

Equations of Power: Models, Authority, and the Politics of Knowledge

Andrea Saltelli

Responsible Modelling RMU2, Exeter, and seminar of the
Society for the Social Studies of Quantification (SSSQ),
Centre Maurice Halbwachs, September 23, 2026

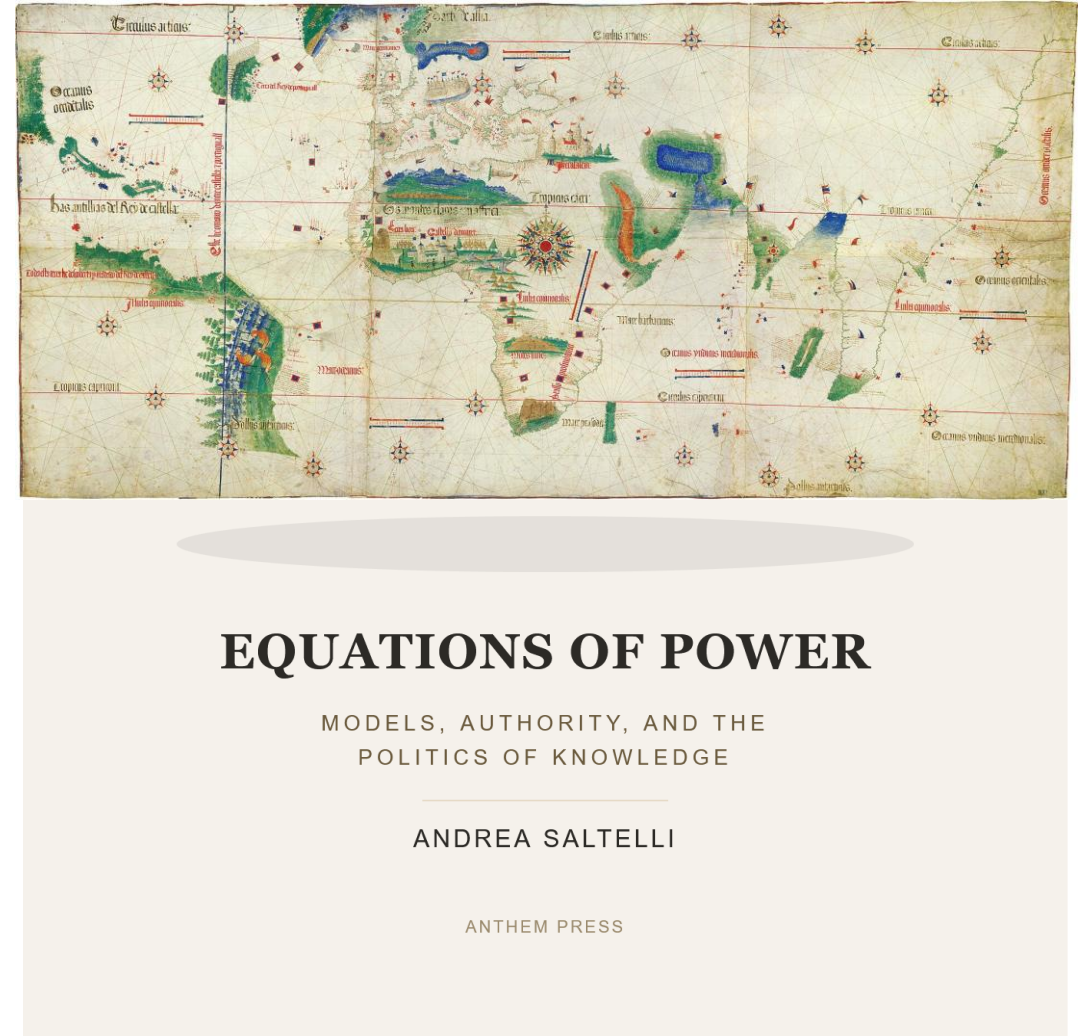
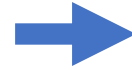


RMU₂

*Society
for the Social
Studies
of Quantification*



2023



2027



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Love Canal, Niagara Falls,
1978. A school built on 22,000
tons of buried chemical waste.
An embattled mother



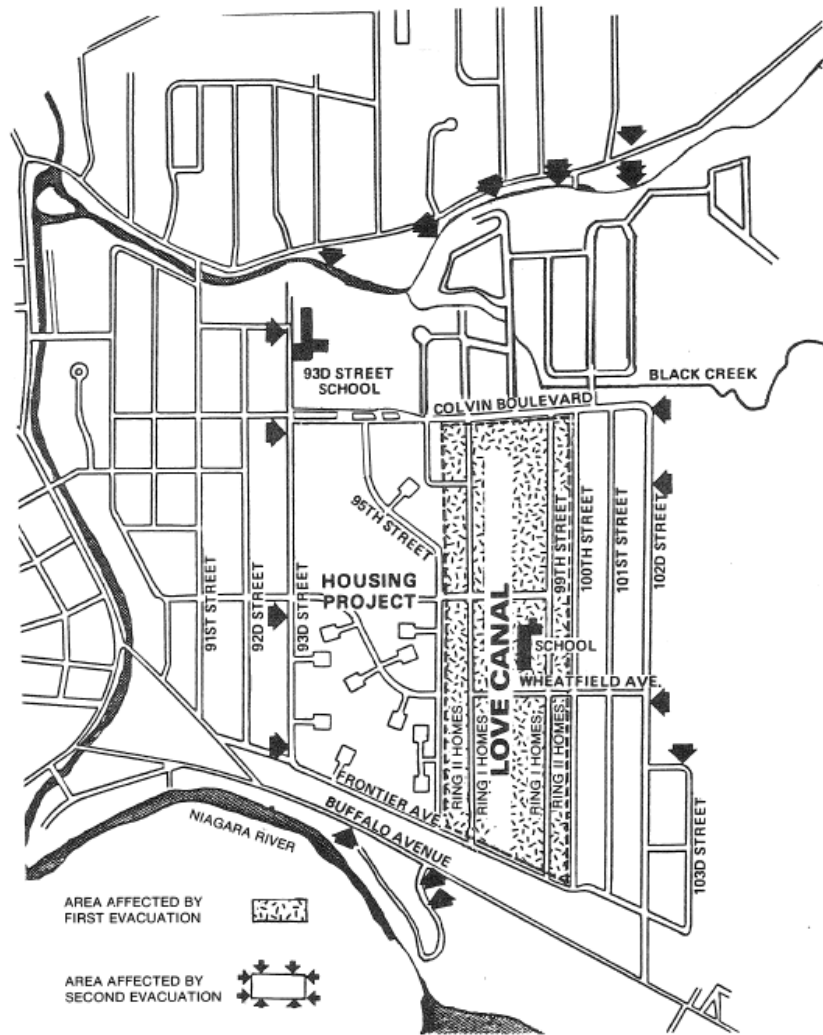
Photo Ric Delaney / Buffalo Courier-Express Collection, SUNY Buffalo State

LOVE CANAL

MY STORY

LOIS MARIE GIBBS

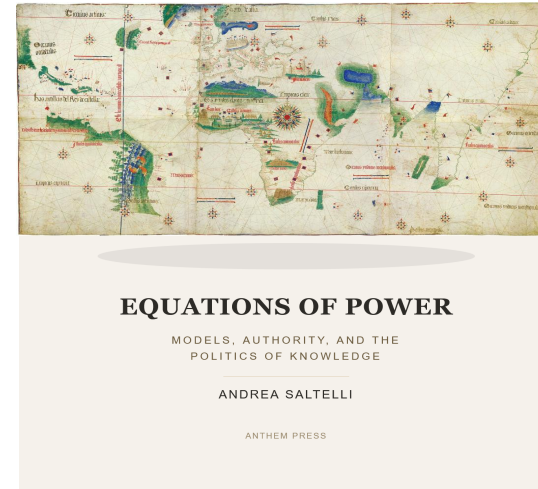
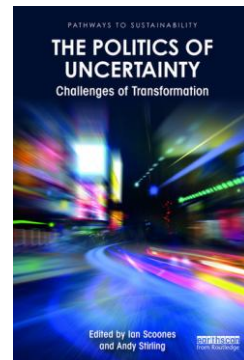
as told to
Murray Levine



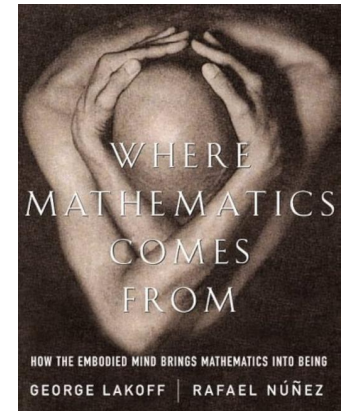
The model had not been defeated by a better model, but by a woman who knew where the trenches were

Ch. 1 Introduction: From invisible science to invisible models

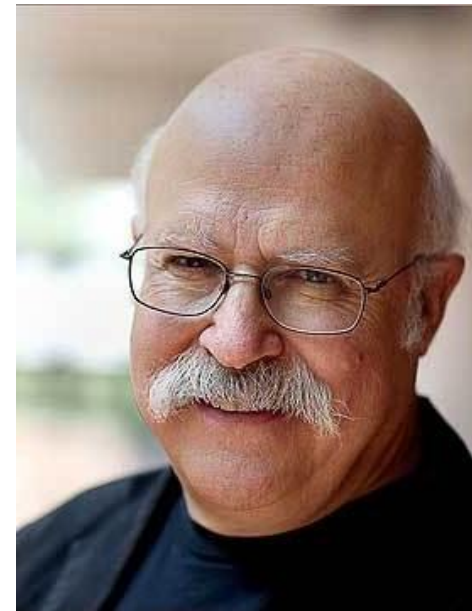
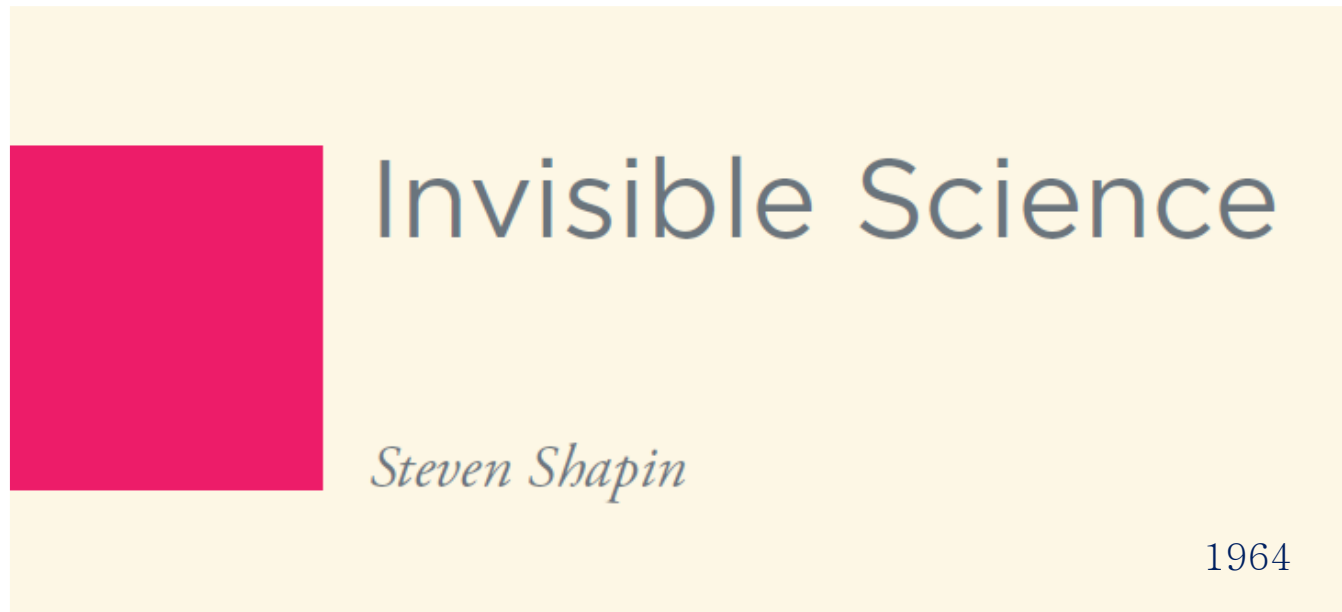
- Prologue
- Look around you
- Pentecostal computers
- An assault on the future?
- Creating worlds



