Does Watershed *Conductivity* Influence the Extent to Which Land Use Affects Lake Water Quality?

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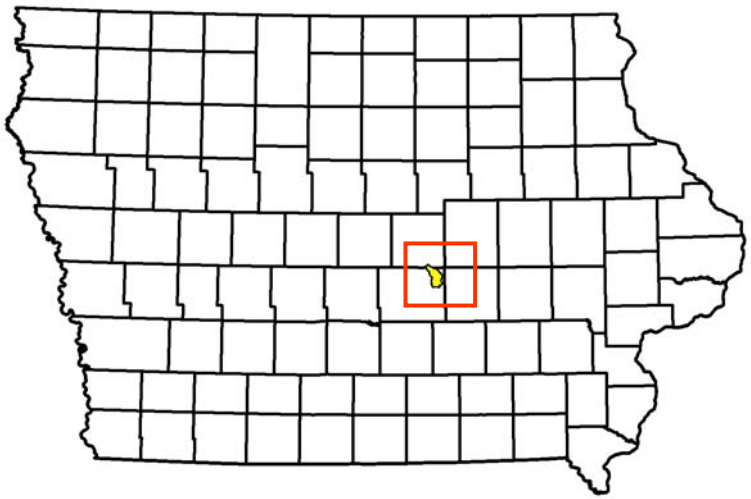
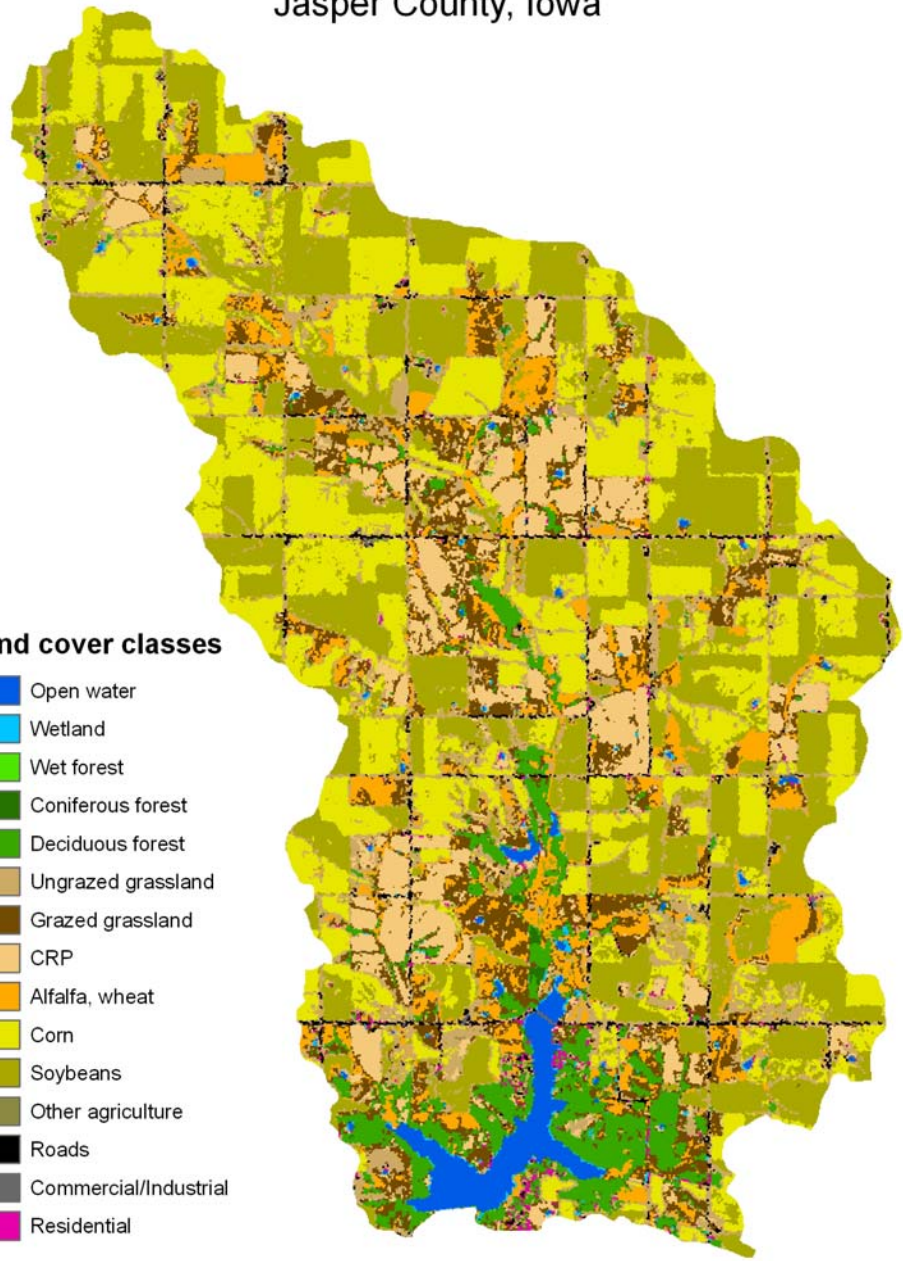
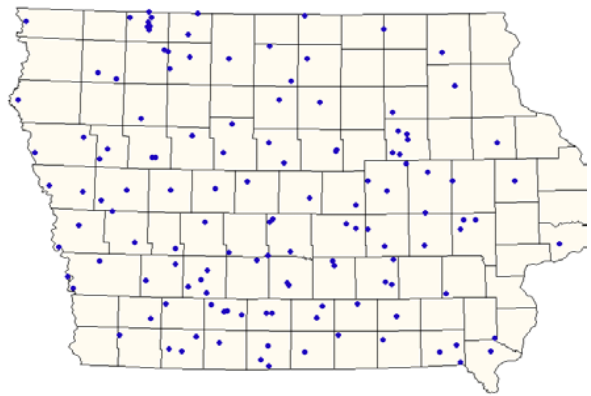
Rock Creek Lake Watershed

