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The 24 June 2026 Venezuela Earthquakes

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About

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THE 32nd ISSUE OF THE NEWSLETTER OF EDCMS – PREFACE

The 32nd Issue of the Newsletter of Environmental, Disasters and Crises Management Strategies (EDCMS) emphasizes on the 24 June 2026 earthquakes that affected the northern part of Venezuela (south America).

This report constitutes a synthesis of: (a) field observations collected during the Greek scientific mission in Venezuela; (b) published information obtained from international scientific organizations, governmental agencies, the scientific literature, and other reliable sources; and (c) experience gained from past earthquake disasters.

The field investigation was conducted by Professors Emeritus E. Lekkas and P. Carydis. The compilation, critical review, and synthesis of the field observations, published information, and experience from previous earthquake disasters were undertaken by Prof. Em. P. Carydis and the members of the Interdisciplinary Committee for Risk and Crisis Management of the National and Kapodistrian University of Athens, namely Prof. Em. E. Lekkas, Professor G. Kaviris, and Dr. S. Mavroulis, with contributions from the specialized collaborators Dr. M. Mavrouli and Dr. E. Stamati, as well as PhD

candidates M. Gogou, K.-N. Katsetsiadou and I. Trigass.

The mission was undertaken within the framework of the international scientific, technical, operational and humanitarian assistance provided to the regions affected by the 24 June 2026 major earthquakes. Its primary objectives were to investigate the geodynamic and seismotectonic setting of the affected region, document and assess the impact of the earthquakes on the built environment, evaluate the geological hazards, and provide scientific support to the local authorities and the international disaster response community.

The 32nd Issue of the Newsletter of EDCMS comprises the following sections:

- Geological, geodynamic and seismotectonic framework of northern Venezuela, including the regional geodynamic setting, the geology of the affected area, active faults, instrumental and historical seismicity, focal mechanisms, seismic zonation, seismic design codes, and the evolution of earthquake-resistant regulations in Venezuela.



THE 32nd ISSUE OF THE NEWSLETTER OF EDCMS – PREFACE

- Historical and recent earthquake activity, presenting the catalogue of destructive historical and instrumental earthquakes that have affected northern Venezuela, the cities exposed to major seismic events, and the regional seismotectonic evolution.
- Analysis of the 24 June 2026 earthquake sequence, including preliminary information on the main shocks and aftershocks, epicentral locations, moment tensor solutions, focal mechanisms, macroseismic intensity distribution, Peak Ground Acceleration (PGA) and Peak Ground Velocity (PGV) maps, slip distribution, and coseismic ground deformation.
- Primary and secondary earthquake environmental effects, documenting the geological hazards generated by the earthquakes, including earthquake-triggered landslides, liquefaction phenomena, ground deformation, surface effects in mud volcano areas, and comparisons with previous effects generated not only from earthquakes but also from hydrometeorological disasters, such as the 1999 debris flows that affected northern Venezuela.
- Earthquake impact on the built environment, including satellite-based damage assessment, characterization of the dominant structural systems, evaluation of their seismic vulnerability, spatial distribution of damage in urban areas, damage to high-rise buildings, principal building collapse mechanisms, the influence of geological conditions on structural performance, and implications for victim survivability and Urban Search and Rescue (USAR) operations.
- Impact on the population, critical infrastructure and public health, including the consequences for affected communities, healthcare facilities and hospitals, the assessment of public health risks, the potential emergence of infectious diseases during the post-earthquake period, the timeline of public health priorities, and the mental health consequences associated with large-scale earthquake disasters.



THE 32nd ISSUE OF THE NEWSLETTER OF EDCMS – PREFACE

- Emergency response and disaster management, presenting the emergency operations implemented after the earthquakes, USAR activities conducted by national and international teams, rapid reconnaissance, early warning and rapid response systems, strategies for reducing disaster impacts on the population, and lessons learned for improving disaster preparedness and resilience.
- Information management during disasters, discussing the spread of misinformation following the seismic events, including miscaptioned photographs, fake videos, online fraud and other forms of disinformation that may hinder emergency response and public awareness.

Beyond documenting the 24 June 2026 earthquake sequence, this Newsletter aims to provide an integrated multidisciplinary reference on one of the most significant recent earthquake disasters in northern South America. It combines field observations, scientific analyses and operational experience to support future research, improve

earthquake risk assessment, strengthen disaster preparedness and response, and contribute to the mitigation of the impacts of future destructive earthquakes in Venezuela and other tectonically active regions.



Topographic map of Venezuela.
The earthquake-affected area is located at the northern part of the country and comprises the Capital District of Caracas and coastal states.



INTERDISCIPLINARY COMMITTEE FOR RISK AND CRISIS MANAGEMENT OF THE NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS



This 32nd Issue of the Newsletter of EDCMS is the result of the collaborative efforts of the members of the Interdisciplinary Committee for Risk and Crisis Management of the National and Kapodistrian University of Athens (NKUA: Professor Emeritus E. Lekkas, Professor G. Kaviris, and Dr. S. Mavroulis), with contributions from specialized collaborators (Professor Emeritus P. Carydis, Dr. M. Mavrouli, Dr. E. Stamati, Dr. I. Trigas, PhD candidates M. Gogou and K.-N. Katsetsiadou).

The Committee constitutes an institutional scientific support body dedicated to address natural, technological, and environmental hazards and crises. It is coordinated by Prof. Em. Lekkas. Its operational structure comprises members from the School of Science, the School of Health Sciences, and the School of Philosophy of the NKUA.

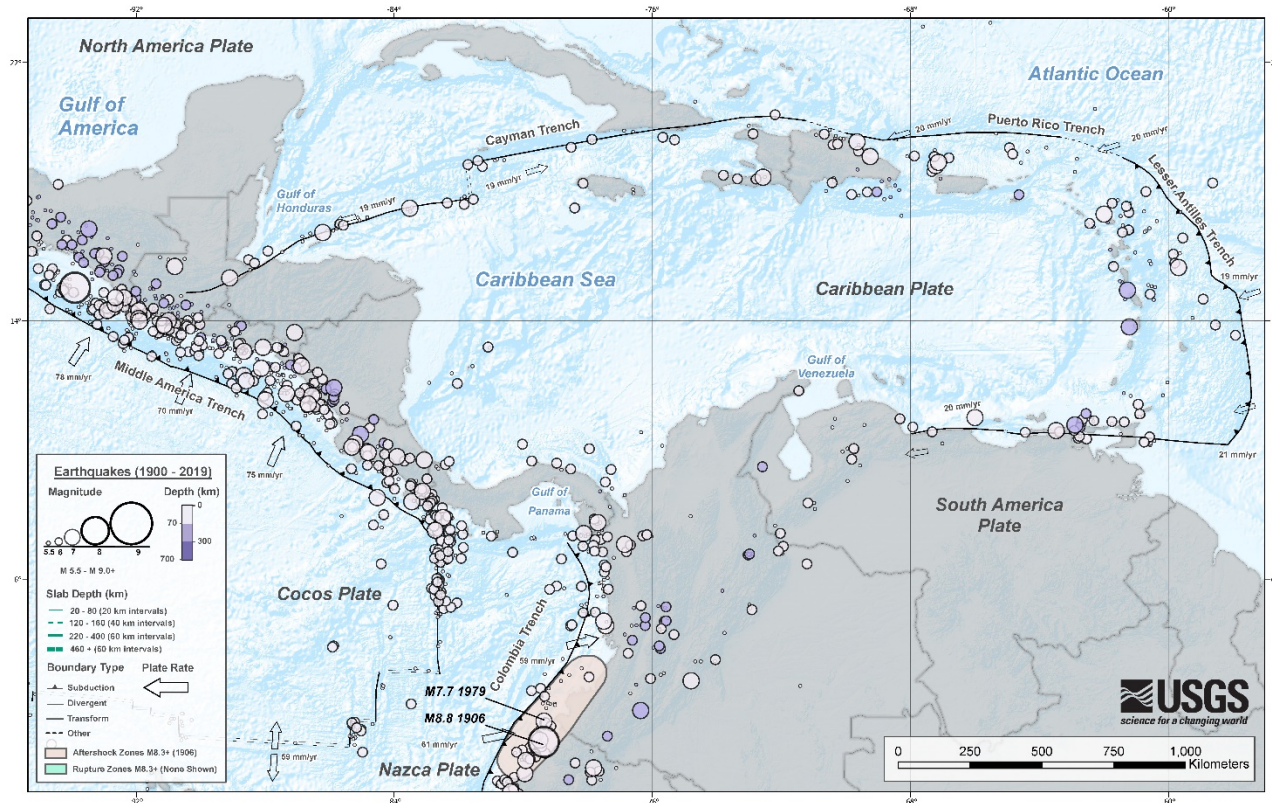
This multidisciplinary framework enables the integrated analysis of geological, geomorphological, seismological, geophysical, and geotechnical data, together with health-related and civil protection considerations, supporting the assessment of evolving hazards and emergency management.

The objectives of the Interdisciplinary Committee for Risk and Crisis Management are:

- The promotion of research across all stages of the disaster management cycle;
- The hazard analysis and risk assessment, including the evaluation of the vulnerability of several elements of the built environment;
- The development of operational planning frameworks and organizational structures for disaster management at all levels of governance;
- The provision of operational coordination for national and international missions in disaster-affected areas;
- The provision of specialized medical care and psychological support to disaster-affected populations;
- The enhancement of public awareness and preparedness regarding natural hazards and disaster management through outreach activities, conferences, lectures, educational programs, and other relevant initiatives.



GEODYNAMIC SETTING OF NORTHERN VENEZUELA



The 24 June 2026 earthquakes were generated southeast of Yumare, Venezuela, resulted from shallow strike-slip faulting in the vicinity of the tectonic boundary between the Caribbean and South American plates. At the earthquake location, the Caribbean Plate moves eastward relative to the South American Plate at a rate of approximately 20

mm/yr. This relative plate motion is primarily accommodated by a major system of right-lateral strike-slip faults across northern Venezuela. The principal structures within this fault system include the San Sebastian Fault, which follows the northern Venezuela coastline, and the Boconó Fault, which extends westward from the epicenter.



GEODYNAMIC SETTING OF NORTHERN VENEZUELA

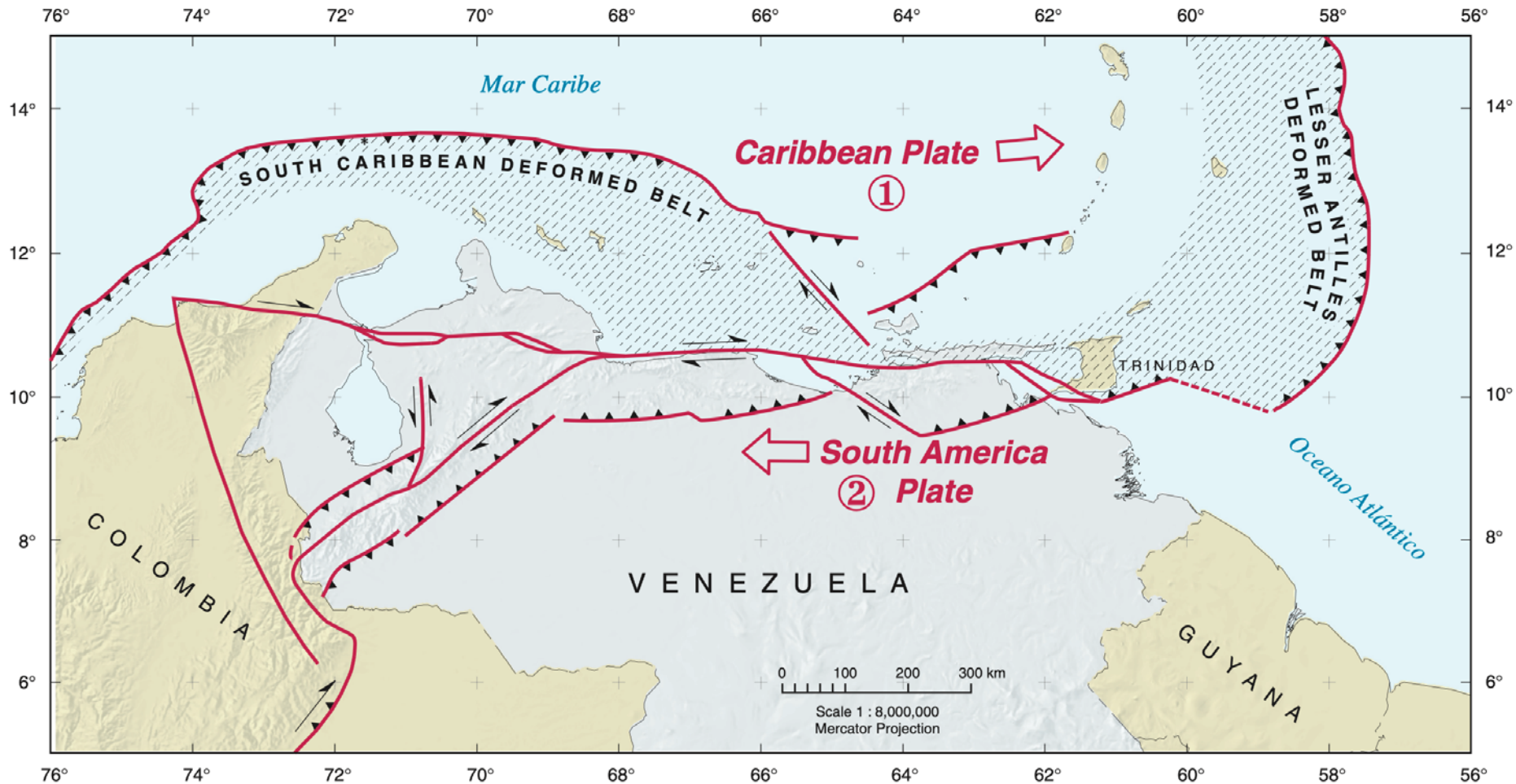
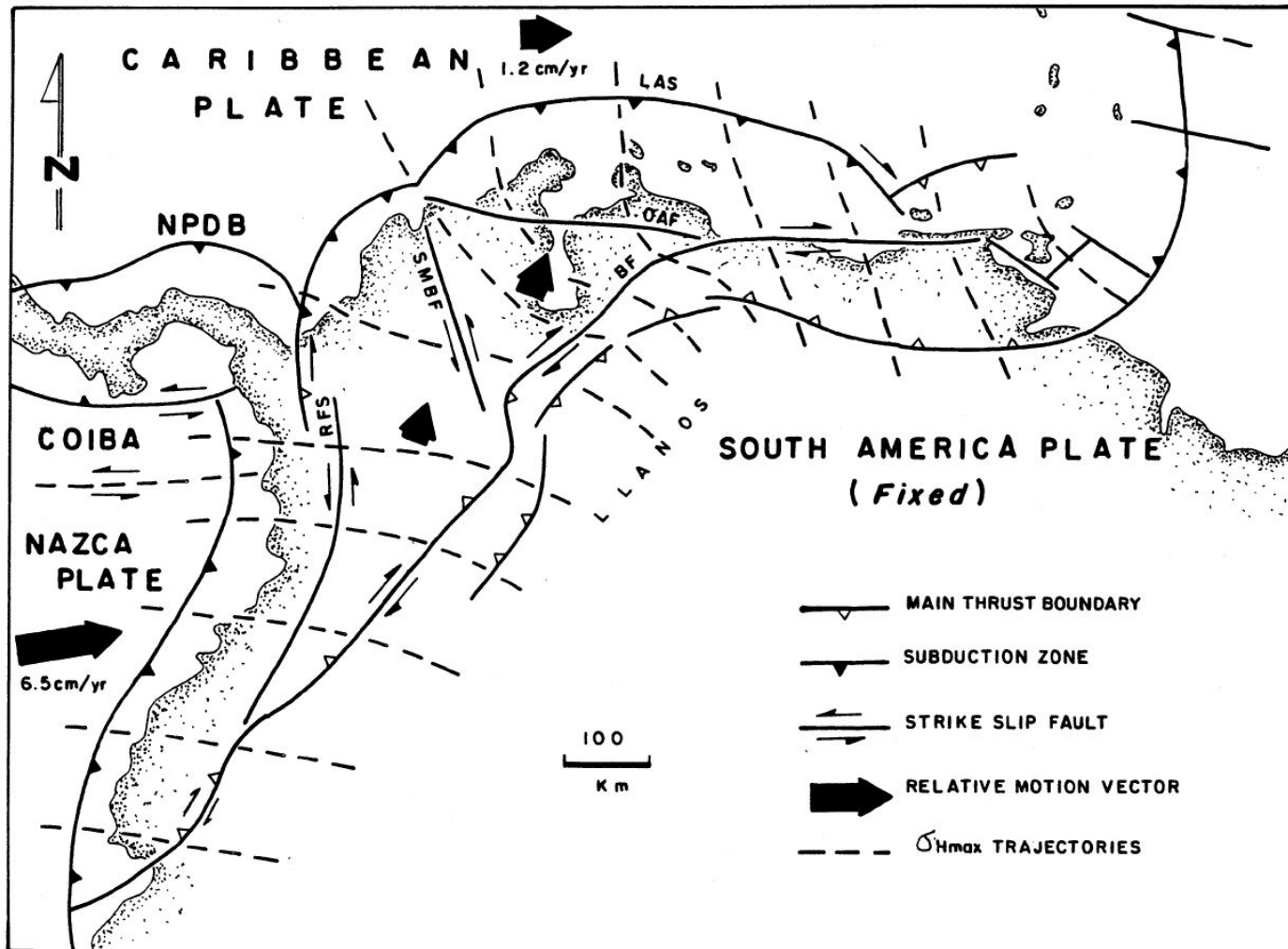


Plate boundaries for Venezuela (after Audemard, 2000)



GEODYNAMIC SETTING OF NORTHERN VENEZUELA



Geodynamic setting of northwestern South America, showing the maximum horizontal stress trajectories and relative motion vectors with respect to South America (after Audemard and Audemard, 2002).



GEODYNAMIC SETTING OF NORTHERN VENEZUELA

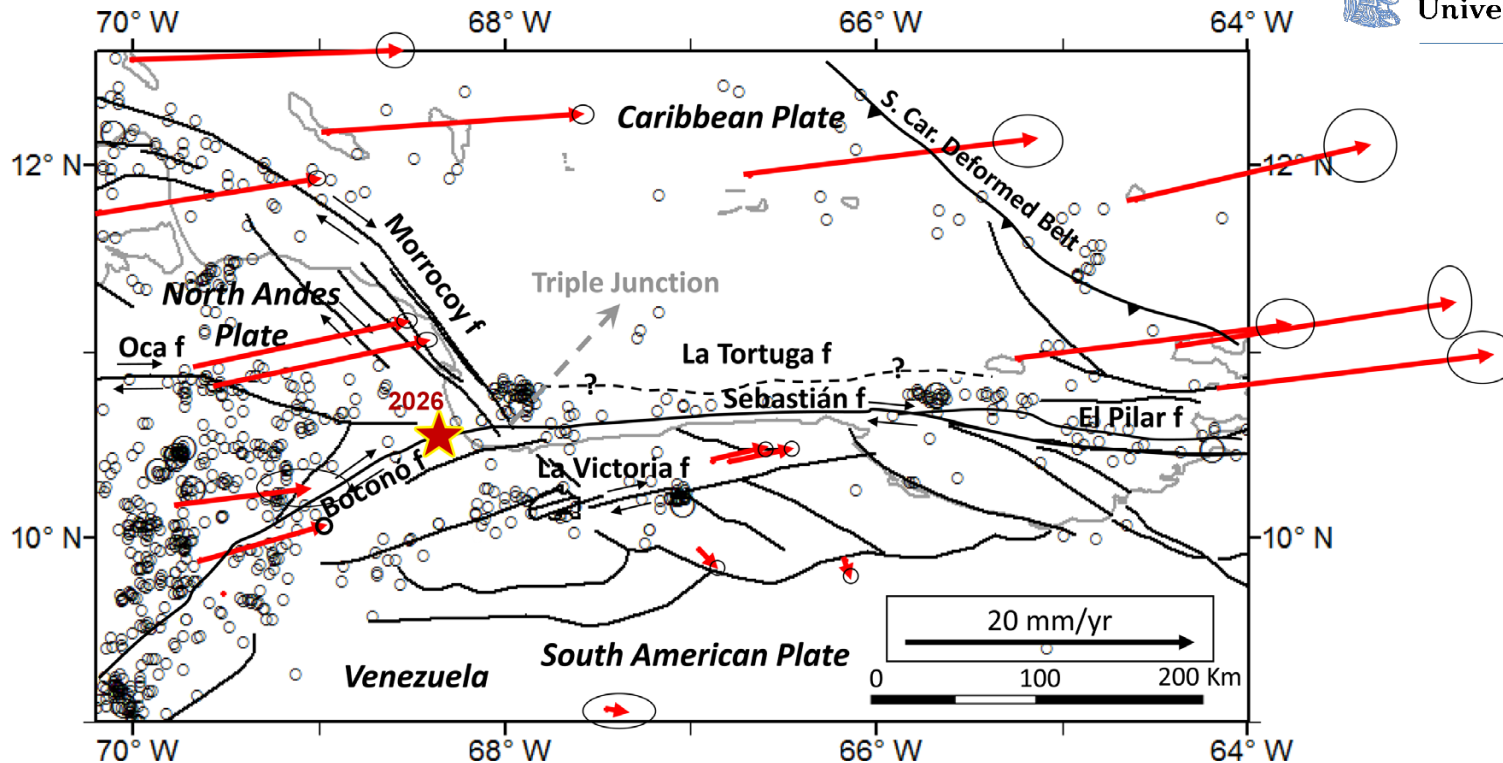


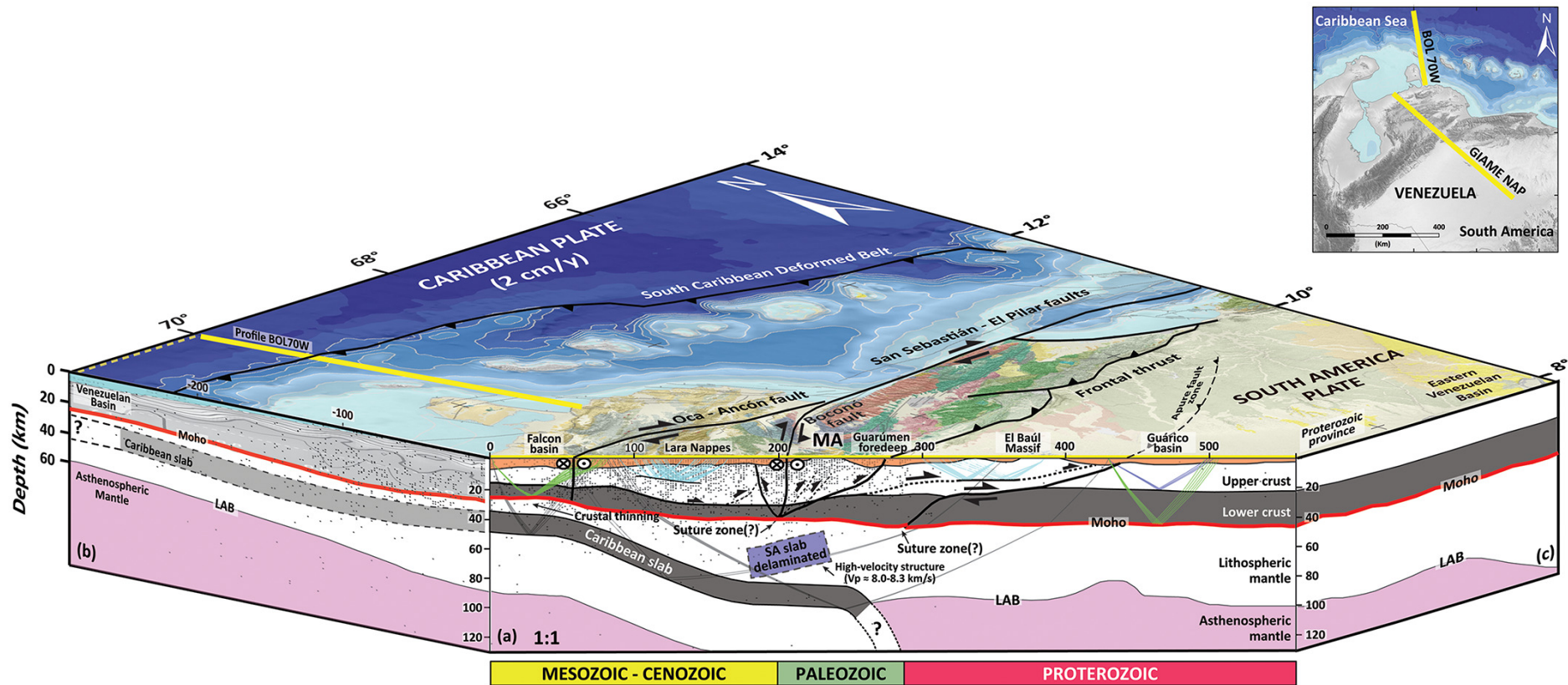
Plate motion derived from GPS measurements indicates that the Caribbean Plate moves eastward relative to the South American Plate, parallel to the transform plate boundary along northern Venezuela, at a relative rate of approximately 19.6 mm/yr (Pérez et al., 2018).

This map illustrates GPS velocity vectors relative to the South American Plate along with epicenters of

microearthquakes ($M_w \geq 2.5$) recorded by the Venezuelan National Seismological Network (FUNVISIS) from 2003 to 2012. Arrows indicate the horizontal sense of fault motion, which is right-lateral along the Boconó and San Sebastián faults. The red star marks the approximate location of the main earthquakes that occurred on 24 June 2026 (modified from Pérez et al., 2018).



GEODYNAMIC SETTING OF NORTHERN VENEZUELA



Schematic model of the lithospheric structure of northwestern Venezuela
(after Mazuera et al., 2000)



GEOLOGY OF THE MOST AFFECTED PART OF COASTAL NORTHERN VENEZUELA

Northern Venezuela is underlain by unconsolidated Quaternary, Pleistocene, and Pliocene sediments, including:

- the Pleistocene and Holocene alluvial deposits (Qal),
- the undivided Pleistocene formations (Qs),
- the Pleistocene La Playita Formation (Qlp), and
- the Pliocene – Pleistocene Guatire Formation (TQg).

The region is also characterized by metamorphic and intrusive rocks ranging in age from the Proterozoic to the Mesozoic. From oldest to youngest, these lithological units comprise:

- the Middle Proterozoic Peña de Mora Augengneiss (Yp),
- the Paleozoic intermediate- to mafic metaplutonic rocks (Pzim),
- the Ordovician – Permian metagranitic rocks (Pzag),
- the Paleozoic San Julián Complex (Pzsj),
- the Silurian Sebastopol Gneiss (Ssg),

- the Mesozoic ultramafic rocks (Mo),
- the Jurassic – Cretaceous Las Brisas Schist (JKlb),
- the Jurassic – Cretaceous Las Mercedes Schist (JKlm),
- the Cretaceous Tacagua Schist (Kta), and
- the Cretaceous Nirgua Complex (Kn).

The related information was derived from the Geological shaded relief map of Venezuela compiled by Hackley et al. (2005) and available online at: <https://pubs.usgs.gov/of/2005/1038/>

The geological map is presented in the following map.



GEOLOGY OF THE MOST AFFECTED PART OF COASTAL NORTHERN VENEZUELA

The area that sustained the greatest damage by the 24 June 2026 Venezuela earthquakes is located in the coastal area of La Guaira state, north of Caracas. The recent deposits in this area consist of Quaternary channel and alluvial fan deposits, while their basement is predominantly composed of metamorphic rocks.

The geology of Caracas and the northern coastal zone of Venezuela has been extensively investigated and documented by Dengo (1953), Wehrmann (1969), Urbani and Ostos (1989), Urbani et al. (1997), and Salcedo (2000).

Mesozoic and Paleozoic formations

The Mesozoic Tacagua formation, composed mainly of schists, crops out parallel to the coastline and extends approximately 1 km inland. Soils developed on these schists are generally thin, ranging from 0.5 to 3.0 m in thickness (Salcedo, 2000), and are characterized by a fine-grained texture and a distinctive red color. They commonly occur as clay-rich colluvial deposits overlying moderately to intensely weathered, strongly foliated bedrock. The

A horizon rarely exceeds 0.3 m in thickness, whereas the weathering profile of the underlying bedrock frequently extends beyond 2 m (Merifield, 2001).

Further inland, the Tacagua formation is succeeded by the Paleozoic San Julián formation, consisting of gneiss and schist, and by the Precambrian Peña de Mora formation, which is composed primarily of gneiss. These lithological units extend to the crest of the Sierra de Ávila. The soils developed over both formations are similarly thin, sandy, and light tan to gray in color, reflecting the presence of shallow weathered bedrock. Their limited thickness is attributed to the high erosion rates associated with the steep mountainous terrain.

Quaternary deposits

Terraces composed of prehistoric debris-flow and fluvial deposits occur 10-20 m above the present stream channels, indicating contemporaneous tectonic uplift of the coastal mountain range coupled with accelerated channel incision.



GEOLOGY OF THE MOST AFFECTED PART OF COASTAL NORTHERN VENEZUELA

An arid climatic interval during the Late Pleistocene has been correlated with elevated terraces containing comparable boulder-rich debris-flow deposits resting directly on bedrock approximately 100 km west of the La Guaira region (Schubert, 1985).

Stallard (1988) estimated uplift rates of approximately 2-5 m per 1,000 years for terraces located at the northern end of the Andes in northwestern Venezuela.

Nevertheless, most Quaternary faults within the study area are interpreted as exhibiting predominantly right-lateral strike-slip displacement rather than significant vertical movement, as exemplified by the San Sebastián Fault (Audemard et al., 2000).

In contrast, offshore Quaternary fault systems may include a substantial vertical displacement component. Additional evidence of vertical tectonic movement is observed near Maiquetía International Airport, where the fault-scarp contact between the Pliocene Cabo Blanco formation and the Mesozoic

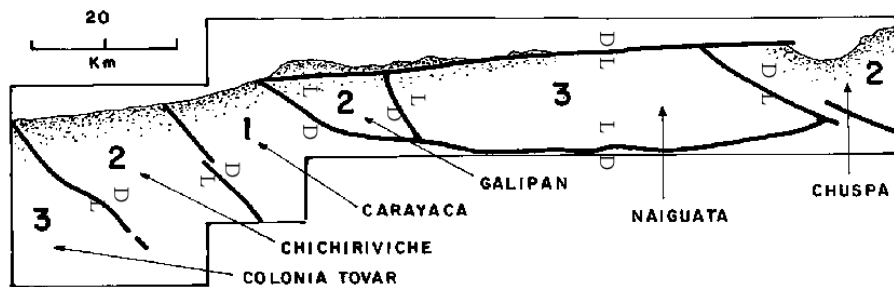
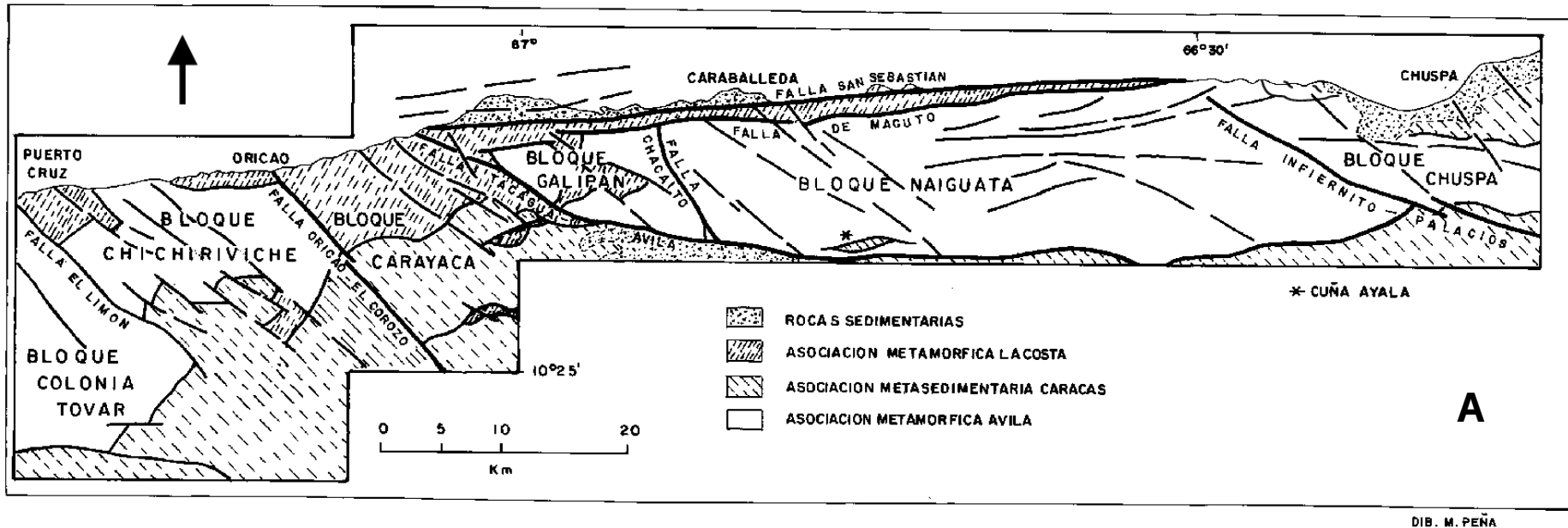
Tacagua formation exhibits measurable vertical offset (Audemard et al., 2000).

The alluvial fans in the Vargas region are only weakly incised. Their central axes are typically elevated by approximately 5 m relative to their lateral margins, while active stream channels have incised the fan surfaces by only a few meters. This limited degree of channel entrenchment suggests that, over geological timescales, sediment supply from the upstream catchments has been equal to or greater than the rate of sediment removal by fluvial processes.

The combination of steep mountainous relief and actively aggrading alluvial fans at the mountain front is indicative of a geomorphically youthful stage in the evolution of the alluvial-fan systems within the region (Sorriso-Valvo, 1988).



GEOLOGY OF THE MOST AFFECTED PART OF COASTAL NORTHERN VENEZUELA



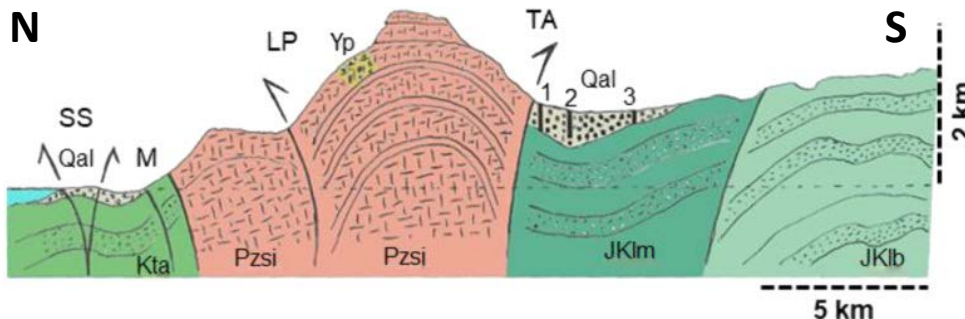
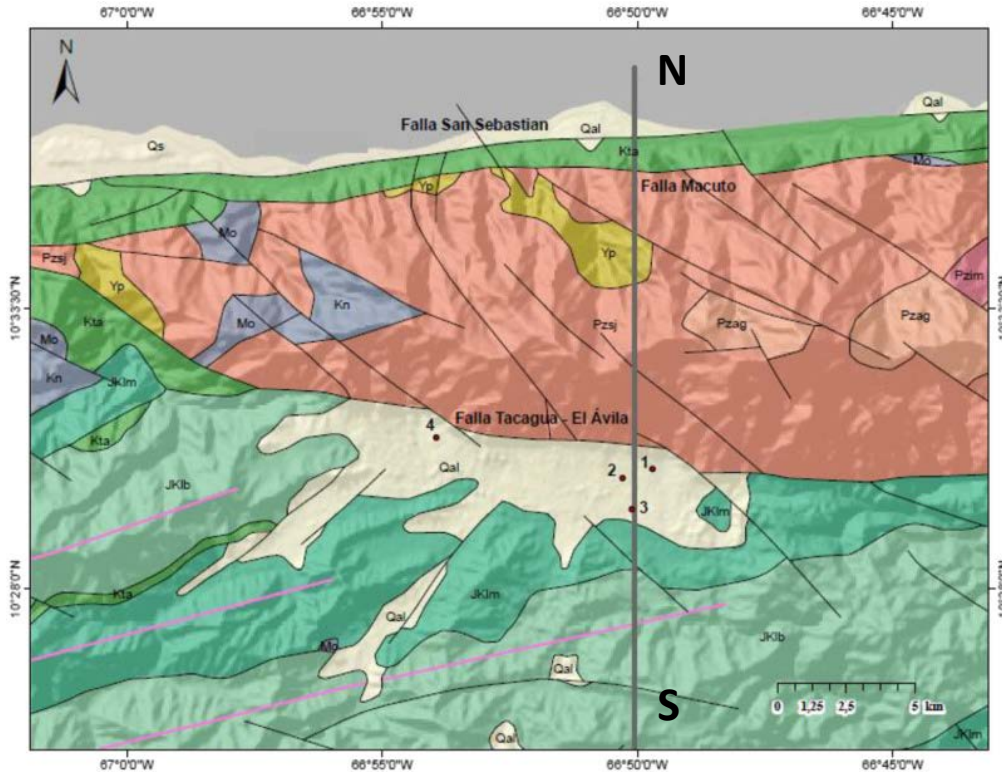
ESQUEMA DE BLOQUES TECTÓNICOS

GRADO RELATIVO DE EXHUMACIÓN:
3: MAYOR
2: INTERMEDIO
1: MENOR

(A) Simplified geological map of the area most affected by the 24 June 2026 earthquakes.
(B) Map of the corresponding fault blocks (after Urbani, 2002).



GEOLOGY OF THE MOST AFFECTED PART OF COASTAL NORTHERN VENEZUELA



◀ Geological map and cross section of the area most affected by the 24 June 2026 earthquakes. Geological units (youngest to older) are:

Qal: Pleistocene to Holocene alluvial deposits

Qs: Pleistocene deposits

Kn: Nirgua complex

Kta: Tacagua schist and Antímano marble

JKIm: Las Mercedes schist

JKlb: Las Brisas schist

Mo: Ultramafic rocks

Pzsj: San Julián complex

Pzag: Ávila metamorphic association, metagranitic rocks

Pzim: Ávila metamorphic association, intermediate to mafic metaplutonic rocks

Yp: Ávila metamorphic association, Peña de Mora augengneiss.

Faults

SS: San Sebastián

M: Macuto

LP: Las Pailas

TA: Tacagua-El Ávila

After Schmitz et al. (2020)



ACTIVE FAULTS OF NORTHERN VENEZUELA – THE BOCONÓ FAULT SYSTEM (VE-06)

The earthquake epicenters on 24 June 2026 are located along a fault that belongs to the Boconó Fault System, which is a major NE-SW–trending right-lateral strike-slip fault system. This system runs slightly oblique to the main axis of the Venezuelan Andes and defines the western boundary of the Caribbean Coast Range of northern Venezuela. It extends for approximately 500 km, from the Táchira Depression at the Venezuela–Colombia border to Morón on the Venezuelan Caribbean coast.

At its northern termination, the Boconó Fault System, after exiting the Yaracuy Depression and entering the Caribbean Sea, bends approximately 45° eastward, where it links with the E-W–trending San Sebastián (VE-16) and El Pilar (VE-13) faults. The entire fault network is regarded as the principal southern boundary of the Caribbean Plate. To the south, the Boconó Fault connects with a left-lateral to reverse fault system that includes the Bramón Fault in Venezuela and the Chinácota and Chucarima faults in Colombia. This system forms the southwestern segment of the Pamplona indenter, characterized by two opposing right-angle

bends, producing an overall “S-shaped” geometry. From the Pamplona indenter in eastern Colombia, the plate boundary continues southward as far as the Jambelí Graben in the Gulf of Guayaquil, Ecuador.

Significant thrust faulting also occurs subparallel to the Boconó Fault on both sides of the Andean range, contributing to the maintenance of topographic elevation. As a result, strain is partitioned between strike-slip motion and shortening due to an oblique E-W-oriented maximum horizontal stress field. A number of active pull-apart basins are associated with releasing bends and stepovers along the trace of the Boconó Fault, including the Las González, Mucuchíes, Cabudare, and Yaracuy basins, among others. The Yaracuy Basin, in particular, appears to be related to a 45° clockwise bend in the fault trace, and its formation may involve processes other than simple transtensional deformation.

Source: Audemard et al. (2000)



ACTIVE FAULTS OF NORTHERN VENEZUELA – THE VE-06e SECTION

VE-06e – Cabudare–Morón Section of Boconó Fault System

This segment of the Boconó Fault extends from Cabudare in the southwest to Morón in the northeast and continues offshore into the Caribbean Sea. It is also referred to as the Yaracuy or San Felipe section, although the former name may be confused with Yaracuy State, while the latter derives from the nearby city of San Felipe.

The fault is characterized by a series of aligned geomorphic features indicative of active dextral strike-slip tectonics. These include fault scarps, faceted spurs, benches, trenches, sag ponds, pop-up structures, shutter ridges, and linear ridges developed within middle- to late-Pleistocene alluvial deposits. The right-lateral displacement of drainage channels and alluvial fans, such as the Yaritagua alluvial fan, provides clear evidence for the sense of motion along the fault.

Toward its northeastern end, this fault segment undergoes an approximately 45° clockwise bend before linking with the predominantly offshore, E-

W-trending San Sebastián Fault (VE-16). This change in fault orientation is considered responsible for the development of the Yaracuy Basin, replacing the earlier interpretation that attributed the basin to pull-apart tectonics.

Related studies indicate a recurrence interval of approximately 700-2,000 years for large earthquakes of magnitude $M_s=7.4-7.5$, corresponding to rupture of the entire fault segment. The estimated slip rate ranges between 1 and 3 mm/yr. The most recent documented displacement appears to be of Holocene age and is observed near the northern onshore termination of the fault, where it crosses the coastal sector of the Yaracuy Basin.

Source: Audemard et al. (2000)



ACTIVE FAULTS OF NORTHERN VENEZUELA – THE SAN SEBASTIÁN FAULT SYSTEM (VE-16)

VE-16 – San Sebastián Fault

The San Sebastián Fault is an approximately 500-km-long strike-slip fault for which relatively little information is available regarding its age and long-term activity. It extends offshore along the north-central coast of Venezuela, forming the northern boundary of the greenschist-facies metamorphic rocks of the Venezuelan Coastal Range. Together with the Boconó (VE-06), El Pilar (VE-13), and Los Bajos (VE-15) faults, it constitutes one of the principal strike-slip structures accommodating the relative motion between the Caribbean and South American plates. The fault is exposed on land only over a very limited distance near Caracas International Airport, where it is locally referred to as the Bruscas Fault.

Prior to the expansion and modernization of the area, the fault displayed a variety of geomorphic features typical of active strike-slip deformation, including offset drainage channels, fault scarps, shutter ridges, linear fault ridges, and sag ponds. These landforms are clearly visible in older aerial photographs but they have been largely destroyed by urban and infrastructure development.

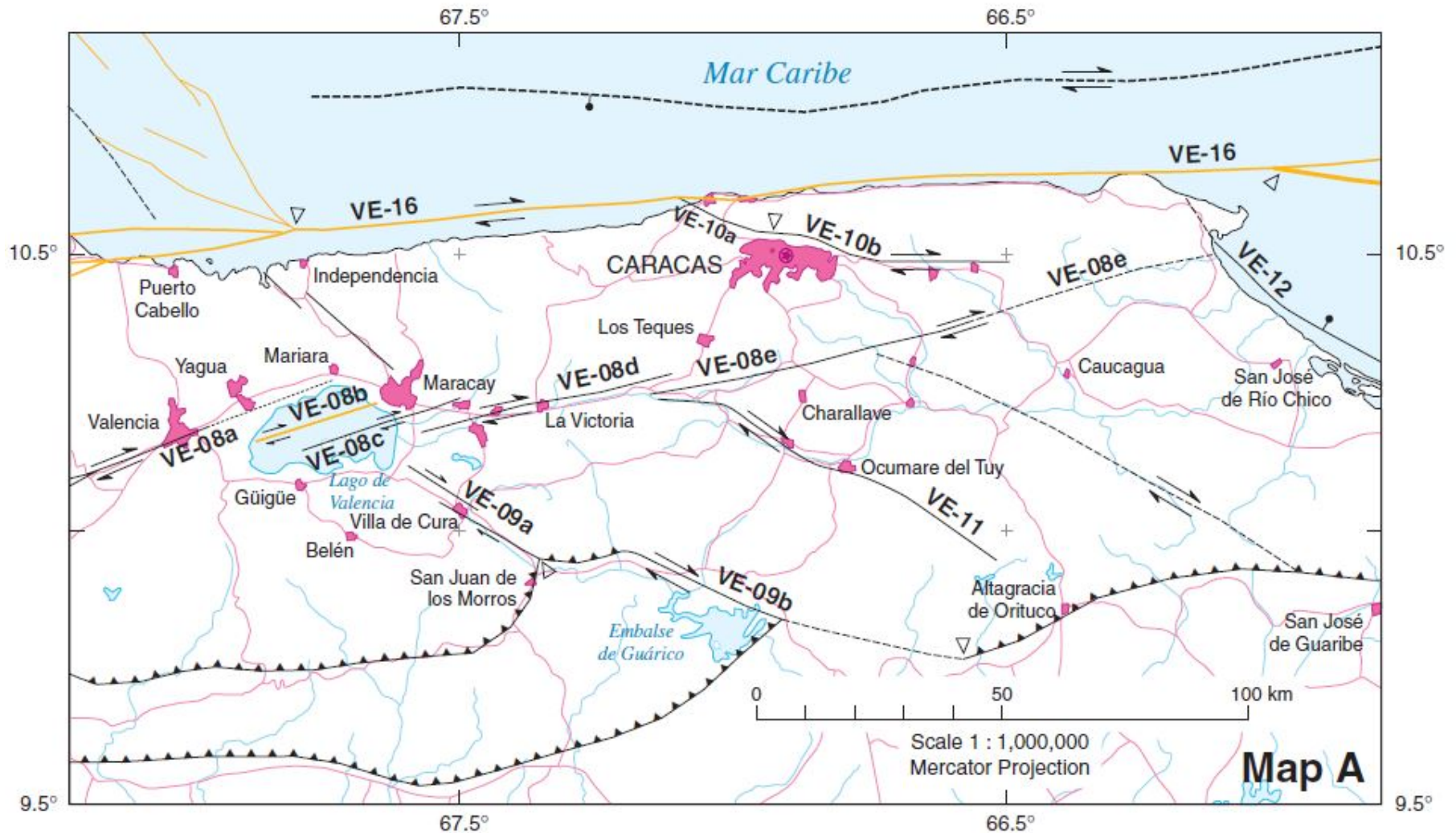
The recurrence interval of large earthquakes along the San Sebastián Fault remained poorly constrained. Its long-term slip rate was estimated at approximately 3–5 mm/yr, based on extrapolation from the adjacent Boconó Fault (VE-06). This estimate reflects the interpretation that the Boconó–San Sebastián–El Pilar fault system represents the principal strike-slip plate boundary between the Caribbean and South American plates. Given that the total relative plate motion is approximately 10 mm/yr, it is inferred that roughly half of this displacement is accommodated by the San Sebastián Fault, while the remaining motion is distributed among other subparallel, predominantly offshore faults within the ~100-km-wide plate boundary zone.

The inferred slip rate of 3–5 mm/yr, together with the presence of relatively young geomorphic features formerly preserved near Caracas International Airport, indicates that the most recent surface displacement is likely younger than approximately 15 ka.

Source: Audemard et al. (2000)



ACTIVE FAULTS OF NORTHERN VENEZUELA – THE SAN SEBASTIÁN FAULT SYSTEM (VE-16)



After Audemard et al. (2000)



ACTIVE FAULTS OF NORTHERN VENEZUELA – THE EL PILAR FAULT (VE-13)

The El Pilar fault extends roughly E-W between the Cariaco Trough and the Gulf of Paria, in northeastern Venezuela. It runs mainly offshore, although a 70-km-long section can be followed onshore in the Sucre State, between the Gulfs of Cariaco and Paria, where it mainly juxtaposes Mesozoic metamorphics rocks exposed in the Araya and Paria Peninsulas on the north against the Mesozoic sedimentary foreland sequence of the Interior Range.

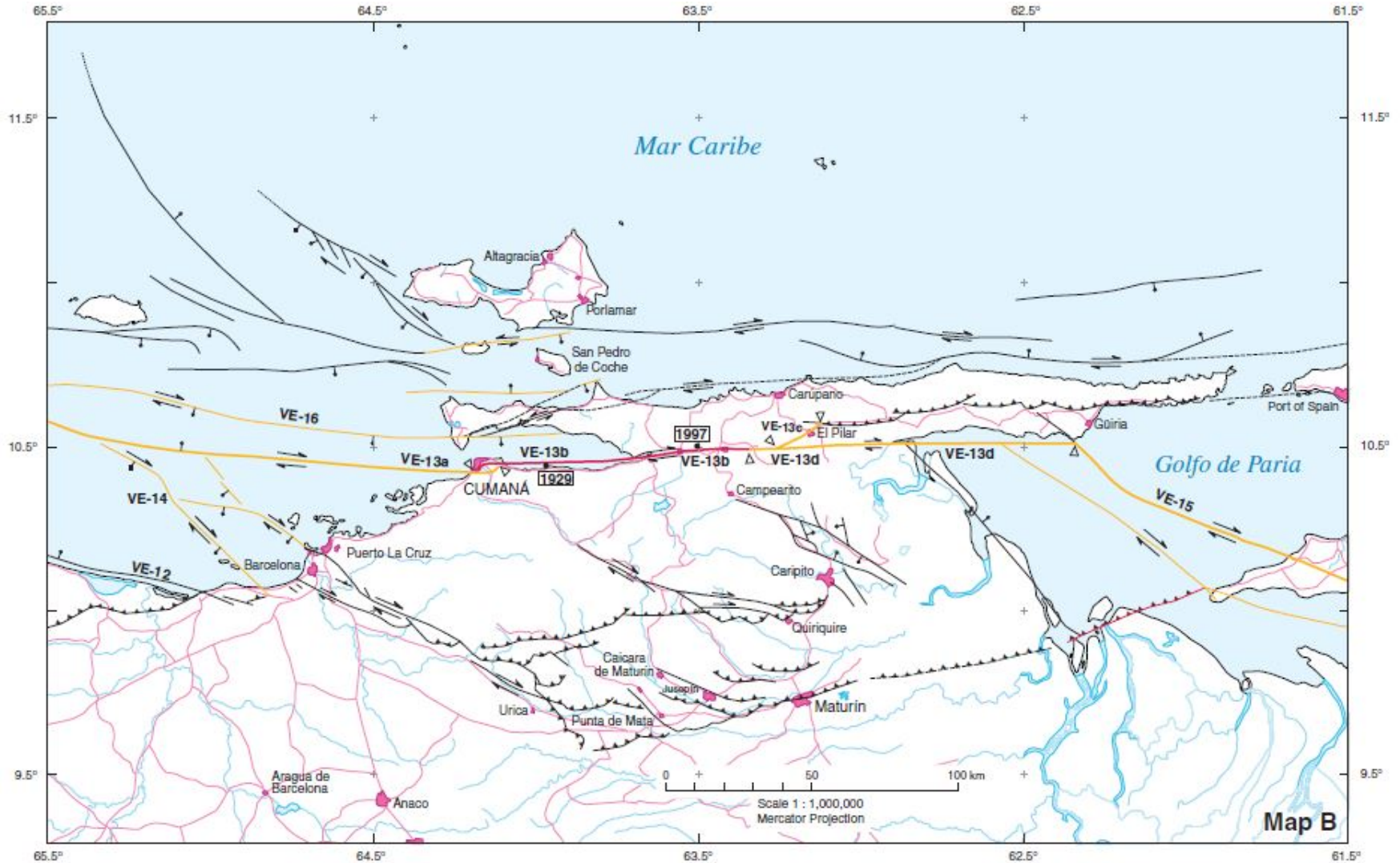
The El Pilar fault, along with the Boconó [VE-08] and San Sebastián [VE-16] faults, is considered to be the main boundary between the Caribbean and South America plates. However, the plate boundary is An almost 100-km-wide zone where active transpression is accommodated and partitioning is occurring (strike-slip mostly along Boconó-San Sebastián-El Pilar fault system and transverse compression accommodated by the entire transpressional zone). Transcurrent slip along this fault has been estimated at as much as 1,000 km, although a new reconstruction of the Southern Caribbean boundary amounts to only 55 km of strike-slip along this major fault system. This new,

much smaller offset seems to be in close agreement with the width of the Cariaco trough as measured along the opening direction (E-W) of the associated releasing bend.

Source: Audemard et al. (2000)



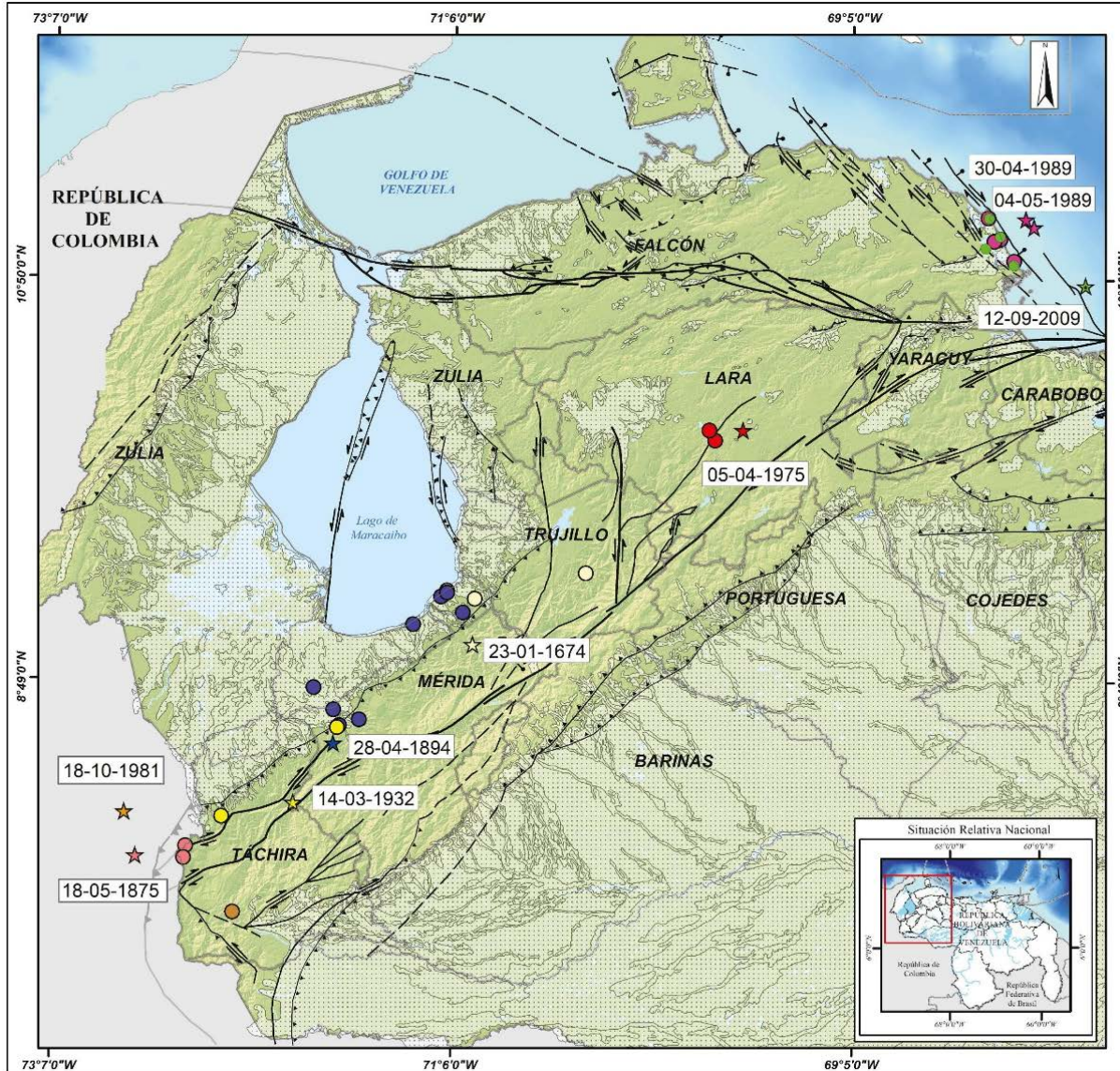
ACTIVE FAULTS OF NORTHERN VENEZUELA – THE EL PILAR FAULT (VE-13)



After Audemard et al. (2000)



ACTIVE FAULTS OF NORTHERN VENEZUELA

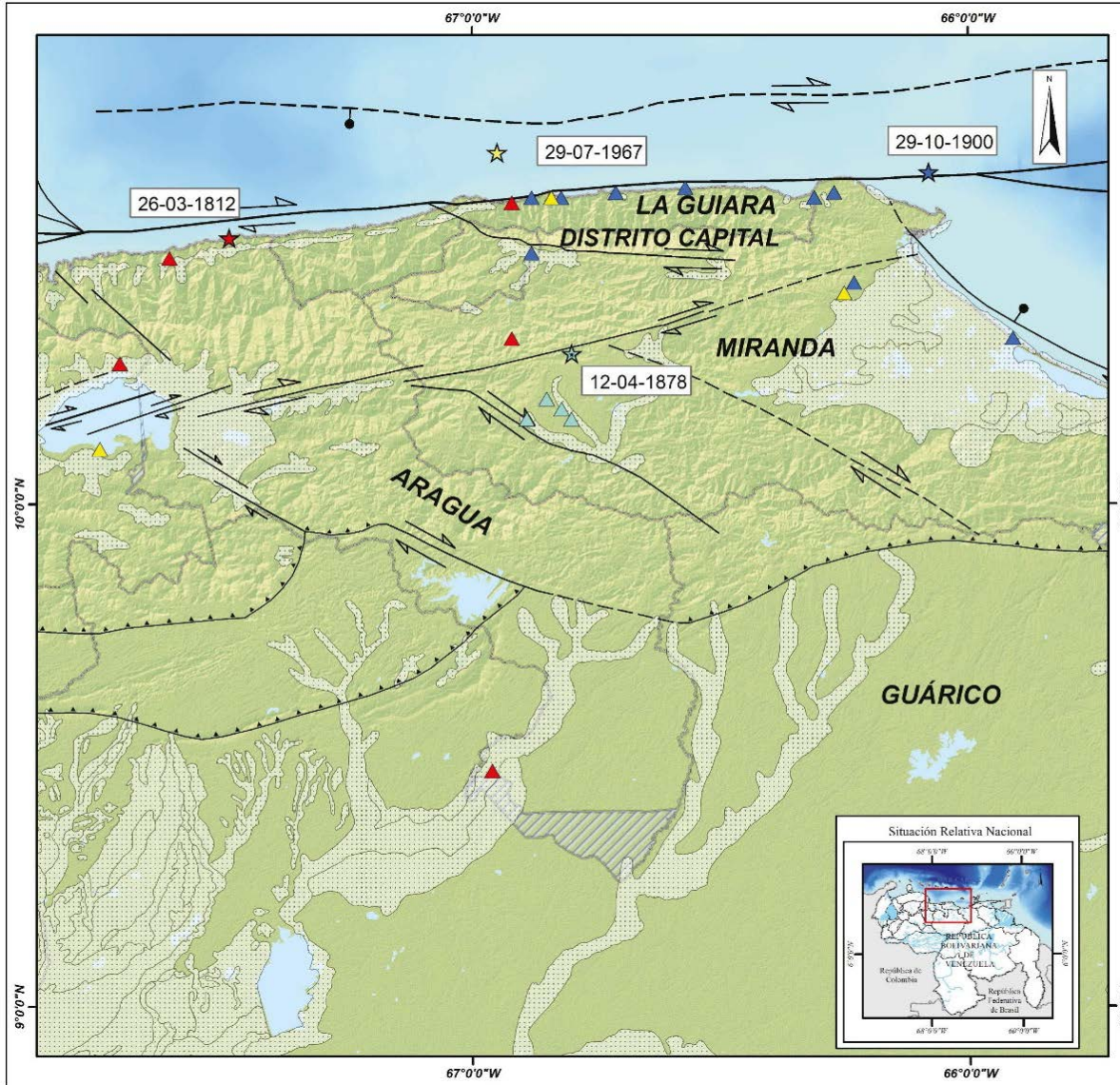


Major faults in the western part of Venezuela, showing the epicentres of strong earthquakes and the locations where liquefaction phenomena have been documented.