- No appeal
- A broad canvas, with bias
- Proteiform, essential
- Enchanted mathematics
- Why this book



Living inside models the way we live inside science,
so thoroughly we no longer see them



No appeal

- Models as ‘accountability sinks’ (Dan Davies)
- A fully documented model can be entirely unappealable



Official Journal
of the European Union

EN

L series

2024/1689

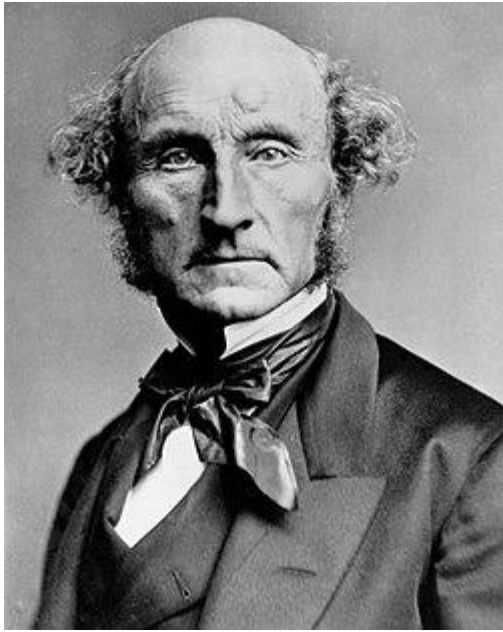
12.7.2024

REGULATION (EU) 2024/1689 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 13 June 2024

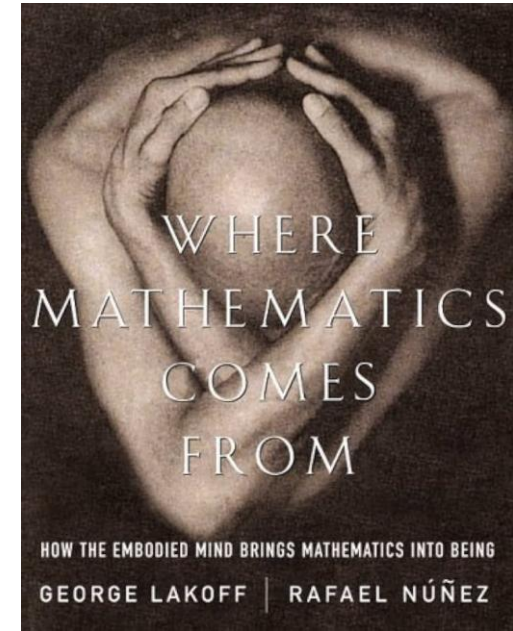
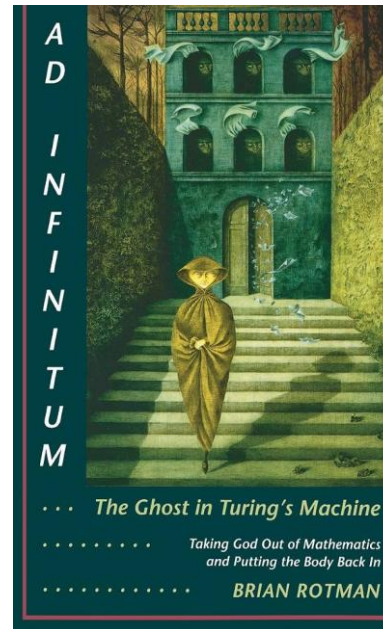
laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act)

Enchanted Math



From John Stuart Mill
(1806–1873) pebbles
disparaged by Friedrich
Ludwig Gottlob Frege
(1848–1925) ...

All this is a minority view
against prevalent ‘rampant
Platonism’

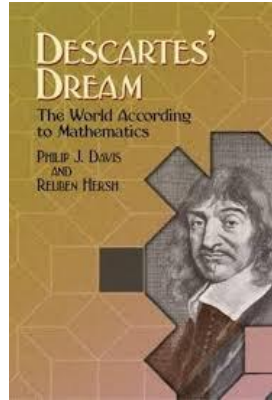
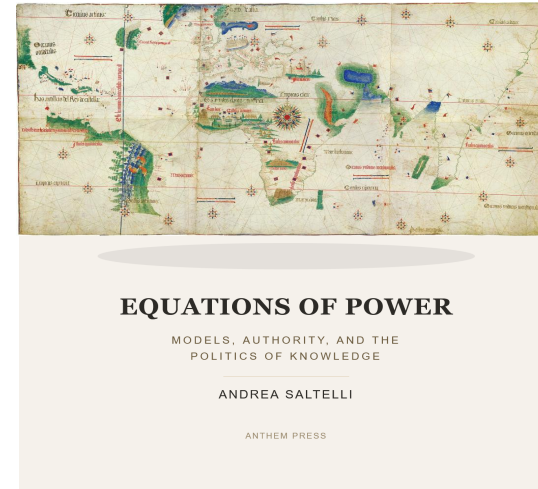


2000

... to the ‘bodily’ mathematics
of cognitive psychologists

*Taking God Out of Mathematics
and Putting the Body Back In*

Ch.2 What is a model



- The world inside the model
- Models as mediators
- Models as new cultural forms
- Models as esoteric
- Who speaks for the model?

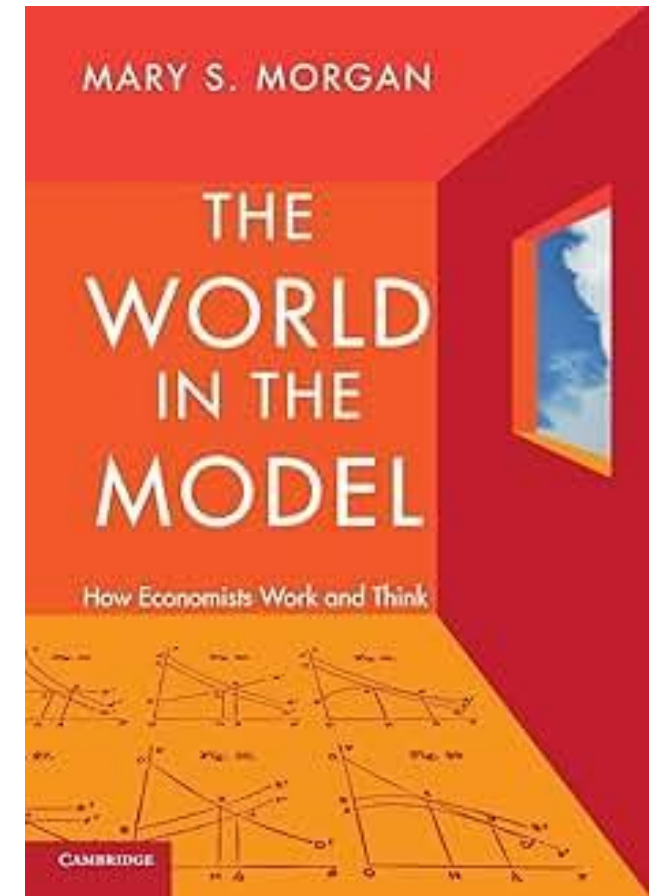
- Models as Cartesian Dreams
- Models as metaphors
- Models from data, models from other models
- Models as science itself
- Wrapping up

~~What is a model?~~

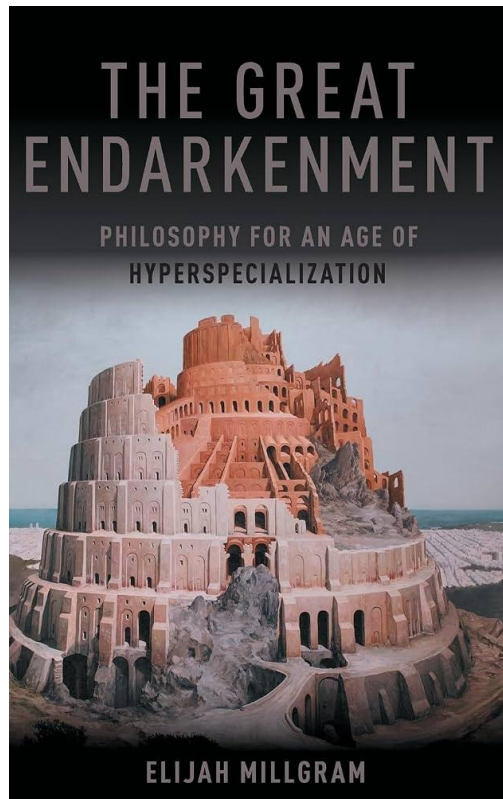
What can be done with a model?

What do we learn from

- David Ricardo's 'Model farm',
- The hydraulic model of the economy by Walter Newlyn and Bill Phillips,
- The Edgeworth graphic box-model of trade;
- The prisoner's dilemma
- ...



