COMPARATIVE RISK ASSESSMENT OF TERRORISM AND NATURAL HAZARDS

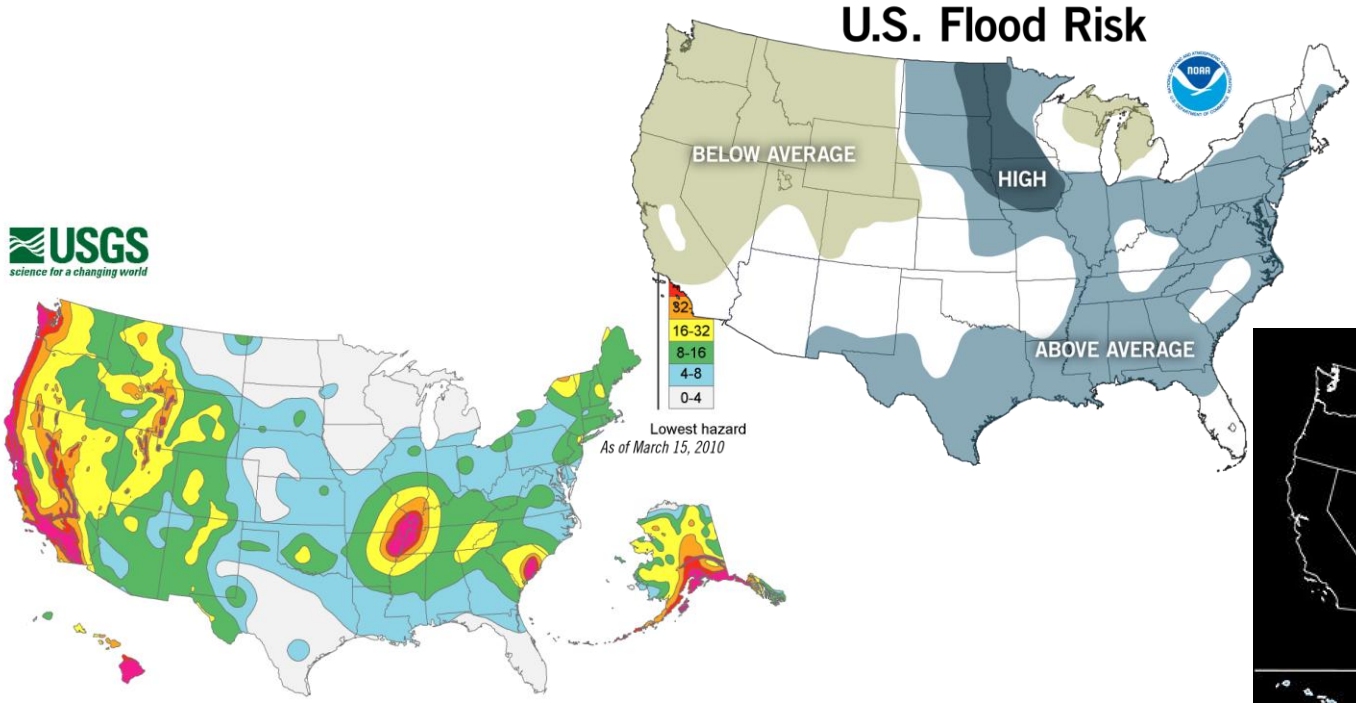
Dr. Gordon Woo

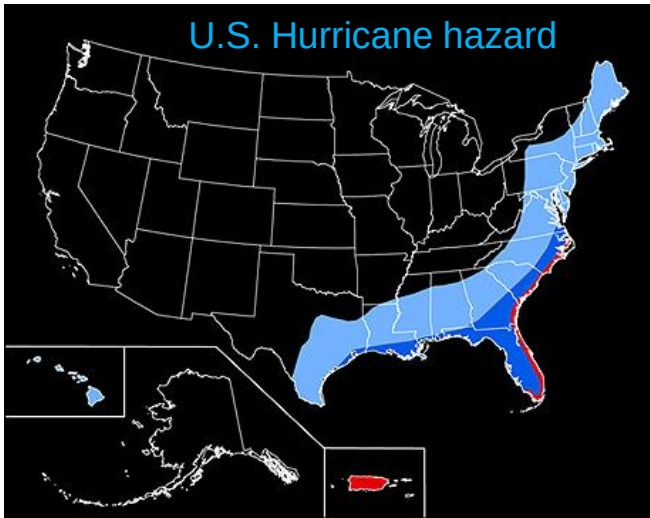
CAS In Focus:

Elephants in the room

Chicago

U.S. public natural hazard maps





2008 Seismic Hazard Map (PGA, 2% in 50 years)

Lack of industry education on terrorism risk modeling

- Terrorism risk analysis is **not** a subject that can be studied by civilians at college or as part of professional accreditation.
- Industry analysts hired with military or law enforcement backgrounds tend not to be very knowledgable about quantitative risk analysis.

