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Social Science Perspectives on Natural Hazards Risk and Uncertainty

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Abstract: The human components of risk are at the heart of the most important difficulties for analyzing the uncertainties present in the context of natural catastrophes. Volcanoes, earthquakes, landslides, and other natural disasters are regarded as natural events. Based on prior experience these events are considered as risks as a further conceptual step that entails temporal awareness of hazards. Risks and the uncertainties surrounding their prediction arise as a result of the complex spatial and temporal interrelationships between natural and social environments and uunderstanding the complexities of these natural and social world interrelationships is the need of the hour. Risks have adverse effects on humans as well as nature. Natural disasters become dangerous as a result of how they are viewed as a problem within the system. In many human scenarios, such as air travel or local settlement, a volcano on Earth is dangerous and poses a risk in a variety of ways. The way that modern societies negotiate and think about risk is broadly acknowledged within contemporary social research.

Keywords: human components, natural hazards, risk, natural disaster, and environments.

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1. Introduction

The article provides us with information regarding the risk assessment as well as uncertainty present in natural environmental hazards. In the study, the comparison has been made to argue the quantification of the risk present in the natural hazards and also helps to identify mitigation strategies. The 'post-normal science periods' that includes uncertain values in disputes, and urgent decisions which has a defensible framework that acts as a tool for making any decision. Natural hazards, including environmental systems are complex in which they are embedded, with many interactions and non-linearity. There is limited information present regarding the nature and ability of the natural hazards (Sword et al. 2018). The effects of the natural hazard should be managed through analyzing the impact on the things. A level of techniques and framework is required for the risk assessment methods for analyzing the natural hazard.

Hazard experts have done the majority of risk assessments and uncertainty evaluations in natural disasters. Experts who acknowledge the complete spectrum of risks have concentrated on the more effective uncertain sources. It should not be suggested that a formal statistical approach can address all forms of natural hazards uncertainty. In the present time, vulnerability to natural hazards is increasing (Brown 2020).

Data on natural disaster loss estimates show an upward trend in catastrophe losses. According to a World Bank evaluation of disaster impacts on the environment, absolute losses are rising in lockstep with global GDP growth. Rapid increment in the population of the urban areas, high vulnerabilities present in the society, innovation in the technology development in the coastal areas and changes in the natural environment are some of the factors which have contributed to these trends. Vulnerability increases in the natural hazards due to the climate changes that increased the sea-level and increased the uncertainty about the frequency of natural disasters in future.

The growth of coastal regions have been taken as an example. On August 29, 2005 Gulf Coast was slammed by Hurricane Katrina that wreaked havoc in New Orleans. It is considered as third most intense hurricane and causing financial damages of about US$72 billion. Japan's eastern region Tsunami and Great Earthquake on March 11, 2018, a magnitude 8.0 earthquake struck in the western Pacific's international seas (Thomas et al. 2019). The earthquake itself caused minimal damage, but minutes later, a powerful and deadly tsunami struck Honshu's eastern shore, killing thousands of people. 13,392 people were killed and 15,133 people went missing in Japan as of April 13, 2018 (Japan National Police Agency, 2017). From the analysis it has been cleared that US faced direct losses of about US$170-180 million. One of the most vulnerable countries to the natural disaster is Japan exposed to major risk of tsunami, earthquakes, typhoons as well as rise in the sea level. Snowball effect during the crisis is considered as cascading wreaking havoc on the environment and producing big, often unanticipated disasters. This occurrence has global ramifications and raised numerous fundamental questions about the adequacy and transparency of technology risk assessments, particularly in the case of major natural disasters (Hess and Sovacool 2020). In high-income countries, the danger of economic losses from natural disasters has increased dramatically.

2. Significance/Purpose of the study

The significance of the study is to understand the increasing vulnerabilities in the environment and the study also signifies the mitigation strategy to reduce those risks present in nature. The way the modern societies negotiate and think about risk is broadly acknowledged within contemporary social research. The significance of the study is to find the actual environmental problems and also to find the solutions (Jorgenson et al. 2019). Quiescence, event itself, imminent threat, and the recovery stage back are the four stages in the natural hazards event which is used as a roller of the natural hazard.