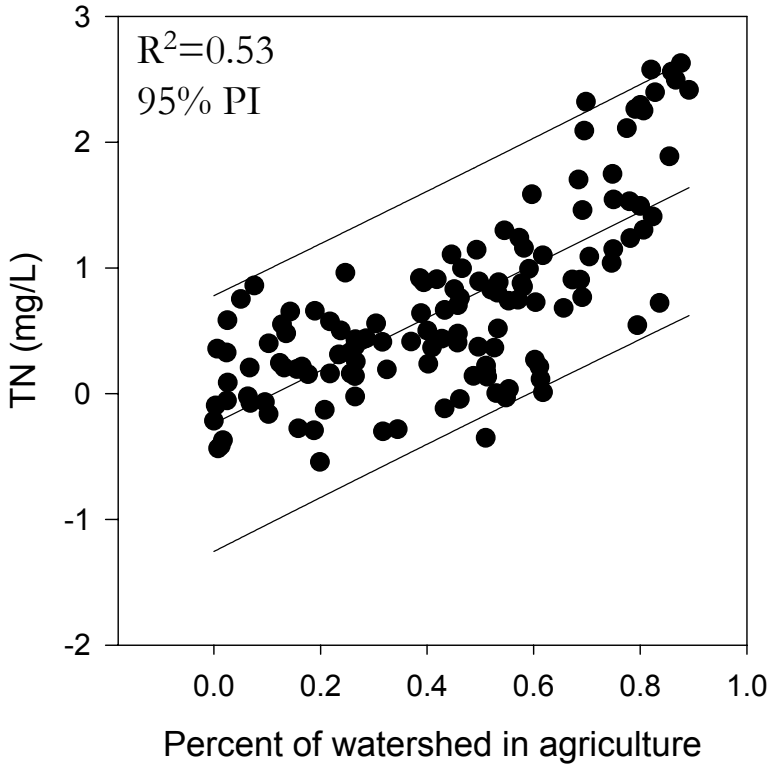
Jasper County, Iowa

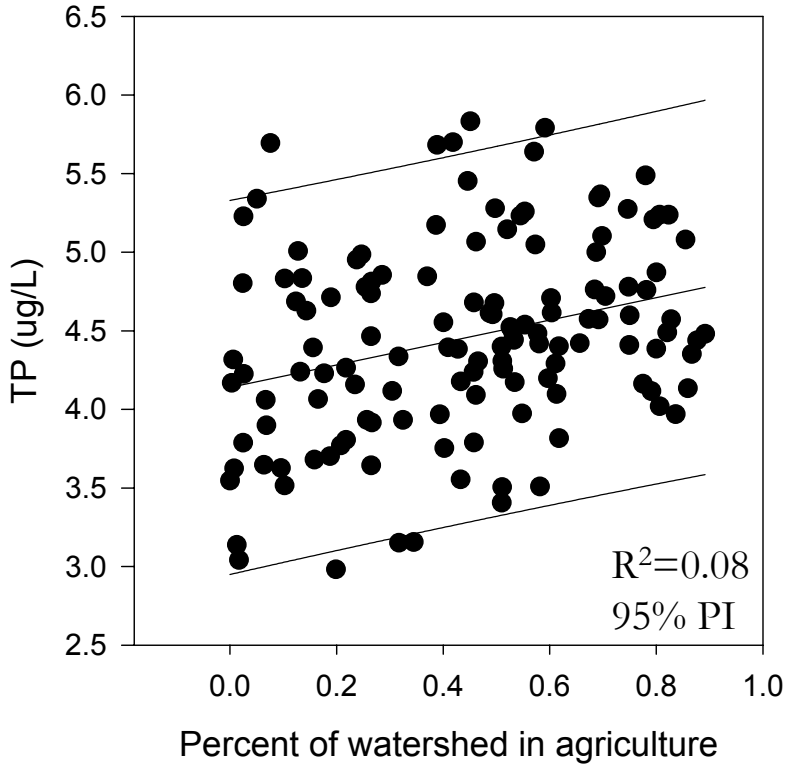




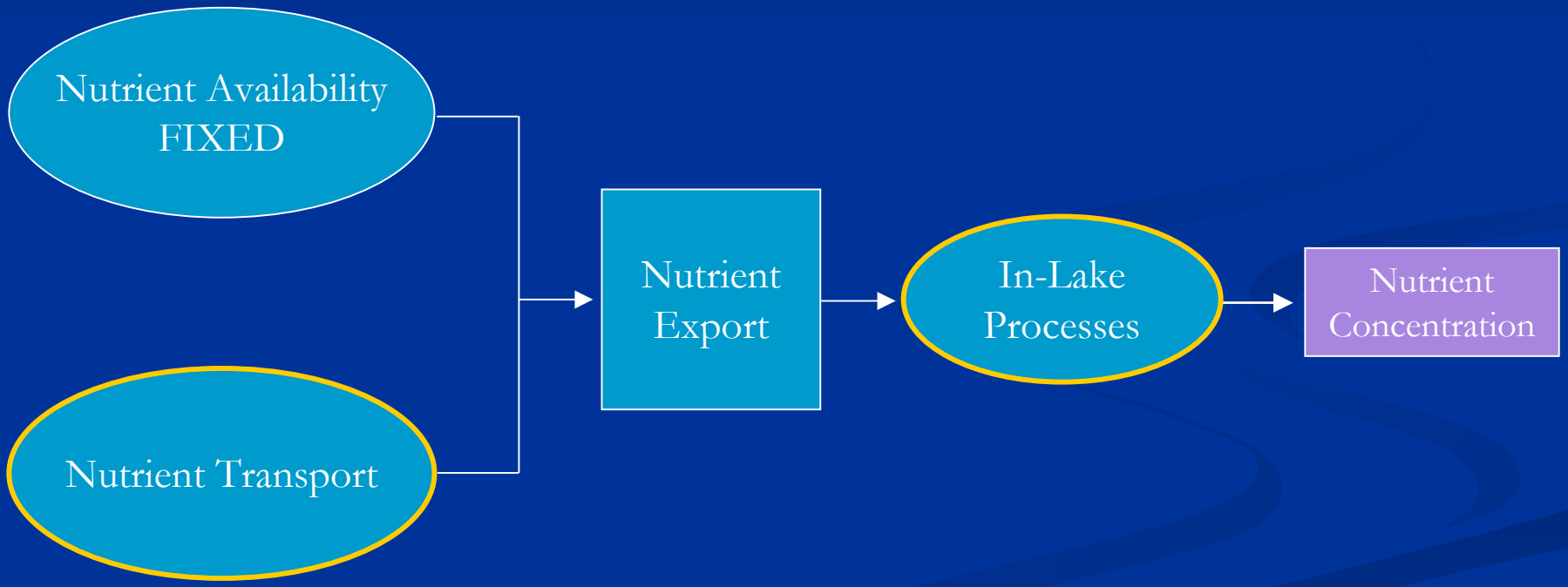
Data from 132 Iowa Lakes (2000-2006)







Reasons the Relationship between Source Cover and Water Quality Varies

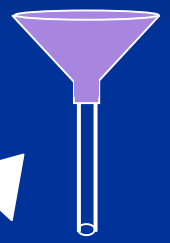


Factors Affecting Nutrient Transport: Watershed Conductivity

Climate: timing and intensity of precipitation

Watershed Properties

- Hydrology
- Soils/ Geology
- Source-cover configuration



