Hazard Sensitivity Results

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NSHMP Update of the Hawaii Seismic Hazard Model Workshop

Wednesday, September 18th, 2019

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U.S. Geological Survey
Geologic Hazard Science Center (Golden, CO)
https://earthquake.usgs.gov/hazards/

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Outline

- Overview of sensitivity models
- Hazard sensitivity results
- Comparisons of sensitivity results with the 1998/2001 model

Overview of Sensitivity Models

Sensitivity Models

- Catalog
  - Earthquakes since 1959; M≥3; Reasenberg (1985) declustering method
- Source Model
  - Gridded Smoothed Seismicity Sources (M5 – M7; point sources)
    - Shallow (≤ 20 km)
      - Fixed Model: Fixed (10 km smoothing kernel; summit zones: *b*-value = 1.2; non-summit zones: *b*-value = 1.0; 1.0 weight)
      - Fixed and Adaptive Model: Fixed (10 km smoothing kernel; summit zones: *b*-value = 1.2; non-summit zones: *b*-value = 1.0; 0.5 weight) and Adaptive (N = 2; all zones: *b*-value = 1.0; 0.5 weight)
    - Deep (> 20 km)
      - Fixed Model: Fixed (10 km smoothing kernel; summit zones: *b*-value = 1.0; non-summit zones: *b*-value = 0.9; 1.0 weight)
      - Fixed and Adaptive Model: Fixed (10 km smoothing kernel; summit zones: *b*-value = 1.0; non-summit zones: *b*-value = 0.9; 0.5 weight) and Adaptive (N = 2; all zones: *b*-value = 1.0, 0.5 weight)
  - Area Sources (≤ 20 km, finite sources; floating ruptures; uniform *a*- and *b*-values)
    - 5 decollement/flank zone sources on the Big Island (Hilea, Hualalai, Kaoiki, Kilauea, and Kona; M6.5 – M7)
    - 1 combined decollement/flank zone source on southeast of the Big Island (Hilea + Kaoiki + Kilauea; M7 - M8.2)
- Ground Motion Model
  - Shallow (shallow gridded smoothed seismicity and area sources)
    - Atkinson - shallow (2010), ASK14, BSSA14, CB14, and CY14 (all with weight of 0.2)
  - Deep (deep gridded smoothed seismicity sources)
    - Atkinson - deep (2010) (0.34 weight), Wong et al. (2015) (0.33 weight), and BC Hydro - intraslab (Abrahamson et al. 2016) (0.33 weight)
- Periods and Site Classes
  - 4 periods (PGA, 0.2s, 1s, and 5s)
  - 1 site class (NEHRP Site Class Boundary B/C: V_{S30} = 760 m/s)

Hazard Sensitivity Results

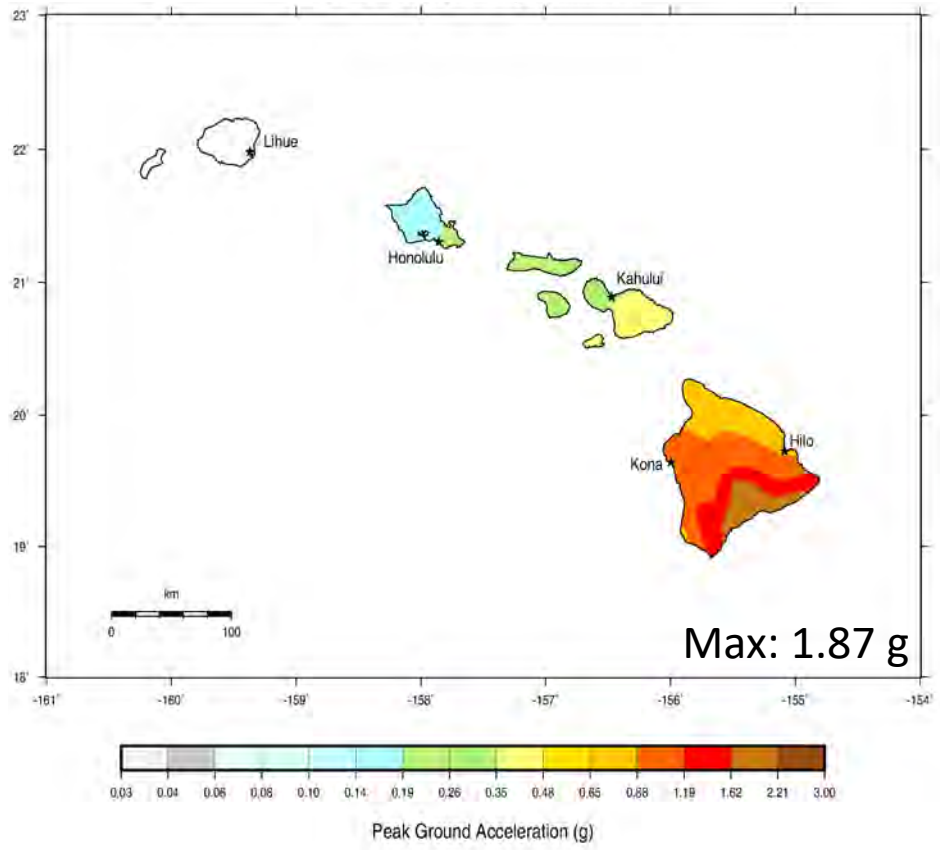
All results for NEHRP Site Class Boundary B/C (V_{S30} = 760 m/s)* and 2% in 50 Years Probability of Exceedance

