

MODELING CRITICAL LOADS, NEW YORK AND BEYOND

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Project Support:

- **NYSERDA**
- **National Park Service**
- **U.S. EPA**
- **U.S. Forest Service**

Outline:

1. Critical Load – What is it?
2. CL vs. TL vs. Exceedance
3. Models
4. Major Research Focus
 - Weathering
 - Critical Limit
 - Extrapolation
5. Exceedance

Terminology

- Critical Load
- Target Load (Dynamic CL)
- Exceedance

Tools

- **Steady State Mass Balance**
 - **SSWC**
- **Process Models**
 - **MAGIC**
 - **PnET-BGC**

Focus

	Aquatic	Terrestrial
Acidification	X	X
N Enrichment		
Biodiversity		

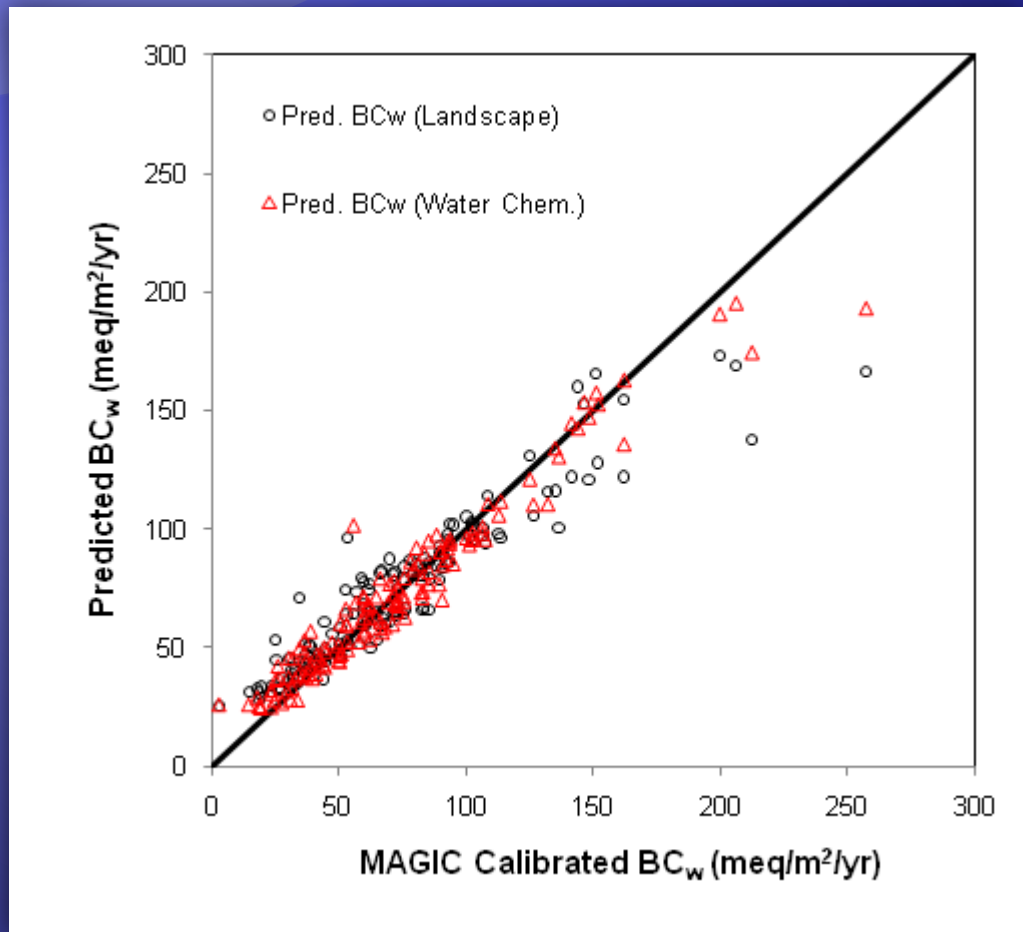
Steady State CL of Acidity

Base cation balance

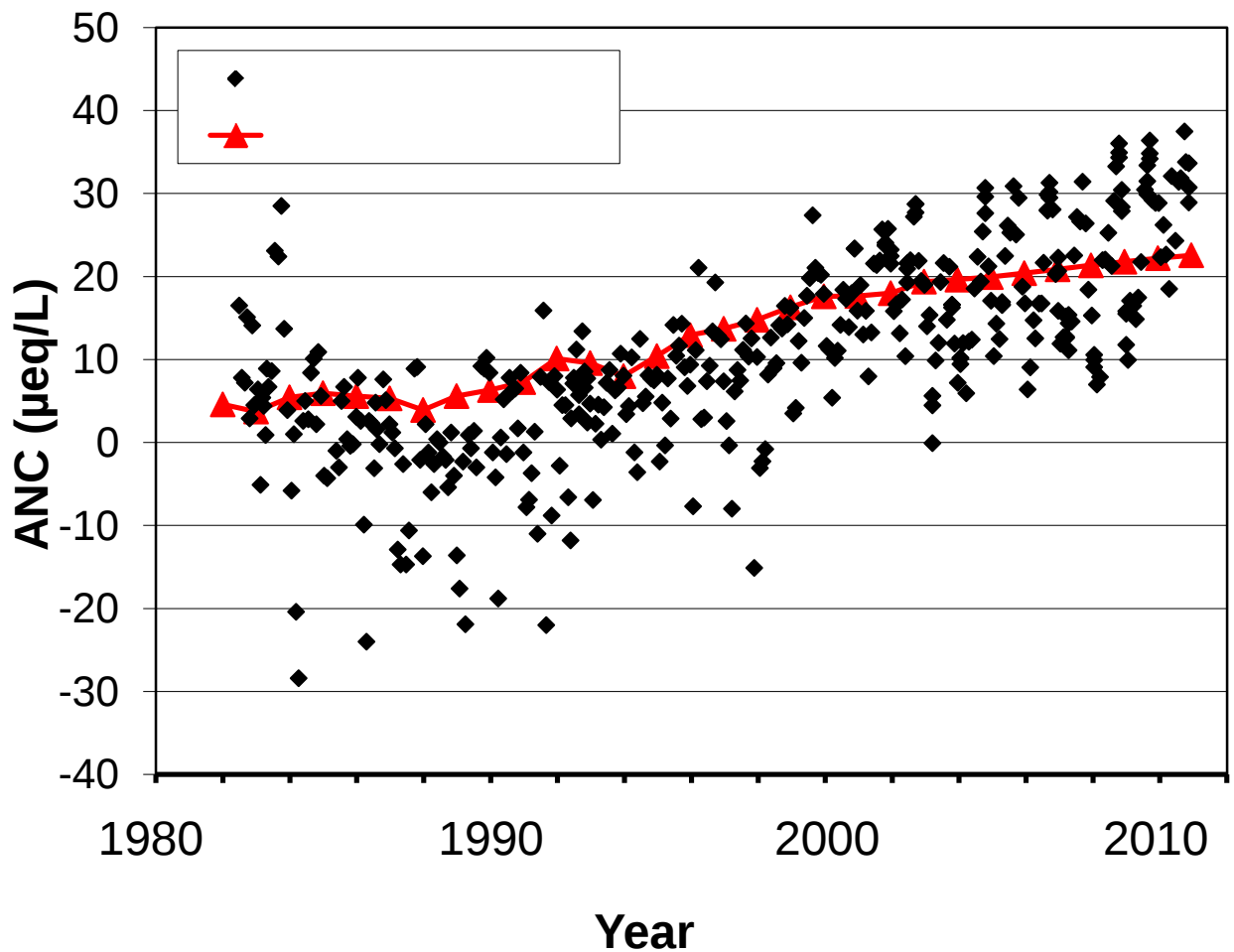
$$\text{CL} = \text{weathering} + \text{deposition} \\ - \text{uptake} - \text{ecological buffer}$$

$CL = \text{weathering} + \text{deposition}$
 $- \text{uptake} - \text{ecological buffer}$

Southeastern Streams



Dart Lake

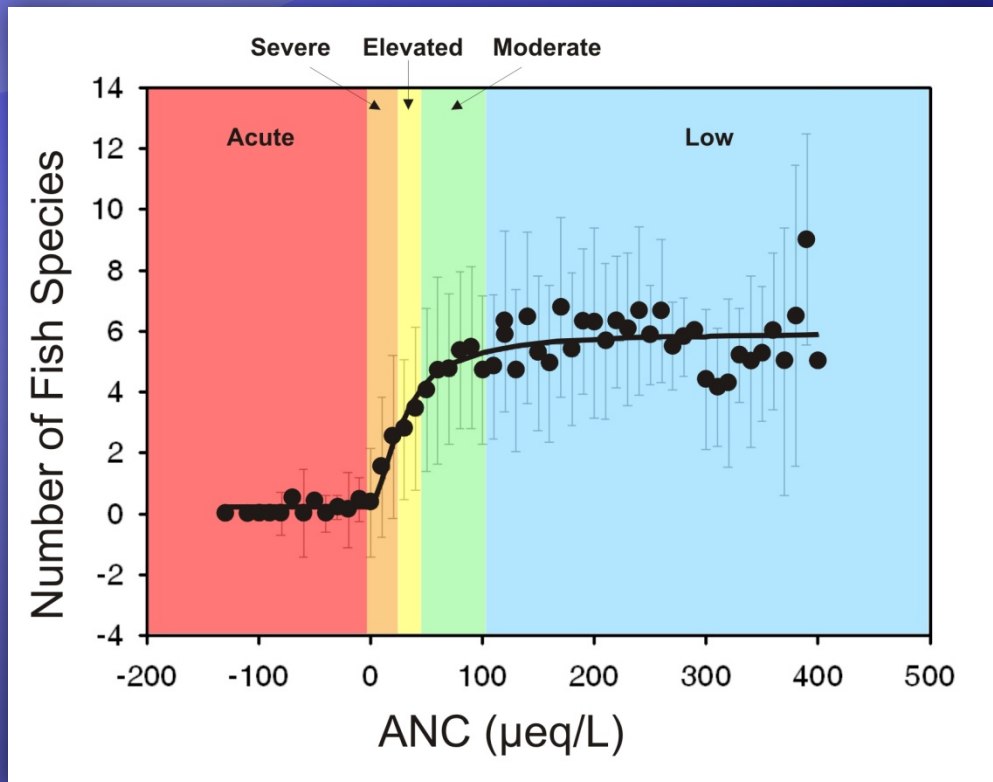


CL = weathering + deposition
- uptake – **ecological buffer**

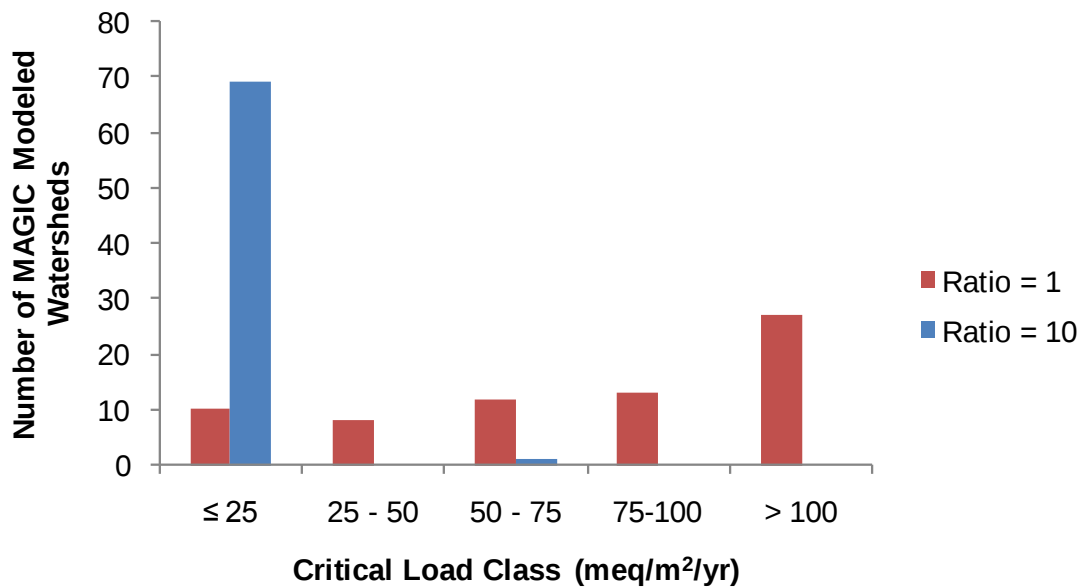
Ecological buffer = runoff x
critical ANC leaching limit

