





# Comparative analysis of natural disasters in the Mexican Pacific: The case of hurricane Otis and its socioeconomic impact on Acapulco

## Análisis comparativo de desastres naturales en el Pacífico mexicano: El caso del huracán Otis y su impacto socioeconómico en Acapulco

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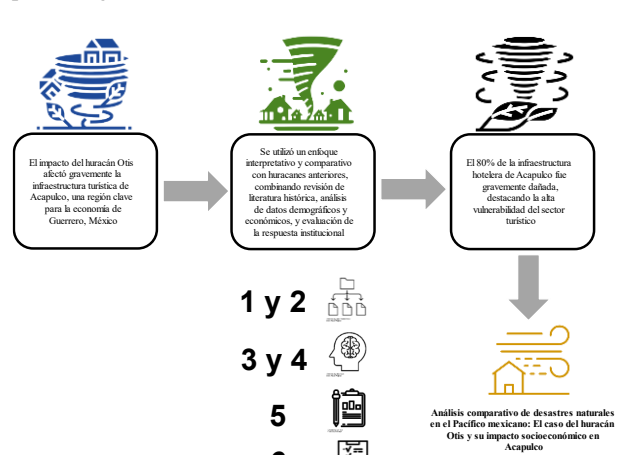
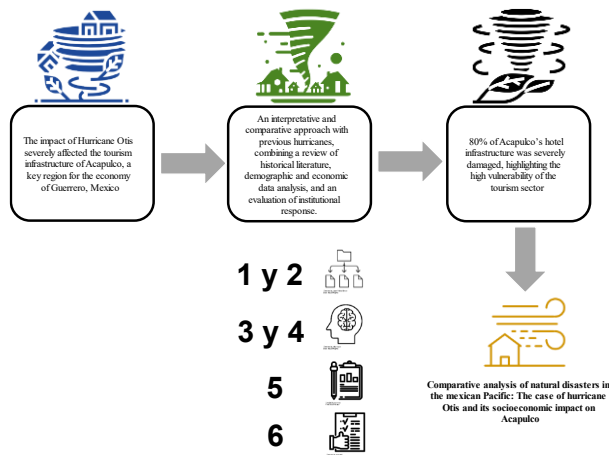
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**Abstract**

The article analyzed the impact of Hurricane Otis on the tourist infrastructure of Acapulco, a key part of Guerrero's economy. Through an interpretative approach and comparison with previous events like Pauline (1997) and Ingrid-Manuel (2013), it identified factors contributing to the vulnerability of the tourism sector to extreme weather events. The mixed methodology combined literature review, data analysis, and institutional response, revealing that 80% of hotel infrastructure was severely affected. Although recovery phases were implemented, risk communication was insufficient, exacerbating the disaster's impact. The study concludes that improving risk management, communication, and promoting policies that ensure resilient economic recovery are essential to mitigate future disasters.

**Resumen**

El artículo analizó el impacto del huracán Otis en la infraestructura turística de Acapulco, clave en la economía de Guerrero. Mediante un enfoque interpretativo y comparativo con eventos previos como Pauline (1997) e Ingrid-Manuel (2013), identificó factores que contribuyen a la vulnerabilidad del sector turístico ante fenómenos extremos. La metodología mixta combinó revisión de literatura, análisis de datos y respuesta institucional, revelando que el 80% de la infraestructura hotelera fue severamente afectada. Aunque se implementaron fases de recuperación, la comunicación de riesgos fue insuficiente, exacerbando el impacto. El estudio concluye la necesidad de mejorar la gestión de riesgos, la comunicación y fomentar políticas que aseguren una recuperación económica resiliente para mitigar futuros desastres.



