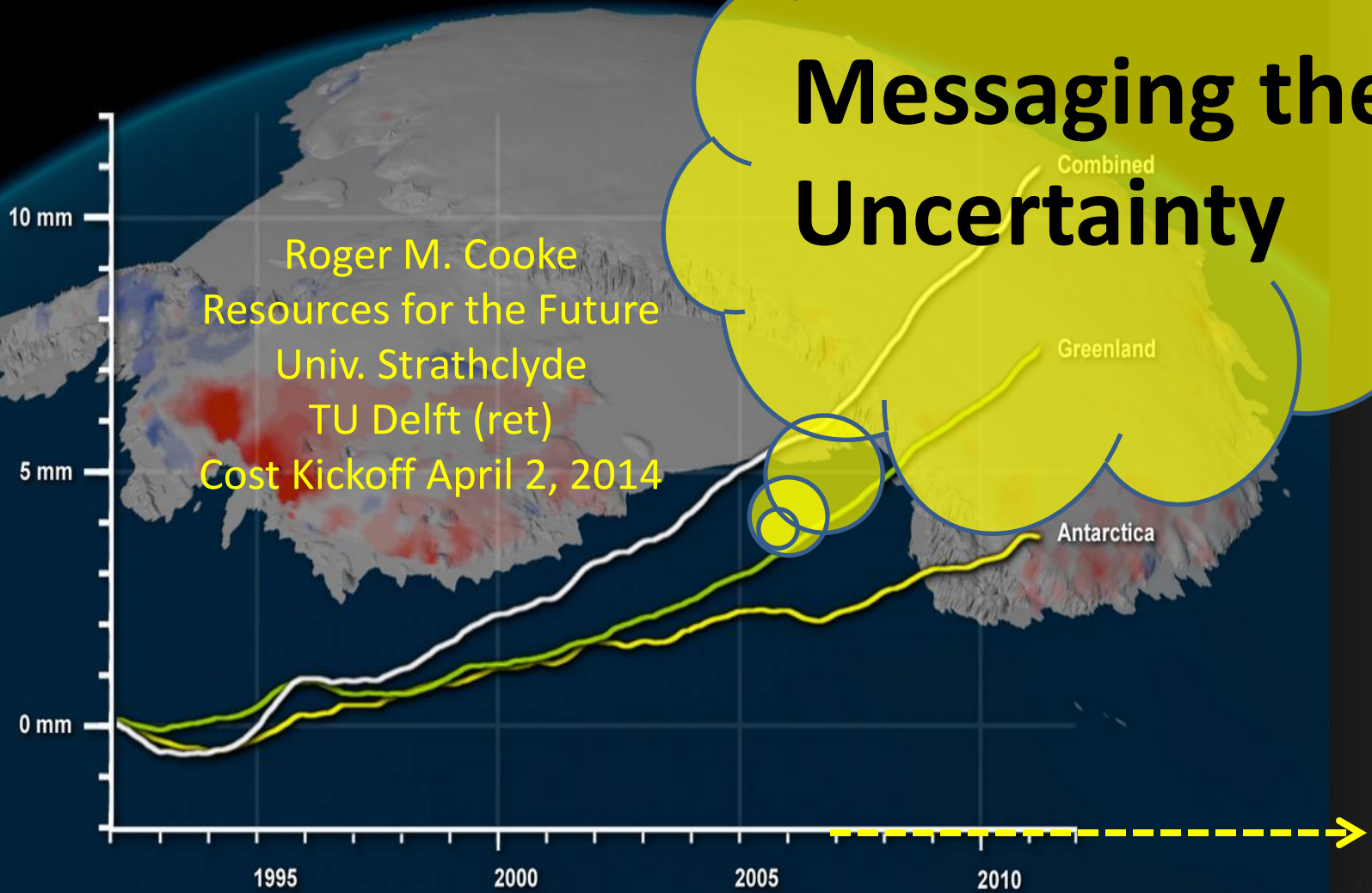# False Certainty or False Uncertainty

Ice Sheet Contribution to Global Sea Level

Roger M. Cooke
Resources for the Future
Univ. Strathclyde
TU Delft (ret)
Cost Kickoff April 2, 2014

Messaging the Uncertainty

Earth near climate 'tipping points,' NASA says

Small temperature increases now can have big impact, study concludes

Australian Antarctic Division via Reuters

Antarctica has shed icebergs like these for eons, but scientists say the continent is getting warmer due to human emissions of greenhouse gases. A new NASA-funded study says the West Antarctic ice sheet is one particularly vulnerable area.

John Shimkus, GOP Rep. Who Denies Climate Change On Religious Grounds, Could Lead House Environmental Policy

The Huffington Post | Nick Wing

First Posted: 11/13/10 11:52 AM ET | Updated: 05/25/11 07:10 PM ET

React ❯ | Important | Funny | Typical | Scary | Outrageous | Amazing | Innovative | Finally

Follow ❯ **Climate Change** , **Gop** , **Gop Climate Change** , **House Committee On Energy And Commerce** , **John Shimkus** , **Shimkus** , **Shimkus Climate Change** , **Shimkus Climate Change God** , **Shimkus Energy And Commerce** , **Shimkus God Climate Change** , **Politics News**

SHARE THIS STORY

f Like 10,973 people like this. Sign Up to see what your friends like.

| 2,597 | 0 | 4 | 0 |

f Share | 🐦 Tweet | ✉ Email | g+1

The highest-ranking House official in charge of environmental and energy policy may soon be a Republican legislator who denies climate change on the grounds of his belief that nothing bad can come of the Earth unless it is preordained by God.

Rep. John Shimkus (R-Ill.), a member of the House Committee on Energy and Commerce since 1997, submitted a letter to his colleagues earlier this week asking for their blessing in his campaign to assume the gavel when Republicans take control of the chamber.

Such a possibility is likely to be particularly worrying to climate change scientists and their supporters, especially considering a specific incident in which Shimkus appeared to reject any notion that mankind could alter the climate or science could alter that only God can "destroy this Earth."

The Toronto Star relays the entire exchange, which took place during a 2009 subcommittee hearing:

Others prepare for Climate Change

NOAH'S ARK BEING REBUILT HERE!

