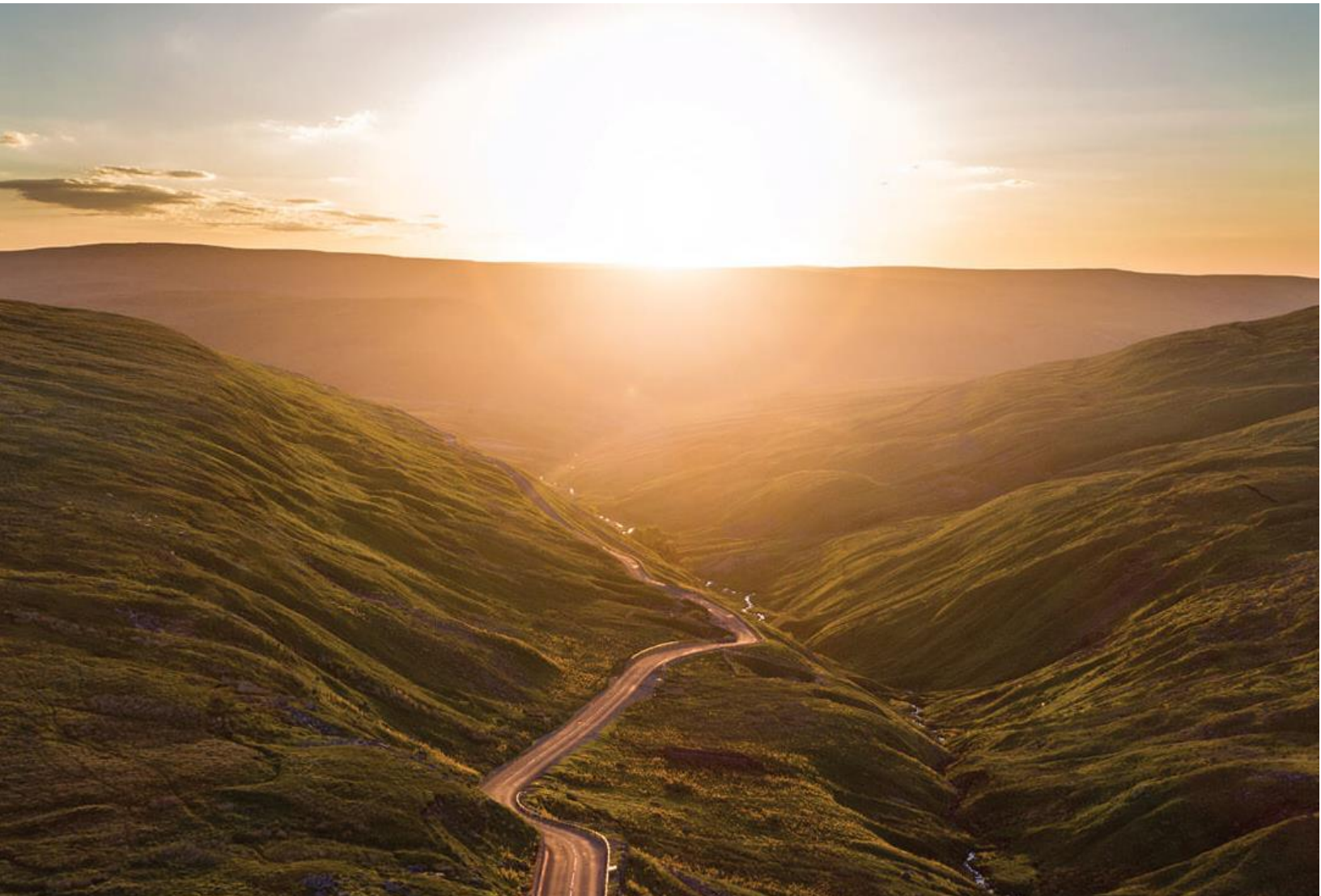
Weekly Cat Report

September 15, 2023



Executive Summary

Event	Affected Region(s)	Fatalities	Economic Loss ($)	Page
Earthquake	Morocco	2,946+	Billions	3
Flooding (Update)	Mediterranean	Thousands	Unknown	6
Tropical Storm Yun-yeung	Japan	3	10s of millions	11
SCS & Flooding	United States	0	Millions	12
Flooding	Thailand	2	Unknown	12
Flooding (Update)	Brazil	47	100s of millions	12
SCS & Flooding	India	45	Unknown	12
Flooding & Landslide	Georgia	3	Unknown	12
SCS & Flooding	Vietnam	9	Unknown	12
SCS & Flooding	Western & Central Europe	0	10s of millions	13

Please note that any financial loss estimate is preliminary and subject to change. These estimates are provided as an initial view of the potential financial impact from a recently completed or ongoing event based on early available assessments. Significant adjustments may inevitably occur. All losses in US dollars ($) unless noted otherwise.

Along with this report, we continue to welcome users to access current and historical natural catastrophe data and event analysis on Impact Forecasting's Catastrophe Insight website: http://catastropheinsight.aon.com

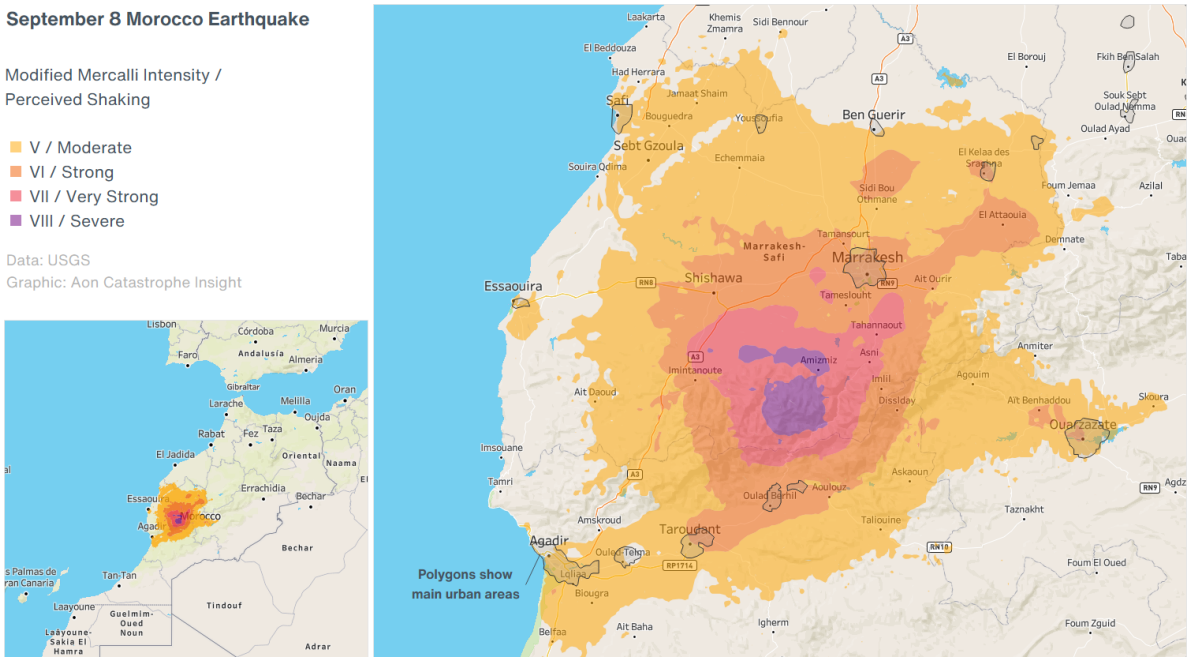
Morocco: Earthquake

Overview

A powerful, magnitude-6.8 earthquake occurred in the Moroccan High Atlas Mountain range near Oukaïmedene on September 8. Earthquakes of this size are rare but not unexpected in the region. As of September 14, the earthquake claimed nearly 3,000 fatalities, injured more than 5,600 people, and caused significant material damage across the affected area. The event is likely to be notable for the local insurance industry, affecting public and private insurance schemes in the country.

Seismological Recap

A shallow, magnitude-6.8 earthquake struck the High Atlas Mountains near Oukaïmedene, Morocco on September 8 around 11:11 pm local time, in a depth of approximately 18 km (11.2 miles).