Available online at:
http://www.funvisis.gob.ve/atlas/pdf/atlas_Atlas_Sismologico_de_Venezuela_WEB.pdf



ACTIVE FAULTS OF NORTHERN VENEZUELA

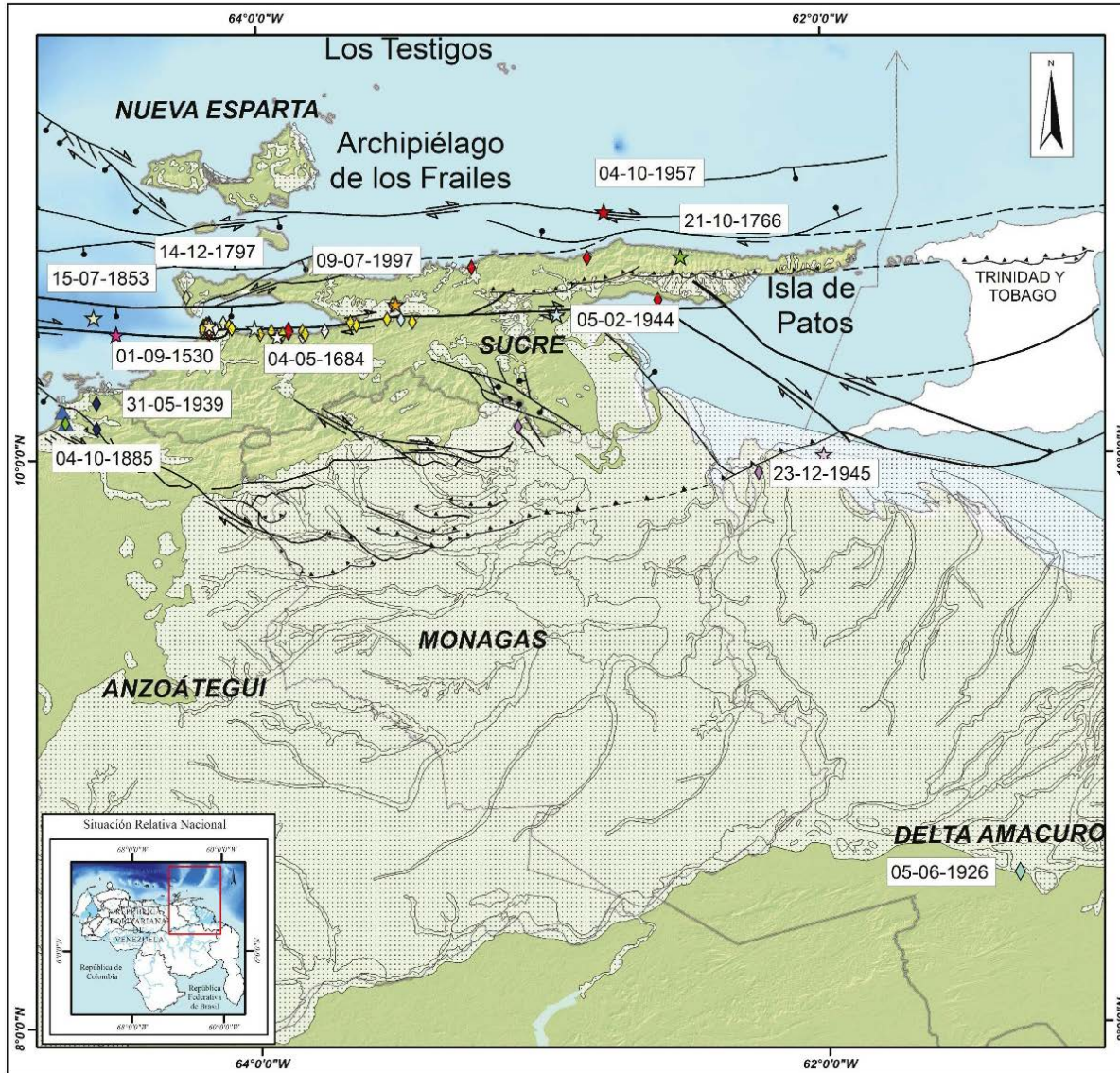


Major faults in the central part of Venezuela, showing the epicentres of strong earthquakes and the locations where liquefaction has been generated.

Available online at:
http://www.funvisis.gob.ve/atlas/pdf/atlas_Atlas_Sismologico_de_Venezuela_WEB.pdf



ACTIVE FAULTS OF NORTHERN VENEZUELA



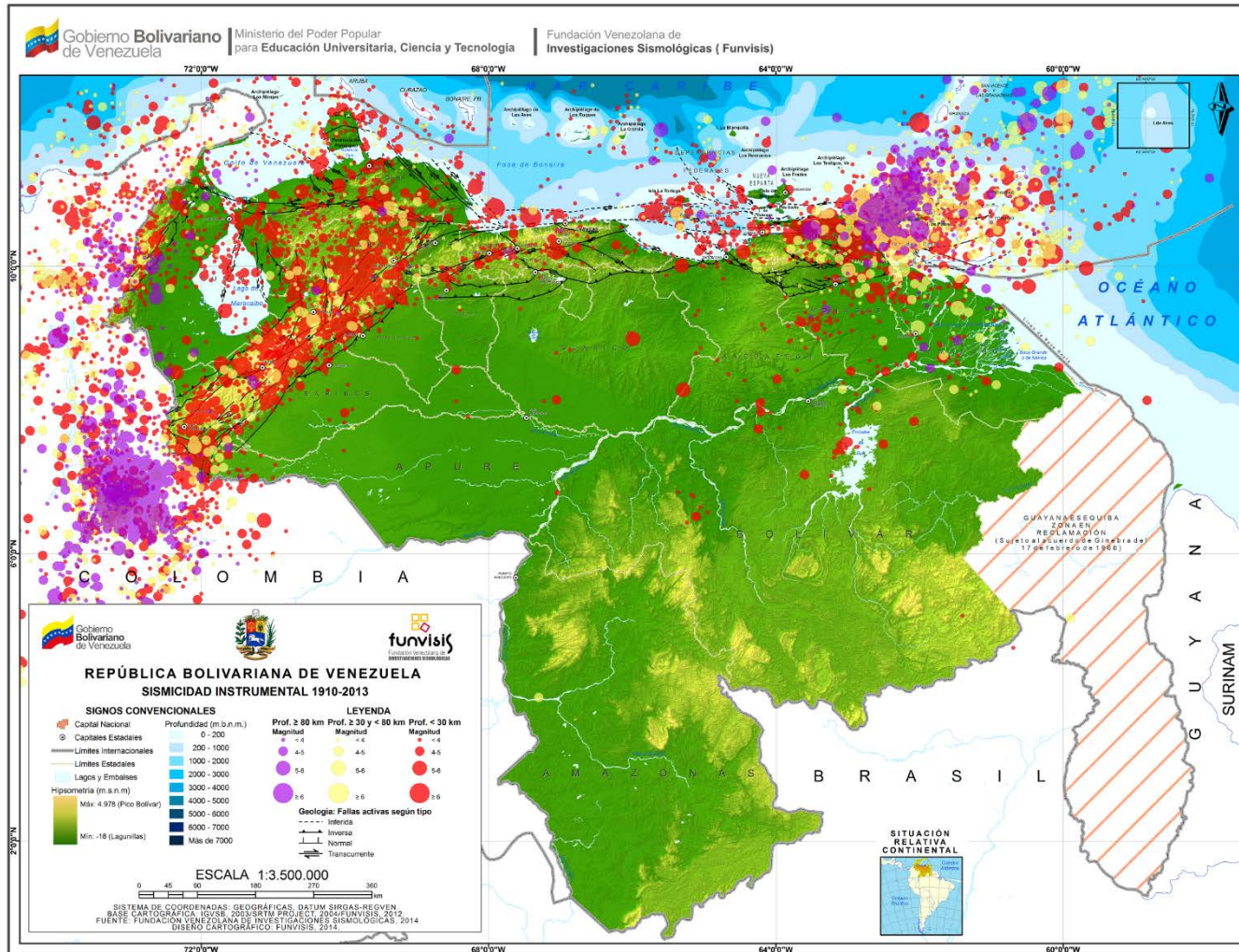
Major faults in the eastern part of Venezuela, showing the epicentres of strong earthquakes and the locations where liquefaction phenomena have been triggered.

Available online at:

http://www.funvisis.gob.ve/atlas/pdf/atlas Atlas Sismologico de Venezuela_WEB.pdf



INSTRUMENTAL SEISMICITY FROM 1910 TO 2013 IN VENEZUELA



Available online at:

http://www.funvisis.gob.ve/old/archivos/mapas/sismicidad_instrumental_1910_2013.png

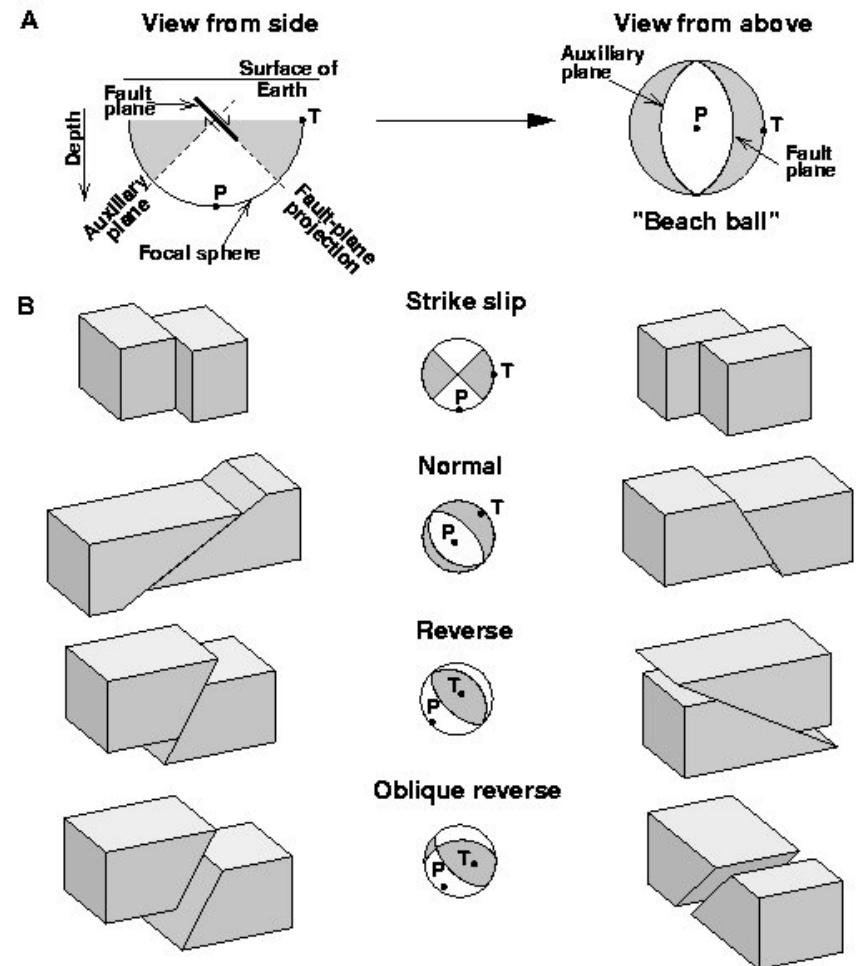


FOCAL MECHANISMS IN VENEZUELA

Strike-slip faulting represents the dominant deformation style along the northern part of Venezuela, particularly within the San Sebastián and El Pilar fault systems, as well as along the Andean chain where it is expressed by the Boconó Fault. These structures accommodate the relative motion between the Caribbean and South American plates and define the principal plate boundary deformation zone in the region.

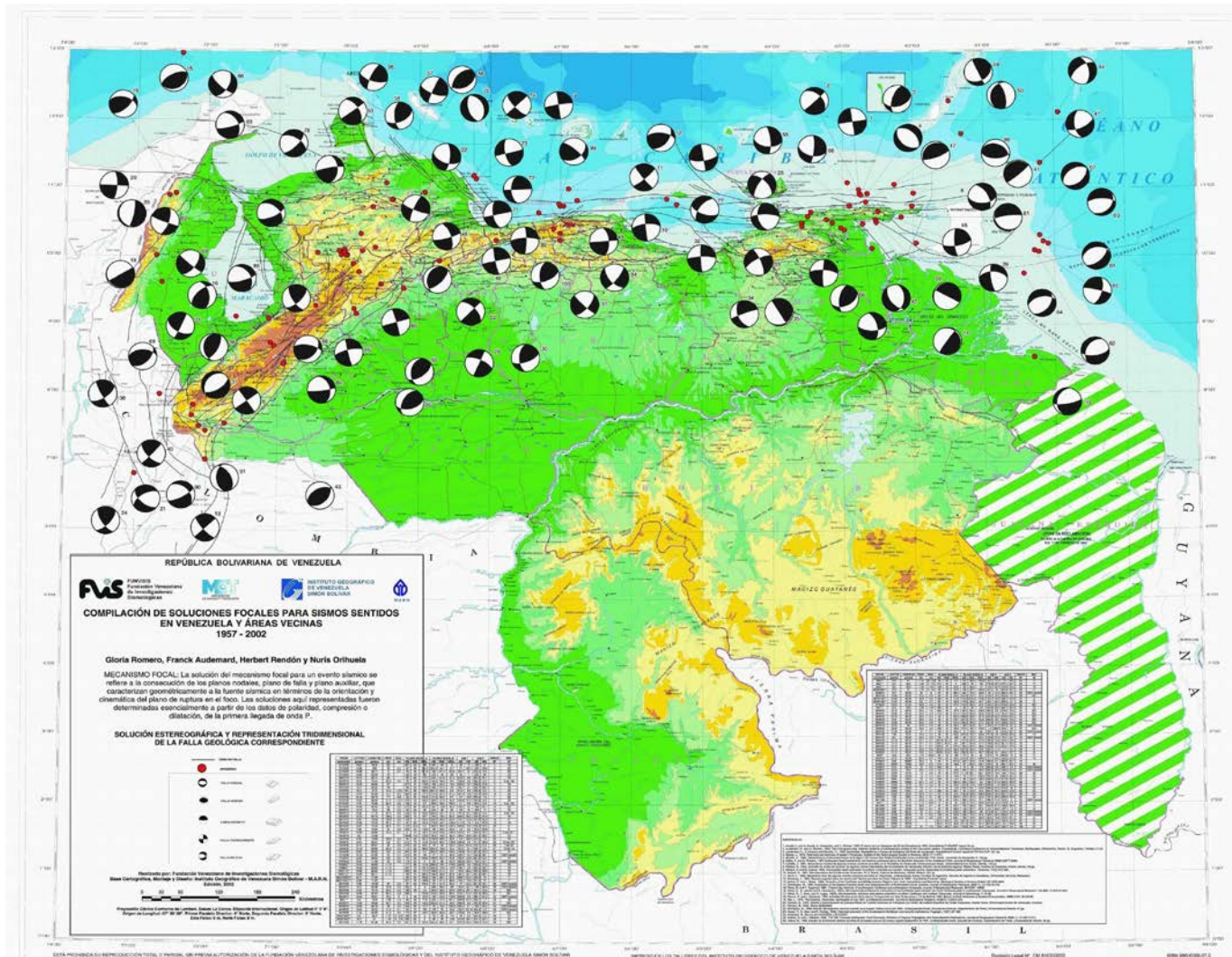
Normal faulting is mainly observed in localized offshore and coastal sectors of northern Venezuela, where changes in fault orientation and stepovers within the strike-slip system generate extensional regimes. These extensional domains give rise to sedimentary basins formed under transtensional tectonic conditions.

Reverse faulting is predominantly developed along the flanks of the Venezuelan Andes and in the western part of the country, where the convergence between tectonic plates is more directly expressed. In these areas, compressional stresses dominate, leading to crustal shortening and uplift through thrust faulting.





FOCAL MECHANISMS IN VENEZUELA AND SURROUNDING AREAS FROM 1957 TO 2002



Available online at:

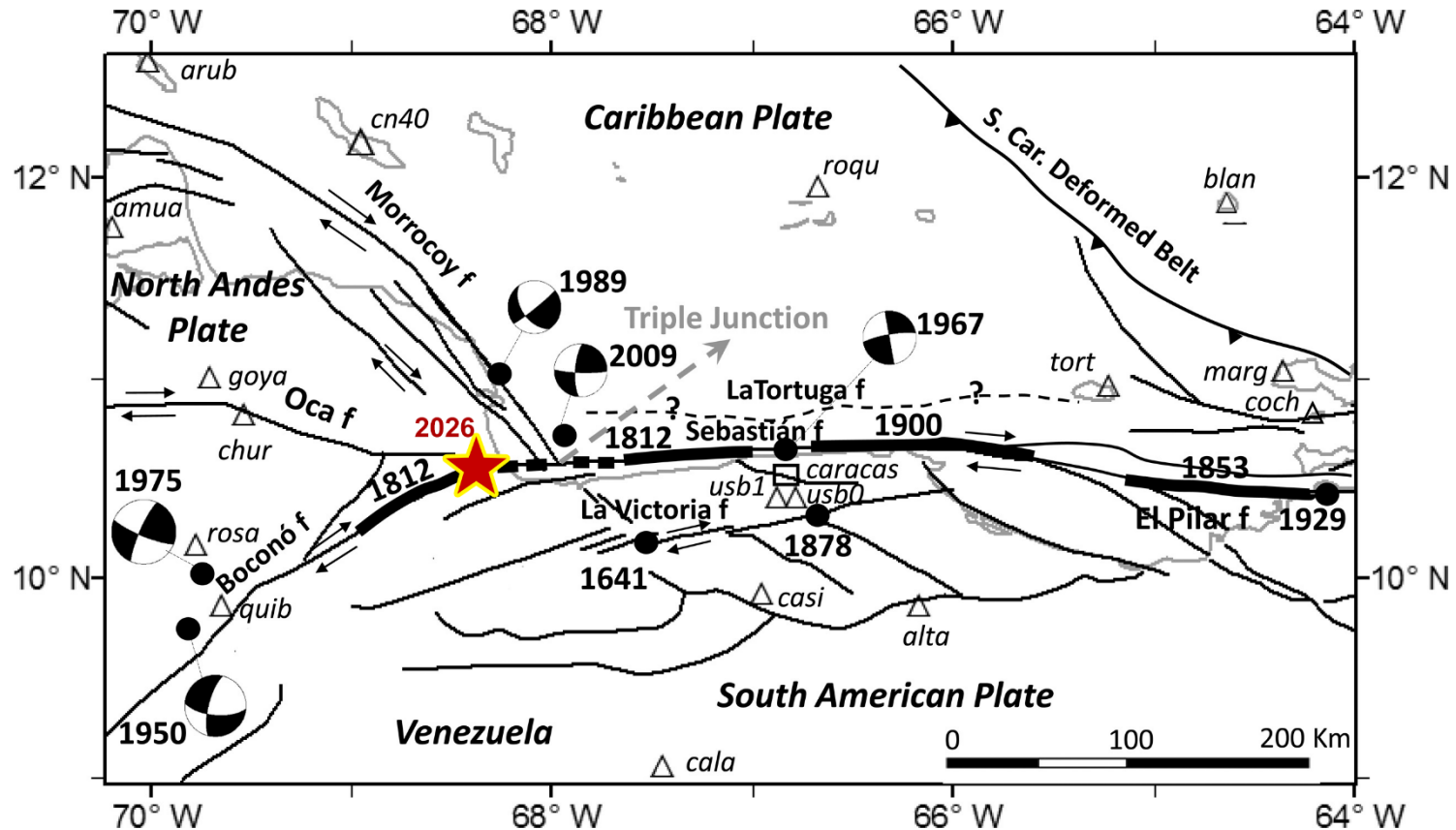
http://www.funvisis.gob.ve/old/archivos/mapas/norma1756_2001.png



RUPTURE ZONES, EPICENTERS AND FOCAL MECHANISMS OF HISTORICAL AND RECENT EARTHQUAKES IN NORTHERN VENEZUELA



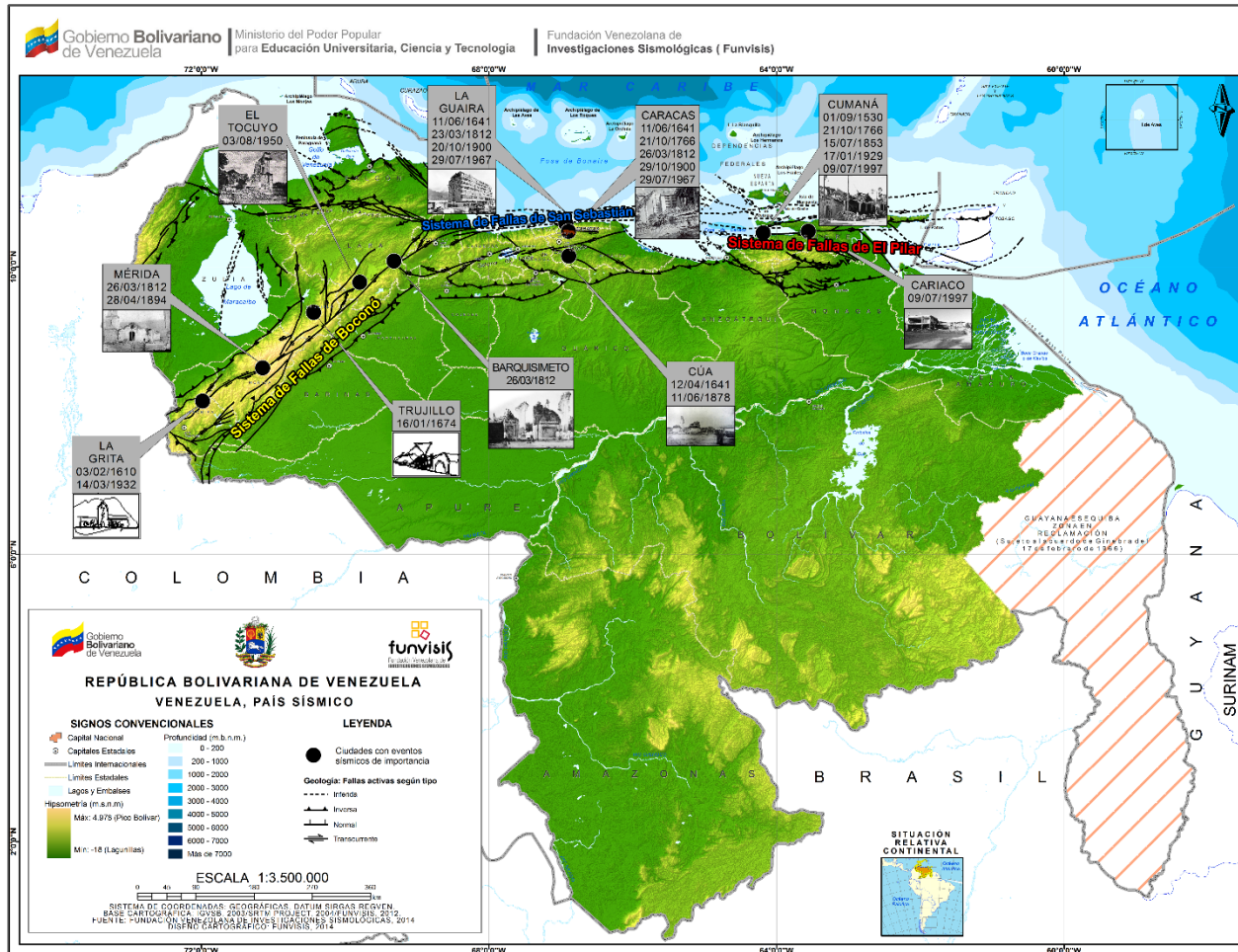
HELLENIC REPUBLIC
National and Kapodistrian
University of Athens
— EST. 1837 —



Rupture zones (thick lines) of major historical earthquakes ($M_w \geq 7.0$) in northern Venezuela since AD 1640, epicenters of large instrumental earthquakes ($M_w \geq 6.0$; black dots), and focal mechanisms of earthquakes that occurred after 1950. The red star marks the approximate location of the 24 June 2026 major earthquakes (modified from Pérez et al., 2018).



CITIES AFFECTED BY SIGNIFICANT HISTORICAL AND RECENT EARTHQUAKES



Caracas
11/06/1641
21/10/1766
26/03/1812
29/10/1900
29/07/1967

Cariaco
09/07/1997

Barquisimeto
26/03/1812

El Tocuyo
03/08/1950

La Guaira
11/06/1641
26/03/1812
29/10/1900
29/07/1967

Trujillo
16/01/1674

Cua
12/04/1641
11/06/1878

Merida
26/03/1812
28/04/1894

Cumana
01/09/1530
21/10/1766
15/07/1853
17/01/1929
09/07/1997

Available online at:

http://www.funvisis.gob.ve/old/archivos/mapas/venezuela_pais_sismico.png



HISTORICAL EARTHQUAKES OF NORTHERN VENEZUELA

Historical seismology is a branch of seismology that began to develop in Venezuela in 1940, when Melchor Centeno Graü, an architect, engineer, and Doctor of Physical and Mathematical Sciences from the Central University of Venezuela (UCV), produced one of the first comprehensive catalogs documenting the earthquakes that had affected the country up to that time.

In Estudios Sismológicos (Seismological Studies), Melchor Centeno Graü compiled one of the first comprehensive catalogs of Venezuelan seismicity, documenting weak, moderate, strong, destructive, and catastrophic earthquakes that occurred between 1530 and 1939. The catalog was developed through an extensive review of historical sources, including books, pamphlets, newspapers, private archival documents, and oral traditions preserved over successive generations. This work provided the first systematic characterization of Venezuela's historical seismicity and laid the foundation for future seismic hazard assessment in the country.

The following section presents historical accounts of

the most destructive earthquakes recorded in the northern part of Venezuela.

11 June 1641

The first historically recorded earthquake affecting Caracas and La Guaira occurred, producing damage consistent with VIII_{MMI} in both localities (Leal Guzmán & Vásquez, 2018). The magnitude of this event has been estimated at Mw=6.0-6.3 (Fiedler, 1972), and its epicenter has been located at approximately 10.9° N, 66.7° W (Fiedler, 1961; Grases, 1990).

This earthquake destroyed the original town of Cúa and caused severe damage in Caracas, where churches and other buildings standing at the time collapsed. The earthquake was also strongly felt in Cumaná. In 1690, a new settlement was established approximately 1 km north of the original site, on the Marín estate, under the name El Rosario de Cúa.



HISTORICAL EARTHQUAKES OF NORTHERN VENEZUELA

21 October 1766

The most significant earthquake of the 18th century struck northeastern Venezuela on 21 October 1766 at 04:30 local time. It was a deep-focus earthquake that was widely felt throughout the region, with its effects documented in 73 localities, where reported intensities ranged from III_{MMI} to X_{MMI} (Mocquet, 2007). The same author estimated the earthquake's magnitude to be between Mw=6.5 and Mw=7.0 and located its epicenter at approximately 11.0° N, 62.5° W.

Due to the extent of its felt area and the duration of its aftershocks, this is probably the largest earthquake to have affected northeastern Venezuela. It caused damage in various localities, including the Castillos de Guayana, as well as Guarenas and Caracas, Margarita Island, and Trinidad. The earthquake was also felt as far west as Maracaibo and as far north as the island of Martinique in the Caribbean Sea. In the Orinoco River, several islands reportedly disappeared.

26 March 1812

This earthquake severely affected widely separated localities, including Mérida, Barquisimeto, San Felipe, and Caracas, leaving behind a tragic toll of victims that is impossible to determine with precision, as well as enormous material losses and severe damage to the urban infrastructure of the affected settlements. It occurred on Maundy Thursday, only minutes after the beginning of the religious service.

In the Mérida region, the human loss is estimated at approximately 5000. In the Barquisimeto and San Felipe areas, both of which suffered severe destruction, fatalities are estimated at around 3000 in San Felipe and between 4000 and 5000 in Barquisimeto. In Caracas, the number of victims is estimated at approximately 10,000. The northern districts of the city were almost completely destroyed, while damage in the southern and western sectors was less severe.



HISTORICAL EARTHQUAKES OF NORTHERN VENEZUELA

Water sources dried up, and cistern piping systems were damaged. In the floodplain areas of the Guaire River, groundwater upwelling and sustained discharge of water were observed for several days.

Significant landslides occurred on El Ávila mountain, accompanied by the formation of large fractures. The earthquake was also felt in other regions of the country.

Based on the spatial distribution of damage, it has been hypothesized that the event may have involved three distinct seismic foci, separated from one another. Choy et al. (2010) identify three distinct events that occurred on that historic Holy Thursday, namely: a Barquisimeto – San Felipe earthquake ($M_w=7.4\pm0.35$) with an epicenter at 10.2° N, 68.95° W; a Caracas – La Guaira earthquake ($M_w=7.1\pm0.33$) with an epicenter at 10.60° N, 67.10° W; and finally, a local earthquake in the city of Mérida ($M_w=6.0$) with an epicenter at 8.65° N, 71.05° W. Taken together, these events unquestionably constitute the most significant national disaster on record.

29 October 1900

The tsunamigenic earthquake of 29 October 1900 at 04:41 local time primarily affected the settlements located along the north-central coastal region of Venezuela and is perhaps one of the largest earthquakes that has occurred in the country.

The magnitude of the 1900 earthquake has been estimated at $M_w=7.6$, and its epicenter has been located at approximately 10.8° N, 66.25° W (Vásquez et al., 2018). This earthquake was widely felt throughout the national territory, from Táchira to Carúpano, and its effects (including casualties, damage, and coseismic phenomena) were reported in 83 Venezuelan localities, with the highest intensities recorded in the capital and eastern regions.

This earthquake affected Macuto, Naiguatá, Guatire, Guarenas, Higuerote, Carenero, and several other towns in the Barlovento region, where extensive damage and casualties were reported.



HISTORICAL EARTHQUAKES OF NORTHERN VENEZUELA

In Caracas, many buildings developed severe cracks and some collapsed due to the 1900 earthquake. According to The Times of London (30 October – 2 November 1900), the second floor of the British Legation was destroyed.

In La Vega and El Valle, houses were damaged and one person was killed. In Baruta, four people were injured. In Antímano and Los Teques, several houses collapsed. In Petare and Los Mariches, injured people and one fatality were reported. In Higuerote, multiple fatalities and injuries occurred.

In San José de Río Chico, the river overflowed its banks and flooded toward Río Chico. In Puerto Tuy, sea waves reportedly rose several meters. Paparo suffered severe damage, while Carenero recorded three fatalities. Tacarigua, Curiepe, Capaya, Caruao, and Río Grande were heavily affected. In Carayaca, injuries were reported. In Naiguatá, Los Caracas, and Camurí Grande, ground fissures, landslides, and fatalities occurred. Chuspa, La Sabana, and Quebrada Seca experienced widespread damage, while Barcelona showed ground cracking and Clarines also sustained damage.



La Guzmania, Macuto, La Guaira.
Source: El Cojo Ilustrado, Caracas (1900).

Available at:
http://www.funvisis.gob.ve/atlas/pdf/atlas_Atlas_Sismologico_de_Venezuela_WEB.pdf



HISTORICAL EARTHQUAKES OF NORTHERN VENEZUELA **DAMAGE CAUSED BY THE 29 OCTOBER 1900 EARTHQUAKE**



House that formerly housed the Protestant church, Caracas.

Source: Venezuelan Foundation of Seismological Research (FUNVISIS).



Partially collapsed house at the corner of Los Traposos, toward the southwest of Caracas.

Source: Venezuelan Foundation of Seismological Research (FUNVISIS).

Available online at:

http://www.funvisis.gob.ve/atlas/pdf/atlas_Atlas_Sismologico_de_Venezuela_WEB.pdf



HISTORICAL EARTHQUAKES OF NORTHERN VENEZUELA **DAMAGE CAUSED BY THE 29 OCTOBER 1900 EARTHQUAKE**



1. Casa La Ceiba, belonging to the Morales Brothers, Macuto.

2. Jiménez Street, Guarenas. **3.** Main Church, Guatire. Available online at:

http://www.funvisis.gob.ve/atlas/pdf/atlas_Atlas_Sismologico_de_Venezuela_WEB.pdf



HISTORICAL EARTHQUAKES OF NORTHERN VENEZUELA **DAMAGE CAUSED BY THE 29 OCTOBER 1900 EARTHQUAKE**



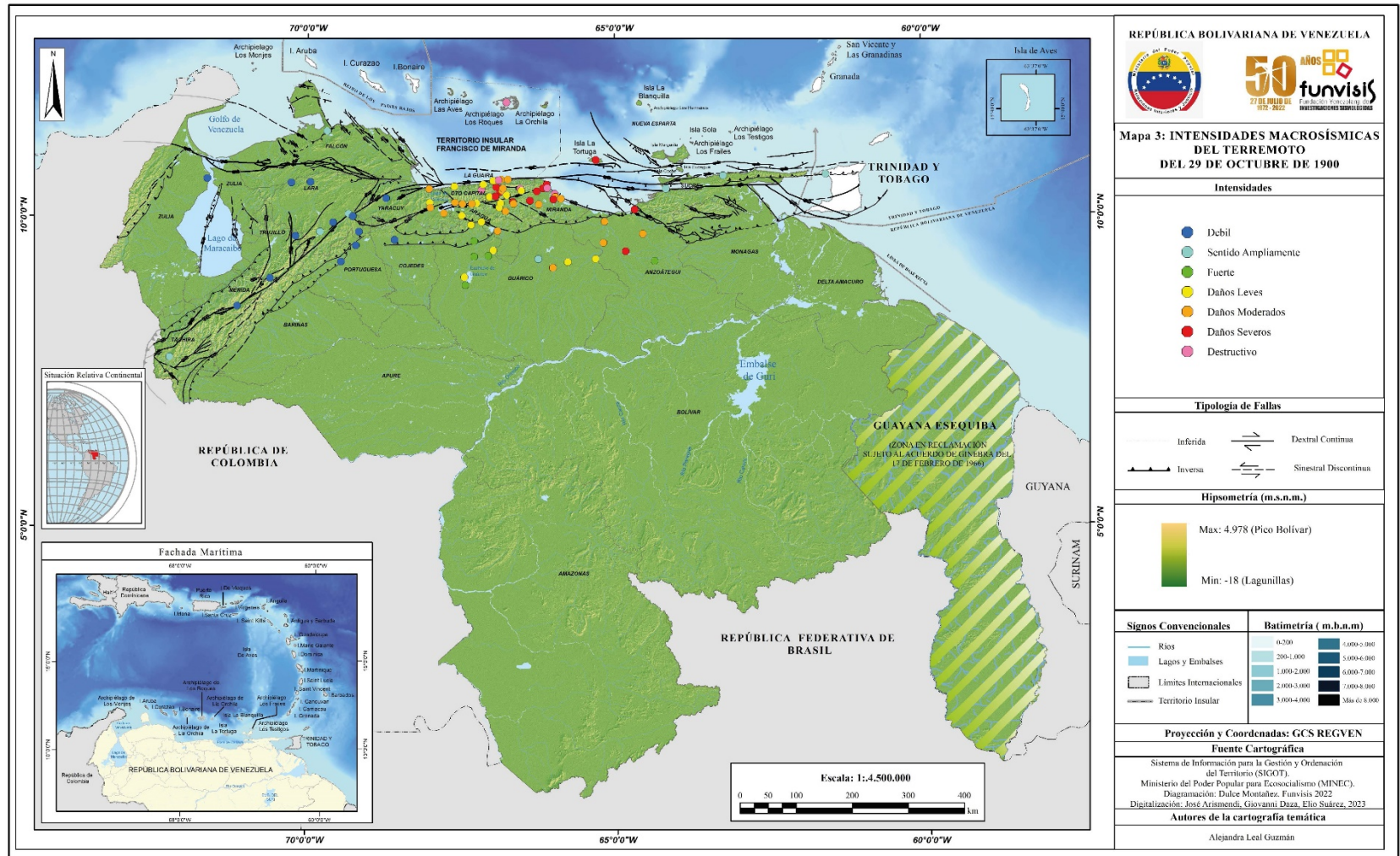
- (1) 1900 earthquake.
Camp in La Pastora.
(2) Guatire.
Ruins of the El Calvario
Chapel and the entrance
façade of the Parish Church.
(3) Effects of the 1900
earthquake on a house in
Caracas.
(4) Maiquetía.
Ruins of the Parish Church
after the earthquake.

Available online at:

[https://funvisisinvestigacion.blogspot.com/2023/10/
el-terremoto-del-29-de-octubre-de-1900.html](https://funvisisinvestigacion.blogspot.com/2023/10/el-terremoto-del-29-de-octubre-de-1900.html)



HISTORICAL EARTHQUAKES OF NORTHERN VENEZUELA THE 29 OCTOBER 1900 EARTHQUAKE



Map of macroseismic intensities of the 29 October 1900 earthquake (Available online at: http://www.funvisis.gob.ve/atlas/pdf/atlas_Atlas_Sismologico_de_Venezuela_WEB.pdf)



RECENT EARTHQUAKES OF NORTHERN VENEZUELA

29 July 1967

This earthquake struck the city of Caracas during the celebration of its Quatricentennial. The event had a magnitude of $M_w=6.6$ and an epicenter located at approximately 10.77° N, 67.10° W (Suárez and Nabelek, 1990).

The Caracas Quatricentennial Earthquake, caused significant damage in Caraballeda, Caracas, and along the central coastal region, and was felt throughout the north-central part of the country. Localized effects were also reported south of Lake Valencia, as well as slope failures and landslides in the Coastal Range (Cordillera de la Costa).

Rial (1977) concluded that the earthquake consisted of a multiple-event rupture along a NW–SE trending strike-slip fault system, comprising three events, possibly associated with the Tacagua Fault system.

The earthquake caused 240 fatalities, 1536 injuries, and an estimated economic loss of 50 million USD. Other national institutional reports indicate 274 fatalities, approximately 2,000 injured, and total losses of up to 100 million USD (Grases, 1990).

The earthquake impact was highly significant for Venezuelan structural engineering practice. The total collapse of four 10–12-storey buildings constructed between 1962 and 1966, the partial collapse of other buildings of similar height, some of which were later demolished, the failure of low-rise structures in the Caraballeda area, and the pronounced site effects in the Caracas Valley and surrounding areas provided critical new evidence for earthquake-resistant design.

Furthermore, the earthquake led to the creation of the Venezuelan Foundation of Seismological Research (Fundación Venezolana de Investigaciones Sismológicas – FUNVISIS) in 1972, with the aim of monitoring and studying seismic hazard in Venezuela.



RECENT EARTHQUAKES OF NORTHERN VENEZUELA

1



1. House affected by liquefaction. Caraballeda, Central Coastal Region.

2. The Charaima Mansion, Caraballeda, 1967. The structure was originally designed for six floors. However, four additional floors were later added, which collapsed from the earthquake.

3. Rubble of the Mijagual Building. Source: Earthquake Investigation Commission (1967).

2



3





SEISMIC ZONATION AND CODES OF VENEZUELA

Seismic zoning map of the COVENIN Standard 1756-1: 2001

Starting in 1990, the seismic standards were revised, and as a result, the “Seismic-Resistant Buildings” Standard COVENIN 1756-1:2001 was published in 2002.

Previously, in 1998, the COVENIN 1756-1:1998 Standard had been issued, which was later modified and improved with respect to the parameters defining spectral shapes, leading to the 1756-1:2001 version. This document expands and improves the description of structural systems.

The maximum horizontal ground acceleration coefficient in the highest hazard zone was increased from 0.30 to 0.40.

Soil classification is more detailed, with each type defined according to shear-wave velocity, and an additional profile (S4) was introduced for distant earthquakes, accounting for surface amplification of rock acceleration in geotechnical profiles with shear-wave velocities typical of very recent alluvial deposits.

The elastic spectral shape of 1982 is maintained, but the inelastic design spectrum was modified.

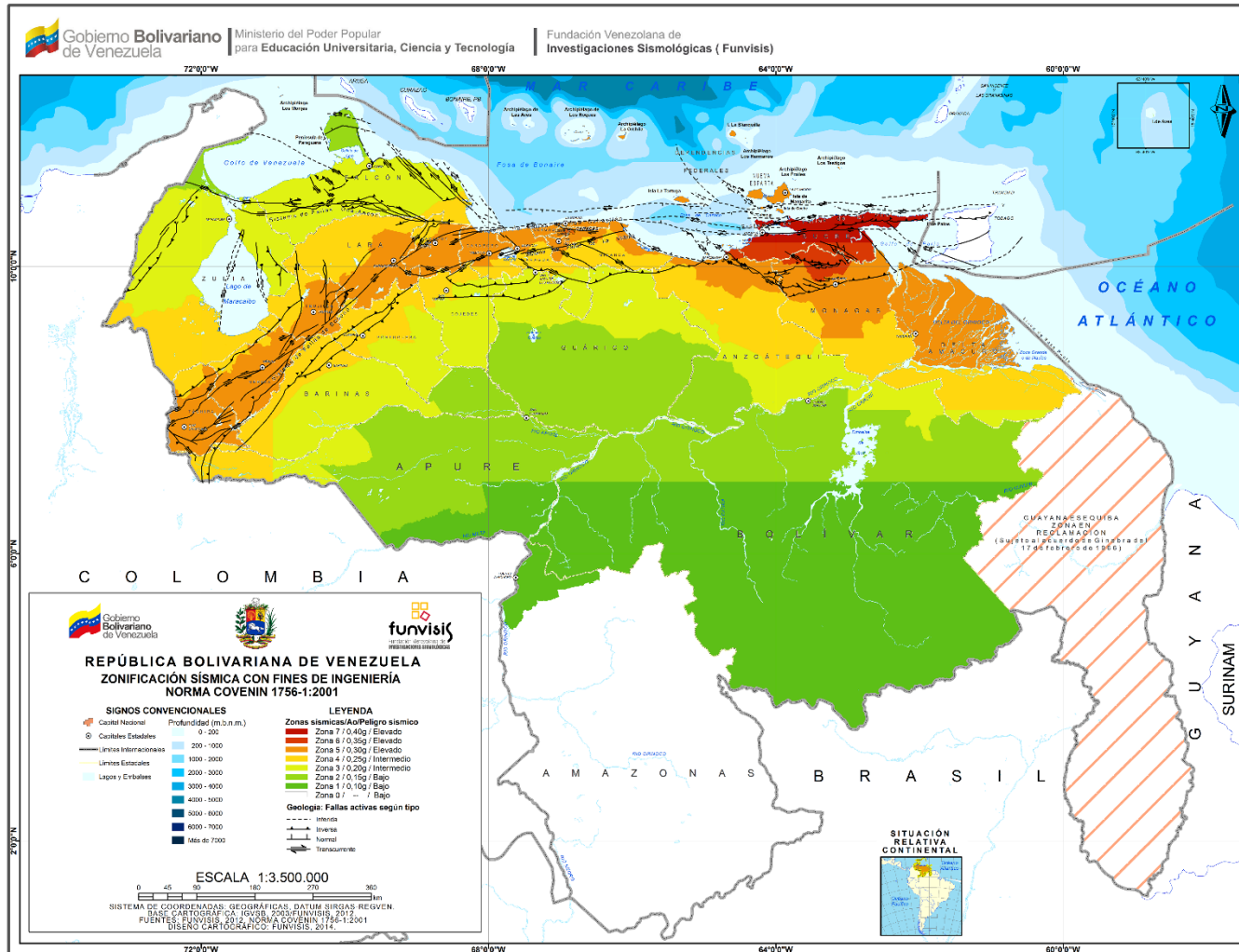
The number of seismic zones in the country was increased from five to eight.

As in the 1982 standard, the final delimitation of the zones follows the country’s political-territorial division, including state and municipal boundaries.

Seismic hazard is expressed through a ground acceleration coefficient (A_0) assigned to each of the eight seismic zones, as shown in the following table.



SEISMIC ZONATION OF VENEZUELA



Seismic hazard zone: A0,
seismic hazard

Zone 7: 0.40g, elevated

Zone 6: 0.35g, elevated

Zone 5: 0.30g, elevated

Zone 4: 0.25g, moderate

Zone 3: 0.20g, moderate

Zone 2: 0.15g, low

Zone 1: 0.10g, low

Zone 0: 0, low

Available online at:

http://www.funvisis.gob.ve/old/archivos/mapas/norma1756_2001.png



SEISMIC ZONATION AND CODES OF VENEZUELA

Maps of the seismic standard COVENIN 1756-1:2019

In the new Venezuelan seismic standard “Earthquake-Resistant Buildings,” COVENIN 1756-1:2019, a series of seismic hazard maps is presented as a basic input for structural analysis and design, both for buildings and industrial facilities. Instead of a single map for one parameter, three maps are now provided, associated with:

- (1) peak ground acceleration (A_0);
- (2) structural response of elastic systems with a 1-second period (A_1); and
- (3) the transition period to the constant displacement response spectral range (T^L).

These maps correspond to a 10% probability of exceedance over a 50-year service life, equivalent to a mean return period (MRP) of 475 years.

The first two maps are presented using variable contour intervals, ranging from 0.005 (for A_0 and $A_1 < 0.03$) to 0.09 (for A_0 and $A_1 > 0.36$), providing adequate visual resolution. The third map is presented with contour intervals of 0.3 s, ranging from 2.7 s to 6.6 s. The following figures show

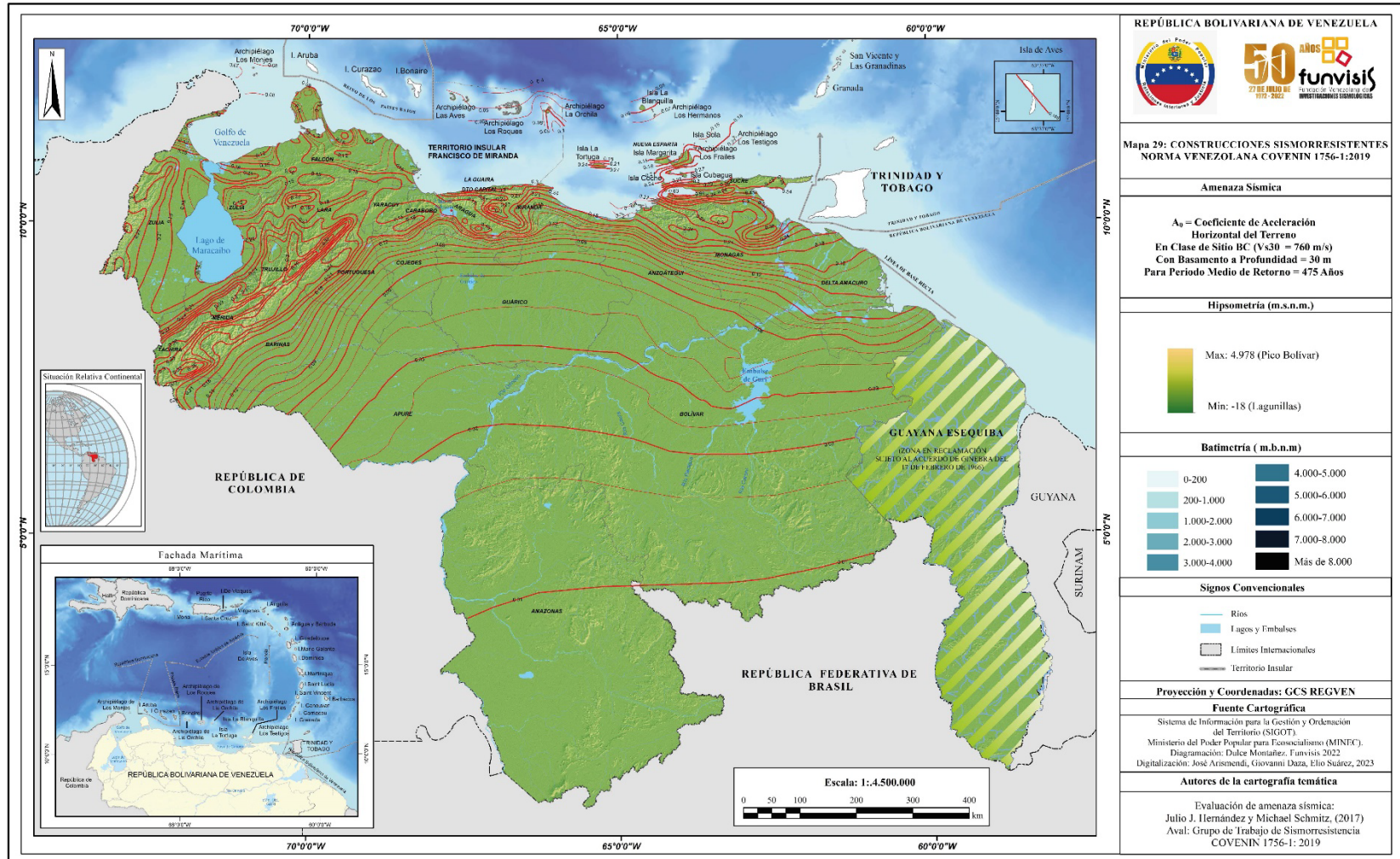
portions of the maps for northwestern Venezuela. It is noteworthy that the new maps provide a more detailed view of seismic hazard in relation to tectonic faults, rather than the previous coarse zoning approach.

With the three parameters provided, more accurate response spectra can be constructed than in previous standards, incorporating the variability of spectral shape, which depends on the project location, instead of the former uniform spectral shape. This variability is given by the ratio A_1/A_0 (instead of the previous constant value) and by T^L , which did not previously exist, leading to excessive conservatism for long-period structures.

Values for analysis at a given site may be obtained by graphical interpolation or from the nearest higher-value contour, without significant error. The elastic spectrum parameters are then modified by site factors associated with soil conditions and by structural response factors to construct the design spectra. They are also adjusted using a factor corresponding to the specific MRP, associated with building importance and earthquake type (standard, extreme, or frequent).



SEISMIC ZONATION OF VENEZUELA MAPS OF THE SEISMIC STANDARD COVENIN 1756-1:2019

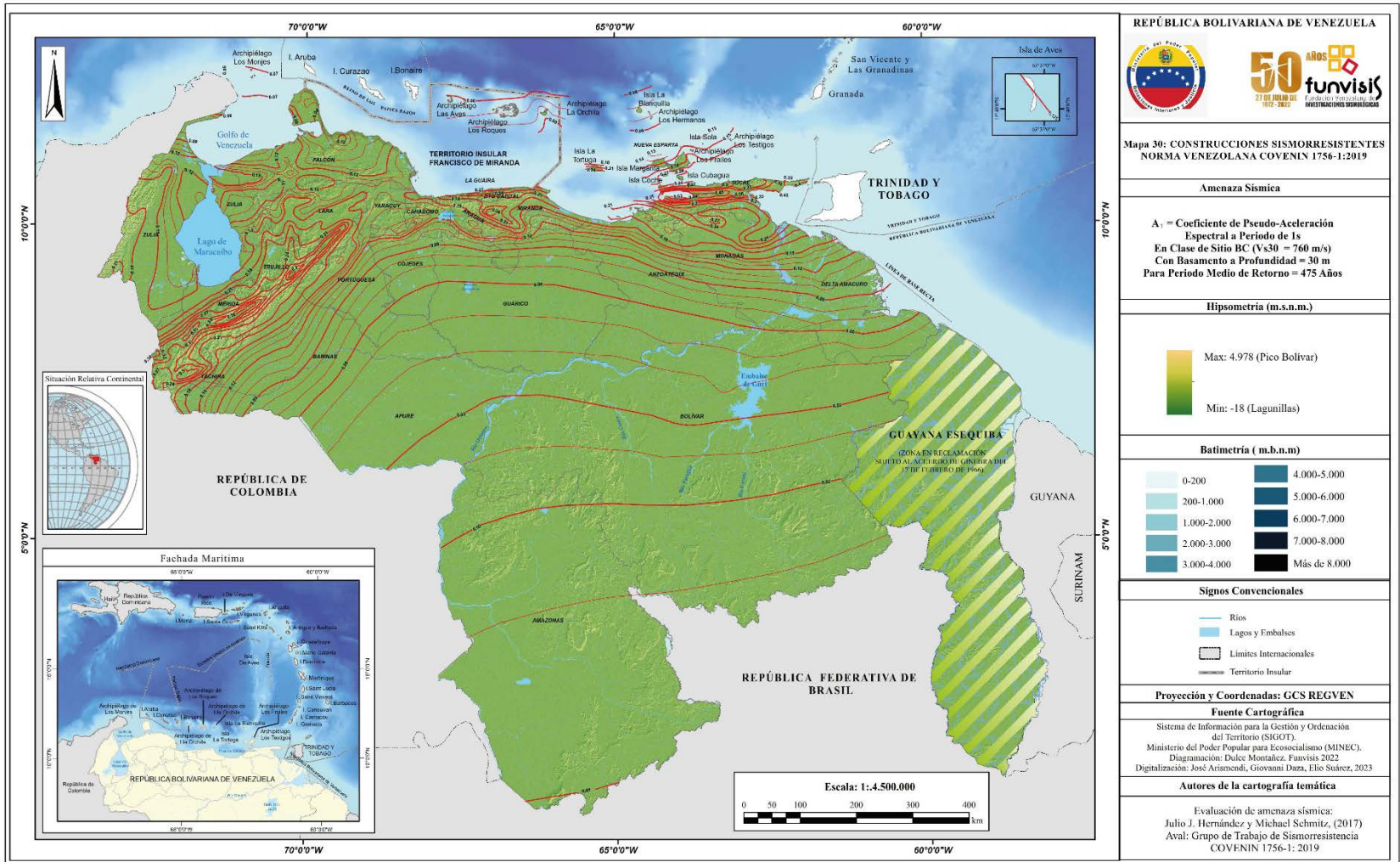


Map of the peak ground acceleration (A_0). Available online at:

http://www.funvisis.gob.ve/atlas/pdf/atlas_Atlas_Sismologico_de_Venezuela_WEB.pdf



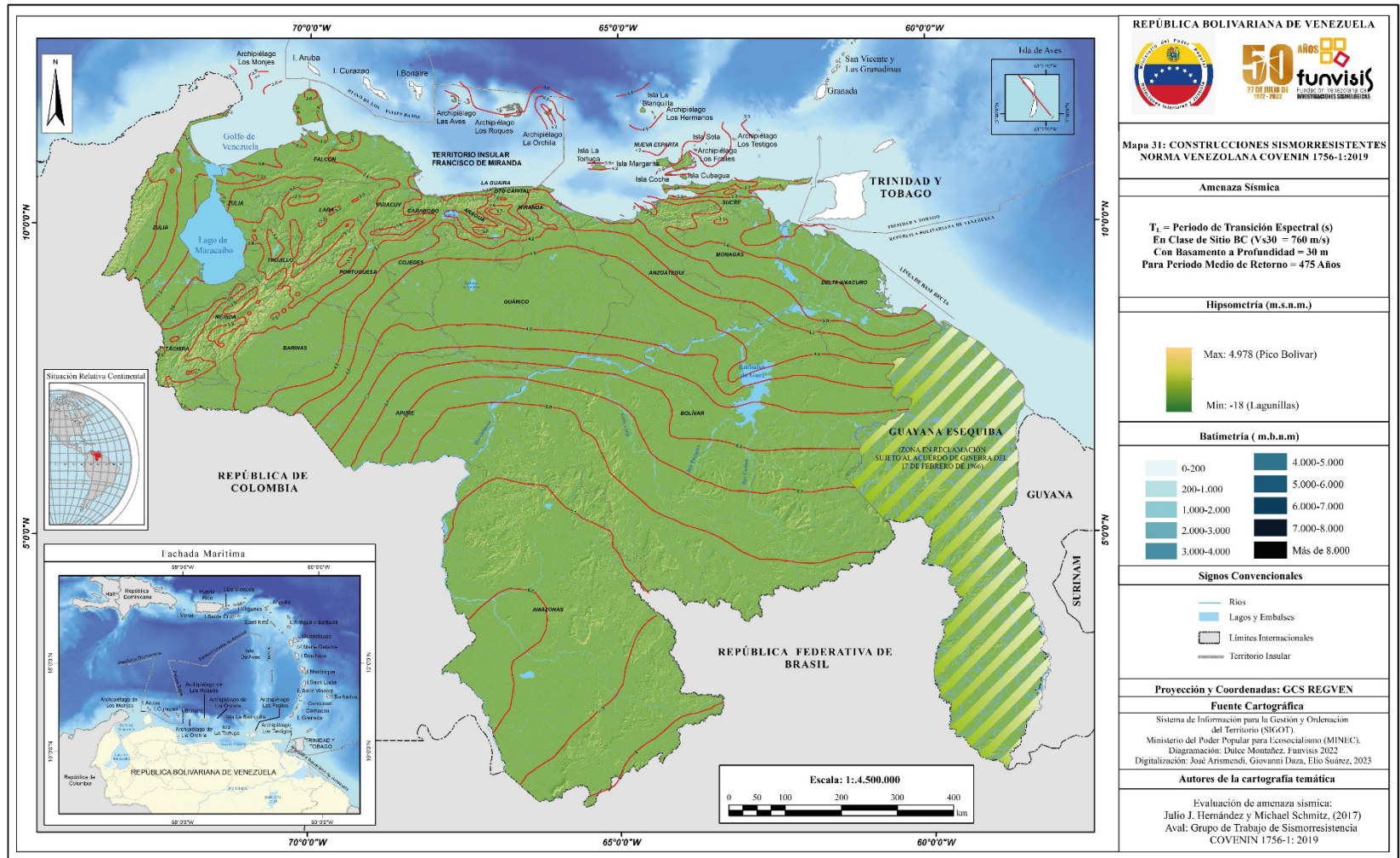
SEISMIC ZONATION OF VENEZUELA MAPS OF THE SEISMIC STANDARD COVENIN 1756-1:2019



Map of the structural response of elastic systems with a 1-second period (A_1). Available online at:
http://www.funvisis.gob.ve/atlas/pdf/atlas_Atlas_Sismologico_de_Venezuela_WEB.pdf



SEISMIC ZONATION OF VENEZUELA MAPS OF THE SEISMIC STANDARD COVENIN 1756-1:2019



Map of the transition period to the constant displacement response spectral range (T_L). Available online at: http://www.funvisis.gob.ve/atlas/pdf/atlas_Atlas_Sismologico_de_Venezuela_WEB.pdf



EVOLUTION AND KEY DEVELOPMENTS OF SEISMIC CODES IN VENEZUELA

Code Year	Seismic Hazard	Structural Regularity	Soil Classification	Direction of Analysis	Analysis Method	Seismic Coefficient	Drift Control
MOP 1939	Mountainous areas: Los Andes and Coastal region	No ref.	No ref.	Perpendicular to any of the facades	Static	$C=0.05$	Not contemplated
MOP 1947	Three seismic zones: A, B, C	No ref.	No ref.	Perpendicular to any of the facades	Static	$C=0.10; 0.05; 0.00$	Not contemplated
MOP 1955	Three seismic zones: A, B, C	No ref.	No ref.	Any direction	Equivalent static method	$C = 0.02 / (N-4.5)$ for Zone B and double for Zone C	Not contemplated
MOP 1967	Three seismic zones: 1, 2, and 3.	No ref.	Rock and alluvial deposits	Any direction	Static equivalent for structures ≤ 60 m high and $T \leq 2.0$ s. Otherwise, dynamic analysis. Also considers twisting.	Depends on soil, Zone, and Type of Structure. Between 0.045 and 0.15.	Maximum drift: 0.002



EVOLUTION AND KEY DEVELOPMENTS OF SEISMIC CODES IN VENEZUELA

Code Year	Seismic Hazard	Structural Regularity	Soil Classification	Direction of Analysis	Analysis Method	Seismic Coefficient	Drift Control
COVENIN 1982	Five seismic zones: from 1 to 4, with accelerated values for a return period of 475 years.	Classifies them into regular and irregular, and definitions for structures.	Classifies soils into S1, S2, and S3.	Two orthogonal non-simultaneous directions.	Equivalent static for regular structures of ≤ 20 floors. Dynamic analysis for greater heights or structures.	Depends on the analysis. Minimum of A_o/R .	Maximum: $R \times 0.010 = 0.020$ (essential structures) and $0.016 \times R$ (for others).
COVENIN 2001	Seven seismic zones: from 0 to 7, with accelerations for a return period of 475 years.	Defines structure forms into regular and irregular, and requirements according to classification.	Classifies profiles into 4 types according to S1, S2, S3, and S4.	Two orthogonal directions, and adds vertical component for specific structures.	Equivalent static for building heights ≤ 10 floors or ≤ 30 m. For irregular ones ≤ 5 floors or ≤ 15 m. Otherwise, dynamic spectrum.	Depends on the analysis. Minimum of A_o/R .	Maximum drift between 0.012 and 0.018 for buildings; 0.004 for residential/commercial; 0.004 for facades.
COVENIN 2019	Seismic zoning maps for a return period of 475 years for roofs and buildings.	Soft storeys and modern vulnerabilities in high risk areas are prohibited.	From Class A to F. Adds shallow shear wave velocity (V_{s30}).	Two orthogonal directions, and adds vertical component for specific structures.	Static method, non-linear static (pushover), and non-linear dynamic analysis.	Depends on the analysis. Minimum of A_o/R . Minimum of 0.01.	Maximum drift: 0.008 to 0.018 (essential structures) and 0.012 to 0.024 for residential/commercial.



THE 24 JUNE 2026 VENEZUELA EARTHQUAKES – INITIAL INFORMATION

Earthquake-affected Area and Perceptibility

On 24 June 2026, northern Venezuela was hit by two significant earthquakes in quick succession, with magnitudes of $M_w=7.2$ and $M_w=7.5$. The two main events occurred just 39 seconds apart. Their epicenters were situated near Morón and Yumare, in the states of Carabobo and Yaracuy, to the west of Caracas.

The seismic events were widely felt throughout Venezuela, affecting areas such as Greater Caracas, La Guaira, Aragua, Carabobo, Miranda, Falcón, and other nearby states. The shaking was also reported in parts of Colombia, the Caribbean, and Brazil, with tremors reaching as far as Martinique and the Brazilian Amazon, over 1,700 km from the epicentral area.

Declaration of an Emergency State

The Government of Venezuela has declared a state of emergency. According to the initial official reports, an estimated 9,730,000 people have been affected, including around 530,000 individuals exposed to severe to extreme levels of seismic intensity. These figures were based on modelled

projections and should be regarded as indicative estimates rather than confirmed counts.

Impact on Population

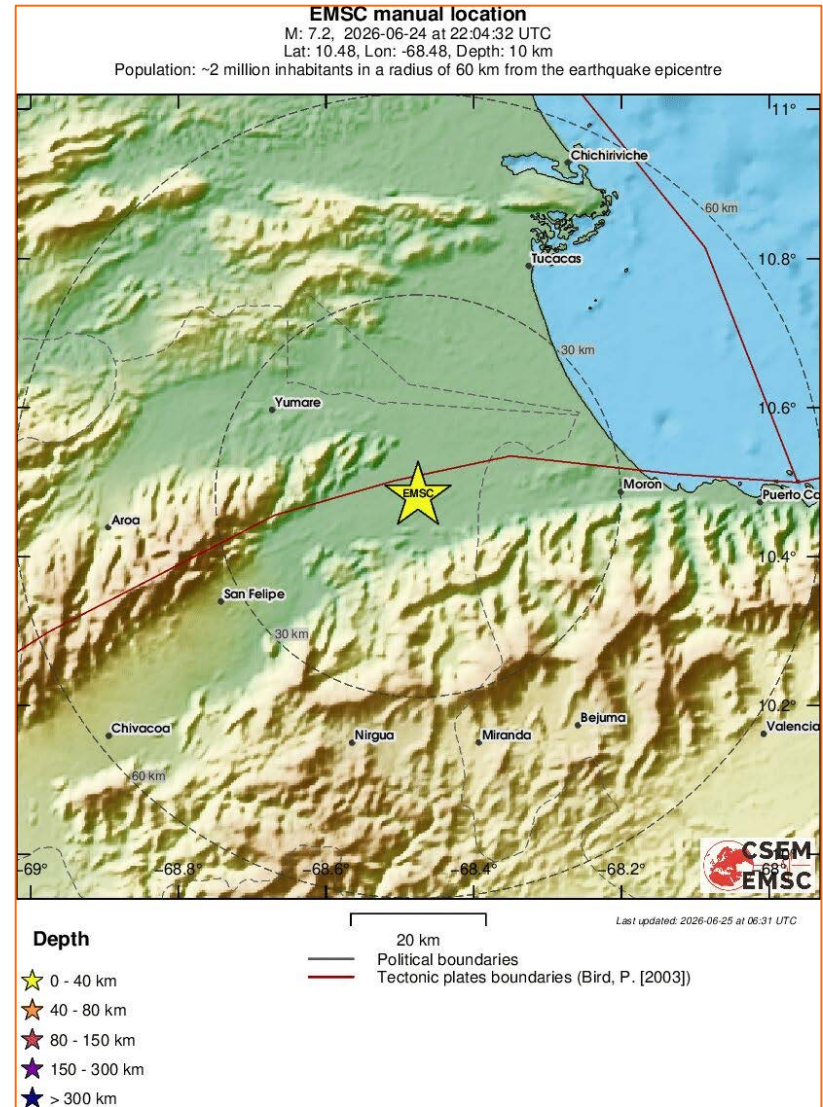
During the initial hours following the earthquakes, at least 188 fatalities and approximately 1,520 injuries were reported, alongside damage to critical infrastructure. This included the collapse of more than 204 buildings, severe structural damage to an additional 217 structures, and partial damage to around 300 more. In the days that followed, the figures for both casualties and structural damage continued to rise.

