DESCARTES

SCIENTIFIC PAPER

UNDERSTANDING GLOBAL NATURAL PERILS: EARTHQUAKE RISK

Earthquakes: A Complex and Unpredictable Phenomenon

Earthquakes, sudden and without warning, rank among the most destructive natural disasters. Their unpredictability and widespread damage leave many individuals and organizations vulnerable, often leading to severe financial losses and long recovery periods.

Just in 2023, earthquakes were reported to be the natural disaster with the highest economic losses. The costliest event of the year was the Turkey and Syria earthquake, accounting for $92 billion in economic losses and $5.7 billion in insured losses, which makes up almost a quarter of all economic losses for the year. This highlights the growing need for more adaptive insurance solutions that can respond quickly and effectively to the financial toll of such disasters.

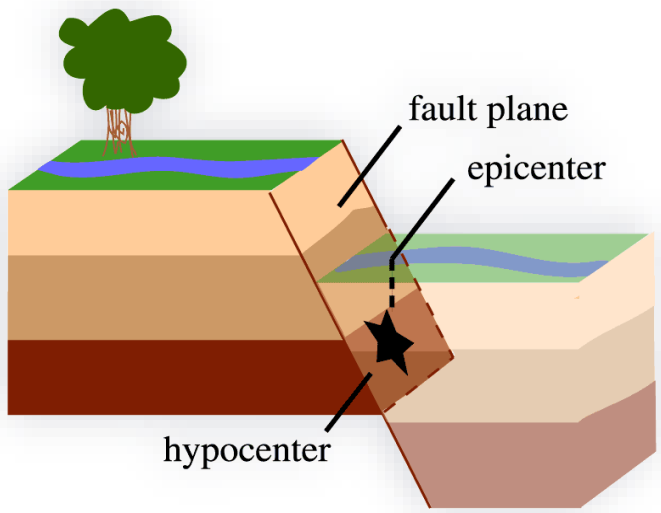
In the face of such uncertainty, traditional insurance may not be sufficient to cover the devastating effects of earthquakes. In this article, we will discuss the science behind earthquakes, how they are measured, what regions are impacted, and how parametric solutions ensure businesses can maintain resilience in the aftermath of property damage, business interruptions, and financial hardships caused by these catastrophic events.

1 - The Science Behind Earthquakes

An earthquake is the sudden and violent shaking of the ground caused by movement between tectonic plates along fault lines in the earth's crust. When two blocks of the earth suddenly slip past each other, an earthquake occurs.

- **Hypocenter**: The location below the earth's surface where the earthquake starts.
- **Epicenter**: The location directly above the hypocenter and on the earth's surface.

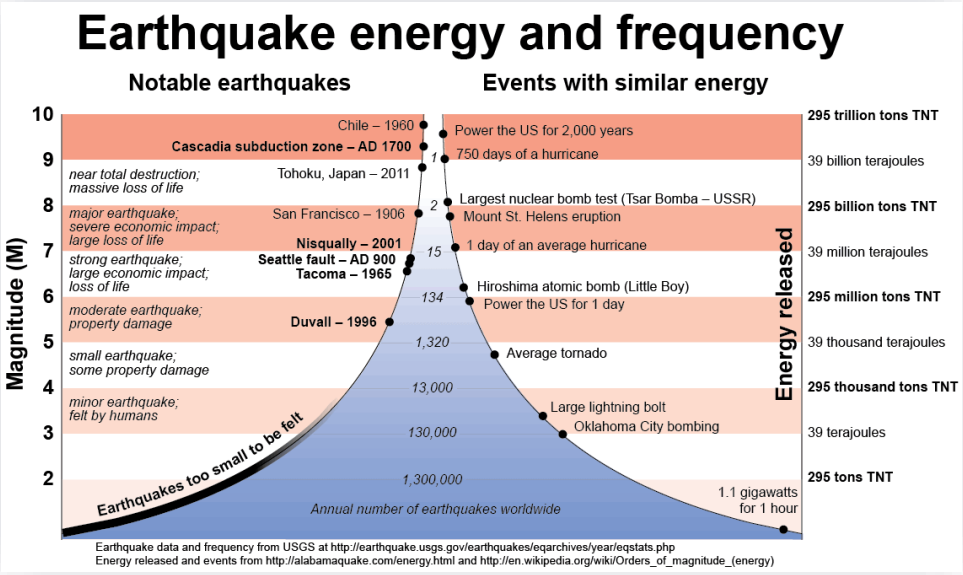
A fault is a fracture or a zone of fractures between two blocks of rock. Before an earthquake, tectonic plates get stuck at their edges due to friction. When the stress on the edge of the tectonic plates overcomes friction, the edges slip on each other, triggering an earthquake.



