NEW YORK
STATE OF
OPPORTUNITY

Department of
Environmental
Conservation

Citizen Science:
To Assessment and Beyond

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NYSFOLA
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Long, Long Ago in a Lake Far, Far Away . . . .

Citizens Statewide Lake Assessment Program

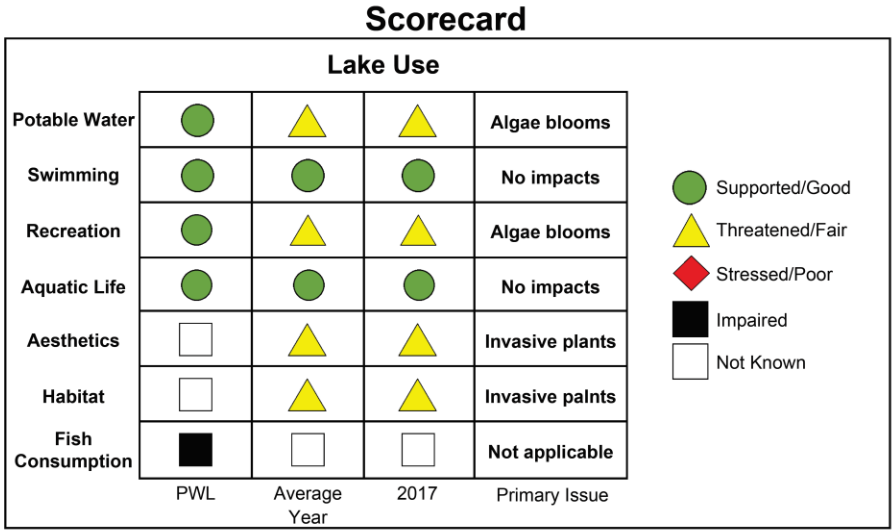
- volunteer lake monitoring/education program
- managed by NYSDEC & NYSFOLA
- initiated 1986 and mandated by ECL (17-0305)

Consistent approach, approved methods, certified labs, quality data

CSLAP

Traditional CSLAP Objectives and Uses

1. Education and outreach
2. Data collection
   - water quality assessments and reporting
3. Baseline and trends in lake health
4. Special studies (HABs, AIS)



CSLAP: A New Hope

Traditional CSLAP Objectives and Uses

1. Education and outreach
2. Data collection
   - water quality assessments and reporting
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4. Special studies (HABs, AIS)

Emerging Needs

Development of complex water quality “tools” for advanced understanding and management (9E, TMDLs)

What are models?

A "model" is simplification of a real system (like a lake)

- A model is a collection of equations that represent the physical, chemical, and biological mechanisms of a system
  - Movement and circulation of water
  - Fate and transport of pollutants
  - Algal response to eutrophication

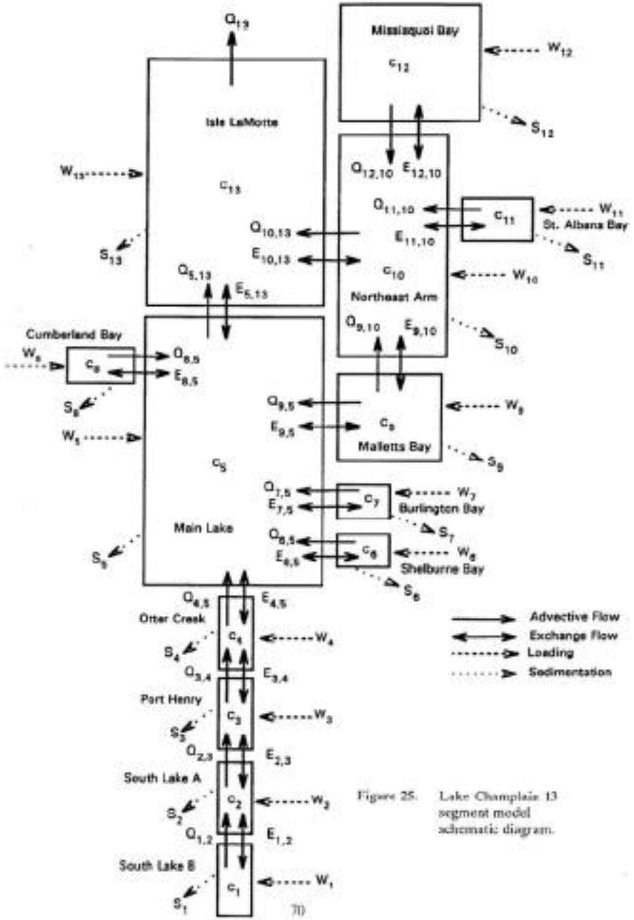
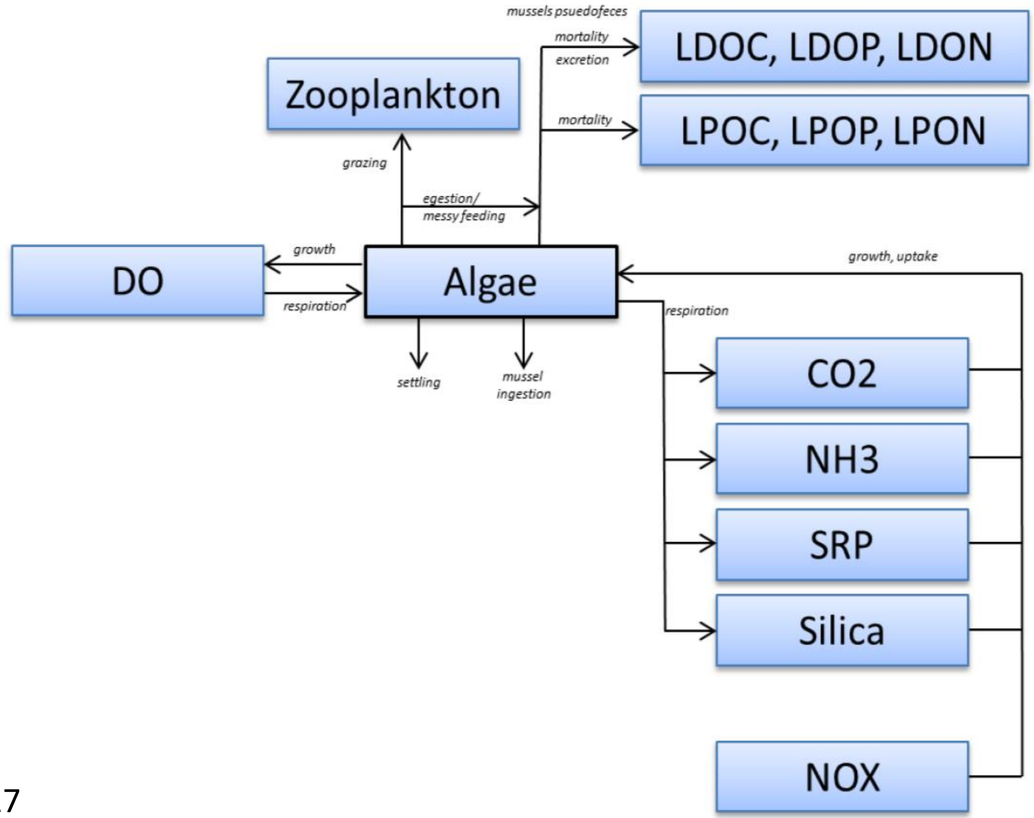


