Defining the Time Scale for Future Phosphorus Scenarios

Gary Shenk

Chesapeake Bay Program

Presentation to AgWG

7/20/17

Ask

- Phosphorus exports respond slowly to changes in inputs
- Changing phosphorus inputs for one year will have a very small effect in that year.

- How many years into the future should we assume that management is held constant
  - 1?
  - 10?
  - 25?
  - Some other number?

AgWG recommendation

- Decision: The AgWG made a recommendation to the WQGIT to move forward with implementing a 25-year time frame for P simulation in the initial Phase 6 scenarios. During the summer of 2017, other time-frames of 1, 10, 25, 50, and 100 years will be tested, and this decision will be revisited during the fall of 2017.





Phase 6 Model Structure

Average Load + ΔInputs * Sensitivity

*

Land Use Acres

*

BMPs

*

Land to Water

*

Stream Delivery

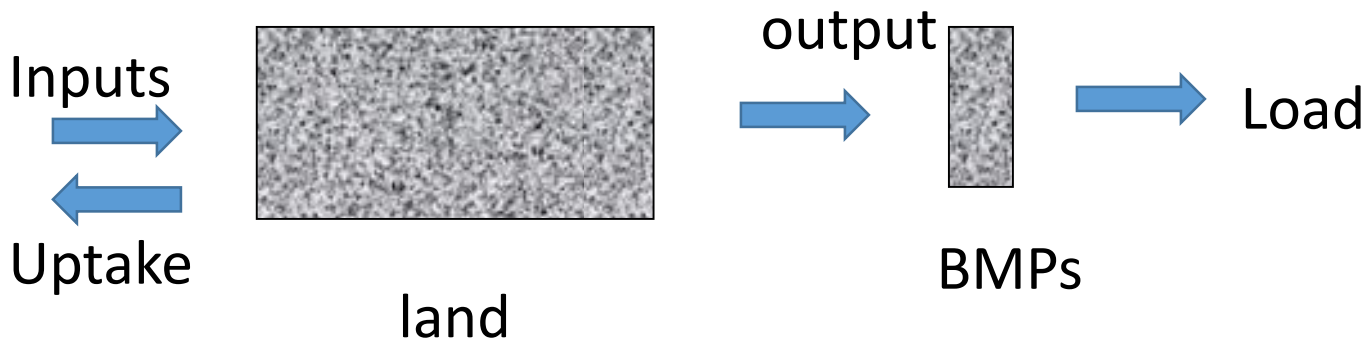
*

River Delivery

Direct Loads

Phase 6

Nitrogen Conceptual Model



1 lb reduction in fertilizer is about a quarter lb reduction in output

STAC Guidance on Phosphorus

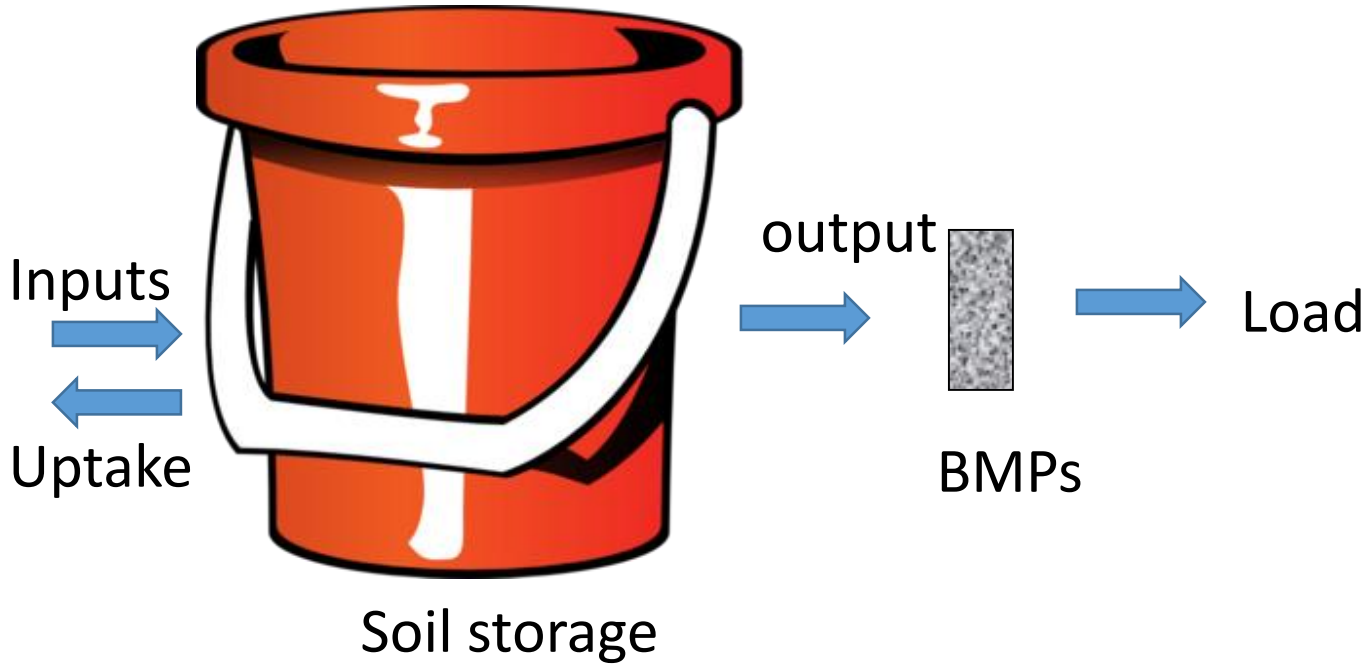
A Review of Agricultural P-dynamics in the Chesapeake Bay Watershed Model

"…output from CBWM [indicated] major reductions in P losses from cropland on the Maryland Eastern Shore that seemed to be inconsistent with research findings and monitoring data in the region."

STAC Recommendations […]

- **Track drawdown and buildup of soil P reservoirs by segment as a source of P runoff**
- **Get better manure, fertilizer, application method, and soil P data**
- **Account for management (method, timing, tillage, etc)**

Phosphorus Conceptual Model



What determines P loads in a given year?

- Soil Storage
- Sediment Washoff
- Stormwater Runoff
- Water Extractable P Applications
- Manure
- Fertilizer
- Uptake

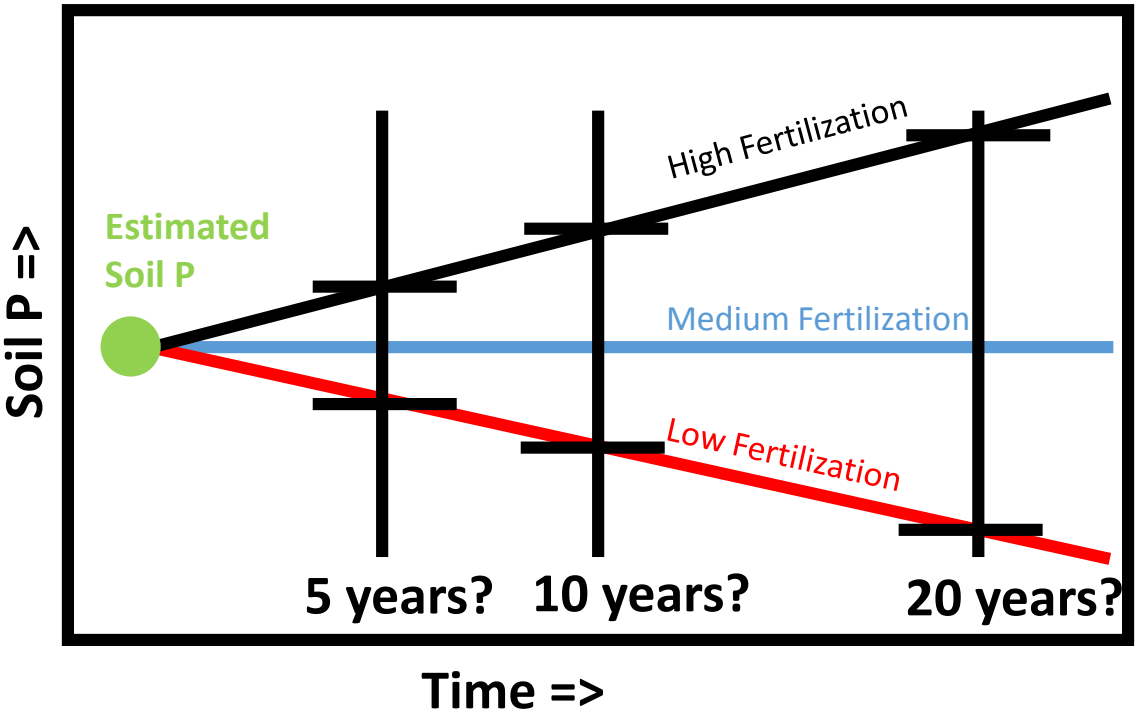
Average Load + ∆Inputs * Sensitivity

P Load from grain without manure =

1.87 + 0.013 * (Mehlich – 98.2) ppm
+ 0.144 * (storm runoff - 6.73) inches
+ 0.049 * (sediment loss - 4.75) tons
+ 0.015 * (WEP – 14.3) lbs

Source: http://www.androidauthority.com/best-android-calculator-apps-577878/

What does a scenario mean?

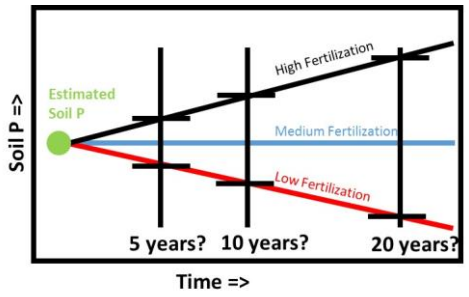


Meaning of Scenarios

- If management was constant through time what would be the long term loading rate?

Meaning of the WIPs

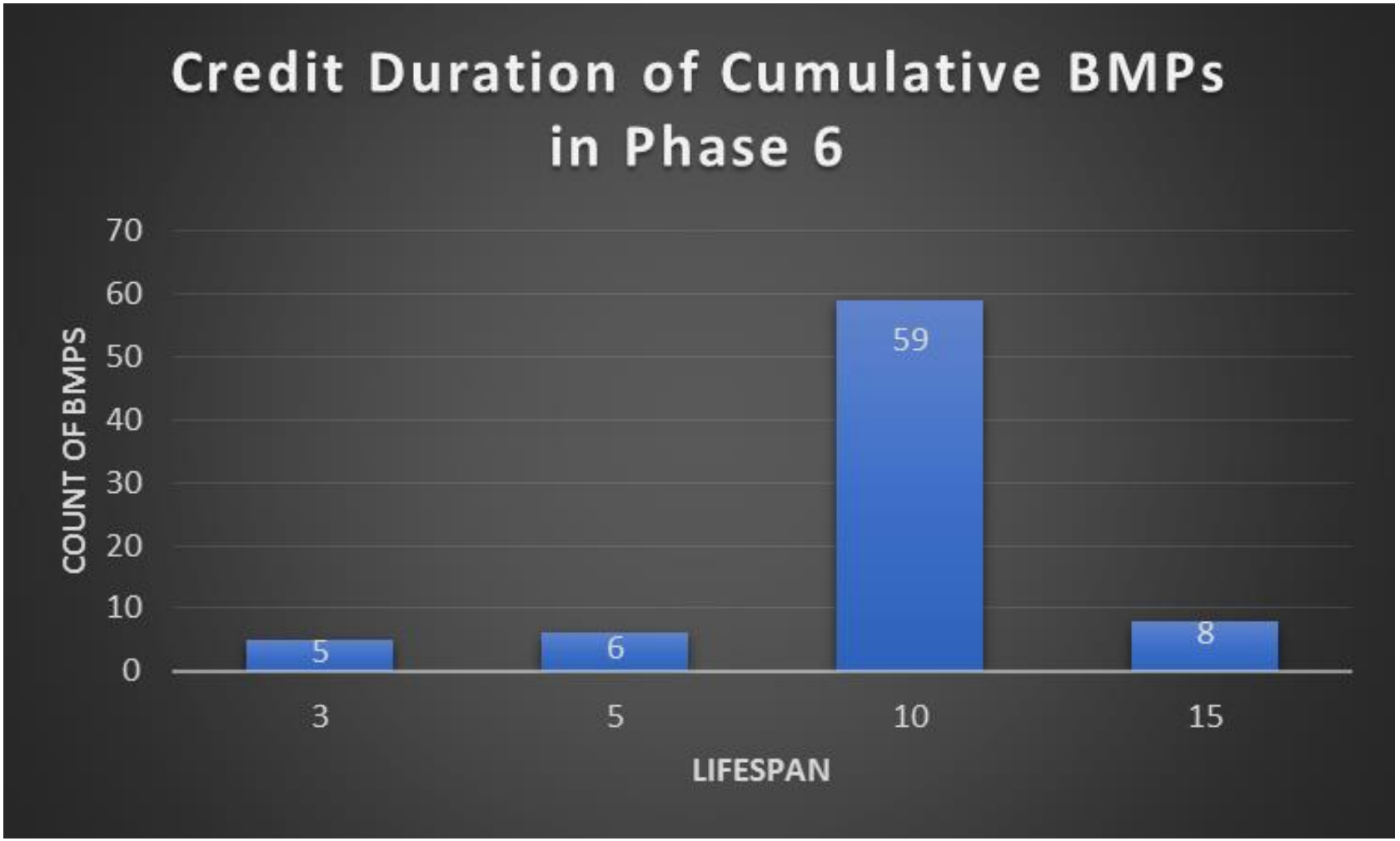
- Necessary implementation to ***eventually*** meet water quality standards



