Sensitivity Tests of Topographic Effects on 3D Simulated Ground Motions in Reno, Nevada

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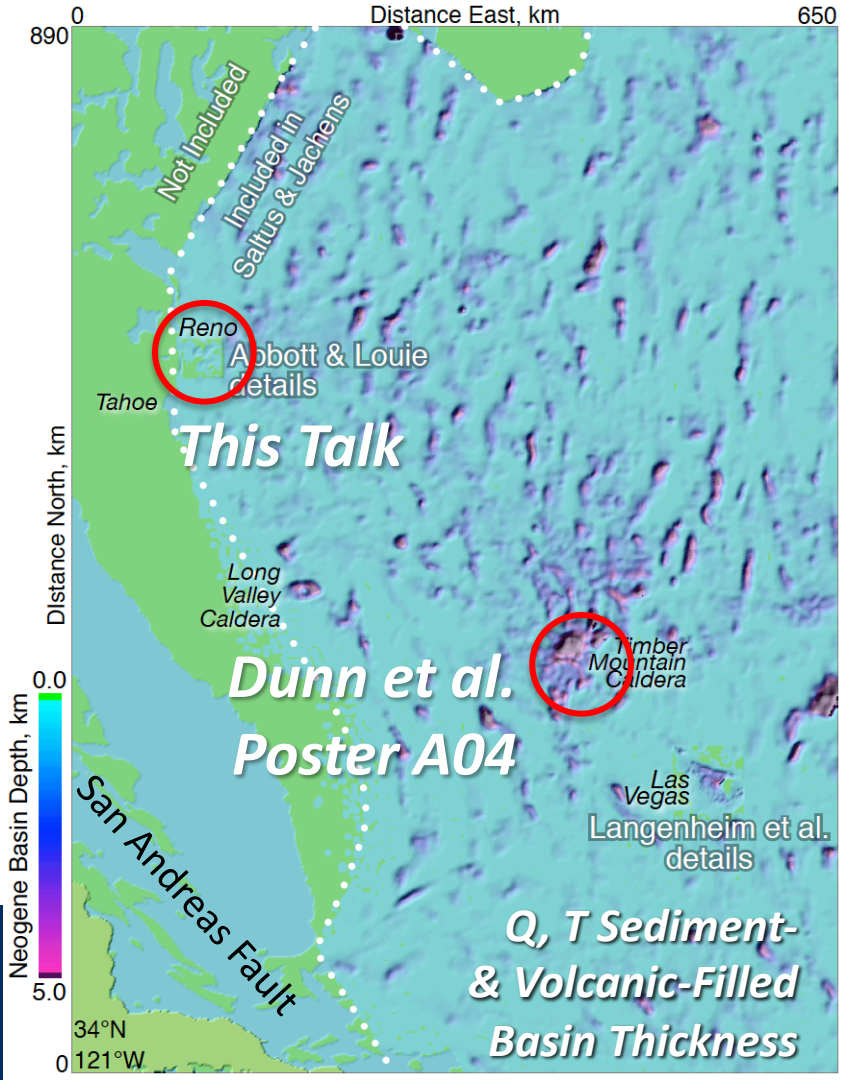
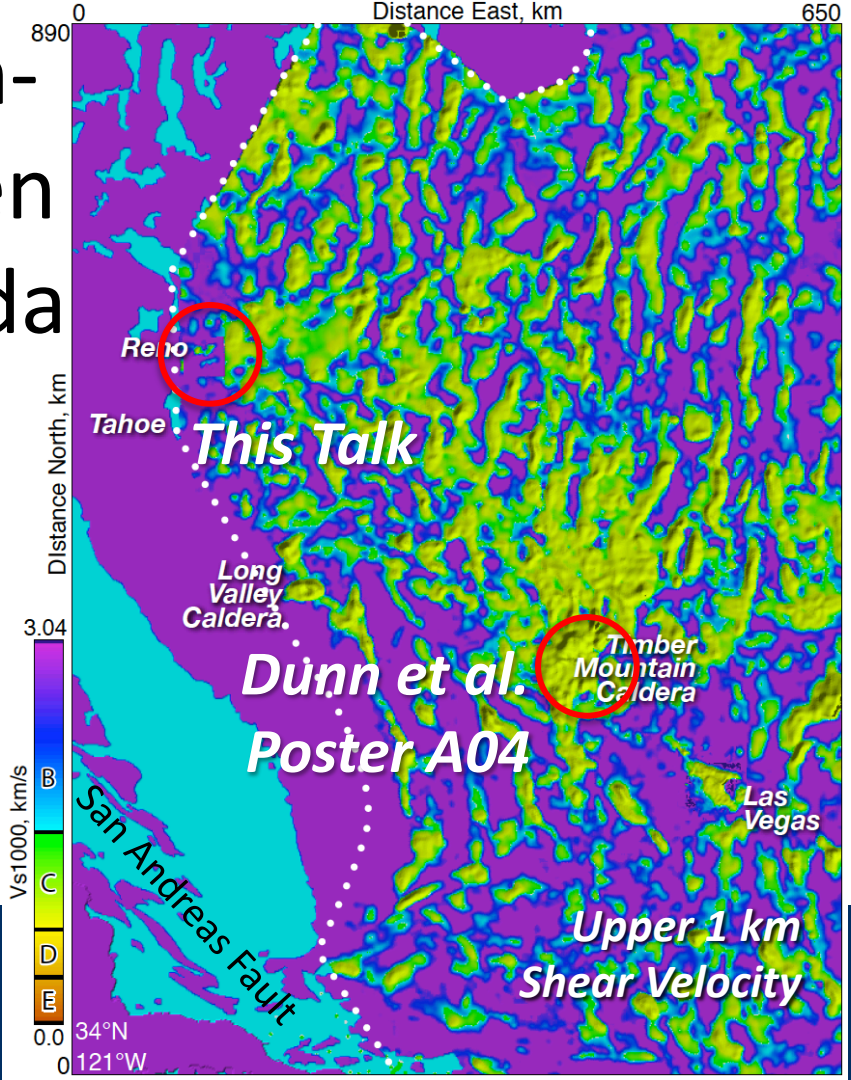
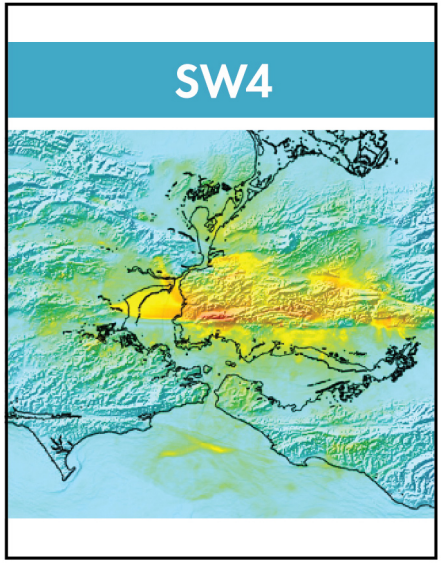
Many thanks to the *ANSS* and the *Computational Infrastructure for Geodynamics (CIG)*
Sponsorship from
Mission Support Test Services, LLC and *Optim Earth, Inc.*

