EMPIRICAL MODEL FOR ESTIMATING THE AVERAGE HORIZONTAL VALUES OF PSEUDO-ABSOLUTE SPECTRAL ACCELERATIONS GENERATED BY CRUSTAL EARTHQUAKES

by
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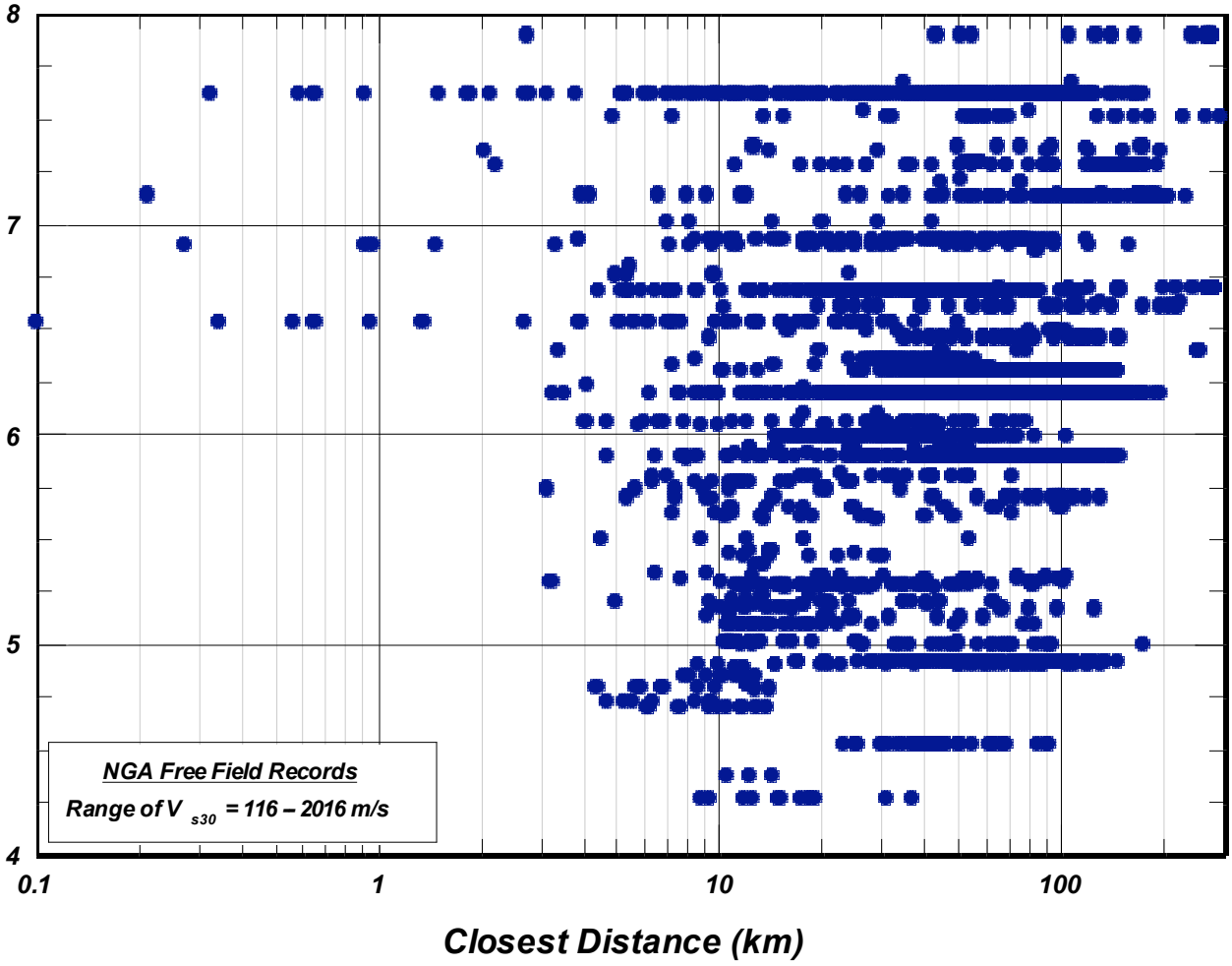
at

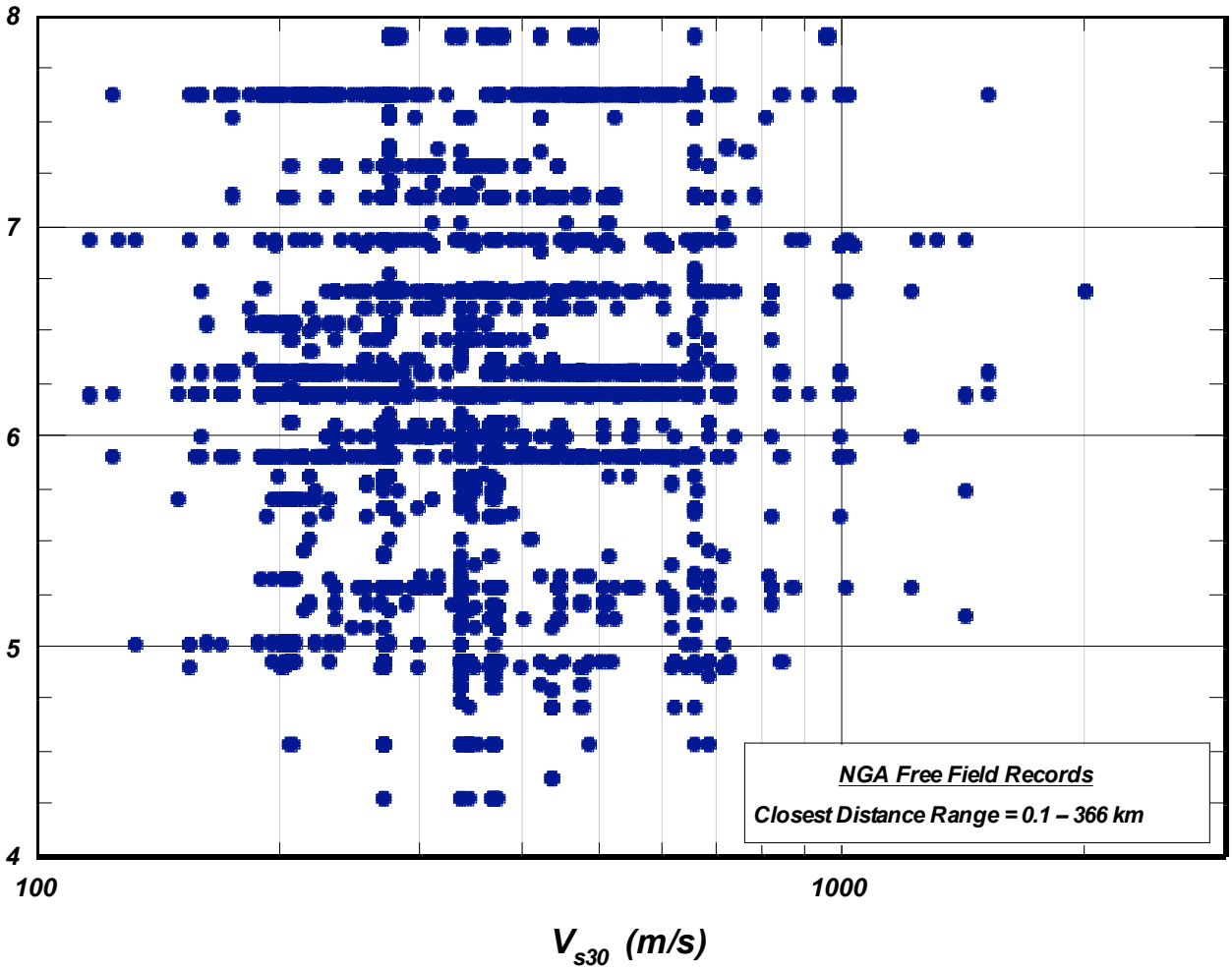
PEER in Richmond, CA

PROCESS

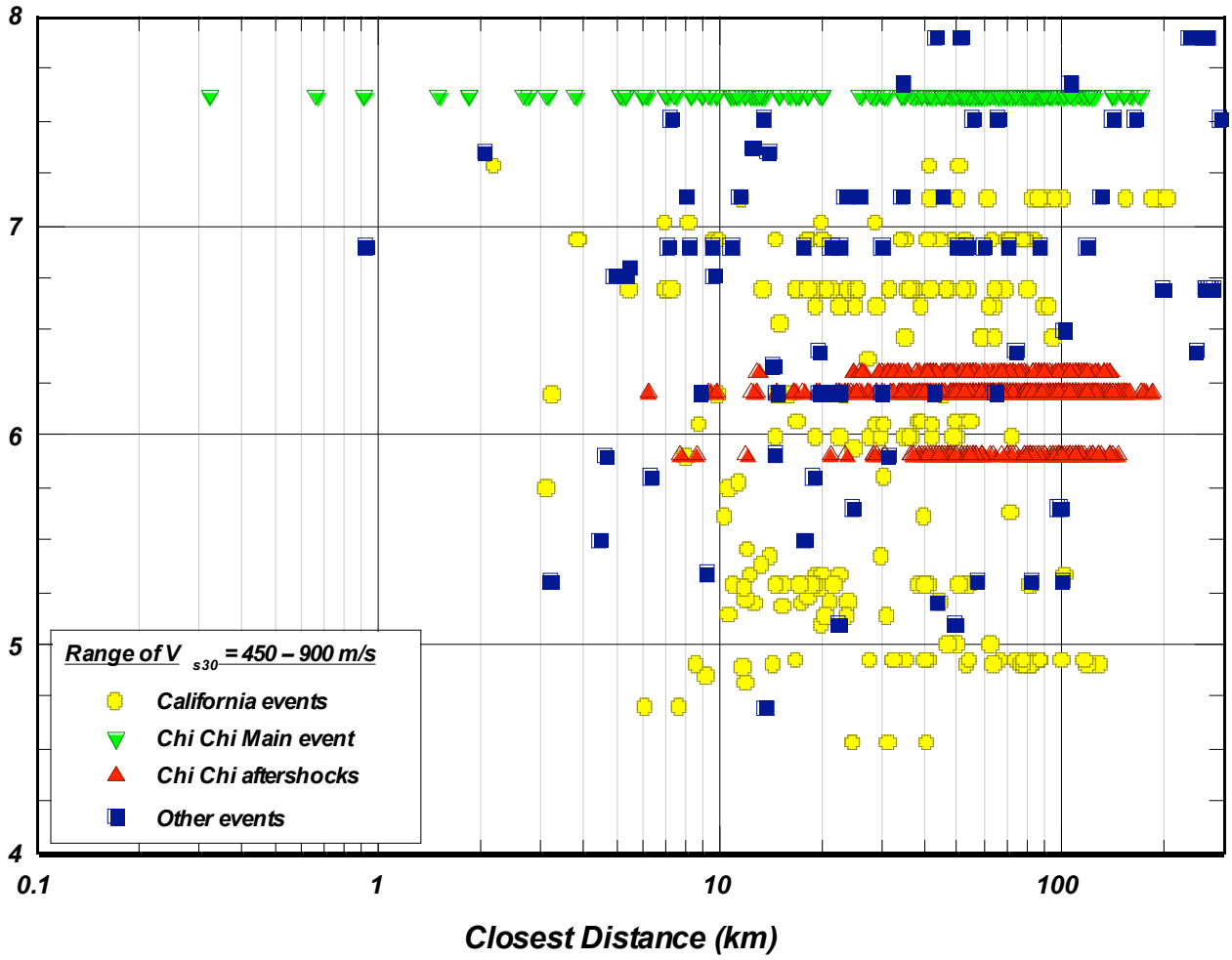
- ***Eliminated all non free-field records such as records in basements, dam crests, dam toes, dam abutments …etc.***
- ***Used V_{s30} bins***
- ***Used latest horizontal component***
- ***Distance ≤ 200 km***
- ***Style of faulting included (Mechanism 0 & 1; Mechanism 2 & 3)***



