



cost
EUROPEAN COOPERATION
IN SCIENCE AND TECHNOLOGY





ISCH COST Action IS1304
Expert Judgment Network: Bridging the Gap
Between Scientific Uncertainty and Evidence-
Based Decision Making

Strathclyde University Business School - 29 August 2014


Aspects of real world problem elicitations in practice

Willy Aspinall
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Cabot Institute



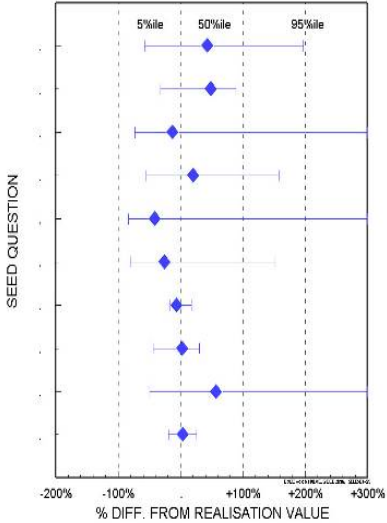
The British Airways experience.....



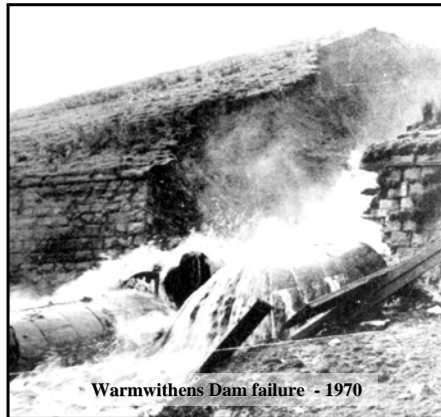
Elicitation of 40 senior long-haul captains concerning rare events risks for compiling a monthly fleet 'severity index' scoring system

- notable variations in individual judgments shows up in Classical Model calibration (see right), notwithstanding common training, operational conditioning
- but weighted pooling generates valid collective outcomes for target items

BRITISH AIRWAYS SESMA DATA:
COMPARISON OF EXPERT JUDGEMENTS
WITH KNOWN VALUES FOR SEED QUESTIONS



From air to water.....



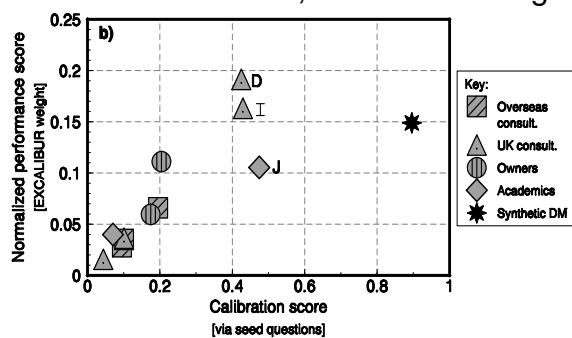
Warmwithens Dam failure - 1970



Cowlyd Reservoir inspection party - 1917

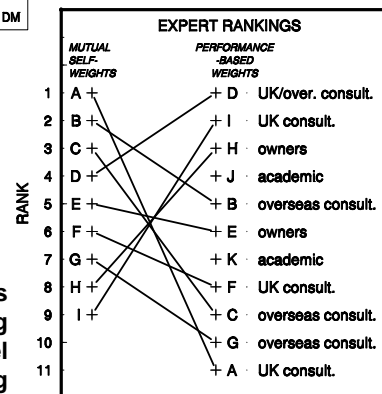
Objective: to develop a generic quantitative model for accelerated internal erosion in Britain's population of 2,500 ageing dams, using elicited quantities for key variables..... reservoir safety risk assessment in the UK³

Reservoir engineers: Classical Model performance-based scores, and mutual weighting rankings



Classical Model performance-based profile (above) is typical

... but note big discrepancies between 'eminence-based' ranking (left col) and Classical Model 'performance-based' ranking



Elicitation of expert judgment when data is absent

The Harvard study on Kuwait's First Gulf War reparations claim



• Health effects claim based on expert elicitation: ~ 35 deaths

Individual experts' best mortality estimates:

13, 32, 54, 110, 164, 2874

Equal Weights (82 deaths;

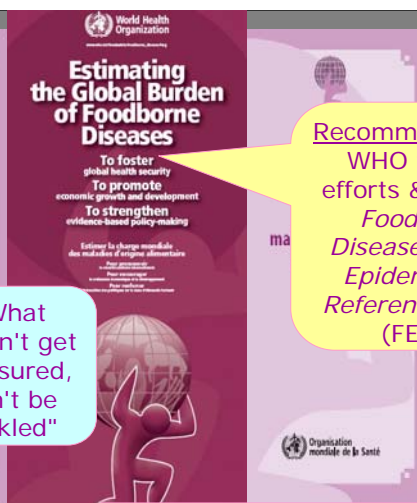
90% conf.: 18 to 400)

Performance Weights (35 deaths;

90% conf.: 16 to 54)

... but the judicial decision of the UN Commission eventually rejected the admissibility of this form of evidence: "...not actual data...."

