COMMUNICATING UNCERTAINTY

Charlotte Boys

January 30, 2020

MSc Scientific Computing, University of Heidelberg

OVERVIEW

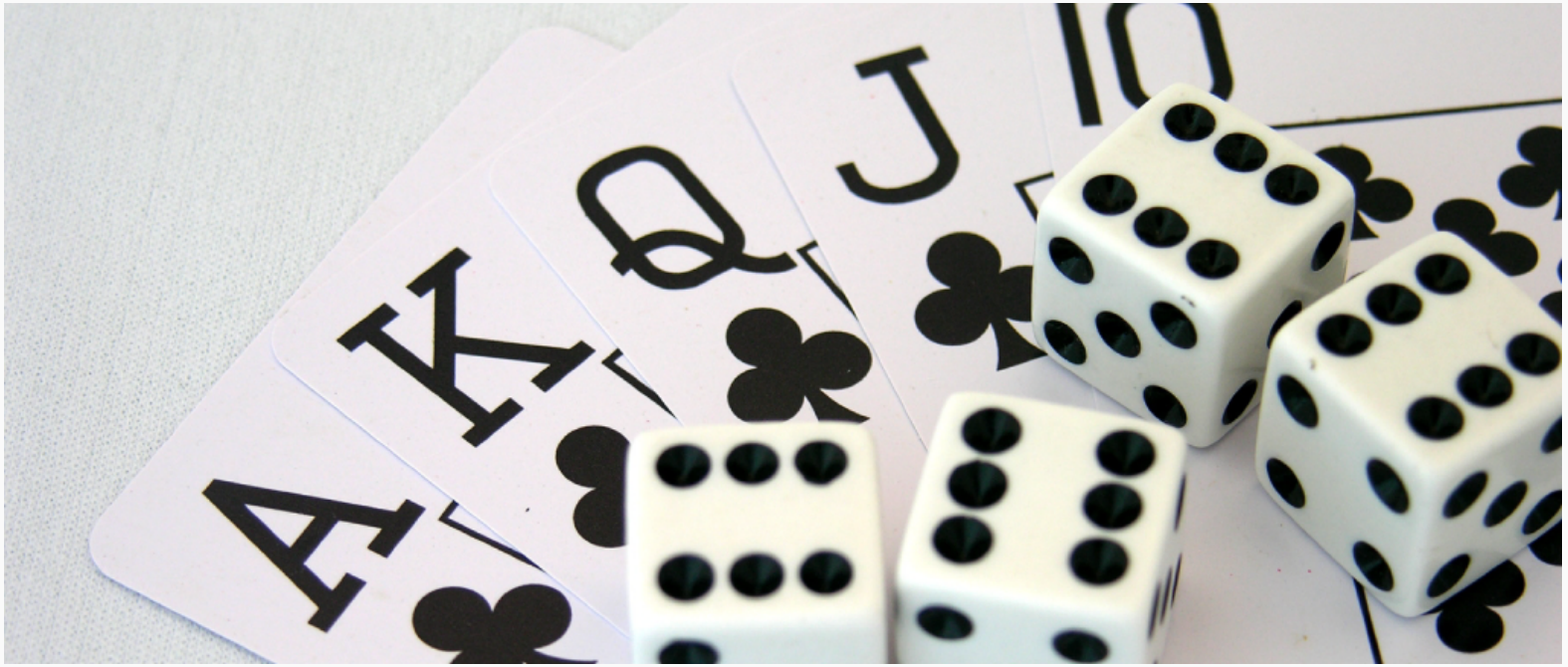
1. Introduction
2. How to Lie with Uncertainty
3. How to Communicate Uncertainty
4. Case studies
5. Conclusion

INTRODUCTION

Sources of uncertainty (Spiegelhalter)

Aleatory Uncertainty

Inevitable unpredictability of the future due to unforeseeable factors, fully expressed by classical probabilities.



Sources of uncertainty (Spiegelhalter)

Epistemic Uncertainty

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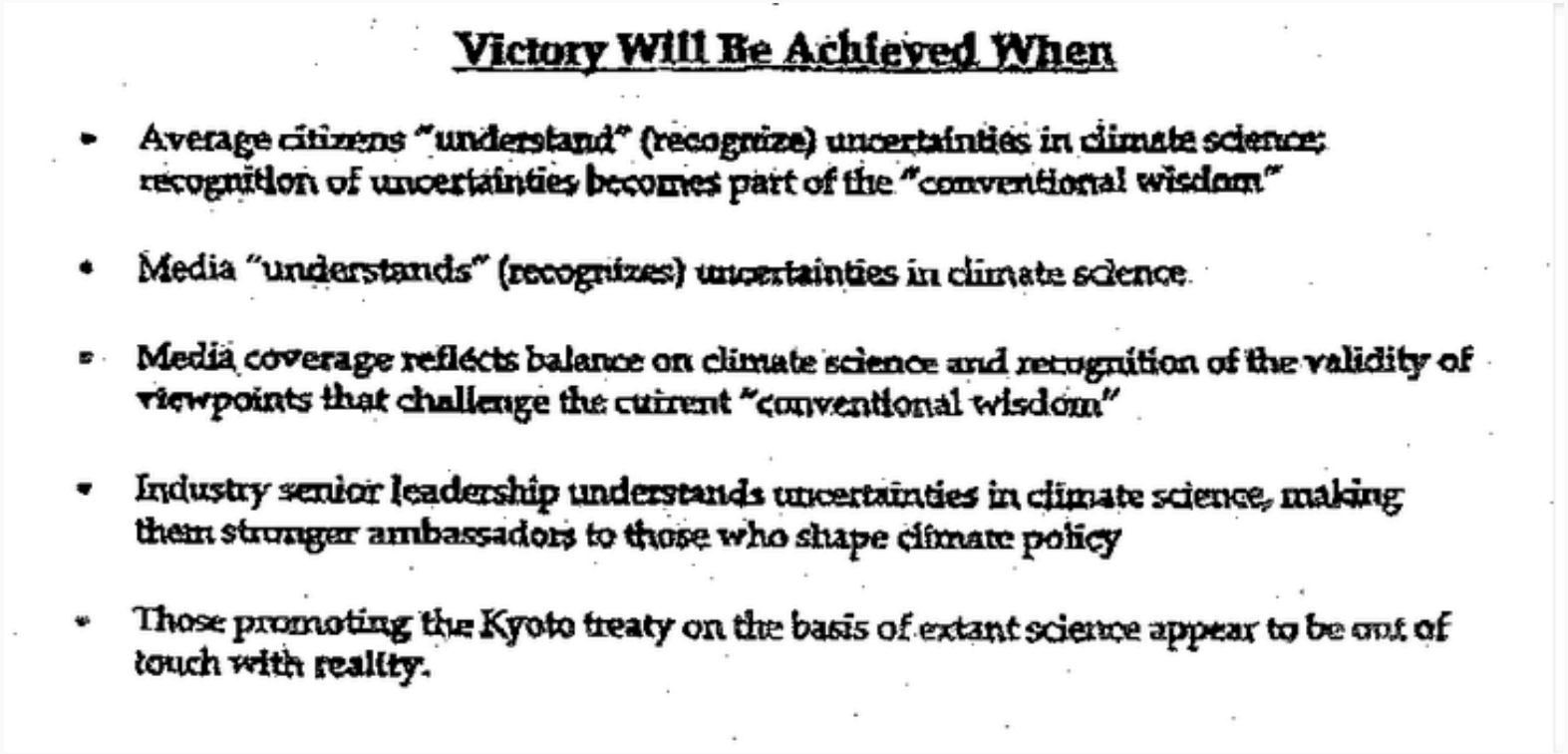
HOW TO LIE WITH UNCERTAINTY

TOBACCO INDUSTRY

- Brown and Williamson Tobacco company internal memo, 1969:

  "Doubt is our product, since it is the best means of competing with the 'body of fact' that exists in the mind of the general public. It is also a means of establishing controversy."

