

## Earthquake of June 23, 2020, M 7.4, Oaxaca, Mexico

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On June 23, 2020, at 15:29 UTC (10:29 am local time), a M 7.4 earthquake was recorded with epicenter 23 km south of Crucecita, Oaxaca, Mexico, as a result of the interaction between the Cocos and the North American plates. According to data from the National Seismological Service (SSN), the coordinates of the epicenter are 15.784° N latitude and 96.120° W longitude, and the focal depth is 22.6 km (Figure 1).



Figure 1. Epicenter of June 23, 2020 earthquake, magnitude 7.4 (SSN).

The focal mechanism of the event (strike = 266.8°, dip = 17.2°, slip = 60.5°) corresponds to a reverse fault, which reached a maximum slip of 3.19 m (SSN), as result of a rupture occurred on either a shallowly dipping thrust fault striking towards the west or on a steeply dipping reverse fault striking towards the ESE, due to the interaction between the Cocos plate, which subducts under the North America plate at a rate of 60 mm / year in this zone (USGS).

The earthquake was felt in the states of Oaxaca, Guerrero, Chiapas, Michoacán, Jalisco, Querétaro, Morelos, Tabasco, Veracruz, Puebla, State of Mexico and in Mexico City (600 Km away from the epicenter) and in several Guatemala cities. Among the significant effects that the seismic event produced, damage to infrastructure has been reported both in the area near the epicenter and in 36 buildings in Mexico City (Figure 2, 3). Also earthquake environmental effects are reported, among the most outstanding, landslides, rock falls, liquefaction (Figures 4 - 11).



Figure 2. Building affected by the 2017 earthquake was affected again by the June 23, 2020 earthquake; the building is located between Tepic and Monterrey streets, in Colonia Roma, Mexico City. Photo, La Jornada newspaper.



Figure 3. Building affected by the June 23, 2020 earthquake in Santa María Huatulco, Oaxaca.

According to the government report of the State of Oaxaca, as of June 24, 10 fatalities are reported, more than 2000 homes affected in 85 municipalities, 4 archaeological zones damaged, 15 health centers affected. Three landslides on three federal roads, and five on state roads. Also, there are reports of damage in Chiapas, Michoacán and Mexico City. Until 22:30, local time of June 24, there have been 2,219 aftershocks, the largest being of magnitude 5.5 (SSN).



Figure 4. Wall of adobe clay house. San Juan Ozolotepec, Oaxaca.



Figure 5. Landslide on Oaxaca-Tehuantepec highway, Km 118. I = VIII ESI-2007.



Figure 6. Crack in sandy terrain. Crucecitas, Oaxaca. I = VII ESI-2007.



Figure 7. Rock fall and landslides in San Sebastian Río Hondo, Oaxaca. I = VII ESI-2007.



Figure 8. Rock wall collapse in Santa Cruz Ozolotepec, Oaxaca.



Figure 9. Landslide on the Totolapan road, Oaxaca. I = VIII ESI-2007.



Figure 10. Tsunami, secondary effect of the Crucecita earthquake, in Huatulco, Oaxaca. I = VII ESI-2007.



Figure 11. The "Antonio Dovalí Jaime" refinery, in Salina Cruz, Oaxaca, registered a shot in the turbogenerators and in the caldera, which caused a fire. Photo taken from @Pemex.

The Mareographic National Service (SMN) registered a moderate tsunami, caused by the earthquake, in some of its stations on the Pacific coast. The maximum variations were registered in the Salina Cruz stations with a maximum of 1.4 m (Figure 12), Huatulco with 0.6 m (Figure 13),

and Puerto Chiapas with 0.26 m, with respect to the level of the tide. They emphasize that in the Huatulco station an abrupt decrease in sea level of approximately 1.25 m was registered, and in addition, a vertical displacement of approximately 0.5511 m, which suggest coastal uplift.

