Illinois Nutrient Loss Reduction Strategy

Nutrient Monitoring Council

12th Meeting, March 19, 2019, Springfield, IL

ILLINOIS NUTRIENT LOSS REDUCTION STRATEGY | Improving our water resources collaboration and innovation

Welcome/Housekeeping

- Important Stuff – bathrooms, lunch, other
- Member and Guess Introductions
- Newsworthy Notes:
  - Hold the Date – NLRS Policy Working Group 5/22/19
  - Hold the Date – NLRS Partnership Conference 12/3-4/19

Nutrient Monitoring Council Members (3/15/18)

Illinois EPA
Gregg Good, Rick Cobb

Illinois State Water Survey
Laura Keefer

Aqua Illinois
Kevin Culver

~~**Illinois Natural History Survey**~~
~~Andrew Casper~~ (Need Replacement?)

Illinois Dept. of Natural Resources
Ann Holtrop or Brian Metzke???

Univ. of IL – Dept. of Agriculture and Biological Engineering
Paul Davidson

Sierra Club
Cindy Skrukrud

MWRDGC
Justin Vick

Illinois Corn Growers Association
Laura Gentry

U.S. Army Corp of Engineers-Rock Island
~~Chuck Theiling~~ Nicole Manasco?

U.S. Geological Survey
Kelly Warner

National Center for Supercomputing Apps
Jong Lee

Univ. of IL – Dept. of Natural Resources and Environmental Sciences (Emeritus)
Greg McIsaac

NLRS Coordinator – Illinois EPA
Trevor Sample

New Member – Lucy Good!

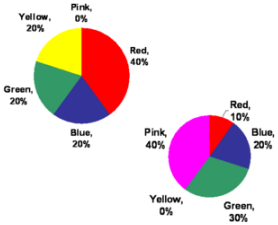
NMC Charges *(Revised 10/26/15)*

1. Coordinate the development and implementation of monitoring activities (e.g., collection, analysis, assessment) that provide the information necessary to:

   a. Generate estimations of 5-year running average loads of Nitrate-Nitrogen and Total Phosphorus *leaving the state of Illinois* compared to 1980-1996 baseline conditions; and
   b. Generate estimations of Nitrate-Nitrogen and Total Phosphorus loads *leaving selected NLRS identified priority watersheds* compared to 1997-2011 baseline conditions; and
   c. Identify Statewide and NLRS priority watershed *trends in loading over time* using NMC developed evaluation criteria.

2. Document *local water quality outcomes* in selected NLRS identified priority watersheds, or smaller watersheds nested within, where future nutrient reduction efforts are being implemented (e.g., increase in fish or aquatic invertebrate population counts or diversity, fewer documented water quality standards violations, fewer algal blooms or offensive conditions, decline in nutrient concentrations in groundwater).

3. Develop a *prioritized list of nutrient monitoring activities and associated funding* needed to accomplish the charges/goals in (1) and (2) above.



August 29, 2019, NMC #11 Meeting

- Review of Meeting
- Minutes (review and approve)

NLRS 2019 Biennial Progress Report: Nitrate-N and Phosphorus Load and Yield Estimates in Illinois Rivers (Draft)

Greg McIsaac, Associate Professor Emeritus

University of Illinois at Urbana Champaign

Collaboration

- Geospatial data support for analyses on N/P changes over time with Prof. Greg McIsaac
  - Catchment analysis of monitoring stations (# stations)
  - Identifying point sources related to certain monitoring stations
  - Identifying unmonitored area in Illinois (with point sources)
  - Generating/visualizing the N/P loads by HUC 8
  - Those geospatial layers will be GLTG contextual layers

Great Lakes to Gulf
VIRTUAL OBSERVATORY

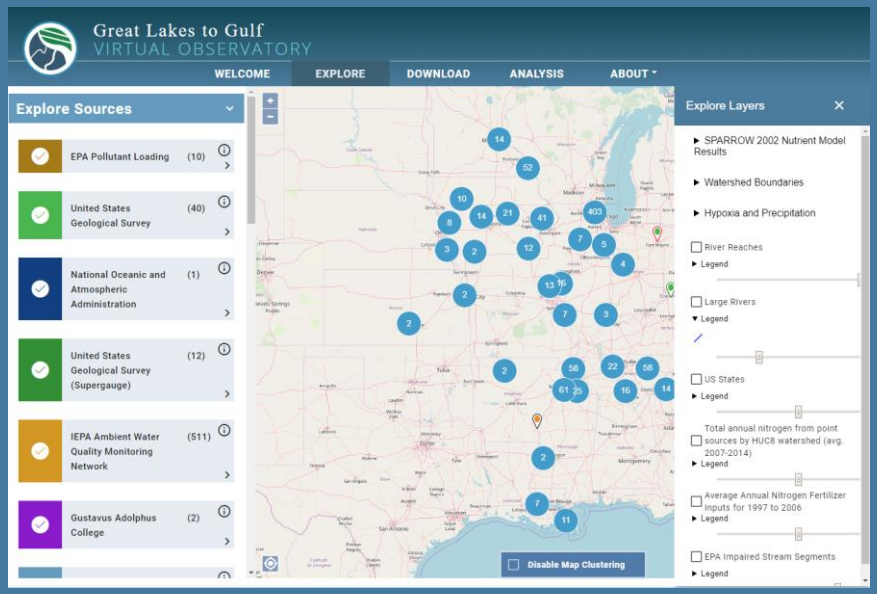
Illinois Nutrient Loss Reduction Strategy Data Portal

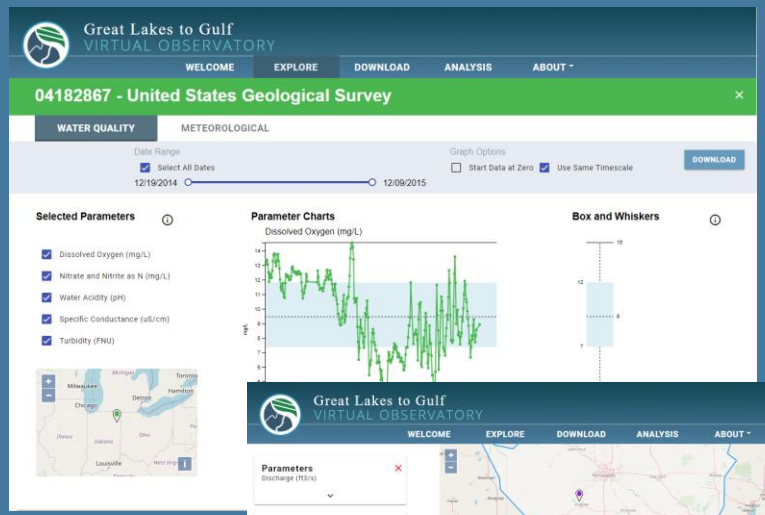
- New data
  - EPA Pollutant Loading
  - Most of IEPA Ambient Water Quality Monitoring Network
  - Fox River Watershed, Fox River Study Group & Illinois State Water Survey
    - Updated with latest data
  - Iowa Water Quality Information System
- It will be updated to V3 soon

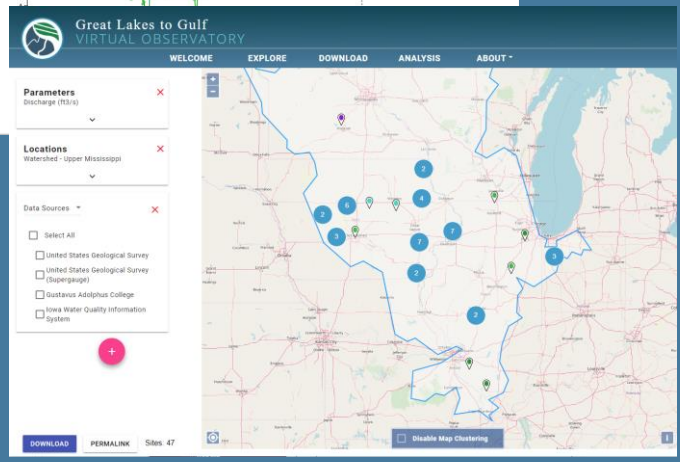
- New layers
  - SPARROW 2002 Nutrient Model Results
  - Hypoxia Contours from 2005 to 2017
  - In progress
    - Cropscape Frequency layer
    - NOAA Precipitation layer
    - Updated impaired stream layer for Illinois

