



Structured expert judgment with the Classical Model –
experiences of an NBD facilitator

Willy Aspinall

SLANG

Internet Slang, Chat Texting & Subculture

NBD

means

Nice But Dim

Harry Enfield's TV character



- Summary of this talk

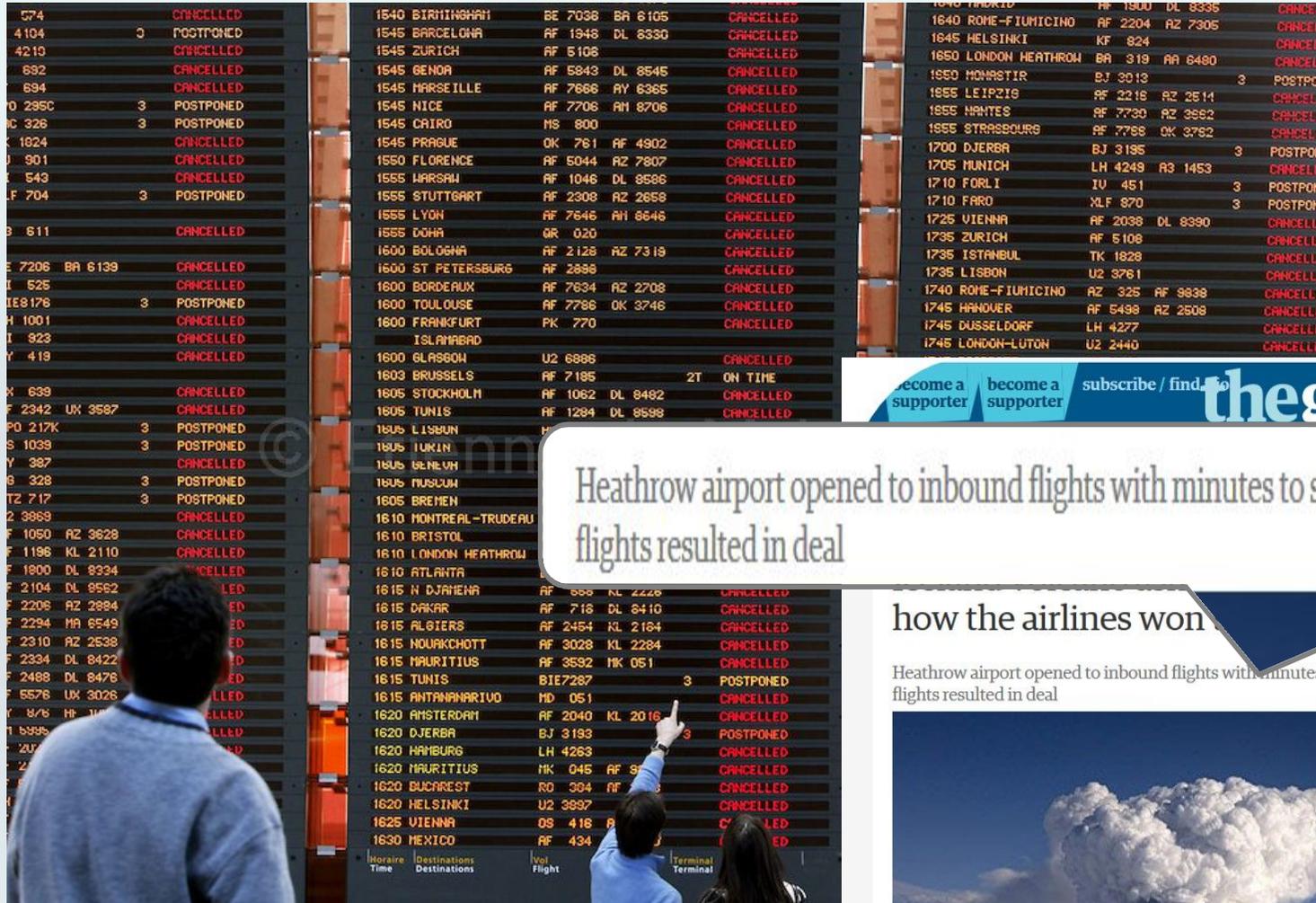
Personal experiences of challenges to the application of the Classical Model, rather than successes

..... starting with a big missed opportunity.



Eyjafjallajökull volcano

Image by illustrator Matt McCarthy,
from The Volcanism Blog



The Icelandic volcanic ash crisis, 2010

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theguardian

how the airlines won... of the skies

Heathrow airport opened to inbound flights with minutes to spare after 96 hours of test flights resulted in deal



Ash billows from Eyjafjallajökull volcano in Iceland. It caused huge disruption to air transport across Europe. Photograph: Ingolfur Juliusson/Reuters



**An Invitation
from
the President of Iceland
Ólafur Ragnar Grímsson**

In the middle of the Atlantic, at the crossroads of European weather systems, the youngest country on Earth has recently reminded the world how, through a combination of a volcanic eruption and enormous quantities of glacial ice, the forces of nature can produce huge ash clouds, impacting on nations far away, even disrupting for a while the travel plans of millions in different continents. For the first time since modern aviation became the pillar of international transport, a volcanic eruption has reminded all of us that our technological and economic systems must take into account the will of nature and how the Earth is capable of ultimate surprises.

Aviation stakeholders must now understand and adapt to this kind of potential disruption. Eyjafjallajökull has become a symbol of this situation, and thus it is appropriate to invite aviation leaders, experts and policy-makers to assemble at the recently established Keilir Aviation Academy at Keflavík International Airport, to discuss the lessons learned and how technology, rules, regulations and aviation training must be improved.

For us in Iceland it is important to make a contribution of this type to the constructive international dialogue that is now needed. Therefore we invite you all to participate in the Atlantic Conference on Eyjafjallajökull and Aviation. It will certainly be a worthwhile experience.



© Hermann Sigurðsson (2010)