- Protect surface water –
 - ANC = 50 $\mu\text{eq/L}$
- Protect soil and vegetation –
 - Soil solution Ca:Al = 1, 10
 - Soil BS = ?

Adirondacks

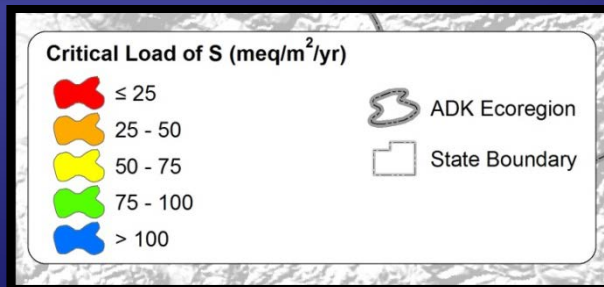
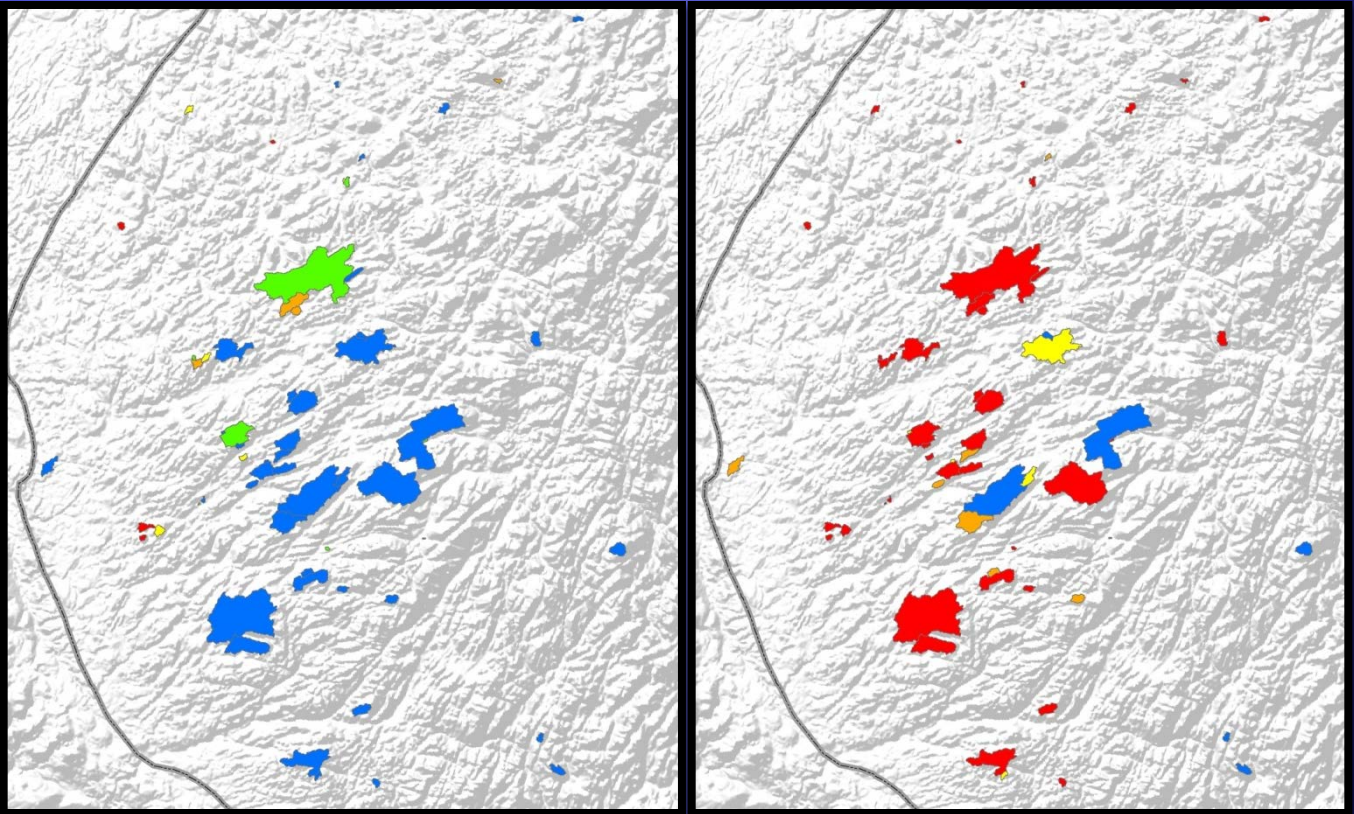


