

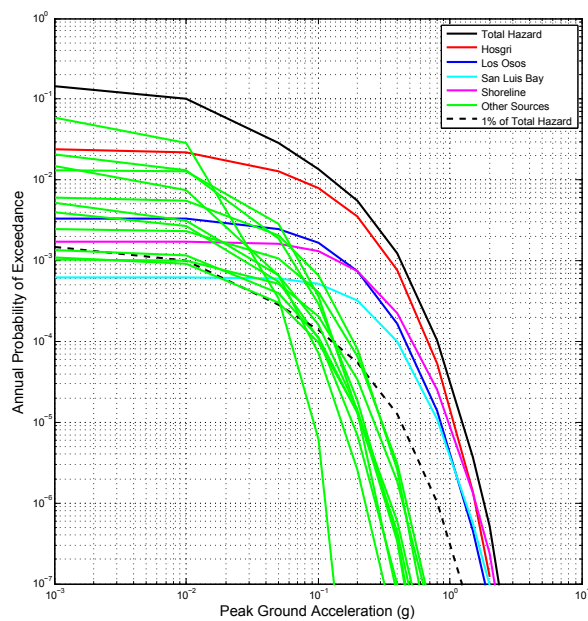
# Sensitivity Studies

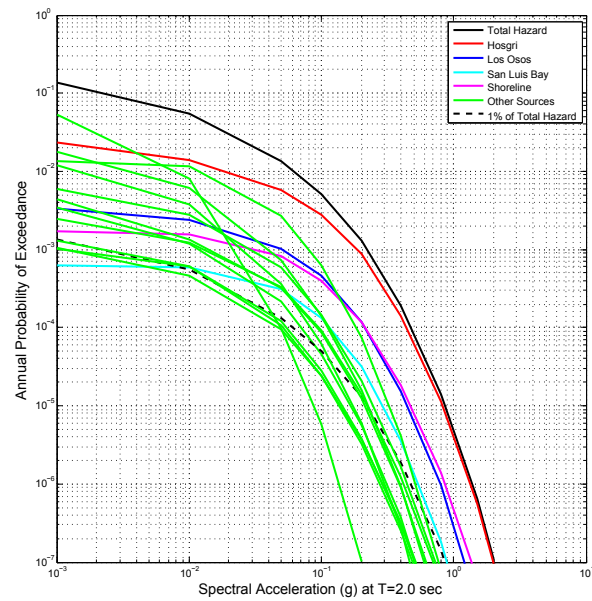
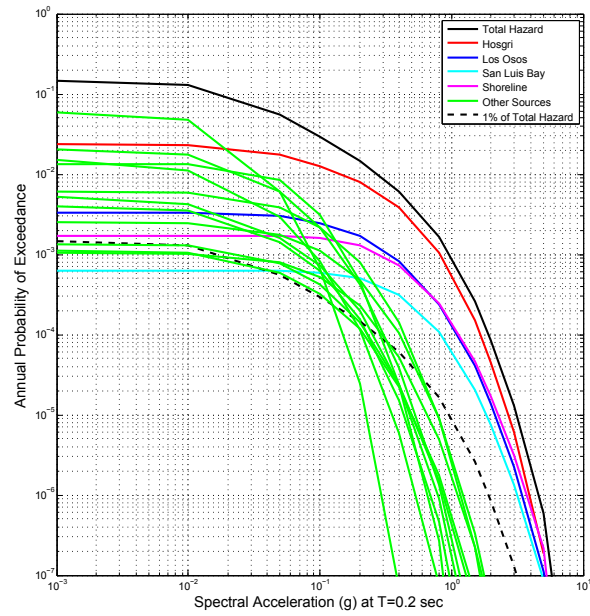
LTSP SSHAC Level 3 Update WS1  
San Luis Obispo, CA

Kathryn Wooddell

Nick Gregor

11/29/2011





## Seismic Source Characterization (SSC) Base Case

FAULT NAME	Percent Contribution to Total Hazard for PGA (10 <sup>-4</sup> Hazard Level)	Percent Contribution to Total Hazard for T=0.2sec (10 <sup>-4</sup> Hazard Level)	Percent Contribution to Total Hazard for T=2.0sec (10 <sup>-4</sup> Hazard Level)
Hosgri	51.24	54.92	75.21
Los Osos	13.47	16.36	8.06
San Luis Bay	10.73	8.70	1.82
Shoreline	24.49	19.84	9.73
Oceanic	0.00	0.00	0.19
West Huasna	0.01	0.04	0.85
Wilmar - Nipomo	0.00	0.01	0.16
Oceano - Pecho	0.02	0.05	0.16
Rinconada	0.00	0.00	0.45
Cambria	0.02	0.07	0.63
San Simeon	0.00	0.00	0.14
Casmalia	0.00	0.01	0.13
Santa Lucia Bank	0.00	0.00	0.47
SAF Southern	0.00	0.00	2.06
SAF Parkfield	0.00	0.00	0.00

## Seismic Source Characterization (SSC)

Sensitivity to the following Seismic Source Characterization (SSC) Parameters was evaluated:

### ❑ Hosgri Fault

- Dip (degrees): (Base Case: 90 (0.1), 85 (0.4), 80 (0.5))
- Mean Characteristic Rupture Length (km): (Base Case: 20 (0.2), 45 (0.4), 70 (0.25), 110 (0.1))
- Slip Rate (mm/yr): (6 (0.1), 3 (0.4), 1 (0.4), 0.5 (0.1))
- Joint Ruptures (Hosgri)
- Location: (Hosgri Main Trace)

### ❑ Shoreline Fault

- Fault Length (km): (Base Case: 23 (0.2), 23 (0.4), 19 (0.3), 15 (0.1))
- Slip Rate (mm/yr): (Base Case: 1.0 (0.05), 0.6 (0.15), 0.3 (0.35), 0.1 (0.35), 0.05 (0.1))

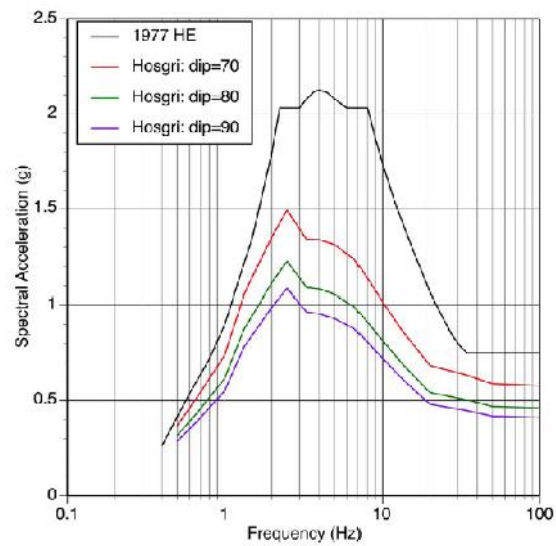
### ❑ Los Osos Fault

- Dip (degrees): (Base Case: 45 (0.3), 60 (0.6), 75 (0.2))
- Mean Characteristic Rupture Length (km): (19km (0.7), 36km (0.3))
- Crustal Thickness (km): (Base Case: 10 (0.2), 12 (0.6), 15 (0.2))
- Slip Rate (mm/yr): (Base Case: OBQ – 0.4v0.2h (0.6), 0.2v0.1h (0.4); REV – 0.4v (0.6), 0.2v (0.4))

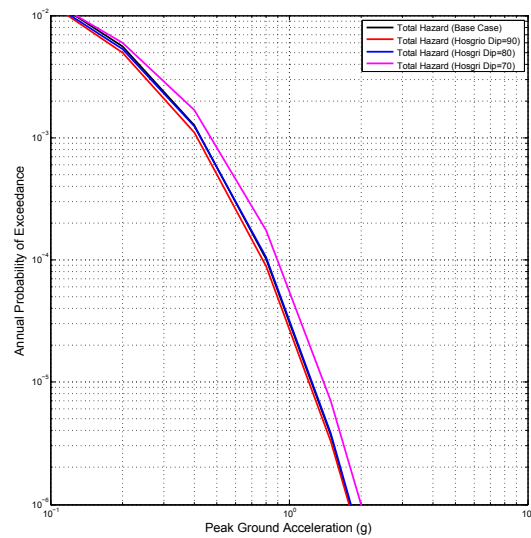
### ❑ San Luis Bay Fault

- Dip: (Base Case (degrees): 50 (0.2), 70 (0.4), 80 (0.4))
- Mean Characteristic Rupture Length (km): (8 (0.5), 16 (0.5))
- Crustal Thickness (km): (Base Case: 10 (0.2), 12 (0.6), 15 (0.2))
- Slip Rate: (Base Case: OBQ – 0.14v0.07h (0.8), 0.08v0.04h (0.2); REV – 0.14v (0.8), 0.08v (0.2))

## Hosgri Fault: Sensitivity to Dip

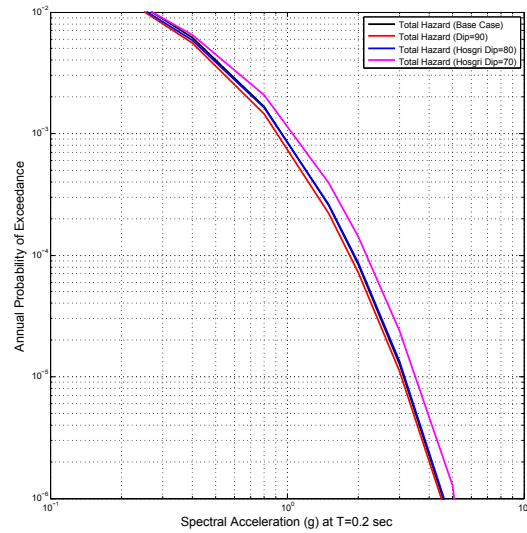


## Hosgri Fault: Sensitivity to Dip



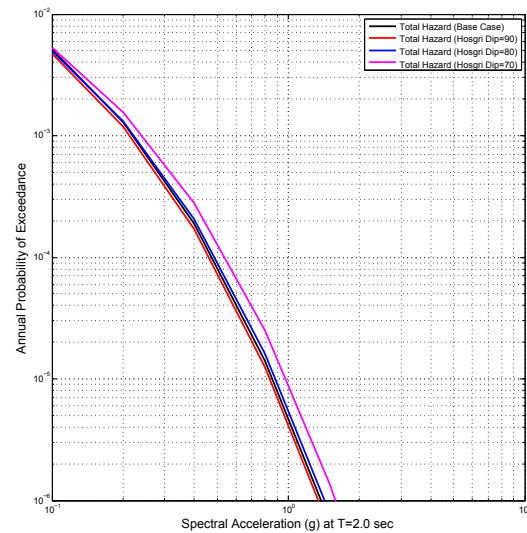
Dip (degrees): (Base Case: 90 (0.1), 85 (0.4), 80 (0.5))