**Keilir
Aviation
Academy**

Atlantic Conference on EYJAFJALLAJÖKULL AND AVIATION

Keflavik Airport, Iceland, September 15.-16. 2010

Second Day of Conference Thursday, 16 September 2010

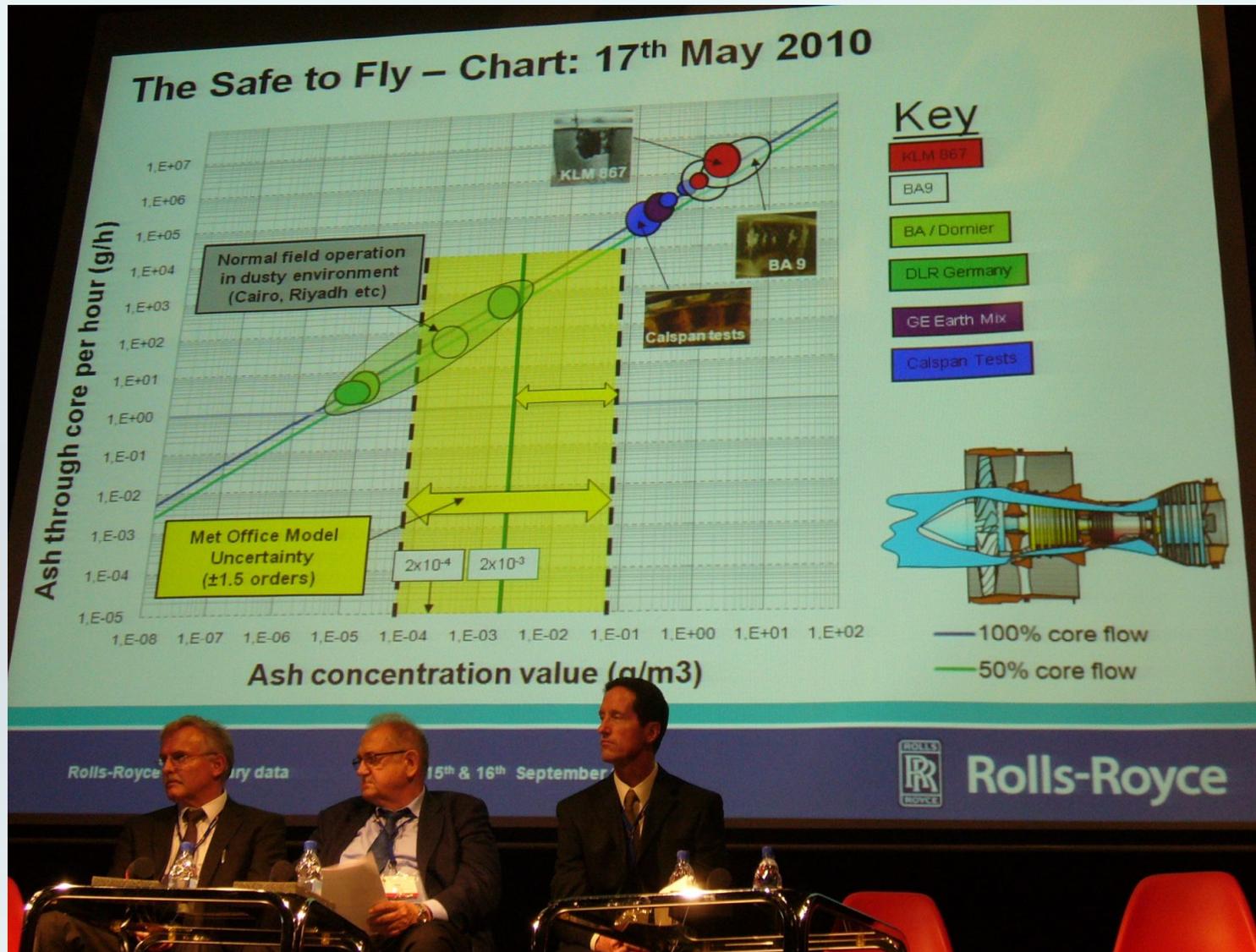
09.00

SIXTH SESSION - Eyjafjallajökull - Scientific Dimension – Volcanic Eruptions

Chairman: Dr. Haraldur Sigurdsson, Volcanologist and Prof. Emeritus, University of Rhode Island, USA.

Probabilistic assessment of volcanic risks

Dr. William Aspinall, Geophysicist and Professor University of Bristol, UK.



“Safe to Fly – Chart” presentation by Rolls-Royce at Atlantic Conference.
Note implied quantitative uncertainties on incidents and test data.

Volcanic Ash and Aircraft Engines

BATA Volcanic Ash Workshop – 15 October 2013

Rory Clarkson

Engine Environmental Protection
Rolls-Royce

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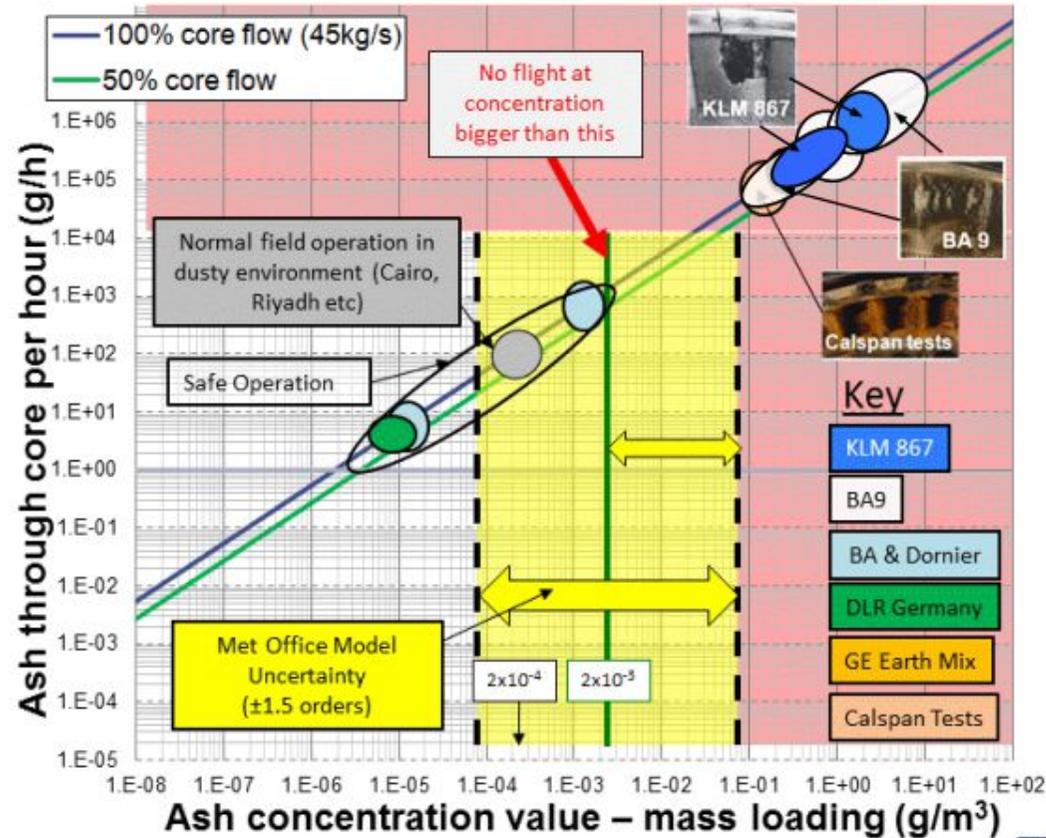


Follow-on presentation in 2013

Rolls-Royce Activities 2010-2013

11

- Engine 'Safe-to-Fly' Chart - 2012 Revision



Apart from addition of photos, essentials of graph are unchanged and, as far as is known, no formal development of quantifications of uncertainty.

My view

- *De facto* (if not *de jure*) flight operational risk ‘standard’ for loss of airworthiness safety is no higher than 10^{-8} per sector.
- One can conjecture plausible scenarios with consequence factors:
 - Plane passes inadvertently through ash for more than a few minutes (e.g. night-time)
 - Actual ash concentration in plume is higher than forecast/monitored
 - Dispersion model fails to forecast wind bringing two plumes together
 - Modern engine technology vulnerability is higher than last generation engines

The probabilities and hence joint scenario probabilities are ill-defined – even unknown. But if jointly they $\gg 10^{-8}$, then the “normal” flight safety margin is eroded.

No-one could, or would, say how the decision to fly would be defended *post hoc*, in the absence of any uncertainty quantification.....

A “deal” was done



As far as I know (and I was involved), no effort was made to quantify all related uncertainties with structured expert judgment, some parties did not even want to discuss this option. Thus I believe the basis of the “deal” was flawed.

Volcano Betting - Insurance for your holiday. - Windows Internet Explorer

http://www.paddypower.com/bet/novelty-betting/novelty-bets/Weather

Volcano Betting - Insurance for your holiday.

