SSC Hazard Sensitivity

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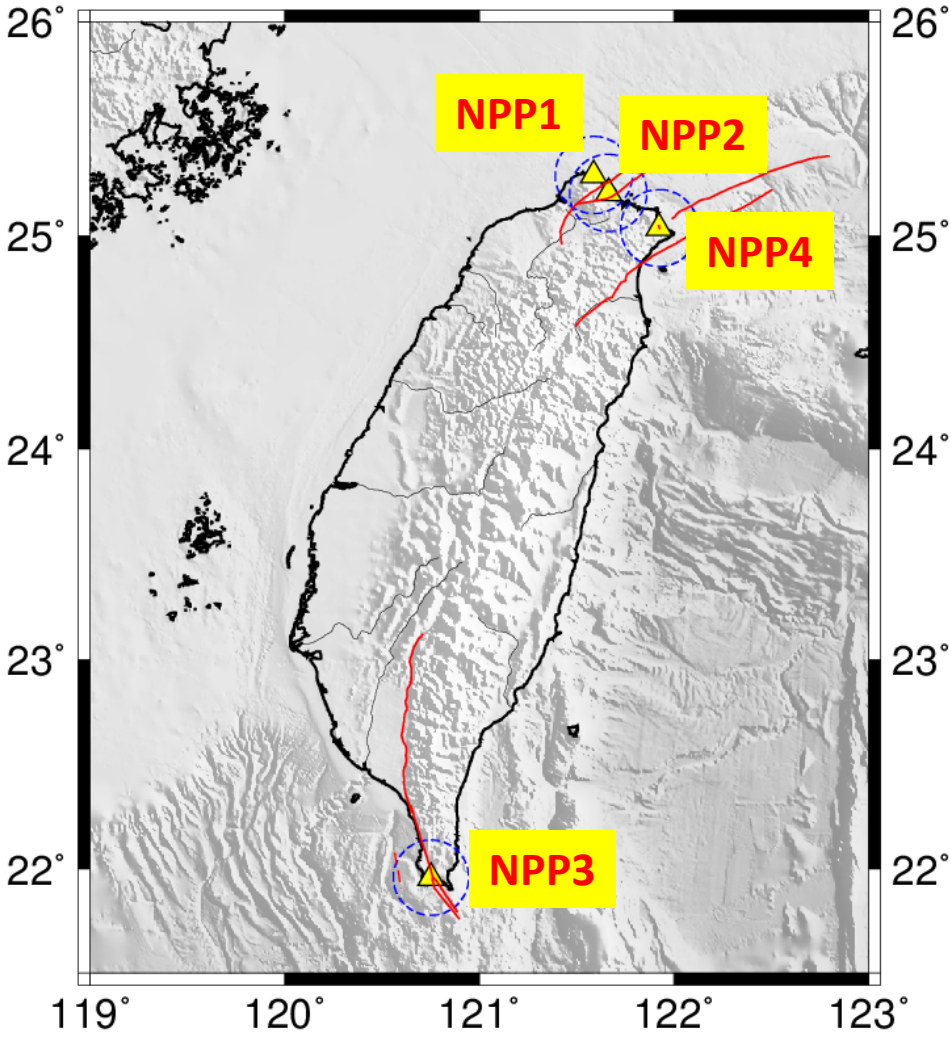
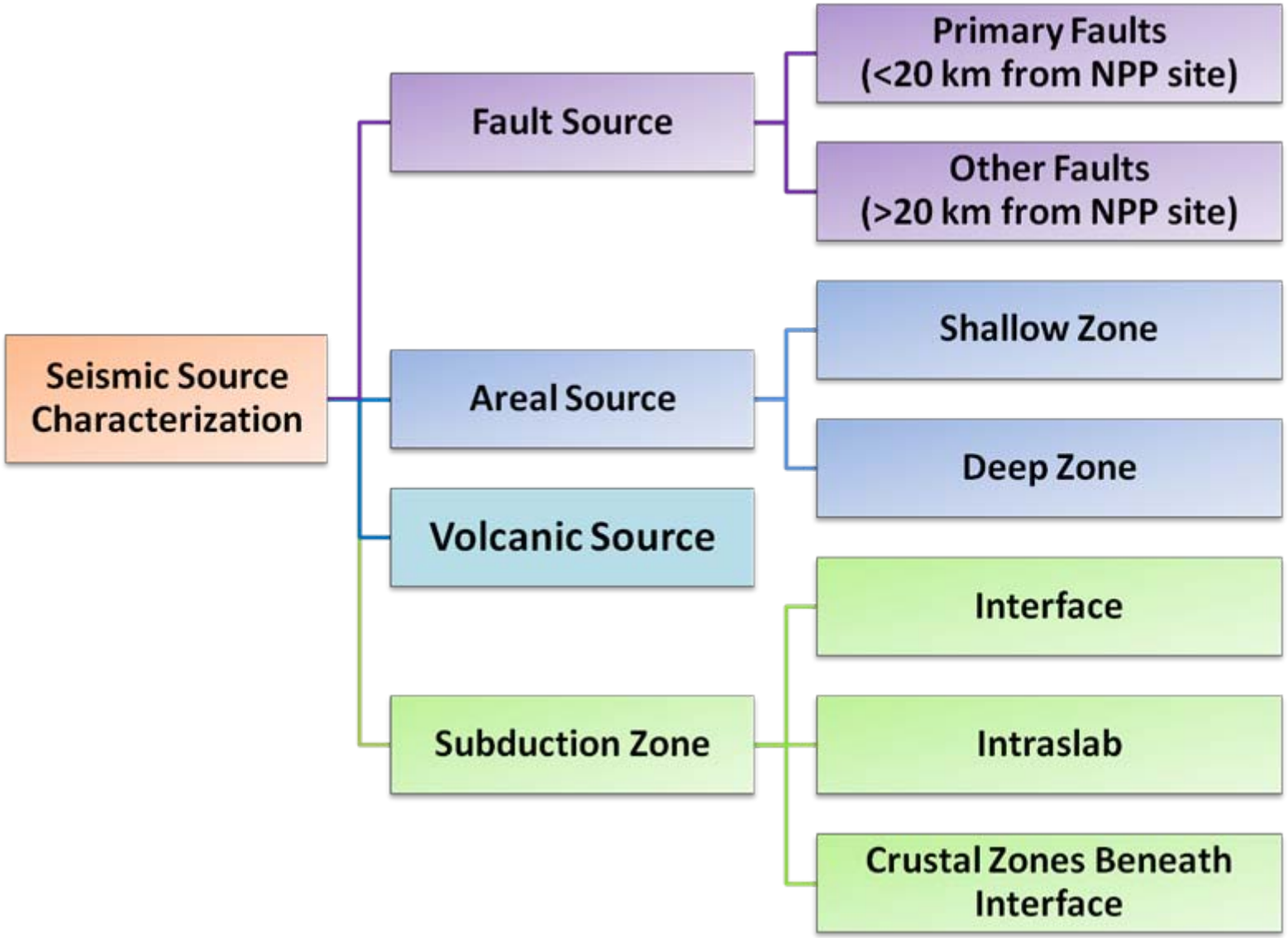
Outline

- SSC Models
- GMPEs Setting for Hazard Calculation
- Hazard Sensitivity
- Hazard Contribution



Seismic Source Characterization in Taiwan



GMPEs

- **Ground Motion Prediction Equation**
  - **Crustal GMPE (equal weighting, fixed sigma=0.55)**
    - ASK14
    - BSSA14
    - CY14
    - CB14
    - ID14
  - **Subduction-zone GMPE (equal weighting, fixed sigma=0.60)**
    - LL08
    - BCHydro
  - **Maximum Epsilon: 4**
  - **V_{s30} for site: 760 m/sec**
  - **Periods: PGA, 0.2sec, 2.0sec**

- Shallow Crustal Earthquake (depth $\leqslant$ 35 or 50km)
- Crustal Fault and Splay Fault
- Volcanic Source

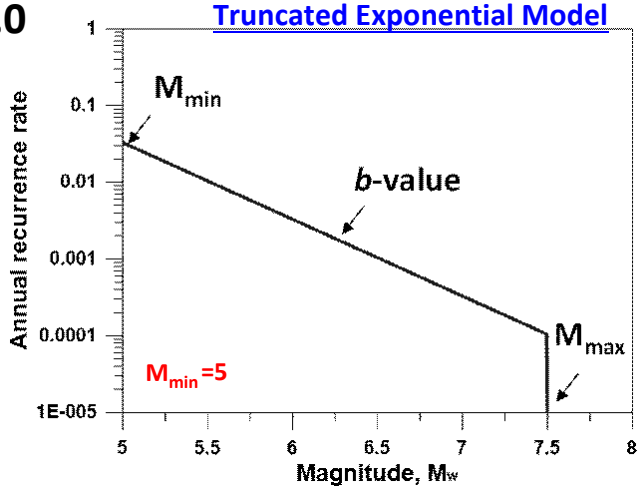
- Deep Earthquake (depth > 35 or 50 km)
- Interface (interface1 / Splay Fault + Interface2 and Beneath Interface Crustal)
- Intraslab

Parameters Setting

Areal Source Zone

- ✓ Method of Estimating b-value and Activity Rate:
  - ➔ Maximum Likelihood Estimation
- ✓ Magnitude Distribution Model:
  - ➔ Truncated Exponential Model
- ✓ Depth Distribution Model:
  - ➔ Truncated Normal Distribution for Shallow Zones
  - ➔ Triangular Distribution for Deep Zones
  - ➔ Uniform Distribution for Intraslab
- ✓ M_{min} = 5.0

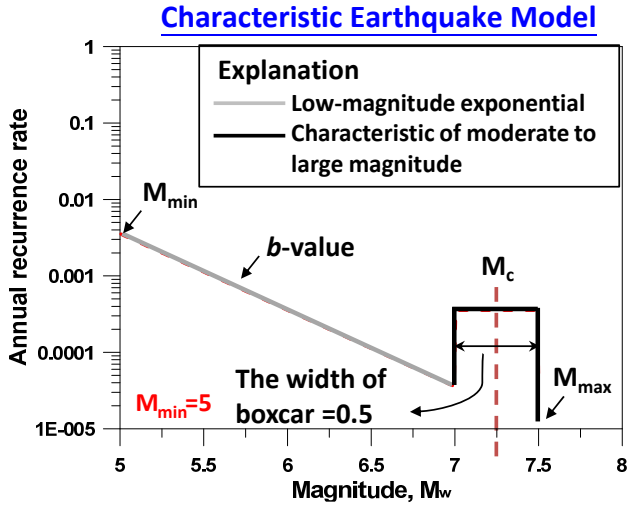
Truncated Exponential Model



Faults and Interface

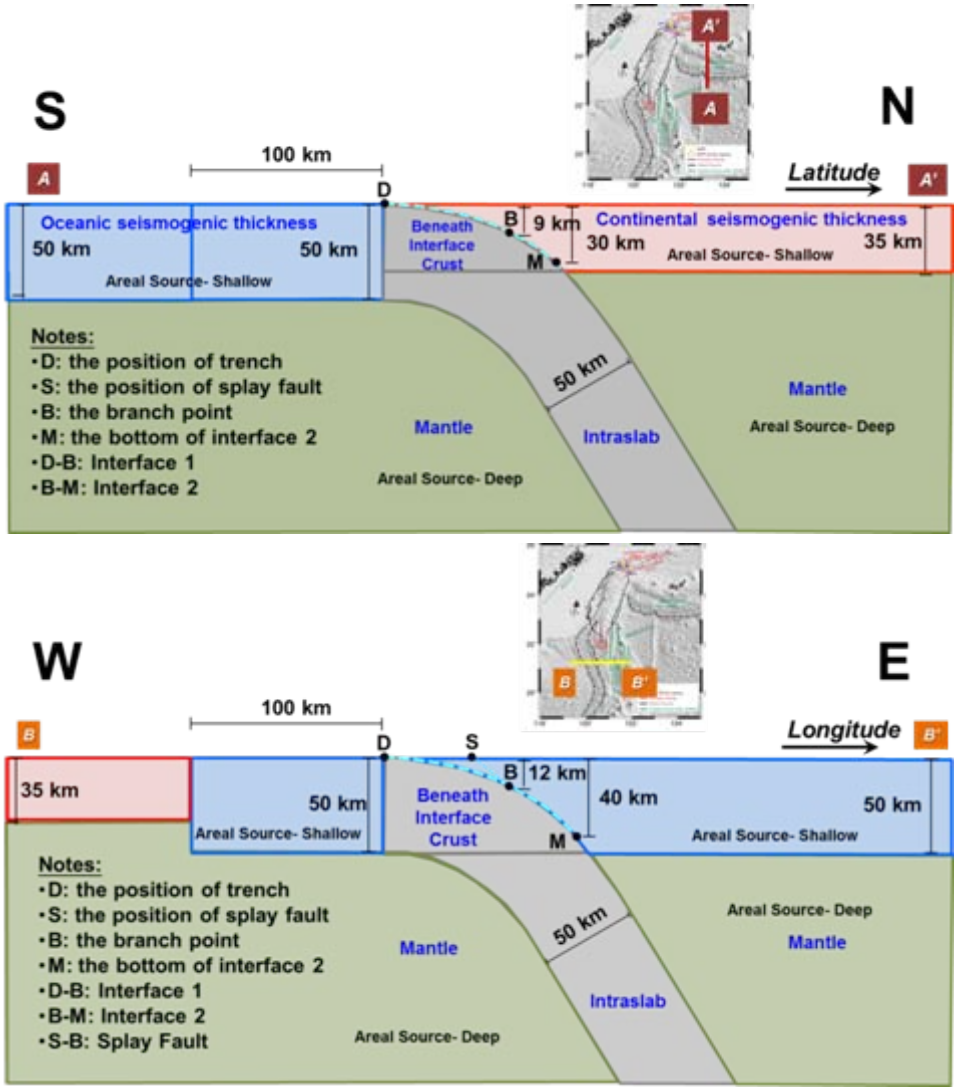
- – b-value = 1.0
- – Magnitude pdf:
  - Characteristic Earthquake Model (Y&C, 1985)
  - Truncated Exponential Model
- – M_{min} = 5.0

Characteristic Earthquake Model

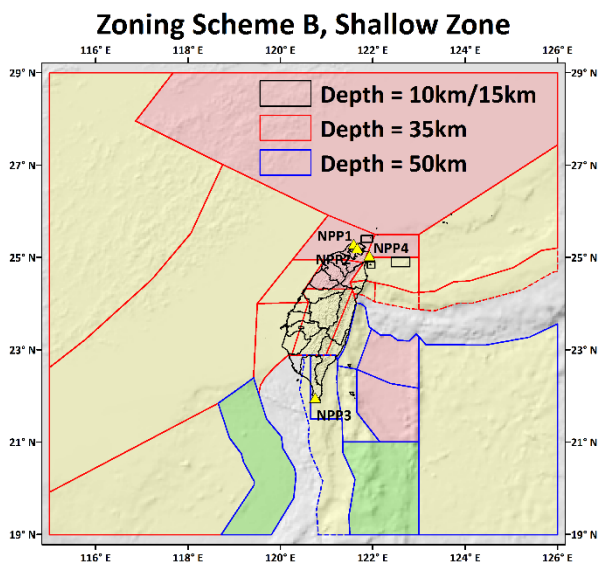


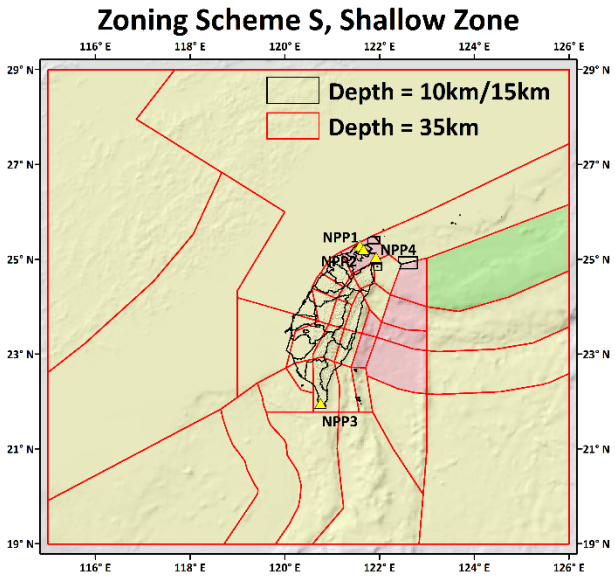
Seismogenic depth setting

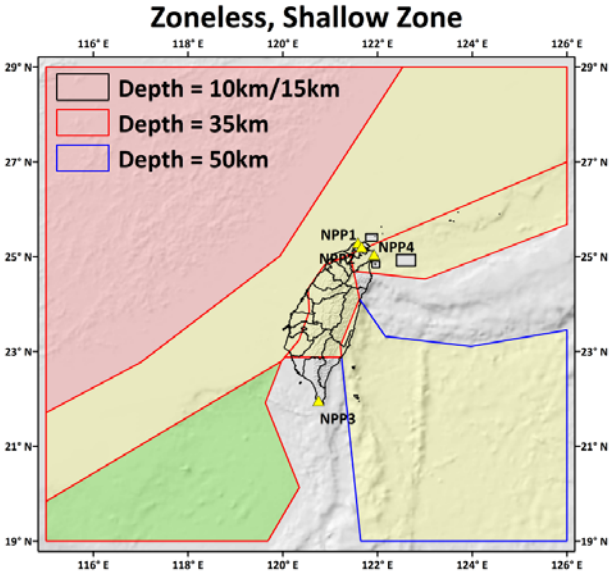
- **Shallow Zone**
  - Depth=0 ~ 35 / 0~ 50km
- **Deep Zone**
  - Depth=35/50 km ~ 300 km
- **Subduction Intraslab**
  - **Ryukyu Trench** (A – A')
    1) **Beneath Interface Crust (Depth: 0 ~ 35km) for ZB, Zoneless**
    1) **Intraslab (35km ~ 300km)**
  - **Manila Trench (B – B')**
    1) **Beneath Interface Crust (Depth: 0 ~ 50km) for ZB, Zoneless**
    1) **Intraslab (50km ~ 250km)**

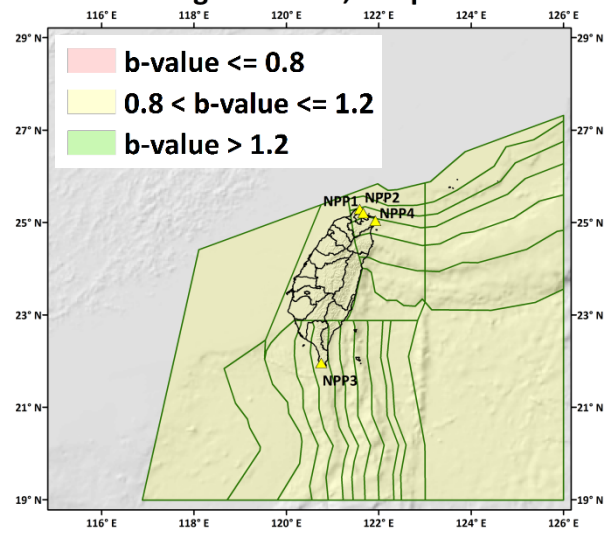


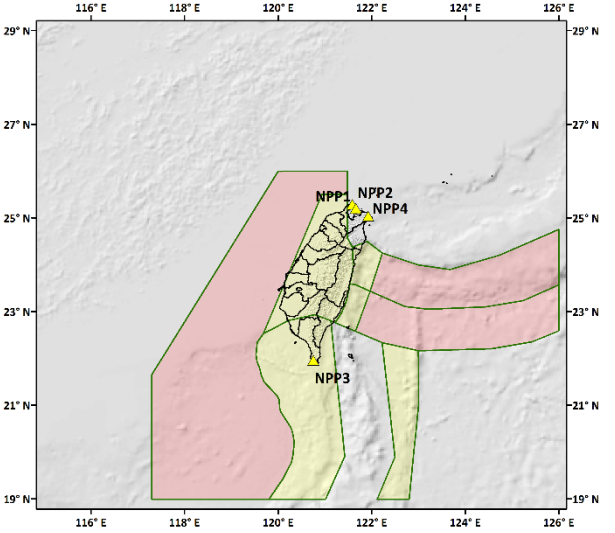
Areal Source Zones: Shallow/ Deep

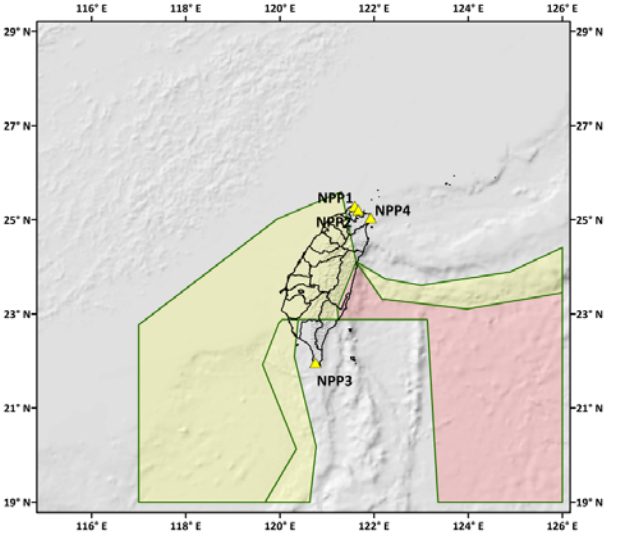




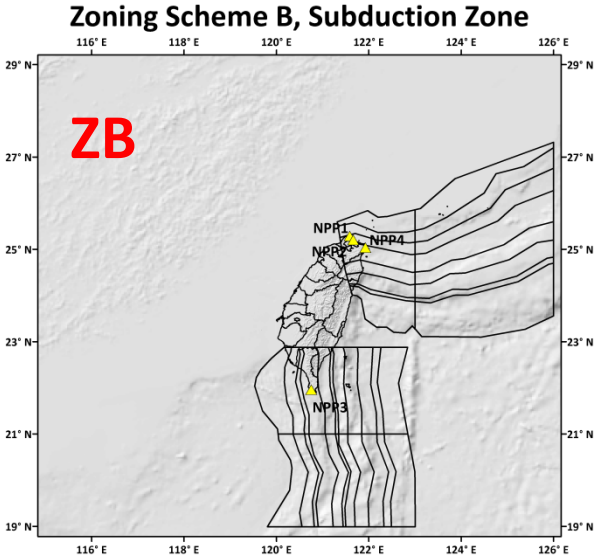


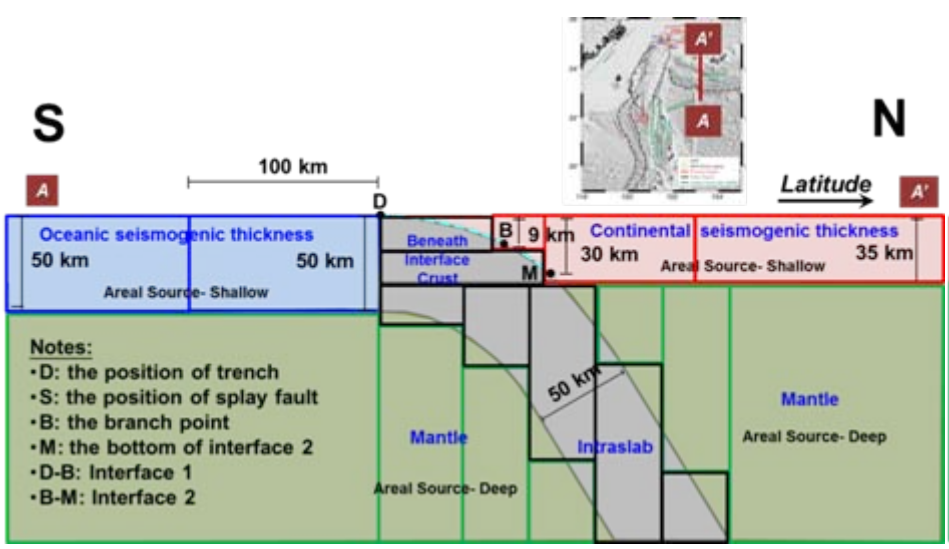


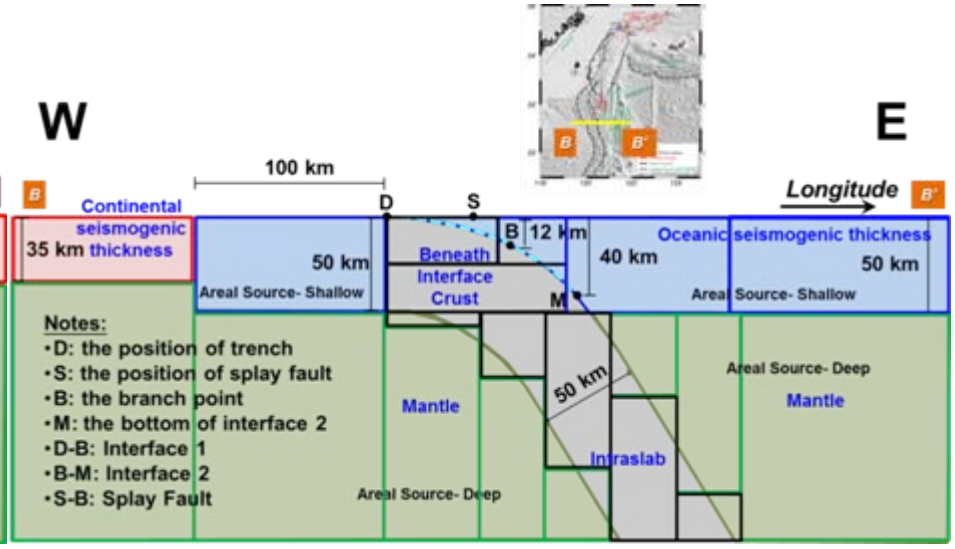




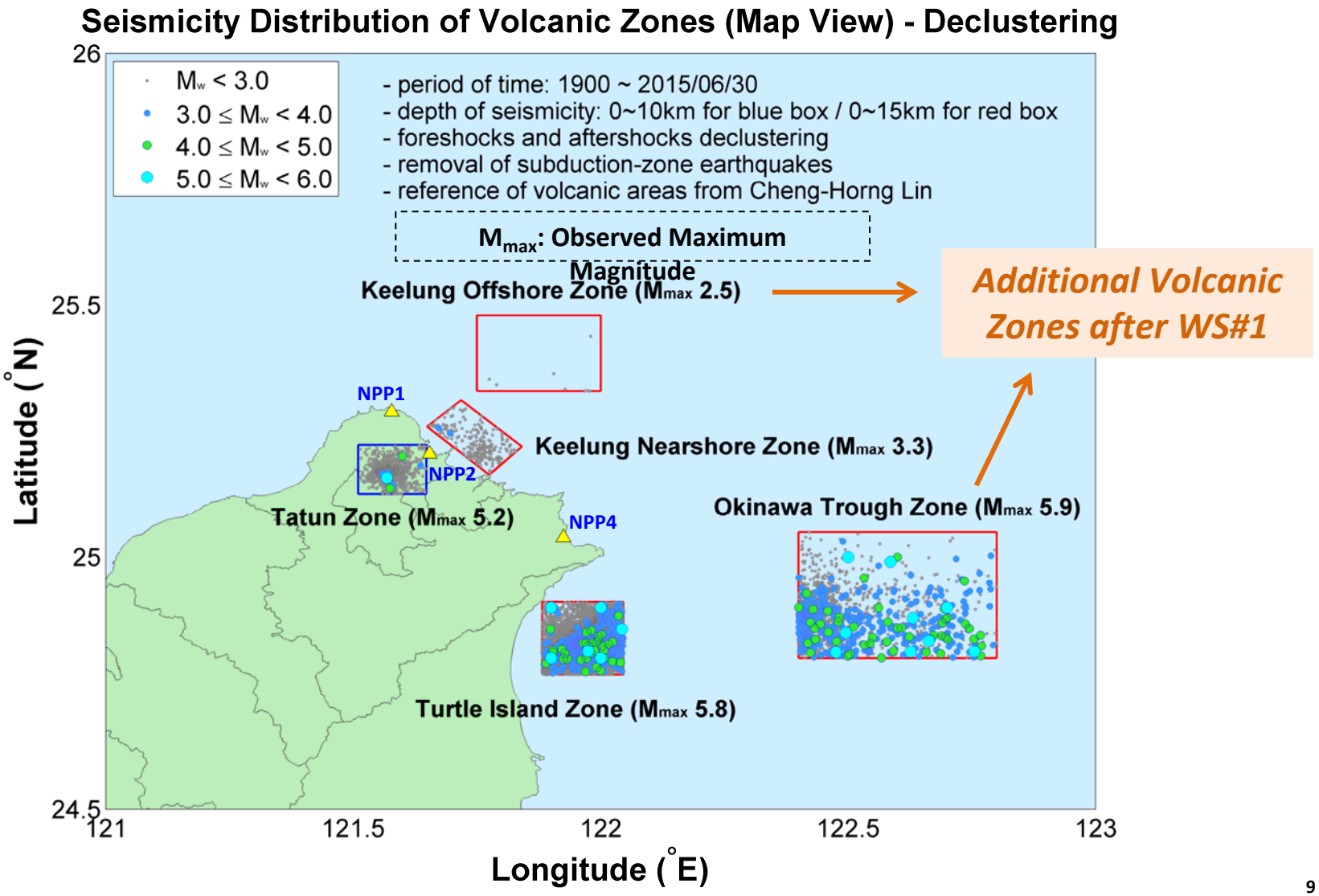
Areal Source Zones: Subduction Zone (ZB, ZS & Zoneless)







The Volcanic Source Zones Nearby Taiwan



Parameters Setting for Hazard Calculation of Volcanic Source Zones (@WS#3)

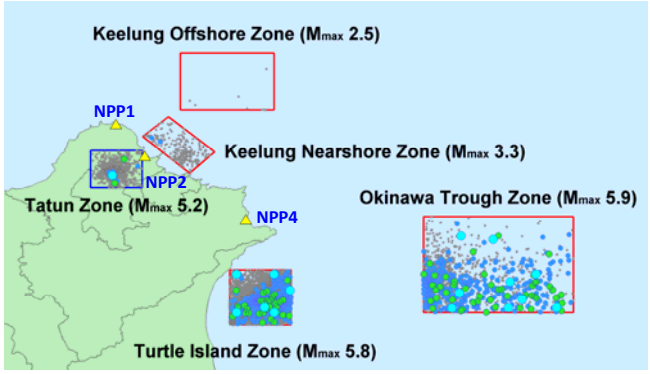
Setting for Seismic Source Calculation					
Name of Zone	**Tatun**	**Keelung Nearshore**	**Keelung Offshore**	**Turtle Island**	**Okinawa Trough**
Depth of Zone (km)	10	15	15	15	15
b-value[1]	1.032 (±0.117)	1.333 (±0.145)	1.000[2]	0.919 (±0.015)	0.811 (±0.048)
N(5.0)[1]	0.0030	0.0003	0.0001	0.1550	0.1980
Max. Magnitude, M_u[3]	6.0	6.0	6.0	6.5	6.5

[1] Based on mainshocks catalog provided by Y.M. Wu, and Maximum Likelihood Estimation ($m_0 \geqslant 2.0$)

[2] Assumed b-value as 1.000 due to lack of seismic data

[3] Additional Reference: Payne et al. (2015). "SSHAC Level 1 Probabilistic Seismic Hazard Analysis for the Idaho National Laboratory," Rev. 0, INL/EXT-15-36682, p.77.

