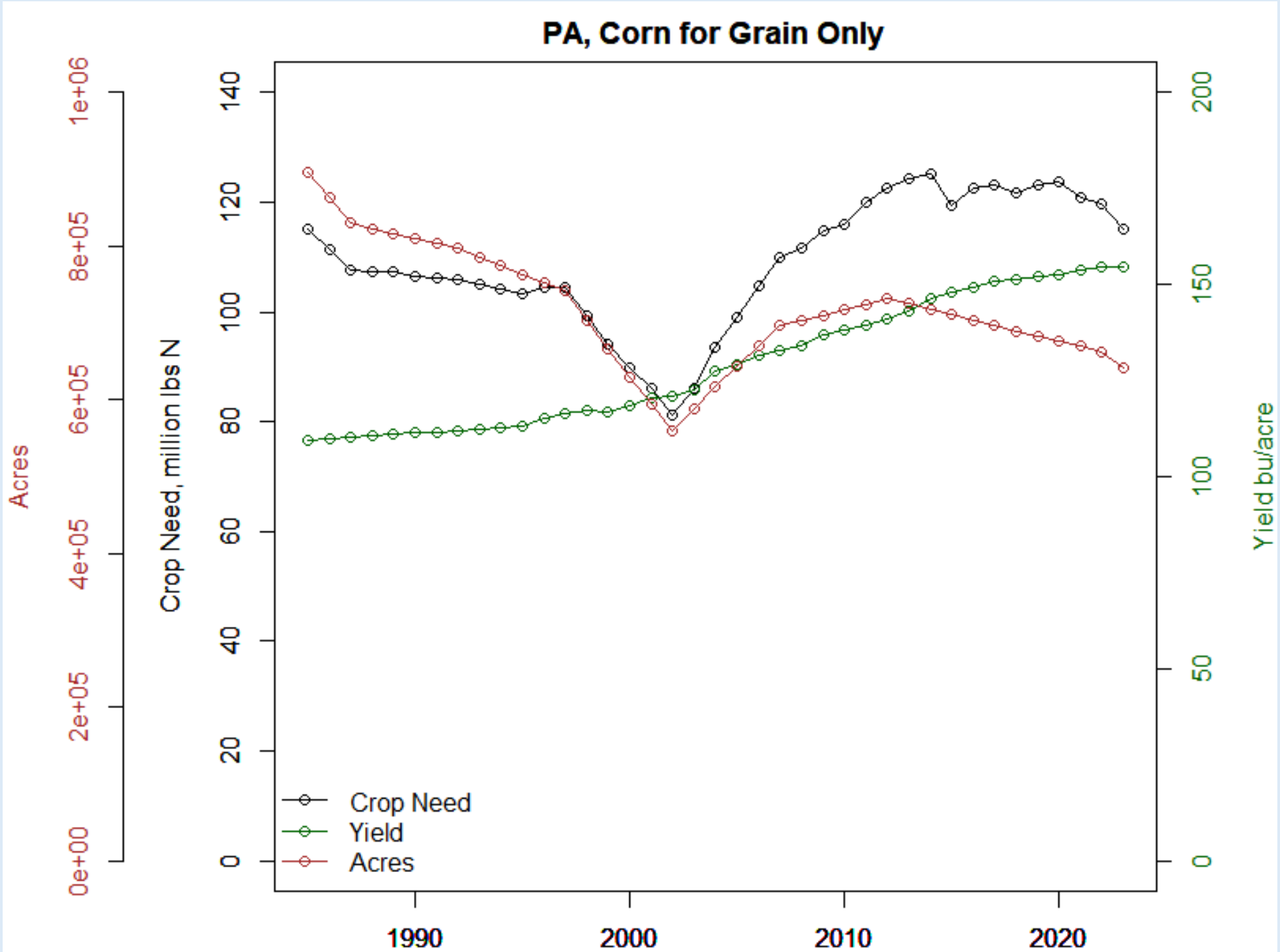
Possible progress with new smoothing

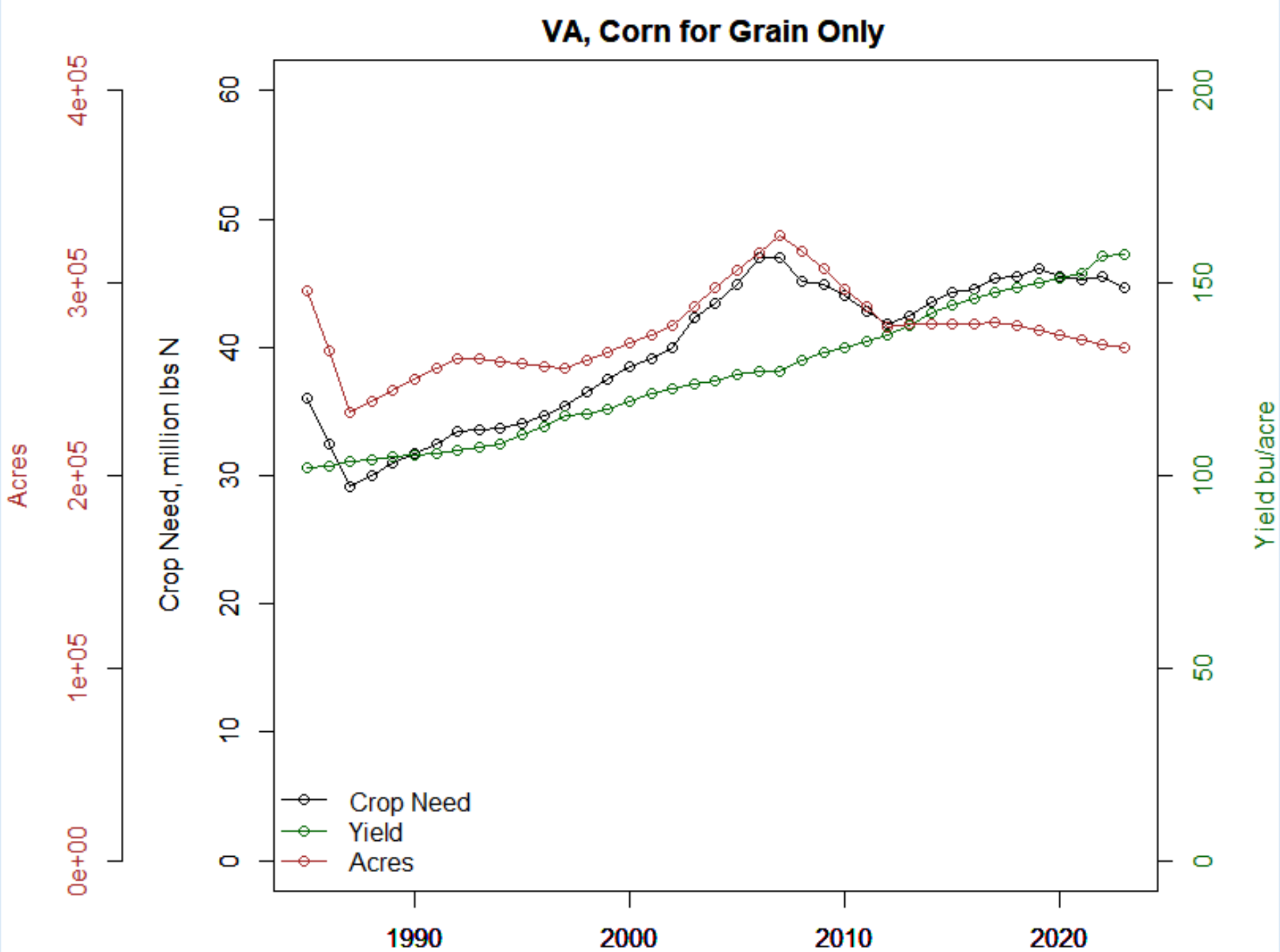
- State Level Fert Buckets
- State Smoothed Level Fert Buckets
- Further discussions might be warranted

