



# What are Geographic Automata Systems?

- Framework for modelling dynamic geospatial systems from the bottom-up
  - Characterized by cellular automata and agent-based models
- Useful for representing, examining, and explaining patterns that emerge from local interactions







































# **Demonstration 1: Urban Growth Modelling**

# Goals

- To demonstrate and compare the Basic and Advanced Cellular Automata tools for modelling urban growth in the City of Chilliwack, British Columbia
- To show how a popular machine learning-cellular automata (ML-CA) approach can be implemented efficiently and without programming















# Results

- *Model A* and *Model B* showed similar calibration measures
- Model performance deviates in the validation period

 Model B forecasted urban developments to more realistic locations in the validation period and fewer "false alarms" (i.e., incorrectly simulated new developments) in calibration and validation periods.

#### Values copied from the Model Evaluation Reports

	Metric	Model A (Basic CA)	Model B (Advanced CA)
<b>Calibration</b> (2000 – 2010)	Overall Accuracy (%)	94.00	94.03
	Urban Accuracy (%)	79.71	79.79
	Карра	0.819	0.820
	Figure of Merit (FOM)	0.346	0.348
<b>Validation</b> (2010 – 2020)	Overall Accuracy (%)	93.14	93.42
	Urban Accuracy (%)	84.94	85.51
	Карра	0.814	0.821
	Figure of Merit (FOM)	0.469	0.484

#### Quality of a model's forecasted changes via FOM components

	Metric	Model A (Basic CA)	Model B (Advanced CA)
<b>Calibration</b> (2000 – 2010)	Hits	10,338	10,394
	Misses	14,895	14,839
	False Alarms	4,662	4,606
<b>Validation</b> (2010 – 2020)	Hits	19,707	20,158
	Misses	12,034	11,583
	False Alarms	10,293	9,842





# **Demonstration 2: Mountain Pine Beetle Infestation Scenarios**

#### Goals

- To implement hypothetical Mountain Pine Beetle (MPB) infestation scenarios around Lightning Lake in Manning Provincial Park, British Columbia, with real-world data
- To demonstrate the effects of layering transition rules and rule types to implement simple to complex model behaviours





https://www2.gov.bc.ca/gov/content/industry/forestry/ma naging-our-forest-resources/forest-health/forestpests/bark-beetles/mountain-pine-beetle

https://www2.gov.bc.ca/assets/gov/farming-naturalresources-and-industry/forestry/foresthealth/beetles/beetle\_forests\_british\_columbia.jpg

van Duynhoven, Alysha, and Suzana Dragićević. "The Geographic Automata Tool: A New General-Purpose Geosimulation Extension for ArcGIS Pro." Applied Sciences 14, no. 15 (2024): 6530.

















Other Use Cases for the *Geographic Automata Add-In* 

### **Research settings**

• E.g., implementing experiments, baselines, and rapid comparisons without programming expertise

## **Educational settings**

• E.g., teaching spatial model building in undergraduate or graduate courses

## **Decision making**

 E.g., exploring different "what-if" scenarios for municipal decisionmaking



