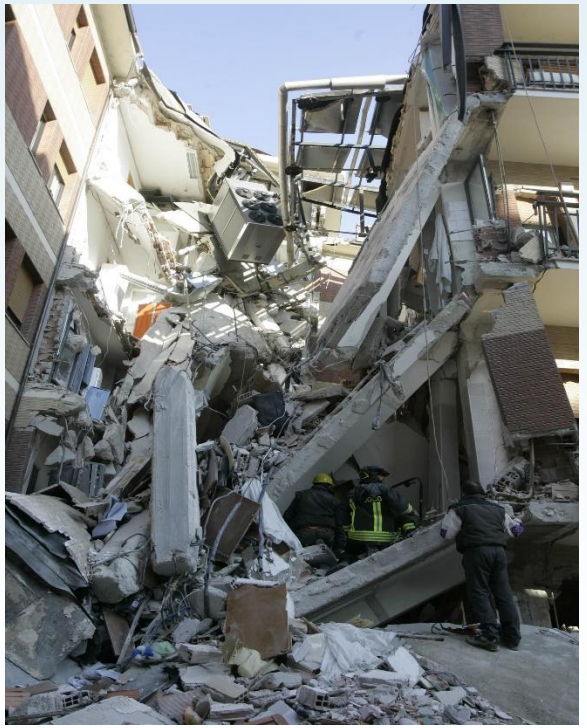
WHY DO NATURAL DISASTERS ALWAYS TAKE US BY SURPRISE? How science can help



Bill McGuire

Professor Emeritus of Geophysical & Climate Hazards UCL

AS OTHERS SEE US…..

"Sometimes you see beautiful people with no brains. Sometimes you have ugly people who are intelligent…..like scientists"

José Mourinho. Chelsea FC Manager
BBC Online. February 20th 2005

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‘UNEXPECTED AND UNPRECEDENTED’

Banda Aceh, Indonesia (2004)

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OUTLINE

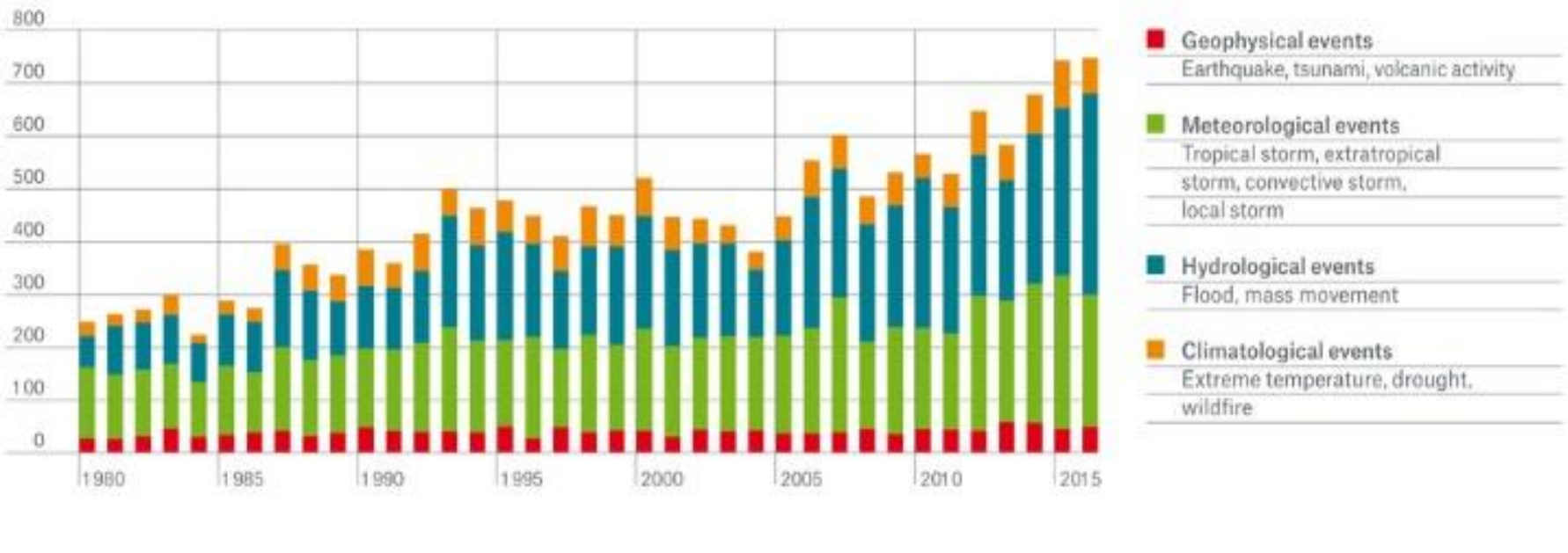
- Personal perspective
- Hazardous Earth
- Urban Earth
- Climate-changed Earth
- How can we get from surprise to readiness?
- How can (does) science (+ engineering) help?
- What next?

A YEAR ON HAZARDOUS EARTH

- 50 - 70 volcanoes erupt every year
- Around 100 damaging earthquakes
- 40 – 50 tropical cyclones
- Numerous floods, landslides, mudflows, tornadoes, extra-tropical storms
- 2016 ~ 1 in 17 affected by natural hazards

2016

2016: ONWARDS AND UPWARDS



ANNUAL NUMBER OF NATURAL HAZARD LOSS EVENTS (Munich Re. 2017)

2016: Cost of natural disasters USD175 billion (10-year average: USD154 billion)
Insured losses USD50 billion (10-year average: USD45 billion)
Fatalities: 9,200 (10-year average: 60,600)

