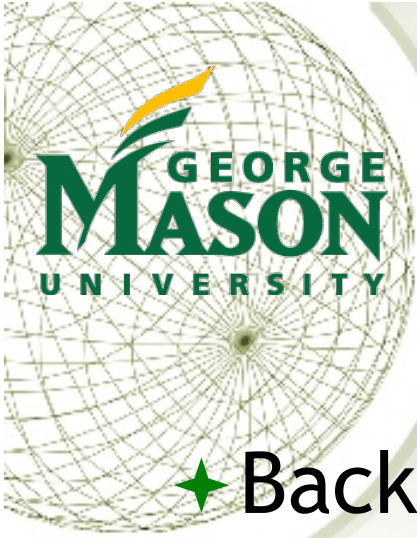




MASON RebeLand: An Agent-Based Model of Politics, Environment, and Insurgency

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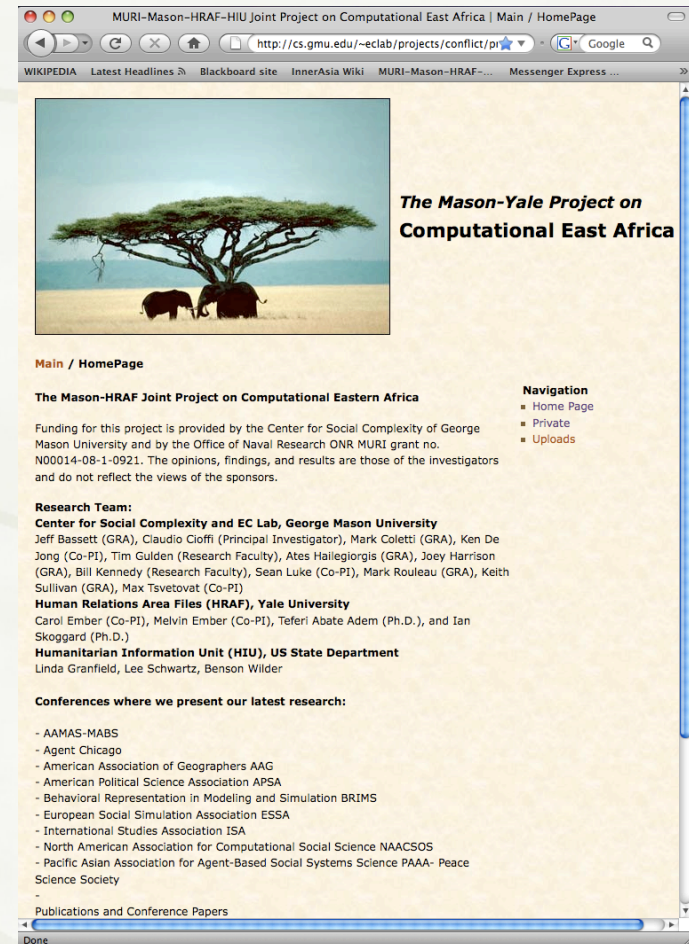
Outline

- ★ Background
- ★ Problem and research questions
- ★ Model structure and dynamics
- ★ Main results
- ★ Conclusions



Mason-HRAF Joint Project on Computational Eastern Africa

- ★ Research funded by **ONR MURI** grant no. **N00014-08-1-0921** (PM Dr. Rebecca Goolsby)
- ★ **Goal:** Develop agent-based models of socio-natural environments to test theories and hypothesis of irregular warfare and cultural dynamics
- ★ **Main models to date:**
 - ★ FarmersAndHerders (Rouleau et al. 2009)
 - ★ RebeLand (Cioffi & Rouleau 2009)
 - ★ AfriLand (Cioffi & Rouleau 2009)
- ★ **Disciplines:** Computational social science, computer science, anthropology, economics, political science, geospatial science





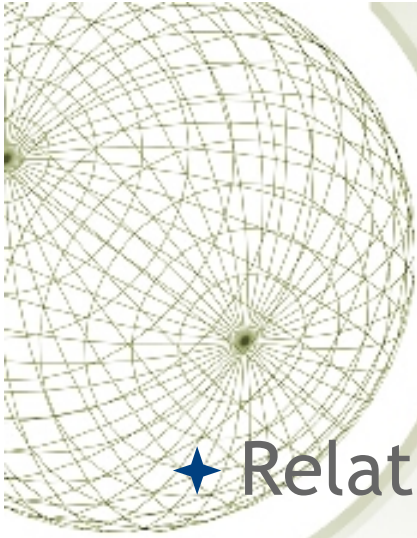
Problem Overview

- ✦ Exploring the complex relationship between Society, Government, and Issues, using an explicit polity (political system) model
- ✦ Understanding the feedback amongst Citizen Satisfaction, Issue Management, and Government Legitimacy
- ✦ Generate emergence of civil unrest and polity instability from the “Bottom Up” within an Agent-Based Model



Research Questions

- ✦ Under what conditions is a polity stable? Unstable? And failed?
- ✦ Under what conditions can civil unrest lead to regime change?
- ✦ What are some early-warning signs of a polity prior to the onset of instability or failure?

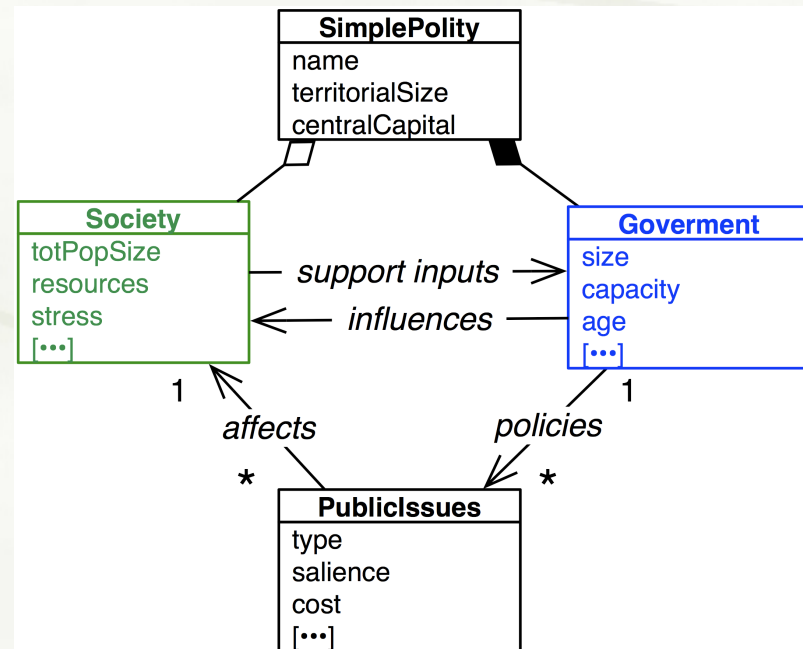


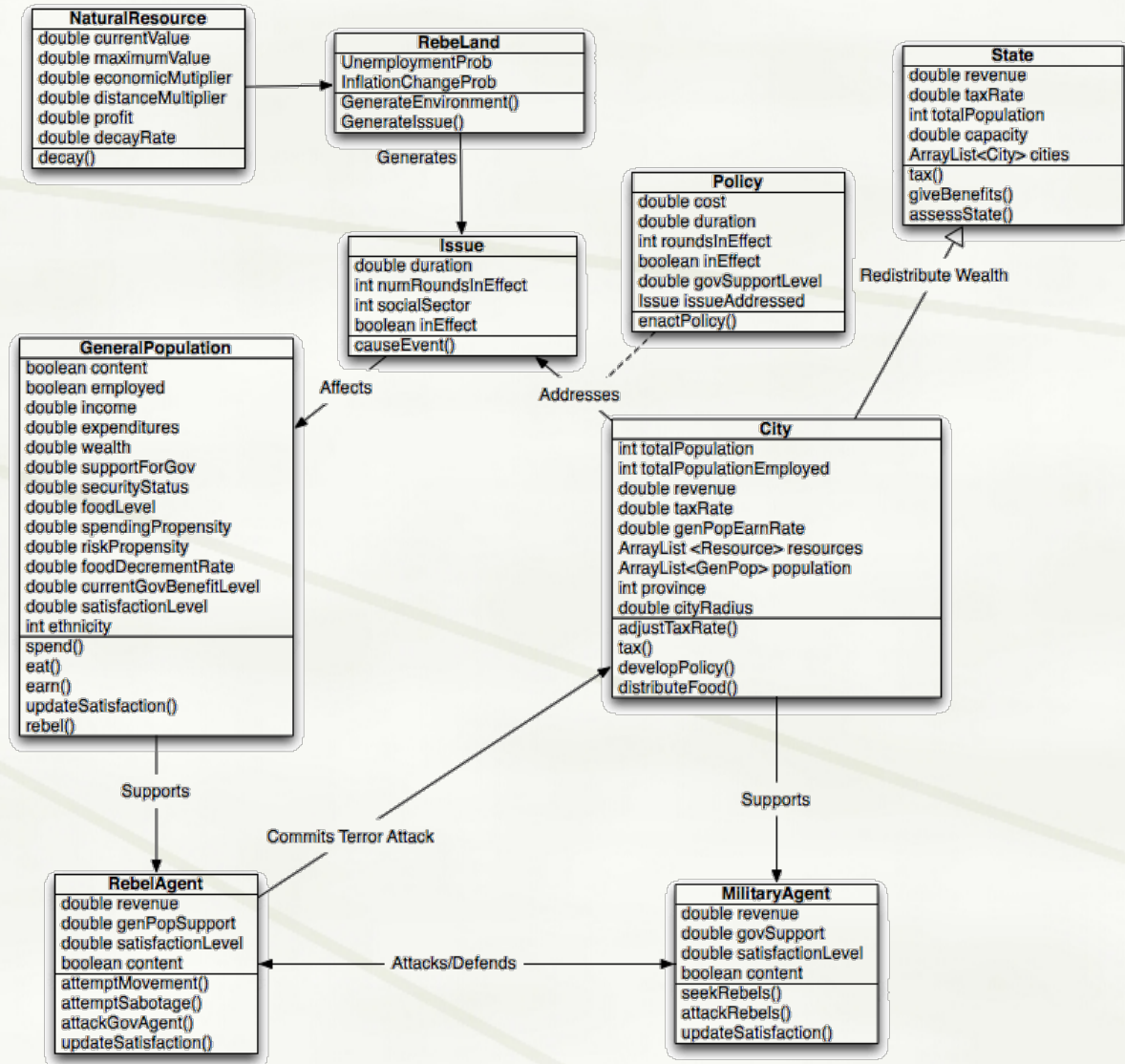
Theoretical background

- ★ Relative deprivation (Gurr 1968)
- ★ Opportunity-willingness (Starr 1978; Cioffi & Starr 1995; Fearon and Laitin 2003)
- ★ Greed and grievance (Collier and Hoeffler 2004)
- ★ Strategy of violence (Kalyvas 2004)
- ★ Battle for the State (Cederman and Girardin 2007)
- ★ Iruba (Doran 2005) and SimPol: standard model of a polity in political science (Cioffi 2009)