Typical case for expert elicitation: Estimating Global Burden of Foodborne Diseases



Recommendation: WHO to lead efforts & appoint Foodborne Disease Burden Epidemiology Reference Group (FERG)

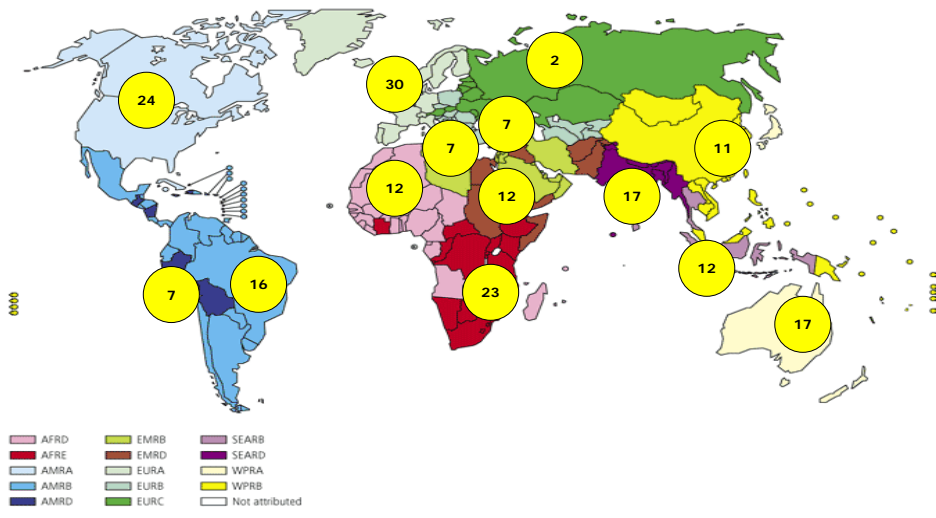
"How to assess effectiveness of food safety policies & interventions?"

"What doesn't get measured, can't be tackled"

.. Major structured Classical Model elicitation launched 2013

Number of experts in WHO sub-regions – representative panels of experts (not all) elicited by neutral facilitators

Fig. 1. WHO subregions and mortality strata

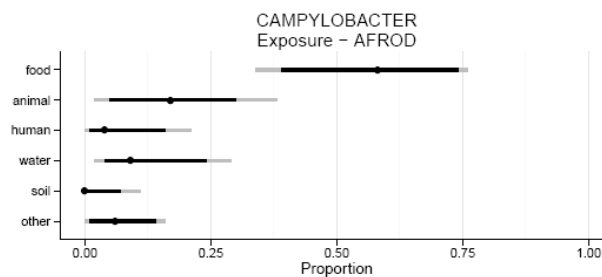


Example output: pathways for campylobacter exposure in one WHO sub-region

2 Results per WHO subregion

2.1 AFROD

	mean	median	2.5%	5%	95%	97.5%
food	0.57	0.58	0.34	0.39	0.74	0.76
animal	0.17	0.17	0.02	0.05	0.30	0.38
human	0.06	0.04	0.00	0.01	0.16	0.21
water	0.11	0.09	0.02	0.04	0.24	0.29
soil	0.02	0.00	0.00	0.00	0.07	0.11
other	0.07	0.06	0.00	0.01	0.14	0.16



Ice sheet melting – projected contributions to future sea-level rise due to climate change



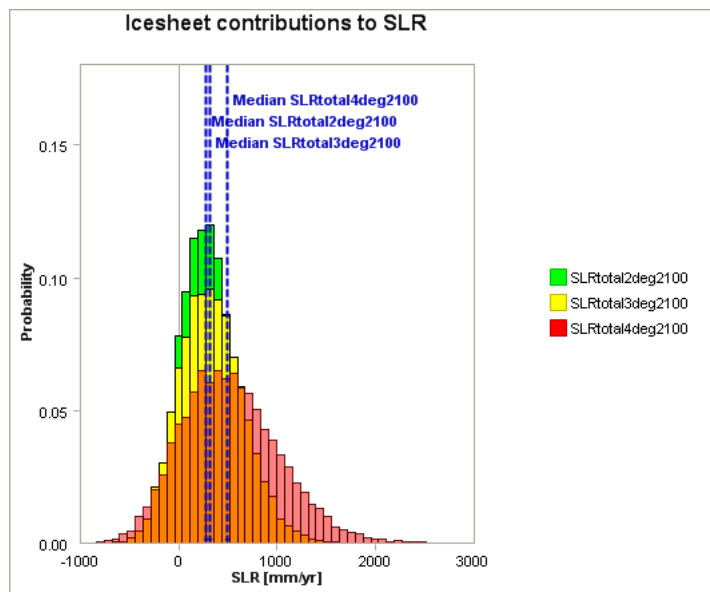
nature climate change **ARTICLES**
 PUBLISHED ONLINE: 23 DECEMBER 2012 | DOI:10.1038/NCLIMATE1778

