VERMONT EPSCoR
Experimental Program to Stimulate Competitive Research

Vermont EPSCoR is competitively funded by the National Science Foundation (NSF) to make possible cutting edge, fundamental research of national importance and economic significance to the state and region.

Adaptation to Climate Change in the Lake Champlain Basin
With New Understanding through Complex Systems Modeling

EPS -1101317

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NSF

Cyber- Infrastructure for Science and Engineering Research and Education

120 Gb redundant connectivity for research and education

Cyber-Infrastructure for Businesses in Vermont

Our fiber network provider has built excess capacity that is serving more than 20 Vermont businesses

Vermont EPSCoR Center for Workforce Development and Diversity

At Saint Michael's College and Johnson State College

Integrates high school and middle school teachers, high school students and undergraduates into our research

Disabled and Veterans

Scholarships support first generation and Abenaki students in STEM majors

Internet2 resources for Education

All Vermont schools, museums, libraries, art galleries and similar community institutions have access to Internet2 resources through the membership paid for the VT EPSCoR

Communicating About Science and Engineering

Television series, Emerging Science, produced in with Vermont Public Television

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$20M Five Year Award

UVM is the lead institution; higher education partners include JSC, Saint Michael's College, Middlebury College, Vermont Technology Council

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Adaptation to Climate Change in the Lake Champlain Basin:

Our goals are not to provide mitigation but rather to **inform adaptive management of the Basin.**

We approach the Basin as a **coupled human and natural system**.

We are collecting information on the human use and governance of the Basin as well as hydrologic and biologic data.

Our lake and watershed research and models **integrate natural and social science data and models** so that we can provide managers and policy makers with the ability to **test scenarios before adopting adaptive management strategies and policies.**

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Stakeholders and Partners:

Vermont Department of Environmental Conservation
Vermont Agency of Natural Resources
Lake Champlain Basin Program
Nature Conservancy (VT), Nature Conservancy (NY)
Ecosystem Restoration Program (formerly, Clean and Clear)
International Missisquoi Bay Task Force (International Joint Commission)

We would like to partner with the **Vermont Climate Cabinet**

Natural and Social Science Leaders:

Jason Stockwell
Arne Bomblies
Christopher Koliba

Kelvin Chu, Judith Van Houten

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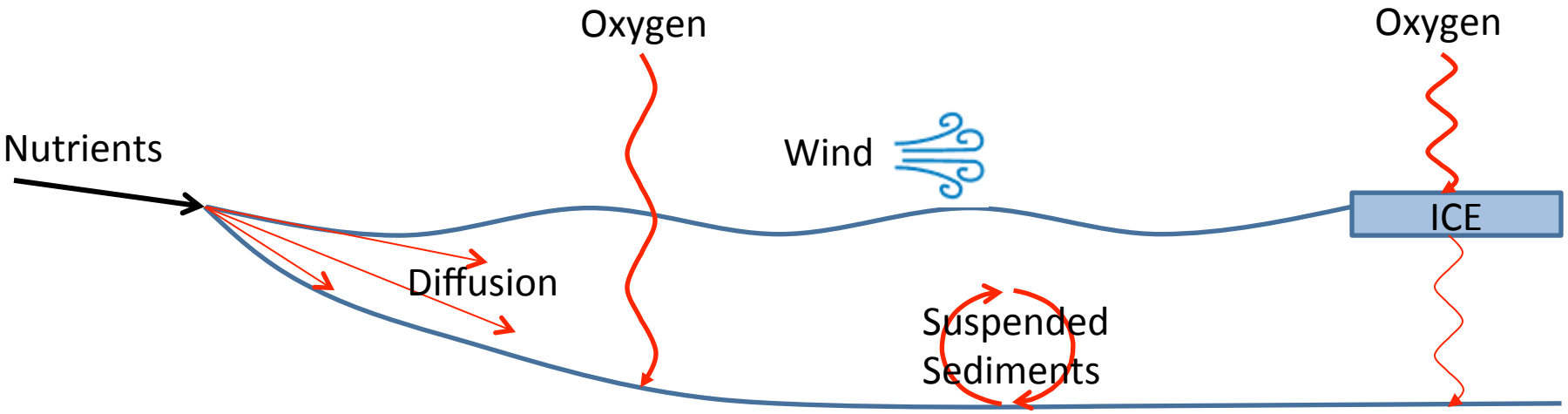
Question 1: Relative importance of "in-lake" versus "to-lake" processes for harmful algal blooms (HABs)?



Invaded Aquatic Communities – promote HABs?





Native Aquatic Communities – more resilient to HABS?

