The State of Lake Champlain – and Need for Complex Systems Research

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EPSCoR Annual Meeting

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A Truly Great Lake . . . .


CATAMOUNT
44

And Some Significant Challenges:

Water Quality

Biodiversity and living resources

Water Quality -- Phosphorus

- Lake Champlain is an impaired water because of P pollution
- Nonpoint sources of phosphorus represent >90% of the load

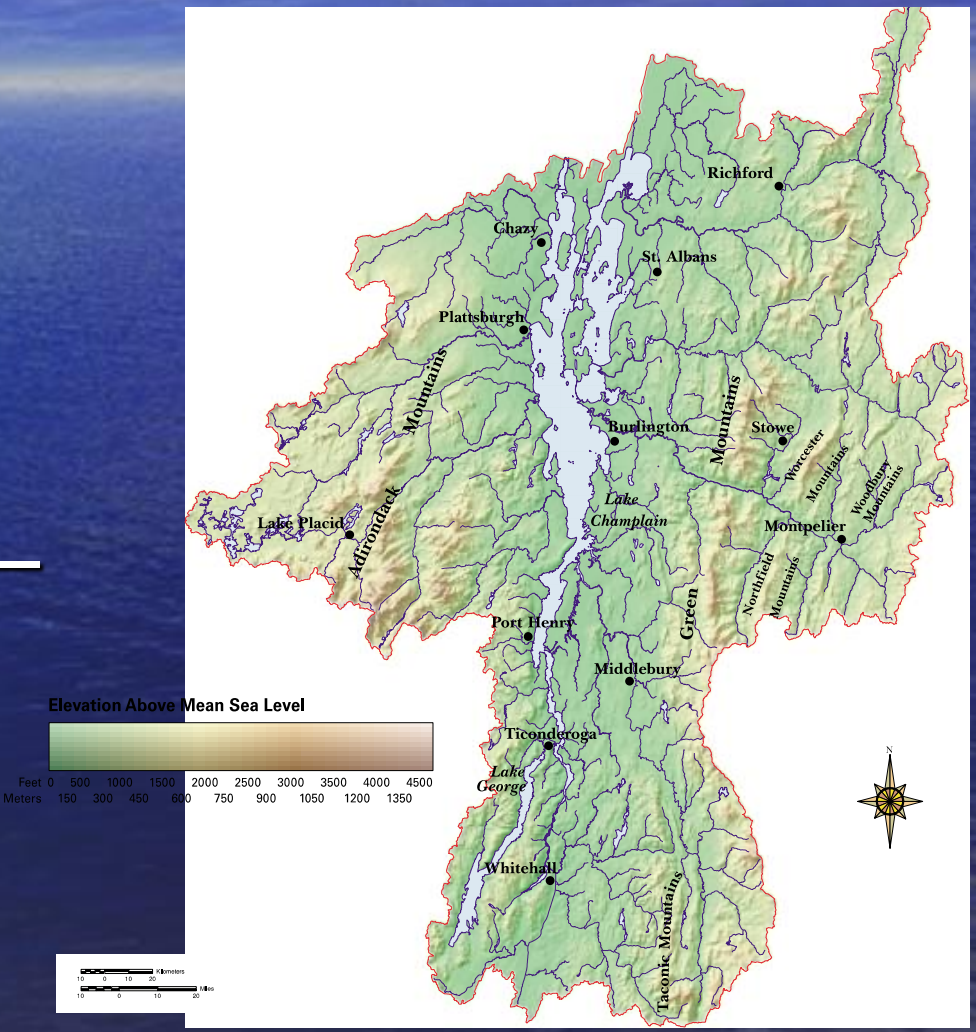
Lake Champlain statistics