An expert judgement assessment of future sea level rise from the ice sheets

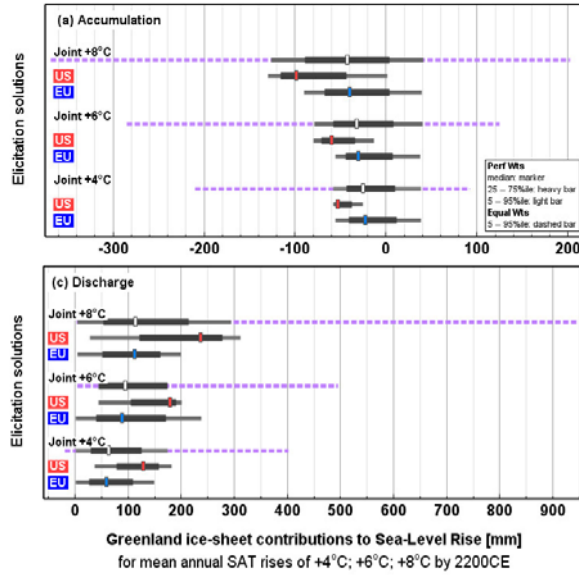
J. L. Bamber^{1*} and W. P. Aspinall²

A major gap in predictive capability concerning the future evolution of the ice sheets was identified in the Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change. As a consequence, it has been suggested that the AR4 estimates of future sea-level rise from this source may have been underestimated. Various approaches for addressing this problem have been tried, including semi-empirical models and conceptual studies. Here, we report a formalized pooling of expert views on uncertainties in future ice-sheet contributions using a structured elicitation approach. We find that the median estimate of such contributions is 29 cm—substantially larger than in the AR4—while the upper 95th percentile value is 84 cm, implying a conceivable risk of a sea-level rise of greater than a metre by 2100. On the critical question of whether recent ice-sheet behaviour is due to variability in the ice sheet-climate system or reflects a long-term trend, expert opinion is shown to be both very uncertain and undecided.

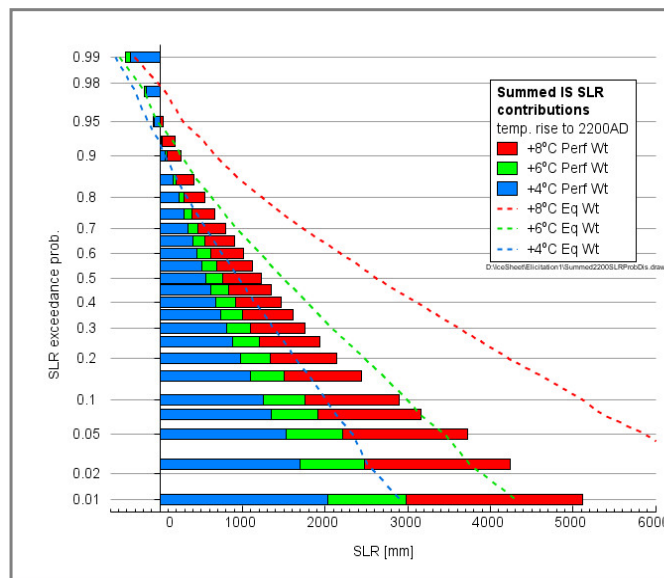
Monte Carlo simulations using experts' quantiles: SLR rate at 2100AD, three temperature scenarios: 2°C, 3°C, 4°C



Two panels, separately elicited and also combined – simulations using quantiles for Sea Level Rise at 2200CE temperature scenarios: +4°C, +6°C, +8°C



Pooled expert judgements on combined ice-sheet contributions to sea-level rise: probability exceedance results



Big news – not only CFS implicated with XMRV (mouse) virus in humans but also prostate cancer!

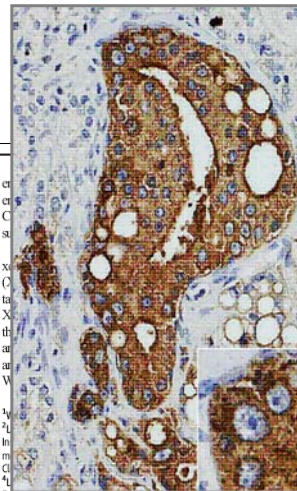
Detection of an Infectious Retrovirus, XMRV, in Blood Cells of Patients with Chronic Fatigue Syndrome

Vincent C. Lombardi,^{1,4} Francis W. Ruscetti,^{2,4} Jaydip Das Gupta,³ Max A. Pfost,¹ Kathryn S. Hagen,¹ Daniel L. Peterson,¹ Sandra K. Ruscetti,⁴ Rachel K. Bagni,⁵ Cari Petrow-Sadowski,⁶ Bert Gold,² Michael Dean,² Robert H. Silverman,³ Judy A. Mikovits^{1†}

Chronic fatigue syndrome (CFS) is a debilitating disease of unknown etiology that is estimated to affect 17 million people worldwide. Studying peripheral blood mononuclear cells (PBMCs) from CFS patients, we identified DNA from a human gammaretrovirus, xenotropic murine leukemia virus-related virus (XMRV), in 68 of 101 patients (67%) as compared to 8 of 218 (3.7%) healthy controls. Cell culture experiments revealed that patient-derived XMRV is infectious and that both cell-associated and cell-free transmission of the virus are possible. Secondary viral infections were established in uninfected primary lymphocytes and indicator cell lines after their exposure to activated PBMCs, B cells, T cells, or plasma derived from CFS patients. These findings raise the possibility that XMRV may be a contributing factor in the pathogenesis of CFS.

Chronic fatigue syndrome (CFS) is a disorder of unknown etiology that affects multiple organ systems in the body. Patients with CFS display abnormalities in immune sys-

tem function, often including chronic activation of the innate immune system and a deficiency in natural killer cell activity (1, 2). A number of viruses, including ubiquitous herpesviruses and



Frederick, Frederick, MD 21702, USA. ⁴Advanced Technology Program, National Cancer Institute-Frederick, Frederick, MD 21701, USA. ⁵Basic Research Program, Scientific Applications International Corporation, National Cancer Institute-Frederick, Frederick, MD 21701, USA.

