Effects of Conservation Practices on Phosphorus Loss Reduction from an Indiana Agricultural Watershed

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SWAT International Conference,
2016, Beijing, China

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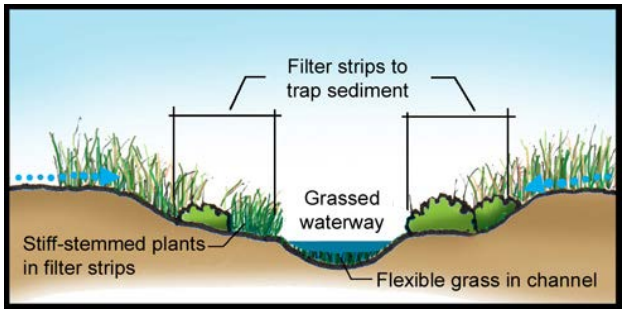
Presentation outline

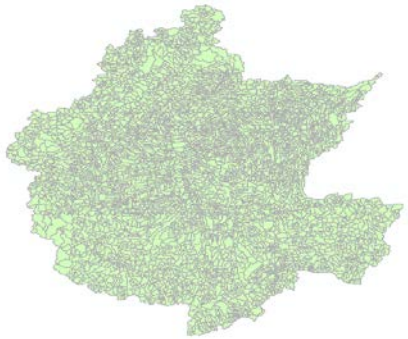
- Objective
- Background
- Method
- Preliminary results

Objectives

- Evaluate phosphorus loss and effectiveness of BMPs for P loss reduction at field scale
  - Evaluate BMP effects with observed data
  - Evaluate BMP effects using APEX at both the field and Maumee River Basin scale
  - Develop online interface for APEX model

APEX
Agricultural Policy Environmental eXtender model





Background: Phosphorus loss is causing serious water quality problems

http://www.toledoblade.com/local/2014/08/03/Water-crisis-grips-area.html

LOCAL

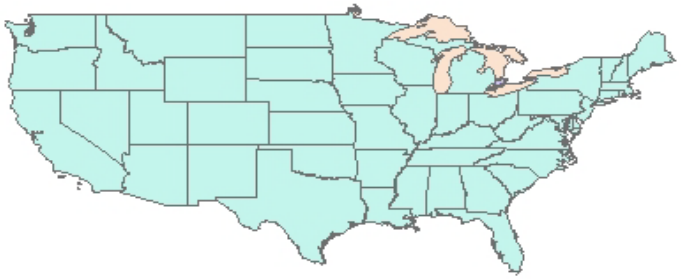
Water crisis grips hundreds of thousands in Toledo area, state of emergency declared

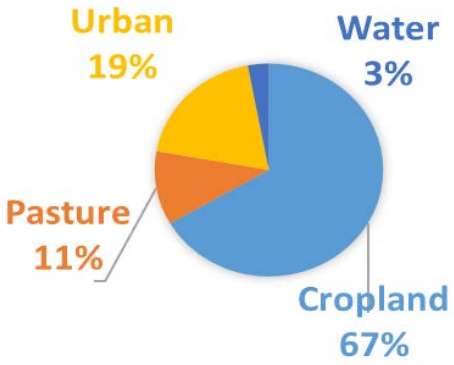
By Tom Henry | BLADE STAFF WRITER

Published on Aug. 3, 2014 | Updated 8:03 p. m.