Figure 25. Lake Champlain 13 segment model schematic diagram.

Nutrient and Algae "Interactions" in a Model



From UFI 2017

Mmm. Modeling . . . Important, It Is

- understand, test, perturb, or control a system
- simpler, faster, less expensive than analyzing the real system all the time
- predict water quality responses to phenomena (effects of climate change)

Varying Complexity

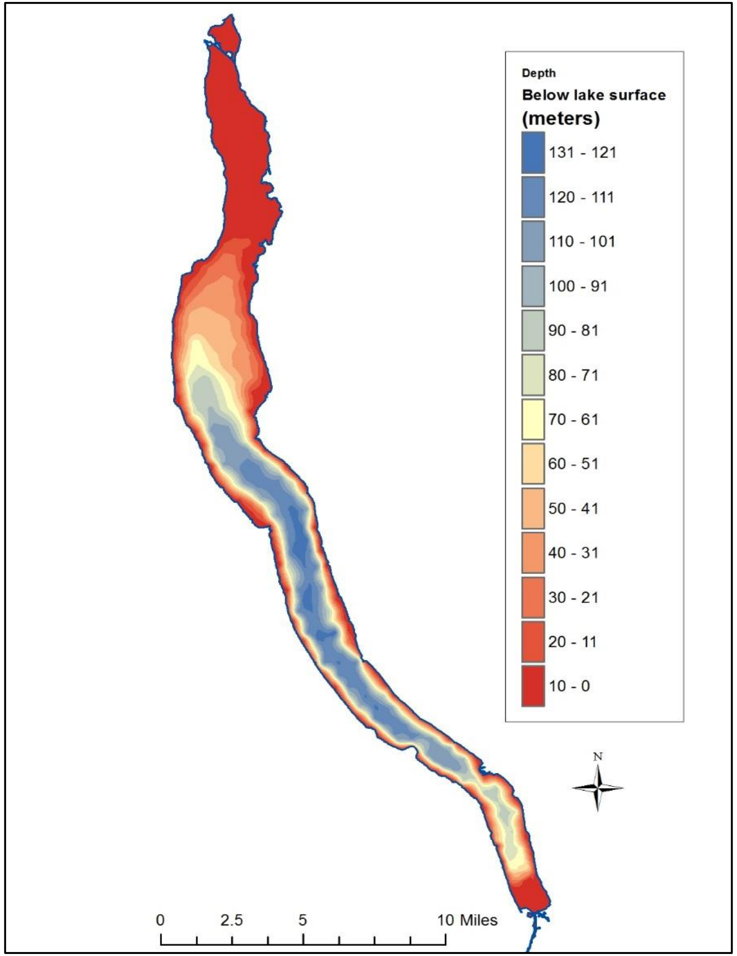
Simple		Moderate	Complex
$		$$$	$$$$
Empirical (statistical) equations	1-D Bathtub Lake 2K	2-D CE-QUAL-W2	3-D EFDC ELCOM

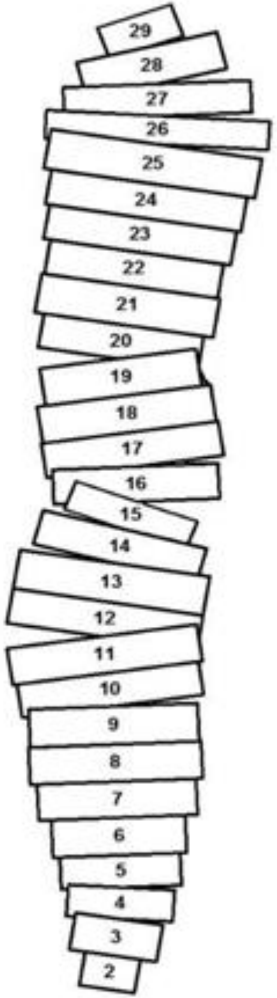
In my Experience There is No Such Thing as Luck

