

Brown et al. 2004.

**Agent-Based and Analytical
Modeling to Evaluate the
Effectiveness of Greenbelts**

**Environmental Modelling &
Software 19: 1097-1109.**

I think, therefore I am.

René Descartes (1596–1650)

Geographically speaking,....

- Global/trend factors
- Local/site factors
- Neighbor/interaction factors
- Scales & Interactions

Why ABM?

- New approach to scientific validation.
- ABM can represent spatial heterogeneity and incorporate complex model specifications.
- Deeper insights into processes.

Advantages of ABM

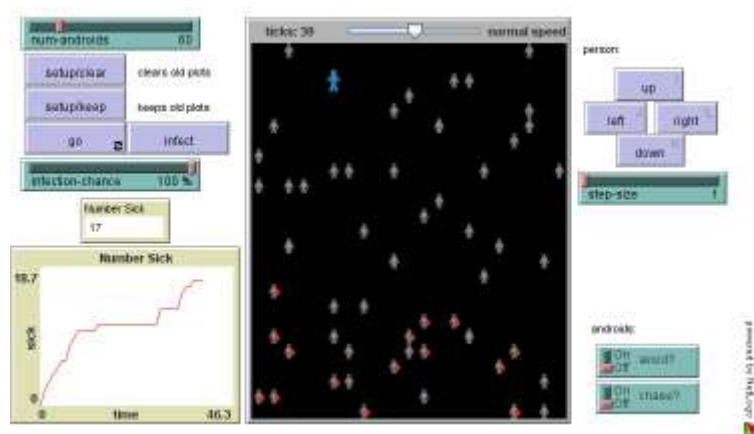
- Bottom up, decentralized autonomy
- Cross-scale capability
- Individual or aggregated interactions of agents/cells
- Dynamic
- Simplicity (simple rules can generate complex patterns)
- GIS ready

Major challenges of ABM

- Explanation vs. prediction
- Implementation
- Validation

Netlogo Disease Solo Simulation

<http://ccl.northwestern.edu/netlogo/models/DiseaseSolo>



Additional reference: Amy H. Auchincloss and Ana V. Diez Roux 2008. A New Tool for Epidemiology: The Usefulness of Dynamic-Agent Models in Understanding Place Effects on Health. *American Journal of Epidemiology* 168(1): 1 - 8.

Effectiveness of Greenbelt Zone in Preventing Sprawl

ABM Approach

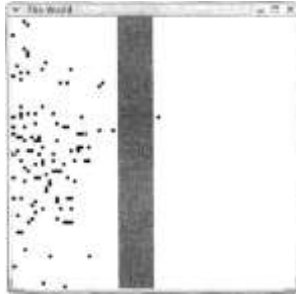
- Agents: residents and service centers
 - Residents: aesthetic preference
 - Residents: service center preference
- Landscape: aesthetic quality (static)
- Constraint: greenbelt
- Utility functions: distance to SC
- Rules:
 - Cells can only be occupied by one agent
 - Move to location with the highest utility
 - Agents have perfect or incomplete information
 - New SC was created when new residents reached 100

Measuring Model Outcomes

- Tuned parameters
 - Weights between preference variables
 - Width and location of greenbelt
- Time to reach 300 sprawled agents

Results

- Left side cells were developed first in 1D model
- 2D models (Table 2)



Experiment	n= 1		n= 15	
	g= 20	g= 40	g= 20	g= 40
2	39 (1)	61 (2)	39 (1)	60 (2)
3	113 (23)	275 (47)	151 (26)	337 (19)
4	86 (19)	194 (52)	103 (29)	278 (39)
5	131 (21)	320 (25)	167 (15)	344 (3)
6	44 (7)	71 (30)	47 (14)	99 (62)
7	77 (12)	171 (33)	93 (20)	221 (39)
8	90 (15)	160 (37)	115 (29)	218 (70)

ABM Tools

- Swarm
- RePast (ArcGIS Agent Analyst)
- Ascape
- Netlogo
- Programming skills are required
 - C, java, Python

Generative explanation for empirical validation



- For more information: Stephen Wolfram 2002. A New Kind of Science (1192 pages)

<http://www.wolframscience.com/nkonline/toc.html>