Analysis of stability dynamics with standard model of a polity

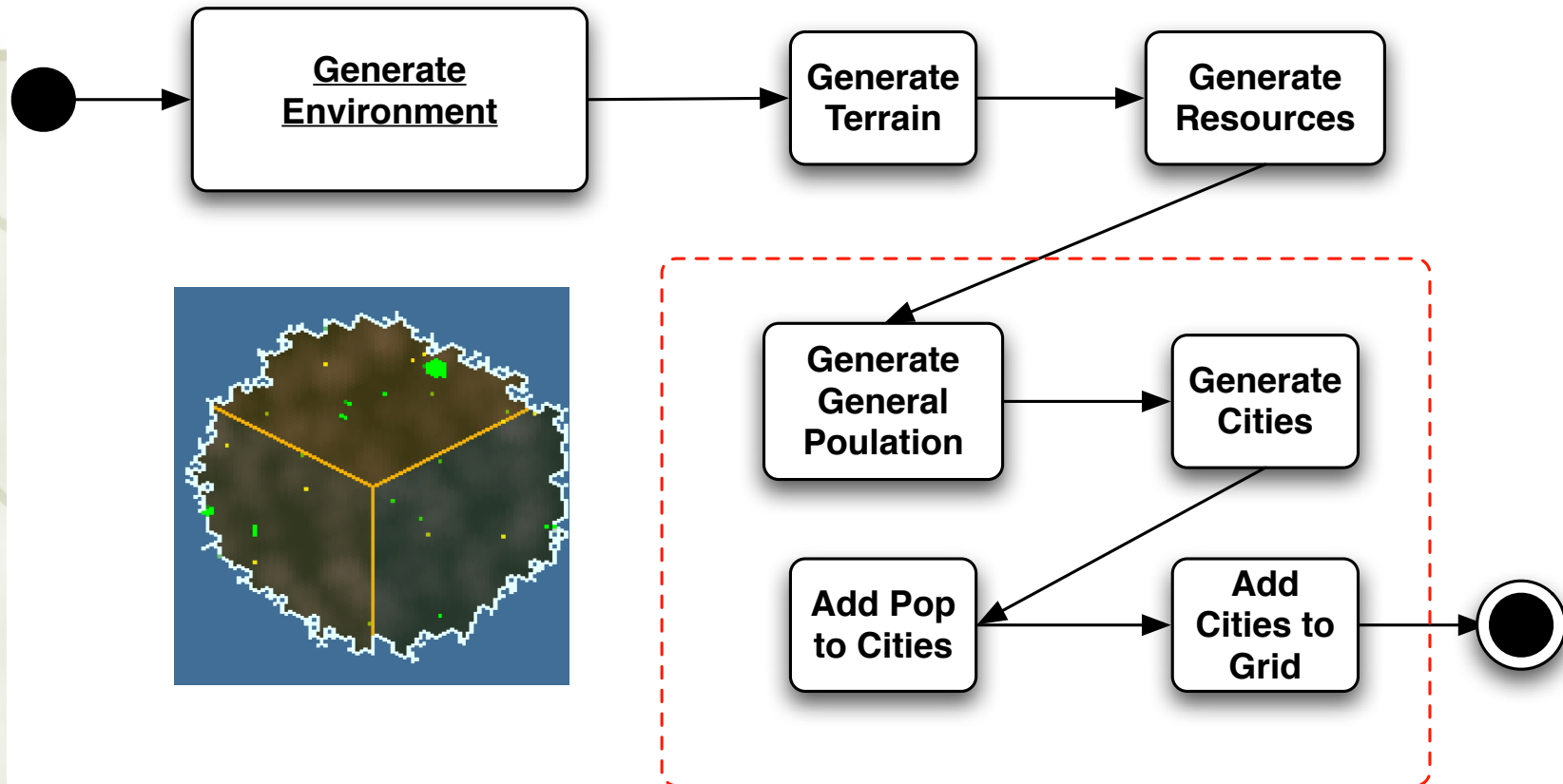
- ★ Standard model as universal and comparative
- ★ Social science is necessary (not optional) for basic model design & evaluation
- ★ RebeLand as first political science-based social ABM of a polity
- ★ Public Issues (initial class):
 - ★ Inflation
 - ★ Insurgency
 - ★ Climate change
- ★ Three scenarios for dynamic analysis:
 - ★ Stable
 - ★ Unstable
 - ★ Failed





MASON RebeLand

Generate Environment (Detailed Breakdown)





