FOLLOWING THE MONEY THROUGH POLICY IMPLEMENTATION NETWORKS: FORMAL ACCOUNTABILITY AND FINANCIAL RESOURCE FLOWS IN WATER QUALITY GOVERNANCE

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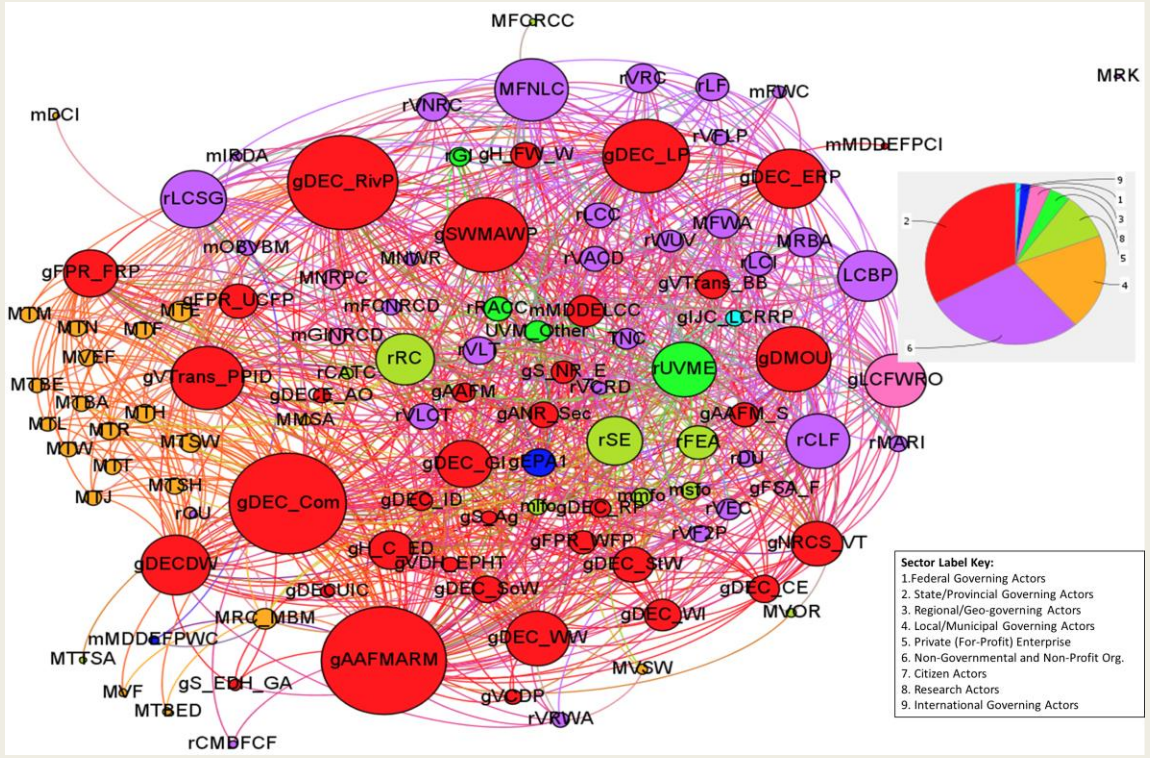
Modeling Policy Actors: Water Quality Policy Networks



2014 Water Quality Network for Missisquoi Watershed (Scheinert et al., 2014; Generated in Gephi)

Research Contributions

- Organizational Network Data Repository
  - *First to develop longitudinal network datasets open to all researchers*
- Boundaries between network functions
  - *Network structures can show which functions are independent from other functions (Scheinert et al, 2015, "The Shape of Watershed Governance: Locating the Boundaries of Multiplex Networks,"* CGN)
- Authority and Power in Organizational Networks
  - *Organizational networks have a mix of authority and interaction (Koliba, Scheinert, and Zia, "Toward a New Economics of Networks: Using Institutional Network Analysis to Study Principal-Agent and Peer-to-Peer Ties," pending submission to* JPART)
- Network Growth
  - *Forecast and calibrate bottom-up organizational network growth (Scheinert et al., 2016, "Growing Collaborations: Forecasting Changes in Partnership Networks at the Agent Level,"* PLoS *(under review))*
- Financial resource flows and Network Capacity
  - *Scenario-driven forecasting of spending in governance networks, using a hybridized model (Scheinert et al., 2016, "Bridging the Meso and Micro Level Scales of Social Complexity within a Socio-Ecological System: Modeling the Relationship between Governance Networks and Land Use Decisions in the Northeastern Segment of the Lake Champlain Basin" In progress)*

