Global Sensitivity Analysis: Why does it matter?

Andrea Saltelli

The 13th Summer School on
Sensitivity Analysis of Model Output (SAMO)
Fiesole (Florence), 8 - 12 June 2026

Andrea Saltelli

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Latest papers

Models and the common good

A short analysis of norms and counter-norms in modelling, discussing how models may misuse their epistemic authority for reasons of occasion, opportunity and interest.

Outline:
Narratives and counter-narratives,
State of exception,
Seeking Cinderella,
Reformation

Ranking the Rankers

Ranking the Rankers? We investigate using global sensitivity analysis the properties of the science-wide author databases' standardised citation indicators produced since 2015 by a team of researchers led by John P. A. Ioannidis.

Digital twins

We reflect on the development of digital twins of

Where to find this talk:

www.andreasaltelli.eu

Dedicated to Ilya M. Sobol’

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Ilya M. Sobol'

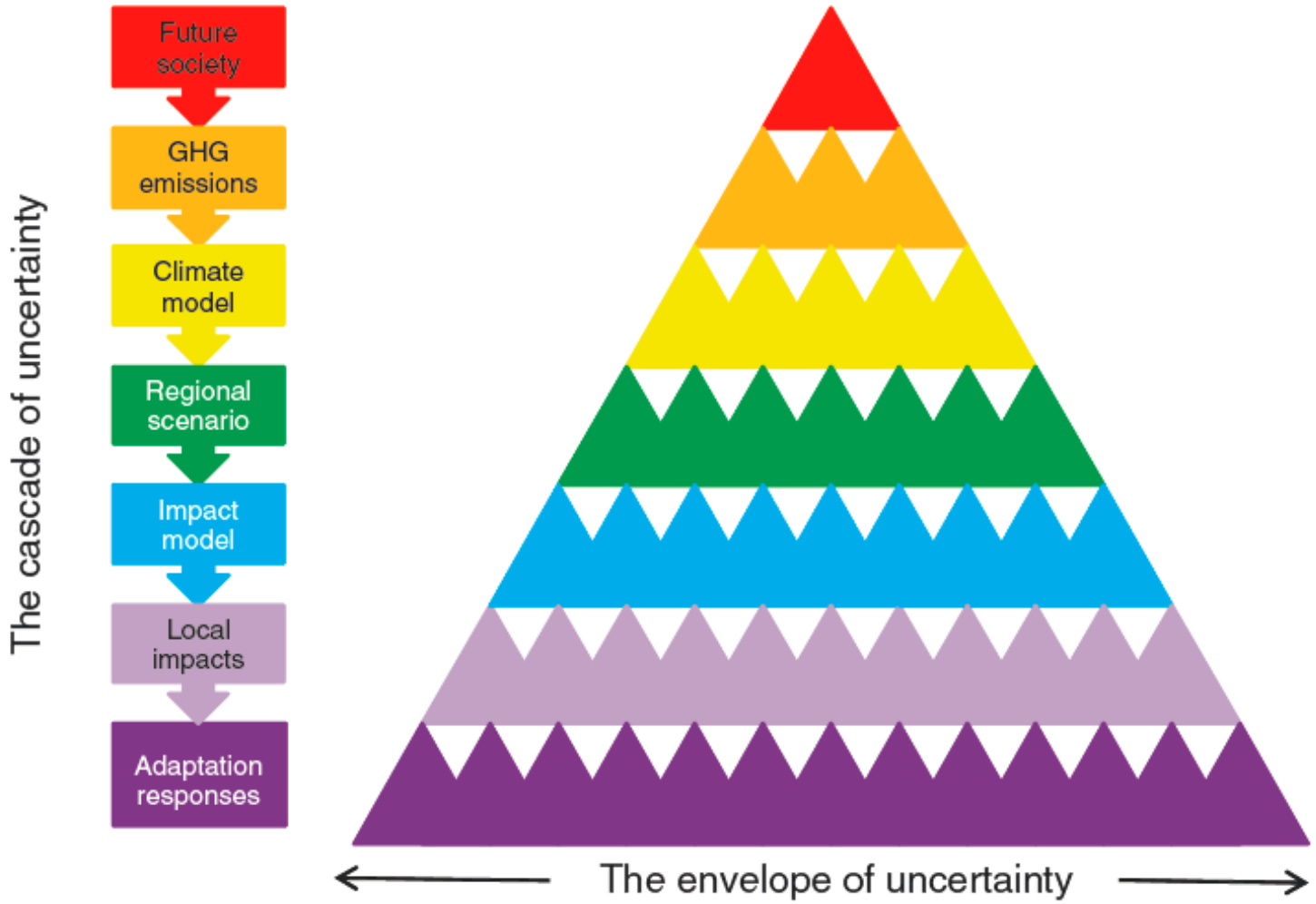
Article Talk

From Wikipedia, the free encyclopedia

Ilya Meyerovich Sobol' (Russian: Илья Меерович Соболь; 15 August 1926 – 9 December 2025) was a Russian mathematician, known for his work on Monte Carlo methods. His research spanned several applications, from nuclear studies to astrophysics, and has contributed significantly to the field of sensitivity analysis.

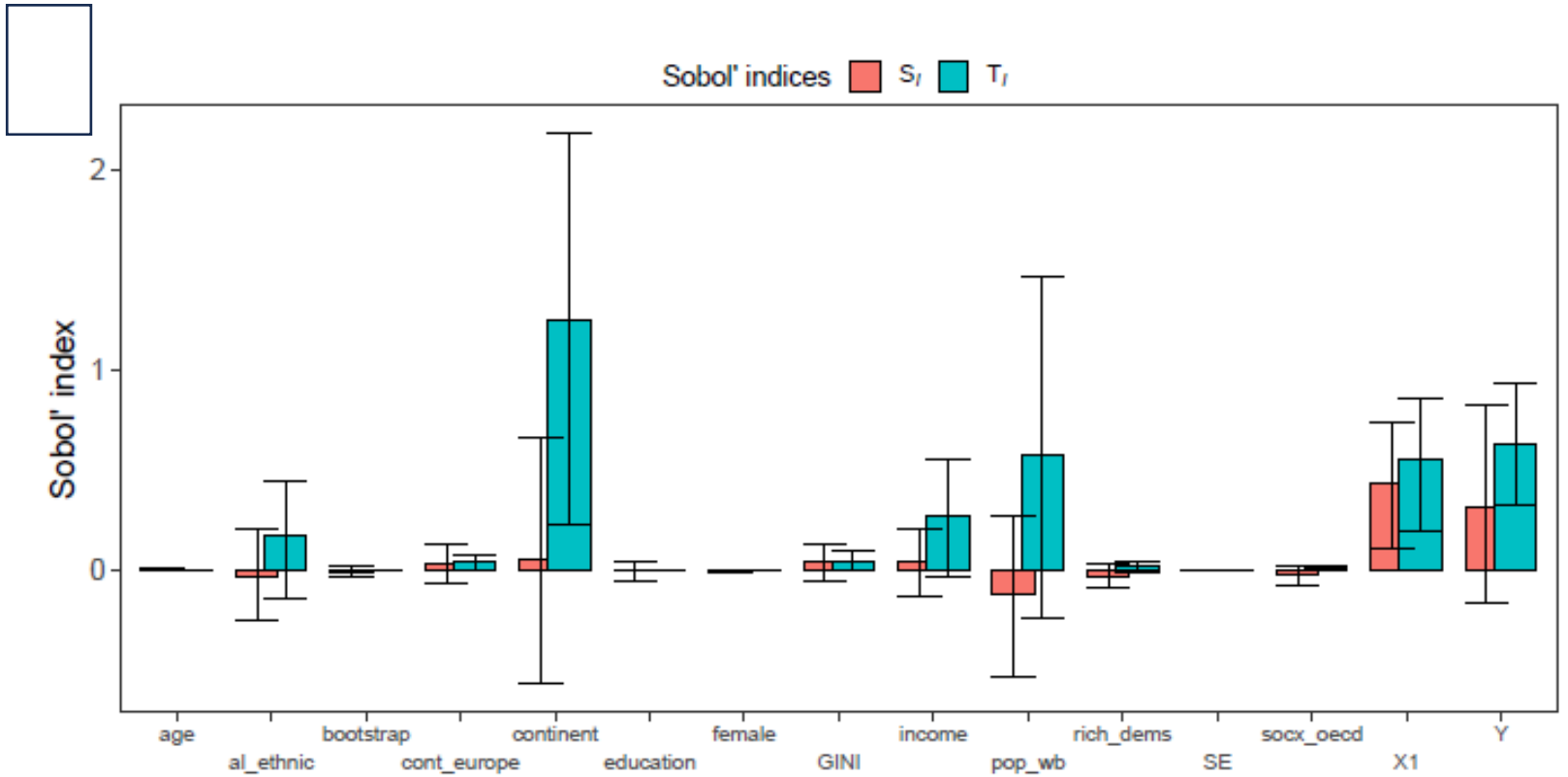
Part I - What are uncertainty analysis and global sensitivity analysis?

Uncertainty analysis: the study of the uncertainty in model output

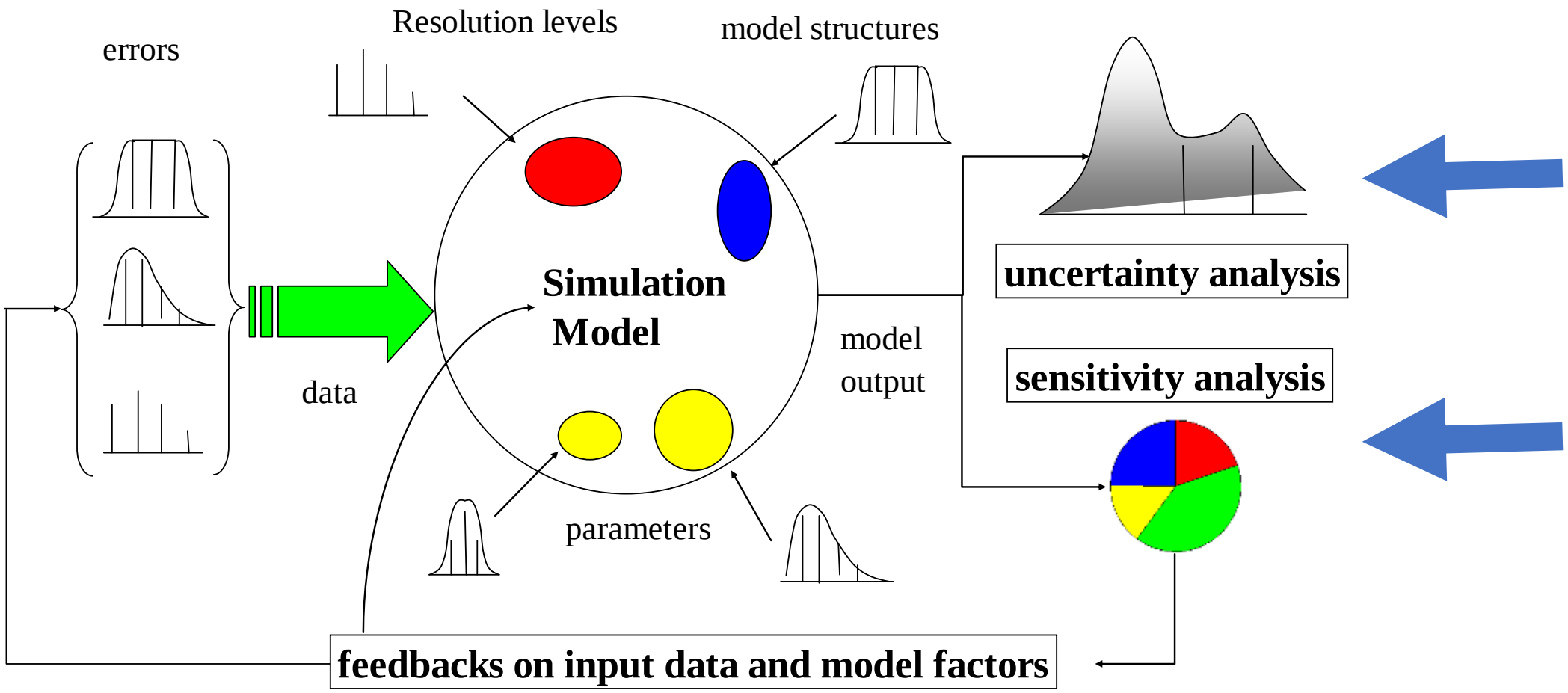


Source: https://www.climate-lab-book.ac.uk/2014/cascade-of-uncertainty/

Sensitivity analysis: the study of the relative importance of different input factors on the model output



Stefano Tarantola, circa 2008



Why global? Why don't we simply move one factor At a Time (OAT)

A geometric proof

Environmental Modelling & Software 25 (2010) 1508–1517

Contents lists available at ScienceDirect

Environmental Modelling & Software

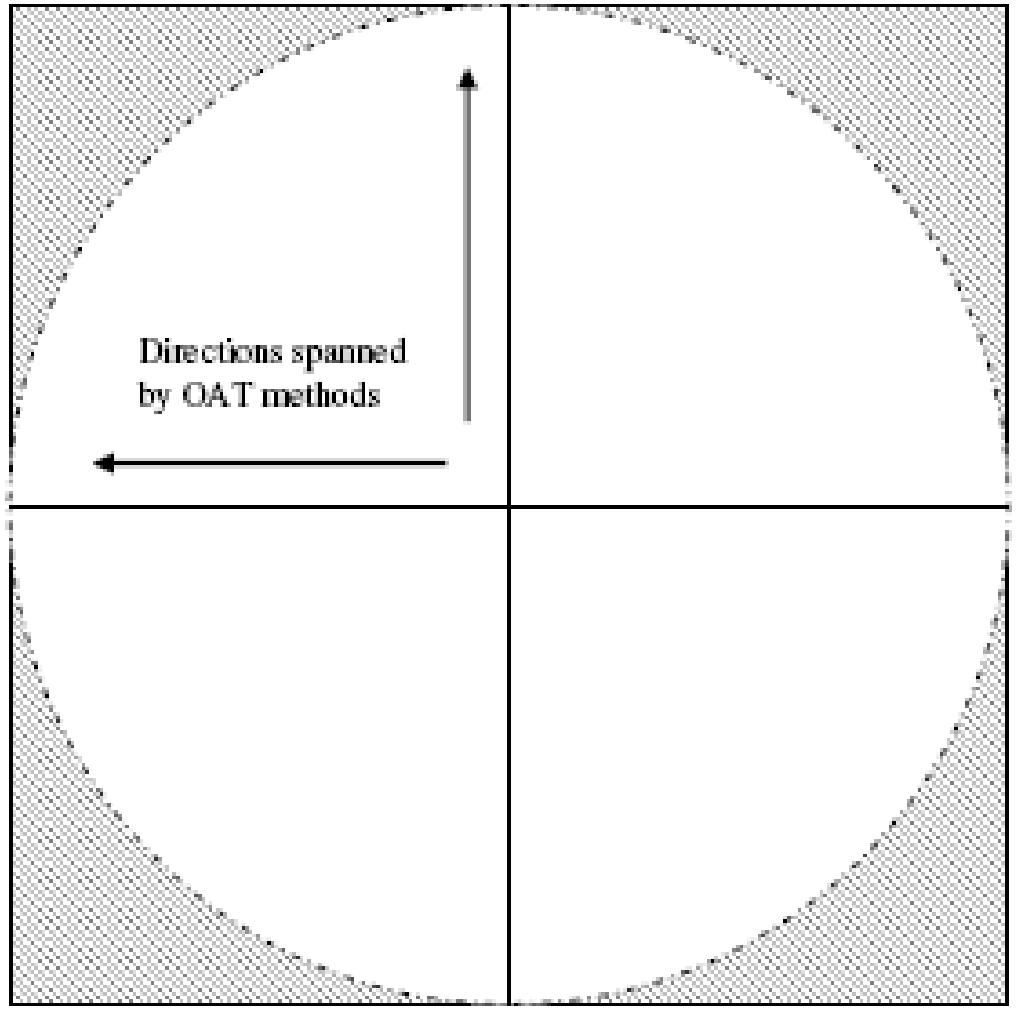
journal homepage: www.elsevier.com/locate/envsoft

How to avoid a perfunctory sensitivity analysis

Andrea Saltelli*, Paola Annoni

Joint Research Center, Institute for the Protection and Security of the Citizen, via E.Fermi, 2749, Ispra VA 21027, Italy

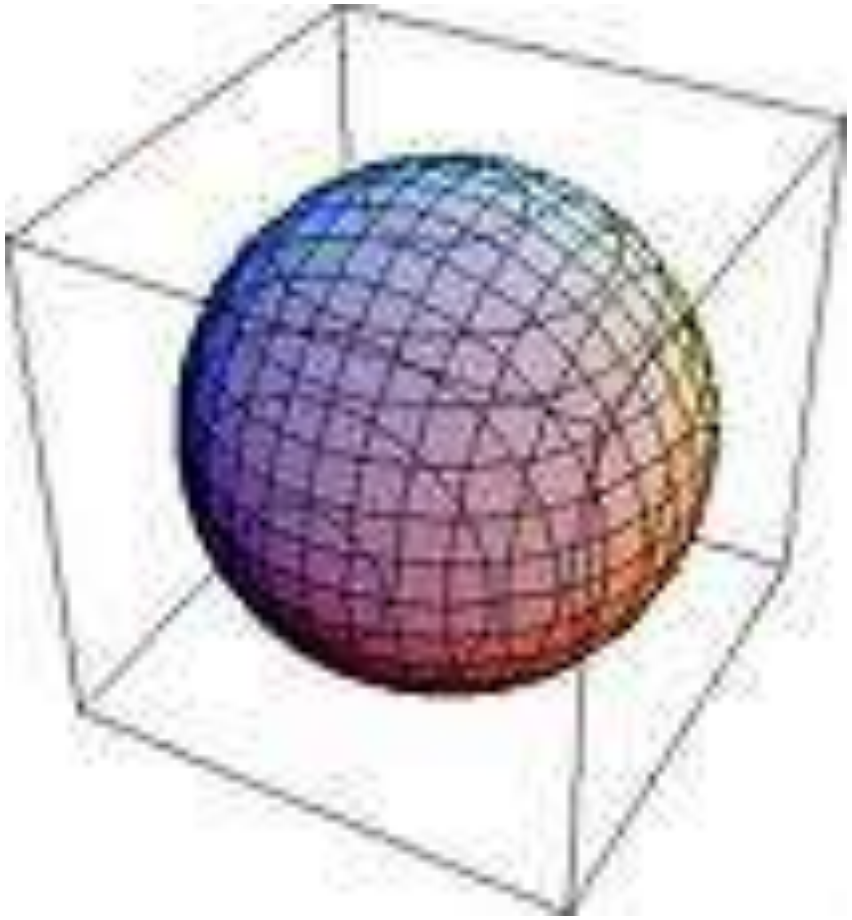
OAT in 2 dimensions



Area circle / area square =?