Timescales of these hazards vary between them and different challenges are present in each stage of the natural hazard. In all the natural hazards the risk assessment is considered a primary challenge and it is important to mitigate them. Quiescence is considered as a long interlude that allows the hazard scientist to mitigate those hazards and improve the society's resilience, actions, and planning (Aerts et al. 2018). Concerns regarding the vulnerable infrastructure, such as a railway line, nuclear reactor residences, often drive such evaluations, which are sometimes codified in regulatory laws (Bulmer 2021).

Changes in legislation, law, mitigation measures, or emergency response plans, such as evacuations, could result from the review. The core contribution of natural and environmental hazards is to analyze a disaster's possible footprint in time. The second method expands on the first by considering a wide variety of potentially dangerous events and their occurrence probability. Danger maps are created by combining these probabilities with the footprint for each incident, which represents the inherent uncertainty of the hazard.
An exceedance probability (EP) curve can be used to illustrate the overall loss in a region where loss can be quantified (Sharma et al. 2020). In this period the loss can be expressed in the form of a risk map, which depicts the possibility of loss above a given threshold. Scientific modeling integrates observations, physical Sprinciples, and expert judgments in each of these approaches.

3. Objective of the study

Objectives of the study are given as below: -

- To identify the environment-related issues that increase the risk and uncertainty of the natural hazards.
- To find the mitigate strategy to reduce the natural hazards
- To understand the various approaches that help to unfold the actual environmental problems
- To find the factors responsible for increasing environmental related issues in the present

4.Methodology

Systematic analysis of the newspaper has been used to collect the record of the damage caused due to the hazards. Various criteria have been used to access the hazards and based on the damage severity the events have been classified. The comparison between the hazards have been done based on the time of climate change in the area.

Natural dangers, on the other hand, make such modeling extremely difficult by their very nature. Rare occurrences, for example, are difficult to analyze timing, as a function of location, intensity as well as magnitude since they cannot be witnessed repeatedly. Far probabilities can be analyzed from smaller-scale occurrences and events occurring at different locations by determining the expert judgement (Oh and Lee, 2020). Except for earthquakes, in most cases natural disasters have a time during which the threat becomes imminent. A big hurricane, heavy rain anticipation leading to a flood threat; the dormant volcanic erupts; rrecent weather conditions becoming favorable for avalanches, forest fires, and landslides are some examples. Based on current instruments, a probabilistic network, or a decision tree, a pre-existing framework, such as an early warning system could be used. It could also entail in-field scientists making the best decision possible based on all available facts, much of which will be qualitative or poorly measured (Herman et al., 2020).

Risk manager at this point may be planning to activate the emergency services, cancel leave, clear arterial highways, and perform evacuations. Both between scientists and risk managers, as well as between risk managers and the general public, effective communication of uncertainty is critical. Because the situation is likely to change quickly, communication must be chosen and focused, such as using visualizations. Updated hazard and risk maps are one option, but because maps are not always well-understood, less formal procedures may be used. The problem of false alarms is a common occurrence. The hazard event may not occur at all, or it may occur at a much lower or higher intensity than predicted. These results may be regarded as scientific "failures" in the public consciousness, which could jeopardize future response credibility and efficacy. As a result, expressing the ambiguity of the impending threat is critical, but also difficult. Another event that plays a critical role in the risk manager's interpretation of the information is the event itself (Ribeiro and Goncalves, 2019).

Time histories of most of the natural phenomena are complicateded: rise and fall of floods, increment in the level of volcanic activity and after intense eruptions movement in the apparent quiescence. The most important occasion is secondary risks, such as landslides and flooding in the aftermath of a storm, or a huge earthquake, landslides, tsunamis, and fires. At this stage, the quality of data varies greatly. Long-duration dangers, such as wildfires, present a comparable problem. However, because real-time information is of varying quality in most rapid-onset and short-duration situations, professional analysis and communication are required. In cases when numerical calculations must be quick and adaptable, quantifying uncertainty is the true challenge (Matin et al., 2018). Documenting the occurrence is crucial for research purposes (Srivastava & Bagga, 2014; Vishnoi & Bagga, T., 2020).). Although such research will not necessarily aid in the resolution of the problem, it will be extremely useful in improving our understanding of natural hazards and risk management. Lack of reliable event data makes it difficult to create and verify physical and statistical models, which is a recurring problem in analyzing natural hazards. The case history documentation must cover not just the events themselves, but also the inferences and judgments that followed. There may be a time of uncertainty as to whether the event is truly over.