Organizational Network Survey

Organizational Group	Number of Contacts		Completed Responses		Response Rate (%)		Observation Rate (%)	
Year	2014	2015	2014	2015	2014	2015	2014	2015
Governmental Programs	56	53	26	30	46.4	56.6	71.75	81.6
Regional Actors and NGOs	50	51	26	24	52.0	47.1	73.47	72.5
Winooski Watershed	52	52	11	29	21.2	55.8	38.16	80.9
Missisquoi Watershed	40	34	12	12	30.0	35.3	51.54	58.8
Total	**198**	**190**	**75**	**95**	**37.9**	**50.0**	**60.26**	**75.1**

Observation Rate:

$$Obs.\ Rate = 1 - \frac{\#\ Unobserved\ Dyads}{Total\ Dyads}$$

$$Obs.\ Rate = 1 - \frac{NRN(NRN-1)}{N(N-1)}$$

- NRN: Non-responding nodes
- N: Total nodes

Survey Dataset

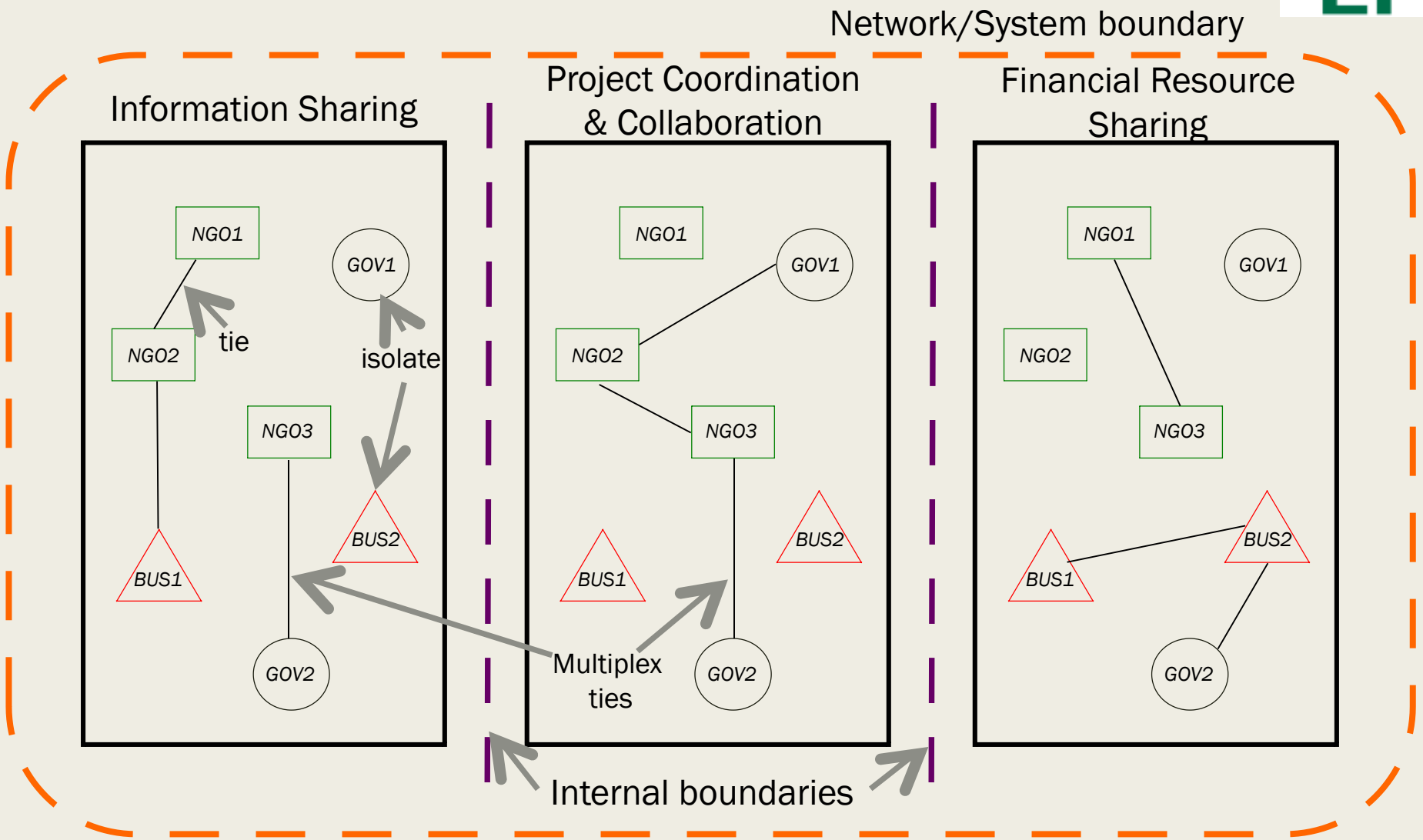
Relational Data

- Information Sharing
- Project Collaboration & Coordination
- Technical Assistance
- Reporting
- Financial Resource Sharing

Organizational Data

- Jurisdiction
  - *Specific Geography*
  - *Geographic Scope*
- Capacity
  - *Budget*
  - *Staff*
- Sector

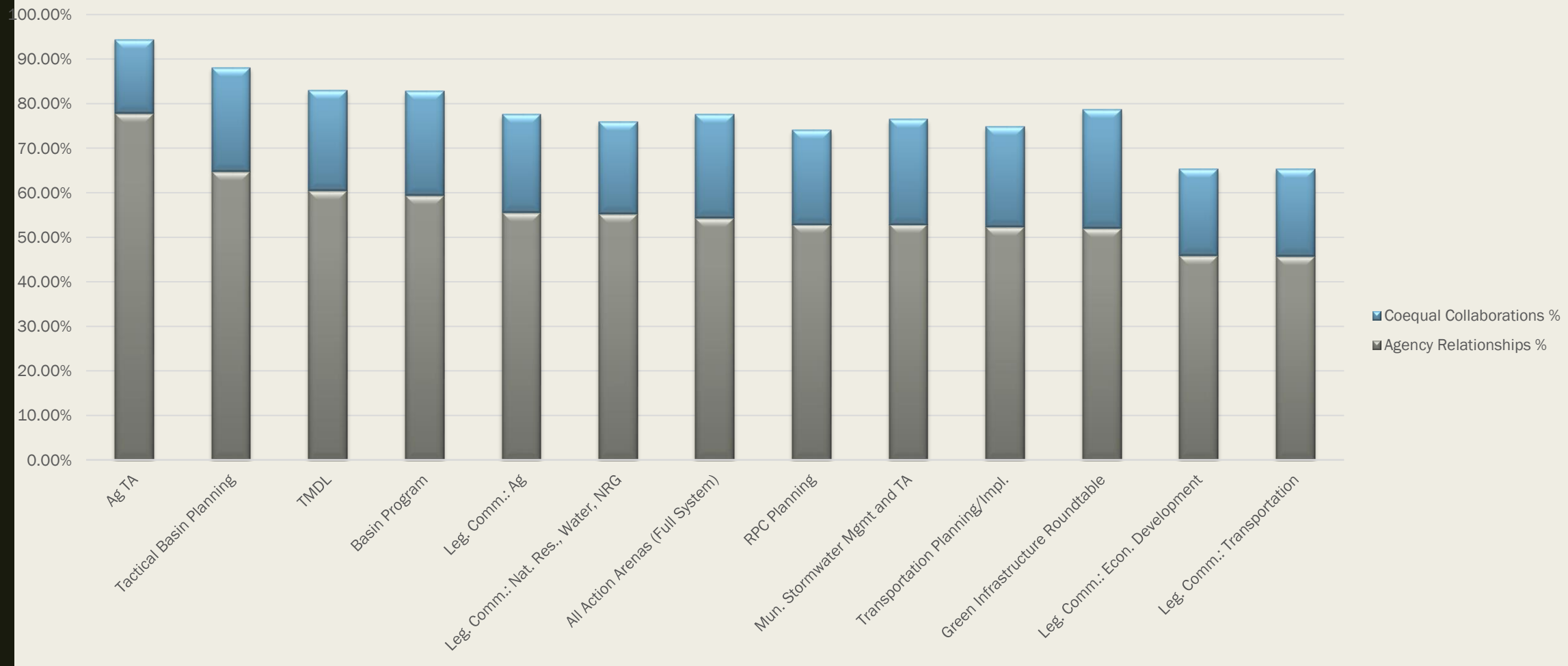
Boundaries between Functional Subnetworks