Great Lakes to Gulf
VIRTUAL OBSERVATORY

New V3







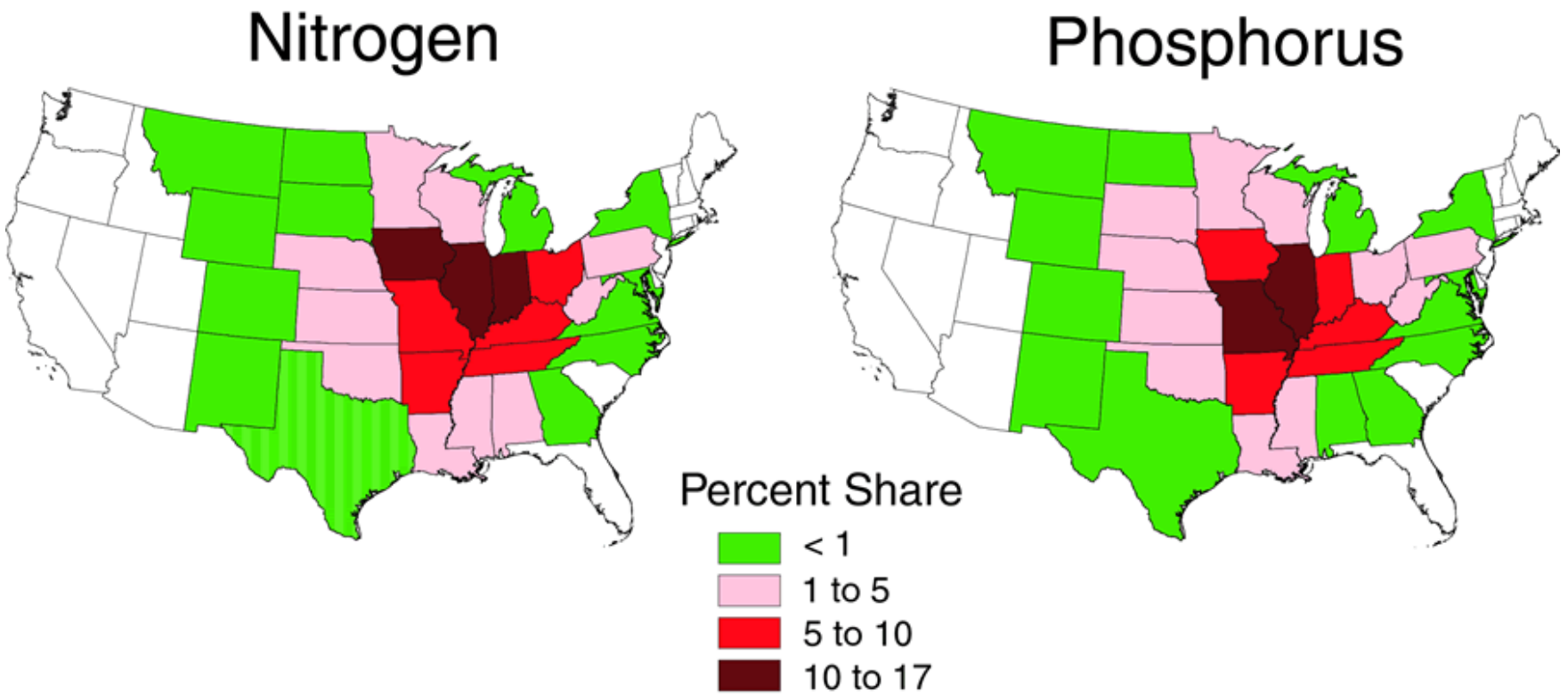
Lunch Time!

Assessment of NPS Nutrient Load Reduction Goals Under Changing Climate

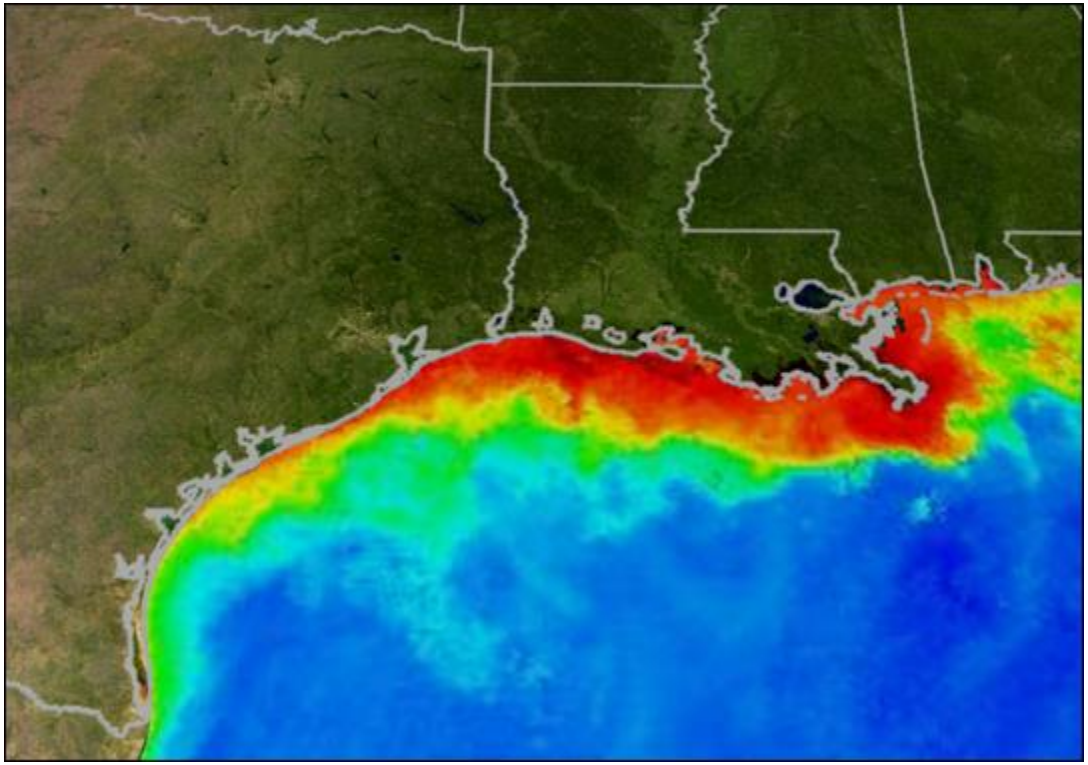
Momcilo Markus, Illinois State Water Survey/PRI/UIUC

State Contributions to Nitrogen and Phosphorus loads delivered by the Mississippi River to the Gulf of Mexico

Total Nitrogen				Total Phosphorus			
State	Percent of Total Flux	Cumulative Percent of Total Flux	Delivered Yield (kg km^{-2} yr^{-1})	State	Percent of Total Flux	Cumulative Percent of Total Flux	Delivered Yield (kg km^{-2} yr^{-1})
Illinois	16.8	16.8	1734.9	Illinois	12.9	12.9	117.4
Iowa	11.3	28.1	1167.2	Missouri	12.1	25.0	89.4
Indiana	10.1	38.2	1806.6	Iowa	9.8	34.8	89.2
Missouri	9.6	47.8	800.5	Arkansas	9.6	44.4	94.6
Arkansas	6.9	54.7	750.1	Kentucky	9.0	53.4	113.4



Nutrient Reduction Goals



- To reduce the size of the hypoxic zone in the Gulf of Mexico, the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force set a nutrient reduction goal of 45% for nitrogen and phosphorus by 2050 to reduce the size of the hypoxic zone from 8000 to 5000 square miles (MRGMWNTF, 2008).

MRGMWNTF (Mississippi River/Gulf of Mexico Watershed Nutrient Task Force). 2008. Gulf Hypoxia Action Plan 2008 for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico and Improving Water Quality in the Mississippi River Basin. Washington, DC: Mississippi River/Gulf of Mexico Watershed Nutrient Task Force http://water.epa.gov/type/watersheds/named/msbasin/actionplan.cfm

The Illinois Nutrient Loss Reduction Strategy

https://www2.illinois.gov/sites/agr/Resources/NutrientLoss/Pages/default.aspx

- The strategy describes a comprehensive suite of best management practices for reducing loads from wastewater treatment plants and urban and agriculture runoff. These practices will help the state reduce its phosphorus load by 25 percent and its nitrate-nitrogen load by 15 percent by 2025.

Presentation Outline

- Nutrient loads are strongly related to climate. Loads in dry years are typically smaller than those in wet years. Loads are particularly related to heavy storms.
- Climate is changing, and as a result, nutrient loads will also be changing.
- What we design today, may not be sufficient in the future. Management strategies that work today may not down the road.
- Is there a way to add climate variability/change to the nutrient loss reduction strategy? Climate-normalized goals?
- Is there a way to use climate information in the future to determine if the strategy actually worked (validation)?
- Would a probabilistic approach to setting the goals be more appropriate (and still practical)?

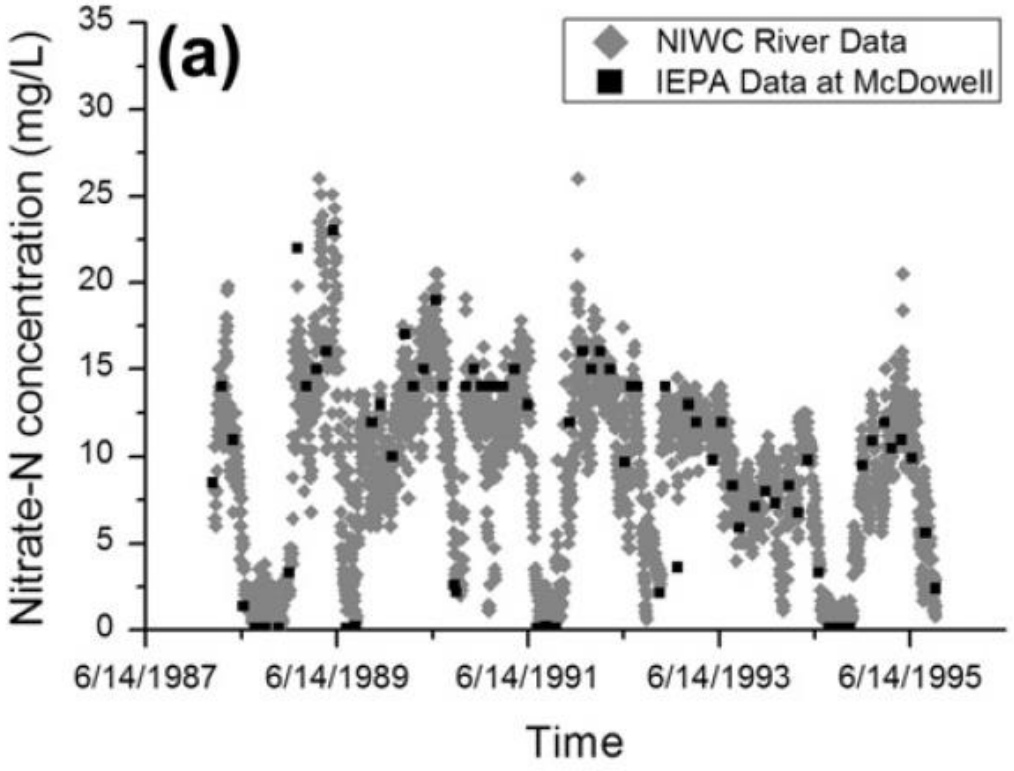
Nutrient loads and storms

- Numerous studies have reported that nutrient export from watersheds mainly happens during a few high flow periods in a year (Richards and Holloway, 1987; Preston et al., 1989; Lewis, 1996; Robertson and Roerish, 1999; Cooper and Watts, 2002; Markus and Demissie, 2006; and Salles et al., 2007).