- Surface area –

  435 mi² (1127 km²)
- Watershed –

  8,234 mi² (21,326 km²)
- Land-Water Ratio –

  19:1



Map by Northern Cartographic

Phosphorus from Nonpoint Sources

Agricultural areas

Urban/suburban areas

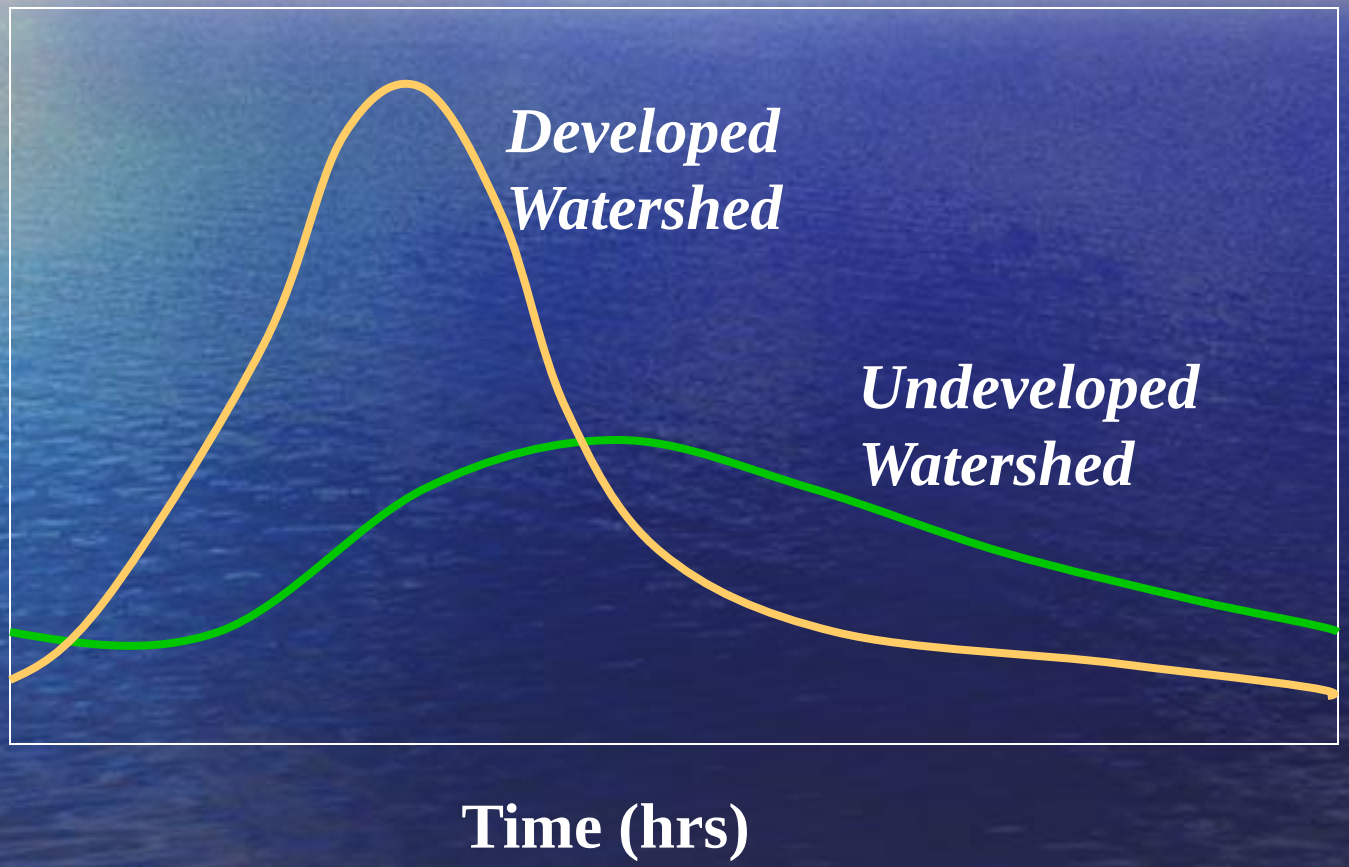
Nonpoint Source Loadings

- NPS loadings vary with land use:

  Developed land > Agricultural land > Forested land

Development Along Allen Brook

Change in Stormwater Flows



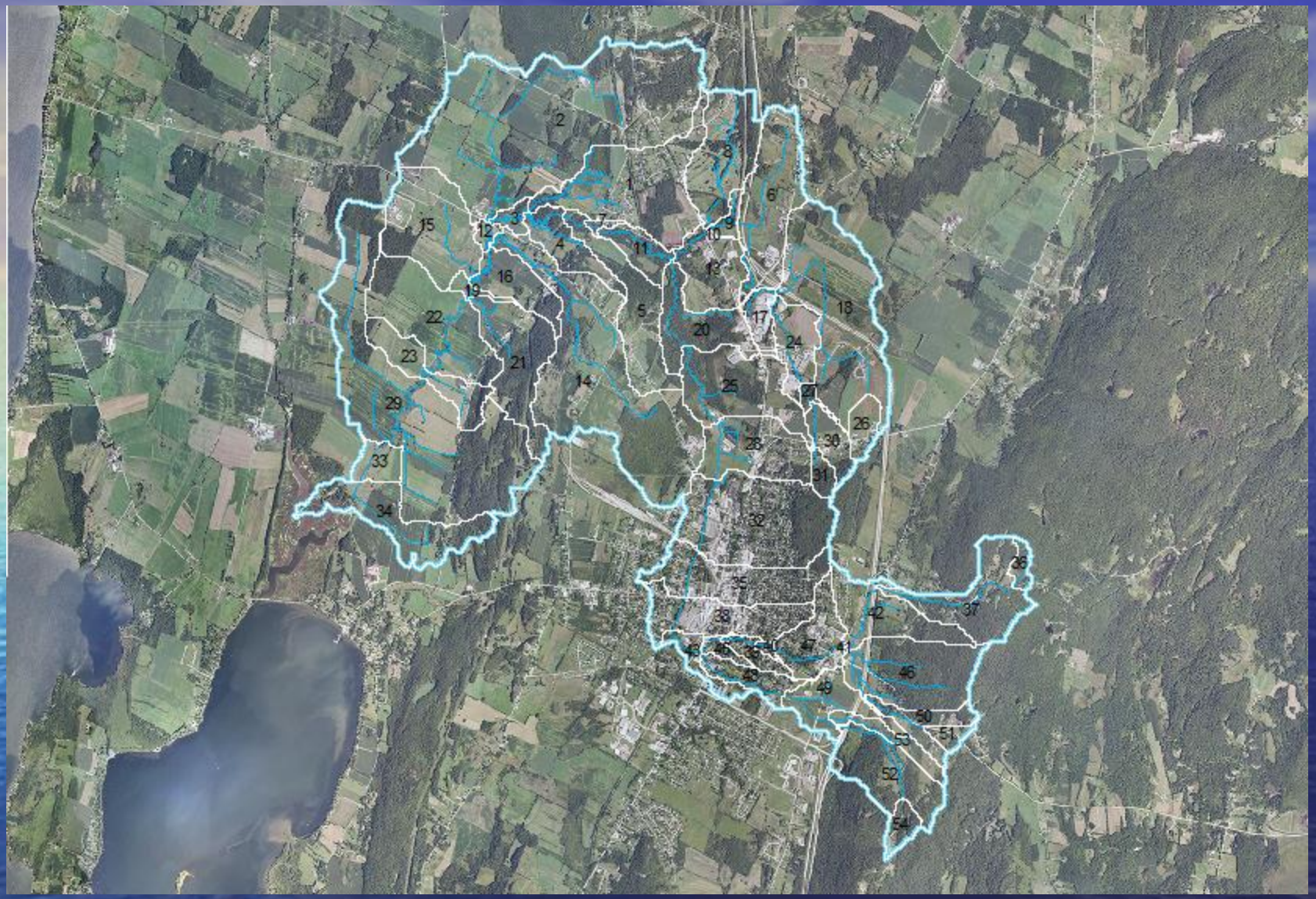
Streams that are out of balance export more phosphorus to Lake Champlain