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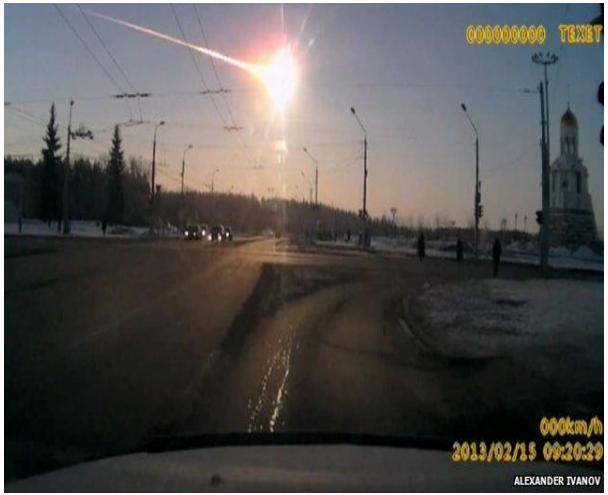
CENTRE OF EXCELLENCE - DEFENCE AGAINST TERRORISM

THE POWER OF NATURE

Super-human scale of natural hazards

At common law, an Act of God is an overwhelming event caused exclusively by natural forces whose effects could not possibly be prevented.

The explosive energy of the impact was equivalent to 460 kilotonnes of TNT. This makes it the most energetic event reported since the June 1908 Tunguska meteorite in Siberia.



Meteorite strike on Chelyabinsk, Russia, February 15, 2013

Self-similarity of landscape

‘Things have a scale. The small may be a model of the large, and the large of the small.

A stone, when it is examined, will be found to be a mountain in miniature.’

John Ruskin

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Power laws from scale invariance

Suppose that physical parameters k and λ are related in a scale invariant way. Under a scale change:

$$k_1 / k_2 = f(\lambda_1 / \lambda_2)$$

$$f(\lambda_1 / \lambda_3) = k_1 / k_3 = \{k_1 / k_2\}\{k_2 / k_3\} = f(\lambda_1 / \lambda_2) f(\lambda_2 / \lambda_3)$$

The only non-trivial continuous solution is:

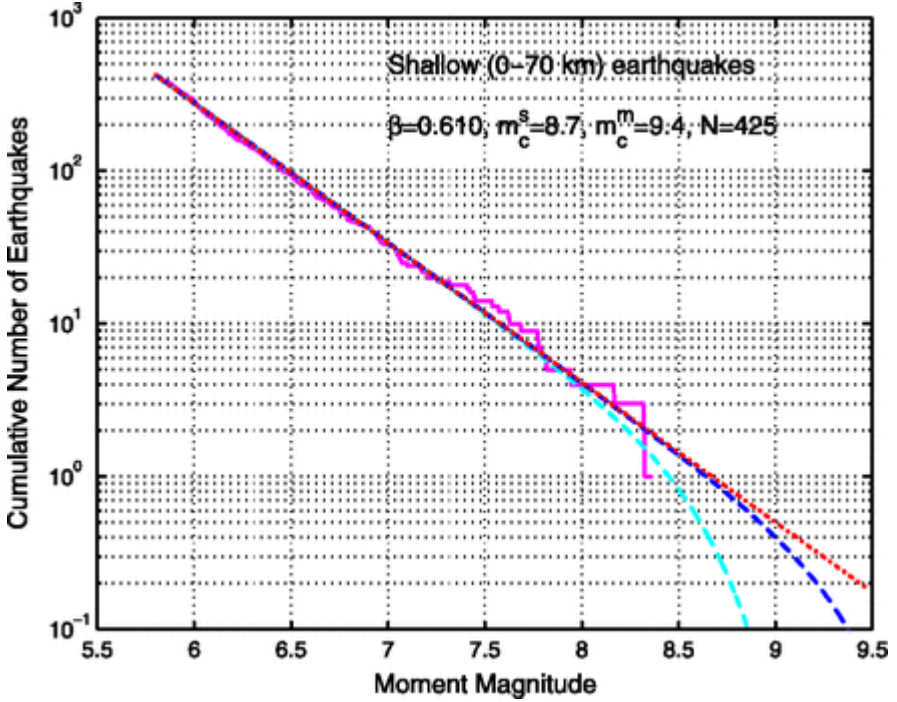
$$f(\lambda) = \lambda^q$$

Power law scaling of earthquakes

Subd. Zone	Mw	Age
N.E. Japan	8.2	130 Myr
Tonga	8.3	120 Myr
Kuriles	8.5	100 Myr
Kamchatka	9.0	80 Myr
Aleutians	9.1	60 Myr
Alaska	9.2	40 Myr
Chile	9.5	20 Myr

(Ruff and Kanamori, 1980)

Any subduction zone might generate a M9 earthquake.



(Kagan & Jackson, 2013)

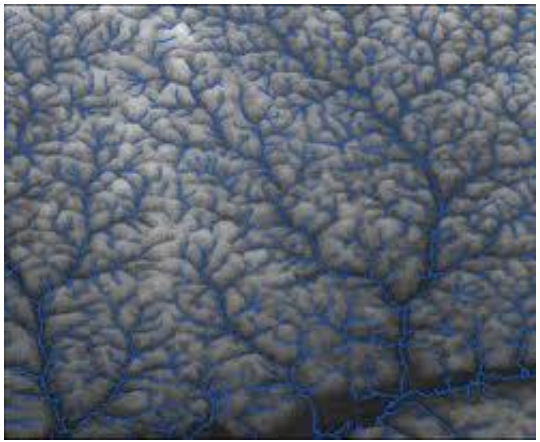
Power law scaling in river basins

The sinuosity of individual river channels, and branching characteristics of the drainage tree were seen with a new perspective post-Mandelbrot.

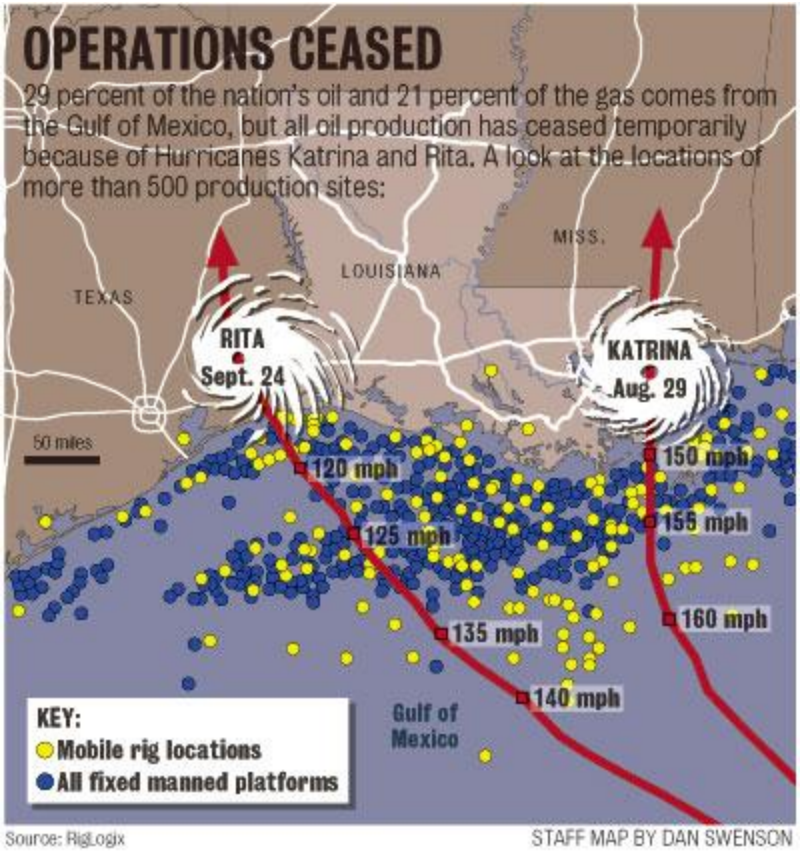
e.g. Hack's Law: The length L of the longest stream in a drainage region is proportional to some power of its area A:

$$L \propto A^{0.6}$$

The number of streams $N(L)$ with length above a given length L is proportional to L^{-D} .