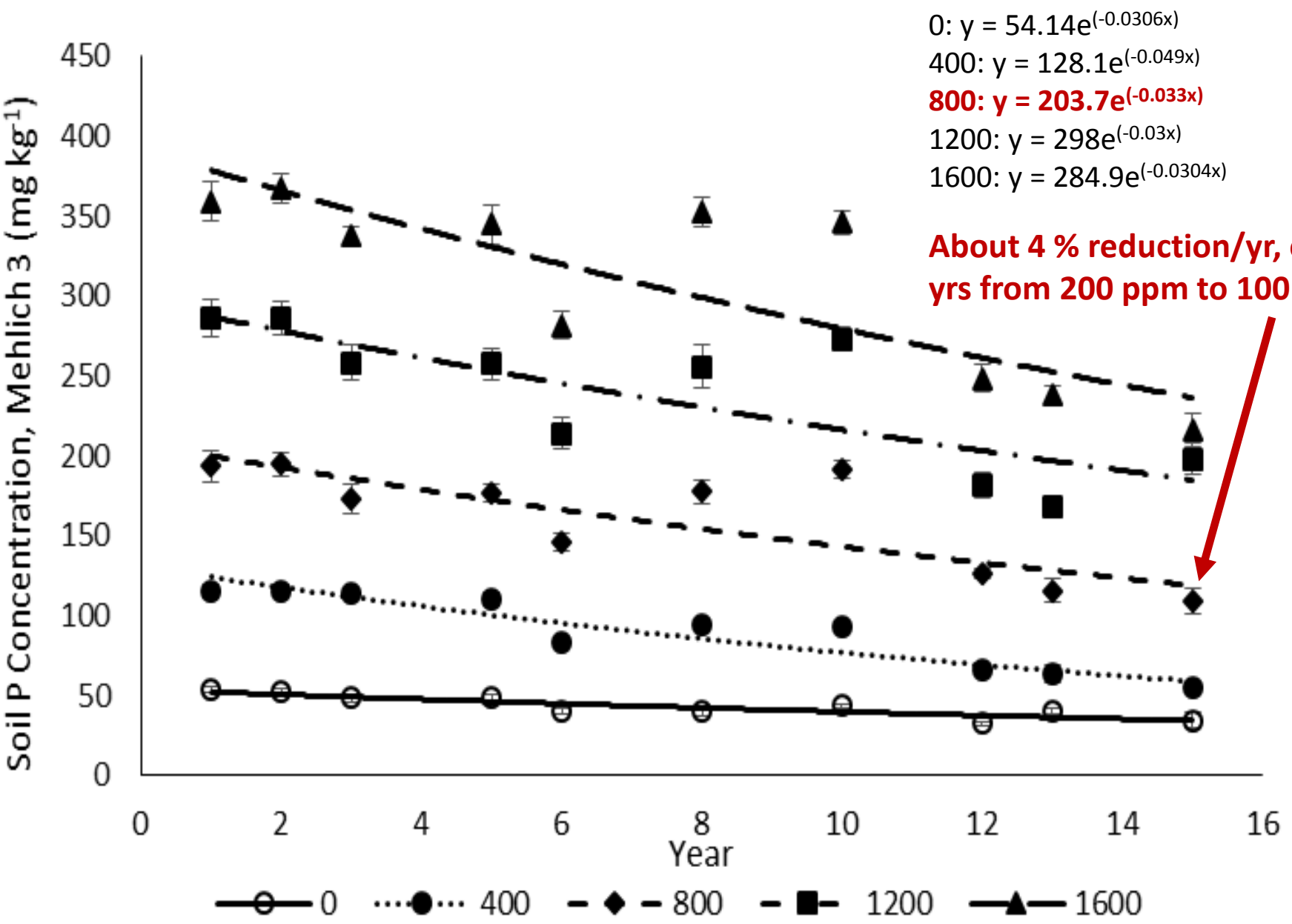
Options for Eventually

- 1 Year
  - Applications could change significantly with very, very minimal change in P soil, and thus P runoff.
  - Wastewater progress is measured in “current year” format.
  - Low uncertainty, low effect
- 10 Years
  - Most common credit duration for BMPs
  - Similar time period to nitrogen load.
- 25 Years
  - P drawdown study on Mid-Atlantic Coastal Plain estimated P could be drawn down from 200 ppm to 100 ppm Mehlich 3 in 25 years with zero additional inputs.
  - High effect, high uncertainty
- Something Else?

Basis for 10 Years?

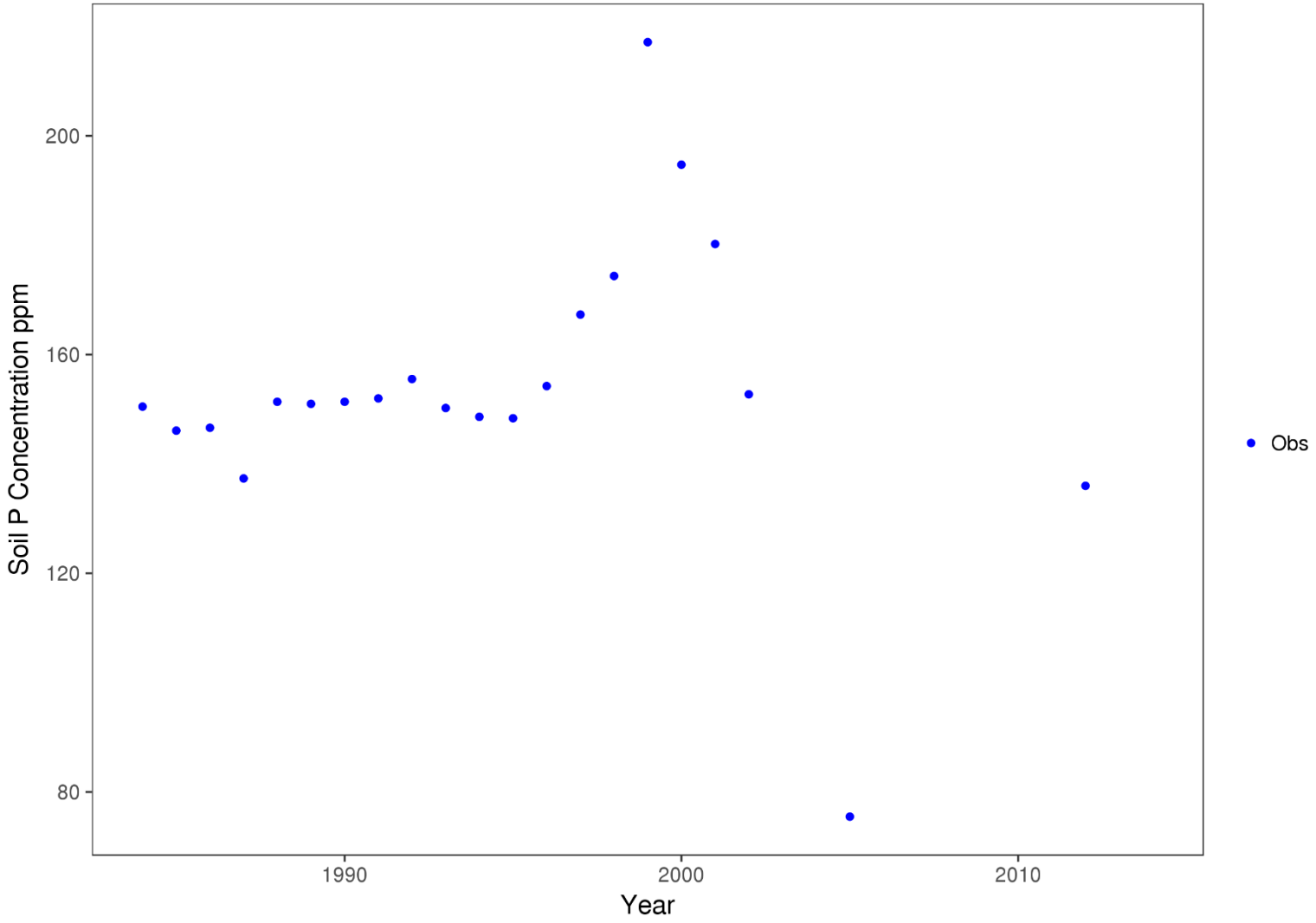


Basis for 25 Years?



Fiorellino, et al., 2017 https://dl.sciencesocieties.org/publications/aj/abstracts/109/2/455?access=0&view=pdf

Wicomico County, MD



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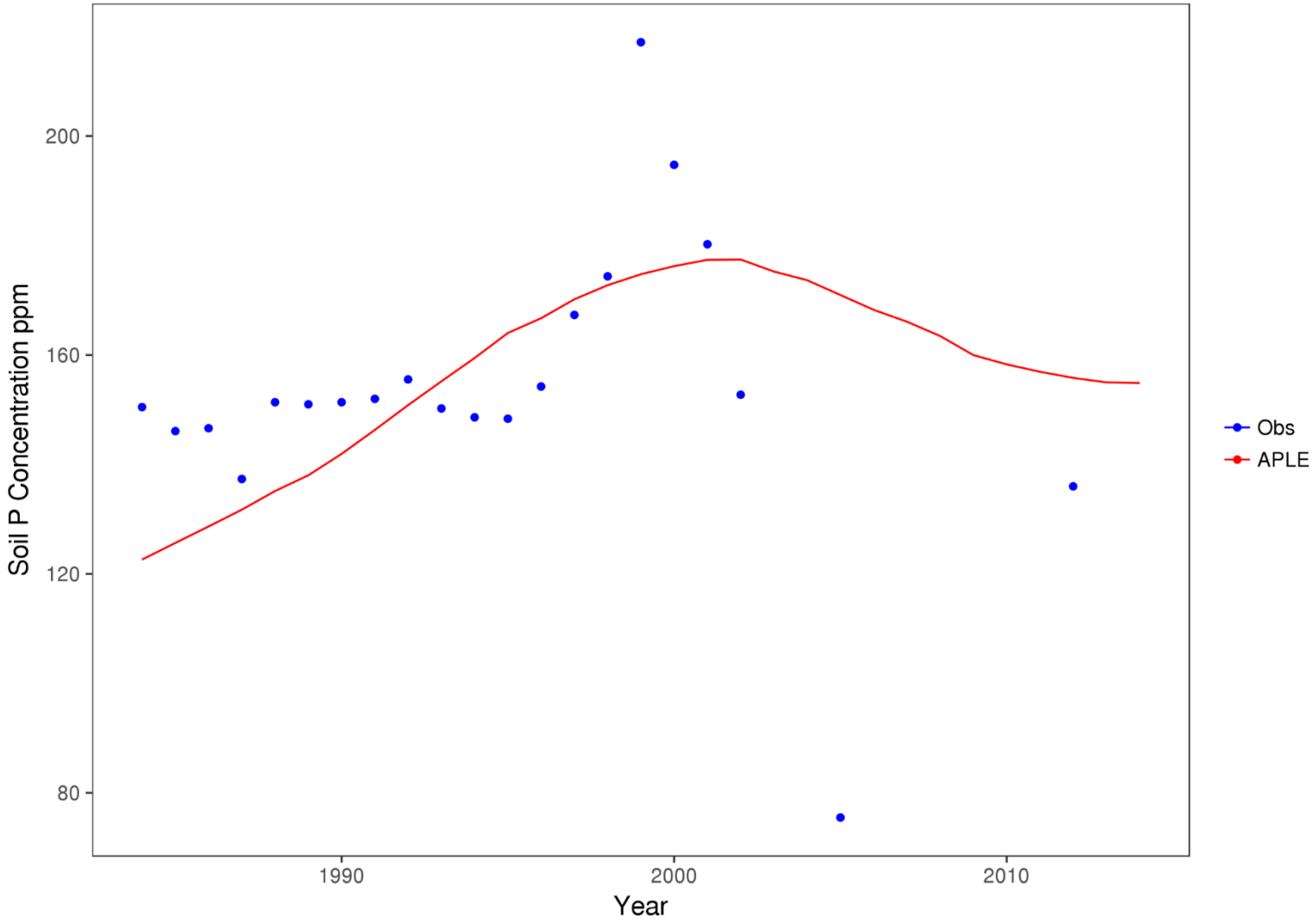

