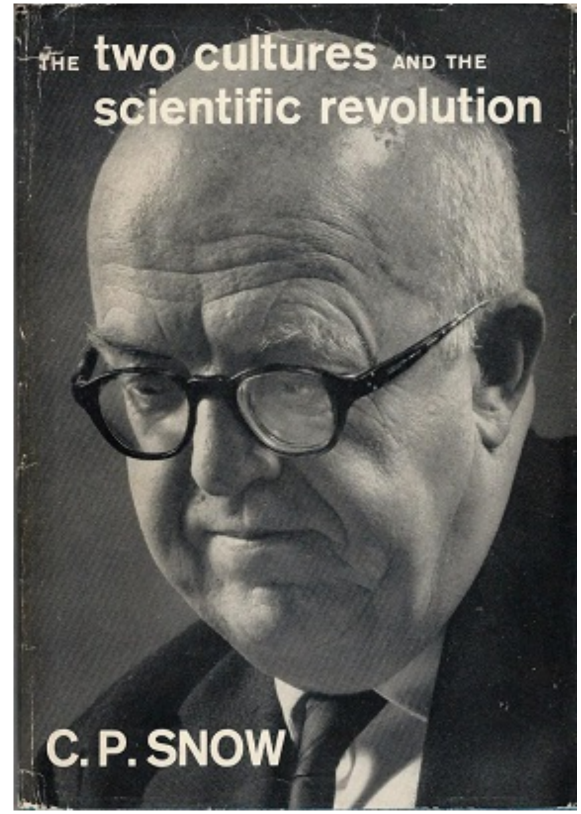
# Two Modeling Cultures

Marco Janssen
School of Sustainability
Center for Behavior, Institutions and the Environment
Arizona State University

# Outline

- Background
- Brief history of integrated global models of humans and the environment.
- The challenges of getting social science represented in integrated models.
- Two examples: Hunter-gather & Water management in Mexico City
- Conclusions

"the intellectual life of the whole of western society" was split into the titular two cultures — namely the sciences and the humanities (1959)



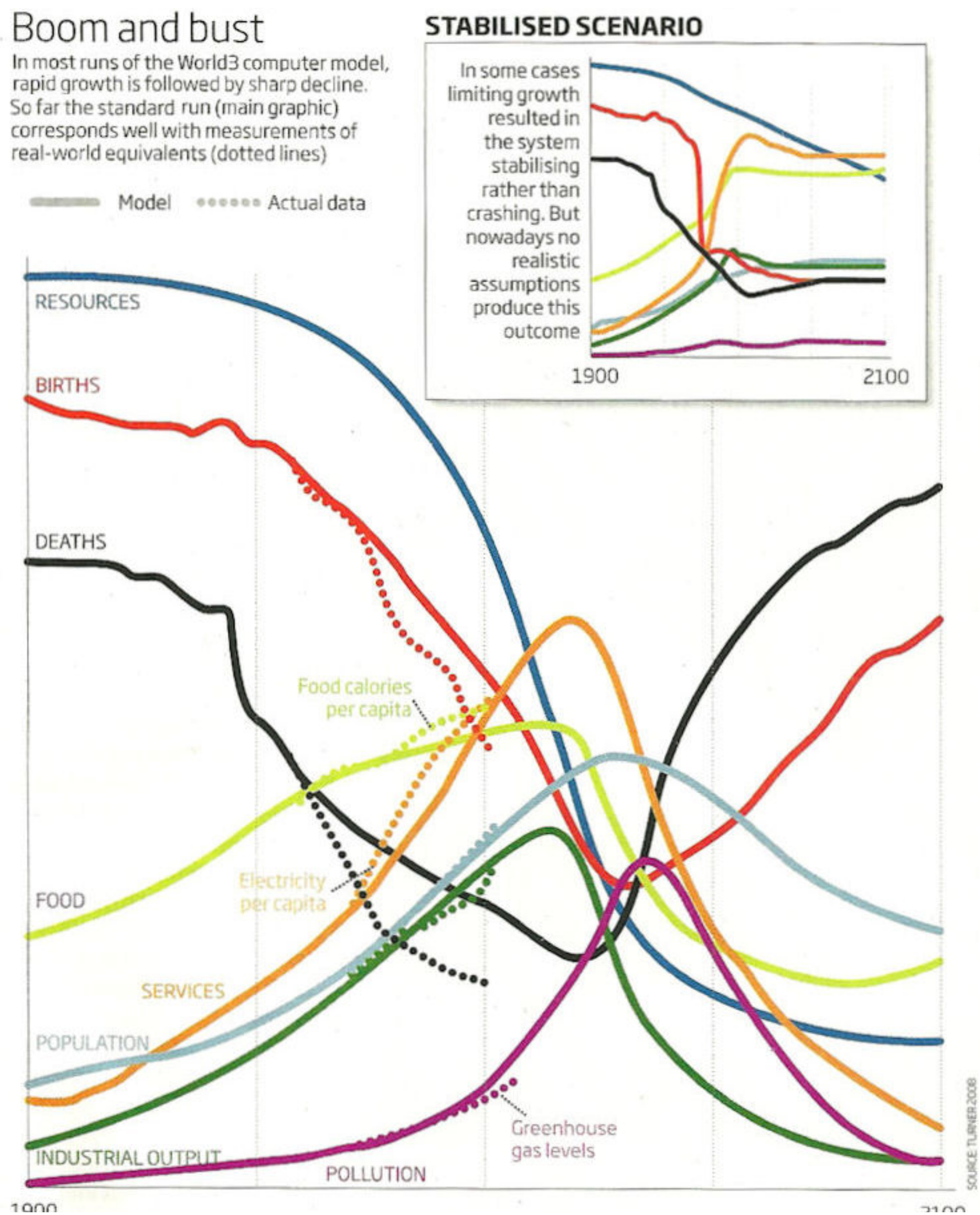

Two modeling cultures: “Social” and “natural” sciences have different ‘cultures’ in the use of mathematics and modeling. When earth system scientists connect to social science there might be a lack understanding which may hinder a productive collaboration.

# My background

- Formal training: Operations Research
- 1991-1998: Researcher on Integrated Assessment Modeling of Climate Change (IMAGE group).
- 1998-2001: Postdoc: Environmental Economics
- 2002-2005: Research Scientist: Political and Behavioral Economics
- 2005-2015: Ass/Assoc Professor @ Department of Anthropology (School of Human Evolution and Social Change), Arizona State University
- 2015-: Professor @ School of Sustainability

# Integrated Modeling

- World 3 model: Limits to Growth report by Dennis Meadows et al.

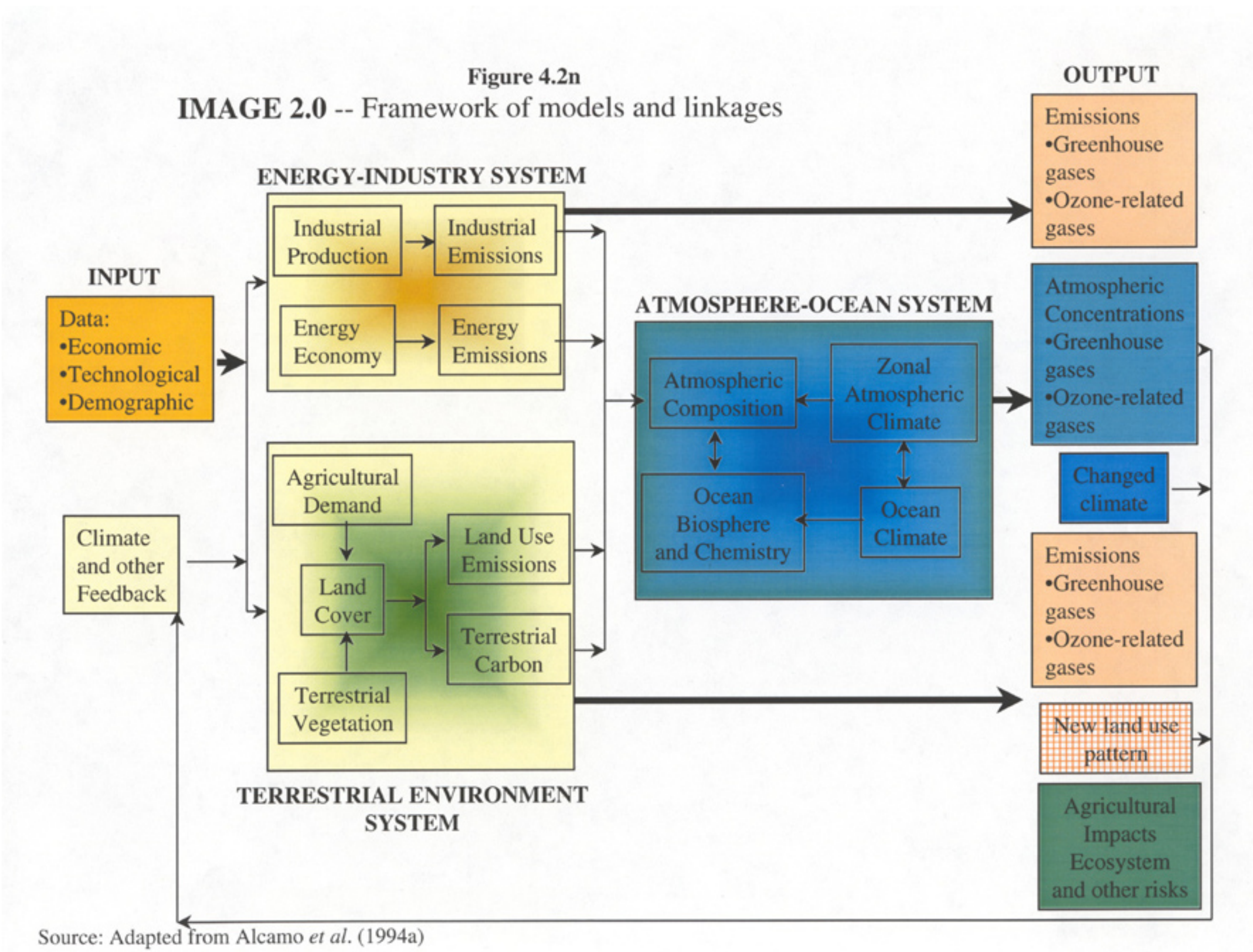


# Critique

- Subjective assumptions driving the results.
- Nordhaus, W.D. (1973), World Dynamics: Measurement without Data, The Economic Journal, 1156- 1183.
- Cole, H.S.D, C. Freeman, M. Jahoda and K.L.R. Pavitt (eds.) (1973), Models of Doom - a critique of The Limits to Growth', Universe Books, New York, USA.

