Los Angeles 'big squeeze' continues, straining earthquake faults

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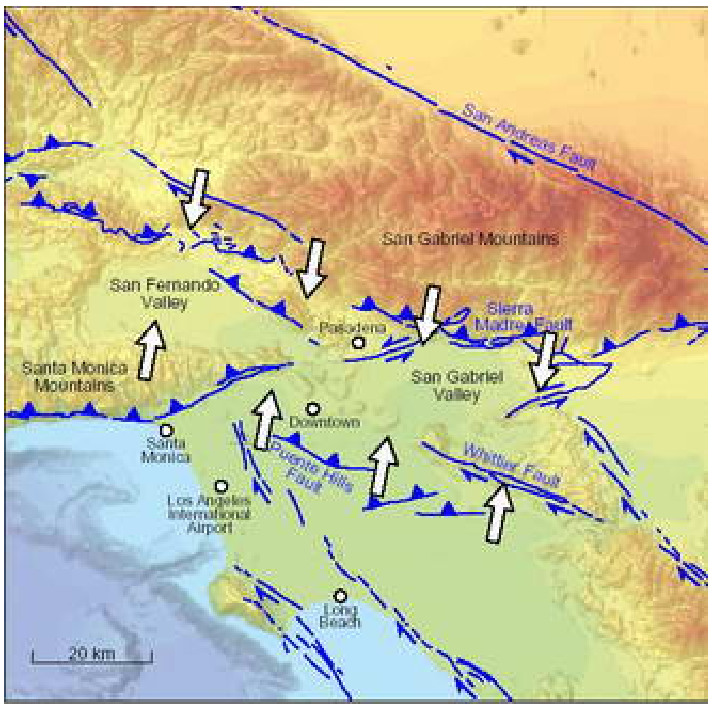

Northern metropolitan Los Angeles is being squeezed at a rate of five millimeters [0.2 inches] a year, straining an area between two earthquake faults that serve as geologic bookends north and south of the affected region, according to NASA scientists.

Image: Map of Greater Los Angeles, depicting selected major faults and *the region in northern metropolitan Los Angeles being squeezed by movements of Earth's tectonic plates.*

The compression of the Los Angeles landscape is being monitored by a network of more than 250 precision global positioning system (GPS) receivers, known as the Southern California Integrated Global Positioning System Network (SCIGN), as well as by measurements from interferometric synthetic aperture radar (InSAR) satellites operated by the European Space Agency (ESA).

Information from these two sources of precision ground deformation measurements is accumulating and enhancing our knowledge of the forces shaping the land surface in the Los Angeles region. These forces include motions of the North American and Pacific tectonic plates and ground movement caused by human activities, such as oil drilling and pumping water into and out of local aquifers.

A team of scientists from NASA's Jet Propulsion Laboratory and University of California at Los Angeles, led by Donald Argus, set out to distinguish between motions induced by human activity and those generated by movements of Earth's tectonic plates. Their results, published in the Journal of Geophysical Research (Solid Earth) in April, indicate human-caused motions are very slow and could not account for the significant ground shift observed in northern Los Angeles.

The new study used space-based navigation to determine the exact position of hundreds of points around the metropolitan area to measure the strain building up across faults. Scientists expect that the strain will ultimately be released in earthquakes much like the 1994 Northridge temblor. The study also suggests which faults might be most likely to rupture. "These findings remove uncertainty about the rate at which strain is building up in northern metropolitan Los Angeles," Argus said. "In addition, by taking into account the effects of humans and observations from the many new global positioning system sites established in the past few years, we can identify the areas where strain is building the fastest."

He cautioned, however, that more studies are needed, since scientists do not yet fully understand the consequences and risks of this stress accumulation. "Nevertheless, these data have important implications for hazard management and retrofitting strategies," he said.

The study finds strain is rapidly accumulating within an area 12 to 25 kilometers [7.5 to 16 miles] south of the San Gabriel Mountains, primarily in the San Gabriel and San Fernando Valleys and nearby hills. The region is located between the Puente Hills fault, which begins south of downtown Los Angeles and extends east, and the Sierra Madre fault, which runs along the base of the San Gabriel Mountains

The new analysis indicates the crust above the Los Angeles segment of the Puente Hills Fault is being squeezed the most. The finding suggests that the Puente Hills Fault and nearby faults in the area, such as the upper Elysian Park Fault, may be more likely to break than those elsewhere in metropolitan Los Angeles. Previous studies have estimated the Puente Hills Fault might generate an earthquake of magnitude 6.6 to 7.5.

The researchers constructed models of the accumulating strain, varying which faults "creep" (move continuously without producing earthquakes), how fast they creep, and the depths at which the faults go from being "locked" in place (and building strain) to creeping. The model that best fit the actual global positioning system observations is one in which a thrust fault (a fault where one block of Earth shifts up or down relative to the other) is locked above six kilometers [four miles] deep and creeps at about nine millimeters [0.4 inches] a year beneath that depth. From that model, they inferred that the deep part of the Los

Angeles segment of the Puente Hills Fault is creeping, as is a deep unknown buried fault east of downtown that lies north of the Whittier Fault and south of the Sierra Madre Fault. The model does not allow the researchers to determine which fault segments are locked.

Argus said a significant discrepancy exists between the relatively shallow locking depth of their model and the historical record of the depth of earthquakes that struck the region in 1971 and 1994, which were much deeper. Scientists speculate the discrepancy may be due to the presence of sediments filling parts of the Los Angeles basin. Further studies are planned to examine how these sediments may be affecting fault strain in the region.

The study used InSAR data collected from 1992 to 2000 from ESA's European Remote Sensing satellite to estimate vertical ground motion. Horizontal strain buildup measurements were made from SCIGN observations from 1994 to 2004.

Source: American Geophysical Union

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