Nutrient loads and storms

2.2.2. Vermilion River at Pontiac

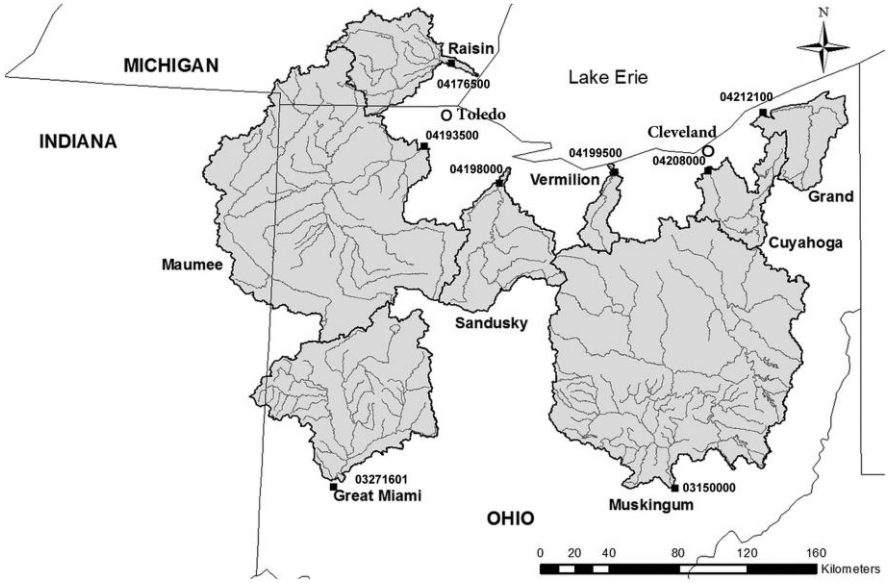
The Vermilion River watershed, located in north-central Illinois, drains an area of approximately 3424 km^2 (Fig. 2). This

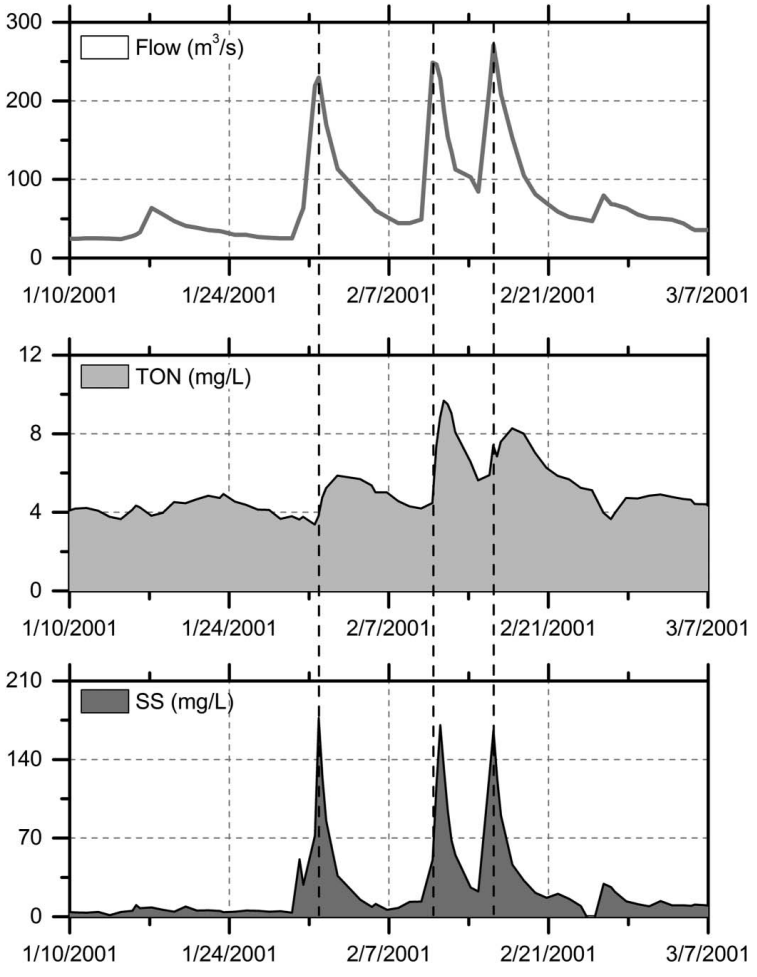


Verma, S., Markus, M., and Cooke, R, 2012, Development of error correction techniques for nitrate-N load estimation methods. J. Hydrol., doi:10.1016/j.jhydrol.2012.02.011

Nutrient Loadings and Climate

- A wet year in terms of nutrient loading is defined by large storm events. The increase is tied to heavy precipitation/river flow.





Typical hydrograph with TON and SS pollutographs for a high-flow event in the Great Miami watershed; TP pollutographs were very similar to those of SS and therefore were not included (Verma et al. 2018)

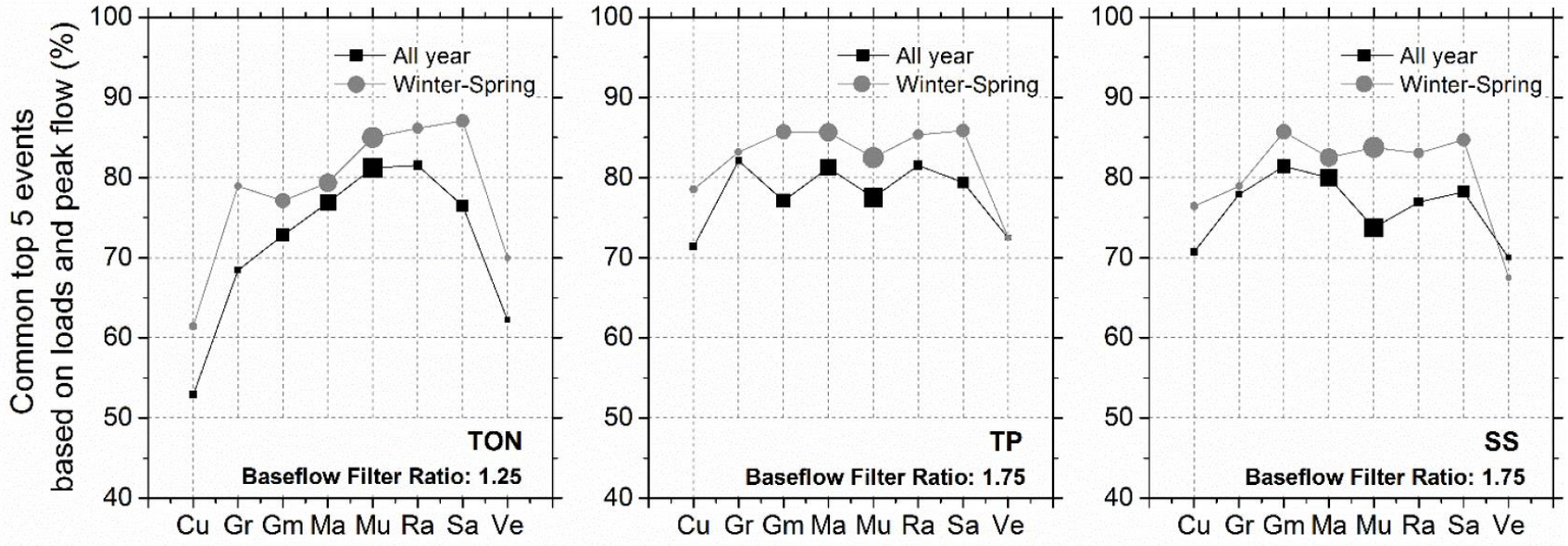
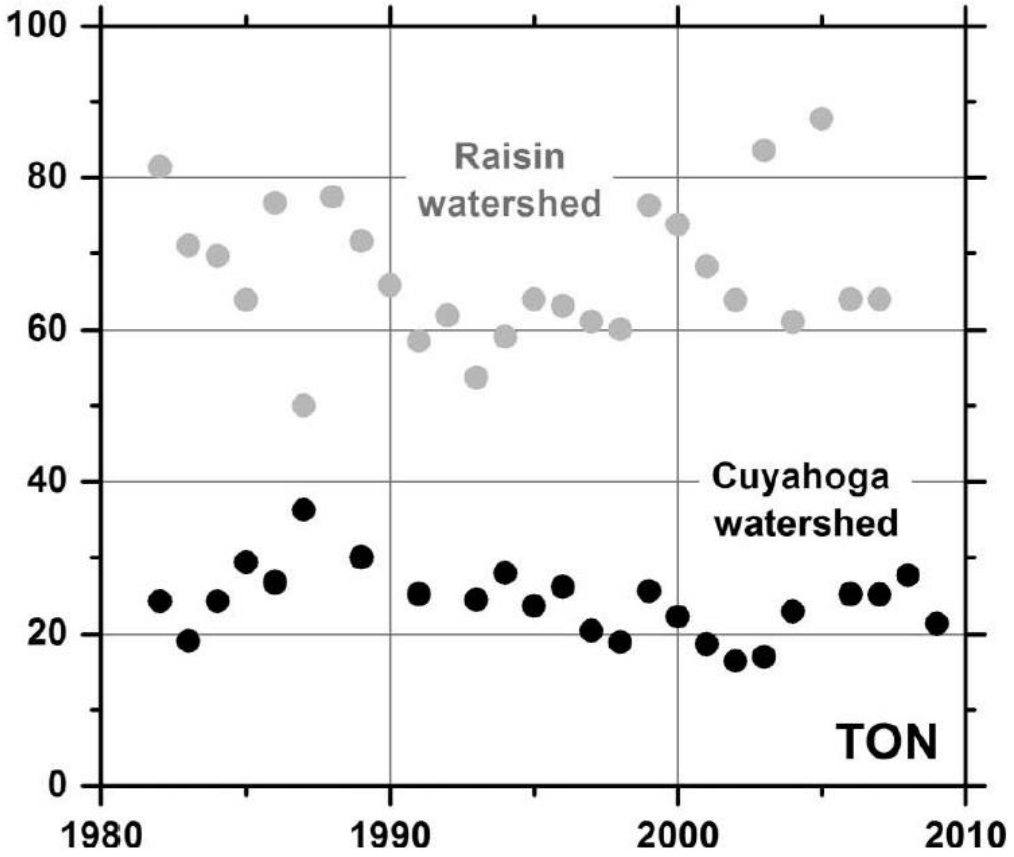


