

FINAL TECHNICAL REPORT

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Seismic Hazard Map Products for the Central and Eastern
United States

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Abstract

The “Seismic Hazard Map Products for the Central and Eastern United States” (ShazMap) project was developed to provide convenient and rapid access to seismic hazard maps (1996 USGS, 1997 NEHRP, Memphis Urban Seismic Hazard Mapping Project), census data (2000), and infrastructure data. Although more current maps had been produced in 2000 by the National Seismic Hazard Mapping Project (NSHMP), we utilized the 1997 NEHRP maps because they were the basis 2002 International Building Code (IBC), which was the current code for CEUS states. The project also provided the same suite of NSHMP maps from 2000 and 2002 (2001 and 2003 NEHRP). The database provided comprehensive information that was relevant to existing seismic building codes and easily accessed from one source. These products provided users with the ability to rapidly overlay social and structural data layers with various probability of exceedence (PE) and spectral acceleration (SA) levels. Users included local, state, and federal emergency managers and planners; engineers; state departments of transportation; policy makers; urban planners; business continuity and contingency planners; and the general public. Infrastructure and social vulnerability data layers were created at regional and local levels, in several different formats (jpeg, emf, and pdf) to ensure compatibility with all operating systems. Including redundant formatting, the database includes over 600 data layers totaling more than 700 MB of information. Although some information from the Memphis Urban Seismic Hazard Mapping Project (MUSHMAP) were only available in gif format, most of the maps developed in the project were of high resolution. Products were distributed directly to dozens of users including the TN Department of Transportation, Oak Ridge National Lab, and local, state and federal emergency managers. The social data enabled the Community and Regional Resiliency Initiative (CARRI at Oak Ridge National Lab) to rapidly generalize the resiliency of the Memphis area and to identify the city as one of its pilot cities in the CARRI project. Unfortunately, the subsequent adoption of new seismic hazard maps in the IBC following negated continued use of ShazMap products because they were no longer relative to code. In retrospect, this project was very beneficial, but considering the short lived nature of seismic hazard maps and census data, future databases of this type would be more effective as an online database using ARC GIS tools or similar map servers with long term approach to funding in order to keep data current and accessible. A database of this nature would be easily updated and also provides critical Meta data and background on each individual data layer.

Report

In direct partnership with the US Geological Survey, The Center for Earthquake Research and Information at the University of Memphis interacts with local, state, and federal agencies concerned with the impacts of a large earthquake in the New Madrid seismic zone. However, users are often overwhelmed with the need to access data from various sources to quickly grasp the most significant areas of ground motion and social vulnerability. Figure 1 is a representative sample of the social vulnerability data in the ShazMap database. The info source is listed at the bottom of each data layer.