Setting for Ground Motion Calculation			
Crustal GMPE	ASK14, BSSA14, CB14, CY14, ID14		
Sigma	0.55	**Max. Epsilon**	4.0



Faults

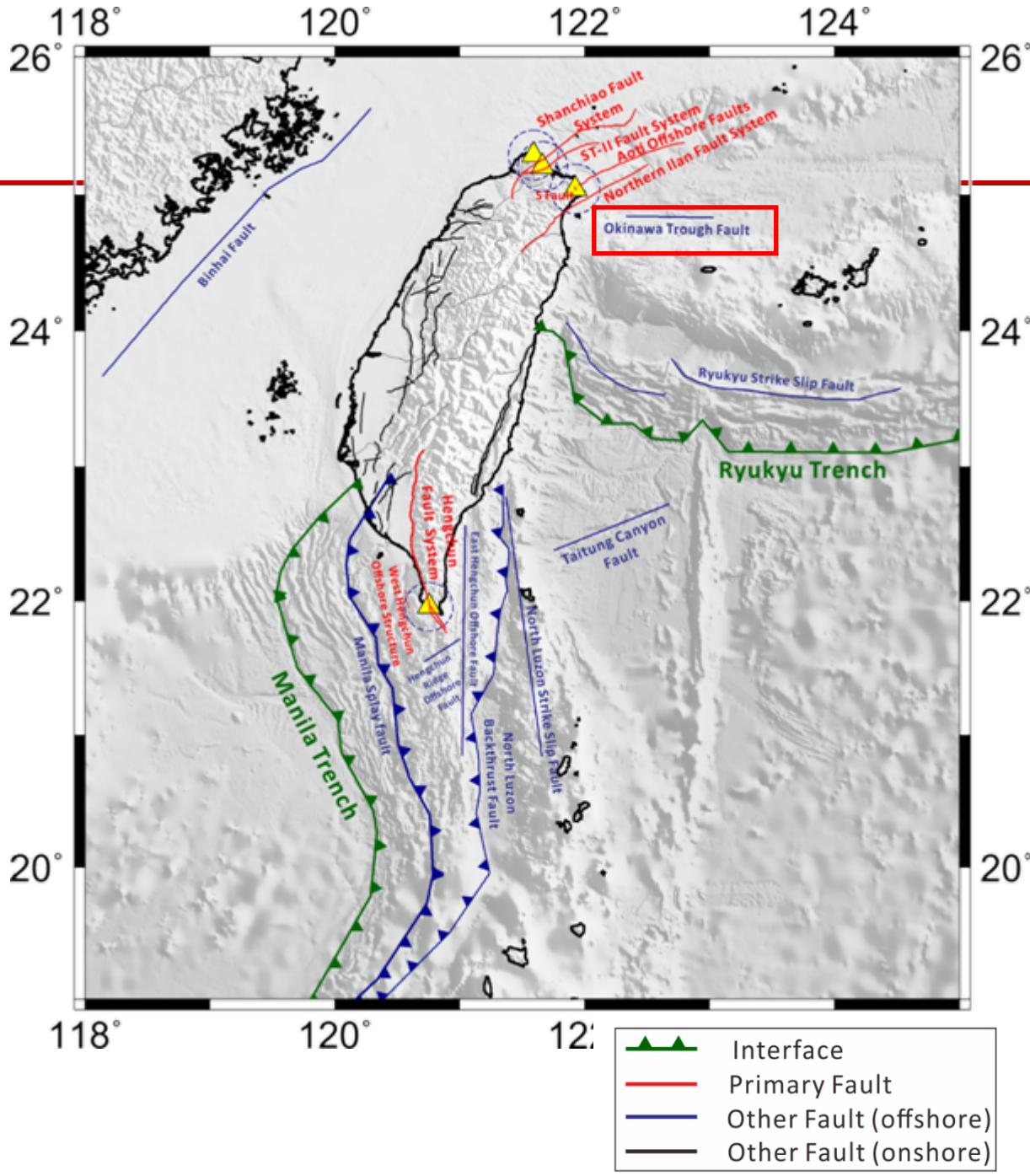
- **7 Primary Faults**

P1	Shanchiao Fault System
P2	ST-II Fault System
P3	S Fault
P4	Aoti Offshore Faults
P5	Northern Ilan Fault System
P6	Hengchun Fault System
P7	West Hengchun Offshore Structure

- **2 Subduction Interfaces**

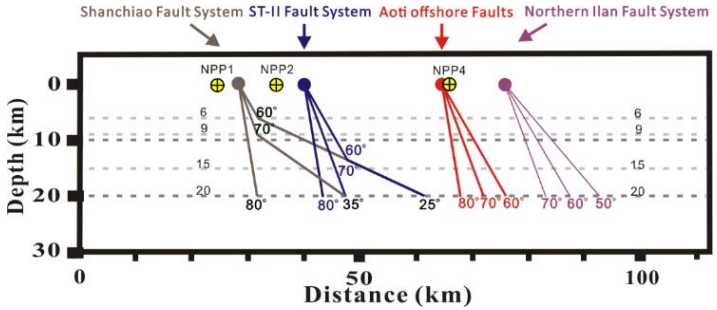
1	Ryukyu Trench
2	Manila Trench

- **48 Other Faults**

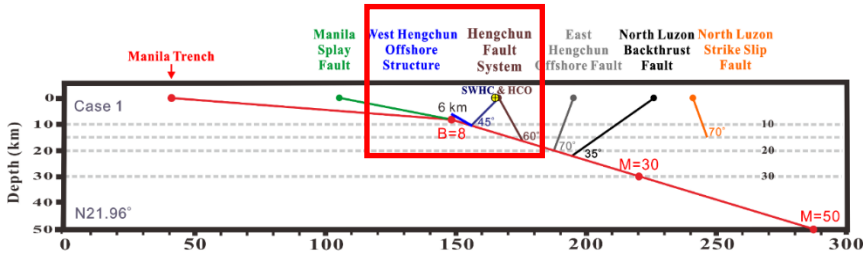


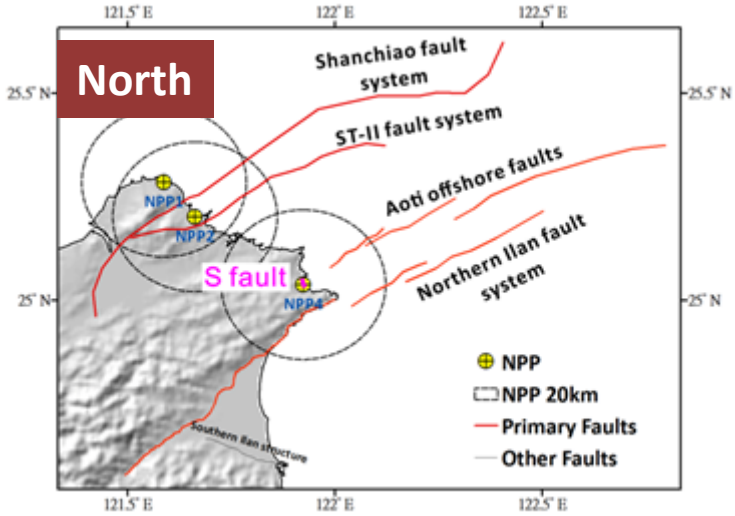
SSC Models – Primary Faults (< 20km Radius from NPPs)

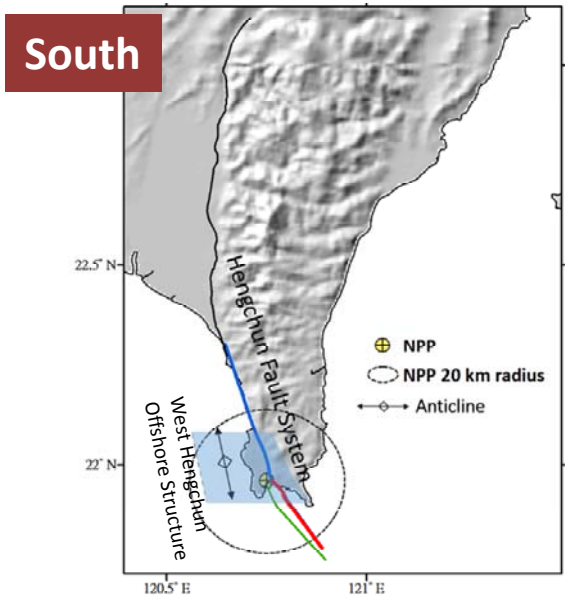
- **Northern Primary Faults**
  1) *Shanchiao Fault System*
  2) *ST-II Fault System*
  3) *Aoti Offshore Faults*
  4) *S Fault*
  5) *Northern Ilan Fault System*



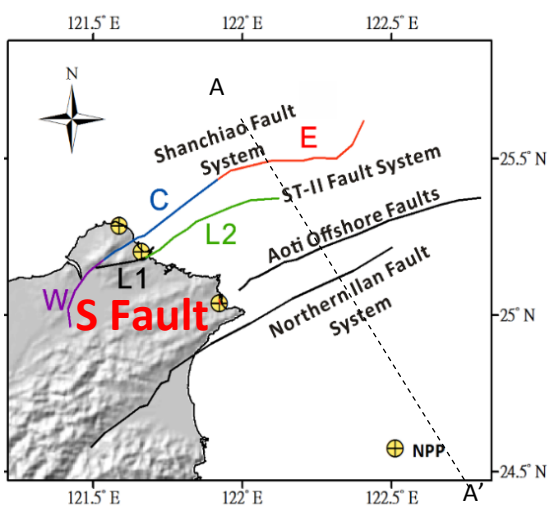
- **Southern Primary Faults**
  1) *Hengchun Fault System*
  2) *West Hengchun Offshore Structure*

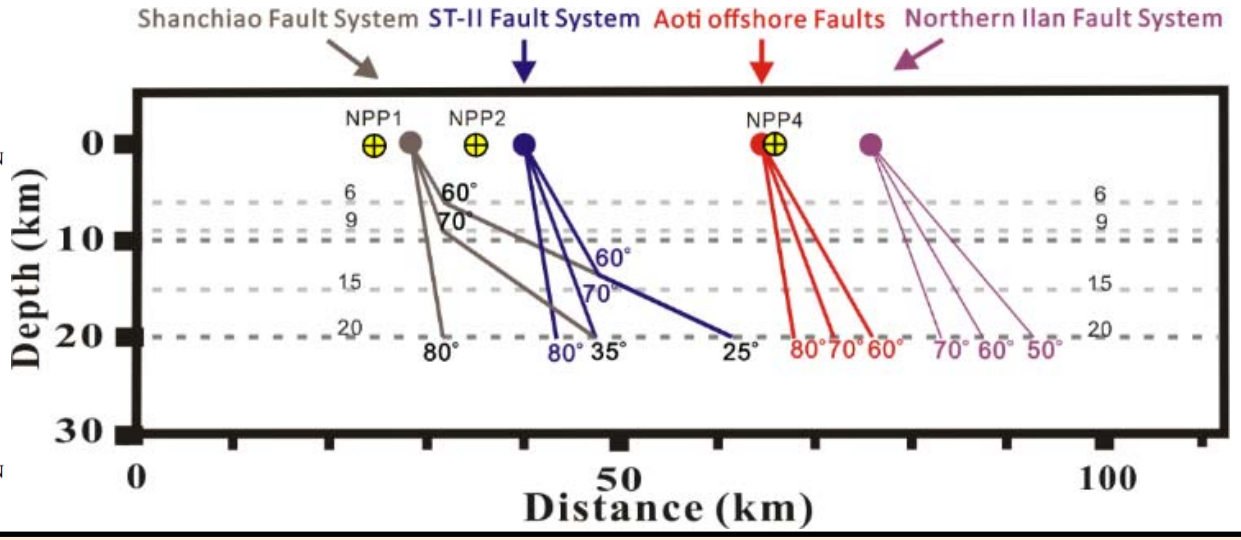






SSC Modeling in Northern Taiwan and the relative locations

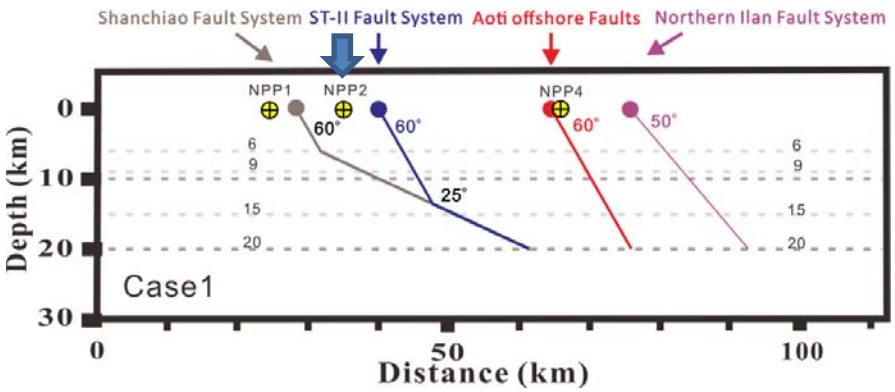




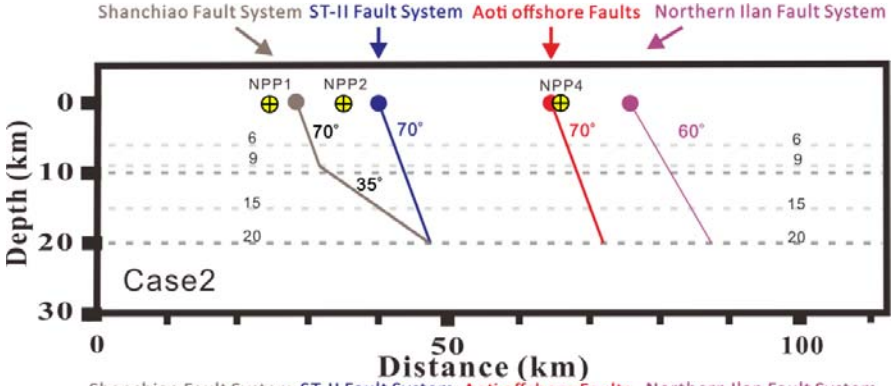
Fault Code	*Style of Faulting*	*Site*	*Location*
Shanchiao	Normal	NPP1	Footwall
		NPP2	**Hanging-wall**
ST-II	Normal	NPP1	Footwall
		NPP2	Footwall
S	Normal	NPP4	Footwall
Northern Ilan	Normal	NPP4	Footwall
Aoti Offshore	Normal	NPP4	Footwall

Sensitivity of Shanchaio Fault System _ Geometry model

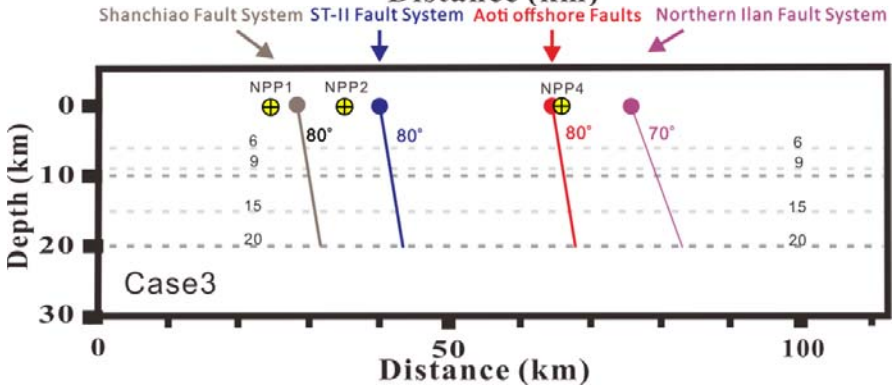
Case 1
[0.3]



Case 2
[0.4]



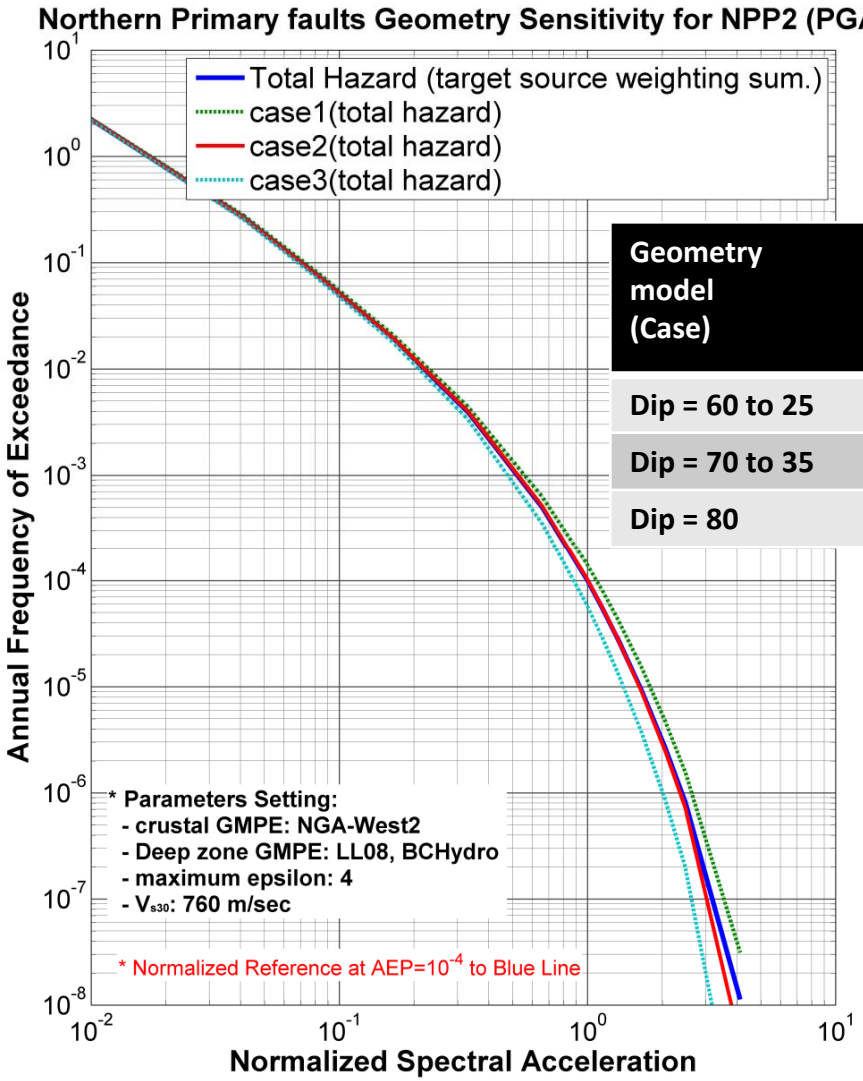
Case 3
[0.3]



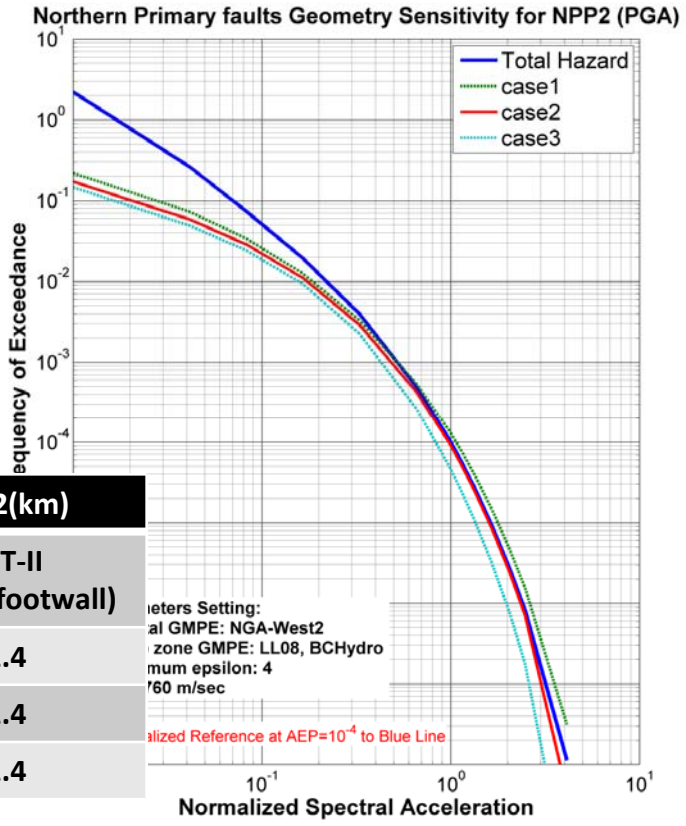
Fault Geometry Model

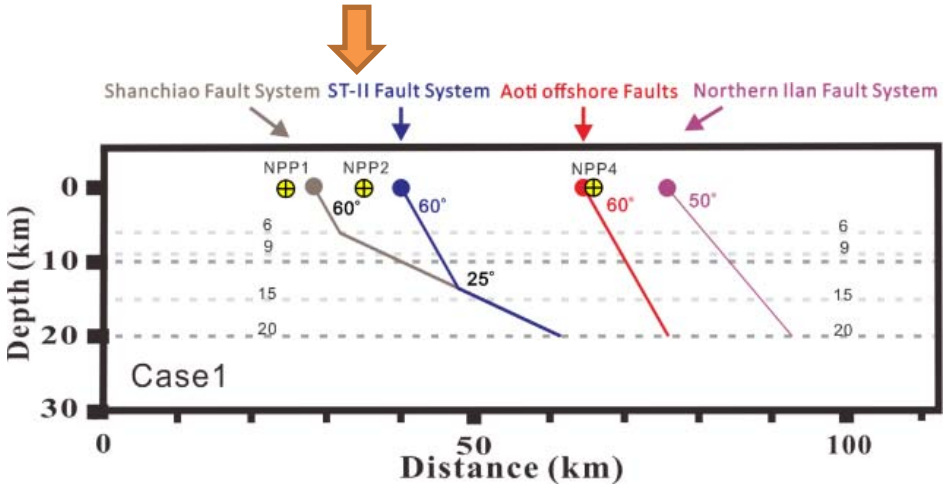
Dip	Seismogenic Depth	
60˚(0-6km) 25˚(>6km)	10	[0.3]
	15	[0.4]
	20	[0.3]
70˚(0-9km) 35˚(>9km)	10	[0.3]
	15	[0.4]
	20	[0.3]
80˚	10	[0.3]
	15	[0.4]
	20	[0.3]

Northern Primary faults geometry sensitivity for NPP2 (PGA)

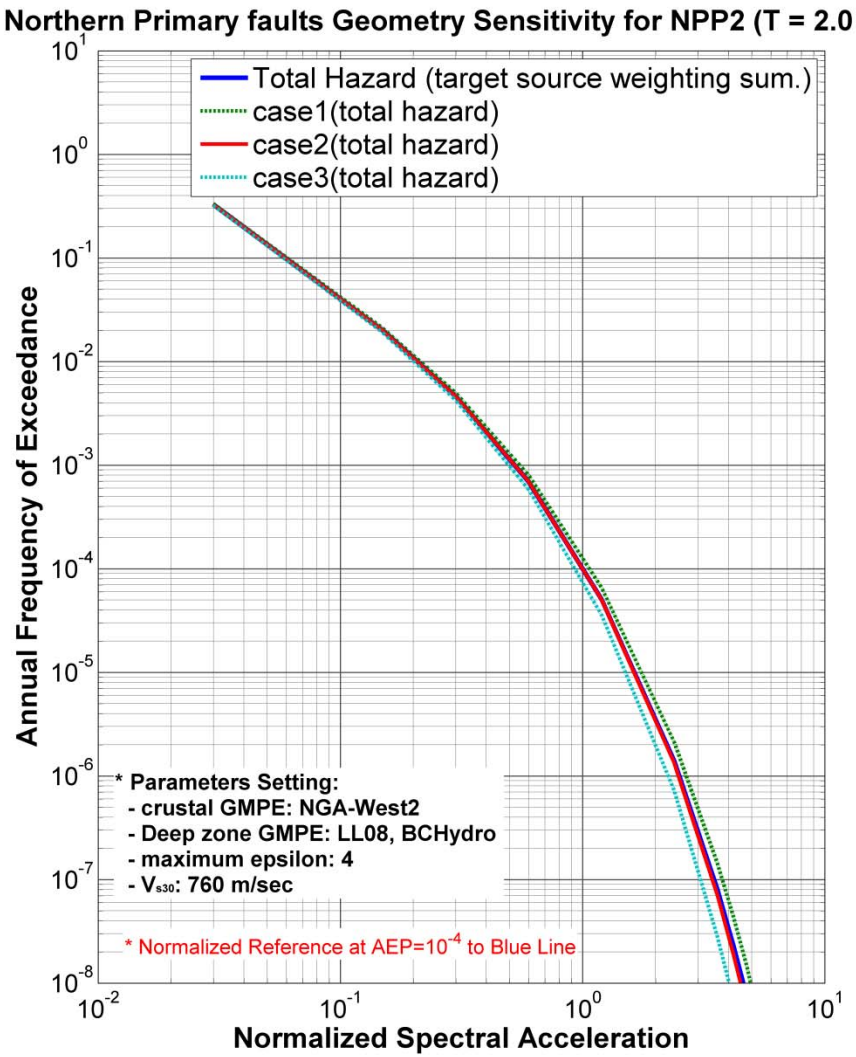


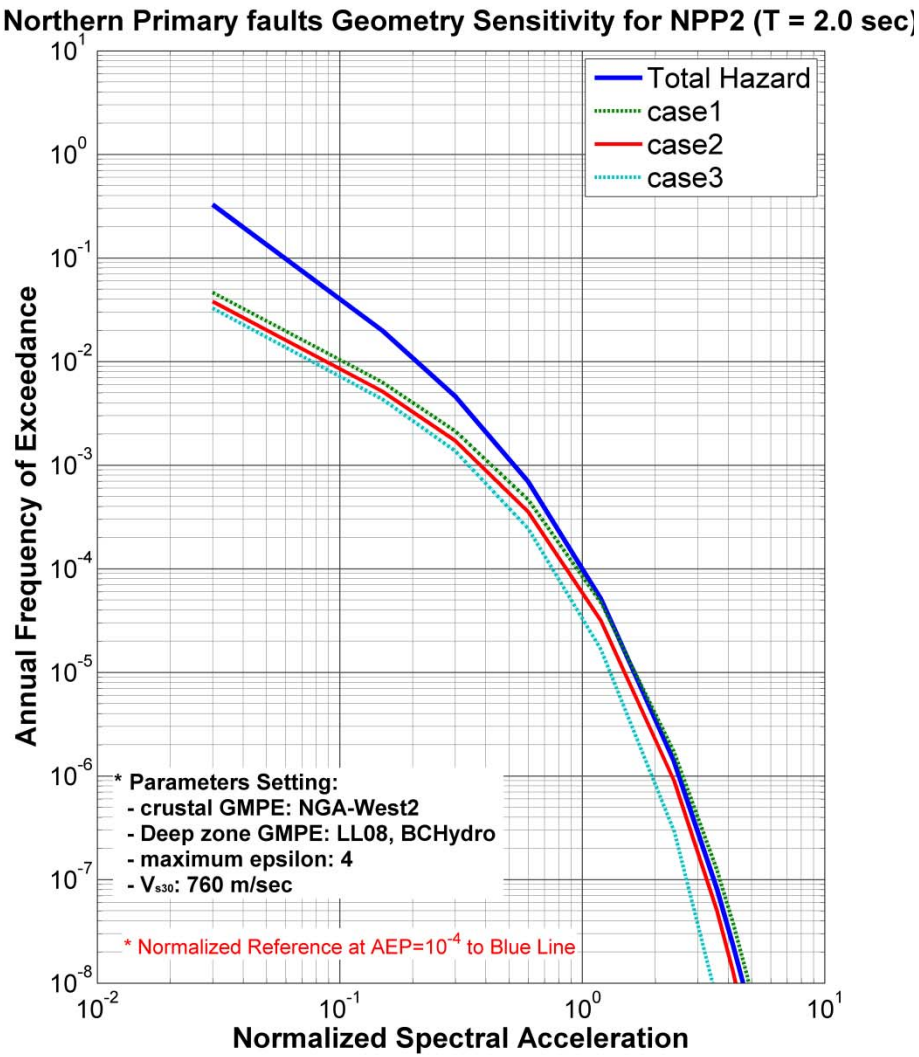
Geometry model (Case)	Distance to NPP2(km)	
	Shanchiao (Hang-wall)	ST-II (footwall)
Dip = 60 to 25	4.3	2.4
Dip = 70 to 35	4.7	2.4
Dip = 80	4.9	2.4





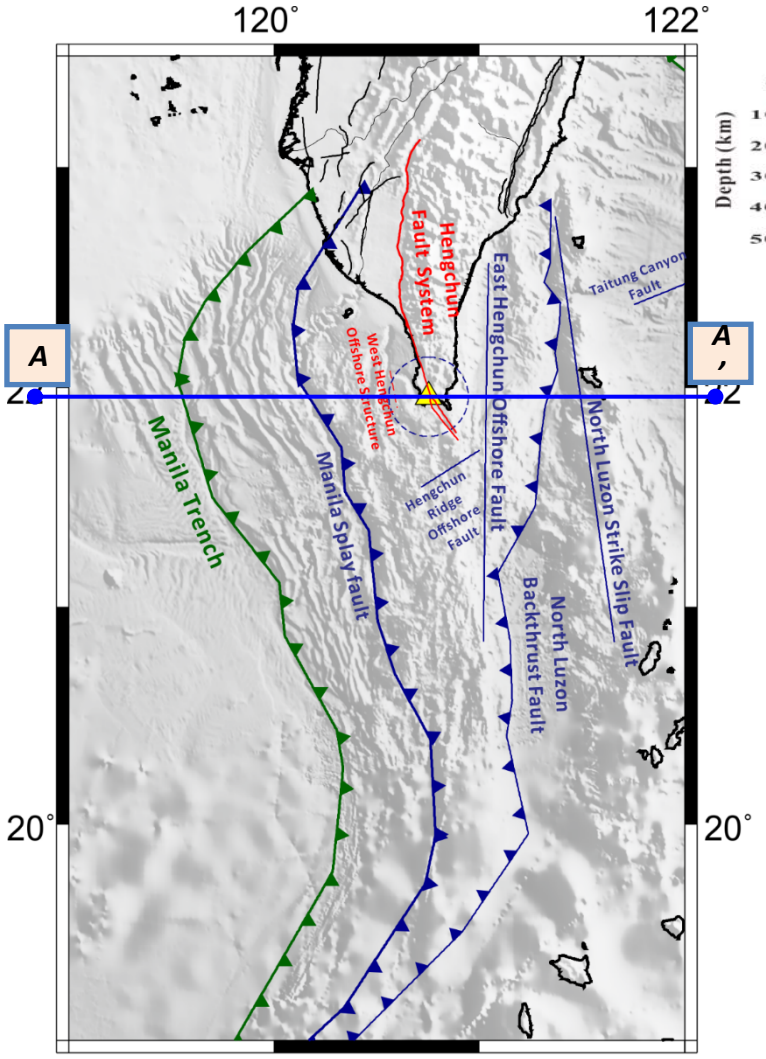
Northern Primary faults geometry sensitivity for NPP2 (T=2.0s)