https://www.watercheck.biz/blogs/news/tagged/toledo

Background: Lake Erie Basin is a heavily agricultural basin

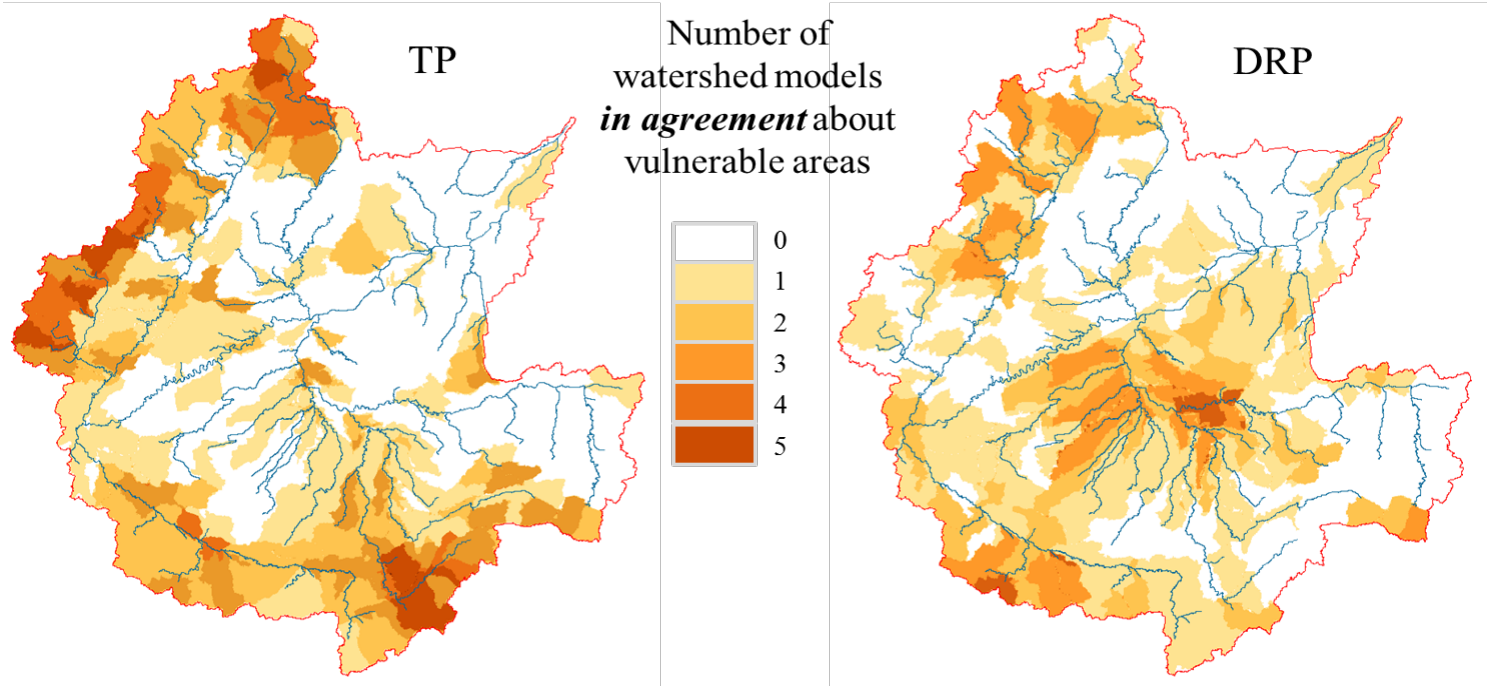




Background: Factors affecting excessive P loss

- Climate change
- Crop
  - Cropping systems
  - Crop nutrient efficiency
  - Roundup ready crops
- Ethanol production
- Fertilizer
  - Fertilizer placement
  - Fertilizer rate
  - Tri-state recommendations
  - Fertilizer source
  - Fertilizer timing
  - Manure
  - Nitrogen
  - Misconceptions about phosphorus loss
- Soil
  - Increased soil pH
  - Products sold to increase soil phosphorus solubility
  - Alteration to soil biology
  - Soil testing and analysis
  - Stratification of phosphorus
- Large farms
- Tillage
  - No-Till
- Tile drainage
- Social activity
  - Commodity prices
  - Rental agreement
- Lower levels of sediment in water
- Zebra Mussels