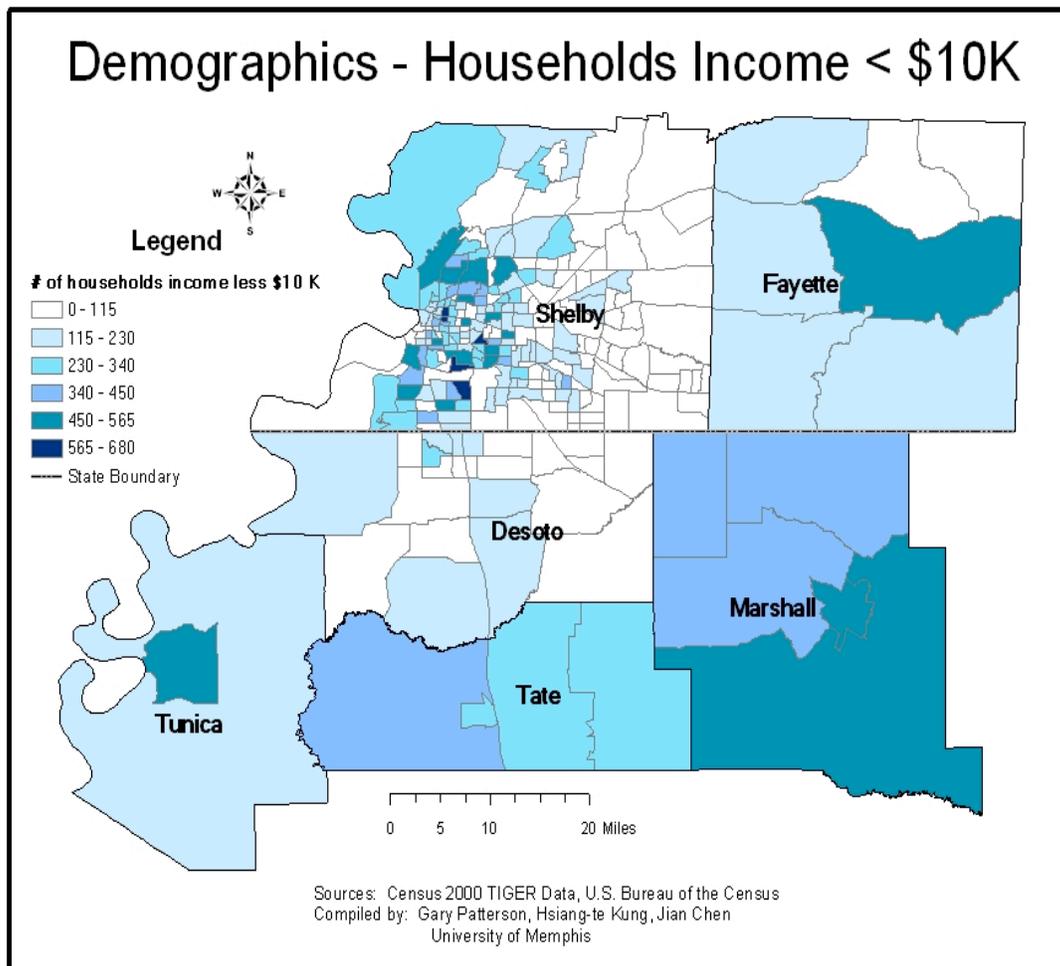


Figure 1. Example of social vulnerability data provided in this project.

Figure 2 shows the 1997 NEHRP (1996 USGS), 2% in 50-year PE (peak ground acceleration) map. These data are easily overlaid to generally identify possible relationships between social vulnerability and seismic hazard (Figure 3). These types of analyses are particularly pertinent based on lessons learned from the fallout of Hurricane Katrina, where socially vulnerable communities were located in geographically vulnerable locations (low lying areas of the 9th Ward).

