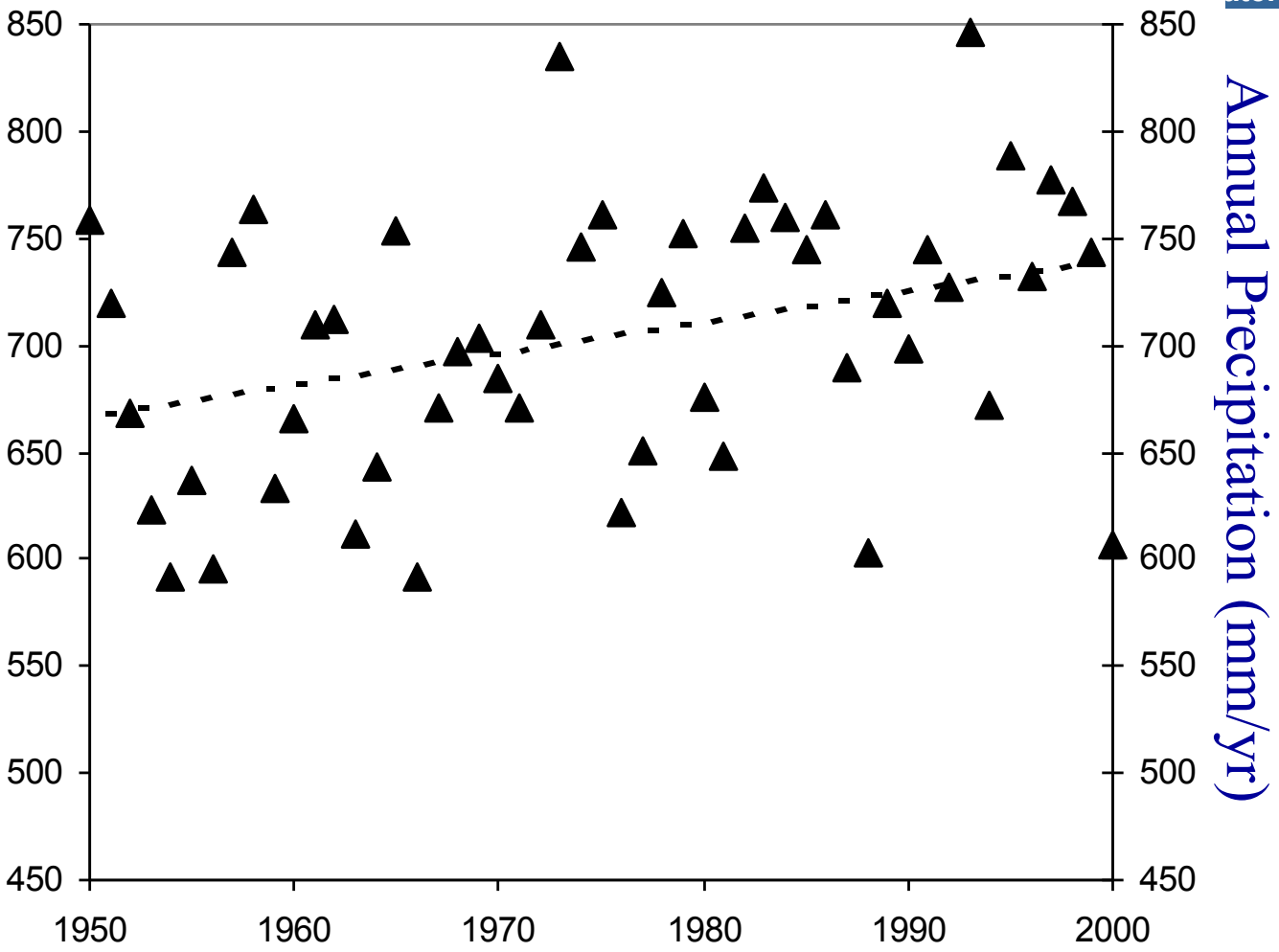
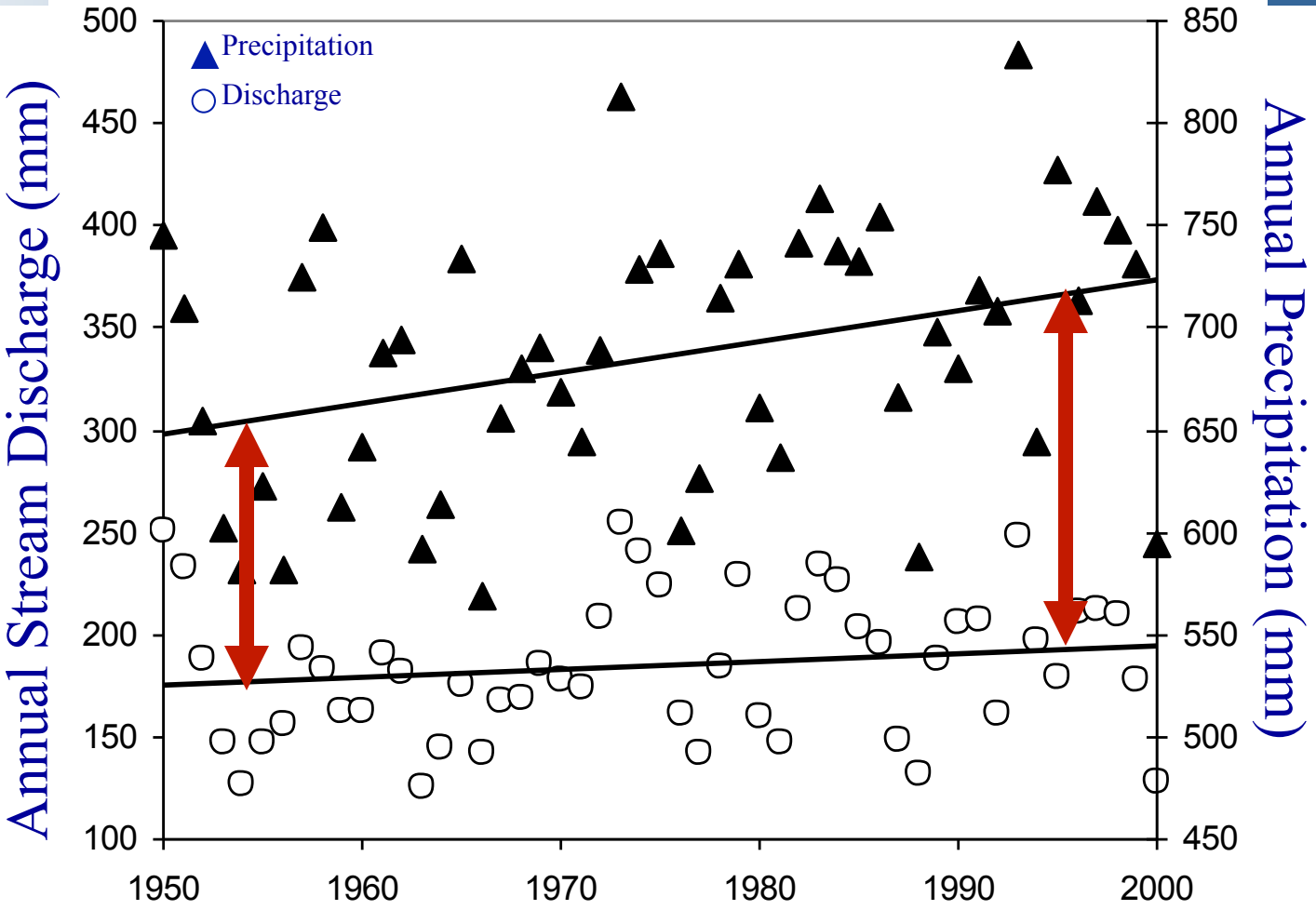
HOW ARE EXTREME WEATHER EVENTS AND CLIMATE CHANGE AFFECTING SOIL EROSION AND NUTRIENT LOSS IN THE AGRICULTURAL LANDSCAPE?