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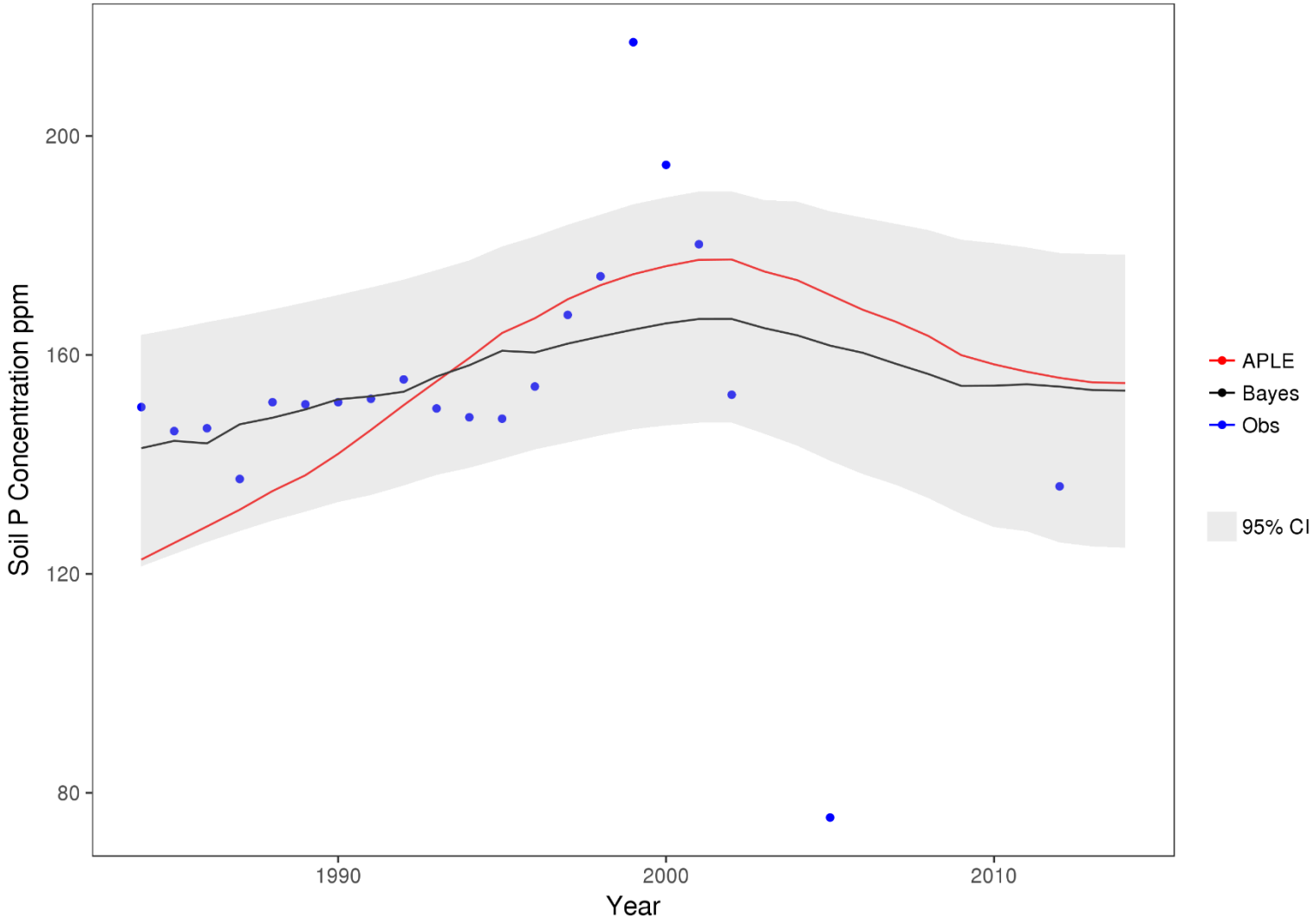

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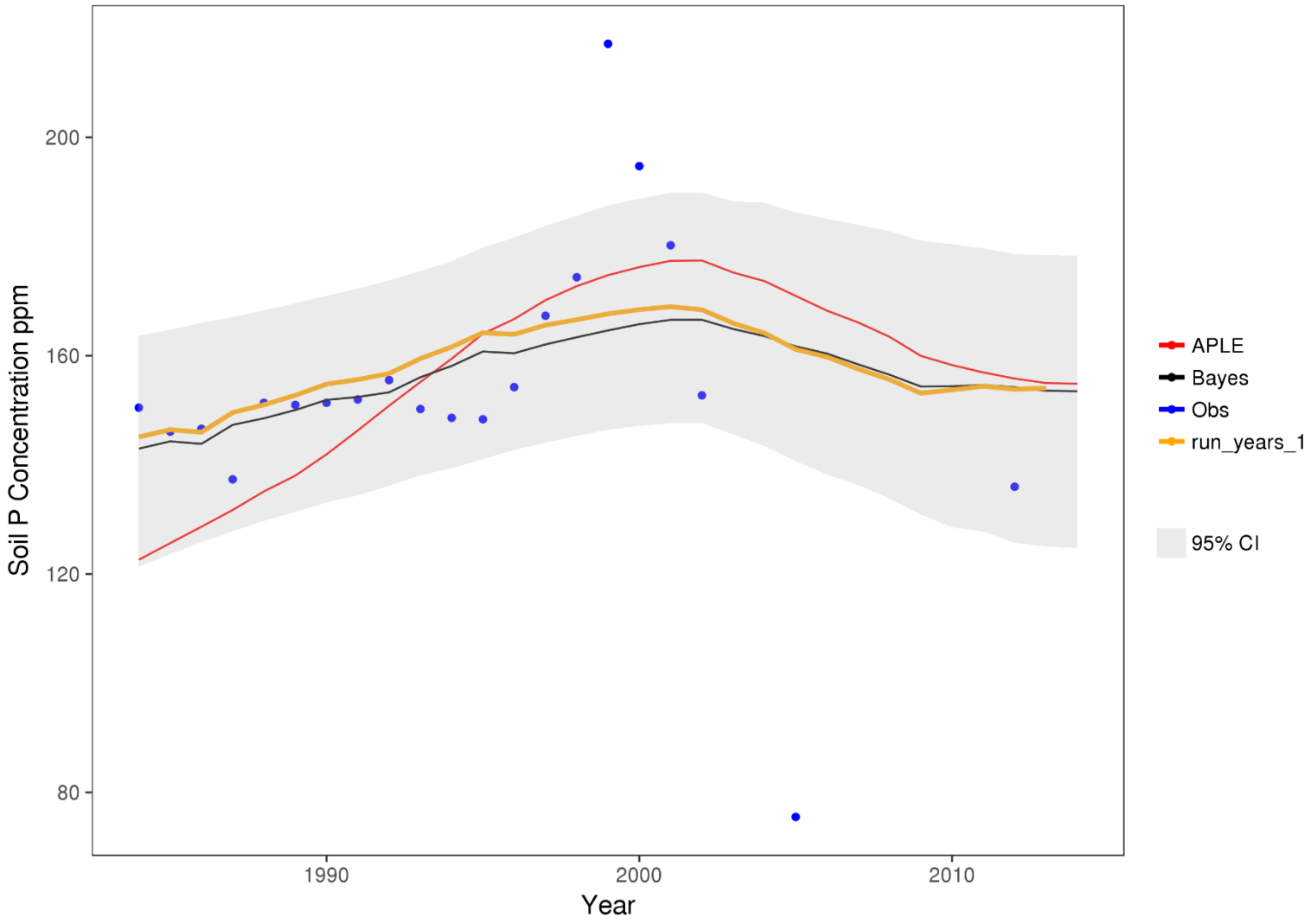

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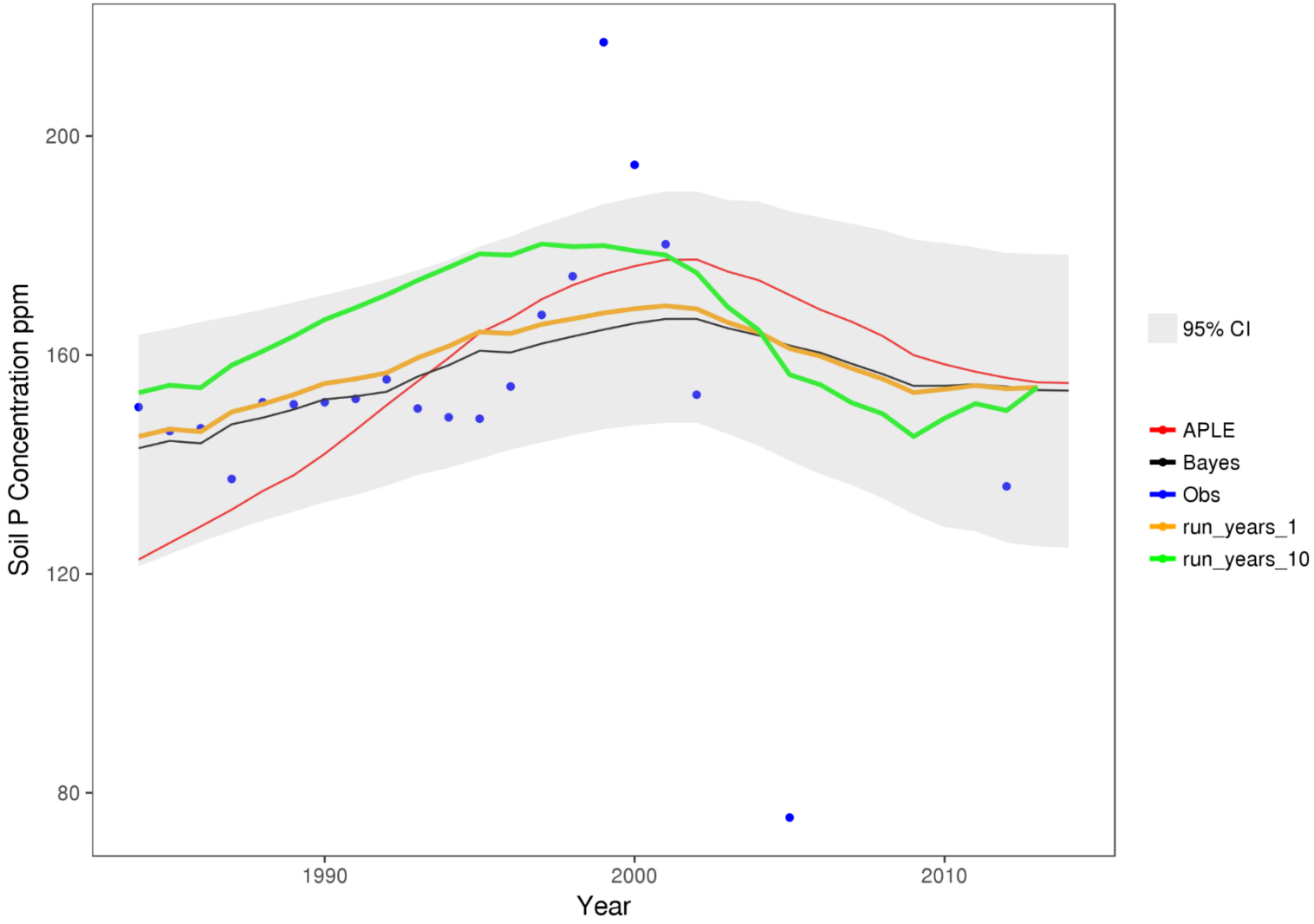