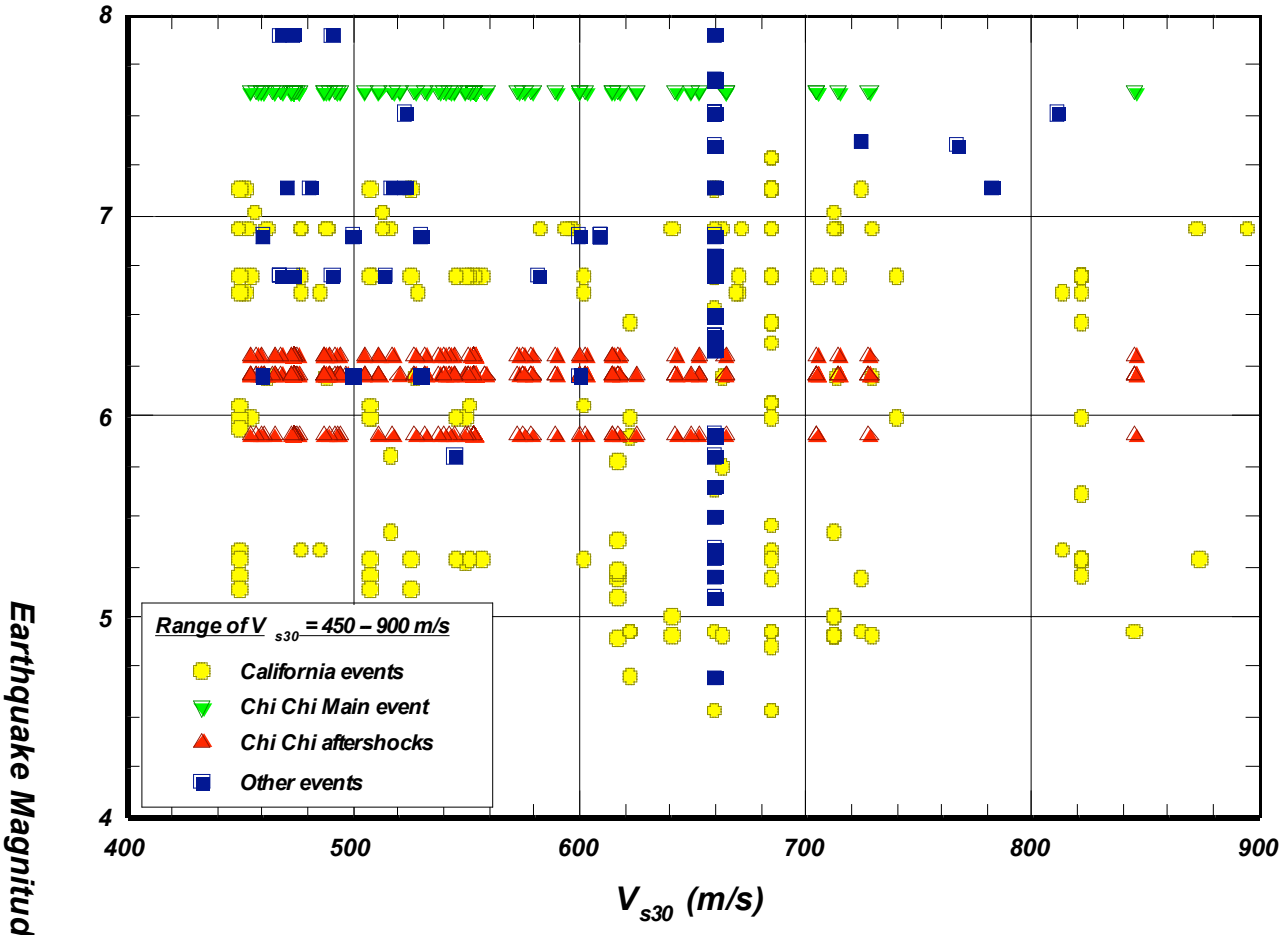
Magnitude-distance distribution of NGA free field records



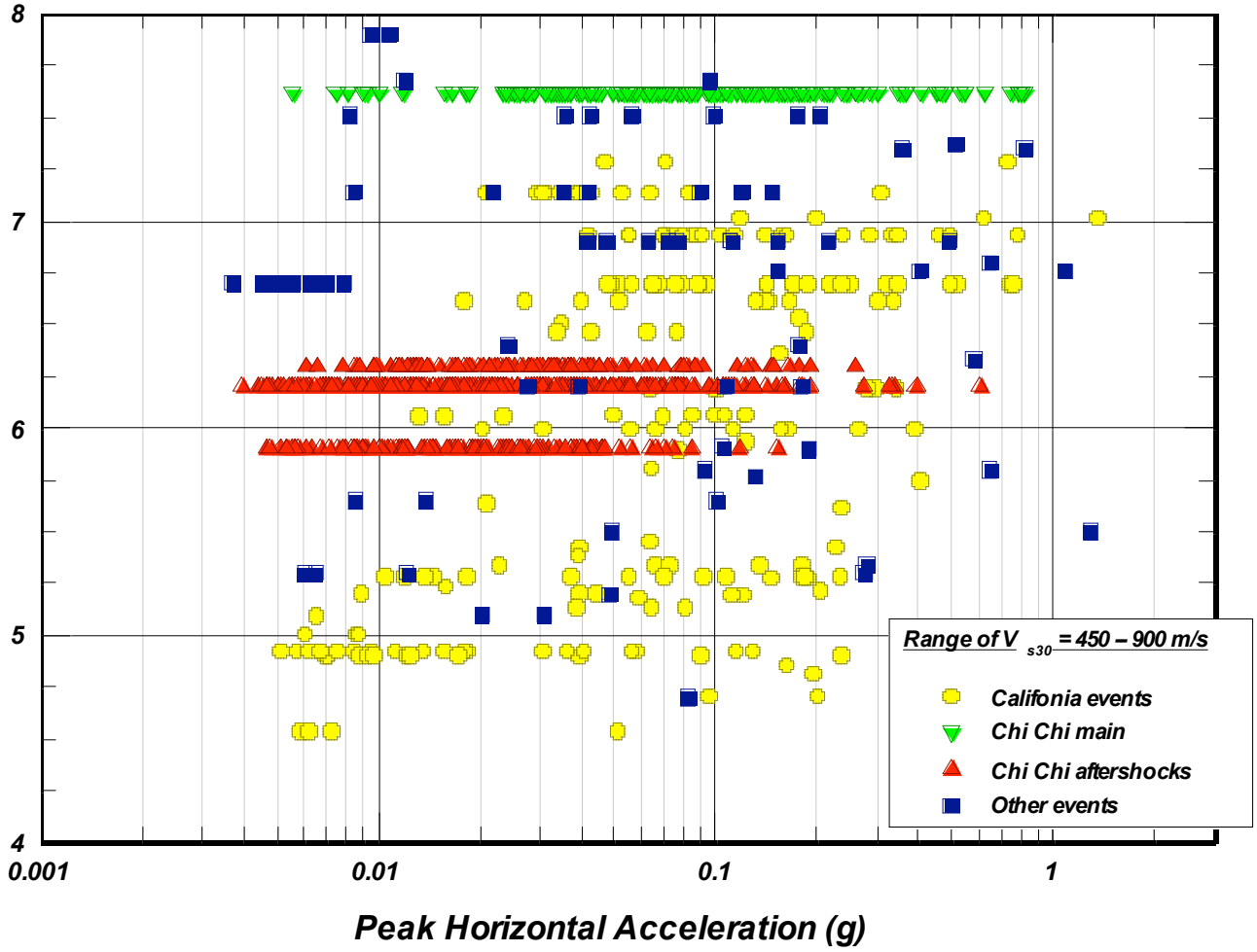
Magnitude-Vs30 distribution of NGA free field records



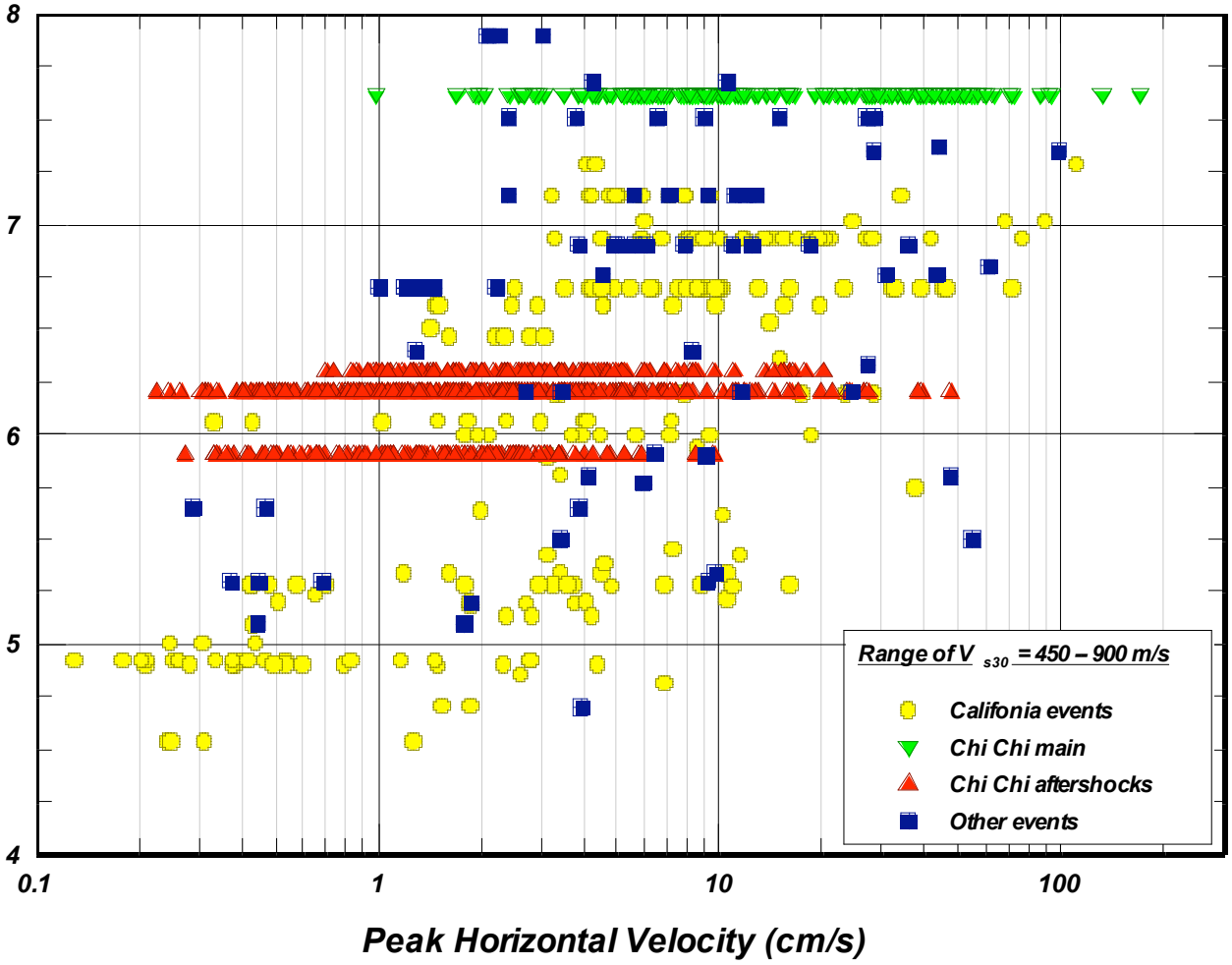
Magnitude-distance distribution of records used in developing earthquake ground motions model for sites having Vs30 ranging from 450 – 900 m/s



Magnitude- Vs30 distribution of records used in Developing earthquake ground motions model for sites having Vs30 ranging from 450 – 900 m/s



Magnitude-peak horizontal acceleration distribution of records used in developing earthquake ground motions model for sites having Vs30 ranging from 450 – 900 m/s