1. Quality Program Components, Planning, and Strategy (QAPP)
2. Data collection and data integrity
3. Model input development and preparation
4. Parameter evaluation and developing inputs
5. Model Calibration
6. Model Validation (or testing)
7. Analysis and Model Use

Model Inputs and Setup

Data Type	
Bathymetry	Geospatial coordinates and water depth, morphology
Physical	Temperature and salinity, density
Inflows	Water and materials coming into a lake
Water Balance	Changes in water elevation and outflows
Meteorology	Temperature, wind speed, wind direction

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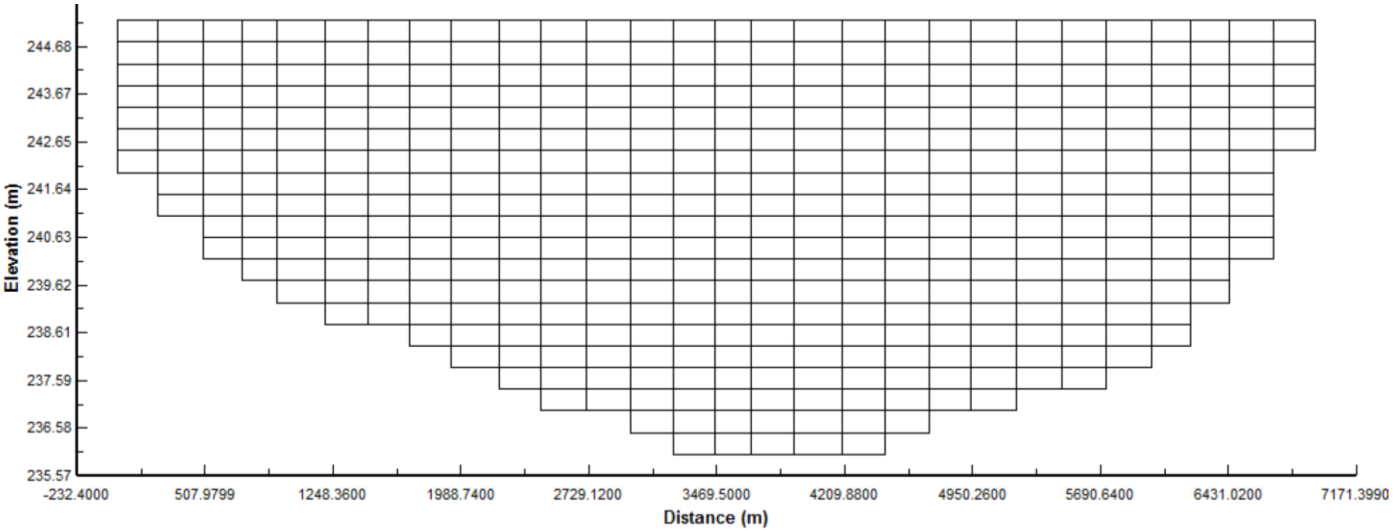
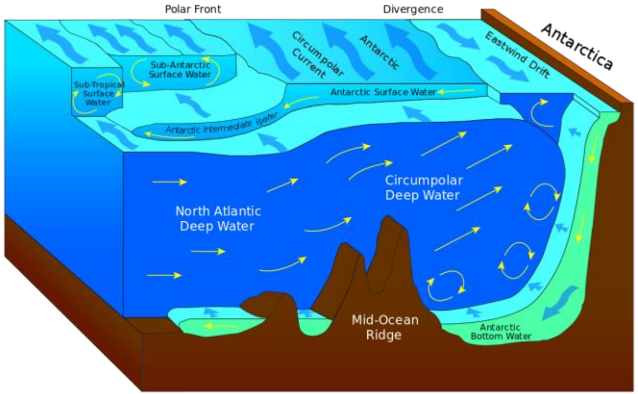

Elevation (m)
244.68
243.67
242.65
241.64
240.63
239.62
238.61
237.59
236.58
235.57
-232.4000
507.9799
1248.3600
1988.7400
2729.1200
3469.5000
4209.8800
4950.2600
5690.6400
6431.0200
7171.3990
Distance (m)

Model Inputs and Setup

Data Type	
Bathymetry	Geospatial coordinates and water depth, morphology
Physical	Temperature and salinity, density -> Water movement
Inflows	Water and materials coming into a lake
Water Balance	Changes in water elevation and outflows
Meteorology	Temperature, wind speed, wind direction