Figure 3. Percentage of common top events based on loads exported and peak flows for BFR = 1.25 (TON) and BFR = 1.75 (SS, TP). For example, the open circle for the Muskingum BFR = 1.25 case shows that 80% of the top five events, based on TON loading and peak flows, were common over the 15 years of monitoring. Point size indicates relative watershed size (not to scale).

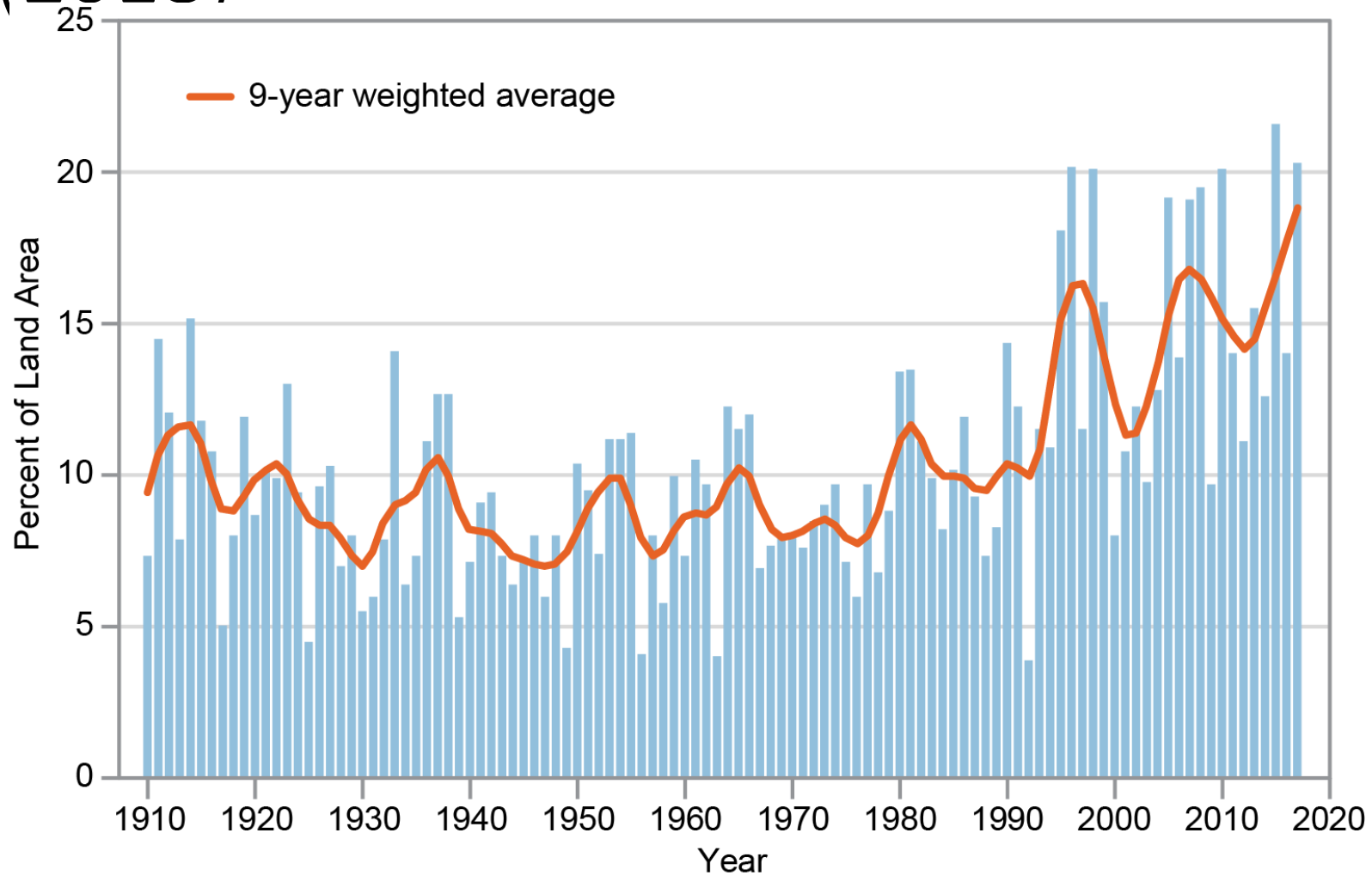
Nitrate loads transported during 5 largest events



- Volume I of the NCA4
- Precipitation will continue to increase (medium confidence)
- Heavy precipitation events will increase in frequency and amounts (high confidence)

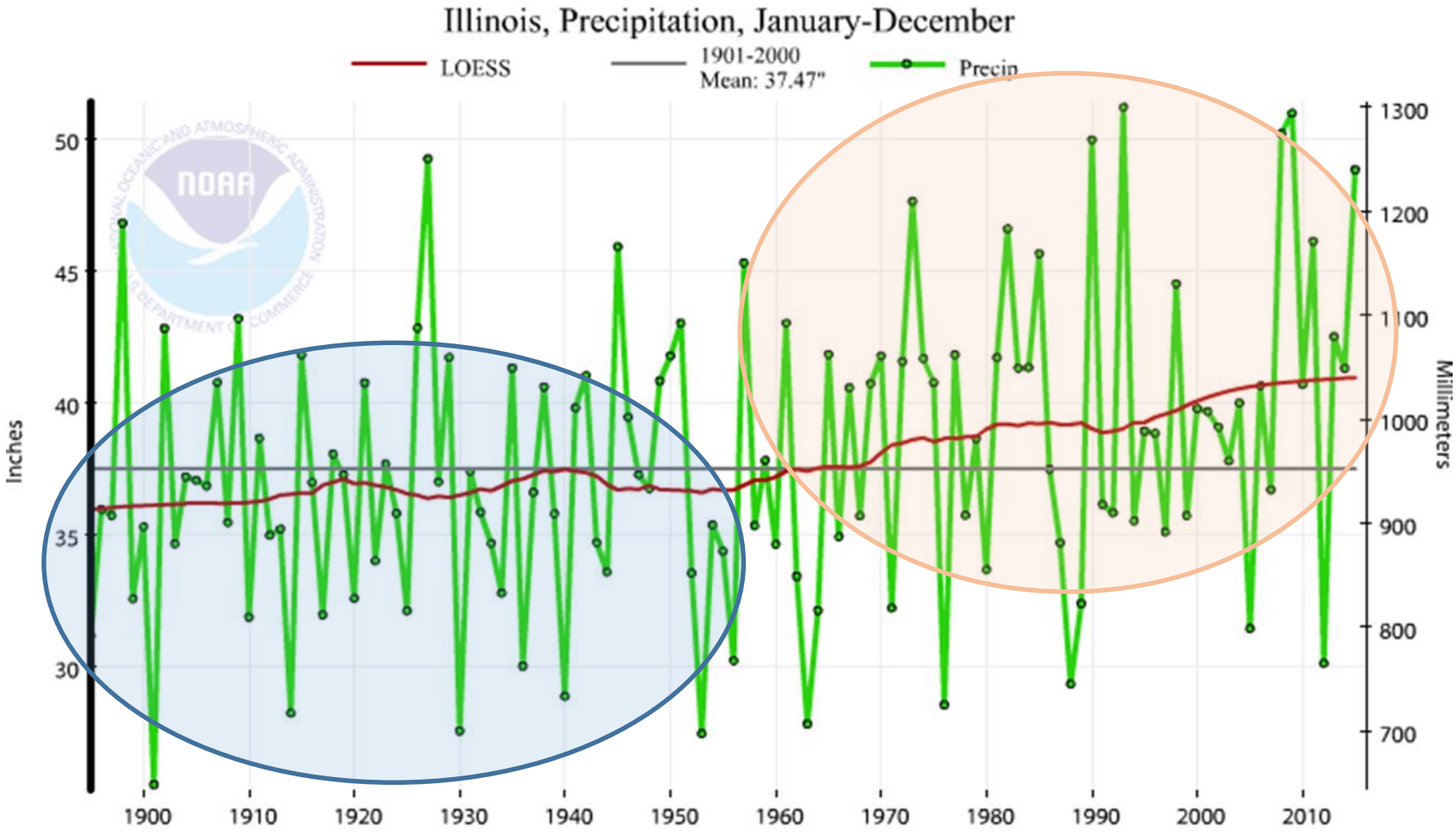
https://science2017.globalchange.gov/

from National Climate Assessment (2018)