# Integrated Assessment Models

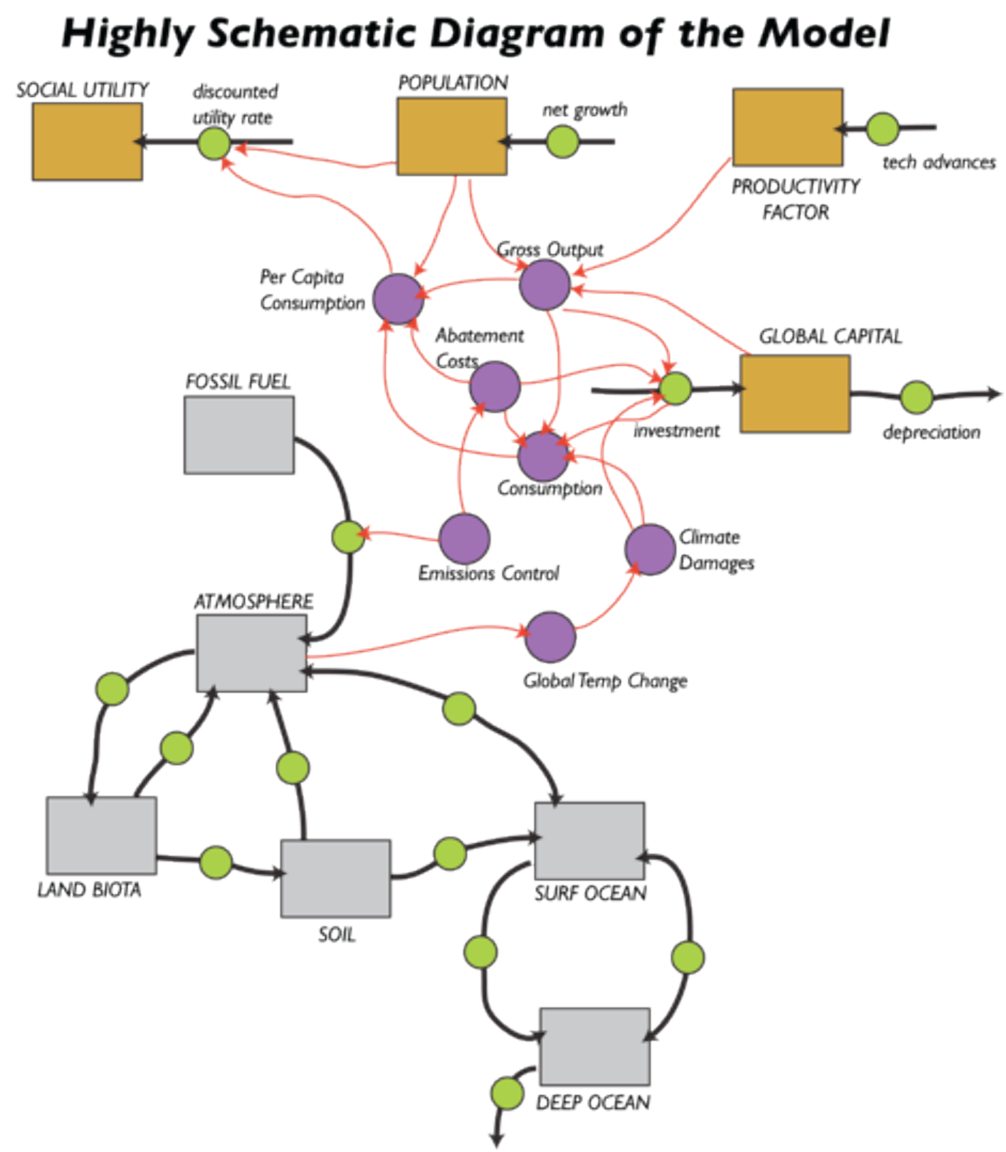
Rotmans, Alcamo et al. Human activities via scenarios



# DICE

Dynamic Integrated Climate-Economy

- Economist Nordhaus.
- Optimization of discounted sum of long term welfare
- Tight feedback between actions and impact.



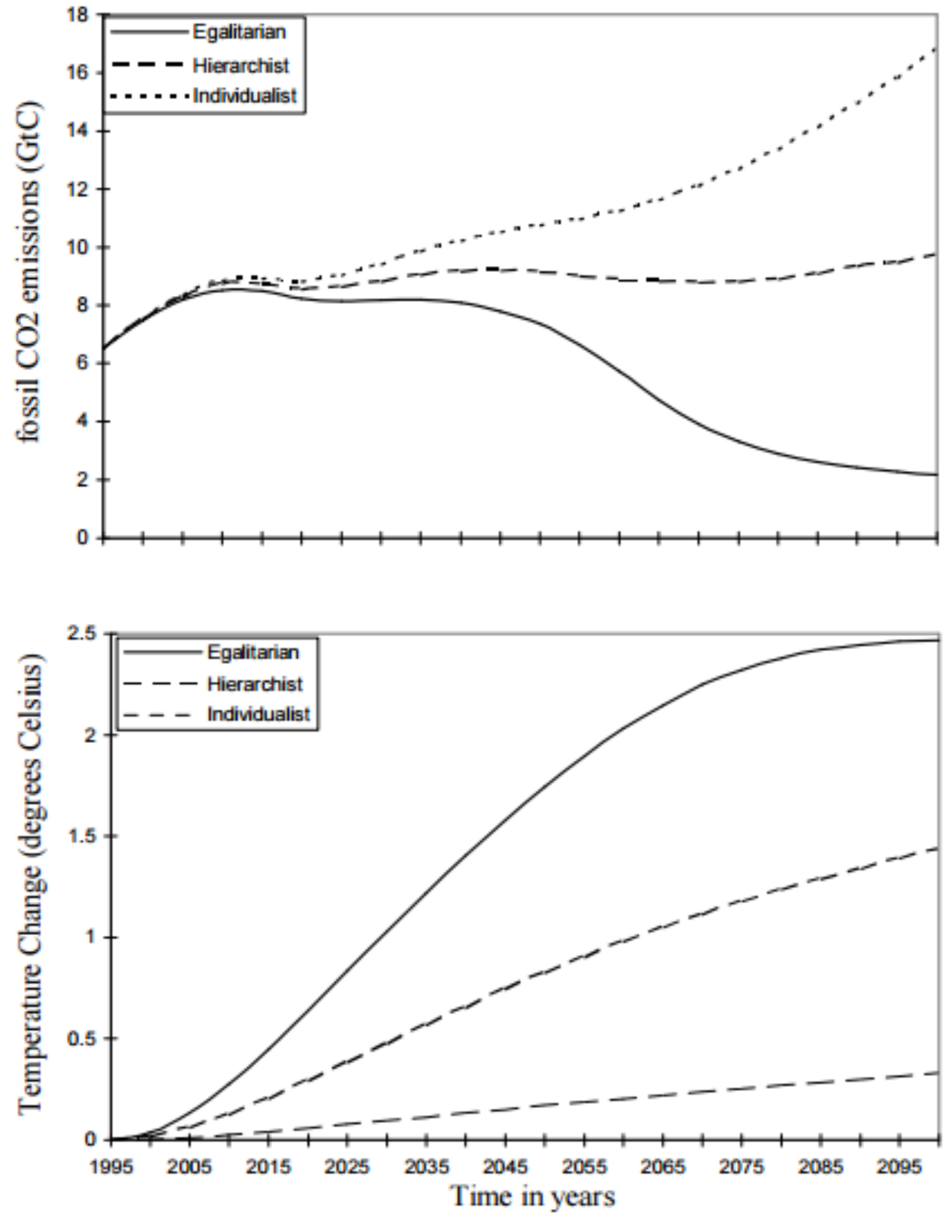
# Two types of IAMs

- Drivers of population, technology and economics, lead to emissions and climate change.
- By simplifying the climate system, calculate optimal response assuming we have control.

- Can we capture both complexity of social and environmental systems?

