Considerations for Application in Dam Engineering Practice

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USSD Workshop

NGA Relationships and Estimation of Ground Motions for Dams

San Francisco, CA

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Key Aspects of NGA-West2 Models

- Significantly expanded ground motions database
- Vetting and review of models and results amongst five developer teams and broad group of stakeholders
- Refinement of model functional forms and improved quantification of uncertainty

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Main Considerations for Dams

- Ground motions for large infrequent earthquakes
  - Small magnitude earthquakes usually not of major concern
- Ground motion estimates at median or higher percentile
- Site-specific studies common for large projects
  - Reduced uncertainty in input parameters

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User Considerations

- More robust estimates of ground motions
- Require quantification of multiple input parameters
  - Sensitivity to input parameters that are uncertain
- Differences between NGA-WEST2 and NGA-WEST1 ground motion estimates
  - Existing projects
  - Projects under planning and design
- Examples of deterministic estimates for California

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Scenario 1
M 6.7 on Reverse Fault at 1.5 km - Hanging Wall Site

Parameter \ Relationship	AS08/ASK14	BA08/BSSA14	CB08/CB14	CY08/CY14	IM08/IM14
Moment Magnitude	6.7	6.7	6.7	6.7	6.7
Depth to Top of Rupture (km)	0.0		0.0	0.0	
Hypocentral depth (km)			- / 11.1		
Style of Faulting	RV	RV	RV	RV	RV
Dip (degrees)	60		60	60	
Down-Dip rupture width (km)	13.9		- / 13.9		
R_{RUP} (km)	1.5		1.5	1.5	1.5
R_{JB} (km)	0.0	0.0	0.0	0.0	
R_x (km)	1.7		- / 1.7	1.7	
HW flag	yes		- / yes	yes	
V_{S30} (m/s)	750	750	750	750	- / 750
Depth to 1.0 km/sec boundary (km)	0.036 / 0.052	- / 0.052		0.025 / 0.044	
Depth to 2.5 km/sec boundary (km)			0.628 / 0.616		

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Scenario 2
M 8.0 on Strike-Slip Fault at 13 km

Parameter \ Relationship	AS08/ASK14	BA08/BSSA14	CB08/CB14	CY08/CY14	IM08/IM14
Moment Magnitude	8.0	8.0	8.0	8.0	8.0
Depth to Top of Rupture (km)	0.0		0.0	0.0	
Hypocentral depth (km)			- / 10.2		
Style of Faulting	SS	SS	SS	SS	SS
Dip (degrees)	90		90	90	
Down-Dip rupture width (km)	15.0		- / 15.0		
R_{RUP} (km)	13.0		13.0	13.0	13.0
R_{JB} (km)	13.0	13.0	13.0	13.0	
R_x (km)	13.0		- / 13.0	13.0	
HW flag	no		- / no	no	
V_{S30} (m/s)	750	750	750	750	- / 750
Depth to 1.0 km/sec boundary (km)	0.036 / 0.052	- / 0.052		0.025 / 0.044	
Depth to 2.5 km/sec boundary (km)			0.628 / 0.616		