Basin-Ridden Nevada USA







Simulations in SW4

$$v = f\lambda$$

Wavelength = points per wavelength * grid spacing

Minimum shear velocity

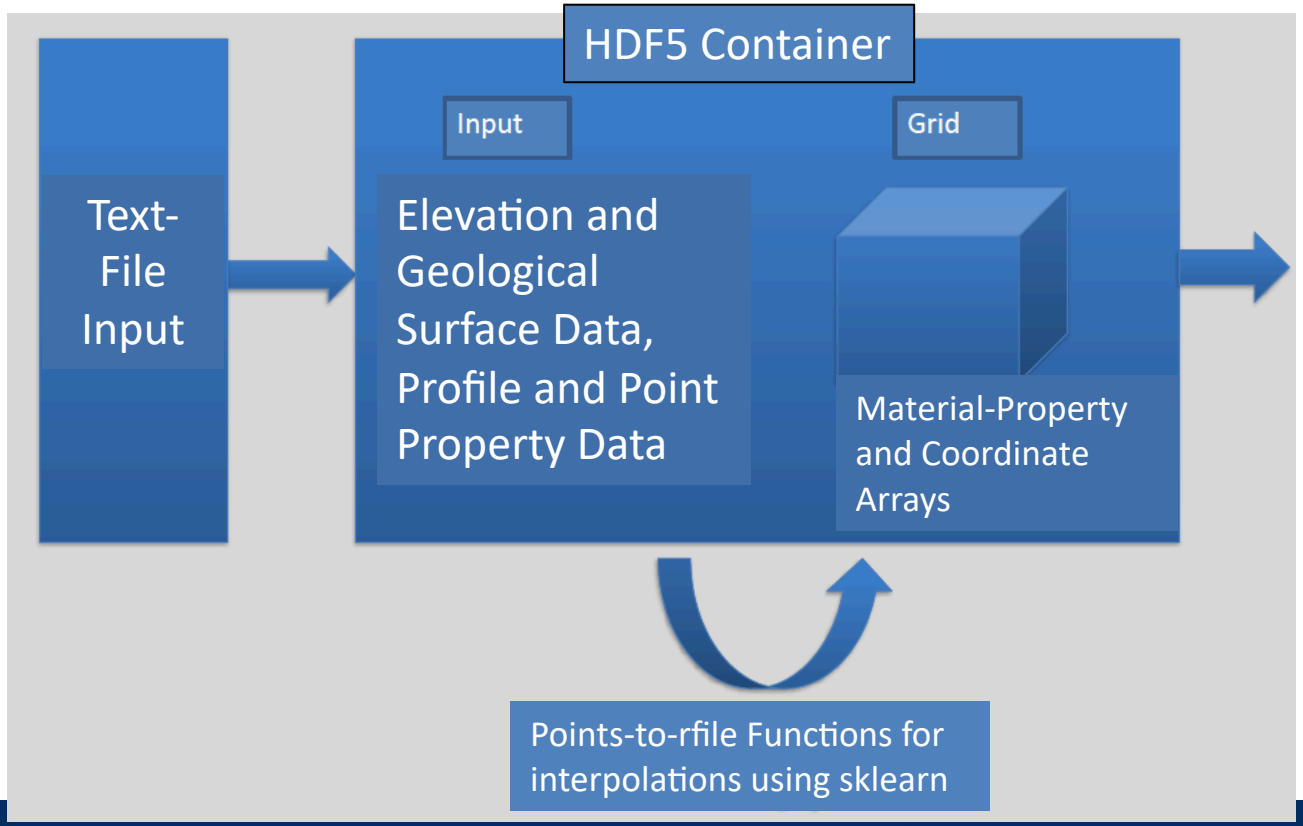
Maximum Frequency of computation

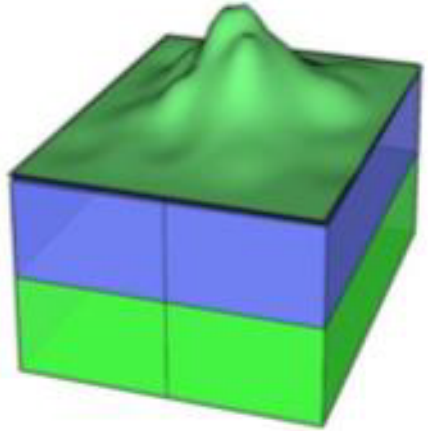
Computation Effort proportional to $16f$

Material Model + Source → Computational grid → Synthetic Seismograms

McCallen (UNR/LBNL), Petersson, Rodgers, Pitarka (LLNL) achieved 10 Hz synthetics for the Bay Area model on ***Summit*** at ORNL- 27,648 Nvidia GPUs, 200 Pflop, 10 Pbyte RAM.