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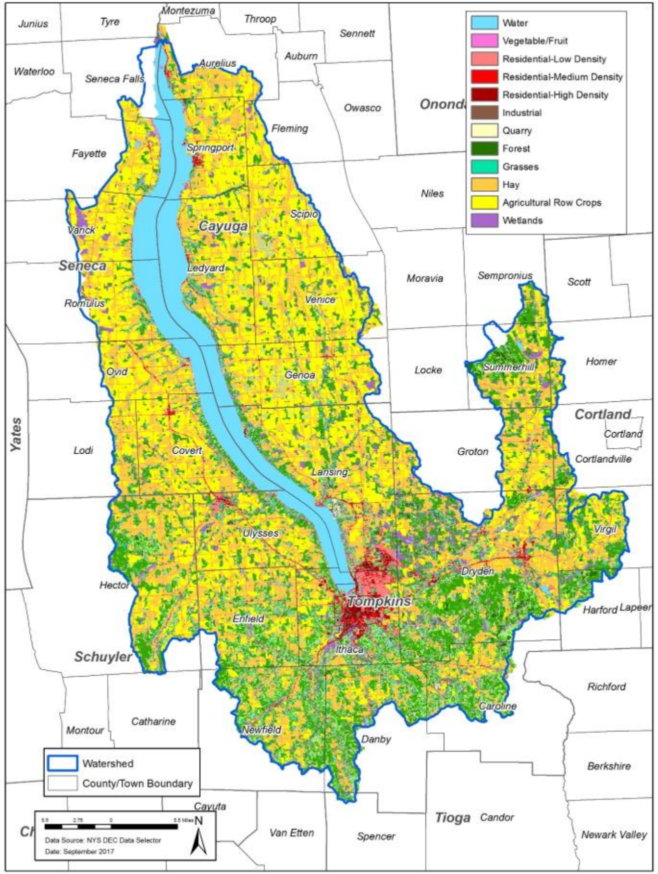
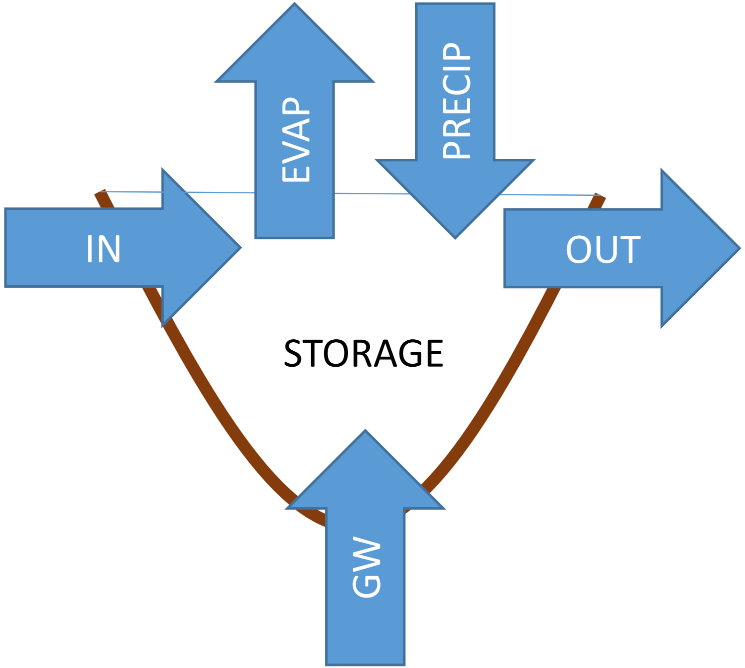
Model Inputs and Setup

Data Type	
Bathymetry	Geospatial coordinates and water depth, morphology
Physical	Temperature and salinity, density
Inflows	Water and materials coming into a lake (streams, WWTPs)
Water Balance	Changes in water elevation and outflows
Meteorology	Temperature, wind speed, wind direction



Model Inputs and Setup

Data Type	
Bathymetry	Geospatial coordinates and water depth, morphology
Physical	Temperature and salinity, density
Inflows	Water and materials coming into a lake
Water Balance	Changes in water elevation and outflows
Meteorology	Temperature, wind speed, wind direction



Model Inputs and Setup

Data Type	
Bathymetry	Geospatial coordinates and water depth, morphology
Physical	Temperature and salinity, density
Inflows	Water and materials coming into a lake
Water Balance	Changes in water elevation and outflows
Meteorology	Temperature, wind speed, wind direction

Model Inputs and Setup

Data Type	
Bathymetry ✓	Geospatial coordinates and water depth, morphology
Physical ✓	Temperature and salinity, density
Inflows ✓	Water and materials coming into a lake
Water Balance ✓	Changes in water elevation and outflows
Meteorology ✓	Temperature, wind speed, wind direction

Proper setup is key, otherwise the model won't represent the system!

Do or Do Not, There is No Try

Basic Water Quality Needs
Temperature, salinity
Phosphorus (multiple forms)
Nitrogen (multiple forms)
Carbon (multiple forms)
Silica
Algal community
Zooplankton community
Others (mussels, sediments, etc)

