



Landscape Influences on Cyanobacteria Harmful Algal Blooms

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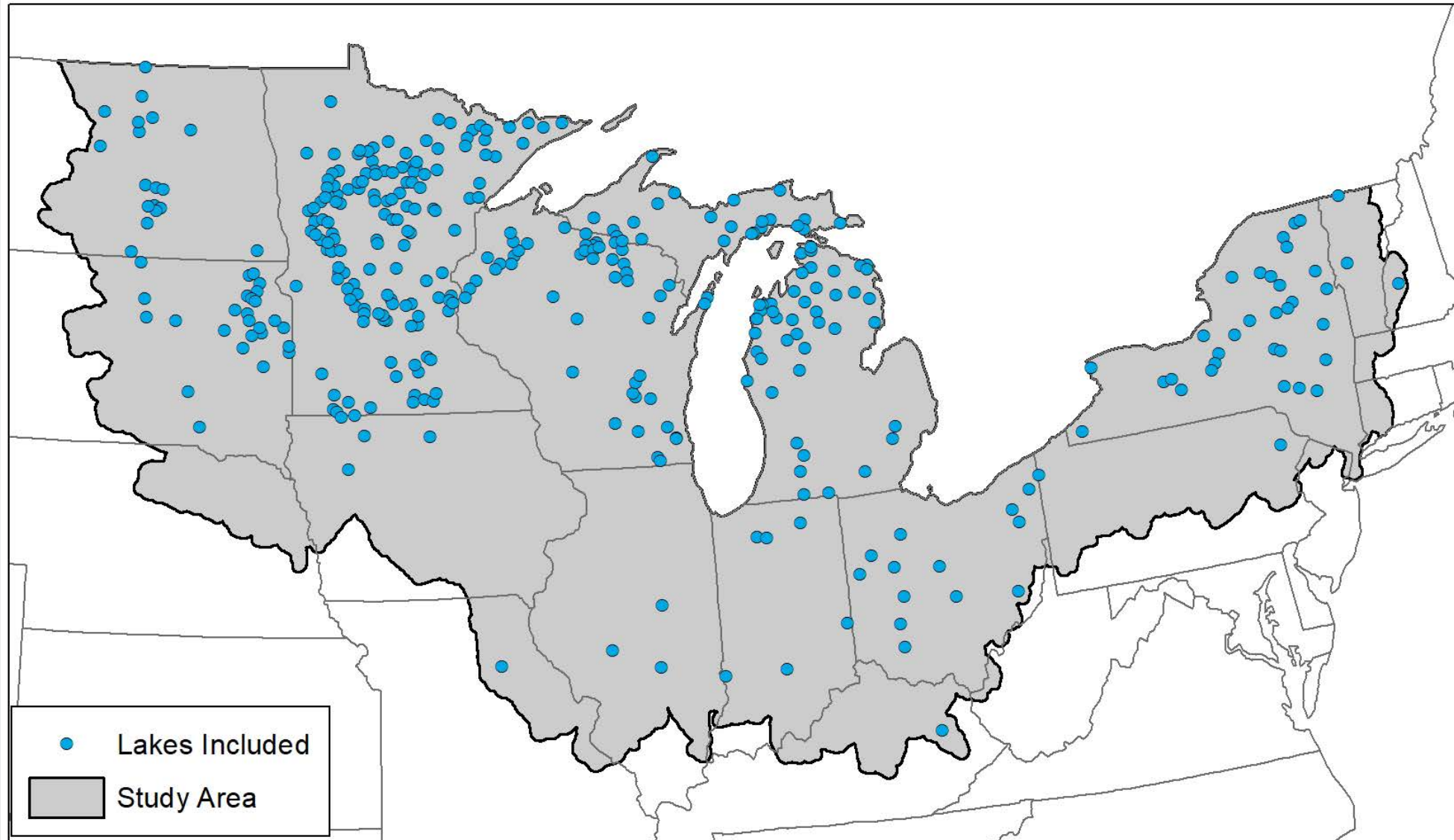
- HAB factors - why do we care?
 - causes
 - mitigation
- We know underlying factors
 - nutrients
 - temperature
 - light
 - stagnant water
- How does landscape determine these?