Physical models are frequently supplanted with explicitly phenomenological models due to the difficulty of modeling the system. Rather than arising as a result of underlying concepts, these are intended to directly reflect observed regularities. As a result, empirical distance/magnitude relationships are routinely used to estimate earthquake footprints. Natural disasters face a common problem that is model limits, that deals almost solely with complex systems. Investing in model improvement is one solution. More processes are typically introduced, or a better resolution solver is implemented. Of course, this doesn't measure uncertainty, and it's unclear whether it even lessens it. More science and modeling frequently raise total uncertainty, according to experience (Hemingway and Gunawan, 2018). More unknown components may be included in complex models however the outcome in the end is more realistic. A related and neglected solution is to assess the epistemic uncertainty caused by model restrictions for existing models. There are three types of uncertainty, input uncertainty; parametric uncertainty, which originates from a lack of knowledge on how to set the model's parameters correctly. which arises from a lack of knowledge about how to set the model's parameters properly. These three elements together form a probabilistic description of the model's informativeness for the underlying system. Independent and partly uniform distributions for each parameter are used to express parametric uncertainty (Demiroz and Haase, 2019). This rarely corresponds to well-informed judgments, which would suggest that the central values of each parameter are more likely than the extreme extremes. One rationale is that uniform distribution is widely misinterpreted. Instead of using the word "weather," we'll use "mean climate. Natural variability (in chaotic models) or measurement error are frequently neglected or rolled into structural uncertainty. Many model assessments, as well as stochastic model replications, are usually required to quantify the epistemic uncertainty caused by model restrictions. As a result, model upgrades are direct competition for extra resources (e.g. computational resources). Natural hazards models are typically smaller than climate models. The adjustment of model parameters to observations is hampered by naive treatments of parametric and input uncertainty, as well as the omission of structural uncertainty. Erroneous forecasts and evaluations, which can have serious consequences can be led through overconfidence for decision-making (which is often driven by the length of the right-hand tail of the loss distribution). Efficiency of model criticism is also reduced through it, which requires a shared understanding of both the model and the system. Demonstrating the environmental models is out current failures which are considered as risk management tools in devaluing scientific contribution, climate science as well as making interest groups as easy targets.

In the field of environmental research modeling failures in certain areas are indicative of a larger inability to make predictions about system behavior. No exact basis for such a harsh conclusion, but it does highlight the urgent need to think more extensively about model constraints, how they can be quantified, and how model-based findings are reported (Palm et al. 2019). Which stakeholder the risk manager represents will determine the size of the loss. This correlation from event to loss is quite simple for various hazard and stakeholder combinations.

Many elements must be taken into consideration, including the city's population changing disposition during the day. The risk manager must next pick between actions based on the information in the risk assessments once the science gap has been resolved. Assumption have been made regarding the action that should be carried out to the end. This is a fictitious assumption we make to emphasize how difficult it is to choose an action without considering the question of completion (White 2019). Decision theory provides a framework for examining how decisions are influenced by judgments, such as judgments about the quantifiable uncertainty used to calculate risks. Decision theory provides a framework for understanding how judgments, such as judgments about the measurable uncertainty used to quantify risks, influence decisions (Daniel and Daniel 2018).

5. Data analysis

Table 1: Rail analysis in natural hazards

Rank	Risk name	Risk factor	Losses	Year
1	Earthquake (Galveston)	3	8000	2005
2	Tsunami (Lake Okeechobee)	4	1834	2009
3	Volacano (Hurricane Katrina)	4	1500	2006
4	Earthquake (Florida Keys)	5	5678	2007

(Source: created by author)

Table 2: Generalized SHELDUS hazard types

SHELDON hazard types	Generalized category
Flooding	Flooding
Earthquake	Geophysical
Heat	
Fog	Severe weather
Tomado	Tomado
Wildfire	Wildfire
Winter Weather	Winter Weather
Hall	

(Source: created by author)

8. Results of the data tables

Comparison of various approaches for different hazard types

Dynamics of risk elements

Table 1 shows the impact of natural hazards on the environment. From the table 1 it has been clear that in the year 2005, 2009, 2006 and 2007 hazard led to the death of the various people.

