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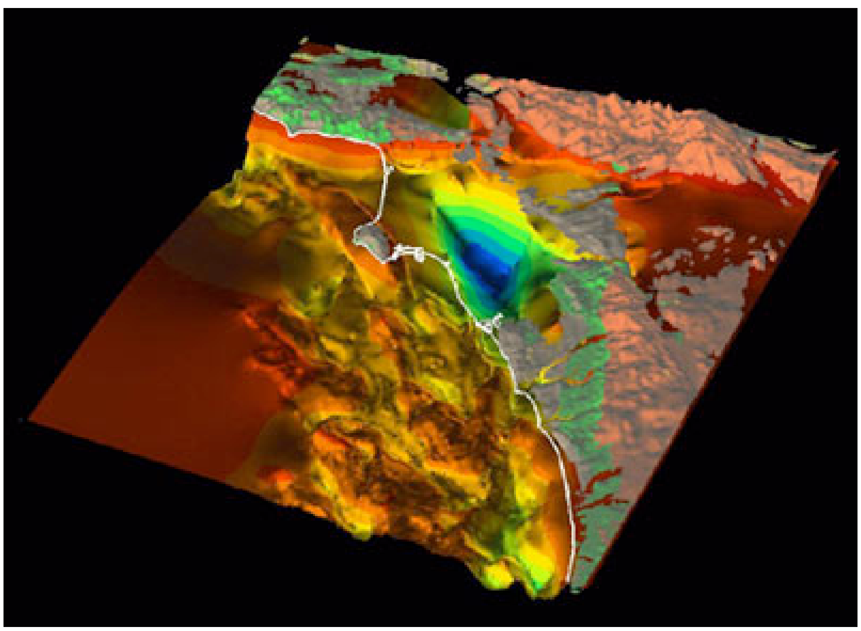
Catching Seismic Waves in 3D

If you're in the Los Angeles area during the next big earthquake, you'll fare better on the solid rock of the mountains around L.A. than in the city, according to new, detailed simulations of how seismic waves travel through the ground beneath L.A.



L.A. rocks. A 3D model of the Los Angeles basin (with the coastline marked in white) may help researchers gauge the impact of future quakes.
CREDIT: JOHN SHAW/HARVARD UNIVERSITY

In traditional earthquake models, seismic waves ripple in neat, concentric circles away from the epicenter on a uniform Earth, because seismologists project only one forward path for waves. But that approach is flawed, says Jeroen Tromp of the California Institute of Technology in Pasadena. Earthquake waves don't travel like ripples in water, they forge distorted paths through rough topography and Earth's complex internal rock layers.

To create a more realistic picture of how seismic waves move, Tromp and colleagues sent virtual seismic waves through a three-dimensional model of the L.A. basin recently devised by geologist John Shaw of Harvard University in Cambridge, Massachusetts. Computers calculated the speed, acceleration, and amplitude of the waves in three directions for each of 45.4 million points, evenly spaced across 261,612 square kilometers and extending 60 kilometers underground.

These simulated waves, propagating from the epicenters of two recent magnitude 4.2 earthquakes, closely matched the actual displacement measured by seismic recording stations during the quakes. And the results match far better with the real data than one-dimensional models do, the team reports in the February issue of the *Bulletin of the Seismological Society of America*. In the simulated quakes, waves lingered in loose sediments and sped through hard rock. As a result, shaking lasts longer and is stronger in the L.A. basin, where sediments trap earthquake energy, than in surrounding hard-rock areas.

Although predicting when the next earthquake will hit is still an elusive goal, Tromp and colleagues think they now have the tools to say exactly how the ground beneath L.A. will move during earthquakes of any magnitude. And that should help prevent destruction in future quakes, says geophysicist Chris Bradley of Los Alamos National Laboratory in New Mexico: "We can do damage estimates better" with this model.

--ELISABETH NADIN

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Jeroen Tromp's site
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