



Article

Analyzing Public Interest in Geohazards Using Google Trends Data

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Abstract: This study investigates public interest in geological disasters by analyzing Google Trends data from 2023. This research focuses on earthquakes, hurricanes, floods, tornadoes, and tsunamis to understand how search behaviors reflect public awareness and concern. This study identifies temporal and geographical patterns in search trends. Key findings reveal that public interest spikes during significant disaster events, such as the February 2023 earthquake in Turkey and Syria and the August 2023 hurricanes in the United States. This study highlights the importance of timely and accurate information dissemination for disaster preparedness and response. Google Trends proves to be a valuable tool for monitoring public interest, offering real-time insights that can enhance disaster management strategies and improve community resilience. This study's insights are essential for policymakers, disaster management agencies, and educational efforts aimed at mitigating the impacts of natural disasters.

Keywords: geohazards; public interest; Google Trends; earthquakes; hurricanes; floods; tornadoes; tsunamis; disaster preparedness; real-time data analysis

1. Introduction

Natural disasters have always captivated human interest and concern, given their profound and often devastating impacts on communities, infrastructure, and ecosystems. These events pose significant threats and challenge societies worldwide. The importance of understanding public interest in these phenomena cannot be overstated, as it plays a crucial role in enhancing disaster preparedness, response strategies, and public education campaigns.

In the digital age, the advent of the Internet and sophisticated data analysis tools has revolutionized our ability to monitor and interpret public interest. Among these tools, Google Trends stands out as a powerful resource for examining the frequency and nature of online searches related to various topics [1], including natural disasters [2]. Google Trends is a free online tool provided by Google that analyzes the popularity of top search queries in Google Search across various regions and languages. It allows users to see how often specific keywords, subjects, and phrases have been queried over a specific period of time. The data are presented on a normalized scale from 0 to 100, where 100 represents the peak popularity of a term. Because the data are normalized relative to the total search volume in each region, population size does not disproportionately affect the results; it reflects the relative interest within each region regardless of its size. By leveraging anonymized and aggregated search data, Google Trends offers insights into the collective interests and concerns of the public. Researchers use this tool to identify trends, compare the relative search volume of different terms, and examine how search interest evolves over time and geography. This makes it a valuable resource for understanding public behavior, forecasting market trends, and conducting social science research.

Understanding public interest in natural disasters is essential for several reasons. Firstly, it provides insights into the level of awareness and concern among the population,



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which is crucial for effective communication and education efforts [3,4]. High search volumes for disaster-related terms can indicate heightened public interest and the need for timely and accurate information.

Secondly, analyzing search trends can help identify geographical regions with increased vulnerability or recent impact [5,6]. For example, a surge in searches related to earthquakes in a specific area may reflect recent seismic activity or public anxiety about potential future events. This information is invaluable for directing resources and support to areas most in need.

Thirdly, public interest trends reveal the temporal dynamics of concern [7,8]. Natural disasters often have immediate and long-term effects, and search behavior can reflect both the initial response and ongoing recovery efforts. For instance, searches for “earthquake safety” might peak immediately following a major earthquake, while searches for “earthquake recovery” might remain high for months as affected communities rebuild.

The primary objective of this study is to analyze public interest in natural disasters using Google Trends data from 2023. By examining the search behavior related to earthquakes, hurricanes, floods, tornadoes, and tsunamis, this study aims to identify patterns and trends in public interest across different regions and time periods. The primary focus of this study was on geohazards that tend to have widespread, global impacts. These geohazards often lead to sudden and significant spikes in public interest due to their large-scale devastation and broad media coverage. The insights of this study can inform disaster preparedness and response strategies, improve public education efforts, and ultimately contribute to mitigating the impacts of natural disasters.

This study is structured as follows. Section 1 introduces the study and outlines its objectives and significance. Section 2 provides a literature review of the previous research on the use of Google Trends for monitoring public interest in various phenomena, particularly natural disasters. Section 3 describes the methods employed in the study. Section 4 presents the results of the study and highlights key findings related to public interest spikes during significant disaster events and variations in search behavior across different regions. Section 5 discusses the implications of the findings for policy and practice as well as the limitations of the study. Finally, Section 6 concludes the study.

2. Literature Review

The use of Google Trends data for analyzing public interest and behavior has gained traction in various fields. Google Trends provides a measure of the relative popularity of search queries over time and across geographic locations. Several studies have leveraged this tool to monitor public interest in disasters, public health issues, and other phenomena.

For instance, Ref. [2] analyzed global search interest for earthquakes on Google and found a spike in interest after destructive earthquakes that decayed exponentially, with the duration of increased interest correlating with death toll and damages but not earthquake magnitude or population exposure, highlighting the need for prompt science communication and disaster-relief efforts. Ref. [9] used Google Trends to monitor and model the dynamics of drought awareness in California and could identify potential triggers for peaks in public interest and fit a power-law decay model to describe the decay patterns of this awareness. Ref. [10] investigated public interest in hurricane information and examined spatial and temporal variations in search behavior and the impact of hurricane forecasts on information-seeking behavior during the 2008 hurricane season in Florida, Louisiana, and Texas.

