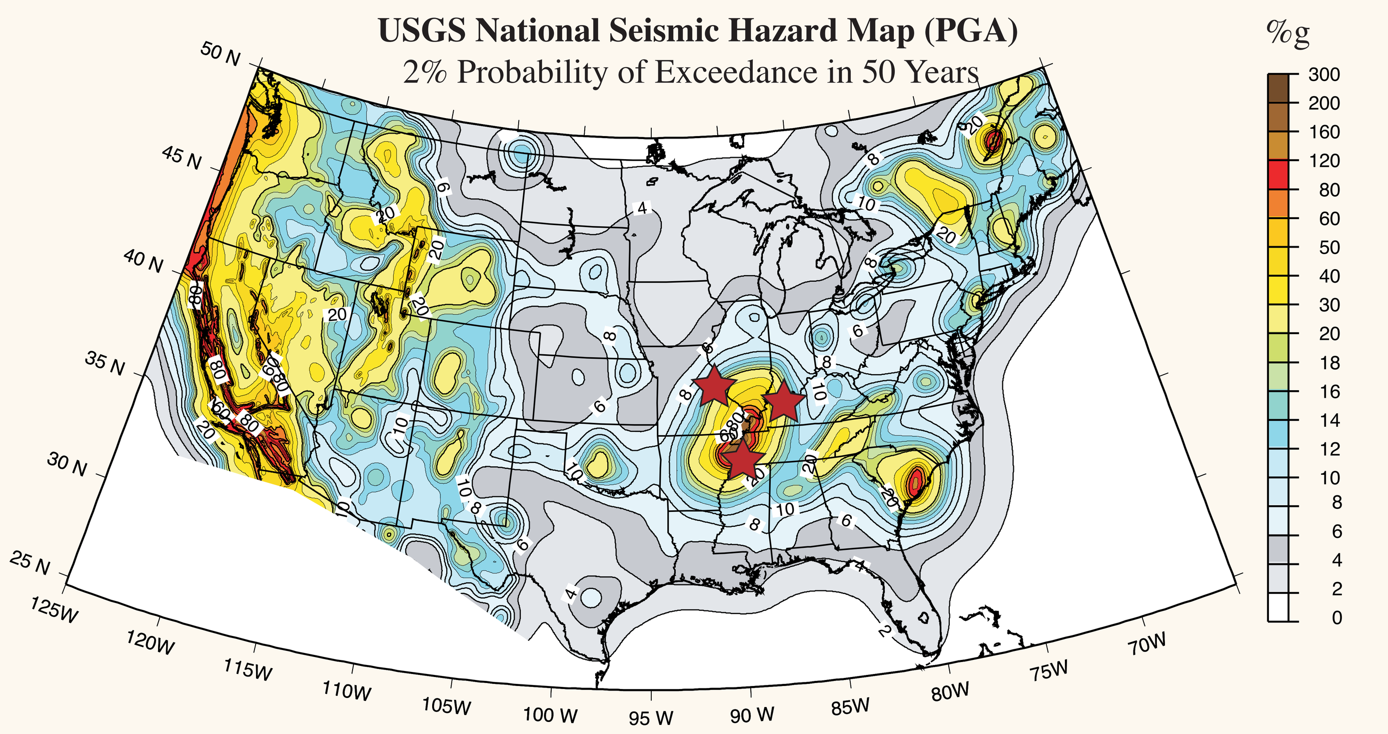
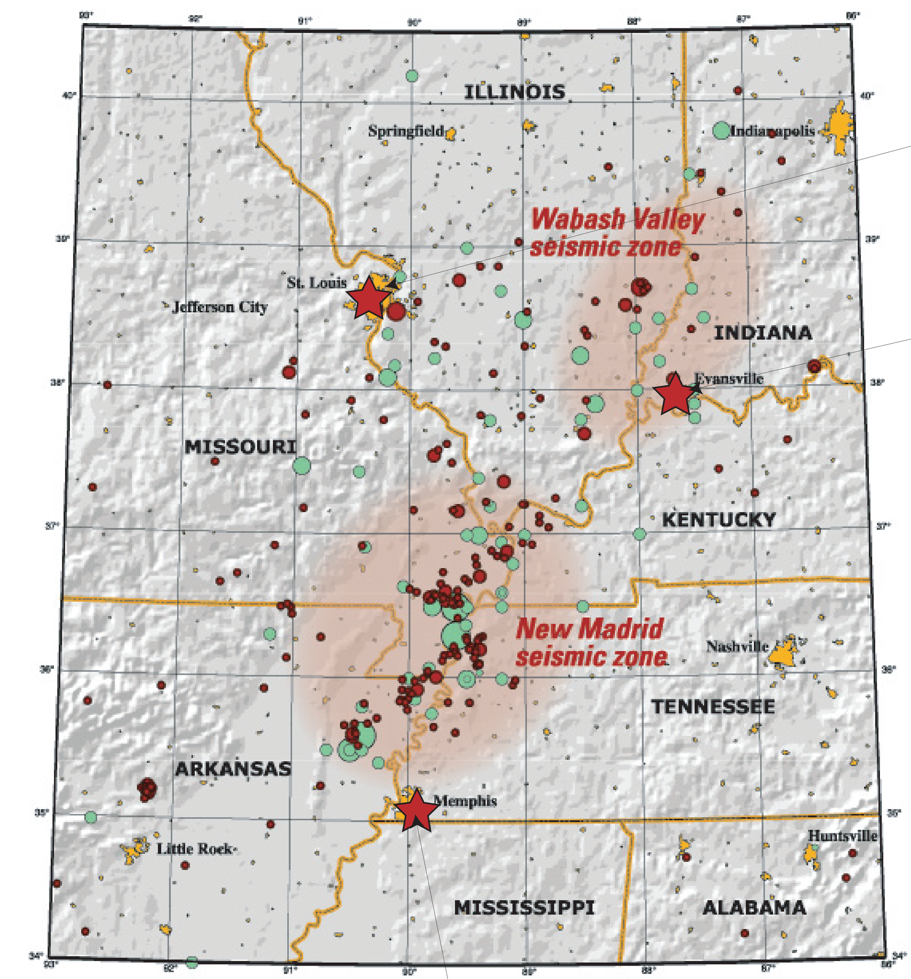
URBAN SEISMIC HAZARD MAPS by the USGS and its Partners

