Nutrient export: role of large events and temporal variability

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WATER SURVEY
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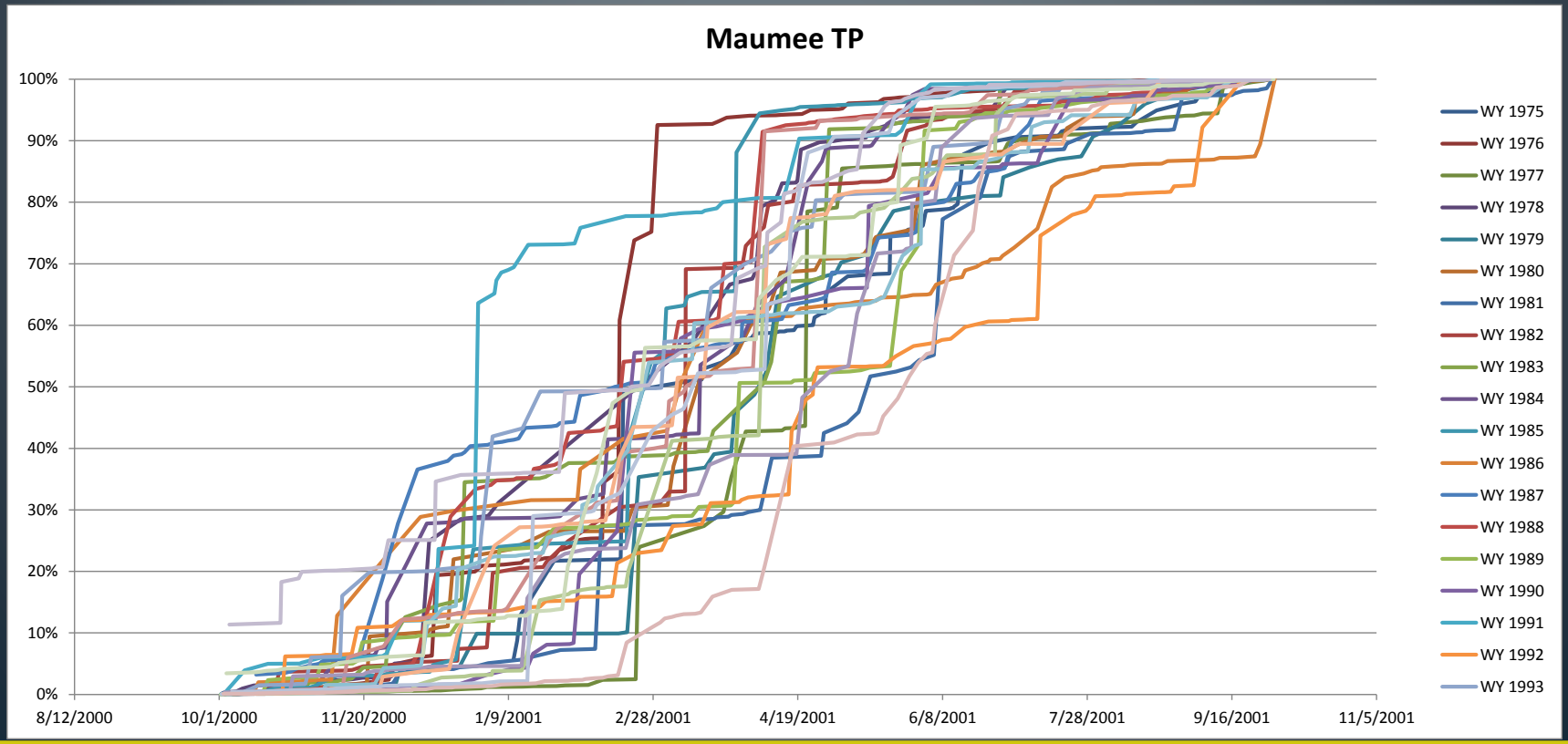
  - City of Decatur, Illinois American Water Company (Northern Illinois Water Corporation), Fox River Study Group, Lower Fox River Watershed Monitoring Program (UW-GB), Illinois State Water Survey

Objective 1

- Predict annual loads based on storm events
  - Total phosphorus and nitrate nitrogen
  - Large events carry a large portion of annual load



Objective II

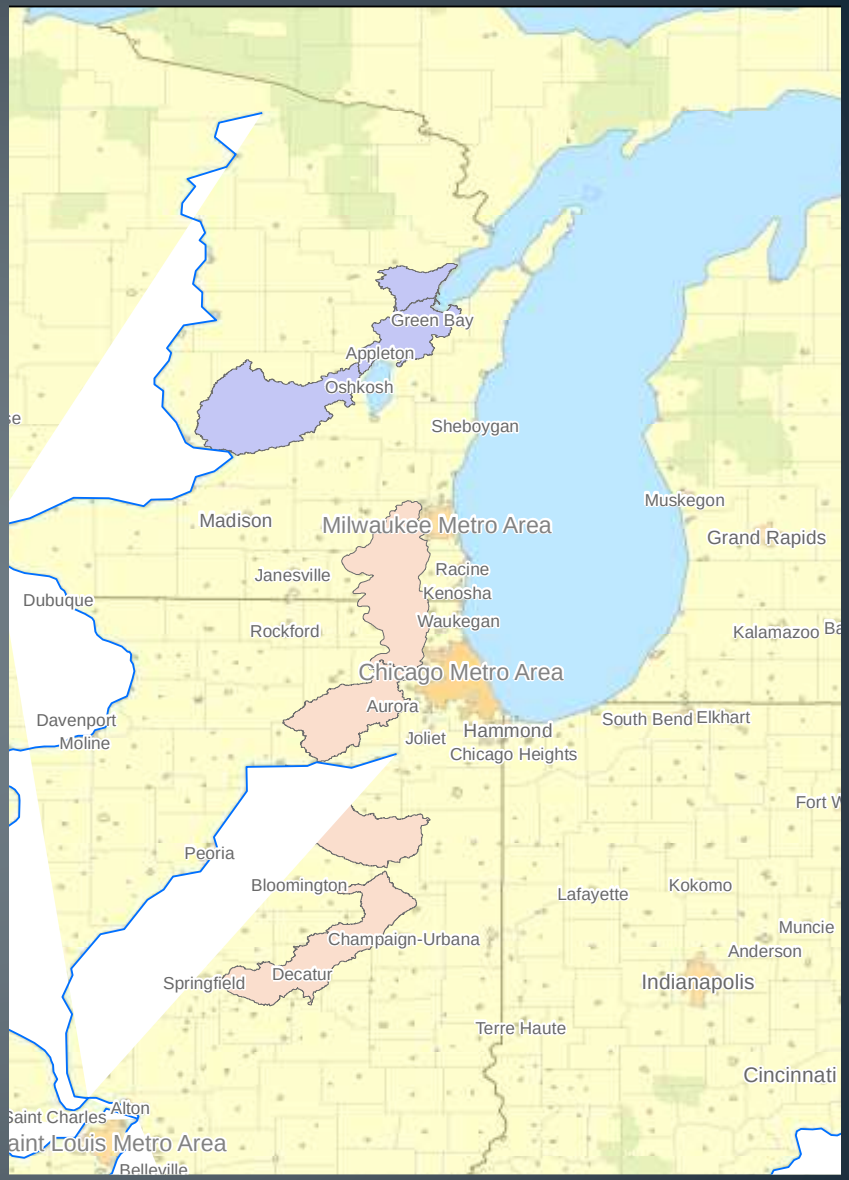
- Characterize temporal patterns of large events
  - Identify/predict occurrence of large events
- Application
  - Better understand climate/water quality interactions
  - Watersheds with limited water quality data
  - Monitoring design
  - Future climate