Most Affected Area – Disaster Zone

The coastal city of La Guaira has been identified as the most severely affected area and has been declared a “Zona de Desastre” (Disaster Zone) by the authorities. Significant damage has also been reported in Greater Caracas, where building collapses have prompted search and rescue (SAR) operations in neighborhoods, such as Los Palos Grandes and Chacao.

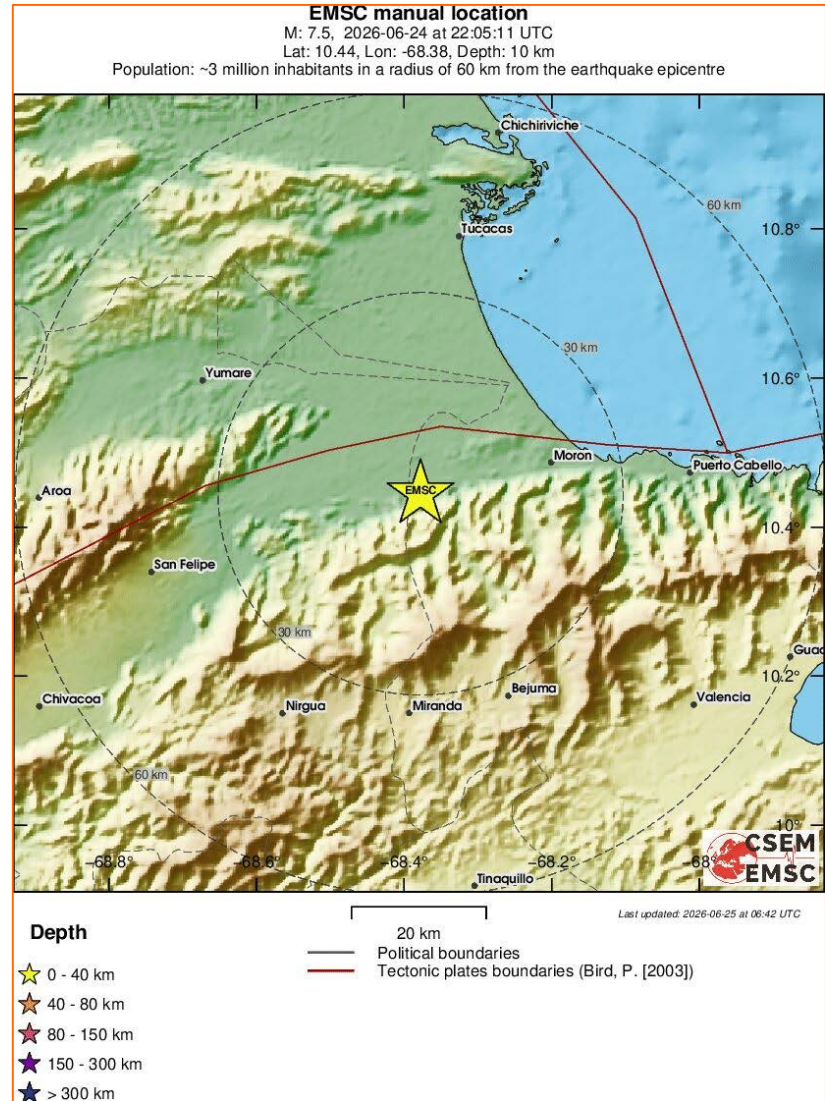
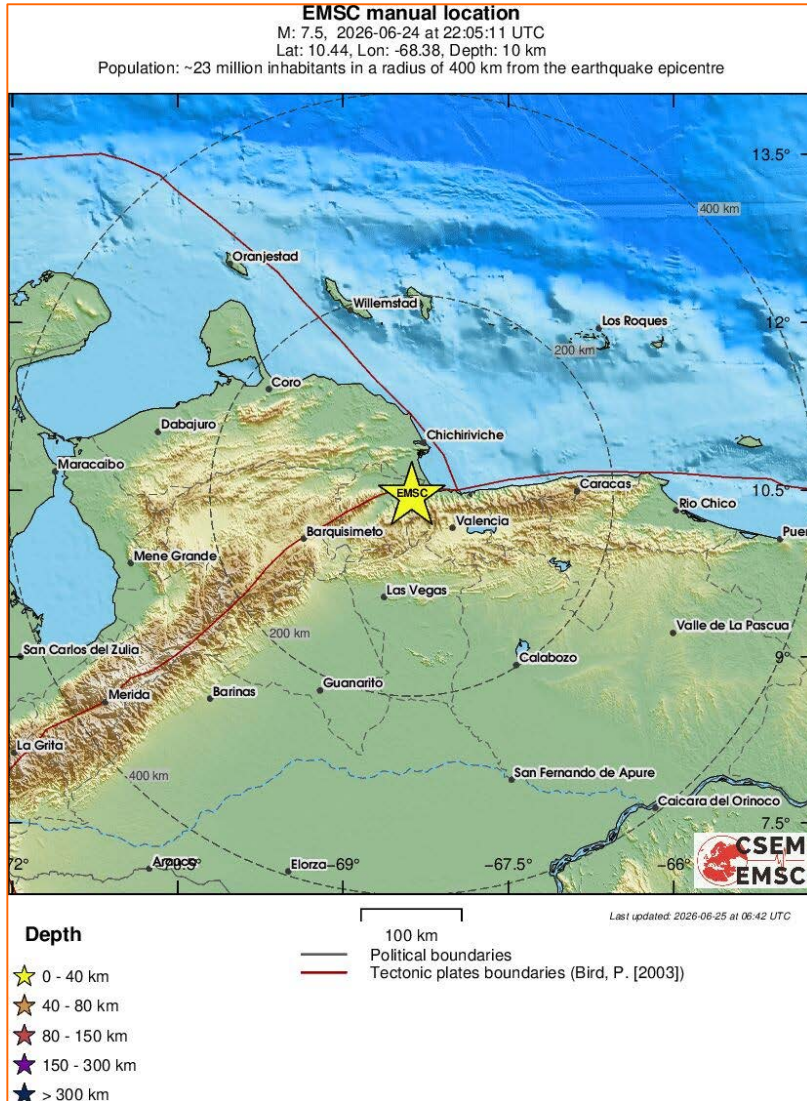


EPICENTER OF THE 24 JUNE 2026, Mw=7.2 EARTHQUAKE





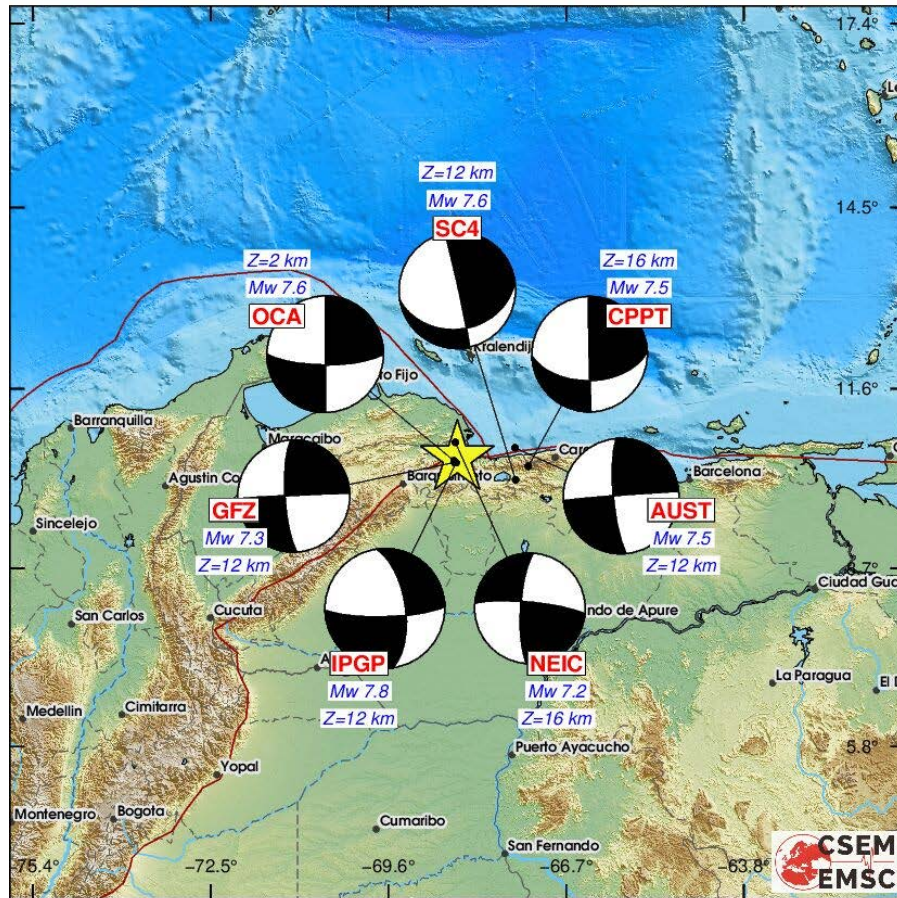
EPICENTER OF THE 24 JUNE 2026, Mw=7.5 EARTHQUAKE





QUICK SOLUTIONS AND REGIONAL MOMENT TENSORS FOR THE 24 JUNE 2026 VENEZUELA EARTHQUAKES

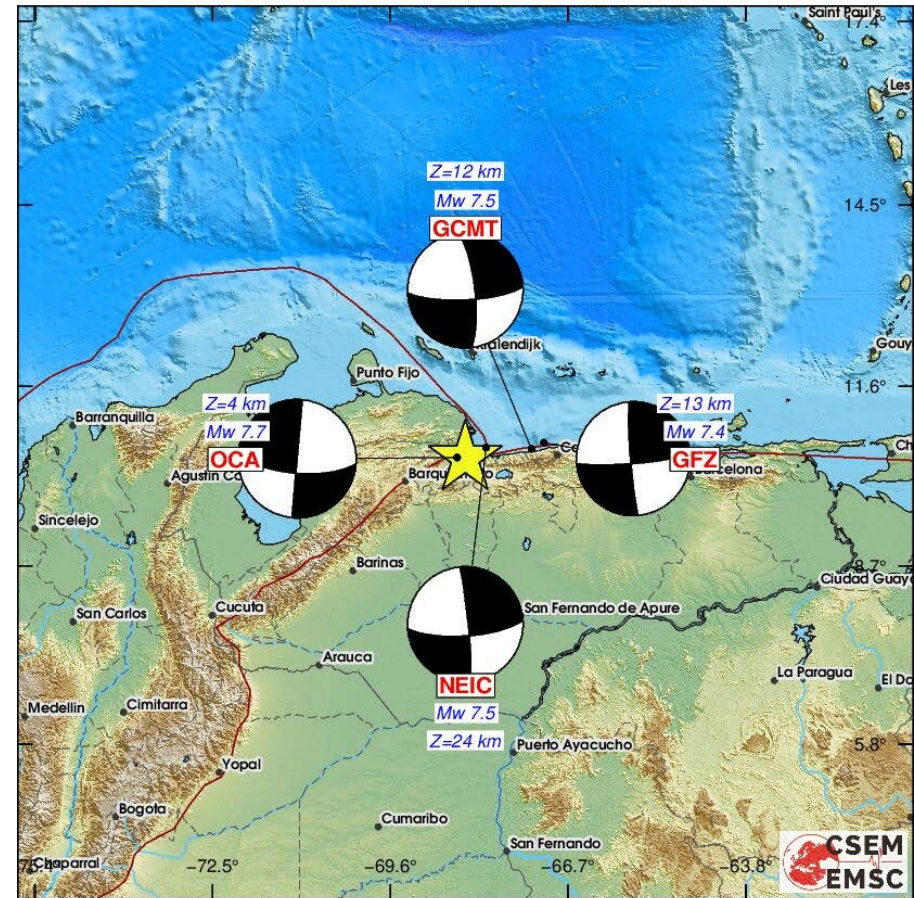
Double-couple MT solution
M: 7.2, 2026-06-24 at 22:04:32 UTC
Lat: 10.48, Lon: -68.48, Depth: 10 km



Last updated: 2026-06-25 at 09:55 UTC

— Political boundaries
— Tectonic plates boundaries (Bird, P. [2003])

Double-couple MT solution
M: 7.5, 2026-06-24 at 22:05:11 UTC
Lat: 10.44, Lon: -68.38, Depth: 10 km



Last updated: 2026-06-25 at 06:48 UTC

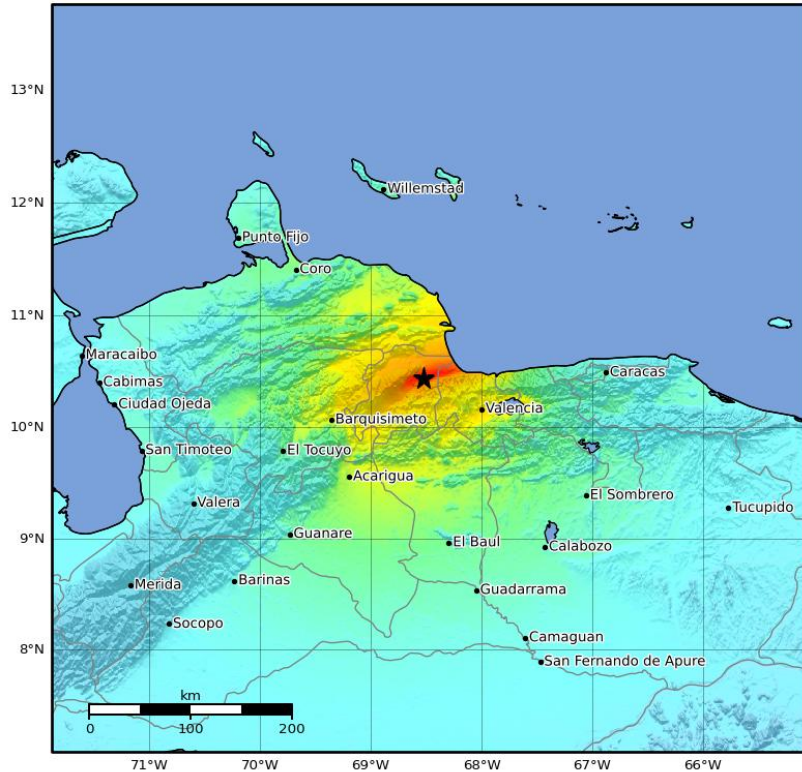
— Political boundaries
— Tectonic plates boundaries (Bird, P. [2003])



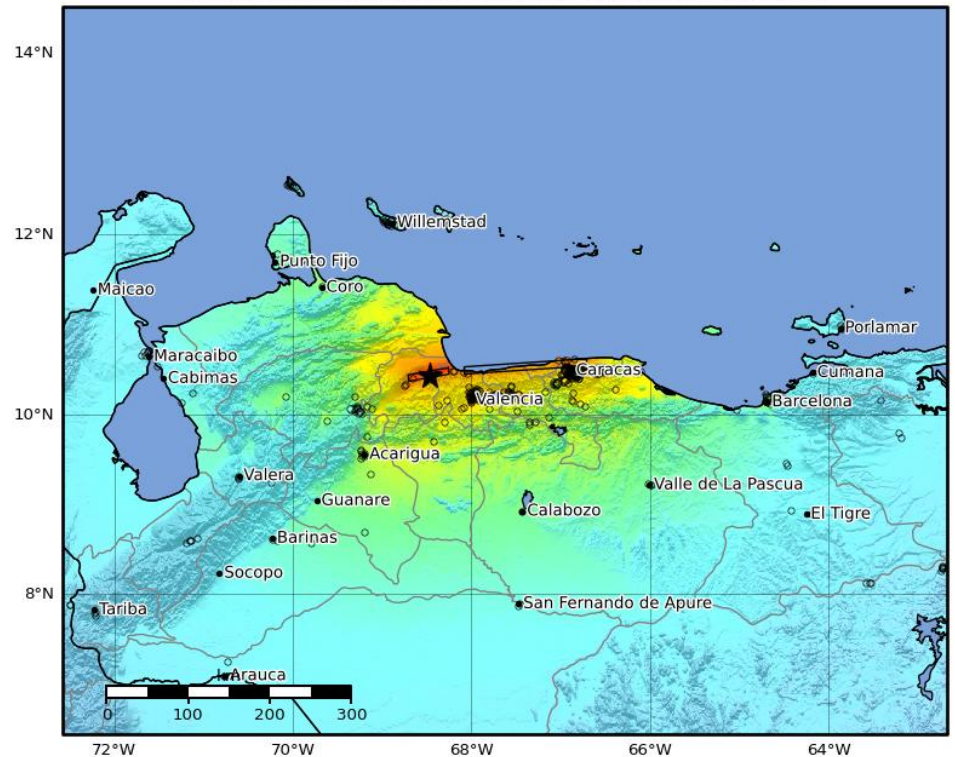
MACROSEISMIC INTENSITY MAPS FOR THE 24 JUNE 2026 VENEZUELA EARTHQUAKES



Macroseismic Intensity Map USGS
ShakeMap: 23 km SE of Yumare, Venezuela
Jun 24, 2026 22:04:33 UTC M7.2 N10.44 W68.53 Depth: 20.3km ID:us6000t7zc



Macroseismic Intensity Map USGS
ShakeMap: 28 km SE of Yumare, Venezuela
Jun 24, 2026 22:05:11 UTC M7.5 N10.44 W68.47 Depth: 10.0km ID:us6000t7zp



SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	None	None	None	Very light	Light	Moderate	Moderate/heavy	Heavy	Very heavy
PGA(%g)	<0.0464	0.297	2.76	6.2	11.5	21.5	40.1	74.7	>139
PGV(cm/s)	<0.0215	0.135	1.41	4.65	9.64	20	41.4	85.8	>178
INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

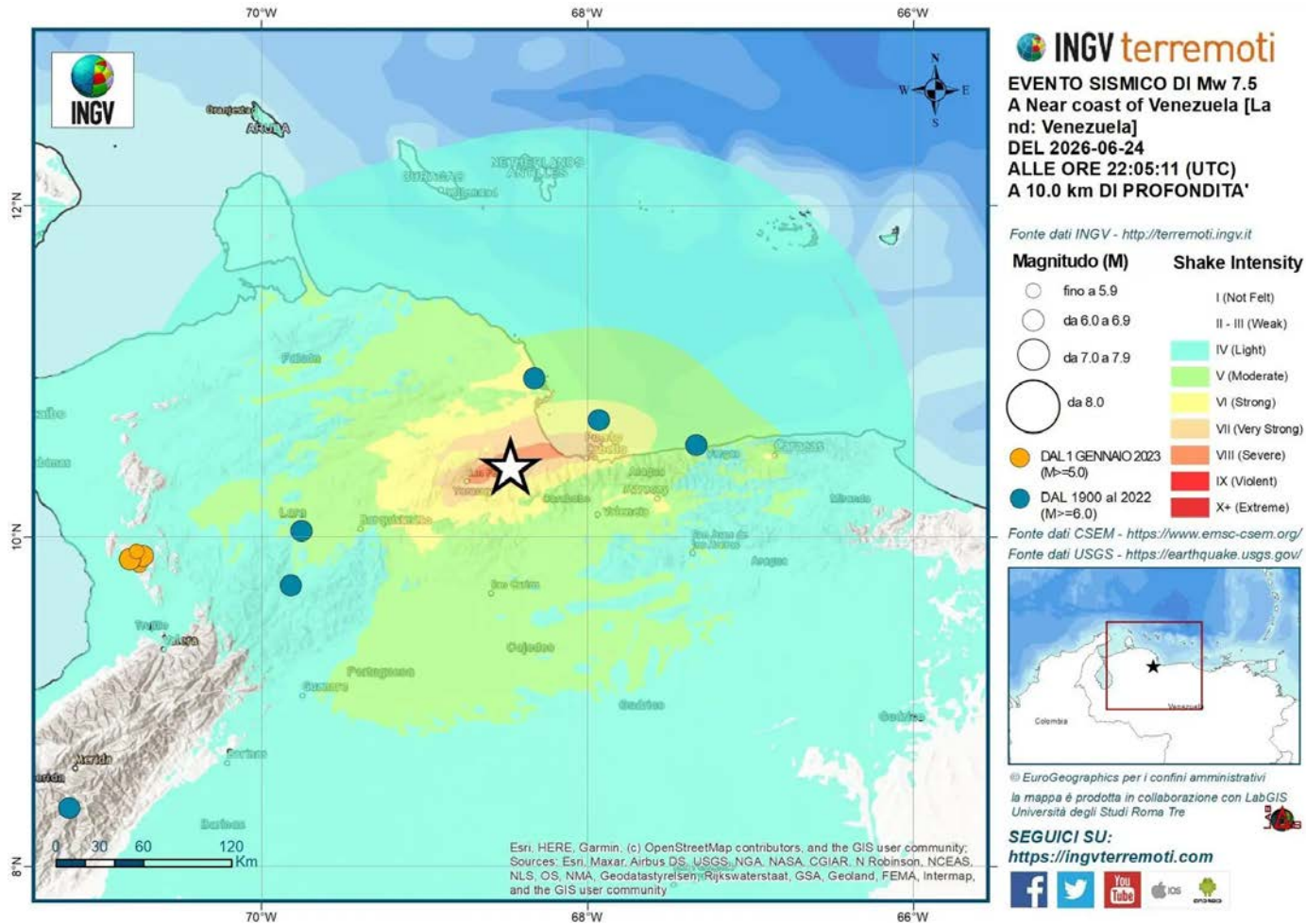
Scale based on Worden et al. (2012)
Version 5: Processed 2026-06-25T22:31:44Z
△ Seismic Instrument ○ Reported Intensity ★ Epicenter

SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	None	None	None	Very light	Light	Moderate	Moderate/heavy	Heavy	Very heavy
PGA(%g)	<0.0464	0.297	2.76	6.2	11.5	21.5	40.1	74.7	>139
PGV(cm/s)	<0.0215	0.135	1.41	4.65	9.64	20	41.4	85.8	>178
INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Scale based on Worden et al. (2012)
Version 9: Processed 2026-07-01T03:52:02Z
△ Seismic Instrument ○ Reported Intensity ★ Epicenter □ Rupture



MACROSEISMIC INTENSITY MAPS FOR THE 24 JUNE 2026 VENEZUELA EARTHQUAKES



Available online at: <https://www.ingv.it/en/resources-and-services/environment-earthquakes-and-volcanoes/reports-reports-and-reports/earthquakes-in-Venezuela-June-2026>

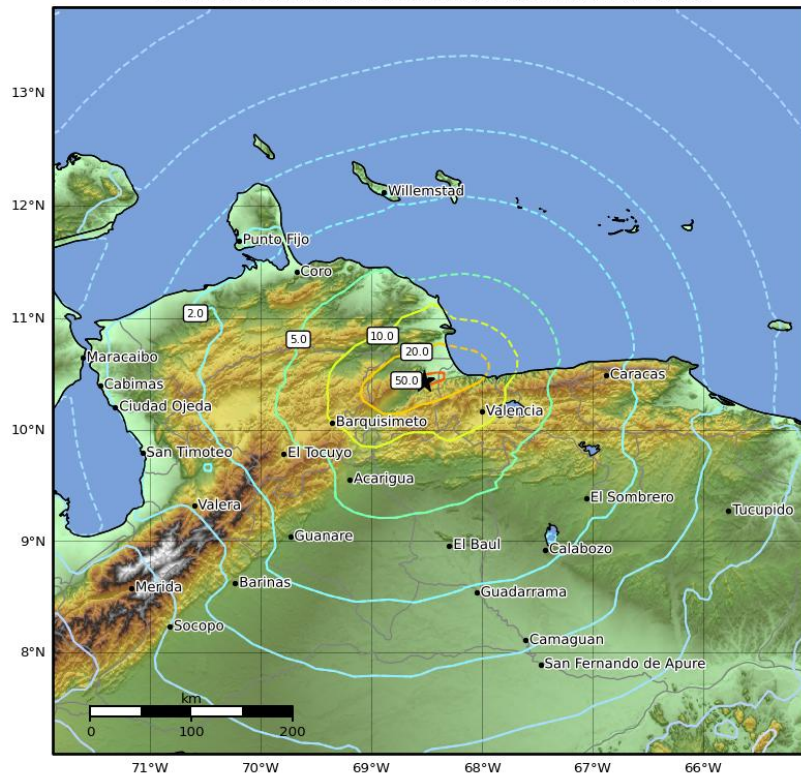
Available online at: <https://www.ingv.it/en/resources-and-services/environment-earthquakes-and-volcanoes/reports-reports-and-reports/earthquakes-in-Venezuela-June-2026>



PEAK GROUND ACCELERATION MAPS FOR THE 24 JUNE 2026 VENEZUELA EARTHQUAKES



Peak Ground Acceleration Map USGS
ShakeMap: 23 km SE of Yumare, Venezuela
Jun 24, 2026 22:04:33 UTC M7.2 N10.44 W68.53 Depth: 20.3km ID:us6000t7zc



PGA (%g) 0.1 0.2 0.5 1 2 5 10 20 50 100 200

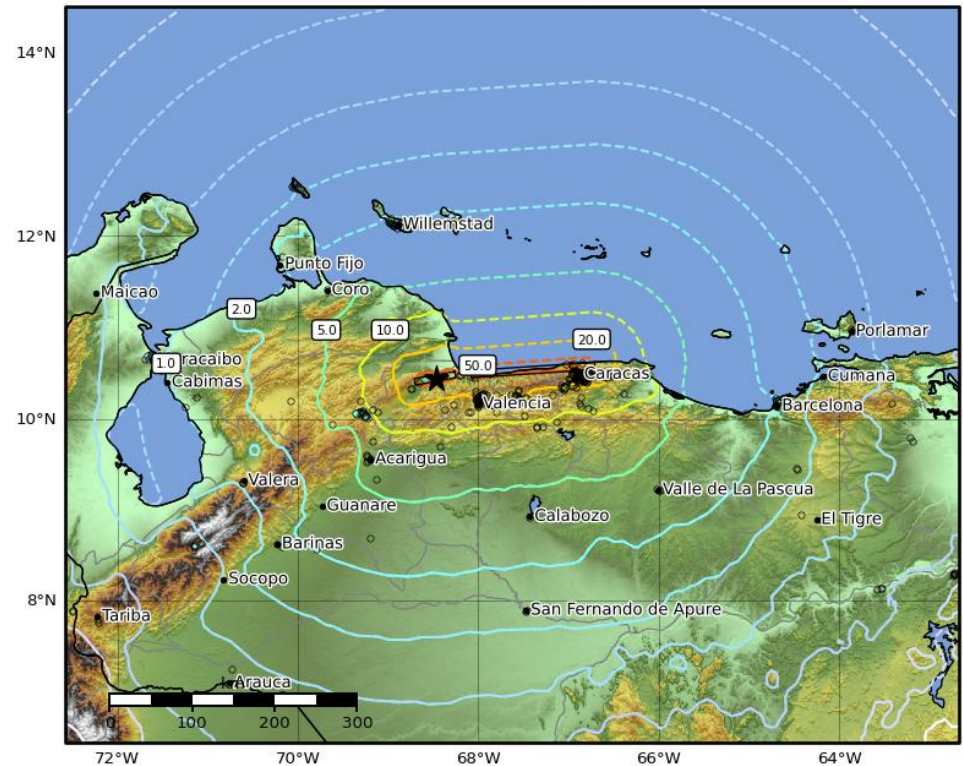
Scale based on Worden et al. (2012)

△ Seismic Instrument ○ Reported Intensity

★ Epicenter

Version 5: Processed 2026-06-25T22:31:44Z

Peak Ground Acceleration Map USGS
ShakeMap: 28 km SE of Yumare, Venezuela
Jun 24, 2026 22:05:11 UTC M7.5 N10.44 W68.47 Depth: 10.0km ID:us6000t7zp



PGA (%g) 0.1 0.2 0.5 1 2 5 10 20 50 100 200

Scale based on Worden et al. (2012)

△ Seismic Instrument ○ Reported Intensity

★ Epicenter

— Rupture

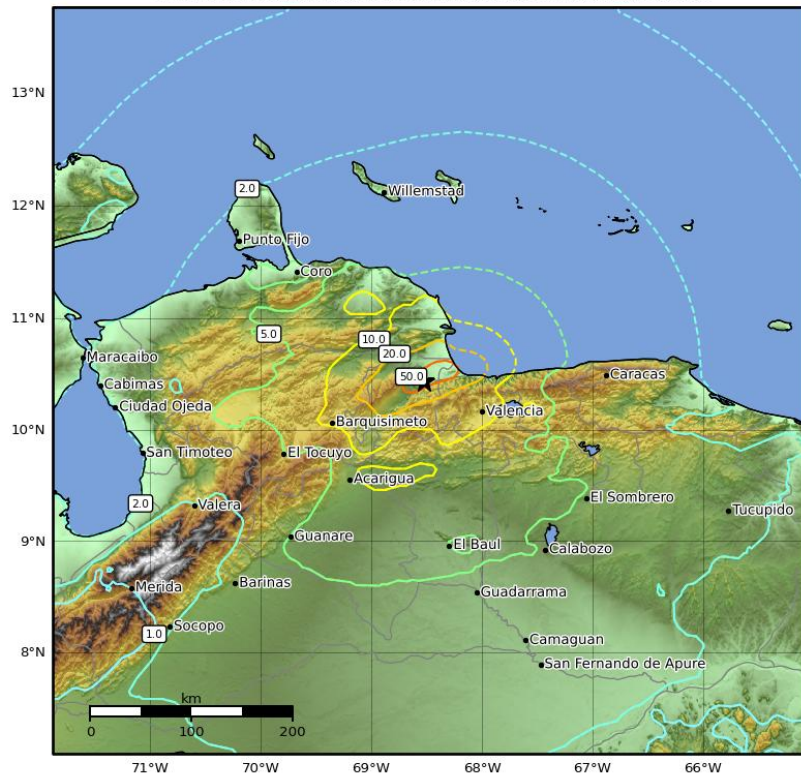
Version 9: Processed 2026-07-01T03:52:02Z



PEAK GROUND VELOCITY MAPS FOR THE 24 JUNE 2026 VENEZUELA EARTHQUAKES



Peak Ground Velocity Map USGS
ShakeMap: 23 km SE of Yumare, Venezuela
Jun 24, 2026 22:04:33 UTC M7.2 N10.44 W68.53 Depth: 20.3km ID:us6000t7zc



PGV (cm/s) 0.1 0.2 0.5 1 2 5 10 20 50 100 200

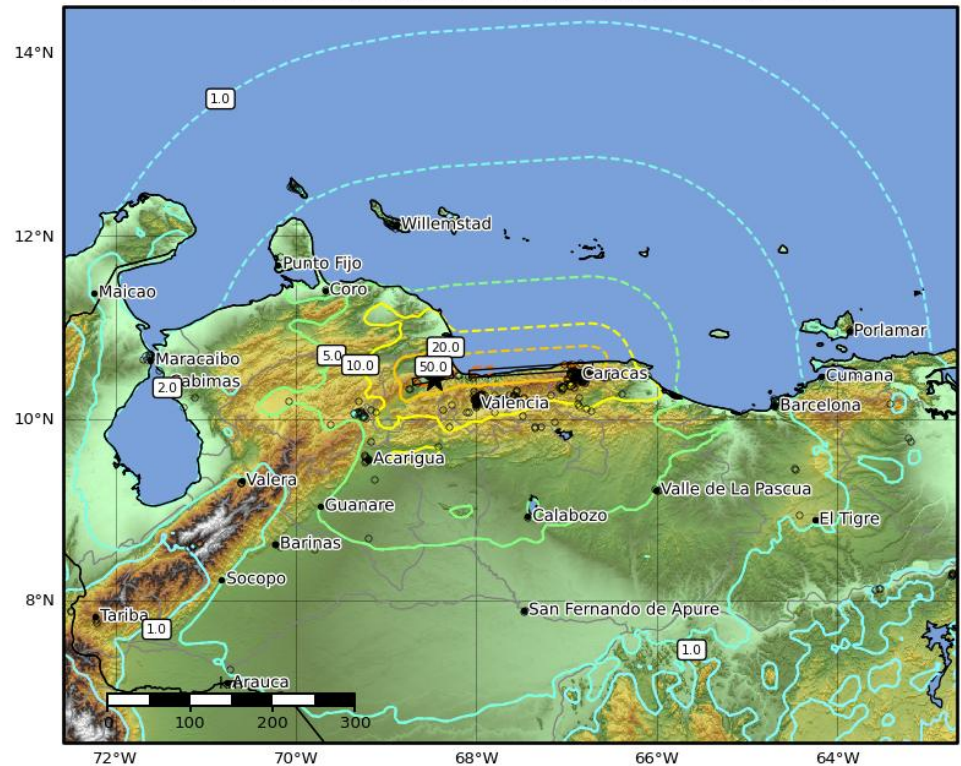
Scale based on Worden et al. (2012)

Version 5: Processed 2026-06-25T22:31:44Z

△ Seismic Instrument ○ Reported Intensity

★ Epicenter

Peak Ground Velocity Map USGS
ShakeMap: 28 km SE of Yumare, Venezuela
Jun 24, 2026 22:05:11 UTC M7.5 N10.44 W68.47 Depth: 10.0km ID:us6000t7zp



PGV (cm/s) 0.1 0.2 0.5 1 2 5 10 20 50 100 200

Scale based on Worden et al. (2012)

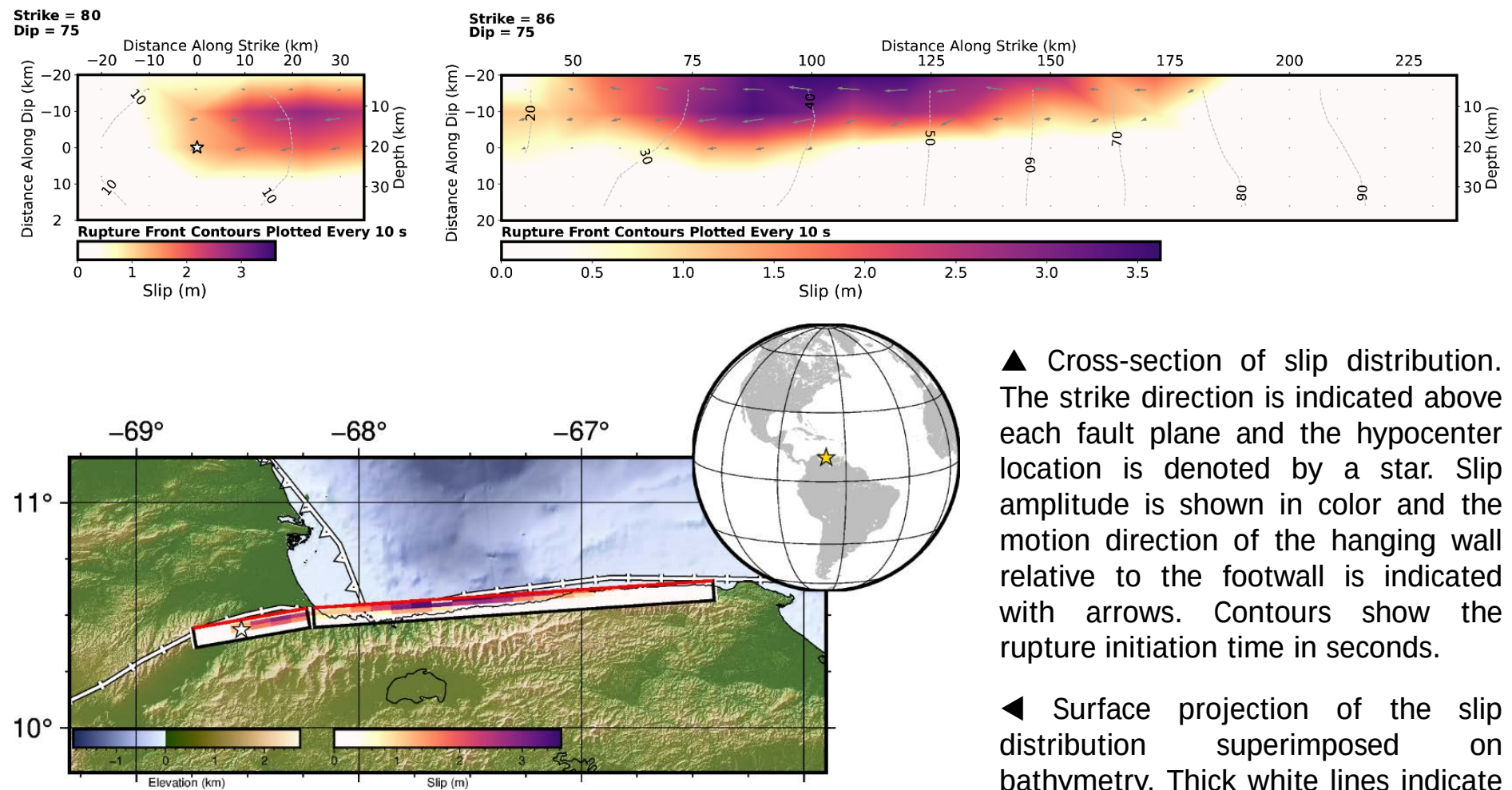
Version 9: Processed 2026-07-01T03:52:02Z

△ Seismic Instrument ○ Reported Intensity

★ Epicenter — Rupture



SLIP DISTRIBUTION FOR THE 24 JUNE 2026 VENEZUELA M=7.5 EARTHQUAKE



▲ Cross-section of slip distribution. The strike direction is indicated above each fault plane and the hypocenter location is denoted by a star. Slip amplitude is shown in color and the motion direction of the hanging wall relative to the footwall is indicated with arrows. Contours show the rupture initiation time in seconds.

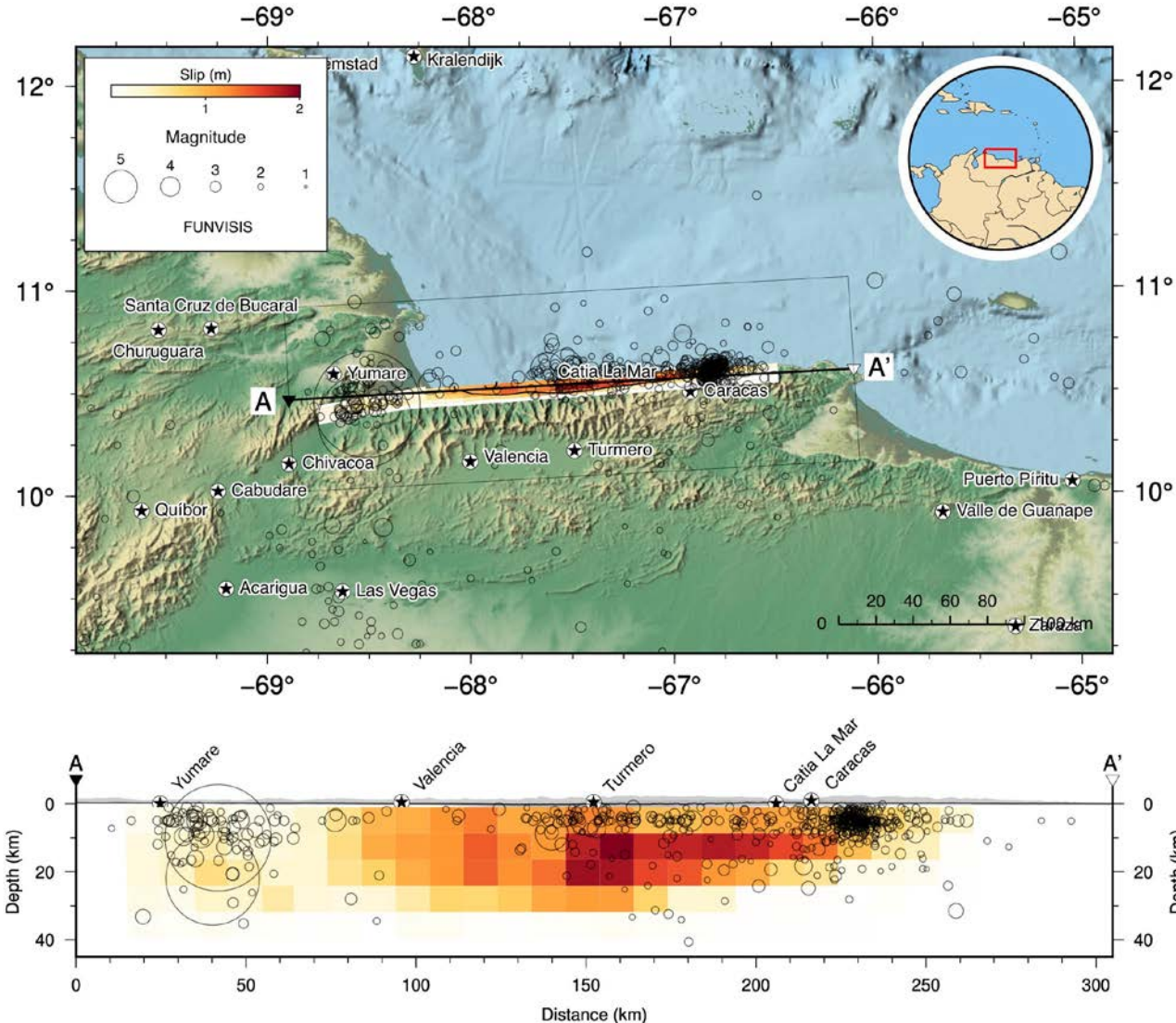
◀ Surface projection of the slip distribution superimposed on bathymetry. Thick white lines indicate major plate boundaries (Bird, 2003).

Available online at:

<https://earthquake.usgs.gov/earthquakes/eventpage/us6000t7zp/finite-fault>



SLIP DISTRIBUTION FOR THE 24 JUNE 2026 VENEZUELA M=7.5 EARTHQUAKE

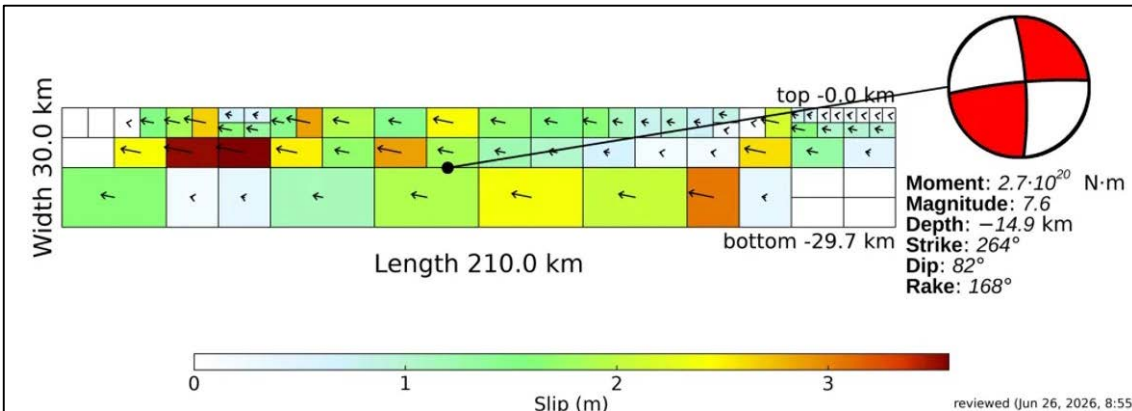


This is a plot of the preliminary slip model from the USGS behind the seismicity. The eastern half of the rupture matches up to an area of higher slip ($\sim 1.5\text{--}2\text{ m}$), with stronger seismicity framing the edges of this higher slip area. The seismicity near the epicenter also sits on an area with slightly higher slip than the surroundings.

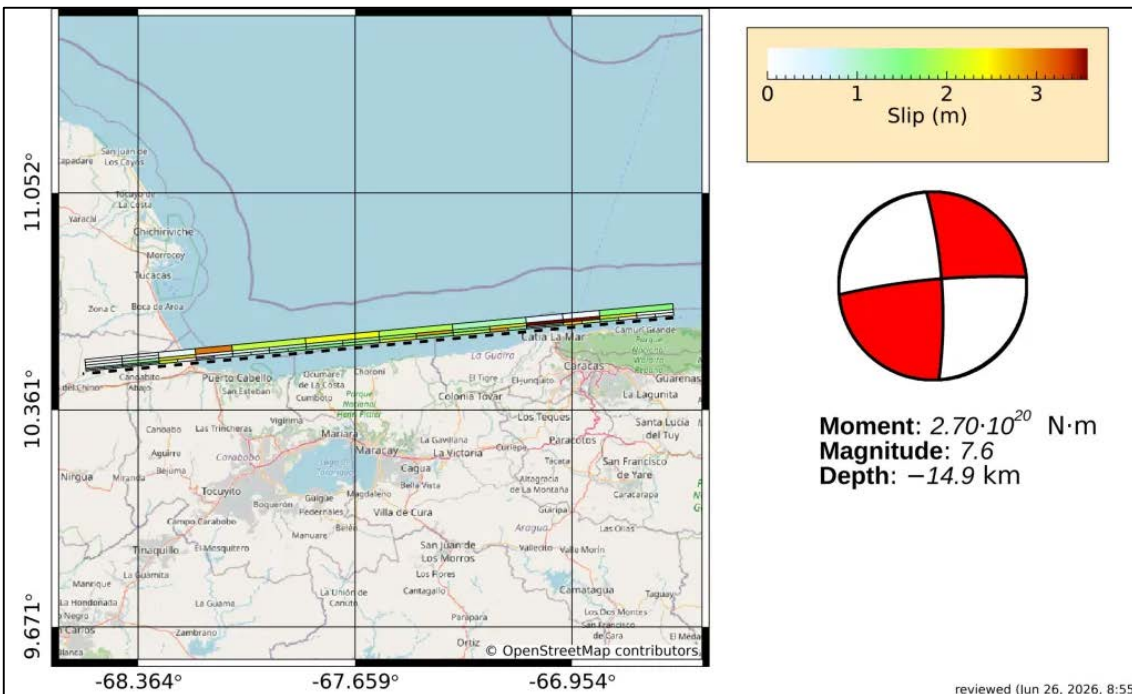
Available online by Judith Hubbard and Kyle Bradley at:
<https://earthquakeinsights.substack.com/p/aftershocks-and-satellite-imaging>



SLIP DISTRIBUTION FOR THE 24 JUNE 2026 VENEZUELA M=7.5 EARTHQUAKE



Slip distribution on the fault plane: the colors indicate the slip intensity, while the arrows describe the direction. Since this is a frontal view from approximately the north, West is on the right of the image, and East is on the left.



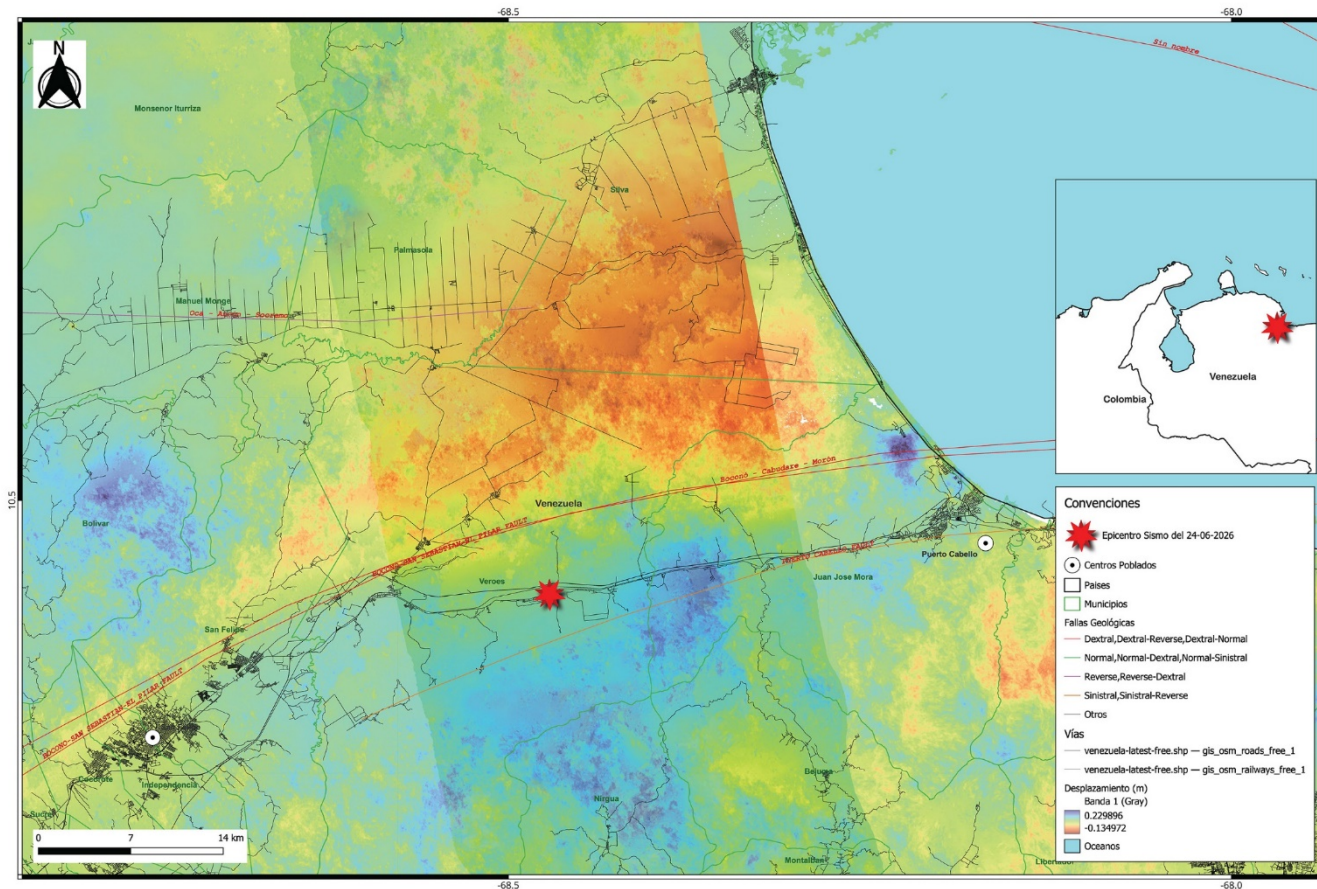
Surface projection of the slip distribution.

Available online at:

<https://ingvterremoti.com/2026/06/26/sorgente-estesa-della-sequenza-sismica-in-venezuela-24-giugno-2026/>



COSEISMIC DISPLACEMENT ASSOCIATED WITH THE 24 JUNE 2026 VENEZUELA EARTHQUAKES



Coseismic displacement associated with the 24 June 2026 Venezuela earthquakes. Creation date: 27 June 2026. Production: Unidad Nacional para la Gestión del Riesgo de Desastres.



Activation-1036 (Call-1186) - Earthquake in VENEZUELA
Desplazamiento Cosísmico de los eventos sísmicos de Mw 7.5 y Mw 7.2 de Yaracuy (Venezuela) del día 24-06-2026.

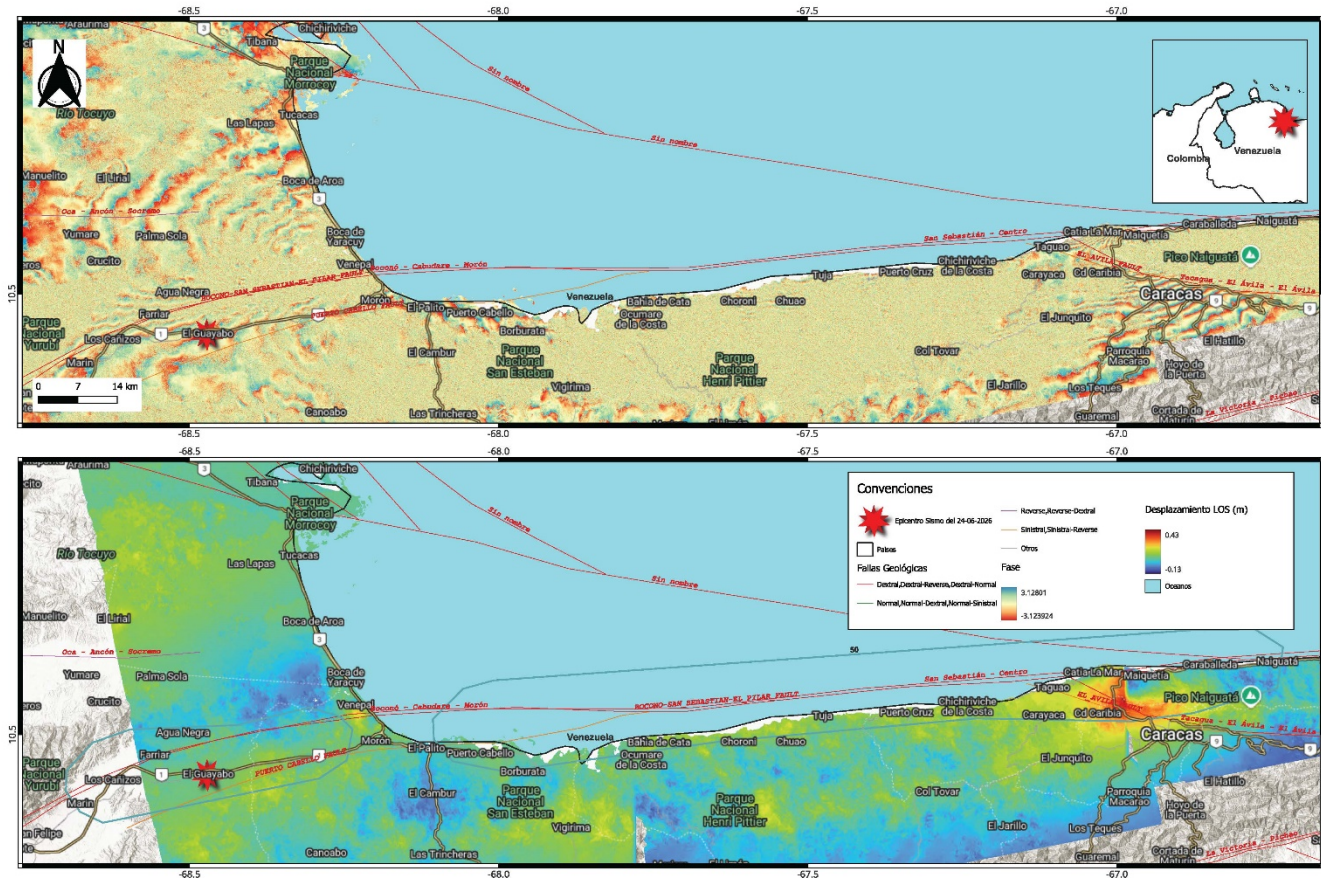
Descripción
El 24 de junio de 2026, el norte de Venezuela fue afectado por un doble sismo conformado por un sismo precursor de magnitud Mw 7.2, seguido apenas 39 segundos después por el evento principal de magnitud Mw 7.5, ambos sismos se localizaron en el municipio de Yaracuy, estado Yaracuy. El evento principal presentó una profundidad focal somera de aproximadamente 10 km, condición que contribuyó significativamente a la intensidad del movimiento del terreno y a la magnitud de sus efectos en superficie. Aprovechando la cobertura de la misión Sentinel-1 (Copernicus/ESA), se generó un interferograma diferencial cosísmico mediante el procesamiento de cuatro imágenes SAR de la crisis sismológica. Para ello se emplearon dos pares interferométricos: el primero conformado por las actualizaciones del 18 de junio de 2026 (precursor) y el 24 de junio de 2026 (principal), y el segundo por las imágenes del 18 y 25 de junio de 2026. El procesamiento se realizó utilizando el software SNAP, desarrollado por la Agencia Espacial Europea (ESA). Las imágenes resultantes corresponden a la fase interferométrica desmodulada convertida a desplazamiento, la cual evidencia deformaciones con subsidencias de hasta aproximadamente 14 cm y levantamientos del orden de 22 cm.

Available online at:

<https://disasterscharter.org/activations/earthquake-in-venezuela-activation-1036->



COSEISMIC DISPLACEMENT ASSOCIATED WITH THE 24 JUNE 2026 VENEZUELA EARTHQUAKES



Coseismic displacement associated with the 24 June 2026 Venezuela earthquakes.
Creation date: 3 July 2026
Production: Unidad Nacional para la Gestión del Riesgo de Desastres

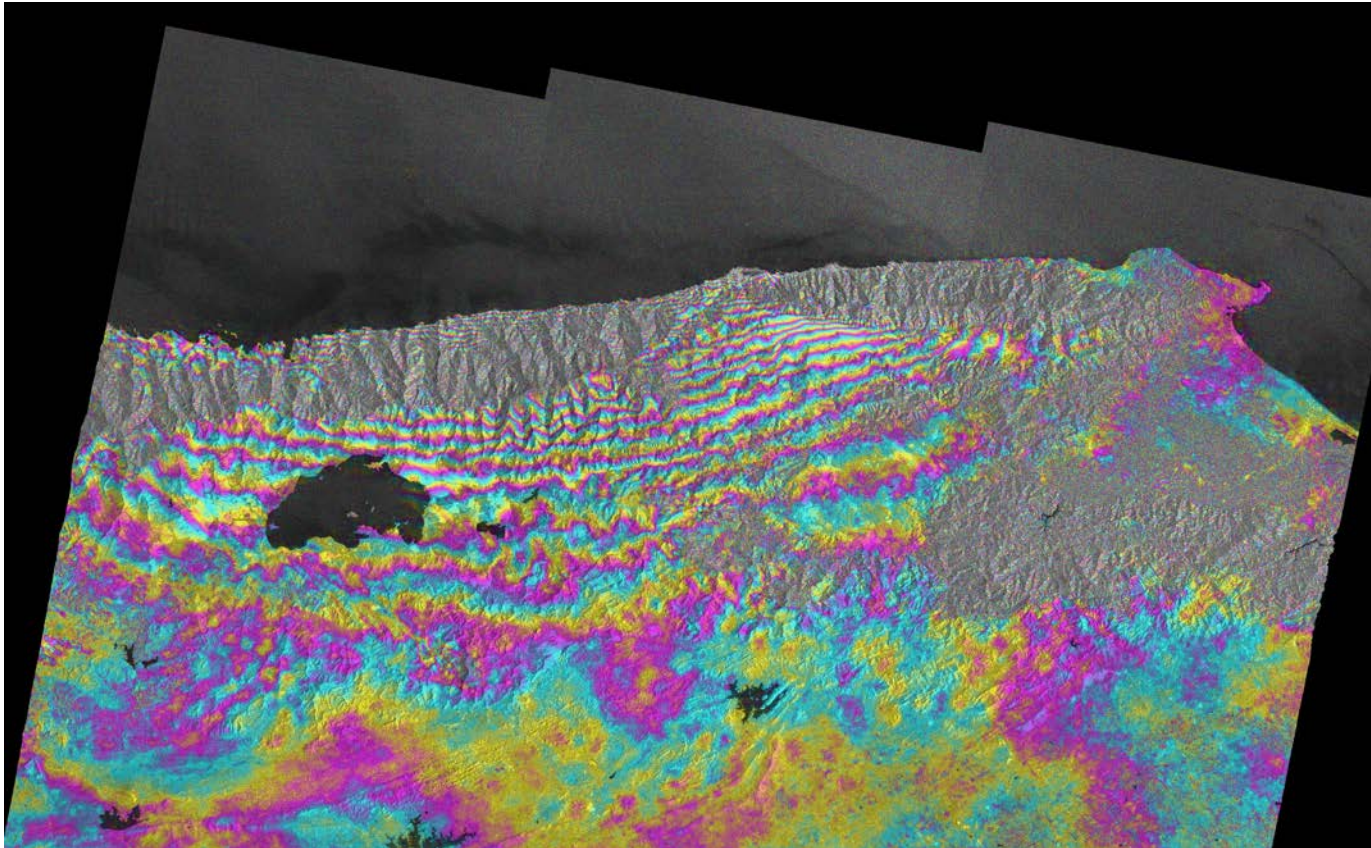


Activation-1036 (Call-1186) - Earthquake in VENEZUELA
Desplazamiento Cosísmico de los eventos sísmicos de Mx 7.5 y Mw 7.2 de Yaracuy (Venezuela) del día 24-06-2026 V2

Descripción
Este mapa muestra el desplazamiento de la superficie terrestre producido por el doble sismo (Mw 7.2 y Mw 7.5) que azotó el centro-este de Venezuela, derivado mediante interferometría radar (InSAR) utilizando imágenes de Sentinel-1 en orbita ascendente. Los valores corresponden a la línea de vista (LOS) del satélite, donde los tonos rojos indican elevación (hasta +0.43 m) y los tonos azules indican hundimiento (hasta -0.43 m). La máxima elevación se concentra en el área epicentral, en el sector Maricao-Turkey-Falga, que abarca las ciudades de Valencia y Caraballeda y los municipios de San José María, San Felipe y Naval Maracaibo, con un límite de subducción epicentral. Este patrón es característico de una ruptura superficial, consistente con la profundidad de ~10 km del sismo principal. Se detallan tanto los epicentros como las principales fallas de subducción de Puerto Cabello, San Felipe, Turkey, Falcón, Caura y Falcón, y Valencia en el sector subyacente y, al este, el sector de La Guaira, gobernando al lado de La Guaira, Maricao, Caraballeda y Carta La Mar (municipio de Vargas) donde los datos registran un hundimiento moderado (-0.20 a -0.1 m LOS). Tanto de elevación como de hundimiento.



