Providing block level Hazus-MH earthquake loss scenario data to the public using Internet Mapping Services

Seth J. Wittke
Wyoming State Geological Survey

Overview

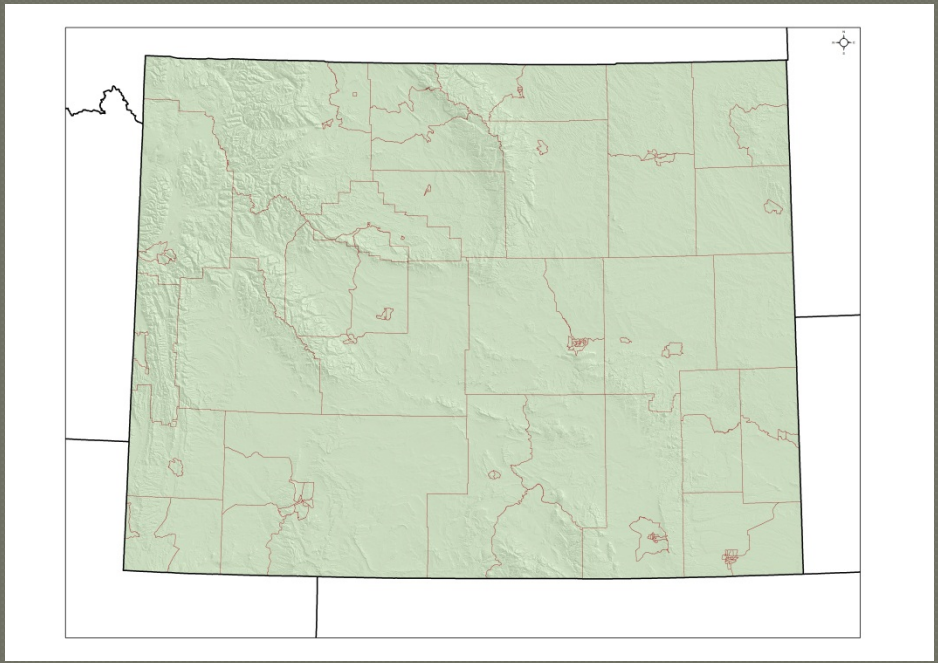
- Project initiation
- Data manipulation
- Scenarios
- Creating the IMS
- Lessons learned

Project Initiation

- County-wide block level probabilistic models created in 2004 for state mitigation plan
  - PBS&J and FEMA Region VIII helped develop tract to block method
- 2009, recognized the need/opportunity to use the updated HAZUS databases in deterministic models
- 2010 Used FEMA state assistance funds to create scenarios and report of results
- 2011 Used FEMA monies to create the Wyoming Earthquake Scenarios IMS

Tract vs. Block – The rural disparity

- Currently EQ is only run at "tract" level
- Only 127 tracts
- Results are modeled at the centroid of each tract



WSGS Modifications

- Run at "block" level
  - Expanded to 66,012 blocks
  - Entire database was rebuilt
  - All schools were W1, modified based on occupancy
  - Imported landslides, liquefaction potential, and soils

Block Conversion

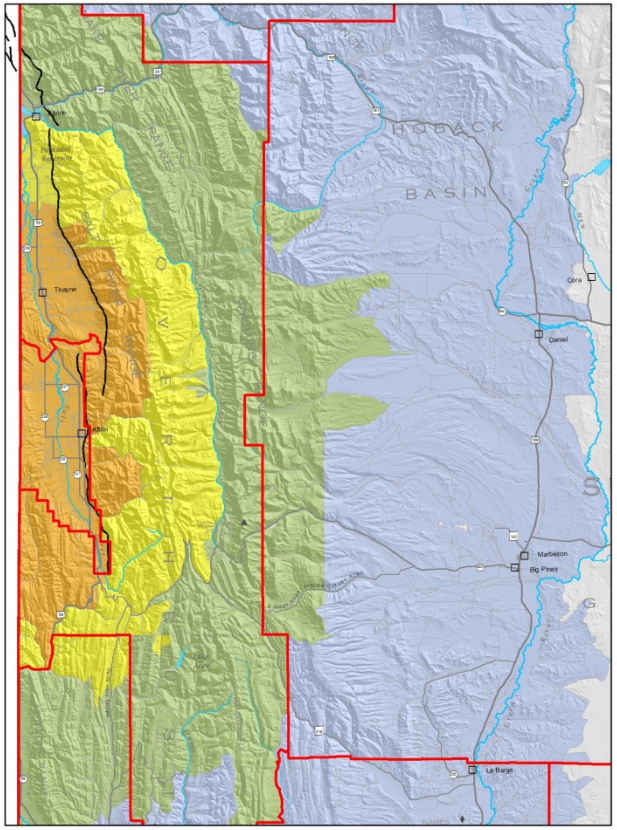
- Simple but involved process
  - FEMA international process
  - Modify the syBoundary file (tract)
    - Essentially tricking HAZUS into thinking the tract boundaries are the block boundaries
    - Supplied by FEMA
  - Reassign tract numbers for all MR4 data based on spatial relationships to blocks
    - Ultimately a spatial join/calculate function