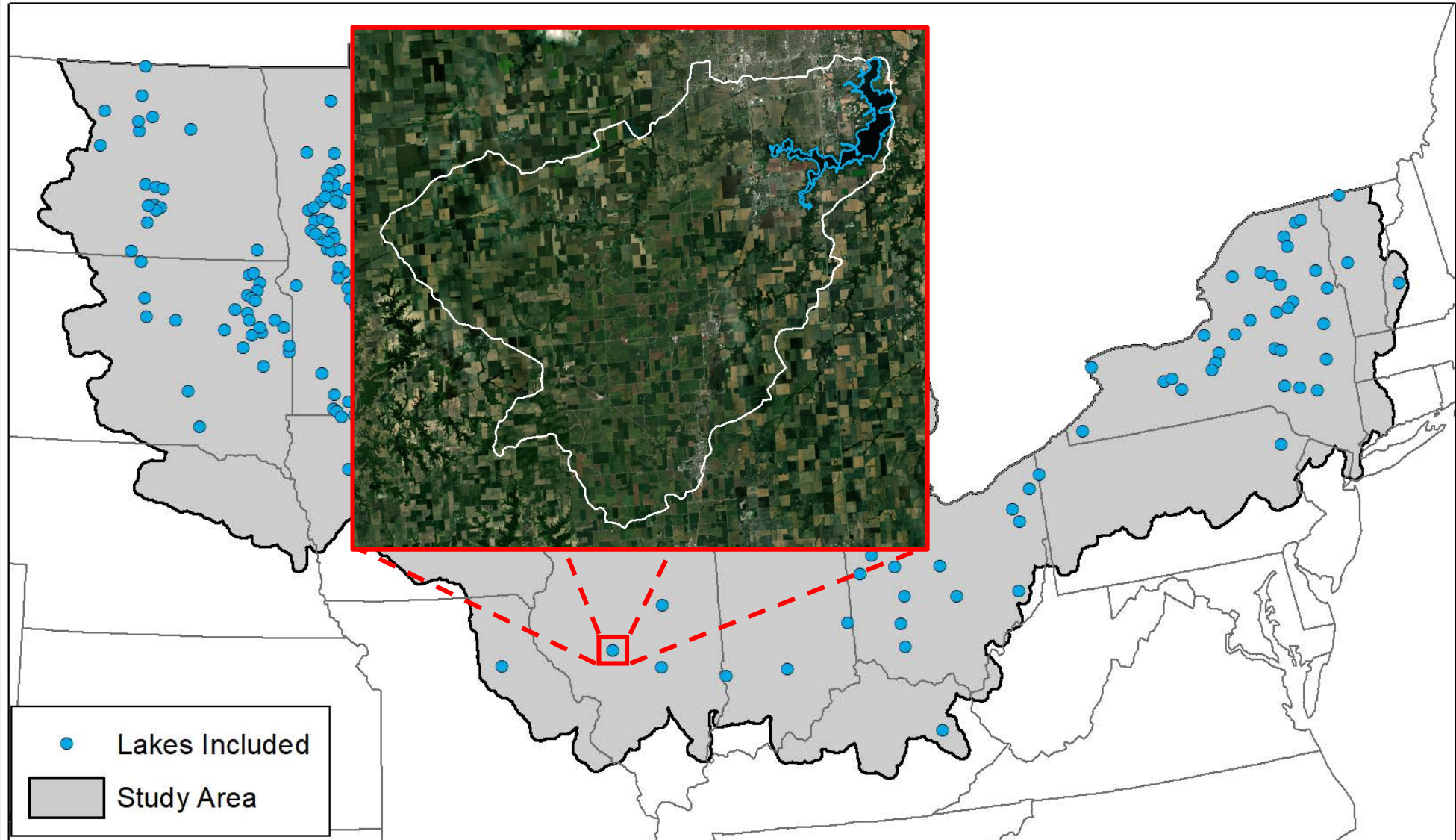
- HAB factors - why do we care?
 - causes
 - mitigation
- We know underlying factors
 - nutrients
 - temperature
 - light
 - stagnant water
- How does landscape determine these?
- **Objective:** develop a **model** to reveal major **landscape factors**



