WATERSHED MODELING

APPROACH AND PRELIMINARY RESULTS

2013 Cayuga Lake Study

Technical Briefing (CLTAC)
Cayuga Lake Modeling Project
May 19, 2014
Albany, NY

Ultimate Goals and Objectives

- Estimate phosphorus loads from the watershed to the lake:
  - Establish baseline
  - Input to the lake model

- Management scenario testing and forecasting

http://warrior481.blogspot.com/2012/03/skinny-atlas.html

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Objective to Date

- Develop a repeatable strategy for setting-up watershed models that best represents the hydrology and phosphorus dynamics of the entire watershed

http://www.cityofithaca.org/departments/dpw/water/wtp.cfm
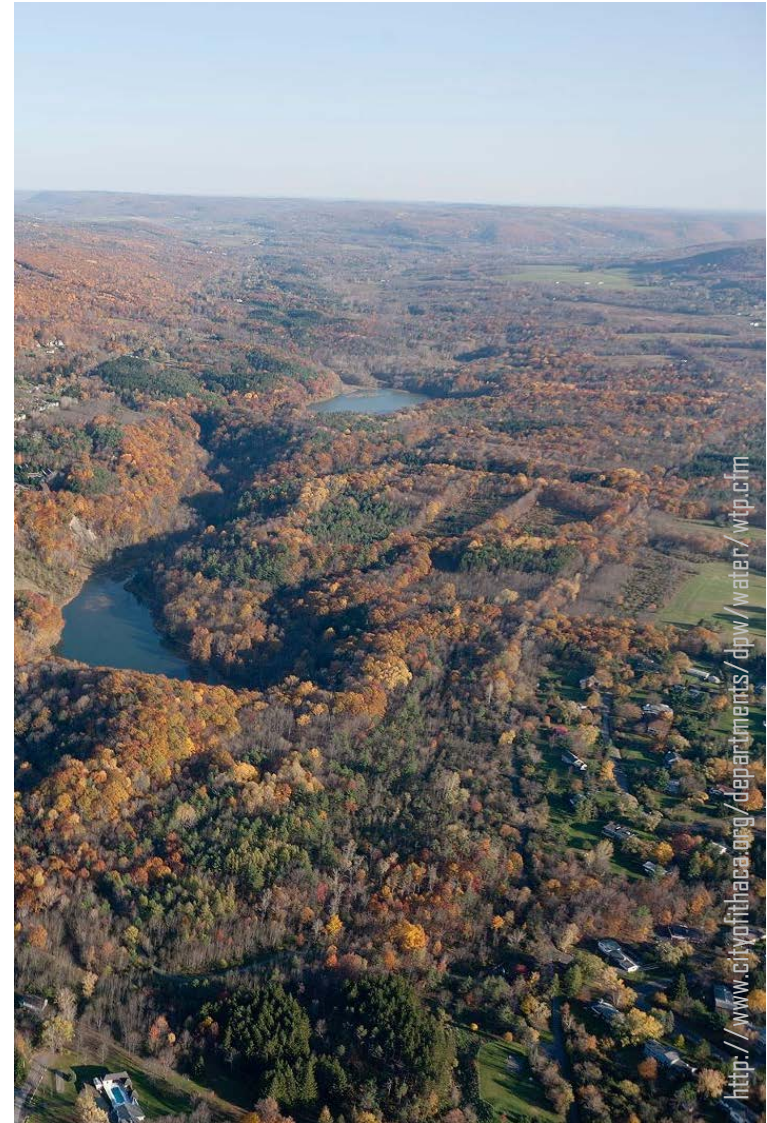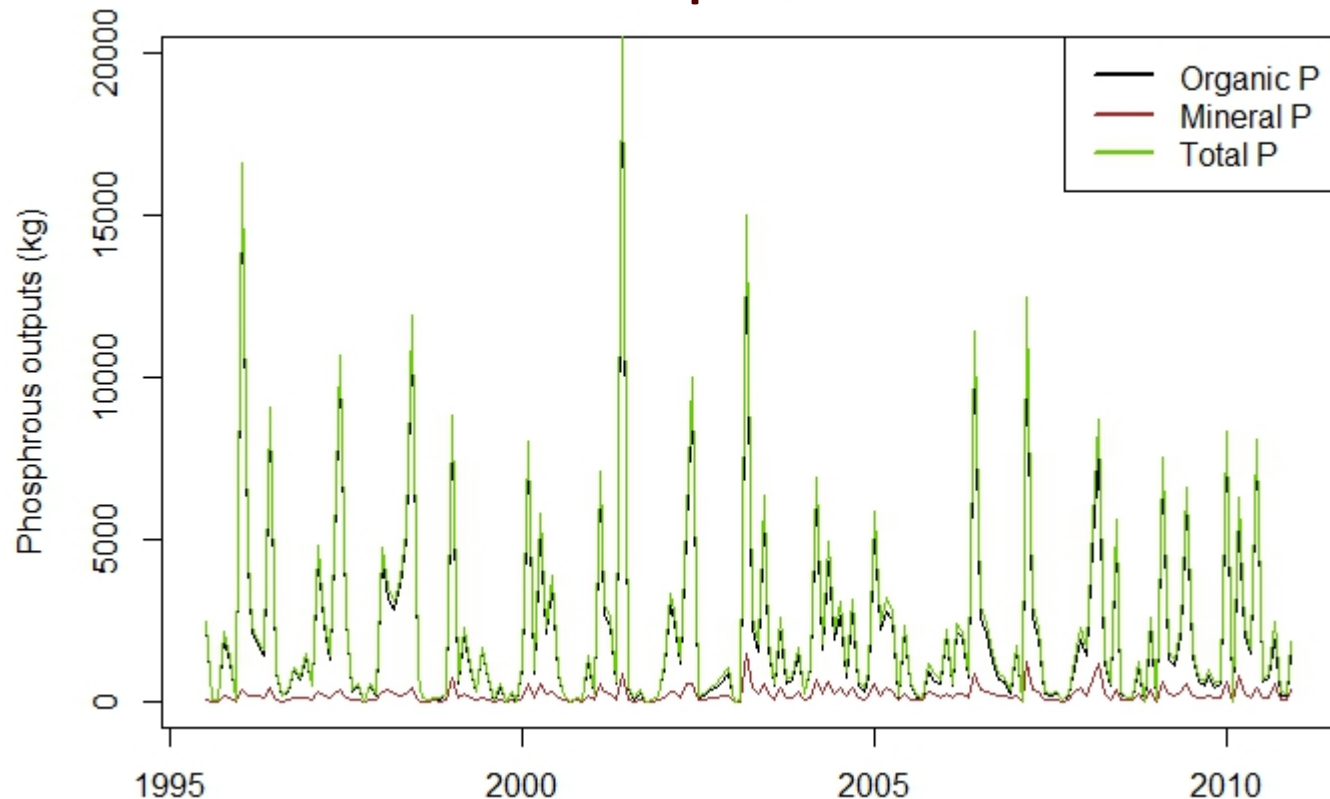
Model Choice and Rationale

- **Soil Water Assessment Tool (SWAT)**
  - Developed by USDA-ARS, Texas AM
  - Widely used in TMDL-type projects
  - Simulates TDP and TP
  - We have Experience with the model
  - Adaptable to NE conditions (sort of)
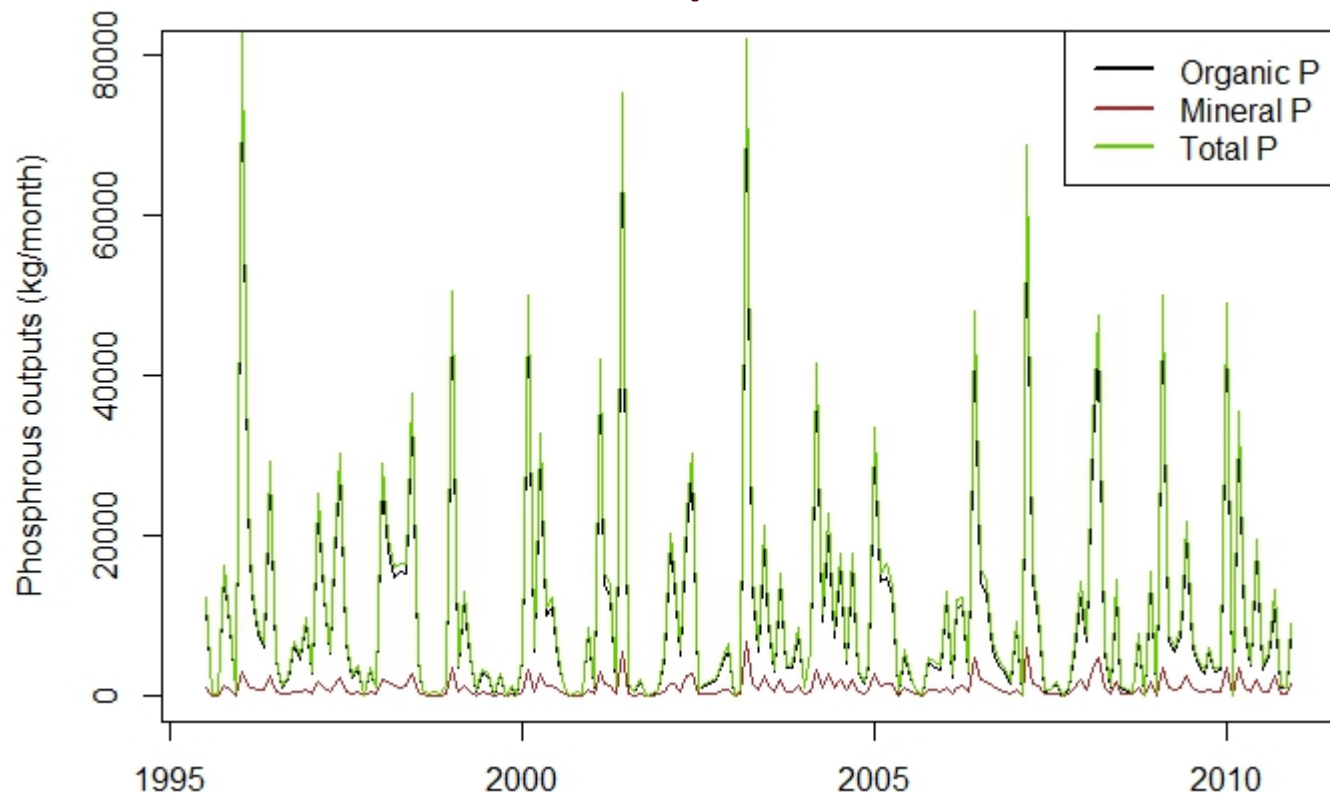 - Flexible management input

