



Envisioning the Future of the Yahara Watershed

WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

Steve Carpenter
Center for Limnology
University of Wisconsin-Madison

Chris Kucharik
Jenny Seifert
Eric Booth
Adena Rissman
Monica Turner
Steve Loheide
Chloe Wardropper
Melissa Motew
Jiangxiao Qiu
Sam Zipper
Jason Schatz
Sean Gillon
Amber Mase
Xi Chen
Pavel Pinkas
John Miller



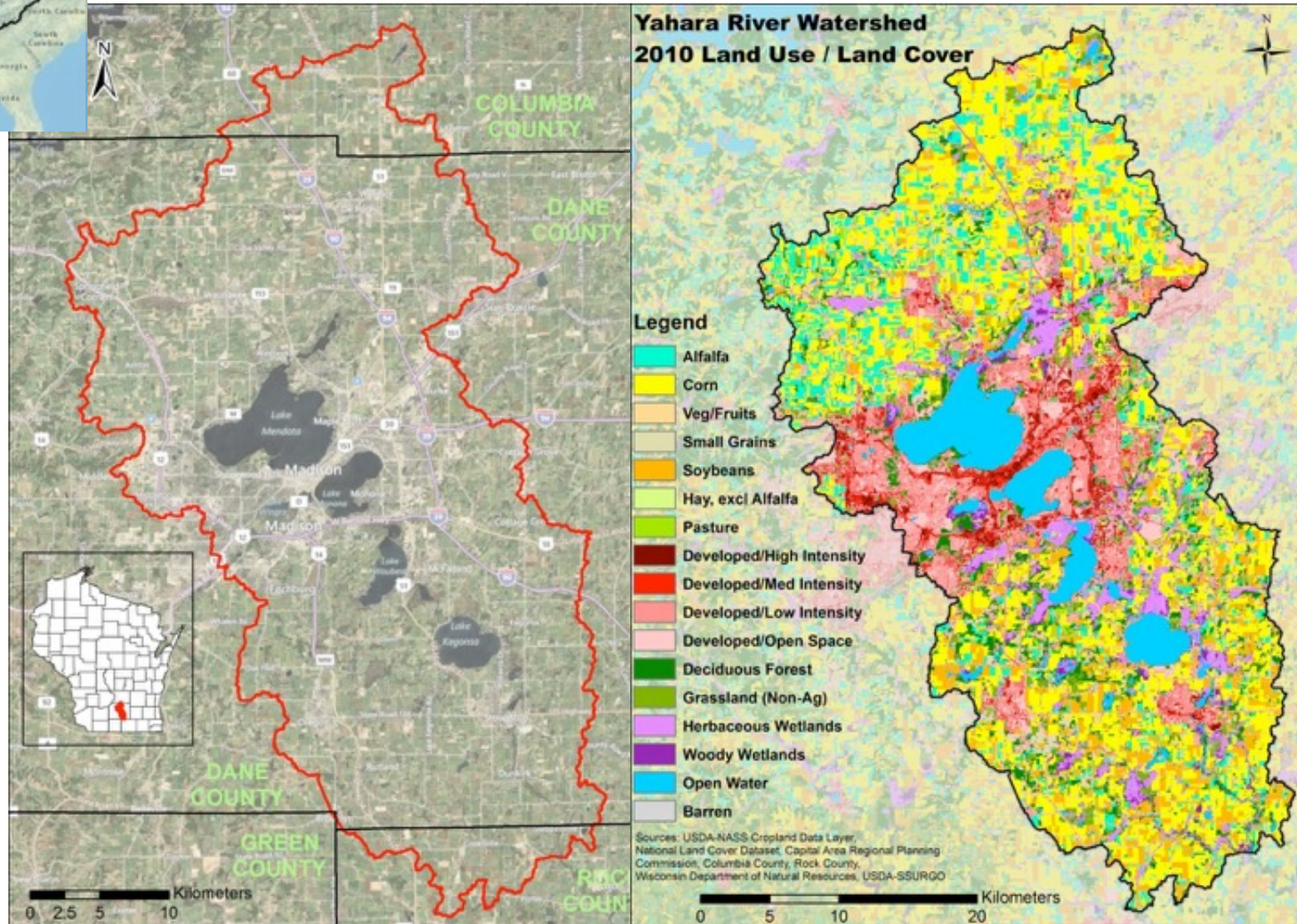
Research funded under grant DEB-1038759
Water Sustainability and Climate (WSC)

Yahara River Watershed of southern Wisconsin (city of Madison)



Aerial Photo (2011)

Land Cover (2010)



Imagery from Microsoft Bing Maps via ESRI ArcMap

Data from USDA-NASS Cropland Data Layer

- Heavily Influenced by glaciation
- Urbanizing agricultural region
- 47% ag, 27% urban, 19% natural veg
- Lakes are environmental centerpiece
- 372,000 people; 359 square miles

Watershed challenges

- Loss of agricultural land; increasing population
- Urban development pressures
- Increasing demand for biofuels
- Impacts of climate change / variability
- Enhanced hydrologic response (flashiness)



WISCONSIN STATE JOURNAL

HOME NEWS BUSINESS OPINION WEATHER COMMUNITIES ARCHIVES GET IT HOMES

WEATHER CURRENT LIVE RADAR FORECAST SEVERE WEATHER AIRLINE DELAYS

New subdivisions come at a cost to farmland, existing home sales

STORY DISCUSSION Font Size: [icon] [icon]

KAREN RIVEDAL | krivedal@madison.com | 608-252-6106 | No Comments Posted | Posted: Tuesday, November 8, 2011 5:00 am

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Construction of new subdivisions like Bishops Bay means tradeoffs in two areas: loss of farmland and perhaps less attention to existing homes for sale.

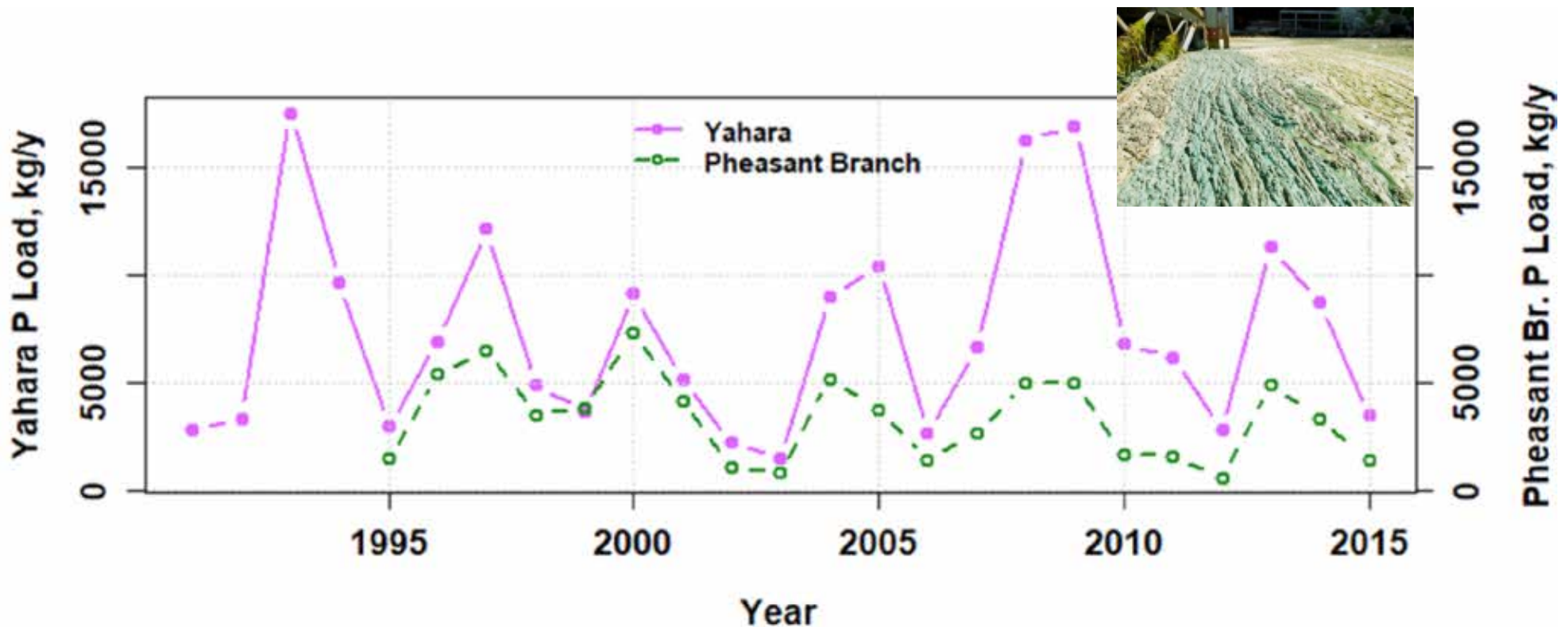
Pat Sutter, conservationist for Dane County government, said the 780 acres slated for Bishops Bay was "really good farmland."