In-lake water quality needs can be substantial

- These inputs guide development of the model's water quality portion

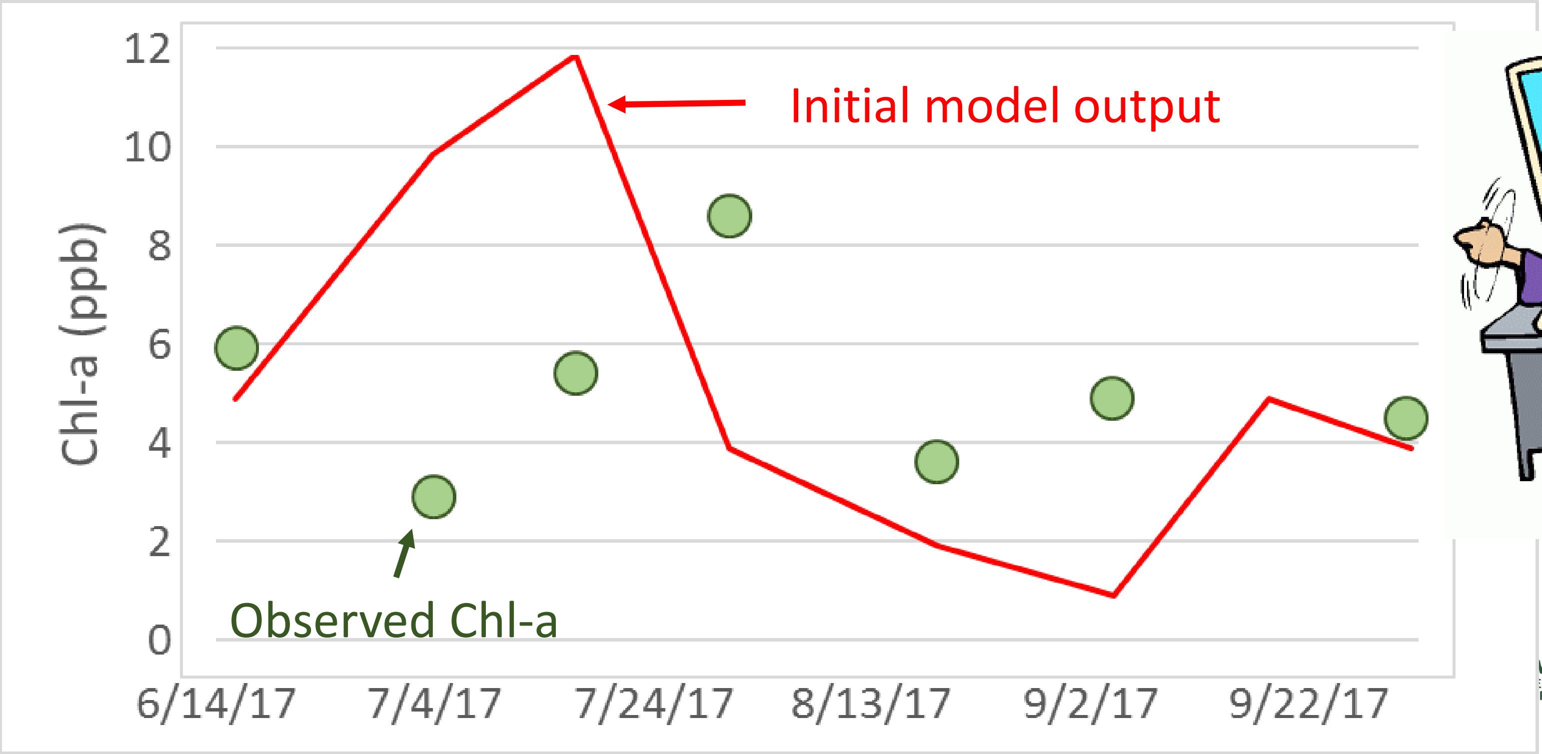
Otherwise models are built on assumptions

I Find Your Lack of Faith Disturbing

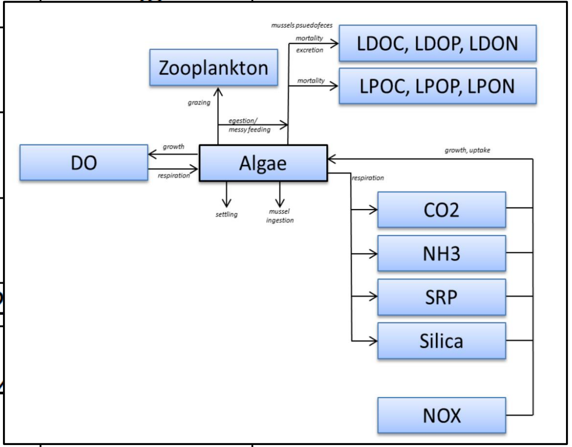
- “Essentially, all models are wrong, but some are useful”
  - George E. P. Box

A model is only as good as the data used to construct it!

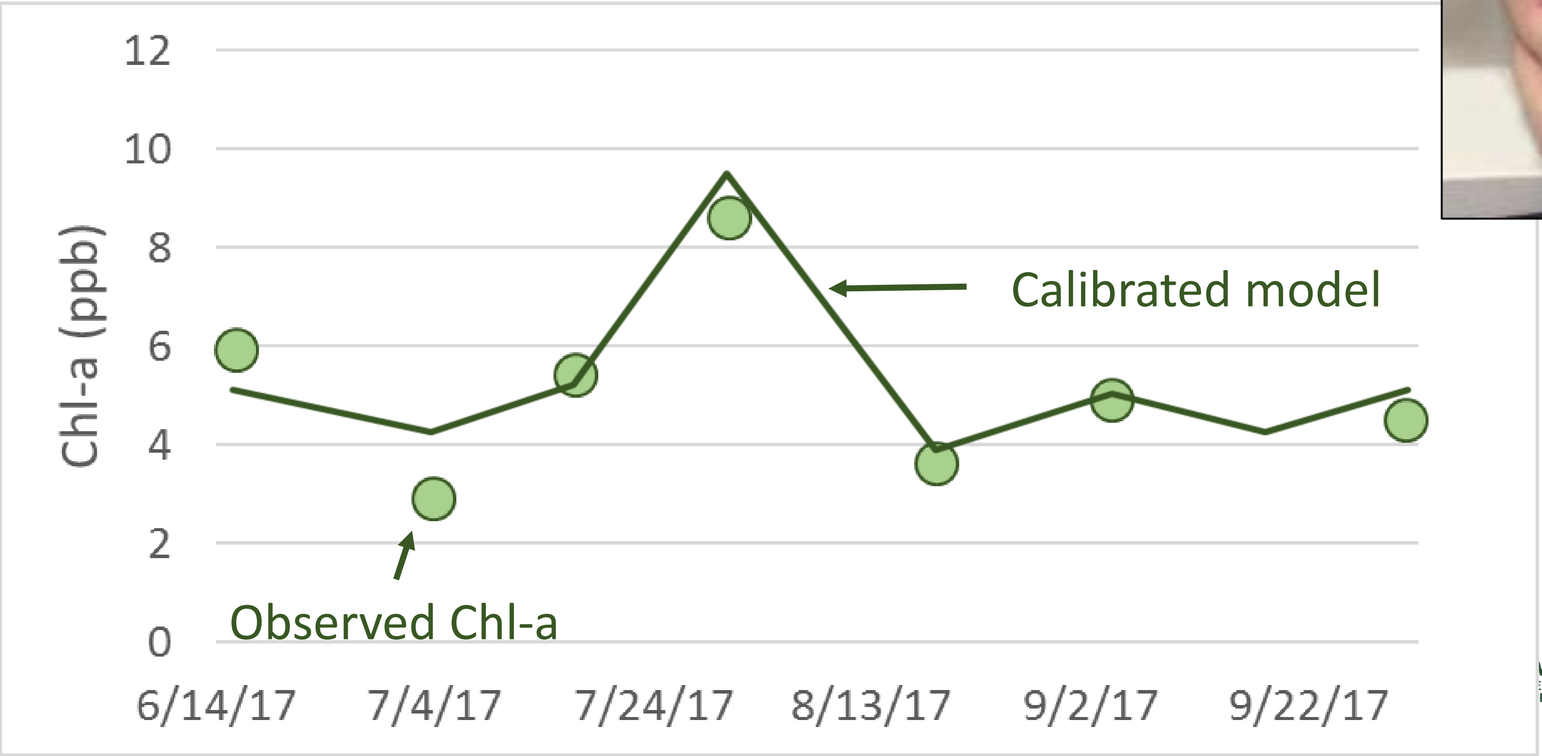
Water Quality Calibration – An Important Step