* The Wong et al. (2015) GMM assumes a site condition of V_{S30} = 428 m/s

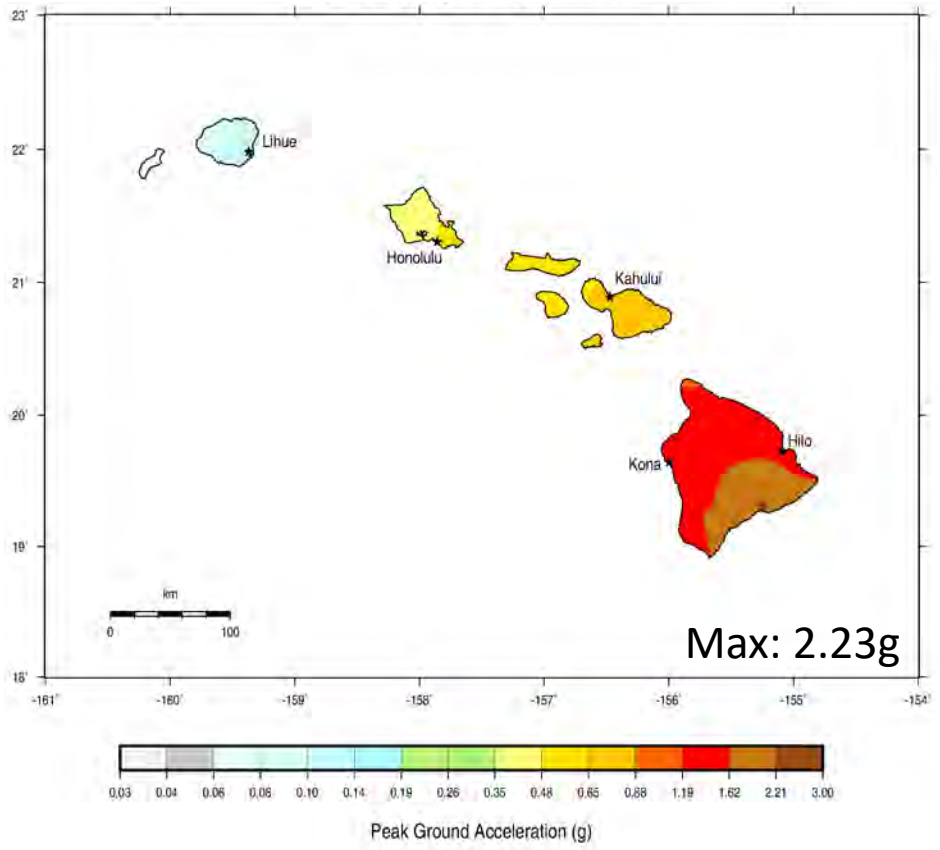
PGA Total Mean Hazard

NEHRP Site Class Boundary B/C (V_{S30} = 760 m/s)
2% in 50 Years Probability of Exceedance

Fixed Smoothing (10 km)



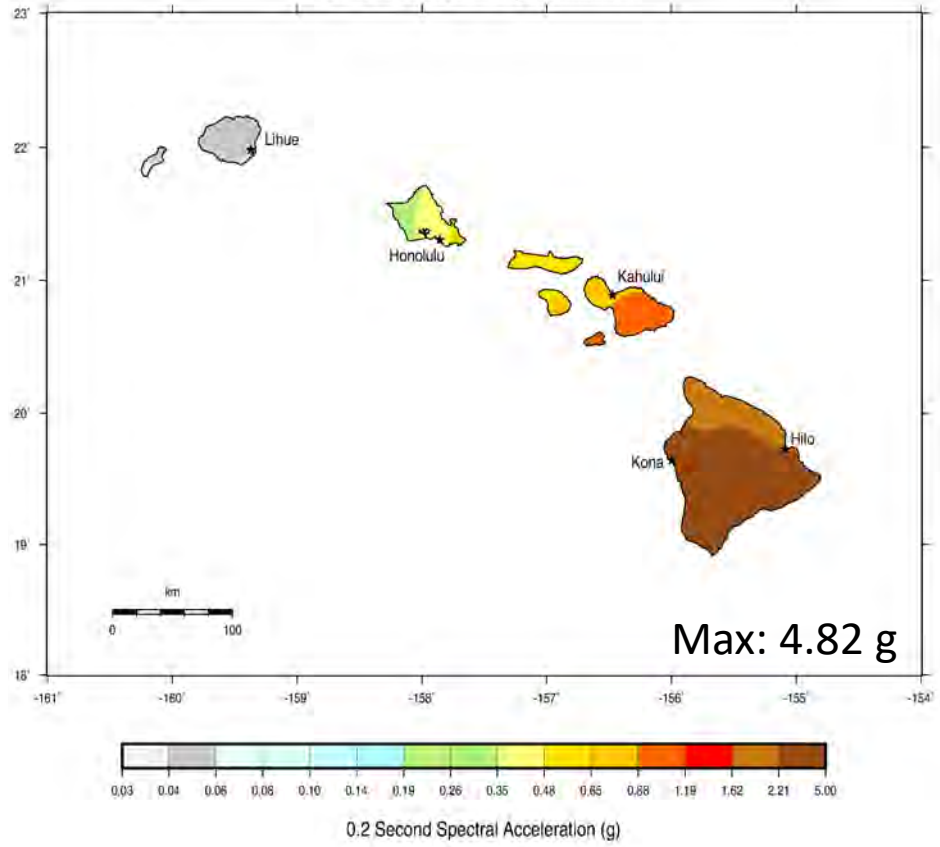
Fixed Smoothing (10 km) and Adaptive Smoothing (N = 2)