~ 3/4

OAT in 3 dimensions

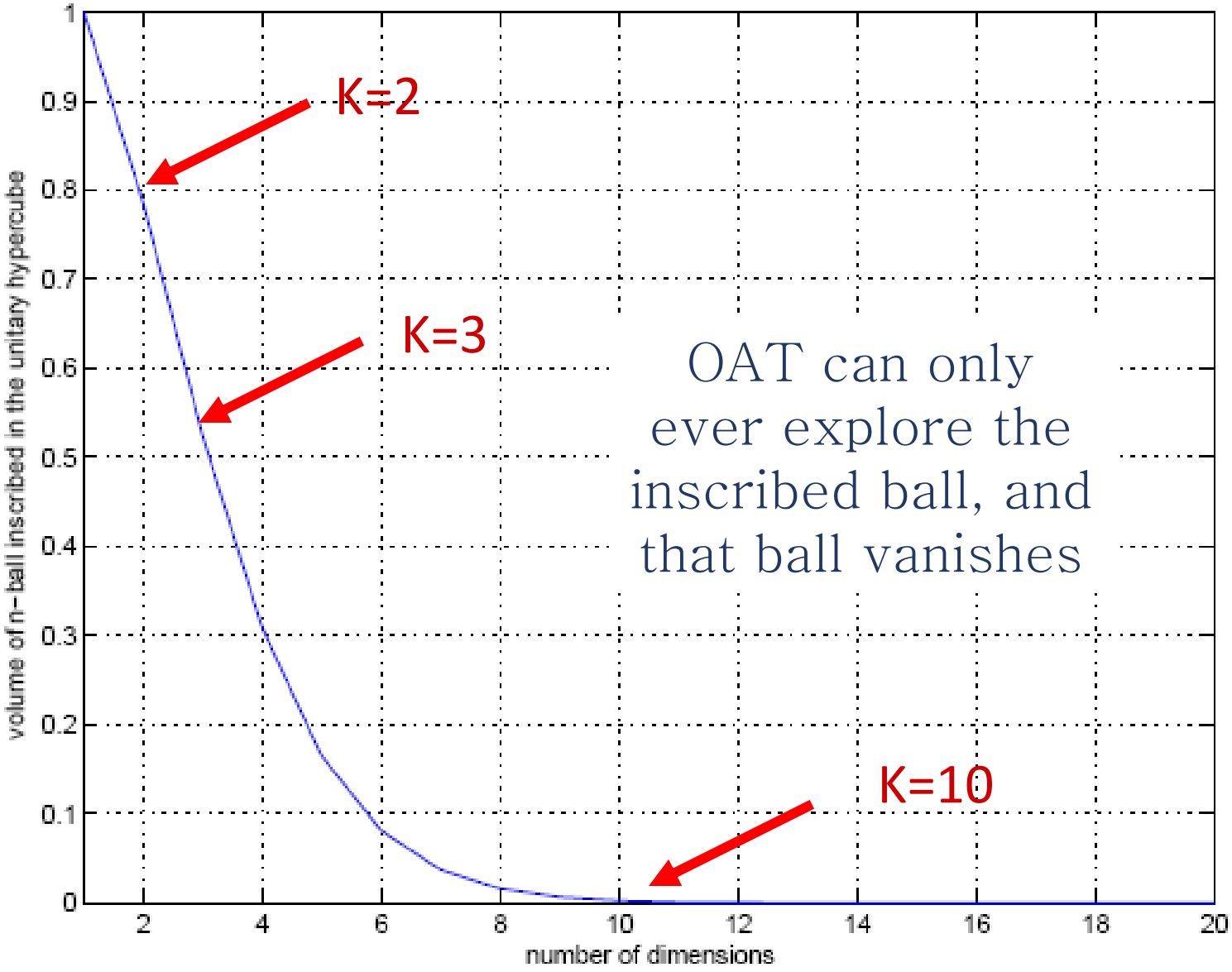


Volume sphere / volume cube =?

~ 1/2

OAT in 10 dimensions; Volume hypersphere / volume ten dimensional hypercube =? ~ 0.0025

OAT in k dimensions

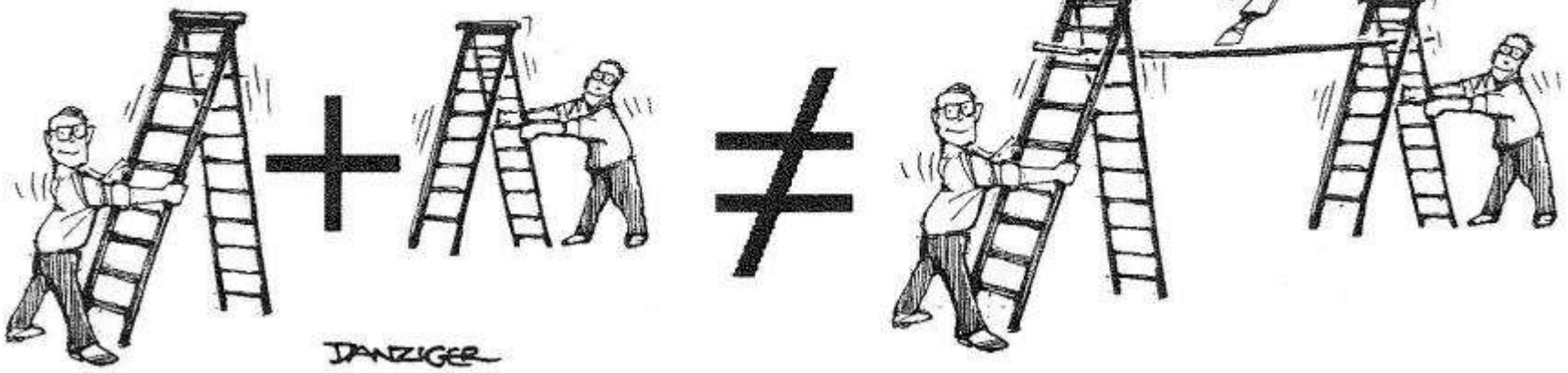


OAT does not capture interactions

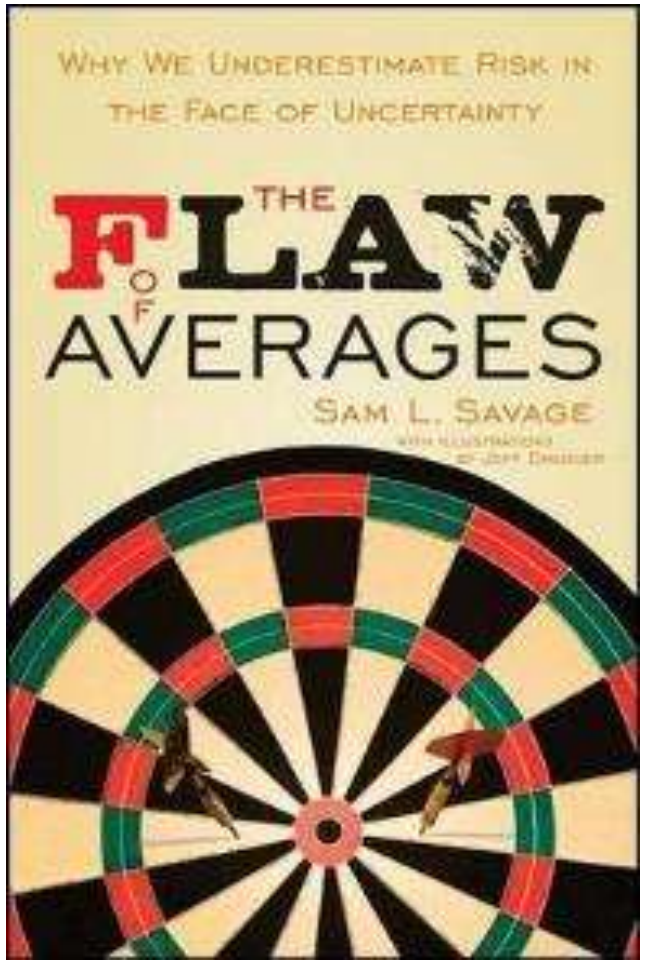
➔ The resulting analysis is non conservative

How would you test the scaffolding?

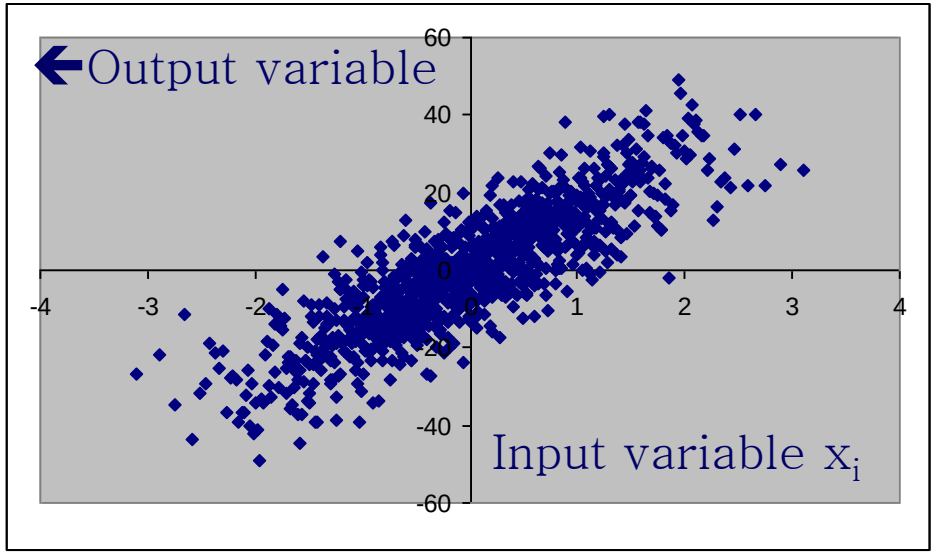
How coupled ladders are shaken in most of available literature

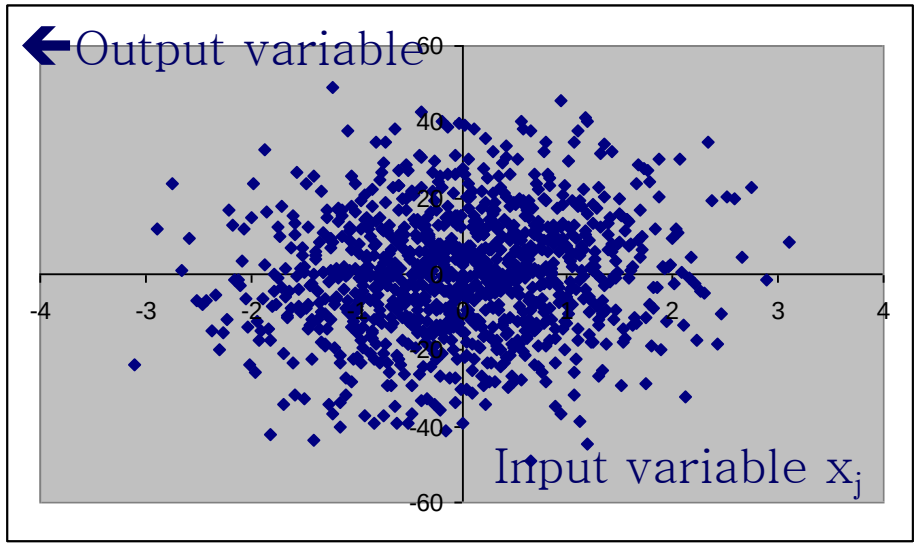


How to shake coupled ladders



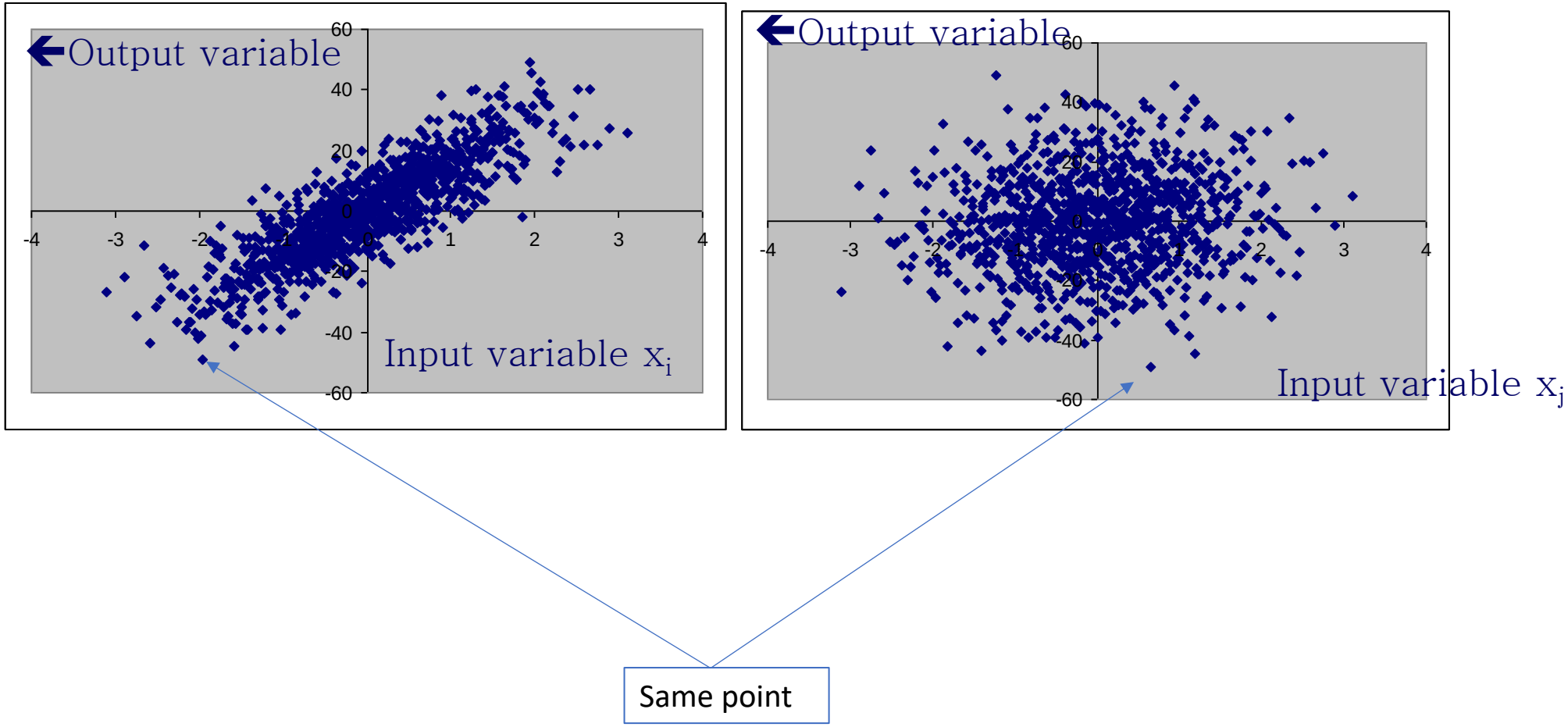
Essence of variance-based methods



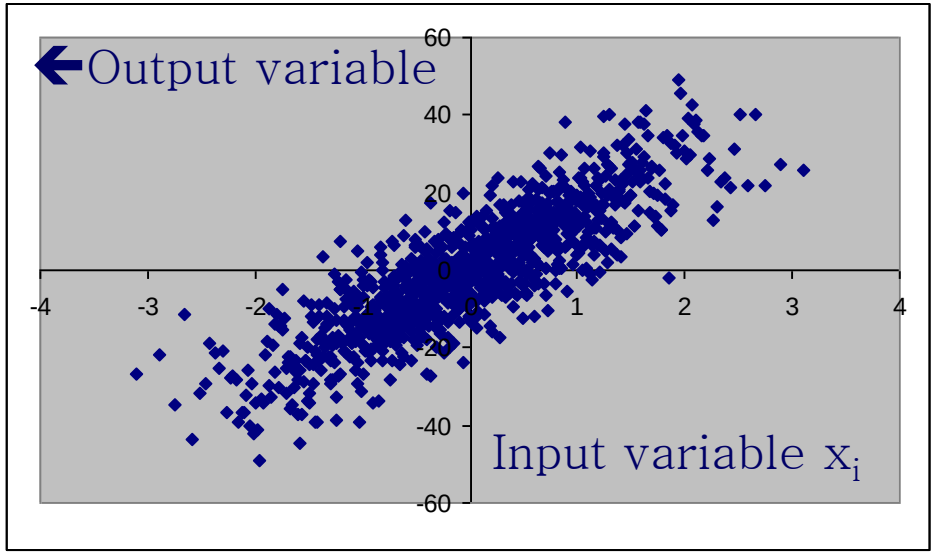


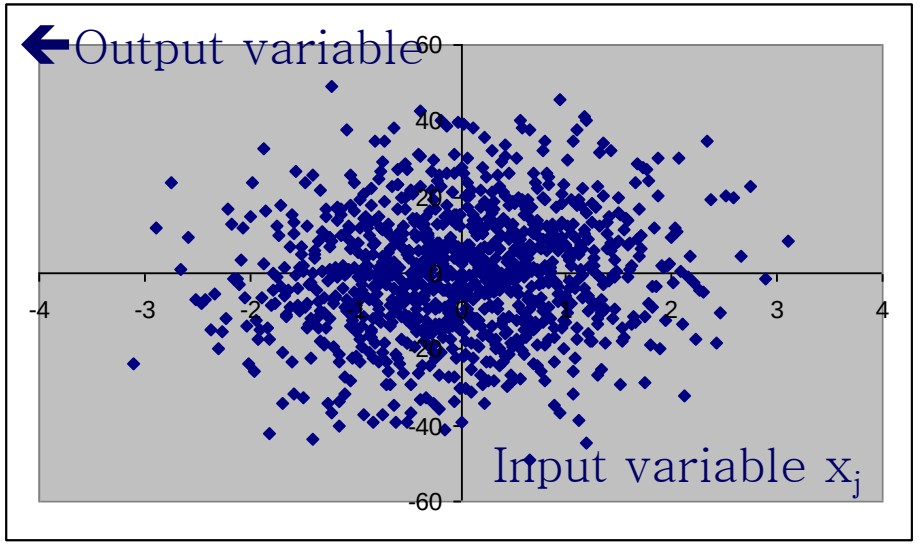
Plotting the output as a function of two different input factors:

The model has been run 1,000 times sampling all uncertain factors; two of them are shown here, x_i (left) and x_j (right). The output variable has first been sorted by increasing x_i then by increasing x_j.



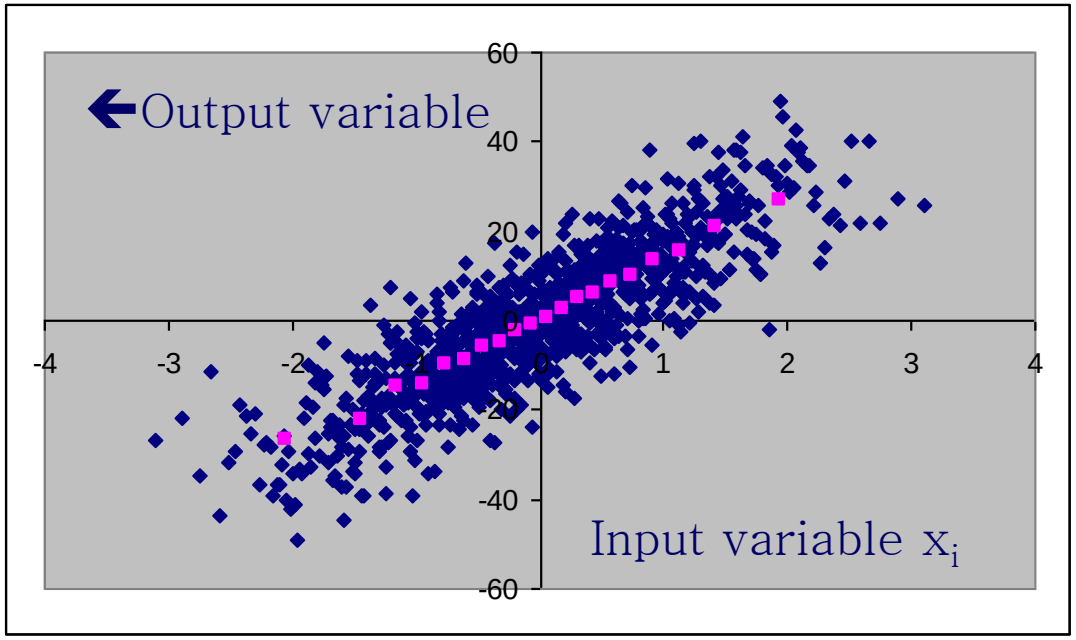
The points are always the same, only sorted differently

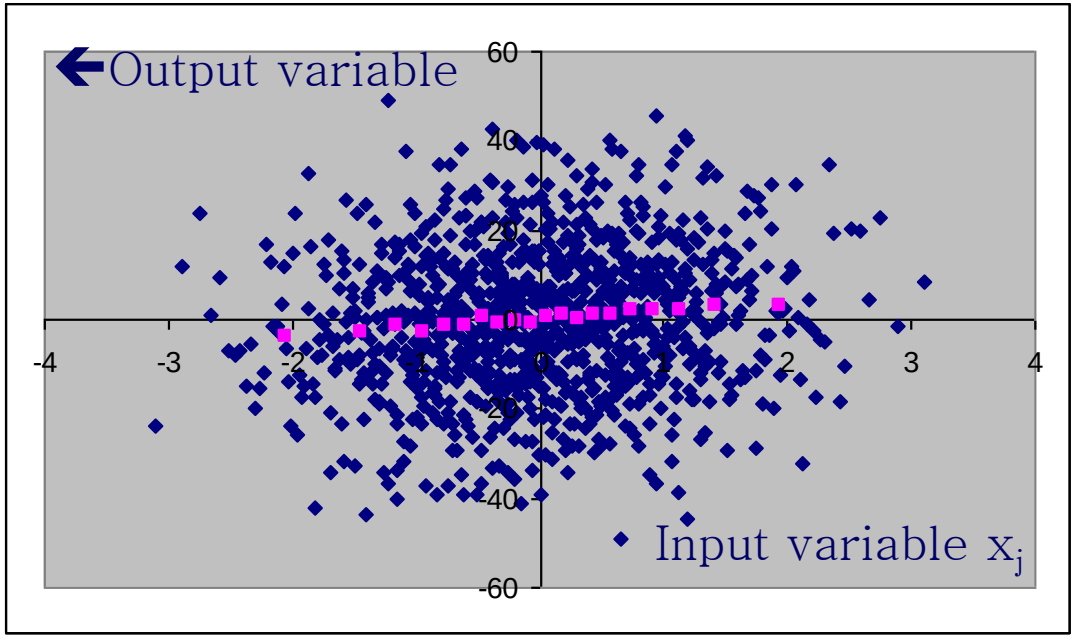




Plotting the output as a function of two different input factors

Which factor is more important?