<u>Strongly conductive</u>

- moves water and nutrients quickly
- transmits climate-driven variability

→ proximity of source cover is not important; entire watershed contributes

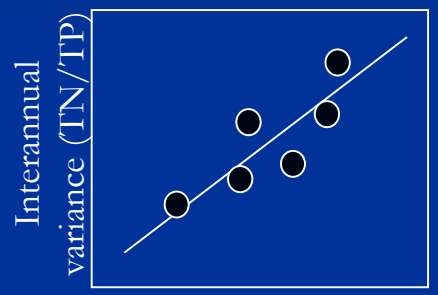
<u>Weakly conductive</u>

- moves water and nutrients slowly
- does not transmit variability

→ proximity of land cover is important; nearby sources contribute more

Characterizing and Examining the Influence of Watershed Conductivity

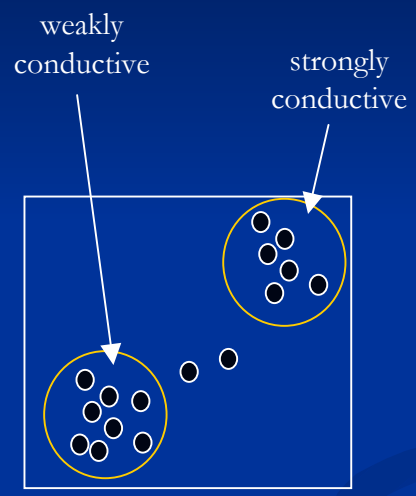
1.