CL of S for Ca/Al Ratio Criterion for the Year 2100

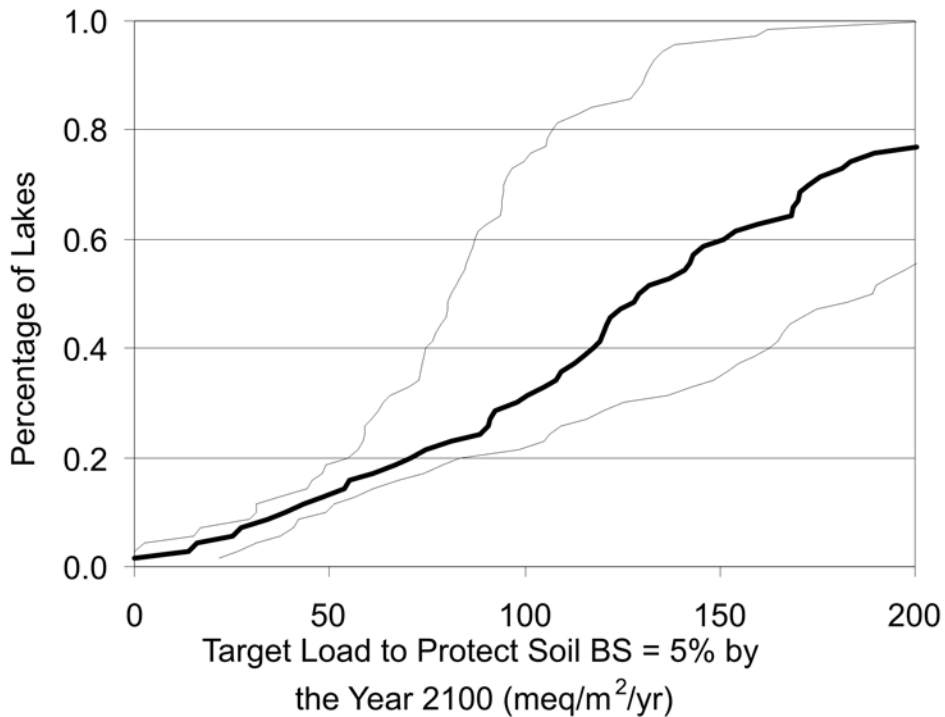


MAGIC Model Watersheds

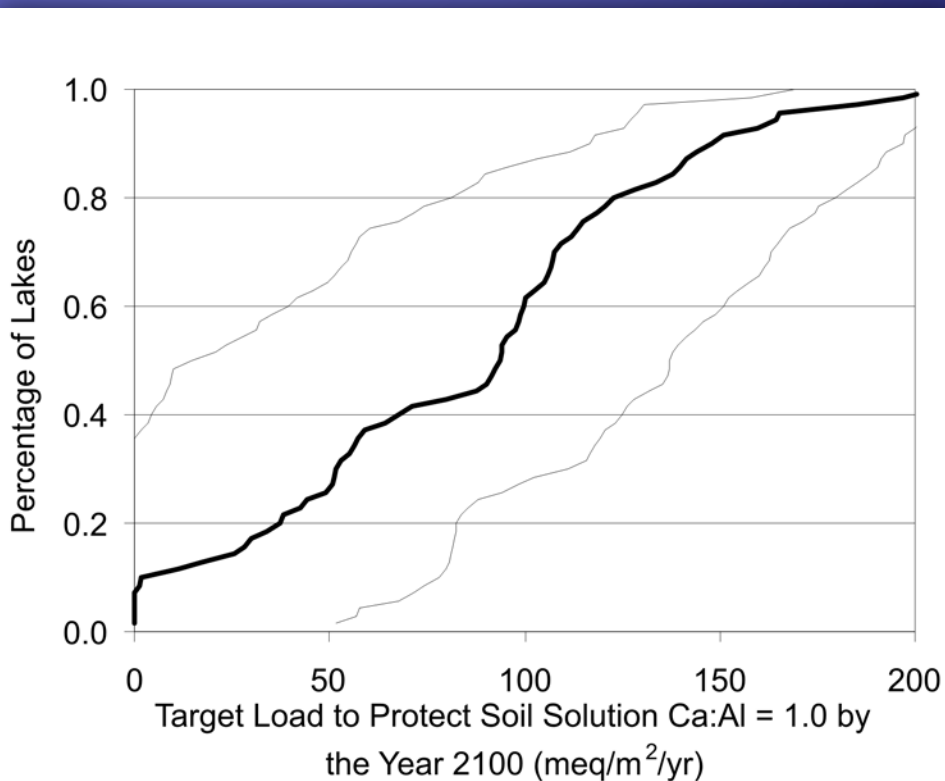
Soil Base Saturation: 5% in 2100 Soil Base Saturation: 10% in 2100

