

Natural disasters affect one in thirty people across the world each year. All nations are at risk and the field of natural hazards is one of the fastest growing areas of research in the Earth and Climate Sciences.

About the UCL Hazard Centre

Established in 1997, the UCL Hazard Centre delivers the latest research and knowledge on natural hazards to industry, humanitarian and development organisations, government and civil protection agencies. It co-ordinates two postgraduate programmes – UCL's MSc in Geophysical Hazards and Postgraduate Certificate Natural Hazards for Insurers – and provides bespoke workshops on understanding and communicating natural hazards.

Hazard Research & Mitigation

The UCLHC specialises in

- Fundamental research on the geophysical processes that drive natural hazards.
- Practical strategies for forecasting natural hazards and their impact.
- Communicating hazard information to decision makers and vulnerable communities.

Training

The MSc in Geophysical Hazards provides essential training for careers in hazard assessment and risk evaluation, from academia to industry and from governmental agencies to humanitarian organisations. For more information, see:

www.ucl.ac.uk/earth-sciences/study-here/postgraduate/geophysical-hazards

The Postgraduate Certificate Natural Hazards for Insurers is designed for insurers, re-insurers and others in the financial sector who require a strong grounding in natural hazards and risk.

For more information, see:

www.ucl.ac.uk/earth-sciences/study-here/postgraduate/natural-hazards-insurers

The UCLHC provides bespoke workshops on natural hazards for humanitarian and development organisations, the business community, civil protection agencies, the media and the public. For more information, please visit our website (see below).

Want to know more? Please browse our website at: www.ucl.ac.uk/hazard-centre

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Cover Photo: Lava flows on Mt Etna, Sicily. C.R.J. Kilburn.

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Understanding Natural Hazards
Research - Training - Mitigation

Non-Modelled Perils: Insurance & Re-insurance Industry

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Non-Modelled Perils

Tsunamis generated by the 2011 Tohoku earthquake in Japan, plus the disruption caused by the 2010 Eyjafjallajökull eruption in Iceland, are recent illustrations of why insurers need to better understand how non-modelled perils could impact their portfolios.

Improved estimates of risk must include how non-modelled perils contribute to insurance losses and how they link to modelled perils. The UCL Hazard Centre has been working with the insurance industry to apply scientific and technical knowledge for model development and catastrophe management, in order to create a more accurate picture of overall catastrophe risk.

Volcanoes, landslides and tsunamis are three key non-modelled perils. This is an introductory guide to highlight 10 important characteristics of each peril, focusing on hazard and vulnerability, which insurers should know and consider when assessing their risks.

Volcanic Hazards

Volcanoes erupt at long enough intervals for populations and businesses to risk settling within range. A volcanic event may not have triggered large insured losses recently, but the potential remains and this emphasises the need to learn more about the hazards and their interactions with insured assets. As a first step, the insurance industry should focus on volcanic hotspots, such as Japan, New Zealand, North West U.S., Chile, Iceland and Italy, in relation to return periods, magnitudes and the challenges of different types and impacts of eruptions.

- 1) At least 1,500 active volcanoes have been identified on Earth. The actual number may be twice as large.
- 2) About 50 volcanoes are in eruption each year.

▫ Mount Rainier and Tacoma, Washington. Photograph courtesy of the United States Geological Survey and taken on 20 August 1984 by Lyn Topinka.



▫ Iceland's Eyjafjallajökull volcano erupting a thick plume of ash on 11 May 2010. Image courtesy of Jer Schmalz of the MODIS Rapid Response Team at the NASA Goddard Space Flight Center.

- 3) Most volcanoes are found on the edges of landmasses, notably countries bordering the Pacific Ocean, the northern Mediterranean and the Caribbean Sea. Volcanoes within continents are found in Africa.
- 4) Almost 10% of the world's population lives within range of an active volcano.
- 5) Less than 10% of active volcanoes are permanently monitored.
- 6) The main volcanic hazards are flows and surges of hot ash and gas, mudflows, ash clouds and falls, lava flows and tsunami; ash clouds pose a significant far-reaching hazard.
- 7) Volcanic ash is the end product of the violent disruption of magma. It is a ubiquitous product of explosive volcanic eruptions at all scales.
- 8) As a consequence of its low density and height of expulsion into the atmosphere, ash extends enormously the disruptive potential and range of explosive eruptions.
- 9) Local impacts of ash include roof collapse; transport and power disruption; damage to electronics; crop destruction; water contamination; health problems for humans and livestock.
- 10) The primary regional and wider impact of volcanic ash is the serious, temporary disruption of commercial aviation and associated business and supply chain interruption — such as Eyjafjallajökull in 2010 and Puyehue-Cordon Caulle in Chile in 2011.