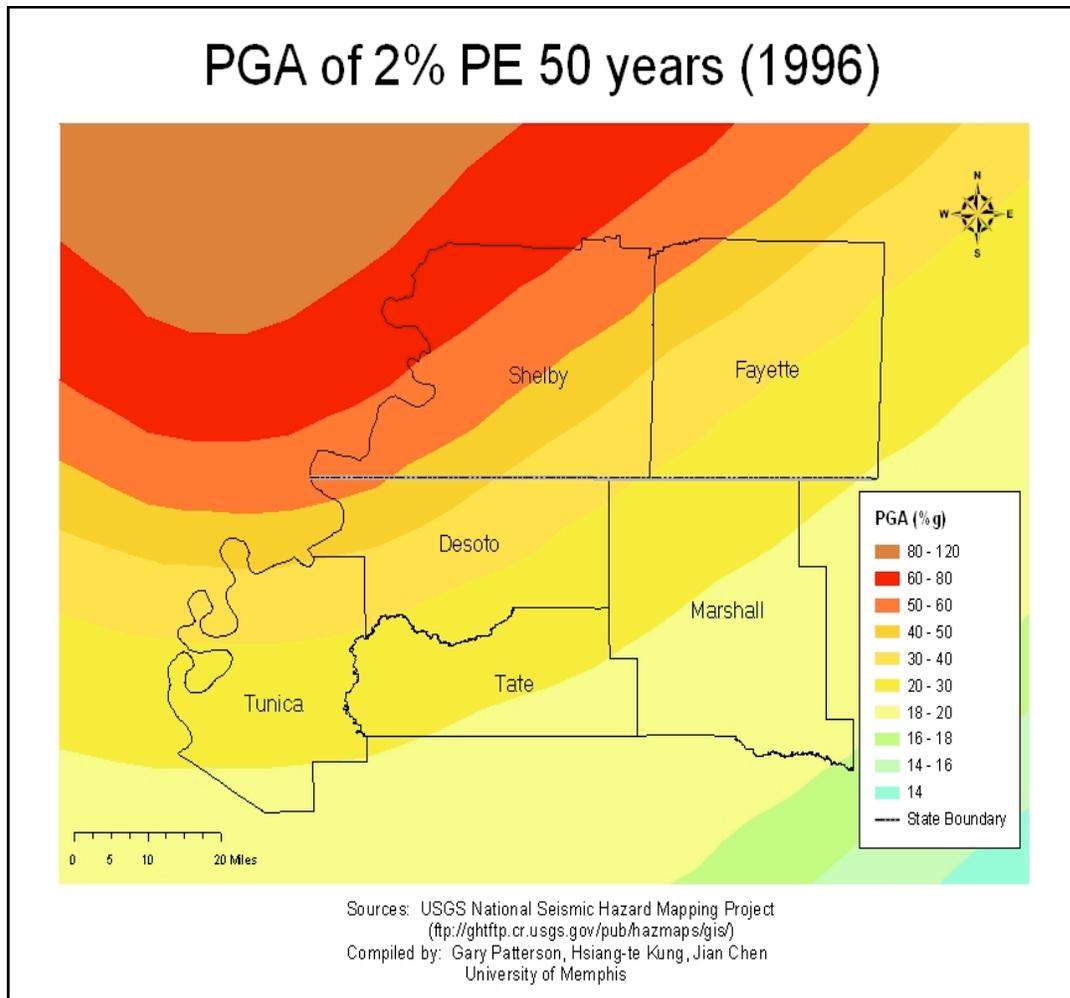


Figure 2. 1996 National Seismic Hazard Map. Peak Ground Acceleration with a 2% PE in 50 years.

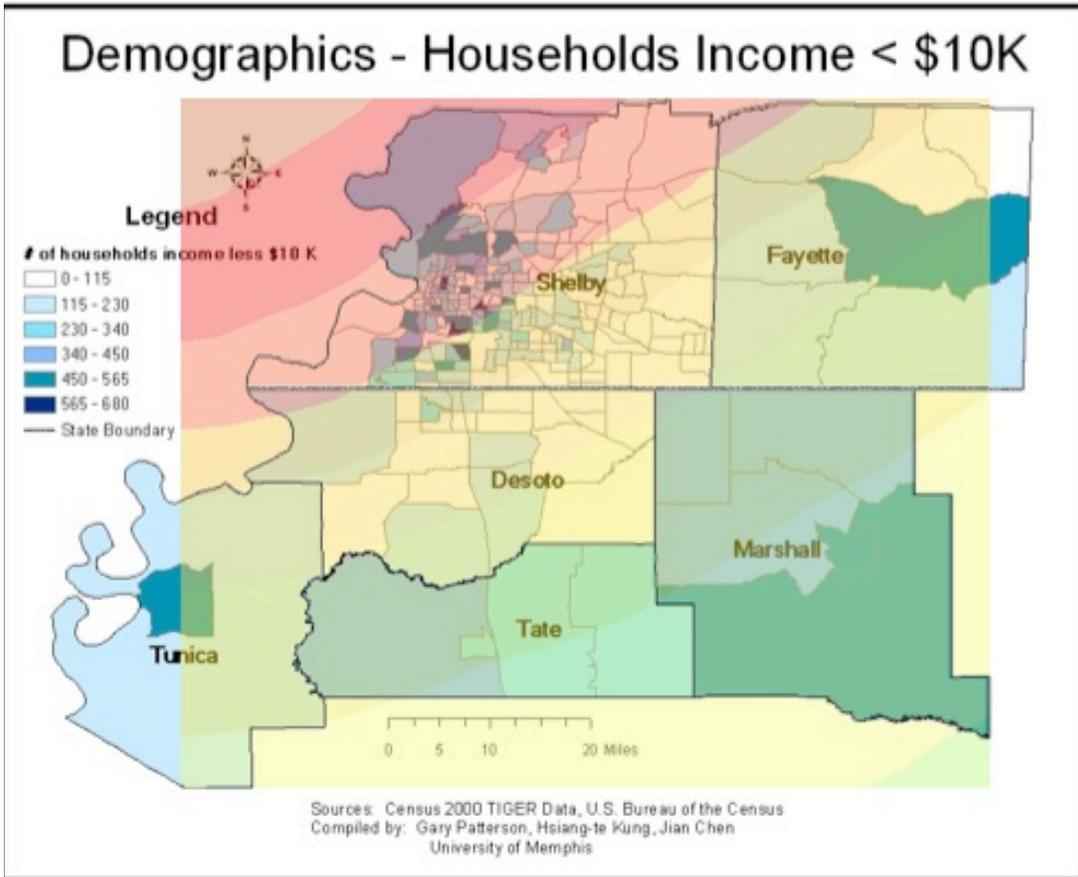


Figure 3. Overlay of seismic hazard and average household income by census tract.