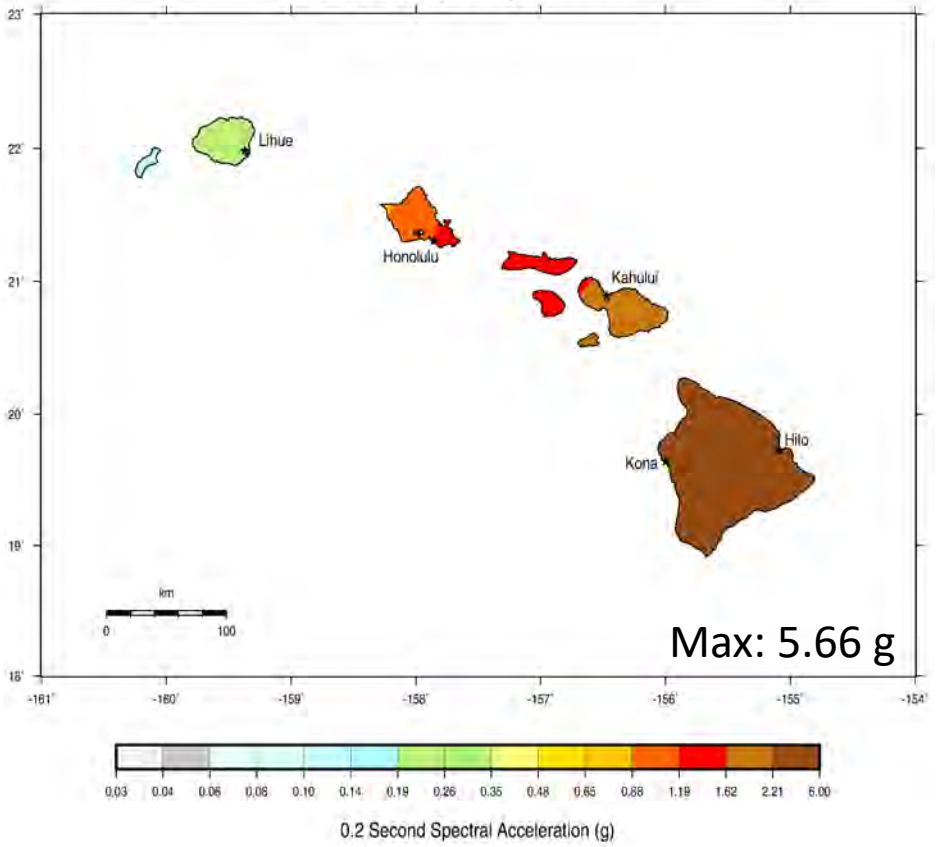
0.2s Total Mean Hazard

NEHRP Site Class Boundary B/C (V_{S30} = 760 m/s)
2% in 50 Years Probability of Exceedance

Fixed Smoothing (10 km)



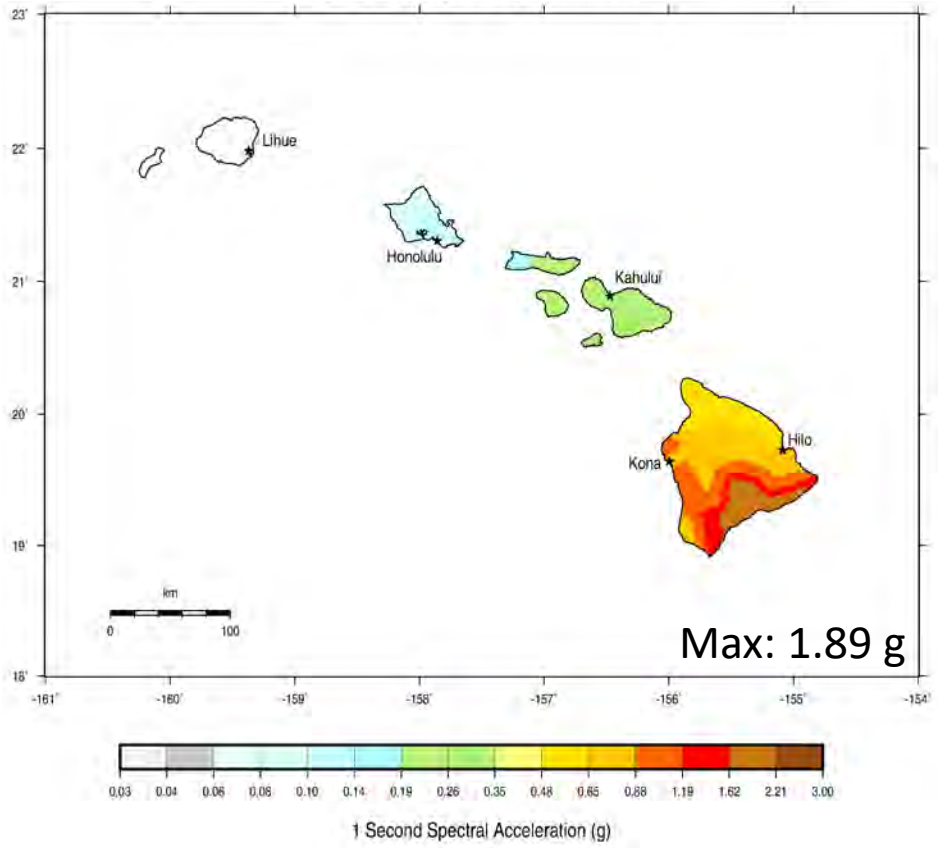
Fixed Smoothing (10 km) and Adaptive Smoothing (N = 2)