Nonpoint Source Loadings

- NPS loadings vary with land use:

  Developed land > Agricultural land > Forested land

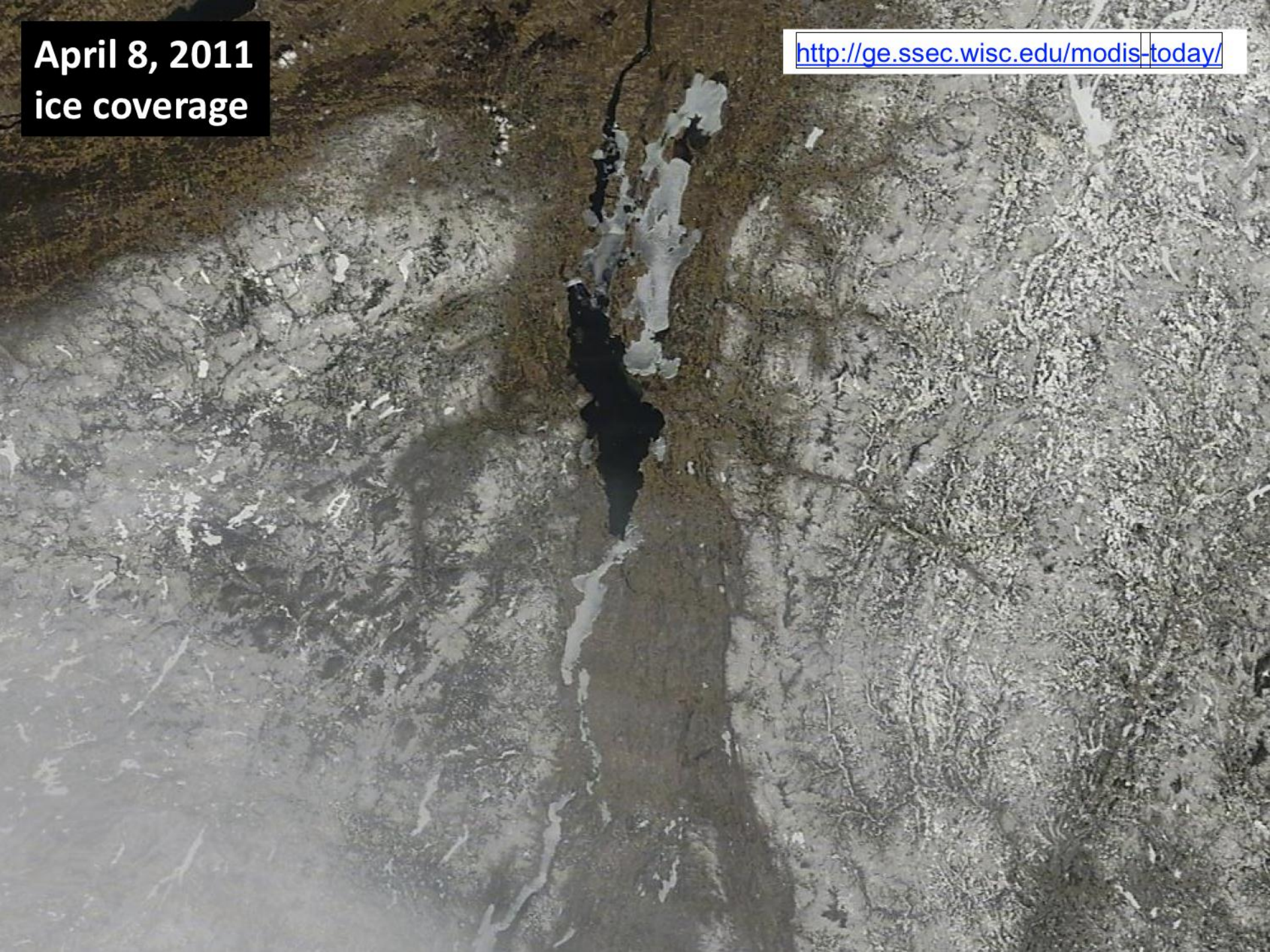
- Are there critical thresholds of land use change that result in altered conditions in the watershed or Lake Champlain?
- How do land use, stream geomorphology, and water quality interact?



