Saving Lives with Agent-Based GeoComputation *[paper]*

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Biography

Assistant Professor of Geography, University of Maryland, 2002-present. Research in spatial evolutionary GeoComputation and optimization, with emphases on theoretical and computational epidemiology, scientific inference with agent-based simulations on richly structured 3D geographic landscapes, synthesis and analysis of spatial small-world globalization networks, and long-run regional modeling of socio-economic and environmental systems.

Abstract

This paper could present recent advances in methods for the synthesis and calibration of diverse richly structured landscapes for agent-based simulations such as the GeoGraph (Dibble and Feldman 2004) landscapes illustrated in Figure 1. Or it could focus on presenting GeoGraph implementations of agent-based simulation models of dynamic warlord hierarchies among geographically mobile agents, civil violence riots and genocide, deforestation and reforestation, or pandemics of infectious diseases.

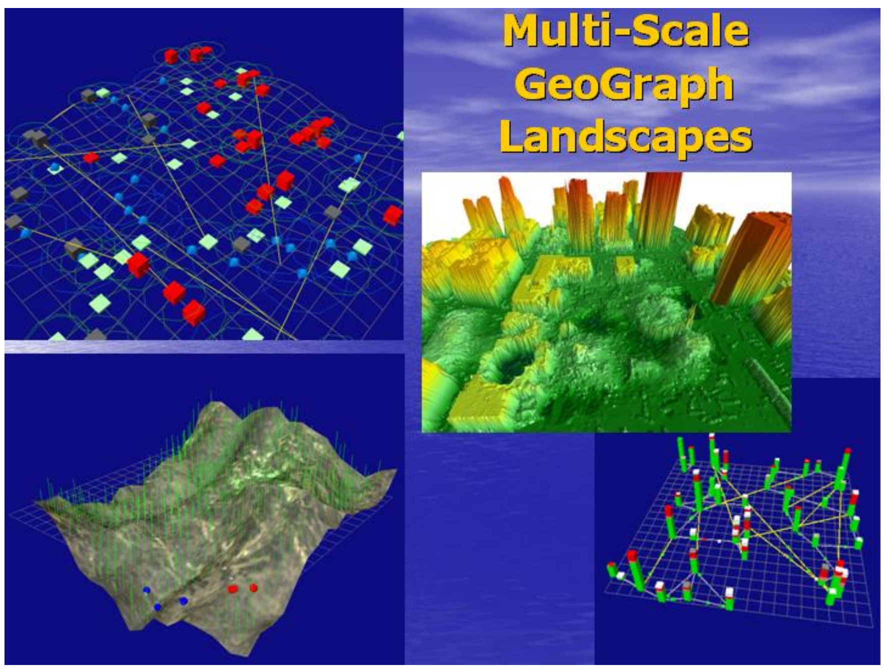

Figure 1: GeoGraph 3D Landscapes for Agent-Based GeoComputation

Yet Agent-Based GeoComputation is not about building models. It is, ultimately, about the art and science of solving complex spatial problems with computers; for sound inference on matters of importance. An appropriate model is necessary, but not sufficient. This paper discusses the complementary laboratory tools and practices sufficient for inference with agent-based computational laboratory research for effective responses in emergency situations.

Methodological advances for sufficient computational laboratory tools and practices have been motivated by a potential pandemic influenza emergency due to an unusually deadly (A/H5N1) influenza pandemic among ducks and chickens in South-East Asia, which killed 32 of its 44 human victims in Thailand and

Vietnam in 2004 (*Washington Post* 13-Nov-04) and could adapt to spread directly among humans. This threat is magnified by severely limited resources such as vaccines, antiviral drugs, and personnel for interventions to respond to the crisis. US population is just under 300 million, yet antiviral drugs are limited to 1 million courses in the Strategic National Stockpile, and the first 2 million doses of H5N1 vaccine are still being prepared. Current NIH-funded Models of Infectious Disease Agents Study (MIDAS) simulation models evaluate the effectiveness of epidemic control measures within communities. Successful control at this level would be ideal, yet it is essential to prepare for effective inter-city interventions in the event of escalation to Pandemic Phase 1 (multiple outbreaks).

This paper will discuss the lessons learned this winter during the author's research using complementary computational laboratory tools to evaluate and optimize geographic deployment of limited resources to inhibit the inter-city spread of pandemic influenza. The crucial substantive challenges harnesses advantages of geographic structure to amplify the protective leverage of available resources, in order to minimize mortality and gain time for vaccine production and administration. The crucial methodological challenge is to conduct sufficient sensitivity and risk analyses of the model and of recommended interventions to provide as much information as possible for decision-makers, in the event that model results must be used to recommend deployments of interventions during a pandemic emergency.

The epistemological insights and methodological extensions motivated by responding to this potential emergency provide helpful guidelines for effective calibrations, experimental designs, optimizations, and risk analyses of spatial agent-based computational laboratory research.

References

Dibble, Catherine and Philip G. Feldman (2004) The GeoGraph 3D Computational Laboratory, *Journal of Artificial Societies and Social Simulation* vol. 7, no. 1. http://jasss.soc.surrey.ac.uk/7/1/7.html