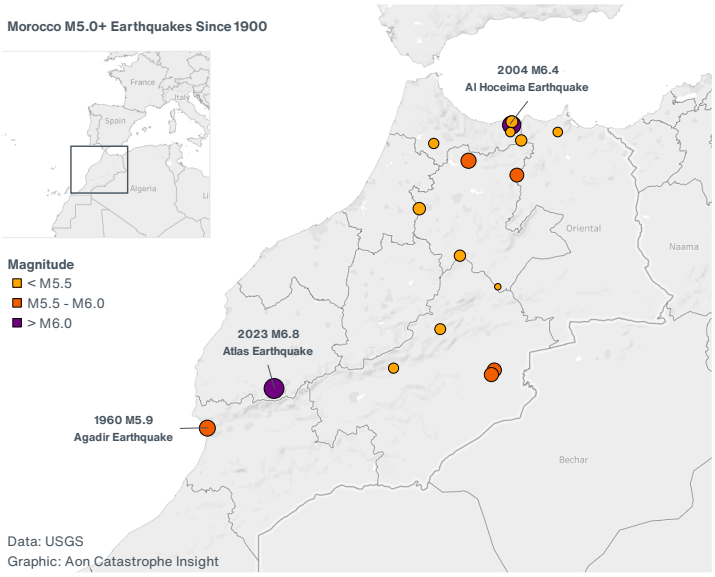
The Mediterranean region is seismically active due to the northward convergence of the African and Eurasian plates, with hotspots far east of the recent event in Morocco due to the higher rates of convergence. Although seismicity rates are comparatively low along the northern margin of the African continent, large destructive earthquakes have been recorded and reported from Morocco in the western Mediterranean, to the Dead Sea in the eastern Mediterranean. The latest earthquake was the result of oblique reverse faulting on a roughly east-west or northwest-southeast oriented fault, possibly the North Atlas fault, a range front reverse fault that roughly matches the faulting mechanism of the earthquake.

More earthquakes than usual will likely continue to occur in the region surrounding Oukaïmedene. These aftershocks will decrease in frequency in the days, weeks, and months, after the main seismic event. The largest aftershock so far has been a magnitude 4.9, but magnitude 5 and larger aftershocks are also possible over the next week, month, and beyond.

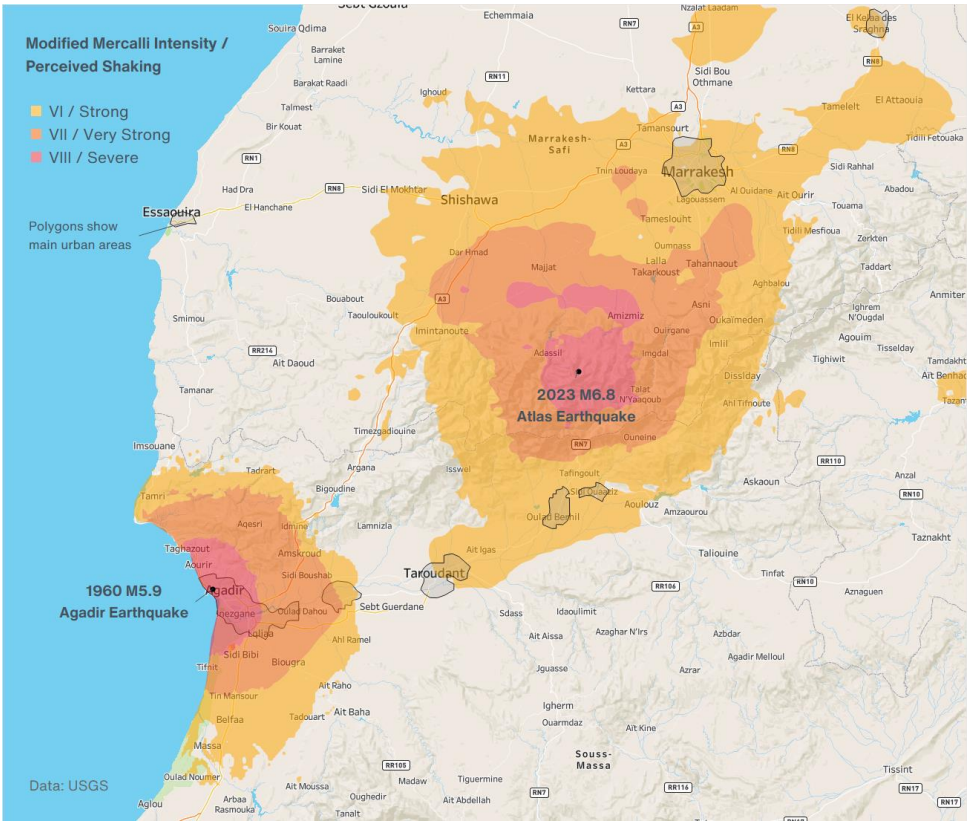
Historical Context

Earthquakes of this size are rare but not unexpected in Morocco as much of the Mediterranean region is seismically active. One of the most impactful earthquakes with a magnitude of 5.9 occurred in 1960 near Agadir, killing more than 13,000 people in the region (estimates vary). More than 630 people died after a strong earthquake near Al Hoceima in 2004.

According to the USGS's records since 1900, there have been no earthquakes of M6.0+ within 500 km (310 miles) of the recent event. There have been only two M6.0+ events and 17 tremors of M5.0+ since 1900 in Morocco.



Intensity footprints from the USGS allow for a comparison with the historic **1960 Agadir Earthquake**. While the 2023 event is larger in magnitude, the main impact occurred in mostly rural areas of the Atlas Mountains. It is also noteworthy that in 1960, the population of Agadir was around 40,000 (over 13,000 were killed). Today's population of the city is 12x larger (~490K).



Event Details

Most of the impacts related to the event were recorded in the **Al Haouz Province** of the Marrakech-Safi Region and the **Taroudant Province** of the Souss-Massa Region. Vast majority of fatalities and material damage occurred here, although additional impacts were observed in other regions. While the epicentre of the earthquake was located in a relatively sparsely populated area, the extensive footprint of the event encompassed important population centers.

Strong shaking propagated to **Marrakech** and many other cities and villages in the proximity of the High Atlas Mountains, caused devastating loss of life and injuries across the region. Given the earthquake's shallow depth, its proximity to high population centers, and the many residences vulnerable to shaking, numerous buildings and structures collapsed over a widespread area. This included the city of Marrakech, one of Morocco's largest cities.

Source: MENA IFRC

According to the information from the Morocco Ministry of the Interior as of September 14, the death toll stood at **2,946**, along with more than **5,600 injured**. Most fatalities occurred in the **Al Haouz district** within the High Atlas Mountains. The number of casualties is expected to further rise as operations continue.

Based on initial damage assessments, thousands of buildings were destroyed across the impacted area. The Copernicus Emergency Management Service was activated in rapid mapping mode on 9 September, providing a damage assessment in 8 areas of interest. In total, this service monitored more than 1,660 destroyed, damaged, or possibly damaged structures - 757 in Talat Nyaaqoub, 273 in Tamarirt, 192 in Amizmiz, 132 in Imzilene, 98 in Asni, 93 in Tahnaout, 82 in Aourir, and 36 in Assakoui-Ighil.

Large aftershocks could cause additional damage, especially in weakened or poorly constructed structures. However, no significant aftershocks were recorded in the region, unlike to the situation after the main February 6 shock in Turkey and Syria, which was followed by a prolonged sequence of strong aftershocks.

Financial Loss

Based on the PAGER methodology, the USGS initially estimated potentially high casualties and extensive damage caused by an earthquake, placing a 67 percent likelihood of total economic losses in the billions (USD). Estimated economic losses can potentially constitute up to 8% of Morocco's GDP.

The event is significant for the country's insurance system. Media reports suggested that the government is likely to get payout from the public parametric scheme facilitated by FSEC, which provides coverage to uninsured population. Similarly, the EV CAT natural catastrophe pool was potentially to be affected.

Mediterranean: Flooding (Update)

Overview

Following the impact in Southeastern Europe and particularly severe flooding in central Greece, storm Daniel caused catastrophic damage and likely killed thousands of people in northeastern parts of Libya on September 9-11. Most of the damage was incurred in the city of Derna, as intense rainfall swelled local wadis and also caused several dam breaks. Crumbling infrastructure and lack of effective warning systems greatly contributed to the catastrophic nature of the event. Entire neighborhoods were swept away by floodwaters.

Meteorological Recap

Greece

Storm Daniel brought unprecedented record-breaking rainfall in **Greece** between September 4 and 8 (See previous Weekly Cat Report). The table below shows stations in the Thessaly Region, that registered the highest daily and event rainfall totals, according to the data validated by the Greek Meteorological Institute.