TN: lake order

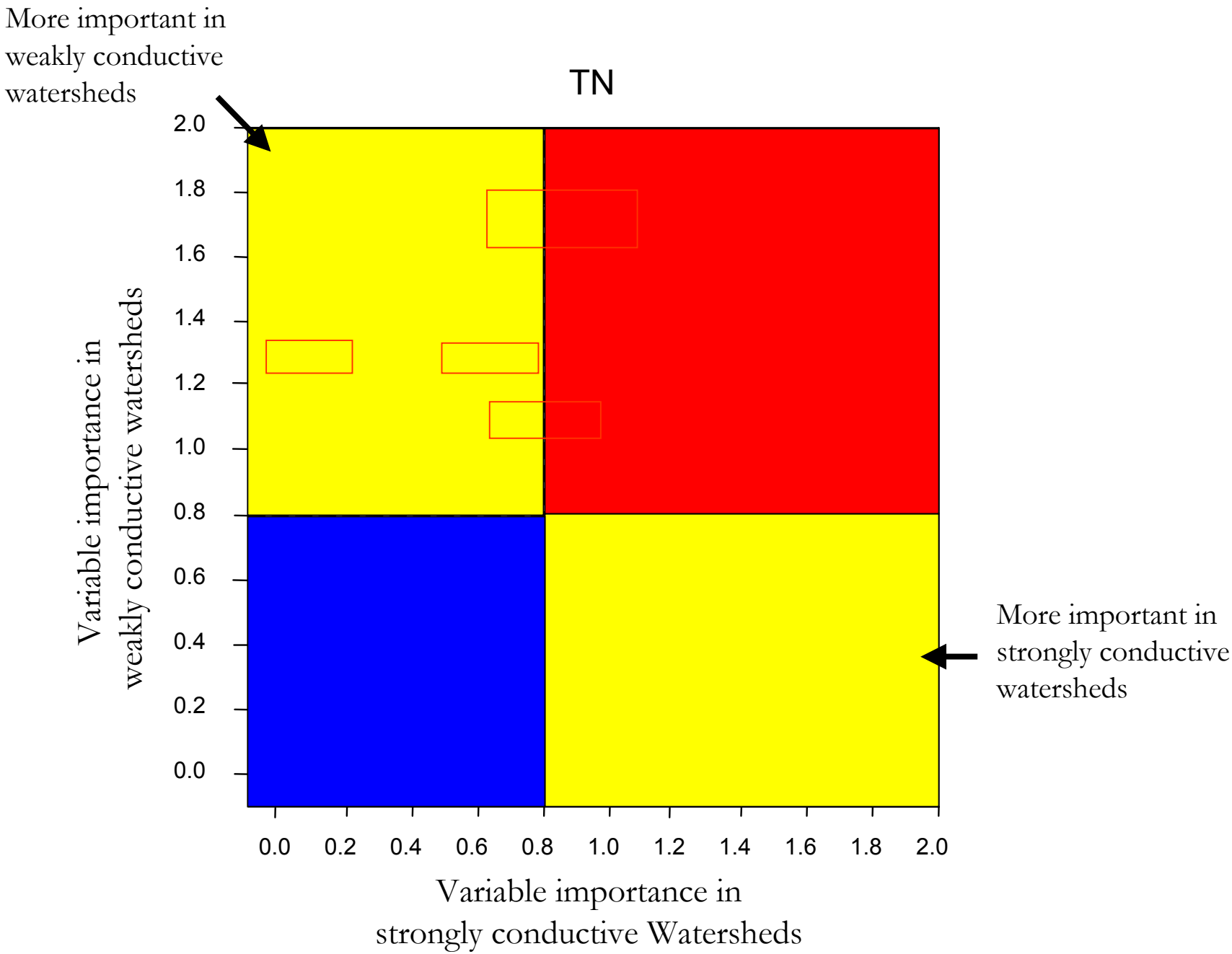
TP: total watershed area
lake flush rate
watershed area : lake area
drainage density
% tile drained
lake area : lake volume

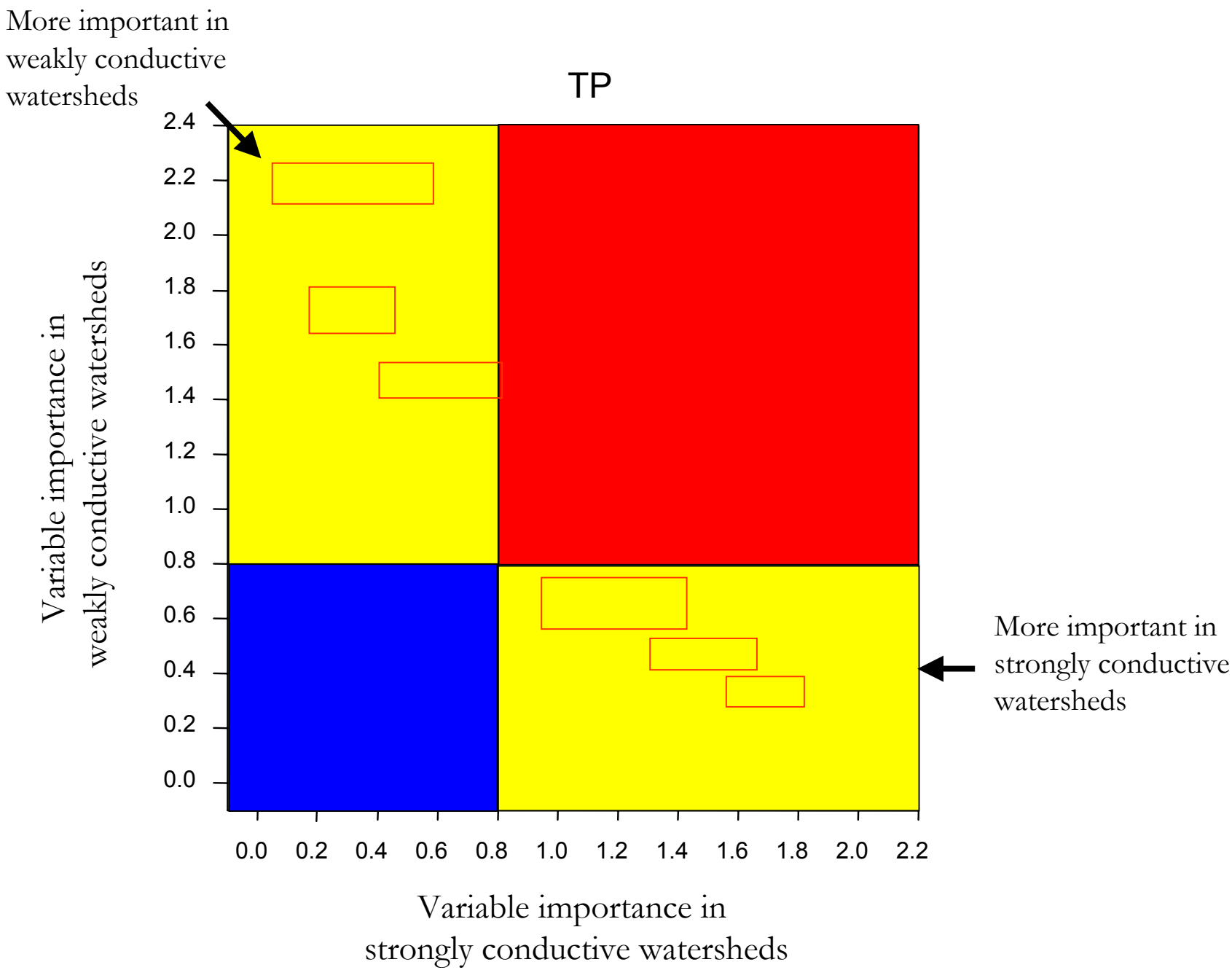
2.