FOSSIL FUEL INDUSTRY

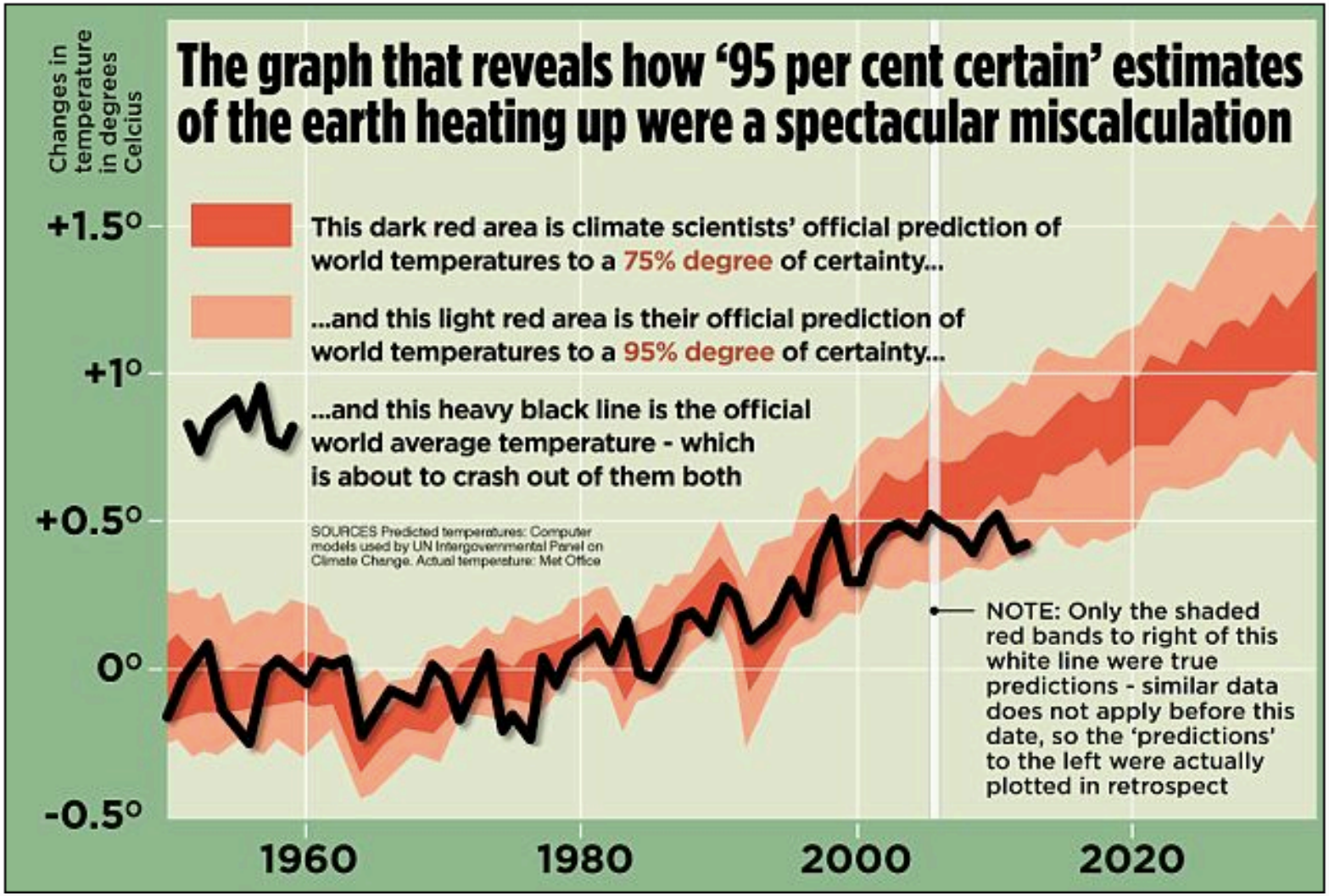


Victory Will Be Achieved When

- Average citizens "understand" (recognize) uncertainties in climate science; recognition of uncertainties becomes part of the "conventional wisdom"
- Media "understands" (recognizes) uncertainties in climate science
- Media coverage reflects balance on climate science and recognition of the validity of viewpoints that challenge the current "conventional wisdom"
- Industry senior leadership understands uncertainties in climate science, making them stronger ambassadors to those who shape climate policy
- Those promoting the Kyoto treaty on the basis of extant science appear to be out of touch with reality.

American Petroleum Institute, 1998

WILFUL MISUNDERSTANDING?

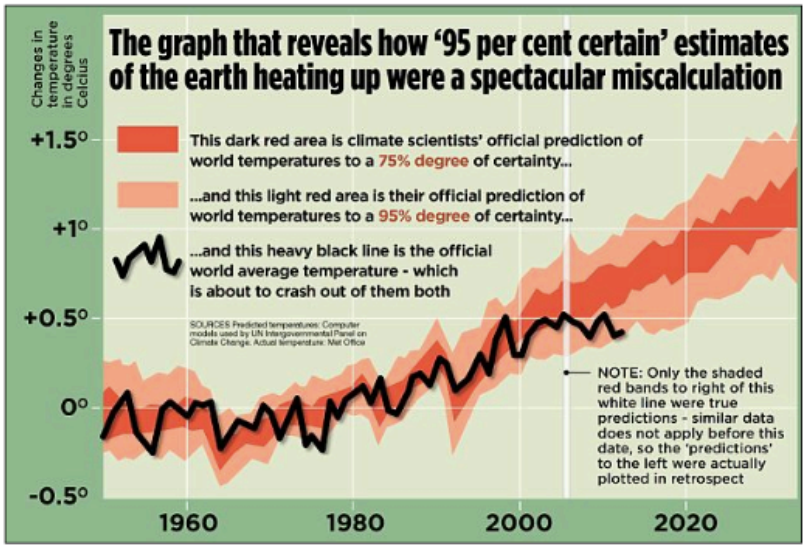


Daily Mail, March 16. 2013

WILFUL MISUNDERSTANDING?

The graph shows a world stubbornly refusing to warm. Indeed, it shows the world is soon set to be cooler.

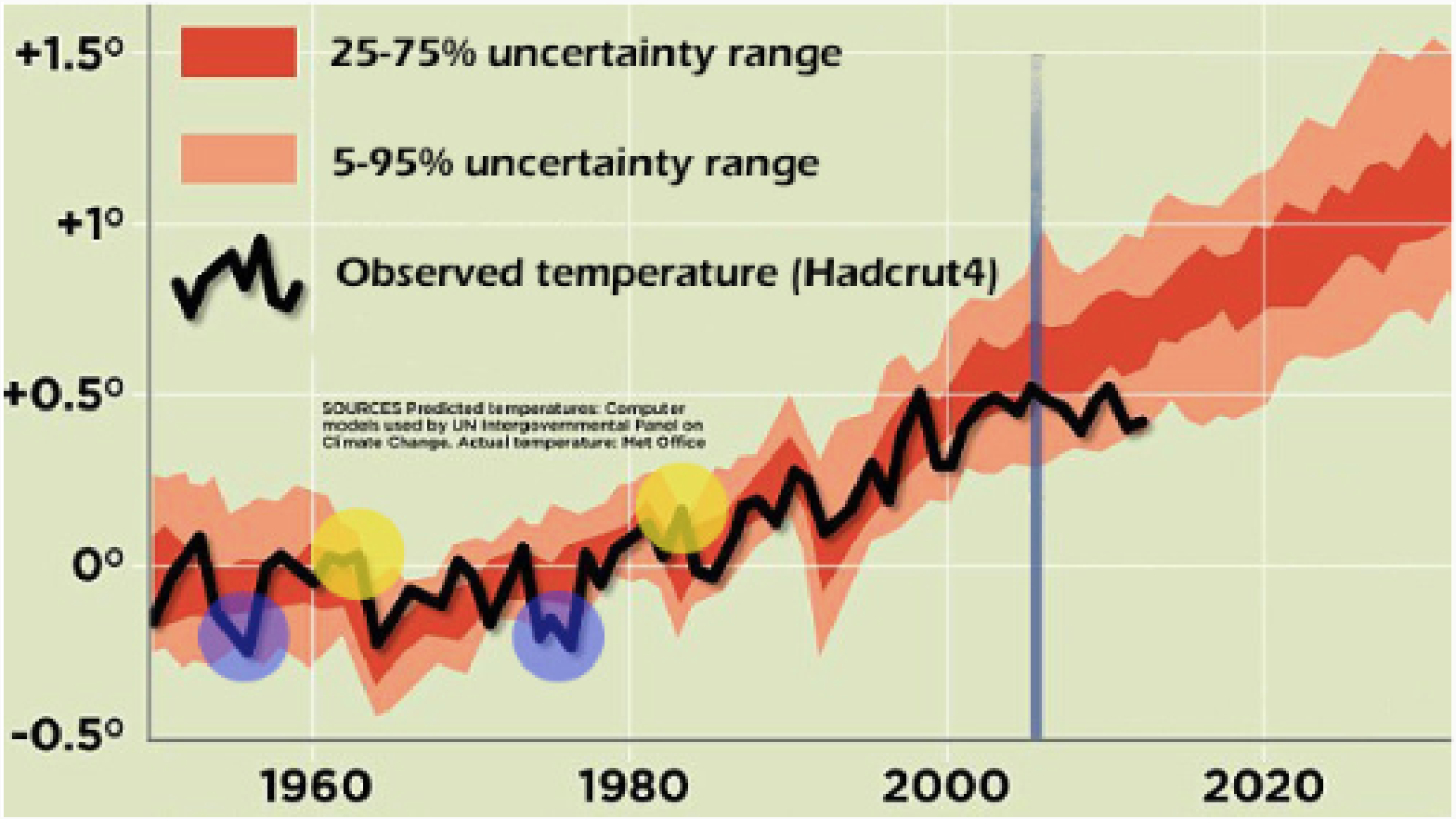
The awkward fact is that the earth has warmed just 0.5 degrees over the past 50 years. And Met Office records show that for the past 16 years temperatures have plateaued and, if anything, are going down.



As the graph shows, the longer this goes on, the more the actual, real-world temperature record will diverge from the IPCC's doom-laden prediction.

Daily Mail, March 16. 2013

WILFUL MISUNDERSTANDING?



