

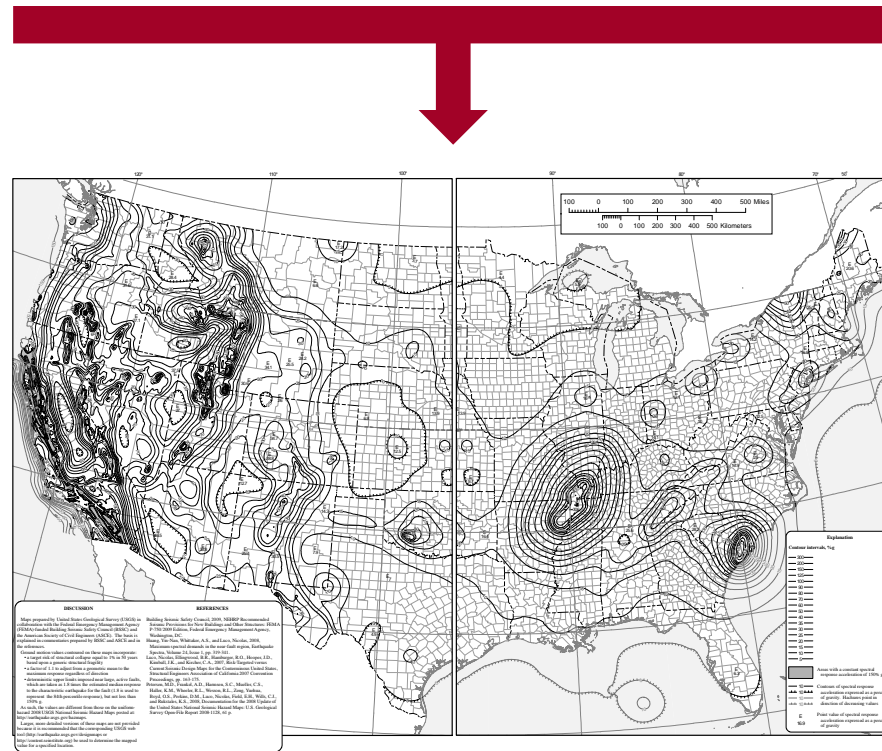
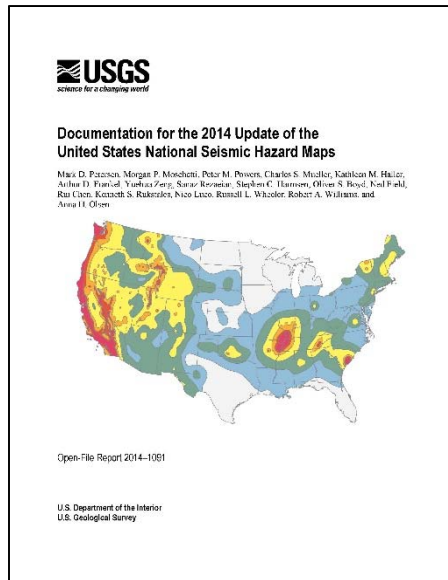
2018 Update of USGS National Seismic Hazard Model

Building Seismic Safety Council (BSSC) Provisions Update Committee (PUC) Meeting

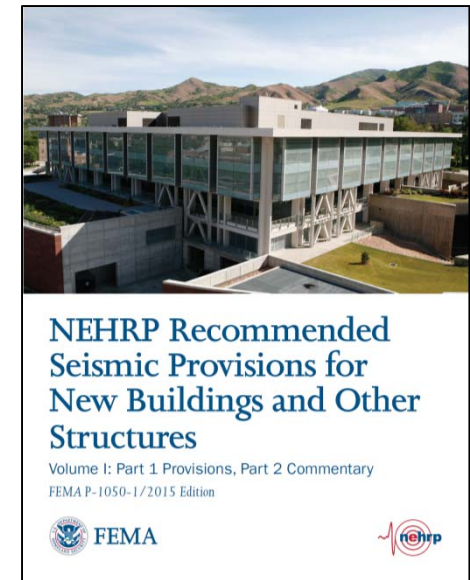
Nicolas Luco & Sanaz Rezaeian
Research Structural Engineers
U.S. Geological Survey
Golden, Colorado

Basis of MCE_R Ground Motion Maps

USGS National Seismic Hazard Model (NSHM)



Site-Specific Ground Motion Procedures of ...



Risk-Targeted Maximum Considered Earthquake (MCE_R) Ground Motion Maps

Building Seismic Safety Council (BSSC) Provisions Update Committee (PUC) Meeting

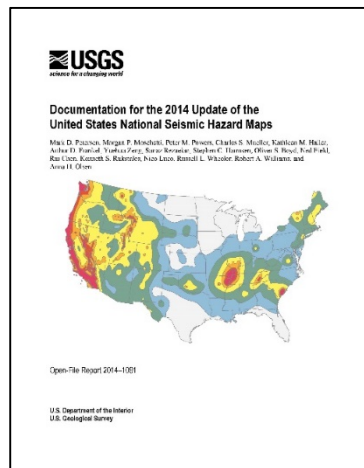
"2018 Update of USGS National Seismic Hazard Model," N. Luco & S. Rezaeian (USGS)

December 4, 2018

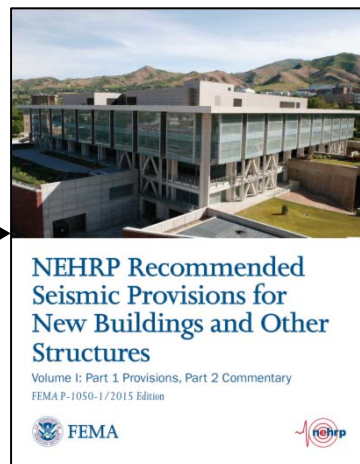
USGS & NEHRP Updates

USGS NSHM	NEHRP Provisions	ASCE 7 Standard	IBC
1996	1997, 2000	1998, 2002	2000, 20003
2002	2003	2005	2006, 2009
2008	2009	2010	2012, 2015
2014	2015	2016	2018