Background: Modelling efforts are focusing on large river basins



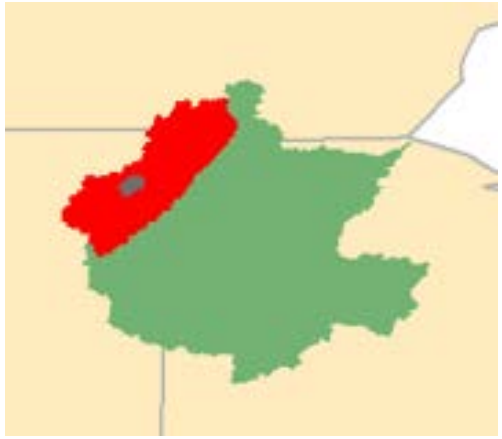
Final report from: Informing Lake Erie Agriculture Nutrient Management via Scenario Evaluation

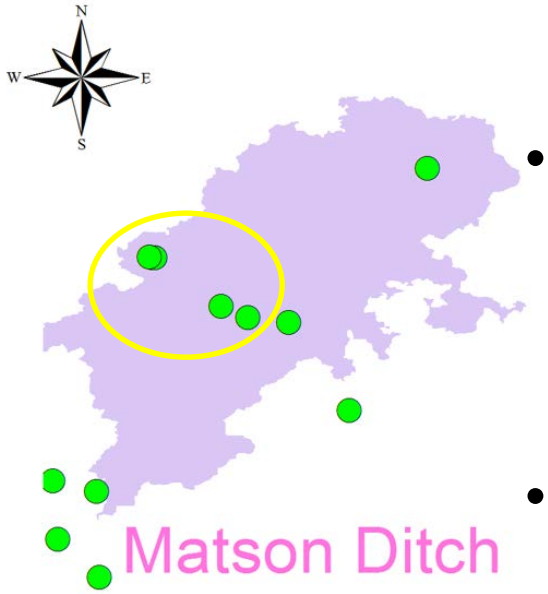
- Field scale information if missing with large scale model results
  - Missing the important processes of DRP loss
  - Generally aggregated, even though HRUs in the SWAT model could be smaller

Methods

- Evaluate BMP effects with observed data
  - Data availability
  - Analysis of data
- Evaluate BMP effects using APEX at field and Maumee River Basin
  - Calibrate and validate APEX at the edge of field
  - Simulate different BMPs using APEX model
  - Simulate all fields in the Maumee River basin
- Develop online interface for APEX model

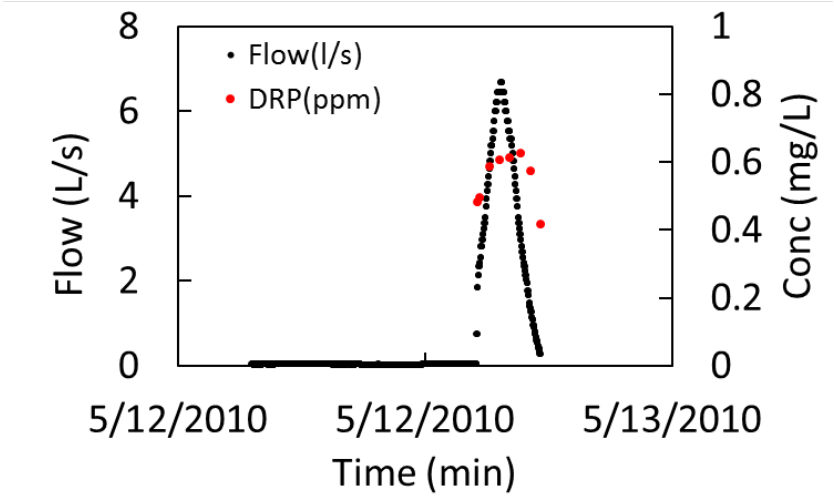
Methods: Data availability (2004 to now)