Issues with conversion

- Process required approximately a month ~180 hours, and help from FEMA
- The best way to QC the conversion is with regional scenarios, then trouble shoot as needed
- There are multiple relationships set up in the MR4 database which can complicate finding errors
- Region size limitations, ran into a computational wall at about 5000 blocks
  - SQL issue – has been resolved with v2.0

Worth the time and effort

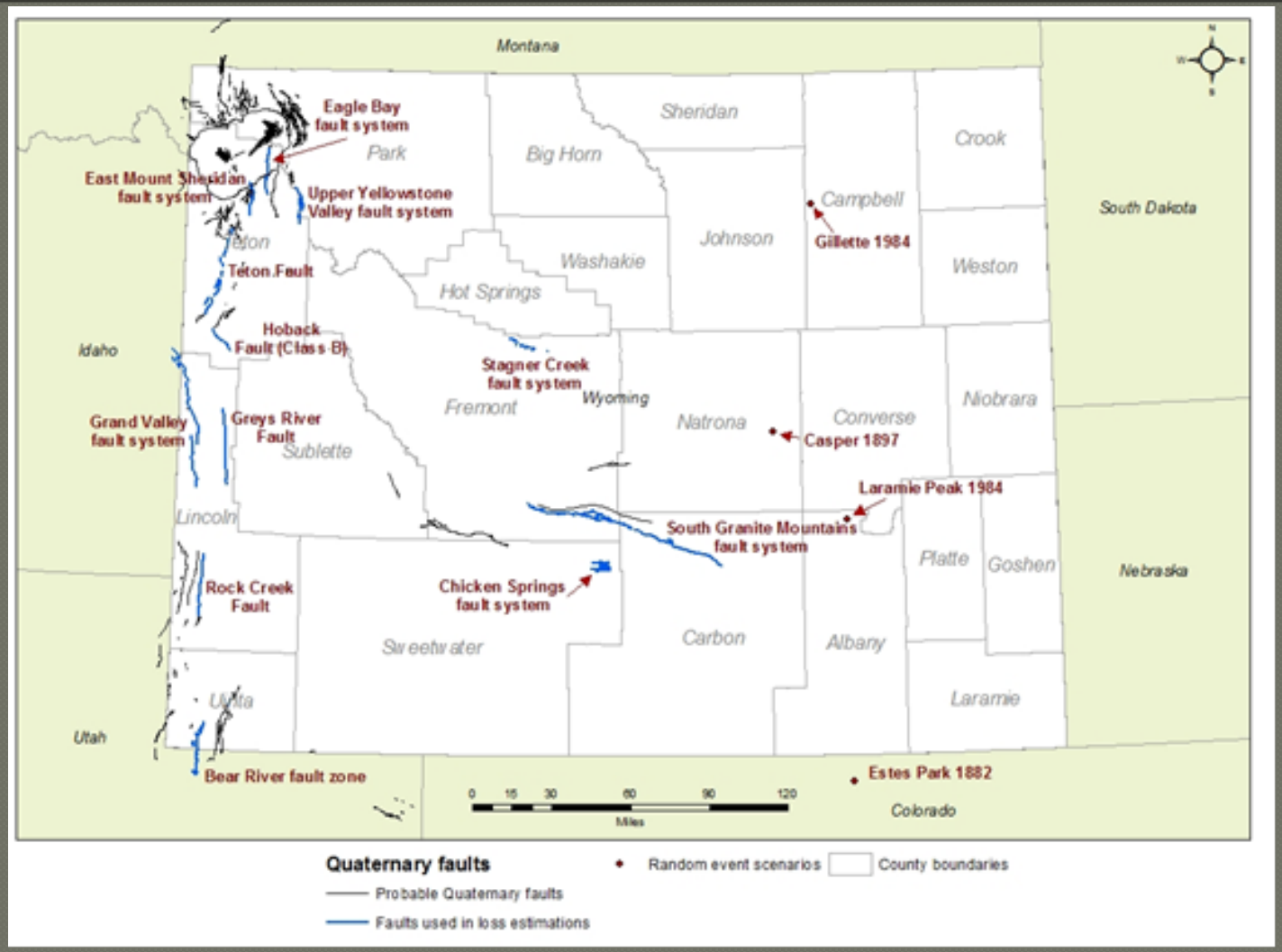
- Red – tract boundaries
- Colors based on USGS SHAKEMAP intensity scale (V – VIII)
- Exponential increase in resolution



