RACC Question 3

Adaptive Management of Complex Governance Networks in the Lake Champlain Basin

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The "Q3"Social Science Team:

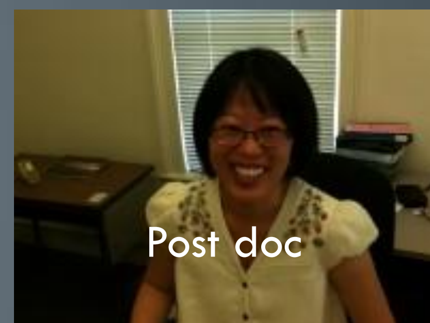
Not pictured: Steve Scheinert

The "Q3"Social Science Team:

Env. Policy Expert

Team Lead

Lead modeler



Post doc

Landscape designer

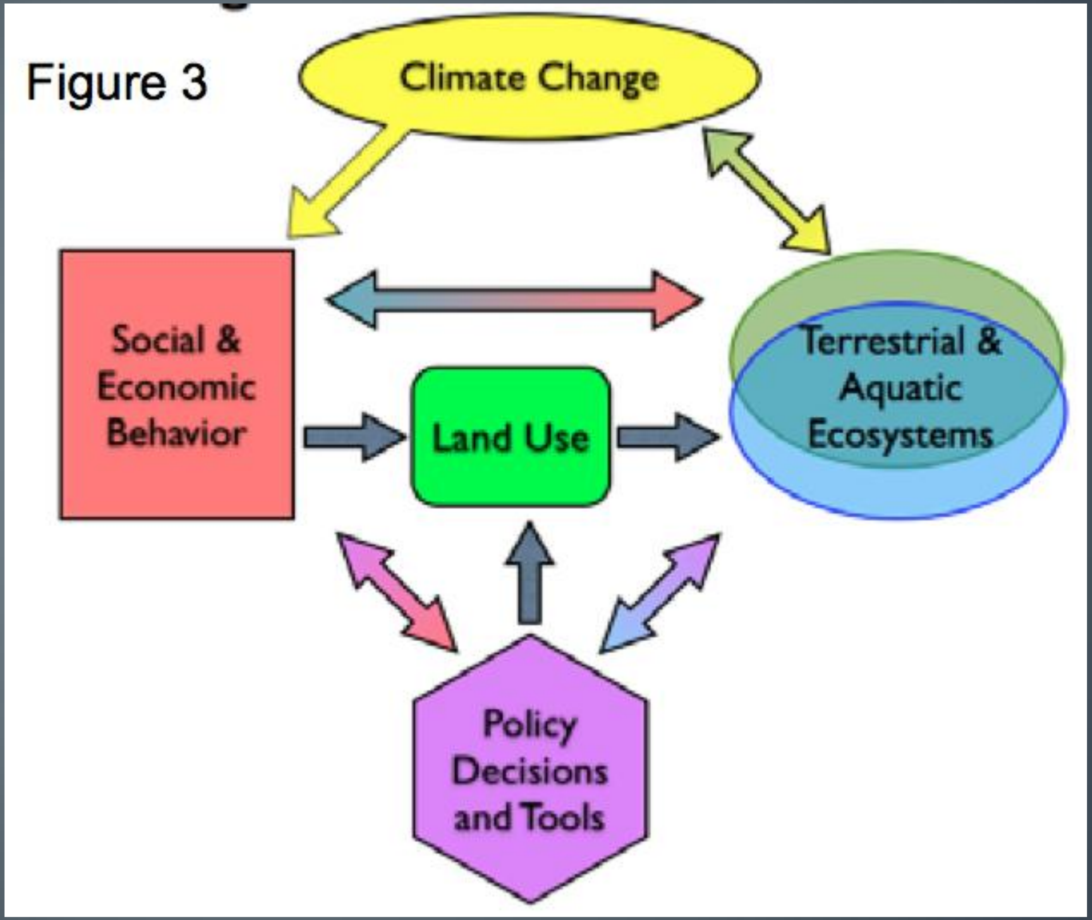
Graduate assistant

Spatial analysis

Partner

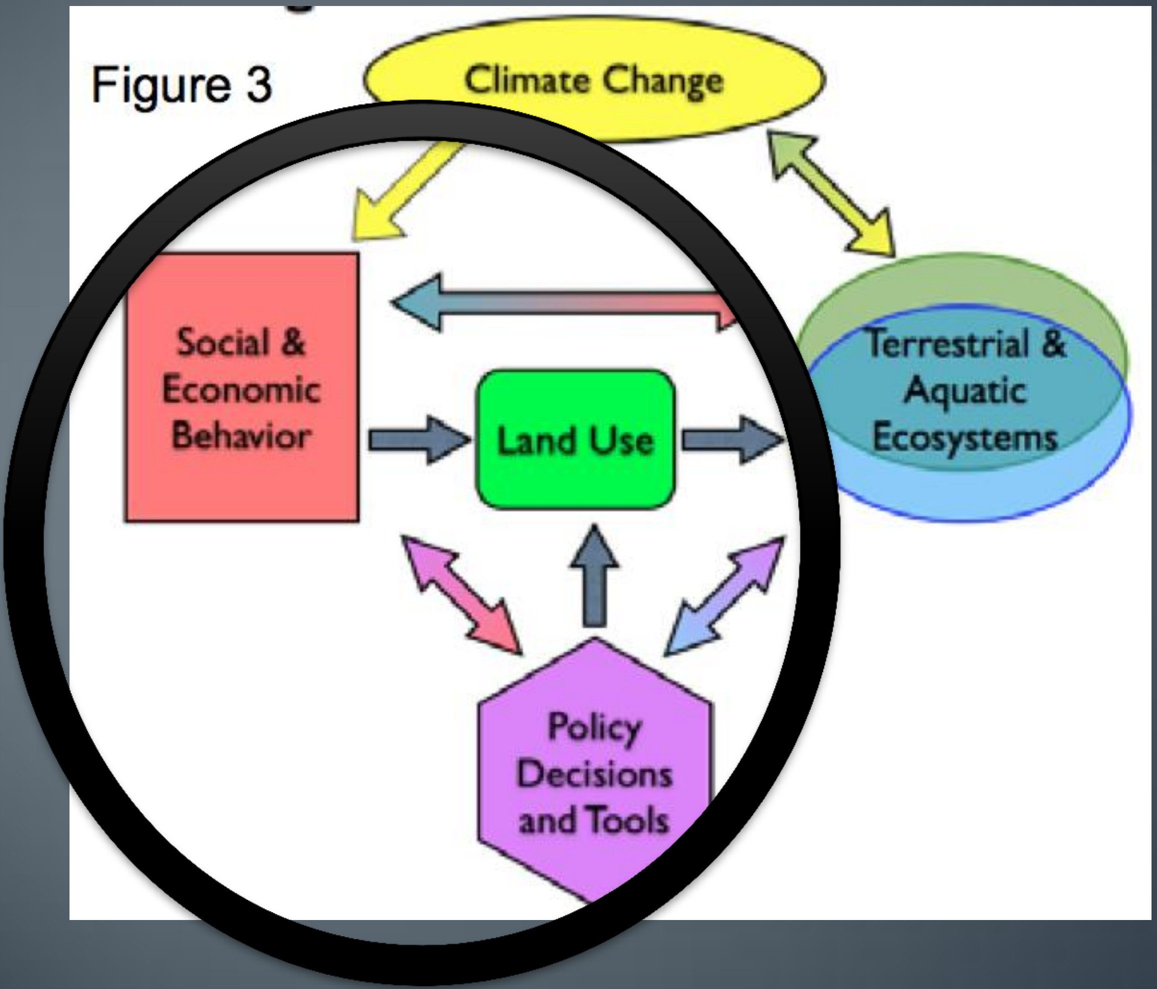
Not pictured: Steve Scheinert
Post Doc

A complex system…



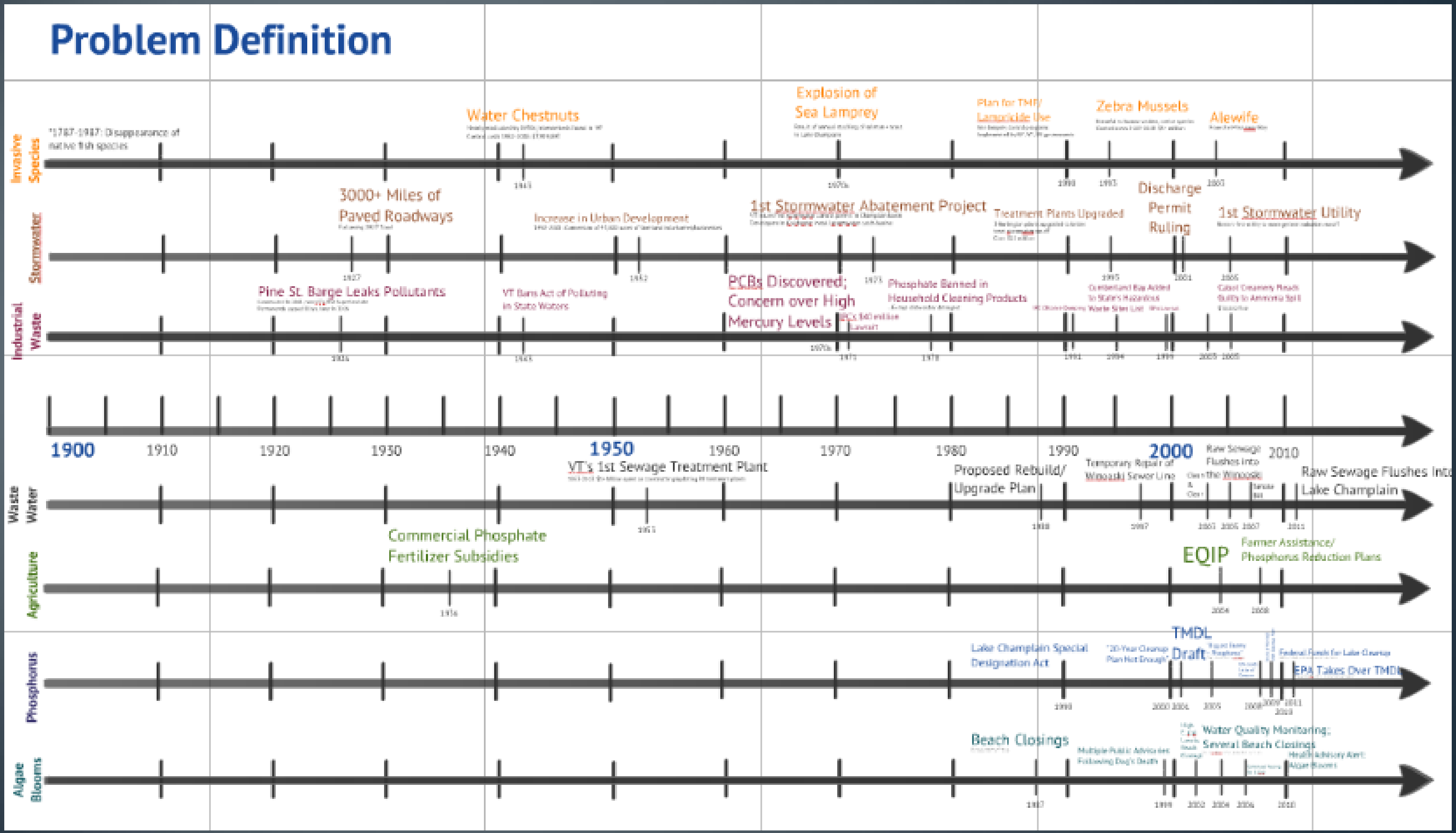
Research on Adaptation to Climate Change 2010 Proposal, VT EPSCoR