**Risk management, Hurricane Otis, Climate vulnerability**

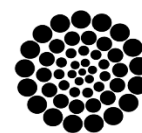
**Gestión de riesgos, Huracán Otis, Vulnerabilidad climática**

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## Introduction

The devastating impact of Hurricane Otis on the coastal area of Acapulco, Guerrero, on October 25, 2023, has created an urgent need to analyze and understand the consequences of this event. The purpose of this research is to conduct a detailed analysis of the material damages and the social and economic implications of the hurricane, with a particular focus on aspects such as the flooding of buildings, loss of life, and the effects on essential services, including hotels, restaurants, educational institutions, and health centers.

The effects of hurricanes on coastal regions have been widely studied in geographical literature, beginning with the pioneering work of Gilbert White between 1930 and 1960, who established the distinction between "hazardous natural phenomena," "disasters," and "risks" (White, 1942 & 1974). This research aligns with a conceptual framework that integrates the study of natural and anthropogenic risks, encompassing a wide range of threats, including seismic, volcanic, slope processes, and hydrometeorological hazards (Espinosa Rodríguez, 2020).

In this context, factors such as climate change, environmental degradation, soil erosion, and vulnerability (Rodríguez, 2017) play a crucial role in the assessment of natural disasters. Previous studies on Hurricane Otis, such as that by Luz María Cruz Martín del Campo, highlighted the destruction of essential infrastructure, including electrical, hydraulic, communication, transportation, and building infrastructure, in addition to natural environments.

The magnitude of the impact was such that incidents of looting in businesses, banks, and homes were recorded, underscoring the severity of the situation and the vulnerability of the affected region. This research addresses the need to fill a gap in the scientific literature, particularly regarding the combined effects of wind and water on buildings ranging from two to fifteen stories located along Acapulco's coastline, as indicated by Ramírez-Fernández et al., (2023).

The land-sea and continental interface of Acapulco is a key area of study, where efforts have been made to understand how Hurricane Otis affected vegetation, communities, and infrastructure along its path (García-Méndez et al., 2020). The knowledge derived from this research is fundamental in supporting informed decision-making at local, national, and international levels, particularly in the context of disaster risk management and resilience against hydrometeorological phenomena (Wang & Kim, 2018).

Over the past 50 years, cyclones have caused an average of 43 deaths daily and significant economic losses, although improvements in forecasting, alerts, and risk reduction measures have considerably reduced the number of fatalities (Andrew, 2023). Finally, the relevance of this study is highlighted not only for its contribution to understanding the immediate effects of Hurricane Otis but also for its potential to influence future risk management policies and urban planning in vulnerable coastal areas.

Historical impact of tropical cyclones in Acapulco and the uniqueness of hurricane Otis. The Acapulco region has experienced a particular pattern regarding the direct impact of tropical cyclones, underscoring the uniqueness of Hurricane Otis. In 1973, Tropical Storm Claudia made landfall approximately 30 miles east of Acapulco, causing heavy rains in southern Mexico. However, aside from this event, no tropical storms or hurricanes have directly impacted within a 50-mile radius of Acapulco, according to Henson et al., (2023). This pattern suggests that direct impacts from tropical cyclones in the region are relatively rare.

Nevertheless, when these phenomena have affected the region, their consequences have been devastating. In 1997, Hurricane Pauline devastated approximately 5,000 homes due to flash floods and landslides in various areas of the port.

This phenomenon affected high-altitude zones with steep slopes in El Veladero National Park, located near the city center. As a result, most residents of Acapulco were left without electricity and water, with a loss of up to 500 lives (Rodríguez, 2017).

In the context of recent tropical cyclones, research by Gao et al., (2022) suggested that the El Niño phenomenon in the central-northern Pacific played a crucial role in the development of these cyclones. This characterization is particularly relevant for Mexico, and especially for the Acapulco region, which has witnessed extreme climatic events.

