

Using Shakemap Data in a HAZUS-MH Earthquake Scenario

HAZUS-MH provides the ability to integrate user-provided hazard and inventory data into the analysis process. The result of this process is typically more credible analysis which can lead to a wider range of purposes to which HAZUS-MH can be applied.

This document provides guidance for finding and integrating Shakemap data into the HAZUS-MH earthquake analysis process. ShakeMaps are a product of the U.S. Geological Survey Earthquake Hazards Program in conjunction with regional seismic network operators. ShakeMap sites provide near-real-time maps of ground motion and shaking intensity following significant earthquakes. These maps are used by federal, state, and local organizations, both public and private, for post-earthquake response and recovery, public and scientific information, as well as for preparedness exercises and disaster planning.

Step 1: Obtain ShakeMap Data

There are a number of data providers that make ShakeMap available for anyone with an Internet connection. Examples include, but may not be limited to, the following:

United States Geological Survey

<http://earthquake.usgs.gov/eqcenter/shakemap/>

California Integrated Seismic Network (CISN)

<http://www.cisn.org/shakemap/sc/shake/archive/scenario.html>

Note that the CISN site provides shapefiles specifically designed for HAZUS-MH users. If you acquire shapefiles from other sources, you need to be sure that they have been designed for HAZUS-MH use. The following text accompanies these files.

Please note that these are average ground motions, whereas most ShakeMap amplitudes are given as peak. Average ground motions are 15% less than peak.

This is an archive of files (three files for each of the mapped parameters) compressed in zip format.

The three files are:

.dbf = A DBase file with layer attributes

.shp = The file with geographic coordinates

.shx = An index file

These shape files are designed with intervals that are appropriate for use with the HAZUS software, though they may be imported into any GIS package that can read ArcView shapefiles. Because HAZUS expects PGV in inches/sec, and all amplitudes to be average, not peak, this file may not be suitable for all applications; see "Shape Files" below for another set of shapefiles with peak amplitudes and more generally useful units.

The contour intervals are 0.04g for PGA and the three spectral acceleration parameters (only two of which are used by HAZUS), and 4 inches/second for PGV. The file also includes MMI contour polygons in intervals of 0.2 intensity units.

Shake map data for HAZUS-MH must include a minimum of four files - peak ground acceleration (typically named PGA.shp), permanent ground deformation (typically named PGD.shp), spectral acceleration at 1 second (typically named psa10.shp) and spectral acceleration at .03 seconds (typically named psa03.shp).

The following instructions describe the process for downloading Shakemap data from the CISN site. Other sites may differ significantly from these steps.

Click on a Scenario Name *(ex: [Rose Canyon M6.9 Scenario](#))*

Click on the **Download** tab to view the list of files that are available for downloading.

There is a great deal of useful data on this site. It is worth your time to explore it at some point.

Scroll down to the **GIS Files** section and click the **hazus.zip** link.

These files are in a 'near HAZUS ready' format. They merely need to be reprojected and converted to a geodatabase format as described later in this document.

Save the file to a location of your choice on your computer.

Use Winzip or another tool to unzip the file.

Step 2: Define the Shakemap Projection

HAZUS-MH provides a utility, described in step 3, that converts shakemap shapefiles available from CISN and elsewhere to the geodatabase format required by HAZUS-MH MH MR3. Unfortunately, as of the release of this document (August 2008) this utility does not currently allow input of shapefiles before they have a defined map projection which is required in ArcGIS and, in the case of shapefiles, is provided in the prj file. This prj file is not included with Shakemap shapefiles from CISN or most other sites. This may be because these sites designed the shapefiles for use in an earlier version of HAZUS which was based on ArcView 3.x and thus did not require projection

information. In addition, it is quite possible that the shakemaps that you acquire will be in WGS 84 coordinates rather than the GCS NAD83 coordinates required by HAZUS-MH. In that event you will need to define the projection of the original data and then reproject it to the required coordinate system. Always check the metadata documentation of your shakemap source files to determine if this is necessary.