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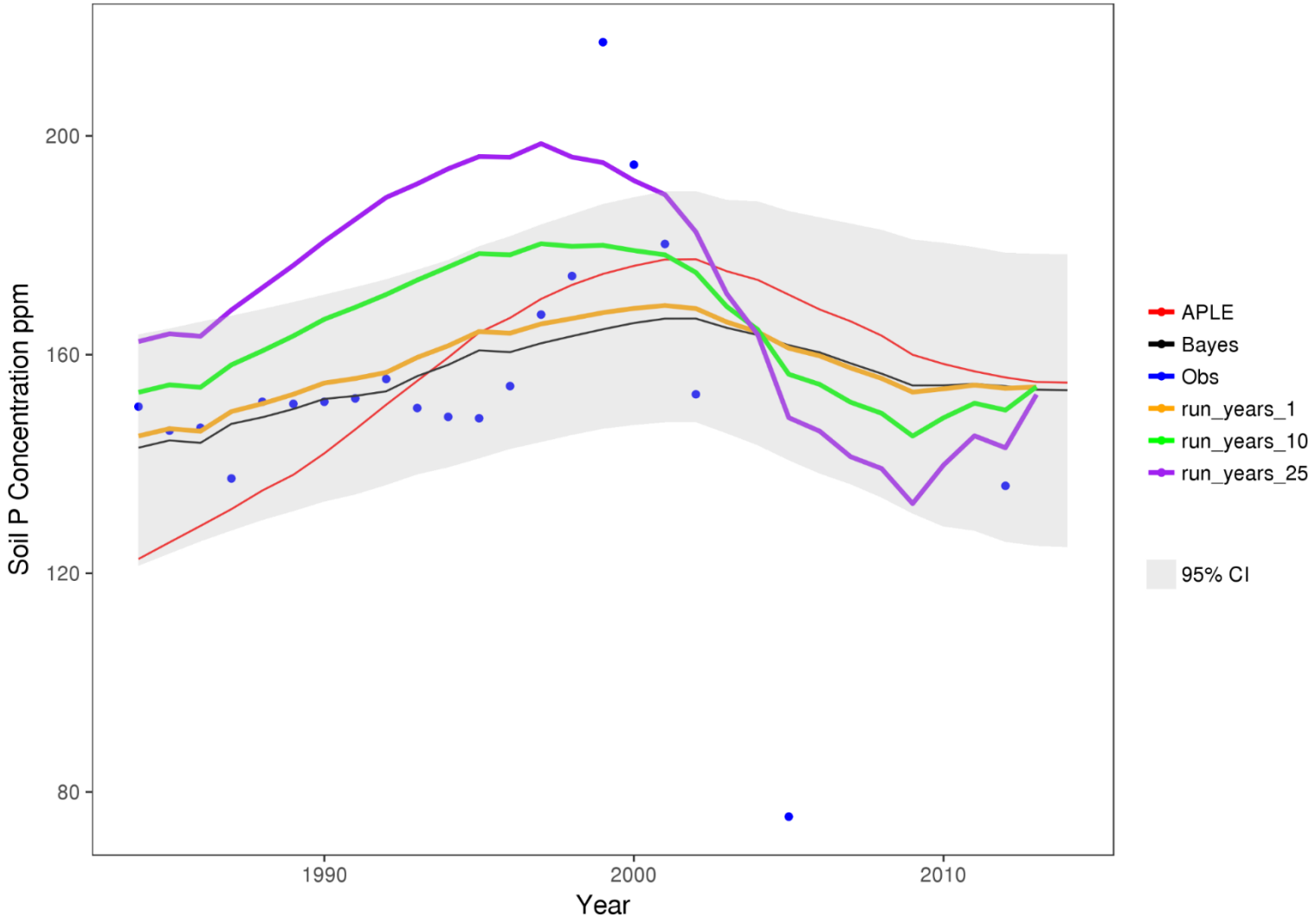

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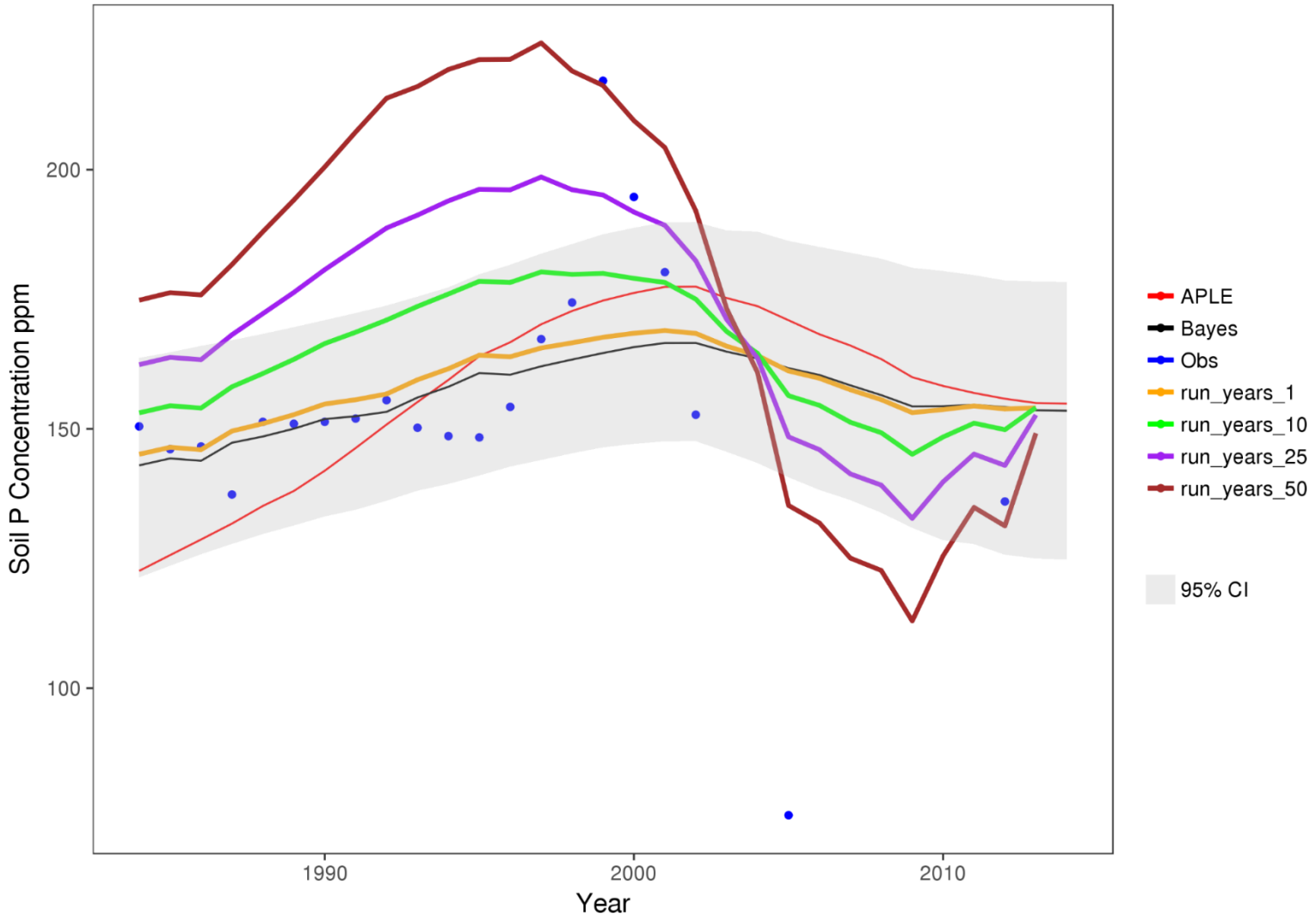