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Hurricane Otis, which made landfall on October 25, 2023, is a paradigmatic example of the intensification of extreme meteorological phenomena in the region. According to the National Meteorological Service, Otis "even surpassed the intensity of Hurricane Patricia in October 2015, which impacted the state of Jalisco, Mexico" (BBC Mundo, 2023, p.1; García et al., 2024). The unprecedented intensity of Otis prompted alerts from the National Meteorological Service of the National Water Commission (CONAGUA), in conjunction with the United States National Hurricane Center and the WMO Regional Specialized Meteorological Center in Miami. These organizations warned of the possibility of catastrophic storm surges, deadly winds, and flash floods in urban areas due to the hurricane (Reliefweb, 2023, p.1).

## Methodology

This article employed an investigative methodology grounded in the interpretative paradigm, focusing on understanding phenomena from the perspective of specific contexts.

## Article

The research was designed as an exploratory and descriptive study aimed at identifying and describing the characteristics and effects of Hurricanes Pauline, Ingrid-Manuel, and Otis in the Acapulco region of Guerrero, Mexico. A combination of qualitative and quantitative techniques was used to achieve a comprehensive understanding of Hurricane Otis's impact, with the analysis rooted in the theoretical concepts of disaster geography.

Theoretical and methodological approach. The theory underpinning this study was based on the geography of natural disasters in Mexico, with a particular emphasis on the contributions of Dr. Irasema Alcántara Ayala, who conducted extensive research on earthquakes, floods, landslides, and hurricanes. This theoretical framework provided a crucial analytical foundation for examining the impact of Hurricane Otis in Acapulco, Guerrero, and was essential for territorial planning and management, encompassing infrastructure location, sustainable urban development, natural resource conservation, and natural risk mitigation.

Research phases. The study's methodology was structured into five essential phases:

First phase: Literature review. An exhaustive review of both printed and digital literature related to risk geography, disasters, tourism, and hurricanes affecting Acapulco from 1921 to 2023 was conducted (Niño-Gutiérrez et al., 2017). The review also included specialized literature on sustainability (Mercado & Ramírez, 2023) and tourism (Fernández-Palacios & Haroun, 2007). This review facilitated addressing key questions regarding the vulnerability of Acapulco Bay to flood disasters and the associated risk management and reduction methods.

Second phase: Collection of secondary data. This phase focused on collecting secondary data by examining digital archives and printed documents, both bibliographic and hemerographic, containing information on the development of Hurricane Otis and its effects on the economic, tourism, social, and environmental sectors. The goal was to balance the quality of sources focused on risk and disaster geography while identifying possible information gaps that determined the scope and limitations of the research.

Third phase: Analysis of historical hurricanes. An analysis of hurricanes impacting Mexico from 1921 to 2023 was conducted, including the creation of a 1:22,000,000 scale representation of each hurricane's trajectory that directly or indirectly passed through Acapulco. To obtain precise knowledge of the sites and neighborhoods affected by Hurricane Otis, fieldwork was carried out between November 2023 and April 2024. During this phase, tools such as cameras for visual documentation and a field logbook for collecting qualitative and quantitative data were utilized.

Fourth phase: Compilation of detailed statistics. Detailed statistics were generated on the impacts caused by Hurricanes Pauline, Ingrid-Manuel, and Otis to highlight the magnitude of these hydrometeorological catastrophes in southern Mexico. The collected information was processed at the Master's Program in Sustainable Tourism Management at the Autonomous University of Guerrero, where it was also organized into concentrated tables.

Fifth phase: Final analysis and article writing. An exhaustive analysis of the documentary information, statistics, and demographic databases was conducted. Based on this information, explanatory texts were developed, and the final manuscript of the article was drafted. During this stage, it was ensured that the employed methodology remained consistent with the objectives proposed in the study's introduction.

Sampling method. A non-probabilistic convenience sampling method was used, selected due to the exploratory nature of the study and the need to access specific information from relevant and accessible sources. This method included reviewing historical documents and hurricane records, as well as direct field observation for collecting qualitative and quantitative data in the areas affected by Hurricane Otis.