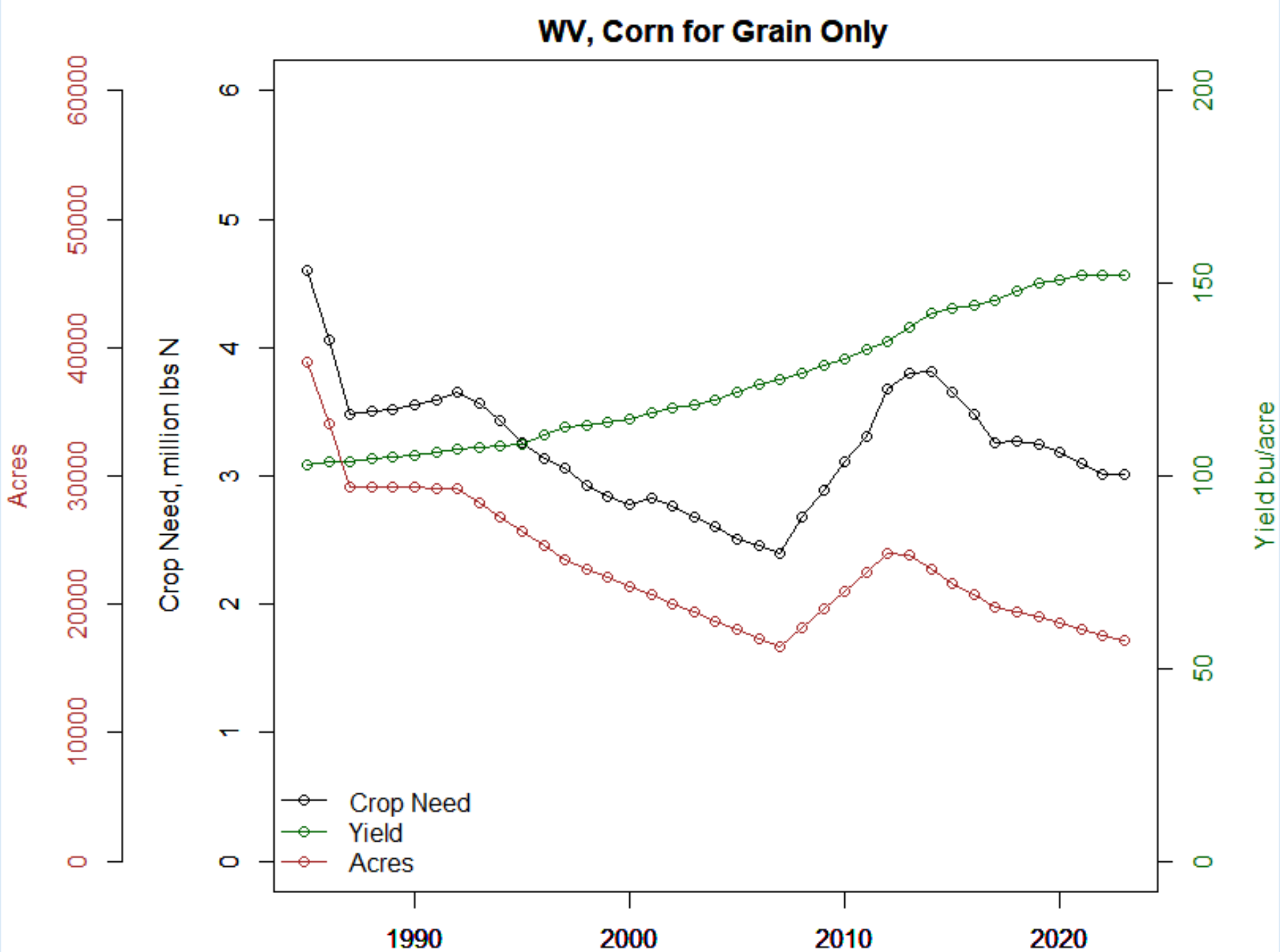

DE, Corn for Grain Only
Acres
0
50000
100000
150000
200000
250000
300000
Crop Need, million lbs N
0
10
20
30
40
50
Yield bu/acre
0
50
100
150
200
1990
2000
2010
2020
Crop Need
Yield
Acres


MD, Corn for Grain Only
Acres
0e+00
1e+05
2e+05
3e+05
4e+05
5e+05
6e+05
Crop Need, million lbs N
0
20
40
60
80
100
Yield bu/acre
0
50
100
150
200
1990
2000
2010
2020
Crop Need
Yield
Acres


NY, Corn for Grain Only
Crop Need, million lbs N
Yield bu/acre
Acres
0
10
20
30
40
50
60
0
50
100
150
200
0e+00
1e+05
2e+05
3e+05
4e+05
1990
2000
2010
2020
Crop Need
Yield
Acres


PA, Corn for Grain Only
Acres
0e+00
2e+05
4e+05
6e+05
8e+05
1e+06
Crop Need, million lbs N
0
20
40
60
80
100
120
140
Yield bu/acre
0
50
100
150
200
1990
2000
2010
2020
Crop Need
Yield
Acres