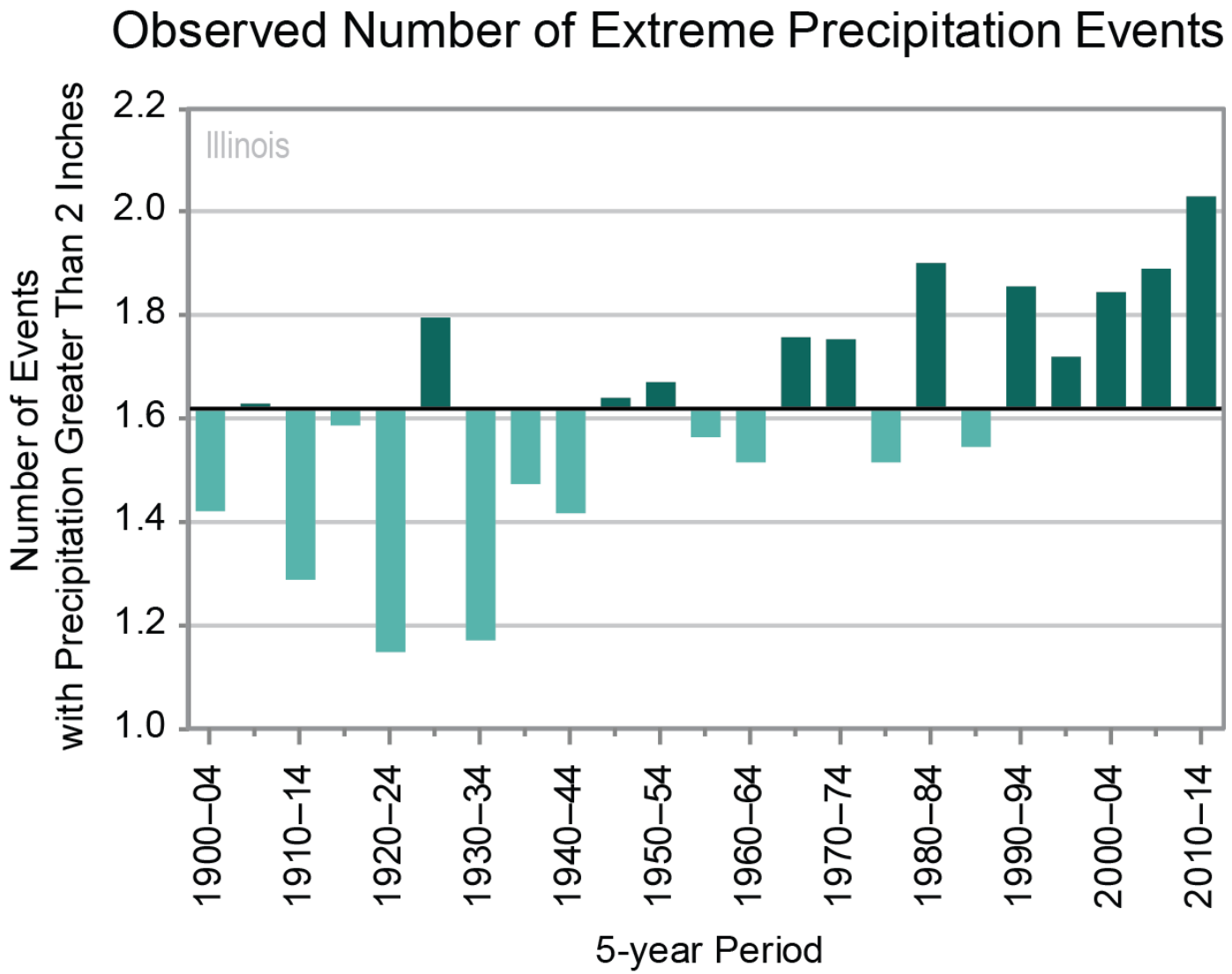


(from NCA Report (2018) Figure 10.4: The figure shows the percent of land area in the contiguous 48 states experiencing extreme one-day precipitation events between 1910 and 2017. These extreme events pose erosion and water quality risks that have increased in recent decades. The bars represent individual years, and the orange line is a nine-year weighted average. Source: adapted from EPA 2016.171

Annual precipitation in Illinois



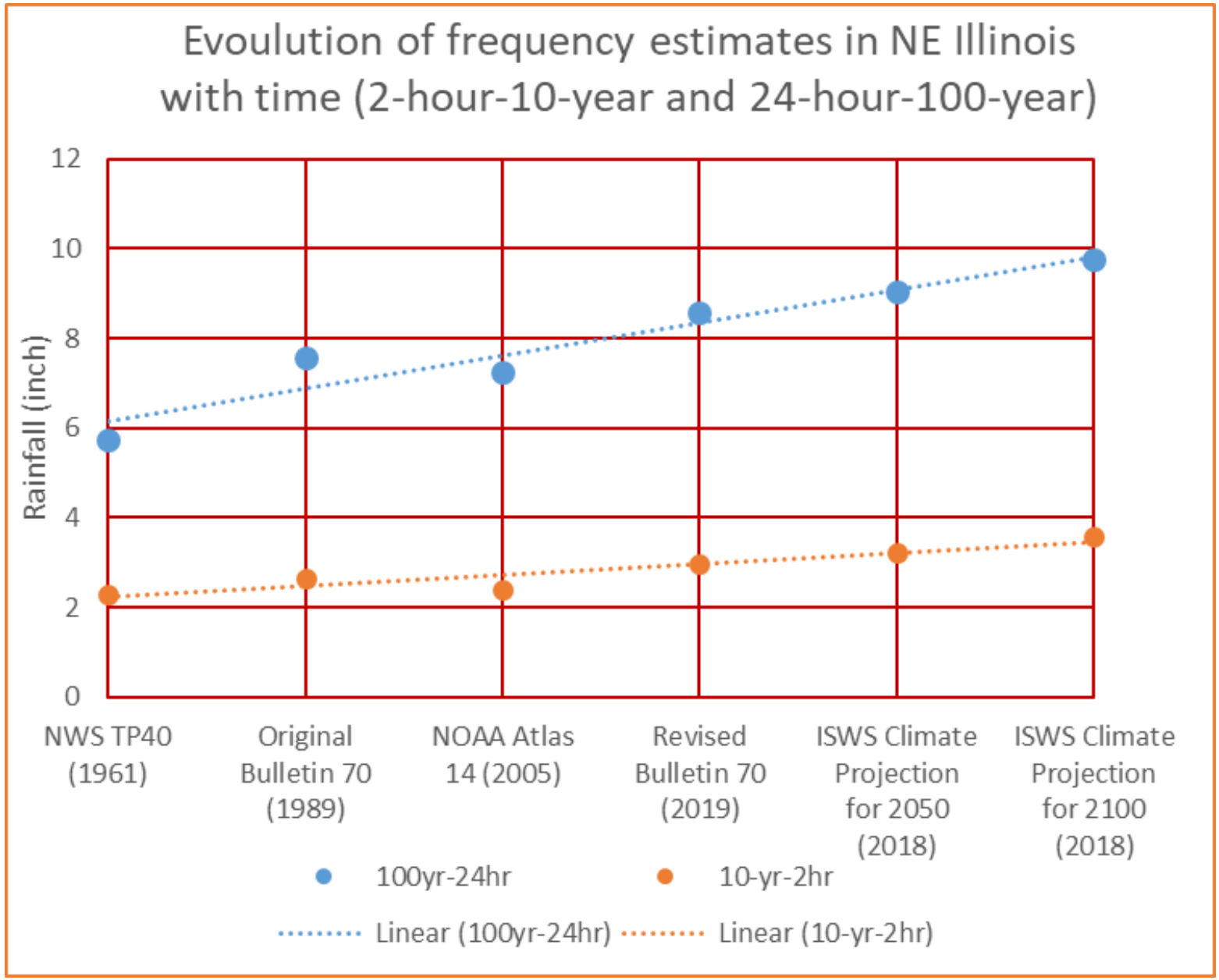
Heavy precipitation in Illinois



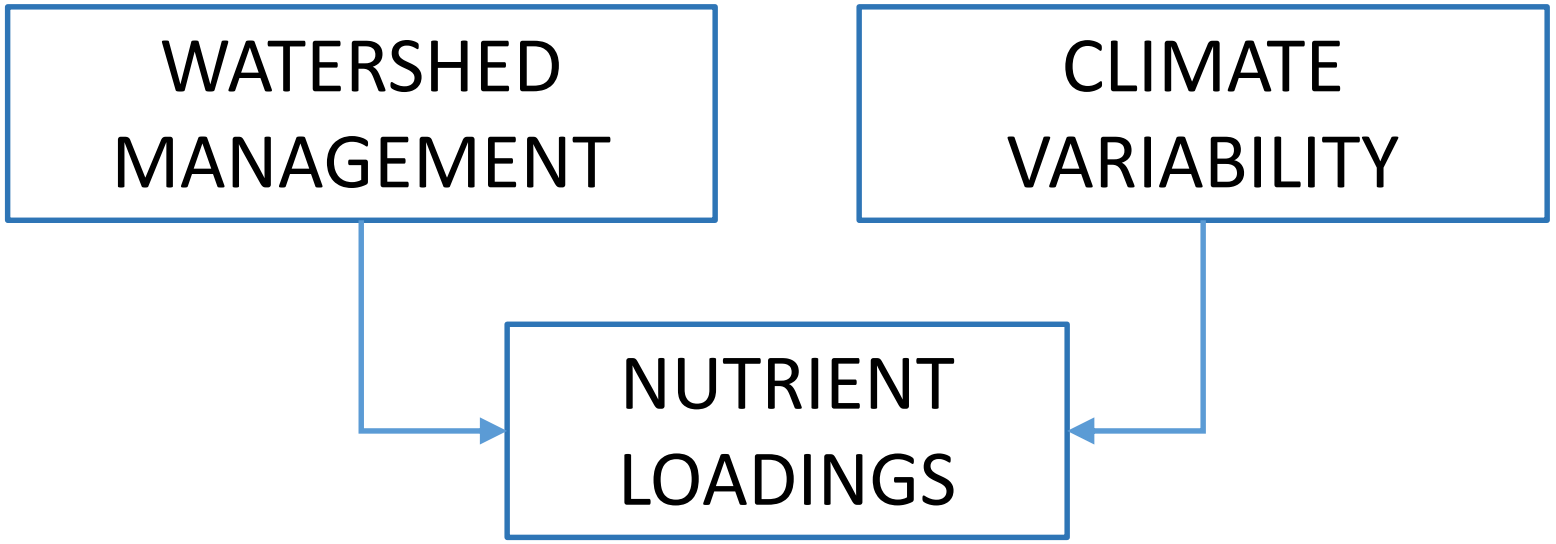
Changes in Water Quantity and Quality, NCA (2018)

- Significant changes in water quantity and quality are evident across the country. These changes, which are expected to persist, present an ongoing risk to coupled human and natural systems and related ecosystem services.