Study Area



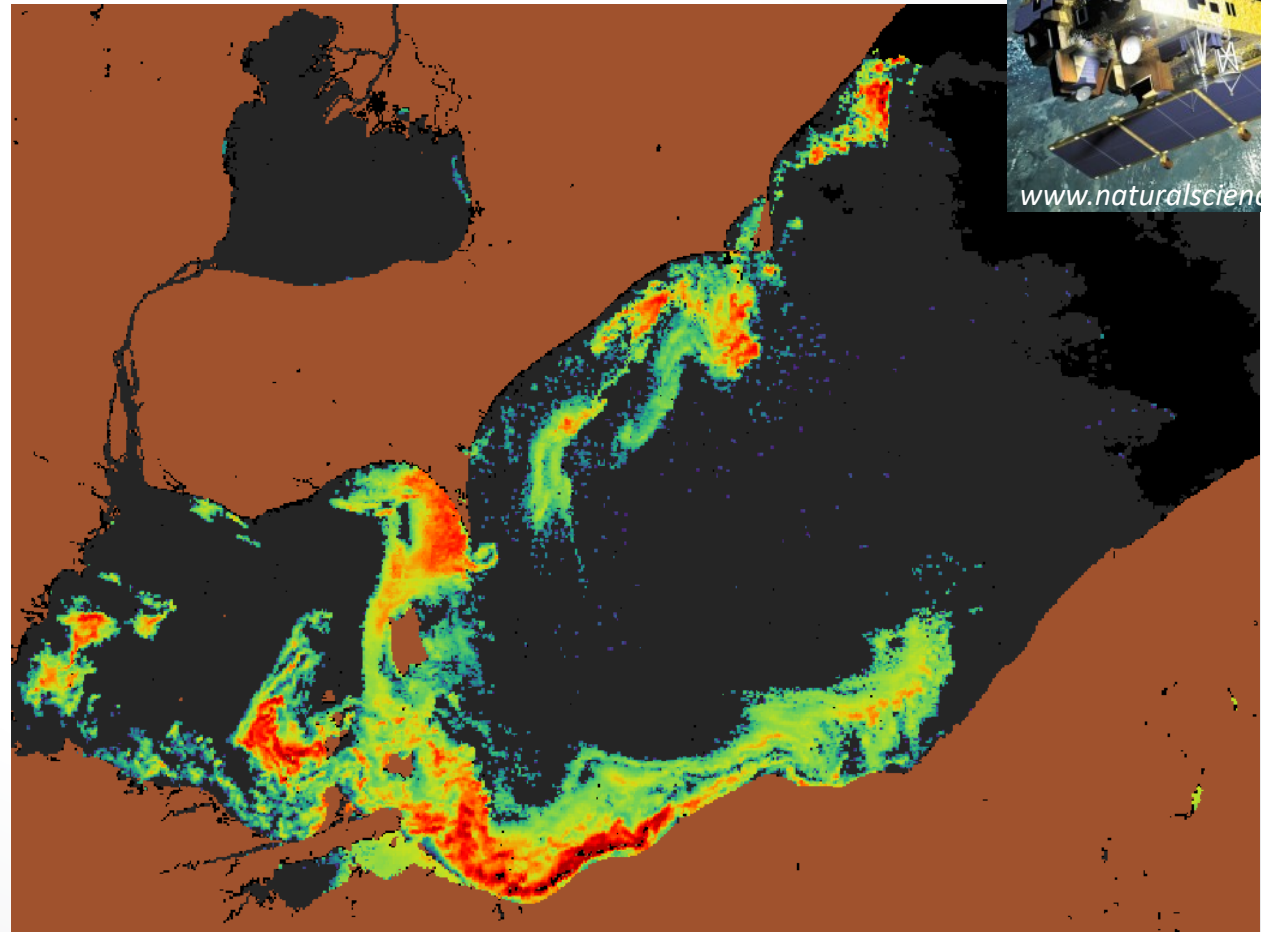
Study Area



88 factors considered:

- Climate
- Nutrient application
- Landscape hydraulics
- Soil
- Lake morphology
- Land class
 - entire watershed
 - lake and stream buffers