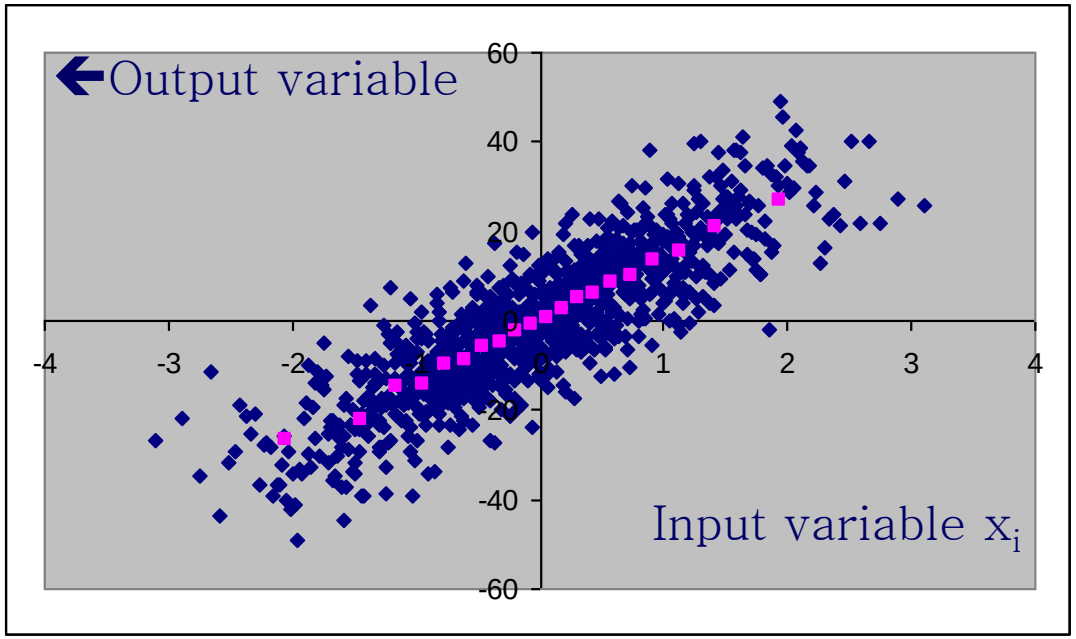




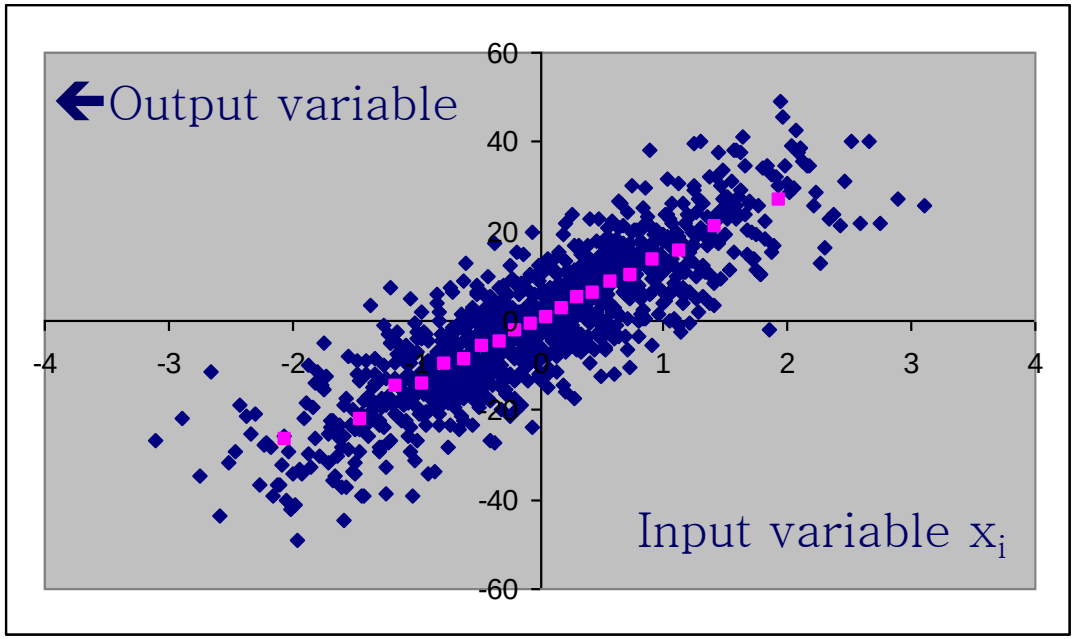
~1,000 blue points

Divide them in 20 bins of ~ 50 points

Compute the bin's average (pink dots)

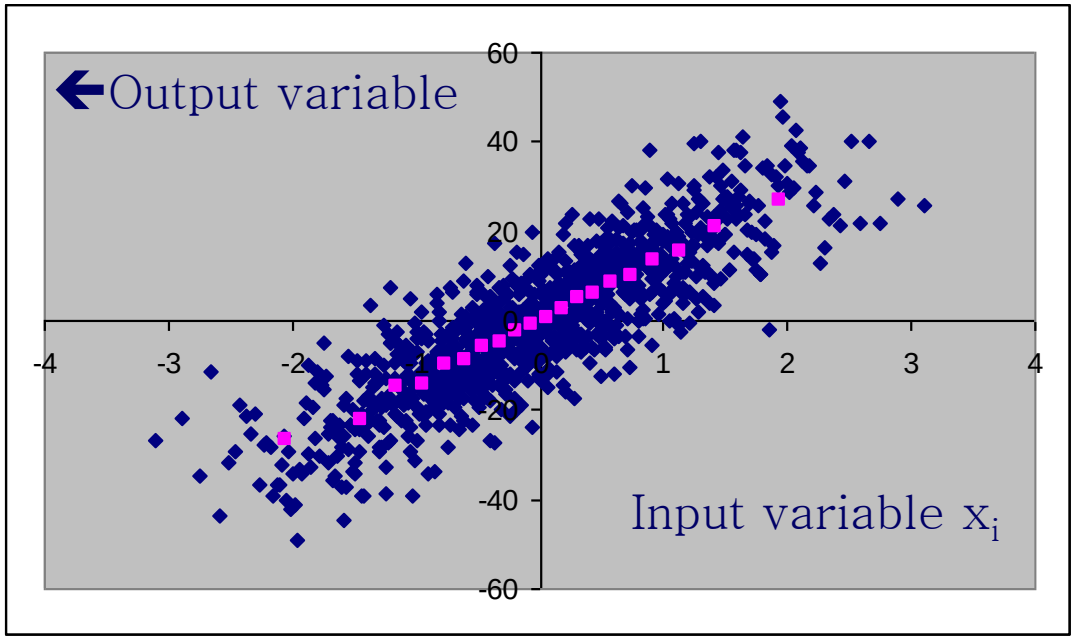


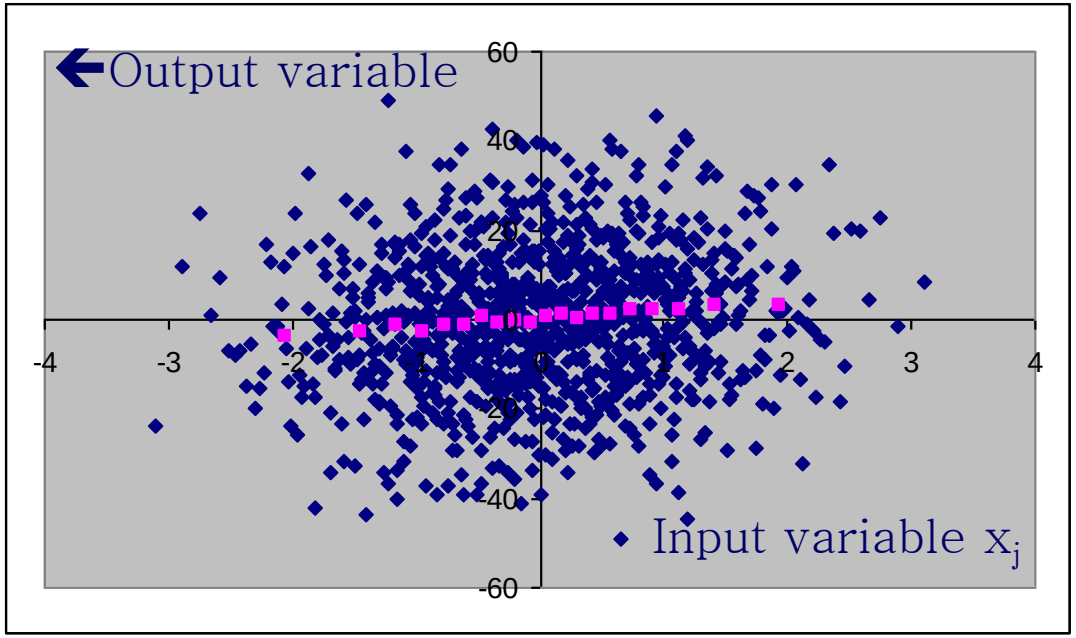
Each pink point is ~ $E_{\mathbf{X}_{\sim i}}\left(Y \middle| X_i\right)$



Taking the variance of the pink points one obtains a sensitivity measure

$$V_{X_i}\left(E_{\mathbf{X}_{\sim i}}\left(Y|X_i\right)\right)$$



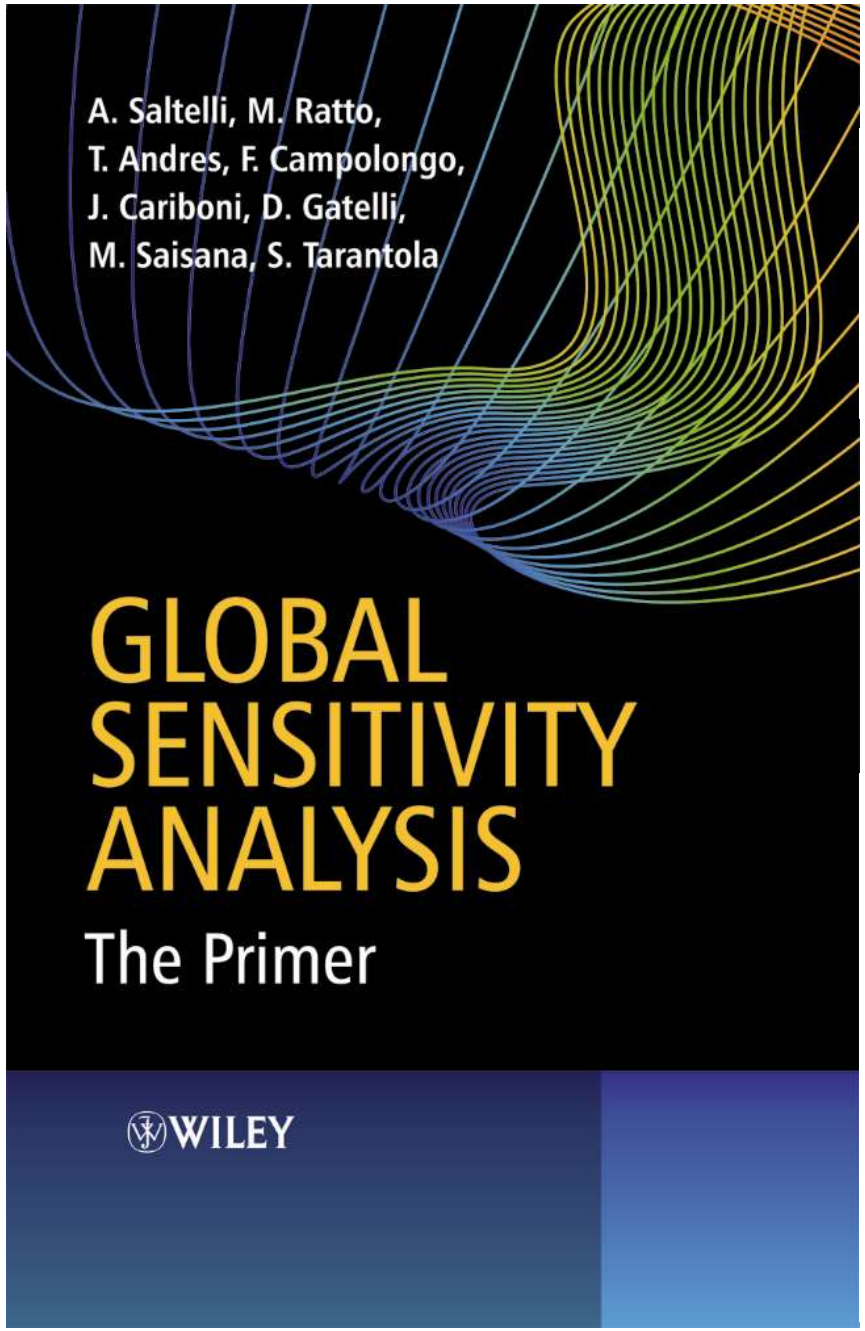


Which factor has the highest

$$V_{X_i}\left(E_{\mathbf{X}_{\sim i}}\left(Y\middle|X_i\right)\right)?$$

$$S_i = \frac{V_{X_i}\left(E_{\mathbf{X}_{\sim i}}\left(Y|X_i\right)\right)}{V(Y)}$$

The partial variance divided by the total variance is the so-called sensitivity index of the first order



All about variance-based sensitivity analysis and Sobol indices

(available online)

1.6 EXERCISES

1. Prove that

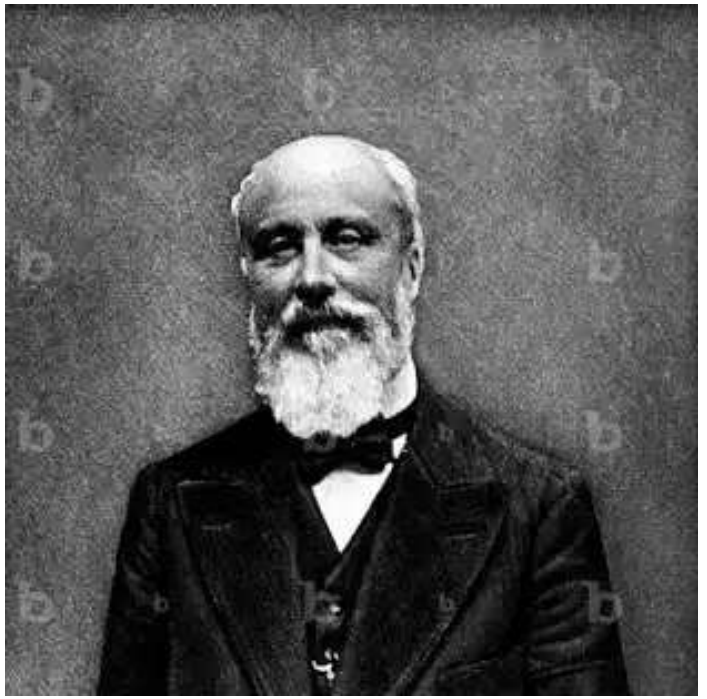
$$V(Y) = E(Y^2) - E^2(Y).$$

2. Prove that for an additive model of two independent variables X_1 and X_2, fixing one variable can only decrease the variance of the model.

Part II - Is GSA important? According to whom?

"… inferences from mathematical models of phenomena to real physical applications must also be demonstrated to be approximately correct when the assumptions of the model are only approximately true" [1]

Pierre Duhem (1861–1916) and his 'Principle of stability' ~1906

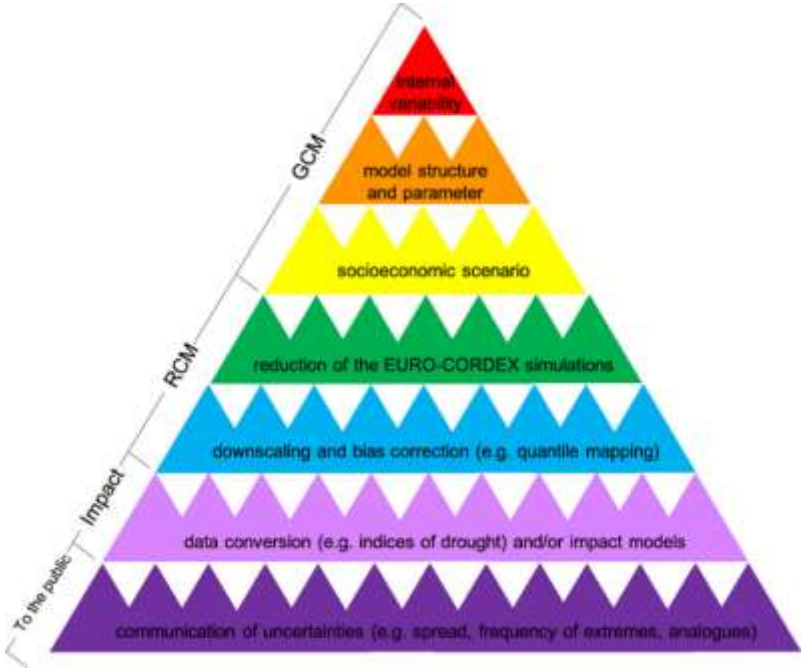


[1] See: S. C. Fletcher, 'The Principle of Stability', Philosopher's Imprint, vol. 20, no. 3, 2020, Accessed: Sep. 08, 2024. [Online].

Models are fragile

Duhem's principle of stability [1], links to the occurrence of either Butterfly [2] or Hawkmoth effects [3] … as well as to the accumulation of parametric error in a model, the so-called uncertainty cascade [4], that is the subject of global sensitivity analysis studies

[1] S. C. Fletcher, 'The Principle of Stability', Philosopher's Imprint, vol. 20, no. 3, 2020, Accessed: Sep. 08, 2024. [Online].
[2] H. G. Schuster, Deterministic Chaos: An Introduction, 2nd Rev edition. Weinheim: Vch Pub, 1998.
[3] E. Winsberg, 'Appendix: Structural Stability and the "Hawkmoth Effect"', in Philosophy and Climate Science, Cambridge: Cambridge University Press, 2018, pp. 232–246. doi: 10.1017/9781108164290.016.
[4] M. Christie, A. Cliffe, P. Dawid, and S. S. Senn, Simplicity, Complexity and Modelling. Wiley, 2011.



"I have proposed a form of organised sensitivity analysis that I call 'global sensitivity analysis' in which a neighborhood of alternative assumptions is selected and the corresponding interval of inferences is identified. Conclusions are judged to be sturdy only if the neighborhood of assumptions is wide enough to be credible and the corresponding interval of inferences is narrow enough to be useful."

Edward E. Leamer, Let's Take the Con Out of Econometrics, *American Economics Review*, **73** (March **1983**), 31-43.

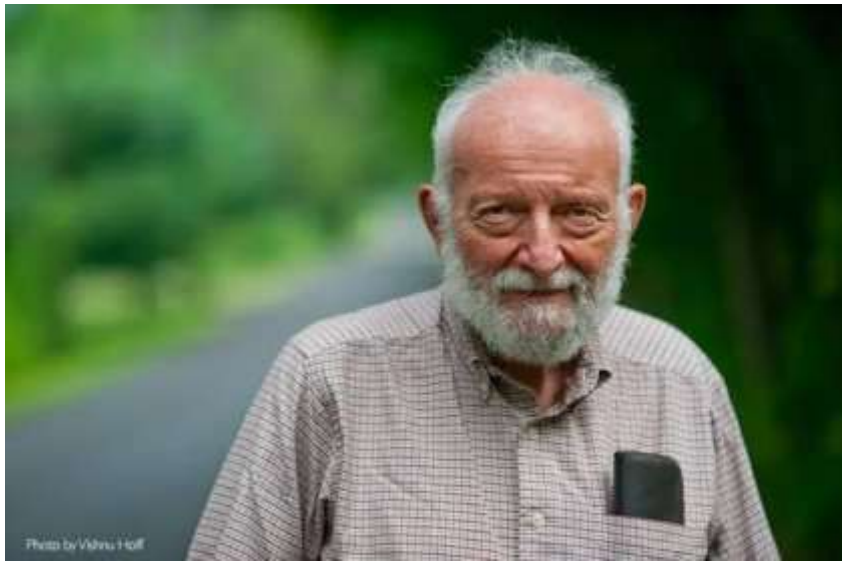
Edward E. Leamer

"One reason these methods are rarely used is their honesty seems destructive."

