What does the future of hydrologic/water quality modeling hold?

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Trends Impacting Modeling

- Model improvement
- Computational capabilities
- Sensors and data
- Data science

Advances in Models

- Better representation of processes
  - Additional processes represented
  - Interactions of processes
  - Span spatial scales
  - …..

Computational capabilities

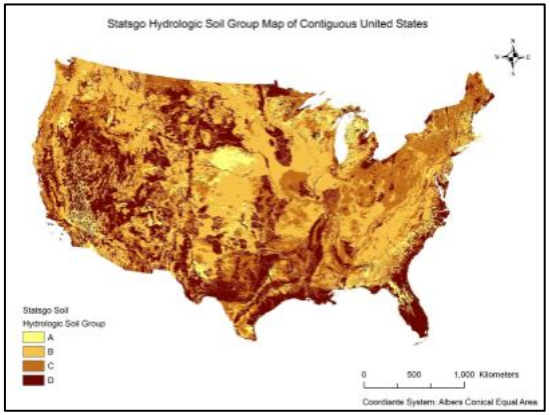
- Supercomputers
- Parallel computing
- Cloud based computing and storage
- Edge computing

Large Area Assessment

- NLCD 2011 edition datasets (2001, 2006, 2011, and 2016) across the nation makes the assessment of urbanization impacts on surface runoff at the national level feasible.

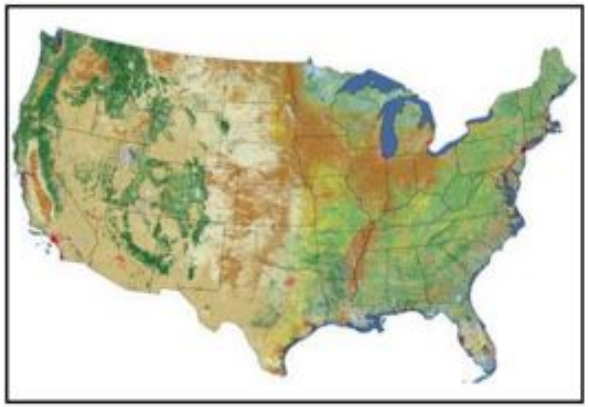
Input Data:

Soil



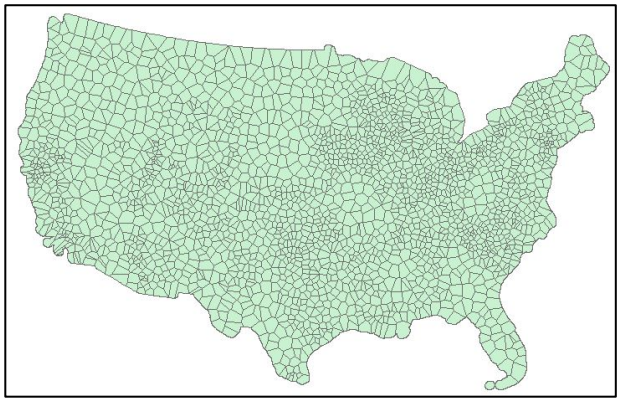
The State Soil Geographic (STATSGO) dataset (Wolock, 1997)

Land use



The NLCD 2001, 2006, 2011, and 2016

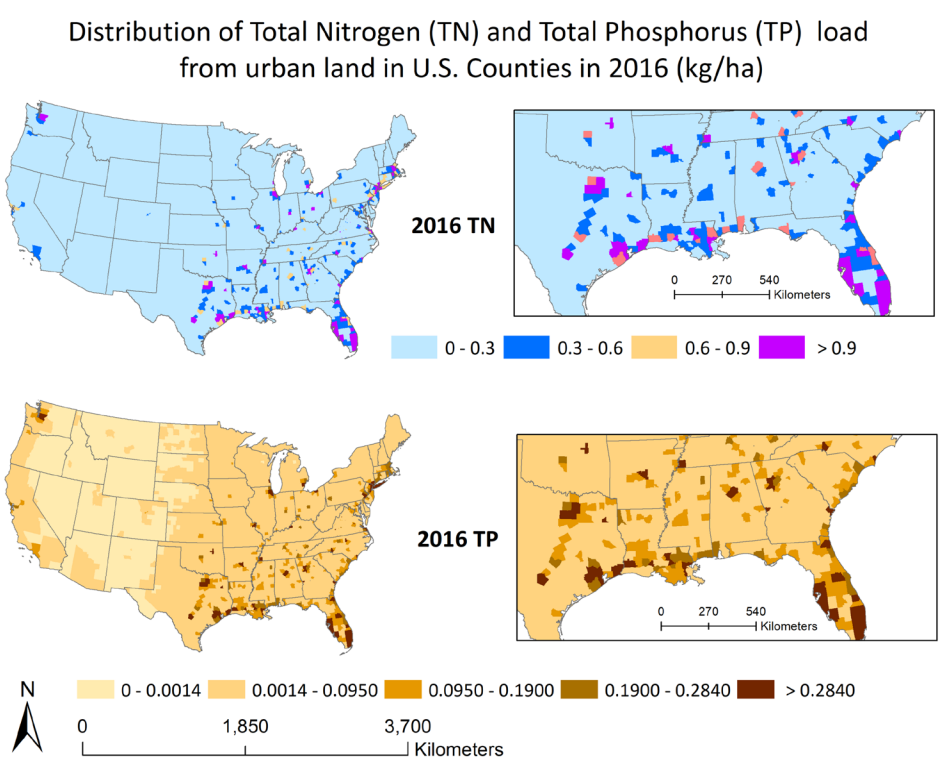
Precipitation

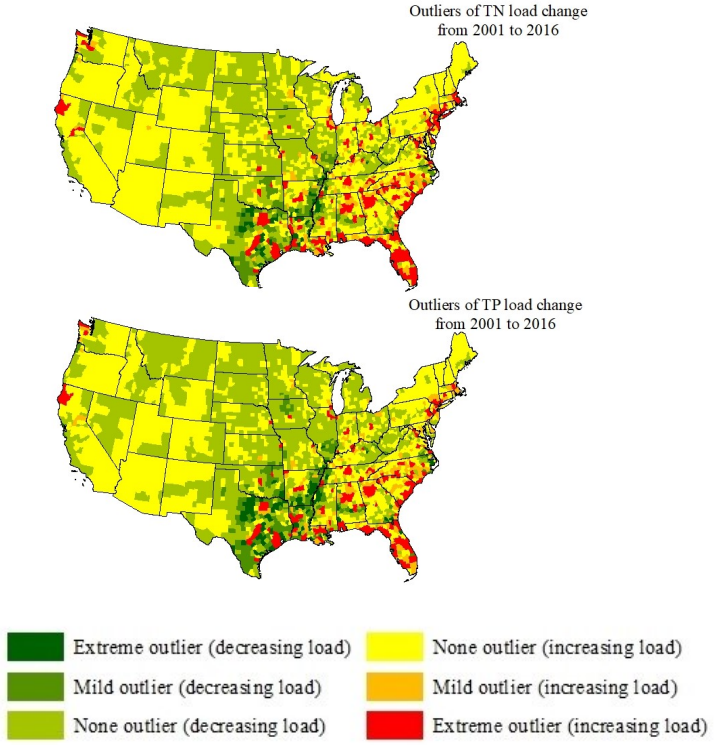


CLIGEN (climate generator) 50-year daily precipitation for each of 2,527 weather stations

Focused on urban land

How has urbanization impacted water quality on a national scale?