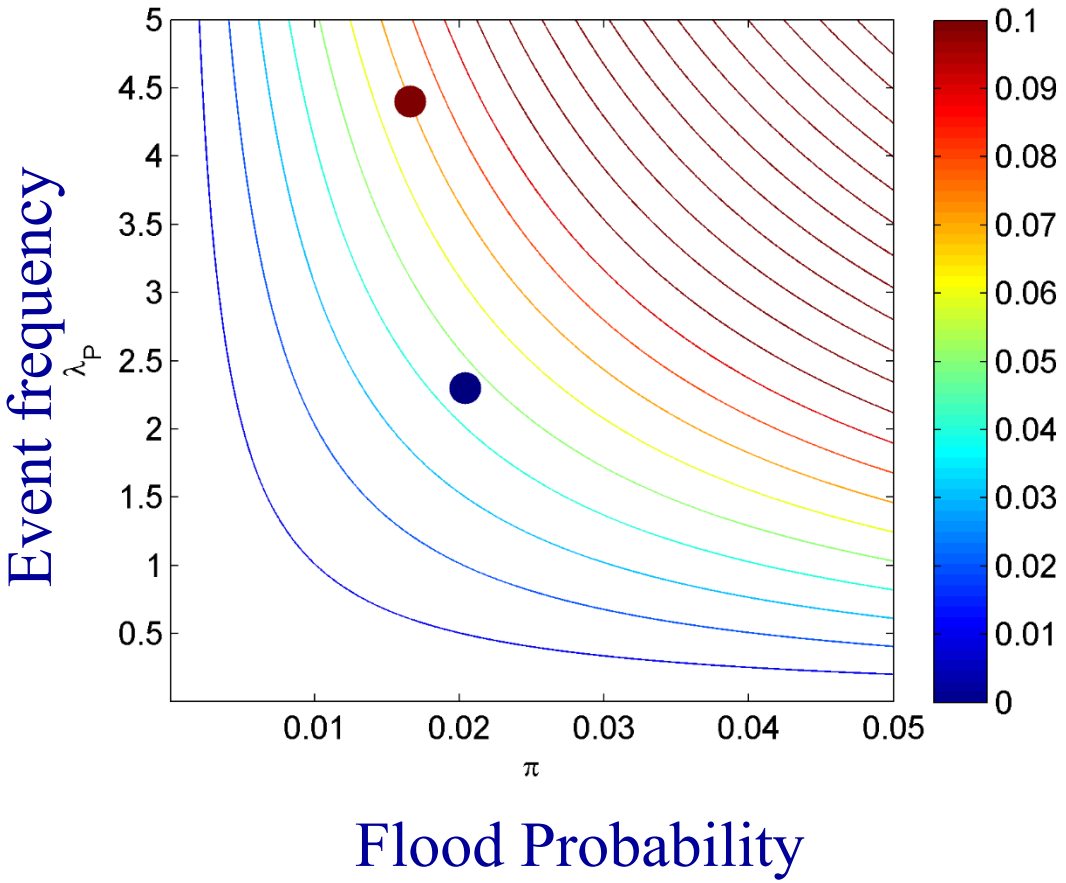
WATERSHED ISSUES OF THE NORTHEAST

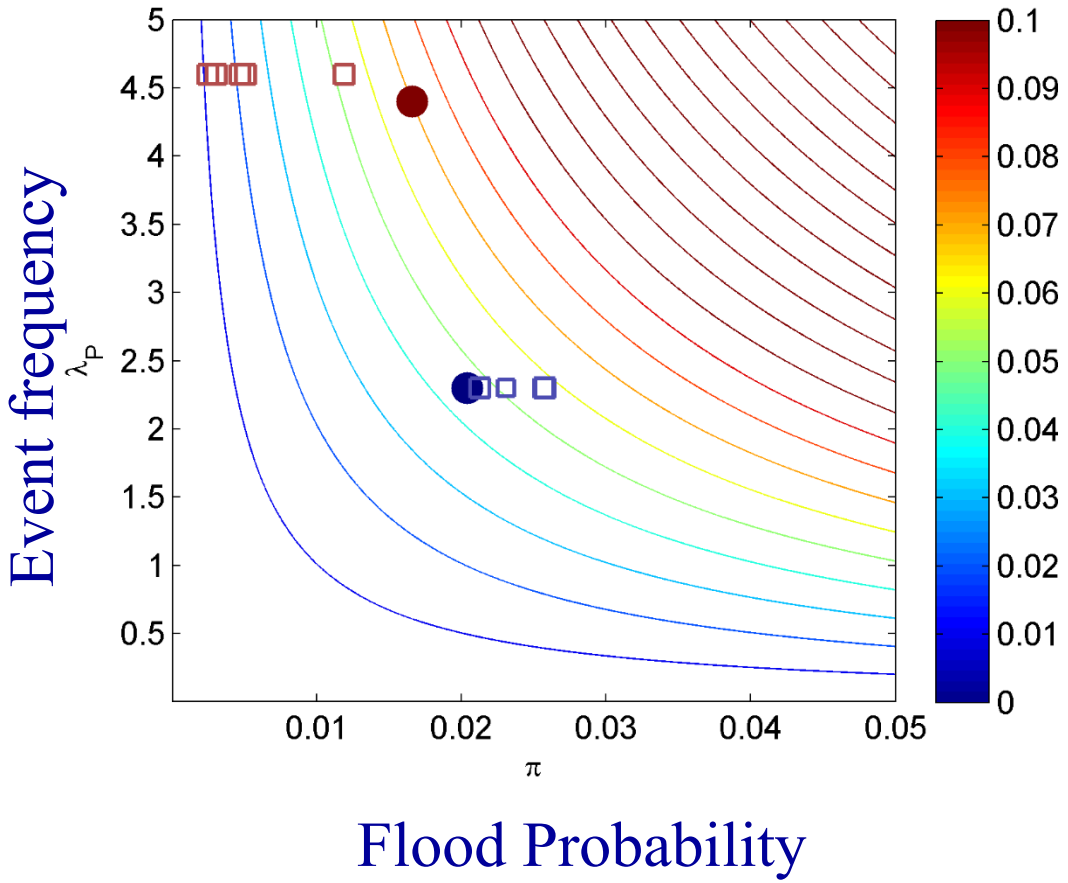
Todd Walter

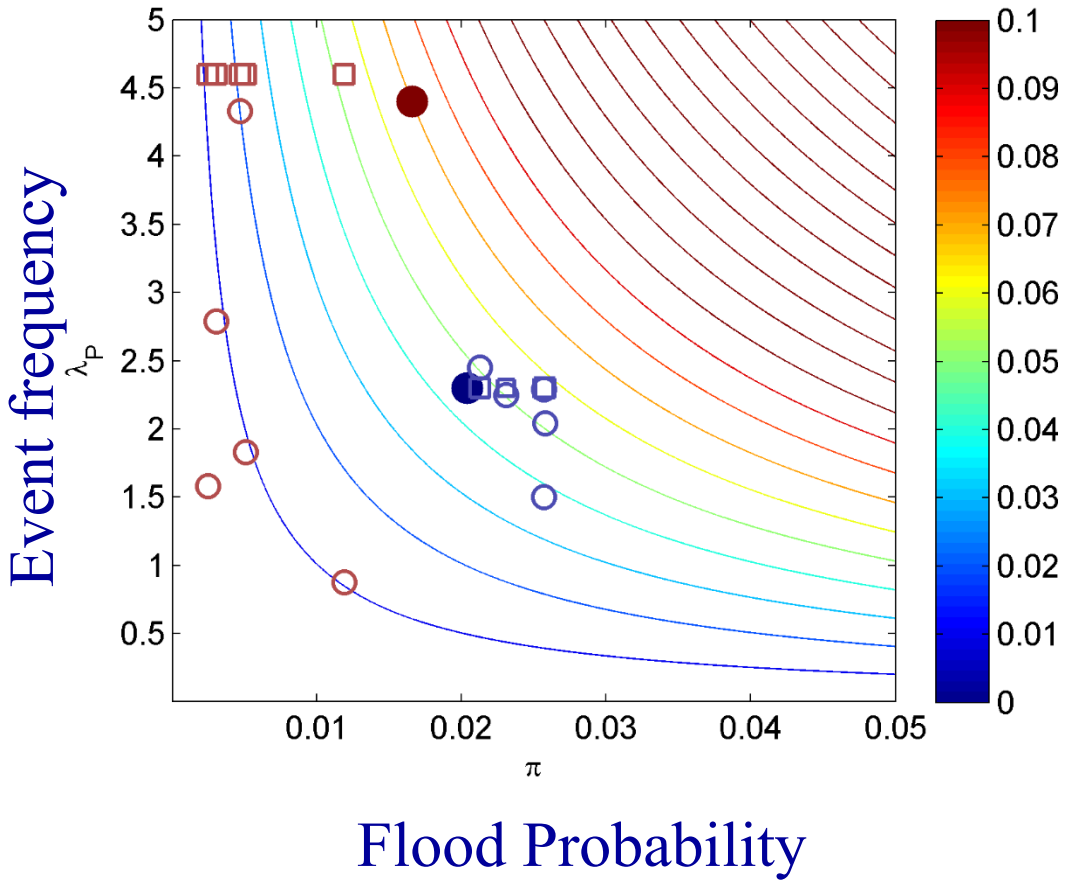
Oct. 17-18, 2017
Adaptation to Climate Change: Information and Tools for Decision-Making

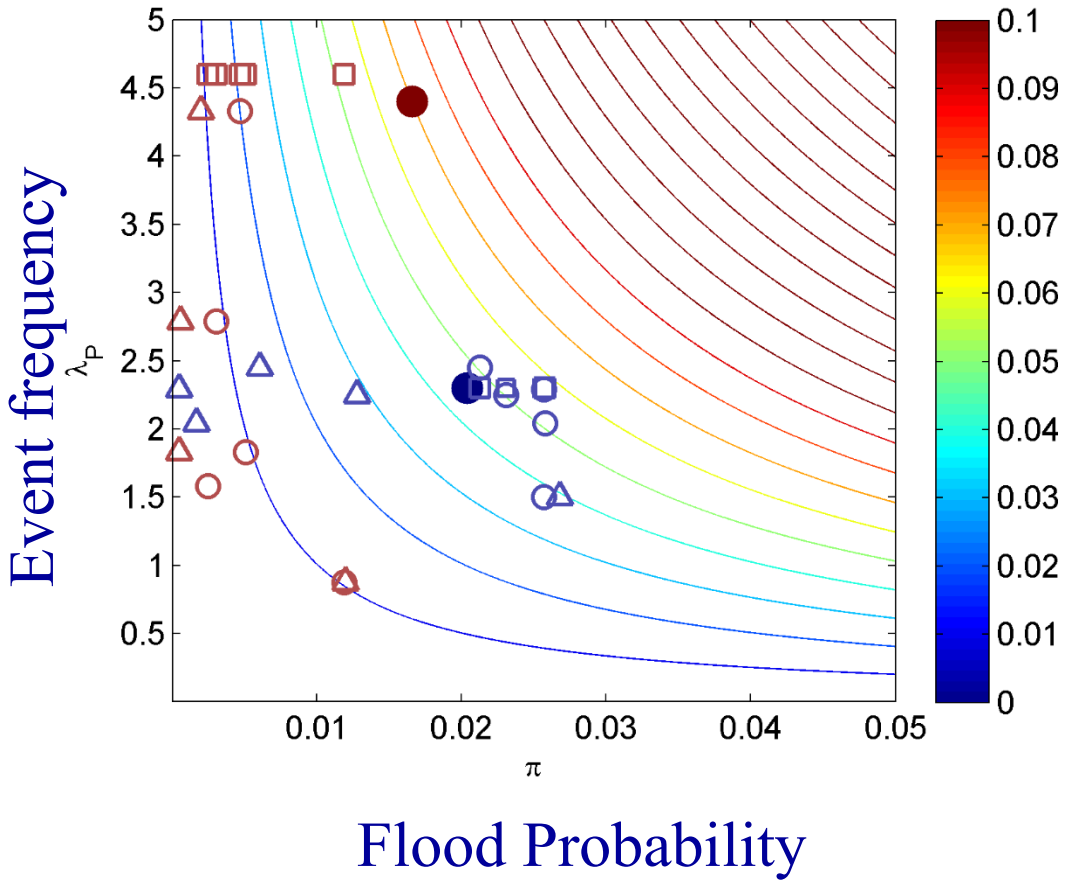

850
800
750
700
650
600
550
500
450
1950
1960
1970
1980
1990
2000
Annual Precipitation (mm/yr)

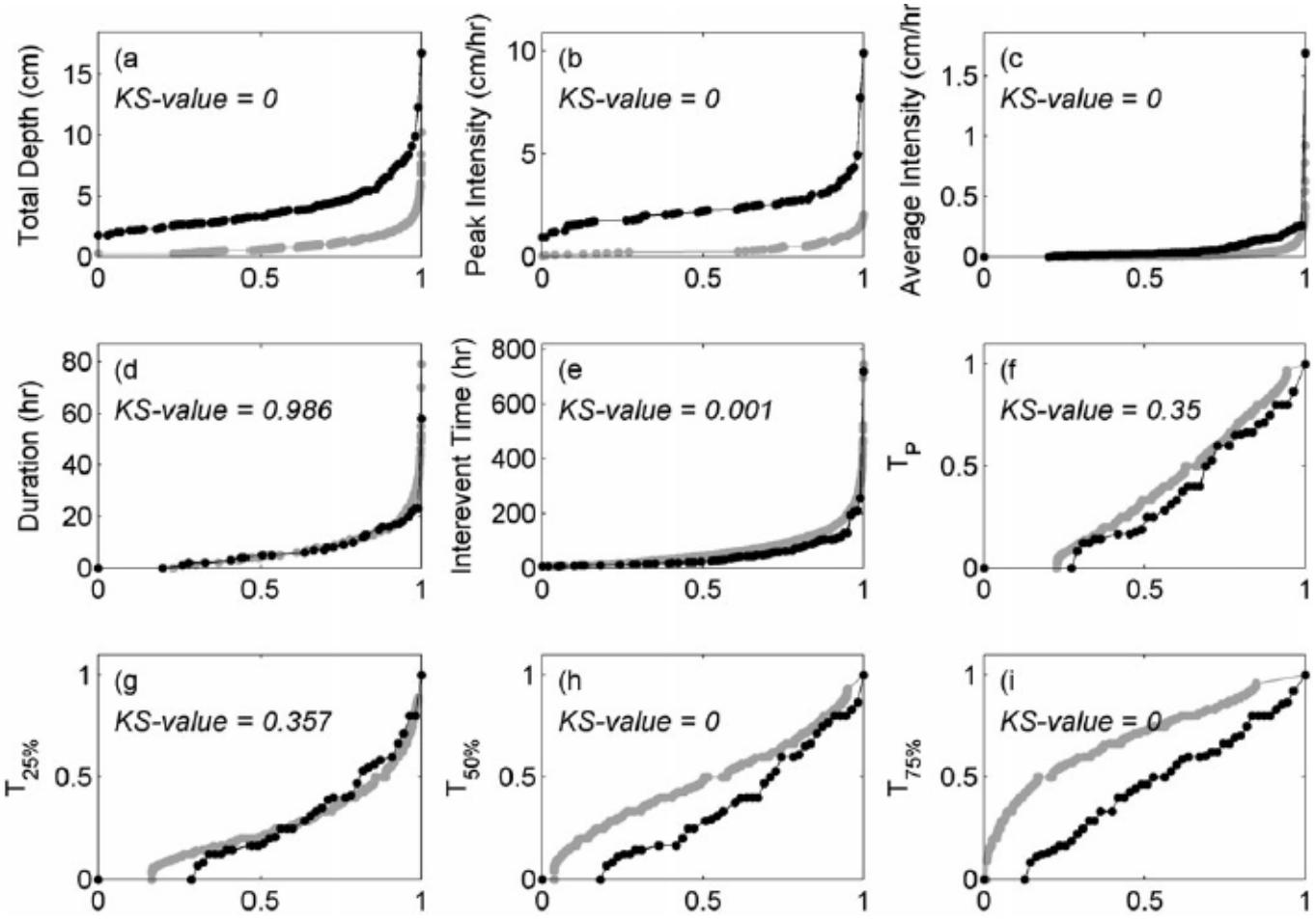

Precipitation
Discharge
Annual Stream Discharge (mm)
Annual Precipitation (mm)
500
450
400
350
300
250
200
150
100
850
800
750
700
650
600
550
500
450
1950
1960
1970
1980
1990
2000


Event frequency
λ_P
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0.01
0.02
0.03
0.04
0.05
π
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Flood Probability


Event frequency
λ_P
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0.01
0.02
0.03
0.04
0.05
π
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Flood Probability