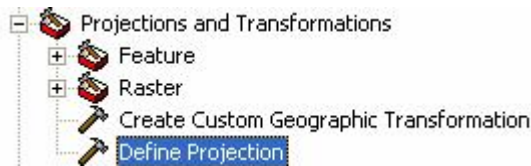
The next few steps describe an example of the process of preparing shakemap shapefiles provided in WGS84 format for use in a HAZUS-MH MR3 earthquake study region.

Start ArcCatalog.

Click the **ArcToolbox** button  to open ArcToolbox.


Navigate in ArcToolbox to **Data Management Tools> Projections**.

This part of ArcToolbox contains the tools that you will need to define the projection and datum of the current data (WGS84) and to project the current data to the HAZUS-MH compliant format (GCS NAD83).




Use the **Define Projection** tool to assign the **WGS84** projection to each of the four shapefiles in the folder where you unzipped your Shakemap data.

*If you are unfamiliar with the Define Projection Tool, you can find instructions for how to use the tool by clicking the **Show Help** button in the lower right corner of the Define Projection Window and then clicking the **Help** button in the Show Help window.*

*The WGS84 projection can be selected by clicking the **coordinate system** button , clicking the **Select** button on the Spatial Reference Properties window, and then navigating to **Geographic Coordinate Systems>World>WGS84**.*

Use the **Project** tool in ArcToolbox to project each of the Shakemap files from WGS84 to GCS NAD83.

*The WGS84 projection can be selected by clicking the **output coordinate system** button , clicking the **Select** button on the Spatial Reference Properties window, and then navigating to **Geographic***

The Project tool will automatically name the projected files to the original

name followed by _Project. Accept this convention.

Delete the four original Shakemap files that are projected (the ones named pga.shp, pgv.shp, psa10.shp, and psa03.shp)

Rename the four projected shapefiles as follows:

PGA_projected.shp to PGA.shp

PGV_projected.shp to PGV.shp

PSA10_projected.shp to PSA10.shp

PSA03_projected.shp to PSA03.shp

Coordinate Systems>North America>North American Datum 1983.

You can also move these files elsewhere if you like. The goal is to remove them from this folder since you will be renaming the projected files to the same names as the original files in the next step.

The HAZUS provided Shakemap utility expects user provided shakemap files to follow a specific naming convention.

Step 3: Convert Shakemap Shapefiles to HAZUS-MH Compliant Geodatabase

The HAZUS-MH Shakemap utility converts shapefiles to a personal geodatabase, the format required by HAZUS-MH MR3. This utility can be found on the HAZUS Applications DVD in a folder named Shakemap. It is not automatically installed when you install HAZUS-MH, so you need to use Windows Explorer to copy the utility from the Applications DVD to your local computer when you wish to use it.

Open Windows Explorer and navigate to the location of the Shakemap data.

Double-click the **Shakemap** utility.

Fill in the **Input** section as shown below.

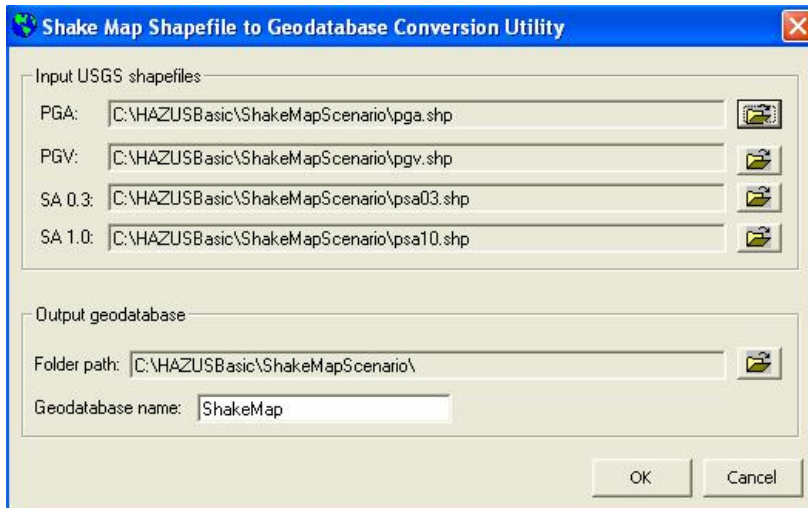
Note that the location of the Shakemap files may not match your file location.