Study area

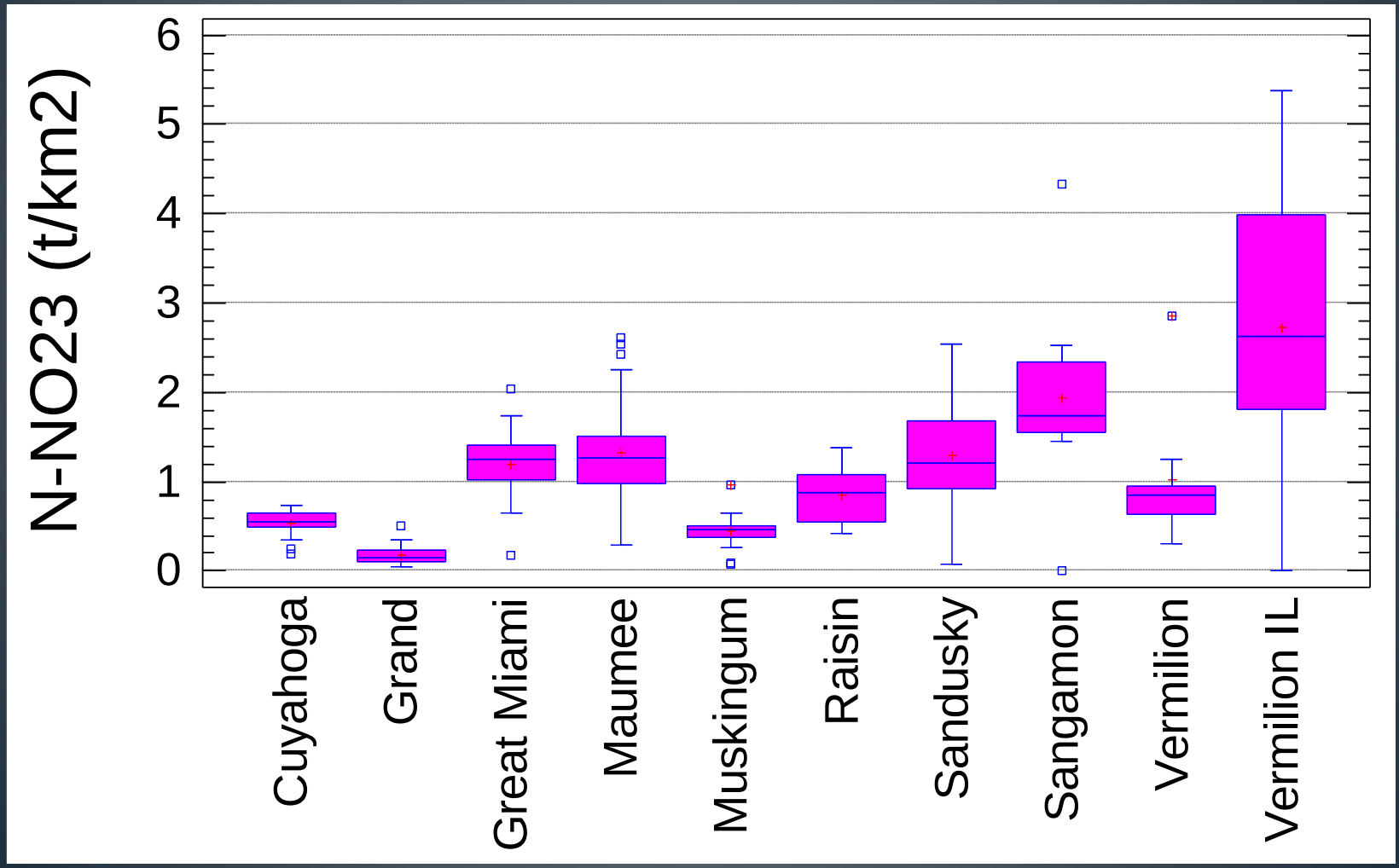
- Analyze data and develop relationships for watersheds with extensive data
- WQL/ NCWQR
  - Daily + storm samples
  - Long-term dataset (30 years)