Event frequency
λ_P
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0.01
0.02
0.03
0.04
0.05
π
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Flood Probability

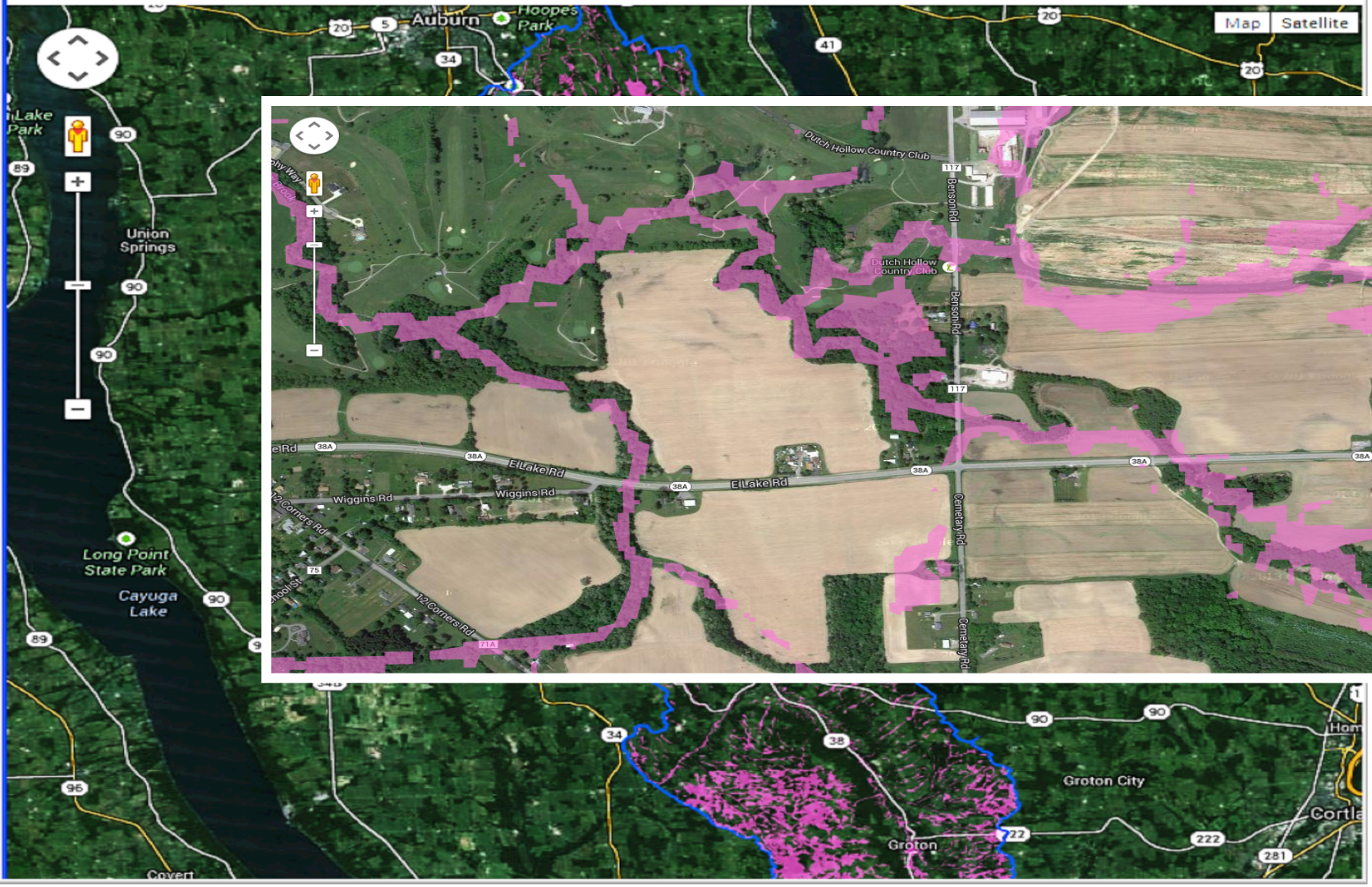

Event frequency
λ_P
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0.01
0.02
0.03
0.04
0.05
π
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Flood Probability

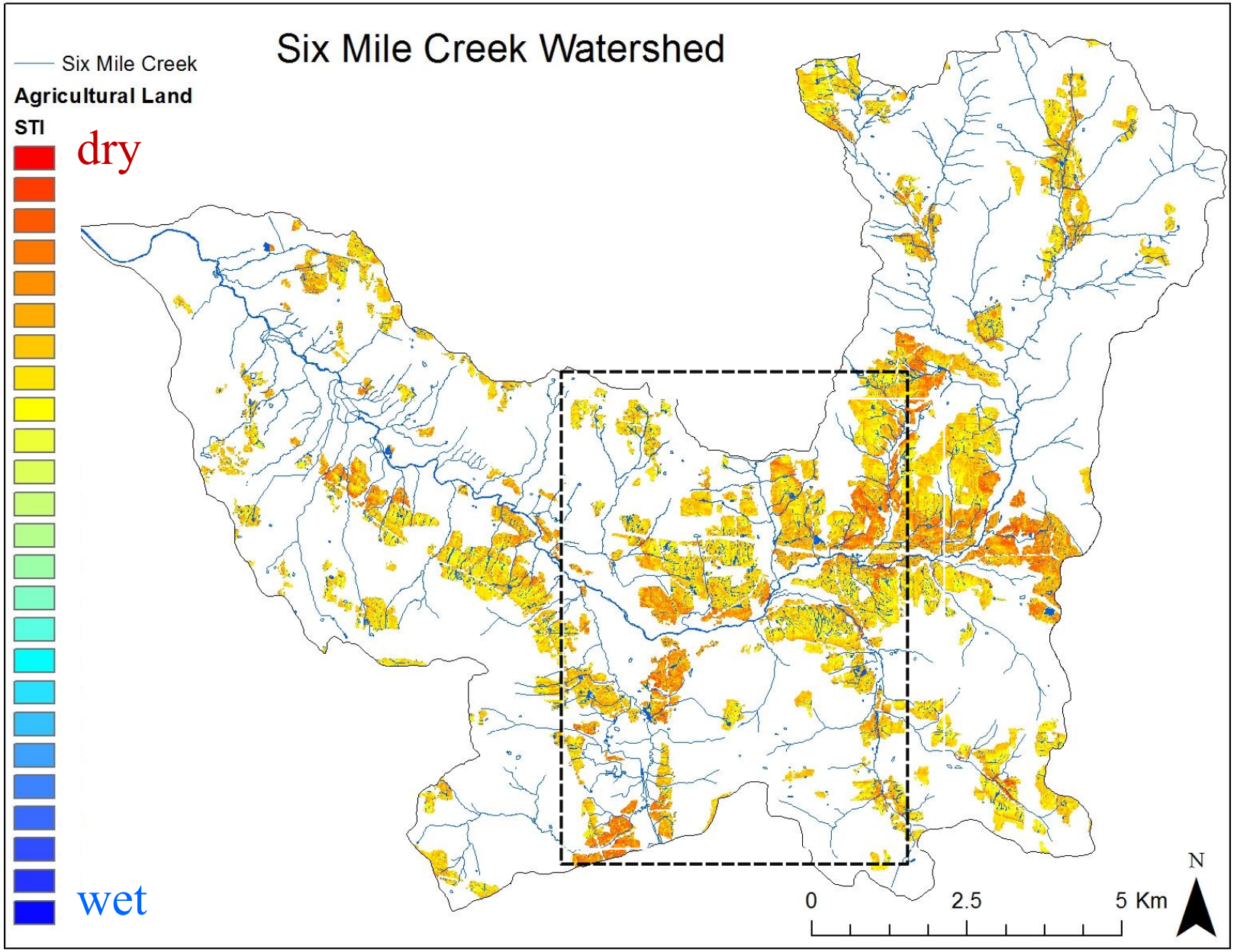

(a
KS-value = 0
Total Depth (cm)
(b
KS-value = 0
Peak Intensity (cm/hr)
(c
KS-value = 0
Average Intensity (cm/hr
(d
KS-value = 0.986
Duration (hr)
(e
KS-value = 0.001
Interevent Time (hr)
(f
KS-value = 0.35
T_P
(g
KS-value = 0.357
$T_{25\%}$
(h
KS-value = 0
$T_{50\%}$
(i
KS-value = 0
$T_{75\%}$

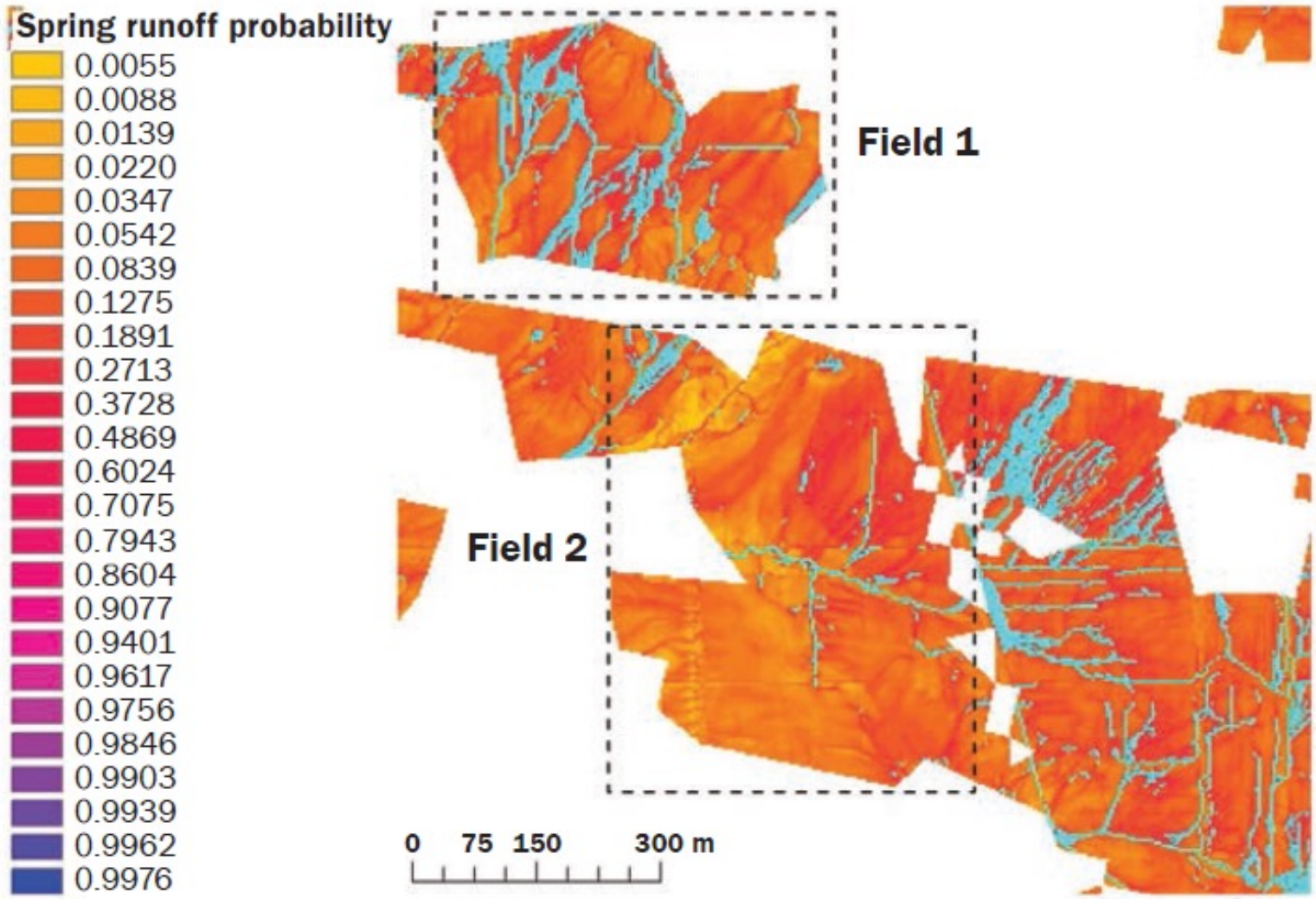
Hydrologically Sensitive Areas Model

About this tool Blog View high risk areas Hide banner

Date	Todays Observation	Thurs, Dec 05, 2013	Fri, Dec 06, 2013	Sat, Dec 07, 2013
Rain/Snow melt, mm	0	0	12	0
Chance of precip (%)	NA	17	85	70
% watershed saturated	10	0	20	10
Last updated 2013-12-04 10:30:05				