New Model Construction Methods in Python

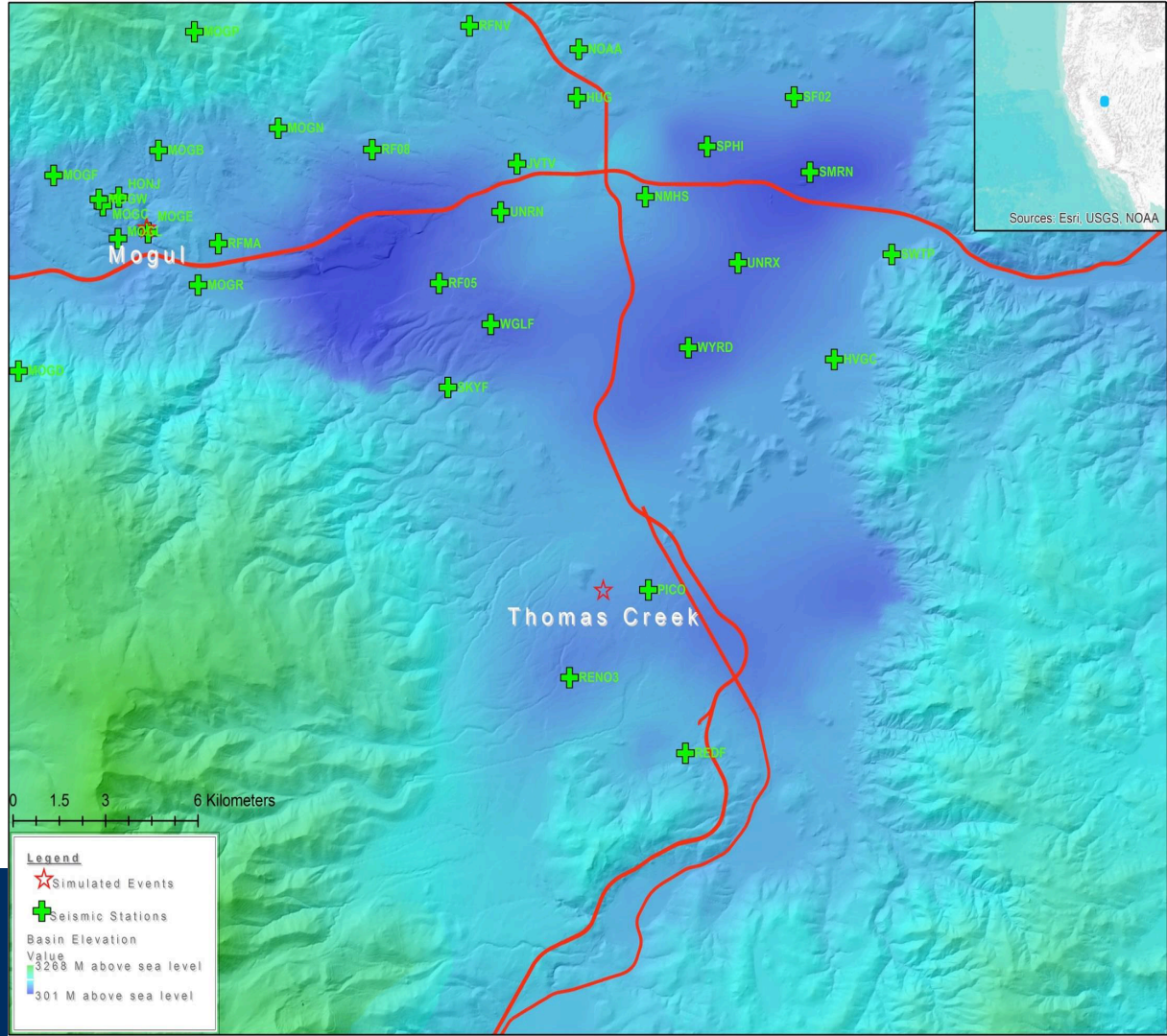




SW4 “rfile” for scalable computation

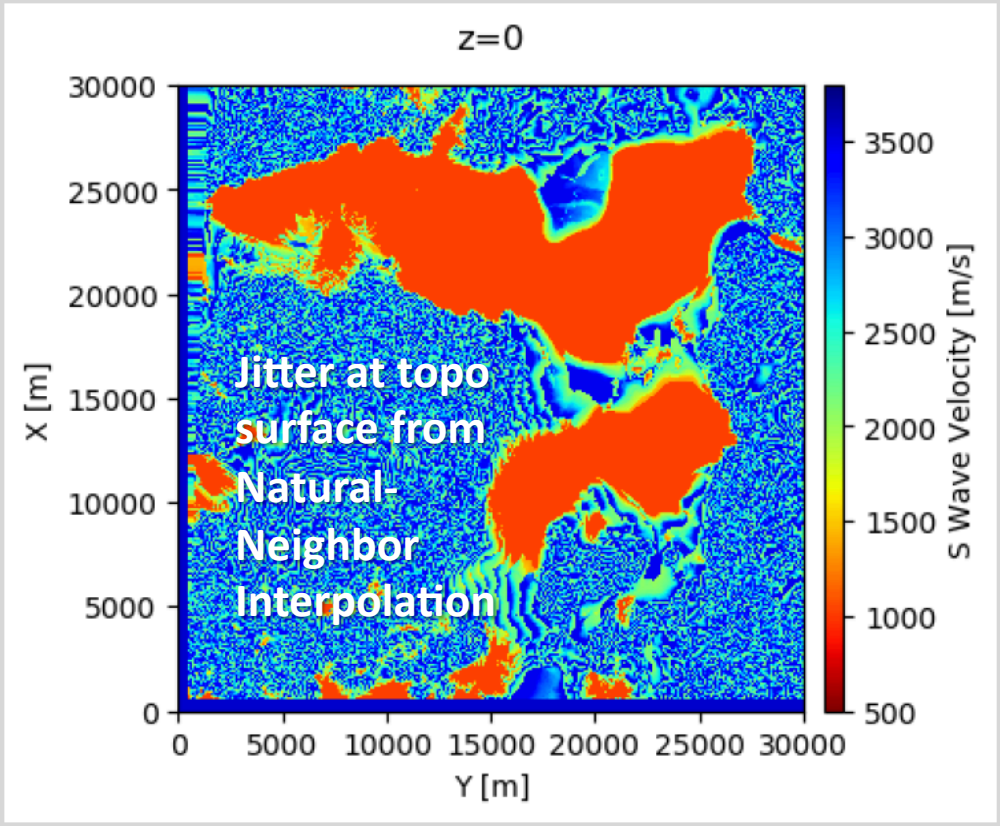
The Reno-Area Basin

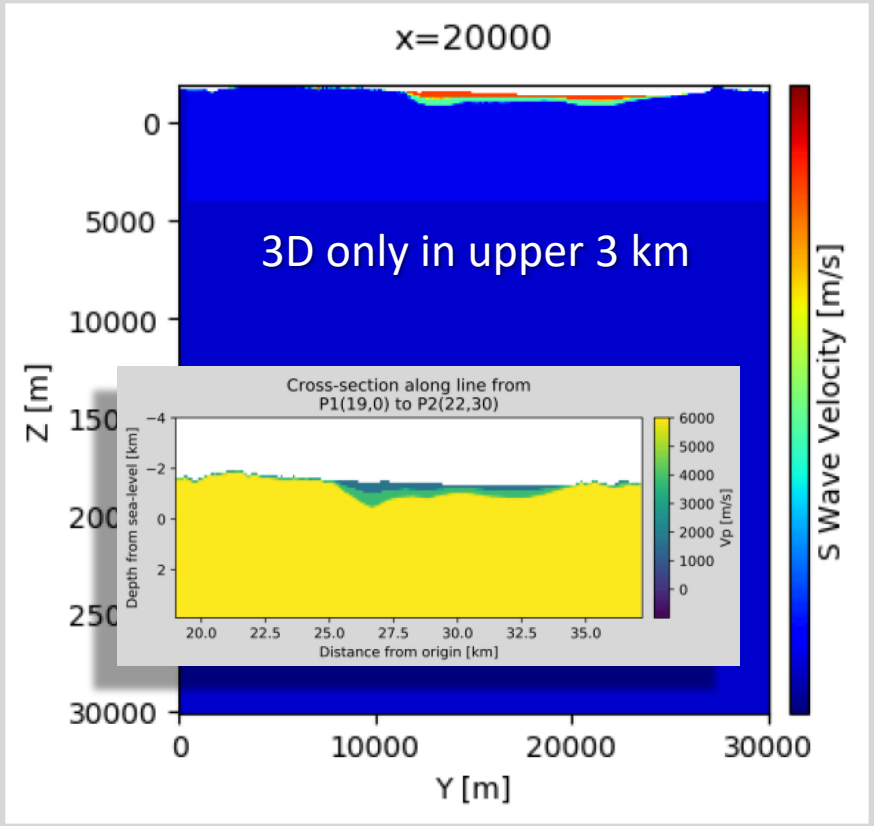
- Basin structure from gravity compilations
- 2 km topography
- Two M4-M5 events recorded from below basin (stars)