Land use, crop rotation

Fertilizer

Sub basin

Soil type

Google Images
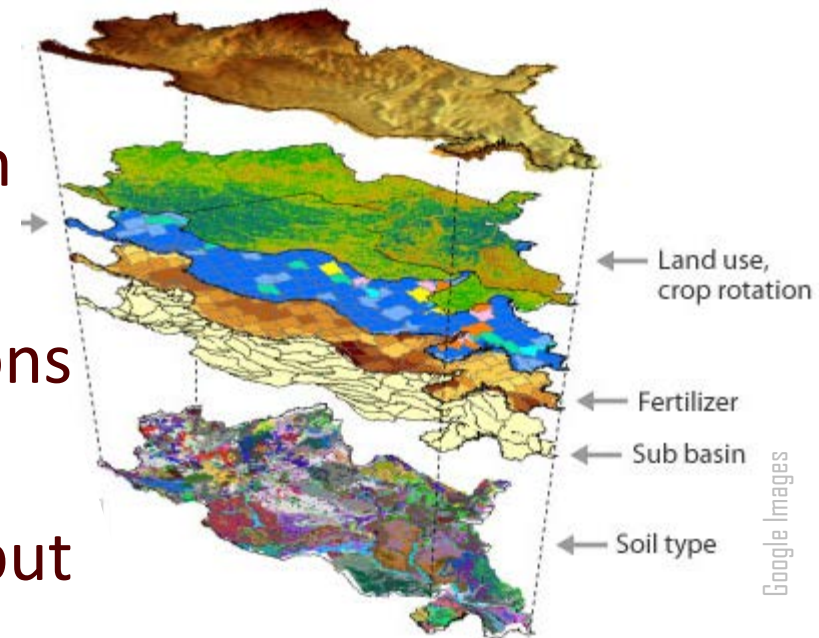
Model Choice and Rationale