Sensing and Data

- IoT
- Better spatial and temporal resolution data
- Flows of data from federal, state and other sources
- Data that modelers have been wishing for becoming available or on horizon

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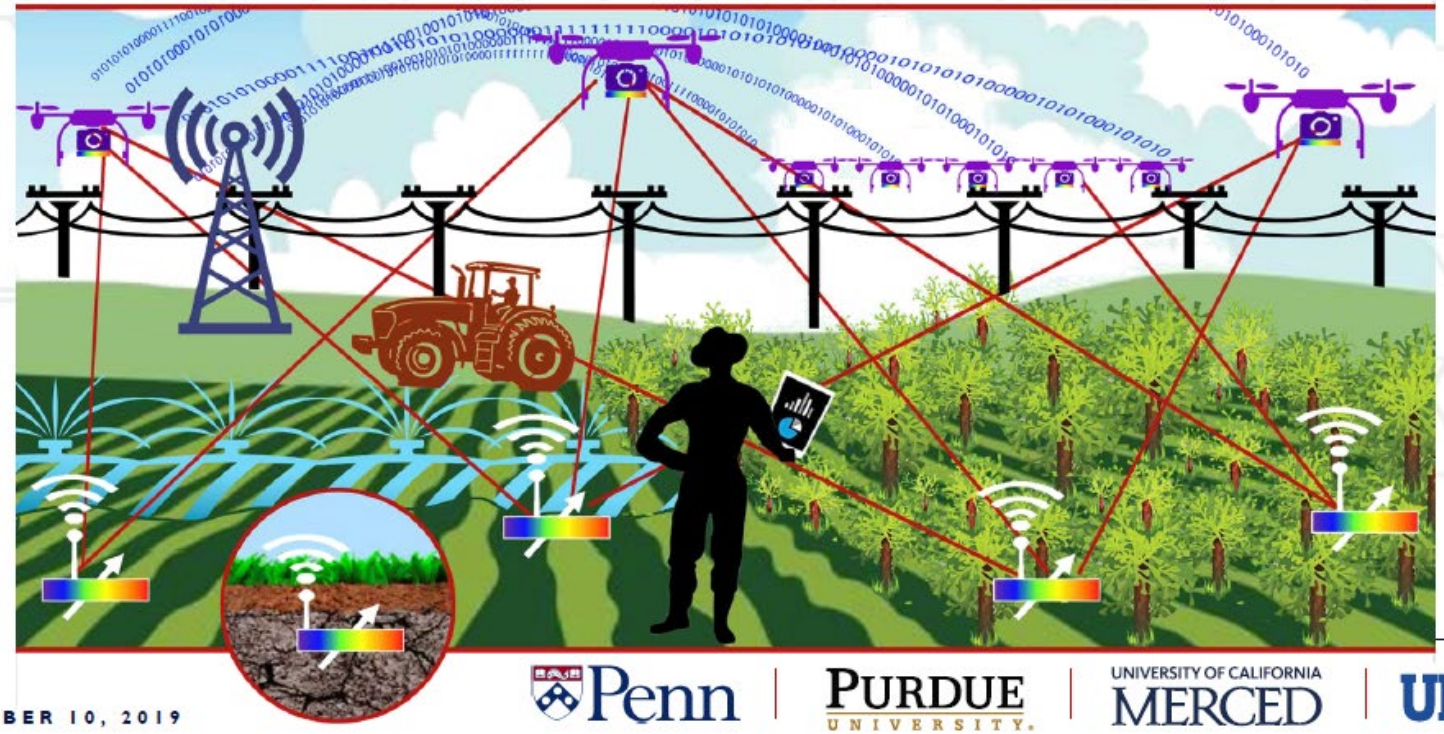
IoT4Ag

IoT4Ag Mission

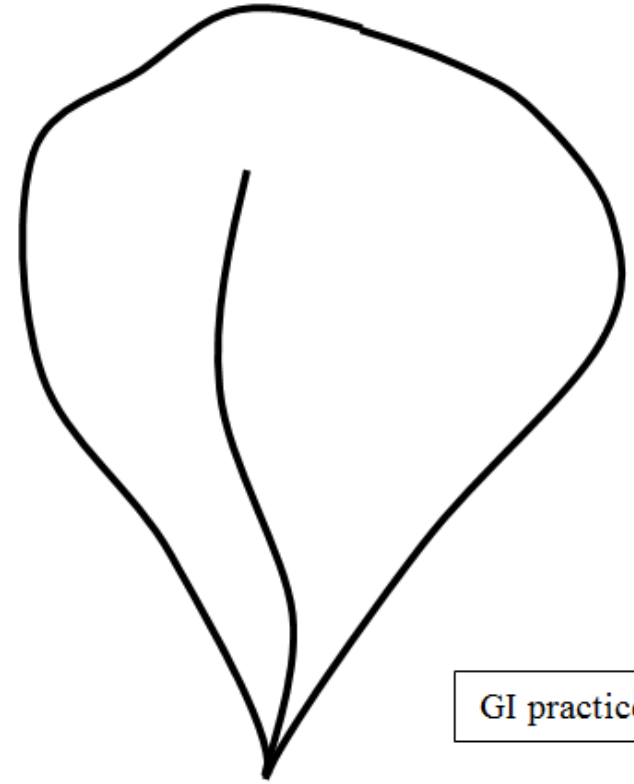
To create and translate to practice Internet of Things (IoT) technologies for precision agriculture and to train and educate a diverse workforce that will address the societal grand challenge of food, energy, and water security for decades to come.



Data Science

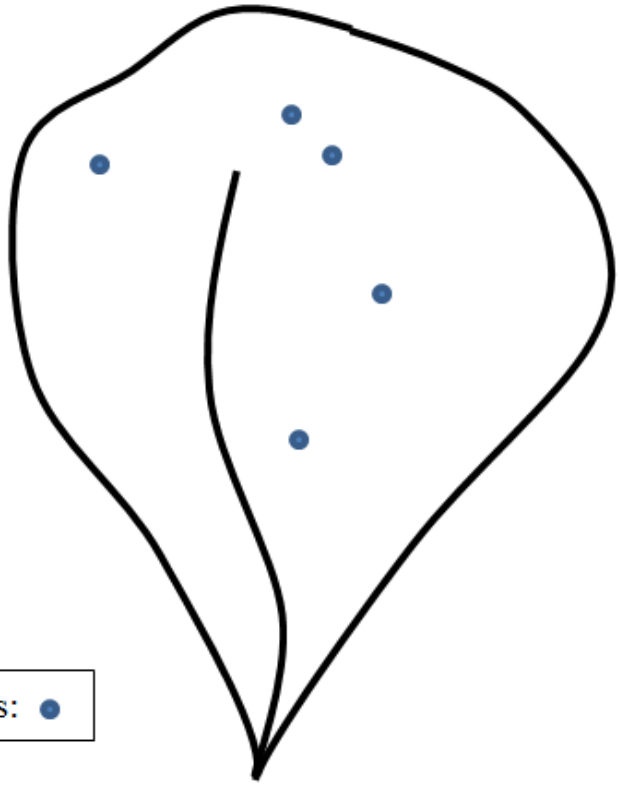
- Data flows/Data pipelines
- Machine learning
- AI