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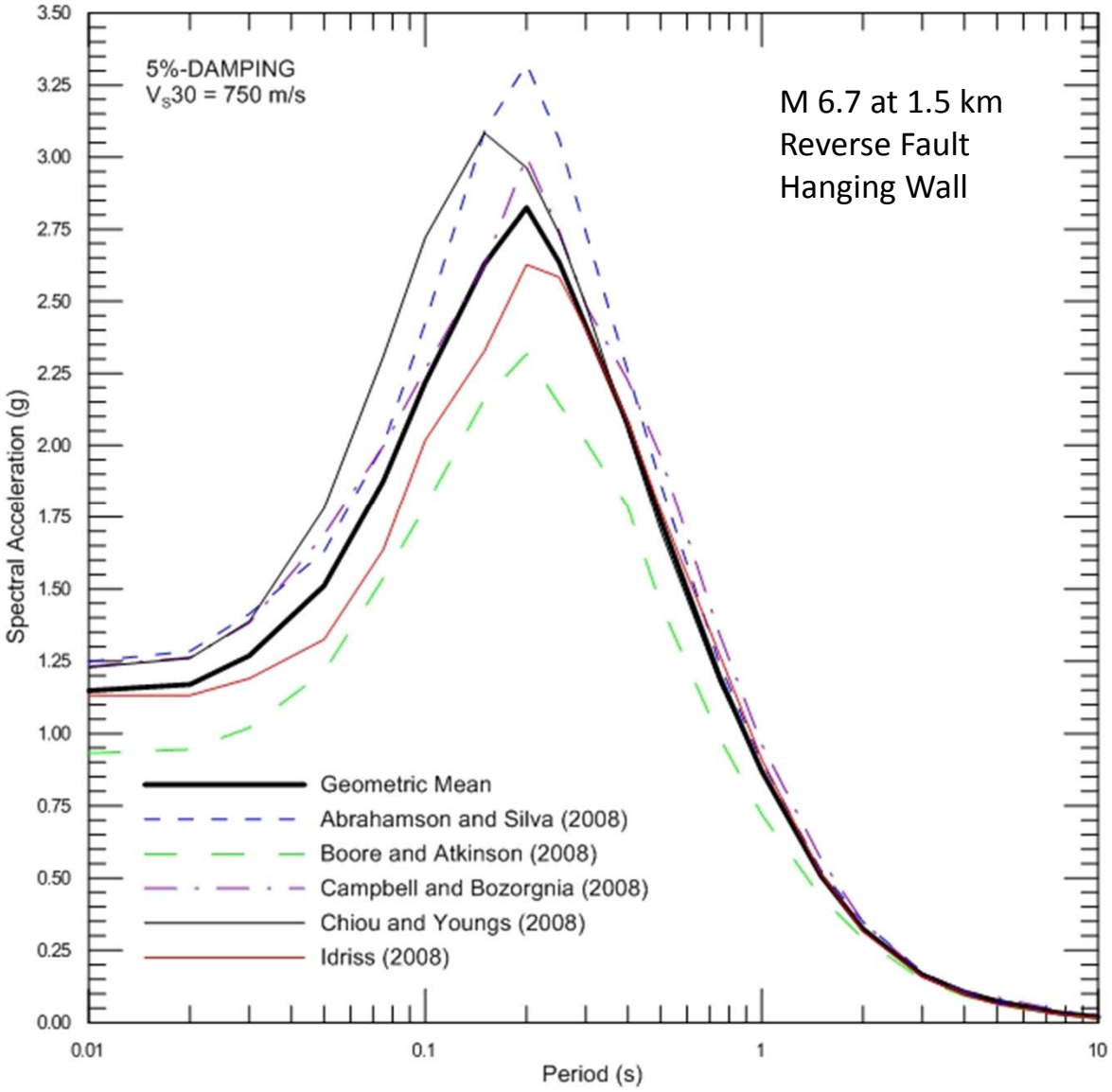