The study focused on natural hazard risk assessments research that only looked at the hazard was not included.d. Except for two research, all of them provide clear representations of hazard severity and/or likelihood, as well as exposure. The population living within a given radius of earth are considered in the study. Freire et al. (2019). Approximately two-thirds of the papers analyzed feature an explicit depiction of vulnerability (Williams et al. 2018). There is no noticeable variation in the proportion of studies that consider susceptibility across the major threats as we approach closer to the most recent publications. Due to the difficulties of large-scale modelling, there are currently no global-scale risk models for pluvial floods and SCS. None of the evaluated studies contain future forecasts for geological hazards, while almost two-thirds of the studies for hydrological, climatological, and meteorological risks such as projections as risk factors. The difference between hydro logical, climatological, and meteorological hazards studies and geological hazards studies in projections could be due to the former group's climate-change-related focus (Ruangpan et al. 2020). This sets the stage for doing upcoming hazard estimates to assess the impact of change on the climate and risk.

Resolution and data type

General trends toward higher-resolution risk evaluations have been shown in table 1. Various risks have developed to resolutions of 29″ or 2 km, and in some cases as high as 80 m per point value. Differences between the hazards can be observed by us Schildberg 2018). The majority of early coastal flood risk estimates employed coastal segments from the DIVA database, however current research has moved to 29″ or 2 km. Drought resolution is typically substantially lower, ranging between 0.5 and 1.8. In the present time volcano risk studies have looked at danger on a raster grid rather than at the level of individual volcanoes. Several earthquake investigations have recently been conducted. The risk analysis is completed in the as the hazard and exposure datasets are used as input are completed. When this isn't the case, the trend is to resample the lower-resolution datasets to the higher resolution, or vice versa (Woodhead et al. 2018). The risk analysis is usually resolved after exposure of hazard and dataset.. As a result, same general patterns as the above-mentioned risk computations are followed by the resolution of the input hazard and exposure databases. Grid datasets of population and GDP are the most widely utilized to depict exposure. Land use data is used to measure direct economic damage (based on building typologies) have become more popular in recent earthquake and tsunami research. Because agricultural influences on drought are so important, datasets like gridded agricultural areas are used to represent exposure. Vulnerability is represented using a wide range of methods and datasets (Di et al. 2019). The use of intensity–damage functions is the most prevalent strategy among flood experts (IDFs). The IDF is a depth–damage function when it comes to floods. For instance, earthquake and tsunami disasters, building stock data based on building typologies are used.

Risk Indicators

The number of impacted people is the most widely utilized risk indicator, appearing in 59 percent of the research reviewed. Many studies employ some indicators of direct economic loss (42%) as well as fatalities (24%) and damaged GDP (28%) as well. Flood and drought risk studies have measured fatalities significantly less frequently than other hazards studies, opening up the opportunity of cross-hazard information exchange on fatality assessment methodologies (Clark and Winegard 2020).

Future DRR measures

Few studies have referenced future DRR activities specifically, and they are all concerning Global-scale assessments in coastal flooding, flooding have been upcoming-thinking from the outset, because they were intended to facilitate climate changes strategy. As a result, a wider range of DRR measurements have been included that are structural and natural based with recent river flood studies that explicitly incorporated DRR criteria (Lunn et al. 2020). The costs of DRR strategies have been analysed through coastal or river flood risk. As a result, they include a wider range of DRR measurements (both structural and natural-based) are included than recent river flood studies that explicitly incorporated DRR criteria (Lunn et al. 2020).

Types of analysis

Table 1 demonstrates how research is classified as probabilistic (P) and non-probabilistic (NP) with probabilistic studies that analyze annual impacts. In recent years, there has been a shift towards more probabilistic research in flood and earthquake investigations, and the two tsunami studies evaluated take probabilistic methodology as well. Both methodologies are utilized in the case of wildfires and TCs, but there are too few studies to identify any particular shift in focus over time. In most of the hazards, stochastic modeling is used. Throughout the last decade global natural hazard risk have been developed (Eggers 2020). Natural hazard threats on a continental or regional scale are done through the additional opportunities for

learning the tools and approaches. We found potential solutions to several of the major issues in the environment. Due to space constraints, this is not intended to be an exhaustive list, but rather to encourage more discussion about information sharing among scientists working on a variety of hazards and risks at various spatial scales (Shah et al. 2018). For global risk modelers is the dearth of high-quality impact data for model validation. Hazard modeling must continue to develop, both in terms of accurately representing processes and increasing resolution. This is aided by higher-precision input datasets with improved resolution, which is considered as common topics in hazard studies. A global volcanic hazard assessment (9 km) that takes into consideration ash fall affected by local wind conditions has been presented.
In India Earthquake is considered a less frequent destructive event. Strong earthquakes have a magnitude larger than 6, while significant earthquakes have a magnitude greater than 7.0, both of which are regarded as major earthquakes with the potential for considerable damage (Tiernan et al. 2019).