- Six Mile Creek (at USGS gauge) – Un-calibrated SWAT output

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Model Choice and Rationale

- Fall Creek (at USGS gauge) – Un-calibrated SWAT output

Setting-up SWAT

SC

0   5   10   20 Kilometers

N

0   2.5   5   10 km

Dissolved P
kg ha-1 y-1

	0 - 0.12
	0.13 - 0.38
	0.39 - 0.65
	0.66 - 0.93
	0.94 - 1.20

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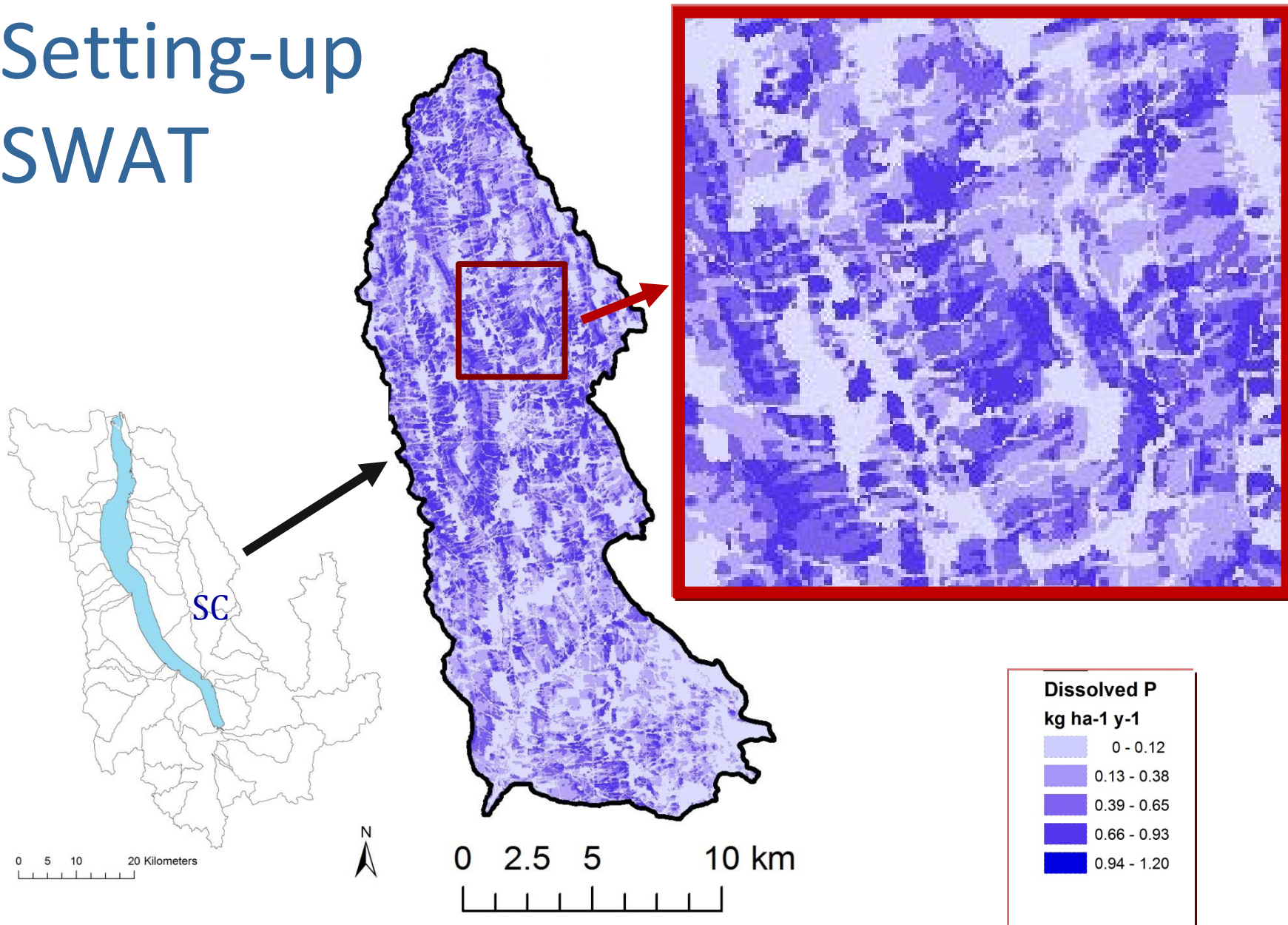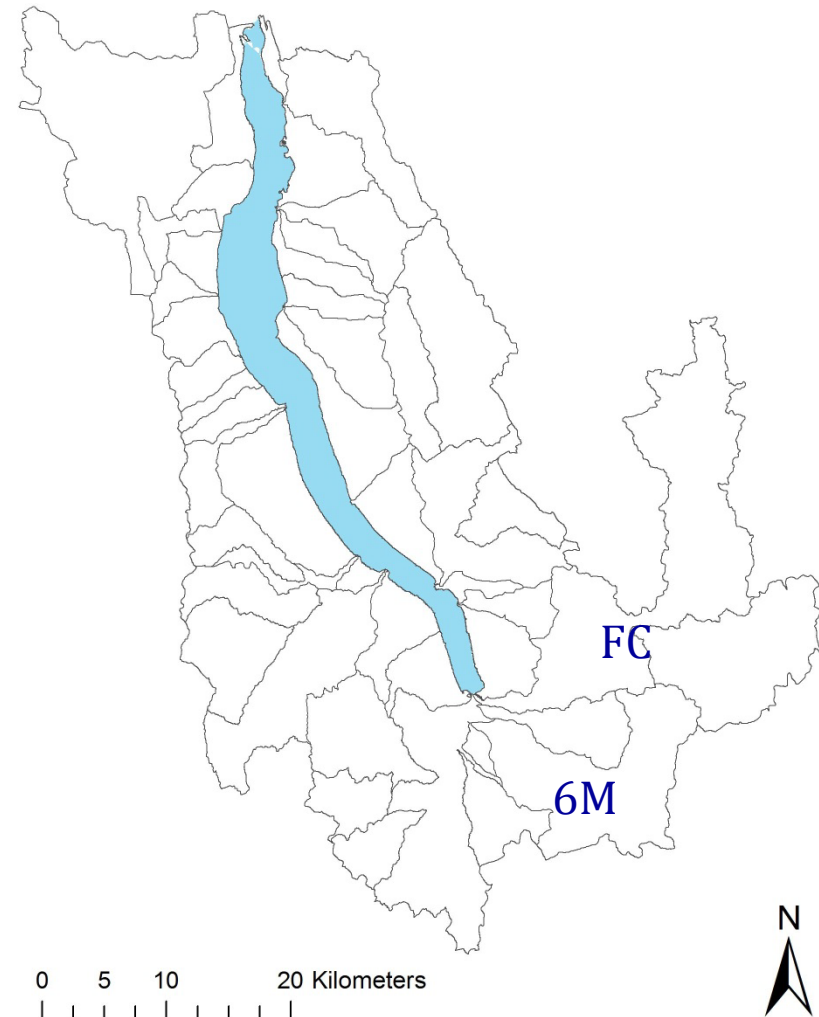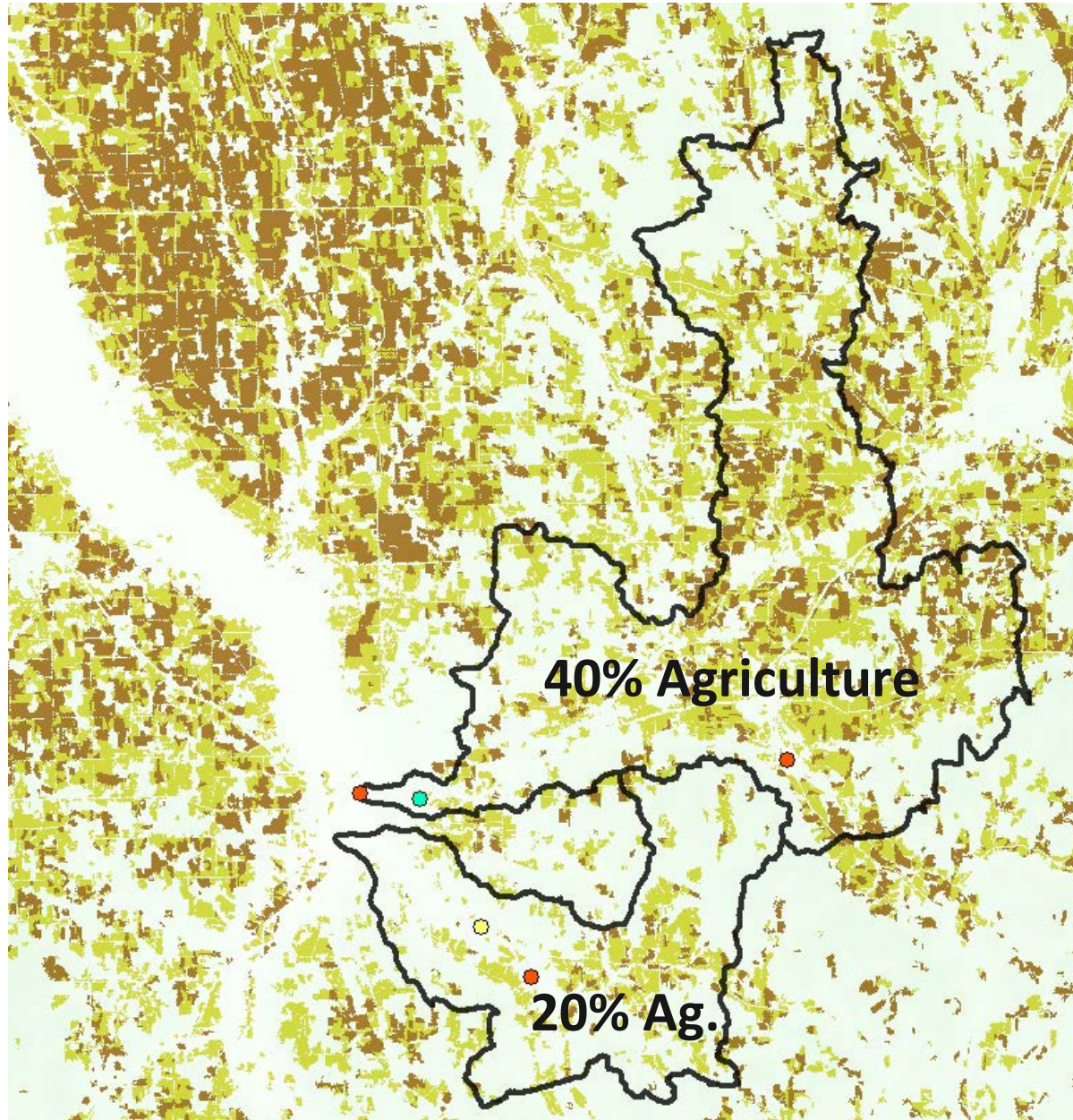
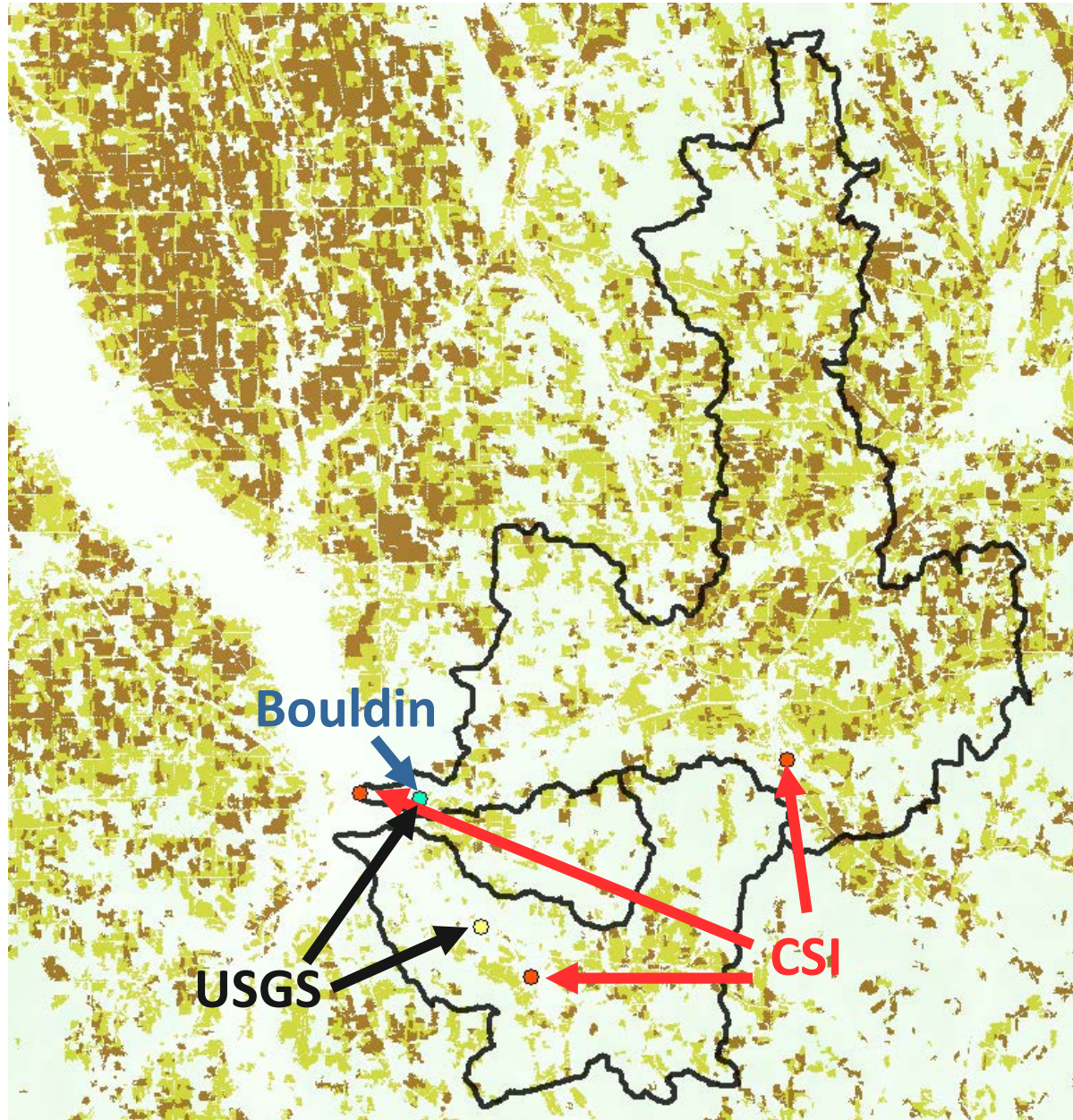# Fall Creek and Six Mile Creek

Cayuga Lake subbasins

- USGS flow records

- CSI and Bouldin phosphorus data

- Represent a range of agricultural intensiveness

- Represent a range of "near-by" weather stations

- Dan Karig's concerns about sediment sources

FC

6M

N

0   5   10   20 Kilometers

Fall Creek and Six Mile Creek

40% Agriculture

20% Ag.

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Fall Creek and
Six Mile Creek

Bouldin

USGS

CSI

Challenges

- What is the best source of weather data?

- What soils data should we use?

