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On-Field Ohio !

Evaluate/Revise the Ohio P Risk Index using Field-Scale Edge-of-Field Monitoring Data

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Agenda

- Introduction/Background
- Research Process
- Some Results/Findings

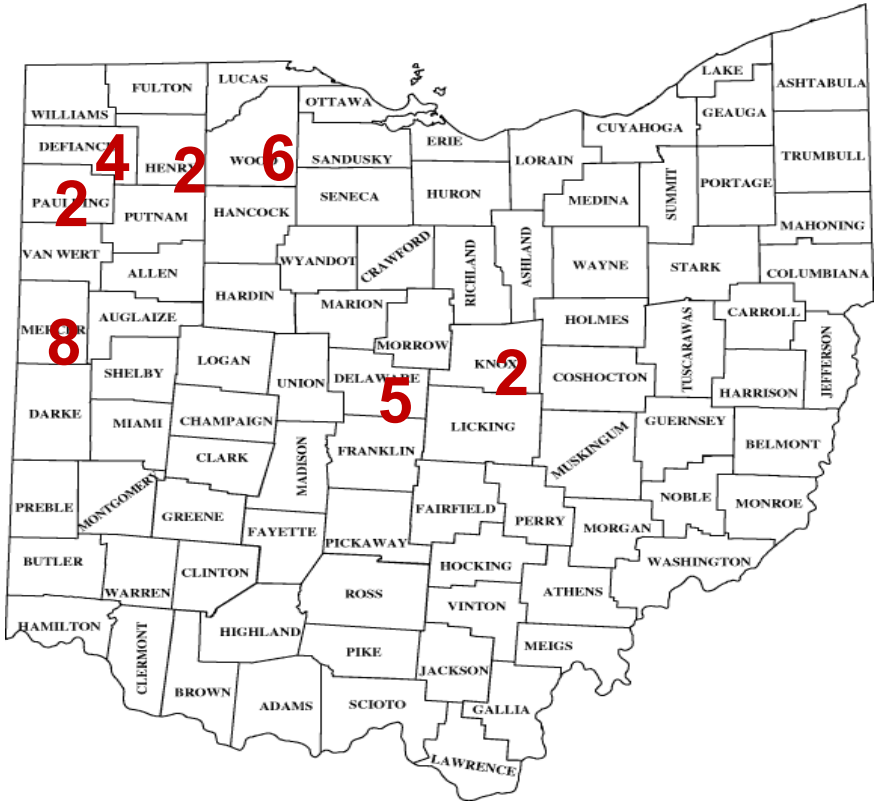
The Ohio P Index intended to provide a field-scale estimate of P runoff RISK

Includes:
4Rs & Tri-State Fertility Guidelines

Allow Farmers to Assess their own Field-Scale P Runoff Risk

Increasingly
Used to Judge Farmer Performance
So We Have to Get it Right !

Introduction



29 Field Sites

Project Sites

- 8 in GLSM
- 7 in Scioto
- 14 in WLEB

Most with Surface & Tile runoff samplers

Special Thanks to our Participating Farmers

Introduction

Tile Runoff

Surface Runoff

- Identify contributing areas
- Install sampler
- Measure water flow (Q)
- Collect runoff samples

On-Field Ohio!

Ohio P Risk Index Parameters	Sub-Value Score
Erosion Potential (RUSLE2)	Ton/acre/yr
Connectivity to water	0 - 16
Runoff Class	0 - 15
Soil Test P (Bray-P1, ppm)	STP X 0.07
Amount Fert / Manure	P_2O_5 X 0.05
Placement Meth. Fert / Manure	0 - 6
Filter Strip (Yes/No)	2
Total	P Index Score

< 15 = Lo, 5–30 = Med, 31–45 = Hi, > 45 = Very Hi

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Research Process

Initial Evaluations

Multiple Scales
- **State-Wide**
- **Field-Scale**
- **Small Plot-Scale**

Research Process

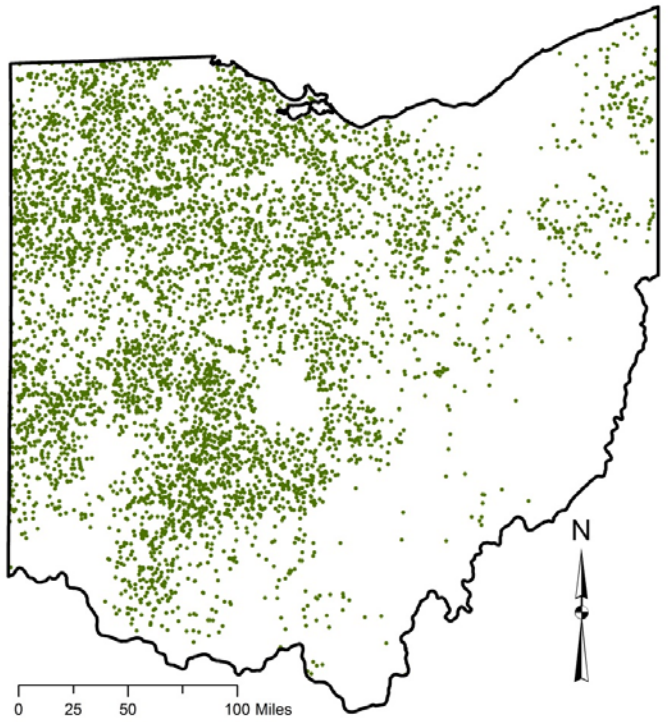
Statewide Simulations

Run Test Scenarios:

- **All Point Locations**

Output for Both

- **Erosion (RUSLE2)**
- **Ohio P Risk Index**



6134 Point Locations

Results for: Each P Index Parameter for Each Crop Year & Rotation Avg.

Thanks Steve Baker & Mike Monin, Ohio-NRCS

Research Process

Simulator Continued

Precursor to P Index Delivery Tool

So Farmers can calculate their P Index scores

Currently Used Internally

Assist with P Index Revision Decisions

Illustrate Impact of Potential Changes

Sensitivity Analysis
JEP 2017 8(2)141-158

Ultimately can be Used for Education

Illustrate Impacts of Crop Mngmnt Decisions

Field-Scale / Regionally / Statewide

Sensitivity Analysis Results

Ohio P Index Parameter	Explanatory Power %
Soil Test P	32
Connectivity to Water	30
Erosion Potential	13.4
Fert./Manure Amount	11.3
Runoff Class	9.5
Fert./Manure Plcmt Meth.	2.2
Filter strip	2.0

Test Simulations of Ohio P Index & Erosion

Across 4 Crop Management Scenarios (CMS) of Increasing soil disturbance

STIR = Soil Tillage Intensity Rating (0 – 100)

	STIR	Farmer Management Scenario
1	2.6	NT Soybeans / NT Corn
2	7.8	NT Soybeans / NT Corn Fall coulter caddy, w/ smooth coulters, rolling basket incorporator
3	38.3	NT Soybeans Fall Chisel / Spring Cultivator Corn
4	93.6	Spring Chisel/Cultivator Soybeans Fall plow, moldboard / Spring disk/cultivate Corn

Thanks to T.J. Oliver Ohio-NRCS, Chilicothe

Parameter	Sub-Value Score
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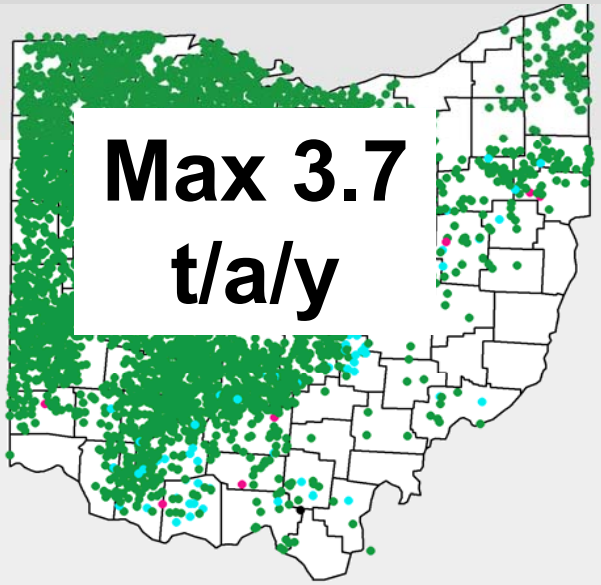
Erosion Matters

RUSLE2 Output

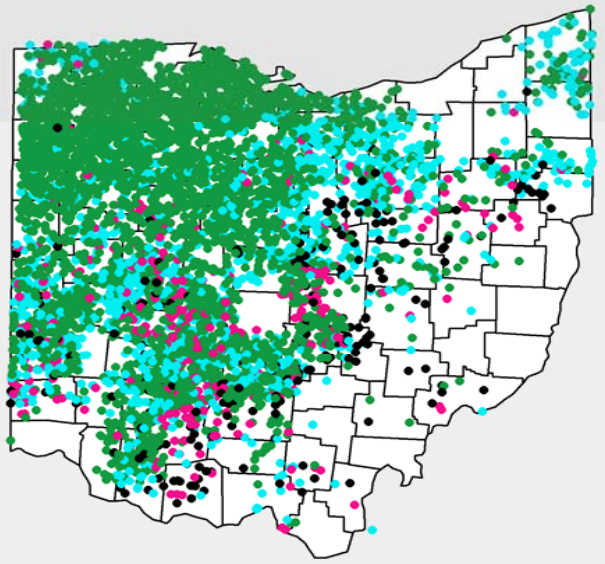
Erosion t A^{-1} yr^{-2}

- < 1
- 1 - 2
- 2 - 3
- > 3

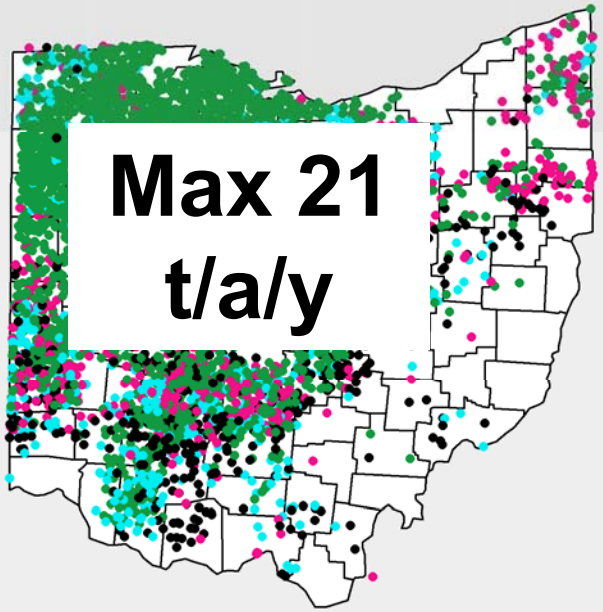
(1) STIR = 2.6



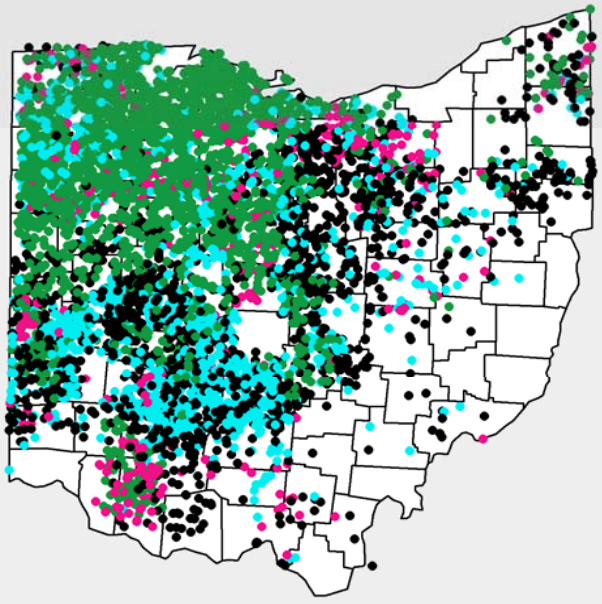
(2) STIR = 7.8



(3) STIR = 38.3



(4) STIR = 93.6



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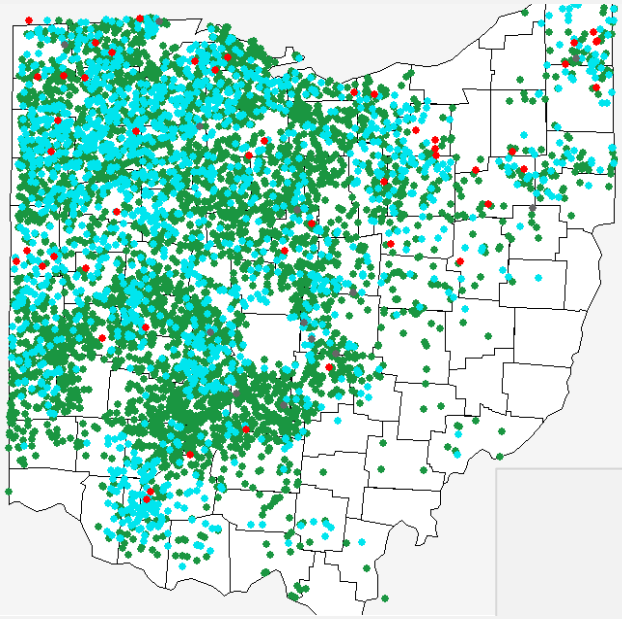
Resulting Ohio P Index Scores

Finding:
P Index Score Not Sensitive to Erosion !