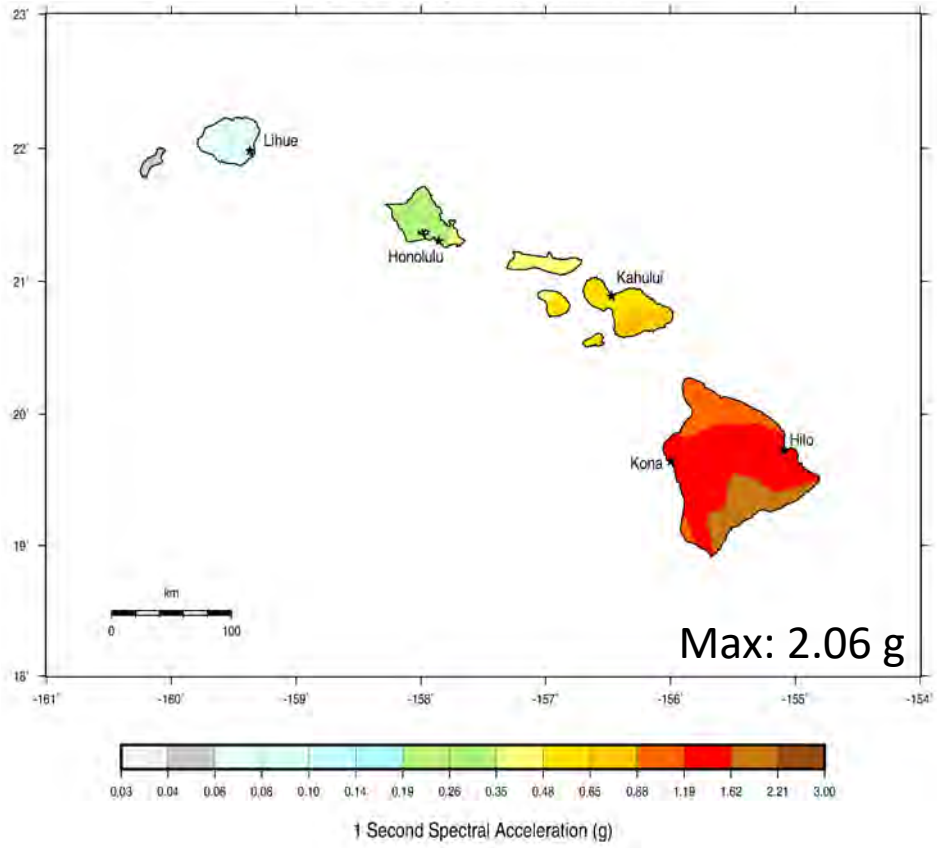
1s Total Mean Hazard

NEHRP Site Class Boundary B/C (V_{S30} = 760 m/s)
2% in 50 Years Probability of Exceedance

Fixed Smoothing (10 km)



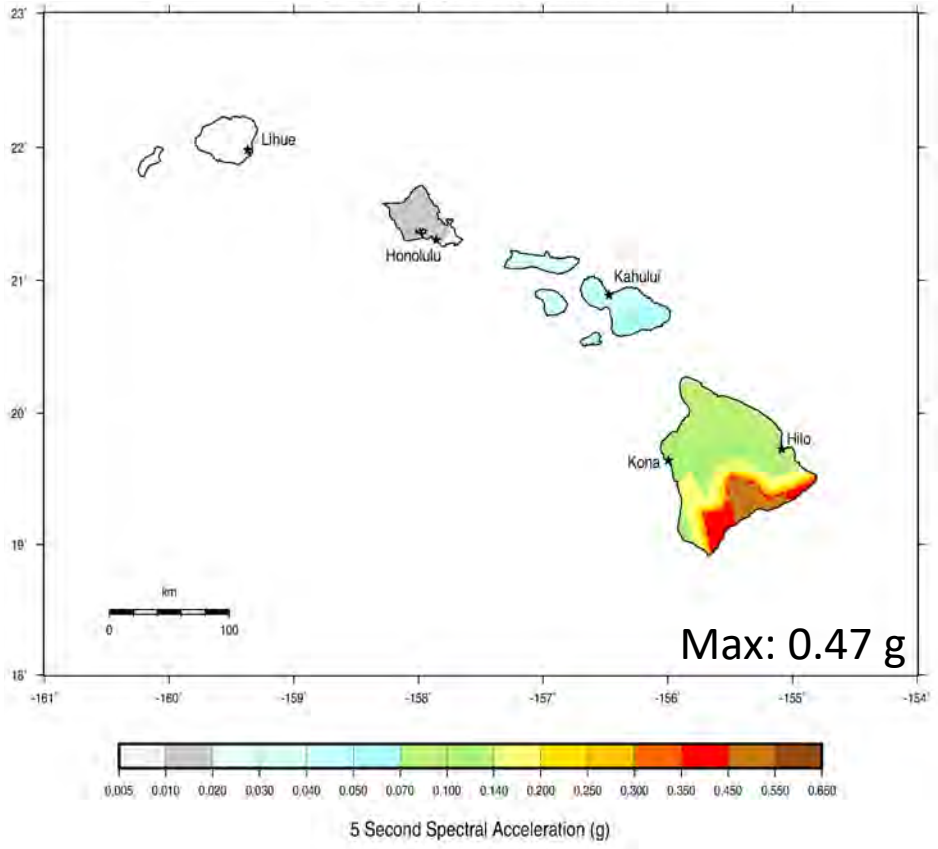
Fixed Smoothing (10 km) and Adaptive Smoothing (N = 2)



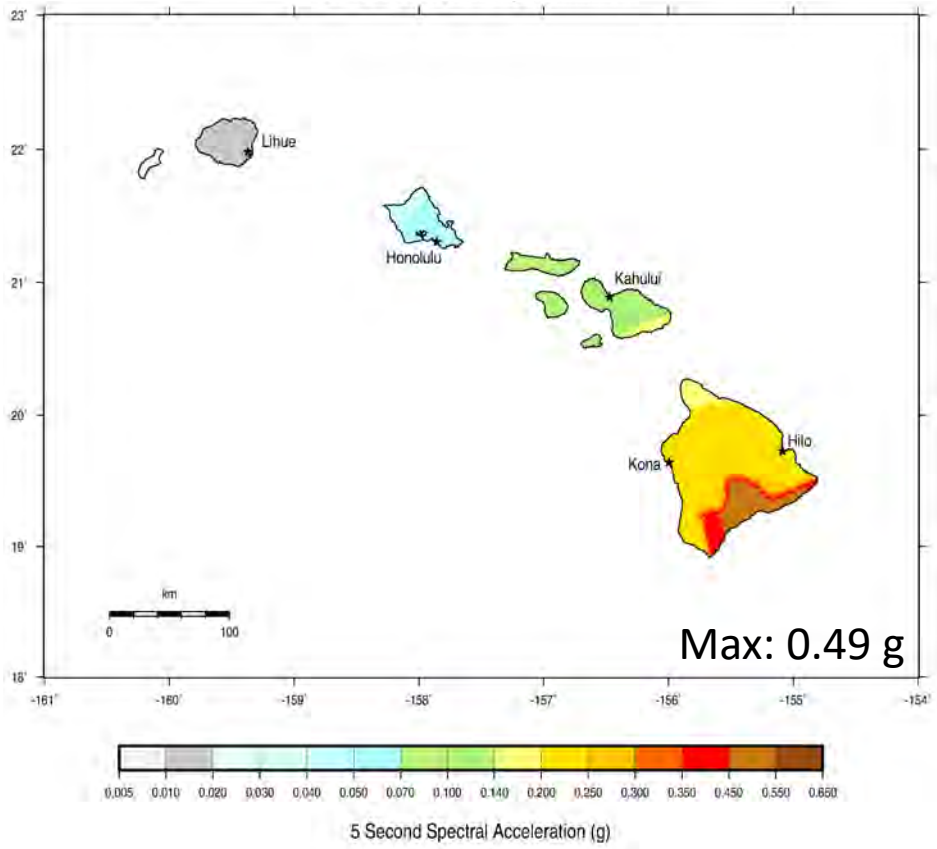
5s Total Mean Hazard

NEHRP Site Class Boundary B/C (V_{S30} = 760 m/s)
2% in 50 Years Probability of Exceedance