A complex system…



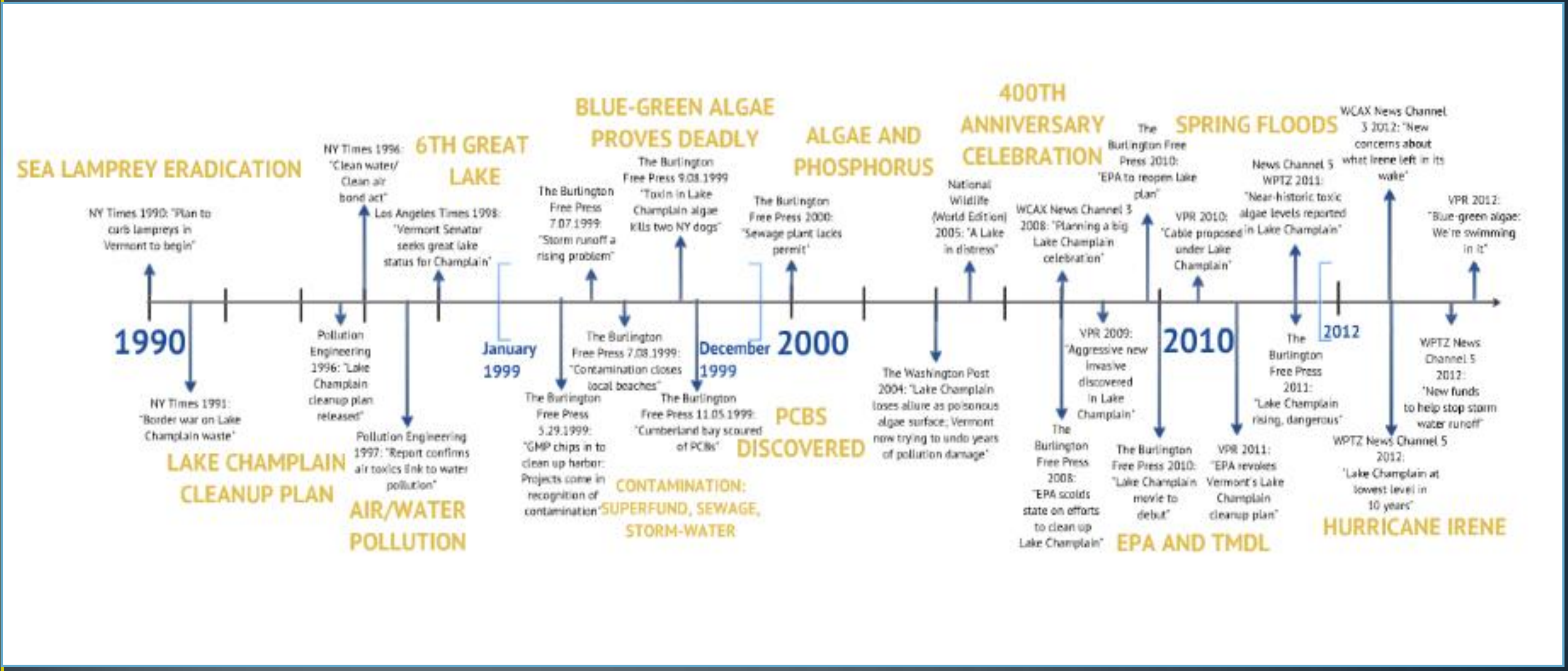
Research on Adaptation to Climate Change 2010 Proposal, VT EPSCoR

The changing nature of water quality problem definition

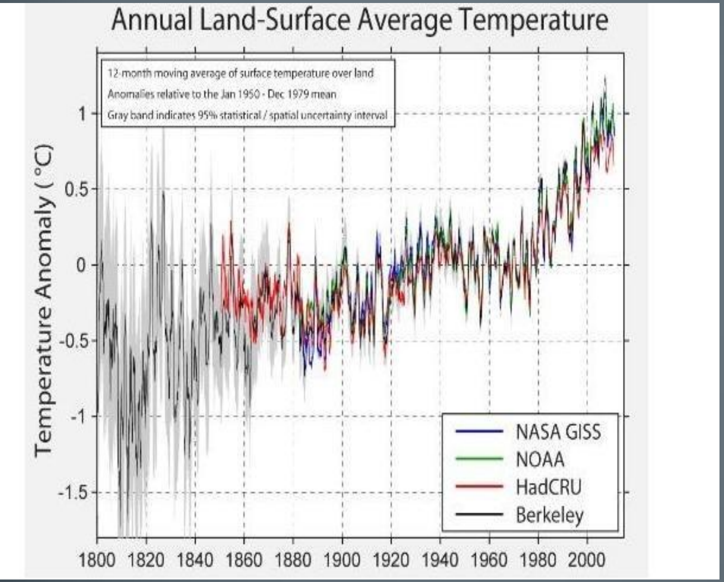


Chun, E. 2012, (EPSCoR Summer Intern)

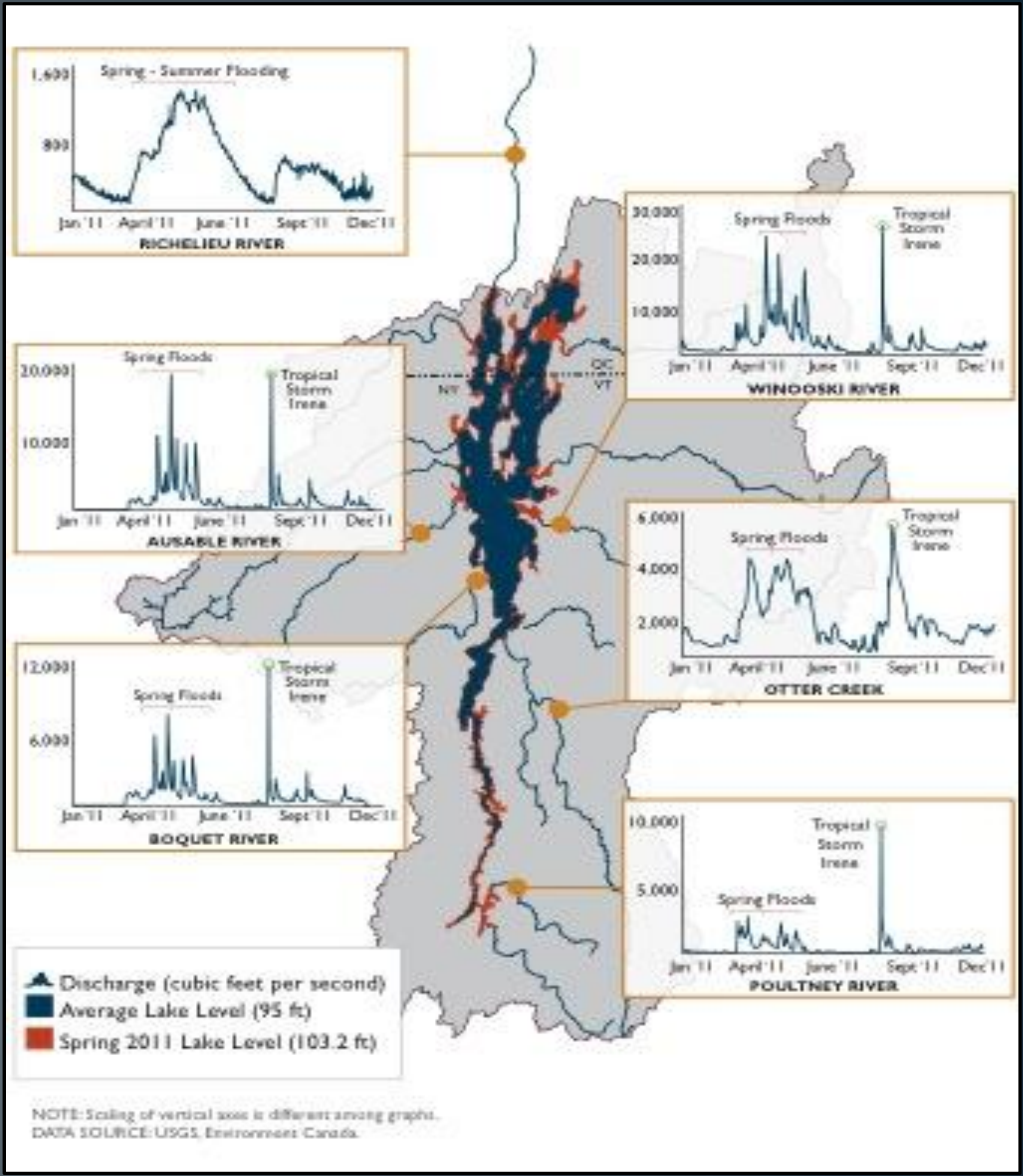
Lake Champlain in the Media



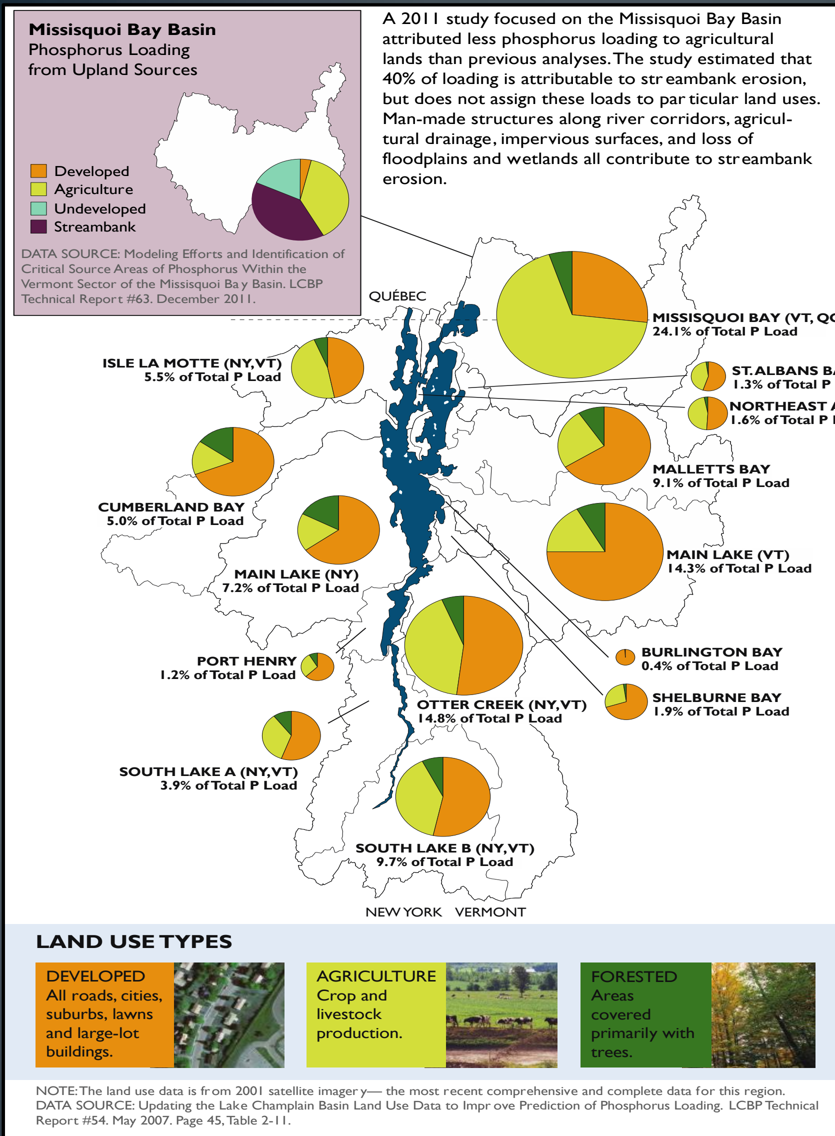
Shapiro, M. 2012 (EPSCoR Summer intern)



(Berkeley Earth Surface Temperature Study , 2012)