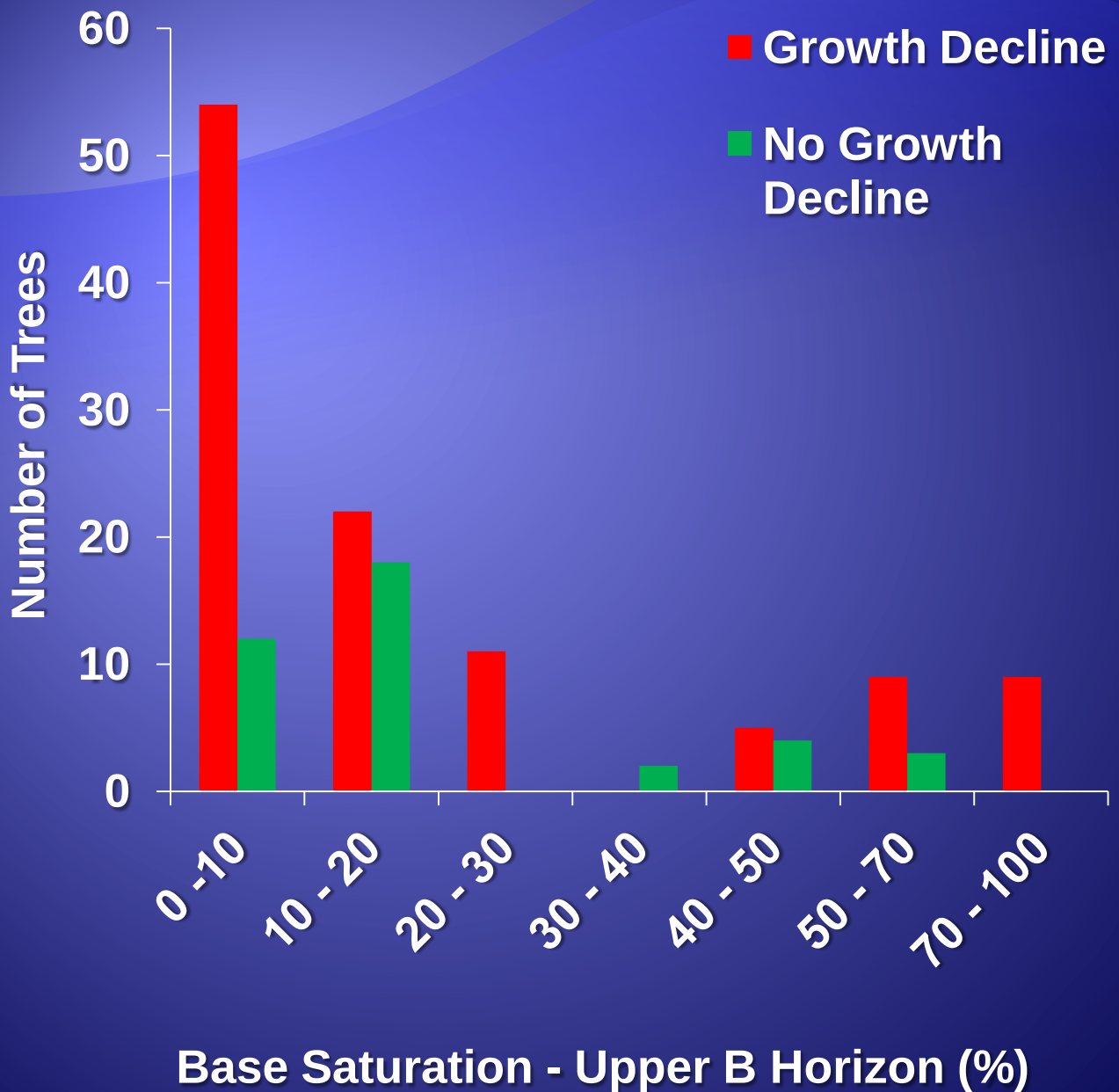


Soil BS

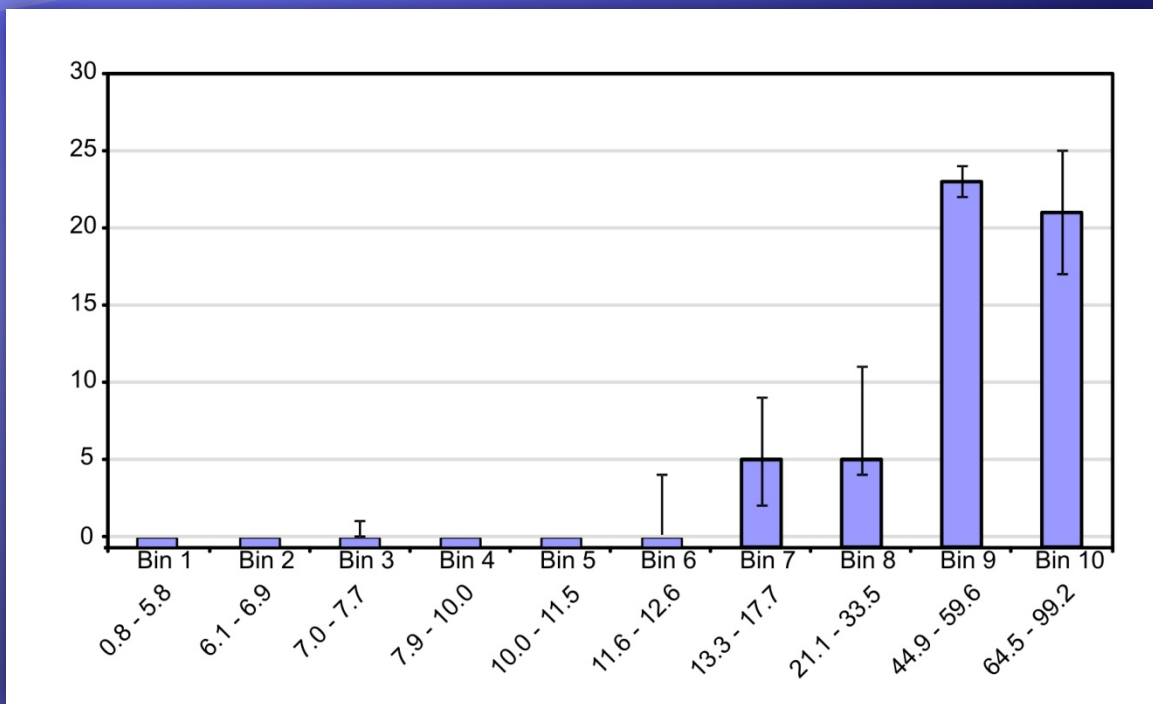


Soil Solution Ca:Al





Sugar Maple Seedling Count

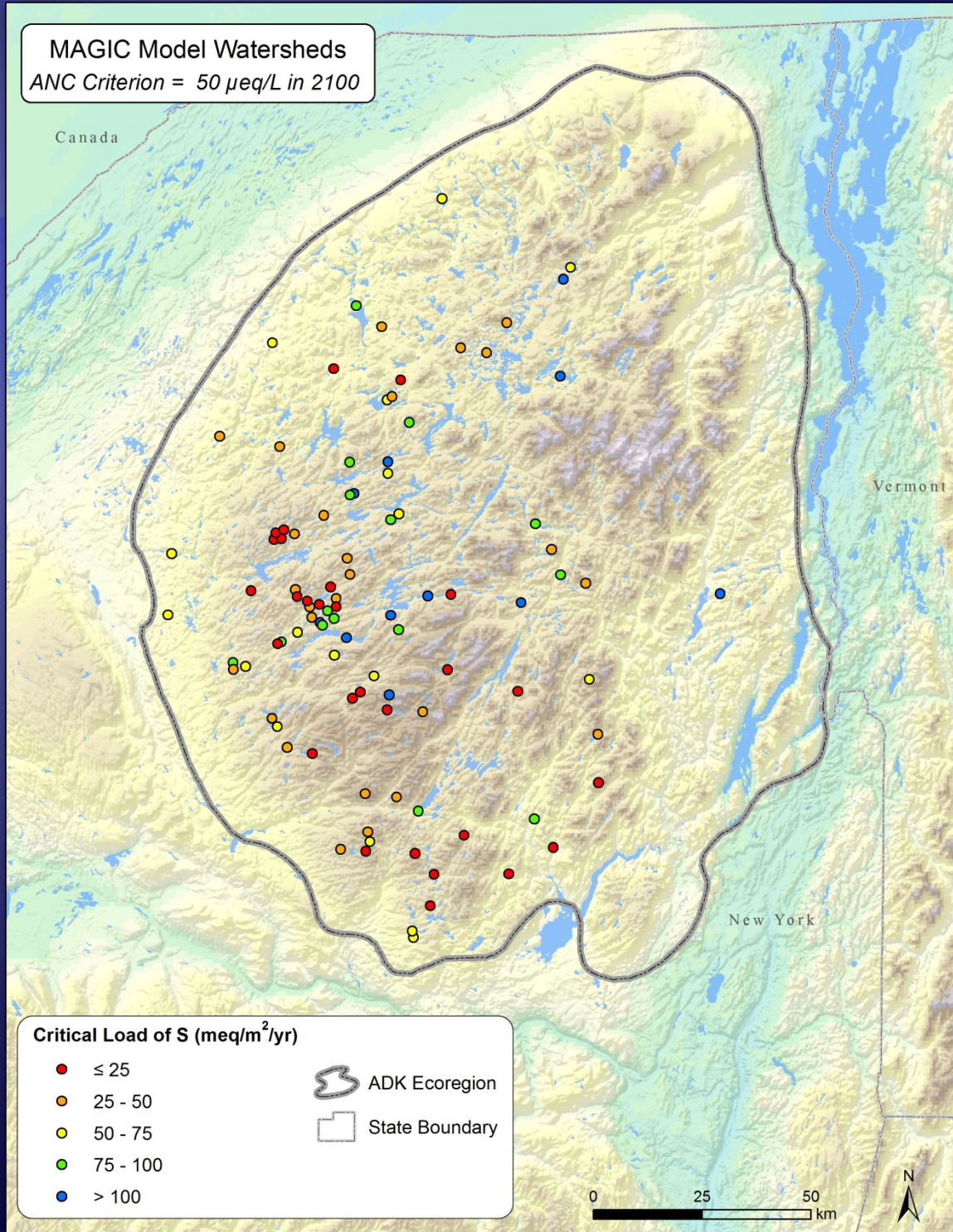


% Base Saturation in Upper B Horizon

EXTRAPOLATION

- Numeric
- Spatial

MAGIC Model Watersheds