Location	Sep 4	Sep 5	Sep 6	Sep 7	Sep 8	Total (mm)
Zagora	**134.6**	**759.6**	**3.8**	**197.6**	**0.6**	**1096.2 (43.2 in)**
Portaria	108.2	761.9	14.4*	0*	0*	884.5 (34.8 in)
Pezoula	43.2	250.0	378.4	90.8	0	762.4 (30.0 in)
Karditsa	42.4	185.2	404.4	26.8	0	658.8 (25.9 in)
Pertouli	0.6*	58.6*	415.2	165.8	2.4	642.6 (25.3 in)
Volos	35.2	450.8	121.0*	10.4	0	617.4 (24.3 in)

** Data might be missing due to the station disruption*

Libya

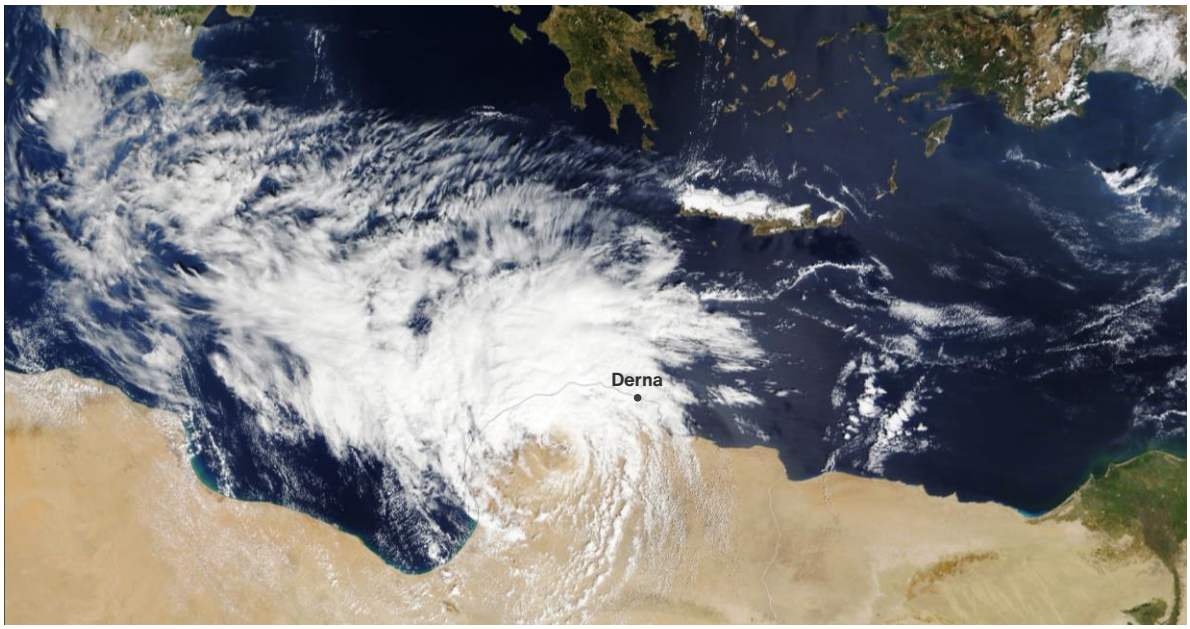
After bringing intense flooding to Greece, Bulgaria, and Turkey, Storm Daniel then moved south over the Mediterranean Sea and began acquiring tropical storm-like characteristics and was referred to as *Medicane Daniel*. Intense winds up to 80 kph (50 mph) and heavy rains then began affecting **Libya** on September 9-11. This normally very arid region saw extreme amounts of rainfall.

According to the National Center of Meteorology in Libya, in a 24-hour period to 10 September, staggering rainfall totals were recorded:

- 414.1 mm / 16.3 in Bayda
- 240 mm / 9.4 in Marawah in the District of Jabal al Akhdar
- 170 mm / 6.7 in Al Abraq in the Derna District

According to figures from the World Meteorological Organization (WMO), the city of Derna recorded 73 mm / 2.9 of rain in 24 hours to 11 September.

Satellite-based rainfall estimate for September 9-11
Data: NASA, GPM



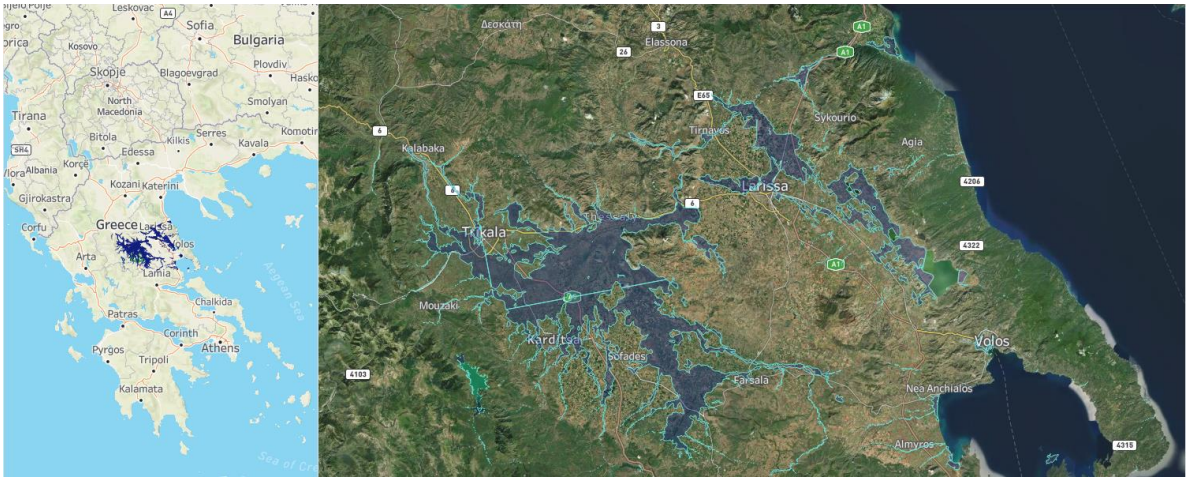
Storm Daniel affecting northeastern Libya
Source: NASA

Event Details

Greece

Since the last update, 11 additional deaths were reported in the Thessaly region due to flooding, raising the total death toll in the country to 15. According to the updated footprint of recent floods provided by

the Copernicus Rapid Mapping system, an area of nearly 86,000 hectares (212,500 acres) was inundated (see the map below).

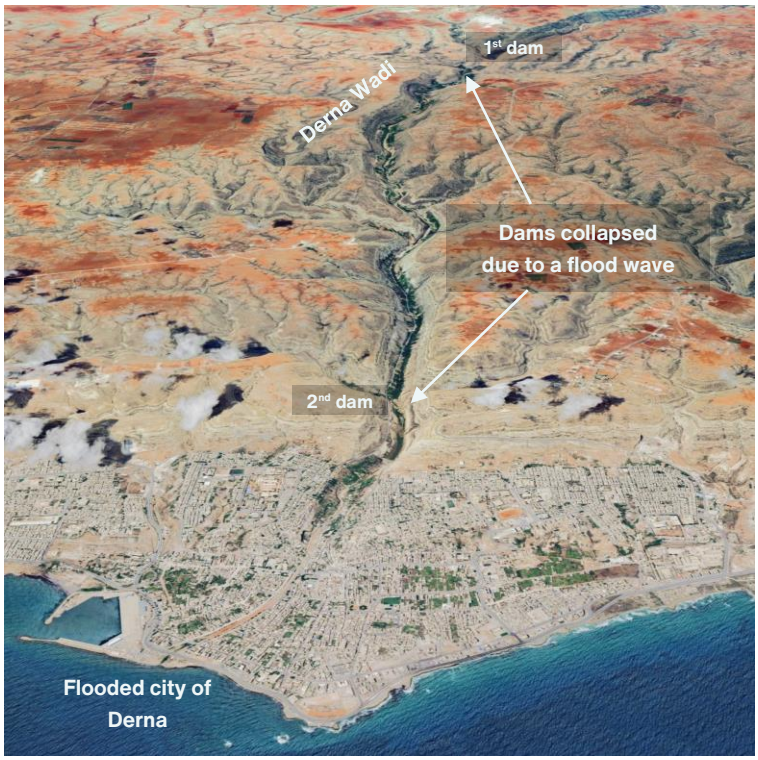


Updated estimation of the flooding footprint by the Rapid Mapping System
Source: Copernicus

Libya

Heavy rainfall affected populated areas of the northeastern coast of Libya. Due to a combination of unfortunate factors, the city of **Derna** experienced catastrophic flash flooding, which resulted in about 25% of the city reportedly destroyed. Derna is estimated to have around 100,000 residents.

The disaster in Derna was caused by heavy rainfall, which also resulted in the collapse of two dams in the Derna Wadi. This resulted in a flood wave that inundated a large portion of the city. Based on the UN Satellite Centre (UNOSAT) assessment, approximately 2,200 buildings appear to be exposed to floodwater within the city of Derna, including more than 700 damaged buildings and several destroyed bridges.



Overview of the situation in Derna
Source: NASA Worldview, Google Earth

Areas of Albayda, and Al Mkheley were also severely impacted. More than 30,000 people have been displaced.

The total death toll related to this unprecedented event remains unclear. It is possible that it will run into the lower tens of thousands. According to the latest figures circulating in the media as of September 14, at least 11,300 are now believed to have died, while thousands or even tens of thousands of others are still missing. The Libyan Red Crescent Society denied the reports attributing the 11,300+ death toll to their statements. In their last update, the spokesman of the Red Crescent Tawfiq Al-Shukri confirmed more than 2,000 fatalities in his latest statement. UN OCHA estimated that the current toll stands at 5,000–6,000. Figures are expected to change and will be verified in the upcoming days and weeks.