## Hosgri Fault: Sensitivity to Dip



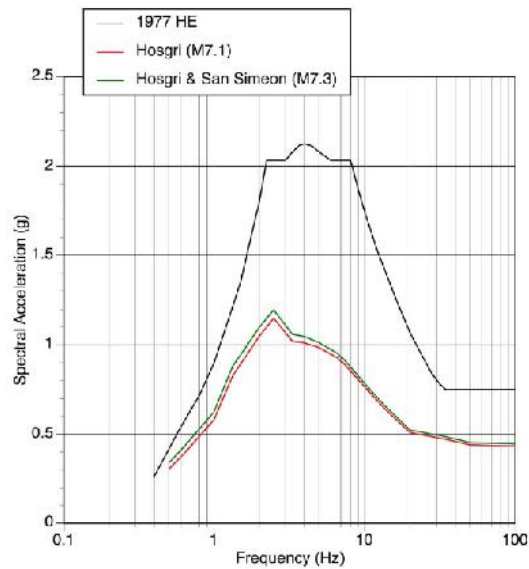
Dip (degrees): (Base Case: 90 (0.1), 85 (0.4), 80 (0.5))

## Hosgri Fault: Sensitivity to Dip

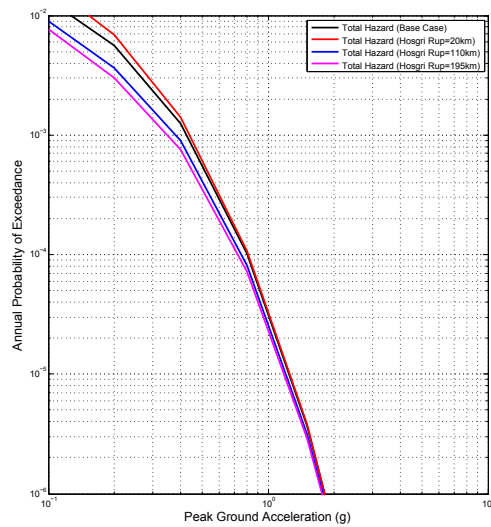


Dip (degrees): (Base Case: 90 (0.1), 85 (0.4), 80 (0.5))

## Hosgri Fault: Sensitivity to Mean Char. Rupture Length

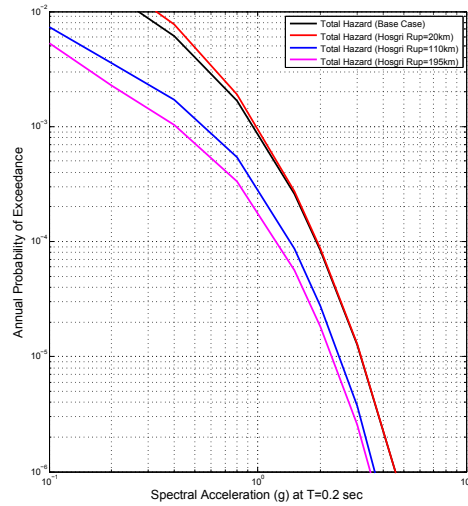


## Hosgri Fault: Sensitivity to Mean Char. Rupture Length



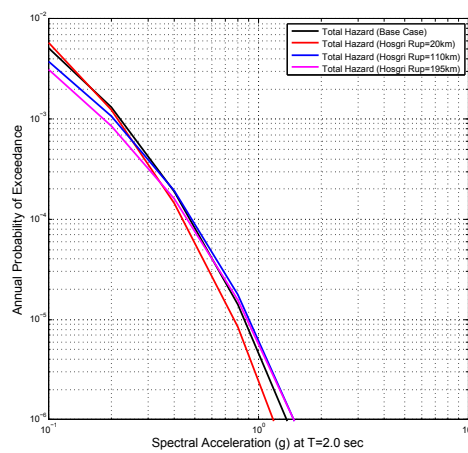
(Base Case: 20 (0.2), 45 (0.4), 70 (0.25), 110 (0.1))

## Hosgri Fault: Sensitivity to Mean Char. Rupture Length



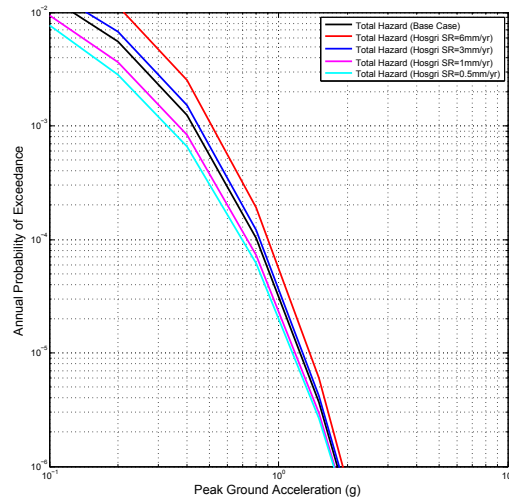
(Base Case: 20 (0.2), 45 (0.4), 70 (0.25), 110 (0.1))

## Hosgri Fault: Sensitivity to Mean Char. Rupture Length



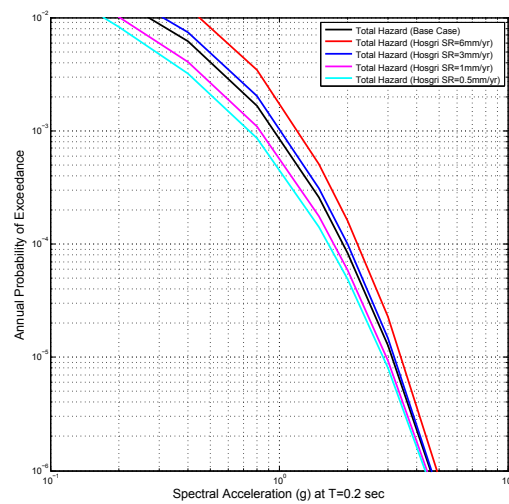
(Base Case: 20 (0.2), 45 (0.4), 70 (0.25), 110 (0.1))

## Hosgri Fault: Sensitivity to Slip Rate



Slip Rate (mm/yr): (6 (0.1), 3 (0.4), 1 (0.4), 0.5 (0.1))

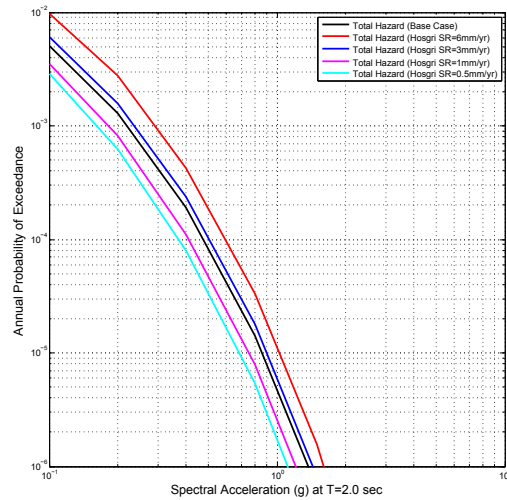
## Hosgri Fault: Sensitivity to Slip Rate



Slip Rate (mm/yr): (6 (0.1), 3 (0.4), 1 (0.4), 0.5 (0.1))

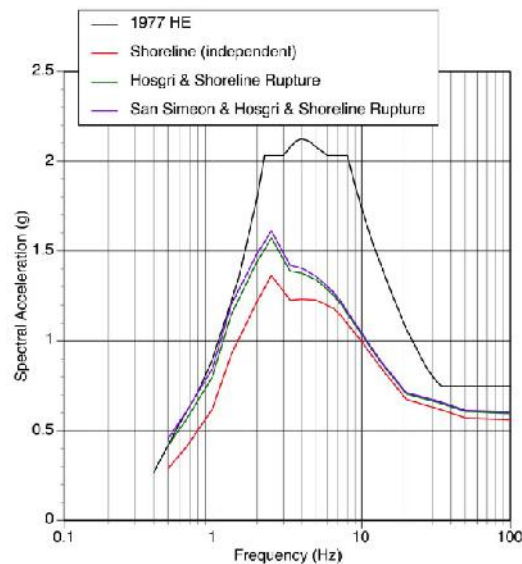


## Hosgri Fault: Sensitivity to Slip Rate



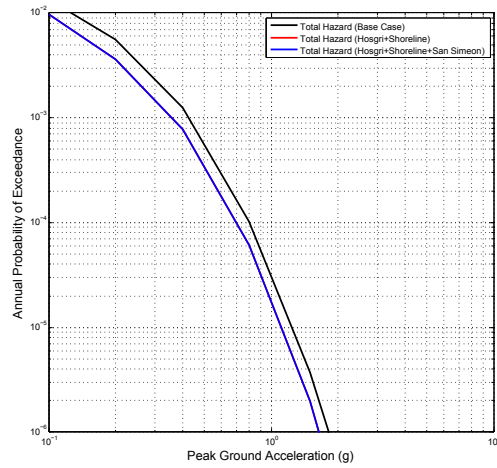
Slip Rate (mm/yr): (6 (0.1), 3 (0.4), 1 (0.4), 0.5 (0.1))

## Hosgri Fault: Sensitivity to Joint Ruptures



## Hosgri Fault: Sensitivity to Joint Ruptures

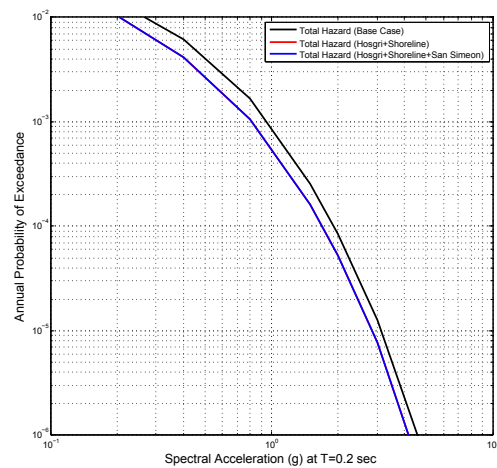
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Base Case: Hosgri Alone

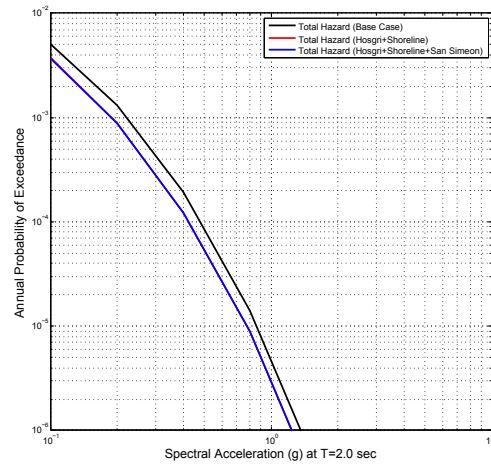
## Hosgri Fault: Sensitivity to Joint Ruptures