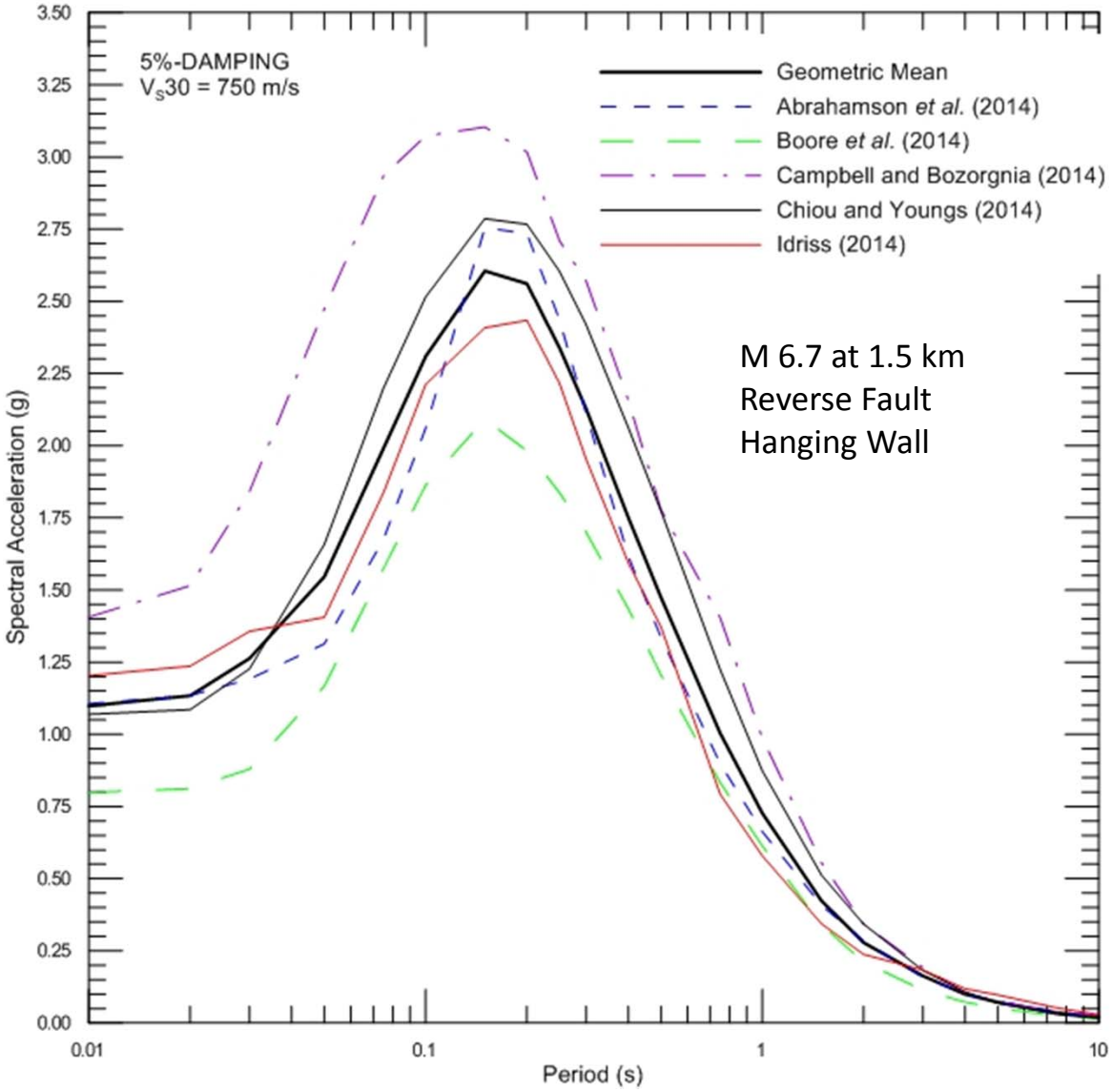
84TH-PERCENTILE ACCELERATION RESPONSE SPECTRA FOR SCENARIO 1 – NGA-WEST1



