

NASA Applied Sciences Disasters Program Support for the September 2017 Mexico Earthquakes

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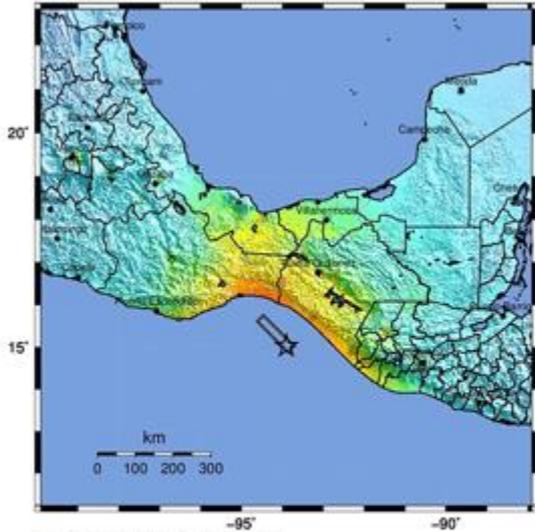
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The NASA Disasters Program promotes the use of Earth observations to improve the prediction of, preparation for, response to, and recovery from natural and technological disasters.

The 8 September M 8.1 Tehuantepec earthquake, the largest earthquake recorded in Mexico over the last 100 years, and the 19 September M 7.1 Puebla earthquakes both caused widespread damage, affecting several million people and causing numerous casualties.

A NASA Disasters team activated soon after these devastating earthquakes in order to support decision makers in Mexico, using NASA modeling and international remote sensing capabilities to generate decision support products to aid in response and recovery.



Map Version 11 Processed 2018-05-12 16:23:01 UTC

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC (mg)	<0.05	0.5	2.8	6.2	12	22	40	75	>150
PEAK VEL (cm/s)	<0.02	0.1	1.4	4.7	8.6	20	41	86	>178
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	Xa



Photo credit: Presidencia de la República Mexicana, CC-BY-2.0

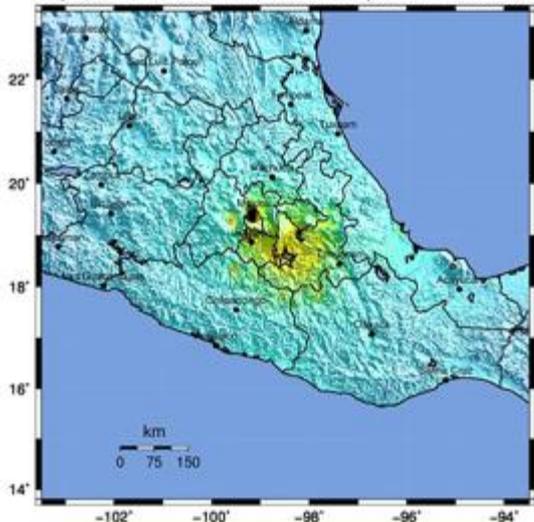
The 8 September M 8.1 Tehuantepec earthquake was the largest earthquake recorded in Mexico over the last 100 years

It generated a tsunami and several aftershocks, affected millions of people damaged thousands of homes, and caused nearly 100 casualties.

Pictured above, Mexico's President Enrique Peña Nieto is inspecting damage to a home in Juchitán, Oaxaca

USGS ShakeMap : PUEBLA, MEXICO

Sep 19, 2017 18:14:38 UTC M 7.1 N18.55 W98.49 Depth: 48.5km ID:sv2000a20



Map Version 13 Processed 2018-03-12 20:36:01 UTC

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	Very light	Light	Moderate	Mod. Heavy	Heavy	Very Heavy	
PEAK ACC (mg)	<0.05	0.3	2.8	8.2	12	22	40	75	>120
PEAK VEL (cm/s)	<0.02	0.1	1.4	4.7	8.6	20	41	80	>170
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X

Scale based upon Vidale et al. (2010)



Photo credit: Anto Fran, CC-BY-SA-4.0

Just over a week later, the Puebla earthquake struck on 19 September 2017, causing numerous fatalities, building collapses and widespread damage.