Composited with NMDS to provide single measure of watershed conductivity

3. Partial least squares regression (PLS) to examine explanatory power of independent variables in strongly and weakly conductive watersheds


More important in weakly conductive watersheds
TN
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Variable importance in weakly conductive watersheds
More important in strongly conductive watersheds
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Variable importance in strongly conductive Watersheds


More important in weakly conductive watersheds
TP
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Variable importance in weakly conductive watersheds
More important in strongly conductive watersheds
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
Variable importance in strongly conductive watersheds

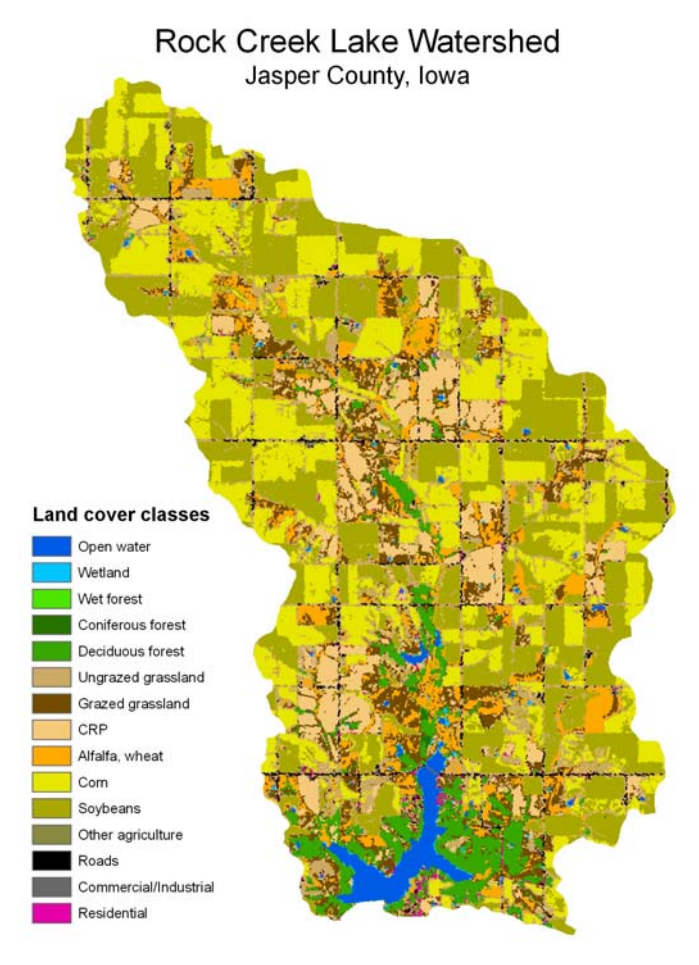
Take Home

- Differences in watershed conductivity contribute to variability in the relationship between source cover and water quality

- Watershed conductivity and the factors that characterize it vary for TN and TP

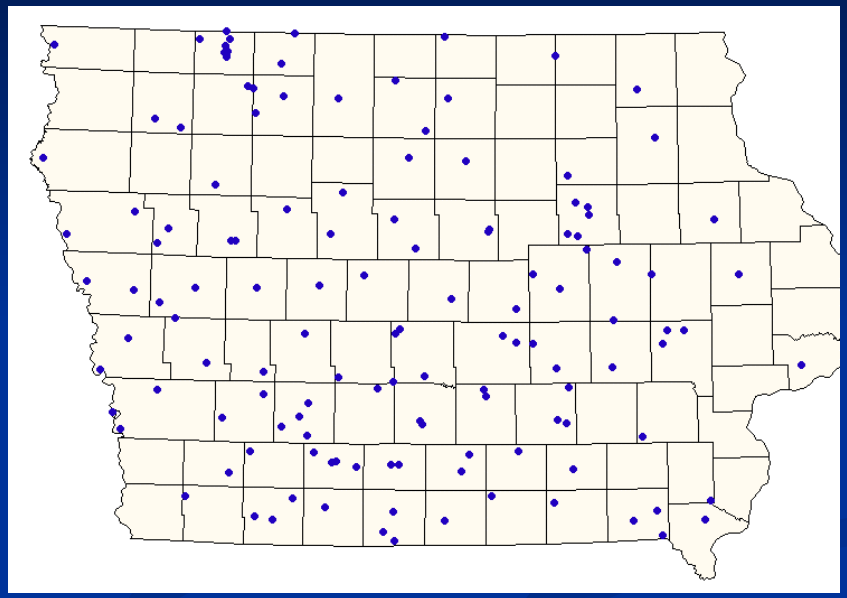
- TN
  - Amount of forest and agriculture w/in 100 m are important in weakly conductive watersheds but not necessarily in strongly conductive watersheds