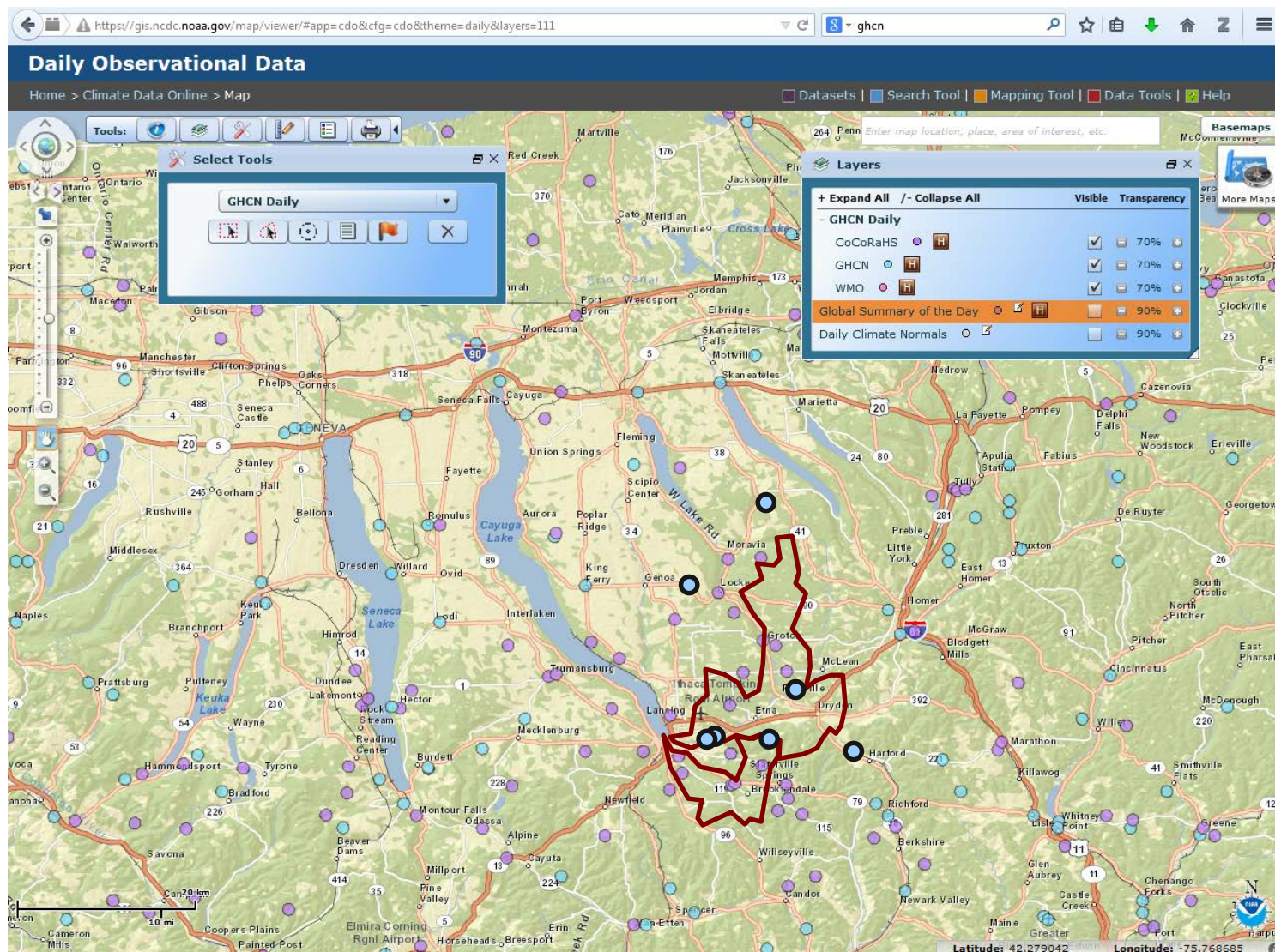- What is a representative management algorithm?

- Calibration?

http://www.cityofithaca.org/departments/dpw/water/wtp.cfm

Weather Data

- ## Weather station records

  - ### Long records

  - ### Data are generally considered good (although quality depends on who's monitoring)

  - ### Sparsely distributed

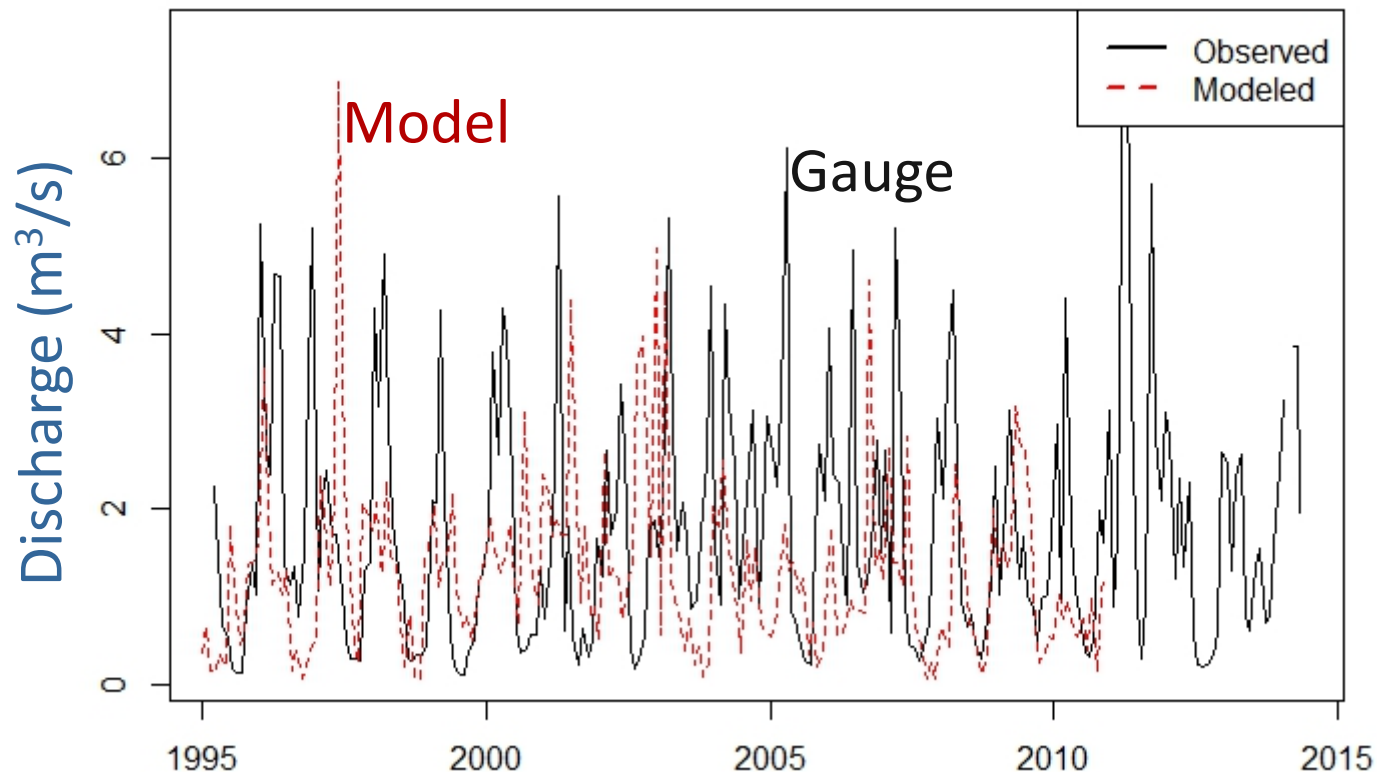 - ### Point measurements may not represent entire watersheds

