What would an earthquake of M10 on the Richter scale feel like?

Magnitude Scales

First, I would like to state that the best scale to use for measuring very great earthquakes is the moment magnitude scale (M_W), because it is related to a rupturing fault's area, slip distance, and physical characteristics and is, therefore, a very 'process representative' measure and is the choice of modern seismologists. The Richter scale (M_L) was a very good scale to use in California for quakes up to about M_W 7.0. The Richter scale saturates significantly for larger quakes. That is, an M_W 7.0 quake would measure about M_L 6.75, an M_W 8.0 would measure about M_L 7.2, an M_W 9.0 about M_L 7.3, etc. Please understand that these comparisons are very approximate in nature, because many factors affect these measures. [Ref. Relationships between Magnitude Scales by Tokuji Utsu, *International Handbook of Earthquake and Engineering Seismology*, Part A, 2002]

Fault Rupture Length

In 1960, the greatest quake ever instrumentally measured (M9.5) had a fracture length of about 1000 km (621 mi) and occurred on a plate margin of the Pacific Rim near Chile. This monster was a megathrust earthquake, which resulted from the Nazca Plate subducting beneath the South American Plate. A large tsunami was generated with waves as high as 10.7 m (35 ft) that were recorded 10,000 km (6,210 mi) from the epicenter, and as far away as Japan and the Philippines. Hilo, Hawaii was devastated.

The approximate relative energy of an M10 quake would be (10-9.5=0.5 and 31.6^0.5=5.6) about 5.6 times the energy of the M9.5 Chilean quake. Thus, if all other fault characteristics and slip distance were the same, the rupture length of an M10 quake would be about 5,600 km (3,480 mi). Please realize that many details are being glossed over, here.

What would it feel like?

Note that the total energy of an M10 quake would be distributed along and radiate from the entire length of the fault rupture and so someone located a distance from the fault could feel only a portion of that energy. When the fault is rupturing near the person's location, the shaking would be most intense. As the rupture unzips along at greater distances from the observer, the shaking would be less intense with increasing distance. However, the total time of the shaking would be very long (up to 30 minutes?). This is just speculation, because a fault rupture of that length has never been observed. Also, the shaking intensity will vary considerably with the geological structure between the fault and the observer. Solid bedrock doesn't shake as intensely, while sedimentary basins can shake wildly as energy waves reverberate and resonate. Instances of vertical ground motions exceeding 1.0 G in sedimentary basins do occur with large quakes. During an M10 quake, an observer at such a site could be thrown into the air repeatedly for some time. The ground motions might be quite complex, so one probably could not stay on one's feet for long.

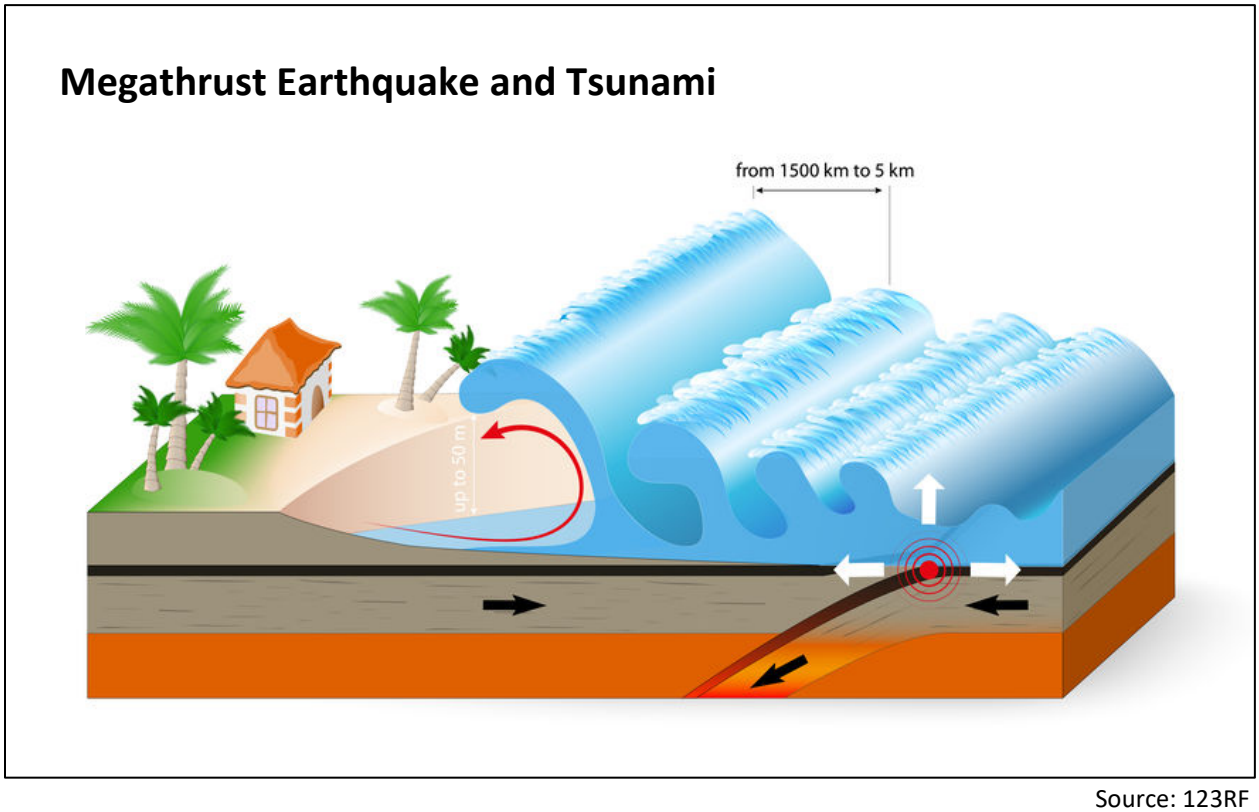
What is the outlook for global seismicity in the next decade?

For a rather technical forecast of great (M8+) and mega (M9+) quakes, worldwide, as projected by the new field of *Celestial Geodynamics*, please see the article, *"A global forecast for great earthquakes and large volcanic eruptions in the next decade: 2018–2028"*

https://celestialgeodynamics.files.wordpress.com/2018/10/a-global-forecast-for-next-decade-d10.pdf

Reader: Thirty minutes of earth shaking is difficult to imagine. Is it possible that the rupture length remains same (1000 km) and ground shaking is 5.6x the Chilean quake?

Doug Z: Again, a quake of M10 has not been observed by modern scientists, so there is some uncertainty. However, the longest duration of noticeable shaking should be experienced near the middle of the final length of the ruptured fault. And how much 'felt' intensity can be transmitted from fault ends that are 2,800 km (1,740 mi) away would depend substantially on the intervening geology. A relevant example might be that the 1964 Alaskan M9.3 quake (8.9% of the energy of an M10) shook for 4 minutes and 38 seconds and was felt in northern California, which is about 3,000 km (1,860 mi) from the epicenter.



Source: 123RF

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