Test areas

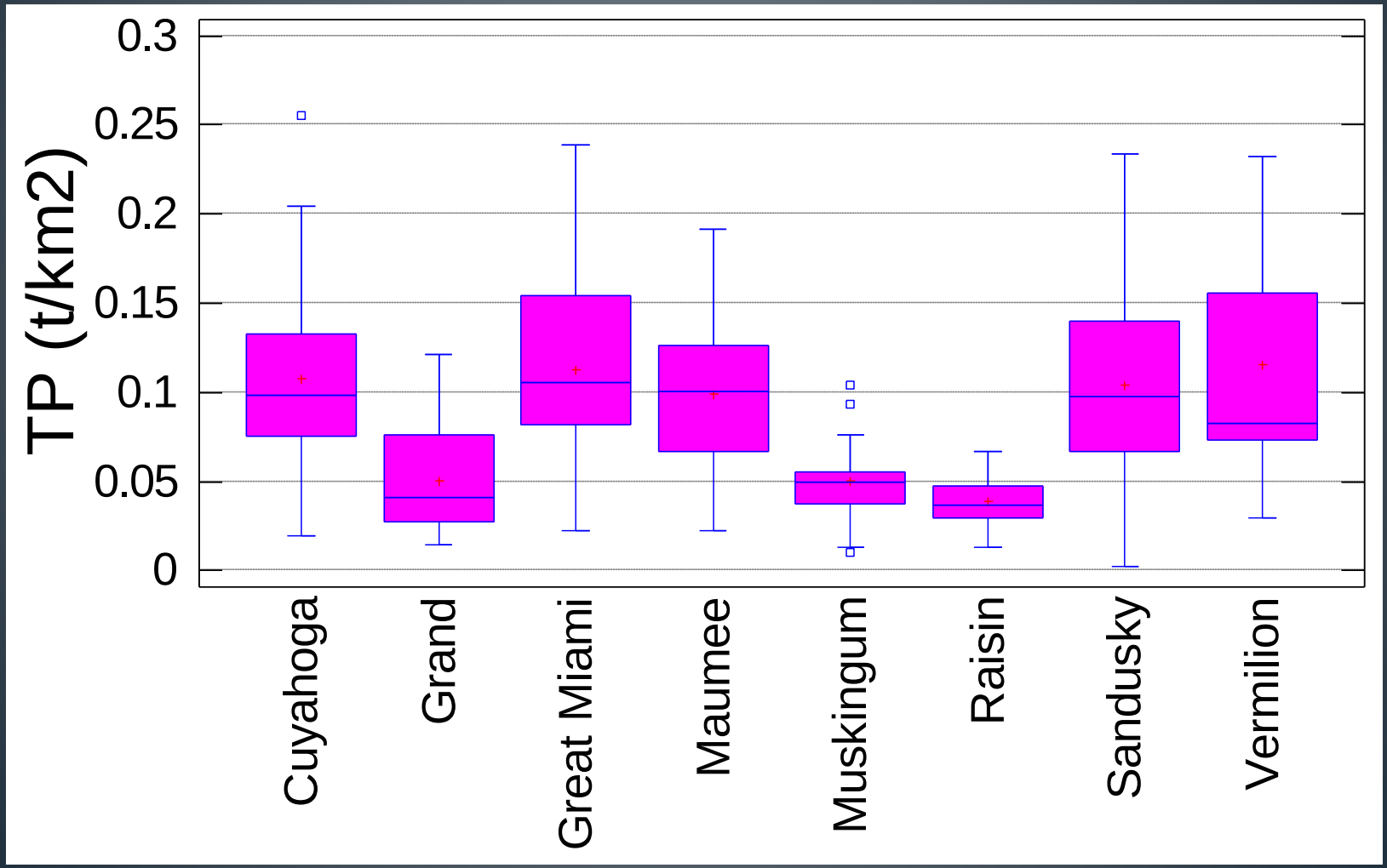
- Test and apply relationships for watersheds in Lake Michigan basin (or similar)
- Fox (WI), Fox (IL)
  - Regular + storm samples
  - 2-6 years
- Vermillion (IL), Sangamon (IL)
  - Daily Nitrate data
  - 6-11 years