Models as esoteric — the new Latin; even the people who built the model no longer remember what went into it. Opacity as structure



Home → International Journal of Foresight and Innovation Policy → Vol. 9, No. 2-3-4

🔒 NO ACCESS

What do I make of your **latinorum**? Sensitivity auditing of mathematical modelling

Andrea Saltelli ✉, Ângela Guimarães Pereira, Jeroen P. Van der Sluijs and Silvio Funtowicz

Published Online: January 13, 2014 · pp 213-234 · <https://doi.org/10.1504/IJFIP.2013.058610>

Implications of speaking in Latin

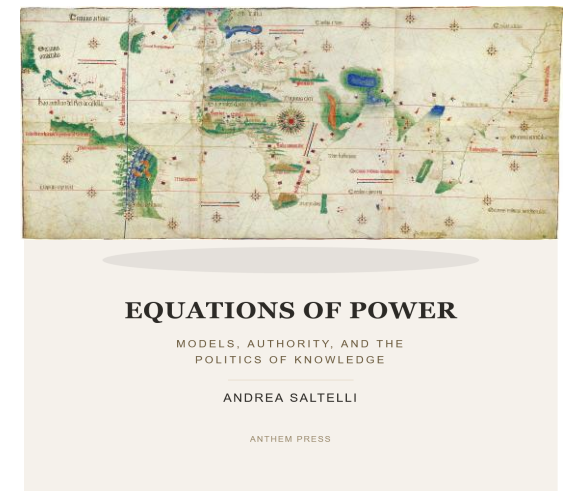
Opacity vs opportunity; rituals and liturgy

Eric B. Winsberg's representational
overextension in climate models (2026)



Winsberg on Moral Models
https://www.youtube.com/watch?v=_cgCTK17ics.

Ch. 3 Using models



- Models and justice
- Narratives and counter-narratives
- The model is the message
- State of exception
- Models and participation
- Models and rituals
- Is science a social activity?
- Models in system and policy analysis
- Models that travel
- Reductionism, solutionism and other 'isms'
- Science's governance, polycrises and the politics of modelling
- What do citizens need to know
- Wrapping up

What is a model? A philosopher's take

STRUCTURE

Three possibilities:

1. concrete,
2. mathematical,
3. computational

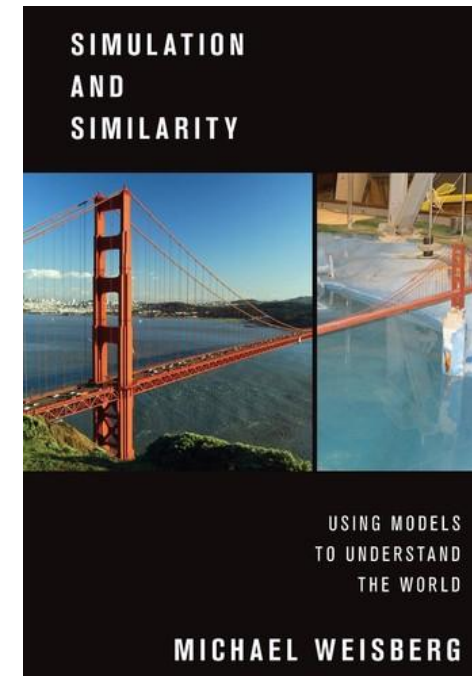
—MODEL DESCRIPTION—



THE WORLD
(target system)

CONSTRUAL

1. assignment,
2. scope,
3. dynamical fidelity,
4. representational fidelity



A philosopher's take

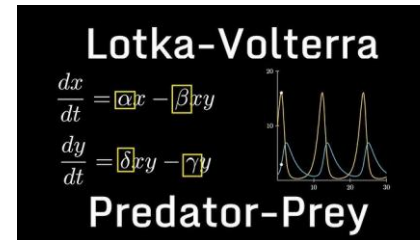
STRUCTURE

Three possibilities:

1. Concrete, physical scale model of San Francisco Bay



2. Mathematical, Lotka-Volterra



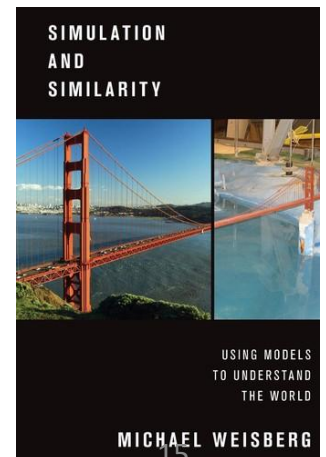
3. Computational, Schelling's segregation model



Dissatisfied because
only 1/4 (25%) of
neighbors are X

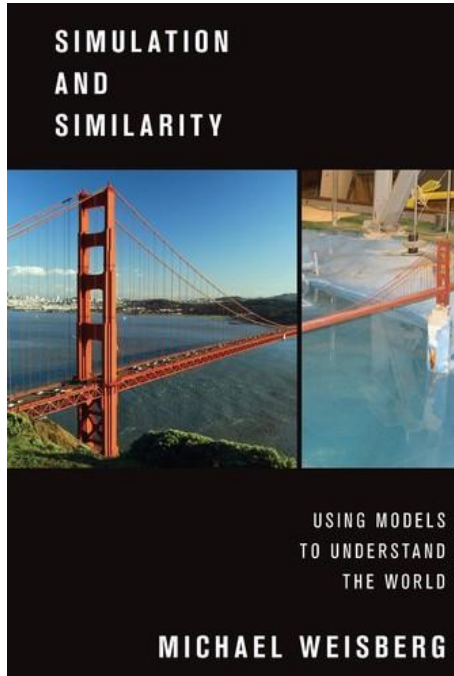
X	X	O	X	O
X	O	O	O	O
X	X			
X	O	X	X	X
X	O	O		O

Source: <http://nifty.stanford.edu/2014/mccown-schelling-model-segregation/>



A philosopher's take

CONSTRUAL



x = Adriatic sardine population

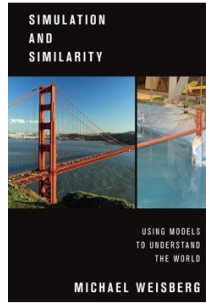
Small pelagic species under moderate exploitation regimes

Does it predict well?

Does it predict well for the right reasons?

- ← 1. assignment,
- ← 2. scope,
- ← 3. dynamical fidelity,
- ← 4. representational fidelity

A philosopher's take



CONSTRUAL

- x = Adriatic sardine population ← 1. assignment,
- Small pelagic species under moderate exploitation regimes ← 2. scope,
- Does it predict well? ← 3. dynamical fidelity,
- Does it predict well for the right reason? ← 4. representational fidelity

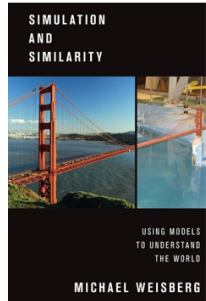
What the construal
does not include: a
model's telos



A model commissioned by a large
fishing company will differ from
one produced by a local fishers'
organisation



A philosopher's take



CONSTRUAL

- x = Adriatic sardine population ← 1. assignment,
- Small pelagic species under moderate exploitation regimes ← 2. scope,
- Does it predict well? ← 3. dynamical fidelity,
- Does it predict well for the right reason? ← 4. representational fidelity

What the construal does not include: a model's telos

Dissatisfied because only 1/4 (25%) of neighbors are X

X	X	O	X	O
	O	O	O	O
X	X			
X	O	X	X	X
X	O	O		O

Source: <http://nifty.stanford.edu/2014/mccown-schelling-model-segregation/>

Schelling segregation: an agent moves if fewer than a third of its neighbours are of the same type. The construal is silent on redlining, restrictive covenants, racially selective mortgage lending ...

CONSTRUAL

1. Assignment → Sign
2. Scope → Object
3. ? ← Interpretant

Construal versus Charles Sanders Peirce's triadic conception of the sign as structure connecting three elements

- the sign / *representamen*
- an object
- an “interpretant”



Elements for a comprehensive assessment
of public indicators



Paul-Marie Boulanger
2014

Editor: Andrea Saltelli



Report EUR 26921 EN

<http://publications.jrc.ec.europa.eu/repository/bitstream/JRC92162/lbna26921enn.pdf>

Sign ↔ Cry



Object ↔ Predator



The African vervet monkey
(*Cercopithecus aethiops*)
can distinguish with its
cry the nature of the
predator: aerial (eagle),
terrestrial (leopard),
ground (snake)

Interpretant ↔ Behaviour

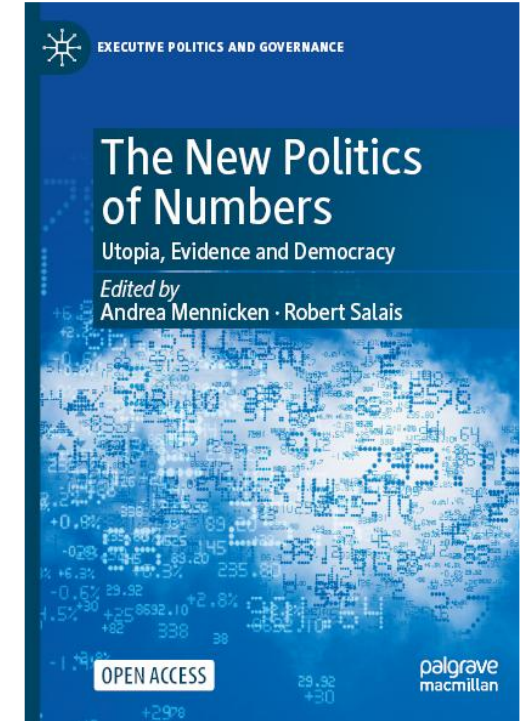
↑
↓
Telos



<http://publications.jrc.ec.europa.eu/repository/bitstream/JRC92162/lbna26921enn.pdf>

Weisberg gives us the anatomy of a model. It misses its political physiology

Double dimension of quality: technical + normative, by Robert Salais, drawing on Amartya Sen



Justice: Means
versus Freedoms

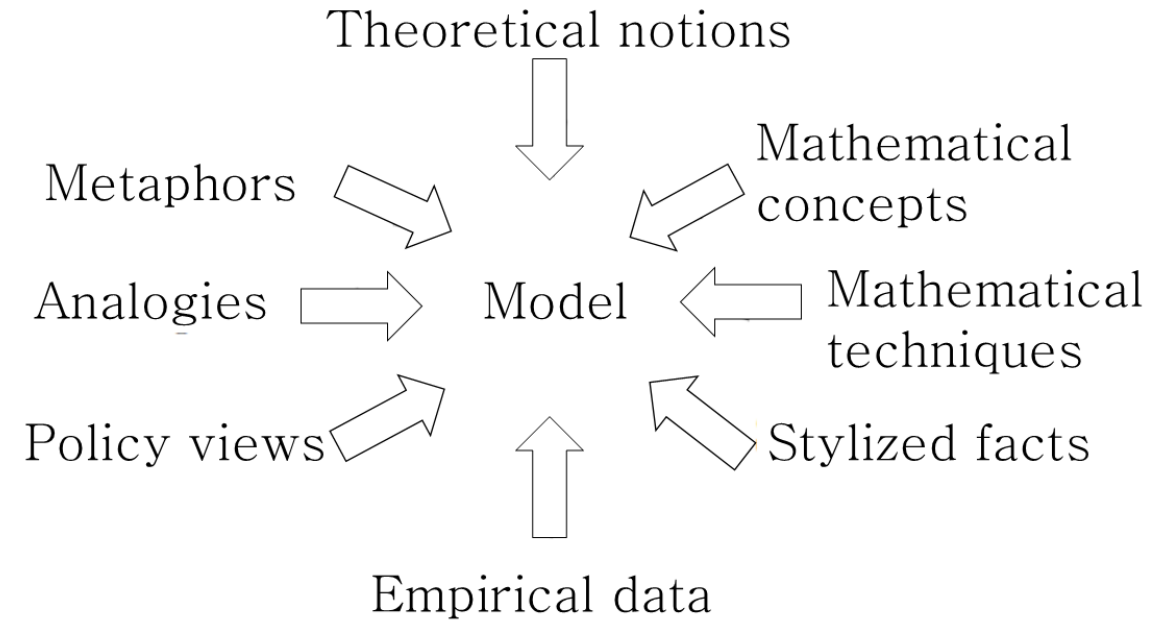
Philosophy & Public Affairs

Vol. 19, No. 2 (Spring, 1990)