Weather Station Data

Weather Station Data

- ■ Using just one weather station
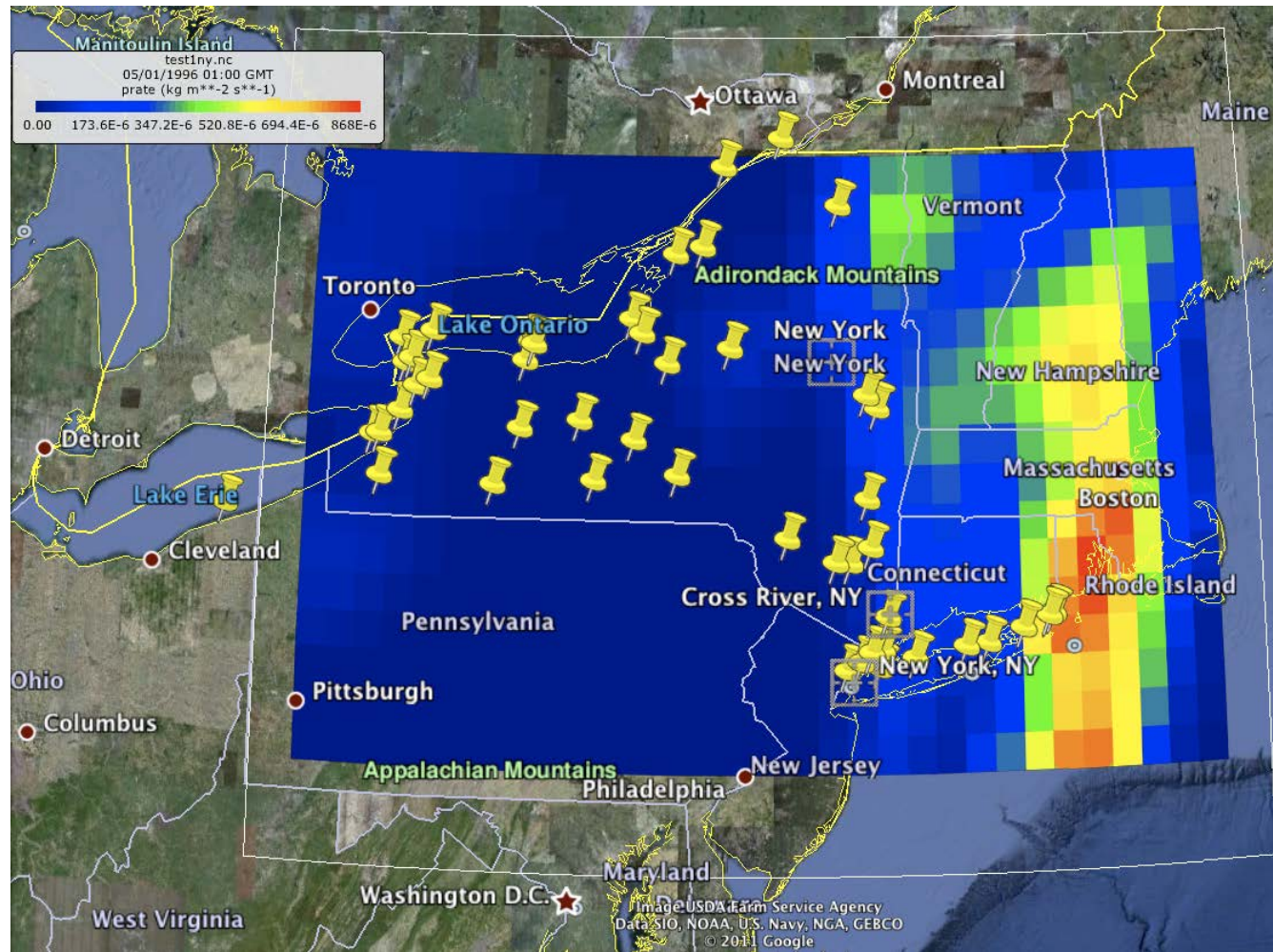
Six Mile Cr. monthly discharge

Weather Data

- Gridded data products, e.g., Climate Forecast System Reanalysis (CFSR)

  - Continuous spatial coverage

  - Represents average weather over large areas

  - Relatively short record (1979-present)

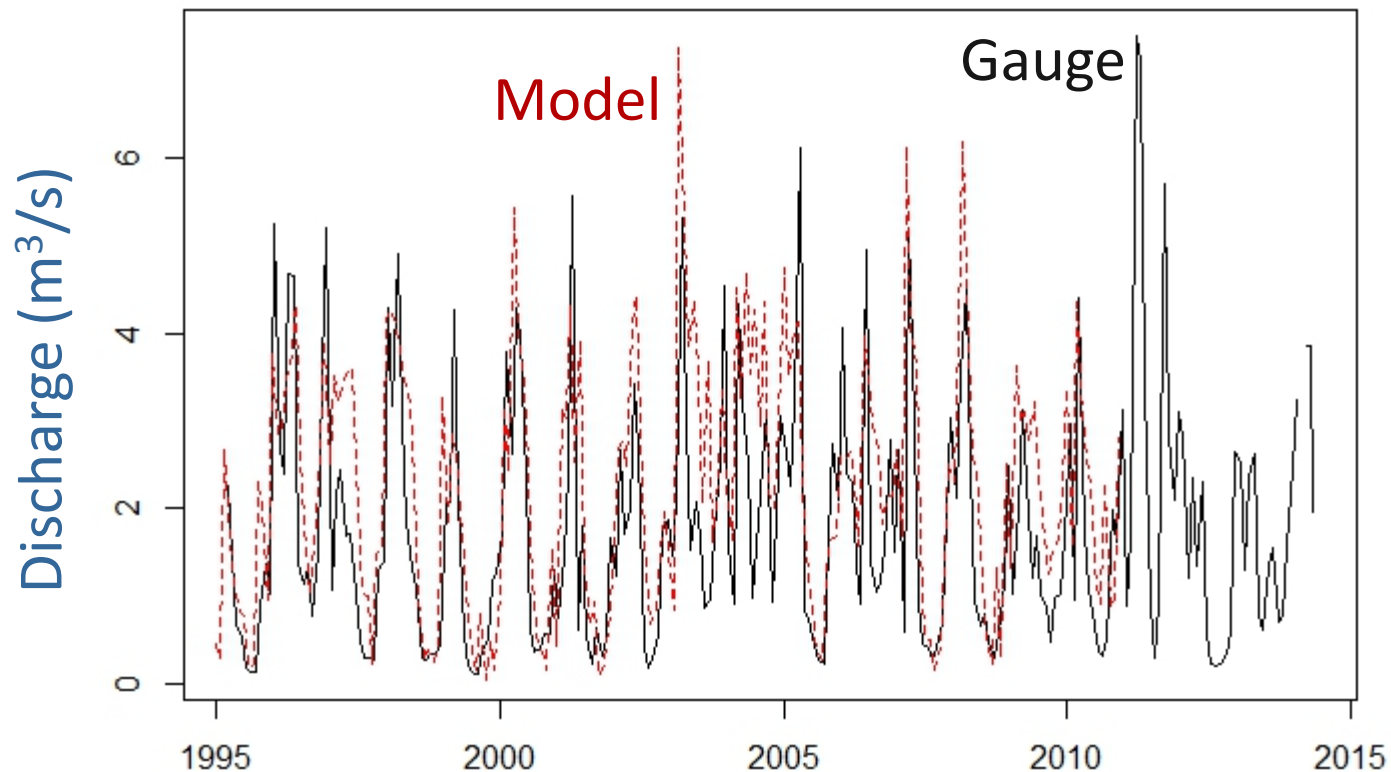 - Large precipitation events are muted

Weather Data

- Climate Forecast System Reanalysis (CFSR)