THINGS CAN ONLY GET WORSE

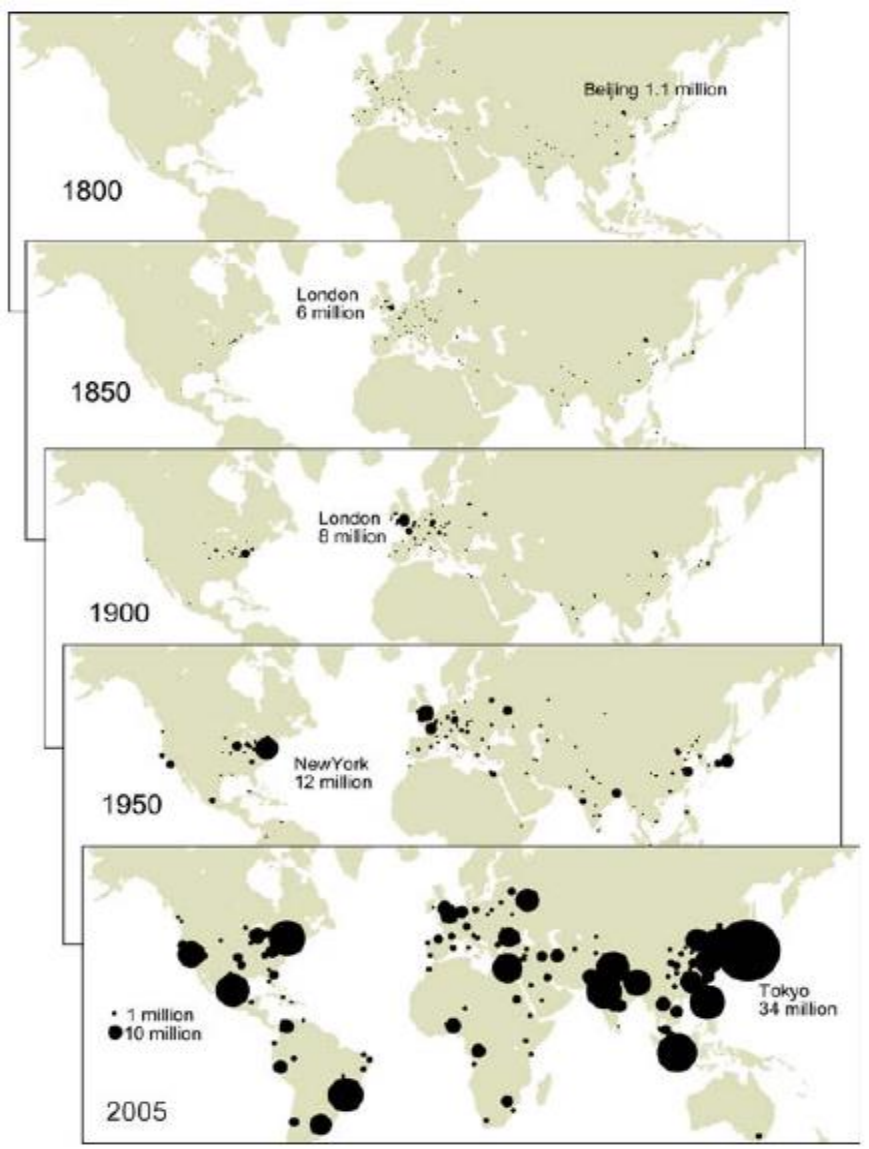
- More people
- Increasing concentration of people and wealth
- By 2050, 2/3 global population forecast to be urban
- Growing occupation of marginal and high-risk land
- Climate change and increased environmental degradation
- All act to multiply the NH threat

CITIES AS NATURAL HAZARD TARGETS

- More exposed
  - provide more populous, higher-density targets
- More hazardous
  - often occupy coastal locations coincident with tectonic plate margins
  - exacerbation due to urbanisation
- More vulnerable
  - large concentrations of poor quality buildings and infrastructure
  - occupation of marginal land (steep slopes; flood plains)

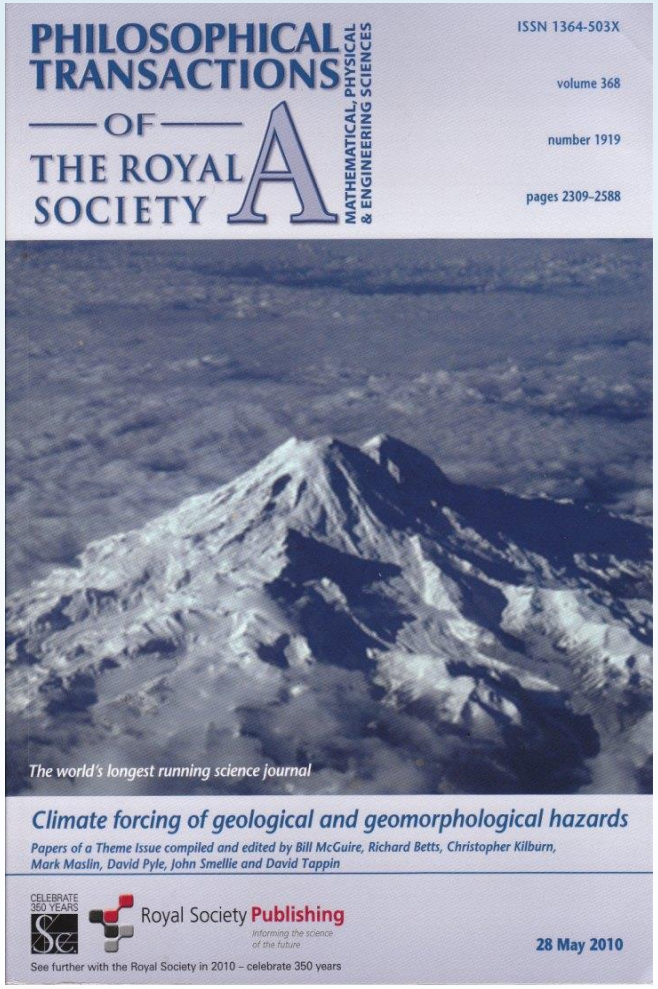
PAST NOT THE KEY TO PRESENT OR FUTURE

- Worst-case NH have very long return periods measured in centuries
- Last affected many of world's megacities when little more than small towns or villages
- Impacts of future events far worse than last time round
- Million-death natural catastrophes now possible
- Climate change is huge threat multiplier