Earthquake Scenarios

- 12 Fault Based
  - Used two methods
    - USGS Shakemap
    - HAZUS attenuation functions + WSGS soils
  - Based on locations of Quaternary aged faults (<2.6 ma)
  - M_{MAX} used for each scenario
- 4 Historic Events
  - Largest in eastern Wyoming
  - All scenarios ran at M6.0 to normalize loss estimates

Scenarios


Montana
Eagle Bay fault system
Park
Sheridan
Big Horn
Crook
East Mount Sheridan fault system
Upper Yellowstone Valley fault system
Campbell
Gillette 1984
South Dakota
Johnson
Teton
Washakie
Weston
Teton Fault
Hot Springs
Hoback Fault (Class B)
Idaho
Stagner Creek fault system
Wyoming
Fremont
Natrona
Converse
Niobrara
Grand Valley fault system
Greys River Fault
Sublette
Casper 1897
Laramie Peak 1984
Lincoln
South Granite Mountains fault system
Platte
Goshen
Nebraska
Rock Creek Fault
Chicken Springs fault system
Sweetwater
Carbon
Albany
Uinta
Laramie
Utah
Bear River fault zone
Estes Park 1882
0 15 30 60 90 120
Miles
Colorado
Quaternary faults
Random event scenarios
County boundaries
Probable Quaternary faults
Faults used in loss estimations

Scenario Report

- Wyoming Earthquake Hazard and Risk Analysis: HAZUS-MH Loss Estimations for 16 Earthquake Scenarios - released in January of 2011
- Downloadable from the IMS
- Select loss estimates:
  - Fault description
  - Infrastructure losses
  - EF damage and functionality
  - Direct economic losses

Developing the IMS

- Target audience is mitigation officials and the general public
  - Assumed high level users would contact us directly for specific datasets
  - Specifically designed to provide county and city planners data and mapping functionality for their mitigation plan updates

Developing the IMS

- User friendly
  - Easy to navigate
  - Ability to create user defined maps
  - Tried to balance a simple interface with full data accessibility
    - Linked specific reports to GIS data
      - Debris, direct economic, global

Notes about provided data

- Because the IMS is a public document, no point data were included
  - EF functionality for example
- Only scenario wide data are provided
  - Dataset not robust enough for community specific results – i.e. structural damage
  - There are some specific data available if a user would know where to look, but nothing spatial is provided in the IMS

Included Spatial Data

- Location data
  - Epicenter, existing fault trace
- Landslides
  - WSGS data, the landslide probability maps are questionable because of the centroid issue
  - Used for planning purposes
    - All landslide area with PGA > 10% will reactivate
- Probability of liquefaction
  - Useful for planning response routes