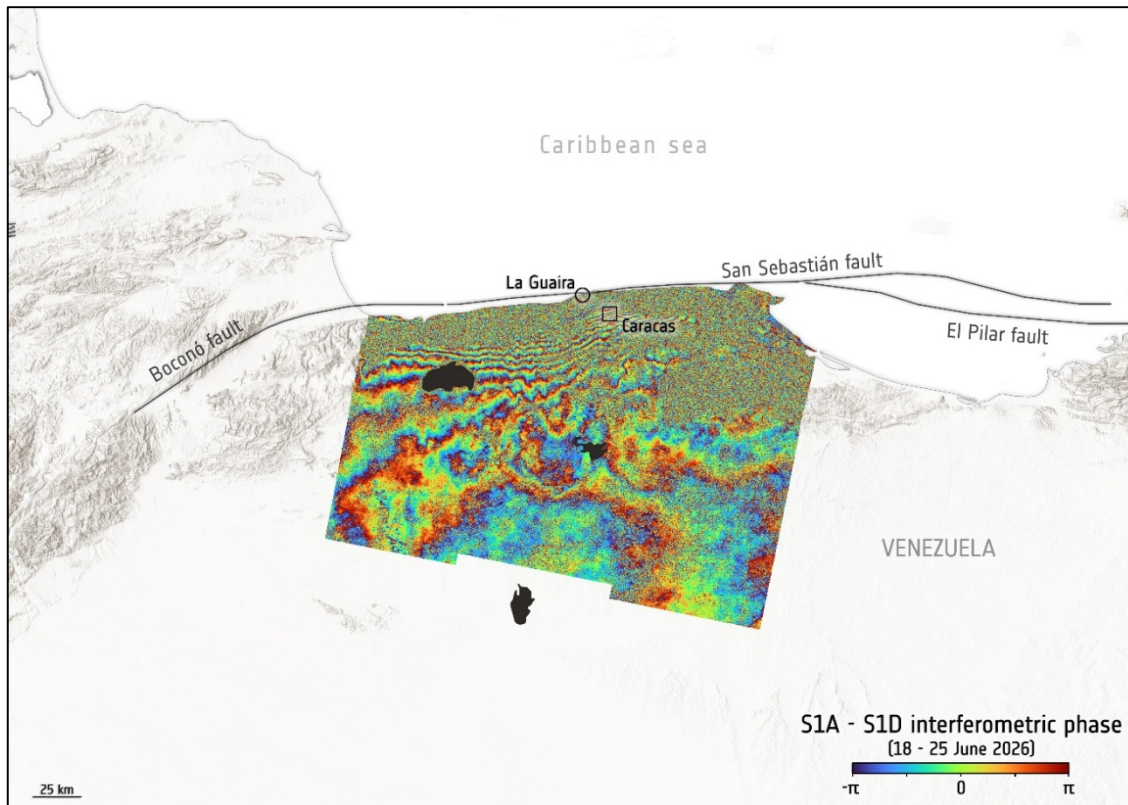
GROUND DEFORMATION BASED ON SATELLITE DATA



InSAR image of the deformation field generated by the earthquake. Each fringe corresponds to approximately 2.8 cm of displacement. In areas closest to the coast, ground displacement of up to 80 cm is estimated. The InSAR data were generated with imagery from the Sentinel-1 satellites (Copernicus program). Available online at: <https://ingvterremoti.com/2026/06/26/sorgente-estesa-della-sequenza-sismica-in-venezuela-24-giugno-2026/>



GROUND DEFORMATION BASED ON SATELLITE DATA



The map is an interferogram derived from the comparison of Sentinel-1 data on two dates: on the 18 June before the earthquakes and on 25 June a day after. The fringed pattern on the north of the image shows the extent of the region where ground deformation occurred. The preliminary data indicate ground displacement of the order of 30 cm in the line of sight.

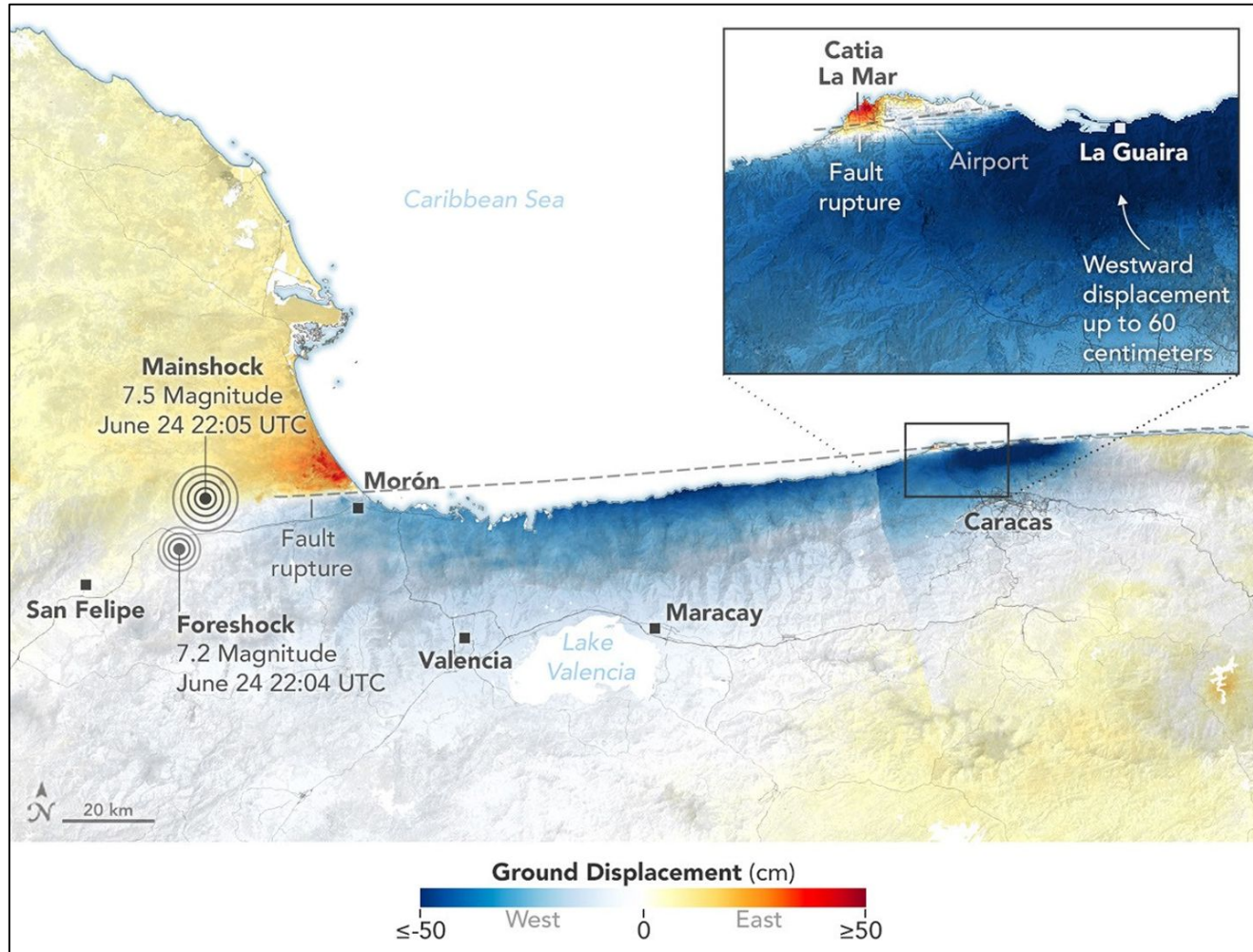
This image shows the affected area, which extends from Caracas, in northern Venezuela, towards the city of Puerto Cabello, about 210 km west of the capital. The city of La Guaira, some 20 km north of Caracas, is one of the worst-hit areas.

Available online at:

https://www.esa.int/ESA_Multimedia/Images/2026/06/Sentinel-1_shows_ground_displacement_after_Venezuela_earthquakes#:~:text=The%20northern%20coast%20of%20Venezuela,to%20hit%20Venezuela%20since%201900



PRIMARY ENVIRONMENTAL EFFECTS OF THE 24 JUNE 2026 EARTHQUAKES GROUND DEFORMATION BASED ON SATELLITE DATA

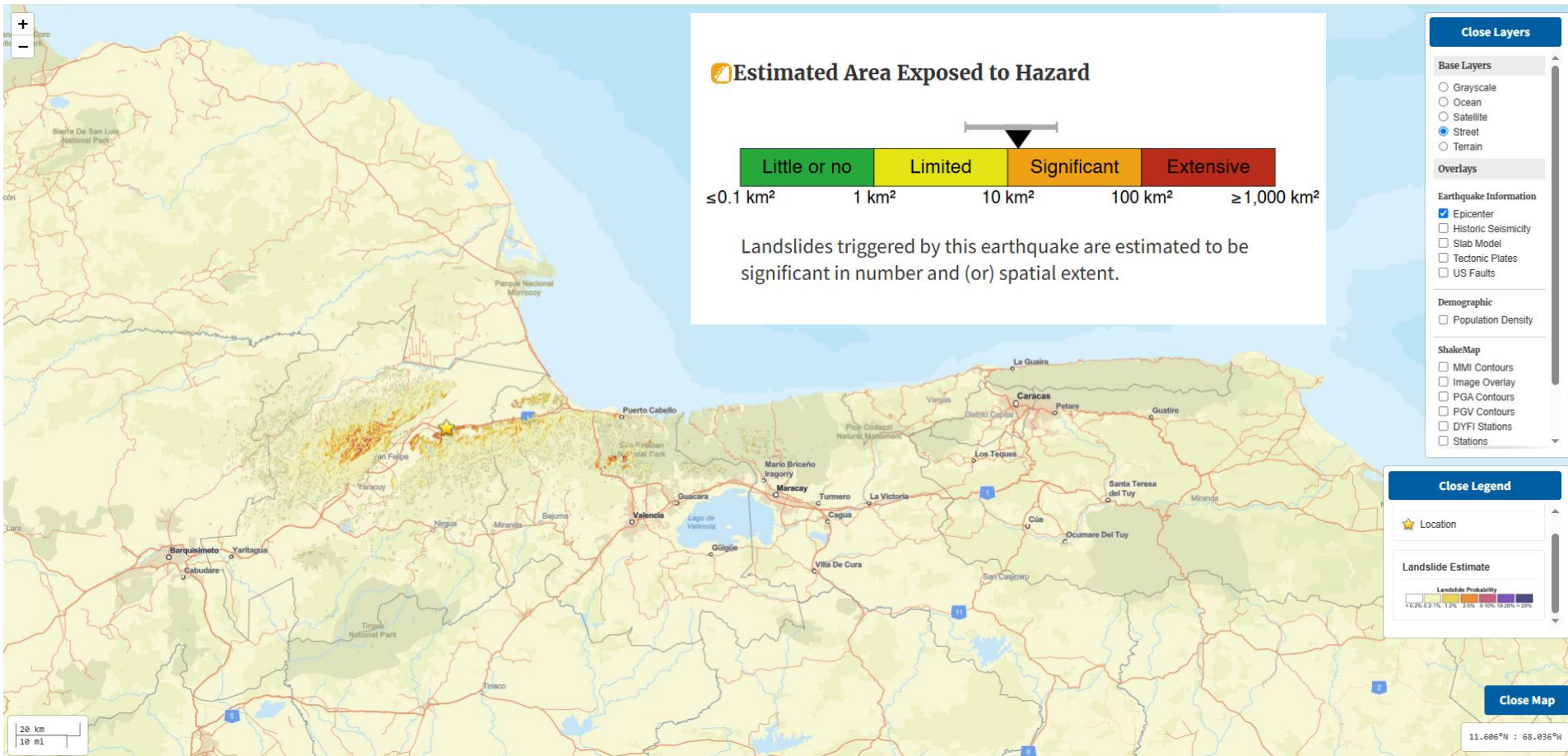


This map was derived from NISAR (NASA-ISRO Synthetic Aperture Radar) data acquired on June 25 and June 30 (after the earthquakes) and June 13 and June 18 (before the earthquakes). Based on this map, a westward displacement up to 60 cm was calculated in the La Guaira area located east of the international airport.



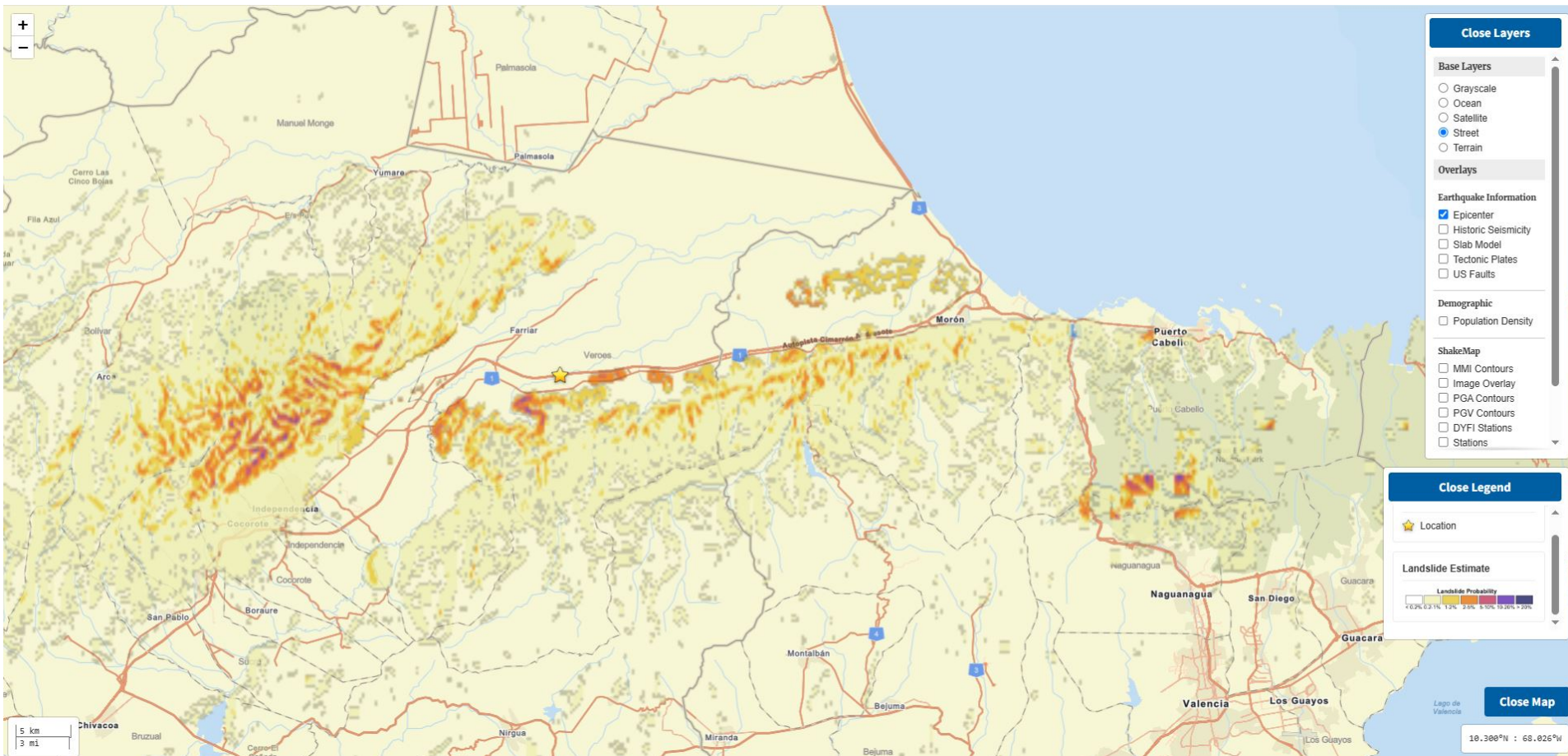


ESTIMATED DISTRIBUTION OF LANDSLIDES TRIGGERED BY THE 24 JUNE 2026 Mw=7.2 EARTHQUAKE





ESTIMATED DISTRIBUTION OF LANDSLIDES TRIGGERED BY THE 24 JUNE 2026 Mw=7.2 EARTHQUAKE



Available online at: <https://earthquake.usgs.gov/earthquakes/eventpage/us6000t7zc/ground-failure/summary>



ESTIMATED DISTRIBUTION OF LANDSLIDES TRIGGERED BY THE 24 JUNE 2026 Mw=7.2 EARTHQUAKE



The United States Geological Survey (USGS) identified several areas affected by landslide activity, including:

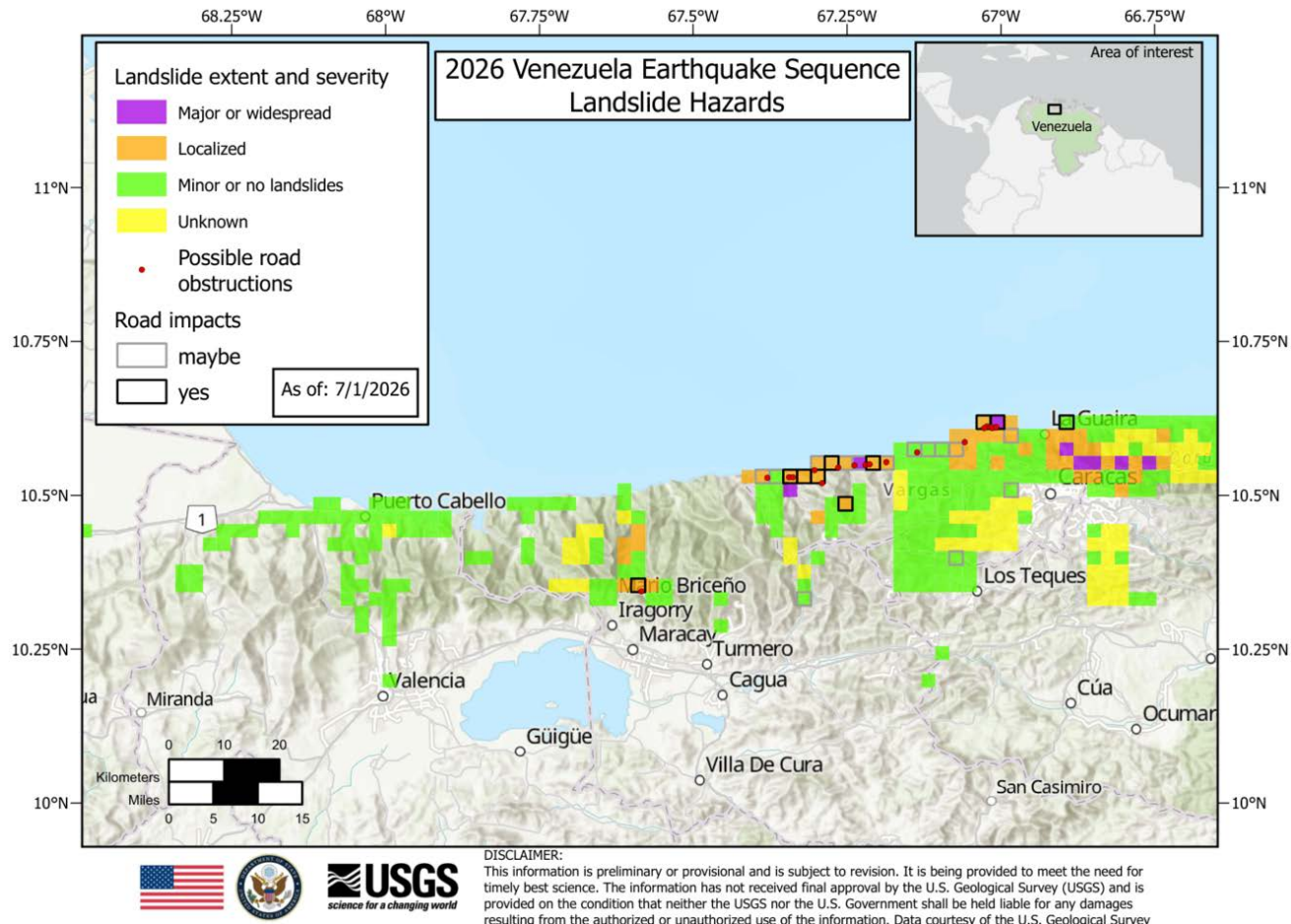
- Buried or structurally damaged buildings in the Catia La Mar and Playa Grande areas.
- Potentially isolated communities resulting from partial or complete blockage of the coastal roadway extending westward from Catia La Mar to Puerto Cruz, with inland settlements in this region potentially becoming disconnected from coastal communities.
- Localized structural damage associated with landslide occurrences in the vicinity of Highway 6, north of Maracay.
- Extensive landslide activity throughout the coastal mountainous terrain extending from La Guaira to Naiguatá.

According to the preliminary, yet incomplete, damage assessment, the majority of the documented landslide impacts are concentrated toward the eastern segment of the surface fault rupture.

The spatial distribution of the earthquake-triggered landslides exhibits improved agreement with both the USGS ShakeMap and Ground Failure models. Nevertheless, the observed landslide occurrence and overall severity remain lower than those predicted by the susceptibility models, particularly within the western sector of the affected region.



ESTIMATED DISTRIBUTION OF LANDSLIDES TRIGGERED BY THE 24 JUNE 2026 Mw=7.5 EARTHQUAKE

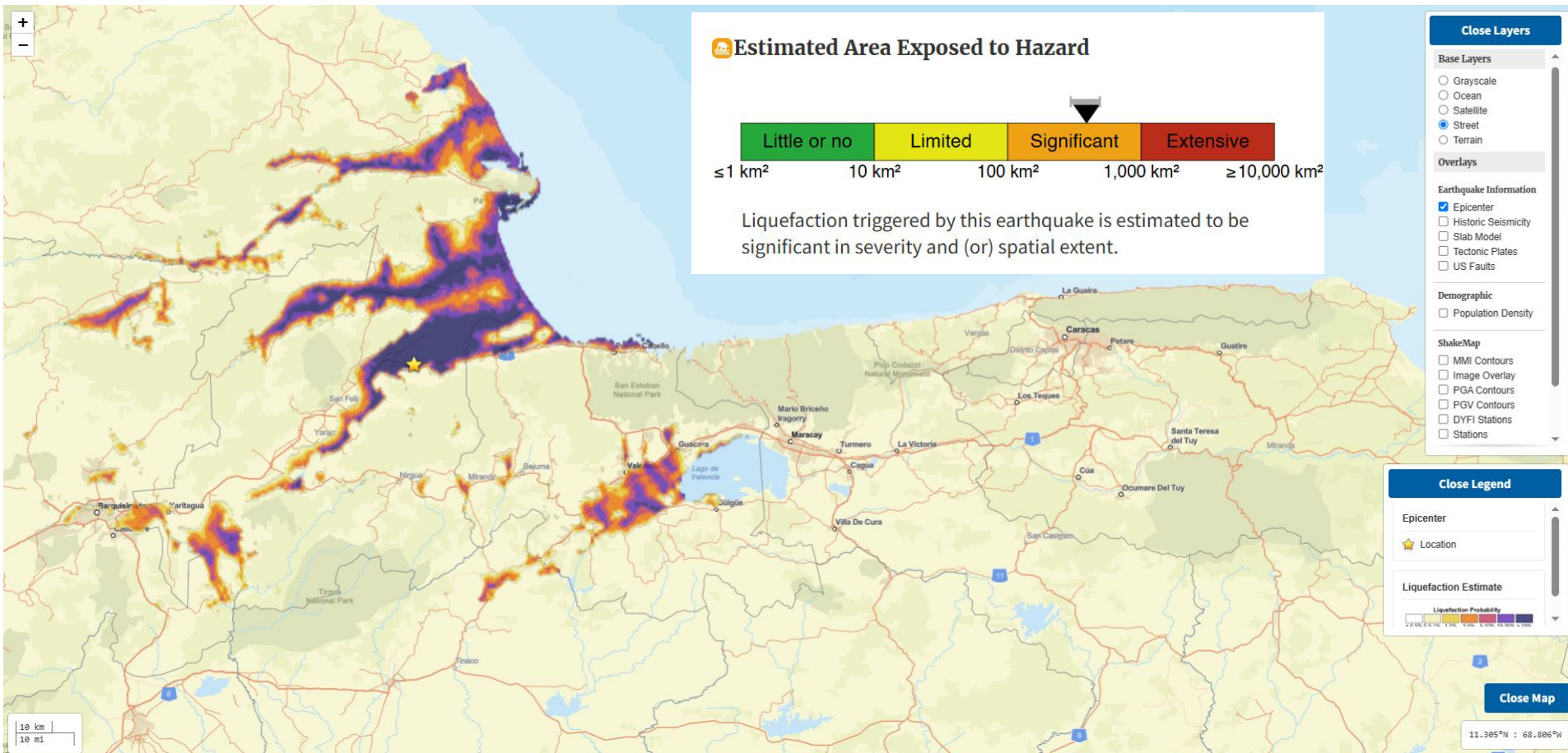


2026 Venezuela Sequence Earthquake-Triggered Landslide Hazards

Available online at: <https://www.usgs.gov/programs/landslide-hazards/science/2026-venezuela-sequence-earthquake-triggered-landslide-hazards>

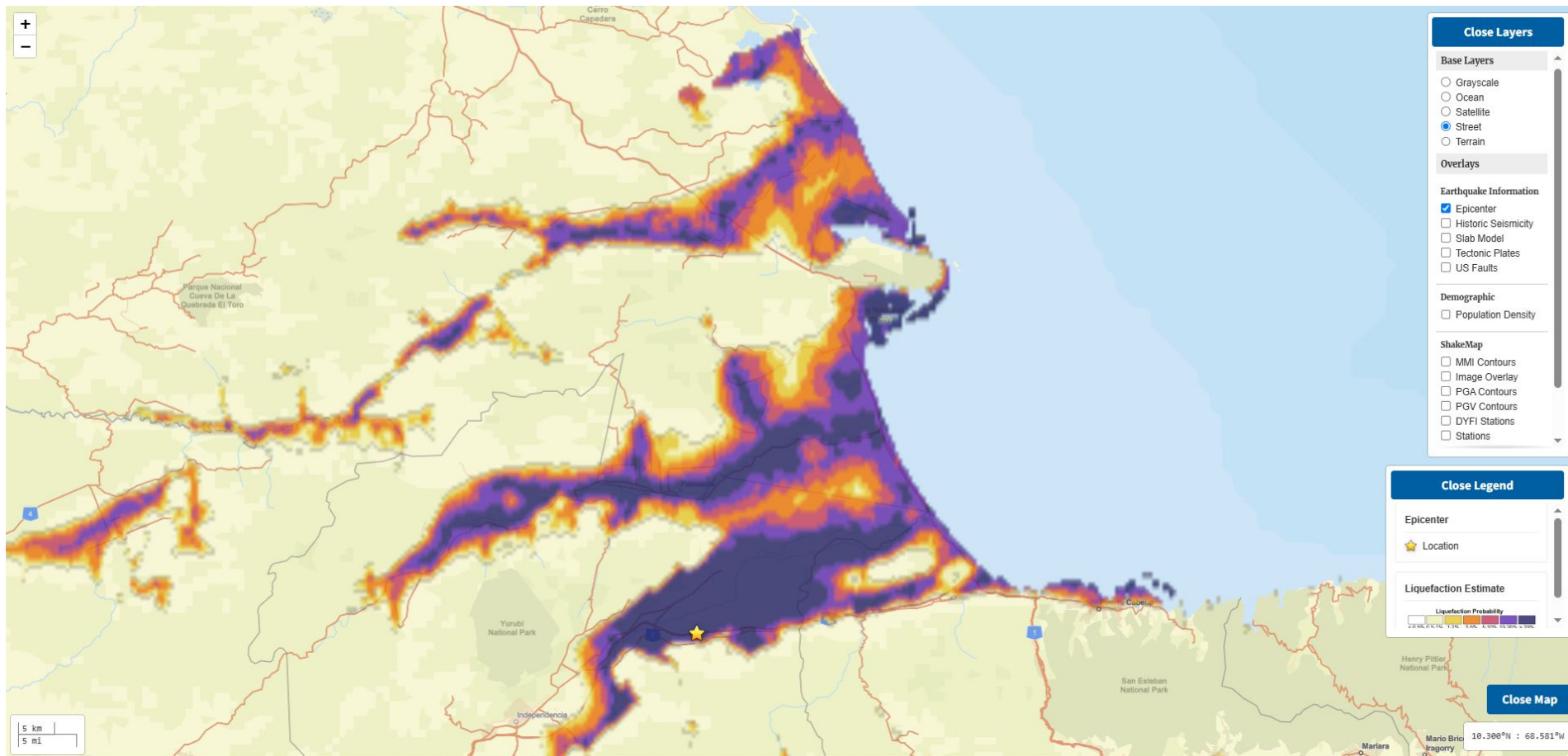


ESTIMATED DISTRIBUTION OF LIQUEFACTION TRIGGERED BY THE 24 JUNE 2026 Mw=7.2 EARTHQUAKE





ESTIMATED DISTRIBUTION OF LIQUEFACTION TRIGGERED BY THE 24 JUNE 2026 Mw=7.2 EARTHQUAKE



Available online at: <https://earthquake.usgs.gov/earthquakes/eventpage/us6000t7zc/ground-failure/summary>



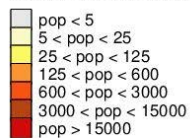
DISTRIBUTION OF POPULATION IN THE EPICENTRAL AREA OF THE 24 JUNE 2026 VENEZUELA EARTHQUAKES

Poulation density within 500 km from epicentre

M: 7.2, 2026-06-24T22:04:32 UTC
Lat: 10.48, Lon: -68.48, Depth: 10 km



Number of inhabitants per square km



★ Earthquake epicentre

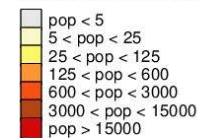
Last updated: 2026-06-25 at 06:31 UTC

Poulation density within 500 km from epicentre

M: 7.5, 2026-06-24T22:05:11 UTC
Lat: 10.44, Lon: -68.38, Depth: 10 km



Number of inhabitants per square km



★ Earthquake epicentre

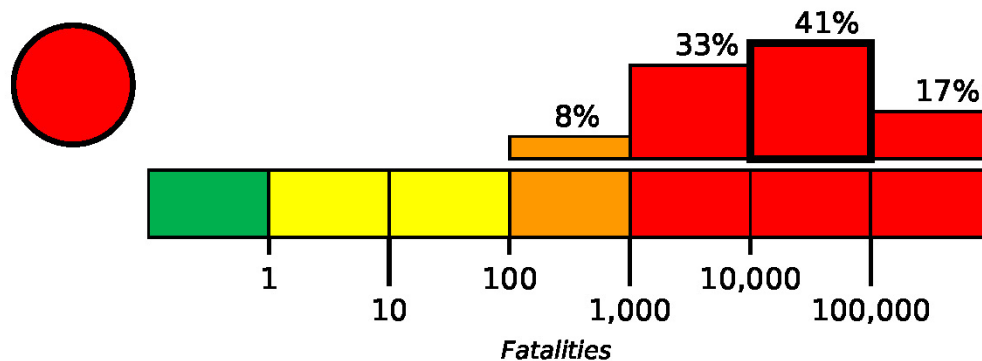
Last updated: 2026-06-25 at 06:42 UTC



ESTIMATED LOSSES FOR THE 24 JUNE 2026 Mw=7.2 EARTHQUAKE

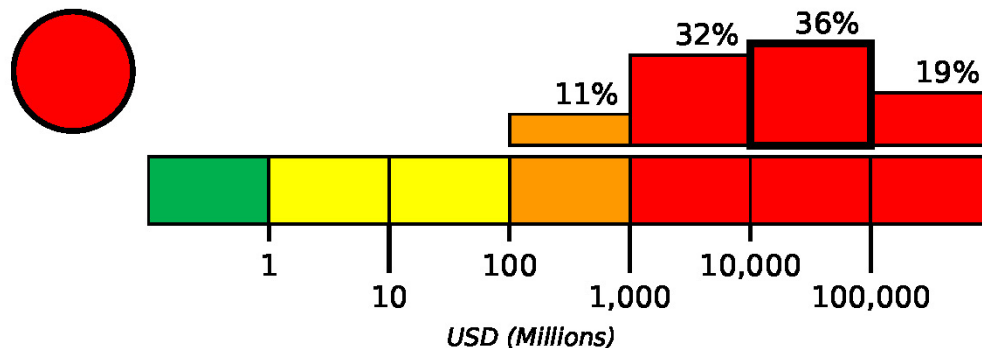


Estimated Fatalities



Red alert for shaking-related fatalities. High casualties and extensive damage are probable and the disaster is likely widespread. Past red alerts have required a national or international response.

Estimated Economic Losses



Available online at:
<https://earthquake.usgs.gov/earthquake/eventpage/us6000t7zc/pager>

Red alert for economic losses. Estimated economic losses are 0-7% GDP of Venezuela.



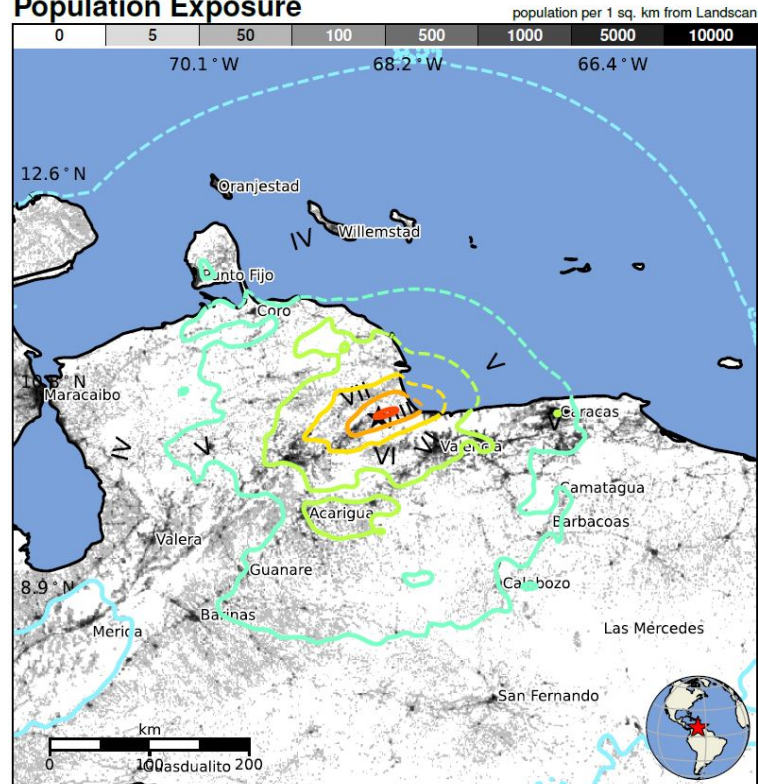
POPULATION EXPOSURE TO THE 24 JUNE 2026 Mw=7.2 EARTHQUAKE SHAKING

Estimated Population Exposed to Earthquake Shaking

ESTIMATED POPULATION EXPOSURE (k=x1000)		—*	655k*	9,142k*	6,129k	6,993k	627k	332k	37k	0
ESTIMATED MODIFIED MERCALLI INTENSITY		I	II-III	IV	V	VI	VII	VIII	IX	X+
PERCEIVED SHAKING		Not felt	Weak	Light	Moderate	Strong	Very Strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	Resistant Structures	None	None	None	V. Light	Light	Moderate	Mod./Heavy	Heavy	V. Heavy
	Vulnerable Structures	None	None	None	Light	Moderate	Mod./Heavy	Heavy	V. Heavy	V. Heavy

*Estimated exposure only includes population within the map area.

Population Exposure



Structures

Overall, the population in this region resides in structures that are vulnerable to earthquake shaking, though resistant structures exist. The predominant vulnerable building types are unreinforced brick masonry and adobe block construction.

Historical Earthquakes

Date (UTC)	Dist. (km)	Mag.	Max MMI(#)	Shaking Deaths
1986-07-18	103	5.4	VII(1k)	0
1975-04-05	131	6.3	VIII(50k)	3
1967-07-30	133	6.6	VIII(952k)	240

Recent earthquakes in this area have caused secondary hazards such as tsunamis that might have contributed to losses.

Selected City Exposure

from simplemaps.com

MMI	City	Population
VIII	San Felipe	221k
VII	Puerto Cabello	209k
VII	Tucacas	14k
VI	Los Guayos	130k
VI	Valencia	1,484k
VI	Yaritagua	140k
VI	Tocuyito	197k
VI	San Diego	187k
VI	Guacara	200k
VI	Caracas	2,246k
VI	Barquisimeto	1,059k

bold cities appear on map.

(k=x1000)

Available online at:

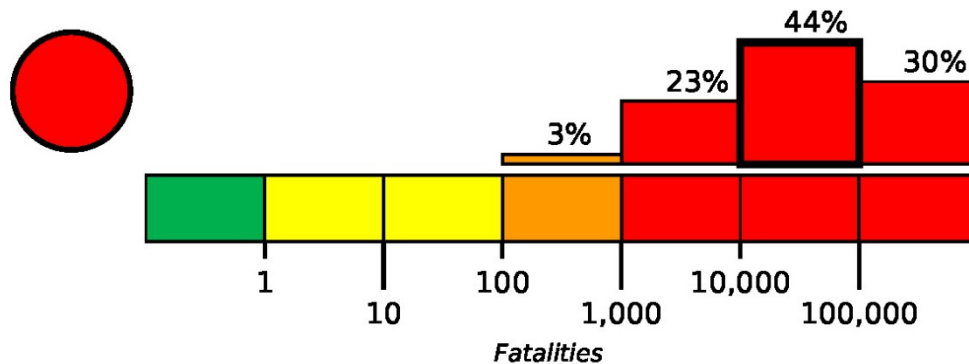
<https://earthquake.usgs.gov/pdl/products/urn:usgs-product:us:losspager:us6000t7zc:1782353996983/contents/onepager.pdf>



ESTIMATED LOSSES FOR THE 24 JUNE 2026 Mw=7.5 EARTHQUAKE

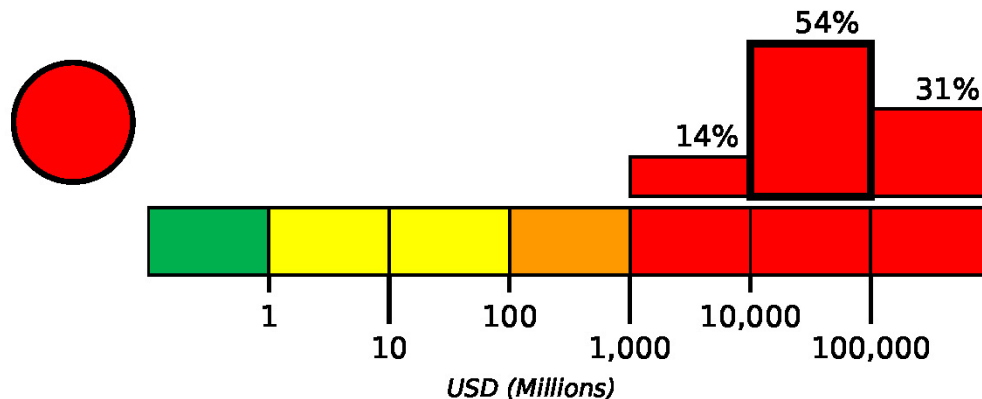


Estimated Fatalities



Red alert for shaking-related fatalities and economic losses. High casualties and extensive damage are probable and the disaster is likely widespread. Past red alerts have required a national or international response.

Estimated Economic Losses



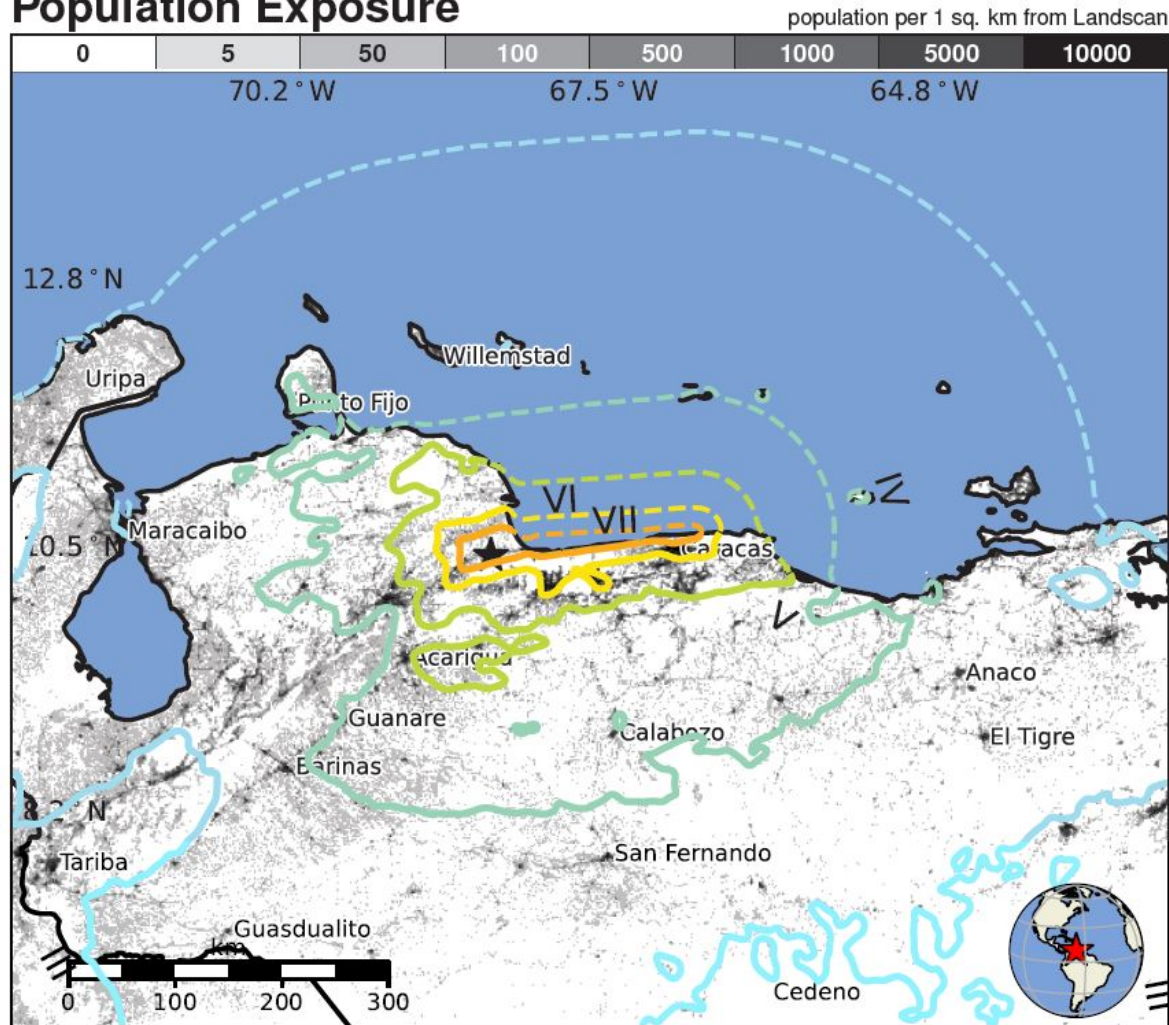
Available online at:
<https://earthquake.usgs.gov/earthquake/eventpage/us6000t7zp/pager>

Red alert for economic losses. Estimated economic losses are 4-20% GDP of Venezuela.



POPULATION EXPOSURE TO THE 24 JUNE 2026 Mw=7.5 EARTHQUAKE SHAKING

Population Exposure



PAGER content is automatically generated, and only considers losses due to structural damage. Limitations of input data, shaking estimates, and loss models may add uncertainty.
<https://earthquake.usgs.gov/earthquakes/eventpage/us6000t7zp#pager>

Available online at:

<https://earthquake.usgs.gov/pdl/products/urn:usgs-product:us:losspager:us6000t7zp:1782878367492/contents/onepager.pdf>



THE 24 JUNE 2026 VENEZUELA EARTHQUAKES – IMPACT ON THE POPULATION

Data on the impacts of the Venezuela earthquakes presented in the following table are derived from the daily situation reports of the Office for the Coordination of Humanitarian Affairs (OCHA). These reports began to be published the day after the earthquakes and continued through 1 July.

The OCHA's daily situation reports provide a comprehensive operational and humanitarian overview of the emergency situation triggered by the two powerful earthquakes that occurred on 24 June 2026, outlining the seismic activity and the geographical areas affected, as well as the human losses and estimates of the impacted population. They also detail extensive damage to housing and critical infrastructure.

In addition, they analyze the status of essential services, including the health system, transportation networks, telecommunications, and utility services, all of which have been severely disrupted. The report further describes the activation of national civil protection mechanisms and international humanitarian coordination, including SAR operations and the deployment of assistance by UN agencies and partners, while also presenting risk

assessments and operational requirements for both immediate and medium-term response, such as shelter, healthcare, and the restoration of critical infrastructure.

**Situation Report No. 8**
Earthquakes in Venezuela
01 July 2026
Time: 7:00 pm

Highlights

- Following the 24 June earthquakes of magnitude 7.2 and 7.5 (18:00 local time), authorities report more than 700 aftershocks.
- At least seven (7) states have been impacted. La Guaira remains the most affected state.
- Official toll: 2,295 people dead and 11,267 injured.
- More than 26,000 people have been affected.
- A total of 6,461 people have been rescued.
- One week after the earthquakes, Urban Search and Rescue (USAR) teams continue operations in coordination with OCHA.
- The United Nations system and its partner organizations, in coordination with the Government, are responding with multisectoral actions and will continue to scale up assistance to affected people.

**2,295**
Dead people

**11,267**
Injured people

Situation overview

Venezuela is facing a national emergency following two consecutive high-magnitude earthquakes (7.2 and 7.5) that struck on 24 June (18:00 local time) in the north-central region, with the epicentre located along the San Felipe–Yumare–Montalbán axis (Yaracuy/Carabobo). Authorities report 782 aftershocks. Although their frequency and intensity have decreased, risk conditions persist.

One week after the earthquakes, authorities report a toll of 2,295 people dead, 11,267 injured, and 6,461 rescued since the onset of the emergency. In addition, approximately 13,000 people have been discharged from health facilities following their recovery.





THE 24 JUNE 2026 VENEZUELA EARTHQUAKES – IMPACT ON THE POPULATION

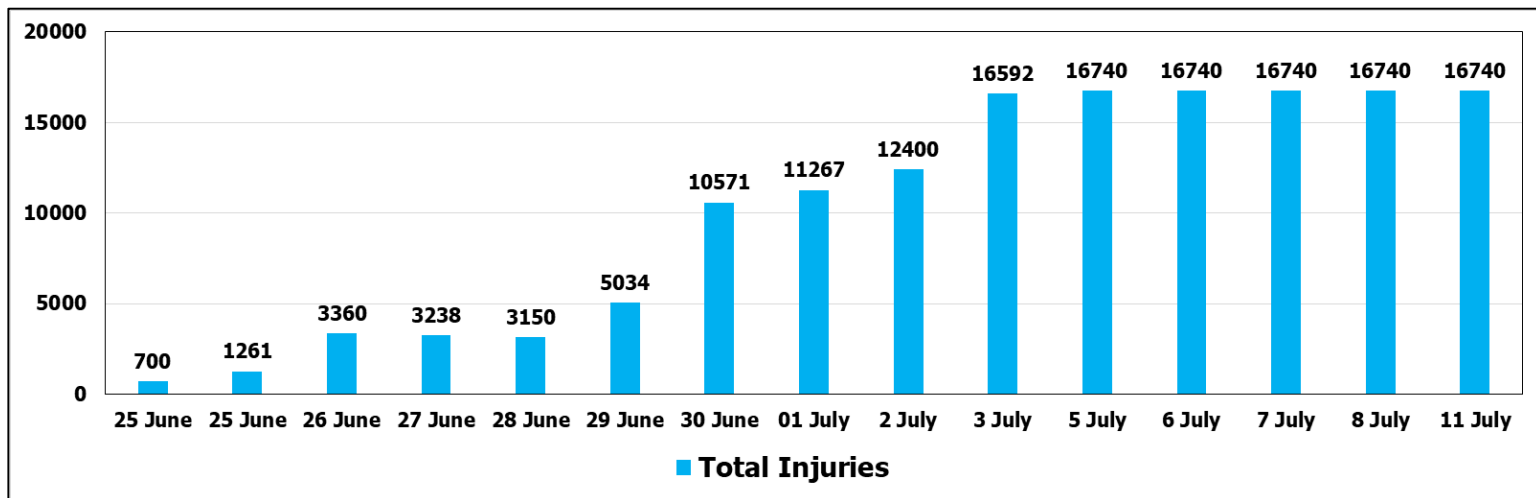
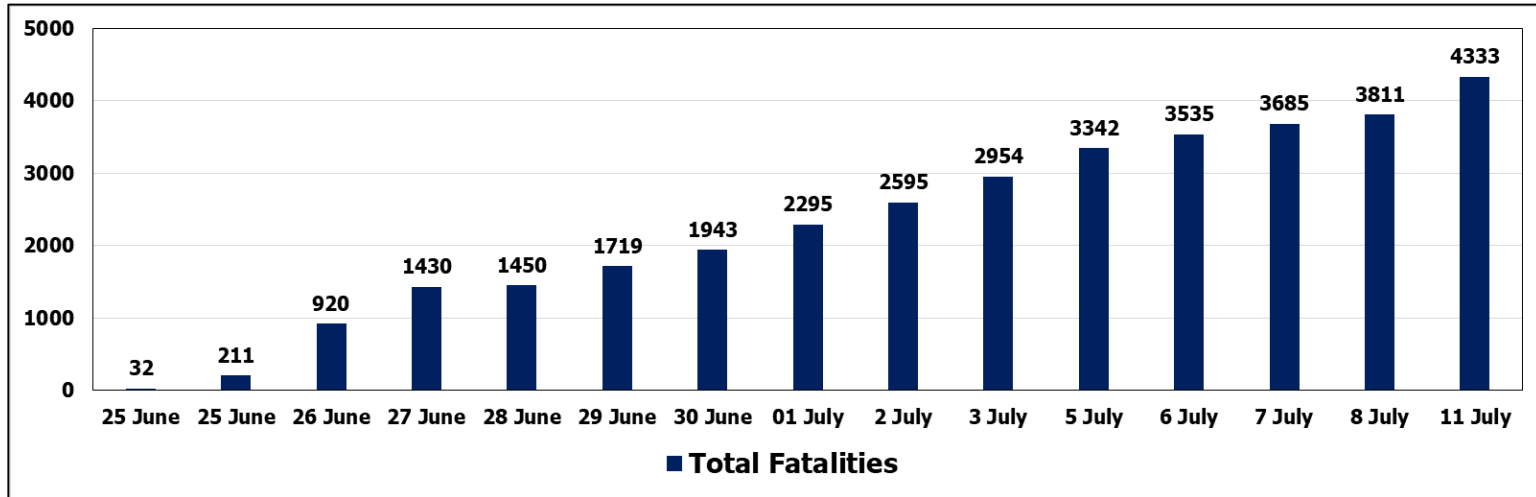
Day	Fatalities	Injuries	Affected structures	Aftershocks
25 June	32	700	not reported	not reported
25 June	211	1261	250	20
26 June	920	3360	1423	302
27 June	1430	3238	1423	430
28 June	1450	3150	2501	500
29 June	1719	5034	2501	609
30 June	1943	10571	2501	611
1 July	2295	11267	2501	700
2 July	2595	12400	2501	862
3 July	2954	16592	2501	942
5 July	3342	16740	2501	995
6 July	3535	16740	2501	1048
7 July	3685	16740	2501	1076
8 July	3811	16740	2501	1102
11 July	4333	16740	2501	1171

This table provides a chronological overview of the evolving impact of the Venezuela earthquake sequence from 25 June to 11 July 2026 based on the daily situation reports of OCHA. It integrates key humanitarian and seismological indicators, including cumulative fatalities and injuries, the progression of heavily damaged or structurally affected buildings, and the recorded number of aftershocks over time.





THE 24 JUNE 2026 VENEZUELA EARTHQUAKES – IMPACT ON THE POPULATION



Diagrams for the total fatalities and injured people from 25 June to 11 July 2026 based on the previous table with information from the OCHA



THE 24 JUNE 2026 VENEZUELA EARTHQUAKES – IMPACT ON THE POPULATION

Based on the data presented in the previous tables and diagrams, several clear epidemiological and operational conclusions can be drawn regarding the evolution of the earthquake impacts:

There is a rapid increase in fatalities during the initial days, with numbers rising from tens to hundreds and then exceeding one thousand within a few days. The immediate impact was not fully captured at first, a common occurrence in large-scale seismic events due to limited accessibility, infrastructure collapse, and ongoing SAR operations.

Fatalities and injuries follow different temporal dynamics. Injuries increase more sharply and with greater variability (e.g., from 3,238 on 27 June to 10,571 on 30 June), likely reflecting the progressive consolidation of reporting systems, as well as the continued discovery and evacuation of injured individuals by SAR teams.

From 1 July onwards, a clear divergence in the curves becomes evident. The number of injured experienced a final sharp surge (16592 on 3 July), before reaching a definitive plateau (16740 on 5 July). This stabilization, which persisted until 11 July, indicates that triage, medical admissions, and rescue of survivors had effectively concluded.

In contrast, total fatalities showed no signs of stabilization by the end of the reporting period. They continued to rise at a steady, almost linear rate, from 2,295 on 1 July to 4,333 on 11 July. This near-doubling of fatalities during the first critical weeks of July underscores the grim reality of prolonged SAR operations, where bodies were progressively recovered from collapsed structures long after the window for survival had closed.

The overall pattern is consistent with a reporting lag effect and gradual data reconciliation, in which early figures significantly underestimate the disaster scale. This is typical in large-scale emergencies, where critical infrastructure is severely disrupted.

Overall, the tables and diagrams of total fatalities and injuries reflects an evolving humanitarian crisis characterized by substantial initial underreporting, continuous revision of casualty figures, and a prolonged increase in recorded impacts, underscoring both the severity of the seismic event. While the medical response to survivors plateaued by early July, the retrieval of fatalities continued to climb, revealing the true and devastating scale of the disaster.



DAMAGE ASSESSEMENT IN THE AFFECTED AREA BASED ON SATELLITE IMAGERY

The European Union's Copernicus Emergency Management Service (CEMS) was activated (activation code EMSR884) for tracking the impact of the 24 June 2026 Mw=7.2 and Mw=7.5 earthquakes that struck northern Venezuela.

The CEMS platform contains detailed narrative information on the disaster timeline, including exact event and activation timestamps, alongside a comprehensive list of 13 designated Areas of Interest (Aois), such as the severely affected Caraballeda section, which local authorities and satellite imagery flagged for strict damage monitoring. It hosts over 25 highly specialized digital maps generated from the data processing of Sentinel satellites, which are coupled with detailed statistical charts assessing the scope of structural collapses and infrastructural damage across major Venezuelan states.

In terms of utility, the portal provides emergency responders with three primary categories of satellite products:

1. Reference maps to analyze the baseline geography before the seismic activity,
2. Delineation Maps to clearly outline the physical

- boundaries of the disaster zones, and
3. Grading Maps which systematically classify the severity of structural damage suffered by buildings, roads, and critical facilities.

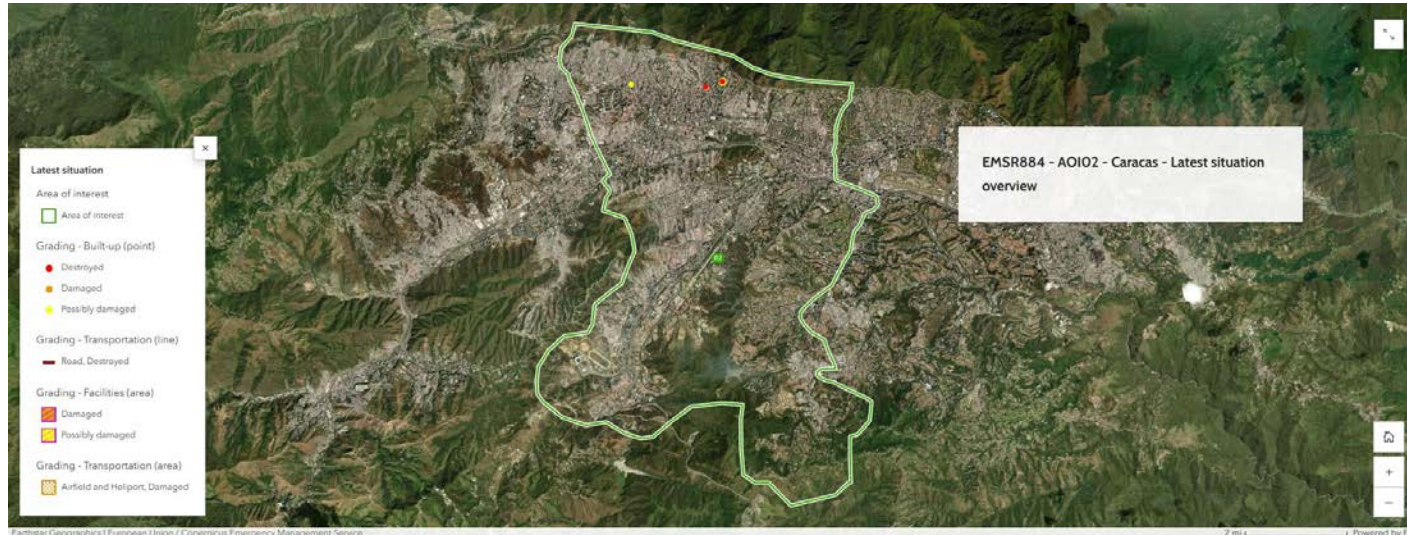
Through this central information hub, the European Commission equips civil defense squads, non-governmental organizations, and global agencies with the intelligence required to coordinate rapid ground relief inside Venezuela.

Exposed and Impacted Elements	Quantitative Information
Potentially Exposed area	22850 ha
Potentially Impacted buildings	3119 buildings
Potentially Exposed Population	2762000 residents
Potentially Exposed Railway	110 km
Potentially Exposed Roads	6720 km

Exposed and impacted elements in northern Venezuela based on the information provided by CEMS for the 24 June 2026 earthquakes.



DAMAGE ASSESSEMENT IN THE AFFECTED AREA BASED ON SATELLITE IMAGERY

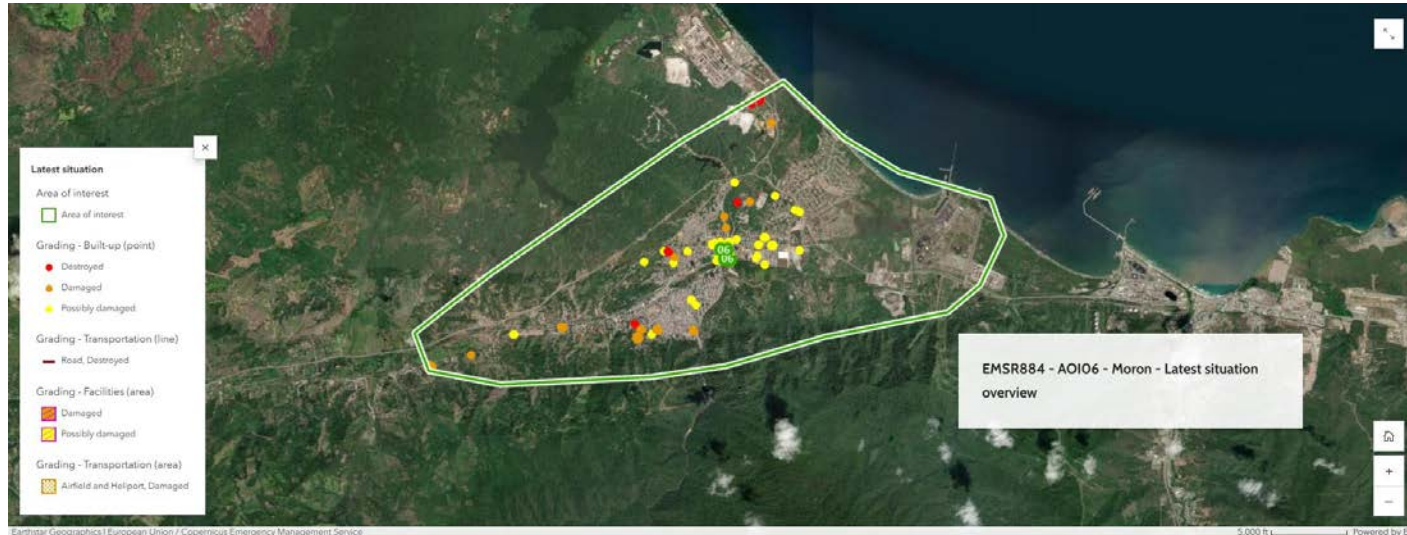


According to the emergency mapping produced by the Copernicus Emergency Management Service (CEMS), Caracas and Santa Cruz were the least affected areas, with the lowest numbers of affected and collapsed buildings.
(up) Caracas.
(down) Santa Cruz.