9. Graphical Representation

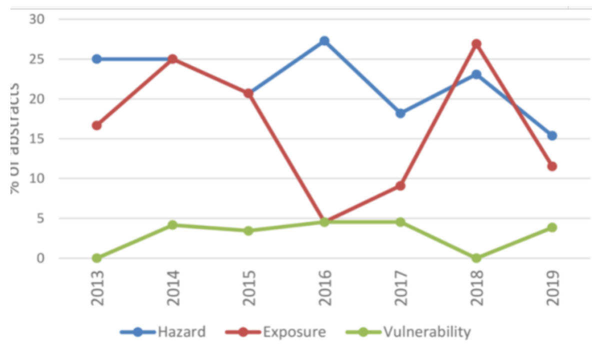

Figure 1: The percentage of accepted abstracts that were presented at the EGU session. (Source: created by author)

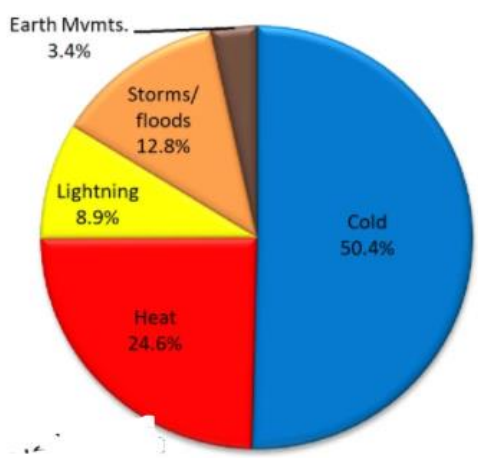

Figure 2; Natural Hazard death by event type
(Source: created by author)

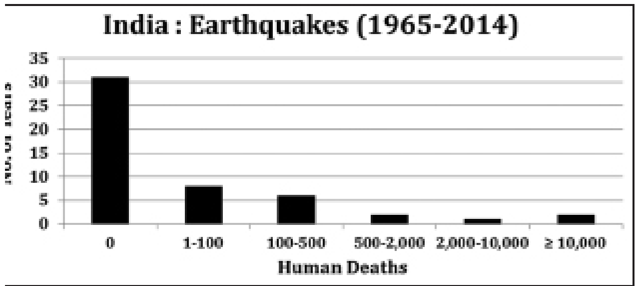

Figure 3: Human casualty during the distribution of earthquakes
(Source: created by the author