Surging Seas

Sea level rise, storms & global warming's threat to the US coast

A Climate Central Report
March 14, 2012

Executive Summary

Global warming has raised sea level about 8 inches since 1880, and the rate of rise is accelerating. Scientists expect 20 to 80 more inches this century, a lot depending upon how much more heat-trapping pollution humanity puts into the sky. This study makes mid-range projections of 1-8 inches by 2030, and 4-19 inches by 2050, depending upon location across the contiguous 48 states.

ipcc

INTERGOVERNMENTAL PANEL ON **climate change**

Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties

IPCC Cross-Working Group Meeting on Consistent Treatment of Uncertainties
Jasper Ridge, CA, USA
6-7 July 2010

Core Writing Team:
Michael D. Mastrandrea, Christopher B. Field, Thomas F. Stocker,
Ottmar Edenhofer, Kristie L. Ebi, David J. Frame, Hermann Held, Elmar Kriegler,
Katharine J. Mach, Patrick R. Matschoss, Gian-Kasper Plattner, Gary W. Yohe,
and Francis W. Zwiers

IPCC's Calibrated Language
High or Very confidence:

US National Research Council 2010 report *Advancing the Science of Climate Change*
(http://www.nap.edu/catalog.php?record_id=12782

1. Earth is warming

2. Most of the warming over the last several decades can be attributed to human activities

3. Natural climate variability ... cannot explain or offset the long-term warming trend.

4. Global warming is closely associated with a broad spectrum of other changes,

5. Human-induced climate change and its impacts will continue for many decades,

6. The ultimate magnitude of climate change and the severity of its impacts depend strongly on the actions that human societies take to respond to these risks.

High confidence = "≥ 8 out of 10"

High confidence in 1 &

High confidence in 2 & ......

High confidence in 6

= High Confidence in 1&2&3&4&5&6 ??????

IF each has probability 0.8 of being true,
    probability of ALL $\in$ [0, 0.8]

Conditional or joint probability???

High Confidence: Earth is warming

High Confidence: Most of the warming over the last several decades can be attributed to human activities

= High confidence: "Given Earth is warming, humans caused it"

OR

= High confidence "Earth is warming AND humans caused it"

High Confidence (condition) × High Confidence(consequence) = ?

1977: Artificial Intelligence turns from chess to science E.A.Feigenbaum (1977) The Art of Artificial Intelligence"

The "Grand Masters" don't reason probabilistically

Fuzziness,

Imprecision,

Certainty factors,

Degree of possibility,

Belief functions,

Non-monotonic reasoning,

Random sets,

The fuzzy uncertainty of A & B…& E = minimum of their fuzzy uncertainties

So, if

fuzzy uncert'y **"Quincy is a man**" = ½ = fuzzy Uncert'y "**Quincy is a woman**"

Then fuzzy uncert'y "**Quincy is a man AND a woman**" = ½.

Artificial Intelligence:
UAI Proceedings digitized 1985 – 2012
word count:

2012

- non-monotonic 0%
- fuzzy 1%
- certainty factor 0%
- possibilistic 0%
- belief function 0%
- belief function 1%
- imprecise prob 1%
- non-monotonic 5%
- Bayes 26%
- belief function 1%
- random sets 1%
- Bayes 78%
- Bayes 97%
- imprecise prob 0%
- possibilistic 0%
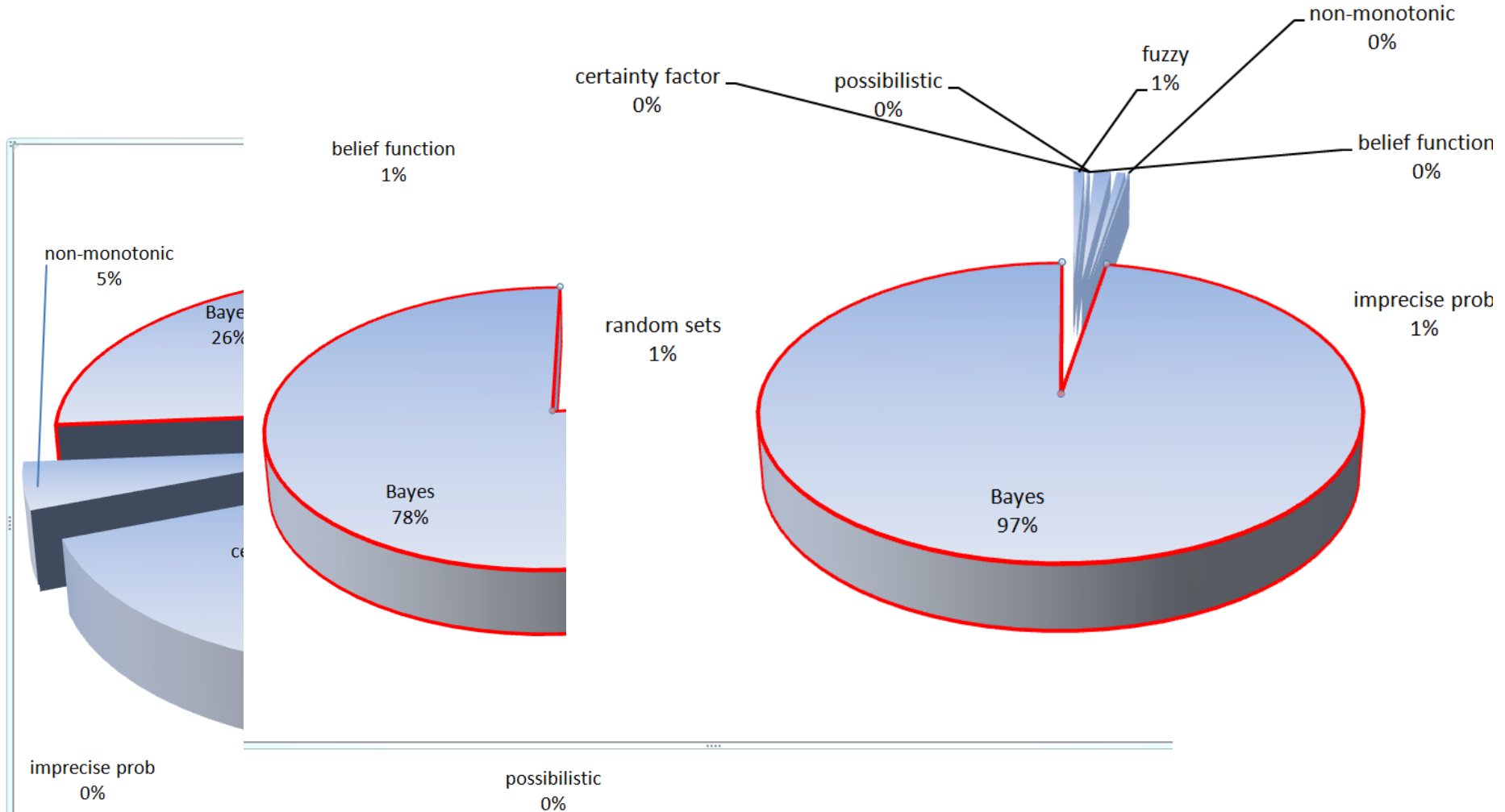
Current flavor of the month......