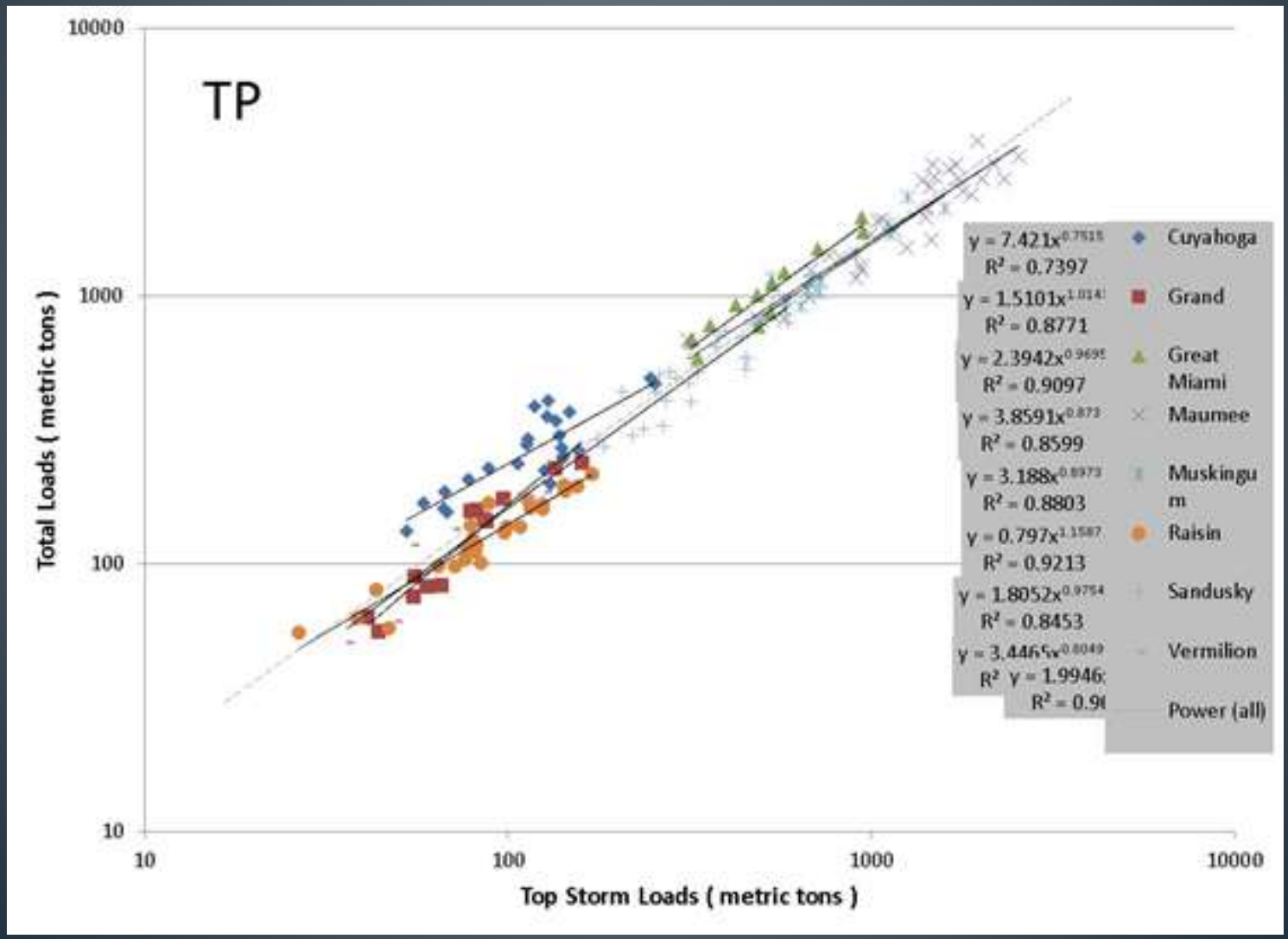
Annual Nitrate nitrogen yields



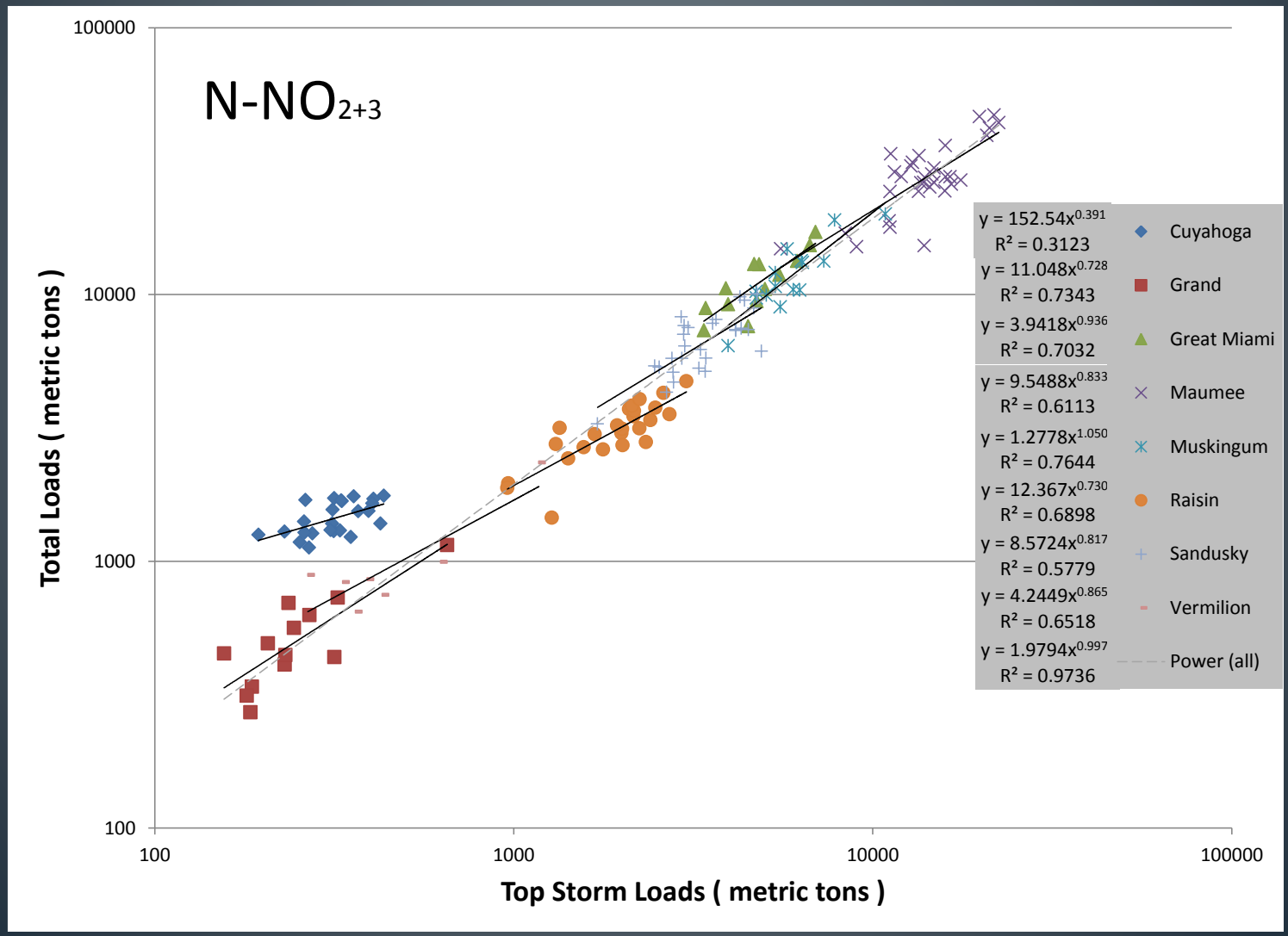
Annual total phosphorus yields



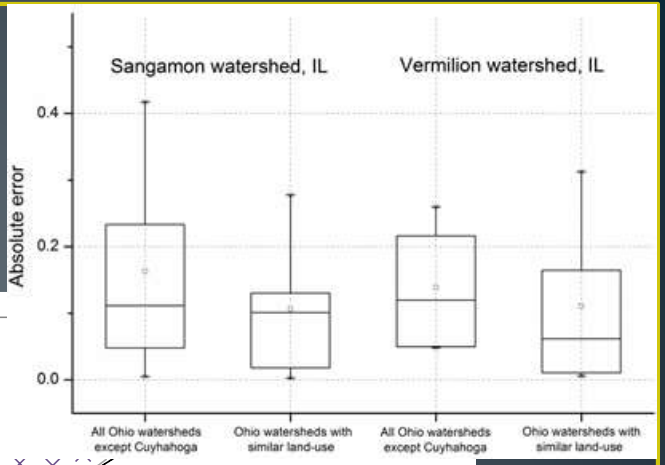
Annual total phosphorus loads

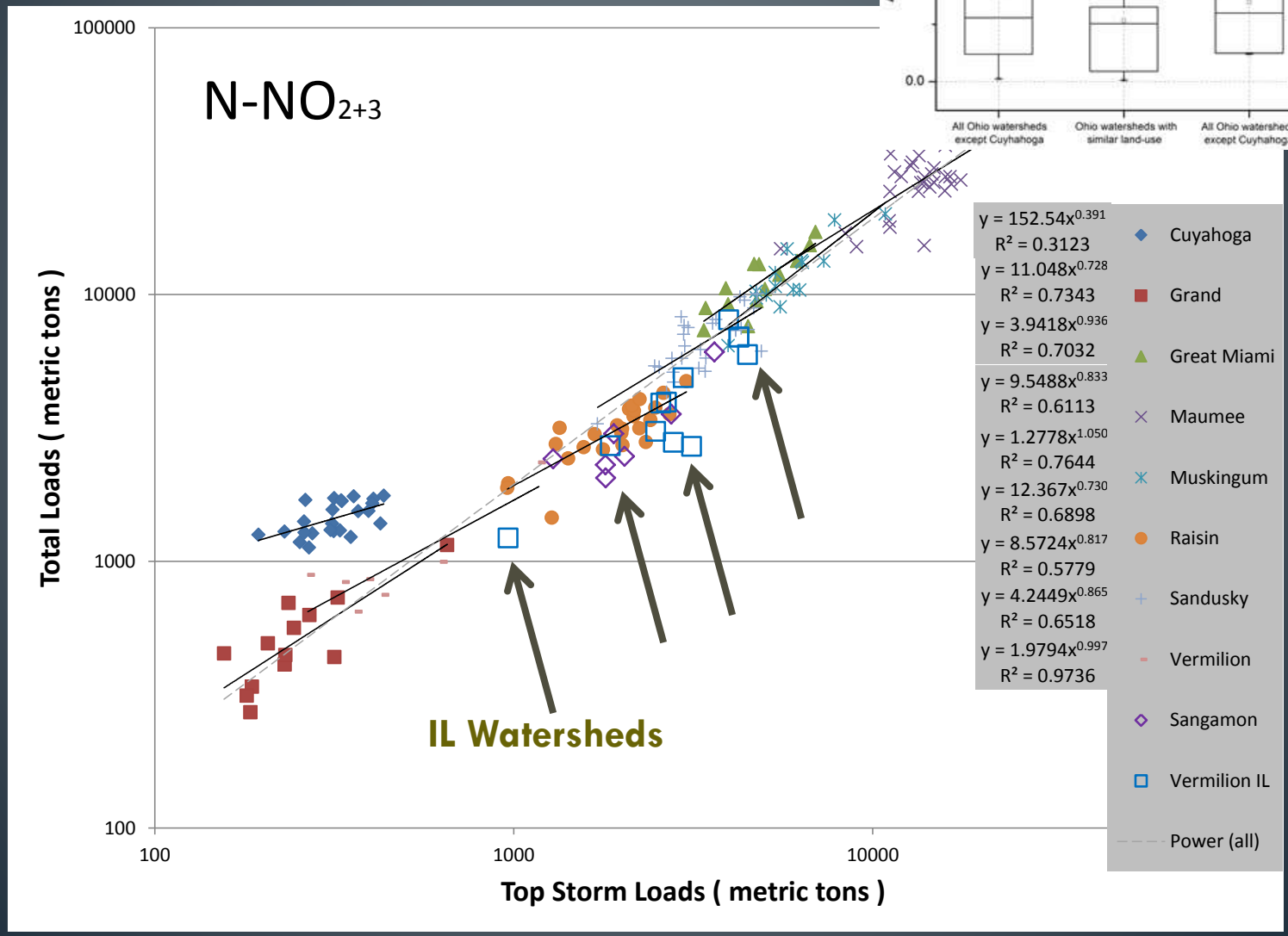


Annual Nitrate nitrogen loads

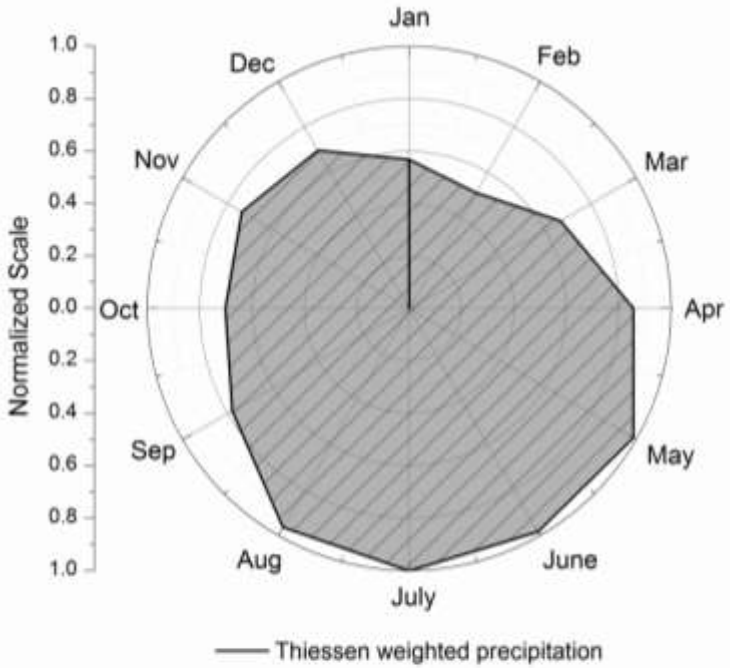


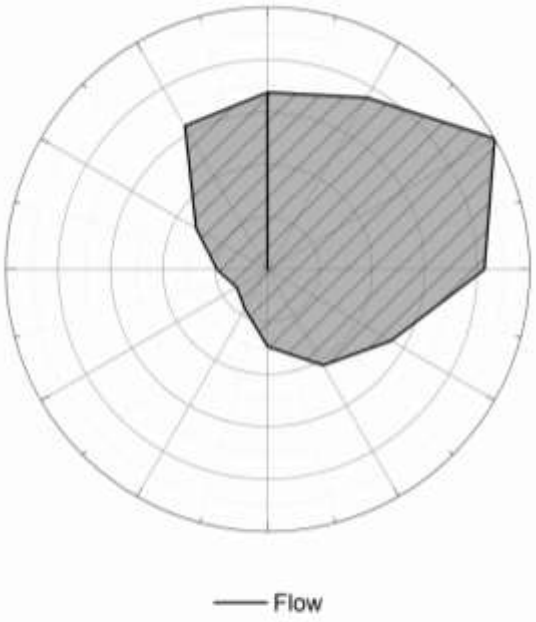
Spatial transferability

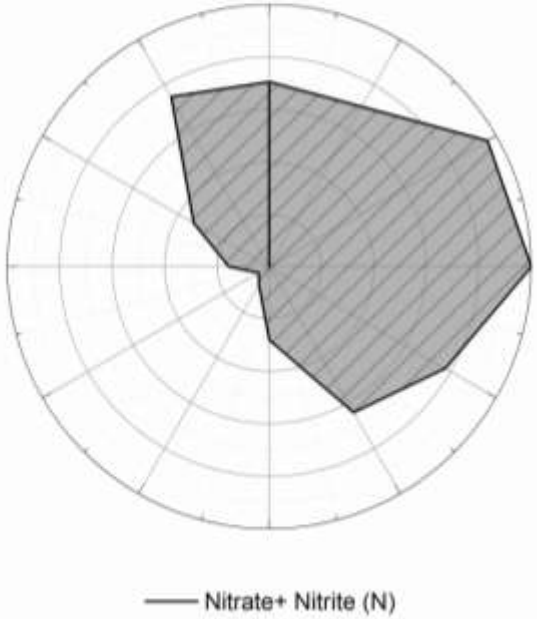


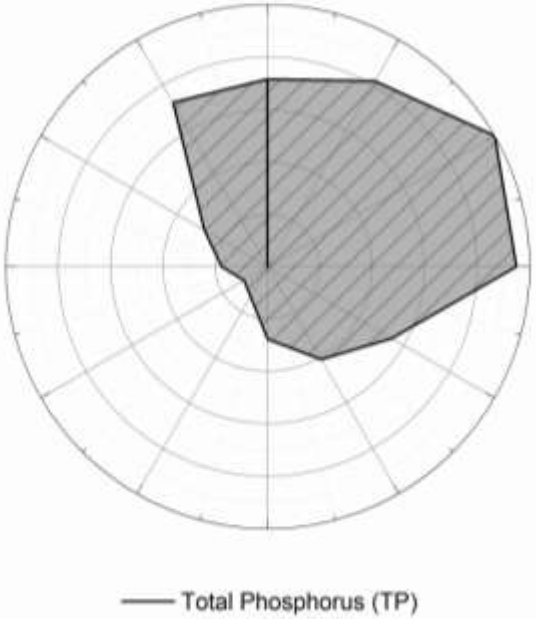


Monthly average values