Flood damage in Derna
Source: Libyan IFRC

Historical Context

Even though the death toll is still uncertain and needs to be verified, this flooding will likely become one of the deadliest events on record on the African continent (excluding droughts and famines). **Death tolls from Storm Daniel and the Morocco Earthquake are preliminary and subject to change.**

Event Name	Date	Location	Fatalities
Agadir Earthquake	Feb 29, 1960	Morocco	13,100
Storm Daniel	**Sep 9-12, 2023**	**Libya**	**11,300(?)**
El Asnam Earthquake	October 10, 1980	Algeria	5,000
High Atlas Earthquake	**Sep 8, 2023**	**Morocco**	**2,946+**
Somalia Floods	Oct 19-Nov 17, 1997	Somalia	2,311
Bourmerdes Earthquake	May 21, 2003	Algeria	2,266
Mostaganem Floods	Nov 26-27, 1927	Algeria	2,000
Mt. Oku Volcanic Field Activity	Aug 21, 1986	Cameroon	1,734
Chlef Earthquake	Sep 9, 1954	Algeria	1,500
Cyclone Freddy	**Feb 20-Mar 15, 2023**	**Southern Africa**	**1,434**

Financial Loss

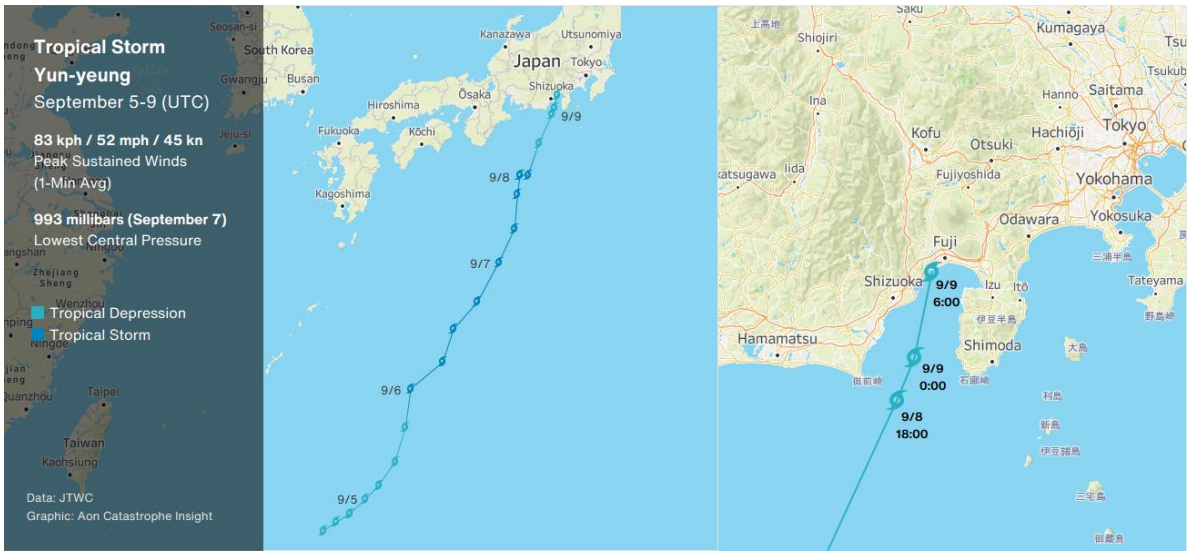
As damage assessments in all affected countries are still ongoing, it is too early to determine the estimated economic impact caused by Storm Daniel. Regarding the extensive damage caused over a large area, assessments suggest a significant impact on property, infrastructure, and agriculture, that will likely run into the billions of USD. Insured losses will be notably lower due to relatively low insurance penetration, particularly in Libya.

Japan: Tropical Storm Yun-yeung

Overview

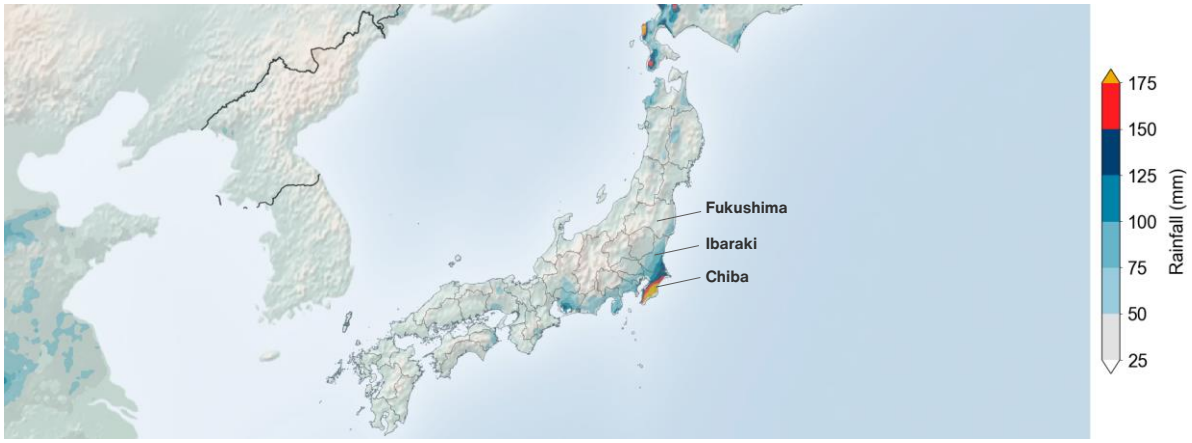
Despite never reaching typhoon strength, the remnants of tropical storm Yun-yeung brought intense rainfall to eastern Honshu Island in Japan on September 8-9. Significant flooding and landslides mainly affected the Fukushima, Chiba, and Ibaraki Prefectures. Three people were killed, and more than 3,200 buildings were flooded. Total economic and insured losses could reach the tens of millions USD.

Meteorological Recap



Yun-yeung started in the Philippine Sea as a tropical depression late on September 5. A subtropical ridge east of the storm helped steer it toward central and eastern Honshu Island in Japan over the next 4 days. As Yun-yeung progressed toward the northeastward, strong vertical wind shear prevented it from ever reaching typhoon strength. The system eventually lost all tropical characteristics by September 9 as it approached Mount Fuji.

Despite this, Yun-yeung still brought historic rainfall on September 8-9 to the Fukushima, Chiba, and Ibaraki Prefectures. Even as the center of the system was offshore, a linear band of strong convection brought multiple rounds of intense, rapid precipitation over several areas. Notably, in just 6 hours on September 8, the cities of Kamogawa and Morbara recorded 246 mm (9.7 inches) and 219.5 mm (8.6 inches), respectively. Both locations saw more rainfall in 6 hours than they typically receive on average for the entire month of September. More historic rainfall was observed in cities such as Kimitsu, Katsuura, Ichihara, and Otaki.



Heaviest rainfall was limited to southeastern part of Honshu – as shown on a satellite rainfall estimate
Data: NASA, GPM

Event Details

While Yun-yeung did not generate any notable wind impacts, the extreme rainfall triggered widespread flooding and power outages over much of eastern Honshu Island. Within the Chiba and Ibaraki Prefectures, 3 people were killed while another 22 were injured. Over 200 landslides were reported, including several reports in the town of Otaki. Eight rivers in the Chiba Prefecture overflowed their banks, and nearly 400 people in Mobara had to move to evacuation centers.

According to Japan's Fire and Disaster Management Agency, the rainfall followed the remnants of the storm resulted in more than 3,000 buildings flooded, with roughly a half located in the Fukushima Prefecture.

Financial Loss

Due to the notable flooding caused by historic rainfall over eastern Honshu, total economic and insured losses could reach into the hundreds of millions USD.

Natural Catastrophes: In Brief

SCS & Flooding (United States)

Multiple rounds of powerful storms impacted several states along the Atlantic Coast on September 8-12. This included some larger population centers such as NYC, Richmond, and Baltimore. Falling trees from strong winds caused widespread property damage and power outages, especially in New Jersey. Flash flooding occurred in Pennsylvania, particularly in Lackawanna County where several people had to be rescued. Some nearby states, such as New Jersey, Massachusetts, and Rhode Island, also saw flash flooding. Notably, severe storms caused widespread damage at the Blue Ridge Rock Festival in Virginia.

Flooding (Thailand)

Much of the eastern half of Thailand has been impacted by heavy rainfall since September 9. As of September 14, flash flooding has affected around 26,500 people across 11 provinces. According to ADINet, 2 people have died between the Mae Hong Son and Phitsanulok provinces.

Flooding (Brazil) – Update

Heavy rainfall since the start of September has continued to impact southern Brazil, especially the state of Rio Grande do Sul. As of late September 14, 47 people have died due to the intense flooding while another 943 have been injured. According to the state government Civil Defense report, 9 people remain missing, and another 3,130 people have been rescued. The historic floods have affected 102 municipalities and nearly 355,000 people in total.

SCS & Flooding (India)

On September 9-11, monsoon rains and severe weather continued to affect much of northern India, causing widespread flooding incidents. According to MOHA, 45 people were killed – 19 of whom died in Uttar Predesh alone. Flooding also affected more than 26,000 people and damaged around 606 homes. Additional heavy rainfall also affected Odisha state in eastern India, where a red warning was issued by the IMD for very heavy rainfall over 6 districts on September 14. Areas such as Bolangir saw over 200mm (7.87 inches) of rainfall, while around 40 homes in Koraput were damaged by flood waters.