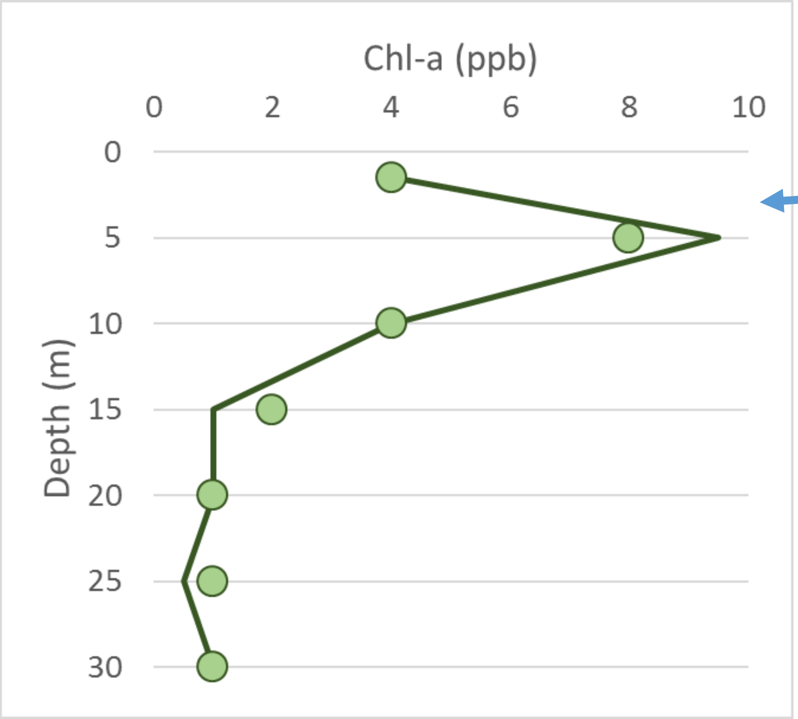
Parameter	Description	Units	Typical Values	Calibrated Value
WSC	Wind sheltering coefficient	-	0.8-1.2	1.1-1.2
BETA	Fraction of incident solar radiation absorbed at the water surface	-	0.45	0.45
EXH20	Extinction for water	/m	0.25	0.25
EXA	Extinction due to algae	$m^3/m/g$	0.1-0.2	0.2
AG, group 1	Maximum growth rate	/day	1 – 2.5	1.5
AS, group 1	Settling rate	/day	0-1	0.1
ASAT, group 1	Saturation intensity at maximum photosynthetic rate	W/m^2	10-150	90
AT1, group 1	Lower temperature for algal growth	ºC	4-10	8
AT2, group 1	Lower temperature for maximum algal growth	ºC	6-20	12
AT3, group 1	Upper temperature for maximum algal growth	ºC	15-25	20
AT4, group 1	Upper temperature for algal growth	ºC	20-30	
ALGP, group 1	Stoichiometric equivalent between organic matter and phosphorus		0.003-0.014	
ALGN, group 1	Stoichiometric equivalent between organic matter and nitrogen		0.04-0.11	
AHSP, group 1	Half-saturation constant for phosphorous	g/m	0.002 to 0.1	
AHSN, group 1	Half-saturation constant for nitrogen	g/m^3	0.005-0.2	
ACHLA, group 1	Ratio between algal biomass and chlorophyll a in terms of mg algae/μg chl a	mg algae/μg chl a	0.01 to 0.4	

