Why?

- In order to model the lake, we need to estimate how much phosphorus is flowing into it – the watershed model will provide this information to the lake model.
- Models are a convenient tool for testing the likely consequences of different scenarios, e.g., changes in land management.
Phosphorus Sources
Phosphorus Sources
Phosphorus Sources
Phosphorus Transport
Phosphorus Transport

www.epa.gov
One Modeling Challenge

Rain
Phosphorus
Etc.

Simple
Complex

Transparent
Opaque

Streamflow
Phosphorus
Etc.
One Modeling Challenge

- **Transparent**
- **Opaque**

- **Simple**
- **Complex**

Streamflow
Phosphorus
Etc.

Rain
Phosphorus
Etc.
We will use both modeling approaches together to take advantages of the each approaches benefits.
Modeling Strategy: Big Picture

Cayuga Lake Watershed Phosphorus Export

Land use + soils + weather \(\rightarrow\) Phosphorus Export

Courtesy of Doulas Haith
Salmon Creek Variable -

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

0  2.5  5  10 km
Preliminary Output (TDP)
Monitoring/Data Strategy

New Sites

Inside Watershed

Watershed Outlet

Other Sites

Fall Creek near Ithaca

0.234000 - FC near Ithaca
UFI Tributary Monitoring

- **Routine Monitoring**
  - Program began in March and has continued biweekly (3/18-10/30)
  - *more than 17 routine monitoring days collected in 2013*
  - Field measurements and chemistry analytes have been collected

- **Event Monitoring** *(4 events were proposed for the project)*
  - Events were monitored in April, June, July, August, September, and October
  - 6 runoff events (~ 55 total samples) monitored for Fall Creek, including Aug. 8-10 which was the highest flow peak of the year.
  - Similar results for other 3 streams *(Salmon Creek, Six-Mile Creek, and Cayuga Inlet)*
UFI Tributary Monitoring Coverage: Fall Creek

42 days sampled
> 1 sample per day

Fall Creek Daily Flow and Sampling Dates
Fall Creek

TP (ug/L)

Series1
upstream
discharge (m3/s)

Discharge (m3/L)

0 10 20 30 40 50 60 70 80 90 100

0 200 400 600 800 1000 1200

12/31/2012 02/19/2013 04/10/2013 05/30/2013 07/19/2013 09/07/2013 10/27/2013
Fall Creek (Bouldin data)
Fall Creek (CSI data)
Fall Creek (CSI data)
Some Known Data Sources

- USGS – Stream discharge, Fall Cr., Sixmile Cr., Inlet, some Salmon Cr.
- Dave Bouldin – Fall Creek, Cayuga Lake
- CSI – Various points along several creeks
- Various independent research projects
  - Easton et al. 2007. Water Resources Research

Looking for more as part of this project
Thank You

**Acknowledgements**
Erin Menzies, Brian Buchanan, Becky Marjerison

**Also thanks to:**
Zach Easton, Tammo Steenhuis, Larry Geohring, Dan Fuka, NYC-DEP (Schneiderman/Zion), USDA-ARS (Gburek/Sharpley), NYS-DEC (Bishop)

Could run through an example modeling analysis from the NYC watersheds
Evaluate “Best Management Practices”

- New drainage, waterways, etc.
• Riparian fencing/buffers
• Barnyard improvements

e.g., re-grade, divert water, concrete pad
• Use the NYS P-Index to develop spreading schedule
Dissolved Phosphorus

- **Pre BMP**
  - Observed: 0.49 kg/ha-yr
  - Predicted: 0.48 kg/ha-yr
- **Post BMP**
  - Observed: 0.27 kg/ha-yr
  - Predicted: 0.27 kg/ha-yr

What If: We made no changes?

Pre BMP
Post BMP

Observed 0.49 0.27 kg/ha-yr
Modeled 0.48 0.42
Complex Patterns of P Loss

Post-BMP P Loss (g ha\(^{-1}\) d\(^{-1}\))

No BMPs P Loss (g ha\(^{-1}\) d\(^{-1}\))
Thank You

Acknowledgements
Erin Menzies, Brian Buchanan, Becky Marjerison

Also thanks to:
Zach Easton, Tammo Steenhuis, Larry Geohring, Dan Fuka, NYC-DEP (Schneiderman/Zion), USDA-ARS (Gburek/Sharpley), NYS-DEC (Bishop)
We want to avoid this
Monitoring/Data Strategy

Why do we need new data? Why so many sites? Why not more data?

- We want to capture spatial and temporal variability
- We want as much data as possible
Some Known Data Sources

- USGS – Stream discharge, Fall Cr., Sixmile Cr., Inlet, some Salmon Cr.
- Dave Bouldin – Fall Creek, Cayuga Lake
- CSI – Various points along several creeks

We will look for more as part of this project
Distributed Modeling

- ET
- Precip
- Interflow
- Percolation
- Bedrock Reservoir
- Runoff
- Baseflow
Example: Management questions

![Graph showing dissolved P (kg) and cumulative export (kg) over time with Pre BMP and Post BMP comparisons.](image)

**Potassium Phosphate (kg)***

<table>
<thead>
<tr>
<th></th>
<th>Pre BMP</th>
<th>Post BMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed</td>
<td>0.49</td>
<td>0.27</td>
</tr>
<tr>
<td>Predicted</td>
<td>0.48</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Take-home messages

• Nobody believes the model
  (except the guy who made it)
• Everybody believes the data
  (except the guy who collected them)
• So do both
What is a Watershed Model?

- A collection of equations that calculate the flow of water and pollutants.

- Weather
- Topography
- Land use
- Soils
Stream flow and Water Quality Data?

- **Calibration**: Because we do not have a perfect understanding of how the environment works, some equations need to be calibrated.

- **“Validation” (or testing)**: We need to check that our calibrated model works be testing it against different data.
Example from the Catskills

E = 0.84

Calibration Period

Observed

Simulated

Stream Flow (cm/day)

Progress to Date

• Assembled most base data (e.g., topography, land use, etc.)
• Proof-of-concept simple and complex modeling for Salmon Creek watershed
• Developing a systematic way to calibrate sub-watersheds
• Working on algorithm to predict stream sediment loads