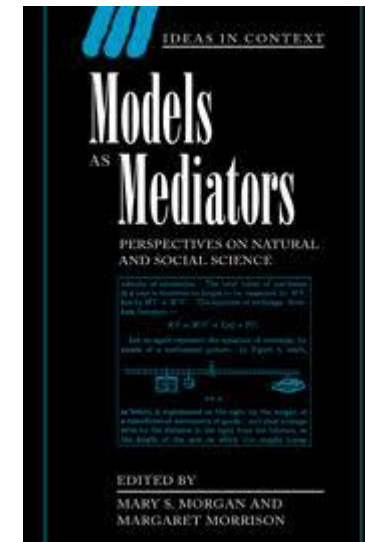
CHAPTER 12, “La donnée
n’est pas un donné”:
Statistics, Quantification and
Democratic Choice, *Robert
Salais*

Models: state of exception

- Richest repertoire
- Under the radar
- Epistemic authority
- The uncertainty cascade
- Incestuous model/data symbiosis (Paul Edwards)
- Too assertive



From Marcel Bouman in



The political economy of models:

- ability to act as chameleons (Paul Pfleiderer);
- the more apolitical a model appears, the more political power it carries
- bring their topic to the forefront

➔ Michel Callon's *problématisation* ➔



Source: National Geographic



A model constitutes, not merely represents:

- University rankings create higher education as a globalised enterprise

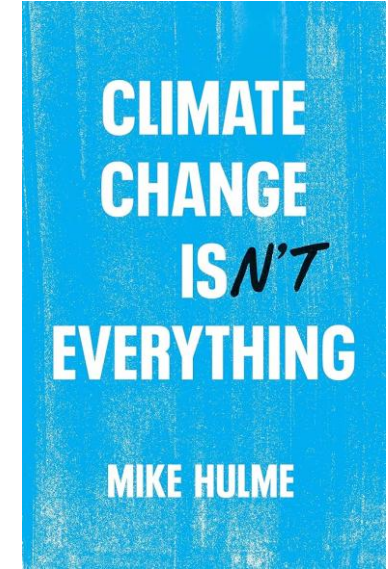
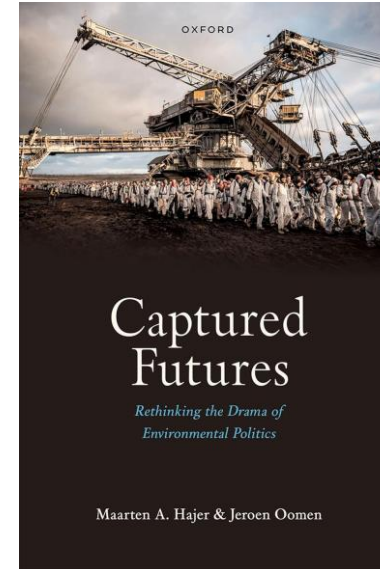
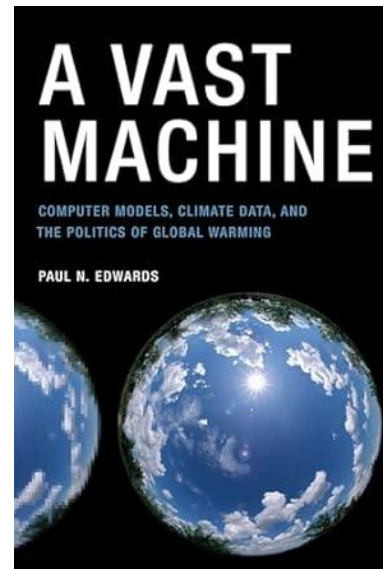
- Pandemic models create the policies adopted to fight them

Follow the science!

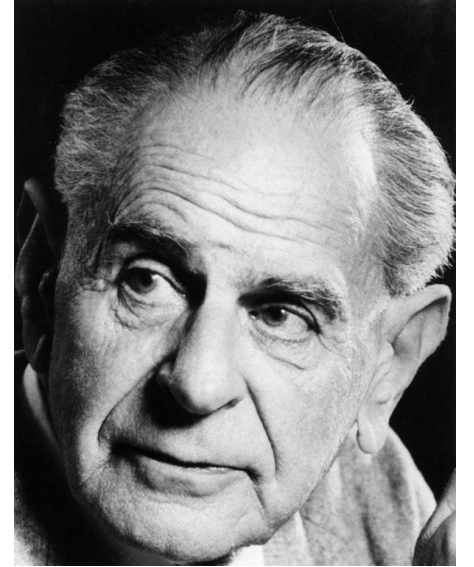
- IAMs create global climate as we know it



THE WORLD'S MOST PRESTIGIOUS UNIVERSITIES		
VIA TIMES HIGHER EDUCATION	BOARDROOM	2024 RANKINGS
1. OXFORD	11. ETH zürich	ETH ZÜRICH
2. MIT	12. TSINGHUA UNIVERSITY	
T-3. PRINCETON	13. PEKING UNIVERSITY	
T-3. CAMBRIDGE	14. PENN	
T-5. HARVARD	15. UCHICAGO	
T-5. STANFORD	16. JOHNS HOPKINS UNIVERSITY	
7. CAL TECH	17. NATIONAL UNIVERSITY OF SINGAPORE	
8. IMPERIAL COLLEGE	T-18. CORNELL	
9. UC BERKELEY	T-18. UCLA	UCLA
10. Yale	20. COLUMBIA	



Climate models projecting CO2 costs through the year 2300. Nuclear waste safety models covering a million years. Digital twins simulating ecosystem dynamics with 50-year horizons ...



Karl Popper
(1902–1994)

These models take no risks. No severe tests here

➔ the models claiming the most scientific authority are, by science's own criterion, the least scientific

Lane's lesson in participatory science: what local stakeholders knew



Doing flood risk science differently: an experiment in radical scientific method

S N Lane*, N Odoni*, C Landström**, S J Whatmore**,
N Ward† and S Bradley‡

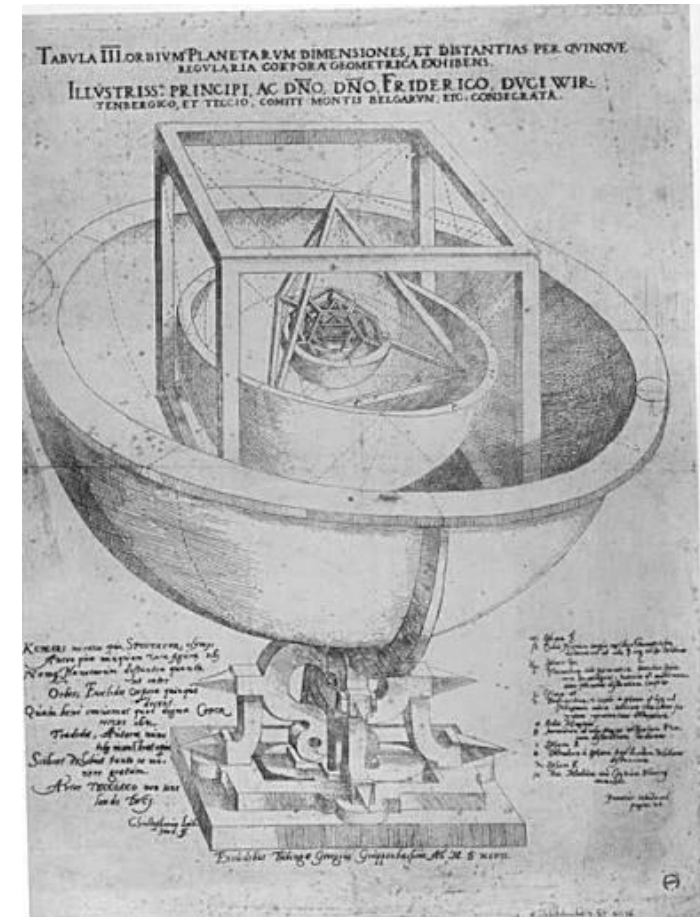
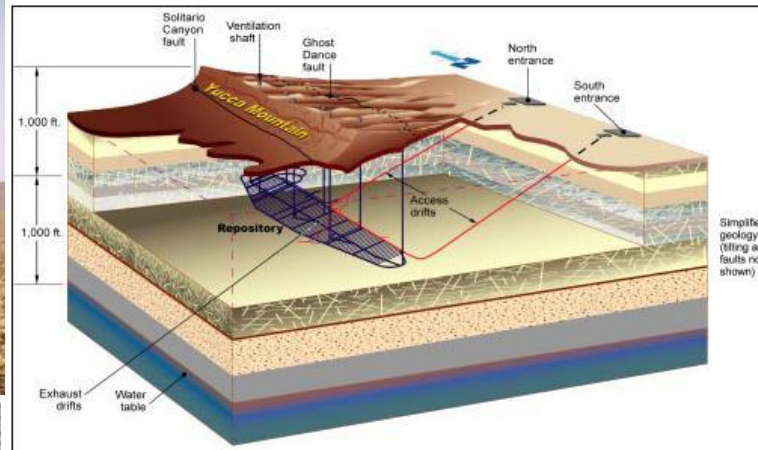


Ch. 4 Cases

- Models that inspire
- Excess symmetry
- COVID
- Water resources
- The Ecological Footprint
- Then versus now: two energy studies
- Models of risk
- Models that act
- Mathematisation of economics
- Multiverses and forking paths
- From models of the world to its digital twins
- Climate, models and politics
- Wrapping up

Excess symmetry: the Platonic trap

Yucca Mountain's one-million-year certainty



Keplerian solids, source:
https://www.princeton.edu/~his291/Keplerian_Solids.html

The radial symmetry encoding error (as in Love Canal)

Saviours or public troubles?

Behind the Virus Report That Jarred the U.S. and the U.K. to Action **The New York Times**



By [Mark Landler](#) and [Stephen Castle](#)

Published March 17, 2020 Updated April 2, 2020

ROGER PIELKE JR.