Simulation Agents & Stressing Issues

★ Primary Agents

- ★ General Population

- ★ City

- ★ State

★ Secondary Agents

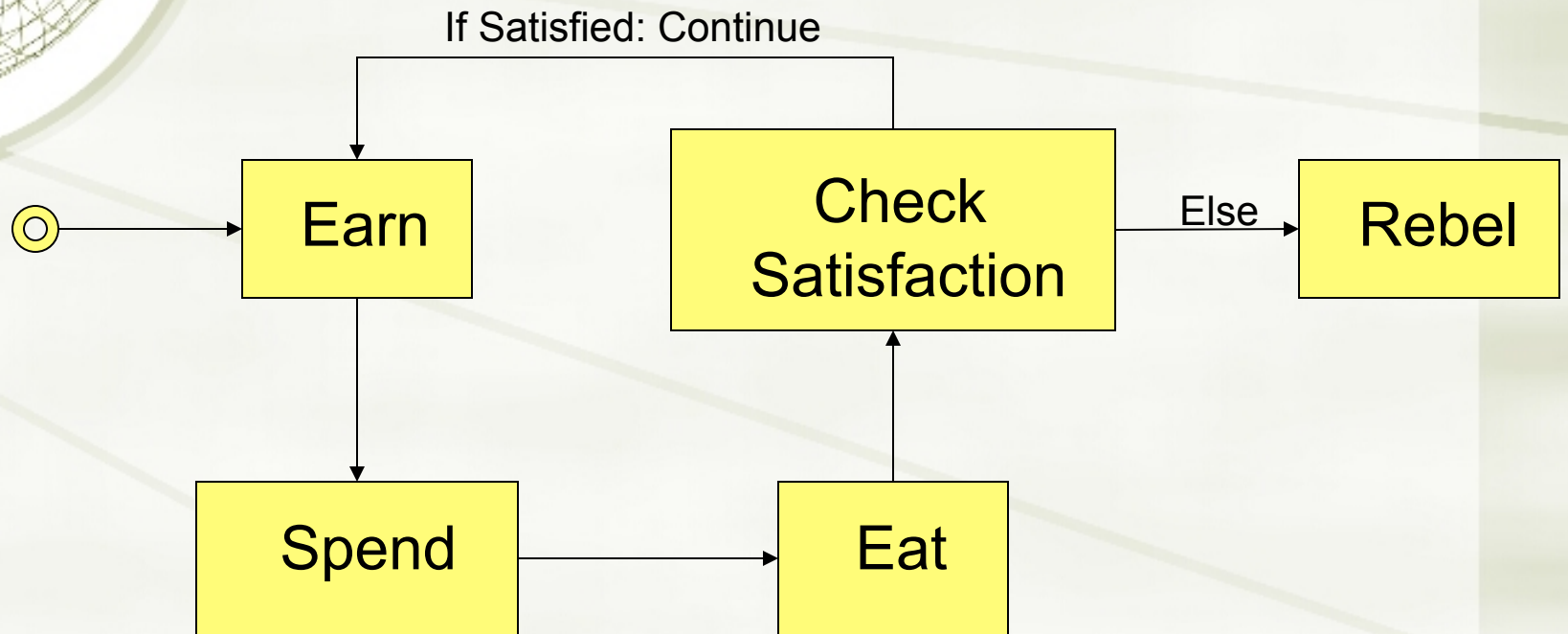
- ★ Rebel

- ★ Rebel Group

- ★ Police/Military Unit

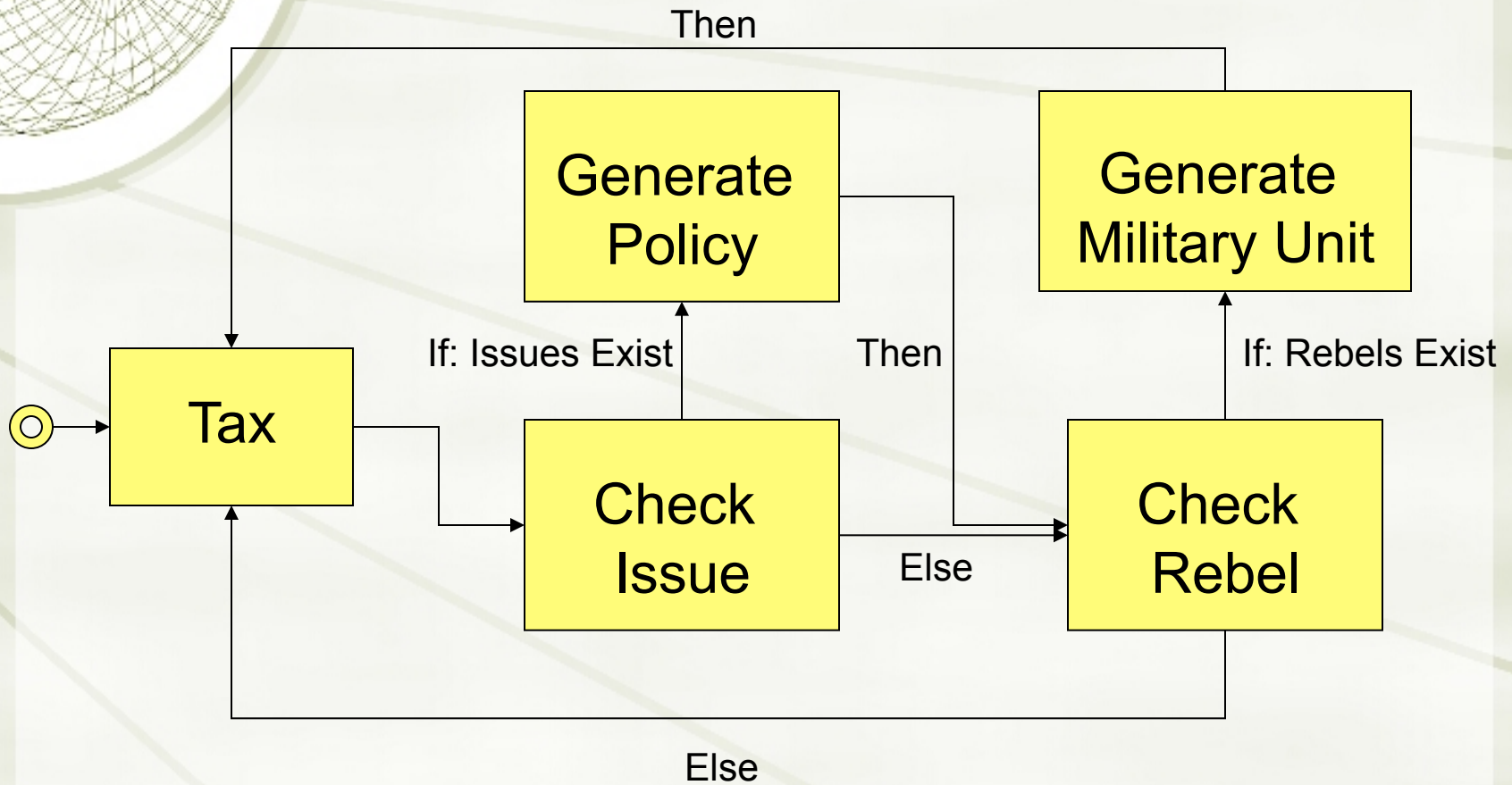


General Population





City





Secondary Agents

★ Rebel

- ★ Avoid security units
- ★ Defend from attack
- ★ Commit terrorism

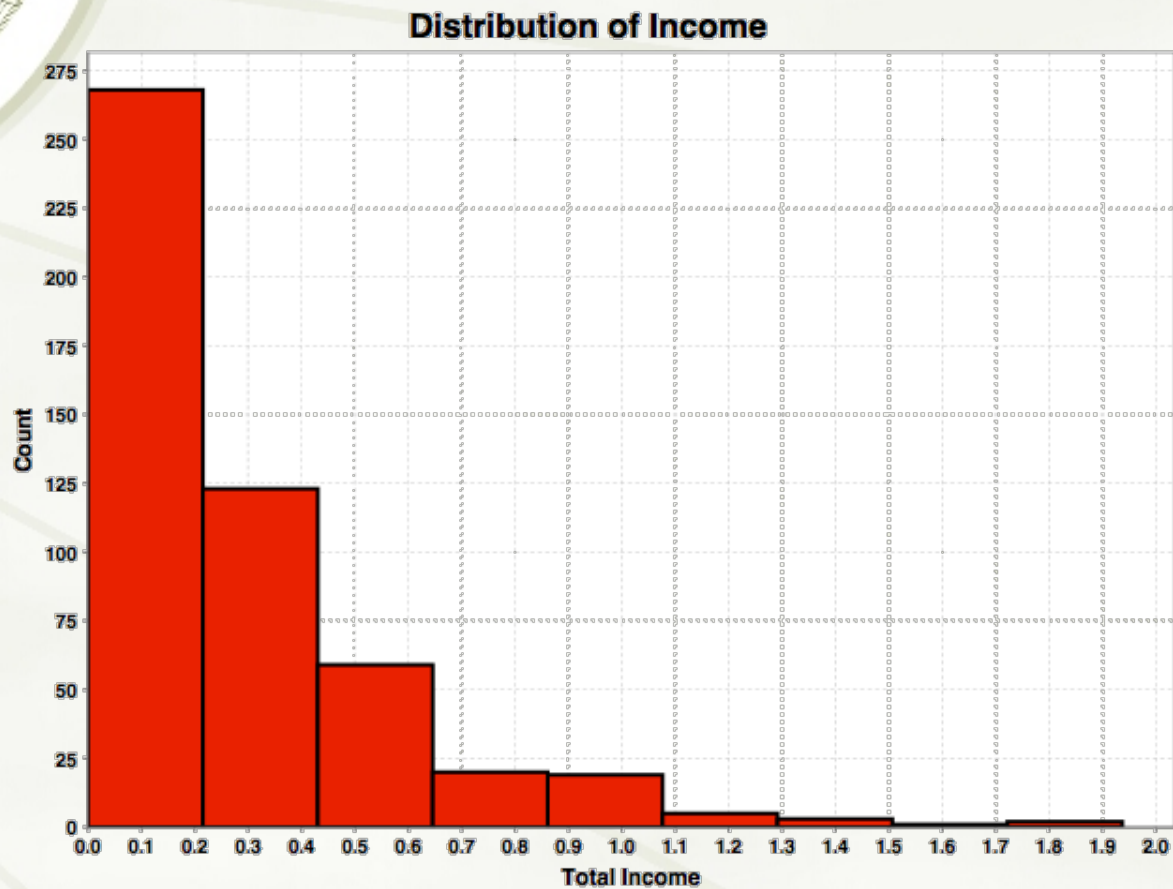
★ Rebel Group

- ★ Support rebels
- ★ Fund alternative policies (rouge State)

★ Security (police/military) units

- ★ Seek Rebels
- ★ Attack Rebels
- ★ Guard home city

Example validation: Emergence of Pareto distribution of household income



MASON RebeLand 1.1 (Cioffi & Rouleau 2009, *Intl. St. Rev.*)



Computational analysis

★ Scenario #1: Stable State

- ★ Low issue complexity/No terrorism
- ★ Main result: Government remains legitimate

★ Scenario #Unstable State

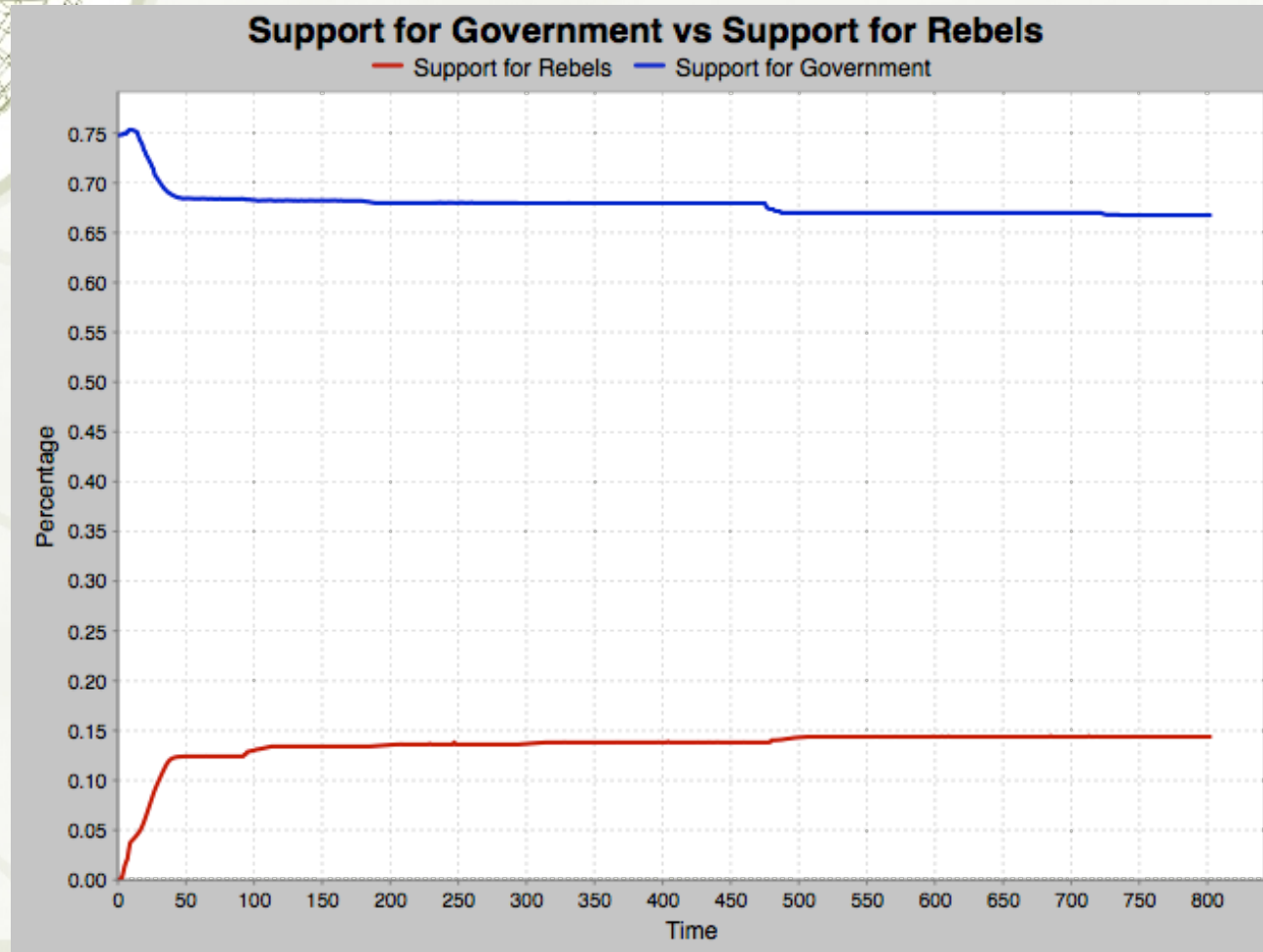
- ★ Medium to high issue complexity
- ★ Strong security pressure on rebels
- ★ Main result: Regime change unlikely

★ Scenario #3: Failing State

- ★ Medium to high issue complexity; Insurgency
- ★ Rebels exploit government weakness
- ★ Main result: Government usually falls