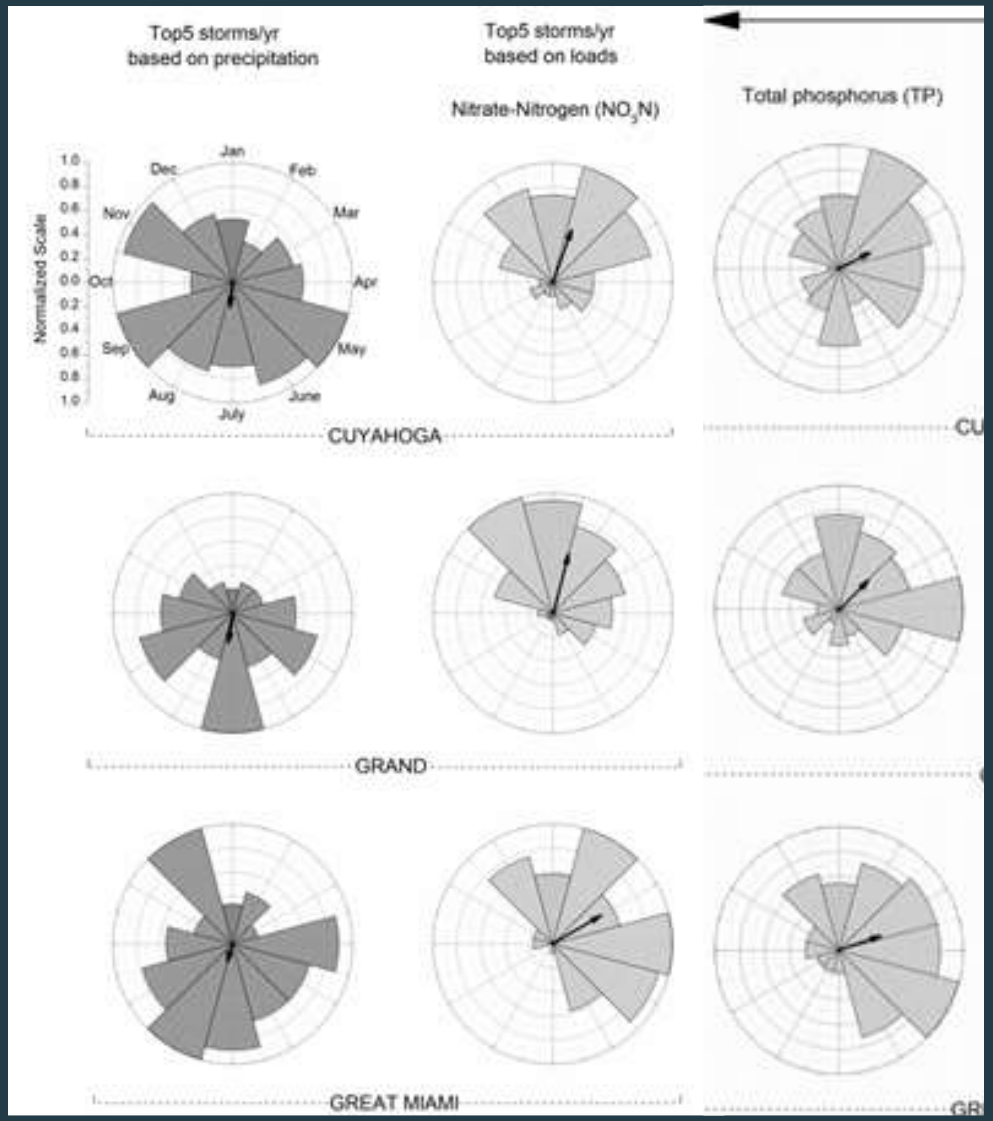




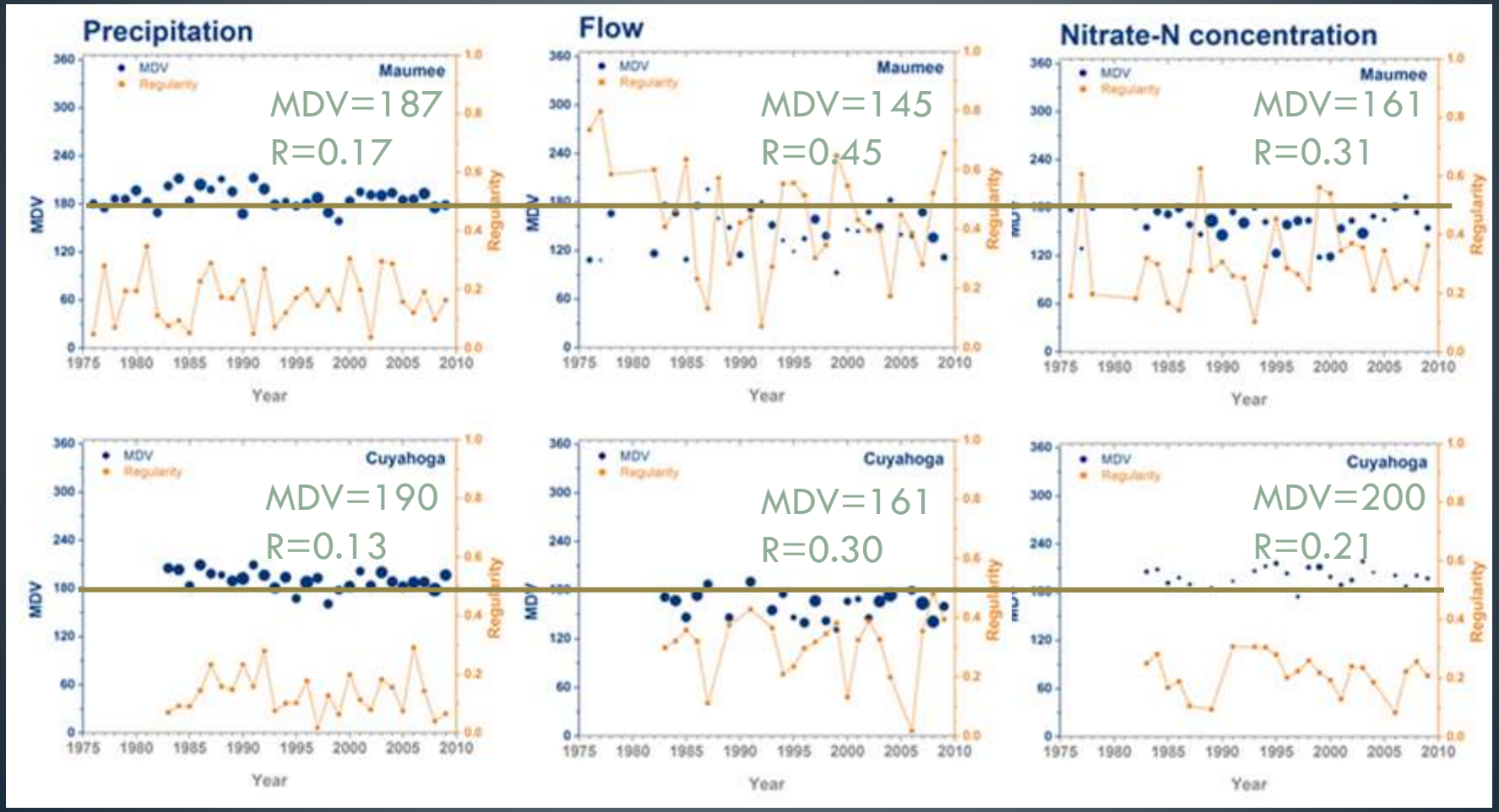
Occurrence of large events

N-NO_3 load November to April

TP, TKN and SS loads February to May

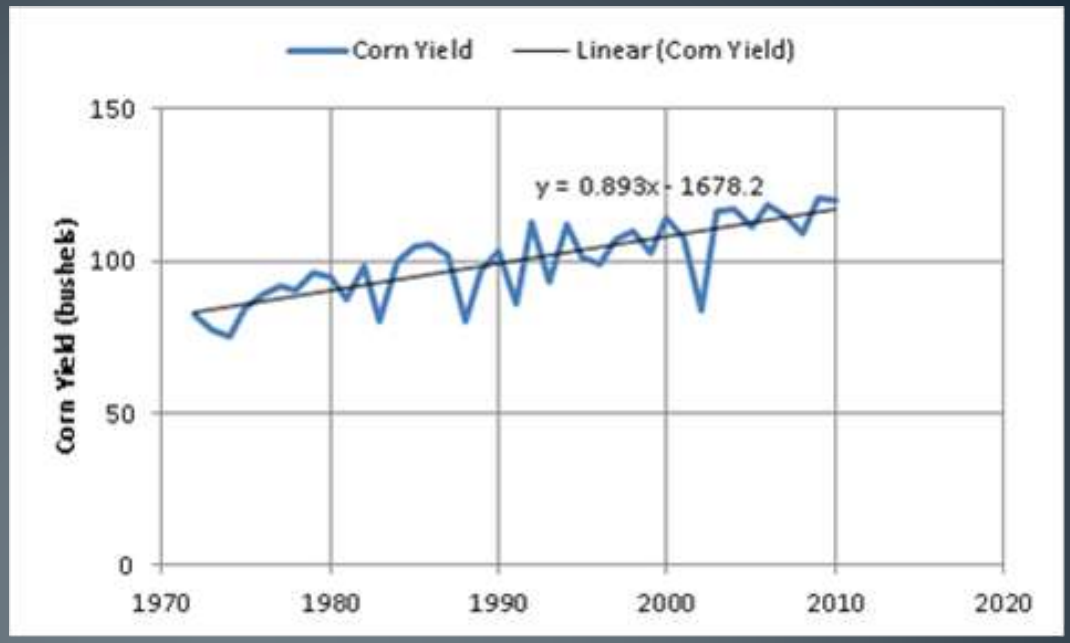


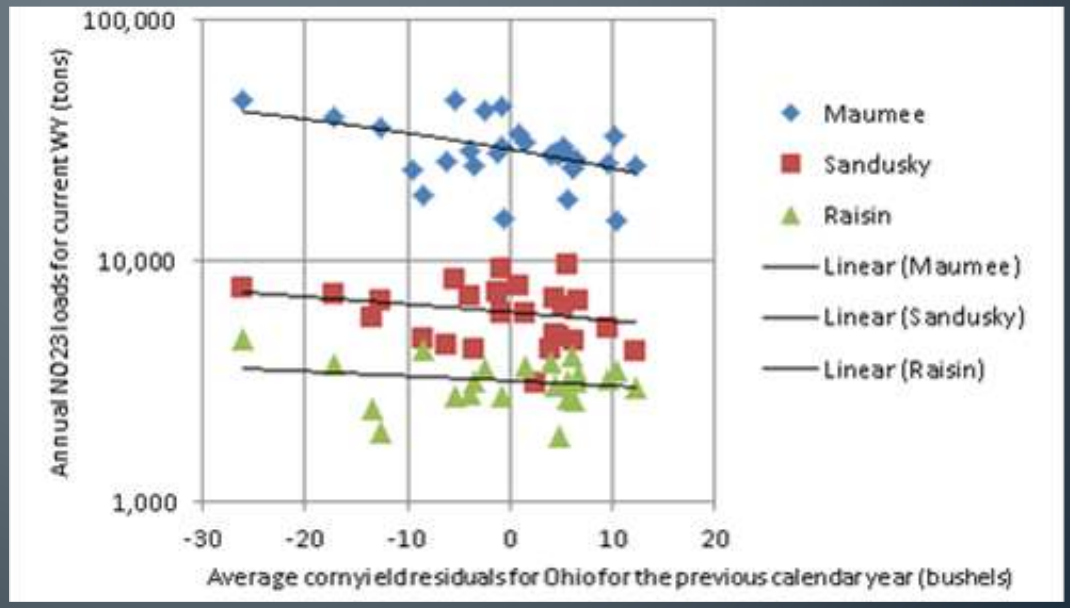
INTRA-ANNUAL PATTERNS



INTER-ANNUAL DEPENDENCIES

Corn yield may indicate how well were the nutrients on ag. lands utilized

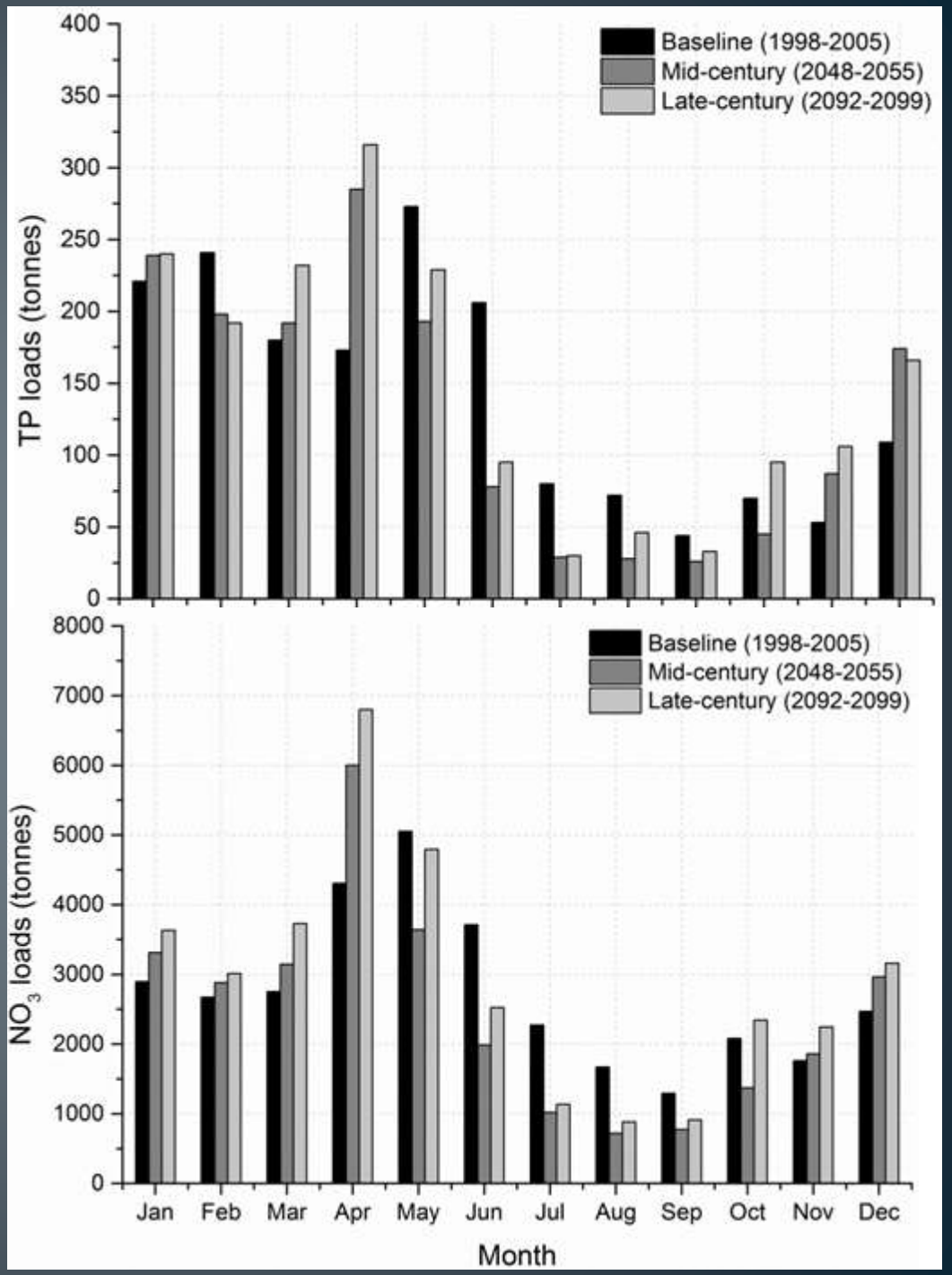




CLIMATE CHANGE IMPACT

Initial analyses
SWAT model
Maumee River
IPCC A1B