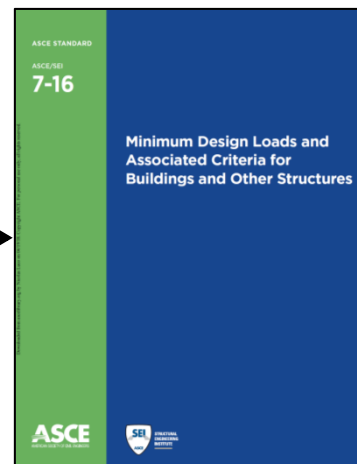
2018



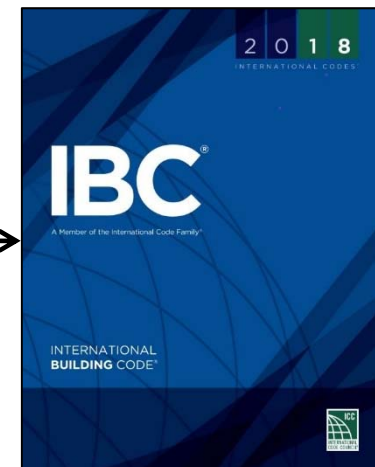
2020



2022



2024



Building Seismic Safety Council (BSSC) Provisions Update Committee (PUC) Meeting

"2018 Update of USGS National Seismic Hazard Model," N. Luco & S. Rezaeian (USGS)

December 4, 2018

Updates for 2020 NEHRP Provisions

1. 2018 USGS NSHM

Preliminary 2018 Update of the U.S. National Seismic Hazard Model: Overview of Model, Changes, and Implications

M.D. Petersen, A.M. Shumway, P.M. Powers, C.S. Mueller, M.P. Moschetti, A.D. Frankel, S. Rezaeian, D.E. McNamara, S.M. Hoover, N. Luco, O.S. Boyd, K.S. Rukstales, K.S. Jaiswal, E.M. Thompson, B. Clayton, E.H. Field, and Y. Zeng

We value and seek the feedback of the public and informed technical community on the 2018 Update of the U.S. National Seismic Hazard Model. This draft manuscript is only shared for purposes of scientific peer review and public feedback. Because the manuscript has not yet been approved for publication by the U.S. Geological Survey (USGS), it does not represent any official USGS finding or policy and should not be used in any engineering or other application at this time. The draft will be available on our website (<https://earthquake.usgs.gov/hazards/>) from November 7, 2018 to December 7, 2018 for public comment.

Abstract

During 2017-2018, the National Seismic Hazard Model (NSHM) was updated by incorporating (1) new median ground motion models, new estimates of their epistemic uncertainties and aleatory variabilities, and new soil amplification factors for the central and eastern U.S., (2) amplification of long-period ground motions in deep sedimentary basins in the Los Angeles, San Francisco, Seattle, and Salt Lake City areas, (3) an updated seismicity catalog, which includes new earthquakes that occurred between 2012 and 2017, and (4) an improved computer code and implementation details. Results show increased ground shaking in many (but not all) locations across the central and eastern U.S., as well as near the four aforementioned urban areas in the western U.S. More people live or work in areas of high or moderate seismic hazard than ever before, leading to higher risk of undesirable consequences from future ground shaking.

Introduction

Over the past four decades, the U.S. National Seismic Hazard Model (NSHM) Project of the U.S. Geological Survey (USGS; e.g., Algermissen and Perkins, 1976; Frankel et al., 1996, 2002b; Petersen et al., 1996, 2008, 2014, 2015) has provided science-based hazard information for use in seismic provisions of U.S. building codes for buildings, bridges, railways, and defense facilities (e.g., from NEHRP, ASCE, IBC, AASHTO, AREMA, UFC)¹, among other structures; risk assessments for insurance and disaster management planning (e.g., Core-logic, AIR, RMS)²; and federal, state, and local governmental policy decisions (e.g., U.S. Army Corps of Engineers, Bureau of Reclamation, FEMA, California Geological Survey, local land use plans)³. These probabilistic seismic hazard models integrate two fundamental inputs (Cornell, 1968): (1) earthquake rupture forecast models, which define a potential range of earthquakes that could strike at any location across the U.S. and (2) ground motion models (GMMs), which provide estimates of the potential range of ground shaking from each event. Seismic hazard forecasts from such models show where

¹ National Earthquake Hazard Reduction Program (NEHRP), American Society of Civil Engineers (ASCE), International Building Code (IBC), American Association of State Highway and Transportation Officials (AASHTO), American Railway Engineering and Maintenance-of-Way Association (AREMA), Unified Facilities Criteria (UFC).

² Core-logic Catastrophe Risk Management (Core-logic), Air Worldwide (AIR), Risk Management Solutions (RMS).

³ Federal Emergency Management Agency (FEMA).

2. BSSC Project '17

Project 17 Final Report

September 26, 2018

by

National Institute of Building Sciences
Building Seismic Safety Council
Project 17 Committee (chair: Ron Hamburger)

Sponsored by

Federal Emergency Management Agency
in coordination with the
U.S. Geological Survey



