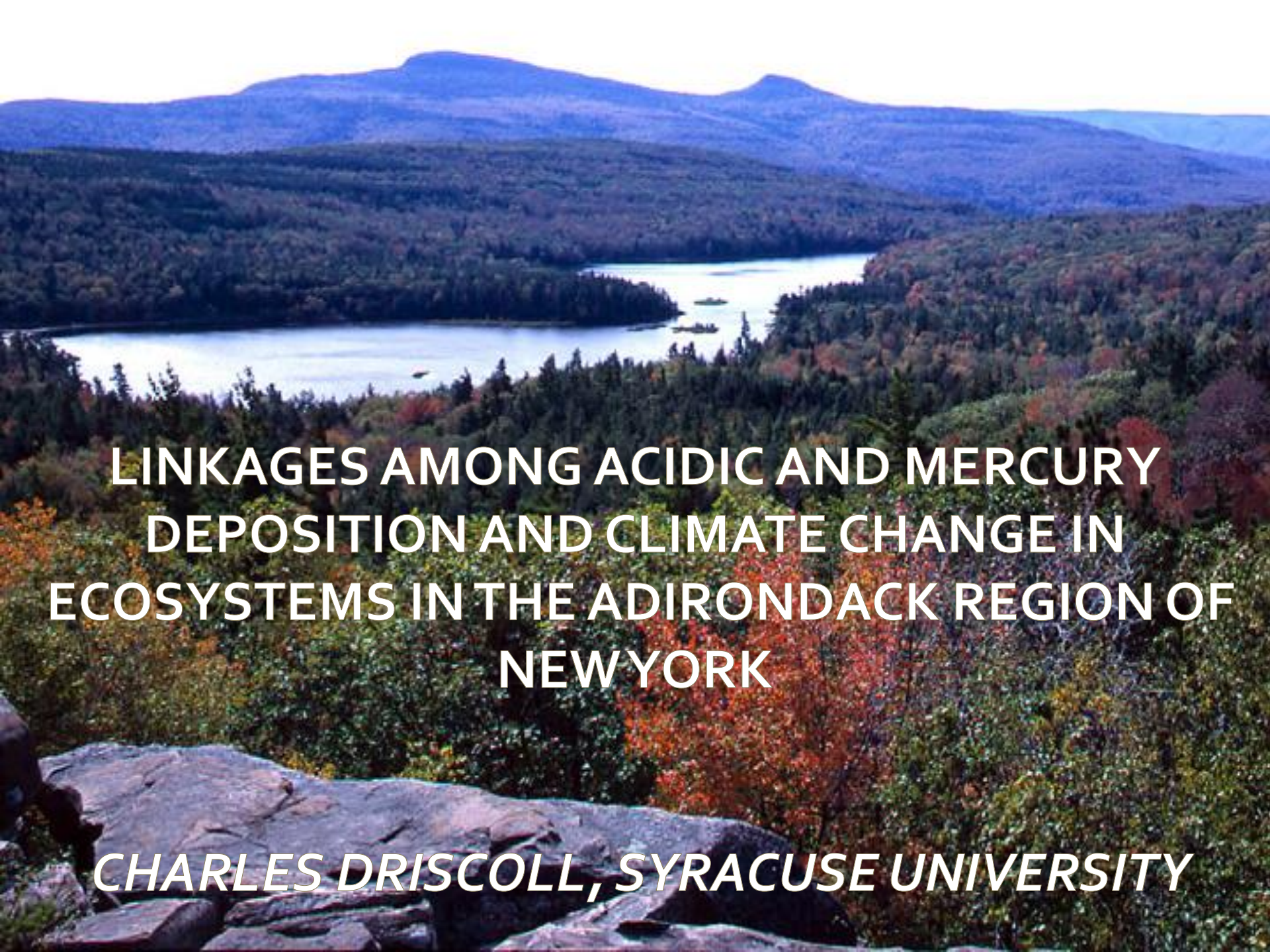
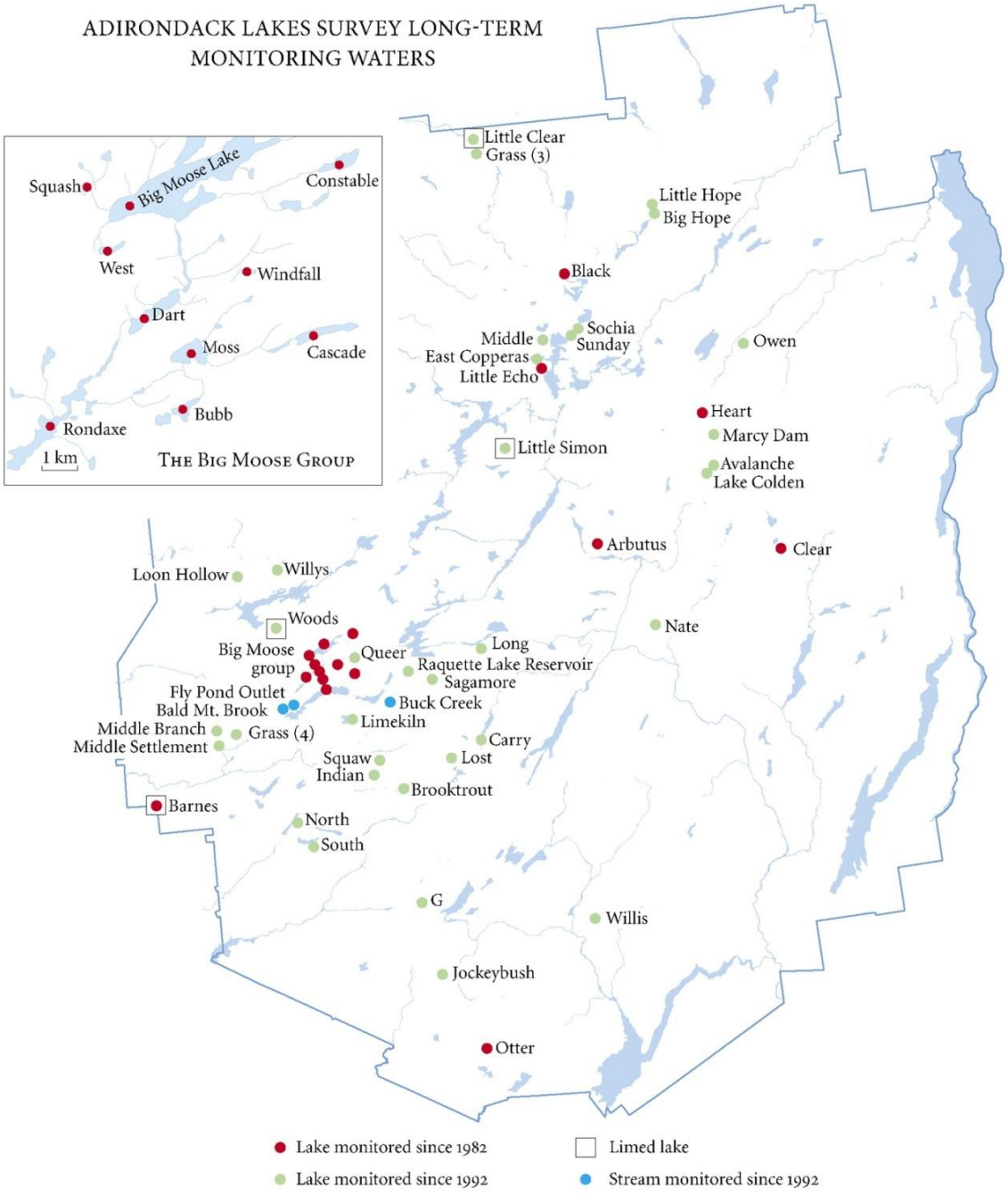


LINKAGES AMONG ACIDIC AND MERCURY DEPOSITION AND CLIMATE CHANGE IN ECOSYSTEMS IN THE ADIRONDACK REGION OF NEW YORK

CHARLES DRISCOLL, SYRACUSE UNIVERSITY

Outline

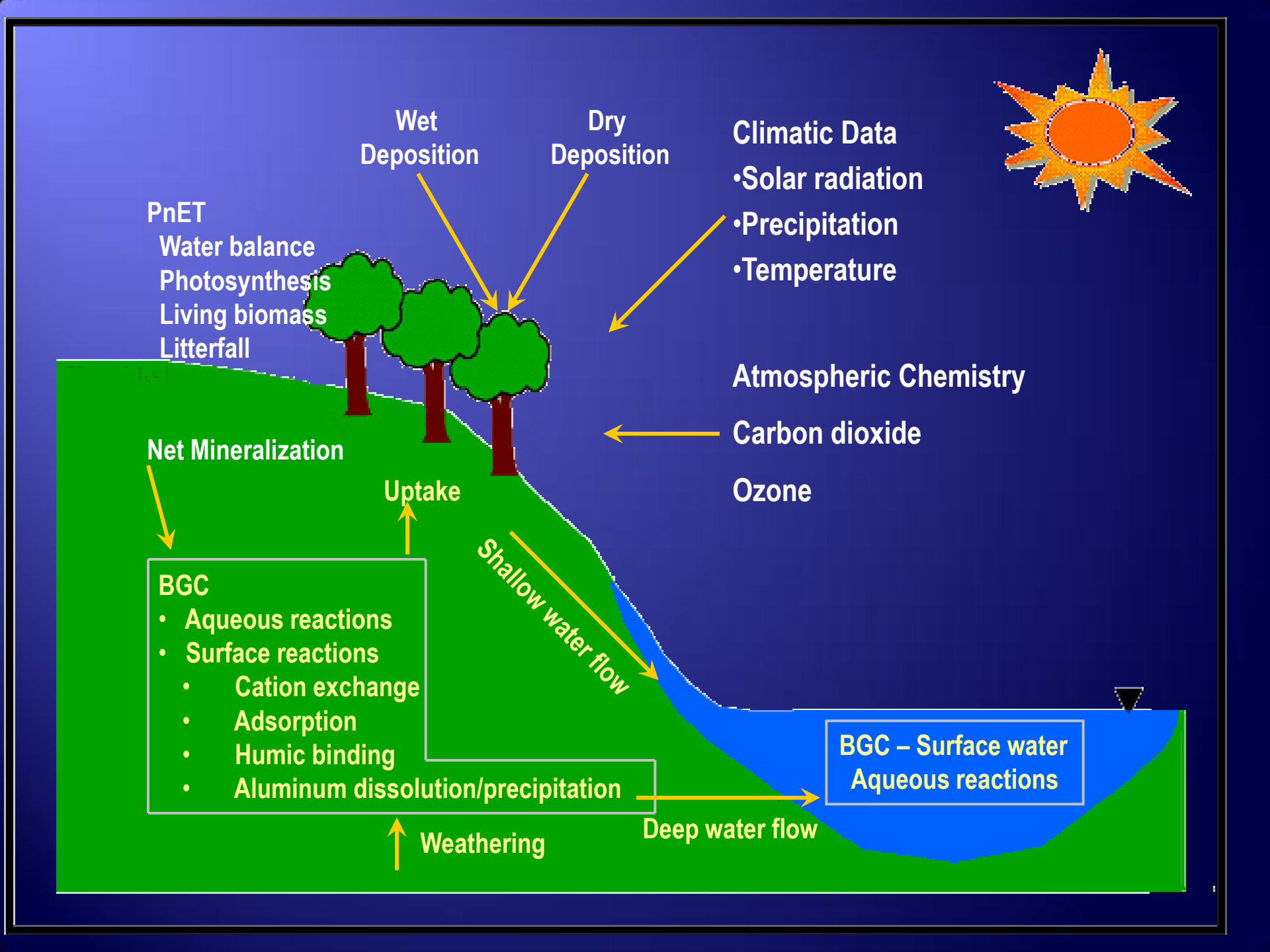
- Background
- Acidic deposition patterns and issues
- Linkages with mercury
- Linkages with climate change
- Linkage with State, regional and U.S programs
- Final thoughts