- Variable precipitation and rising temperature are intensifying droughts, increasing heavy downpours, and reducing snowpack. Surface water quality is declining as water temperature increases and more frequent high-intensity rainfall events mobilize pollutants such as sediments and nutrients.


Evoulution of frequency estimates in NE Illinois with time (2-hour-10-year and 24-hour-100-year)
Rainfall (inch)
12
10
8
6
4
2
0
NWS TP40 (1961)
Original Bulletin 70 (1989)
NOAA Atlas 14 (2005)
Revised Bulletin 70 (2019)
ISWS Climate Projection for 2050 (2018)
ISWS Climate Projection for 2100 (2018)
100yr-24hr
10-yr-2hr
Linear (100yr-24hr)
Linear (10-yr-2hr)

Nutrient Loadings: Contributing factors



- NPS nutrient loads depend not only on BMPs, but also on climate.
- As a result, success in achieving the nutrient reduction goals may depend on climate.
- Can the nutrient reduction goals be climate-normalized?
- Will the nutrient goals (and their eventual validation) need to be reassessed due to the changing climate?

Environmental Science & Technology

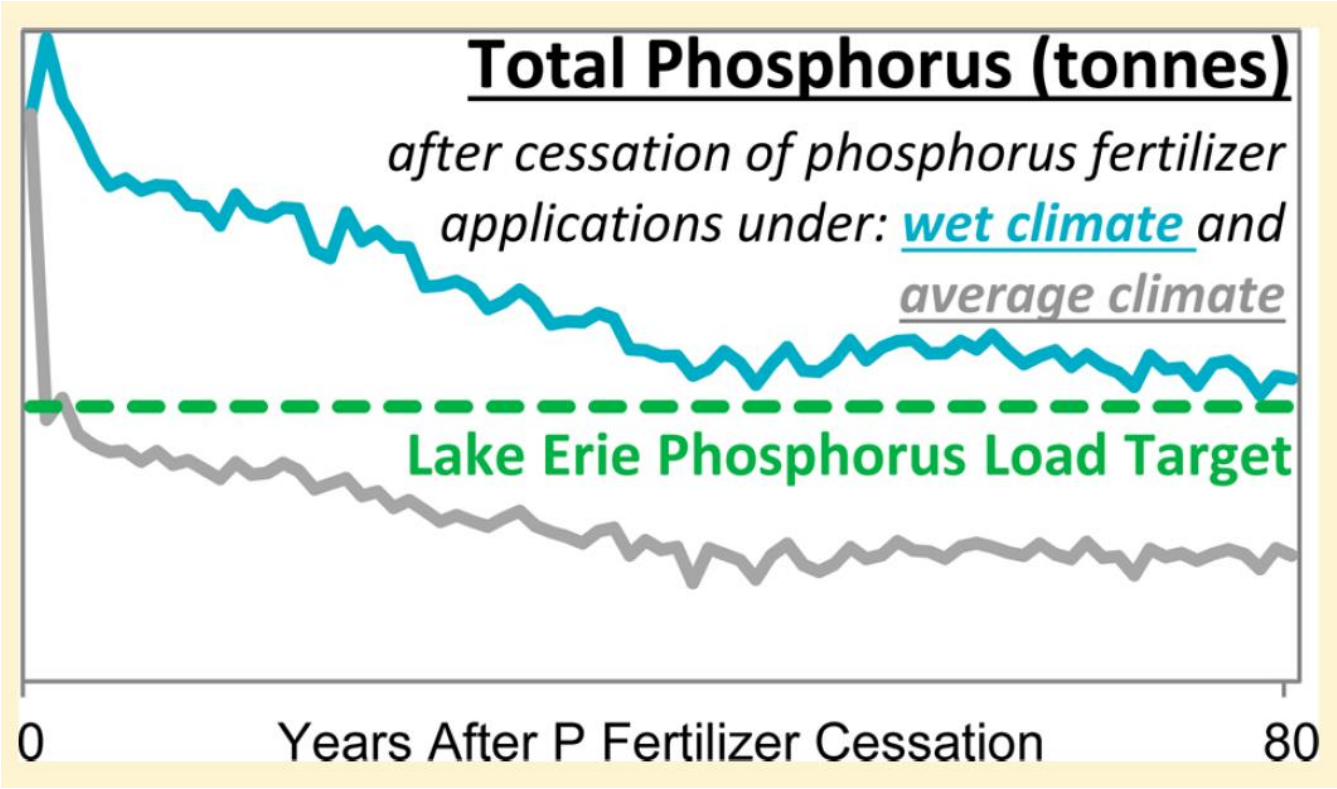
Article

pubs.acs.org/est

Evaluating the Impact of Legacy P and Agricultural Conservation Practices on Nutrient Loads from the Maumee River Watershed

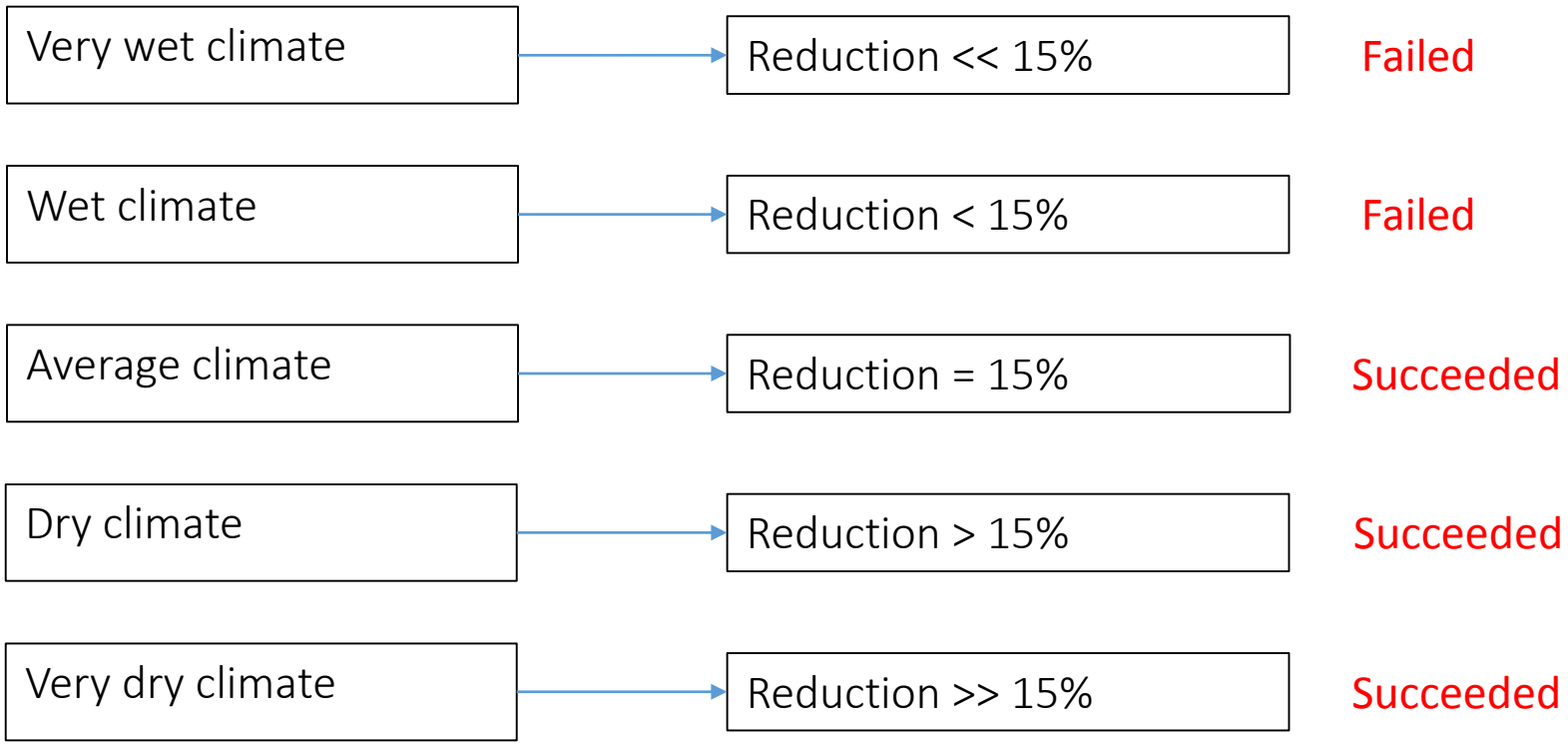
Rebecca Logsdon Muenich,* Margaret Kalcic,† and Donald Scavia