Comparative studies have also been conducted to assess the effectiveness of Google Trends against other data sources. Ref. [11] compared Twitter and Google Trends by analyzing how COVID-19-related information and misinformation spread on Twitter versus the search behaviors and patterns observed through Google Trends. They found that, while Twitter is a major source of real-time information, it also facilitates the rapid spread of misinformation, whereas Google Trends data provided insights into public interest and awareness levels, which showed a strong negative correlation with the number of COVID-

19 cases. The comparison between Twitter and Google Trends [12] highlights that Twitter sentiment responses to lockdowns show significant socioeconomic segregation, with more negative sentiments observed among the wealthiest cohorts, while Google Trends data indicate an increase in search intensity related to the pandemic when more people are under lockdown, but without any clear socioeconomic distinctions.

Google Trends data have also been used for predictions [13,14]. This could be applicable to disaster studies as well, where early signals can aid in preparedness.

Despite these advancements, there are several gaps in the literature that this study addresses. First, there is limited research that systematically analyzes multiple types of natural disasters using Google Trends. Most studies focus on a single event or type of disaster. This study fills this gap by comparing public interest across five geohazards, including earthquakes, hurricanes, floods, tornadoes, and tsunamis.

Second, while existing research has highlighted the potential of Google Trends for monitoring public interest, few studies have integrated this data with practical applications for disaster management. This study not only analyzes search data but also discusses how these insights can be applied to improve disaster preparedness and response strategies.

3. Data and Methods

The methodology is structured into three key components: data collection, data preprocessing, and data analysis, each designed to ensure the accuracy, relevance, and comprehensiveness of the findings.

Google Trends was selected as the data source for this study due to its ability to reflect real-time public interest by capturing search volume data. Google Trends provides a score for each search term, which ranges from 0 to 100, where 0 represents no interest, and 100 signifies peak popularity for a given term. This normalized score allows for the comparison of relative search interest across different regions and time periods and offers valuable insights into public engagement and concern about natural disasters.

For this study, data were collected over the course of the year 2023, focusing on five major types of geohazards: earthquakes, hurricanes, floods, tornadoes, and tsunamis. Weekly data collection was chosen to capture temporal trends in search interest and to detect spikes corresponding to significant disaster events. To ensure comprehensiveness, the keywords selected for this analysis included general terms like “earthquake”, “flood”, “hurricane”, “tsunami”, and “tornado”.

The analysis of the Google Trends data was conducted using both quantitative and qualitative methods. Quantitatively, we tracked trends in search volume over time to identify periods of heightened public interest. This allowed us to correlate spikes in search activity with real-world disaster events. For example, a peak in search queries for “earthquake today” typically indicated recent seismic activity in a specific region. This approach provided immediate insights into public concern and awareness following major geohazards.

Geographically, we analyzed the search volume data to identify regions with high levels of search interest for each type of disaster. This analysis provided valuable insights into areas with increased vulnerability, recent disaster impacts, or regions that were particularly concerned with preparedness efforts. For instance, high search volumes for hurricanes in the Caribbean indicated both a heightened awareness and preparedness within that region, reflecting the geographical risks and recent hurricane events.

Google Trends also provides related topics and queries associated with the search terms, which offer additional insights into public concerns and information-seeking behavior. For each geohazard, we examined these related queries to understand the specific aspects of disaster preparedness and response that attracted public attention. For example, searches related to earthquakes included queries about aftershocks, safety measures, and recovery efforts, reflecting a broad concern for both immediate safety and long-term recovery. This qualitative analysis helped us interpret the broader public concerns associated with each natural disaster. Here, the preprocessing of the data was essential to maintain

clarity and accuracy. Initially, search terms were grouped according to the disaster type they referred to. Keywords and phrases were filtered to remove any irrelevant or ambiguous terms that might skew the results. In cases where search terms could have multiple meanings, we reviewed related queries to ensure the correct context was captured.

The weekly data allowed for a temporal analysis, which revealed how public interest fluctuated over time, particularly in response to specific disaster events. For example, search interest for earthquakes typically spiked immediately following significant seismic events but tapered off as time passed, while interest in hurricanes often persisted over longer periods due to the ongoing nature of hurricane seasons and preparedness efforts.

A comparative analysis was also conducted across the five different disaster types. This analysis highlighted both common and unique patterns in public search behavior. For instance, while earthquakes triggered immediate searches for safety information, hurricanes prompted continuous interest in tracking and preparedness. Such comparisons helped identify the different informational needs and concerns associated with each type of geohazard, which is critical for improving public communication and disaster management strategies.

4. Results

4.1. Earthquakes

From Figure 1, we see that the searches for “earthquake” had three major peaks in 2023. The largest peak with a score of 100 was in the week of 5–11 February when a 7.8 earthquake struck Syria and Turkey. We observed other peaks in the week of 19–25 March, with a score of 38 when a 6.5 earthquake happened in the Badakhshan Province of Afghanistan, and in the week of 31 December–6 January, with a score of 38 when there was a 7.5 earthquake in Suzu (Japan).