Introduction



P load

GI practices:



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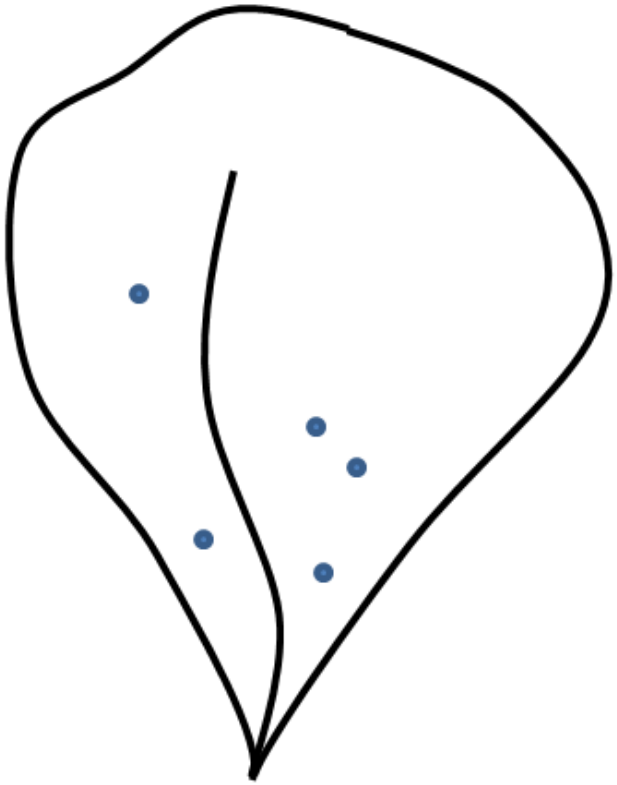
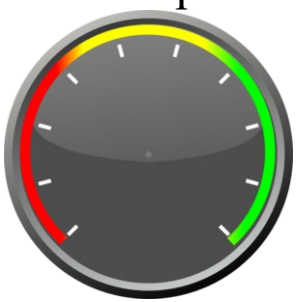