"Almost all the land north of Lake Mendota is prime, and after it's gone, it's gone," he said.

"It's just the reality of what's happening in that transition zone between city and rural," Sutter added. "When there's development, that's often where it's going to go. I understand cities need to grow, and hopefully they're growing in a smart manner. But I do know that agriculture is very important to Dane County."

Persistent Water Quality Problems

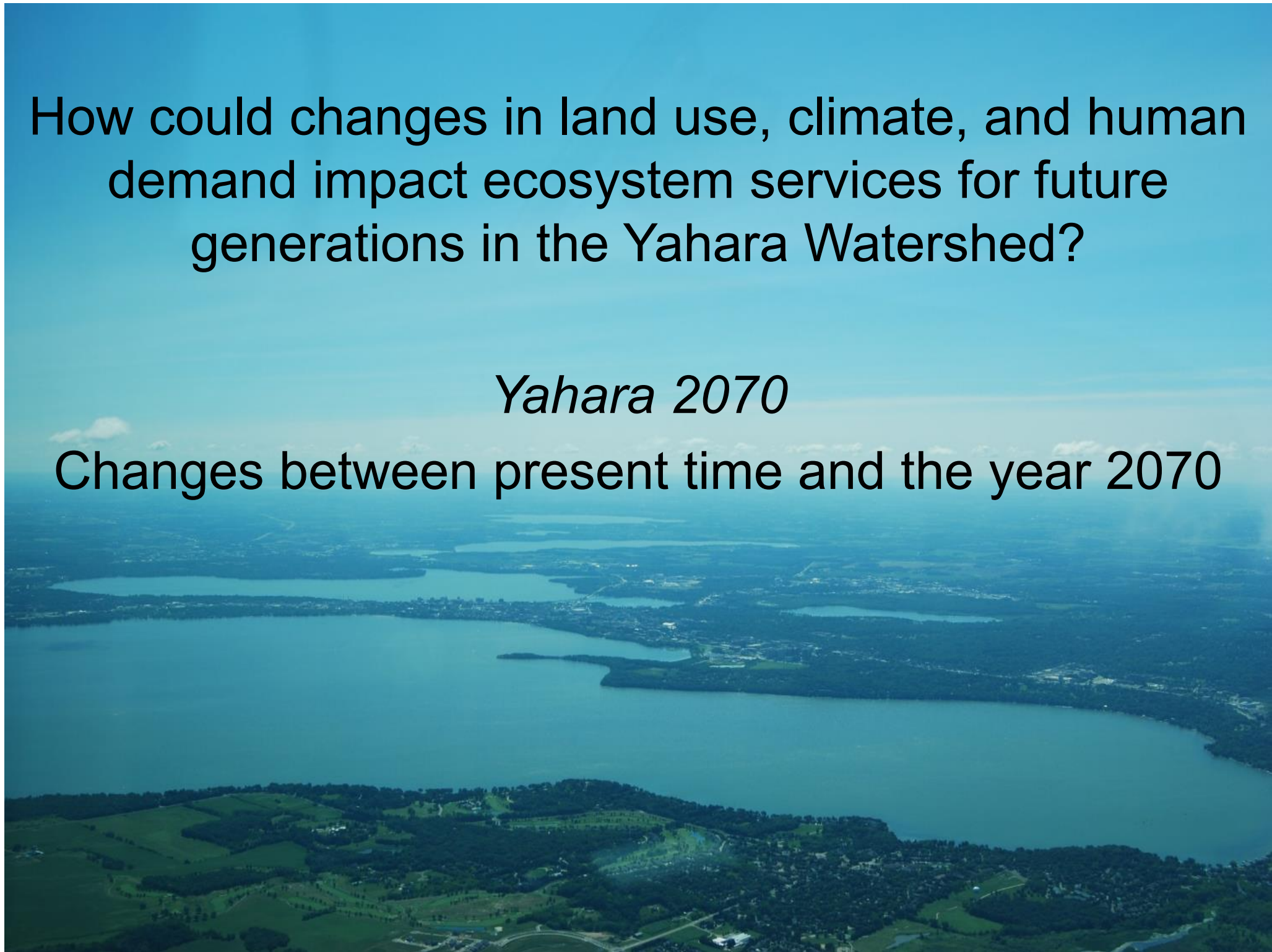
- Nutrient enrichment of lakes, streams, groundwater
 - Non-point sources (manure, agricultural fertilizer, urban, erosion)
 - Causes algal blooms, public health, & aesthetics issues, groundwater contamination from nitrate
 - 30+ Years of BMPs - little change in P-loading to lakes



How could changes in land use, climate, and human demand impact ecosystem services for future generations in the Yahara Watershed?

Yahara 2070

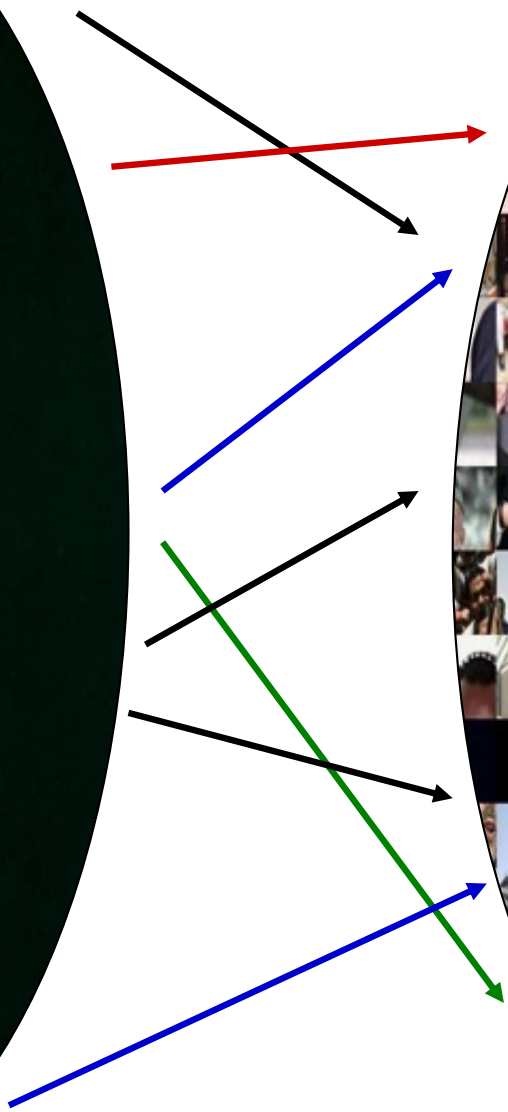
Changes between present time and the year 2070



The World



Lots of Perspectives



Scenarios for environmental futures:

Start with the viewpoints of the people who are involved.

Hopes? Fears?

What do they want to preserve?

What do they want to change?

What is resilient, and what is unstable?

What are the clusters of beliefs about how to proceed?

Where are the lines of fracture among these clusters?

Construct a plausible story about the logical consequences of each cluster of beliefs.

(Iterate. Get a lot of feedback. This takes time.)