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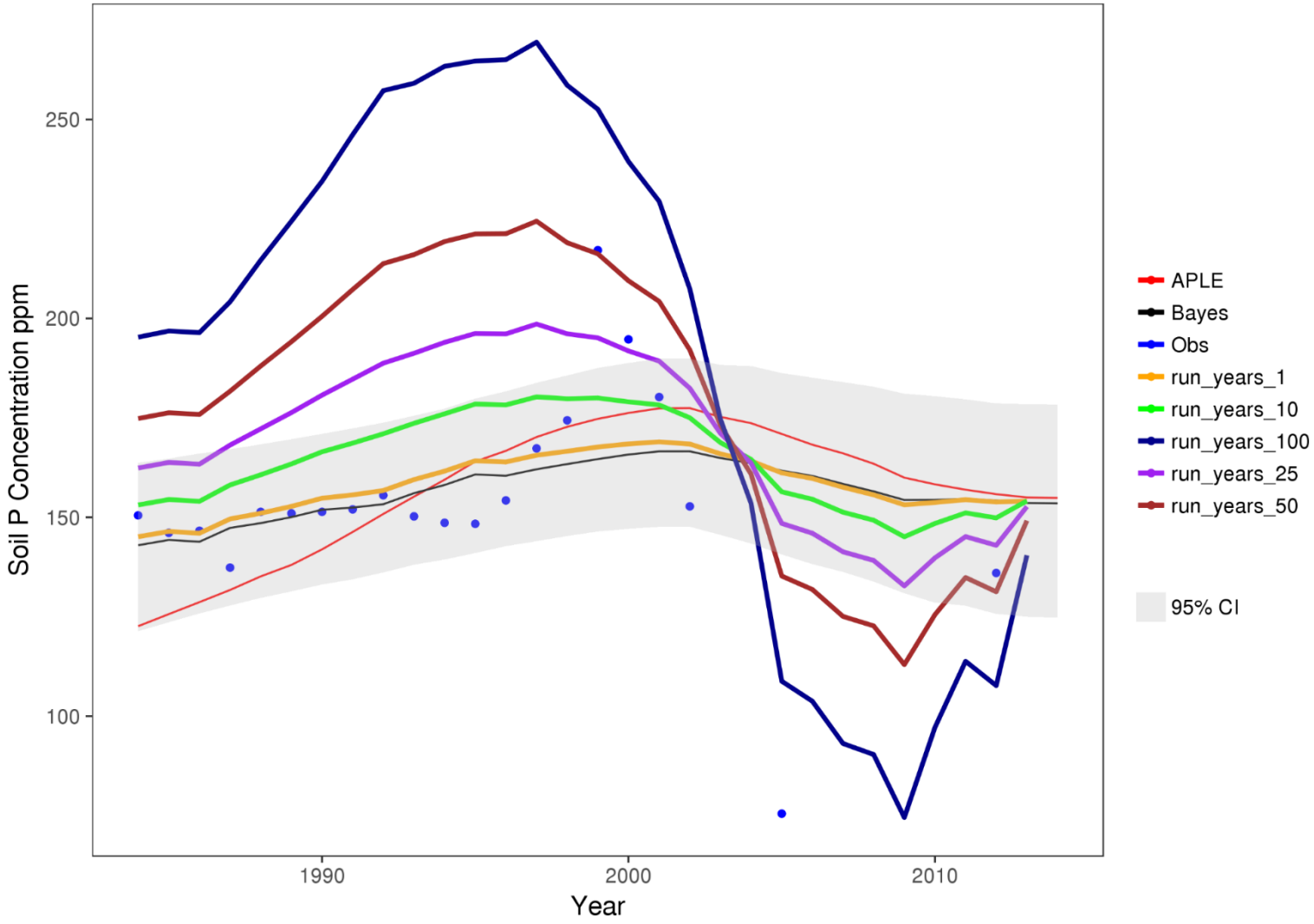
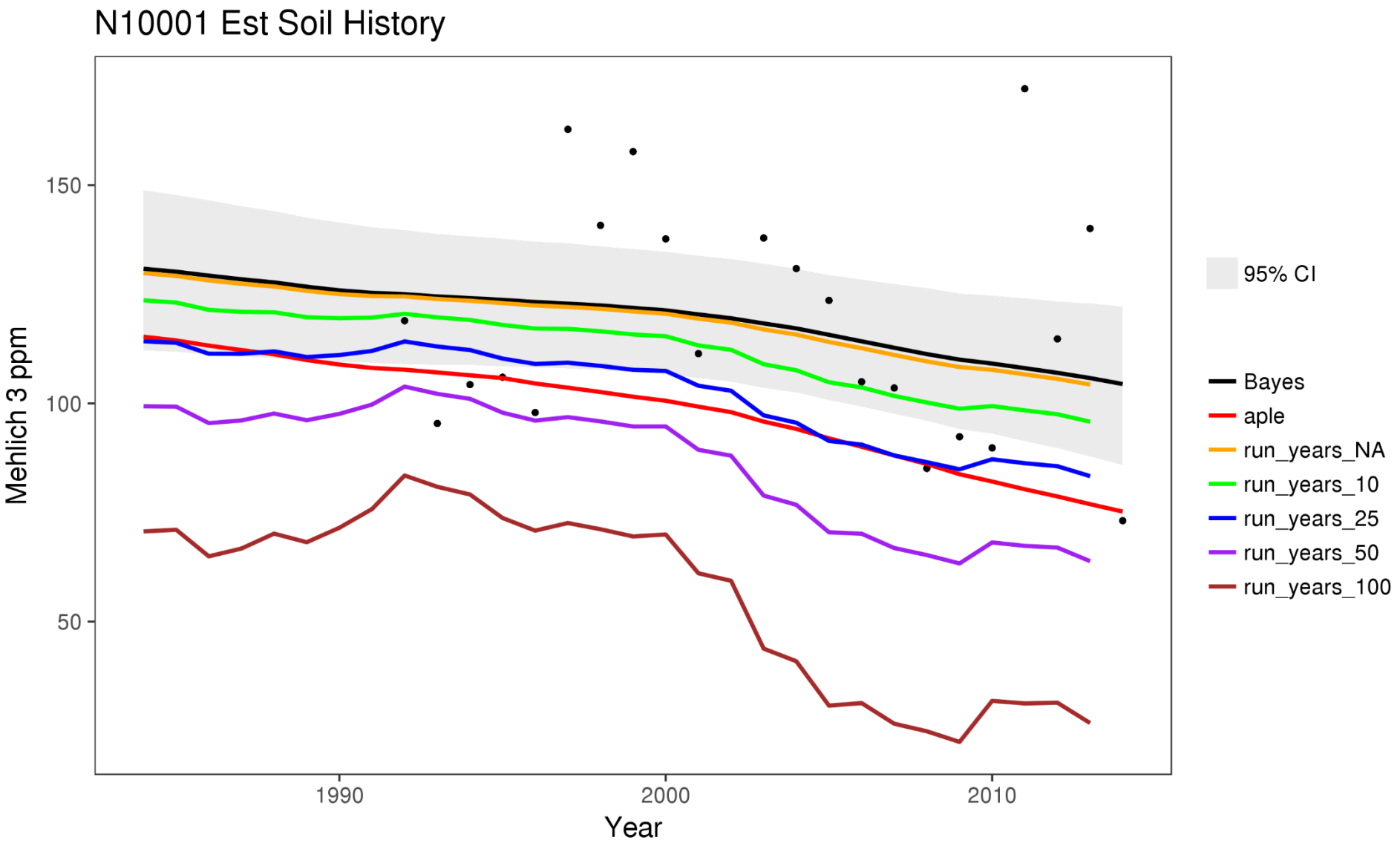
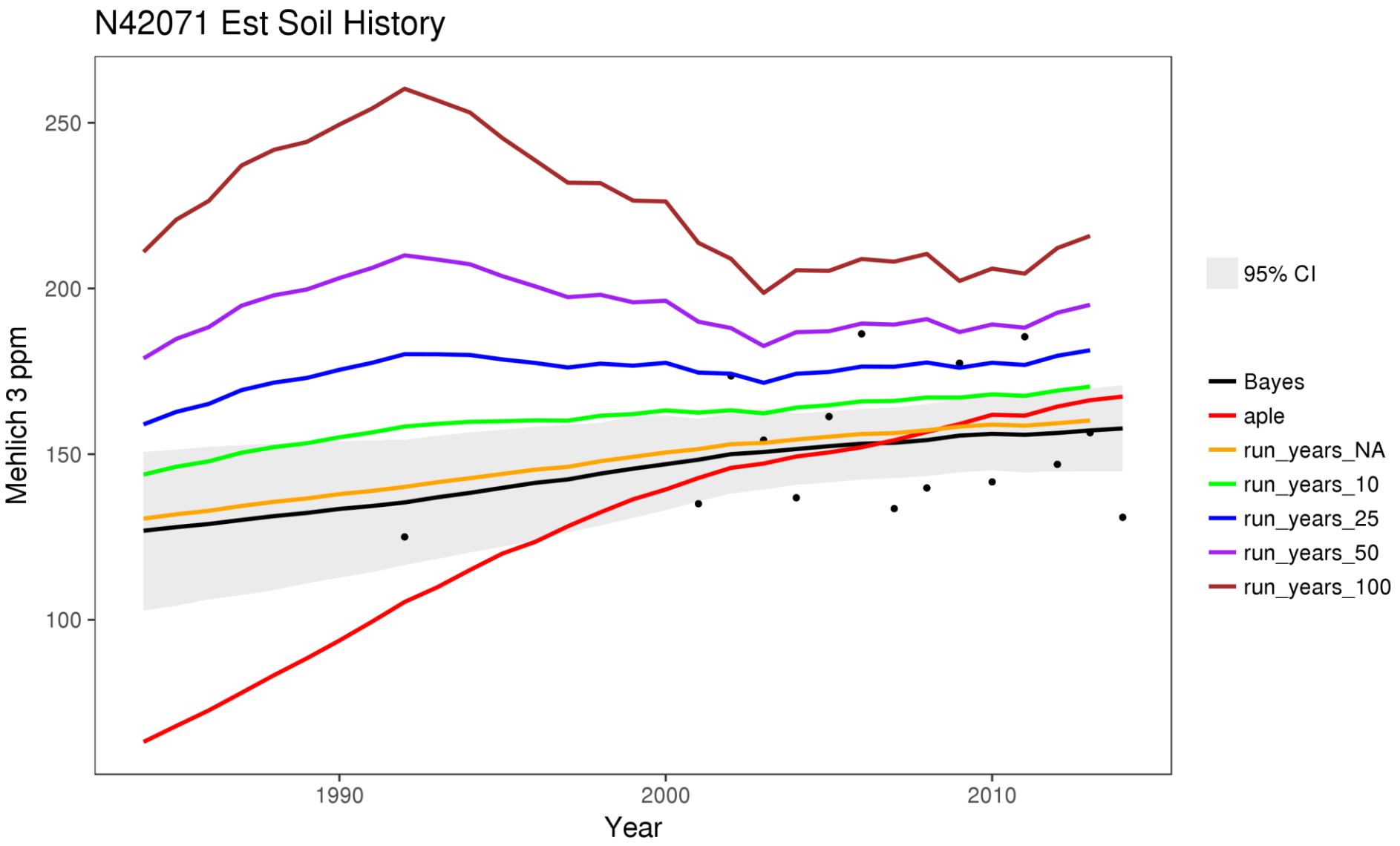


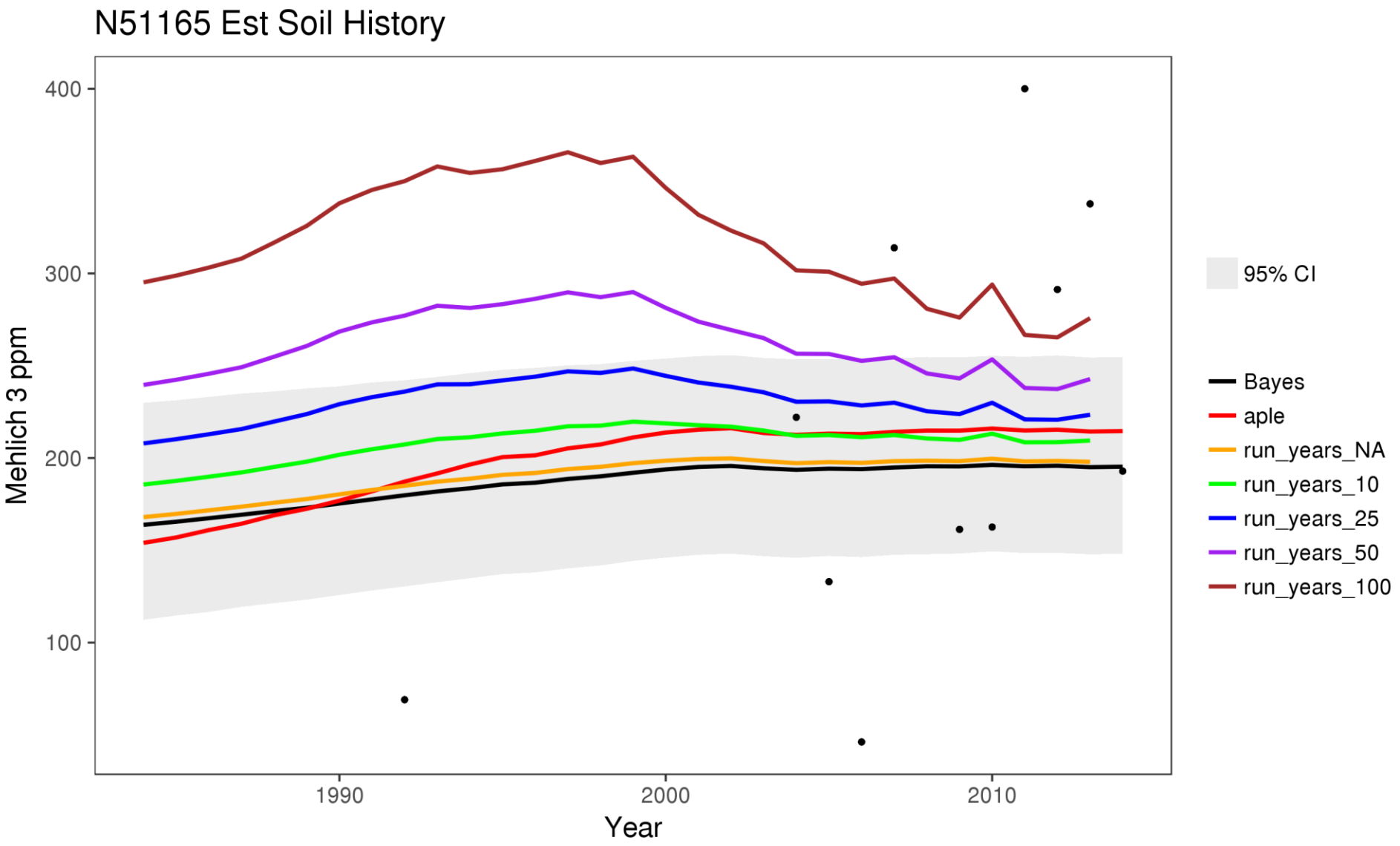
Kent, DE


N10001 Est Soil History
Mehlich 3 ppm
150
100
50
1990
2000
2010
Year
95% CI
Bayes
aple
run_years_NA
run_years_10
run_years_25
run_years_50
run_years_100