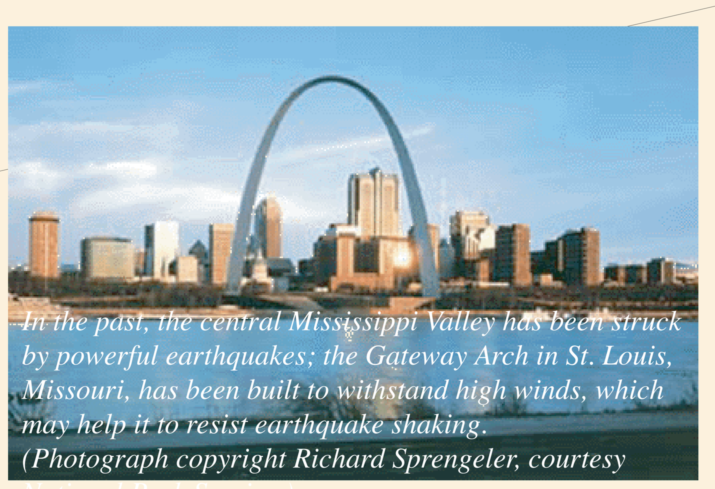
science for a changing world



At long periods of exposure, the USGS National Seismic Hazard maps (above) show the hazard in the Central US to be comparable to the highest hazard in California. The National maps do not account for variations in local geology, particularly sediments and buried topography, that are known to significantly affect earthquake ground motions. The USGS is working with its partners to make maps that do take local effects into account, at a level of detail useful within an urban area. Mapping is complete for the urban area of Memphis and underway for the areas of St. Louis and Evansville (stars on maps above and to the right).