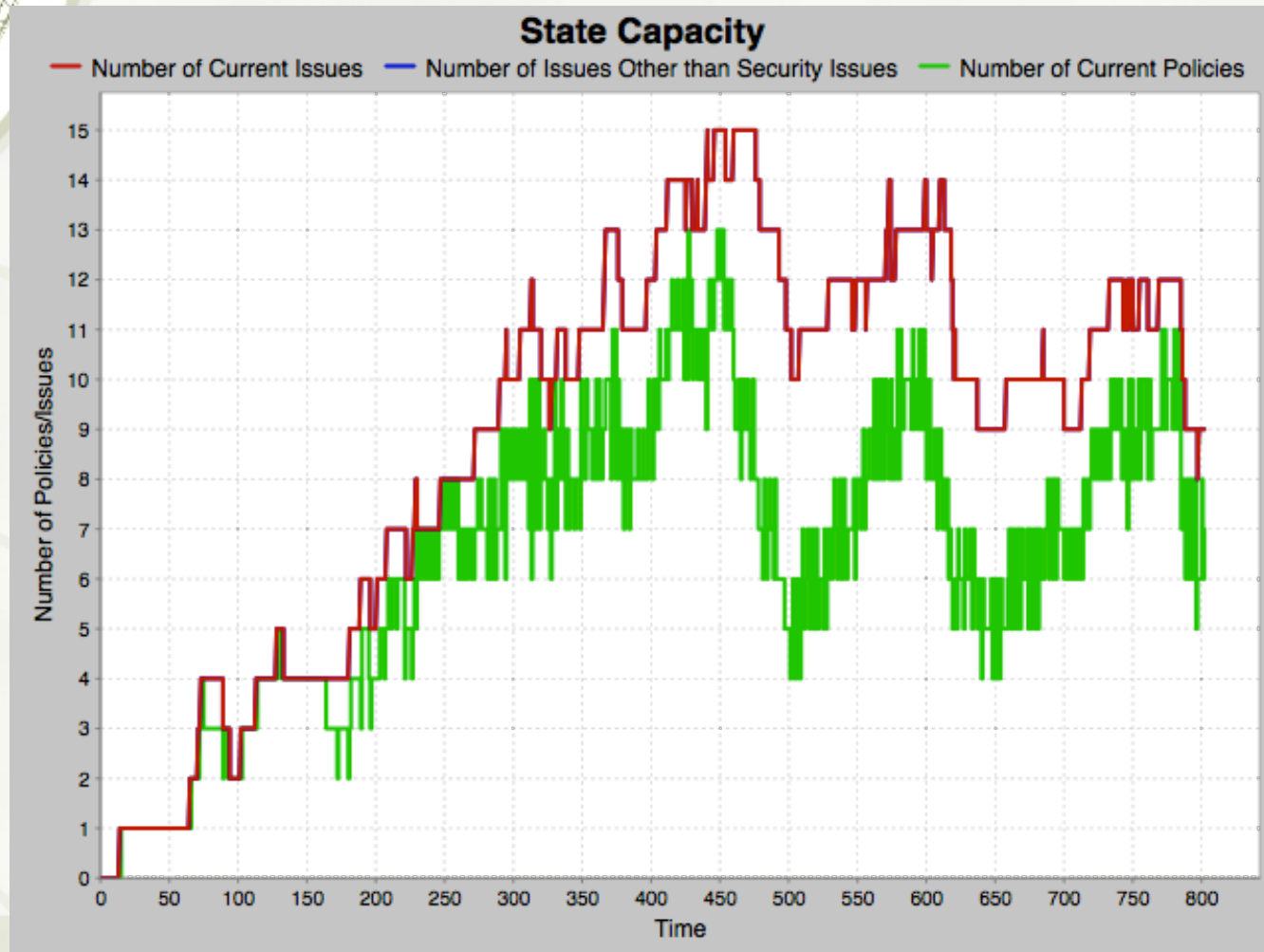


Results - Scenario 1 (1/3)



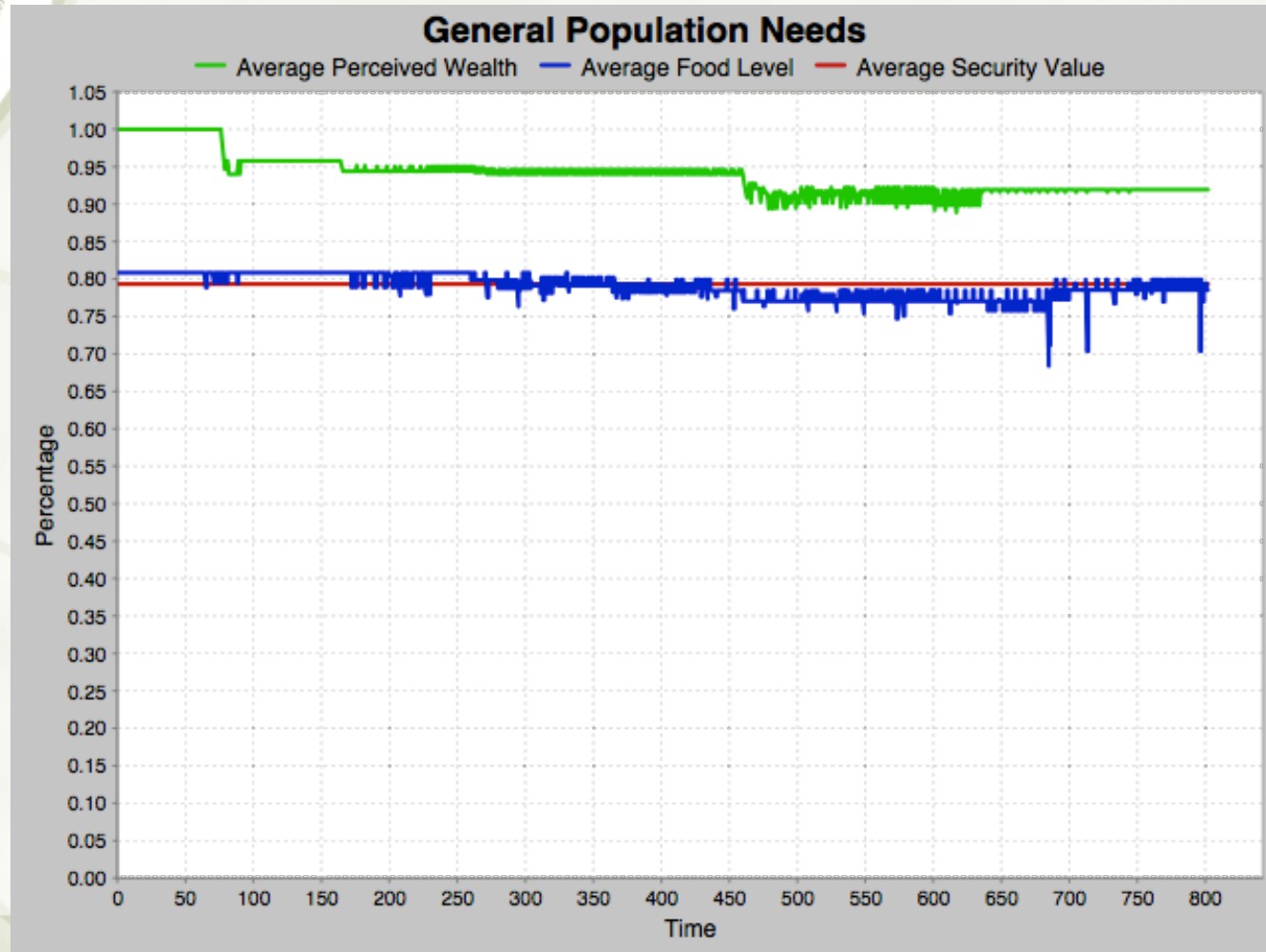


Results - Scenario 1 (2/3)



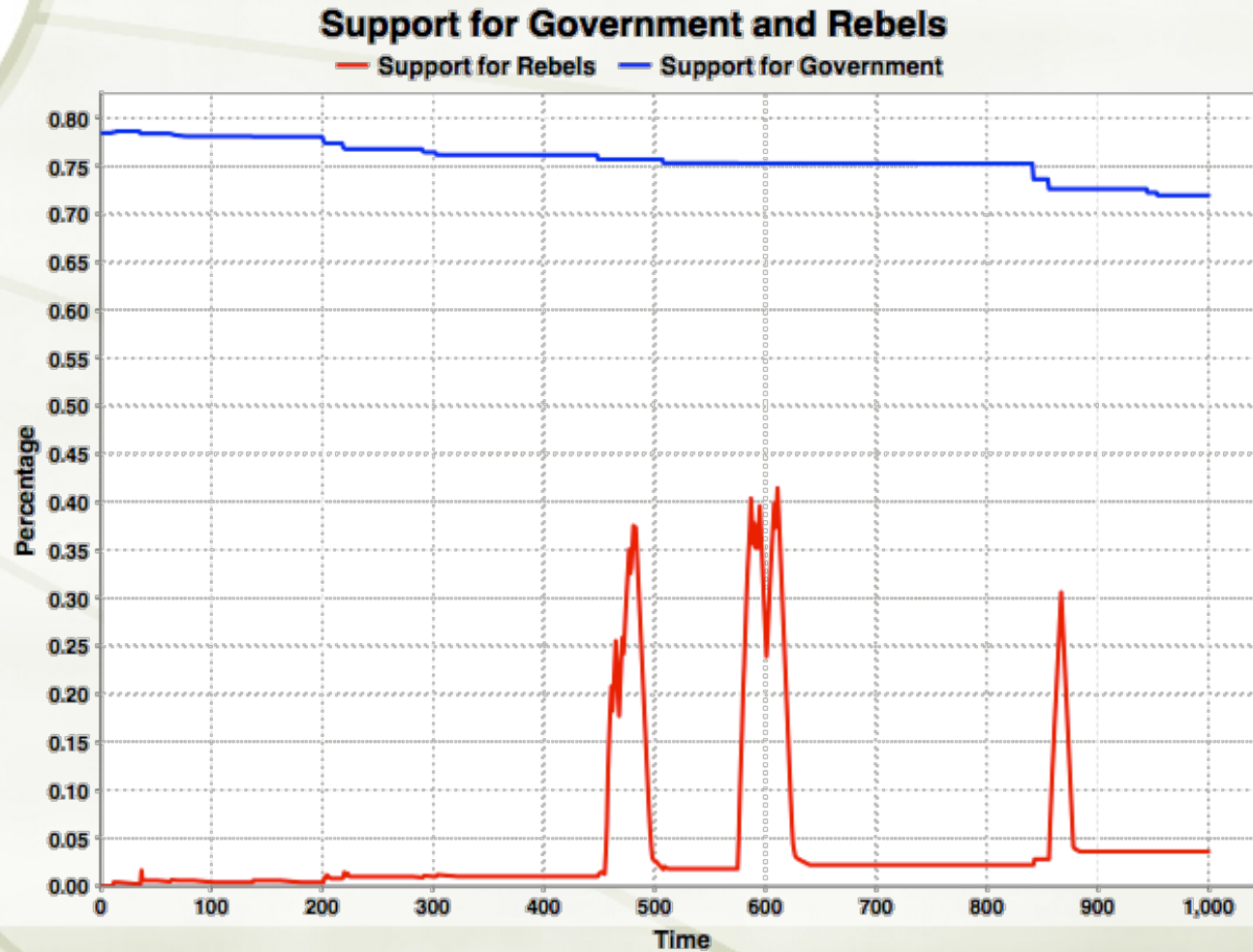


Results - Scenario 1 (3/3)





Results - Scenario 2 (1/3)