Skeptical Science, April 17. 2013

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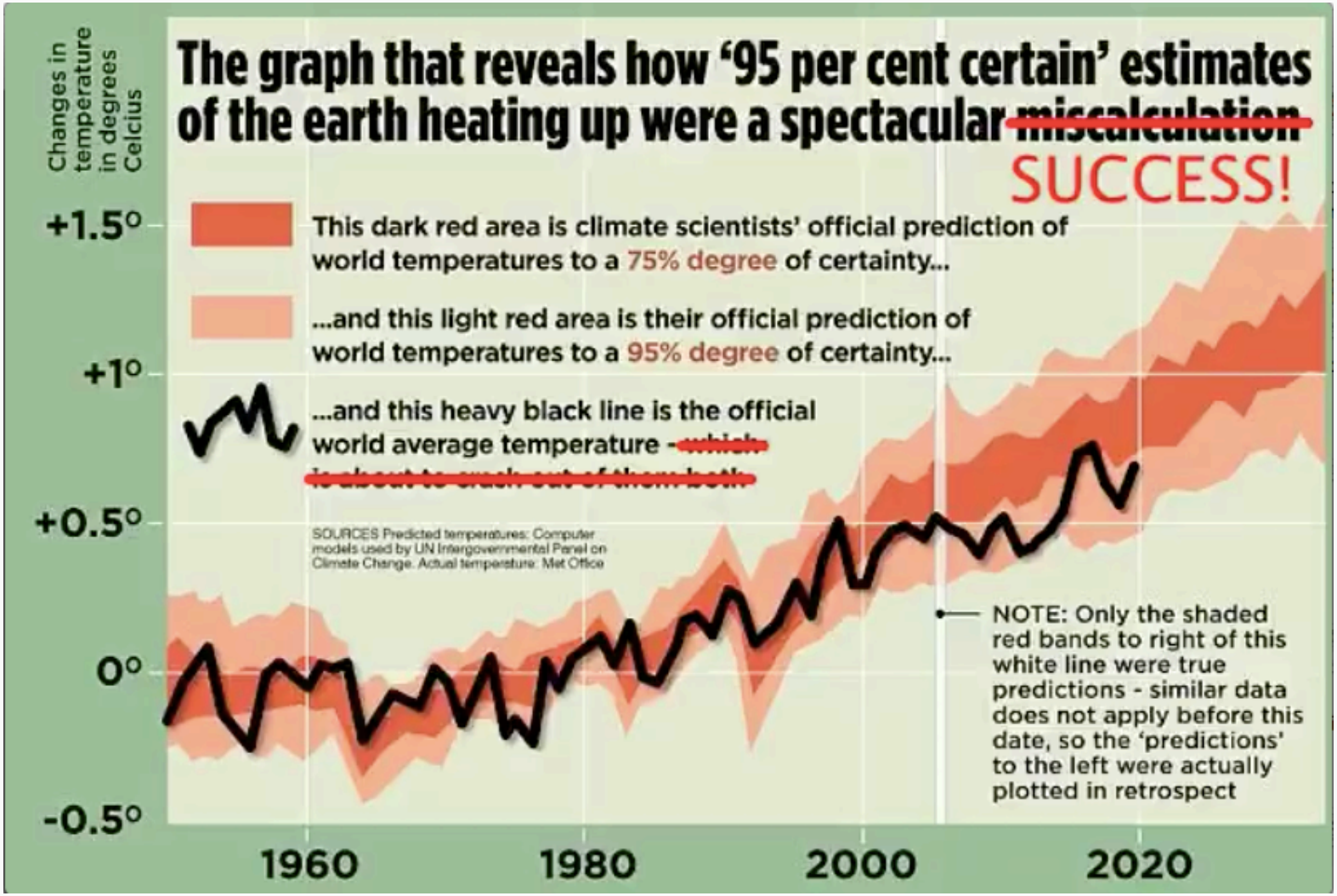

Kevin Pluck, December 17. 2019

UNEMPLOYMENT HEADLINES

UK unemployment falls to 1.44 million

24 January 2018 | Share

UK unemployment fell by 3,000 to 1.44 million in the three months to November, official figures show.

BBC, January 24. 2018

changes in the numbers. For example, for September to November 2017, the estimated change in the number of unemployed people since June to August 2017 was a small fall of 3,000, with a 95% confidence interval of plus or minus 77,000. This means that we are 95% confident the actual change in unemployment was somewhere between an increase of 74,000 and a fall of 80,000, with the best estimate being a small fall of 3,000. As the estimated fall in unemployment of 3,000 is smaller than 77,000, the estimated fall in unemployment is said to be "not statistically significant".

ONS, UK Labour Market January 2018

HOW TO COMMUNICATE UNCERTAINTY

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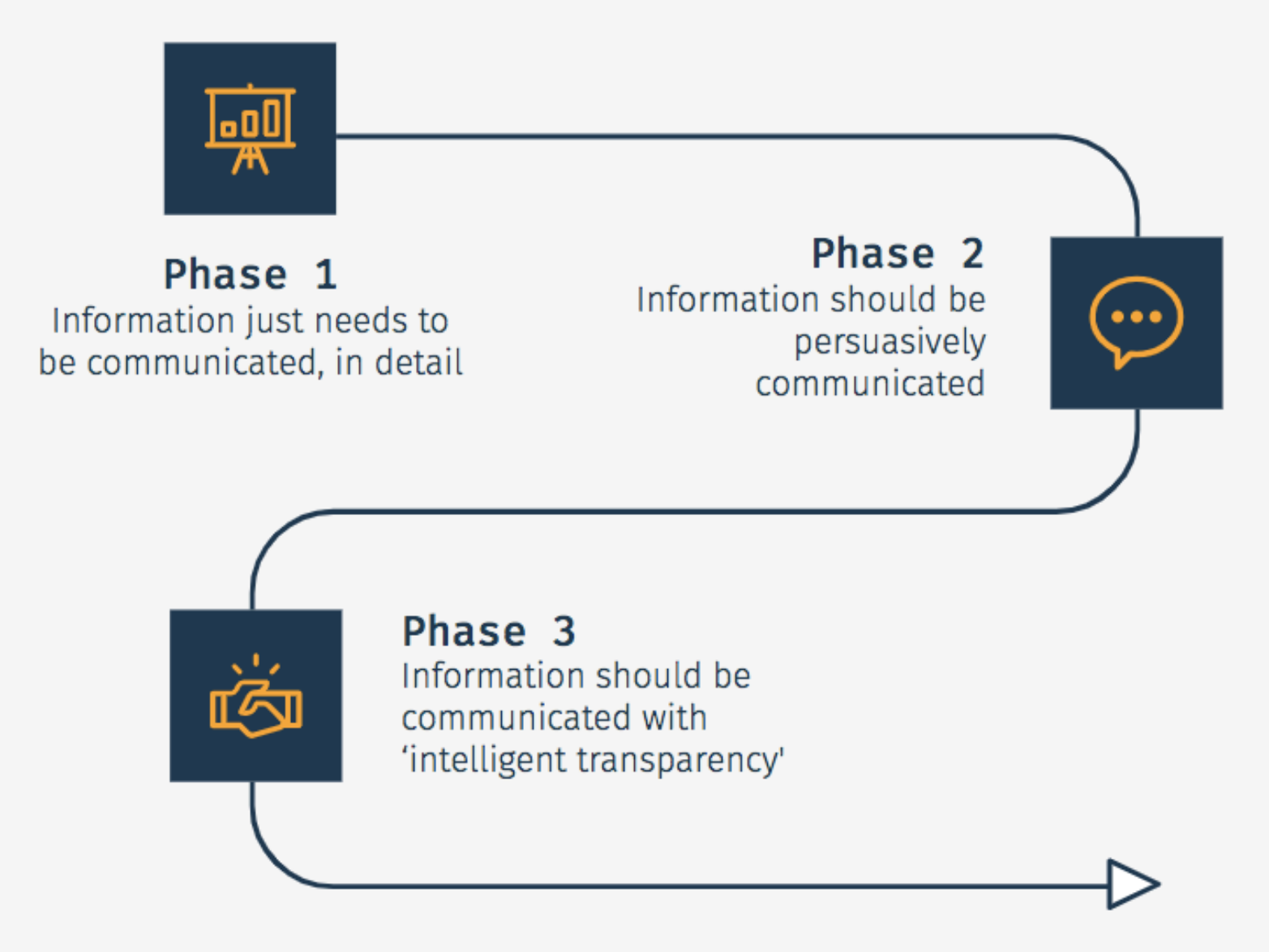
IN THEORY

Our aim when communicating risk and uncertainty is to inform decision-making.