Lake Classes

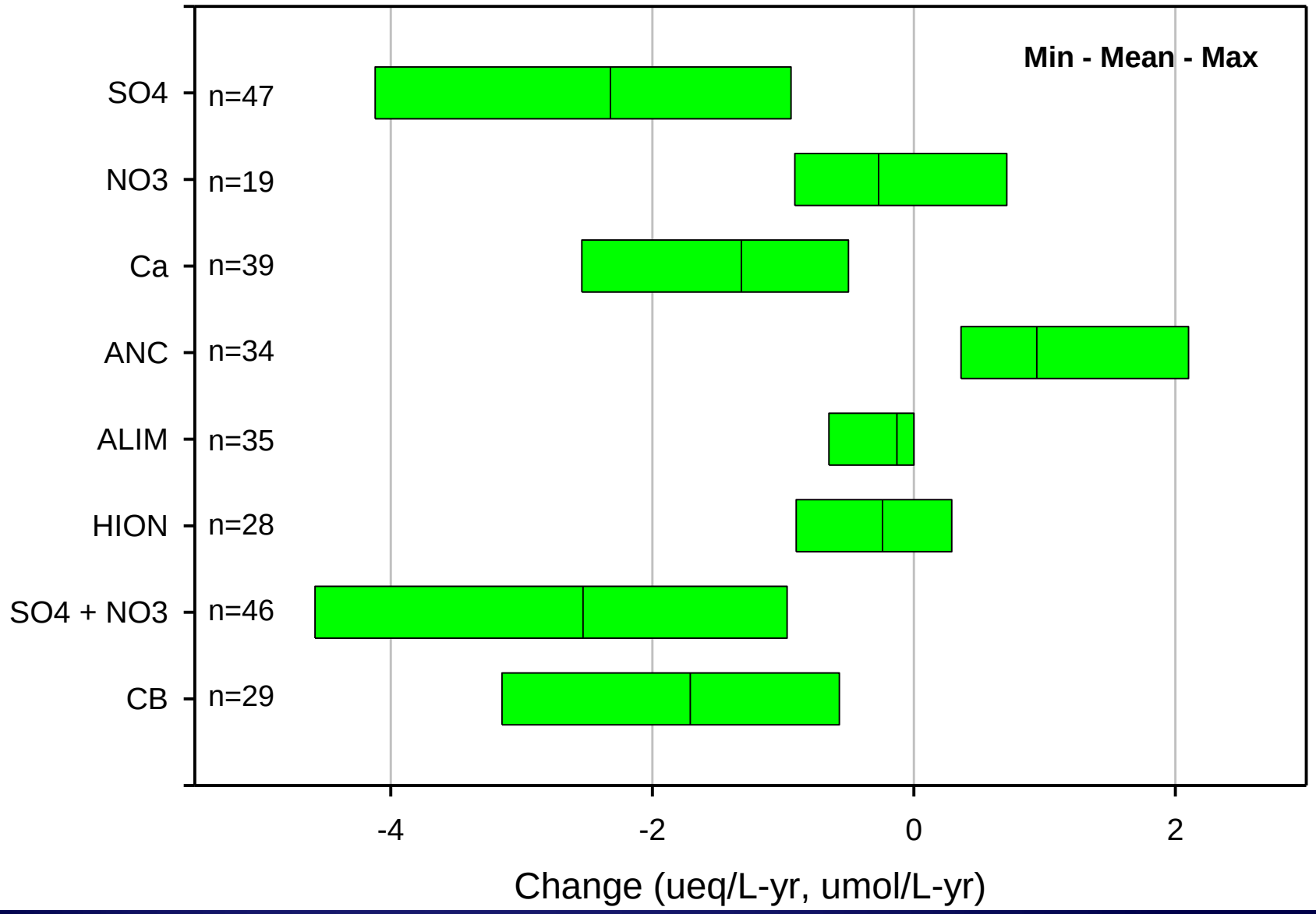
- Seepage
- Drainage
  - Thin till
  - Medium till
  - Thick till
  - Carbonate

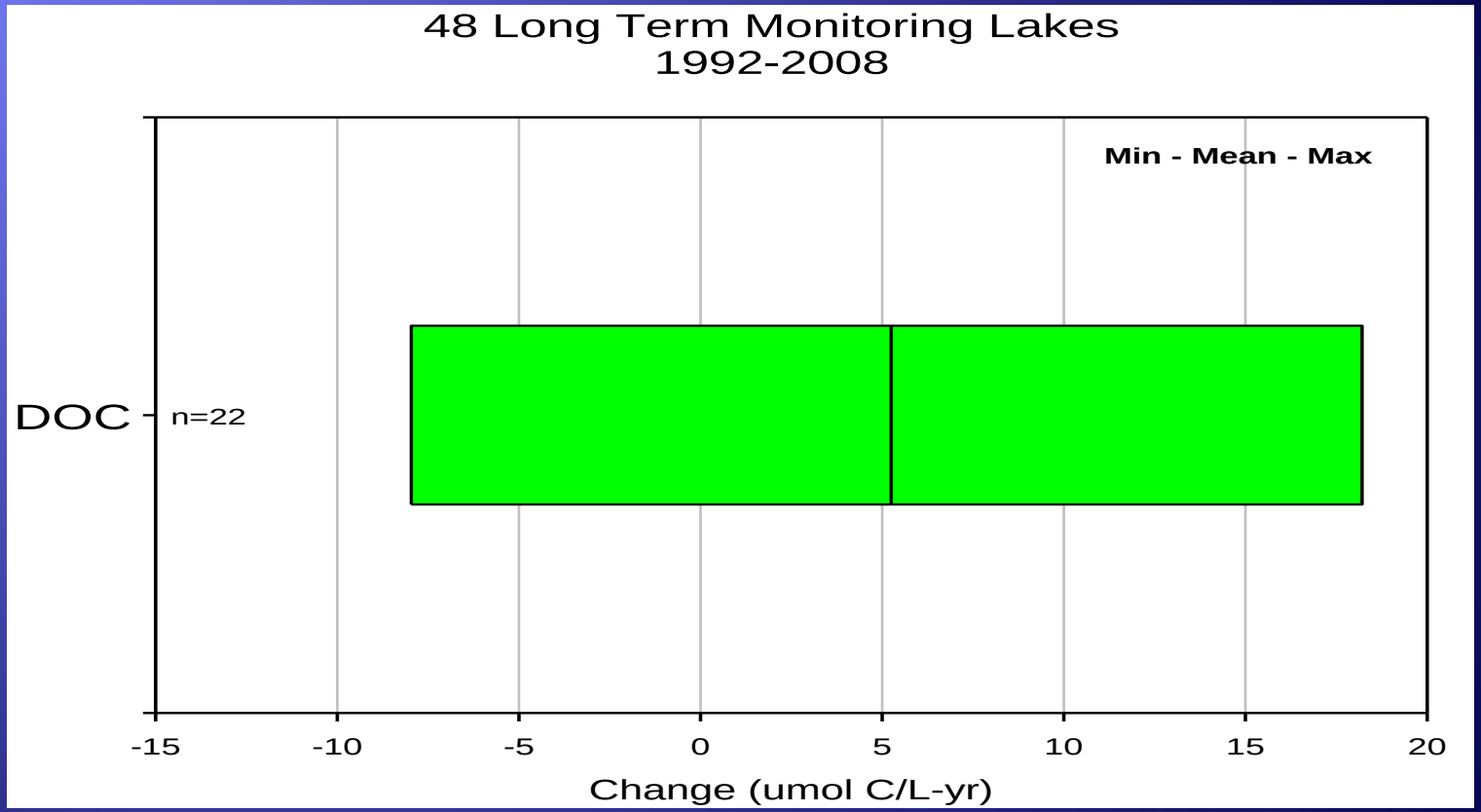
Arbutus Lake – 48.2 ha


Wet Deposition
Dry Deposition
Climatic Data
•Solar radiation
•Precipitation
•Temperature
PnET
Water balance
Photosynthesis
Living biomass
Litterfall
Atmospheric Chemistry
Carbon dioxide
Ozone
Net Mineralization
Uptake
Shallow water flow
BGC
• Aqueous reactions
• Surface reactions
• Cation exchange
• Adsorption
• Humic binding
• Aluminum dissolution/precipitation
BGC – Surface water
Aqueous reactions
Deep water flow
Weathering