Source: Bilham 2009

CLIMATE-CHANGED EARTH



Rising temperatures

Ice-mass and permafrost loss

Ocean mass increase

Elevated precipitation

CLIMATE CHANGE DRIVERS

Load pressure variations

Pore-water pressurization

KEY ENVIRONMENTAL TRIGGERS

FAULT RUPTURE

MAGMA PRODUCTION

RELEASE OF STORED MAGMA

SUBAERIAL AND SUBMARINE MASS MOVEMENT

POTENTIAL CONSEQUENCES

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TAKEN BY SURPRISE

- Inadequate awareness of hazards
- Poor understanding of risk
- Focus still response skewed
- Lack of political will, monetary support, technical expertise
- Corruption and graft
- Ineffective engagement between scientists and other stakeholders
- Insufficient belief or confidence in scientific forecasts

18th Caribbean Geological Conference
Dominican Republic
ENRIQUILLO-PLANTAIN GARDEN STRIKE-SLIP FAULT ZONE: A MAJOR SEISMIC HAZARD AFFECTING DOMINICAN REPUBLIC, HAITI AND JAMAICA (Paul Mann and others)

Published 2008: Earthquake 2010


Contents lists available at ScienceDirect

Physics of the Earth and Planetary Interiors

journal homepage: www.elsevier.com/locate/pepi

ELSEVIER

Interseismic strain accumulation measured by GPS in the seismic gap between Constitución and Concepción in Chile

J.C. Ruegg[a,*], A. Rudloff[b], C. Vigny[b], R. Madariaga[b], J.B. de Chabalier[a], J. Campos[c], E. Kausel[c], S. Barrientos[c], D. Dimitrov[d]

[a] Institut de Physique du Globe (IPGP), Paris, France
[b] Laboratoire de Géologie, Ecole Normale Supérieure (ENS), CNRS, Paris, France
[c] Departamento de Geofísica (DGF), Universidad de Chile, Santiago, Chile
[d] Bulgarian Academy of Sciences, Sofia, Bulgaria

Published 2008: Earthquake 2010

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PREPAREDNESS IS EVERYTHING

- Disaster response inadequate
  - does nothing to reduce disaster risk
- Effective preparedness THE key to stopping NH translating to natural disasters
  - Reduces required level of response materially and financially
  - Increases resilience and reduces recovery time
  - Decreases impact of hazards on society and economy
- Is thus also a KEY element in improving response

HOW CAN (DOES) SCIENCE HELP?

- Effective preparedness requires hazard & risk….
  - Recognition and evaluation
  - Process & mechanism research
  - Monitoring (maybe)
  - Forecasting and/or prediction
  - Mitigation/avoidance
  - Education & Communication
- Hazard & risk science community has a major role to play

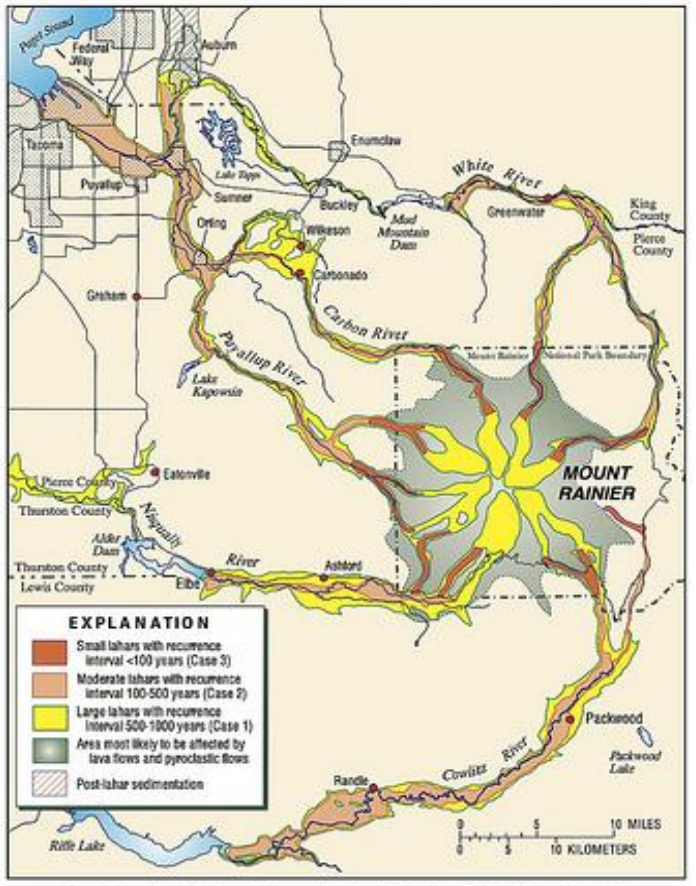

FIGURE 3.—Hazard zones for lahars, lava flows, and pyroclastic flows from Mount Rainier (Hobbitt and others, 1998; US Geological Survey Open-File Report 98-428).