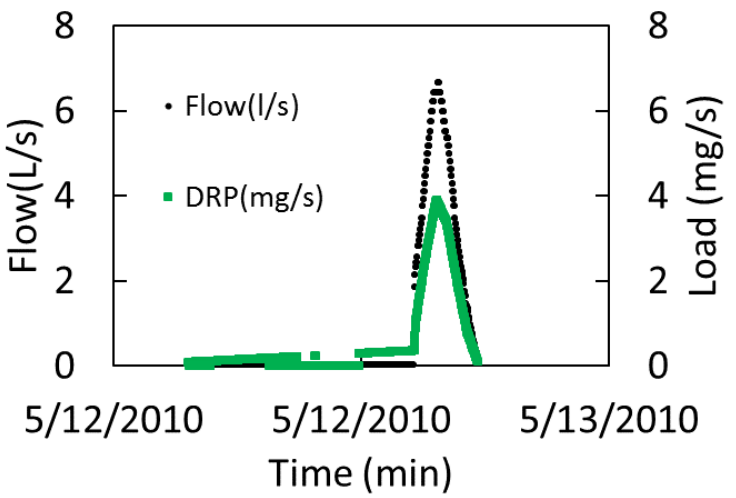


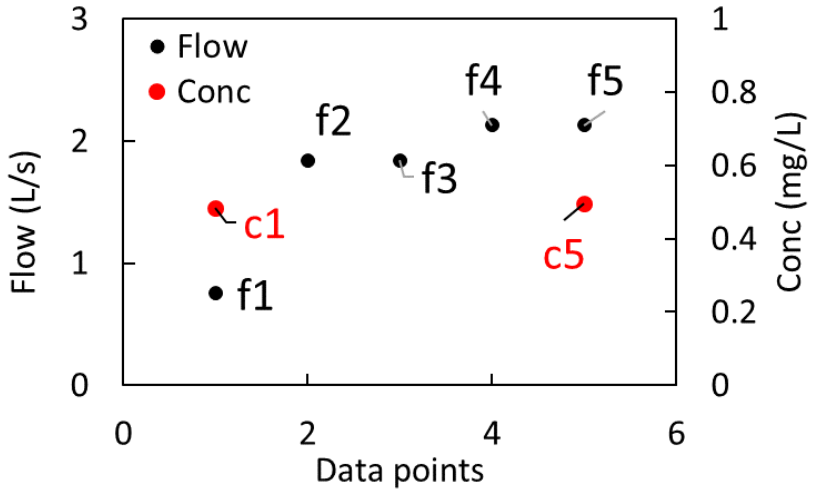


- Flow:
  - Surface: 2 mins interval
  - Tile: 10 min normally and 1 mins at larger flow events
- Water quality
  - NH4, NO2, NO3, TKN, OP, TP, and others
  - Event based monitoring
- Climate:
  - Prcp, max and min temperature, solar radiation, wind speed, and relative humidity
  - 10 mins
- Management practices recorded by contractor.