FEMA

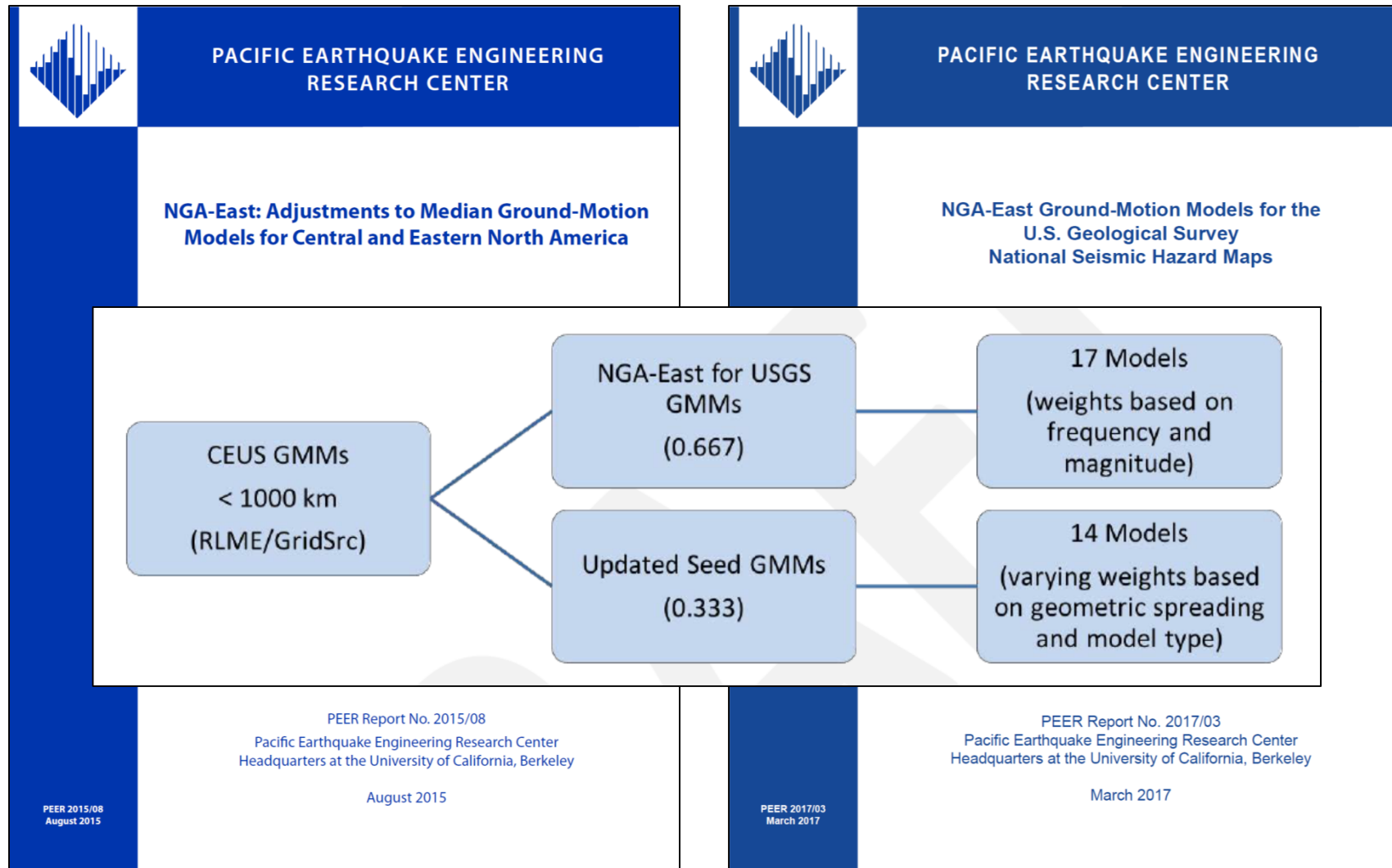


Building Seismic Safety Council (BSSC) Provisions Update Committee (PUC) Meeting

1. Updates for 2018 USGS NSHM

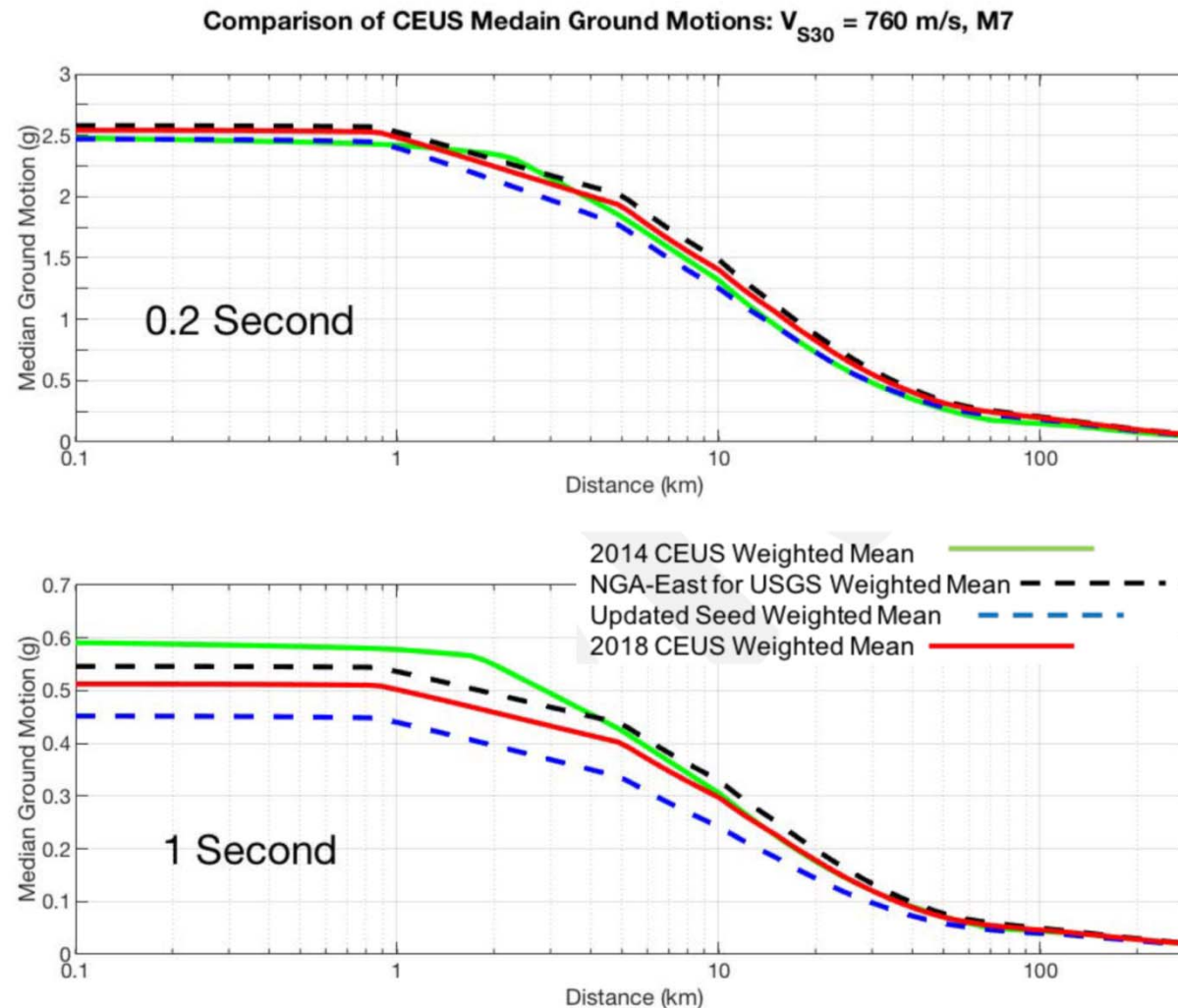
- 1a. PEER NGA-East ground motion models (GMMs) for Central & Eastern U.S.
- 1b. Basin effects via PEER NGA-West2 GMMs in Los Angeles, Seattle, San Francisco, and Salt Lake City regions
- 1c. 2013-2017 earthquakes and other updates for smoothed seismicity sources outside California
- 1d. Removal of Idriss (2014) and Atkinson & Boore (2003, 2008) GMMs