# Adaptive agents

- Combining economics of DICE and climate system of IMAGE.
- Investment and emission policy driven by learning given that the world functions according to a specific perspective.





Janssen, M.A. and H.J.M. de Vries (1998) The battle of perspectives: a multi-agent model with adaptive responses to climate change, *Ecological Economics* 26(1): 43-65.

# On the human component

# How Did Economists Get It So Wrong?

# Climate Change Policy: What Do the Models Tell Us?†

Robert S. Pindyck*

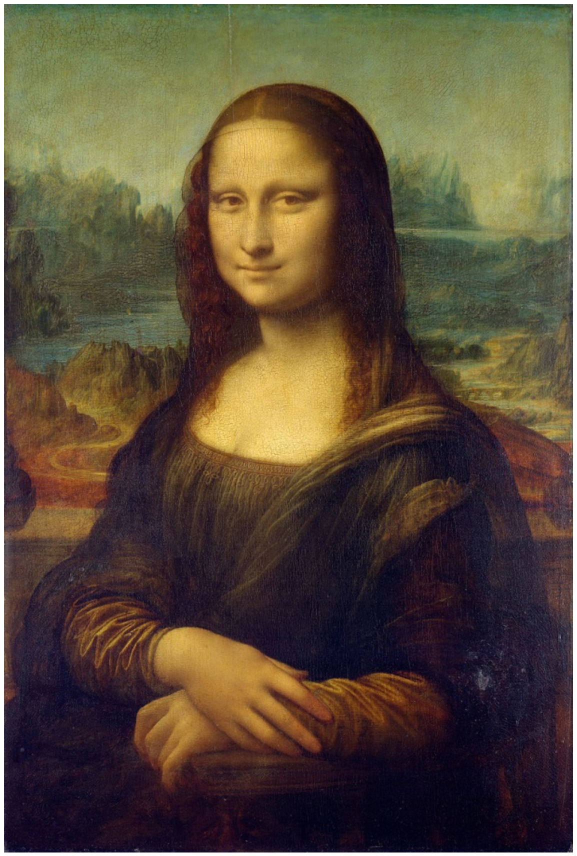
*Very little. A plethora of integrated assessment models (IAMs) have been constructed and used to estimate the social cost of carbon (SCC) and evaluate alternative abatement policies. These models have crucial flaws that make them close to useless as tools for policy analysis: certain inputs (e.g., the discount rate) are arbitrary, but have huge effects on the SCC estimates the models produce; the models' descriptions of the impact of climate change are completely ad hoc, with no theoretical or empirical foundation; and the models can tell us nothing about the most important driver of the SCC, the possibility of a catastrophic climate outcome. IAM-based analyses of climate policy create a perception of knowledge and precision, but that perception is illusory and misleading.* (*JEL* C51, Q54, Q58)

previous two decades, which he attributed in part to improved economic policy making.

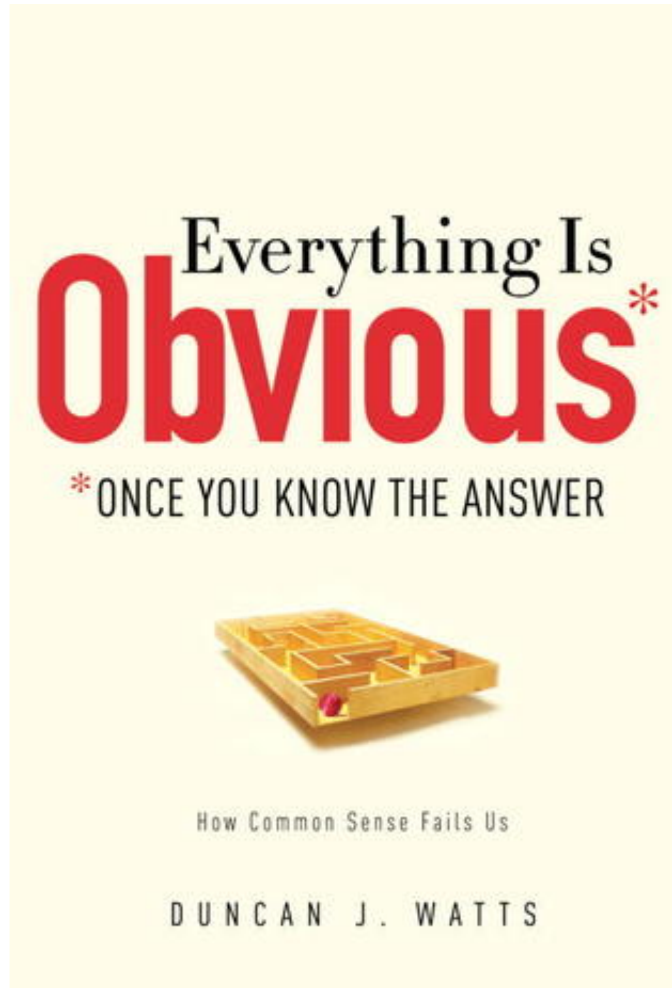
# Beyond mainstream economics

- Behavioral economics, evolutionary economics, new institutional economics, ..
- Psychology (social, neuro, environmental, ..)
- Anthropology (cultural, physical, ..)
- Sociology (political ecology, collective choice, ..)
- History, philosophy, …

# Social science often generate obvious generalities



- Why is the Mona Lisa the most famous painting in the world? Quality or fluke?



# Challenges for modellers

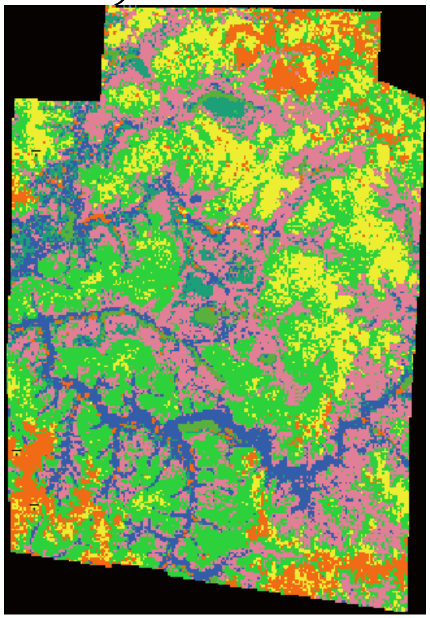
- Many theories. Social scientists like to disagree with each other.
- Theories are often narratives.
- No community effort to test and falsify theories to come to the true theory.
- Importance of context, interpretation and meaning.

# Modeling human systems

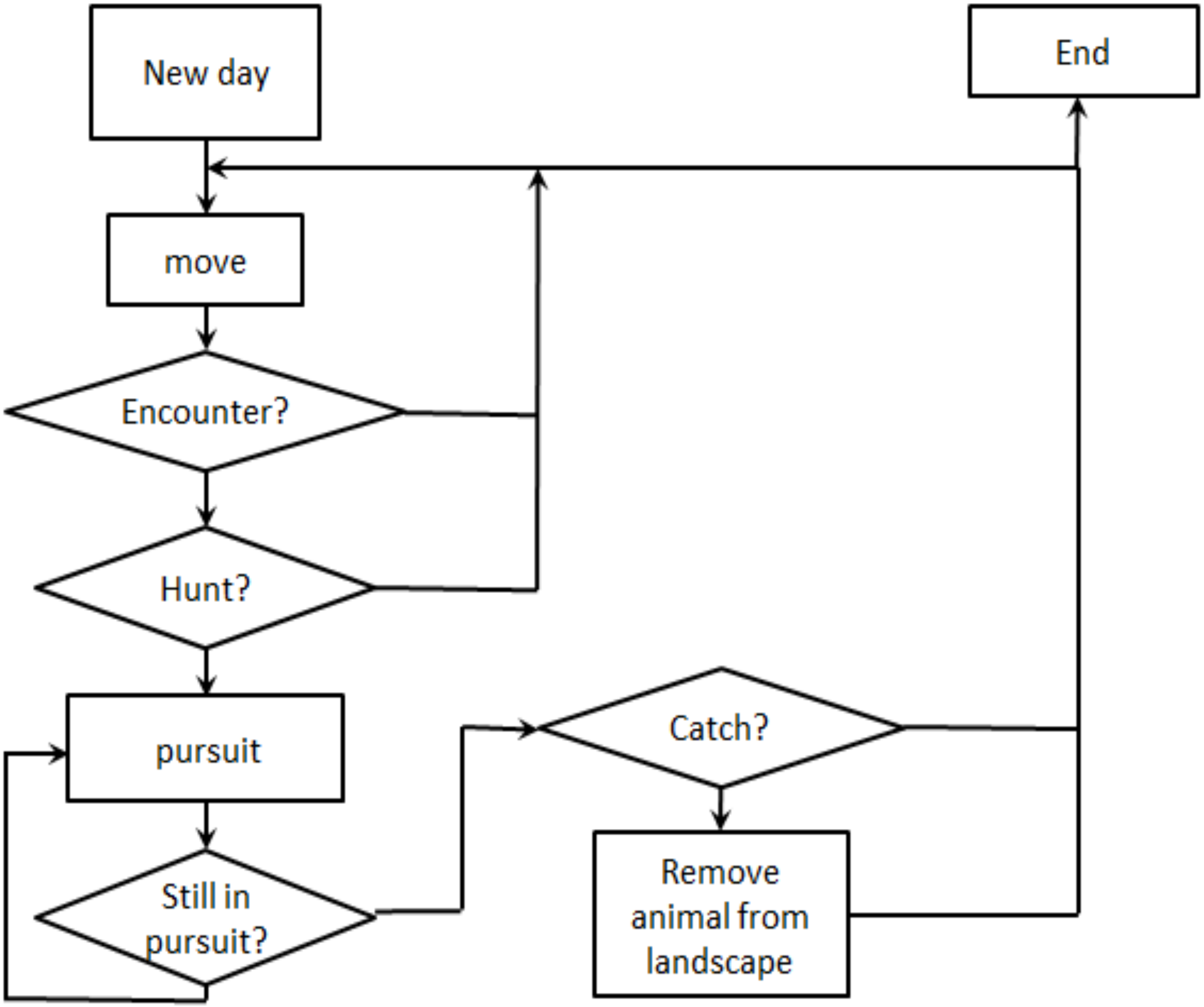
- Take into account the diversity of theories (robustness analysis).
- Modeling is a subjective enterprise (so be transparent).
- Specific questions
- Do modeling projects advance social science?