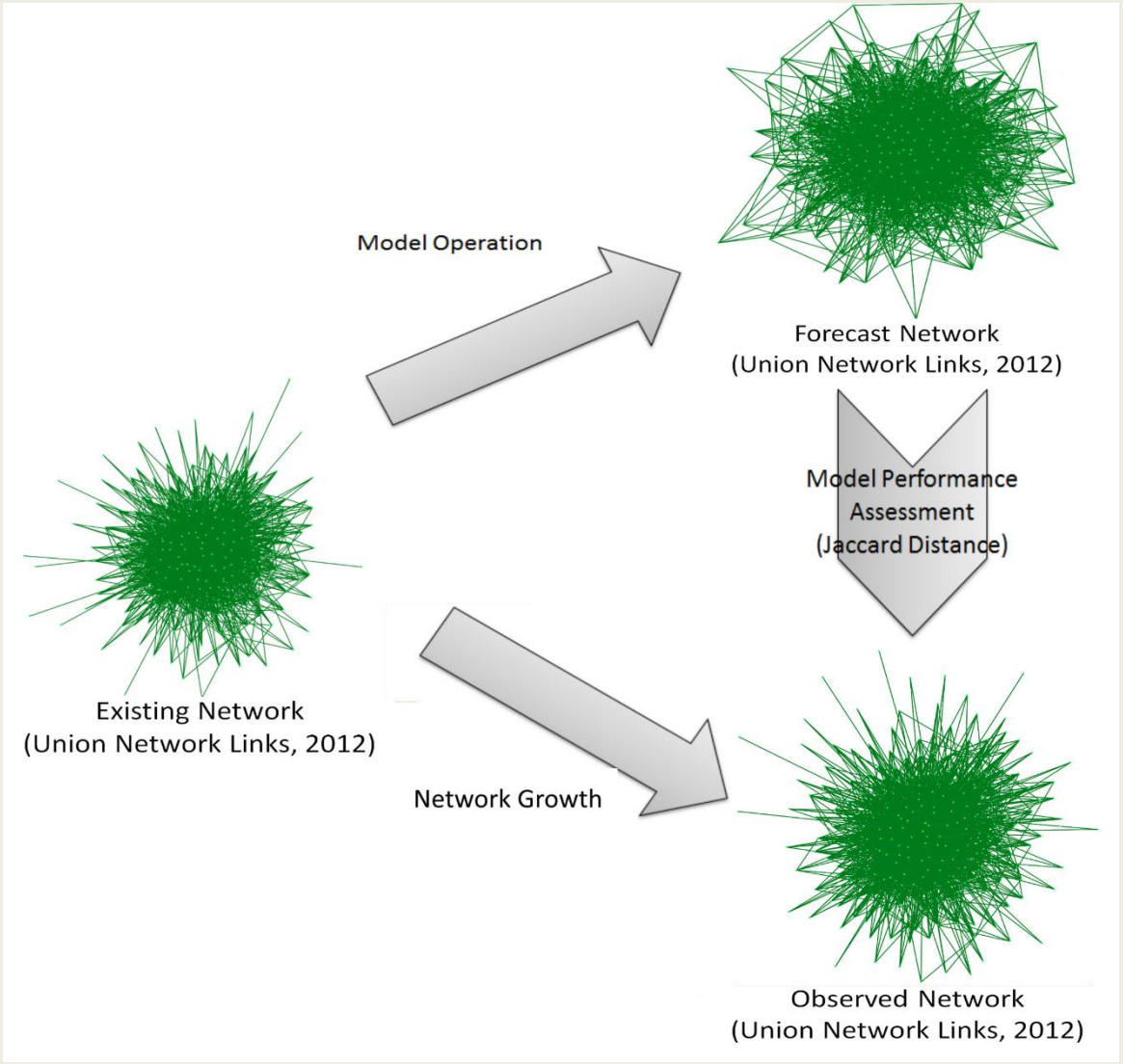
Agency Theory Links in Networked Governance

