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The 2014-2016 Updates of the National Seismic Hazard Models for the Central and Eastern United States: Insights for Hazard in Stable Continental Regions

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During 2014 the USGS released the U.S. National Seismic Hazard Models for the lower 48 states and began developing new products to better communicate with end-users (Petersen et al., 2014, Figure 1). The seismic hazard assessment was based on the best available science at the time of the update, and incorporated a broad range of new datasets, models, and updated input parameters. For the Central and Eastern U.S. (CEUS), we implemented a new moment magnitude (Mw) earthquake catalog. The earthquake catalog was updated to consider Mw based on new information from the CEUS-SSC (2012). In addition, we modified the maximum-magnitude distribution based on new global study by Wheeler (2014) and CEUS-SSC (2012). We account for a broader range of magnitudes up to M 7.95. For the first time we considered the adaptive (nearest neighbour) smoothing model of Helmstetter et al. (2007). These input modifications resulted in ± 30% local changes across the CEUS. However, most of the CEUS hazard was within ±10% of the previous maps.

Since the release of the 2014 model we have also made new models that account for man-made earthquakes (mostly caused by wastewater injection). We have also developed a one-year 2016 seismic hazard model for induced seismicity and natural earthquakes. This model shows dramatic ground motion increases of more than a factor of three in areas of induced seismicity compared to the 2014 model. We consider variable catalog lengths to predict earthquake rates in 2016, alternative smoothing distance parameters to predict the locations of future earthquakes, a new distribution of maximum magnitudes to account for alternative opinions of how large an induced earthquake can be, and a suite of ground motion models to account for differences in induced and natural earthquake shaking. Modified Mercalli Intensity (MMI) maps show that this increased hazard could result in shaking damage of MMI VI or greater in at least 6 states (Oklahoma, Kansas, Texas, Colorado, New Mexico, and Arkansas) from these induced earthquakes.
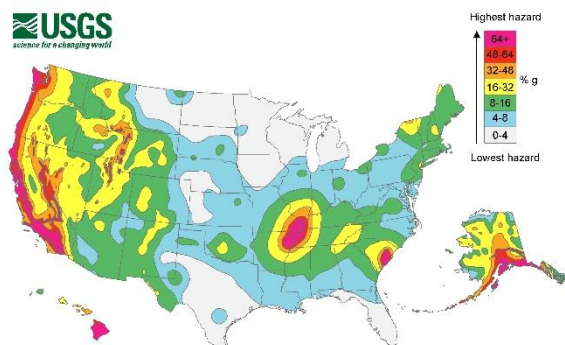

Figure 1: 2014 U.S. National Seismic Hazard Map

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