Hurricane damage in the Gulf of Mexico



46 platforms were destroyed and 20 others damaged by Hurricane Katrina.

Hurricane Rita destroyed 69 platforms and damaged an additional 32.

Some 457 pipelines were damaged by the storms.

Katrina has joined the Jihad.

TERRORISM MODELING: ASYMMETRIC WARFARE

MODELABLE AND UNMODELABLE RISK

Modelable Risk

Identification of quantitative principles governing the risk.

Structured model based on these principles, with few parameters.

These may be assigned largely on the basis of observable data, with a minimal resort to expert judgement.

Unmodelable Risk

Lack of guiding quantitative principles governing the risk.

Unstructured model results in a proliferation of parameters.

These involve a high degree of subjective opinion to assign, and with little explanatory or predictive capability.

Asymmetric warfare

- Heckler & Koch 416 assault rifle

- EOTech holographic weapon sight
- $65k night vision goggles

'Empty AK47 magazine.
He hadn't even prepared a defence.'

No Easy Day

Terrorism: a thinking man's game

Dr. George Habash

Co-founder PFLP

Dr. Ayman Al-Zawahiri

Al Qaeda's Chief Strategist

'…This is a thinking man's game. Especially when one is as poor as the Popular Front is. It would be silly for us to even think of waging a regular war. We will continue our present strategy.
It's a smart one, you see…..'

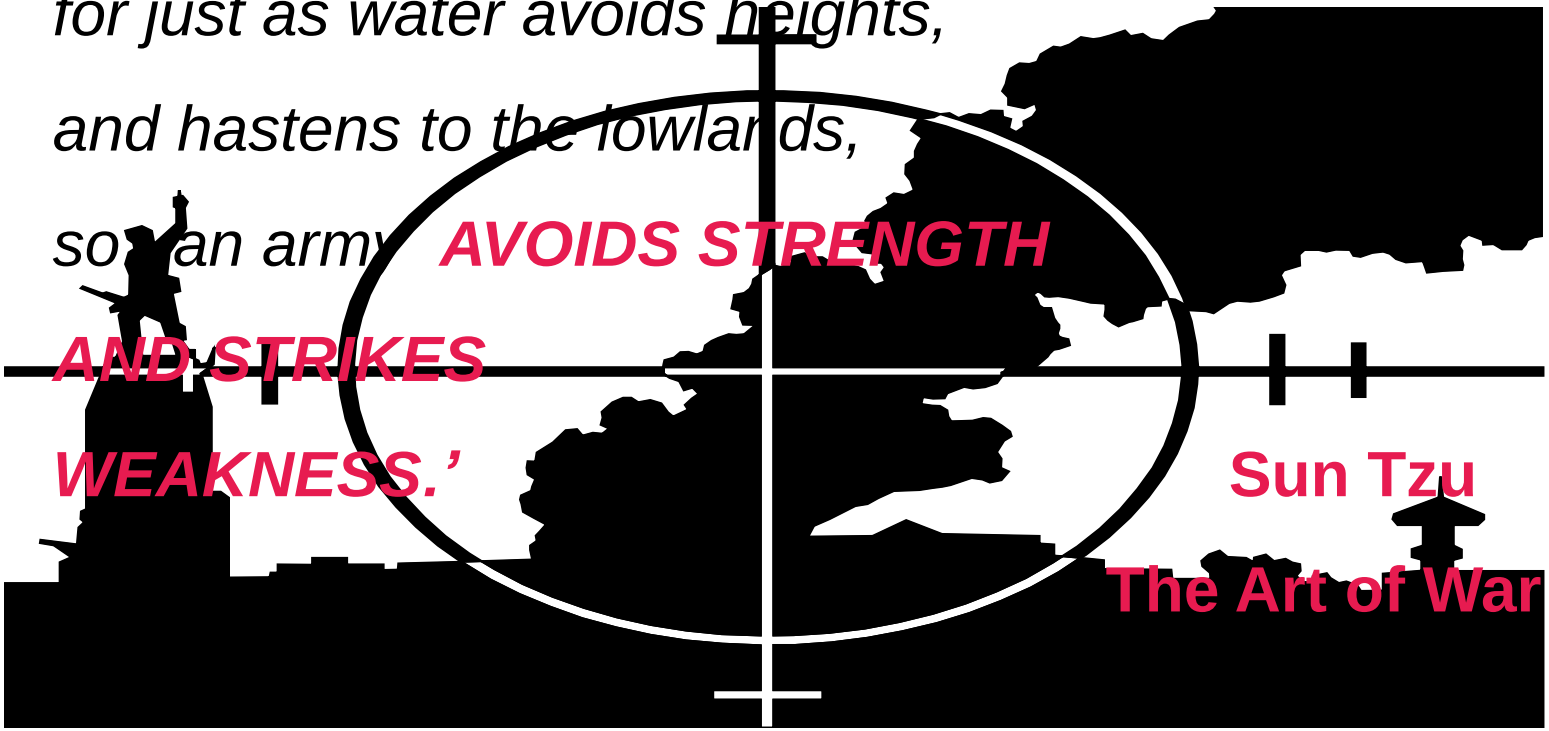
George Habash (1970)