Figure 1. “Earthquake” Google Trends global scores in 2023. (In this and the subsequent figures, the vertical axis represents the Google Trends score, while the horizontal axis displays the timeline).

There were varying levels of interest across different countries, reflecting both their geographical context and recent seismic activities (see Figure 2). Countries with the highest interest were Lebanon (100), Jamaica (81), Nepal (75), the Philippines (67), Pakistan (61), New Zealand (61), Albania (60), Cyprus (49), and North Macedonia (39). Other notable countries included Australia (30), the United Arab Emirates (27), Bangladesh (27), India (26), Syria (26), South Africa (26), Ghana (24), Morocco (24), Qatar (23), Singapore (21), the United States (20), Ireland (20), and Myanmar (17).

Related topics and queries point to heightened global awareness and concern about seismic activities driven by recent events and historical precedents. There is a clear demand for information, safety measures, and scientific understanding to better prepare for and mitigate the impacts of these natural disasters.

The clustering of topics around Turkey and the recent earthquake events indicates a significant spike in public interest driven by recent disasters. This is complemented by a notable concern for safety and the dissemination of information, reflecting the need for effective communication during such events.

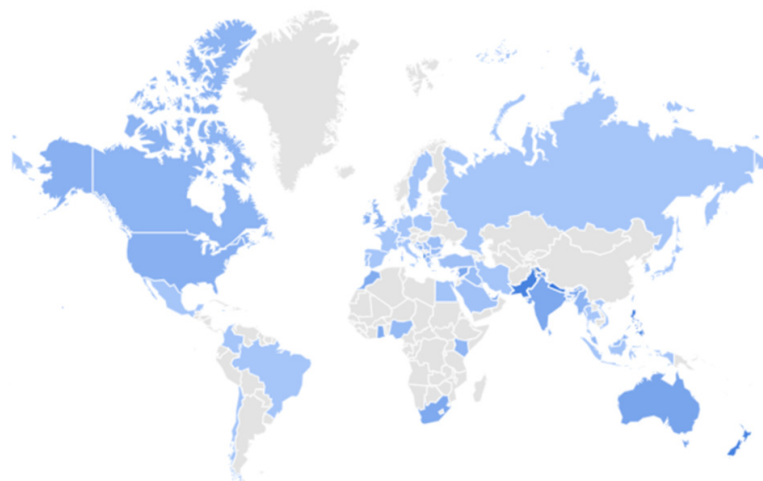


Figure 2. “Earthquake” Google Trends geographical distribution in 2023. (In this and the subsequent figures, the darker blue color indicates a higher Google Trends score).

The global spread of interest, from California and Los Angeles to Nepal and the Philippines, shows a widespread awareness and concern about seismic activity influenced by recent events and historical context. This global perspective is crucial for understanding how different regions prepare for and respond to earthquakes.

The rising trends, particularly in areas like Buffalo, Lebanon, and Marrakesh, suggest that recent seismic activities brought these regions into focus. The significant increase in search interest for terms like “earthquake on the Afghan-Pakistan border in 2022” and the involvement of various regions in the Indian subcontinent highlights a regional concern for earthquake preparedness and response.

Scientific and technical terms such as magnitude, tsunami, and plate tectonics, along with institutions like the US Geological Survey, emphasize the public’s interest in understanding the scientific basis of earthquakes. This knowledge is essential for improving preparedness and response strategies.

4.2. Hurricanes

The highest search interest occurred during the week of August 27–September 2, when the Category 4 Idalia hurricane occurred (see Figure 3). The two lower peaks at 52 and 36, which occurred in the weeks of August 13–19 and August 20–26, were connected with the Category 4 Hilary hurricane. The peak in the week of September 10–16 at 37 was due to the Category 5 Lee hurricane. A smaller peak of 11 in the week of October 22–28 was associated with the Category 5 Otis hurricane.

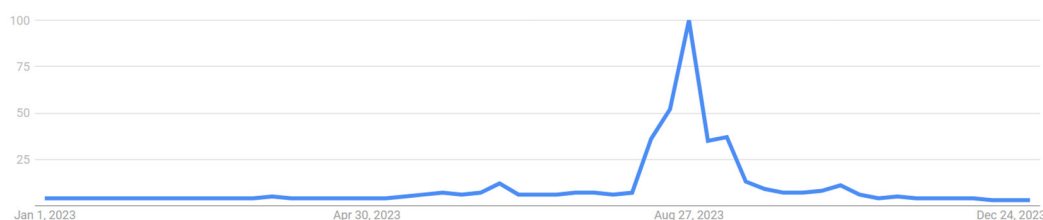


Figure 3. “Hurricane” Google Trends global scores in 2023.