Sample Perspectives



Cluster
the
Samples



Condense
to a few
Scenarios

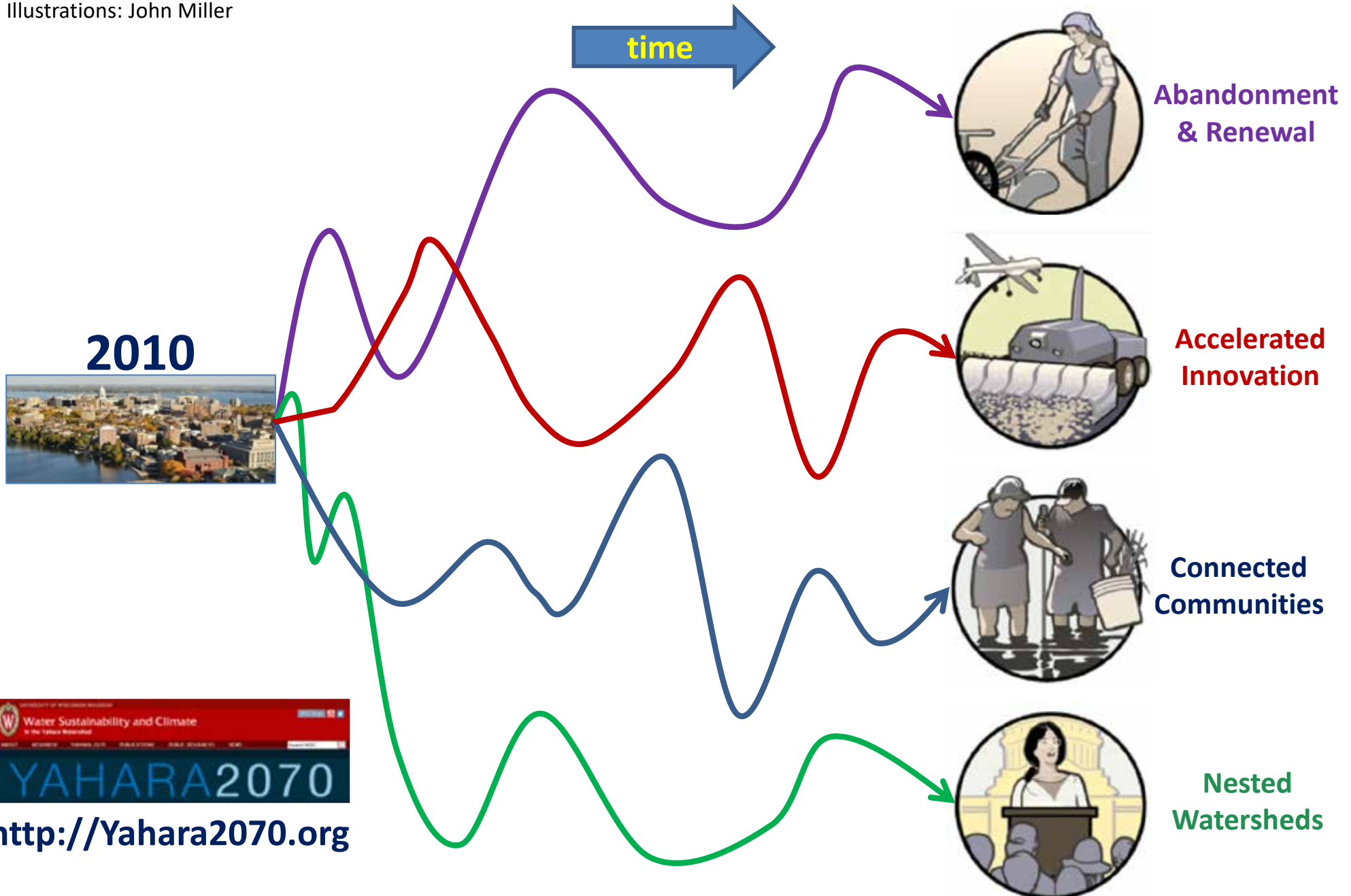


Icons by John Miller

Iterate With Stakeholders to Improve Scenarios

2070

Illustrations: John Miller



Motivating Questions for Alternative Futures

Illustrations: John Miller

What if we don't adapt to climate and social pressures on land and water?



Abandonment
& Renewal

What if we increase our investment in education, green technology, better land & water management?



Accelerated
Innovation

What if there is a generational shift toward values that embrace environmental stewardship?



Connected
Communities

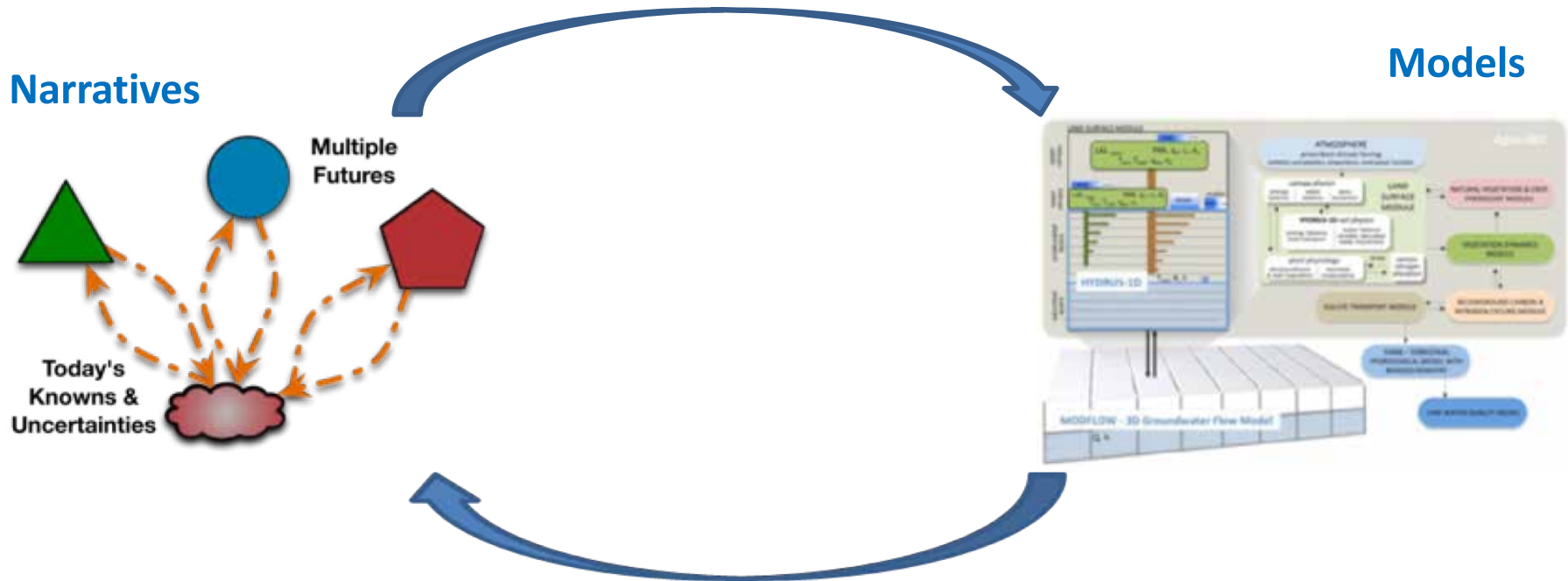
What if governance treats clean freshwater as a valued resource?



Nested
Watersheds

Linking the Narratives to Numerical Models

Narratives frame goals and scope for model analyses
Models are grounded in long-term data and process studies
Together they help create a richer view of Yahara 2070