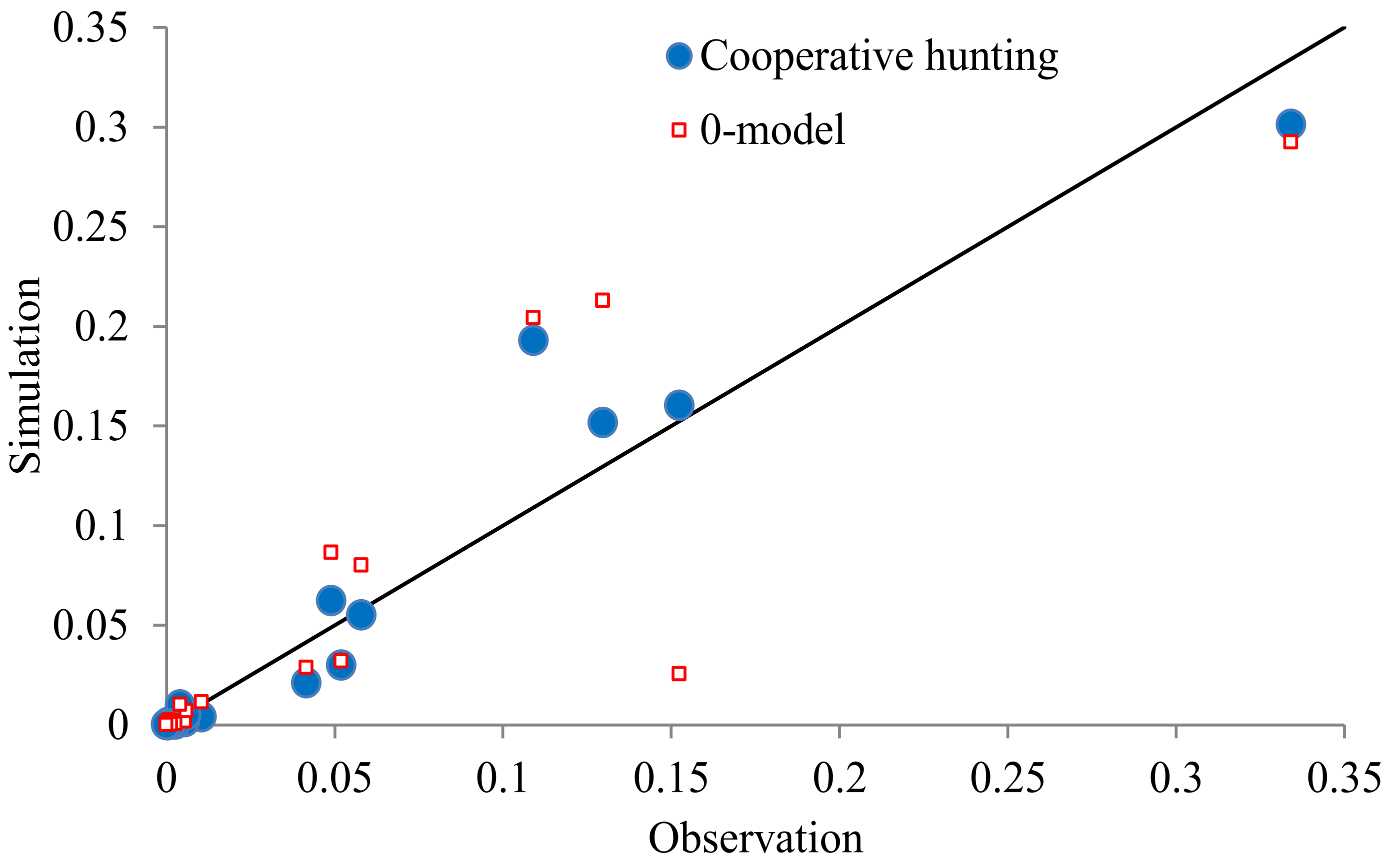
# Hunting of Ache men

- Based on transect data (encounter rates), observations (time spend hunting, success rates, pursuit time) over a 30 year period.
- 30 species, 5 minute resolution on 60,000 hectares.



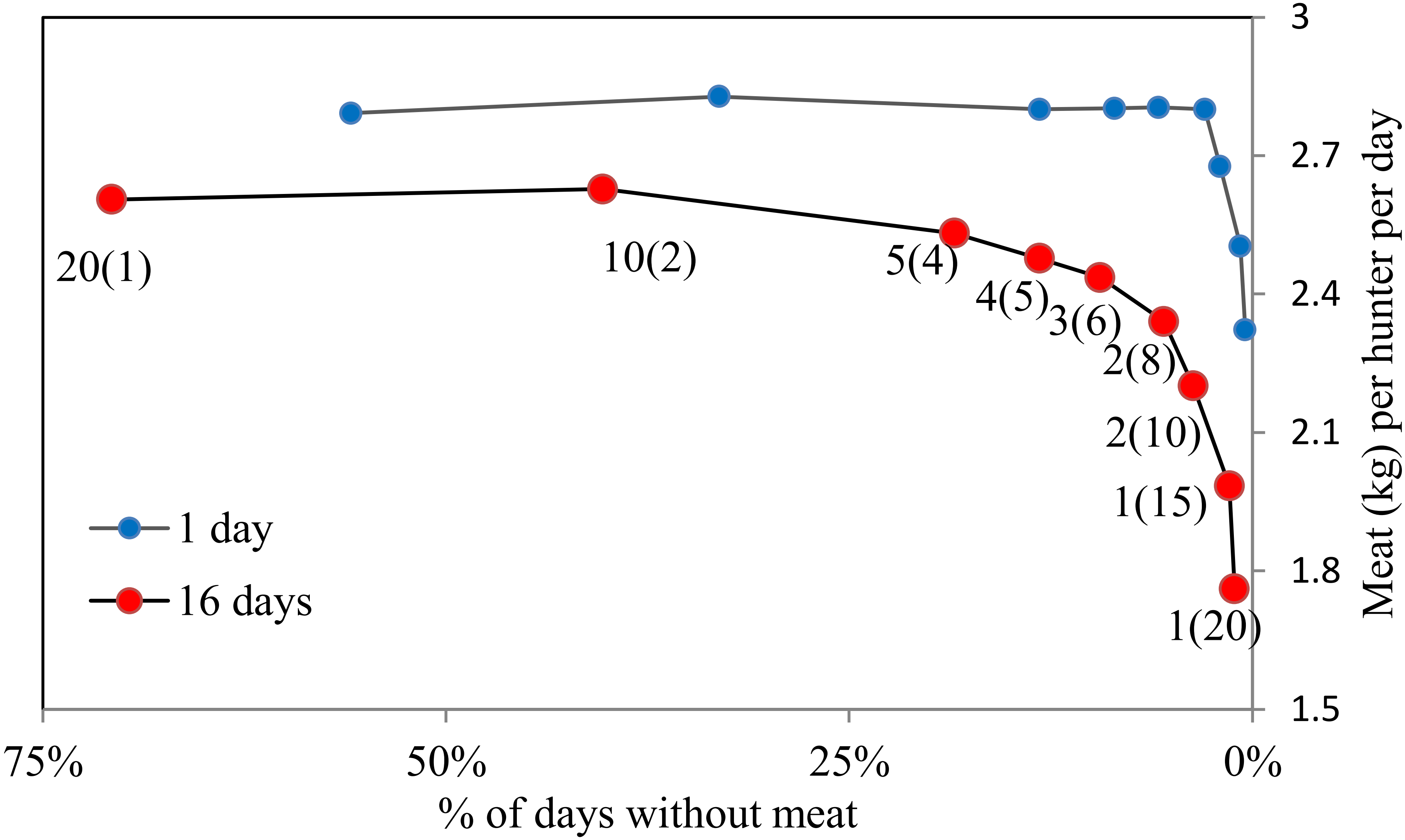
Janssen, M.A. and K. Hill (2014) *Human Ecology* 42(6): 823-835


New day
End
move
Encounter?
Hunt?
pursuit
Catch?
Still in pursuit?
Remove animal from landscape




| Model | Correlation with data |
|---|---|
| 0 model | 0.87 |
| Random movements | 0.88 |
| Random movements with 5 hunters per camp | 0.92 |
| Flocking behavior | 0.93 |
| Flocking behavior with cooperative hunting | 0.97 |