The earthquake damaged buildings in the states of Puebla and Morelos as well as in Mexico City.

The picture above shows a collapsed building in Mexico City.

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DISASTERS PROGRAM
NASA Applied Sciences Program | www.nasa.gov

ORGANIZATION DISASTERS PRODUCTS
RESOURCES

Southern Mexico Earthquake 2017

Southern Mexico Earthquake 2017

Start Date
September 8, 2017

Overview
A M 8.1 offshore Chiapas Mexico occurred at 2017-09-08 04:49:23 UT. This was an intermediate depth earthquake with an estimated source depth of approximately 70 km. This was the largest of 9 earthquakes M7.0 and larger within 250 km in the past century. The largest reported shaking by USGS 2nd you feel #1 was MMI VII (Moderate Heavy Shaking) roughly 200 km from the epicenter. There was an initial tsunami warning, but the threat has now passed (<http://www.tsunami.gov/>). There have been at least 20 M4 or greater aftershocks in the region. For more details on the event, please go to: <https://earthquake.usgs.gov/earthquakes/eventpage/us2000afv08a/summary>. NASA is coordinating with relevant agencies for this disaster to provide support for this event.

Disaster Types
Earthquakes

Latest Updates
September 16, 2017
Sentinel-1 Radar Shows Ground Motion due to September 2017 Oaxaca-Chiapas Earthquake in Mexico
NASA and its partners are contributing important observations and expertise to the ongoing response to the September 7, 2017 (local time), magnitude 8.1 Oaxaca-Chiapas earthquake in Mexico. This earthquake was the strongest over a century for Mexico. It has caused a significant humanitarian crisis with widespread building damage and triggered landslides throughout the region. Scientists with the Advanced Rapid Imaging and Analysis project (ARIA),
<https://earthquake.usgs.gov/earthquakes/eventpage/us2000afv08a/summary>

September 14, 2017
Landslide Maps for the 2017 Mexico Earthquake

<https://disasters.nasa.gov/mexico-earthquake-2017>

The Disasters Program website offers information about the Program, as well as event activations. Individual events have pages where summary information and products are listed.

The Disasters Program activated for the two September 2017 earthquakes. Event pages were created for each with summaries and products. The Program supported both domestic and international partners responding to the event.

We worked with Mexico's space agency (AEM), the National Center for Prevention of Disasters (CENAPRED), and NASA scientists. We also worked with academic partners, technical institutions, and field responders, including the USGS and OFDA.

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ORGANIZATION DISASTERS PRODUCTS
RESOURCES

Mexico City Earthquake 2017

Mexico City Earthquake 2017

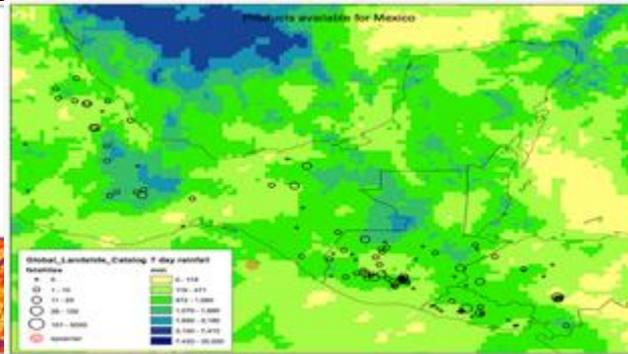
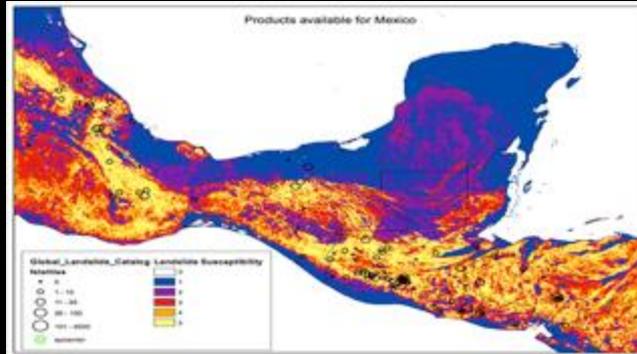
Start Date
September 19, 2017