## Results and Discussion

The port of Acapulco, located in the state of Guerrero, occupies a geographically privileged position in the southern portion of the Mexican Republic, bordered to the south by the Pacific Ocean.

This state lies between the extreme geographical coordinates of 16°18' to 18°48' north latitude and 98°03' to 102°12' west longitude relative to Greenwich (INEGI, 2024). It is bordered to the north by the State of Mexico, to the northwest by Puebla, to the east by Oaxaca, and to the south by the Pacific Ocean, which spans a coastline of 500 km.

Acapulco is characterized by a warm subhumid climate with summer rains (Aw1). Torrential precipitation is concentrated from May to November, with an average of 72 cloudy days per year. The annual mean temperature is 26.5°C, with minimal thermal oscillations due to the moderating influence of the ocean. This climate, along with its proximity to the Pacific Ocean, creates an ideal tropical environment for tourism, a vital activity for the local economy since its development in the 1940s.

The physical configuration of Acapulco's coastline is of significant interest from a physiographic and geomorphological perspective. The sedimentary rocks that form the bay, composed of pulverized local gneiss and schist, gave rise to various beaches such as Manzanillo, Tlacopanocha, and Icacos, among others. The 10% slope allowed for the construction of significant tourist infrastructure, including an extensive hotel zone, restaurants, condominium towers, and residences on the alluvial plain of the coastal lowland of the Pacific Ocean (Niño-Gutiérrez et al., 2017).

The prevailing winds in Acapulco follow a west-southwest direction from January to June and a west-northwest direction in August, October, and November, with speeds ranging between 2.52 and 8.64 km/h. During this latter period, cyclones are common due to higher temperatures and lower pressure on the continent compared to the ocean, causing winds to move from the sea towards land, in accordance with Buys-Ballot's first law.

From an administrative standpoint, tourism planning in Acapulco places fundamental importance on the landscape to ensure the stability and dynamics of vegetation and to prudently manage the scenic resources of the beach, which is essential for ecologically sustainable tourism operations. This approach has been particularly relevant for the Federal Maritime Terrestrial Zone (ZOFEMAT) (Niño et al, 2018).

In summary, the combination of a privileged geographic location, an attractive tropical climate, and rich marine biodiversity has positioned Acapulco as a key tourist destination. However, these same characteristics also make it vulnerable to extreme hydrometeorological phenomena, such as cyclones, whose frequency and severity may be exacerbated by climate change, affecting both tourism infrastructure and the natural environment. Hydrographic and marine characteristics of Acapulco bay. Acapulco bay features a limited surface hydrography, with streams that only become active during the rainy season. The local marine wave height averages 75 cm above the water surface, with periods of approximately 1.3 seconds. These hydrographic and maritime conditions are distinctive features of Acapulco's coastal region, enhancing its appeal as a tourist destination.

Soils and ecosystems of the bay. The lithosol soil in Acapulco Bay is characterized by rocky outcrops, which have been utilized for the construction of residential and tourist condominiums up to fifteen stories high. The types of soil present include alluvial, eutric regosol, eutric cambisol, and haplic phaeozem, all of which have low porosity, limited permeability, and poor drainage. The land-sea interface features saline solonchack soils (SPP, 1981), which influence the distribution and management of coastal vegetation. The configuration of Acapulco's marine and terrestrial ecosystems—in terms of relief, soil, vegetation, climate, flora, and fauna—significantly contributes to the development of sun-and-beach tourism in the region. The local flora includes low deciduous forests and species such as coconut (*Cocos nucifera* L.), tamarind (*Tamarindus indica* L.), and amate (*Ficus* sp.), while the diverse marine fauna is supported by the presence of rocky reefs. This biodiversity is a key resource for tourism activities in the bay.