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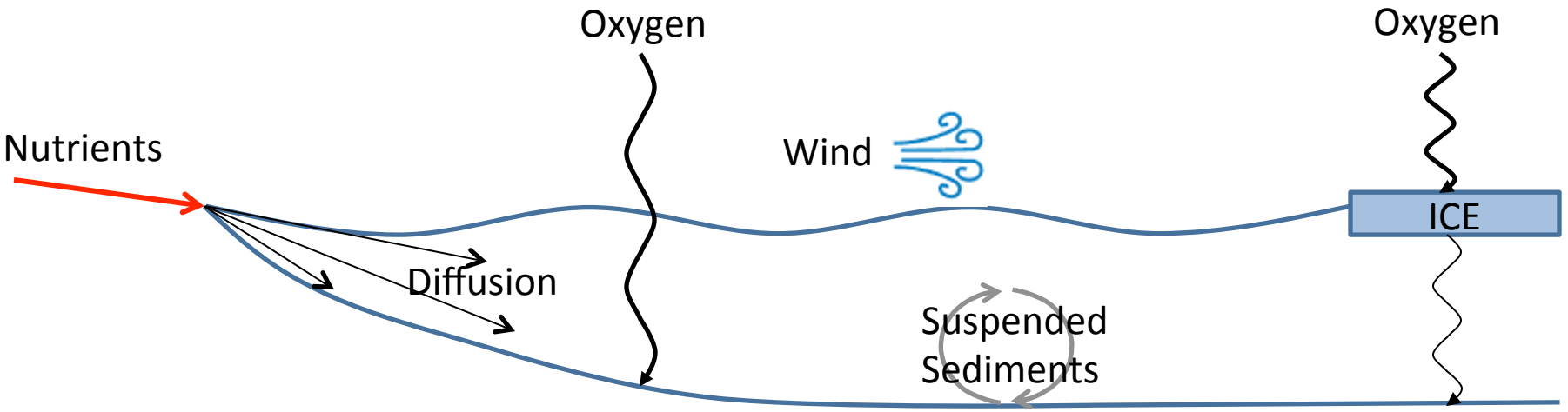
Question 1: Relative importance of "in-lake" versus "to-lake" processes for harmful algal blooms?



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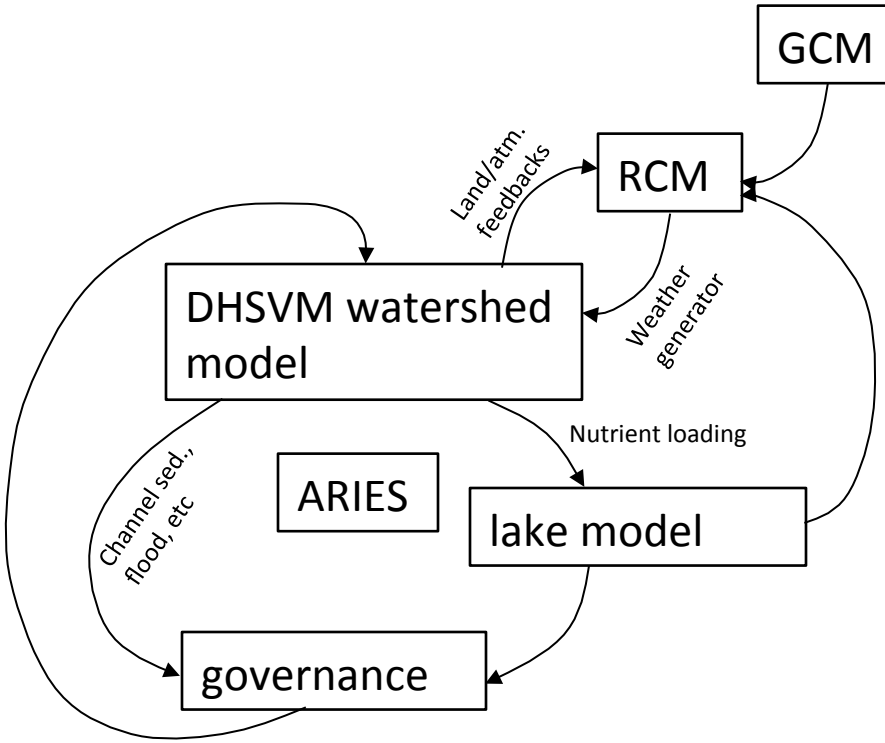
Time frame of models: short-term (20-30 years) and long-term (100-200 years).