Flooding & Landslide (Georgia)

On September 8-10, heavy rain impacted the Guria region of Georgia, triggering landslides and flooding. Three people were killed and another 122 people were evacuated from the Lanchkhuti and Ozurgeti municipalities. Dozens of roads, bridges, and residential homes were damaged by flooding.

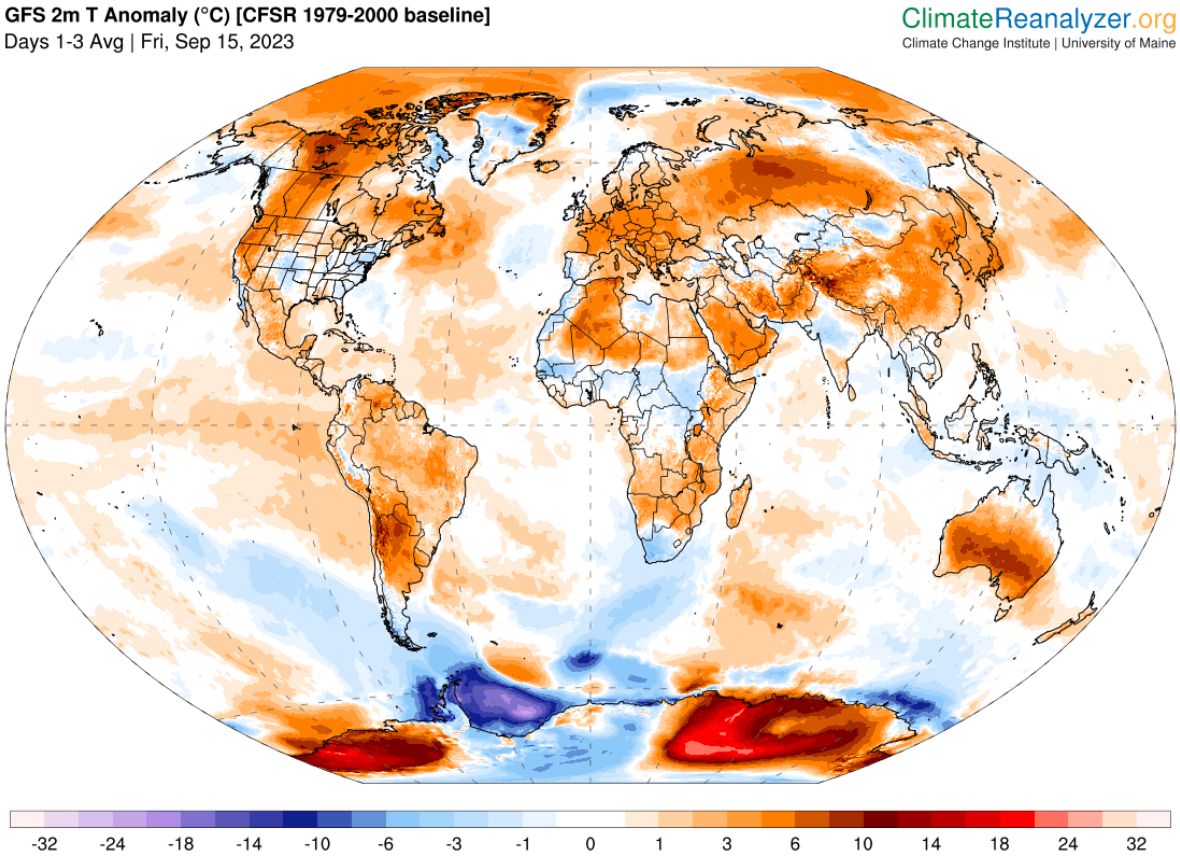
SCS & Flooding (Vietnam)

Northern Vietnam saw heavy rainfall and strong thunderstorms on September 12 that resulted in flash flooding and landslides. In the province of Lao Cai, 9 people were killed while 4 others remain missing. According to the ADINet and local media, severe storms caused damage to 21 homes, 61 fishing farms, and 180 hectares (445 acres) of crops across the Lao Cai, Ha Giang, and Yen Bai provinces.

Severe Convective Storm (Europe)

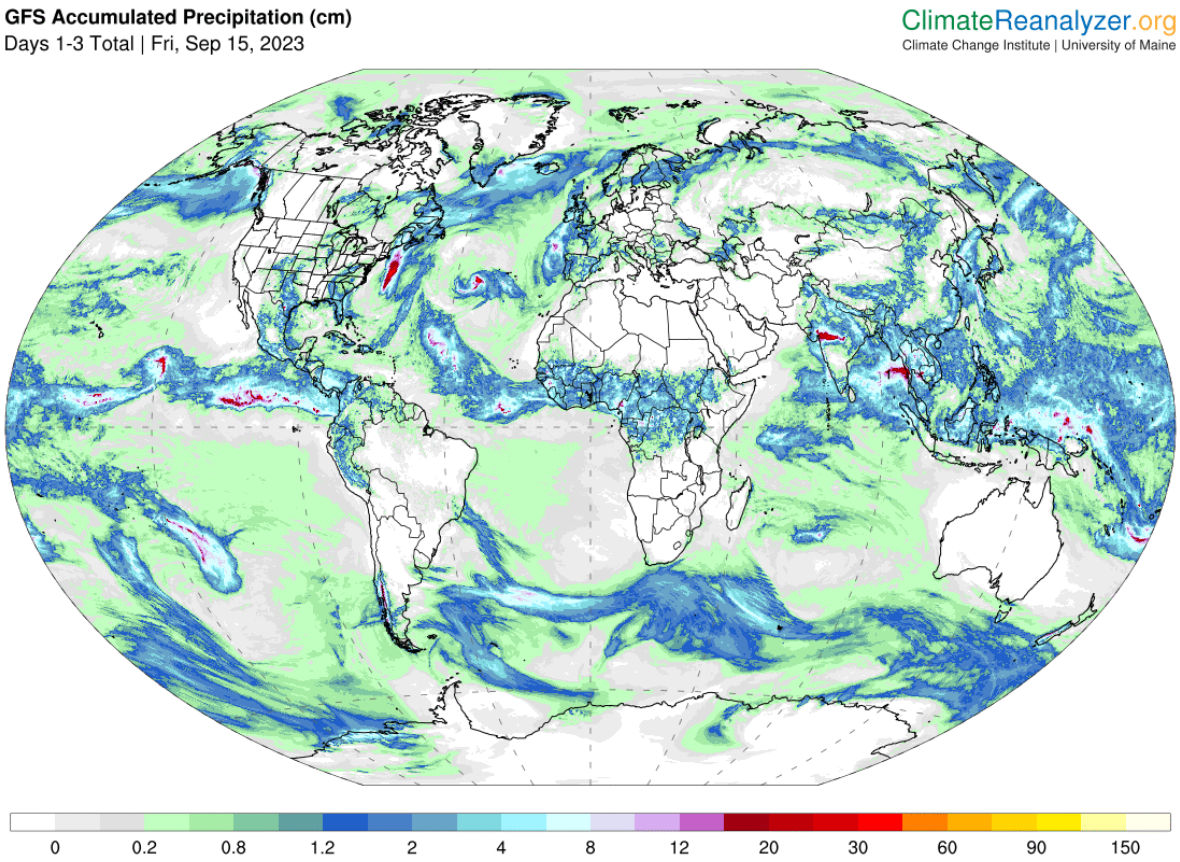
Multiday storm activity generated heavy rainfall, hail, and strong wind gusts in several regions of Western and Central Europe on September 10-13. As the stable blocking pattern from the previous week started to break up, isolated thunderstorms associated with an approaching cold front generated localized heavy rainfall, large hail, and strong wind gusts. Relatively minor hail damage to agriculture and vehicles was incurred in **Spain**, particularly in the autonomous communities of Navarra, Cantabria, and Castilla y León on September 10-11. Passage of a cold front resulted in some damage in Central Europe on September 12-13. Aggregate economic losses from the latest outbreak can potentially reach tens of millions of EUR.