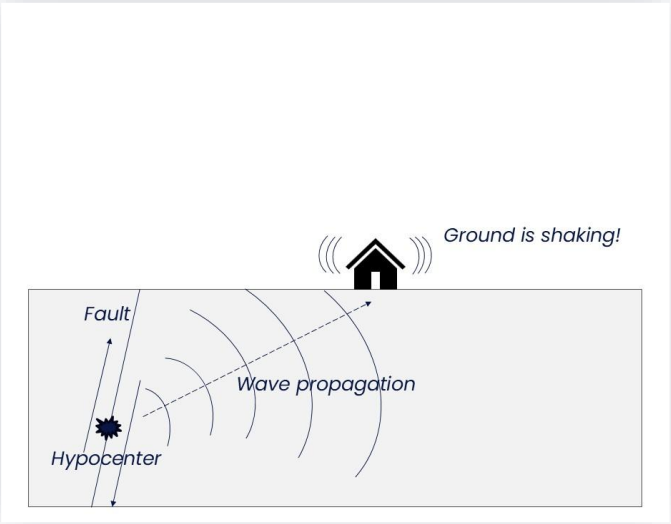
Source: USGS

2 - The Magnitude of an Earthquake

The size of an earthquake is called Magnitude. The Magnitude provides a measure of the total energy released during an earthquake event. There is one Magnitude for each earthquake, and each whole number increase in Magnitude represents a 32 times more energy release.



Credit: Trinidad and Tobago Weather Center, 2022, ttweathercenter.com



Seismic Wave Propagation

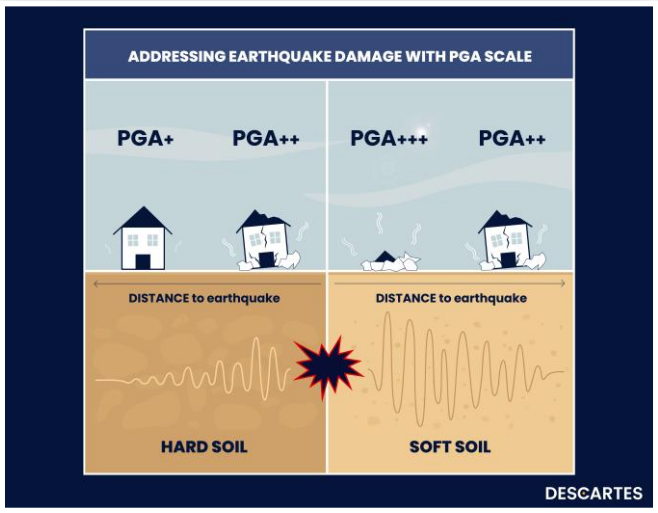
When an earthquake occurs, it releases energy in waves that travel from the fault rupture through the earth's crust, causing the shaking we feel on the ground.

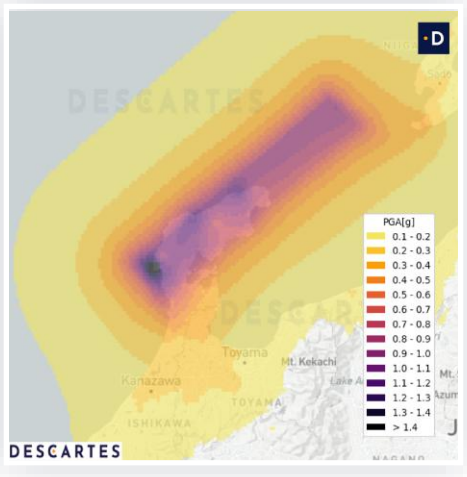
Ground Motion Intensity Measures

Ground shaking can be quantified through different Ground Motion Intensity Measures.