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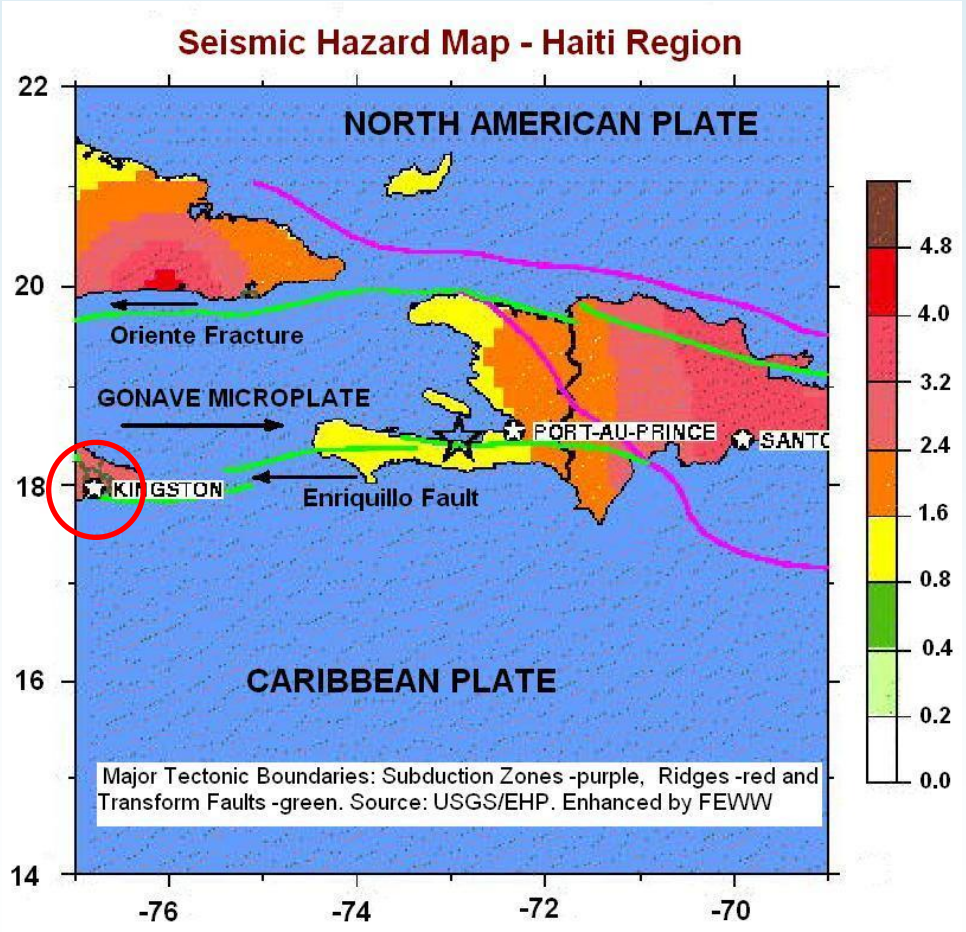
EARTHQUAKES: DOES ANYONE NEED TO DIE?



- Prediction not an issue
- Major earthquake faults known
- Return periods and likely worst-case events reasonably constrained
- We know how to make buildings life-safe

AGAINST THIS

- All the points made in three slides earlier
- Great deal of inertia that needs to be overcome

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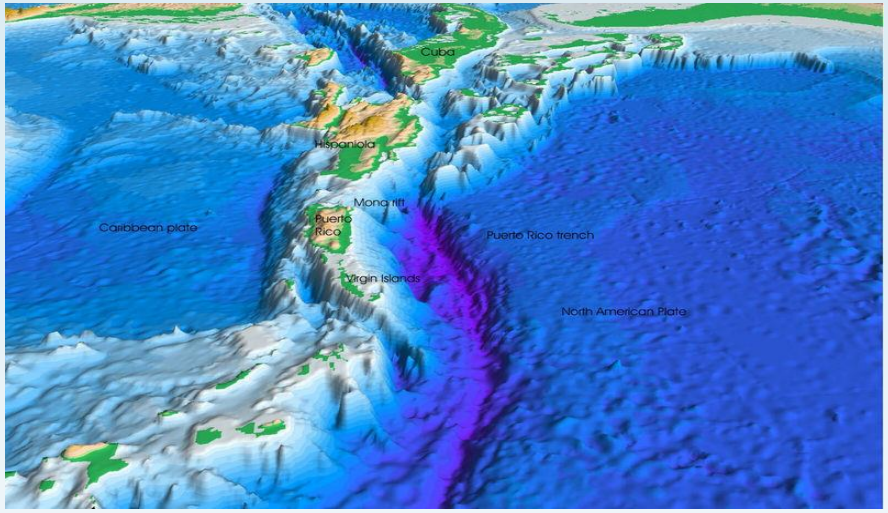
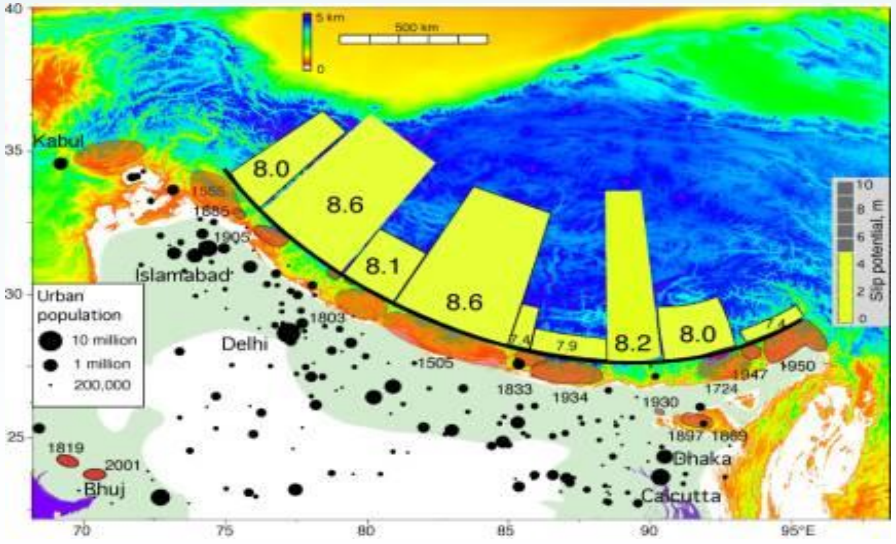
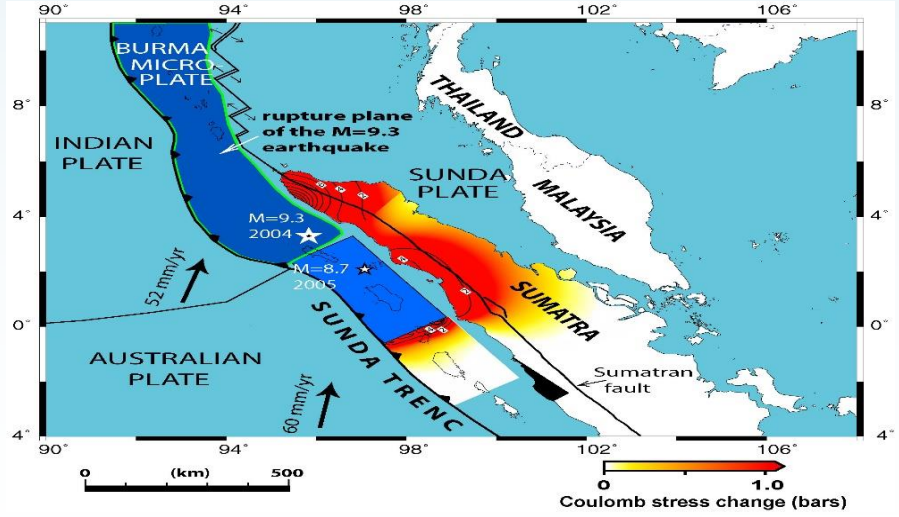
IDENTIFYING AND HIGHLIGHTING THREATS