Magnitude-peak horizontal velocity distribution of records used in developing earthquake ground motions model for sites having Vs30 ranging from 450 – 900 m/s

Sites with V_{s30} = 400 to 760 m/sec
Average ≈ 540 m/sec

$$Ln(y) = \alpha_1 + \alpha_2 M - (\beta_1 + \beta_2 M) Ln(R + 10) + \gamma R + \varphi F + \varepsilon$$

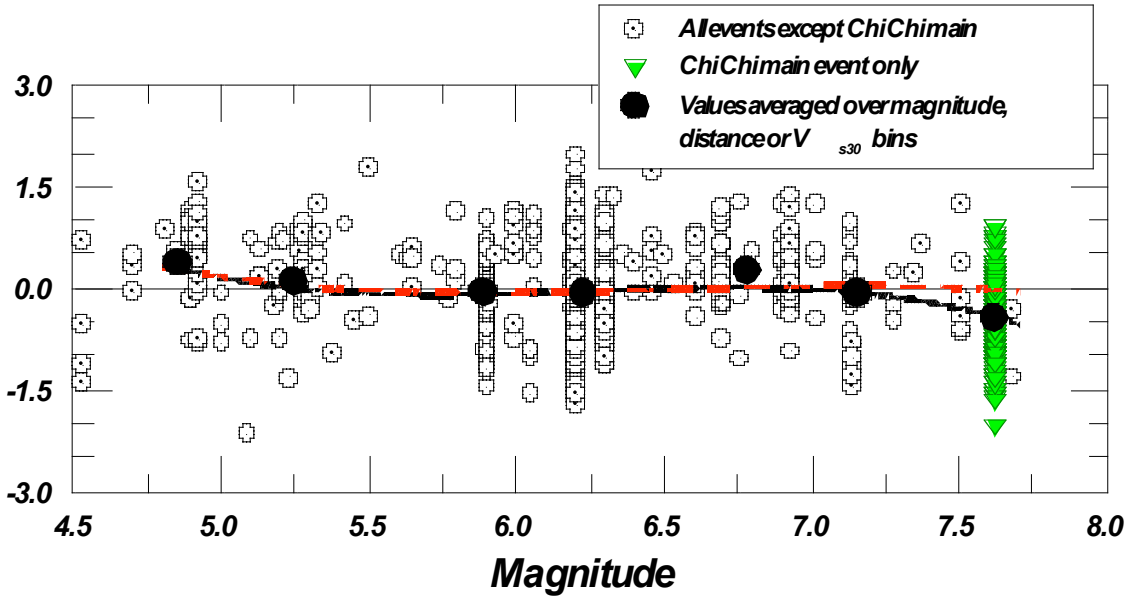
M = moment magnitude

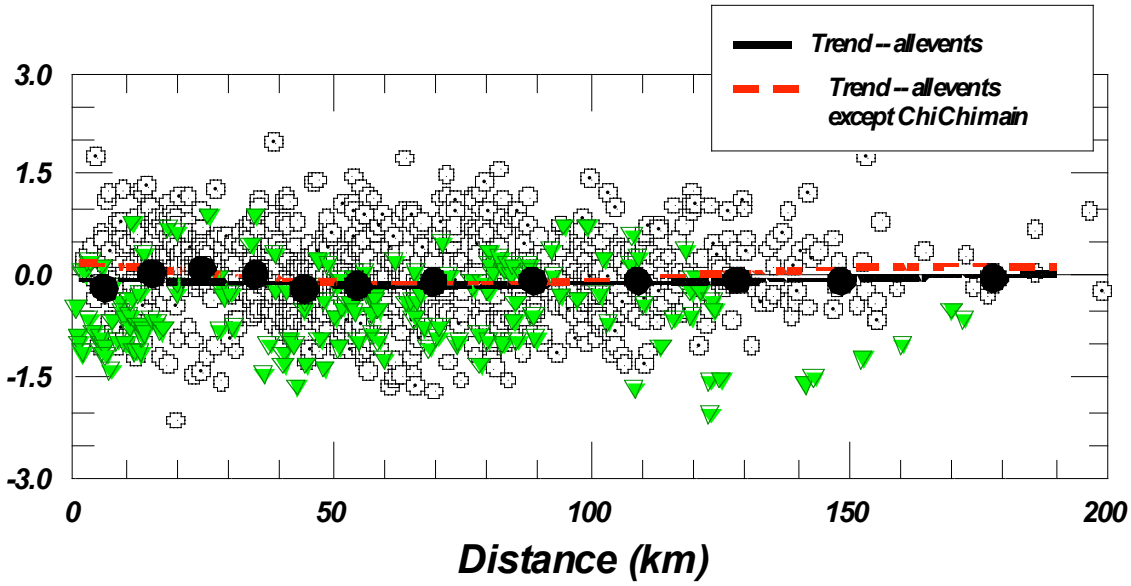
γ = distance adjustment factor

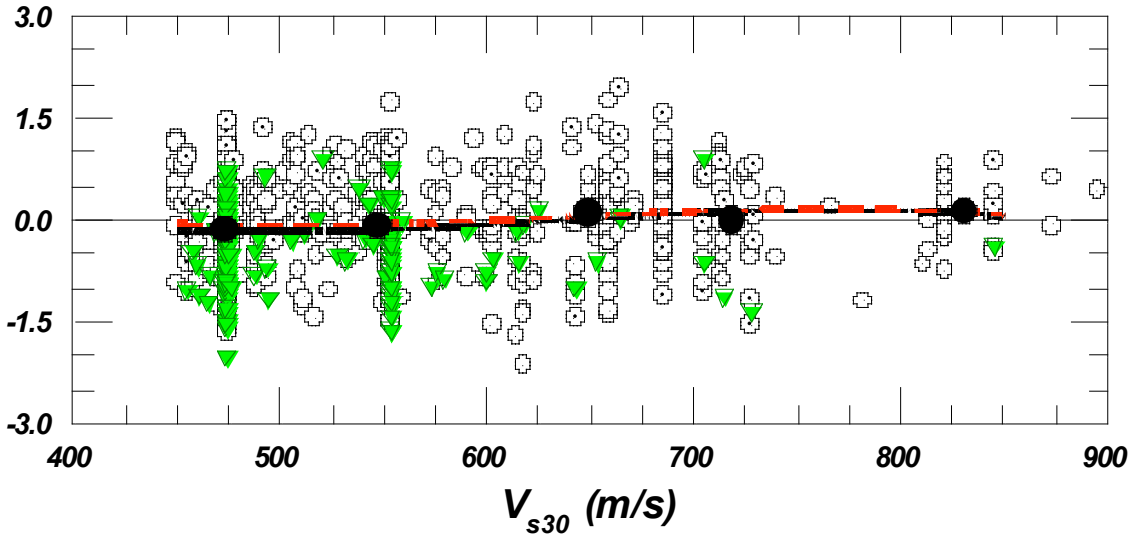
F = 0 for strike-slip & normal; 1 otherwise

ε = SE term (natural log).

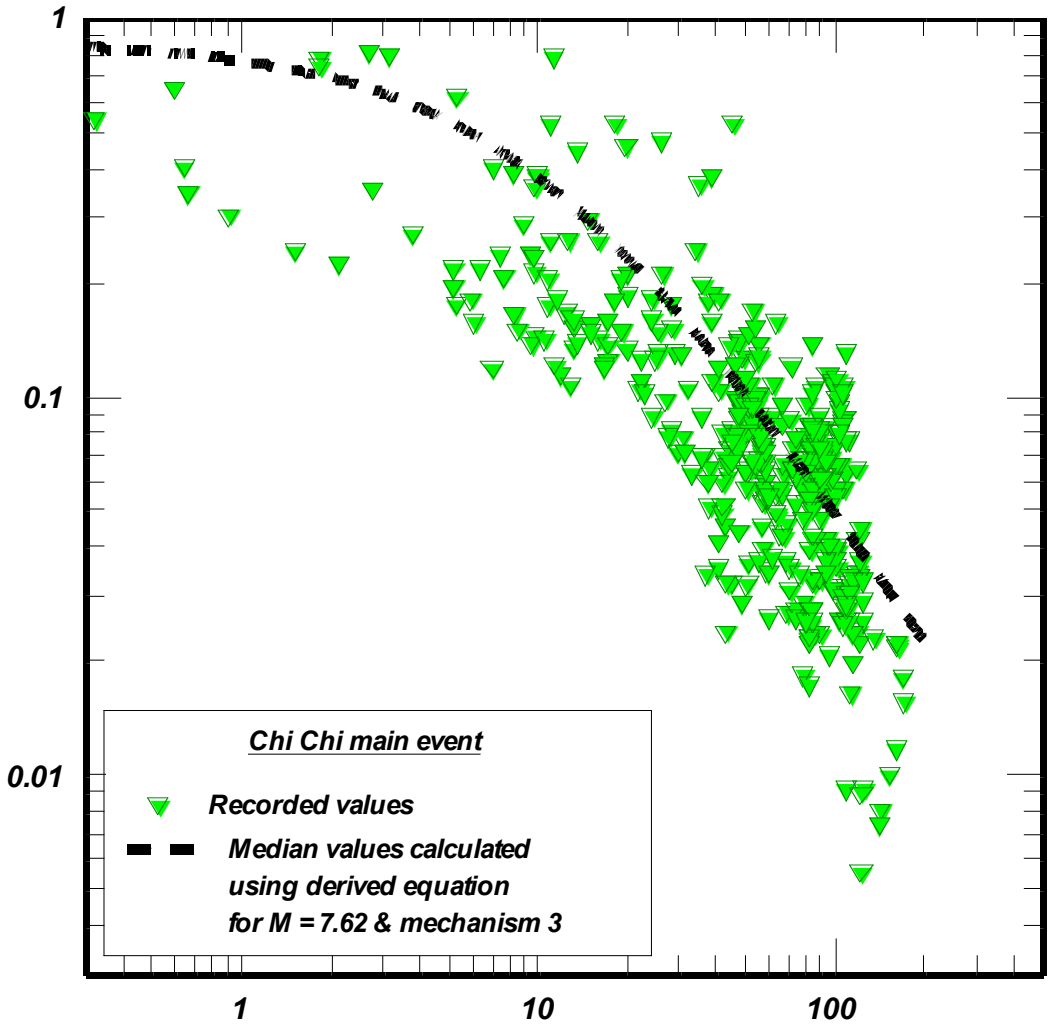
	M < 6.75	M < 6.75	M < 6.75	M < 6.75		M > = 6.75	M > = 6.75	M > = 6.75	M > = 6.75			
Period					Period					Gamma	Phi	Sl
0.01	3.7113	-0.1252	2.9832	-0.2339	0.01	5.6362	-0.4104	2.9832	-0.2339	0.00047	0.12	
0.02	3.7113	-0.1252	2.9832	-0.2339	0.02	5.6362	-0.4104	2.9832	-0.2339	0.00047	0.12	
0.03	3.7613	-0.1252	2.9832	-0.2339	0.03	5.6862	-0.4104	2.9832	-0.2339	0.00047	0.12	
0.04	3.8113	-0.1252	2.9832	-0.2339	0.04	5.7362	-0.4104	2.9832	-0.2339	0.00047	0.12	
0.05					0.05							
0.06					0.06							
0.07					0.07							
0.075					0.075							
0.08					0.08							
0.09					0.09							
0.1	3.2706	-0.0319	2.8554	-0.2305	0.1	3.0705	-0.0023	2.4154	-0.1653	-0.00032	0.12	
0.12					0.12							
0.15					0.15							
0.17					0.17							
0.2	3.5006	-0.0319	2.8554	-0.2305	0.2	3.3005	-0.0023	2.4154	-0.1653	0.00006	0.12	
0.25	2.2702	0.1629	2.8410	-0.2309	0.25	4.5800	-0.1793	2.3918	-0.1644	-0.0001	0.1200	
0.3					0.3							
0.35					0.35							
0.4					0.4							
0.45					0.45							
0.5					0.5							
0.6					0.6							
0.7					0.7							
0.75					0.75							
0.8					0.8							
0.9					0.9							
1	-2.1547	0.5707	2.6904	-0.2371	1	1.1735	0.0777	2.0933	-0.1487	0.00132	0.12	
1.5					1.5							
2					2							
3	-6.2226	0.8805	2.6442	-0.2497	3	-2.2929	0.2992	1.8270	-0.1286	0.00023	0.08	