Tantalus on the Road to Asymptopia, Edward E. Leamer, 2010 *Journal of Economic Perspectives*, 24, (2), 31-46.

27 years

Edward E. Leamer, Let's Take the Con Out of Econometrics, *American Economics Review*, 73 (March 1983), 31-43.



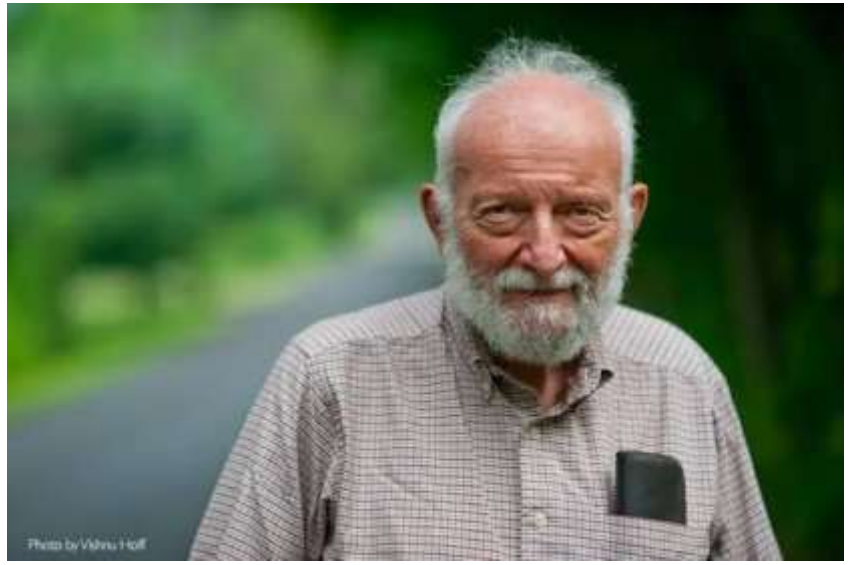
Richard Levins
1930-2016

Richard Levins' robustness analysis:

"Our truth is the intersection of independent lies"

➔ Construct multiple models with different assumptions and treat a result as credible only if it persists across those independent formulations

➔ Identify conclusions that are invariant to idealizations rather than artifacts of any single model.



A fate similar to that of Leamer's global sensitivity analysis befell Richard Levins' robustness analysis

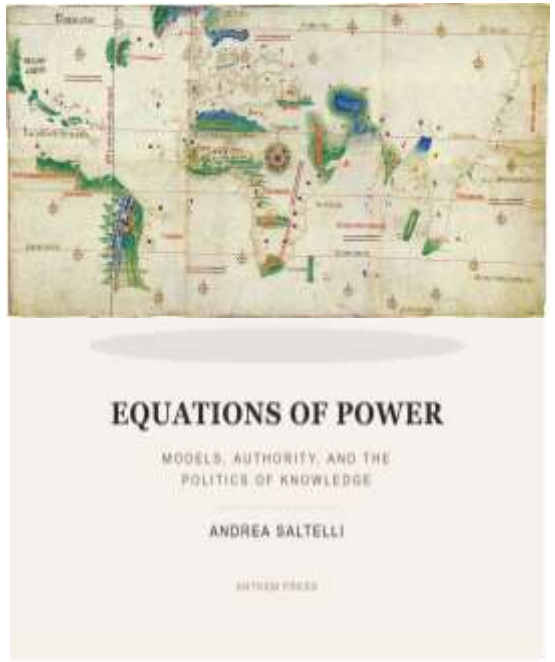
Richard Levins. The Strategy of Model Building in Population Biology. American Scientist, 54(4):421–431, 1966.

40 years

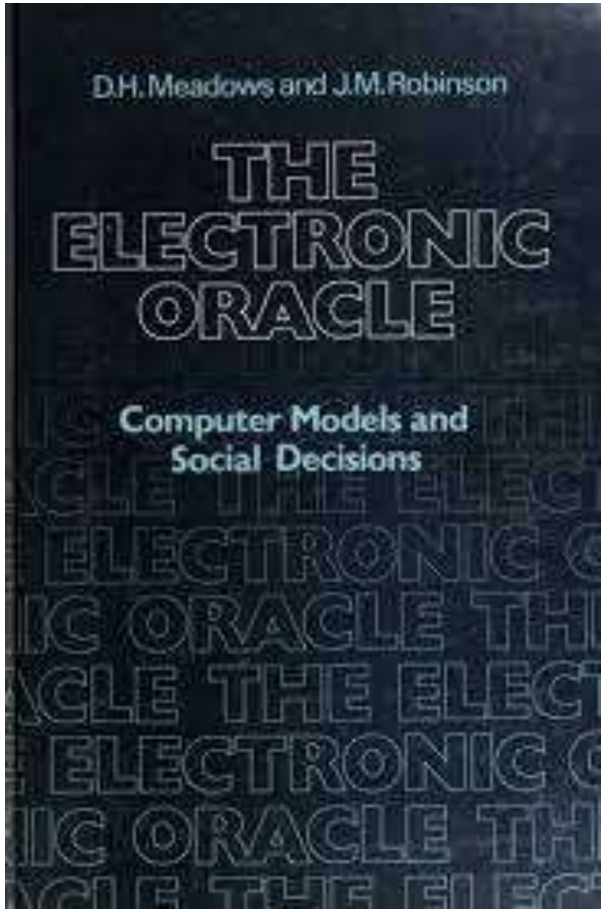
Michael Weisberg. Robustness Analysis. Philosophy of Science, 73(5):730–742, 2006.

Validation methods have historically lacked traction, and Dana Meadows lamented this ‘going on for decades’ in 1985 … Why?

A discussion here

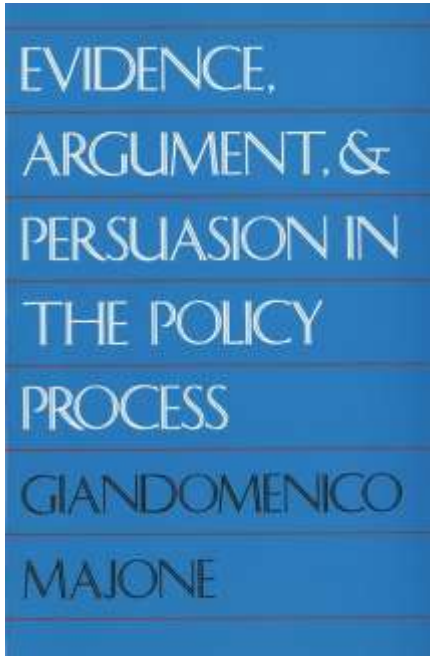


To appear



Published in 1985

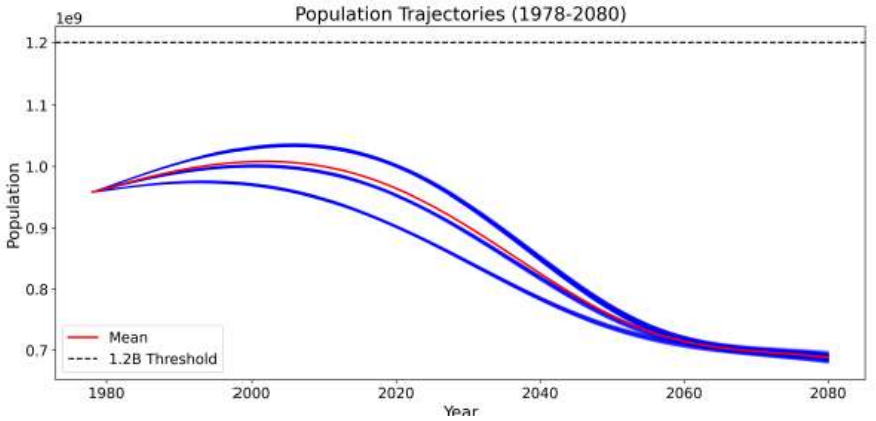
Giandomenico Majone



"Are the results from a particular model more sensitive to changes in the model and the methods used to estimate its parameters, or to changes in the data?"

p. 62, Giandomenico Majone. Evidence, argument, and persuasion in the policy process. Yale University Press, 1989.

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



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SSRN

What Demographic Prediction Can and Cannot Achieve

14 Pages • Posted: 19 May 2026

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University of Colorado at Boulder

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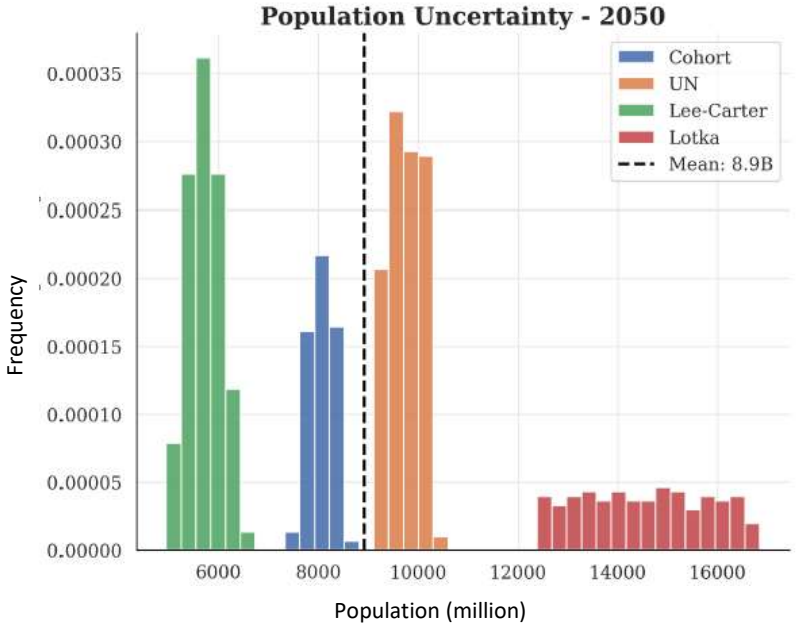
UPF Barcelona School of Management

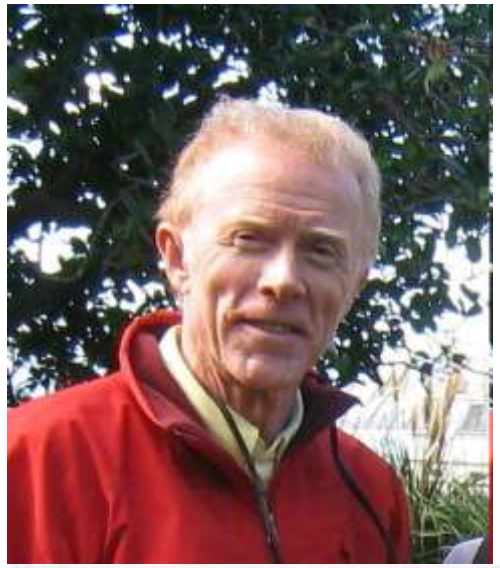
Date Written: May 15, 2026

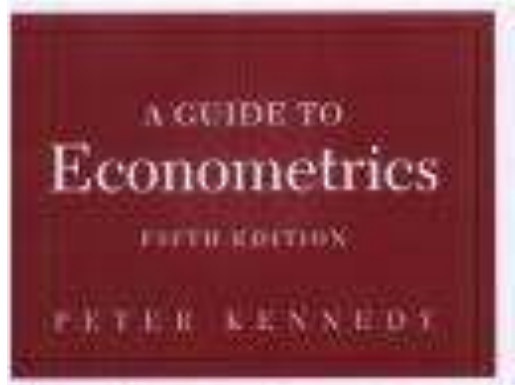
… while projections **today in use** are dramatically model-dependent



Peter Kennedy, A Guide to Econometrics. Anticipating criticism by applying sensitivity analysis. This is one of the ten commandments of applied econometrics according to Peter Kennedy:

<<Thou shall confess in the presence of sensitivity.
Corollary: Thou shall anticipate criticism >>





But the real strength of the models, in my mind at least, were in sensitivity analysis (where one could examine the response of the model to parameters or structures that were not known with precision (i.e., sensitivity analysis), and in the examination of the behavior of the model components relative to that of the real system in question (i.e., validation)

… By undertaking sensitivity analysis and validation, a great deal can be learned about the real system, including what you do not know. (Hall, 2020)

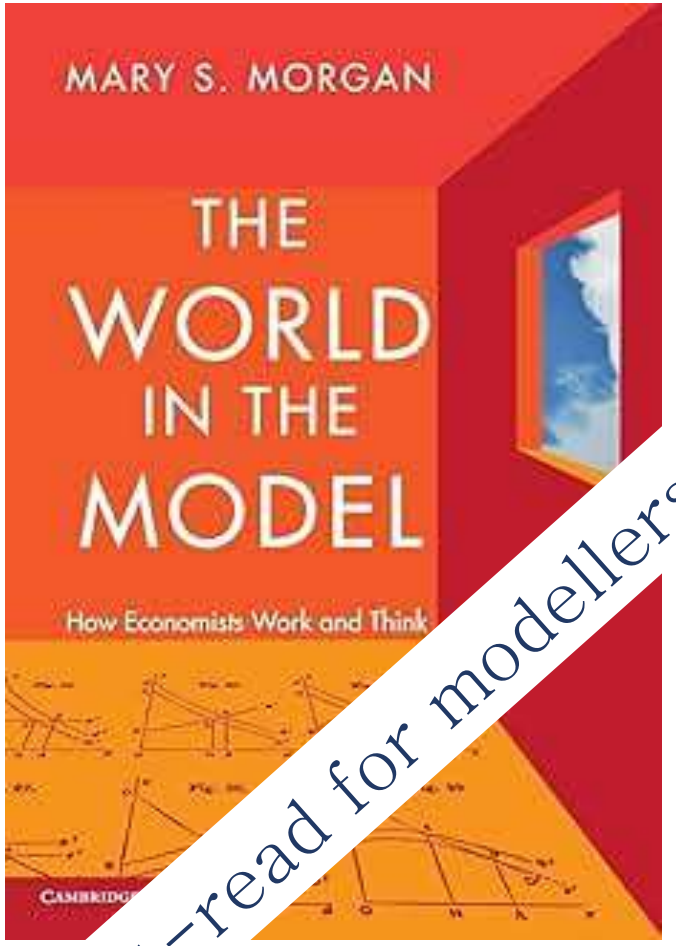
Charles A.S. Hall

Hall, C. A. S. (2020). Systems Ecology and Limits to Growth: History, Models, and Present Status. In G. S. Metcalf, K. Kijima, & H. Deguchi, eds., *Handbook of Systems Sciences*, Singapore: Springer, , pp. 1–38.

Mary S. Morgan

Hall's words resonate with Mary Morgan's 'the world in the model'

Playing with a model's moving parts to see what this gives, before seeing if it chimes with 'the model in the world'

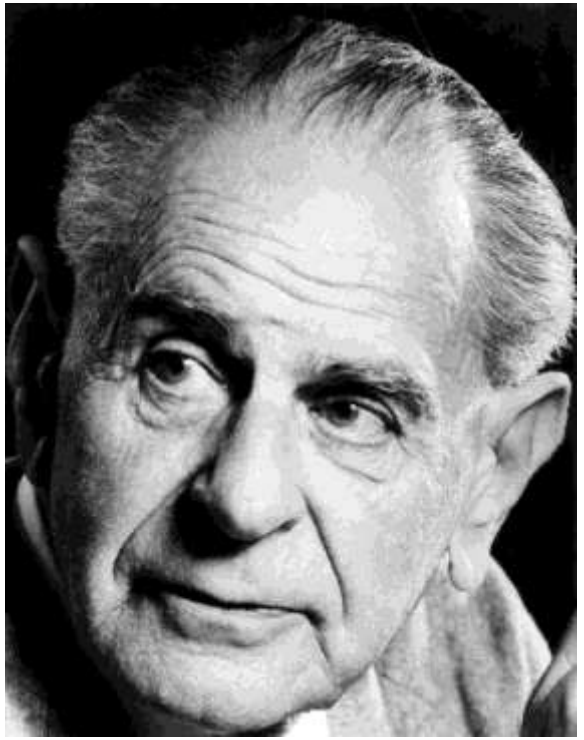


A must-read for modellers

Models that take no risks

The empirical content of a theory is measured by the risks it takes — the observations that could prove it wrong (severe tests)

Climate models projecting to 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

Models that take no risks

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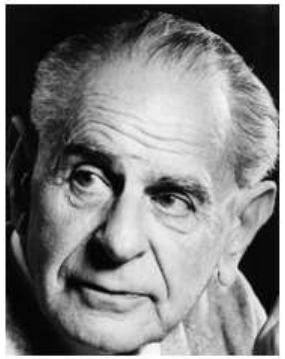
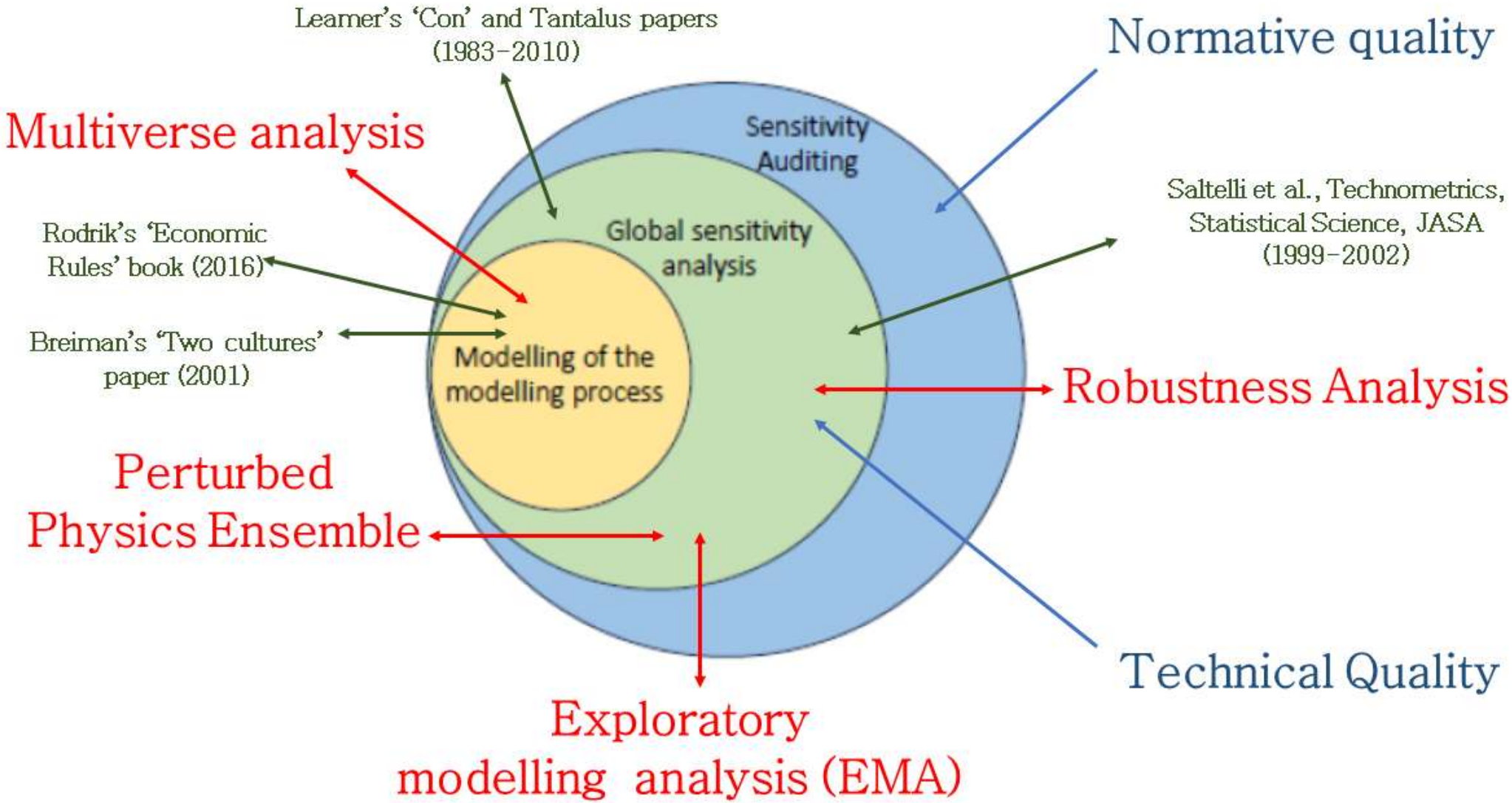