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- > Jog in the Bog
- > Playstation Specials

Sports Novelties

Lottery Specials

London Heathrow - July

Results Calculator

Markets Offered

25 Markets Show

> London Heathrow - July	> London Heathrow - August
> Manchester - July	> Manchester - August
> Birmingham - July	> Birmingham - August
> Dublin - July	> Dublin - August
> Glasgow - July	> Glasgow - August

London Heathrow - July

Thursday 24th June 2010, 22:00

London Heathrow - July Hide

Singles Only. Applies to 2010. Applies to the airport having an unscheduled closure (no flights allowed to land or depart) for at least one hour on the chosen date. Must be confirmed that closure is due to volcanic ash by an official airport spokesperson. PP decision is final. Maximum payout per customer for ALL Volcano Holiday Hedging markets is 5000 euro/pounds. Telephone Betting Phone Ireland: 1800 721 821 Phone UK 08000 565 265 Rest of the World +353 1 4040100

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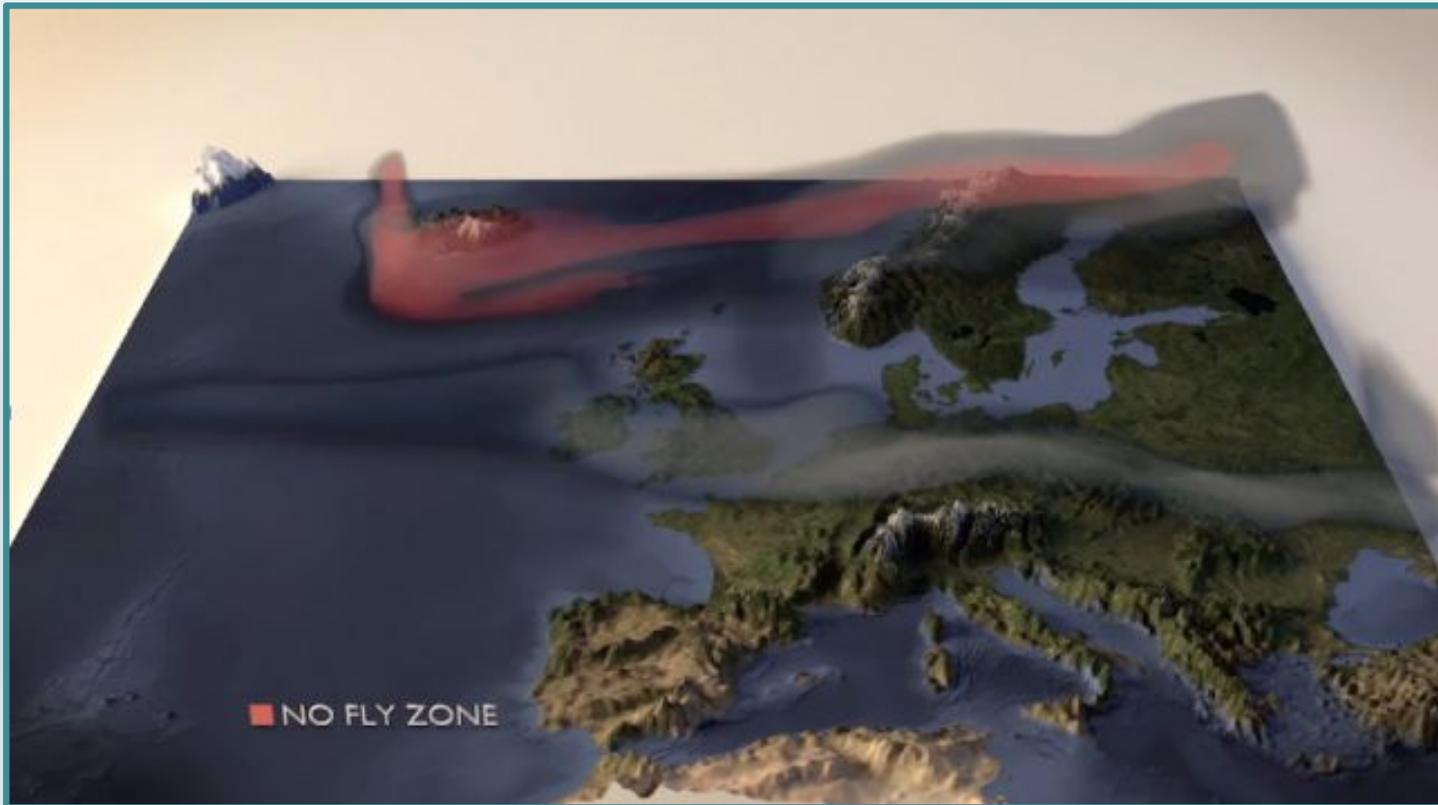
Meanwhile, others were ready to make money on the uncertainties!

Slide 11

WPA1

Willy, 06/07/2017

- Current modelling capabilities



The Barcelona Supercomputing Center (BSC) FALL3D volcanic ash dispersal model. Aim is to merge model forecasts with ATM data (airports, routes, FIRs and flights) at Volcanic Ash Advisory Centres to evaluate impacts based on user-defined criteria: e.g. concentration threshold and maximum engine dose.

BUT, as far as is known, the latter and their uncertainties have not been established (at least publicly).

UK Hazards from a Large Icelandic Effusive Eruption

Effusive Eruption Modelling Project Final Report

Project workers:



Funders:



Cabinet Office



Department for Transport



Government Office for Science



Department of Health



Department for Environment Food & Rural Affairs



Executive Summary

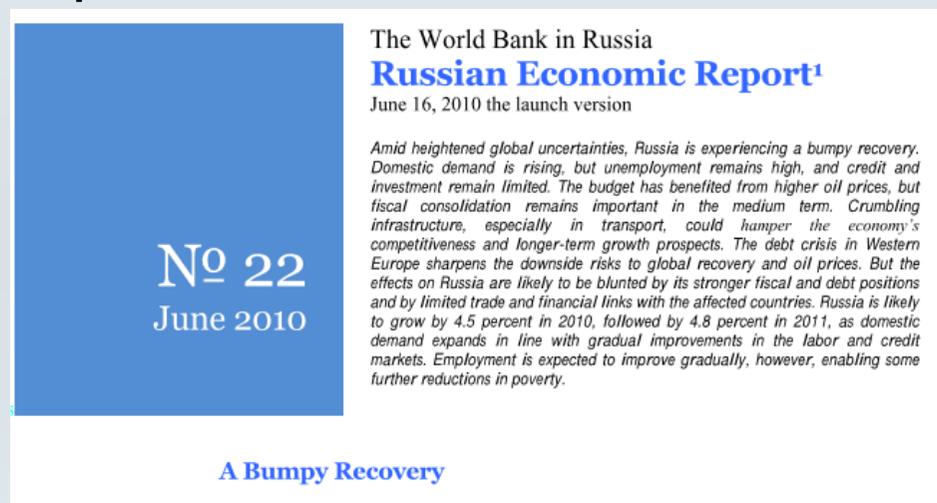
In response to the recent introduction of large, long-lasting gas-rich volcanic eruptions to the UK National Risk Register (risk H55) a modelling project has been conducted to improve our understanding of potential hazards to the UK from such an eruption on Iceland. A precautionary "reasonable worst case" eruption scenario based on the 1783-1784 CE Laki eruption has been determined using the results of an expert elicitation of scientists. This scenario has been simulated 80 times using two different atmospheric chemistry and transport models (NAME and EMEP4UK) over 10 years of meteorology (2003-2012).