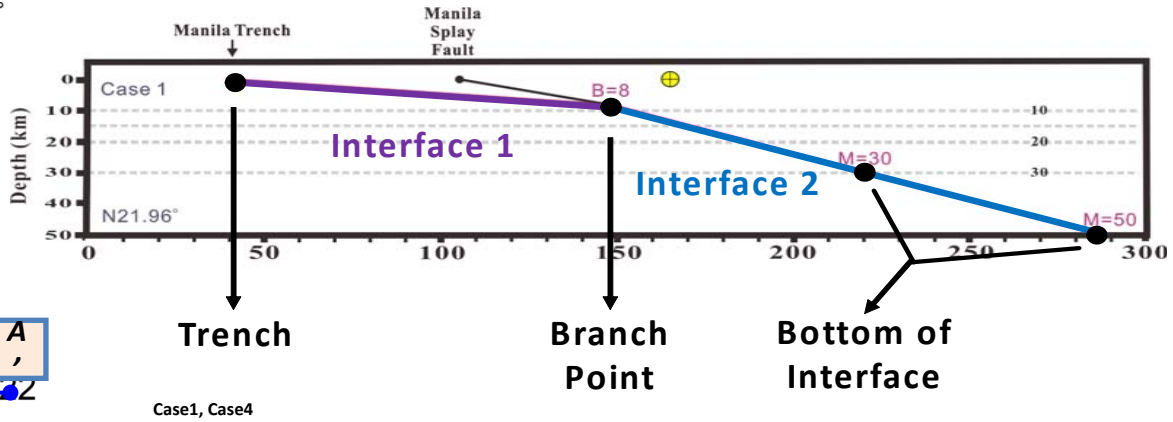




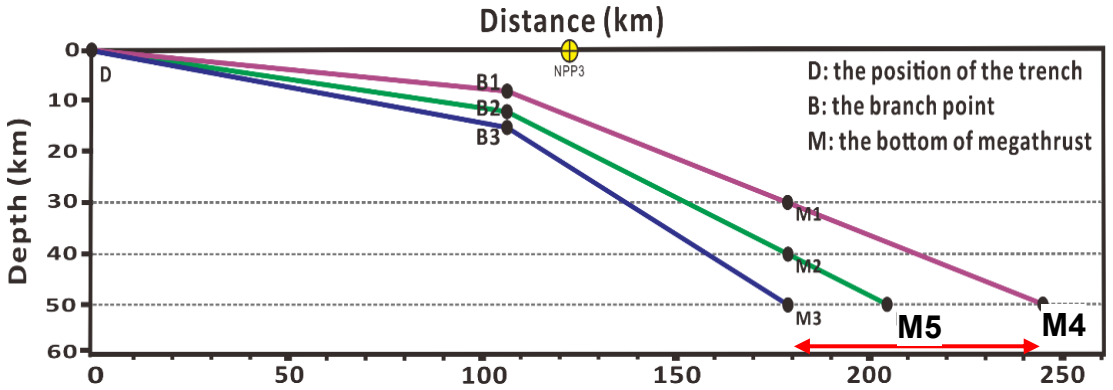
Southern primary faults

Five geometry models Relative to Manila Trench



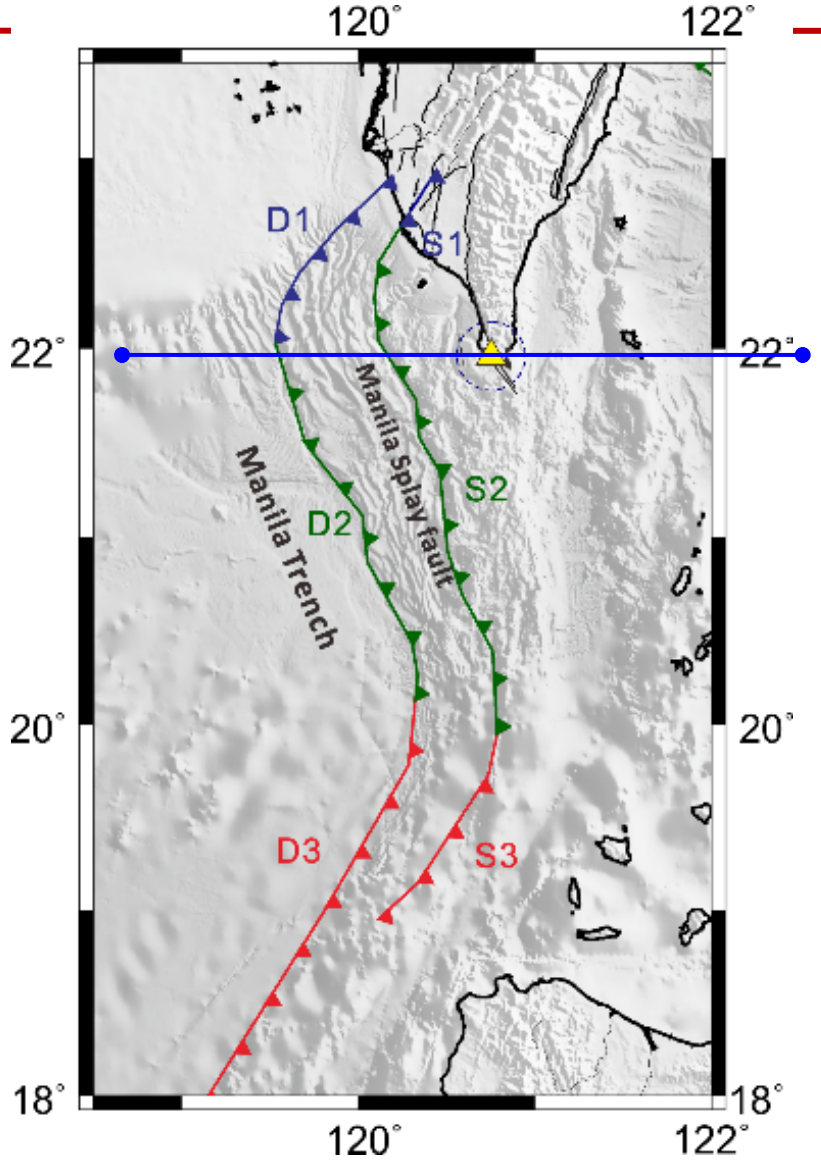


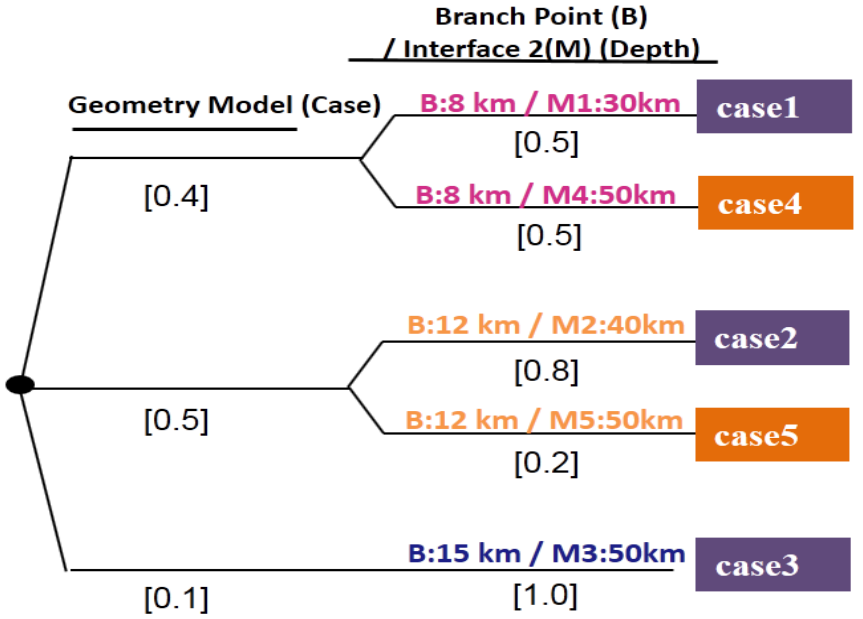
Case1, Case4

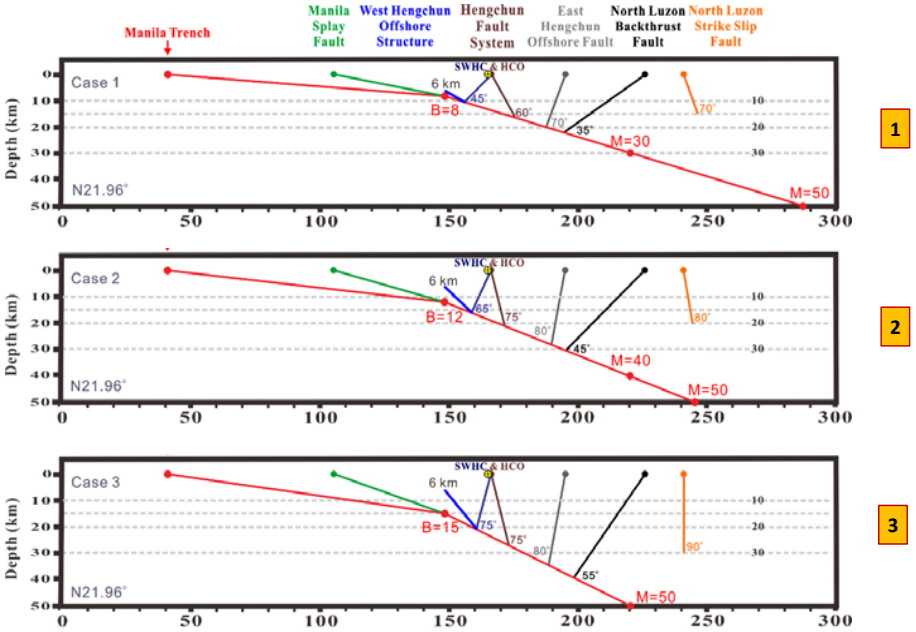


* Extend the interface of depth to 50 km, the rupture area and the maximum magnitude will increase.

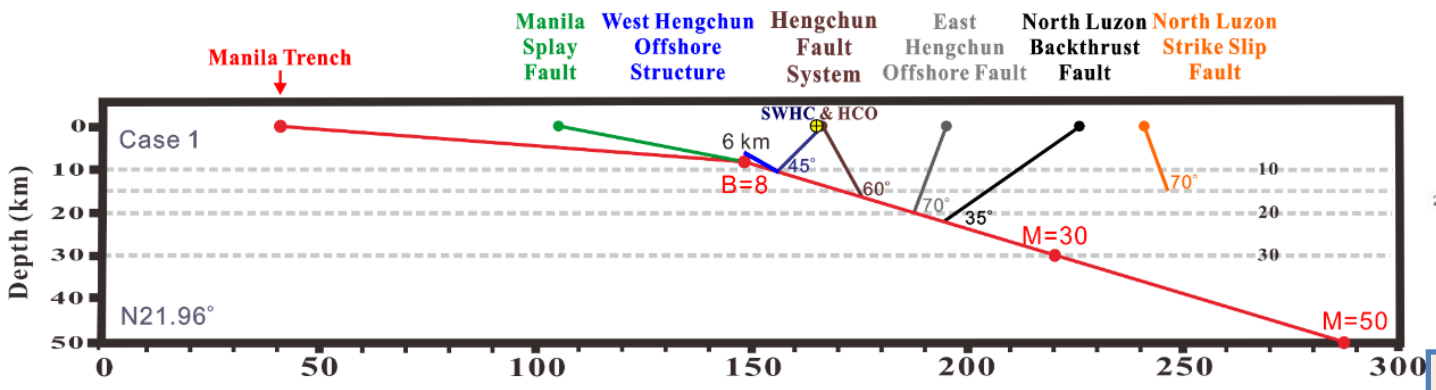
Manila subduction interface – Geometry Model

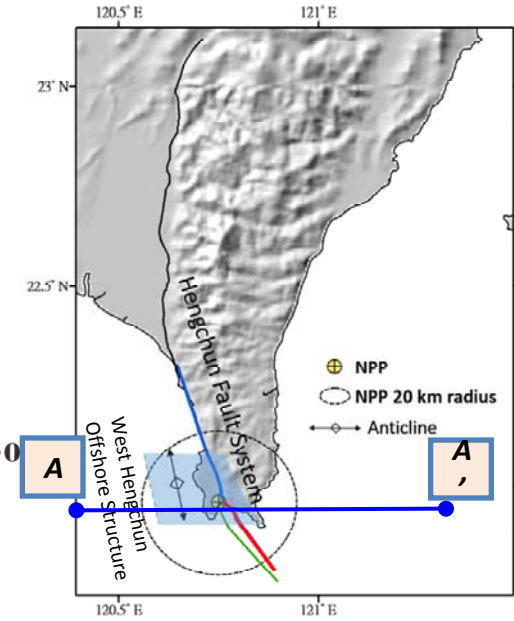






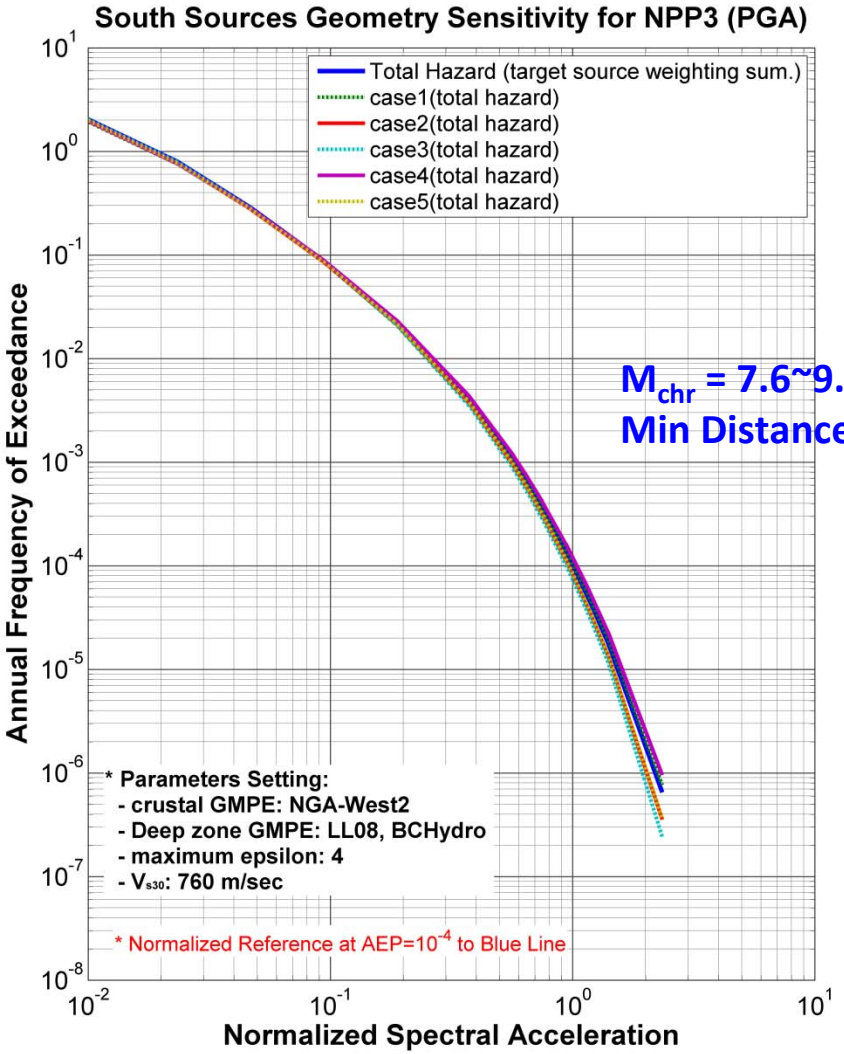
SSC Modeling in Southern Taiwan and the relative locations





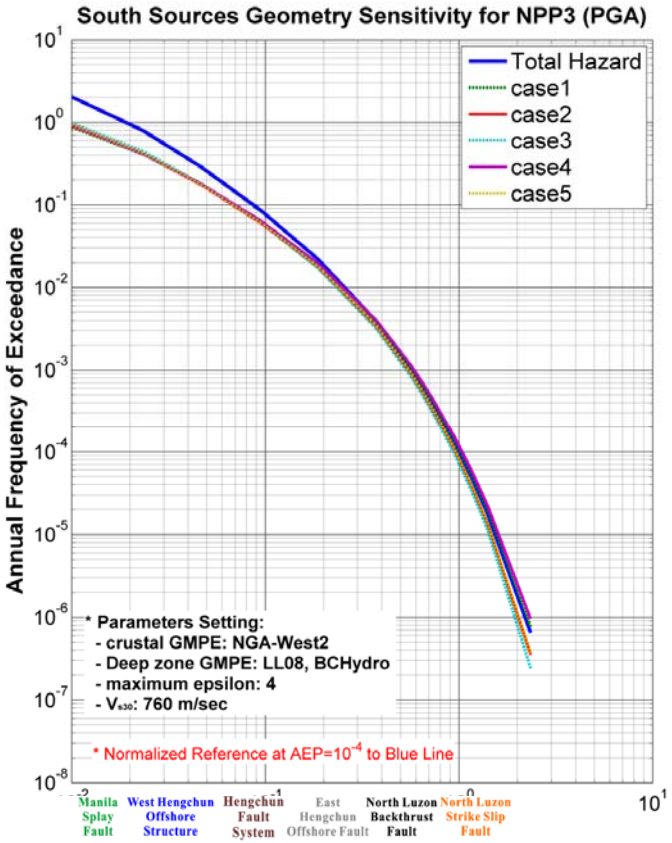
	Name	*Style of Faulting*	*Site*	*Location of NPP3*
Hengchun Fault System	Chaochou	Reverse	Eastward	Footwall
	Hengchun	Reverse	Eastward	Footwall
	Hengchun offshore	Reverse	Eastward	Footwall
	SW Hengchun	Reverse	Westward	**Hanging wall**
	West Hengchun Offshore Structure	Reverse	Eastward	**Hanging wall**

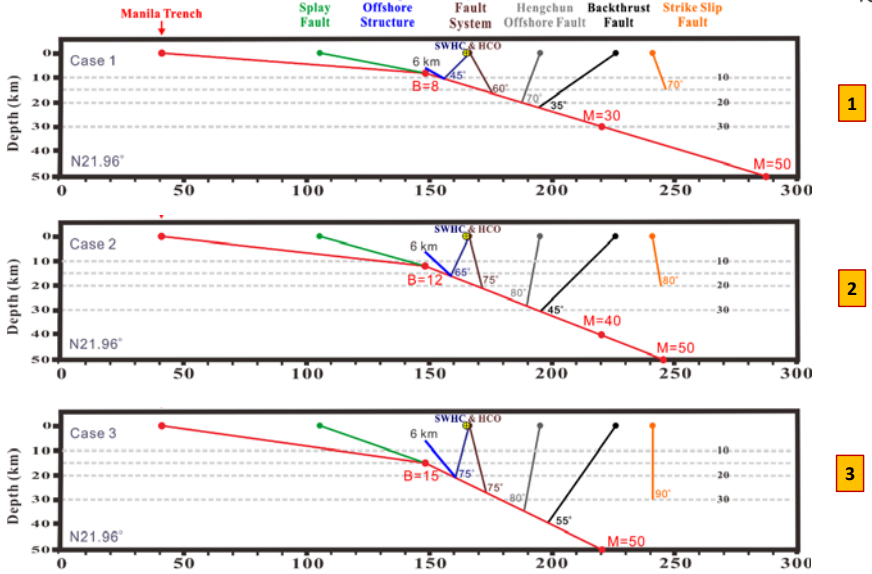
South sources geometry sensitivity for NPP3 (PGA)



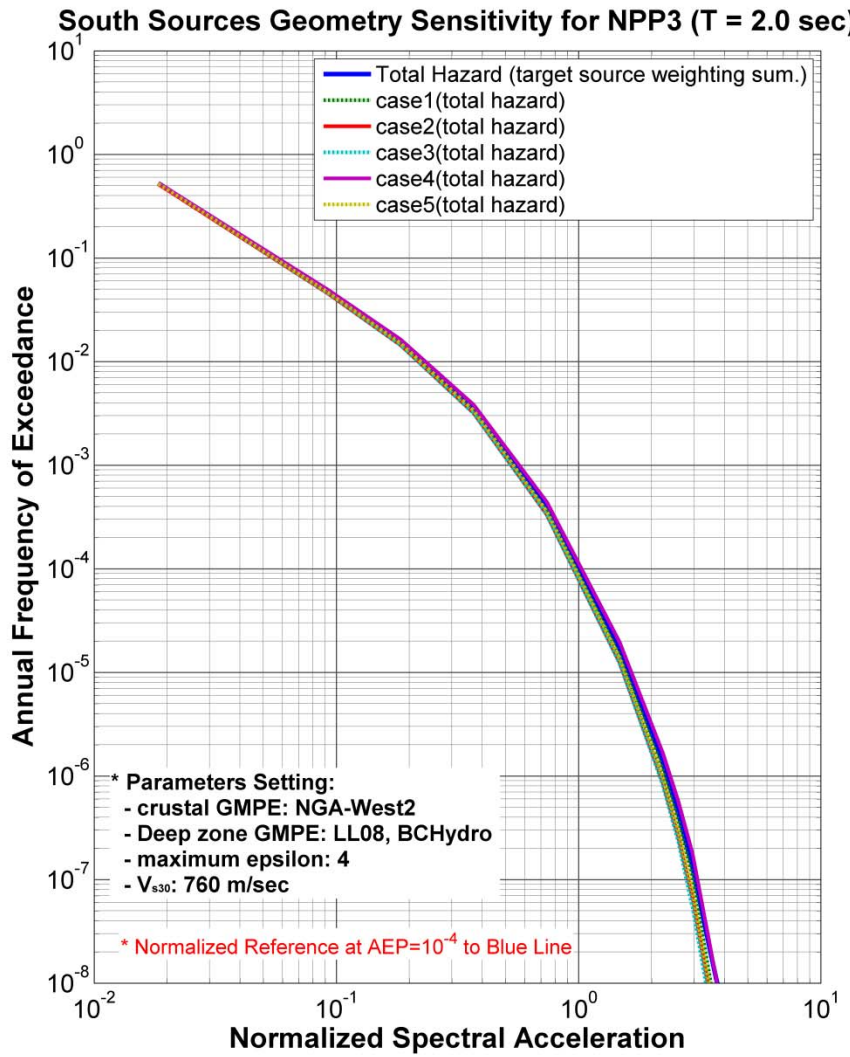
M_{chr} = 7.6~9.0

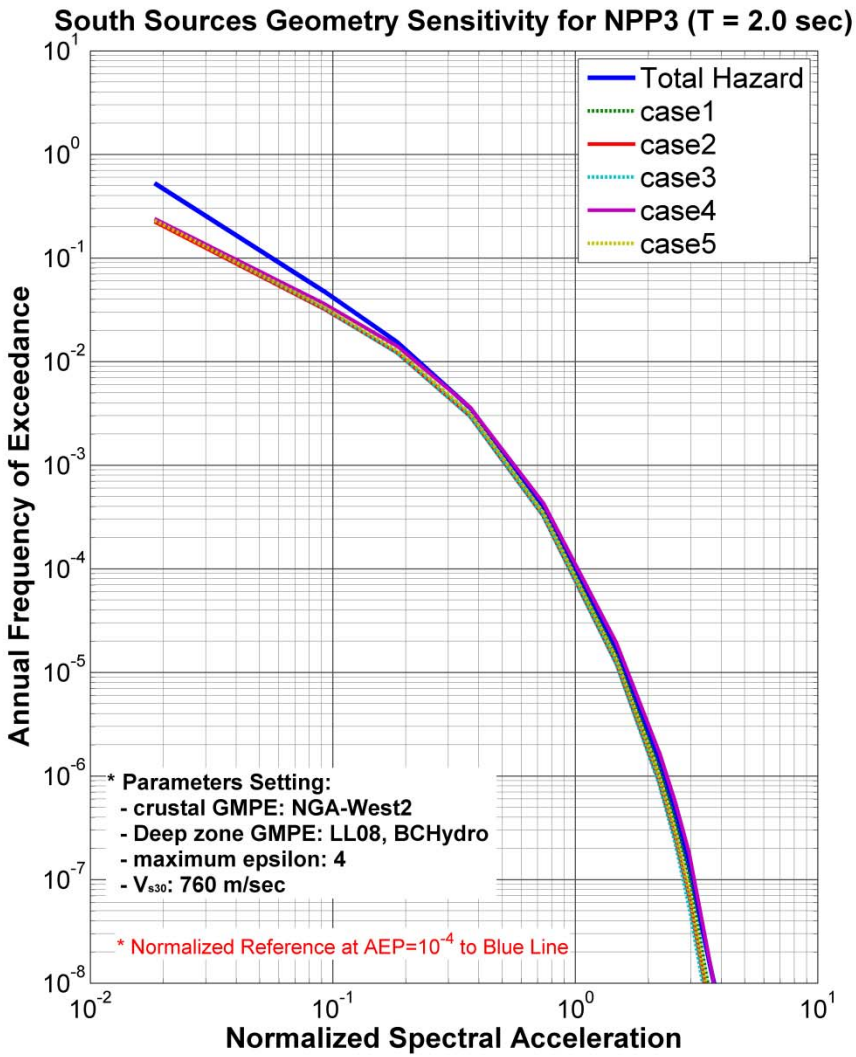
Min Distance = 12.5~22.9



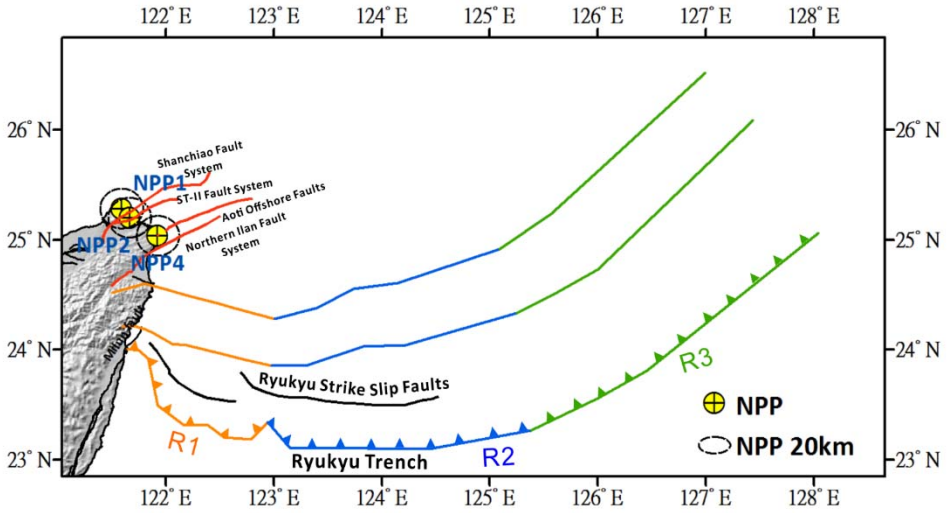


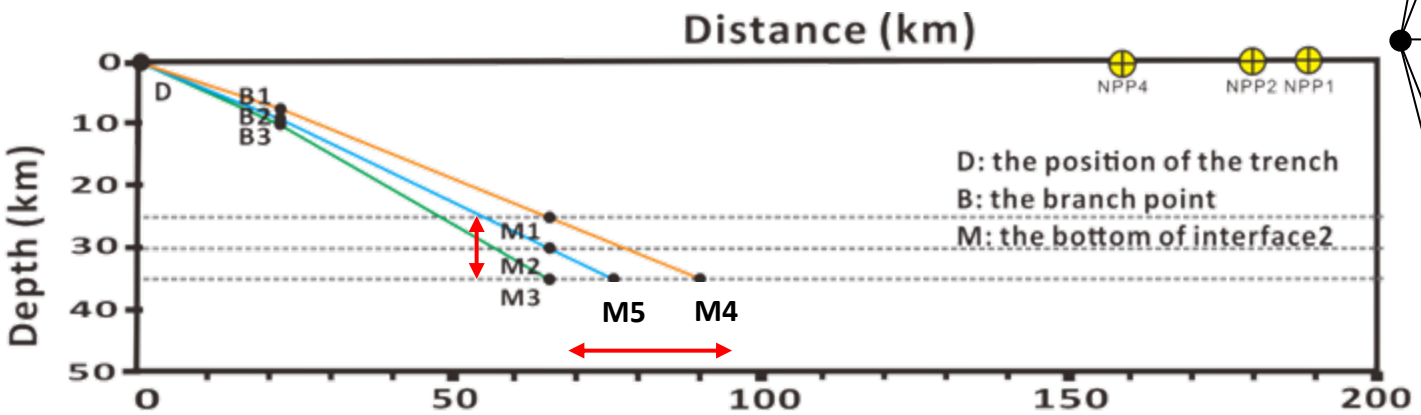
South sources geometry sensitivity for NPP3 (T=2.0s)





Ryukyu Subduction interface





Fault Geometry Model

Branch Point (B)/ Interface2 (M) (Depth)

B1:7.5 km / M1:25km

case1

B1:7.5 km / M4:35km

case4

B2:9km / M2:30km

case2

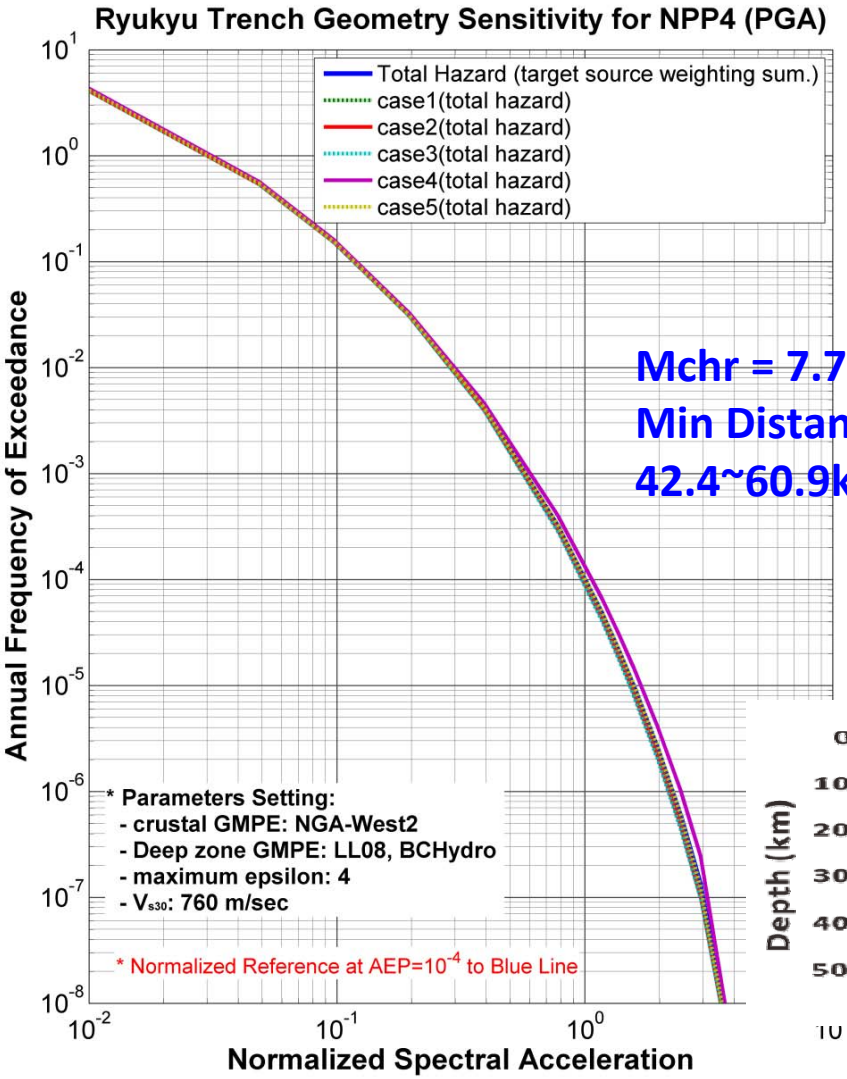
B2:9km / M5:35km

case5

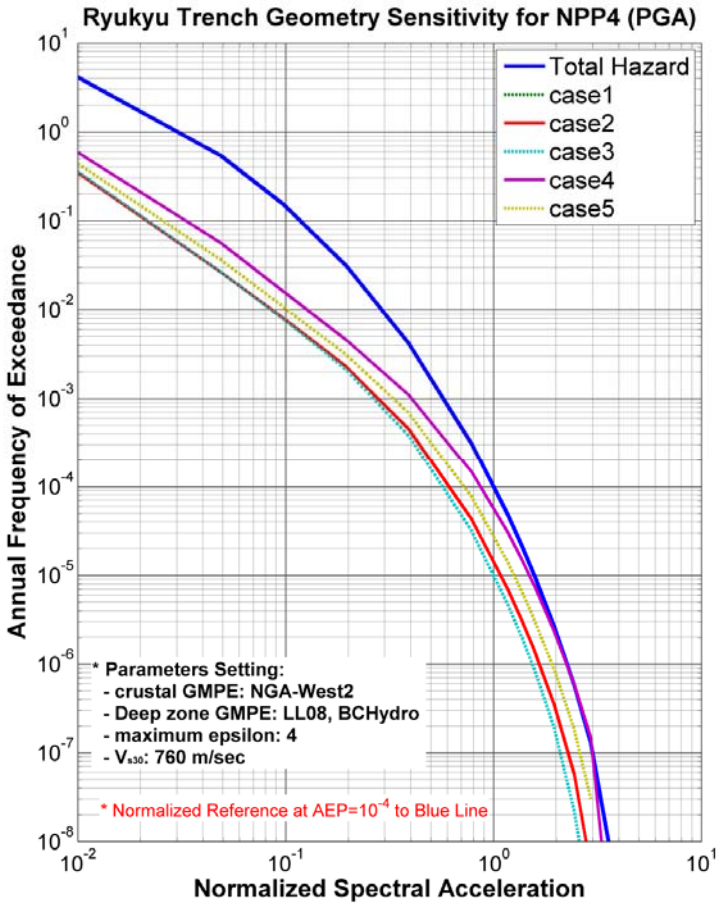
B3:10 km / M3:35km

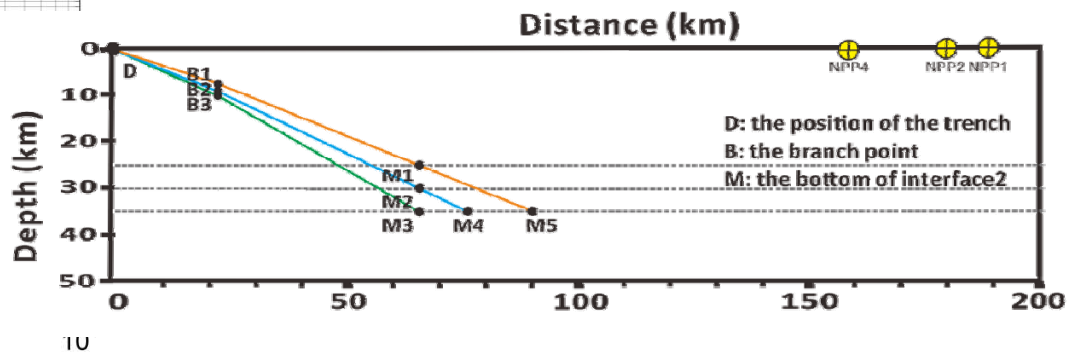
case3

Ryukyu Trench geometry sensitivity for NPP4 (PGA)