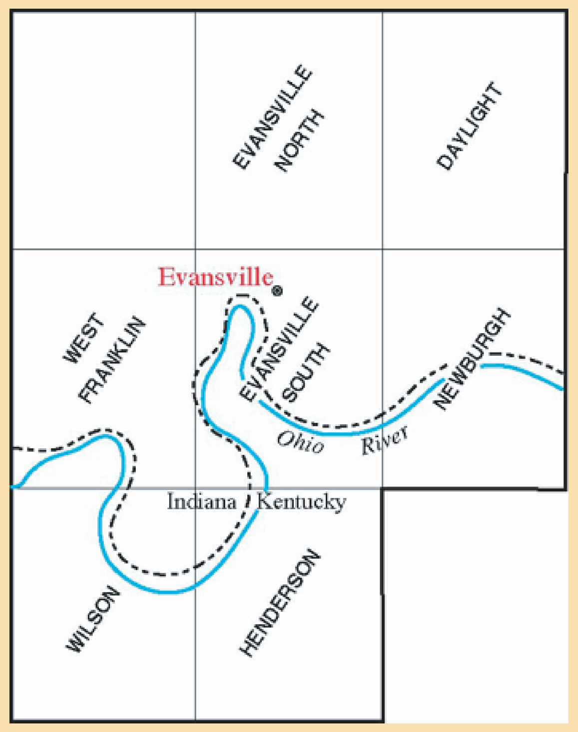
ST. LOUIS



In the past, the central Mississippi Valley has been struck by powerful earthquakes; the Gateway Arch in St. Louis, Missouri, has been built to withstand high winds, which may help it to resist earthquake shaking. (Photograph copyright Richard Sprengeler, courtesy

The urban hazard mapping project here is being lead by representatives from the University of Missouri-Rolla Natural Hazards Institute, the Illinois State Geological Survey, the Missouri Dept. of Natural Resources, the Central U.S. Earthquake Consortium (CUSEC) emergency managers, CUSEC State Geologists, and the USGS.

EVANSVILLE

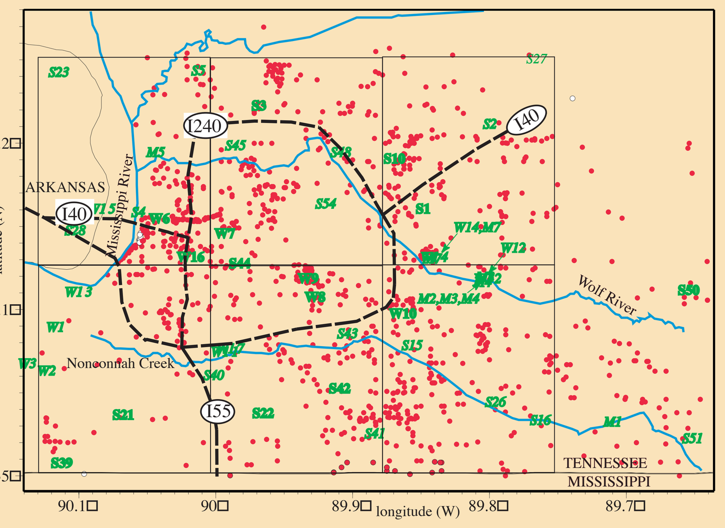


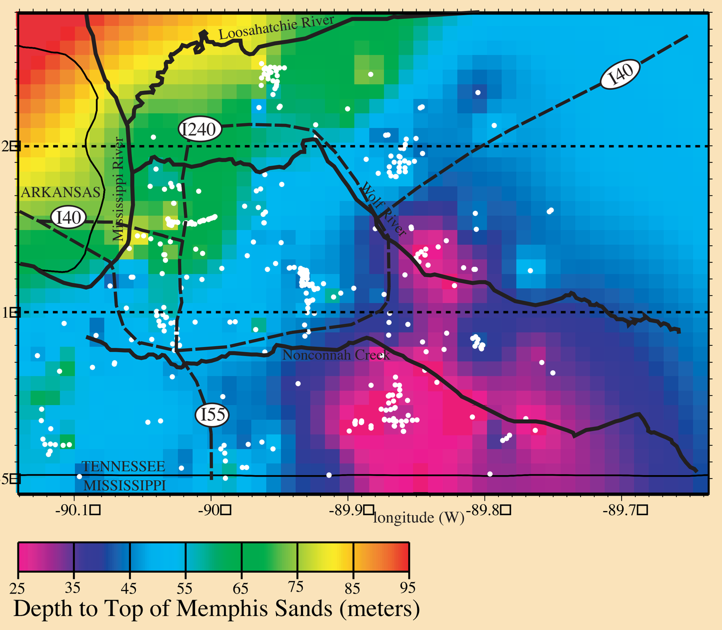
The mapping project here is being lead by representatives from the State Geologic Surveys of Kentucky, Illinois, and Indiana, the Southwest Indiana Disaster Resistant Community Corp., the Central U.S. Earthquake Consortium (CUSEC) emergency managers, CUSEC State Geologists, and the USGS.