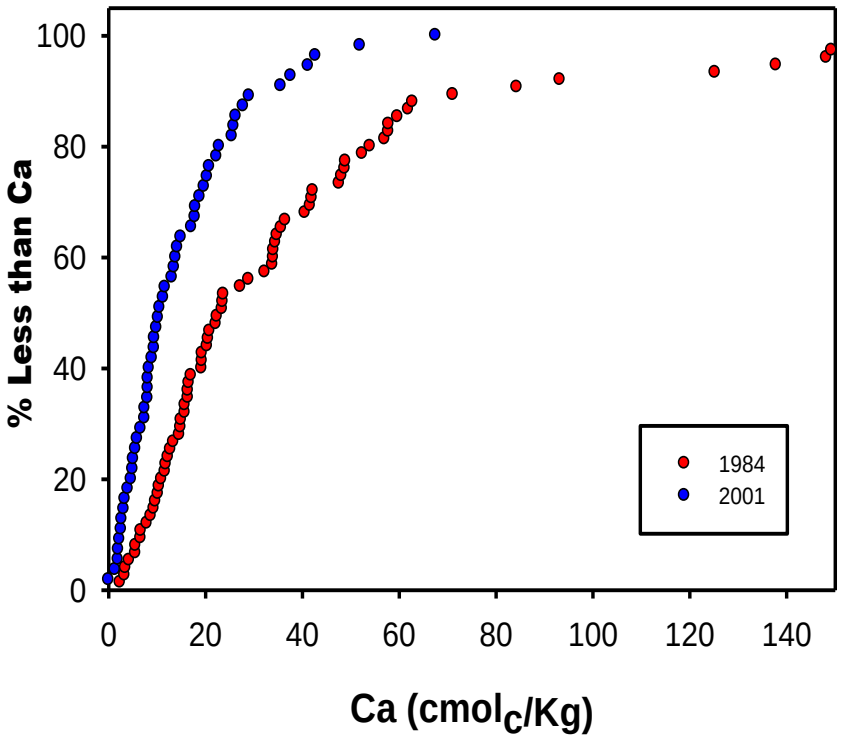

PATTERNS AND TRENDS IN
ACID-BASE STATUS

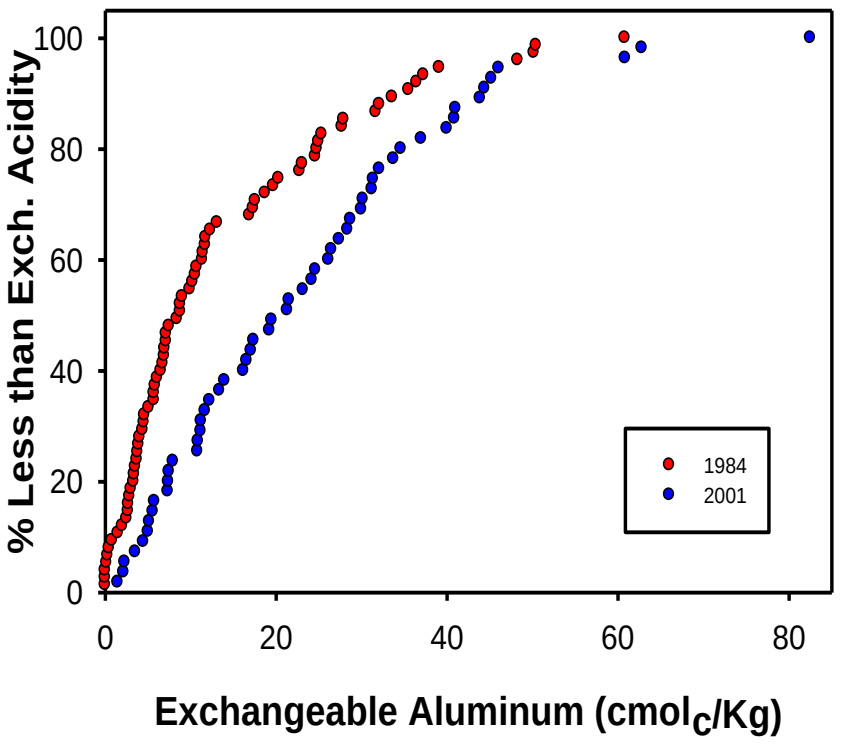
48 Long Term Monitoring Lakes
1992-2008

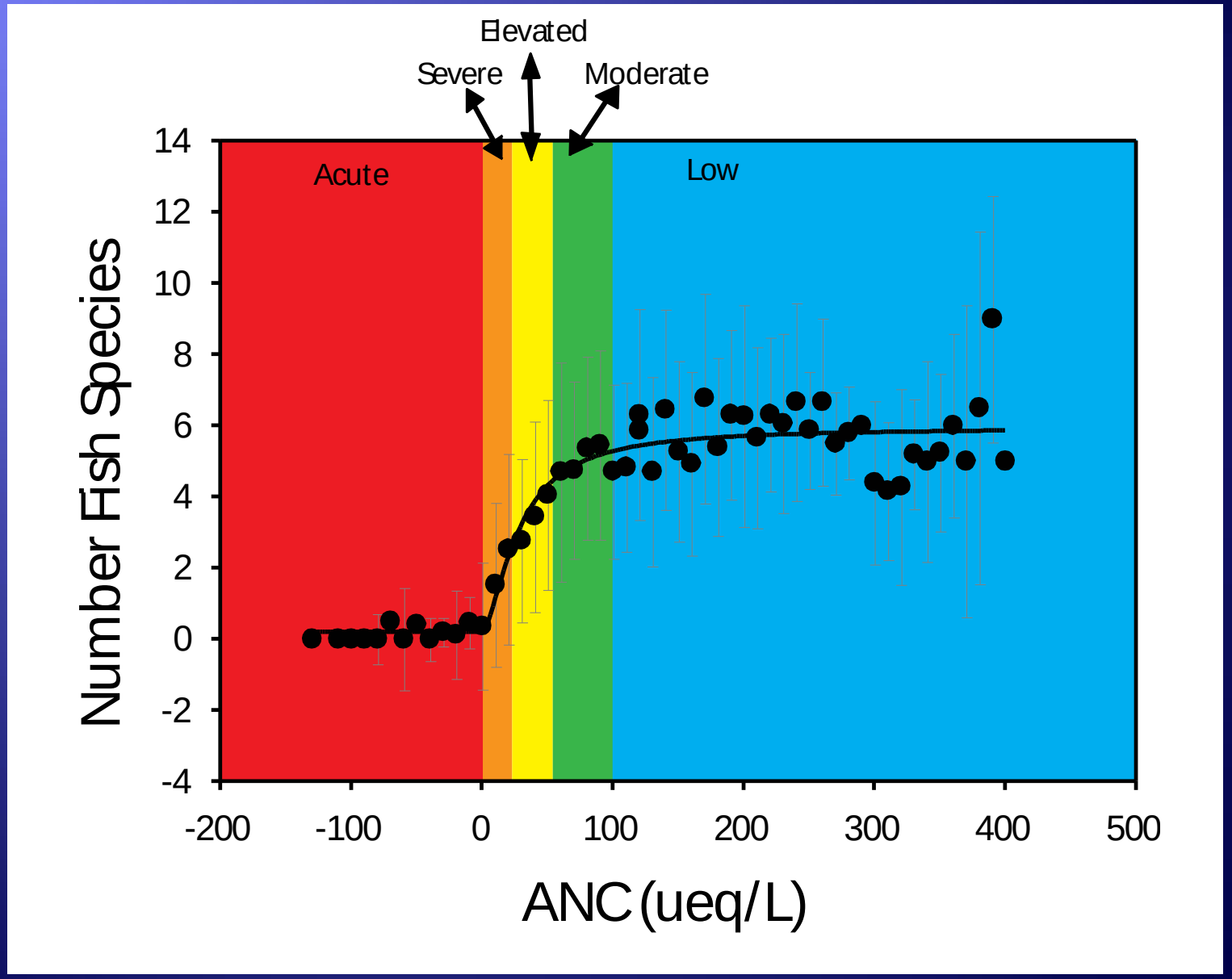




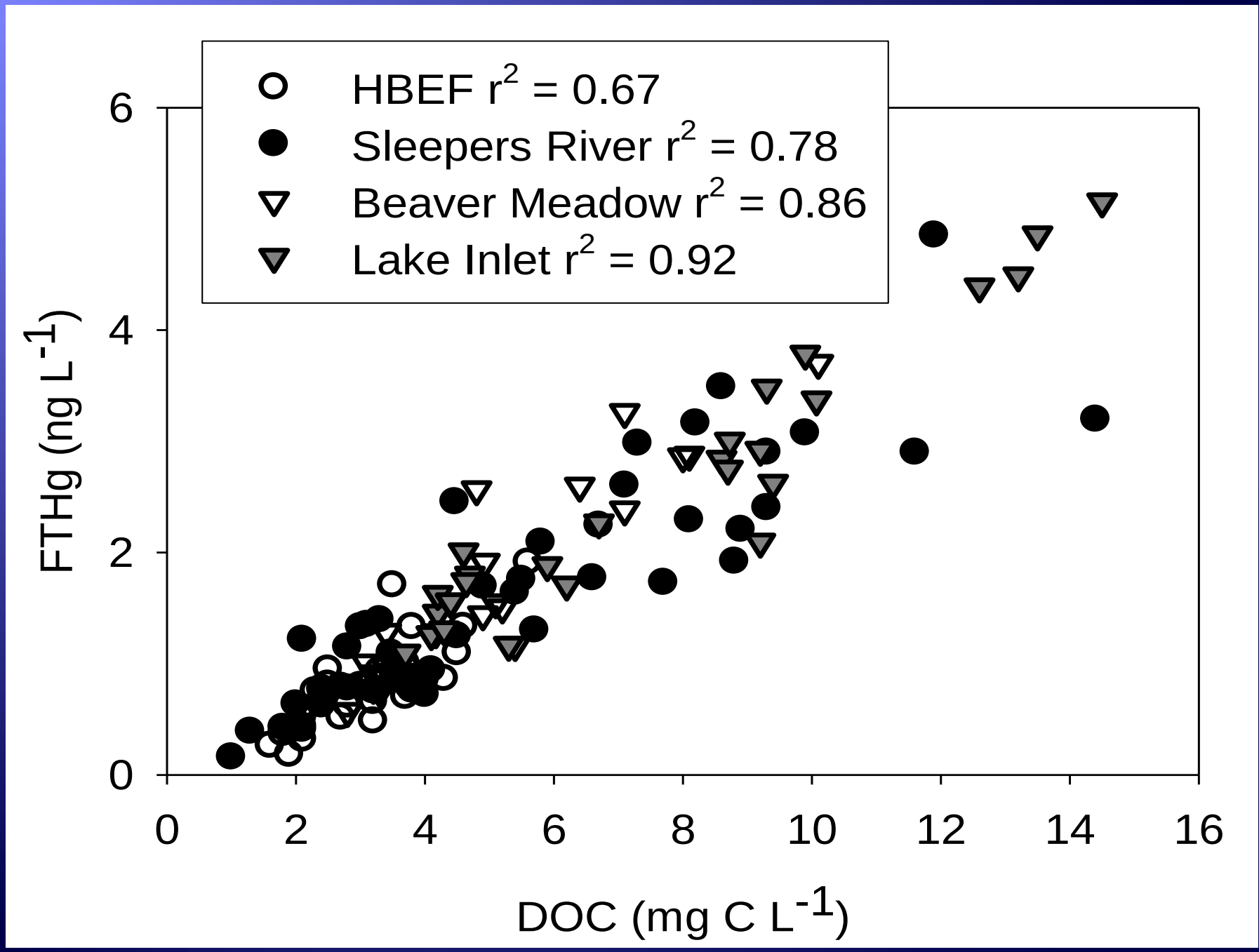
Effects of increases in DOC supply: compensating acidification, enhanced metal transport but decreases in bioavailability, and increase attenuation of light and prolonged thermal stratification

