



# **FROM SCIENCE TO ACTION: THE RISK ANALYST INTERMEDIARY**

Gordon Woo

Rome, 8 October, 2014

# Many natural hazard stakeholders

- Civil protection, police and military authorities
- Infrastructure utility and transport managers
- Industrial and commercial corporations
- Financial and insurance organizations
- Householders and workers
- VIPs and dignitaries
- Tourists and visitors
- Communications media

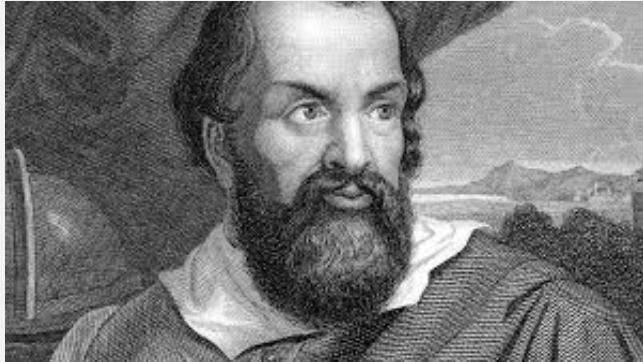
# Natural hazard scientist domain of specific expertise

- Scientific understanding of the natural hazard and associated phenomena
- Knowledge of the scientific literature on the natural hazard
- Professional involvement in data acquisition and analysis
- Quantification of long-term hazard frequency and severity
- Estimation of short-term event probability

# ACADEMIC DISCIPLINE AND PROFESSIONAL DIVIDE

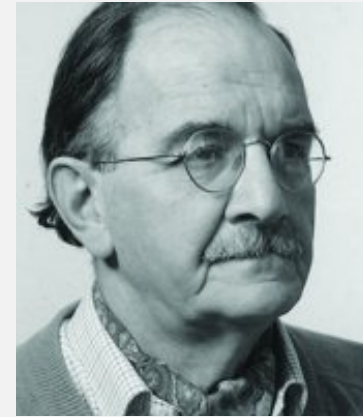
PURE SCIENCE

Pursuit of  
Knowledge



APPLIED SCIENCE

Engineering & Risk  
Solutions



# NOAA TSUNAMI WARNING CENTER: 26 DECEMBER 2004

**2:59 p.m.** The rupture of the great earthquake begins in the Indian Ocean off NW Sumatra.

**3:07 p.m.** Initial seismic signals trigger alarms at the NOAA Pacific Tsunami Warning Center in Hawaii.

**3:10 p.m.** PTWC issues a message to other observatories in the Pacific with preliminary earthquake data.

**3:14 p.m.** PTWC issues a Tsunami Information Bulletin providing information on the earthquake and stating there is no tsunami threat to Pacific coasts.

**[3:15 p.m.] Tsunami waves strike the coasts of northern Sumatra and the Nicobar Islands.**

**4:04 p.m.** PTWC issues a second Tsunami Information Bulletin to the Pacific revising the earthquake magnitude to 8.5 based on later seismic energy. The bulletin again indicates no tsunami threat to the Pacific, but language is added to advise the possibility of a tsunami near the epicenter.