P load

No GI practices

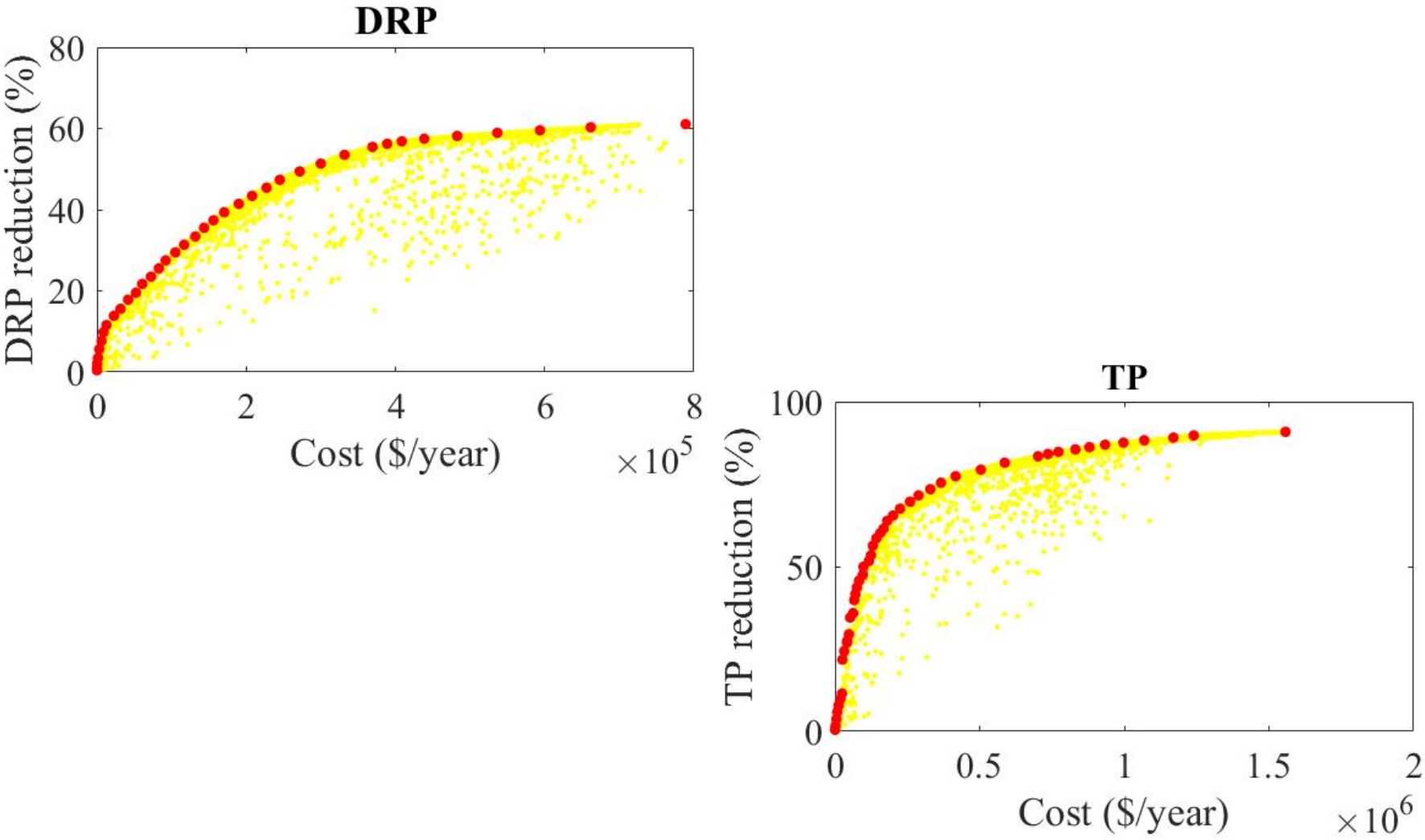
Possible implementation

Optimized implementation



6. Results and Discussion

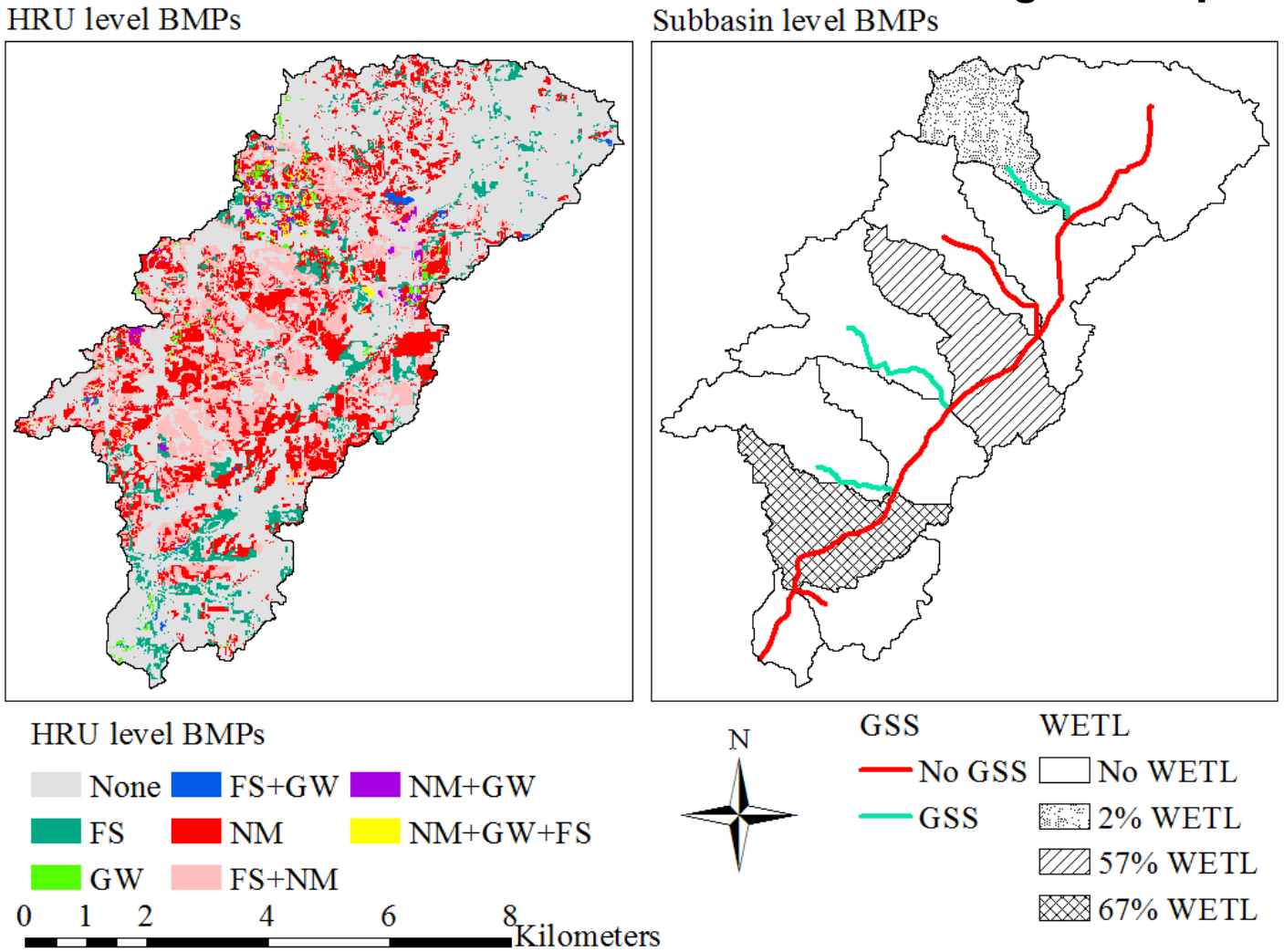
6.2 Watershed level optimization results



Watershed level optimization results.

6. Results and Discussion

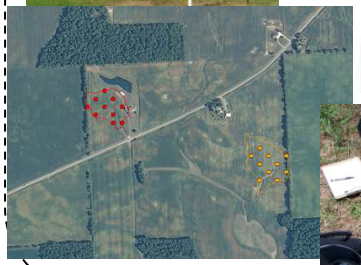
6.3 Optimized scenarios that attain the watershed management plan goal

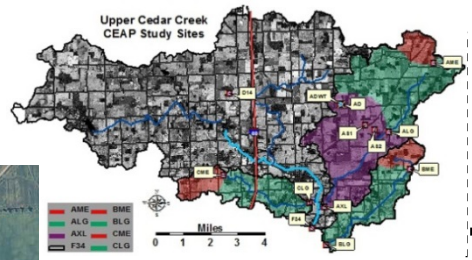


Optimized types, quantities, and spatial locations of BMPs that reduce spring DRP losses by 40% with minimum cost.

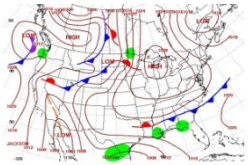
A framework for creation of decision support systems for sustainable water management