Hurley, S.E., Ghebremichael, L., Watzin, M., Working Title: "A Watershed Analysis of the Relative Contributions of Developed and Agricultural Land Uses to Stream Geomorphology and Ecological Condition in the Lake Champlain Basin." [In Preparation]

Extreme Weather Events

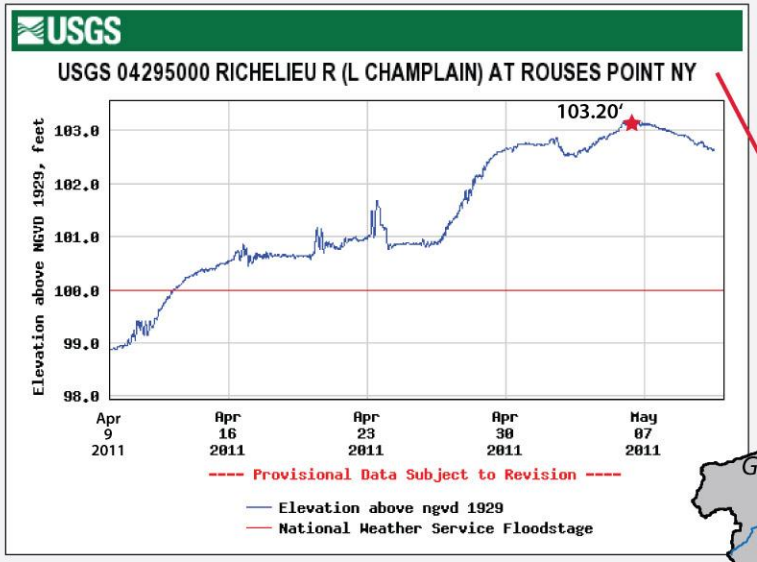
- Winter 2010/2011 the second snowiest on record
- April and May 2011, wettest spring months on record, over 20 inches of rain

