Looking at Long-Term Trends in Your Lake

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Andrew Brainard, PhD

Upstate Freshwater Institute

Acknowledgments

CSLAP Volunteers!

Upstate Freshwater Institute
Monica Matt
Dave Matthews, PhD
Sue O'Donnell
Dave O'Donnell

NYSDEC

NYSFOLA

Overview

- Why care about long-term monitoring and trends?

- Trends in NYS lakes over time
  - Trophic indicators - *total phosphorus, chlorophyll-a, Secchi depth*
  - Climate change

- Applications of long-term monitoring and trends
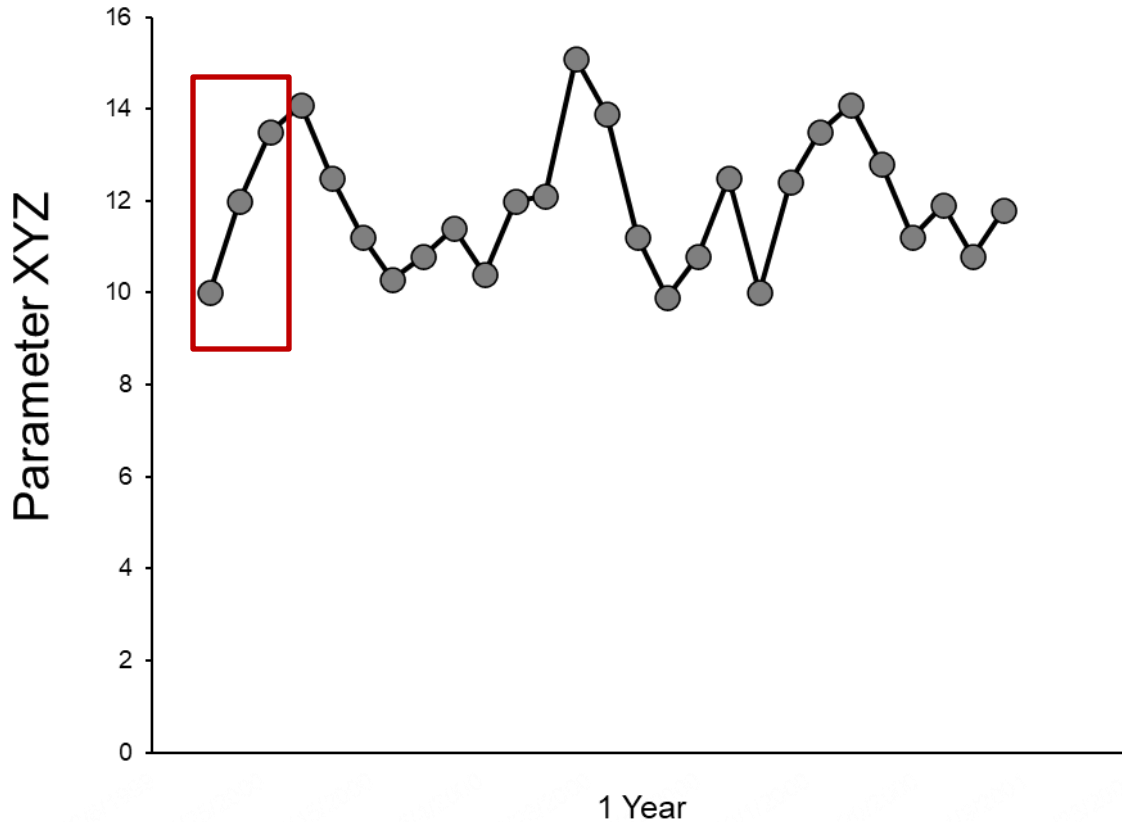
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What is long-term?

- "You know it when you see it …"

- Statistical power

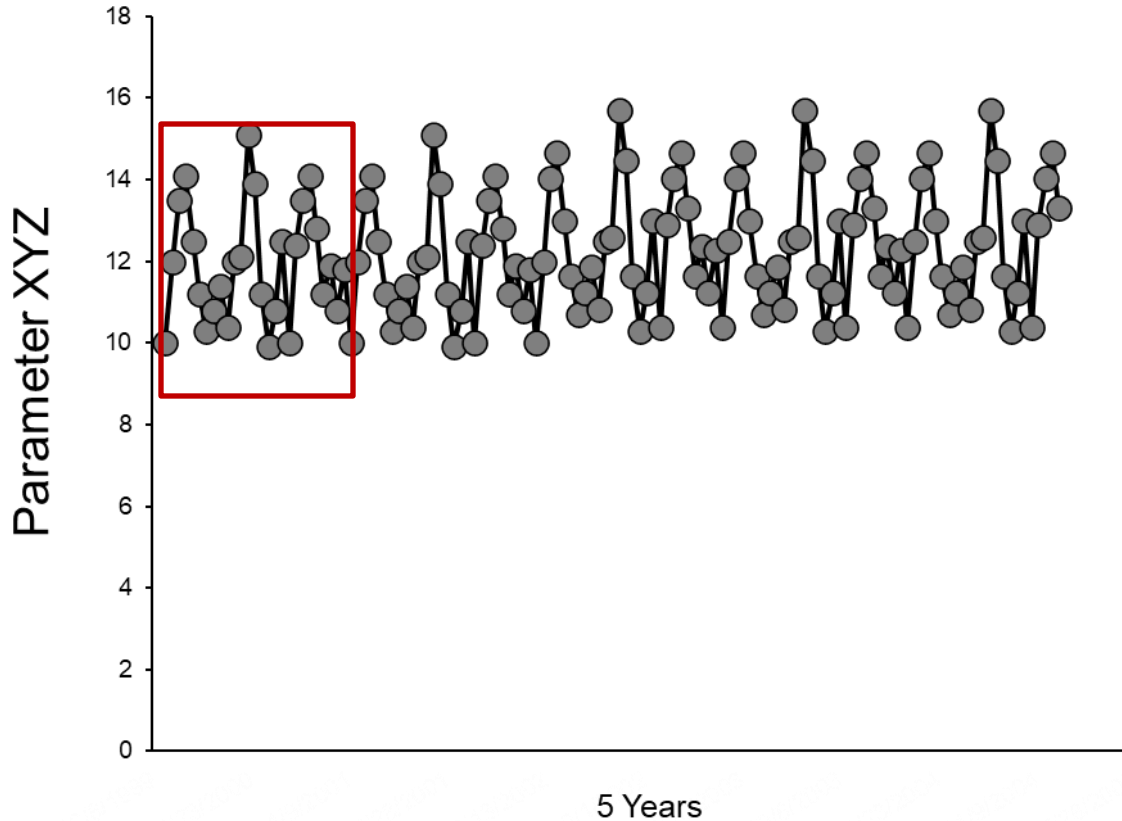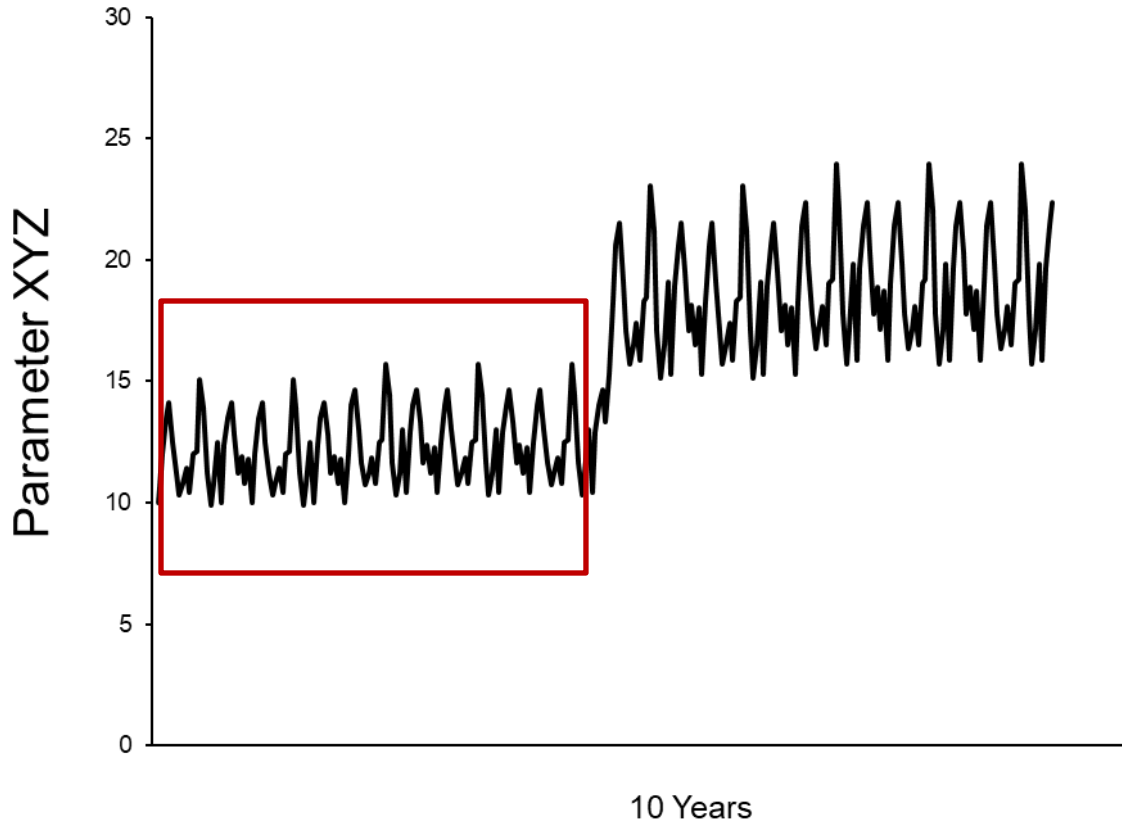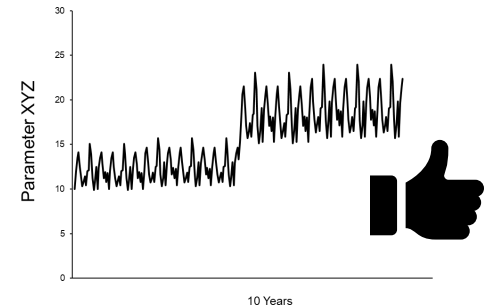- May depend on specific objective/question