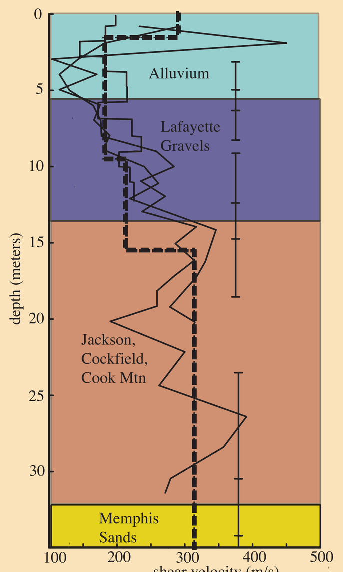
MEMPHIS

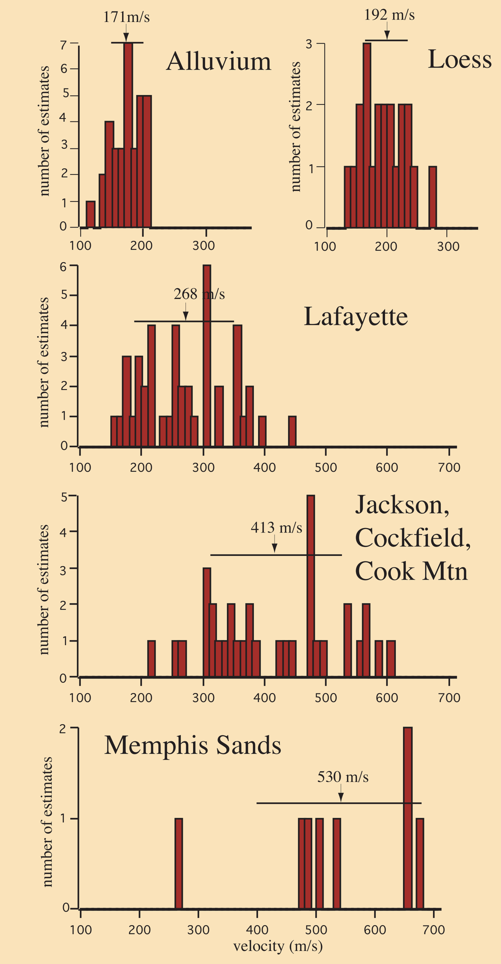
GEOLOGIC & VELOCITY MODELS

A new 3-D model of the geologic layers beneath Memphis was developed using about 1200 boring- and well-logs (red dots, left map). Log information and interpretations are stored in a publicly available database developed by the Ground Water Institute (see below). Layer boundaries (e.g. right map) are fit to the log measurements. This 3-D geologic model is used as a proxy for the shear-wave velocity structure, needed for ground motion calculations. We correlate velocity profiles measured at 76 sites (green labels,left map) with the geologic model at each site (example profiles & unit boundaries shown), to estimate a mean velocity and uncertainties for each unit (histograms on the right).