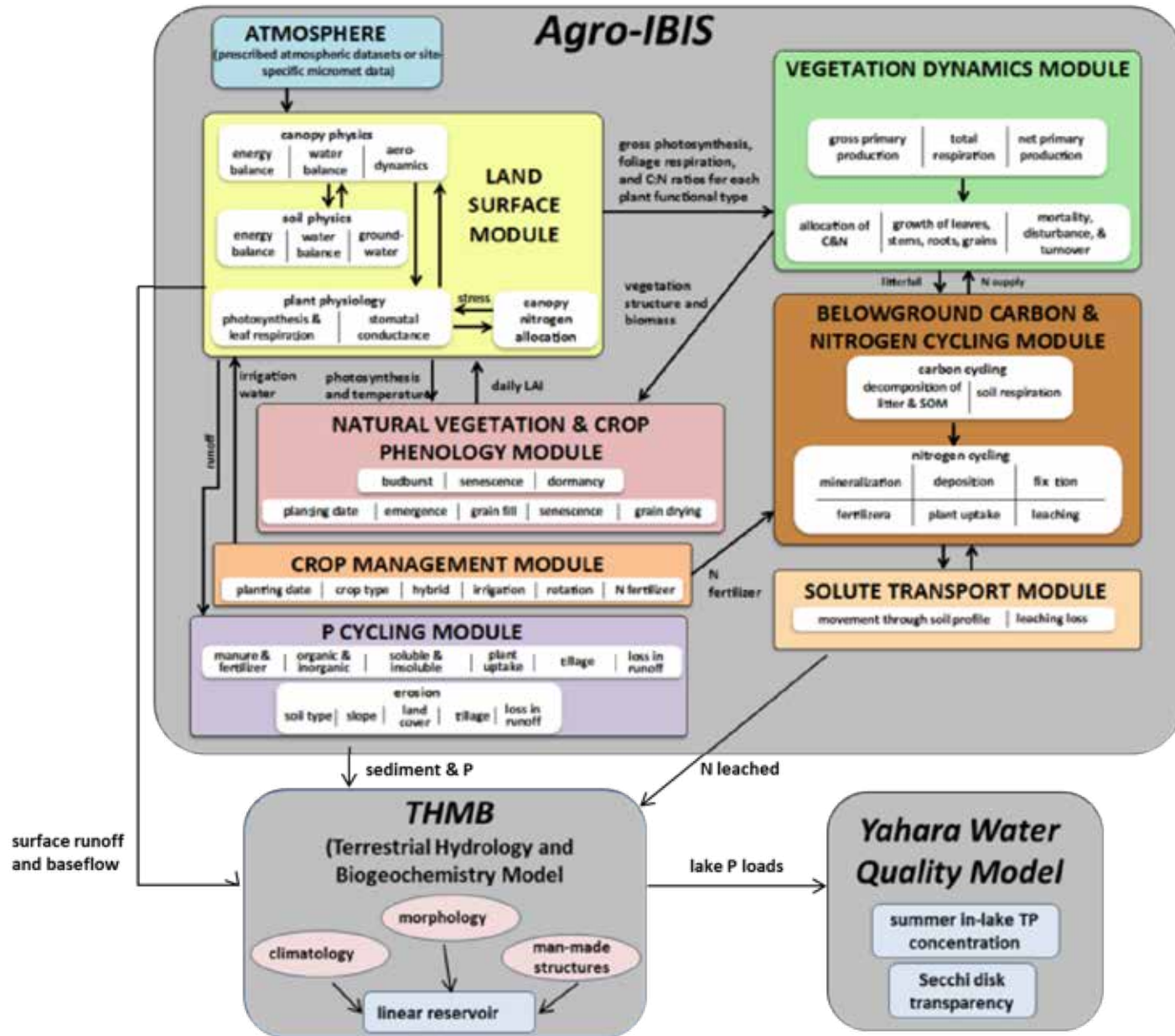


Bridging, Translating, Integrating:

Booth et al., Env. Modeling & Software 85: 80-97

Carpenter et al., 2015, <http://www.ecologyandsociety.org/vol20/iss2/art10/>

Use Data and Models to Fill in the Quantifiable Parts



<http://wsc.limnology.wisc.edu>

Quantitative Projections for Each of 4 Scenarios for 2010-2070:

Weather, land use, transportation, livestock, farm land management

Food production, carbon storage, groundwater storage, Surface and groundwater quality, cyanobacteria blooms, natural ecosystems



Illustration: John Miller

Results available on <http://wsc.limnology.edu>

Products so far (<http://Yahara2070.org>)

Stories with illustrations

Short video of each story

“Readers guide” for book clubs, church groups, etc.

Blog posts and videos about our process and findings

Writing contest (with Madison magazine & Wisconsin Public Radio)

TV show about water resources (with Wisconsin Public TV)

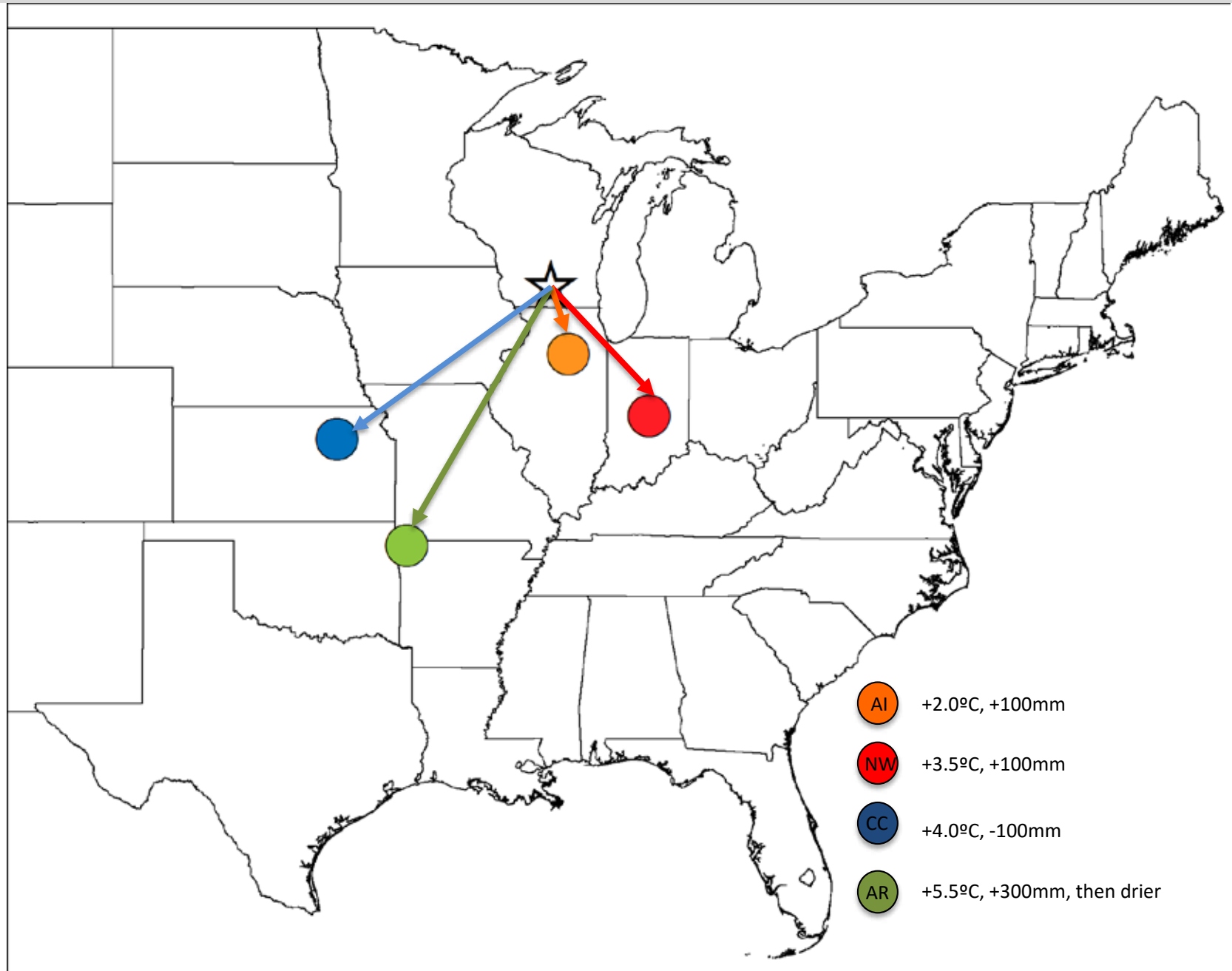
Dozens of interviews and public presentations by project participants