Global Temperature Anomaly Forecast



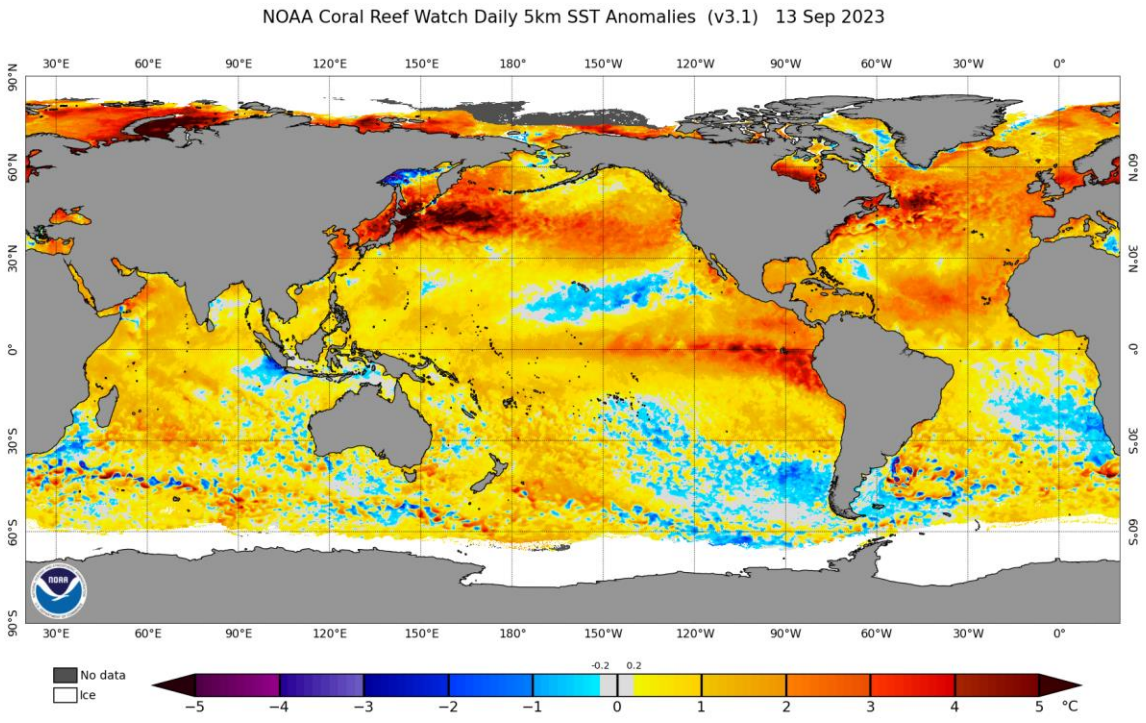
Source: Climate Reanalyzer, Climate Change Institute, University of Maine, USA

Global Precipitation Forecast

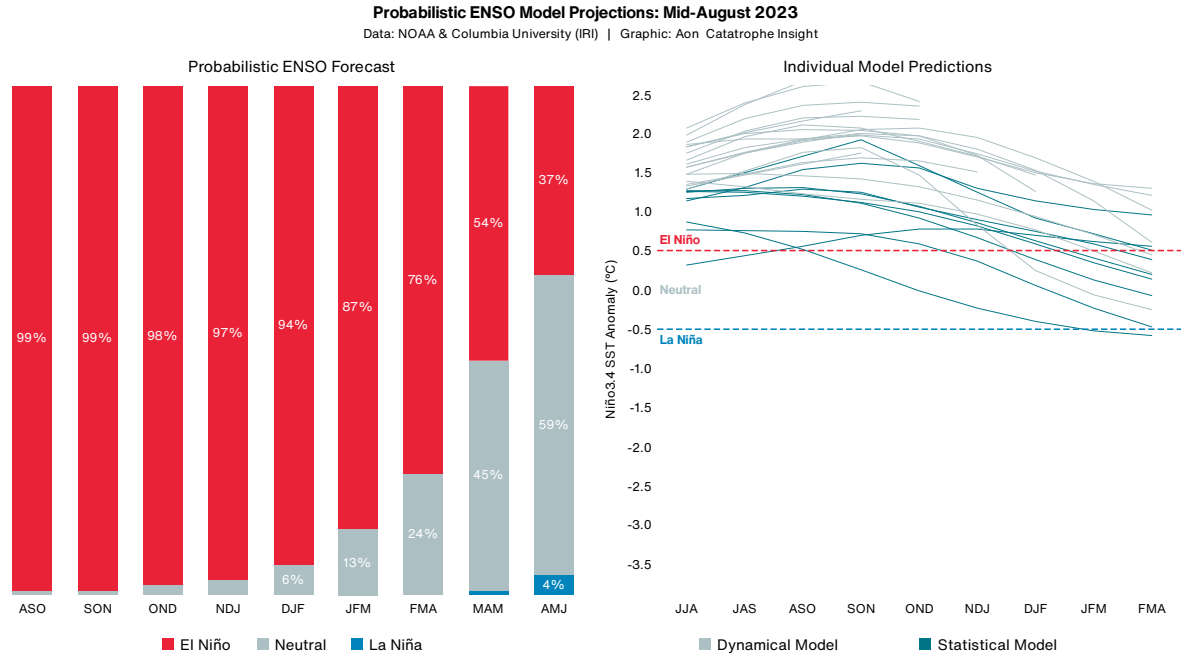


Source: Climate Reanalyzer, Climate Change Institute, University of Maine, USA

Weekly Sea Surface Temperature (SST) Maps (°C)



El Niño-Southern Oscillation (ENSO)



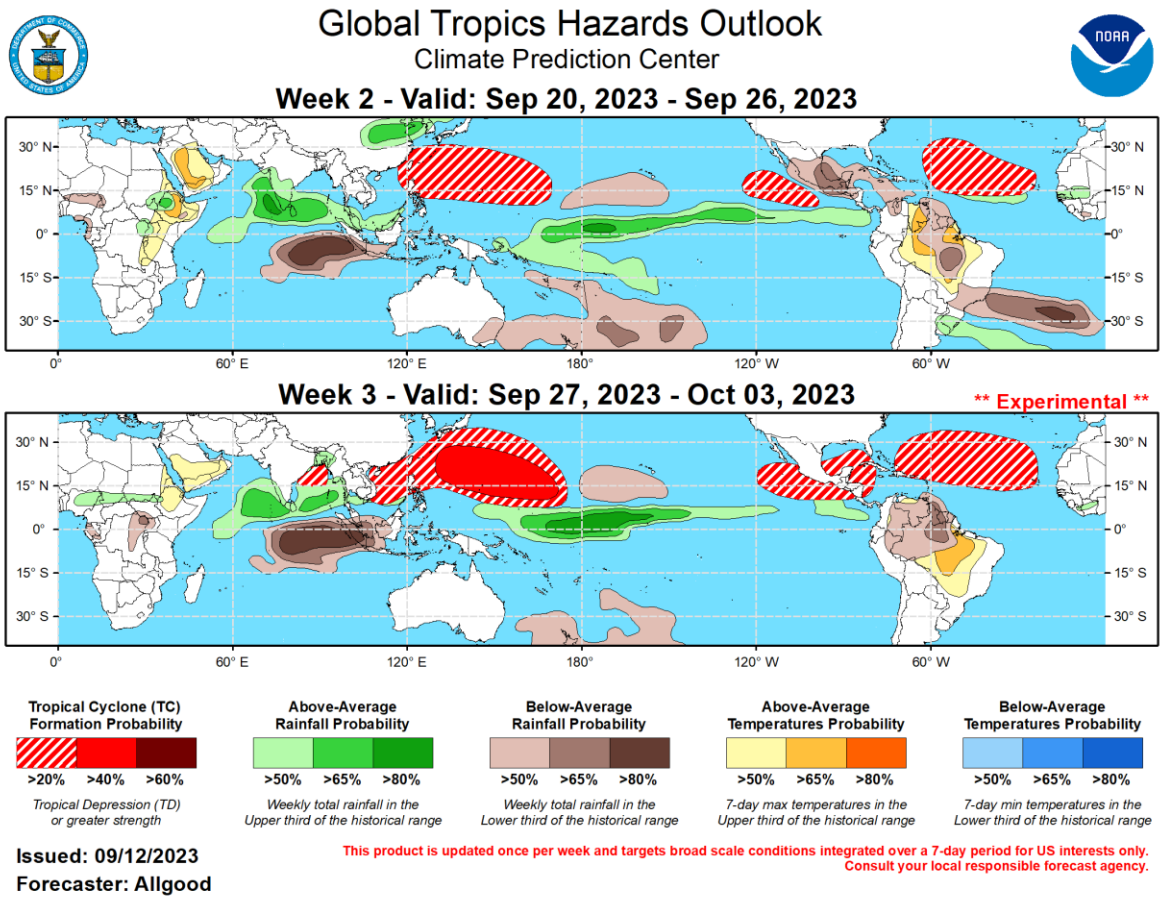
El Niño: *Warm phase of an ENSO cycle. Sea surface temperatures of +0.5°C occur across the east-central equatorial Pacific.*

La Niña: *Cool phase of an ENSO cycle. Sea surface temperatures of -0.5°C occur across the east-central equatorial Pacific.*