Included Spatial Data

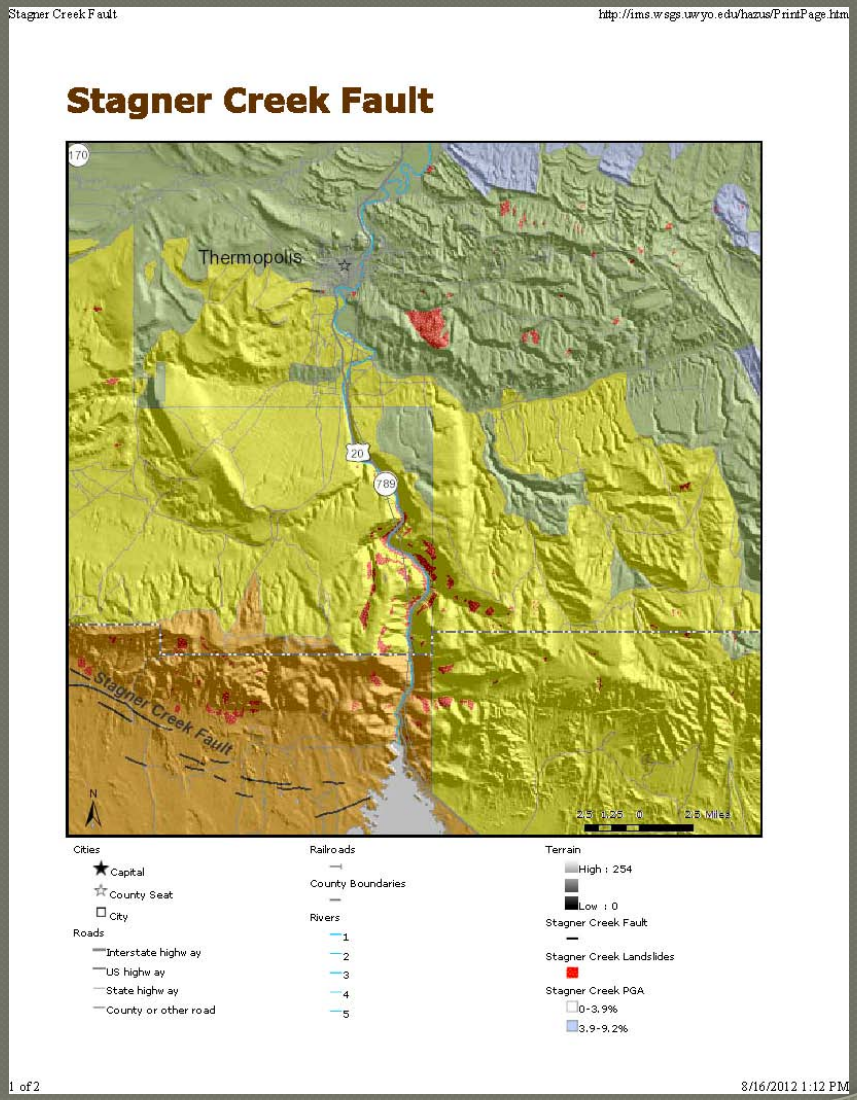
- Debris
  - Correlative to modeled damage states
  - Useful in response planning and shelter siting
- Direct economic losses
- Peak Ground Velocity and Acceleration
  - Indicates high ground motions
  - Useful if there is local knowledge of high loss potential that was missed by the dataset

Creating the IMS

- Used ArcServer software platform
  - WebADF was used to program web application interface
  - Incorporated layout and design directly from .mxd
  - decrease load/display time within the map service using Map Optimizer (ERSI)
  - Used ESRI map services for background data

User Defined Maps

- Maps can be created with spatial data in any combination, or downloaded in csv format
- Map area is taken from the map view in the IMS
- PGA in Wind River Canyon with known areas of slope instability



Lessons Learned

- Tract to Block conversion is time consuming but absolutely worth the effort
- Block level scenarios require additional run time, sometimes up to 6 hours
- IMS development is straight forward using ArcServer software, however some thought should be put into design and purpose before beginning
  - There is some functionality lost from .mxd but new tools and functionality are being added on a regular basis
  - Using community planners as beta testers instead of reviewers could have been more efficient

Lessons Learned

- WSGS developed the IMS internally, time and effort could have been saved if we would have requested professional development help
  - Final product would have been more refined as well
- The IMS itself needs some rebuilding and redesign, we are currently running in 9.3 and will be upgrading to 10.1 shortly

Thank You

- Questions/Discussion?
- Starter:
  - Are there any other states/companies that have attempted similar projects?
- http://ims.wsgs.uwyo.edu/hazus/