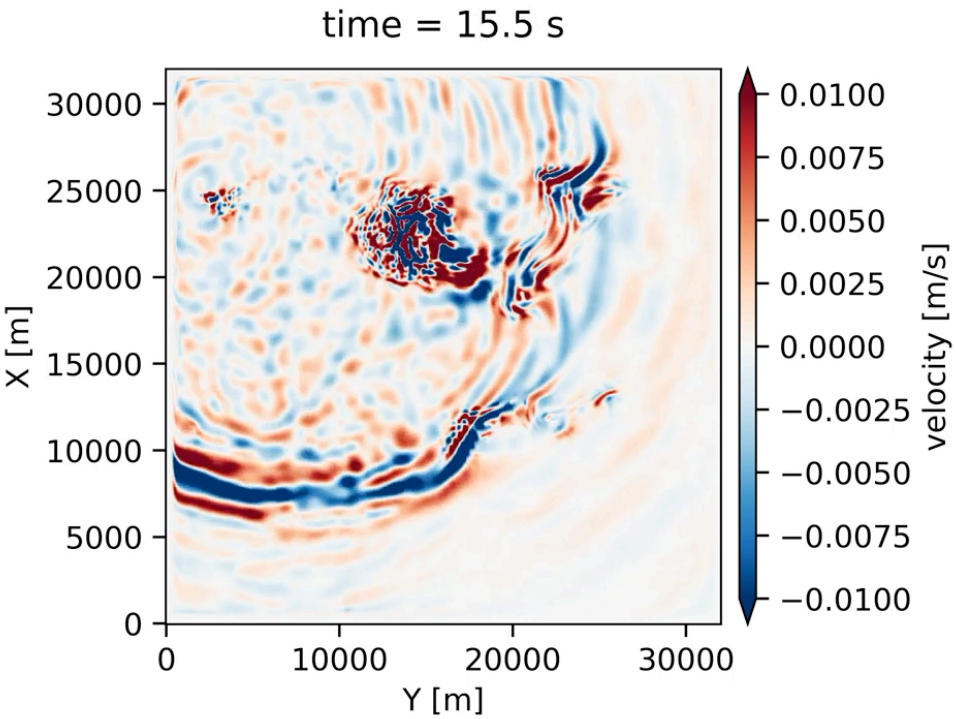
The Reno-Area Basin

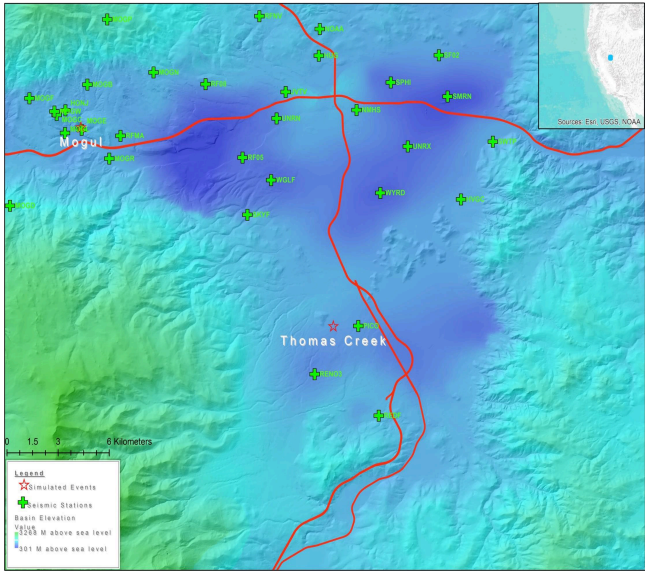
- Velocity grids rendered in Eckert's new scalable Python framework, h=50 m





Mogul M5.0 Computed Shaking at 2.2 Hz





Computation with topography

86 hours on our cluster (80 cores)
Similar on AWS (only $300)

