Additional 2018 NSHM Modeling Details and Discussion

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2018 NSHM Update Workshop

Wednesday, March 7th, 2018

U.S. Department of the Interior
U.S. Geological Survey

NSHMP Update & Release Process

Dev ⟶ **R1**: BSSC/OFR ⟶ 3rd Party Impl. ⟶ Bugs, errors ⟶ **R2**: BAS/Errata

2014 update issues:

- BSSC – Fortran/WUS - OpenSHA/UCERF3 combined models
- Additional periods site classes added after the fact (OFR TBD, spring)
- Slow rollout to online tools (complicated by migration to UHT)

2018 update goals:

- Reduce/eliminate post-BSSC errors
- Public access, review, and use of model prior to publication
- Immediate deployment to web-apps/UHT, with BSSC model edition used for deaggregation;
- Improved documentation – NSHM Implementation Reference

User-needs Workshops:

- SSA, Miami, May 15-17
- 11NCEE, Los Angeles, June 25-29

NSHMP Update & Release Process

Dev ⟶ **R1**: BSSC/OFR ⟶ 3rd Party Impl. ⟶ Bugs, errors ⟶ **R2**: BAS/Errata

2014 model updates:

- Most errata fixed (see online documentation)
- Point source depth bug in CA gridded seismicity model most significant
- Adding support for additional spectral periods and site classes
  - Removing Idriss 2014 (active crust)
  - Removing Atkinson & Moore 2003 (subduction interface and slab)
  - Evenly redistributing logic-tree weight of each

Editions explained:

- Semantic versioning (1996 = 1.0, 2002 = 2.0, 2008 = 3.0)
- 2014 BSSC ⟶ v4.0.0 ('static' hazard curves)
- UHT current ⟶ v4.*.* ('dynamic' calculations: deaggregation)

All code, releases, issues and documentation tracked on GitHub

Web Applications: Unified Hazard Tool (UHT)

Retired legacy apps and deployed UHT, early 2017:

- Static hazard curves
- Dynamic calculations (e.g. deaggregations)

In progress:

- Geographic deaggregation
- Conditional Spectrum
- EQ Probability mapping and services

Additional tools to explore model components:

- GMM spectra and parameter space (e.g. ground motion vs. distance)
- Source model (e.g. MFDs)

2018 Western U.S. Source Model Updates

- Geologic/geodetic model consistency
- Review slab mMax branch weights (#38)
- Seattle fault - (currently reverted to 2008, #17)
- Wasatch - Salt Lake City Segment
- West Valley Fault (low probability? #9)
- Bettles Well – Petrified Springs
- Add geodetic rates to TX faults (2020?)
- Remove Class C faults (e.g. Mt. Hood)
- Consider using geodetic RAKE
  - Currently geologic applied; geodetic used in CA)

2018 Western U.S. Implementation Updates

- Increase grid source discretization (#3)
- Point source implementation improvements
  - Current model poorly captures near-field hanging wall effects
- Review M=6.5 epistemic/aleatory uncertainty cutoff (#26)
- Focal mechanisms using GMM author recommended rake ranges (#9)
- Review zHyp implementation, especially in slab GMMs
- Apply additional epistemic uncertainty to Wasatch cluster model (#14)
- UCERF3 zTop (or zTor) – aseismicity factor inconsistency
  - Aseismicity factor used to reduce moment in UCERF3 inversion
  - Modeled as top-down reduction in fault width
  - Reduction is inconsistent with NGAW2 zTop definition
  - However, removal implies most small magnitude ruptures come all the way to surface; there are no equivalent of down dip floaters modeled in UCERF3 system source.
- UCERF3 rupture parameter averaging (rake, zTop, width)
  - Calculation of rJB, rRup is based off the closest fault section

2018 Central & Eastern U.S. Implementation Updates

- Increase grid source and RLME discretization (#3)
- Point source implementation improvements
- Review normal fault dip consistency (e.g. eastern CO, Cheraw, 60°)
- Scaling relation consistency (e.g. Somerville, #4, #10)
- Review ground motion clamping
  - Median ground motion clamp:
    - PGA and 0.01s --> 1.5g
    - SA < 0.5s --> 3.0g
  - Upper ground motion exceedance clamp:
    - min[3σ, 3.0g (PGA) | 6.0g (SA < 0.75s)]
  - Do these clamps reduce NGA-East ground motions below what may be possible/reasonable?

Gridded Seismicity
Source Model Updates

Sampling issues:

- 0.1° source discretization
- Maps also at 0.1°, resampled to 0.05°
- At short return periods, hazard from low-M, higher-rate events biased high
- But hazard for site-specific calculations between grid nodes biased low