LEISS'S PHASES OF RISK COMMUNICATION



Three Phases in the Evolution of Risk Communication Practice, 1996

Not-so rational decision makers

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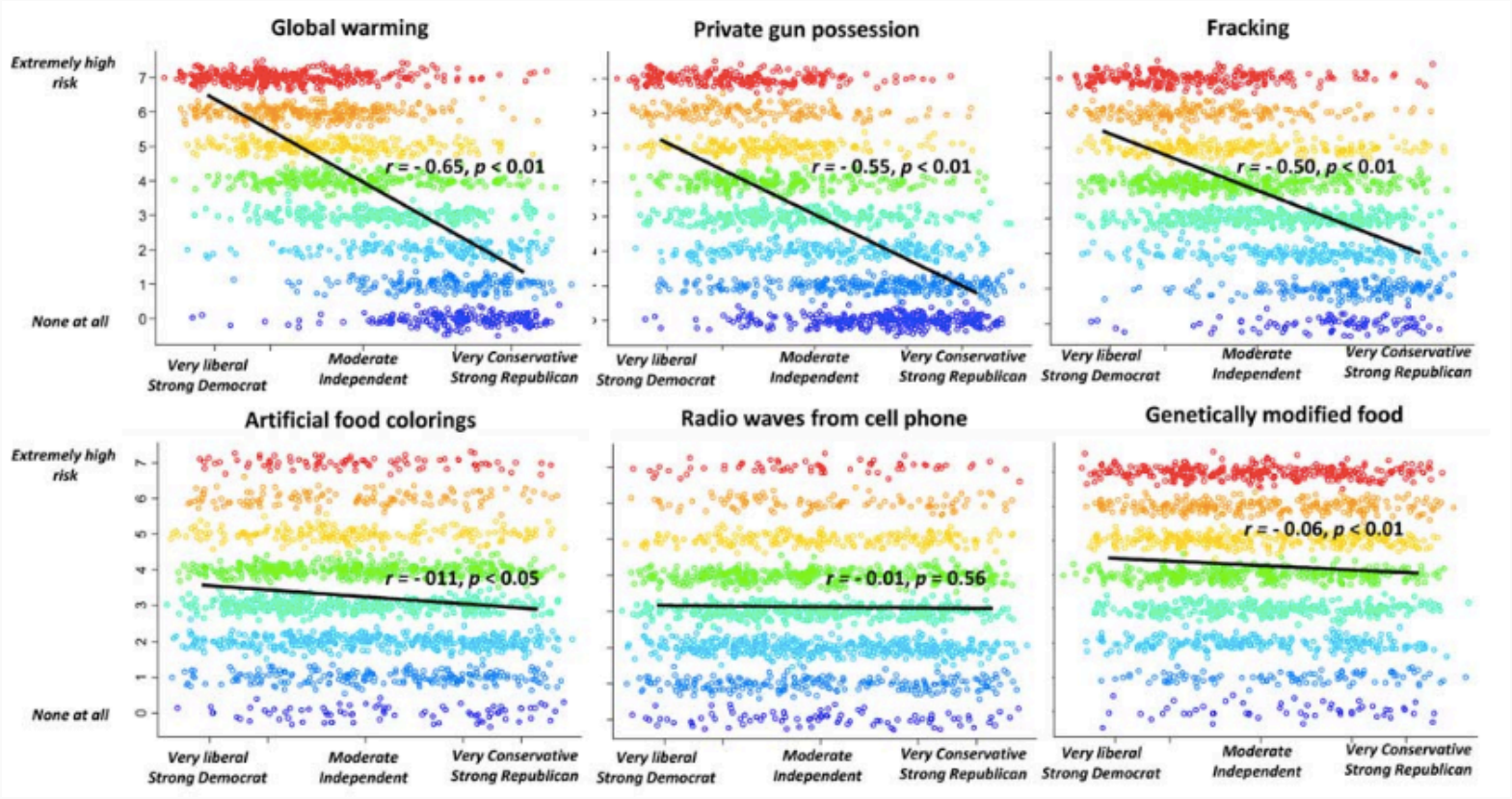
- Uncontrollable, novel, or not understood
- Having catastrophic potential, or dreadful consequences such as fatality
- Bearing an inequitable distribution of risks and benefits
- Delayed in their manifestation of harm

POLARISATION AND RISK PERCEPTION



Climate-science communication and the measurement problem (Kahan, 2015)
Perception of risk for polarised and non-polarised issues. N=1800

So what can we do?

NEW AIMS FOR UNCERTAINTY COMMUNICATION

Onara O'Neill, Philosopher

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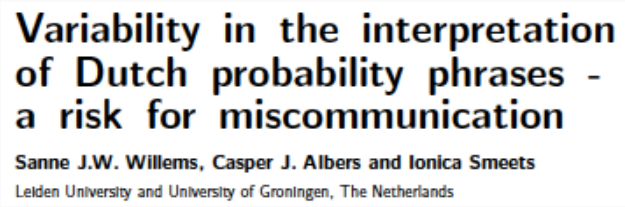
HOW TO COMMUNICATE UNCERTAINTY

LESSONS FROM RISK COMMUNICATION

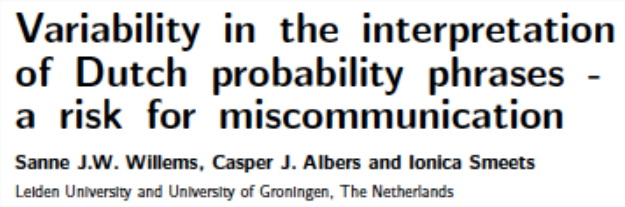
THE PROBLEM WITH WORDS

- Wide variability in interpretation, even within groups (Willems et al., N = 881)



THE PROBLEM WITH WORDS

- Wide variability in interpretation, even within groups (Willems et al., N = 881)
- Asymmetry in interpretation


Variability in the interpretation of Dutch probability phrases - a risk for miscommunication

Sanne J.W. Willems, Casper J. Albers and Ionica Smeets
Leiden University and University of Groningen, The Netherlands

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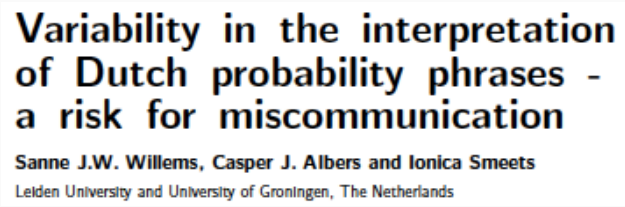
- No reliable ‘translation’ between verbal phrases and numerical values representing probabilities



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- Recommended: *"Common: may affect up to 1 in 10 people"*

COMPARING RISKS

- A survey from Galesic & Garcia-Retamero (2010) asked the following question:

Which of the following numbers represents the biggest risk of getting a disease? 1 in 100, 1 in 1,000, or 1 in 10?

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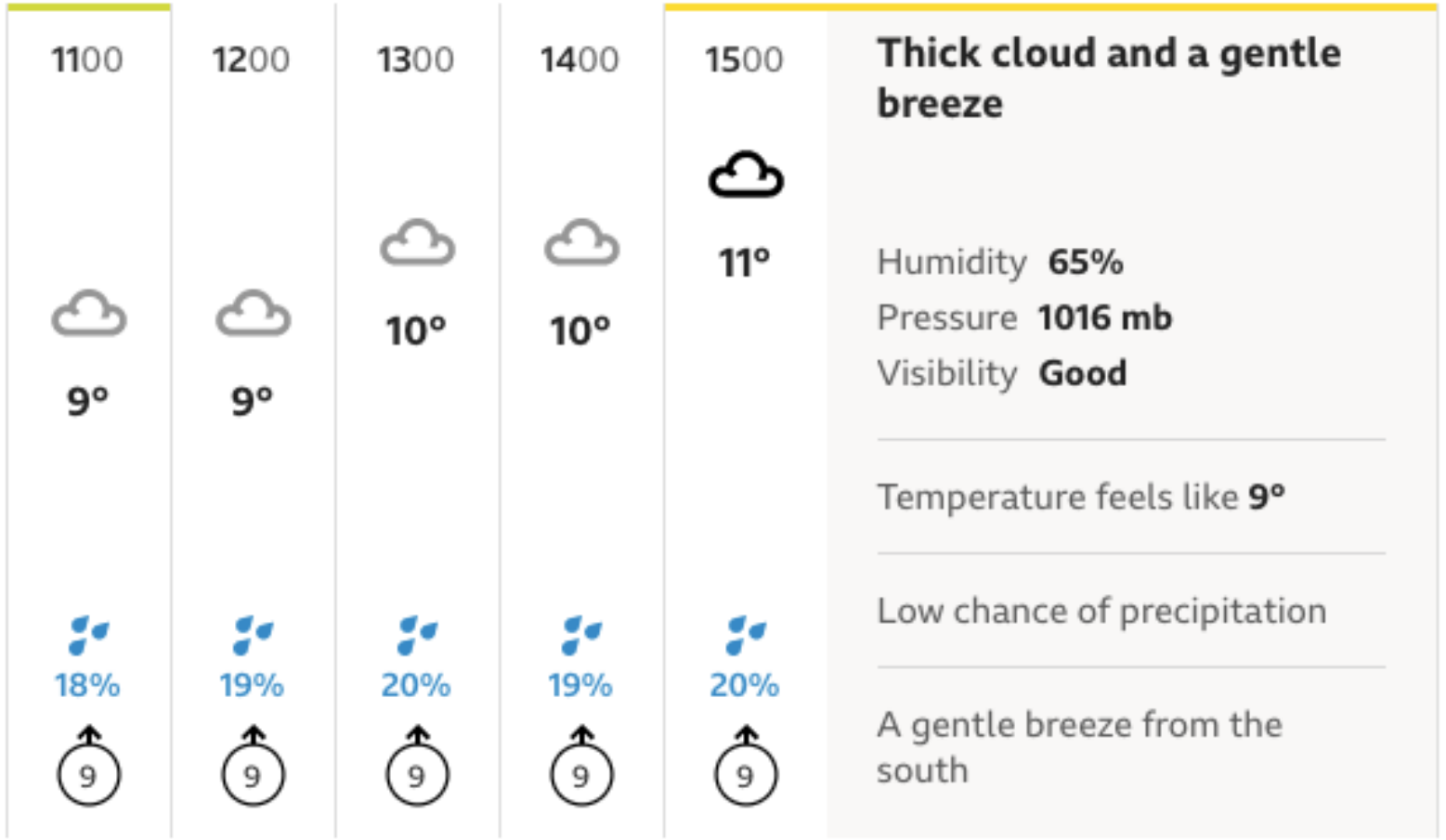
→ Keep the denominator fixed when making comparisons!