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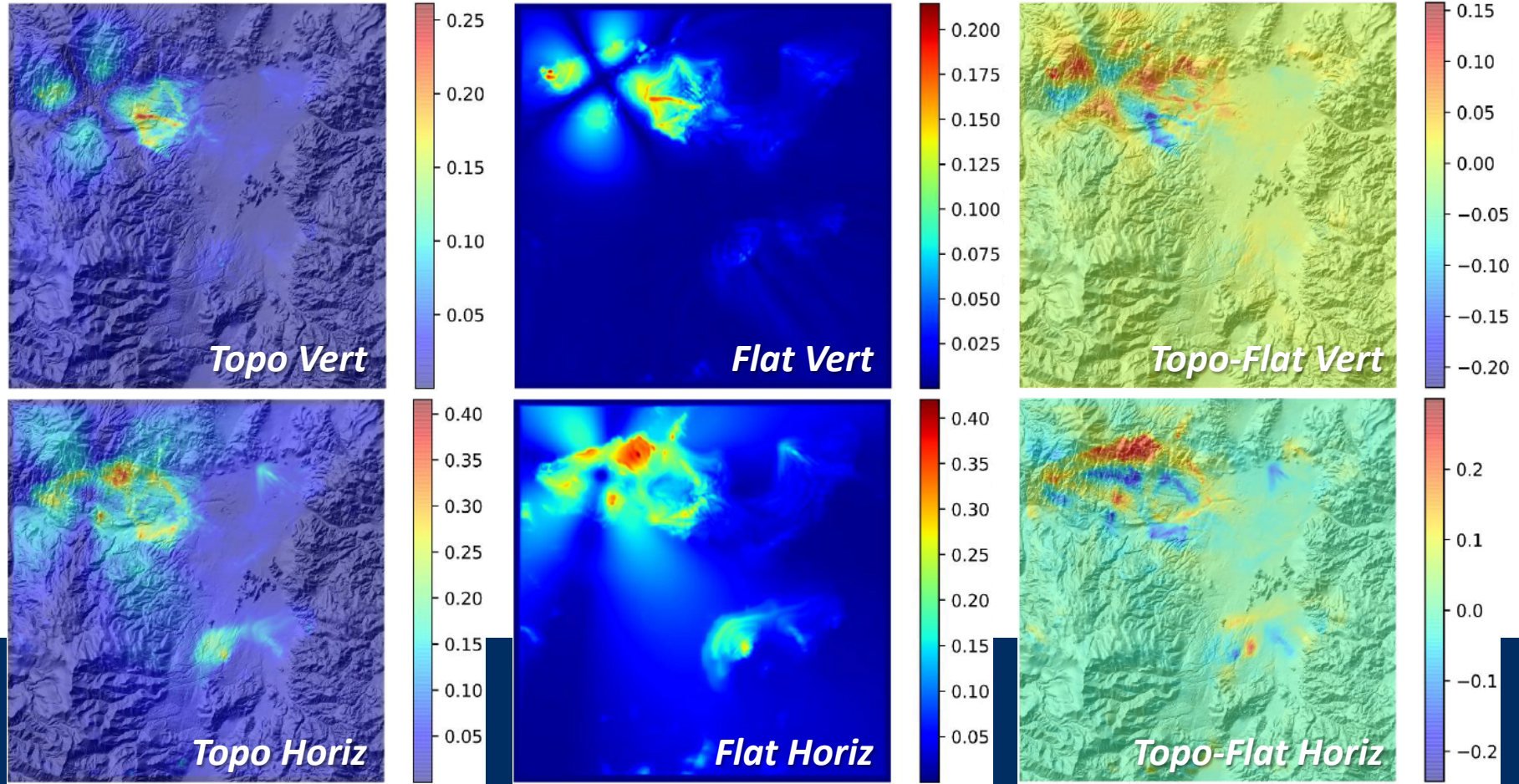
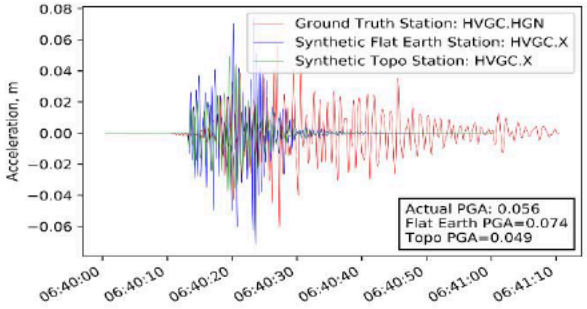
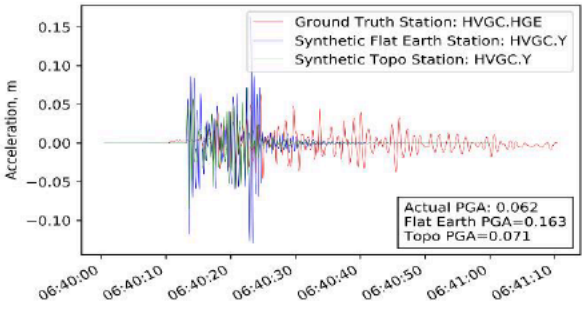
Mogul was extremely shallow- 3.6 km

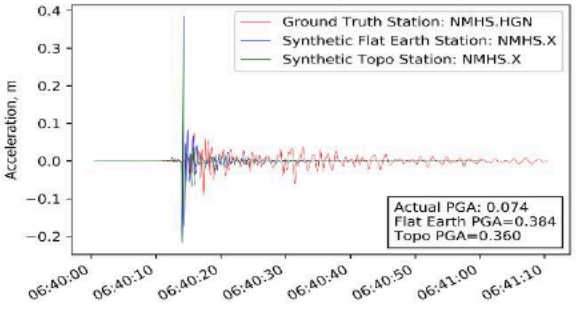
Mogul M5.0 Computed PGV at 2.2 Hz (m/s)

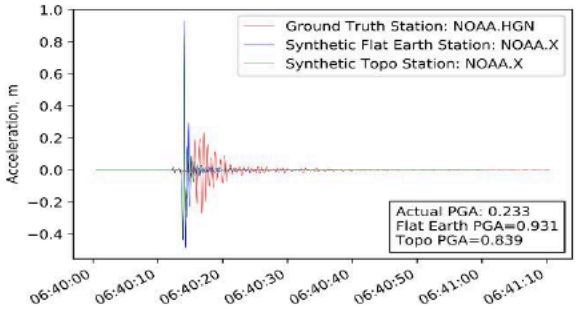


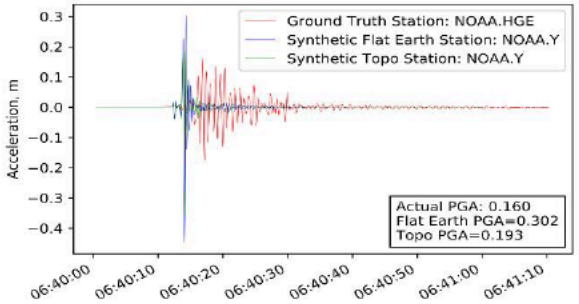
Mogul M5.0 Recorded vs. Computed Accelerograms at 2.2 Hz (m/s^2)