Weather Data

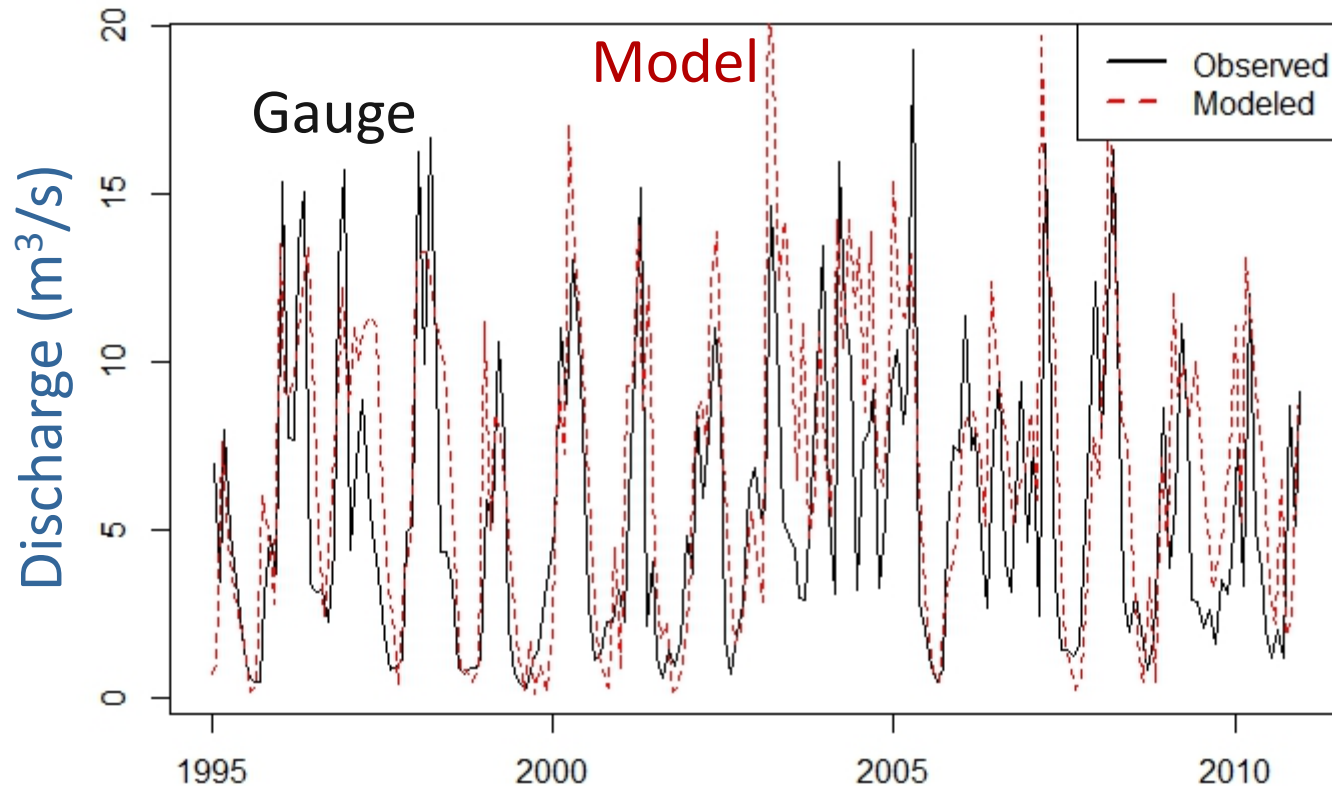- ## Climate Forecast System Reanalysis (CFSR)
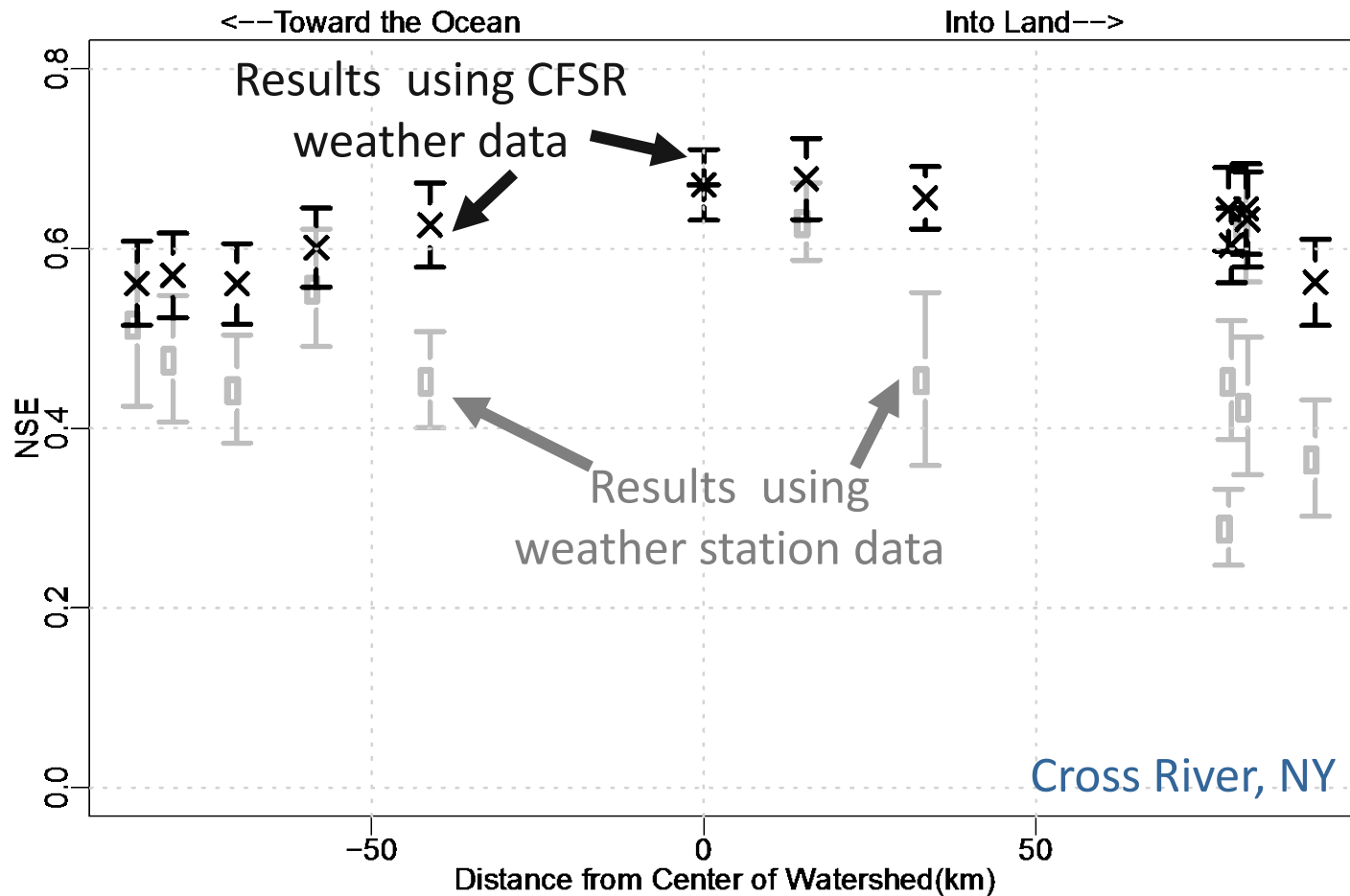
Six Mile Cr. monthly discharge

Weather Data

- **Climate Forecast System Reanalysis (CFSR)**

Fall Cr. monthly discharge

CFSR vs. Weather Station

Fuka, et al. 2014. *Hydrological Processes* (in press)

Soils Data

- Global Soils Data Sets
  - Widely available
  - Coarse resolution
  - Easily accessed

- USDA SSURGO Data
  - Pretty good quality
  - Weird at county boundaries
  - Sometimes challenging to access

- Derived from land forms (Experimental)

Representing management

- How to represent dynamic activities in the landscape

  - e.g., land application of animal wastes – timing, location, loading rate?

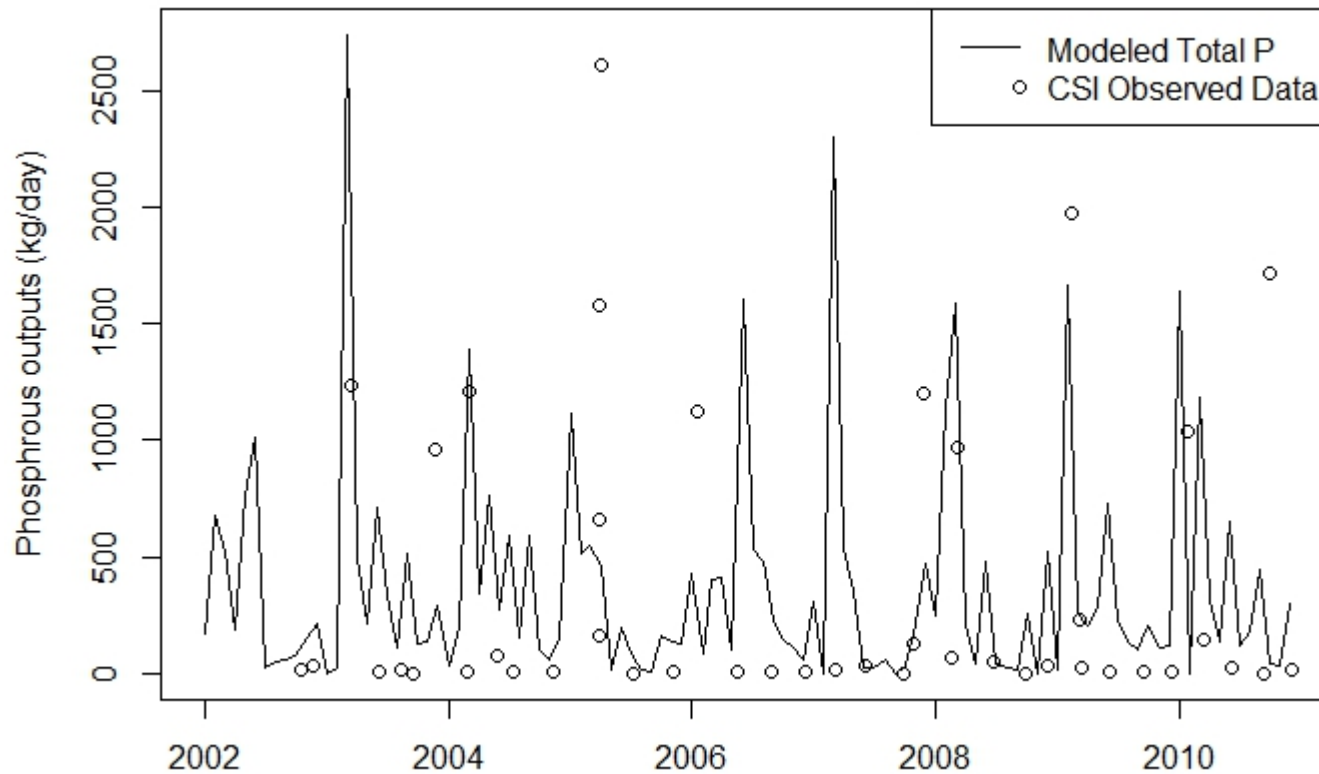- Need to be careful that calibration does not inadvertently compensate for these activities.