IDEAS APR 22, 2020 8:00 AM

The Mudfight Over ‘Wild-Ass’ Covid Numbers Is Pathological

How did epidemiological modeling get so politicized?

Mathematical models as public troubles in COVID-19 infection control: following the numbers

Tim Rhodes  & Kari Lancaster

Pages 177-194 | Received 07 Apr 2020, Accepted 29 Apr 2020, Published online: 13 May 2020

 Cite this article

 <https://doi.org/10.1080/14461242.2020.1764376>



Health Sociology Review >

Volume 29, 2020 - [Issue 2: Special Section on ‘Sociology and the Coronavirus \(COVID-19\) Pandemic’](#)

With COVID and climate models have migrated:



Source: Euronews



Perspective | [Open Access](#) | [CC](#) [i](#)

Bring digital twins back to Earth

[Andrea Saltelli](#) ✉ [Gerd Gigerenzer](#), [Mike Hulme](#), [Konstantinos V. Katsikopoulos](#), [Lieke A. Melsen](#),
[Glen P. Peters](#), [Roger Pielke Jr.](#), [Simon Robertson](#), [Andy Stirling](#), [Massimo Tavoni](#), [Arnald Puy](#)

First published: 26 August 2024 | <https://doi.org/10.1002/wcc.915> | [VIEW METRICS](#)

Edited by Matthias Heymann, Domain Editor and Maria Carmen Lemos, Editor-in-Chief

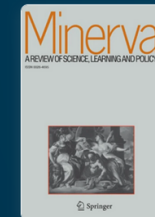
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Essay Review | [Open access](#) | Published: 11 May 2026
(2026) [Cite this article](#)



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[Andrea Saltelli](#)

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➔ From the margins of scientific practice to its epistemic and political core

Mind the assumptions



COMMENT · 24 JUNE 2020

Five ways to ensure that models serve society: a manifesto

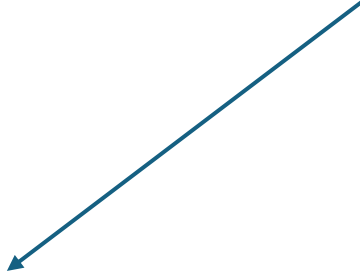


nature

Mind the hubris

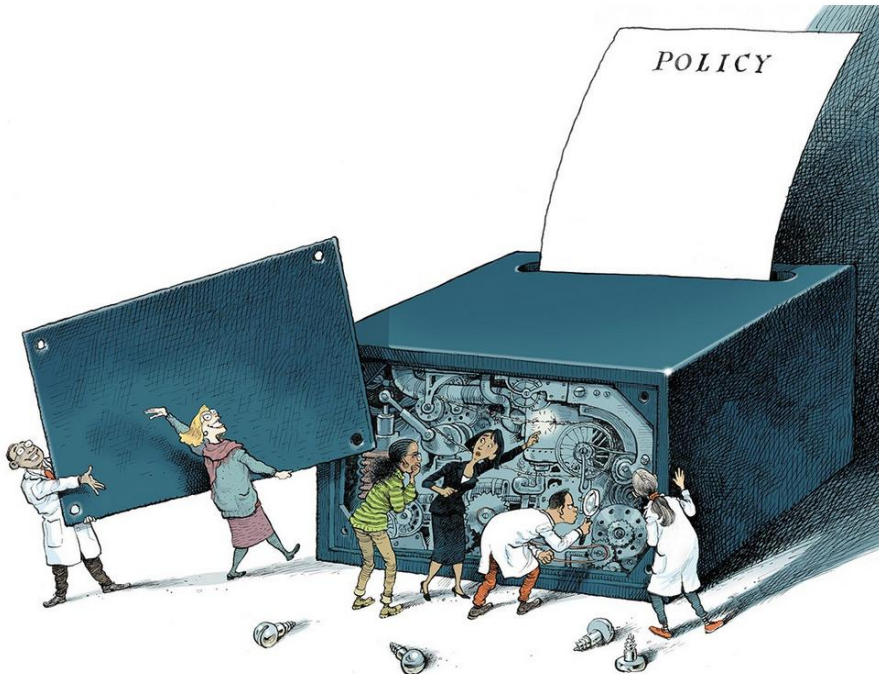
Mind the framing

... Do these work for AI?

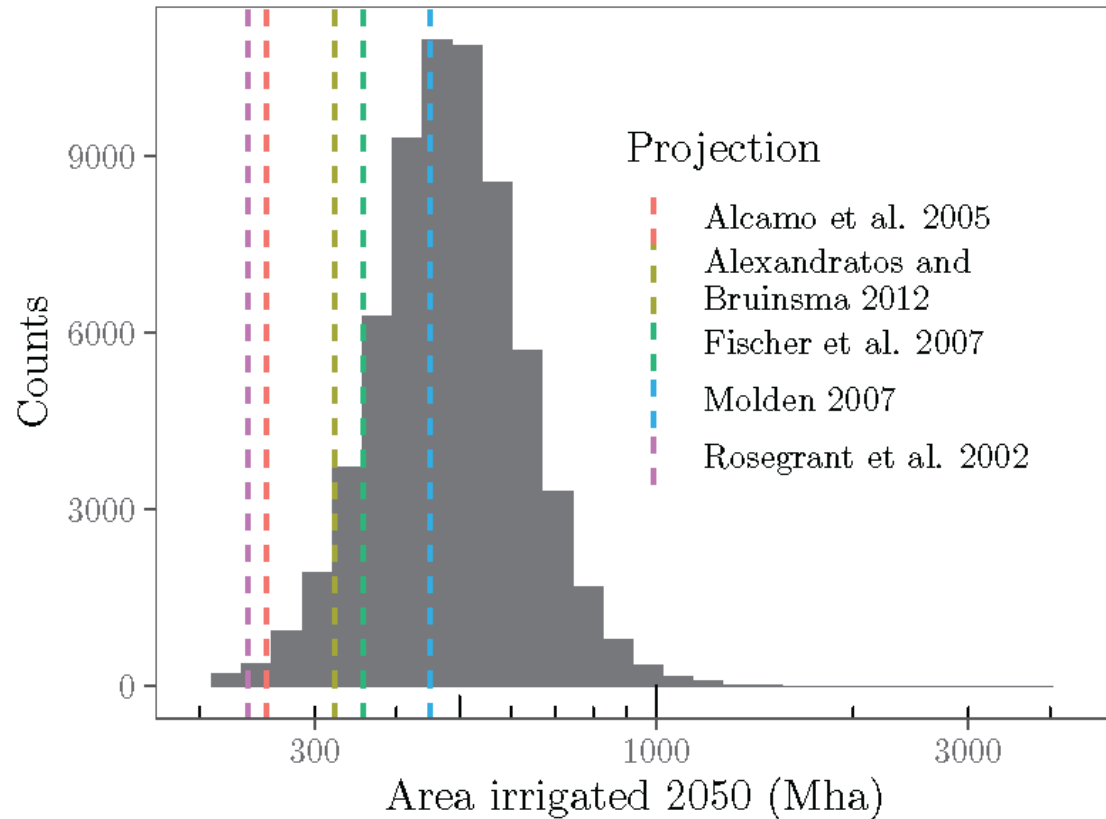


Mind the consequences

Mind the unknowns



Water resources: more detail, more uncertainty; physics-like linguistic confidence; non-conservative



Article

Socio-environmental modeling shows physics-like confidence with water modeling surpassing it in numerical claims

Arnald Puy^{1,13} , Ethan Bacon¹, Alba Carmona^{2,3}, Samuel Flinders¹, David Gefen⁴, Mohammad Khanjani⁵, Kai R. Larsen⁶, Alessio Lachi⁷, Seth N. Linga¹, Samuele Lo Piano⁸, Lieke A. Melsen⁹, Emily Murray¹, Razi Sheikholeslami⁵, Ariana Sobhani¹⁰, Nanxin Wei¹, Andrea Saltelli^{11,12}

Citation:

Puy, A., Lo Piano, S., & Saltelli, A. (2020). Current models underestimate future irrigated areas. *Geophysical Research Letters*, 47, e2020GL087360. <https://doi.org/10.1029/2020GL087360>

Multiverses and forking paths; many-analyst studies; the variance that disappeared

PNAS

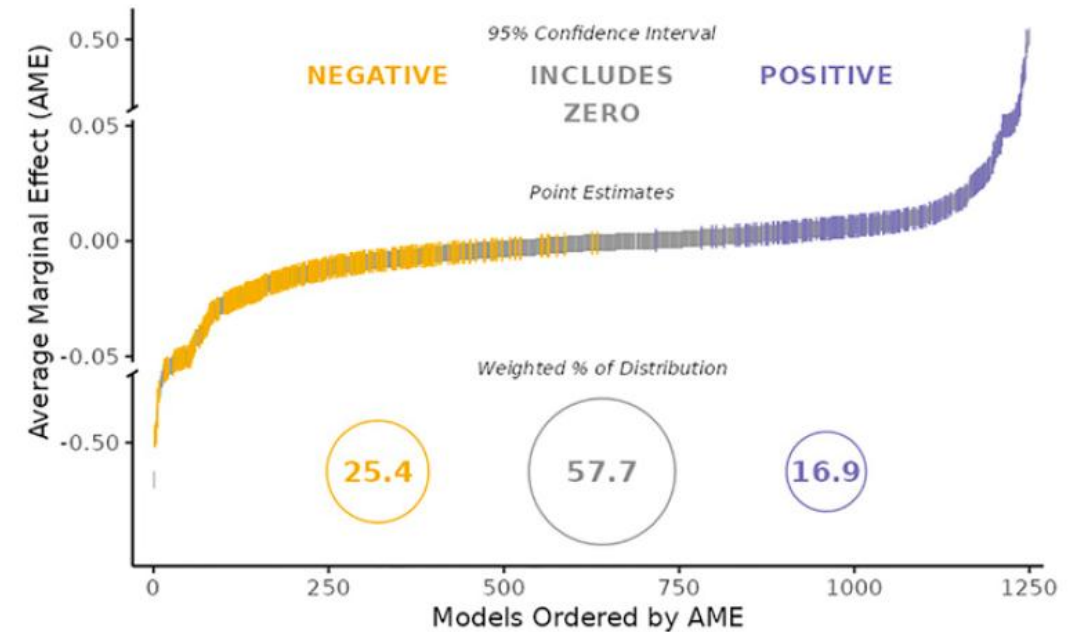
RESEARCH ARTICLE

SOCIAL SCIENCES

OPEN

Observing many researchers using the same data and hypothesis reveals a hidden universe of uncertainty

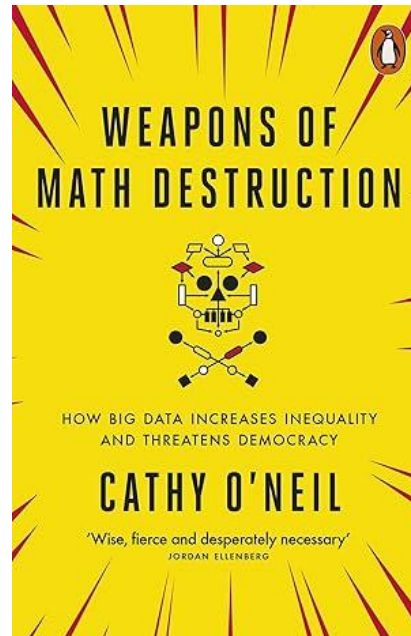
Edited by Douglas Massey, Princeton University, Princeton, NJ; received March 6, 2022; accepted August 22, 2022



‘Solved’ by global sensitivity analysis

Saltelli, A., Lachi, A., Puy, A., & Breznau, N. (2024, December 23). Leamer reloaded: a long-neglected suggestion is rediscovered to apply global sensitivity analysis to a quantification before publishing it, MetaArXiv Preprint <https://doi.org/10.31222/osf.io/sq34n>.