DEEP UNCERTAINTY

*"In fact, the climate change debate is characterized by deep uncertainty, which results from factors such as **lack of information**, **disagreement** about what is known or even knowable, **linguistic imprecision**, **statistical variation**, measurement error, approximation, **subjective judgment**, and **disagreement about structural models**, among others (see Moss and Schneider, 2000)."* U.S. Senate Committee on Commerce, Science and Transportation Hearing on "The Case for Climate

Deep Uncertainty defies quantification because.....

Deep uncertainty is Knightian

Frank Knight, Risk, Uncertainty and Profit, 1921

. "Uncertainty", [in contrast to risk], concerns "partial knowledge" for which "the conception of an objectively measurable probability or chance is simply inapplicable"

...but read further....

*"We can also employ the terms '**objective**' and '**subjective**' probability to designate the **risk** and **uncertainty** respectively, as these expressions are already in general use with a signification akin to that proposed"*

The problem of communicating uncertainty about CC is:

The Communicators don't understand uncertainty

No blame: IPCC synthesizes 'what's out there'
We, not IPCC, must raise the bar

The bar needs raising

- Deniers use uncertainty to shift the proof burden
- Alarmists use uncertainty to frighten us into precipitous action

- No alternative to science-based UQ

- (Forthcoming IPCC report is better)

Foundations 101

Ramsey 1926, Savage (Ogashevitz)1954

If John prefers

$10,000 if France wins...; $1000 otherwise
to
$10,000 if USA wns...; $1000 otherwise,

and

$10,000 if France OR Belgium win...; $1000 otherwise
is preferred to

$10,000 if USA OR Belgium win...; $1000 otherwise.
etc

THEN (+continuity, dominance axioms) John's partial belief is uniquely represented as a (subjective) probability measure.

Quantifying Uncertainty: Structured Expert Judgment

European Commission

Community research

Project report

Nuclear science and technology

Procedures guide for structured expert judgment
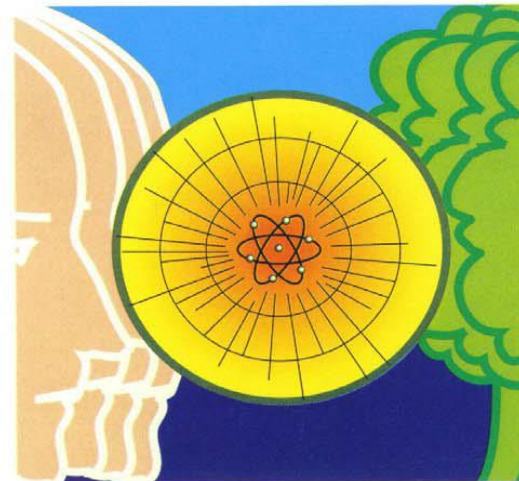
EURATOM

Anno 2013 over 100 professional applications

Partial List: Louis Goossens, Willy Aspinall, Mark Burgman, Tim Bedford, Anca Hanea, Abby Colson, Dorota Kurowicka, Oswaldo Morales, Marion Whitmann, John Rothlisberger, Bernd Kraan, John Evans, Juoni Tuomisto, Margret Palmer, David Lodge, Karen Slijkhjiis, Martijn Frijters, Tom Mazzuchi, Eric Jager, Fred Harper, Jan van Noortwijk, Nicole van Elst, Bram Meima, Arno Willems

Nuclear	EU, USNRC
Aerospace	ESTEC, NASA
Chemical Process	VROM
Dose Response	VROM
Environmental Transport	EU, USNRC, VROM
Banking / Investment	SHELL, AMS Optie
Volcanoes	UK, EU
Aeronautics	VROM, AIRBUS, BA
Project mngt	Robert Woods Johnson
Public Health	Health Canada
Civil Infrastructure	UK, NL, EPA
Invasive Species	NOAA
Ice Sheets	RL Foundation, UK

"Uncertainty from random sampling ...omits important sources of uncertainty" NRC(2003)

All cause mortality, percent increase per 1 μg/m³ increase in PM$_{2.5}$

	Amer Cancer Soc. (reanal.)	Six Cities Study (reanal.)	Harvard Kuwait, Equal weights (US)	Harvard Kuwait, Performance weights (US)
			False Uncertainty	**Goldilocks Uncertainty**
Ratio 95%/50%	0.44 **2.5** 1.12 **False Certainty**	**4.8**	**257**	**63**

Very High Information, Very Poor Statistical Accuracy

False Certainty: Worse than useless

```
Expert no. :    30     Expert name:   035
Items
 44<U>                                   [------*------]
Real  :::::::::::::::::#:::::::::::::::::::::::::::::::::::::::::::::::::::::::::

|45<U>                                              [----*----]
Real  :::::::::::#:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

 46<U>                                          #              [----*---------]
Real  :::::::::::::::::::::::::::::::::::::::::::#:::::::::::::::::::::::::::::::

 47<U>                       [----*-]
Real  :::::::::::::::::::::::::#:::::::::::::::::::::::::::::::::::::::::::::::::

 48<U>               []
Real  :::::::::#:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

 49<U>           !
Real  :::::::#:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

 50<U>      [*]
Real  ::#:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

 51<U>                                 [----*----]
Real  :::::::::#:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

 52<U>                                                    [-*-]
Real  ::::::::::::::::::::::::#::::::::::::::::::::::::::::::::::::::::::::::::::

 53<U>                   [-------*-------]
Real  :::::::::::::::::::::::#::::::::::::::::::::::::::::::::::::::::::::::::::::
```