The geographical distribution of searches for “hurricane” reveals significant regional interest concentrated primarily in the Caribbean and adjacent regions (see Figure 4). Countries with the highest interest are Barbados (100), the Bahamas (49), Puerto Rico (34), Jamaica (25), Trinidad and Tobago (25), and the United States (24). Other countries showing notable interest include Canada (11), the Dominican Republic (7), New Zealand (4), Ireland (4), Germany (3), the United Kingdom (3), and Australia (3). Lower interest levels are

seen in Mexico (2), South Africa (2), the Philippines (1), Switzerland (1), the Netherlands (1), Sweden (1), Austria (1), Nigeria (1), and South Korea (1).

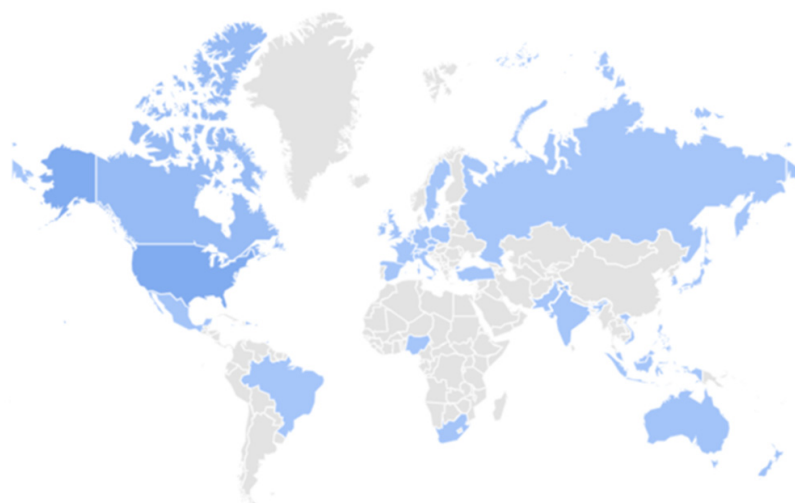


Figure 4. “Hurricane” Google Trends geographical distribution in 2023.

The clustering of topics around tropical cyclones and specific hurricanes indicates a significant public interest in understanding and preparing for these natural phenomena. The focus on the National Hurricane Center and NOAA (National Oceanic and Atmospheric Administration) underscores the importance of reliable information sources during hurricane seasons.

The specific interest in storms like Hurricane Hilary, Tropical Storm Lee, and others highlights the immediate concern driven by recent weather events. The repeated mention of the Atlantic Hurricane Season 2023 indicates a broader concern about that year’s overall hurricane activity, suggesting heightened awareness and preparedness efforts.

Regions like Florida, California, and Southern California show significant interest, reflecting both the historical impact of hurricanes and recent weather anomalies that might have brought these areas into focus. The interest in historical events like the 1858 San Diego hurricane suggests a broader curiosity about unusual weather patterns and historical precedents. The rising trends, including specific storms, indicate how current events can drive public interest and searches. The significant increases in searches for Hurricane Dora, Hurricane Ophelia, and regions like Maui demonstrate how impactful these storms have been in drawing public attention.

4.3. Floods

The largest spike of 100 occurred during the week of 9–15 July due to the July 2023 Northeastern United States floods (see Figure 5). The smaller spike of 51 occurred during the week of 8–14 January due to the California floods.



Figure 5. “Flood” Google Trends global scores in 2023.

The geographical distribution of searches for “flood” in 2023 shows heightened interest in regions frequently affected by floods or with recent significant flooding events (see

Figure 6). Countries with the highest interest include New Zealand (100), Australia (73), the United States (66), the United Kingdom (49), the Philippines and Bangladesh (46), Ireland and Ghana (42), India and Singapore (40), Nigeria, Pakistan (38), Puerto Rico (35), and Canada (33). Malaysia (30), South Africa (29), Nepal (24), Sri Lanka (22), the United Arab Emirates (21), and Kenya (20) also show considerable interest. Lower interest is seen in Hong Kong and South Korea (11), Norway (10), the Netherlands, Greece, Vietnam, Thailand, and Romania (5), Germany, Indonesia, and Turkey (3), France, Spain, Russia, and Colombia (2). The lowest interest is in Argentina, Japan, Brazil, and Iran, all scoring 1.

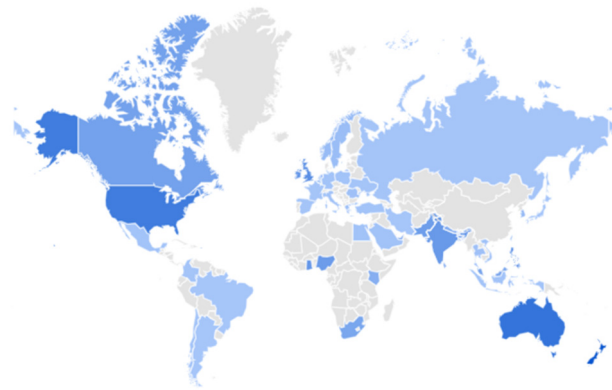


Figure 6. “Flood” Google Trends geographical distribution in 2023.