Why care about long-term trends?
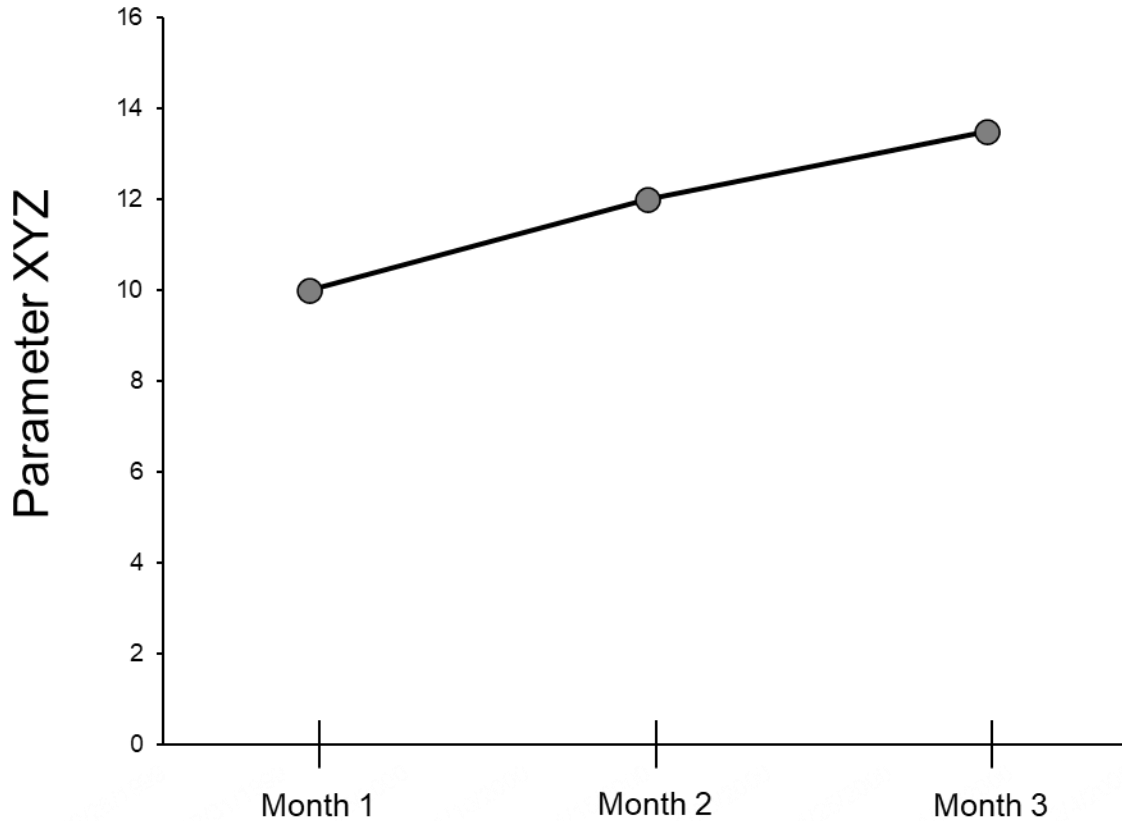
Why care about long-term trends?

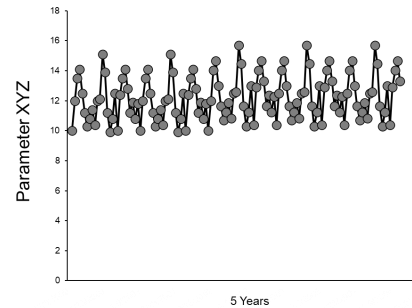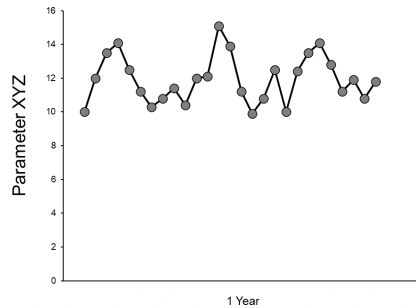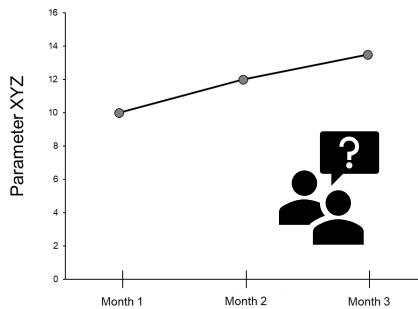# Why care about long-term trends?

Why care about long-term trends?

Why care about long-term trends?

- Patterns!
- Science-based decision(s)
- Scientific discovery
- Applications – models, ecological forecasting

Era of monitoring and "big data" in ecology…

Examples:

- **L**ong-**T**erm **E**cological **R**esearch Network (**LTER**)
- **N**ational **E**cological **O**bservatory **N**etwork (**NEON**)
- **G**lobal **L**ake **E**cological **O**bservatory **N**etwork (**GLEON**)
- **G**reat **L**akes **O**bserving **S**ystem (**GLOS**)
- USGS water data (e.g., stream flow gages), NOAA Tides and Currents, etc.

Availability of environmental data at an all time high (and increasing)!

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Citizens **S**tatewide **L**ake **A**ssessment **P**rogram (**CSLAP**)

- Established in 1985 by NYSDEC and NYSFOLA
  - Trained volunteers collect data from representative lakes throughout New York State

- Goals
  - Collect lake data
  - Identify problems
  - Educate the public

- 164 lakes in 2021!
- Unique dataset!