90% Confidence

True value

Low Information, Good Statistical Accuracy

False Uncertainty: Useless

```
Expert no. :    29      Expert name:   034
Items
  44(U) [------*------------------------------]
Real   ::::::::::::::::#:::::::::::::::::::::::::::::::::::::::::::::::::::::::::

  45(U)    [-----------------------*--------------------------]
Real   :::::::::#::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

  46(U)    [-----------------------------*---------------------------]
Real   ::::::::::::::::::::::::::::::#::::::::::::::::::::::::::::::::::::::::::

  47(U)       [-----*-----------------------------]
Real   :::::::::::::::::::::::::#:::::::::::::::::::::::::::::::::::::::::::::::

  48(U)  [---------------------------------------------*----------------------]
Real   ::::::::::#:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

  49(U) [--------*---------------------------------]
Real   :::::::#::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

  50(U) [--*-----]
Real   ::#:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

  51(U)    [--------------*------------------------]
Real   :::::::::#::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

  52(U)        [-----------------------------*---------------------------]
Real   :::::::::::::::::::::::::#:::::::::::::::::::::::::::::::::::::::::::::::

  53(U)        [------*-----------------------------------------------]
Real   ::::::::::::::::::::::::#:::::::::::::::::::::::::::::::::::::::::::::::::
```

High Information, Decent Statistical Accuracy

Goldilocks Uncertainty

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Expert no. :    16      Expert name:   018
Items
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Real   :::::::::::::::::#::::::::::::::::::::::::::::::::::::::::::::::::::::::::

  45(U)       [--*---]
Real   :::::::#::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

  46(U)                                   [---------*------]
Real   :::::::::::::::::::::::::::::::::#::::::::::::::::::::::::::::::::::::::::

  47(U)          [---*---]
Real   :::::::::::::::::::::::::#::::::::::::::::::::::::::::::::::::::::::::::::

  48(U)          [-*--]
Real   :::::::::#::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

  49(U)     [-*-]
Real   ::::::::#:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

  50(U) [--*]
Real   ::#::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

  51(U)     [--*-]
Real   :::::::::#::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

  52(U)                              [---------*----------]
Real   ::::::::::::::::::::::::::#::::::::::::::::::::::::::::::::::::::::::::::