84TH-PERCENTILE ACCELERATION RESPONSE SPECTRA FOR SCENARIO 1 – NGA-WEST2



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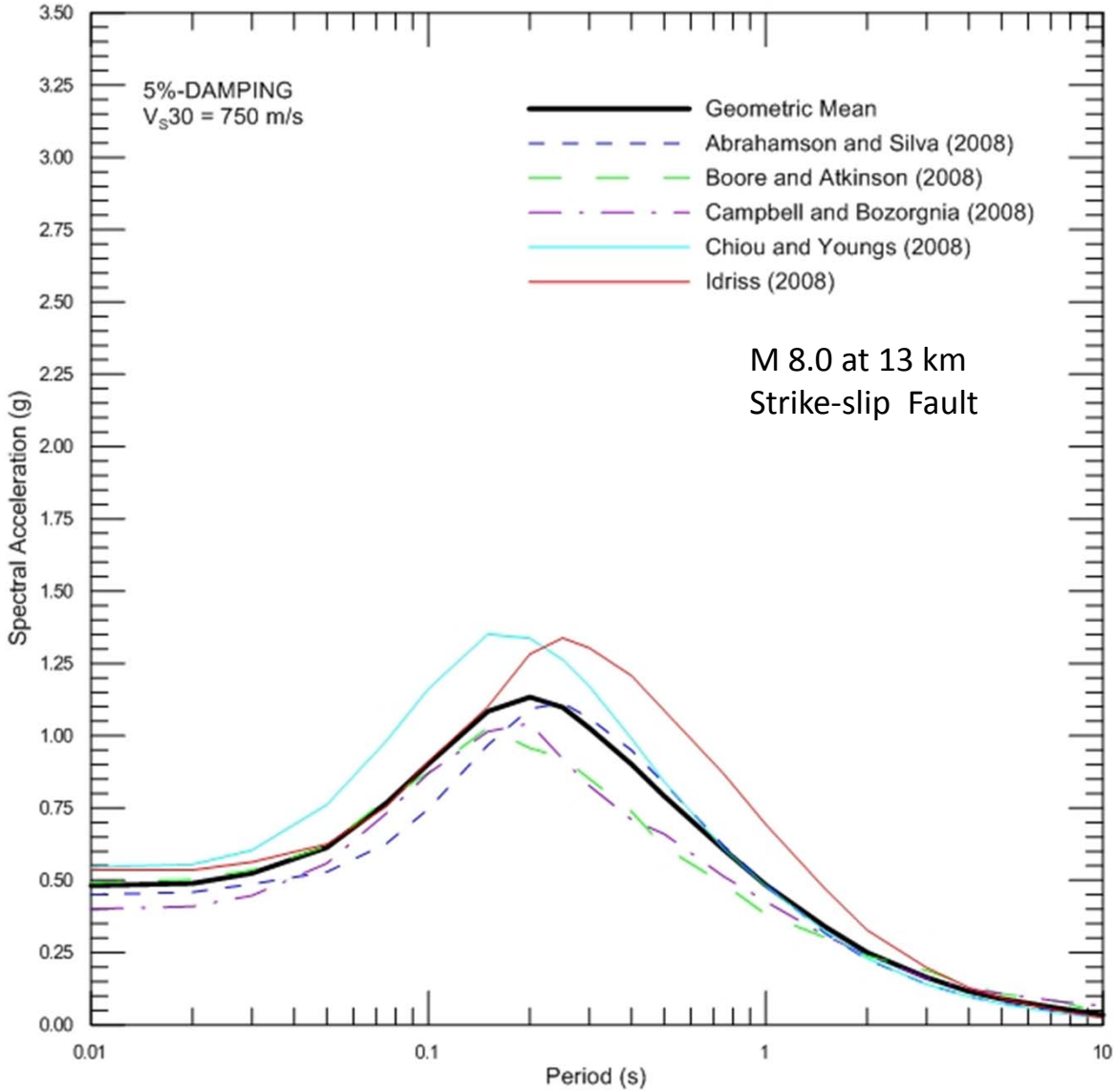
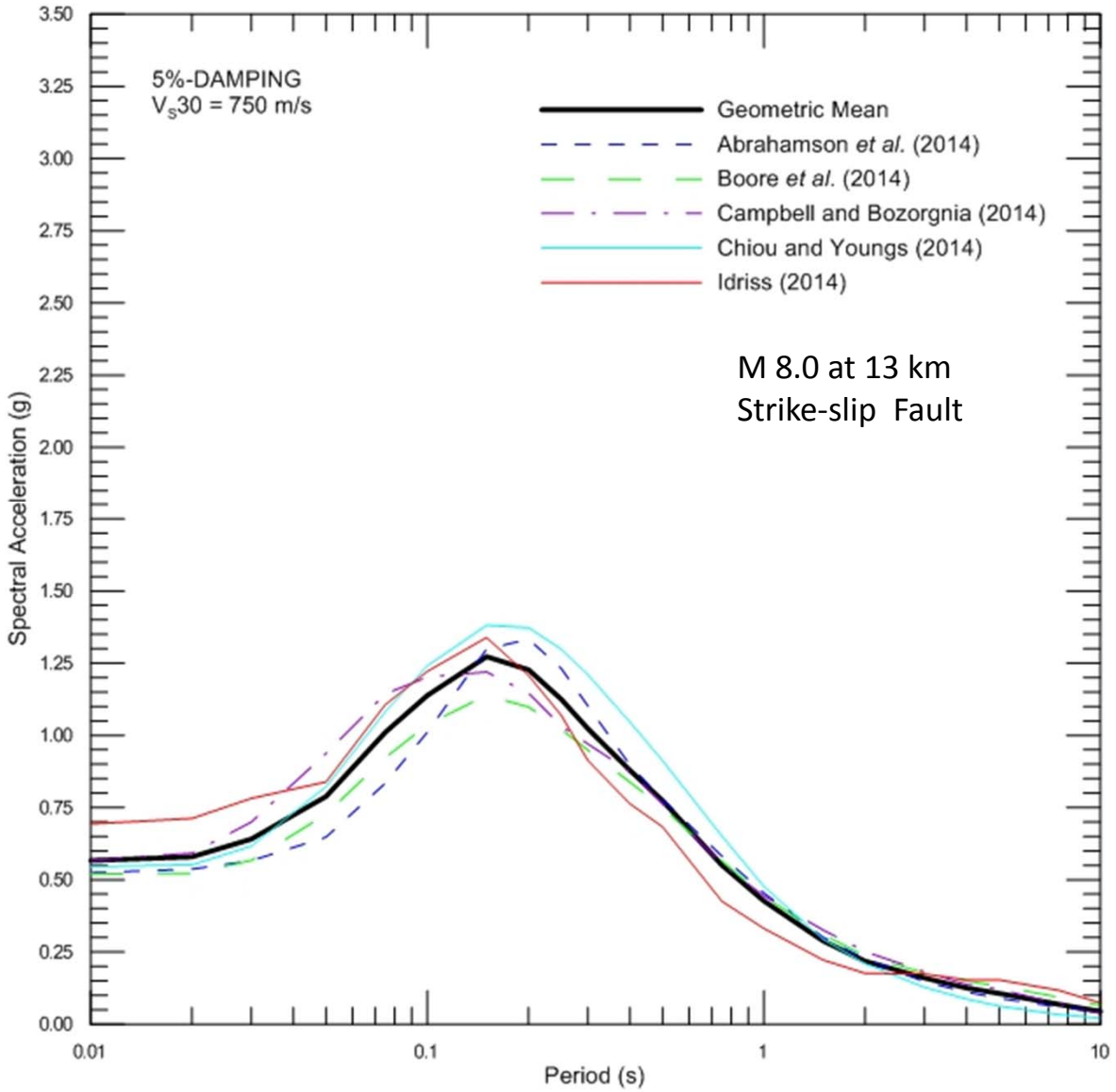