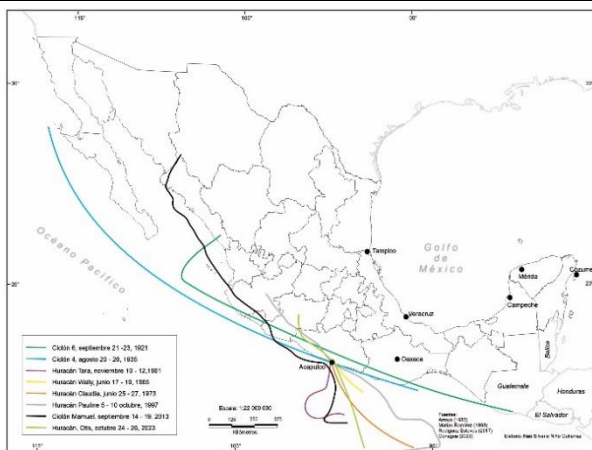
Cyclonic activity in the region. The tropical cyclone season in the Atlantic Ocean, affecting the eastern coast of Mexico, particularly in the states of Tamaulipas and Veracruz, extends from June to November, with a peak in September (Matías, 1998, p. 9). In the Pacific Ocean, the epicenter of cyclone formation is located in the Gulf of Tehuantepec, impacting regions from Chiapas to Baja California.

A less frequent formation center has also been identified in the Gulf of California, affecting the surrounding coastal areas.

The primary scientific result of this study focused on cyclonic activity in the Pacific, with an emphasis on Hurricane Otis. Following Lidia, Otis recorded even stronger winds, reaching 165 mph (265.5 km/h), highlighting the notable intensification of hurricanes in the region during that period. Other significant hurricanes in the history of the Mexican Pacific include Hurricane 12 in 1957 (225.3 km/h), Madeline in 1976 (145 mph or 233.3 km/h), Hurricane Mexico in 1995 (225.3 km/h), Kenna in 2002 (140 mph or 225.3 km/h), Patricia in 2015 (150 mph or 241.4 km/h), and Hurricane Lidia in 2023 (225.3 km/h), all of which recorded extremely strong winds (Poveda, 2004).

These events underscore the importance of close monitoring of cyclonic activity in this region, which is particularly vulnerable to severe impacts. This analysis represents the first significant scientific contribution to risk geography applied to Hurricane Otis, developed by local researchers (Figure 1).

### Box 1



**Figure 1**

Hurricanes that have impacted Acapulco, Guerrero, Mexico 1921-2023

Source: Matías (1998); Arroyo (1983); Rodríguez (2017); Servicio Meteorológico Nacional-CONAGUA (2023); & Niño-Gutiérrez (2023).

Impact of hurricane Otis on tourism infrastructure. Tourism has historically been the primary source of income for the state of Guerrero, generating an economic impact of 6 million pesos in 2023, driven by a flow of 977,000 people and an average hotel occupancy rate of 65.3% (Gobierno del Estado de Guerrero, 2024).

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However, Hurricane Otis severely impacted this industry, affecting 80% of the hotel infrastructure, according to the Acapulco Hotel and Tourism Business Association (AHETA). The estimated losses in infrastructure damage amounted to 15 billion dollars, as reported by the National Business Council for Tourism of Mexico.

The results highlighted both the vulnerability and resilience of Acapulco's port in the face of extreme climatic events. The tourism infrastructure, essential to the region's economy, was severely affected, underscoring the urgent need to improve disaster preparedness and response capacity.

Demographic growth and risk vulnerability. Population growth in Acapulco from 1900 to 2023 shows a significant trend that has increased the region's exposure to hydrometeorological phenomena. The municipality's population grew from 4,932 people in 1900 to 852,622 in 2023 (INEGI, 2023). This demographic increase was partly driven by the rise of commerce and the flourishing of tourism since the 1960s, which has heightened the population's exposure to risks such as hurricanes and floods.

The accelerated population growth and economic development in recent decades have exacerbated the consequences of extreme climatic events. A notable example was Hurricane Pauline in 1997, one of the most significant natural disasters in Acapulco's recent history, with devastating effects on the region (Rodríguez, 2017).