Neutral: *A period when neither El Niño nor La Niña conditions are present.*

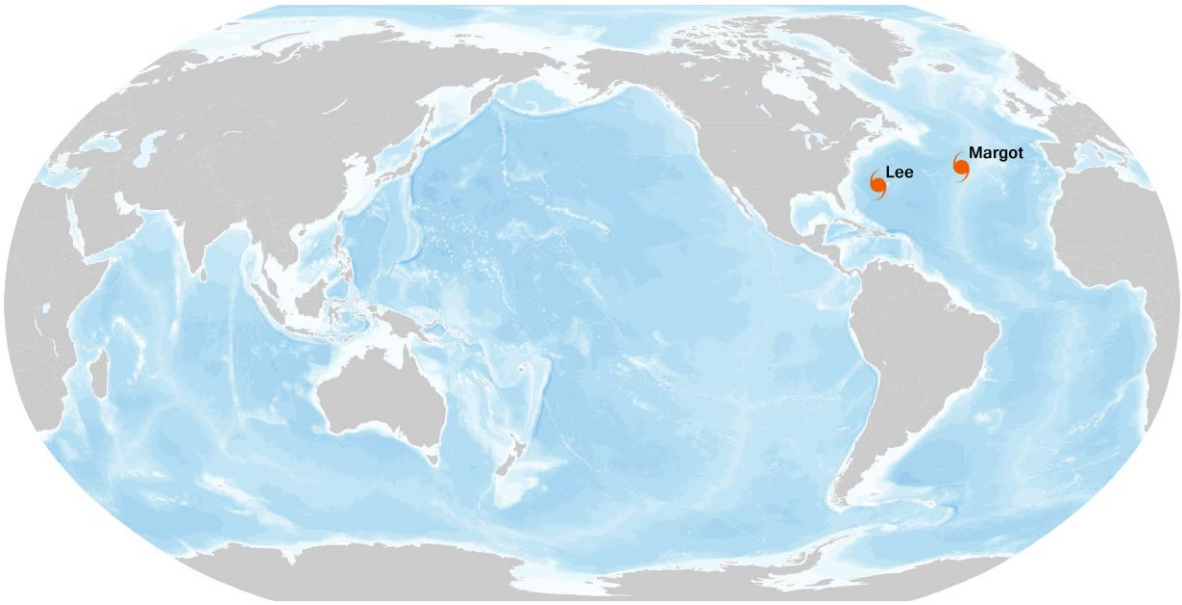
El Niño (La Niña) is a phenomenon in the equatorial Pacific Ocean characterized by a five consecutive 3-month running mean of sea surface temperature (SST) anomalies in the Niño 3.4 region that is above the threshold of +0.5°C (-0.5°C). This is known as the Oceanic Niño Index (ONI).

Global Tropics Outlook



Source: Climate Prediction Center (NOAA)

Current Tropical Cyclone Activity

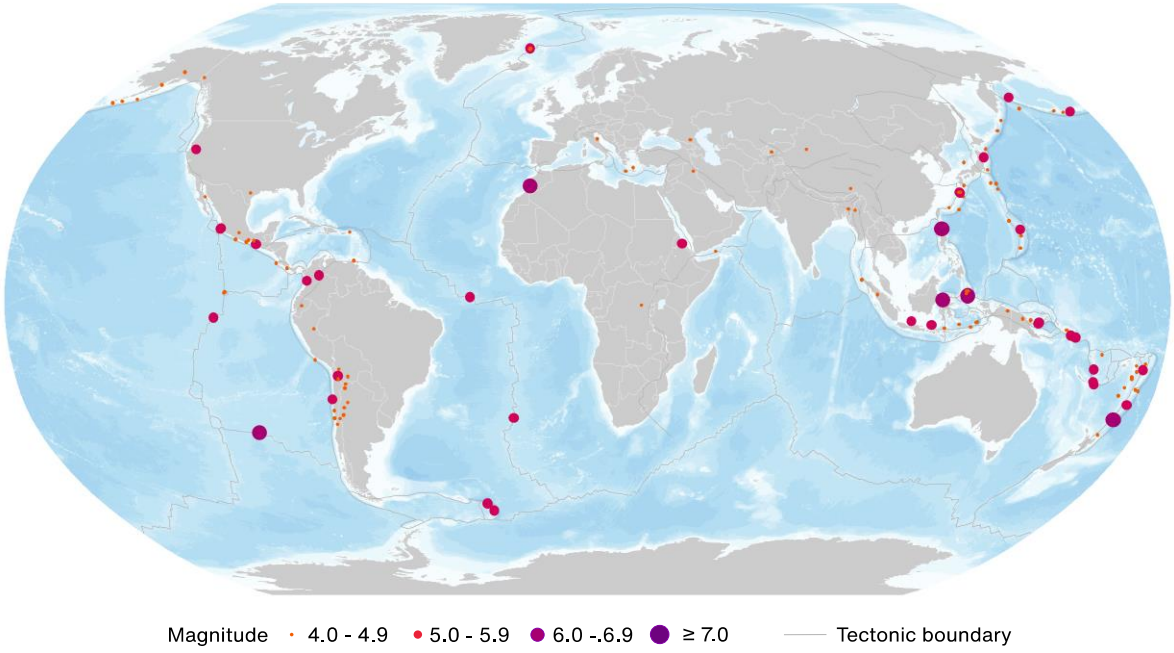


Name	Location	Winds	Center
HU Margot	36.9N, 39.0W	75	735 miles (1,185 km) W from Ponta Delgada, Portugal
HU Lee	32.1N, 68.0W	85	190 miles (305 km) W from Hamilton, United Kingdom

* TD: Tropical Depression, TS: Tropical Storm, HU: Hurricane, TY: Typhoon, CY: Cyclone
** N: North, S: South, E: East, W: West, NW: Northwest, NE: Northeast, SE: Southeast, SW: Southwest

Source: National Hurricane Center, Joint Typhoon Warning Center, Central Pacific Hurricane Center (NOAA)

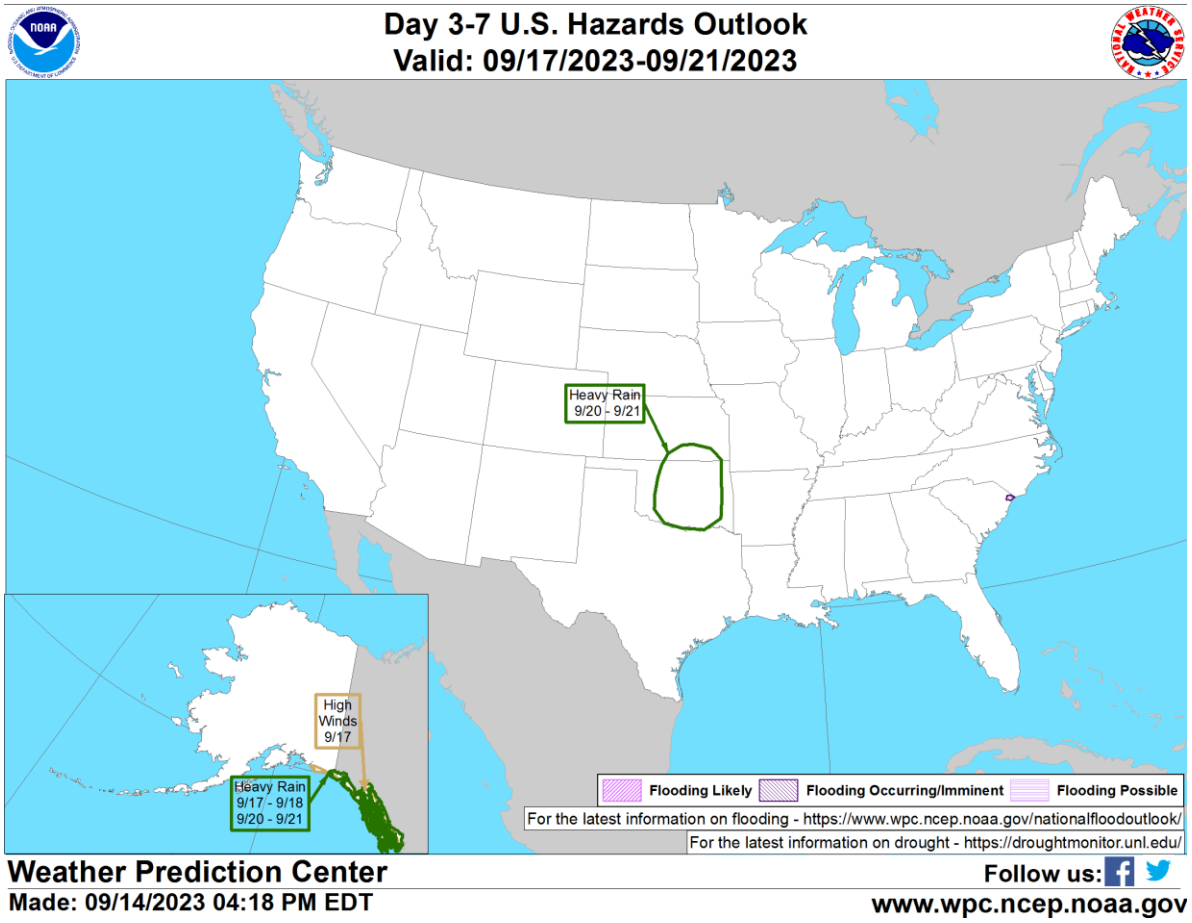
Global Earthquake Activity (≥M4.0): September 8-14