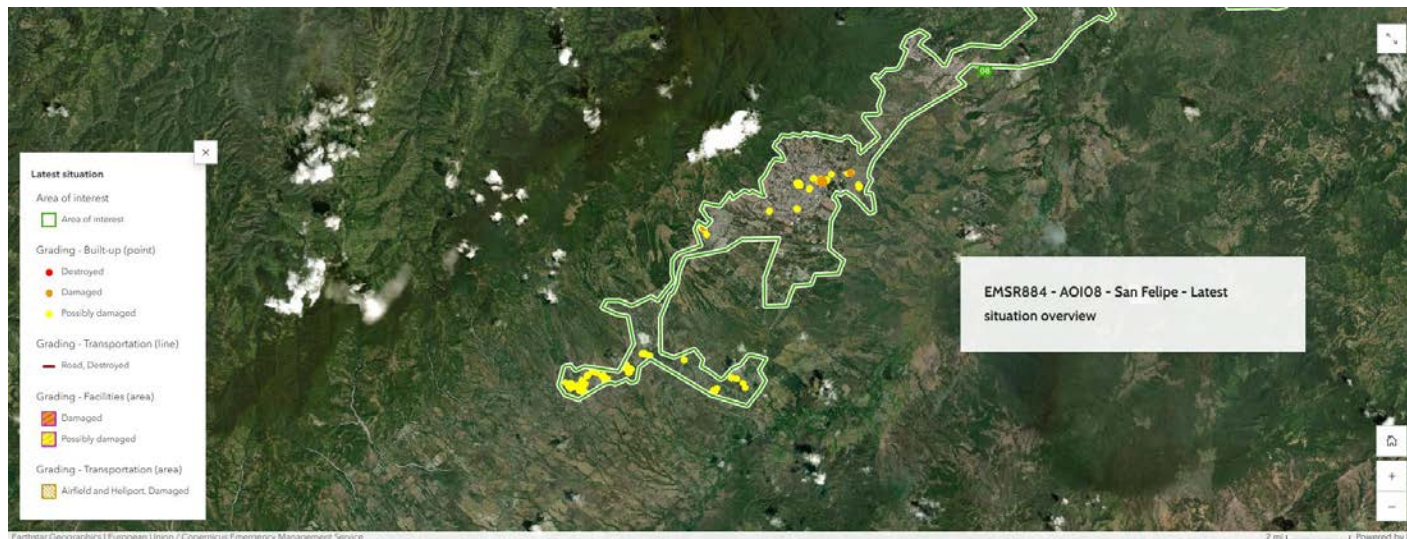




DAMAGE ASSESSEMENT IN THE AFFECTED AREA BASED ON SATELLITE IMAGERY

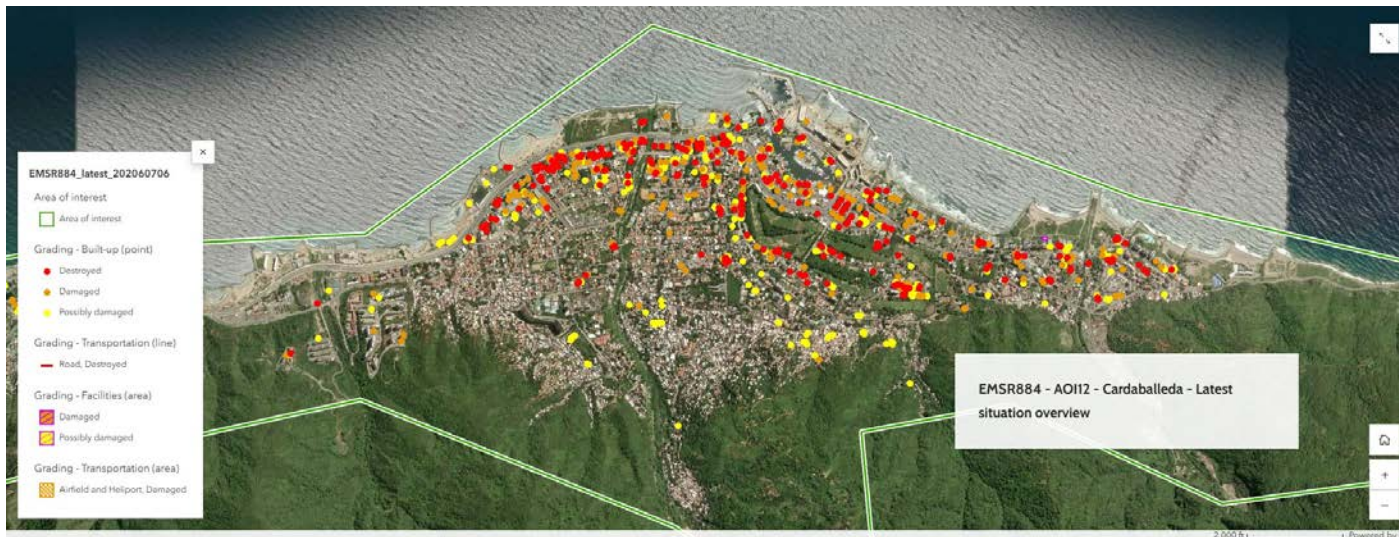
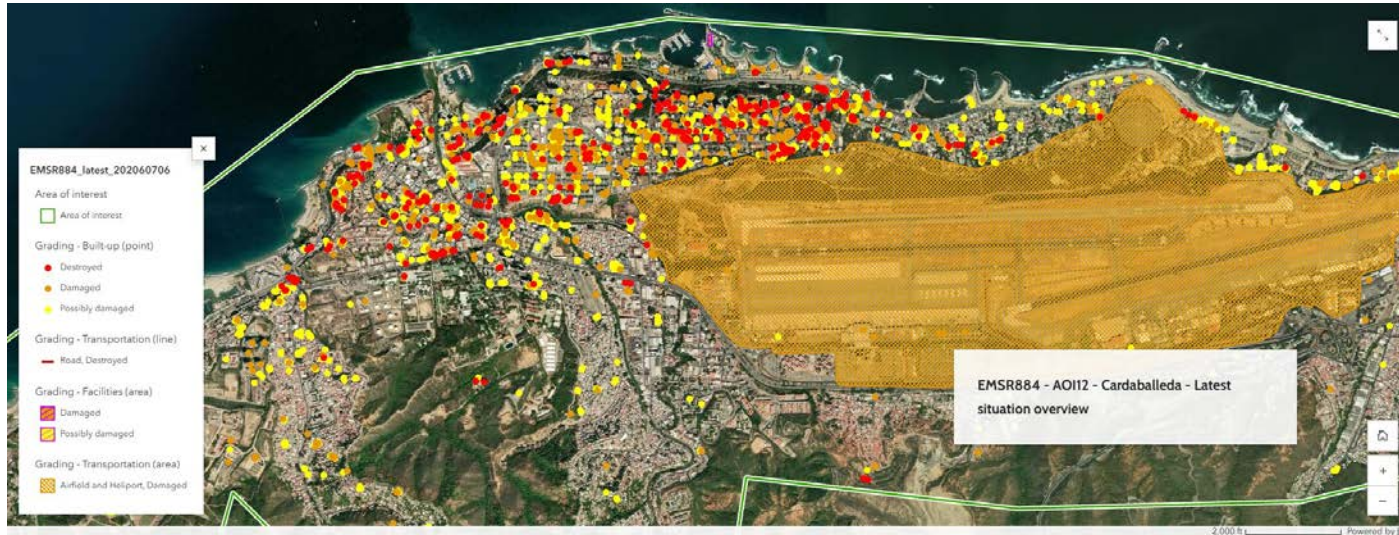


Based on the emergency mapping produced by the CEMS, the areas of Morón and San Felipe experienced a moderate level of impact compared with the coastal areas located farther east of the epicentral area.
(up) Morón.
(down) San Felipe.





DAMAGE ASSESSEMENT IN THE AFFECTED AREA BASED ON SATELLITE IMAGERY



Based on the emergency mapping produced by the Copernicus Emergency Management Service (CEMS), the most severely affected areas of northern Venezuela were Catia La Mar, Maiquetía, La Guaira, and Cardaballeda, where hundreds of buildings were partially or totally collapsed, resulting in thousands of casualties and economic losses amounting to millions. (up) Catia La Mar (down) Cardaballeda.



DAMAGE ASSESSEMENT IN THE AFFECTED AREA BASED ON SATELLITE IMAGERY

The Humanitarian Data Exchange (HDX) provides open access to earthquake damage assessment datasets for the 24 June 2026 northern Venezuela earthquakes.

The related data contains geospatial information and remote-sensing-based damage assessments focused on the affected areas, following the earthquake sequence that struck northern Venezuela on 24 June 2026. The dataset was developed to support rapid post-earthquake impact assessment by identifying and quantifying building damage using satellite imagery and machine learning-based classification methods. It provides spatially explicit information on structural damage severity, including the distribution of affected buildings and the extent of urban impact across the study area.

The data are primarily derived from very high-resolution satellite imagery combined with artificial intelligence models for building damage detection, as well as ancillary geospatial layers such as building footprints and structural characteristics. These outputs are intended to support rapid

situational awareness, guide field verification, and assist in prioritizing response and recovery operations.

Preliminary analyses indicate that a significant proportion of the building stock in Catia La Mar has sustained damage, with some assessments suggesting that approximately one-third of structures may be affected to varying degrees. The dataset is considered provisional and subject to refinement as additional satellite imagery and ground-truth information become available. It is provided in Geographic Information System (GIS) formats compatible with standard platforms such as QGIS and ArcGIS, and is intended for use by humanitarian responders, government agencies, and researchers involved in earthquake damage assessment, urban impact analysis, and recovery planning.

HDX

UN
environment
programme



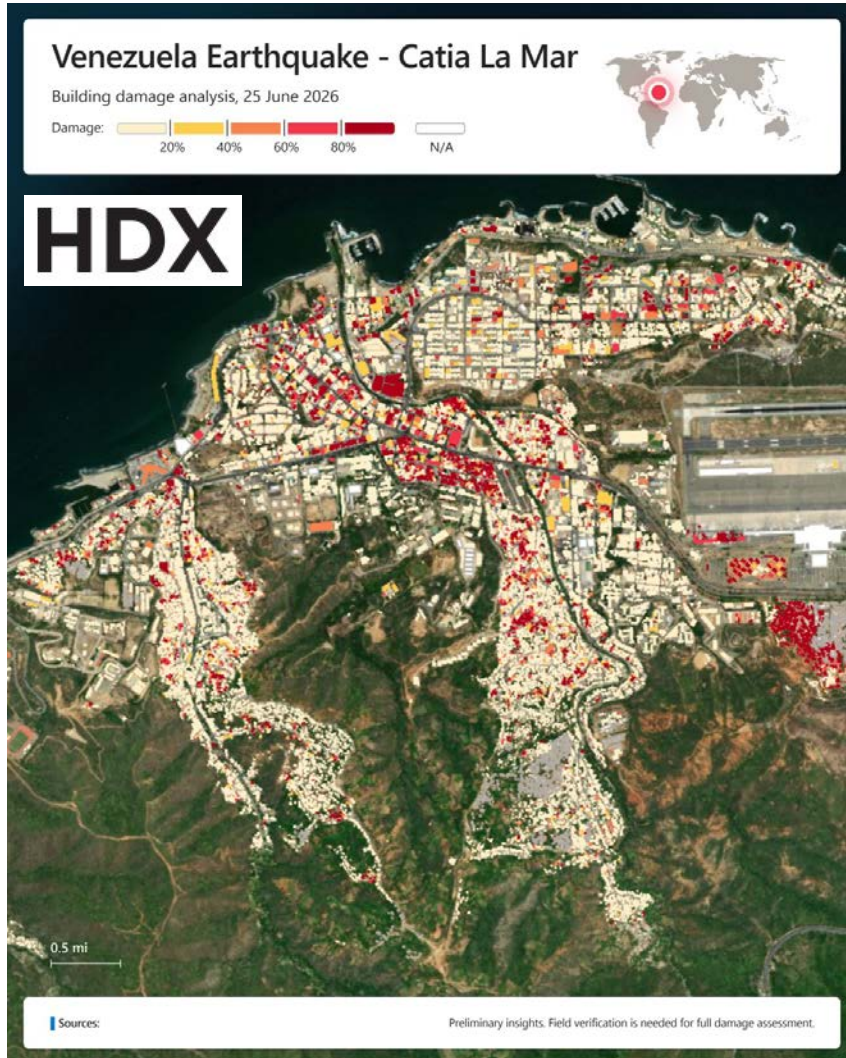
OCHA

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UNIT

Responding to Emergencies, Protecting the Environment



DAMAGE ASSESSEMENT IN THE AFFECTED AREA BASED ON SATELLITE IMAGERY



<https://data.humdata.org/dataset/venezuela-earthquakes-catia-la-mar>



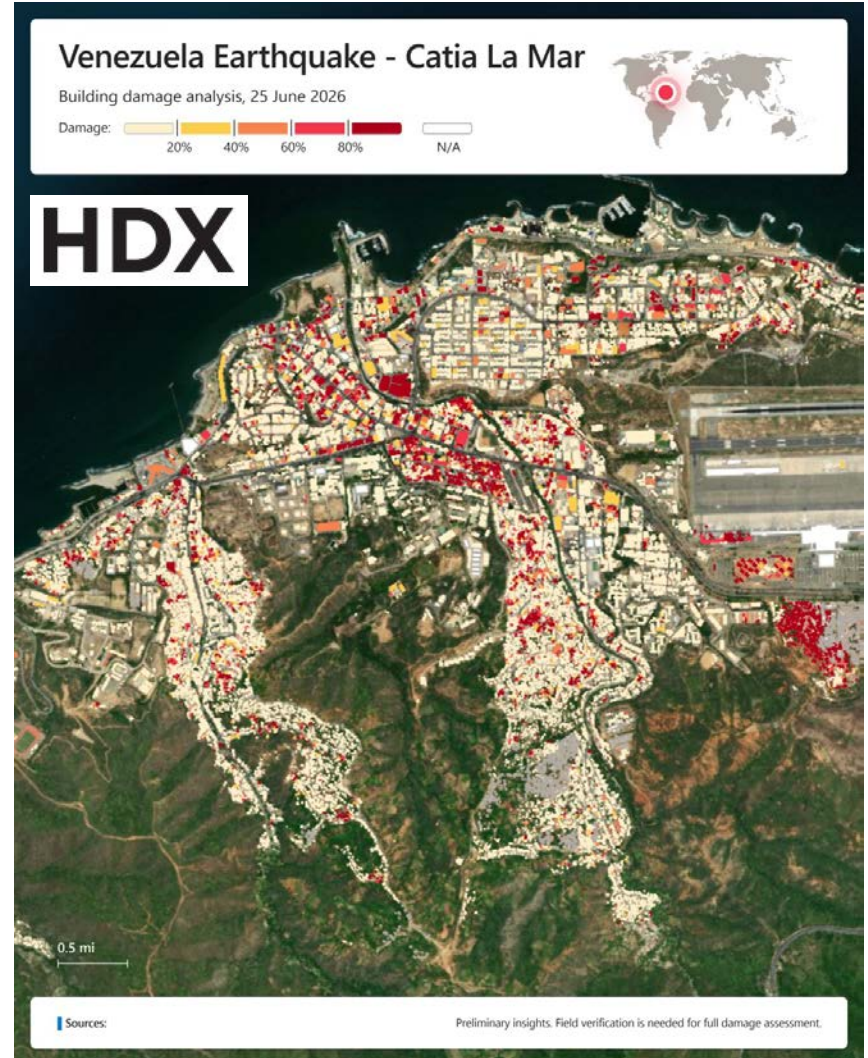
<https://data.humdata.org/dataset/venezuela-earthquakes-building-damage-assessment-in-catia-la-mar-east>



DAMAGE ASSESSEMENT IN THE AFFECTED AREA BASED ON SATELLITE IMAGERY



<https://data.humdata.org/dataset/venezuela-earthquakes-catia-la-mar>



<https://data.humdata.org/dataset/venezuela-earthquakes-building-damage-assessment-in-catia-la-mar-east>



SATELLITE IMAGERY FOR ASSESING EARTHQUAKE DAMAGE DISTRIBUTION

Before



After



Before



After





SATELLITE IMAGERY FOR ASSESING EARTHQUAKE DAMAGE DISTRIBUTION

Before



After



Before



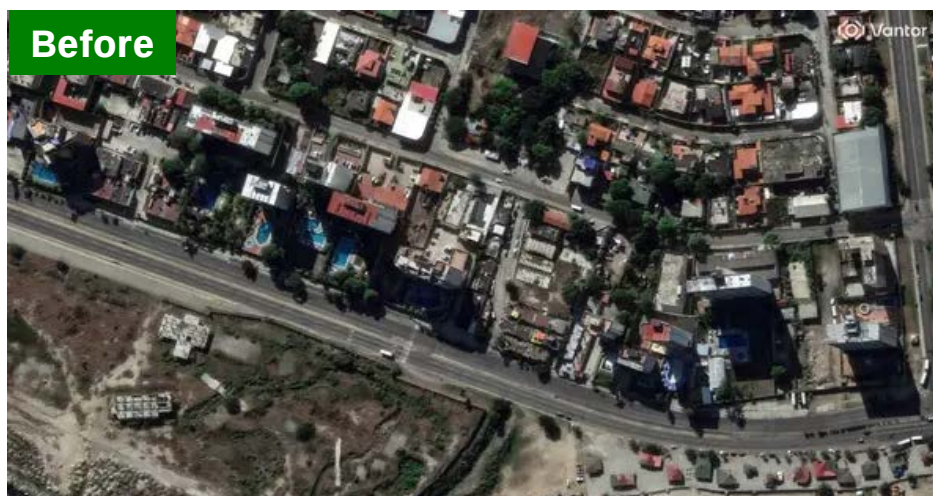
After



Caraballeda (up) and Macuto (down)



SATELLITE IMAGERY FOR ASSESING EARTHQUAKE DAMAGE DISTRIBUTION



Maiquetia (up) and Caraballeda (down)



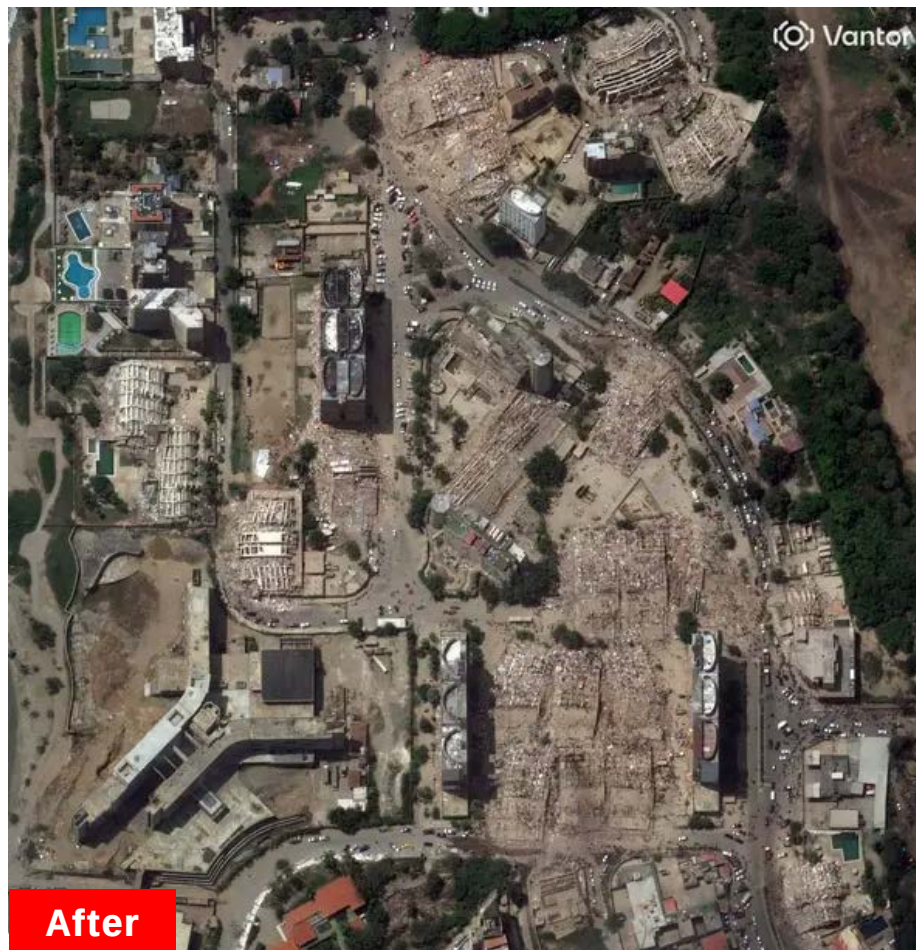
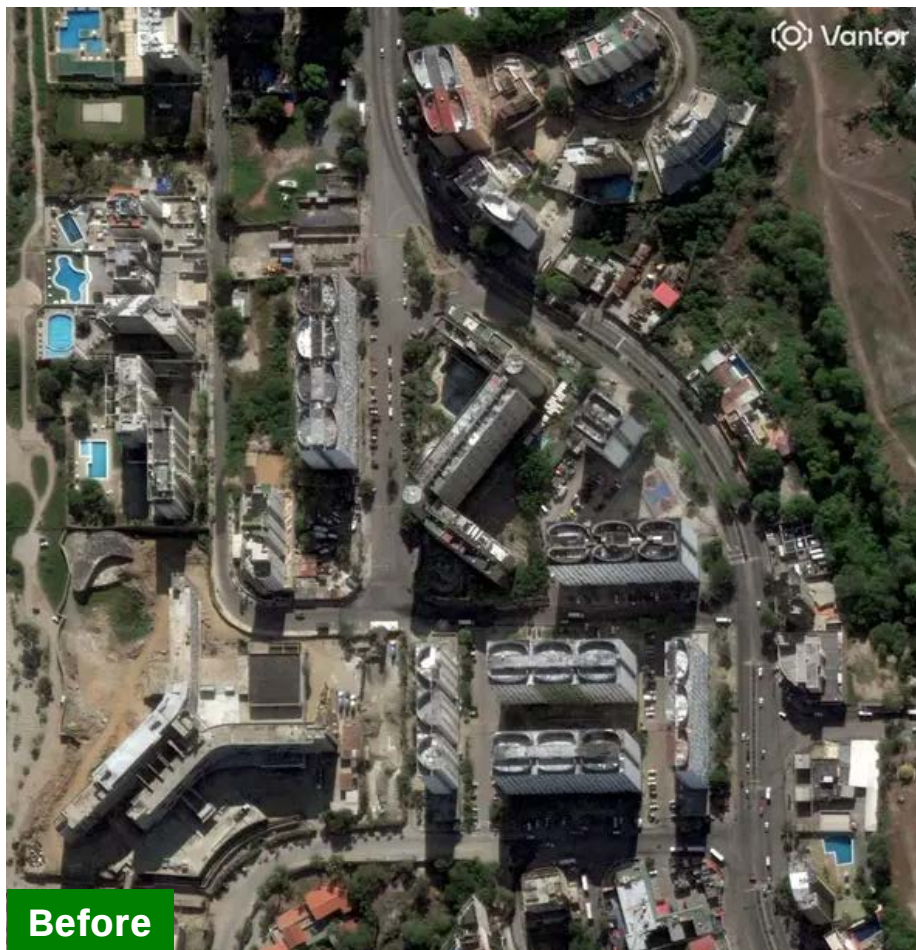
SATELLITE IMAGERY FOR ASSESING EARTHQUAKE DAMAGE DISTRIBUTION



Caraballeda (up) and Marina de Caraballeda (down)



SATELLITE IMAGERY FOR ASSESING EARTHQUAKE DAMAGE DISTRIBUTION





DOMINANT BUILDING TYPES

The building stock in the areas affected by the 2026 earthquakes in northern Venezuela is characterized by considerable typological diversity, comprising both modern reinforced concrete structures and older or structurally deficient masonry buildings. The varying seismic performance of these structural systems, combined with local geotechnical conditions and construction quality, played a decisive role in determining the extent of the observed damage.

The predominant structural typology in urban areas consists of reinforced concrete (RC) frames with masonry infill walls. Most mid-rise and high-rise residential and office buildings belong to this building type. According to available housing statistics, approximately 85% of residential buildings have walls constructed from brick masonry or concrete blocks, a substantial proportion of which are either unreinforced or inadequately reinforced. However, a substantial proportion of the building stock was constructed before the major revisions of the Venezuelan seismic design code following the 1967 earthquake, particularly prior to the significant code improvements introduced in

1982. Consequently, many buildings exhibit inadequate confinement of RC columns, deficient beam-column joints, insufficient transverse reinforcement, and, overall, limited ductility. In coastal areas, prolonged exposure to the marine environment has also contributed to reinforcement corrosion and material deterioration, further reducing the structural capacity of older RC buildings.

Buildings with soft-storey configurations proved particularly vulnerable. In these structures, the ground floor is typically used for open parking areas or commercial spaces, resulting in a reduced number of vertical load-resisting elements. In addition, several structural and geometric deficiencies are commonly observed, including short-column effects, torsional irregularities caused by asymmetric stiffness distribution, irregular masonry infill layouts, and pounding between adjacent buildings due to insufficient seismic separation gaps. Field observations indicate that the majority of severe structural damage occurred in mid-rise RC buildings exhibiting one or more of these deficiencies.



DOMINANT BUILDING TYPES AND THEIR SEISMIC VULNERABILITY

A significant portion of the residential building stock also consists of non-engineered RC and masonry constructions, which were constructed incrementally without comprehensive structural or seismic design. These buildings are typically characterized by poor-quality concrete, inadequate reinforcement detailing, unverified vertical extensions, and foundations constructed on fill material or steep slopes. Under strong ground shaking, these deficiencies often interact with geotechnical failures, including slope instability and landslides, and retaining-wall failures, substantially increasing the intensity of structural damage.

In areas located closer to the earthquake epicenters, particularly within parts of La Guaira State, the building stock includes a considerable number of low-rise load-bearing masonry buildings, owner-built RC structures, as well as unreinforced brick masonry and adobe structures. These construction types exhibit particularly high seismic vulnerability due to the low tensile strength of masonry materials, the absence of reinforcement, and inadequate connections between walls and roof or floor diaphragms.

In major urban centers, particularly Caracas, a substantial proportion of the population resides in informal hillside settlements. Dwellings in these areas are typically self-built masonry and RC structures of poor construction quality, built with limited engineering supervision and frequently supported by inadequate foundations. Many of these dwellings have been expanded incrementally through additional storeys without structural assessment, resulting in increased seismic vulnerability. Their location on steep slopes significantly increases their susceptibility to the combined effects of strong seismic shaking and earthquake-induced landslides.

In addition to residential buildings, the affected region includes critical infrastructure such as port facilities, Simón Bolívar International Airport, and petrochemical installations. These structures are susceptible to earthquake-induced damage involving structural connections, bracing systems, excessive drift, storage tanks, and pipeline networks, representing an additional source of seismic risk beyond conventional building stock.



DOMINANT BUILDING TYPES – THE FLAT SLAB SYSTEM

In the earthquake-affected area of northern Venezuela, a dominant structural system is the flat slab system. This structural system consists of a continuous RC slab that is directly supported by columns without the use of beams. Vertical load transfer occurs directly from the slab to the columns through flexure and shear mechanisms at the slab-column connection, where significant shear and punching shear stresses develop. In many cases, the slab is locally thickened in the column regions by means of drop panels or column capitals in order to enhance punching shear resistance and improve local stiffness at the critical connection zones.

From a constructional and architectural viewpoint, the system offers several significant advantages. The absence of beams allows for flat soffits, which provides high architectural flexibility in spatial planning, enabling unrestricted layout of internal partitions and greater independence between structural and architectural design. Furthermore, the reduction in floor-to-floor height, since beam depth is eliminated, can lead to an overall reduction in building height, with potential economic benefits in façade construction, vertical circulation elements,

and building services installations. In addition, the system facilitates the integration and routing of mechanical, electrical, and plumbing services, while the repetitive slab formwork typically contributes to faster construction cycles and improved construction efficiency.

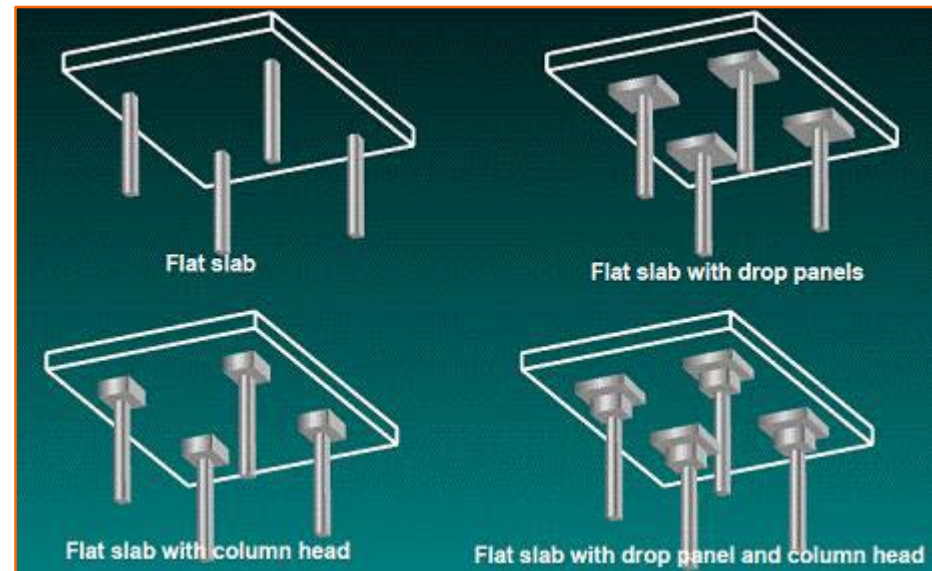
However, in terms of seismic performance, the flat slab system exhibits specific structural limitations that make it less favorable in earthquake-prone regions unless appropriate mitigation measures are implemented. The absence of beams results in reduced lateral stiffness of the structural system, leading to increased inter-storey drifts under seismic loading. Moreover, the critical failure mode associated with this system is punching shear failure at the slab-column connection. This type of failure is particularly hazardous because it is typically brittle and occurs with limited or no prior warning, thereby significantly reducing the overall ductility of the structural system.



DOMINANT BUILDING TYPES – THE FLAT SLAB SYSTEM

In contrast to conventional beam-slab frames, where beams act as primary locations for plastic hinge formation and contribute to a more distributed inelastic response mechanism, flat slab systems tend to concentrate inelastic demands at the column regions and slab-column joints. For this reason, seismic design of flat slab structures generally requires the incorporation of additional lateral force-resisting elements, such as reinforced concrete shear walls or cores, in order to ensure adequate global stiffness, strength, and energy dissipation capacity. Furthermore, the slab-column connection regions must be carefully detailed with appropriate shear reinforcement or geometrical enhancements to ensure sufficient punching shear capacity and to promote a ductile failure mechanism.

Overall, the flat slab system represents an efficient structural solution in terms of architectural flexibility and construction simplicity. Nevertheless, in seismic regions it requires careful and comprehensive structural design to address its inherent deficiencies in lateral stiffness, ductility, and particularly its vulnerability to brittle punching shear failure.



Different profile of flat slab
(after Nirkhe et al., 2016)



DISTRIBUTION OF DAMAGE ALONG THE COASTAL NORTHERN VENEZUELA

The severe structural damage that led to partial or complete building collapses in the coastal zone of northern Venezuela was not uniformly distributed throughout the region, which is largely underlain by Quaternary alluvial deposits, including alluvial fans, coastal sediments, and fluvial-alluvial deposits. The most significant collapses were concentrated in specific areas where the thickness of the unconsolidated sedimentary deposits, and the reduced soil stiffness created conditions of increased seismic amplification and enhanced structural demand.

The coastal geometry of the region, characterized by local sedimentary basins formed between the underlying rock formations and younger unconsolidated deposits, contributed to the occurrence of site amplification and basin effects. In contrast to locations directly founded on rock, where the seismic response is typically characterized by higher-frequency ground motions and limited duration of amplification (rock site response), areas underlain by thick layers of soft sediments exhibited a significantly different dynamic behavior (soft sediment site response). The

trapping and multiple reflections of seismic waves within the sedimentary basin, combined with the low stiffness of the deposits, resulted in amplification of the predominant periods of ground motion and an increase in the duration of strong shaking.

In these areas, the fundamental period of the soil column approached the predominant periods of the seismic excitation, leading to unfavorable soil–structure interaction conditions. This resulted in increased seismic demands on structures, particularly on taller and more flexible buildings, which are inherently more sensitive to long-period ground motions.

These adverse conditions were further aggravated by the occurrence of two strong seismic events within a very short time interval (39 s). The close temporal proximity of the two events meant that structures had not yet completed the dissipation of vibrations induced by the first earthquake before being subjected to the second, more intense and longer-duration excitation.



DISTRIBUTION OF DAMAGE ALONG THE COASTAL NORTHERN VENEZUELA

This cumulative loading effect increased the overall seismic demand, amplified the resulting structural deformations, and exacerbated damage in buildings located within the narrow coastal zone of maximum impact. Conversely, outside the narrow coastal zone characterized by recent unconsolidated deposits, areas underlain by the regional geological bedrock formations, consisting mainly of metamorphic rock

units, did not exhibit comparable systematic collapses or extensive damage. In these locations, the rock-site response, characterized by higher stiffness and limited potential for amplification of seismic ground motion, resulted in a more effective seismic response compared with that of the soft coastal sedimentary zones.



The heavily affected narrow coastal zone of Caraballeda with extended collapses of high-rise buildings in a small distance from the sea front.

Drone photos by
Lekkas and Carydis



DISTRIBUTION OF DAMAGE IN HIGH-RISE MULTI-STOREY BUILDINGS

A characteristic feature of the multi-storey buildings that sustained damage without collapsing in the coastal region of northern Venezuela was the concentration of damage in the lower storeys, with the severity of damage progressively increasing from the upper floors towards the ground floor.

This damage pattern is primarily attributed to the increase in seismic storey shear towards the base of the structure, as the ground floor resists the cumulative inertial forces of all the overlying storeys, as well as to the concentration of interstorey drift in the lower levels. Owing to the strong interaction between the reinforced concrete structural frame and the masonry infill walls, the latter were forced to deform, developing equivalent diagonal compression struts and experiencing significant shear stresses.

At the upper storeys, where shear demands and interstorey drifts were relatively limited, damage was generally confined to the detachment of plaster from the masonry surfaces. In contrast, towards the lower storeys, where seismic demands were substantially greater, deformations exceeded the

deformation capacity of the infill walls, resulting in extensive cracking, separation of the masonry infills from the reinforced concrete frame, and, in several cases, complete collapse of the infill panels.

Nevertheless, the observed damage remained mainly non-structural, as the primary structural system retained its load-carrying capacity without exhibiting extensive structural damage. The concentration of damage in the masonry infill walls, together with the satisfactory performance of the primary structural frame, enabled the buildings to remain standing even after the strong earthquakes, thereby safeguarding residents.



DISTRIBUTION OF DAMAGE IN HIGH-RISE MULTI-STOREY BUILDINGS



Representative case of a multi-storey RC building in the coastal Caraballeda, north of Caracas, showing damage concentration in the lower storeys. While the upper storeys remained largely undamaged and almost intact, the lower levels exhibited extensive damage to the masonry infill panels, including separation from the RC frame and partial to complete collapse.

Photos by Lekkas and Carydis



DISTRIBUTION OF DAMAGE IN HIGH-RISE MULTI-STOREY BUILDINGS



Typical cases of multi-storey RC buildings in the coastal Caraballeda, north of Caracas, showing damage concentration in the lower storeys. Photos by Lekkas and Carydis.



DISTRIBUTION OF DAMAGE IN HIGH-RISE MULTI-STOREY BUILDINGS



Representative case of multi-storey RC buildings in the coastal La Guaira state, showing damage concentration in the lower storeys.

Photos from the ERT news reporting mission to Venezuela. The team consisted of journalist Maria Stathopoulou, cameraman Stefanos Nikolopoulos, and sound engineer Antonis Kypraios.



MAIN BUILDING COLLAPSE MECHANISMS

Two predominant collapse mechanisms were identified in the earthquake-affected coastal La Guaira state as well as in the city of Caracas. The first mechanism corresponds to the uprooting collapse, while the second is associated with the pancake collapse mechanism.

The uprooting collapse mechanism was identified in several high-rise RC structures. In these cases, the ground-floor structural elements lost their connection with the foundation or experienced severe damage at their base, resulting in the upper part of the building overturning and moving as a rigid block. Previous studies have demonstrated that uprooting collapse is not exclusively related to poor construction quality, but it also results from the combined effect of extreme seismic demands, unfavorable structural characteristics, and inadequate lateral stiffness (Smyrou et al., 2025).

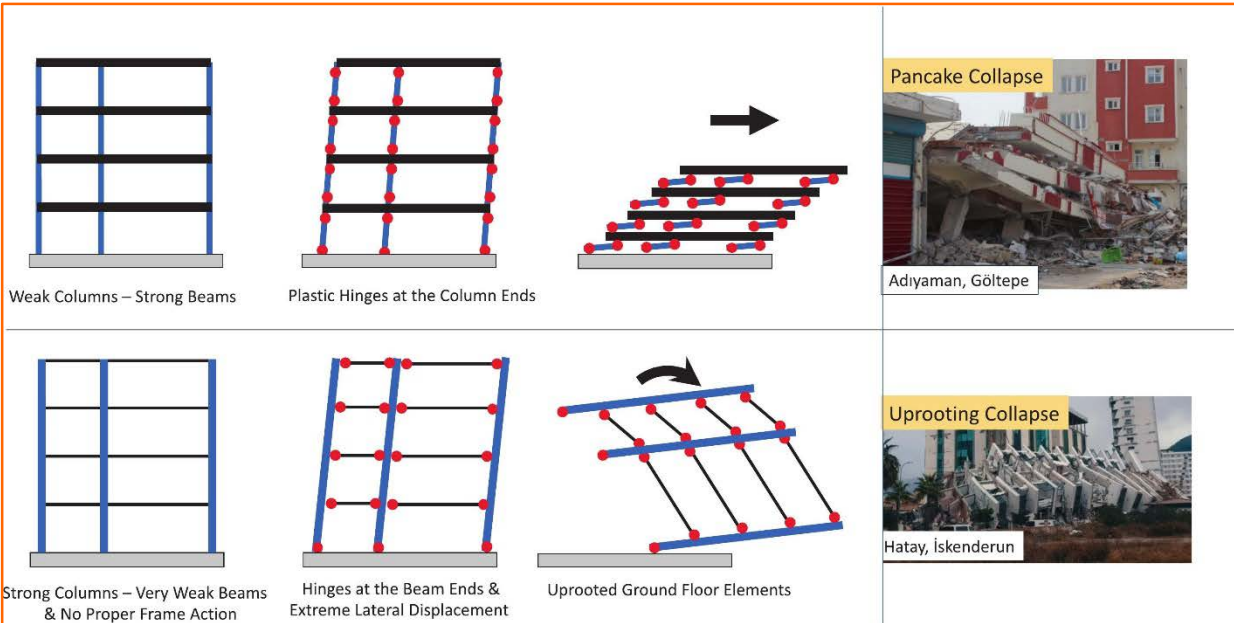
This collapse mechanism was extensively observed during the devastating earthquakes that struck southeastern Turkey in early 2023. According to the investigation conducted by Smyrou et al. (2025) on buildings exhibiting this type of collapse, the observed failures were attributed to a combination

of factors, including significant loss of axial load-carrying capacity in perimeter columns, exceptionally large roof displacements exceeding 1.0 m in a 36 m-high structure, and extremely high compressive and tensile strains concentrated in the ground-floor columns.

Based on the findings of the aforementioned study, it was concluded that even structures designed in accordance with modern seismic provisions may remain vulnerable under extreme ground-motion conditions when a critical combination of unfavorable factors occurs. The numerical analyses indicated that if the building had been completed and occupied it would still have exhibited a very high probability of collapse under the recorded seismic demands. High peak ground velocities (PGV), excessive height-to-width ratios, inadequate development of frame action, and insufficient contribution of structural walls to the lateral-force-resisting system were identified as key factors contributing to the collapse mechanism.



MAIN BUILDING COLLAPSE MECHANISMS



Comparison of uprooting collapse to overturning and pancake type collapse mechanisms.

After Smyrou et al. (2025)



Comparison of uprooting collapse and typical pancake collapse observed in post-earthquake satellite images from Antakya City, which was affected by the early 2023 southeastern Turkey earthquakes.

In the pancake collapse, the structure is reduced to rubble, obscuring structural details, whereas in the uprooting collapse, the floors and contours of the load bearing RC frame remain clearly visible.

After Smyrou et al. (2025)



MAIN BUILDING COLLAPSE MECHANISMS



Representative view of buildings exhibiting uprooting collapse in the coastal area of Caraballeda

Photos by Lekkas and Carydis



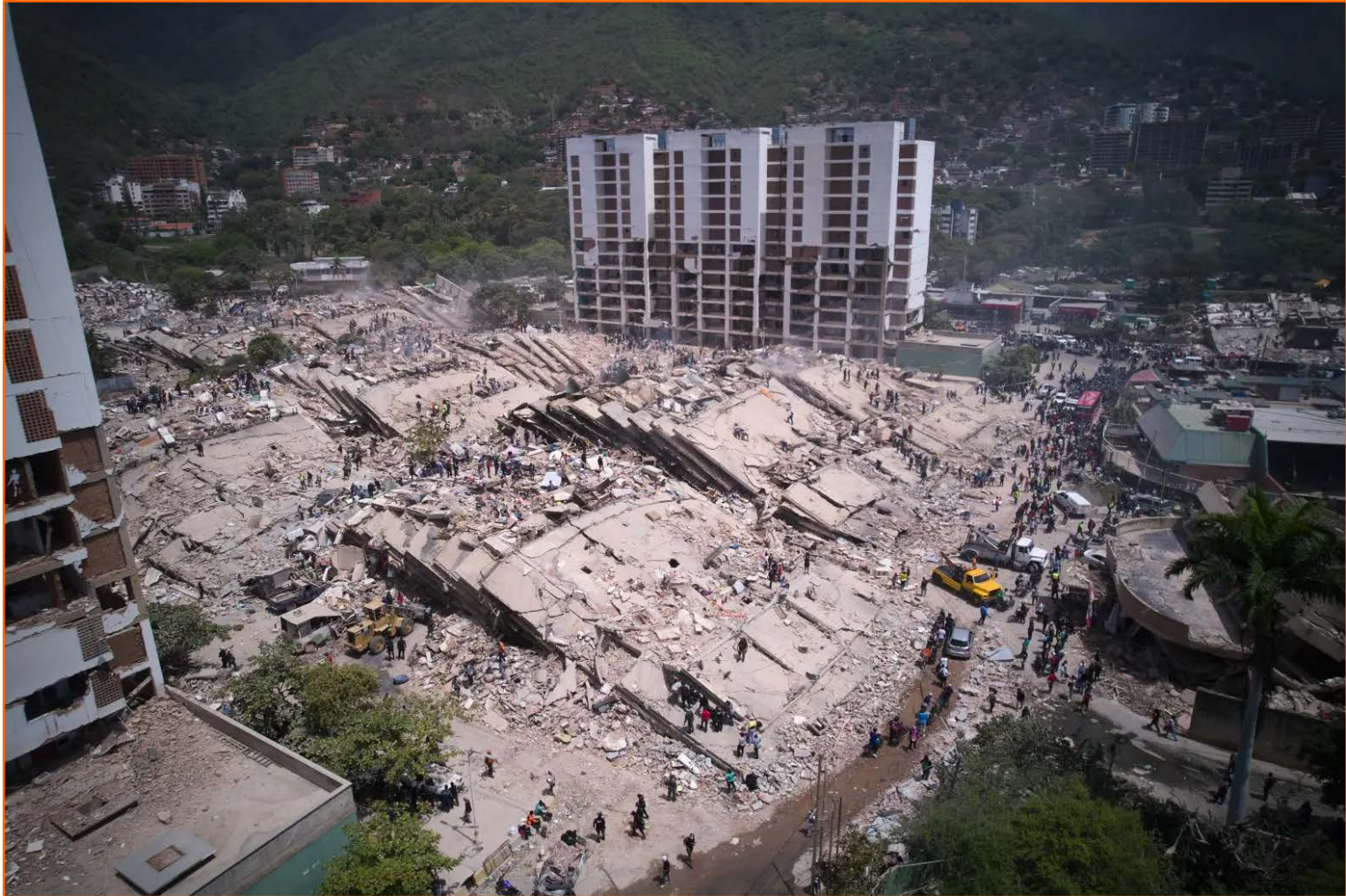
MAIN BUILDING COLLAPSE MECHANISMS



Pancake and uprooting collapse mechanisms are shown on the left and right sides of the image, respectively. The pancake collapse obscures the structural configuration of the building, whereas the uprooting collapse may leave the structural members exposed and clearly identifiable. Photos by Lekkas and Carydis in Caraballeda area.



MAIN BUILDING COLLAPSE MECHANISMS



All types of collapse mechanisms and damage to buildings in the earthquake-affected area mentioned before are presented in this figure from Caraballeda (AP Photo/Juan Pablo Arraez).



COLLAPSE MECHANISM AND THEIR SIGNIFICANCE FOR SURVIVABILITY AND USAR

The collapse mechanism of a building constitutes a fundamental indicator for assessing both the structural system and the failure mechanism activated during seismic excitation, as well as the conditions affecting the survival and rescue prospects of trapped occupants. The configuration of the debris field, the geometry of the collapse, and the condition of the structural members provide valuable information regarding the structural response during the earthquake and represent key parameters for planning and conducting SAR.

In earthquake-affected Venezuela, particularly in the coastal La Guaira state as well as in Caracas, numerous buildings exhibited pancake-type collapse, in which successive floor slabs collapsed almost vertically onto one another following the loss of load-carrying capacity of the vertical structural elements or their connections. This collapse mechanism obscures structural details and results in a drastic reduction, or even complete elimination, of survivable voids, which constitute the primary protective spaces where trapped occupants may remain alive until SAR operations are completed.

Consequently, the probability of survival is significantly reduced because of the extremely high crushing forces generated during collapse, while the survival time of trapped victims depends largely on the existence of limited localized void spaces.

The morphology of the debris piles further reflected the severity of the structural failure. In the majority of cases, recognizable or relatively intact reinforced concrete structural members, such as floor slabs, beams, or columns, were absent. Instead, the debris consisted of a dense, amorphous mass of heavily fragmented construction materials. This pattern indicates extensive concrete crushing, localized or global failure of the primary load-bearing system, and a substantial loss of structural integrity, all of which significantly hinder both victim location and the safe access of rescue personnel.



COLLAPSE MECHANISM AND THEIR SIGNIFICANCE FOR SURVIVABILITY AND USAR

Furthermore, the extensive fragmentation of structural components generated large quantities of fine particulate dust composed primarily of pulverized concrete, aggregates, mortar, and other fractured construction materials.

The suspension of this dust within the confined spaces of the collapsed structures severely compromised the survivability of trapped occupants by causing respiratory distress, impaired visibility, dehydration, and, in many cases, asphyxiation resulting from airway obstruction or prolonged exposure to environments with reduced oxygen availability.

At the same time, these conditions substantially complicated USAR operations by limiting visibility, reducing the effectiveness of rescue equipment, and increasing the risk of secondary collapses during rescue activities.

Experience from major destructive earthquakes worldwide has demonstrated that the collapse mechanism is one of the most critical factors influencing victim survivability.

While other collapse configurations, like lean-to or V-shaped collapses, may create larger and more stable survivable voids, pancake collapses are widely recognized as among the most unfavorable structural failure modes. They are characterized by minimal available void space, severe crushing of occupants, and consequently extremely limited opportunities for survival and successful rescue.



COLLAPSE MECHANISM AND THEIR SIGNIFICANCE FOR SURVIVABILITY AND USAR

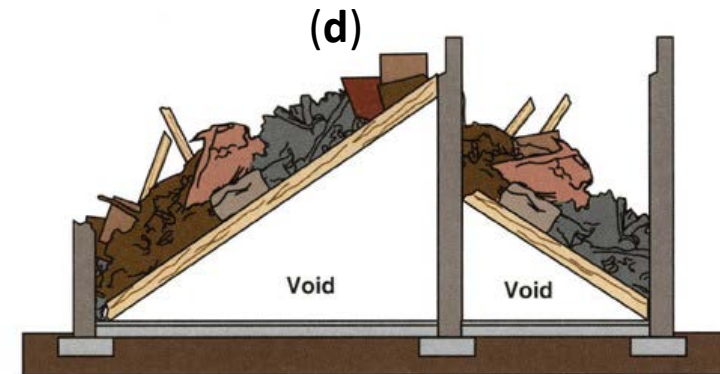
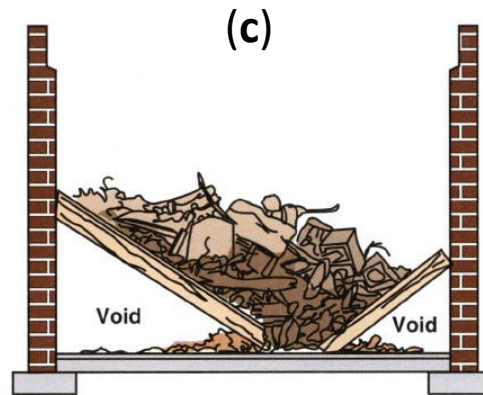
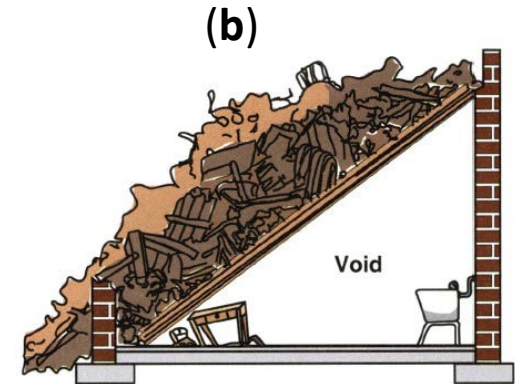
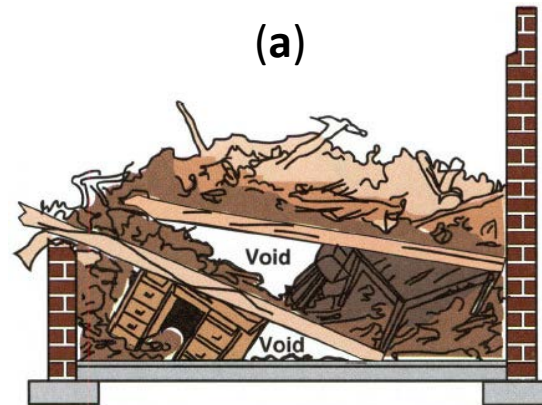
Examples from La Guaira state



Pancake collapse



Uprooting collapse



Void spaces, survival zones and search areas in: (a) pancake collapse, (b) lean-to collapse, (c) v-shaped and (d) a-frame collapse.



PROPERTIES OF BUILDINGS AS RISK FACTOR FOR EARTHQUAKE DAMAGE

One of the most significant mechanisms contributing to the collapse of buildings in Venezuela was the presence of structural and design deficiencies that led to the concentration of seismic demands in specific structural elements. A particularly critical factor was the occurrence of soft-storey mechanisms. In several buildings, the ground floor was configured as an open space for parking, commercial activities, or other uses, resulting in significantly lower stiffness and lateral strength compared with the upper storeys.

During a strong earthquake, the abrupt difference in stiffness between the ground floor and the upper storeys causes seismic deformations to concentrate at the lower level. The ground-floor columns are subjected to excessive lateral forces and deformation demands, which may lead to a gradual or sudden loss of their load-carrying capacity. The failure of these columns can result in the loss of support for the upper storeys and ultimately lead to the collapse of the entire building.

This failure mechanism is frequently associated with pancake-type collapses. This type of collapse is

particularly hazardous because it generates a large volume of debris and significantly reduces the formation of survivable voids that could provide protection for trapped occupants.

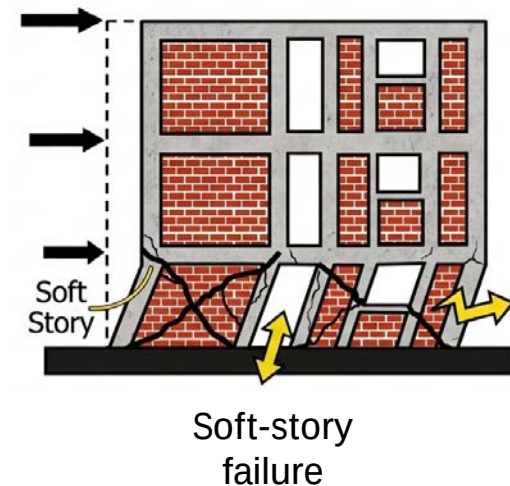
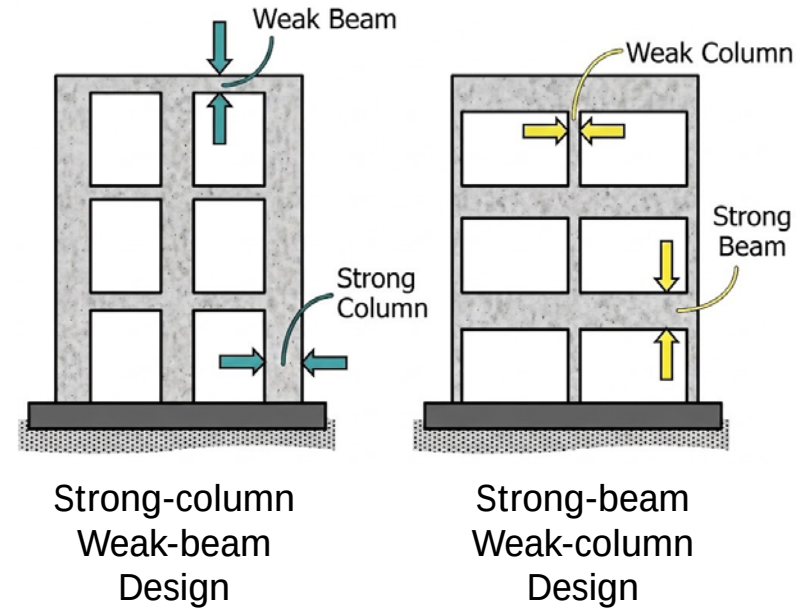
In addition to soft-storey effects, other seismic design deficiencies played an important role, as they can trigger sudden and brittle failure mechanisms. One such deficiency is the presence of short-column effects. The addition of masonry walls or other non-structural elements that restrict the effective deformation length of columns significantly increases the shear stresses developed during earthquake loading. As a result, columns may experience sudden shear failure without sufficient prior ductile deformation, preventing the structure from effectively dissipating seismic energy.



PROPERTIES OF BUILDINGS AS RISK FACTOR FOR EARTHQUAKE BUILDING DAMAGE

Furthermore, some buildings exhibited the unfavorable mechanism of “strong-beam weak-column”. In proper seismic design, the objective is to achieve a “strong-column weak-beam” behavior, where beams develop plastic hinges before columns. This allows the structure to undergo controlled inelastic deformations and dissipate earthquake energy through ductile mechanisms. Conversely, when columns are weaker than beams, column failure can rapidly compromise the vertical load-carrying capacity of the structure and may trigger progressive collapse of the entire building.

Therefore, the collapse of many buildings in Venezuela was not solely a consequence of the intensity of the seismic excitation, but also of pre-existing structural vulnerabilities. The presence of soft-storey configurations, short-column effects, and unfavorable failure mechanisms such as the strong-beam–weak-column condition significantly reduced the seismic resilience of the structures and contributed to the occurrence of sudden and extensive collapses.





THE GEOLOGICAL STRUCTURE AS A RISK FACTOR FOR EARTHQUAKE BUILDING DAMAGE

The coastal region of northern Venezuela, which was affected by the 2026 earthquake sequence, had previously experienced one of the most devastating natural disasters in its history. In December 1999, the region was struck by an extreme hydrometeorological event characterized by exceptionally intense and prolonged rainfall. These conditions triggered widespread debris flows and mudflows that originated in the mountainous and foothill areas south of the coastal plain and propagated downslope along ephemeral stream channels, reaching the coastal alluvial fans.

The debris flows and mudflows completely devastated numerous coastal communities, resulting in one of the deadliest natural disasters ever recorded in Latin America. The human losses reached or exceeded 30,000 people, with the majority of them being buried beneath thick debris deposits or swept into the Caribbean Sea.

In addition to the loss of life and infrastructure, these events resulted in the deposition of thick alluvial and torrential sediments, forming extensive unconsolidated surficial deposits with poor geotechnical properties. In the years that followed,

new residential developments and infrastructure were constructed on these recently deposited materials.

However, the presence of unconsolidated alluvial deposits in northern Venezuela is not solely a consequence of the 1999 disaster. A significant proportion of the pre-existing urban development had already been established on similar deposits that had accumulated during previous debris flow and mudflow events throughout the geological history of the region. Consequently, much of the coastal urban area has largely been founded on young, poorly consolidated alluvial fan deposits that are particularly susceptible to seismic amplification, differential settlement, and other forms of earthquake-induced ground deformation.

The following sections summarize the principal characteristics and impacts of the 1999 disaster, with emphasis on the geological conditions of the northern Venezuelan coastal zone. These conditions play a fundamental role in controlling local site response during earthquakes and significantly increase building vulnerability to ground shaking.



MAIN PROPERTIES OF THE 1999 DEBRIS FLOWS AND FLOODS IN THE NORTHERN VENEZUELA

The coastal region of northern Venezuela has, as previously mentioned, been repeatedly affected by major natural disasters throughout its history. Among these events, the debris flows and floods of December 1999 represent one of the most catastrophic episodes recorded in Latin America in terms of human losses, ranking among the most severe natural hazard events in the region.

The extreme rainfall event of 14-16 December 1999 triggered widespread and destructive landslides and flooding along a 40-km-long coastal zone extending from La Guaira to Naiguatá, in the northern coastal state of Vargas (La Guaira). The event caused severe damage to residential areas and critical infrastructure. In La Guaira, more than 8,000 individual houses and approximately 700 apartment buildings were either destroyed or significantly damaged. In addition, essential networks, including roads, telecommunications, electricity, water supply, and sewage systems, suffered extensive disruption. The overall economic losses were estimated at approximately 1.79 billion USD.

Initial assessments suggested that the number of fatalities ranged between 5,000 and 50,000, while

later estimates commonly cited approximately 30,000 fatalities. Determining the exact number of victims was particularly difficult because many people were buried beneath debris or carried out offshore by debris flows and floodwaters. Only around 1,000 bodies were recovered. Furthermore, the absence of recent population census data for La Guaira, which had an estimated population of about 300,000 before the disaster, made accurate evaluation challenging. The potential loss of up to 10% of the local population highlights the exceptional magnitude and destructive impact of this event.

The December 1999 disaster in coastal northern Venezuela was characterized by a complex sequence of intense flooding and repeated high-energy debris flows, which transported large boulders and tree trunks, deposited substantial volumes of sediment on alluvial fans, and were subsequently partially incised and eroded by later floods. The high flow velocities, continuous sediment supply from tributary channels, and successive debris-flow surges contributed to the extensive impact and severity of the disaster.



MAIN PROPERTIES OF THE 1999 DEBRIS FLOWS AND FLOODS IN THE NORTHERN VENEZUELA

Complex interaction between flooding and debris-flow processes

Most drainage channels and alluvial fans were initially affected by intense flood flows, followed by high-energy debris flows that produced extensive sediment deposition.

Multiple debris-flow surges

The event was not characterized by a single debris flow, but by a sequence of successive surges, several of which were highly destructive.

Transport and deposition of large boulders and organic debris

The debris flows transported and deposited exceptionally large boulders, tree trunks, and abundant sandy to gravelly sediments, producing deposits locally reaching thicknesses of approximately 3 m.

Post-event fluvial incision and erosion

During the later stages of the storm, flood flows incised and partially eroded previously deposited debris-flow material within the channels.

Significant sediment contribution from tributary channels

Tributaries played a major role in sustaining and amplifying debris flows by supplying additional sediment to the main channels, resulting in thicker deposits downstream of tributary junctions.

Short-lived channel dams

Temporary obstructions formed by large boulders and woody debris were observed locally. However, these dams were of limited duration and were not considered the primary cause of the destructive debris-flow surges.



MAIN PROPERTIES OF THE 1999 DEBRIS FLOWS AND FLOODS IN THE NORTHERN VENEZUELA

Temporal evolution of the event:

- Flooding began at approximately 20:00 local time on 15 December 1999.
- The first debris-flow activity was reported around 20:30 on 15 December.
- Additional debris-flow surges occurred between 02:00–03:00, 05:00–07:00, and 08:00–09:00 on 16 December.
- Flood flows continued until late afternoon on 16 December, causing further erosion of debris-flow deposits.

Severe channel erosion in upstream areas

In the upper parts of the drainage basins, bedrock channels were intensely scoured and largely stripped of sediment due to the high erosive capacity of the flows.

Extensive downstream sediment deposition

Debris-flow deposits extended from mountainous channels to coastal alluvial fans and continued

offshore, forming subaqueous fan deposits beyond the shoreline.

High flow velocities

Estimated mean flow velocities ranged from approximately 4 to 14.5 m/s, indicating highly energetic flows capable of transporting very large boulders.

Highly heterogeneous debris-flow structure

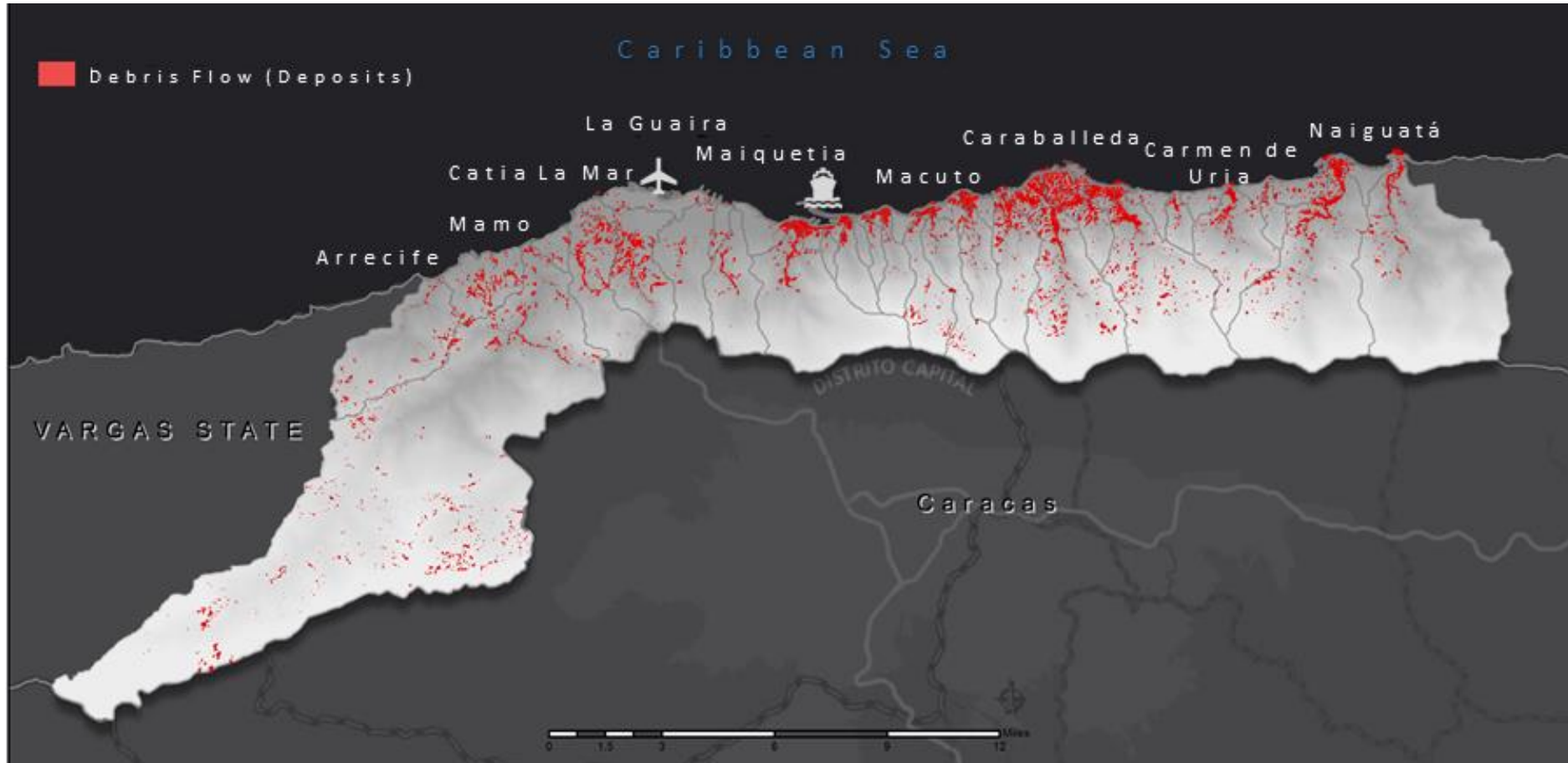
Individual debris-flow surges consisted of (i) a steep, bouldery flow front or snout, (ii) a dense sediment-rich slurry containing coarse particles in suspension, and (iii) a more dilute trailing phase dominated by water and fine-grained sediment.