Presentations of model results to technical staffs of agencies

Theses, peer-reviewed papers, model packages

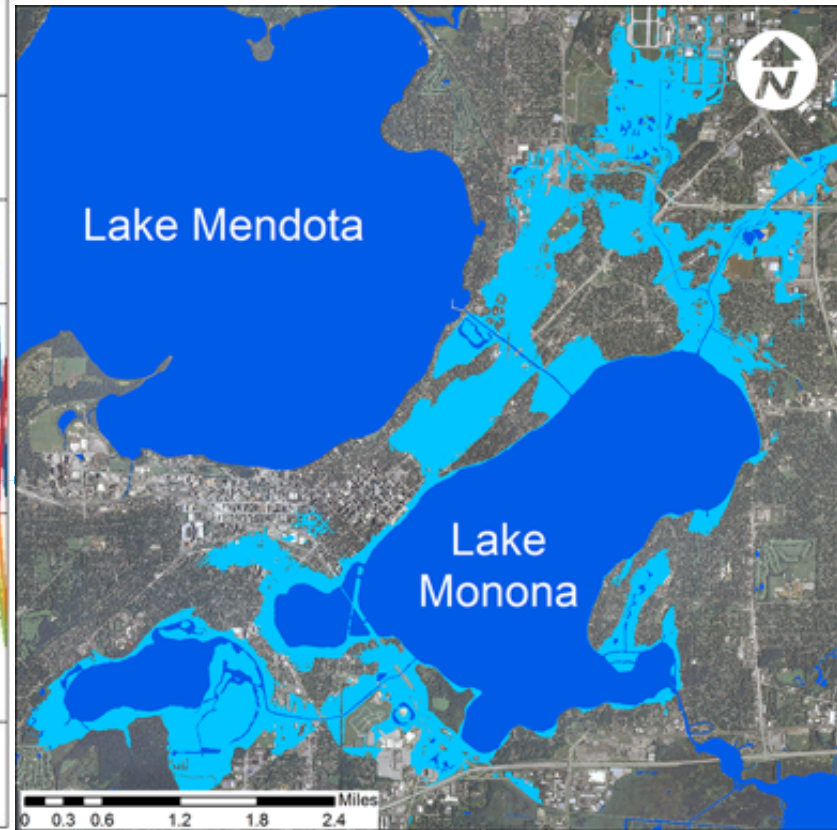
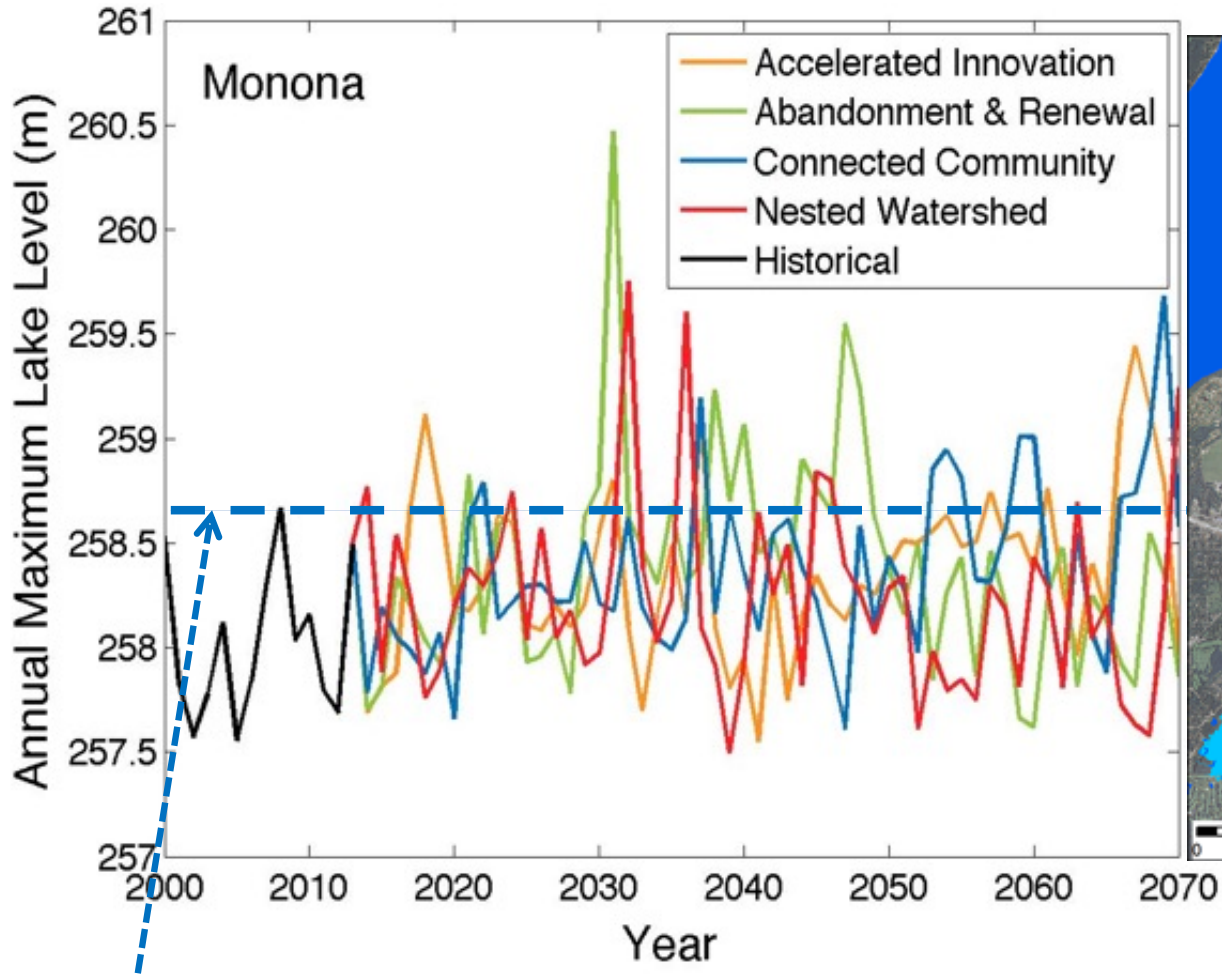
Discussions with County Executive and Board on ag & water issues

Climate Analogs for Scenarios



Annual Maximum Lake Levels (Monona)