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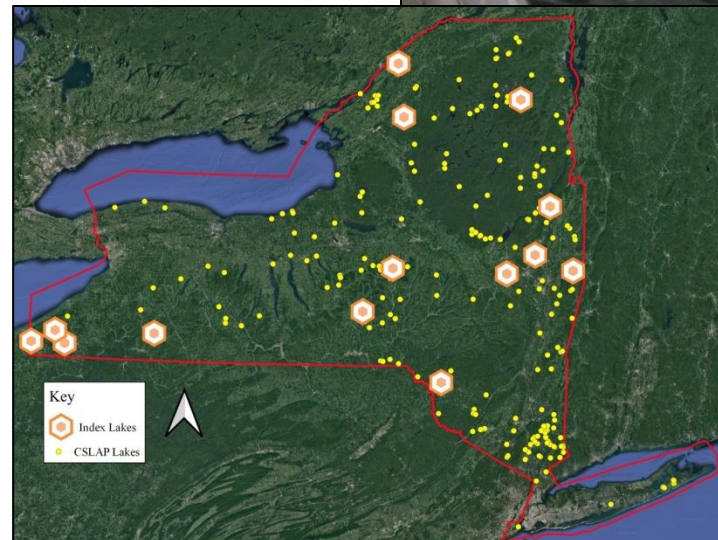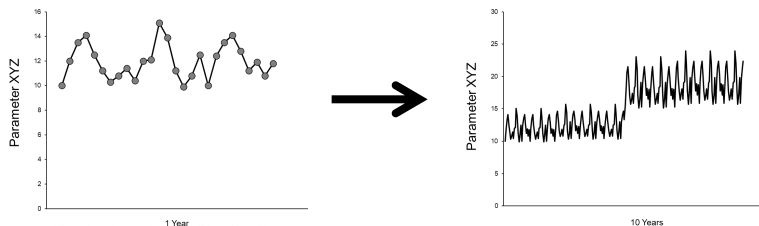
CSLAP Annual Reports

- Important milestones in the long-term stories of our lakes

- Power of consistent long-term monitoring for trend analysis

Annual reports are like chapters in a very long book or rest stops on the highway

OR,

"Rest areas – necessary, but not memorable"

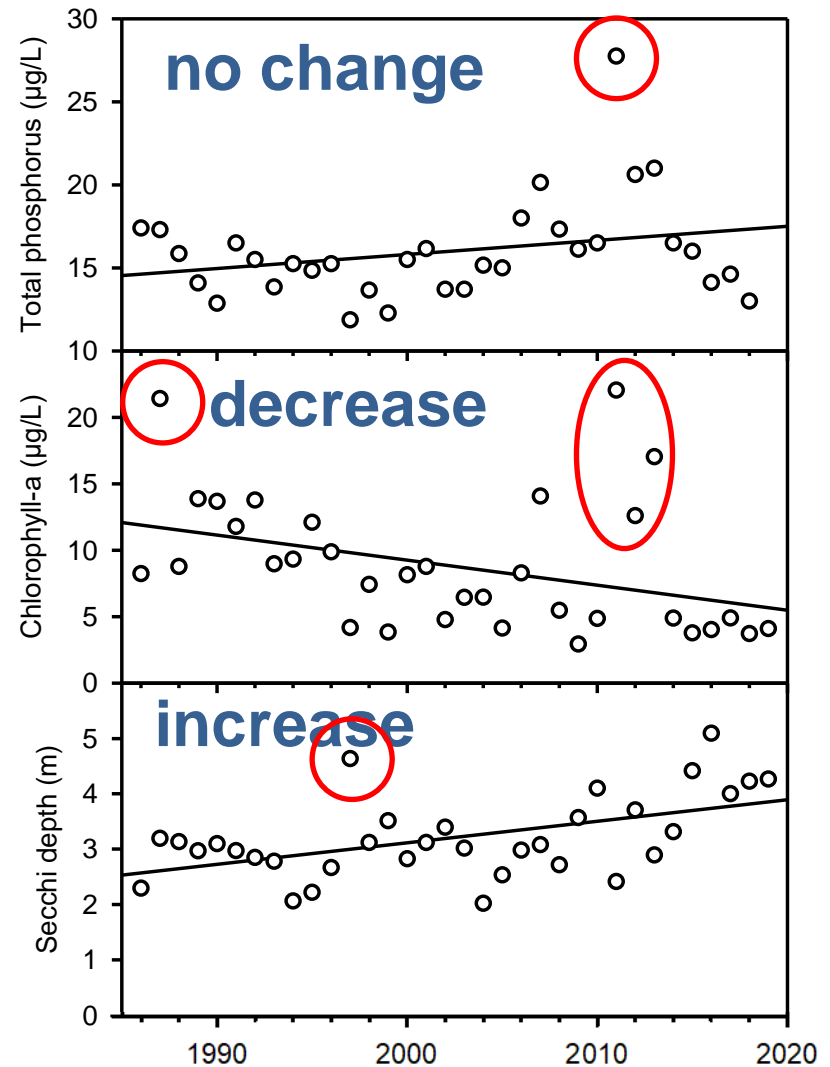
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Trends in Trophic Indicators
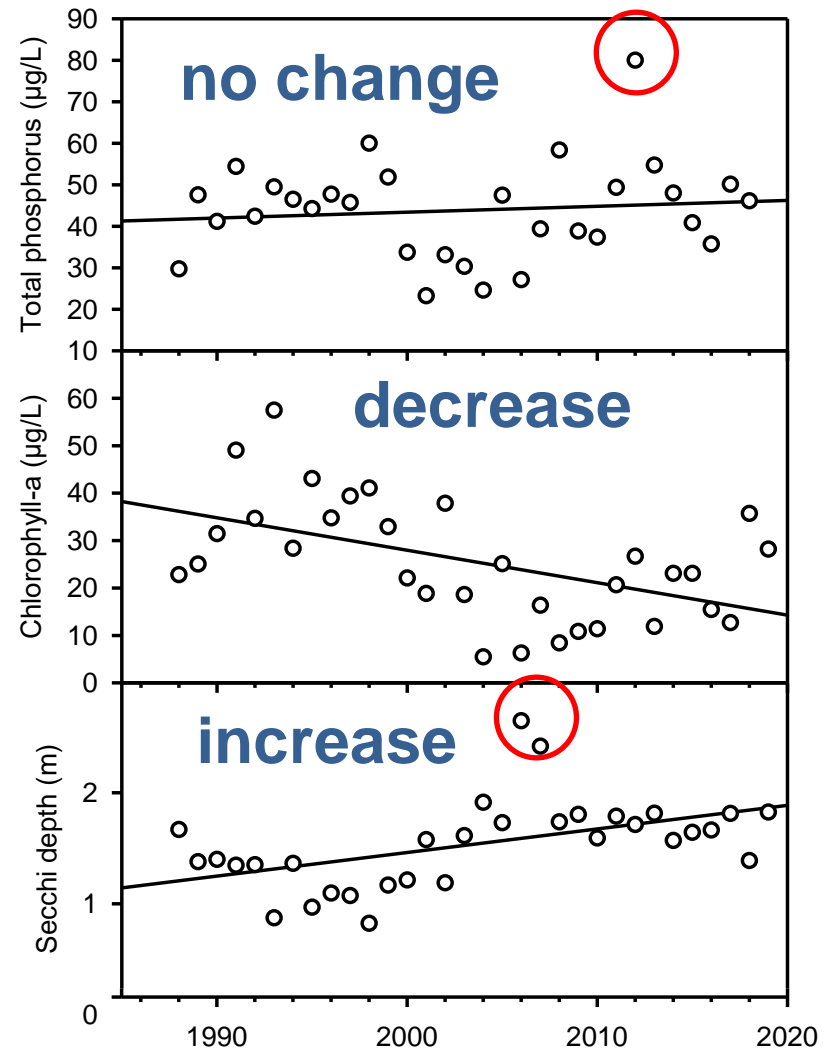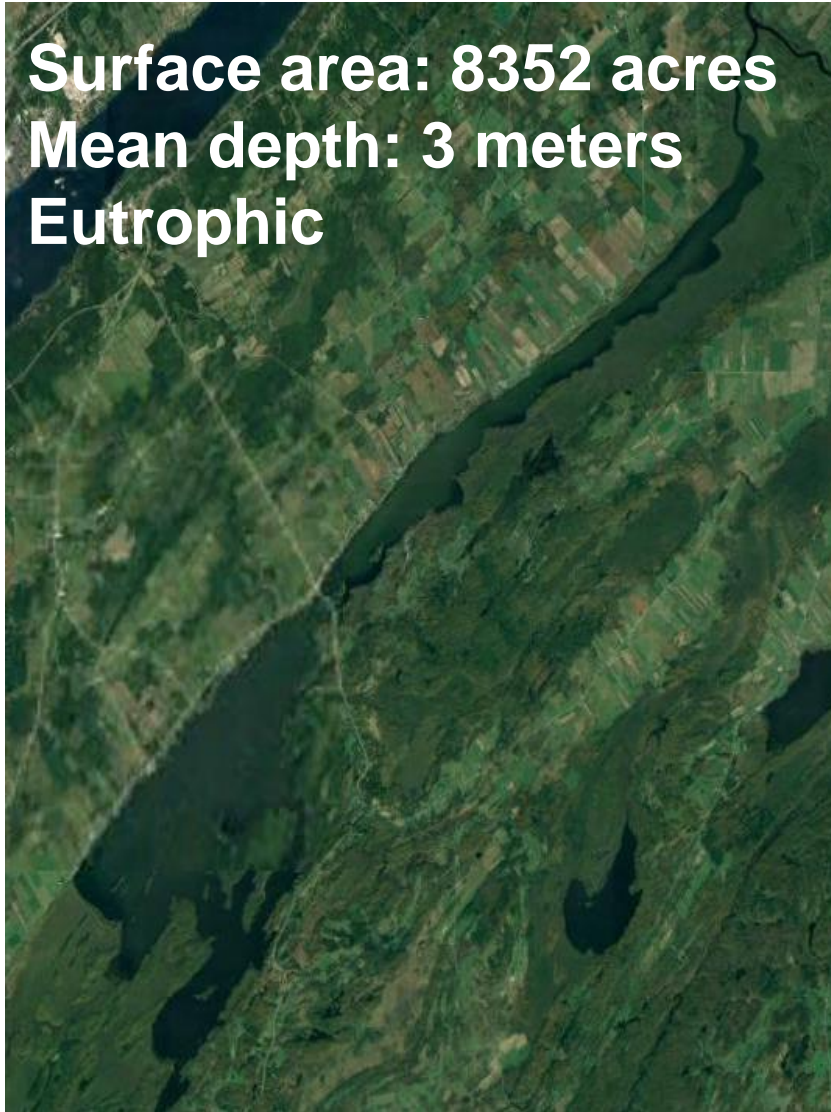
Examples with CSLAP data