Karl Popper
(1902-1994)

These models take no risks. No severe tests here

Global sensitivity analysis as models' risky tests

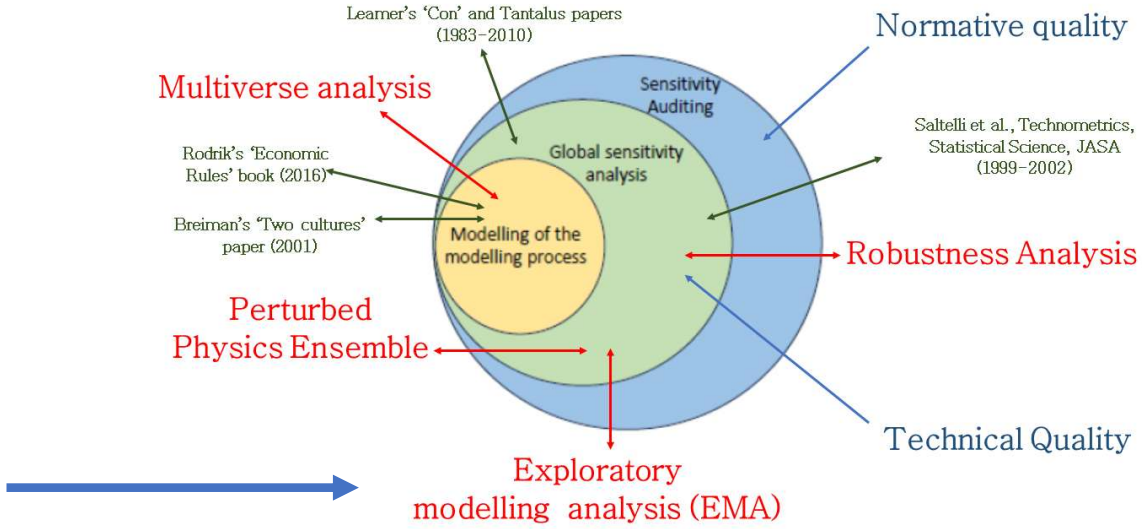
Part III GSA, machine learning, multiverse and neighbourhoods


Learner's 'Con' and Tantalus papers (1983-2010)
Normative quality
Multiverse analysis
Sensitivity Auditing
Saltelli et al., Technometrics, Statistical Science, JASA (1999-2002)
Rodrik's 'Economic Rules' book (2016)
Global sensitivity analysis
Breiman's 'Two cultures' paper (2001)
Modelling of the modelling process
Robustness Analysis
Perturbed Physics Ensemble
Technical Quality
Exploratory modelling analysis (EMA)

Exploratory modelling analysis (RAND corporation)

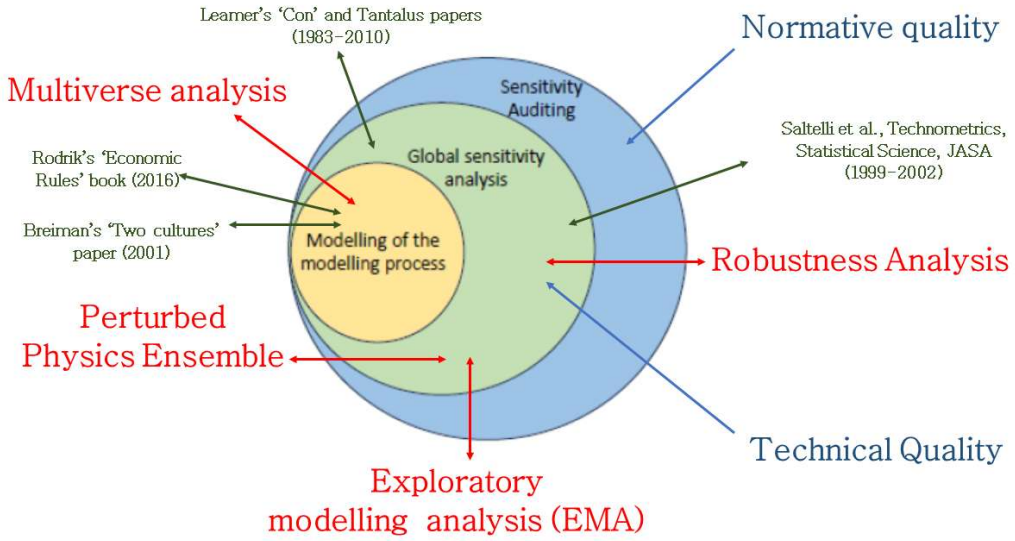
Explore scenarios and simulate

(Too) liberally?



Jan H. Kwakkel and Erik Pruyt. Exploratory Modeling and Analysis, an approach for model-based foresight under deep uncertainty. Technological Forecasting and Social Change, 80(3):419-431, March 2013.

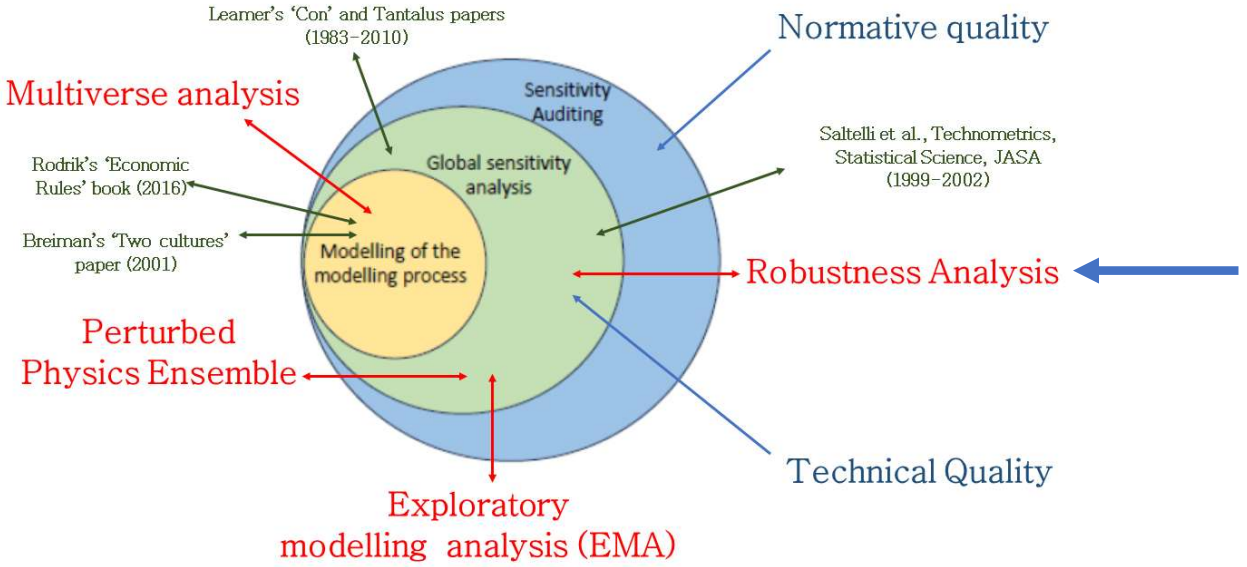
Perturbed parameter (or physics) ensemble: same as uncertainty quantification and sensitivity analysis when done by physicists in climate modelling



John W. Rostron, David M. H. Sexton, Carol F. McSweeney, Kuniko Yamazaki, Timothy Andrews, Kalli Furtado, Mark A. Ringer, and Yoko Tsushima. The impact of performance filtering on climate feedbacks in a perturbed parameter ensemble. Climate Dynamics, 55(3):521–551, August 2020. doi:10.1007/s00382-020-05281-8

Robustness analysis (Houkes et al., 2024)

parameter RA ➔ dependence on model parameters
structural RA ➔ dependence on structural assumption
representational RA ➔ model philosophy, e.g., moving from a math / differential equations to agent-based modelling



Wybo Houkes, Dunja Šešelja, and Krist Vaesen. Robustness Analysis. In Tarja Knuuttila, Natalia Carrillo, and Rami Koskinen, editors, The Routledge Handbook of Philosophy of Scientific Modeling, pages 195–207. Routledge, Abingdon, Oxon ; New York, NY, 2024.

Leo Breiman
1928-2005

Leo Breiman's 'Two cultures' work

"The goal is not interpretability, but accurate information"

➔ Embrace model-agnostic algorithmic culture that prioritizes empirical predictive accuracy

Leo Breiman. Statistical Modeling: The Two Cultures
Statistical Science, 16(3):199–231, August 2001

Two cultures

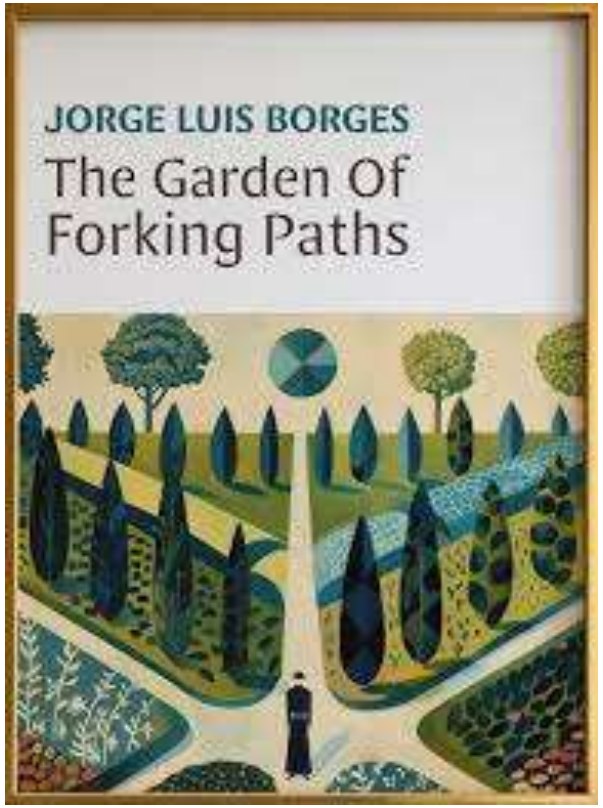
The Data Modelling Culture
Data are generated by a specific stochastic model; estimate its parameters.

The Algorithmic Modelling Culture
The data-generating mechanism is unknown; focus on predictive accuracy using algorithms.

Leo Breiman. Statistical Modeling: The Two Cultures Statistical Science, 16(3):199–231, August 2001

The Algorithmic Modelling Culture
Provided an epistemological justification for machine learning and, in time, AI

The Data Modelling Culture
Discovered the ‘Garden of Forking Paths; opened the season of multi-analyst experiments and multiverse analysis



Application to Machine Learning

Example use SA to ascertain that an algorithm does not make implicit use of protected attributes

More reading about explainable ML

Lu, Xuefei, and Emanuele Borgonovo. 2026. “How Do I Explain That Decision? A New Approach Combining Counterfactuals and Sensitivity Analyses.” European Journal of Operational Research 334 (1): 200–215. https://doi.org/10.1016/j.ejor.2026.04.035.

Giulia Vannucci, Roberta Siciliano, Andrea Saltelli, 2026, Global sensitivity analysis in random forests: unveiling generative variable importance. Statistical Methods and Applications, 34(5), https://doi.org/10.1007/s10260-026-00839-y.

Bénesse, C., Gamboa, F., Loubes, J.-M., & Boissin, T. (2022). Fairness seen as Global Sensitivity Analysis. *Machine Learning*. https://doi.org/10.1007/s10994-022-06202-y

More reading about explainable ML

Bénesse, C., Gamboa, F., Loubes, J.-M., & Boissin, T. (2022). Fairness seen as Global Sensitivity Analysis. *Machine Learning*. https://doi.org/10.1007/s10994-022-06202-y

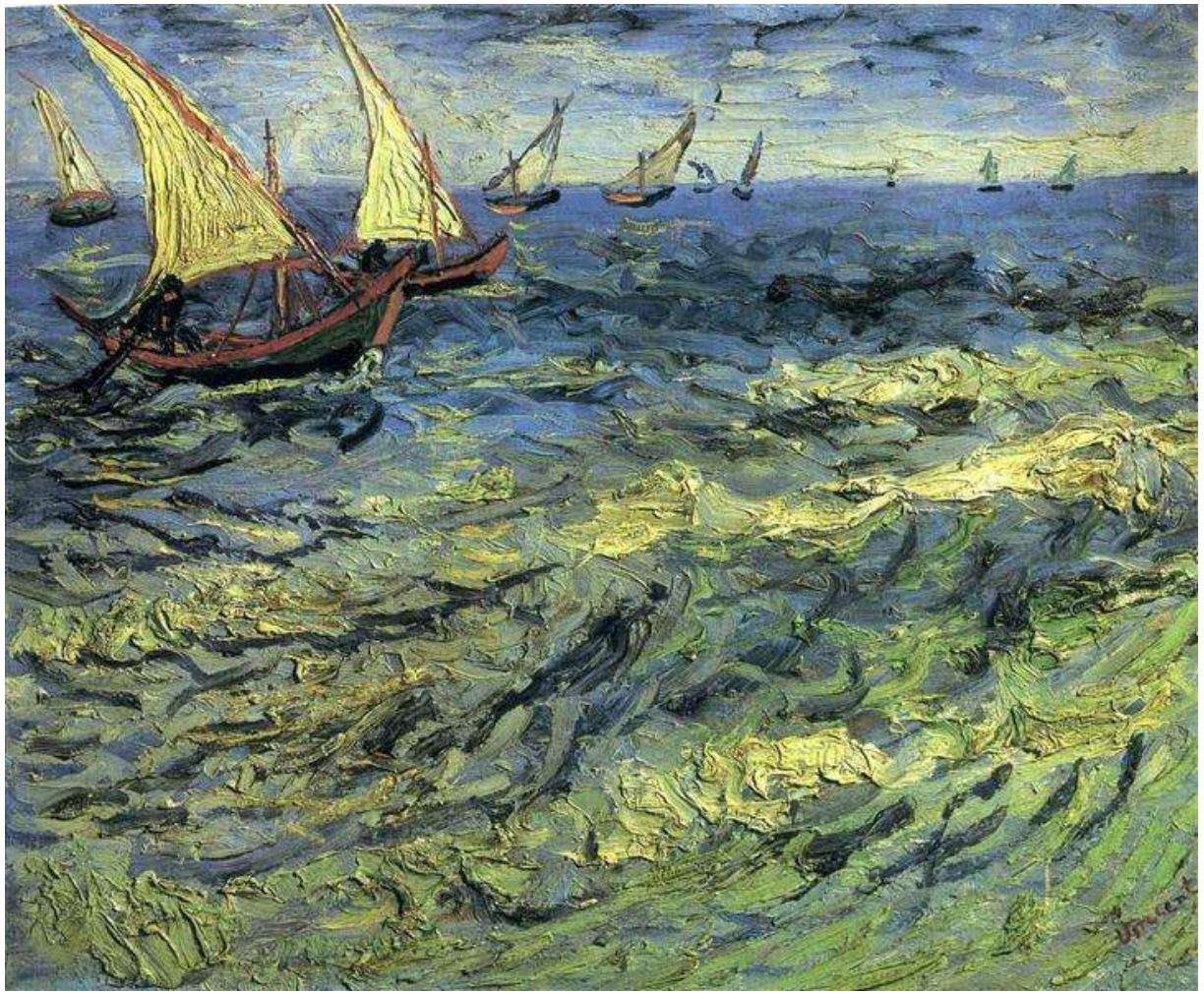
"fairness can be defined using a special framework based on Global Sensitivity Analysis …"

More reading about explainable ML: combining counterfactual and Shapley values

Lu, Xuefei, and Emanuele Borgonovo. 2026. “How Do I Explain That Decision? A New Approach Combining Counterfactuals and Sensitivity Analyses.” European Journal of Operational Research 334 (1): 200–215. https://doi.org/10.1016/j.ejor.2026.04.035.

“In machine learning, [the idea is]to treat features as players and model predictions as rewards”

Fishing expeditions? Forking paths?



Vincent van Gogh, Fishing Boats at Sea, source: https://www.wikiart.org/

Jorge Luis Borges
(1899-1986)

Taking different narratives within the same novel like Ts'ui Pên

The garden of forking paths: Why multiple comparisons can be a problem, even when there is no "fishing expedition" or "p-hacking" and the research hypothesis was posited ahead of time*

Andrew Gelman† and Eric Loken‡

14 Nov 2013

Many multi-analyst studies ongoing, e.g.:

"Are soccer players with dark skin tone more likely to receive red cards from referees?", Silberzahn et al. 2018

"Is there an impact of compulsory schooling on teenage pregnancy rates?", Huntington-Klein et al. (2021)

Source: BBC https://www.bbc.com/sport/football/68435064

HUNTINGTON-KLEIN, N., ARENAS, A., BEAM, E., BERTONI, M., BLOEM, J. R., BURLI, P., CHEN, N., GRIECO, P., EKPE, G., PUGATCH, T. et al. (2021). The influence of hidden researcher decisions in applied microeconomics. Economic Inquiry 59 944–960.
SILBERZAHN, R., UHLMANN, E. L., MARTIN, D. P., ANSELMI, P., AUST, F., AWTREY, E., BAHNÍK, Š., BAI, F., BANNARD, C., BONNIER, E. et al. (2018). Many analysts, one data set: Making transparent how variations in analytic choices affect results. Advances in Methods and Practices in Psychological Science 1, 337–356.

Multi-analyst studies ➔ multiverse analysis, though the two are different:

	Multi-Analyst Study	Multiverse Analysis
Unit of variation	Different analysts	Different analytic specifications
Source of variability	Human judgment	Enumerated decision space
Structure	Decentralized	Systematic grid
Scalability	Limited by analyst pool	Limited by comput. Complexity
Epistemic target	Researcher heterogeneity	Specification robustness

➔ **Multi-analyst studies** examine social epistemology — how scientific communities generate variability.

➔ **Multiverse analyses** examine statistical robustness — how conclusions depend on modelling choices.

Defining the multiverse (Simonsohn et al. 2020)

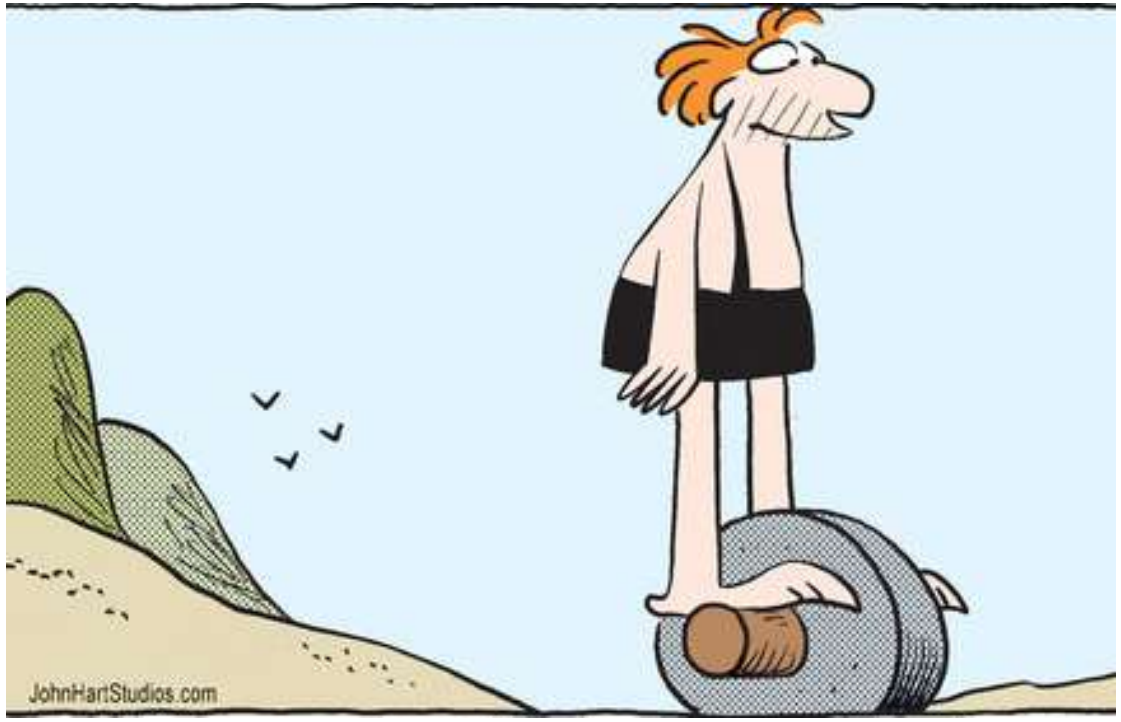
A systematic approach to handling:

- Researchers' degrees of freedom
- Analytic flexibility
- Model specification choice

https://www.istockphoto.com/

Simonsohn, Uri, Joseph P. Simmons, and Leif D. Nelson. 2020. "Specification Curve Analysis." Nature Human Behaviour 4 (11): 1208–14.