1a. NGA-East Ground Motions Models



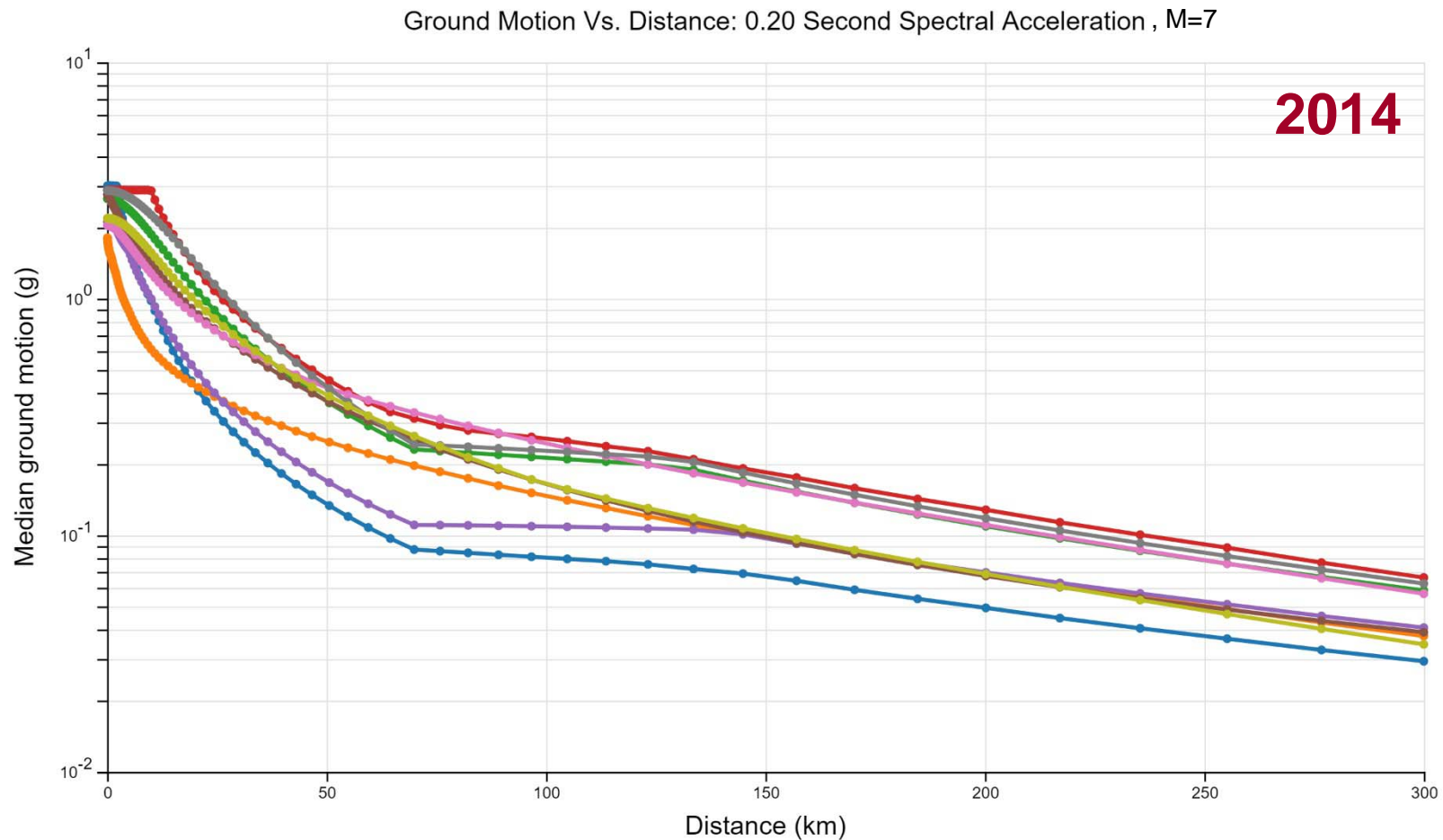
Building Seismic Safety Council (BSSC) Provisions Update Committee (PUC) Meeting

Changes in Median Ground Motions



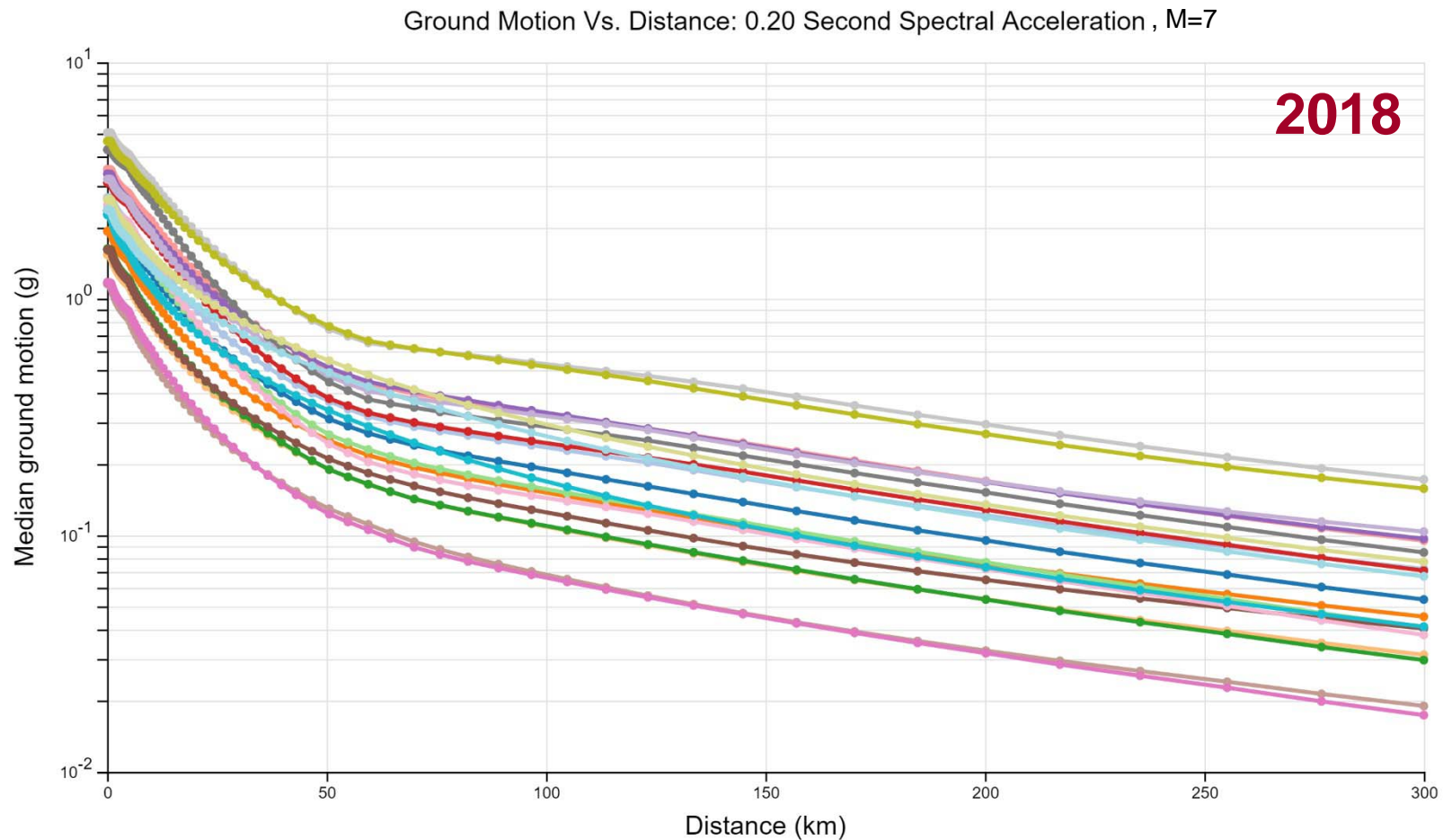
Building Seismic Safety Council (BSSC) Provisions Update Committee (PUC) Meeting