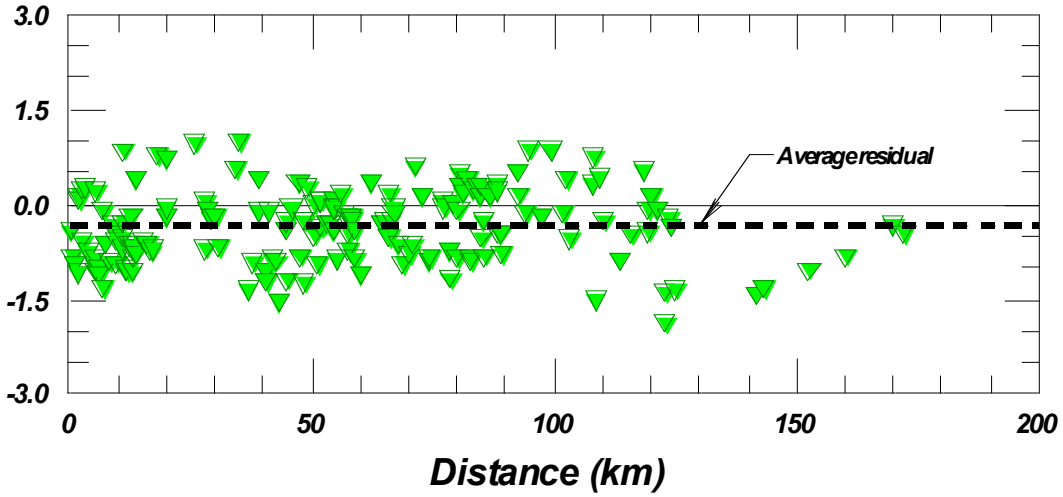


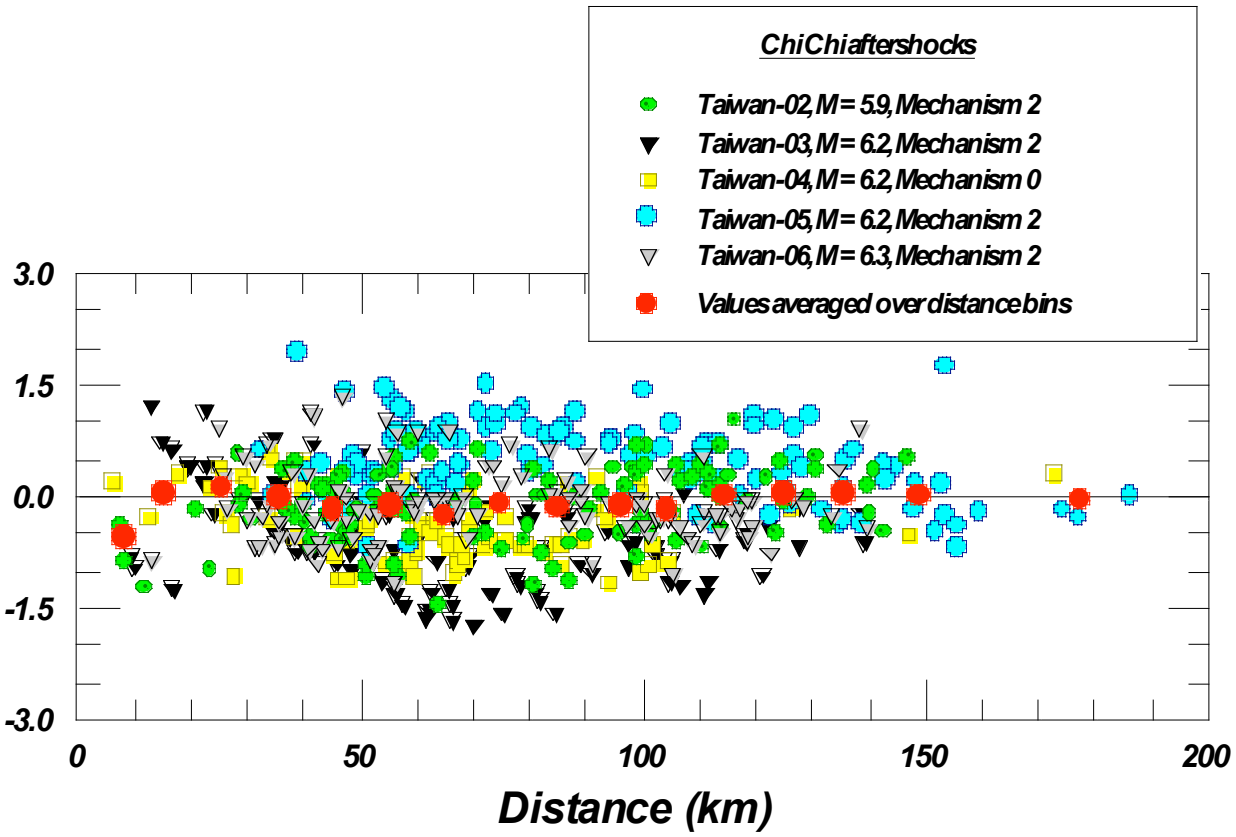




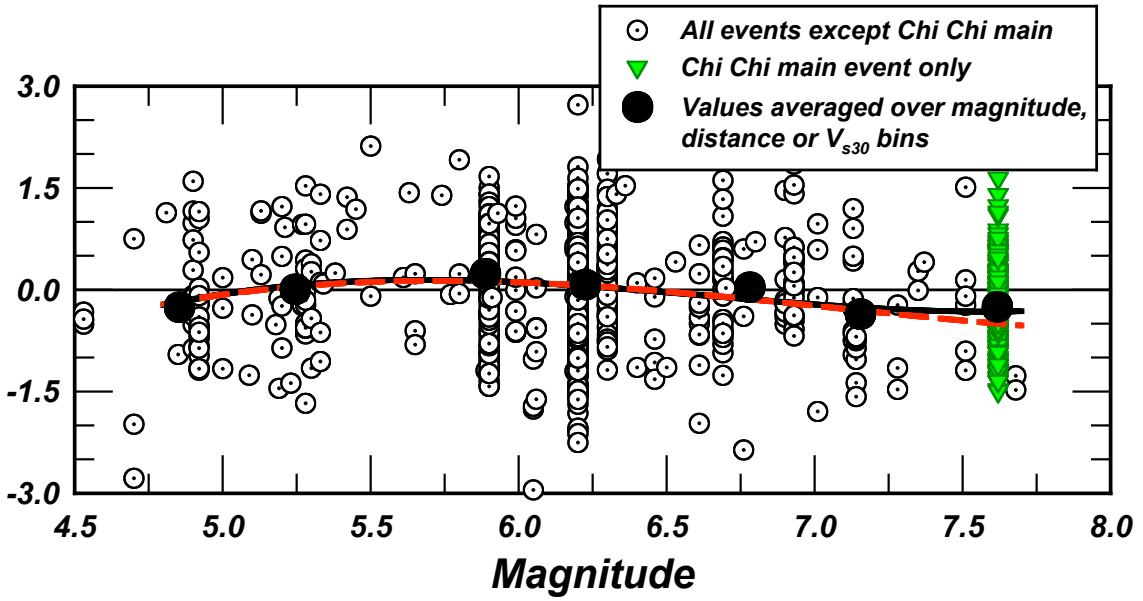
Residuals versus magnitude, closest distance and Vs30 using Eq. [xx] for estimating

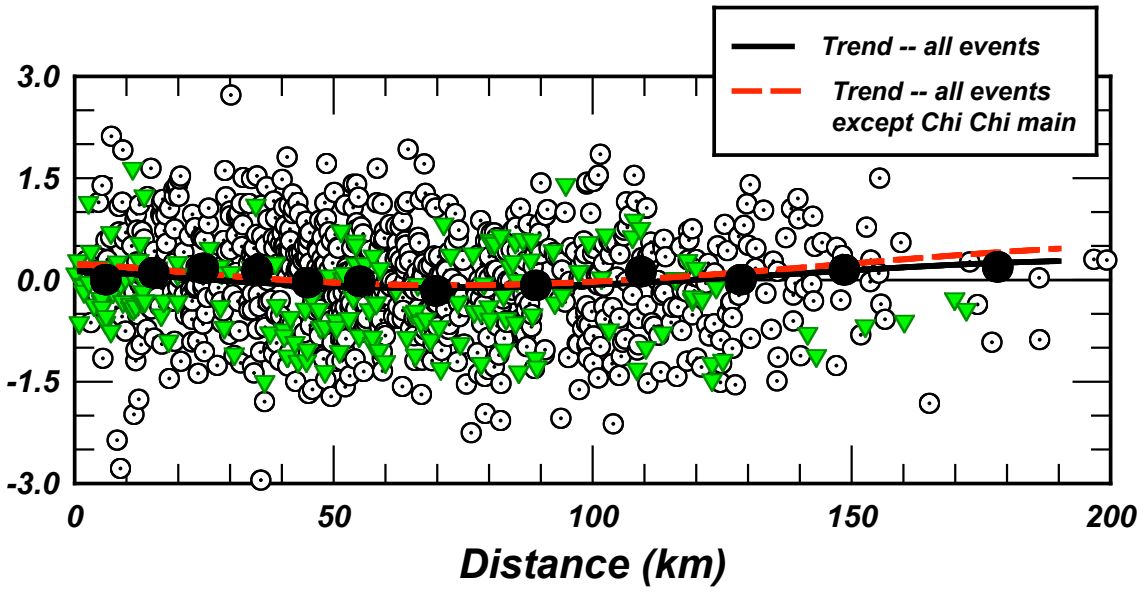

1
0.1
0.01
Chi Chi main event
Recorded values
Median values calculated
using derived equation
for M = 7.62 & mechanism 3
1
10
100
Closest Distance (km)

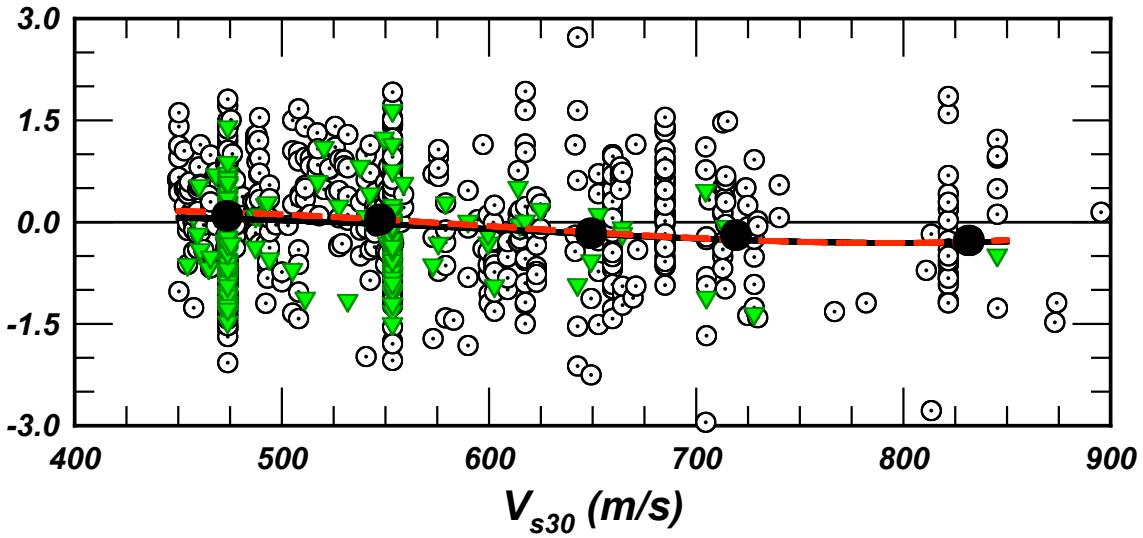

3.0
1.5
0.0
-1.5
-3.0
Average residual
0
50
100
150
200
Distance (km)