Interpolating phosphorus load







$$l1 = f1 * c1$$

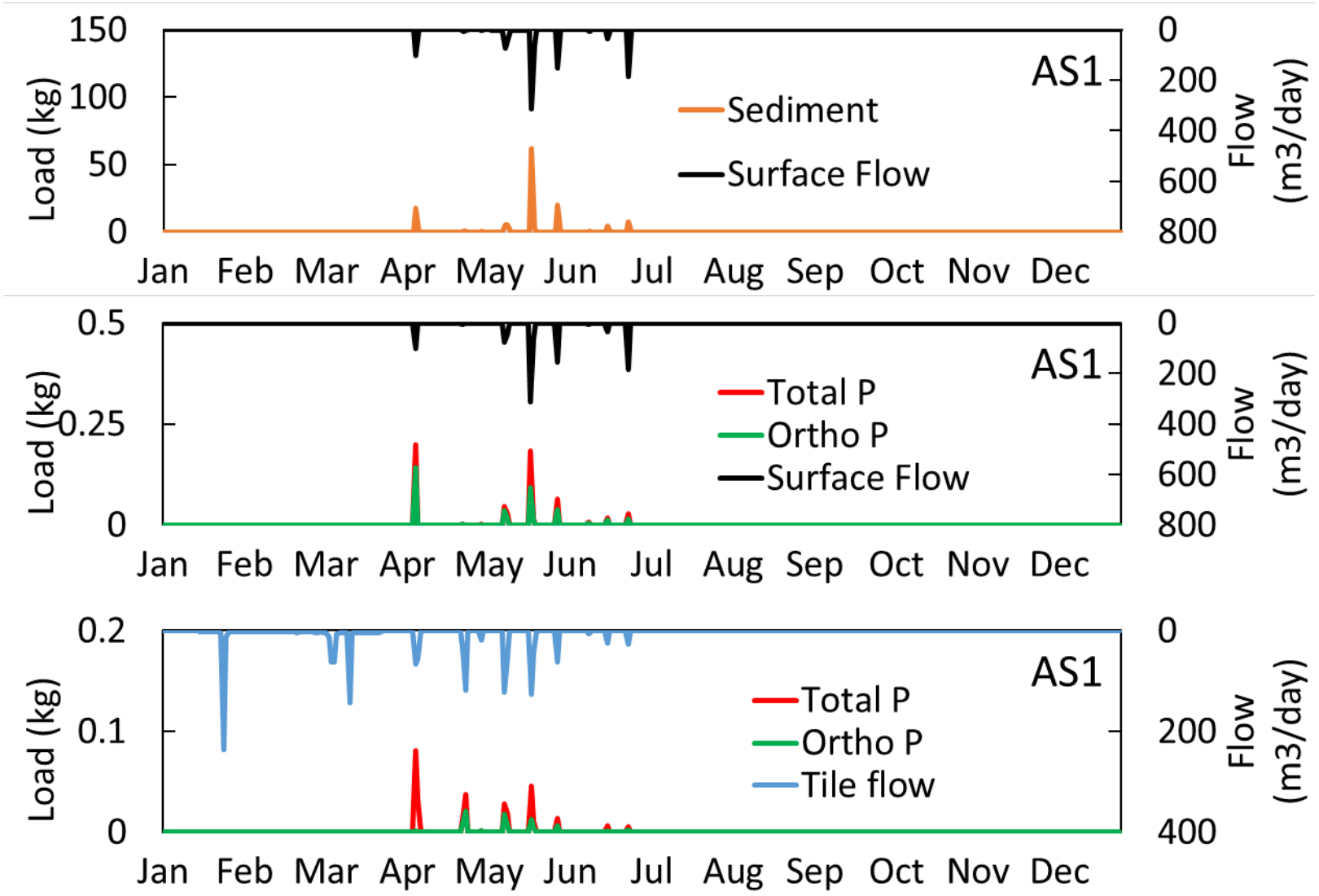
$$l5 = f5 * c5$$

$$l2 = a * f2 + b$$

$$l3 = a * f3 + b$$

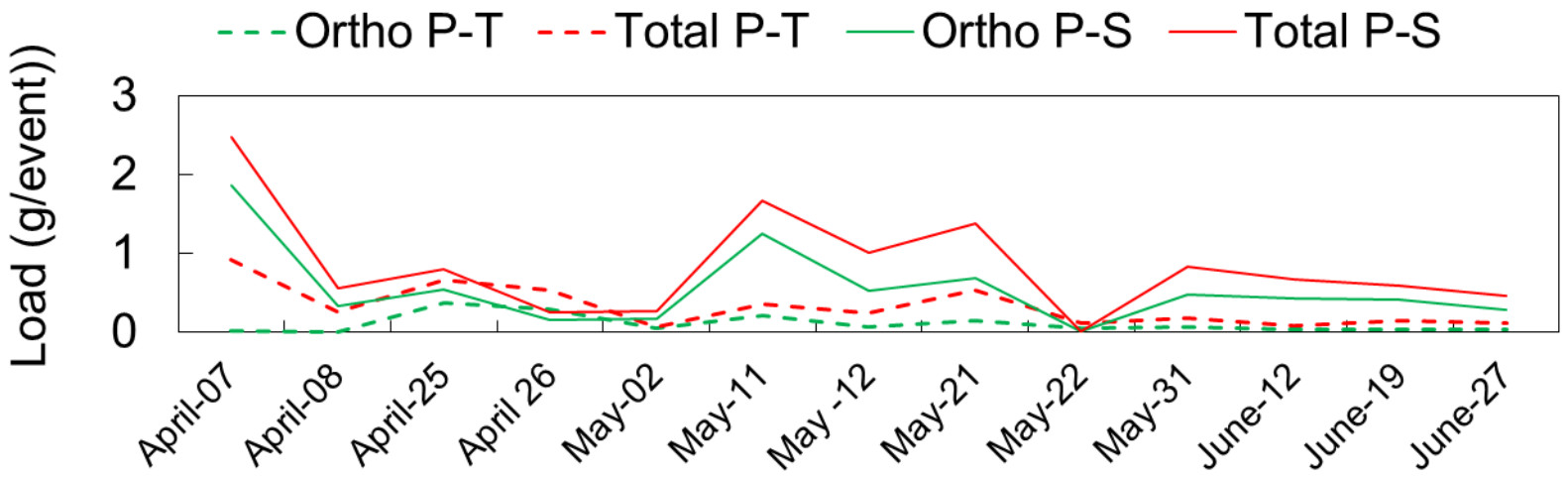
$$l4 = a * f4 + b$$

Flow and phosphorus at daily level



Surface vs tile P loss

	Avg ratio Ortho P /Total P Load	Total P load growing season (kg/ha)
Surface	0.58	0.59
Tile	0.35	0.36