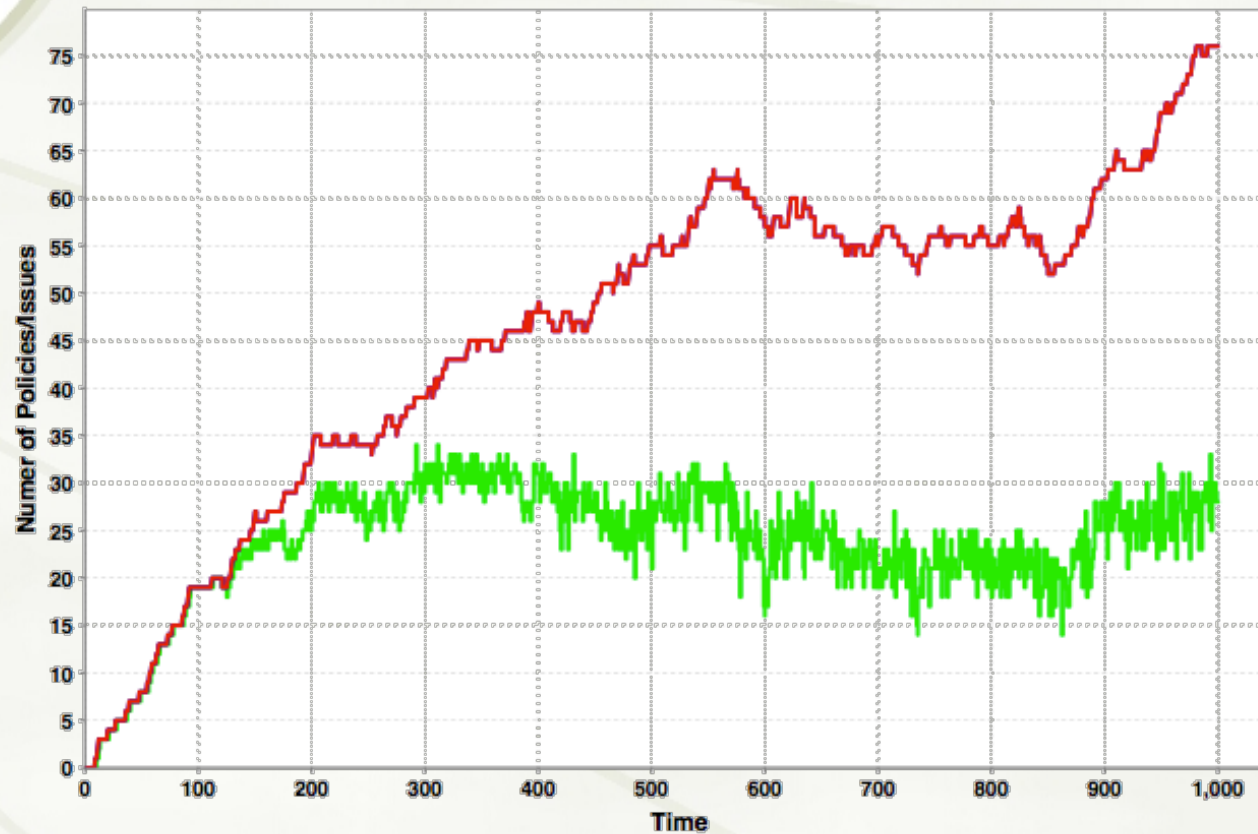




Results - Scenario 2 (2/3)

State Capacity

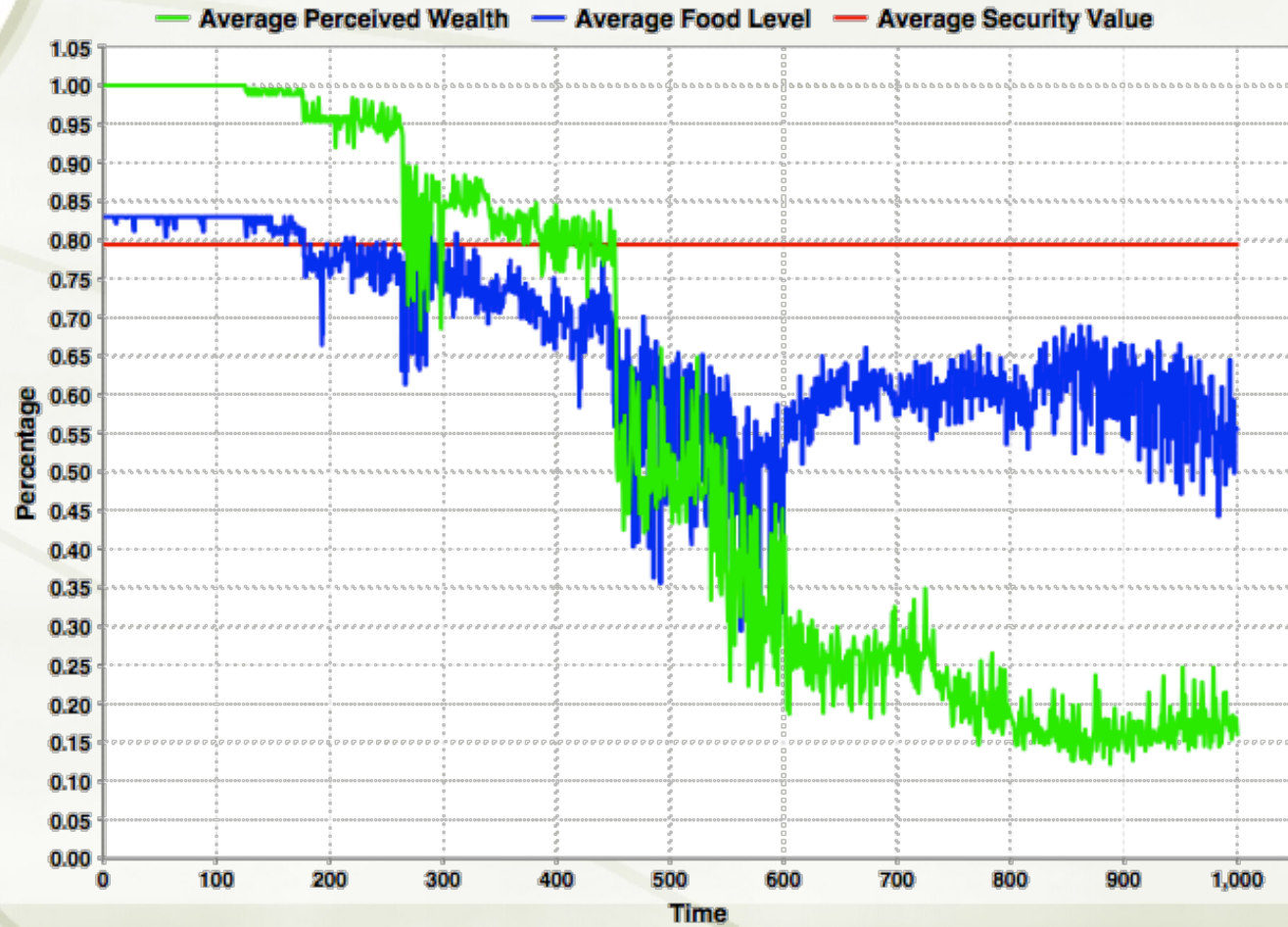
— Number of Current Issues — Number of Issues Other than Security Issues
— Number of Current Policies





Results - Scenario 2 (3/3)

General Population Needs

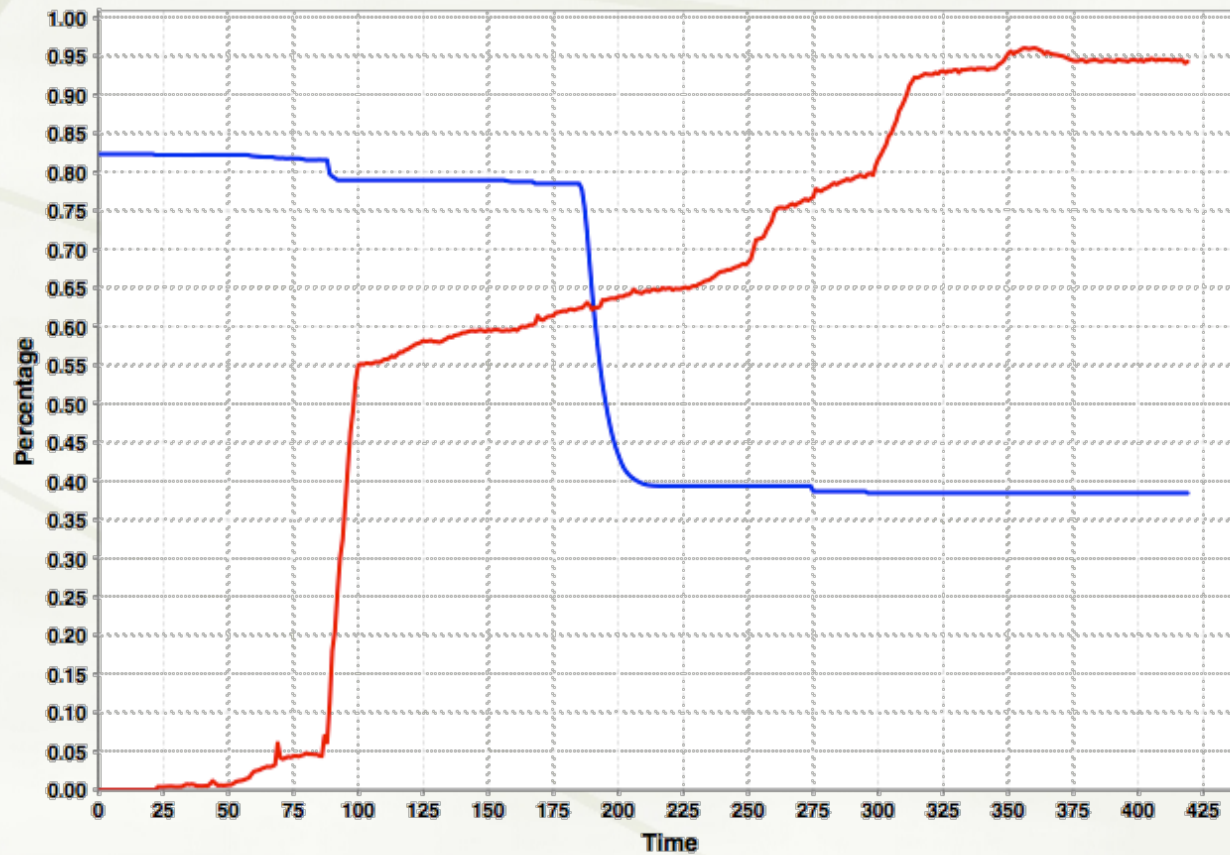




Results - Scenario 3 (1/3)