  53(U)                       [------*-------]
Real   ::::::::::::::::::::::::#::::::::::::::::::::::::::::::::::::::::::::::::
```

OPINION

A route to more tractable expert advice

There are mathematically advanced ways to weigh and pool scientific advice. They should be used more to quantify uncertainty and improve decision-making, says **Willy Aspinall**.

The Classical Model

THE COOKE METHOD

Estimating how long an old earth dam can withstand a leak.

▲ ▌ Best estimate
├───┤ Credible interval (90% probability of falling in this range)

Time to failure for the dam (hours)
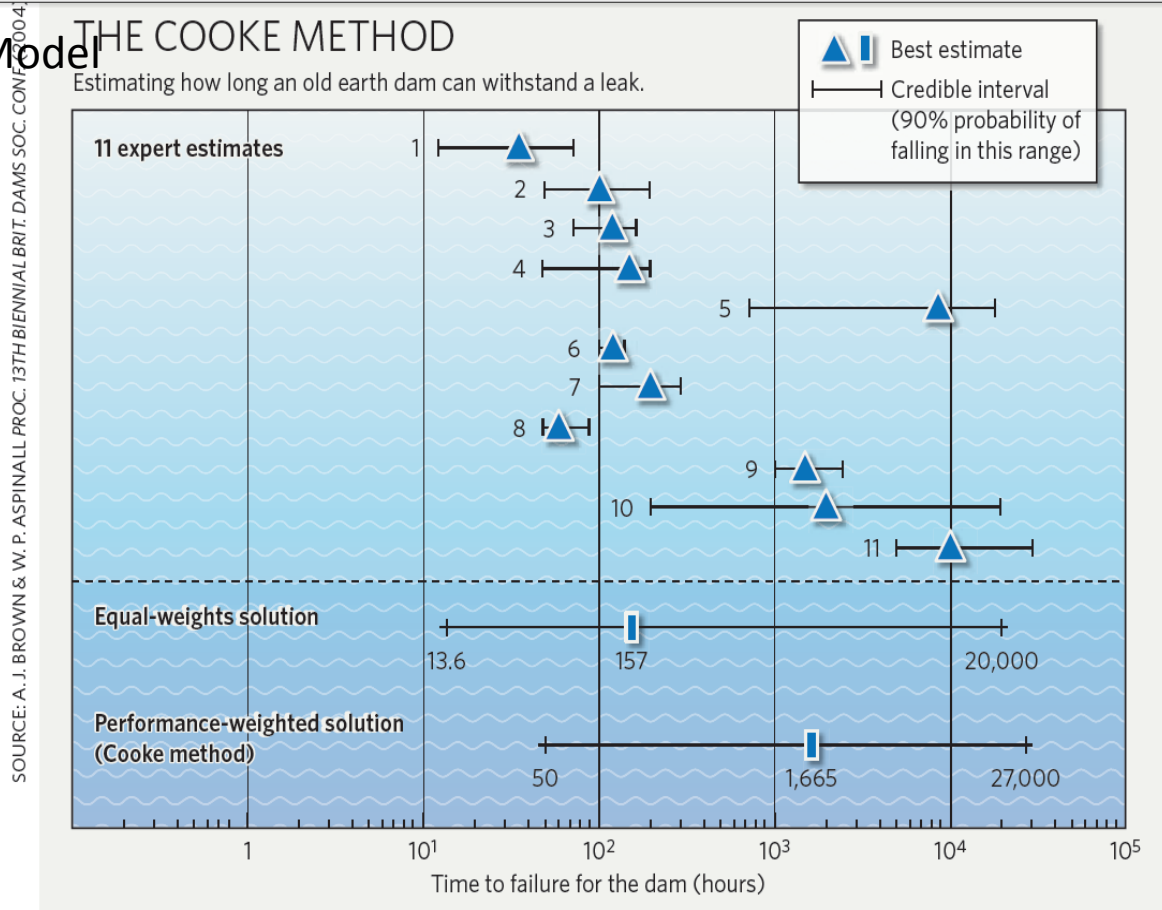
Figure 1 | Estimates from 11 experts of the time-to-failure of an earth dam, once the core starts to leak. The performance-weighted best judgement is about 70 days — much longer than the equal-weights solution of about a week.