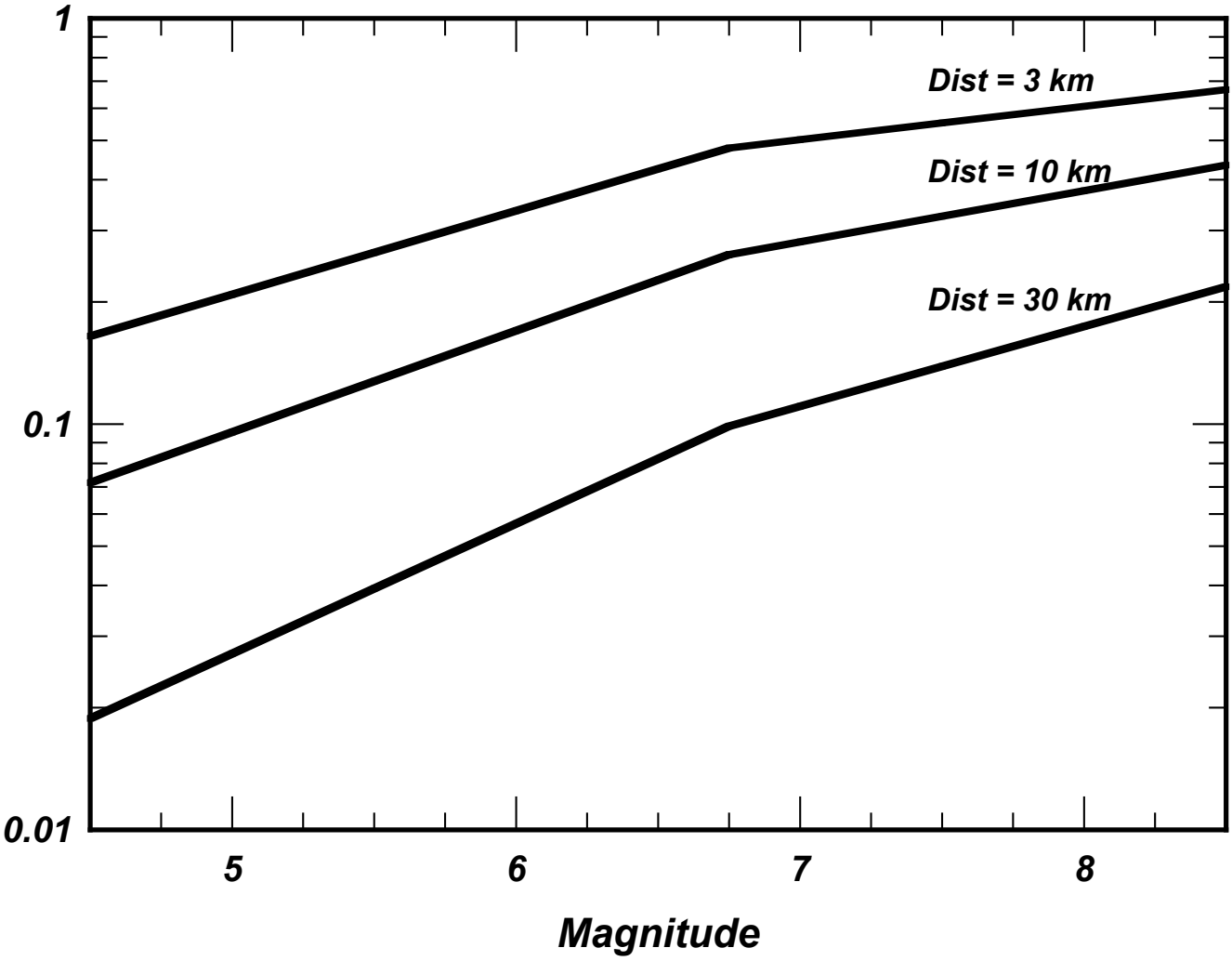
Residuals – peak horizontal acceleration recorded during the five Chi-Chi earthquake aftershocks obtained using Eq. [xx] with magnitude and mechanism as shown in the legend



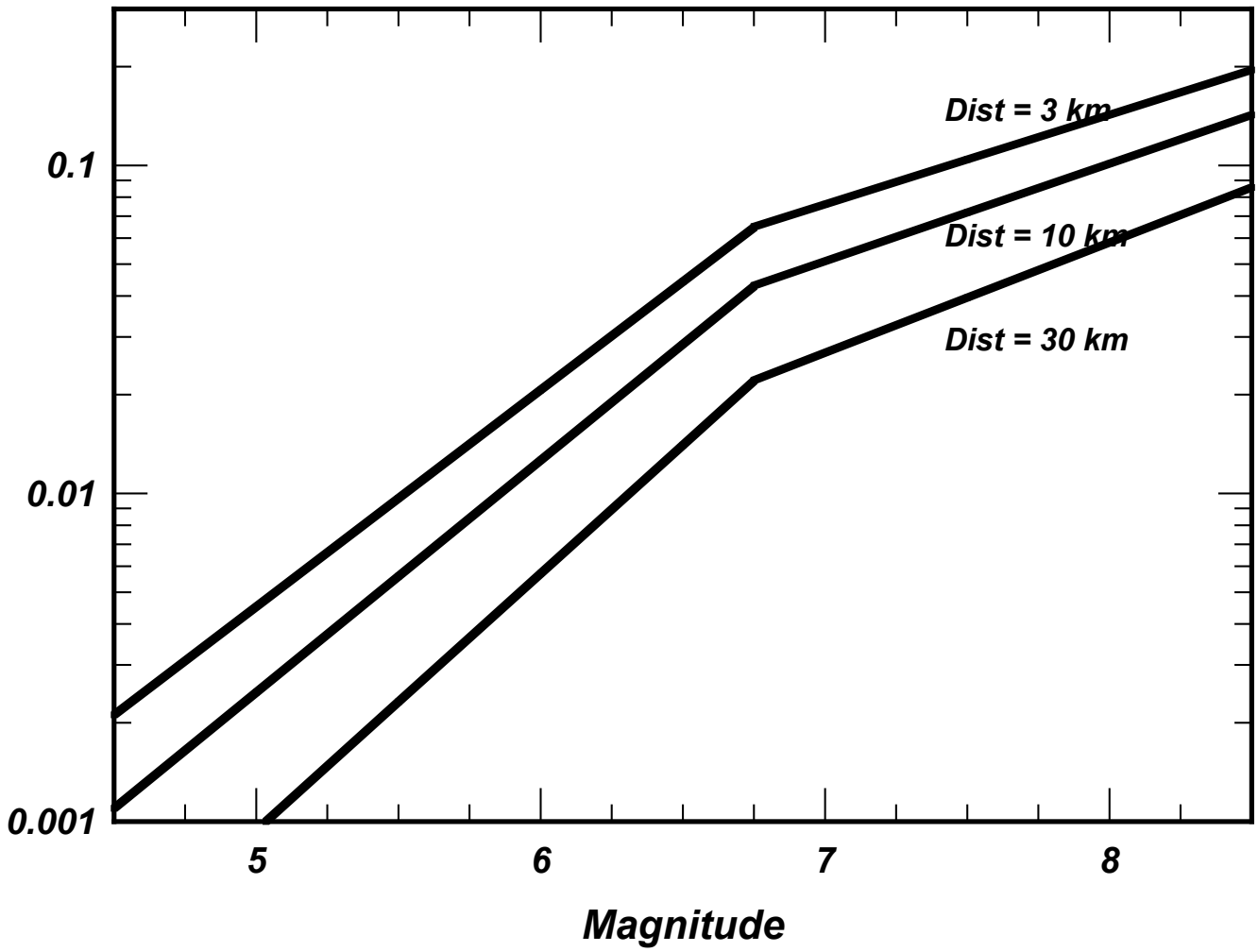




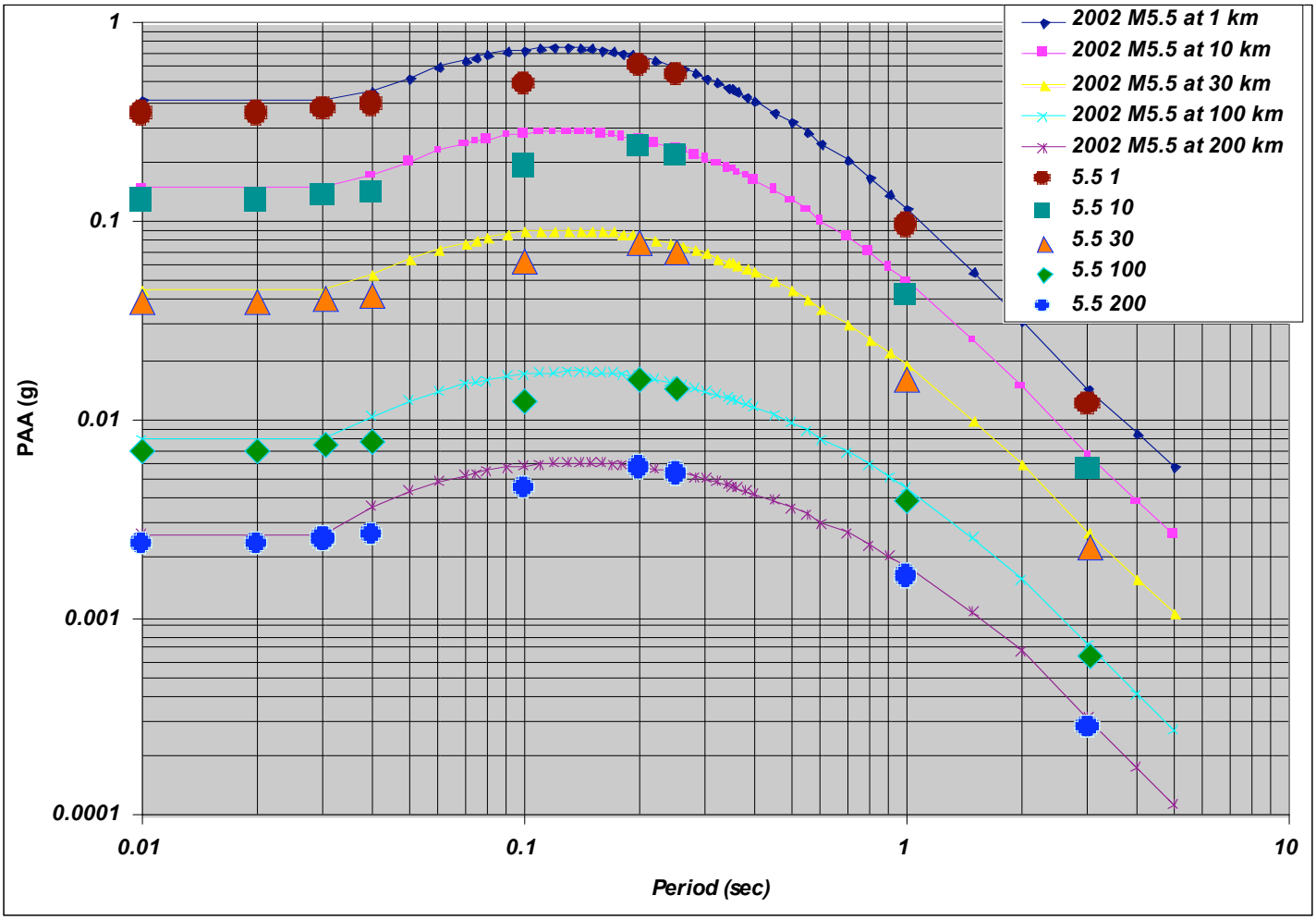
Residuals versus magnitude, closest distance and Vs30 using Eq. [xx] for estimating