Support for Government and Rebels

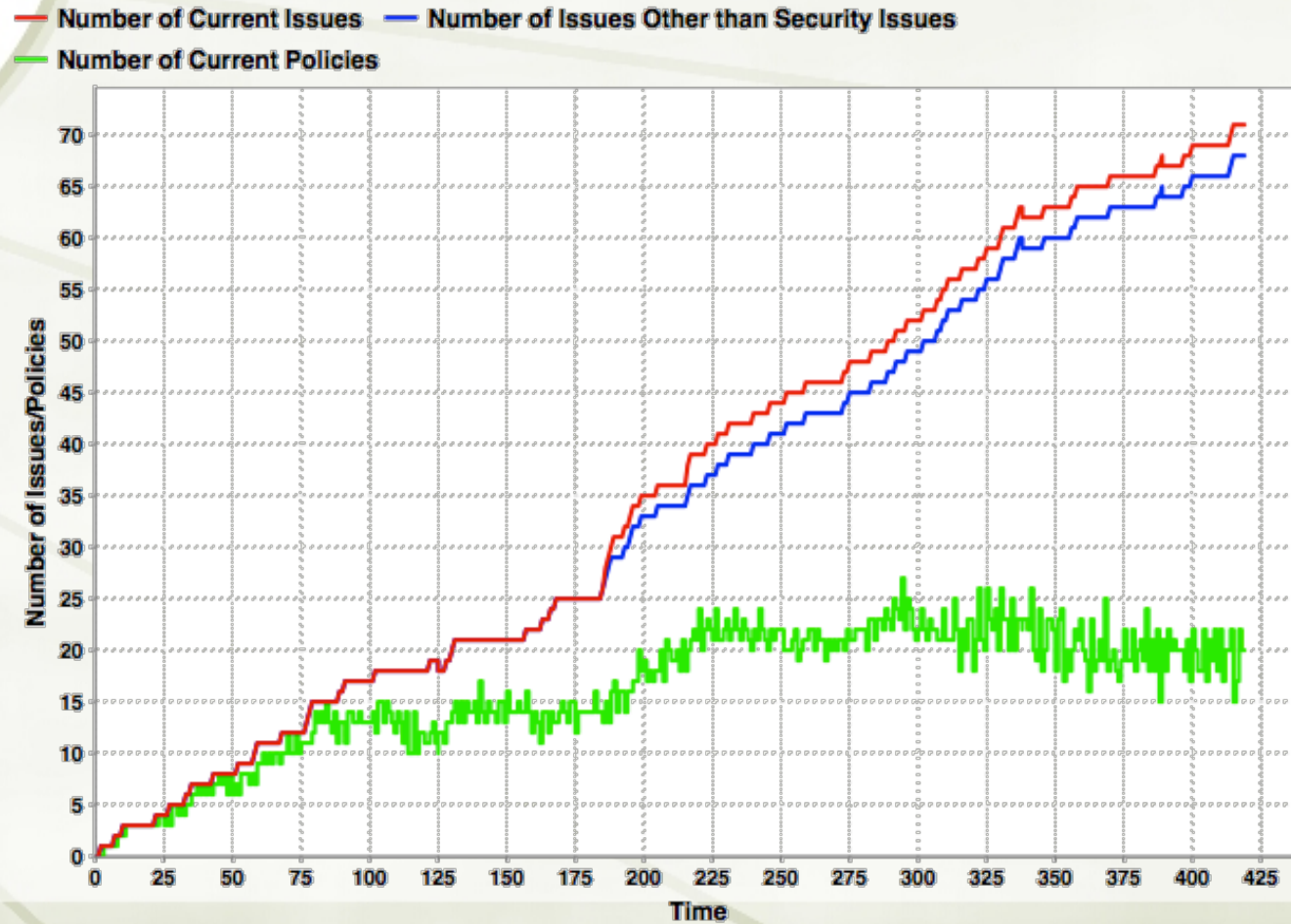
— Support for Rebels — Support for Government





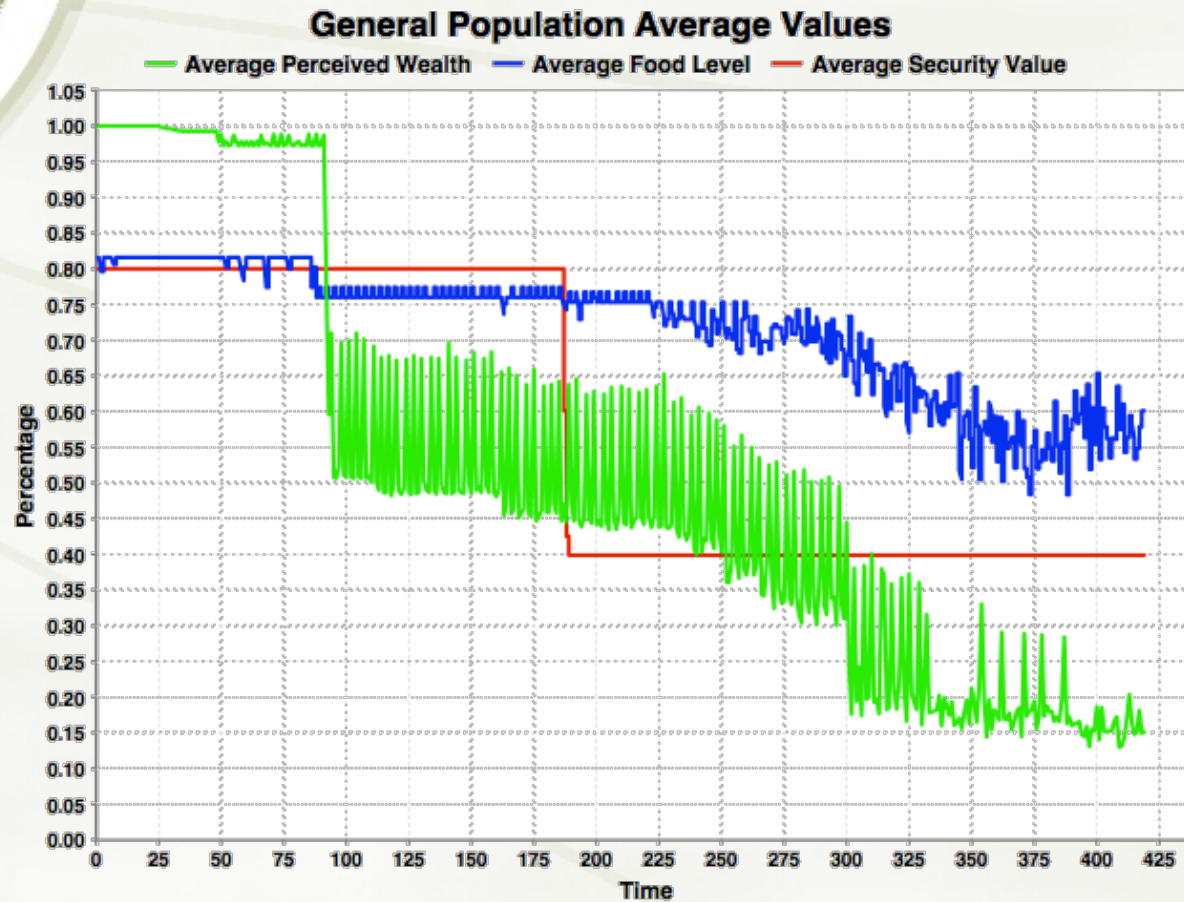
Results - Scenario 3 (2/3)

State Capacity by Number of Issues





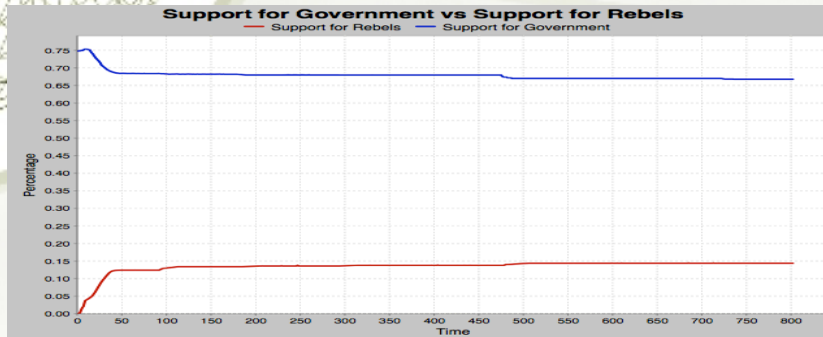
Results - Scenario 3 (3/3)



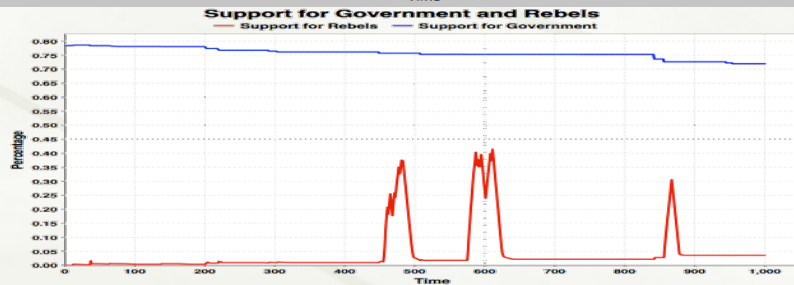
Evolution of state stability dynamics in the MASON RebeLand ABM (Cioffi & Rouleau 2010)

State vs. insurgent support

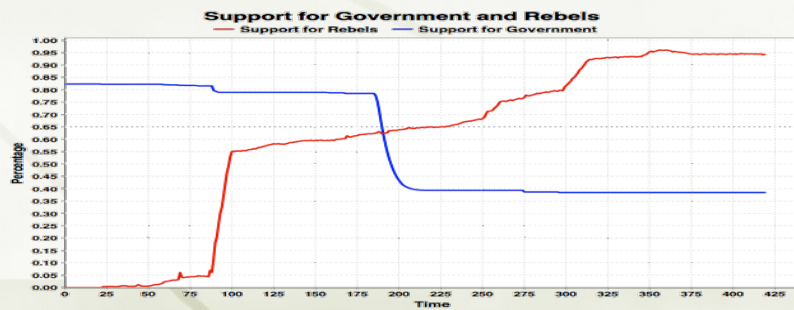
(1)