# Tradeoff between amount and frequency



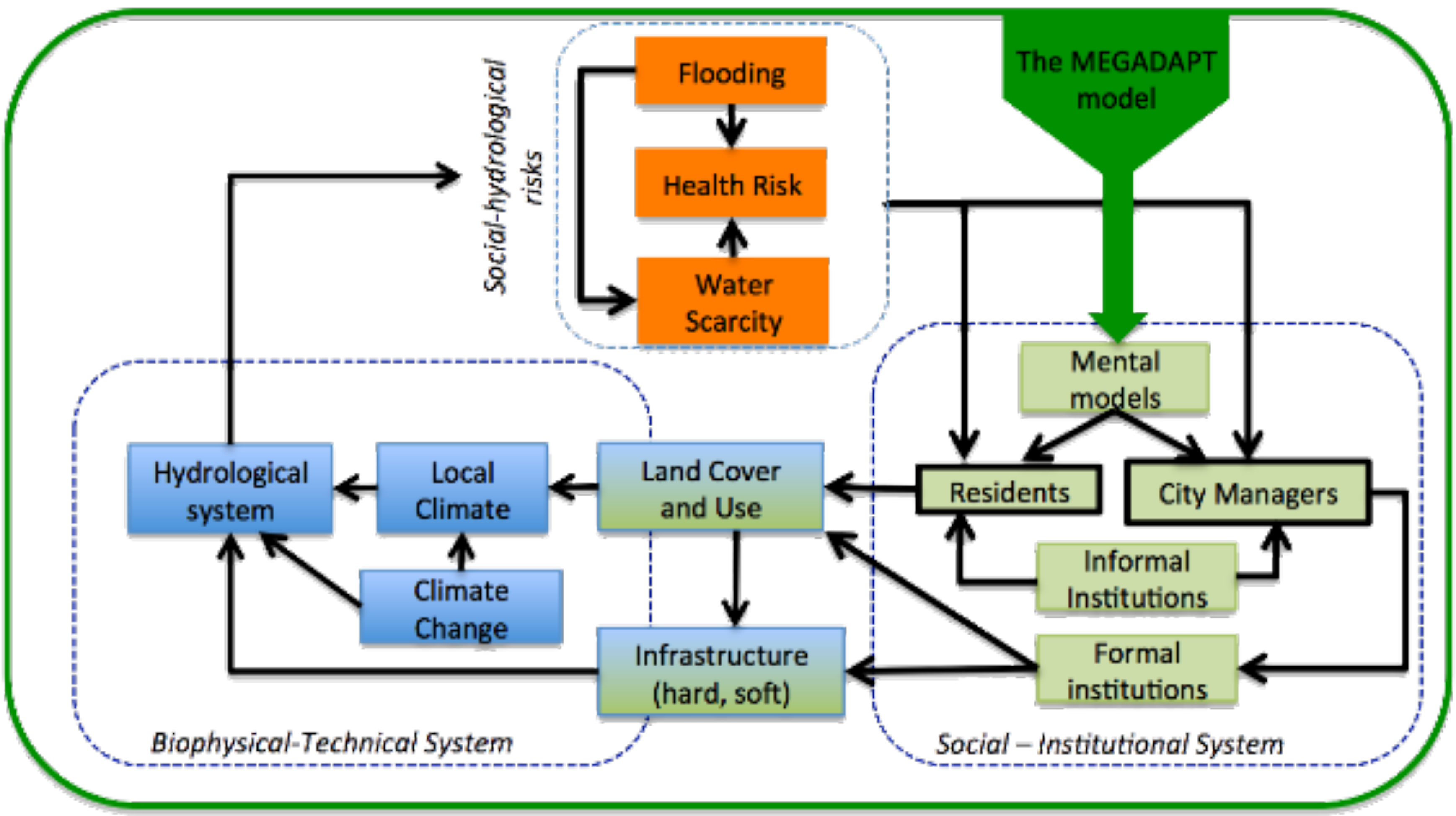
# Conclusions

- We can describe observed behavior and derive better insights of the system.
- Model is used as a starting point for modeling hunter gathering in coastal South Africa 100,000 years ago. Besides hunting, we include material procurement, wood collection, shell fish, and plant gathering.

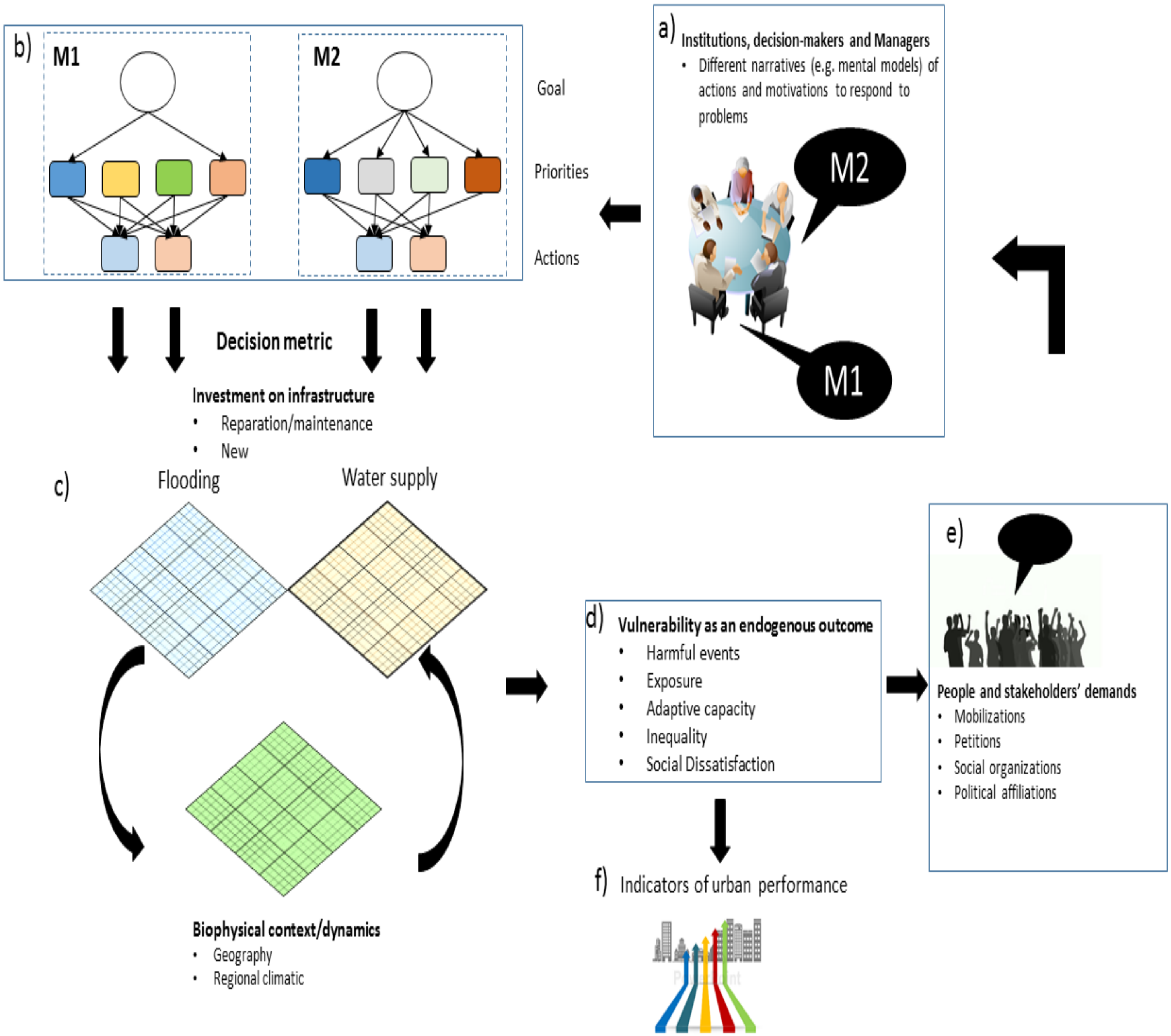
# Flooding and Water scarcity in Mexico City

- Capital of Mexico
- 8 million people (20M when counting the suburbs)
- 6th largest City  in the world (Megacity)
- Highly densif
- High inequali