Lancaster, PA



Rockingham, VA



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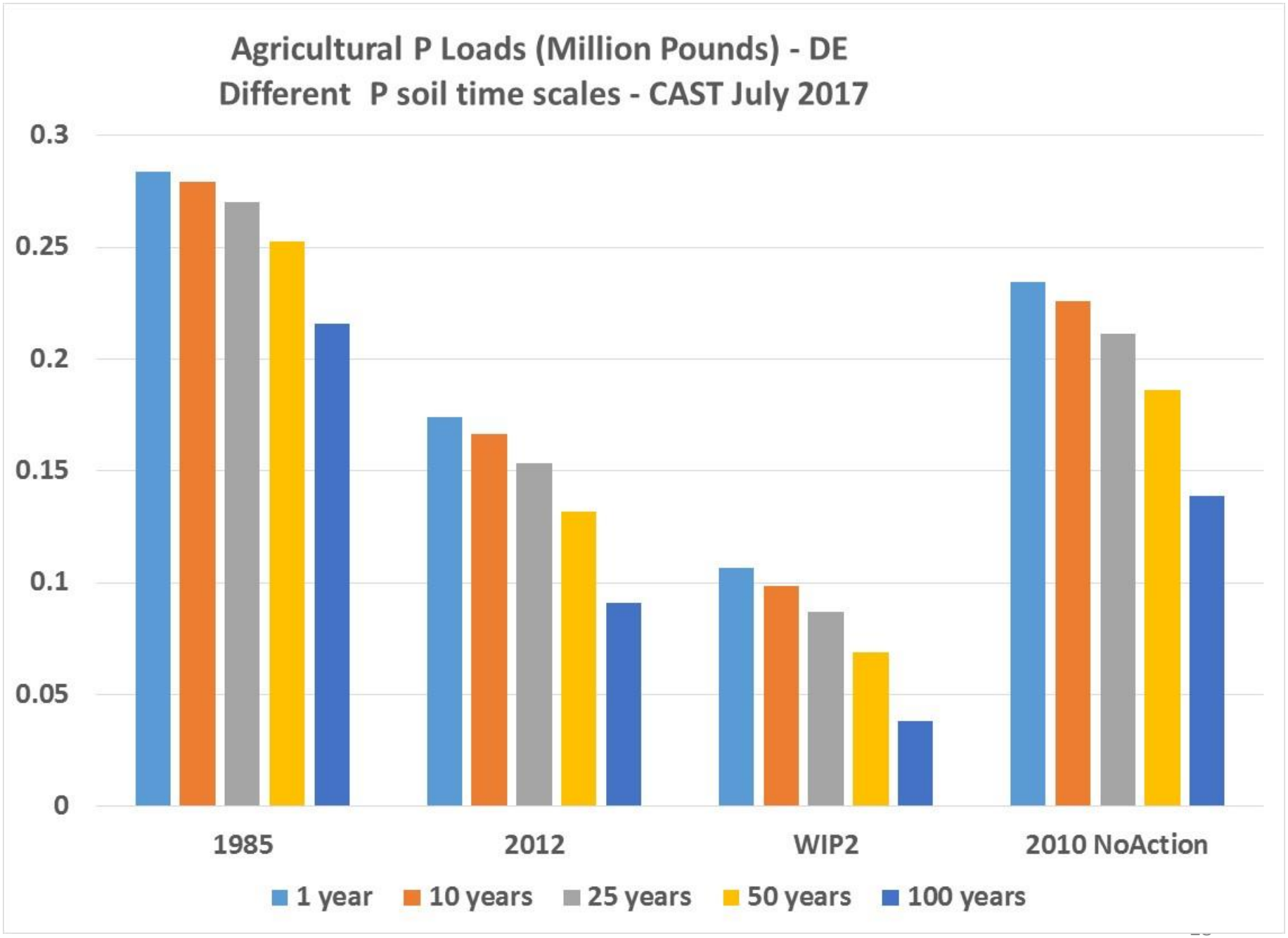
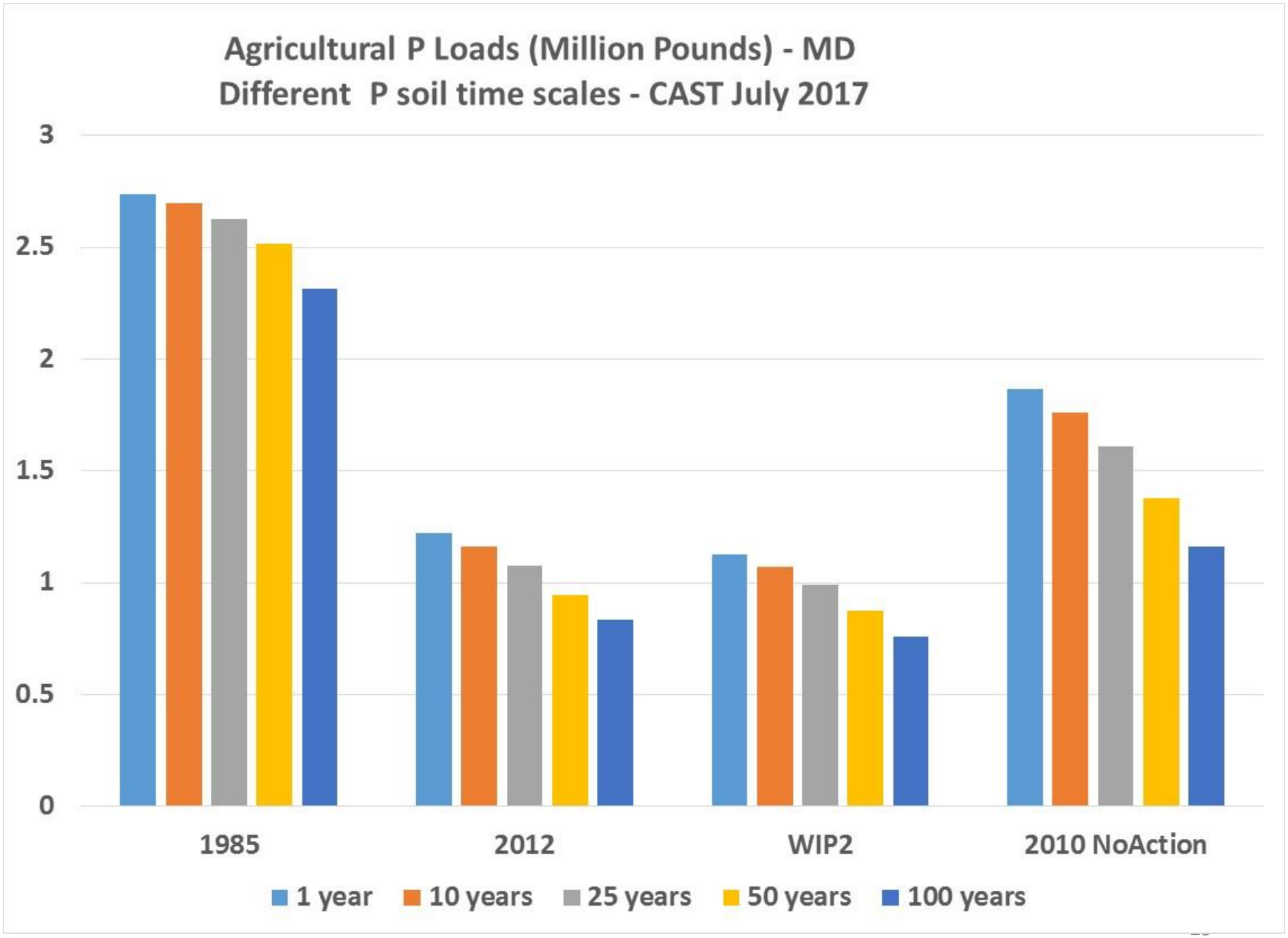
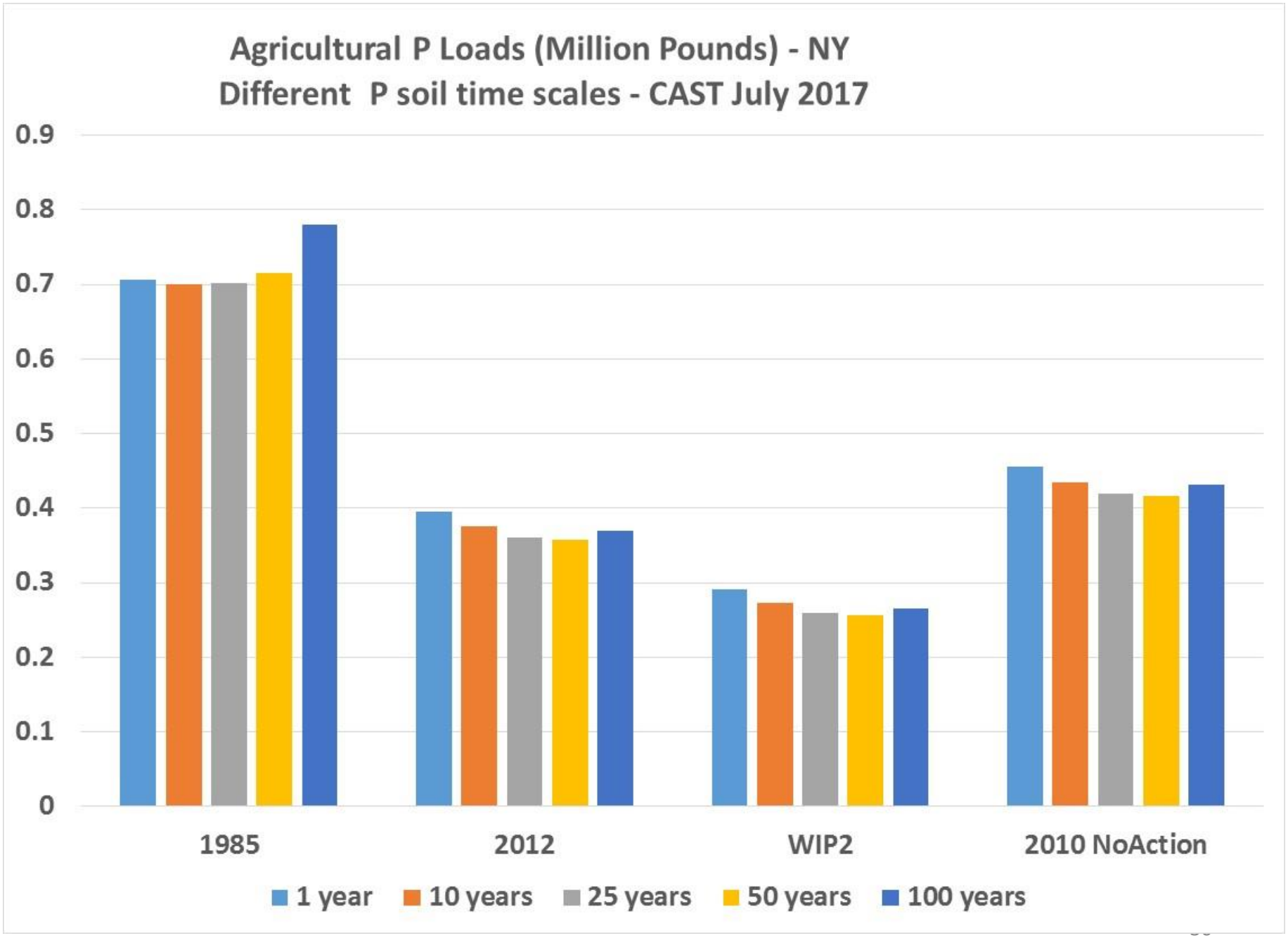
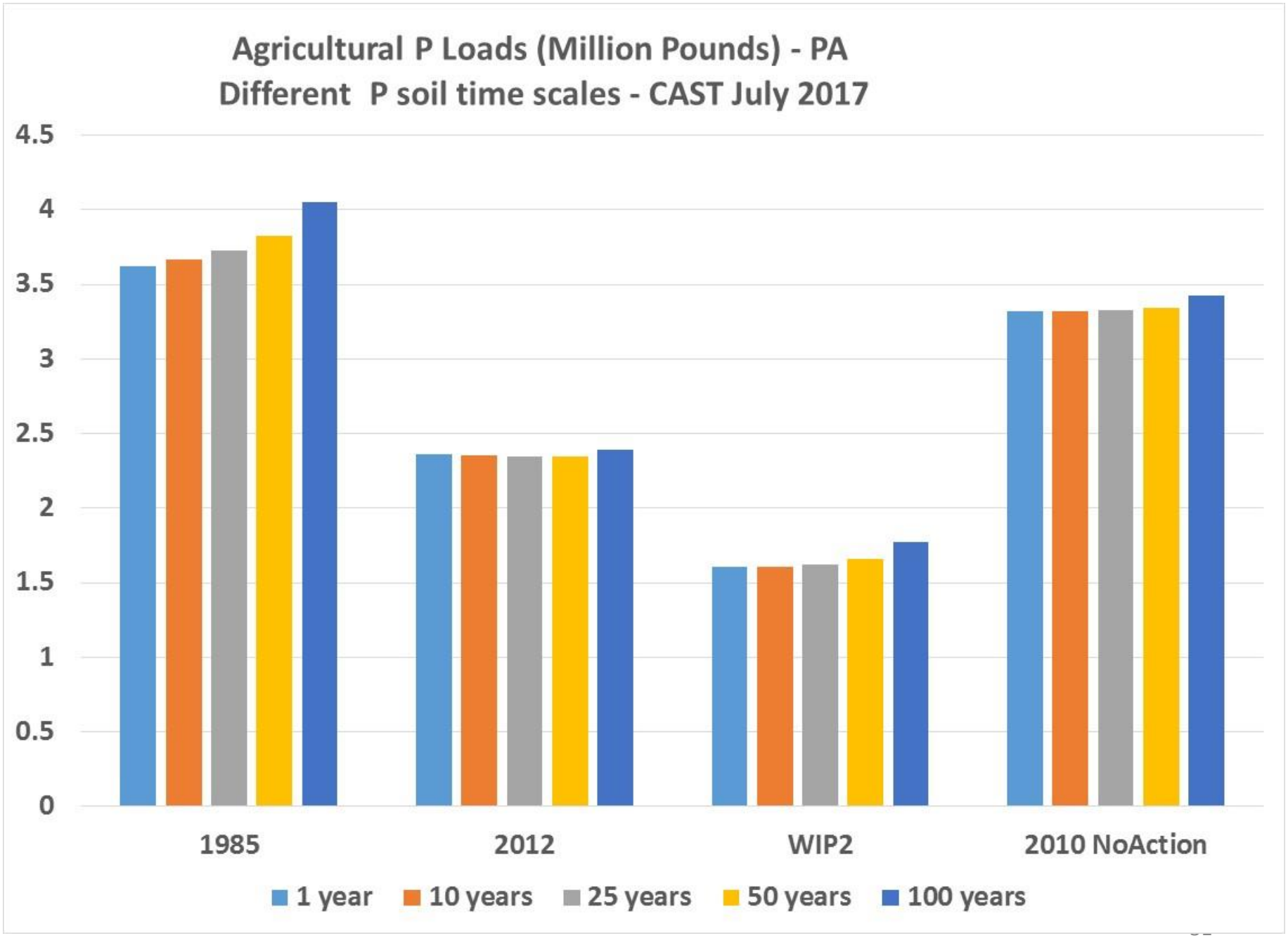
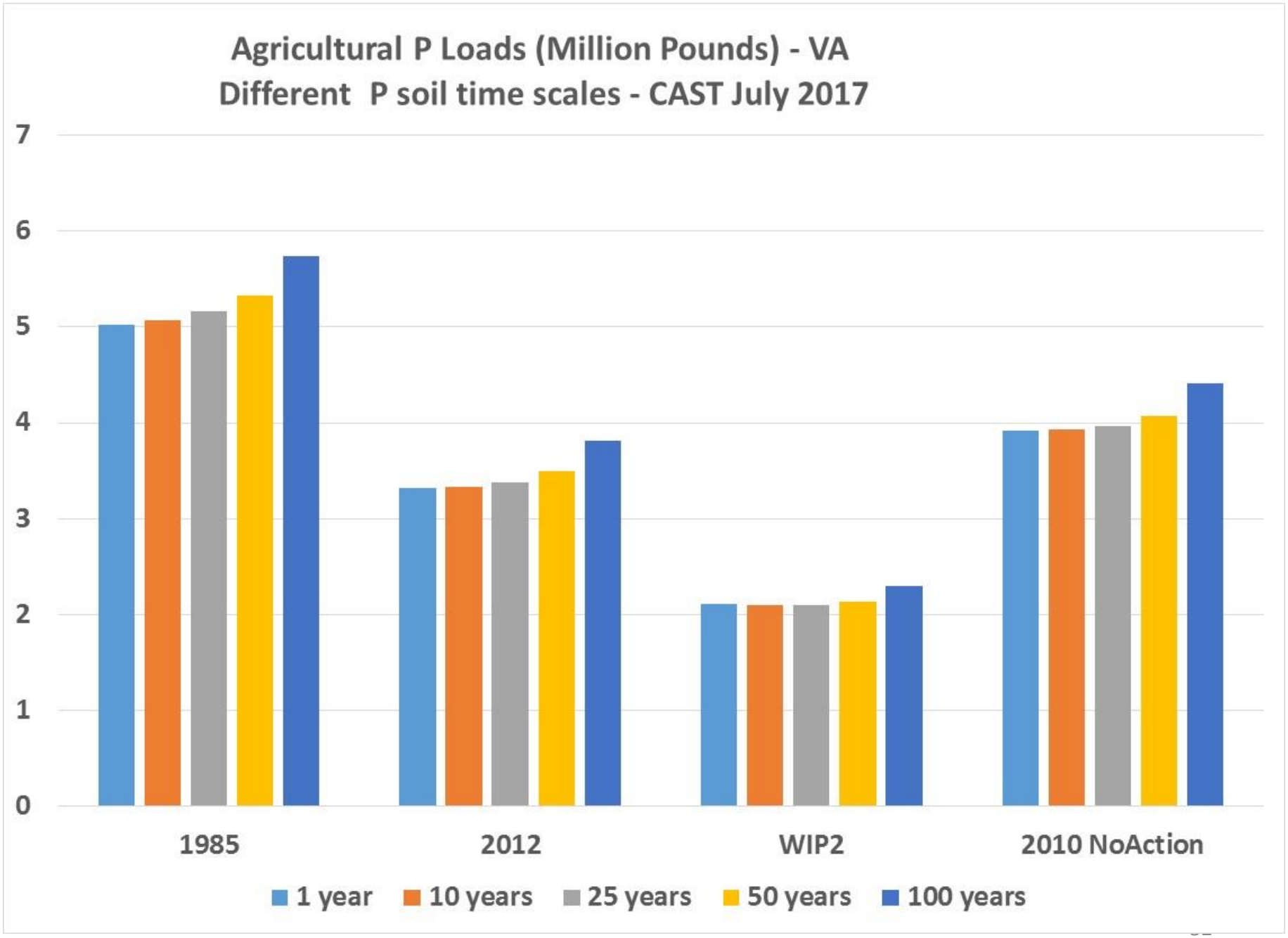
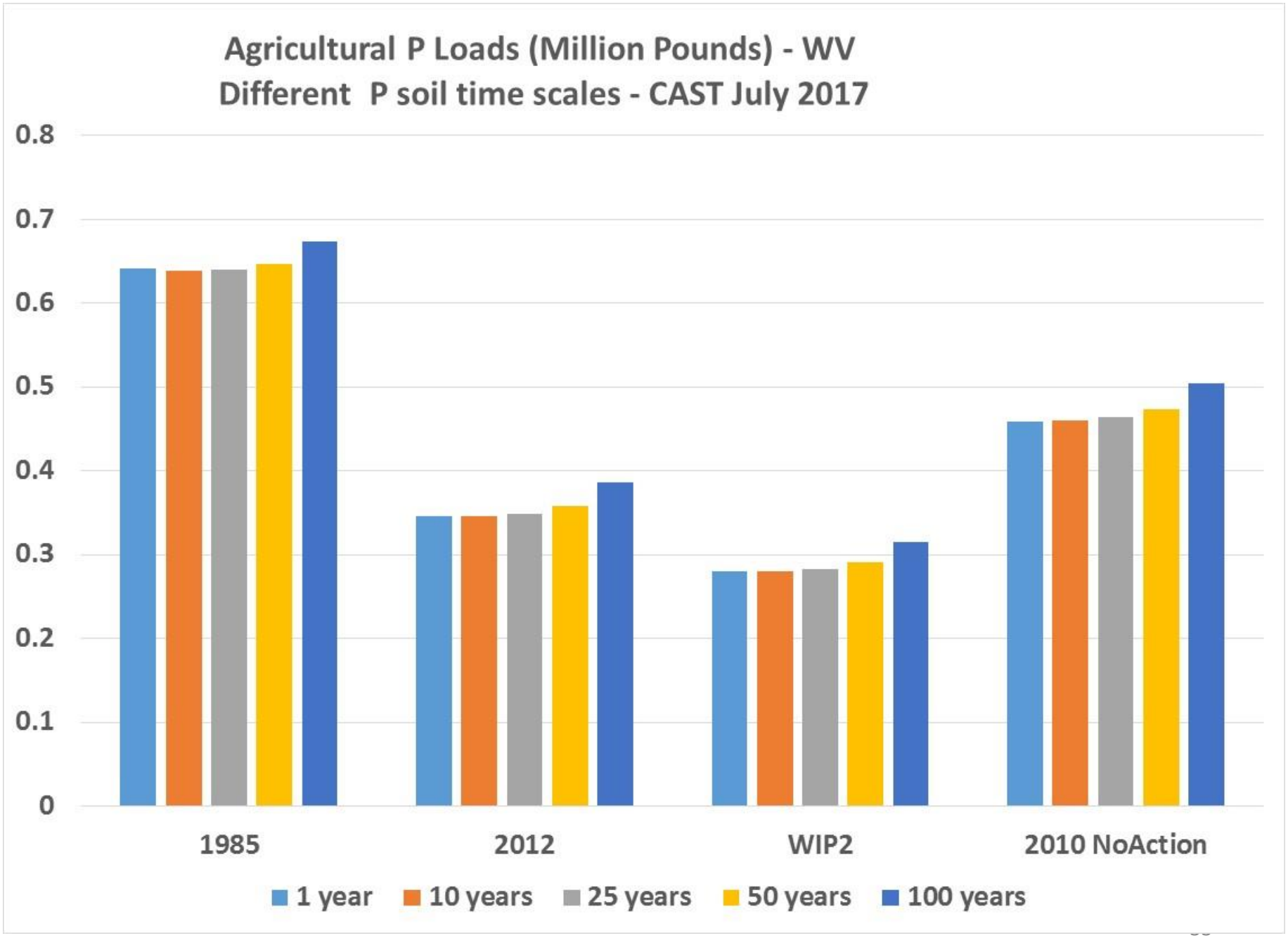