Six Mile Creek Watershed
Six Mile Creek
Agricultural Land
STI
dry
wet
0
2.5
5 Km
N


Legend
Spring runoff probability
0.0055
0.0088
0.0139
0.0220
0.0347
0.0542
0.0839
0.1275
0.1891
0.2713
0.3728
0.4869
0.6024
0.7075
0.7943
0.8604
0.9077
0.9401
0.9617
0.9756
0.9846
0.9903
0.9939
0.9962
0.9976
Field 1
Field 2
0 75 150 300 m

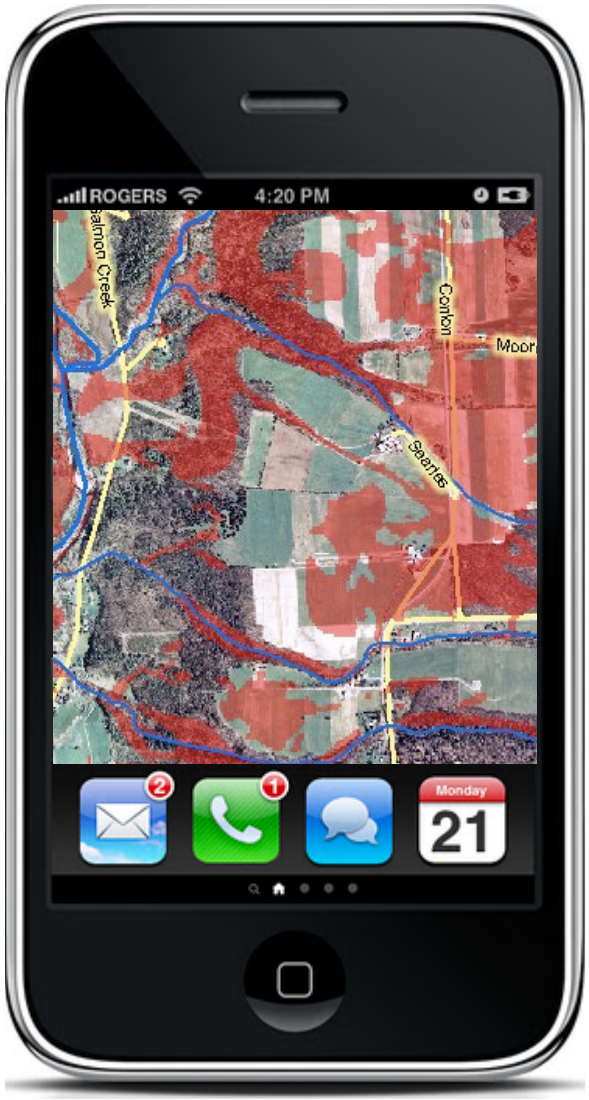
Rill erosion in a corn/ soybean field

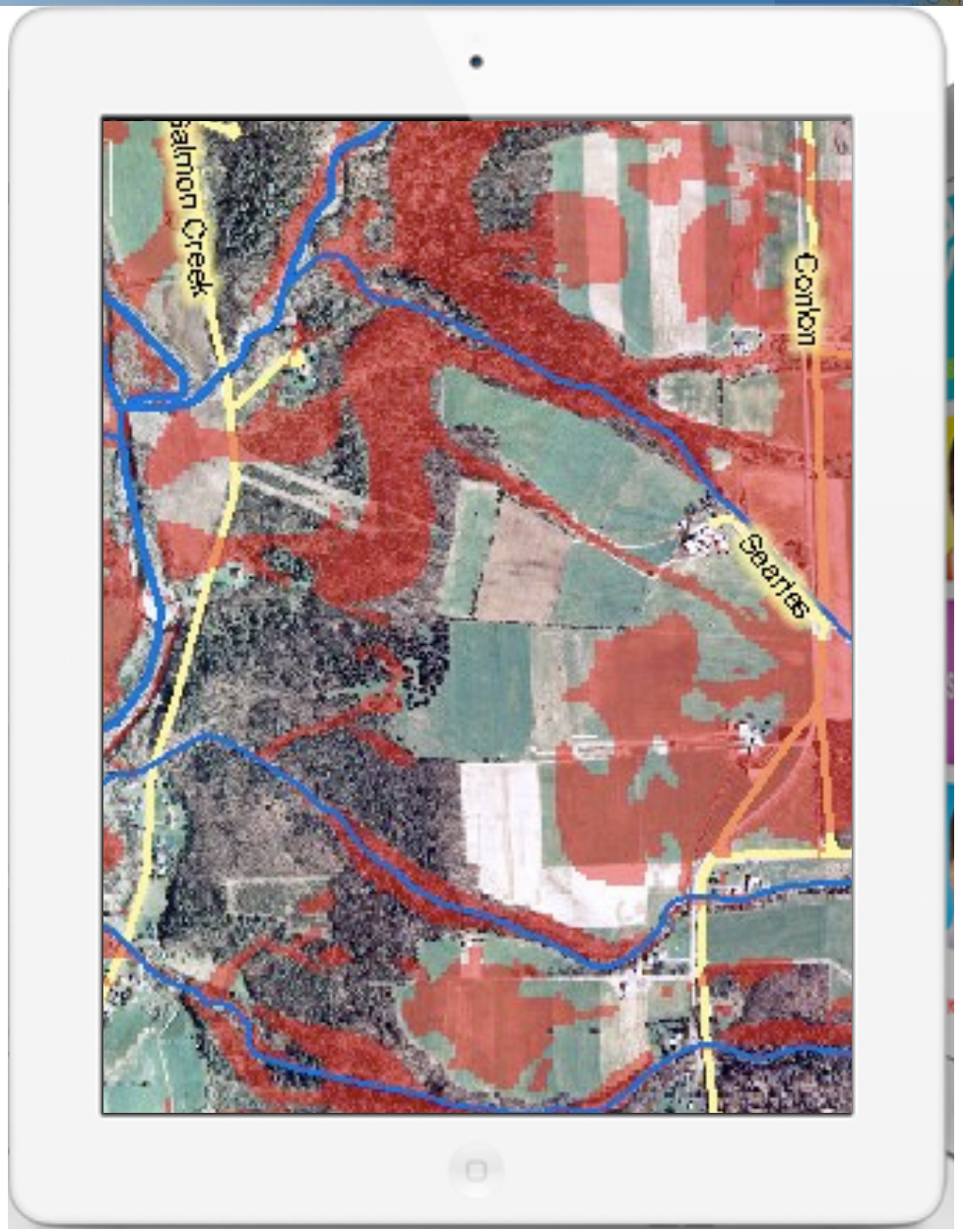
Sol

Katie

Christine

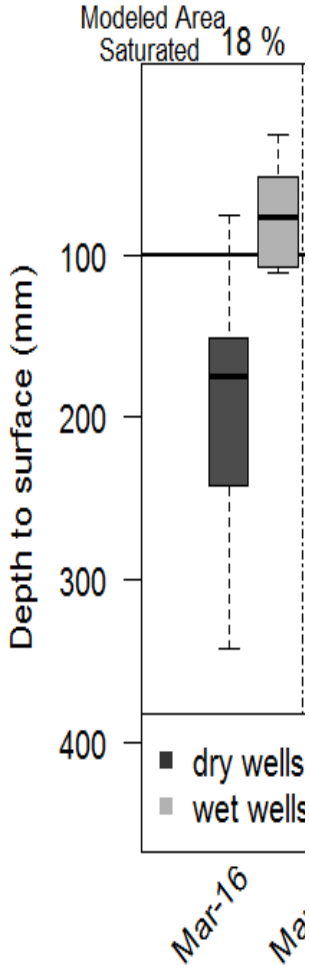
Rill erosion in a corn/ soybean field

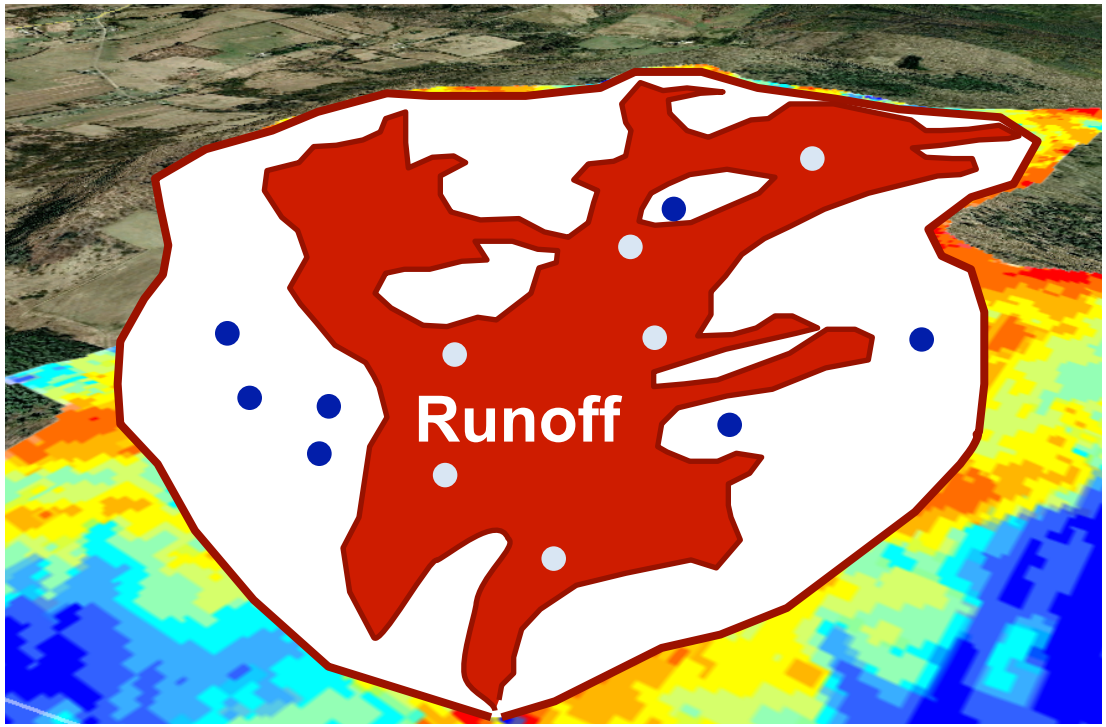




Lesson: Red-Green Color Blindness is more common than we thought