Trophic Indicators - Lake Moraine

Surface area: 250 acres
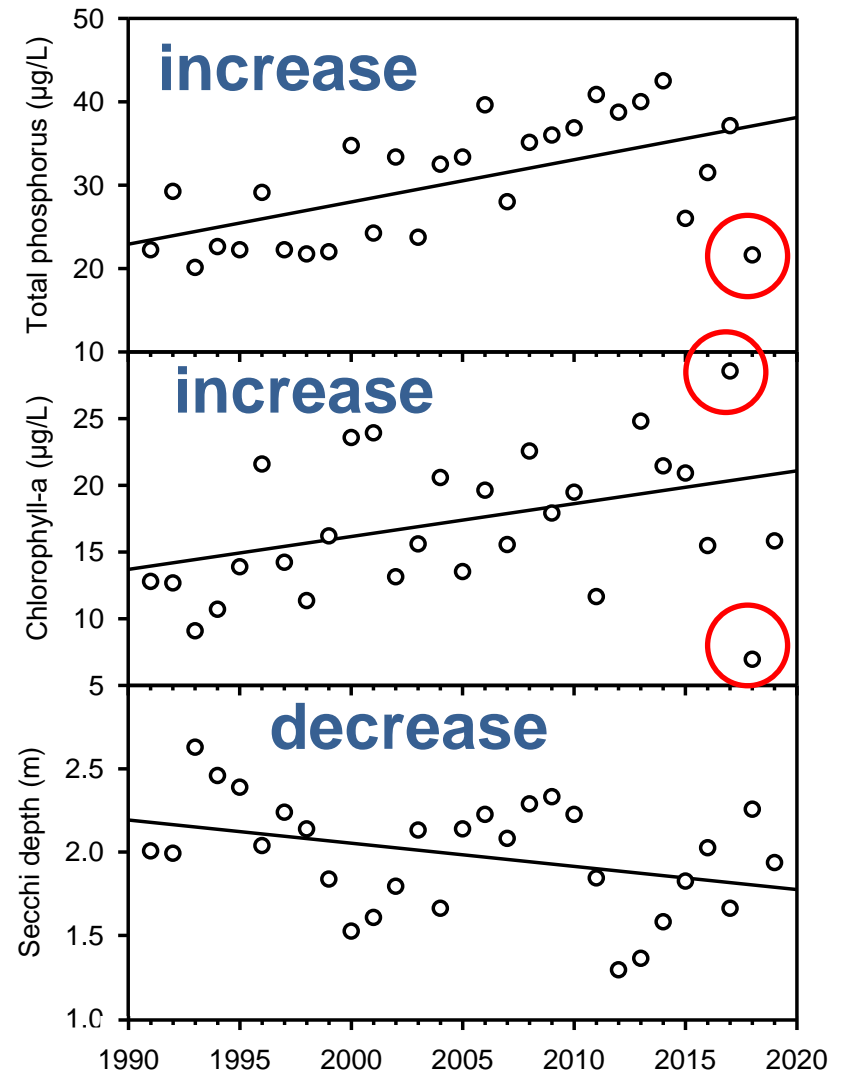Mean depth: 6 meters
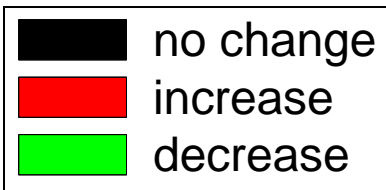Meso-eutrophic
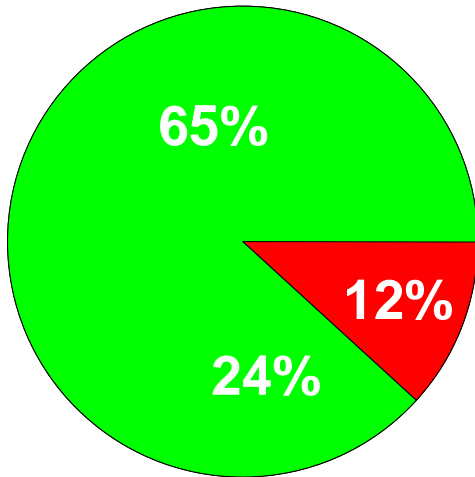
34 years

Trophic Indicators – Black Lake

Surface area: 8352 acres
Mean depth: 3 meters
Eutrophic

no change

decrease

increase

32 years

Trophic Indicators – Ballston Lake

Surface area: 278 acres
Mean depth: 7 meters
Eutrophic

Ballston Lake

increase

increase

decrease

Total phosphorus (μg/L)

Chlorophyll-a (μg/L)