Authors: Claire Witham¹, Willy Aspinal², Christine Braban³, Jane Hall⁴, Sue Loughlin⁵, Anja Schmidt⁶, Massimo Vieno³, Bill Bealey³, Matthew Hort¹, Evgenia Ilyinskaya⁵, John Kentisbeer³, Elin Roberts³, Ed Rowe⁴.

However, as a consequence of the Eyjafjallajökull episode, work was commissioned on potential hazards from a Laki-type eruption for the UK National Risk Register, with extensive SEJ on volcanological uncertainties:

Other failures (by me) to get the Classical Model engaged:

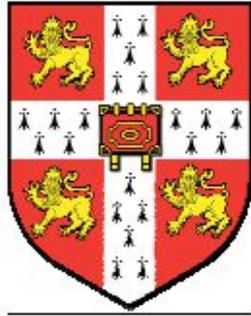
Major London insurer of geo-political risks in Russia



Big pharma company – drug development selection criteria

Lesson: need “buy in” from senior management

An unfinished elicitation: risks from arsenic in the air



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

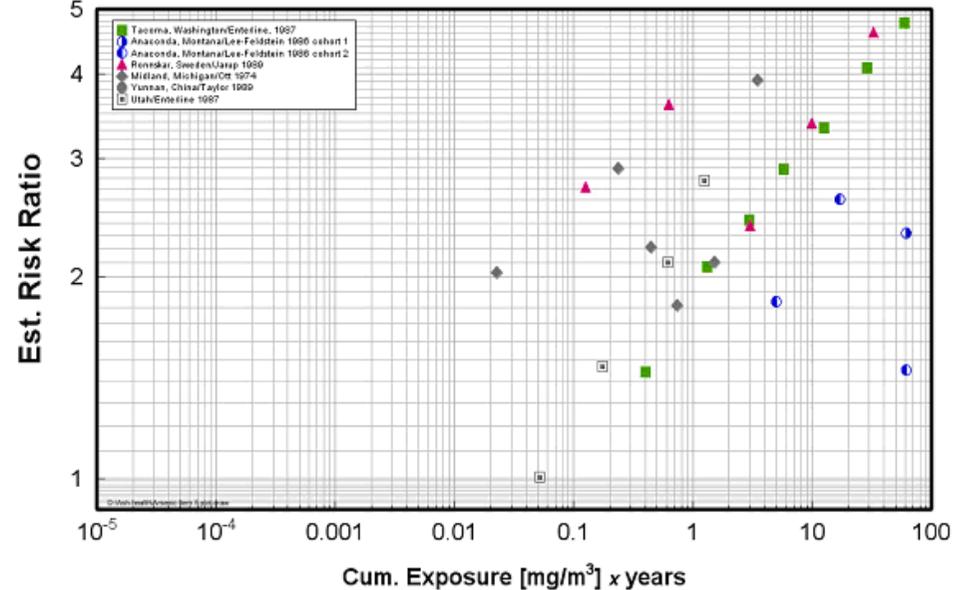
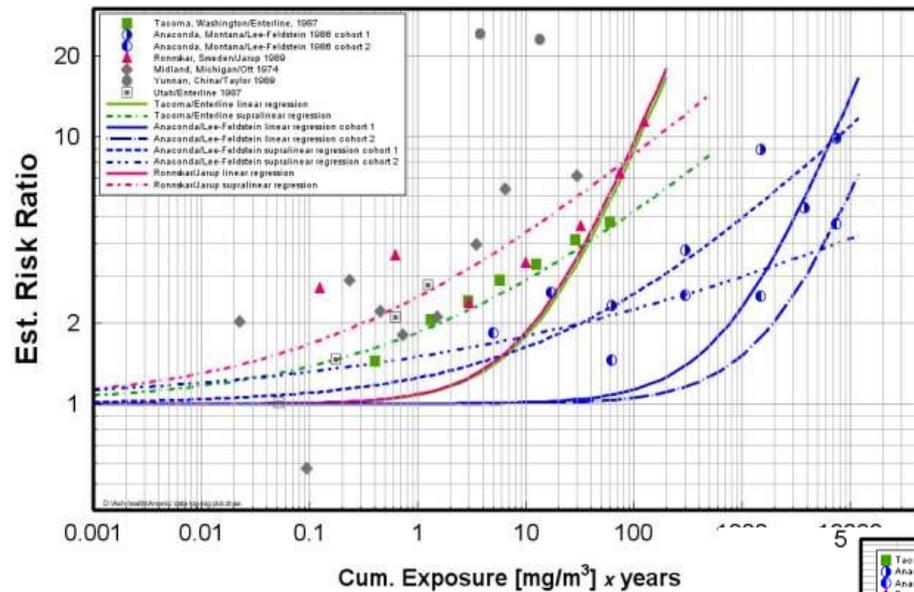
JOSEPH M. HANZICH
PEMBROKE COLLEGE

