

## Epistemology of Modeling and Simulation: Variations on a Theme

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The three papers that follow formed part of a 3-day conference in the Epistemology of Modeling and Simulation at the University of Pittsburgh, 1st through 3rd April 2011 ([www.modelingepistemology.pitt.edu](http://www.modelingepistemology.pitt.edu)). They reflect variations on a theme that emerged in the course of the conference both in more traditional paper sessions and in breakout workshops on specific computational models: the Long House Valley Anasazi model,<sup>1</sup> the CCSM3 climate change model,<sup>2</sup> and the Epstein smallpox model.<sup>3</sup>

The papers collected here concentrate on issues of modeling and simulation, experimentation, and materiality. Tarja Knuuttilla and Andrea Loettger's "Modeling and Experimenting: The Combinatorial Modeling Strategy of Synthetic Biology" explores a triangulation strategy between model organisms, synthetic experimentation, and mathematical models and associated simulations. The authors argue that each of these fulfills a specific epistemic role, with an analysis of cases that adds significant nuance to older debates regarding simulation, experimentation, and materiality.

The central modeling goal of simplification is the focus of Gerhard König's "Simulation and the Problem of Simplification: Between Scylla and Charybdis?" König's piece is particularly valuable in that it is not content to emphasize the dangers

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<sup>1</sup>Axtell, Epstein, Dean, Gumerman, Swedland, Harburger, Chakravarty, Hammond, Parker, & Parker, "Population growth and collapse in a multiagent model of the Kayenta Anasazi in Long House Valley." <http://www.pnas.org/content/99/suppl.3/7275.short>.

<sup>2</sup>Collins, Bitz, Blackmon, Bonan, Bretherton, Carton, Chang, Doney, Hack, Henderson, Kiehl, Large, McKenna, Santer, and Smith, "The Community Climate System Model Version 3 (CCSM3)" ([www.cgd.ucar.edu/cms/wcollins/papers/jcl\\_2006\\_v19\\_p2122.pdf](http://www.cgd.ucar.edu/cms/wcollins/papers/jcl_2006_v19_p2122.pdf)), and "Modelling the Climate," Chapter 5 of John Houghton, *Global Warming: The Complete Briefing* (third edition), Cambridge University Press, 2004.

<sup>3</sup>Epstein, Cummings, Chakravarty, Singha & Burke, *Toward a Containment Strategy for Smallpox Bioterror: An Individual-Based Computational Approach*. <http://www.brookings.edu/press/Books/2004/towardacontainmentstrategyforsmallpoxbioterror.aspx>.

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of oversimplification on one side. It emphasizes not only the technical but the epistemic difficulties on the side of complexity as well.

In a piece that includes both theoretical exploration and personal reflection, Nicholas Rescher's "How Modeling Can Go Wrong" attempts a catalogue of various ways in which modeling can go wrong. Here, again, overcomplexification and overestimation are emphasized as epistemic dangers fully parallel to oversimplification and underestimation. "How Modeling Can Go Wrong" is abbreviated from a keynote at the conference.

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