- Mandated Links
  - *Reporting*
  - *Financial Resource Sharing*
- Voluntary Links
  - *Project Collaboration and Coordination*
- We can use these to build more complex types of interactions
  - *Principal-Agent Links*
  - *Principal-Steward Links*
  - *Coequal Collaboration Links*

Principal-Agent Tie Types as Percentage of Multiplex Ties in Action Arenas Networks



Modeling Network Growth



Calibrating the Model

Subnetwork	Accretion			Decay		
	Expected	Average Observed	Ratio (Obs./Exp.)	Expected	Average Observed	Ratio (Obs./Exp.)
"Existing" Information Sharing	222	312.08	1.41	---	---	---
"Existing" Collaboration	121	138.60	1.15	---	---	---
"Existing" Resource Sharing	48	88.32	1.84	---	---	---
"Existing" Union	242	277.44	1.15	---	---	---
"New" Information Sharing	692	476.92	0.69	883	1,109.34	1.26
"New" Collaboration	489	144.67	0.30	348	480.67	1.38
"New" Resource Sharing	290	228.86	0.79	144	199.05	1.38
"New" Union	900	368.65	0.41	845	1,181.72	1.40

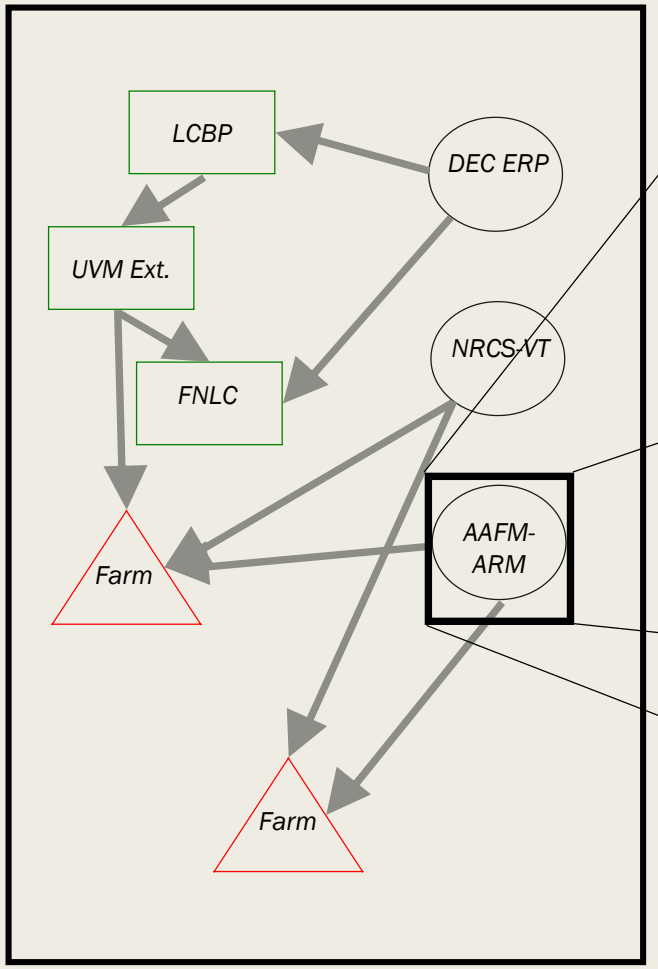
Modeling Resource Flows in a Governance Network

BASIC RESEARCH QUESTIONS: How do resources move through a governance network? How can we structure an Agent-Base Model (ABM) to recreate existing resource flows and forecast future flows?