Changes in Epistemic Uncertainty



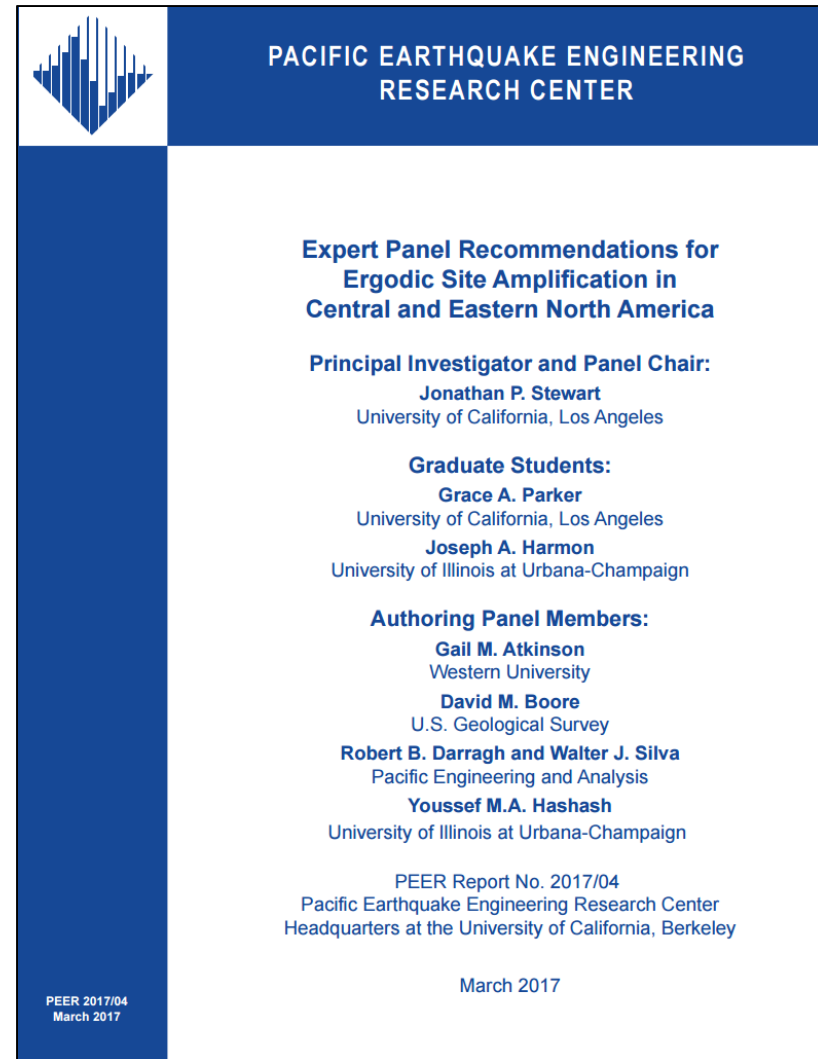
Building Seismic Safety Council (BSSC) Provisions Update Committee (PUC) Meeting