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

31 JULY 2007

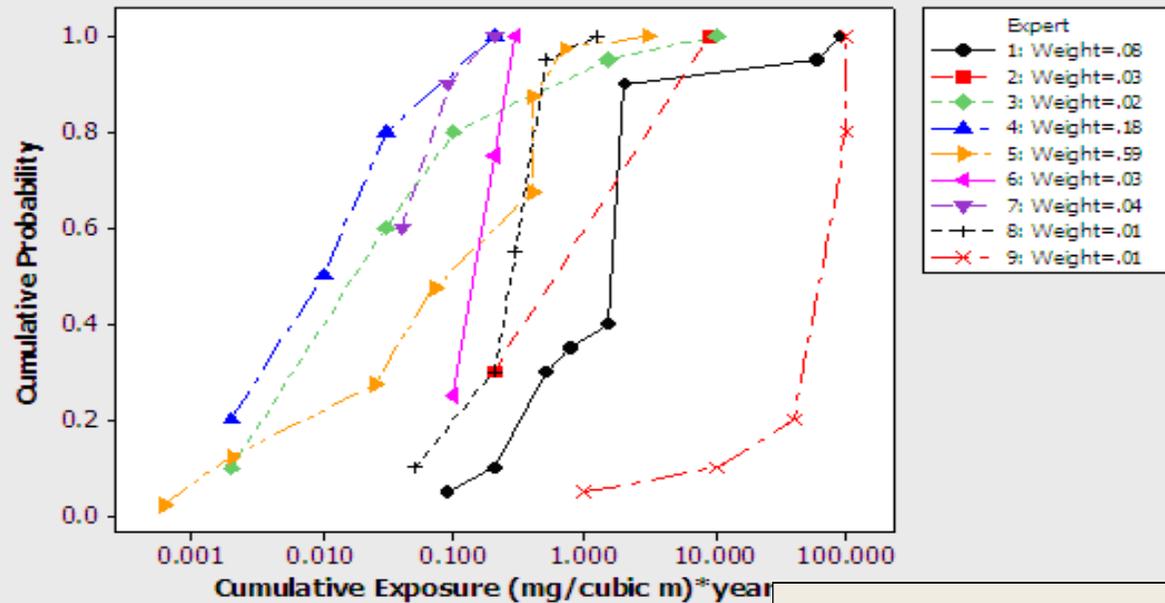


Estimating dose-response curves for cancer risk from airborne arsenic



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

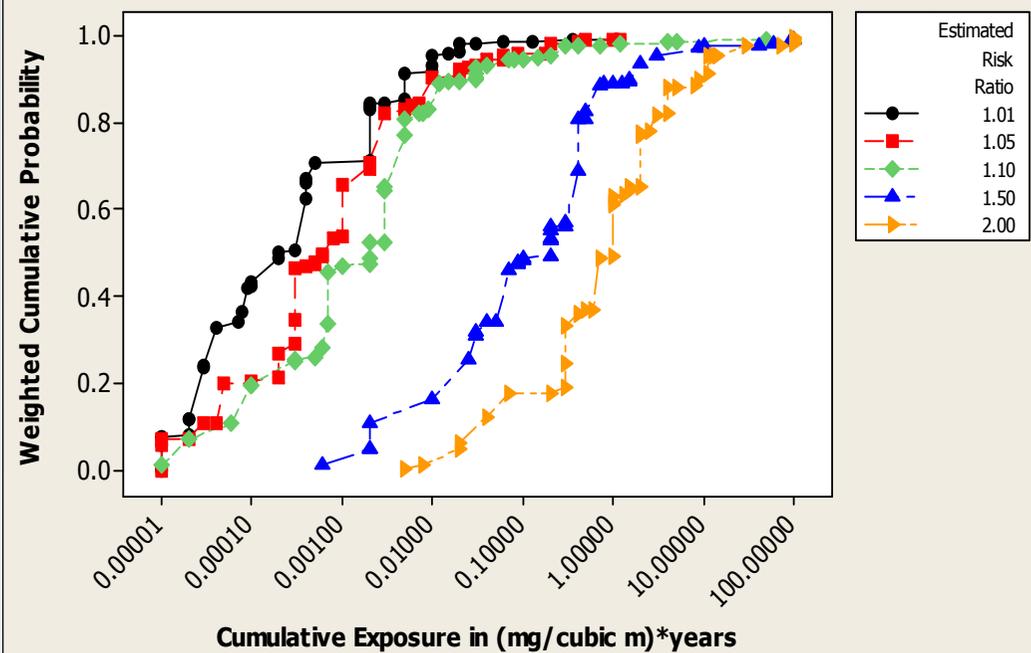
Risk Ratio 1.5: Cumulative Probability vs Cumulative Exposure by Expert



Example self-weighted curves from one individual expert for one risk ratio value.....

.... these look a noisy mess, but when combined with Classical Model weights a rational pattern emerges.

Weighted Cumulative Probability vs Cumulative Exposure



A salutary case

Big news!

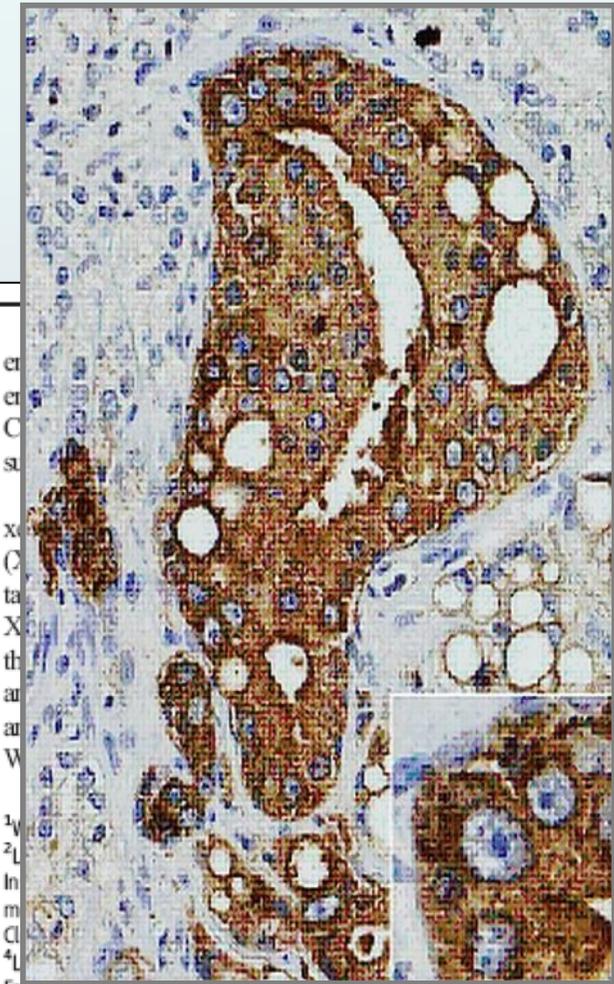
Detection of an Infectious Retrovirus, XMRV, in Blood Cells of Patients with Chronic Fatigue Syndrome

Vincent C. Lombardi,^{1*} Francis W. Ruscetti,^{2*} Jaydip Das Gupta,³ Max A. Pfof,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 21701, USA. Advanced Technology Program, National Cancer Institute–Frederick, Frederick, MD 21701, USA. ⁶Basic 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 panel in Ottawa, Canada