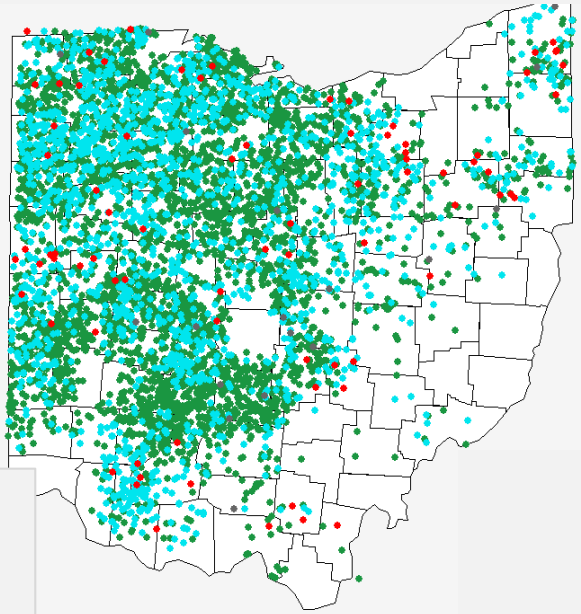
Ohio P Index Score

- Low (< 15)
- Medium (15-30)
- High (30-45)
- Very High (>45)

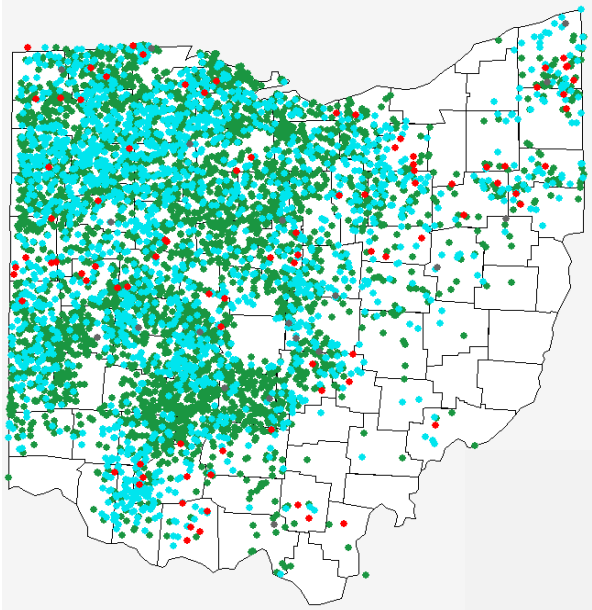
(1) STIR = 2.6



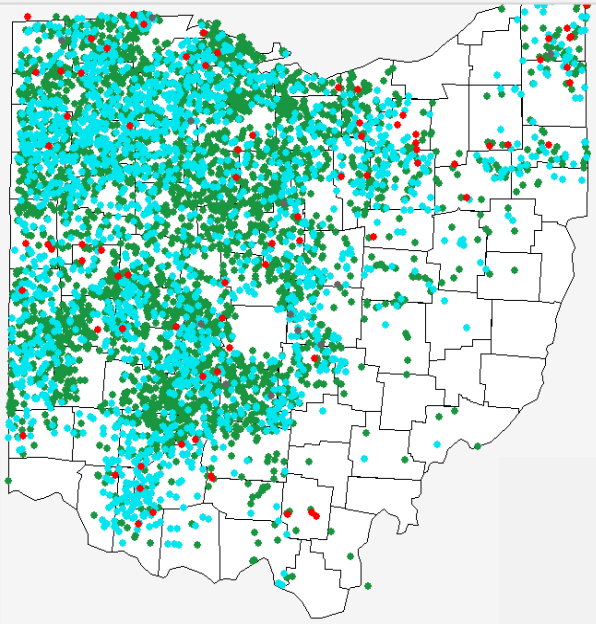
(2) STIR = 7.8



(1) STIR = 38.3



(1) STIR = 93.6



Example

Parameter	Sub-Value Score
Erosion Potential (RUSLE2)	Ton/acre/yr
Connectivity to water	0 - 16
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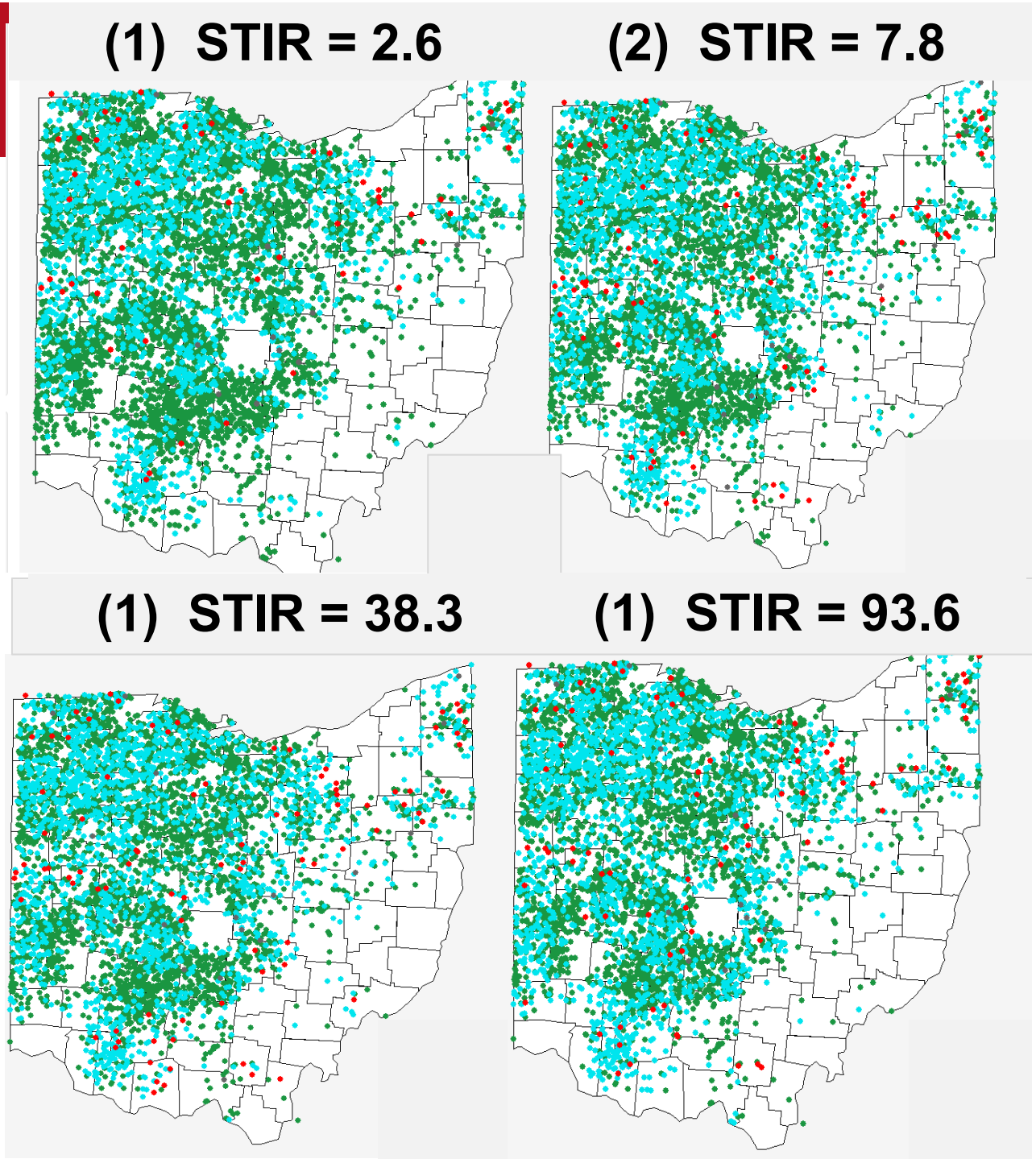
Soil Test P & P Index Scores

STP Randomly Selected from Ohio Soil Test Lab dataset

Ohio P Index Score

- Low (< 15)
- Medium (15-30)
- High (30-45)
- Very High (>45)

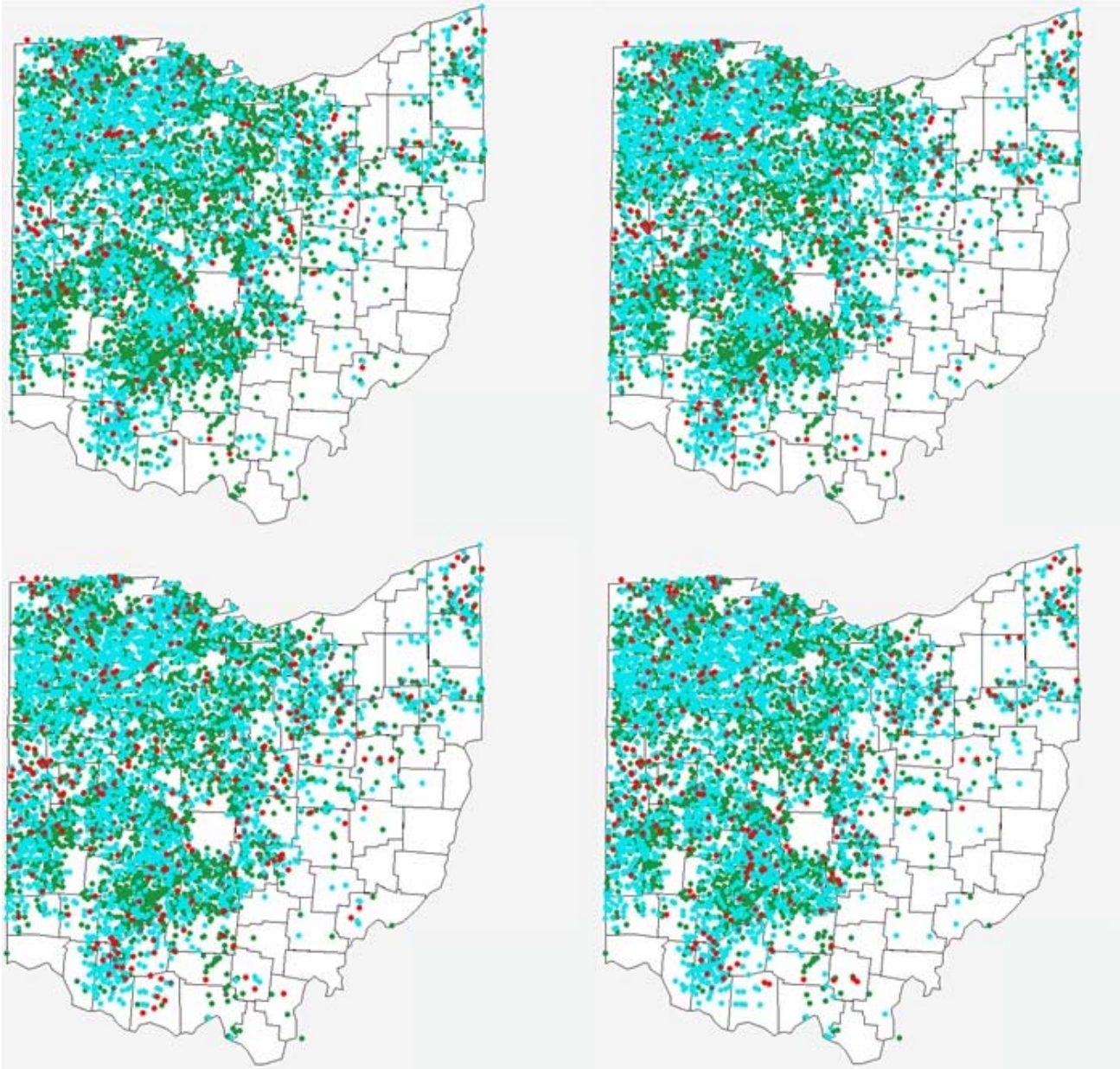


Research Process

Soil Test P & P Index Scores

STP X 2

Not much Difference?