**[4:30 p.m.]** PTWC attempts to contact the Australian Bureau of Meteorology to verify they received the bulletin.

**[4:45 p.m.] Tsunami waves strike the coasts of Sri Lanka, India and Thailand.**

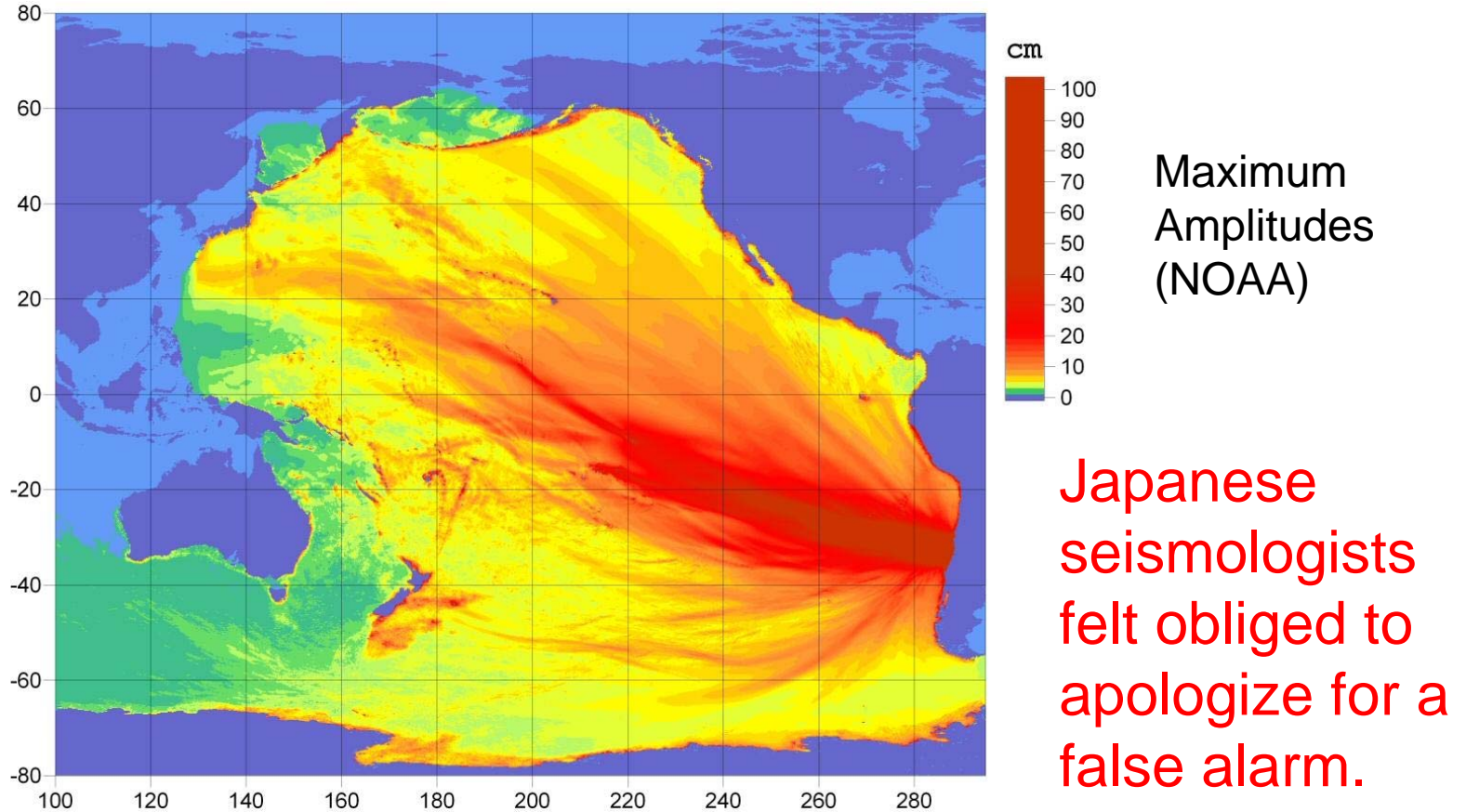
# Indian Ocean tsunami: 26 December 2004

A hazard warning from the Indian military base on the Andaman Islands could have triggered a radiation alert drill.



**Kalpakkam**  
Nuclear Power Station

# Maule, Chile, earthquake Mw 8.8: 27 February 2010



# Tsunami alert decision making

- Decision making has traditionally been scientifically deterministic, so tsunami observatory staff have not been required to be familiar with risk analysis.
- Run-up heights are subject to significant spatial variability.
- **Probability distributions for run-up heights are not calculated.**
- However new methods of estimating run-up using integrated observational data may bring about change.