ANC Criterion = 50 $\mu\text{eq/L}$ in 2100



Candidate Variables for Extrapolating Critical Load for Adirondack Lakes

Landscape Characteristics

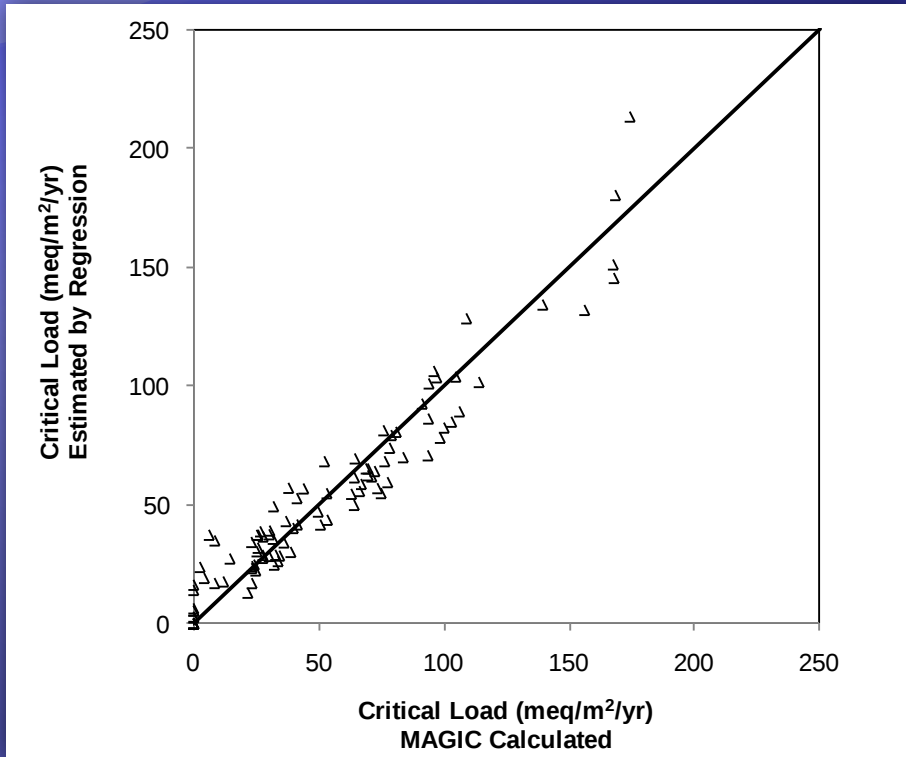
- Watershed area
- WA:SA
- Elevation
- Slope
- % clay in soil
- Soil pH
- Soil depth to restricting layer