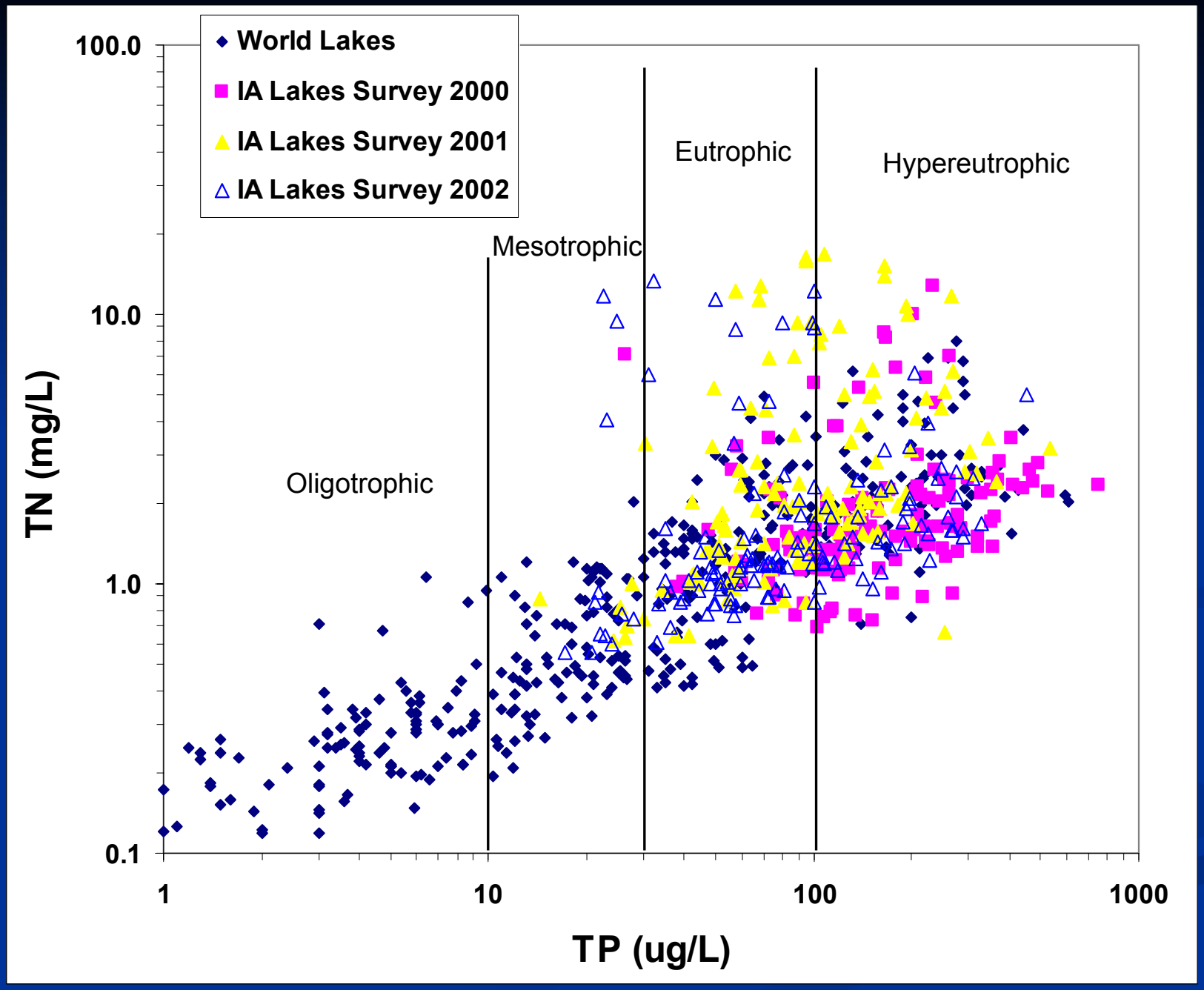
- TP
  - Amount of agriculture and grass important in strongly conductive watersheds, whereas commercial w/in 100 m and amount of timber are important in weakly conductive watersheds