Research Process

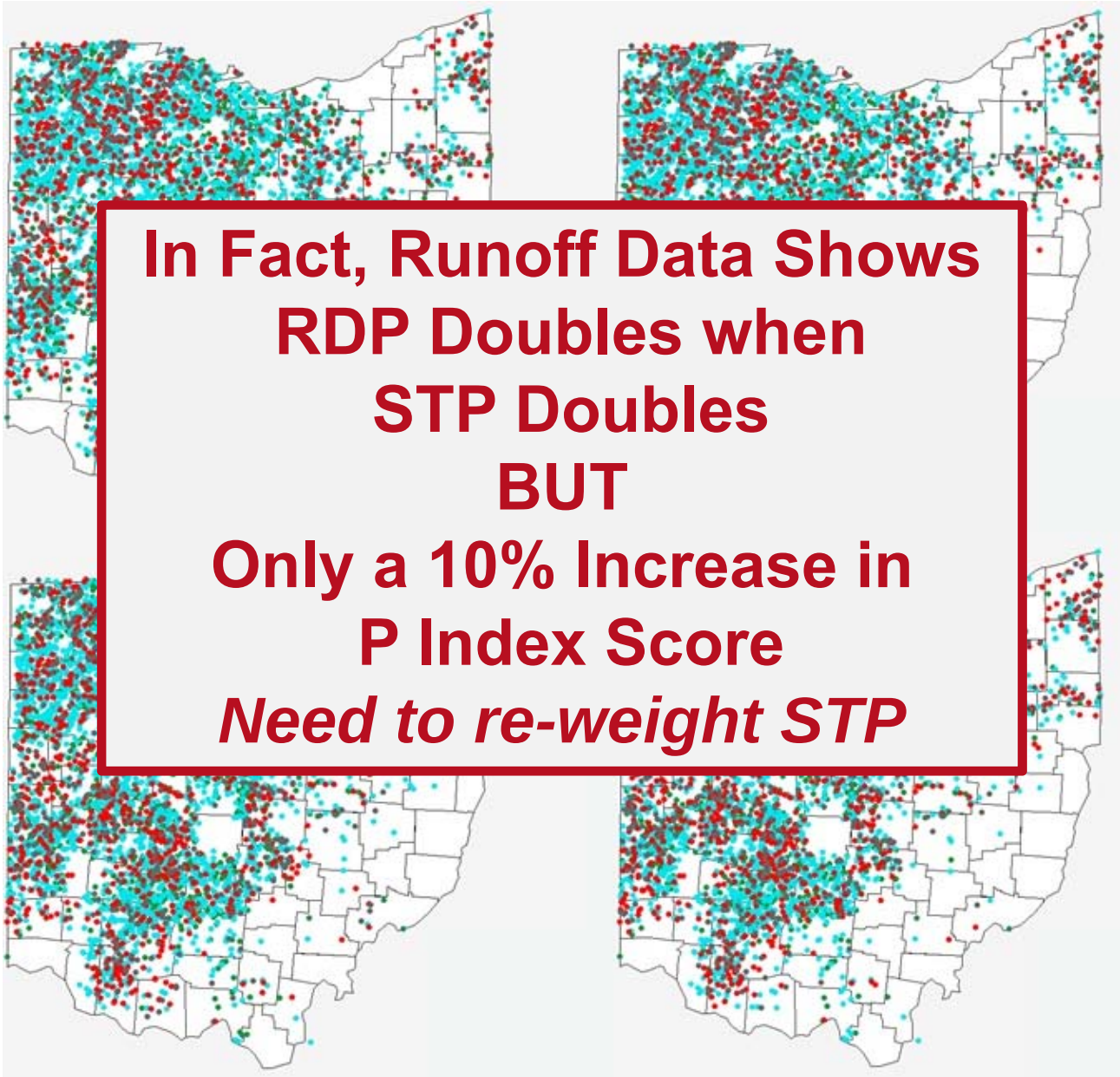
Soil Test P & P Index Scores

STP X5

Now we see differences !

Ohio P Index Score

- Low (< 15)
- Medium (15-30)
- High (30-45)
- Very High (>45)



In Fact, Runoff Data Shows RDP Doubles when STP Doubles BUT Only a 10% Increase in P Index Score

Need to re-weight STP

What does the runoff data show?
Does farmer management matter?
Is there any hope?

Examine Runoff Risk Drivers

Evaluate Spike/Baseline Events Separately

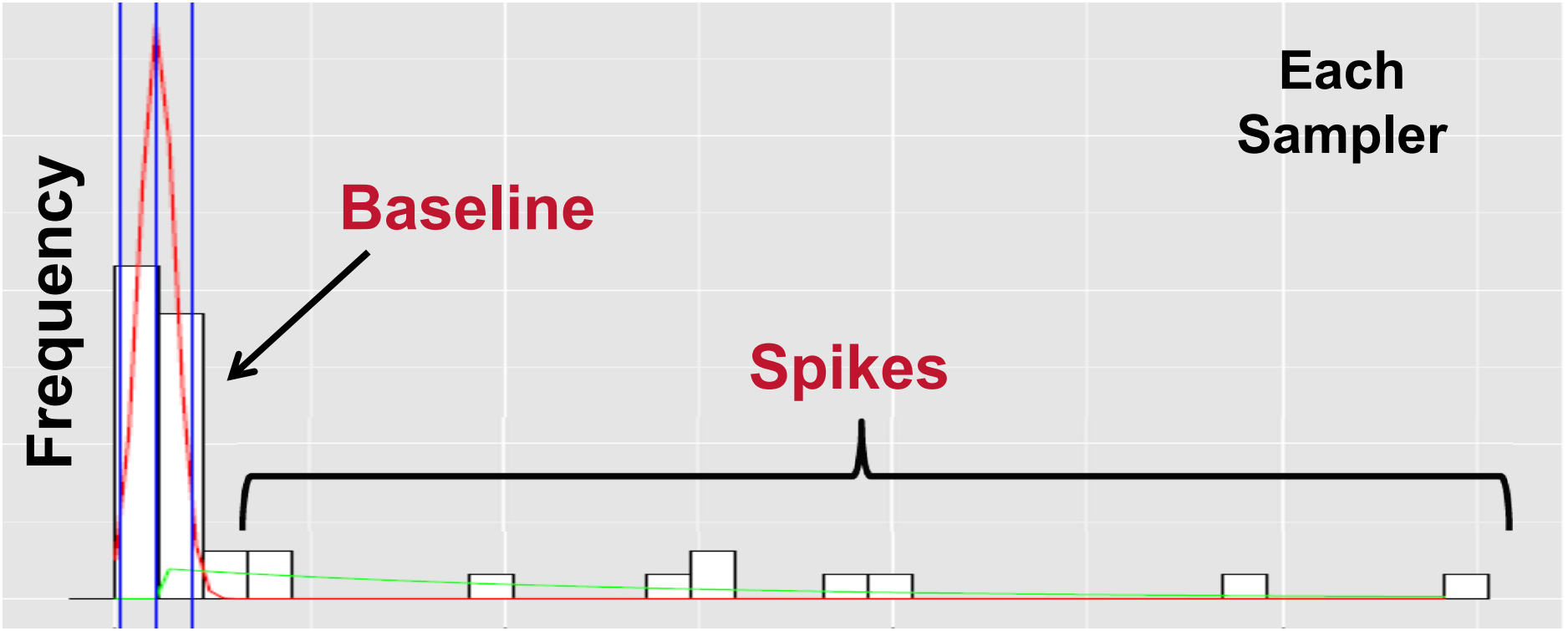
SPIKE
Short-Term
High RISK

BASELINE
Year-Round
Chronic RISK

- Gully-Washer Rainstorm
- Major Tillage Erosion
- Fertilizer Application
- Erosion / Field Cover
- Soil Test P

Novel Approach

Distribution of Runoff Events



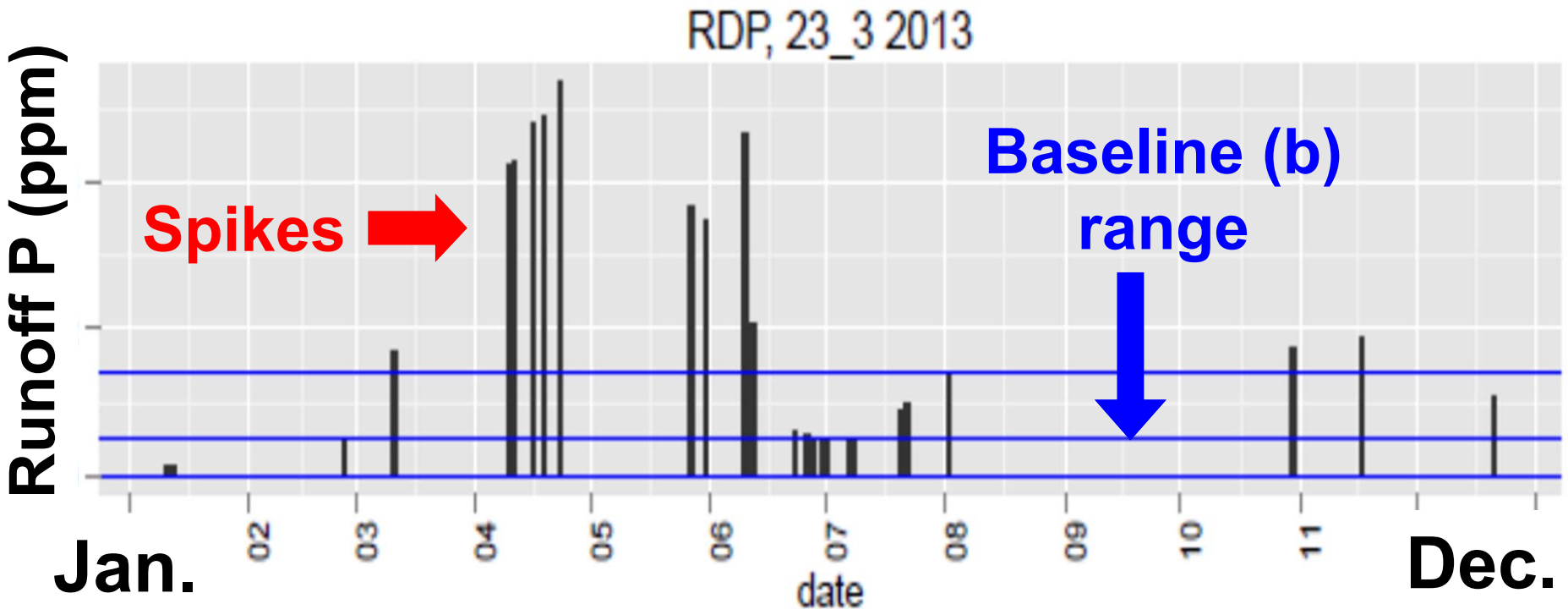
Runoff P Concentration

Markov chain Monte Carlo algorithm to separate

≈ 80% baseline events

Example: Timeline w/ Baselines (b) & Spikes

RDPb = 0.052 (ppm), STP = 12.2 (ppm)



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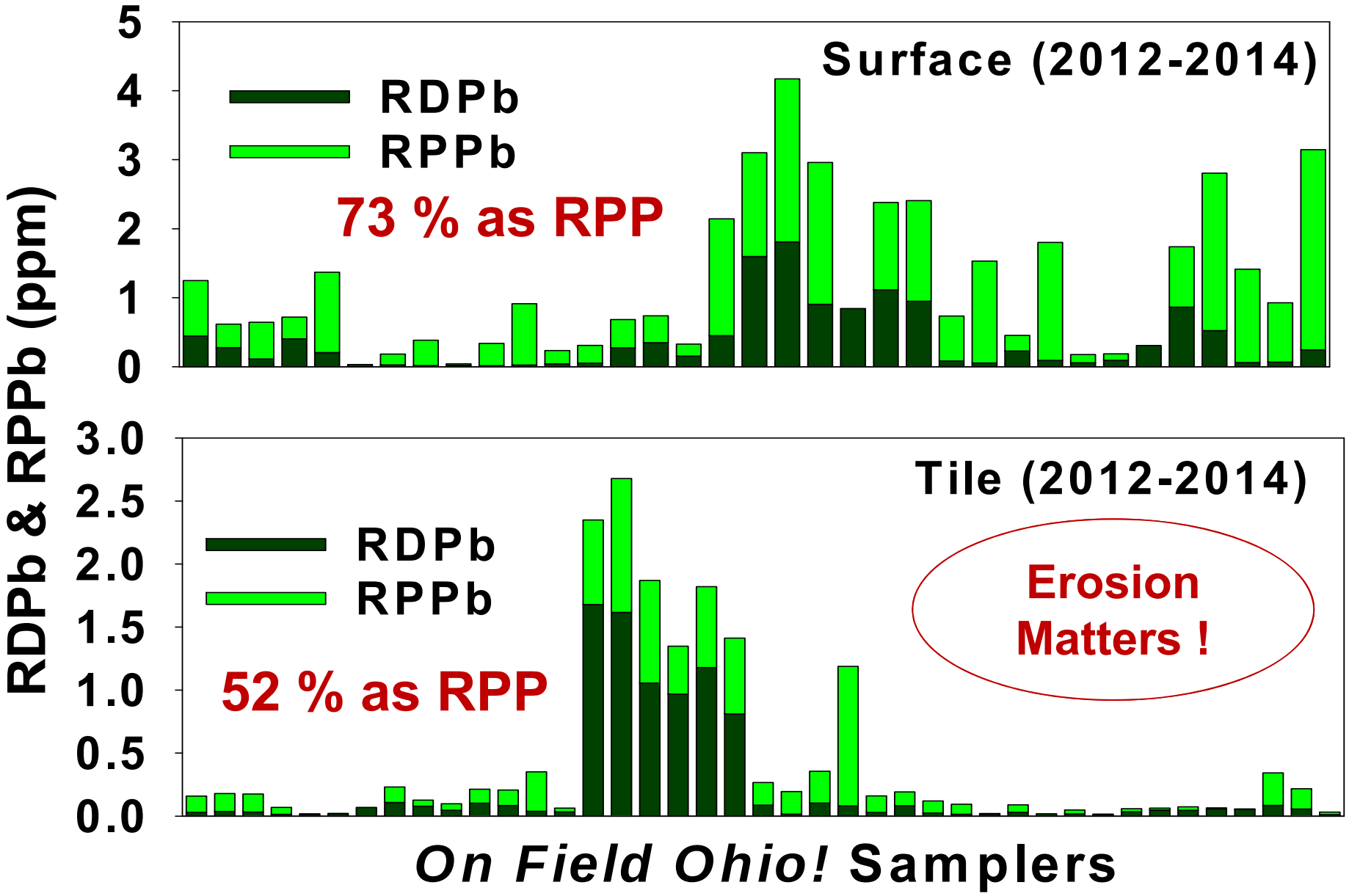
Baseline RDP + RPP = RTP