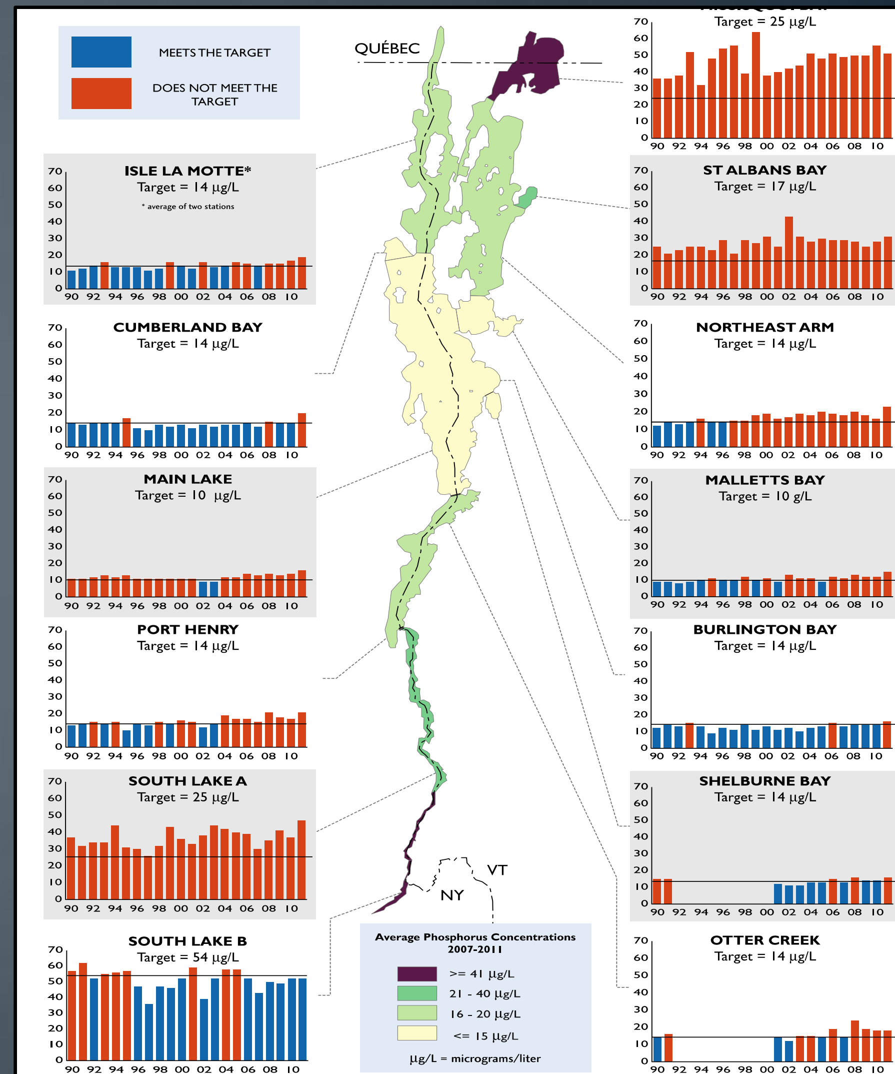


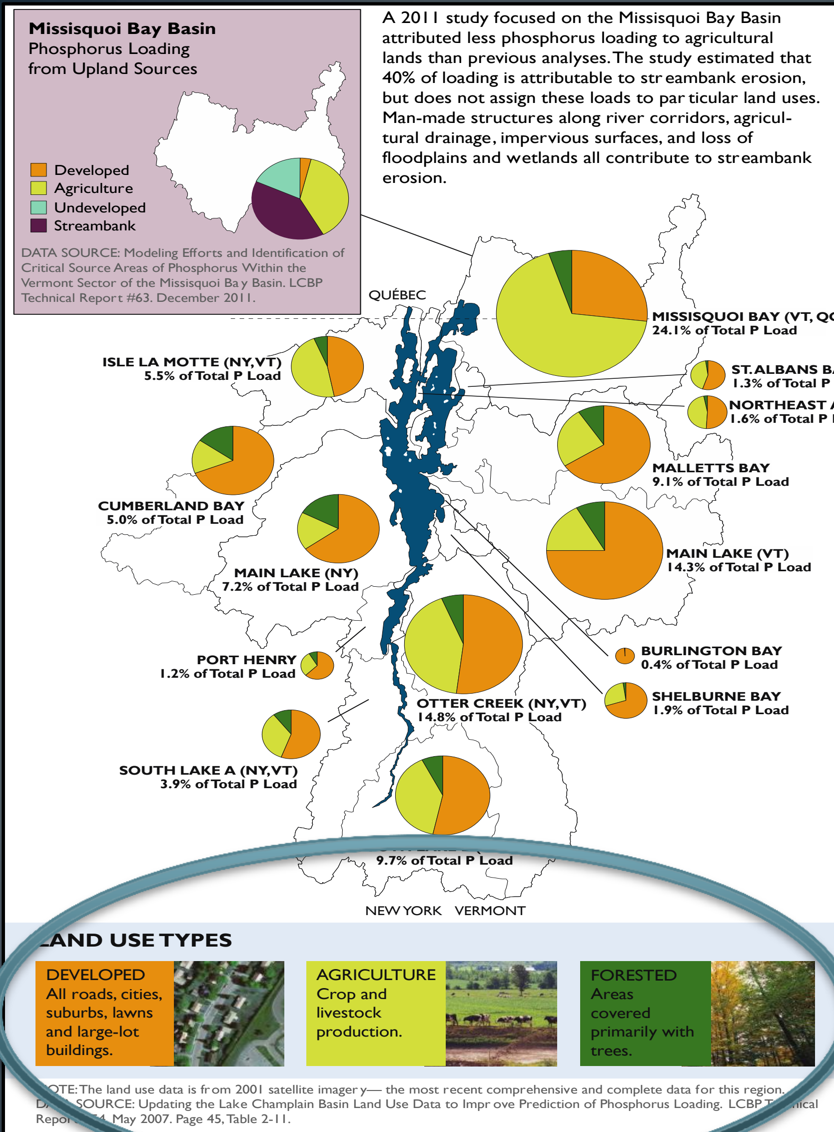
(State of the Lake (SoL), LCBP, 2012, figure 24; p.35)



(SoL, LCBP, 2012, figure 7; page 9)

(SoL, LCBP, 2012, figure 3; page 6)





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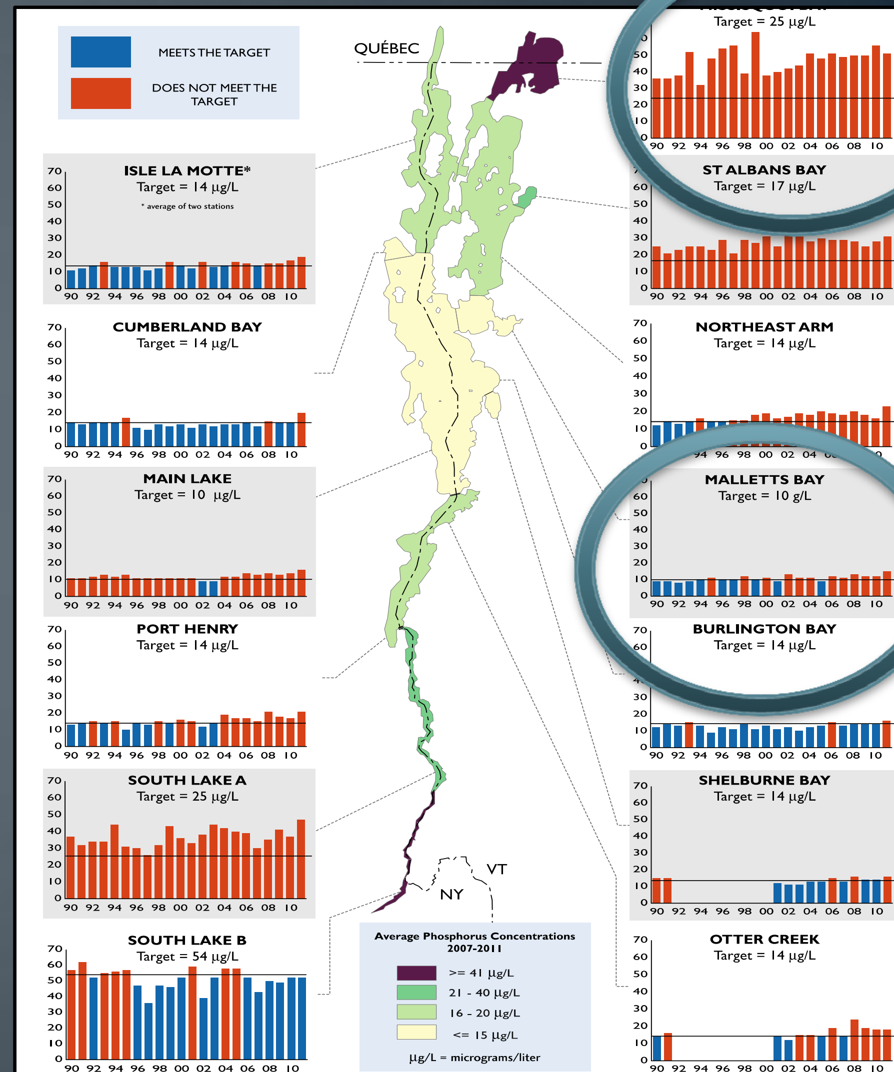
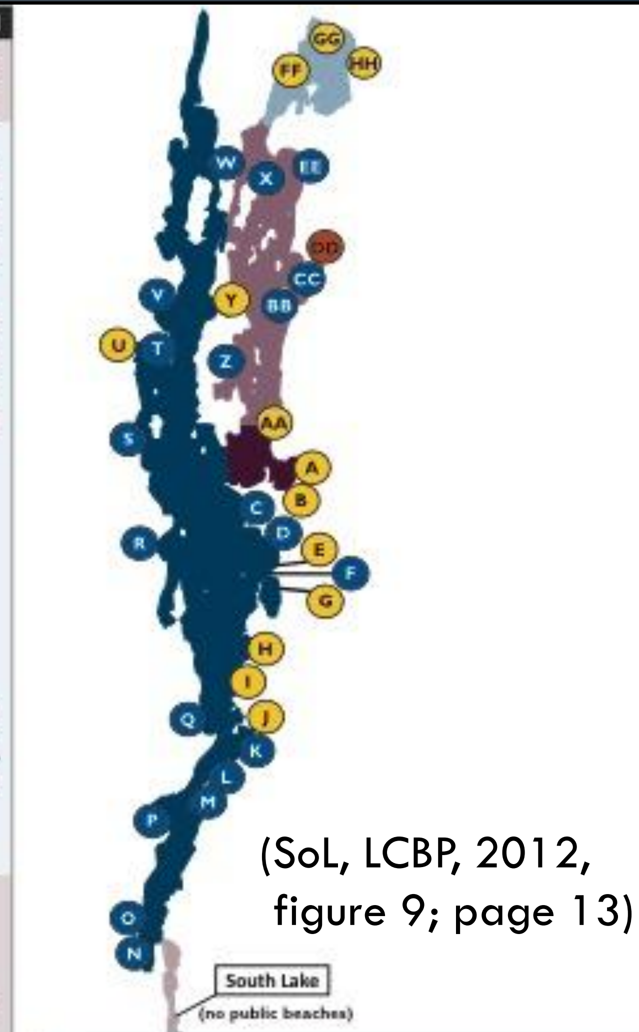
(SoL, LCBP, 2012, figure 3 page 6)



DRIVERS OF PUBLIC CONCERN?