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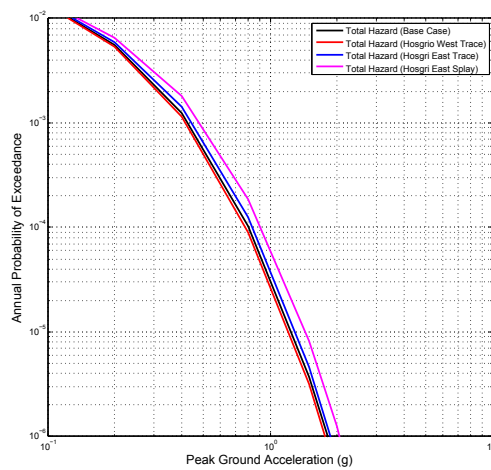
Base Case: Hosgri Alone

## Hosgri Fault: Sensitivity to Joint Ruptures



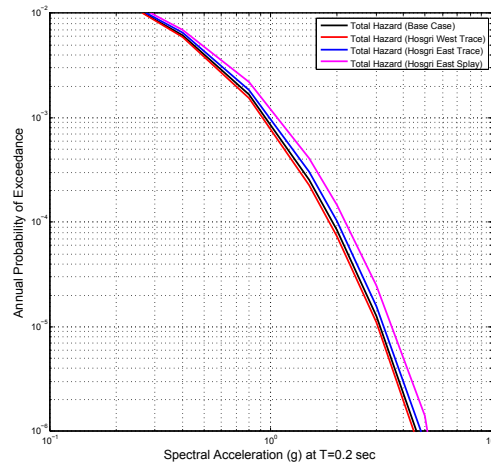
Base Case: Hosgri Alone

## Hosgri Fault: Sensitivity to Location



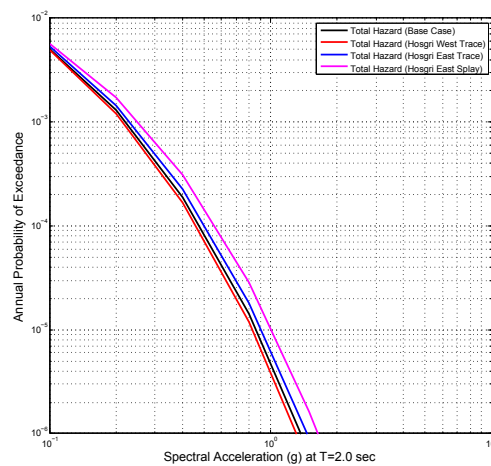
Base Case: Hosgri Main Trace

## Hosgri Fault: Sensitivity to Location



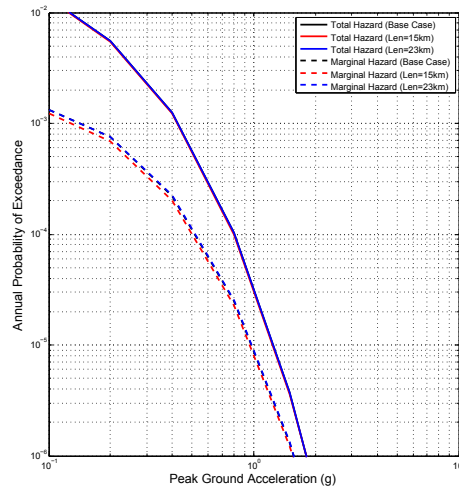
Base Case: Hosgri Main Trace

## Hosgri Fault: Sensitivity to Location



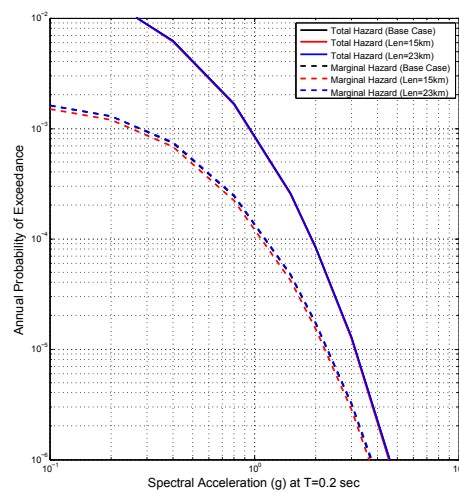
Base Case: Hosgri Main Trace

## Shoreline Fault: Sensitivity to Fault Length



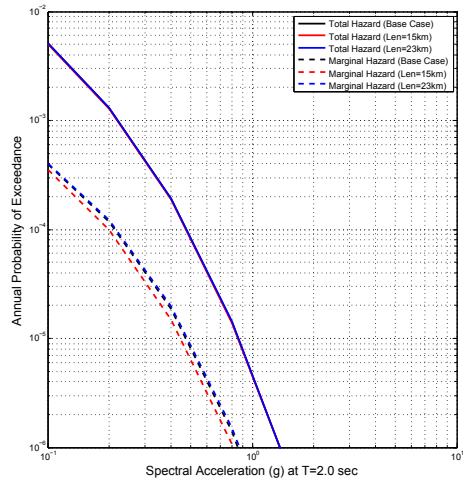
(Base Case: 23 (0.2), 23 (0.4), 19 (0.3), 15 (0.1))

## Shoreline Fault: Sensitivity to Fault Length



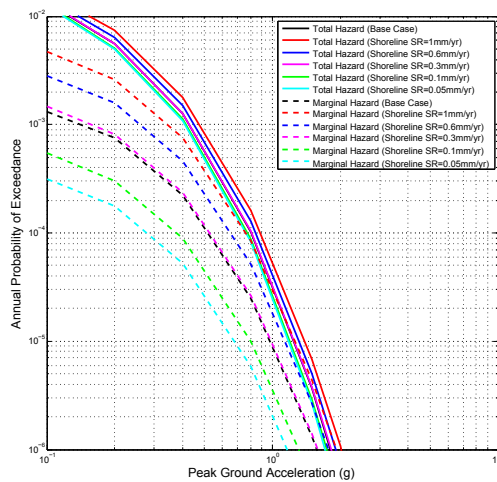
(Base Case: 23 (0.2), 23 (0.4), 19 (0.3), 15 (0.1))

## Shoreline Fault: Sensitivity to Fault Length



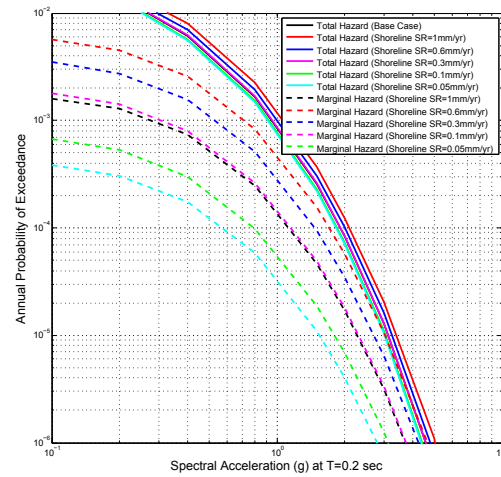
(Base Case: 23 (0.2), 23 (0.4), 19 (0.3), 15 (0.1))

## Shoreline Fault: Sensitivity to Slip Rate



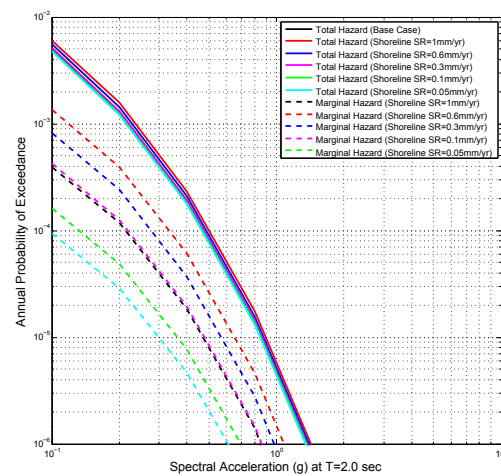
(Base Case: 1.0 (0.05), 0.6 (0.15), 0.3 (0.35), 0.1 (0.35), 0.05 (0.1))

## Shoreline Fault: Sensitivity to Slip Rate



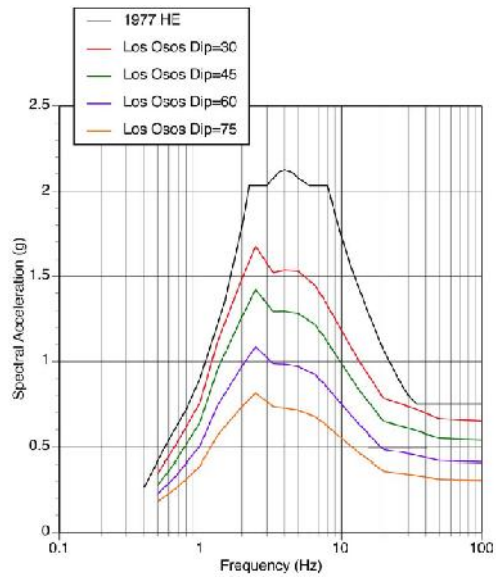
(Base Case: 1.0 (0.05), 0.6 (0.15), 0.3 (0.35), 0.1 (0.35), 0.05 (0.1))

## Shoreline Fault: Sensitivity to Slip Rate

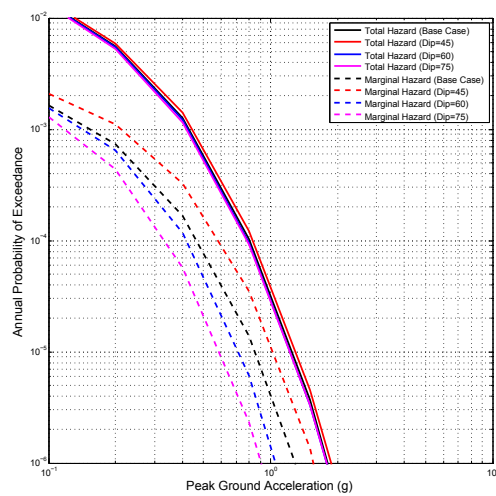


(Base Case: 1.0 (0.05), 0.6 (0.15), 0.3 (0.35), 0.1 (0.35), 0.05 (0.1))

## Los Osos Fault: Sensitivity to Dip



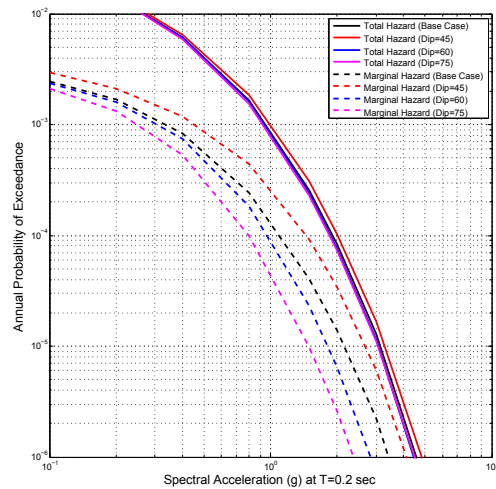
## Los Osos Fault: Sensitivity to Dip



(Base Case: 45 (0.3), 60 (0.6), 75 (0.2))