Overview
On September 19th a 7.1 magnitude earthquake occurred in the Puebla state of Mexico, approximately 75 miles from Mexico City. It impacted a large portion of the country and caused over 200 fatalities and 1,300 injuries. Extensive damage to buildings and infrastructure has also been reported. As of 4am on September 20th, over 24 aftershocks have been reported.
The NASA Disasters Program is supporting this event and is coordinating with US response agencies. We are also in contact with CENAPRED and AEM of Mexico and plan to support by providing landslide susceptibility models and radar based deformation and damage assessment products.
Image Credit: USGS
<https://earthquake.usgs.gov/earthquakes/eventpage/us2000afv08a/summary>

Disaster Types
Earthquakes

Latest Updates
September 21, 2017
Sentinel-1 Interferogram for September 2017 Raboso-Puebla Earthquake in Mexico
NASA and its partners are contributing important observations and expertise to the ongoing response to the September 19, 2017, magnitude 7.1 Puebla earthquake in Mexico. This earthquake has caused widespread building damage and triggered landslides throughout the region, including Mexico City. Scientists with the Advanced Rapid Imaging and Analysis project (ARIA), a collaboration between NASA's Jet Propulsion Laboratory, Pasadena, California, and the...

<https://disasters.nasa.gov/mexico-city-earthquake-2017>



The global Landslide Hazard Assessment for Situational Awareness (LHASA) model is developed to provide situational awareness of landslide hazards for a wide range of users.

Precipitation is a common trigger of landslides. The GPM Integrated Multi-satellite Retrievals for GPM (IMERG) data shows recent precipitation, updated every thirty minutes.

A LHASA landslide “nowcast” is created by comparing GPM data from the last seven days to the long-term precipitation record provided by the Tropical Rainfall Measuring Mission (TRMM) Multi-satellite Precipitation Analysis (TMPA).

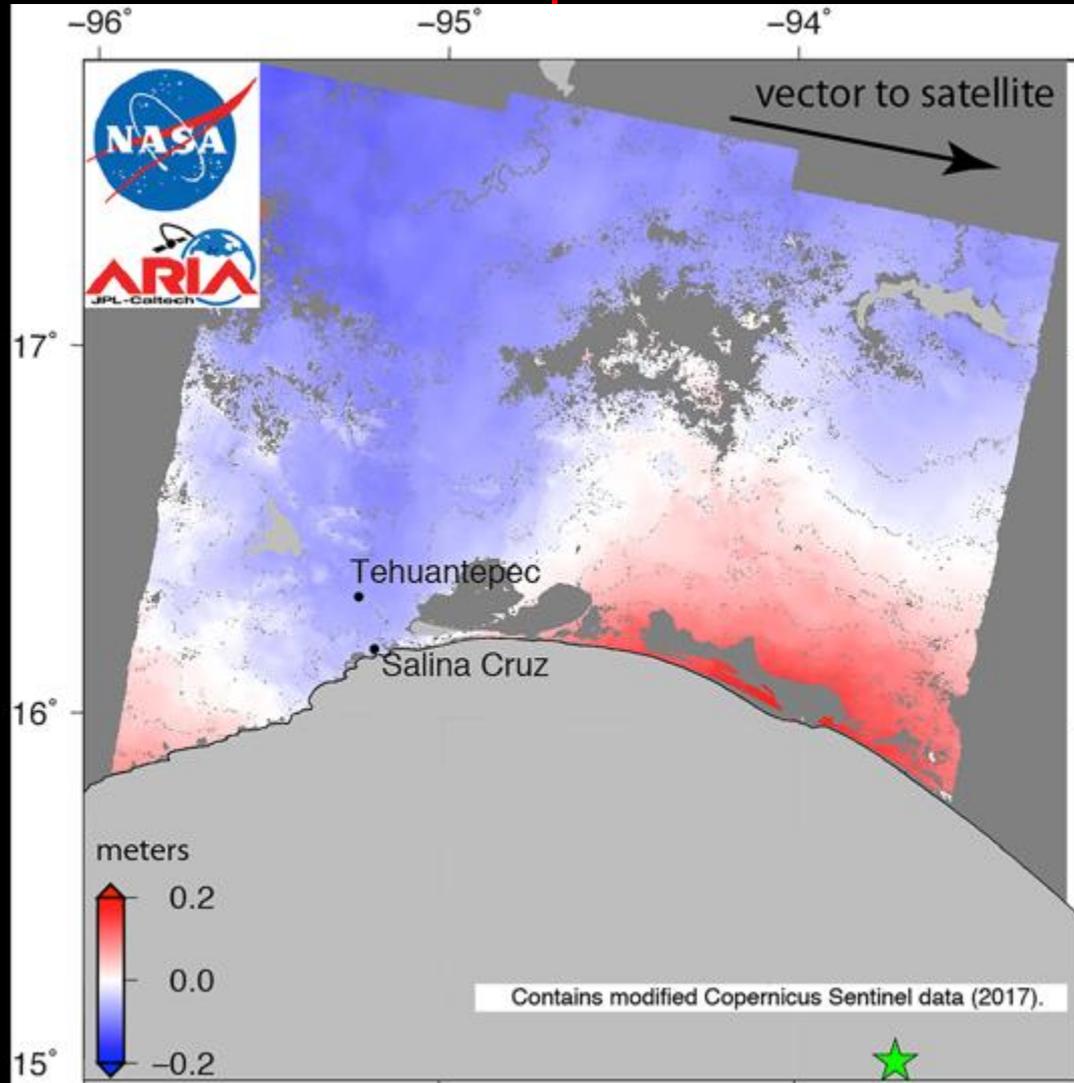
CENAPRED analyzed the landslide susceptibility and nowcast data and integrated them into their "National Risk Atlas" visualization system. <https://disasters.nasa.gov/mexico-earthquake-2017/landslide-maps-2017-mexico-earthquake>