		BEACH	2008	2009	2010	2011
MALLETTS BAY	A	Niquette Bay State Park	1		1	1
MALLETTS BAY	B	Bayside Beach		2	2	2
MAIN LAKE	C	Leddy Beach			2	
MAIN LAKE	D	North Beach				1
MAIN LAKE	E	Blanchard Beach	1	1	2	1
MAIN LAKE	F	Oakledge Beach			1	1
MAIN LAKE	G	Red Rocks Beach	2	2	2	
MAIN LAKE	H	Shelburne Town Beach	1	2	2	1
MAIN LAKE	I	Charlotte Town Beach		2		1
MAIN LAKE	J	Kingsland Bay State Park	2			1
MAIN LAKE	K	Ferrisburgh Town Beach			1	1
MAIN LAKE	L	DAR State Park				
MAIN LAKE	M	Button Bay State Park				
MAIN LAKE	N	Bulwagga Bay Beach				
MAIN LAKE	O	Port Henry Municipal Beach				
MAIN LAKE	P	Westport Town Beach	▲	▲		
MAIN LAKE	Q	Noblewood Park Beach				
MAIN LAKE	R	Port Douglas Beach				
MAIN LAKE	S	Ausable Point State Park		1		1
MAIN LAKE	T	Cumberland Bay State Park				▲
MAIN LAKE	U	Plattsburgh Municipal Beach		1	1	2
MAIN LAKE	V	Point Au Roche State Park	1		1	
MAIN LAKE	W	Alburg Dunes State Park	1		1	
NORTHEAST ARM	X	North Hero State Park			1	
NORTHEAST ARM	Y	Knight Point State Park	1		2	
NORTHEAST ARM	Z	Grand Isle State Park			1	
NORTHEAST ARM	AA	Sand Bar State Park	3		1	2
NORTHEAST ARM	BB	Burton Island State Park				
NORTHEAST ARM	CC	Kill Kare State Park				
NORTHEAST ARM	DD	St. Albans Bay State Park	1		5	4
NORTHEAST ARM	EE	Cohen Park				
MISSISQUOI BAY	FF	Saint Georges de Clarenceville	1			2
MISSISQUOI BAY	GG	Venise en Quebec	1		1	2
MISSISQUOI BAY	HH	Saint Armand	1			2



STATUS (2008-2011)

- GOOD: Closed 0-2 times
- FAIR: Closed 3-7 times
- POOR: Closed 8+ times
- Closed due to bacteria
- Closed due to cyanobacteria
- Closed for longer than one week
- Closed for the season, due to flood damage
- Closed for the season, due to lack of lifeguard

NOTE: The number in each circle represents a single closure, but the closure may have been for more than one consecutive day.
DATA SOURCES: Town Offices, UVM, NYS DOH, MDDEP

(SoL, LCBP, 2012, figure 9; page 13)

"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 interventions

HYPOTHESIS STATED IN PROPOSAL:

Under business-as-usual policy scenarios, societal actors in the Basin have limited adaptive capacity, and display inertia and lags in responding to climate-driven land use and lake response scenarios. In contrast, under sustainable policy development scenarios, societal actors in the Basin have enhanced resiliency, and overcome inertia and lags.

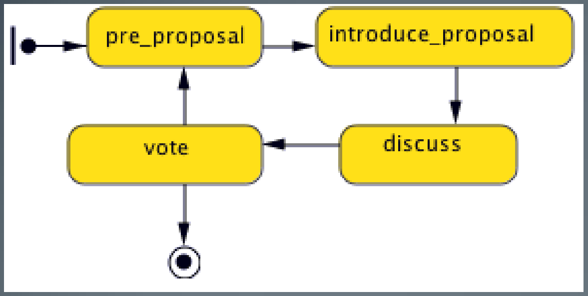
Mediated Modeling

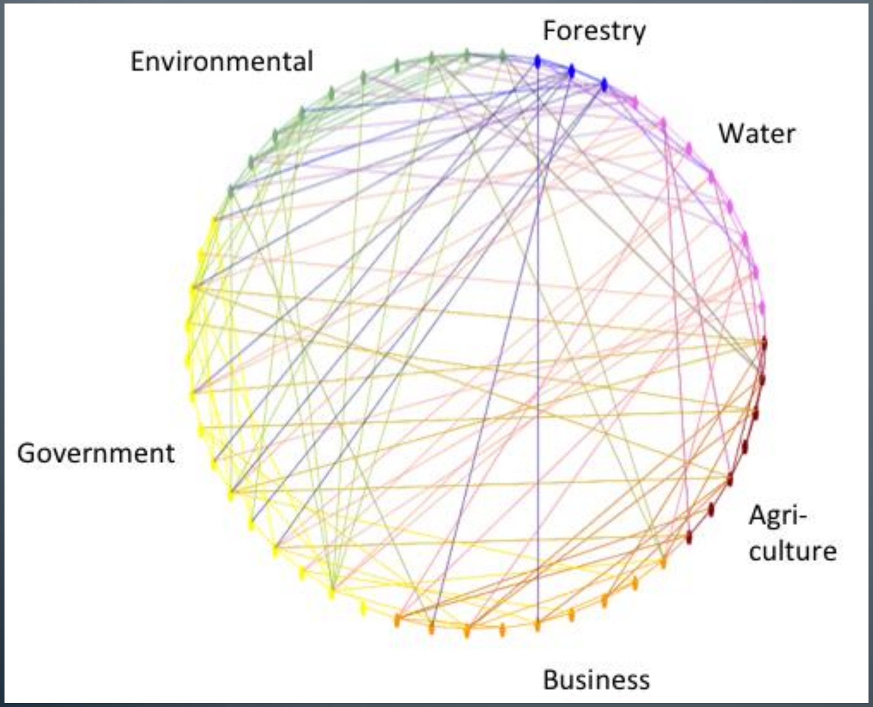
- Climate change scenarios
- Generation of alternate scenarios
- Multi-criteria decision making to determine valuable adaptive management interventions
- Use to refine IAM model

		Degree of Consensus among Stakeholders	
		Low	High
Degree of Understanding of the System Dynamics	Low	**Status Quo** Typical result: Confrontational debate and little improvement	**Mediated Discussion** Typical result: Consensus on goals or problems but no help on how to achieve the goals or solve the problems
	High	**Expert Modeling** Typical result: Specialized model whose recommendations rarely get implemented because they lack stakeholder support	**Mediated Modeling** Typical result: Consensus on both problems/goals and process leading to effective and implementable policies

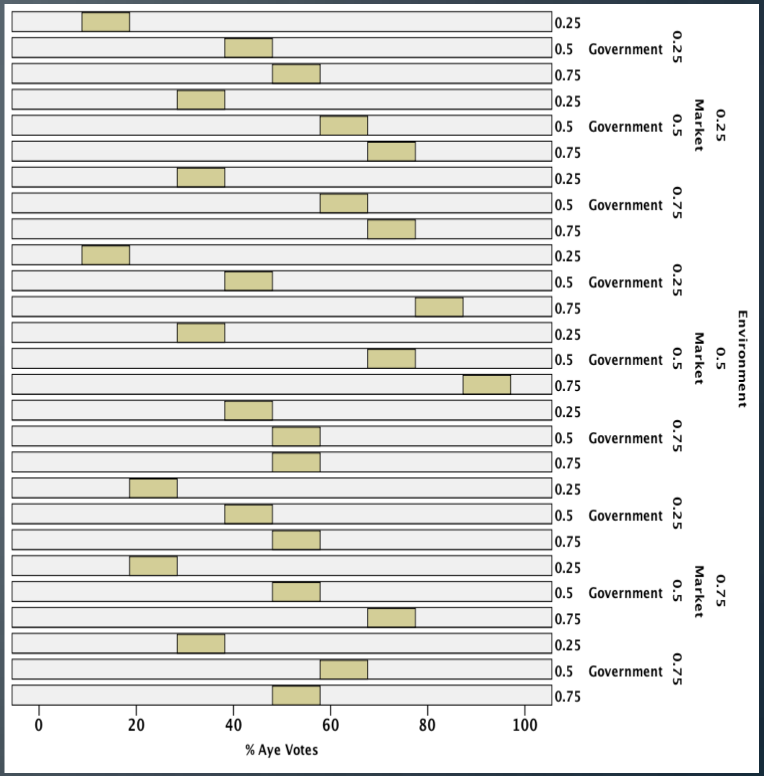
Source: Van den Belt, 2004, p.18

Agent-Based Modeling





Zia, A., Metcalf, S., Koliba, C. and Widner, M. 2011a. Agent Based Models of Cross-Jurisdictional Governance Networks: Simulating the Emergence of Project Prioritization Patterns Under Alternate Policy Theoretical Frameworks and Network Structures. COMPACT Conference. Rotterdam, the Netherlands.



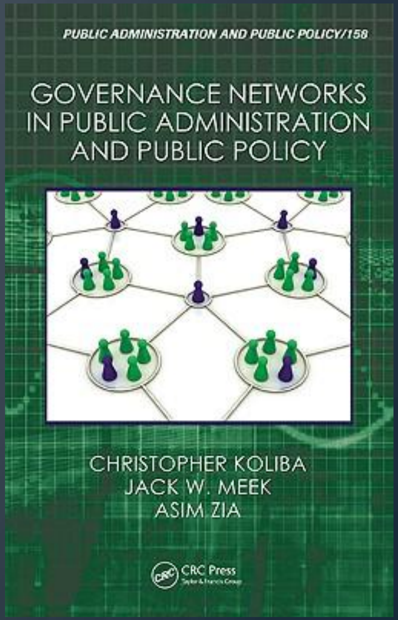
Adaptive management

Adaptive management is a systematic process for improving management policies and practices by **learning from the outcomes of management strategies** that have already been implemented. Adaptive water management aims to increase the adaptive capacity of the water system by putting in place both learning processes and the conditions needed for learning processes to take place.

(Geldof 1995, Pahl-Wostl 2004, 2007)

"Governance Network" as unit of analysis:

- Relatively stable pattern of coordinated action and resource exchanges;
- involving policy actors crossing different social scales, drawn from the public, private or non-profit sectors and across geographic levels;
- who interact through a variety of competitive, command and control, cooperative, and negotiated arrangements;
- for purposes anchored in one or more facets of the policy stream. (Koliba, Meek & Zia, 2010)

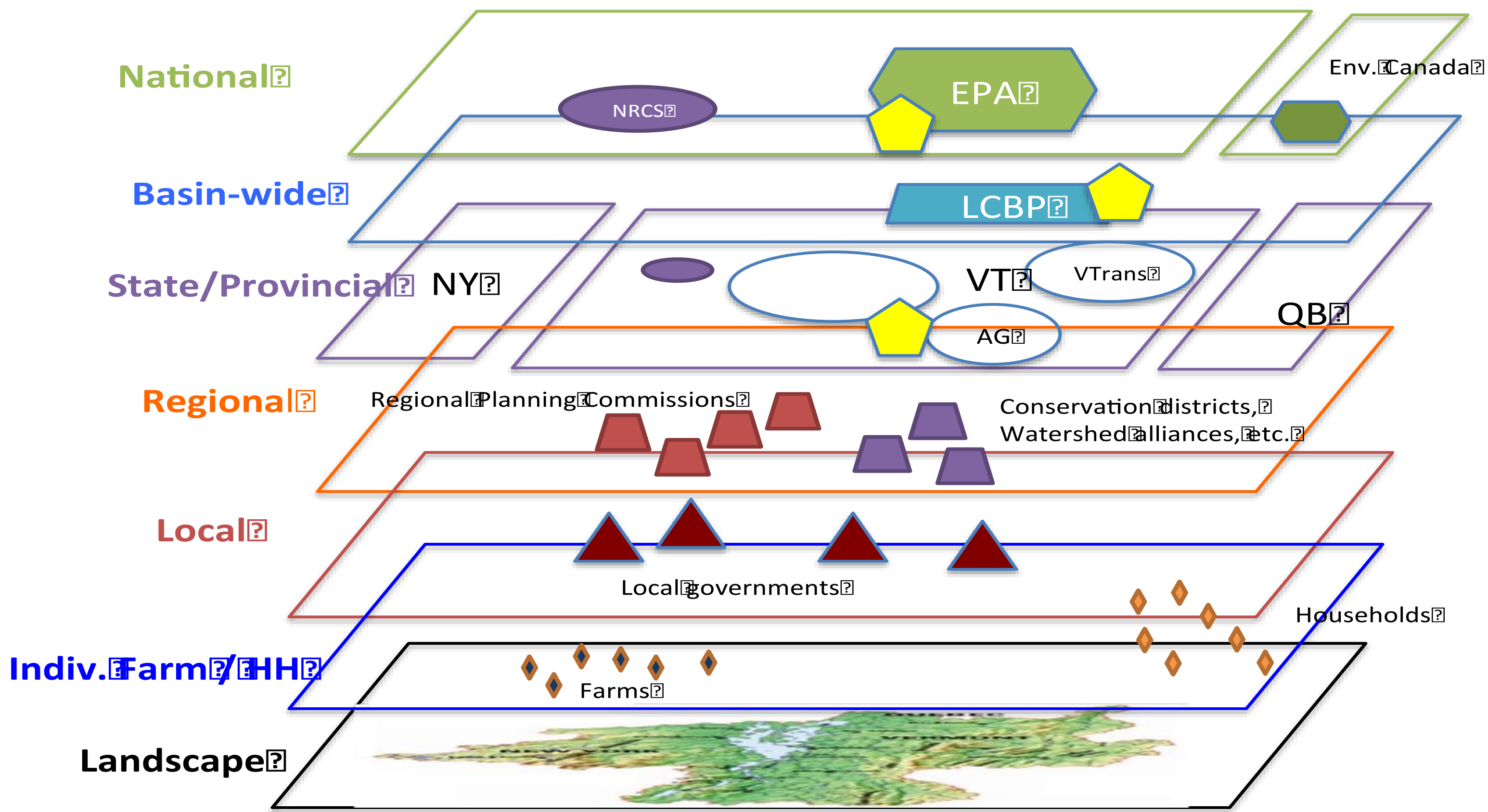


The elements of a governance informatics project include:

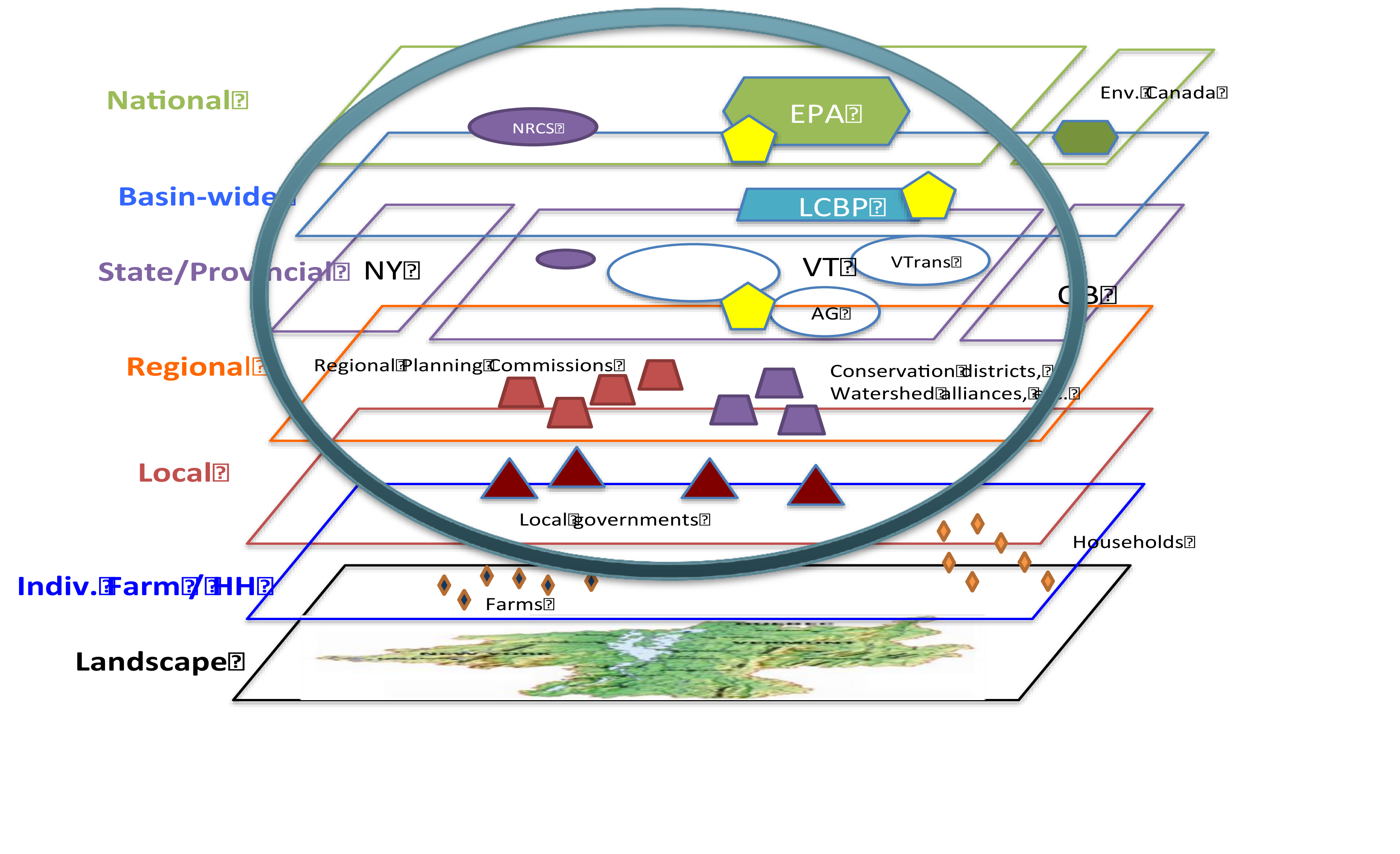
- Clarification of initial **boundary conditions**
- Undertaking of **participatory modeling** sessions with stakeholders
- Development of early **scoping models**
- Visualization of **new design considerations and scenarios**
- Construction of **pattern-oriented, agent-based models**
- **Continuous engagement** with stakeholders

(Koliba and Meek, accepted for publication)

Watershed Governance Scoping Model of Lake Champlain Basin



Watershed Governance Scoping Model of Lake Champlain Basin



Governance Network Analysis Research & Modeling Methods

Research methods:

- Surveys
- Interviews
- Focus groups
- Source documents analysis
- Comprehensive case study
- Critical events analysis
- Institutional ethnography

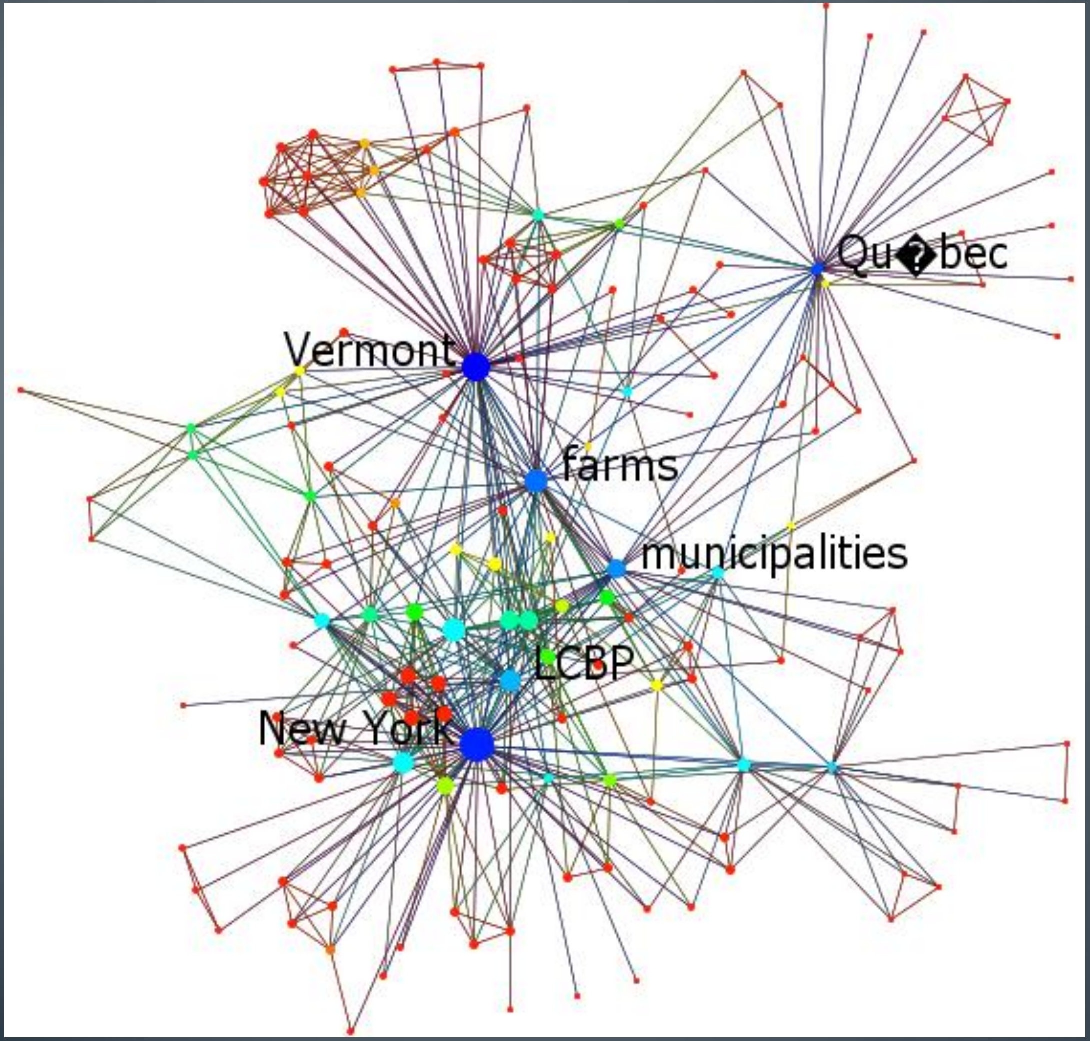
Computer simulation models:

- Agent Based Models
- Systems Dynamics Models
- Discrete Event Models
- Multi-criteria Analysis
- Social Network Analysis

What are the major governing assemblages operating in this region?

- Lake Champlain Basin Program’s Opportunities for Action (OFA)
- Vermont’s Total Maximum Daily Load (TMDL) Plan

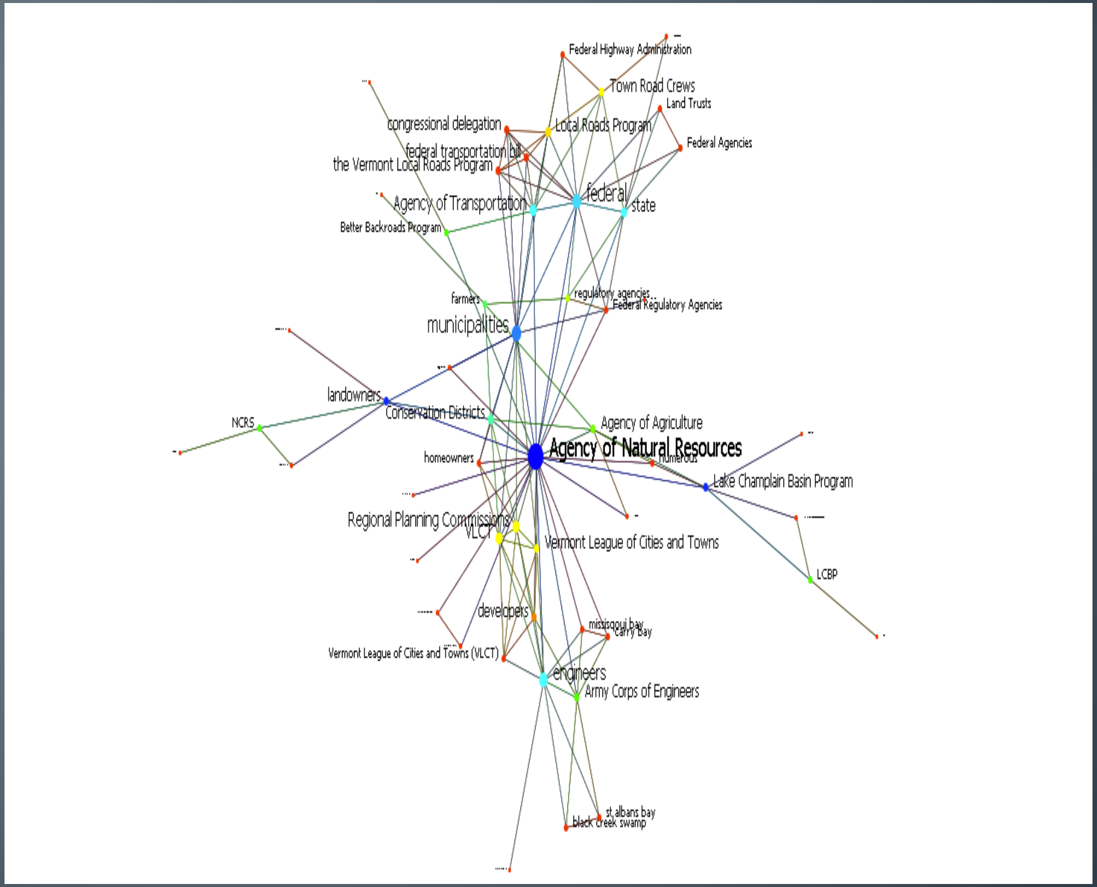
Social Network Map for LCBP: 2010 Opportunities for Action