Are different words being used for the same thing?



BC, comic strip by cartoonist Johnny Hart

The Tower of Babel by Pieter Bruegel the Elder (1563). Source: Wikipedia Commons

Or is this a wheel rediscovered

Back to the garden

The garden of forking paths: Why multiple comparisons can be a problem, even when there is no "fishing expedition" or "p-hacking" and the research hypothesis was posited ahead of time*

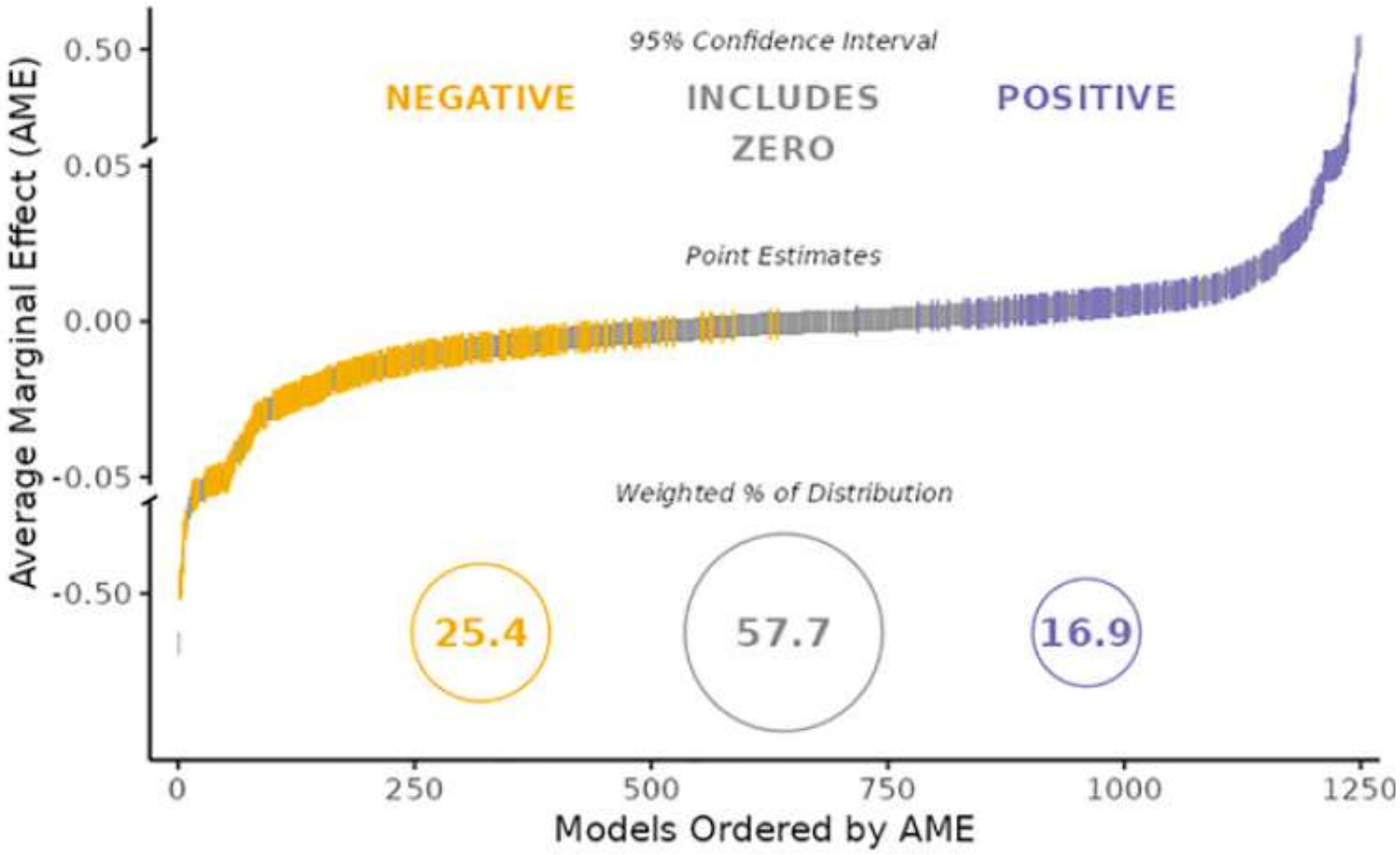
Andrew Gelman† and Eric Loken‡

14 Nov 2013

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



"Will different researchers [73 teams] converge on similar findings when analysing the same data?

…teams' results varied greatly, ranging from large negative to large positive effects"

PNAS RESEARCH ARTICLE | SOCIAL SCIENCES OPEN

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In the PNAS multi-analyst study the normative (political) orientation of the analysts was found **not** to explain much of the variance

The modelling variables themselves were found to explain at most a few percent of the variance of the results … **where does the variance come from?**

https://www.istockphoto.com/

Simulate different paths using triggers

k_i	Variable	Description
1	*age*	Inclusion or non-inclusion of the covariates age and square age of participants
2	*all − ethnic*	Inclusion or non-inclusion of a covariate that takes into account all ethnic categories
3	*bootstrap*	Inclusion or non-inclusion of the bootstrap procedure
4	*cont − europe*	Inclusion or non-inclusion of continental Europe countries in the analysis
9	*income*	Inclusion or non-inclusion of the covariate related to the income
10	*pop − wb*	Inclusion or non-inclusion of the covariate related to the information about country-specific numerosity of population
11	*rich − dems*	Inclusion or non-inclusion of rich democracies in the analysis
12	*SE*	Inclusion or non-inclusion of clustered standard error
13	*socx − oecd*	Inclusion or non-inclusion of the covariate related to social expenditure
14	*X*1	Inclusion or non-inclusion of the covariates related to the migration indexes
15	*Y*	Choice of policy dependent variable

3 *bootstrap* Inclusion or non-inclusion of the bootstrap procedure
4 *cont − europe* Inclusion or non-inclusion of continental Europe countries in the analysis

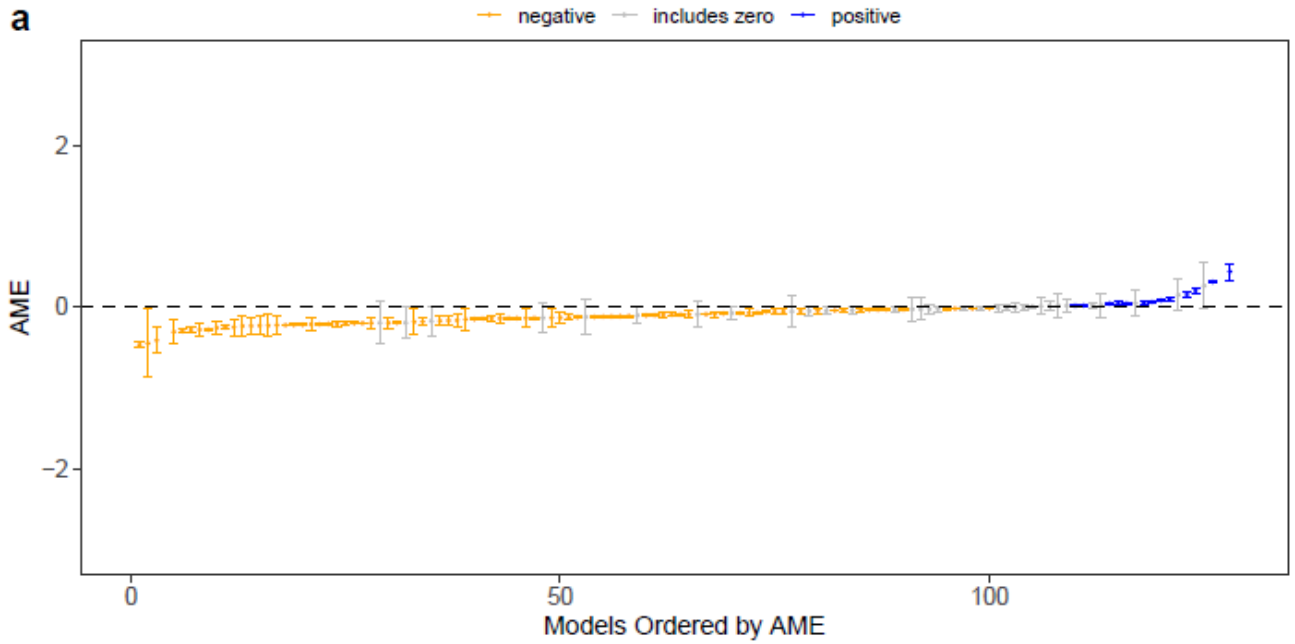
Table 1. Descriptions of variables included in the analysis.

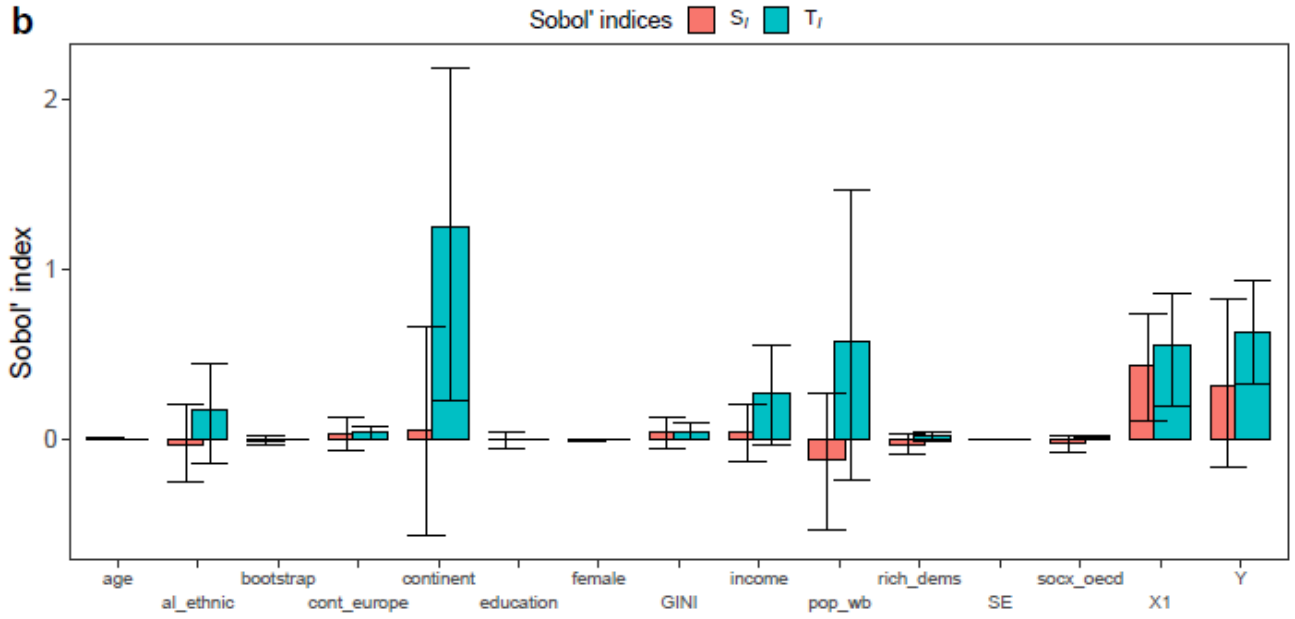
Leamer Reloaded: A Long-Neglected Suggestion Is Rediscovered To Apply Global Sensitivity Analysis To A Quantification Before Publishing It

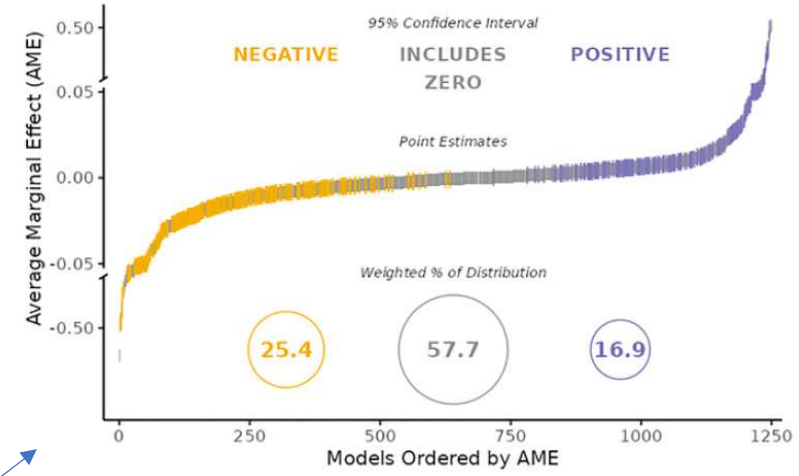
Andrea Saltelli*[1,2], Alessio Lachi[3,4], Arnald Puy[5], and Nate Breznau[6]

OSF

https://osf.io/preprints/metaarxiv/sq34n_v1



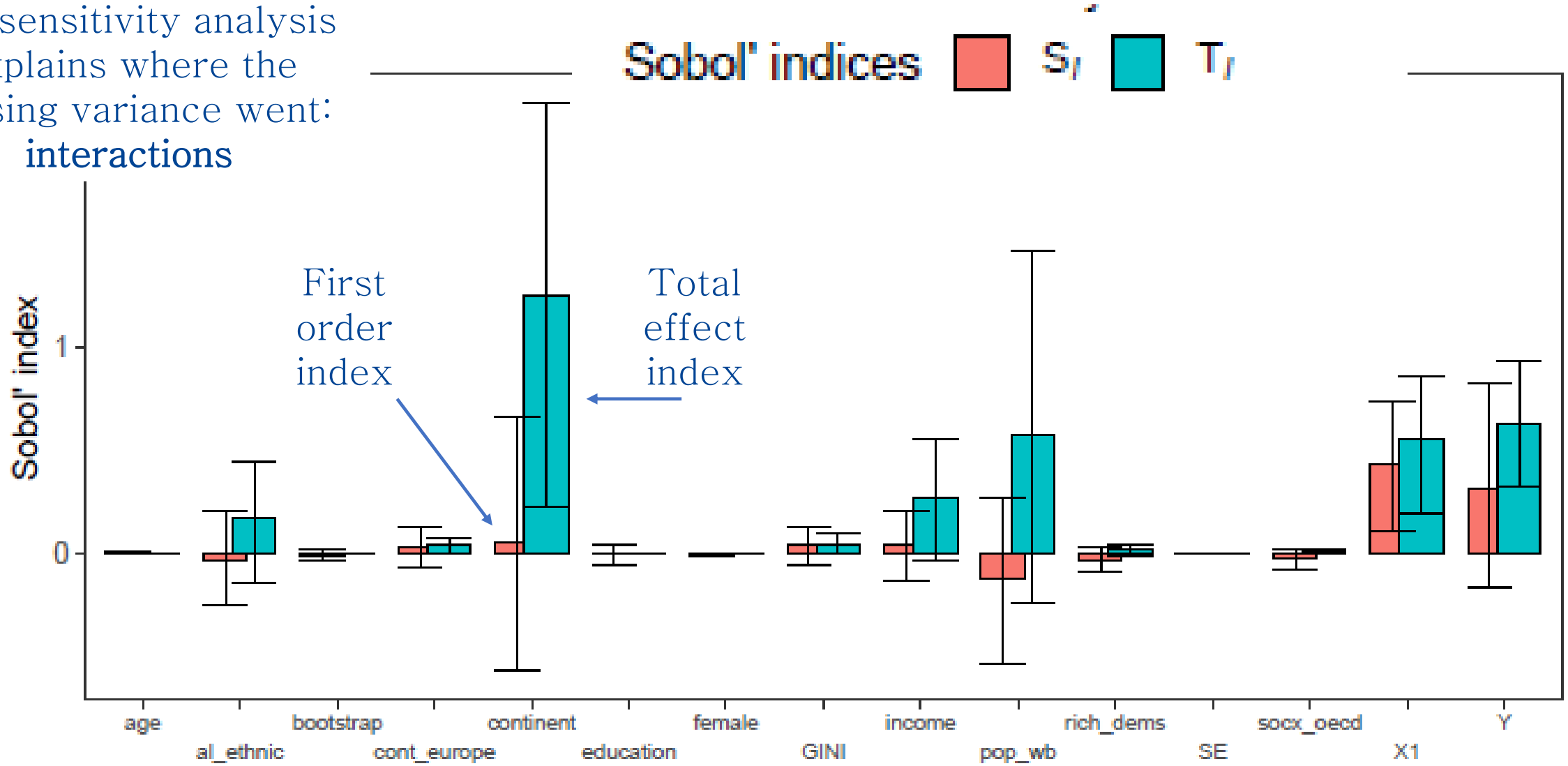




Uncertainty analysis broadly reproduces the results of the multi-analyst experiment

Our sensitivity analysis explains where the missing variance went: **interactions**

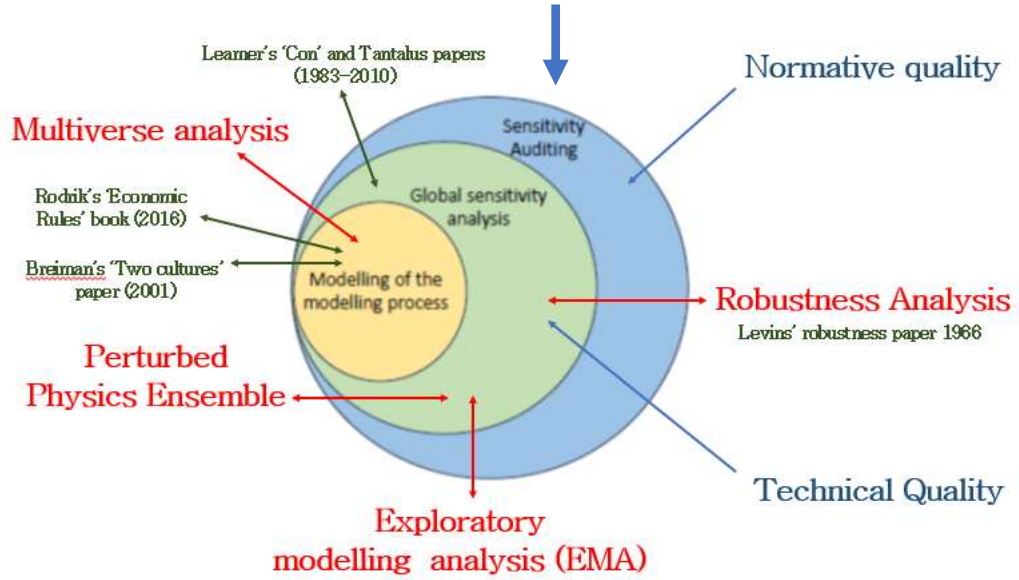
Our sensitivity analysis explains where the missing variance went: **interactions**



Modelling of the modelling process and multiverse analysis tells us how sensitive conclusions are to the paths taken …

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

Sensitivity auditing: "Sensitivity auditing is a wider consideration of the effect of all types of uncertainty, including structural assumptions embedded in the model, and subjective decisions taken in the framing of the problem" (European Commission, 2021).