VA, Corn for Grain Only
Acres
0e+00
1e+05
2e+05
3e+05
4e+05
Crop Need, million lbs N
0
10
20
30
40
50
60
Yield bu/acre
0
50
100
150
200
1990
2000
2010
2020
Crop Need
Yield
Acres


WV, Corn for Grain Only
Acres
Crop Need, million lbs N
Yield bu/acre
0
10000
20000
30000
40000
50000
60000
0
1
2
3
4
5
6
0
50
100
150
200
1990
2000
2010
2020
Crop Need
Yield
Acres

Item 4 Supply County Level data for crop need

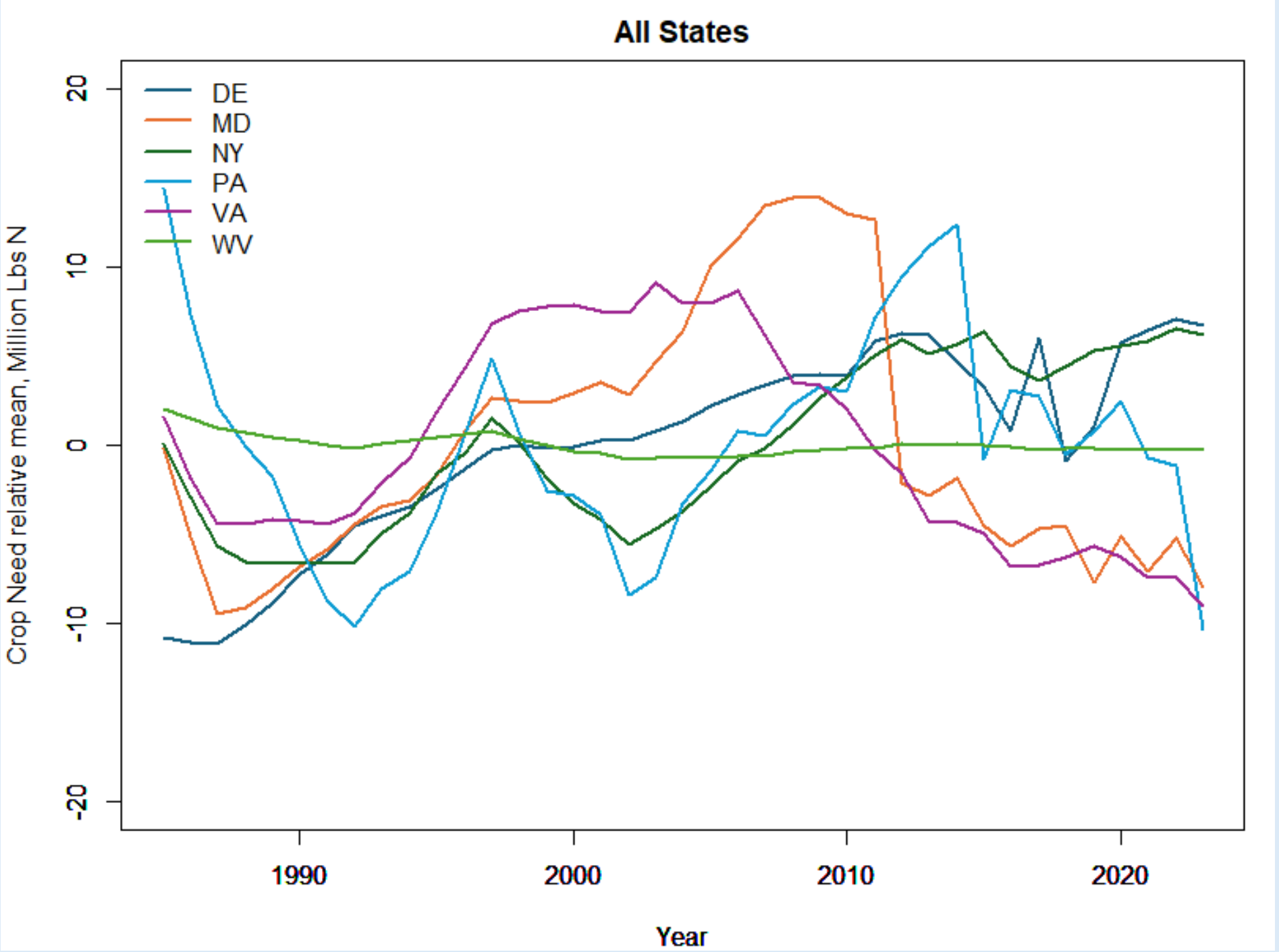
State Level Fert Buckets	State Smoothed Level Fert Buckets
• NOT SMOOTHED • 1985-2020 • Load Source AND Crop tabs	• SMOOTHED (11/14 methods) • 1985-2020 • Load Source AND Crop tabs