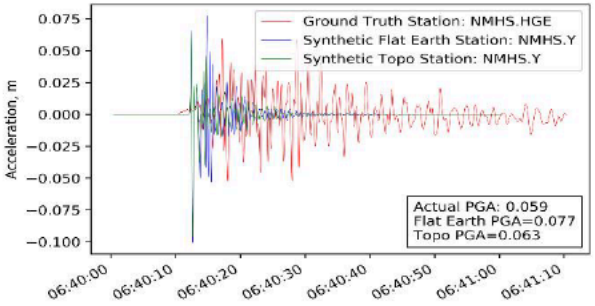


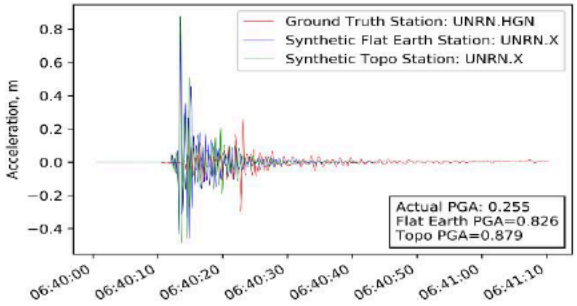


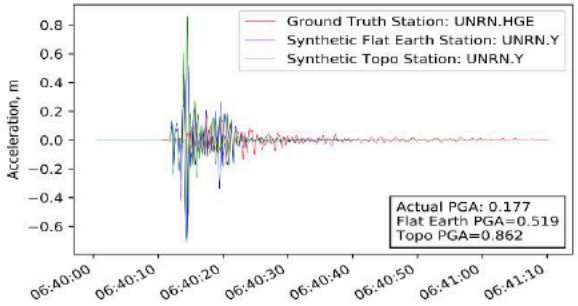


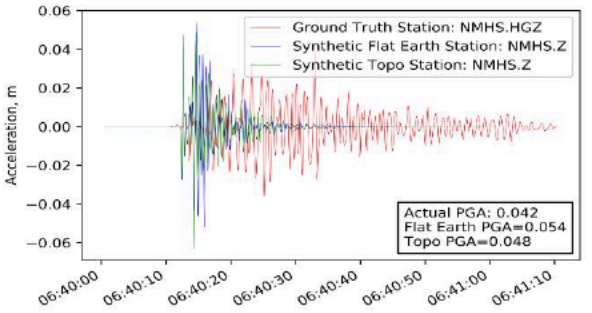




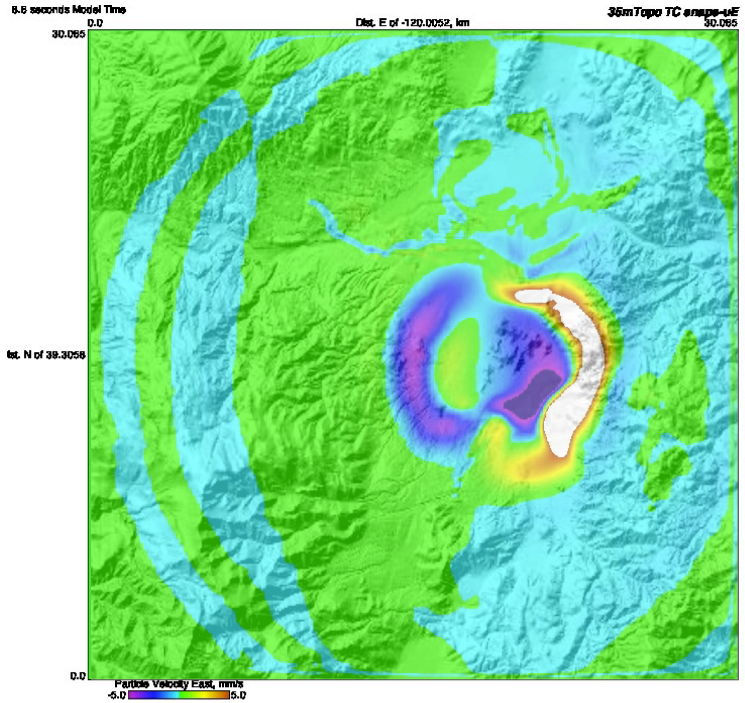


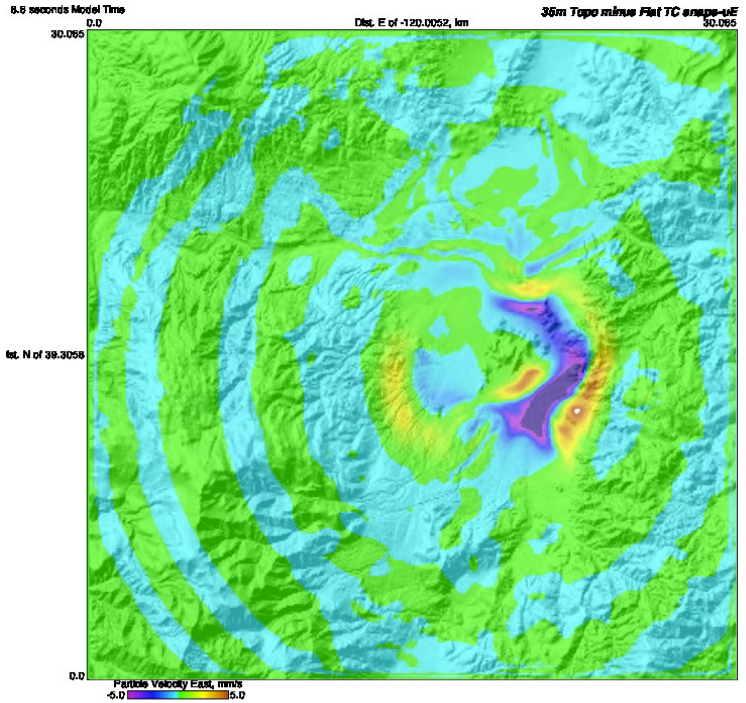






Thomas Cr. M4.3 Computed GV at 3.3 Hz, mm/s





~130 hours on our cluster (80 cores)
Similar on AWS (only $500)

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Topo sensitivity test- differences originate at topo edge + basin edge