[†]These authors contributed equally to this work. ^{††}To whom correspondence should be addressed. E-mail: judym@wpinstitute.org

XMRV Expert Elicitation Workshop



International expert group convened by Public Health Agency of Canada to be elicited on public health risk issues related to XMRV

Multiple Target Item values sought for Risk Model

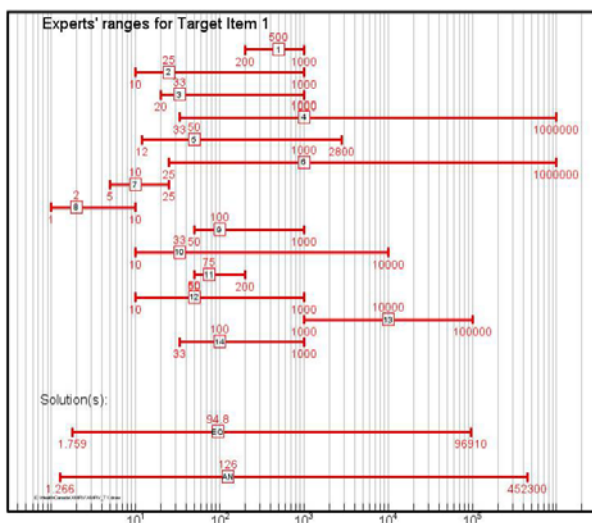
Questions

Subject Area

1-7	Prevalence
8-11	Risk Parameters
12-15	Latency
16-22	Routes of Transmission
23-25	Risk Mitigation
26-30	Disease Relationships (causal and non-causal)

Target Questions 1, 3-6

A set of target questions that asked about the current prevalence of XMRV infection in the world (1), Canada (3), USA (4), UK (5) and France (6) in the general adult population? (1 in xxxxx)



Expert Weighted:

- 1 in 126
- Range: 1.2-452,300

Note huge uncertainty spread – hinting at a specious problem (other items were similarly unconstrained)

Initial results not replicated

Table. Published studies October 2009 to June 2011

First author, country	Journal, date	Patients positive for XMRV?
Lombardi, USA	Science, October 2009	Yes (67%)
Erlwein, UK	PLoS One, January 2010 & March 2011 (re-analysis)	No
van Kuppelweld, Netherlands	British Medical Journal, February 2010	No
Groom, UK	Retrovirology, February 2010	No
Swizer, USA	Retrovirology, July 2010	No
Lo, USA	Proc Natl Acad Sci, August 2010	No (but 86.5% MLV)
Hong, China	Virology Journal, September 2010	No
Henrich, USA	J Infect Dis, November 2010	No
Hohn, Germany	PLoS One, December 2010	No
Satterfield, USA	Retrovirology, February 2011	No
Furuta, Japan	Retrovirology, March 2011	No
Schutzer, USA	Ann Neurol, April 2011	No
Shin, USA	Journal of Virology, May 2011	No
Knox, USA	Science, May 2011	No

17

Editor of Science eventually flagged up issue when authors would not withdraw their paper

The screenshot shows the Science journal website interface. At the top, there are navigation tabs for 'REPORTS', 'COMMENTARY', and 'LETTERS'. The 'COMMENTARY' tab is active, showing a grid of articles with the number '38' and a 'Think again' button. Below this, the 'LETTERS' section is visible, edited by Jennifer Sills. The main article is titled 'Editorial Expression of Concern' and discusses the controversy surrounding the XMRV study. The text mentions that the study by Lombardi et al. (2009) had provided patient samples to Lombardi et al. for comprehensive assays, but the authors did not withdraw their paper. The article is signed by Bruce Alberts, Editor-in-Chief. A vertical watermark on the right side reads 'Downloaded from www.sciencemag.org on July 2, 2011'.

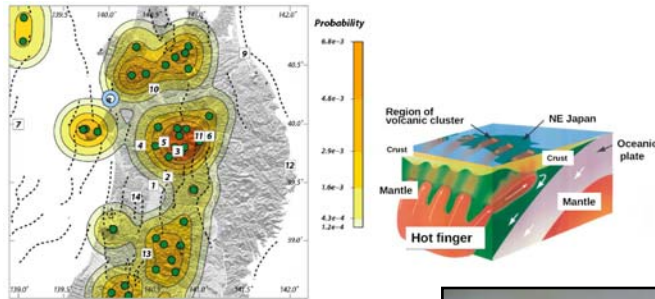
XMRV elicitation – salutary aspects

- Huge ranges of elicited uncertainties from panel of leading international experts on multiple items should have alerted problem owner to questionable nature of the problem
- Unknown to facilitator (me) at the time, one of the panel of experts was a lead author on the original paper (and remains an uncompromising proponent of its findings and validity)
- Two of the panel had already taken out patent applications for a test for XMRV in humans

Notwithstanding scientific debunking, the issue rumbles on in social media and with the public - the ultimate arbiters on rational judgement?...



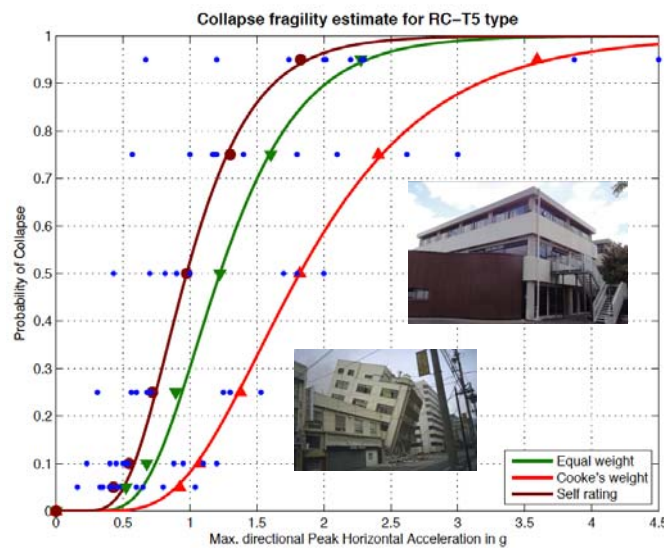
But there is progress: TOPAZ Project, Japan - modelling future evolution of tectonism and volcanism out to 1Myr!