McLaughlin Centre for Population Health Risk Assessment

Target Question Grouping

Questions

Subject Area

1-7

Prevalence

8-11

Risk Parameters

12-15

Latency

16-22

Routes of Transmission

23-25

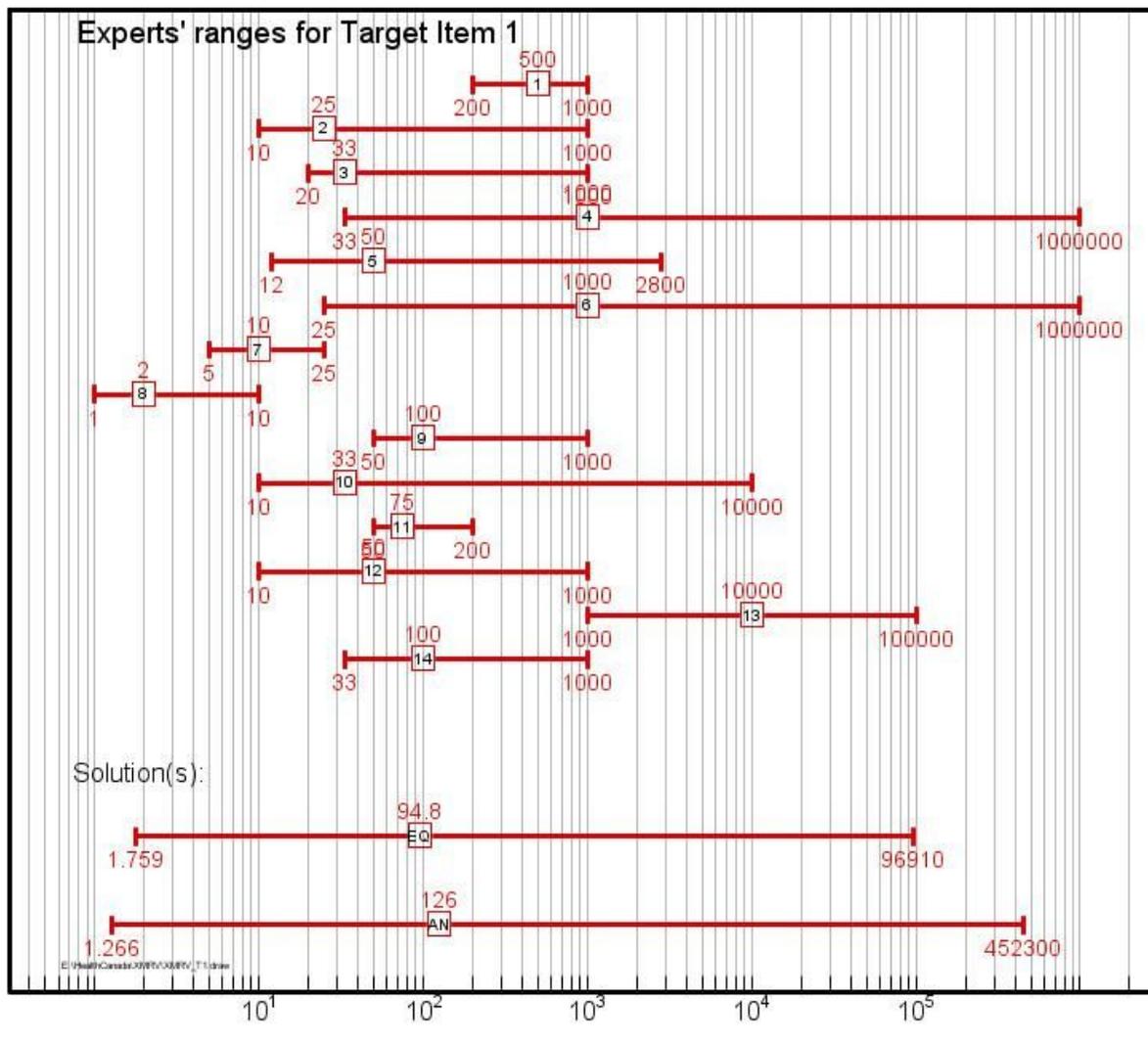
Risk Mitigation

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)



Weighted DM:

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

Prevalence: 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)

Country	Weighted DM median	DM 90% Credible Interval
Canada	1 in 335	1 in 12 → 1 in 305,500
USA	1 in 280	1 in 12 → 1 in 305,500
UK	1 in 450	1 in 12 → 1 in 305,500
France	1 in 450	1 in 12 → 1 in 305,500

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

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

Vincent C. Lombardi,^{1*} Francis W. Ruscetti,^{2*} Jaydip Das Gupta,³ Max A. Pfost,¹

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REPORTS

No Evidence of Murine-Like Gammaretroviruses in CFS Patients Previously Identified as XMRV-Infected

Konstance Knox,^{1,2} Donald Carrigan,^{1,2} Graham Simmons,^{3,4} Fernando Teque,⁵ Yanchen Zhou,^{3,4} John Hackett Jr.,⁶ Xiaoxin Andreas M. Kogelnik,² Ja

Members of the gammaretrovirus XMRV [xenotropic murine leukemia virus-related virus] were present in the blood of patients from 61 patients with CFS previously identified as XMRV-positive. We used reverse transcription polymerase chain reaction for detection of infectious murine-like retroviruses other than XMRV in these blood samples from CFS patients and healthy controls, which would be unlikely. Consistent with laboratory reagents. Our findings suggest that CFS is likely attributable

Xenotropic retroviruses in mice, have the potential of being endogenous to mice, i.e., integrated into the genome and able to reinfect cells from the same animal (*xenos*, fore

enteroviruses, have been implicated as possible environmental triggers of CFS (1). Patients with CFS often have active β herpesvirus infections, suggesting an underlying immune deficiency.

The recent discovery of a gammaretrovirus, xenotropic murine leukemia virus-related virus (XMRV), in the tumor tissue of a subset of prostate cancer patients prompted us to test whether XMRV might be associated with CFS. Both of

and reagents (e.g., *Taq* polymerase) (15) with mouse DNA containing MLV-like sequences has been reported.

To investigate these discrepancies in a more direct manner, we performed an extensive virological evaluation of blood samples from two human populations with a clinical diagnosis of CFS (16), many of whom had been diagnosed previously as XMRV-infected. The first (P1) con-

COMMENTARY

Science sightseeing

38

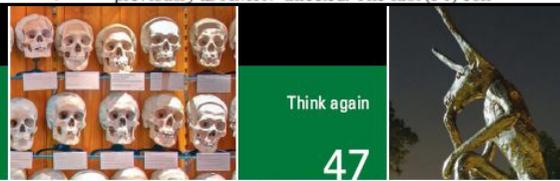
LETTERS | BOOKS | POL

LETTERS

edited by Jennifer Sills

Editorial Expression of Concern

IN THE ISSUE OF 23 OCTOBER 2009, *SCIENCE* PUBLISHED THE REPORT "Detection of an infectious retrovirus, XMRV, in blood cells of patients with chronic fatigue syndrome," a study by Lombardi *et al.* purporting to show that a retrovirus called XMRV (xenotropic murine leukemia virus-related virus) was present in the blood of 67% of patients with chronic fatigue syndrome (CFS) compared with 3.7% of healthy controls (1). Since then, at least 10 studies conducted by other investigators and published elsewhere have reported a failure to detect XMRV in independent populations of CFS patients. In this issue, we are publishing two Reports that strongly support the growing view that the association between XMRV and CFS described by Lombardi *et al.* likely reflects contamination of laboratories and research reagents with the virus. In one Report, "Recombinant origin of the retrovirus XMRV" (2), T. Paprotka *et al.* trace the ancestry of XMRV and provide evidence that the virus originated when two mouse leukemia viruses underwent recombination during experimental passage of a human prostate tumor xenograft in mice in the 1990s. A combination of sequencing, phylogenetic, and probability analyses lead Paprotka *et al.* to conclude that laboratory contamination with XMRV produced by a cell line (22Rv1) derived from these early xenograft experiments is the most likely explanation for detection of the virus in patient samples. In the other Report, "No evidence of murine-like gammaretroviruses in CFS patients previously ident



Think again

47

Chicago Tribune NEWS

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Discredited chronic fatigue researcher in California jail

Patients rally around Judy Mikovits, accused of theft

November 22, 2011 | By Trine Tsouderos, Chicago Tribune reporter

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Two years ago, researcher Judy Mikovits was riding high atop a wave of promise.

She had published one of the most discussed papers of the year in one of the most prestigious scientific publications in the world.

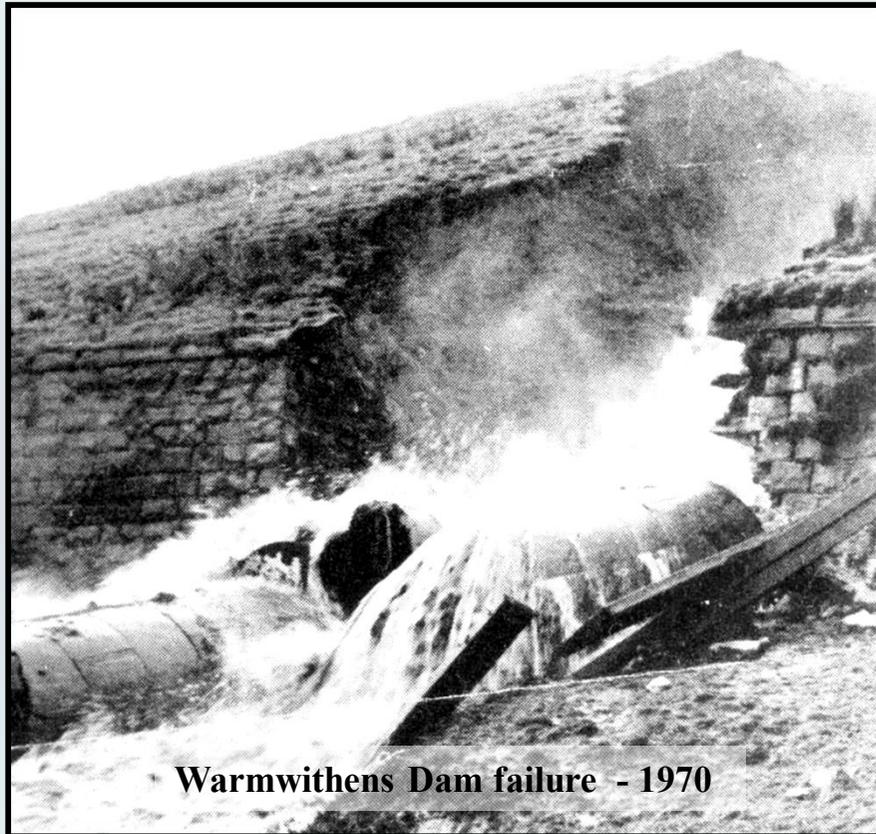
Her team's findings were hailed as a potential breakthrough for an illness — chronic fatigue syndrome — that had long frustrated researchers. She was invited to speak at scientific conferences around the globe. Adoring patients crowded her at her talks.

