Enhancing Collaborative Solution-Building for Urban Sustainability with Computer Simulations: Water Management in the Chicago Region

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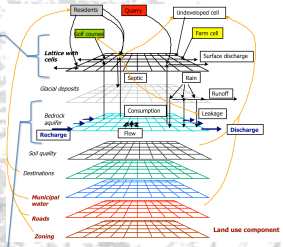
Environmental planning decisions are typically made by diverse groups of stakeholders, each representing an area of expertise (e.g., science, advocacy, business). Although they are experts in their field, stakeholders often lack a more complete understanding of how different human and environmental factors might combine to produce unintended outcomes. We propose to construct software to support collaborative processes in the Chicago region, to assist stakeholders to jointly learn and explore a wide range of impacts of planning decisions.

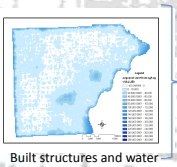
Why Agent-Based Models are Useful for *Exploring Planning Outcomes*

Agent-Based Models are ***spatially and temporally explicit***
- The *placement and timing of elements* affects the *outcome* of the simulation
- This is a better representation of human-environmental systems
  - People choose where to live based on natural and economic resources
  - Environmental resources are affected by how people use them
  - One-size-does-*not*-fit-all: what may work for one region and at one time may fail elsewhere

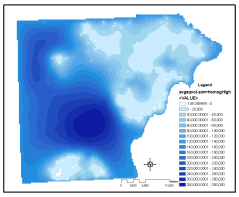
Agent-Based Models are ***explicit about process***
- Stakeholders can see how specific decisions lead to impacts

"Resident" agents choose where to live based on customizable preferences and proximity to amenities.





Built structures and water withdrawals affect the available groundwater



Availability of groundwater when residents live in high-density developments. This effect can be obtained via multiple means: e.g., changing resident preferences, or economic conditions, etc.

Why Agent-Based Models are Useful for *Collaboration*

Key social challenge of urban sustainability is to ***coordinate collective action***
- Requires shared understanding of problem to avoid circular arguments
- Requires integration of different forms of knowledge, which is based on assumptions specific to areas of expertise

Agent-Based Models are non-"black box"
- Stakeholders can *contribute* specialized knowledge in the form of rules
- Other stakeholders can *inspect* these rules to understand (and perhaps challenge) assumptions

Preliminary Findings

Our team conducted preliminary telephone interviews with a variety of stakeholders participating in environmental planning committees in the Chicago region. We found that:
- When traditional software tools for examining tradeoffs are provided, they are not trusted
  - The tools' "black box" nature makes it hard for stakeholders to assess the degree of bias that might exist, resulting in *attitude polarization*
  - Stakeholders whose views are challenged tend to claim bias and dismiss the tool's output
  - Stakeholders whose views go unchallenged tend not to think very deeply about the tool's underlying assumptions
- Agent-based models, if designed appropriately, can overcome these obstacles.

Future Work

We will conduct a formative assessment workshop, using an existing agent-based modeling package, with environmental planning stakeholders in the region. Through this workshop we will extract design principles for both the software and the participatory setting, focusing specifically on how different design elements can contribute to trust and to non-circular discussions, and pilot appropriate metrics to evaluate these interventions. We will subsequently test the design principles in controlled experiments, measuring the learning, planning and environmental outcomes.