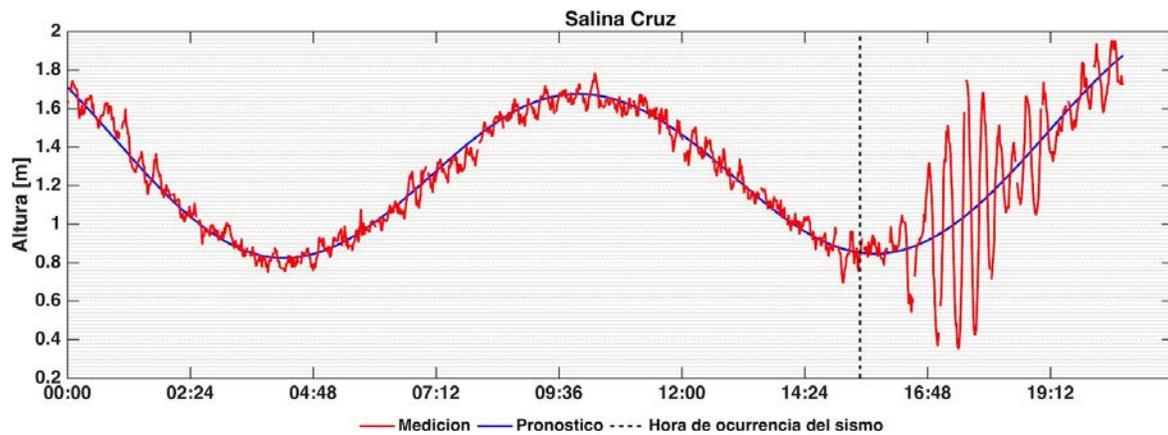


Figure 12: Measured data (red) and astronomical tide forecast (blue) at the Salina Cruz station, Oaxaca. The graph starts at 00:00 UTC, and is possible to see the behavior of the signal prior to the occurrence of the tsunami (SMN).

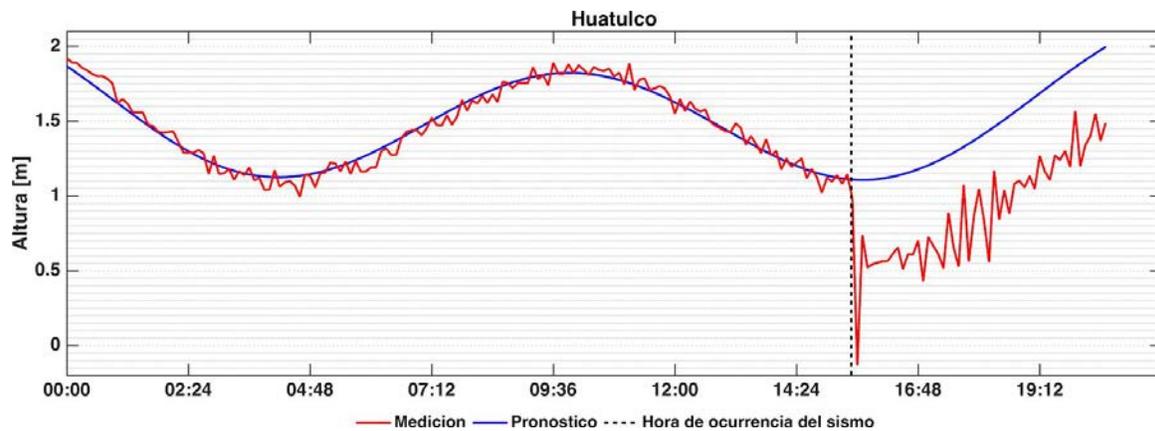


Figure 13: Measured data (red) and astronomical tide forecast (blue) at the Huatulco station, Oaxaca (22 km from the epicenter). The graph starts at 00:00 UTC, and is possible to see the behavior of the signal prior to the occurrence of the tsunami (SMN).

The macroseismic intensity maps published by the SSN (Figure 14) and the USGS (Figure 15), show that the earthquake affected at least 12 states of the republic, more than 700 km away from the epicenter, where possibly some effects have been recorded.

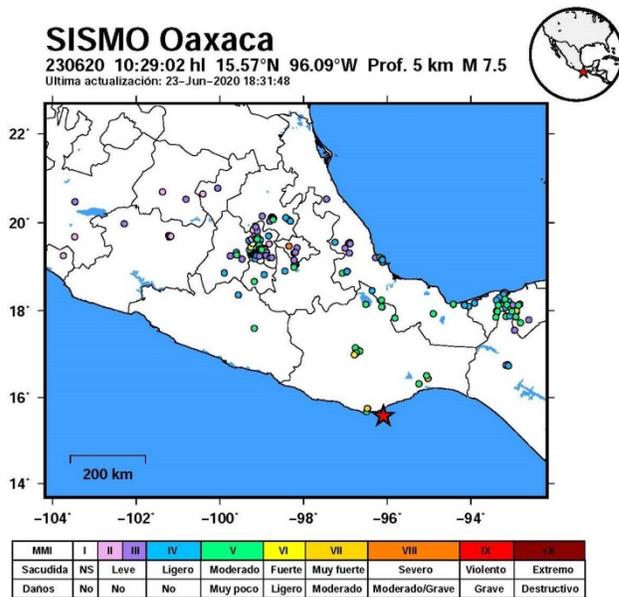


Figure 14. Macro seismic intensity map of the Internet community, made by the Autonomous University of Nuevo León, Faculty of Earth Sciences, taken from the SSN.



Figure 15. Macro seismic intensity map generated by the “Did You Feel It?” Program. USGS.

