An Agent-Based Model of Governance Networks and Community Flood Resilience in the Pearl River Delta, China

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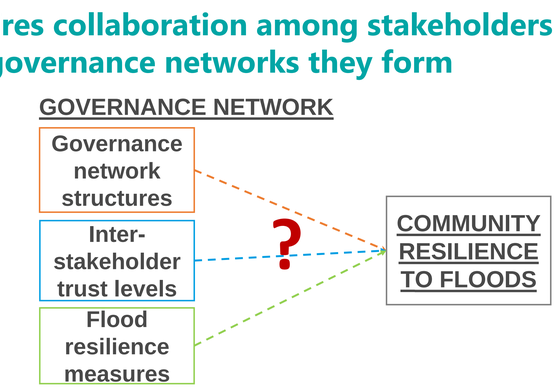
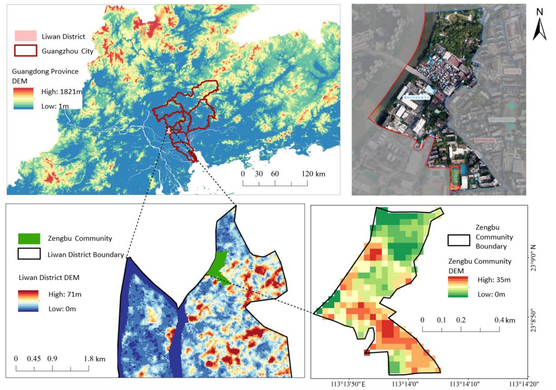
1. Introduction

Climate change adaptation requires collaboration among stakeholders and strategically managing the governance networks they form

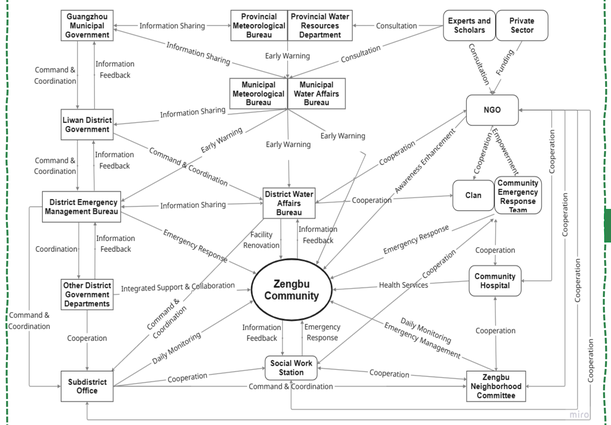
- Addressing increasingly frequent and intense climate-induced flooding in today's world demands → network perspective, stakeholder coordination √
- **Gap**: the relationships between different governance networks and community resilience to climate change?
- The Pearl River Delta (PRD) in China: Dense populations and buildings + frequent meteorological disasters → significant loss risks → Case: **Zengbu Community,** hundred-year long experience coping with flooding risks