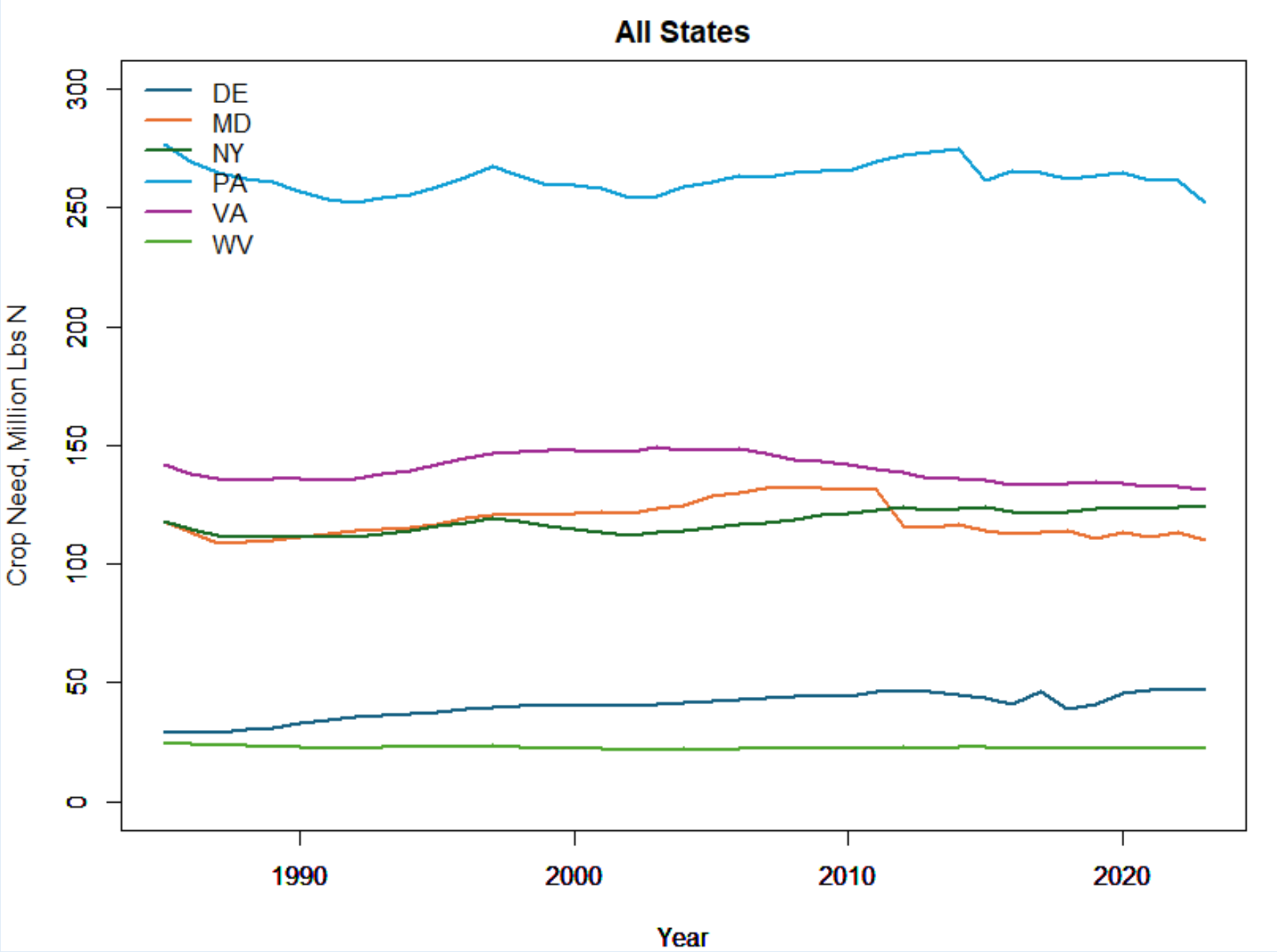
Item 5 Compare national and Chesapeake watershed scale fertilizer and crop data trends