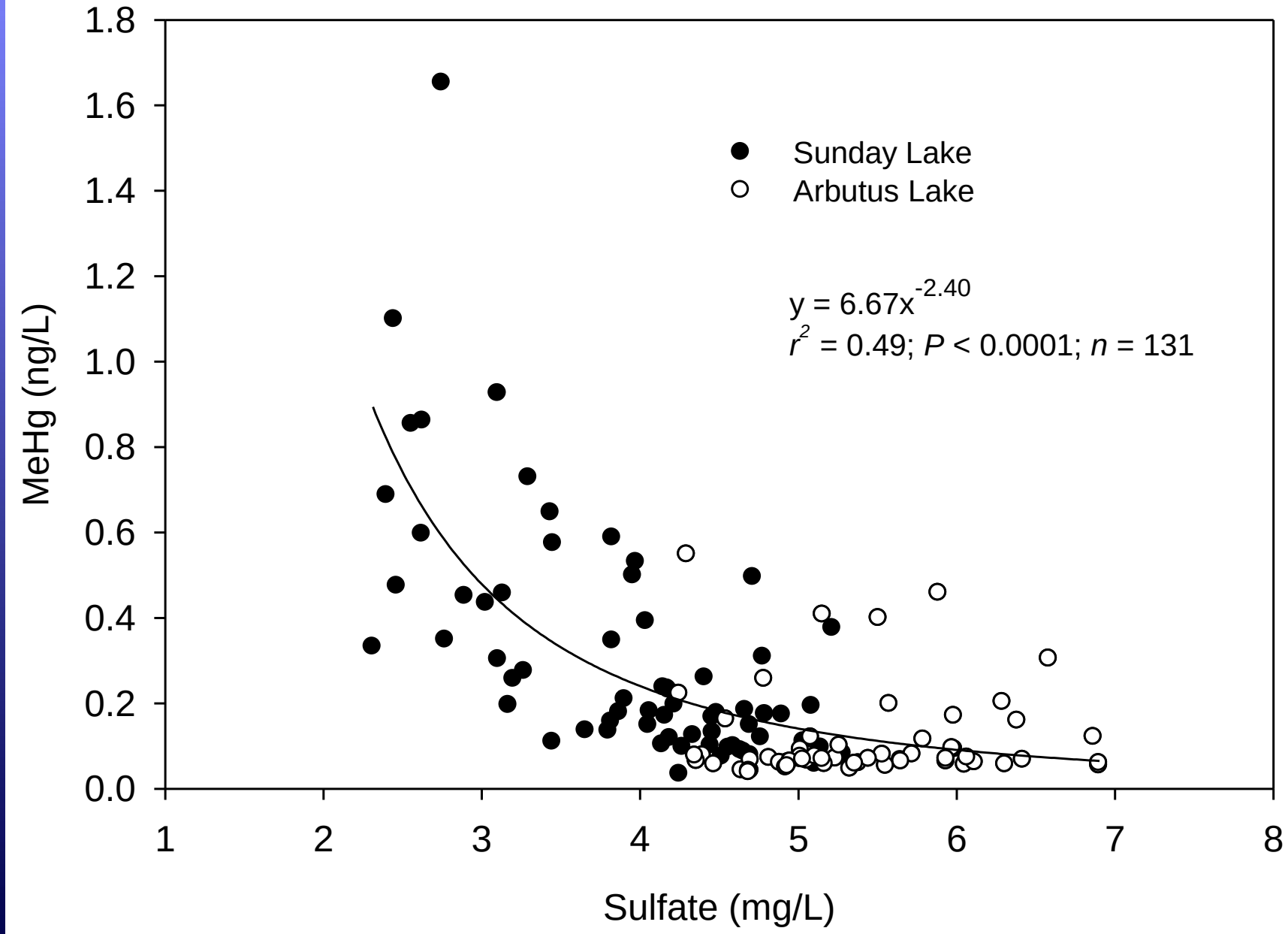

Cumulative Frequency Diagram for Ca (cmol$_c$/Kg)
Ca Normalized to C (Oa Horizon)
% Less than Ca
Ca (cmol$_c$/Kg)
1984
2001
0
20
40
60
80
100
120
140

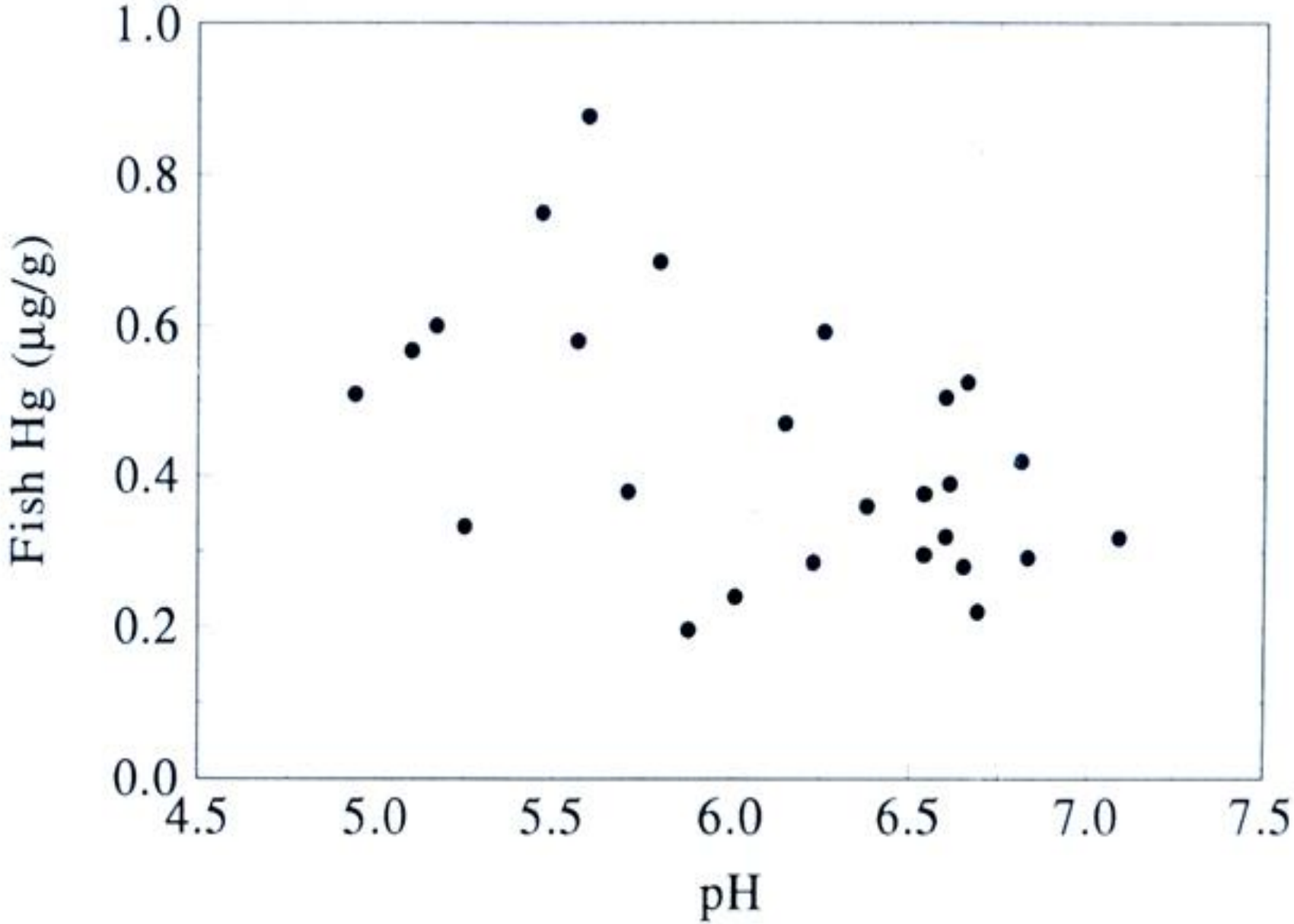

Cumulative Frequency Diagram for Exch. Al (cmol$_c$/Kg)
Exch. Al Normalized to C (Oa Horizon)
% Less than Exch. Acidity
Exchangeable Aluminum (cmol$_c$/Kg)
1984
2001
0
20
40
60
80
100


Elevated
Severe
Moderate
Acute
Low
Number Fish Species
14
12
10
8
6
4
2
0
-2
-4
-200
-100
0
100
200
300
400
500
ANC (ueq/L)


LINKAGES WITH MERCURY DEPOSITION


HBEF r2 = 0.67
Sleepers River r2 = 0.78
Beaver Meadow r2 = 0.86
Lake Inlet r2 = 0.92
FTHg (ng L-1)
DOC (mg C L-1)
0
2
4
6
8
10
12
14
16