Fixed Smoothing (10 km)



Fixed Smoothing (10 km) and Adaptive Smoothing (N = 2)



Comparison of Sensitivity Results with the 1998/2001 Model

All comparisons for NEHRP Site Class Boundary B/C (V_{S30} = 760 m/s)* and 2% in 50 Years Probability of Exceedance

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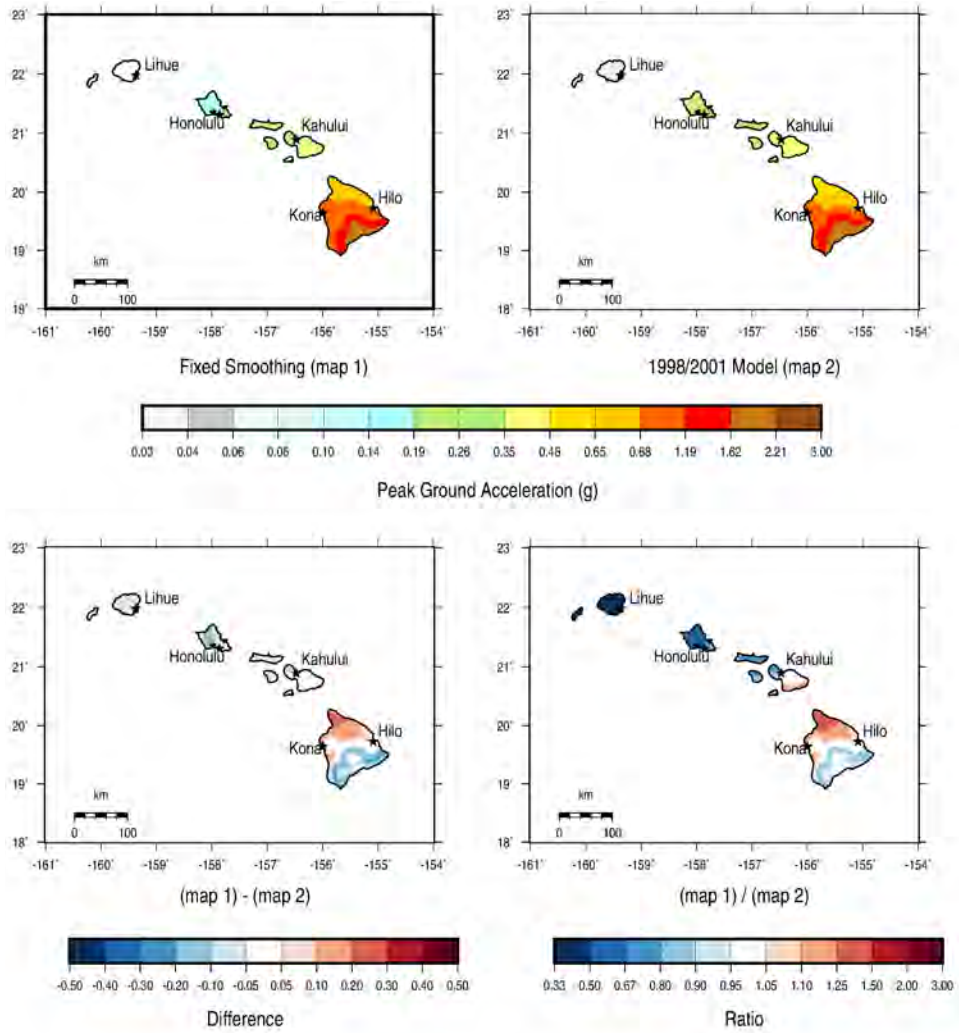
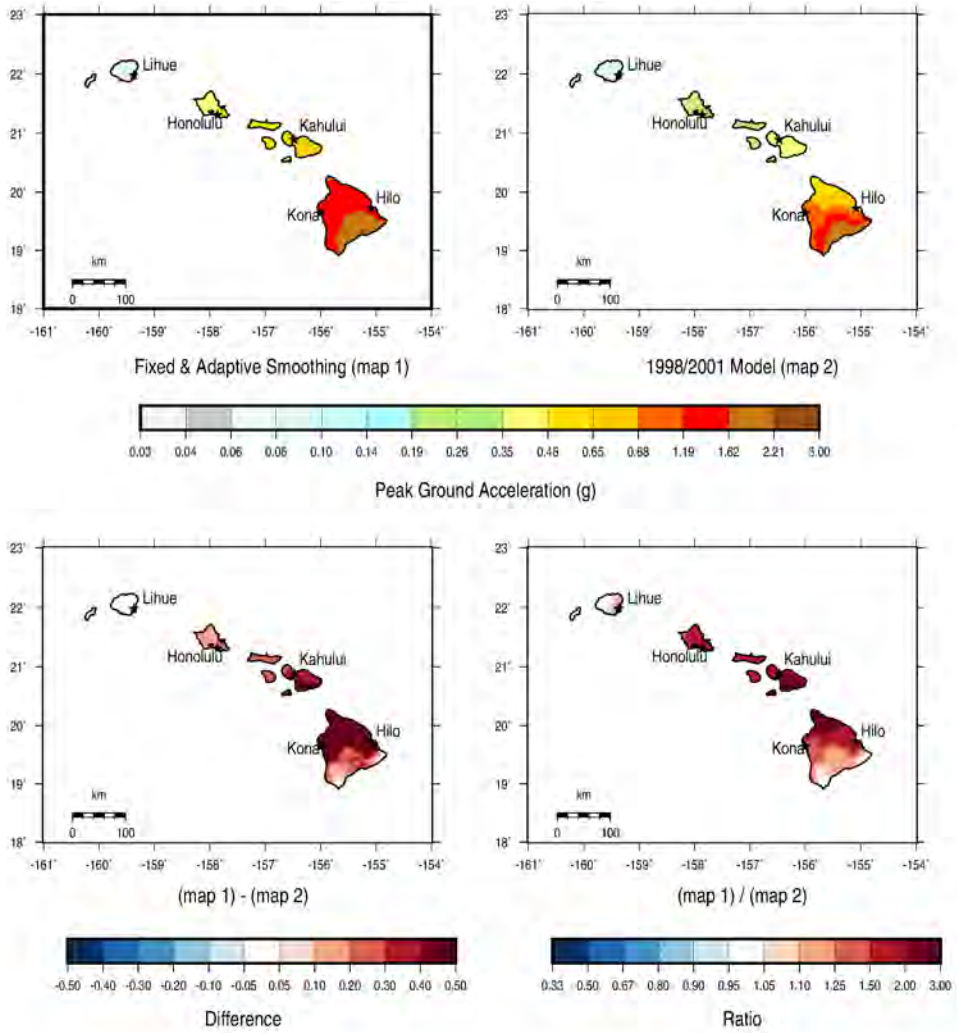
PGA