2012: first ever structured expert elicitation in Japan: tectonic and volcanic hazard factors for radwaste repository siting



Seismic Collapse Fragility Modeling



RC-T5: Modern seismically designed ductile reinforced concrete regular moment frame with masonry infill walls (1 to 3 stories)

Jaiswal et al 2013, ICOSAR Meeting

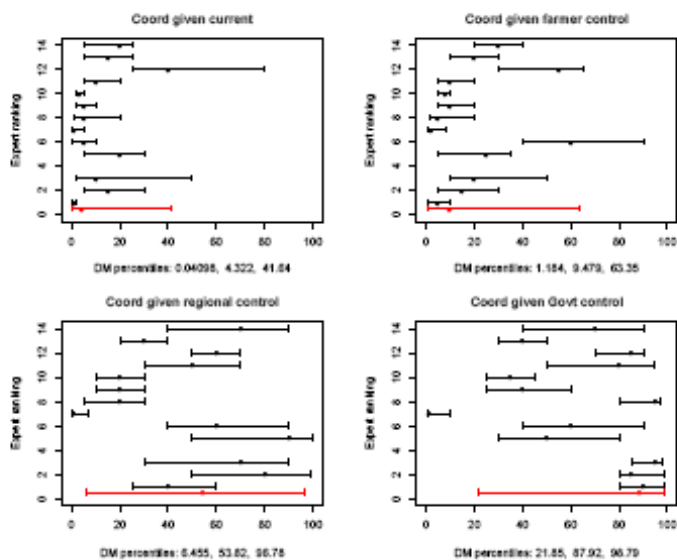
More exotic elicitations: scabby sheep

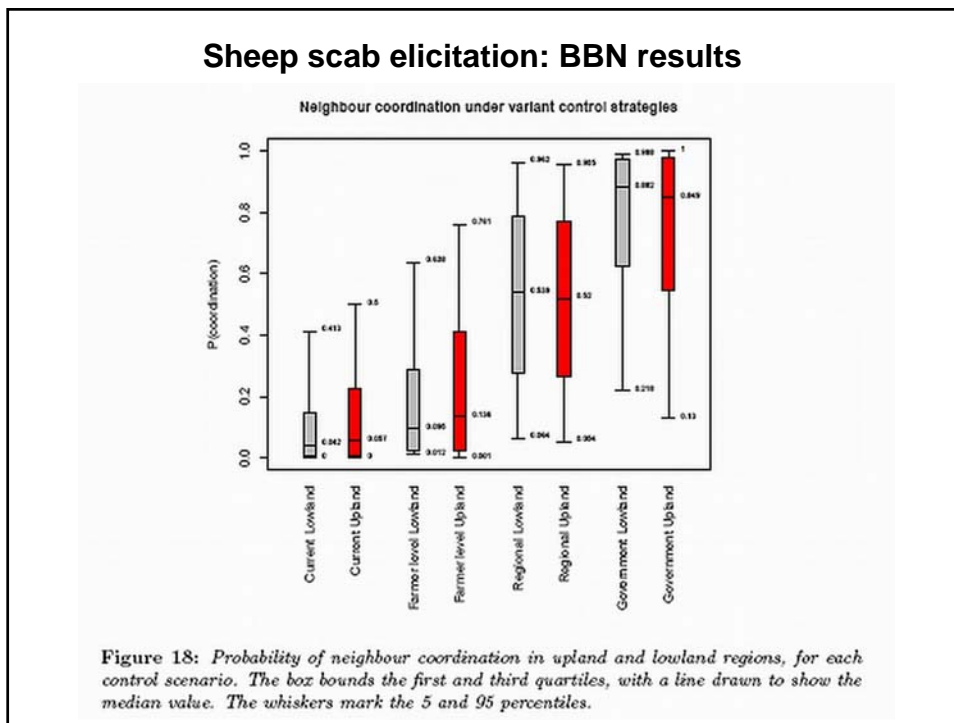
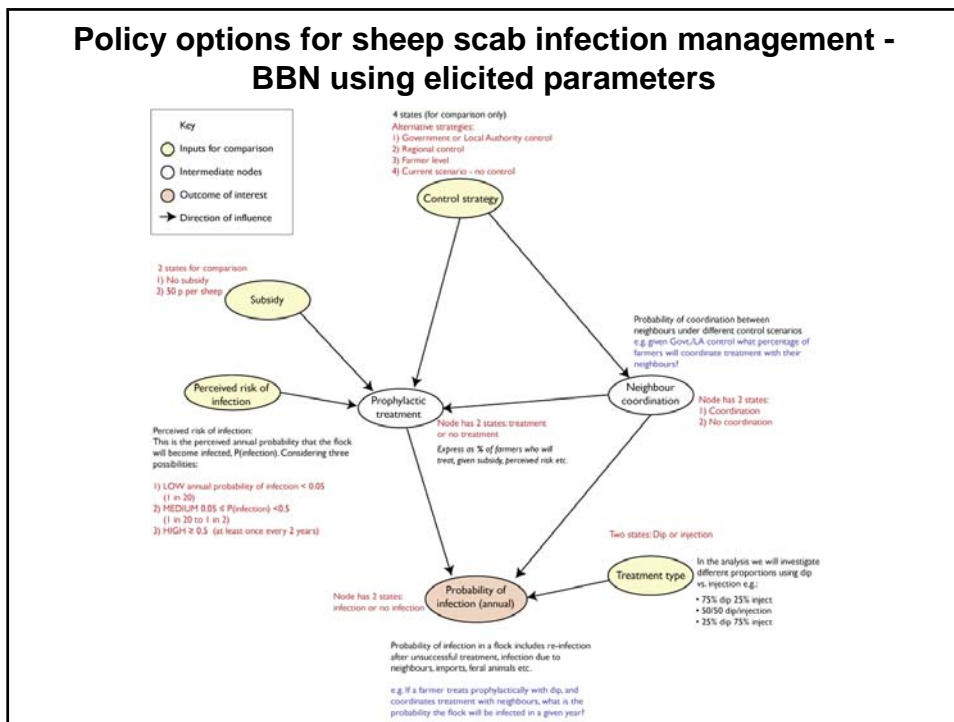