Results

Parameter	Sub-Value Points
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Soil Test P (bray, ppm)	STP X 0.07
Amount Fert / Manure	P_2O_5 X 0.05
Placement Fert / Manure	0 - 6
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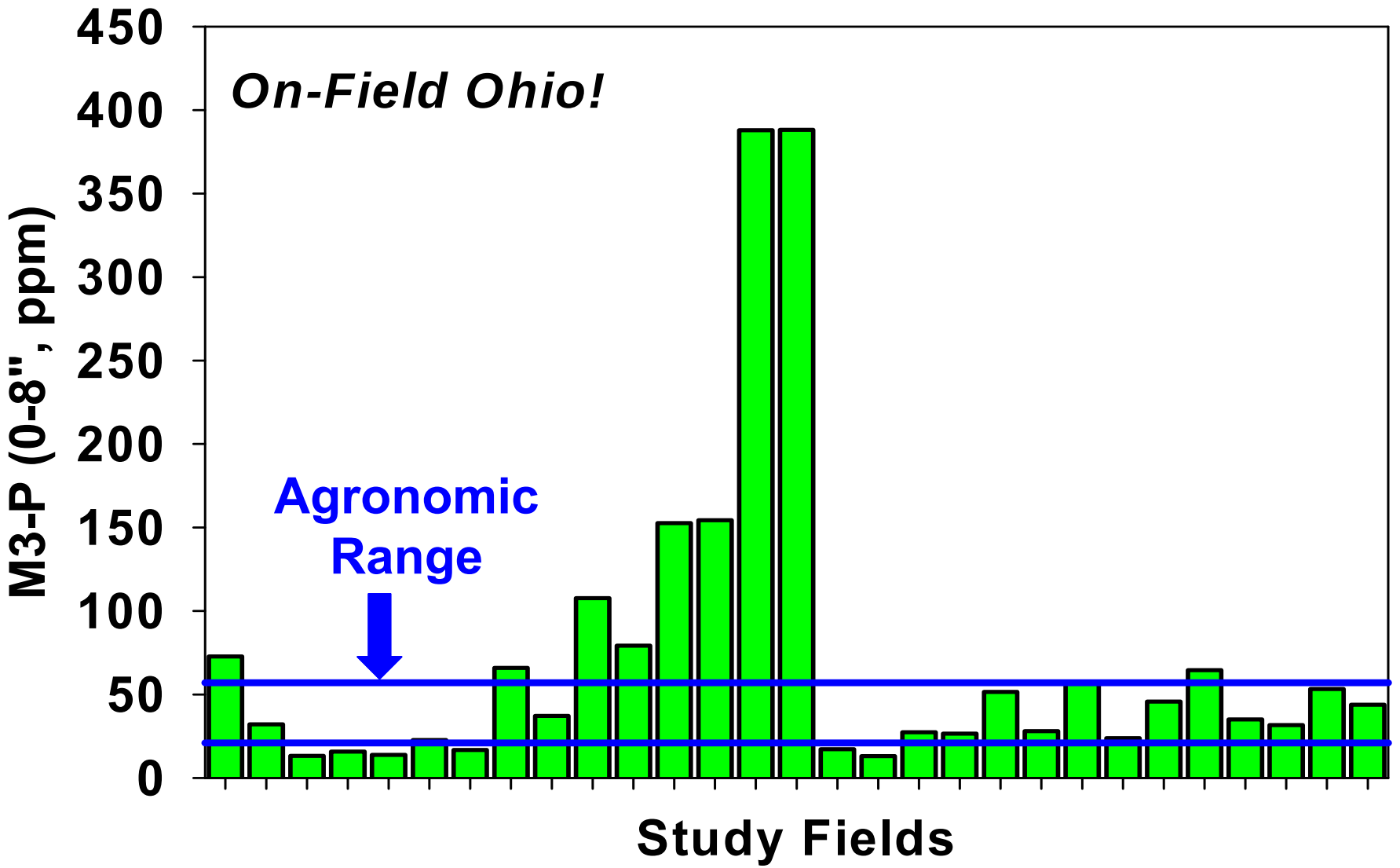
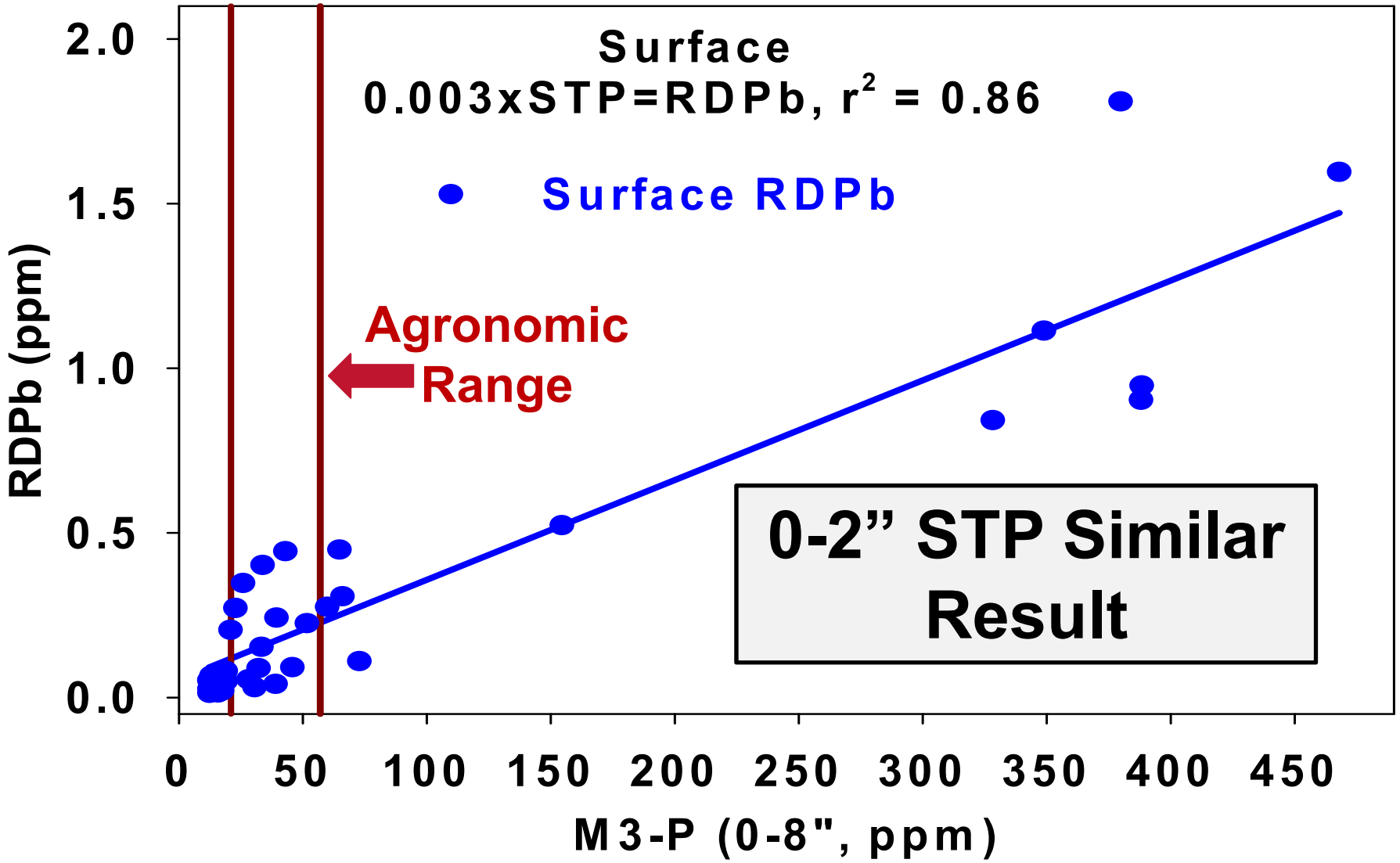
Results


On-Field Ohio!
Agronomic Range
M3-P (0-8", ppm)
450
400
350
300
250
200
150
100
50
0
Study Fields