Adam Reynolds, 2012

Social Network Map for 2010 Vermont TMDL Plan

Adam Reynolds, 2012



Policy Tools Employed to Manage Water Quality

from Regional Plans

Policy Tool	Plan Text
Environmental Regulation	“Continue enforcement of the winter manure-spreading ban (December 15-April 1) to minimize the water-quality impacts associated with spreading manure on frozen or snow covered ground.”
Public Information	“Conduct education forums in target watersheds to educate stakeholders about priority surface water issues and engage partners in implementing high-priority water-quality strategies in conjunction with DEC’s Basin planning effort.”
Permits	“Following EPA review of the draft CAFO permit, Vermont will finalize the permit and begin to implement CAFO requirements as appropriate and as expeditiously as feasible.”
Grants	“Continue to make up to $500,000 per year of Clean and Clear Ecosystem Restoration grants and other grant monies for phosphorus-reduction projects available to local municipalities and nonprofits.”
Tax Incentives	“institute a tax relief program for all landowners who allow all land within 100’ of a streambank to be managed for riparian conservation”

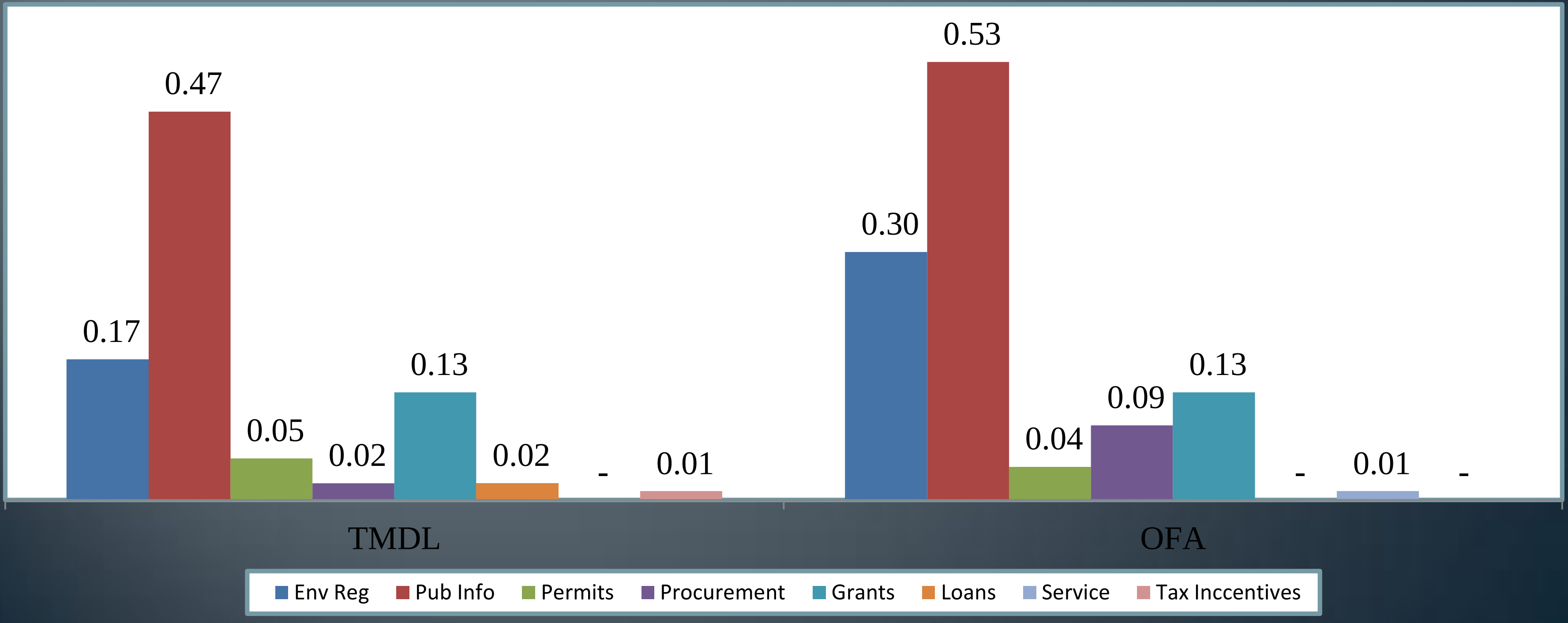
Proportion of Tasks Utilizing Policy Tools

Adam Reynolds, 2012

	TMDL	OFA
N	19.6%	6.8%
Y	80.4%	93.2%
1 Tool	*73.3%*	*78.1%*
2 Tools	*7.0%*	*15.1%*

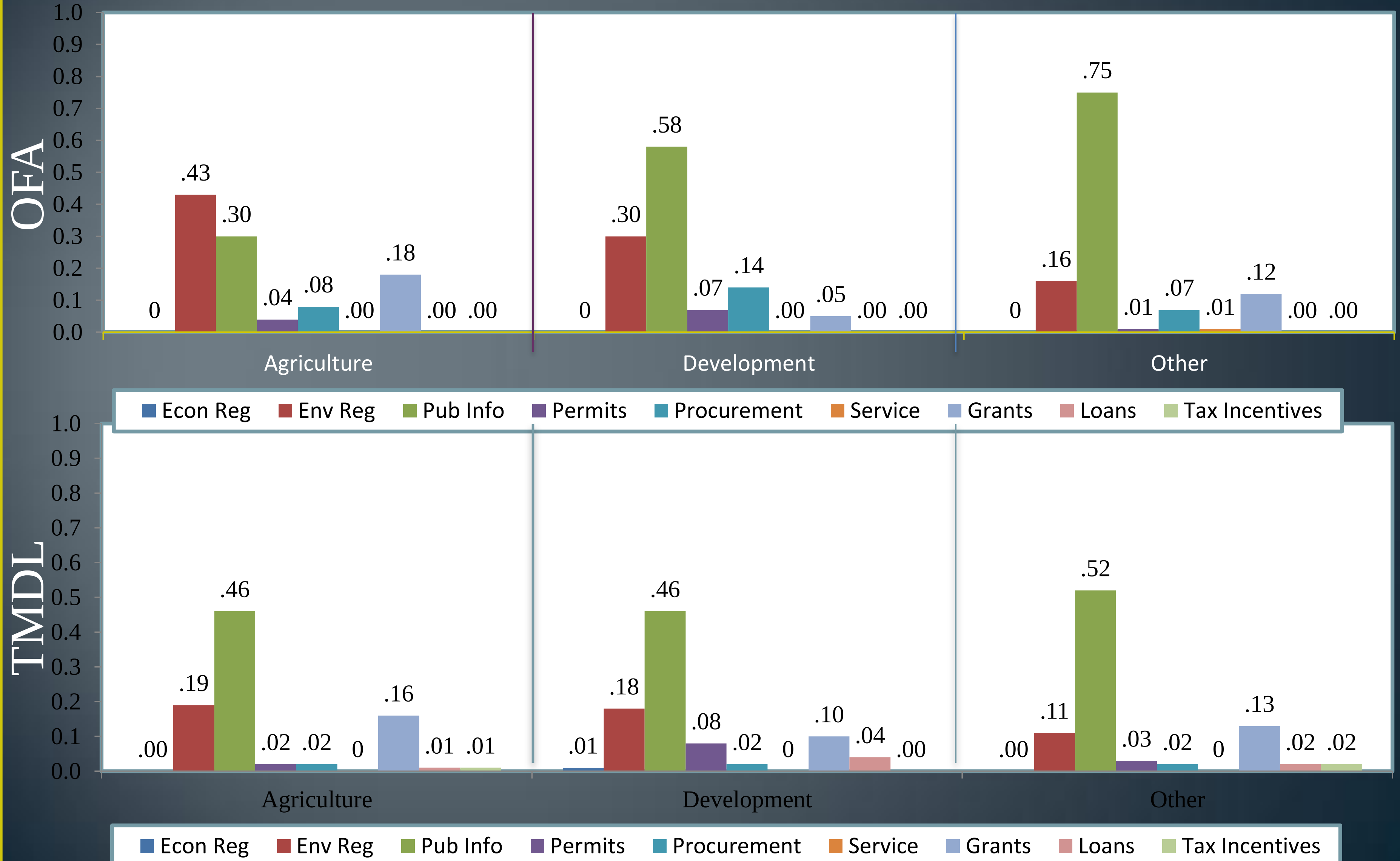
Similar distributions of tool choices, but there were fewer tasks in the TMDL in which tools were identified.

Additionally, there were more tasks in the OFA in which two policy tools were identified.



Policy Tools within the Two Planning Regimes

Adam Reynolds, 2012



Domain Function Emphasis in Plans

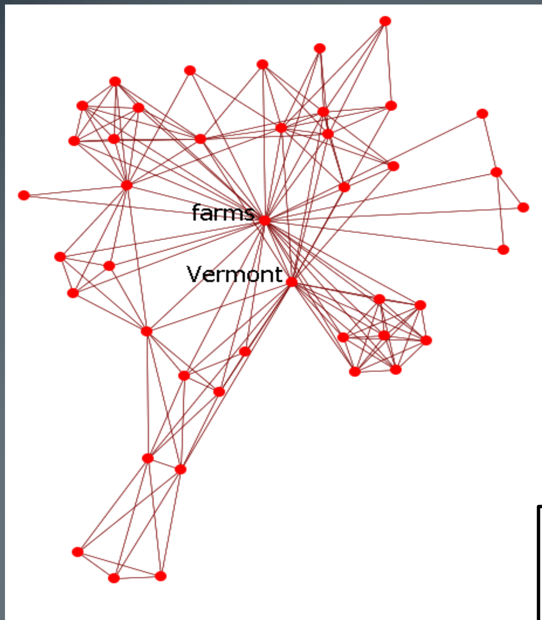
Adam Reynolds, 2012

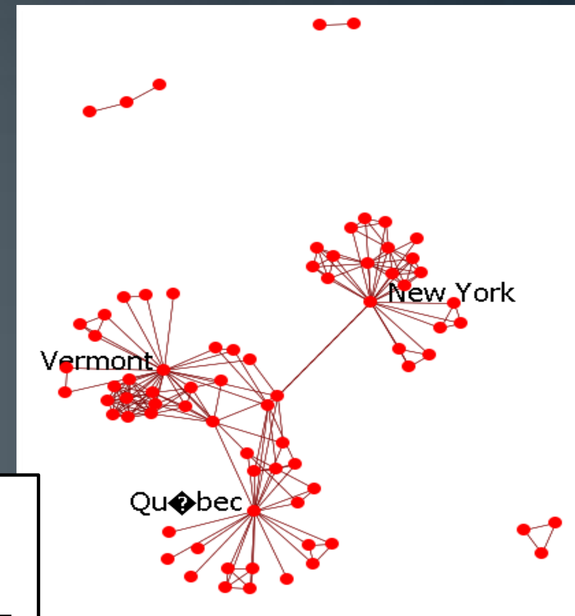
		Agriculture	Development	Other	*Total*
OFA 2010	Tasks Devoted	93	129	63	*285*
		(32.6%)	*(45.3%)*	*(22.1%)*	
	Participating Actors	18	42	32	*73*
		(24.7%)	*(57.5%)*	*(43.8%)*	
	Graph Density	.07	.10	.04	
TMDL 2010	Tasks Devoted	77	43	73	*193*
		(39.9%)	*(22.3%)*	*(37.8%)*	
	Participating Actors	44	76	75	*156*
		(28.2%)	*(48.7%)*	*(48.1%)*	
	Graph Density	.17	.07	.09	