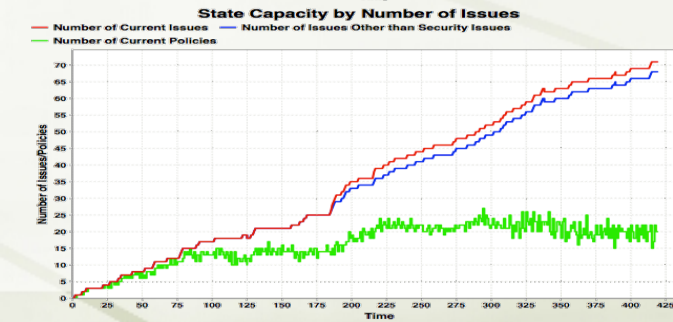
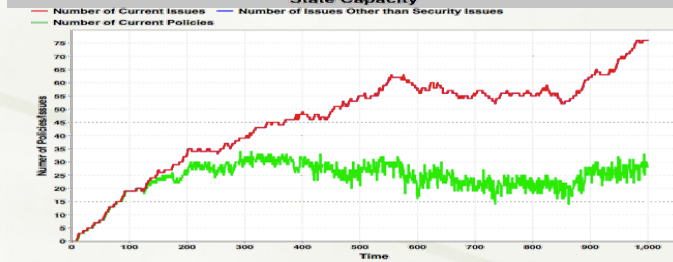
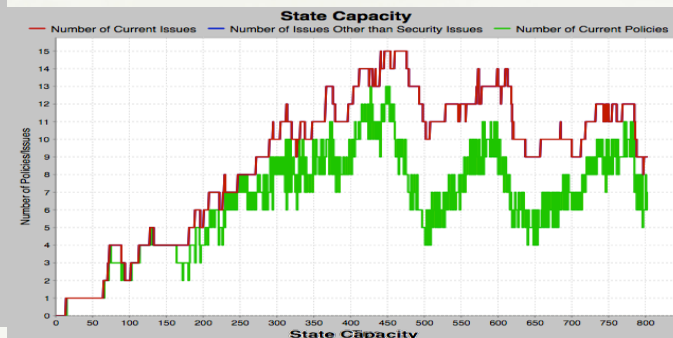
(2)



(3)



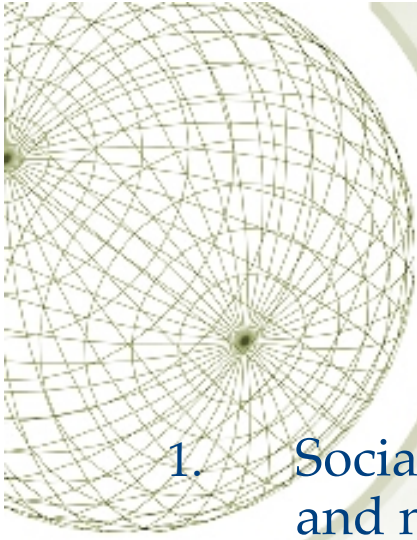
State capacity



RebeLand paper-of-record

- ★ Cioffi-Revilla, Claudio, and Mark Rouleau. 2010. MASON RebeLand: An Agent-Based Model of Politics, Environment, and Insurgency. *International Studies Review* 12 (1): In press.





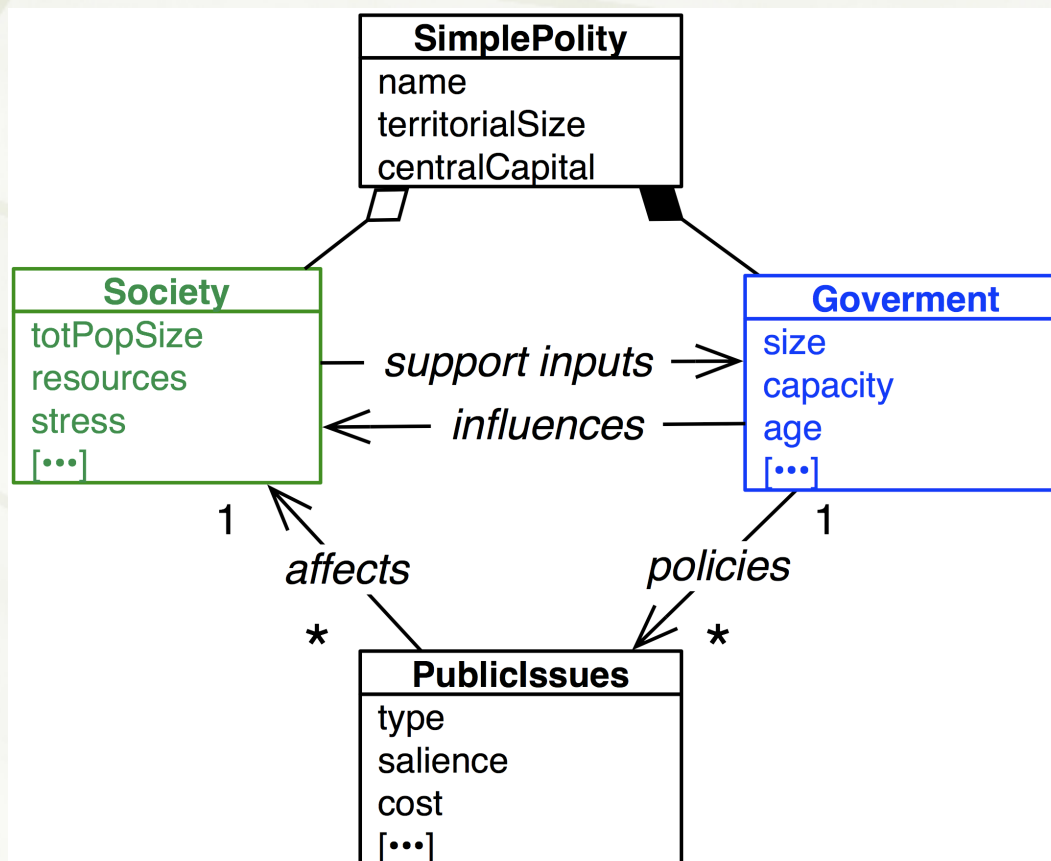
Conclusions

1. Social simulations can and should draw upon relevant extant and new social theory (political science in this project)
2. Object-oriented ABMs provide an effective lingua franca for developing viable testable theories of social dynamics
3. Socio-natural representation is necessary, not optional
4. Further advanced methods (e.g., evolutionary computation) are needed for understanding the parameter and phase space of complex socio-natural systems



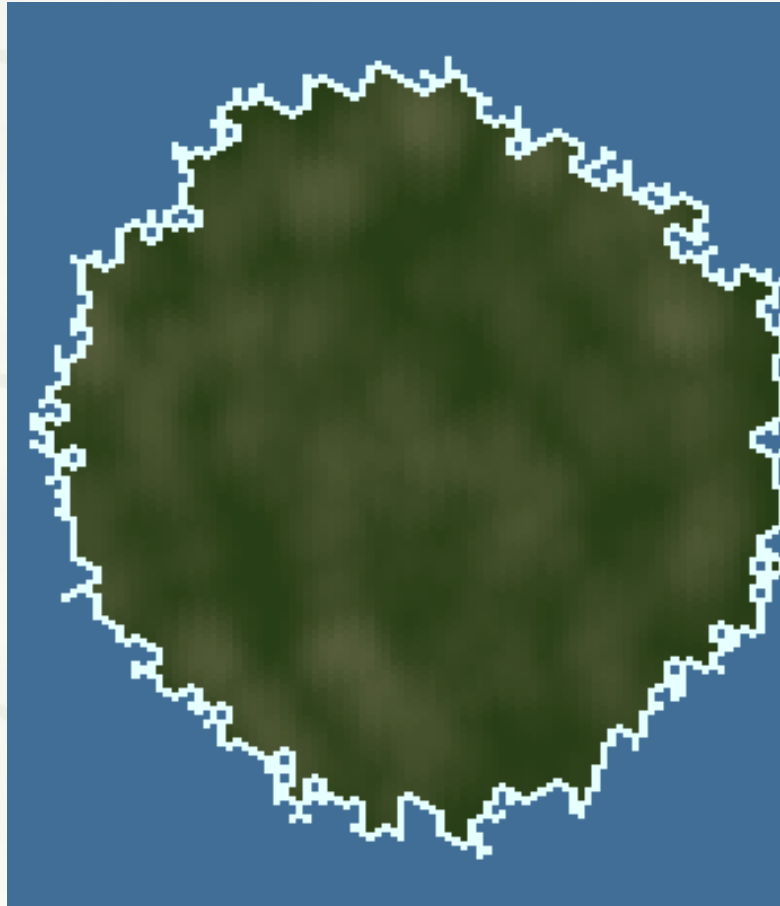
Questions?

Standard model of a polity: Universal and comparative



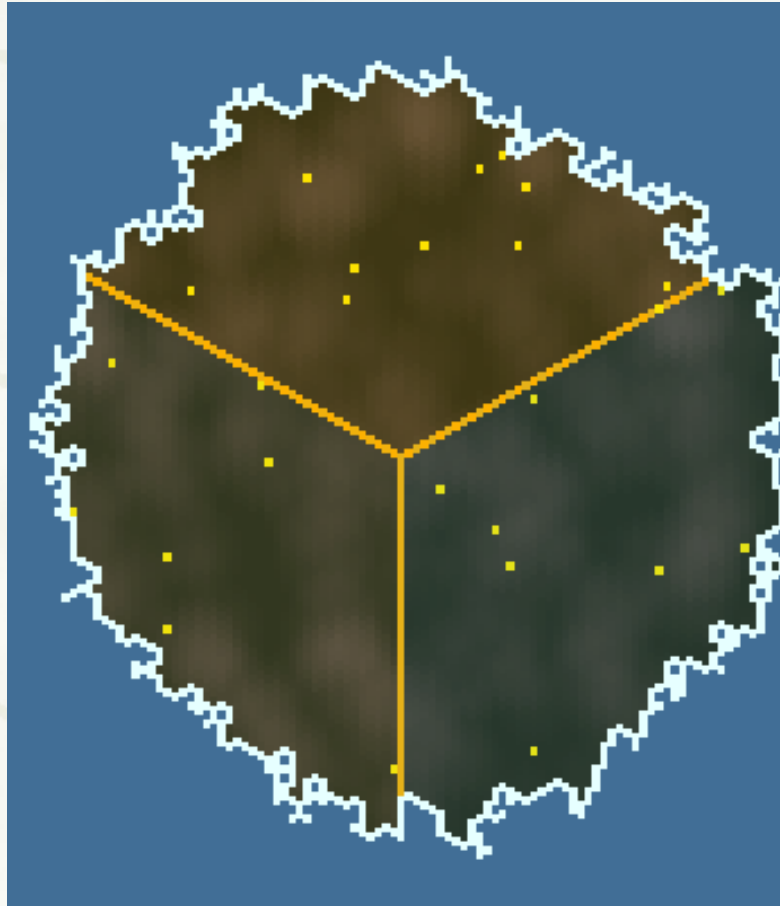


Agent Environment (1/4)