Observe the following:

Once you select the PGA file, the other files are automatically found as well as long as they follow the naming convention that was described above.

The output folder will automatically be populated with the same folder where the input data is stored.

The output geodatabase is automatically named shakemap.



Click **OK** to begin the process.

The conversion process should only take a few moments.

Click **OK** when prompted to acknowledge that the process has finished.

You are now ready to integrate your Shakemap data into a HAZUS-MH study region.

Step 4: Import Shakemap Data to a HAZUS-MH Study Region

Create an earthquake study region for the area that you wish to analyze with your Shakemap data.

Open the study region.

From the **Hazard** menu choose **Data Maps** to open the data maps dialog.

Click the **Add map to list** button to open the browse dialog.

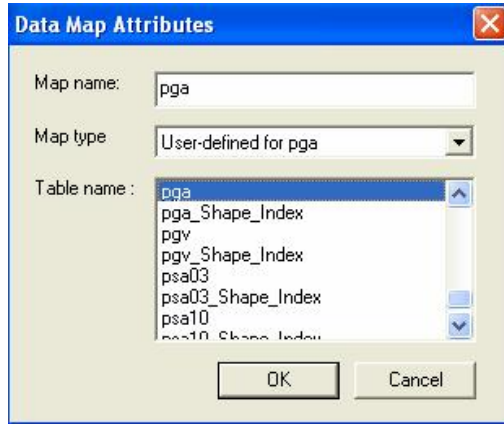
Navigate to the location of the Shakemap geodatabase.

Double-click the **Shakemap** database to open the Data Map Attributes window.

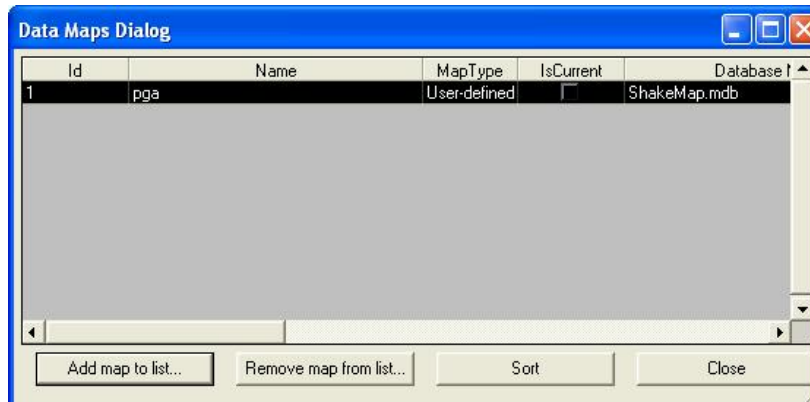
Enter **PGA** for the map name.

Select **User-defined for pga** for the map type.

Select the **PGA** table from the list of tables.



Click **OK** to close the Data Map Attributes window and to add the map to the list.



Add the three additional shakemap feature classes in the Shakemap geodatabase to the Data Maps list. Use the following parameters to complete this task.