Evidence of larger prehistoric events

Older geomorphic deposits contained thicker sediment accumulations and larger boulders than those observed during the 1999 event, suggesting that although the Vargas disaster was exceptionally severe, it did not represent the maximum possible magnitude event for the region.



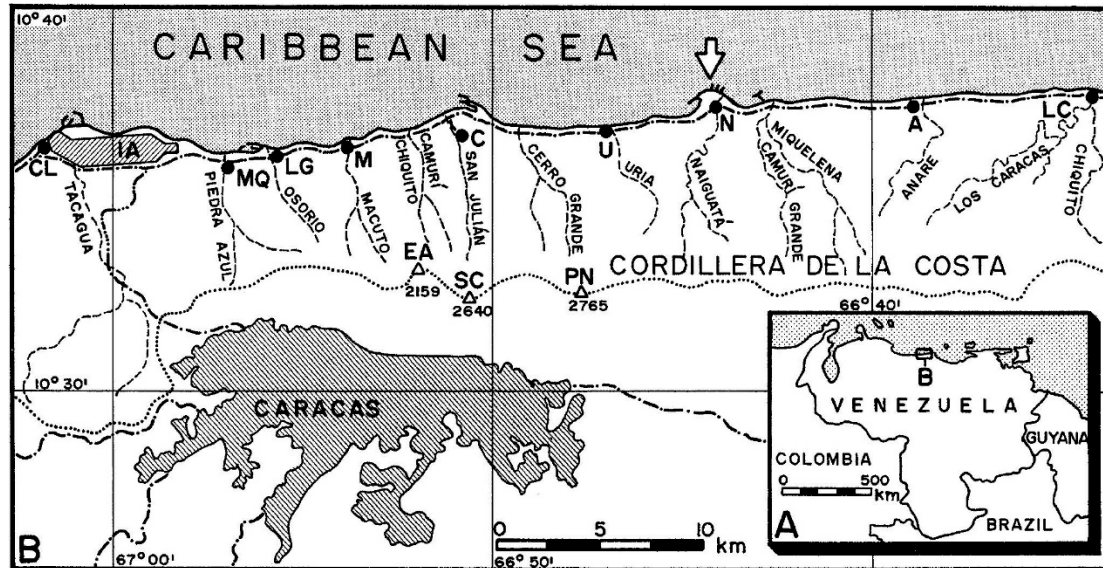
DISTRIBUTION OF DEBRIS FLOW DEPOSITS IN THE COASTAL NORTHERN VENEZUELA



Debris deposits in the 1999 debris-flow-affected area (after Rendon, 2007), which corresponds to the area most severely affected by the 24 June 2026 northern Venezuela earthquakes

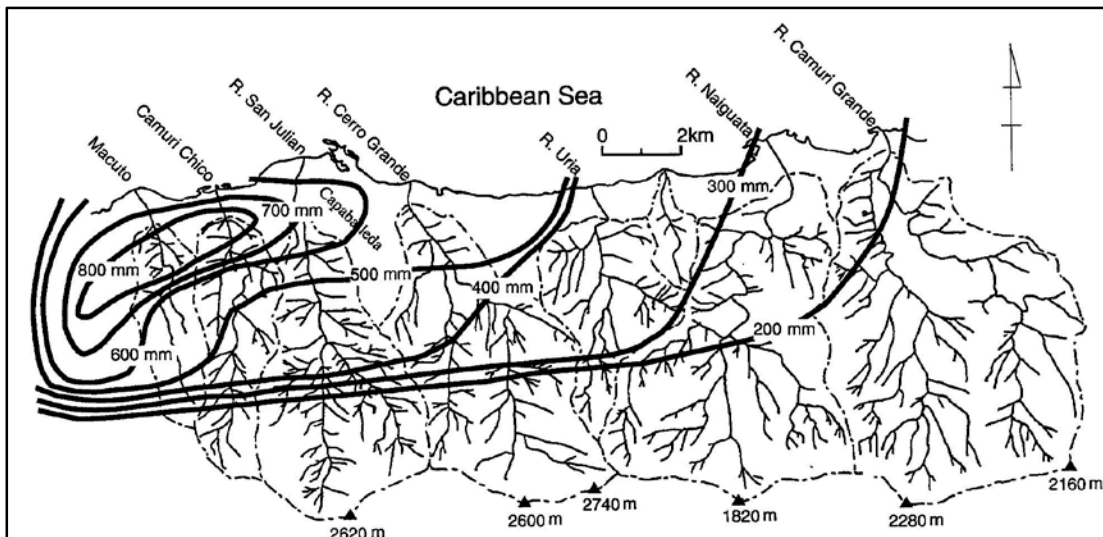


MAIN PROPERTIES OF THE 1999 DEBRIS FLOWS AND FLOODS IN THE NORTHERN VENEZUELA



Area of central coastal Venezuela most severely affected by torrential precipitation in December 1999.

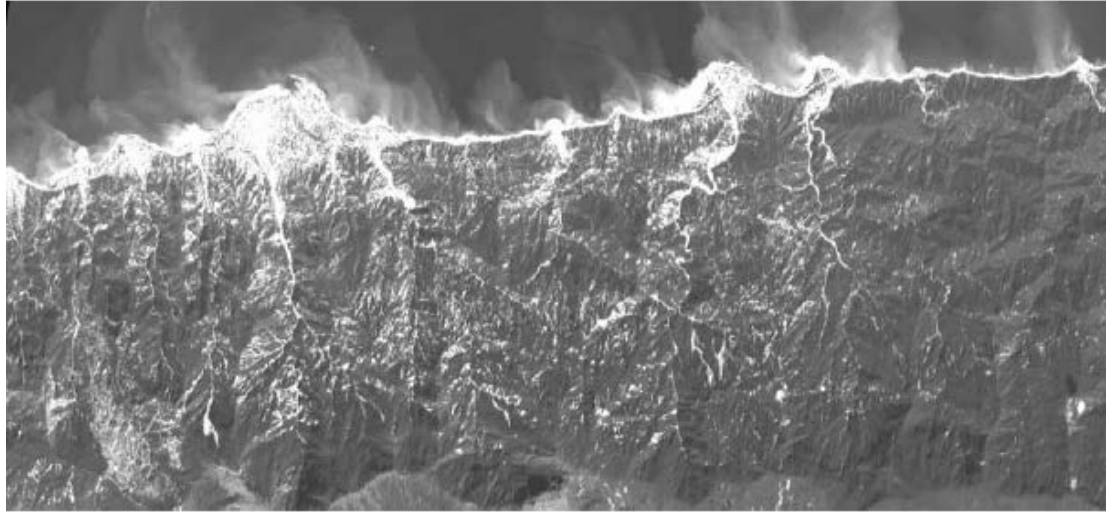
CL: Catia La Mar, **MQ:** Maiquetia, **LG:** La Guaira (port), **M:** Macuto, **C:** Caraballeda, **U:** Uria, **N:** Naiguata, **A:** Anare, **LC:** Los Caracas (after Perez, 2000).



Major river systems and isohyetal lines of the December 1999 rainfall (after Takahashi et al., 2001).



MAIN PROPERTIES OF THE 1999 DEBRIS FLOWS AND FLOODS IN THE NORTHERN VENEZUELA



◀ Satellite image taken a few days after the December 1999 event. It presents the north coastal range of Venezuela with the Avila Mountain and small towns developed on the affected alluvial fans.

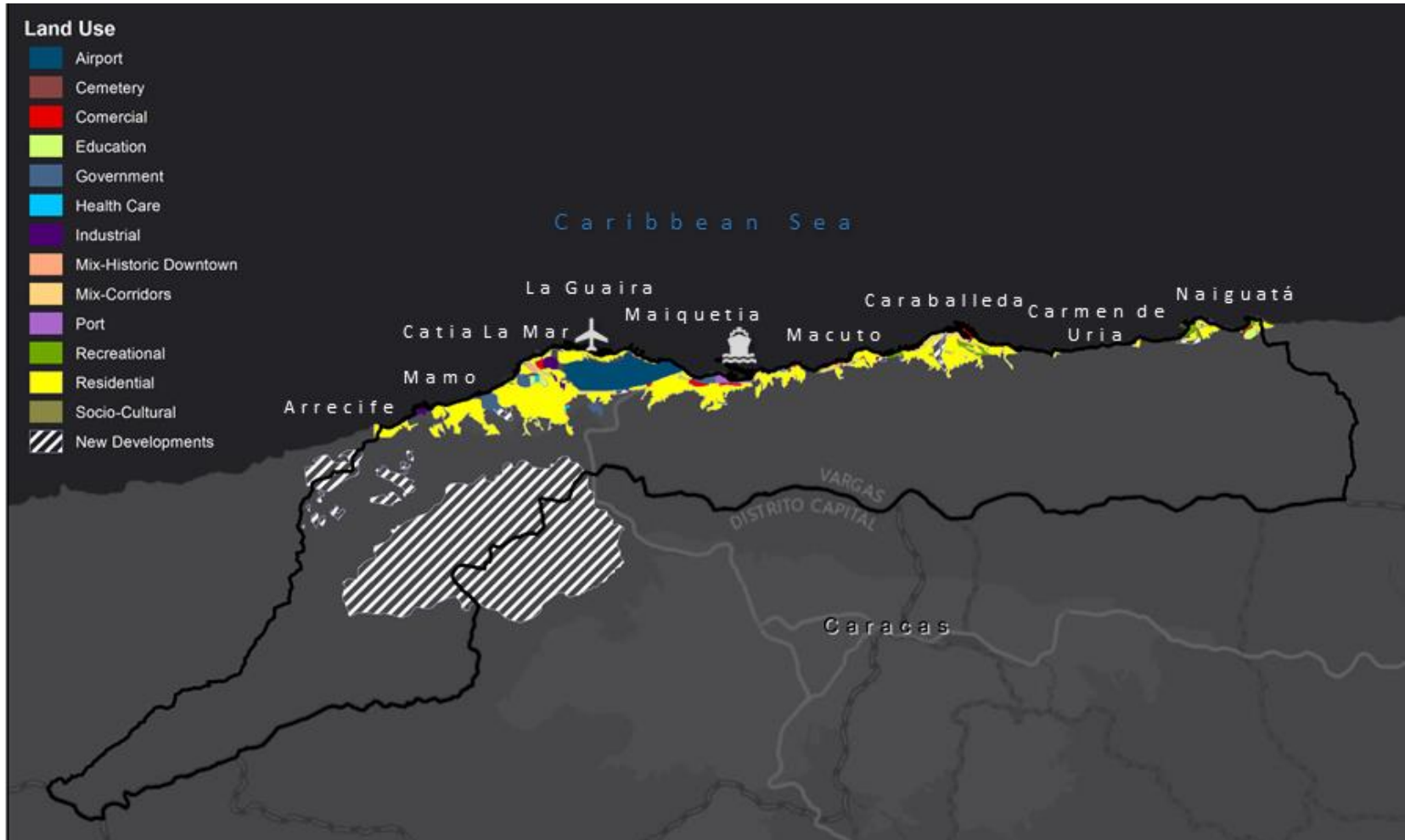
▼ Aerial photos of the alluvial fan of San Julian River taken in 1998 (left) and a few days after the December 1999 disaster (right).



After Lopez and Courtel (1999)



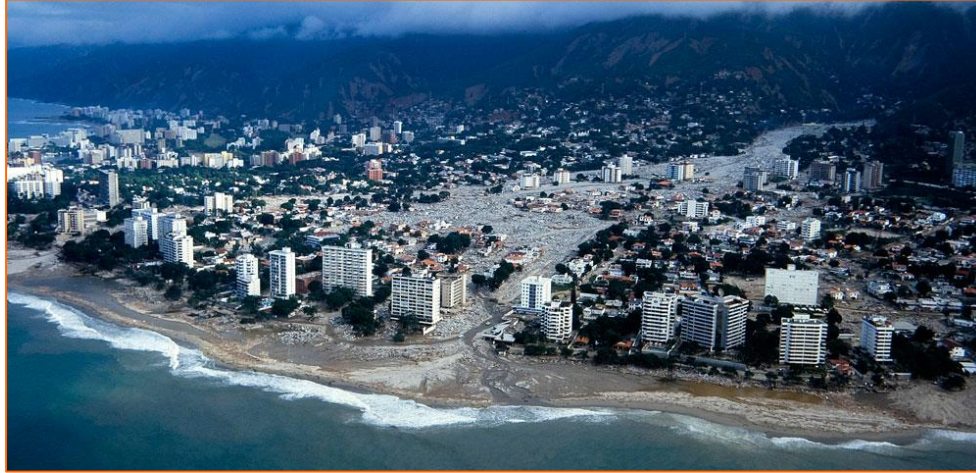
MAIN PROPERTIES OF THE 1999 DEBRIS FLOWS AND FLOODS IN THE NORTHERN VENEZUELA



Land use within the 1999 debris-flow affected area, which corresponds to the area most severely affected by the 24 June 2026 northern Venezuela earthquakes (after Rendon, 2007).



THE IMPACT OF THE 1999 DEBRIS FLOWS AND FLOODS IN THE NORTHERN VENEZUELA



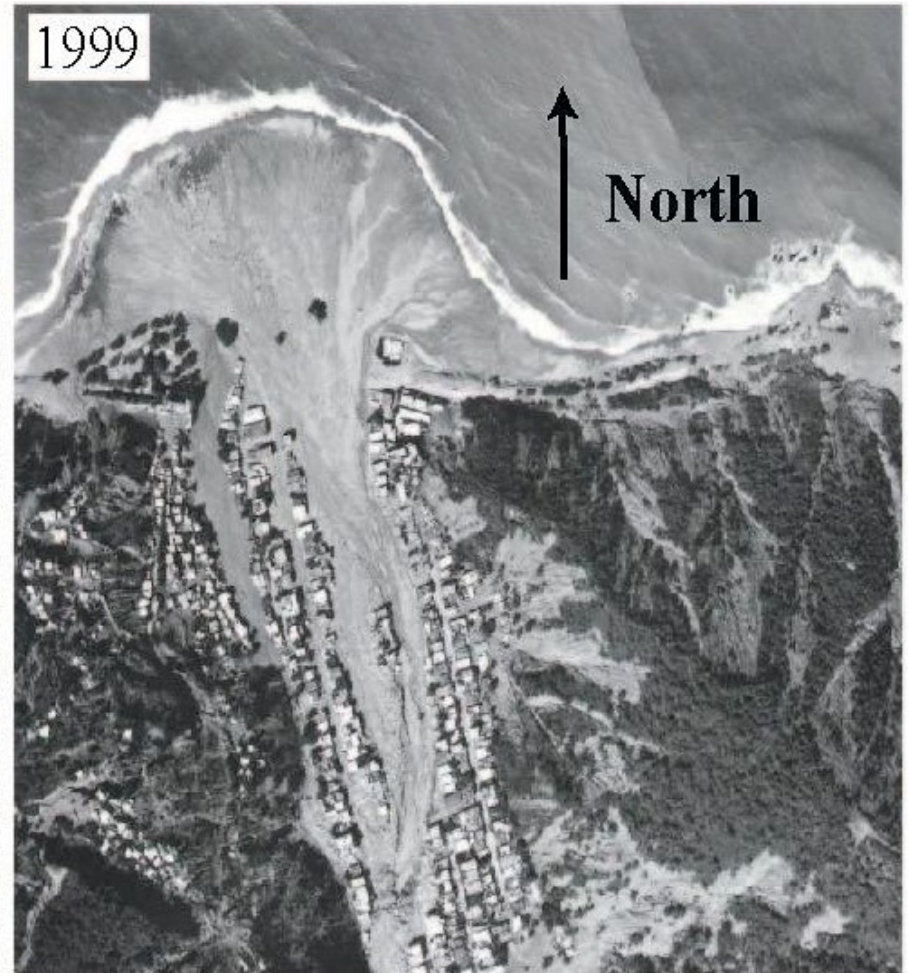
Devastation of Los Corales in the La Guaira State, northern Venezuela. The area is located close to Macuto and La Guaira (after Rendon, 2007).



Aerial view of debris-flow deposition resulting in extensive destruction on the Caraballeda fan. The debris volume reached 1.8 million m³ and the thickness up to 6 meters (after Wieczorek et al., 2001).



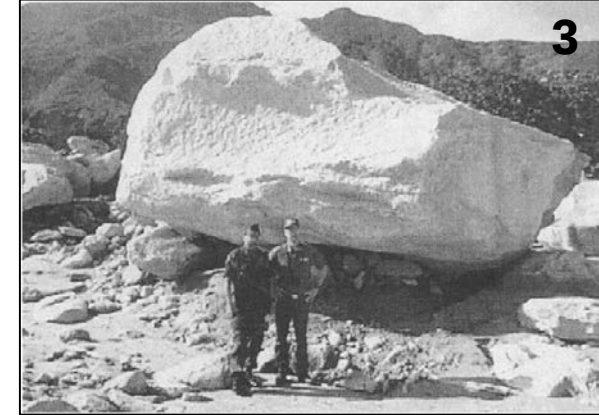
THE IMPACT OF THE 1999 DEBRIS FLOWS AND FLOODS IN THE NORTHERN VENEZUELA



Aerial photographs taken in 1994 and after the December 1999 event illustrating the destruction of the Carmen de Uria community and shoreline progradation (after Larsen et al., 2001).



THE IMPACT OF THE 1999 DEBRIS FLOWS AND FLOODS IN THE NORTHERN VENEZUELA



Impact of the boulder-rich debris generated by the December 1999 debris flows on several coastal areas of northern Venezuela and on RC buildings constructed on the alluvial fans of the region.

Large residential areas were swept away by the debris flows and associated floods. Small buildings were buried beneath the deposits, whereas high-rise RC buildings partially or completely collapsed due to impacts from large boulders.

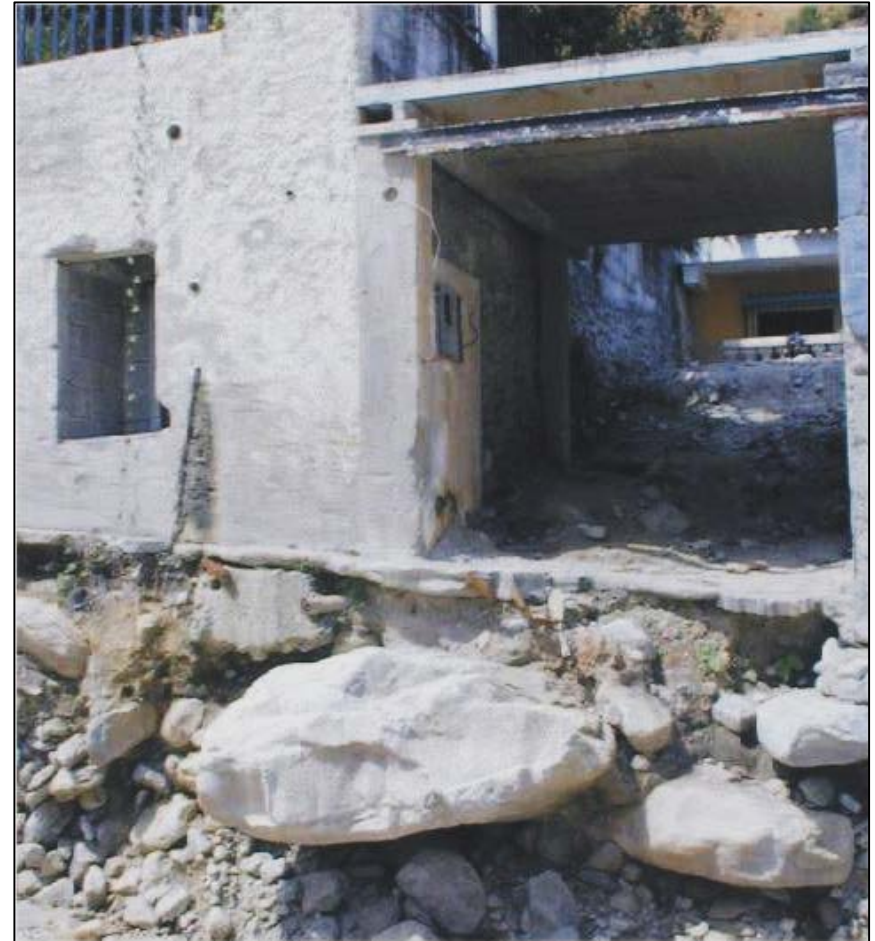
- (1) West of Caraballeda town (after Perez, 2001)
- (2) Naguayata river (after Perez, 2001)
- (3) Caraballeda (after Larsen et al., 2001)
- (4) Caraballeda (after Wiczorek et al., 2001)
- (5) Caraballeda (after Lopez and Courtel, 1999)



THE IMPACT OF THE 1999 DEBRIS FLOWS AND FLOODS IN THE NORTHERN VENEZUELA

The most critical characteristic of the 1999 disaster that significantly influenced the extent and severity of the 2026 earthquakes impacts along the coastal zone of northern Venezuela was the widespread presence of several-meter-thick unconsolidated sedimentary deposits formed by flood and debris-flow processes. These young, poorly consolidated alluvial and debris-flow deposits covered large portions of the coastal plain, creating highly variable and potentially unfavorable foundation conditions.

In particular, in the La Guaira area, numerous multi-storey residential buildings had been constructed directly on these recent deposits. During the earthquakes of 24 June 2026, these structures experienced severe structural distress, including partial and total collapse in several cases. The combination of earthquake-induced ground shaking and the underlying unconsolidated deposits likely contributed to the amplification of seismic effects, increased ground deformation, and reduced foundation performance. Consequently, many of these buildings sustained damage of such severity that they were considered beyond economical repair and classified as requiring demolition.



Building constructed on Caraballeda fan with exposed foundation showing old debris flow deposits comprising boulders of various sizes (after Larsen et al., 2001)



SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES LANDSLIDES

The geomorphology of the coastal La Guaira state is characterized by the presence of alluvial fans. These fans constitute the main geomorphological framework upon which a significant part of the urban fabric of La Guaira has developed, including densely built-up areas, tourist facilities, and multi-storey buildings.

The transition from the alluvial fans towards the coastal zone occurs through steep, high-relief slopes that represent prominent geomorphological discontinuities and exhibit increased susceptibility to landslides, including rockfalls and soil slides. The stability of these slopes is controlled by the combined influence of geological structure, intense weathering of rock masses, the presence of discontinuities and fault-related fractures, steep slope gradients, as well as the high seismicity and extreme hydro-meteorological events affecting the region.

Due to the 24 June 2026 earthquakes, localized landslides were triggered along the coastal slopes, resulting in the development of additional geohazards affecting adjacent urban areas along

with buildings, infrastructures and related facilities.

At the same time, significantly increased levels of structural damage were observed in multi-storey residential buildings, hotel complexes, and other structures located in close proximity to these slopes.

The observed damage included severe failures of structural elements and, in several cases, partial or total building collapses. In several locations, the limited setback distance between buildings and the slope crest resulted in the deposition of collapsed structural components and debris from failed buildings onto the slope surfaces.

The increased vulnerability of structures in these areas can be attributed to the synergy of the observed adverse geomorphological, geological, geotechnical conditions and the seismological parameters.



INVENTORY OF LANDSLIDES AND DEBRIS FLOWS IN THE COASTAL NORTHERN VENEZUELA

Historical records indicate that hydrologic events leading to landslides have occurred in this region in February **1798**, August **1912**, January **1914**, November **1938**, May **1944**, November **1944**, August **1948**, and February **1951** (Salcedo, 2000). On average, at least one or two high-magnitude flash-flood or landslide events per century have been recorded in this region since the 17th century (Larsen et al., 2000).

Flash floods and debris flows in La Guaira in February **1798** caused extensive damage to (219) homes and government buildings, and destroyed all bridges (Röhl, 1950). Examination of deposits exposed on terraces and along the banks of river channels reveals a record of prehistoric floods and debris flows as well.

During the February **1951** event, rainfall of 282 mm was recorded at Maiquetia (43 m msl), whereas at the higher elevation of El Infiernito (1750 m msl) rainfall of 529 mm was recorded. Rainfall at higher elevations of the El Avila were about double of amounts recorded along the coast. The rainfall total at Maiquetia in the December 1999 storm (911 mm) was notably larger in 1999 than in February of 1951

(282 mm). In Vargas the development and population growth on the alluvial fans that has occurred since the 1950's has increased the risk from such events.

On 9 September **1987**, the Río Limón drainage, located in the State of Aragua approximately 100 km west of Caracas, was impacted by heavy rainfall. A measured 174 mm of rain fell in less than 5 hours, triggering shallow landslides that quickly transformed into debris flows. About 20,000 people who were returning from a weekend at the beach were isolated by the debris flows that damaged or destroyed approximately 1500 homes, 500 cars, three bridges, and 25 km of roads. About 210 people were killed, 400 injured, and more than 30,000 temporarily isolated by the event (Audemard et al., 1989). Landslides also regularly pose problems in low-income "barrios" of Caracas where the potential for property damage is generally low, but loss of life is high, and in higher-income areas where property damage can be high, but loss of life is low.



SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES LANDSLIDES



(up) View from Caraballeda area towards W.

(down) View from Caraballeda area towards E.

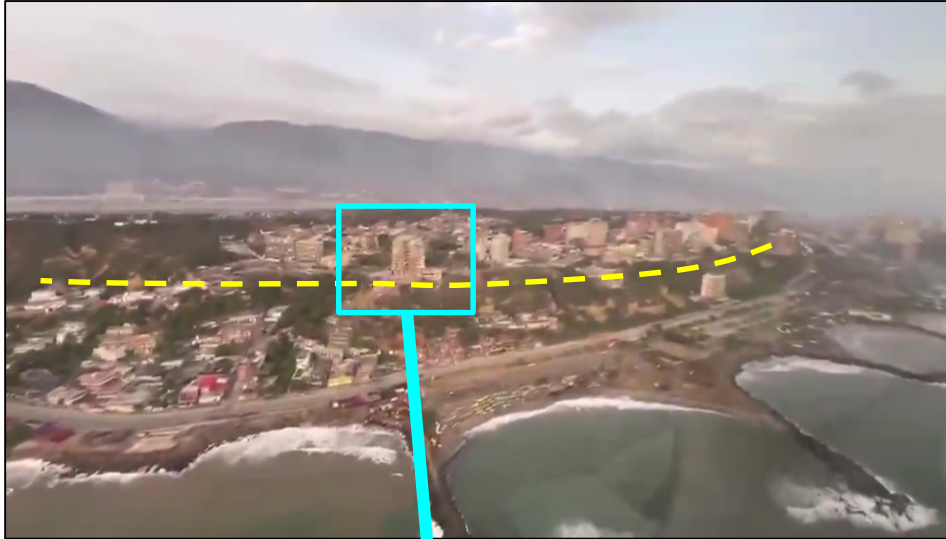


In both views, the transition from the alluvial fans towards the coastal zone occurs through steep, high-relief slopes that represent prominent geomorphological discontinuities and exhibit increased susceptibility to slope instability phenomena, including rockfalls and soil slides.

Photos from Lekkas and Carydis



SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES LANDSLIDES



Abrupt topographic changes and morphological discontinuities may induce local amplification of seismic ground motions due to topographic effects. Furthermore, the reduction in slope stability during strong seismic loading increases the likelihood of earthquake-induced landslides.

In addition, spatial variations in the geotechnical properties of near-surface formations, the presence of anthropogenic fills or locally weathered materials, and soil-structure dynamic interaction effects may have contributed to the amplification of seismic response and, consequently, to the occurrence of disproportionately severe damage in structures located in small distance from the aforementioned coastal slopes.

◀ The coastal slope in La Guaira with a heavily damaged building founded on the crest of the slope (yellow dotted line).
Snapshots from video uploaded by Alerta Mundial [@TuiteroSismico] and available online at:
<https://x.com/TuiteroSismico/status/2070205467918241856>



SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES LANDSLIDES



Representative views of the post-earthquake situation close to the crest of steep slopes in La Guaira sector located in the coastal zone of the Northern Venezuela. Several recently constructed buildings were heavily damaged and suffered partial or total collapse with building debris fallen on the slope surfaces.

Snapshots from a video uploaded by Alerta Mundial
[@TuiteroSismico]. Available online at:
<https://x.com/TuiteroSismico/status/2069951555944501286/video/1>





SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES LANDSLIDES

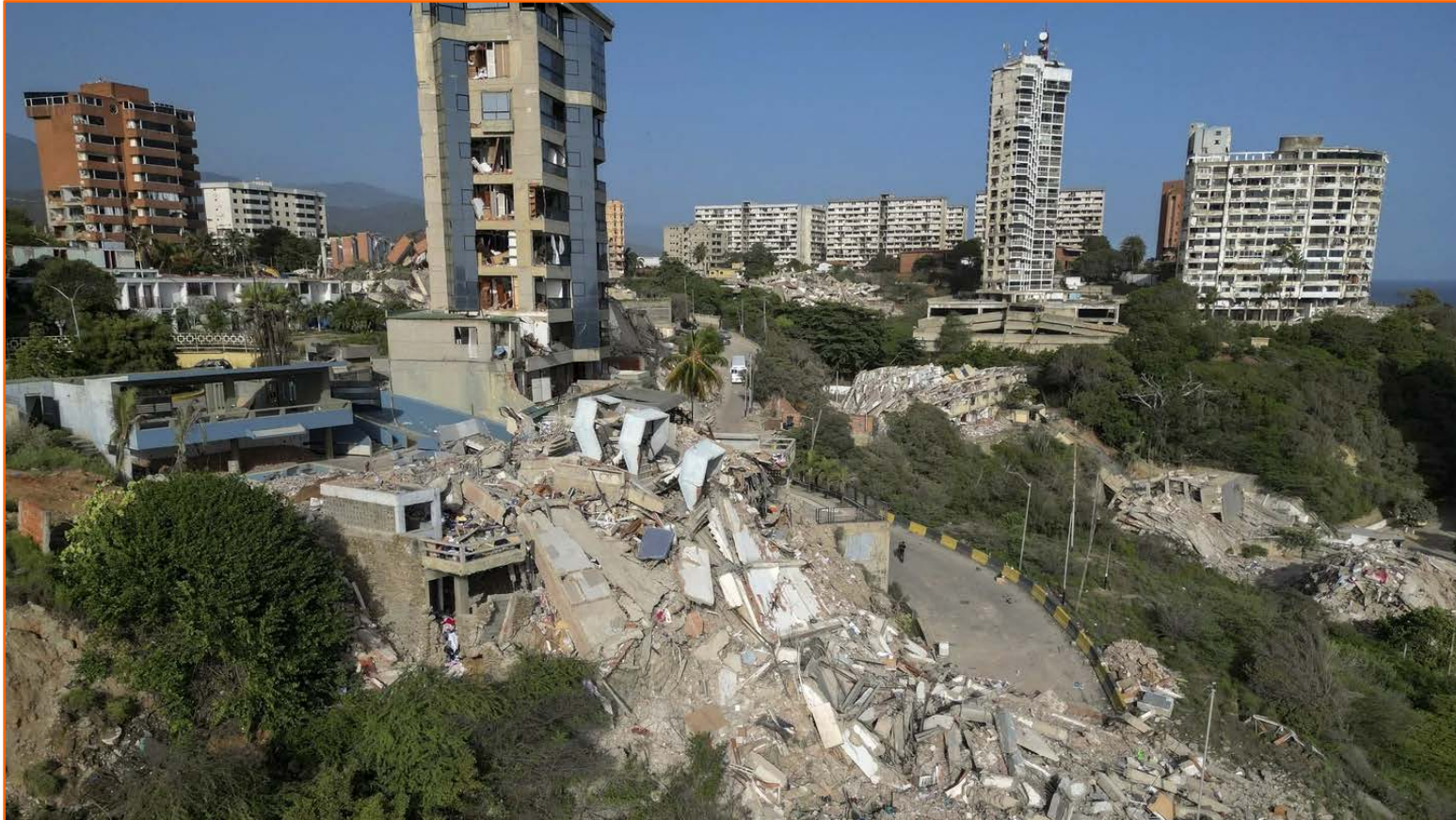


Typical example of a partially collapsed building located near the crest of the steep slopes in La Guaira State. The transition zone between the alluvial fans and the flat coastal plain amplified seismic ground motion, leading to increased ground-shaking intensity and, consequently, more severe structural damage.

(After Reuters)



SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES LANDSLIDES



Several buildings founded close to the crest of coastal slopes in Catia La Mar were heavily damaged and suffered partial or total collapse with debris fallen on the slope surfaces (After Getty).



INVENTORY OF EARTHQUAKE-TRIGGERED LIQUEFACTION PHENOMENA IN THE AREA AFFECTED BY THE 24 JUNE 2026 NORTHERN VENEZUELA EARTHQUAKES

The coastal area where the most severe impacts from the 24 June 2026 earthquakes were recorded is not only susceptible to liquefaction phenomena, but also has a rich inventory of liquefaction occurrences triggered by both historical and recent earthquakes.

According to the study of Rodríguez, Audemard and Rodríguez (2006), the coastal area of the northern Venezuela was affected by liquefaction phenomena during earthquakes on 26 March **1812**, 12 April **1878**, 29 October **1900**, and 29 July **1967**.

During the **26 March 1812 earthquake**, liquefaction phenomena were reported in La Guaira, Caracas (El Paraíso, on the floodplain of the Guaire River), Aragua State (the Choroní, Barbacoas, and La Victoria areas), La Cabrera (Vallecito and the Mariara floodplains), San Diego, located east of Valencia, and the Aroa Mountains, Cojedes.

The **12 April 1878 earthquake** triggered liquefaction near the Cúa River (Urdaneta Municipality), Miranda.

Liquefaction phenomena were also documented following the **29 October 1900 earthquake** in the areas of Macuto, Caraballeda, Camurí Grande, Los Caracas, La Sabana, Chuspa, and Píparo along the northern Venezuelan coastal zone, as well as in Miranda State (along the railway line between Carenero and Río Chico; northeast of Caserío La Marturetera, Capaya, Miranda), Caracas (San Jacinto, Caracas, Capital District), and Anzoátegui State (Puerto El Rincón, on the banks of the Neverí River, and Barcelona, on the coast, Los Roques Island).

A similar situation occurred during the **29 July 1967 earthquake**, when liquefaction phenomena were observed in Playa Caraballeda, in the former Vargas province (present-day La Guaira), in the Las Morochas area, near the Agua Colorada River (Miranda), and along the southern shore of Lake Valencia, northeast of Güigüe, Carabobo.

More information on these phenomena are presented in the following tables and maps after Rodríguez, Audemard and Rodríguez (2006).



INVENTORY OF EARTHQUAKE-TRIGGERED LIQUEFACTION PHENOMENA IN THE AREA AFFECTED BY THE 24 JUNE 2026 NORTHERN VENEZUELA EARTHQUAKES

DATOS EVENTO SÍSMICO									
Nº/ord	Fecha	Hora local	Ubic epic km	M Mb/Ms	IoMM	Coordenadas		Fuente	
						Long N	Lat N		
1	26-03-1812	4:07pm	Mar Caribe	6,3 MI (FIED) 7Ms revaluado en este trabajo	IX (FIED)	-67,49 -66,9	10,53 10,6	Revaluado en este trabajo FIED (1961)	
DATOS FENÓMENO DE LICUACIÓN DE SEDIMENTOS									
Localidad/ estado	Fuente	Coordenadas		I oMM	Dist. Km	Dist. recal Km	Tipo efecto geológico	Ambiente sedimentario	Tipo de Licuación
La Guaira/ Vargas	18, 37, 38, 40, 57, 60	-66,92	10,6	VIII (JPGG 1990)		-62,78	c,d	Fluvio- aluvial	▲
El Paraíso vega del río Guaire, Caracas	38, 57	-66,92	10,33	VIII (JPGG 1990)		66,17	a, c, d	Aluvial	▲
Choroní / Aragua	38, 57	-67,61	10,49	VI (JPGG 1990)		13,85	a, c	Costero	■ ▲
Barbacoas/ Aragua	18, 38, 57	-66,96	9,47	VI (ALTEZ 2000)		131,36	a, c	Aluvial	▲
La Victoria	57	-67,71	10,28	VII (JPGG 1990)	36,76	95,44	b, c	Fluvio- lacustre	▲
Vallecico, Vegas de Mariara, La Cabrera	38, 57	¿?	¿?				b, c	Fluvio- lacustre	▲
San Diego al este de Valencia	38, 57	¿?	¿?				a, c		▲
Montañas de Aroa / Cojedes	57	¿?	¿?				a, c		▲

Information on the 26 March 1812 earthquake and the triggered liquefaction phenomena

After Rodríguez, Audemard and Rodríguez (2006)



INVENTORY OF EARTHQUAKE-TRIGGERED LIQUEFACTION PHENOMENA IN THE AREA AFFECTED BY THE 24 JUNE 2026 NORTHERN VENEZUELA EARTHQUAKES

DATOS EVENTO SÍSMICO									
Nº/ord	Fecha	Hora local	Ubic epic Km	M Mb/Ms	IoMM	Coordenadas		Fuente	
						Long N	Lat N		
2	12-04-1878	8:40pm	Al noreste de Charallave / Miranda	5,9 Ml (FIED)	VIII (FIED)	-66,8	10,3	FIED (1961)	
DATOS FENÓMENO DE LICUACIÓN DE SEDIMENTOS									
Localidad/	Fuente	Coordenadas		I	Dist.	Dist. recal	Tipo efecto	Ambiente	Tipo de
estado		Long W	Lat N	oMM	Km	Km	geológico	sedimentario	Licuación
Cerca del Río Cúa (municipio Urdaneta)/ Miranda	7, 18, 38, 57	-66,89	10,17	VIII (JPGG 1990)		17,49	c, d	fluvial	▲

Information on the 12 April 1878 earthquake and the triggered liquefaction phenomena

After Rodríguez, Audemard and Rodríguez (2006)



INVENTORY OF EARTHQUAKE-TRIGGERED LIQUEFACTION PHENOMENA IN THE AREA AFFECTED BY THE 24 JUNE 2026 NORTHERN VENEZUELA EARTHQUAKES

DATOS EVENTO SÍSMICO									
Nº/ord	Fecha	Hora local	Ubic epic Km	M Mb/Ms	IoMM	Coordenadas		Fuente	
						Long N	Lat N		
3	29-10-1900	04:42am	Mar Caribe	7,2 (Jakubowicz y Larotta) 8,4 Ms (CRS)	VIII (FIED)	-66,08 -66,8	10,66 10,9	Revaluado en este trabajo FIED (1961)	
DATOS FENÓMENO DE LICUACIÓN DE SEDIMENTOS									
Localidad/estado	Fuente	Coordenadas		I oMM	Dist. Km	Dist. recal Km	Tipo efecto geológico	Ambiente sedimentario	Tipo de Licuación
Macuto/Vargas	18, 22, 72	-66,88	10,61	VIII (LUGO 1984)	116,33	87,59	d	Fluvio-aluvial-costero	△
Caraballeda/Vargas	18, 57	-66,82	10,61	VIII (LUGO 1984)	110,98	81,05	d	Fluvio-aluvial-costero	△
Camurí Grande	18, 57	-66,71	10,62	VIII (LUGO 1984)	100,82	68,98	c	Fluvio-aluvial-costero	△
Los Caracas	18, 57	-66,57	10,63	VIII (LUGO 1984)	88,81	53,64	c	Fluvio-aluvial-costero	△
La Sabana/Vargas	18, 57	-66,31	10,61	VIII (LUGO 1984)	73,81	25,74	c, d	Fluvio-aluvial-costero	▲
Chuspa/Vargas	18, 57	-66,27	10,62	VIII (LUGO 1984)	70,90	21,23	c, d	Fluvio-aluvial-costero	▲
Paparo/Miranda	18, 57	-65,91	10,33	VII (LUGO 1984)	97,22	41,13	b	Fluvio-aluvial-costero	△
Vía Férrea entre Carenero y Río Chico/Miranda	18, 57	-65,91	10,33	VII (LUGO 1984)	97,22	41,13	b		▲

Information on the 29 October 1900 earthquake and the triggered liquefaction phenomena

After Rodríguez, Audemard and Rodríguez (2006)



INVENTORY OF EARTHQUAKE-TRIGGERED LIQUEFACTION PHENOMENA IN THE AREA AFFECTED BY THE 24 JUNE 2026 NORTHERN VENEZUELA EARTHQUAKES

DATOS EVENTO SÍSMICO								
Nº/ord	Fecha	Hora local	Ubic epic Km	M Mb/Ms	IoMM	Coordenadas		Fuente
						Long N	Lat N	
3	29-10-1900	04:42am	Mar Caribe	7,2 (Jakubowicz y Larotta) 8,4 Ms (CRS)	VIII (FIED)	-66,08 -66,8	10,66 10,9	Revaluado en este trabajo FIED (1961)
DATOS FENÓMENO DE LICUACIÓN DE SEDIMENTOS								
Localidad/ estado	Fuente	Coordenadas		I oMM	Dist. Km	Dist. recal Km	Tipo efecto geológico	Tipo de Ambiente sedimentario
NE Caserío la Marturetera en Capaya/ Miranda	18, 57	-66,23	10,44	VII (LUGO 1984)	88,15	29,45	b	▲
San Jacinto Caracas/ Dto. Capital	18, 57	-66,9	10,5	VII (LUGO 1984)	123,65	89,22	a, d	△
Puerto El Rincón a orillas del río Neverí/ Anzoátegui	18, 57	-64,69	10,17	VII (LUGO 1984)	183,29	161,46	a, b, c, d, e	Fluvio-deltaico ■ ▲
Barcelona a orillas del mar, Isla Los Roques/ Anzoátegui	18, 22, 57							■

Information on the 29 October 1900 earthquake and the triggered liquefaction phenomena

After Rodríguez, Audemard and Rodríguez (2006)



INVENTORY OF EARTHQUAKE-TRIGGERED LIQUEFACTION PHENOMENA IN THE AREA AFFECTED BY THE 24 JUNE 2026 NORTHERN VENEZUELA EARTHQUAKES

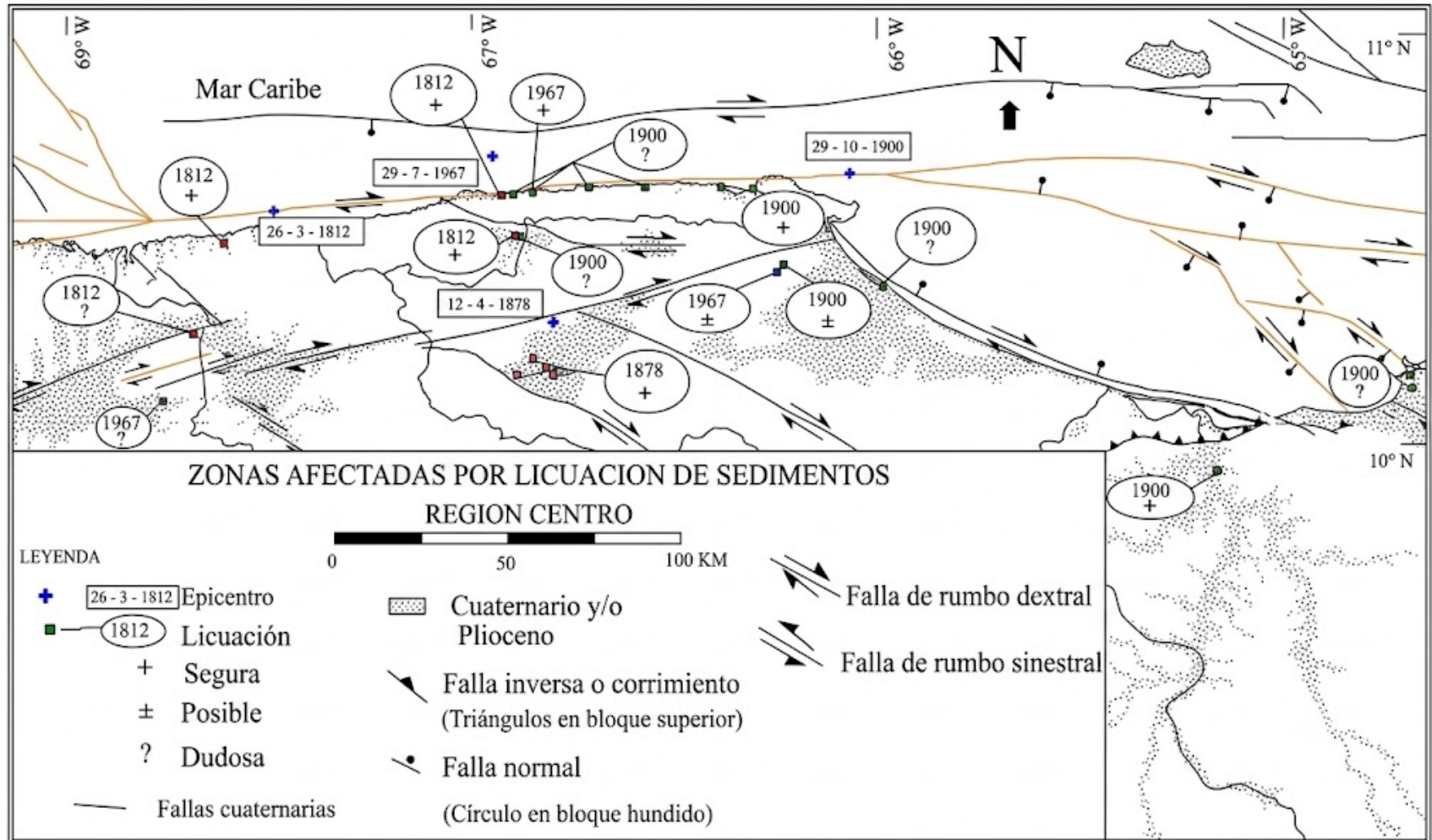
DATOS EVENTO SÍSMICO									
Nº/ord	Fecha	Hora local	Ubic epic Km	M Mb/Ms	IoMM	Coordenadas		Fuente	
						Long N	Lat N		
4	29-07-1967	08:05pm	Al NW de La Guaira	6,6 Ms (CRS) 6,3 (JPGG)	VIII (CRS)	-66,95	10,7	(Suárez Navelek 1990)	y
DATOS FENÓMENO DE LICUACIÓN DE SEDIMENTOS									
Localidad/ estado	Fuente	Coordenadas		I oMM	Dist. Km	Dist. recal Km	Tipo efecto geológico	Ambiente sedimentario	Tipo de Licuación
Playa Caraballeda / Vargas	18, 57	-66,84	10,61	VIII (JPGG 1990)	15,64		b, c, d, e	Costero	■ ▲
Playa Caraballeda/ Vargas	18, 57	-66,84	10,61	VIII (JPGG 1990)	15,64		b, c, d, e	Costero	■ ▲
Las Morochas cerca del río Agua Colorada/ Miranda	18, 57	-66,25	10,42	VI (PGG 1990)	82,60		l	Fluvial	▲
Rivera sur del lago de Valencia al NE de Guigue/ Carabobo	18, 22, 57	-67,75	10,11	IX (JPGG 1990)	109,34		d	lacustre	■

Information on the 29 July 1967 earthquake and the triggered liquefaction phenomena

After Rodríguez, Audemard and Rodríguez (2006)



INVENTORY OF EARTHQUAKE-TRIGGERED LIQUEFACTION PHENOMENA IN THE AREA AFFECTED BY THE 24 JUNE 2026 NORTHERN VENEZUELA EARTHQUAKES



Spatial distribution of earthquakes that have triggered liquefaction phenomena in the coastal part of the northern Venezuela (after Rodríguez, Audemard and Rodríguez, 2004, 2006)



SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES LIQUEFACTION

Earthquake-induced liquefaction, including the ejection of liquefied soil material (sand boils or sand ejecta), the development of characteristic liquefaction-induced ground features, and lateral spreading, were observed in coastal areas of northern Venezuela during the June 2026 seismic sequence. The occurrence of these phenomena is closely associated with the distinctive geological, geomorphological, and hydrogeological conditions that characterize the coastal lowlands of the region.

The La Guaira coastal area is mainly composed of recent Quaternary deposits, comprising coastal, deltaic, alluvial, and locally anthropogenic fill materials. These deposits consist mainly of loose to medium-dense sands, silty sands, sandy silts, and locally fine-grained conglomeratic sediments. They are characterized by a high degree of saturation resulting from the shallow groundwater table and the direct hydraulic connection with the Caribbean Sea. These conditions, combined with the high seismicity of northern Venezuela, create a highly susceptible environment for the development of soil liquefaction during strong earthquake shaking.

A representative example is provided by the waterfront area, particularly the La Guaira Marina, where extensive lateral spreading was documented. Elongated, subparallel ground cracks, significant horizontal displacement of the surficial soil mass towards the shoreline, and localized sand ejecta reaching the ground surface were observed. These ground deformations severely affected the stability and serviceability of the port infrastructure, causing substantial damage to the marina pier, quay facilities, and associated coastal infrastructure.

Overall, the liquefaction phenomena documented in the La Guaira coastal zone demonstrate the high seismic vulnerability of recently deposited, water-saturated Quaternary sediments and emphasize the critical role of local geological and geotechnical conditions in controlling the spatial distribution and severity of earthquake-induced ground failures.



SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES LIQUEFACTION



Liquefaction phenomena observed at **Bahía de Cata** Beach, Cata Bay, Aragua State, northern Venezuela, included the ejection and surface flow of liquefied soil material, as well as the development of ground cracks associated with earthquake-induced lateral spreading toward the shoreline. The extrusion and flow of liquefied material were also observed on the seabed, indicating the occurrence of submarine liquefaction-related ground deformation.

Snapshots from a video available online at:
<https://x.com/amilcarrock/status/207175773535222075>



SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES LIQUEFACTION



The ground cracks due to lateral spreading observed in **Bahía de Cata** Beach, Cata Bay, Aragua State, northern Venezuela also affected touristic facilities constructed in the sandy beach.

Snapshots from a video available online at:
<https://x.com/05t1n40/status/2073086968297136612>

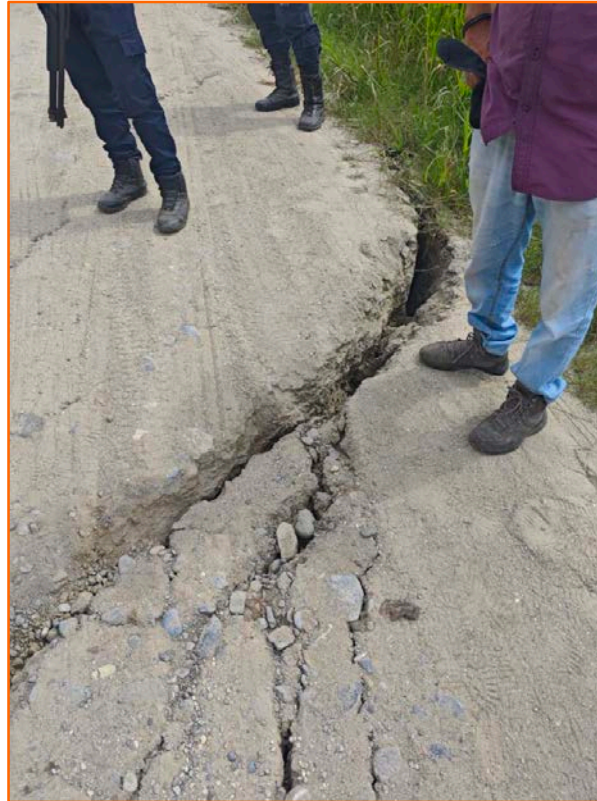


SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES LIQUEFACTION



REPÚBLICA BOLIVARIANA DE
VENEZUELA

Ministerio del Poder Popular para
**CIENCIA Y
TECNOLOGÍA**



Liquefaction was also triggered in the municipality of **Veroes**, in the state of Yaracuy, The phenomena was similar to what was documented during the 1997 Cariaco earthquake. The 2026 phenomena included ground cracks and ejection of liquefied material to the surface, resulting in sand boils. The photographs were provided by the staff of the Ministry of Science and Technology of Venezuela and their related report, which is available online at: <https://mincyt.gob.ve/la-estabilidad-de-nuestros-suelos-y-el-reto-de-la-licuacion/>



SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES LIQUEFACTION PHENOMENA



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SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES LIQUEFACTION



Following the 24 June 2026 earthquakes, several structures in the area **El Río en Boca de Aroa** were affected by liquefaction. The houses only settled or tilted rather than completely collapsing shows that the structures maintained their overall integrity, preventing further economic and human losses.

Available online at: https://www.instagram.com/reel/DaJo6eJO_9T/



SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES **LIQUEFACTION**



Liquefaction phenomena in the sandy soil of **Chuao area** of Aragua State, triggered by the 24 June 2026 major earthquakes in the northern part of Venezuela.



SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES LIQUEFACTION

As documented in numerous earthquake disasters worldwide, liquefaction-induced ground failures frequently occur within urban areas developed on liquefaction-prone deposits, particularly in coastal environments, river floodplains, estuarine settings, and lake margins. Under strong seismic loading, saturated, loose granular soils undergo a rapid loss of shear strength and stiffness due to the generation of excess pore-water pressures, resulting in reduction in bearing capacity beneath shallow foundations. Consequently, buildings founded on such deposits may experience characteristic patterns of liquefaction-induced damage, even when their structural systems remain largely intact.

The principal categories of building damage associated with liquefaction include: (a) differential or uniform foundation settlement with little or no structural damage to the superstructure; (b) building tilting caused by differential foundation movements, frequently accompanied by pounding against adjacent structures and the development of impact-related damage; and (c) severe overturning associated with progressive foundation failure, leading to partial or complete structural collapse.

The severity of these damage patterns is governed not only by the intensity and duration of earthquake shaking but also by the thickness and lateral continuity of liquefiable deposits, groundwater conditions, foundation type, and the interaction between the soil and the structure.

Representative recent examples were documented during the 2023 Turkey earthquakes, particularly in the cities of Antakya, İskenderun, and Gölbaşı (Mavroulis et al., 2023). Antakya is developed on the alluvial deposits of the Orontes River floodplain, İskenderun occupies low-lying coastal deposits along the Gulf of İskenderun, while Gölbaşı is founded on unconsolidated sediments adjacent to Lake Gölbaşı. In all three urban areas, widespread manifestations of liquefaction were associated with severe building damage, predominantly within approximately 2 km of rivers, the coastline, or lake margins, highlighting the strong spatial correlation between saturated unconsolidated sediments and earthquake-induced ground failure.



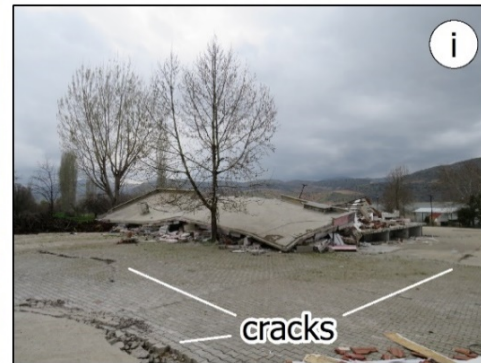
SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES **BUILDING DAMAGE ATTRIBUTED TO LIQUEFACTION – RECENT EXAMPLES FROM 2023 TURKEY EARTHQUAKES**



(a-d) sinking



(e-g) tilting



(h-i) collapse

After
Mavroulis et al. (2023)



SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES LIQUEFACTION

A comparable geotechnical setting characterizes the coastal zone of La Guaira in northern Venezuela. Large parts of the urban area have been developed on recent Quaternary coastal, beach, alluvial, and locally reclaimed deposits consisting predominantly of loose to medium-dense sandy soils with a shallow groundwater table and direct hydraulic connection to the Caribbean Sea. These geological and hydrogeological conditions render the coastal plain highly susceptible to earthquake-induced liquefaction during strong ground shaking. The extensive urban development immediately adjacent to the shoreline has therefore significantly increased the exposure of buildings and critical infrastructure to liquefaction-related ground deformation.

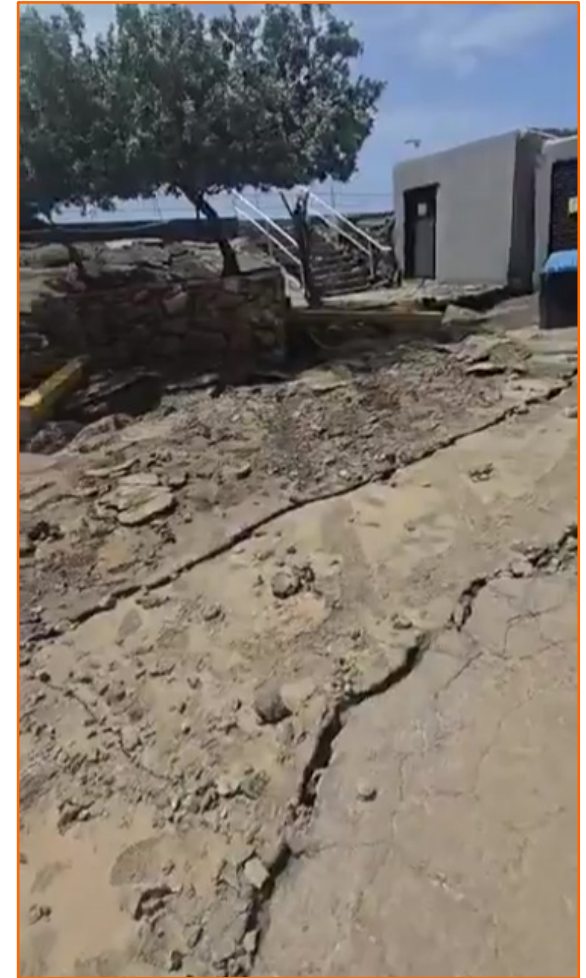
Based on field observations following the June 2026 earthquake sequence, together with the spatial distribution of structural damage and documented manifestations of ground failure, it is highly probable that liquefaction constituted one of the principal geotechnical mechanisms responsible for a substantial proportion of the building damage within the coastal zone of northern Venezuela. Liquefaction may have developed either at the

ground surface or within shallow subsurface sandy deposits, producing settlement, loss of foundation support, lateral ground movements, and differential displacements that significantly affected the performance of shallow-founded structures.

Characteristic examples include buildings exhibiting pronounced foundation settlement, significant tilting from the vertical, and, in several cases, partial or complete collapse consistent with liquefaction-induced foundation failure. These damage patterns were systematically documented during the post-earthquake field reconnaissance and were further corroborated by numerous photographs and videos recorded by local residents, journalists, and emergency response personnel. The spatial coincidence between these structural failures and areas underlain by recent water-saturated coastal sediments provides strong qualitative evidence supporting the interpretation that earthquake-induced liquefaction played a major role in controlling the observed damage distribution throughout the coastal urban areas of La Guaira.