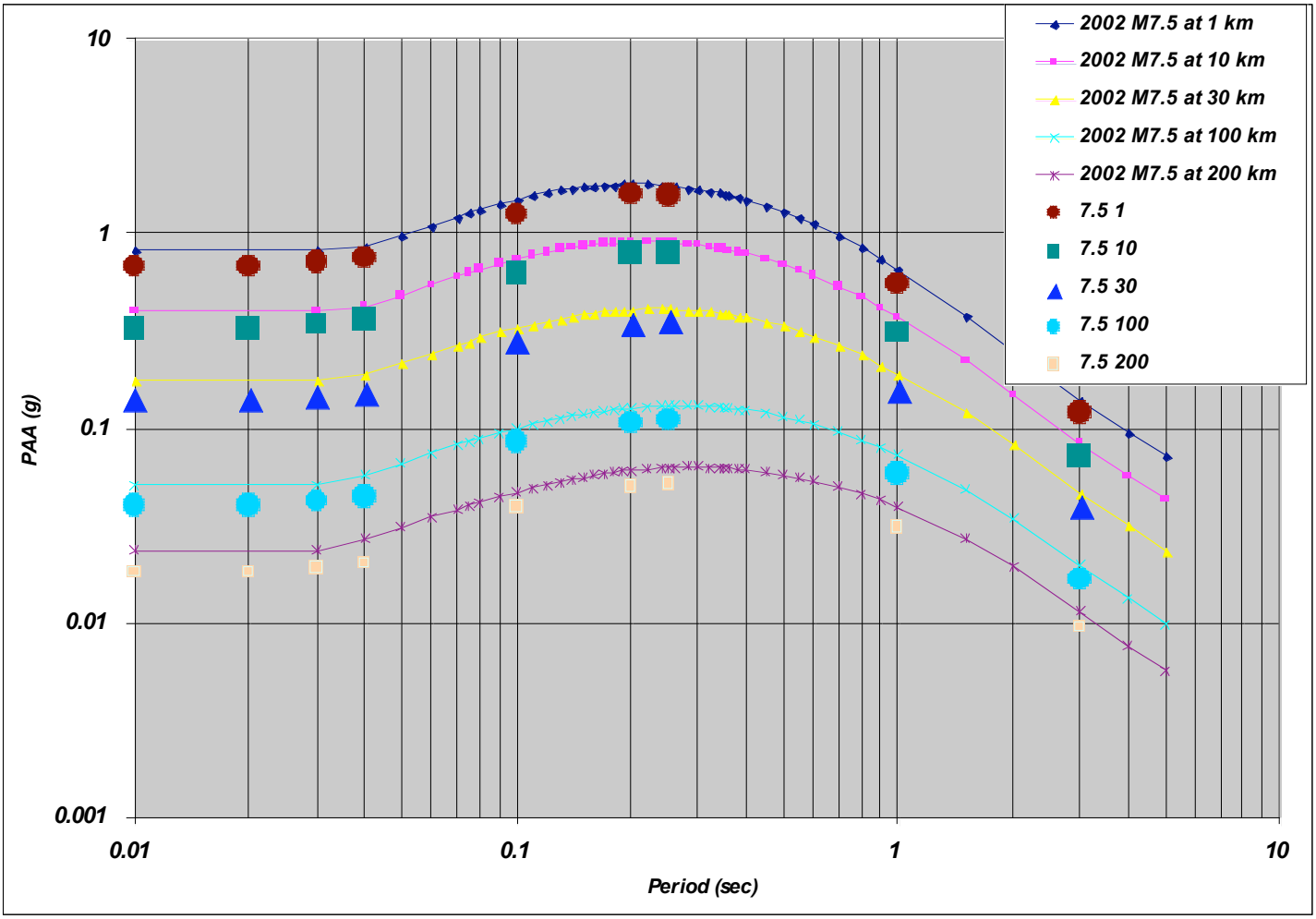
Calculated values of pga versus magnitude at 1, 10, & 30 km



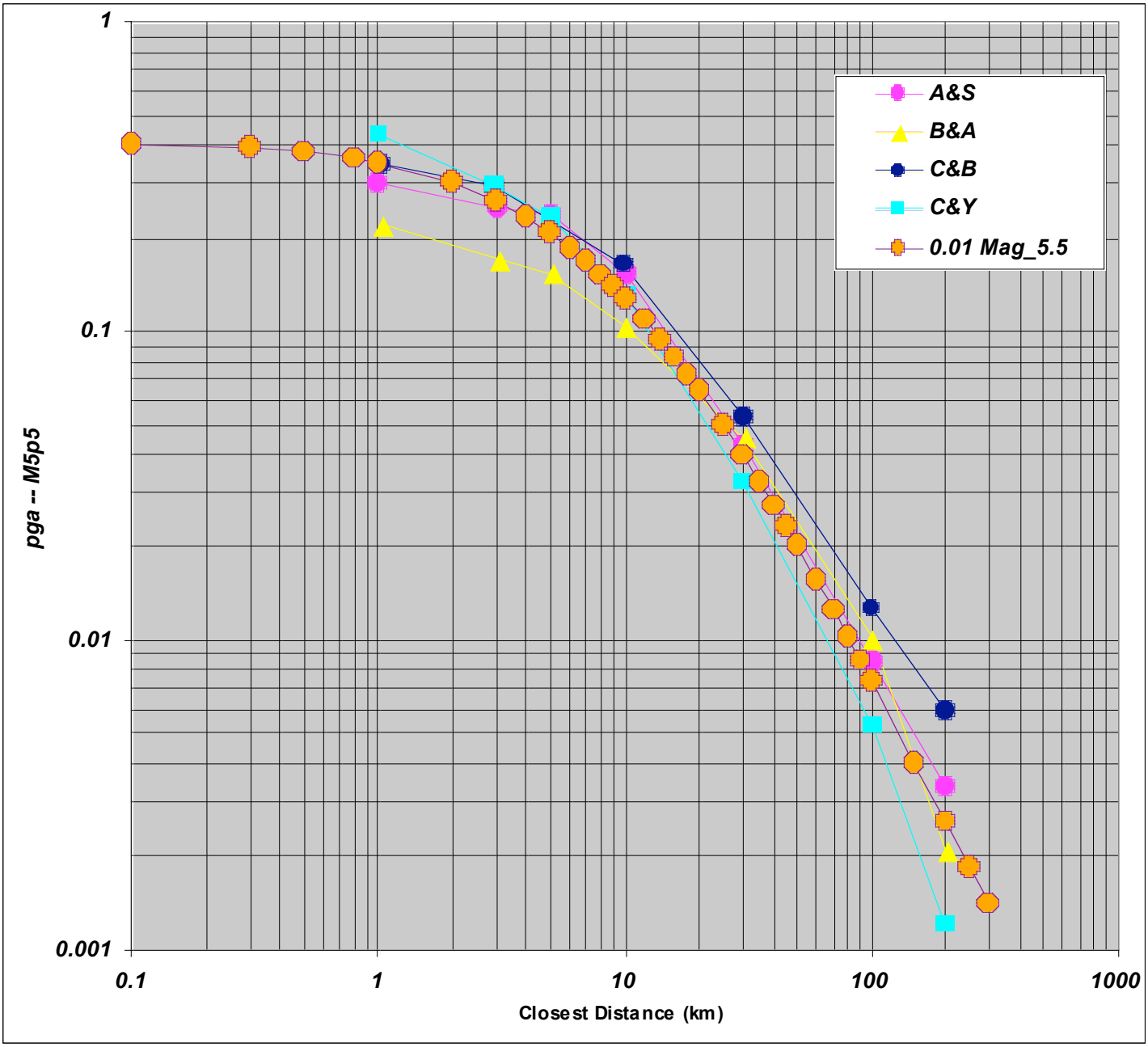
Calculated values of PAA for T = 3 sec versus magnitud
at 1, 10, & 30 km



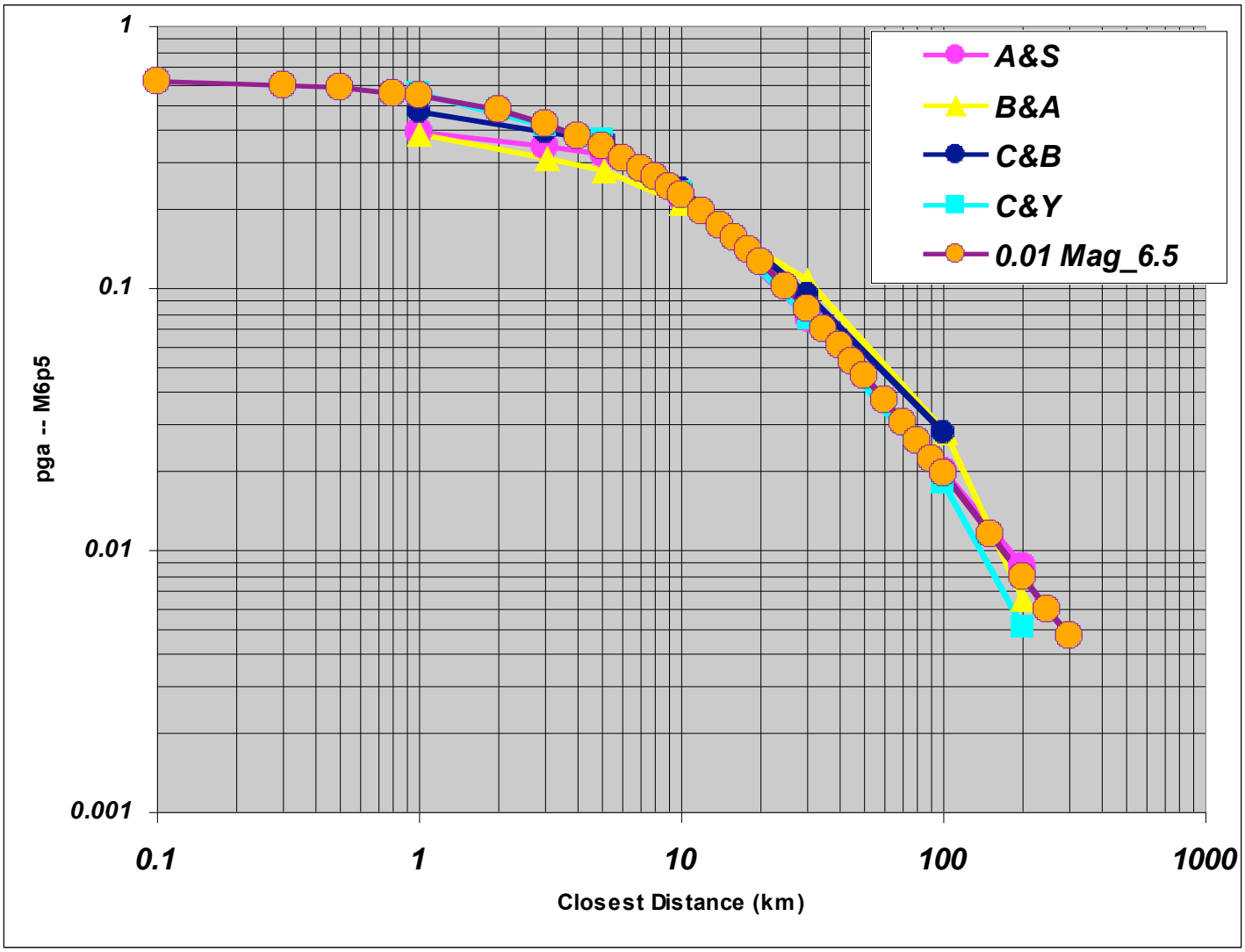
Comparison of Calculated values of pga with Those obtained using 2002 relationships M = 5.5 at 1, 10, 30, 100 & 200 km