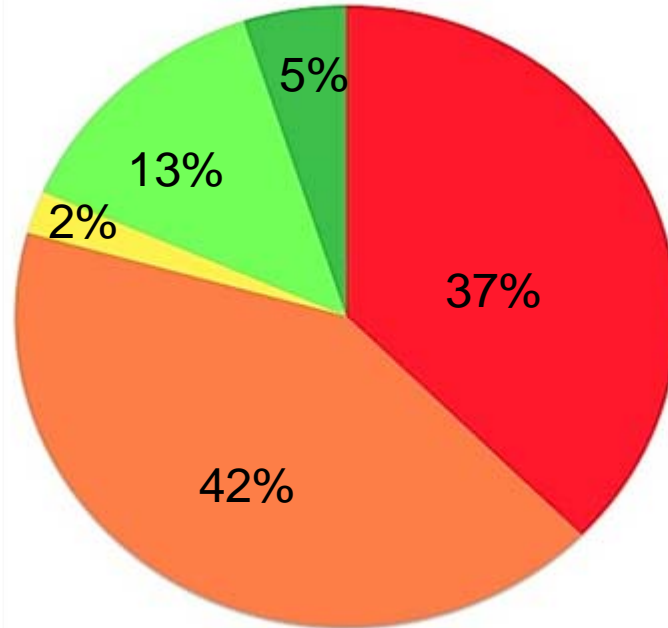
Perfect

Almost

Premature

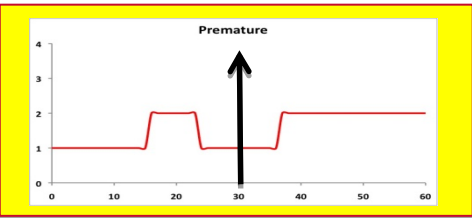
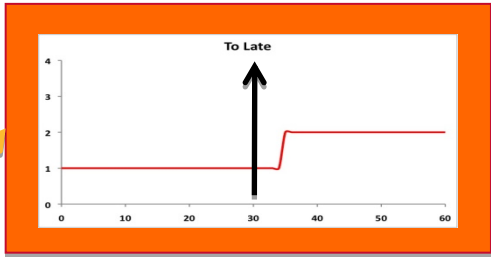
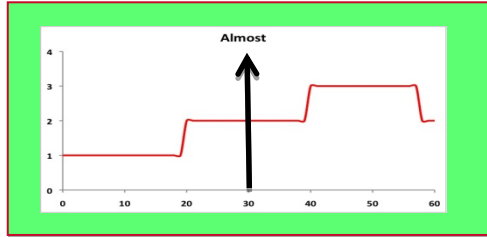
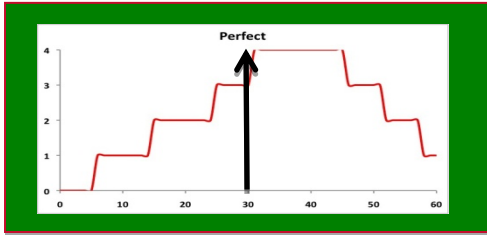
Too Late

Missed

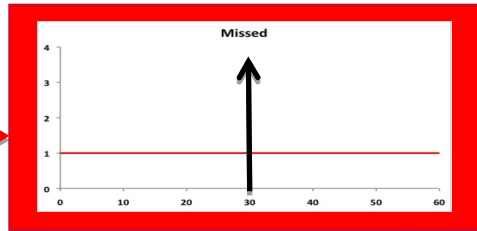


c.79% of eruptions can be broadly categorized as **NOT** being anticipated by a change in alert levels

**“Unsuccessful”**



**“Successful”**



# Indiana State Fair stage collapse tragedy

Throughout the day and evening of the concert, August 13, 2011, the National Weather Service issued notices and warnings predicting strong thunderstorms.

The public address announcer stated that a storm was approaching but that the show would go on. He gave instructions on how to evacuate to the buildings nearby, in case conditions got worse.

**But there was no directive to actually proceed with an evacuation.**



The structure landed among a crowd of spectators, killing seven people and injuring 58 others. The maximum wind speed was ~ 95 km/hr, about 25 km/hr more than the structure could withstand.



On the night of 28th October 2013, the UK Met Office forecast a violent windstorm in southern England.

This was estimated to be somewhat less than the great storm of 1987, which brought down 1% of trees in England.

Is it worth re-parking this car?