### Historical seismicity in the area

Particularly in the region of Oaxaca (the state with the most structural damage reported by the September 08, 2017 earthquake), approximately 25% of the seismic activity in the territory is recorded (NSS). Earthquakes of  $M > 7$  have been recorded in recent years (Table 1).

Table 1. Earthquakes  $M \geq 8$  in Mexican territory and seismicity  $M > 7$  from 1900 to date in the States of Oaxaca and Chiapas (Data from the National Seismological Service).

Date	Magnitude	Location
September 7, 2017	8.2	Gulf of Tehuantepec
June 3, 1932	8.2	Jalisco
September 19, 1985	8.1	Michoacán
October 9, 1995	8.0	Jalisco
<b>Oaxaca and Chiapas</b>		
April 19, 1902	7.5	Mexico Guatemala border
September 23, 1902	7.7	Chiapas
January 14, 1903	7.6	Chiapas
January 14, 1931	7.8	Oaxaca
August 23, 1965	7.5	Oaxaca
April 29, 1970	7.3	Chiapas
November 29, 1978	7.6	Oaxaca
September 10, 1993	7.2	Chiapas
September 30, 1999	7.4	Oaxaca

March 20, 2012	7.5	Oaxaca
November 7, 2012	7.3	Chiapas
February 16, 2018	7.2	Oaxaca
June 23, 2020	7.4	Oaxaca

The epicenter of the Tehuantepec earthquake of September 08, 2017, Mw 8.2, is located 240 km southeast of Crucecita, Oaxaca, epicenter of the recent earthquake. The Tehuantepec earthquake was an intraplate event, inside the Cocos plate with a normal mechanism that caused significant damage in the region; at least 94 fatalities and 250 wounded in the states of Oaxaca and Chiapas. In addition, significant earthquake environmental effects were registered, which are still being evaluated under the ESI-2007 scale in order to obtain the macroseismic field of intensities (Figure 16), this, as a postdoctoral research project, at the Università degli Studi Del'Insubria, Italy. According to the above, the identification and evaluation of the earthquake environmental effects by the ESI-2007 scale of the earthquake of June 23 in Oaxaca, of smaller magnitude, but more superficial, will be very useful to confront the effects produced by two earthquakes in the seismic zone more active of Mexico. Data from an intraplate event and an interplate event will allow a better understanding of the knowledge and evaluation of seismic hazard in the region and the analysis of the attenuation of intensity with distance.

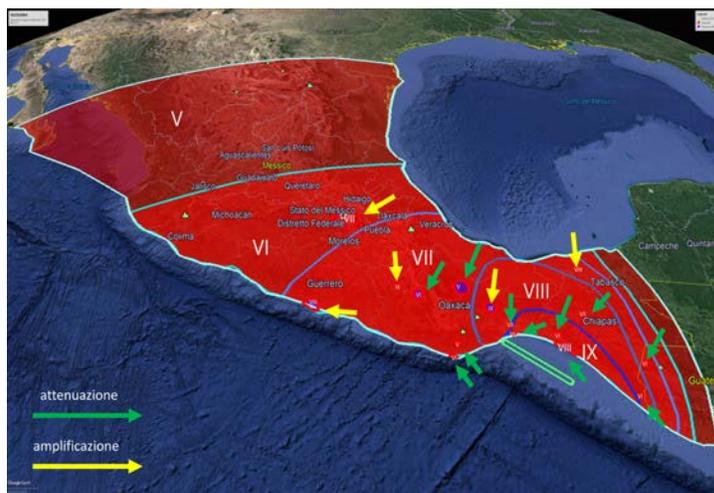


Figure 16. Preliminary intensity map ESI-2007, from analysed earthquake environmental effects (EEE) data of September 8, 2017

## References

<https://earthquake.usgs.gov/earthquakes/eventpage/us6000ah9t/dyfi/intensity>

SSN (2020): Servicio Sismológico Nacional, Instituto de Geofísica, Universidad Nacional Autónoma de México, México. URL: <http://www.ssn.unam.mx>

SMN (2020). Reporte del tsunami producido por el sismo de magnitud 7.4 ocurrido el día 23 de junio de 2020 al sureste de Crucecita, Oaxaca. Geofísica – UNAM.  
<http://www.mareografico.unam.mx/portal/>

<https://www.jornada.com.mx/ultimas/2020/06/23/fuerte-sismo-de-7-5-remece-centro-y-sur-de-mexico>

<https://www.radioformula.com.mx/noticias/20200623/tsunami-oaxaca-ya-inicio-cuando-podria-llegar-tiempo-duracion-2020/>

<https://www.facebook.com/eljaguardelsol/photos/pcb.176786947203276/176794460535858/?type=3&theater>

<https://www.facebook.com/Santa-Cruz-Ozolotepec-227617597312923/>

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