Unlike Magnitude, which is a unique value for each earthquake, Ground Motion Intensity Measures vary for each affected point. Indeed, Ground Shaking Intensity Measures account for a multitude of factors, such as geological features (soft and hard soil), topography, distance from the location to the earthquake's rupture, Magnitude, rupture fault geometry, etc.

For instance, soil typology plays a significant role in determining the ground shaking intensity and therefore plays into the potential damage from an earthquake. Soft soil tends to amplify ground shaking, which means that – with all conditions being equal – the impact of an earthquake can be more severe in areas with soft soil compared to those with hard, rocky soil.





PGA Shakemap for the 2024 Magnitude 7.5 Noto Earthquake

One of the most used Ground Motion Intensity Measures is Peak Ground Acceleration (PGA). PGA is the maximum ground acceleration at a given location during an earthquake event.

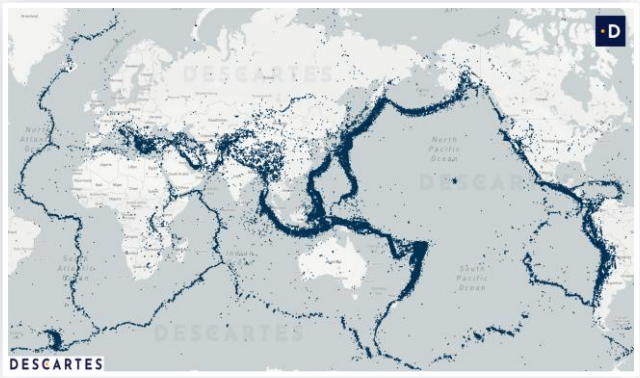
A selection of Ground Motion Intensity Measures, including PGA, are reported by the USGS (United States Geological Survey) after an earthquake.

3 - REGIONS AT RISK

Some regions severely impacted by earthquakes are the United States, New Zealand, Morocco, Mexico, Chile, Japan, Indonesia, Taiwan, and Turkey. While earthquakes are unpredictable and can hit any location at any time, we can observe 'earthquake belts' from the pattern of past events, where seismic activity is particularly concentrated.

From the figure below, three major belts can be identified:

- **Circum-Pacific seismic belt**: Often called the "Ring of Fire", this is the world's greatest belt and found along the rim of the Pacific Ocean where about 81% of the planet's largest earthquakes occur. This belt includes the largest Magnitude earthquake ever recorded, the 1960 Magnitude 9.5 Valdivia Earthquake in Chile.
- **Alpide earthquake belt**: This belt extends from Java to Sumatra, through the Himalayas, the Mediterranean, and out into the Atlantic. This belt accounts for about 17% of the world's largest earthquakes, including some of the most destructive, such as 2004 Magnitude 9.1 Indonesia Earthquake, which induced a devastating tsunami.
- **Mid-Atlantic Ridge**: This ridge is mostly underwater and far from human development, besides Iceland, which sits directly over the mid-Atlantic Ridge.



Earthquakes of Magnitude >=5 from 1900, post-processed from USGS

However, it is important to highlight that devastating earthquakes can occur also along faults outside from these main zones. Although less frequent, these earthquakes can be just as destructive as those along the belt zones. Some examples include the New Madrid seismic sequence (1811-1812) and Missouri in the US.

4 - PARAMETRIC INSURANCE AS A VIABLE SOLUTION

The challenge we see today with indemnity-based insurance is accurately estimating the value of exposed assets at risk, as well as the possibility of non-damage business interruptions (NDBI). Most of the coverage from the traditional market covers property damage, like the collapse of an infrastructure, whereas intangible losses, such as a lack of attraction or a halt in business operations, could also result from an earthquake event and not be adequately covered.