1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
MeHg (ng/L)
1
2
3
4
5
6
7
8
Sulfate (mg/L)
Sunday Lake
Arbutus Lake
y = 6.67x-2.40
r2 = 0.49; P < 0.0001; n = 131


1.0
0.8
0.6
0.4
0.2
0.0
Fish Hg (µg/g)
4.5
5.0
5.5
6.0
6.5
7.0
7.5
pH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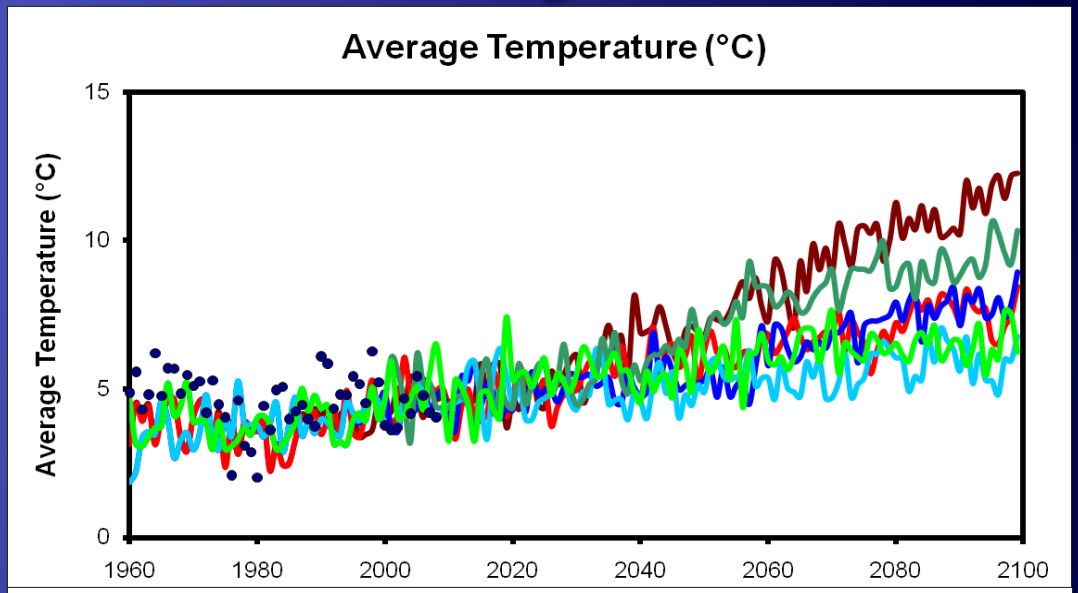
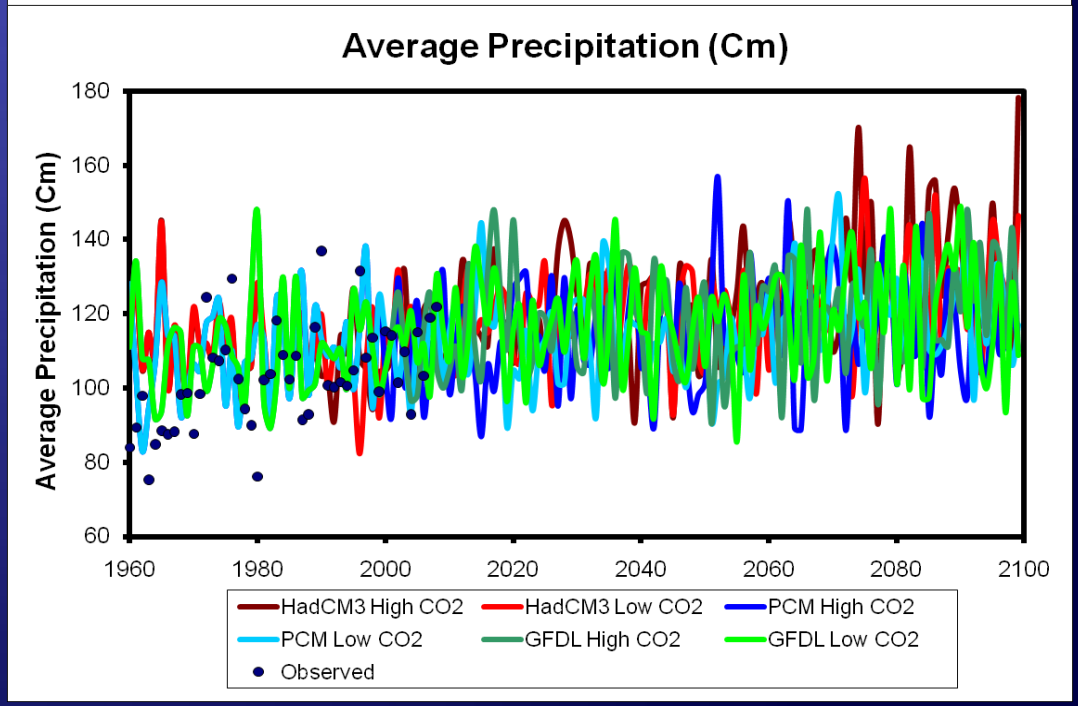
LINKAGES WITH CLIMATE CHANGE

AOGCM Temperature Projections

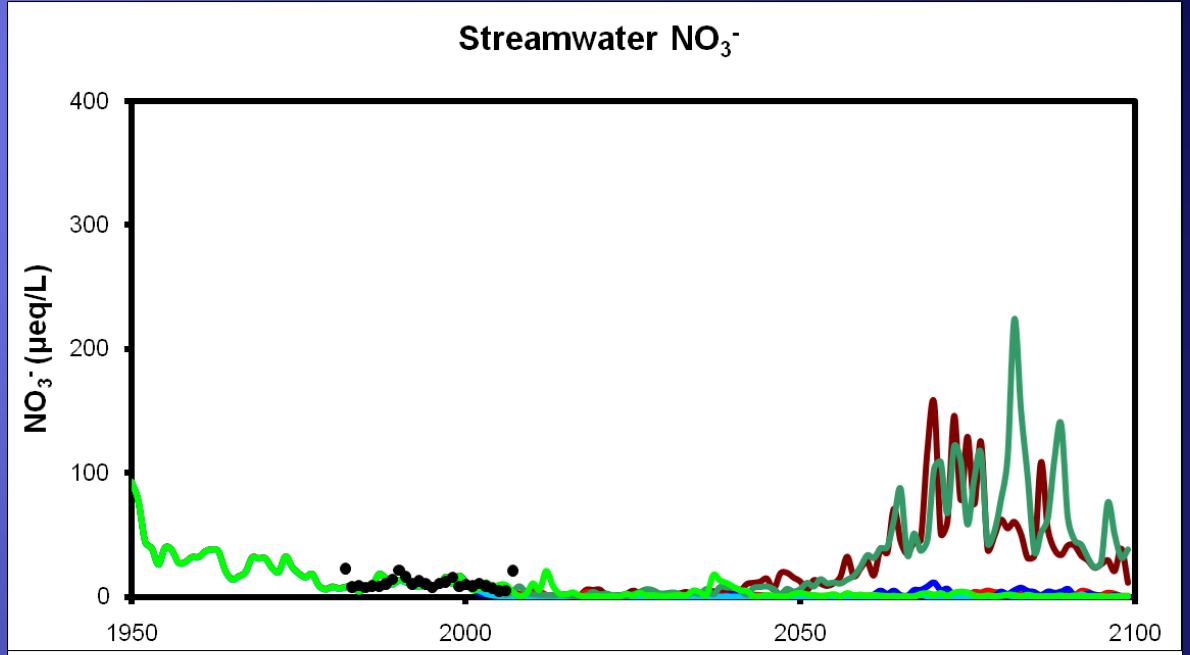
AOGCM
- Hadley (high sensitivity)
- GFDL (mid sensitivity)
- PCM (low sensitivity)

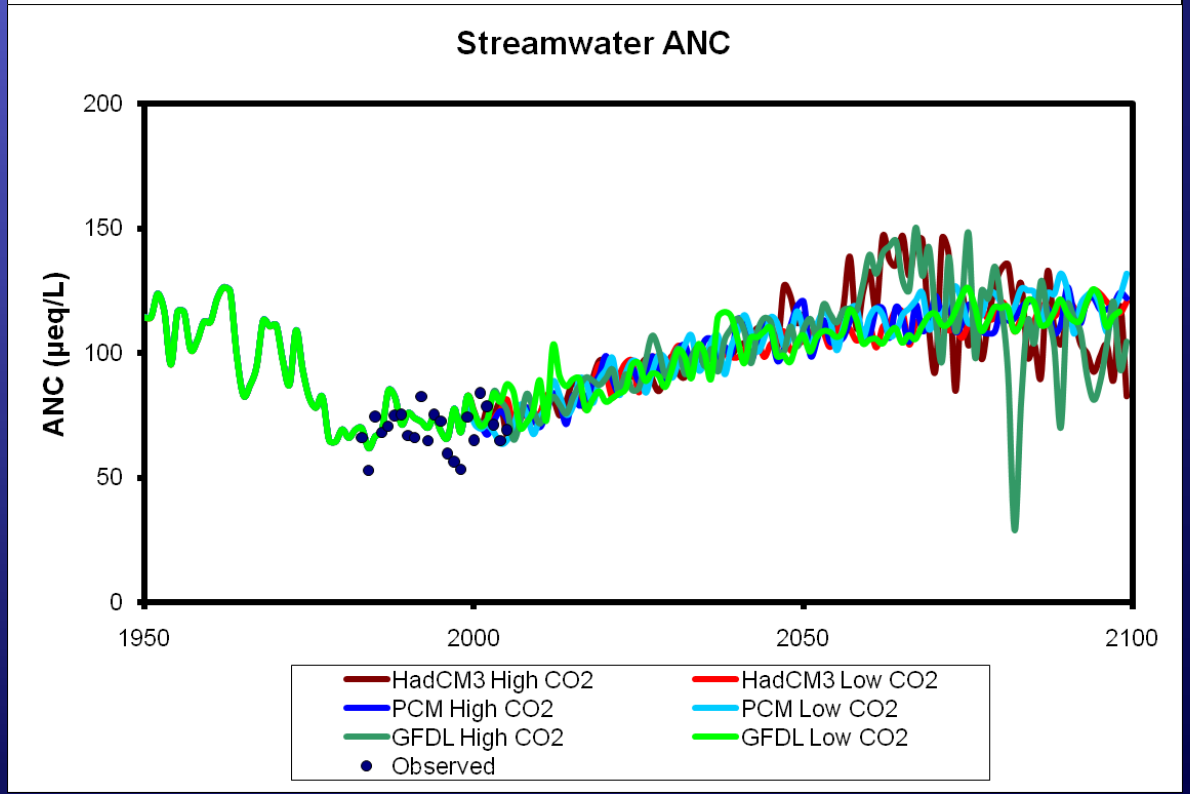
Low CO_2 = 550 ppm
High CO_2 = 970 ppm
at 2100