European Commission. November 2021. "Better Regulation: Guidelines and Toolbox." https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-and-how/better-regulation-guidelines-and-toolbox_en

Int. J. Foresight and Innovation Policy, Vol. 9, Nos. 2/3/4, 2013 213

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

ELSEVIER

Energy Research & Social Science
Volume 127, September 2025, 104296

Original research article

Energy policy-making in the European Union between past and present ☆

Samuele Lo Piano [a b], Andrea Saltelli [b c]

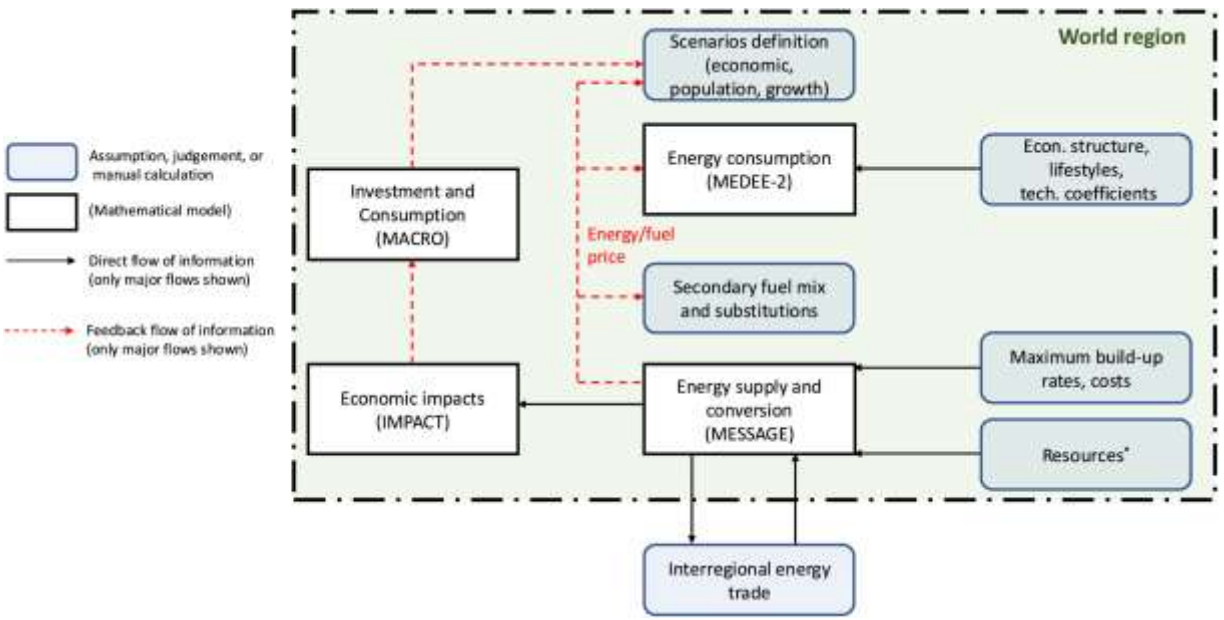
Show more

A recent application to show that old pathologies in modelling persist

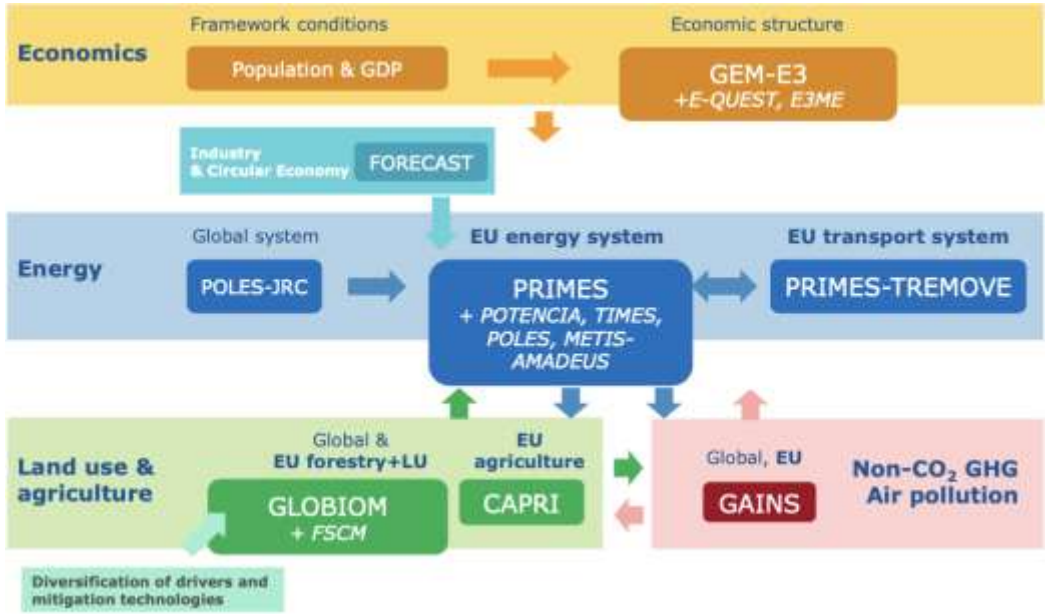
upf. BARCELONA SCHOOL OF MANAGEMENT

- We contrast a 1980s energy study and a 2024 EU impact assessment on emissions.
- Auditing reveals persistent flaws when models are used to inform policy.

IIASA 1980's



EC 2024



The rhetoric of the concatenated suite of models

Home › Policy Sciences › Article

The institutional context of science, models, and policy: The IIASA energy study

Published: September 1984

Volume 17, pages 277–320, (1984) Cite this article

Brian Wynne (and others such as William Keepin) debunked in the early 80's the off-the-mark model-based energy future, declared as 'scientifically prescribed' by analysts at IIASA …

A fast breeder reactor in the Netherlands, today an amusement park

See a summary here

ELSEVIER

Energy Research & Social Science

Volume 127, September 2025, 104296

Original research article

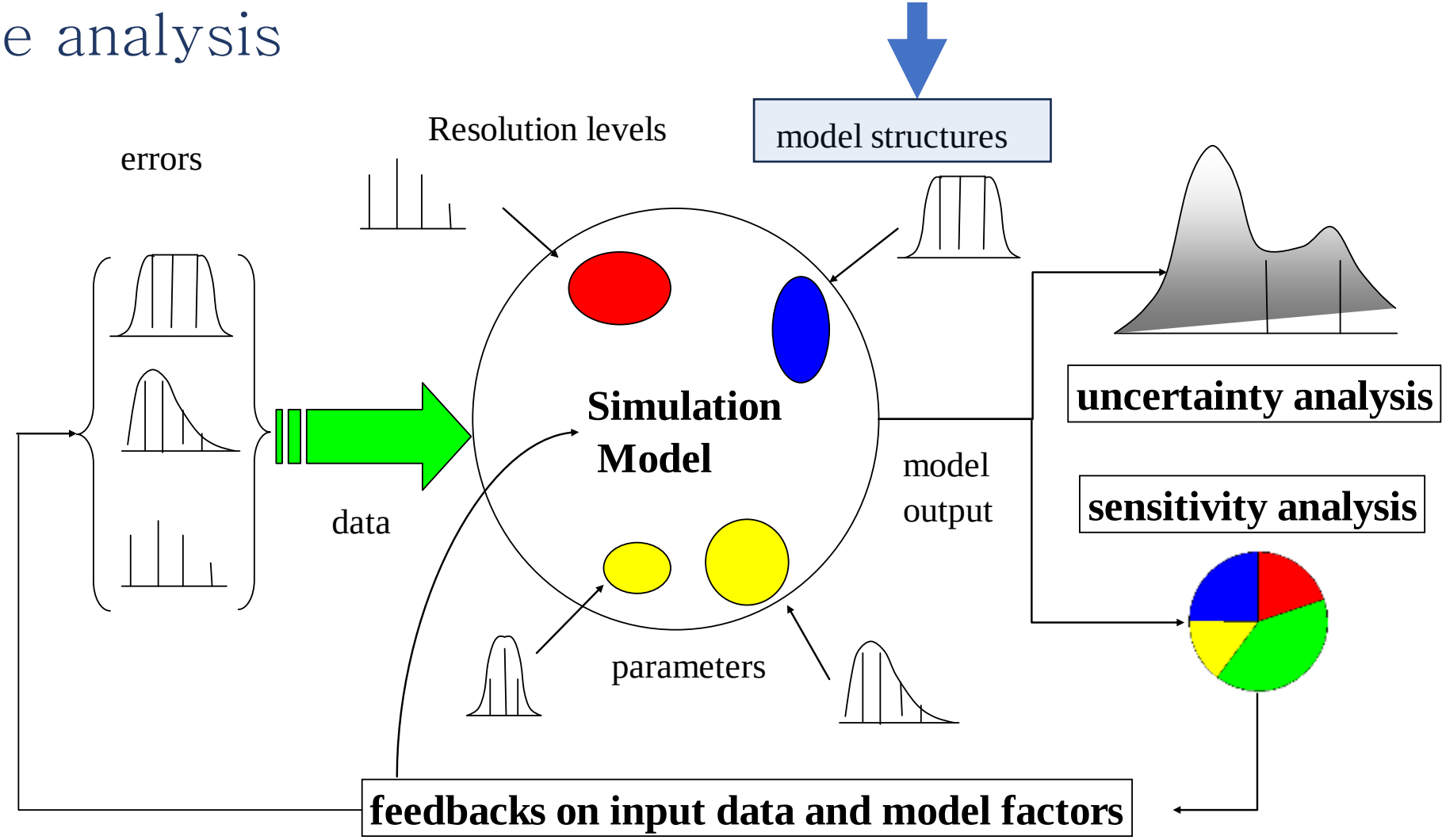
Energy policy-making in the European Union between past and present ☆

Samuele Lo Piano [a b], Andrea Saltelli [b c]

Show more

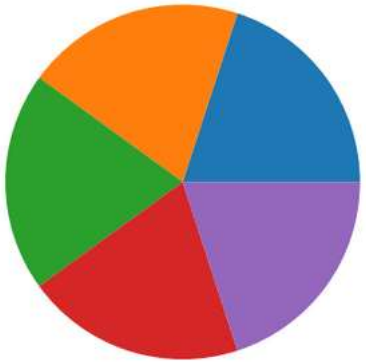
Part IV GSA’s dos and don'ts

Sample modelling choices via ‘triggers’. Global sensitivity analysis becomes thus a modelling of the modelling process = multiverse analysis



Example of using triggers: an integer in [1-5] is used to select one out of 5 possible evapotranspiration formulae at each model run

Trigger=an integer variable, whose value is determined via 'Russian roulette' in Monte Carlo jargon



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The delusive accuracy of global irrigation water withdrawal estimates

Arnald Puy ✉, Razi Sheikholeslami, Hoshin V. Gupta, Jim W. Hall, Bruce Lankford, Samuele Lo Piano, Jonas Meier, Florian Pappenberger, Amilcare Porporato, Giulia Vico & Andrea Saltelli

Nature Communications **13**, Article number: 3183 (2022) | Cite this article

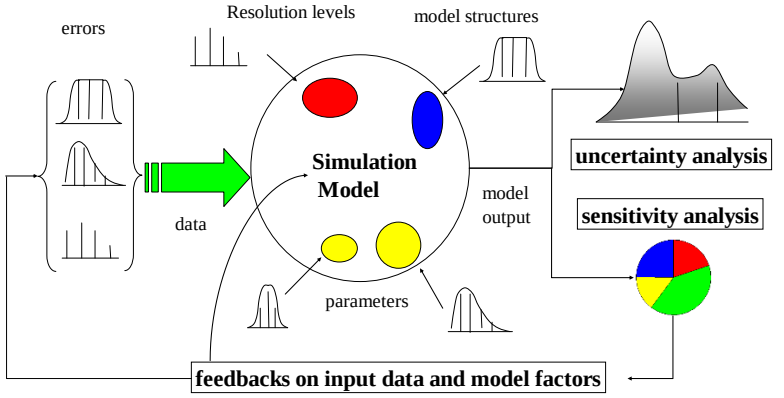
10k Accesses | **79** Citations | **93** Altmetric | Metrics

Russian roulette as depicted in the 1925 film The Night Club. Source: Wikipedia Commons

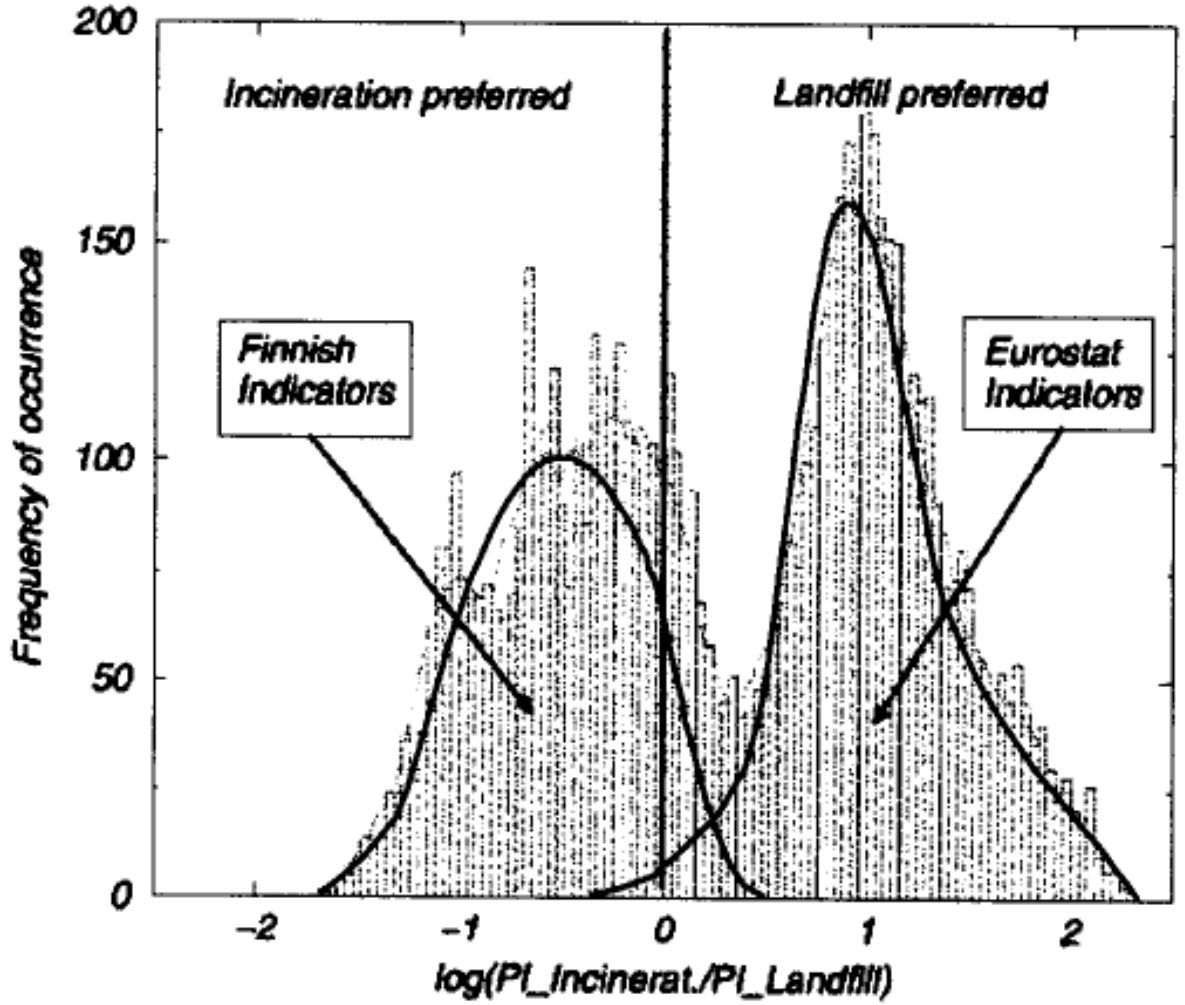
➔ Don't sample just parameters and boundary conditions: explore the space of assumptions thoroughly

One can sample more than just factors:

- modelling assumptions,
- alternative data sets,
- resolution levels,
- policies



Look at policy options versus existing uncertainties: e.g., test whether the choice of the model determines the choice of the policy



November 2000

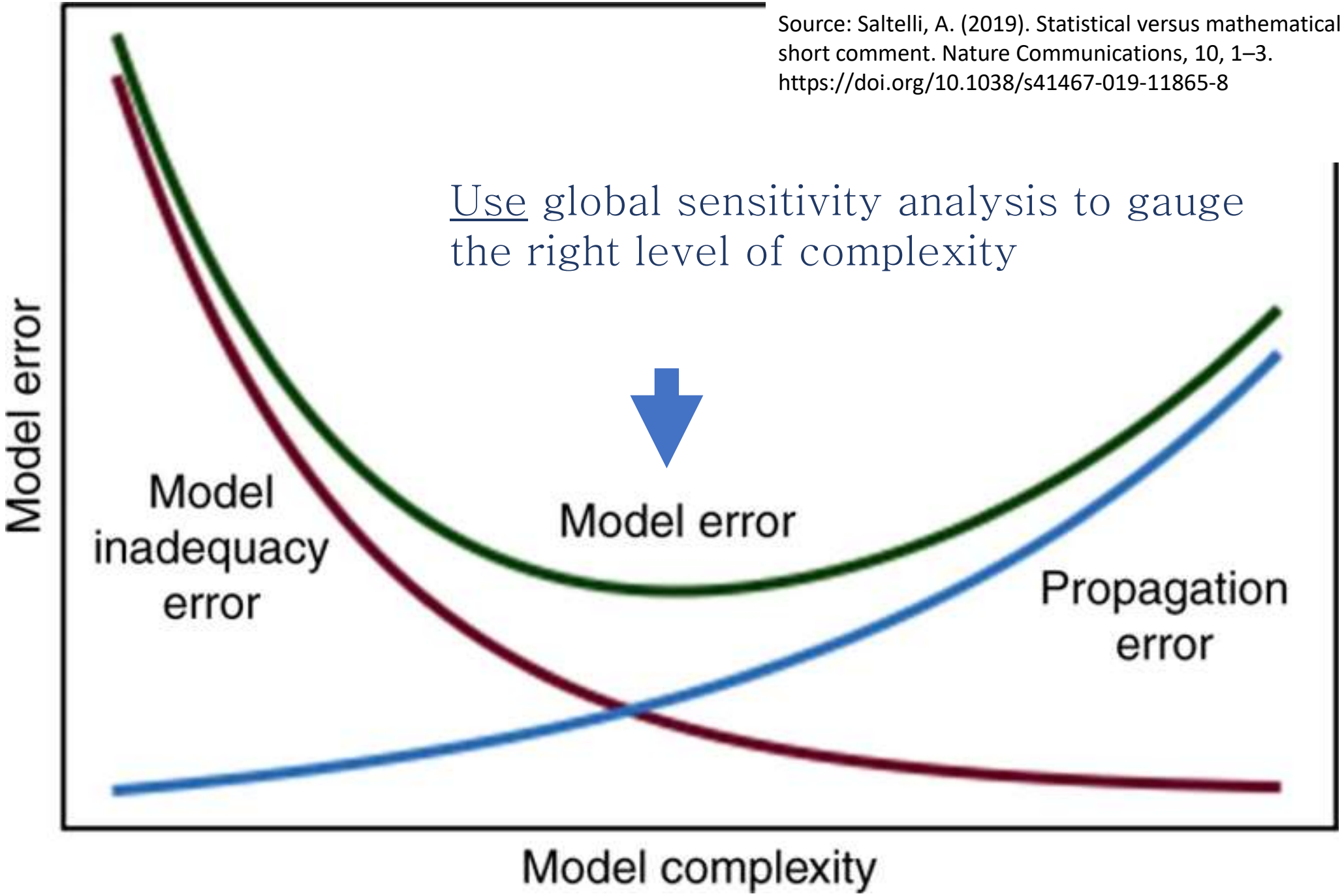
Sensitivity Anaysis as an Ingredient of Modeling

F. Campolongo, A. Saltelli, S. Tarantola

BARCELONA SCHOOL OF MANAGEMENT

Source: Saltelli, A. (2019). Statistical versus mathematical modelling: A short comment. Nature Communications, 10, 1–3. https://doi.org/10.1038/s41467-019-11865-8

Use global sensitivity analysis to gauge the right level of complexity

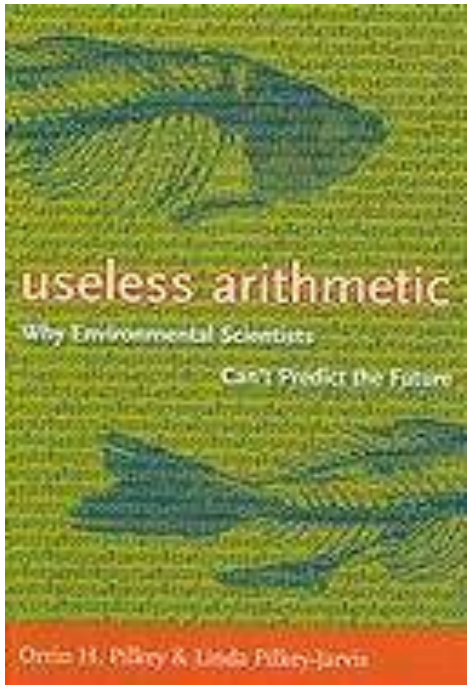


Don’t confuse the map with the territory

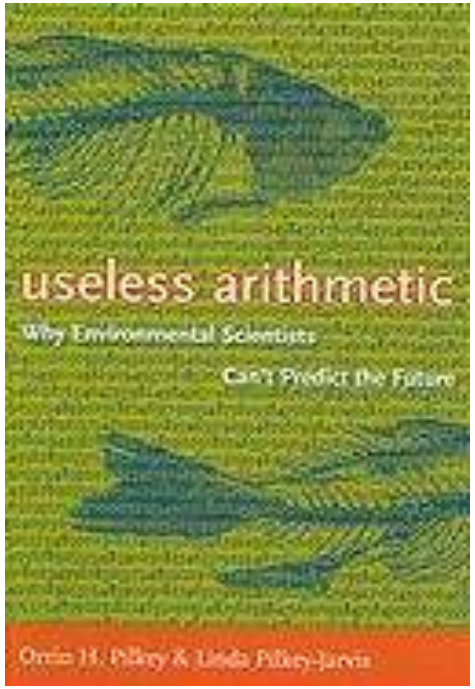
If you do, sensitivity analysis will not save you

<<It is important, however, to recognize that the sensitivity of the parameter in the equation is what is being determined, not the sensitivity of the parameter in nature>>

Orrin H. Pilkey



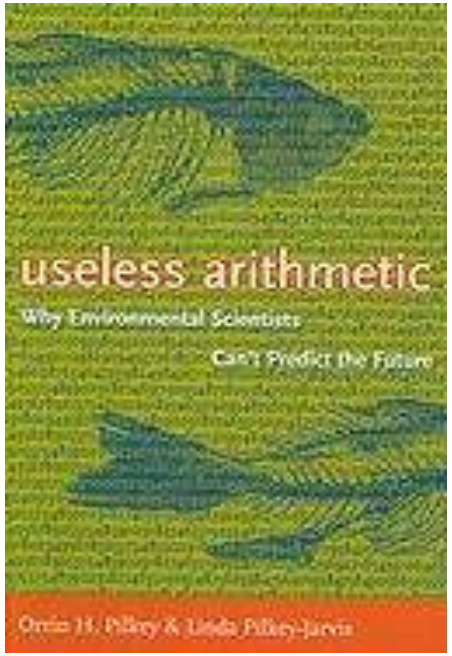
Useless Arithmetic: Why Environmental Scientists Can't Predict the Future
by Orrin H. Pilkey and Linda Pilkey-Jarvis, Columbia University Press, 2009.