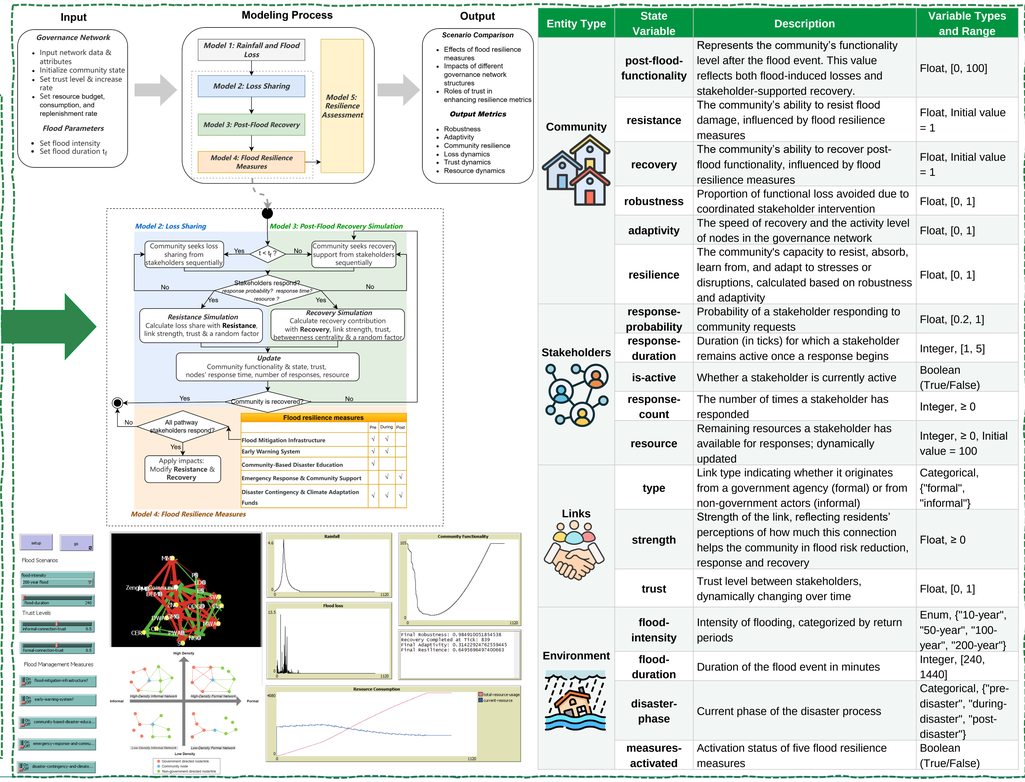
2. Methodology

From an empirical governance network to an agent-based model



Data source

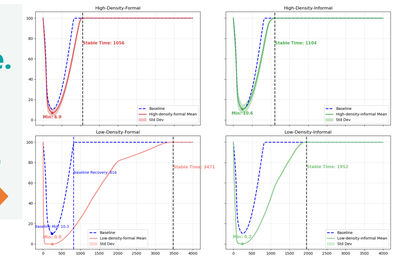
- ❑ Nov 2022 - Feb 2023: 1160 valid questionnaires in 29 communities with local NGO
- ❑ Feb 2023-Feb 2024: Fieldwork, 29 household interviews
- ❑ Oct 2024: 2 resident workshops
- ❑ 3 expert evaluation

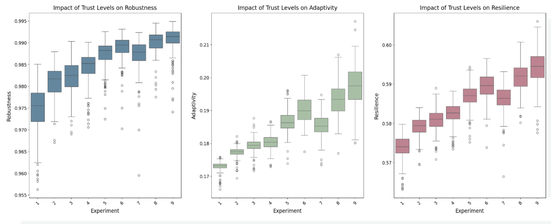


Entity Type	State Variable	Description	Variable Types and Range
Community	post-flood-functionality	Represents the community's functionality level after the flood event. This value reflects both flood-induced losses and stakeholder-supported recovery.	Float, [0, 100]
	resistance	The community's ability to resist flood damage, influenced by flood resilience measures	Float, Initial value = 1
	recovery	The community's ability to recover post-flood functionality, influenced by flood resilience measures	Float, Initial value = 1
	robustness	Proportion of functional loss avoided due to coordinated stakeholder intervention	Float, [0, 1]
	adaptivity	The speed of recovery and the activity level of nodes in the governance network	Float, [0, 1]
	resilience	The community's capacity to resist, absorb, learn from, and adapt to stresses or disruptions, calculated based on robustness and adaptivity	Float, [0, 1]
Stakeholders	response-probability	Probability of a stakeholder responding to community requests	Float, [0.2, 1]
	response-duration	Duration (in ticks) for which a stakeholder remains active once a response begins	Integer, [1, 5]
	is-active	Whether a stakeholder is currently active	Boolean (True/False)
	response-count	The number of times a stakeholder has responded	Integer, ≥ 0
	resource	Remaining resources a stakeholder has available for responses; dynamically updated	Integer, ≥ 0, Initial value = 100
Links	type	Link type indicating whether it originates from a government agency (formal) or from non-government actors (informal)	Categorical, {"formal", "informal"}
	strength	Strength of the link, reflecting residents' perceptions of how much this connection helps the community in flood risk reduction, response and recovery	Float, ≥ 0
	trust	Trust level between stakeholders, dynamically changing over time	Float, [0, 1]
Environment	flood-intensity	Intensity of flooding, categorized by return periods	Enum, {"10-year", "50-year", "100-year", "200-year"}
	flood-duration	Duration of the flood event in minutes	Integer, [240, 1440]
	disaster-phase	Current phase of the disaster process	Categorical, {"pre-disaster", "during-disaster", "post-disaster"}
	measures-activated	Activation status of five flood resilience measures	Boolean (True/False)

3. Results and discussion

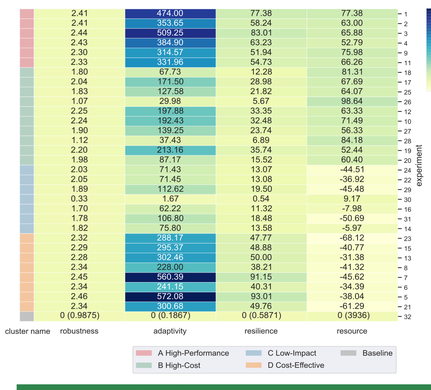
3.1 Increasing network density does not always improve resilience. In networks with less connections, more non-government actors help community cope with and recover from floods better

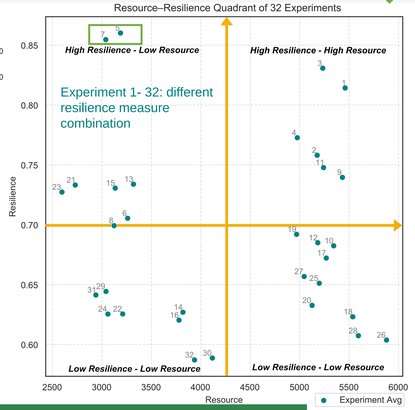




3.2 Increasing trust in non-government actors is more effective, especially when trust to government agencies is low

3.3 Social and institutional interventions combined with physical measures are most effective, but excessive or misallocated resources can reduce their benefits!





4. Conclusions

- Presented an empirically grounded agent-based model (ABM) of governance networks
- Informed evidence-based and context-specific flood resilience policies and advanced theoretical understanding
- **Future research**: Expand to multiple communities, explore power imbalances and conflicting stakeholder priorities

EGU25-2839

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