Downloaded

Judgment in the face of scientific uncertainty: the last word in rationality...



Diagnosing elicitation issues - UK reservoir risks



Warmwithens Dam failure - 1970

Last UK dam failure 1970 –
no casualties

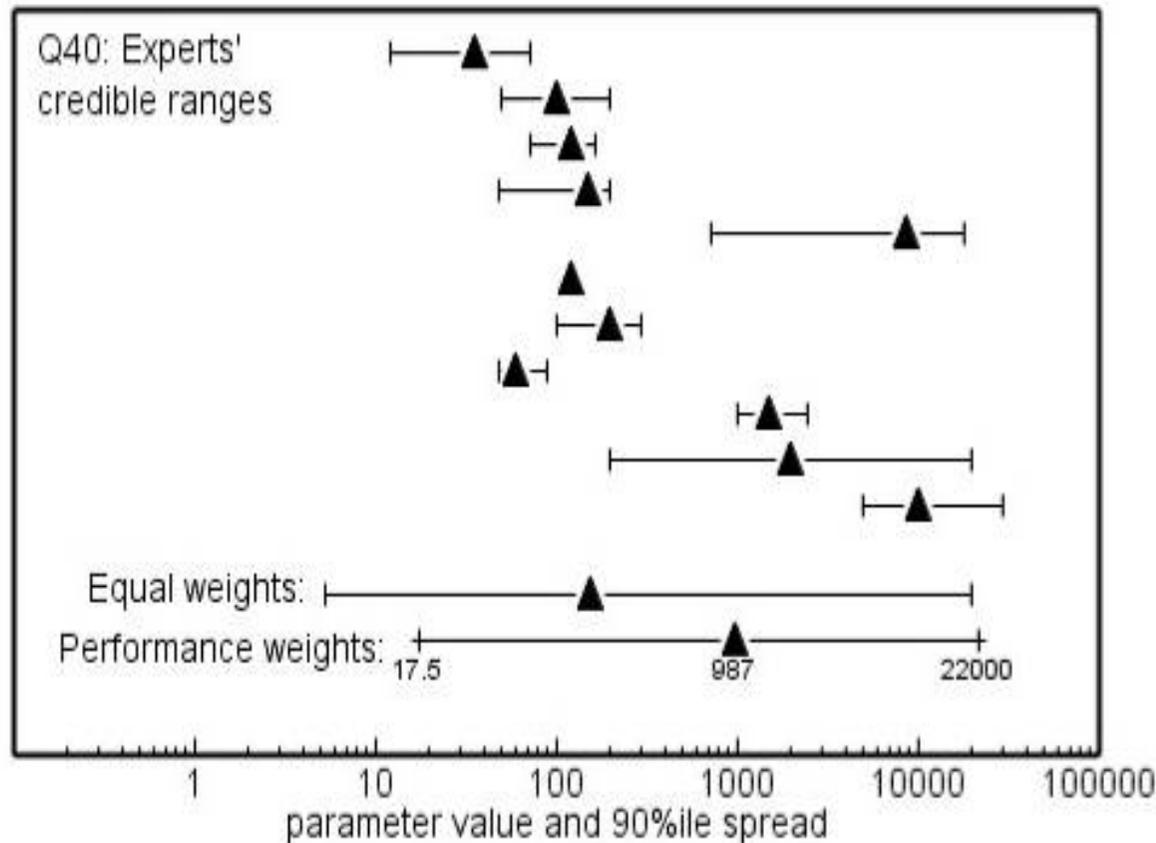


Cowlyd Reservoir inspection party - 1917

Experts, in former times!

Example of group inconsistency

Experts' opinions on the time-to-failure (in days from first detection) of the 10%ile slowest cases, and two alternative ways of pooling weighted opinions – Equal weights and Performance-based DMs

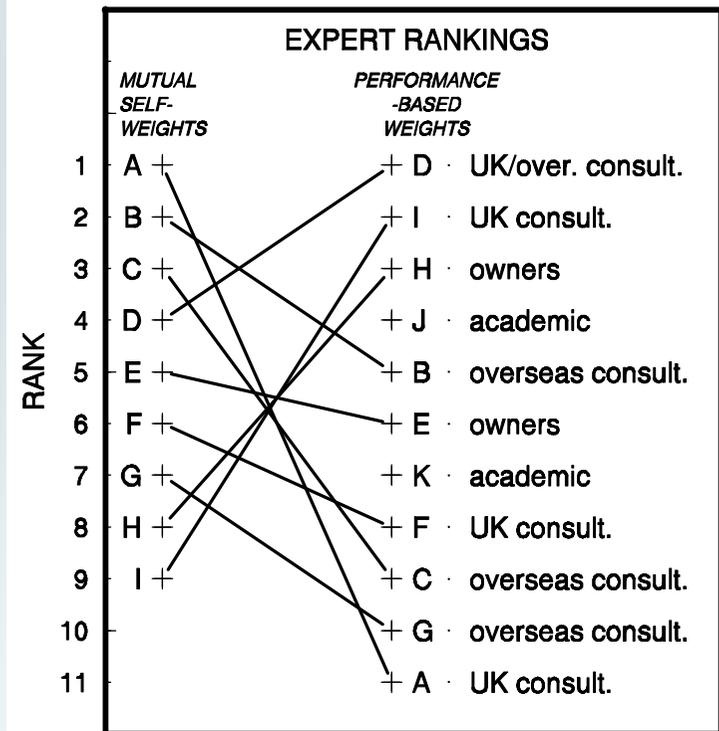
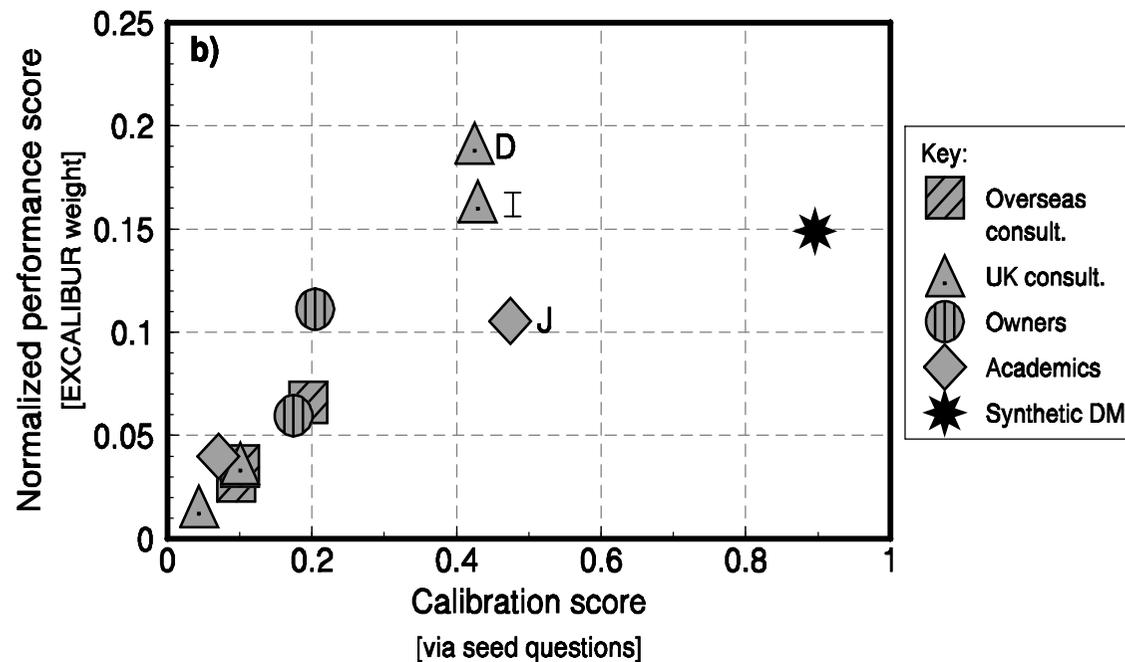