Graham Sustainability Institute, University of Michigan, 625 East Liberty Street, Suite 300, Ann Arbor, Michigan 48104, United States

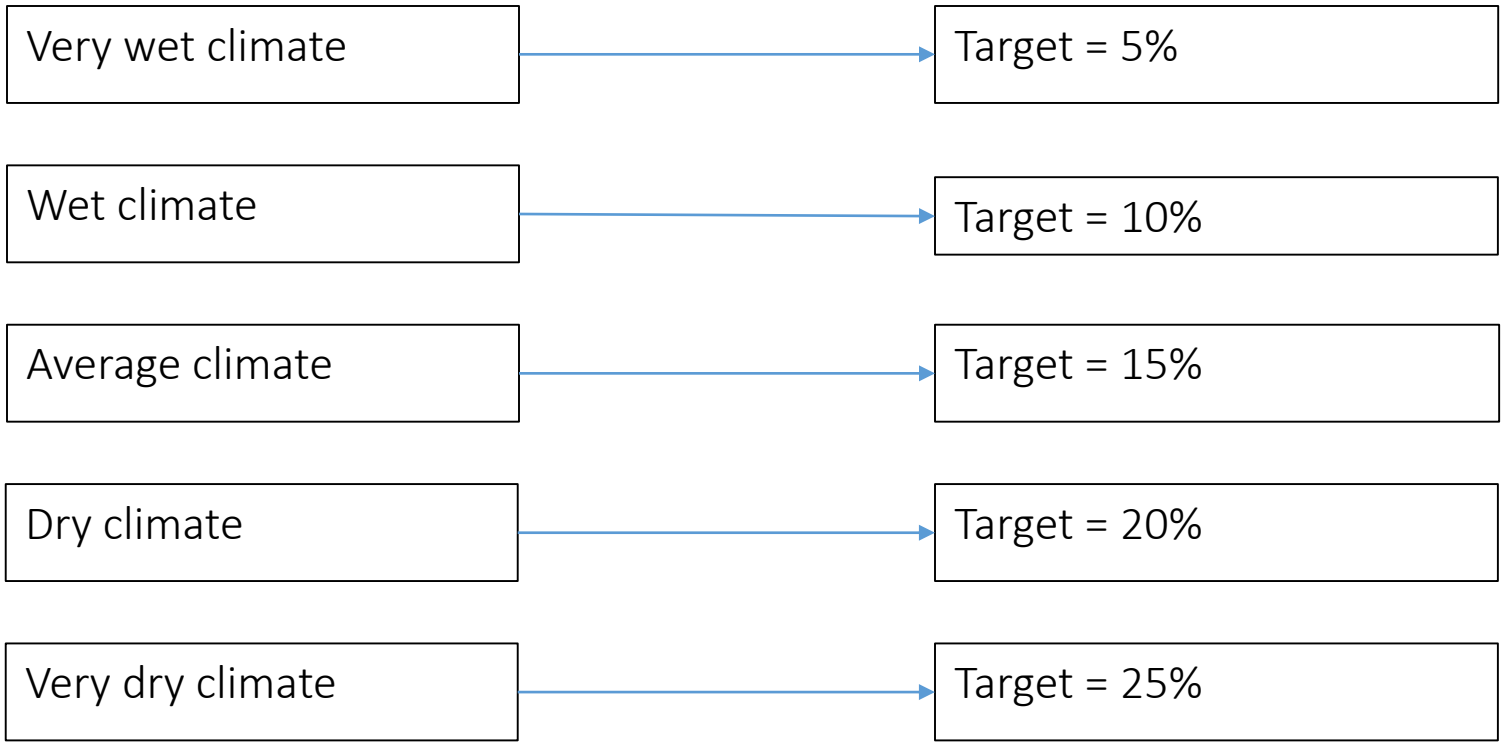


A hypothetical range of present climates and nutrient reduction outcomes

Fixed Target (= 15%)



A hypothetical possible range of climate-normalized nutrient reduction goals



* More complex and uncertain in a changing climate

Challenge: What is a wet or dry year?

- Use data mining to determine which climate factors produce largest loads
- Loads often depend on wet/dry sequences
- Can we design a climate index which reasonably accurately predicts potential for riverine nutrient loads?

NREC research

U of I study shows unexpected source contr

BY KAY SHIPMAN
FarmWeek

Illinois needs to tackle nutrient losses from unexpected sources to achieve the state's Nutrient Loss Reduction Strategy (NLRS) goals of lower nitrogen and phosphorous losses based on the results of a 25-year University of Illinois study.

"Tile nitrogen losses are not simply a matter of excessive fertilization, although I know people want to point fingers," Lowell Gentry, U of I agriculture researcher, said at last week's Illinois Fertilizer and Chemical

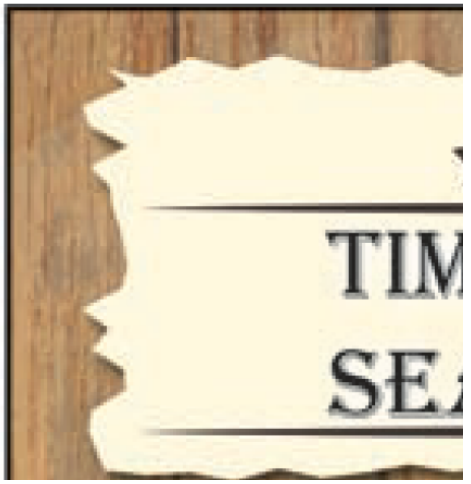
reduced rate 120 pounds spring anhydrous; 80 pounds spring anhydrous and 80 pounds UAN side-dressed; and 80 pounds spring anhydrous and 80 pounds UAN side-dressed plus cover crops. An oats-radish mix was seeded into standing soybean crop, and cereal rye was seeded after corn.

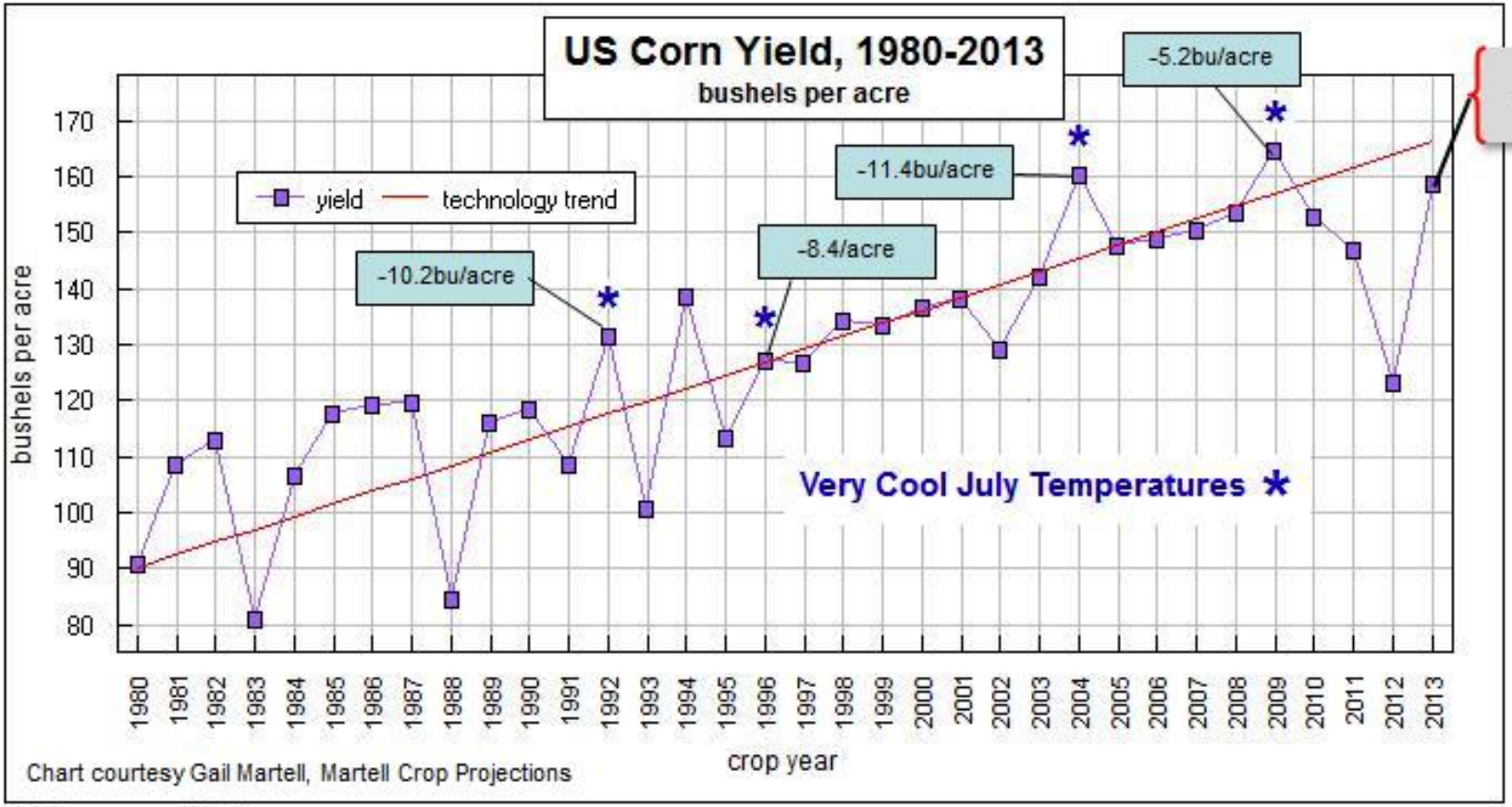
"In general, there were hardly any corn yield differences among the five full nitrogen rate treatments during the last three years, regardless of when the nitrogen fertilizer was applied," Gentry said.

included a cover crop reduced nitrogen losses by 41 percent compared to those with fall-applied nitrogen, Gentry reported. High corn yields in 2018 helped reduce tile nitrogen losses, he noted.