Expert elicitation 2010, 2012, 2012a (J.Bamber and W. Aspinall) Dependence Elicitation Dec. 18, 19, 2012, (JB, WA, RC)
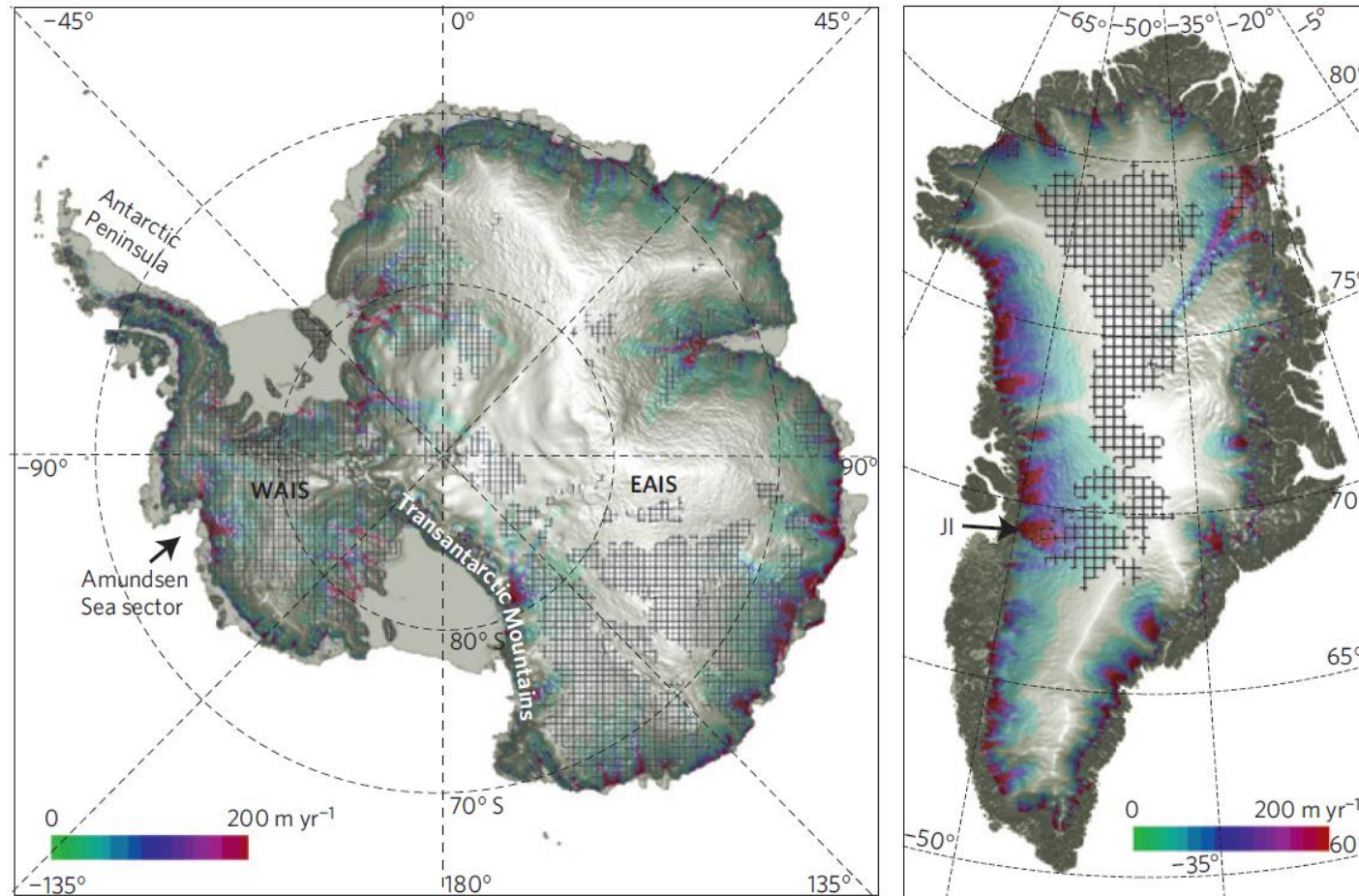
Figure 1 | Shade relief maps of Antarctica and Greenland showing regions of enhanced flow (in colour) and areas of the ice sheets grounded below sea level (hatched). Also shown are regions discussed in the text. JI refers to Jakobshavn Isbrae, a glacier that doubled in velocity during the late 1990s[7].

EXPERT JUDGEMENT ASSESSMENT

Quantifying uncertainty on thin ice

The contribution of ice sheets to sea-level rise still has large uncertainties that are yet to be quantified.