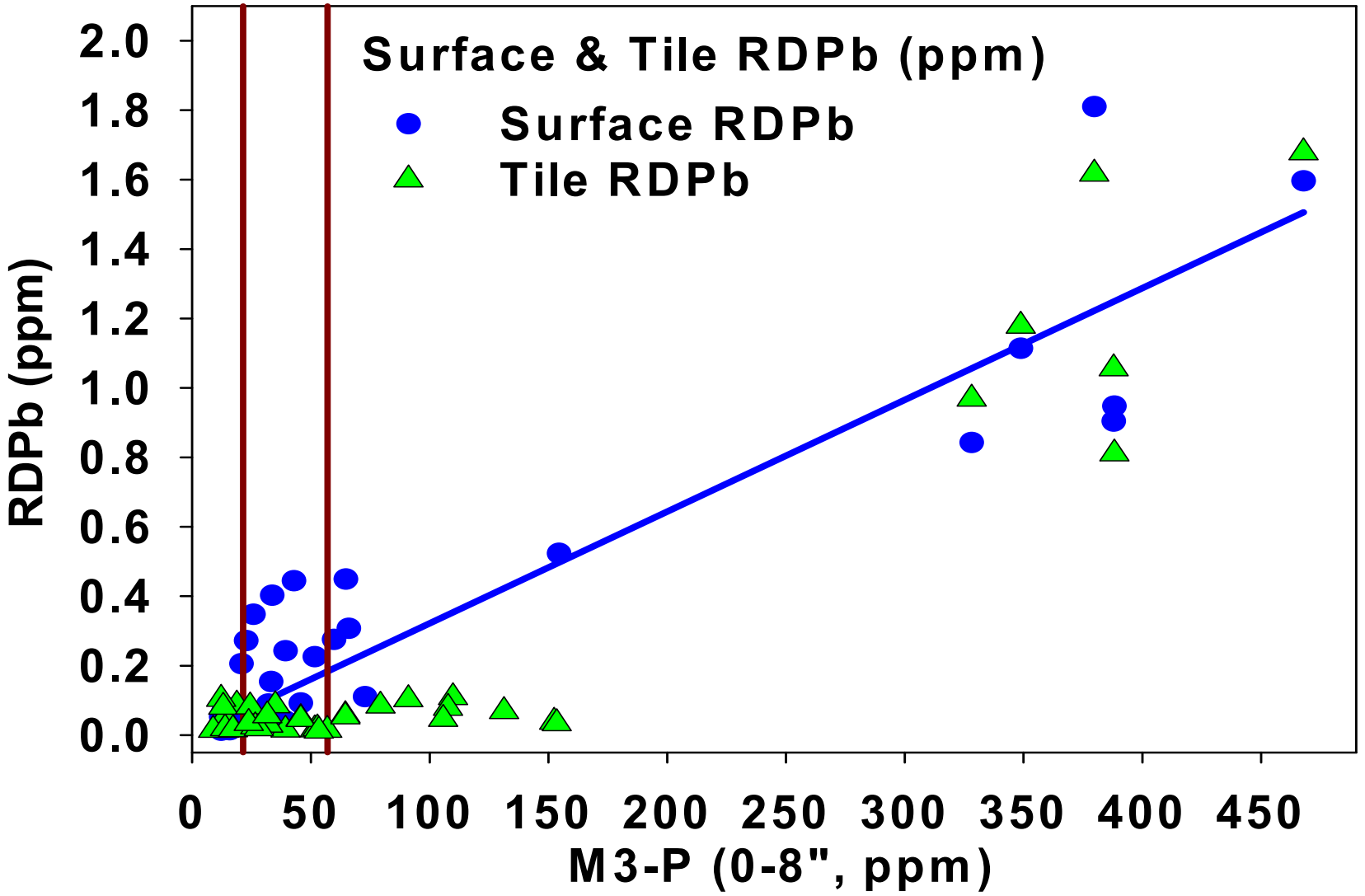
Results

Strong Relationship Surface RDPb & STP

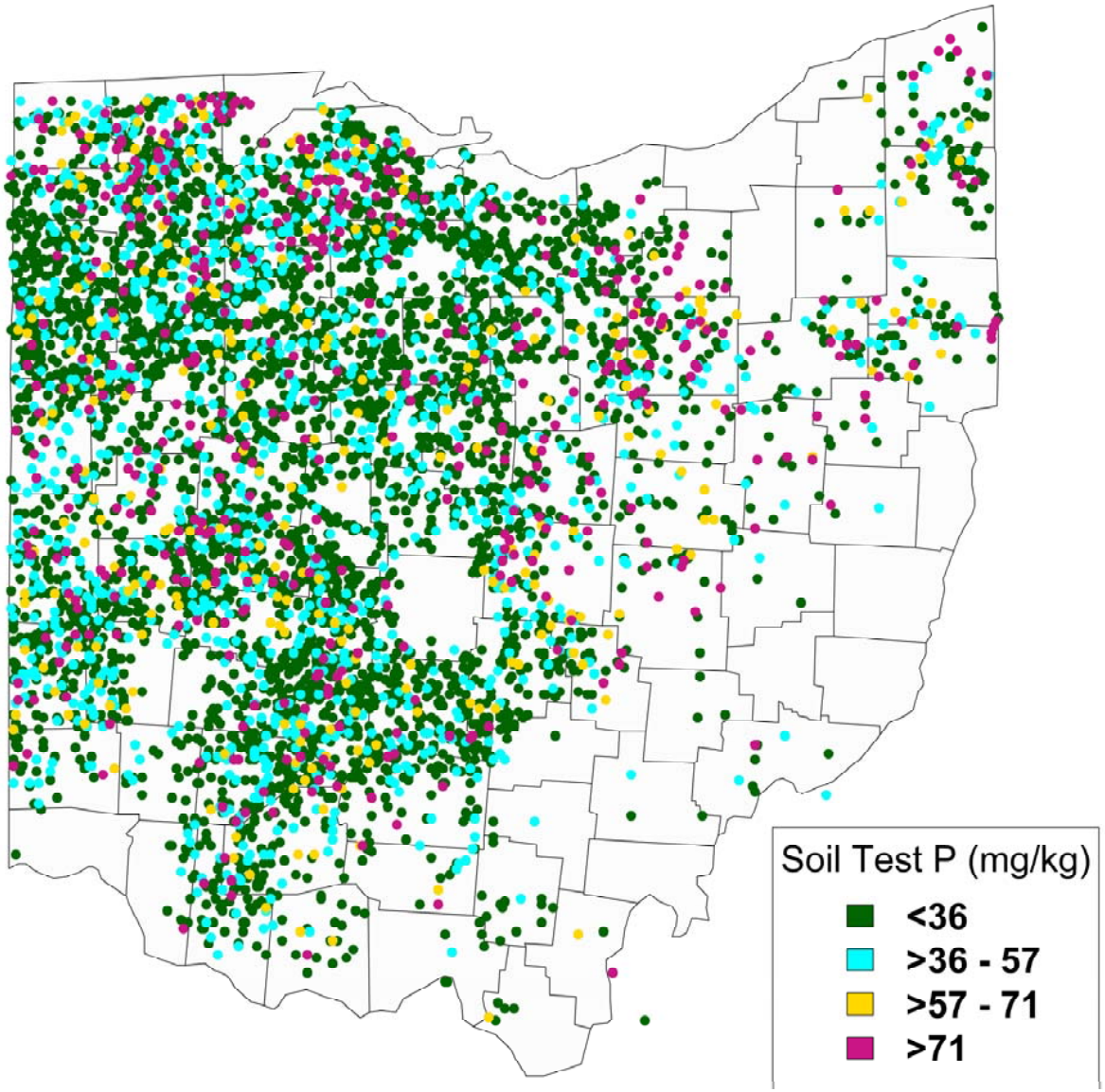


Results

Poor Relationship Between Tile RDPb & STP



Statewide



Mehlich3P STP (ppm)

Range
2 to 692 ppm

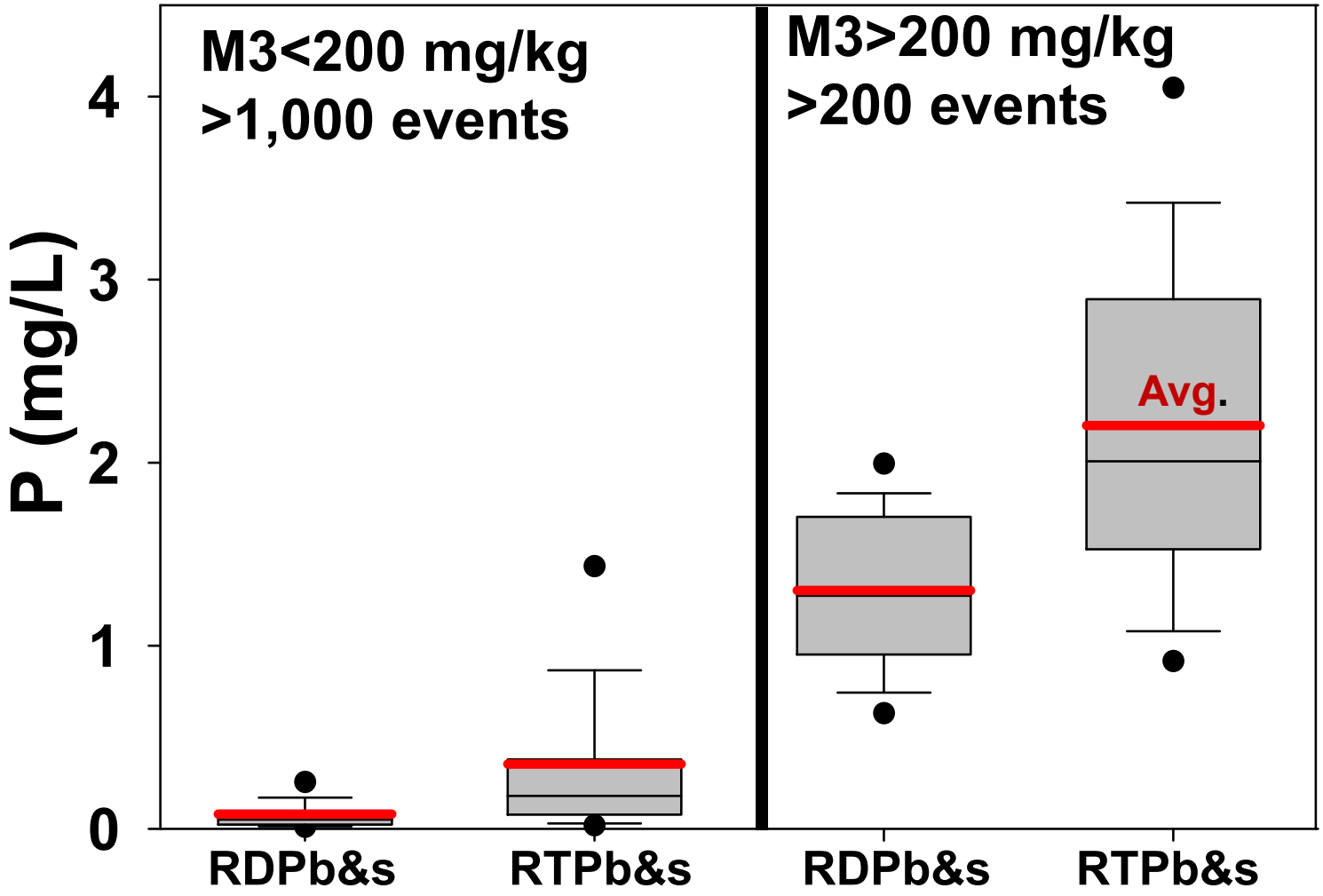
Thanks to:
A&L Great Lakes Labs
Brookside Labs
Spectrum Analytic

Statewide

Concentration Surface (RDPb, ppm)

Range
0.006 to 2.2 ppm

Baseline and Spike Tile P Concentrations

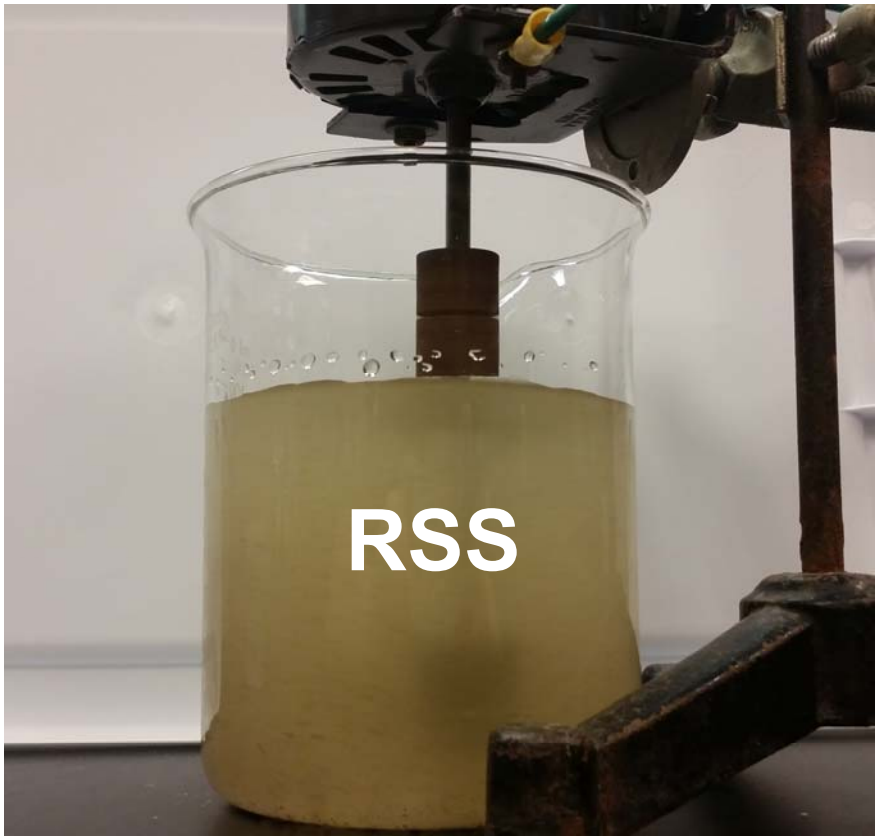


No relationship between Tile RDP/RTP and STP <200 mg/kg

Do not need to consider b and s separately for tile

Runoff Total P (RTP) Erosion & STP Matter

Multiple Regression w/ (RSS & STP)



- How much RSS (erosion)
- How much P on RSS

Results

Strong Relationship Between RTPb and (STP & RSSb)

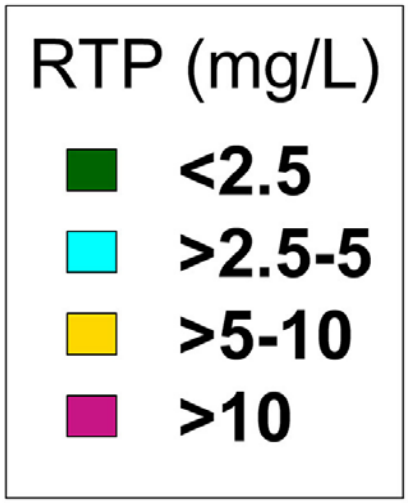
Surface RTPb	r^2
RTP = 0.0047(STP) + 2.07(RSS) - 0.005	0.85

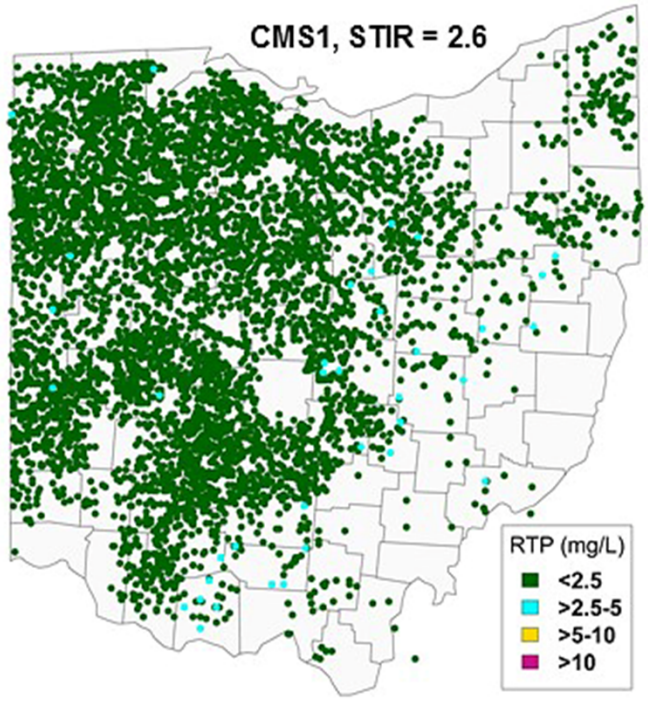
Tile RTPb	r^2
RTP = 0.0024(STP) + 3.98(RSS) - 0.0090	0.84

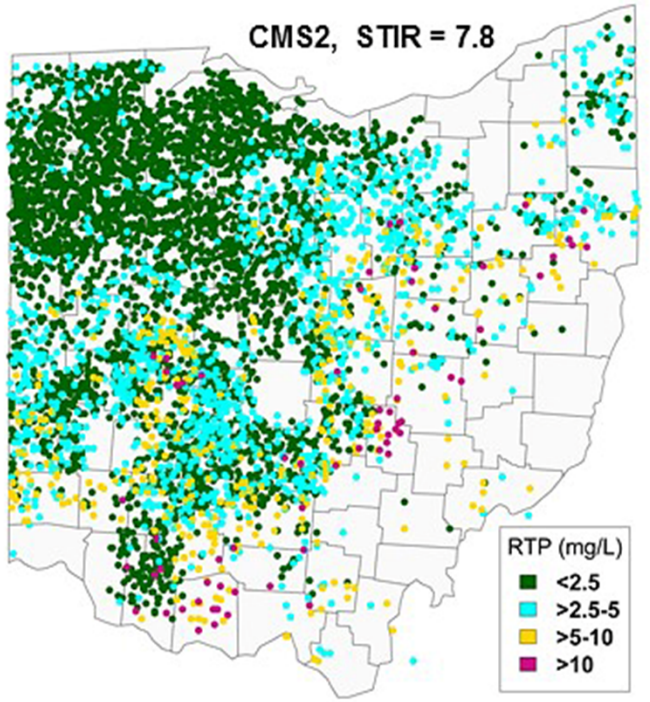
USE
Erosion & Surface Flow to Estimate RSS g/L