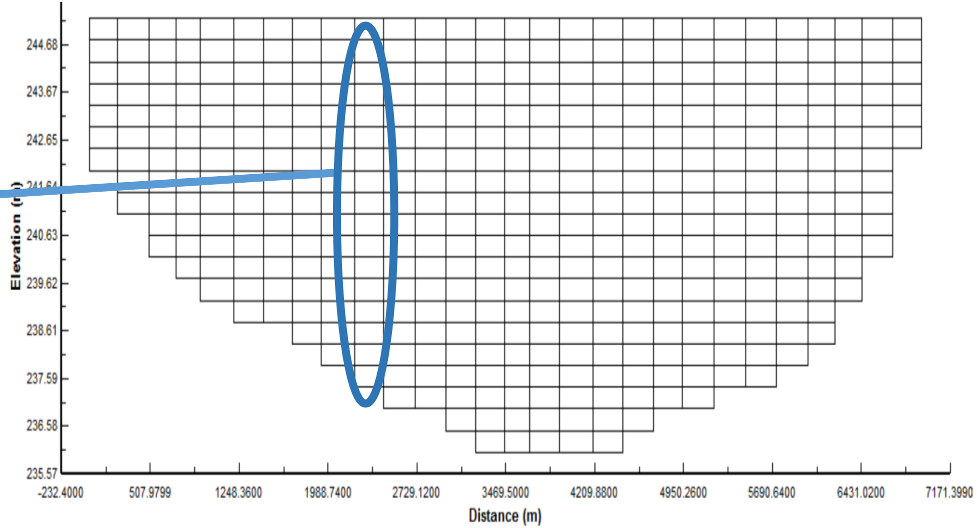


Water Quality Calibration



Calibration – Another Example





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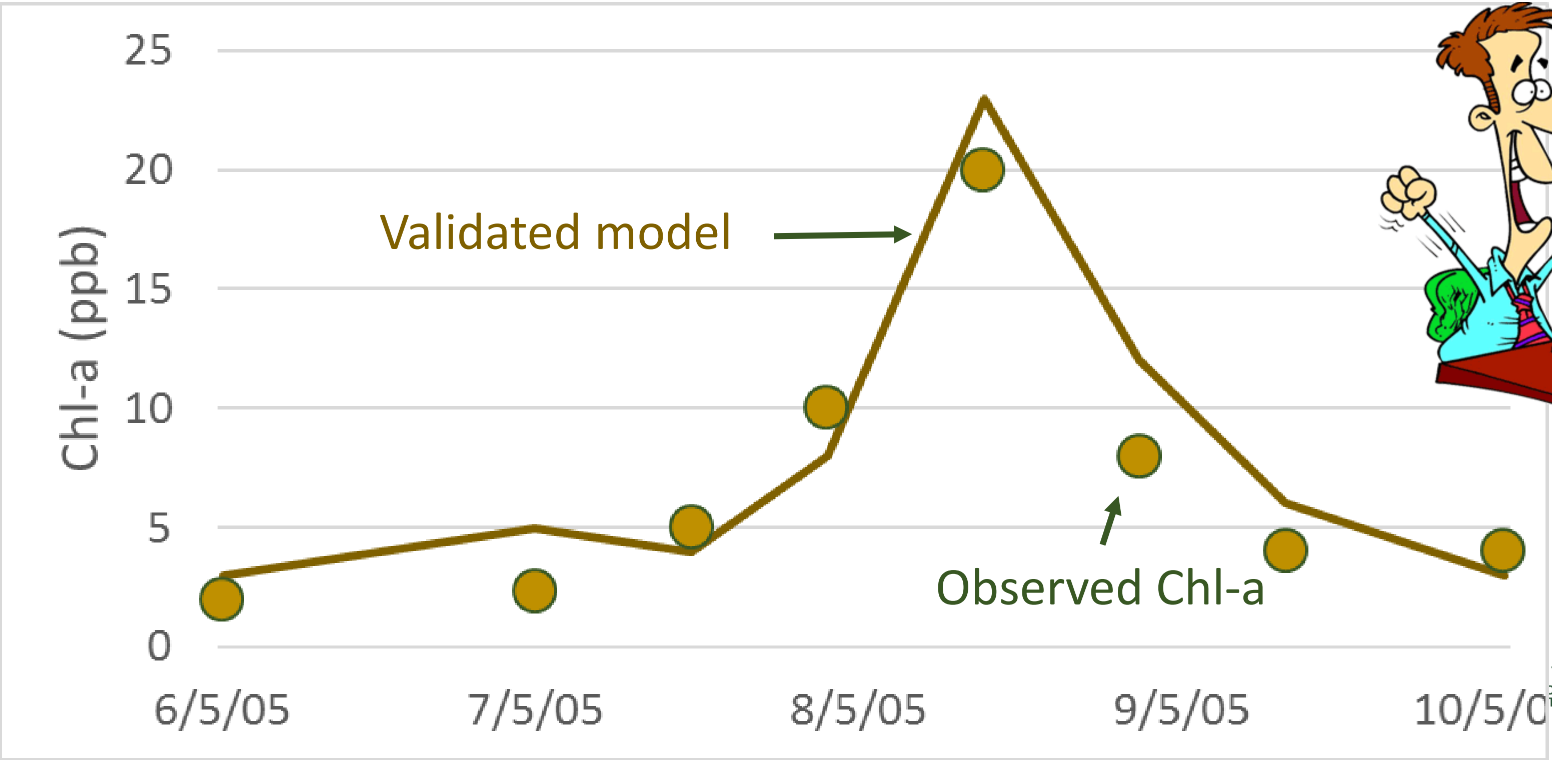
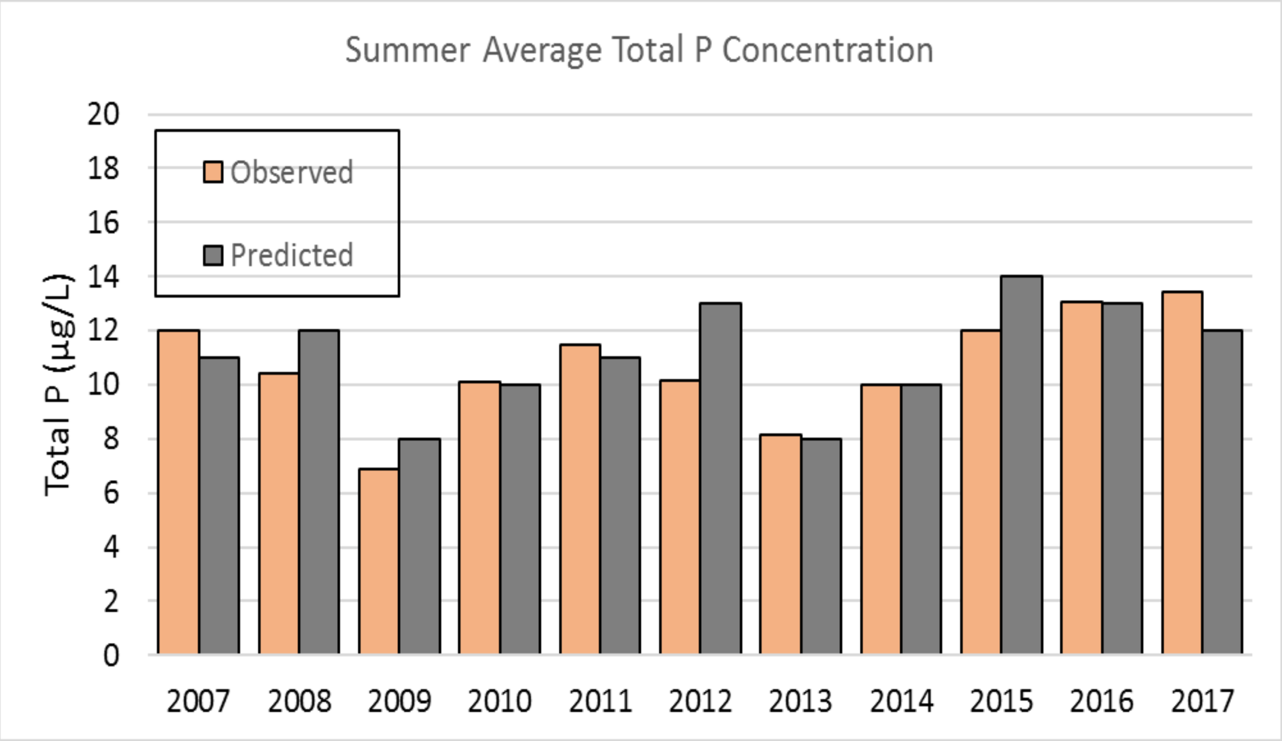
Model Validation – Testing the Calibration