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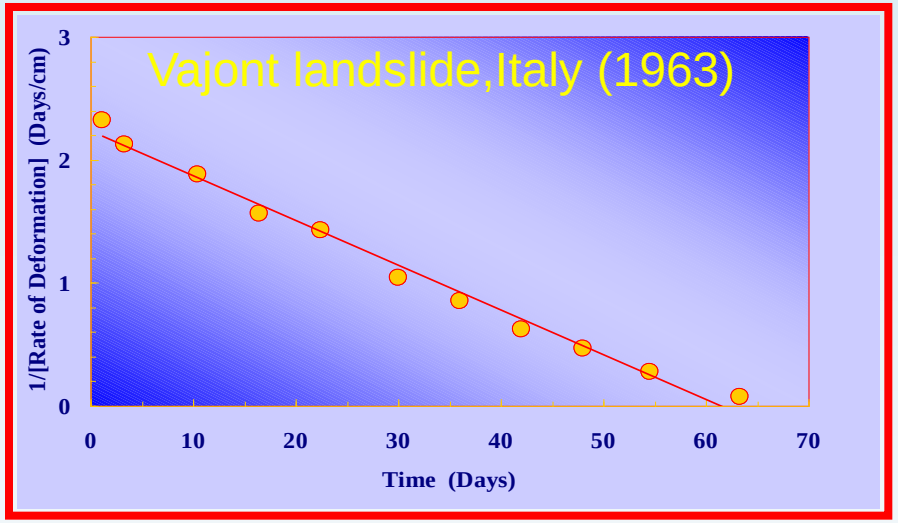
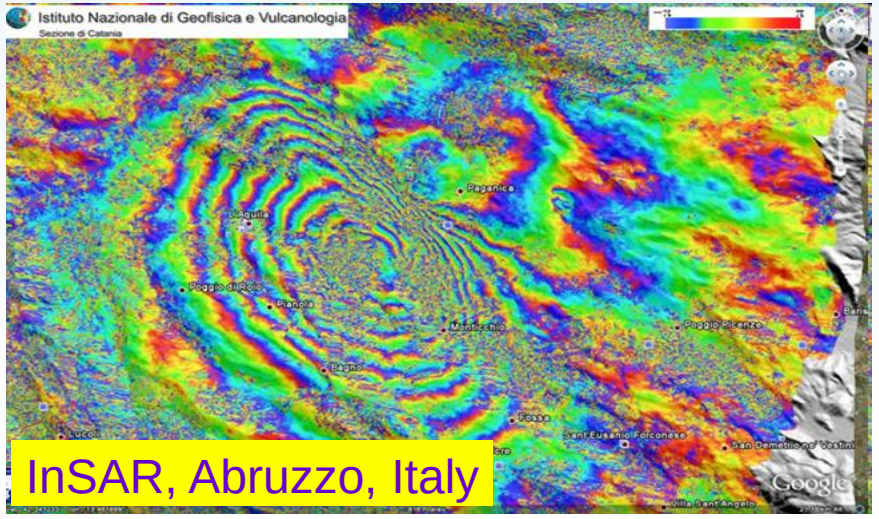
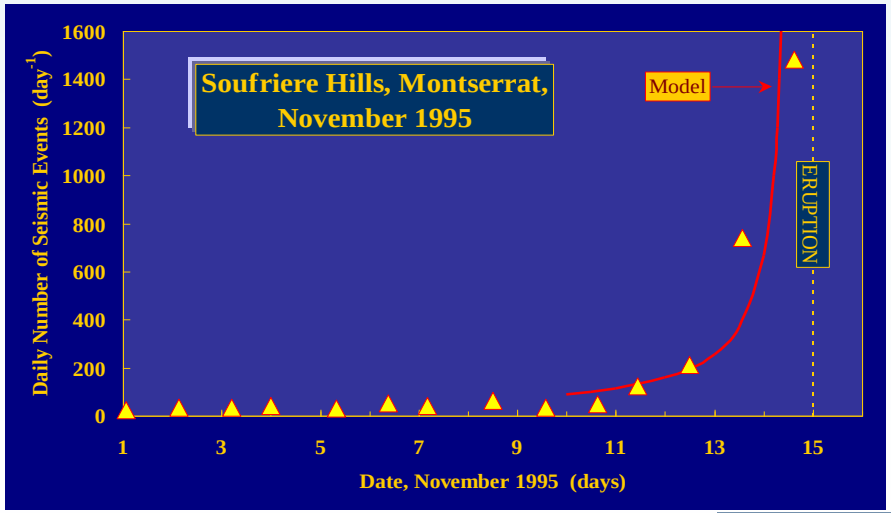
MONITORING AND PREDICTION