Despite the ever-present risk of earthquakes and secondary crises in many regions, opportunities are emerging for businesses and public entities to build resilience against natural perils through the growth of alternative risk transfer solutions, such as parametric insurance. Unlike traditional insurance, which often entails a lengthy loss assessment process, parametric insurance pays out once a catastrophic event occurs and is designed to cover the full financial impact of an earthquake, including NDBI.

Parametric Earthquake Products: Magnitude vs. Intensity

Parametric earthquake products can be divided into two main types: Magnitude-based and Intensity-based. Magnitude-based products provide payouts when the earthquake's Magnitude reaches a predefined value, while Intensity-based products provide payouts when the Ground Motion Intensity Measure reaches a predefined threshold.

The choice of which product type to go with depends on the specificities of each case, such as the nature of the cover (property damage, business interruption, etc.), what assets, the areas covered, etc. While both products are commonly used and valuable, Intensity-based ones tend to be more granular, reflecting ground shaking and damage distribution.

CASE STUDIES

A Demolished Building after the 2023 Turkey Earthquake

1 Reinforcing Insurance Capacity After the 2023 Turkey Earthquake

Situated on the Anatolian transform fault system, Turkey is one of the most earthquake-prone countries in the world. On February 6, 2023, a Magnitude 7.8 earthquake struck, with a maximum Peak Ground Acceleration (PGA) of 105.7% g according to USGS, causing widespread destruction across the south-central region. The Magnitude 7.8 mainshock was followed by a Magnitude 7.5 earthquake after a few hours.

This catastrophic event served as a harsh reality for a corporate company, exposing the inadequacy of their existing earthquake insurance limit in one of the world's most seismically active and high-risk areas. The significant losses sustained had underscored the critical need for more comprehensive coverage to protect against such extreme natural disasters.

The company searched for additional international capacity, where they opted to go for a parametric cover due to the increased rates that international insurers were charging following the 2023 event. Descartes' parametric insurance met their needs.

Read more

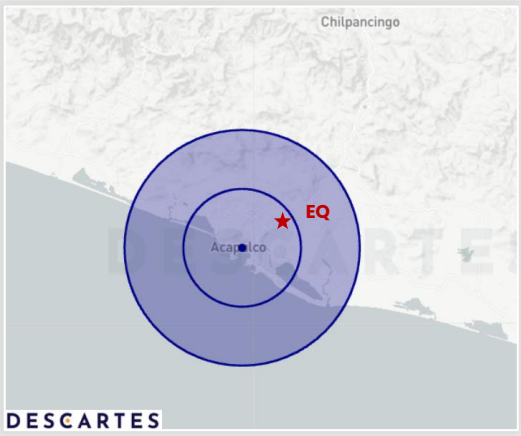
2 - Supporting Financial Recovery After an Earthquake in Mexico

On September 7th, 2021, a Magnitude 7 earthquake struck the city of Acapulco, Mexico, causing thousands of reports of property damage and left millions without power, leading to a halt in operations for many companies within the area.

A resort in the region experienced significant property damage, business interruptions (operational delays, loss of attraction, etc.) and other non-damage financial impacts from the earthquake. After this event, the company realized that their traditional insurance cover did not provide adequate capacity to guarantee a complete, swift recovery.

To avoid this issue in the future, the hospitality company could opt for Descartes' Cat-in-a-Circle cover, giving them confidence that they would receive a quick payout after an earthquake event, accounting for any tangible or intangible losses that might occur.

Read more



2021 Acapulco Earthquake (M7)

Empowering Resilience Through Parametric Insurance

Thanks to parametric solutions, companies and public entities can achieve financial security when exposed to earthquake risks. Being data-driven, parametric insurance offers transparency and ensures quick indemnification in the aftermath of natural catastrophes.

INTERESTED IN KNOWING MORE?

Please reach out to our Commercial Team!

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