Changes in Epistemic Uncertainty



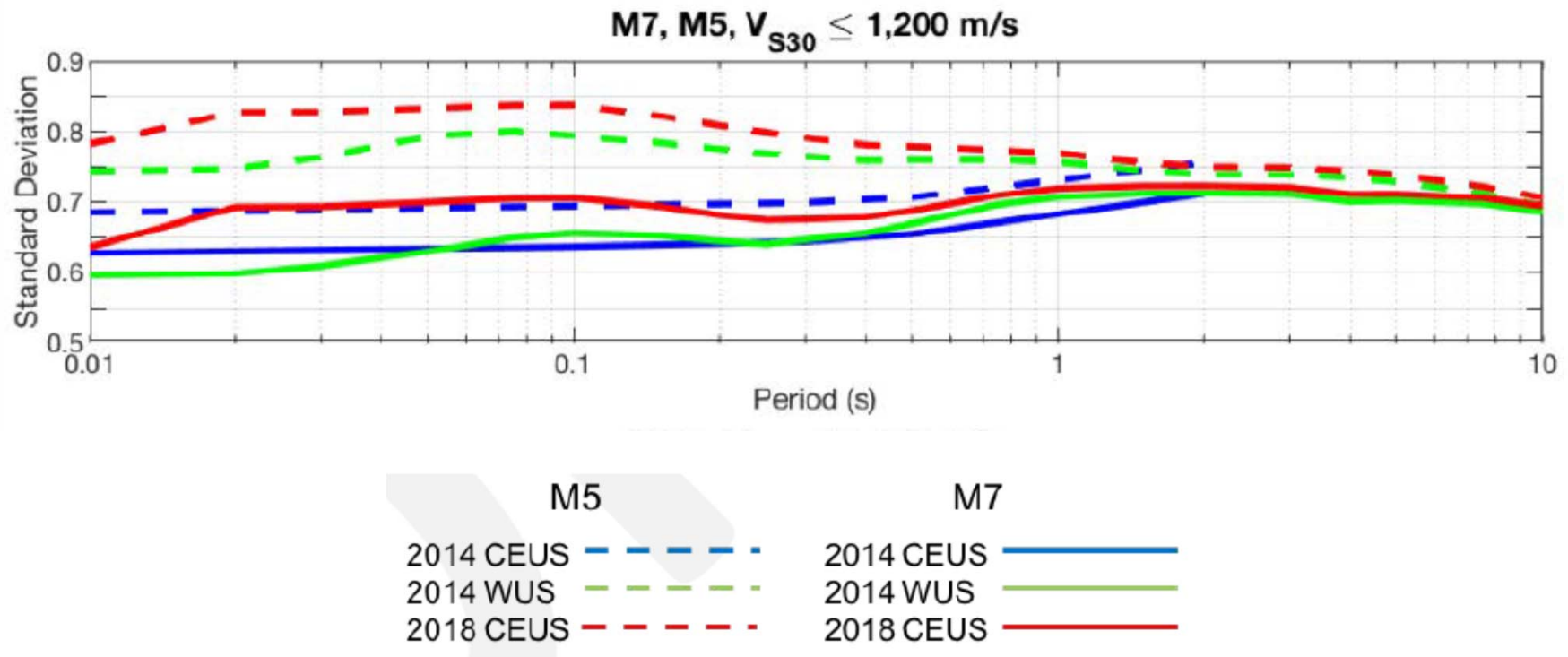
Building Seismic Safety Council (BSSC) Provisions Update Committee (PUC) Meeting

1a. NGA-East Ground Motions Models



Building Seismic Safety Council (BSSC) Provisions Update Committee (PUC) Meeting

Changes in Aleatory Uncertainty



Building Seismic Safety Council (BSSC) Provisions Update Committee (PUC) Meeting

Changes in Aleatory Uncertainty

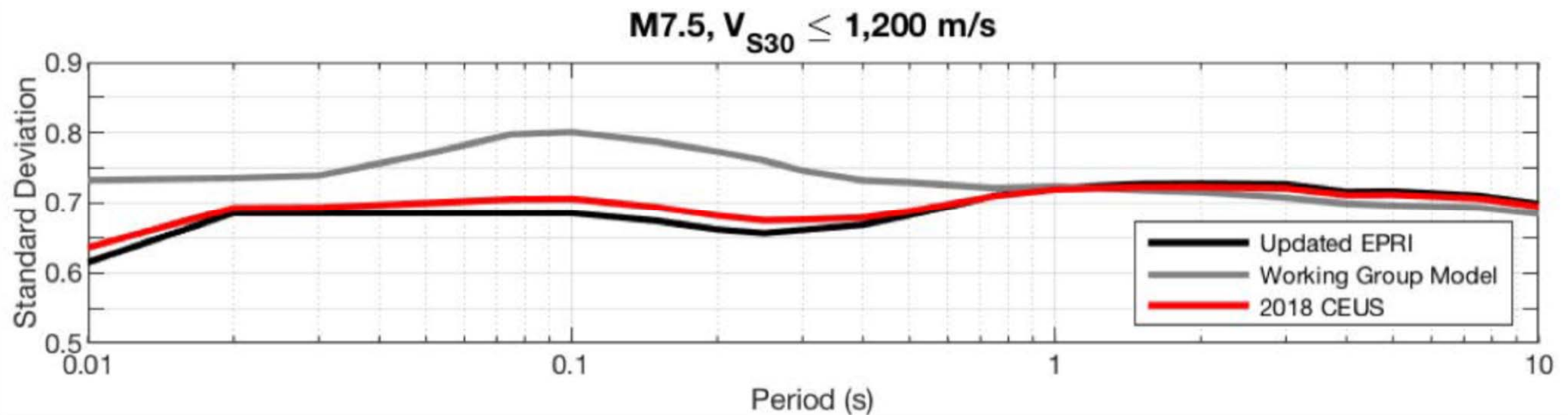
Memorandum

Date: July 13, 2018

To: The USGS National Seismic Hazard Mapping Project

From: Jonathan P. Stewart, Grace A. Parker, Linda Al Atik, Gail M. Atkinson, Christine Goulet