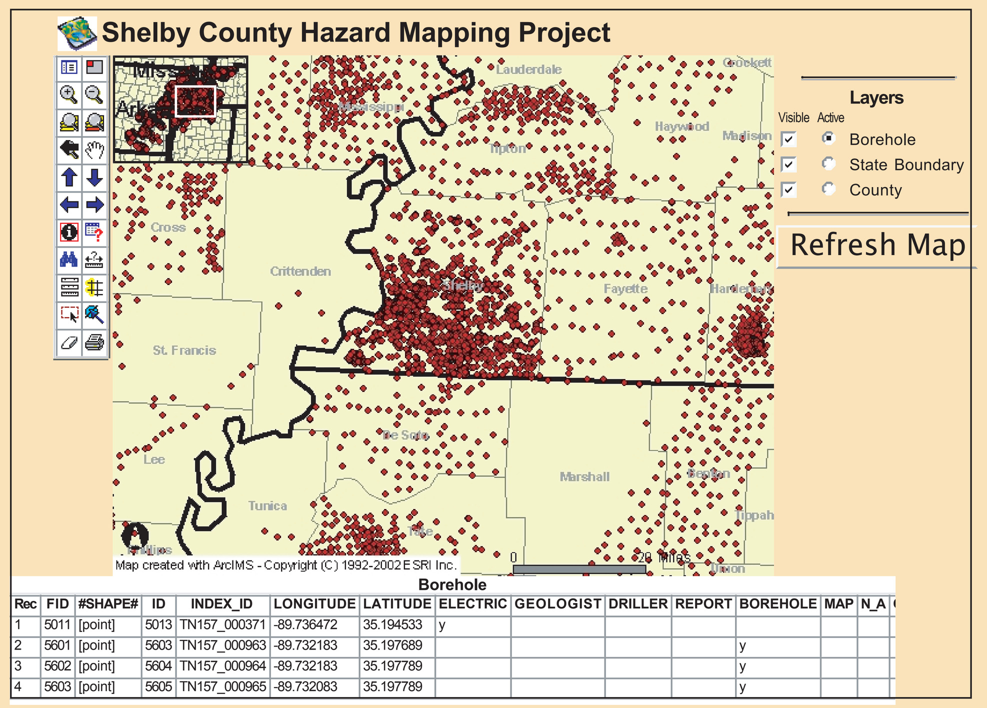








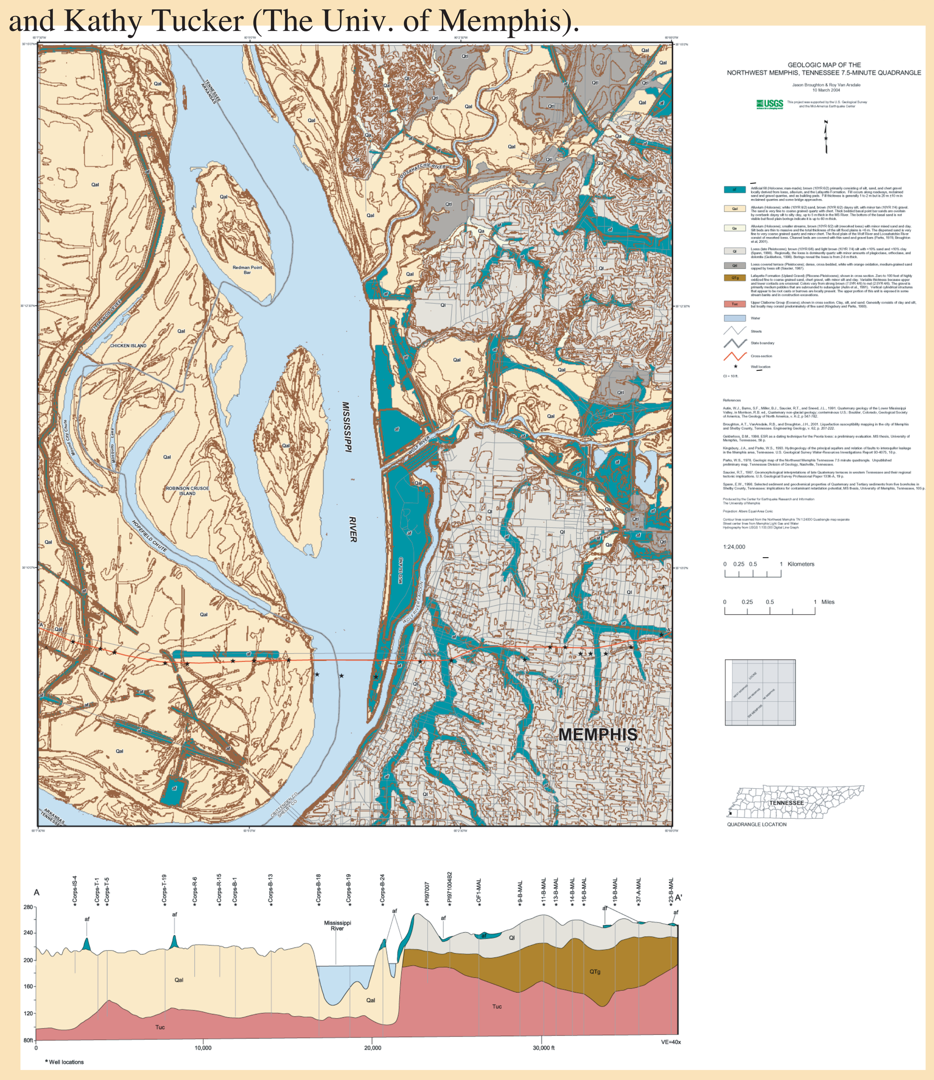
SUBSURFACE DATABASE



The Ground Water Institute at The Univ. of Memphis maintains a database of subsurface information based primarily on engineering boring and water well logs. It can be accessed using a Web-based mapserver or using ARCView; see http://gwidc.memphis.edu/website/introduction/

