

Meeting Notes  
**COLORADO EARTHQUAKE HAZARD MITIGATION COUNCIL**  
January 23, 2020, Golden, Colorado

1. Attendees:  
Matt Morgan, CGS  
Steve Boand, CO Office of Emergency Management  
Mark Petersen, USGS  
Rob Jackson, AECOM  
Linda Rowan, UNAVCO  
Chuck Mueller, USGS  
Robin McGuire, LCI  
Will Levandowski, Tetra Tech  
Jim Harris, JR Harris and Co.  
Joellen Thiel, Division of Fire Protection  
Michael Haughey, Silvertip
2. Introductions: Linda Rowan is with UNAVCO. Headquartered in Boulder, UNAVCO is a non-profit university-governed consortium, facilitating geoscience research and education using geodesy.
3. Additions to agenda: The CGS website is being updated including the CEHMC portion. This will be discussed in further detail in the March meeting, including how meeting minutes will be handled.
4. Minutes from the November 21, 2019 meeting. Matt Morgan moves to approve. Robin McGuire seconds.
5. Contributions were taken for the funding of the CEHMC website domain names (\$40 annually, member-supported).
6. Presentations by Chuck Mueller and Mark Petersen of the USGS on the new 2018 National Seismic Hazard Maps and associated Colorado issues:

Petersen presentation:

The new maps use an updated catalog. New completeness zones in EUS. Induced events removed. For the CEUS the 2014 GMMs only applicable up to 2sec, and site class A (Need updated GMMs, e.g., NGA-East)

New ground motion models incl. median estimates, aleatory uncertainties, soil amplification factors  
Two sets of GMMs from NGA-East: Seed models. At periods greater than 0.2s, there is little difference in median ground motions relative to prior models

Aleatory uncertainty changed

CEUS amplification models differ in median GM vs. period space – Higher CEUS motions at periods near 0.1s, including a wide range of motion at periods near 0.1s for hypocentral distance below 50 km  
CEUS amplification changed. CEUS much higher than WUS.

New GMMs have increased within 1000 km of New Madrid – up 19% in Memphis, 25% in Chicago, 30% in St. Louis

Catalog changes have decreased hazard in NEUS, ETSZ

Vs30 does not scale to site response as well in the CEUS as in the West

WUS & Subduction: Remove GMMs not applicable for soft sites & long periods and re-weight GMMs  
o Basin effects for long T and soft sites

Other Regions: Use Response Spectrum Shape Factors, developed based on WUS GMMs, until USGS updates are available for each region

Western U.S. – Basin models for SLC, LA, SF, Seattle

- Ground motion model applies an “average” basin depth for a specified Vs30 (model dependent).
- Typically used if you don’t have any information on basin depth.
- Soft soils already include basin amplification because much of data overlies sedimentary basins.
- Amplification applied at periods greater than 1s
- Largely based on  $Z_{1.0}$  and  $Z_{2.5}$
- Only the deepest part of the basin is treated because basin edges would have reduced ground motions, but we know that there can be large basin-edge effects
- Differences of up to ~40% @ 5 sec SA
- Deep soils could be considered under Denver..next time

Realizing the shortcomings of the current simple design spectrum, the building code has decided to take advantage of USGS additional maps and has requested additional periods and site classes to develop multi-period design spectrum for the next-generation of seismic design value maps for Project ‘17. 22 “NGA” spectral periods and 8 site classes. Deterministic caps retained.

Future Changes:

- Update CEUS/WUS border: Transition zone?
- What to do with faults that have unknown/poorly known slip rates? How to appraise uncertainties?
- Amplification models for Gulf Coast and Atlantic Coastal Plain: Not Vs30 but rather total sediment thickness. Predominant period?
- Update declustering algorithm/model

2018NSHM→ 2020 NEHRP→2022 ASCE 7→2024 IBC

Mueller presentation:

The Colorado Front Range is in the NSHM Rocky Mountain zone (just west of -105 deg longitude).

Historical seismicity is low near the Front Range, increasing westward; this led to reduced hazard along the Front Range in the 1996 NSHM; this was controversial because it’s the probable location of the 1882 earthquake.

CEUS treatment of background seismicity in the NSHM:

- In each grid cell, compare cell historical rate (might be 0) with broad regional floor rate:
- If historical > floor, final cell rate = historical rate
- If historical < floor, final cell rate =  $0.8 \times \text{historical} + 0.2 \times \text{floor}$  (...except Rocky Mountain zone)
- (Including the floor provides some protection in quiet areas.)

To address the Front Range issue, the Rocky Mountain zone has been treated differently since 2002.

Paraphrasing from the 2002 NSHM documentation: For the 2002 maps, a weight of 1.0 was assigned for the Rocky Mountain floor (instead of 0.2), in effect replacing the local historical rate with the floor rate everywhere in the zone. This causes about a 10% increase in the probabilistic ground motions along the Front Range and generally aligns the ground motion contours parallel to the Front Range. This change is justified by noting the short seismic history in the region and the attendant high uncertainties.

The reasons given in the 2002 documentation are mostly still valid. However, modification of the weighting scheme was considered for the 2018 update because:

- It is somewhat conservative & the rate boundary/zone looks artificial in the final hazard maps
- Catalogs & completeness treatments now are better than they were in 2002
- It looks like seismicity is low just west of -105° for ~100km+, then increases westward. The 2002 floor treatment fills this in, but should it?

It was decided not to change the Rocky Mountain zone treatment due to: (1) lack of consensus, and (2) the hazard was already being reduced due to a revised magnitude treatment (following CEUS-SSC, 2012, SSHAC Level 3). Colorado Rockies, Wyoming, and Colorado Plateau treated with CEUS attenuation and GMMs. Lack published conversions from MI, Md to estimated Mw, which is problematic because the midcontinent catalog is dominated by MI, Md, and similar

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Discussion followed. Rob Jackson pointed out that the new hazard maps were previewed by the SEAC Seismic Committee during the BSSC Member Organization reviews. It was found that the new maps will substantially reduce the ground motions from those of ASCE 7-16 along the Front Range. Denver, Ft. Collins and other Front Range cities will be able to use Seismic Design Category A (no seismic design) even for the default Site Class D. In the past, Seismic Design Category A has only been able to be used at some locations along the Front Range when the soils were Site Class C or better, but not Site Class D. Jim Harris mentioned that there may need to be some collaboration among various local engineering, geology and geotechnical organizations to bring attention to this pending code situation. Chuck Mueller added that more research is needed to improve the magnitude treatment in the Intermountain West.

7. Developing a Critical Facilities Inventory Subcommittee -Not discussed. Keith Porter could not attend.
8. NETAP requested training has been approved. The training must take place before July 31, 2020.
  - a. FEMA E-74, Reducing the Risks of Nonstructural Earthquake Damage
  - b. FEMA P-154 and ROVER, Rapid Visual Screening of Buildings for Potential Seismic Hazards (Third Edition), and Rapid Observation of Vulnerability and Estimation of Risk
9. Updated brochure was reviewed briefly. A fourth panel to be added. Comments to Matt Morgan as soon as possible.
10. SAP training April 5 in Boulder -Not discussed.
11. 2019 Cheraw fault trenching update- Mark Z. (deferred)
12. A new instrument near Greeley is in the works. Not yet in IRIS or CGS. McAlpin and Matt M. have a grant to evaluate the Ute Pass fault.