‘Now an army may be likened to water,

for just as water avoids heights,

and hastens to the lowlands,

so an army ***AVOIDS STRENGTH AND STRIKES WEAKNESS.’***



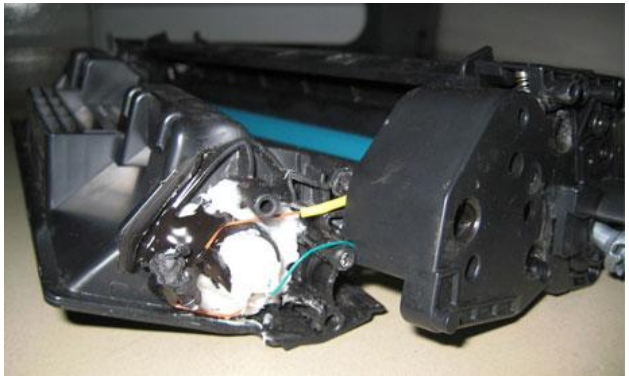
Sun Tzu

The Art of War

Maximizing impact/effort ratio

On 28 October 2010, a UPS flight to Philadelphia from East Midlands airport, UK, was inspected by MI5. On board was a boxed Hewlett Packard copier, containing a cartridge with explosives, rather than toner powder. This box originated in Sana'a, Yemen.

'Two Nokia mobiles, $150 each, two HP printers, $300 each, plus shipping, transportation and other miscellaneous expenses add up to a total bill of $4,200. That is all what Operation Hemorrhage cost us.'



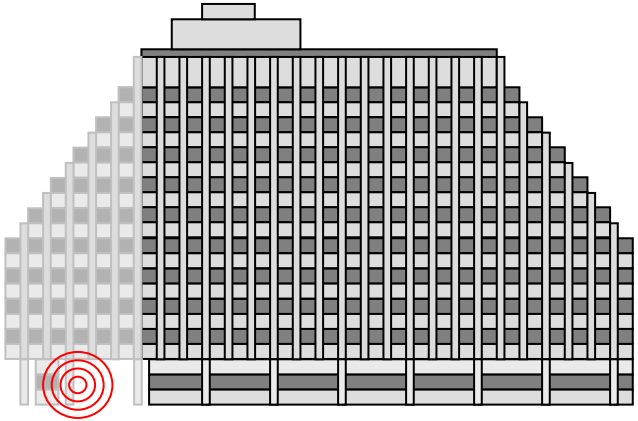
Inspire Magazine

'This is what we call leverage.'

Leverage in vehicle bombing

IRA bombing at St. Mary Axe, London, April 1992

Taba Hilton Bombing, Sinai, Egypt, October 2004



The principles of terrorist modus operandi

- Terrorists seek to maximize loss, subject to security changes.
- Terrorists follow the path of least resistance in their operational planning.
- Terrorists are members of social networks, which are under surveillance from counter-terrorism intelligence and law enforcement services.

The covert intelligence game

Clifford Cocks, mathematician who developed the RSA algorithm for public key cryptography at GCHQ.

Rajib Karim, BA computer staff member, planned to get a bomb on a plane to the USA in 2010. His elaborately encrypted messages to the radical cleric, Anwar Al-Awlaki, were decrypted.

Edward Snowden, whistleblower, whose NSA surveillance revelations have affirmed the counter-terrorism significance of RMS social network modeling.