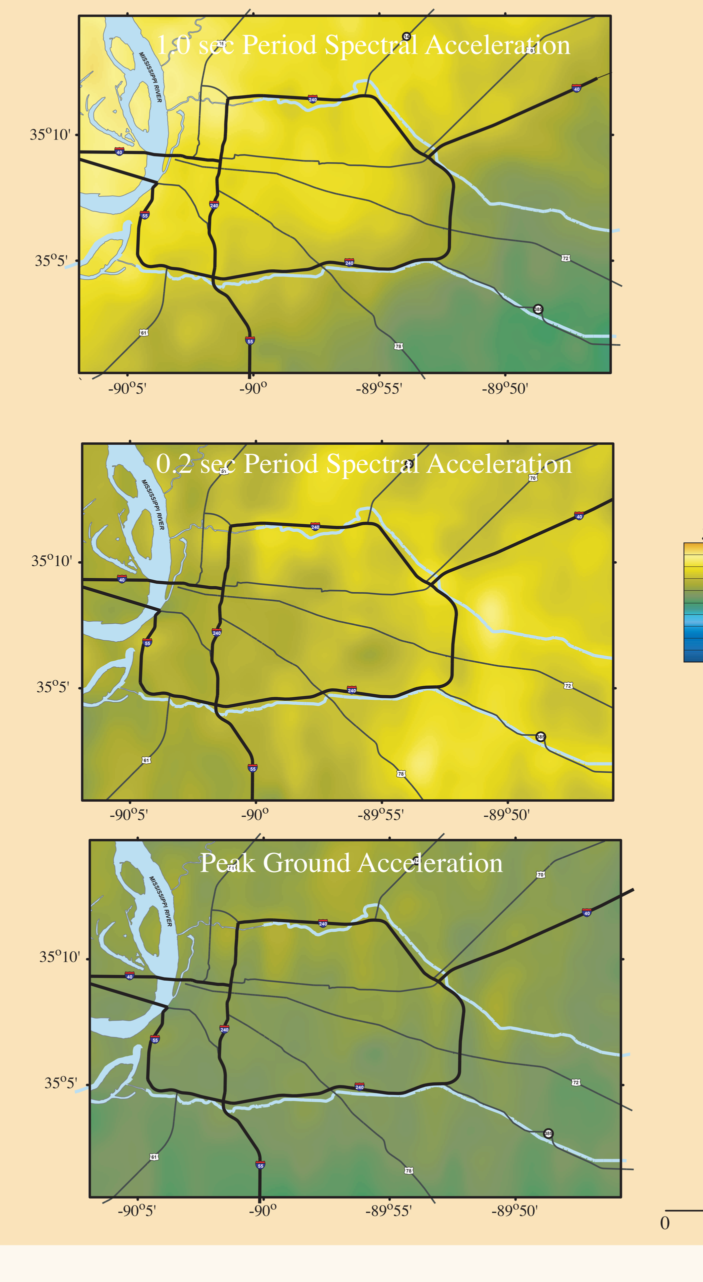
GEOLOGIC MAPS

We have produced new surficial geologic maps for the six 1:24,000 quadrangles covering the study area. These are being published as USGS digital MF maps. Authors include Dave Moore and Sharon Diehl (USGS), Roy VanArsdale, Randy Cox, Aaron & Jason Broughton, and Kathy Tucker (The Univ. of Memphis).