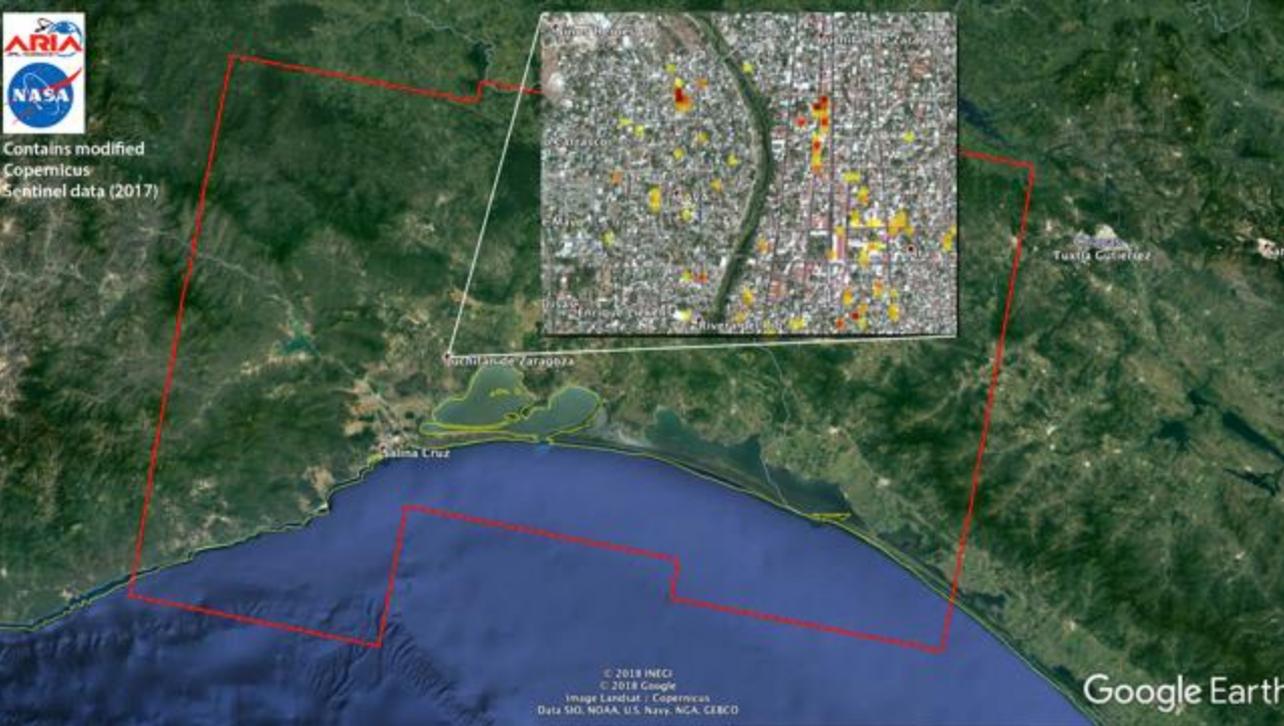


Products generated by the Disasters Program were used by AEM in collaboration with other government agencies in Mexico to make appropriate decisions for mapping damage, rescue and recovery, and informing the population regarding areas prone to potential risk.

Scientists with the Advanced Rapid Imaging and Analysis project (ARIA), a collaboration between NASA's Jet Propulsion Laboratory, Pasadena, California, and the California Institute of Technology in Pasadena, analyzed interferometric synthetic aperture radar images from the radar instrument on the Copernicus Sentinel-1A and Sentinel-1B satellites, operated by the European Space Agency (ESA), to calculate maps of the deformation of Earth's surface. This false-color map shows