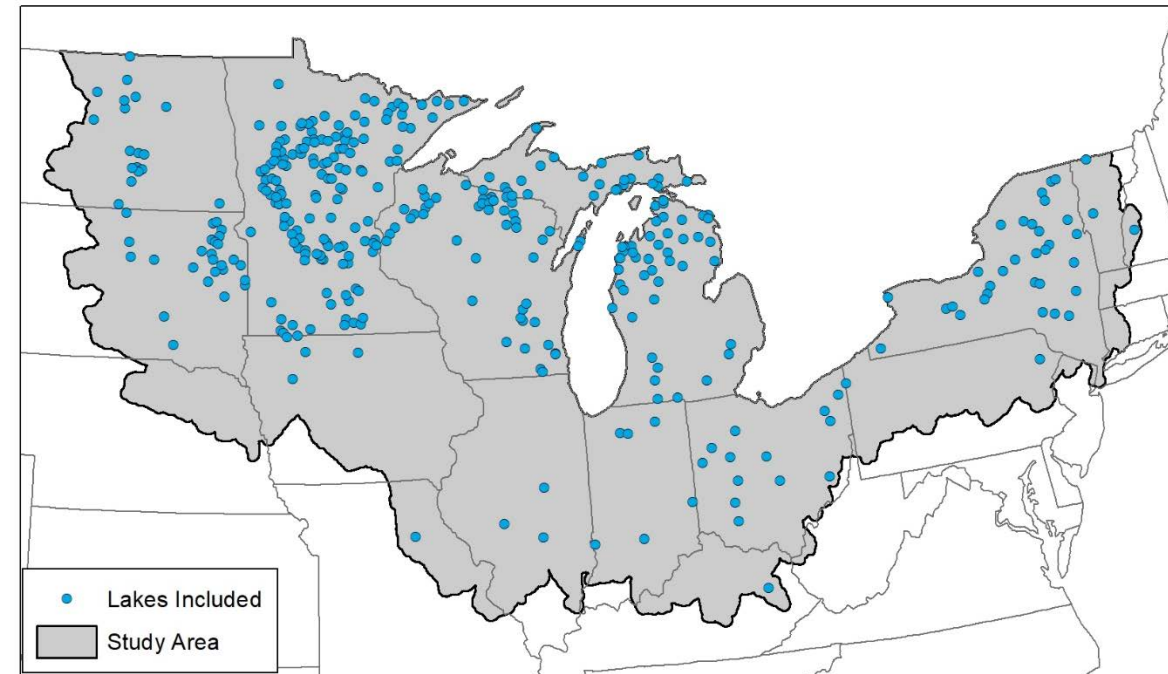
Cyanobacteria levels:
MERIS satellite sensor



Results

Of top 20 factors:

- 14 agriculture ↑ cyanos
 - 4 of top 8: nutrient or manure application
- 4 natural vegetation ↓ cyanos
- 5 buffer zone