Storm Runoff Predictions

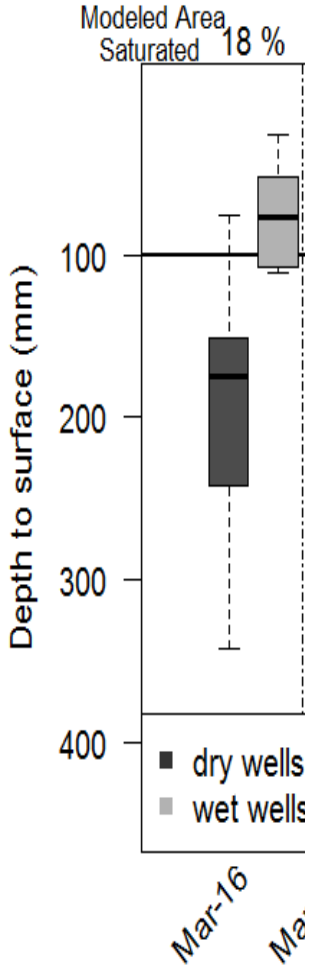


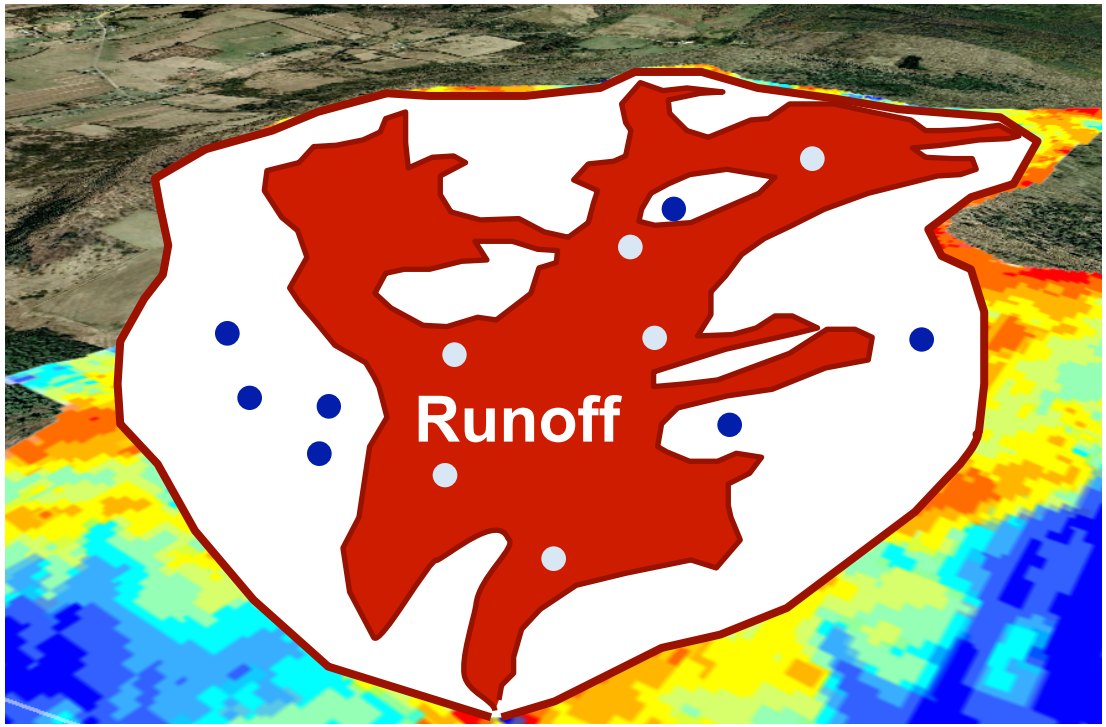


Event Dates

Archibald et al. 2014. *Journal of Hydrology: Regional Studies* 1: 74-91

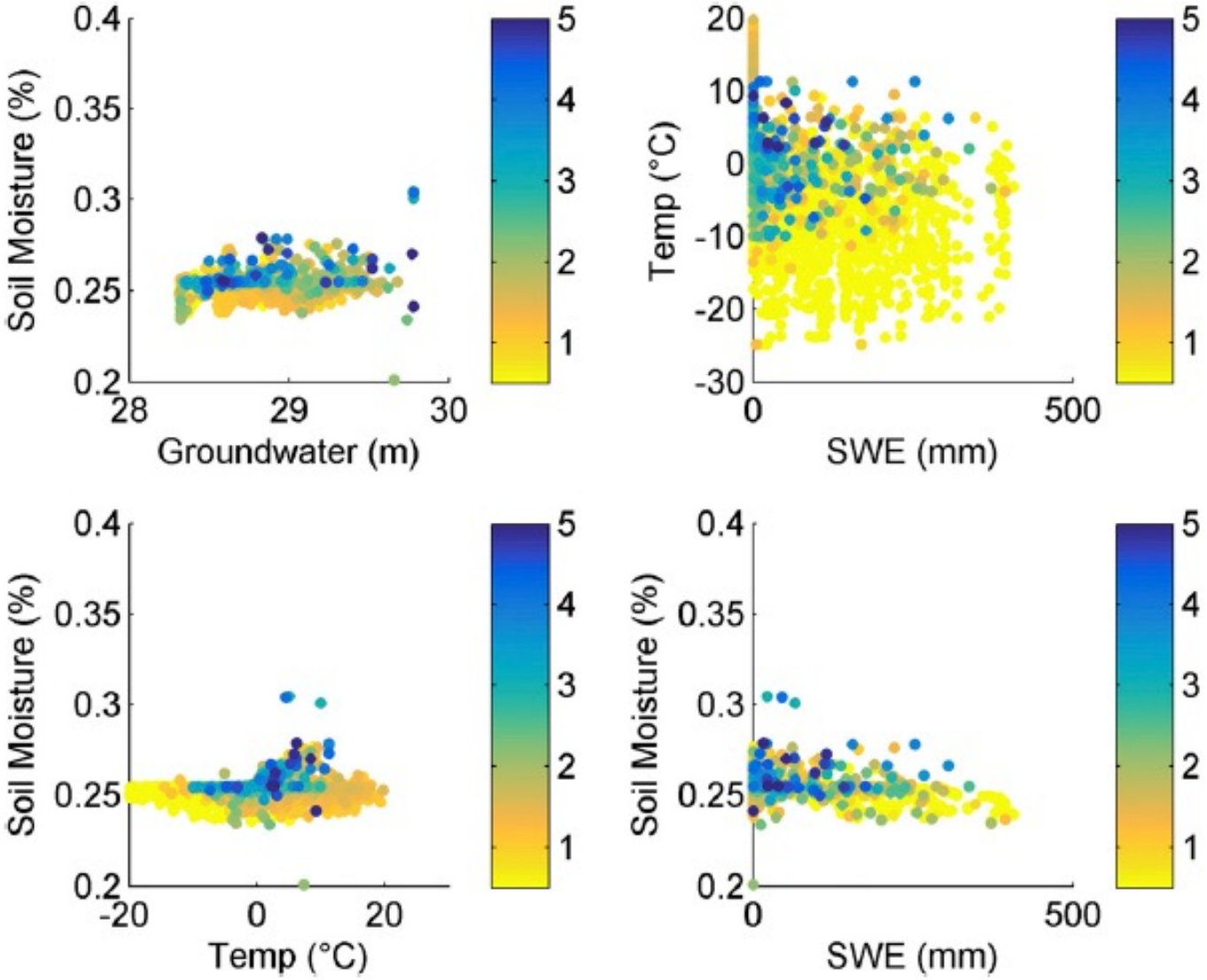
Storm Runoff Predictions

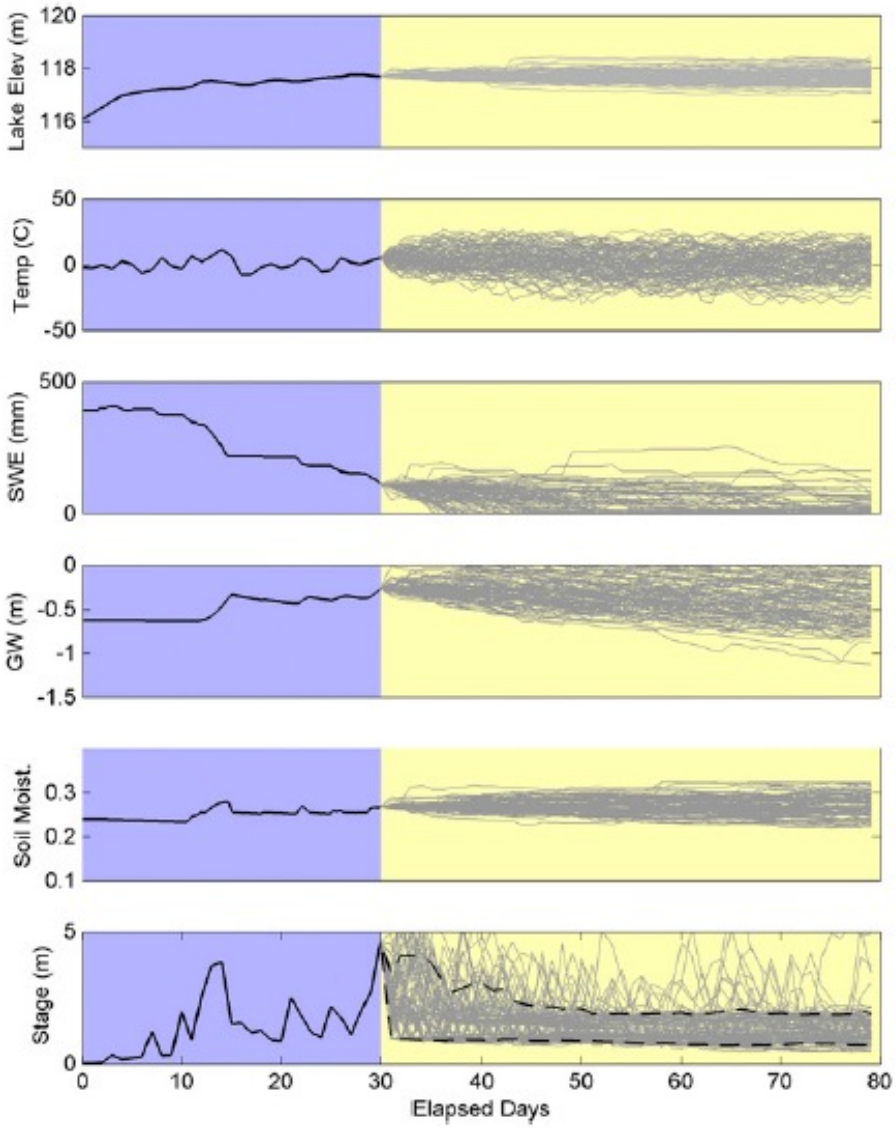


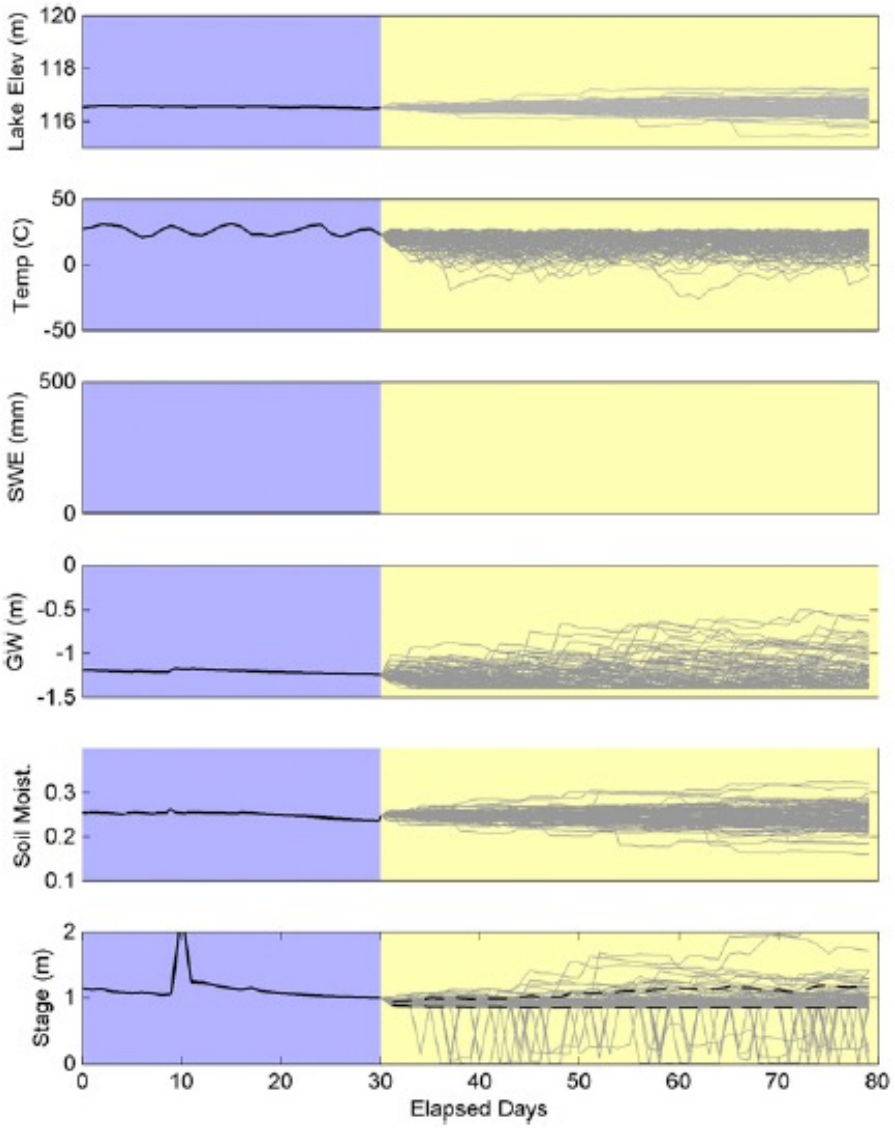


Event Dates

Archibald et al. 2014. *Journal of Hydrology: Regional Studies* 1: 74-91


Soil Moisture (%)
0.4
0.35
0.3
0.25
0.2
28
29
30
Groundwater (m)
5
4
3
2
1
Temp (°C)
20
10
0
-10
-20
-30
0
500
SWE (mm)
Soil Moisture (%)
-20
0
20
Temp (°C)
SWE (mm)