UNDERSTANDING THE REFERENCE CLASS



BBC Weather

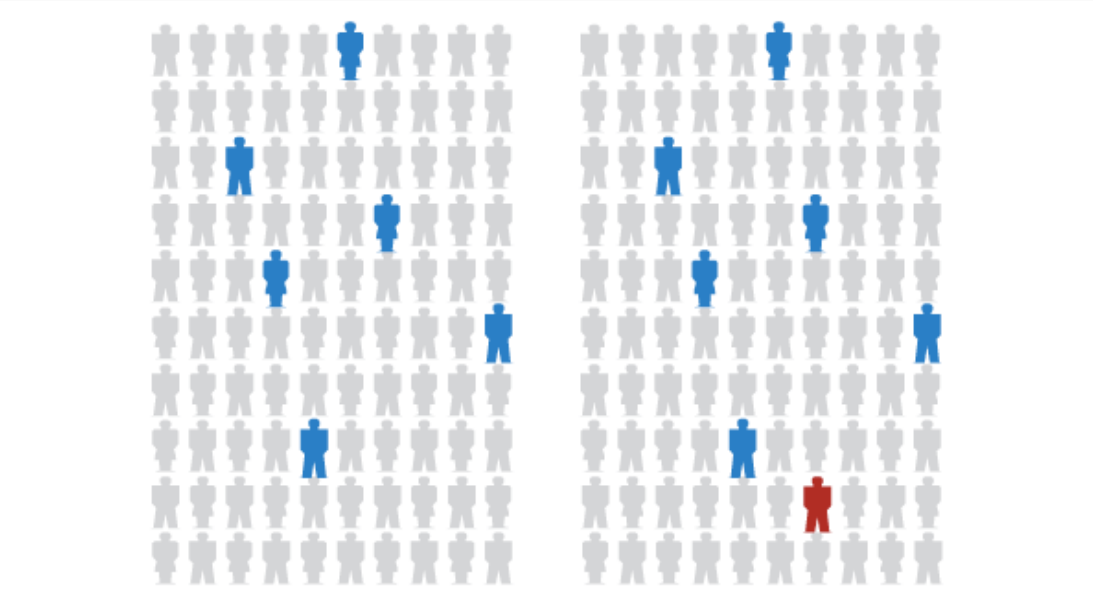
RELATIVE RISK VS. ABSOLUTE RISK

Processed meats - such as bacon, sausages and ham - do cause cancer, according to the World Health Organization (WHO).

Its report said 50g of processed meat a day - less than two slices of bacon - increased the chance of developing colorectal cancer by 18%.

BBC, 26. October 2015

RELATIVE RISK VS. ABSOLUTE RISK



Spiegelhalter, 2017

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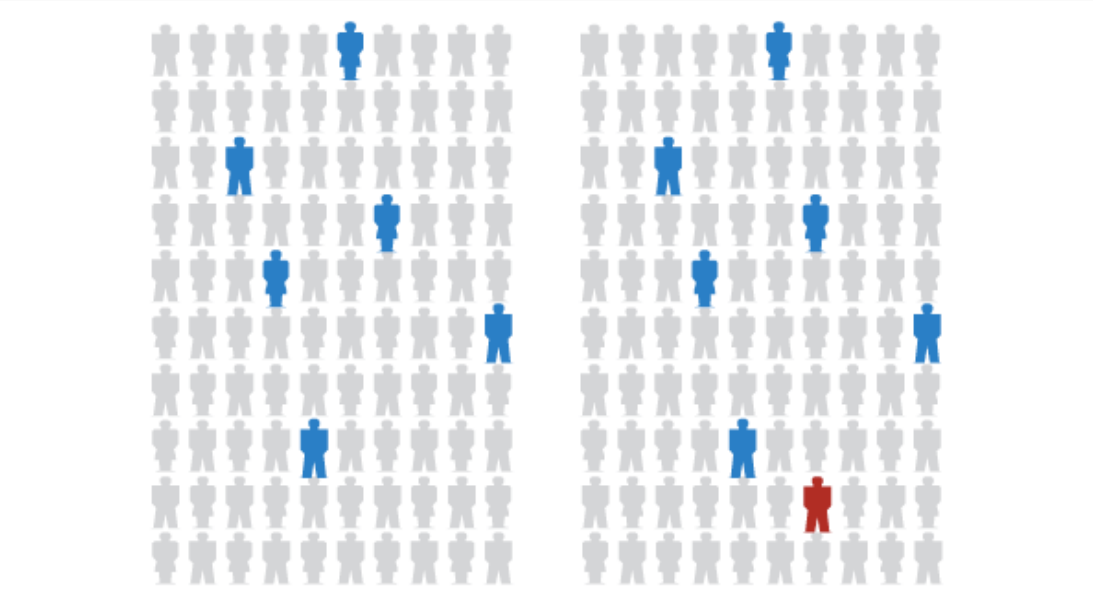

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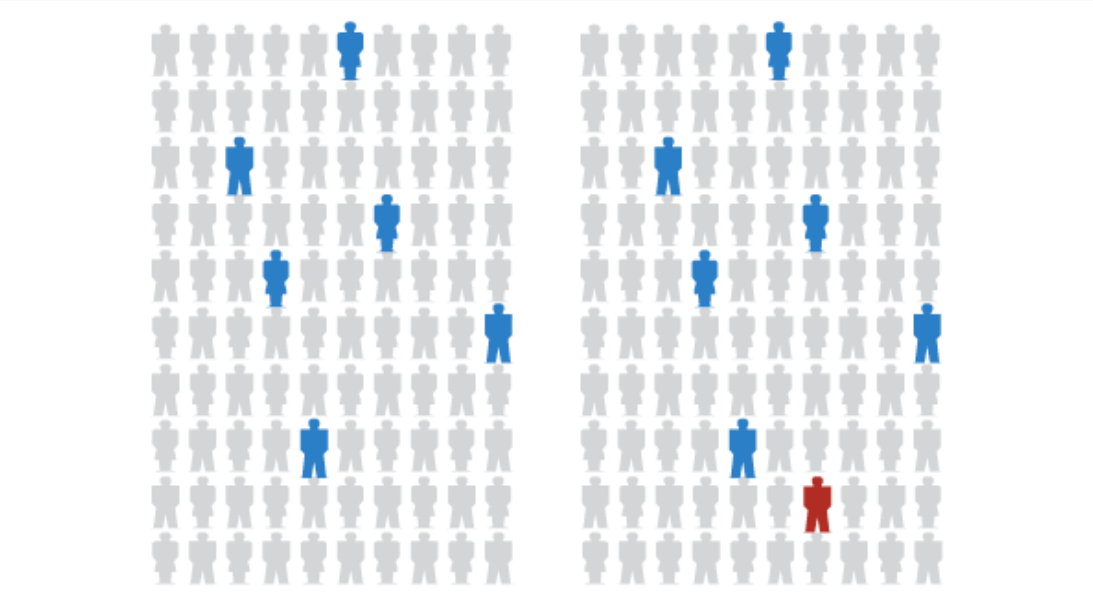

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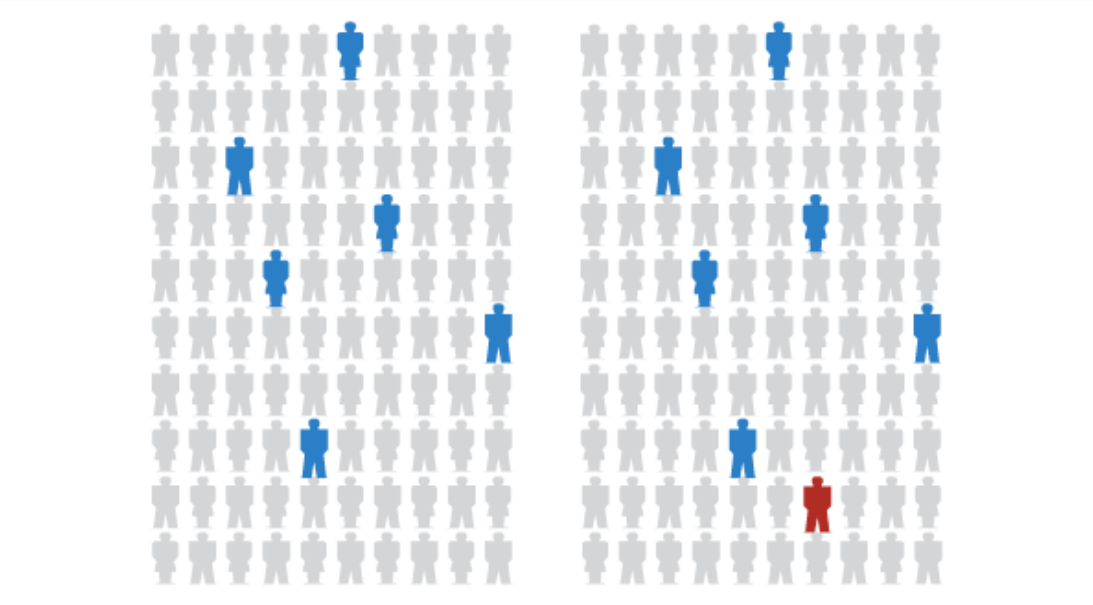

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POSITIVE AND NEGATIVE FRAMING

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- “10% of patients get a blistering rash”
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  $\rightarrow$ 1.43 on a risk scale of 1 - 5
- “10% of patients experience a blistering rash, and 90% do not”