R. M. Cooke

2010
2012

O = Observationalist
M = Modeler
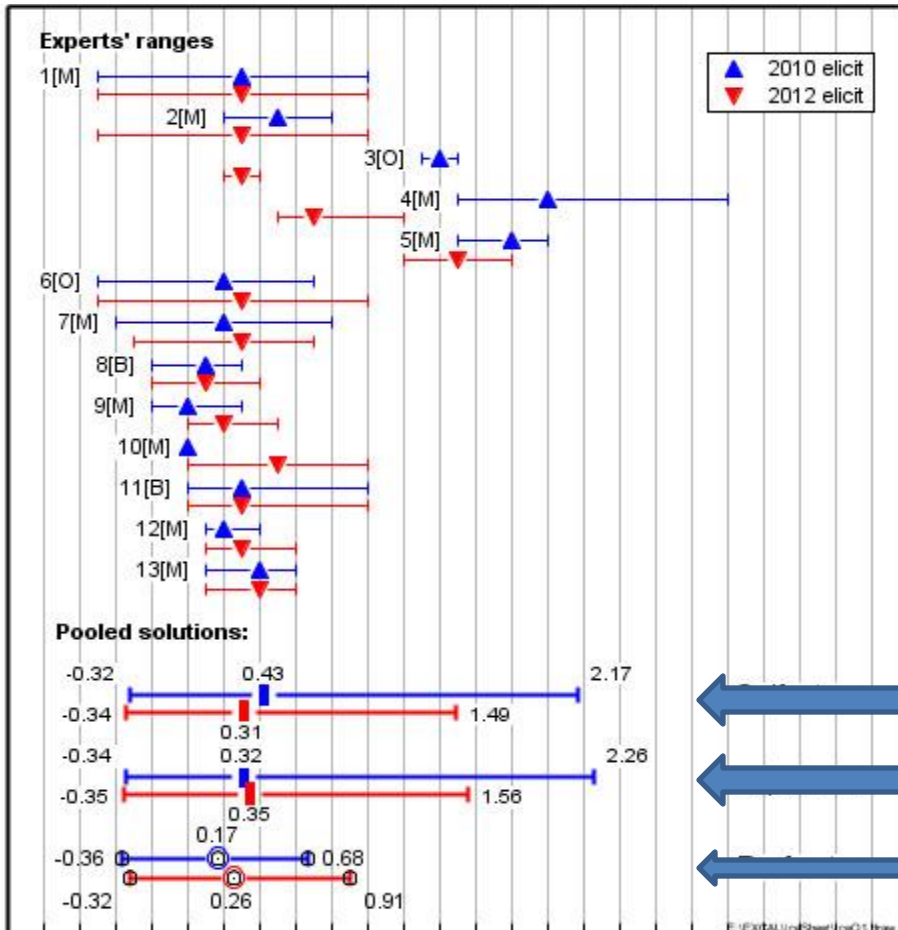
Self – weights

Equal weights

Performance based weights

20th Century combined Ice Sheet contribution to SLR [mm/yr]
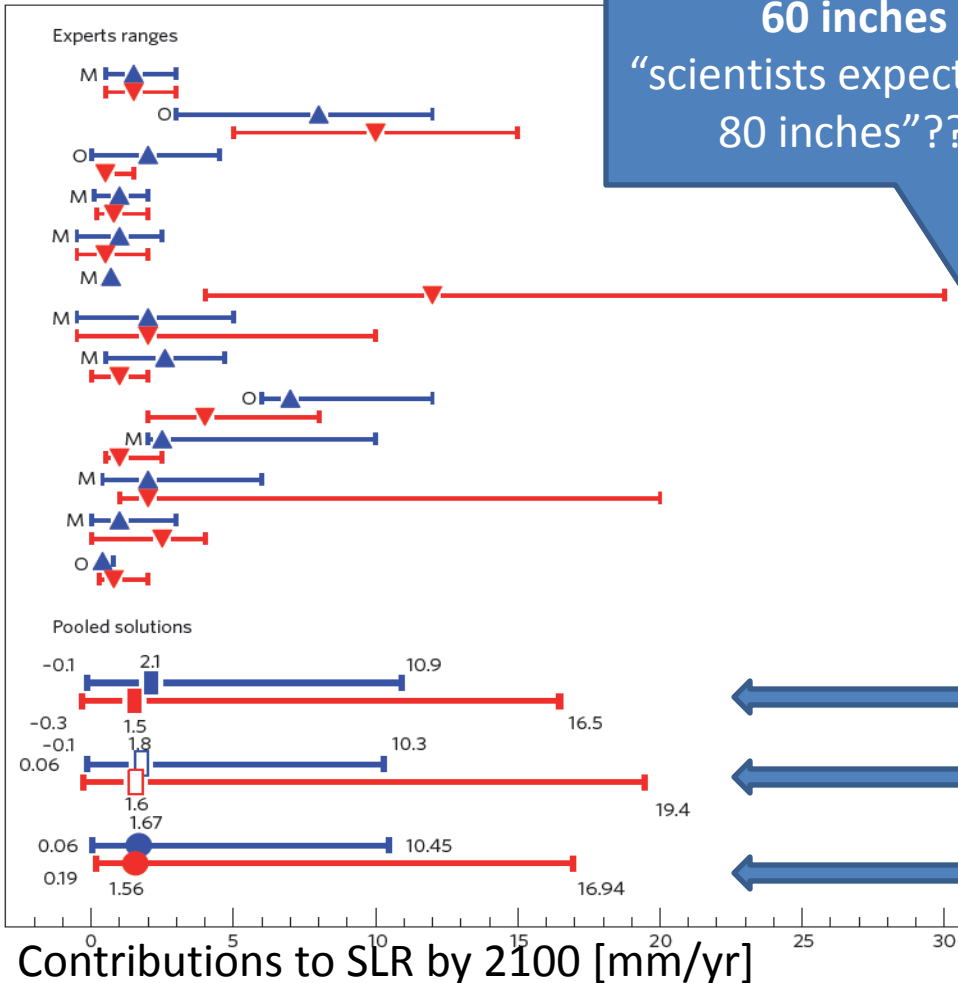
What Else?

WIRED MAGAZINE: 17.03

TECH BIZ : IT

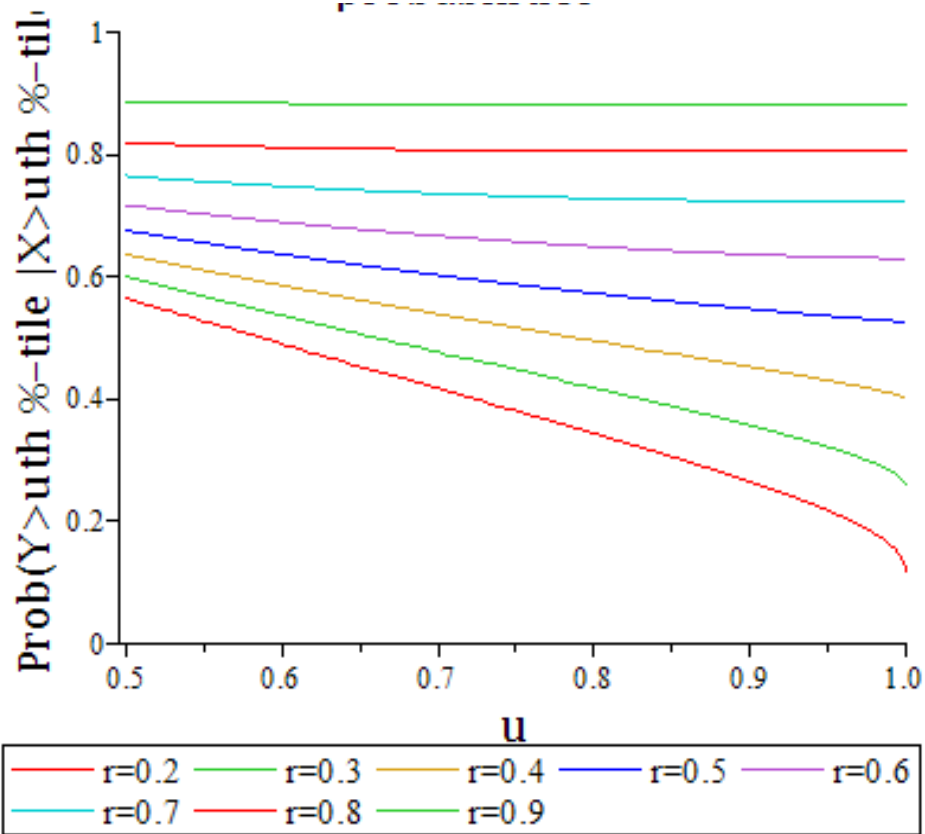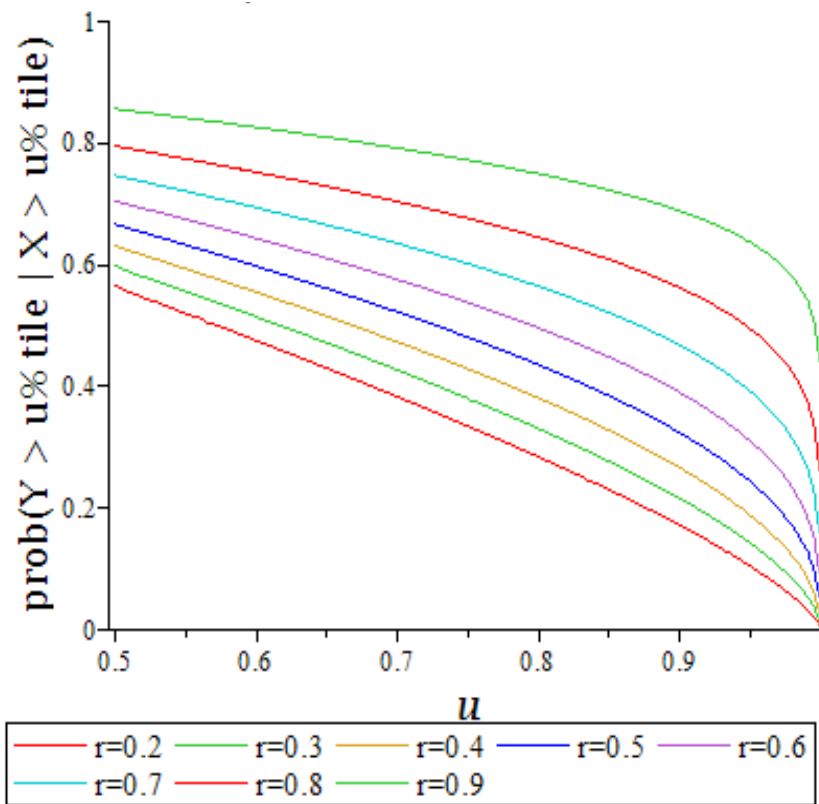# Recipe for Disaster: The Formula That Killed Wall Street

By Felix Salmon ✉   02.23.09

Tail (in)dependence: Normal Copula

"Suppose X is really bad, what is the probability that also Y is really bad?"

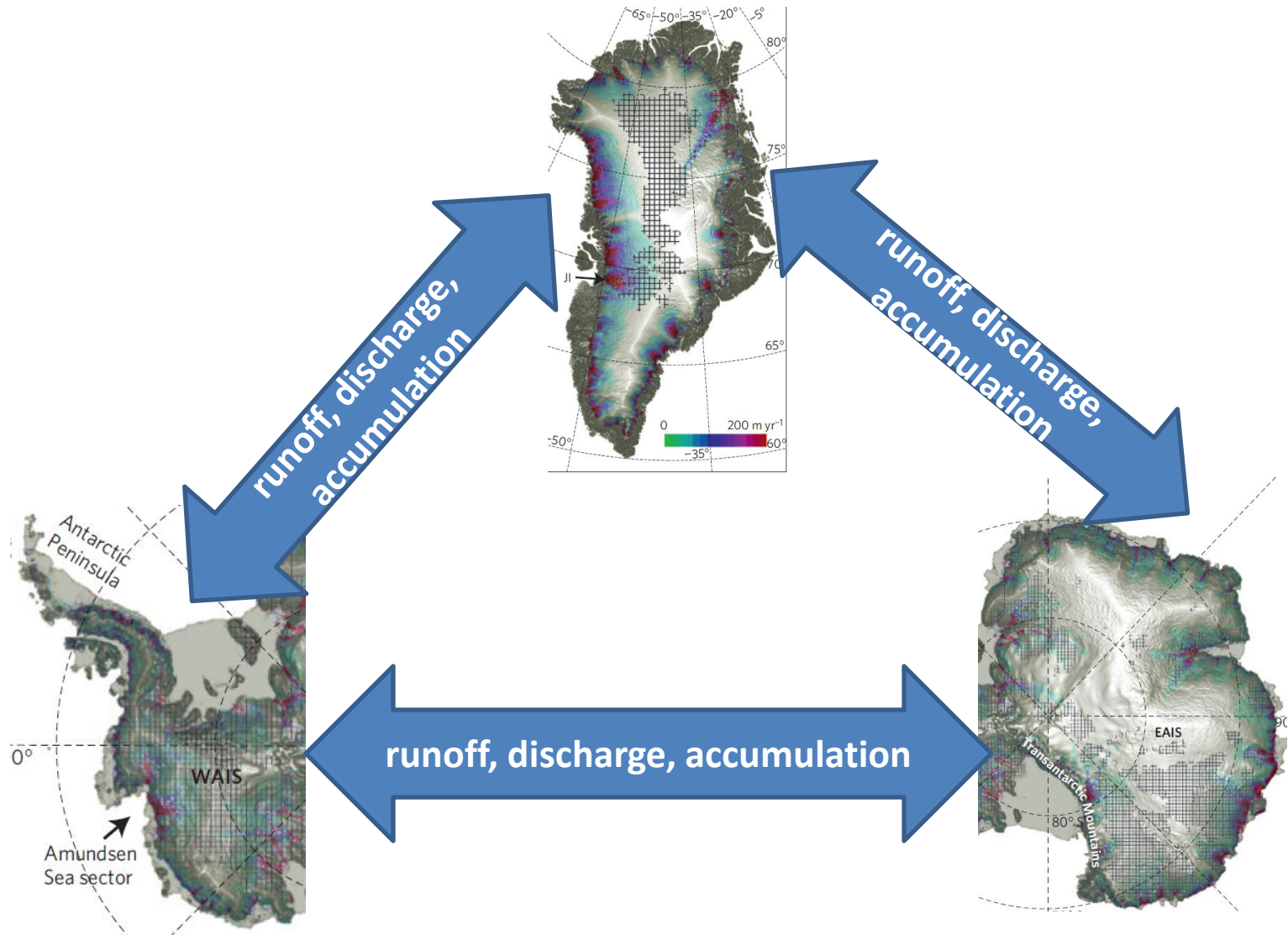**Conditional exceedance probabilities as function of correlation**

Normal copula   **Reverse Clayton Copula**