Extensive tsunami damage at Manamisanriku following the Tohoku earthquake and tsunami on 11 March 2011. Photograph courtesy of David Tappin of the British Geological Survey and taken on 10 May 2011.

Landslide Hazards

The potential for damaging landslides in and around urban areas exists throughout the world, particularly where construction is increasingly using vulnerable slopes for new development. The risk from landslides in an area may be assessed by examining pre-existing landslides; by estimating the location, frequency and volume of potential landslides; and combining these assessments with estimates of building vulnerability. This will allow for the quantification of risk to landslides within a portfolio and to build this into multi-peril loss estimates.

- 1) Landslides are the most widespread geological hazard, common in young mountain belts and along coastlines. Precipitation, earthquakes or land-use changes usually trigger them; they are often reactivated.
- 2) Landslide hotspots include western parts of North and South America, the Alps and Himalayas, the Caribbean and South East Asia.
- 3) Environments susceptible to landslides are variable and complex, requiring location-specific hazard and vulnerability assessments for meaningful quantification of potential insured losses.
- 4) Mapping the location of historical landslides with topographical (slope angle and soil type/depth) features allows high-risk landslide locations to be identified.
- 5) Landslide mitigation through slope strengthening (mostly for man-made slopes) is employed in some urban areas experiencing high levels of landslide activity. Hazard assessments should account for the consequent reduction of damaging landslide incidence over time.
- 6) The volume, depth and flow velocity of landslide debris (representing event magnitude) having return periods of several hundred years can be estimated using location-specific recurrence models developed from landslide event databases.
- 7) Large natural terrain landslides may run-out several hundred metres down-slope and cause damage (and insured losses) within dense built environments.
- 8) The vulnerability of built structures to landslide damage/loss can be parameterised in terms of their construction quality, height, foundation depth and other key properties.
- 9) Large landslides have relatively localised but severe impacts, potentially with total loss to a small number of insured risks. Consequently, accurate and detailed location and exposure data are critical.
- 10) Generic methods to estimate landslide insured losses must be combined with high resolution location-specific hazard, vulnerability and exposure data.

▫ The La Conchita Landslide, Ventura County, California, which was reactivated in January 2005. Photograph courtesy of the United States Geological Survey and taken by Mark Reid in 2005.



Tsunami Hazards

High levels of tsunami damage from the Tohoku Japan earthquake highlight the insurance industry's need to understand more about this peril. What research and information are needed—both regarding tsunami hazards and the vulnerability of insured assets—in order to produce useful and accurate tsunami catastrophe models?

- 1) Around 80% of damaging tsunamis are produced by earthquakes, but other significant sources include volcanic eruptions, volcanic island collapses and submarine landslides.
- 2) Although tsunami sources are concentrated around the Pacific and in South East Asia, tsunami risks may be disproportionately high on flat-lying coasts around other ocean basins, such as the Atlantic and the Mediterranean.
- 3) Tsunami hazard is dominated by large, relatively infrequent source events, so historical event catalogues may be a poor guide to long-term and future tsunami hazards.
- 4) Certain geological signatures of tsunamis are highly distinctive, so geological studies offer the potential to better understand tsunami occurrences and resulting hazards.
- 5) Computer models of tsunamis can offer many insights into tsunami behaviour and enable prediction of tsunami run-ups and inundation zones.
- 6) Worldwide application of tsunami models to produce accurate hazard maps of coastal areas will require a major effort in collecting key input data, such as coastal and near-shore seafloor topography.
- 7) Tsunami damage to built structures occurs by a variety of mechanisms and modelling these requires local measures of tsunami intensity, along with assessing the potential for debris impact, scour and fire.
- 8) The resistance of structures depends on their ability to sustain loadings as well as allowing flow-through of water. Designing accordingly, and also satisfying the requirements of earthquake-resistant design, presents significant engineering challenges.
- 9) Building and infrastructure insured losses will dominate in larger tsunamis but this hazard also triggers significant contents and business interruption costs—especially in more frequent, smaller events.
- 10) Since direct tsunami damage is mainly confined to narrow coastal inundation zones, high resolution location data for value-at-risk inputs will be required for accurate application of tsunami catastrophe models.