Study Details

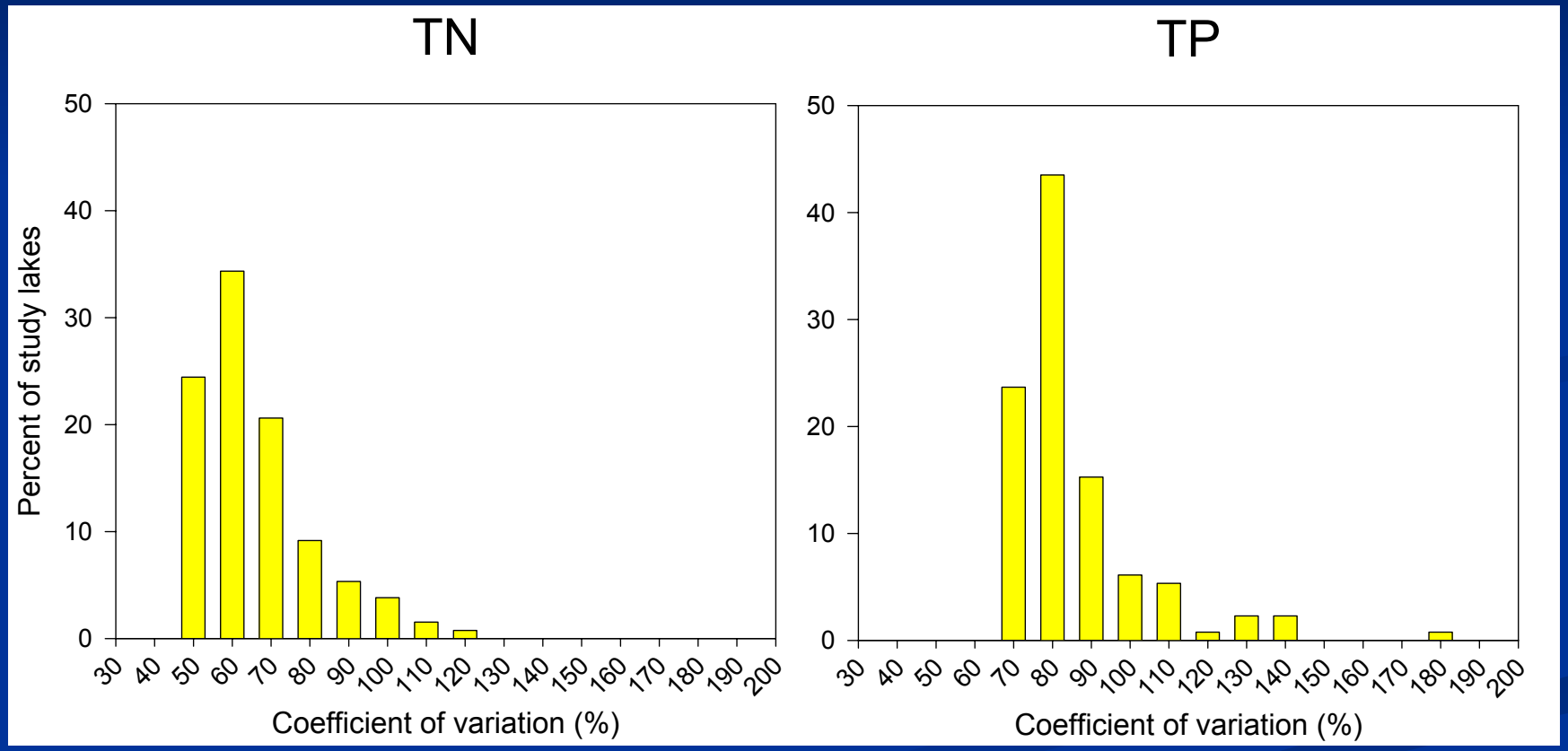
- Sites
  - 132 lakes throughout Iowa
- Data (2000-2006)
  - Water chemistry
  - Aquatic communities
  - Physical data
- Lake morphology
- Watershed-scale land cover (2002)