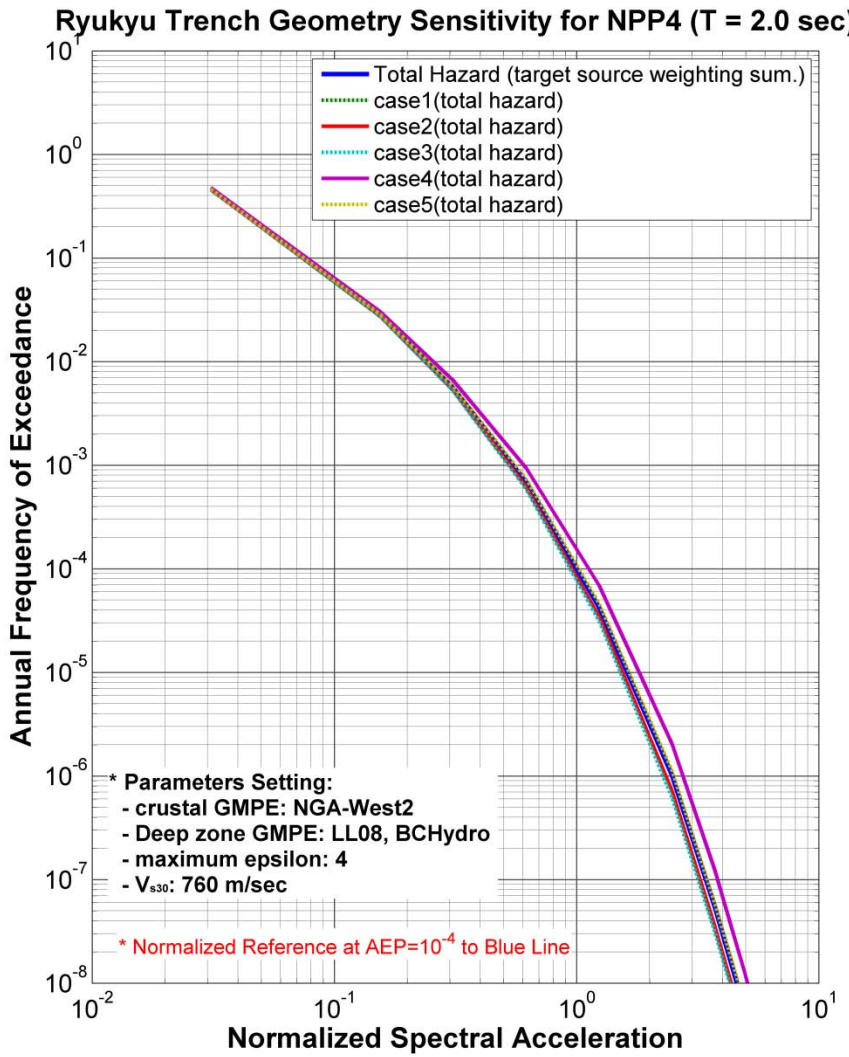


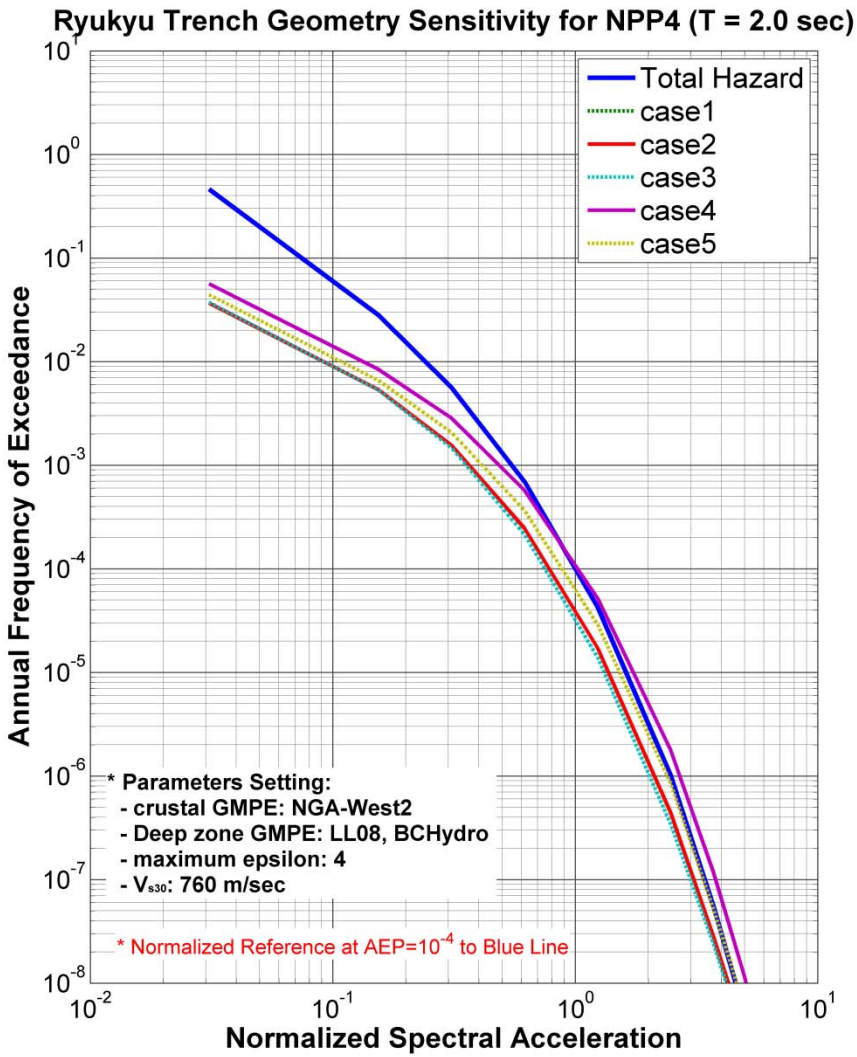
Mchr = 7.7~9.2
Min Distance = 42.4~60.9km





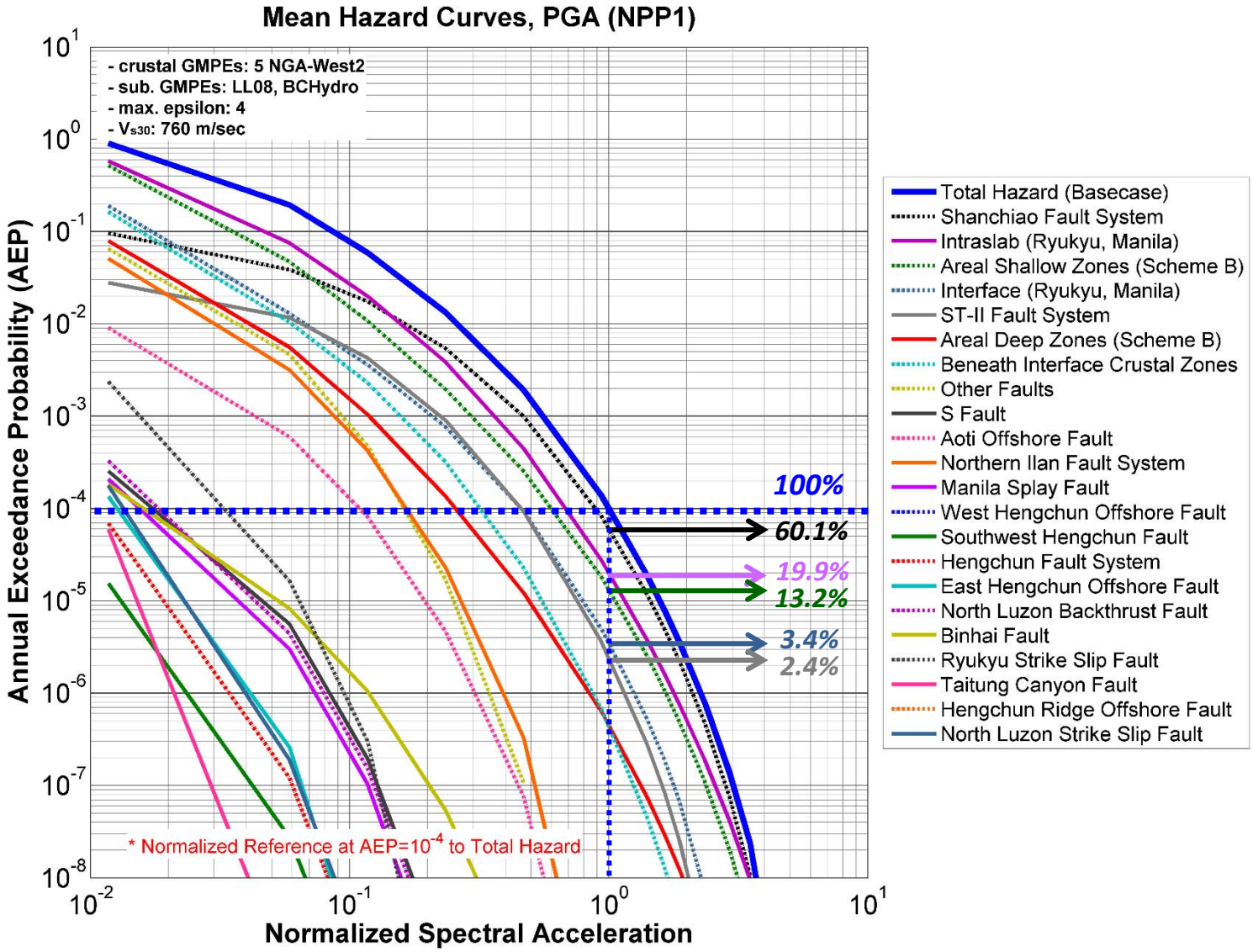
Ryukyu Trench geometry sensitivity for NPP4 (T=2.0s)





HAZARD CONTRIBUTION FROM EACH SOURCE FOR NPPS

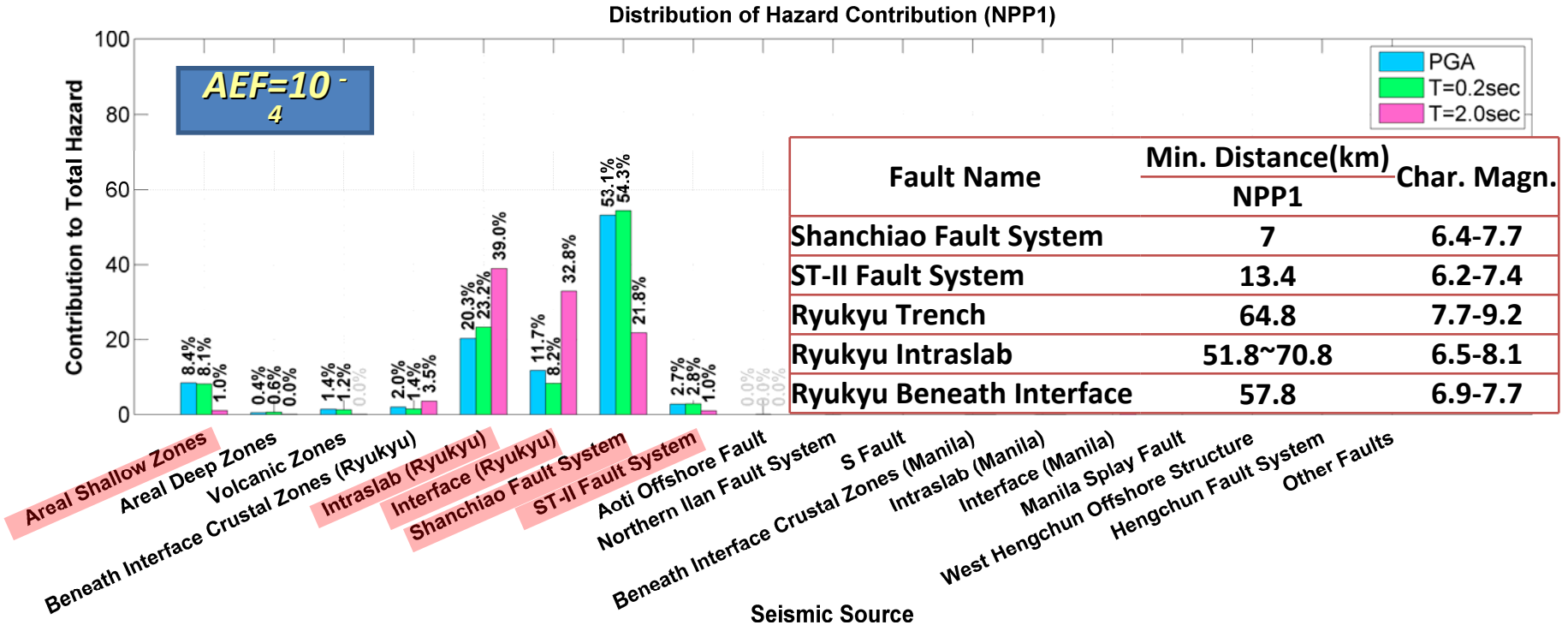
SSC Sensitivity
Hazard Curves



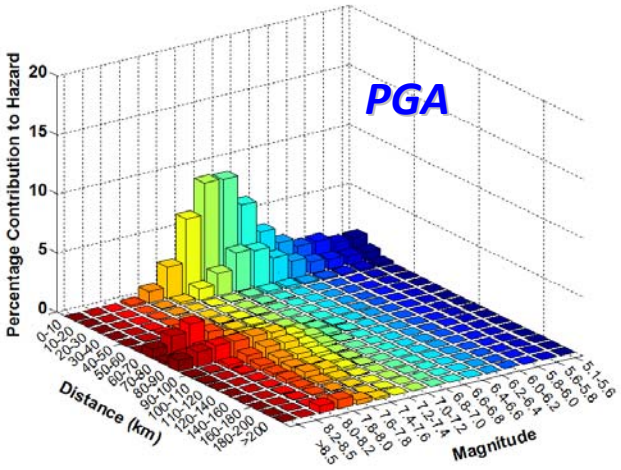
Hazard Contribution @WS#3

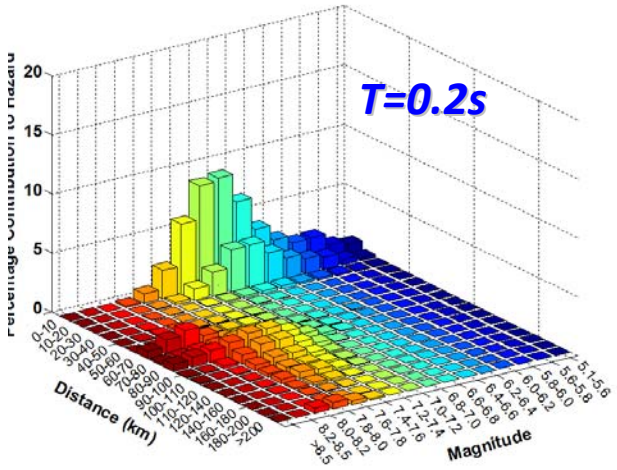
THE FOUR NPP SITES IN TAIWAN

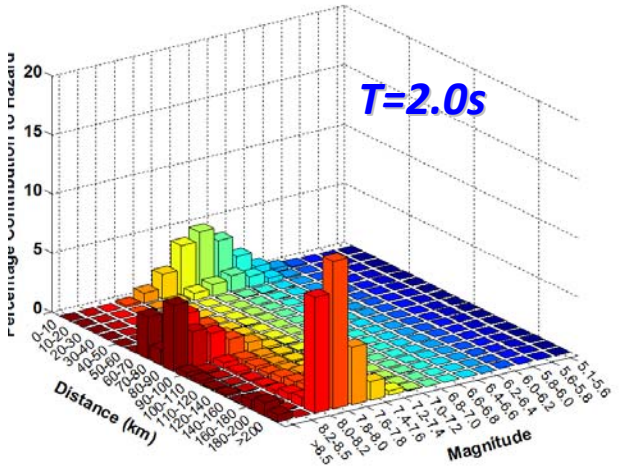
Distribution of Hazard Contribution (NPP1)



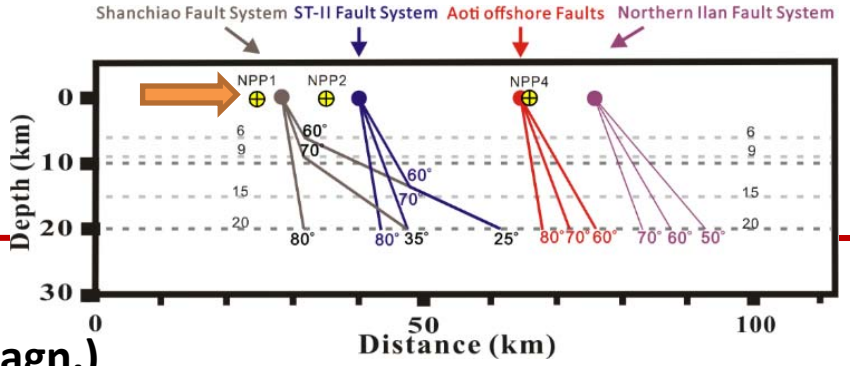
Fault Name	Min. Distance(km) NPP1	Char. Magn.
Shanchiao Fault System	7	6.4-7.7
ST-II Fault System	13.4	6.2-7.4
Ryukyu Trench	64.8	7.7-9.2
Ryukyu Intraslab	51.8~70.8	6.5-8.1
Ryukyu Beneath Interface	57.8	6.9-7.7



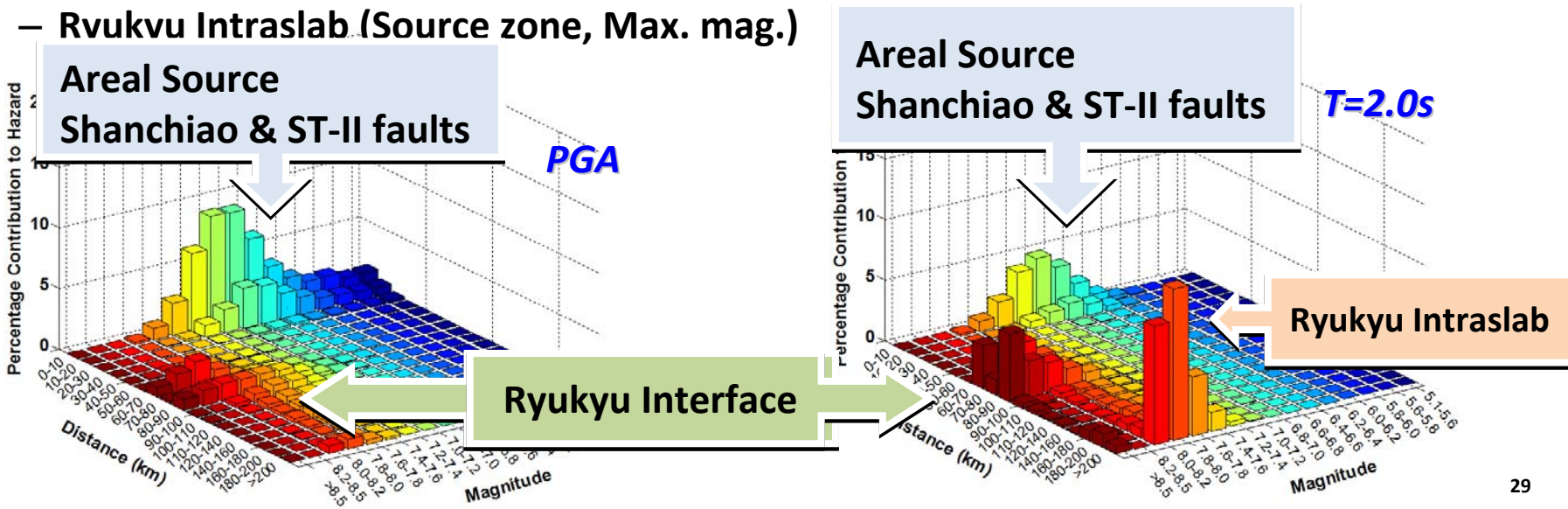




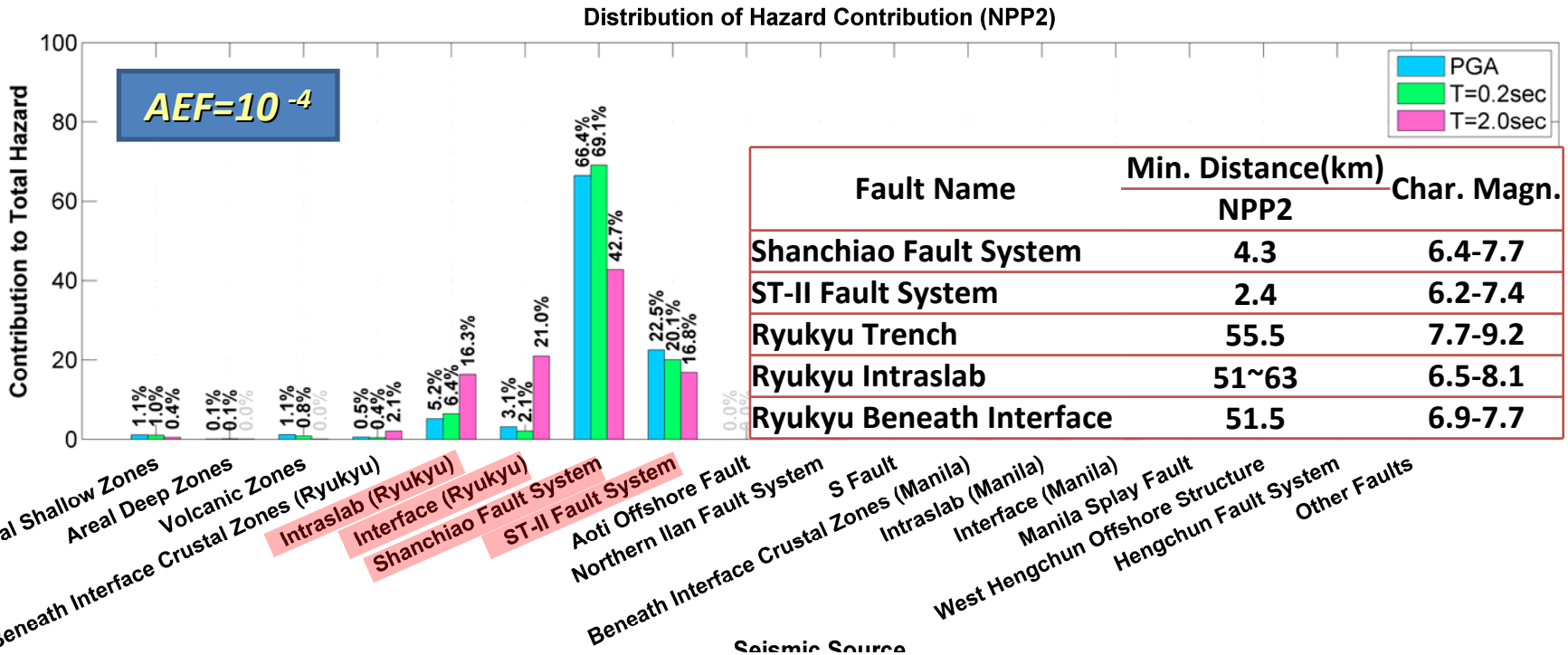
Main Sensitivity Parameters of controlling earthquake NPP



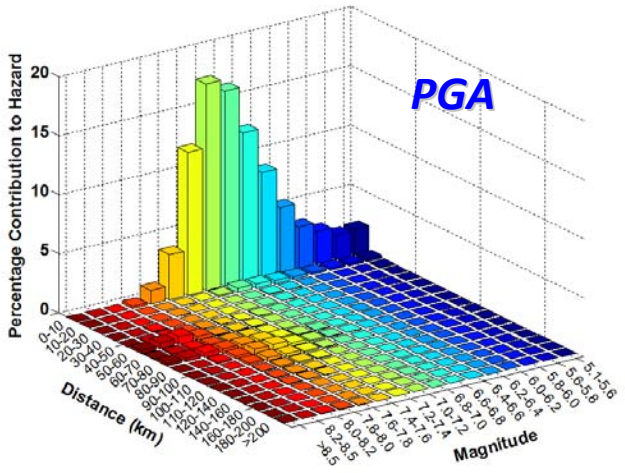
- **For PGA**
  - Primary faults (Geometry, Slip rate, Max. magn.)
  - Areal Source Zone (Activity rate, Max. magn.)
  - Ryukyu Interface (Geometry, Slip rate, Max. magn.)
  - Ryukyu Intraslab (Source zone, Max. mag.)
- **For T=2.0s**
  - Primary faults (Slip rate, Max. magn.)
  - Ryukyu Interface (Geometry, Slip rate, Max. magn.)
  - Ryukyu Intraslab (Source zone, Max. mag.)

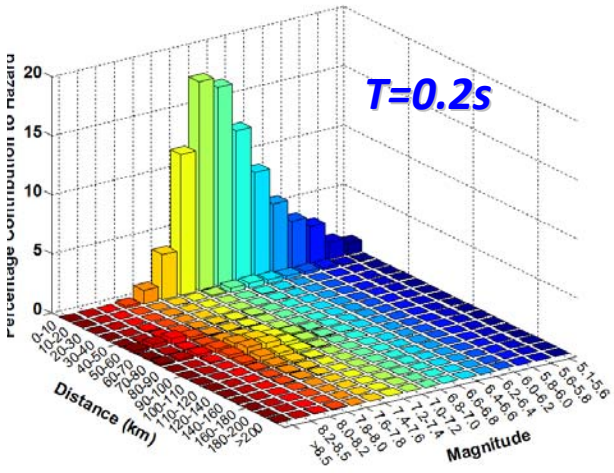


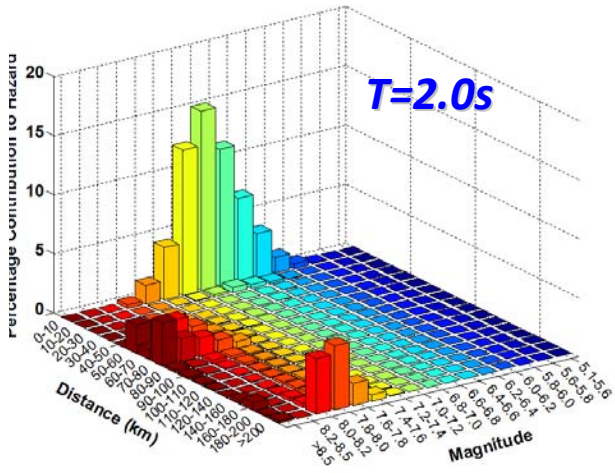
Distribution of Hazard Contribution (NPP2)



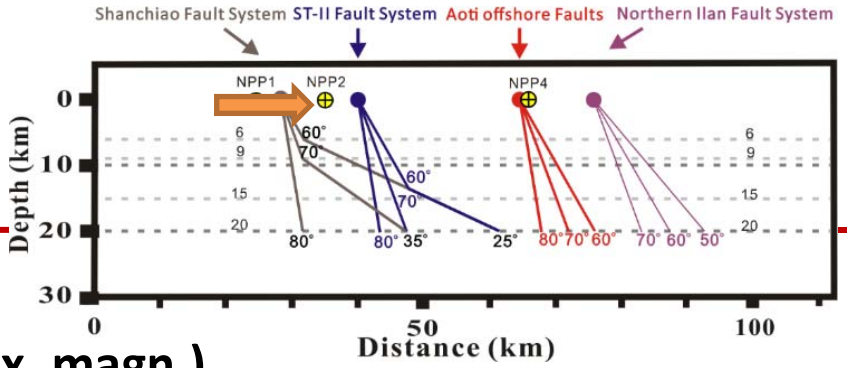
Fault Name	Min. Distance(km) NPP2	Char. Magn.
Shanchiao Fault System	4.3	6.4-7.7
ST-II Fault System	2.4	6.2-7.4
Ryukyu Trench	55.5	7.7-9.2
Ryukyu Intraslab	51~63	6.5-8.1
Ryukyu Beneath Interface	51.5	6.9-7.7



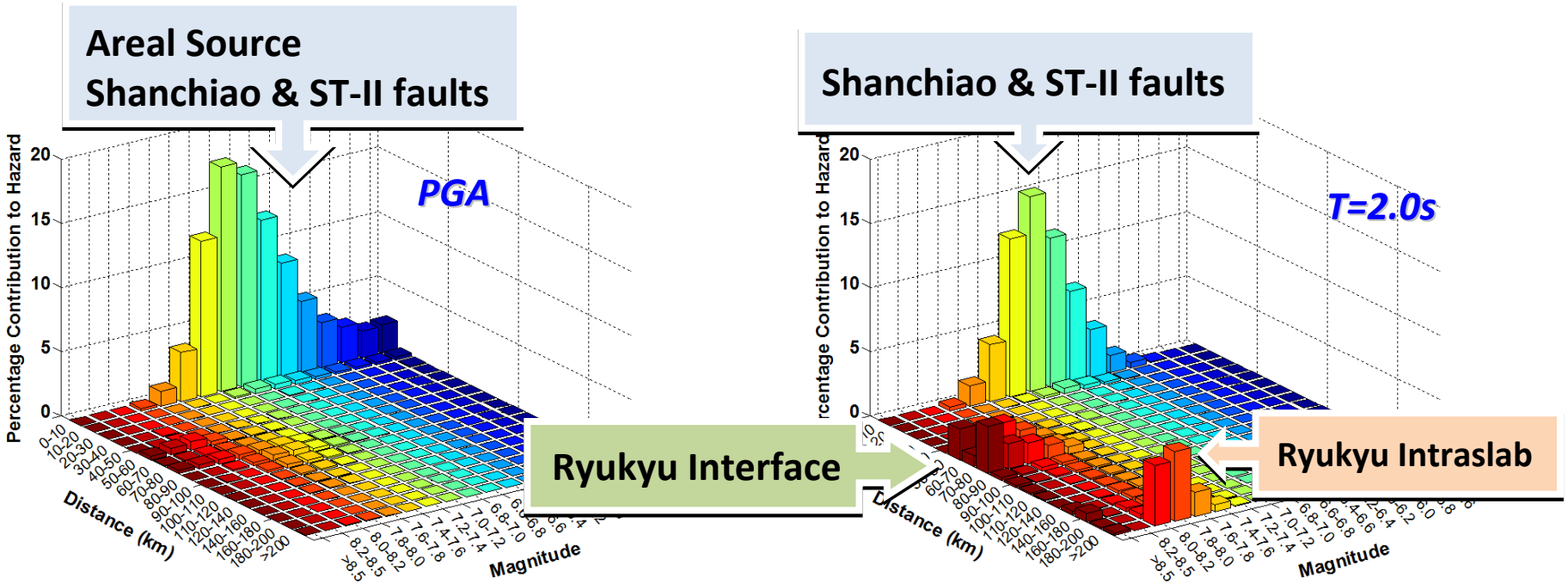




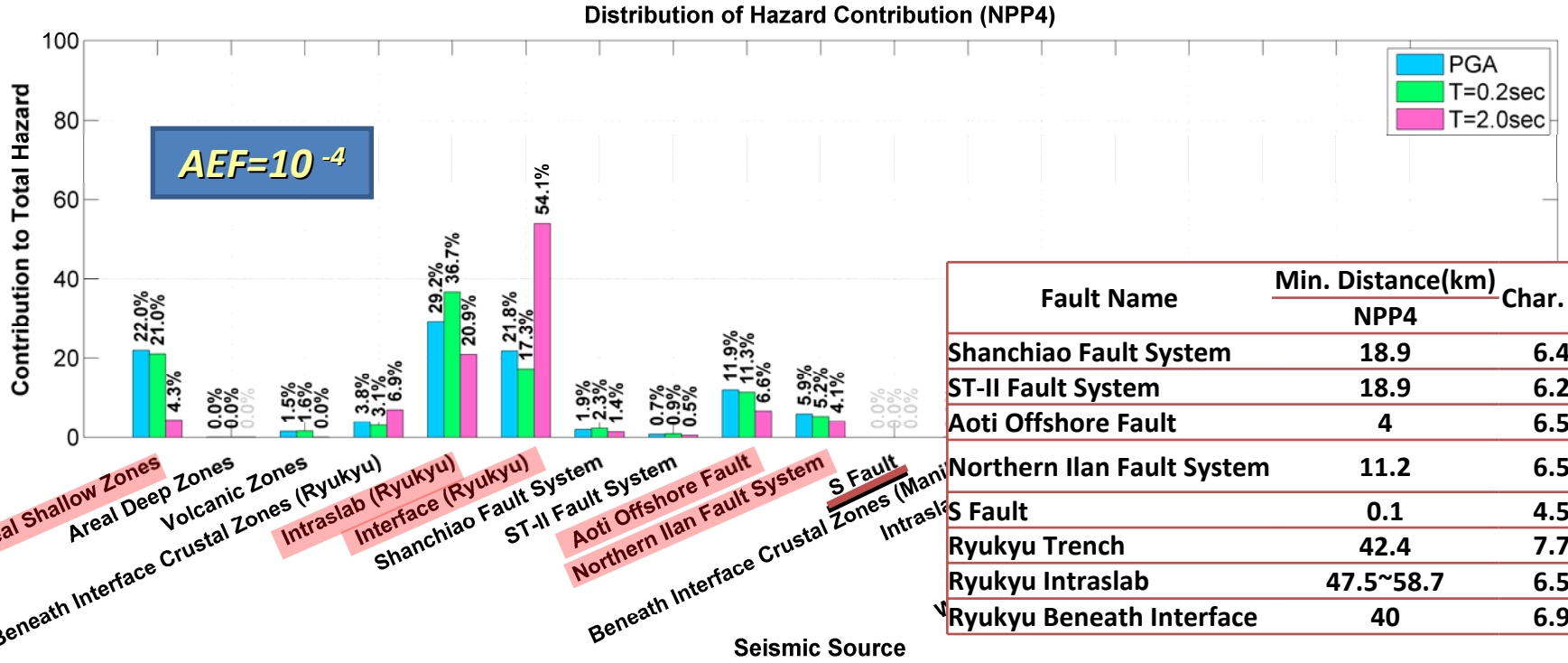
Main Sensitivity Parameters of controlling earthquake NPP 2



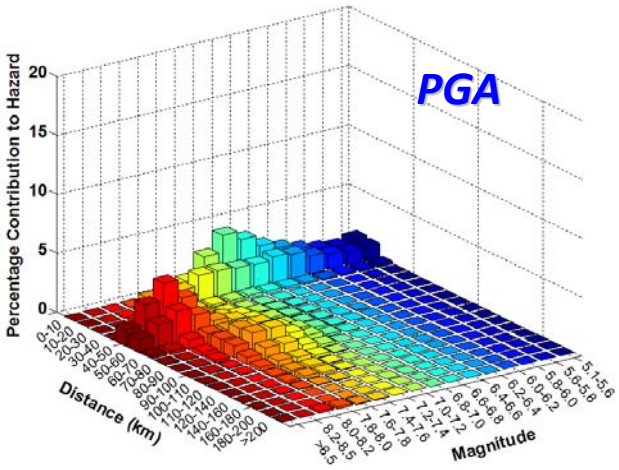
- **For PGA**
  - Primary faults (Geometry, Slip rate, Max. magn.)
- **For T=2.0s**
  - Primary faults (Geometry, Slip rate, Max. magn.)
  - Ryukyu Interface (Geometry, Slip rate, Max. magn.)
  - Ryukyu Intraslab (Max. mag.)