In Situ Input

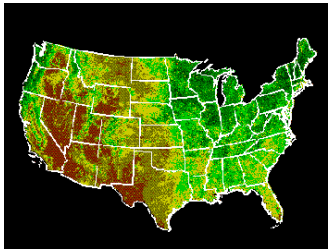


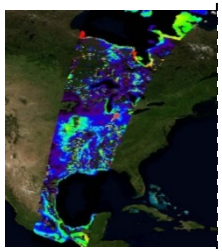


Remote Sensing Based Inputs



Weather,
Vegetation Vigor
Soil Moisture





Multiscale Models

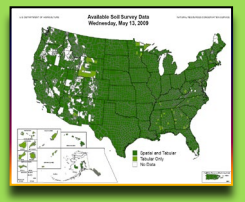
Field Scale Model 1

Field Scale Model 2

Watershed Scale Models

Regional Scale Models

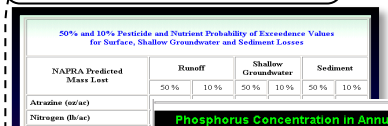
Databases

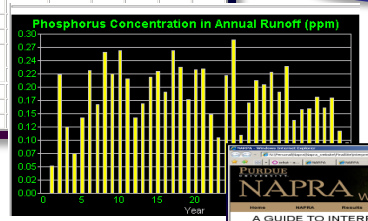


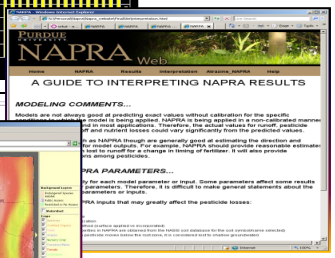
SSURGO Soil Data

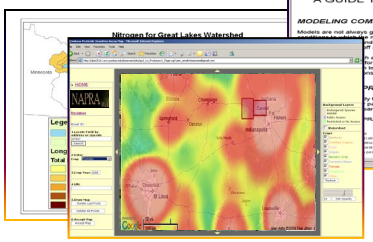
Site Output

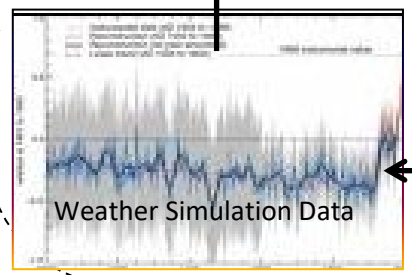
Database Downloadable



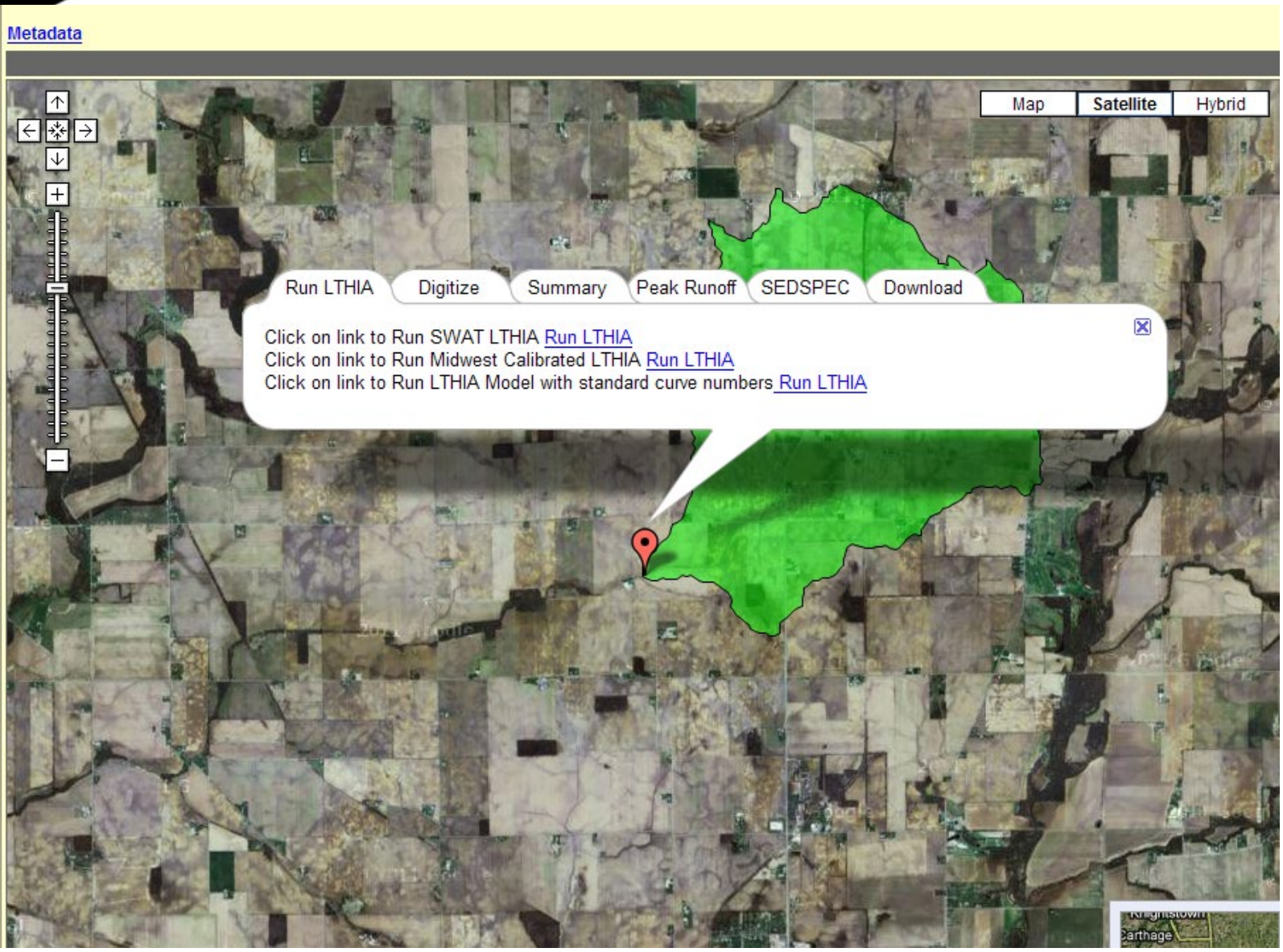








Weather Generator


Metadata
Map
Satellite
Hybrid
Run LTHIA
Digitize
Summary
Peak Runoff
SEDSPEC
Download
Click on link to Run SWAT LTHIA Run LTHIA
Click on link to Run Midwest Calibrated LTHIA Run LTHIA
Click on link to Run LTHIA Model with standard curve numbers Run LTHIA