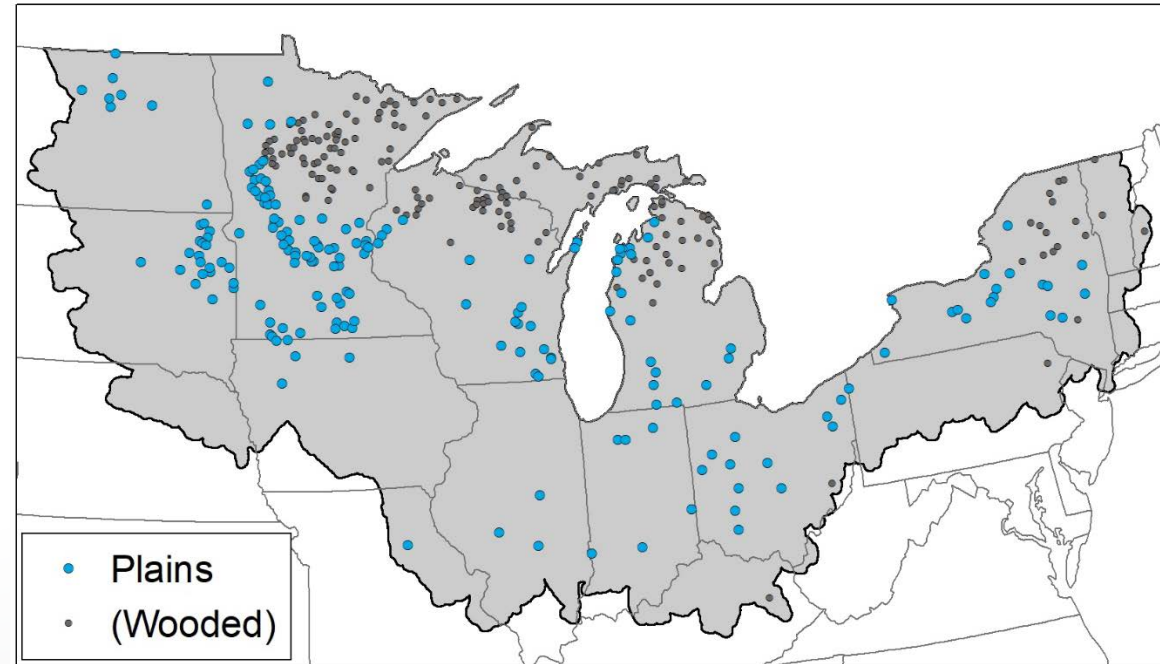
Ecozones



Plains Ecozone



Getty Images

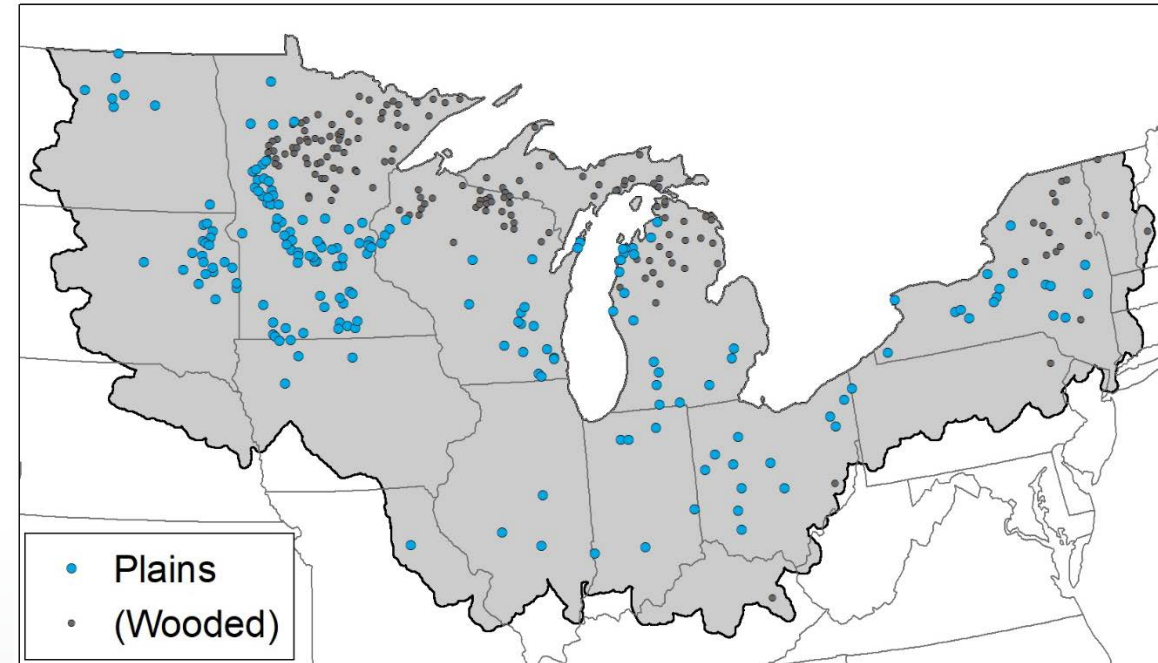


Of top 20 factors:

- 9 agriculture
- 3 natural vegetation
- 4 buffer zone

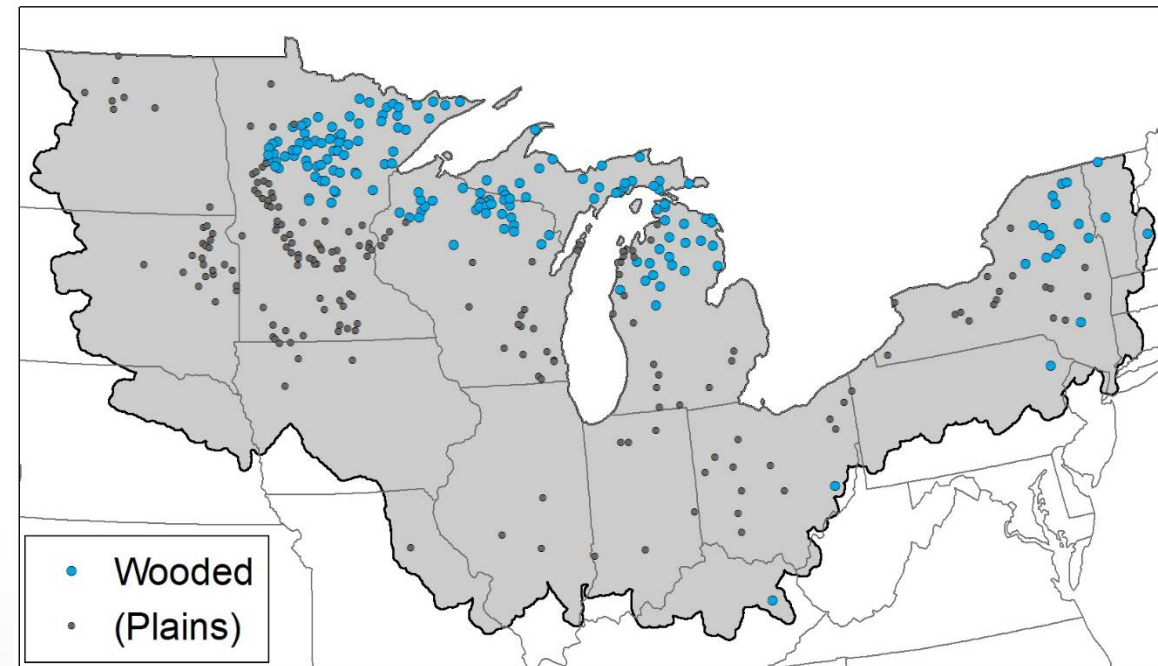
↑ cyanos

↓ cyanos





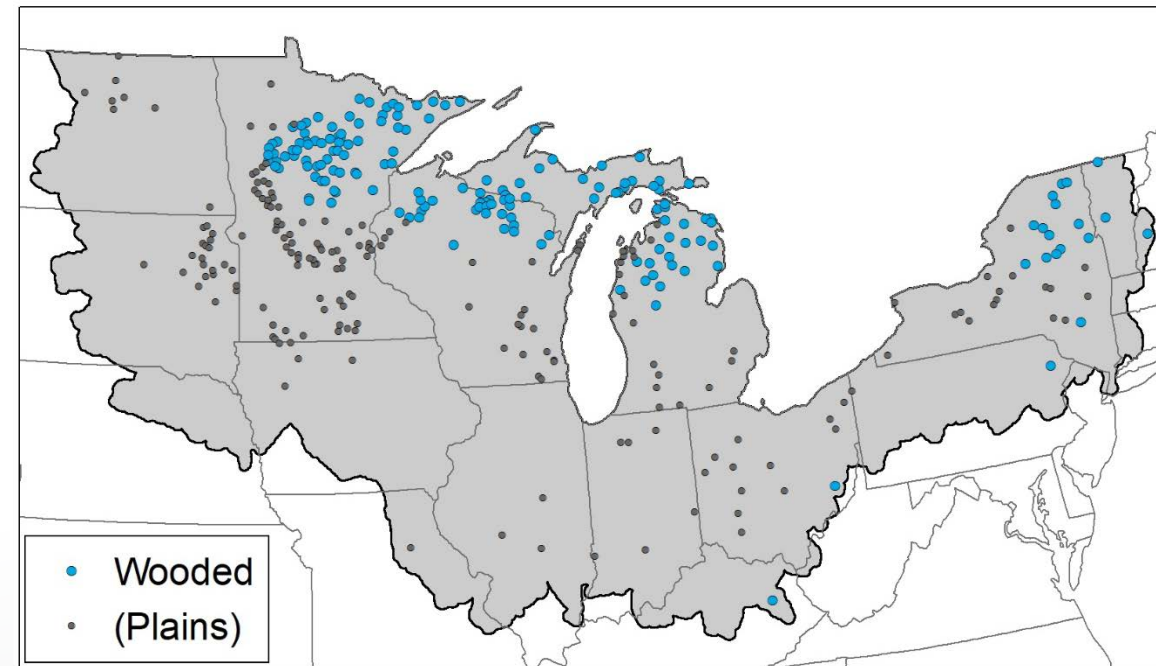
Wooded Ecozone



Wooded Ecozone

Of top 20 factors:

- 1 agriculture ↑ cyanos
- 2 natural vegetation ↓ cyanos
- 10 naturally occurring ↑ ↓
- 4 buffer zone



- Agricultural inputs and runoff
- Natural vegetation
 - placement within watershed
- Factors vary





Acknowledgements

- CyAN and EPA Collaborators
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- NOAA
- U.S. Geological Survey Toxic Substances Hydrology Program



Thank you! Questions?



<https://www.epa.gov/cyanoproject>



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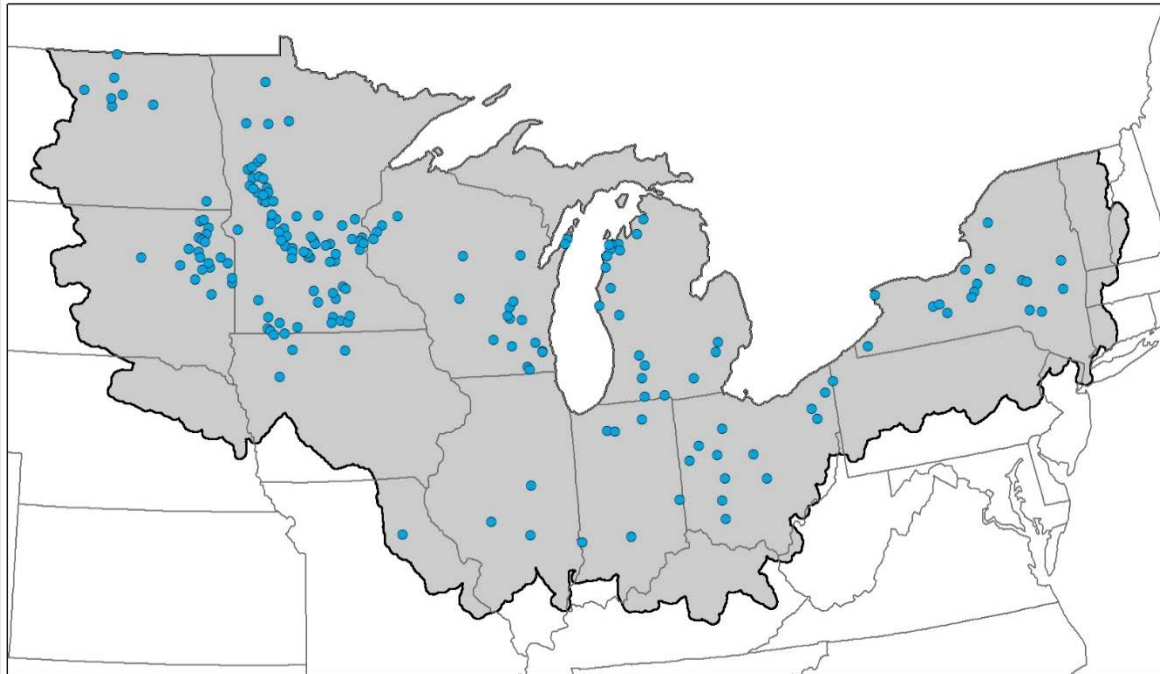
Full Study Area

Rank	Variable
1	% artificially drained
2	Soil erodibility of ag. land
3	% area crop
4	% area total forest
5	Sub-surface N-NH3 app. rate
6	Surface mineral P app. rate
7	Surface N-NH3 app. rate
8	Manure app. rate
9	% of ag. untreated by sink
10	Soil clay %
11	% area ag., row crops in 90 m stream buffer
12	% area wetland in 90 m lake buffer
13	% of sinks that treat ag.
14	% area deciduous forest
15	Runoff
16	% area hay
17	% area ag., hay in 90 m stream buffer
18	% area shrub in 90 m lake buffer
19	% area ag., row crops in 90 m lake buffer
20	Surface N-NO3 app. rate