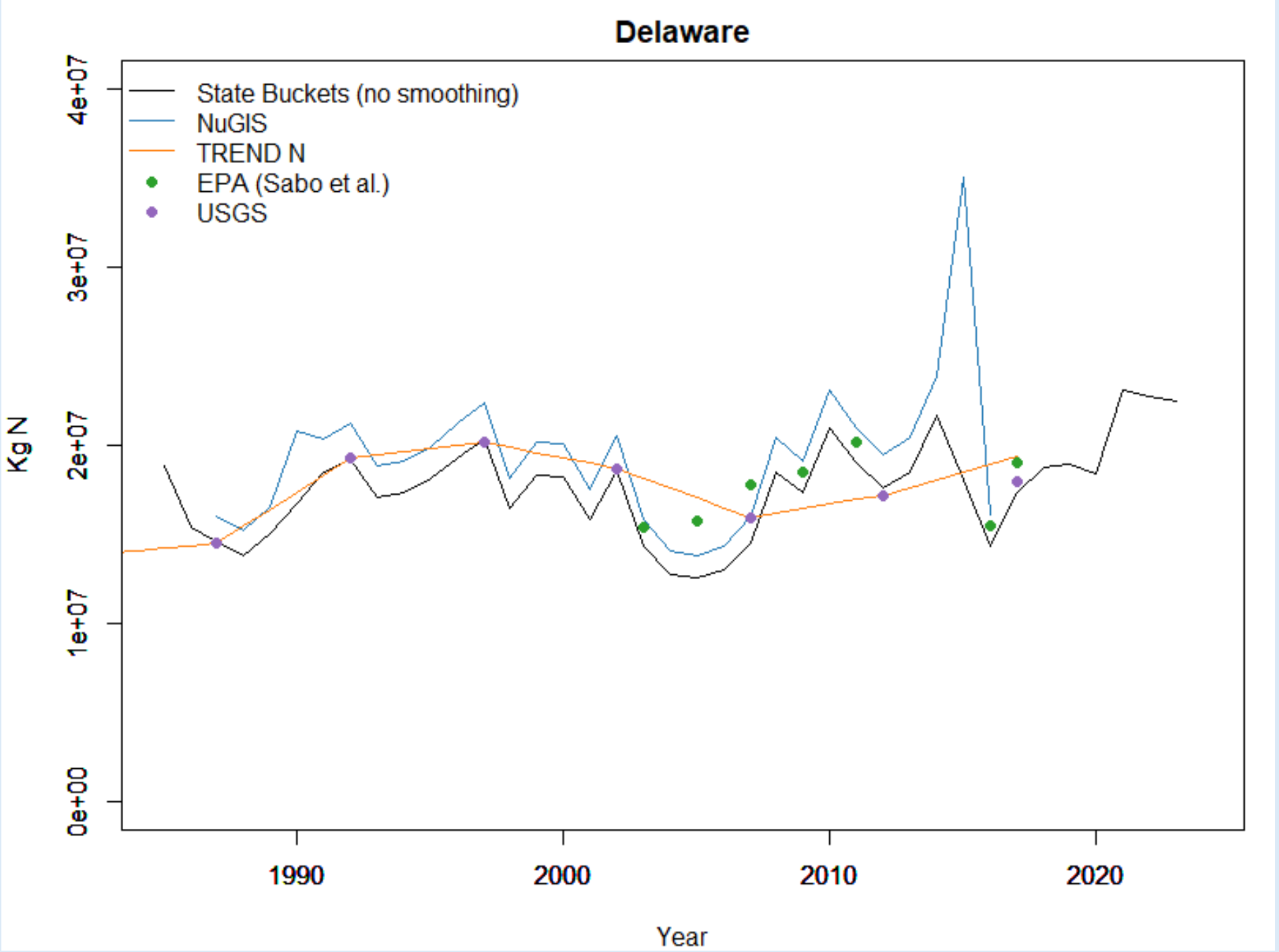
Examine state crop need

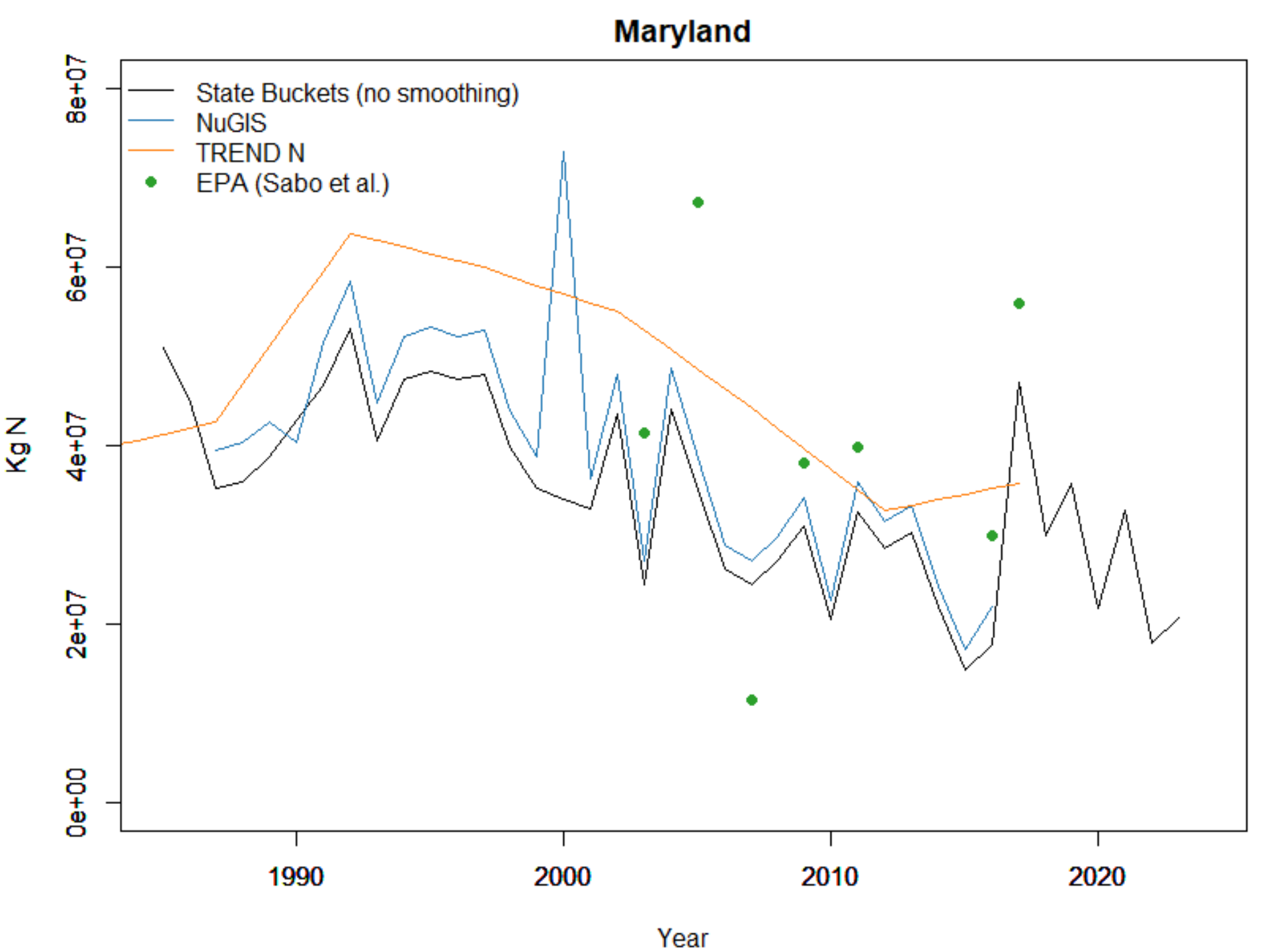
Compare several fertilizer data sets

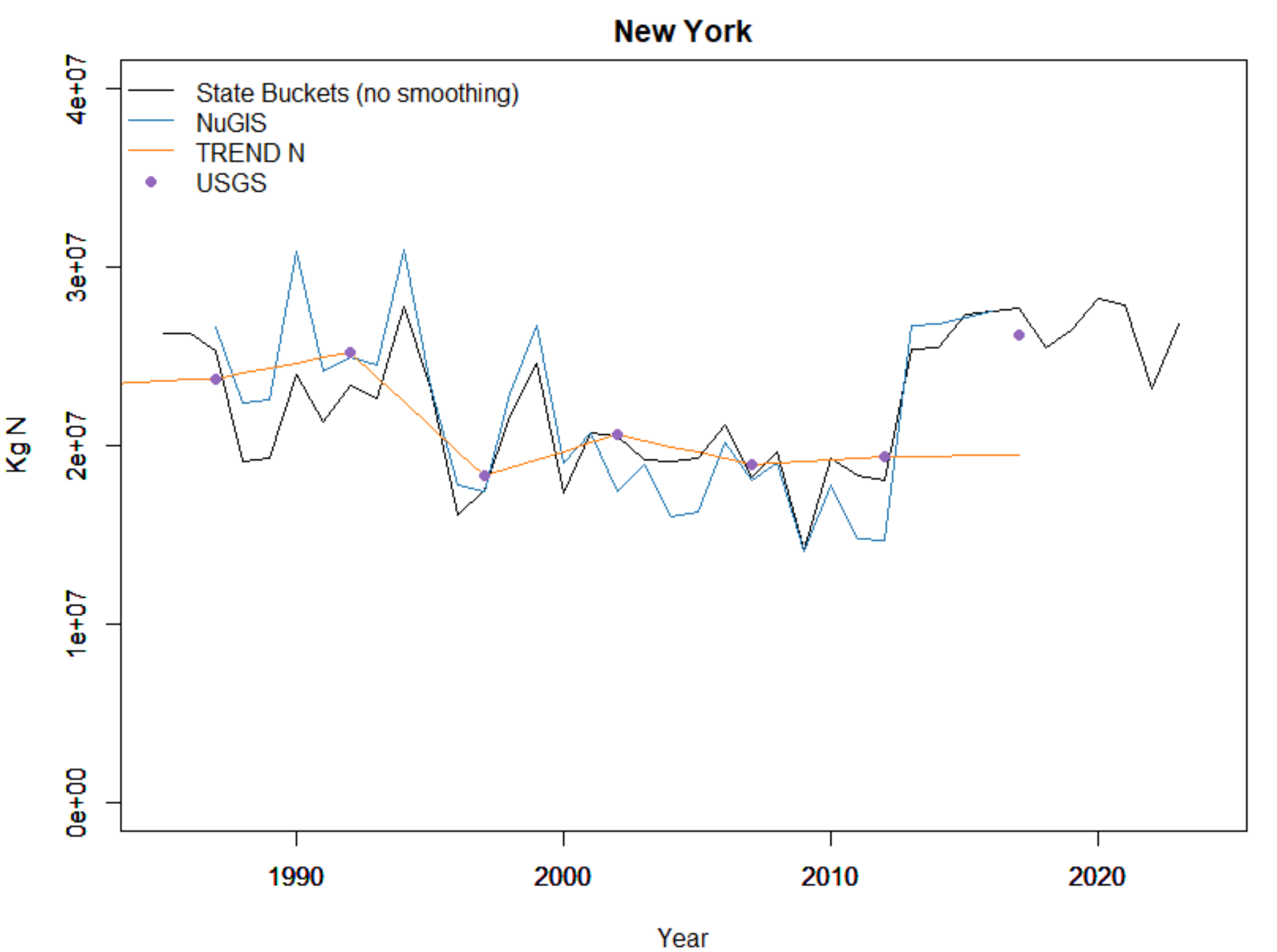
Examine USDA reported application to corn