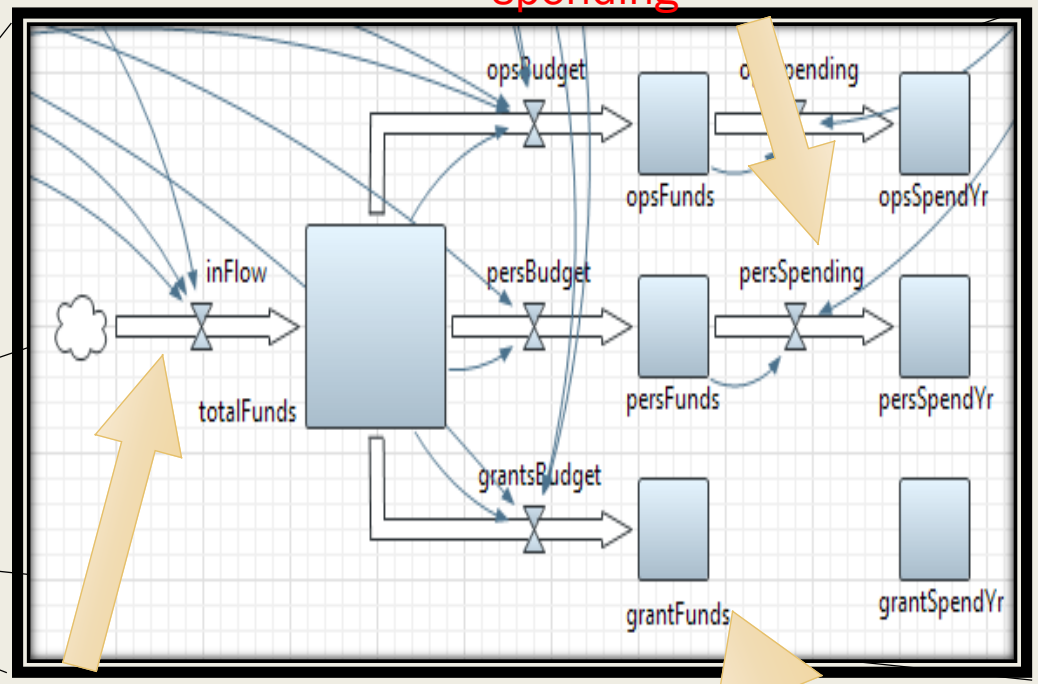
WORKING HYPOTHESIS: Effective watershed governance networks may a induce watershed into a stable state that is valued relatively higher by society and policy makers.

METHODS EMPLOYED: Institutional network analysis was conducted in R/*ergm* using data drawn from a comprehensive survey of watershed management organizations and programs operating within the Lake Champlain Basin and focused on financial resource exchange. Hybridized ABM and Systems Dynamics (SD) modeling using AnyLogic.