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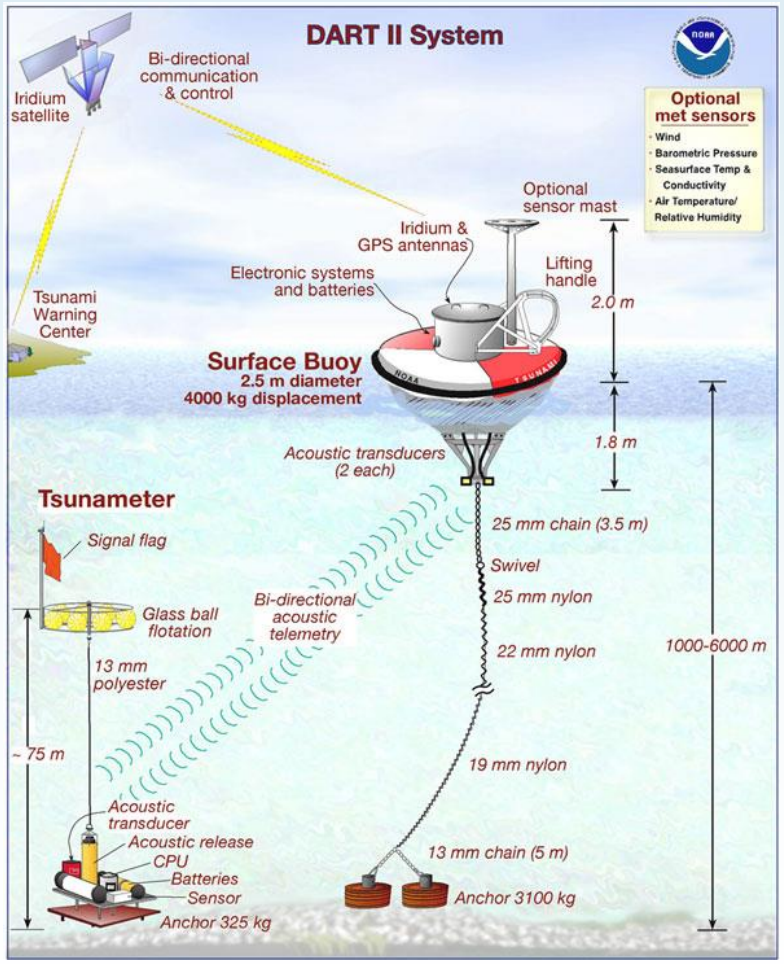
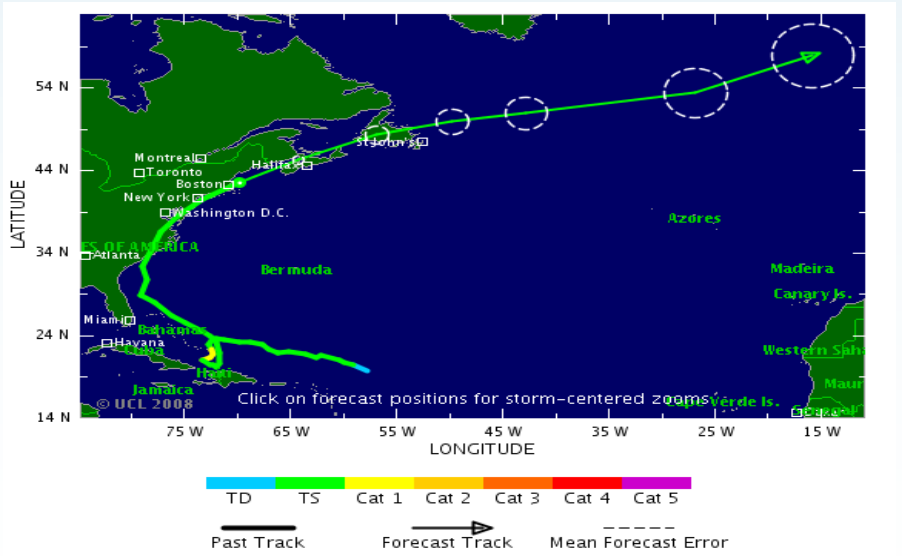
FORECASTING: HOURS TO YEARS AHEAD





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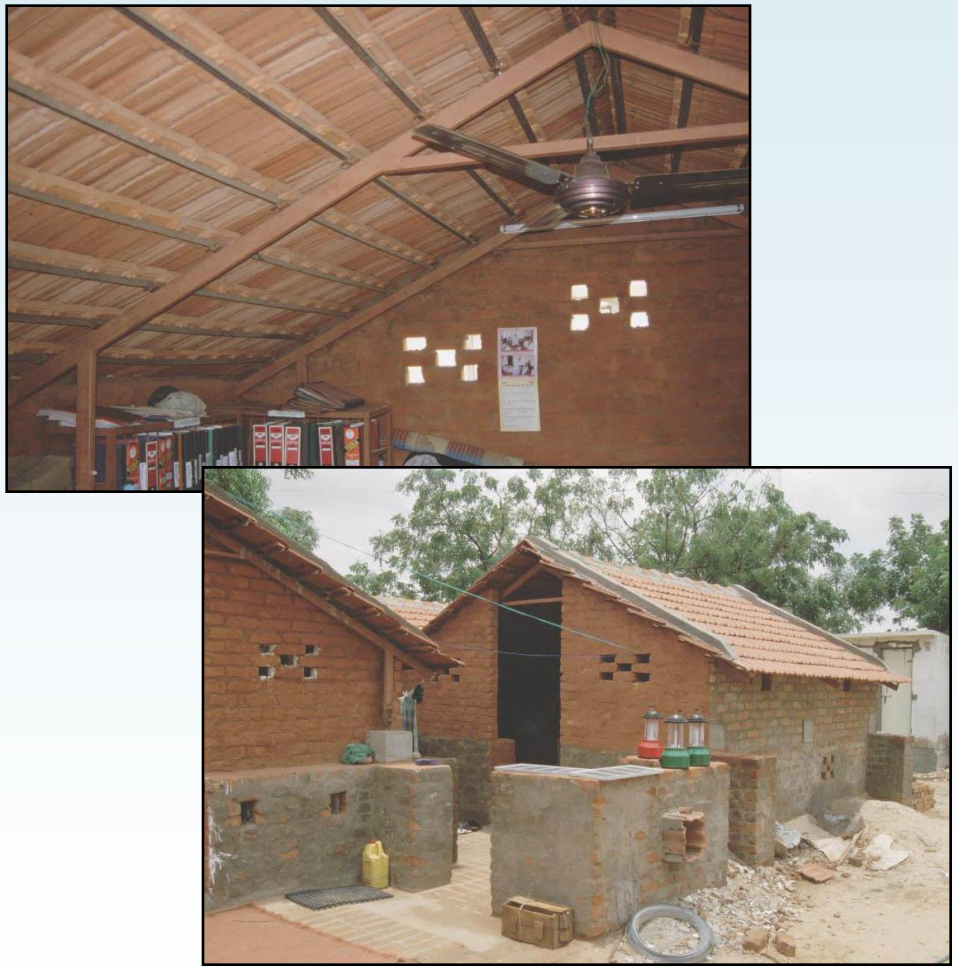
AVOIDANCE AND MITIGATION