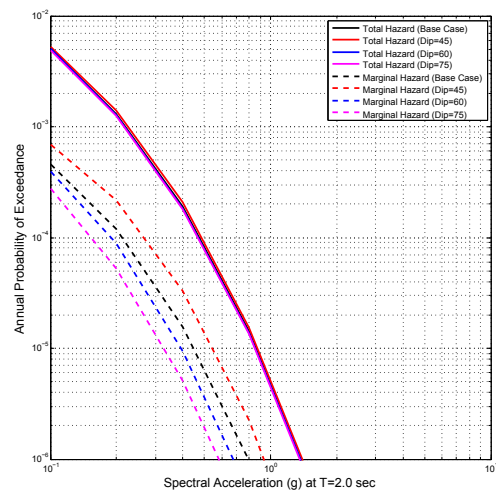


## Los Osos Fault: Sensitivity to Dip



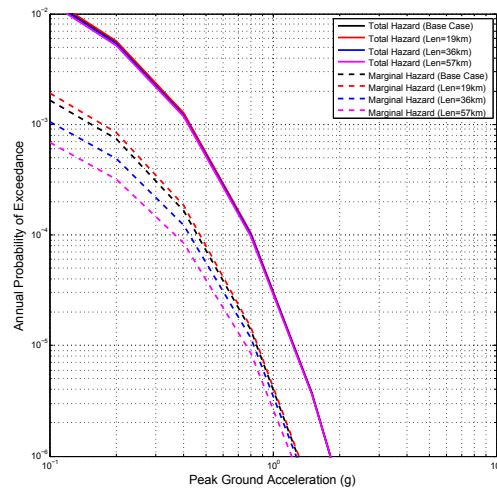
(Base Case: 45 (0.3), 60 (0.6), 75 (0.2))

## Los Osos Fault: Sensitivity to Dip



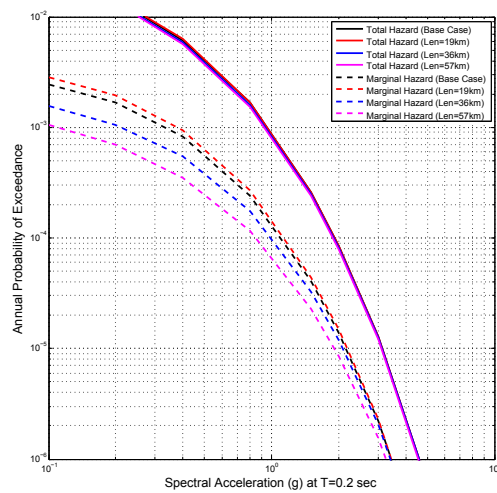
(Base Case: 45 (0.3), 60 (0.6), 75 (0.2))

## Los Osos Fault: Sensitivity to Rupture Length



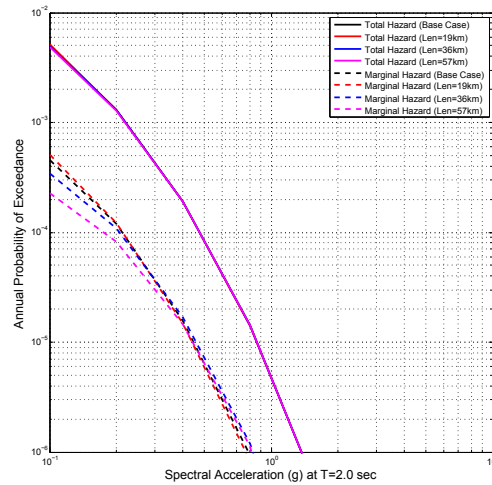
Base Case: (19km (0.7), 36km (0.3))

## Los Osos Fault: Sensitivity to Rupture Length



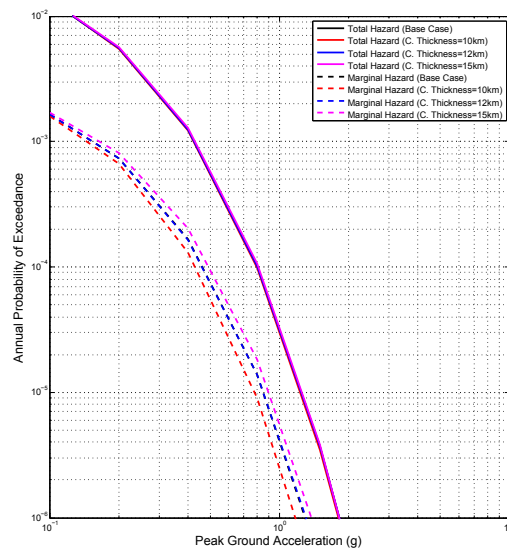
Base Case: (19km (0.7), 36km (0.3))

## Los Osos Fault: Sensitivity to Rupture Length



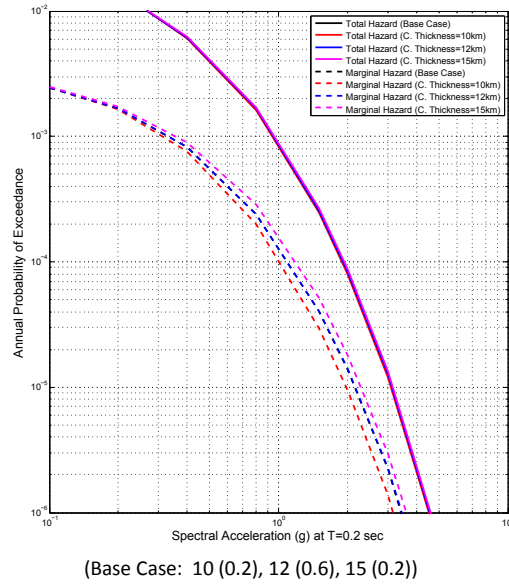
Base Case: (19km (0.7), 36km (0.3))

## Los Osos Fault: Sensitivity to Crustal Thickness

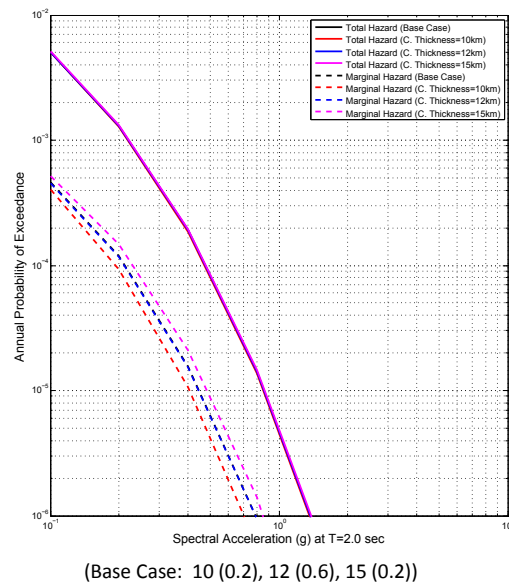


(Base Case: 10 (0.2), 12 (0.6), 15 (0.2))

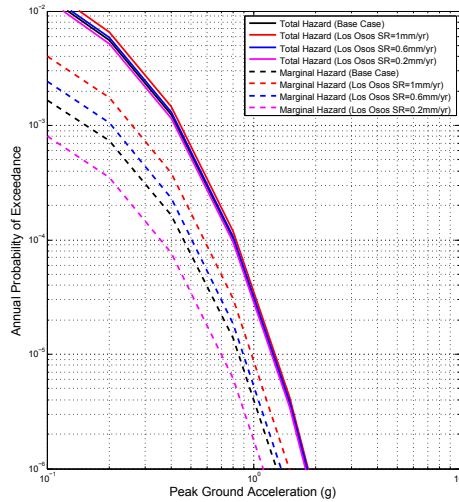
## Los Osos Fault: Sensitivity to Crustal Thickness



## Los Osos Fault: Sensitivity to Crustal Thickness

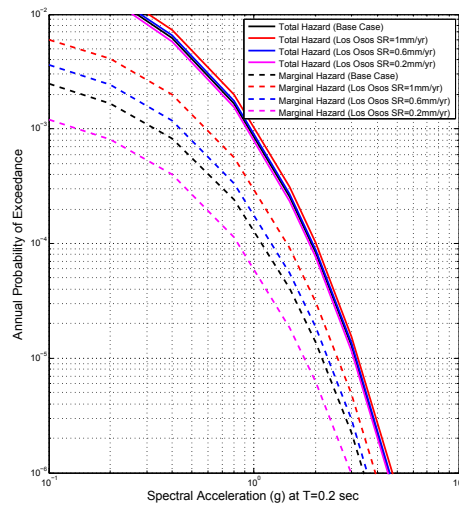


## Los Osos Fault: Sensitivity to Slip Rate



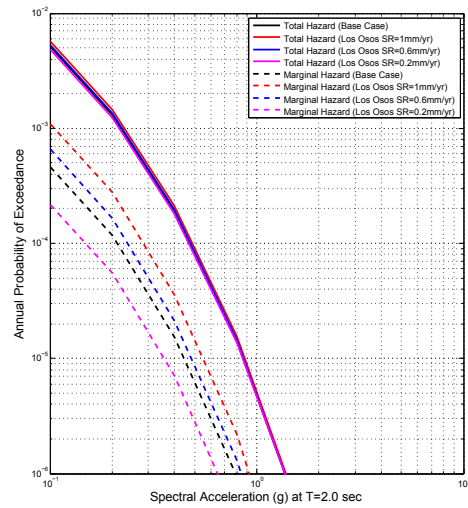
(Base Case: OBQ – 0.4v0.2h (0.6), 0.2v0.1h (0.4); REV – 0.4v (0.6), 0.2v (0.4))

## Los Osos Fault: Sensitivity to Slip Rate



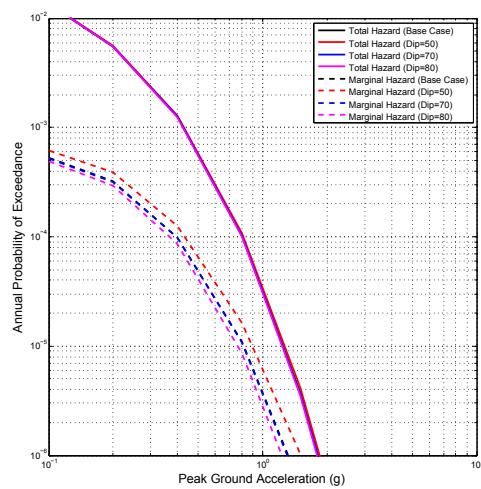
(Base Case: OBQ – 0.4v0.2h (0.6), 0.2v0.1h (0.4); REV – 0.4v (0.6), 0.2v (0.4))