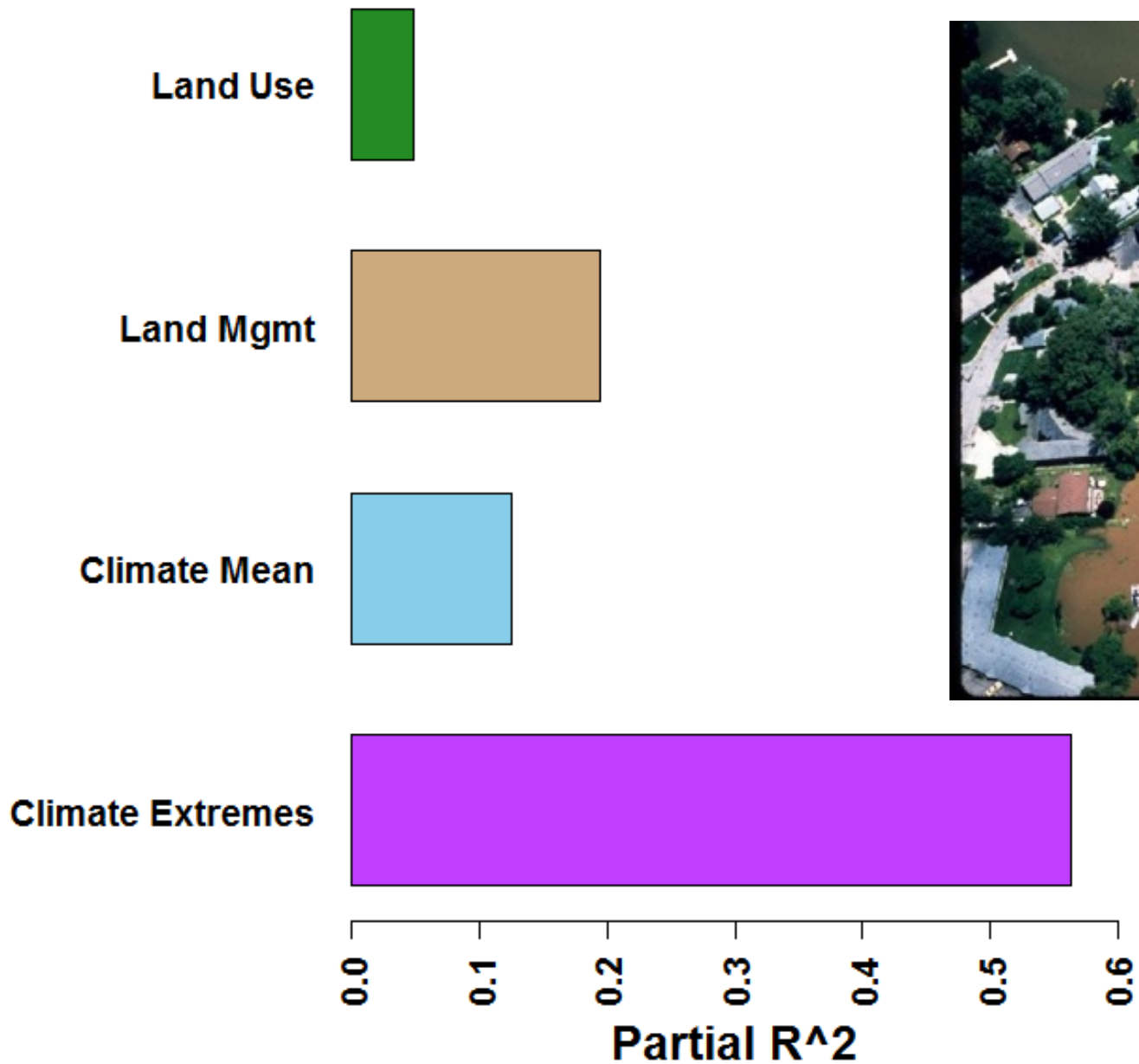
Flood mitigation



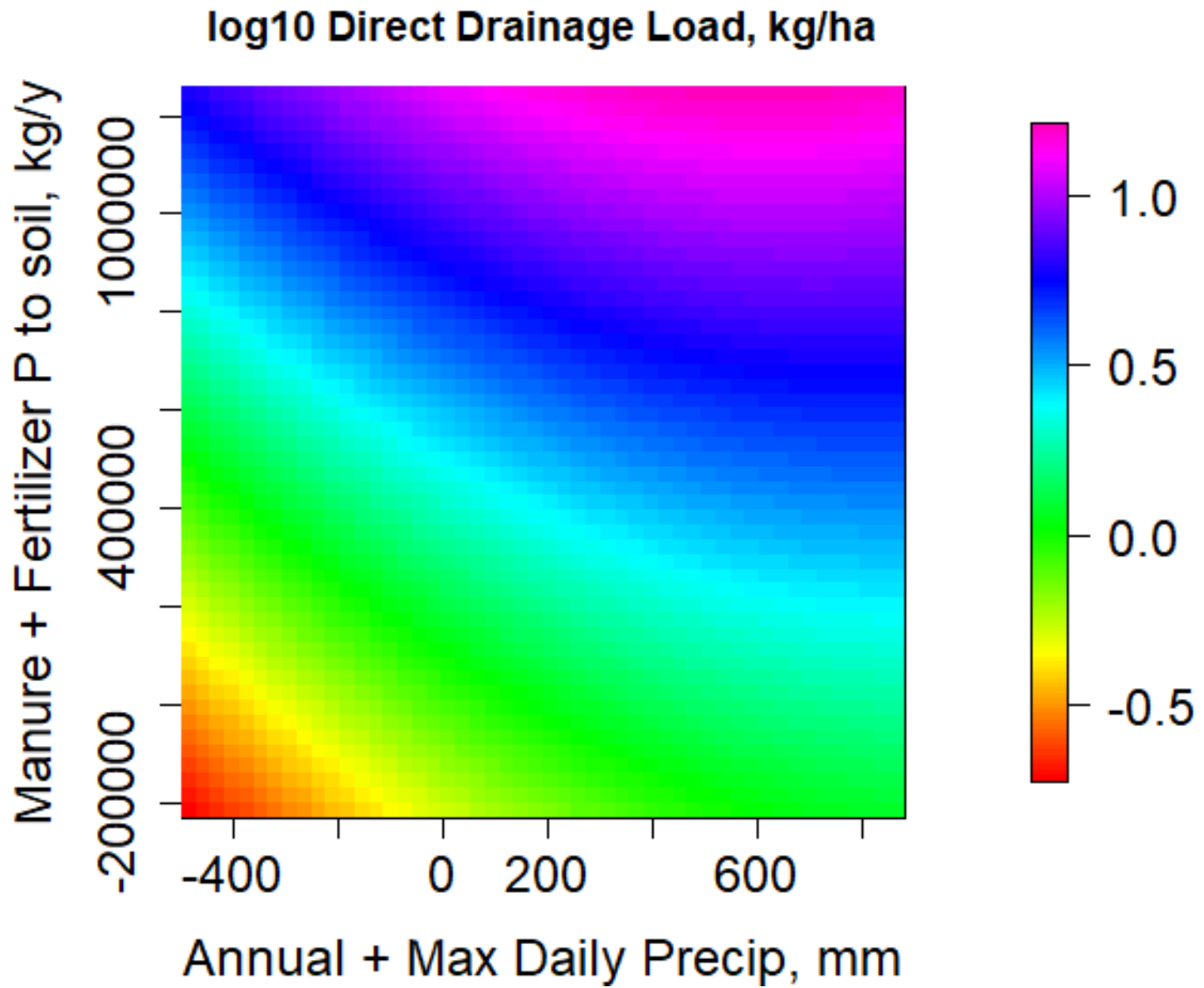
2008 benchmark for comparison : watershed received 8-10 inches of rain June 5-13

Factors that Affect Direct Drainage Loads, All Lakes

Partial R² for Direct Drainage Load, All Lakes

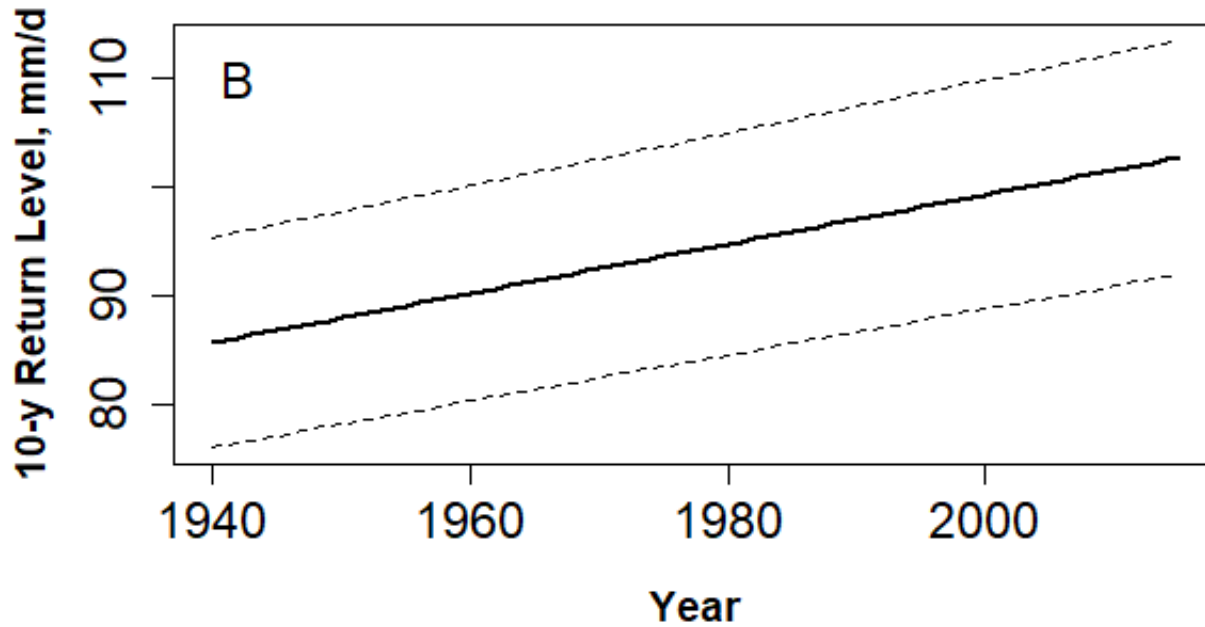
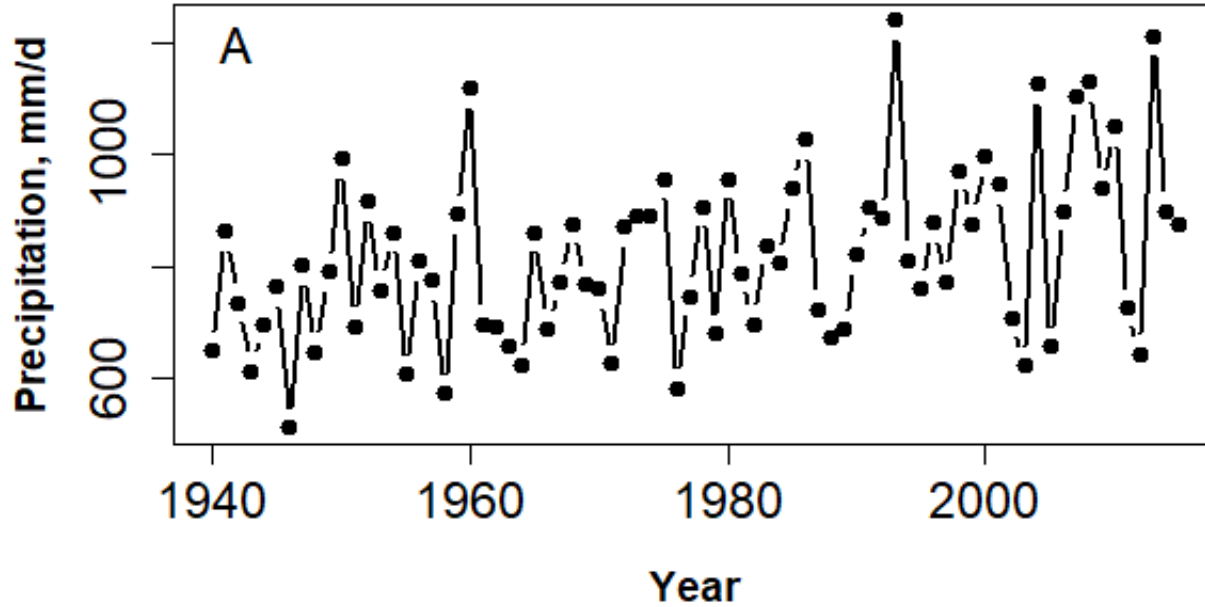