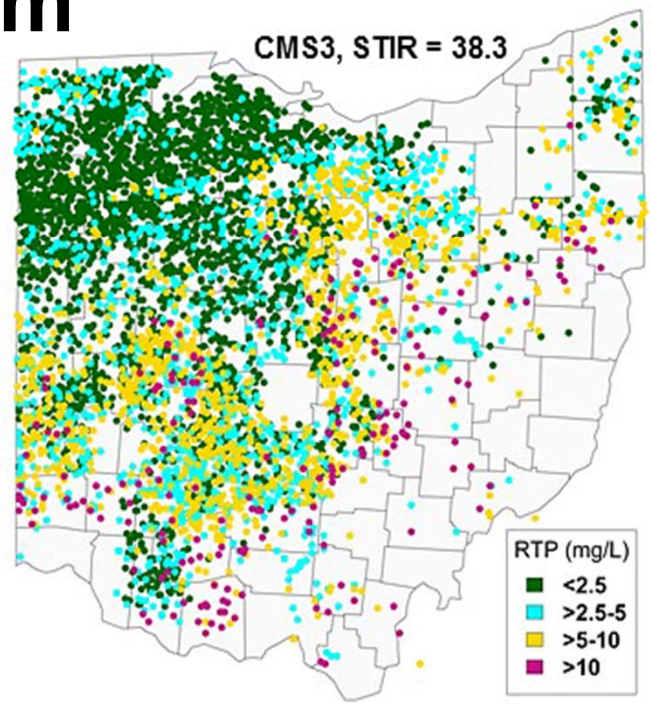
Surface Concentration RTP (mg/L)

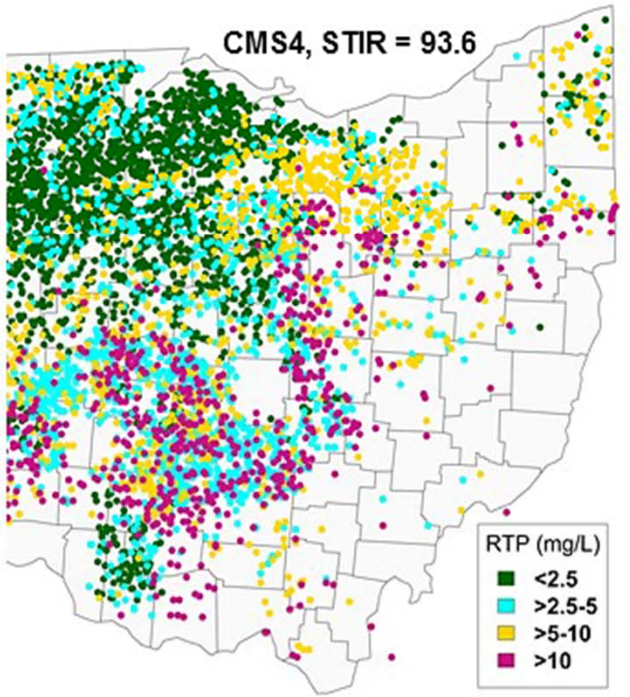
Range 0.05 to 28 ppm











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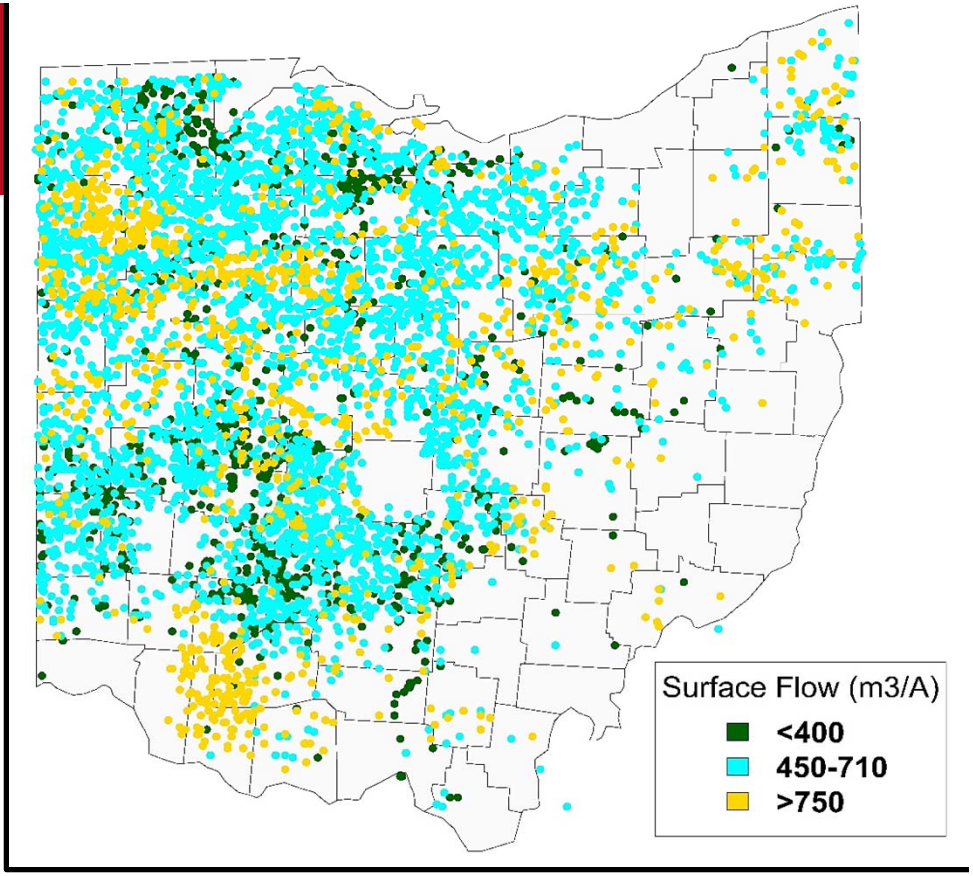
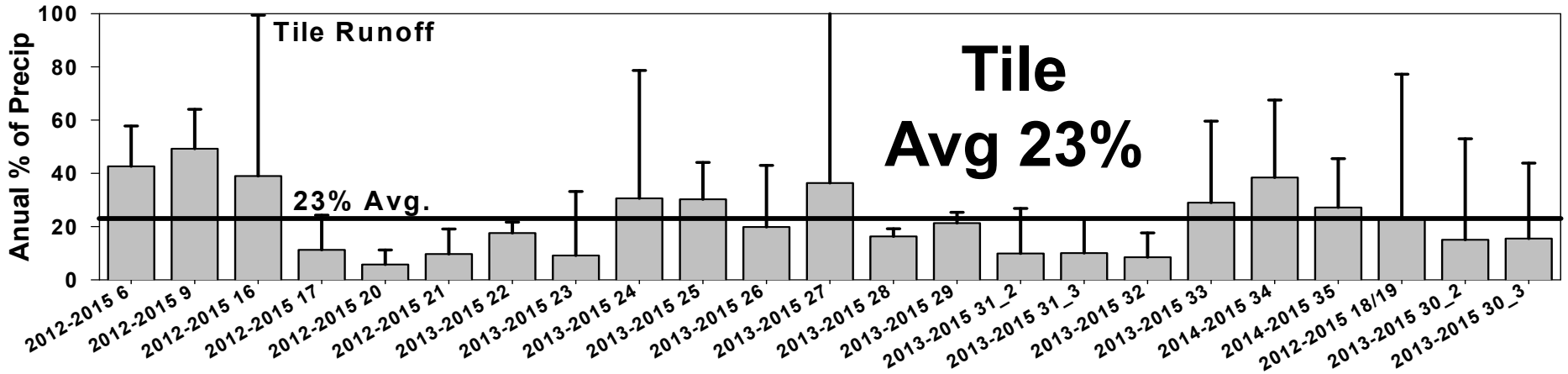
Surface Flow Estimates
Based on soil infiltration rate (APLE)
5 – 40 % of ppt

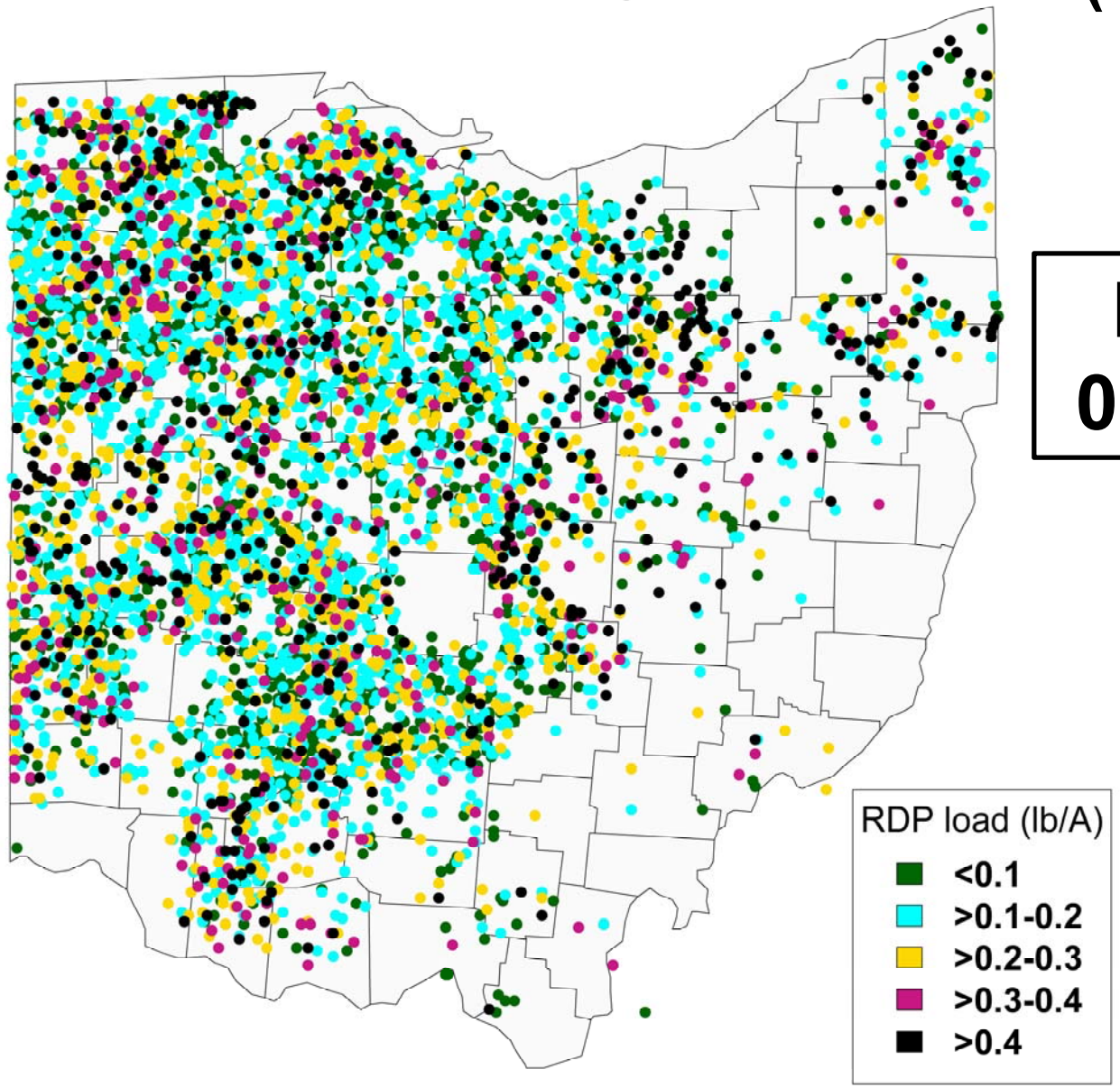
Tile Flow Estimates
Based on % ppt
Comparable to literature





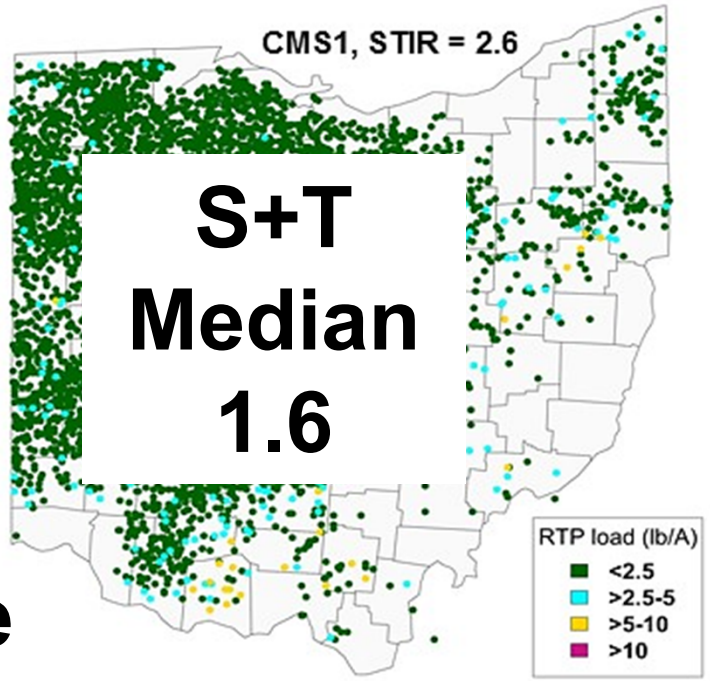
Concentration X Flow = Load

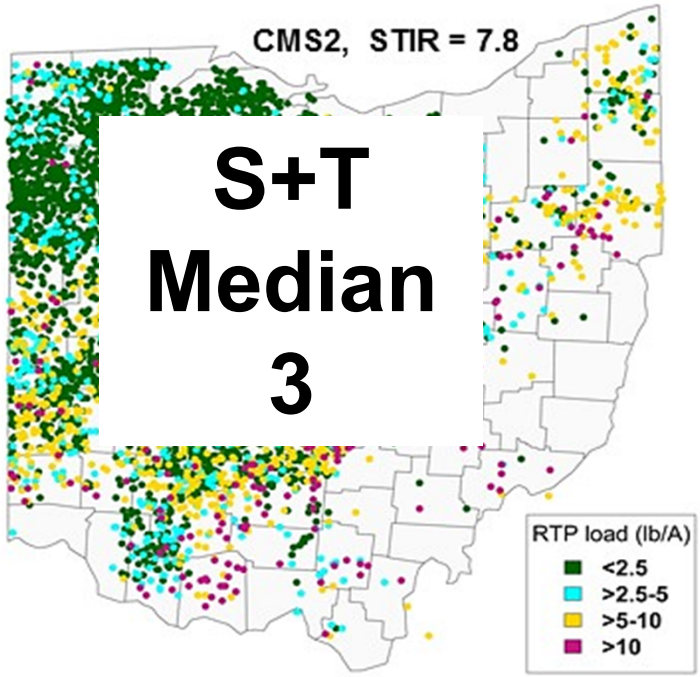
Surface RDPb Load (lb/A)