CASE STUDIES

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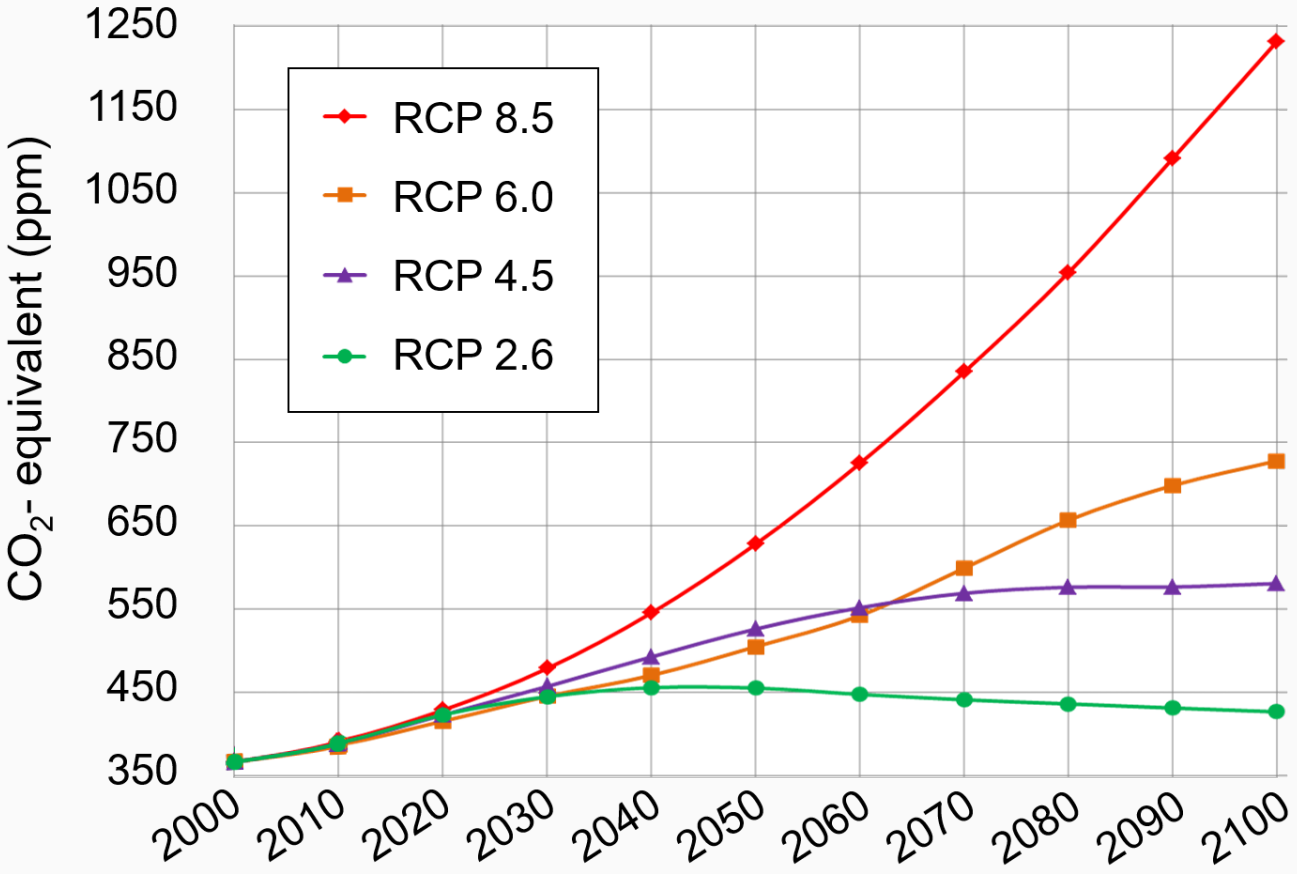
CLIMATE AND WEATHER FORECASTING

IPCC AR5 Greenhouse Gas Concentration Pathways

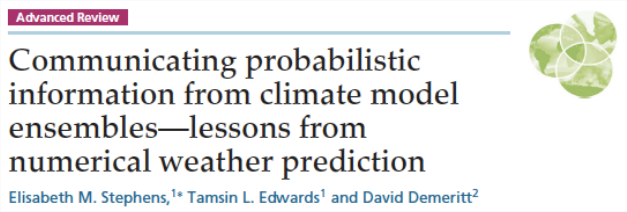
Representative Concentration Pathways (RCPs) from the fifth Assessment Report by the International Panel on Climate Change



Wikipedia: Representative Concentration Pathway

COMMUNICATING UNCERTAINTY FROM EMS

The following communication priorities need to be balanced:



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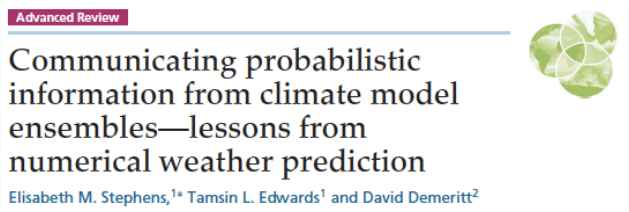
- richness

  → amount of information communicated



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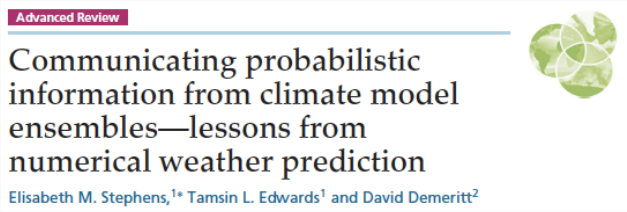

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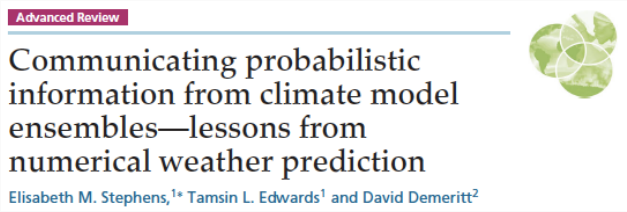
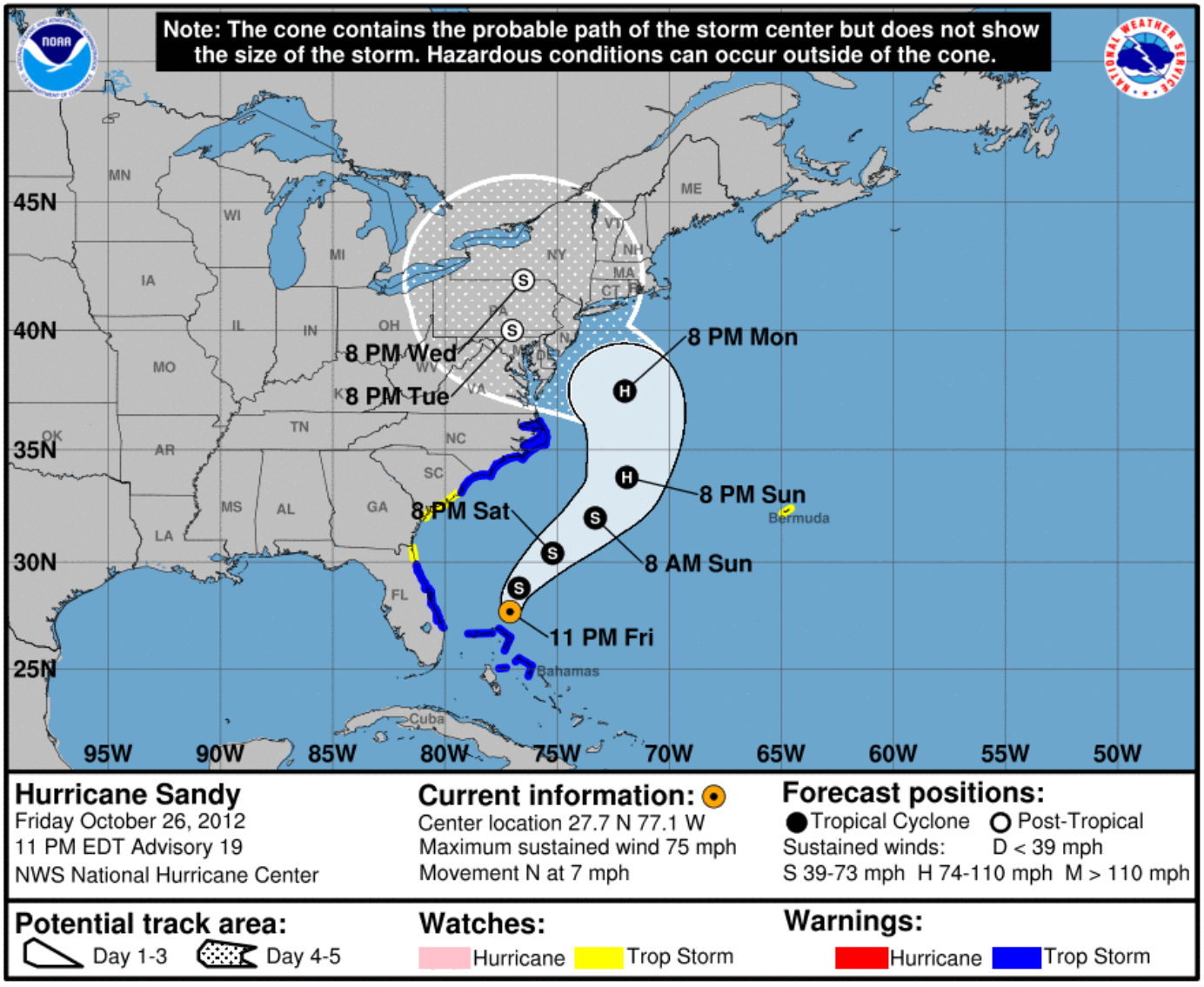
- robustness
  - → the extent to which the trustworthiness of the model is communicated
- saliency
  - → interpretability and usefulness for the target audience


Advanced Review

Communicating probabilistic information from climate model ensembles—lessons from numerical weather prediction

Elisabeth M. Stephens,[1]* Tamsin L. Edwards[1] and David Demeritt[2]