P Loads Increase With P Added to Soil and with Precipitation



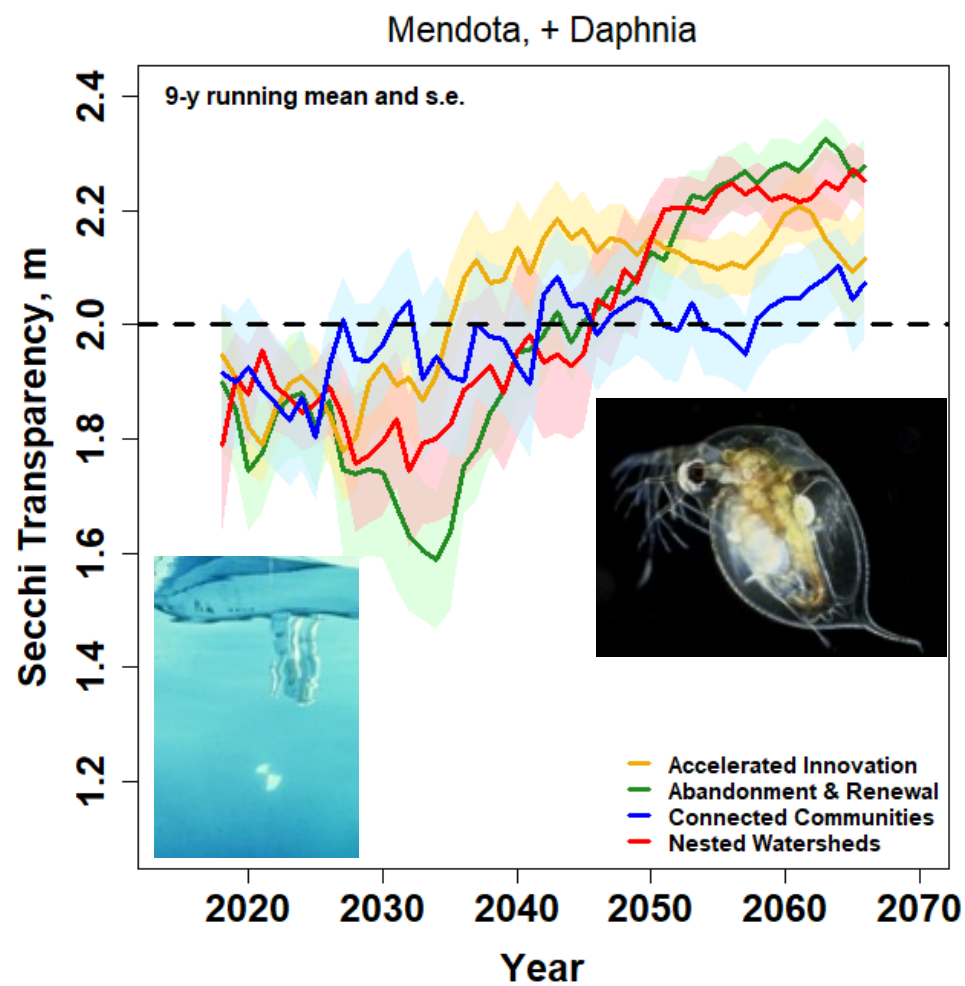
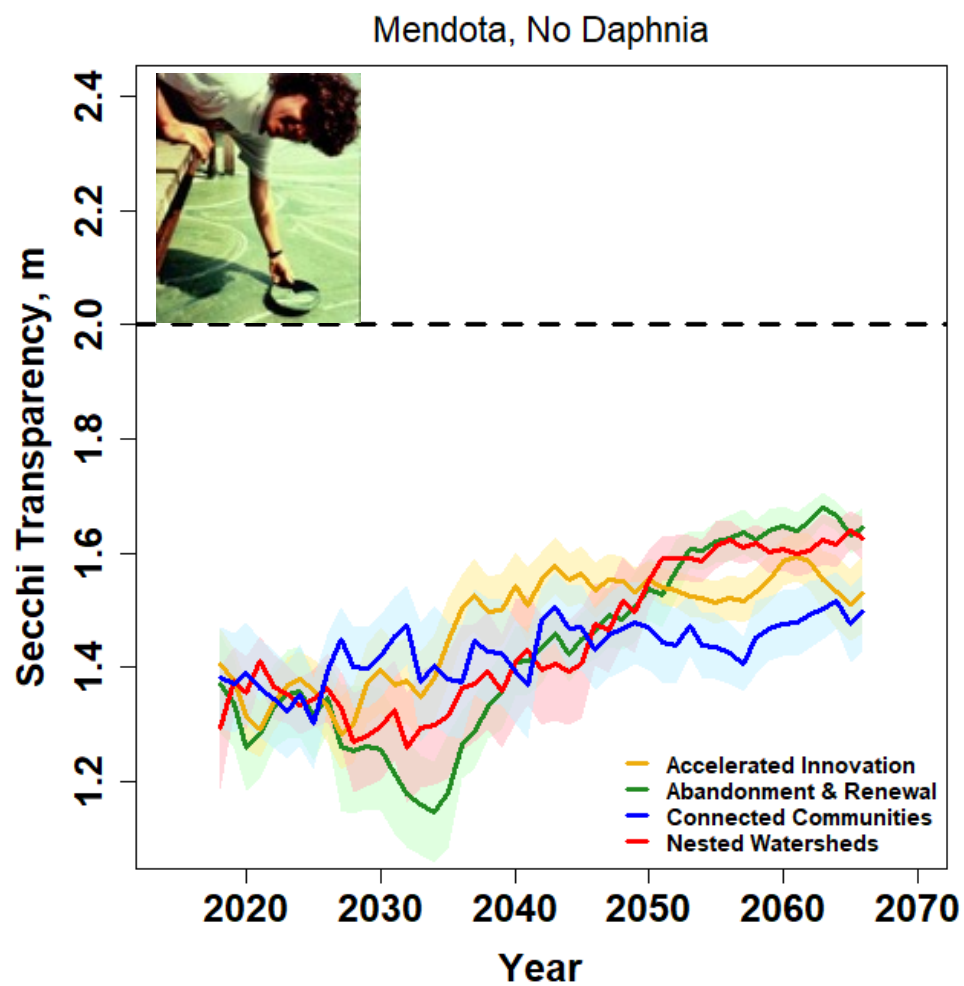
Carpenter, Kucharik, Booth et al. in prep.