Secchi depth (m)
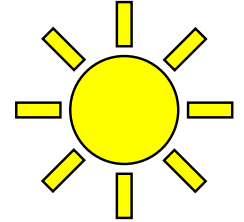
29 years

Trophic Indicators - Trends
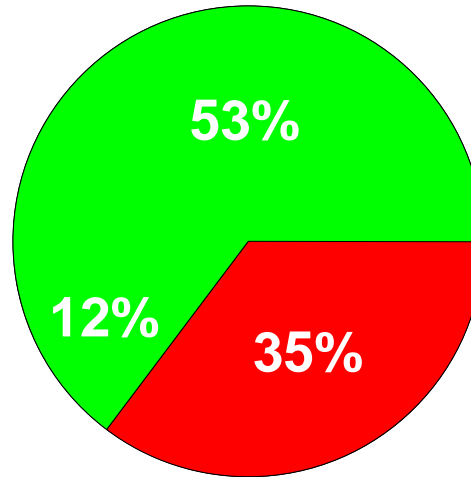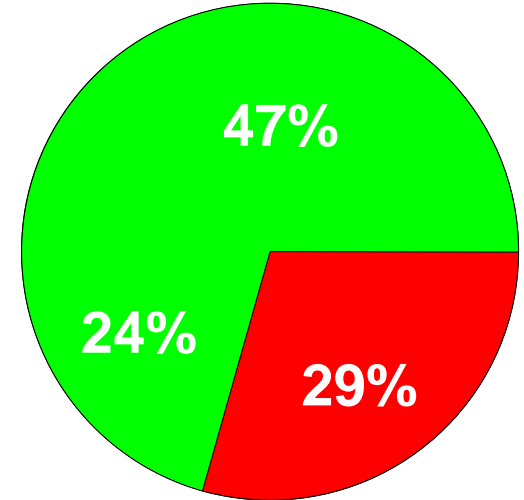
Climate change trends

Examples from NYS lakes

Climate Change and Lakes

What's the big deal?

Typical stratification of dimictic lake – Spring → Summer

Warm, lower density
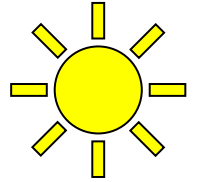
Stratification strength (J/m^2)

Cold, higher density

Climate Change and Lakes

What's the big deal?

Climate impacts on dimictic lake – Spring → Summer

Warmer, lower density

Surface temperature, earlier in the season

<u>Increased</u> stratification strength (J/m^2)
More energy required to mix, based on greater density difference – increased length of stratification
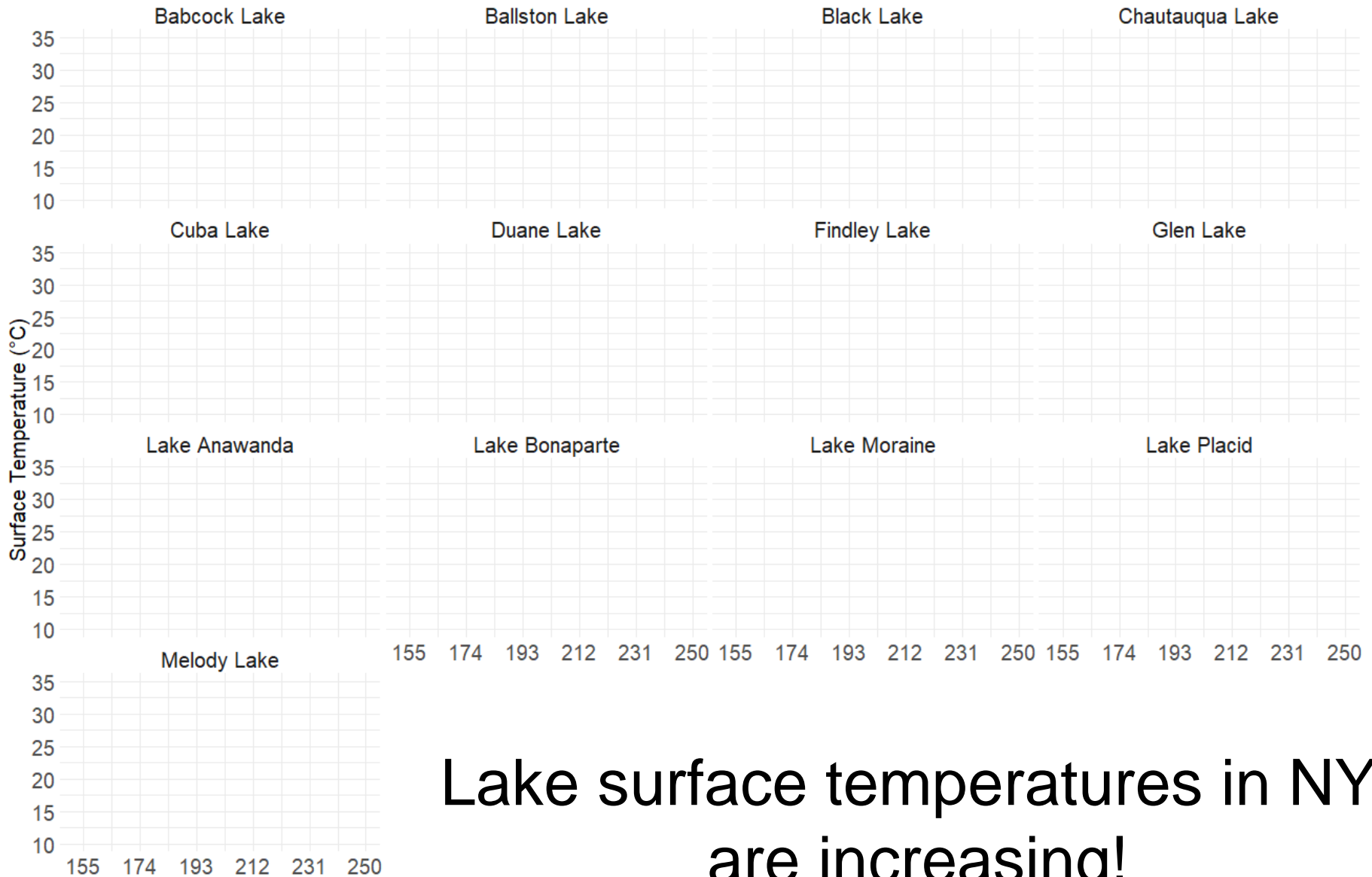
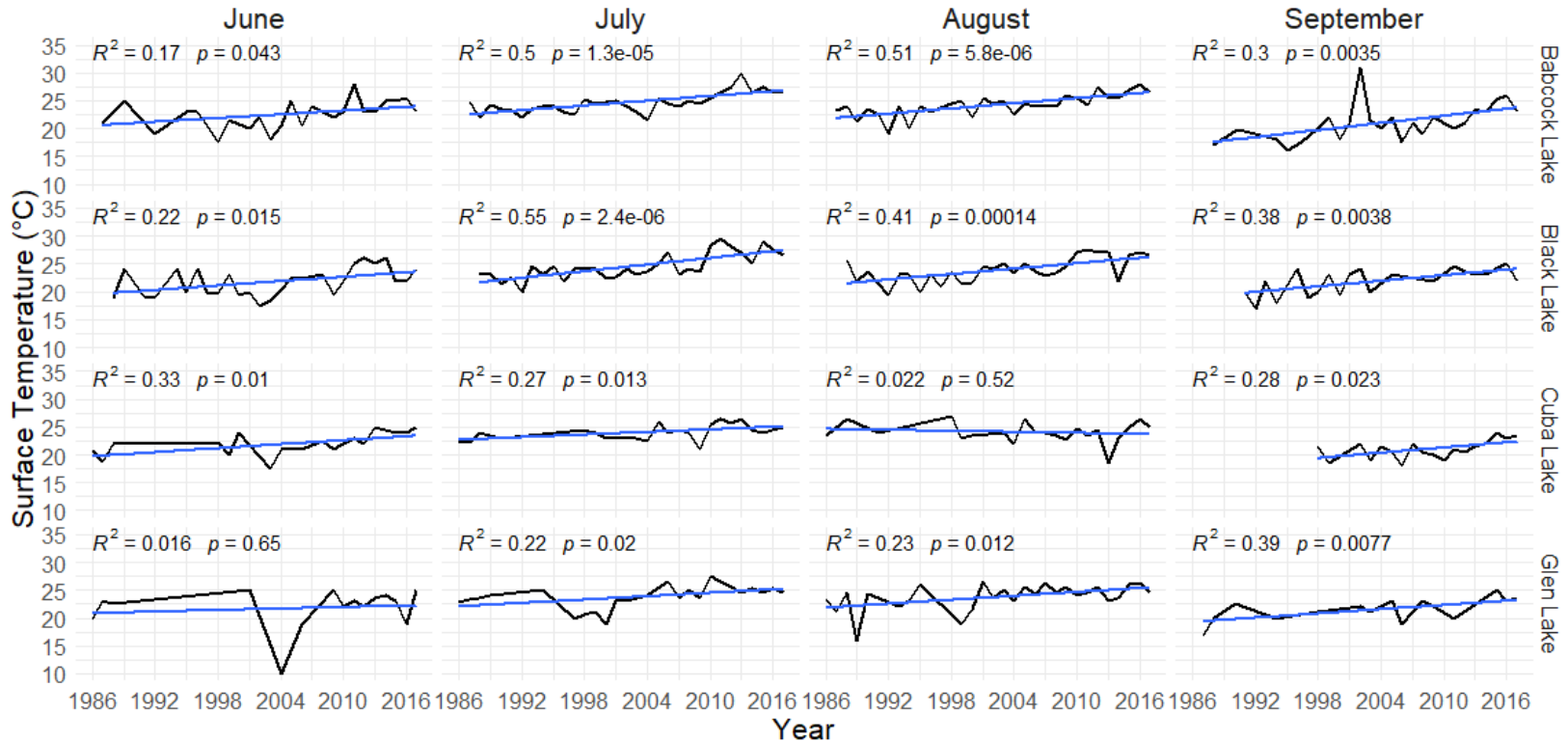*Col<u>de</u>r, higher density*