CONE OF UNCERTAINTY



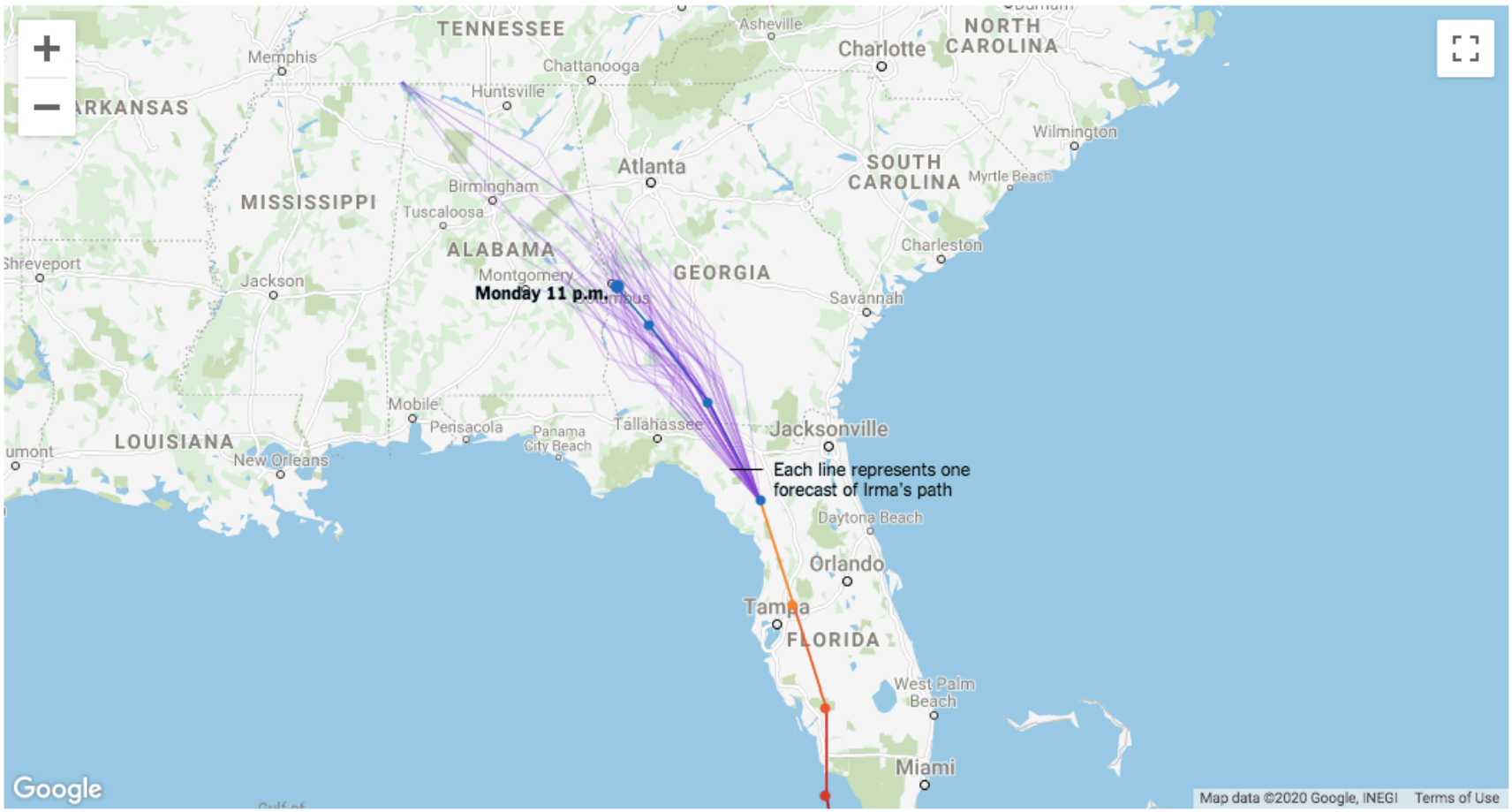
National Hurricane Center, US

SHARPIEGATE

Donald Trump has gone to great lengths to defend his tweet that said that Alabama would be affected by Hurricane Dorian. Photograph by Tom Brenner / Bloomberg / Getty

The New Yorker, September 6. 2019

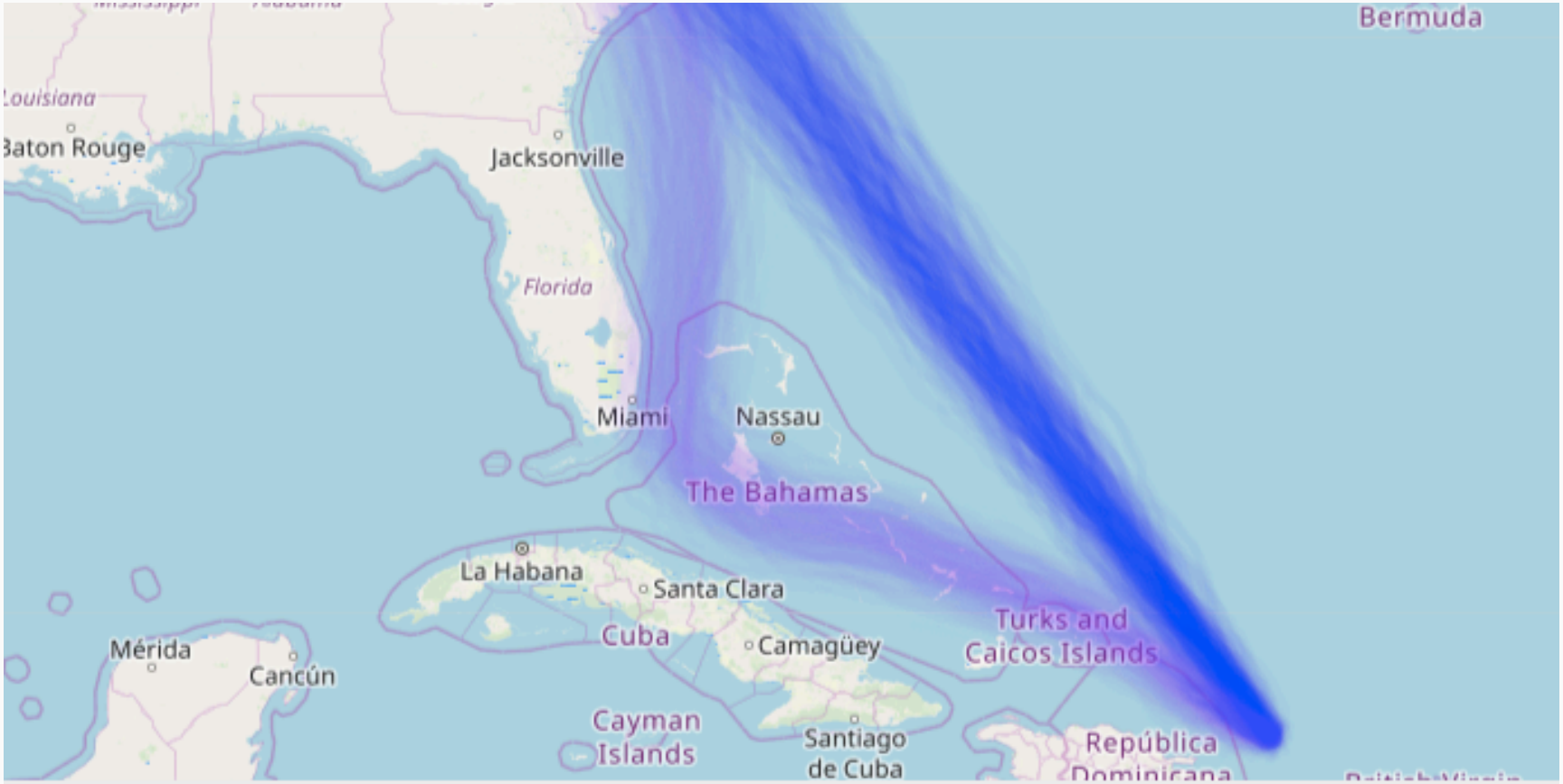
SPAGHETTI PLOTS



Source: European Center for Medium-Range Weather Forecasts, National Weather Service

New York Times, September 5. 2017

HEATMAPS AND SPAGHETTI PLOTS



Hugo Bowne-Anderson, September 18. 2017

CASE STUDIES

CORONAVIRUS

MODEL UNCERTAINTY

	Baseline[1]	Smaller catchment[1]	Shorter detection window[1]	6 exported cases	8 exported cases
Exported number of confirmed cases[2]	7	7	7	6	8
Daily international passengers travelling out of Wuhan International Airport[3]	3,301	3,301	3,301	3,301	3,301
Effective catchment population of Wuhan International Airport	19 million	11 million	19 million	19 million	19 million
Detection window (days)	10 days	10 days	8 days	10 days	10 days
Estimated total number of cases (95% CI)	4,000 (1,700 – 7,800)	2,300 (1,000 – 4,500)	5,000 (2,200 – 9,700)	3,400 (1,400 – 7,000)	4,600 (2,100 – 8,600)

[1]We now report uncertainty around our central estimate as the range spanned by the 95% confidence intervals of these three scenarios. [2]reported number of confirmed cases detected internationally. [3]calculated from the 3-month totals reported by [19] corrected for the travel surge during Chinese New Year (see Summary).