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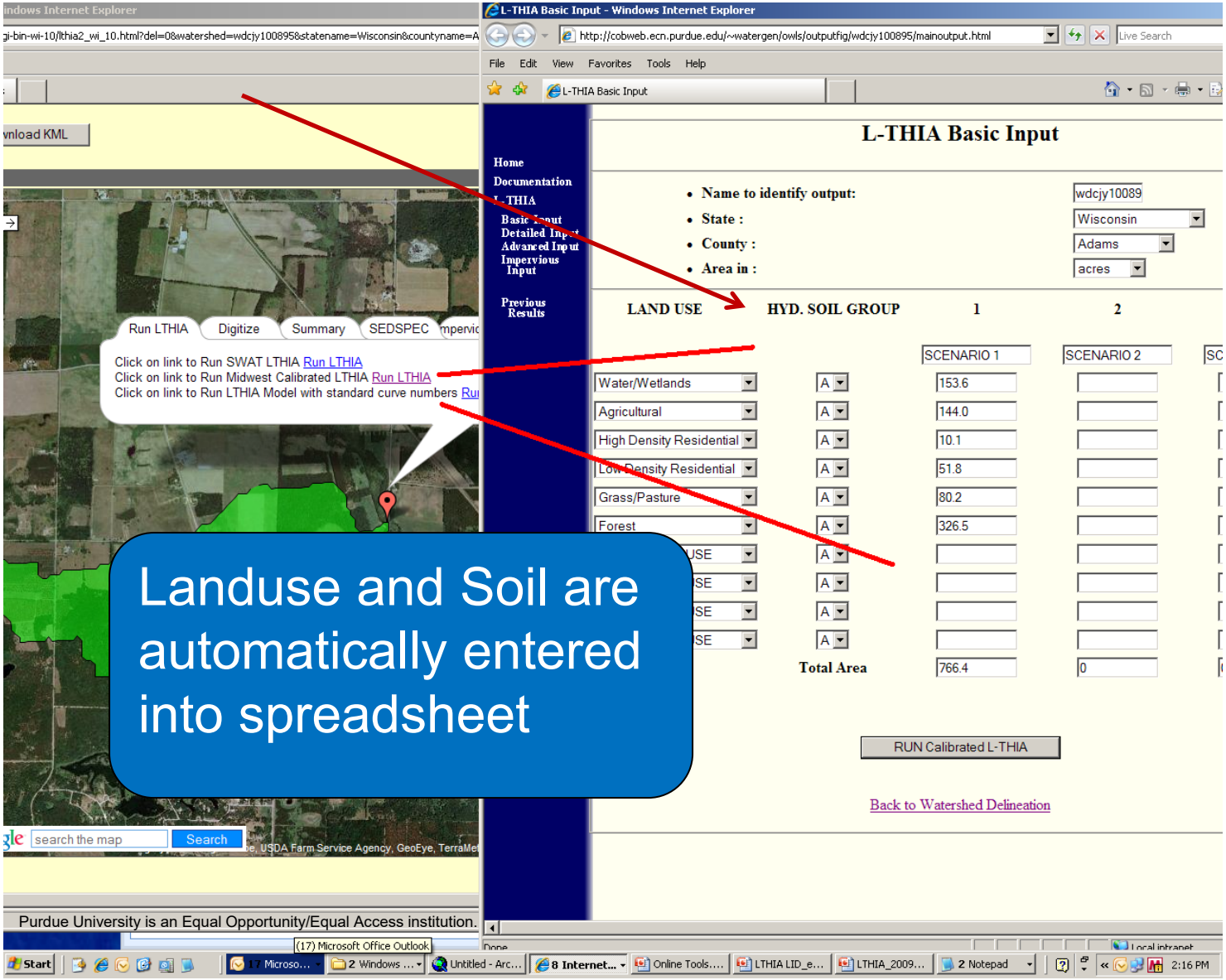
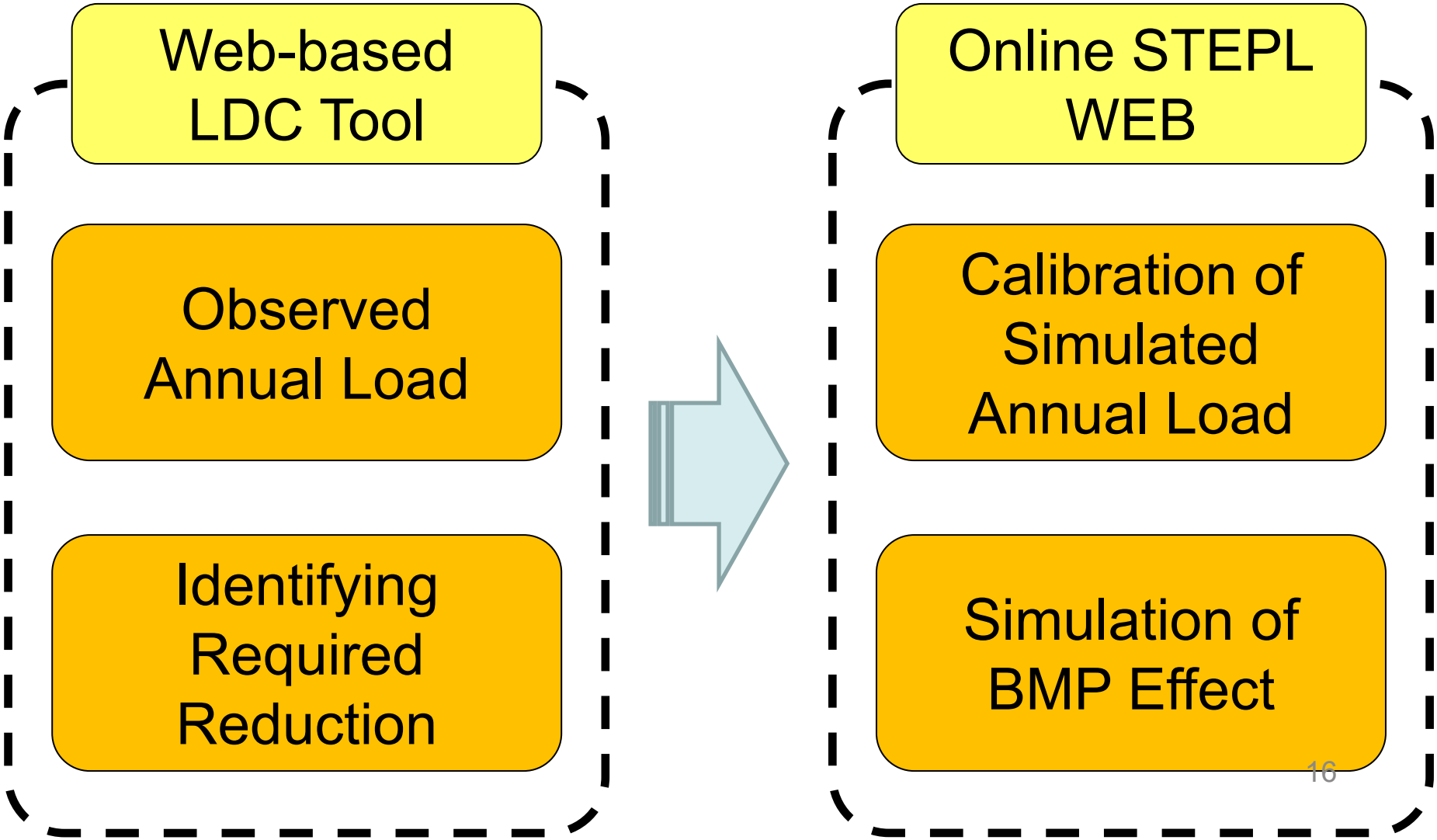
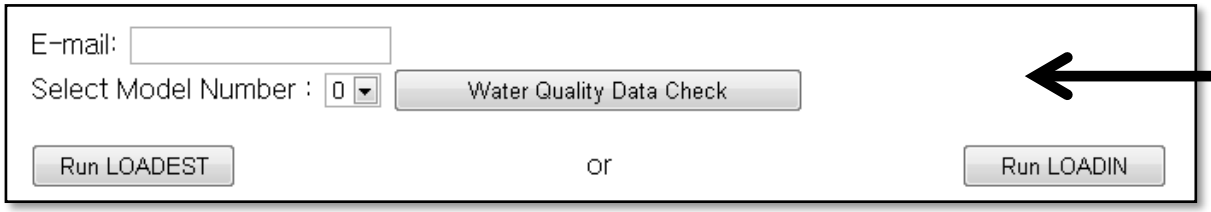


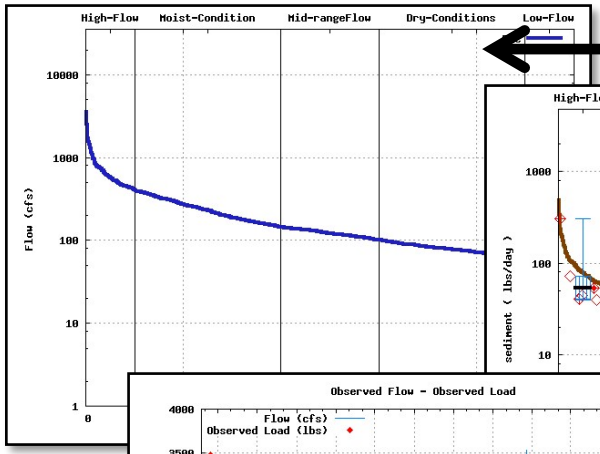
Overview of Web-based LDC Tool and STEPL



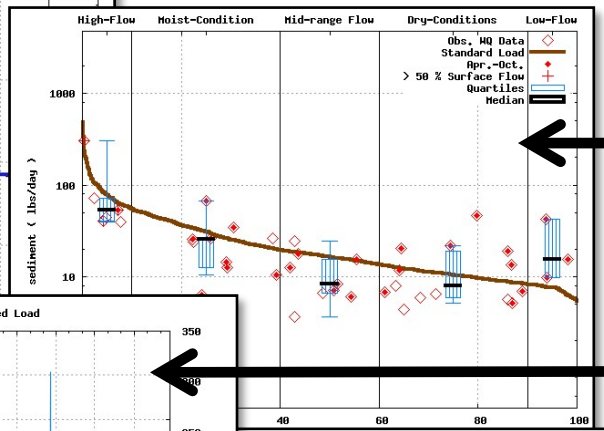
Enhancement of Web-based LDC Tool – Result