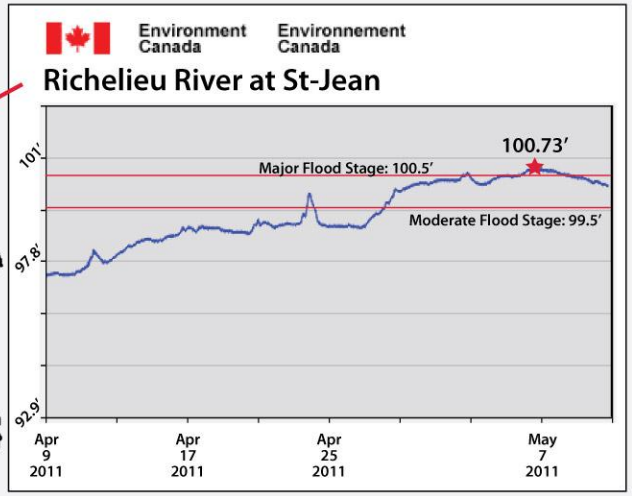

April 8, 2011
ice coverage
http://ge.ssec.wisc.edu/modis-today/

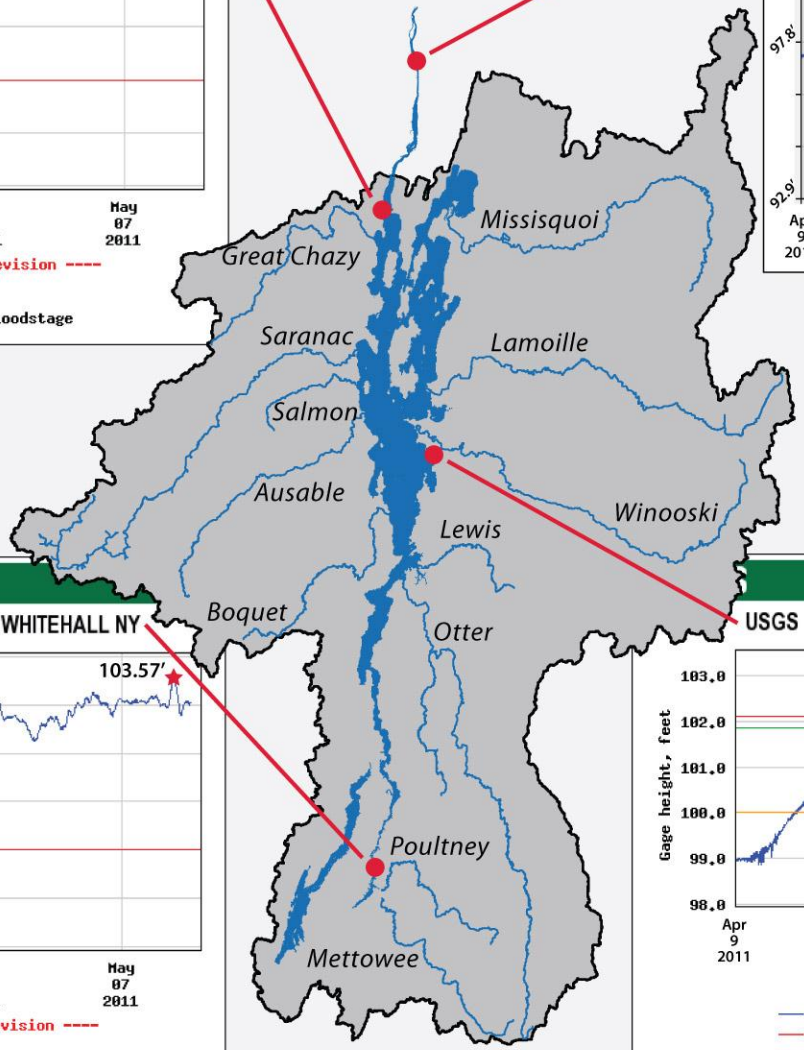
Winooski River, Central VT – May 2011

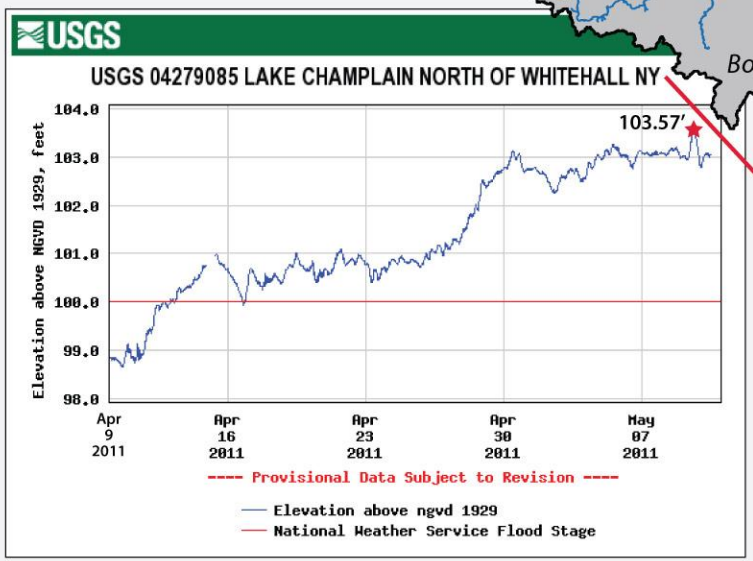

May 10, 2011
sediment loading

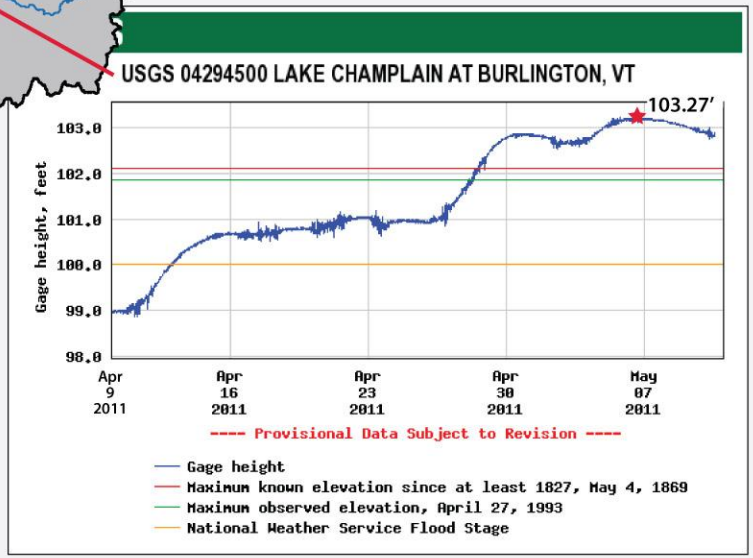
Lake Champlain gages from 4/9/11 to 5/11/11











Flooding
Perkins Pier, Burlington, VT

Flooding
Wally's Point, South Hero, VT

Sediment Plume, Winooski River Delta
Colchester/Burlington, VT

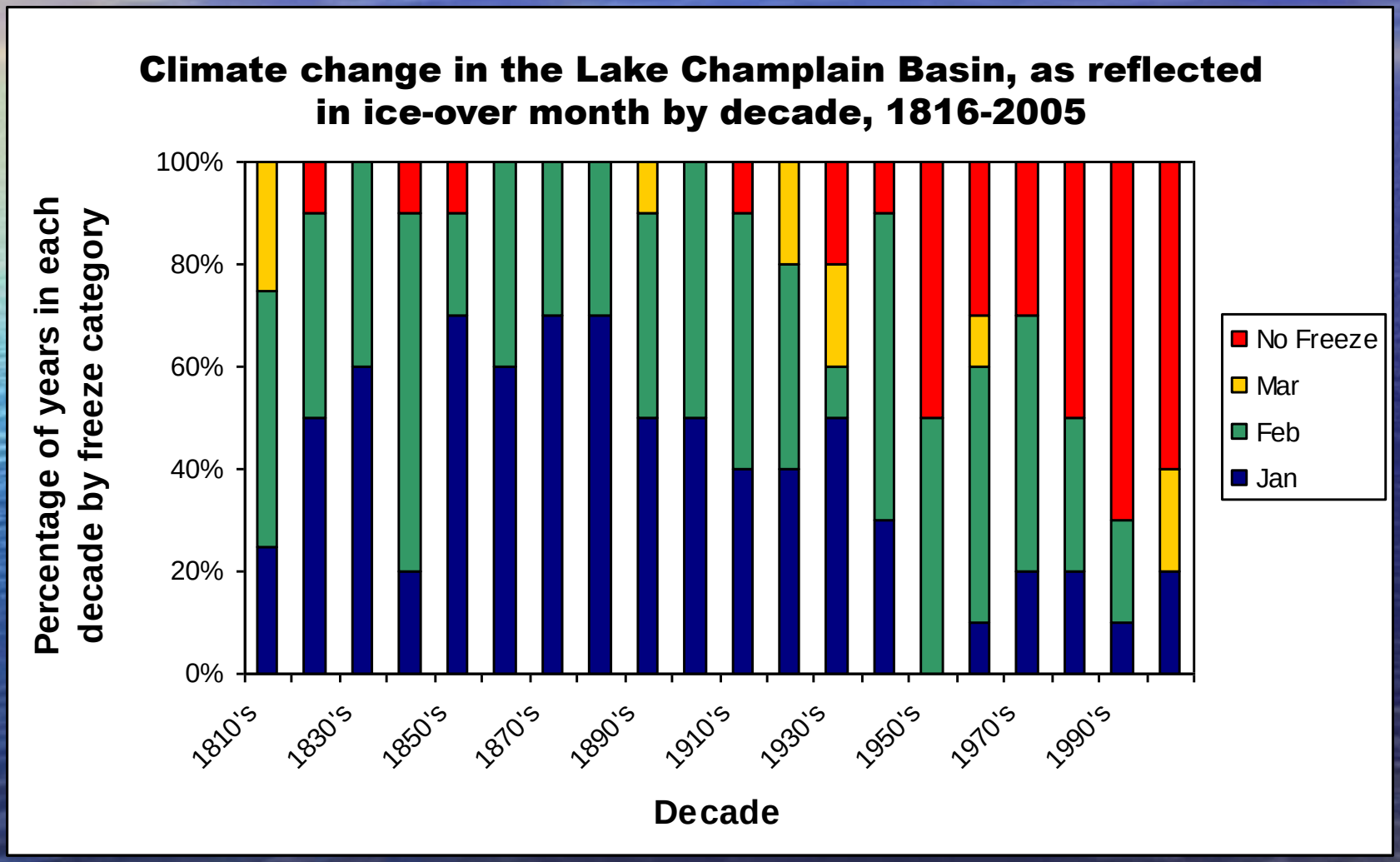
Mixing sediment plumes in the main lake from Lamoille River, Winooski River, and South Hero Island shoreline erosion
4/30/11