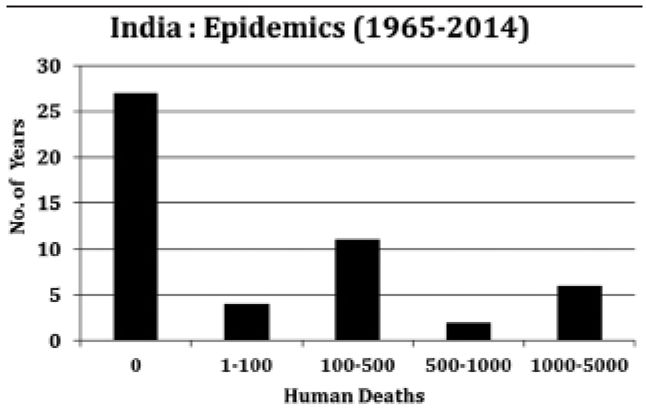

Figure 4: Human casualty distribution by ep[idemics

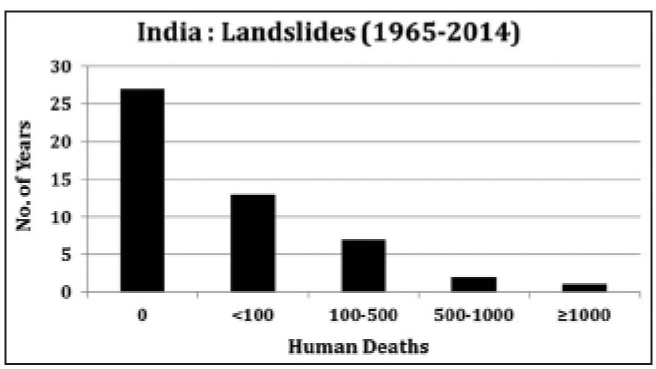

Figure 5: Human casualty distribution of landslides
(Source: created by author)

10. Discussion

All of these are speculative matters, and the in-field research access the probabilities of getting evidences in hand. After the completion of event, scientists can chronicle the event's impact and improve understanding during the initial recovery period. Given the complexity and rarity of large-scale hazardous occurrences, the importance of conducting a forensic post-event inquiry cannot be overstated. (Zhan et al. 2022). Concerns about 'who is to blame' can stifle post-event analysis, preventing emergency actors from being entirely honest. The healing stage will pass, giving place to the first stage of "going about your business," and the abilities learnt can be used to future resilience. Natural disaster science relies heavily on models. The inherent uncertainty of the hazard is described using statistical models. Statistical models map out the hazard footprint that are developed by using the physical theories ; they are also used to quantify loss in specific areas, such as structural damage assessment. To describe the public's views of risk and uncertainty, more broad qualitative models are used. To show how people will react if they see evidence of a natural disaster approaching or already occurred (Asgary et al. 2020). For the sake of simplicity, we'll concentrate on physical modeling of the hazard footprint (the spatial and temporal consequences of a hazard event. Hydraulic models for flooding, weather models for hydro meteorological hazards, and plume models for volcanic ash deposition are present in the physical models.

Various models for volcanic pyroclastic flows and lahars are present for snow avalanches and landslides, and elastic wave models for earthquakes. The model only captures a portion of the underlying system's complexity, and additional simplifications may be necessary for tractability or computing constraints. waves or fluids (often in many stages) causes various dangers that travel through the hydrosphere, Physical theories are used to develop through and lithosphere. Furthermore, the surroundings are frequently characterized by complicated topographies and micro-scale fluctuations that are difficult to predict. Even the most advanced risks models, with empirically proven parameterizations of the missing physics. There are problems in terms of structural simplifications and series expansion truncation. Understanding a natural hazard process is complex where the physics is well understood

11. Conclusion

Although natural catastrophes are by definition harmful to humans, they frequently provide significant environmental advantages. The method has been refined for the entire United States, and it has been used to assess current and future flood risk on a continental scale in the United States. Simulation of water levels for coastal flooding is done through hydrodynamic modes GTSM. . The impacts of water-level attenuation owing to varying land cover on flood hazard is quantify through different approach, the relevance of accounting for hydrodynamic processes. This method can be utilized as a first step in bettering the global evaluation of coastal flood risk. While big disasters may have a wide global scope, hazard hot spots may be considerably more localized. Improvements in flood hydrodynamic modeling are one path to better global hazard modeling for water-related hazards Hydrodynamic on a European scale, the LI FLOOD-FP model was used to evaluate the coastal flood danger, and it was also used to assess coastal flood hazard. Tsunami events are also modeled using hydrodynamic inundation modeling. The upgrading of worldwide exposure databases is a never-ending process. Investment data has been used to generate global capital databases, which are now widely used in earthquake worldwide. In most situations, this data might be extended to other dangerous kinds through communication and collaboration within hazard communities, assuming they were available.

12. Recommendations

Vulnerability and the likelihood of unforeseen disasters. increased due to rapid increment in the population as well as urbanization. While the absolute economic losses associated with such events may be lower, development in low-income countries are far greater. Lost livelihoods, trauma, as well as political stability, there are also less quantifiable but equally substantial repercussions on those affected by catastrophes.

The tsunami that accompanied the mega thrust rupture killed an estimated 280 000 people in Indian Ocean countries, with the majority of deaths happening near the breach. The magnitude of an earthquake is extremely rare and difficult to forecast. If the 2018 the Philippines or Indonesia were stuck by the earthquake and tsunami, for example, the death toll would have been substantially greater.

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