Example: Network Links and Resource Flows



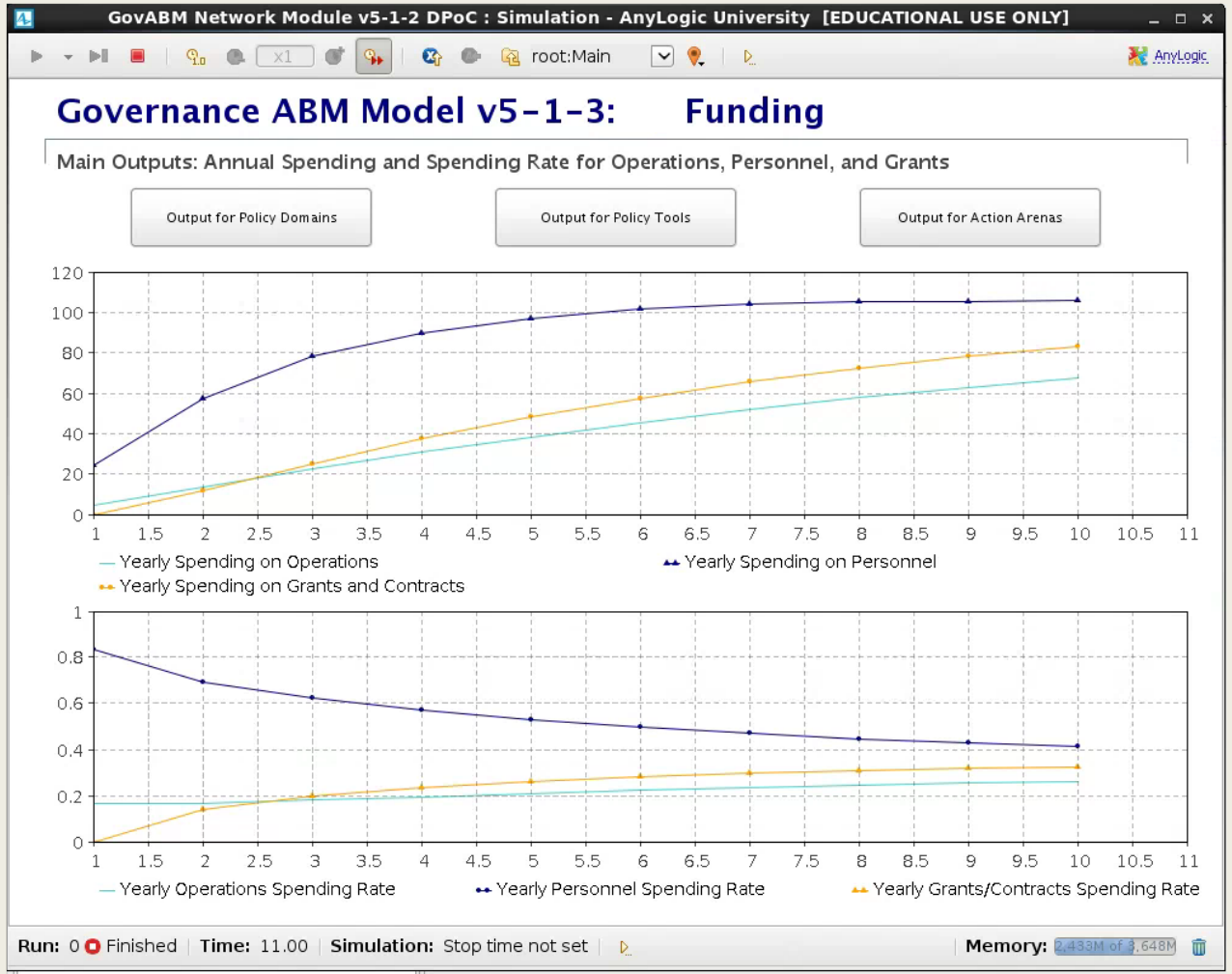
Based on historic spending



Every organization has an independent source of funds, either tax or sales receipts, or fund raising

Transfer budget: What is transferred Across the network's links

Business as Usual: Operations, Personnel, and Transfers



CONCLUSIONS on the Hybrid Modeling of "Governance Networks:"

1. **Scenario development**: Modeling the behavior of systems allows us to anticipate the response of those systems to interventions in the system.
2. **Hypothesis testing**: Modeling the impact of policies to forecast their outcomes.
3. **Transdisciplinary theory development and tuning:** Modeling feedback between governance structure, incentives and regulations, human behavior, and ecosystem responses.
4. **Methodological advancement**: Agent-Based Models, System Dynamic and Network modeling allows for building agents who act independently and so we can model emergent behavior.