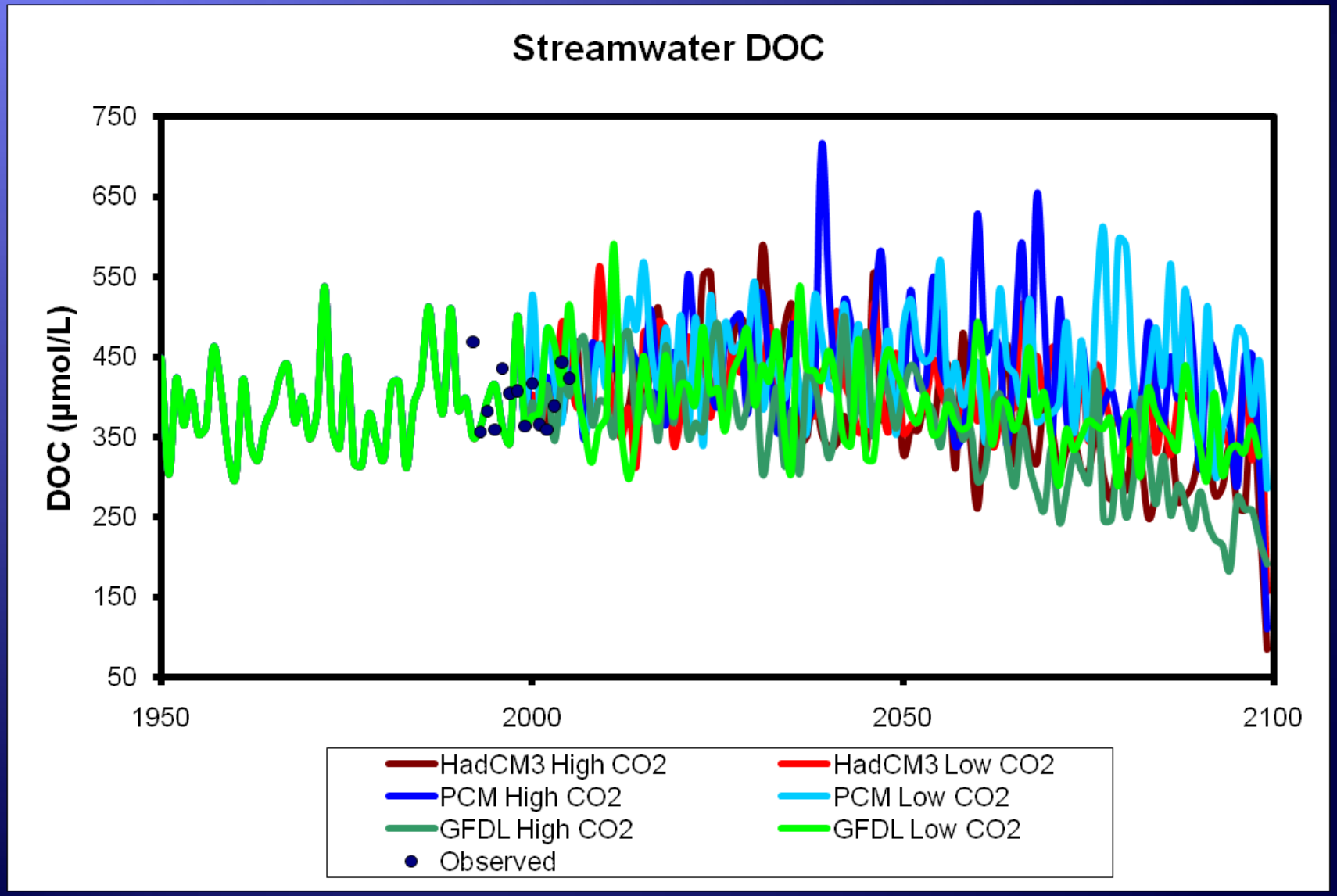


With CO_2 Fertilization

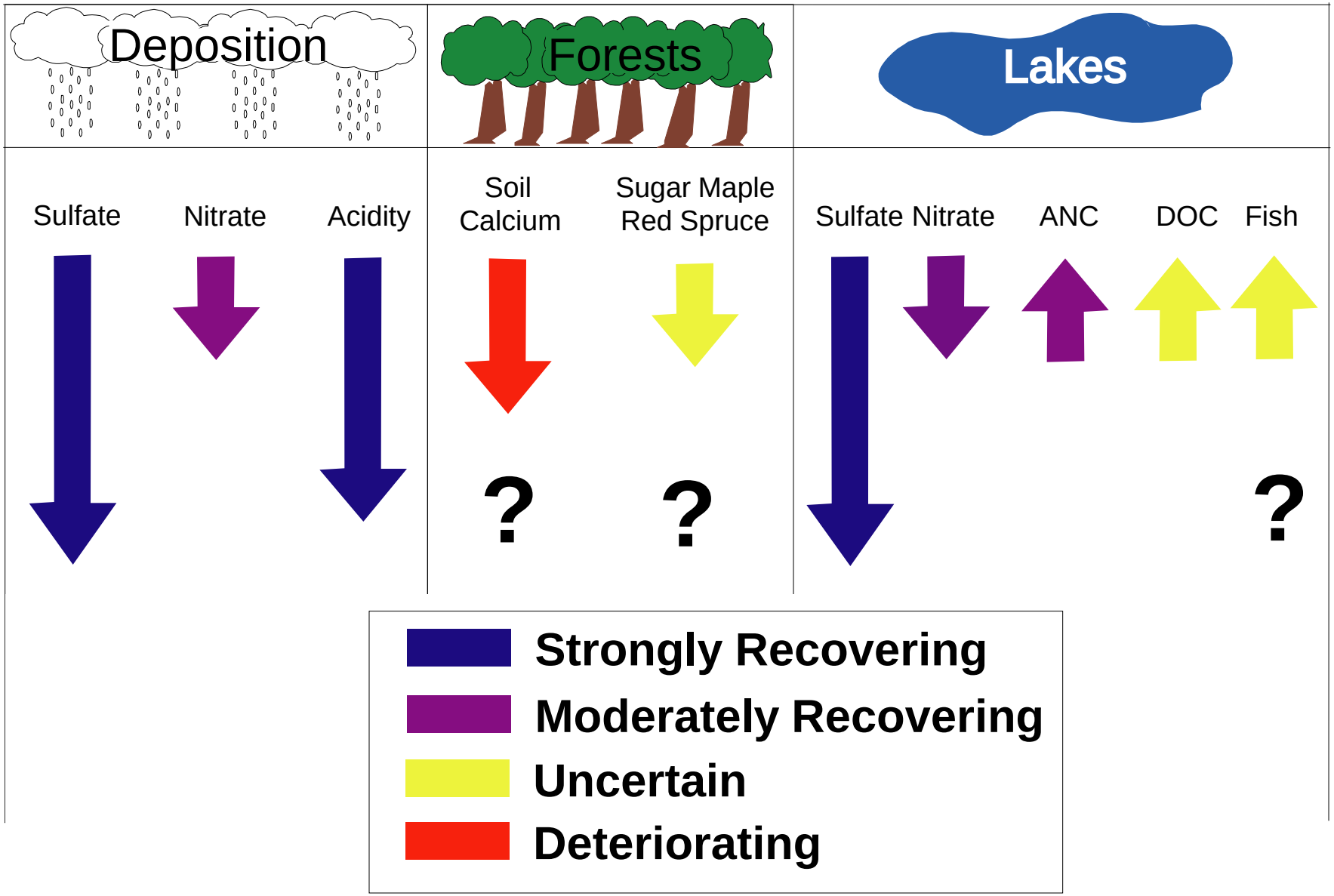




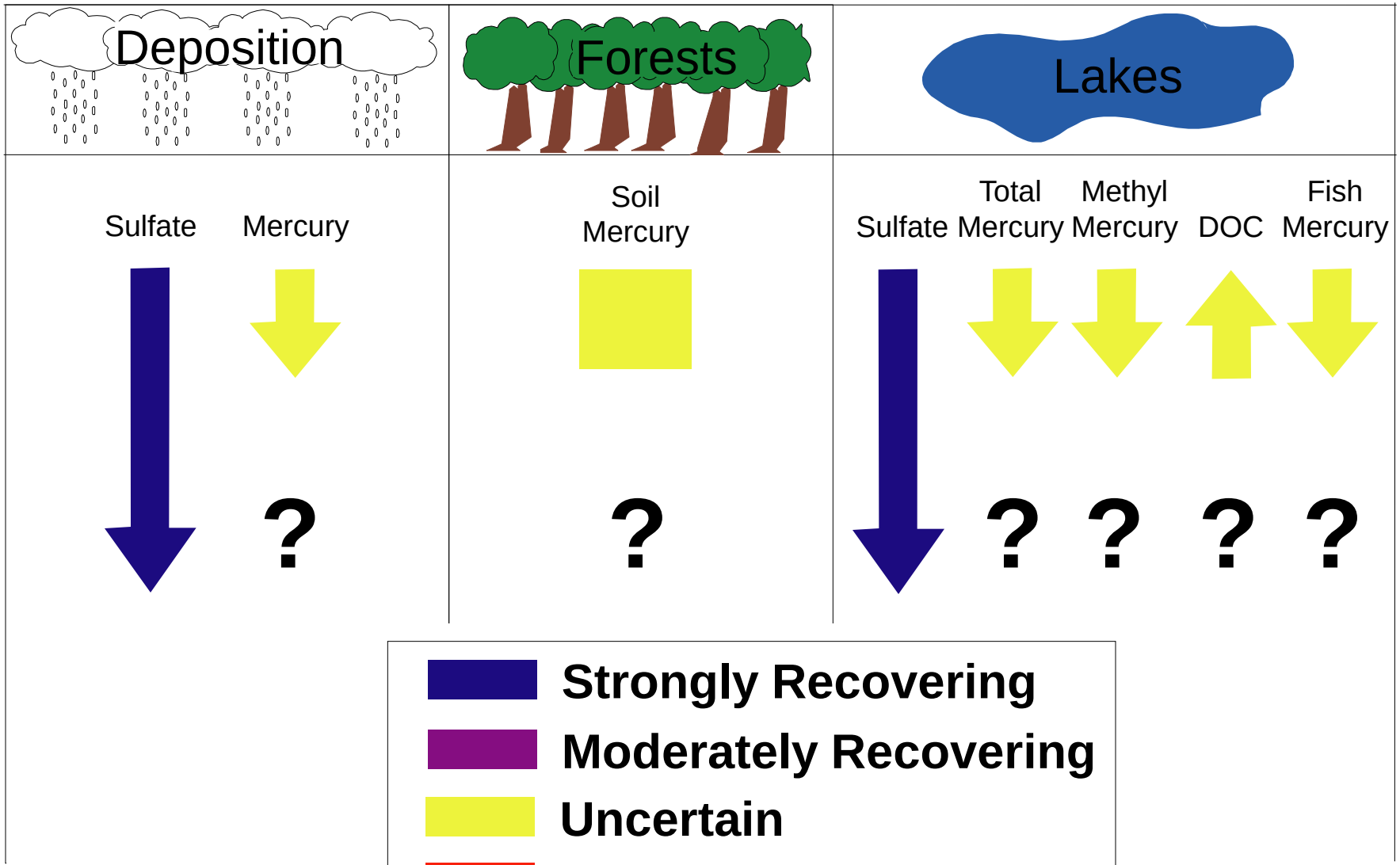
Streamwater DOC



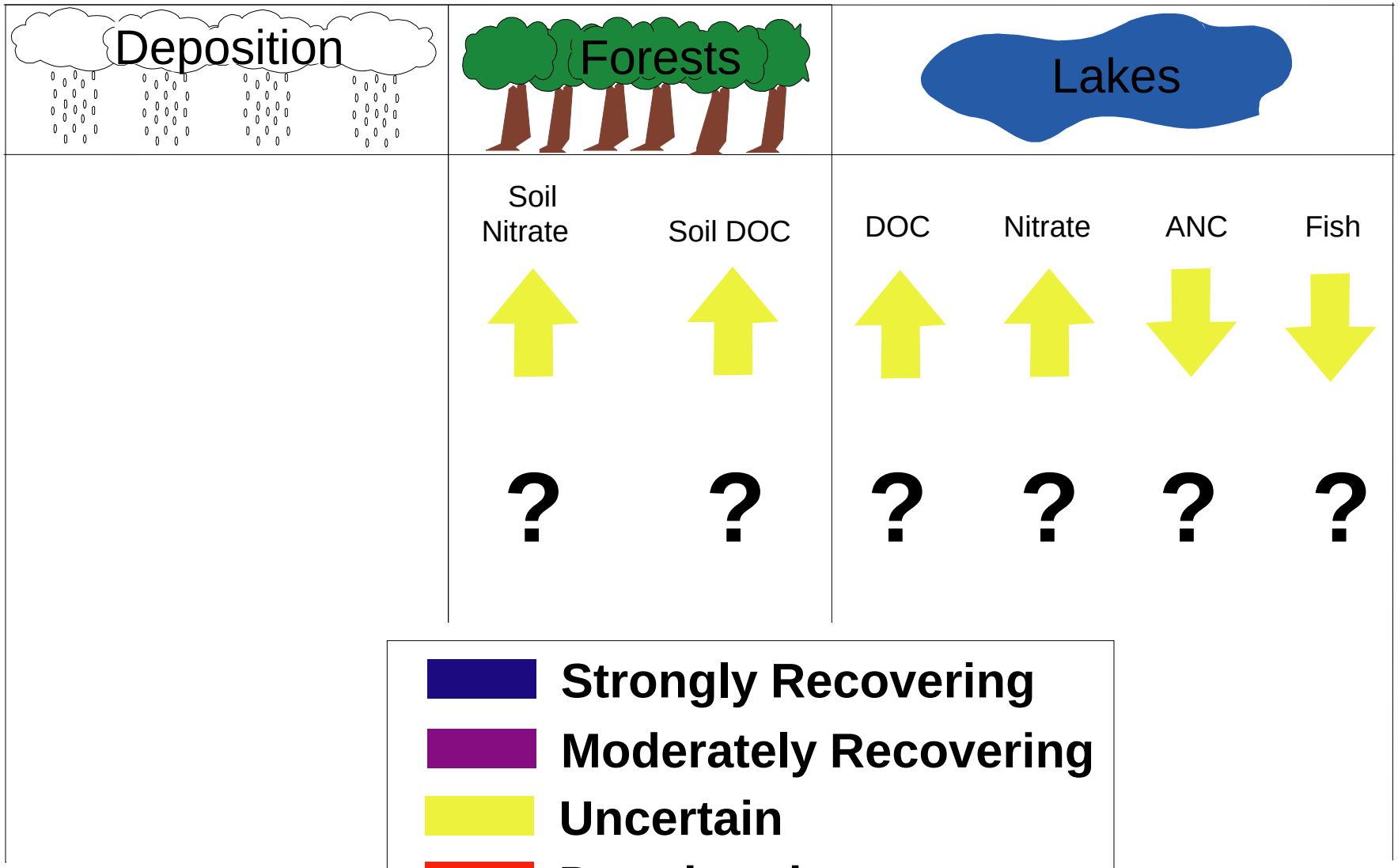
Acidification Recovery



Mercury Interactions

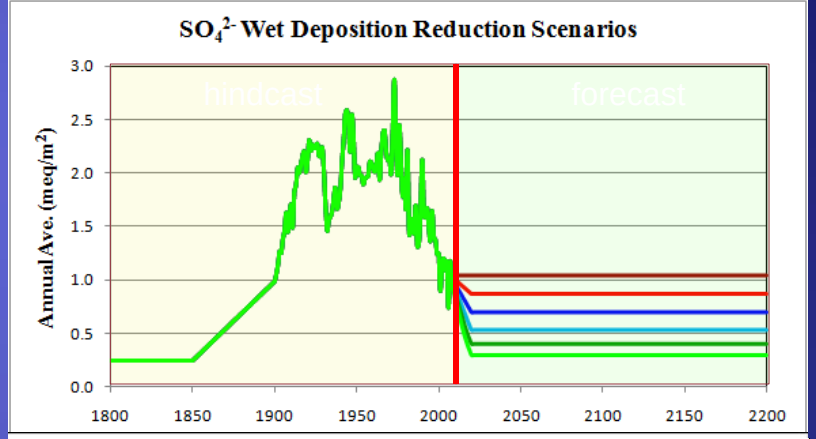


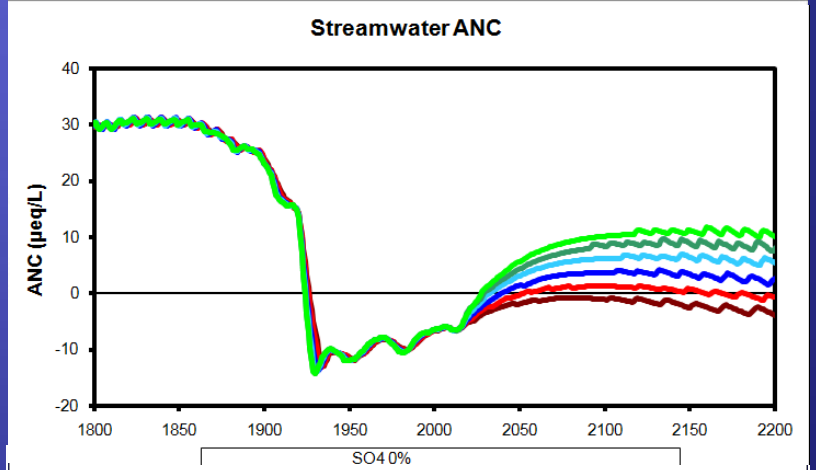
Climate Interactions

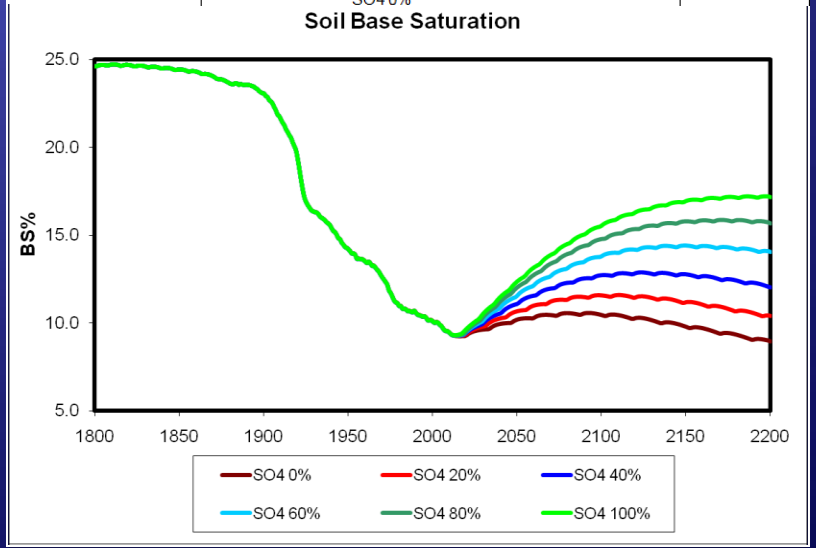


Linkages with State, Regional and Federal Management Programs

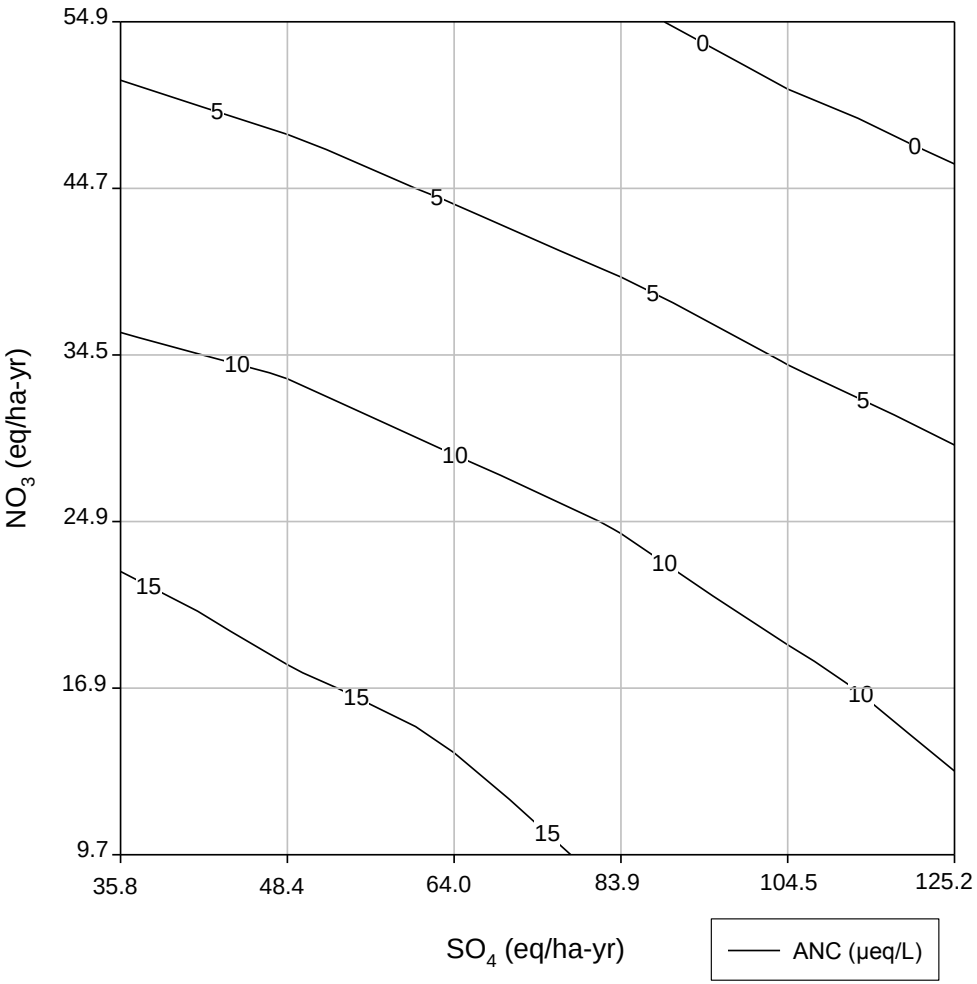
- NADP, CASTNet, LTM, TIME
- CLAD/FOCUS/CASAC