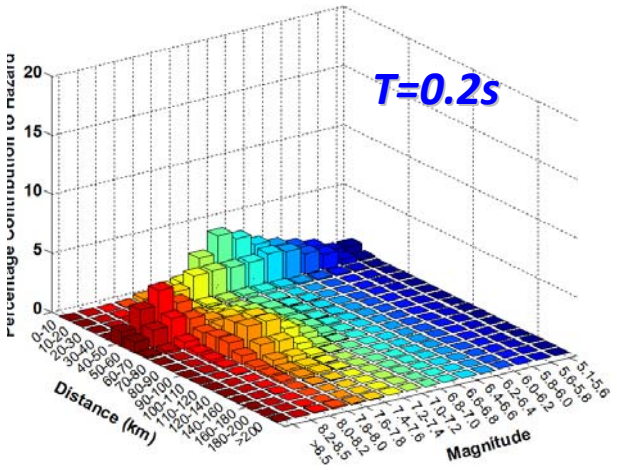


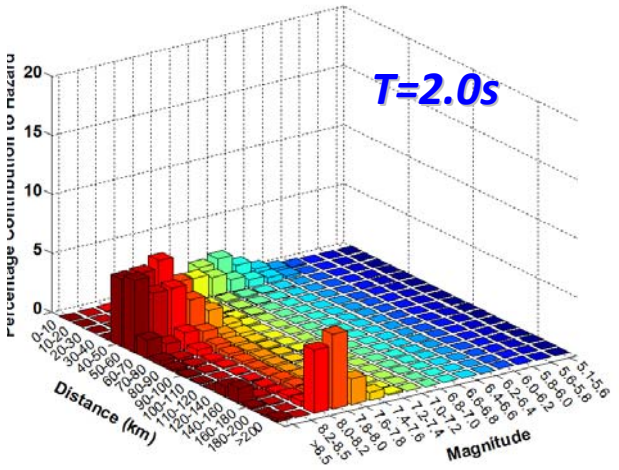
Distribution of Hazard Contribution (NPP4)



Fault Name	Min. Distance(km) NPP4	Char. Magn.
Shanchiao Fault System	18.9	6.4-7.7
ST-II Fault System	18.9	6.2-7.4
Aoti Offshore Fault	4	6.5-7.5
Northern Ilan Fault System	11.2	6.5-7.6
S Fault	0.1	4.5-5.6
Ryukyu Trench	42.4	7.7-9.2
Ryukyu Intraslab	47.5~58.7	6.5-8.1
Ryukyu Beneath Interface	40	6.9-7.7



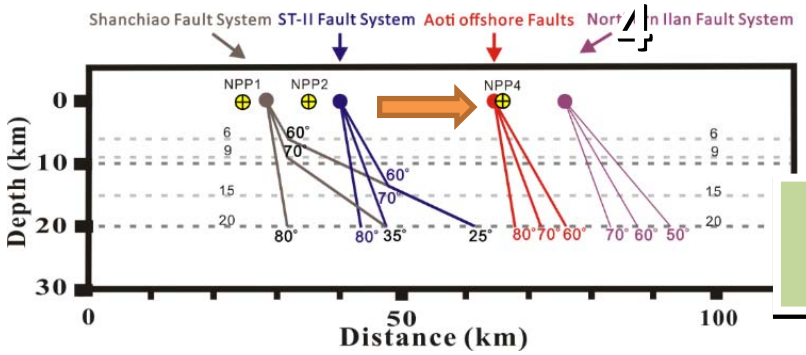


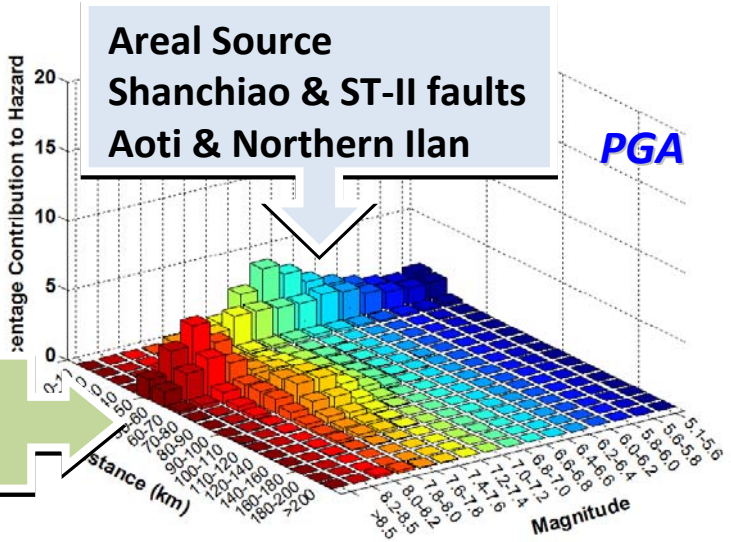


Main Sensitivity Parameters

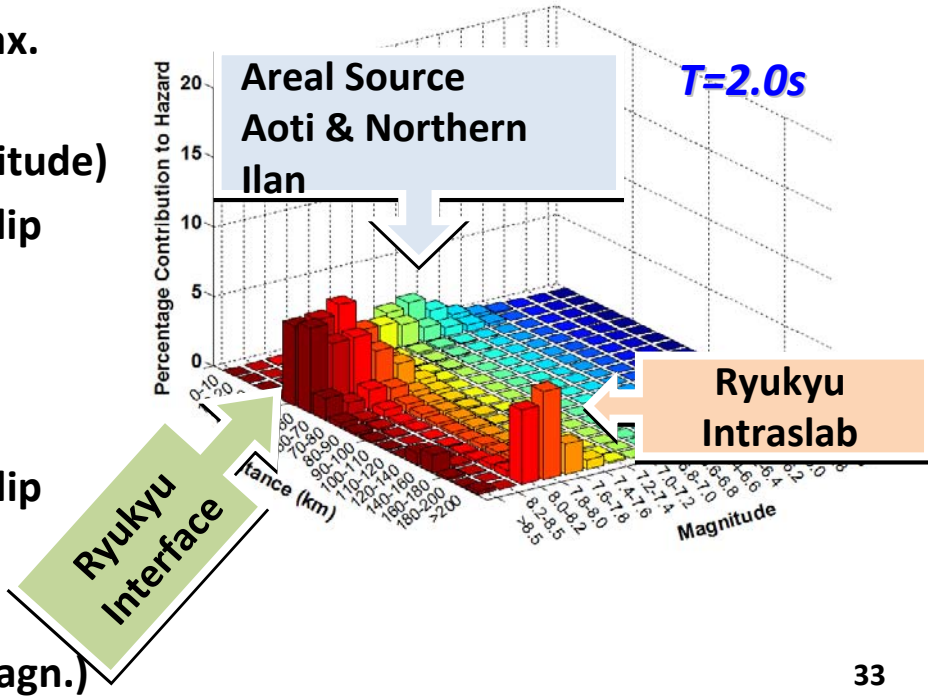
of controlling earthquake (NPP4)

NPP



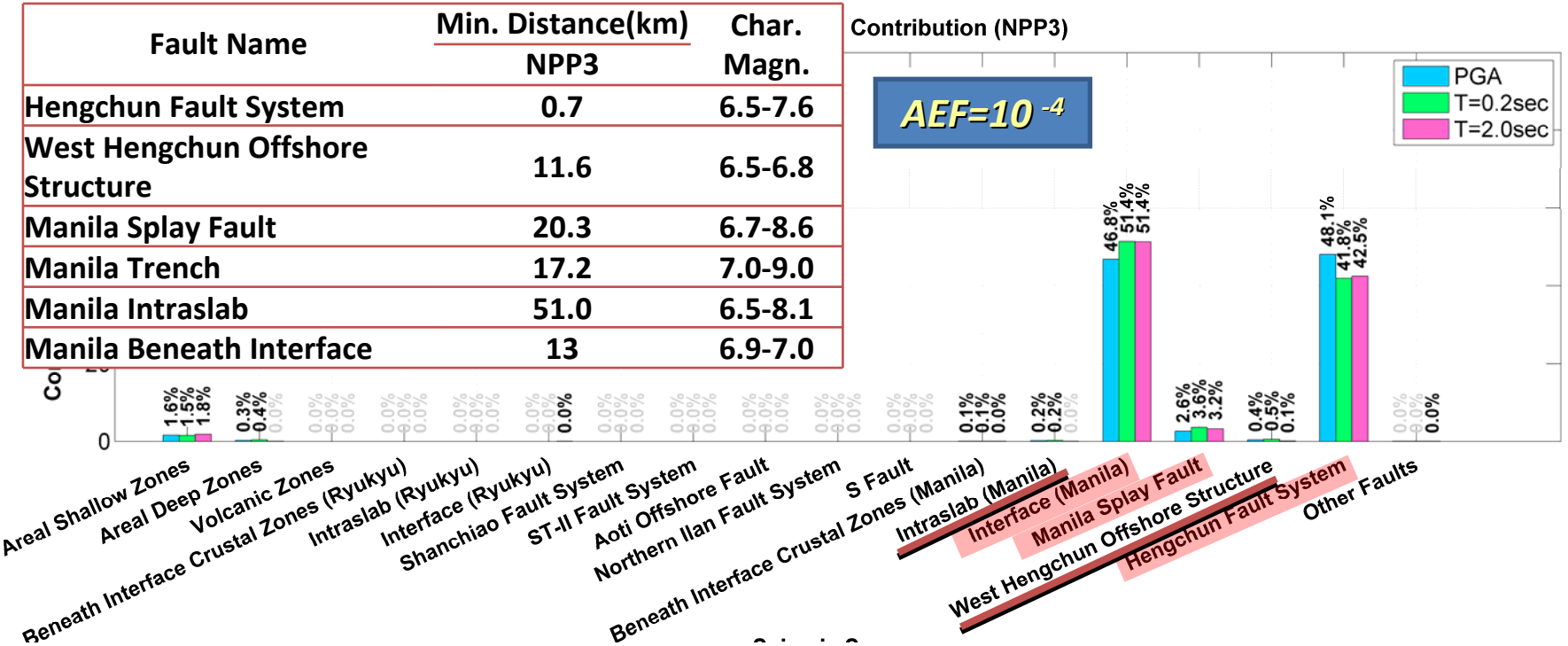


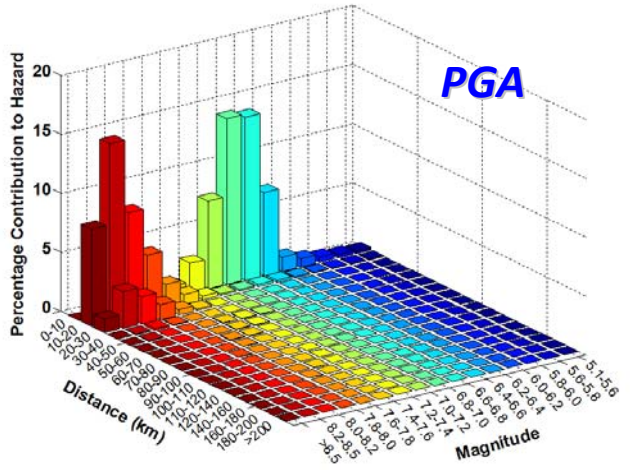
- **For PGA**
  - Primary faults (Slip rate, Geometry(Dip), Max. magn.)
  - Areal Source Zone(Activity rate, Max. Magnitude)
  - Ryukyu Interface (Geometry, Max. magn., Slip rate,)
  - Ryukyu Intraslab (Source Zone, Max. mag.)
- **For T=2.0s**
  - Ryukyu Interface (Geometry, Max. magn., Slip rate)
  - Ryukyu Intraslab (Source Zone, Max. mag.)
  - Primary faults (Slip rate, Geometry, Max. magn.)

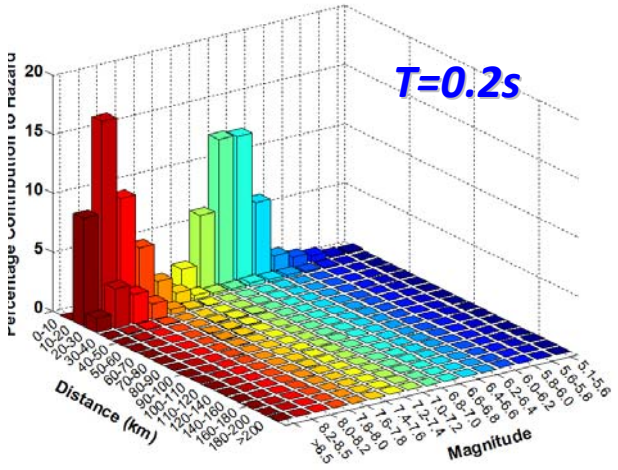


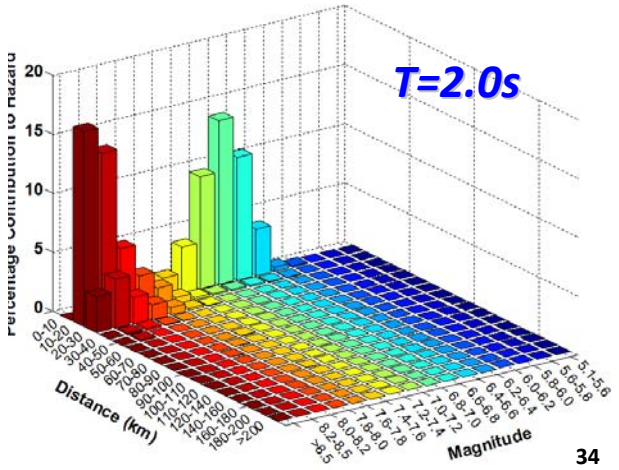
Distribution of Hazard Contribution (NPP3)

Fault Name	Min. Distance(km) NPP3	Char. Magn.
Hengchun Fault System	0.7	6.5-7.6
West Hengchun Offshore Structure	11.6	6.5-6.8
Manila Splay Fault	20.3	6.7-8.6
Manila Trench	17.2	7.0-9.0
Manila Intraslab	51.0	6.5-8.1
Manila Beneath Interface	13	6.9-7.0

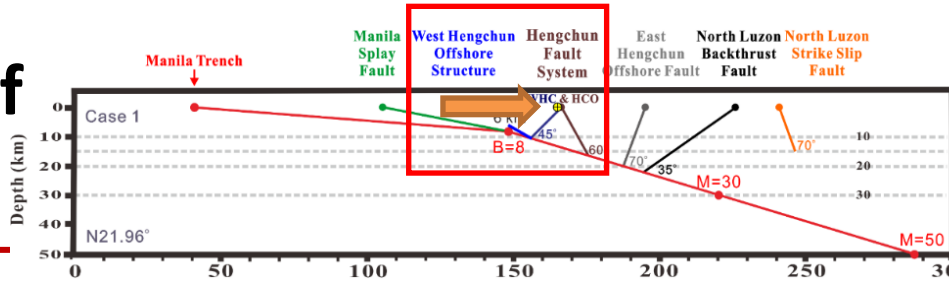








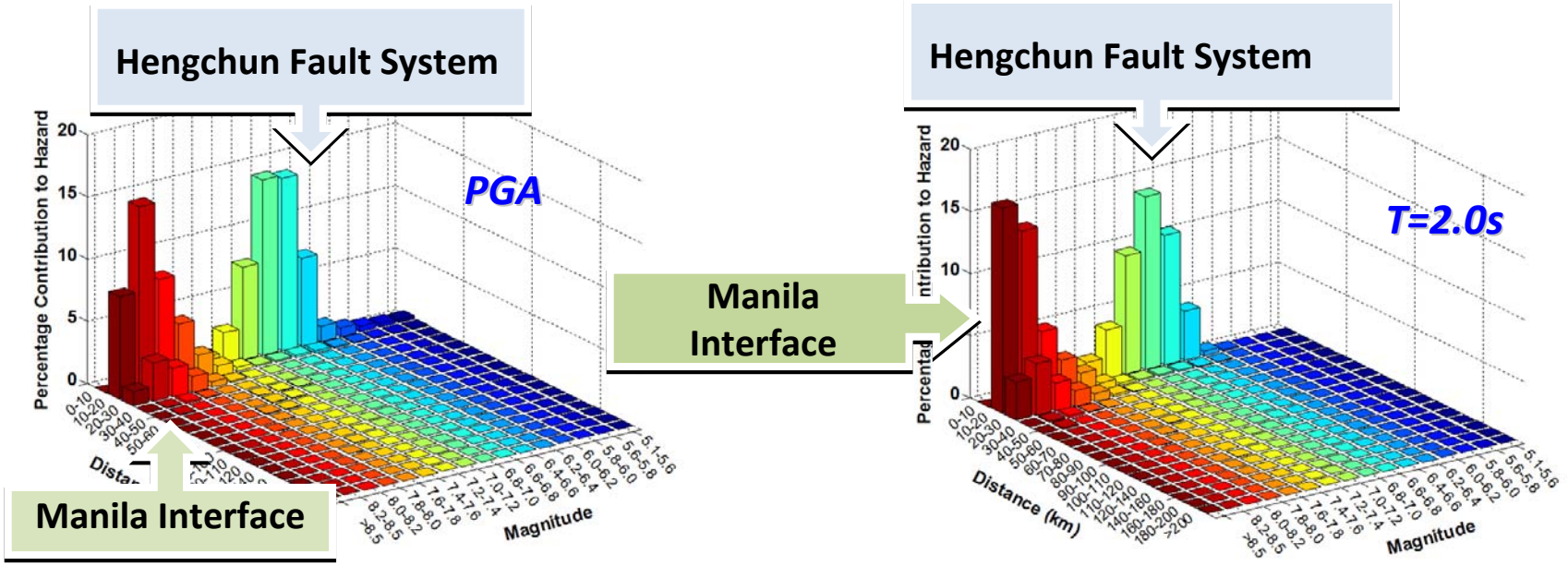
Main Sensitivity Parameters of controlling earthquake



- **For PGA**
  - Primary faults (Slip rate, Geometry(Dip), Max. magn.)
  - Manila Interface (Geometry, Max. magn., Slip rate)
- **For T=2.0s**
  - Manila faults (Slip rate, Geometry, Max. magn.)
  - Manila Interface (Geometry, Max. magn., Slip rate)

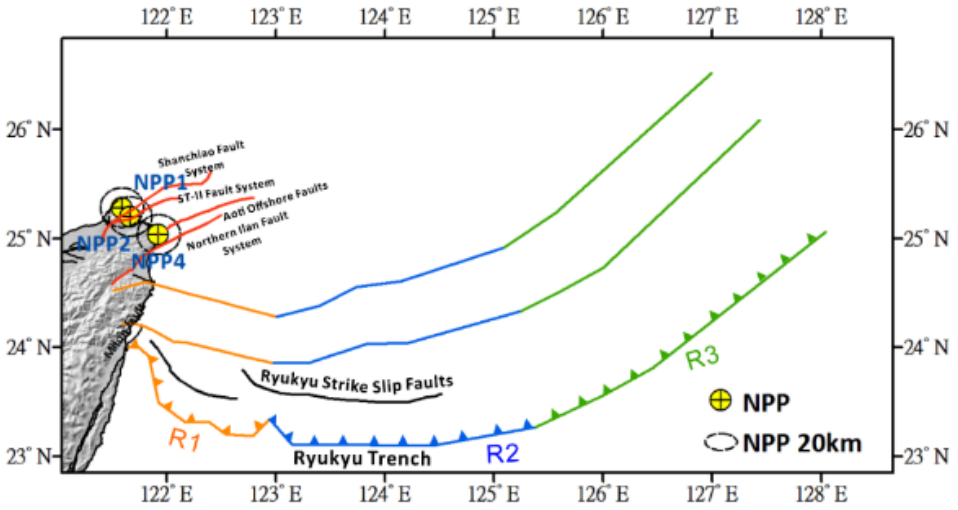
NPP

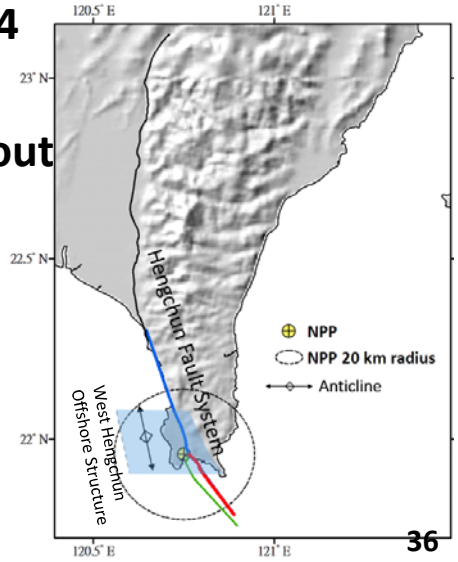
3



Summary: The most contributing source for NPP sites

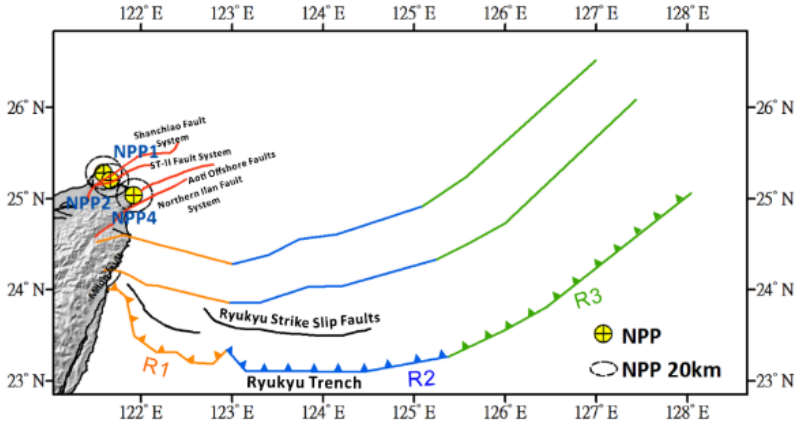
- **For NPP1 and 2**
  - Shanchiao and ST-II Fault
  - Ryukyu Interface
  - Areal Source
- **For NPP4**
  - Areal Source
  - Ryukyu Interface
  - Ryukyu Intraslab
  - The hazard contribution from Aoti and North Ilan faults for NPP4 is about 20%(PGA)
  - The hazard contribution from S, Shanchiao and ST-II faults is about 3%(PGA)
- **For NPP3**
  - Hengchun Fault System
  - Manila Interface

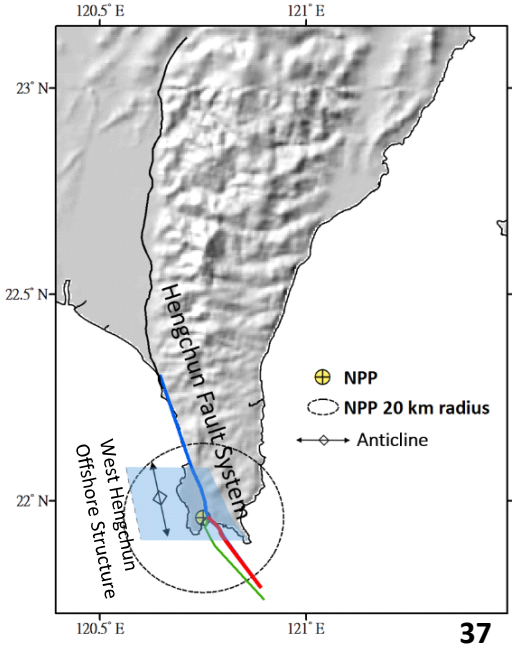




Summary: The main parameters of contributing source for NPP sites

- **Areal Source Zone**
  - Important for NPP1, NPP4
  - Parameters:
  - Zoning Scheme, Activity rate, Max. magn.
- **Primary faults**
  - NPP1 & NPP2 : Shanchiao and ST-II Fault
  - NPP3: Hengchun Fault System
  - Parameters:
    - Slip rate, Geometry, Max. magn.
- **Ryukyu Interface & intraslab**
  - Important for NPP1, 2 & NPP4
  - Geometry, Slip rate , Max. magn., Source zone of slab
- **Manila Interface**
  - Important for NPP3
  - Geometry, Slip rate , Max. magn.