Models that act —
COMPAS; from
models that shape
decisions to models
that take them



Recidivism + Criminal Justice Reform + Criminal Justice + Artificial Intelligence +
Machine Learning +

COMPAS — an AI tool sending or keeping people in Jail



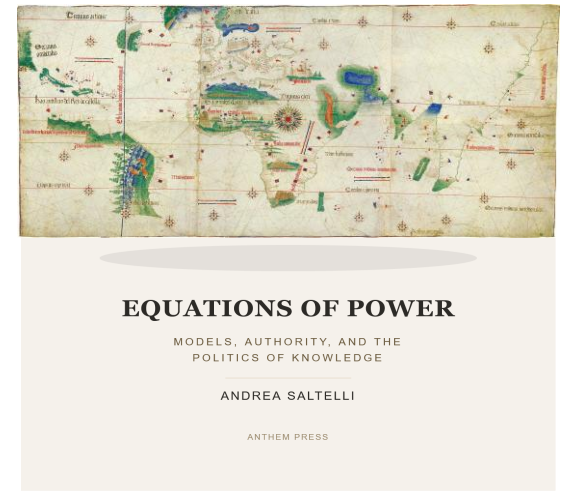
Ekata Deb

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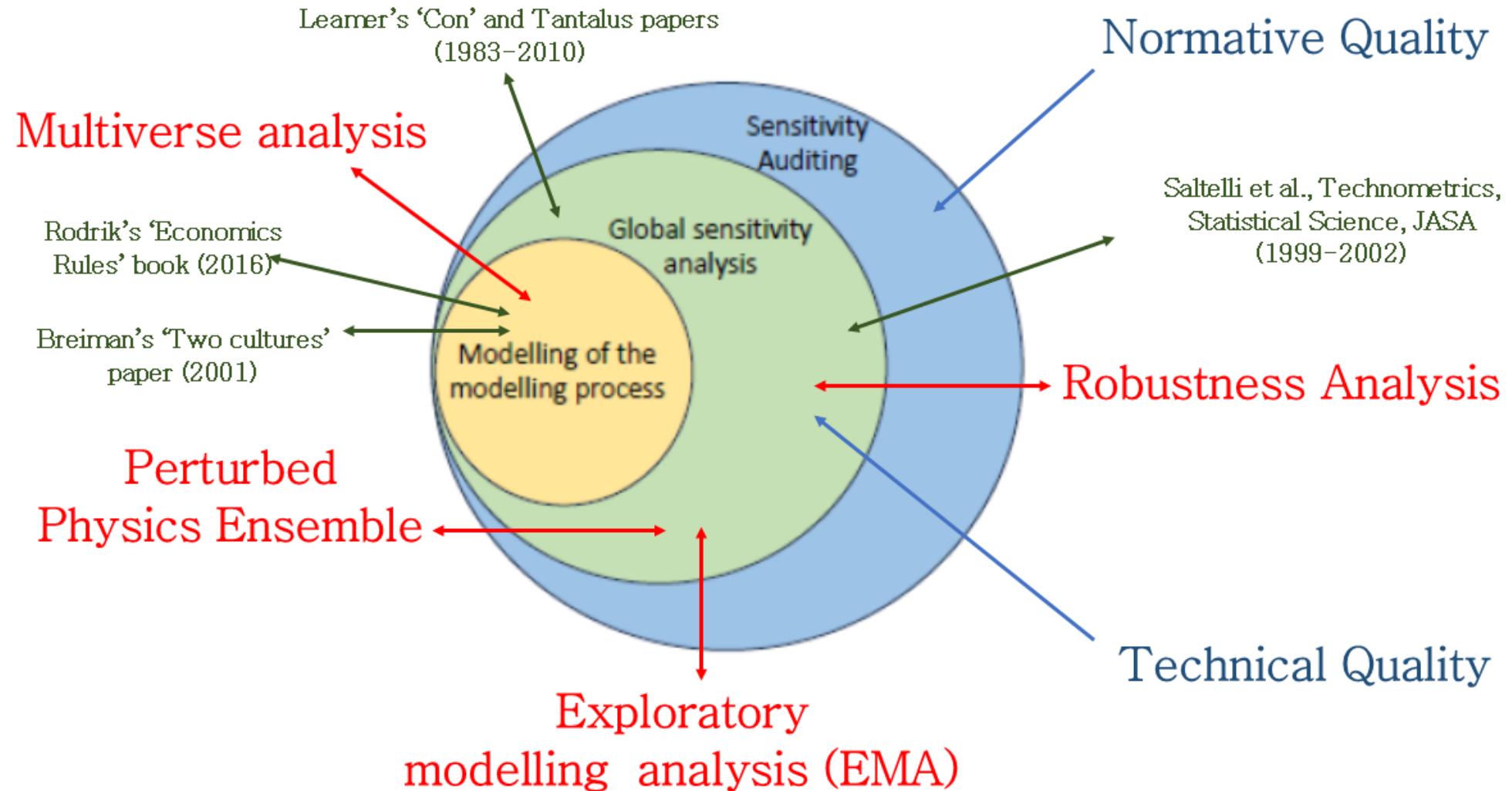
<https://edblogs.medium.com/compas-an-ai-tool-sending-or-keeping-people-in-jail-d9228df3a2c6>

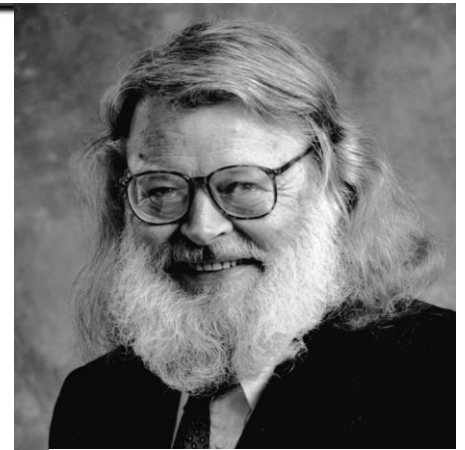
Ch. 5 Fixing, repairing and other measures



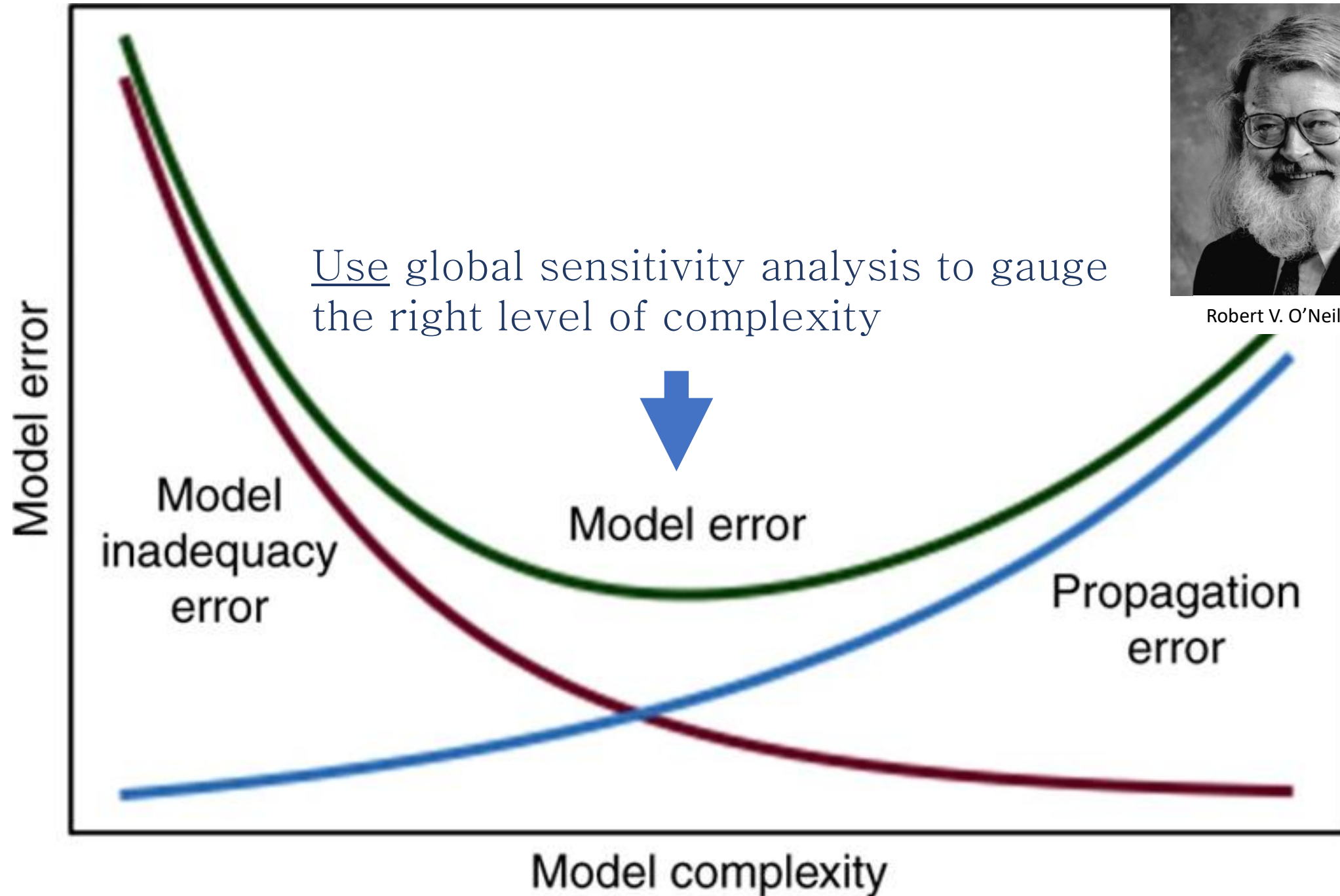
- Something technical: Global sensitivity analysis
- Modelling the modelling process
- Something less technical: Sensitivity auditing
- Critical Friends
- Statistics and Statactivism
- How about observatories?
- Conditions for engagement
- Wrapping up

The same craft under many names





Robert V. O'Neil, Oak Ridge



The Song Jian / one-child policy 1980's model. We find near-insensitivity to inputs ...