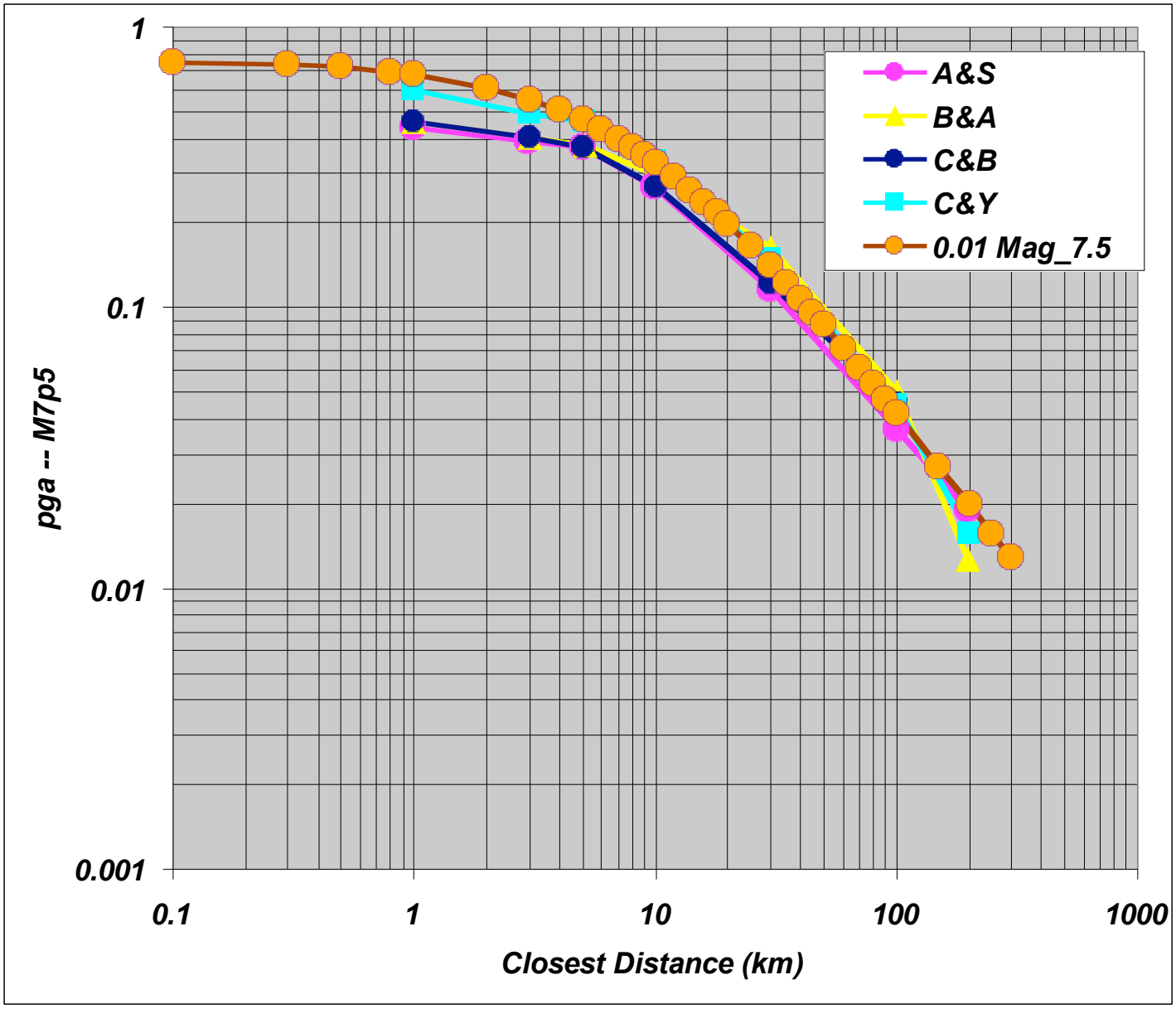
Comparison of Calculated values of pga with Those obtained using 2002 relationships M = 7.5 at 1, 10, 30, 100 & 200 km



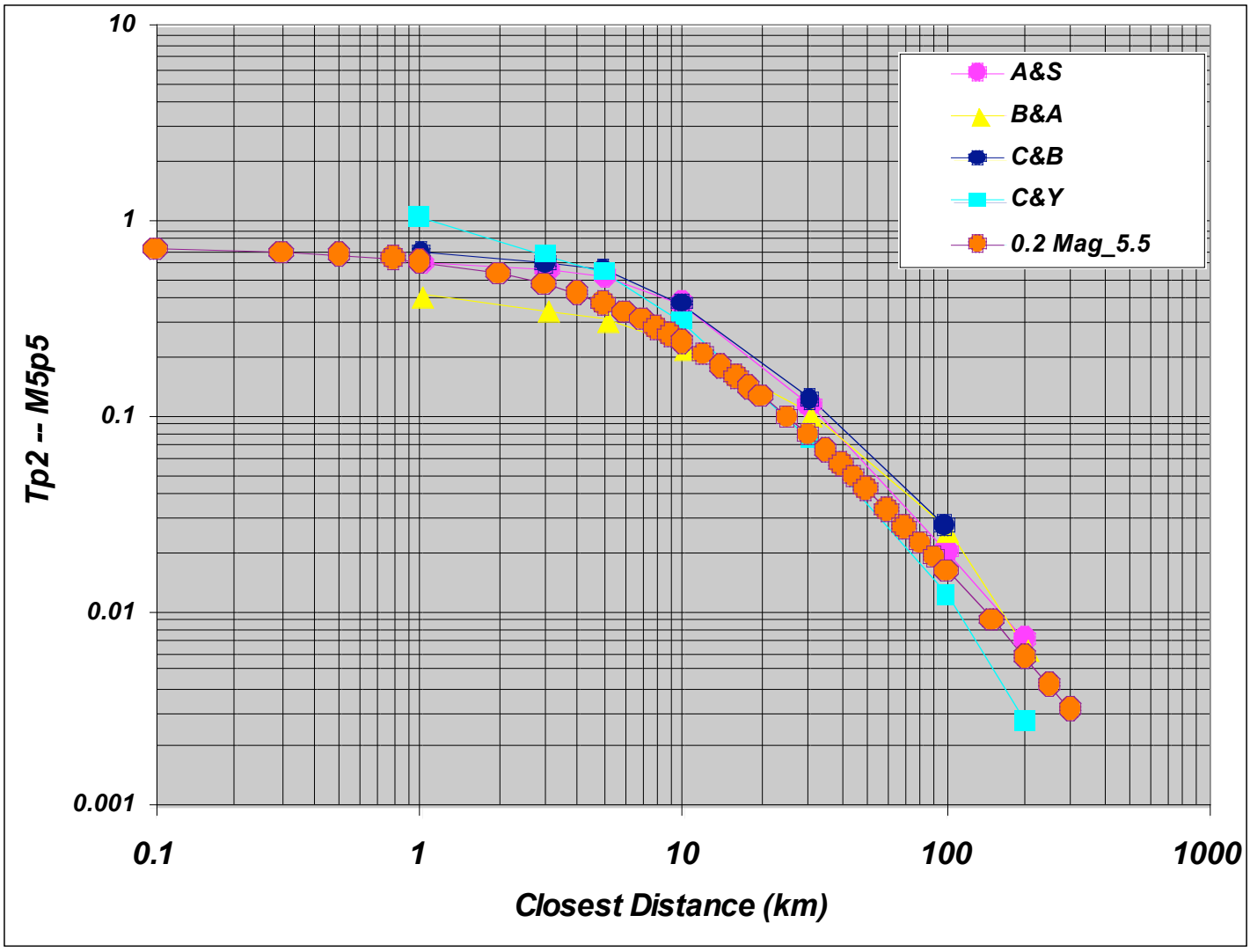
Comparison of Calculated values of pga versus Distance with those obtained using other NGA relationships
M = 5.5



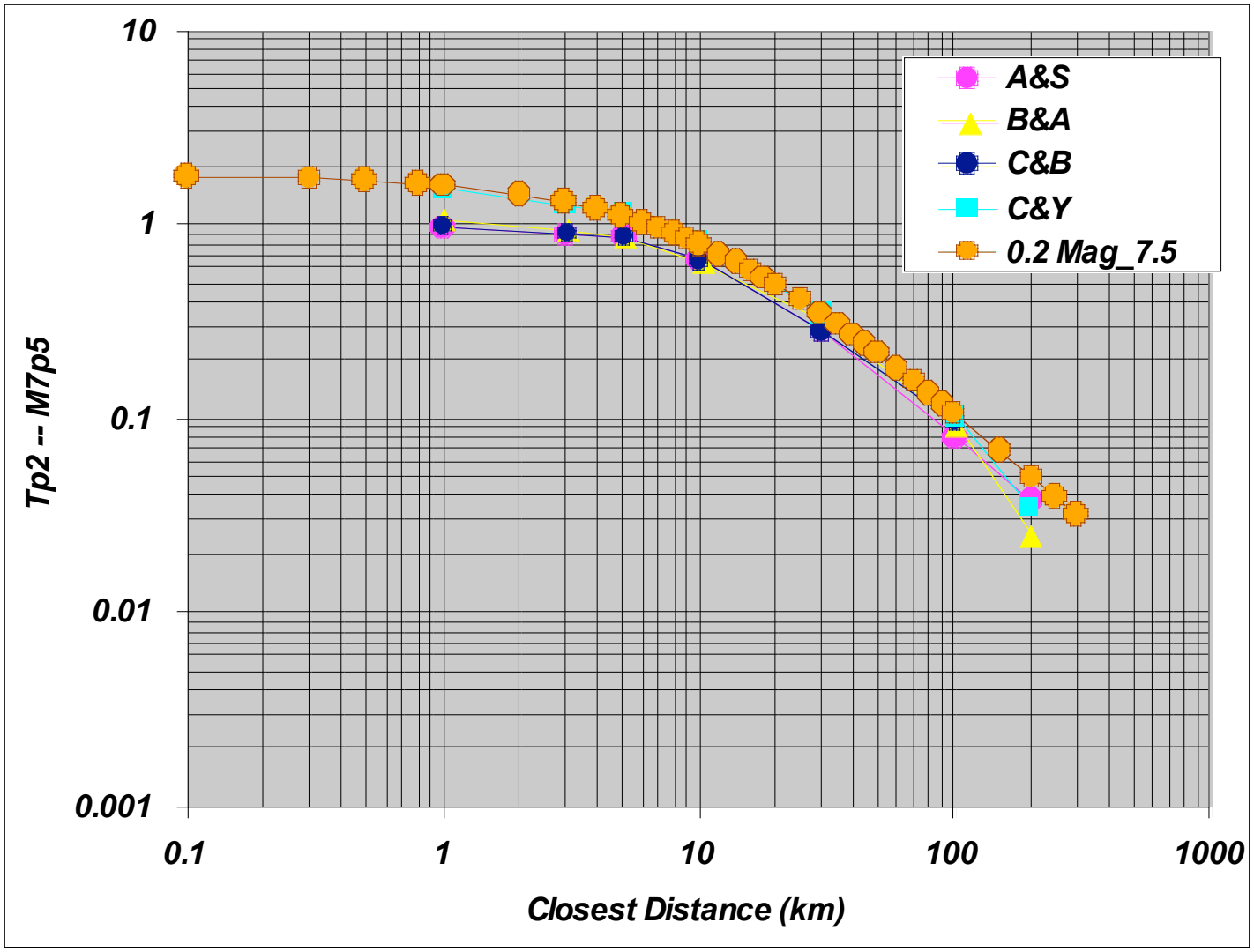
Comparison of Calculated values of pga versus Distance with those obtained using other NGA relationships M = 6.5