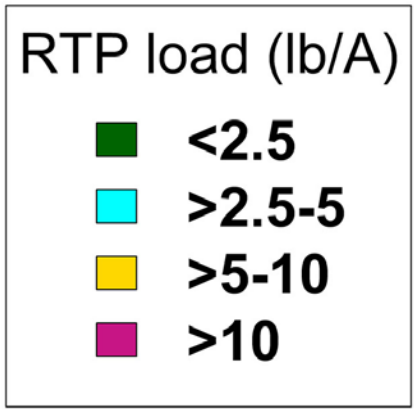
Range RDPb
0.01 to 3.7 lb/A

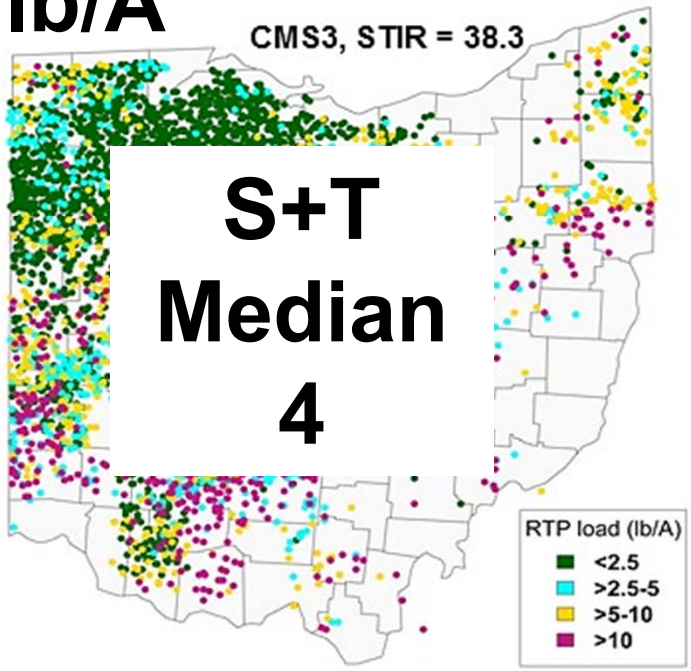
Surface Load RTP (lb/A)

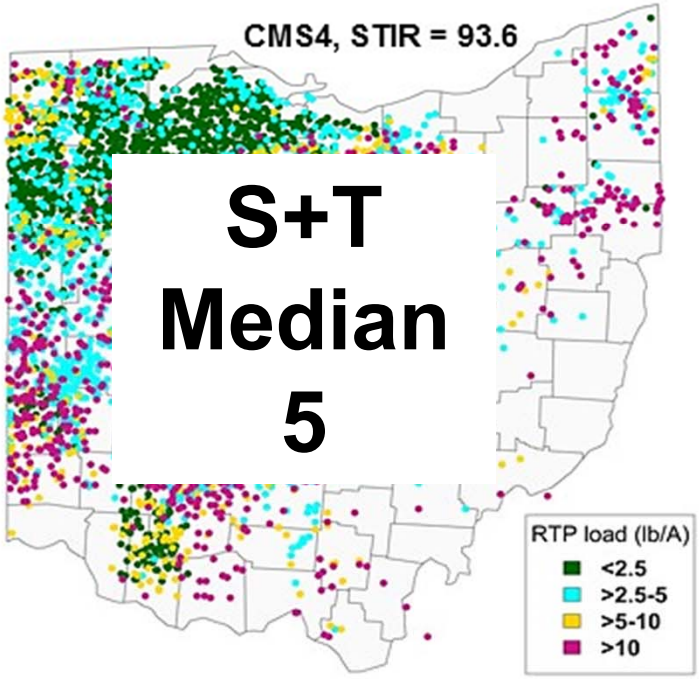




Range 0.05 to 58 lb/A

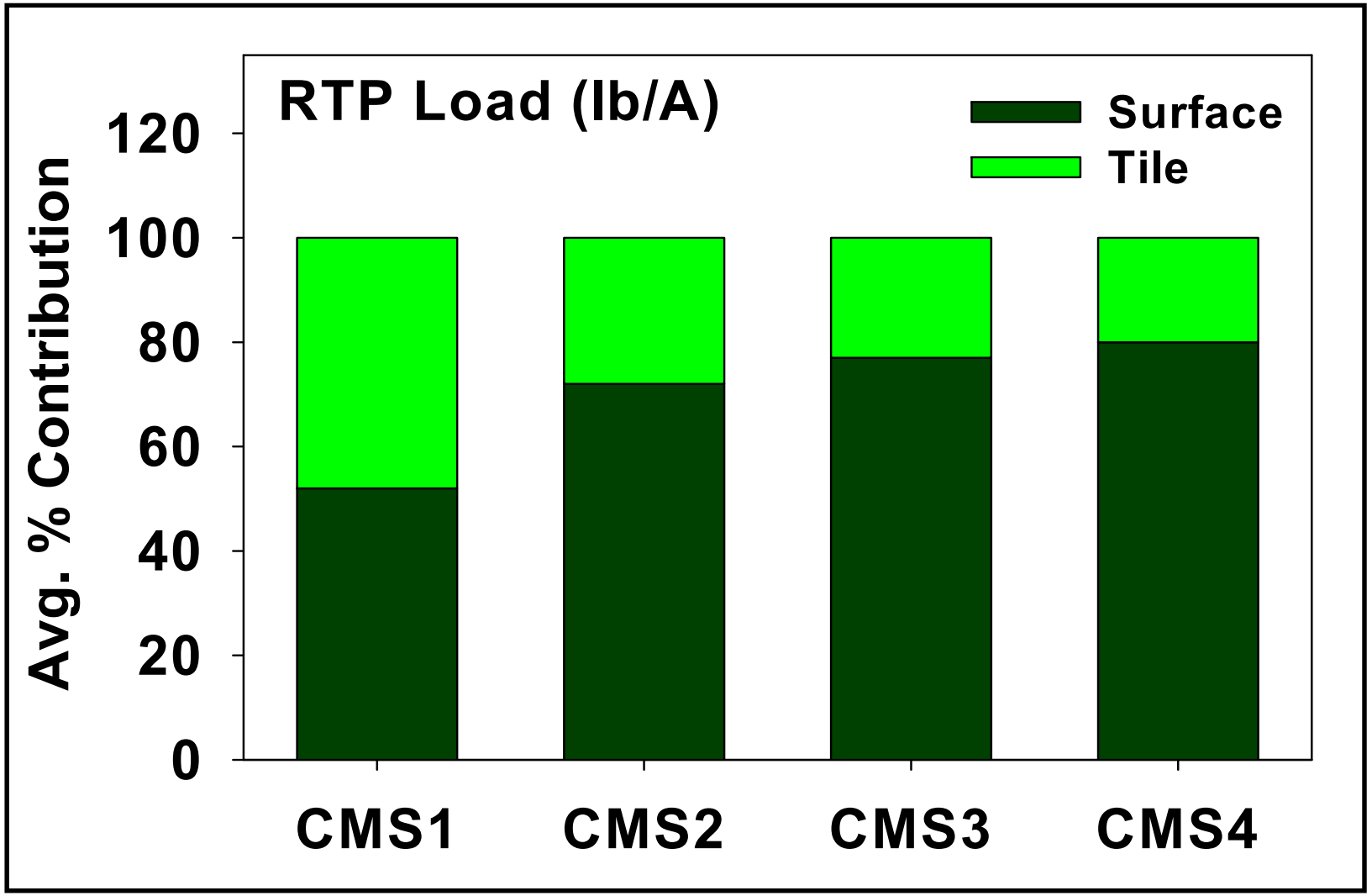






Baseline Summary

Surface vs Tile % Contribution



Spike Runoff Risk

Focus on Risky Practices Not Geography

Fert./Man. Placement High Risk But….
How many instances? Where? Method?
Coincidence of a surface runoff event

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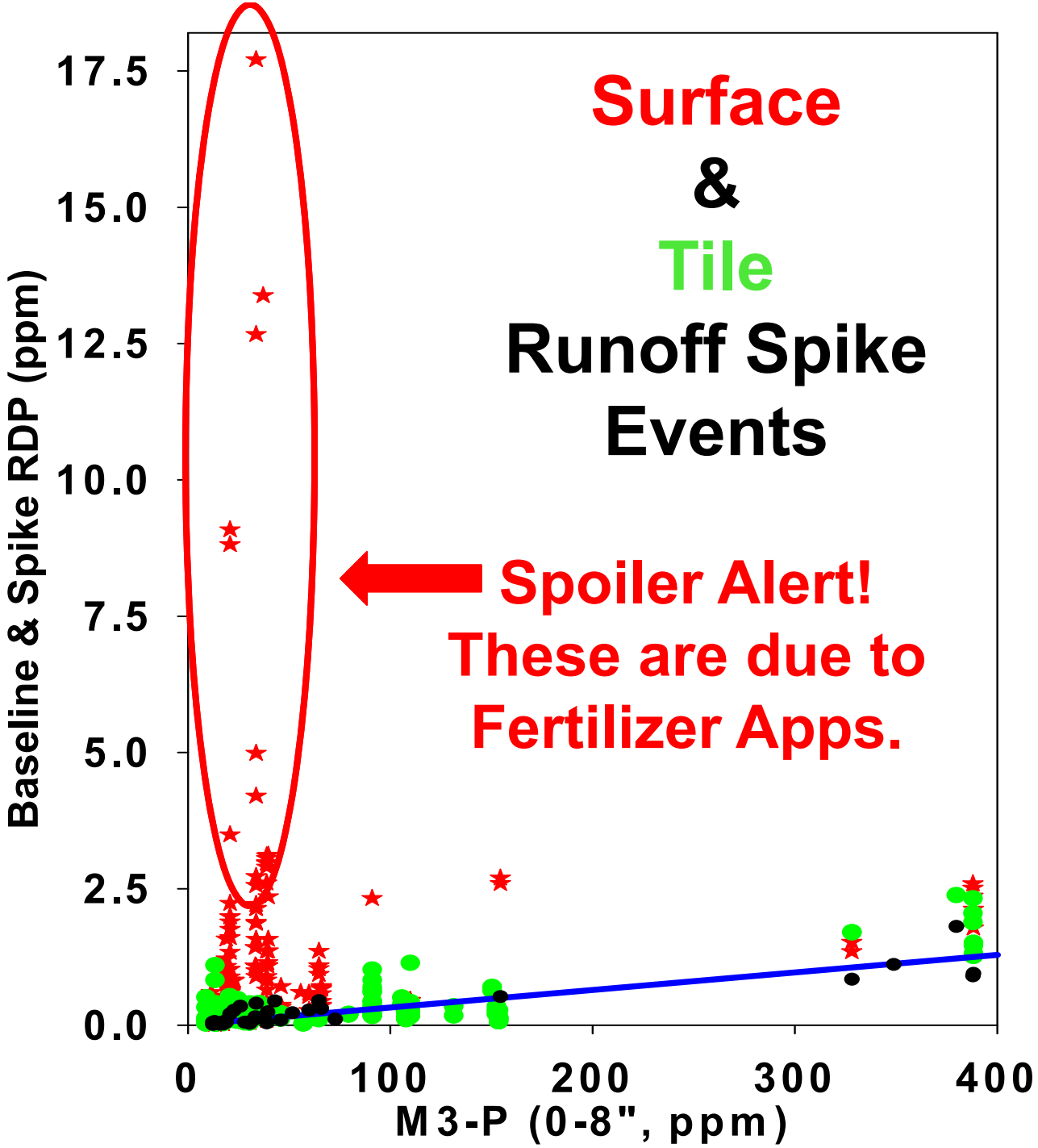
YIKES ! Runoff SPIKES Not Related to STP

Magnitude Surface >>> Tile Runoff Spikes



Results

Finding:

All Bets are Off For Surface Runoff Spike Risk Needs to be Managed Specifically

- Associated with High Risk Practices (fert/manure application, tillage)
- Associated with Gully-Washer rain
- Not related to STP

It's all about the MAGNITUDE
Magnitude of Surface Spikes >>> Tile

Spike Runoff Risk

Comparison of Fertilizer Placement Methods Across Varying P Sources and Levels of Surface Cover Using Simulated Rainfall and Small Plots

Thanks !!
Harold Watters &
Western Experiment Station

Ohio Corn&Wheat

SOY OHIO
Ohio Soybean Council

Current P-Index

Evaluating

Fertilizer Placement Method	Points
0 Applied	0
Incorporate immediately Or Applied on 80% Cover	0.75
Incorporate < 1 week Or Applied on 50–80% Cover	1.5
Incorporate > 1 week < 3 mos. Or Applied on 30-49% Cover	3
No Incorporation or > 3 mos. Or Applied on < 30% Cover	6

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Residue Cover

< 10% ≈ 50% > 80%

Mimic Ohio P Index Ranges for Surface Cover

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5 Fert. Plcmnt Meths.