## Los Osos Fault: Sensitivity to Slip Rate



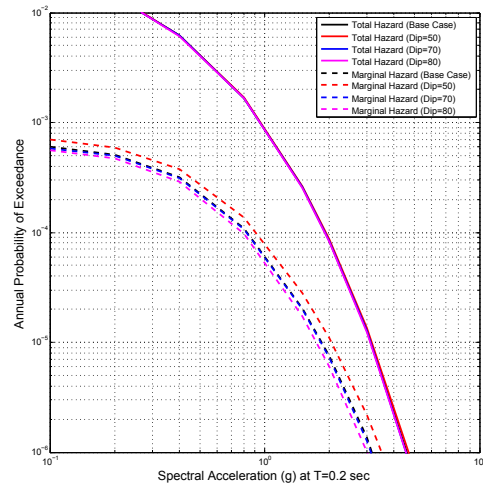
(Base Case: OBQ – 0.4v0.2h (0.6), 0.2v0.1h (0.4); REV – 0.4v (0.6), 0.2v (0.4))

## San Luis Bay Fault: Sensitivity to Dip



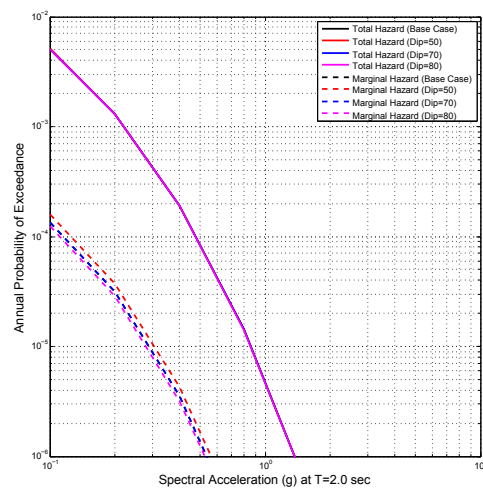
(Base Case (degrees): 50 (0.2), 70 (0.4), 80 (0.4))

## San Luis Bay Fault: Sensitivity to Dip



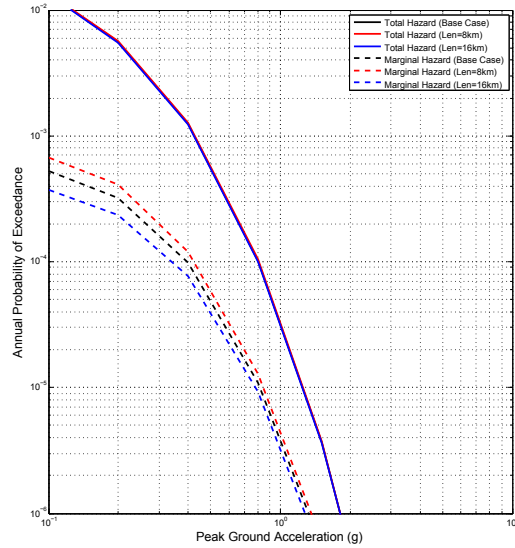
(Base Case (degrees): 50 (0.2), 70 (0.4), 80 (0.4))

## San Luis Bay Fault: Sensitivity to Dip



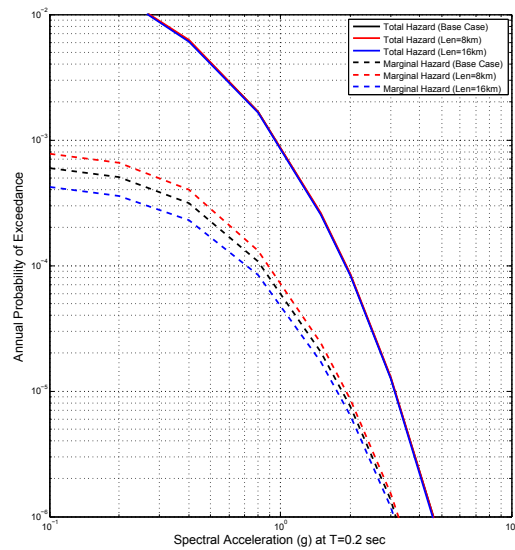
(Base Case (degrees): 50 (0.2), 70 (0.4), 80 (0.4))

## San Luis Bay Fault: Sensitivity to Rupture Length



Base Case: (8 (0.5), 16 (0.5))

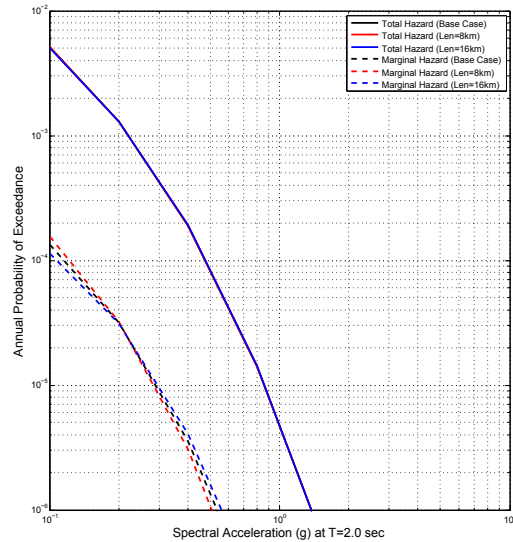
## San Luis Bay Fault: Sensitivity to Rupture Length



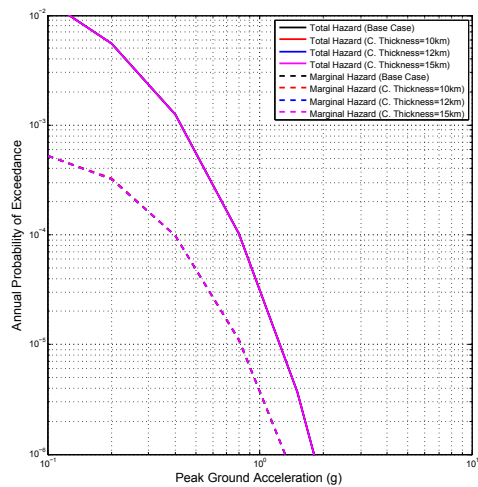
Base Case: (8 (0.5), 16 (0.5))



## San Luis Bay Fault: Sensitivity to Rupture Length

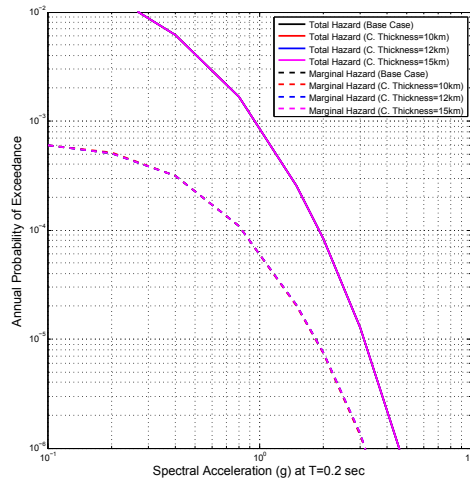


## San Luis Bay Fault: Sensitivity to Crustal Thickness



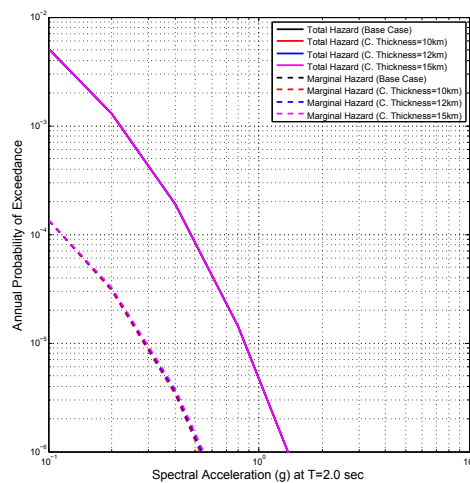
(Base Case: 10 (0.2), 12 (0.6), 15 (0.2))

## San Luis Bay Fault: Sensitivity to Crustal Thickness



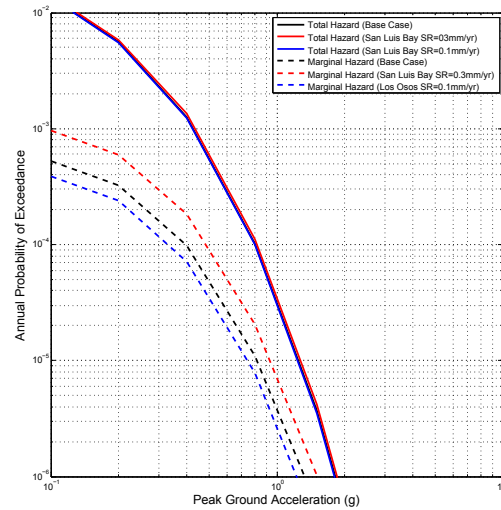
(Base Case: 10 (0.2), 12 (0.6), 15 (0.2))

## San Luis Bay Fault: Sensitivity to Crustal Thickness



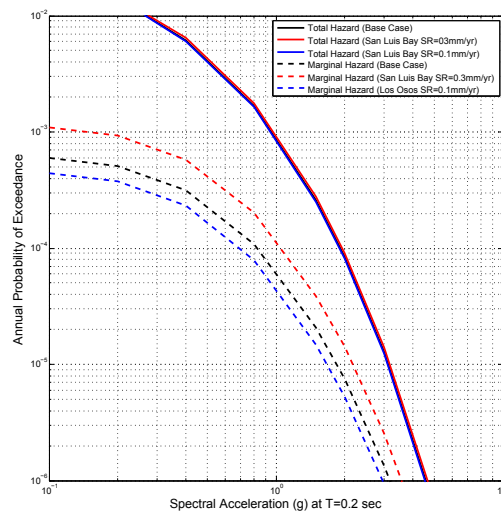
(Base Case: 10 (0.2), 12 (0.6), 15 (0.2))

## San Luis Bay Fault: Sensitivity to Slip Rate



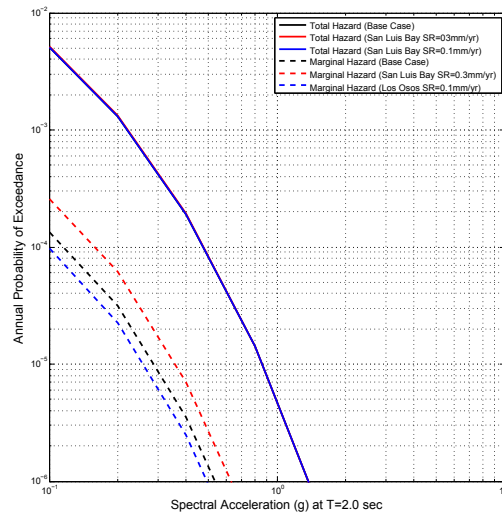
(Base Case: OBQ—0.14v0.07h (0.8), 0.08v0.04h (0.2); REV — 0.14v (0.8), 0.08v (0.2))