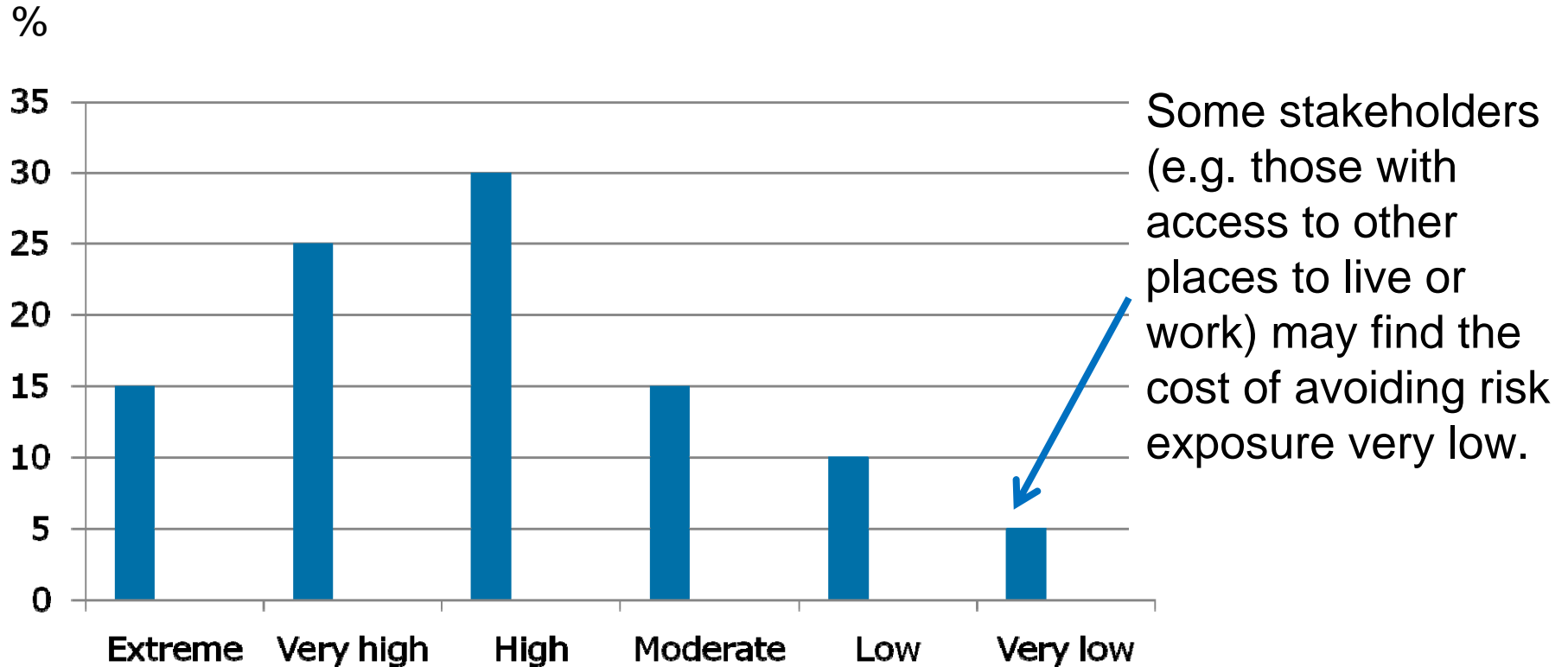
A 17-year-old schoolgirl was crushed to death after a 30ft tree toppled on to a caravan she was sleeping in as winds of almost 100mph battered England on 28th October 2013.

Bethany Freeman's home in Hever, Kent was being refurbished at the time.