Related searches and queries point to a well-rounded public interest in understanding flood risks, seeking timely information, and implementing protective measures. This comprehensive awareness is vital for enhancing preparedness, ensuring safety, and mitigating the impacts of floods.

The clustering of topics around flooding highlights a comprehensive public interest in understanding and mitigating the impacts of floods. The significant focus on immediate flood warnings, such as “flood alert”, “flash flood”, and “coastal flood warning”, underscores the public’s need for timely and accurate information to ensure safety during flood events.

Insurance-related topics like “insurance”, “flood insurance”, and “risk” indicate a strong concern for financial protection and risk management in flood-prone areas. This reflects the public’s understanding of the economic impact of floods and the importance of being adequately insured.

Governmental agencies such as the “Federal Emergency Management Agency” and the “Emergency Management Agency” are crucial for public reliance on effective flood management and response. The interest in “flood protection”, “disaster”, “floodplain”, and regional impacts (“county”) highlights the need for comprehensive flood management strategies and localized protective measures.

Geographically, the increased interest in regions like “Delhi”, “Yamuna”, “Vermont”, “Punjab”, “Chennai”, “Auckland”, and “Libya” indicates that significant flooding events in these areas have driven public attention. Historical context, such as the “list of California floods” and “floods in Kerala 2018”, suggests a public desire to learn from past events to better prepare for future floods.

Rising trends, including the dramatic increase in searches for terms like “coastal flooding”, “Libya”, and “Delhi”, reflect the immediate impact of recent flood events on public interest. The sharp increases in searches for “coastal flood advisory”, “coastal flood watch”, and related terms indicate heightened concern for coastal flooding.

4.4. Tornadoes

We see the largest peak with tornadoes of 100 in the week of 26 March–1 April, when the most prolific tornado outbreak of 2023 occurred on 31 March, with more than 160 tornadoes that tore across many southern and central US states (see Figure 7). The

peak of 52 occurred during the week of 26 February–4 March, when five tornadoes were recorded on 27 February 2023 in Ohio, which had held the previous February record for tornadoes since 1950. A peak of 50 was observed the week of 6–12 August, when, during a tornado outbreak sequence, numerous tornadoes struck the Eastern United States, the Plains, and the Midwest. Peaks of 49 occurred in the week of 9–15 July, when tornadoes hit Barrhaven, and the week of 10–16 December, when multiple damaging tornadoes affected Tennessee and other states.



Figure 7. “Tornado” Google Trends global scores in 2023.

The geographical distribution of searches for “tornado” in 2023 shows significant interest in regions frequently affected by tornadoes (see Figure 8). Countries with the highest interest are the United States (100), Argentina (59), Canada (54), Mexico (38), Paraguay (34), New Zealand (32), Brazil (31), Germany (27), Costa Rica (25), and Ireland (25). With the lowest interest are Vietnam, Turkey, Russia, South Korea (4), and Japan (1).

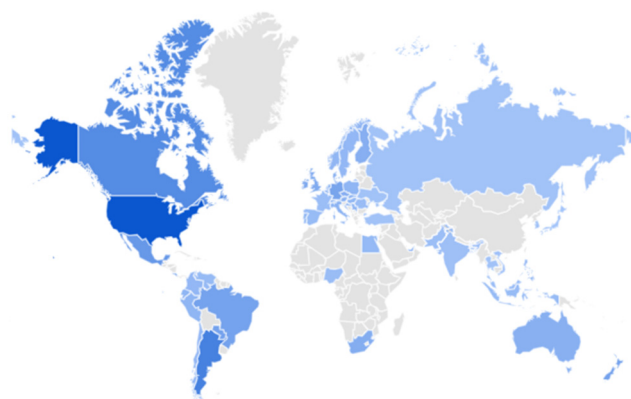


Figure 8. “Tornado” Google Trends geographical distribution in 2023.

Related searches and queries point to a comprehensive public interest in understanding tornadoes, receiving timely warnings, and implementing effective safety measures. This awareness and preparedness are vital for enhancing community resilience and reducing the impacts of tornadoes.

The clustering of topics around tornadoes and related severe weather events indicates a significant public interest in understanding and preparing for these natural disasters. The central focus on the term “tornado” itself highlights the general curiosity and concern about the phenomenon. The high interest in the terms “tornado warning” and “tornado watch” underscores the importance of timely alerts and public readiness to respond to potential tornado threats.

The regional focus on states like Texas, Tennessee, and Mississippi, as well as cities like Nashville and Little Rock, reflects areas frequently affected by tornadoes. This regional interest is crucial for targeted preparedness and response efforts, ensuring that communities in high-risk areas are well-informed and equipped to handle tornado occurrences.

Related severe weather terms like “tropical cyclone”, “storm”, “thunderstorm”, and “wind” show a broader concern for weather patterns that can contribute to or result from tornadoes. Understanding these connections helps in comprehensively preparing for severe weather events and mitigating their impacts.