- MercNet
- Mercury pollution committee in NYS
- RGGI


SO_4^{2-} Wet Deposition Reduction Scenarios
hindcast
forecast
Annual Ave. (meq/m²)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1800
1850
1900
1950
2000
2050
2100
2150
2200

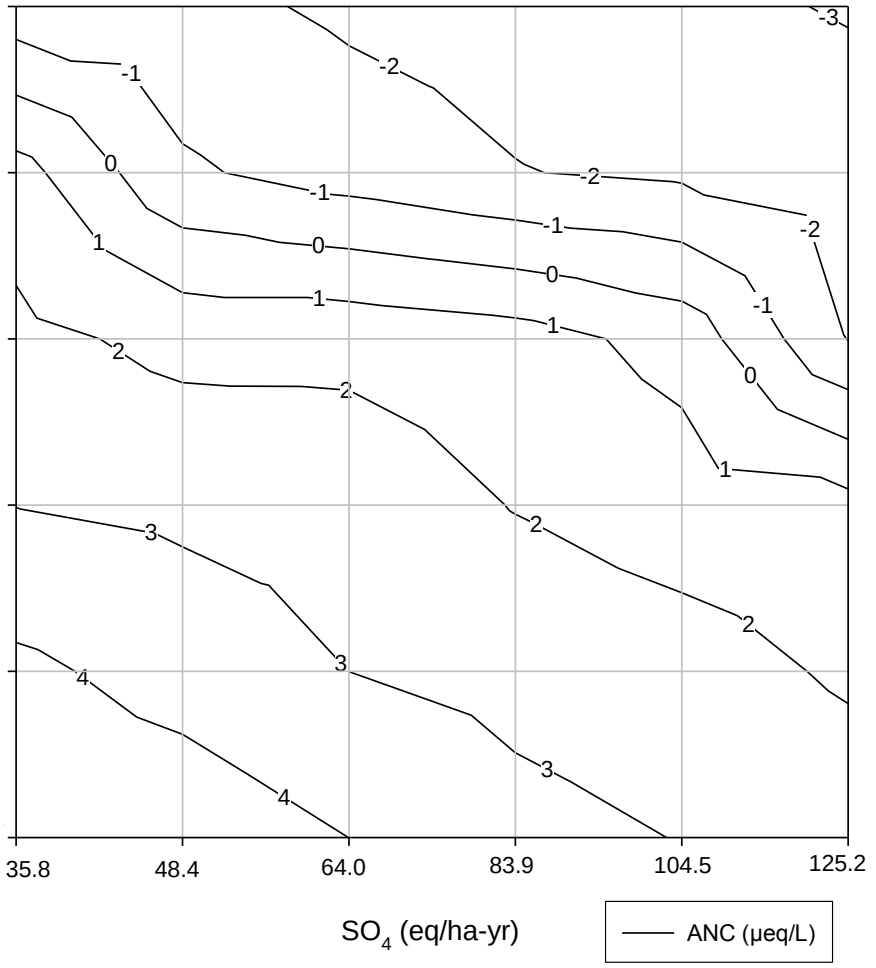

Streamwater ANC
ANC (µeq/L)
40
30
20
10
0
-10
-20
1800
1850
1900
1950
2000
2050
2100
2150
2200
SO4 0%

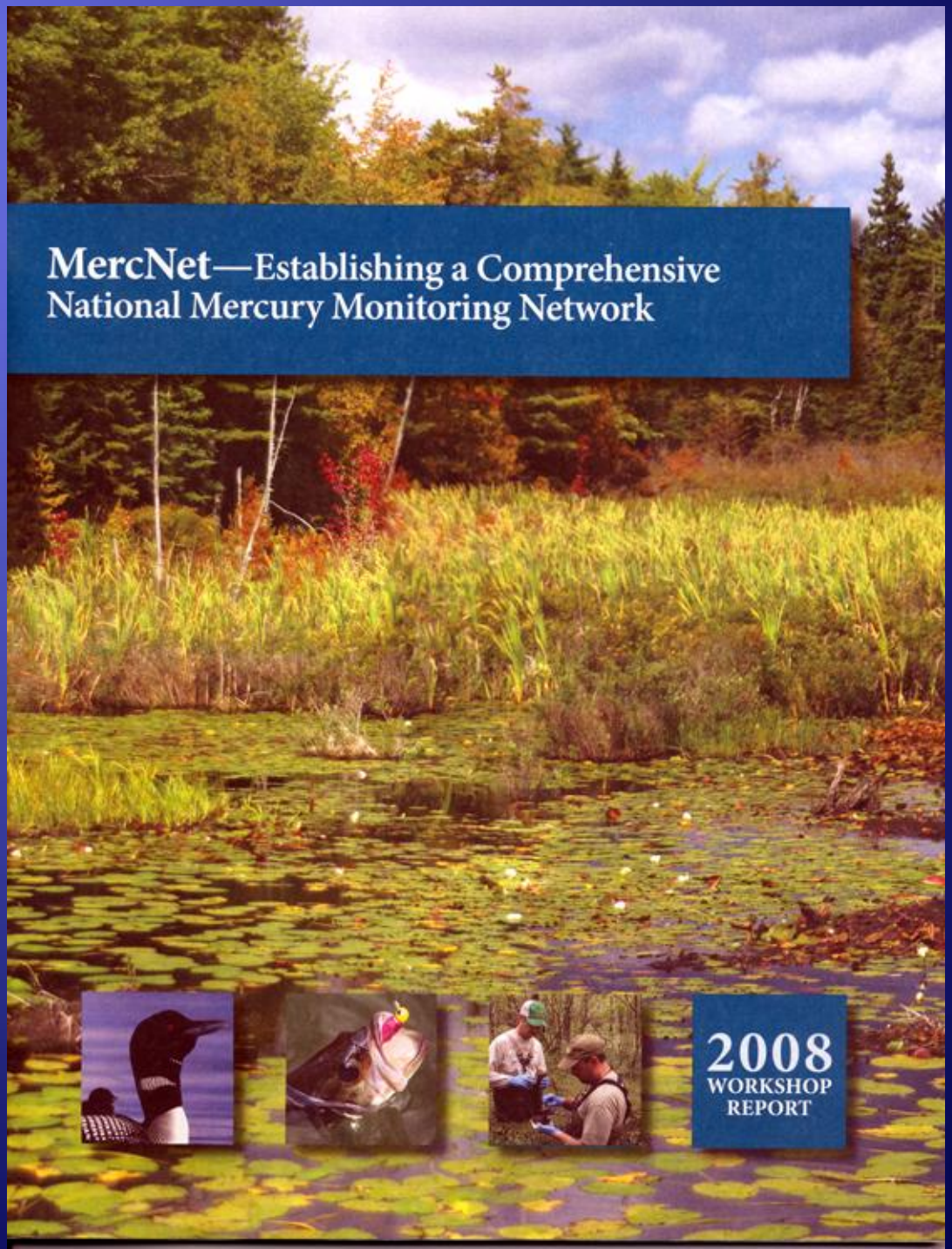

Soil Base Saturation
BS%
25.0
20.0
15.0
10.0
5.0
1800
1850
1900
1950
2000
2050
2100
2150
2200
SO4 0%
SO4 20%
SO4 40%
SO4 60%
SO4 80%
SO4 100%

Isopleth of ANC - Critical Load



Isopleth of ANC - Target Load (2030)




MercNet—Establishing a Comprehensive
National Mercury Monitoring Network
2008
WORKSHOP
REPORT

Final Thoughts

- Continue monitoring, link acidic deposition, mercury and climate change monitoring and modeling
- Link between atmospheric and watershed models
- Better understanding of changes and effects of DOC supply
- Improved understanding and predictions of biological response to climate and chemical change
- Improved dialog between research and management programs