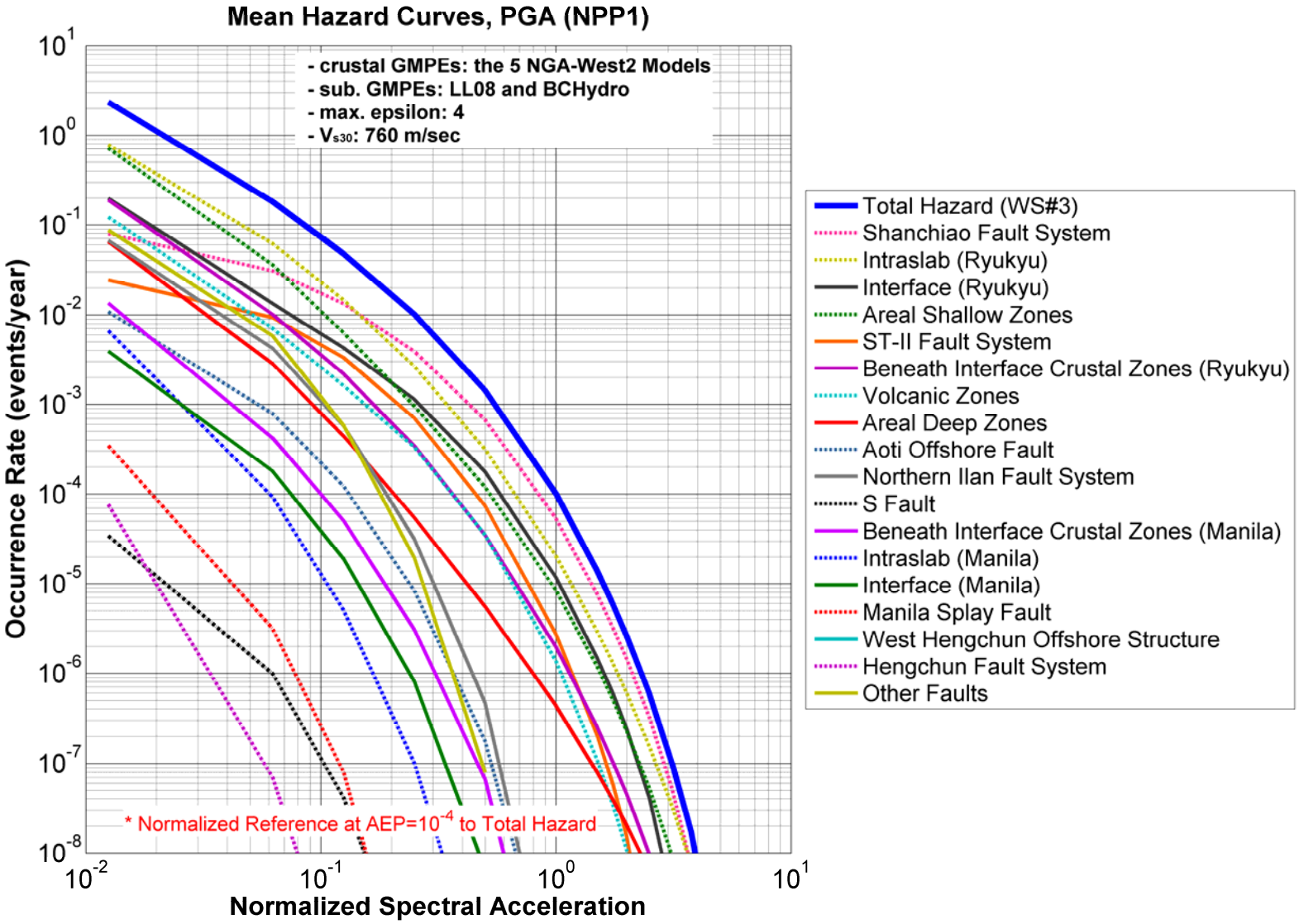


Thank You for Your Attention

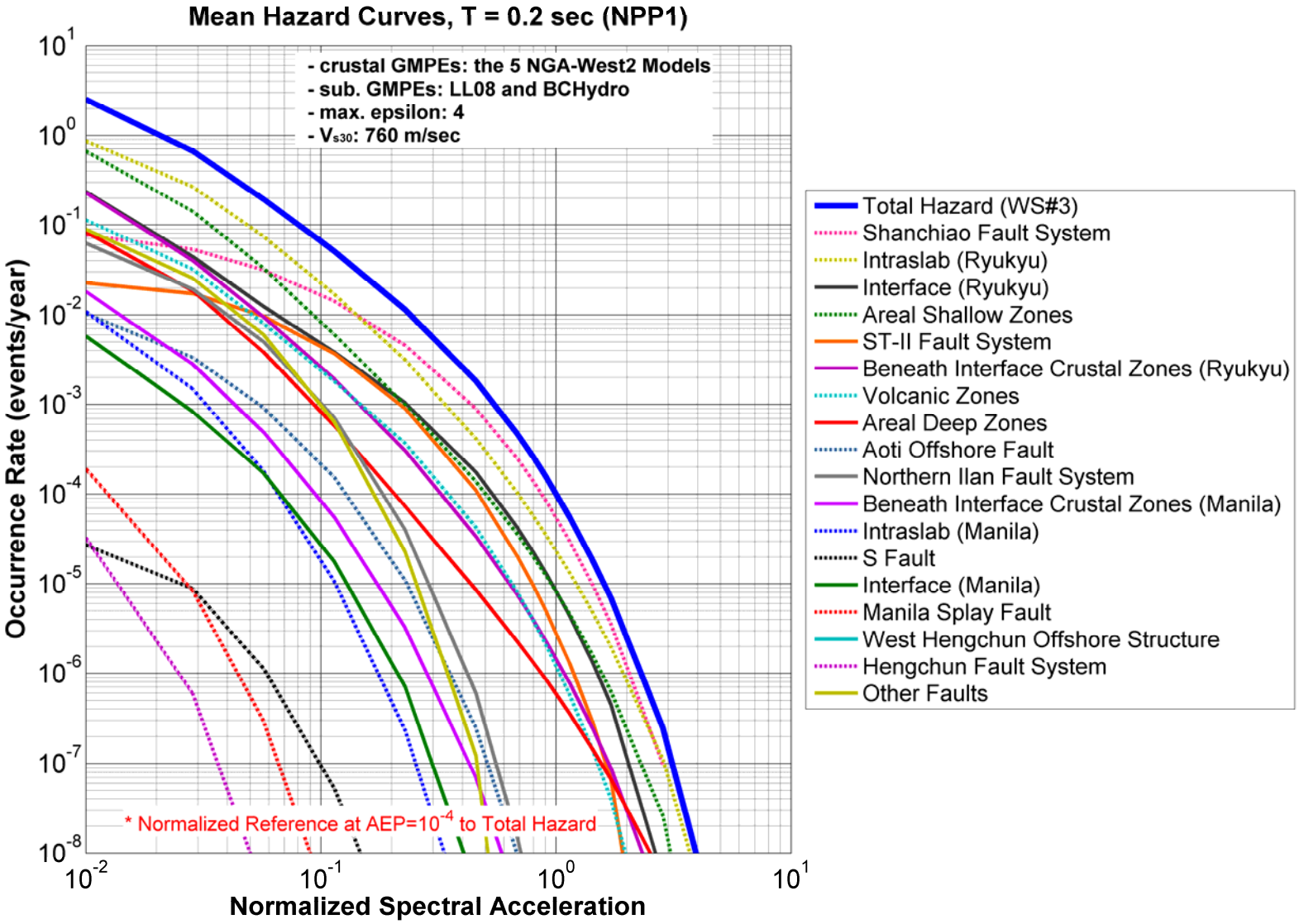
Hazard Curves @WS#3

NPP1

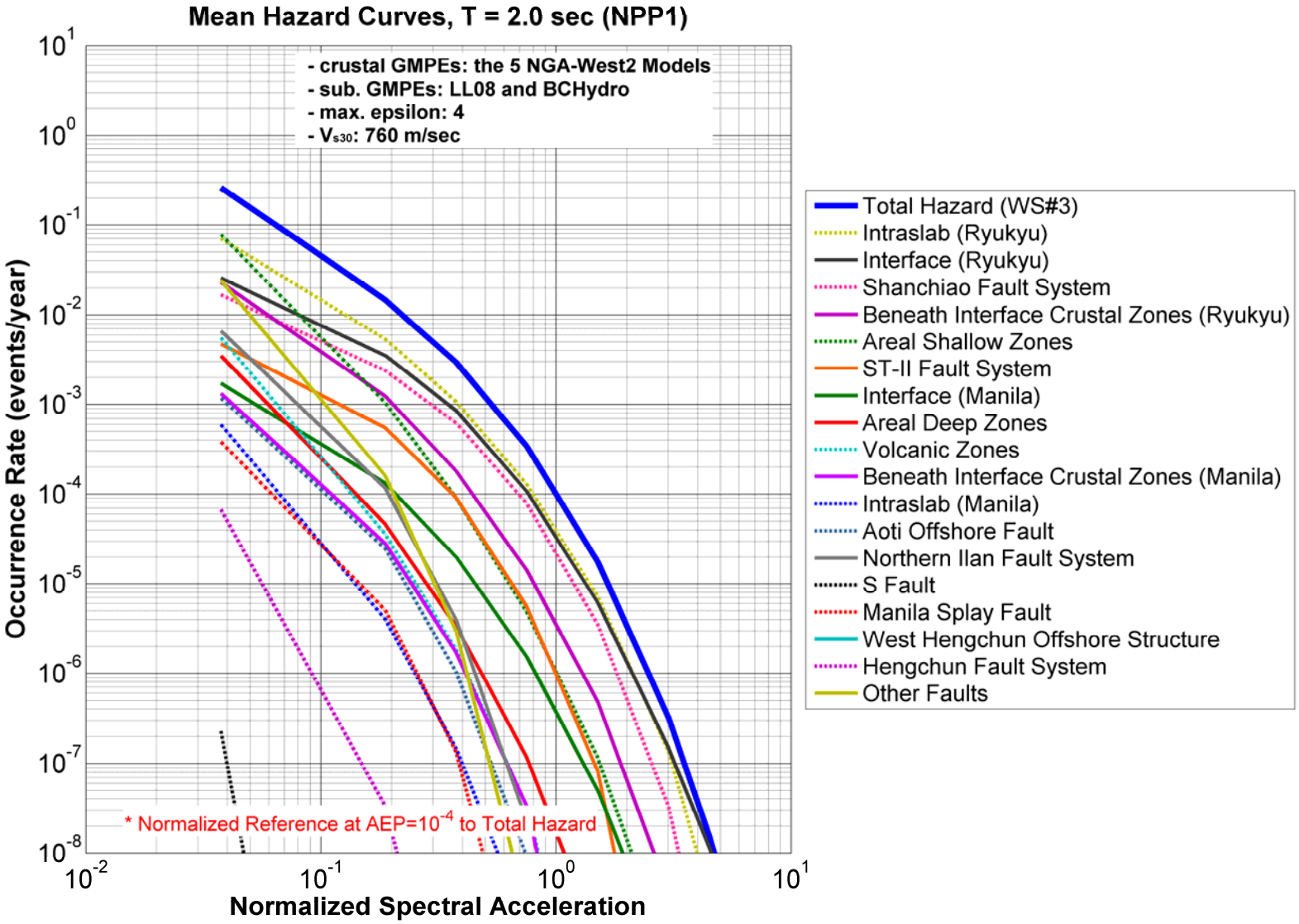
Hazard Curves – NPP1, PGA



Hazard Curves – NPP1, T=0.2s



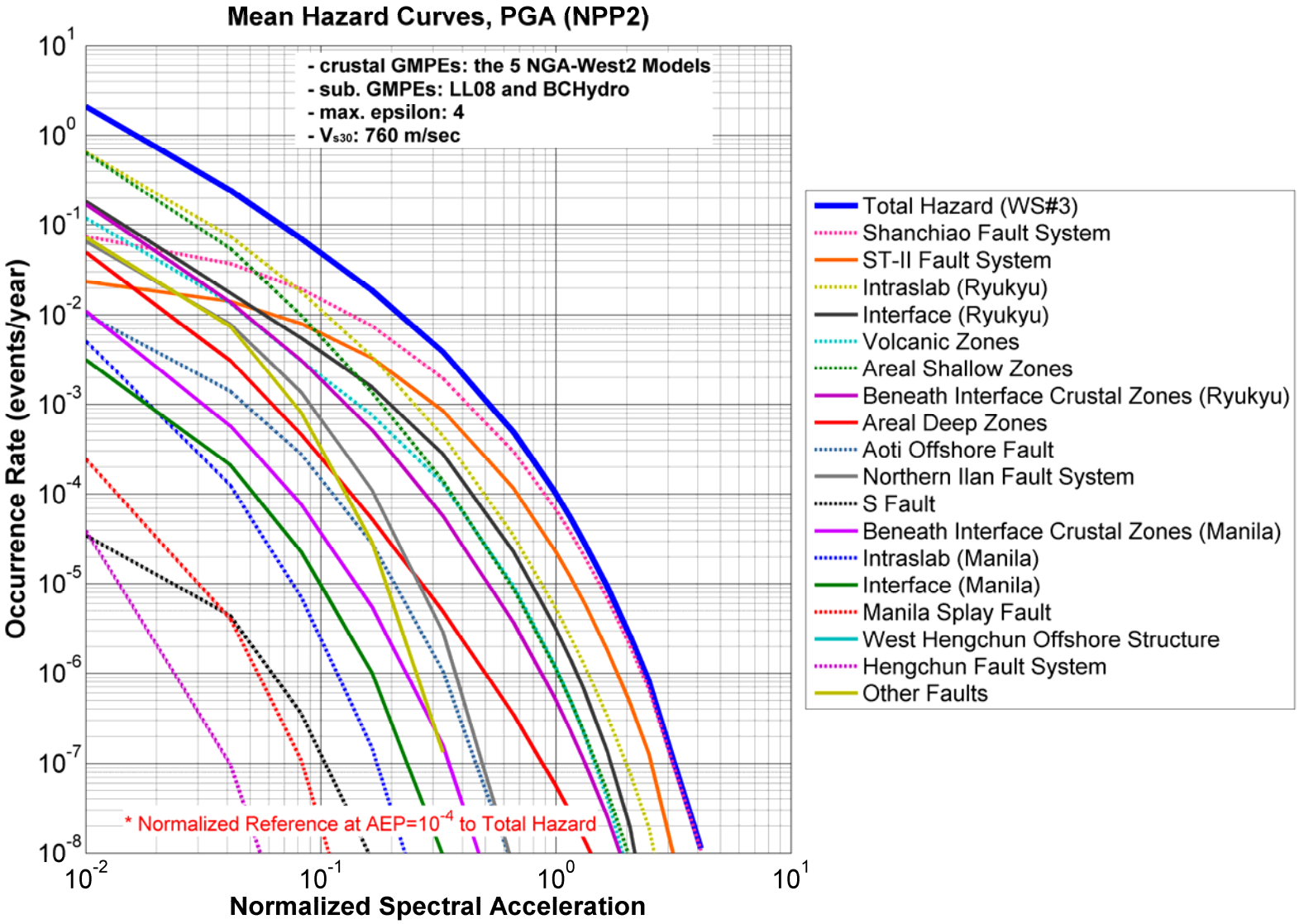
Hazard Curves – NPP1, T=2.0s



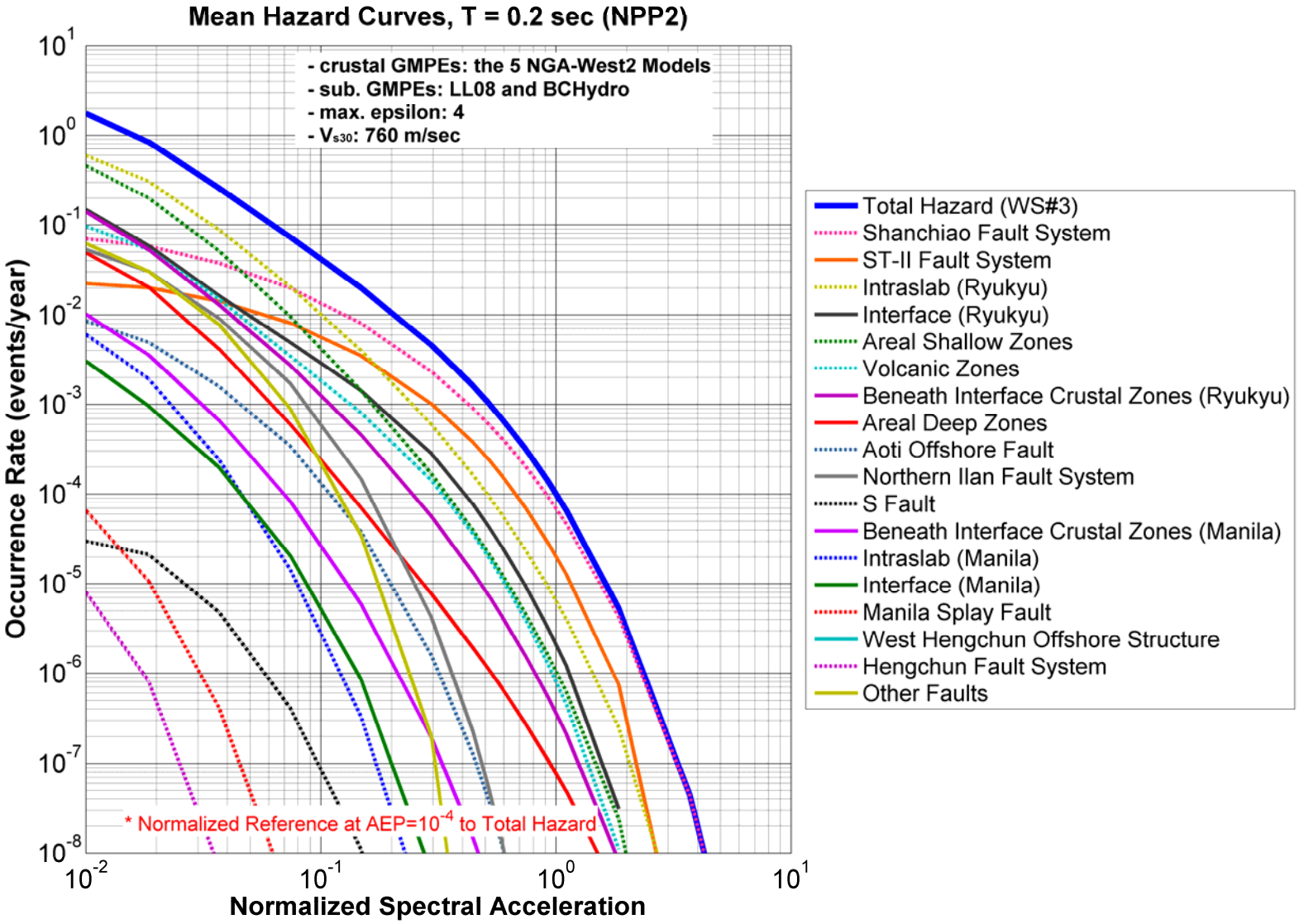
Hazard Curves @WS#3

NPP2

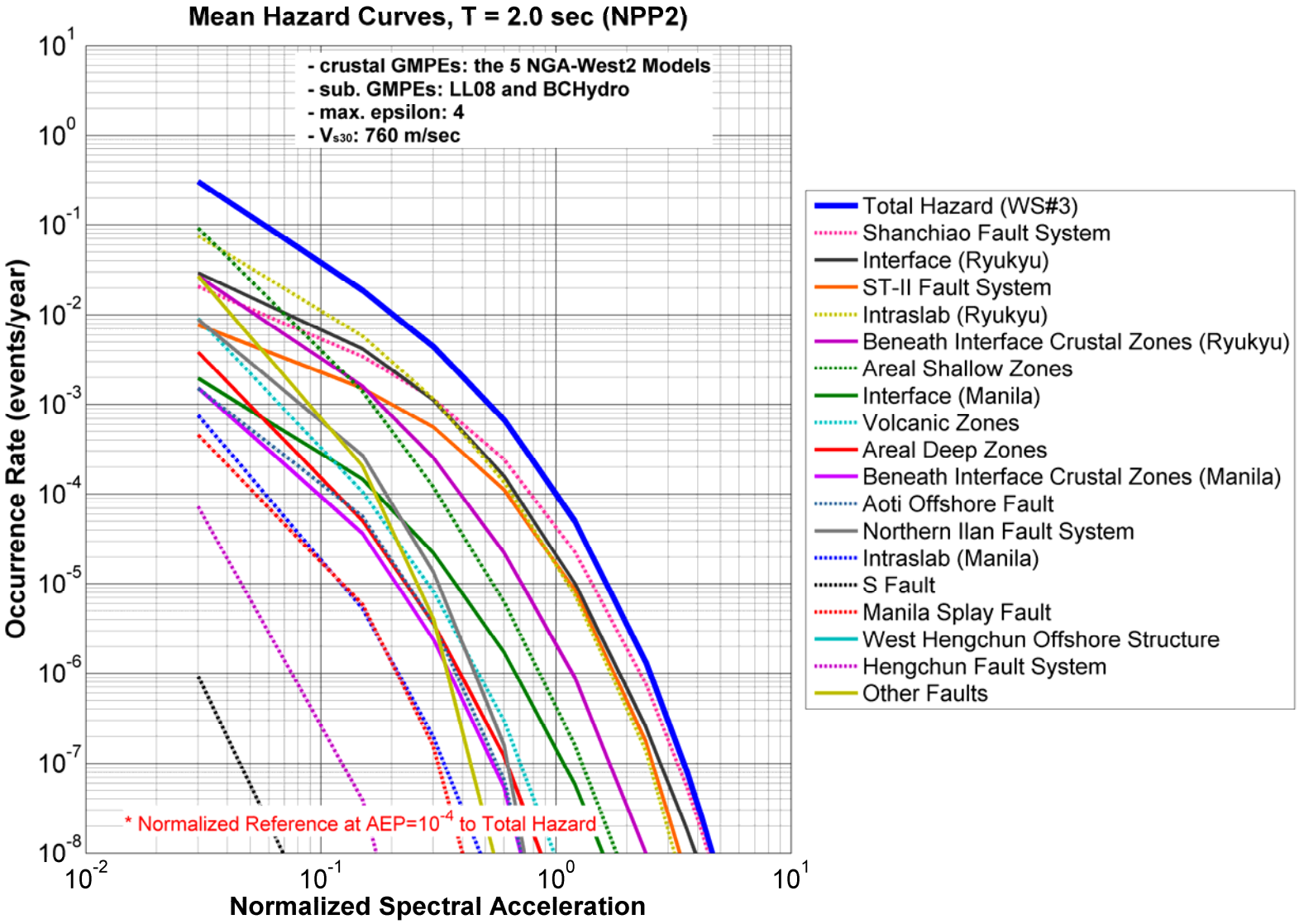
Hazard Curves – NPP2, PGA



Hazard Curves – NPP2, T=0.2s



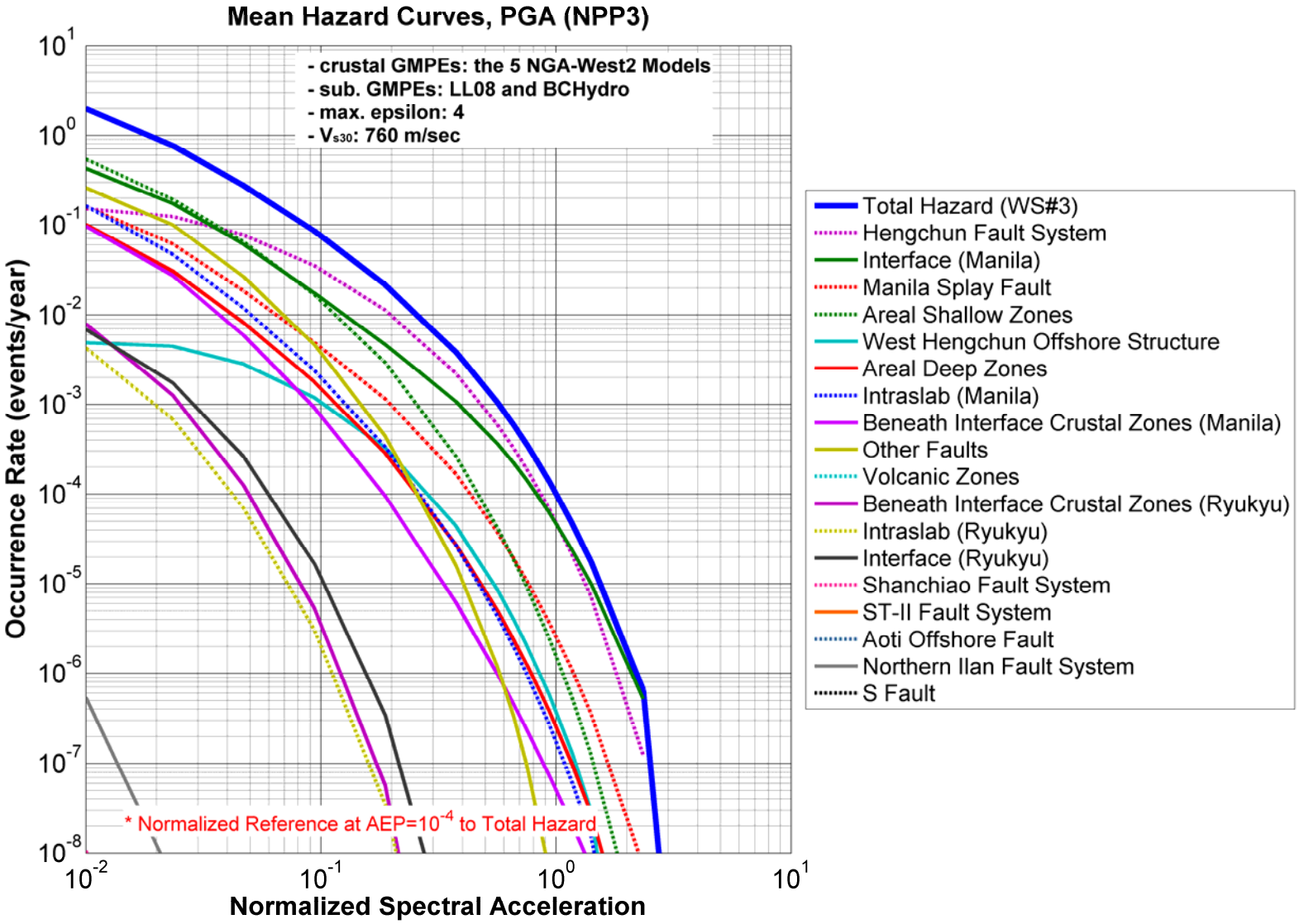
Hazard Curves – NPP2, T=2.0s



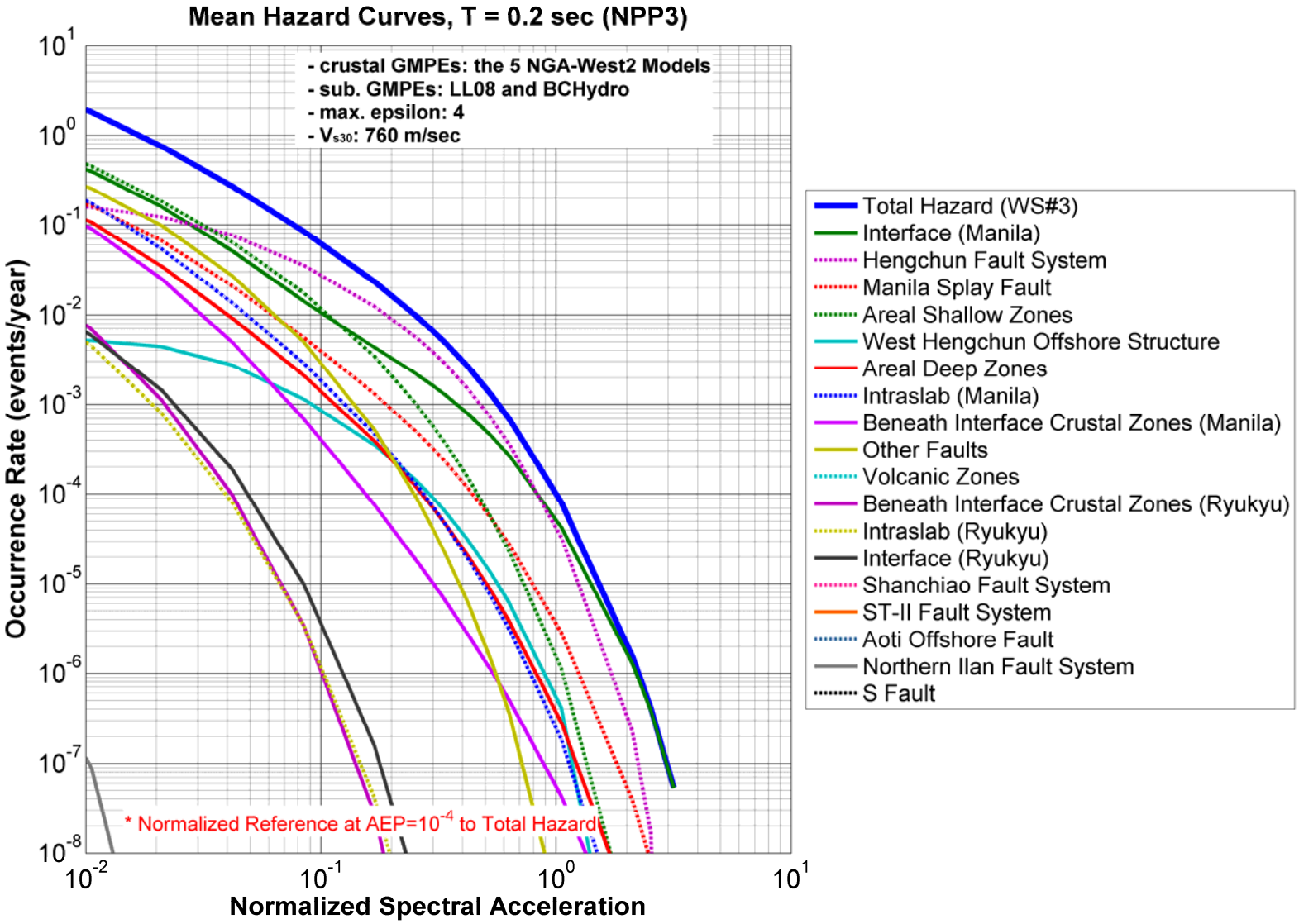
Hazard Curves @WS#3

NPP3

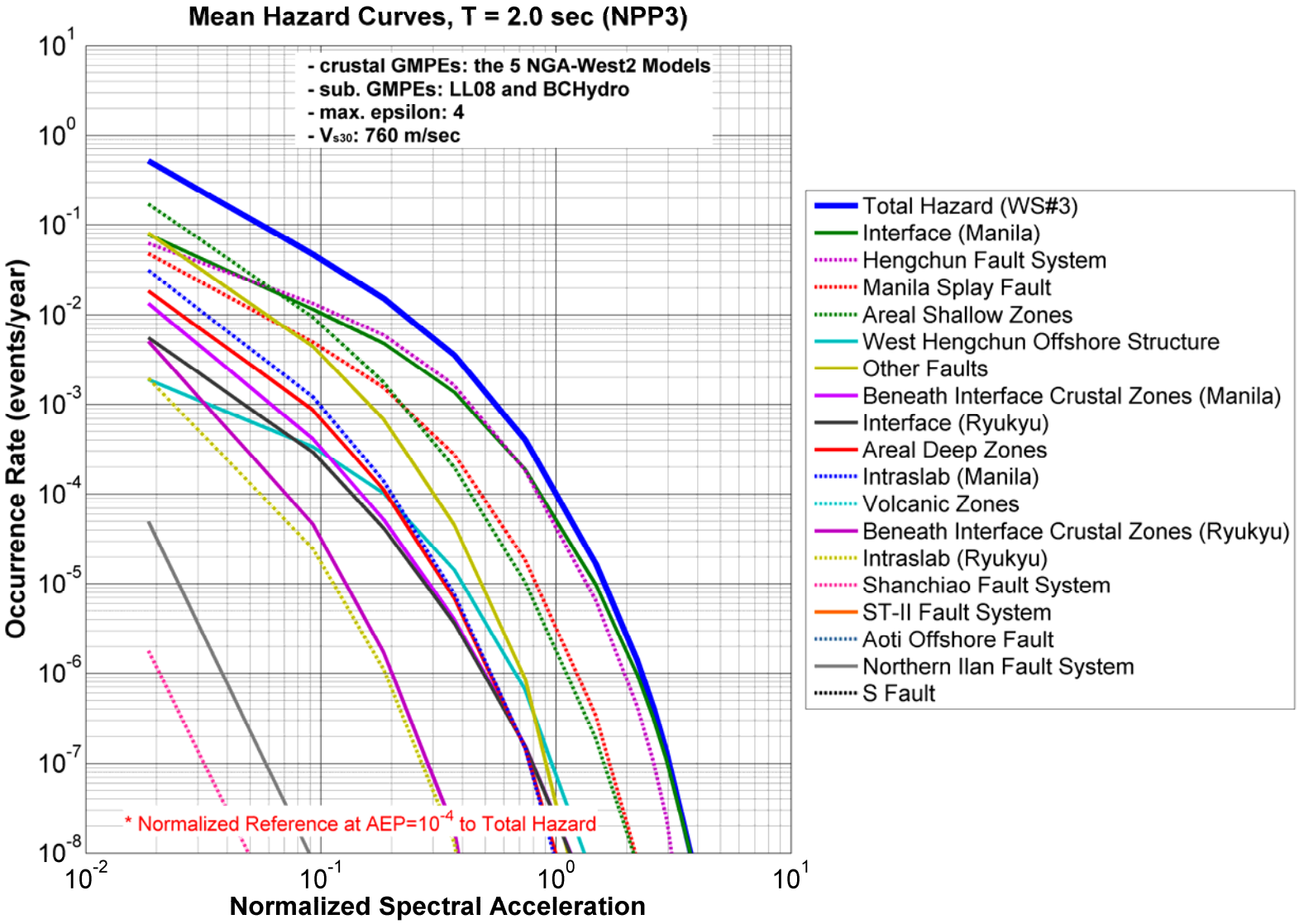
Hazard Curves – NPP3, PGA



Hazard Curves – NPP3, T=0.2s



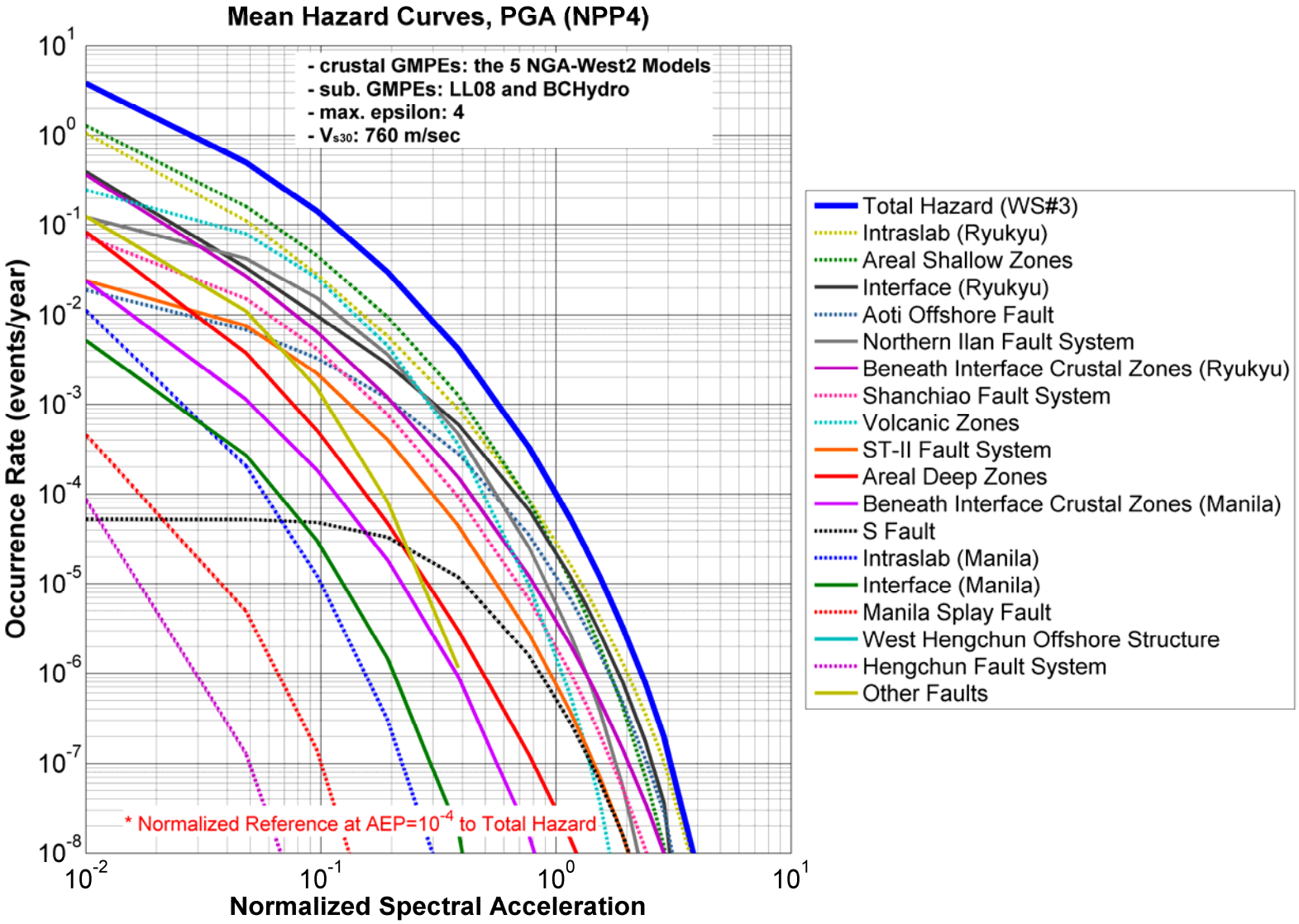
Hazard Curves – NPP3, T=2.0s



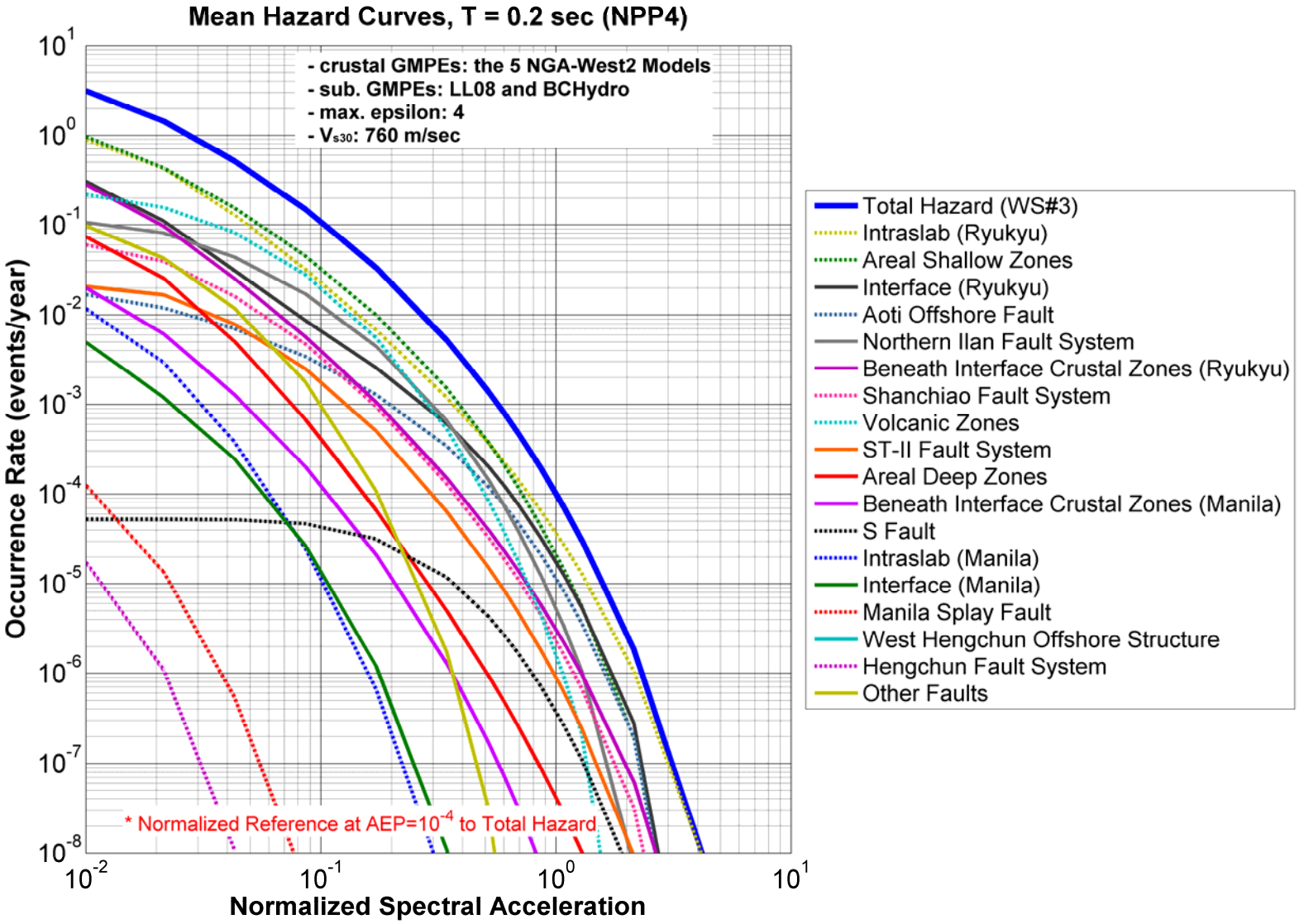
Hazard Curves @WS#3

NPP4

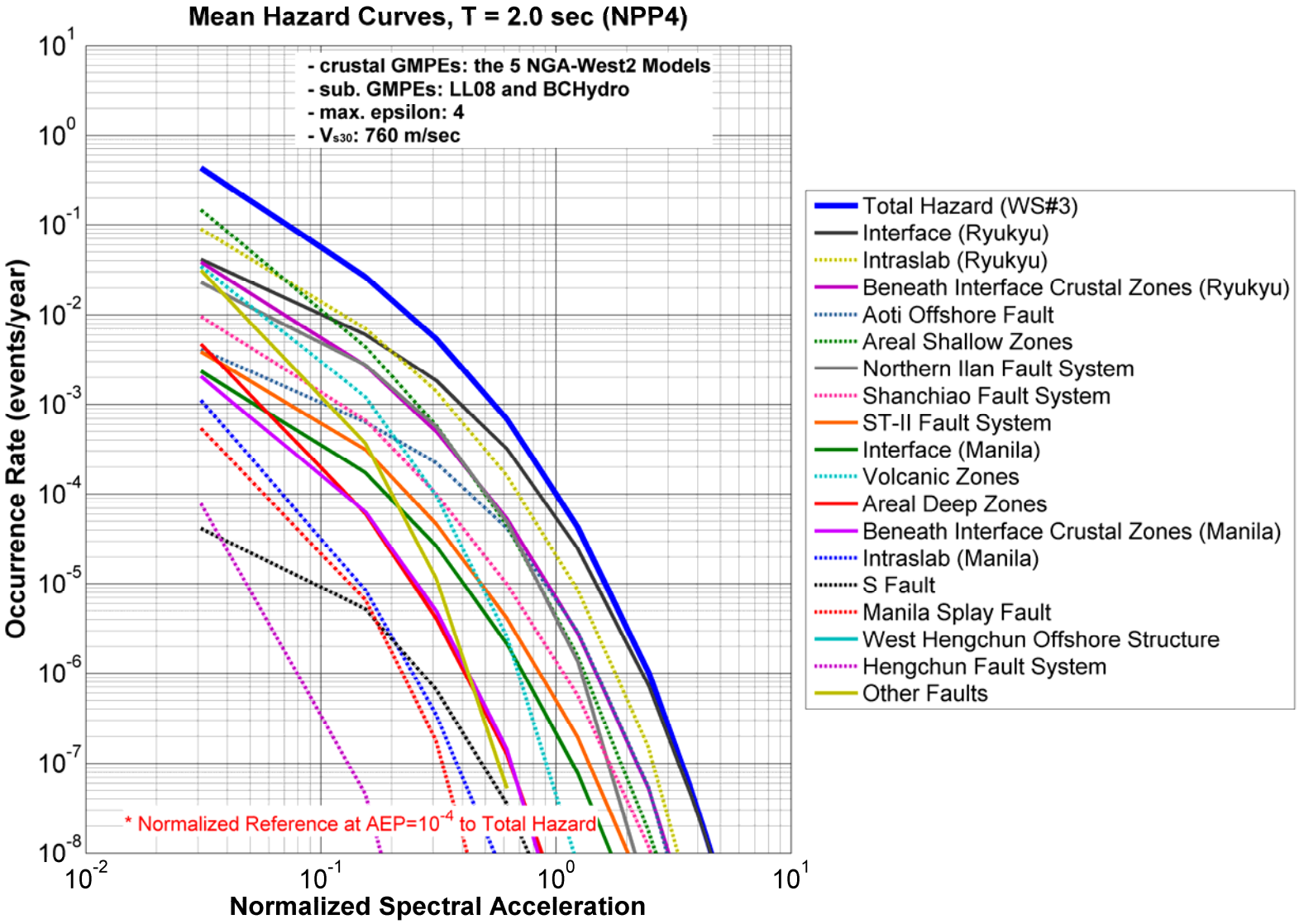
Hazard Curves – NPP4, PGA



Hazard Curves – NPP4, T=0.2s

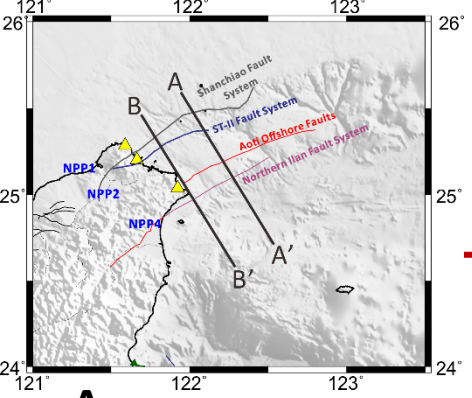


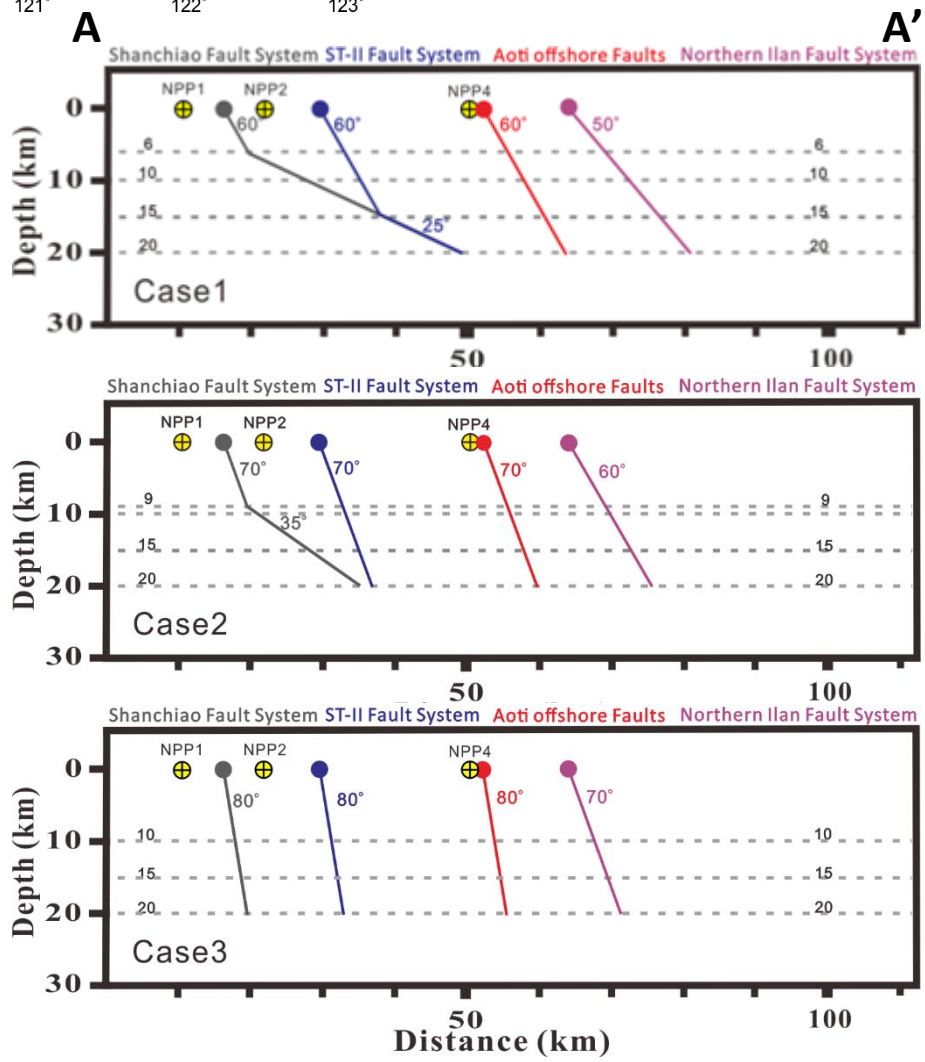
Hazard Curves – NPP4, T=2.0s

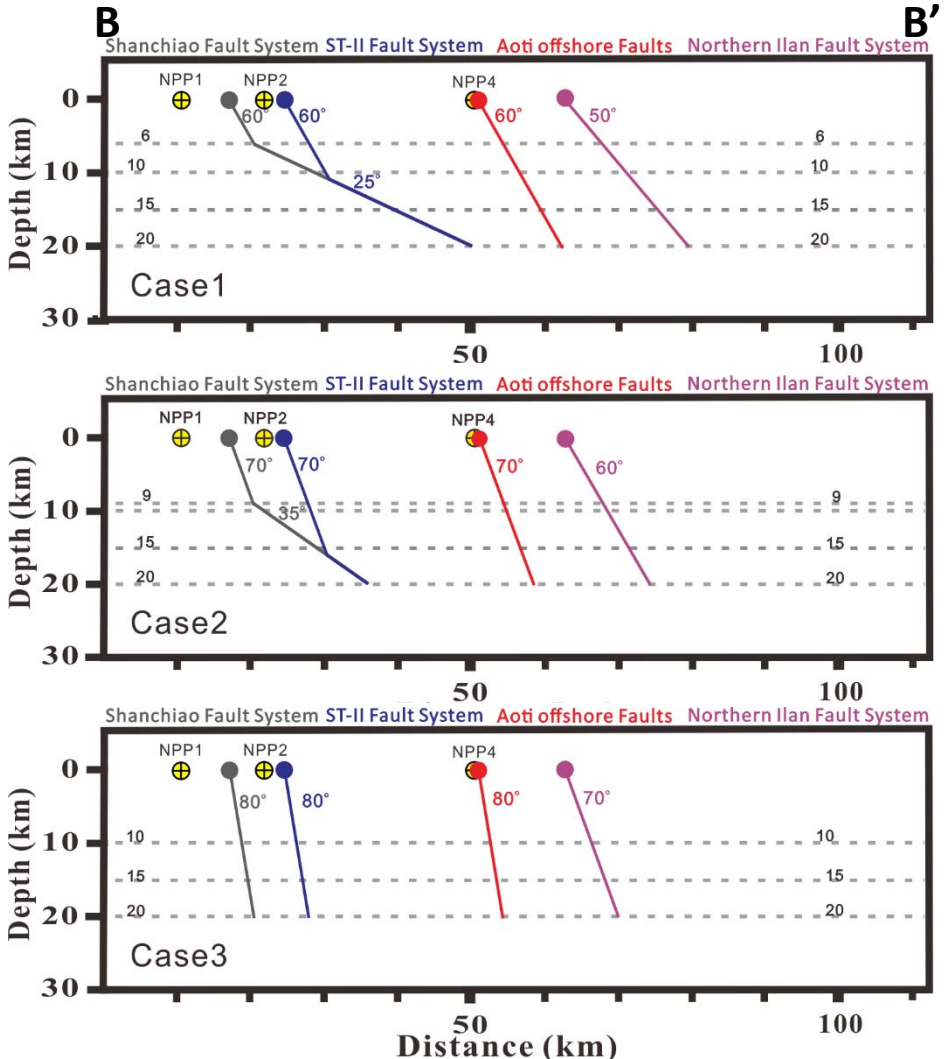


SSC LOGIC TREE

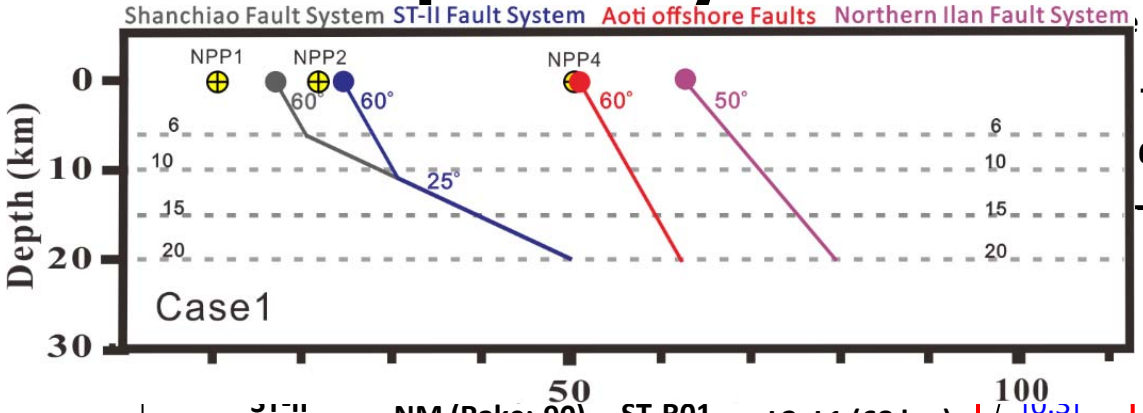
Northern primary faults







Northern primary faults



					Fault Geometry Model		Magnitude Distribution Model	
					Dip	Seismogenic Depth	Max. Magn.	Magnitude pdf
Case 1 [0.3]	If L1 is Seismogenic [0.6]	NM (Rake:-90) [0.4]	ST-R01	L2+L1 (68 km)	60˚(0-6km) 25˚(>6km)	10 [0.3] 15 [0.4] 20 [0.3]	W&C (L)+0.25 [0.4] W&C (A)+0.25 [0.3] Y&M+0.25 [0.3]	Y&C Char [0.5] Truncated Exponential [0.5]
				L1 (17km)				
				L2 (51km)				
		NM/OB (Rake:-50) [0.6]						
	If L1 is not Seismogenic [0.4]	NM (Rake:-90) [0.4]	ST-R01	L2 (51km)				
		NM/OB (Rake:-50) [0.6]						
	Aoti Fault	NM (Rake:-90) [0.5]	AT-R01	A1+A2 (93km)				
				A1 (41 km)				
				A2 (52 km)				
		NM/OB (Rake:-50) [0.5]						
	North Ilan Fault	NM (Rake:-90) [0.5]	N-R01	A+B+C (127km)				
				A+B (88 km)				
				B+C (78km)				
				A (49 km)				
				B (40 km)				
				C (38 km)				
		NM/OB (Rake:-50) [0.5]						

[0.5, 1.0] [0.4] [1.0, 2.0] [0.4] [L2] [0.2] [0.3] [1.0] [0.4] [2.0] [0.3] 0.1 [0.3] 0.5 [0.4] 2.0 [0.3] 0.9 [0.3] 2.85 [0.4] 4.8 [0.3]

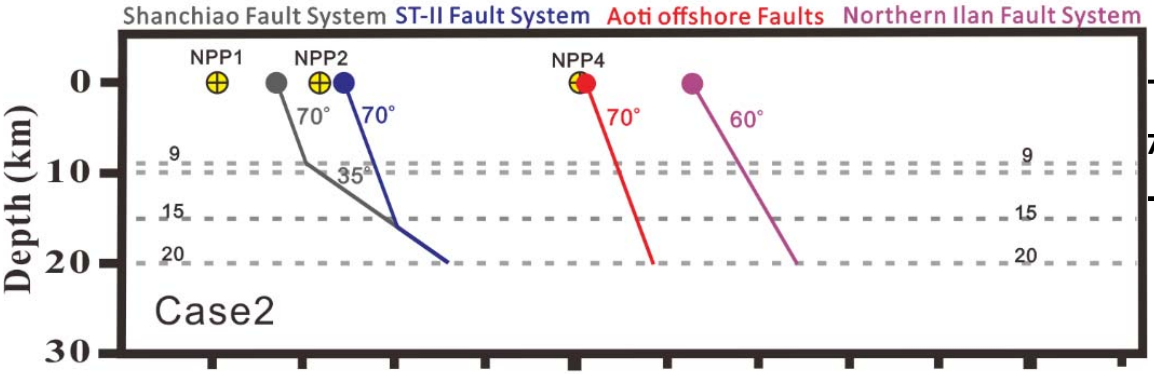
* 60˚ 25˚ *depth: related to shanchiao Fault System

60˚ 25˚

60˚

50˚

Northern primary faults



Fault Geometry Model: Dip | Seismogenic Depth
Magnitude Distribution Model: Max. Magn. | Magnitude pdf

Case 2 [0.4]

- If L1 is Seismogenic [0.6]
  - NM (Rake:-90) [0.4] — L1 (17 km); L2 (51 km)
  - NM/OB (Rake:-50) [0.6]