Water Chemistry

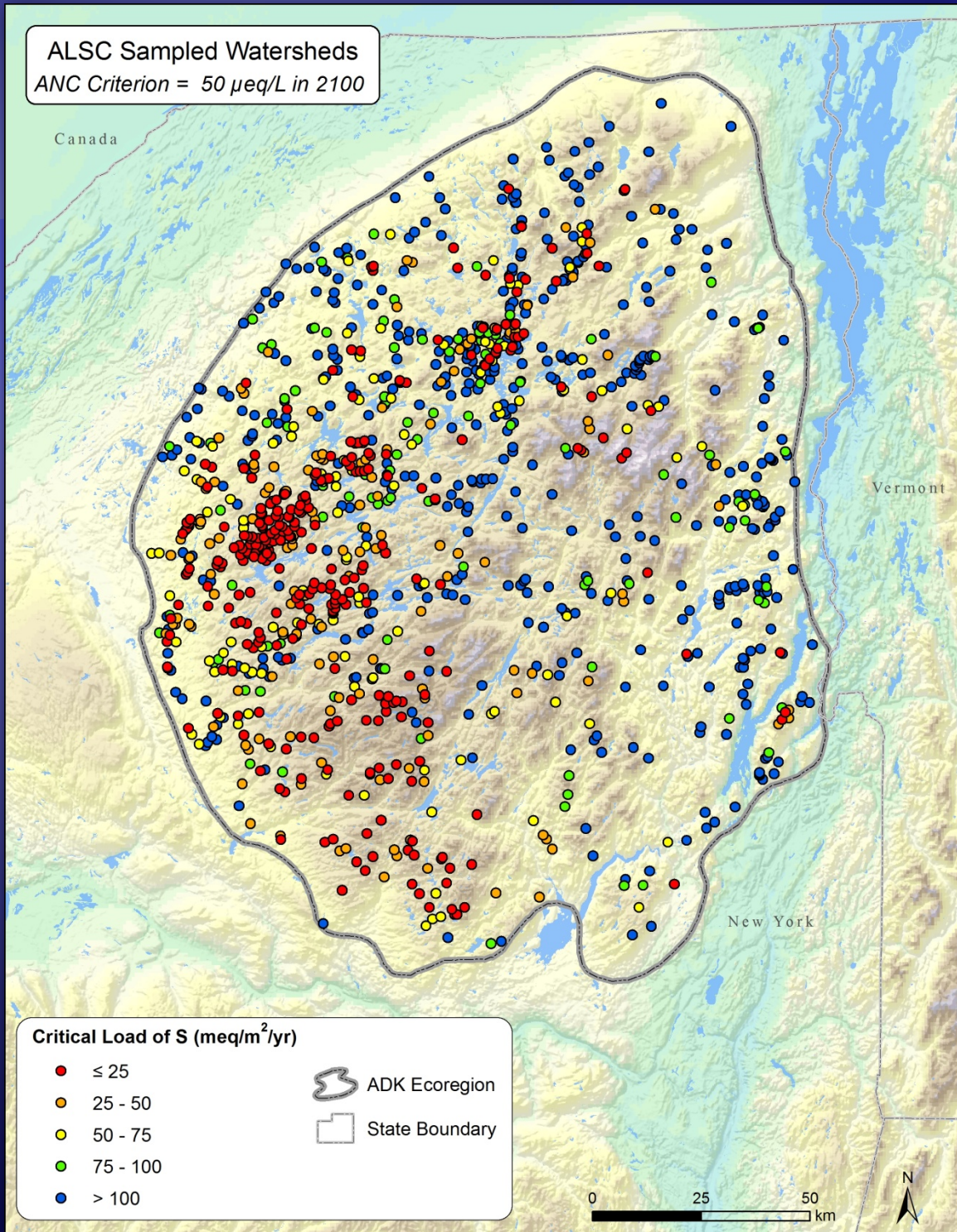
- ANC
- pH
- Sum of base cations
- Sum of base cations – chloride
- Sulfate
- Nitrate