Source: United States Geological Survey

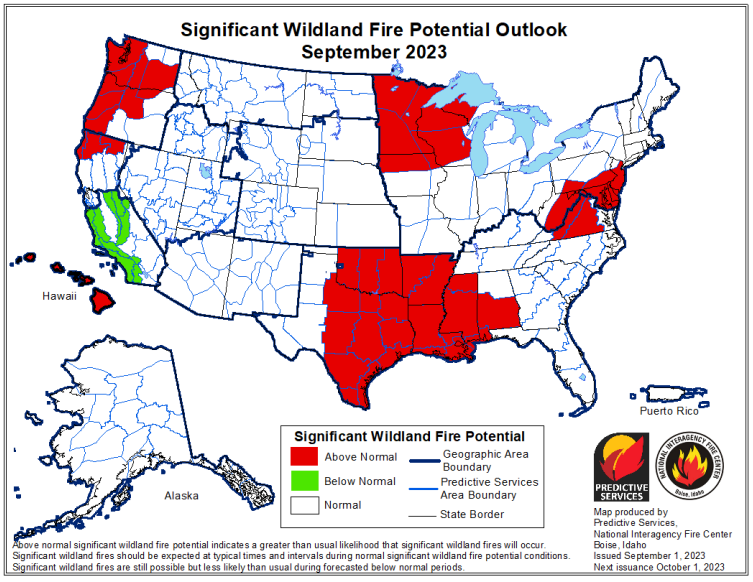
Date (UTC)	Location	Mag	Epicenter
9/8/2023	32.72S, 179.31W	6.6	South of the Kermadec Islands
9/8/2023	31.07N, 8.41W	6.8	54 km (34 miles) WSW of Oukaïmedene, Morocco
9/9/2023	0.01N, 119.77E	6	10 km (6 miles) N of Palu, Indonesia
9/11/2023	1.13N, 127.48E	6	38 km (24 miles) NNE of Ternate, Indonesia
9/12/2023	19.27N, 121.22E	6.3	73 km (45 miles) N of Namuac, Philippines
9/13/2023	36.22S, 97.94W	6.1	West Chile Rise

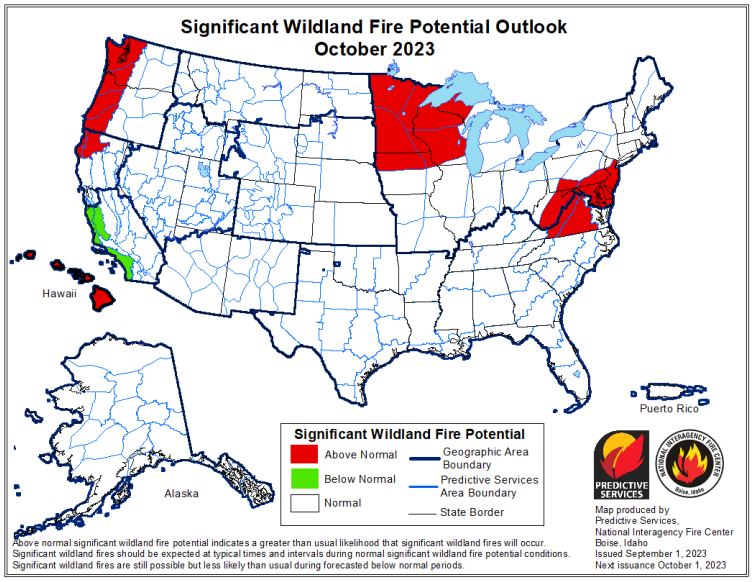
U.S. Hazard Outlook



Source: Climate Prediction Center (NOAA)

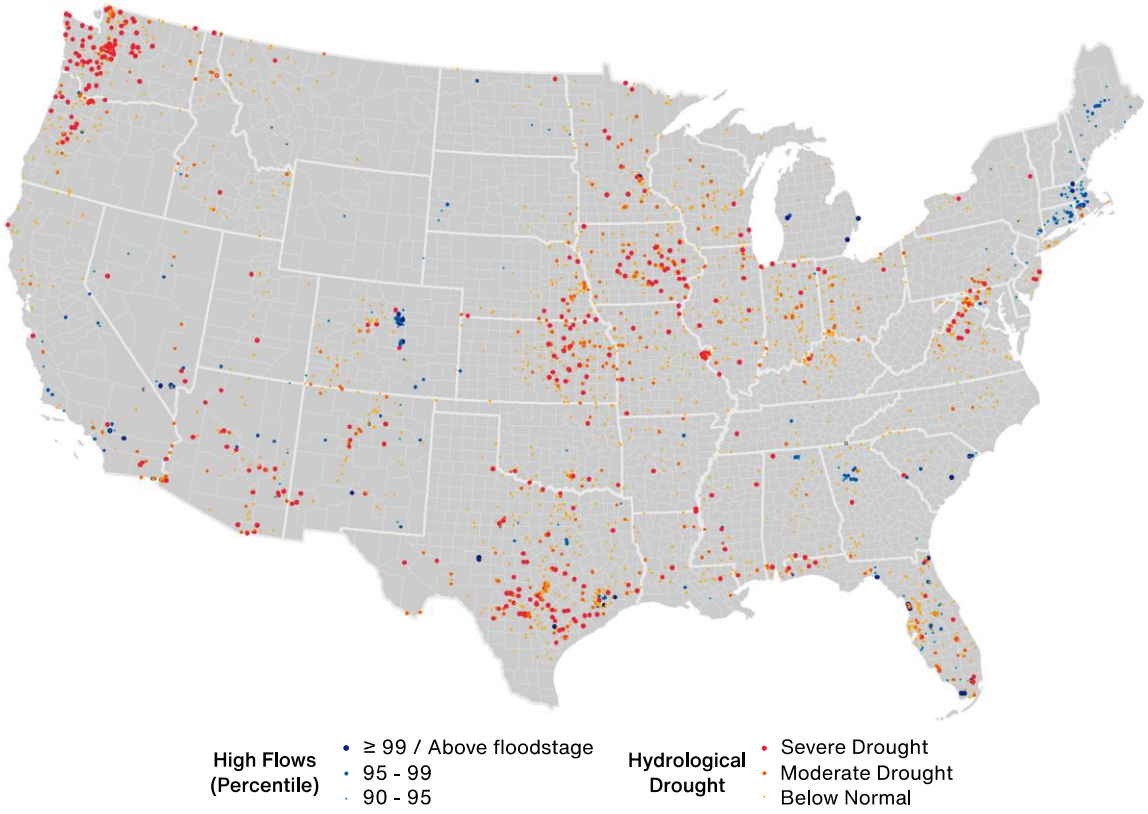
U.S. Wildfire: Significant Fire Risk Outlook & Activity





Source: NIFC

U.S. Current Riverine Flood Risk



A ≥99th percentile indicates that estimated streamflow is greater than the 99th percentile for all days of the year. This methodology also applies for the other two categories. A steam in a state of severe drought has 7-day average streamflow of less than or equal to the 5th percentile for this day of the year. Moderate drought indicates that estimated 7-day streamflow is between the 6th and 9th percentile for this day of the year and 'below normal' state is between 10th and 24th percentile.

Source: United States Geological Survey

Source Information

Morocco: Earthquake

USGS
Morocco Ministry of the Interior
The International Federation of Red Cross and Red Crescent Societies (IFRC)

Mediterranean: Flooding (Update)

The National Center of Meteorology in Libya
The Greek Meteorological Institute
The International Federation of Red Cross and Red Crescent Societies (IFRC)
Copernicus

Japan: Typhoon Yun-Yeung

Floodlist
FDMA, Japan
Tropical Storm "Yun-yeung" heading toward Japan, *The Watchers*
Tropical Storm Yun-yeung brings heavy rain to Kanto region, *The Japan Times*
At least 3 dead as record rains cause flooding in Japan, *La Prensa Latina Media*
Elderly Man Dies as Typhoon Yun-yeung Wreaks Havoc in 3 Prefectures, *The Japan News*
Tropical storm Yun-yeung approaching central Japan, *NHK World-Japan*

Natural Catastrophes: In Brief

TAKE A LOOK: Storms cause widespread damage at Blue Ridge Rock Festival, *WDBJ7*
Severe storms cause power outages, shut down schools across Hanover, Henrico, Richmond, Chesterfield, *ABC8 News*
Severe weather moves through parts of NYC, NJ with more storms possible to start the week, *NBC4 New York*
Overnight storms down trees, flood roads and knock power across Baltimore region, *CBS News*
Civil Defense of Rio Grande do Sul State Government
The Disaster Management Division Ministry of Home Affairs (MOHA)
House Damaged, Bridges Submerged As Heavy Rains hit Odisha, *Republic World*
The European Severe Weather Database (ESWD)
Floodlist

Contacts

Michal Lörinc
Head of Catastrophe Insight
michal.lorinc@aon.com

Ondřej Hotový
Catastrophe Analyst
ondrej.hotovy@aon.com

Antonio Elizondo
Senior Scientist, Catastrophe Insight
antonio.elizondo@aon.com

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