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14 Pages • Posted: 19 May 2026

[Samuele Lo Piano](#)
Gdańsk University of Technology - Faculty of Management and Economics

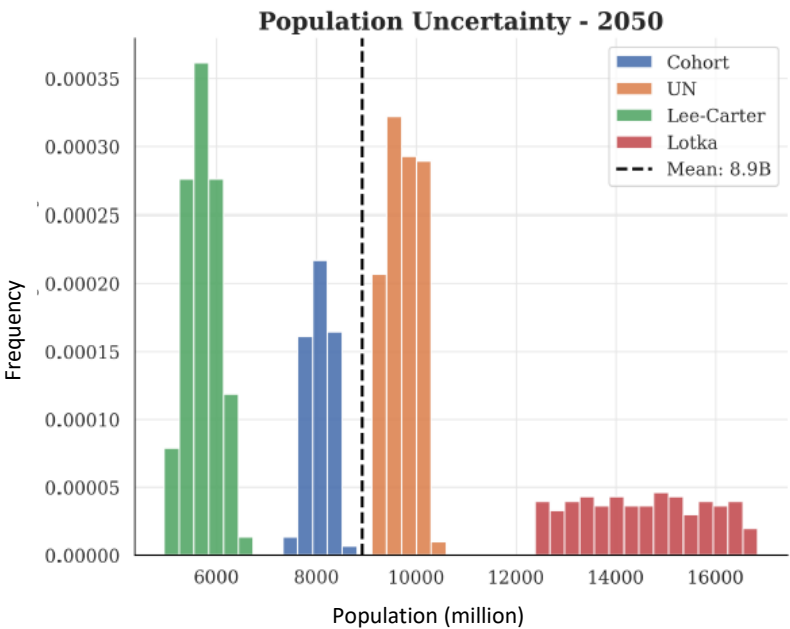
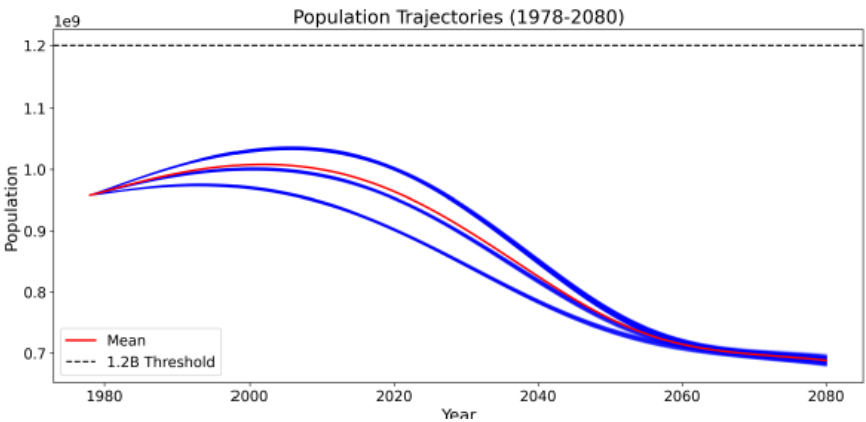
[Marta Kuc Czarnecka](#)
Gdańsk University of Technology

[Roger Pielke](#)
University of Colorado at Boulder

[Andrea Saltelli](#)
UPF Barcelona School of Management

Date Written: May 15, 2026

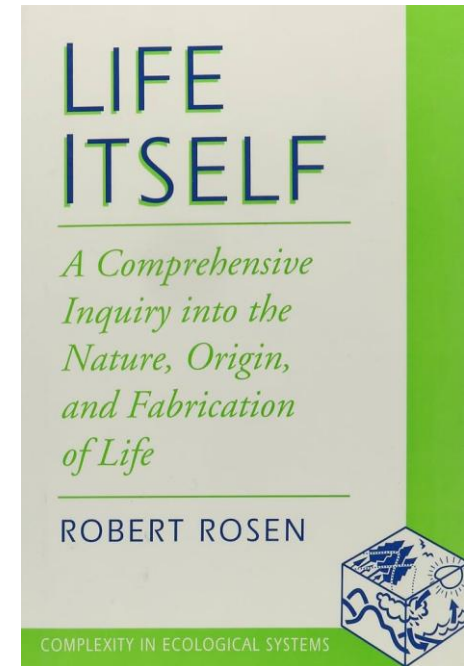
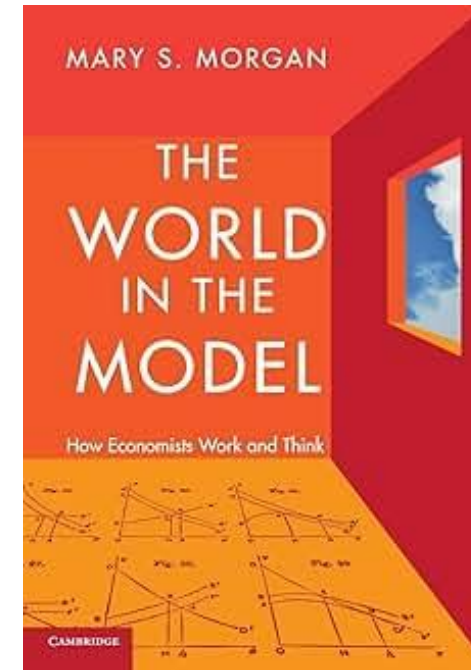
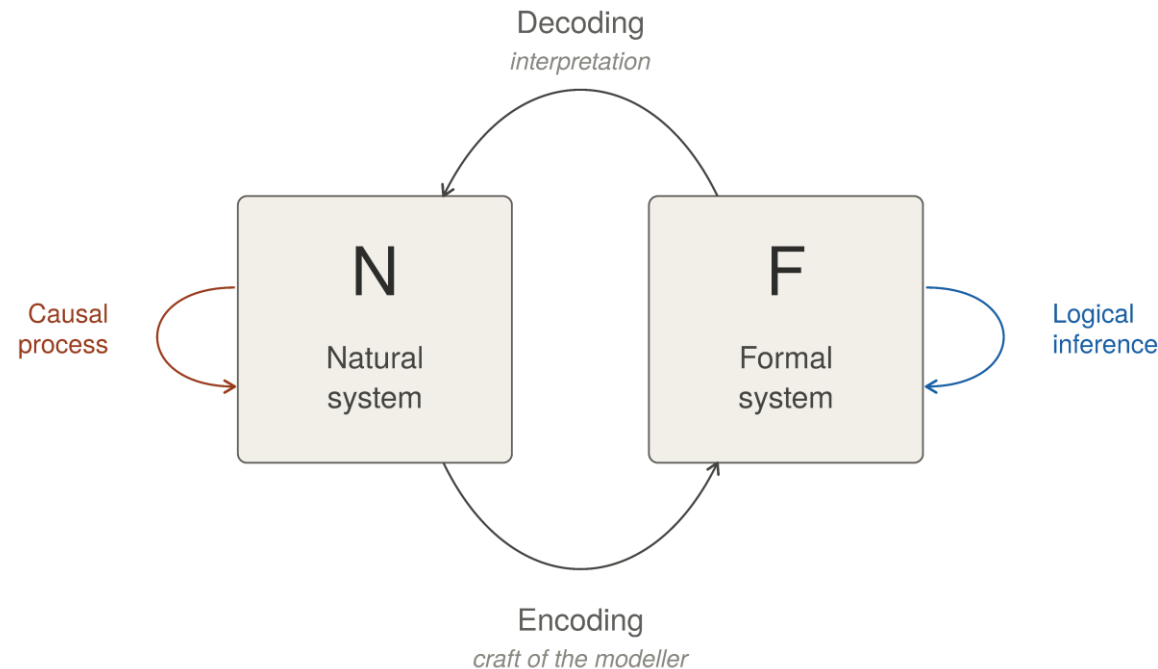
... and projections today
in use are dramatically
model-dependent



Paradoxes at the heart of sensitivity analysis

The first act of selection happens in the modeller's mind

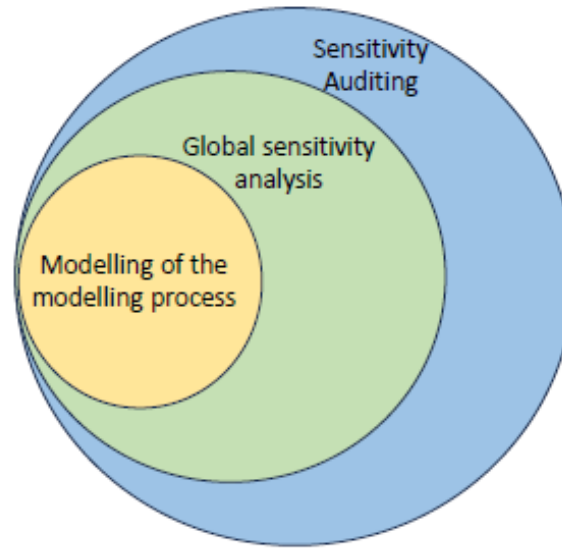
GSA operates entirely within Mary Morgan's "world in the model" and Robert Rosen's 'F'



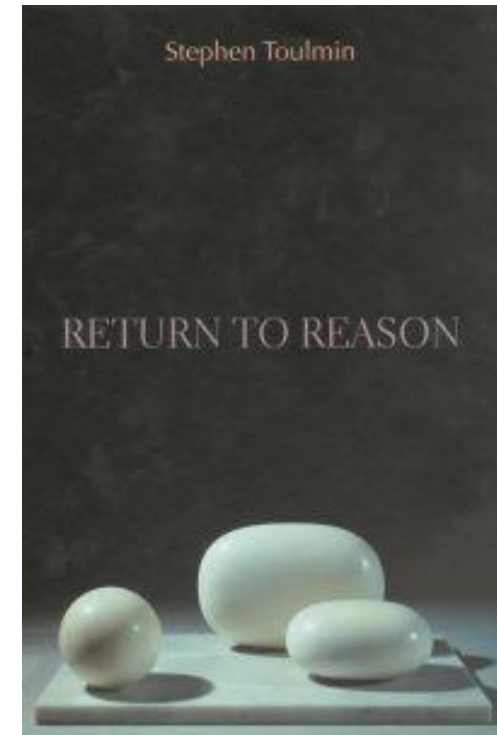
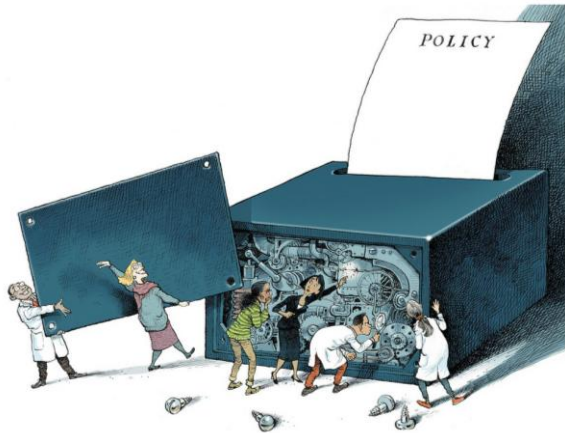
Sensitivity auditing from the technical to the political (interpretant):

- Check for inflation/deflation of uncertainty

- Hunt for assumptions



- Do the right sums



Do the right sums: Global sensitivity analysis tell us how sensitive conclusions are to the paths taken ...