Dependence in Ice Sheet Uncertainty?

Contribution to SLR / yr = Runoff + Discharge - Accumulation

"Uncertainty effects":

	Ice sheet contribution to SLR in 2100 @ 3C warming [mm]					
		Mean	**StDev**	**5%-ile**	**50%-ile**	**95%-ile**
Decision maker (expert combination)	Performance weights, Independent	335	200	71	307	719
	Performance weights, Normal copulae					
	Performance weights, Tail Dependent	338	229	71	292	785
	Equal weights, Independent	615	270	238	581	1120

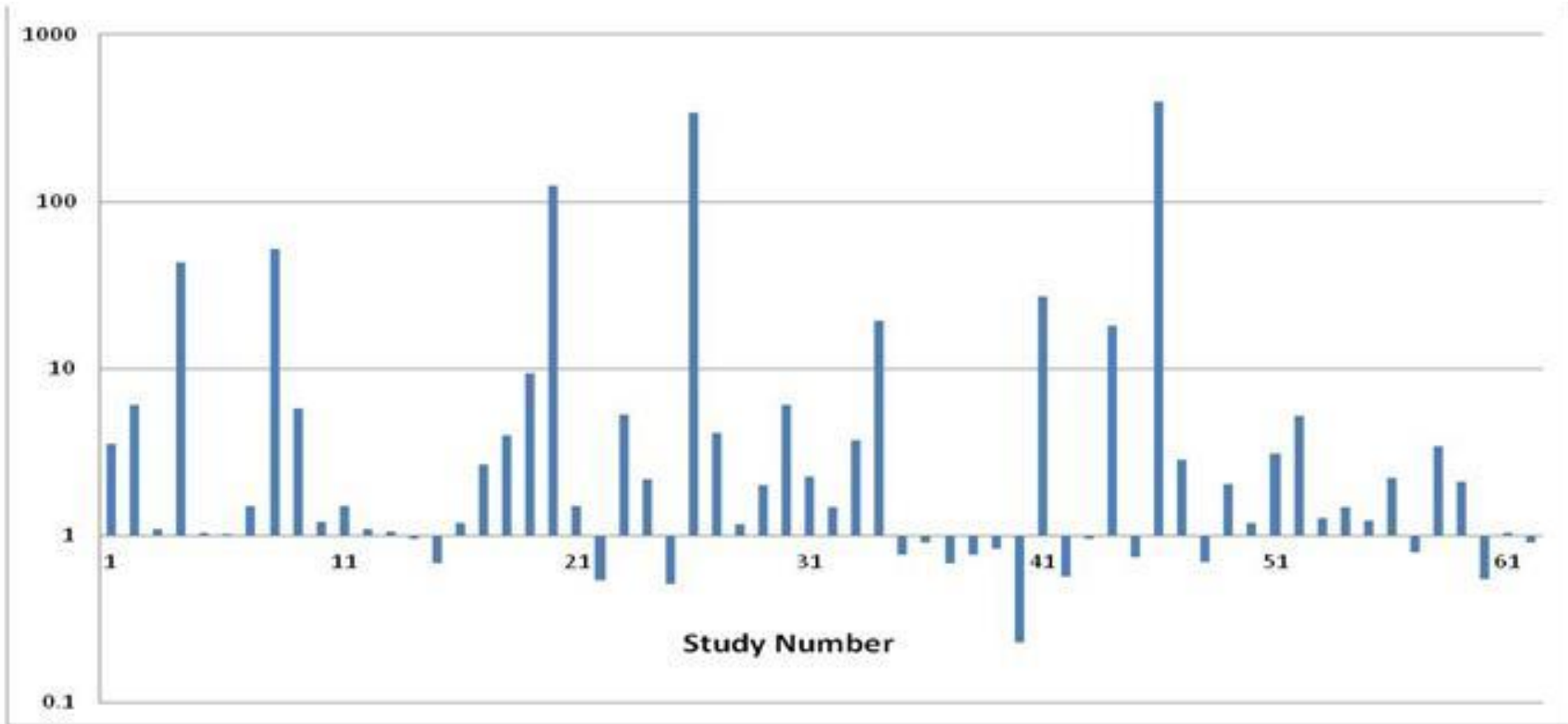**Goldilocks Uncertainty**

False Uncertainty

What Else?

Outs of Sample Validation:
of Classical Model

62 studies, per study: geomeans of comparisons of PW/EW combined score ratios. Eggstaff, Mazzuchi, Sarkani (2013 RESS);