Acceptable Levels of Wrongness

Percent difference between simulated and measured values (summer average values)

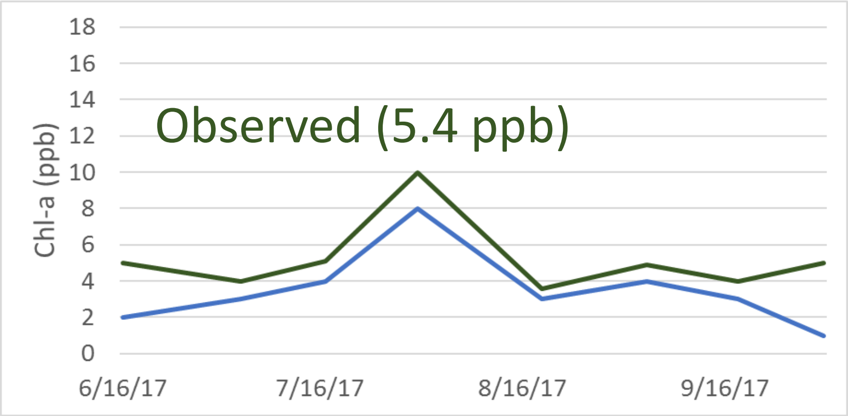
Water quality and nutrients	
Very Good	<15%
Good	15-25%
Fair	25-35%
Poor	>35%



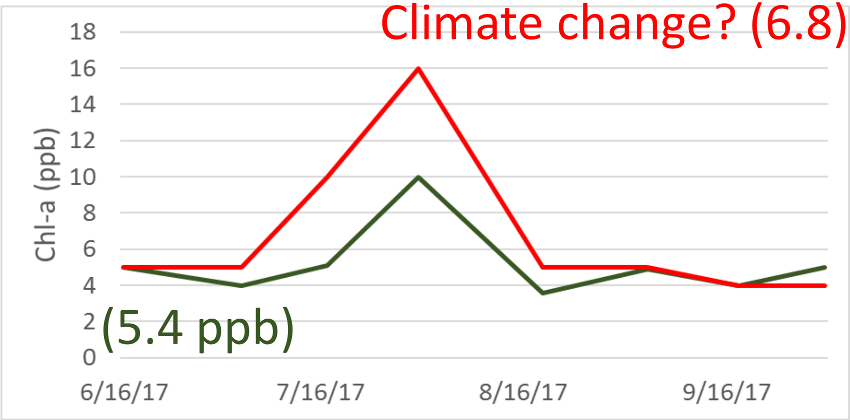
Now Witness the Firepower of this Fully Operational Model

Reduce a Nutrient Source

Increase the Temperature?



Reduce a point source? (3.5 ppb)



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CSLAP: A New Hope?

Emerging and expanding role of volunteer scientists

- A substantial portion of calibration and validation datasets can be collected by CLSAP
  - Some program adjustments, additions

Data Needs
Temperature, salinity
Phosphorus (multiple forms)
Nitrogen (multiple forms)
Carbon (multiple forms)
Silica
Algal community
Zooplankton community
Others

Consistent approach, approved methods, certified labs, quality data

Owasco Lake

- 2018 In-lake Model Study
  - Similar to other Finger Lakes modeling projects
  - 2D model
  - Water quality, biology
    - Eutrophication and HABs

CSLAP data – calibration and primary validation data sets

Help Us CSLAP, You're Our Only Hope

Advantages of the citizen science approach/integration in modeling

1. Quality program and data
2. Dedicates resources to specialized questions/ research
3. Local expertise is invaluable
4. Promotes interest/buy in

CSLAP's expanded role will be vital to the protection/ remediation of NY resources

Thank You and May the Fourth Be With You

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