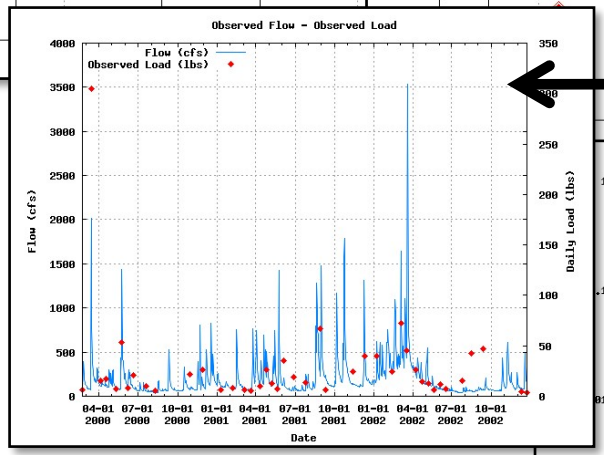
LOADEST Run



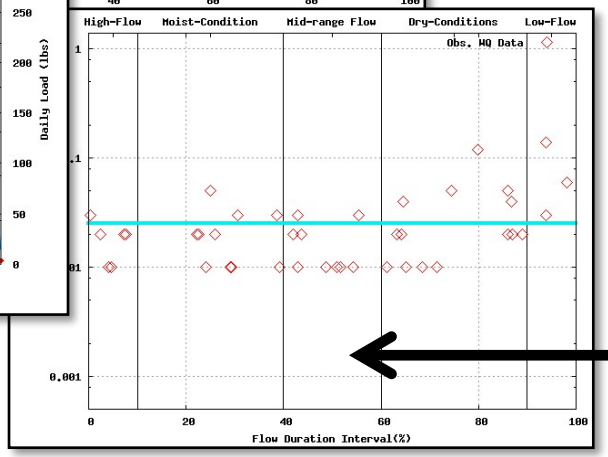
Flow Duration Curve



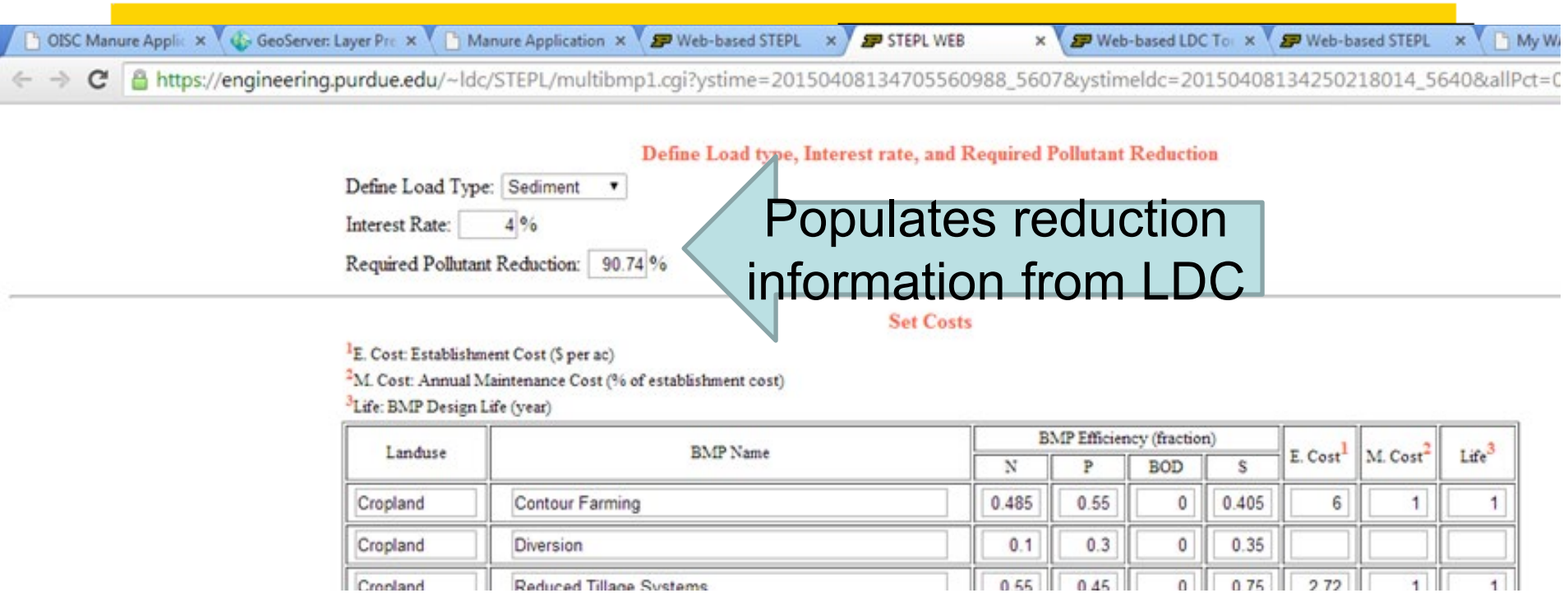
Load Duration Curve



Time Series Plot



Concentration Plot



User can run an optimization module to compare efficiency of BMPs for the specific load target.

Landuse	BMP Name	BMP Efficiency (fraction) N	P	BOD	S	E. Cost[1]	M. Cost[2]	Life[3]
Forest	Road hydro mulch	0	0	0	0.41		1	10
Forest	Road straw mulch	0	0	0	0.41		1	10
Forest	Road tree planting	0	0	0	0.5		1	10
Forest	Site preparation/hydro mulch/seed/fertilizer	0	0	0	0.71	1500	1	10
Forest	Site preparation/hydro mulch/seed/fertilizer/transplants	0	0	0	0.69		1	10
Forest	Site preparation/steep slope seeder/transplant	0	0	0	0.81			
Forest	Site preparation/straw/crimp seed/fertilizer/transplant	0	0	0	0.95			
Forest	Site preparation/straw/crimp/net	0	0	0	0.93	14359	1	10
Forest	Site preparation/straw/net/seed/fertilizer/transplant	0	0	0	0.83		1	10