# Megadapt project



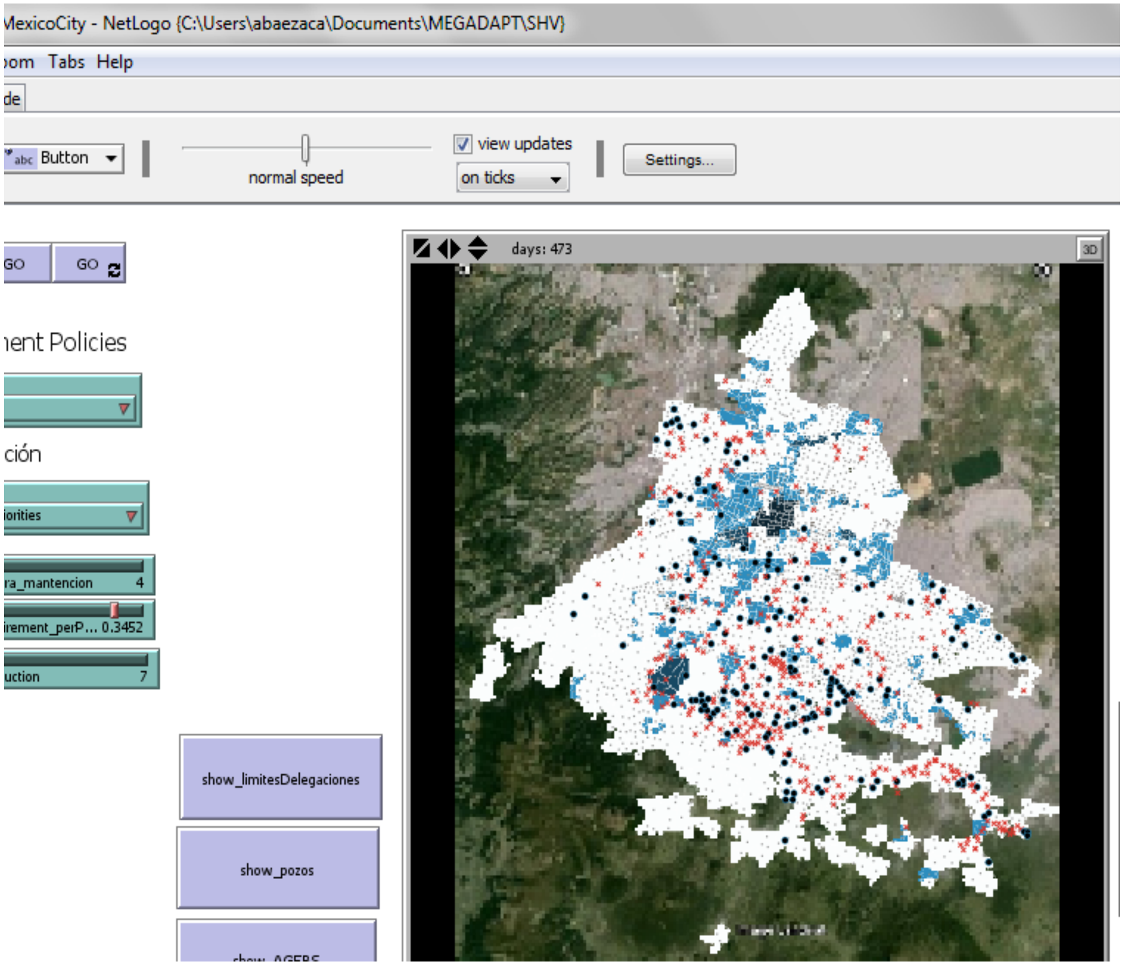

Social-hydrological Risk as an outcome of risk/response interactions in Mexico City.


b)
M1
M2
Goal
Priorities
Actions
a) Institutions, decision-makers and Managers
Different narratives (e.g. mental models) of actions and motivations to respond to problems
M2
M1
Decision metric
Investment on infrastructure
Reparation/maintenance
New
c)
Flooding
Water supply
Biophysical context/dynamics
Geography
Regional climatic
d) Vulnerability as an endogenous outcome
Harmful events
Exposure
Adaptive capacity
Inequality
Social Dissatisfaction
e)
People and stakeholders' demands
Mobilizations
Petitions
Social organizations
Political affiliations
f) Indicators of urban performance

# Example of Water Authority action: Areas for water extraction

Blue areas: Low values to take actions

Red areas: High level of social pressure (mobilizations)



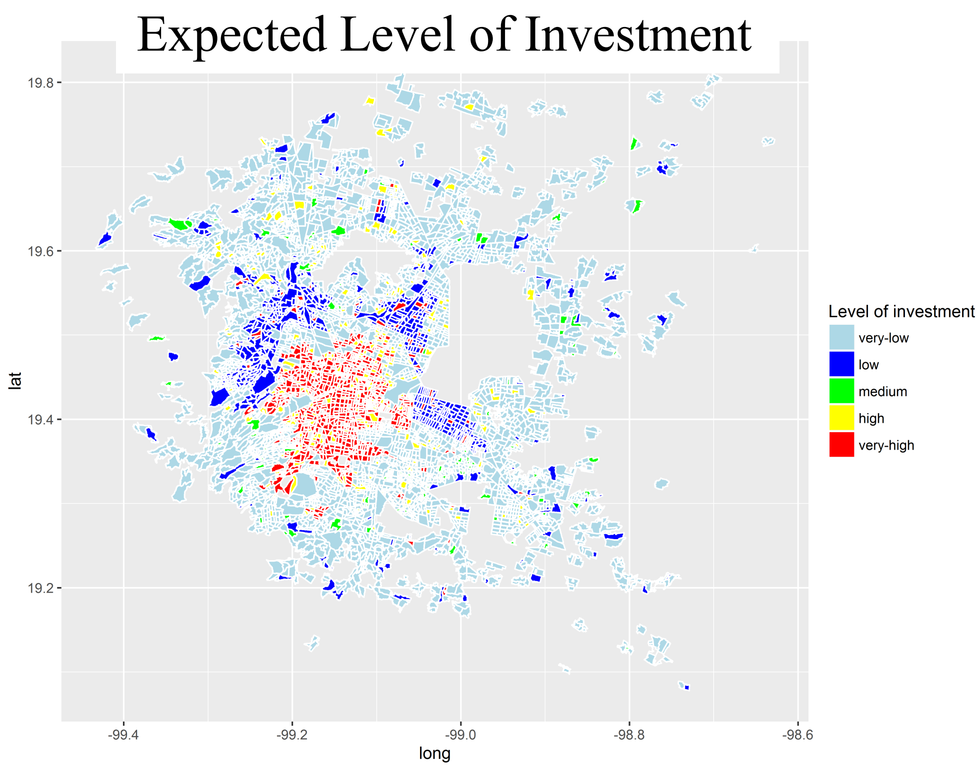

Interactive use with stakeholders.

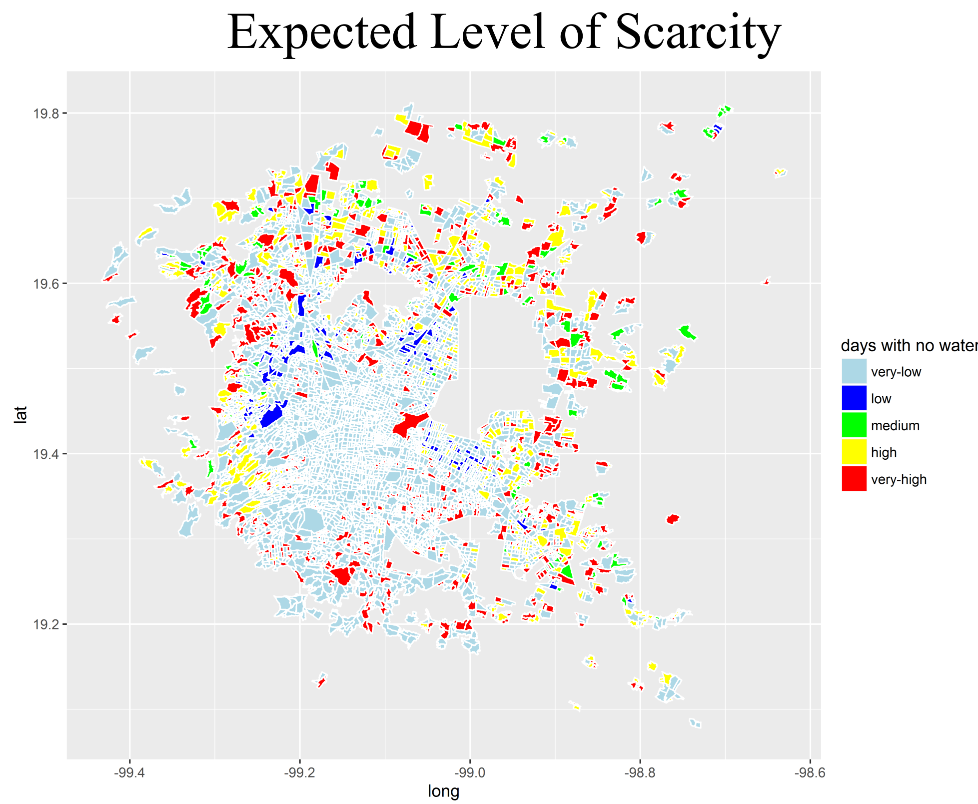
Evaluation of spatial explicit vulnerabilities.

Visualize the long term consequences of certain priorities.

Connect with climate and hydrological models.

# Number of changes made by the water authority in each census block and the level of water scarcity after 20 years



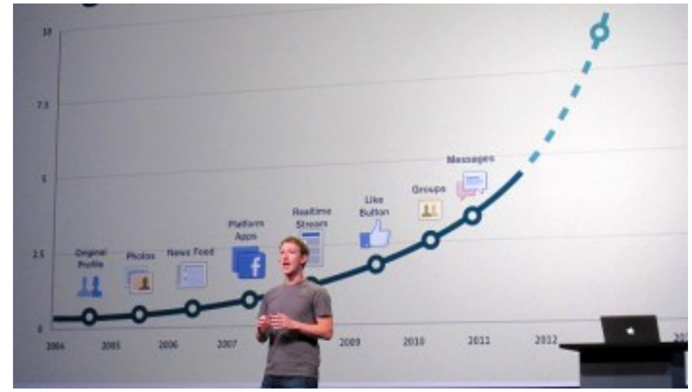



# Discussion

- Much of the social science is qualitative and describe theories in narratives.
- From narratives to algorithmic statements require subjective interpretations.
- Models useful to explore sensitivity to alternative theories and implementations of theories.
- Substantial time investment is needed to bridge the two modeling cultures.