- If L1 is not Seismogenic [0.4]
  - NM (Rake:-90) [0.4] — ST-R01 — L2 (51km)
  - NM/OB (Rake:-50) [0.6]
- Aoti Fault
  - NM (Rake:-90) [0.5] — AT-R01 — A1+A2 (93km); A1 (41 km); A2 (52 km)
  - NM/OB (Rake:-50) [0.5]
- North Ilan Fault
  - NM (Rake:-90) [0.5] — N-R01 — A+B+C (127km); A+B (88 km); B+C (78km); A (49 km); B (40 km); C (38 km)
  - NM/OB (Rake:-50) [0.5]

Dip:
- 70°(0-9km) / 35°(>9km) [0.5, 1.0]
- * 70° / 35° [1.0]
- 70° [1.0]
- 70° [1.0]
- 60° [1.0]

*depth: related to shanchiao Fault System

Seismogenic Depth:
- 10 [0.3]
- 15 [0.4]
- 20 [0.3]

Max. Magn.:
- W&C (L)+0.25 [0.4]
- W&C (A)+0.25 [0.3]
- Y&M+0.25 [0.3]

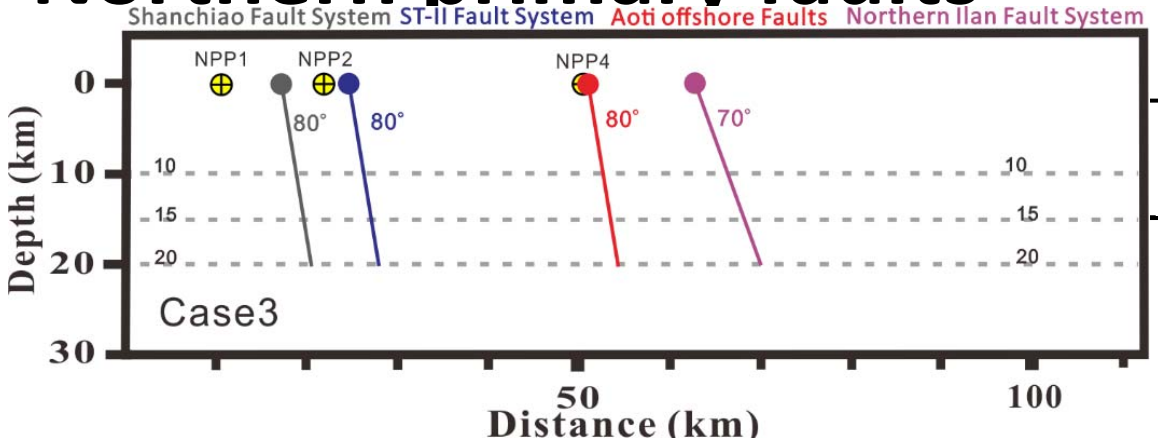
Magnitude pdf:
- Y&C Char [0.5]
- Truncated Exponential [0.5]

[L2]
- [0.2] [0.3]
- [1.0] [0.4]
- [2.0] [0.3]

- 0.1 [0.3]
- 0.5 [0.4]
- 2.0 [0.3]

- 0.9 [0.3]
- 2.85 [0.4]
- 4.8 [0.3]

Northern primary faults



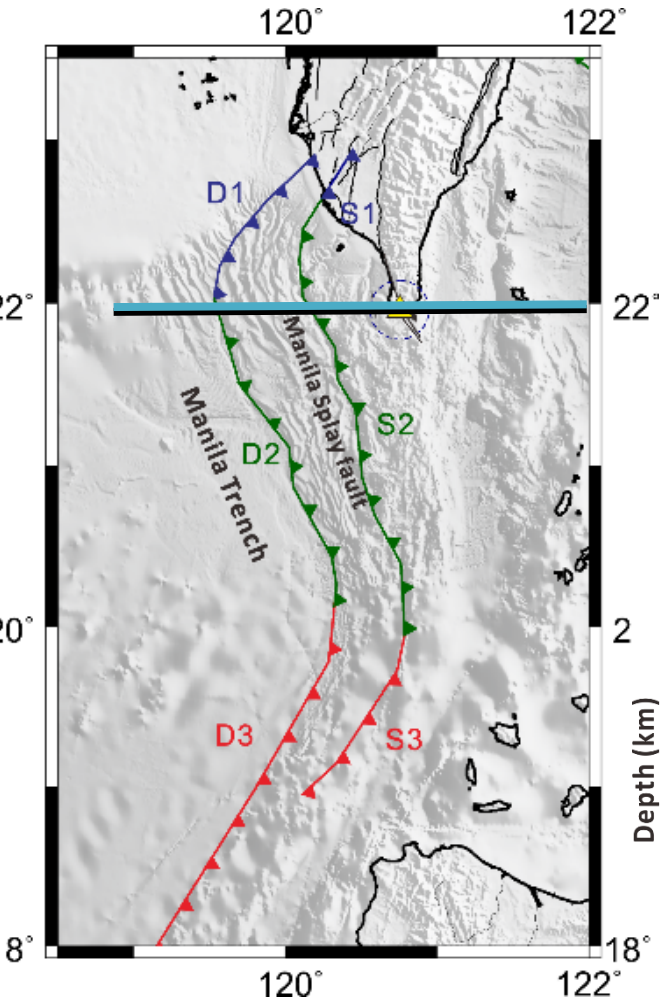
Case 3 [0.3]

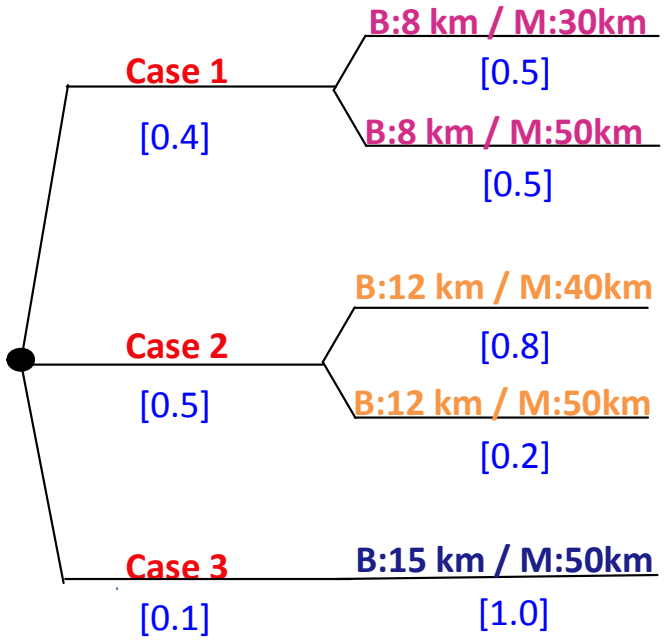
				Fault Geometry Model: Dip	Fault Geometry Model: Seismogenic Depth	Magnitude Distribution Model: Max. Magn.	Magnitude Distribution Model: Magnitude pdf
If L1 is Seismogenic [0.6]	[0.4]	L1 (17km)	[0.5, 1.0] [0.4]	80°	10 [0.3]	W&C (L)+0.25 [0.4]	Y&C Char [0.5]
		L2 (51km)	[1.0, 2.0] [0.6]		15 [0.4]	W&C (A)+0.25 [0.3]	Truncated Exponential [0.5]
	NM/OB (Rake:-50) [0.6]				20 [0.3]	Y&M+0.25 [0.3]	
If L1 is not Seismogenic [0.4]	NM (Rake:-90) [0.4]	ST-R01	L2 (51km) [L2]	[0.2] [0.3]	10 [0.3]	W&C (L) +0.25 [0.4]	Y&C Char [0.5]
				[1.0] [0.4]	80° 15 [0.4]	W&C (A)+0.25 [0.3]	Truncated Exponential [0.5]
				[2.0] [0.3]	20 [0.3]	Y&M+0.25 [0.3]	
	NM/OB (Rake:-50) [0.6]						
Aoti Fault	NM (Rake:-90) [0.5]	AT-R01	A1+A2 (93km)	0.1 [0.3]	10 [0.3]	W&C (L)+0.25 [0.4]	Y&C Char [0.5]
			A1 (41 km)	0.5 [0.4]	80° 15 [0.4]	W&C (A)+0.25 [0.3]	Truncated Exponential [0.5]
			A2 (52 km)	2.0 [0.3]	20 [0.3]	Y&M+0.25 [0.3]	
	NM/OB (Rake:-50) [0.5]						
North Ilan Fault	NM (Rake:-90) [0.5]	N-R01	A+B+C (127km)	0.9 [0.3]	10 [0.3]	W&C (L)+0.25 [0.4]	Y&C Char [0.5]
			A+B (88 km)	2.85 [0.4]	70° 15 [0.4]	W&C (A)+0.25 [0.3]	Truncated Exponential [0.5]
			B+C (78km)	4.8 [0.3]	20 [0.3]	Y&M+0.25 [0.3]	
			A (49 km)				
			B (40 km)				
			C (38 km)				
	NM/OB (Rake:-50) [0.5]						

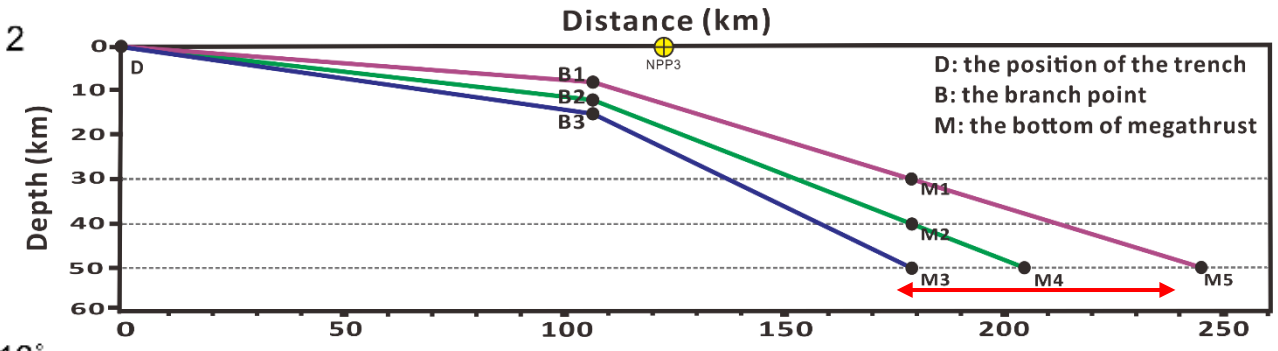
Manila subduction interface

Geometry Model (Case)

Branch Point (B) / Interface 2(M) (Depth)

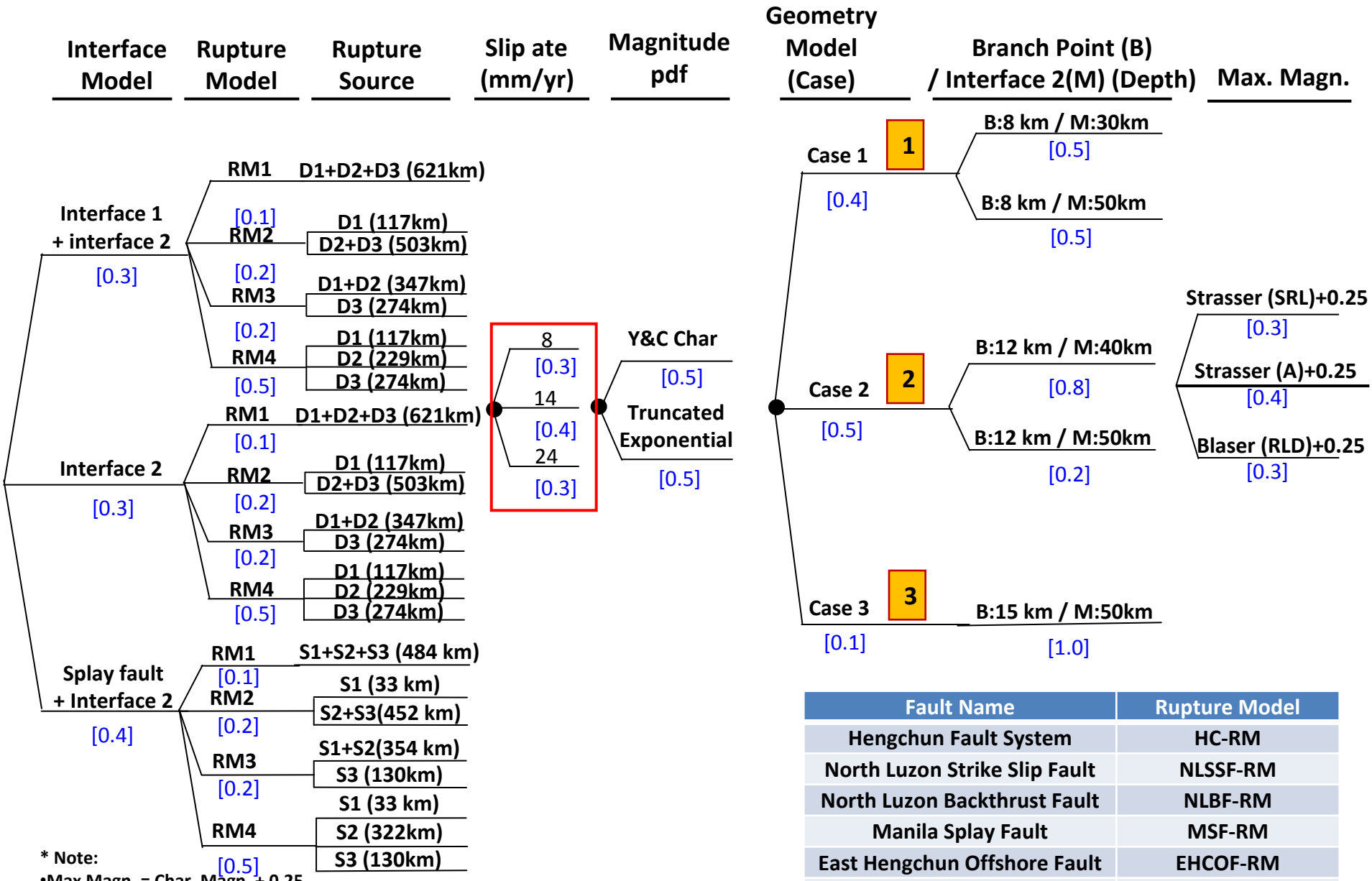






* Extend the interface of depth to 50 km, the rupture area and the maximum magnitude will increase.