Policy options for
Psoroptes ovis
management

work with Thea Hincks
(PhD), Jon Stone and
UoBristol vets

Example range graphs for experts' judgments and weighted combination quantiles (red)





“Achieving Consensus ... use in Law and Policy”

Work with the late Joey Hanzich (Cambridge University Env. Epid. MPhil 2006-07) and Dr Peter Baxter at IPH Cambridge



ACHIEVING CONSENSUS:
AN ANALYSIS OF METHODS TO SYNTHESIZE EPIDEMIOLOGICAL
DATA FOR USE IN LAW AND POLICY

JOSEPH M. HANZICH
PEMBROKE COLLEGE

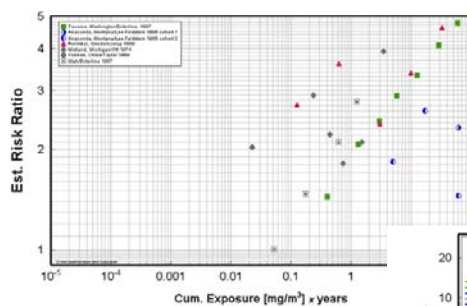
DEPARTMENT OF PUBLIC HEALTH & PRIMARY CARE
INSTITUTE OF PUBLIC HEALTH
UNIVERSITY OF CAMBRIDGE

31 JULY 2007

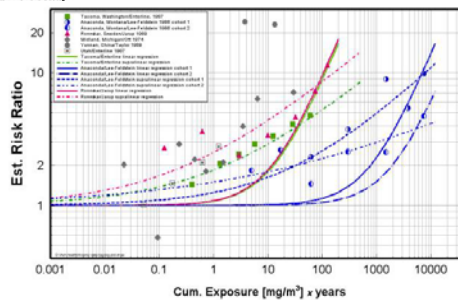


27

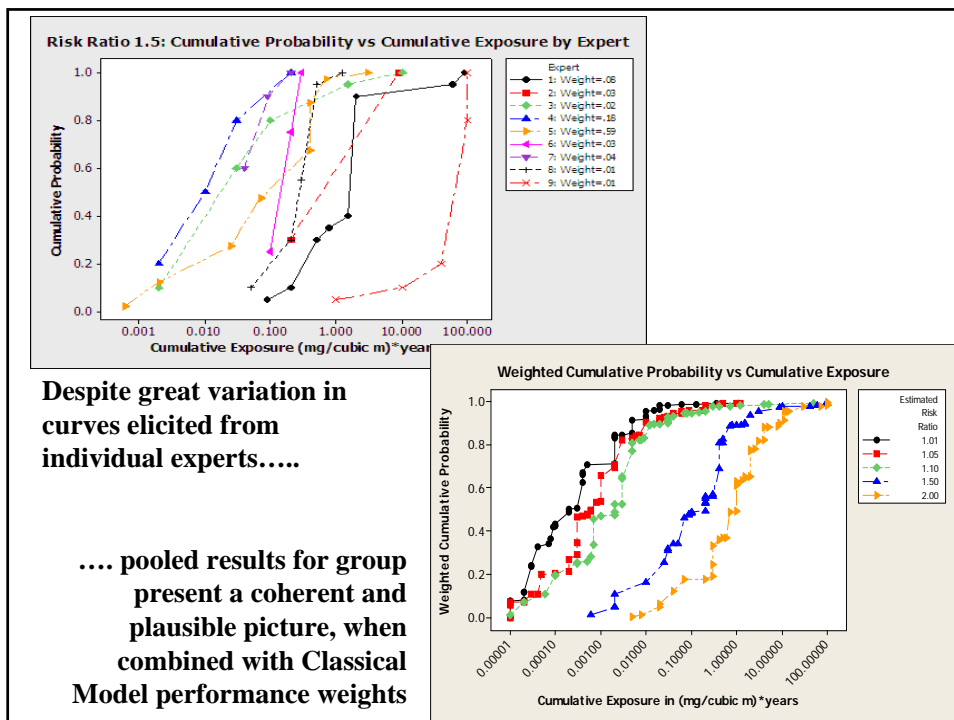
Estimating dose-response curves for cancer risk from airborne arsenic when no low-dose data exists, only dated high-dose findings from smelter towns



No expert consensus on
dose-response curves or
thresholds



28



A BIG ISSUE: Vesuvius, and the future threat to Naples

WORLD NEWS 123

THE SUNDAY TIMES MARCH 4, 2007

Vesuvius blast could kill 300,000

By John Follain

The next eruption of Vesuvius could kill at least 300,000 people, nearly 20 times as many as the AD79 disaster that buried the ancient city of Pompeii, according to Italian government research.

More than half a million people live in the so-called "red zone" of 18 towns in a four-mile radius of the volcano and most would die if an evacuation could not be completed in time, the research says.