Shazmap Components:

In addition to all the products provided by the Memphis Urban Seismic Hazard Mapping Project, the data for this project included:

1996 NSHMP:

- PGA of 2% PE in 50
- PGA of 5% PE in 50
- PGA of 10% PE in 50
- 0.2 second SA 2% PE in 50
- 0.2 second SA 5% PE in 50
- 0.2 second SA 10% PE in 50
- 0.3 second SA 2% PE in 50
- 0.3 second SA 5% PE in 50
- 0.3 second SA 10% PE in 50
- 1.0 second SA 2% PE in 50
- 1.0 second SA 5% PE in 50
- 1.0 second SA 10% PE in 50

2001 NSHMP:

- PGA of 2% PE in 50
- PGA of 10% PE in 50
- 0.2 second SA 2% PE in 50
- 0.2 second SA 5% PE in 50
- 0.2 second SA 10% PE in 50
- 0.3 second SA 2% PE in 50
- 0.3 second SA 5% PE in 50
- 0.3 second SA 10% PE in 50
- 1.0 second SA 2% PE in 50
- 1.0 second SA 5% PE in 50
- 1.0 second SA 10% PE in 50

2003:

- PGA of 2% PE in 50
- PGA of 10% PE in 50
- 0.2 second SA 2% PE in 50
- 0.2 second SA 10% PE in 50
- 1.0 second SA 2% PE in 50
- 1.0 second SA 10% PE in 50

II. Comparison (Variation between and among 1996, 2001 NEHRP, and 2003 NEHRP:

- PGA of 2% PE in 50 years - 1996/2001/2003
- PGA of 10% PE in 50 years 1996/2001/2003
- 0.2 second SA 2% PE in 50 years - 1996/2001/2003
- 0.2 second SA 5% PE in 50 years - 1996/2001
- 0.2 second SA 10% PE in 50 years - 1996/2001/2003
- 0.3 second SA 2% PE in 50 years - 1996/2001/2003

0.3 second SA 5% PE in 50 years – 1996/2001
0.3 second SA 10% PE in 50 years - 1996/2001/2003
1.0 second SA 2% PE in 50 years - 1996/2001/2003
1.0 second SA 5% PE in 50 years – 1996/2001/2003
1.0 second SA 10% PE in 50 years - 1996/2001/2003

III. Infrastructure Maps

-Transportation:

Highway
Bridge
Railway
Railway Bridge
Airport Facility
Port Facility

-Utility:

Electric Power Plant
Natural Gas Facility
Natural Gas Distribution Pipes – Brittle Pipe
Natural Gas Distribution Pipes – Ductile Pipe
Natural Gas Distribution Pipes – Total Pipe
Oil Facility
Portable Water Facility
Portable Water Distribution Pipes – Brittle Pipe
Portable Water Distribution Pipes – Ductile Pipe
Portable Water Distribution Pipes – Total Pipe
Waste Water Facility
Waste Water Distribution Pipes – Brittle Pipe
Waste Water Distribution Pipes – Ductile Pipe
Waste Water Distribution Pipes – Total Pipe
Utility Facility
Communication Facility

-Essential Facility:

Emergency Center
Fire Station
Hospital
Police Station
School

-High Potential Loss Facility:

Dams
Hazardous Materials

IV. General Building Stock Maps

Number of Buildings - Agriculture
Number of Buildings - Commercial
Number of Buildings - Education
Number of Buildings - Government
Number of Buildings - Industry
Number of Buildings - Religion
Number of Buildings - Residential
Number of Buildings - Total
Square Footage - Agriculture
Square Footage - Commercial
Square Footage - Education
Square Footage - Government
Square Footage - Industry
Square Footage - Religion
Square Footage - Residential
Square Footage – Total Dollar Exposure –
Agriculture Dollar Exposure –
Commercial Dollar Exposure –
Education Dollar Exposure –
Government Dollar Exposure –
Industry Dollar Exposure –
Religion Dollar Exposure –
Residential Dollar Exposure –

V. Demographics Maps:

Population
White Population
Black Population
Native American Population
Asian Population
Hispanic Population
Pacific Island Population
Other Race Population
Male Population
Female Population
Male Aged < 16
Male Aged > 65
Female Aged < 16
Female Aged > 65
Households
Households Income < \$ 10K
Households Income > \$ 100K
Resident at Day
Resident at Night
College Population
Schools

Results and Conclusions

The Shazmap project provided critical data for users seeking information on the exposure of infrastructure, buildings, and people with respect to state of the art seismic hazard maps from the NSHMP. The data were an important contribution to the development of regional damage assessments, the code adoption process, business planning, land use planning, infrastructure planning, and dozens of other applications. In hindsight, the project was very successful, but the short-lived nature of these important data requires a system to update information with on line access through an ARC GIS or similar map server.

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Related Publications: None