the amount of permanent surface movement caused almost entirely by the earthquake, as viewed by the satellite, during a 6-day interval between radar images acquired by the two Sentinel-1 satellites on September 7 and September 13, 2017.

<https://disasters.nasa.gov/mexico-earthquake-2017/sentinel-1-radar-shows-ground-motion-due-september-2017-oaxaca-chiapas>





ARIA created this Damage Proxy Map (DPM) depicting areas of Southern Mexico that are likely damaged as a result of the Chiapas earthquake, shown by red and yellow pixels.

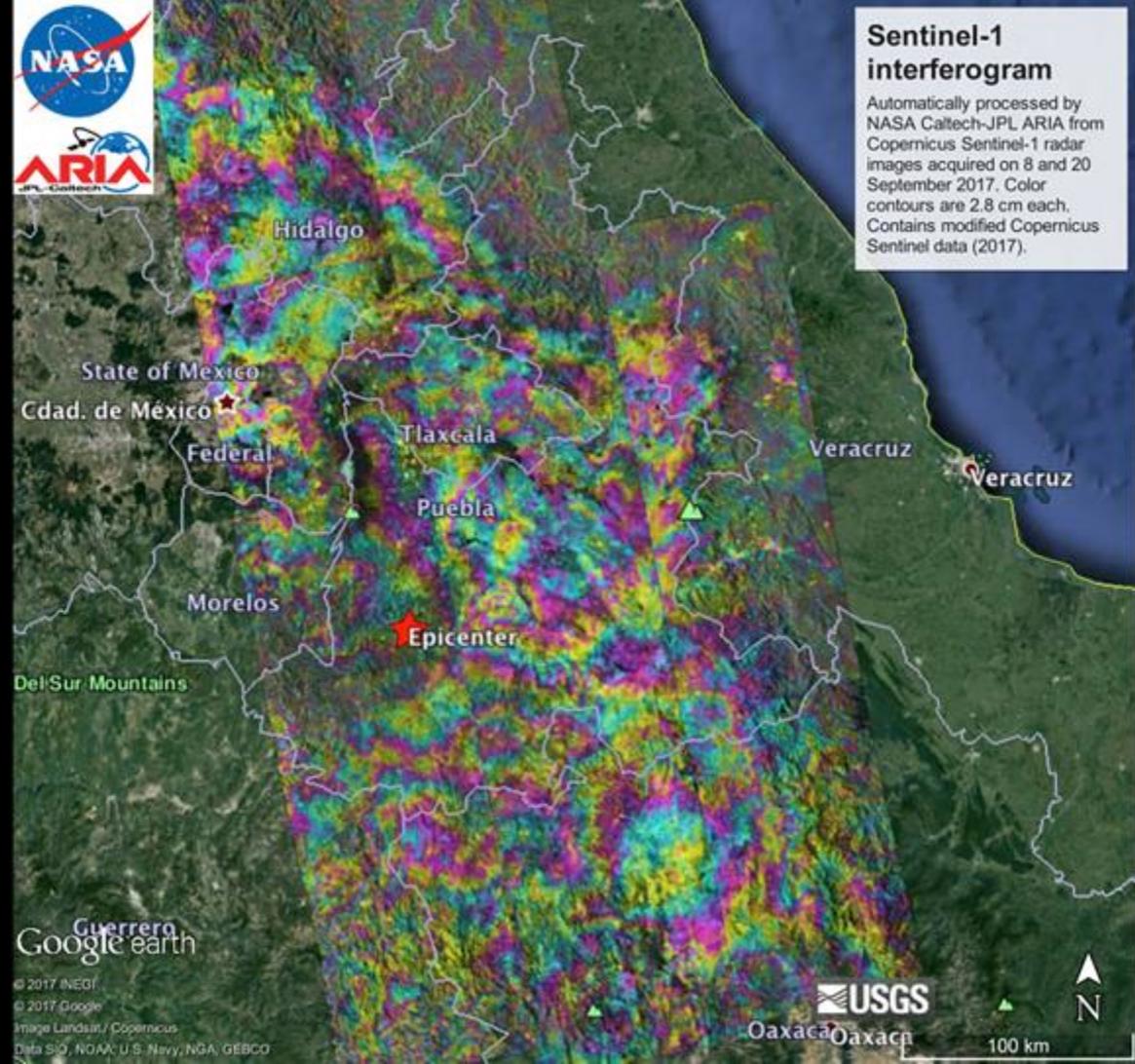
The color variation from yellow to red indicates increasingly more significant ground surface change. Preliminary validation was done by comparing to optical satellite imagery by the DigitalGlobe.