Climatic characteristics and recovery challenges. Acapulco bay, with its distinctive "shell" shape and tropical climate with summer rains (Aw), has become a world-renowned tourist icon, attracting both national and international visitors. However, its geography and climate also make it vulnerable to intense climatic phenomena. Precipitation is more frequent between June and November, with September and October being the months of highest risk for catastrophic hurricanes.

These climatic events not only affect environmental recovery but also impose high costs on the economic restoration of the affected infrastructure.

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Notable examples of these challenges include Hurricanes Pauline in 1997, Ingrid-Manuel in 2013, and Otis in 2023, which have had a lasting impact on the region.

Recovery prospects and investment opportunities. In the context of Acapulco's tourism recovery, authorities indicated that of the 284 hotel establishments, 80% had a capacity of up to 40 rooms. According to SERFIMEX, the current gap in tourism could represent an opportunity for investors in sectors such as hotels, entertainment, restaurants, and services (Figuerola, 2023).

The resilience of Acapulco and the recovery initiatives provide an opportunity to reimagine and strengthen the tourism infrastructure, promoting investments that not only restore what was lost but also enhance the region's capacity to face future climatic challenges.

Impact of hurricane Otis and comparison with previous events. Hurricane Otis was compared with previous events such as Pauline in 1997 and Ingrid-Manuel in 2013, revealing a continuous pattern of significant damage in the region. This comparative analysis, presented in Table 1, represented the second scientific contribution to the geography of risk by identifying the elements that have made these hydrometeorological phenomena notorious. The findings highlighted the urgent need to develop more robust strategies for risk mitigation and post-disaster recovery in Acapulco.

Evaluation of institutional response and risk communication. Federal authorities implemented an early warning system, providing meteorological information to state and municipal governments as well as the exposed population. However, despite these efforts, the effectiveness of risk communication was deemed insufficient to prevent disasters. The failure to comply with effective communication, which involves five phases (preparation, initiation, control, recovery, and evaluation), resulted in inadequate preparedness by both authorities and the local population, exacerbating the magnitude of the disaster caused by Otis (Presidencia de la Nación, 2016; IFRC, 2023).

In response to the impact of Hurricane Otis, the phases of initiation, control, recovery, and risk evaluation were addressed through coordinated actions under a unified command involving all governmental agencies. The federal government led efforts to mitigate flood damage in critical areas of Acapulco, including Colonia Zapata, Ciudad Renacimiento, Avenida Costera Miguel Alemán, Costa Azul, Pie de la Cuesta, and Diamante (UNFCCC, 2023).

Governmental response and support for recovery. Under the leadership of Secretary Ariadna Montiel Reyes, the Federal Ministry of Welfare implemented measures for the cleaning and reconstruction of homes affected by Hurricane Otis. A total of more than 322,000 support packages were distributed in two phases, coordinated by the Ministry of Welfare, to assist families impacted by the damage in Acapulco (Secretaría de Bienestar, 2024).

At the state level, the Ministry of Inclusion and Social Welfare (SIBISO), based in Chilpancingo, coordinated public policies on social development, equity promotion, and community social services in the state of Guerrero (Gobierno del Estado de Guerrero, 2024). At the federal level, the National Institute of Transparency, Access to Information, and Personal Data Protection (INAI) instructed the Ministry of Welfare to search for and, if necessary, disclose detailed documentation of the census of people affected by Hurricane Otis in Acapulco and Coyuca de Benítez, Guerrero (Redacción El Economista, 2024).