Geographic scope of models: Winooski and Missisquoi watersheds, divided into subwatersheds

Model time step: range from hourly to yearly for various processes



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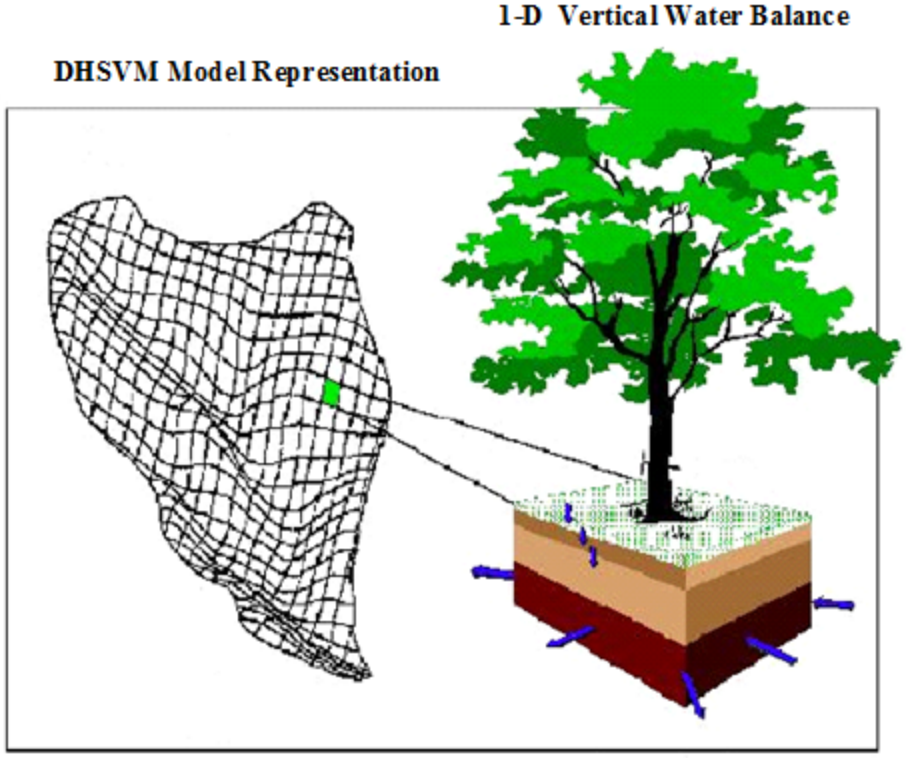
Distributed hydrology-soil-vegetation model (DHSVM)



- Physically based hydrologic model that represents the effects of
  - Topography
  - Soil
  - Vegetation
- Solves the energy and water balance at each grid cell at each timestep

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We are taking a SYSTEMS APPROACH to impacts and adaptation studies.

We seek to understand:

1. The watershed/lake system as a complex adaptive system
2. The expected impact of precipitation change on:
    1. Sediment and non-point phosphorus mobilization
    2. Flooding/scouring of channels and floodplains
    3. Natural vegetation and farming practices
    4. Infrastructure

    } Watershed model
3. The expected impact of temperature change on:
    1. Natural vegetation
    2. Frozen ground
    3. Snow/rain ratio

    } Regional Climate Model
4. System resilience to future changes under a variety of scenarios
    1. What variables dominate? (e.g. land use, governance, etc)
    2. What alternative stable states may the watershed take on? (agricultural/ urban, forest succession, healthy channels/impacted,etc)

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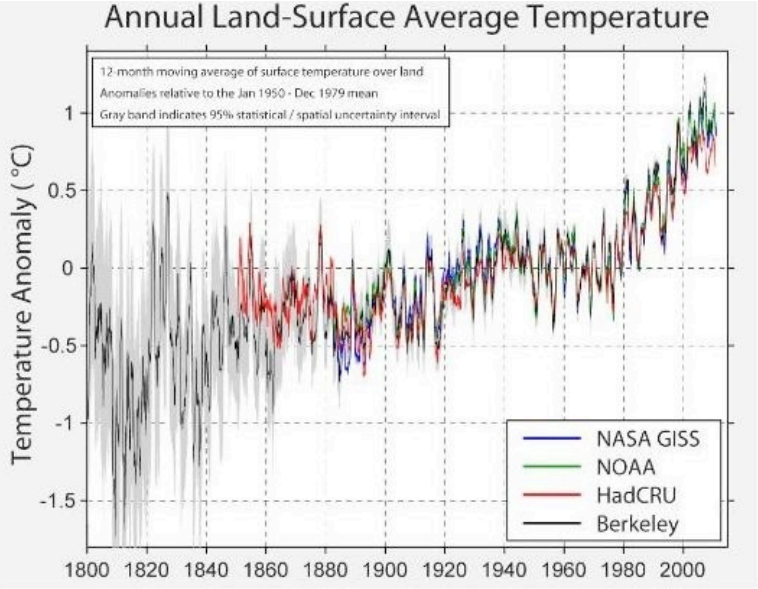
Climate Scenario Storylines

- Develop a shared "mental model" of possible climate change scenarios
- Identify parameter ranges; categories of analysis
- Undertake with partners



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Question 3: In the face of uncertainties about climate change, land use and lake response scenarios, how can adaptive management interventions (e.g. regulation, incentives, treaties) be *designed*, valued and implemented in the multi-jurisdictional Lake Champlain Basin?