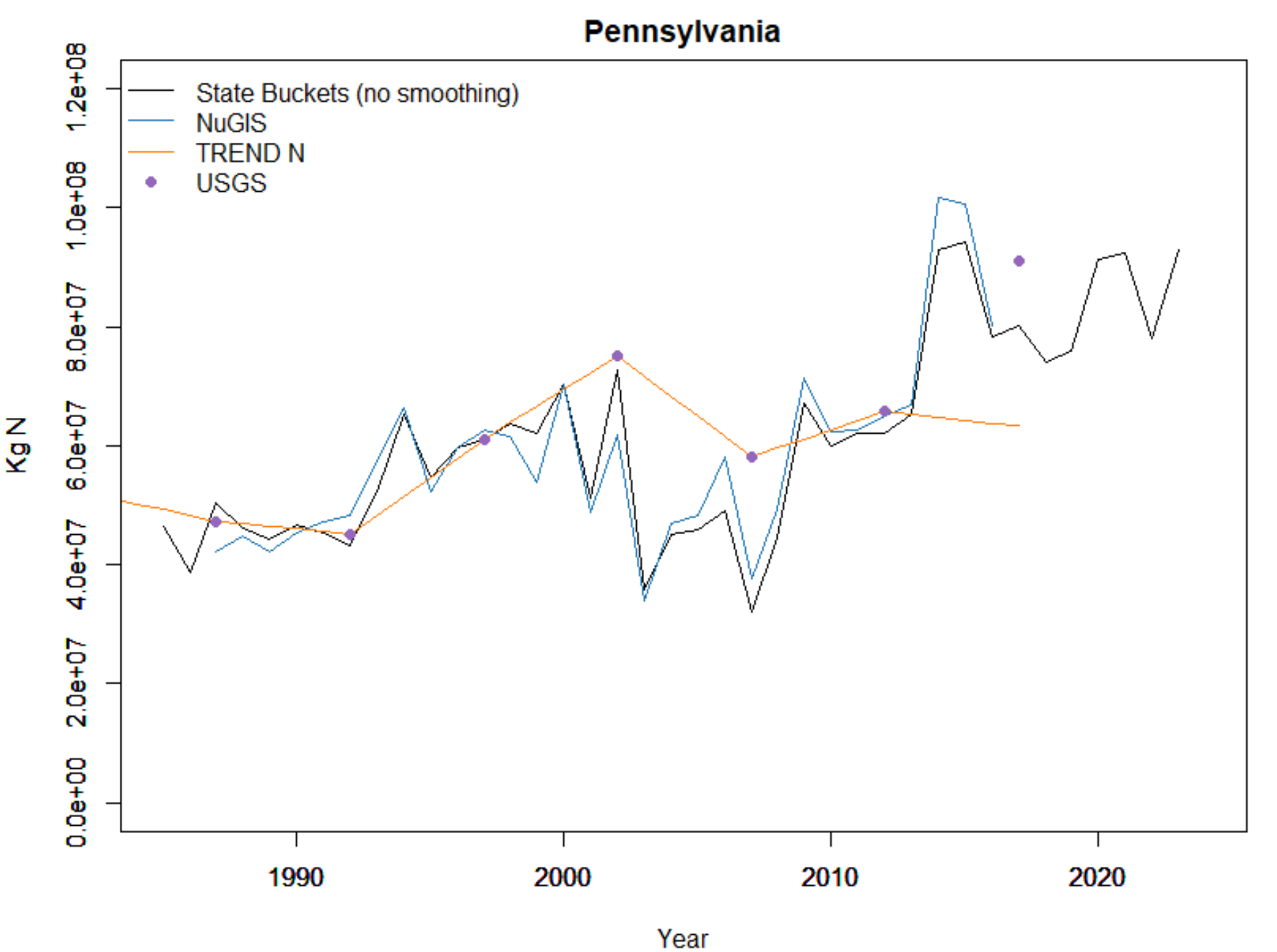

All States
DE
MD
NY
PA
VA
WV
Crop Need relative mean, Million Lbs N
20
10
0
-10
-20
1990
2000
2010
2020
Year

