

Measuring Disaster Risk

KEY MESSAGES

- Observed deaths and economic losses cannot be used to measure progress in disaster risk reduction
- Probabilistic approaches, which have been used by the insurance industry for 25 years, can be leveraged to measure risk, and changes in risk over time, in villages, cities, and countries and for cost-benefit analyses of mitigation measures
- These approaches use simulated events for thousands of possible years to capture the range and probability of catastrophes

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.

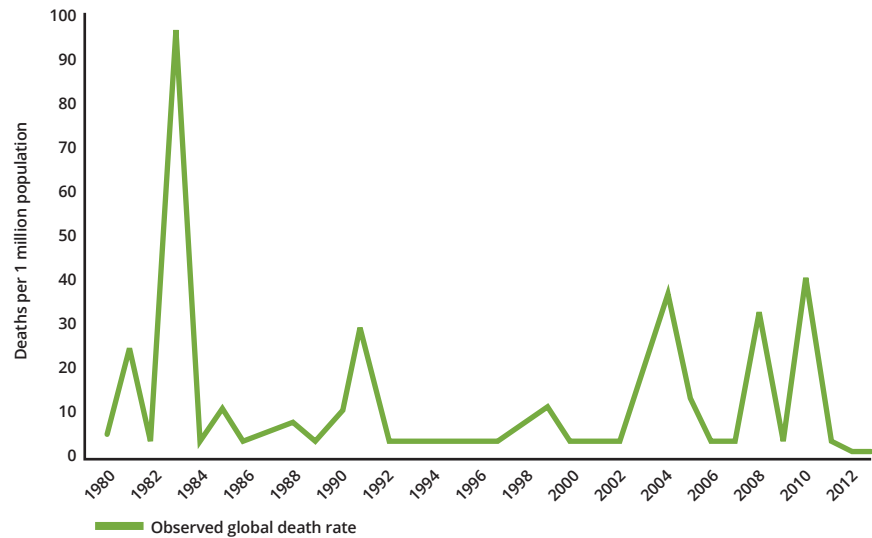
Why can't we use observed deaths and economic losses to measure progress in disaster risk reduction?

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 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.



Global disaster-related mortality rate (per million global population), 1980–2013 (From *Setting, measuring and monitoring targets for disaster risk reduction: recommendations for post-2015 international policy frameworks*. Source: adapted from www.emdat.be)



CASE STUDIES

Measuring Disaster Risk: City Level

RMS is working with the Rockefeller Foundation on the 100 Resilient Cities campaign, starting with the pilot city of San Francisco. One key aim is to help the city understand and subsequently mitigate its risks related to sea-level rise. This work will equip San Francisco with data and guidance to create comprehensive policy directives.

Cost-Benefit Analyses of Mitigation Measures

RMS is working to identify the overall potential benefits of an earthquake warning system on the U.S. West Coast. The cost-effectiveness is being assessed with a view to helping to elicit private and public sector funding for the operation of the system.

Quantifying the Costs of Climate Change

The Risky Business Project focused on quantifying the economic costs of climate change in the U.S. through the end of the 21st century. RMS analysis found that sea-level rise alone—one of the most certain aspects of a warmer climate—has the potential to more than double the economic losses from hurricanes by the end of the century.

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

CASE STUDY

Measuring Disaster Risk: Country and Global Level

RMS has worked alongside the ODI and CRED to advise the U.K. Department for International Development and the UN on Setting, Measuring and Monitoring Targets for reducing Disaster Risk for Post 2015 Frameworks, with the following findings and recommendations:

- The use of quantifiable targets is the key to understanding whether goals are being met
- Measurement cannot rely on the experience of disasters alone
- Progress in disaster risk reduction should be measured using hazard maps, exposure data, and vulnerability to derive a risk metric

How can disaster risk reduction be measured?

Three main components are needed to measure disaster risk:

- 1) **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).
- 2) **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).
- 3) **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).



A catastrophe model comprises five modules. Data from historical events and scientific research are used to inform, validate and update the models.



Where can I learn more?

Measuring and Monitoring Targets for Reducing Disaster Risk:
Recommendations for Post-2015 International Policy Frameworks
<http://rms.com/resources/publications/additional>

Visit the RMS website, rms.com

For further information, e-mail wcdrr@rms.com

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About RMS

RMS models and software help financial institutions and public agencies evaluate and manage catastrophe risks, promoting resilient societies and a sustainable global economy. RMS began building models for the insurance industry over 25 years ago, to solve the problem of how to measure disaster risks, and now has models for more than 50 countries.

RMS is working toward its mission of building a more resilient society through partnerships with the **UNISDR, UNEP Finance Initiative's Principles for Sustainable Insurance, Risky Business, and 100 Resilient Cities**, as well as providing direct philanthropic support to **Build Change**, a charity that helps to improve construction practices in developing countries. We welcome further partnerships to assist with our mission.

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