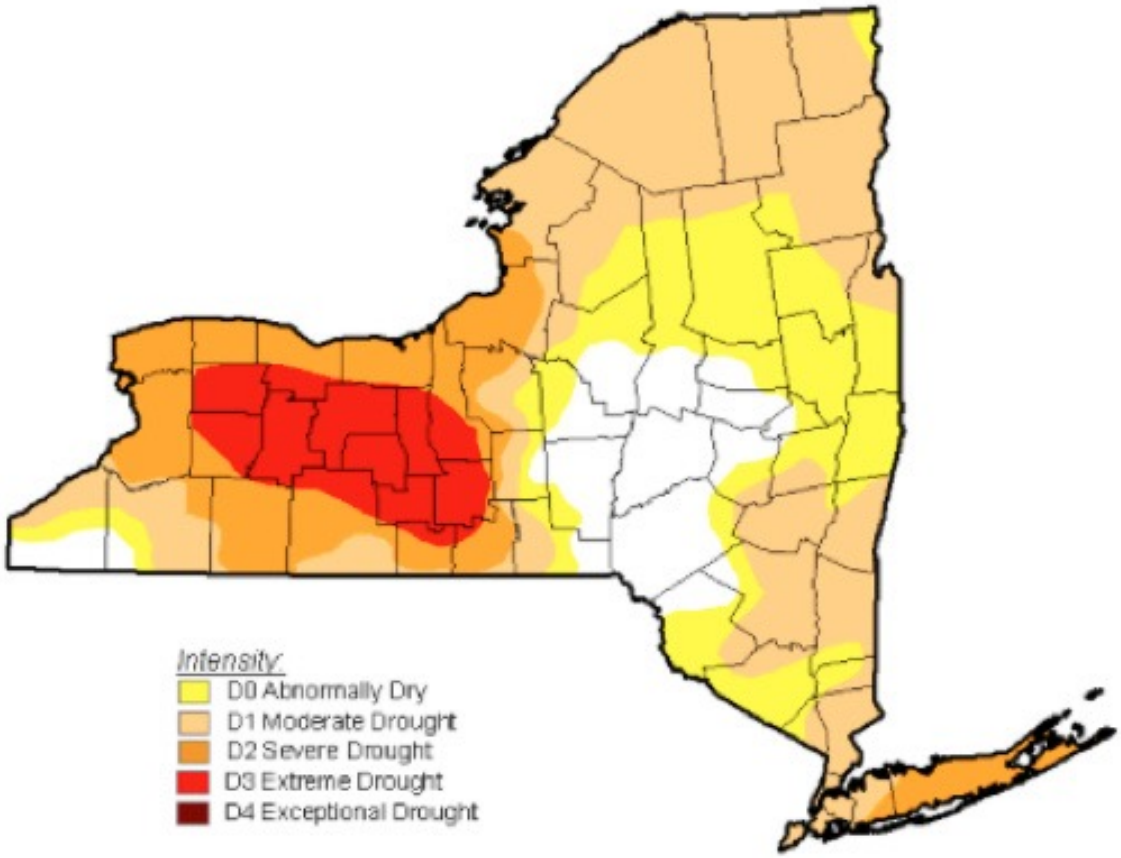

Lake Elev (m)
120
118
116
Temp (C)
50
0
-50
SWE (mm)
500
0
GW (m)
0
-0.5
-1
-1.5
Soil Moist.
0.3
0.2
0.1
Stage (m)
5
0
0
10
20
30
40
50
60
70
80
Elapsed Days


Lake Elev (m)
120
118
116
Temp (C)
50
0
-50
SWE (mm)
500
0
GW (m)
0
-0.5
-1
-1.5
Soil Moist.
0.3
0.2
0.1
Stage (m)
2
1
0
0
10
20
30
40
50
60
70
80
Elapsed Days

September 13, 2016

(Released Thursday September 15, 2016)

Valid 8 a.m. EDT

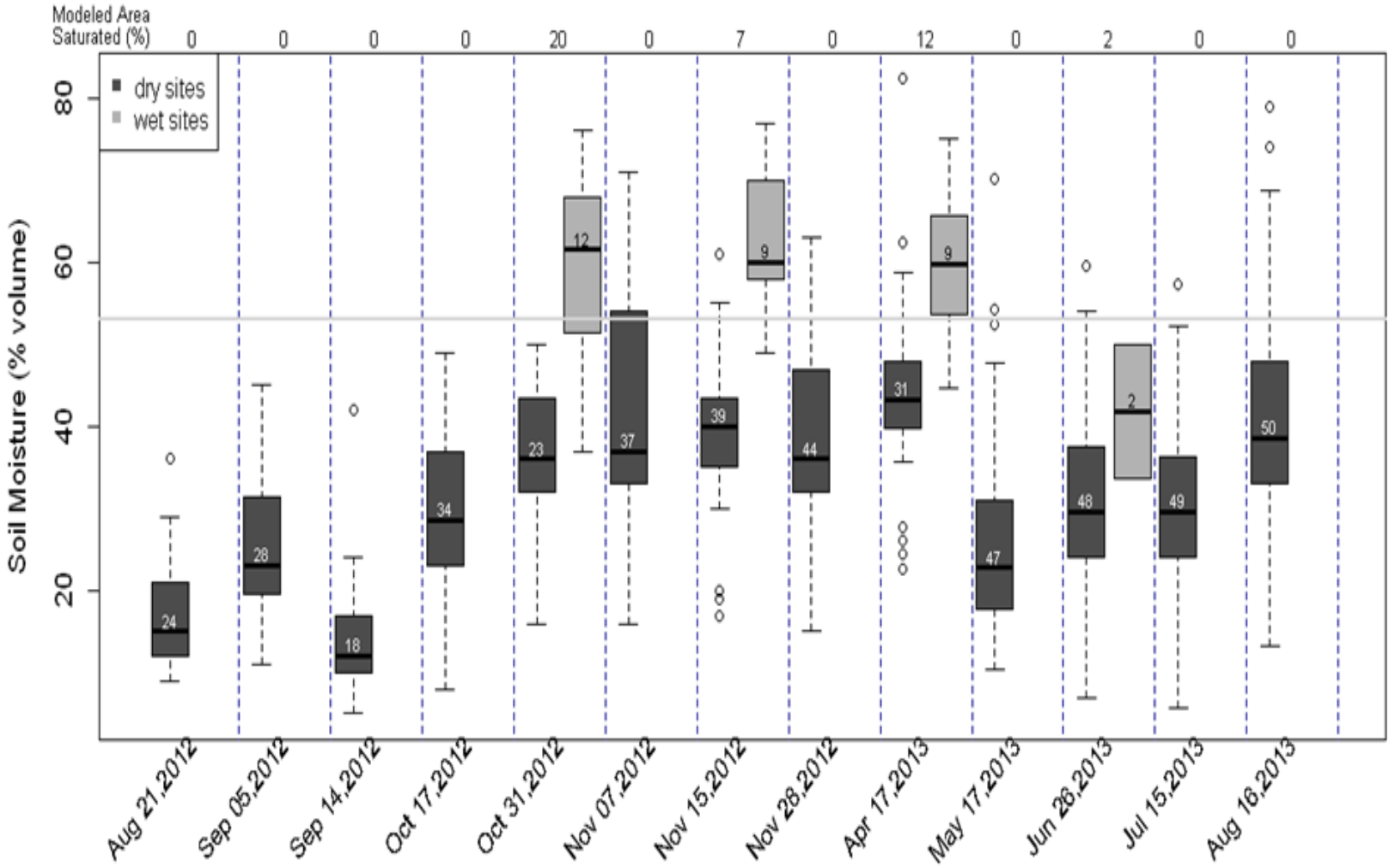


Water is the original substance, and hence is the material cause of all things

-Aristotle ~300 BC

probably quoting Thales ~500 BC

Storm Runoff Predictions



Fall Creek

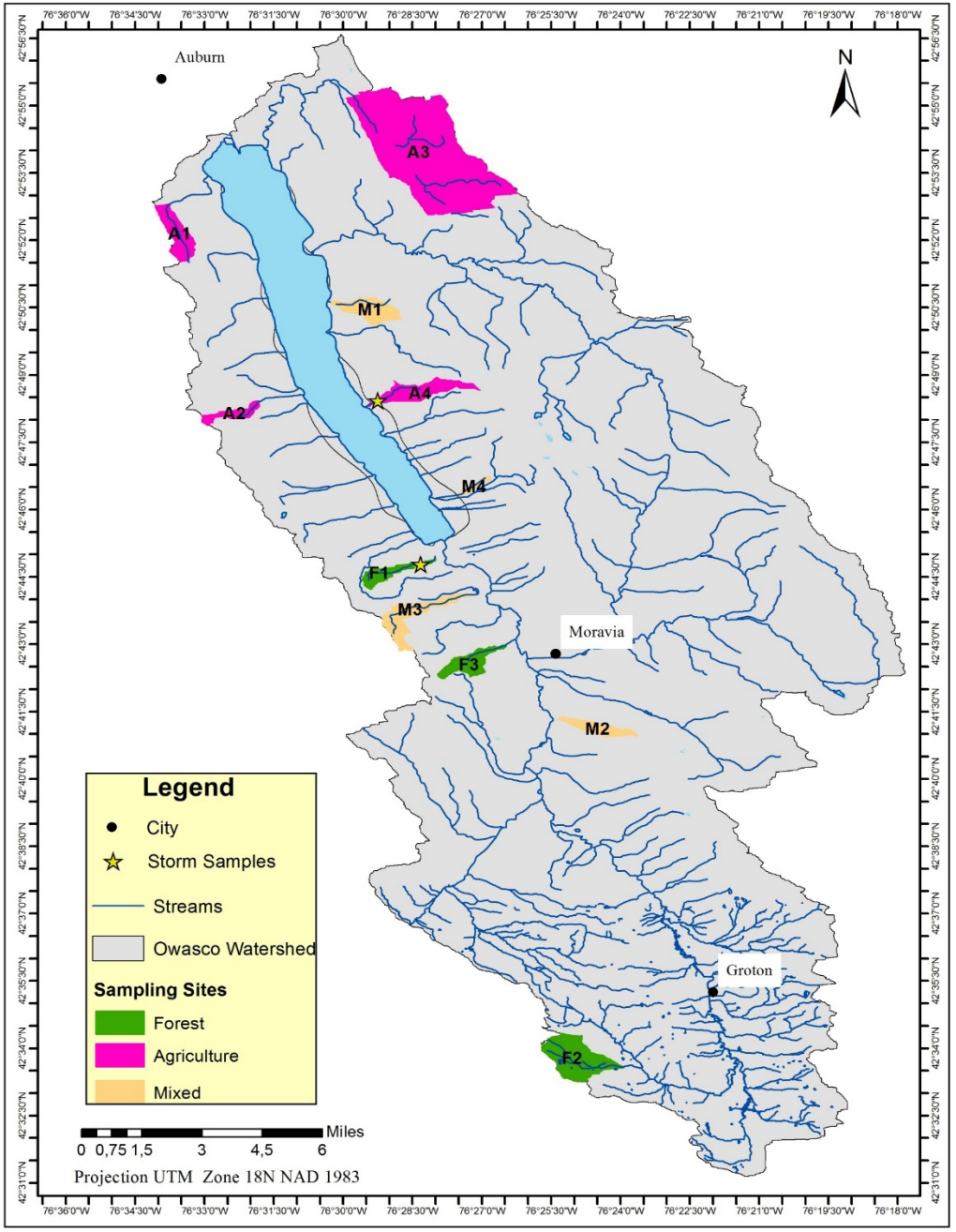
Erosion of shallow soils forms gullies in corn/soybean field

Tributary Monitoring
Our Questions

- 1. How much P load flows into lakes from small tributaries?
- 2. What is the role of the different land-uses as a source of P to the lake?
- 3. How did the 2016 prolonged drought influence the P loads?