# Appendix

# Big Data



WIRED

<< Back to Article

**Big data and machine learning are powerful to extrapolate behavior from recent clicks.**
**Use for applications in human-environmental interactions unclear.**

of processors. Our ability to capture, warehouse, and understand massive amounts of data is changing science, medicine, business, and technology. As our collection of facts and figures grows, so will the opportunity to find answers to fundamental questions. Because in the era of big data, more isn't just more. More is different.

what choice did we have? Only models, from cosmological equations to theories of human behavior, seemed to be able to consistently, if imperfectly, explain the world around us. Until now. Today companies like Google, which have grown up in an era of massively abundant data, don't have to settle for wrong models. Indeed, they don't have to settle for models at all.

Sixty years ago, digital computers made information readable. Twenty years ago, the Internet made it reachable. Ten years ago, the first search engine

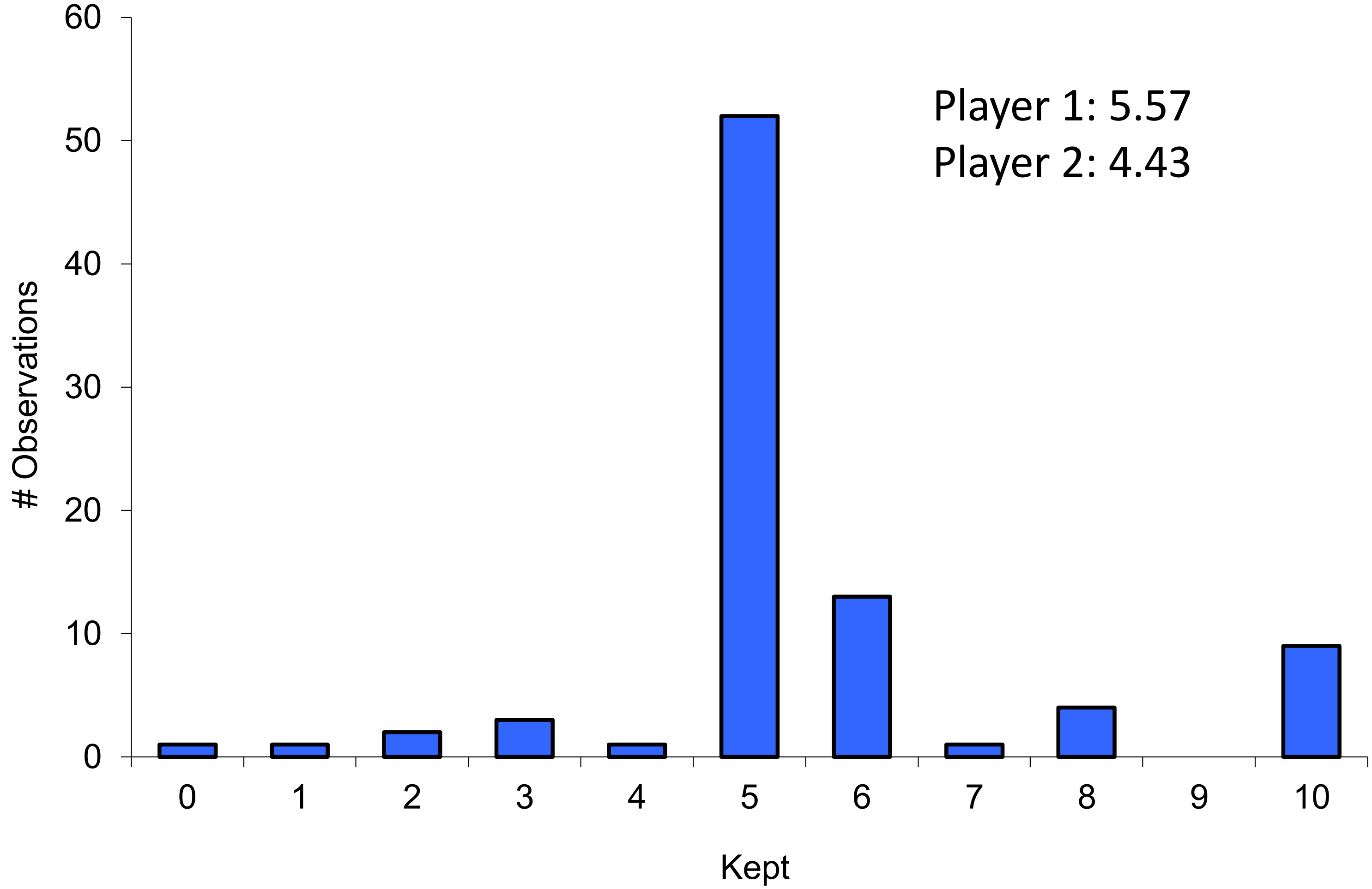
# The rise of experimental approach

- Various types of experiments (lab, online, in field) in diverse disciplines.
- Increasing popularity in economics, psychology, sociology, political science, ..
- Measuring trust, honesty, decision making under risk, altruism,

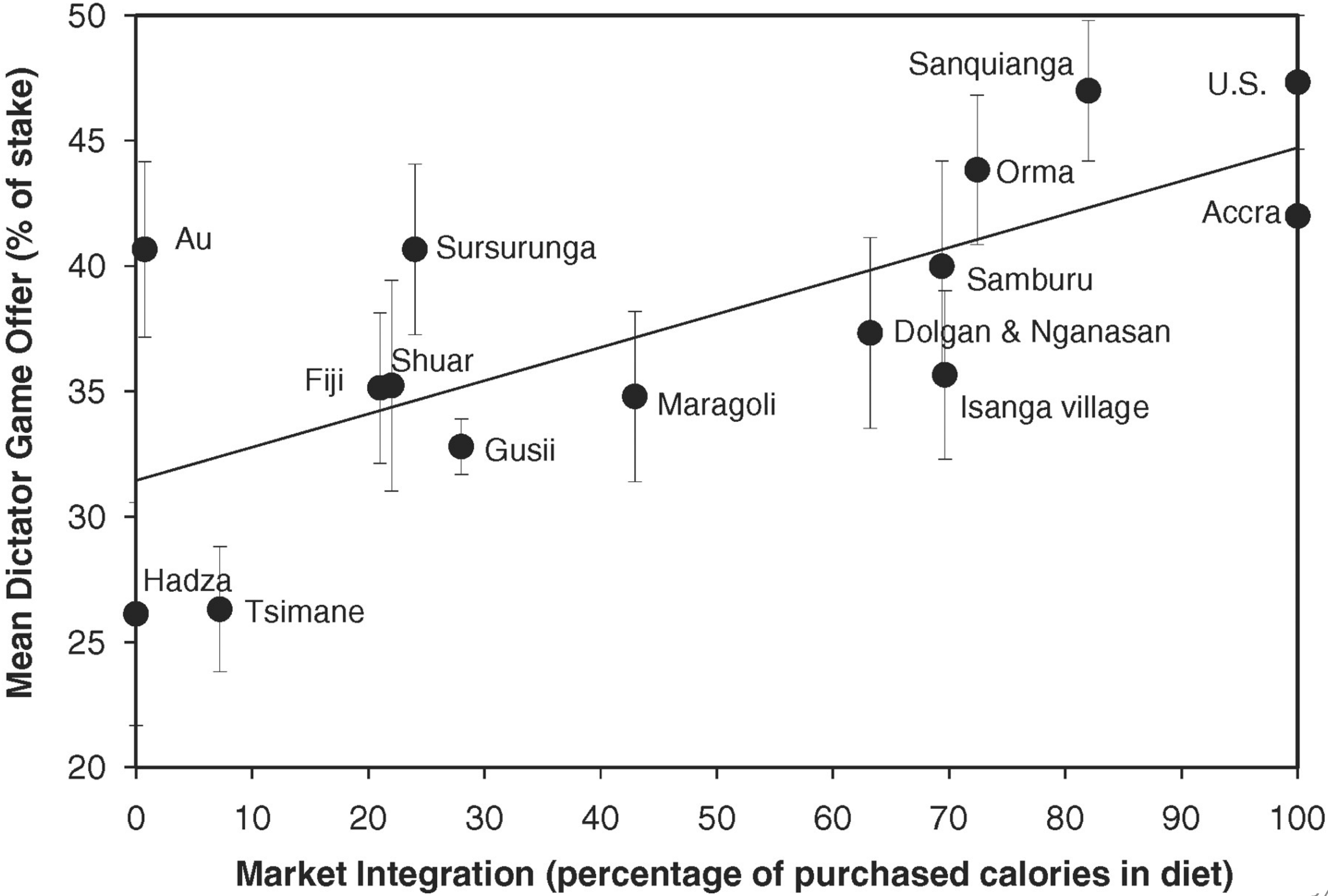
# Example: Dictator game

- Two individuals A & B. They do not know each identity and cannot communicate. They may never know they were matched with each other.
- A gets 10 dollars and can give a share to person B. B cannot make a decision. What will person A do?