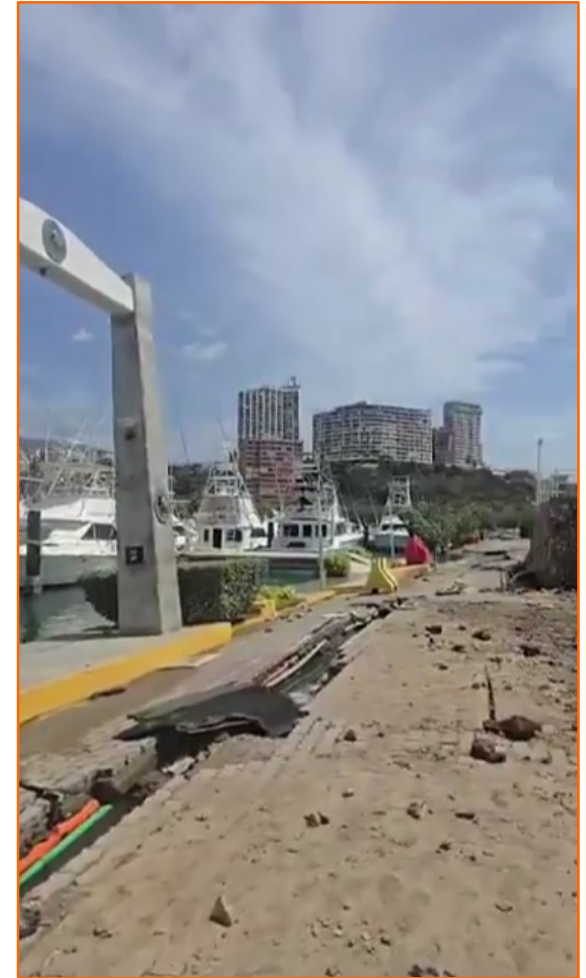
SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES LIQUEFACTION



Snapshots from a video presenting liquefaction in **Marina of La Guaira** uploaded by Alerta Mundial [@TuiteroSismico]. Available online at: <https://x.com/TuiteroSismico/status/2070589357870772558>



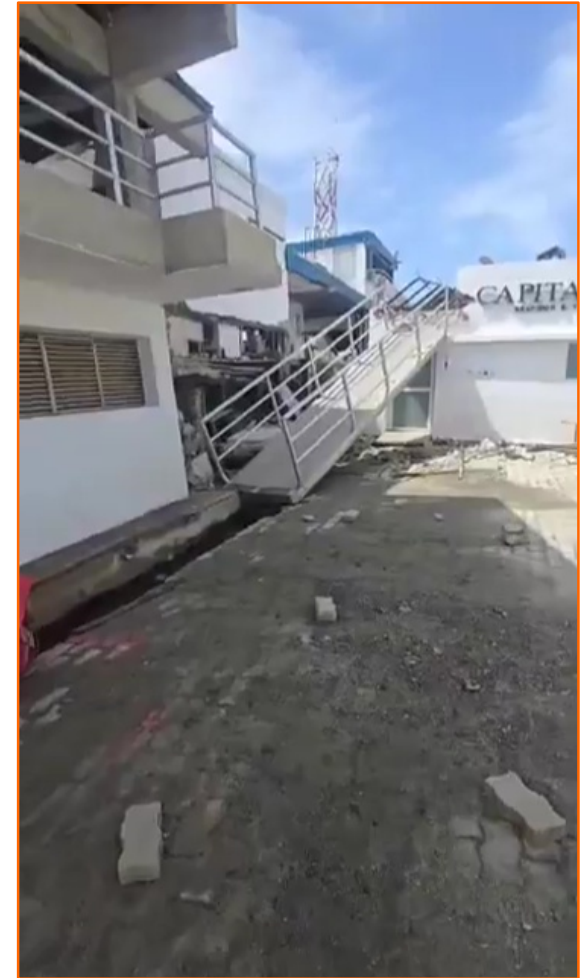
SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES LIQUEFACTION



Snapshots from a video presenting liquefaction in **Marina of La Guaira** uploaded by Alerta Mundial [@TuiteroSismico]. Available online at: <https://x.com/TuiteroSismico/status/2070589357870772558>



SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES LIQUEFACTION



Snapshots from a video presenting liquefaction in **Marina of La Guaira** uploaded by Alerta Mundial [@TuiteroSismico]. Available online at: <https://x.com/TuiteroSismico/status/2070589357870772558>



ENVIRONMENTAL EFFECTS OF THE 24 JUNE 2026 EARTHQUAKES GROUND DEFOMATION BASED ON FIELD SURVEY



Ground cracks in a highway in Morón area located close to the epicenters of the 24 June 2026 earthquakes.

Photos by Lekkas and Carydis ▲
and the ERT news reporting mission to Venezuela ►





SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES

GROUND DEFORMATION IN AREAS WITH MUD VOLCANOES

Trinidad and Tobago lie close to the South American continent, northeast of Venezuela and northwest of Guyana. The region is influenced by a major system of strike-slip faults, including the El Pilar Fault (VE-13) and the San Sebastián Fault (VE-16), which define the northern coastline of Venezuela with an E-W trend. These structures extend into the southern part of Trinidad and Tobago, significantly affecting the geological framework and present-day geomorphological configuration of the area (Audemard, 2000).

The major right-lateral strike-slip fault system, known as the Los Bajos Fault (VE-15), traverses the southwestern part of the island in an ESE–WNW direction, cutting and displacing all pre-existing structures in a dextral sense. Mud volcanoes have been identified and studied within the zone of influence of this fault system. The mud volcanoes of Trinidad can be divided into two groups based on their geochemical composition and their spatial relationship to the Los Bajos Fault. The southwestern group is aligned along the Southern Anticline. These mud volcanoes result from a complex mixing process involving fluids derived

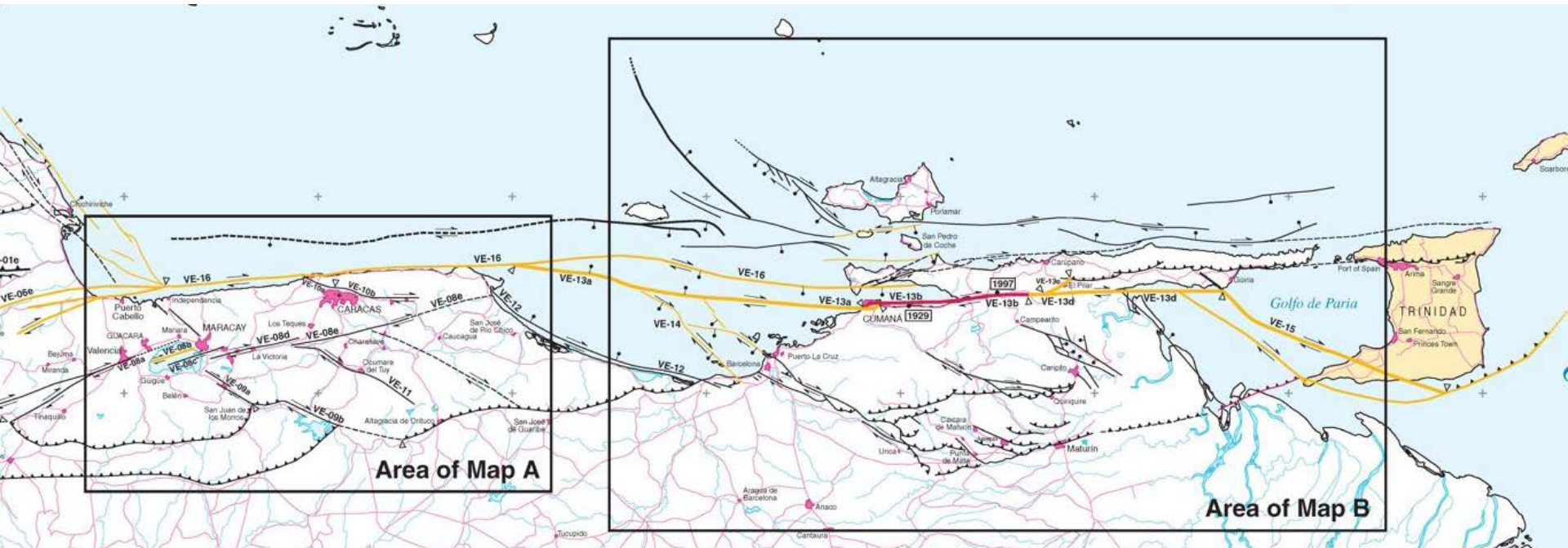
from two deep reservoirs, combined with contributions from near-surface aquifers (Dia et al., 1999).

The area affected by the 24 June 2026 earthquakes is located at the southwestern extremity of Trinidad, where the Southern Anticline is developed. This structural setting facilitates the migration of overpressured, previously subducted fluids (water, hydrocarbons, and gases) from depth toward the surface, leading to the formation of a linear belt of mud volcanoes along the coastline.

Due to reactivation of these processes, recent ground deformation has been observed at Galfa Beach. These features include extensive ground cracks and coastal scarps, resulting from approximately 6 m of uplift. These landforms give the impression of lateral spreading structures associated with sediment liquefaction.



ACTIVE FAULTS OF VENEZUELA AND TRINIDAD

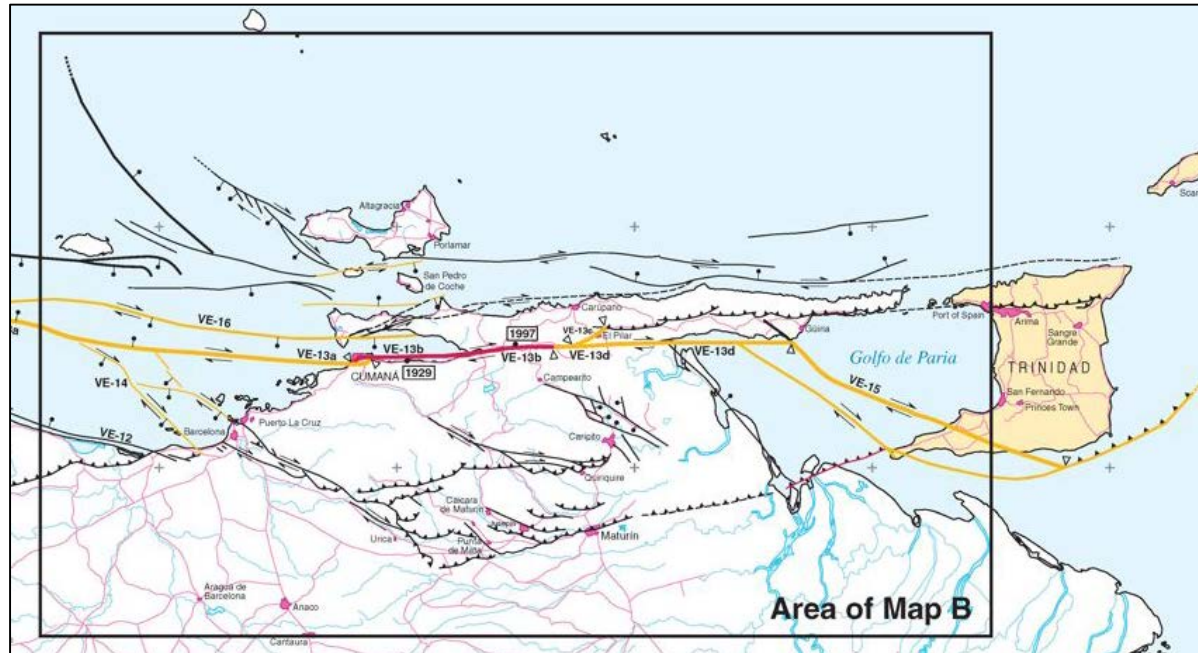


In western and central Venezuela, large, subparallel strike-slip fault systems dominate, including the San Sebastián and the El Pilar Faults. These structures accommodate the dextral motion of the Caribbean Plate relative to the South American Plate.

Towards the east, the main fault system, particularly the El Pilar Fault, extends into the Gulf of Paria. In this region, the tectonic deformation becomes increasingly segmented and complex. The area behaves as a pull-apart basin, where strike-slip motion is combined with extensional deformation, resulting in localized subsidence and basin formation.



ACTIVE FAULTS OF VENEZUELA AND TRINIDAD

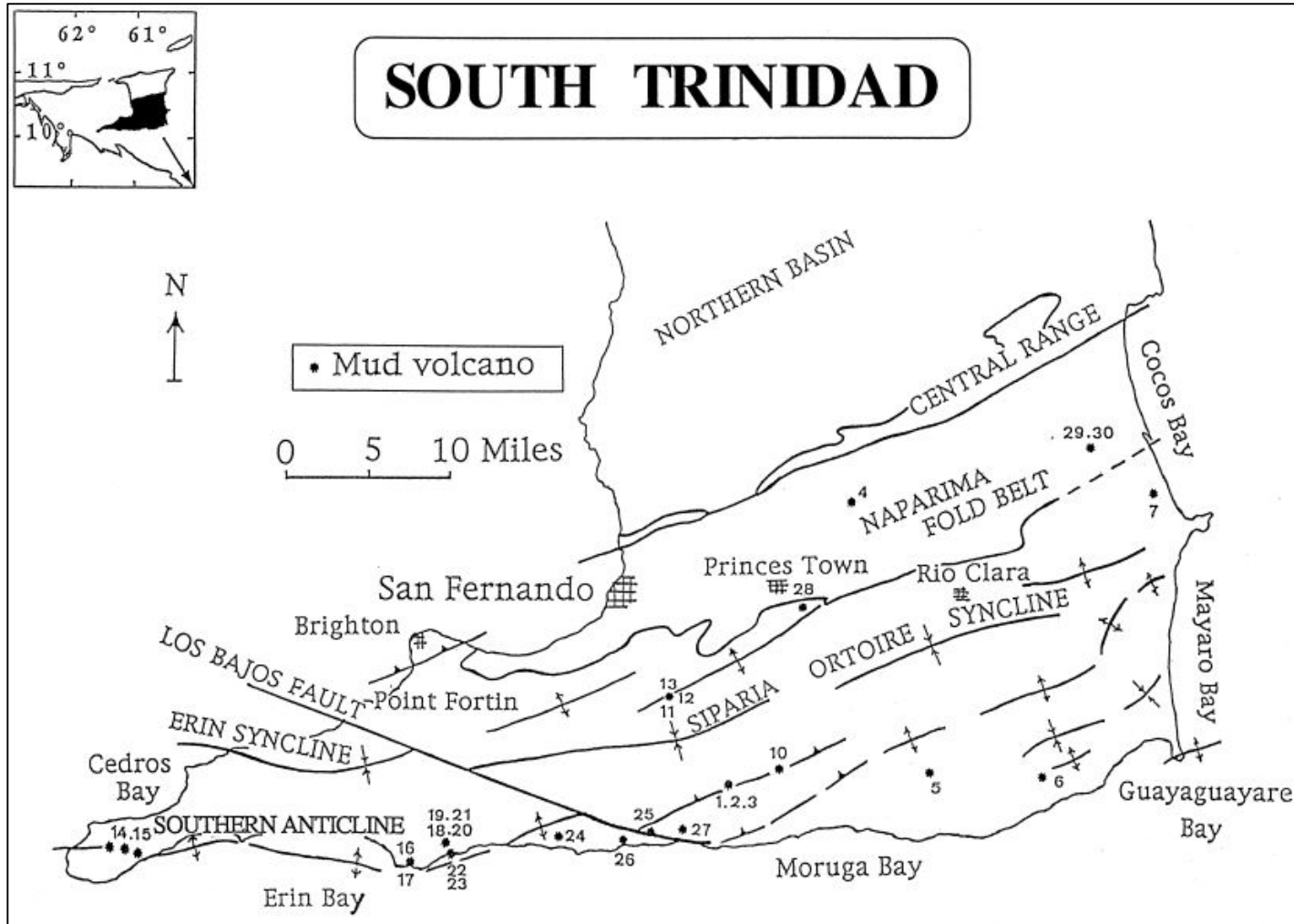


Upon reaching Trinidad, the strike-slip structures of Venezuela are directly linked to the major fault systems of the island. The El Pilar Fault continues along the southern margin of the Northern Range of Trinidad. In addition, further south on the island, structures such as the Los Bajos Fault are present, leading to a more complex tectonic regime

characterized by a combination of compression (folding and reverse faulting) and strike-slip deformation. This interplay of compressional stress and sediment overpressure in southern Trinidad promotes the upward migration of fluids and the development of mud volcanoes, as illustrated in the previous map.



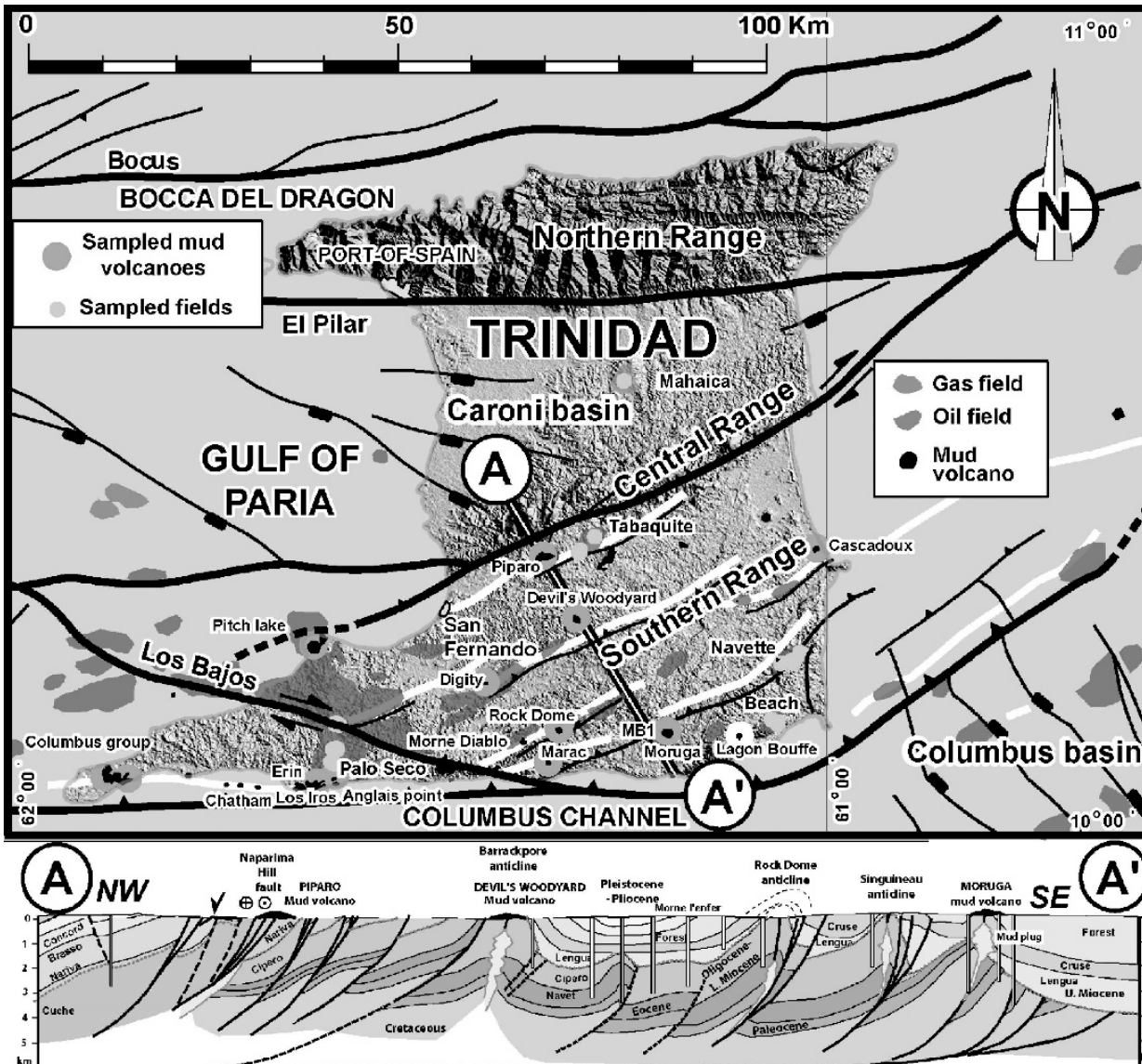
FAULTS AND MUD VOLCANOES IN SOUTHERN TRINIDAD



Map of southern Trinidad with the main geological features and location of mud volcanoes (Dia et al., 1999). The uplifter coastal area is located in the southwestern part of the country, where the southern anticline has been formed.



FAULTS AND MUD VOLCANOES IN SOUTHERN TRINIDAD

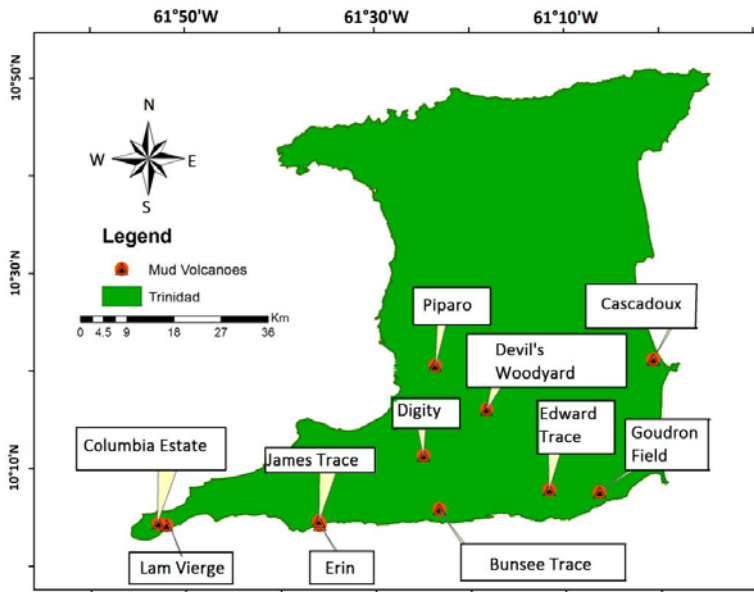


This map displays the geological structure, hydrocarbon reservoirs, and mud volcanoes of Trinidad island. It depicts the island's main mountain ranges and basins, such as the Northern Range, the Central Range, the Southern Range, and the Caroni basin. The locations of mud volcanoes studied or sampled by Battani et al. (2010) are marked with black dots and gray circles. Areas with gas fields and oil fields are also shown. The area affected by the 24 June 2026 earthquakes is located at the southwestern part of the country.

After Battani et al. (2010)



TYPICAL VIEWS OF MUD VOLCANOES IN TRINIDAD



(up) Mud volcano locations and selected mud volcanoes in Trinidad with representative cones (Hosein et al., 2014). (down) Views of the 1997 Piparo mud volcano eruption, which left 108 people homeless and buried three houses, more than a dozen vehicles and scores of farm animals, poultry and houses pets under tons of gaseous grey mud spewed some 200 feet into the air.





SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES **GROUND DEFORMATION IN AREAS WITH MUD VOLCANOES**

This uplift led to the exposure of a large portion of the seafloor and the consequent destruction of benthic and other marine organisms inhabiting the area, including fish, brachyuran crabs, bivalve mollusks (clams), and stingrays.

On the newly exposed seabed, small pools of trapped seawater formed. Within these pools, gas bubbling and the extrusion of sandy material to the surface were observed.



▲ ► Pre-seismic condition of Galfa Beach, showing geomorphic and structural features associated with mud volcano activity in the area.

The snapshots presented herein originate from the YouTube channel “South West Adventures” and specifically from the respective videos uploaded on 26, 29, and 30 June 2026.





SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES **GROUND DEFORMATION IN AREAS WITH MUD VOLCANOES**



Typical views of the Galfa beach located at the southwestern part of Trinidad. The snapshots presented herein originate from the YouTube channel “South West Adventures” and specifically from the respective videos uploaded to the channel on 29 June 2026.

Available online at:

<https://www.youtube.com/watch?v=9wO9oddzuyg>



SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES **GROUND DEFORMATION IN AREAS WITH MUD VOLCANOES**



Typical views of the Galfa beach located at the southwestern part of Trinidad. The snapshots presented herein originate from the YouTube channel “South West Adventures” and specifically from the respective videos uploaded to the channel on 29 June 2026.

Available online at:
<https://www.youtube.com/watch?v=4M8UpZYz4ss>



**SECONDARY ENVIRONMENTAL EFFECTS
CAUSED BY THE 24 JUNE 2026
EARTHQUAKES**
GROUND DEFORMATION IN AREAS WITH
MUD VOLCANOES

The coastal area experienced rapid uplift, resulting in the immediate retreat of seawater and the exposure of the seabed. Consequently, the marine organisms inhabiting the affected area were exposed to the air and perished due to the sudden change in their environment.



Available online at:
<https://www.youtube.com/watch?v=4M8UpZYz4ss>



SECONDARY ENVIRONMENTAL EFFECTS CAUSED BY THE 24 JUNE 2026 EARTHQUAKES **GROUND DEFORMATION IN AREAS WITH MUD VOLCANOES**

A recent mud extrusion discovered at Palo Seco Bay has become the latest geological feature to emerge along Trinidad's south-western coastline, following the powerful twin earthquakes that struck the coast of northern Venezuela.

The newly formed mud feature highlights the ongoing geological activity in the region, where tectonic forces continue to shape the landscape. The earthquakes appear to have triggered changes beneath the surface, potentially contributing to the release of underground fluids, gases, and sediment.

The emergence of this feature at Palo Seco Bay adds to a growing list of recent geological changes observed along Trinidad's south-western coastline. Scientists and local authorities are expected to monitor the site closely to assess its development, stability, and any potential implications for nearby communities and coastal ecosystems.

► Views of the newly formed mud feature in Palo Seco Bay (Trinidad and Tobago). Source: Reuters.





THE 24 JUNE 2026 VENEZUELA EARTHQUAKES – IMPACT ON CRITICAL ENTITIES

Electric Power System

The earthquakes caused widespread power outages across the Lower Caroní region due to extensive damage to the electrical transmission network. In La Guaira, electrical service has only been partially restored (approximately 60% of customers), primarily because of the collapse of a high-voltage transmission tower located in the mountainous terrain. The failure of this critical transmission component significantly disrupted regional power distribution and complicated restoration efforts owing to the difficult topographic conditions.

Potable Water Supply

The seismic shaking resulted in the rupture of major water transmission mains, causing extensive flooding in western Caracas and substantial disruption to the potable water distribution system. Water supply was interrupted across the states of Yaracuy, Falcón, Miranda, and Zulia, where damage to pipelines, pumping facilities, and associated infrastructure severely impaired service delivery. These failures highlight the high seismic vulnerability of buried lifeline networks and their

susceptibility to permanent ground deformation.

Natural Gas Distribution

As a precautionary measure, natural gas service was suspended throughout Greater Caracas immediately following the earthquake sequence. The shutdown was implemented to reduce the risk of secondary hazards, including gas leaks, fires, and explosions associated with damage to the underground gas distribution network and customer service connections.

Transportation Infrastructure

The Simón Bolívar International Airport at Maiquetía was closed after post-earthquake inspections identified significant structural damage to the passenger terminal, rendering the facility unsafe for normal operations. In addition, the Port of La Guaira was rendered inoperative, disrupting maritime transportation and cargo handling activities. The loss of both international airports and one of its busiest seaports substantially affected emergency response logistics, humanitarian assistance, and the movement of goods and personnel.



THE 24 JUNE 2026 VENEZUELA EARTHQUAKES – IMPACT ON CRITICAL ENTITIES

Communication disruptions

Communication disruptions have separated families, prompting Red Cross Societies in Ecuador, Colombia, Mexico, Costa Rica, Honduras, and Argentina to activate Restoring Family Links (RFL) services for members of the Venezuelan diaspora.

Health system

The healthcare system is under severe pressure. Public health facilities, which serve more than 90% of the population, are dealing with a sharp increase in trauma cases, while already facing shortages of medical staff, essential supplies, and functional operating theatres. Eight hospitals have been affected by the earthquakes, with some evacuated and patients relocated to other facilities.

The hospital at the Venezuelan Red Cross headquarters was compelled to shut down on the first night after reaching full capacity. At the same time, in the hardest-hit region of La Guaira, some patients are being transferred to Caracas in order to receive appropriate treatment, due to the overload of the local healthcare system.

Education

The Ministry of Education suspended all educational activities indefinitely following the earthquake sequence while comprehensive structural safety assessments were initiated.

Preliminary damage assessments indicate that at least 432 schools in Caracas, representing more than one-third of the capital's educational facilities, sustained varying degrees of earthquake damage, including structural cracking, non-structural failures, and damage requiring detailed engineering evaluation before reoccupation.

Crowdsourced observations submitted through the ArcGIS Citizen Sensor platform reported the complete collapse of the Ibero-American School in El Junquito, representing one of the most severe cases of educational infrastructure failure. In addition, the Faculty of Engineering at the University of Carabobo sustained significant structural damage, raising concerns regarding seismic performance of related facilities and the need for post-earthquake structural evaluations.



IMPACT ON HEALTH FACILITIES **EXPOSURE OF HOSPITALS TO HIGH SEISMIC INTENSITIES**



Based on the geospatial data presented in the PAHO damaged hospitals dashboard with the spatial distribution and exposure of hospitals, the following situation assessment is derived regarding the operational readiness and vulnerability of health infrastructure:

Identification of critical healthcare vulnerability within the affected zone

In the area corresponding to the highest estimated seismic intensity, close to the earthquake epicenters and in the Caracas and La Guaira areas located eastwards, a concentration of healthcare facilities is observed (yellow indicators in the map of the next page). These facilities were exposed to the highest levels of seismic loading (seismic intensities >VI), indicating an increased likelihood of structural damage and a potential reduction or even loss of operational functionality.

Spatial differentiation of operational resilience

The majority of hospital facilities across the broader territory of Venezuela (green indicators in the map of the next page) are located outside the zone of

high seismic intensity (intensity < IV). Consequently, these facilities are considered to retain a significant degree of operational capacity (services continuity) and may support emergency response operations by serving as secondary healthcare delivery hubs.

Expected operational burden on the healthcare network

Hospitals located within the peripheral zone of the affected area (yellow indicators in the map of the next page, intensity IV-VI) experienced increased operational stress, either due to partial functional limitations or as a result of increased patient inflow from the epicentral region. This situation necessitated the rapid reinforcement of available human and material resources in order to ensure the adequacy and continuity of healthcare service delivery.

Damage Hospitals Dashboard

This dashboard presented in the next page is freely available online at:

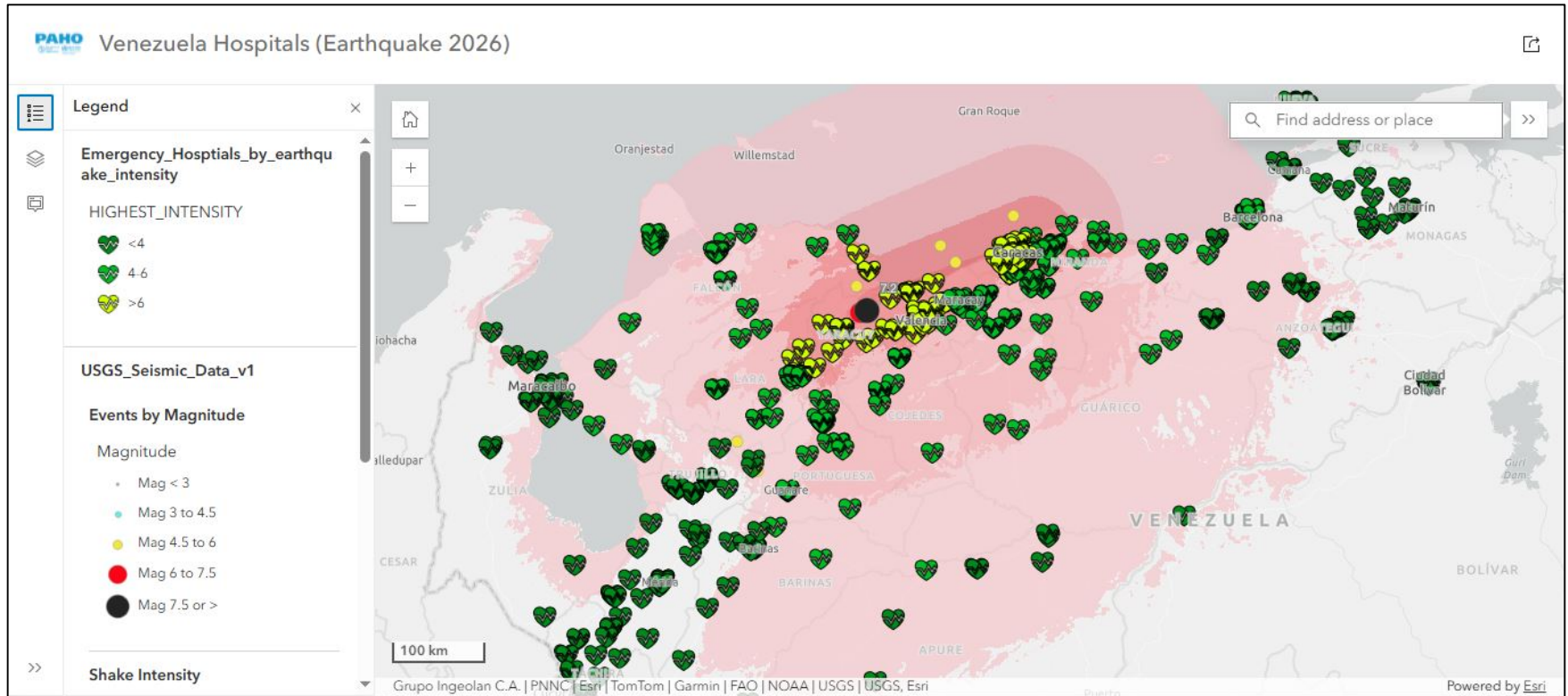
<https://who.maps.arcgis.com/apps/instant/sidebar/index.html?appid=5237d93ca8f94b149621c60cc4648bb1> (accessed on 3 July 2026)



IMPACT ON HEALTH FACILITIES EXPOSURE OF HOSPITALS TO HIGH SEISMIC INTENSITIES



DAMAGE HOSPITALS DASHBOARD COMPILED BY THE PAHO



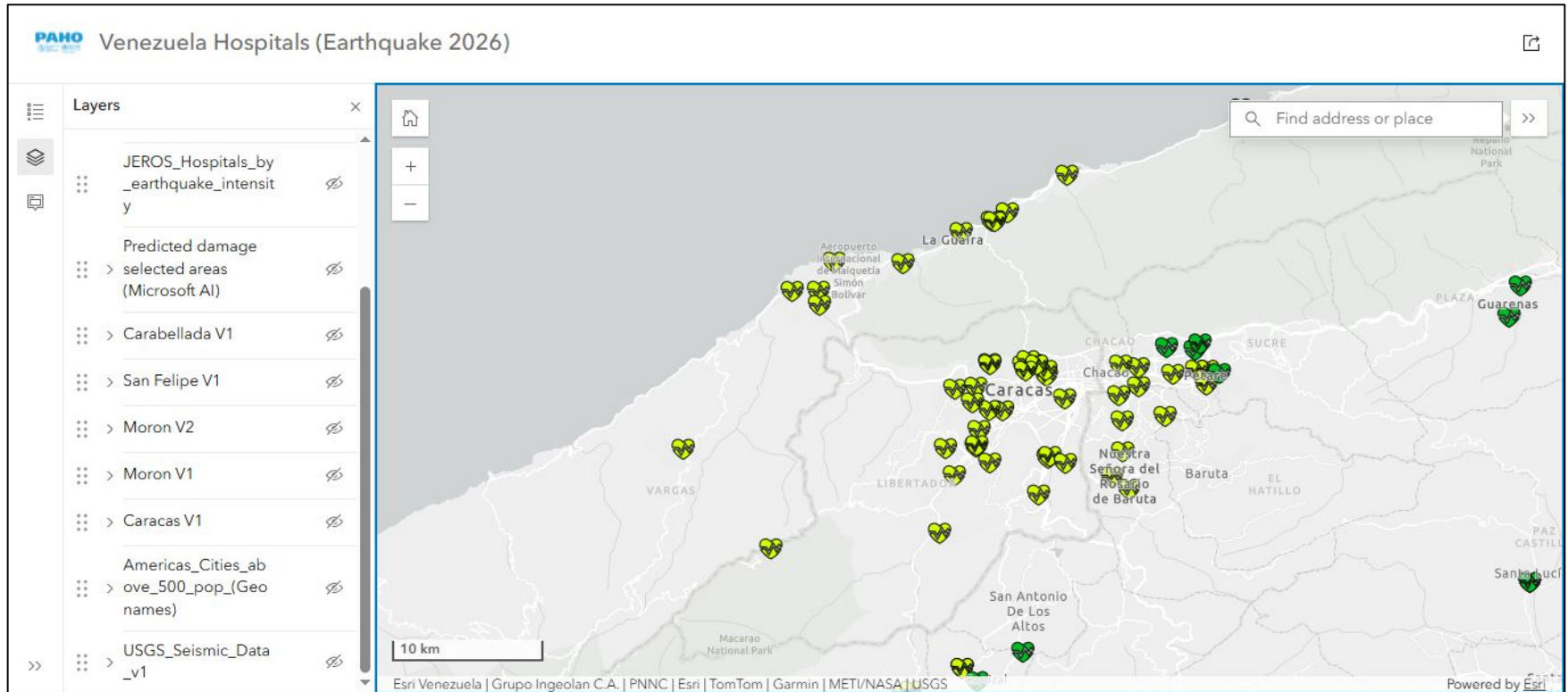
This screenshot of the Venezuela Damaged Hospital Dashboard shows an interactive geospatial application developed by PAHO, which visualizes the exposure of healthcare facilities (symbolized as hearts) within the affected and surrounding areas to seismic intensity (red polygons) as recorded by the USGS. The yellow heart symbols indicate hospitals within the highest-impact zone, several of which are reported to be affected and potentially non-operational following the seismic event.



IMPACT ON HEALTH FACILITIES EXPOSURE OF HOSPITALS TO HIGH SEISMIC INTENSITIES



DAMAGE HOSPITALS DASHBOARD COMPILED BY THE PAHO



This screenshot of the Venezuela Damaged Hospital Dashboard shows an interactive geospatial application developed by PAHO, which visualizes the exposure of healthcare facilities (symbolized as hearts) within the affected and surrounding areas to seismic intensity (red polygons) as recorded by the USGS. The majority of the hospital facilities in La Guaira area were exposed to the high seismic intensities and remained non-operational after the generation of the earthquakes.



IMPACT OF EARTHQUAKE ON PUBLIC HEALTH

RISK FACTORS FOR INFECTIOUS DISEASES EMERGENCE IN EARTHQUAKE-AFFECTED AREAS

The risk factors for the occurrence of infectious diseases in earthquake-affected areas are the following:

- Heavy structural damage to critical healthcare infrastructure causing delayed management and treatment of severe infectious diseases cases.
- Severely injured earthquake highly exposed to high pathogen densities in soil.
- Immense changes in climate and aggravating weather conditions in the emergency response phase.
- Emergency shelters and evacuation camps with:
 - High population density and overcrowding.
 - Poor living conditions.
 - Lack of clean running water due to damage and contamination of the water supply systems and water sources, respectively.
 - Unsanitary conditions (poor hand hygiene) due to a shortage of personal hygiene items.
 - Malnutrition due to insufficient food provision and shortage of long-lasting food supplies.
 - Insufficient equipment (poor ventilation

and air conditioning systems among others.

- Rodent/vector infestation.

- Increased exposure to vectors and rodents due to earthquake-triggered ecological changes.
- The weak immune system of vulnerable groups of the affected population comprising the elderly, the chronically ill individuals, and young children.
- Poor socio-economic conditions.
- Poor health education and training on infectious disease prevention and control.
- Lack of emergency preparedness and training of residents and medical staff for infectious disease prevention.
- Insufficient or low vaccination coverage due to limited vaccination campaigns and short supplies.
- Close contact with cases and activities and interaction in areas where clusters of infectious disease cases have been observed.

Source: Mavrouli et al. (2023), in Microorganisms



IMPACT OF EARTHQUAKES ON PUBLIC HEALTH RISK FACTORS FOR INFECTIOUS DISEASE EMERGENCE IN VENEZUELA AFFECTED AREAS



The disaster has severely compromised healthcare facilities. Many hospitals are damaged or operating under significant strain, while shortages of medical supplies and the loss of key healthcare personnel have further reduced emergency response capacity.

The earthquakes have increased the risk of infectious disease outbreaks through the synergy of population displacement, overcrowded shelters, damaged water and sanitation infrastructure, and disruption of essential public health services.

WHO and PAHO have identified heightened risks for **waterborne diseases**, **vaccine-preventable infections** such as measles, diphtheria, and pertussis, and **vector-borne diseases** including dengue, chikungunya, Zika virus disease, yellow fever, malaria, and Oropouche fever.

These risks are amplified by low pre-existing vaccination coverage and the interruption of routine immunization and vector-control programs.

The deterioration of healthcare infrastructure is expected to delay disease detection and outbreak response. Overburdened hospitals, compromised

laboratory and surveillance capacity, inadequate biosafety measures, and disruptions to patient registration systems may hinder the timely identification of infectious disease clusters.

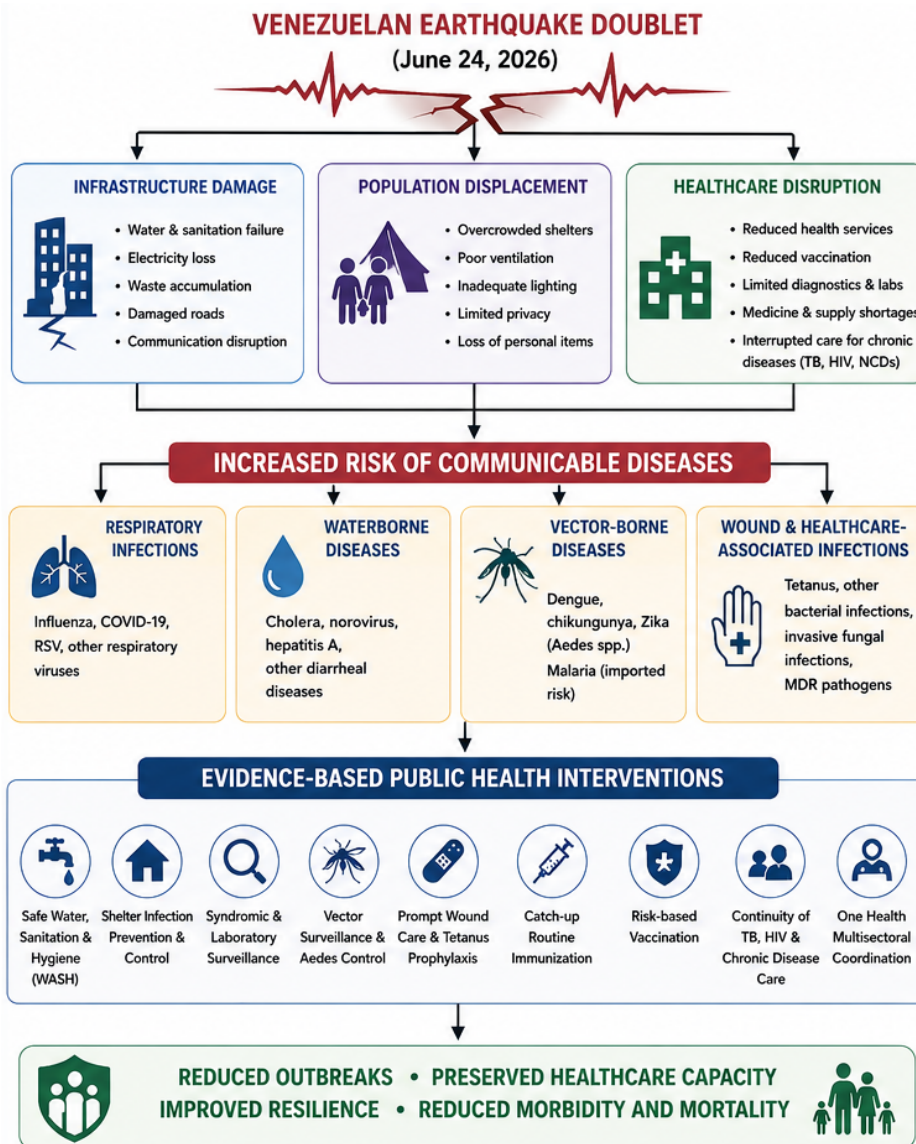
In parallel, the loss of specialist healthcare workers, particularly in maternal health services, is likely to increase indirect health consequences beyond communicable diseases, while long-standing shortages within Venezuela's health workforce continue to constrain recovery efforts.

Although Venezuela has not experienced sustained endemic cholera transmission in recent decades, the current conditions, including damaged sewerage systems, stagnant water, and inadequate sanitation in displacement settings, could create an environment conducive to disease emergence.

Disruption of vector-control activities is expected to increase transmission of mosquito-borne diseases already circulating before the disaster. Continued epidemiological surveillance will therefore be essential for the early detection of outbreaks and for guiding public health interventions.



IMPACT OF EARTHQUAKE ON PUBLIC HEALTH PATHWAY FROM EARTHQUAKE TO INFECTIOUS DISEASE RISK AND PUBLIC HEALTH RESPONSE

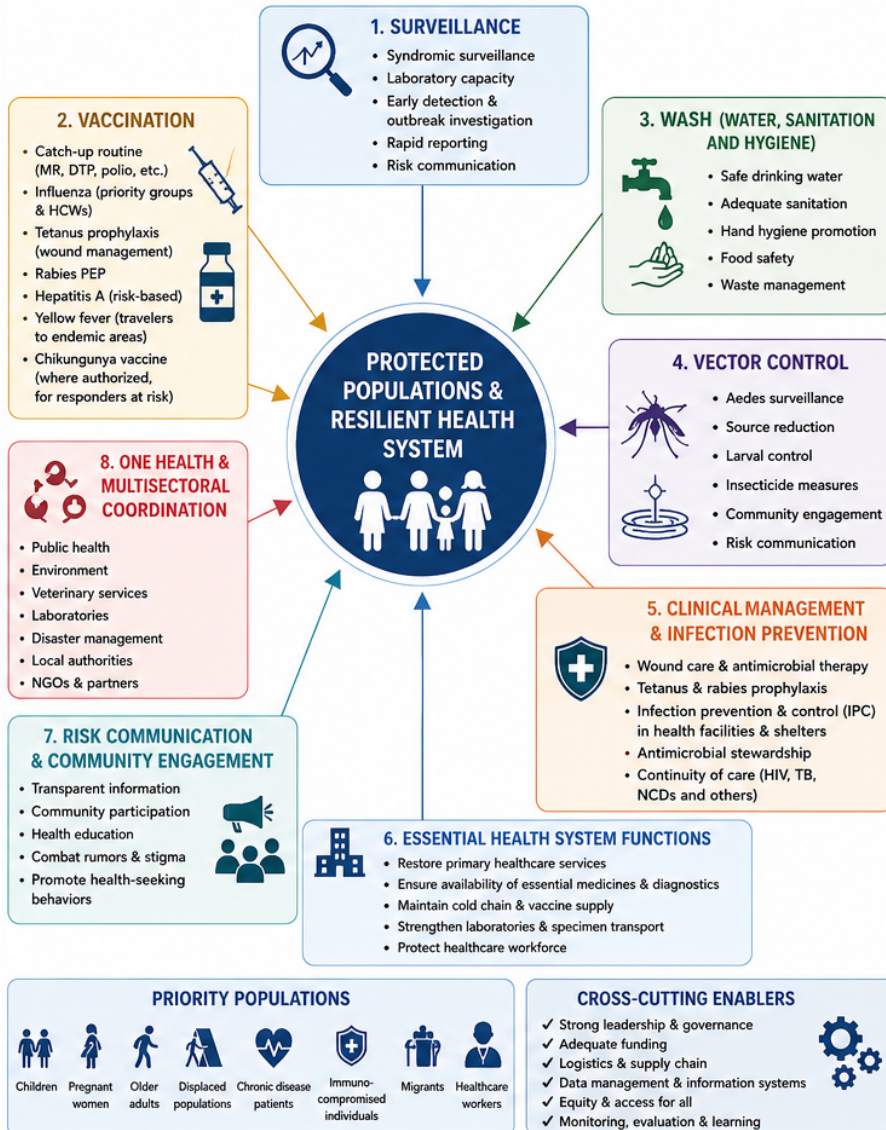


Earthquakes do not directly cause epidemics. They create conditions conducive to communicable disease transmission through disruption of healthcare services, water, sanitation and hygiene (WASH) systems, and large-scale population displacement.

Early, integrated public health interventions, including disease surveillance, infection prevention and control, vector control, wound management, and targeted vaccination, are essential to reduce the risk of post-disaster communicable disease outbreaks and preserve health system capacity.



IMPACT OF EARTHQUAKE ON PUBLIC HEALTH INTEGRATED POST-EARTHQUAKE INFECTIOUS DISEASE PREVENTION FRAMEWORK



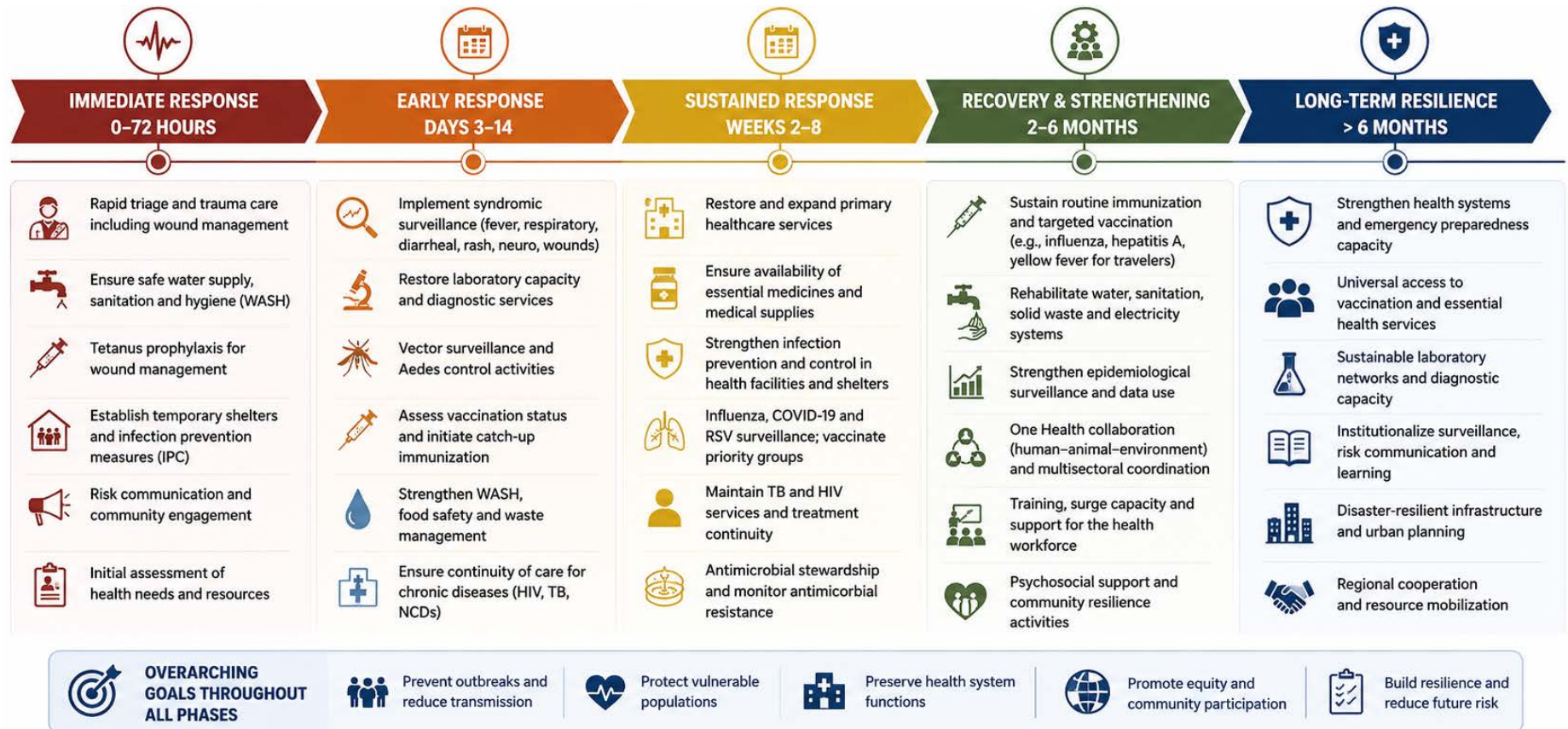
Effective post-earthquake infectious disease prevention requires a coordinated, multisectoral approach integrating surveillance, vaccination, WASH, vector control, clinical management, infection prevention and control, and restoration of essential health services. Together, these complementary interventions help maintain essential health services, reduce the risk of communicable disease outbreaks, and minimize preventable morbidity and mortality.



IMPACT OF EARTHQUAKE ON PUBLIC HEALTH

TIMELINE OF PUBLIC HEALTH PRIORITIES FOLLOWING THE VENEZUELAN EARTHQUAKE DOUBLET

Dynamic, phased response to reduce infectious disease risk and preserve essential health services



Public health priorities evolve throughout emergency response and recovery. Initial life-saving interventions should gradually transition toward disease surveillance, restoration of essential health

services, targeted vaccination programs, health system recovery, and long-term preparedness to reduce the risk of infectious disease emergence and strengthen health system resilience.



CORPSE RECOVERY AFTER EARTHQUAKES: Managing Risks, Protecting People, Preventing Disease

Evidence shows that bodies of earthquake victims are NOT a significant source of outbreaks. Disease risk is much more related to water, sanitation and hygiene conditions.

THE FACTS

- ✓ Dead bodies of people who died from trauma (e.g., earthquake) do NOT pose a significant risk of infectious disease to the general population.
- ✓ Outbreaks after earthquakes are mainly caused by problems with water, sanitation, hygiene, crowding and disrupted health services.
- ✓ Dignified and timely recovery of the dead is important for public health, psychological well-being and the community.

RISKS FOR RECOVERY WORKERS

Most risks come from **DIRECT CONTACT** with body fluids, not from the dead body itself.

Potential risks:

- Cuts, punctures, abrasions
- Contact with blood or body fluids
- Inhalation of dust, mold or chemicals
- Vector exposure (e.g., rodents, insects)

Reduce risk by using PPE, safe procedures and good hygiene.



WHAT INFLUENCES OUTBREAKS AFTER EARTHQUAKES?

HIGHER RISK FACTORS

- Damaged water supply
- Poor sanitation and sewage contamination
- Crowding in shelters
- Poor hygiene practices
- Disrupted health services



LOW RISK FACTOR

Presence of dead bodies (from trauma)



PERSONAL PROTECTION IS ESSENTIAL for everyone involved in corpse recovery



- Head protection (helmet)
- Eye protection (goggles/face shield)
- Respiratory protection (surgical mask or N95)
- Body protection (coverall or gown)
- Gloves (heavy-duty)
- Boots (waterproof)



Use PPE correctly and consistently. Change if damaged or heavily soiled. Wash hands thoroughly after removing gloves.

OTHER IMPORTANT MEASURES

- Restore safe water supply
- Ensure proper sanitation and waste management
- Promote hygiene in shelters (handwashing, cleaning)
- Strengthen health services and surveillance
- Communicate with communities and provide clear information

SAFE CORPSE RECOVERY: KEY PRACTICES



Plan and coordinate
Work with authorities.
Assess safety.



Use trained teams
Ensure adequate
staff and supervision.



Use appropriate PPE
Before, during and
after the recovery.



Handle bodies
with care
Minimize exposure.
Avoid unnecessary
contact.



Place remains in
body bags
Seal properly and
label if possible.



Practice hand
hygiene
Wash hands with soap
and water or use
alcohol-based rub.



Decontaminate
equipment
Clean and disinfect
tools and reusable
equipment.





IMPACT OF EARTHQUAKE ON PUBLIC HEALTH

STRATEGIES FOR MITIGATING THE RISK OF EARTHQUAKE-INDUCED INFECTIOUS DISEASES

The following strategies should be adopted and applied for mitigating the risk of earthquake-triggered infectious diseases :

- Establishment of proper disease surveillance system to immediately and effectively identify the pre- and post-disaster infectious disease cases and trends.
- Prevention of infectious diseases in emergency shelters with:
 - o measures for first responders and personnel involved in the emergency response
 - o mitigation measures for accommodated staff and visitors in emergency shelters
 - o administrative and engineering controls in emergency shelters, including changes in the layout of facilities and distribution practices of supplies
 - o designation of isolation facilities to separate suspected cases of infectious diseases
 - o reduction of overcrowding in emergency shelters to avoid increased incidence of respiratory diseases
- Ensuring the safety of drinking water and sewerage systems to avoid the occurrence of waterborne diseases
- Compliance with the existing safety and hygiene measures
- Where existing measures are not sufficient, educational activities for hygiene and sanitation awareness raising should be conducted
- Large-scale preventive vaccination and medicine programs for several infectious diseases should be implemented
- A long-term empowering and strengthening of the public sector health system

After Mavrouli et al. (2023), in *Microorganisms*



THE MENTAL HEALTH IMPACT OF THE VENEZUELA EARTHQUAKES (JUNE 2026)

On 24 June 2026, two powerful earthquakes (M7.2 and M7.5) struck north-central Venezuela, causing massive destruction, loss of life, and widespread displacement. Beyond the physical devastation, the mental health impact on affected populations is profound and long-lasting.

KEY FIGURES (AS OF 1 JULY 2026)

- 2,295** Deaths
- 11,267** Injured
- >26,000** People affected or displaced
- At least **7** states affected, with La Guaira the most severely impacted

Source: OCHA Situation Report No. 8 (01 Jul 2026)

WHY MENTAL HEALTH IS AT RISK



Destruction of homes and infrastructure, loss of belongings, and disruption of livelihoods



Displacement, overcrowded shelters, uncertainty, and ongoing safety concerns



Separation from family, missing relatives, and exposure to death and injuries



These stressors can lead to acute stress reactions, anxiety, depression, prolonged grief, and post-traumatic stress disorder (PTSD).

High-risk groups: children, older adults, people with pre-existing mental illness, those who have lost loved ones, and survivors of severe personal loss.



IMPACT ON MENTAL HEALTH

Survivors may experience a range of emotional and behavioral reactions.



Anxiety and fear



Sadness, depression and hopelessness



Sleep disturbances and fatigue



Irritability, anger and emotional distress



Behavioral changes in children



Risk of long-term PTSD and complicated grief

International evidence shows that a significant minority of survivors develop persistent mental health conditions that can last for months or years after disasters.

LIMITED CAPACITY TO RESPOND



At least two specialized mental health facilities in La Guaira sustained structural damage and are operating with reduced capacity.



Shortages of medications for psychiatric emergencies further restrict access to care.



Hospitals are overwhelmed with trauma cases, limiting the ability to provide psychological care.



Chronic shortage of health professionals due to years of emigration and underinvestment in the health sector.

MENTAL HEALTH AND PSYCHOSOCIAL SUPPORT (MHPSS) RESPONSE

PAHO has identified MHPSS as a priority area, targeting:



Affected communities



Families searching for missing relatives



Healthcare workers



Emergency personnel

Key interventions include:

- ✓ Psychological first aid and basic psychosocial support
- ✓ Community-based psychosocial activities
- ✓ Protection of children and other vulnerable groups
- ✓ Strengthening referral pathways for severe mental health conditions
- ✓ Support for the mental well-being of health and emergency workers

DISPLACEMENT AND LIVING CONDITIONS THAT INCREASE PSYCHOLOGICAL DISTRESS



Overcrowded shelters and improvised accommodations with limited privacy



Poor sanitation, limited water, and inadequate basic services



Disrupted social support networks and uncertainty about the future



Increased stress, interpersonal conflict, gender-based violence, and caregiver burden



First responders and health workers are at high risk of burnout, compassion fatigue, and secondary traumatic stress.

LOOKING AHEAD



Mental health consequences will persist long after the acute emergency phase.



Ongoing surveillance, community engagement, and early identification of mental health problems are essential.



Sustained investment in mental health services is critical to support recovery and resilience.

“Rebuilding lives after earthquakes means not only reconstructing buildings, but also healing minds and restoring hope.”



Mental health is a fundamental component of disaster response and recovery.