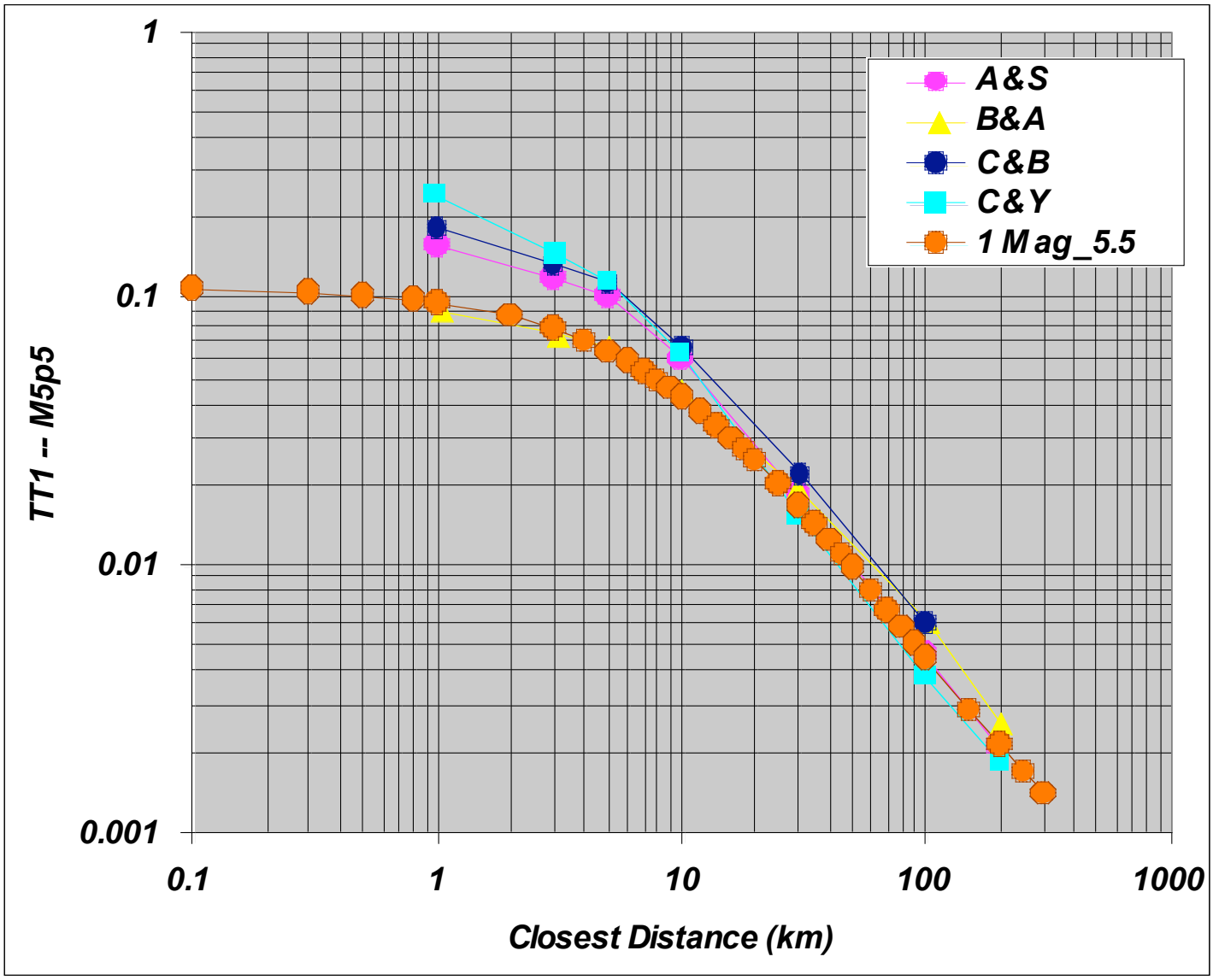
Comparison of Calculated values of pga versus Distance with those obtained using other NGA relationships
M = 7.5



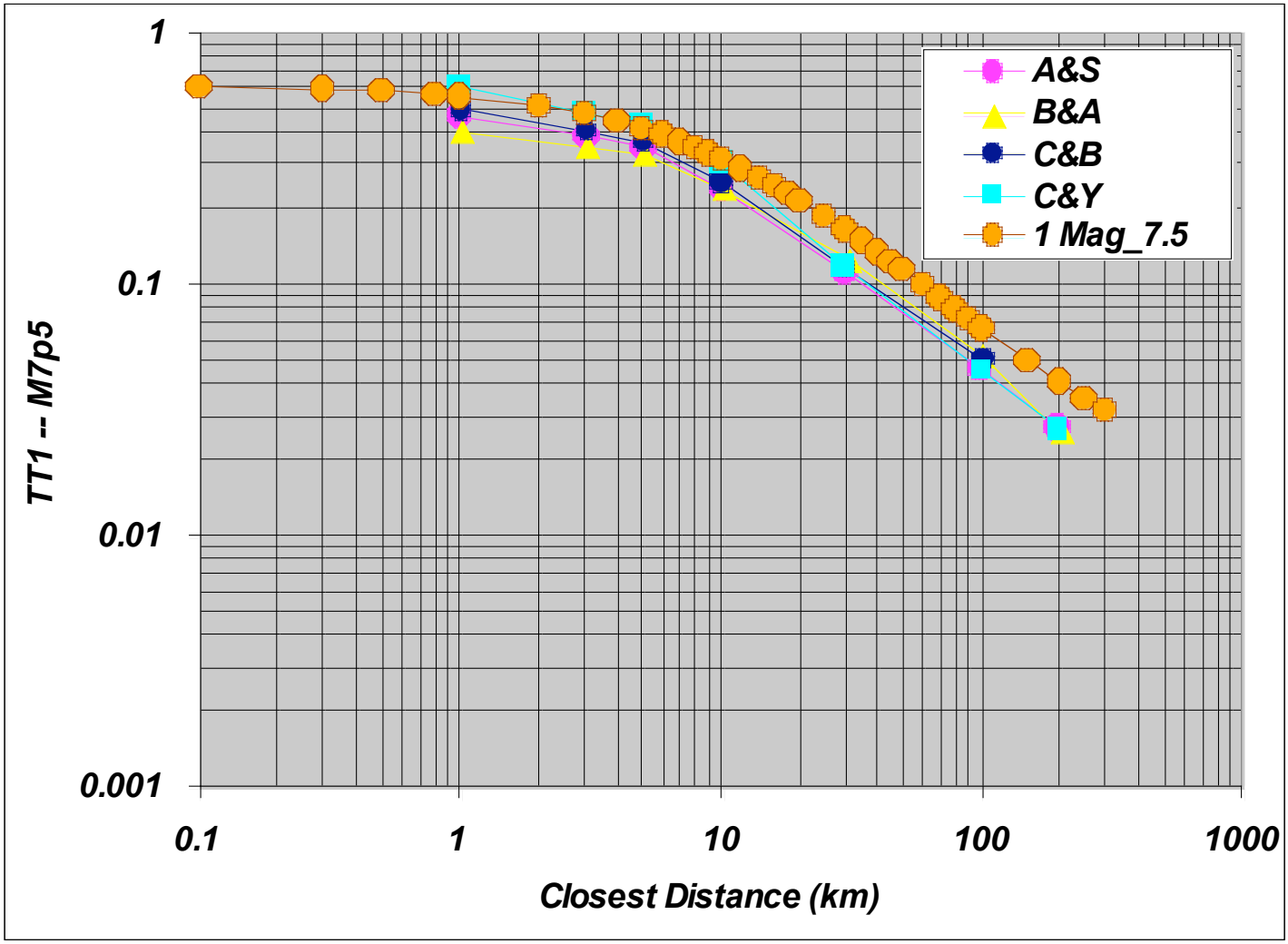
Comparison of Calculated values of PAA versus Distance with those obtained using other NGA relationships M = 5.5 – T = 0.2 sec



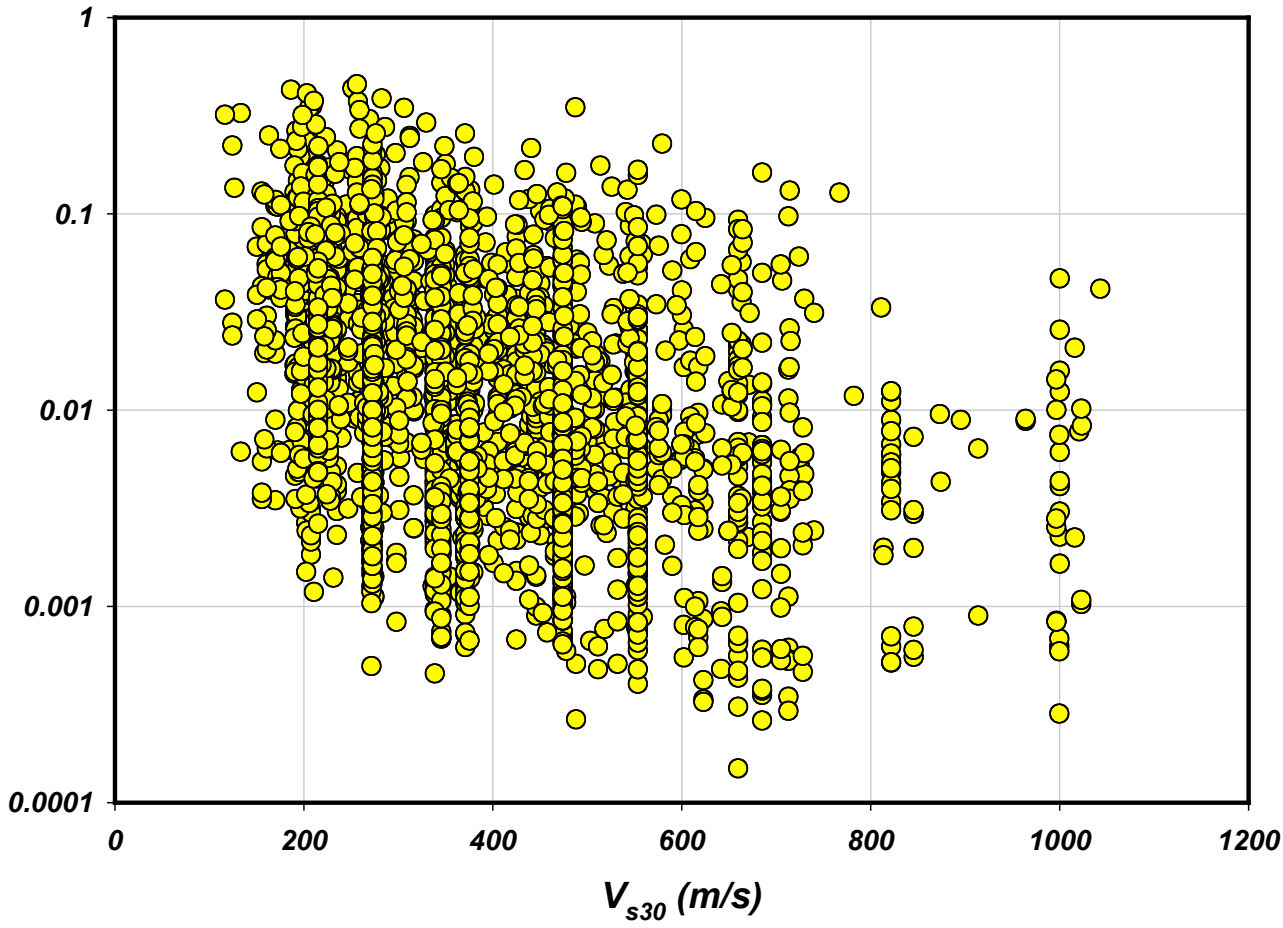
Comparison of Calculated values of PAA versus Distance with those obtained using other NGA relationships
M = 7.5 – T = 0.2 sec



Comparison of Calculated values of PAA versus Distance with those obtained using other NGA relationships
M = 5.5 – T = 1 sec



Comparison of Calculated values of PAA versus Distance with those obtained using other NGA relationships M = 7.5 – T = 1 sec


1
0.1
0.01
0.001
0.0001
0
200
400
600
800
1000
1200
V_{s30} (m/s)

Variations with V_{s30}

1. *V_{s30} > 900 m/s – Category A (hard rock ?)*

2. *450 < V_{s30} < 900 m/s -- Category B (soft rock/stiff soils?)*

1. *350 < V_{s30} < 450 m/s -- Category C*

2. *250 < V_{s30} < 350 m/s -- Category D*

3. *180 < V_{s30} < 250 m/s -- Category E*

4. *V_{s30} < 180 m/s – Soft soil sites*