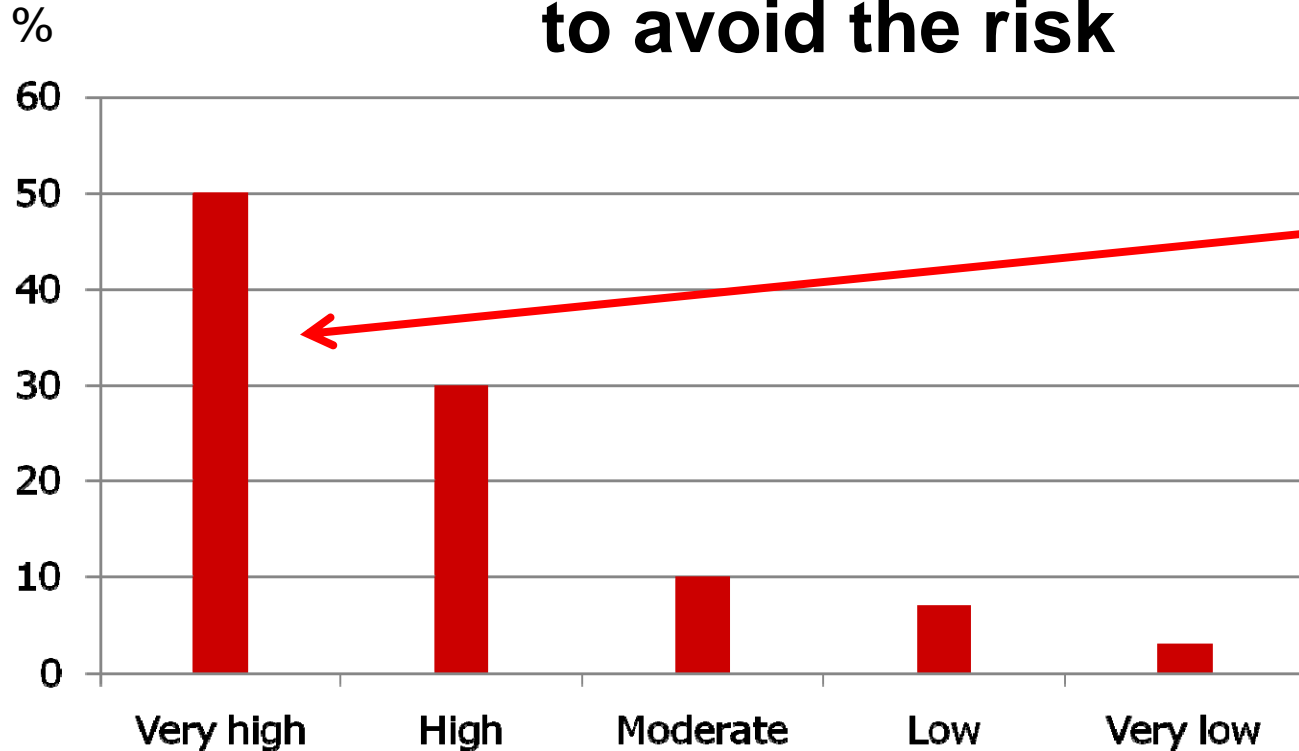
# Scientists and risk management

- Earth and Atmospheric scientists may have little or no formal training or experience in risk assessment or management.
- In particular, they may have no prior specific expertise in risk advisories.
- Risk management is a professional discipline in its own right, and requires special training.

# Stakeholder's cost in avoiding risk exposure



# Stakeholder's willingness to pay to avoid the risk



Some stakeholders may be willing to pay a very high price to avoid or mitigate the risk.



# Stakeholder's personality trait: locus of control

- People with an external locus of control have fatalistic views of the world, feel their fate is in the hands of chance, and view themselves more as victims.
- People with an internal locus of control are self-determined and tend to feel they have control over their fate. They are more likely to believe, personalize, and respond to a public warning than those with an external locus of control.
- These stakeholders are more likely to take active decisions to mitigate risk to themselves and their families.



**Julian Rotter**

**Scientists are few;  
but stakeholders  
are many and  
very diverse.**

**How can they  
be involved in  
meaningful  
participatory  
decision  
making?**



Scientists

Risk analyst  
intermediaries

Stakeholders

**In commerce, service staff are trained to help customers of all backgrounds cope effectively and safely with new technology.**

**A subscription service may be offered to premium customers.**



Scientists

Service intermediaries

Customers

# Operational Earthquake Forecasting actions involving stakeholder participation

- Provision of extra school and adult education
- Organization of additional earthquake drills
- Safety inspections of critical infrastructure
- Constriction of traffic flow on weak bridges
- Inventory reduction of hazardous or fragile stocks
- Expediting seismic retrofit schedules

# Risk analyst/manager domain of specific expertise

- Knowledge of the applied science of natural hazards
- Assessment and quantification of uncertainty
- Analysis of the economics of loss impact
- Understanding of the social psychology and risk perception of individual stakeholders



International Institute for  
Applied Systems Analysis

# Scope for elicitation of expert judgement

- Quantifying the uncertainty associated with hazard event warnings
- Quantifying the uncertainty in the loss consequences of a diverse range of potential mitigating actions
- Characterizing the loss utility functions of decision makers and other stakeholders