The interest in safety measures and technology, including “radar” and “siren”, highlights the public’s reliance on technological advancements to detect and warn about tornadoes. This reliance on technology is essential for improving the effectiveness of early warning systems and enhancing public safety during tornado events.

In the rising trends, significant spikes in searches for terms like “Rolling Fork”, “Montebello”, “Perryton”, and “2020 Nashville tornado outbreak” reflect the immediate impact of recent tornado events on public interest. These spikes indicate that specific tornado occurrences drive heightened awareness and search activity, underlining the need for timely information and response during such events.

The notable increase in searches for authoritative sources like the “National Weather Service” emphasizes the public’s reliance on trusted information during severe weather events. This reliance on authoritative sources is crucial for ensuring that the public receives accurate and reliable information to guide their actions during tornado threats.

4.5. Tsunamis

We observed a peak of 100 in the week of 31 December–6 January when a tsunami followed the 7.5 earthquake, causing widespread destruction on the Noto Peninsula (see Figure 9). A smaller peak of 52 can be observed in the week of 5–11 February when a tsunami was generated in the eastern Mediterranean Sea following the 6 February 2023 7.8 earthquake in Syria and Turkey.



Figure 9. “Tsunami” Google Trends global scores in 2023.

The geographical distribution of searches for “tsunami” in 2023 reveals significant interest in regions prone to tsunamis or with notable tsunami events (see Figure 10). Countries with the highest interest are Lebanon (100), Indonesia (90), New Zealand (81), Sri Lanka (79), the Philippines (68), Costa Rica (65), Chile (65), Puerto Rico (57), Australia (55), and Italy (49). Countries with the lowest interest are Pakistan (11), Algeria (10), Greece (10), Japan (6), and South Korea (5).

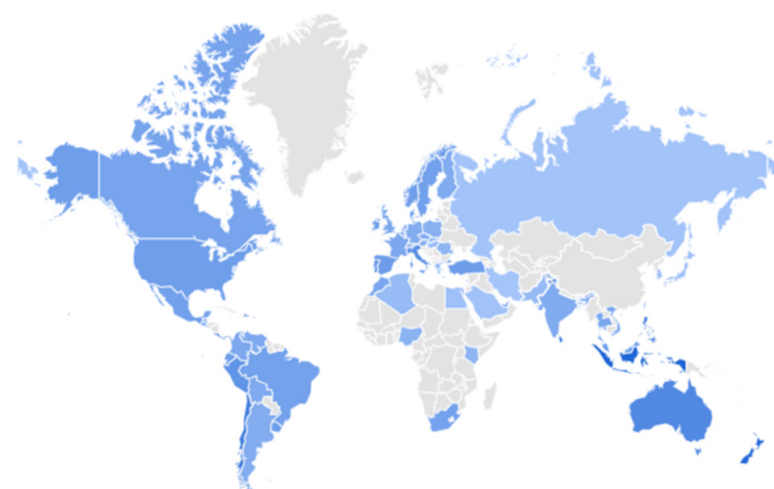


Figure 10. “Tsunami” Google Trends geographical distribution in 2023.

Related topics and queries point to a comprehensive public interest in understanding tsunamis, their causes, and their impacts. This awareness is crucial for enhancing disaster preparedness, improving early warning systems, and fostering resilience in communities vulnerable to these powerful natural disasters.

The clustering of topics around tsunamis highlights a broad public interest in understanding these powerful natural phenomena and their associated risks. The central focus on “tsunami” and the significant interest in “earthquake” underscore the critical relationship between seismic activity and tsunamis, emphasizing the need for comprehensive knowledge of earthquake dynamics.

Historical events such as the “2004 Indian Ocean earthquake and tsunami” and the “2011 Tōhoku earthquake and tsunami” continue to captivate public attention due to their devastating impacts and the lessons learned from these disasters. The specific years, “2004” and “2011”, reflect a targeted interest in these landmark events, indicating their lasting significance in public memory.

The interest in the “Lituya Bay Megatsunami 1958” shows a fascination with extreme and historical natural events, while the “tsunami warning system” reflects the public’s concern for effective early warning mechanisms that can save lives and mitigate damage during tsunami events.

Geographical interest in regions like “Indonesia” and “Alaska” highlights areas affected by tsunamis, indicating a need for regional preparedness and response strategies. The terms “flooding”, “volcanic eruption”, and “volcano” suggest a broader interest in natural disasters related to or triggering tsunamis, underscoring the interconnectedness of different geological events.

Cultural interest is also evident with searches for “The Impossible”, a movie depicting the 2004 tsunami, showing how media and cultural representations influence public interest. The ongoing interest in the “Fukushima nuclear disaster” linked to the 2011 tsunami emphasizes the broader impact of such events beyond immediate physical destruction.

In the rising trends, the significant spike in searches for “Santa Catarina” reflects a recent tsunami in that region, highlighting how current occurrences drive public interest and awareness. The increase in searches for “Alaska” suggests heightened concern due to recent seismic activity, while the “Fukushima nuclear disaster” continues to draw attention due to its long-term implications.