# Dictator game



# Markets stimulate fairness?




Henrich et al. (2010) Science

BEHAVIORAL AND BRAIN SCIENCES (2010) **33**, 61–135
doi:10.1017/S0140525X0999152X

# The weirdest people in the world?

**Joseph Henrich**
*Department of Psychology and Department of Economics, University of British Columbia, Vancouver V6T 1Z4, Canada*
**joseph.henrich@gmail.com**
**http://www.psych.ubc.ca/~henrich/home.html**

**Steven J. Heine**
*Department of Psychology, University of British Columbia, Vancouver V6T 1Z4, Canada*
**heine@psych.ubc.ca**

**Ara Norenzayan**
*Department of Psychology, University of British Columbia, Vancouver V6T 1Z4, Canada*
**ara@psych.ubc.ca**

**Abstract:** Behavioral scientists routinely publish broad claims about human psychology and behavior in the world's top journals based on samples drawn entirely from Western, Educated, Industrialized, Rich, and Democratic (WEIRD) societies. Researchers – often implicitly – assume that either there is little variation across human populations, or that these "standard subjects" are as representative of the species as any other population. Are these assumptions justified? Here, our review of the comparative database from across the behavioral sciences suggests both that there is substantial variability in experimental results across populations and that WEIRD subjects are particularly unusual compared with the rest of the species – frequent outliers. The domains reviewed include visual perception, fairness, cooperation, spatial reasoning, categorization and inferential induction, moral reasoning, reasoning styles, self-concepts and related motivations, and the heritability of IQ. The findings suggest that members of WEIRD societies, including young children, are among the least representative populations one could find for generalizing about humans. Many of these findings involve domains that are associated with fundamental aspects of psychology, motivation, and behavior – hence, there are no obvious *a priori* grounds for claiming that a particular behavioral phenomenon is universal based on sampling from a single subpopulation. Overall, these empirical patterns suggests that we need to be less cavalier in addressing questions of *human* nature on the basis of data drawn from this particularly thin, and rather unusual, slice of humanity. We close by proposing ways to structurally re-organize the behavioral sciences to best tackle these challenges.

# Conditional cooperation and confusion in public-goods experiments

Maxwell N. Burton-Chellew[a,b,c], Claire El Mouden[a,c], and Stuart A. West[a,b,1]

[a]Department of Zoology, University of Oxford, Oxford OX1 3PS, United Kingdom; [b]Calleva Research Centre for Evolution
College, Oxford OX1 4AU, United Kingdom; and [c]Sociology Group, Nuffield College, Oxford OX1 1NF, United Kingdom

Edited by Raghavendra Gadagkar, Indian Institute of Science, Bangalore, India, and approved December 9, 2015 (receivec

**Economic experiments are often used to study if humans altruistically value the welfare of others. A canonical result from public-good games is that humans vary in how they value the welfare of others, dividing into fair-minded conditional cooperators, who match the cooperation of others, and selfish noncooperators. However, an alternative explanation for the data are that individuals vary in their understanding of how to maximize income, with misunderstanding leading to the appearance of cooperation. We show that (*i*) individuals divide into the same behavioral types when playing with computers, whom they cannot be concerned with the welfare of; (*ii*) behavior across games with computers and humans is correlated and can be explained by variation in understanding of how to maximize income; (*iii*) misunderstanding correlates with higher levels of cooperation; and (*iv*) standard control questions do not guarantee understanding. These results cast doubt on certain experimental methods and demonstrate that a common assumption in behavioral economics experiments, that choices reveal motivations, will not necessarily hold.**

altruism | strategy method | inequity aversion | reciprocity | social preferences

possible explanations for the variation in the extent to which individuals unde individuals might cooperate or cooper takenly think this will make them m reasons why individuals might misun responses to suggestive cues in the exp superficially reminding them of everyda is favored (27–31).

If the variation in levels of coopera mainly due to variation in understandi into behavioral types would be an arti ments are conducted, rather than any preferences. Consequently, any resea based on the division would be based importance of these alterative explar behavior is controversial; whereas son players are responsible for around 50% in public-goods games (32, 33), other players only make up 6–10% of the p tested between two competing expla preferences or differences in understa

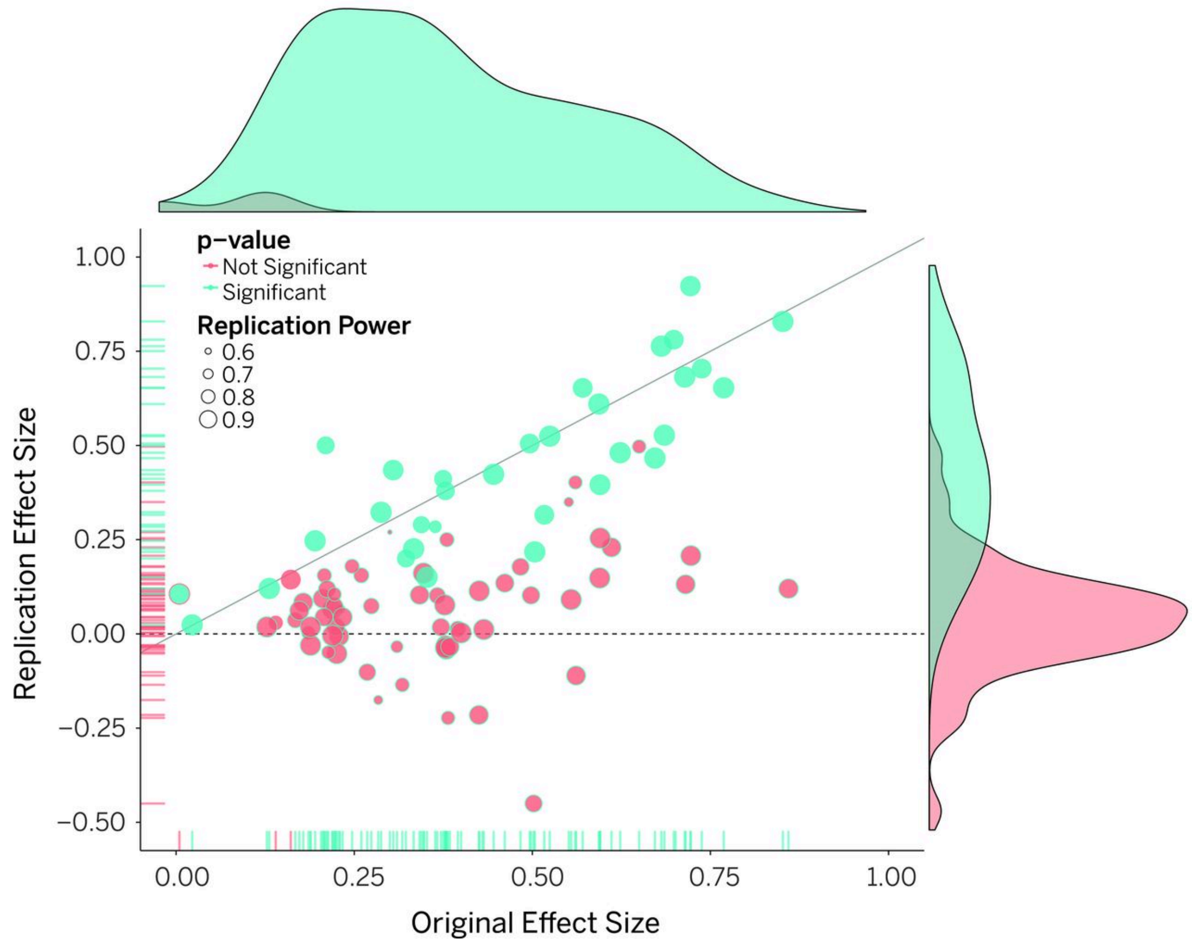
RESEARCH ARTICLE SUMMARY

PSYCHOLOGY

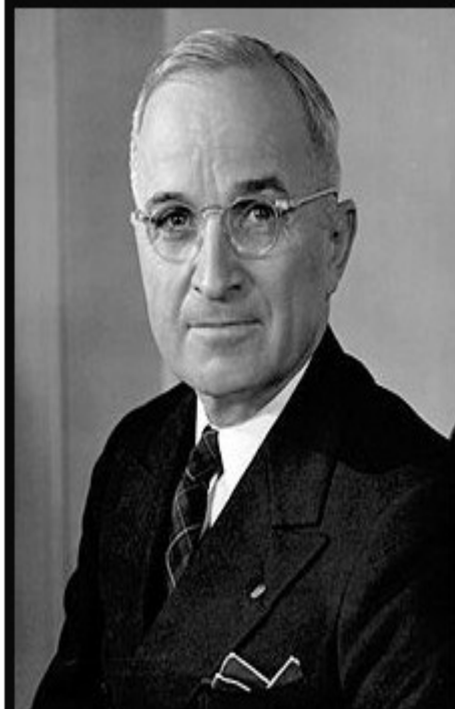
# Estimating the reproducibility of psychological science

Open Science Collaboration*

**Original study effect size versus replication effect size (correlation coefficients).**




**Open Science Collaboration Science 2015;349:aac4716**



Give me a one-handed economist! All my economists say, On the one hand on the other.

(Harry S. Truman)

# Ecosystem of models

## IIASA Integrated Assessment Framework