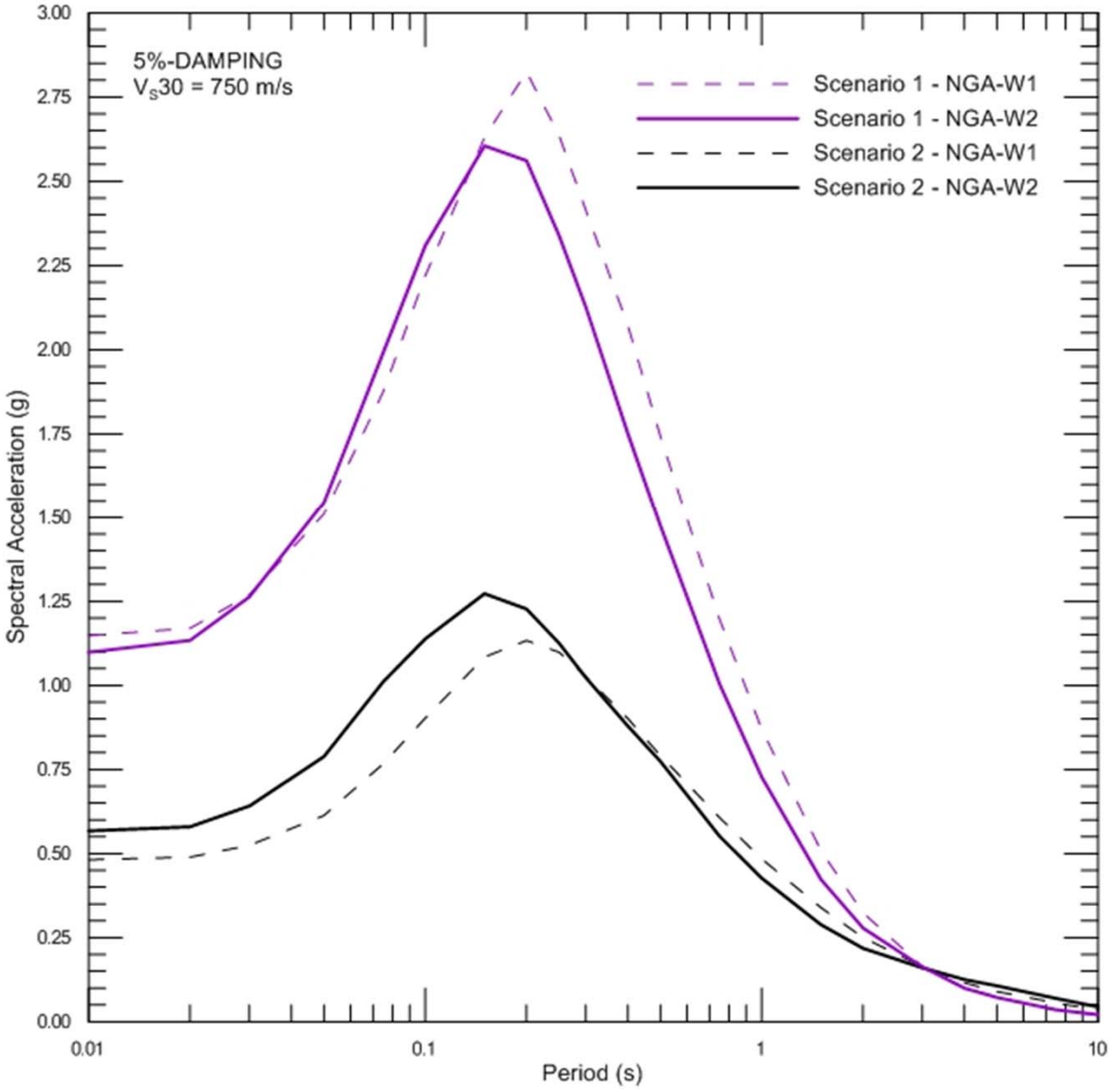
84TH-PERCENTILE ACCELERATION RESPONSE SPECTRA FOR SCENARIO 2 – NGA-WEST1



