Expert: Julia Hall (and Robert Muir-Wood)

Title of the Session: The use of modelling for Disaster Risk Reduction

Date: 01/06/2015 to 07/06/2015

Summary

Measuring progress in disaster risk reduction is much more complex than you might think. You can't purely count the loss of lives or the economic loss over a 10 year period (even if it is normalized by population or GDP).

Risk models have been used by the insurance industry for the past 25 years, to solve the issue of how to measure disaster risk. As UN frameworks such as the Sendai Framework and the Sustainable Development Goals – which demand measurement - are being agreed upon this year, the learnings from the insurance industry should be applied.

Context

In 2010, more than 200,000 lost their lives in a tragic earthquake in Haiti. However, between 1900 and 2009, earthquakes in this country killed fewer than 10 people. This experience shows that it is not possible to measure the true level of risk from a few decades of catastrophe losses. Yet at the same time, to be able to manage risk effectively, you need to be able to measure it.

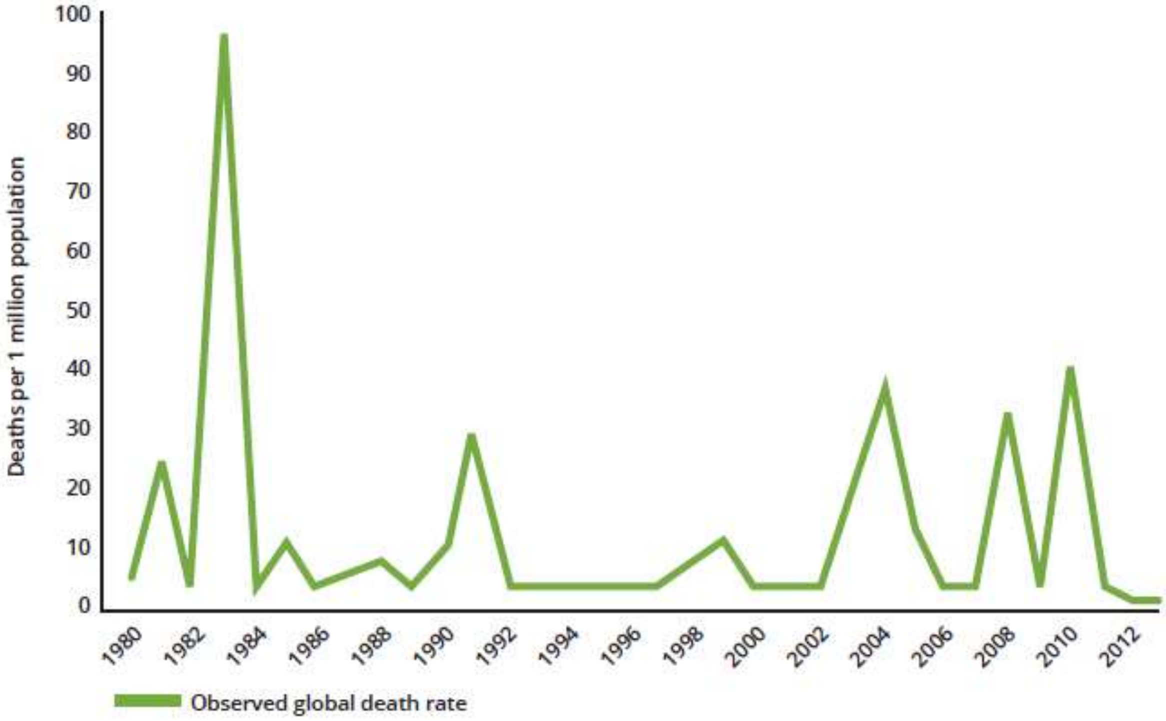
Why can't we use observed deaths and economic losses to measure progress in disaster risk reduction?

Recent historical experience does not give a clear indication of the level of risk in a country or region, because catastrophes have a wide range of probabilities. It is not possible to develop reliable estimates of average casualties or disaster losses based on a few decades of data. Therefore, attempting to assess trends over the next 15 years, purely based on observed deaths or losses, will give a misleading impression of success (or failure) if countries or regions are lucky in avoiding (or unlucky in experiencing) severe disaster events in that period.

As this graph on the next page indicates, even on a global level, infrequent events dominate the disaster mortality data and from the record of a decade, it is not possible to find the true average.

Is there a way to measure disaster risk reduction?

In the early 1990s, the insurance industry confronted the same challenge of how to measure disaster risk. Insurers struggled to accurately price disaster insurance. This was demonstrated when nine insurers became insolvent as a result of losses from Hurricane Andrew in 1992. The disaster losses from a few decades in a particular region were insufficient to determine the true average cost, or the potential for large catastrophes. In response, insurers and reinsurers turned to probabilistic catastrophe models, which simulate a full range of potential catastrophe events for thousands of possible years. Today, all global reinsurers writing business exposed to catastrophes use probabilistic methodologies.



Risk metrics, from these methodologies, can be used to:

- **Measure disaster risk** in a village, city, or country and how it changes over time.

- **Analyze the cost-benefit of mitigation measures:**

  For a region: For example, the average annual savings of a flood defense or earthquake early warning system.

  For a location: For example, choosing which building has the biggest reduction in risk if retrofitted.

- **Quantify the impact of climate change** and how these costs are expected to vary over time.

How can disaster risk reduction be measured?

Three main components are needed to measure disaster risk:

Exposure: The location and characteristics of economic exposure (buildings, contents, crops, infrastructure, economic activity at risk of interruption) or human exposure (number and demographic of people).

Hazard: The characteristics and likelihood of the catastrophe. For example, the strength of ground shaking or flood depth expected at each location at a given annual probability or return period (for example, 1% annual probability or 100-year return period).

Vulnerability: The degree of damage, or other forms of loss, as a result of the impact of the hazard. For example, vulnerability functions can convert a peak gust wind speed of 40m/s into an average damage of 15% of the property's value for a given type of building, or be used to estimate the number of deaths and injuries.

Datasets such as **return period hazard maps** are a useful tool in deriving a disaster risk metric. These datasets can be produced for different perils, such as earthquake or flood, on a country or regional basis. By using these maps in conjunction with exposure and vulnerability data, it is possible to derive a risk metric for measuring disaster risk reduction.

This process can be refined if multiple return period hazard maps are used for the same peril region. For example, having 20-year, 50-year and 100-year hazard maps would give greater insight into the losses because catastrophes have a range of likelihoods of occurrence.

For more complex and comprehensive analyses, **probabilistic catastrophe models** can be used where available, which assess tens of thousands of possible catastrophic events. By analyzing the exposure, hazard and vulnerability for each of these simulated events, catastrophe models can estimate the expected loss per year (or average annual loss).