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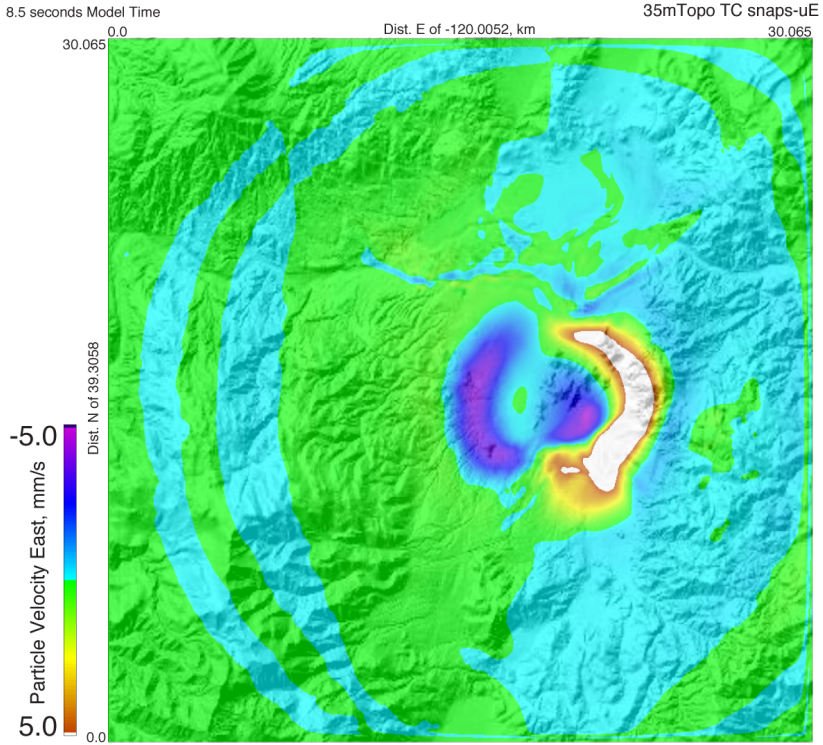

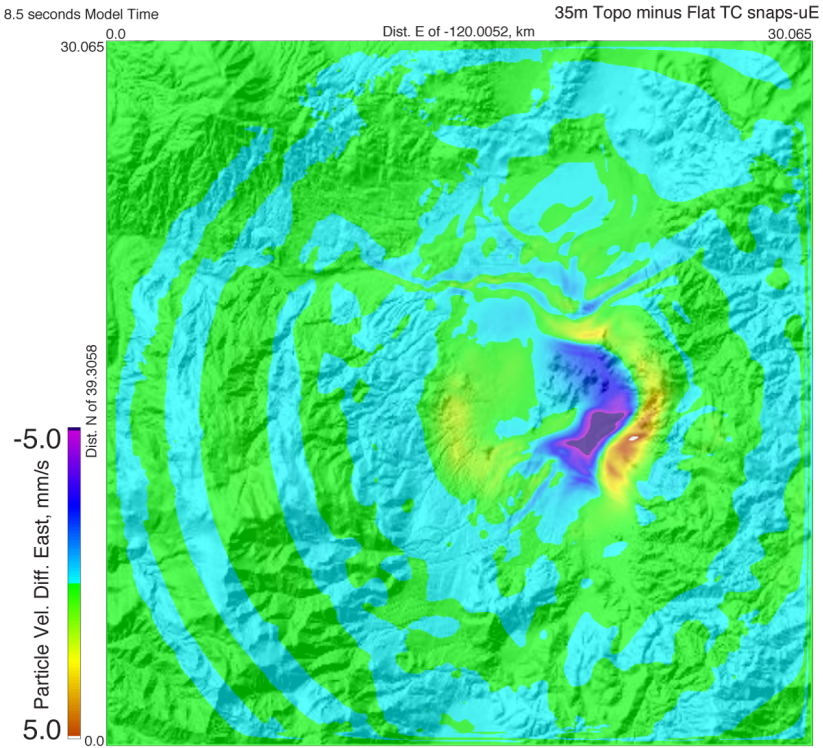

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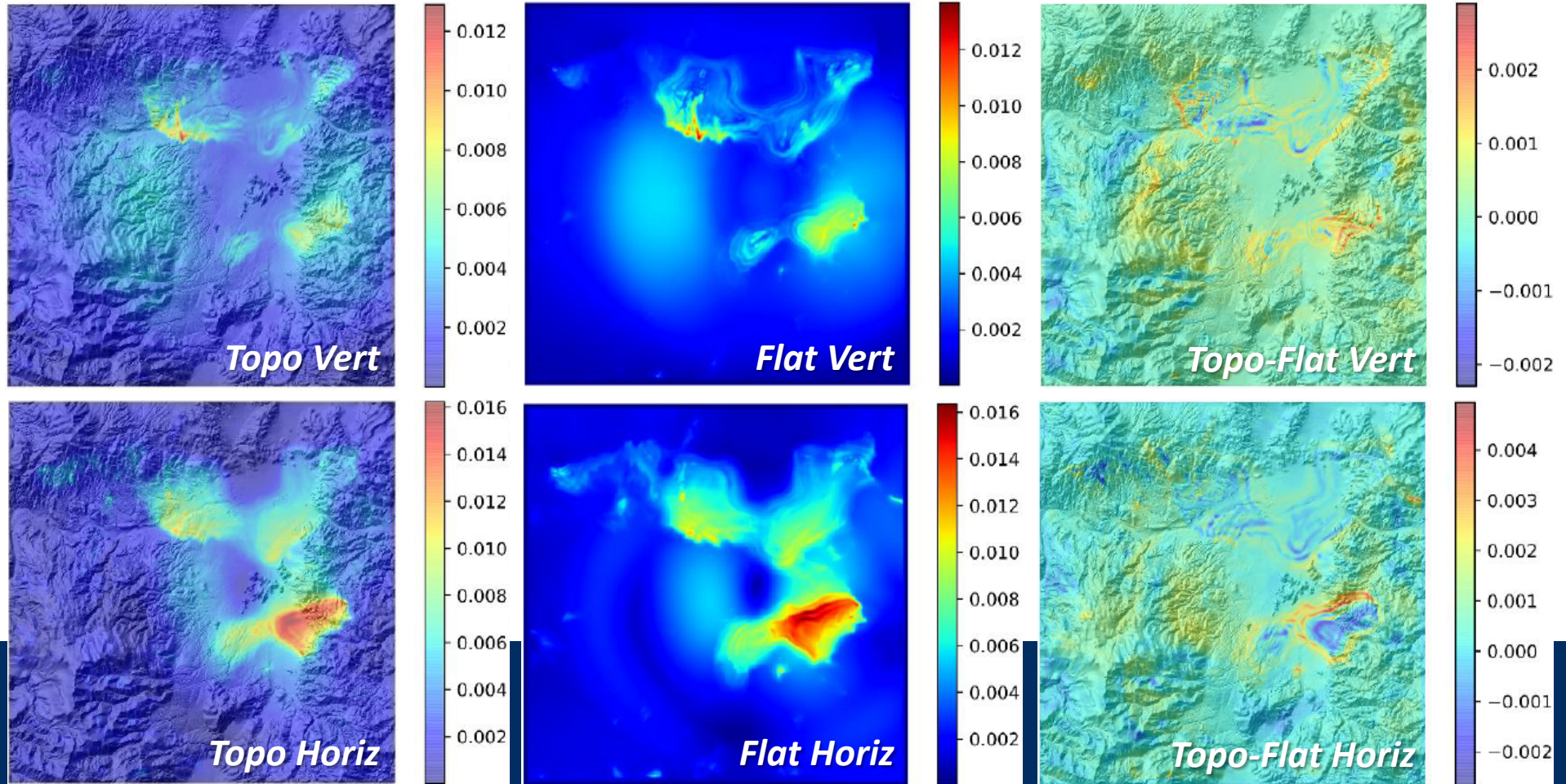
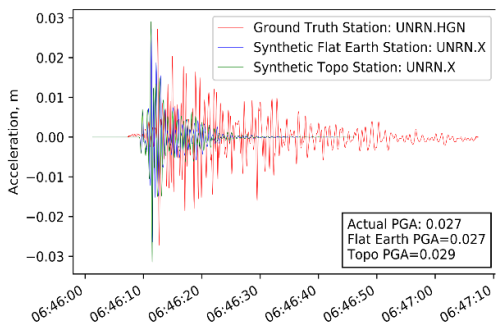
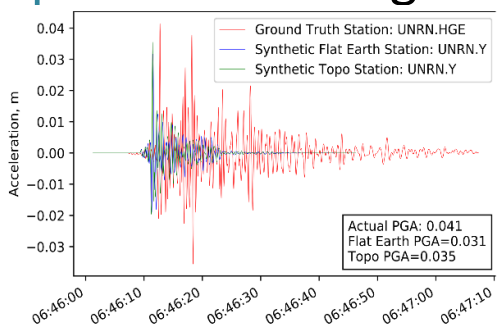