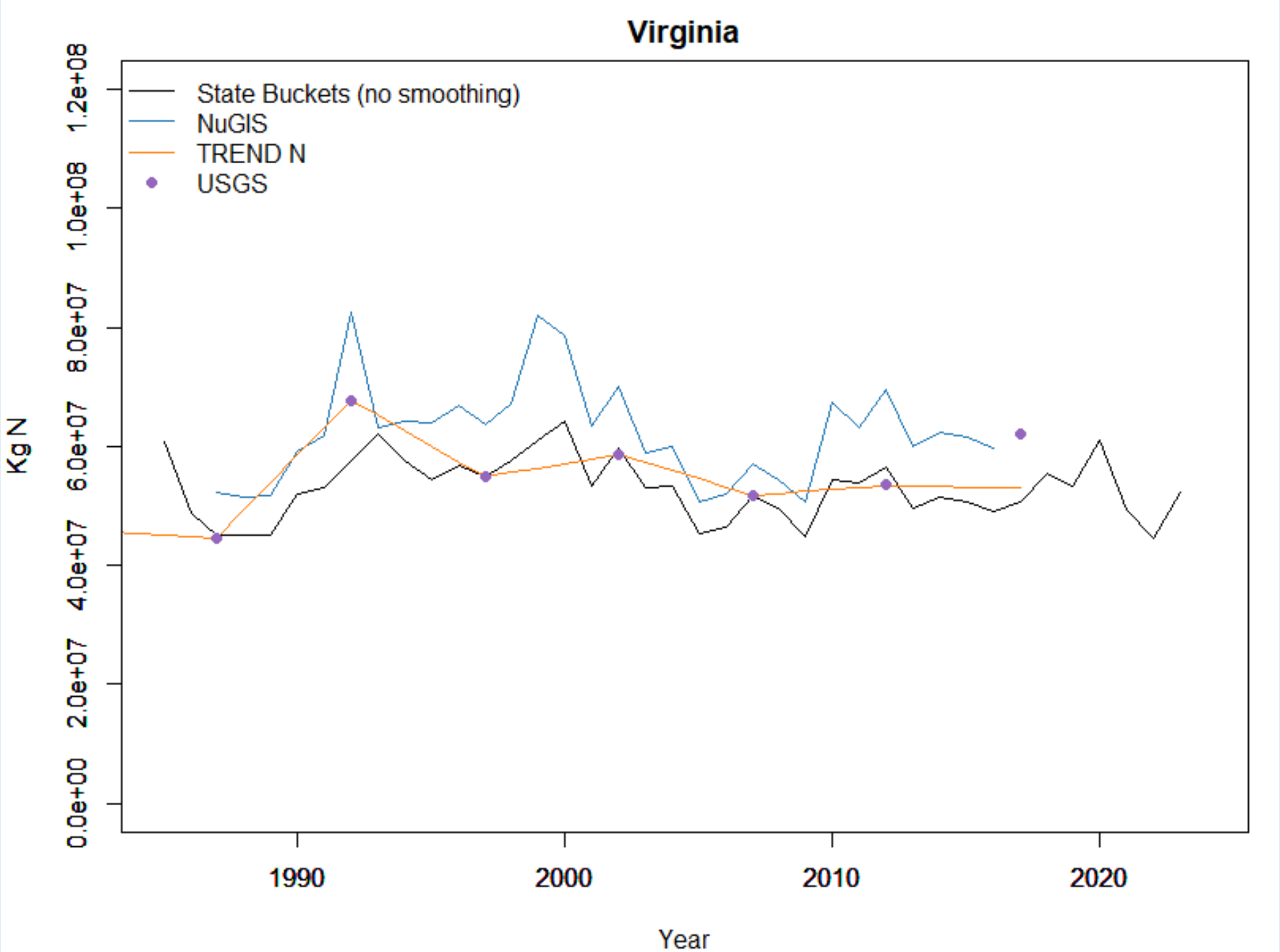

All States
DE
MD
NY
PA
VA
WV
Crop Need, Million Lbs N
0
50
100
150
200
250
300
1990
2000
2010
2020
Year

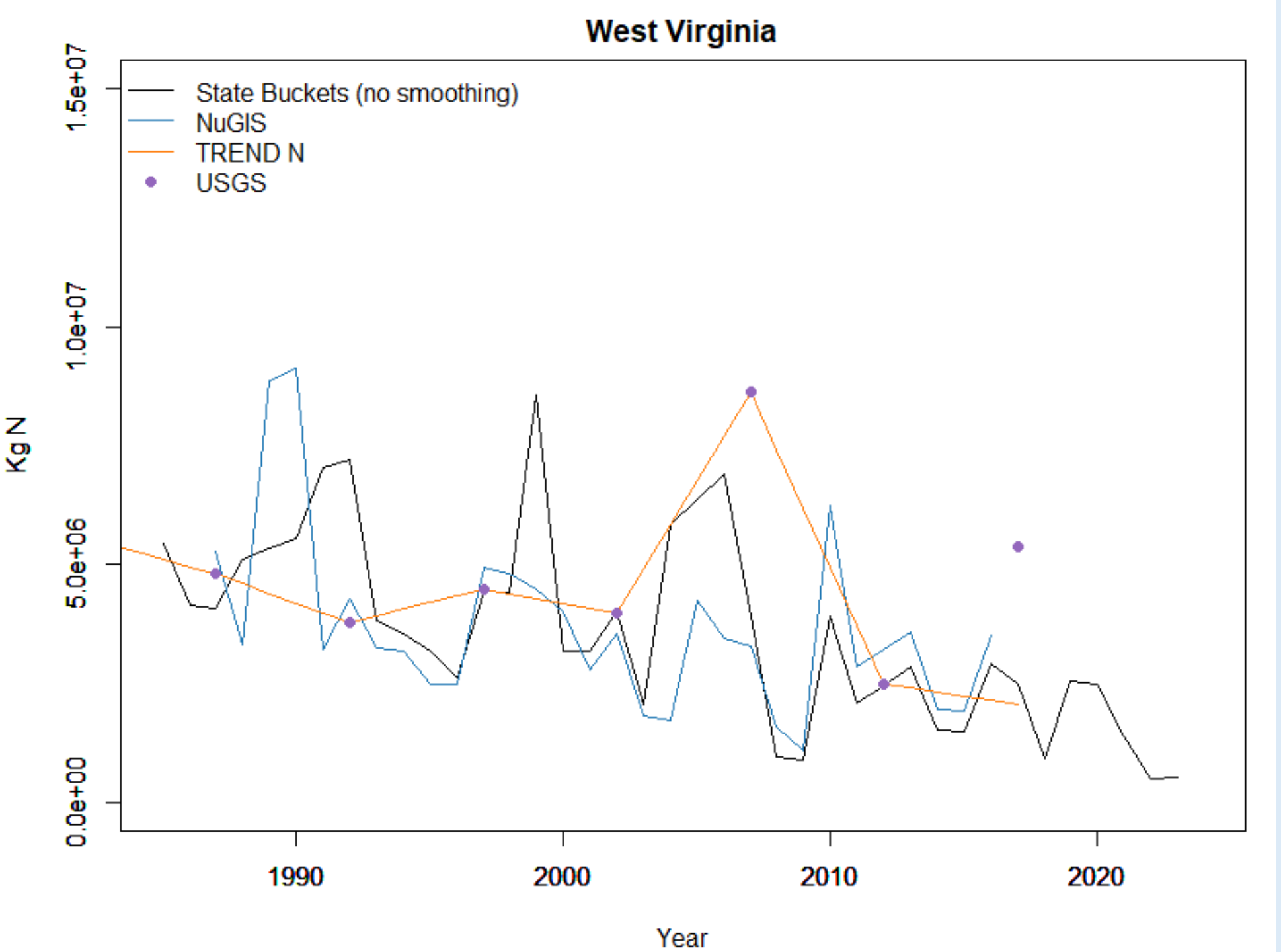

Delaware
State Buckets (no smoothing)
NuGIS
TREND N
EPA (Sabo et al.)
USGS
Kg N
0e+00
1e+07
2e+07
3e+07
4e+07
1990
2000
2010
2020
Year