Study Area

Site ID	Sample Point
A1	Veness Brook at Silver Street Road
A2	Wyckoff Road across from #3892
A3	Melrose Rd 0.3 mi west of O'Neil Rd
A4	Rockefeller Rd 2nd trib north of Arnold Rd
F1	Route 38 first trib south of lake
F2	Sharpsteen Rd
F3	Route 38/ Long Hill Road near to ice cream shop
M1	Koenig Point at lake shore
M2	Rockefeller Rd upstream of Koenig Point
M3	Route 38 south of #1458
M4	Route 38 across from #2440
M5	Rockefeller Rd 2nd trib north of Indian Cove



Cornell sampling Sites 2016
Source: Own

Measured in stream

- pH
- Dissolved Oxygen
- Conductivity
- Temperature
- Discharge

Lab Analysis

- **Total P**
- **Soluble Reactive P**
- **Total Suspended Solids**
- Nitrate
- Invertebrates

Forest use

4 areas >80% AGRICULTURE

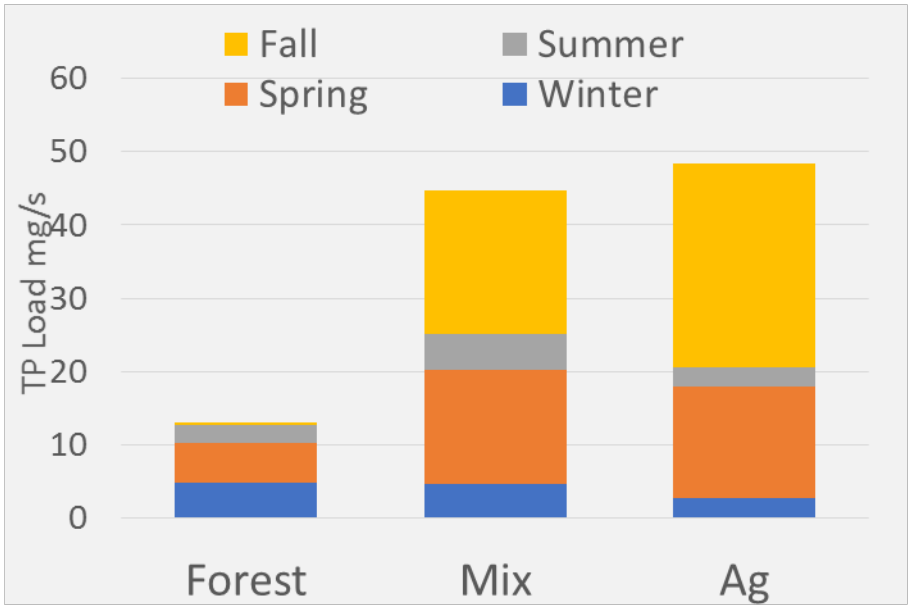
5 areas 40-60% Ag MIX

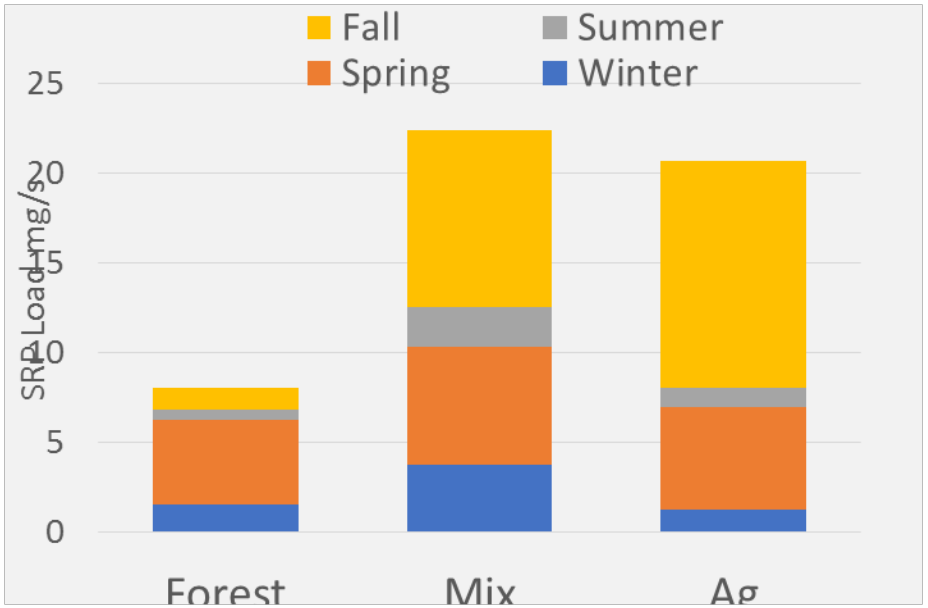
3 areas >70% FOREST

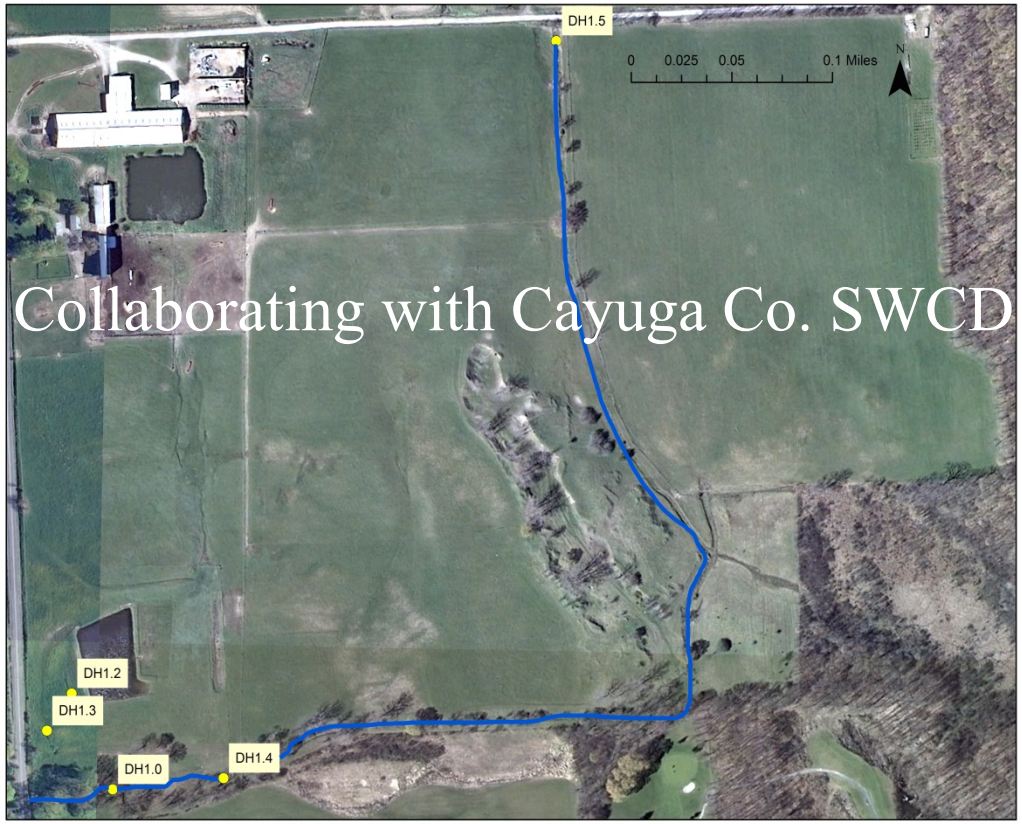
Agricultural use

Mixed use

Preliminary Results: TP and SRP Loads







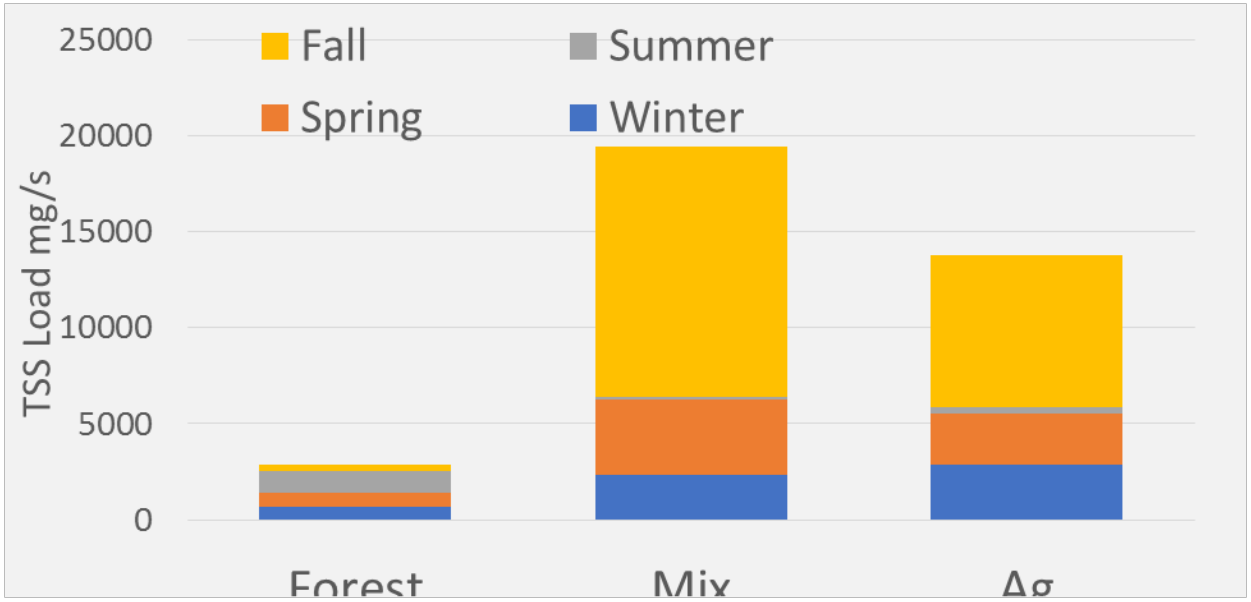
Collaborating with Cayuga Co. SWCD

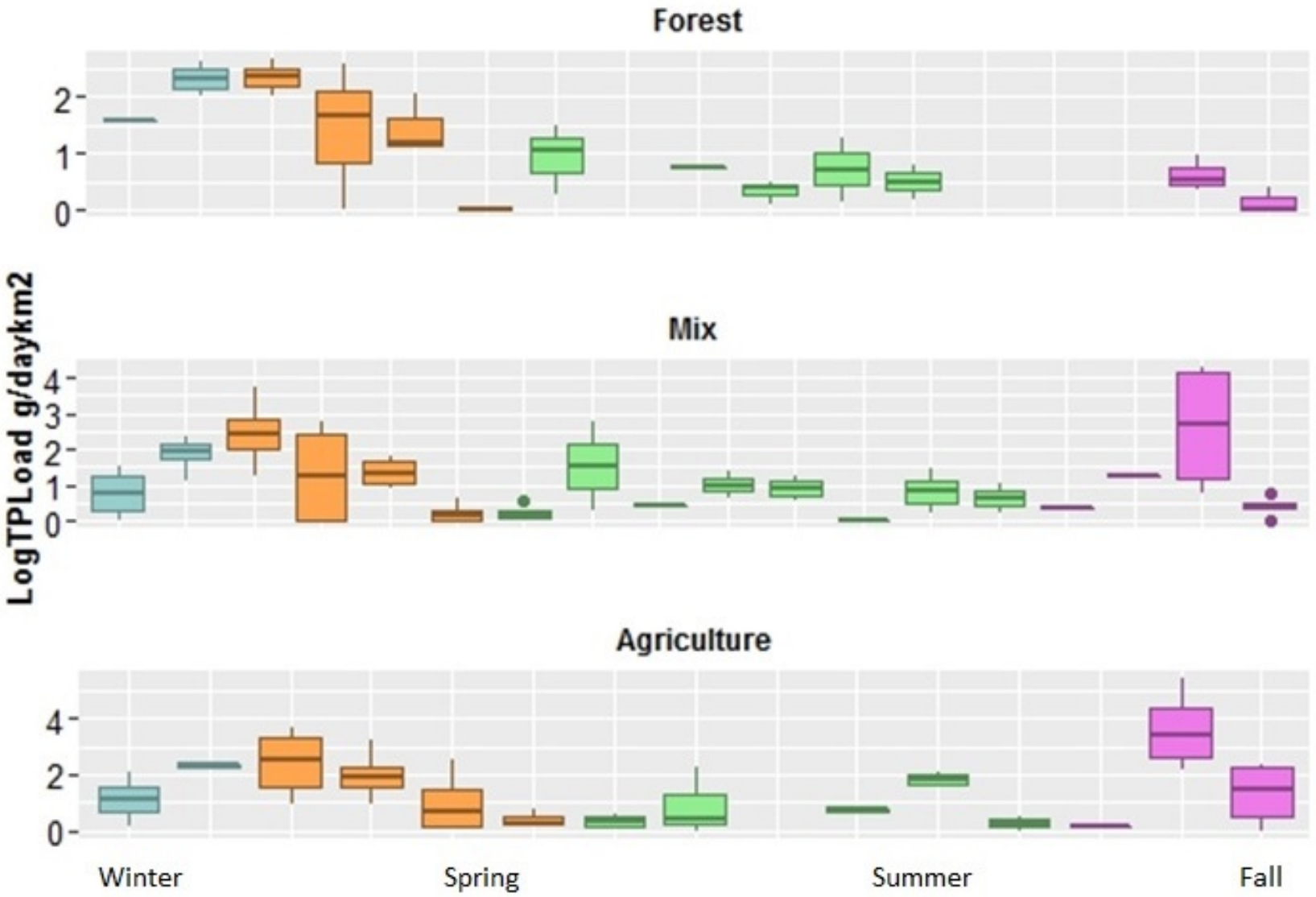
Inlet

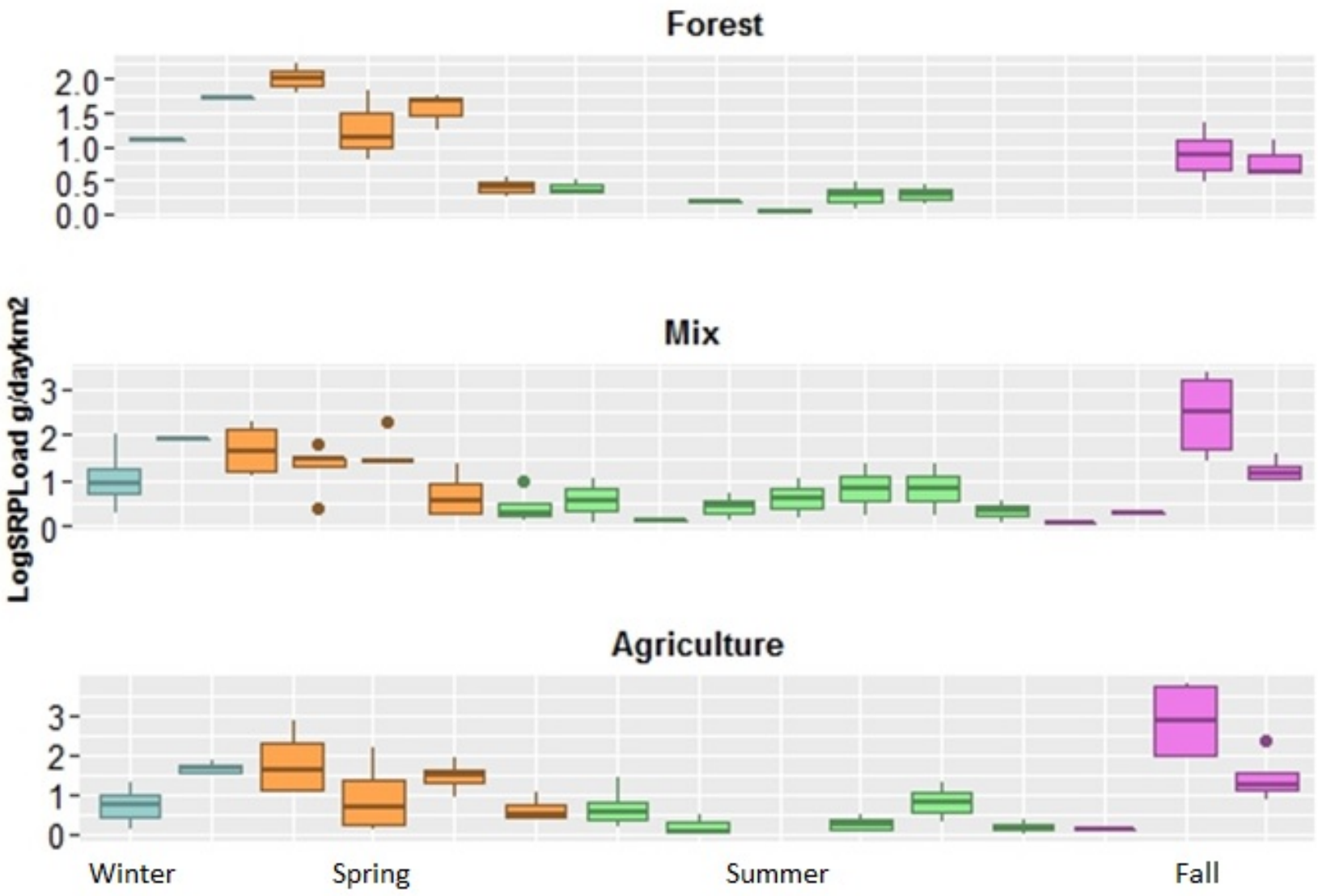
The replacement dairy site will receive exclusion fencing along the entire length of the stream.

Outlet

Preliminary Results: TSS Load




Forest
Mix
Agriculture
LogTPLoad g/daykm2
0
1
2
3
4
Winter
Spring
Summer
Fall


Forest
Mix
Agriculture
LogSRPLoad g/day/km2
2.0
1.5
1.0
0.5
0.0
3
2
1
0
Winter
Spring
Summer
Fall

Preliminary Conclusions

- P and sediments loads varies across the landuses depending on the season
- P load peaks during the spring for forested areas, while agricultural and mixed areas have their peak during the fall by the end of the growing season, immediately after the dry period.

- We think that the prolonged drought during the growing season resulted in unusually high fall loads from agricultural and mixed areas, which may not be the behavior for normal and wet years.

Next Steps – Future questions

- How does landuse-season interact during normal and wet years?
- Algal bloom and phosphorus relationship
  - What happens to P when it goes into the lake?
  - What is the mechanism that triggers algal bloom?

Other ideas?

A Survey of Property Owners in the Owasco Lake Watershed

Grace Tucker
CALS Class of 2017

Dr. Rich Stedman
Cornell University Human Dimensions Research Unit

Background

- Hand-delivered paper survey in August and September 2016