Representing management
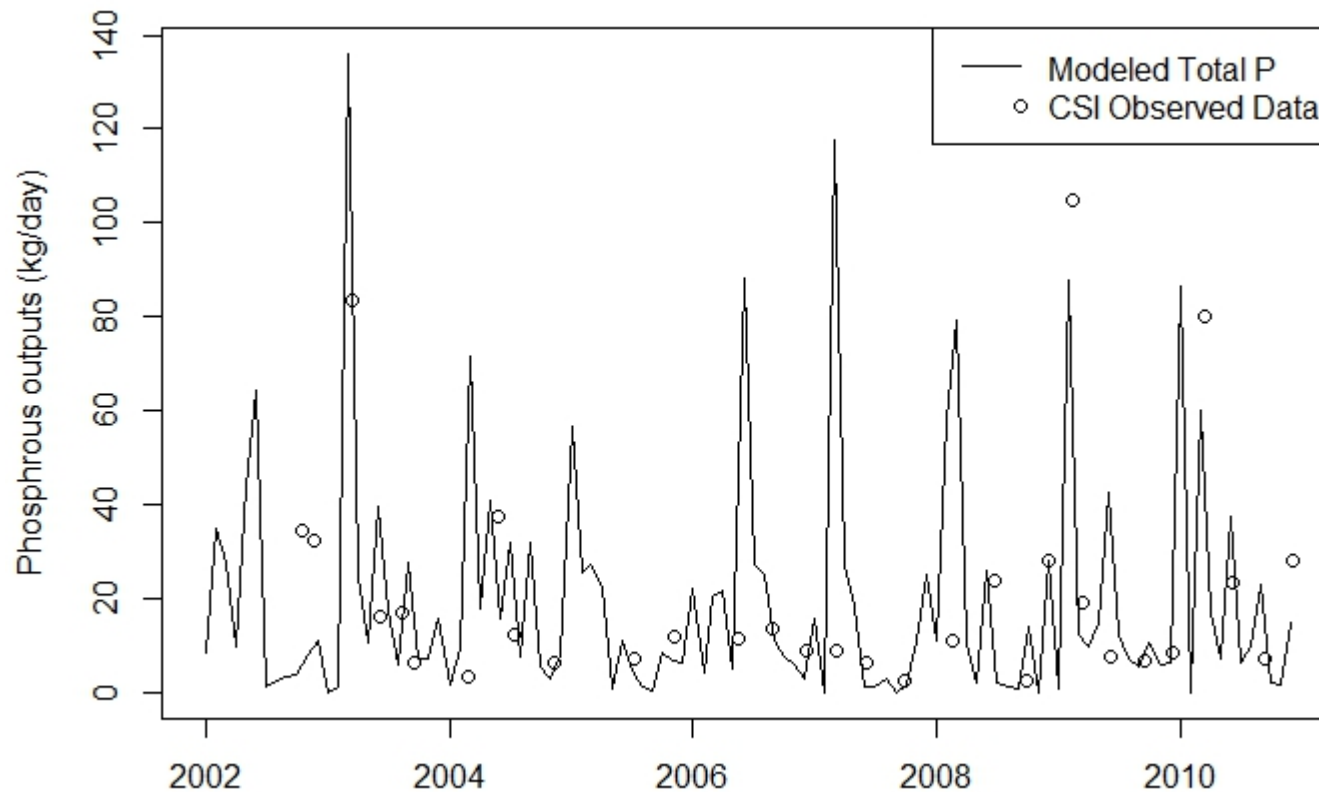
- Un-calibrated SWAT output – Six Mile Creek

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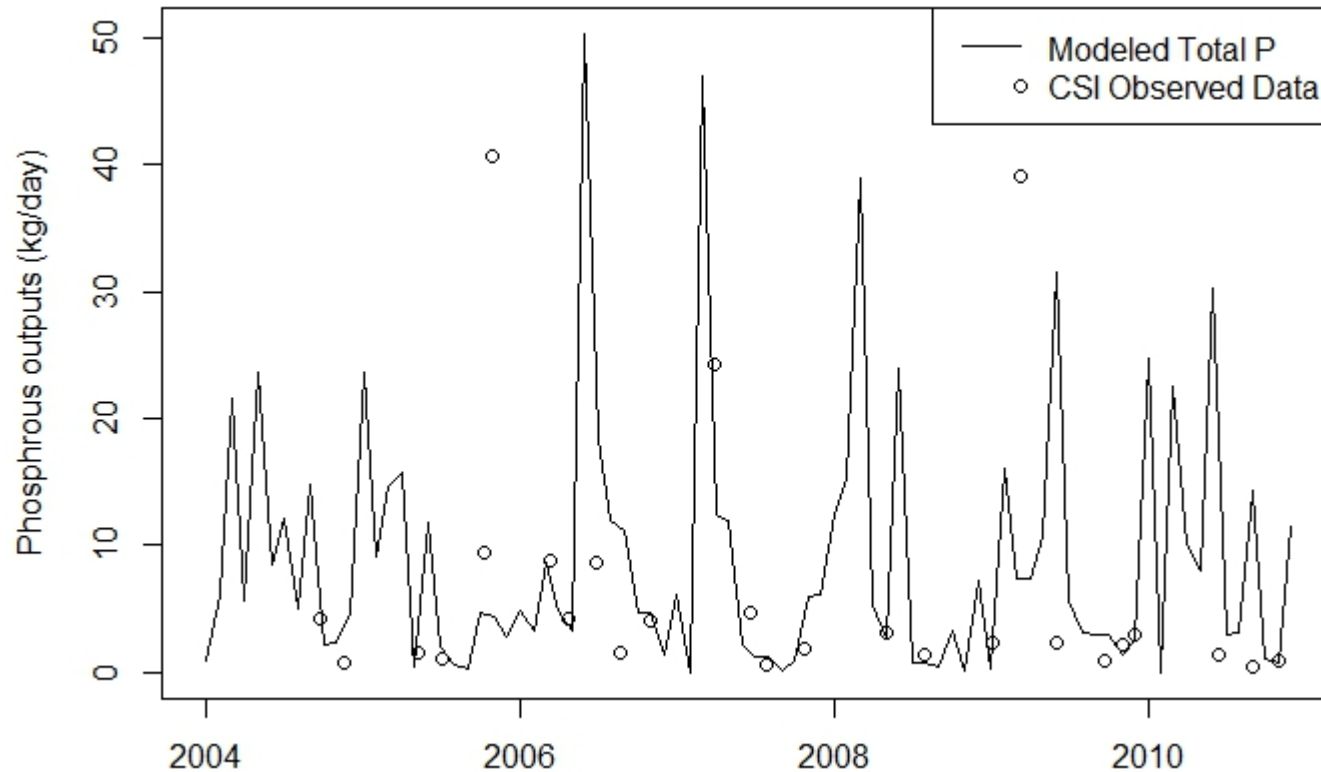
Representing management

- ## Un-calibrated SWAT output – Fall Creek

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Representing management

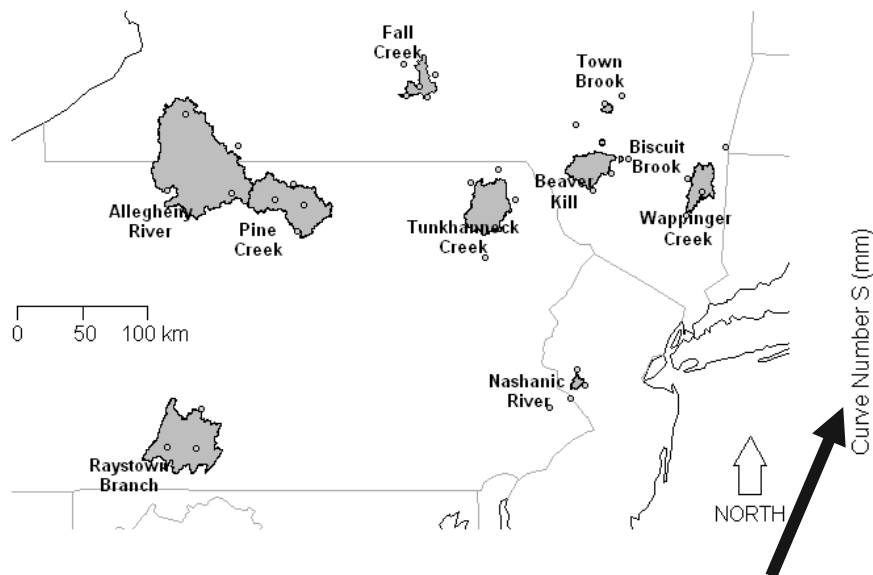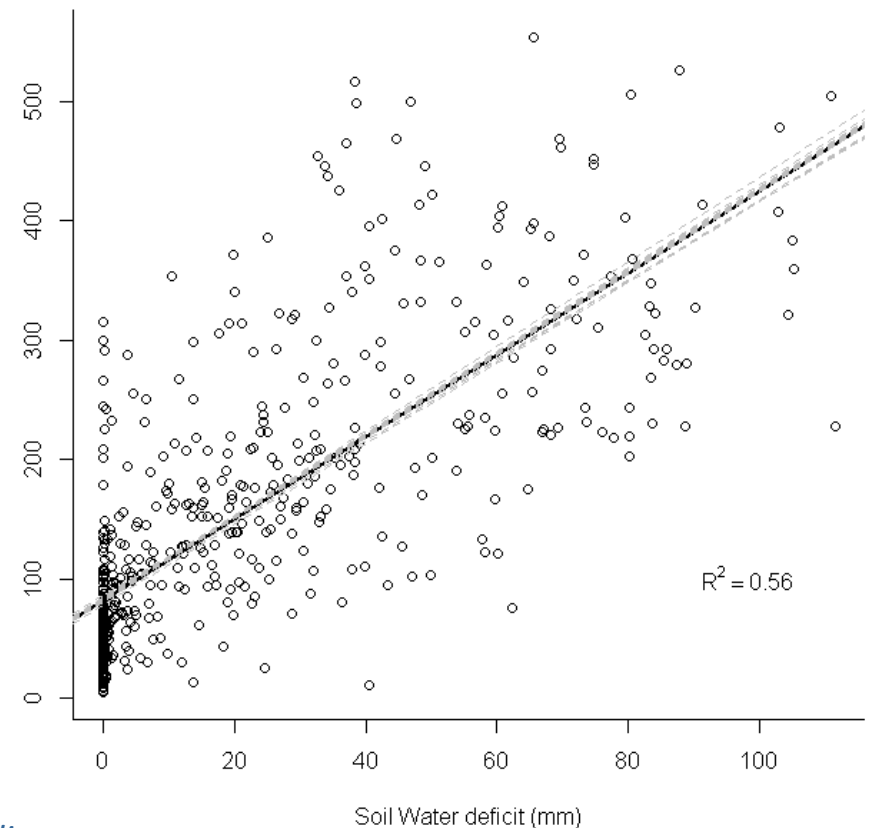■ Un-calibrated SWAT output – Virgil Creek