Note the “two schools of thought” effect...

and the strong ‘opinionation’ of many experts

Reservoir engineers: performance-based scores, and peer assessment rankings

Note: peer weighting is poor predictor of performance-based weights!



Matters arising

- Who wants to know their own calibration score?
- Voight effect proximity of expert's medians to realizations for experts with identical statistical accuracy scores?
- Paper, pencil, eraser –v– spreadsheet?

- How erratic are elicited scientists??

Despite built-in check formula and Warning Flags in spreadsheet, multiple non-increasing quantiles (NIQ) appeared in CDC elicitation files:

Study: 7188 expert-target responses over 15 panels;

no panel had zero NIQ errors;

73 NIQs in total on 444 targets;

20 of 48 experts had at least one NIQ;

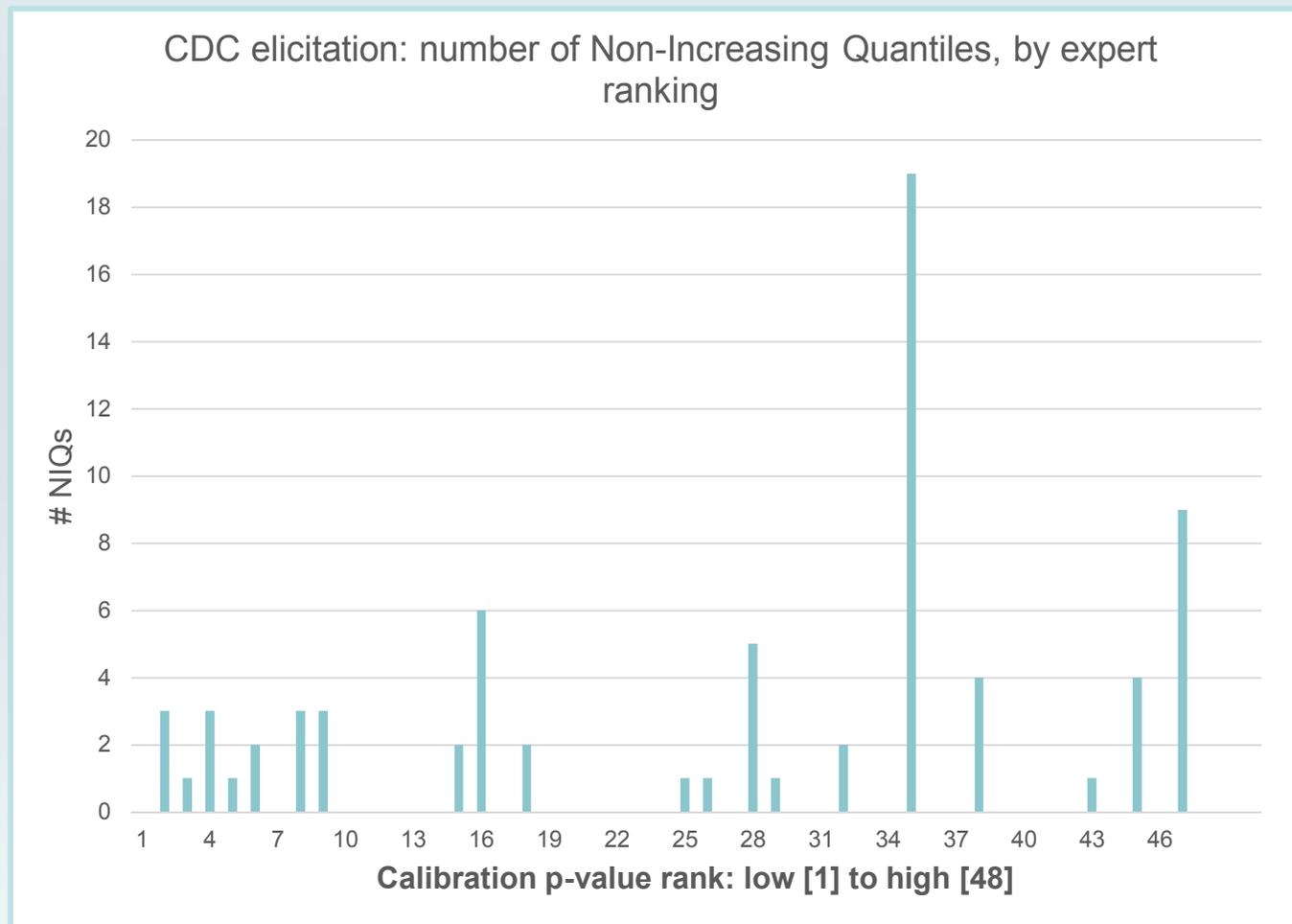
highest rate of NIQs was 4.9% on Panel1 (from 225 expert•targets);

average 1.4% NIQs over all panels;

biggest recidivist had 19 NIQs on 143 targets

- Revising responses – one expert changed calibration item quantiles; their P-value went from 10^{-7} to 1.0!

NIQs not correlated with Classical Model calibration p-value



CDC study

- Another error encountered was the "impossible event" or the "certain event". For some items, some experts assigned 0% to all quantiles, and others 100% to at least the 50% and 95% quantiles.
- A frequency-based approach can help, by guiding experts to think in terms of "1 in 1,000,000" or "9999 in 10000", etc.
- The message: probabilistic thinking is not easy for everyone, and *improbable* is often mistaken for *impossible*. Cromwell's advice, writing to the General Assembly of the Church of Scotland on 5 August 1650: "*I beseech you, in the bowels of Christ, think it possible that you may be mistaken.*"





A reflection on the Classical Model in the Montserrat volcano case:

“ Those are not the exact numbers I would use, but I can’t argue with them “

Senior USGS volcanologist, Montserrat Volcano Observatory: 1995.

- Despite my remarks, not all things are negative

.....



"It's snowing still," said Eeyore gloomily.
"So it is."
"And freezing."
"Is it?"
"Yes," said Eeyore. "However," he said, brightening up a little, "we haven't had an earthquake lately."

A.A. Milne: *"The House at Pooh Corner"* 1928

Thank you!