Lower temperature @ depth

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Lake surface temperatures in NY are increasing!

+0.6°C/Decade

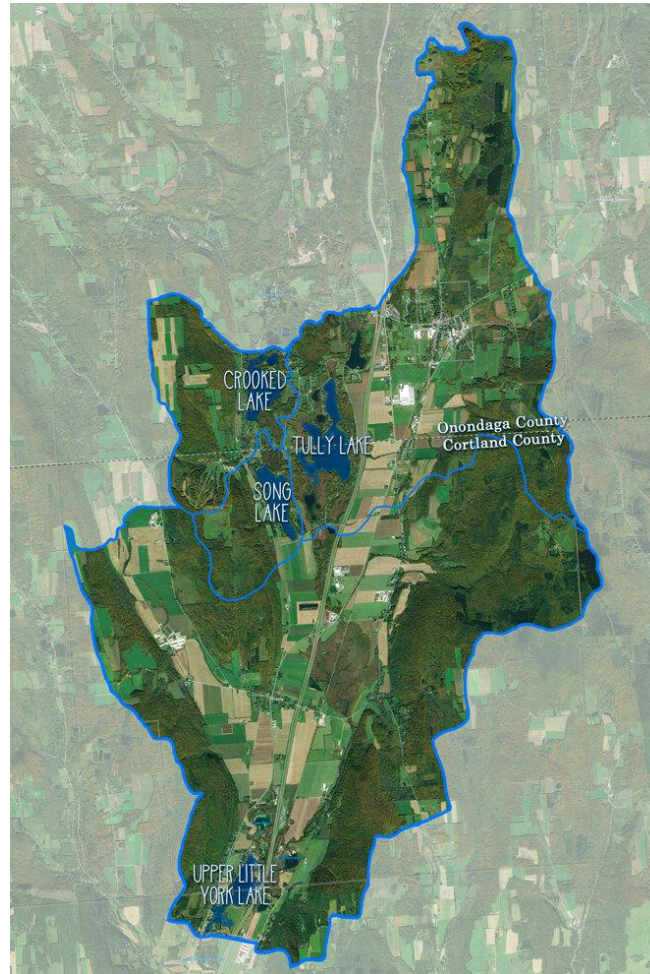# Monthly Increases in Surface Temperatures

+0.6°C/Decade°C   +1.1°C

What about right here in CNY?

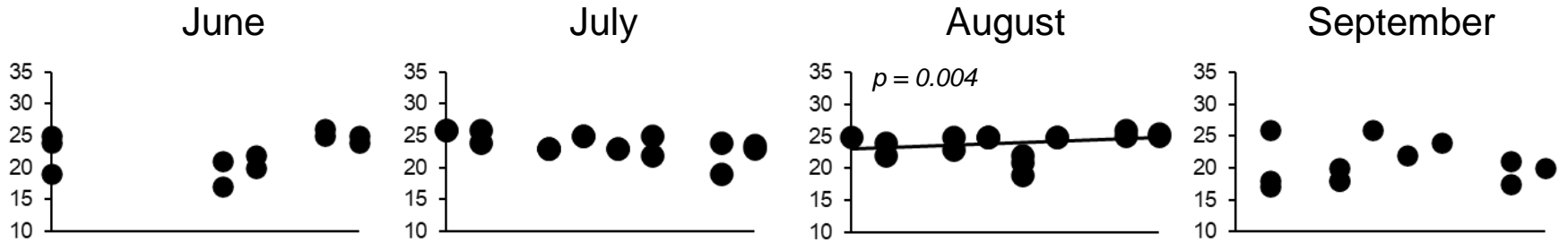**Cortland-Onondaga Federation of Kettle Lake Associations (C-OFOKLA)**

Little York Lake
Tully Lake
Song Lake
Crooked Lake

Map credit: Upper Susquehanna Coalition
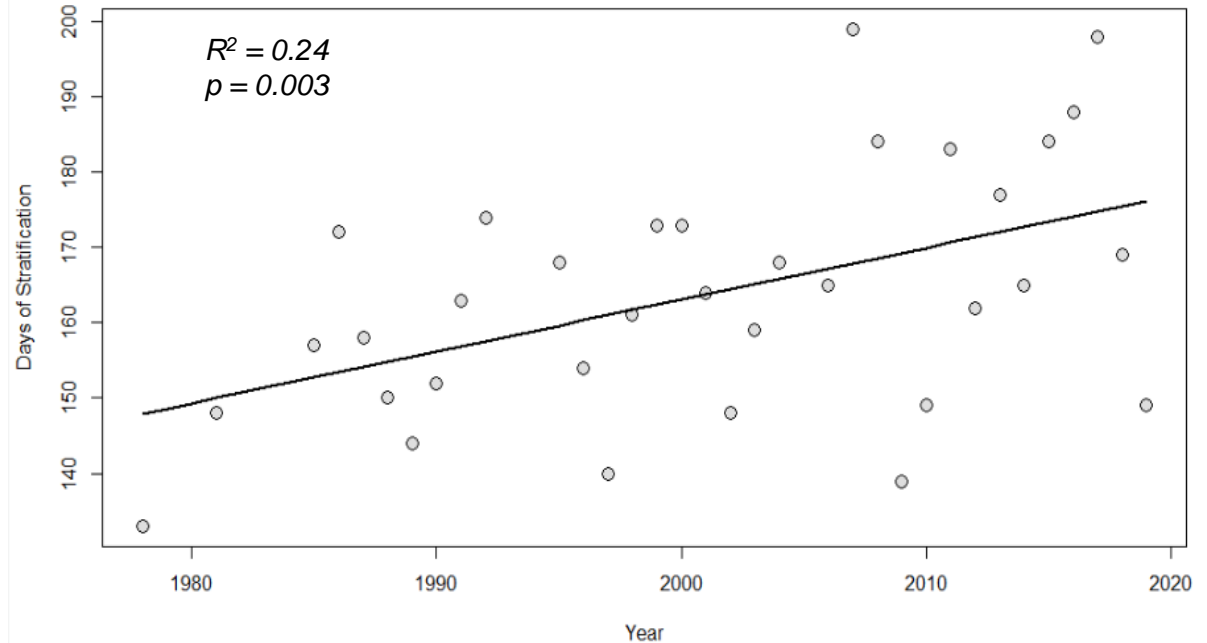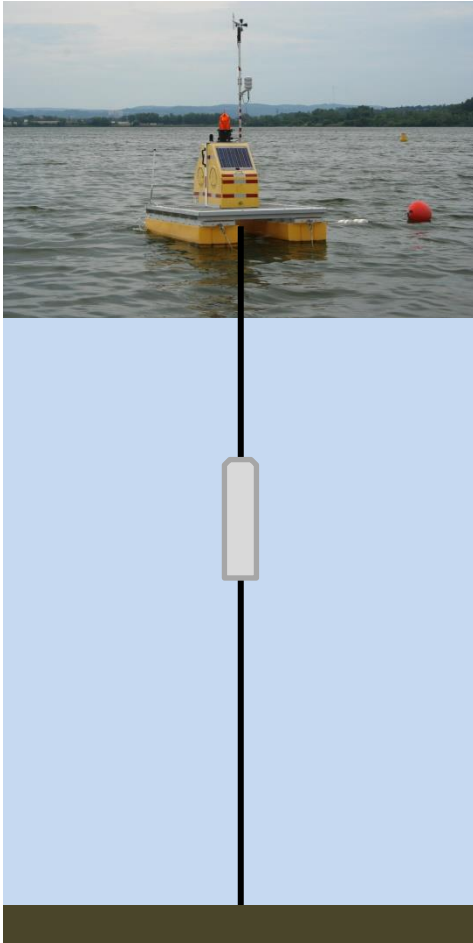
Surface Water Temperatures