Limiting Calibration

- Why?
  - Right answer, wrong reason
  - Many optimal fits achieved with different parameters
  - May end up compensating for bad input data
- We think we can regionalize some critical parameters.
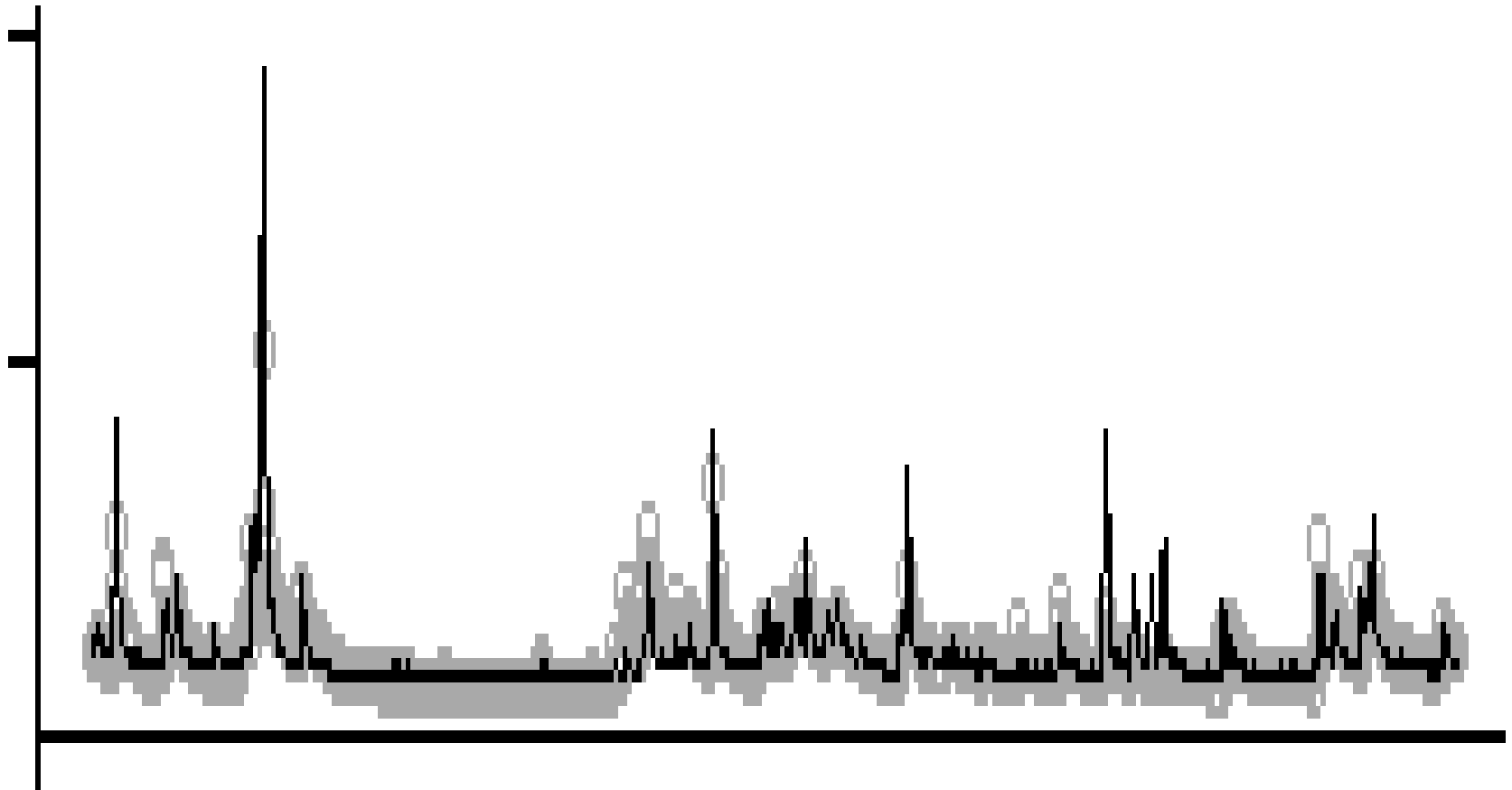
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Regionalizing storm runoff parameters

The primary storm runoff parameter in SWAT

Regionalizing storm runoff parameters – Fall Cr., Daily Flows

Archibald et al. submitted. *Journal of Hydrology: Regional Studies*

Date	Mon, Oct 29, 2012	Tues, Oct 30, 2012	Wed, Oct 31, 2012
Rain, mm	3	25	6
Chance of rain (%)	NA	100	94
% watershed saturated	0	30	20

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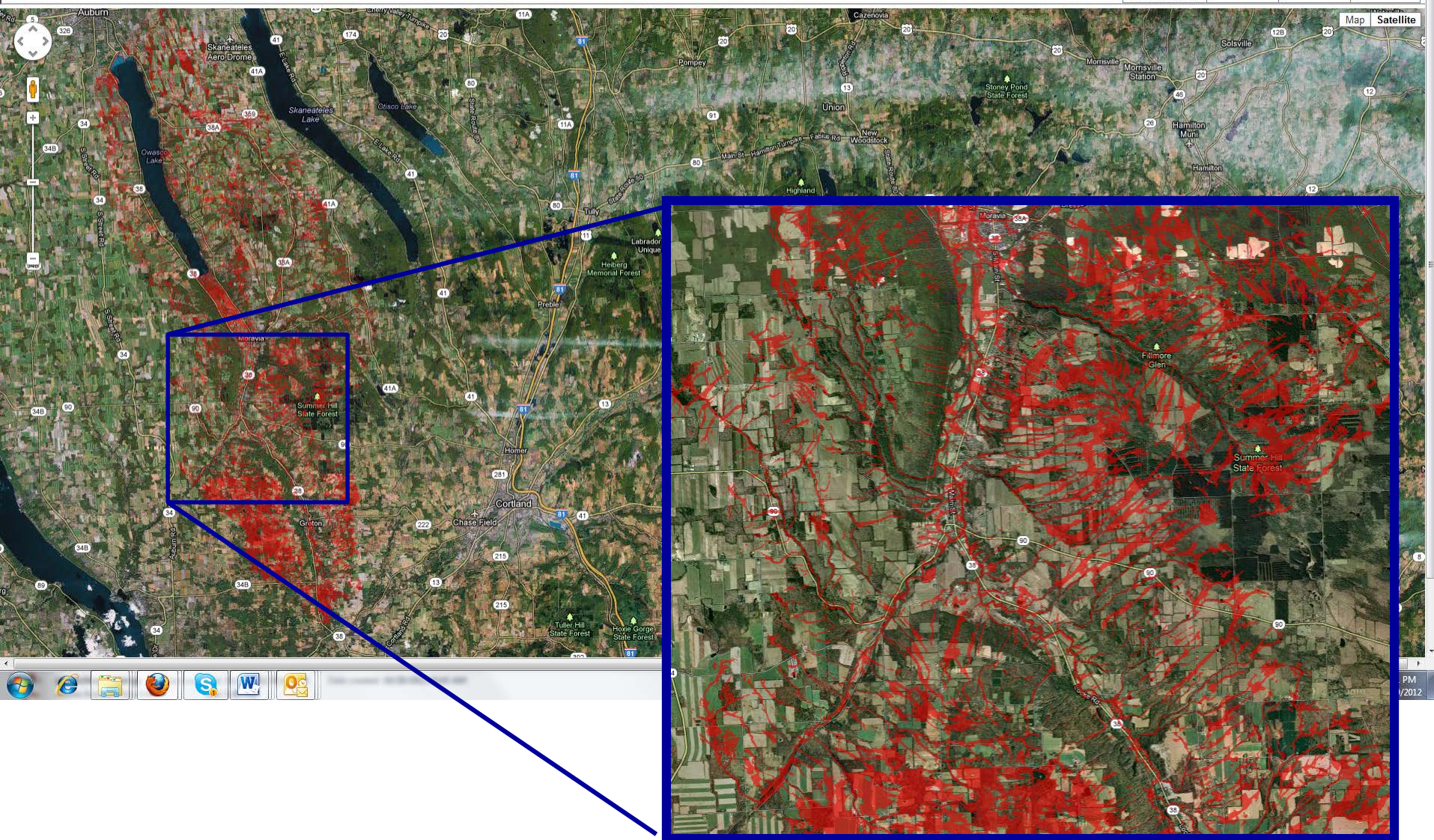
Next Immediate Steps

- Determine optimal weather data
  - probably 4 nearest weather stations with caveats regarding distance from watershed
- Adopt and test regionalized parameter sets
- Develop management algorithms and test against farmer and SWCD expertise (iterative process)
- Continue testing on Fall and Six Mile Creeks and setting up the rest of the watersheds as protocols are settled-on

Thank You

Acknowledgements
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