Piatt County studies longer rotation

A longer crop rotation of corn, soybeans and wheat tack-

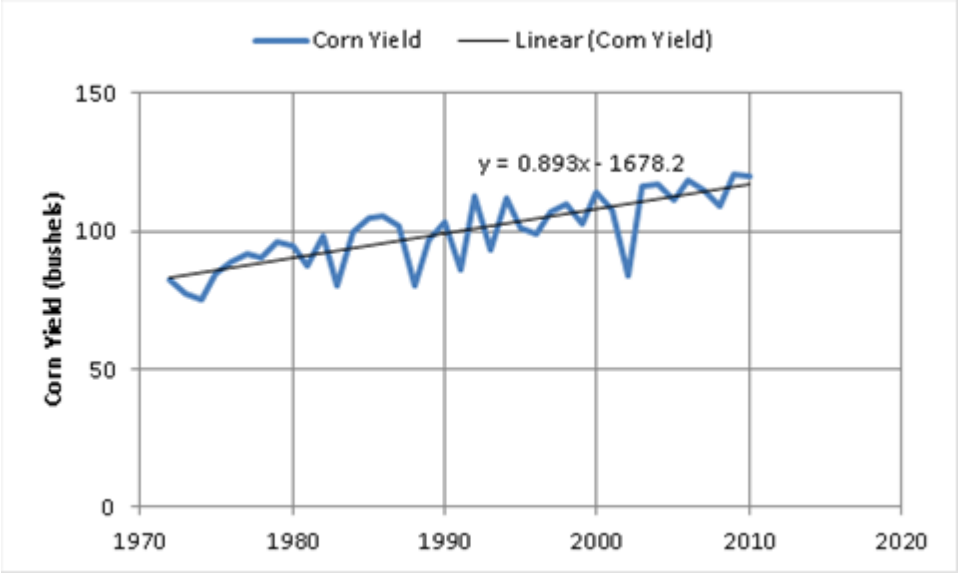


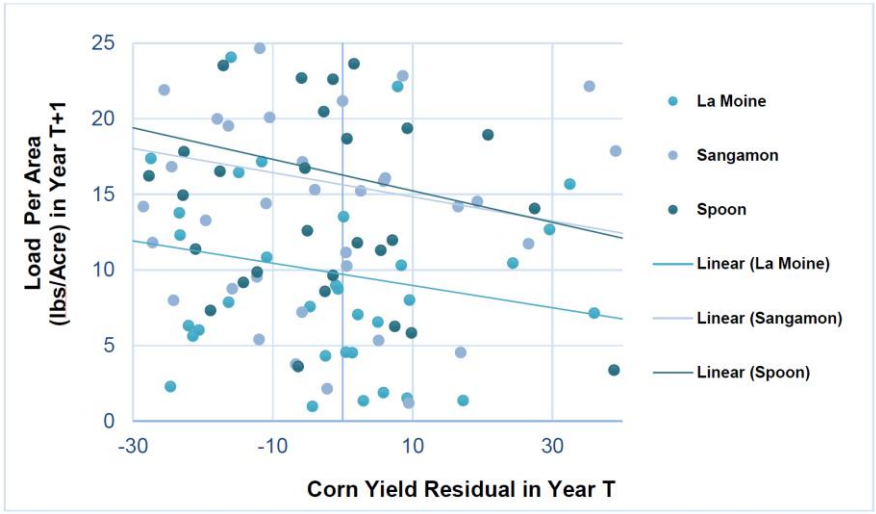


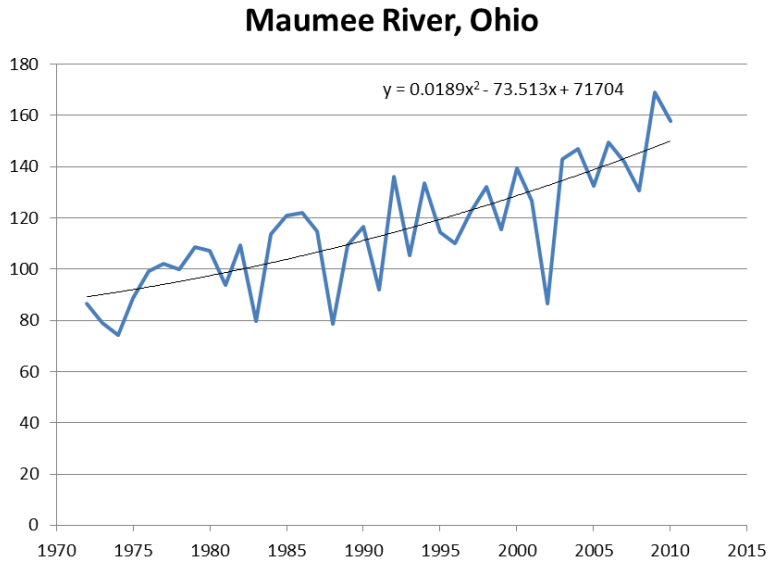
174-176

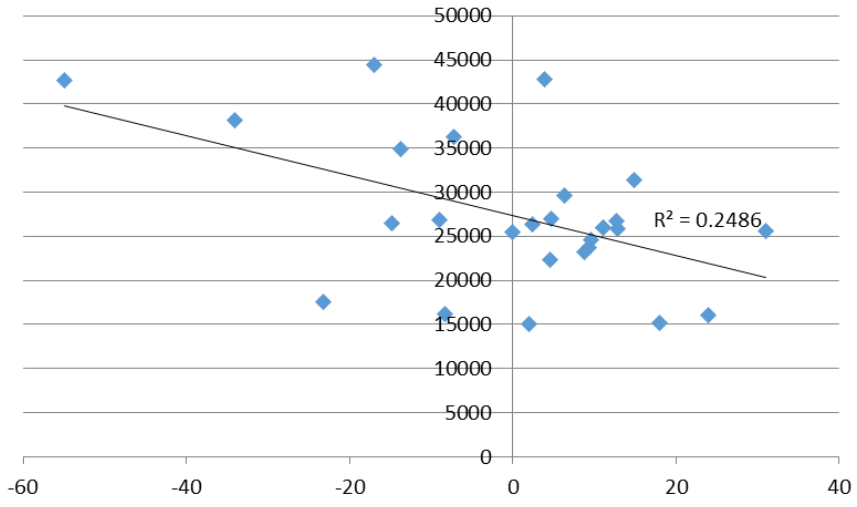
Data source USDA

Corn yield as a load predictor









Possible initial tests

- Use climate model-generated future projected precipitation and temperature data along with calibrated watershed models (e.g. SWAT) to get an initial idea about the direction of changes.
  - Daily data available. Hourly data in preparation.
- Apply statistical data mining to fine tune the relationship between climate indices and nutrient loads.
- Design a probabilistic (ensemble) validation method.

Questions/comments?

mmarkus@Illinois.edu

USGS Happenings and Updates

Kelly Warner and Paul Terrio

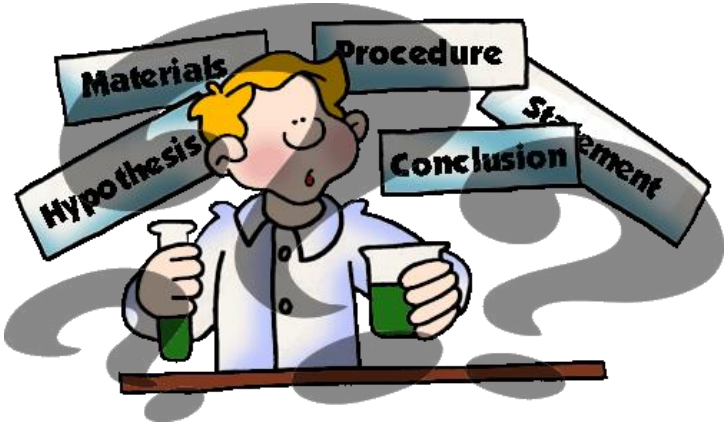
- Super Gage Stations Update
- Impact of Government Shutdown?
- Future Super Gage Network Funding – current funding allows operation thru September 2020

USGS
science for a changing world

NLRS Nutrient Science Advisory Committee (NSAC) Update

Paul Terrio, Committee Member

- Report is complete – Paul is happy!
- Public comment thru 4/30/19
- Next Steps?



NLRS 2019 Biennial Report Update
Trevor Sample

Proposed UMR Water Quality Improvement Act Legislative Framework (draft 1/31/19)

Gregg Good

- Establish and implement a State-Federal collaborative for the reduction, monitoring, and assessment of sediment, nutrients, and other contaminants.
- Minimize the effects of excess sediment and nutrients on the UMR and the Gulf of Mexico.
- Improve knowledge of water quality status and trends.

Proposed UMR Water Quality Improvement Act Legislative Framework (draft 1/31/19)

- Title I: Sediment/Nutrient Runoff Reduction
- Title II: Sediment and Nutrient Monitoring Network
- Title III: Modeling and Research
- Title IV: Communications Strategy
- Title V: Authorization of Appropriations
  - Establish Mississippi River National Program Office jointly administered by USEPA and NRCS with specific responsibilities for USGS and UMRBA
  - Funding authorization for states and establishment of grant programs

NMC Member Updates
Exciting or Boring News to Share?

"Next Steps" Summary
(NMC March 19, 2019)

- Today's Action Items?
  - A.
  - B.
  - C.
- Topics/Presentations for Next Meeting?
- Other (TBD)

Next NMC Meetings

- *March 19, 2019 (#12)*
- *_____(#13)*
- *_____(#14)*
- *_____(#15)*