Little York Lake

Increases in Duration of Stratification

Onondaga Lake

+1 Week/Decade

$R^2 = 0.24$
$p = 0.003$

Temperature profiles every meter, twice a day
~ April to October each year

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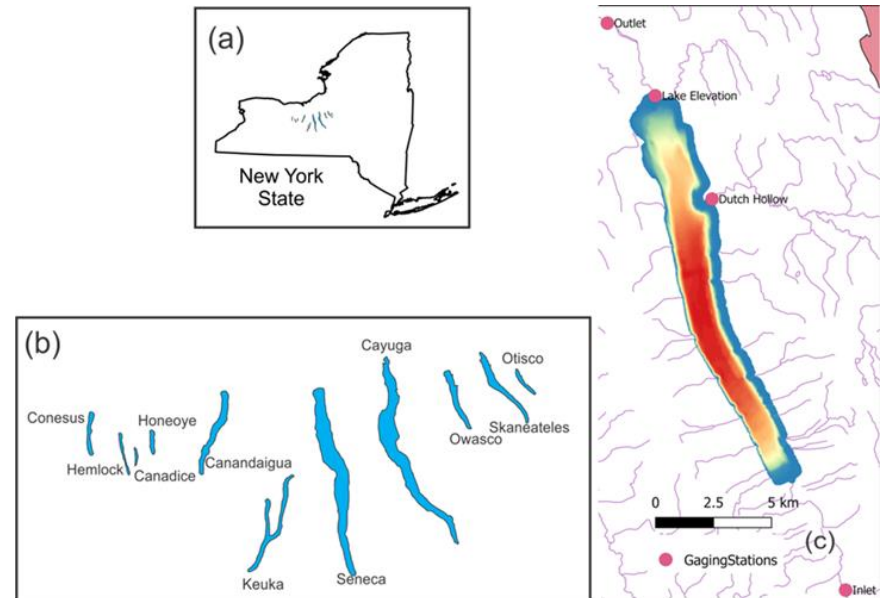# Application of long-term monitoring and trends

Models and scenario evaluations

Applications of long-term trends
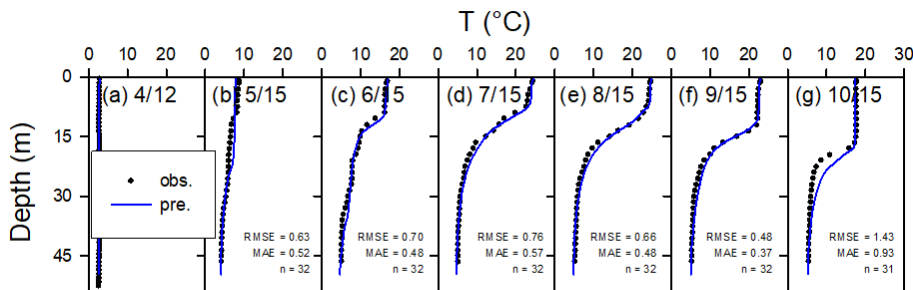
Example:

Owasco Lake and HABs

- NYS 303(d) List of Impaired Waters

- In-lake water quality model
  Simulate summer conditions
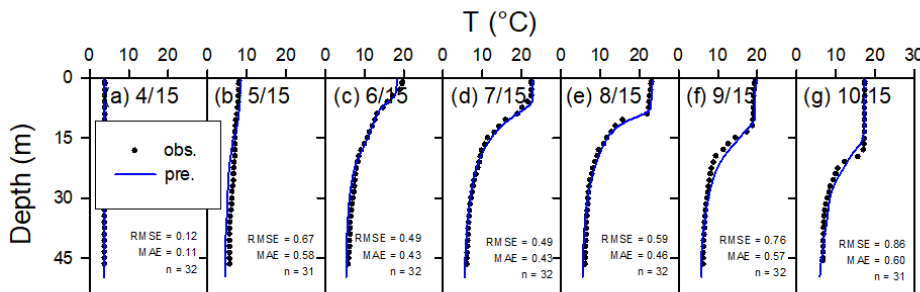 Illustrate management actions
  and HAB factors

Model application - Owasco Lake

Hydrothermal Model Results

Calibration
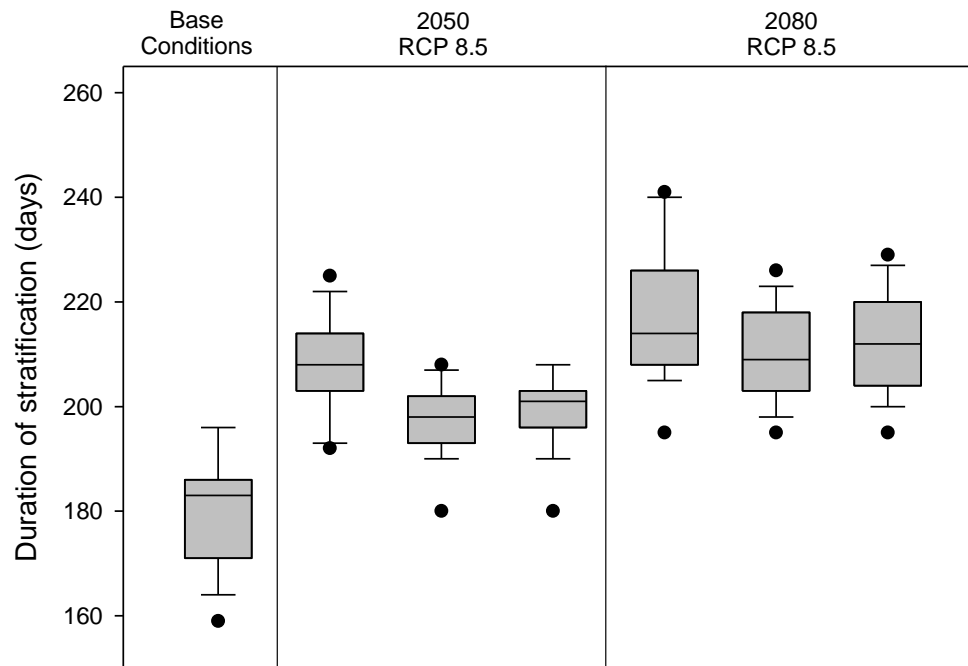

Confirmation

Applied use of long-term monitoring and trends!