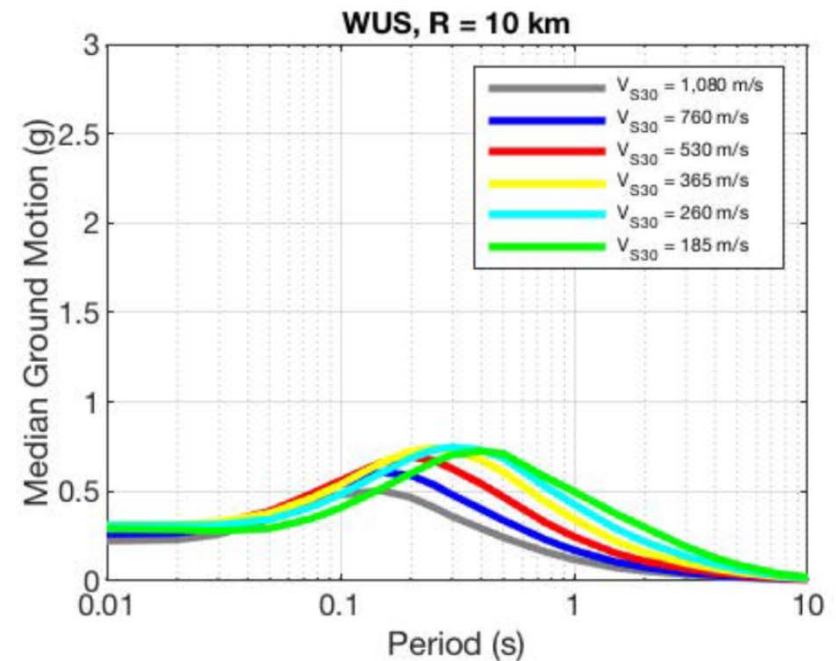
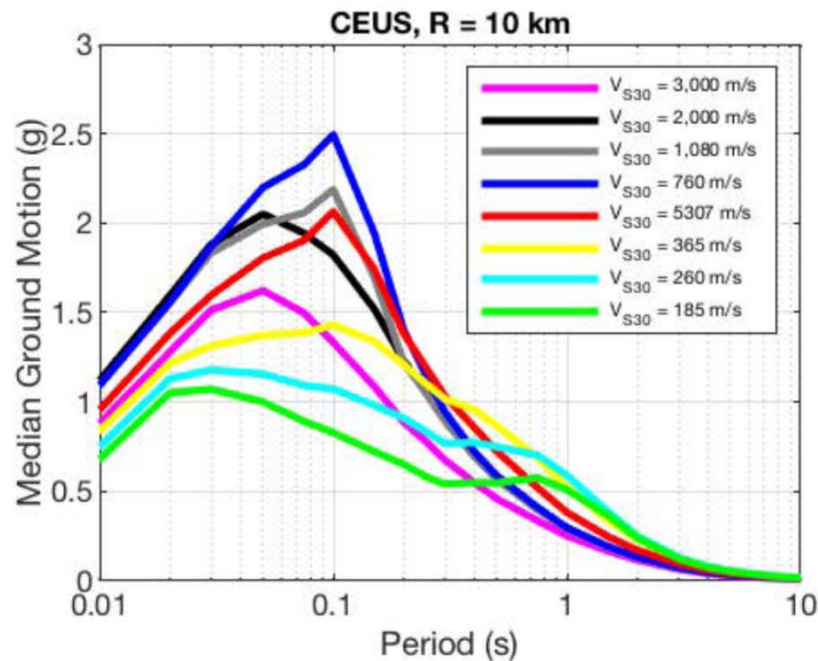
RE: Modified ϕ_{S2S} model for CENA



Building Seismic Safety Council (BSSC) Provisions Update Committee (PUC) Meeting

Changes in Site Effects

Comparison of 2018 NSHM Median Ground Motions: M7



Building Seismic Safety Council (BSSC) Provisions Update Committee (PUC) Meeting

Changes in Site Effects

Memorandum

Date: July 18, 2018 (updated July 26 2018)

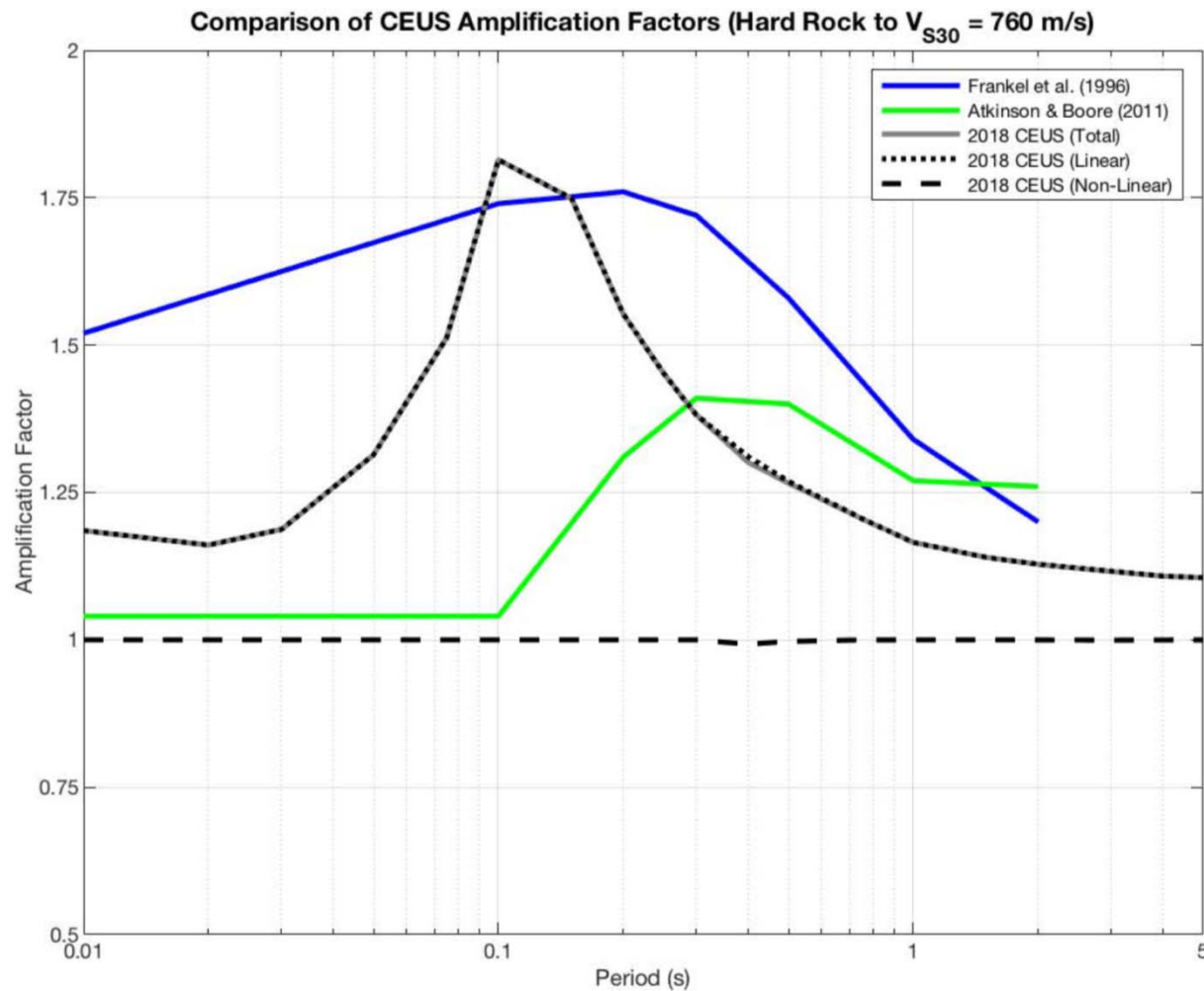
To: The USGS National Seismic Hazard Mapping Project

From: Jonathan P. Stewart, Grace A. Parker, Youssef M.A. Hashash, Gail M. Atkinson, David M. Boore, Robert B. Darragh, Walter J. Silva, Okan Ilhan and Joseph A. Harmon