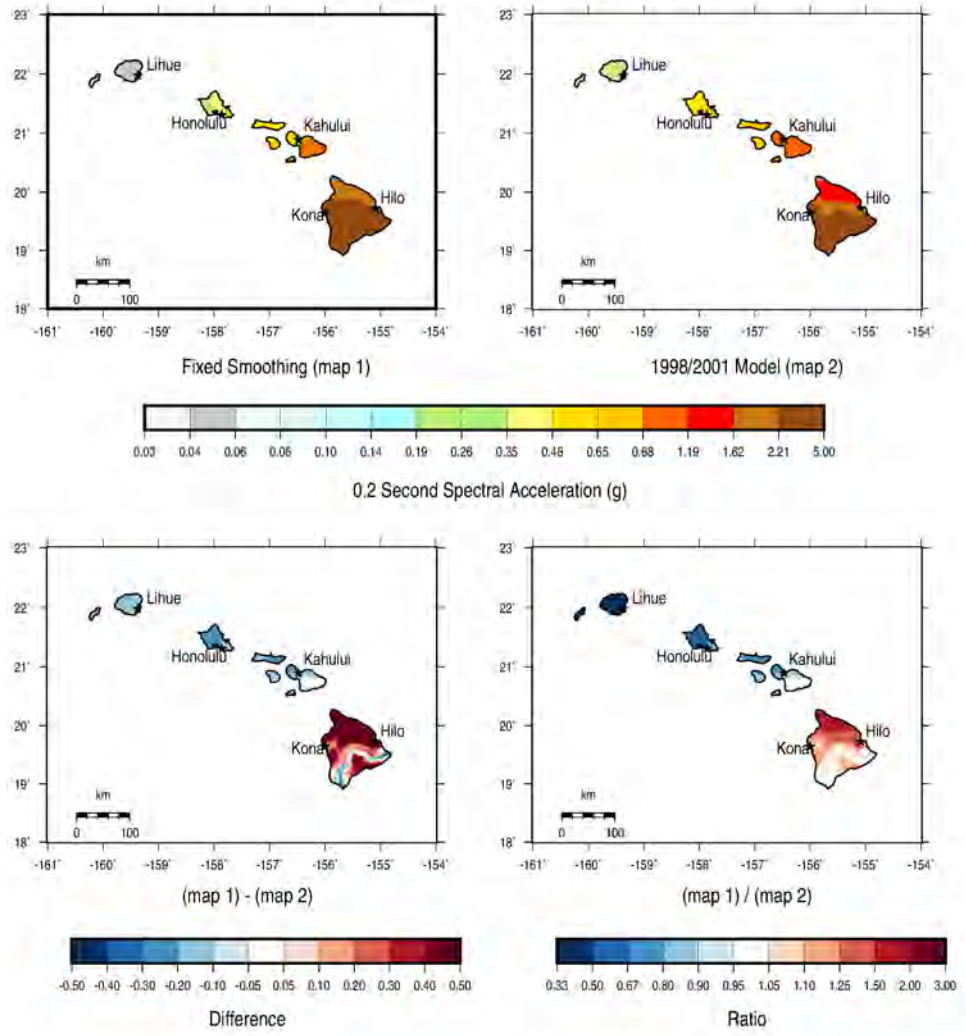


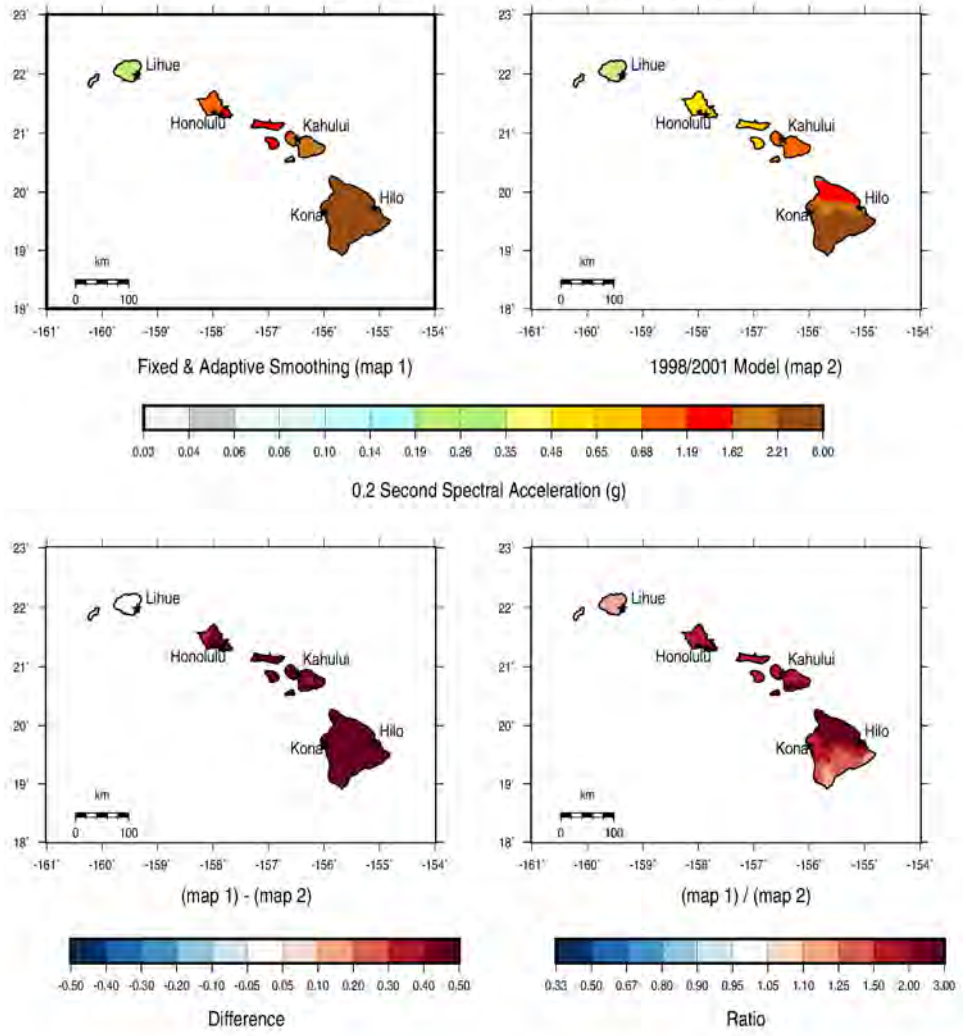


2% in 50 Years Probability of Exceedance PGA Ground Motion						
	Site	Lat	Long	Fixed (g)	1998/2001 (g)	Difference (g)	Ratio
SE	Hilo	19.7	-155.06	1.09	0.83	0.26	1.31
↓	Kona	19.66	-156	1.1	1.02	0.08	1.08
	Kahului	20.9	-156.5	0.33	0.36	-0.03	0.92
	Honolulu	21.3	-157.86	0.19	0.27	-0.08	0.70
NW	Lihue	21.96	-159.36	0.03	0.1	-0.07	0.30

2% in 50 Years Probability of Exceedance PGA Ground Motion						
	Site	Lat	Long	Fixed and Adaptive (g)	1998/2001 (g)	Difference (g)	Ratio
SE	Hilo	19.7	-155.06	1.5	0.83	0.67	1.81
↓	Kona	19.66	-156	1.47	1.02	0.45	1.44
	Kahului	20.9	-156.5	0.7	0.36	0.34	1.94
	Honolulu	21.3	-157.86	0.48	0.27	0.21	1.78
NW	Lihue	21.96	-159.36	0.12	0.1	0.02	1.20