Precipitation and Extremes are Increasing in Dane County



Carpenter, Kucharik, & Booth Limnology & Oceanography 2018

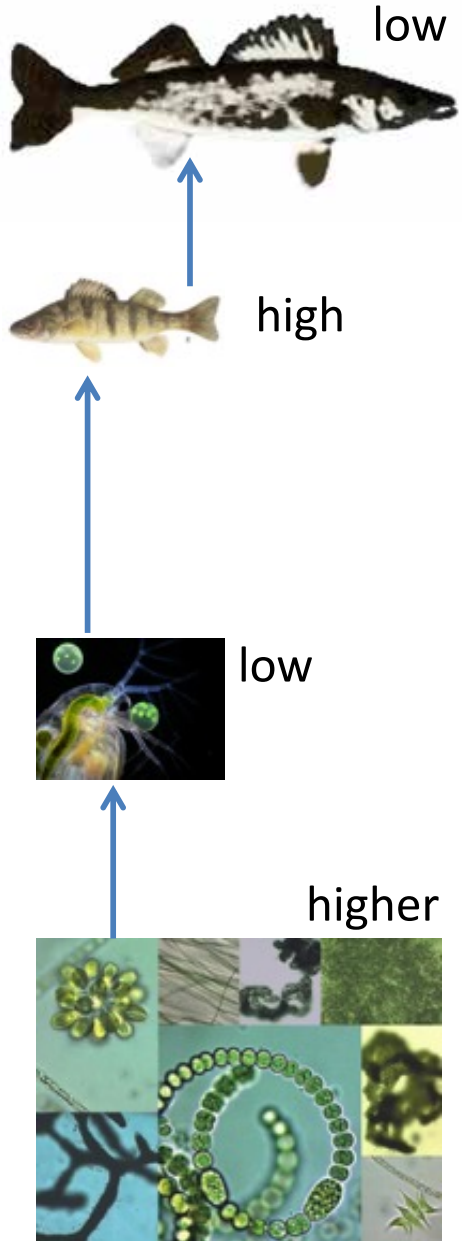
Example of the Range of Outcomes Among Scenarios



Before 1987

1988 - 2008

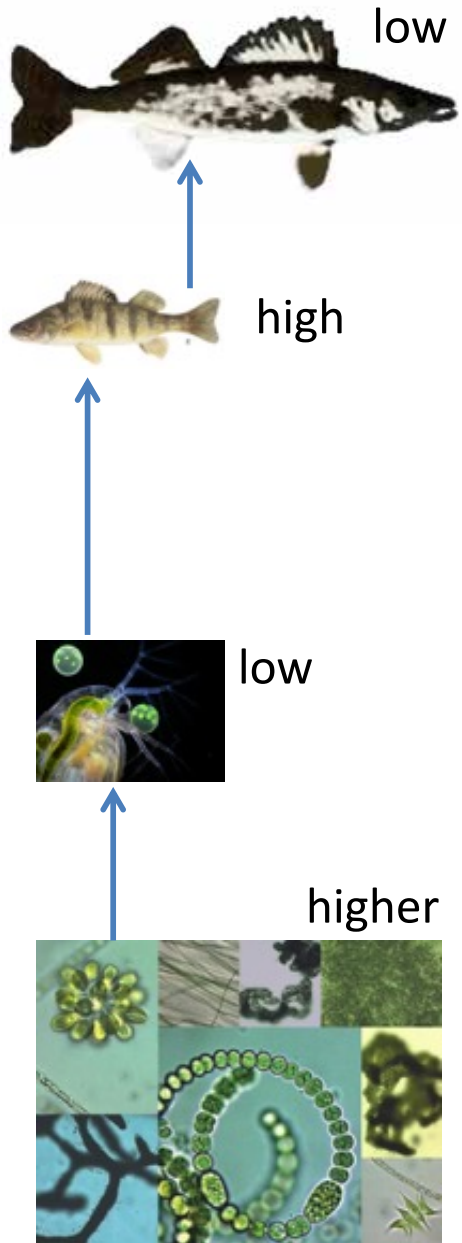
After 2009



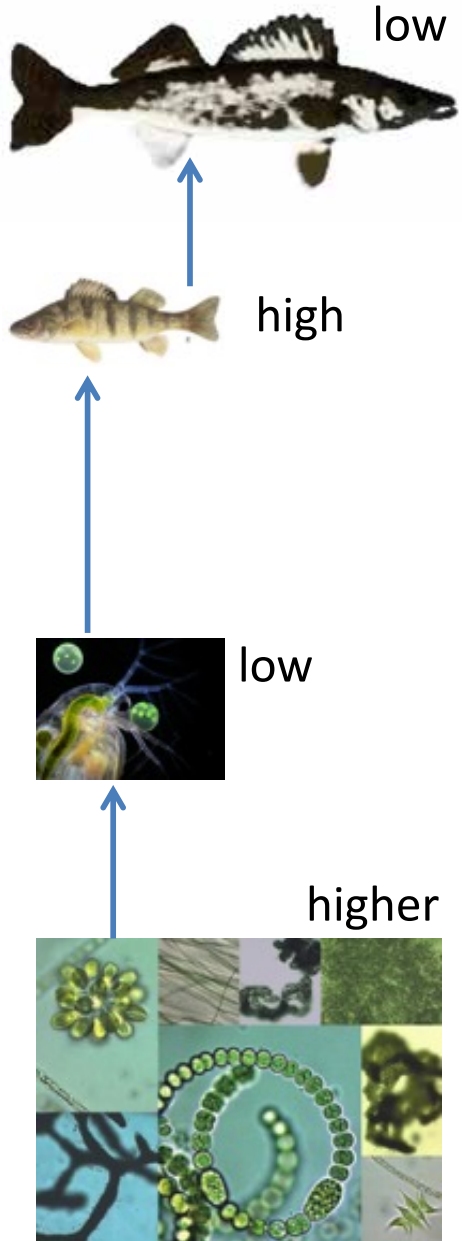
Before 1987

1988 - 2008

After 2009



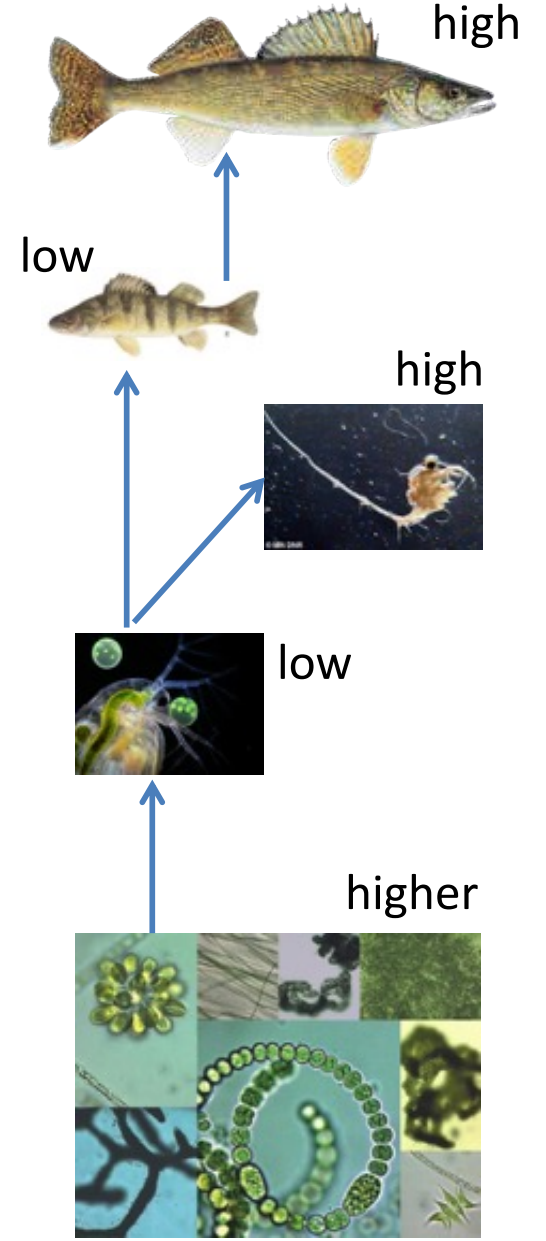
Before 1987



1988 - 2008



After 2009



And now here come the zebra mussels

It's a Jungle Down There: Zebra Mussels Transforming Depths of Lake Mendota

August 28, 2017 Adam Hinterthuer 6 Comments



Zebra mussels encrust sections of the UW Hoofers sailing pier pulled out of the water fall, 2016. The invasion has only gotten worse. Photo: A. Hinterthuer

Mike Spear & Adam Hinterthuer

<http://blog.limnology.wisc.edu/its-a-jungle-down-there-zebra-mussels-transforming-depths-of-lake-mendota/>

What will we see in Zebra mussel-infested lakes?

Clearer water much of the time

Occasional severe toxic blooms

More growth of rooted plants

**More green glop (periphyton)
growing on the lake bottom and
fouling beaches**



Adam Hinterthuer

**More cuts and abrasions from sharp shells on
beaches, buoys, boats, and moorings.**

Changing fish production as the food base changes.

Tradeoffs and choices for the future

What do we want the watershed to provide?

What do we need the watershed to provide?

What is biophysically possible?

What is socially acceptable?

What choices handle shocks and build resilience?



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<http://wsc.limnology.wisc.edu>

<http://Yahara2070.org>

Steve.Carpenter@wisc.edu

Center for Limnology, University of Wisconsin-Madison