Economic impact on the tourism sector and resilience. Hurricane Otis caused severe damage to the hotel sector, particularly along the coastal strip of Acapulco and Coyuca de Benítez. Small business owners, including those of commercial establishments, restaurants, bars, and hotels, required accessible loans to rebuild their assets. In response, the federal government, through the National Financial Institution for Welfare in Mexico, offered two support schemes. The first, aimed at microenterprises, offered amounts of 25,000 pesos at zero interest, with a 30-month term and a six-month grace period. The second scheme provided loans ranging from 30,000 to 300,000 pesos, with an annual interest rate of 6.5%, payable over 24 months with a four-month grace period (El Sol de Acapulco, 2024a).

## Article

Additionally, insurance companies paid more than two billion dollars to owners of automobiles, businesses, and hotels in Acapulco and Coyuca de Benítez for the damages caused by Otis. This hurricane became the third most catastrophic natural phenomenon for the insurance sector in Mexico, following the Covid-19 pandemic and Hurricane Vilma ([El Sol de Acapulco, 2024b](#)).

These efforts highlighted the need for accessible loans and the importance of insurance in economic recovery, which are critical measures for the resilience of the tourism sector and the local economy.

Impact of hurricane Otis and the insurance sector's response. Hurricane Otis triggered one of the largest demands for insurance claims in Mexico's history, with 104 claims from hoteliers and 20 claims from homeowners.

As of April 15, 2024, 73 billion pesos had been paid in indemnities for losses related to automobiles, homes, hotels, restaurants, and other sectors, although some payments were still being processed ([El Sol de Acapulco, 2024c](#)). This disaster became one of the most costly natural events recorded in the country ([El Sur Acapulco, 2024](#)).

Need for investments and policies for sustainable recovery. Despite comparisons with previous studies that indicated a rapid recovery of the tourism sector following natural disasters due to effective reconstruction strategies ([Poveda, 2004](#)), findings in Acapulco suggest an urgent need for investments and policies that support a sustainable and resilient recovery.

The effects of hurricane Otis manifested in a real estate crisis and spatial segregation in areas such as Las Cruces, La Colonia Zapata, and Ciudad Renacimiento, as well as in the devaluation of residential developments, hotels, and restaurants in tourist zones like Punta Diamante ([Valentín, 2024](#)).

These results align with studies advocating for more sustainable and resilient urban planning in vulnerable areas ([Zárate, 2024](#)).

Impact of hurricane Otis on infrastructure and housing. Residents of popular neighborhoods in Acapulco, such as Renacimiento, Santa Cecilia, Simón Bolívar, Lázaro Cárdenas, Primero de Mayo, Vicente Guerrero, Los Lirios, and Benito Juárez, witnessed the severe impact of Hurricane Otis on homes, streets, bridges, and public services ([El Sol de Acapulco, 2024c](#)).

In response to the devastation, a working group was held on April 30, 2024, to facilitate the reconstruction of Acapulco post-Otis, attended by more than 50 representatives from the Dorada and Diamante zones. At this event, Julián Urióstegui Carbajal, president of the Business Coordinating Council (CCE) of Guerrero, highlighted that the Diamante area was one of the most affected, with 40 buildings and condominiums housing 8,000 apartments suffering significant damage, representing almost half of Acapulco's tourist real estate offering ([El Sur Acapulco, 2024](#)).

Prospects for resilient recovery. The study's results underscore the need to build a more resilient community in the face of current and future extreme climatic events, such as Hurricane Otis. To achieve this goal, it is essential to continue improving risk preparedness, risk communication, and the population's adaptive capacity. Laura Polanco shared this perspective, noting that Acapulco needed a catalytic project with substantial capital investment to promote a sustainable and resilient destination in the face of economic fluctuations, pandemics, natural disasters, and changes in global tourism trends.

Context of natural disasters in Mexico. "According to the EM-DAT database, 231 disasters were recorded in Mexico between 1900 and 2018" ([Alcántara-Ayala, 2019, p. 4](#)).

The most significant disasters in the country were primarily related to storms, followed by floods, earthquakes, mass removal processes, and, finally, volcanic activity. In Acapulco's coastal strip, all of these events were present, except for volcanic eruptions, maintaining a notable parallel in terms of the magnitude and frequency of such disasters at both local and national levels ([Delgado-Ramos et al., 2024](#)).