Permanent Ground Deformation

- Map Name: PGV
- Map Type: User-defined for PGV
- Table Name: pgv

Spectral Acceleration at 1.0 seconds

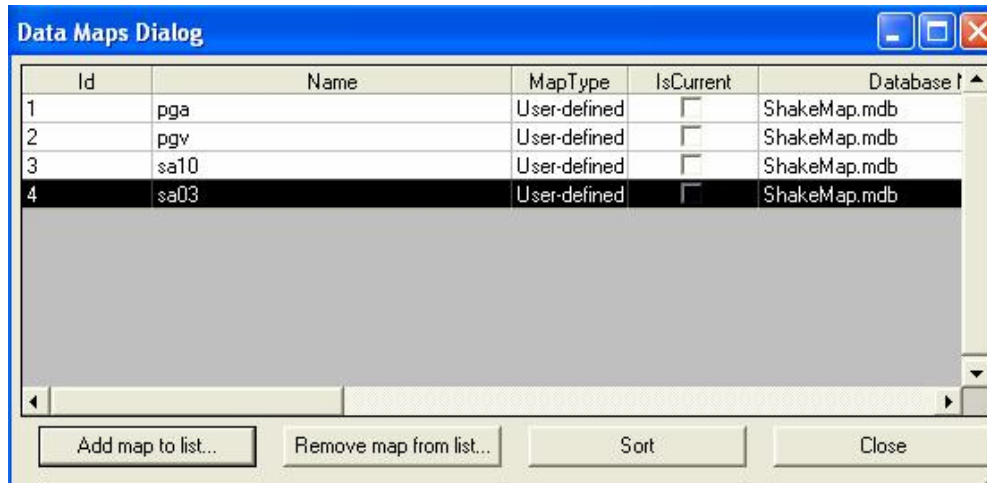
- Map Name: SA10
- Map Type: User-defined at period=1.0 seconds
- Table Name: psa10

Spectral Acceleration at 1.0 seconds

- Map Name: SA03
- Map Type: User-defined at period=0.3 seconds
- Table Name: psa03

When you are finished, the Data Map

Dialog should appear as follows:



Click **Close** to close the Data Maps Dialog.

You are now ready to run the analysis.

Step 5: Create a New Scenario

From the **Hazard** menu choose **Scenario**.

Click **Next** to move to the Earthquake Hazard Scenario Selection window.

Select **Define a new scenario** and click **Next** to move to the Seismic Hazard Type Selection window.

Select **User-supplied hazard** and click **Next** to move to the User-defined Hazard Option window.

Complete the options on the Ground Shaking Maps tab as shown below.

Note the following:

It is vital that you enter the magnitude upon which the Shakemap scenario is based since this impacts some of the analysis options in the earthquake model.

The other tabs on this screen provide more options for expert users, but do not need to be completed to run a basic Shakemap scenario.

The screenshot shows a software window titled "Scenario Wizard" with a close button in the top right corner. Below the title bar, the window is titled "User-defined Hazard Option" with the subtitle "Define other parameters for the User-defined Event option". There is a small icon of a person and a map in the top right corner of the window. The main area contains several tabs: "Ground Shaking Maps", "Liquefaction Maps", "Landslide Maps", and "Surface Fault Rupture". The "Ground Shaking Maps" tab is selected. Inside this tab, there are three groups of dropdown menus. The first group is "PGA countour map:" with a dropdown menu showing "pga". The second group is "PGV countour map:" with a dropdown menu showing "pgv". The third group is "Spectral Response Maps:" with two sub-items: "At 0.3 seconds:" with a dropdown menu showing "sa03", and "At 1.0 seconds:" with a dropdown menu showing "sa10". Below these groups is a text input field labeled "Magnitude generating the event:" containing the value "7.8". At the bottom of the window, there are three buttons: "< Back", "Next >", and "Cancel".

Click the **Next** button to move to the Hazard Scenario Event Name window.

Enter the *name of the event* that you want to use for this scenario and click **Next** to move to the final window.

Click **Finish** to close the Scenario Wizard.

Step 6: Run Analysis

From the **Analysis** menu choose **Run**.

Select the analysis options that you wish to analyze and click **OK** to begin the analysis.

When the analysis is finished, you may review the results as you can with any other earthquake scenario.