## San Luis Bay Fault: Sensitivity to Slip Rate



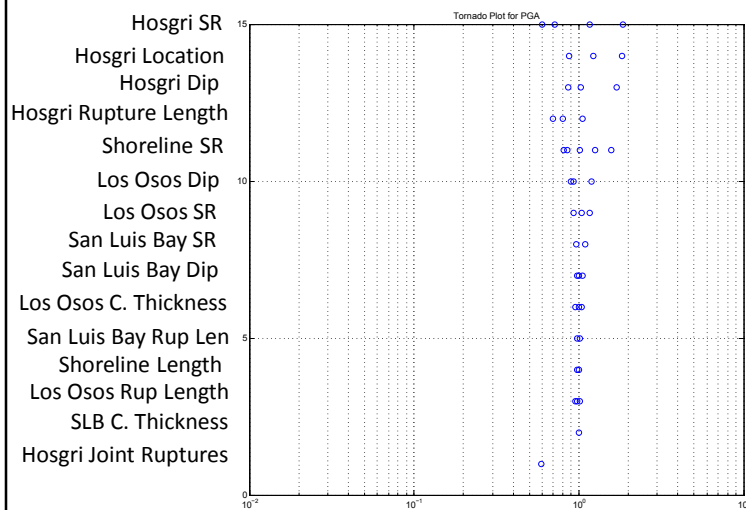
(Base Case: OBQ—0.14v0.07h (0.8), 0.08v0.04h (0.2); REV — 0.14v (0.8), 0.08v (0.2))

## San Luis Bay Fault: Sensitivity to Slip Rate

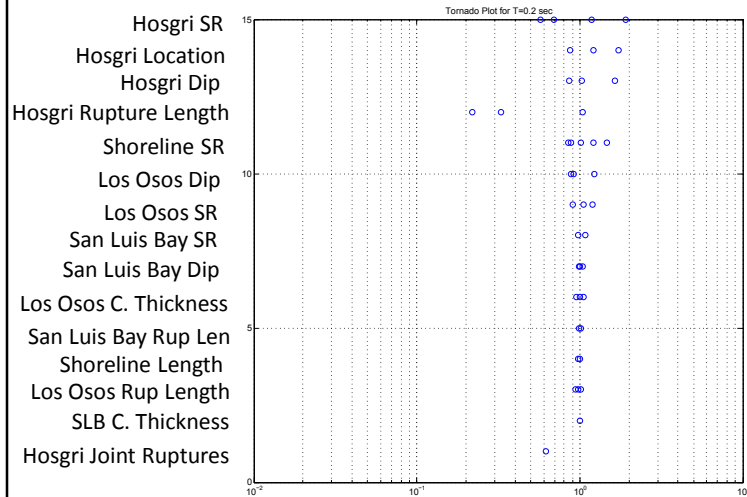


(Base Case: OBQ—0.14v0.07h (0.8), 0.08v0.04h (0.2); REV — 0.14v (0.8), 0.08v (0.2))

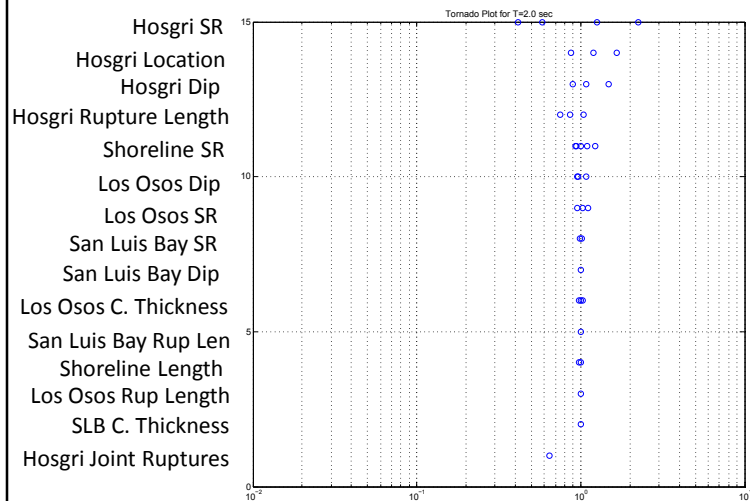
## Summary of SSC Sensitivity: PGA



## Summary of SSC Sensitivity: T=0.2 sec



## Summary of SSC Sensitivity: T=2.0 sec



## Ground Motion Characterization (GMC)

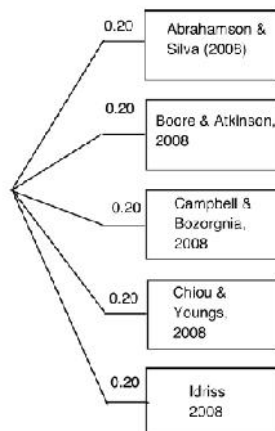
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Sensitivity to the following Ground Motion Characterization (GMC) Parameters was evaluated:

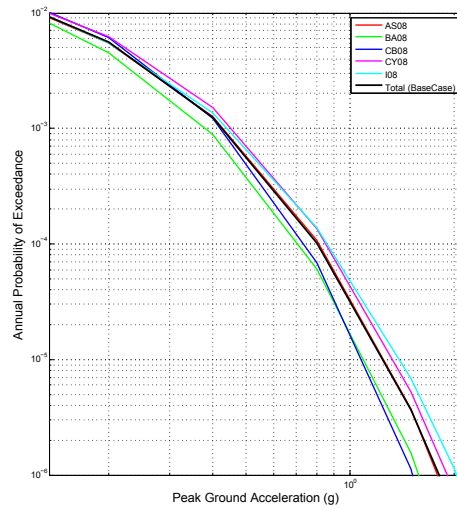
- ☐ Ground Motion Prediction Equations (GMPEs)
  - Next Generation Attenuation (NGA) Models
  - Additional Epistemic Uncertainty Model
- ☐ Ergodic Assumption
  - Site-Specific Single-Station Sigma Approach vs. Ergodic Approach
- ☐ Hanging Wall Factor
  - HW factor in the AS08 model
  - HW factor in the CY08 model
- ☐ Sigma Model
  - 3 Constant phiSS models
  - Magnitude Dependent phiSS
  - Magnitude & Distance Dependent phiSS
- ☐ Sigma Truncation for Ground Motion Model
- ☐ Directivity
  - Average Horizontal
  - Fault Normal
  - Fault Parallel
  - Spudich & Chiou
- ☐ Fling

## Ground Motion Model Logic tree

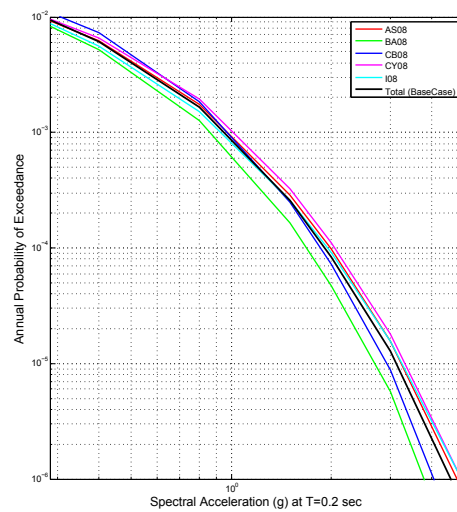
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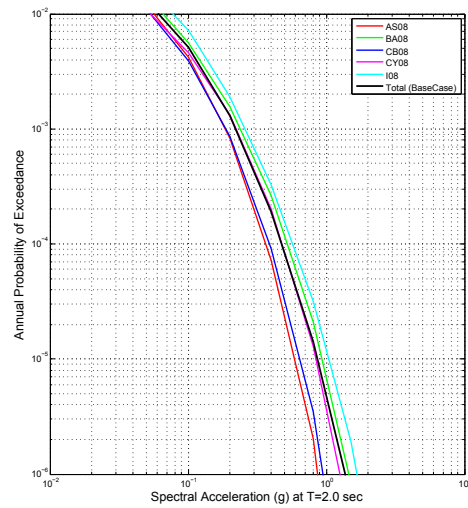
## Sensitivity to GMPE