5. Discussion

5.1. Recurring Patterns and Temporal Trends

The temporal spikes in search interest across different natural disasters reveal patterns that correlate strongly with specific events. For instance, earthquakes in Syria and Turkey, hurricanes like Idalia and Hilary, and significant floods in California and the Northeastern United States all drove sharp increases in search activity. This indicates that public interest is highly reactive to significant, impactful events, suggesting that real-time search data can be a valuable tool for understanding and responding to public concerns during crises. Furthermore, the regional analysis across various geohazards provides insights into the specific types of disasters that dominate public interest in different areas, as well as overall trends in public concern (see Figures 11 and 12). For instance, the analysis reveals that earthquakes and hurricanes generated the highest search volumes, indicating a greater level of public engagement and awareness regarding these hazards.

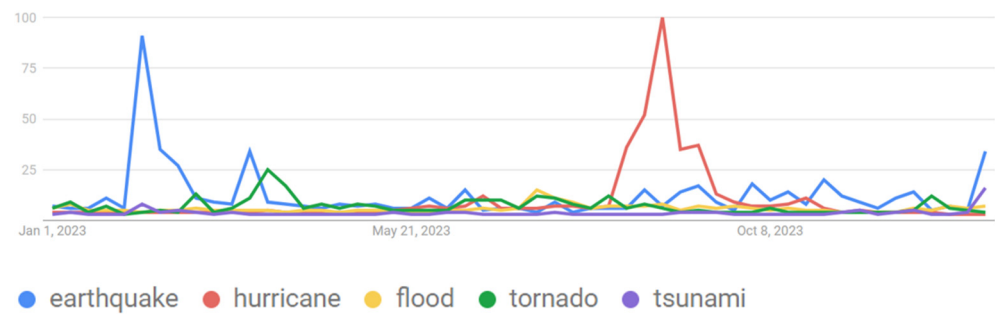


Figure 11. Google Trends global scores in 2023 across various geohazards.

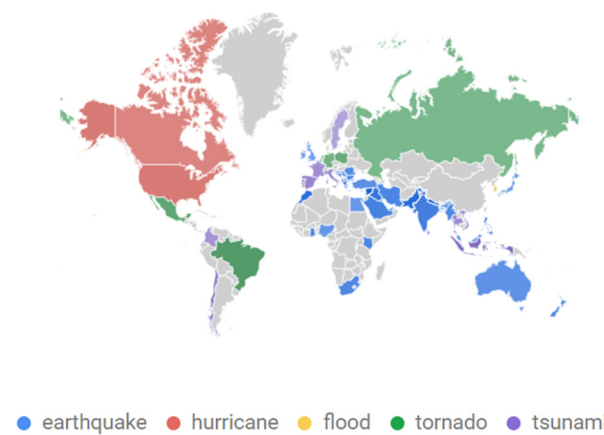


Figure 12. Google Trends geographical distribution in 2023 across various geohazards.

We also find clusters of related topics that show intersections across different disasters and highlight common informational needs and concerns.

Real-time information and alerts: Across all disaster types, there is a strong demand for immediate updates and warnings, as seen in searches for “today earthquake”, “hurricane tracker”, “flood warning”, and “tornado warning”. This underscores the critical importance of timely information in disaster preparedness and response.

Safety and preparedness: Queries related to safety measures, such as “earthquake safety information” and “flood alert”, indicate a universal concern for personal and community safety during natural disasters. This reflects a common need for accessible, actionable information to mitigate risks.

Historical events and learning: Interest in past events, such as the 2004 Indian Ocean tsunami and historical earthquakes in Syria, suggests that significant disasters have a lasting impact on public awareness and educational efforts. These searches highlight the role of historical events in shaping current preparedness and awareness.

Impact and aftermath: Searches related to the human impact, such as “Turkey earthquake death count” and “Libya flood death toll”, emphasize the public’s concern for the humanitarian consequences of natural disasters. This interest in the aftermath highlights the importance of effective communication and support during recovery phases.

5.2. Implications for Policy and Practice

One of the primary applications of Google Trends data is in enhancing early warning systems [15]. This study’s findings indicate that public interest spikes in the immediate aftermath of a disaster. By monitoring search trends in real time, disaster management agencies can gauge public awareness and ensure that warning messages are effectively disseminated. In the event of increased search activity for terms such as “earthquake today” or “tsunami warning” relevant agencies can prioritize and intensify their communication strategies in the impacted regions.

The temporal patterns observed in search trends [16] provide insights into the stages at which the public seeks information. During the onset of a disaster, there is a high demand for immediate updates and safety measures. In the aftermath, the focus shifts to recovery and support information. Policymakers can use these insights to tailor their communication strategies and ensure that the public receives timely and relevant information. During a hurricane, the provision of continuous updates on the storm's trajectory and preparedness guidelines can mitigate panic and improve overall readiness.