MRC Centre for Global Infectious Disease Analysis

COMMUNICATING UNCERTAINTY

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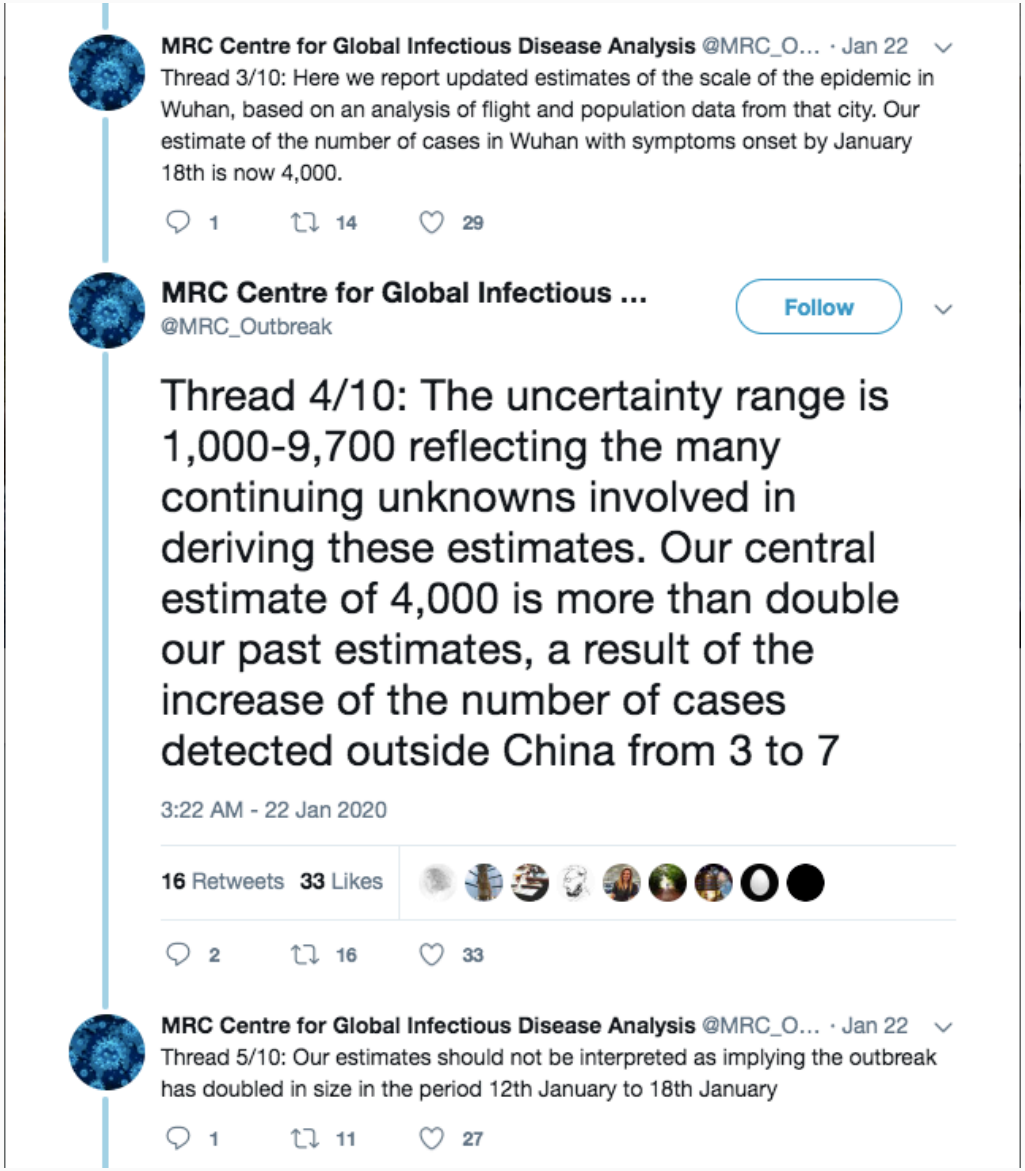

MRC Centre for Global Infectious Disease Analysis @MRC_O... · Jan 22

Thread 3/10: Here we report updated estimates of the scale of the epidemic in Wuhan, based on an analysis of flight and population data from that city. Our estimate of the number of cases in Wuhan with symptoms onset by January 18th is now 4,000.

1 14 29

MRC Centre for Global Infectious ...

@MRC_Outbreak

Follow

Thread 4/10: The uncertainty range is 1,000-9,700 reflecting the many continuing unknowns involved in deriving these estimates. Our central estimate of 4,000 is more than double our past estimates, a result of the increase of the number of cases detected outside China from 3 to 7

3:22 AM - 22 Jan 2020

16 Retweets **33** Likes

2 16 33

MRC Centre for Global Infectious Disease Analysis @MRC_O... · Jan 22

Thread 5/10: Our estimates should not be interpreted as implying the outbreak has doubled in size in the period 12th January to 18th January

1 11 27

COMMUNICATING UNCERTAINTY


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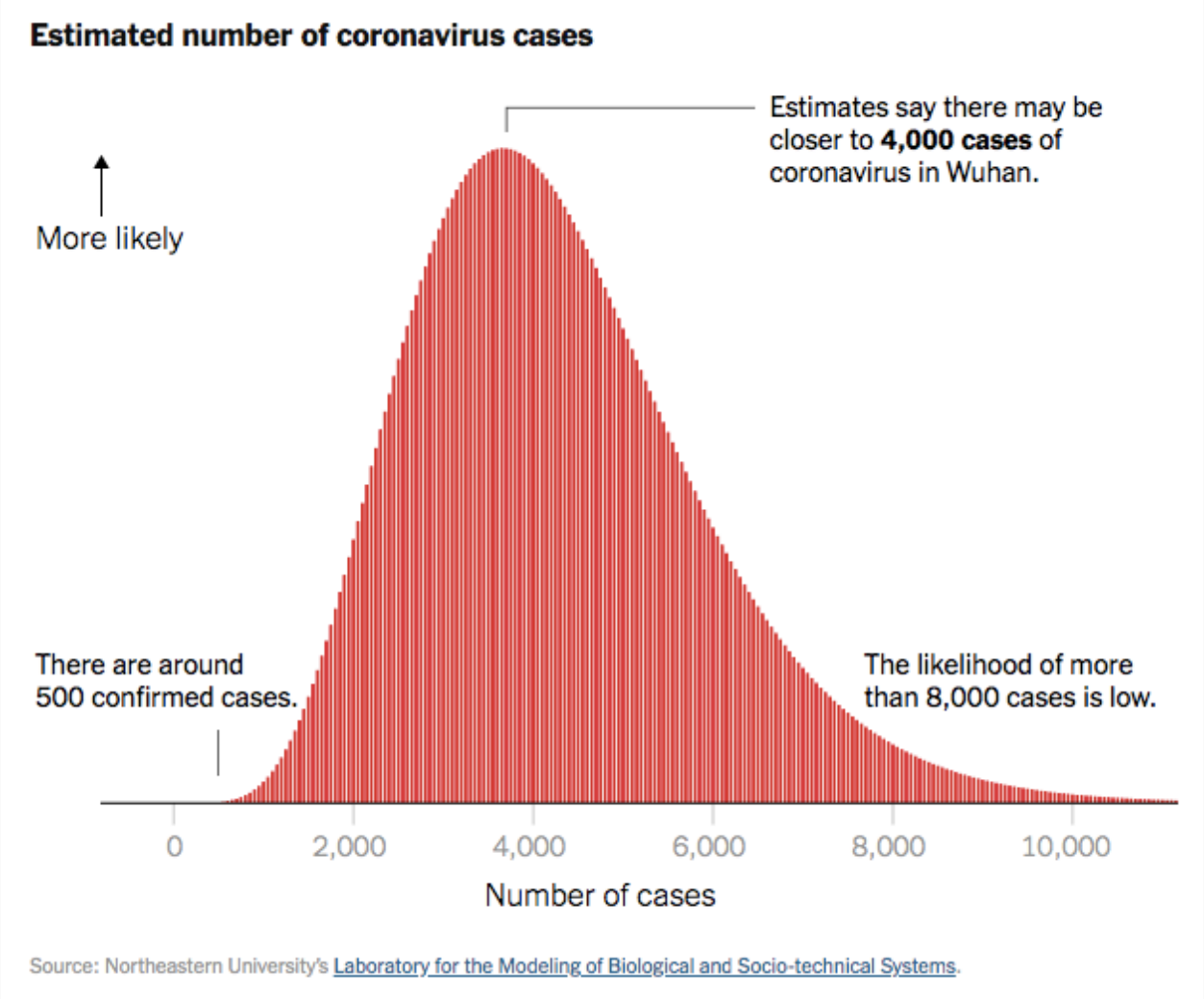
PANDEMIC THREAT Coronavirus 'could've infected 10,000 already' amid warning it's 'as deadly as Spanish flu – that killed 50 million'
LATEST
Lizzie Parry | Shaun Wooller
22 Jan 2020, 11:25 | Updated: 22 Jan 2020, 21:43

COMMUNICATING UNCERTAINTY



NY Times, January 23. 2020

CONCLUSION

Information about uncertainty should:

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- Be accessible, comprehensible, usable, and assessable.

FINAL REMARKS

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- Carefully consider audience, context and framing.

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- Carefully consider audience, context and framing.
- Use combinations of words, numbers and visuals to minimise misunderstanding.
- Be communicated with humility about the extent of our knowledge; demonstrating trustworthiness, rather than demanding trust.

SELECTED REFERENCES

- Elisabeth M Stephens, Tamsin L Edwards, and David Demeritt, *Communicating probabilistic information from climate model ensembles—lessons from numerical weather prediction*, Wiley interdisciplinary reviews: climate change **3** (2012), no. 5, 409–426.
- David Spiegelhalter, *Risk and uncertainty communication*, Annual Review of Statistics and Its Application **4** (2017), 31–60.
- Sanne JW Willems, Casper J Albers, and Ionica Smeets, *Variability in the interpretation of dutch probability phrases-a risk for miscommunication*, arXiv preprint arXiv:1901.09686 (2019).