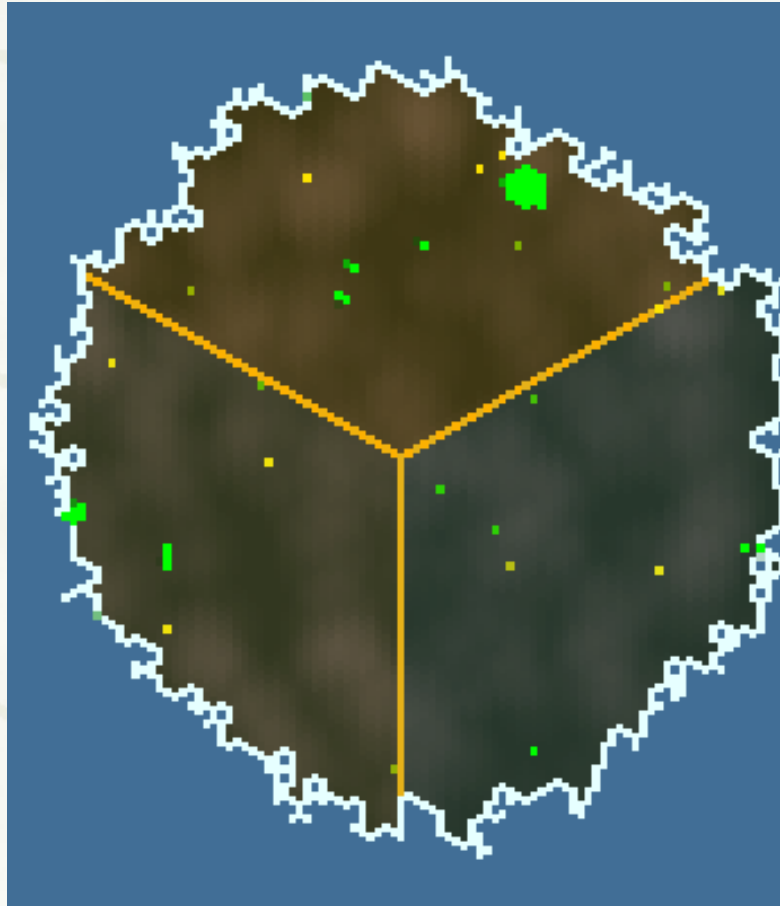


Agent Environment (2/4)



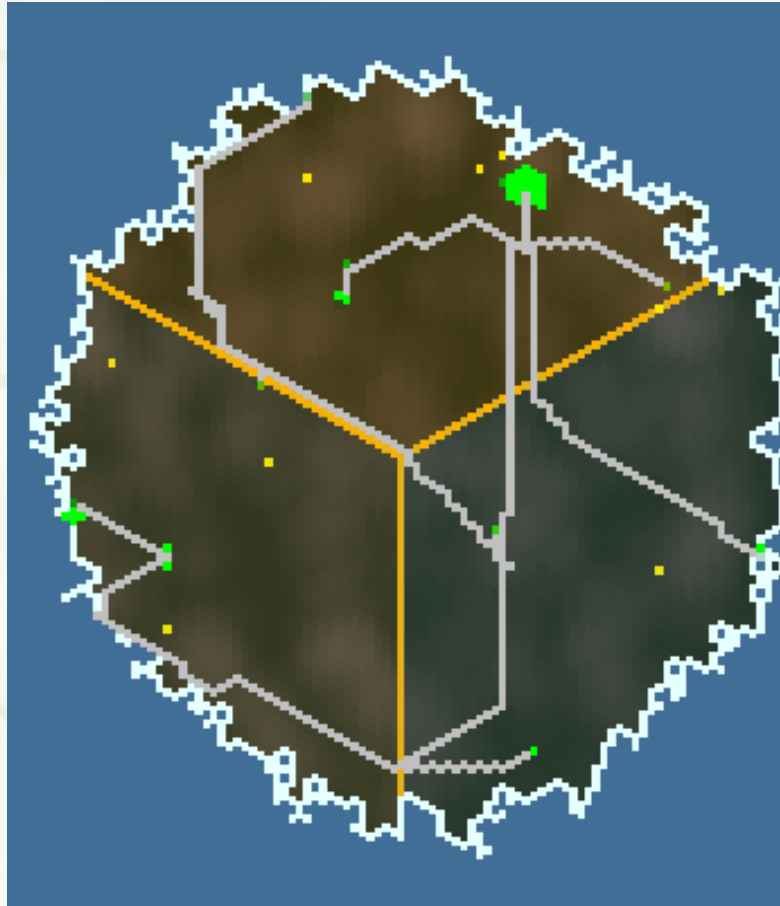


Agent Environment (3/4)



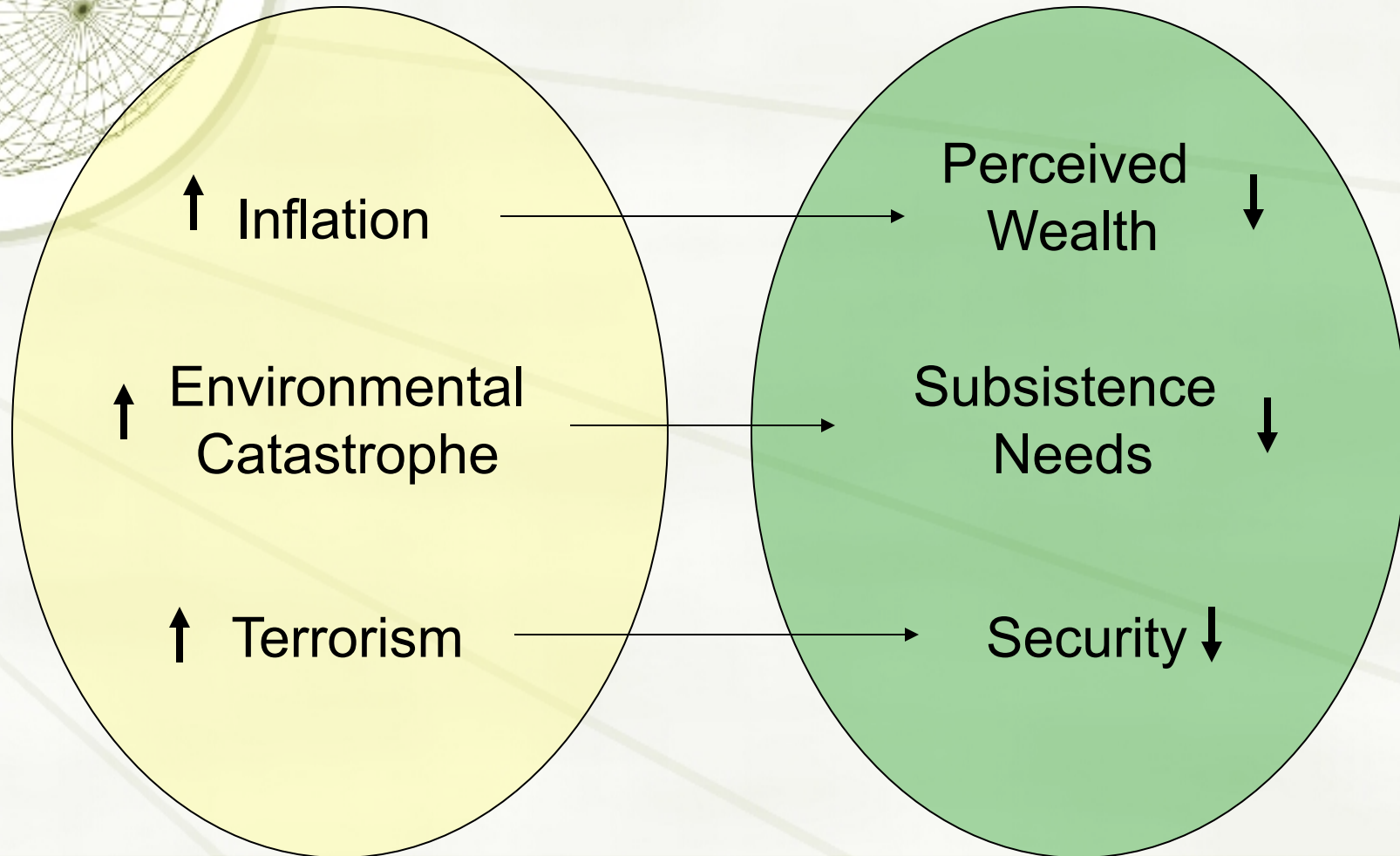


Agent Environment (4/4)





Check Satisfaction

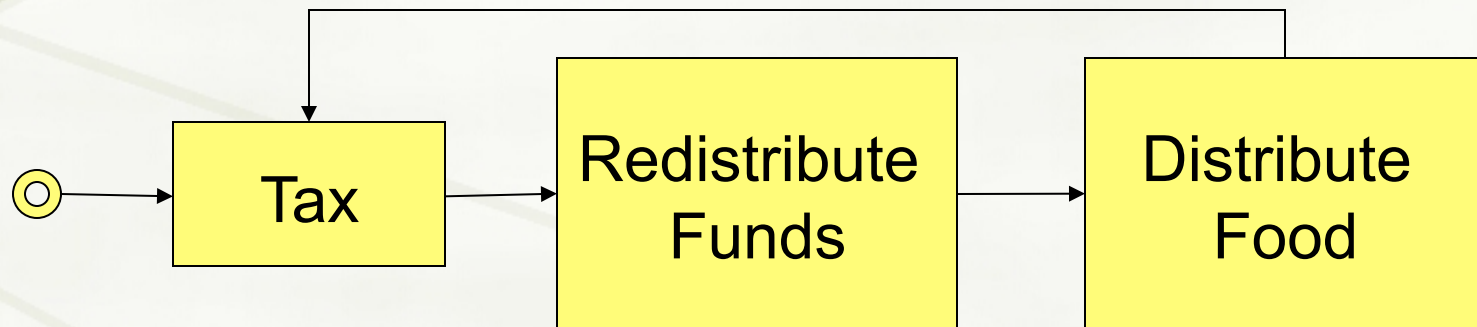


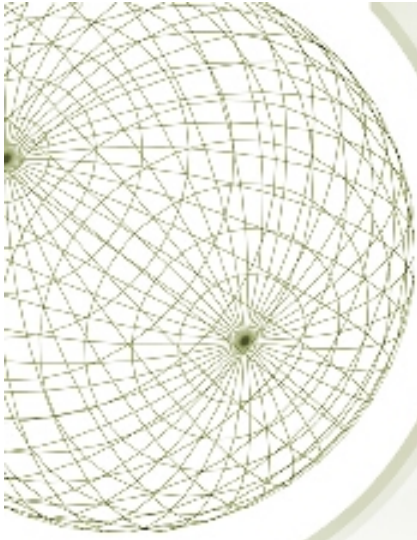
Unaddressed Social Issues

Satisfaction



State





(a)

RebeLand

(b)