 Agriculture
 Vegetation



Plains Ecozone

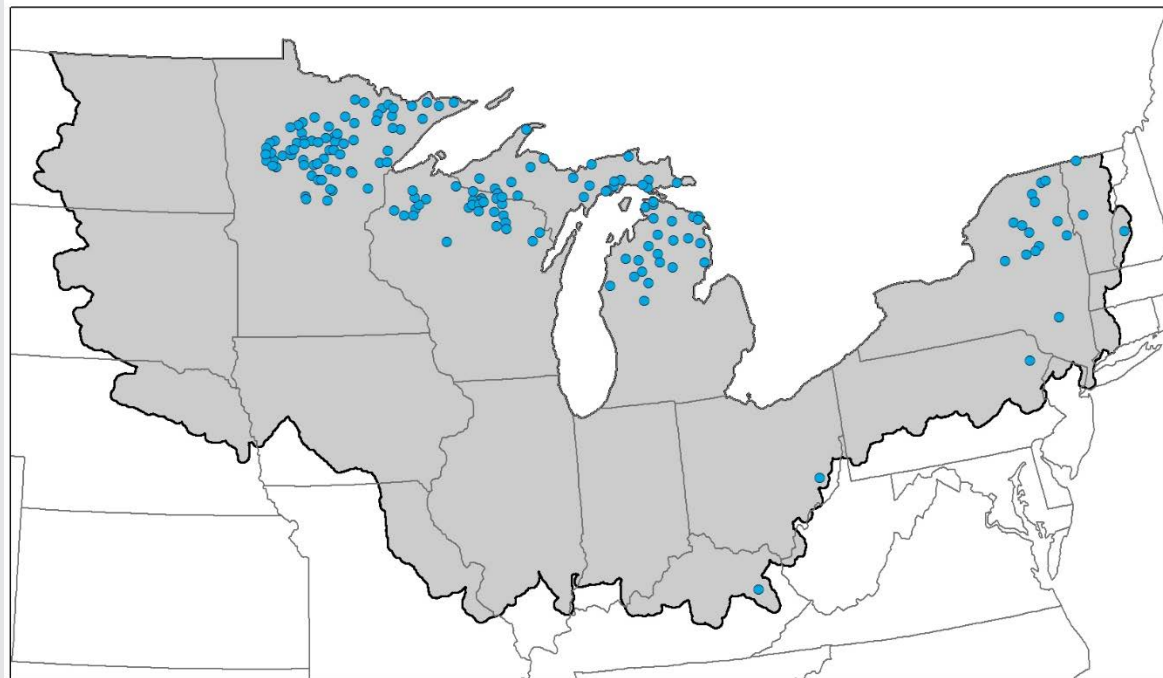



- Agriculture
- Vegetation
- Development

Rank	Variable
1	% artificially drained
2	Manure app. rate
3	% area crop
4	Surface N-NH3 app. rate
5	% of ag. untreated by sink
6	Soil erodibility of ag. land
7	Runoff
8	Soil clay %
9	Sub-surface N-NH3 app. rate
10	Longitude
11	% area shrub/scrub
12	% area ag., row crops in 90 m stream buffer
13	% area shrub in 90 m lake buffer
14	% area wetland in 90 m lake buffer
15	avg. dist. of ag. to stream through buffers
16	Water table depth
17	% area herbaceous in 90 m stream buffer
18	Road density
19	% area deciduous forest
20	Surface mineral P app. rate



Wooded Ecozone



-  Agriculture
-  Vegetation
-  Development

Rank	Variable
1	Soil erodibility
2	Precip., max. 72-hour period
3	Organic matter content
4	% area wetland
5	Water table depth
6	% area shrub/scrub
7	Soil clay %
8	Mean Lake Depth
9	Road-stream intersection density
10	Housing unit density
11	Population density
12	Precip., total seasonal
13	Ratio of lakeshed to lake area
14	% area ag., hay in 90 m lake buffer
15	Lake Volume
16	% lithological N content
17	% area developed: low + medium intensity in 90 m lake buffer
18	% area evergreen forest in 90 m lake buffer
19	% area deciduous forest in 90 m lake buffer
20	% area deciduous forest