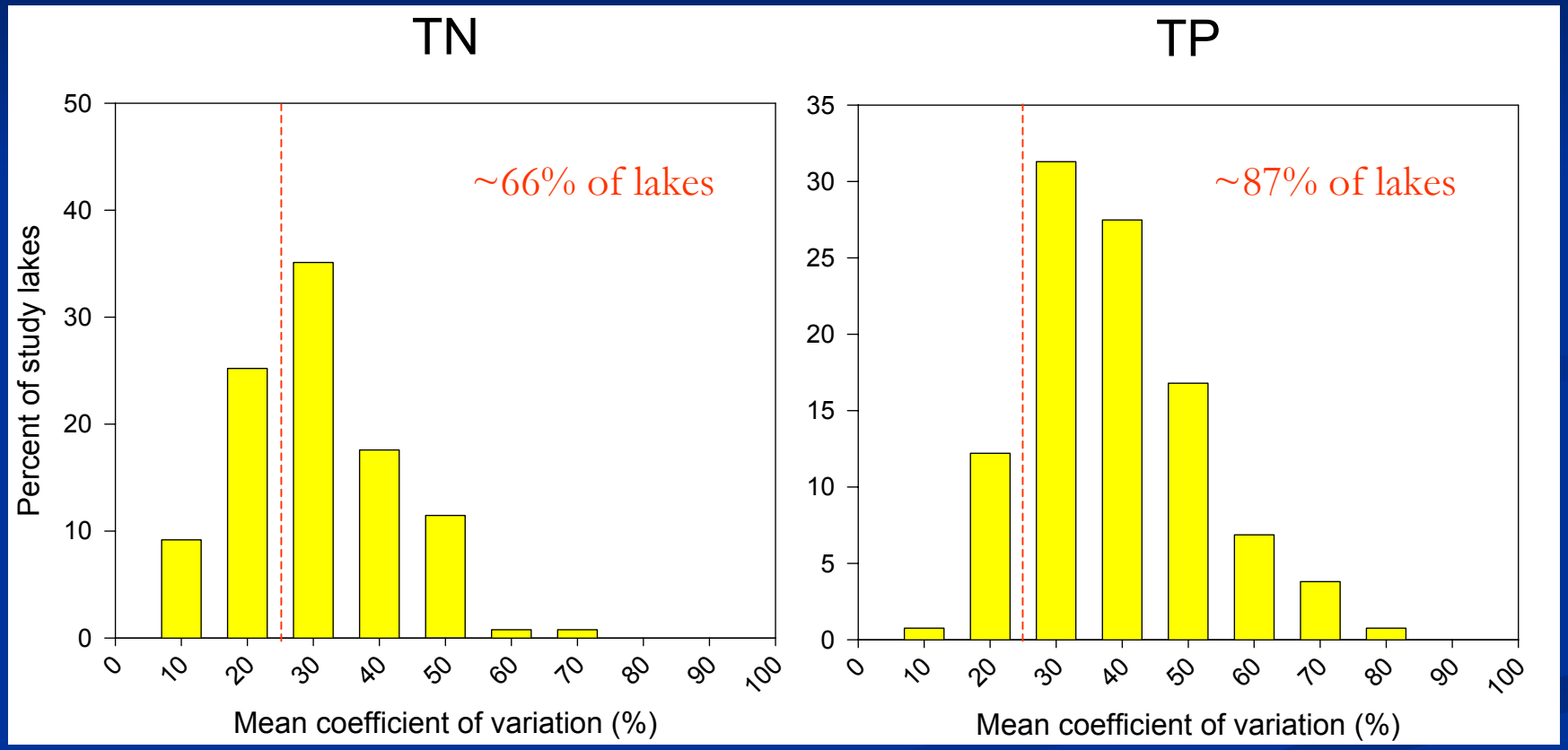


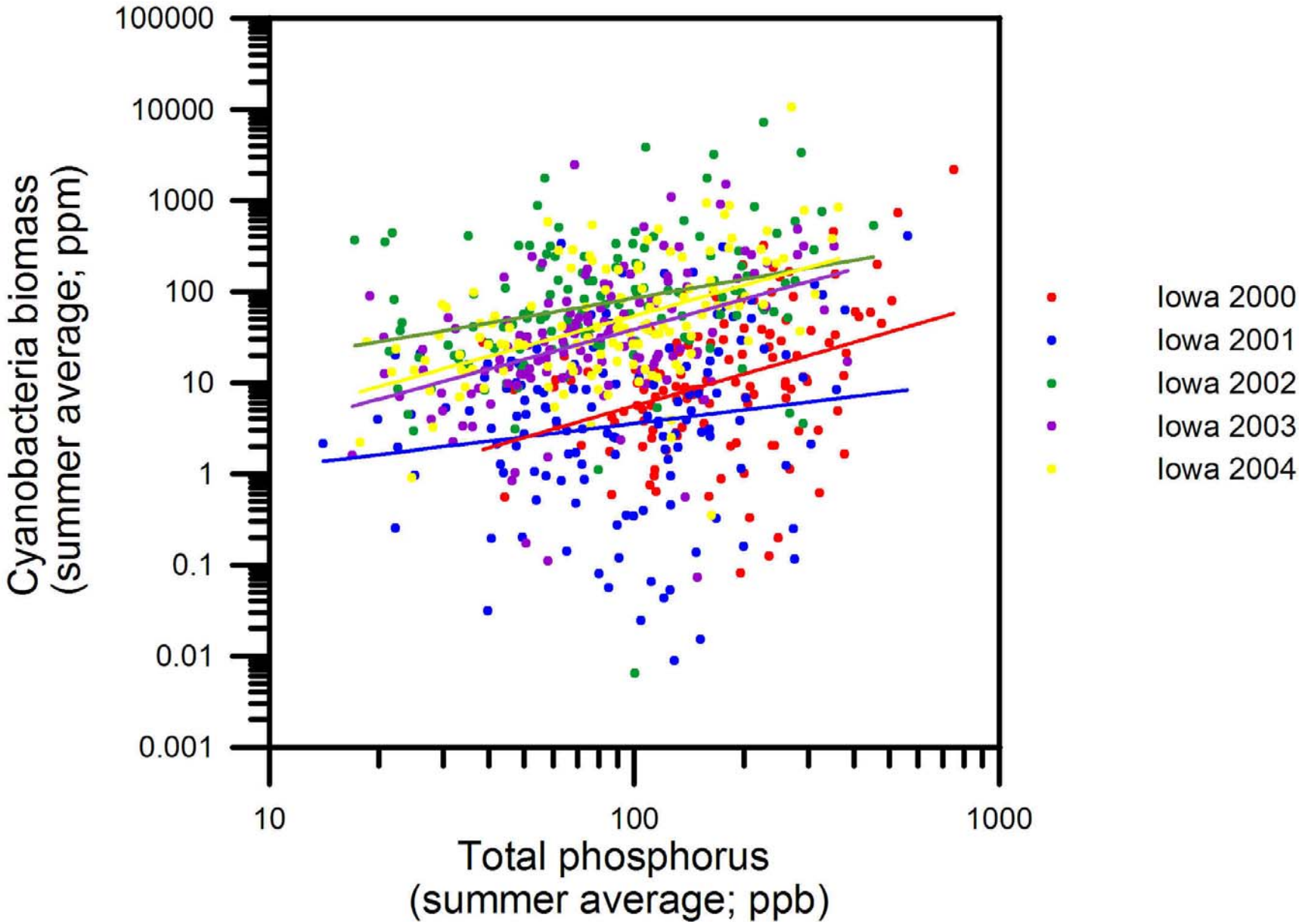
Data on World Lakes from McCauley and Downing, 1993

Interannual Variation of Water Chemistry



Intra-annual Variation of Water Chemistry




100000
10000
1000
100
10
1
0.1
0.01
0.001
Cyanobacteria biomass
(summer average; ppm)
10
100
1000
Total phosphorus
(summer average; ppb)
Iowa 2000
Iowa 2001
Iowa 2002
Iowa 2003
Iowa 2004