0.2s

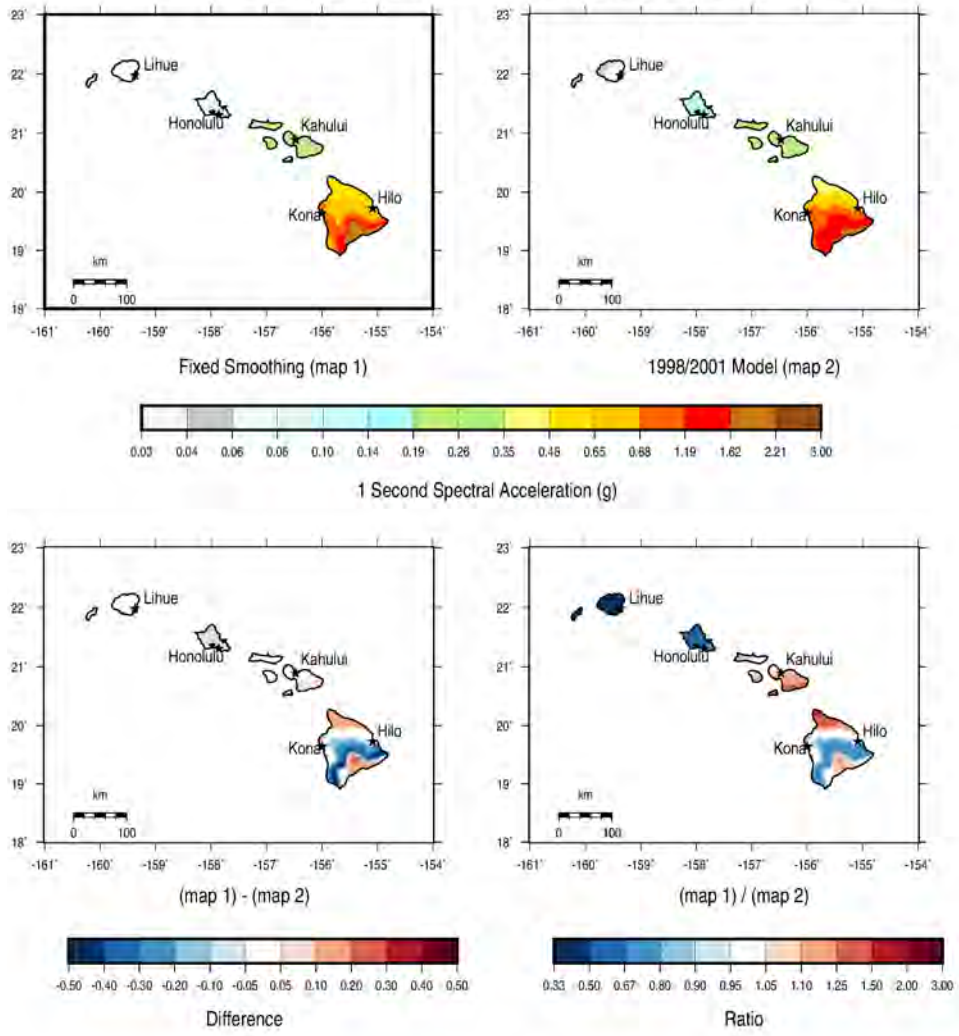


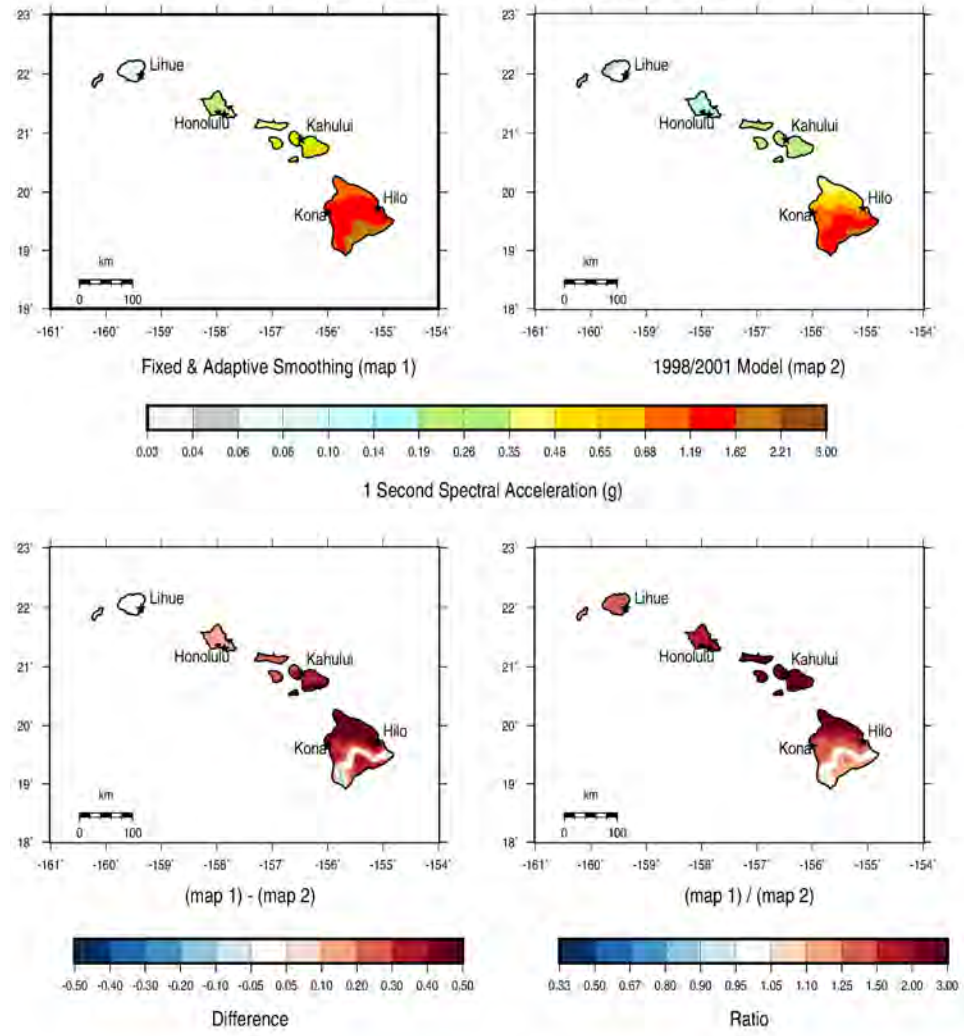


2% in 50 Years Probability of Exceedance 0.2s Ground Motion						
Site	Lat	Long	Fixed (g)	1998/2001 (g)	Difference (g)	Ratio
SE Hilo	19.7	-155.06	2.75	1.8	0.95	1.53
Kona	19.66	-156	2.78	2.43	0.35	1.14
Kahului	20.9	-156.5	0.81	0.97	-0.16	0.84
Honolulu	21.3	-157.86	0.43	0.61	-0.18	0.70
NW Lihue	21.96	-159.36	0.06	0.25	-0.19	0.24

2% in 50 Years Probability of Exceedance 0.2s Ground Motion						
Site	Lat	Long	Fixed and Adaptive	1998/2001	Difference	Ratio
SE Hilo	19.7	-155.06	4.02	1.8	2.22	2.23
Kona	19.66	-156	3.82	2.43	1.39	1.57
Kahului	20.9	-156.5	1.78	0.97	0.81	1.84
Honolulu	21.3	-157.86	1.19	0.61	0.58	1.95
NW Lihue	21.96	-159.36	0.29	0.25	0.04	1.16

1s





2% in 50 Years Probability of Exceedance 1s Ground Motions						
Site	Lat	Long	Fixed (g)	1998/2001 (g)	Difference (g)	Ratio
Hilo	19.7	-155.06	0.92	0.77	0.15	1.19
Kona	19.66	-156	0.92	0.92	0	1.00
Kahului	20.9	-156.5	0.27	0.25	0.02	1.08
Honolulu	21.3	-157.86	0.12	0.18	-0.06	0.67
Lihue	21.96	-159.36	0.02	0.07	-0.05	0.29

SE ↓ NW

2% in 50 Years Probability of Exceedance 1s Ground Motions						
Site	Lat	Long	Fixed and Adaptive	1998/2001	Difference	Ratio
Hilo	19.7	-155.06	1.28	0.77	0.51	1.66
Kona	19.66	-156	1.22	0.92	0.3	1.33
Kahului	20.9	-156.5	0.57	0.25	0.32	2.28
Honolulu	21.3	-157.86	0.33	0.18	0.15	1.83
Lihue	21.96	-159.36	0.1	0.07	0.03	1.43

SE ↓ NW

Conclusions

- The highest hazard is on the Big Island, and decreases as you move northwest along the island chain
- Fixed smoothing model only: shows similar higher hazard on the Big Island but much lower hazard on the outer islands vs. the 1998/2001 model
- Fixed and Adaptive smoothing models together: show much higher hazard than the 1998/2001 model across the whole island chain
- Most likely need a model that varies fixed and adaptive parameters when on the Big Island vs. the outer islands to model rates correctly.