The findings are from a study by some of Europe's leading volcanologists and public health experts, including Dr Peter Baxter of Cambridge University's Department of Public Health.

5 mins after it begins
Columns of red-hot ash, gas and rock collapse on to mountains, blasting towards populated areas

15 mins
Pyroclastic flow surges through houses built higgly on slopes

20 mins
Flows burst through town from other side in Pompeii

8079 eruption: plumes of ash and lava burst from the sky at 400mph

Black homes spew down slopes

Rippling trenches at 60 mph

Up to 300,000 could be killed

8079 eruption: plumes of ash and lava burst from the sky at 400mph

Black homes spew down slopes

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Expert elicitations



Vesuvius last awoke with a small blast in 1944. A large eruption could unleash incalculable pyroclastic and ash that would threaten millions of people.

EUROPE'S TICKING TIME BOMB

Vesuvius is one of the most dangerous volcanoes in the world — but scientists and the civil authorities can't agree on how to prepare for a future eruption.

It starts with a blast so strong that a column of ash and stone rockets 40 kilometres up into the stratosphere. The debris then drops to Earth, pelting the surface with boiling hot fragments of pumice and covering the ground with a thick layer of ash. Roads crumble

BY KATHERINE BARNES

small eruption in 1944, but recent studies suggest that Vesuvius could be more dangerous than previously assumed, which has prompted a vigorous debate about the risk and scale of

interpret this layer as an active magma reservoir, which could produce large-scale 'plinian-style' eruptions — named after Pliny the Younger, who described the AD79 eruption. The first rumblings of activity at Vesuvius could come weeks to years before an eruption.

..... Nature, 12 May 2011

Cooke's Classical Model has been used extensively with expert volcanologists to characterize hazards and risks for various possible future eruption scenarios at Vesuvius

Neri, A. et al. (Editors) (2008). Evaluating explosive eruption risk at European volcanoes. J. Volcanol. Geotherm. Res. Spec. Vol. 178.

Aspinall WP, Woo G, Voight B, Baxter PJ. (2003). Evidence-based volcanology: an application to volcanic crises. J. Volcanol. Geotherm. Res. 128: 273-285.

31

... and many

Iceland volcanoes - a topical real-world problem!



H55 Effusive Eruption Modelling Project

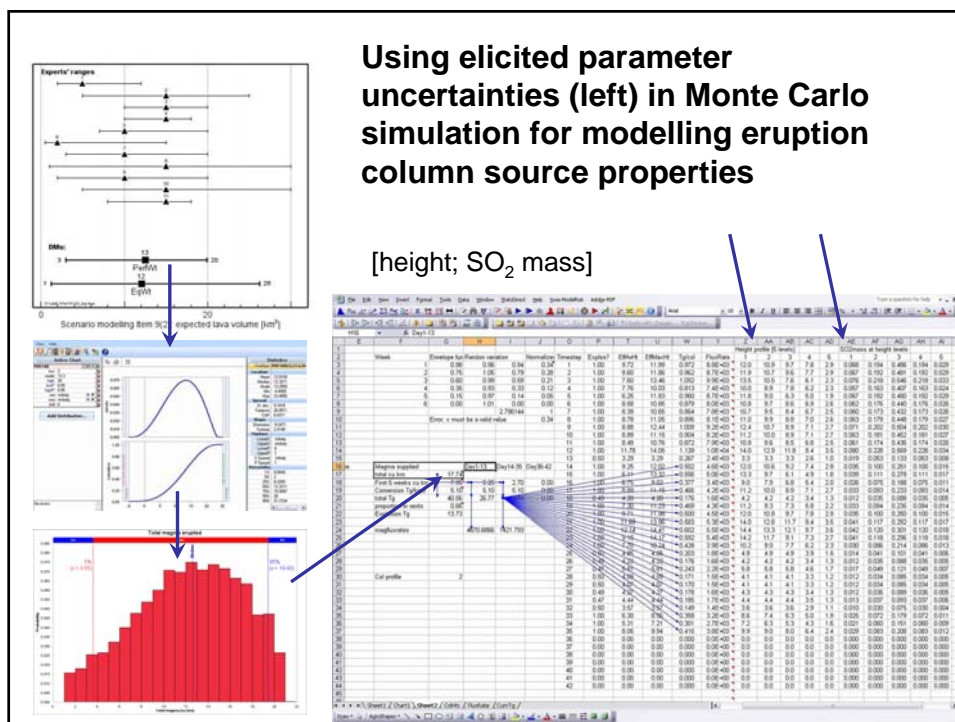
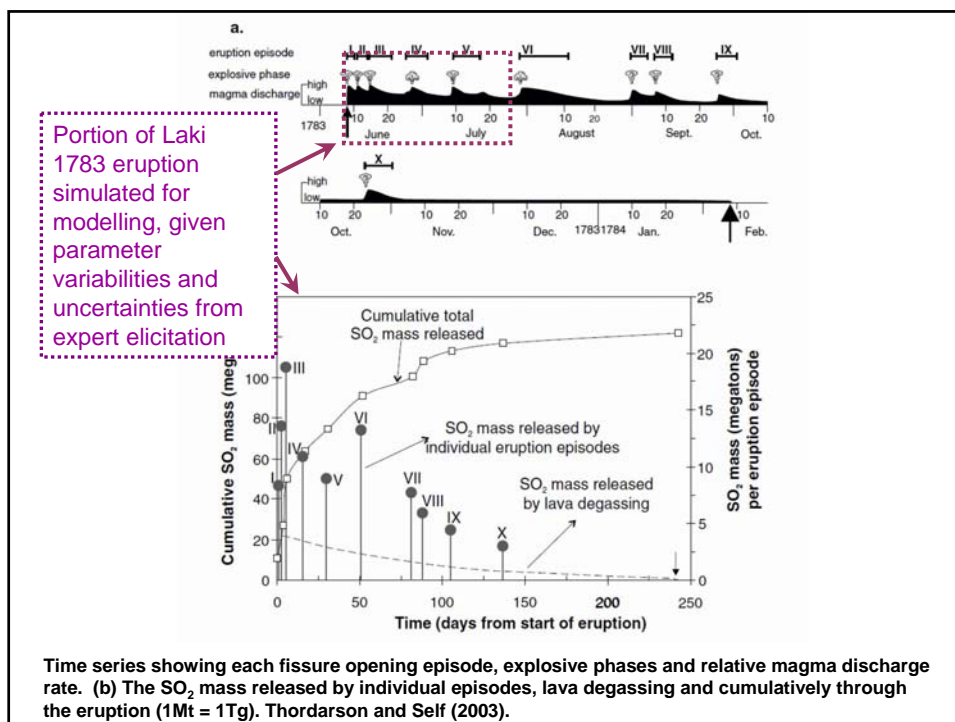
Expert Advisory Group meeting – 14 July 2014