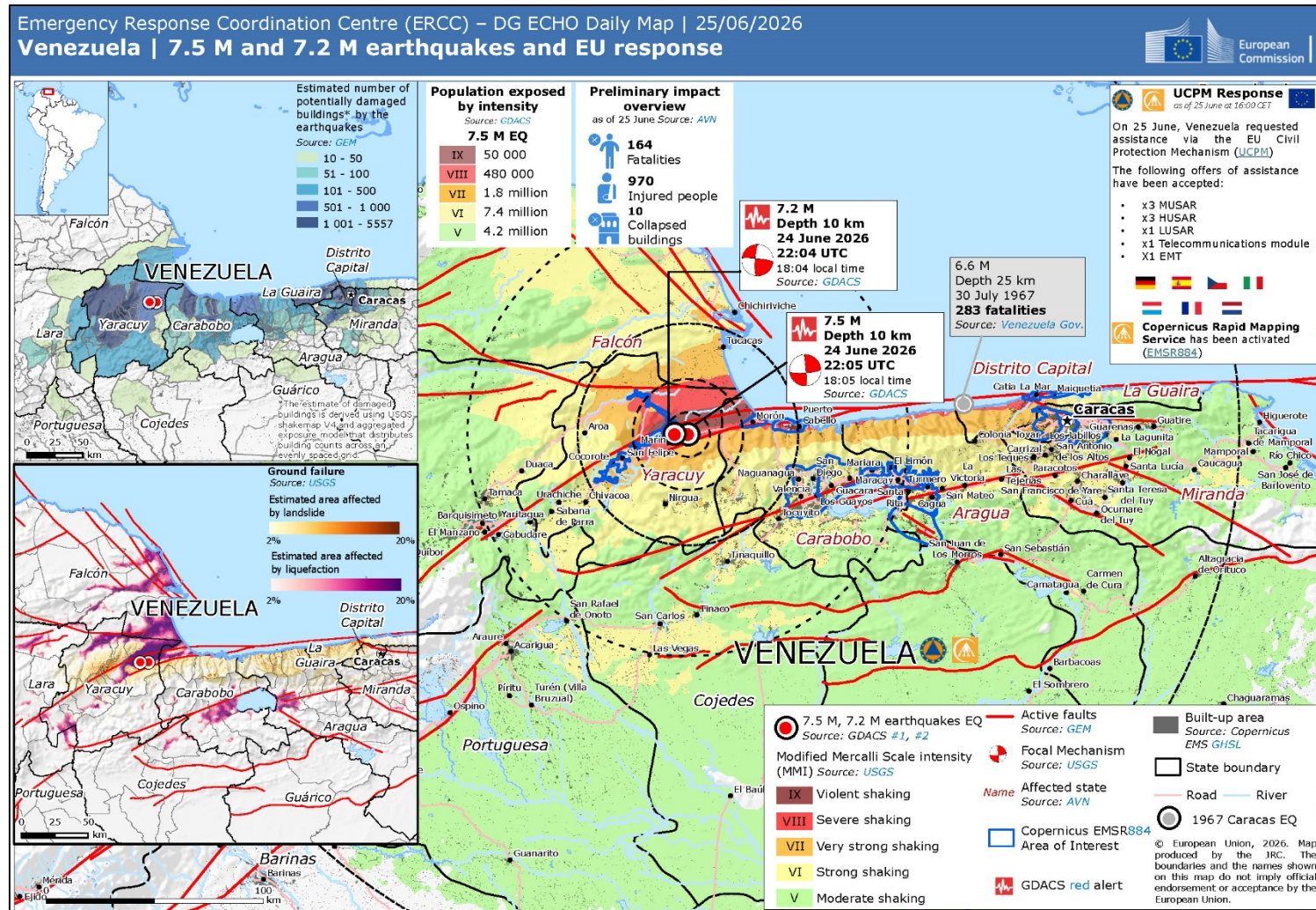
Sources: PAHO/WHO – Earthquakes in Venezuela 2026 (Situation Reports 1–4) | OCHA Situation Report No. 8 (01 Jul 2026)
Reuters | AP News | UNHCR Assessments

PAHO

World Health Organization
Americas

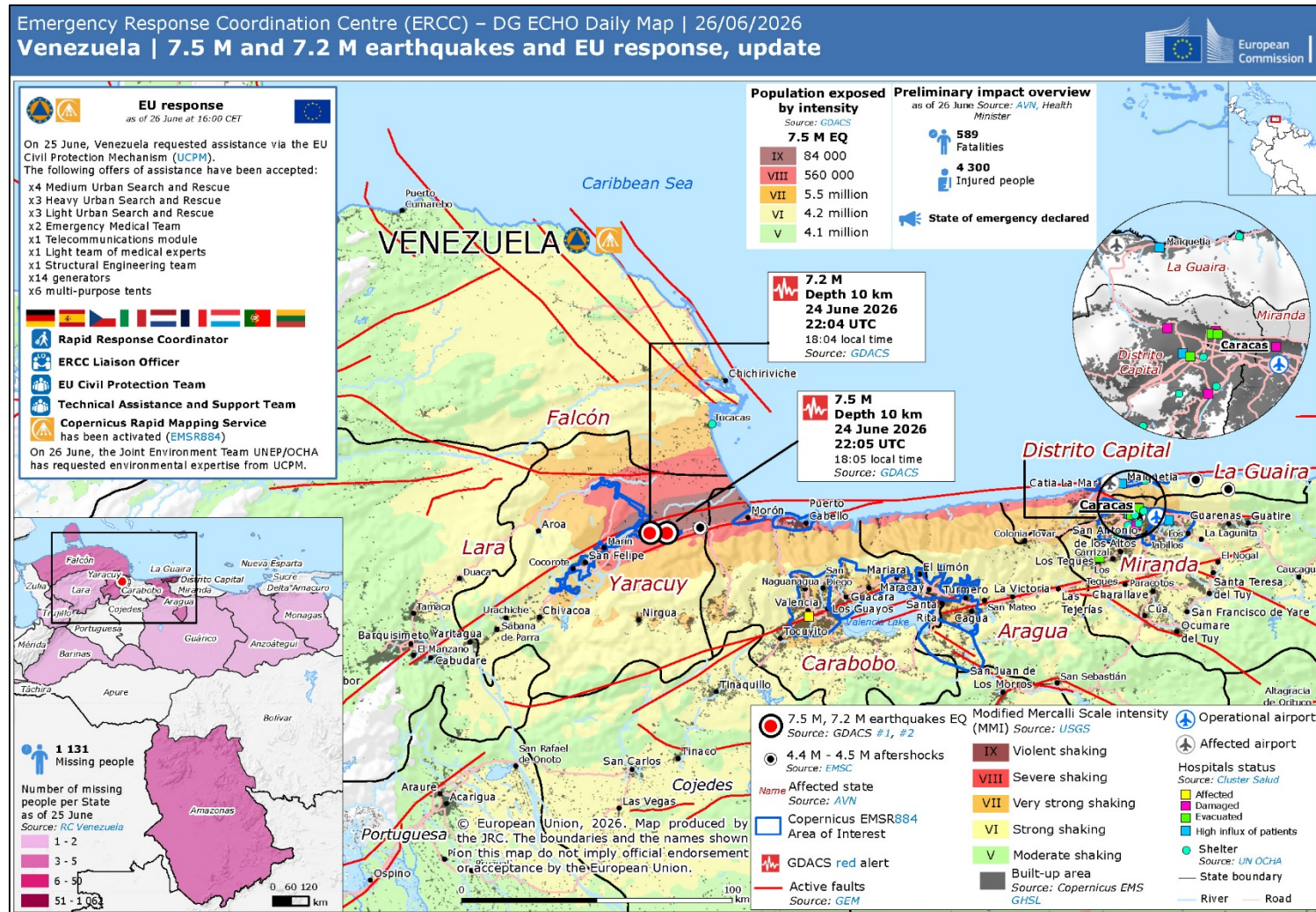


EMERGENCY RESPONSE COORDINATION DG ECHO DAILY MAP ON 25 JUNE 2026



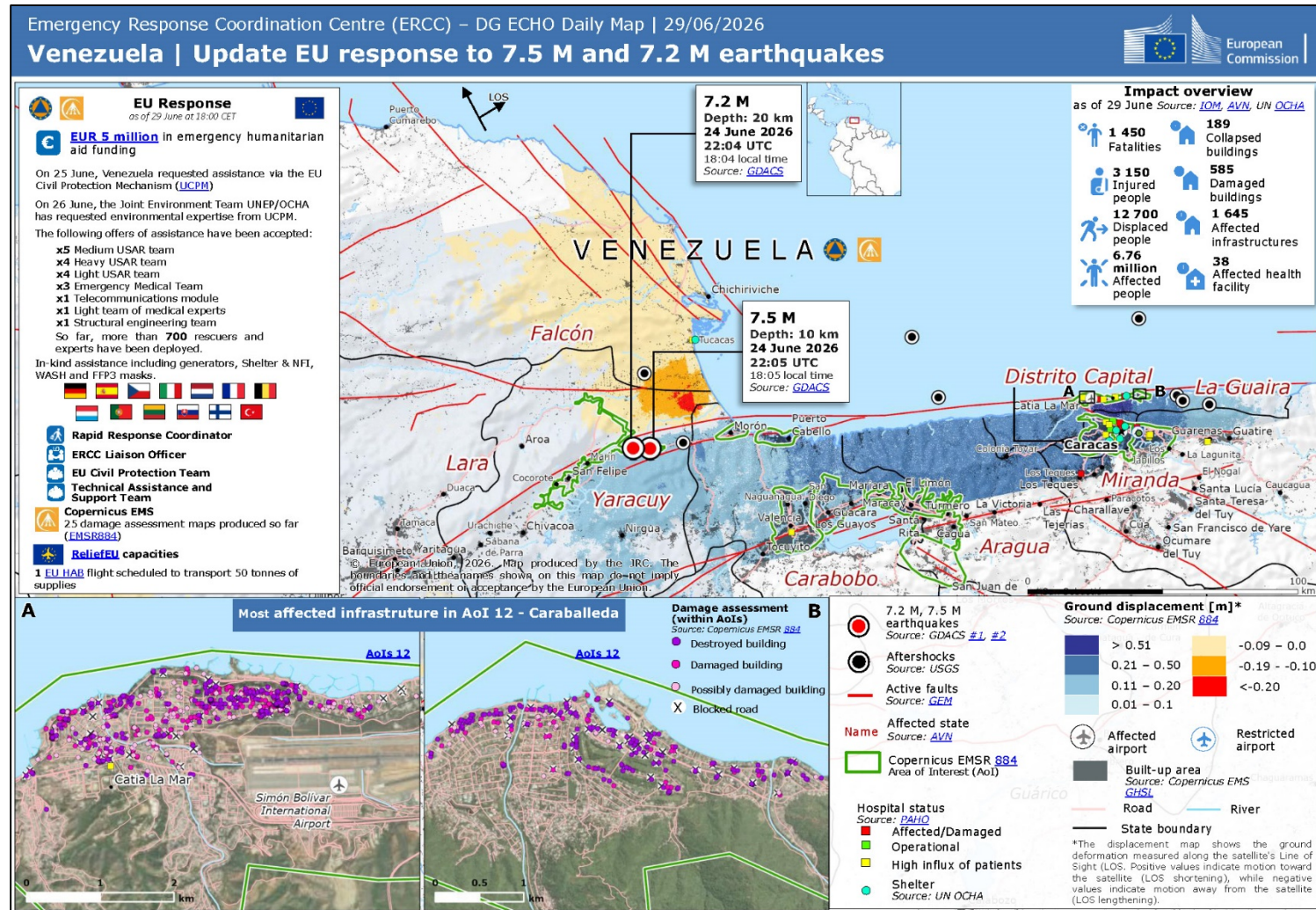


EMERGENCY RESPONSE COORDINATION DG ECHO DAILY MAP ON 26 JUNE 2026



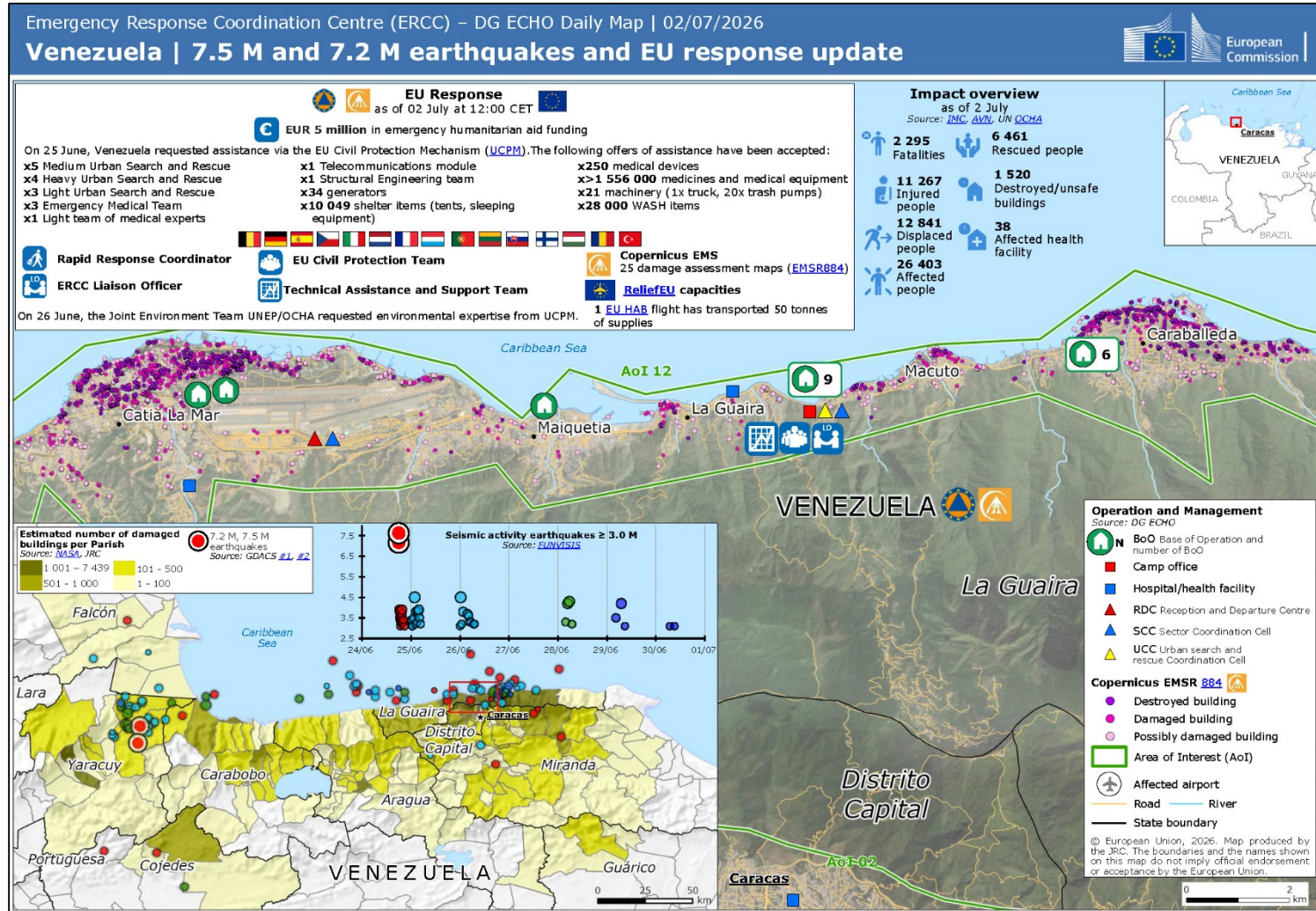


EMERGENCY RESPONSE COORDINATION DG ECHO DAILY MAP ON 29 JUNE 2026





EMERGENCY RESPONSE COORDINATION DG ECHO DAILY MAP ON 2 JULY 2026





NATIONAL AND INTERNATIONAL RESPONSE

The national and international response has included the activation of the National Emergency System and Civil Protection mechanisms, alongside the deployment of USAR teams to the affected areas. A central coordination General Staff has been established, and a national state of emergency has been declared to ensure unified command and resource management. In parallel, the public and private healthcare networks have been fully activated to provide mass casualty management and treatment for the injured population.

At the request of the Government of Venezuela, USAR teams from 28 countries with more than 2,200 personnel and 165 search dogs, have arrived in the country to locate and extract people trapped by collapsed structures and provide initial medical support. The OCHA has activated its emergency response tools and supported the teams.

AFFECTED AREAS





THE WORLD STANDS WITH VENEZUELA

International aid and solidarity after the devastating earthquakes

Rescue Personnel Search Dogs (K9) Equipment & Supplies Medical & Health Support Logistics & Airlift

NORTH AMERICA

	UNITED STATES 341 29
Relief personnel, equipment and humanitarian aid. Navy ships deployed to support relief operations.	
	MEXICO 300 15
Rescuers ("the moles"), search dogs and supplies.	
	EL SALVADOR 66 1
Rescuers and paramedics, equipment, medicines and essential supplies.	

SOUTH AMERICA

	ARGENTINA 134 7
Rescuers, search dogs.	
	BRAZIL 59 7
Rescuers, search dogs.	
	CHILE 45
Rescuers, tons of cargo.	
	COLOMBIA 64 4
Rescuers, search dogs.	
	ECUADOR 105 4
Humanitarian aid and agency supplies.	
	PERU 41 1
Rescuers, search dog.	
	PANAMA 61 4
Rescuers, search dogs.	



VENEZUELA



People from many countries.

One common purpose:

TO SAVE LIVES AND BRING HOPE.

EUROPE

	SPAIN 144 24
Rescuers, search dogs (2 urban search & rescue teams).	
	SWITZERLAND 80 8
Rescuers, search dogs, tons of supplies.	
	GERMANY 74 7
Offered 6 A400M aircraft for airlift of personnel and supplies.	
	NETHERLANDS 64 8
Rescuers, search dogs, €2 million allocated.	
	FRANCE 91 4
Rescuers, search dogs (Expressed solidarity and willingness to help).	
	PORTUGAL 122 12
Rescuers, search dogs.	
	UNITED KINGDOM (UK) 68 6
Rescuers, 6 search dogs.	
	ITALY 25
Rescuers.	
	CZECH REPUBLIC 69 8
Rescuers, 8 search dogs.	
	LITHUANIA 23
23 rescuers, 2 search dogs.	
	SLOVAKIA 20
20 rescuers, 4 search dogs.	

OTHER REGIONS

	TÜRKİYE 43 2
Rescuers, search dogs.	
	QATAR 39 6
Rescuers, search dogs.	
	SYRIA 15
Rescuers.	
	JORDAN 105 6
Rescuers, search dogs.	
	CURAÇAO 8
Rescuers.	

UN & INTERNATIONAL ORGANIZATIONS

	INTERNATIONAL FEDERATION OF RED CROSS AND RED CRESCENT SOCIETIES Operational in Venezuela. Supporting search and rescue, shelter, healthcare, water, sanitation and basic needs.
	UNITED NATIONS Preparing a rapid response team to support the government-led response and vulnerable communities.

VENEZUELA EARTHQUAKES JUNE 2026
ODM | Urban Search and Rescue (USAR) Team Snapshot



FROM AROUND
THE WORLD

More than 30 countries and international organizations are standing with Venezuela.



2,000+
RESCUERS, PARAMEDICS
AND HUMANITARIAN
PROFESSIONALS



100+
SEARCH DOGS (K9)
DEPLOYED



TENS OF TONS
OF EQUIPMENT, SUPPLIES,
MEDICINES AND ESSENTIAL
AID DELIVERED



**AIRLIFTS, SHIPS
AND LOGISTICS**
COORDINATED ACROSS
CONTINENTS



**SOLIDARITY HAS
NO BORDERS.
HUMANITY
UNITES US.**



INTERNATIONAL RESPONSE

COUNTRY NAME - PERSONNEL - DOGS (K9)

COUNTRY	LEVEL	PERSONNEL	DOGS
Argentina	-	29	4
Argentina	-	30	0
Argentina	-	30	0
Argentina	-	45	3
Brazil	Heavy	44	6
Brazil	-	6	0
Brazil	Light	9	1
Chile	Medium*	45	0
Colombia	Medium*	64	4
Costa Rica	-	48	0
Curacao	-	8	0
Czech Republic	Heavy*	69	8
Dominican Republic	-	10	0
Ecuador	Medium*	46	2
Ecuador	-	59	2
El Salvador	-	66	1
France	Heavy*	85	4
France	-	6	0
Germany	Medium*	48	4
Germany	Light*	24	3
Germany	-	2	0
Italy	Light*	25	0
Jordan	Heavy*	105	6
Lithuania	Light*	23	2
Mexico	-	7	0
Mexico	Medium	15	1

COUNTRY	LEVEL	PERSONNEL	DOGS
Mexico	-	250	10
Mexico	-	13	0
Mexico - Red Cross	-	15	4
Netherlands	Heavy*	64	8
Panama	Light	61	4
Peru	-	41	1
Portugal	-	60	6
Portugal	-	62	6
Qatar	Heavy*	39	6
Slovakia	-	20	4
Spain	Medium*	51	8
Spain	Medium*	40	4
Spain	-	10	1
Spain	-	7	2
Spain	-	36	9
Switzerland	Heavy*	80	8
Syria	-	15	0
Türkiye	Medium*	43	2
UK	Heavy*	68	6
USA	Heavy*	79	6
USA	Heavy*	74	6
USA	Light	12	3
USA	-	80	6
USA	-	79	5
USA	-	17	3
Venezuela	-	12	0



VENEZUELA EARTHQUAKES JUNE 2026 Urban Search and Rescue (USAR) Team Snapshot

As of 30 June (12:00 GMT-4)



51

TEAMS



2,276

PERSONNEL



28

COUNTRIES



165

K9 DOGS

- 51 teams from
- 28 countries with more than
- 2,200 personnel and
- 165 search dogs

have arrived in Venezuela to rescue survivors from collapsed structures and provide initial medical support.



SEARCH AND RESCUE OPERATIONS



a



b



c

(a) Members of the French Civil Security Training and Intervention Regiment and U.S. rescuers carry a person after being rescued from the rubble in Caraballeda on 28 June 2026 (photo by Miguel Medina, AA Photos).

(b) U.S. rescuers cut through rebar during SAR at a collapsed building in La Guaira on 30 June 2026 (photo by Ariana Cubillos, AA Photos)

(c) Rescue workers carry a survivor after 8 days trapped in a collapsed building in Catia La Mar, on 2 July 2026 (photo by Fernando Vergara, AA Photos).



SEARCH AND RESCUE OPERATIONS



SAR teams search through rubbles of collapsed buildings and rescue survivors in:

(a) Caracas City, on 24 June 24, 2026
(photo by Ariana Cubillos)

(b) La Guaira on 27 June 2026
(photo by Fernando Vergara).

(c) La Guaira on 28 June 2026
(photo by Matias Delacroix).

Source: AP Photos



SEARCH AND RESCUE OPERATIONS



(a) Members of a Brazilian SAR team sift through earthquake rubble in La Guaira (photo by Matias Delacroix).

(b) Rescue workers search through rubble three days after the earthquakes struck Catia La Mar (photo by Fernando Vergara).

(c) SAR team of the US firefighters from the Fairfax County, Virginia, pull a boy from the rubble after rescuing him and his father from a collapsed building in La Guaira on 28 June 2026 (photo by Matias Delacroix).

Source: AP Photos



STRATEGIES FOR MITIGATING IMPACT ON POPULATION

EARLY WARNING AND REAPID RESPONSE SYSTEM: THE ANDROID EARTHQUAKE ALERTS SYSTEM

One of the most important technological tools contributing to life safety seconds after the occurrence of earthquakes in northern Venezuela was Google's Android Earthquake Alerts System. This system represents a large-scale Earthquake Early Warning (EEW) technology that transforms millions of Android smartphones into a distributed seismic detection network. By exploiting the built-in accelerometers of smartphones, the system is capable of detecting the initial, faster-moving P-waves generated by an earthquake. The detected signals are transmitted anonymously to Google's earthquake detection servers, where data from multiple nearby devices are rapidly combined to confirm the occurrence of an earthquake, estimate its location and magnitude, and determine the expected level of ground shaking.

Once an earthquake is confirmed, the system issues warning alerts to affected Android users before the arrival of the more destructive S-waves. Depending on the distance from the epicentral area, these alerts may provide several seconds, and in some cases longer time intervals, allowing individuals and emergency response personnel to undertake

immediate protective actions. Such actions include the internationally recommended "Drop, Cover, and Hold On" procedure, moving away from unstable structures, protecting critical equipment, and initiating emergency response protocols.

It should be emphasized that the Android Earthquake Alerts System is not for earthquake prediction. Earthquake prediction attempts to determine the future occurrence of an earthquake, whereas earthquake early warning systems detect an earthquake after rupture initiation and provide rapid notification before the strongest ground motions arrive. Therefore, these systems represent a critical component of modern seismic risk reduction and emergency management strategies.

During the 24 June 2026 Venezuela earthquakes, the Android Earthquake Alerts System reportedly detected the seismic events within seconds and issued early warnings to millions of users in the affected region. The rapid dissemination of alerts expanded as the seismic waves propagated, providing residents with valuable response time before the arrival of intense shaking.

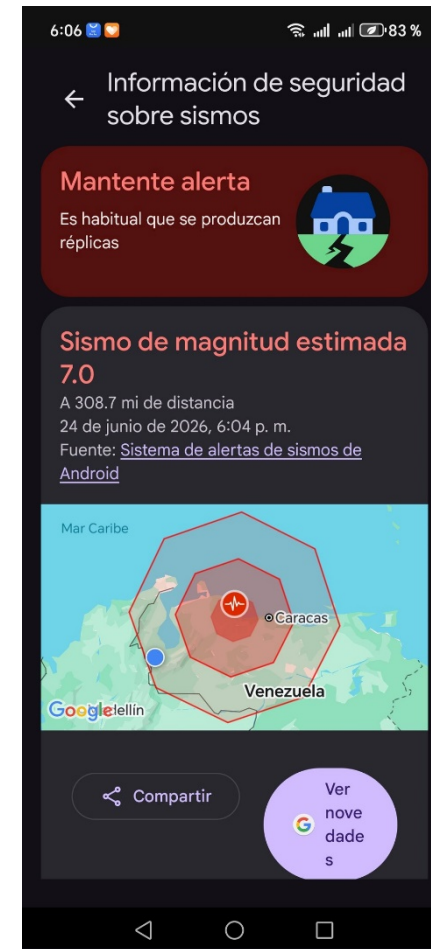


STRATEGIES FOR MITIGATING IMPACT ON POPULATION

EARLY WARNING AND REAPID RESPONSE SYSTEM: THE ANDROID EARTHQUAKE ALERTS SYSTEM

This early warning capability contributed to increased public awareness and encouraged many residents to evacuate vulnerable buildings, avoid partially damaged structures, and adopt immediate protective measures. Although the effectiveness of earthquake early warning systems depends on factors such as epicentral distance, network density, communication infrastructure, and user response, even a few seconds of warning can significantly reduce injuries and improve the emergency preparedness, particularly in densely populated areas and critical facilities.

Several testimonies and videos documenting residents receiving earthquake alerts, reacting before the arrival of strong shaking, and sharing their experiences have been published through social networking platforms and news media. These observations provide valuable information regarding public response, risk perception, and the operational effectiveness of smartphone-based earthquake early warning technologies.

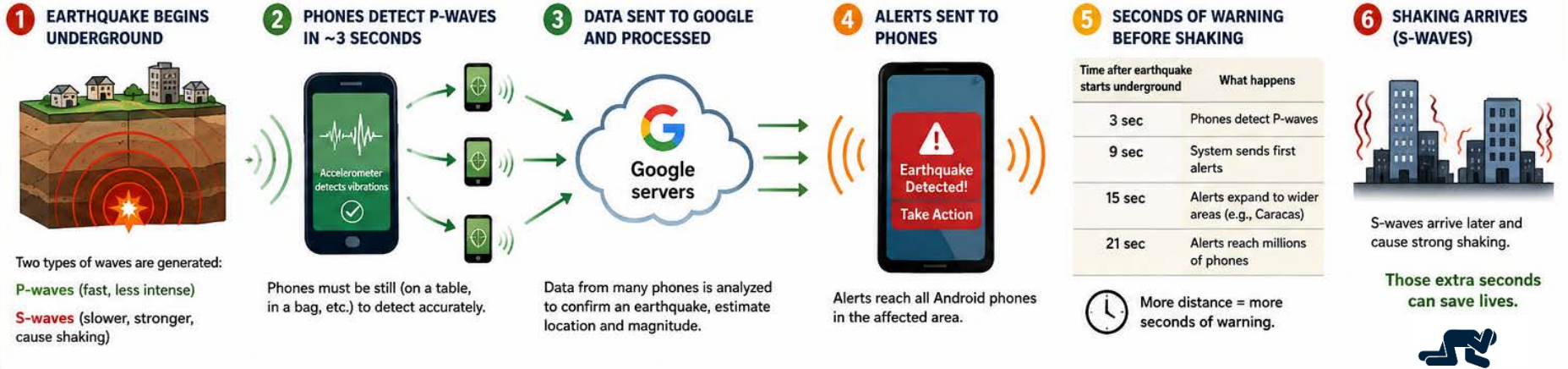


Screenshot of the Android Earthquake Alert received by residents in northern Venezuela following the 24 June 2026 earthquakes.



How Android Earthquake Alerts Work

Turning billions of phones into a global early warning network



TYPES OF ALERTS

- TAKE ACTION (Severe)**
For areas where very strong shaking is expected. Loud sound + urgent message. Take immediate action.
- BE PREPARED (Moderate)**
For areas with expected moderate shaking. Warning tone + notification.
- BE AWARE (Light)**
For areas with light shaking. Quiet alert to stay informed and be vigilant.

WHERE IT WORKS

- Uses the accelerometer in Android phones (the same sensor that detects screen rotation).
- Works in 98 countries (as of 2023) – even in places without government warning systems.
- ~70% of smartphones worldwide use Android.

REAL EXAMPLE: VENEZUELA EARTHQUAKES

- Two strong earthquakes: M7.2 and M7.5 (the strongest since 1900).
- In just 3 seconds, phones detected P-waves.
- First alerts sent 6–9 seconds after the start.
- Alert zone expanded as shaking intensified.
- Alerts reached 11.4 million people.
- Nearly 1.4 million received “Take Action” alerts in the strongest shaking areas.



WHY IT CAN SAVE LIVES

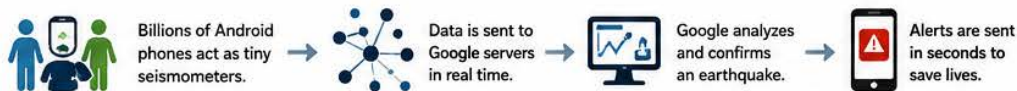
Even a few seconds of warning can give people time to:

- Drop
- Cover
- Hold on



Early warnings don't predict earthquakes. They detect them very quickly and warn before the strong shaking arrives.

THE BIG PICTURE



Google began Android Earthquake Alerts in 2021 (NZ, Greece, Turkey, Philippines, Central Asia) and expanded to 98 countries by 2023.



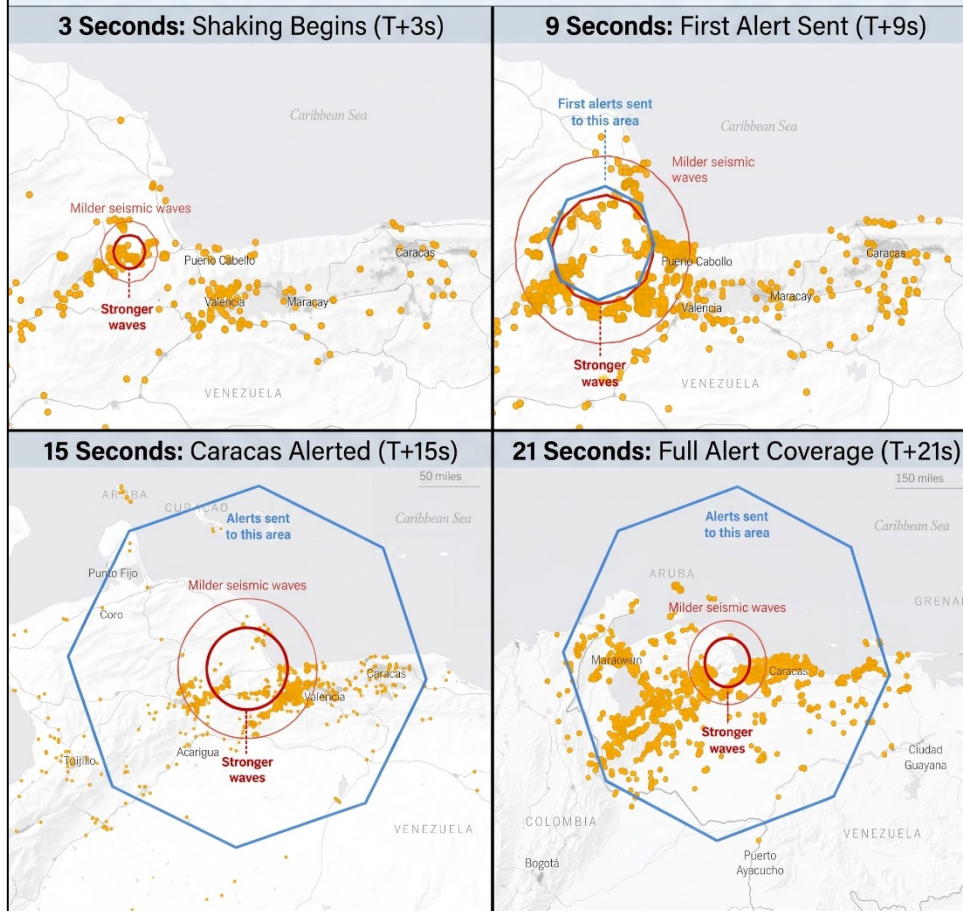
It's still too early to know how many lives were saved, but every second counts.

Be informed. Be ready. Stay safe.



EARLY WARNING AND REAPID RESPONSE SYSTEM THE ANDROID EARTHQUAKE ALERTS SYSTEM IN THE CASE OF THE VENEZUELA EARTHQUAKES

Android Earthquake Alert System: Venezuela Timeline



3 seconds – Shaking Begins

Seismic waves reached the surface and were picked up by phones.

9 seconds – First Alert

The system had crunched enough data from phones to identify an earthquake and send out the first alerts.

15 seconds – Caracas Alerted

The system continued to collect data from phones and sent alerts to a broader area that included Caracas.

21 seconds – Full Alert

Alerts eventually reached millions of phones across a large area.

Available online at:

<https://www.nytimes.com/es/interactive/2026/06/29/espanol/america-latina/venezuela-alerta-sismo-celulares-android.html>



MISINFORMATION **MISCAPTIONED / FAKE IMAGES / VIDEOS AND FRAUDS ONLINE**

The Venezuela earthquakes have become a textbook example of the four dominant forms of visual misinformation surrounding major disasters:

1. Fake rumors
2. Recycled footage from other countries,
3. Old videos falsely presented as current, and
4. AI-generated content designed to farm engagement online and spread fear.

Along with dozens of independent digital news outlets that remain blocked in Venezuela, access to the social media platform X has also been restricted since 8 August 2024. However, following the earthquakes, several internet service providers began lifting the block, restoring access to the platform for many users.

According to Cazadores de Fake News, an independent team of investigative journalists and fact-checkers dedicated to combating disinformation in Venezuela, the 24 June 2026, earthquakes triggered the largest episode of information disorder

the organization has ever documented. Most of the false or misleading content does not appear to have originated from coordinated political campaigns. Instead, it consists largely of user-generated content that spread rapidly across social media.

Several examples of disinformation and misleading content follow in the next pages. The examples were collected from various journalistic sources and social media platforms, all of which are clearly identified for each individual post.



MISINFORMATION MISCAPTIONED / FAKE IMAGES / VIDEOS AND FRAUDS ONLINE

WHAT'S BEING SHARED?

Footage of a **high-rise building collapsing** that posters claimed was a result of the Venezuela quakes.



Screenshot of a Threads post

WHAT ARE THE FACTS?

Reverse image searches traced the video to **Turkey's Ihlas News Agency**. The footage shows the **controlled demolition** of an apartment building damaged in a **2023 earthquake** that unexpectedly collapsed forward.



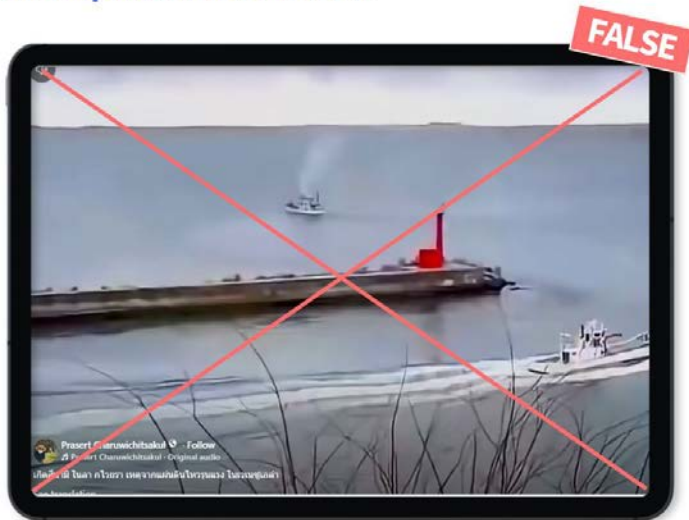
Comparisons of the false post and an article by the Ihlas News Agency



MISINFORMATION MISCAPTIONED / FAKE IMAGES / VIDEOS AND FRAUDS ONLINE

WHAT'S BEING SHARED?

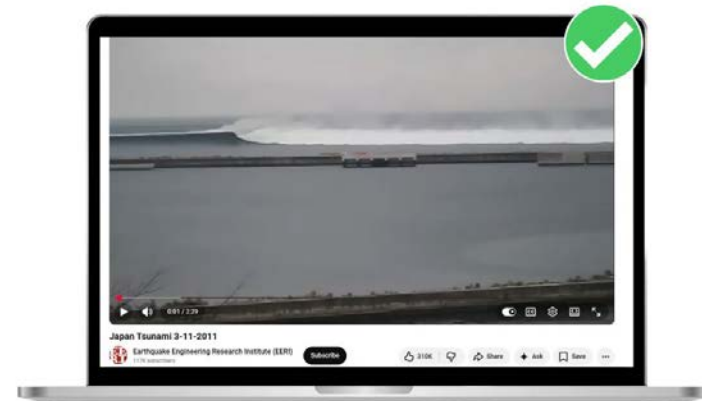
Video of a **tsunami** destroying sea vessels before hitting the coast line, purportedly following **the earthquakes in Venezuela**.



Screenshot of a post on Facebook

WHAT ARE THE FACTS?

A reverse image search found the shows the **2011 tsunami** following an **earthquake in Japan** that destroyed the **Fukushima** nuclear plant.



Screenshot of a YouTube video



MISINFORMATION

MISCAPTIONED / FAKE IMAGES / VIDEOS AND FRAUDS ONLINE

WHAT'S BEING SHARED?

A video **claiming** to show **Venezuelans taking cover** during one of the quakes.



Screenshot of a post on X

WHAT ARE THE FACTS?

This video actually shows beauty salon employees taking cover during a **2025 earthquake in Myanmar**.

The **salon posted the CCTV footage on TikTok on May 6, 2025** saying its employees were safe but the business was looking for a new location.



Screenshot of a TikTok post



MISINFORMATION

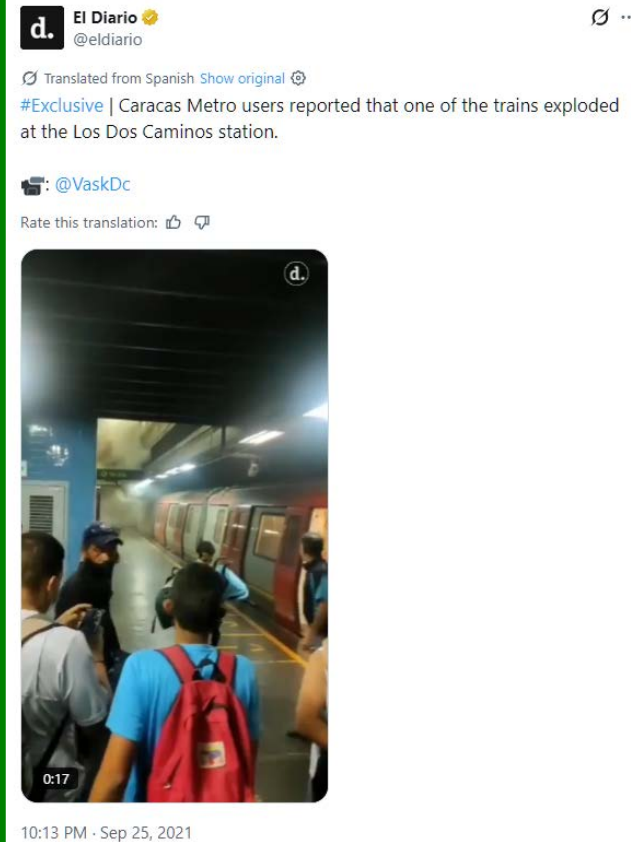
MISCAPTIONED / FAKE IMAGES / VIDEOS AND FRAUDS ONLINE

What's being shared?



Chaos in Caracas metro as powerful earthquakes hit Venezuela hard. Footage shows panic underground.

What are the facts?



Explosion in the Caracas Metro in September 2021, as the result of a severe short circuit on tracks.



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What's being shared?

 **Umar pashteen** ✓
@umerpashtoon

Translated from Urdu [Show original](#)

A few seconds of earthquake in Venezuela has caused devastation
Oh God, how terrifying will the Day of Judgment be

Rate this translation: 👍 👎



A few seconds of earthquake in Venezuela has caused devastation

AI-generated content

 **JoJo Liew**
11 February 2025 · 🌐

美国开曼群岛8.2级地震~
#地震

See translation



AI-generated video published for first time on 11 February 2025



ASSESSMENT OF DEBRIS FROM COLLAPSED BUILDINGS IN THE NORTHERN VENEZUELA

The Humanitarian Data Exchange (HDX) is the open humanitarian data-sharing platform operated by the United Nations Office for the Coordination of Humanitarian Affairs (OCHA). The platform was established to facilitate the collection, management, and dissemination of reliable humanitarian datasets that support disaster preparedness, emergency response, and post-disaster recovery. HDX provides open access to data for humanitarian organizations, government agencies, researchers, and civil protection authorities involved in disaster risk management and emergency response.

The platform hosts a geospatial dataset developed following the earthquakes that struck Venezuela on 24 June 2026. The dataset provides estimates of the volume and spatial distribution of building debris generated by collapsed and severely damaged buildings. These estimates support debris management planning, restoration of access to affected areas, search and rescue operations, and post-earthquake recovery and reconstruction activities. The debris assessment was produced through the integration of satellite imagery, artificial intelligence-based building damage detection,

building footprint and height information, and engineering-based analyses using the RAPIDA (Rapid Post-Disaster Damage Assessment) methodology developed by the United Nations Development Programme (UNDP).

According to the preliminary assessment, approximately 1.2 million tonnes of building debris were generated in La Guaira State, the area most severely affected by the earthquake sequence. The estimates are considered preliminary and will be updated as additional satellite imagery and field-based damage assessments become available. The dataset is distributed in standard Geographic Information System (GIS) formats compatible with software such as QGIS and ArcGIS and is intended to support humanitarian agencies, emergency management authorities, governmental institutions, and researchers involved in post-earthquake damage assessment, debris management, and recovery planning.

HDX

UN
environment
programme



**JOINT
ENVIRONMENT
UNIT**

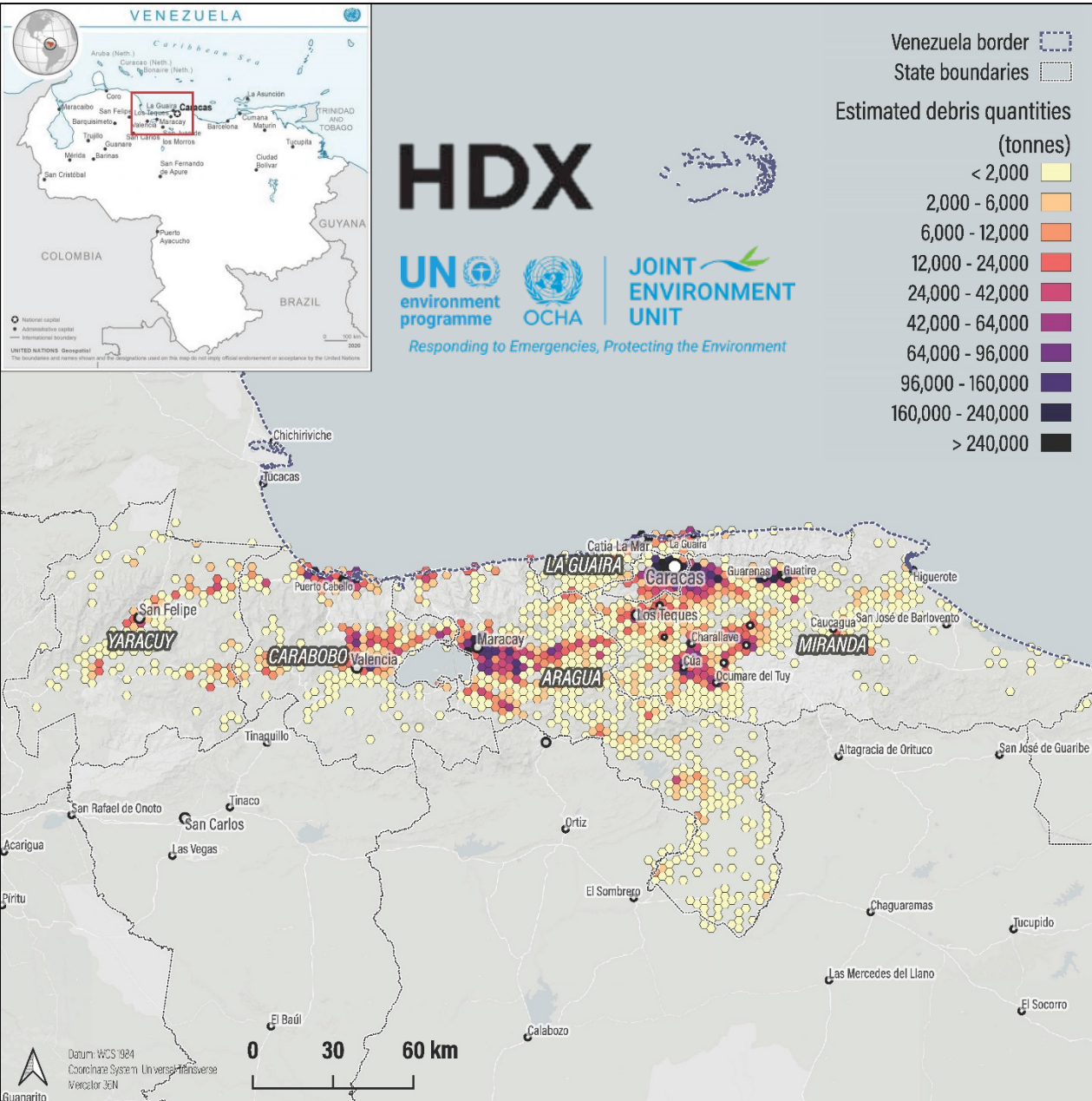
Responding to Emergencies, Protecting the Environment



SPATIAL DISTRIBUTION AND VOLUME OF EARTHQUAKE DEBRIS

Based on the data provided by the Humanitarian Data Exchange (HDX) platform, 96,046 buildings have been damaged or destroyed, corresponding to nearly 3% of all buildings in the assessed states.

State Debris	
Miranda	5,301,589 t
Aragua	3,626,829 t
Caracas (DC)	3,470,517 t
Carabobo	2,604,595 t
La Guaira	1,616,938 t
Yaracuy	398,824 t
Total	17,038,700 t

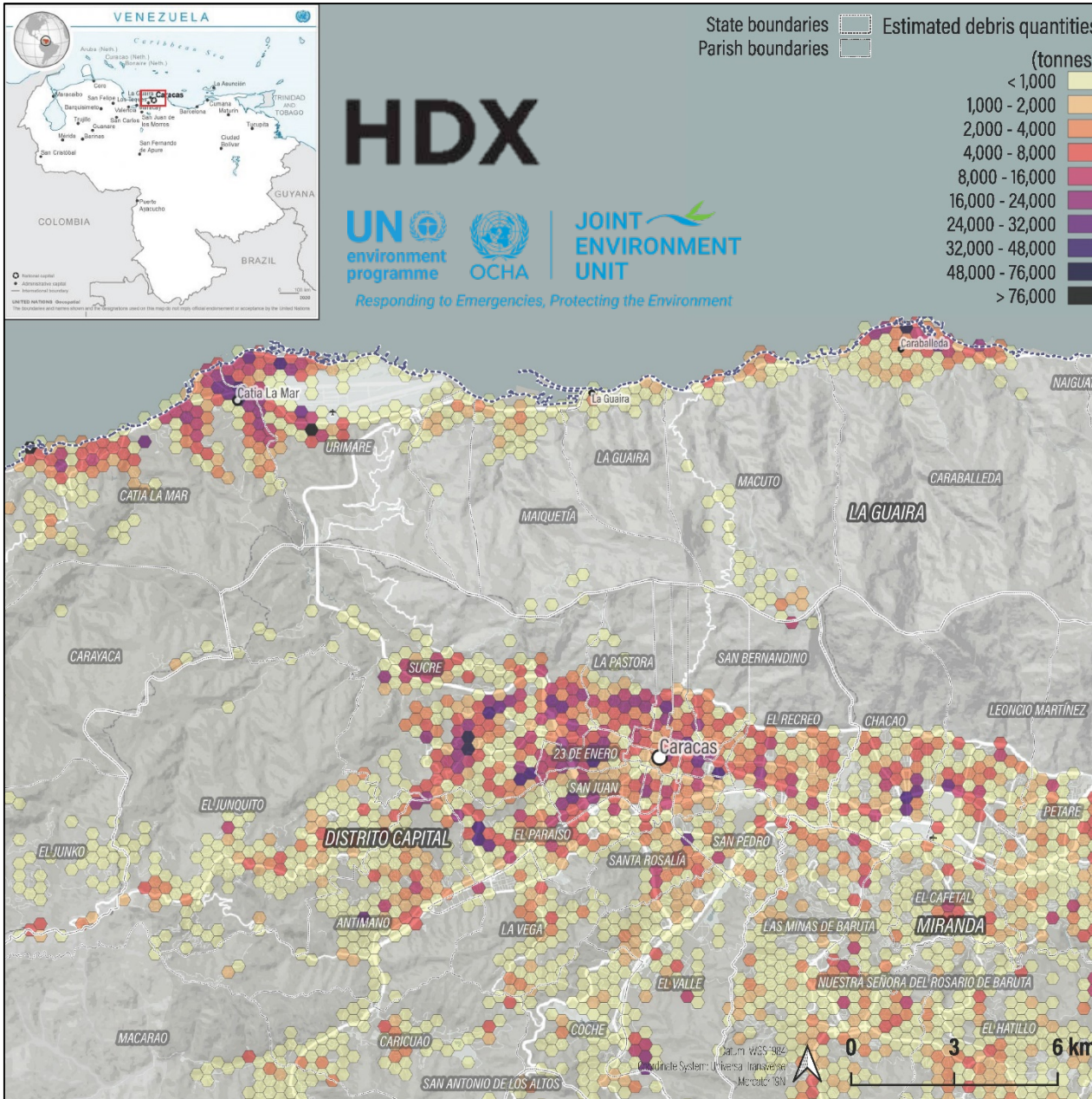




SPATIAL DISTRIBUTION AND VOLUME OF EARTHQUAKE DEBRIS

Based on the data provided by the Humanitarian Data Exchange (HDX) platform, 32,800 buildings have been damaged or destroyed in the parished surrounding Caracas and La Guaira.

Parish Debris	
Sucre	1,057,053 t
Catia la Mar	713,310 t
Urimare	467,930 t
N. Sra. R. de Baruta	307,507 t
El Paraiso	302,807 t
Petare	297,630 t





HEALTH AND ENVIRONMENTAL HAZARDS FOR MANAGING EARTHQUAKE DEBRIS AND RELATED IMPACTS

HAZARD SOURCE IN DEBRIS	POTENTIAL HAZARDS (HEALTH & ENVIRONMENT)	EXPOSURE PATHWAYS	HEALTH IMPACTS
Dust and Particulate Matter 	• Respirable silica • Cement dust • Fine particulate matter (PM_{2.5}, PM₁₀) • Asbestos fibers (where present)	 • Inhalation of dust • Deposition on skin and eyes • Ingestion (hand-to-mouth)	 • Irritation of eyes, nose, throat • Asthma and bronchitis • Silicosis • Asbestosis, mesothelioma, lung cancer • Cardiovascular effects
Chemical Contaminants 	• Heavy metals (lead, chromium, etc.) • Oils, fuels, solvents • Paints, pesticides • Treated wood preservatives • Industrial chemicals	 • Ingestion • Inhalation of vapors • Dermal contact • Leaching to water and soil	 • Acute poisoning • Neurological damage • Kidney and liver damage • Endocrine disruption • Cancers
Biological and Infectious Agents 	• Pathogenic bacteria and viruses (from sewage, waste) • Decomposing organic matter • Rodents, insects, vectors	 • Contact with contaminated materials • Inhalation of bioaerosols • Bites and stings • Ingestion of contaminated food/water	 • Diarrheal diseases • Skin and wound infections • Tetanus • Leptospirosis • Vector-borne diseases (e.g., dengue, leptospirosis)
Physical and Safety Hazards 	• Sharp objects, metal, glass • Unstable structures • Heavy machinery risks • Noise and vibration	 • Physical injury • Crush injuries • Falls • Noise exposure	 • Cuts, lacerations, fractures • Amputations • Hearing loss • Stress and mental health effects
Solid Waste and Mixed Debris 	• Mixed municipal waste • Plastics, insulation, foam • Hazardous household waste (batteries, electronics, etc.)	 • Ingestion • Inhalation (burning) • Leaching • Attraction of pests	 • Toxic exposures • Respiratory irritation • Endocrine and reproductive effects • Mental stress



HEALTH AND ENVIRONMENTAL HAZARDS FOR MANAGING EARTHQUAKE DEBRIS AND RELATED IMPACTS

HAZARD SOURCE IN DEBRIS	ENVIRONMENTAL IMPACTS	IMPACTS ON COMMUNITIES AND RECOVERY
Dust and Particulate Matter 	 • Air pollution • Dust deposition on soil and vegetation • Reduced air quality	 • Increased morbidity and healthcare costs • Reduced quality of life • Slower recovery of communities • Disruption of daily activities
Chemical Contaminants 	 • Soil contamination • Groundwater and surface water pollution • Bioaccumulation in ecosystems	 • Long-term contamination of resources • Fisheries and agriculture losses • High remediation costs • Increased social and economic burden
Biological and Infectious Agents 	 • Contamination of water bodies • Proliferation of pests • Degradation of urban and natural habitats	 • Disease outbreaks • Overburdened health systems • Mortality and morbidity increase • Social disruption and public fear
Physical and Safety Hazards 	 • Soil compaction • Erosion and landscape alteration • Damage to vegetation	 • Injuries and loss of productivity • Increased rehabilitation needs • Delays in debris clearance • Economic losses
Solid Waste and Mixed Debris 	 • Air pollution (toxic fumes, dioxins) • Soil and water contamination • Greenhouse gas emissions	 • Degraded living conditions • Reduced property values • Long-term environmental liabilities • Slower and costlier reconstruction

More details in
Mavroutis et al. (2023),
in Applied Sciences
and
Mavroutis et al. (2023),
in Environments



MEASURES TO ADDRESS DEBRIS MANAGEMENT RISKS ON PUBLIC HEALTH AND NATURAL ENVIRONMENT

1. PLANNING AND PREPAREDNESS



- Develop pre-disaster debris management plans
- Identify and secure temporary storage and final disposal sites
- Conduct risk assessments
- Train personnel and raise public awareness
- Establish multi-agency coordination mechanisms

2. SAFE OPERATIONS AND WORKER PROTECTION



- Use appropriate PPE
- Provide worker training
- Implement dust suppression (water spraying, covers)
- Ensure safe use of machinery
- Enforce occupational health surveillance and vaccination (e.g., tetanus)

3. DEBRIS CHARACTERIZATION AND SEGREGATION



- Rapid assessment of debris types
- Separate hazardous materials (asbestos, chemicals, batteries)
- Segregate recyclables (metal, concrete, wood, etc.)
- Prevent mixing of hazardous and non-hazardous waste

4. TRANSPORT AND TEMPORARY STORAGE



- Use covered trucks to minimize dust
- Follow designated routes
- Store debris in lined and well-managed sites
- Control runoff and leachate
- Secure sites to prevent scavenging and fires

5. TREATMENT, RECYCLING AND DISPOSAL



- Recycle concrete, steel, wood and other materials
- Use recycled aggregates for road base and construction
- Dispose of non-recyclables in engineered landfills
- Treat hazardous waste according to regulations

6. ENVIRONMENTAL MONITORING AND HEALTH SURVEILLANCE



- Monitor air quality (PM, hazardous gases)
- Monitor surface water, groundwater and soil quality
- Monitor noise and vibration
- Conduct health surveillance of workers and nearby communities
- Report data and adapt measures

7. COMMUNITY ENGAGEMENT AND COMMUNICATION



- Inform communities about risks and protective measures
- Engage stakeholders in decision making
- Provide accessible channels for complaints and feedback
- Promote transparent reporting

More details in
Mavroulis et al. (2023),
in Applied Sciences
and
Mavroulis et al. (2023),
in Environments



CONCLUSIONS

On 24 June 2026, at 22:04:32.7 UTC (18:04:32.7 local time), an $M_w=7.2$ earthquake occurred in northern Venezuela, with an epicenter located 33 km northeast of San Felipe. Approximately 39 seconds later, at 18:05:11.5 local Venezuelan time, a second $M_w=7.5$ earthquake occurred in the same area, with an epicenter located approximately 6 km east of that of the first event. According to the available focal parameter solutions, both earthquakes occurred at shallow depths (10-20 km). Due to their close temporal and spatial proximity, the first earthquake, owing to its lower magnitude, is classified as a foreshock of the second event.

The occurrence of two major earthquakes in such a short time introduces significant new considerations, both from a seismological perspective and their impacts on the natural and, particularly, the built environment.

The earthquakes occurred near major tectonic plate boundaries. Specifically, along the northern coast of Venezuela, an E-W-trending continental transform boundary separates the South American Plate to the south from the Caribbean Plate to the north. Further

west, this tectonic structure changes orientation toward the southwest, forming the boundary between the South American Plate and the North Andes microplate in northwestern Venezuela. The epicenters of the two major earthquakes of 24 June 2026 are located at the eastern termination of this second plate boundary segment, while slightly farther east lies the triple junction between this boundary and the divergent plate boundary, located to the north between the Caribbean Plate and the North Andes microplate, which trends northwestward.

The activated fault zone is characterized by right-lateral strike-slip motion. It trends generally E-W, extends along the northern Venezuelan coastline, and controls the linear morphological development of the coast.



CONCLUSIONS

Regarding the impacts of the two earthquakes on the built environment, extensive and severe structural damage was observed in high-rise buildings, including partial and total collapses, particularly within the coastal zone of La Guaira State in northern Venezuela. This area is located approximately 200 km from the epicentral region, where significantly more limited damage was observed compared with the coastal zone. It is noteworthy that, even within the epicentral area, older buildings that were not designed according to modern seismic codes sustained no significant structural damage and remained essentially unaffected by the ground shaking.

The severity and spatial distribution of the observed damage were controlled by the combined effect of several factors, including the geomorphological setting of the coastal zone (particularly the morphology of alluvial fan systems), the geological characteristics of the near-surface formations (including the origin, lithology, age, and degree of saturation of recent deposits), the occurrence of two major earthquakes within a very short time interval, the resulting amplification of ground motion, and the

vulnerability characteristics of the affected structures. The interaction of these factors contributed to the destruction of thousands of buildings within the coastal zone.

The geological structure of the most severely affected area is characterized by recent debris-flow deposits originating from catastrophic events that occurred in Vargas Province (present-day La Guaira State) in December 1999, as well as from similar, smaller-scale events in the past. These deposits have created highly variable and, in many cases, unfavorable foundation conditions for buildings in the coastal area. This was clearly demonstrated by the spatial distribution of structural damage and building collapses observed after the earthquakes

The dominant failure mechanisms included uprooting and pancake-type collapse mechanisms, which affected a large number of high-rise buildings. These collapse patterns resulted in different survival probabilities for trapped occupants and required different approaches for urban search and rescue (USAR) operations during the post-earthquake response phase.



CONCLUSIONS

Collapses displaying a systematic spatial pattern occurred in buildings constructed close to or on the crests of slopes developed along the transition zone between alluvial fans and the flat coastal plain. In this coastal plain, the combined influence of deposit lithology, groundwater saturation due to proximity to water bodies (including stream channels and the sea), and intense earthquake-induced ground shaking contributed to the initiation of near-surface liquefaction phenomena and the development of damage patterns characteristic of such processes.

Comparable examples have been documented in recent earthquakes (early 2023 Turkey seismic events), where extensive liquefaction phenomena within urban areas affected buildings located near water bodies, including lakes, coastal zones, and major river systems. It is noteworthy that, in many cases, these phenomena did not produce the typical surface geomorphic expressions commonly associated with liquefaction. Instead, they generated near-surface instability conditions that resulted in severe impacts on elements of the built environment, including buildings and infrastructure.

The analysis of the historical occurrence of secondary earthquake environmental effects (including landslides and liquefaction) in northern Venezuela, particularly in the area affected by the 24 June 2026 earthquakes, indicates that the most severely impacted coastal zone has a well-documented history of liquefaction occurrences associated with both historical and recent earthquakes. Consequently, the area exhibits high liquefaction susceptibility.

Similarly, the analysis of the historical occurrence of debris flows and mudflows triggered by extreme hydrometeorological events in northern Venezuela indicates that the most affected coastal zone has experienced repeated debris-flow activity. The deposition of young, poorly consolidated alluvial and debris-flow materials has not only modified the geomorphological characteristics of extensive parts of the coastal plain, but has also define the vulnerability of the built environment by creating highly heterogeneous and potentially unfavorable foundation conditions.



CONCLUSIONS

The environmental impacts associated with the earthquakes were classified into primary and secondary effects. Primary effects included ground deformation, which reached approximately 60 cm of horizontal displacement in the La Guaira area, as documented through satellite-based observations.

Secondary effects included liquefaction phenomena, landslides, and the development of geomorphological features associated with mud volcano processes. Liquefaction occurred mainly in coastal areas adjacent to the shoreline. Landslides were observed along coastal slopes developed at the transition zone between debris-flow and recent marine deposits. In addition, geomorphological features associated with mud volcano activity developed along the southwestern offshore continuation of the activated fault zone within the region of Trinidad and Tobago.

The first two categories of secondary environmental effects contributed directly to damage within the built environment. The third category developed in coastal areas without significant buildings or infrastructure. However, this does not imply a negligible hazard potential, as demonstrated by

previous events in the region, such as the 1997 Piparo mud volcano eruption.

The assessment of the geological, geomorphological, and environmental conditions of the affected areas highlights the strong interaction between tectonic setting, near-surface geological conditions, earthquake sequence characteristics, and anthropogenic factors in controlling the spatial distribution and severity of impacts. The combination of a shallow earthquake sequence, complex coastal geomorphology, unconsolidated and saturated deposits, and vulnerable construction conditions resulted in significant consequences for both the natural and built environments.

The observed damage patterns and environmental effects emphasize the importance of integrating geological and geotechnical investigations, remote sensing observations, seismological data, and civil protection considerations in post-earthquake emergency response and long-term disaster risk reduction strategies.



CONCLUSIONS

According to the Humanitarian Data Exchange (HDX), the earthquakes destroyed or damaged tens of thousands of buildings, generating an estimated total of 17,038,700 tonnes of debris. The management of this enormous volume of disaster waste presents significant environmental and public health risks, including exposure to asbestos and silica dust, chemical contamination of soils, and physical injuries. Therefore, the implementation of appropriate UNDP protocols for the segregation, recycling, and safe disposal of construction and demolition waste is essential.

The public health system is under unprecedented pressure due to the sharp increase in the number of injured people, shortages of personnel and medical supplies, and damage to at least eight hospitals. Geospatial analysis based on the PAHO Damage Hospitals Dashboard indicated that most healthcare facilities in La Guaira were exposed to high seismic intensities and became partially or fully non-operational, resulting in the large-scale transfer of patients to Caracas.

The emergence of infectious diseases, including waterborne, vector-borne, and respiratory infections,

is facilitated by the combined effects of overcrowding in temporary shelters, inadequate sanitation conditions, disruption of vaccination programs, and damage to healthcare infrastructure. Conversely, scientific evidence from the WHO refutes the misconception that the bodies of trauma victims constitute a source of infection for the general population. The main health risks are primarily associated with occupational exposure and the need for appropriate personal protective equipment (PPE) among recovery and body-retrieval personnel.

The psychological distress experienced by survivors, including anxiety, depression, and post-traumatic stress disorder (PTSD), is profound and potentially long-lasting. These impacts are exacerbated by the loss of family members, displacement, and persistent fear of aftershocks. The provision of Mental Health and Psychosocial Support (MHPSS) by PAHO constitutes an immediate priority. However, response capacity is constrained by structural damage to related facilities in La Guaira and by the chronic shortage of mental health professionals, partly associated with workforce migration.



CONCLUSIONS

Regarding response, the Government of Venezuela activated the National Emergency System and submitted a request for international assistance. 51 USAR teams from 28 countries were deployed, comprising more than 2,200 rescuers and 165 search dogs. These teams successfully rescued survivors trapped beneath collapsed structures, including individuals recovered alive up to eight days after the disaster.

The Google Earthquake Alerts system functioned as a critical life-safety tool by transforming millions of mobile devices into distributed seismic sensors through their built-in accelerometers. The system rapidly detected P-wave arrivals and issued alerts to 11.4 million users in Venezuela, including 1.4 million users who received the “Take Action” alert, between 5 and 21 seconds before the arrival of destructive S-waves, providing valuable time for protective actions.

These earthquakes triggered the largest wave of “information disruption” ever recorded in the country. Four major categories of visual misinformation were identified, primarily aimed at generating user engagement and amplifying public fear and panic.