RE: Proposed Recommendations to the USGS on 3000 to 760 m/s Site Amplification Factors and Related Issues

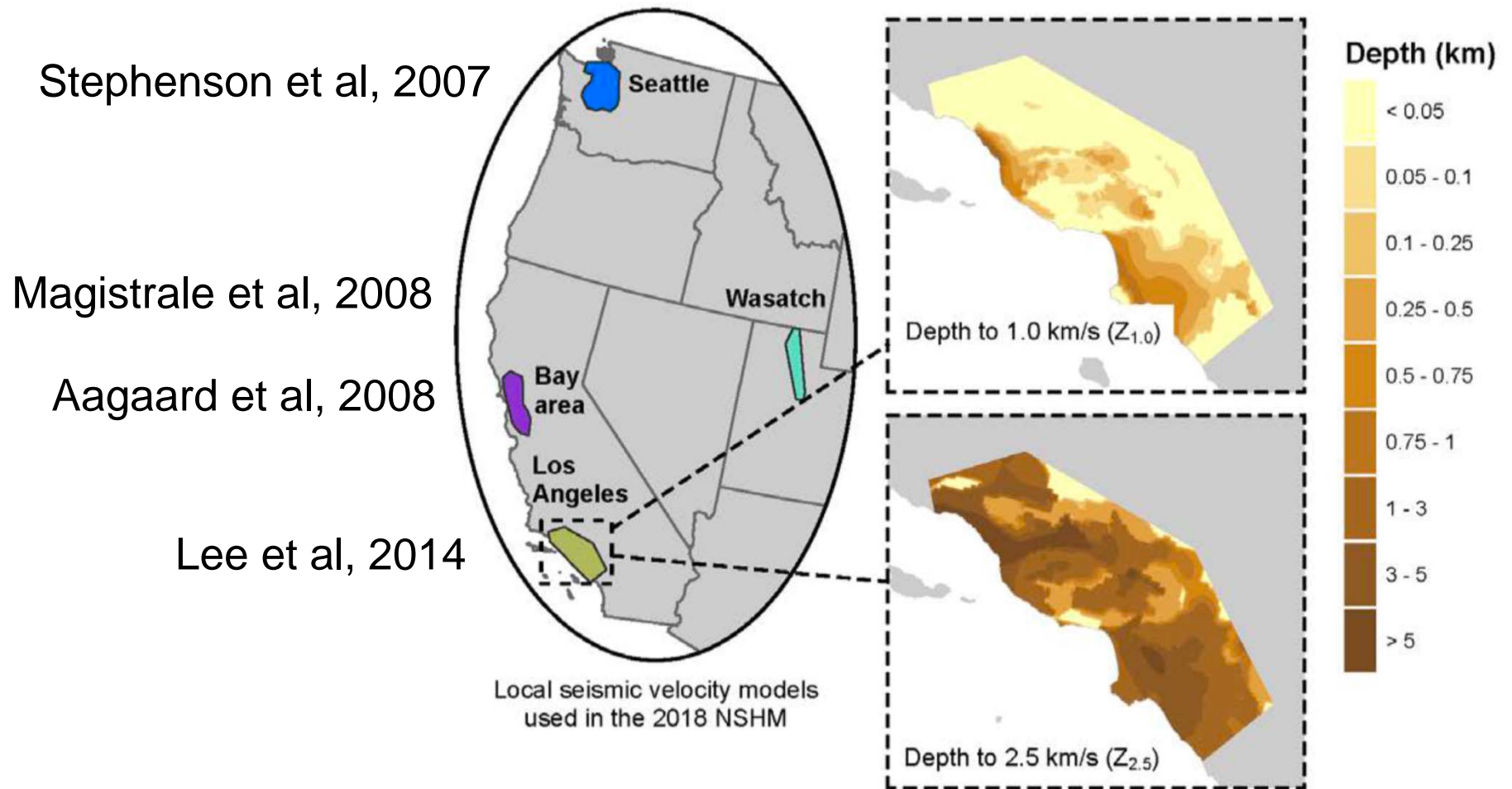
Building Seismic Safety Council (BSSC) Provisions Update Committee (PUC) Meeting

Changes in Site Effects



Building Seismic Safety Council (BSSC) Provisions Update Committee (PUC) Meeting

1b. Basin Effects on Ground Motions



2018 USGS NSHM Use of Basin Depths

- Within the four regions, only the portions of the basins deeper than the NGA-West2 defaults are used, pending better understanding of shallow basin edge effects.
- Outside of these deep portions, default basin depths are used.

Table 2: NGA-West2 default basin depths (km).

Site Class	V_{S30} (m/s) ¹	ASK14 ($Z_{1.0}$) ²	BSSA14 ($Z_{1.0}$) ³	CB14 ($Z_{2.5}$) ⁴	CY14 ($Z_{1.0}$) ⁵
A	2000	0	0	0.201	0
A/B	1500	0	0.001	0.279	0.001
B	1080	0.005	0.005	0.406	0.005
B/C	760	0.048	0.041	0.607	0.041
C	530	0.213	0.194	0.917	0.194
C/D	365	0.401	0.397	1.4	0.4
D	260	0.475	0.486	2.07	0.485
D/E	185	0.497	0.513	3.06	0.513
E	150	0.502	0.519	3.88	0.519

2. Project '17 Recommendations

- 2a. *Stabilizing mapped values:* Map Seismic Design Category, separately from MCE_R ground motions
- 2b. *Acceptable risk:* Retain 1%-in-50-years collapse risk with deterministic ground motion caps
- 2c. *Deterministic values:* Calculate via epsilons from deaggregation of probabilistic hazard (or risk)
- 2d. *Multi-period spectral values:* Use USGS hazard computations for 22 spectral periods from PGA to 10 sec and eight V_{S30} 's from 150 to 2,000 m/s

Summary of Updates

1. *2018 USGS National Seismic Hazard Model*
 - a. NGA-East medians, epistemic & aleatory uncertainties, and site amplifications
 - b. Deep basin effects in four western U.S. urban regions
 - c. Recent earthquakes for smoothed seismicity sources
2. *Building Seismic Safety Council (BSSC) Project '17*
 - a. Seismic Design Category (SDC) maps
 - b. Deterministic capping via deaggregation epsilons
 - d. Multi-period, multi- V_{s30} ground motions from USGS