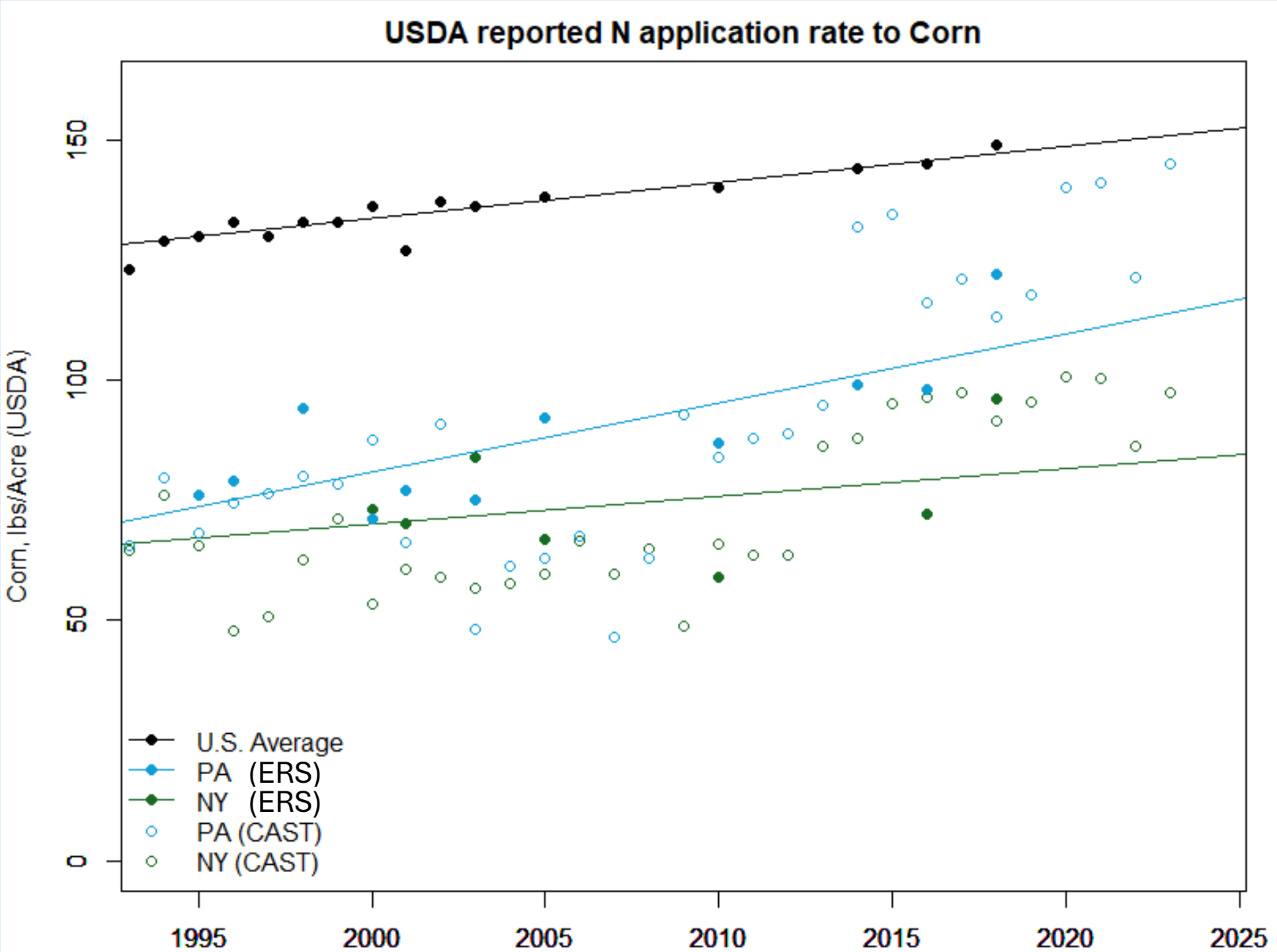

Maryland
State Buckets (no smoothing)
NuGIS
TREND N
EPA (Sabo et al.)
Kg N
0e+00
2e+07
4e+07
6e+07
8e+07
1990
2000
2010
2020
Year


New York
State Buckets (no smoothing)
NuGIS
TREND N
USGS
Kg N
0e+00
1e+07
2e+07
3e+07
4e+07
1990
2000
2010
2020
Year


Pennsylvania
State Buckets (no smoothing)
NuGIS
TREND N
USGS
Kg N
0.0e+00
2.0e+07
4.0e+07
6.0e+07
8.0e+07
1.0e+08
1.2e+08
1990
2000
2010
2020
Year


Virginia
State Buckets (no smoothing)
NuGIS
TREND N
USGS
Kg N
0.0e+00
2.0e+07
4.0e+07
6.0e+07
8.0e+07
1.0e+08
1.2e+08
1990
2000
2010
2020
Year


West Virginia
State Buckets (no smoothing)
NuGIS
TREND N
USGS
Kg N
0.0e+00
5.0e+06
1.0e+07
1.5e+07
1990
2000
2010
2020
Year


USDA reported N application rate to Corn
Corn, lbs/Acre (USDA)
0
50
100
150
1995
2000
2005
2010
2015
2020
2025
U.S. Average
PA (ERS)
NY (ERS)
PA (CAST)
NY (CAST)

Takeaways:

- **Data trends are consistent over time and across multiple sources**
  - Crop need is consistent over time
  - Multiple fertilizer data sets show similar trends
  - For states with application data on corn
    - Below the national average
  - Corn in CAST appears consistent with observed data

Questions?

Next steps:

- Nutrient application algorithm
  - Inorganic replacement of organic “cap” based on crop need?

Data references

- NuGIS
  - Home :: NUGIS
- TREND
  - Nitrogen and phosphorus inputs from fertilizer and manure in the Continental United States, 2002-2017 - ScienceBase-Catalog
- USGS
  - Estimates of county-level nitrogen and phosphorus from fertilizer and manure from 1950 through 2017 in the conterminous United States
- USDA ERS
  - Fertilizer Use and Price | Economic Research Service
- EPA