PROBABILISTIC GROUND MOTION MAPS

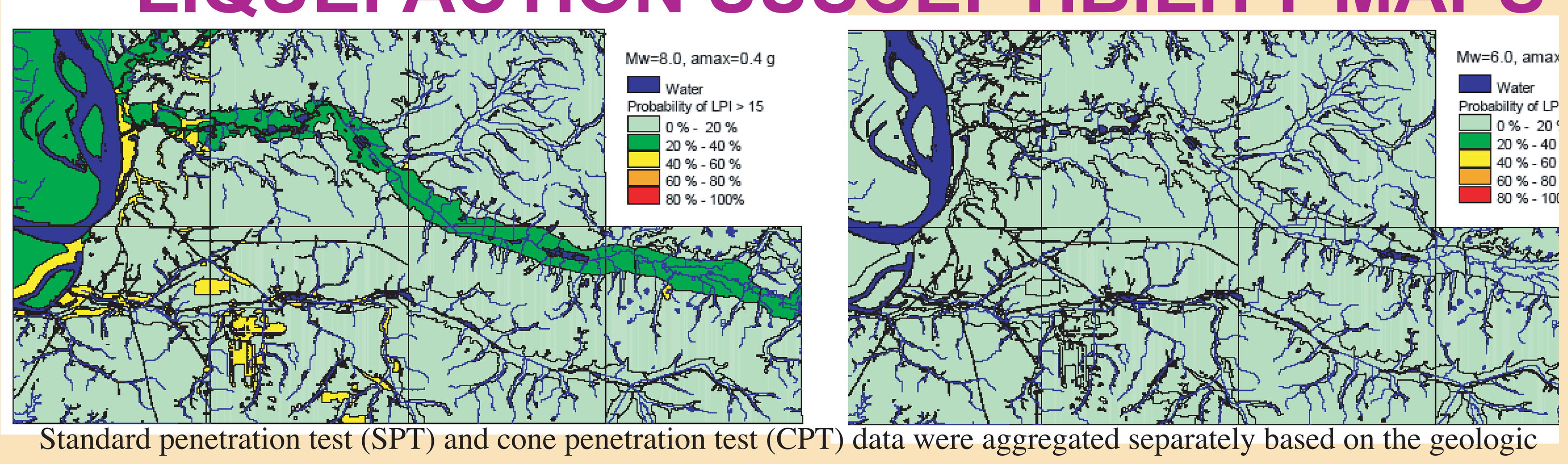
We include the effects of local sediments directly in the probabilistic calculations, rather than as corrections to maps that assume uniform rock conditions. This fully probabilistic approach preserves the true probabilities and accounts for uncertainties. Below we show maps for 2% probability of exceedance in 50 years, for various types of ground motions.



SCENARIO GROUND MOTION MAPS

Scenario maps for a M 7.7 earthquake on a fault coincident with the southern end of the southwest trending line of seismicity in the New Madrid seismic zone. These use all the same inputs as the probabilistic maps, but try to answer the question "What would the shaking be like if an earthquake of this size at this place were to occur?"

LIQUEFACTION SUSCEPTIBILITY MAPS



Standard penetration test (SPT) and cone penetration test (CPT) data were aggregated separately based on the geologic unit mapped at the measurement site, and analyzed to calculate the 'factor of safety' as a function of depth. These depth profiles and auxilary data are used to estimate the liquefaction potential index (LPI), representing the liquefaction susceptibility of each type of surficial geologic material for a given peak ground acceleration and moment magnitude (a proxy for duration). The probabilities of exceeding a particular LPI for each surficial geologic unit were estimated for various earthquake scenarios: minor liquefaction (LPI > 5) and major liquefaction (LPI > 15).

This work is by Glenn J. Rix and Salome Romero-Hudock at the Georgia Institute of Technology.