Agriculture

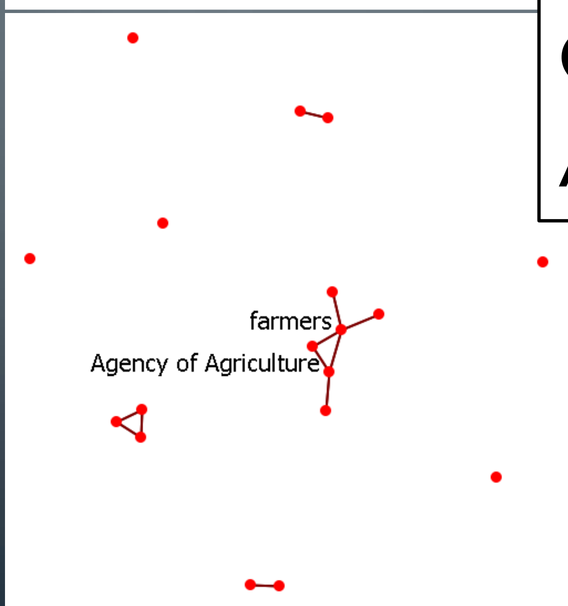
Development

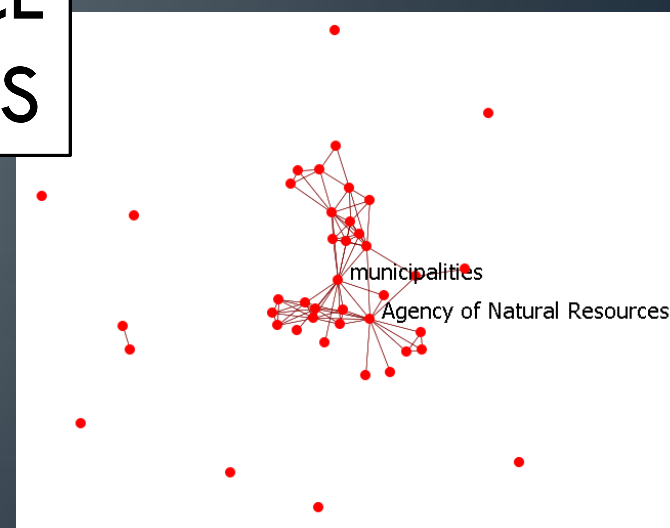
OFA





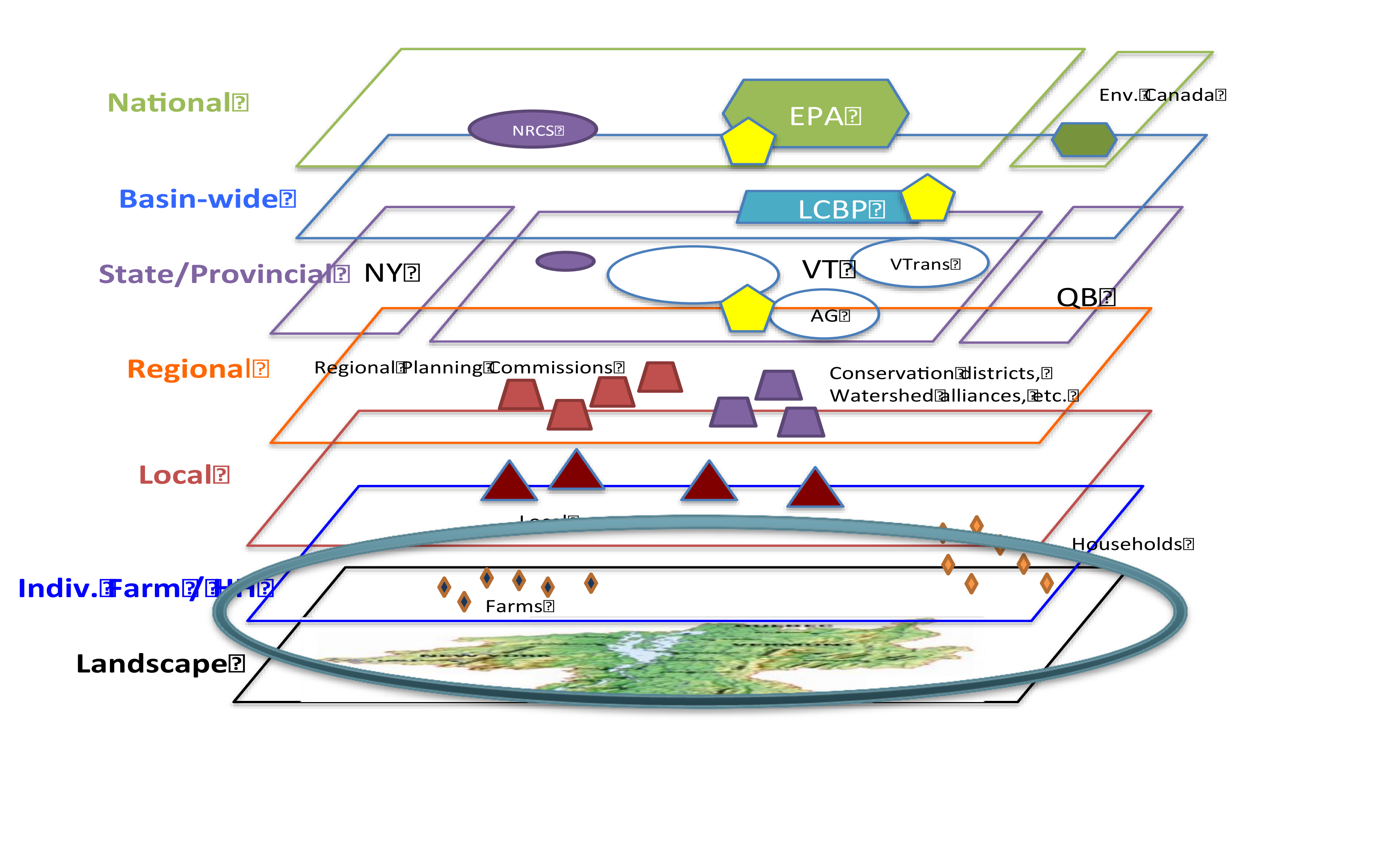
TMDL





Examples of GOVERNANCE ASSEMBLAGES

Watershed Governance Network to be Derived through the Construction of Assemblages:



Agent Compliance Continuum

Strategy:	Coercive	Remunerative	Normative
Principal Goal:	Maintain order	Negotiate to make best deal	Develop organizational culture
Agent Response:	Indifference / Hostility	Calculation	Intrinsic values followed

(Adapted from Etzioni, 1961 and Sergiovanni, 1995)

Policy tools impact agent behaviors:

- Induce behaviors
- Reward behaviors
- Sanction behaviors

Policy tools impact agent behaviors:

- Induce behaviors
- Reward behaviors
- Sanction behaviors

Of FARMERS

Of HOUSEHOLDS

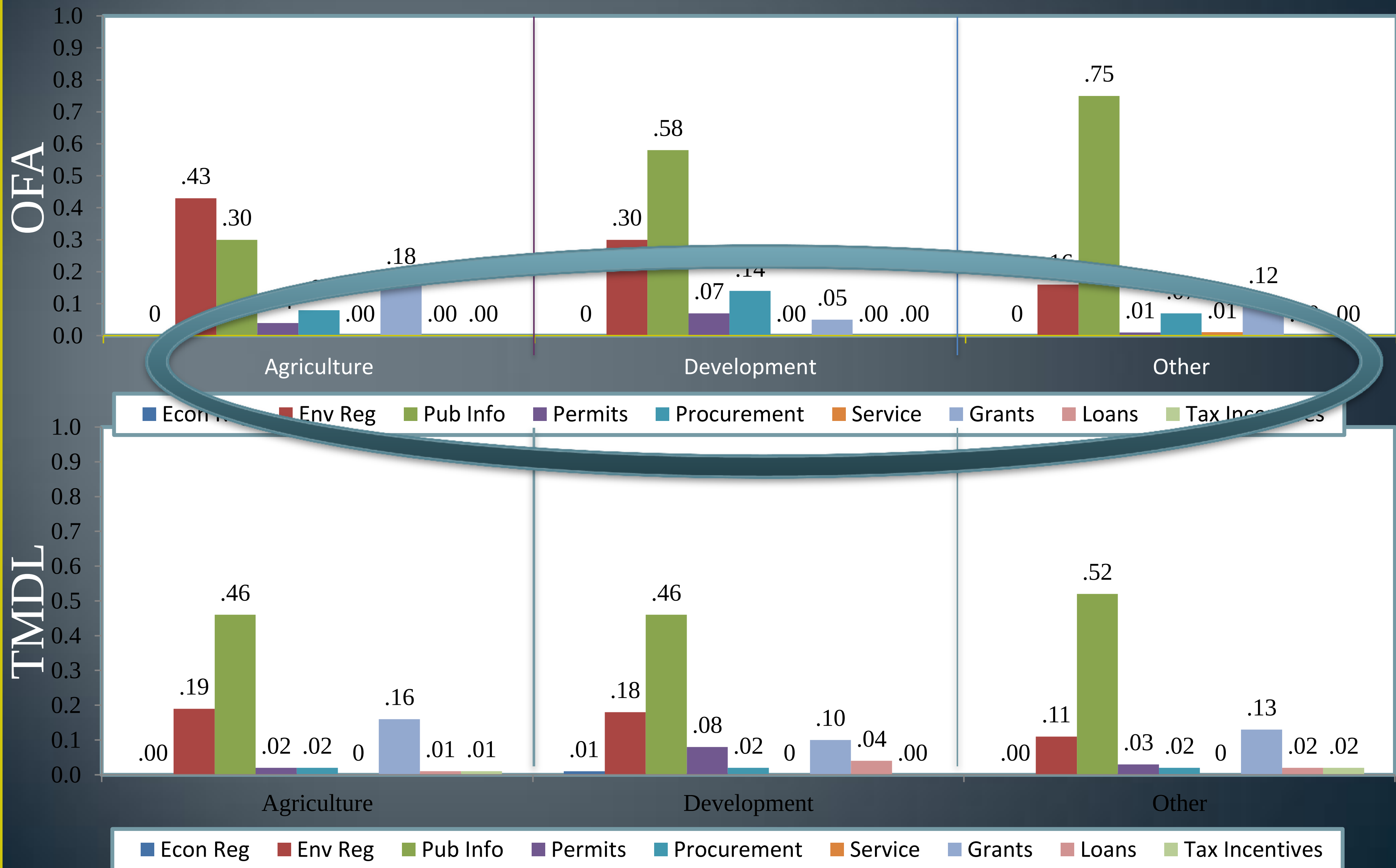
Of OTHER LANDOWNERS/USERS:

FORESTERS

DEVELOPERS

Policy Tools within the Two Planning Regimes

Adam Reynolds, 2012

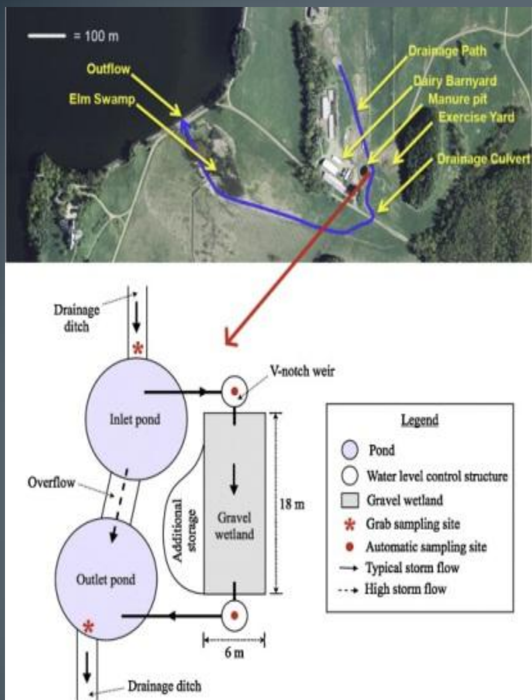


Work to be done:
Agricultural Practices

- Survey of current agricultural practices
- Inventory of interventions implemented
- Farmers as stakeholders- guiding the process with mediated modeling
- AFRI & Food systems spire funding pursued

FARM BEST MANAGEMENT PRACTICES

Shelburne Farms



Shelburne Farms Plan to reduce water pollution from their farm into Lake Champlain 2004-present

- Two-pond system reduced Phosphorus concentrations by 43% across storm events

New York generic agriculture best management practices summary

MANAGEMENT PRACTICES	RELATIVE COST	LIMITING CONDITIONS	MAINTENANCE	ADVANTAGES	DISADVANTAGES	SPECIAL CONSIDERATIONS
Field Diversion	$2 - $5 per foot	Slopes must be < 15% not suitable in high sediment producing areas	Periodic inspections	Takes only a small amount of land out of production easy to design and install	Little impact on runoff volumes	Cost may be offset by hay harvesting
Subsurface Drainage	$3.50 per foot				Root infiltration by hydrophyllic trees	
Grassed Waterway	$2 - $5 per foot	Not suitable where base flow exists, or areas with excessive sediment loads	Annual inspections	Easy to design and install; can also act as a filter strip	Can fill up with sediments; takes land our of crop production	
Filter Strip		Not effective in hilly areas	Regular inspections, mowing, sediment removal	Unobtrusive easy to install and maintain; benefits wildlife	Not effective with soluble forms of phosphorus or during winter; short lifetime (< 5 yr)	Sediment accumulation reduces effectiveness
Streambank Stabilization						
Barnyard Runoff Management	$3,000 - >$50,000		Varies - can be intensive	Improves herd health and milk production	Expensive; requires a high level of management skill	Overland flow systems are more effective than channelized flow systems
Fencing / Livestock Exclusion	$2 - $5 per foot		Regular inspections	Inexpensive but effective	Labor intensive to install	May require alternate water supply
Fertilizer Management	Minimal		Periodic update of plan, soil testing	Cost savings in fertilizer; cost effective approach	High level of management skills	

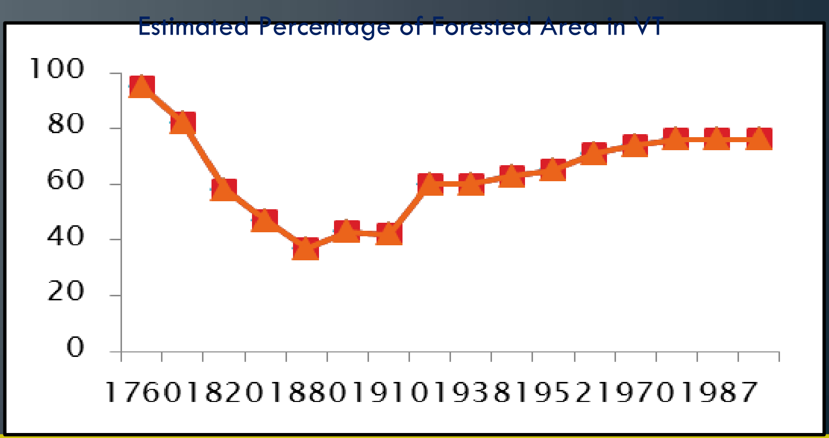
Lavellee, C., 2012 EPSCoR Intern

Reforestation and Forest Management

Stream crossings are the major source of the sediment and water temperature change from timber harvesting operations in Vermont

New York generic forest best management practices summary

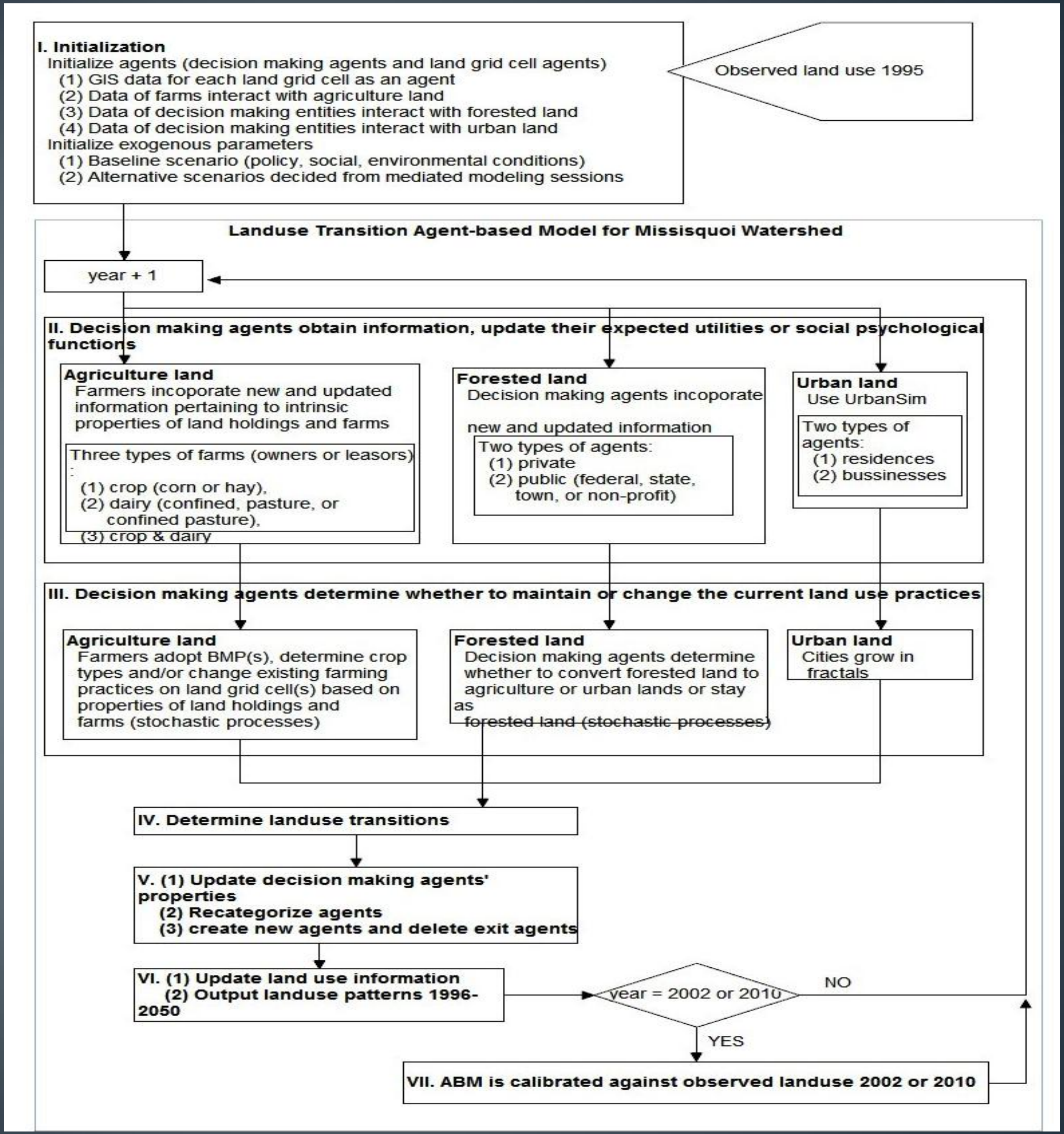
MANAGEMENT PRACTICES	RELATIVE COST	LIMITING CONDITIONS	MAINTENANCE	ADVANTAGES	DISADVANTAGES	SPECIAL CONSIDERATIONS
Access Routes/Road Water Management	Low	Avoid wet soils, steep slopes, rock outcrops and riparian buffer zones	Routine inspections, frequent mainten-ance during harvest season	Improves efficiency of operations, protection of wildlife	Requires planning time	Routes must be stabilized and stream crossings removed after harvest operations cease
Riparian Buffer Protection	Low		Boundaries marked before logging begins	Effective, easily implemented; benefits ecosystem	Loss of timber in buffer zone; longer road/trail network may be needed	Buffer distance varies according to soil type, slope, cover and season
Watercourse Crossings	Moderate to high	Natural resources may limit location and types of crossings; vehicle ac-cess requirements may restrict use	Periodic removal of debris	Bridges can be removed and reused	May interfere with fish spawning and migration; flooding and channel erosion may result from constrictions	No equipment should be operated in the watercourse; disturbed area after removal should be stabilized immediately
Sediment Barriers	Low	Not suited to large drainage areas	Regular inspections; clean out accumu-lated sediment	Easy to install, fences can be reused; straw bales can be used for mulch	High percentage of failure from poor maintenance	Soil particle size may limit effectiveness
Planned Harvest Operations	Low		Regular inspection of management practices, post-harvest inspection	Improves efficiency of operations, protection of wildlife	Requires planning time	
Vegetation Establishment	Site dependent	Large sites may require revegetation in stages	Protect area until vegetation is estab-lished; periodic topdressing of fertilizer may be needed	Food and cover for wildlife	Large sites may require special equipment	Soil tests, seed selection and amendments improve success



Lavellee, C., 2012 EPSCoR Intern

Residential/Commercial (Development) Practices

- Stormwater systems
- Development
- Households


I. Initialization
Initialize agents (decision making agents and land grid cell agents)
(1) GIS data for each land grid cell as an agent
(2) Data of farms interact with agriculture land
(3) Data of decision making entities interact with forested land
(4) Data of decision making entities interact with urban land
Initialize exogenous parameters
(1) Baseline scenario (policy, social, environmental conditions)
(2) Alternative scenarios decided from mediated modeling sessions
Observed land use 1995
Landuse Transition Agent-based Model for Missisquoi Watershed
year + 1
II. Decision making agents obtain information, update their expected utilities or social psychological functions
Agriculture land
Farmers incoporate new and updated information pertaining to intrinsic properties of land holdings and farms
Three types of farms (owners or leasors):
(1) crop (corn or hay),
(2) dairy (confined, pasture, or confined pasture),
(3) crop & dairy
Forested land
Decision making agents incoporate new and updated information
Two types of agents:
(1) private
(2) public (federal, state, town, or non-profit)
Urban land
Use UrbanSim
Two types of agents:
(1) residences
(2) bussinesses
III. Decision making agents determine whether to maintain or change the current land use practices
Agriculture land
Farmers adopt BMP(s), determine crop types and/or change existing farming practices on land grid cell(s) based on properties of land holdings and farms (stochastic processes)
Forested land
Decision making agents determine whether to convert forested land to agriculture or urban lands or stay as forested land (stochastic processes)
Urban land
Cities grow in fractals
IV. Determine landuse transitions
V. (1) Update decision making agents' properties
(2) Recategorize agents
(3) create new agents and delete exit agents
VI. (1) Update land use information
(2) Output landuse patterns 1996-2050
year = 2002 or 2010
NO
YES
VII. ABM is calibrated against observed landuse 2002 or 2010

Meeting milestone for "Q3":

- Convene mediated modeling sessions regarding climate change, land use storylines, coupled human system drivers, policy and governance drivers
  - First mediated modeling session to be held: November 2012
  - Second mediated modeling session to be held: April 2013
- Develop conceptual models of watershed governance, parameterize watershed governance ABM, calibrate and validate governance ABMs
  - Initial scoping models completed and presented here