Agricultural P Loads (Million Pounds) - DE
Different P soil time scales - CAST July 2017
0.3
0.25
0.2
0.15
0.1
0.05
0
1985
2012
WIP2
2010 NoAction
1 year
10 years
25 years
50 years
100 years

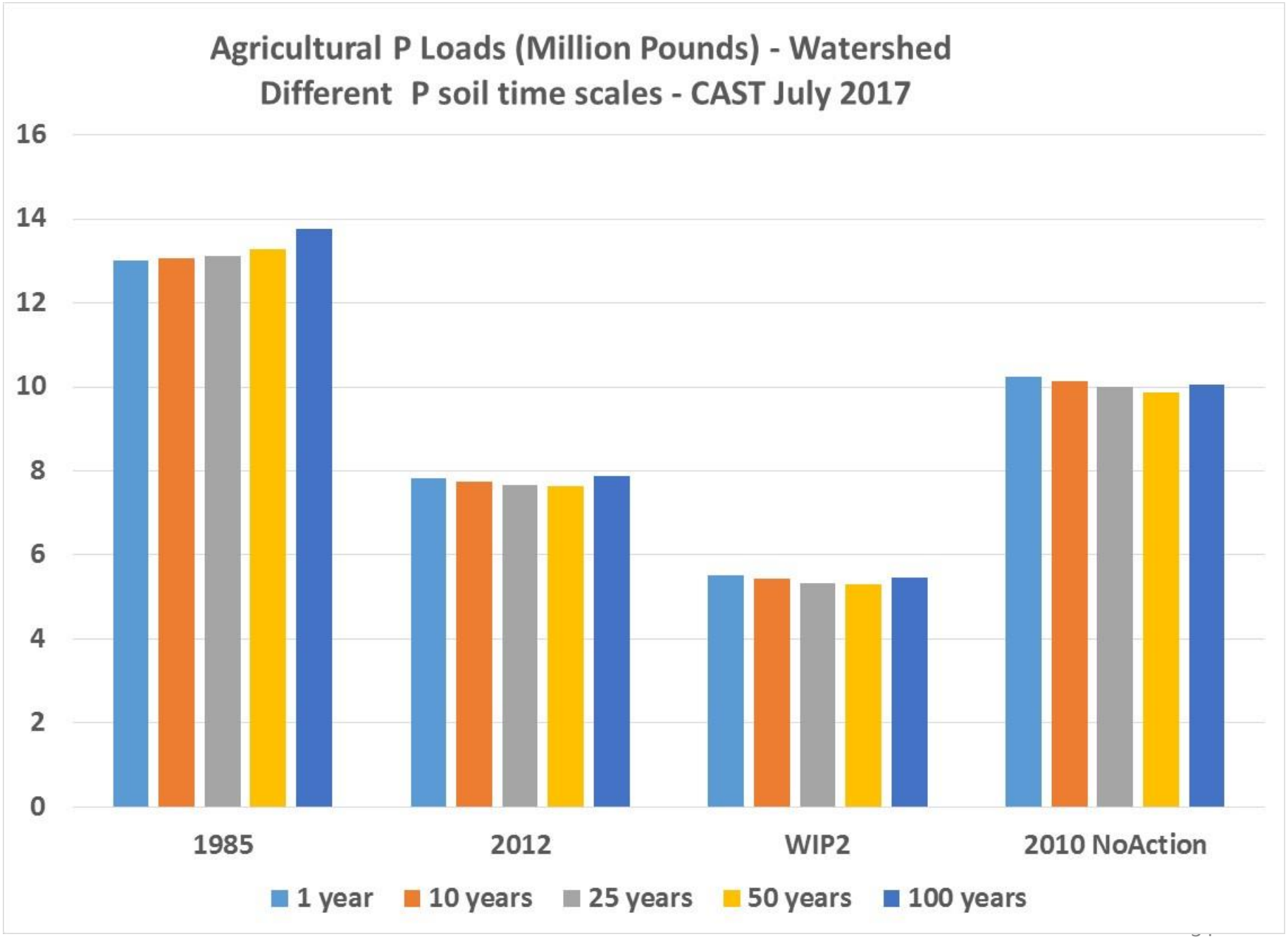

Agricultural P Loads (Million Pounds) - MD
Different P soil time scales - CAST July 2017
3
2.5
2
1.5
1
0.5
0
1985
2012
WIP2
2010 NoAction
1 year
10 years
25 years
50 years
100 years