Quake-proof homes (Gujarat)

- Nature and parameters of hazard needs to be known in advance
  - Likely event
  - Maximum event
- Long-term
  - Land-use planning
  - Construction codes
- Short-term
  - Temporary barriers (flood; lava)
- Issues
  - Cost/expertise
  - Prioritisation
  - Political will
  - Enforcement
- Links to education

EDUCATION AND COMMUNICATION

- IT REALLY WORKS! Rabaul eruption (PNG) 1994
- PROJECT CARIB: Communications during Volcanic Crises (media; scientists; civil authorities)
- ESWAVE (Education for Self-warning and Voluntary Evacuation): action of choice for indigenous populations

WHAT NEXT? COUNTRY BY COUNTRY

inTERRAgate

Lucy Stanbrough (L.Stanbrough@ucl.ac.uk)
Benfield Hazard Research Centre Department of Earth Sciences
136 Gower Street, UCL, London, WC1E 6BT

Developing global hazard preparedness

INTRODUCTION

2005 saw 91,963 people killed and 157,511,938 affected in a series of major disasters that included the aftermath of the Asian tsunami, the Pakistan earthquake, and hurricane Katrina, all of which highlighted the fundamental lack of hazard information held by disaster management NGOs and humanitarian agencies across the world.

Although large magnitude hazards capture global attention and generate volumes of post disaster data, there are numerous areas across the world that often experience or are overdue for small to medium scale hazard events, which have very little information held on them.

Collation of fundamental information including; those countries most prone to hazards and the types they face, potential future events, and the impacts of past events is sorely lacking. It is this information that is vital in order to provide effective pre-, during- and post- disaster data and analysis, which will enable full utilisation of resources to save lives and develop informed hazard planning and mitigation strategies.

inTERRAgate is aimed at filling this knowledge gap through the development of an online gateway aimed at disaster management NGOs and humanitarian agencies, which will provide a natural hazard inventory for every country in the world.

PARTNERSHIPS AND SERVICES

Benfield Hazard Research Centre (BHRC) and SARAID (Search And Rescue Assistance In Disasters) are working together to develop inTERRAgate - a global online database comprising:

- A hazard profile for every nation
- Forecasts and early warnings of hazardous events
- Past disasters and their impacts, to identify the potential scale and consequences of future events along with the most likely affected areas
- Contact details of in-country government departments, NGOs, and scientific contacts
- Links to online sources of information, including available and appropriate online GIS applications

Benfield Hazard Research Centre is able to draw on the services of a wide range of hazard and risk expertise from within University College London (UCL) and through an extensive research and operations network, which will be combined with logistical and primary contact data collected and updates by SARAID. This will include specific data about access to and mobility within individual countries and across the world.

WEBSITE DELIVERABLES

The inTERRAgate website will provide an online gateway to comprehensive hazard information on each of the world's nation states - drawing attention to potential future threats to improve preparedness and foster appropriate mitigation and management methodologies.

Through use of the inTERRAgate site, disaster management NGOs and humanitarian agencies can be better prepared for the occurrence of natural hazards through country specific pages that will continuously be updated with possible scenarios and effects.

Upon completion of the database it will automatically update and users will be able to upload data to it. With use of the inTERRAgate system, international response teams will be 90 percent prepared for all eventualities, being able to identify the most vulnerable countries, check the likely range of anticipated hazards, and view on-tap information about the host country.

Discussion boards will also provide a platform for the exchange of vital information between groups, and the discussion of, new research, design practices, and hazard event threads as disasters unfold.

Users will also be able to sign up to the site to receive details of important developments and events.

KNOWLEDGE, DATA, EXPERIENCE, HAZARDS

Figure 1 – InTERRAgate system and development user interface - A sample page can be seen online at: www.inTERRAgate.info/countries/iran/index.html (Images: Benfield Hazard Research Centre, SARAID, NASA)

Work with us....

PROJECT SPONSORS

BENFIELD Hazard Research Centre

S.A.R.A.I.D.

UCL

inTERRAgate is currently working with BHRC, SARAID, and UCL. We are looking for further project sponsors and data sources to provide users with the most extensive information network available in order to make informed decisions.

If you believe that you have services or links that may be useful to the inTERRAgate project, please contact Lucy Stanbrough at L.Stanbrough@ucl.ac.uk. A sample project page can be seen at www.inTERRAgate.info/countries/iran/index.html, from which you can see the sites user interface and other development pages currently available for viewing.