Simplified downscaling

A1B: A future world of very rapid economic growth, global population that peaks mid-century and declines thereafter, and rapid introduction of new and more efficient technologies. The energy system balances across all sources (fossil vs. non-fossil).



SUMMARY

- Mechanistic differences that exist in export of different constituents have a significant impact on accuracy of load estimates
- Average annual pollutant concentrations, loads and their respective trends are sensitive to amounts of data used for calculations.
- More than half of the annual load is transported during 5 large storm events. The pollutant load transported during these top 5 load events can be used to predict total annual loads with high accuracies (also for similar watersheds).
- A strong temporal pattern in pollutant export was observed.
  - NO3-N export occurred primarily between November and April.
  - SS and TP export occurred primarily between February and May.
  - Higher NO3-N loads often occur after dry years indicated by low corn yields.
  - The presence of point sources and impoundments in the watershed can significantly alter temporal and statistical characteristics of loads comparing to agriculture watersheds.
- Future climate changes are projected to have a potentially significant impact on flows and loads in Midwestern watersheds.
  - The impact will vary throughout the year.

Period	Temperature	Precipitation	Flow	TSS	TP	N-NO3
Mid-century	2.9%	-3.2%	-8.5%	-10.4%	-8.5%	-9.7%
Late-century	4.3%	5.6%	9.7%	19.6%	3.5%	6.8%