Stormwater culvert outflow
North Hero, VT
4/28/11

Burlington Wastewater Treatment Plant, VT

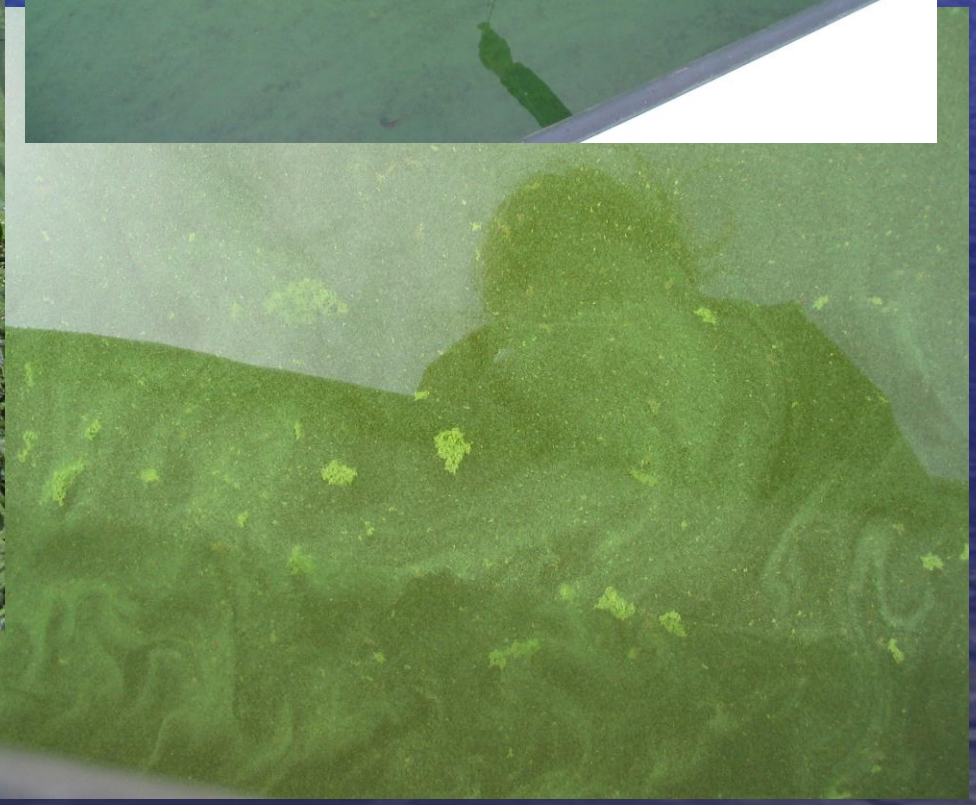
May 28, 2011 Winooski River, Stephanie Hurley

Global climate change



What are the ecosystem implications?

- Water Quality – loads of sediment, phosphorus, and other pollutants will be orders of magnitude higher than "normal."
- In one day in the last week of April, the Winooski River phosphorus load was 77 metric tons, equal to ½ the usual **annual** load for this river (LCBP).
- Form of pollutants will affect bioavailability and ecological effects - complexity