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GeoAPEXOL

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USDA

ARS

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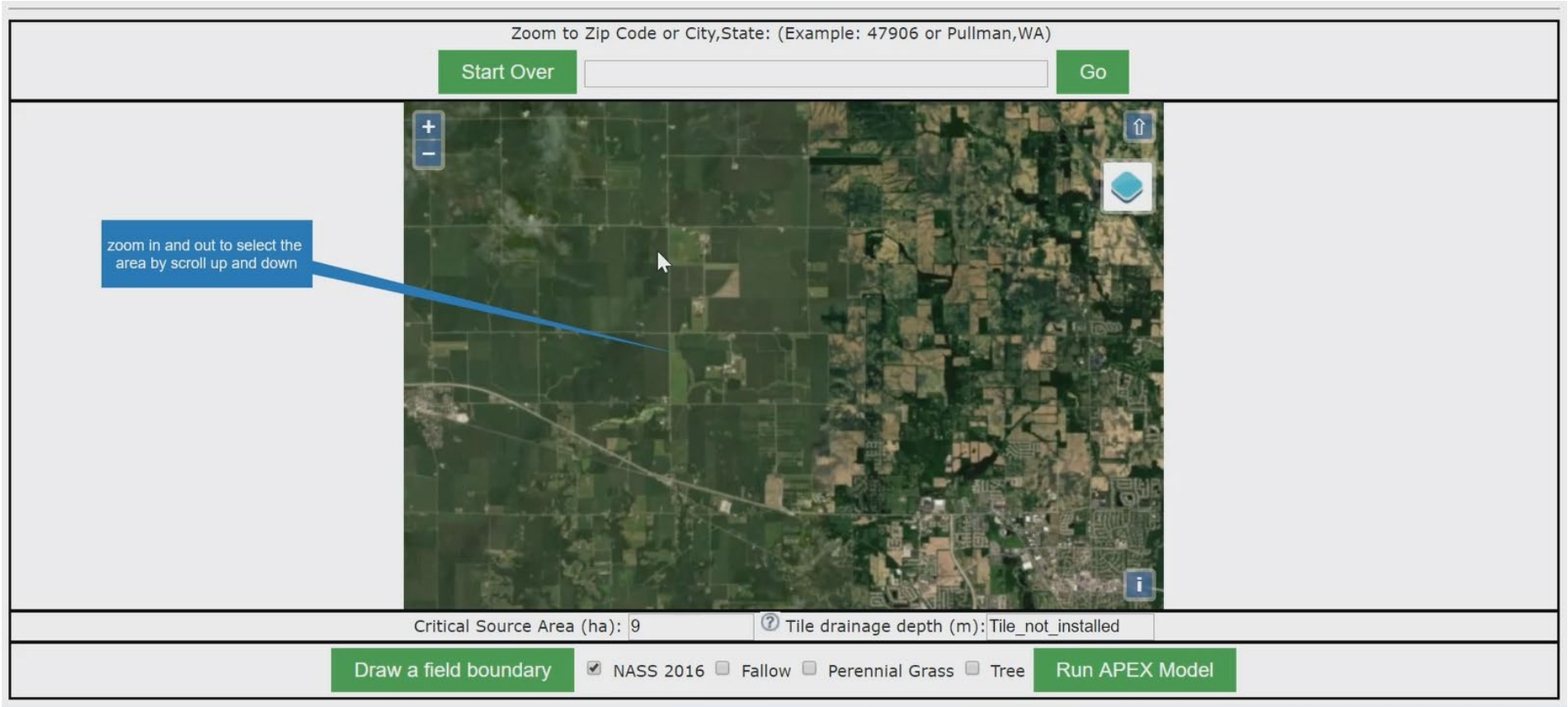

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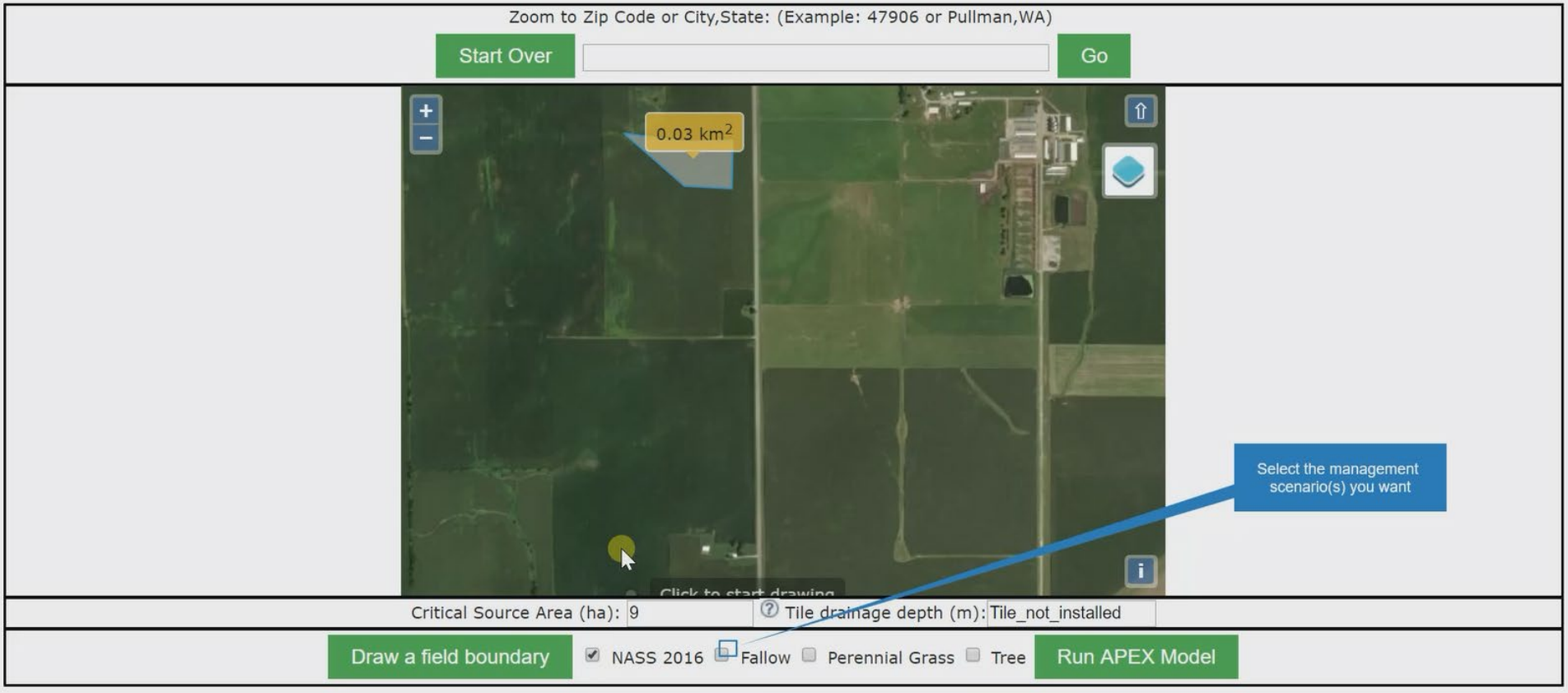

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Wait for couple seconds to 1 minute, you will have the results and scroll down to see the results

Critical Source Area (ha): 9 | Tile drainage depth (m): Tile_not_installed

Draw a field boundary | NASS 2016 | Fallow | Perennial Grass | Tree | Run APEX Model

Area Weighted Average Annual Values for the field

Scenario	Surface runoff (mm)	Soil Erosion (ton/ha)	Total Nitrogen (kg/ha)	Total Phosphorus (kg/ha)
nass2016	194.9	0.17	8.49	0.04
fallow	289.9	0.37	2.05	0.06
peregrass	73.2	0.02	0.27	0.03
trees	85.0	0.02	0.85	0.03

What Might the Future Hold?

- Models that learn and adapt to their application area to improve estimates
- Intelligent modeling systems that support local decision making
- Location (field and small watershed) specific regulatory approaches supported by models and real time data
- Within year, location specific regulatory approaches supported by models
- What do all of these have in common?
  - Data science, IoT, computational advances