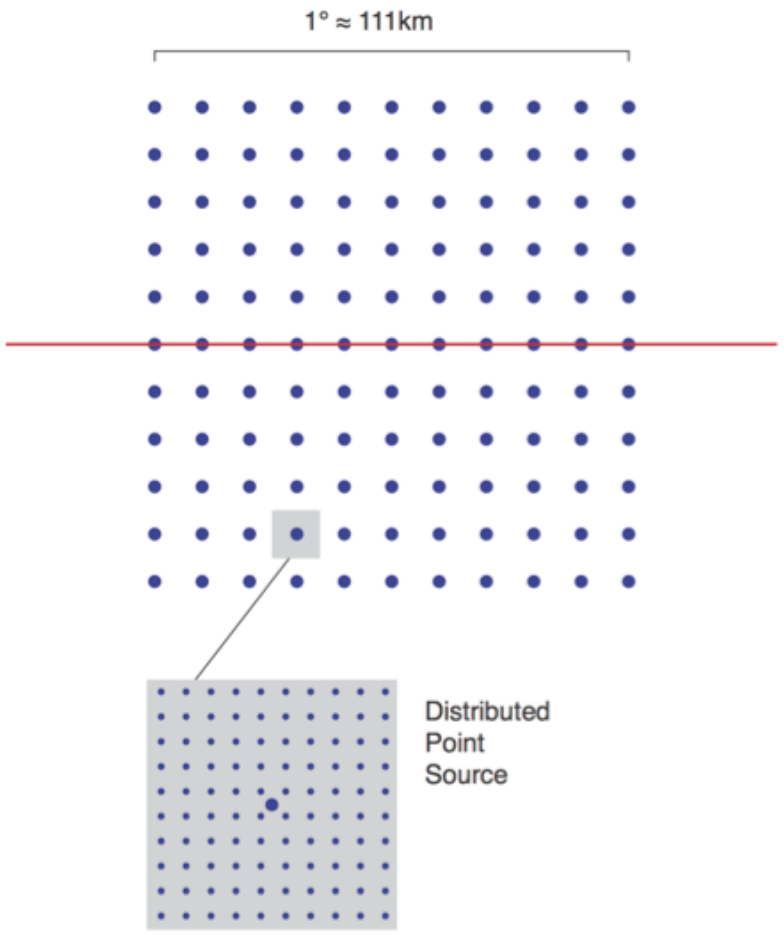
Parameterization and optimization issues:

- Current model developed to handle increased parameterization of hanging-wall terms
- 2014 model poorly captures near-field hanging wall effects
- Distance corrections complicated in near field
- Optimization binning: min rJB = 0.5 (WUS), 2.5 (CEUS) km

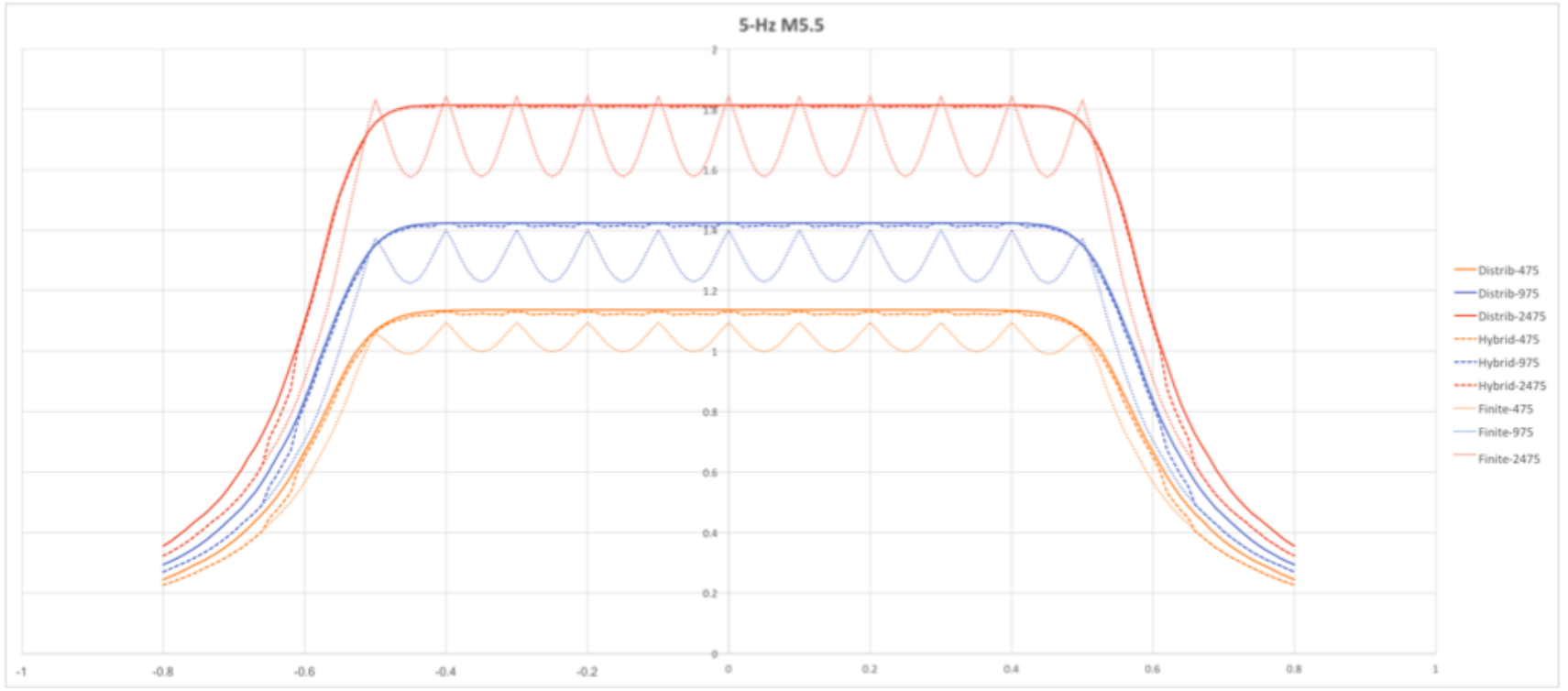
Solutions:

- Approximate ‘truth’ with rediscretization or randomization of near field source locations; explicitly model full range of strikes
- Increase discretization of gridded seismicity sources

Gridded Seismicity
Source Model Updates



- Comparison of current and proposed model
- Source Mw=5
- 3 return periods



Contact and URLs

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Source code:

- https://github.com/usgs/nshmp-haz

Documentation

- https://github.com/usgs/nshmp-haz/wiki

Future 2018 model repository:

- https://github.com/usgs/nshm-cous-2018