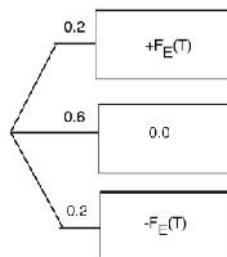
## Sensitivity to GMPE



## Sensitivity to GMPE

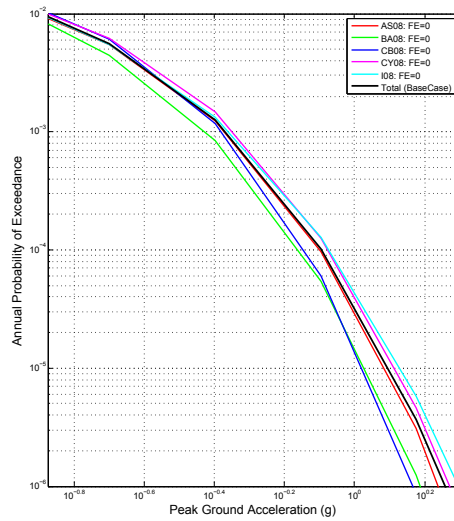


## Epistemic Uncertainty Logic tree

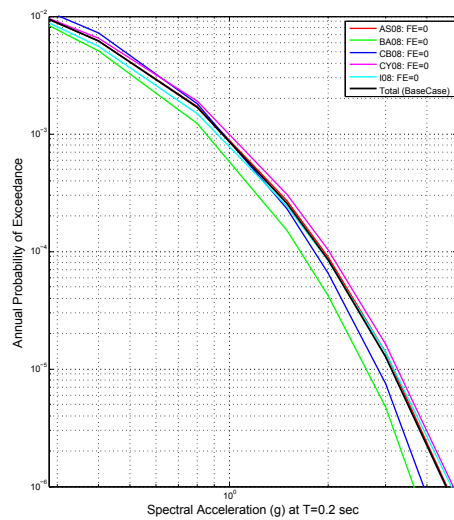




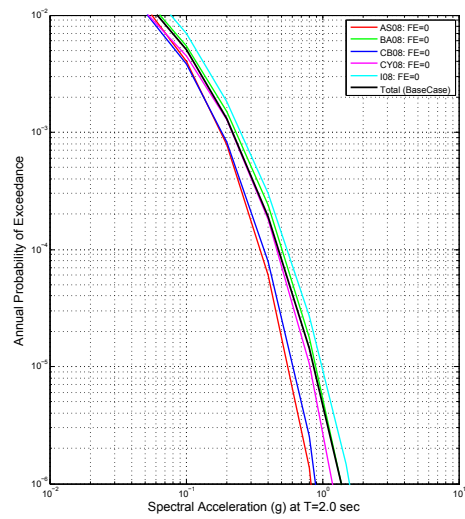
## GMPEs: $FE(T)=0.0$



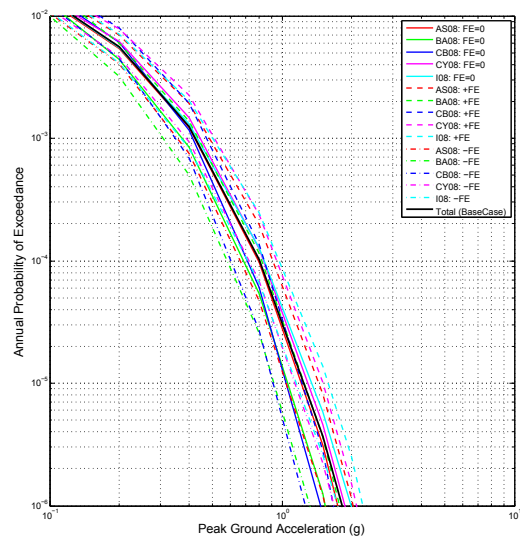
## GMPEs: $FE(T)=0.0$



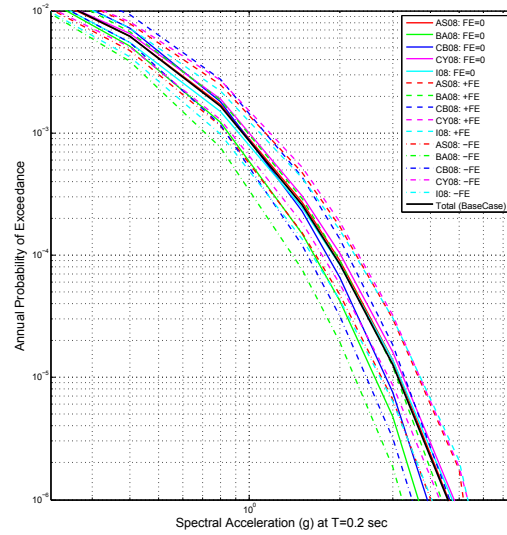
## GMPEs: $FE(T)=0.0$



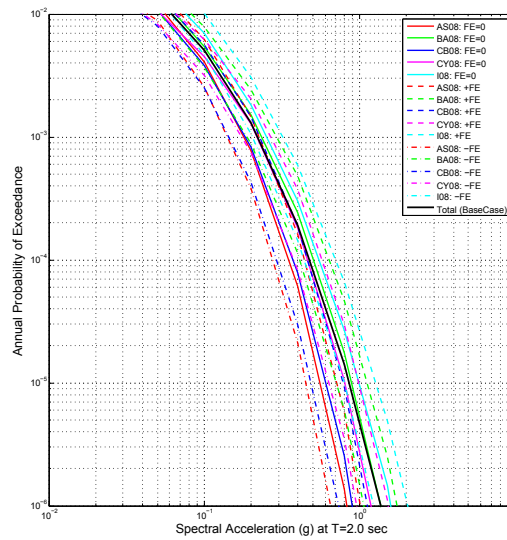
## GMPEs $\pm FE(T)$



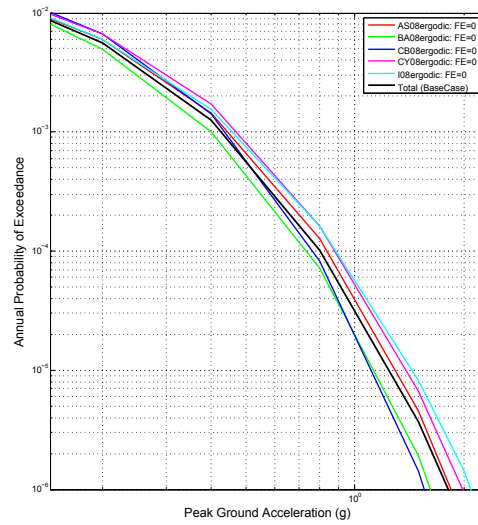
## GMPEs $\pm$ FE(T)



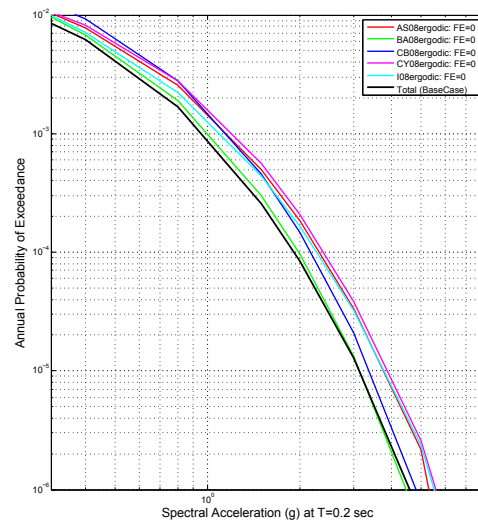
## GMPEs $\pm$ FE(T)



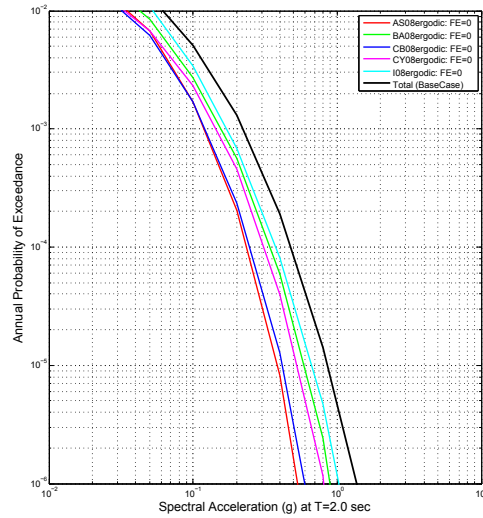
## Sensitivity to Ergodic Assumption: $FE(T)=0.0$



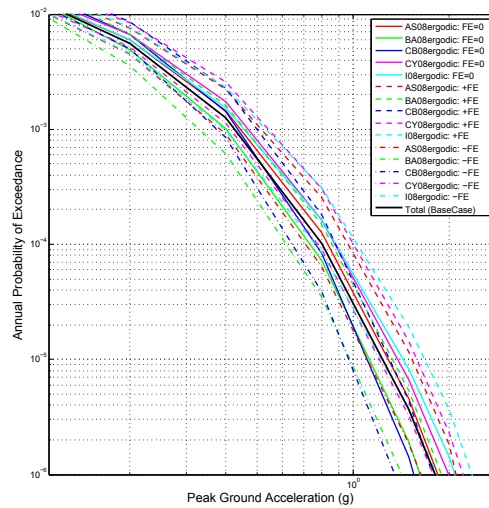
## Sensitivity to Ergodic Assumption: $FE(T)=0.0$



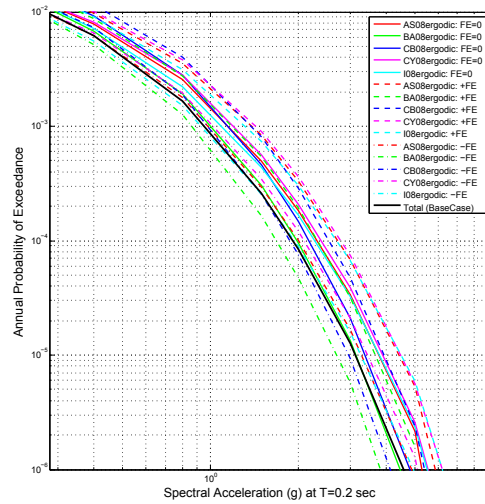
## Sensitivity to Ergodic Assumption: $FE(T)=0.0$



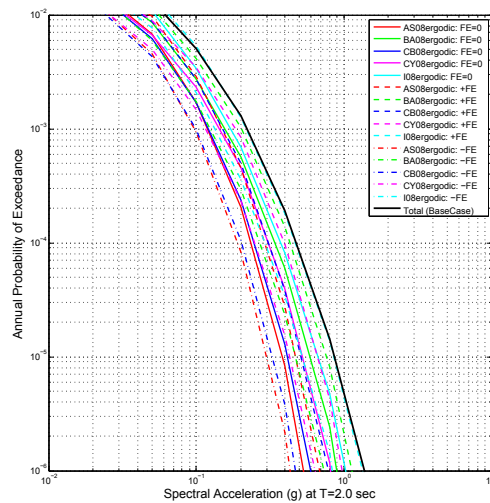
## Sensitivity to Ergodic Assumption $\pm FE(T)$



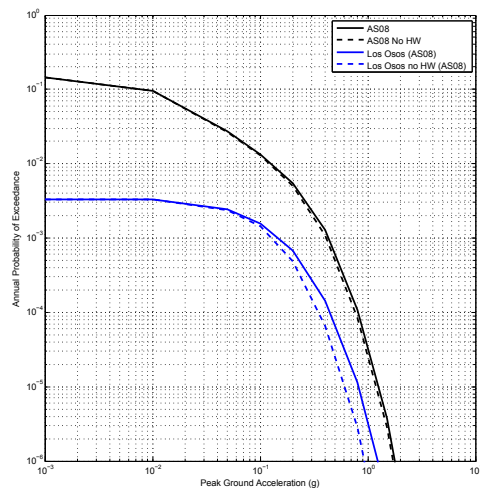
## Sensitivity to Ergodic Assumption $\pm$ FE(T)



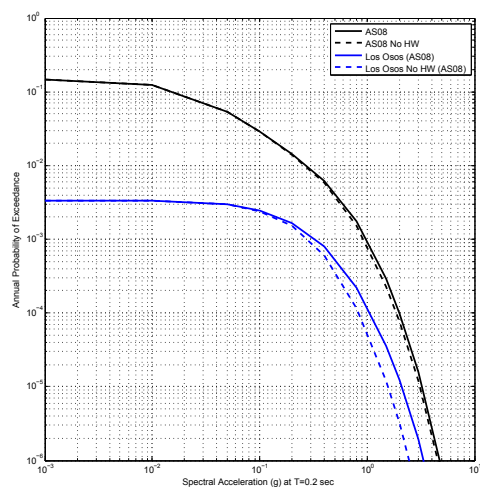
## Sensitivity to Ergodic Assumption $\pm$ FE(T)