"Effective watershed governance networks may induce watershed to a stable state that is valued relatively higher by society and policy makers."

- Questions of governance design
- Questions of trade-offs
- Questions of optimizing our public policy parameters

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Mediated Modeling

- Climate change scenarios
- Generation of alternate scenarios
- Multi-criteria decision making to determine valuable adaptive management interventions
- Use to refine IAM model

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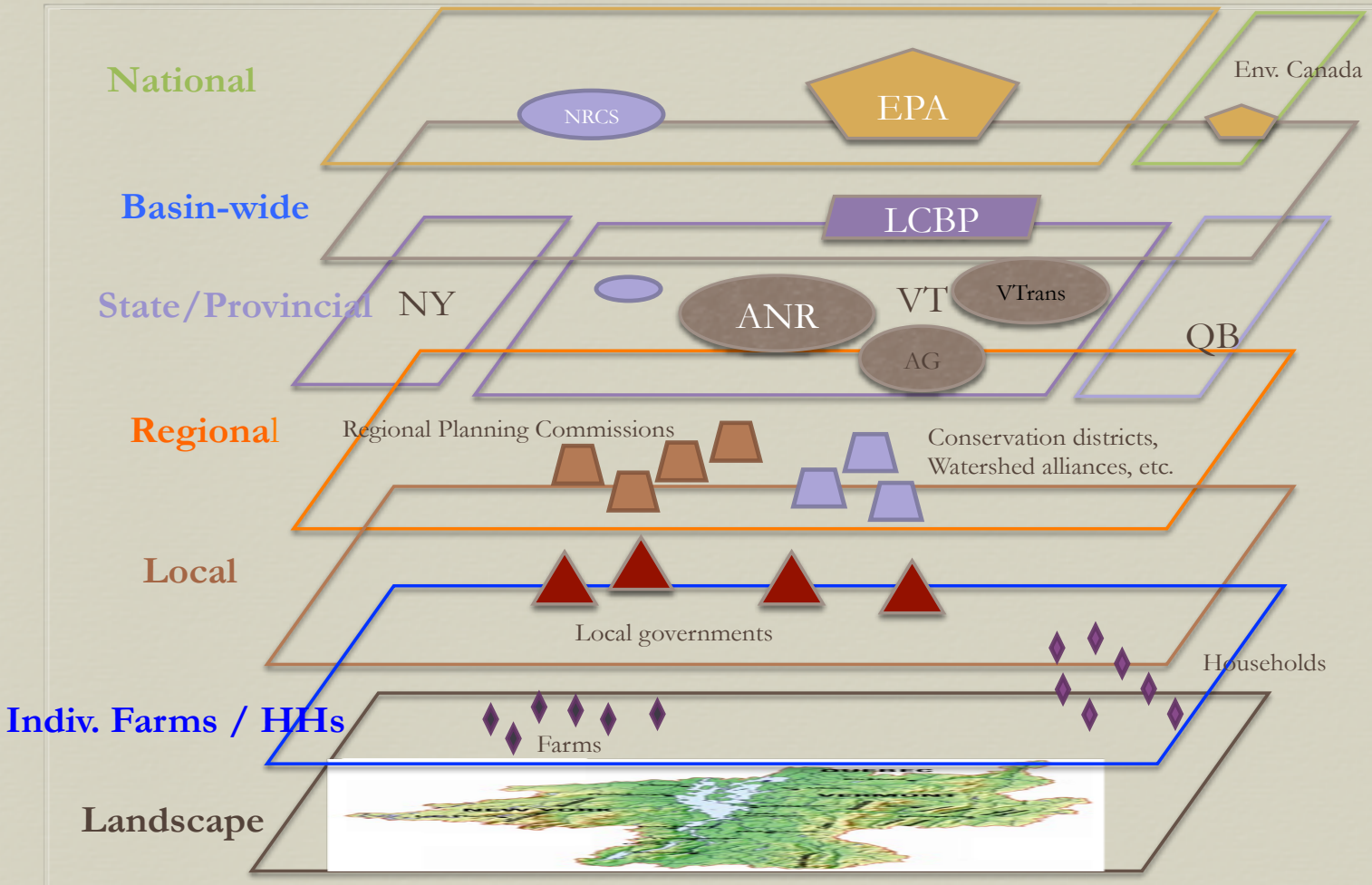

Figure 1. Initial Conceptual Model of Lake Champlain Watershed Governance