<https://disasters.nasa.gov/mexico-earthquake-2017/satellite-radar-detects-damage-caused-september-2017-m81-chiapas-earthquake>

ARIA scientists analyzed images from the radar instrument on the Copernicus Sentinel-1A and Sentinel-1B satellites, operated by the European Space Agency (ESA), to calculate maps of the damage caused by the earthquake.

ARIA scientists analyzed interferometric synthetic aperture radar images from the radar instrument on the Copernicus Sentinel-1A and Sentinel-1B satellites, operated by the European Space Agency (ESA), to calculate maps of the deformation of Earth's surface. Surface displacements are seen as color contours, where each color cycle represents 1.1 inches (2.8 centimeters) of surface motion. The contours show there was broad deformation at the surface around 1-2 inches (3-5 cm) and there were no major surface ruptures due to the earthquake at 30 miles (50 km) depth. Scientists use these maps to build detailed models of the fault slip at depth and associated land movements to better understand the impact on future earthquake activity.

<https://disasters.nasa.gov/mexico-city-earthquake-2017/sentinel-1-interferogram-september-2017-raboso-puebla-earthquake-mexico>





This image is a Damage Proxy Map (DPM) depicting areas of Central Mexico, including Mexico City, that were likely damaged (shown by red and yellow pixels) from the magnitude 7.1 Raboso earthquake.

The color variation from yellow to red indicates increasingly more significant ground surface change. Preliminary validation was done by comparing the DPM to a crowd-sourced Google Map

<https://disasters.nasa.gov/mexico-city-earthquake-2017/aria-damage-proxy-map-m71-raboso-mexico-earthquake>

ARIA scientists analyzed images from the radar instrument on the Copernicus Sentinel-1A and Sentinel-1B satellites, operated by the European Space Agency (ESA), to calculate maps of the damage caused by the earthquake.

The Disasters Program provided government agencies in Mexico with products that helped inform decisions for response and recovery.



From the General Director of AEM:

"Your valuable contribution through the NASA Earth Science Disaster Program made it possible – in collaboration with other government agencies in Mexico – to take the appropriate decisions for mapping damage, rescuing and eventually recovery of the damage, as well as to address and inform to the population about the affected zones and the areas prone to further risk."

Thank you!

<https://disasters.nasa.gov>