... But was the right garden entered in the first place?

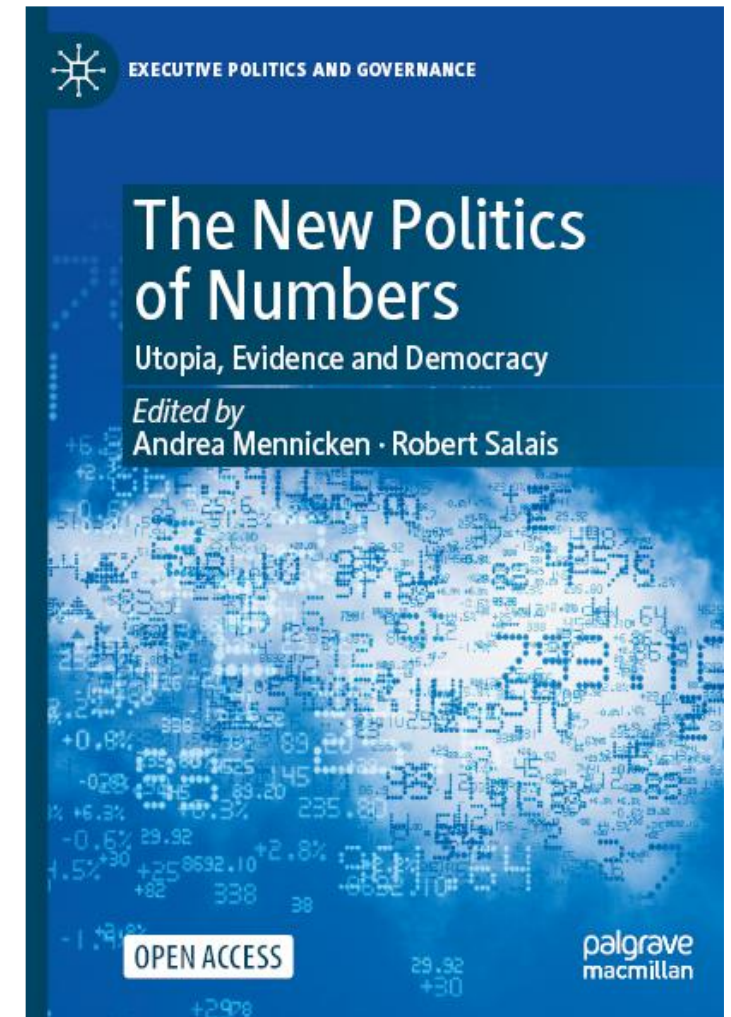




How to be a "statactiviste"?
Defend with judo, denounce bad numbers,
propose better ones, uncover invisibilities



Is there an equivalent in
modelling?



Equations of power

Models, authority, and the politics of knowledge

What models are

How models work

What goes wrong

STATE OF EXCEPTION

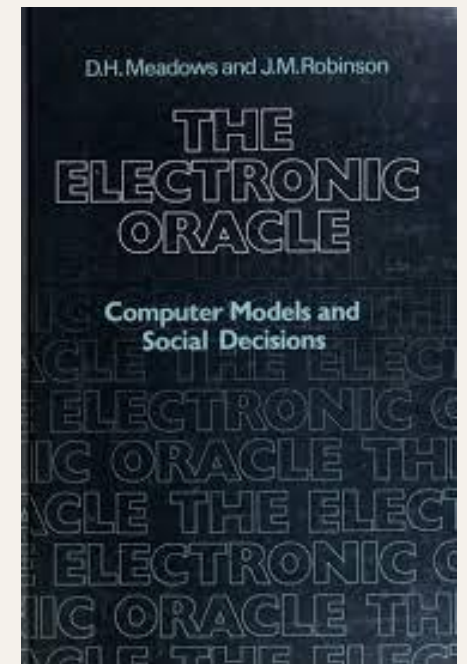
Cases

Fixing, repairing

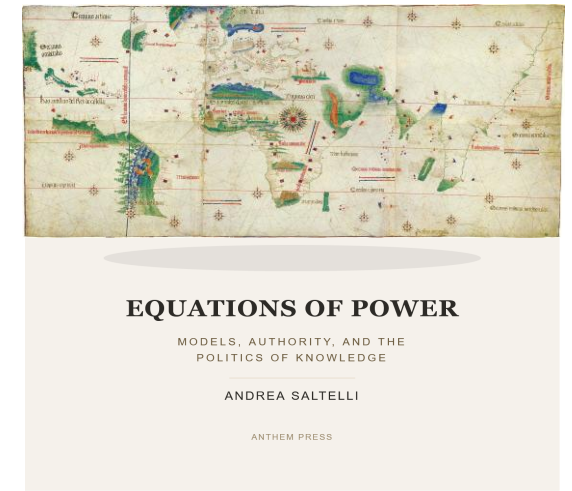
LOW TRACTION

What reformation?

1985



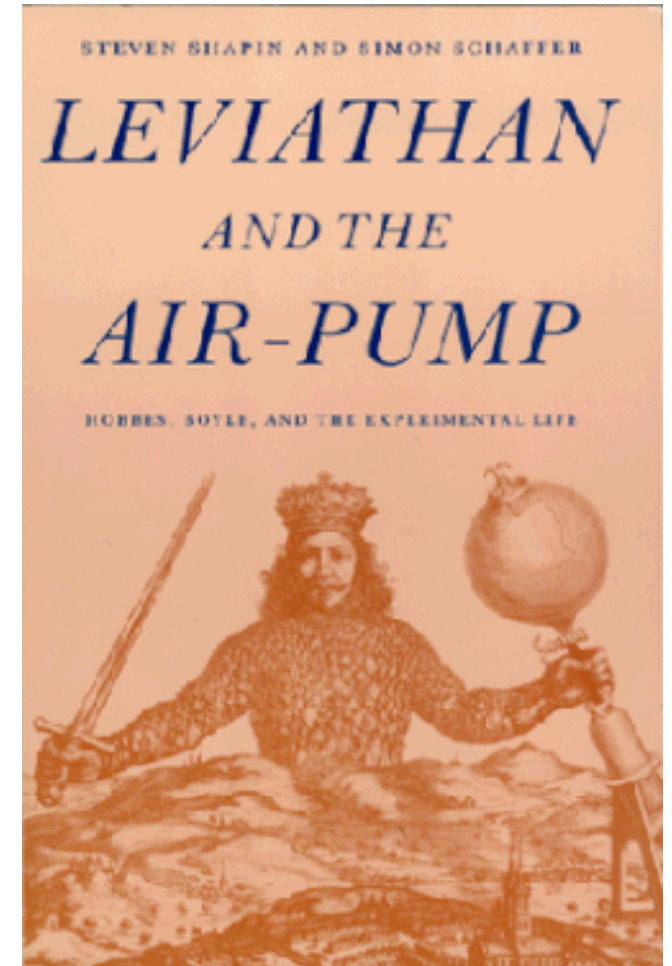
Ch. 6 Conclusion: What Reformation?



- A reflection about models
- Science reformation imaginaries
- What should change?
- Reformation blues
- Science fiction, again?
- Back to models
- A close of the close

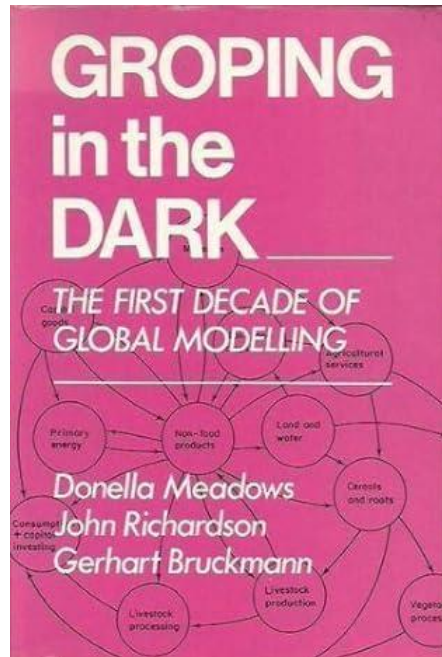
Are we on the verge of a renegotiation of the compact between science and society?

Last chapter in ➡



The ladder of delegation: calculate → judge → act

- Decades with models, years with algorithms, months with AI
- What models did under the radar, algorithms do above; then radars are made obsolete by AI



1982



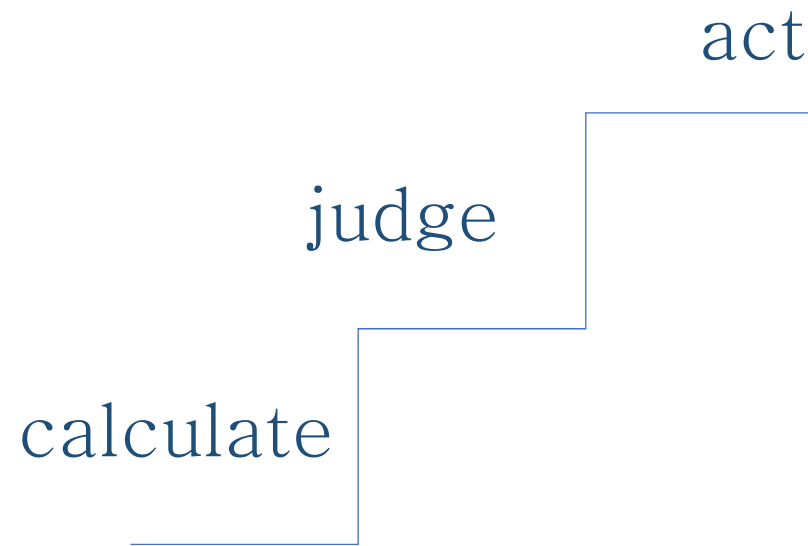
Source: <https://www.nature.com/articles/d41586-020-00086-5?>

Donella (Dona) Meadows
1941–2001



Source: Wikipedia
Sam Altman

The ladder of delegation: whether the ladder can be descended is the question a Reformation would have to answer



Reformation in the Church of Science

How the truth monopoly was broken up

Andrea Saltelli and Daniel Sarewitz