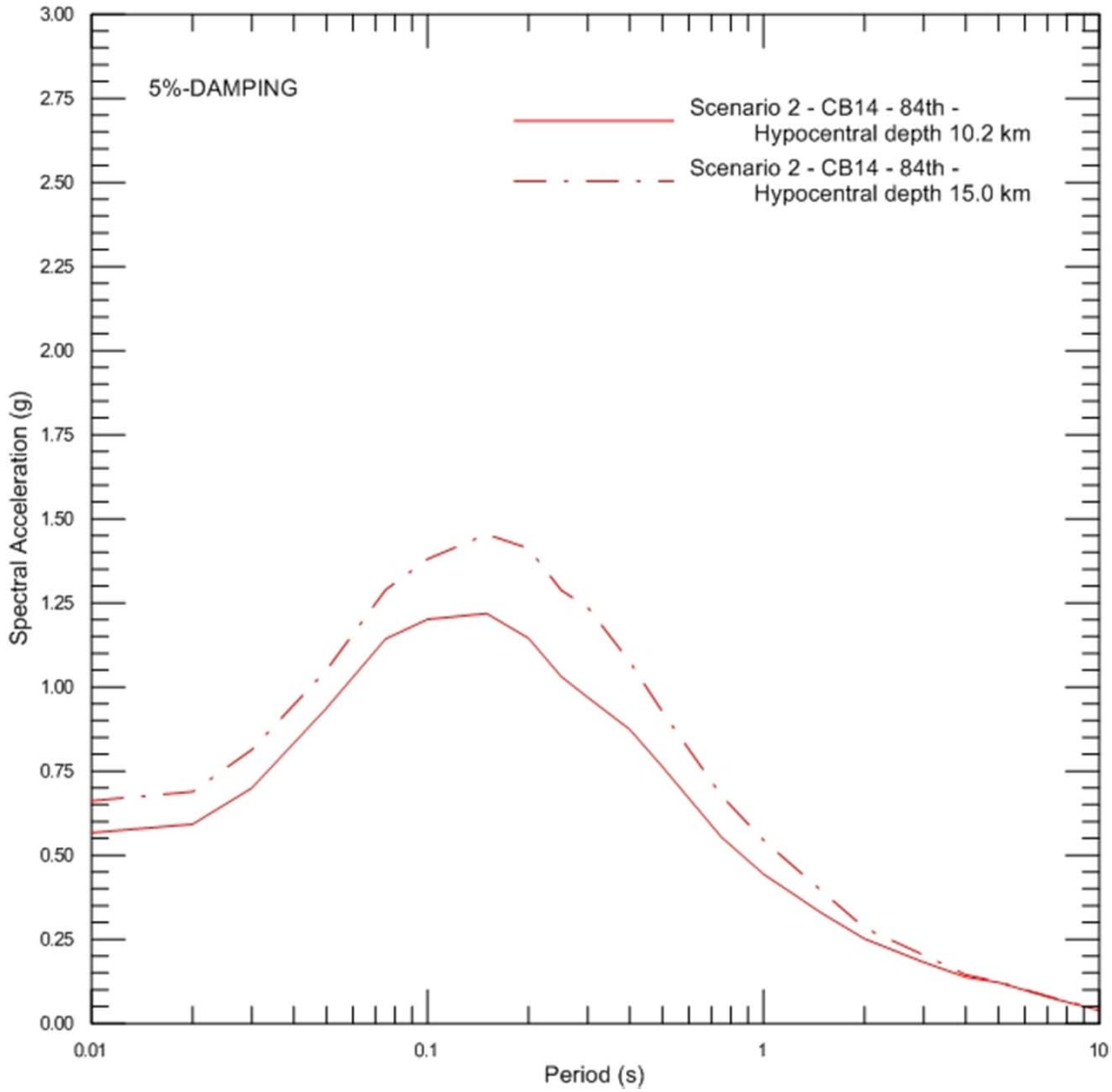
84TH-PERCENTILE ACCELERATION RESPONSE SPECTRA FOR SCENARIO 2 – NGA-WEST2



COMPARISON OF MEAN 84TH-PERCENTILE ACCELERATION RESPONSE SPECTRA FOR SCENARIOS 1 AND 2



SENSITIVITY TO HYPOCENTRAL DEPTH FOR CAMPBELL AND BOZORGNIA RELATIONSHIP



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Summary

- Differences between ground motion estimates obtained with individual NGA-WEST2 and NGA-WEST1 relationships may be large
- Ranges of ground motion estimates obtained with NGA-WEST2 relationships are generally similar to those obtained with NGA-WEST1 relationships
- Differences between average estimates obtained with NGA-WEST2 and NGA-WEST1 relationships may be significant from dam safety viewpoint
- Sensitivity of estimates to uncertain input parameters may be significant

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Thank you