Surface (Surf)

Surf + Field Cultivator (Fc)

Plus Check (Chk)
No Fert.

Banding (Band)

Surf + Chisel/disk (Chsl)

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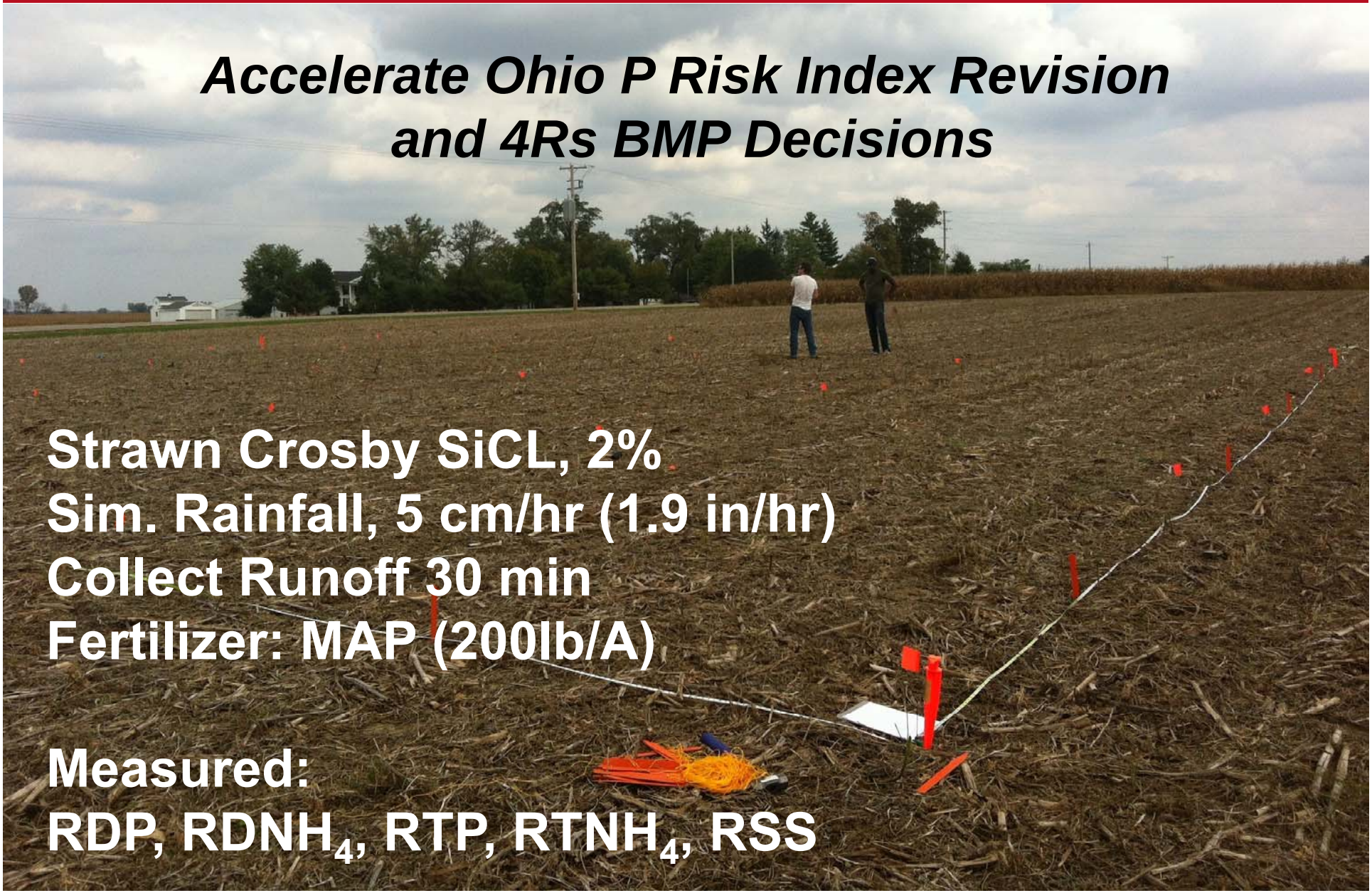
Simulated Rainfall Parameters



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Plot Set-up

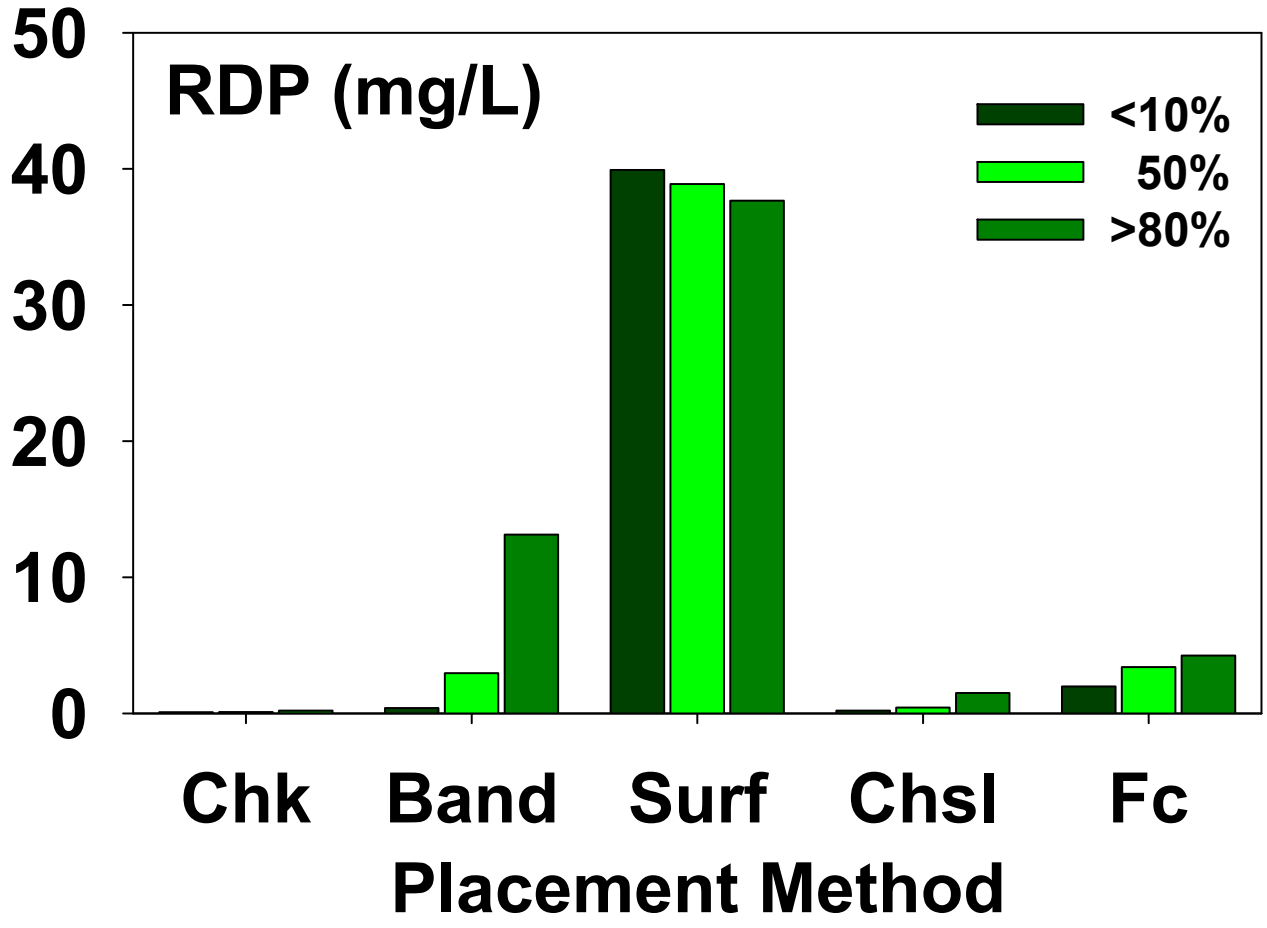
Plot borders in place

Collecting runoff

Spike Runoff Risk

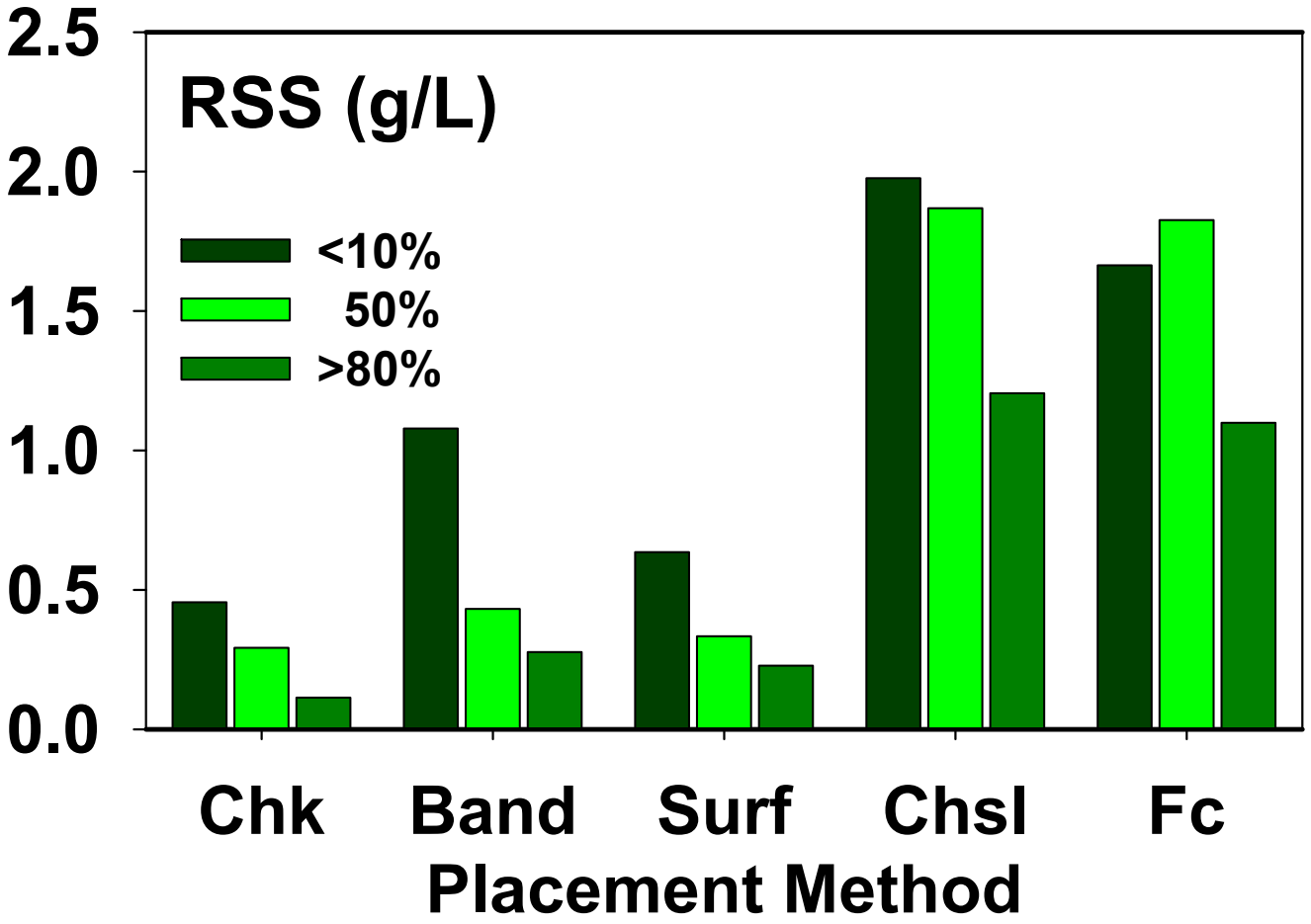
Humongous Difference Due to Placement Method

Not so Much For Surface Cover



Erosion Risk

Humongous difference due to Placement method
Humongous difference Due to Surface Cover



Results

Tremendous Results so Far !

Additional data Collection Cycles to come
Multi-Way Split Plot Design w/ adaptive elements
Balance Fert. Placement w/ Erosion Risk

Runoff P Spike RISK		
Avg. P runoff reduction due to incorporation		
	RDP (ppm)	RDP Load (lb/A)
Reduction	92%	96%

Huge Opportunities
for Runoff P Reduction

Fertilizer/Manure Placement Method

- **Runoff Risk Reduction WRONGLY attributed to Surface Cover in P Index**
- **Residue Cover not significant for P runoff risk**
- **Only 6 points attributed to fert. Placement method despite HUGE runoff Risk**

Essential to Re-weight Ohio P Index for Fertilizer Placement Method

Opportunities for Success

RDPb, range 0.01 to 3.7 lb/A

Cut STP in Half Cuts Surface RDPb in Half

Erosion Matters

73% Surface RTPb is Particulate Bound

Crop Management Scenario Matters

	Range RTPb lb/A	% Red. RTPb	% Red. Erosion
CMS1	0.08 to 11	61	84
CMS3	0.14 to 53		

> 90% Red. in P Runoff Spike Risk w/ Fert. Incorp.

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Questions??

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Ohio Department of Agriculture

SCHLESSMAN Schlessman Hybrids