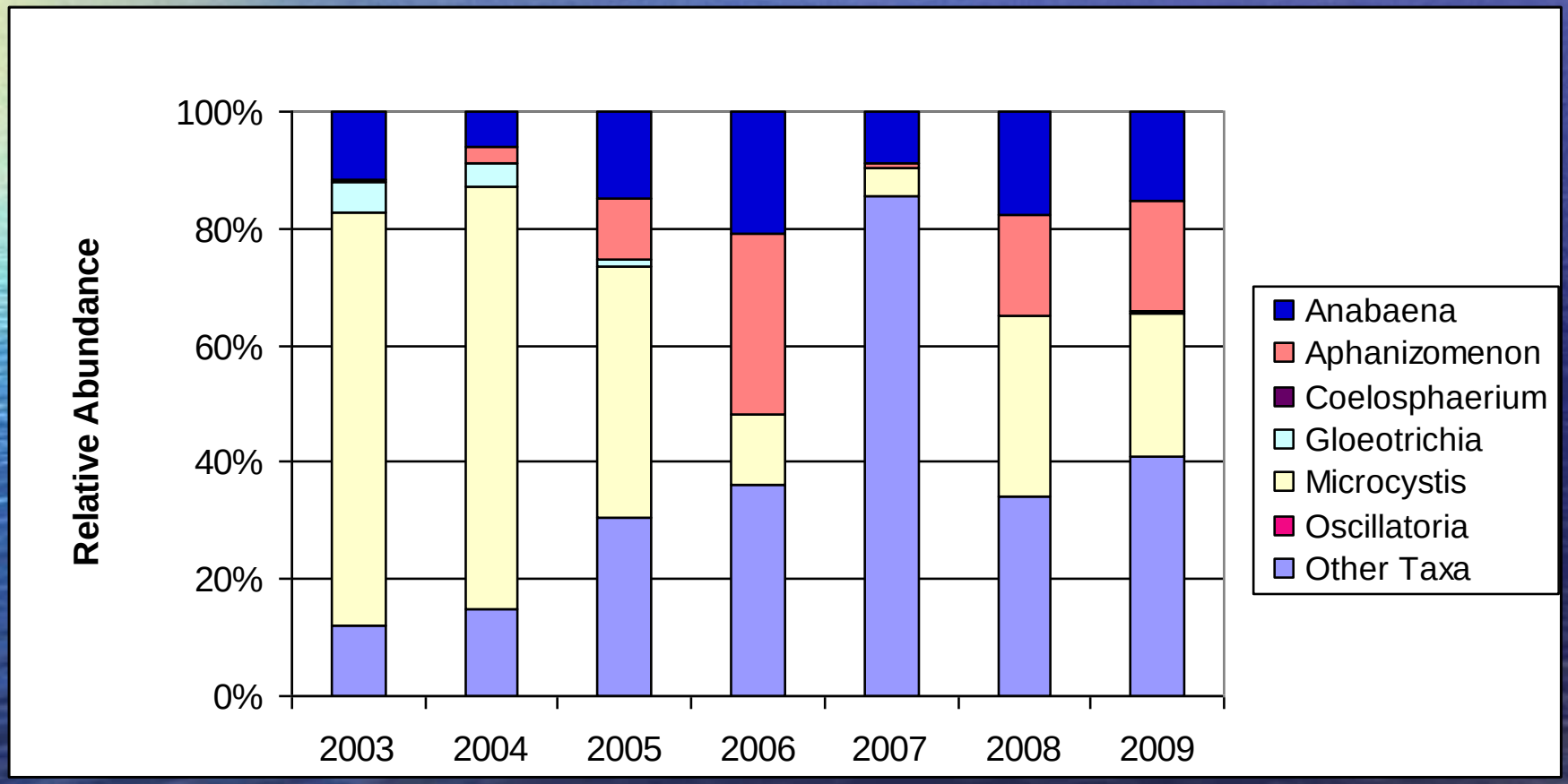


Cyanobacteria Bloom

What are the ecosystem implications?

- Biota – extensive habitat changes – short and long term, including bottom conditions, thermal regime, light penetration, etc.
- Scouring and burial of benthic organisms
- Temperature swings and water levels have affected fish spawning and emergence
- Visual cues and migration
- Winners and losers. . . .

Seasonal Percent Composition of Phytoplankton in Missisquoi Bay, 2003-2009



What are the ecosystem implications?

- Wetlands – functioned to collect sediment and store water
- Invasion and germination of plants in new areas
- Spread of water chestnut seeds, water milfoil, purple loosestrife

Sediment-laden tributaries flood
Stevens and Jewett Brook Marsh, St. Albans Bay, VT

What condition of Lake Champlain Basin do residents want to see?

- Ecologically, Lake Champlain can exist in many states – but some are more desirable than others.
- What "state" do we want?
  - Blue lake vs. green (blue-green) lake
  - What mix of species?
  - What shoreline conditions?

Ecosystem Attributes

- Beach closures

- Water clarity

- Fish consumption advisory

- Basin land use distribution

- Spread of water chestnut

Advisories for PCBs and Mercury

HEALTH ALERT

The Vermont Department of Health recommends that people limit consumption of some fish caught in Vermont waters.

The advisory is based on tests of hundreds of fish caught in Vermont waters in the past 10 years and scientific information about the harmful effects of mercury and, in the case of large lake trout in Lake Champlain and all fish in the Hoosic River, PCBs (polychlorinated biphenyls).

To minimize exposure to these potentially harmful contaminants and to protect your health, follow the guidelines below when eating fish caught in Vermont. Eating the total monthly limit within a single week is not recommended. One meal equals 8 ounces of raw fish fillet.

	Women of childbearing age — particularly pregnant women, women planning to get pregnant, and breastfeeding mothers — **and children age 6 and under**	**All other individuals**
GENERAL ADVISORY:		
Brown Bullhead Pumpkinseed	No Advisory	No Advisory
Walleye	0 Meals	No more than 1 meal/month
Lake Trout Smallmouth Bass Chain Pickerel American Eel	No more than 1 meal/month	No more than 3 meals/month
Largemouth Bass Northern Pike	No more than 2 meals/month	No more than 6 meals/month
Brook Trout Brown Trout Rainbow Trout Yellow Perch	No more than 3-4 meals/month	No Advisory
All Other Fish	No more than 2-3 meals/month	No more than 9 meals/month
SPECIAL ADVISORIES:		
Lake Carmi - Walleye	No more than 4 meals/month	No Advisory
Lake Champlain - Lake Trout (larger than 25 inches)	0 meals (includes all children under 15)	No more than 1 meal/month
Hoosic River - All Fish	0 meals	0 meals
Deerfield Chain (Grout Pond, Somerset Reservoir, Harriman Reservoir, Sherman Reservoir, and Searsburg Reservoir)		
Brown Bullhead Brook Trout	No Advisory	No Advisory
Rainbow Trout Brown Trout (smaller than 14 inches) Rock Bass Rainbow Smelt Yellow Perch	No more than 1 meal/month	No more than 3 meals/month
Brown Trout (larger than 14 inches) All Other Fish	0 meals	No more than 1 meal/month
15 Mile Falls Chain (Comerford Reservoir and Moore Reservoir)		
All Fish	0 meals	No more than 2 meals/month
15 Mile Falls Chain (McIndoes Reservoir)		
Yellow Perch	No more than 2 meals/month	No more than 6 meals/month
All Other Fish	No more than 1 meal/month	No more than 3 meals/month