If you would like to be kept up to date with project development and be alerted when new sections are uploaded please register your interest at www.inTERRAgate.info/contact/index.html

Enquiries and requests for further information can be submitted to Lucy Stanbrough via email at L.Stanbrough@ucl.ac.uk or in writing to: Benfield Hazard Research Centre, Department of Earth Sciences, 136 Gower Street, UCL, London, WC1E 6BT

- Online gateway aimed at government agencies, NGOs, emergency managers and other DRR stakeholders
- Updateable natural hazard and risk inventory for every country
- Wiki-based and so users can upload material.
- Validated by moderators

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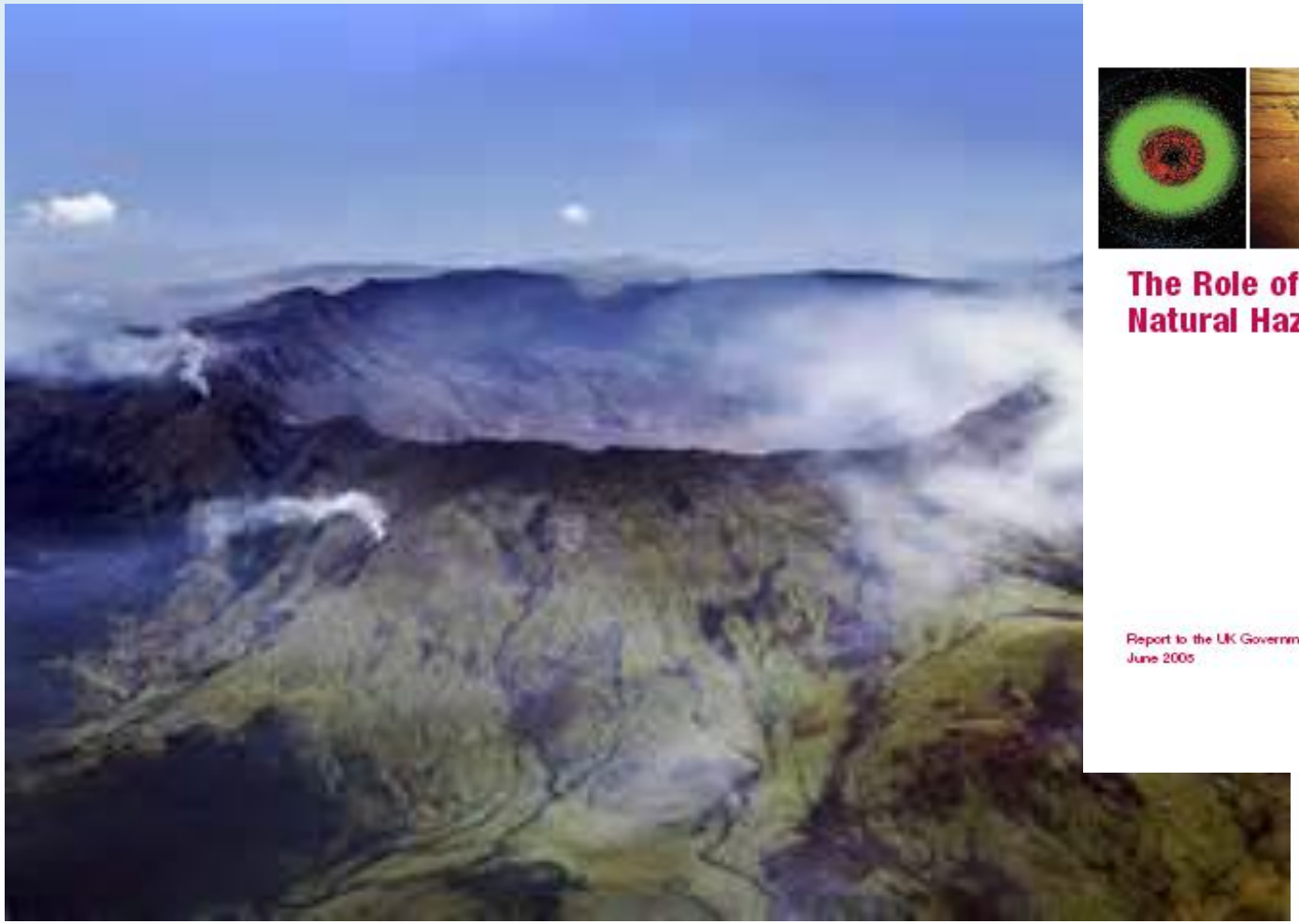
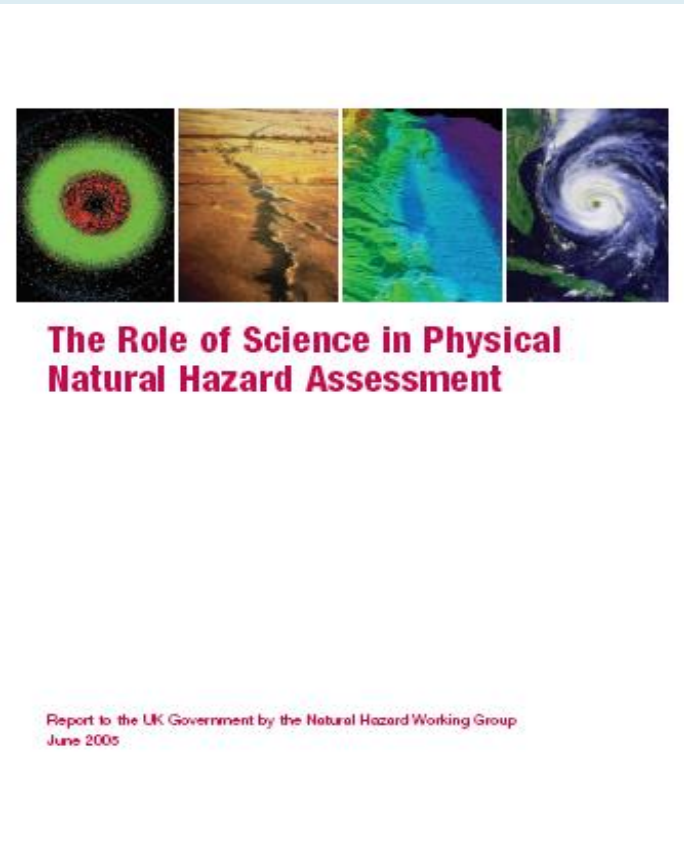
WHAT NEXT? TRANSNATIONAL THREATS





Tambora 1815

DON'T SAY I DIDN'T WARN YOU!

- Uturunca (Bolivia): A 70km-wide bulge that has been growing since the early 1990s might culminate in a gigantic eruption.
- Laguna del Maule (Chile): Swelling at the astonishing rate of 25cm a year is occurring above a massive body of magma just 6km beneath the surface.