WP1.1 Report: Definition of the Eruption Source Term

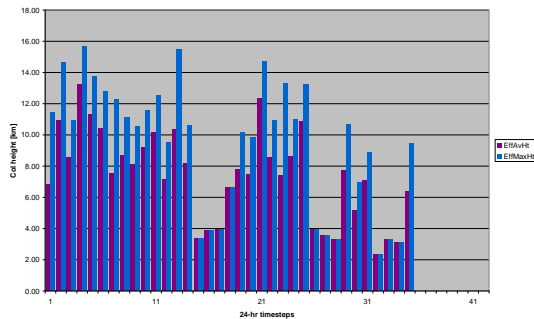
Authors: Sue Loughlin, Willy Aspinall

Date: June 2014

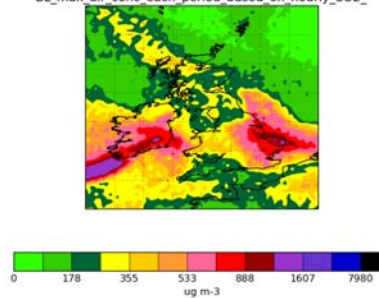




Example of a single 6-week eruption scenario column height time history



BL_max air conc each period based on hourly_SO2_



Case history used for Met Office NAME modelling of gas concentration over UK

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**.

When a volcano became restless on the small, populated island of Montserrat, West Indies, in 1995, there was debate among scientists: did the bursts of steam and ash presage an explosive and deadly eruption, or would the outcome be more benign? Authorities on the island, a British overseas territory, needed advice to determine warning levels, and whether travel restrictions and evacuations were needed. The British government asked me, as an independent volcanologist, to help reconcile differing views within the group.

to remove it from the decision process.

Of the many ways of gathering advice from experts, the Cooke method is, in my view, the most effective when data are sparse, unreliable or unobtainable.

Rational consensus

Advice during an emergency is usually the responsibility of a chief scientist, with all the stresses that involves — including the pressure to be extremely cautious. There is a better way: pooling the opinions of a group of specialists.

There are several methods of such expert

the Delft University of Technology in the Netherlands with his colleagues, instead produces a 'rational consensus'. To see how this works, take as an example an elicitation I conducted in 2003, to estimate the strength of the thousands of small, old earth dams in the United Kingdom. Acting as facilitator, I first organized a discussion between a group of selected experts about how water can leak into the cores of such ageing dams, leading to failure. The experts were then asked individually to give their own opinion of the time-to-failure in a specific type of dam, once such leakage starts.

A BIG BUT!

WORLD VIEW *A personal take on events*



Check your legal position before advising others

Next week's trial of seismologists in Italy highlights the risks to scientists who offer public advice. Willy Aspinall considers what can be done.

SCIENTISTS IN SENSITIVE SITUATIONS SHOULD THINK CAREFULLY ABOUT THEIR USE OF SOCIAL MEDIA.

Nature (2011) Vol 477, page 251

Whither experts, expert judgment, elicitation, and the law?

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HOME > SCIENCE

The legal aftershocks of the earthquake in L'Aquila, Italy

Science is in the dock in Italy as local witnesses finally confront the earthquake on trial for manslaughter who, it is alleged, failed to warn them of the risks



Nuns walk past the ruins of a building after the earthquake on April 6, 2009 in L'Aquila, Italy. Photo: AFP/GETTY IMAGES

By Michael Day
7:30AM GMT 22 Nov 2011

Telegraph 22 Nov 2011

News > Law

A formula for justice

Bayes' theorem is a mathematical equation used in court cases to analyse statistical evidence. But a judge has ruled it can no longer be used. Will it result in more miscarriages of justice?



Angela Saini
guardian.co.uk, Sunday 2 October 2011 21:30 BST
Article history

$$P(A|B) = \frac{P(B|A) P(A)}{P(B)}$$


Bayes' theorem. Photograph: guardian.co.uk

Summing up

- Burgeoning number of applications of the Classical Model in many knowledge domains
- In appropriate circumstances, the approach provides a rational consensus via uncertainty 'snapshots' for decision-support
- However, concepts and principles are not widely familiar and legal ramifications are as uncertain as the scientific issues

Thank you!