Model application - Owasco Lake
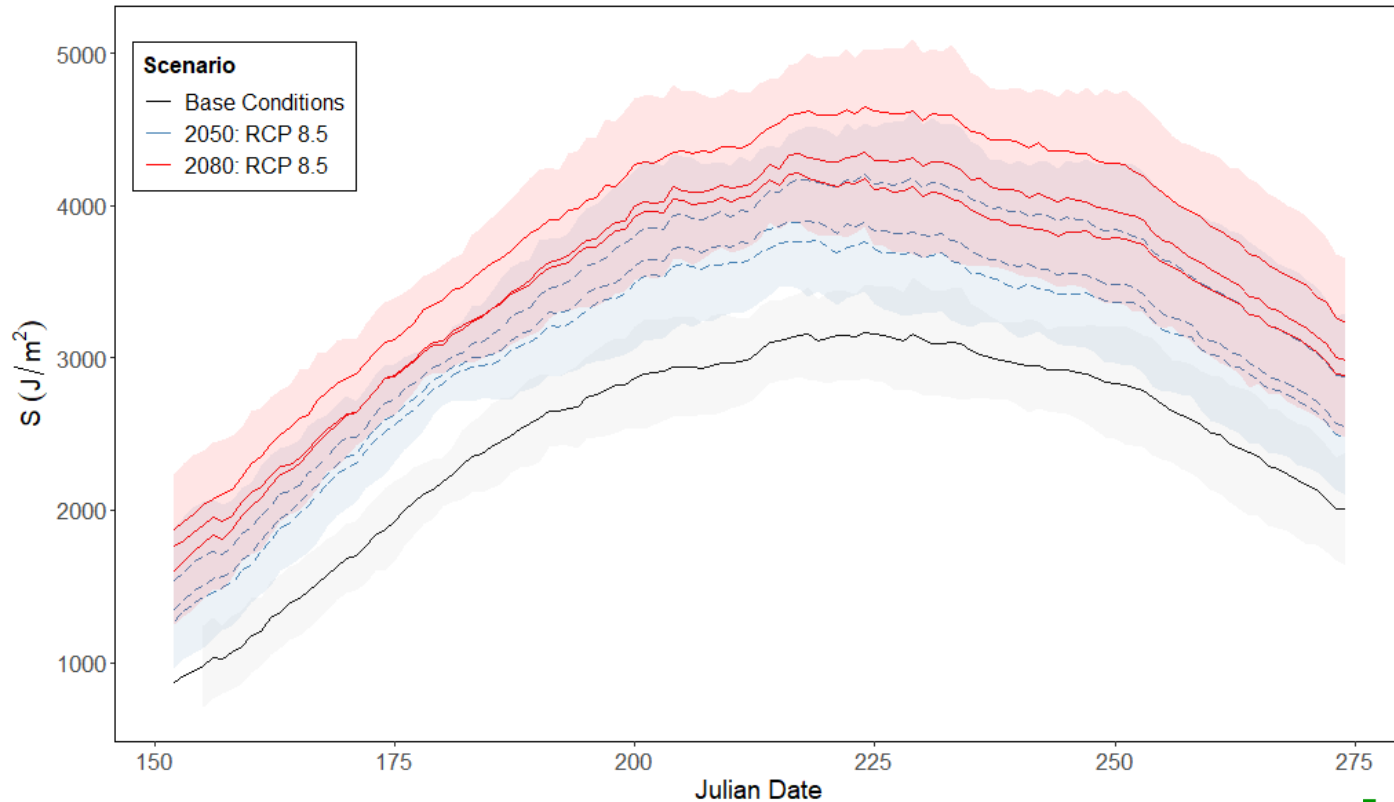
Climate projections and effects

Increased duration of stratification

Model application - Owasco Lake

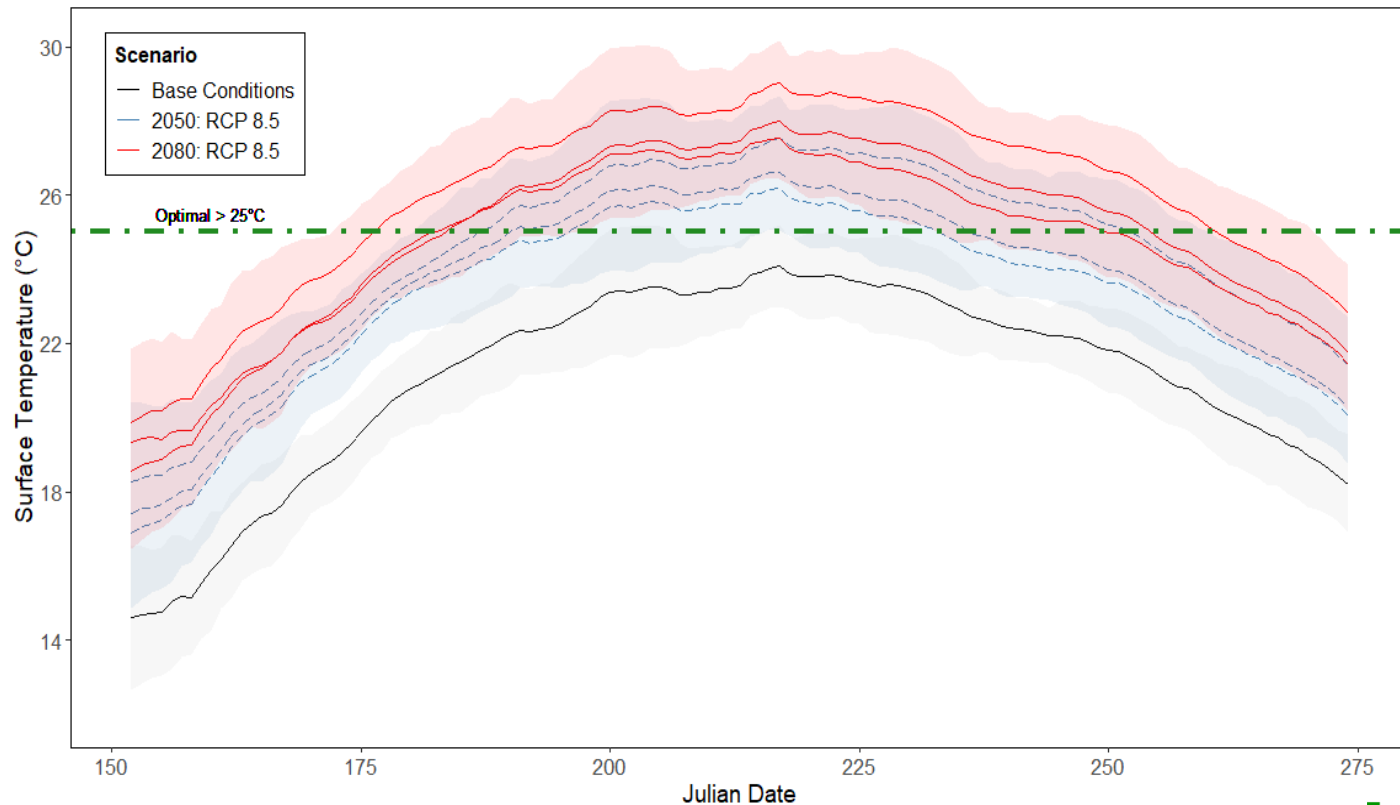**Climate projections and effects**

Stratification strengthens

Model application - Owasco Lake

Climate projections and effects

Surface temperatures increase and favor cyanobacteria

Conclusions and Take-aways

- No obvious trends in trophic condition statewide
- Most NYS lakes are becoming warmer (surface), some rapidly

Every lake has its own story!
  - Annual reports are only a stop along the way

Importance of long-term monitoring and trends
  - Patterns, models and scenarios, scientifically-based decisions

Thank you!

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Andrew Brainard, PhD
asbrainard@upstatefreshwater.org

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