Geographical analysis of search trends helps identify regions with heightened public interest, which often correlates with areas affected by recent disasters. This information can guide resource allocation and support [5]. A surge in searches for terms like "flood relief" or "hurricane shelters" in a specific region signals an urgent demand for aid and resources. Disaster management agencies can use this information to prioritize these areas for prompt support and resource allocation.

This study highlights the importance of public education in disaster preparedness [17,18]. Search trends related to safety measures, such as "earthquake safety tips" or "flood preparedness", indicate that members of the public have an interest in learning how to protect themselves during disasters. Policymakers can leverage this interest by developing targeted education campaigns that provide practical advice and resources.

The insights gained from Google Trends data can inform the development of more effective disaster response strategies. Understanding the public's informational needs allows disaster management agencies to anticipate and address concerns proactively. If search data reveal a heightened interest in "aftershock safety" following an earthquake, response teams can concentrate on delivering targeted information and support related to aftershock preparedness.

Beyond the immediate response, this study's findings have implications for long-term disaster planning and policy development. Analyzing trends over time can reveal recurring patterns and vulnerabilities and help policymakers identify areas that require more robust infrastructure or improved disaster management practices. If certain regions consistently exhibit elevated interest in "flood insurance" or "hurricane evacuation routes", it may suggest a need for improved flood management systems or more robust evacuation strategies.

5.3. Limitations

While this study provides valuable insights into public interest in natural disasters using Google Trends data, it is essential to acknowledge its limitations.

One of the primary limitations of this study is the reliance on Google Trends data. While Google Trends offers a broad view of public interest, it does not capture the full spectrum of public behavior. Although, given that Google has a market share of over 90% [19], we can talk about a relatively impressive reach to analyze. Additionally, Google Trends data are normalized and do not provide absolute search volumes, which can limit the precision of the analysis [20].

The temporal resolution of Google Trends data, aggregated on a weekly basis, may not capture rapid changes in public interest that occur within shorter time frames. This can be particularly relevant for sudden-onset disasters where public interest may spike within hours or days. A finer temporal resolution would provide more detailed insights into public behavior during these critical periods.

While Google Trends data are available globally, there are variations in internet penetration and search behavior across different regions (e.g., almost 93% of desktop search traffic originates from Google in India but only 4% in China and 25% in Russia [21]). In areas with low internet access or where Google is not the dominant search engine, the data may not accurately reflect public interest. This can lead to biases in identifying regions with heightened interest and needs.

Search behavior can vary significantly across different languages and cultures [22]. The same event may be searched using different terms in different regions, which leads to challenges in data aggregation and comparison. This study's reliance on English search

terms may overlook important trends in non-English-speaking regions (But, given the fact that English is the most widely spoken language on the Internet, we reach a relatively higher number of users than with any other language [23]).

Another limitation of this study is that it uses only one year of data, which may restrict the ability to identify long-term trends or variations in public interest across different natural disasters. However, the use of one-year data is justified as it still captures significant events within that period, such as major earthquakes and hurricanes, which are sufficient to analyze short-term public interest spikes and regional responses. This timeframe allows for the identification of patterns in how people seek information during and after disasters and offers valuable real-time insights that can inform immediate disaster preparedness and response strategies. While a longer dataset would provide a more comprehensive understanding, the analysis of a single year still offers meaningful, actionable conclusions.

6. Conclusions

This study provides significant insights into public interest in natural disasters by analyzing Google Trends data from 2023. Using a combination of temporal and geographical analysis, we identified patterns in search behavior related to various geohazards, including earthquakes, hurricanes, floods, tornadoes, and tsunamis. Our results highlight key findings that can inform both disaster preparedness and response strategies.

Firstly, the geographical analysis revealed notable regional differences in public interest across different types of disasters. For instance, regions with high seismic activity, such as Japan and the Philippines, exhibited heightened interest in earthquake-related terms. Similarly, Caribbean countries showed increased search activity in hurricanes, indicating public concern and the need for ongoing preparedness in these areas.

Secondly, the temporal patterns observed in search volume indicated that public interest spikes in response to significant disaster events, such as the February 2023 earthquake in Turkey and Syria. These spikes reflect immediate public concern and information-seeking behavior, underscoring the importance of real-time updates and accurate information dissemination during disaster events.

Additionally, this study's comparative analysis across different disaster types revealed common themes in public search behavior. Regardless of the disaster type, the public consistently searched for real-time alerts, safety measures, and recovery efforts. For instance, searches for "earthquake safety" and "hurricane tracker" demonstrated the public's need for timely, actionable information to mitigate the risks associated with these events.

Google Trends proved to be a valuable tool for monitoring public interest in natural disasters, offering real-time insights that can enhance both disaster preparedness and response strategies. However, future research should aim to integrate Google Trends data with other sources, such as social media and official disaster reports, to provide a more comprehensive view of public behavior and needs during crises.

Finally, while the analysis of a single year provided valuable insights, long-term studies would be beneficial to identify more persistent trends in public interest and preparedness across multiple years and disaster events. Such studies could further inform policy development and help refine disaster management strategies to meet public needs more effectively.

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