Southern primary faults & Manila subduction interface

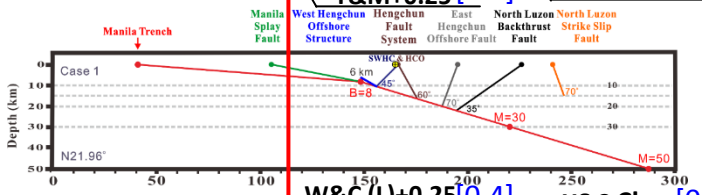


* Note:
•Max Magn. = Char. Magn. + 0.25
•Char. Magn. is calculated from Magnitude Scaling Law: Wells and Coppersmith (1994), Strasser et al (2010) and Blaser et al (2010)

Fault Name	Rupture Model
Hengchun Fault System	HC-RM
North Luzon Strike Slip Fault	NLSSF-RM
North Luzon Backthrust Fault	NLBF-RM
Manila Splay Fault	MSF-RM
East Hengchun Offshore Fault	EHCOF-RM
West Hengchun Offshore Structure	WHCOS-RM

Southern primary faults & Manila subduction interface

Seismogenic Probablility	Style of Faulting	Rupture Model	Rupture Source (Length)	Vertical Rate (mm/yr)	Fault Geometry Model: Dip	Fault Geometry Model: Seismogenic Depth	Magnitude Distribution Model: Max. Magn.	Magnitude Distribution Model: Magnitude pdf
Seismogenic	RV (90)[0.4]	HC-RM	CC+HC+SWHC (144 km)	[0.4, 1,0.5][0.2] [1.6, 4,1.4][0.6] [2.4, 6,2.3][0.2]	60˚ (Stop at Manila interface)	[SWHC, HC, CC]	W&C (L)+0.25[0.4] W&C (A)+0.25[0.3] Y&M+0.25 [0.3]	Y&C Char [0.5] Truncated Exponential [0.5]
	RV/OB (45)[0.6]		CC+HC+HCO (140 km) CC+HC (117 km) HC+HCO (63 km) HC+SWHC (70 km) SWHC (27 km) CC (77 km) HC (40 km) HCO (23 km)					
Seismogenic	RV/OB (45)	NLSSF-RM	(216 km)	4* [0.3] 6 *[0.4] 8* [0.3]	70˚ (Stop at Manila interface)		W&C (L)+0.25[0.4] W&C (A)+0.25[0.3] Y&M+0.25 [0.3]	Y&C Char [0.5] Truncated Exponential [0.5]
Seismogenic	RV (90)	NLBF-RM	(593 km)	5* [0.3] 8* [0.4] 12*[0.3]	35˚ (Stop at Manila interface)		W&C (L)+0.25[0.4] W&C (A)+0.25[0.3] Y&M+0.25 [0.3]	Y&C Char [0.5] Truncated Exponential [0.5]
Seismogenic	RV (90)	MSF-RM1 [0.1]	S1+S2+S3 (484 km)	4* [0.3] 9* [0.4] 15*[0.3]	11˚ (Stop at Manila branch point (8 km))		W&C (L)+0.25[0.4] W&C (A)+0.25[0.3] Y&M+0.25 [0.3]	Y&C Char [0.5] Truncated Exponential [0.5]
		MSF-RM2 [0.2]	S1 (33 km) S2+S3(452 km)					
		MSF-RM3 [0.2]	S1+S2(354 km) S3 (130km)					
		MSF-RM4 [0.5]	S1 (33 km) S2 (322km) S3 (130km)					
Seismogenic	RV (90)	EHCOF-RM	(190 km)	5 [0.3] 7 [0.4] 9 [0.3]	70˚ (Stop at Manila interface)		W&C (L)+0.25[0.4] W&C (A)+0.25[0.3] Y&M+0.25 [0.3]	Y&C Char [0.5] Truncated Exponential [0.5]
[0.5] Seismogenic [0.5]	RV (90)	WHCOS-RM	(19 km)	1.2 [0.2] 1.6 [0.6] 2.4 [0.2]	30˚ (branch fault off interface)		W&C (L)+0.25[0.4] W&C (A)+0.25[0.3] Y&M+0.25 [0.3]	Y&C Char [0.5] Truncated Exponential [0.5]
Non-Seismogenic								



* Means constant slip rate

Southern primary faults & Manila subduction interface

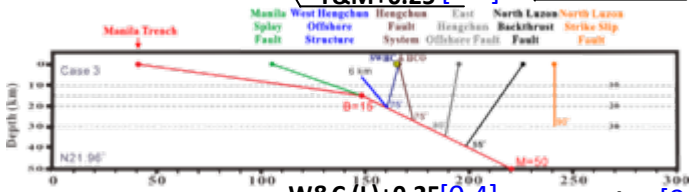
Seismogenic Probablility	Style of Faulting	Rupture Model	Rupture Source (Length)	Vertical Rate (mm/yr)	Fault Geometry Model: Dip	Fault Geometry Model: Seismogenic Depth	Magnitude Distribution Model: Max. Magn.	Magnitude Distribution Model: Magnitude pdf
Seismogenic	RV (90)[0.4]	HC-RM	CC+HC+SWHC (144 km)	[0.4, 1,0.5][0.2] / [1.6, 4,1.4][0.6] / [2.4, 6,2.3][0.2]	75˚	(Stop at Manila interface)	W&C (L)+0.25[0.4] / W&C (A)+0.25[0.3] / Y&M+0.25 [0.3]	Y&C Char [0.5] / Truncated Exponential [0.5]
	RV/OB (45)[0.6]		CC+HC+HCO (140 km)					
			CC+HC (117 km)					
			HC+HCO (63 km)	[SWHC, HC, CC]				
			HC+SWHC (70 km)					
			SWHC (27 km)					
			CC (77 km)					
			HC (40 km)					
			HCO (23 km)					
Seismogenic	RV/OB (45)	NLSSF-RM	(216 km)	4* [0.3] / 6 *[0.4] / 8* [0.3]	80˚	(Stop at Manila interface)	W&C (L)+0.25[0.4] / W&C (A)+0.25[0.3] / Y&M+0.25 [0.3]	Y&C Char [0.5] / Truncated Exponential [0.5]
Seismogenic	RV (90)	NLBF-RM	(593 km)	5* [0.3] / 8* [0.4] / 12*[0.3]	45˚	(Stop at Manila interface)	W&C (L)+0.25[0.4] / W&C (A)+0.25[0.3] / Y&M+0.25 [0.3]	Y&C Char [0.5] / Truncated Exponential [0.5]
Seismogenic	RV (90)	MSF-RM1 [0.1]	S1+S2+S3 (484 km)	4* [0.3] / 9* [0.4] / 15*[0.3]	15˚	(Stop at Manila branch point (8 km))	W&C (L)+0.25[0.4] / W&C (A)+0.25[0.3] / Y&M+0.25 [0.3]	Y&C Char [0.5] / Truncated Exponential [0.5]
		MSF-RM2 [0.2]	S1 (33 km) / S2+S3(452 km)					
		MSF-RM3 [0.2]	S1+S2(354 km) / S3 (130km)					
		MSF-RM4 [0.5]	S1 (33 km) / S2 (322km) / S3 (130km)					
Seismogenic	SS (0)	EHCOF-RM	(190 km)	5 [0.3] / 7 [0.4] / 9 [0.3]	80˚	(Stop at Manila interface)	W&C (L)+0.25[0.4] / W&C (A)+0.25[0.3] / Y&M+0.25 [0.3]	Y&C Char [0.5] / Truncated Exponential [0.5]
[0.5] Seismogenic [0.5]	RV (90)	WHCOS-RM	(19 km)	1.2 [0.2] / 1.6 [0.6] / 2.4 [0.2]	40˚	(branch fault off interface)	W&C (L)+0.25[0.4] / W&C (A)+0.25[0.3] / Y&M+0.25 [0.3]	Y&C Char [0.5] / Truncated Exponential [0.5]
Non-Seismogenic								

* Means constant slip rate

Southern primary faults & Manila subduction interface

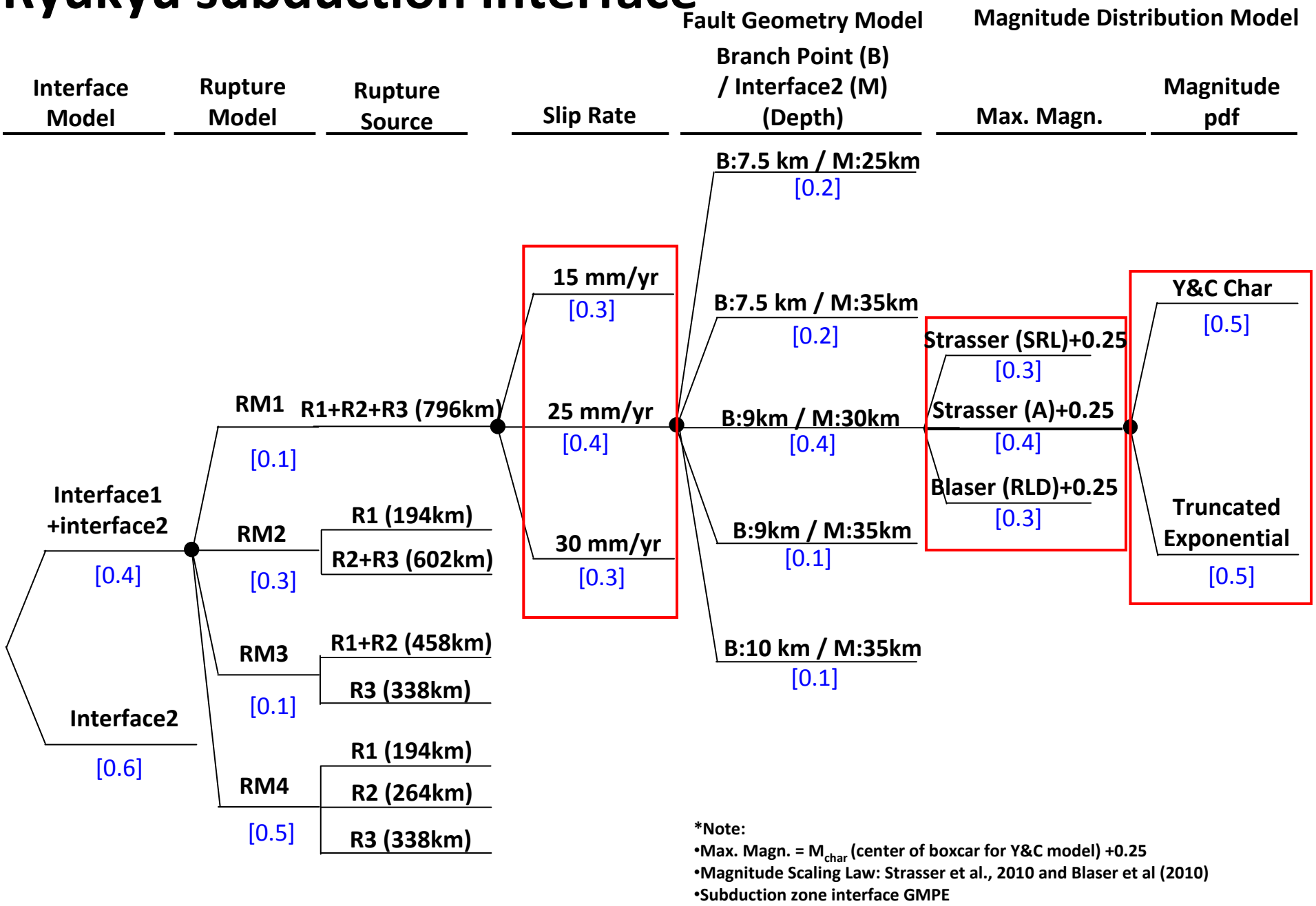
Seismogenic Probablility	Style of Faulting	Rupture Model	Rupture Source (Length)	Vertical Rate (mm/yr)	Fault Geometry Model: Dip	Fault Geometry Model: Seismogenic Depth	Magnitude Distribution Model: Max. Magn.	Magnitude Distribution Model: Magnitude pdf
Seismogenic	RV (90)[0.4]	HC-RM	CC+HC+SWHC (144 km)	[0.4, 1,0.5][0.2] / [1.6, 4,1.4][0.6] / [2.4, 6,2.3][0.2]	75˚	(Stop at Manila interface)	W&C (L)+0.25[0.4] / W&C (A)+0.25[0.3] / Y&M+0.25 [0.3]	Y&C Char [0.5] / Truncated Exponential [0.5]
	RV/OB (45)[0.6]		CC+HC+HCO (140 km)					
			CC+HC (117 km)					
			HC+HCO (63 km)					
			HC+SWHC (70 km)					
			SWHC (27 km)					
			CC (77 km)					
			HC (40 km)					
			HCO (23 km)					
Seismogenic	RV/OB (45)	NLSSF-RM	(216 km)	4* [0.3] / 6 *[0.4] / 8* [0.3]	90˚	(Stop at Manila interface)	W&C (L)+0.25[0.4] / W&C (A)+0.25[0.3] / Y&M+0.25 [0.3]	Y&C Char [0.5] / Truncated Exponential [0.5]
Seismogenic	RV (90)	NLBF-RM	(593 km)	5* [0.3] / 8* [0.4] / 12*[0.3]	55˚	(Stop at Manila interface)	W&C (L)+0.25[0.4] / W&C (A)+0.25[0.3] / Y&M+0.25 [0.3]	Y&C Char [0.5] / Truncated Exponential [0.5]
Seismogenic	RV (90)	MSF-RM1 [0.1]	S1+S2+S3 (484 km)	4* [0.3] / 9* [0.4] / 15*[0.3]	18˚	(Stop at Manila branch point (8 km))	W&C (L)+0.25[0.4] / W&C (A)+0.25[0.3] / Y&M+0.25 [0.3]	Y&C Char [0.5] / Truncated Exponential [0.5]
		MSF-RM2 [0.2]	S1 (33 km) / S2+S3(452 km)					
		MSF-RM3 [0.2]	S1+S2(354 km) / S3 (130km)					
		MSF-RM4 [0.5]	S1 (33 km) / S2 (322km) / S3 (130km)					
Seismogenic	SS (0)	EHCOF-RM	(190 km)	5 [0.3] / 7 [0.4] / 9 [0.3]	80˚	(Stop at Manila interface)	W&C (L)+0.25[0.4] / W&C (A)+0.25[0.3] / Y&M+0.25 [0.3]	Y&C Char [0.5] / Truncated Exponential [0.5]
[0.5] Seismogenic [0.5]	RV (90)	WHCOS-RM	(19 km)	1.2 [0.2] / 1.6 [0.6] / 2.4 [0.2]	50˚	(branch fault off interface)	W&C (L)+0.25[0.4] / W&C (A)+0.25[0.3] / Y&M+0.25 [0.3]	Y&C Char [0.5] / Truncated Exponential [0.5]
Non-Seismogenic								

[SWHC, HC, CC]



* Means constant slip rate

Ryukyu subduction interface

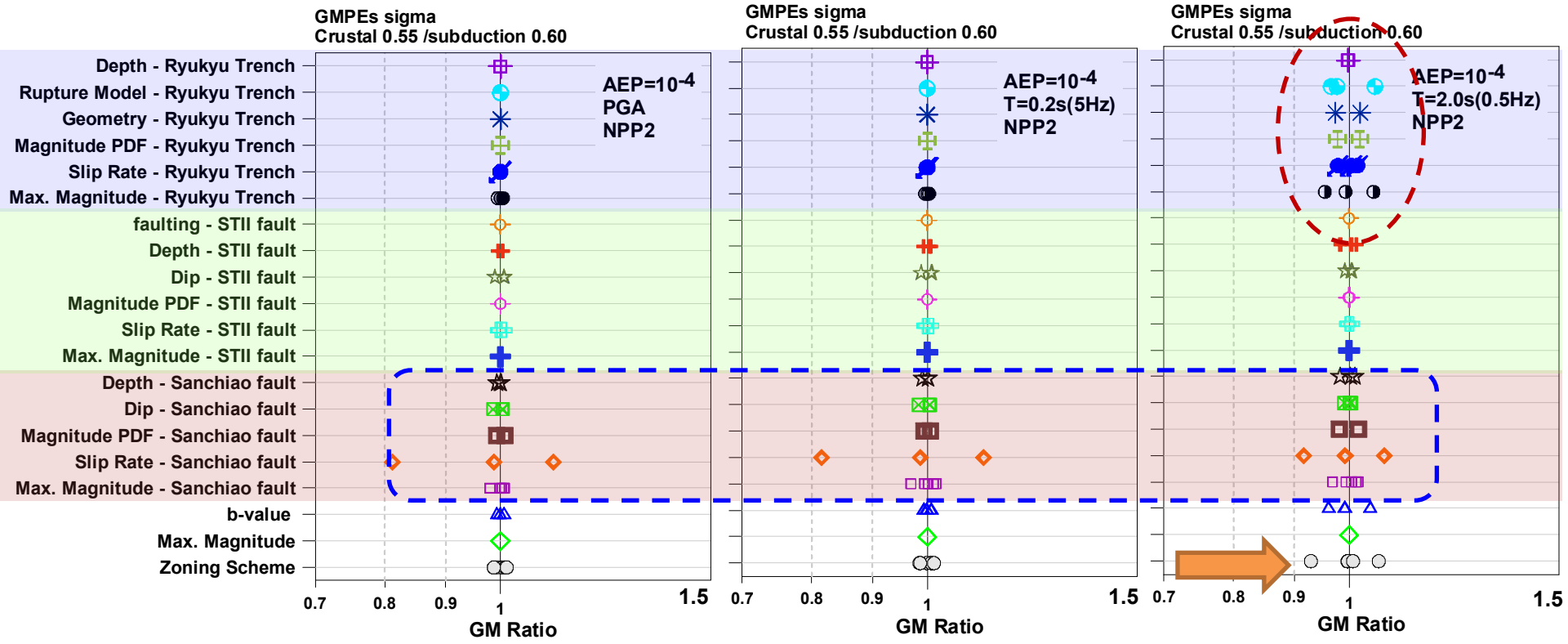


*Note:
- Max. Magn. = M_{char} (center of boxcar for Y&C model) +0.25
- Magnitude Scaling Law: Strasser et al., 2010 and Blaser et al (2010)
- Subduction zone interface GMPE

WS@2

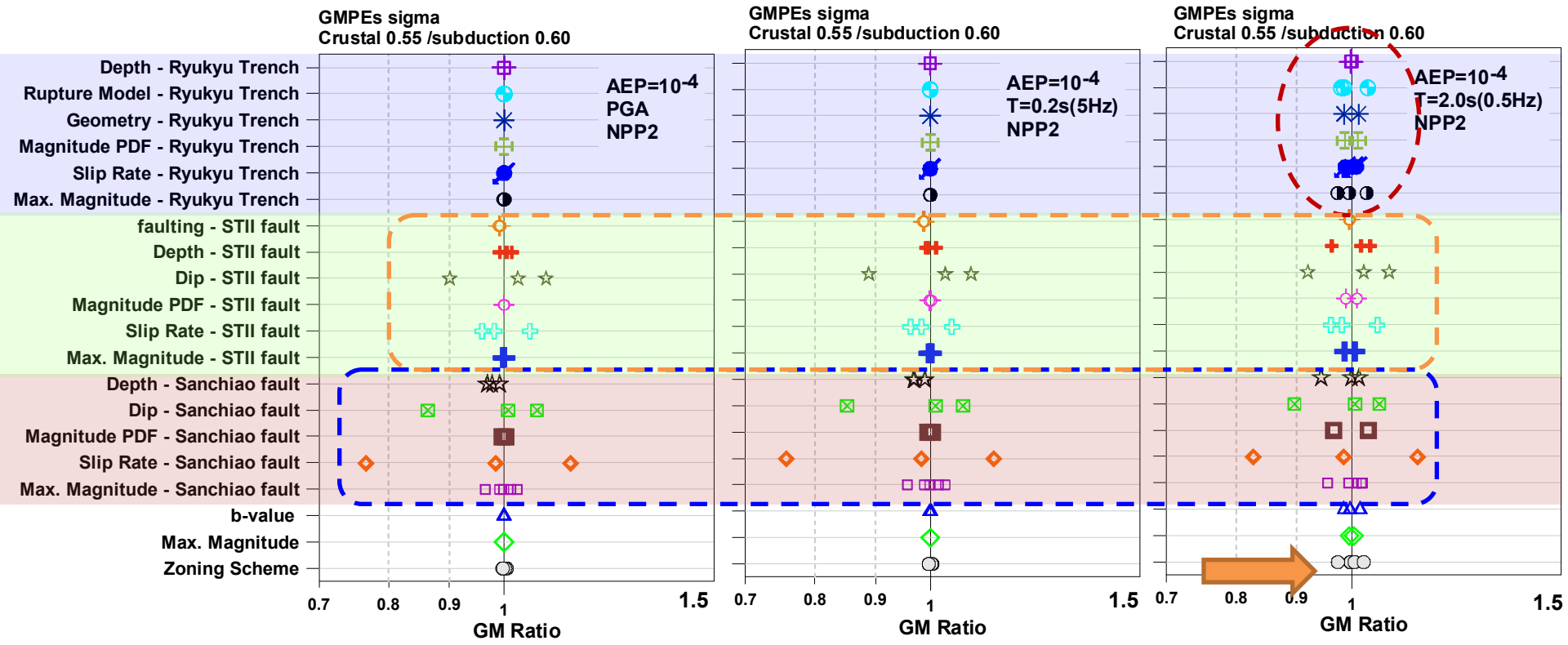
THE TORNADO DIAGRAM

NPP1 AEP=10^{-4}



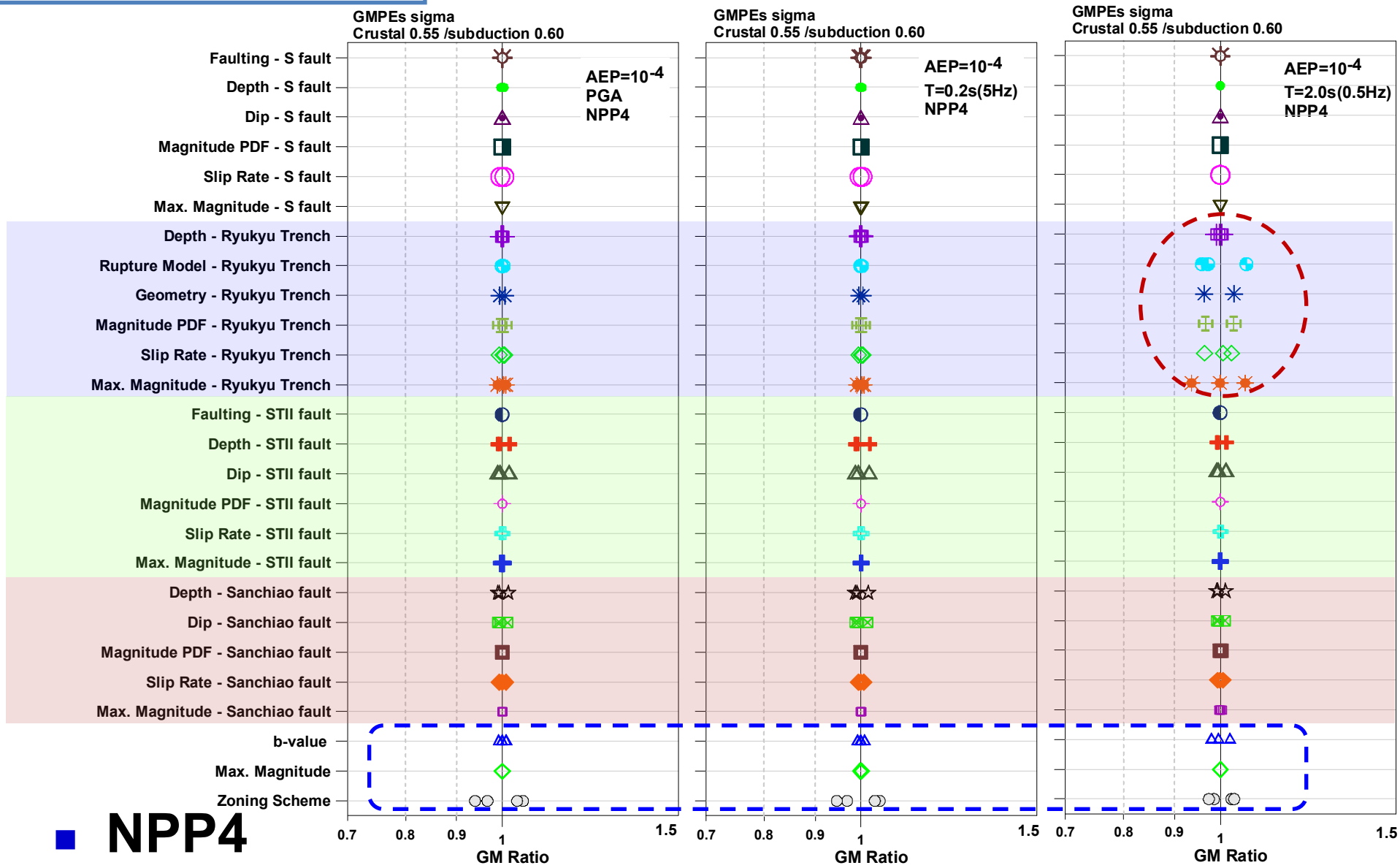
- **NPP1**
  - Close to Shanchiao fault(6.9km), foot wall (geometry, Slip rate, Max. Magnitude)
  - Areal Source (Zoning Scheme(activity rate), Max. Magnitude, GMPE for each seismic source, Activity rate)
  - Ryukyu Trench (geometry, magnitude)

NPP2 AEP=10^{-4}



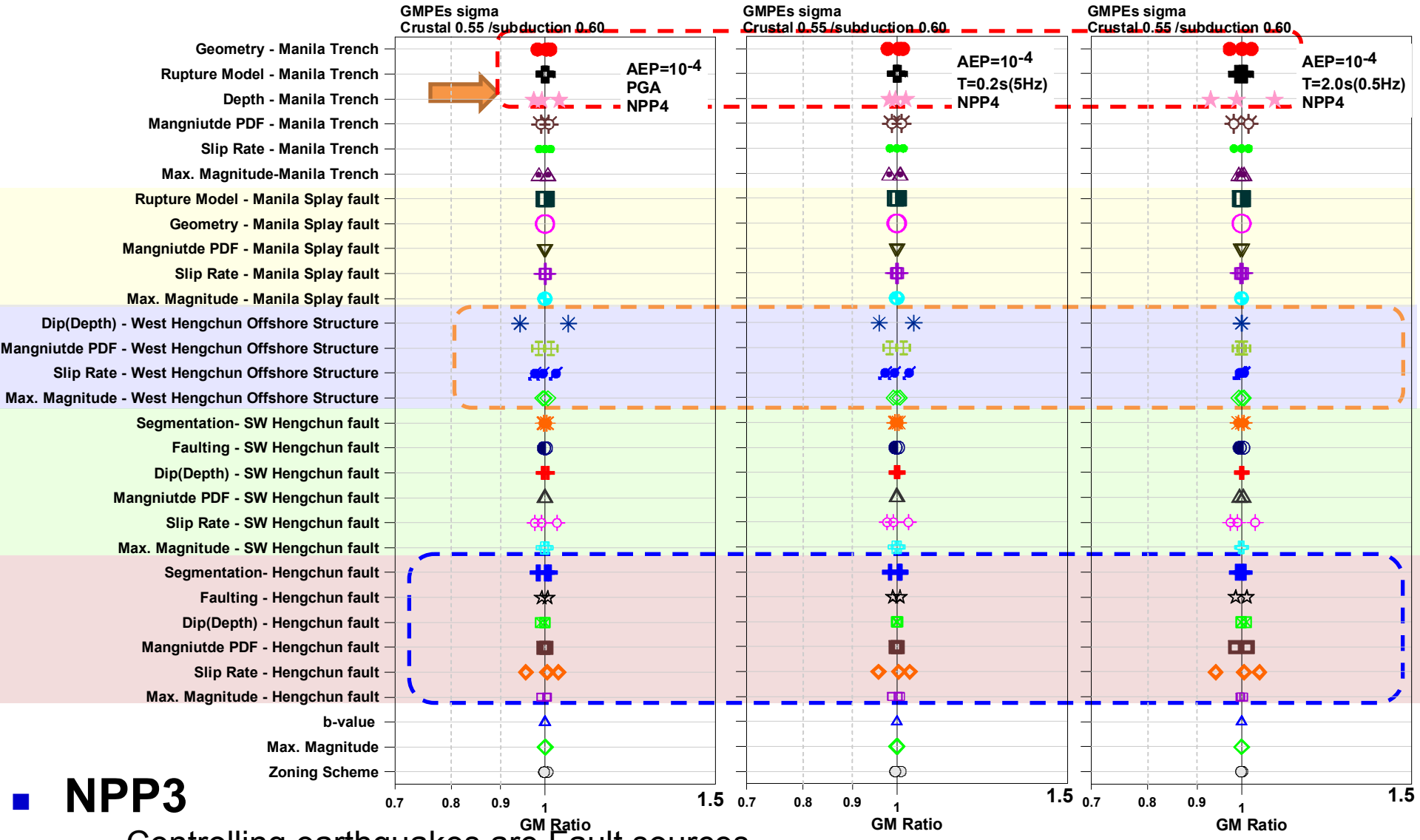
- **NPP2**
  - Close to Shanchiao fault(4.9km), hanging-wall (geometry)
  - Close to STII fault (2.4km), footwall (geometry)
  - Areal Source (Zoning Scheme(activity rate), Max. Magnitude, GMPE for each seismic source)

NPP4 AEP=10^{-4}



- **NPP4**
  - Areal Source (Zoning Scheme, GMPE for each seismic source)
  - Ryukyu Trench (geometry, Max. Magnitude, Slip rate)

NPP3 AEP=10^{-4} PGA



- **NPP3**
  - Controlling earthquakes are Fault sources
    - Hengchun fault / footwall, Southwest Hengchun fault / footwall
    - West Hengchun offshore structure / hanging-wall
    - Manila Trench (**geometry**, Magnitude)