Adirondack Lakes

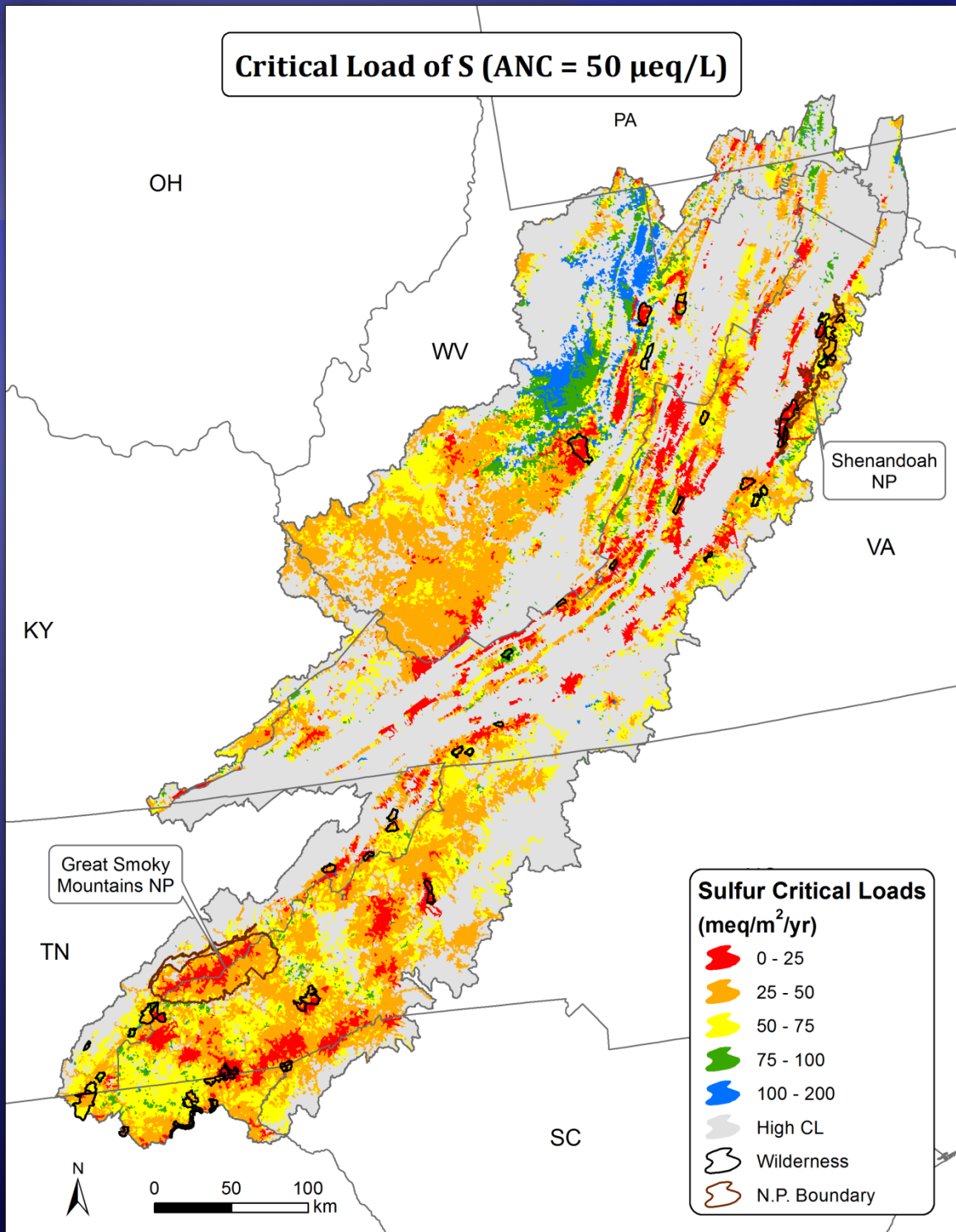
ANC = 50 $\mu\text{eq/L}$. Year 2100



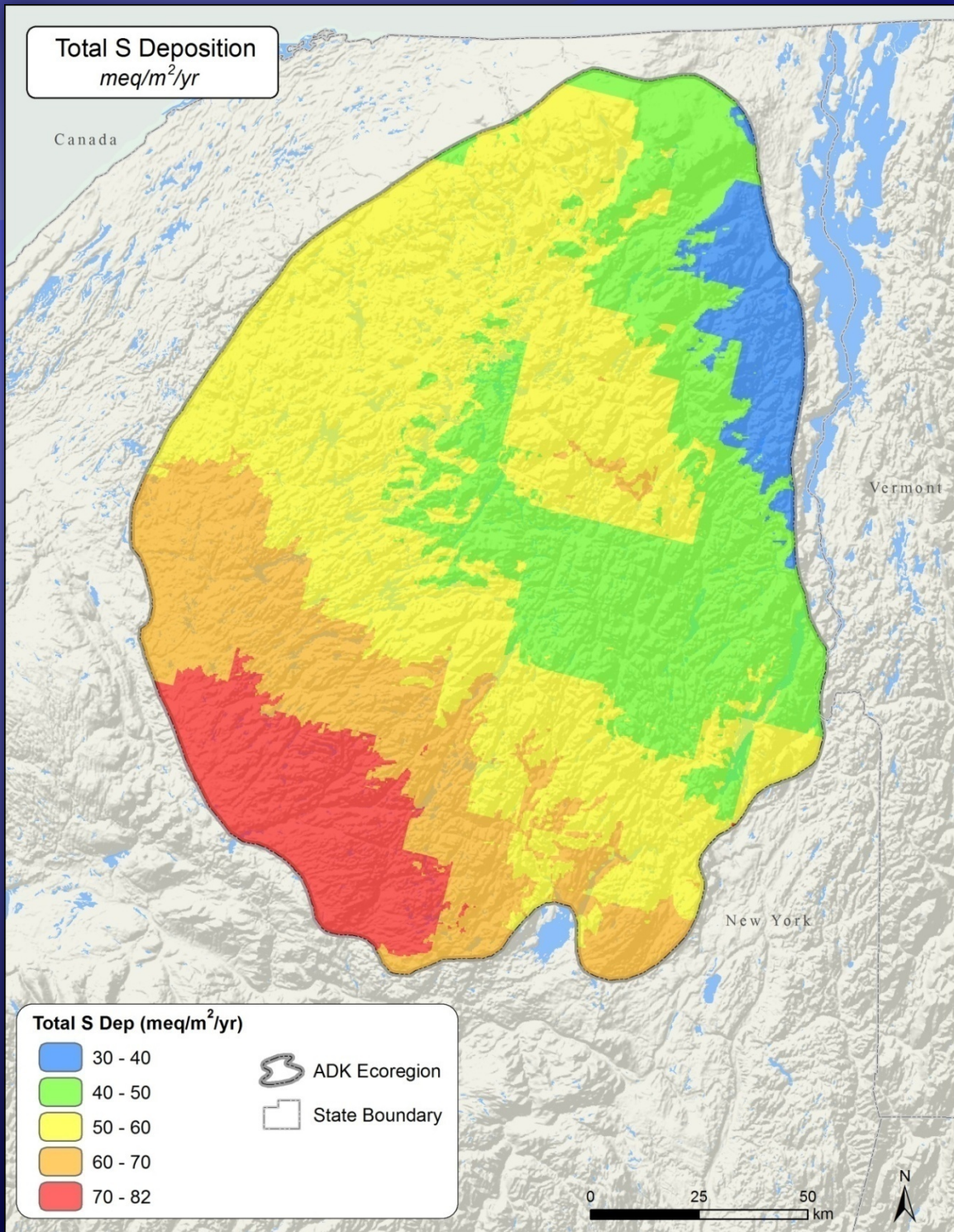
TARGET LOAD



Southeast



Adirondacks



EXCEEDANCE