Recommendations for infrastructure and public services. Finally, it is crucial that the future research agenda focuses on improving the provision and quality of residential, hotel, and restaurant infrastructure in Acapulco's coastal strip (Zárate, 2024). Simultaneously, it would be beneficial to maintain and even enhance municipal public services, preserve the balance of quality public green spaces along Avenida Costera Miguel Alemán Velasco, as well as in the central medians of Las Cruces, La Colonia Zapata, Ciudad Renacimiento, and Vacacional, where public transportation services could be more efficient. In this way, the present discussion remained focused on the study's objectives and the need to ensure balanced and safe urban development in Acapulco.

### Conclusions

The analysis of the impacts of Hurricane Otis in Acapulco revealed the severe vulnerability of the tourism infrastructure, a fundamental pillar of the region's economy. With significant economic losses, it was estimated that 80% of the hotel infrastructure was affected, highlighting the fragility of the tourism sector in the face of large-scale hydrometeorological phenomena.

The study of Acapulco's population growth from 1900 to 2023 showed continuous growth, especially from 1960 onwards, coinciding with the rise of commerce and tourism. This population growth has increased exposure to natural disasters, as evidenced by catastrophic events such as Hurricanes Pauline (1997), Ingrid-Manuel (2013), and Otis (2023).

Despite the implementation of the phases of preparation, initiation, control, recovery, and risk evaluation, risk communication and local preparedness were insufficient to mitigate the devastating impact of Hurricane Otis. This finding reflects the urgent need to improve disaster information management and preparedness in the region.

The comparative analysis with other catastrophic hurricanes in the Mexican Pacific, such as Patricia (2015), Madeline (1976), and Kenna (2002), indicated a trend towards the intensification of hurricanes in the region. The magnitude of the damages caused by Otis, with winds of up to 165 mph, reinforces the importance of continuously monitoring and studying the evolution of these climatic phenomena.

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Finally, the data on insurance and post-Otis indemnities revealed the high economic cost for the insurance sector, with over two billion dollars paid in claims. This demonstrates the considerable financial burden that natural disasters impose, consolidating Otis as one of the most costly natural disasters in Mexico's recent history.

### Declarations

#### Conflict of interest

The author of this article declares that there are no financial, personal, academic, or professional conflicts of interest that could have influenced the research, results, or interpretation of the data presented in this study. All procedures and analyses were conducted independently and objectively, without the influence of external entities that could compromise the integrity of the scientific work performed.

#### Author Contribution

*Niño-Gutiérrez, Naú Silverio:* The author of this article has played an integral role in all phases of the research, from the conception and design of the study to the collection, analysis, and interpretation of the data. The combination of these contributions ensures that the work presented is not only a significant contribution to the field of disaster geography and urban resilience but also a reflection of the author's commitment to rigorous research and the advancement of knowledge in this area.

#### Availability of data and materials

**Availability of data:** The collected data as well as supplementary materials accompanying the publication of this research are accessible to other users. Trough request to the author.

**Availability of materials:** The author specifies that the materials are freely available for the users to use without any restrictions or conditioned associated with Access to them. This means that the materials, such as data sets, or other resources, can be accessed and utilized by anyone interested in the research without requiring permission or facing any limitations.

## Article

This commitment to open Access promotes transparency, reproductibility, and collaboration in research, allowing others to verify findings, replicate experiments, or build upon the work without barriers.

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### Abbreviations

CONAGUA = National Water Commission  
 IFRC= International Federation of Red Cross and Red Crescent Societies  
 INEGI = National Institute of Statistics and Geography  
 SMN = National Meteorological Service  
 SPP = Secretariat of Programming and Budget (now part of the Secretariat of Finance and Public Credit)  
 UNFCCC = United Nations Framework Convention on Climate Change

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