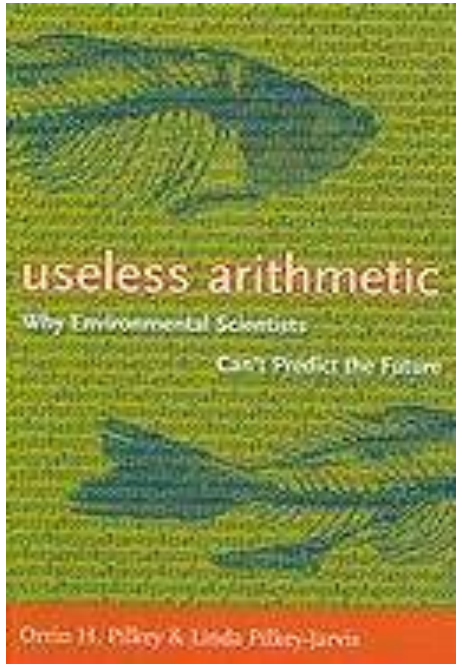


<<…If the model is wrong or if it is a poor representation of reality, determining the sensitivity of an individual parameter in the model is a meaningless pursuit>>

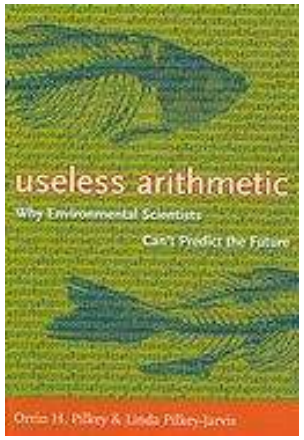
One of the examples discussed concerns the Yucca Mountain repository for radioactive waste. TSPA model (for total system performance assessment) for safety analysis.

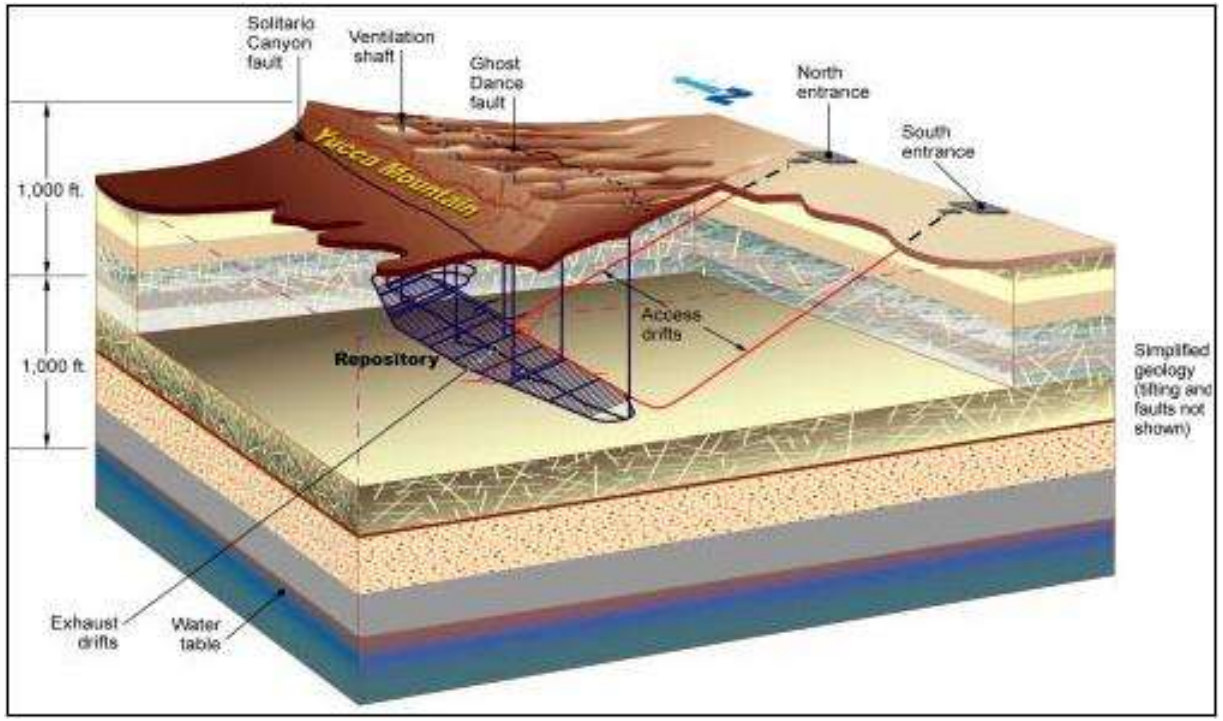
TSPA is Composed of 286 sub-models.





TSPA (like any other model) relies on assumptions → one is the low permeability of the geological formation → long time for the water to percolate from surface to disposal

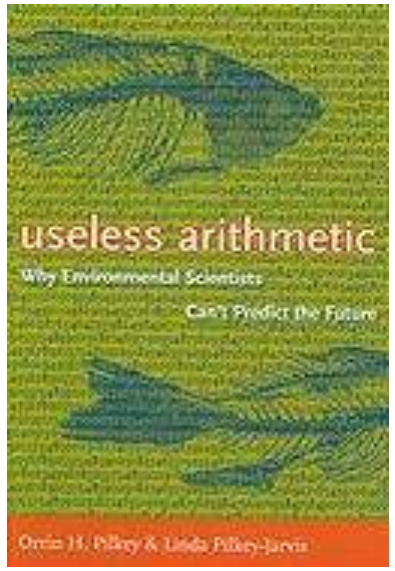




The confidence of the stakeholders in TSPA was not helped when evidence was produced which could lead to an upward revision of 4 orders of magnitude of this parameter
(the ^{36}Cl story)

In the case of TSPA (Yucca mountain) a range of 0.02 to 1 millimetre per year was used for percolation of flux rate.

→… SA useless if it is instead ~ 3,000 millimetres per year.



"Scientific mathematical modelling should involve constant efforts to falsify the model"

➔ Organized skepticism (as per CUDOS)

Communalism, Universalism, Disinterestedness, Organized Skepticism, from sociology of science, Robert K. Merton.

Don’t run the model just once

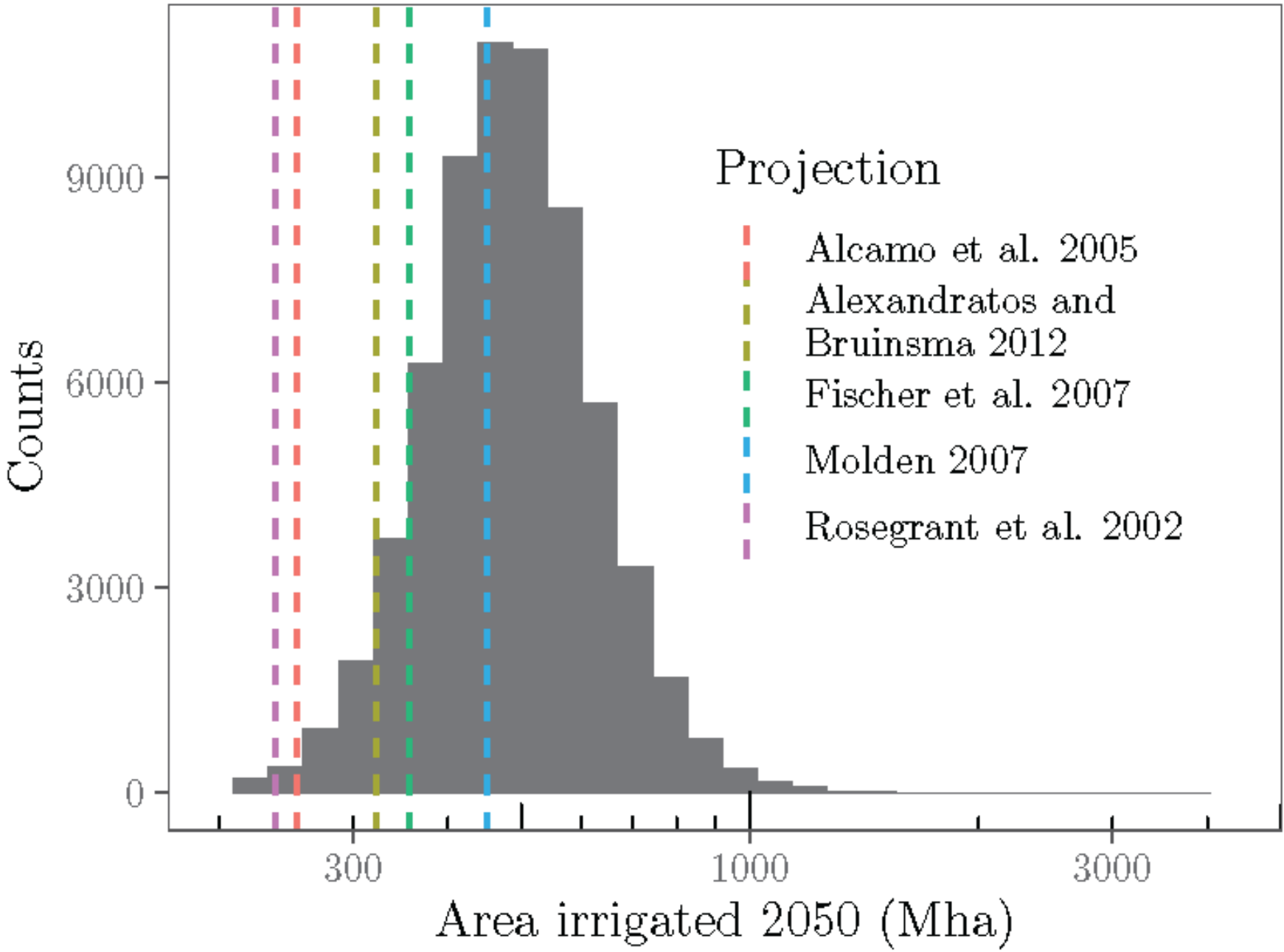
There is much to learn by running the model a few times, especially during model building

Lubarsky's Law of Cybernetic Entomology: there is always one more bug!

Keep in mind that a model routinely used to produce point estimates may become non-conservative when the uncertainty is plugged in

Current Models Underestimate Future Irrigated Areas

- How much land will need to be irrigated by the year 2050?
- Here the dashed lines represent deterministic model predictions from different models and datasets (from FAO & others organizations);
- An uncertainty analysis (grey histogram) reveals that the models are non-conservative: the need might be much larger



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

NEVER vary all factors by the same amount
Be it 5%, 10%, or 20%

New WHO estimates: Up to 190 000 people could die of COVID-19 in Africa if not controlled

07 May 2020

Brazzaville – Eighty-three thousand to 190 000 people in Africa could die of COVID-19 and 29 million to 44 million could get infected in the first year of the pandemic if containment measures fail, a new study by the World Health Organization (WHO) Regional Office for Africa finds. The research, which is based on prediction modelling, looks at 47 countries in the

Speculative scenario in which ten uncertain input probabilities are varied by an arbitrary 10% — as if they were truly equally uncertain — with no theoretical or empirical basis for such a choice

World Health Organization
REGIONAL OFFICE FOR Africa

In a numerical experiment relating to a real-life application, the range of uncertainty of each input is a crucial input to the analysis, and often the most expensive to get

Consider that sensitivity analysis can:

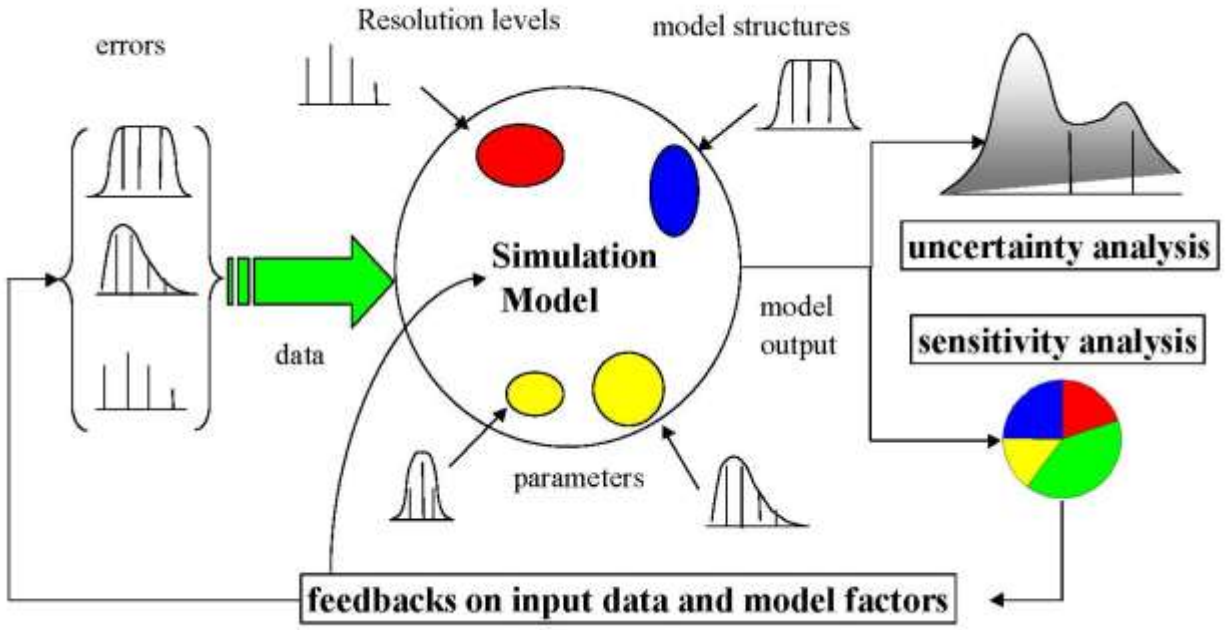
- **surprise the analyst** (consider the multiverse example)
- uncover technical errors in the model (personal experience)
- identify critical regions in the space of the inputs

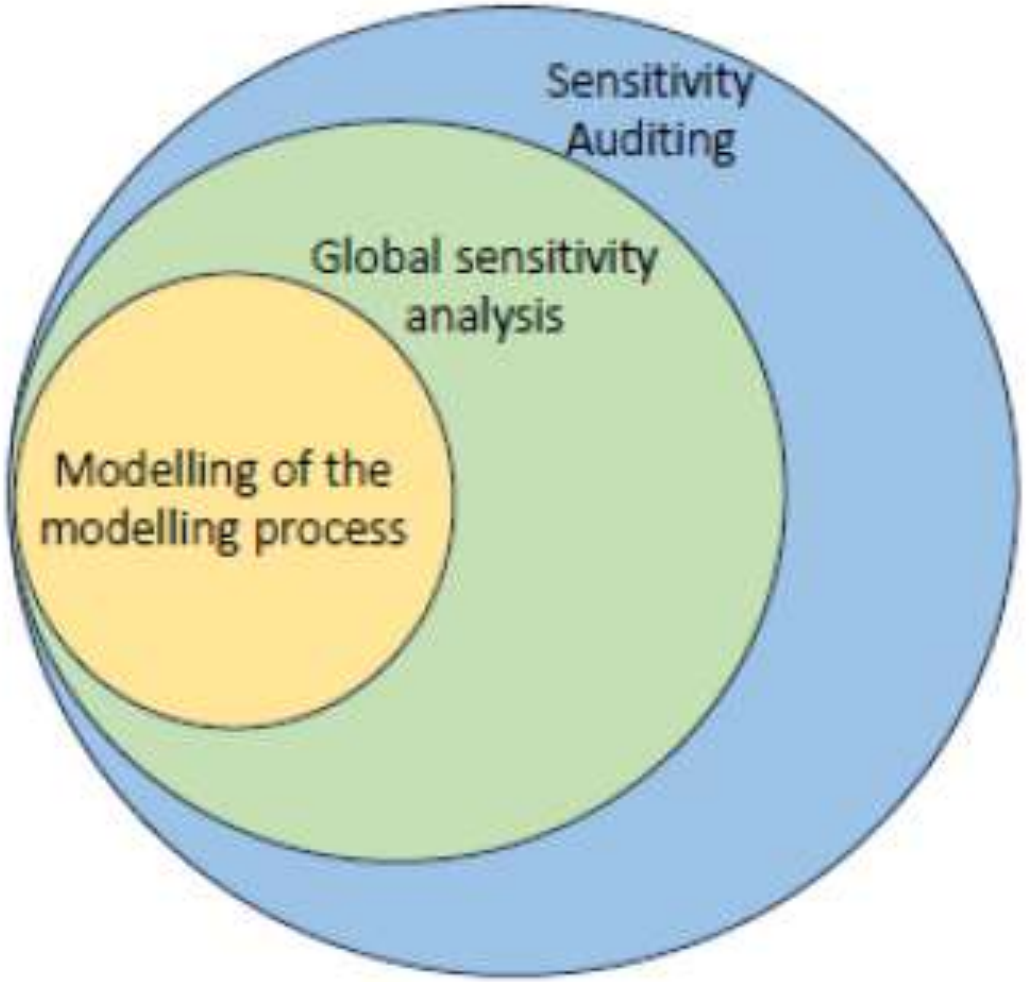
Source: The Simpson, 20th Television Animation (The Walt Disney Company)

Consider that sensitivity analysis can :

surprise the analyst,
uncover technical errors in the model,
identify critical regions in the space of the inputs,
avoid type II errors
establish priorities for research
simplify models
falsify models (show that a model is false or irrelevant)
defend against your own model being falsified

The End


errors
Resolution levels
model structures
Simulation Model
data
model output
uncertainty analysis
sensitivity analysis
parameters
feedbacks on input data and model factors


Sensitivity Auditing
Global sensitivity analysis
Modelling of the modelling process