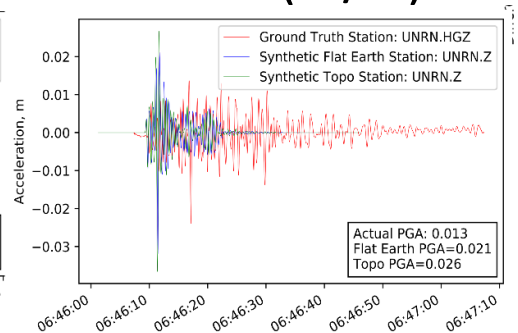
Thomas Cr. M4.3 Recorded vs. Computed Accelerograms at 3.3 Hz (m/s^2)

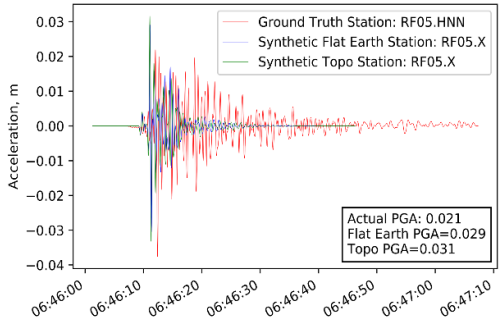
- Better PGA fit in central basin (UNRN, RF05) than eastern (HVGC)
- Mogul simulations give >PGA, TC sims give <PGA, from high Vs_{min} and high Qs in basin
- Too little duration by 3x

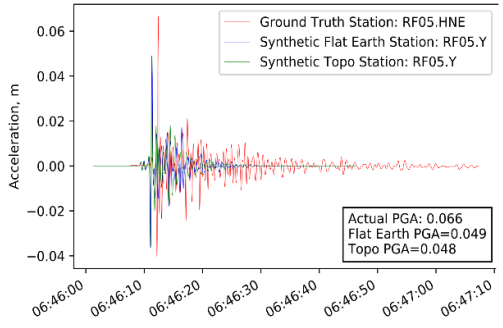
Even with topo!

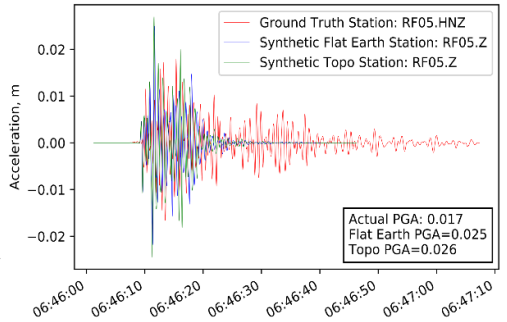


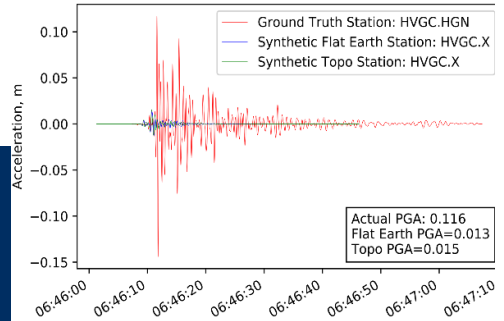


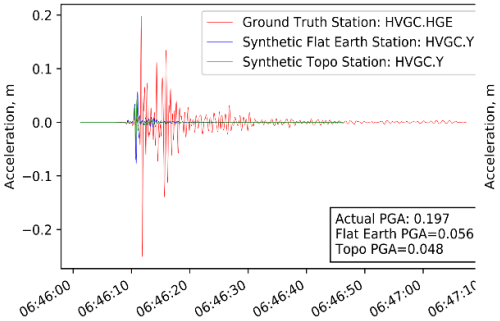


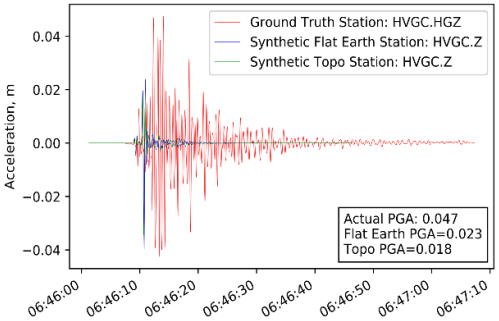












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