- 300 lakeshore property owners
- 300 rural landowners
- Amazing response rates!
  - Lakeshore property owners: 73%
  - Rural landowners: 54%

Research Questions

1. What are landowner's perceptions/ concerns about water quality?

2. How are these perceptions/concerns impacted by landowner location in the Owasco Lake Watershed?

Water Quality

- Importance
  - 75% of respondents think water quality is "very important" (93% of lakeshore, 50% of rural)
- Concern
  - Most lakeshore property owners "very concerned"
  - Relatively similar responses by location
  - Rural owners are concerned to varying extents
- Knowledge
  - Rural respondents have similar or less knowledge than lakeshore respondents for all locations

What's driving problems?

- Perceived watershed pollution sources
  - Large numbers of respondents unsure
  - Pollution sources believed to be "severe problems" involve nutrient (residential) and manure (agricultural) runoff

Key Beliefs

- Respondents want autonomy, are willing to make improvements, but want to know they work first
- Very strong desire to protect the watershed
- Understanding of how individuals can personally negatively impact the watershed
- Agree that residential owners want farms to succeed
- Agree that residential owners impact water quality
- Divergent views about how much farmers care about water quality and how they impact it.

Organization Involvement

- Minimal involvement in a variety of organizations (also noted minimal neighbor collaboration)
- OWLA was most common lakeshore organization
- Rural respondents are more involved with the DEC
- Cayuga Soil & Water had the most involvement from both landowner types

Acknowledgements

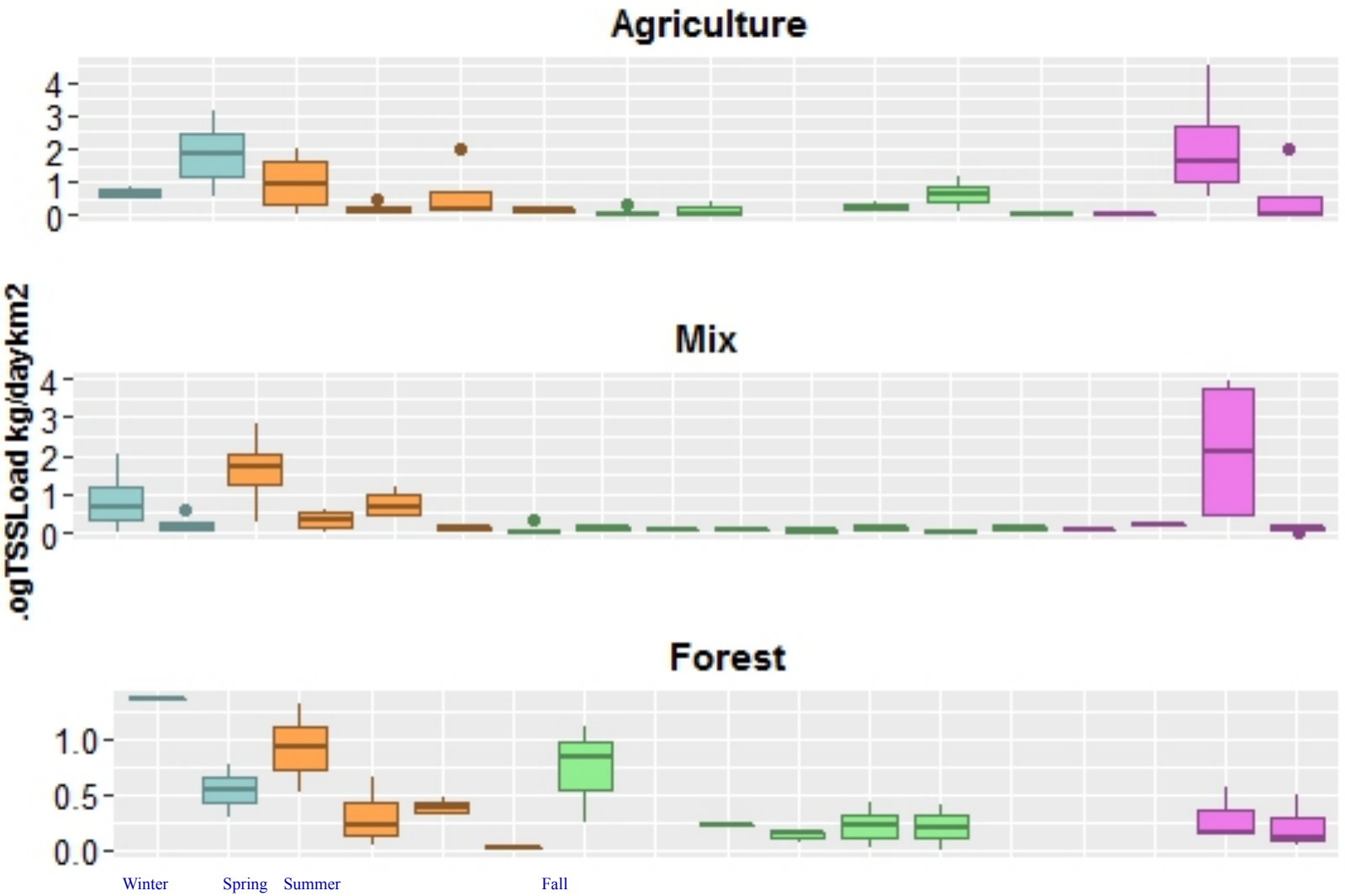
Cayuga Co. SWCD

Recent Students: Sol Lisboa, Daniela Rosero, Chelea Morris, Josephine Archibald, Katy Hofmiester Shiela Saia, Brian Buchanan, Christine Georgakakos, Grace Tucker

Richard Stedman

- Cayuga County: SWCD, land owners, municipal officials
- Cornell Soil and Water Lab staff


Agriculture
Mix
Forest
LogNitrateLoad kg/day km2
0
2
4
6
7
Winter
Spring
Summer
Fall


Agriculture
Mix
Forest
.ogTSSLoad kg/daykm2
4
3
2
1
0
1.0
0.5
0.0
Winter
Spring
Summer
Fall

Contact Information

Want more information? Have questions, concerns, or ideas? Feel free to email us!

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THANKS FOR YOUR ATTENTION!

Strategy for Controlling Nonpoint Source Pollution