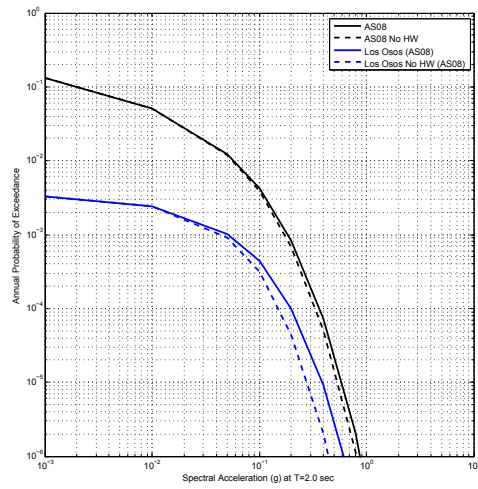
## Sensitivity to HW: AS08



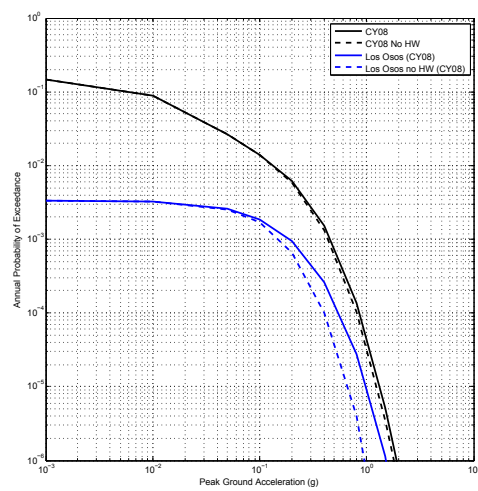
## Sensitivity to HW: AS08



## Sensitivity to HW: AS08



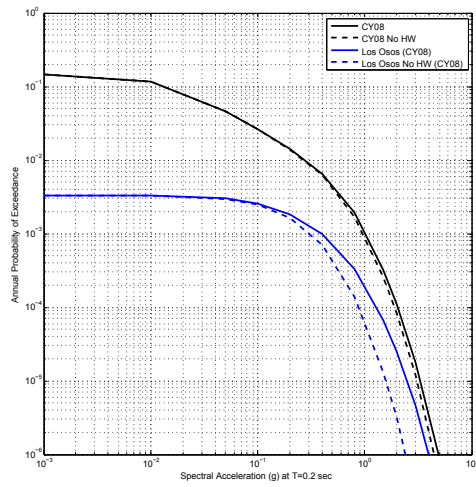
## Sensitivity to HW: CY08





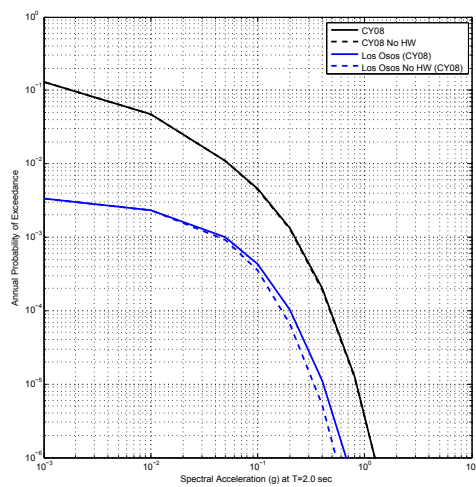
## Sensitivity to HW: CY08

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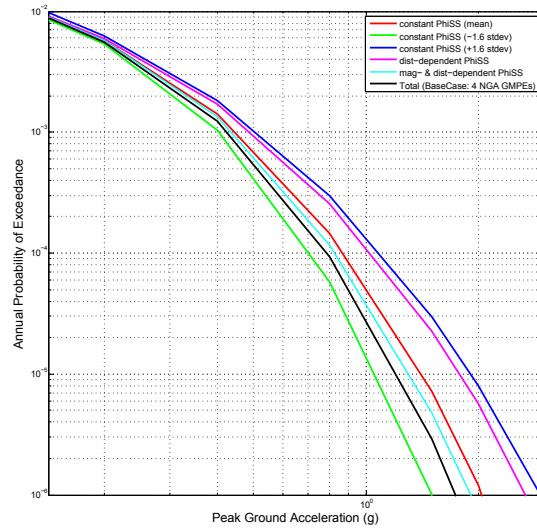


## Sensitivity to HW: CY08

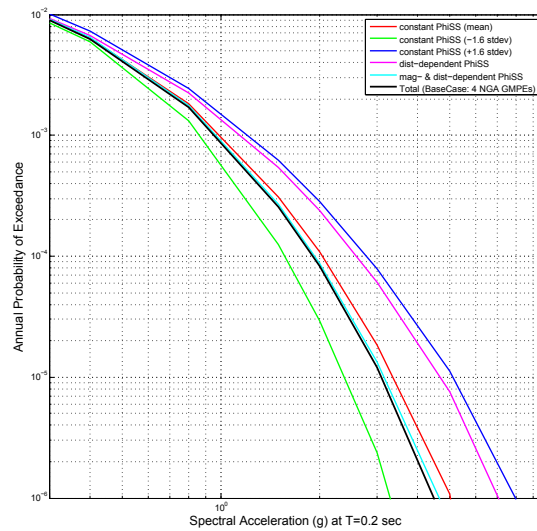
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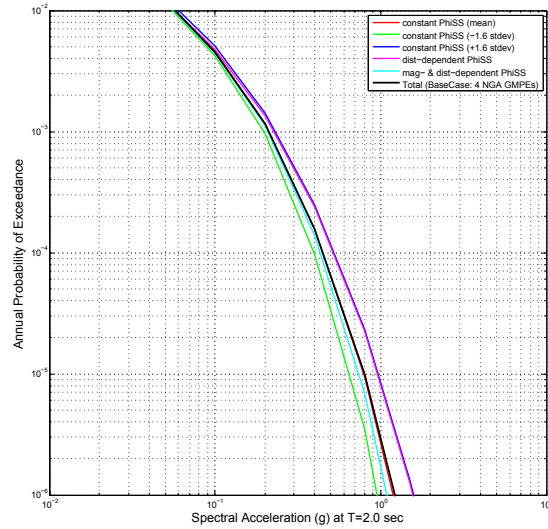
## Sensitivity to Sigma Model



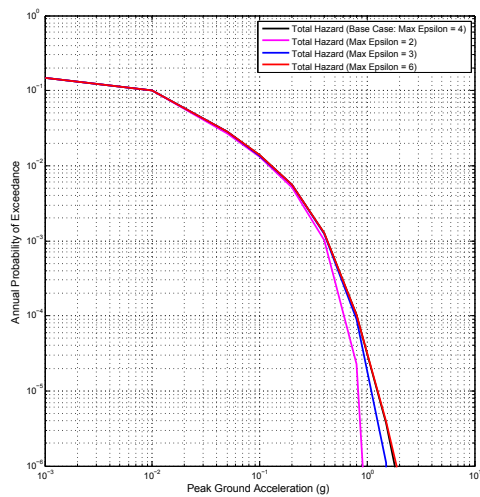
## Sensitivity to Sigma Model



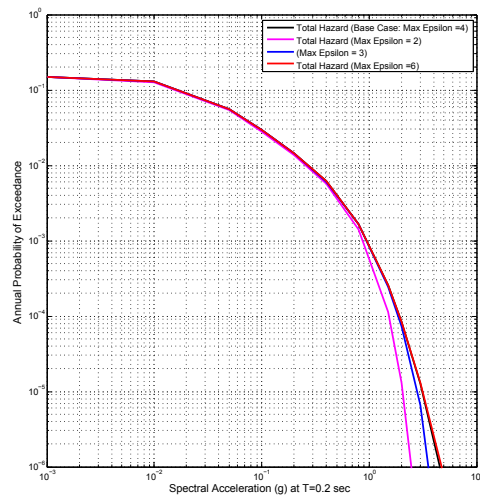
## Sensitivity to Sigma Model



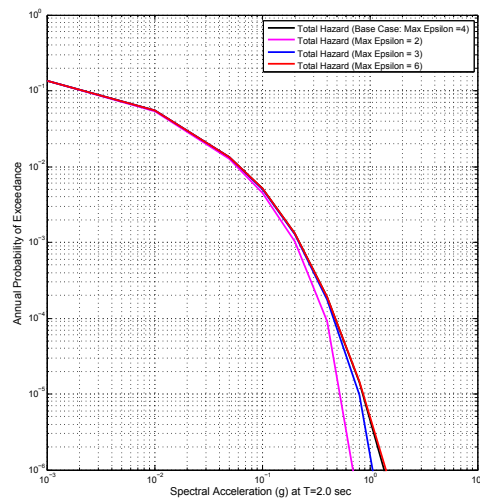
## Sensitivity to Sigma Truncation



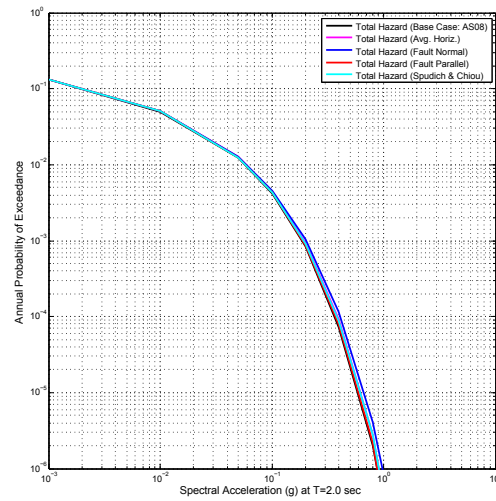
## Sensitivity to Sigma Truncation



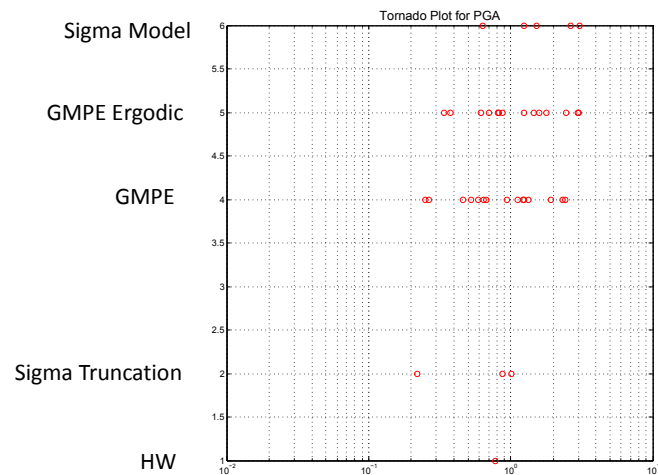
## Sensitivity to Sigma Truncation



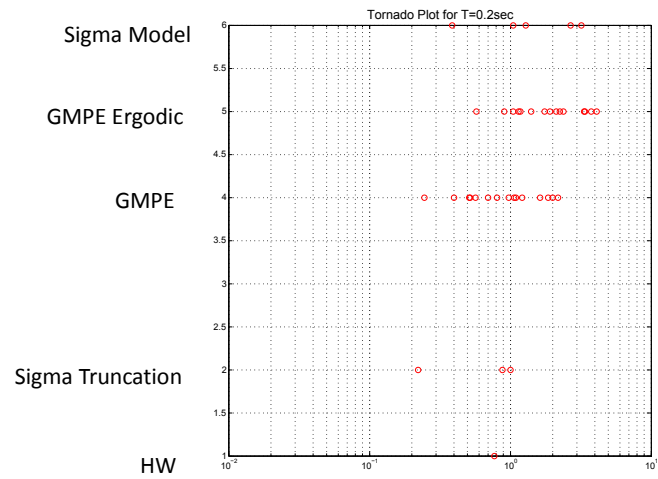
## Sensitivity to Directivity



## Summary of GMC Sensitivity: PGA



## Summary of GMC Sensitivity: T=0.2 sec



## Summary of GMC Sensitivity: T=2.0 sec