HEALTHY VERMONTERS 2010

For more information call 1-800-439-8550
The Vermont Department of Health

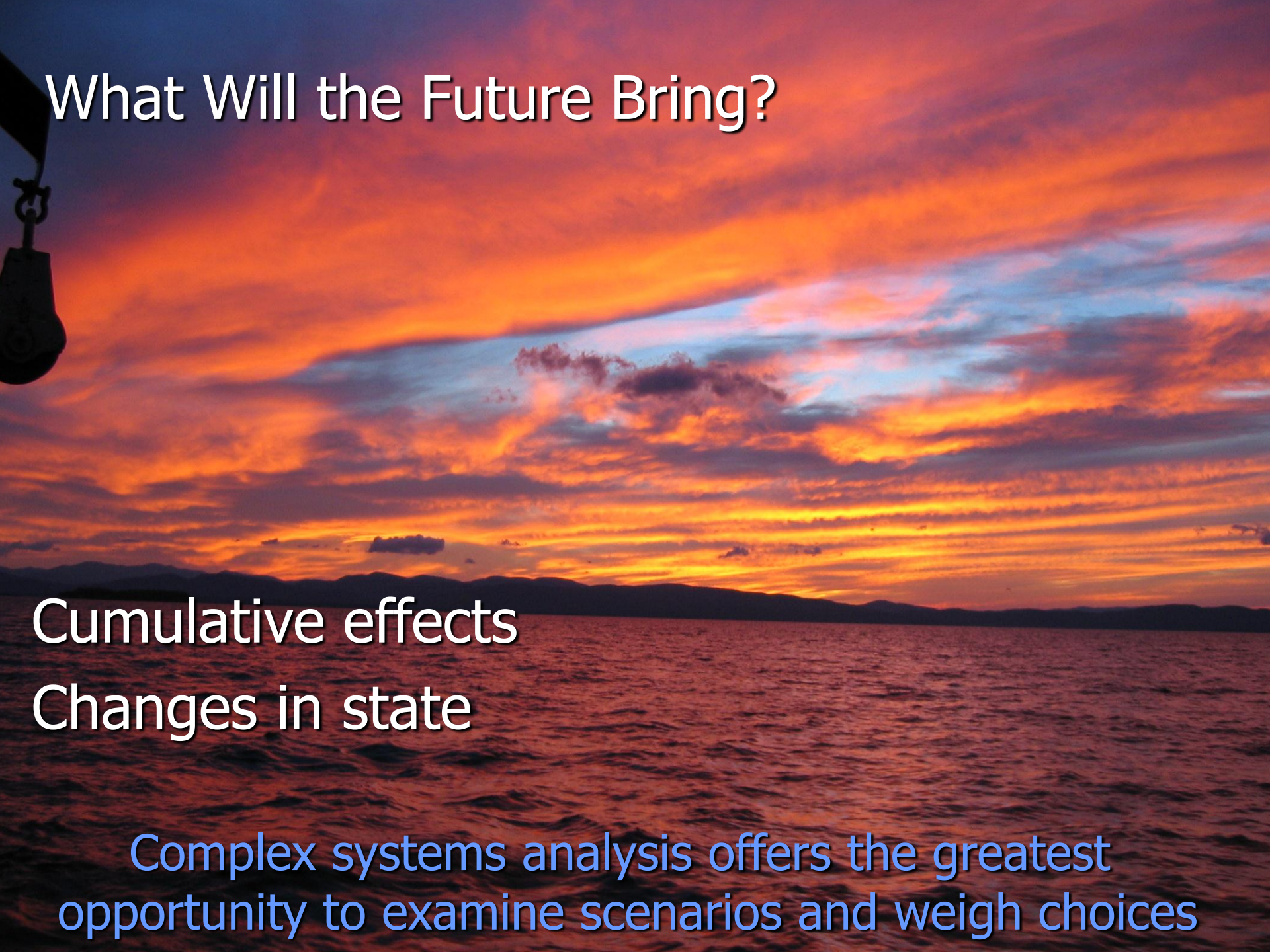
June 2000

NYSDEC

Cumberland Bay dredging.

"Safe Fish Consumption" had broader meaning to many respondents

- While I don't eat Lake Champlain fish, the presence of toxins suggests to me the ecosystem is impaired.
- Fish are indicators and therefore are useful in measuring toxins. If you could make the fish safe, then you have fixed the toxin issues.
- It appears that the health of the lake's inhabitants is indicative of the lake's health. I don't even eat fish but to hear of fish toxicity is alarming in any quantity.
- What spooks me about fish advisories is the impact of toxics on all the species that have no choice on what they eat! Over time it would seem that toxic fish could bring down the entire ecosystem.


What Will the Future Bring?
Cumulative effects
Changes in state
Complex systems analysis offers the greatest opportunity to examine scenarios and weigh choices