Methods: APEX validation at the edge of fields

- Evaluate BMP effects with observed data
  - Data availability
  - Analysis of data
- Evaluate BMP effects using APEX at both the field and Maumee River Basin scale
  - Calibrate and validate APEX at the edge of field
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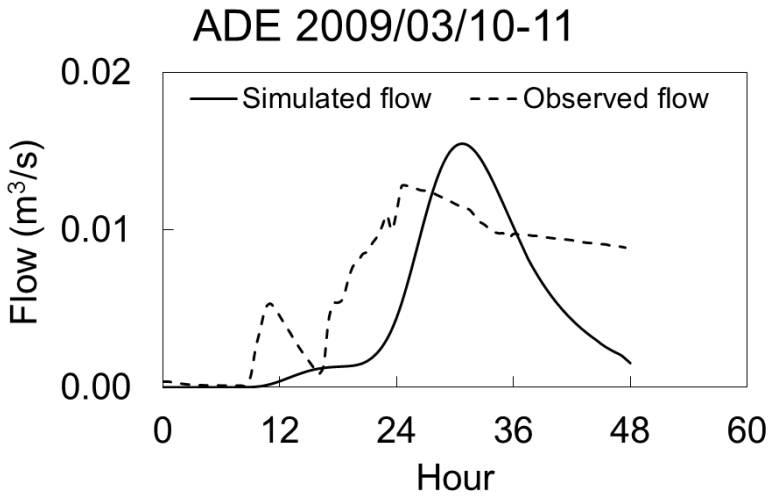
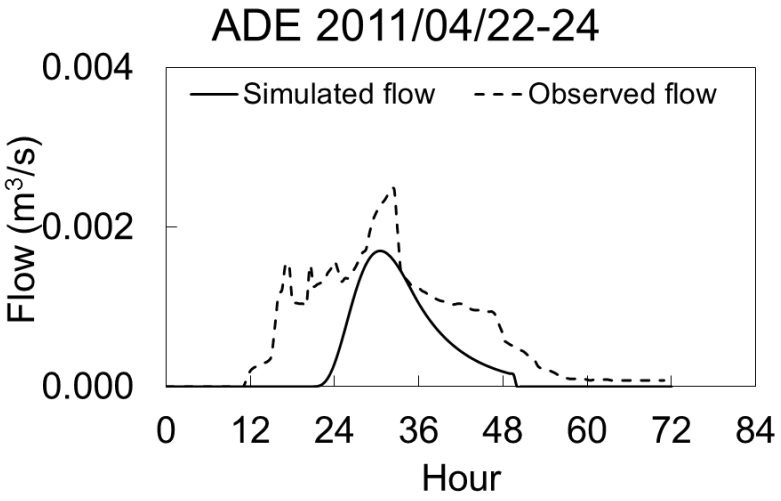
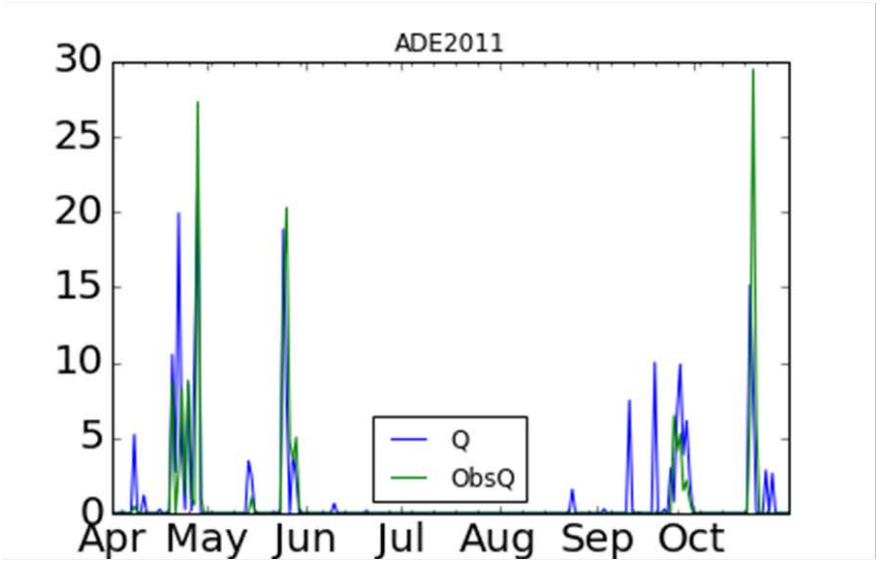
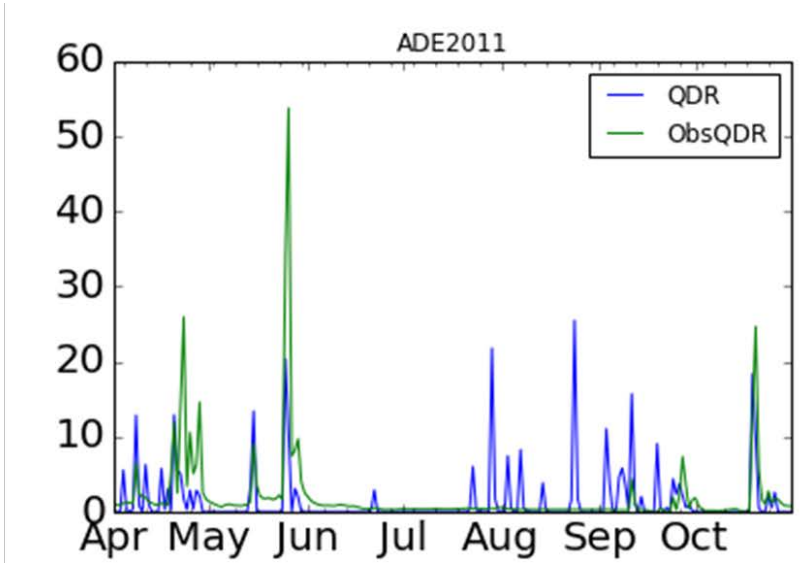
Modelling efforts









Conclusion and next step

- Conclusion:
  - Field data indicated that P loss through surface flow was doubled for those through subsurface flow during the growing season.
  - Ortho P contributed large portion (averaged 70% across events for P surface flow and 35% from tile flow in 2010) of total P.
  - Uncalibrated APEX model provided reasonable simulations for flow loss at the edge of field.
- Next step:
  - Continue data analysis, including the seasonal variations of P load and the effects of conservation practices, relationship between orthography P and organic P.
  - Model these practices using the APEX model.
  - Expand the research to Maumee River basin.