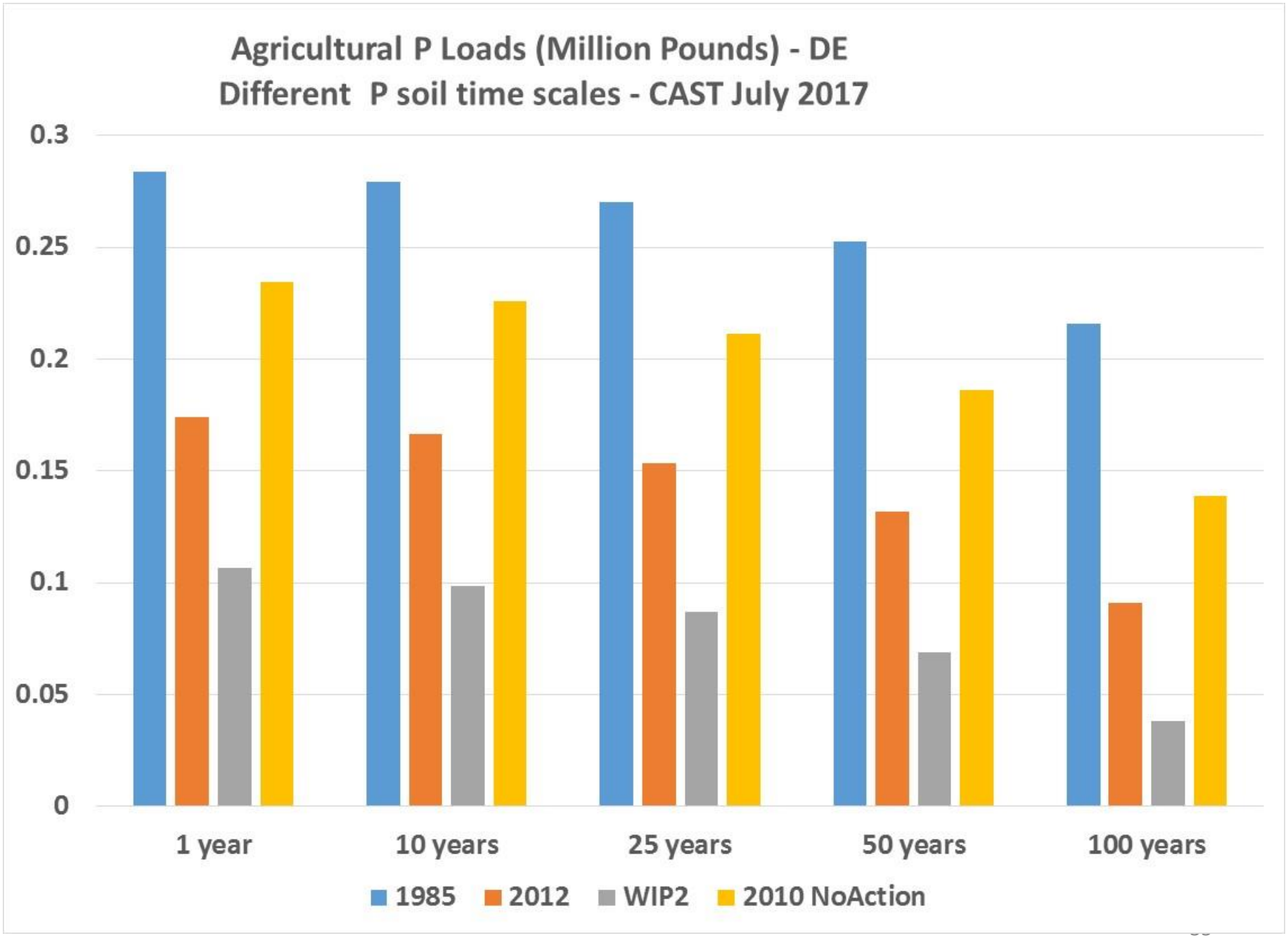

Agricultural P Loads (Million Pounds) - NY
Different P soil time scales - CAST July 2017
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1985
2012
WIP2
2010 NoAction
1 year
10 years
25 years
50 years
100 years


Agricultural P Loads (Million Pounds) - PA
Different P soil time scales - CAST July 2017
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1985
2012
WIP2
2010 NoAction
1 year
10 years
25 years
50 years
100 years


Agricultural P Loads (Million Pounds) - VA
Different P soil time scales - CAST July 2017
7
6
5
4
3
2
1
0
1985
2012
WIP2
2010 NoAction
1 year
10 years
25 years
50 years
100 years


Agricultural P Loads (Million Pounds) - WV
Different P soil time scales - CAST July 2017
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1985
2012
WIP2
2010 NoAction
1 year
10 years
25 years
50 years
100 years


Agricultural P Loads (Million Pounds) - Watershed
Different P soil time scales - CAST July 2017
16
14
12
10
8
6
4
2
0
1985
2012
WIP2
2010 NoAction
1 year
10 years
25 years
50 years
100 years


Agricultural P Loads (Million Pounds) - DE
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0.3
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0.2
0.15
0.1
0.05
0
1 year
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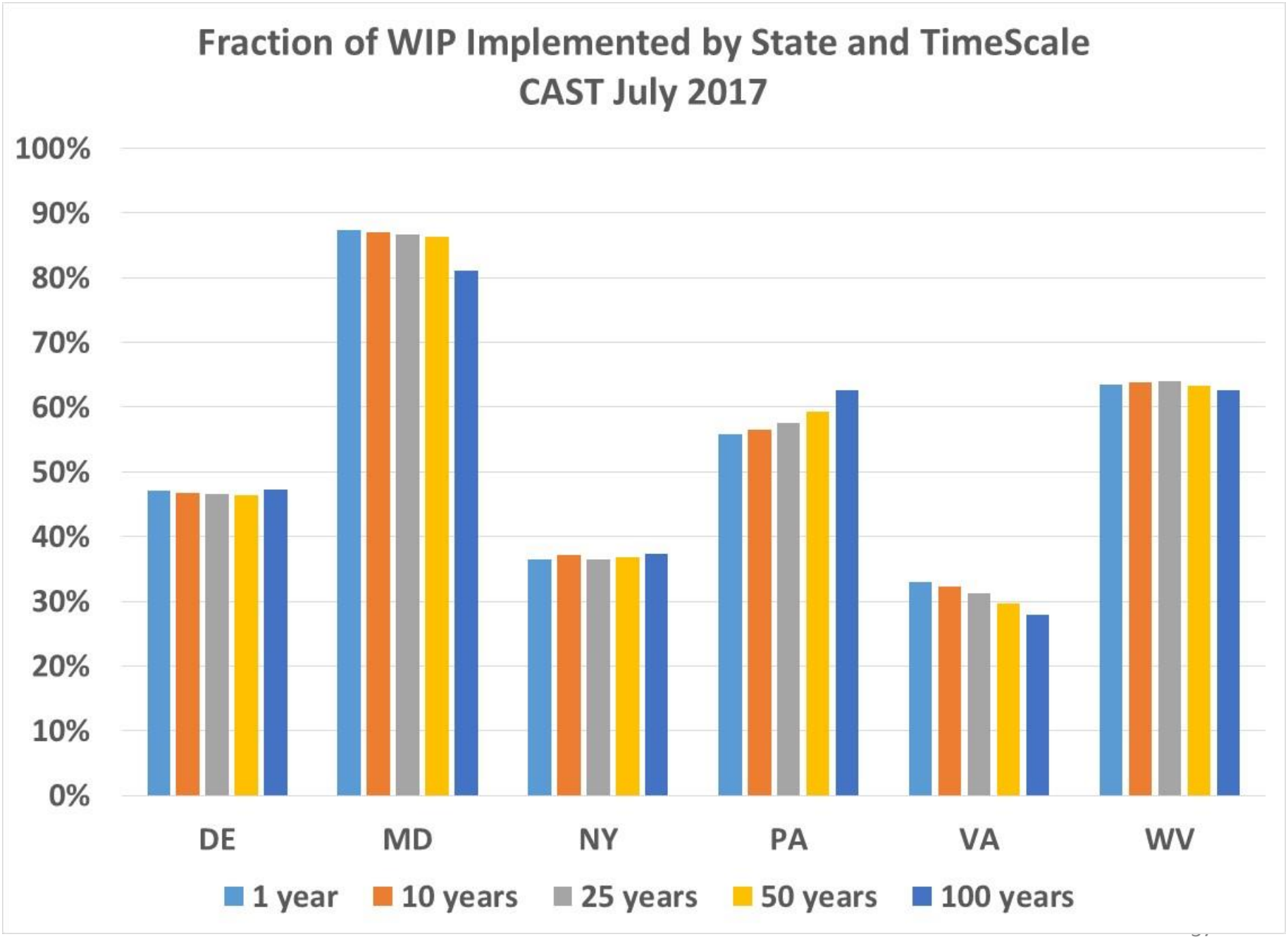
100 years
1985
2012
WIP2
2010 NoAction

How far are we in implementing WIPs?

- Compare (2010 NoAction – 2012) to
  (2010 NoAction – WIP2)


Fraction of WIP Implemented by State and TimeScale
CAST July 2017
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
DE
MD
NY
PA
VA
WV
1 year
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25 years
50 years
100 years

AgWG recommendation

- Decision: The AgWG made a recommendation to the WQGIT to move forward with implementing a 25-year time frame for P simulation in the initial Phase 6 scenarios. During the summer of 2017, other time-frames of 1, 10, 25, and 100 years will be tested, and this decision will be revisited during fall of 2017.

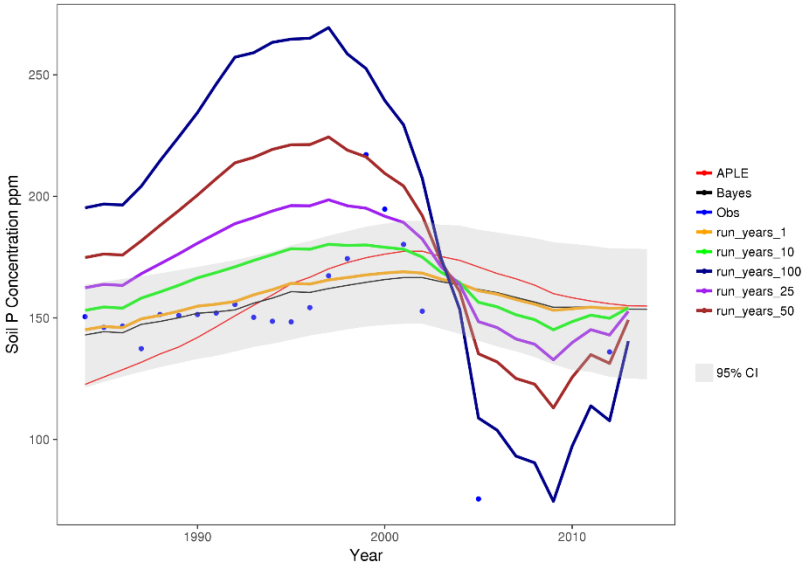
Summary

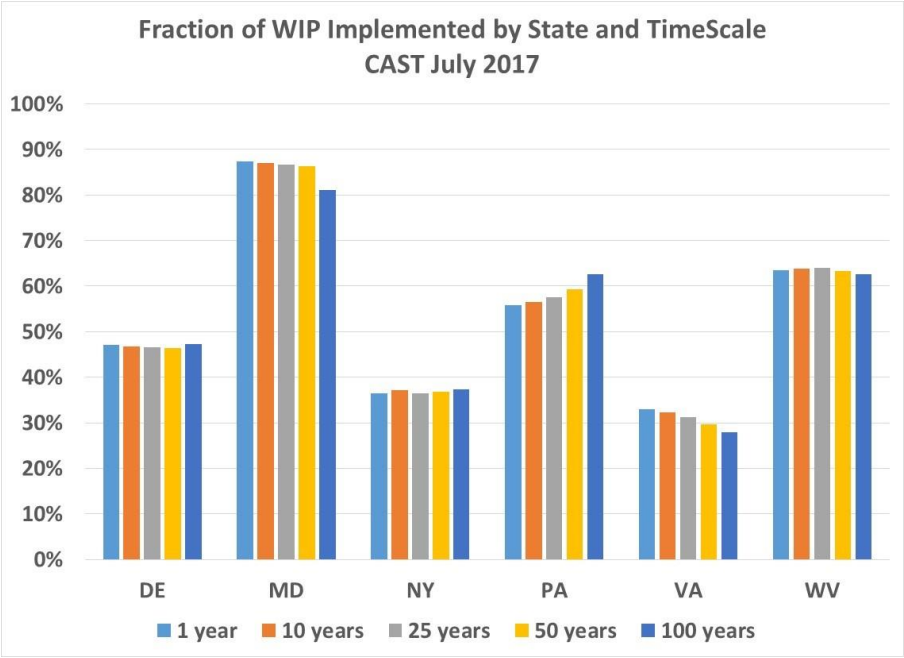
- Significant change in load for some states as we consider longer time frames
  - Others see little difference
- Not much change in assessment of implementation
- More uncertainty in longer time frames

- Decision does not affect the calibration, only scenarios.

- Will make scenarios and history available

Thoughts?





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  - Wastewater progress is measured in "current year" format.
  - Low uncertainty, low effect
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